Concentration / Moisture Measuring System

MircoPolar Moist

LB 568

User's Guide

- Hardware Manual -

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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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.

ℹ 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 (for example, E 60079)

➢ 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

ℹ 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.

ℹ 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

ℹ IMPORTANT

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

ℹ 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 MircoPolar 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.

i IMPORTANT

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

i 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.

Any change in frequency or any other manipulation on the micro-wave device will result in a loss of the frequency approval and will be prosecuted.
The microwave modules do not include any replaceable components and must not be opened.

Chapter 2. General Information

2.1 Use and Function

The MircoPolar 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 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.

Frequency licenses

The LB 568 comply with part 15 of the FCC Rules (FCC: Federal Communications Commission). These devices fulfill the requirements regarding immunity to interference and emitted interference and are licensed for operation.

**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.

2.2 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.

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. This influence is dependent on the measured concentration and moisture content.
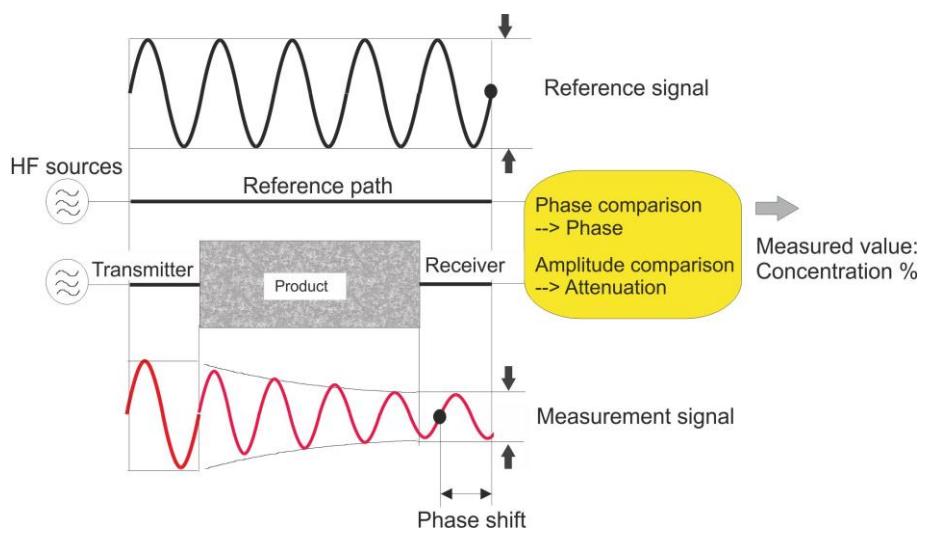
Figure 3-1:
Schematic diagram:
Microwaves are
changed by the product

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 is assigned through sampling to the phase and/or attenuation. The calibration runs automatically and the sampling process is supported by the evaluation unit.

The concentration content to be detected in the material is usually dependent linear on the phase shift and the attenuation. For this reason, a linear calibration can be calculated as follows.

$$\textbf{Measured value} = \frac{\textbf{A} \cdot \textbf{phase}}{\textbf{Load}} + \frac{\textbf{B} \cdot \textbf{attenuation}}{\textbf{Load}} + \textbf{C} \qquad \textbf{Eq. 3-1}$$

where:

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

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).

In contrast to conventional microwave attenuation measuring instruments, MircoPolar Moist is using a wide frequency band both in the phase measurement and in the attenuation measurement. Such a measurement permits a continuous verification of the plausibility of the results of a measurement. The user can define limit values for a desired plausibility range.

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

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*).

The LB 568 allows you to calibrate, display and output two concentrations: Conc1 and Conc2. You have to enter the calibration coefficients separately for concentration 1 and 2. For more information please refer to the Software Manual.

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:
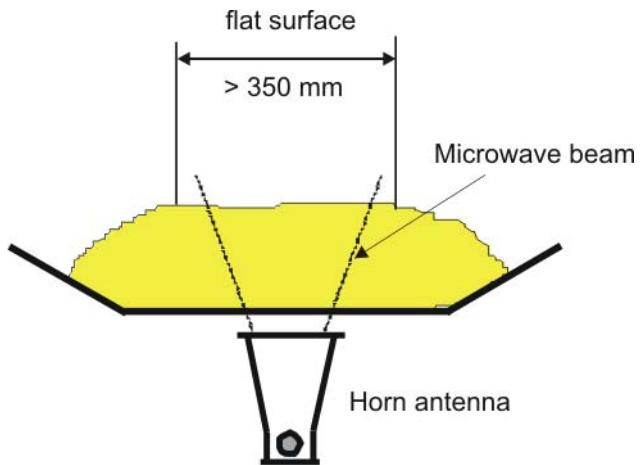
Figure 3-2:
Material profile on
the conveyor belt

The entire material cross-section is transmitted. If the material layer thickness or the bulk density changes (with constant moisture), then the microwave signals will be affected.

The goal of the loading compensation is to compensate for this influence. This is done through standardization with regard to the parameters layer thickness and bulk density which correspond to the mass per unit area:

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

where:

δ bulk density [g/cm^3]
d   material layer thickness [cm]

See Eq. 3-1: the standardization is done through division of the phase and attenuation data by the load.

A mass per unit area compensation need not be performed when the layer thickness and bulk density are constant in a fixed measuring geometry. This is the case, for example, if conveyor belts are always loaded with the same level, or if the filling level in chutes is always the same, and the material has a constant density.

If the loading compensation is not required and not selected, the load is set to 1 (see Eq. 3-1):

Load = 1   Loading compensation not enabled

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. 3-3**

The radiometric measurement path supplies the mass per unit area signal.
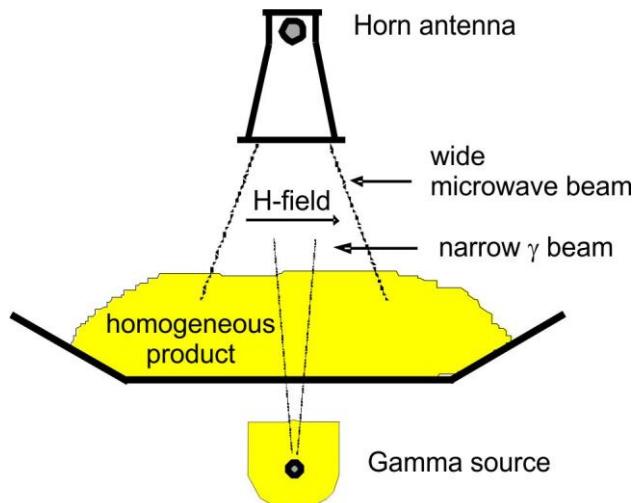
Figure 3-3: Microwaves and gamma radiation field at the conveyor belt

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:

$$I = I_0 \cdot e^{-\mu \, \delta d}$$

Eq. 3-4

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**).:

$$Mpua = \frac{1}{\mu} \cdot \ln\left(\frac{I_0}{I} \right)$$

Eq. 3-5

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. Micro-Moist Polar 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
MircoPolar 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.
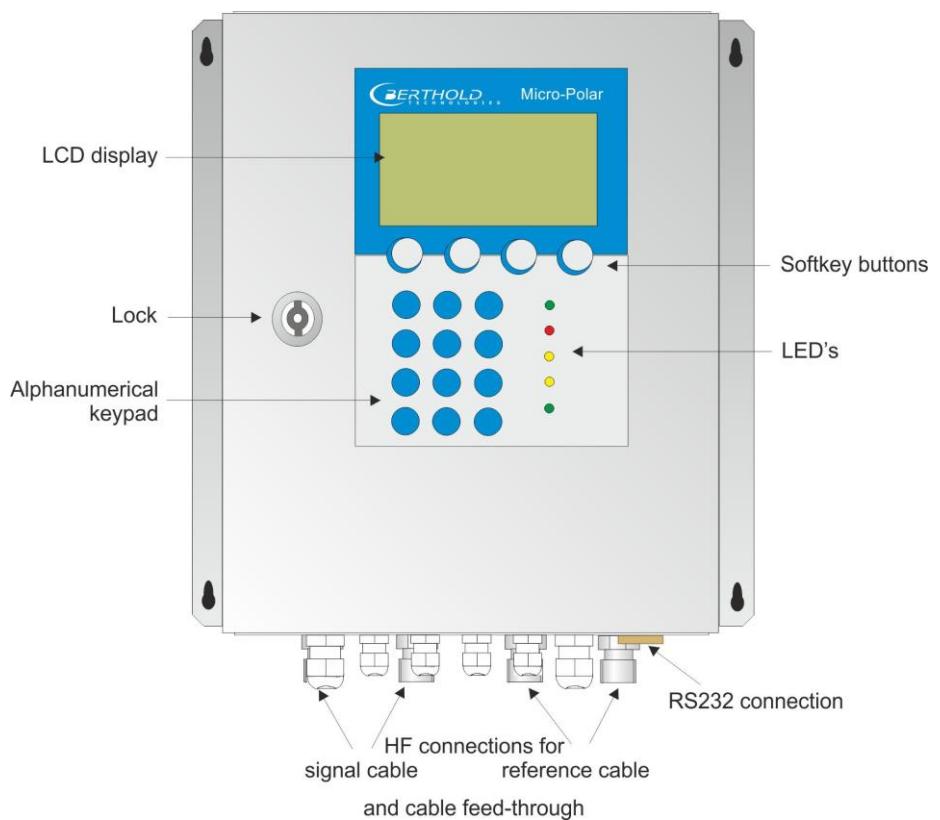
Figure 3-7:
Front view of the
evaluation units
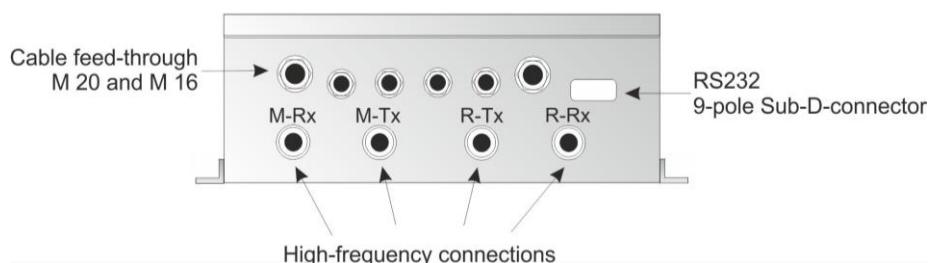
Figure 3-8:
Evaluation units -
bottom view

LED's on the Front Panel

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

LED	Function
Run	<u>On</u>: Device in measurement mode <u>Flashing + ERROR LED off:</u> Device in the warning or stopped state. In the warning state, a display message with error code indicates the cause (see *Software Manual, chapter 8. Error Lists and Device States).*
Error	<u>On</u>: Device in error state. A display message with error code indicates the cause *(see Software Manual, chapter 8. 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.
Signal 2	Display depending on the selected function of relay 2, possible functions: error, alarm min., alarm max., measurement stopped.
Comm	Communication active, e.g. via RS232

For a description of the device states please see the *Software Manual, chapter 8. 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.

Antenna connection (coupler)

Adapter (antenna)

Dissemination direction of the electrical field E

Dissemination direction of the magnetic field H

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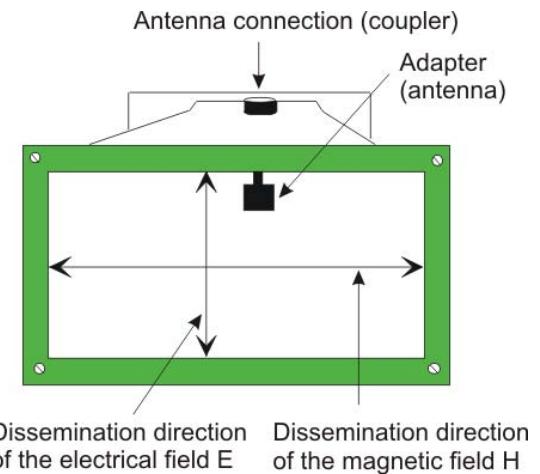
Spiral antenna

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.
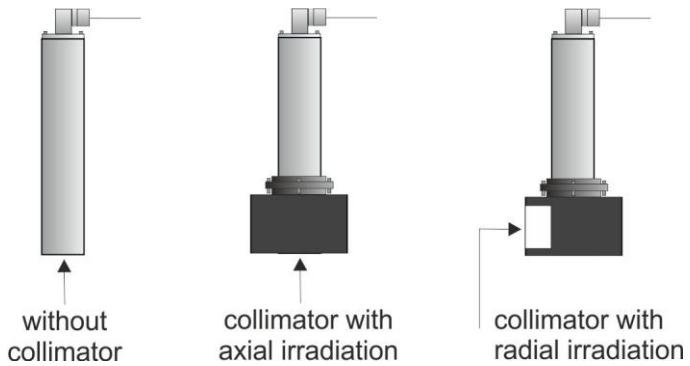
Figure 3-11:
Scintillation counter with
and without collimator

without collimator   collimator with axial irradiation   collimator with radial irradiation

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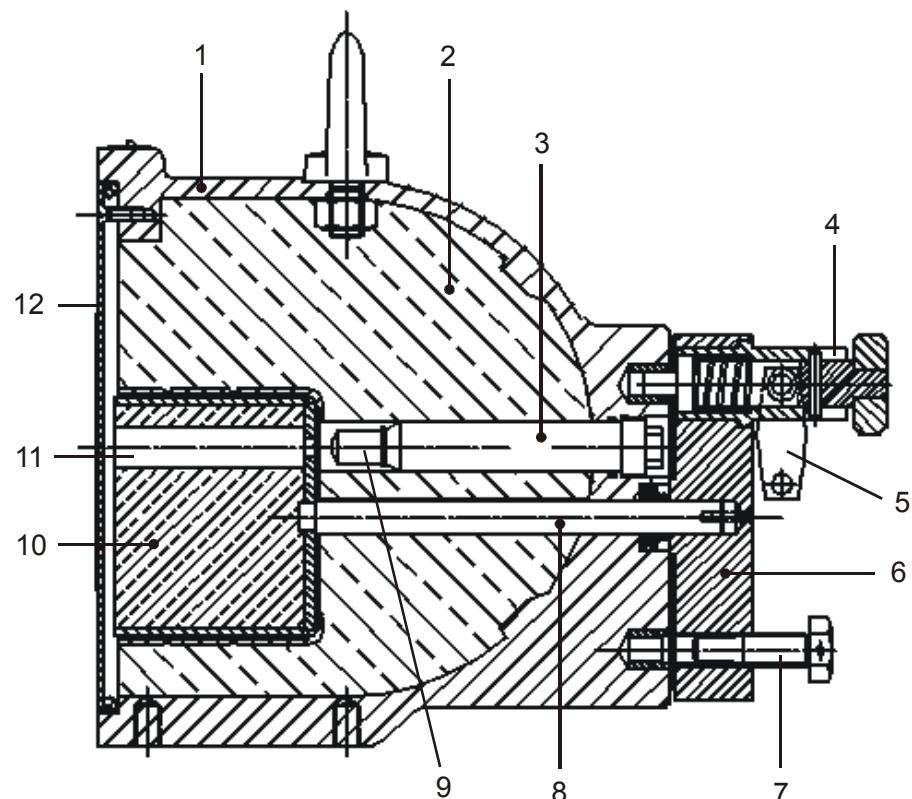
Figure 3-12:
Cross-section shielding
container with source

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.
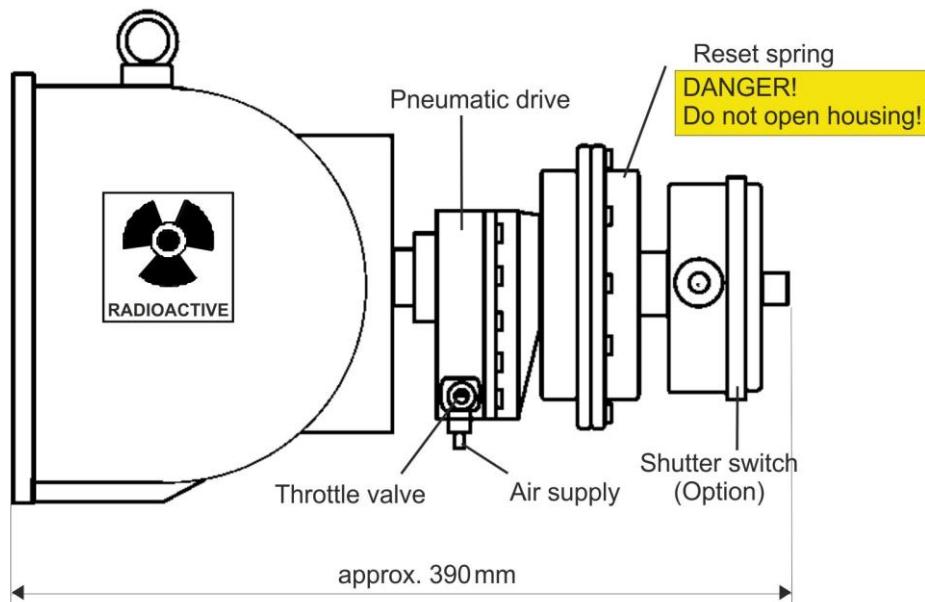
Figure 3-13: Pneumatic lock with limit switch

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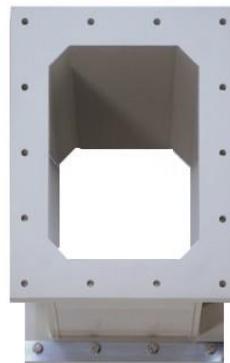
Figure 3-14:
Measuring chute
made of plastic PP-H

The horn antennas, the scintillation counter with collimator and the shielding container with source 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.
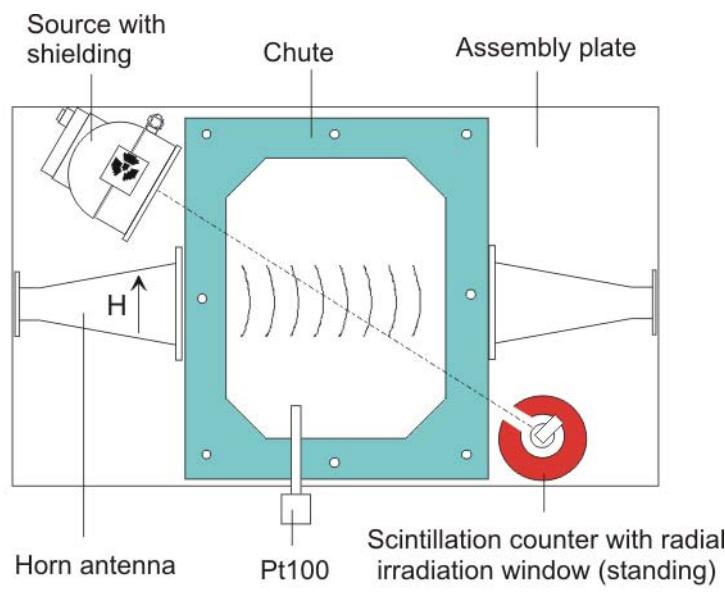
Figure 3-15:
Assembly plate
with chute,
horn antennas and
radiometric measuring
path

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.
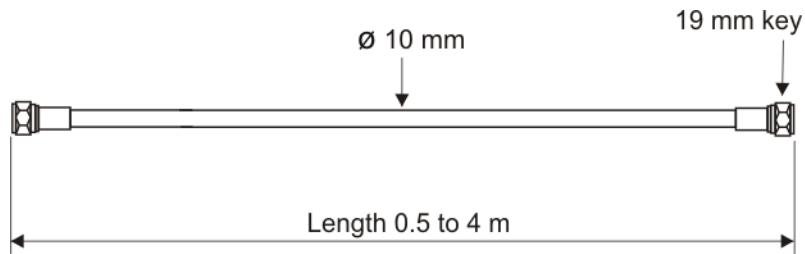
Figure 3-16:
Semi-rigid cable

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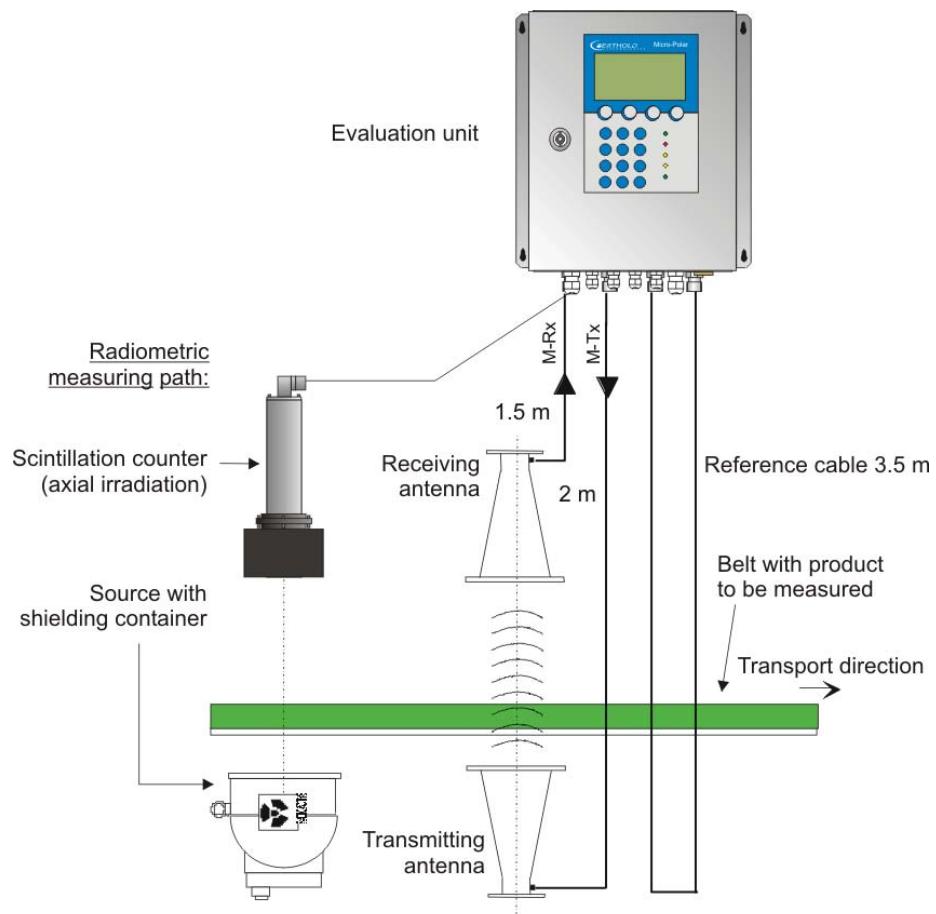
Figure 3-17: Typical measurement configuration on a non-steel reinforced conveyor belt. With horn antennas and radiometric mass per unit area measurement (with example values).

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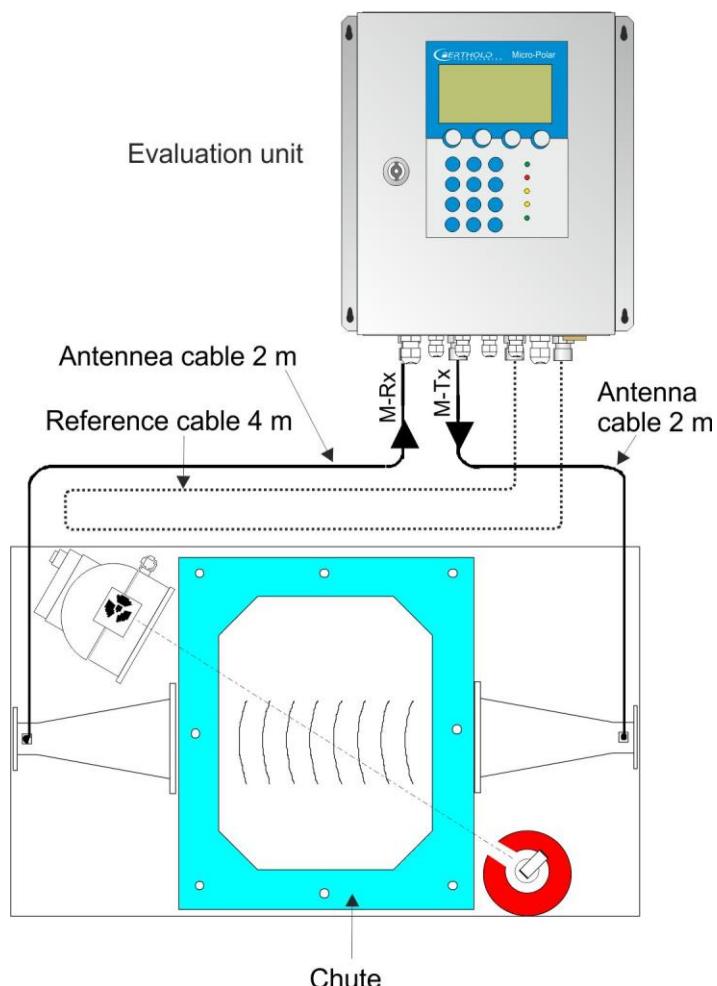
Figure 3-18:
Typical measurement configuration on the measuring chute with example values

Chapter 4. Getting Started

4.1 Transport to the Installation Site

i **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 MircoPolar 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 Possibilities for Compensation*.

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.
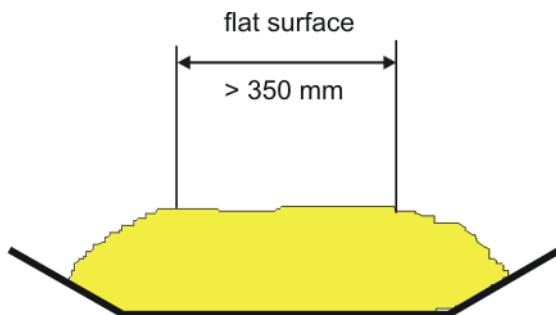
Figure 4-1:
Flat surface
in the beam range
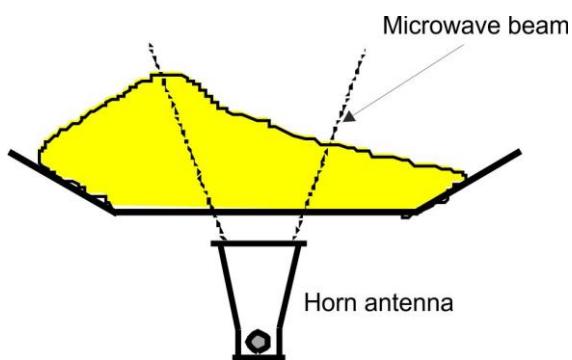
Figure 4-2:
Example 1:
The microwaves
continuously irradiate a
different material layer.
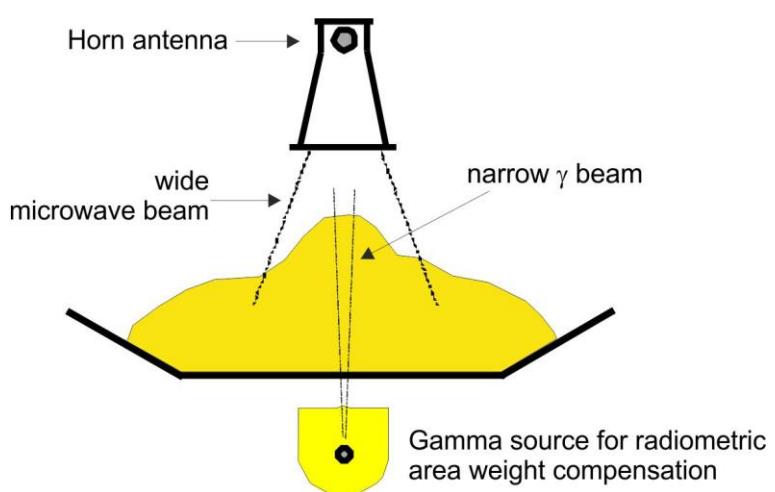
Figure 4-3:
Example 2:
Compensation and
microwave measurement
do not see the same
material layer; therefore,
both measurements do
not correlate with each
other.

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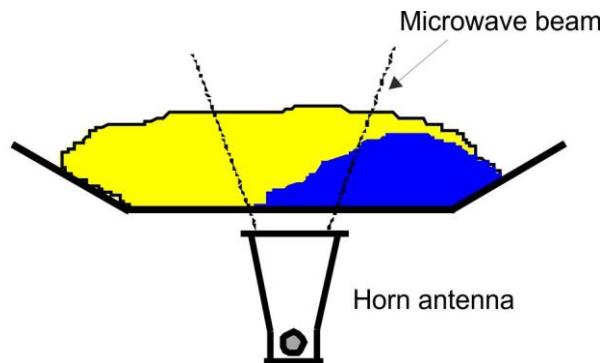
Figure 4-4:
Two different products (e.g. due to different moistures), not mixed and filled asymmetrically.

3. Measuring condition: electrically conductive materials

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

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:

$$d_{\min} = \frac{4}{\delta}$$
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. Because only then the ratio of the two signals is correct (see Eq. 3.1 in chapter 3.2 Measurement Calculation).

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
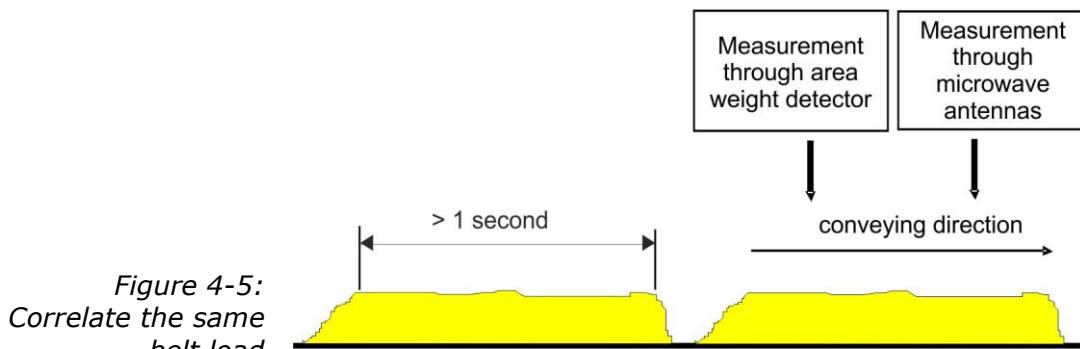
More synchronization options are available for the alternative compensation options (layer thickness sensor / belt weigher), see *chapter 7.3 Synchronization of the Current Input Signals*.

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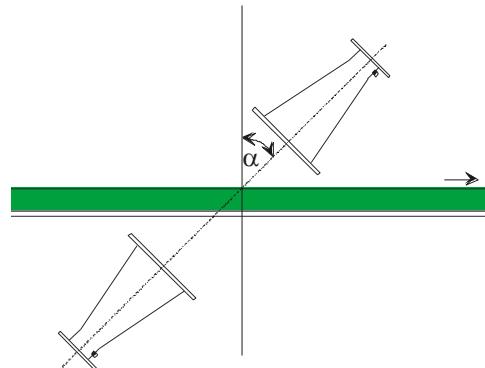
Figure 4-6:
Setup for
oblique transmission
The angle will be defined
by Berthold Technologies

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).
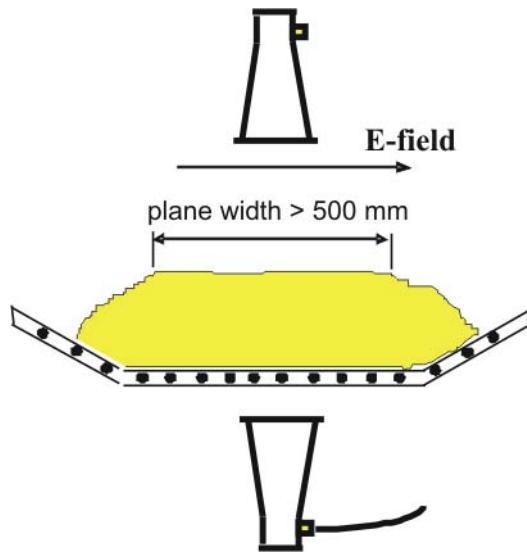
Figure 4-7:
Setup of the
horn antennas with
steel-reinforced
conveyor belt
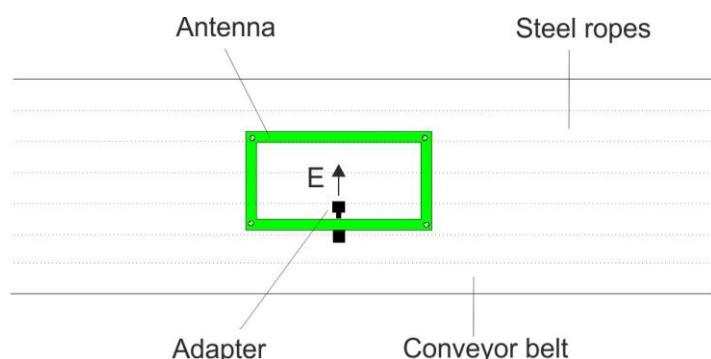
Figure 4-8:
Alignment of the antenna
in the case of parallel
running steel ropes

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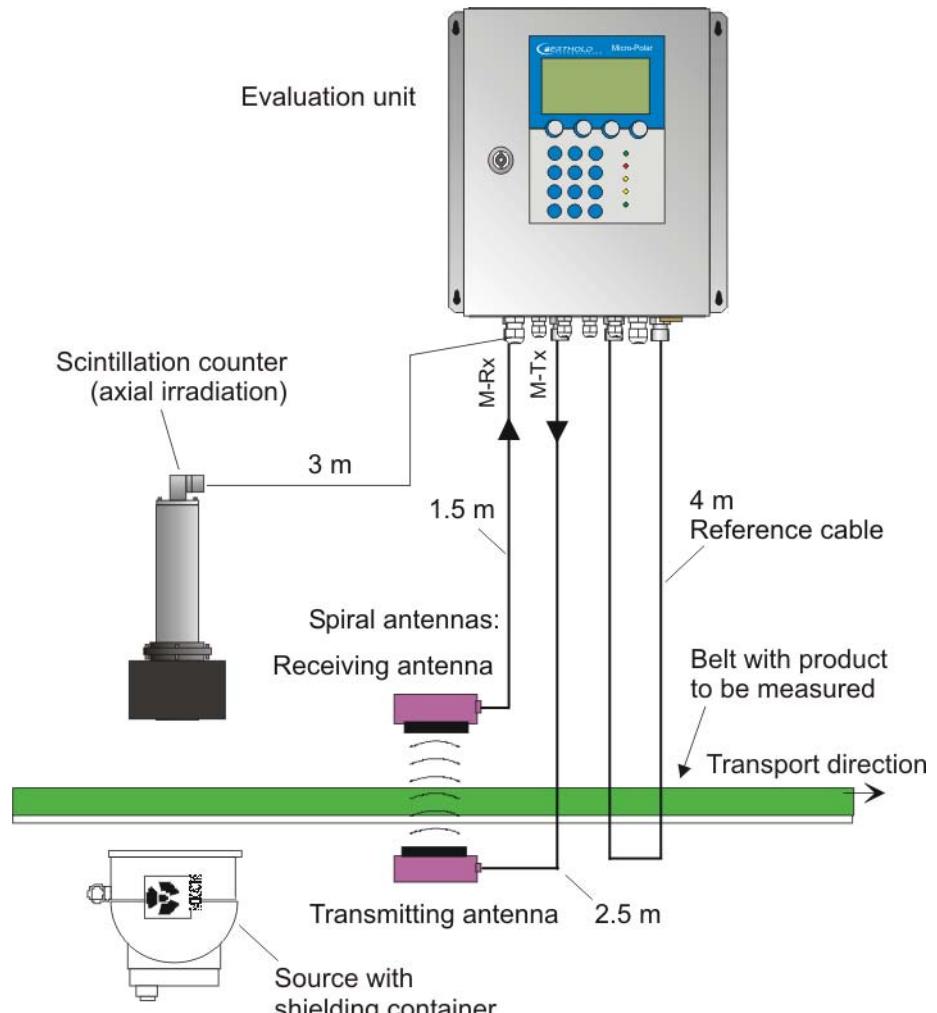
Figure 4-9:
Measurement setup on a conveyor belt with spiral antennas (with example values)

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.

➢ The phase measurement is usually used in homogeneous material. Under certain conditions, an attenuation measurement may also be performed on inhomogeneous material.

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 radiation source 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.
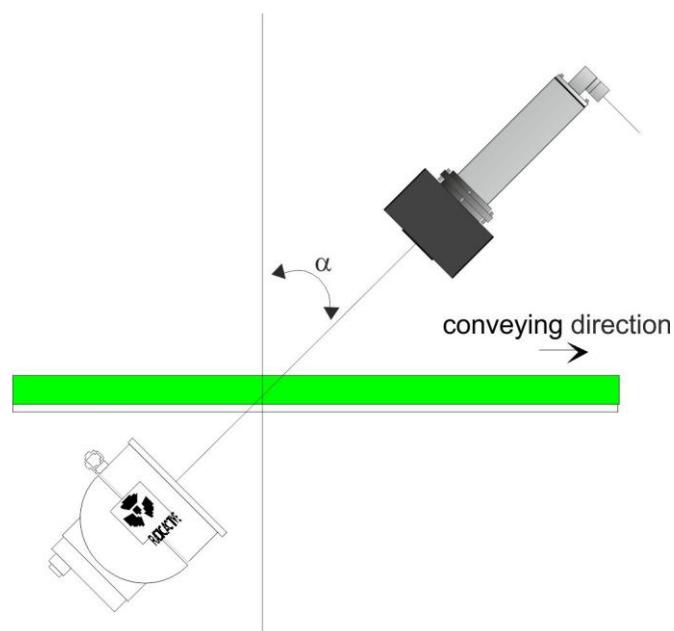
Figure 4-10:

Exception: 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.
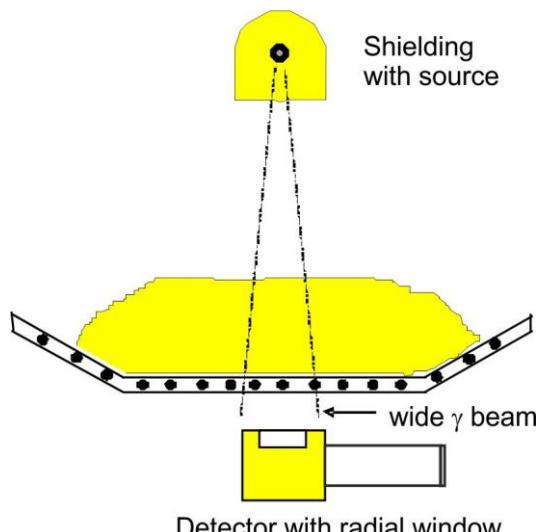
Figure 4-11:

Detector with radial window

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.

➢ For instrument installation you should foresee a cutoff device to allow easy and quick disconnection of the device from the power supply.

➢ 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.

When tightening the connector screw connection (19 mm screw nut), make sure that the connector is not twisted on the cable. If the connector is twisted relative to the cable, the shielding may get damaged and this could result in a bad electrical contact and bad sealing.

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.**

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).

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

ℹ️ 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 3-19 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 including assembly plate and brackets for horn antennas, scintillation counters and shielding containers

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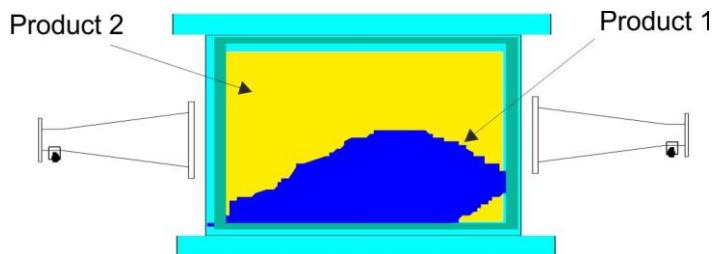
*Figure 4-12:
Two different products
(e.g. through different
moistures) cannot be
mixed and filled
asymmetrically.*

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.

➢ 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.

NOTICE

Caution! Possible hazard, property damage!

Device type LB 568-02 MircoPolar 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!

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

4.4.1 Pin Configuration of the Connector Strip

On the connector strip of the evaluation unit you find the following connections:
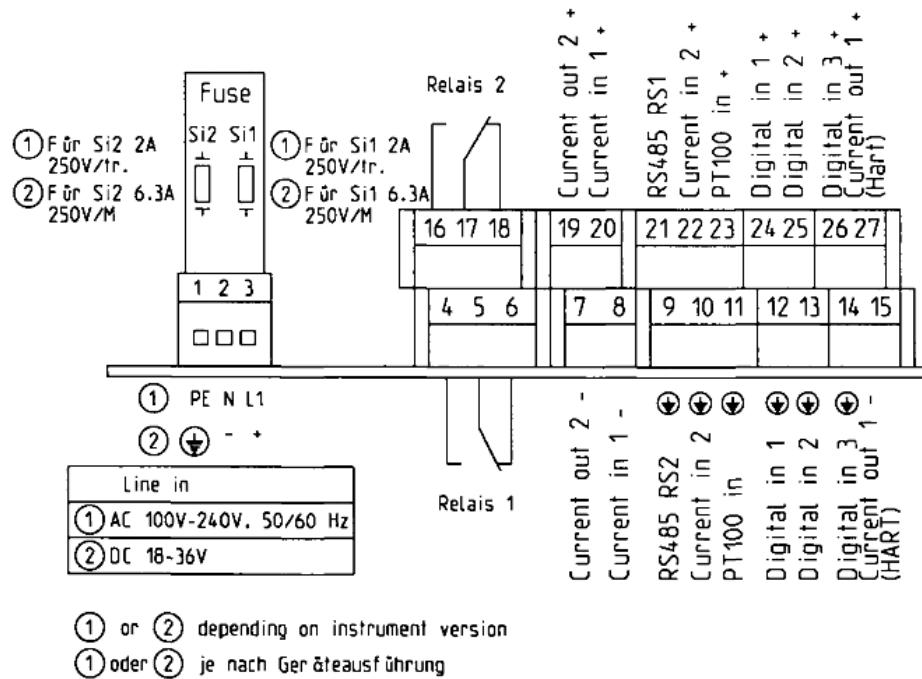
Figure 4-13:
Wiring diagram LB 568

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

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

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.

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.
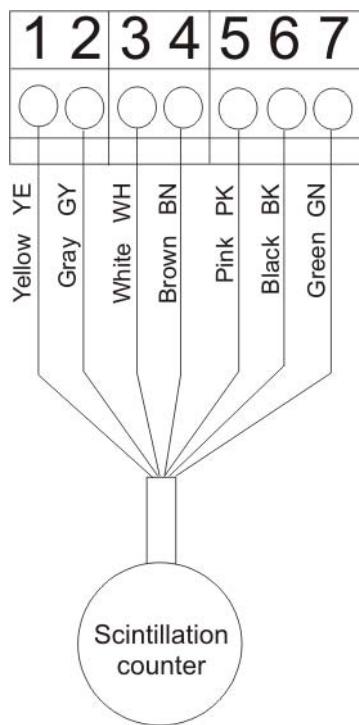
Figure 4-14:
Wiring diagram
Scintillation counter

The assignment of the terminal strip is as follows:
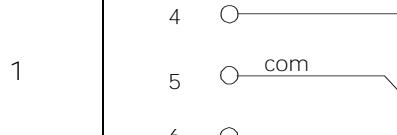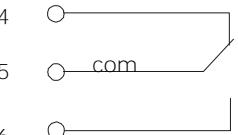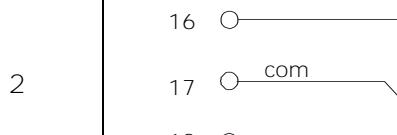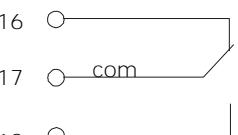
1	Detector +
2	Detector -
3	RS485-A
4	RS485-B
5	+ 24 V
6	Screen
7	24 V GND

4.4.3 Digital Outputs, Relay

The status of the measurement is output via two relays:

➢ Error

➢ Alarm (alarm min. and max.)

➢ measurement stopped

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	4 ⭕ 5 ⭕ com 6 ⭕	4 ⭕ 5 ⭕ com 6 ⭕
2	16 ⭕ 17 ⭕ com 18 ⭕	16 ⭕ 17 ⭕ com 18 ⭕

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.

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.

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

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 correct rating:

Device version	Fuse values	ID no.
100 … 240 V AC	2 x 2.0 A / 250 V / T	4403
18 … 36 V DC	2 x 6.3 A /250 V / M	4408

NOTICE

Spare fuses must match the rating specified by the device manufacturer. Short-circuiting or manipulation is not permitted.
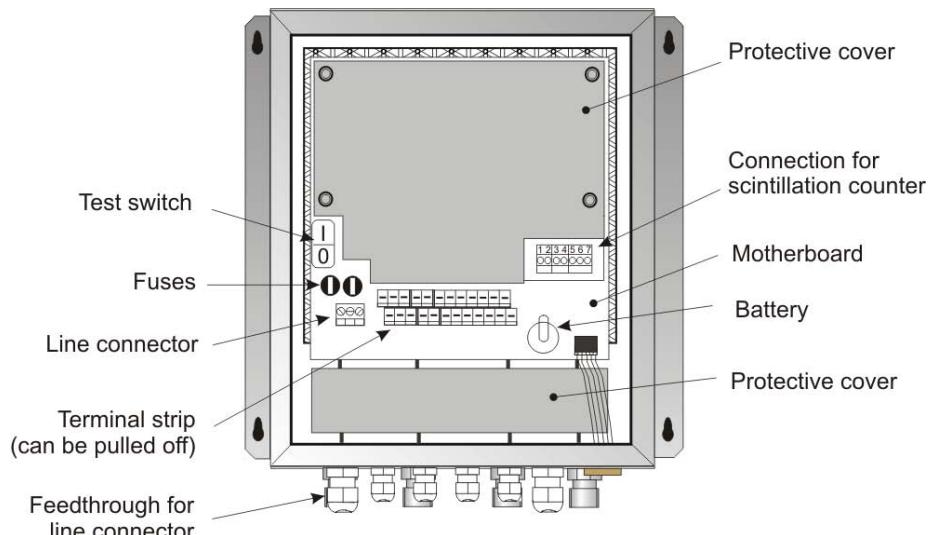
Figure 5-1: Look inside the instrument LB 568

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. 80% in the housing Altitude: max. 2000 m -20…45 °C (253 K …318 K), no condensation
Ambient conditions during storage	-20…70 °C (253 K …343 K), no condensation Relative humidity: max. 80 %
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	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
PT-100 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
	<u>Configuration options:</u> DI1: none, measurement start/stop DI2: none, measurement hold, product selection DI3: none, sampling, product selection

	<u>Function description:</u>
	1. Measurement (Start/Stop)
	    <u>open:</u> measurement stopped
	    <u>closed:</u> measurement started and/or
	             measurement running
	
	2. Hold measurement
	    <u>open:</u> measurement running
	    <u>closed:</u> measurement stopped, i.e.
	             average values and current output
	             are held
	
	3. Product selection via a DI:
	    <u>open:</u> Product 1 (P1), <u>closed:</u> P2;
	
	    Product selection via two DI's:
	    <u>DI2 & DI3 open</u>: P1
	    <u>DI2 closed & DI3 open</u>: P2
	    <u>DI2 open & DI3 closed</u>: P3
	    <u>DI2 & DI3 closed</u>: P4
	
	4. Start sampling: <u>open:</u> no actions, <u>closed:</u>
	    single measurement starts

Relay outputs	2 x relays (SPDT), insulated
	<u>Configuration options:</u> - Collective failure message - Stop measurement - Limit value (min. and max.)
	<u>Load capacity:</u> 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.
	<u>**Restrictions for 24 V DC (18…36 V) mains**</u> <u>supply, if the ground conductor is not</u> <u>connected to terminal 1 (PE):</u> 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 105 Pa (4 bar) max. 4 x 105 Pa (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 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→Mpua¶

Following lines

01.01.2005·00:00:00→0000→0→0→5→1→0.43→5.30→3.11→

1   2   3 4 5 6   7   8   9

0.07→0.98→0.0→0.0→0.0→0.0→75.36→75.00→0.00→0.00→3653→35.8→10.25¶

10   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	Phase offset (phase at frequency = 0 Hz)	X.XX
10	Dispersion of the phase regression	X.XX
11	Correlation of the phase regression	X.XX
12	Device temperature [temperature unit]	X.X
13	Current input 1 [unit of current input]	X.X
14	Current input 2 [unit of current input]	X.X
15	PT100 temperature [temperature unit]	X.X

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

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 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. 7-1**

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

ℹ️ 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.

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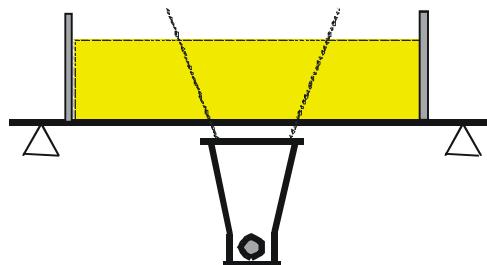
Figure 7-1:
Rectangular material cross-section with weighing system

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:

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

ℹ 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.

---

i 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.

The TC corrects the phase and attenuation before calculating the measured value (calibration), in most applications according to the following formulas (linear compensation, additive).

$$\varphi_{komp} = \varphi_{mess} + K_\varphi \cdot \Delta\theta \qquad \textbf{Eq. 7-6}$$

$$D_{komp} = D_{mess} + K_D \cdot \Delta\theta \qquad \textbf{Eq. 7-7}$$

Where:

φ_{meas}	= measured phase
φ_{comp}	= compensated phase
D_{meas}	= measured attenuation
D_{meas}	= compensated attenuation
$K\varphi$	= temperature coefficient of the phase
K_{att}	= temperature coefficient of the attenuation
$\Delta\theta$	= measured temperature (T_{meas}) – reference temp. (T_{Ref})

Depending on the selected function (additive, multiplicative, quadratic, cubic), the required temperature coefficients appear on the Calibration menu. Temperature coefficients that are not used are set to zero.

If you select two-range calibration (split concentration), separate **TC's have to be entered for both concentration ranges. The** coefficients are entered in the course of calibration.

TC can be carried out via Pt100 or via current input. This has to be defined on the Calibration menu. The Pt100 temperature range is between –50 and +200 °C.

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

7.3 Synchronization of the Current 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. 7-8**

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.
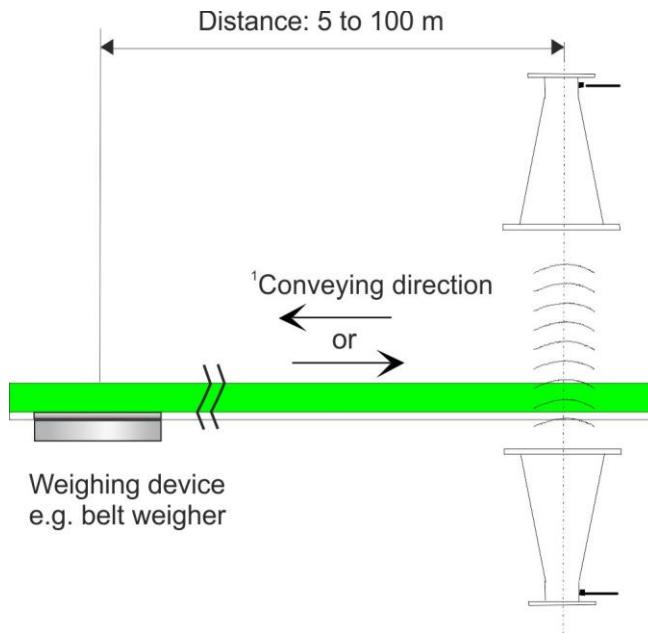
Belt speed

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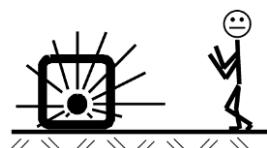
This means the distance between radioactive source and human body. The radiation intensity (dose rate) follows - just like light - an inverse square law. This means that doubling the distance from the source will reduce the dose rate to a quarter.

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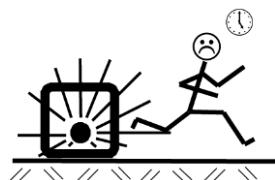
The total time a person stays in the vicinity of a radiometric measuring system and the body is exposed to radiation. The effect is cumulative and is, therefore, greater the longer the exposure to radiation.

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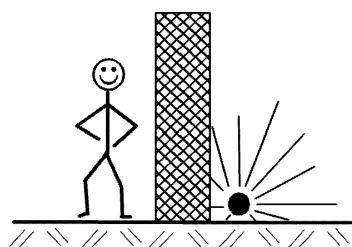
The shielding effect is provided by the shielding material surrounding the source. Because the shielding effect is in an exponential relationship to the product of thickness and density of the shielding material, shielding materials with high specific weight are required. Sufficiently large dimensions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

BERTHOLD TECHNOLOGIES GmbH & Co.KG

Calmbacher Str. 22
75323 Bad Wildbad, Germany

Phone +49 7081 177-0
Fax   +49 7081 177-100
info@Berthold.com
www.Berthold.com

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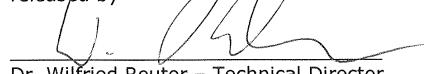
Dr. Wilfried Reuter – Technical Director
Bad Wildbad, 28th of April 2010

Chapter 10. Technical Drawings

10.1 Dimensional Drawing Evaluation Unit Case
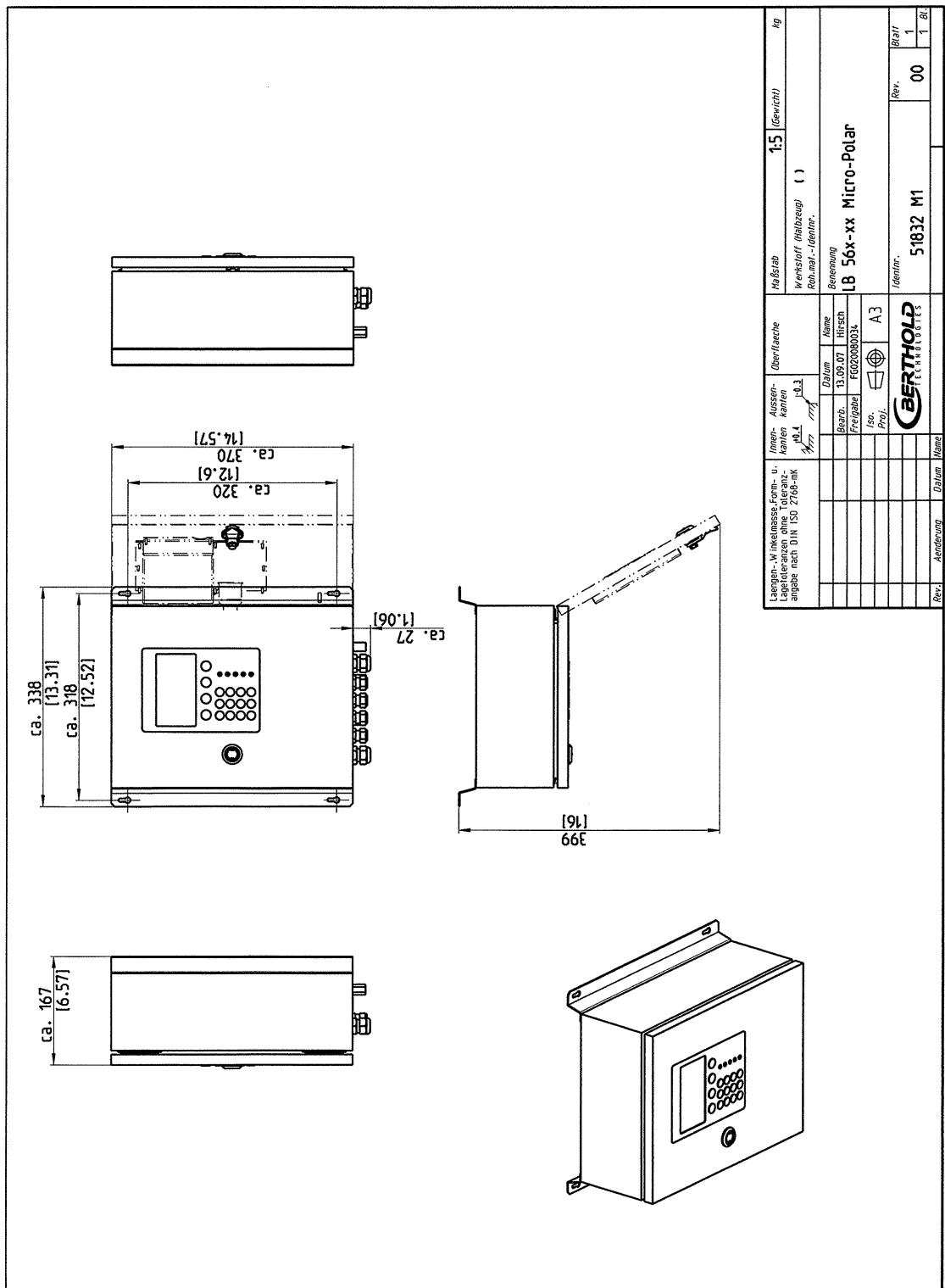
10.2 Electrical Wiring Diagram

10.3 Electrical Wiring Diagram Scintillation Counter

DET   RS485   ━━ 24V ━━
+   -   A   B   + SCREEN GND

1	2	3	4	5	6	7

YE	GY	WH	BN	PK	BK	GN
yellow	grey	white	brown	pink	black	green

Detector   Id.Nr. 56942
Id.Nr. 56943

				Datum	Name	Benennung: Anschlussplan / wiring diagram
		. .		Bearb.	29.07.10	Yilmaz	
		. .		Freigabe	FG020090088	
		. .				A4	Radiometrie Board - Detector
		. .					
		. .					

Zust.	Aenderung	Datum	Name				
02	AE201106019	14.09.11	Scheffel			Identnr.	Rev.	Blatt 1
01	AE201009011	14.09.10	Scheffel	BERTHOLD	41990AP1	02	von 1 Bl.
Zust.	Aenderung	Datum	Name	File-Name: 41990AP1-02.sch	PCB Nr.:		

10.4 Dimensional Drawings Horn and Spiral Antennas

10.4.1 Horn Antenna and Horn Antenna Brackets
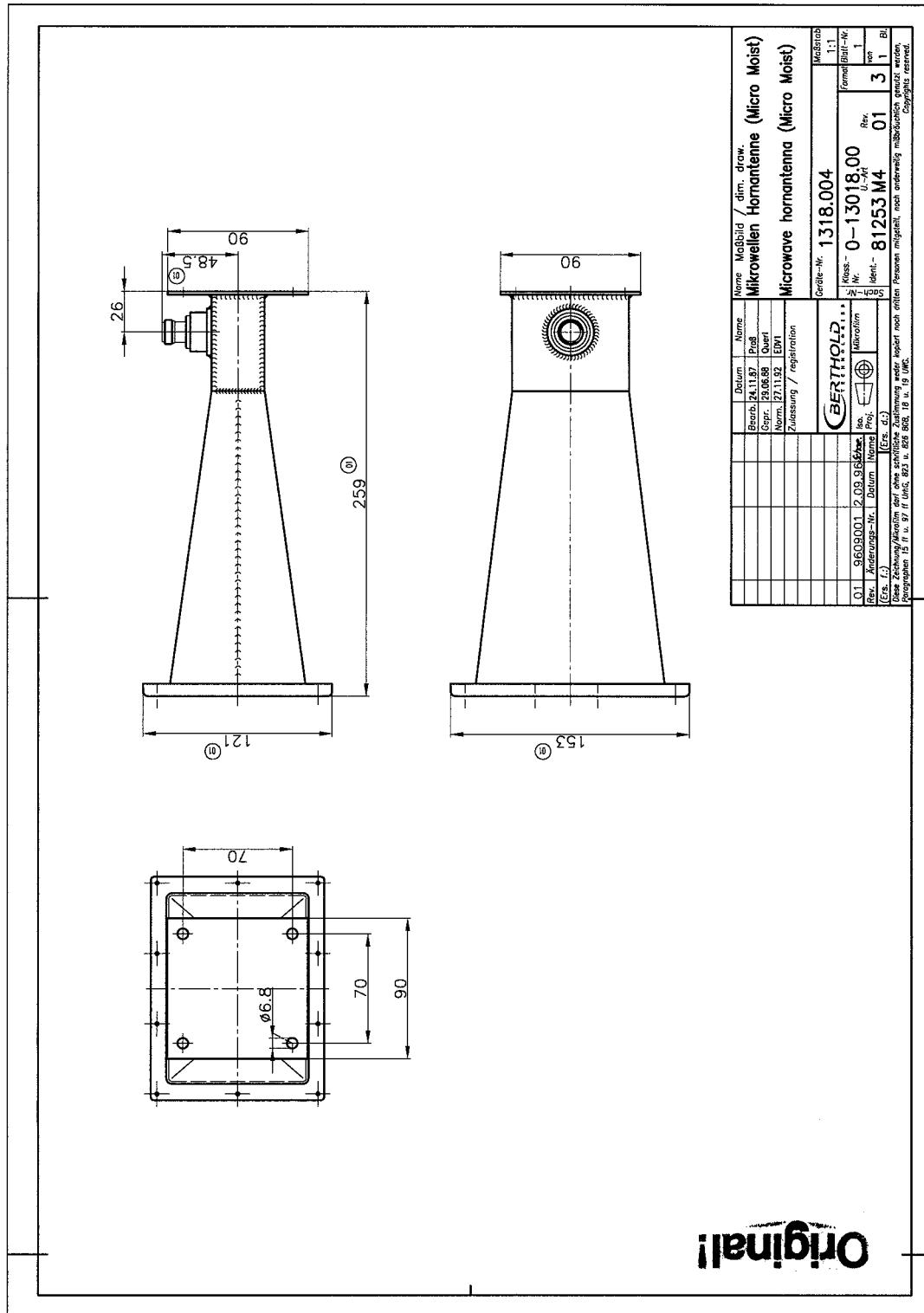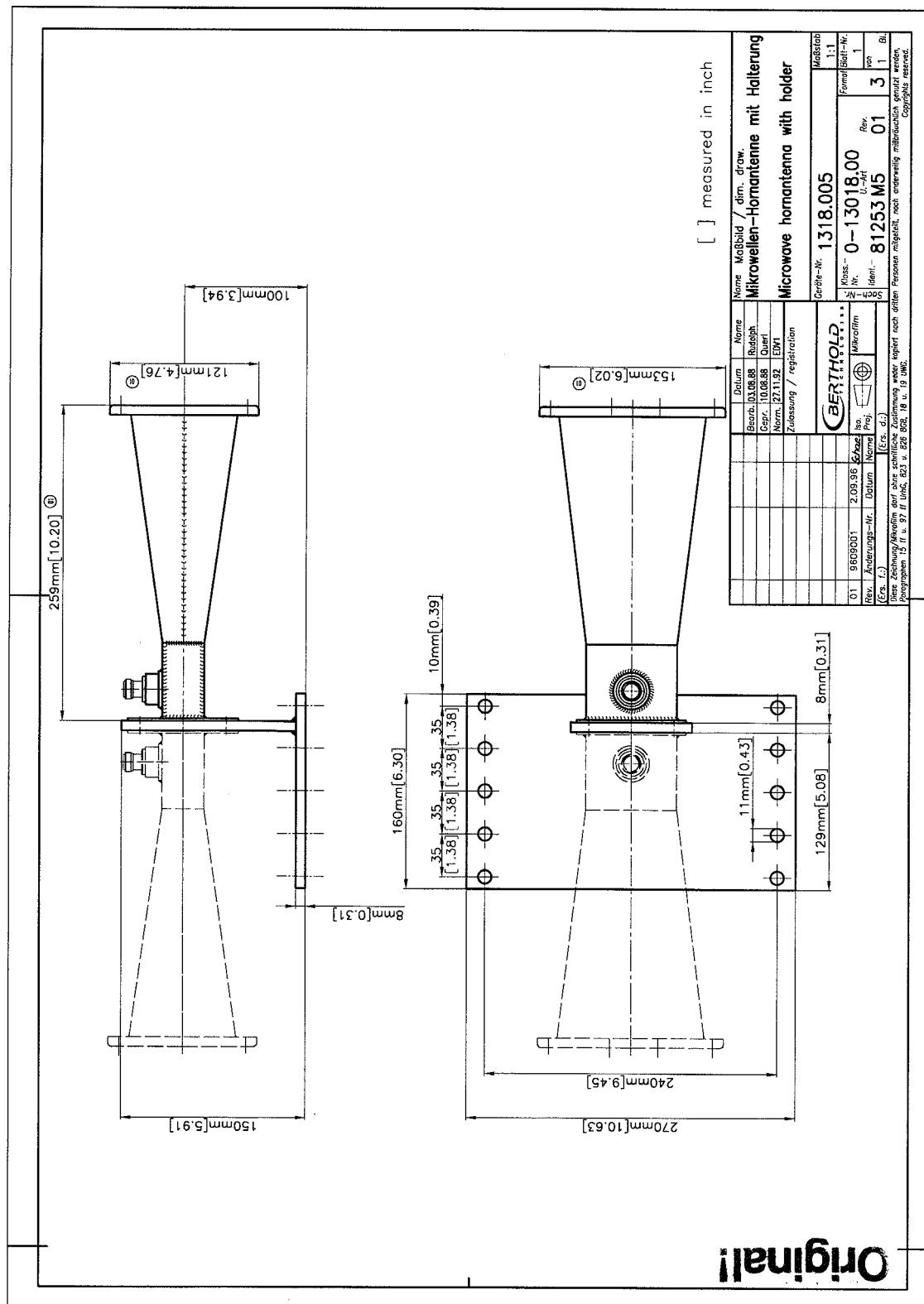
10.4.2   Spiral Antennas
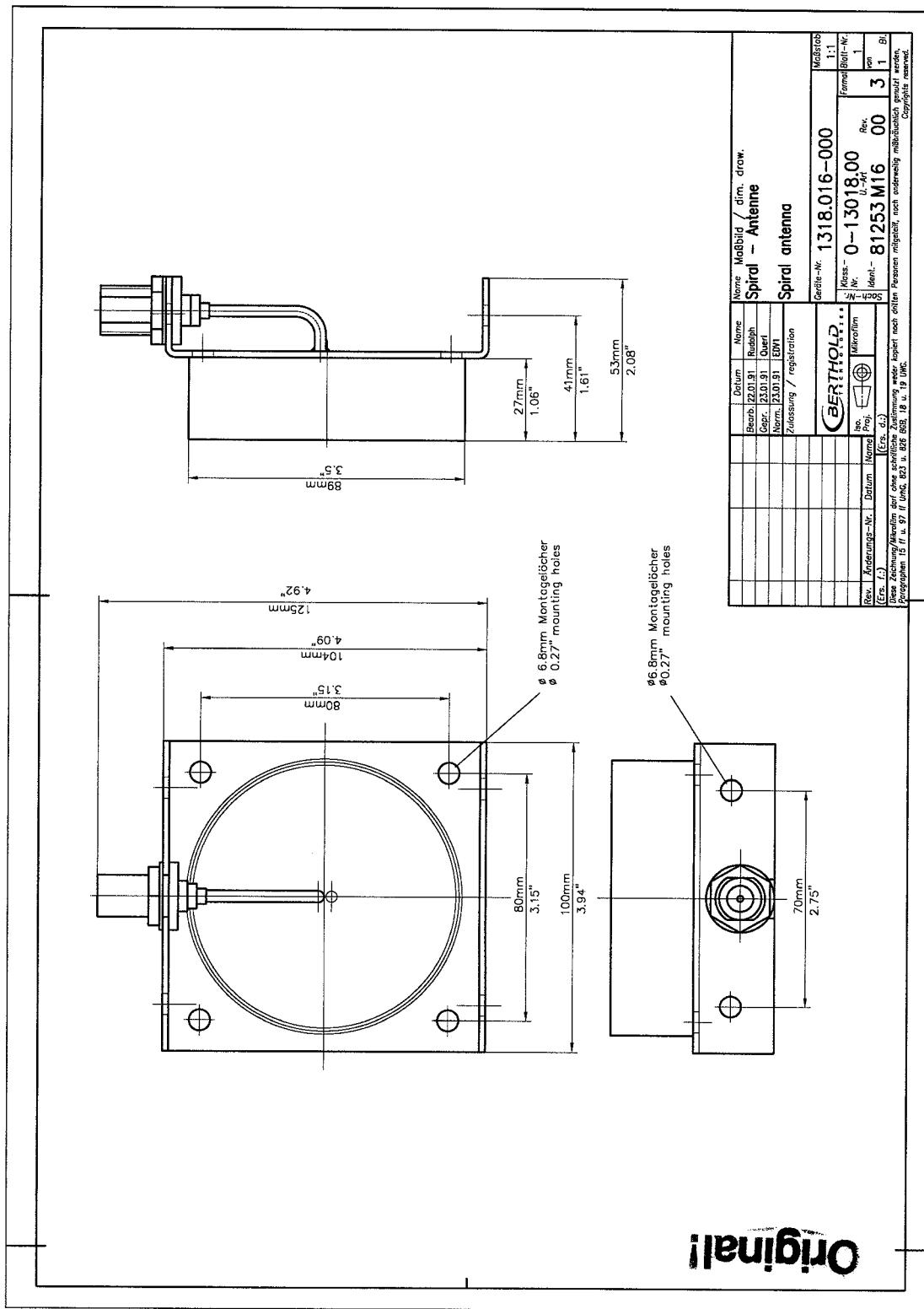
10.5 Dimensional Drawings Radiometric Measuring Path

10.5.1 Scintillation Counter with Axial Collimator
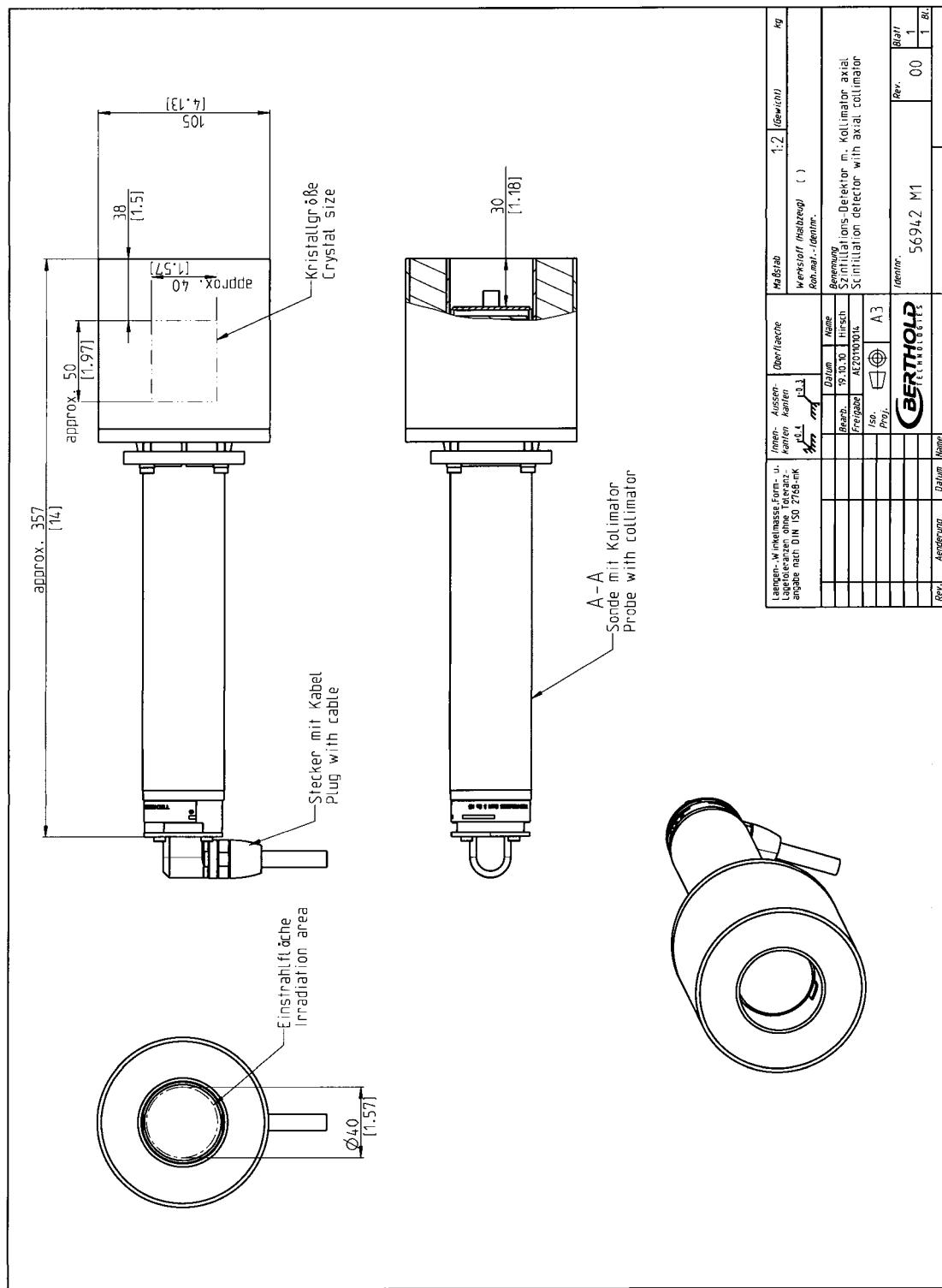
10.5.2   Scintillation Counter with Radial Collimator
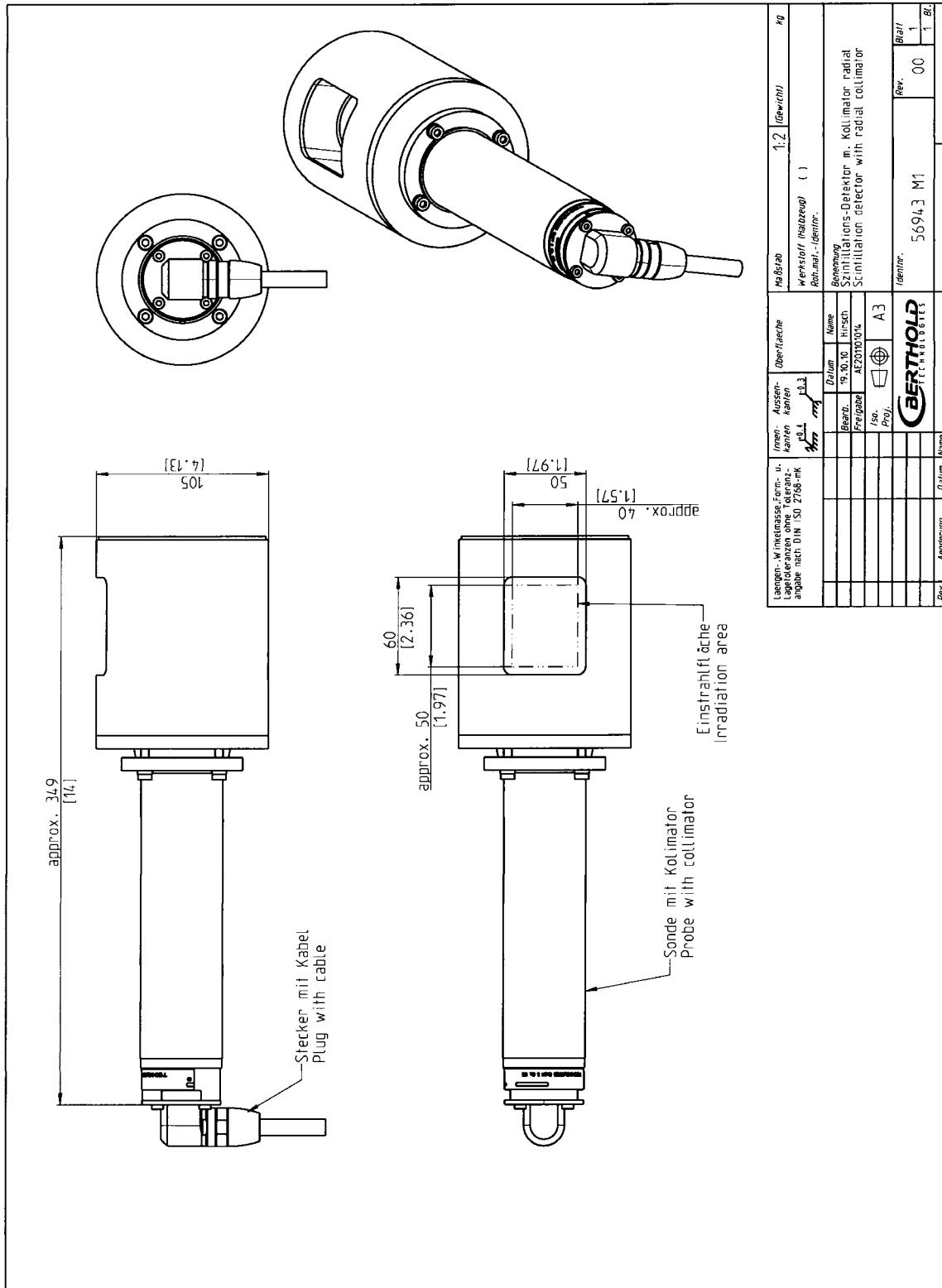
10.5.3   Scintillation Counter with Bracket
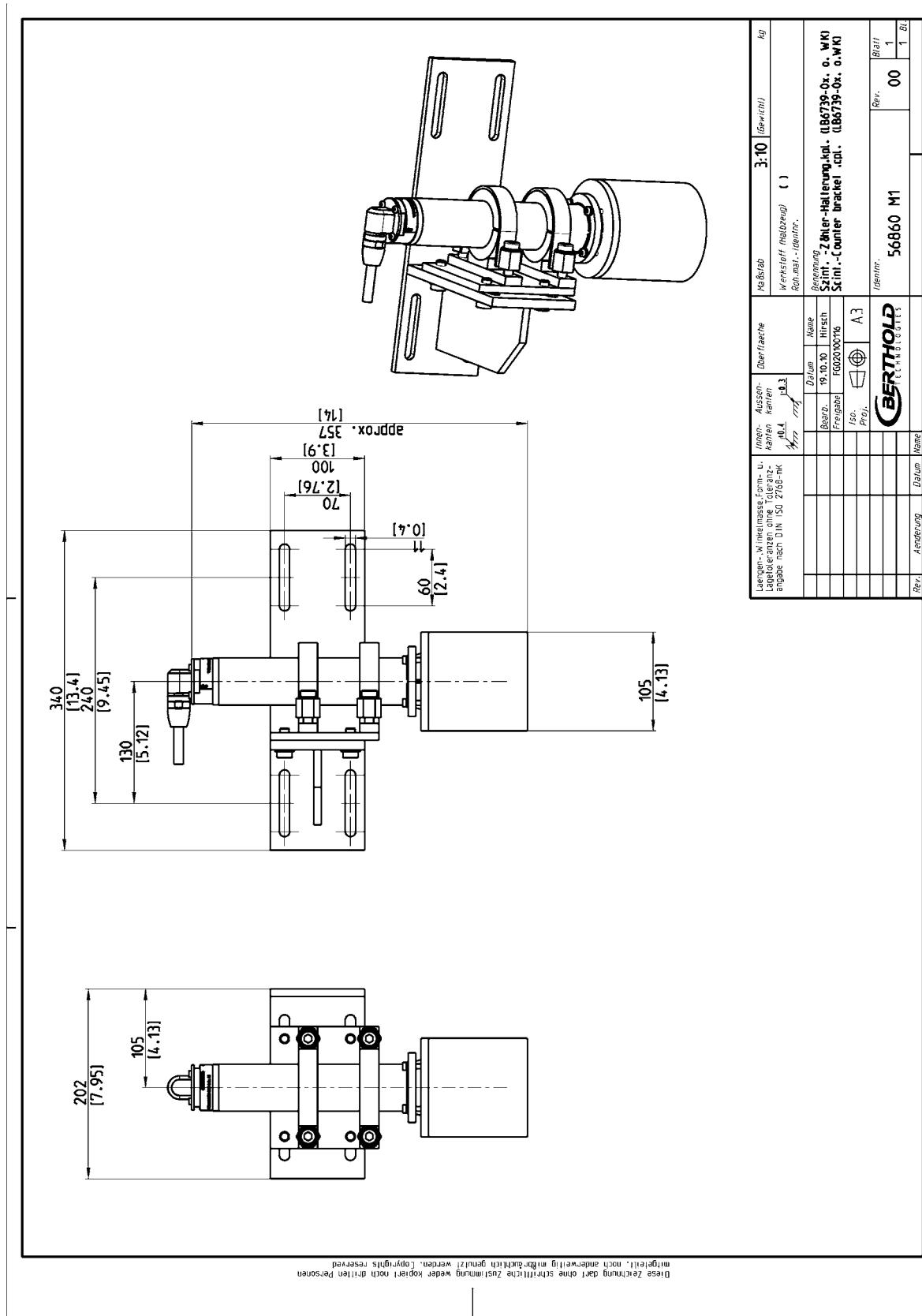
10.5.4   Shielding Container LB 7440/5 with Mounting Plate
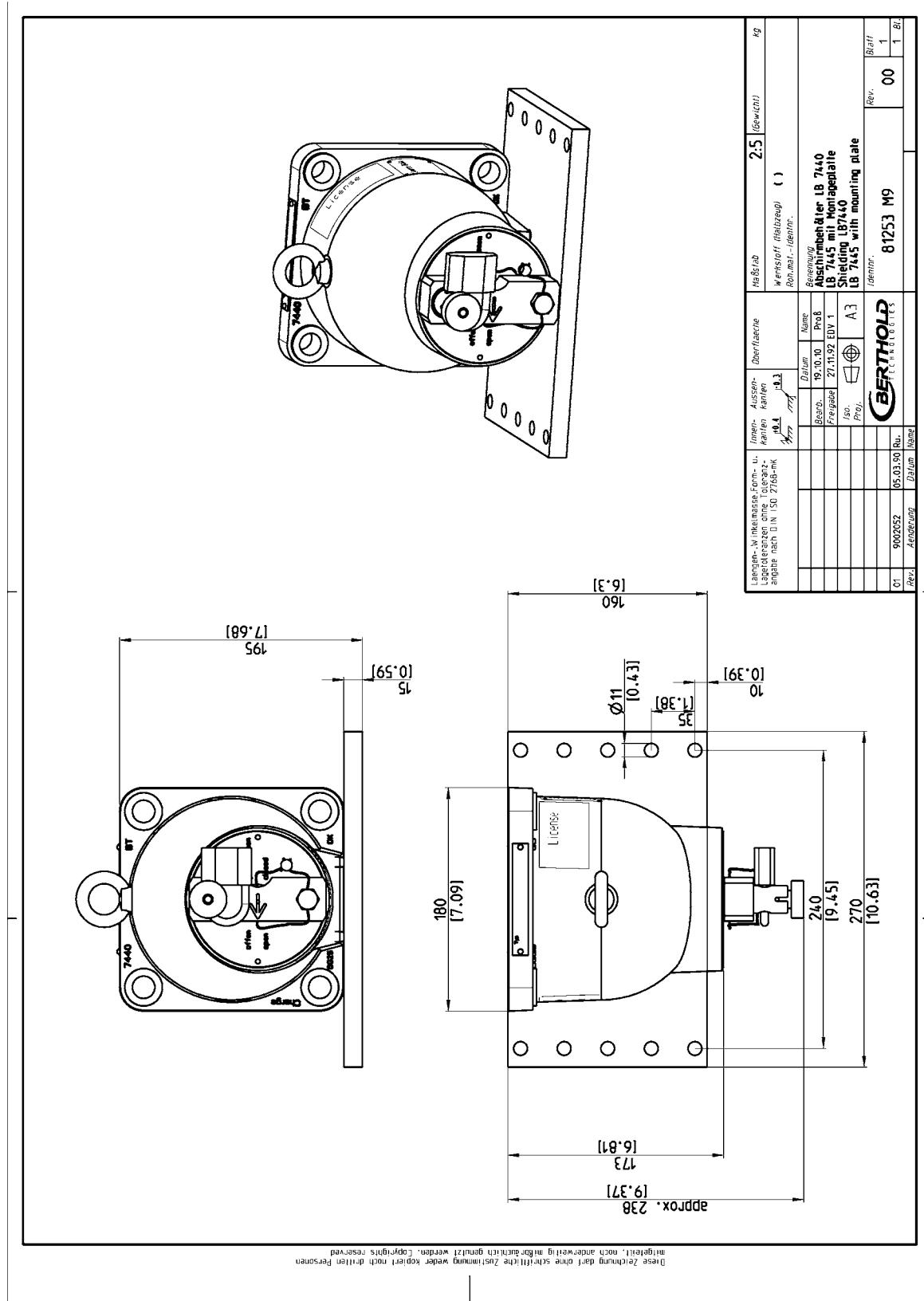
10.5.5 Mounting Plate for Shielding Container
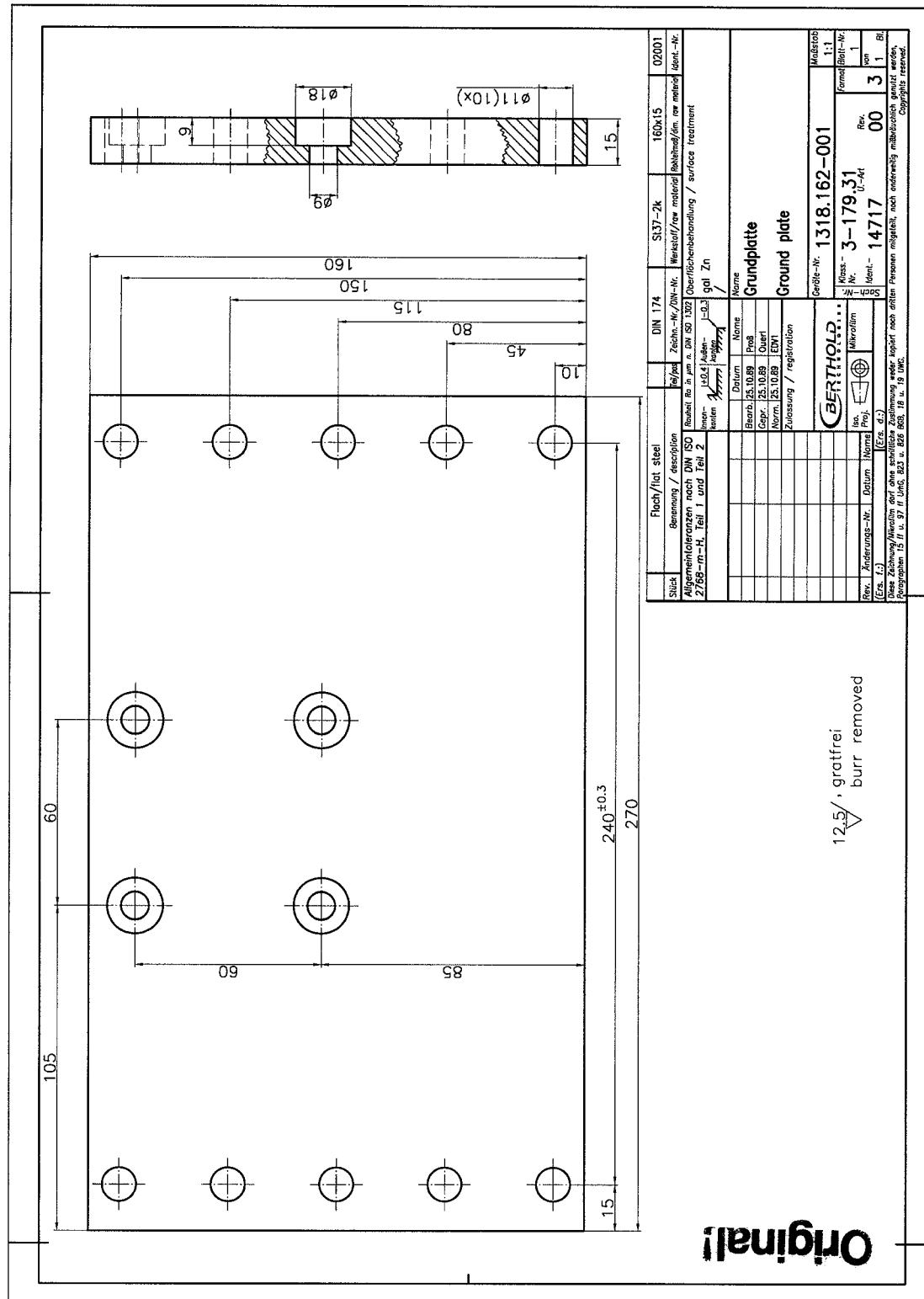
10.6 Installation Proposal at the Conveyor Belt

10.7 Installation Proposal at the Measuring Chute

Index

BERTHOLD
T E C H N O L O G I E S

g/l

Process Control

detect and identify

Concentration / Moisture Measuring System

MicroPolar Moist

LB 568

User's Guide

- Software Manual -

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

➢ safety summary

➢ 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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Chapter 1. **Safety Summary**

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

NOTICE	**Parameter settings**

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. **General Information**

Communication with the LB 568 takes place 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 LED's.

💡 **TIP**

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

LCD display

Lock

Alphanumerical keypad

Softkey buttons

LED's

RS232 connection

HF connections for signal cable   reference cable

and cable feed-through
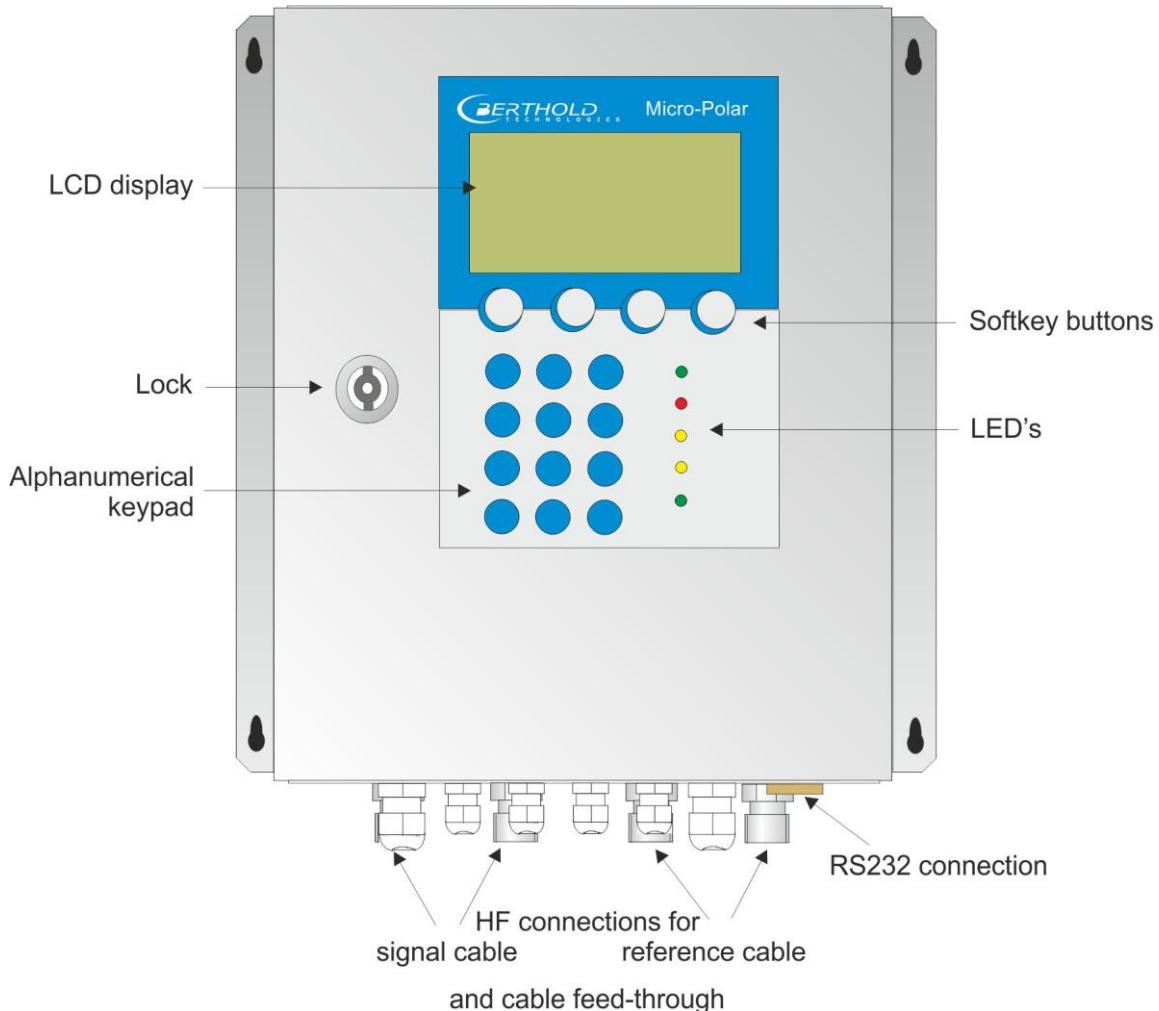
Chapter 3. **Software Functions**

3.1 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.

Depending on the access level, some menu items are hidden. You have to enter an editable password to change from the **Read only** level to **Basic** or **Profi**. The **Service level** is locked; it is foreseen only for equipment manufacturing.

3.2 Menu Structure

Live Display
Diagnostic
Setup
Access level
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Diagnostic

Datalog
Error log
Info
Print Setup

Page 11

Setup

See next page

Access Level

Read only
Basic
Profi
Service

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Language

English
German
French

Page 14

```
1 |     -     | Live Display | 07.05 – 13:25

                    Concentration av.

                    65.50 %

Conc. av.        Conc. act. 64.35%
ESC SAMPLE    ▼▲   ZOOM
```

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Radiometric detector

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Setup

Configuration
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Change password

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Configuration

General data
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System adjust

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Measurement

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Live Display
Diagnostic
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Digital input

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Current output

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"   2

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Sigma max.
Phi/Att ratio
Auto set

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"   2

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Assignment
0/4 mA
20 mA
Range
Test/Adjust
Error current

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Calibration

Cal. order
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Attenuation
Mpua

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Digital input

Status
DI 1 function
DI 2 function
DI 3 function

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Current In 2

Enabled
Adjust
Live current

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3.2.1 Start Menu

```
┌─────────────────────────────┐
│ 1 | - | LB 568 | 07.05 - 13:25 │
│                             │
│  Live Display               │
│  Diagnostic                 │
│  Setup                      │
│  Access level               │
│  Language                   │
│                             │
│ RUN    ▲      ▼      ▶       │
└─────────────────────────────┘
```

LIVE DISPLAY:
Shows the live display.

DIAGNOSTIC:
This menu item contains the submenu items data logger, error log, instrument information and start-up log output.

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 cleared.

LANGUAGE:
Select the dialog language.

3.2.2 Diagnostic

```
┌─────────────────────────────┐
│ 1 | - | Diagnostic | 07.05 – 13:25 │
│                             │
│  Datalog                    │
│  Error log                  │
│  Info                       │
│  Print setup                │
│                             │
│  ◀   ▲      ▼      ▶         │
└─────────────────────────────┘
```
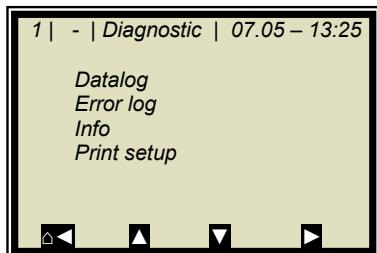
Data log:
The data log records the data corresponding with the format of the serial data output RS232 (see *Hardware Manual, chapter 6.6*).
All measured data of a measurement (Sweep) are averaged over the averaging time (see below) and stored. This time is dependent on the selected log time. The contents of the data log can be displayed on the live display, see *chapter 3.4 Trend Display*. It can also be output as a text file via RS232, and via the memory stick (optional accessory).

- Log type   Disable
                 Single
                 Continuous
                 Stop at error
- Log time   Logging period
-                         15 minutes to 3 days
- Restart log   Clears the data log and starts with the above setting
- Averaging time   Obtained from log time
- Print setup   Printout of table, output via RS232, format see *Hardware Manual, chapter 6.1 Technical Data Evaluation Unit*

Change data log settings:

If you change the log type from "any" to "single", the data log will be cleared and you start again with the current setting.

If you change all other log types and log times, the data log will not be cleared and you continue with the new settings.

Behavior with stopped measurement:

If the measurement will be stopped during the data log for some time, then the measurement pause will be interpreted as log time in the log type "single". In 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:

Output of the start-up log via RS232.

Format, contents and example see *chapter 9. Start-up Log.*

3.2.3 Setup

```
1 | - |  Setup  | 07.05 – 13:25

    Configuration
    Calibration
    Input / Output
    Service
    Product
    Change password
   ◁      ▲      ▼      ▶
```
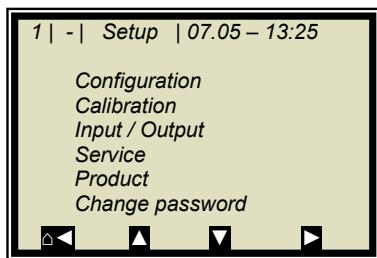
Configuration:

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

Calibration:
- System adjust
- Concentration calibration
- Advanced

Input/Output:
- Current outputs
- Current inputs
- PT100
- Digital outputs
- Digital inputs

Service:

In the Profi mode the SERVICE menu is displayed and can be edited. The following settings are possible:
- Factory settings
- General reset
- Memory stick (operation of the memory sticks, optional accessory)
- Data printout (via RS232, data contents can be selected)

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, data log and calibration) of the current product will be copied to the new product.

Change password:

The password for the access levels Basic / Profi can be changed here.

For more information see *chapter 7 Password*.

3.2.4   Access Level

```
1 | - | Access Level | 07.05 – 13:25


   Read only
   Basic
   Profi
   Service


ESC        ▲▼      ▶
```

Read only:
- Only the live display and the main menu can be selected.
- This mode can be selected on all levels without password.

Basic:
- No password required on higher levels. Password has to be entered for *Read only*.
- Password can be changed.
- On the basic level, some menu items are hidden, for example, the calibration.

Profi:
- As described above. Should be used only if you are sufficiently familiar with the measuring system.
- Changing from Profi to Basic or vice versa is possible without password.

Service:
- This level is reserved for the service personnel.

3.2.5   Language

```
1 |   -  |  LB 568  | 07.05 – 13:25


   LANGUAGE


   English
   German
   French


ESC        ▲▼      √
```

Language:
- Select the dialog language

3.2.6   Configuration
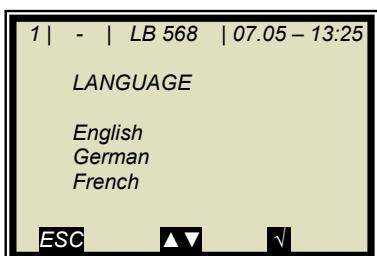
```
┌─────────────────────────────────┐
│ 1 | - | Configuration | 07.05 – 13:25 │
│    General Data                 │
│    Measurement                  │
│    Plausibility                 │
│    Microwave                    │
│    Radiometry                   │
│    Marker                       │
│    Units                        │
│    Synchronization              │
│                                 │
│   ◁     ▲     ▼     ▷           │
└─────────────────────────────────┘
```
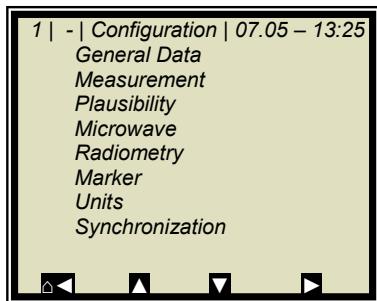
General Data:
- Enter date, time and tag

Measurement:
- Measurement mode (batch/continuous)
- Start mode (keyboard/external)
- Averaging (number of measured values used for averaging)
- Reset average value (yes/no)

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

For more information please see *chapter 3.2.9 Plausibility*

Microwave:
- **Cable:** Enter the cable lengths for the signal and reference cable. For example, for 1.5 and 2.5 m antenna cable and 4 m reference cable, you have to enter 4 m for both lengths.

Radiometry:
Here, the radiometric detector is configured. Description see *chapter 3.3.1 Configuration Radiometric Detector*.

Marker:
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 the chart limits or the current output limits.

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, %, %DS

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

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

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

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.

Details on the synchronization see *chapter 3.2.101 Synchronization*.

3.2.7 General Data

```
1 | - | General Data | 07.05 – 13:25

    Date
    Time
    Tag


  ◁    ▲    ▼    ▷
```
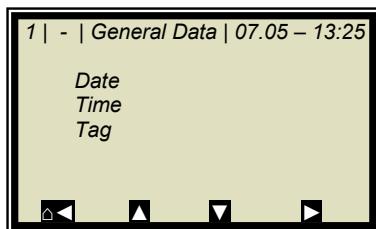
Date:
- Enter the current date

Time:
- Enter the current time

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

3.2.8 Measurement

```
1 | - | Measurement | 07.05 – 13:25

    Meas. mode
    Start mode
    Averaging
    Reset averaging

  ◁    ▲    ▼    ▷
```
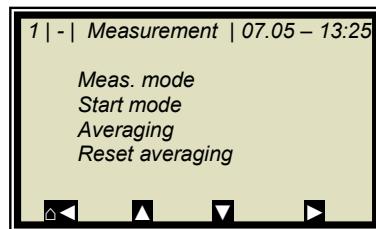
Meas. mode:
Select continuous or batch. In the batch mode, an average value is calculated between start and stop. In the continuous mode, a moving average is calculated depending on the adjusted averaging number.

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

Averaging:
Enter the number of averaging steps. It indicates how many measurements are used to average the concentration value (moving average).

Reset averaging:
Reset averaging (yes/no). This refers to batch and continuous.

3.2.9 Plausibility

```
1 | - | Plausibility | 07.05 – 13:25

    Process limits
    Phase measure



  ◁    ▲    ▼    ▷
```
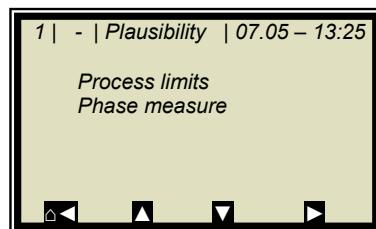
Process limits:
Enter permitted measuring overrange. If the concentration exceeds the range, the concentration average is put on hold and an error message is displayed (error state). The process limits are independent of the current output limits.

Phase measure:
The phase is subjected to a plausibility analysis. For more information please see *chapter 3.2.10 Phase Measurement*.

3.2.10   Phase Measure

The phase and attenuation are calculated for each measured value (measuring cycle) from a multitude of single measurements of different frequencies in a wide frequency band (called sweep/frequency sweep). Such a measurement permits a continuous verification of the plausibility of the results of a measurement.

The size of the frequency range allows you to select a belt to possibly rule out strong interferences (for example due to reflection) from the start. The frequency selection is done manually on the menu **|** *SETUP* **|** *CONFIGURATION* **|** *MICROWAVE*. As a rule, the frequency band "Standard" (this is the factory setting) is a good choice.

The attenuation calculation takes place through averaging via the frequency range, without further plausibility check.

The phase calculation takes place through regression calculation via the frequency range, followed by a plausibility check (see the illustration below).
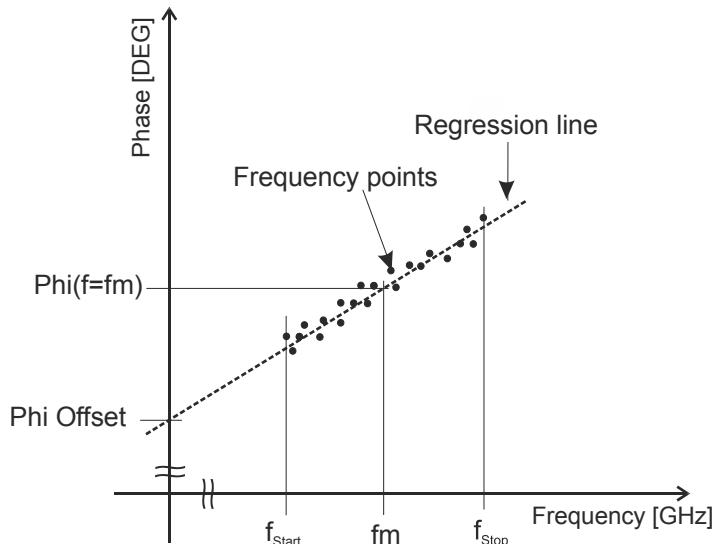
The phase check is always done through Sigma max and a second selectable plausibility of Phi Offset max or Phi/Att ratio. A combination of Phi Offset and Phi/Att ratio is not possible.

If Sigma max or Phi Offset max is exceeded, then the measurement is rejected. If the exceeding occurs continuously exceeded, the evaluation unit changes to the error state. The time up to when the fault is triggered is 75% of the averaging time of the mean concentration value.

In the factory state, the plausibility is adjusted via Phi Offset; this is recommended for all applications.

```
1 | - | Phase Measure | 07.05 – 13:25

Phi offset max          170°
Sigma max.              500
Phi/Att            Disabled
Phi/Att ratio             0
Auto set                OFF

 ◄    ▲    ▼    ►
```
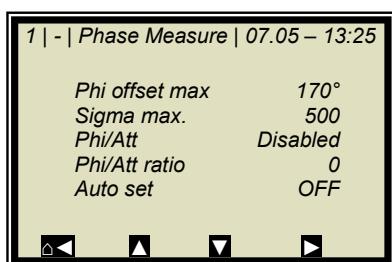
Phi offset max:
Phi Offset is the phase value where the frequency is zero (see illustration above).
Here the maximum permissible value is entered for Phi Offset. Typical values between 150 to 170°. Default: Phi Offset max. = 170°.

With Phi Offset max = 0 the plausibility is turned off.

Sigma max.:
Here you set the maximum sigma of the regression Phase vs. Frequency.
During normal measurement operation, the scattering lies between 0 and 300. Default: Sigma = 500. With sigma = 0, the plausibility is turned off.

Phi/Att ratio:
The ratio of phase and attenuation is used for the phase check. A fixed Phi/Att ratio is entered. If you do not know it, you have to record it once, see the description for "Auto set" below. The exact procedure is described in *chapter 6.1*.

The phase check is done as follows:

$$\varphi_{permitted} = V \cdot D_{meas} \pm \frac{180°}{f_m} \qquad \text{Eg. 3-1}$$

Where:
$\varphi_{permitted}$ = permitted phase range
V = parameter Phi/Att
D_{meas} = measured attenuation
f_m = center frequency

If the phase is not in this range, it is corrected by 360°/fm.

Default: Phi/Att = 0

The Phi/Att ratio can be enabled and disabled.

Auto set:
The automatic ratio measurement Phi/Att can be turned on and off. For details see *chapter 6.3*.

3.2.11 Synchronization

If 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.

```
1 | - |Synchronization| 07.05–13:25


  Sync. config.
  Current input 1
  Current In 2



  ◁   ▲   ▼   ▶
```
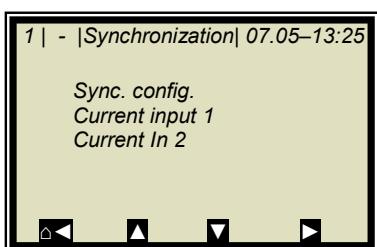
Sync. config.:
Select the synchronization mode and, if necessary, enter the conveying speed.

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.

```
1 | - |Sync. config | 07.05–13:25


  Mode
  Velocity



  ◁   ▲   ▼   ▶
```

Mode:
- Disable
- Constant speed
- Variable speed

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

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

3.2.12 Calibration

```
1 | - | Calibration | 07.05 – 13:25


   System adjust
   Calibrate Conc
   Calibrate Conc 2
   Advanced


   ◢◀    ▲    ▼    ▶
```
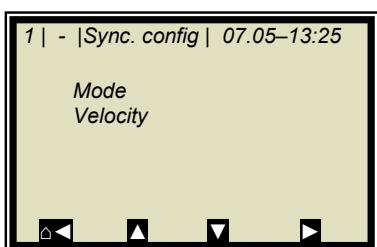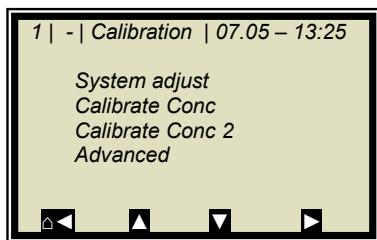
System adjust:
    System calibration is started here.

Calibrate conc:
    Opens the calibration menu of concentration 1.

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

Advanced:
    Here you set the tare values, the number of sweeps, the
    process type, the split value and the extended calibration
    mode. For details see *chapter 3.2.17 Advanced*.

3.2.13 System Adjust

```
1 | - |System Adjust | 07.05 –13:25


   Adjust
   Reference values
   Chart Phi
   Chart Attenuation


   ◢◀    ▲    ▼    ▶
```
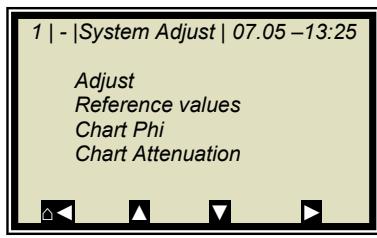
Adjust:
    System calibration is started.

Reference values:
    Upon completion of the reference measurement, the
    reference values for phase (Phi(fm)), attenuation, slope
    and sigma can be output.

Chart Phi:
    Shows the phase values versus the frequency.

Chart Attenuation:
    Shows the attenuation versus the frequency.

The data log will not be deleted by a system calibration (see
chapter 3.2.2 Diagnostic).

3.2.14 Calibrate Concentration

```
1 | - | Calibrate Conc | 07.05 –13:25

   Sampling
   Calibration
   Tuning
   View

   ◁   ▲   ▼   ▶
```
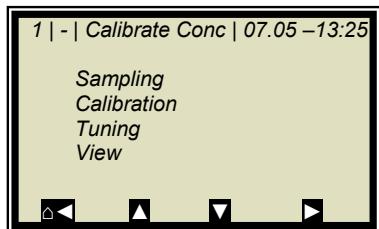
Sampling:

Shows all measured samples and entered lab values.

Calibration:

Here you can choose the calibration order [linear/quadratic], the basis [phase/attenuation or both] and the compensations.

For details please see *chapter 3.2.18 Calibration*.

Select Calibration to enable and parameterize the temperature and loading compensation.

Select Calibration to carry out the automatic calculation of the coefficients.

Tuning:

Subsequent correction of the reading is possible by entering a factor and an offset.

Calculation is carried out using the following formula:

$$\textbf{Corrected display} = \textbf{Display} \cdot \textbf{Factor} + \textbf{Offset} \quad \textbf{Eg. 3-2}$$

View:

Presentation of calibration curve, display of correlation and coefficients.

3.2.15 Sample Table

```
1 |  1/1  | Sample # 1  | 07.05 –13:25

   Next sample
   Active              Yes
   Measured value    65.50%
   Lab value          0.00 %
   Extended
   ◄    DEL    ▲ ▼        √
```
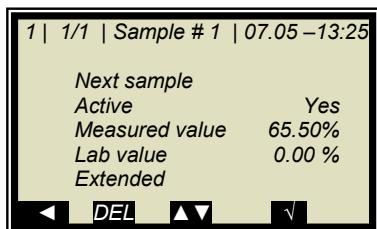
The header includes the following information (from left to right):

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

Up to 20 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 on the display.

Next sample:
Continues with the next sample.

Active:
Here 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 laboratory value.

Extended:
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.

3.2.16 Sample Data (expanded)

```
1 | 1/1 | Sample # 1 | 07.05 –13:25

     Current In 1
     Current In 2
     PT100
     PHI (fm)
     Attenuation
     MPUA loading
   ◄    DEL   ▲▼        √
```
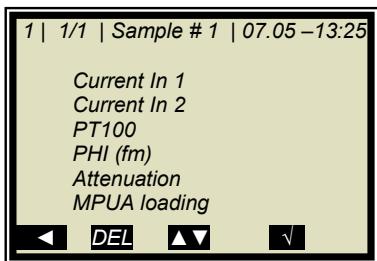
Current In 1:
Display of the first compensation input (editable)

Current In 2:
Display of the second compensation input (editable)

PT100:
Display of the PT100 input (editable)

PHI (fm):
Display of the measured phase.

Attenuation:
Display of the measured attenuation.

MPUA loading
Displays the measured load [g/cm^2]

3.2.17 Advanced

```
1 |  -  | Advanced | 07.05 – 13:25

     Tare values
     Num. cal. sweeps        20
     Process type      Split conc
     Split value         75.00 %
     Extended cal. mode  disabled
   △◄      ▲        ▼        ►
```
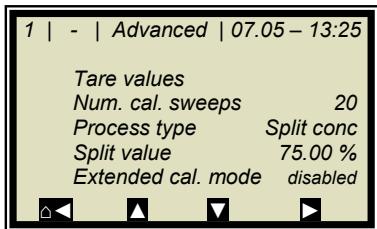
Tare values:
Option to enter tare values for phase and attenuation. The tare values are added to the phase stage and/or the attenuation prior to calibration. The calculation is carried out as follows:
Eg. 3-3 and 3-4

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

Attenuation = Attenuation$_{meas}$ - Attenuation 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.

Extended calibration mode:
Details see *chapter 6.4*.6.

3.2.18 Calibration

```
1 | - |  Calibration  | 07.05 –13:25

   Cal. order
   Cal. base
   Coefficients
   Temp. comp.
   Loading comp.
   Start Calibration
   ◄      ▲      ▼      ►
```
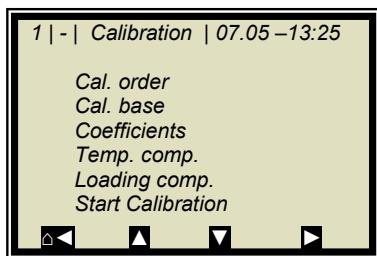
Cal. order

> Here you define the calibration order [linear / quadratic]
> Default: Linear

Cal. base

> The following parameters can be set:
> - Phase
> - Attenuation
> - Phase and attenuation
>
> Default: Attenuation

Coefficients:

> Here you can edit all coefficients for phase and attenuation.
> Default: A1 = 0, B1 = 0, C = 10

Temp. comp.:

> If at least one analog input is active, you may here assign the compensation and set the compensation parameters.
> For details please see *chapter 3.2.19 Temperature Compensation*.

Loading comp.

> If at least one analog input is active, you may here assign the compensation and set the compensation parameters.
> For details please see *chapter 3.2.20 Load Compensation*.

Start Calibration

> Starts the calibration using the parameters you have set earlier.

3.2.19 Temperature Compensation

```
1 | - | Temp. Comp. 1 | 07.05 –13:25
    Input
    Mode
    Order
    TC evaluation
    Reference value
    C_dB 1
 ◄   ▲   ▼   ►
```
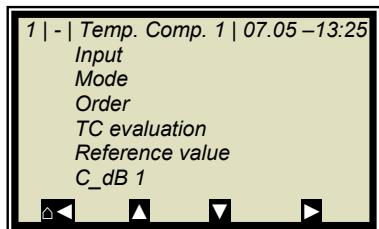
Input:

The compensation can be turned on and off: if no input is selected, the compensation is turned off.

An analog input is assigned to the compensation (current input 1/2, PT100); only the activated inputs are available.

Mode:

The following parameters can be set:
• Additive
• Multiplicative

Order:

The following parameters can be set:
• Linear
• Quadratic

TC evaluation:

The following parameters can be set:
• Sampling
  The temperature coefficients are calculated using the entries in the sample table.
• User-defined
  The temperature coefficients are defaulted, for example, if they are already known from other applications.

Default: Sampling

Reference value

Enter the reference value.

C_dB 1:

All temperature coefficients are listed depending on the previously defined compensation parameters. They can be edited and/or read off here after execution of a calibration calculation with "Start calibration".

See additional explanation in the Hardware Manual in *chapter 7.2 Temperature Compensation*.

3.2.20 Loading Compensation

At least one analog input or the radiometric detector must be active so that the LOADING COMPENSATION menu is displayed. Some compensation modes are displayed only upon activation of two inputs.

```
1 | - | Load Comp | 07.05 – 13:25

   None
   Radiom. MPUA
   Loading (Cin 1)
   Tonnage & Speed
   Mass & Layerheight

   ◁      ▲      ▼      ▷
```
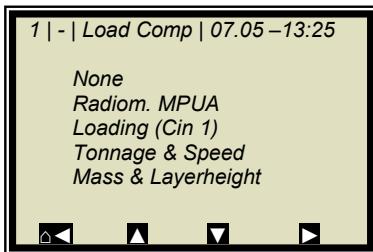
Comp. mode:
　　The following parameters can be set:
- Disabled / Enabled
- Radiom. MPUA
- Loading (Current In 1)
- Tonnage & Speed
- Mass & Layerheight

```
1 | - | Load Comp | 07.05 – 13:25

   Comp. mode          Height
   Loading limit

   ◁      ▲      ▼      ▷
```
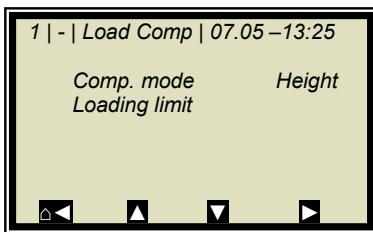
If the loading compensation is selected, the Loading Limit menu appears.

Loading limit:
　　Enter the minimum load; if this value is not reached, the evaluation unit switches to the error state.

Compensation mode Loading (Current In 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

Unit
- 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 & Layerheight
(weight & layer thickness):**
Signal input
- Weight via current input 1
- Layer thickness via current input 2

Unit
- 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.

Compensation mode Radiometric MPUA:
The compensation signal is provided by the scintillation counter.

Unit
- Mass per unit area [g/cm^2]
- Min. load [g/cm^2]

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

3.2.21 Inputs / Outputs

```
1 | - | Inputs/Outputs | 07.05 –13:25

   Current output
   Current input
   PT100
   Digital output
   Digital input
  ◁    ▲    ▼    ▷
```
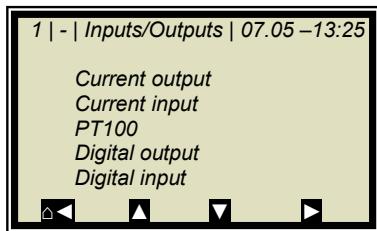
Current output:
> Both outputs can be adjusted, assigned and set up on the selected level.

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.

3.2.22 Current Output

```
1 | - | Current Output | 07.05 –13:25

   Current out 1
   Current out 2



  ◁    ▲    ▼    ▷
```
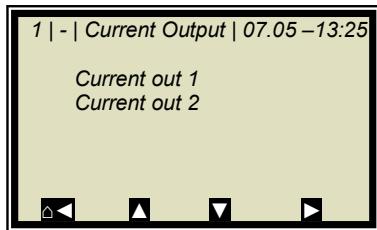
i IMPORTANT

If a measurement is running, enabling a non-used or non-adjusted current input may cause an error.

3.2.23 Current Out 1

```
1 | - |Current Out 1 | 07.05 –13:25

   Assignment
   4 mA
   20 mA
   Test/Adjust
   Error current
  ◁    ▲    ▼    ▷
```
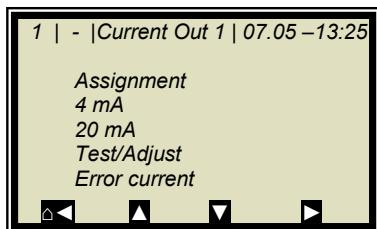
Assignment:
> The following signals can be assigned to the current output.
> - None
> - Concentration
> - Concentration 2 (if active)
> - Mass per unit area (if active)
> - Current input 1 or 2 (if active)
> - PT100 (if active)

4 mA:
Display value assigned to the 4mA value.

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

TIP
Current output 1 only 4 – 20mA possible

If the current output limit is exceeded, then the measurement changes to the warning status, see section 8.4 Device States.

Test/Adjust:
Current test, calibration and display of live current.

The ADJUST menu is displayed only in the Profi mode.

i 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 goes into the error state, a fault current is output via the current output; this fault current can be set here.
- 22 mA
- 3.5mA
- Hold
- Value (selectable)

3.2.24 Current Out 2

```
1 |  - |Current Out 2 | 07.05 –13:25
    Assignment
    4 mA
    20 mA
    Range
    Test/Adjust
    Error current
   ◁   ▲    ▼    ▶
```
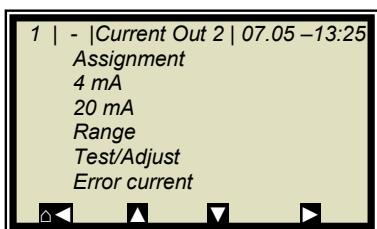
All functions same as current output 1

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

Range:
Change the current output
- 0 – 20mA
- 4 – 20mA

3.2.25 Current Input

```
1 | - | Current Input | 07.05 –13:25

    Current in 1
    Current in 2
```
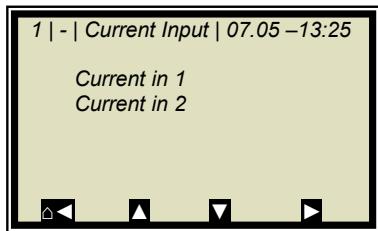
Current in 1:
  When selected, the program changes to the activation and calibration menu.

Current in 2:
  As described above.

3.2.26 Current In 1

```
1 | - | Current Input 1 | 07.05 –13:25
    Status
    Range
    4 mA
    20 mA
    Adjust
    Live current
```
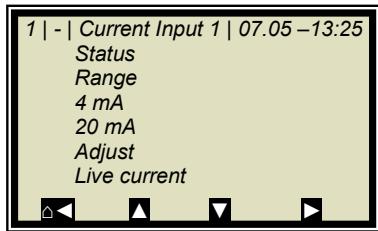
Status:
  Select yes/no to enable or disable the current input.

Range:
  Change the current output
  • 0 – 20mA
  • 4 – 20mA

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

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

Adjust:
  Follow the instructions on the display.

Live current:
  Display of the live current signal.

3.2.27 Current In 2

  Settings correspond to current input 1.

3.2.28 PT100

```
1 | - |    Pt 100    | 07.05 – 13:25

      Enabled
      Adjust PT100
      PT100 live

   ◁     ▲     ▼     ▶
```
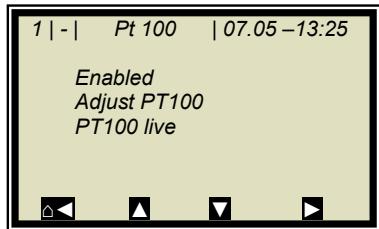
Enabled:

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

ℹ️ IMPORTANT

If a measurement is running, enabling a non-used or non-adjusted PT100 input may cause an error.

Adjust PT100:

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

PT100 live:

Display of the live temperature.

Settings correspond to input 1.

3.2.29 Digital Output

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

1 | - | Digital Output | 07.05 –13:25
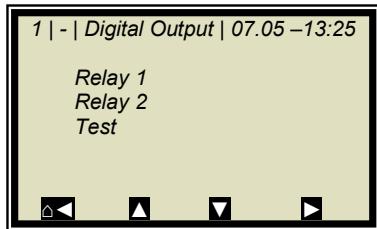
Relay 1
Relay 2
Test

Relay 1:
Different functions can be assigned to relay 1:
- None
- Error
- Hold
- Alarm min.
- Alarm max.

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.

Relay 2:
Same assignments possible as above.

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

3.2.30 Digital Input

The measuring device has 3 digital inputs, to which different functions can be assigned.

1 | - | Digital Input | 07.05 –13:25

Status
DI 1 function
DI 2 function
DI 3 function
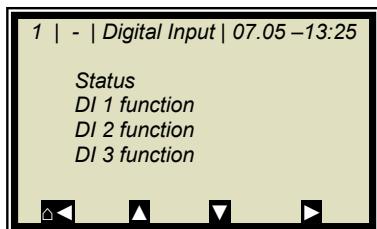
Status:
Shows the status of the input circuit
- open/closed

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 calibration
- 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

3.2.31 Service

```
1 |  -  | Service | 07.05 – 13:25

Factory settings
General reset
Radiom. detector
Memory tool
Data printout           Line
  ◁      ▲      ▼      ▶
```
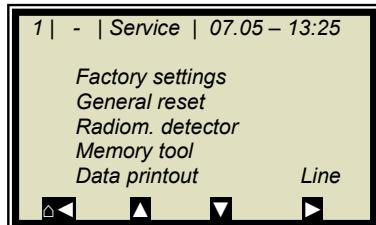
Factory setting and General reset:

See table on the next side.

The Factory setting function allows you to reset the measuring system parameters to their original status.

Memory tool:

Refers to the communication with the external memory stick (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 stick.
- Load parameters: All instrument parameters stored on the memory stick will be loaded onto the evaluation unit. All operating parameters in the evaluation unit will be deleted.
- Save data log: The data log will be saved to the memory stick.
- Save log: The start-up log will be saved to the memory stick.

NOTICE

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

Data printout:

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

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

"Line" is defaulted.

	Factory setting	General reset
Language selection	unchanged	unchanged
Access level	unchanged	default: Basic
Measurement	is stopped	is stopped
Password	unchanged	default: PASS1
Product selection	unchanged	all products deleted
Error log	not deleted	deleted
Data log	not deleted, default settings	deleted, default settings
System adjust	not deleted	deleted
Cable length	unchanged	default
Sampling	not deleted	deleted
TAG label	default	default
All parameters on menu: Measurement Plausibility Marker Unit	default	default
Frequency setting	unchanged	unchanged
Calibrate coefficients	default	default
Temperature compensation	default	default
Load compensation	default	default
All settings for the analog and digital inputs and outputs	default	default
Adjustment of the analog inputs and outputs	unchanged	unchanged
Comment:	affects only the current product	affects all products (P1 to P4)
-		

*Default: Default values, see *chapter 9.1 Example Start-up Log*

3.3 Menu Structure Radiometric Detector

3.3.1 Configuration Radiometric Detector

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

```
Calibration
Adjust
Max. adjust time          180 s
I0                        3 cps
Isotope                   CS137
Ray angle                 0.00°
```

```
Isotope
Isotope

CS137
AM241
```

```
Detector live
Actual impulse rate       11555 cps
Average impulse rate      11550 cps
Current temperature       22.6°C
Actual HV                 500 V
HV control mode           Manual
```

```
Enabled              yes/no
Calibration
Detector live
Measurement
Plausibility
MPUA calculation
```

```
Plausibility
Counting rate band
Max. detector temp.       50.00 °C
```

```
Counting rate band
Validation                activated
Max. counting rate        100000 cps
Min. counting rate        0 cps
```

```
MPUA calculation
MPUA actual               0.00 g/cm^2
Absorption coeff.         0.07
```

```
1 | - | Radiometry | 07.05 – 13:25

Enabled              yes
Calibration
Detector live
Measurement
Plausibility
MPUA calculation
```

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.

```
1 | - | Calibration | 07.05 – 13:25

Adjust
Max adjust time          180s
I0                       3 cps
Isotope                  CS137
Ray angle                0.00 °
```
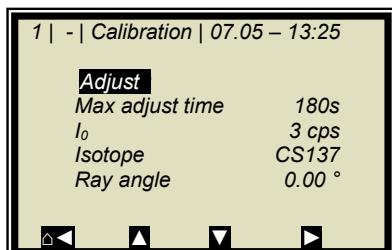
Calibration
Configuration of the Io recording (zero count rate); the following parameters can be configured:
- Max adjust time (duration of Io recording)
- Io (current Io value)
- Isotope (Cs137 and Am241 selectable)
- Ray angle (radiometry)

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

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

Adjust (Io recording)

The Io value can be entered directly or it can be recorded via the ADJUST menu.

The Io recording can be started or stopped on the ADJUST menu. The Io recording is possible only in the STOP mode of the evaluation unit. The progress of Io 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.

```
1 | - | Detector live | 07.05 – 13:25

 Actual impulse rate     55 cps
 Average impulse rate    53 cps
 Actual temperature      25.2°C
 Actual HV               430 V
 HV control mode         Auto

 ◁   ▲   ▼   ▷
```
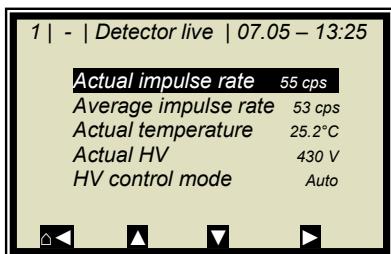
Detector live

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.

```
1 | - | Measurement | 07.05 – 13:25

 Averaging (CPS)         10

 ◁   ▲   ▼   ▷
```

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

Default: 10
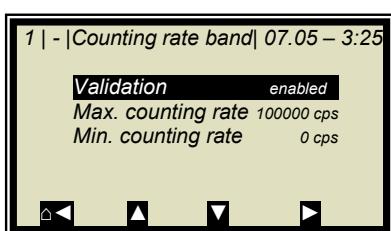
Plausibility / Counting rate band

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

```
1 | - |Counting rate band| 07.05 – 3:25

 Validation            enabled
 Max. counting rate 100000 cps
 Min. counting rate      0 cps

 ◁   ▲   ▼   ▷
```

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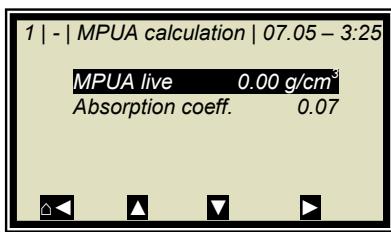
MPUA calculation

Input option absorption coefficient, default value: 0.07

```
1 | - | MPUA calculation | 07.05 – 3:25

 MPUA live         0.00 g/cm³
 Absorption coeff.      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.

3.3.2 Service Radiometric Detector

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

Detector errors	
Acknowledge error	
Actual error	none
Error descriptor	0
Error date	--
Error time	--
Error priority	-1

Detector errors
Detector errors
HV setup
Plateau
Factory reset
Detector reset
Info

HV setup	
HV actual	525.0 V
HV manual	525.0 V
HV default	525.0 V
HV control mode	Manual
Actual impulse rate	125 cps

HV control mode	
HV control mode	
Automatic	
Manual	

Plateau
Plateau measure
Operating point setup
Plateau charts

Plateau measure	
Plateau time	10s
Plateau stop	800 V
Plateau start	400 V
Plateau step	25 V
Measure plateau	

Info	
Software version	1.2.1
Unique ID	1563256845
Detector code	

Plateau charts	
Plateau date	11.11.2010
Plateau time	15:18
Chart plateau	
Print plateau	

1 | - |Detector errors| 07.05 –13:25	
Acknowledge error	
Actual error	--
Error descriptor	-1
Error date	--
Error time	--
Error priority	-1

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.

1 | - |HV setup| 07.05–13:25	
HV actual	420.0 V
HV manual	420.0 V
HV default	430.0 V
HV control mode	autom.
Actual impulse rate	55 cps
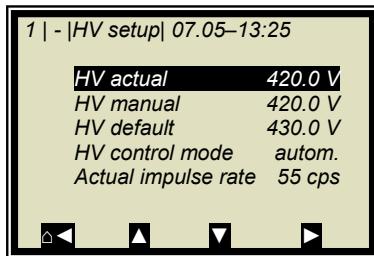
HV setup (HV = high voltage)

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)

```
1 | - | Plateau | 07.05 – 13:25

Plateau measure
Operating point setup
Plateau charts
```
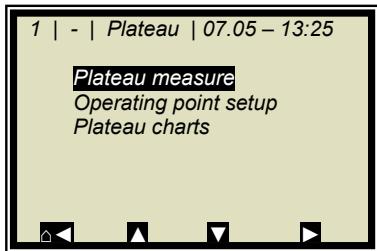
Plateau / Plateau measure

- 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)

```
1 | - | Plateau charts | 07.05 – 13:25

Plateau date        01.10.2012
Plateau time            00:00
Chart plateau
Print plateau
```
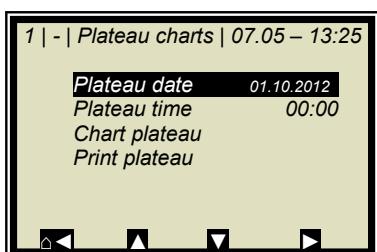
Plateau / Plateau charts

- 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 300 V to 1200 V, for example, only a range of 400 V to 800 V 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)

3.4 Live Display

1	-	Live Display	07.05 – 13:25
Concentration av.
43.20 %
Conc. av.   Conc. act. Act.45 %
ESC SAMPLE ▲ ▼   ZOOM
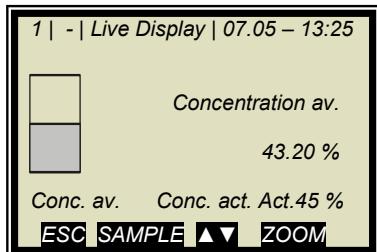
Push the ZOOM button to enlarge the measurement value which is surrounded by a frame.

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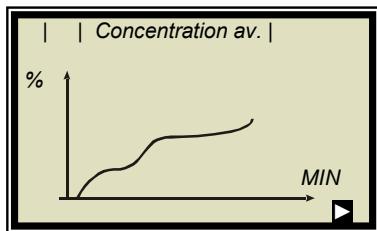
By pushing the ZOOM button for a longer time, the enlarged measurement value will be displayed as trend over the entire display.

The trend display corresponds to the contents of the data log. The data log 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 4. **Configuration**

Before carrying out any calibration work, the required analog inputs and the radiometric detector have to be enabled and configured, and the configuration parameters have to be checked and corrected, if necessary.

Without activation of the required inputs, some menus are not displayed and a proper configuration and calibration will not be possible. The current outputs, digital outputs can be enabled and configured after the calibration.

The measuring system includes two separate floating current outputs.

Note: The measuring system has been connected properly and the normal operating temperature has been reached (approx. 45 min. acclimatization).

4.1 Configuration Setup

Starting from the main menu, you get in the Profi mode to the display to the left by selecting | SETUP |

```
1 | - | Setup | 07.05 – 13:25

  Configuration
  Calibration
  Input / Output
  Service
  Product
  Change password
 ◁   ▲   ▼   ▷
```

➤ CONFIGURATION

4.1.1 General Data

```
1 | - | Configuration | 07.05 – 13:25
  General Data
  Measurement
  Plausibility
  Microwave
  Radiometry
  Marker
  Units
  Synchronization
 ◁   ▲   ▼   ▷
```

➤ GENERAL DATA

```
┌─────────────────────────────────┐
│ 1 | - | General Data  | 07.05 – 13:25 │
│                                 │
│   Date            07.05.2004    │
│   Time                  13:25   │
│   Tag                   App.1   │
│                                 │
│                                 │
│   ◿◀      ▲       ▼       ▶      │
└─────────────────────────────────┘
```
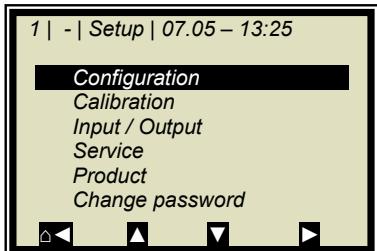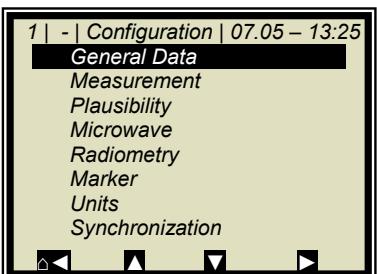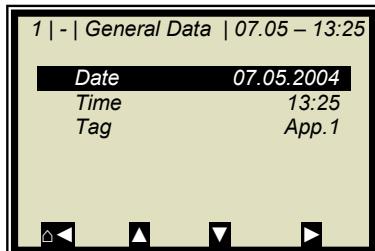
Example:
Select the respective entry, edit and store it.

➢ DATE

```
┌─────────────────────────────────┐
│ 1 | - | General Data | 07.05 – 13:25 │
│                                 │
│   Date                          │
│                                 │
│   07.05.2004 |                  │
│                                 │
│   ESC   ?   DEL   √             │
└─────────────────────────────────┘
```

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 [**.**].

4.1.2   Measurement

```
┌─────────────────────────────────┐
│ 1 | - | Measurement | 07.05 – 13:25 │
│                                 │
│   Meas. mode      Continuous    │
│   Start mode          Keypad    │
│   Averaging               20    │
│   Reset averaging         no    │
│                                 │
│   ◿◀      ▲       ▼       ▶      │
└─────────────────────────────────┘
```
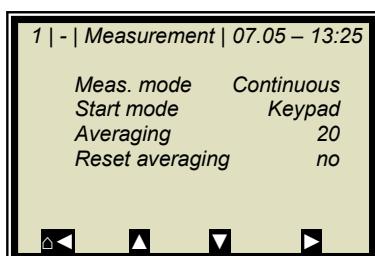
You have to check the settings on this display and adapt them to the measurement conditions.
For example, you have to adapt the measurement mode, the start mode and the averaging to the actual operating conditions.

4.1.3   Plausibility

```
┌─────────────────────────────────┐
│ 1 |  -  | Plausibility  | 07.05 – 13:25 │
│                                 │
│   Process limits                │
│   Phase measure                 │
│                                 │
│                                 │
│                                 │
│   ◿◀      ▲       ▼       ▶      │
└─────────────────────────────────┘
```
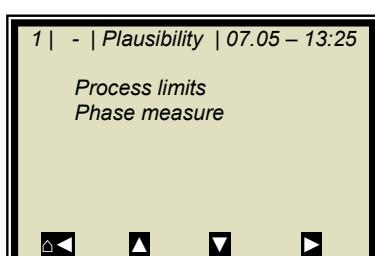
Adjust the **process limits**. Allow for an absolute measuring overrange of ± 3%.
Example: The measurement range is 5 -10% moisture. Enter 2 -13% moisture as process limits.

The process limits are independent of the current output limits.

For details on the **phase measurement**, see *chapter 4.3 Configuration Plausibility.*

4.1.4 Microwave/Cable

```
1 |  -  | Microwave | 07.05 – 13:25

   Cables
   Frequency



  ⌂◀      ▲       ▼       ▶
```

➢ CABLES

```
1 |  -  | Cables |    07.05 – 13:25

   Ref. cable length       4 m
   Signal cable length     4 m




  ⌂◀      ▲       ▼       ▶
```
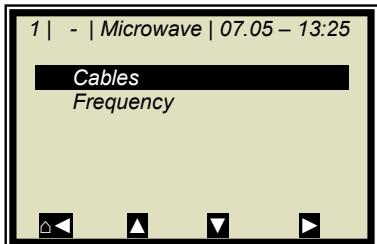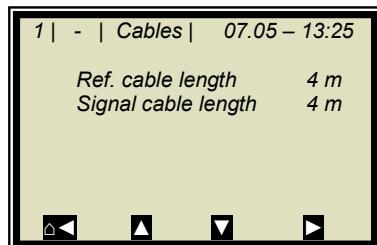
If the factory-set cable lengths do not match the actual geometry conditions, you have to correct the values.

Example: For 1.5 and 2.5 m long antenna cable and 4 m reference cable, you have to enter 4 m for both lengths.

4.1.5 Configuration Radiometry

Configure the detector by selecting it.
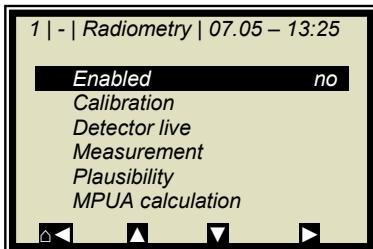
Starting from the main menu, you get in the Profi mode to the display to the left via
| SETUP | CONFIGURATION | RADIOMETRY |

```
1 | - | Radiometry | 07.05 – 13:25

   Enabled                    no
   Calibration
   Detector live
   Measurement
   Plausibility
   MPUA calculation
  ◁    ▲    ▼    ▷
```

➢ ENABLED

Enable the detector here.

Then go to the measurement.

➢ MEASUREMENT

```
1 | - | Measurement | 07.05 – 13:25

   Averaging (CPS)            10




  ◁    ▲    ▼    ▷
```
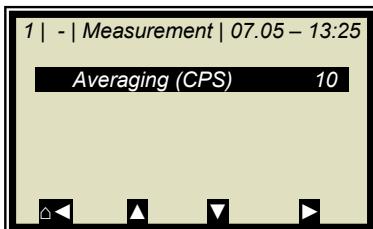
The averaging number for the count rate can be adjusted depending on the application. For applications where the mass per unit area changes only slowly, the averaging number can be increased to 30.

4.1.6 Marker

```
1 | - | Configuration | 07.05 – 13:25
   General Data
   Measurement
   Plausibility
   Microwave
   Radiometry
   Marker
   Units
   Synchronization
  ◁    ▲    ▼    ▷
```
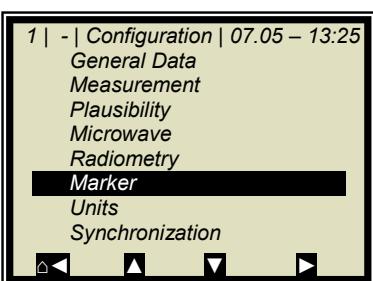
You can set a marker comprising max. 5 characters which identify the value set in the live display.

➢ MARKER

4.1.7 Units

```
1 | - | Configuration | 07.05 – 13:25
      General Data
      Measurement
      Plausibility
      Microwave
      Radiometry
      Marker
      Units
      Synchronization
   ◁    ▲    ▼    ▶
```
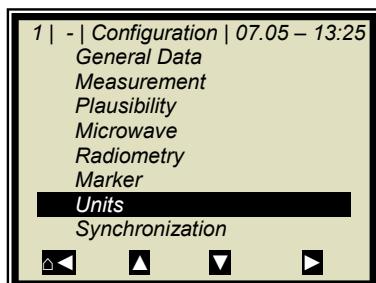
Set the units as desired.

➢ UNITS

```
1 | - | Units | 07.05 – 13:25

      Conc              % DS
      Conc 2               %
      Current input 1      °C
      Current input 2     m/s
      Temp. PT100
   ◁    ▲    ▼    ▶
```
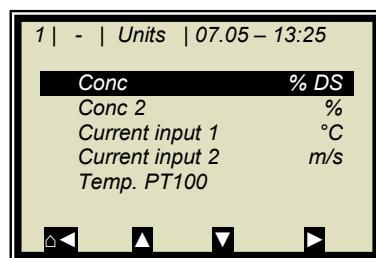
The units of the concentrations (conc 1 and 2) and those of the enabled analog inputs can be selected.

➢ CONC / CONC 2

➢ %

```
1 | - | Units | 07.05 – 13:25

      Conc.
      None
      Specific
      %
      % DS

   ESC  ?    ▲▼    √
```
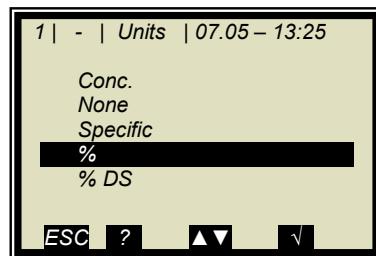
Different units can be set for both concentrations.

```
1 | - | Units | 07.05 – 13:25

      Conc              % DS
      Conc 2               %
      Current input 1      °C



   ◁    ▲    ▼    ▶
```

➢ CURRENT IN 1

```
1 | - | Units | 07.05 – 13:25
      Current input 1

      None
      Specific
      °C
      °F
      g/cm^2  …
   ESC  ?    ▲▼    √
```
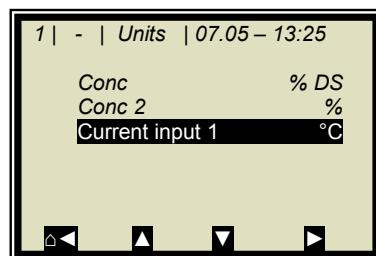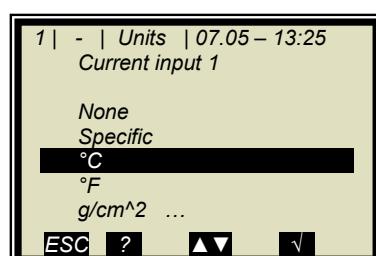
➢ °C

The selection of the units for current input 1 and 2 are different. This depends on the fixed assignment of the current inputs for loading compensation.

4.2 Start Calibration Coefficients

Starting from the main menu, you get in the Profi mode to the display to the left by selecting:
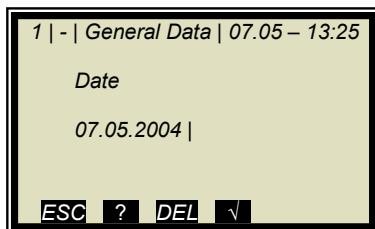| SETUP | CALIBRATION | CALIBRATE CONC |

```
1 | - | Calibrate Conc | 07.05 –13:25

    Sampling
    Calibration
    Tuning
    View

   ◁  ▲  ▼  ▶
```

➢ CALIBRATION

```
1 |  - | Calibration | 07.05 – 13:25

    Cal. order        Linear
    Cal. base         PHI
    Coefficients
    Temp. comp.
    Loading comp.
    Start calibration

   ◁  ▲  ▼  ▶
```
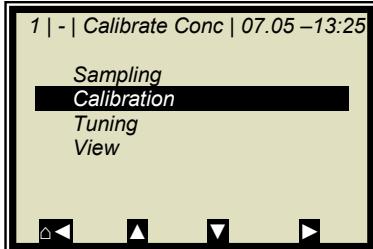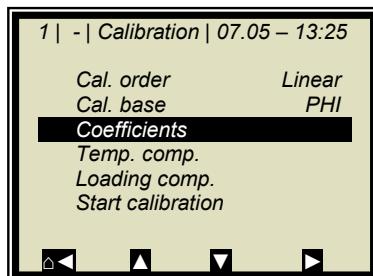
➢ COEFFICIENTS

The concentration is calculated as follows.
$Con = B1 \cdot D + C$ with D = attenuation

```
1 | - | General Data | 07.05 – 13:25

    B1                0
    C                 10


   ◁  ▲  ▼  ▶
```
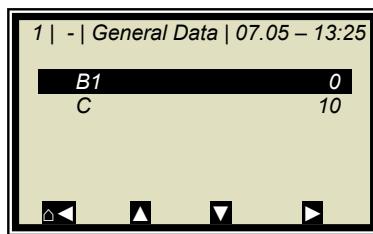
Check the coefficients B1 and C and correct them, if necessary, as follows:

C = medium measuring range value (concentration value)

B1 = 0

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

4.3 Configuration Plausibility

As described in *chapter 3.2.10 Phase Measure*, the plausibility via Phi Offset is preferred for all applications.

Starting from the main menu, you get in the Profi mode to the display to the left by selecting:
| SETUP | CONFIGURATION | PLAUSIBILITY | PHASE MEASURE |
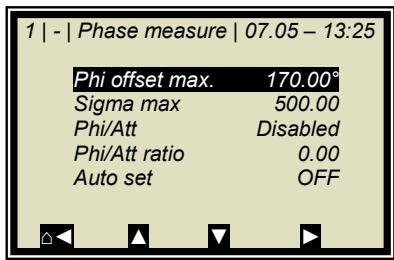
The display to the left shows the default settings; these may have to be entered, if necessary.

A subsequent restriction of Phi Offset max and Sigma max may be useful in order to eliminate phase jumps. The following adjustment ranges are recommended:

Phi Offset max.:   150° - 170°
Sigma max: 50 - 500

If a phase jump elimination is not possible, then either an attenuation calibration (preferably with conveyor belts) has to be carried out, or the plausibility has to be determined via the behavior of Phi/Att, see *chapter 6.1 Phi/Att ratio*.

Setup of an attenuation calibration:
Starting from the default values (see display on the left) Phi Offset max must be set to 0. Sigma max should be set roughly, so that various problems can be ruled out.

```
1 | - | Phase measure | 07.05 – 13:25

   Phi offset max.        170.00°
   Sigma max              500.00
   Phi/Att                Disabled
   Phi/Att ratio            0.00
   Auto set                OFF

   ◄       ▲       ▼       ►
```

Chapter 5. **Calibration**

Prerequisite: chapter **4. Configuration**
has been completed.

5.1 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 Profi mode to the display 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. Details see *chapter 3.3.1 Configuration Radiometric Detector*.

➢ ADJUST

```
1 | - | Calibration | 07.05 – 13:25

    Adjust
    Max adjust time        180s
    I0                     3 cps
    Isotope                Cs137
    Ray angle              0.00 °

    ◁      ▲      ▼      ▷
```

🔆 **TIP**

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

Start the plateau measurement:

➢ START

```
1 | - | I0 read-in | 07.05 – 13:25

    Io current             48 cps
    Io                     15 cps



CANCEL  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.

```
1 | - | I0 read-in | 07.05 – 13:25

    Io current             48 cps
    Io                     15 cps
    _____

    _____O_____

CANCEL                  DONE
```

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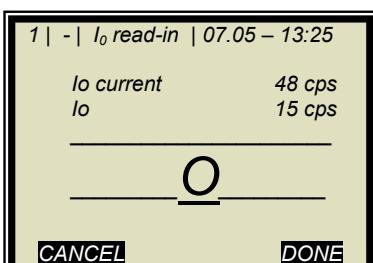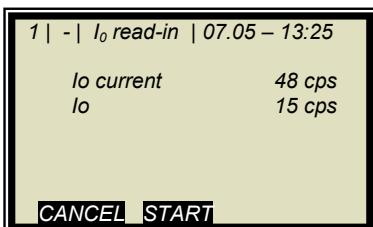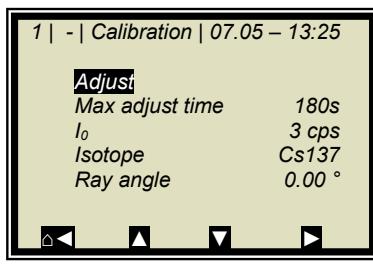
5.2 System Calibration

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 Phi Offset (>170°) and 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.

```
1 |  - |  LB 568 | 07.05 – 13:25

    Live Display
    Diagnostic
    Setup
    Access level        Basic
    Language           English

RUN      ▲      ▼      ▶
```

➢ SETUP

```
1 |  - | Setup | 07.05 – 13:25

    Configuration
    Calibration
    Input / Output
    Product


  ◁      ▲      ▼      ▶
```

➢ CALIBRATION

```
1 |  - | Calibration | 07.05 – 13:25

    System adjust
    Calibrate Conc



  ◁      ▲      ▼      ▶
```

➢ SYSTEM ADJUST

```
1 | - |System Adjust | 07.05 –13:25

Adjust




◻◀    ▲    ▼    ▶
```

➢ ADJUST

```
1 | - |System Adjust | 07.05 –13:25



System adjustment now?



X              √
```

Confirm

```
1 | - |System Adjust | 07.05 –13:25

Adjustment in process ...


..................................................
```
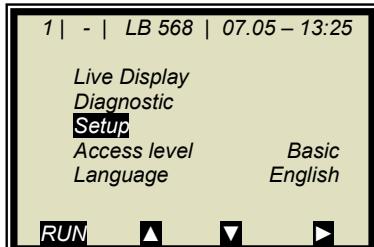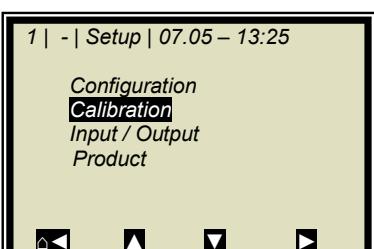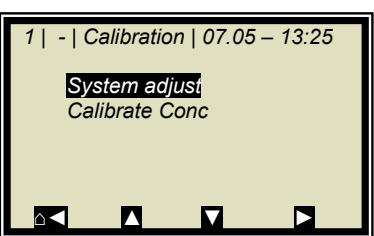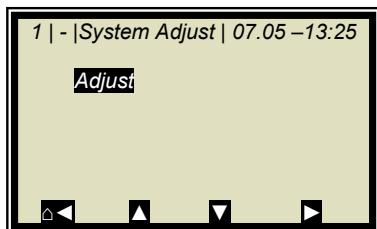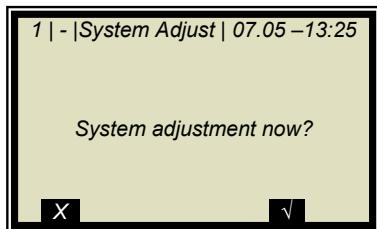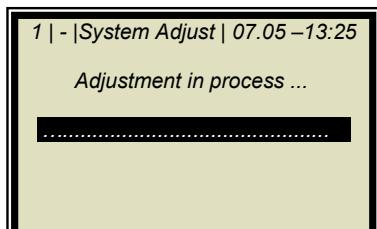
System adjustment is in process.

```
1 | - |System Adjust | 07.05 –13:25


Adjusted!



OK
```
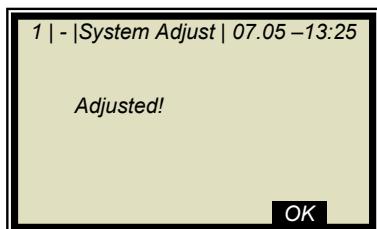
Push **OK** to confirm and push ◻◀ three times to return to the main menu.

5.2.1 Verifying the Reference Values

Starting from the main menu, you get in the Profi mode to the display to the left by selecting:
| SETUP | CALIBRATION | SYSTEM ADJUST |

```
1 | - |System Adjust | 07.05 –13:25

    Adjust
    Reference values
    Chart Phi
    Chart Attenuation


   ◁    ▲    ▼    ▷
```

➢ REFERENCE VALUES

```
1 | - | Reference Values | 07.05 – 13:25

    Phi(fm)        125.00 °/GHz
    Attenuation       22.5 dB
    Slope          120.55 °/GHz
    Sigma             15.20


   ◁    ▲    ▼    ▷
```
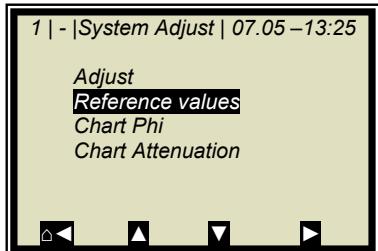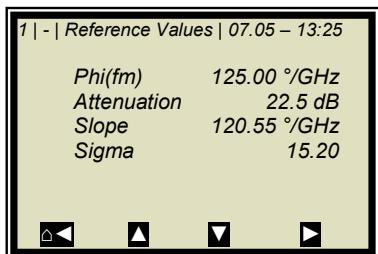
Typical values for the reference measurement with empty belt (chute); of particular importance are:

Sigma: should be less than 400 (reliable microwave irradiation)

Attenuation: should be less than 25 dB (antennas and cable OK, belt not conductive)

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

Sigma: should be less than 400 (reliable microwave irradiation)

Attenuation: should be less than 60 dB (antennas and cable O. K., belt not conductive)

5.2.2 Tare Measurement

Prerequisite:

- You are in the Profi mode.

- The conveyor belt or the chute are empty, clean and dry.

- The measurement is in the measurement mode.

Following the reference measurement with full belt, 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
Slope   = _____ GRD/GHz
Phi Offset   = _____ GRD

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 OK, belt not conductive)
Phi Offset   should be less than +/- 170
                (no phase jump)

If the phase is used for calibration, the phase value also has to be checked. The phase (Phi(fm); as a rule negative) should be approximately:
Moisture of the previously measured product x mass per unit area (+ /- 20)

Check if this value is within the + /- 20 tolerance. Exception: Product with higher share of bound water, e.g. lignite, where the measurement effect is lower by a factor of about 0.7. If not, check if the empty belt measurement is not affected by a phase jump. A phase jump would induce a load-dependent measurement error. Contact a Berthold Technologies Service Center for more information about Phase tare.

Starting from the main menu, you get in the Profi mode to the display to the left by selecting:
| SETUP | CALIBRATION | ADVANCED |

```
1 |  -  | Advanced | 07.05 – 13:25

Tare values
Num. cal. sweeps        20
Process type        1 Conc.
Extended cal. mode   disabled


 �ём◀     ▲       ▼       ▶
```

➢   TARE VALUES

```
1 |  -  | Tare Values | 07.05 – 13:25

Phi tare           0.00 °/GHz
Attenuation tare    0.00 dB




 ◦◀      ▲       ▼       ▶
```
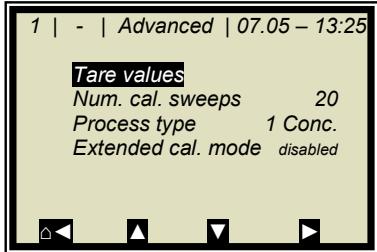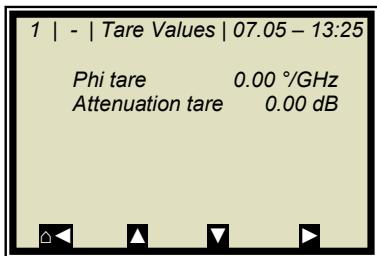
Enter the last recorded values of Phi(fm) and attenuation, taking into account the algebraic sign "- ".

5.3 Sampling

> Before running a sample measurement you have to enable the desired compensation input 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.

```
1 |  - |  LB 568 | 07.05 – 13:25

  Live Display
  Diagnostic
  Setup
  Access level          Basic
  Language            English

RUN       ▲       ▼       ►
```
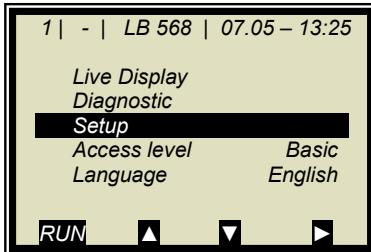
Push **RUN** to start the measuring system.

```
1 | - |   Start / Stop | 07.05 –13:25


  Switch operating mode?




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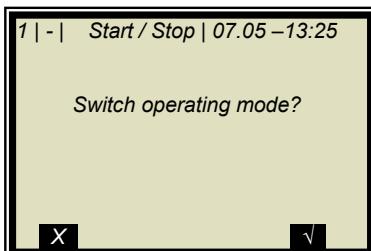
Push **√** to confirm the safety prompt and the device switches to the measurement mode.

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.

```
1 |  - | Live Display | 07.05 – 13:25

              Concentration av.
              65.50 %

Conc. av.  Conc. act.  .   64.35%
ESC  SAMPLE   ▲▼   ZOOM
```
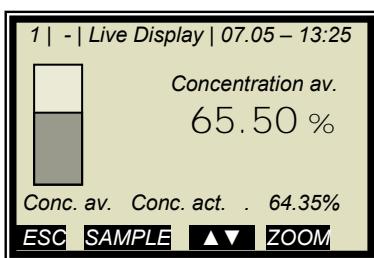
The display to the left appears if you push **RUN**.

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.

```
1 |  - | Live Display | 07.05 – 13:25

              Taking Sample #1

Conc av.          Conc act   64.35%
 X            ▲▼
```
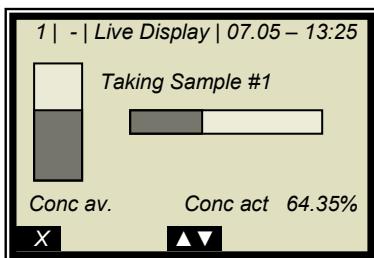
Sampling is in process……

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

```
1 |  - | Live Display | 07.05 – 13:25

              Save sample
                    no. 1?

Conc av.          Conc act   64.35%
 X            ▲▼        √
```
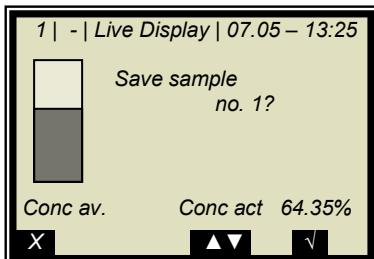
If the sampling process has been completed without any problem, push the **√** button to save the sample in the table and the measurement continues.

You have to repeat the process described above for each further sample.

The moisture/concentration of the samples should be distributed over the entire measuring range. In case of additional temperature compensation, the temperature of the samples should be distributed over the entire temperature range.

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

About 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.

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

The measuring system has to operate at a normal throughput and the usual material under actual operating conditions.
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.
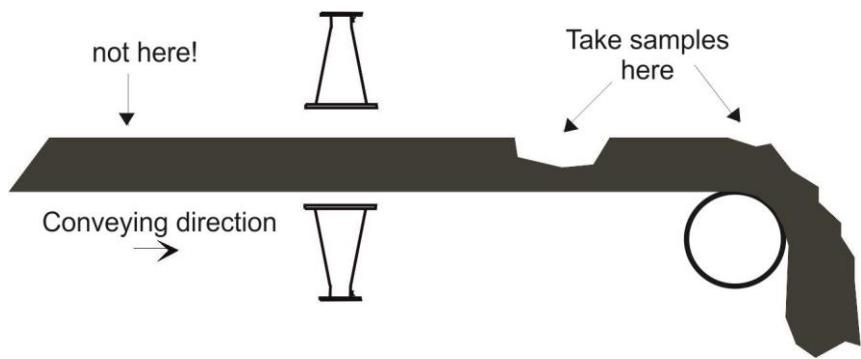
Figure 5-1
Sampling point on the
conveyor belt

5.3.1   Entering the Lab Values
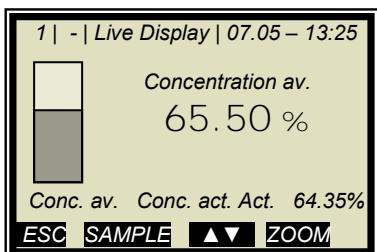
1 | - | Live Display | 07.05 – 13:25 Concentration av. 65.50 % Conc. av. Conc. act. Act. 64.35% ESC SAMPLE ▲▼ ZOOM	Push ESC to go to the main menu. A measurement can be stopped only on the main menu.
1 | - | LB 568 | 07.05 – 13:25 Live Display Diagnostic Setup Access level Basic Language English STOP ▲ ▼ ▶	Push STOP to stop the measuring system.
1 | - | Start / Stop | 07.05 –13:25 Switch operating mode? X √	Push √ to confirm the prompt and the measurement switches to the STOP mode.
1 | - | LB 568 | 07.05 – 13:25 Live Display Diagnostic Setup Access level Basic Language English RUN ▲ ▼ ▶	➢ SETUP
1 | - | Setup | 07.05 – 13:25 Configuration Calibration Input / Output Product ◁ ▲ ▼ ▶	➢ CALIBRATION
1 | - | Calibration | 07.05 – 13:25 System adjust Calibrate conc ◁ ▲ ▼ ▶	➢ CALIBRATE CONC
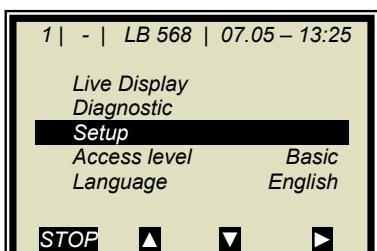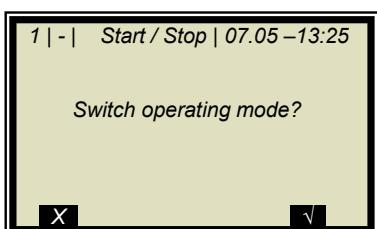
```
┌─────────────────────────────────┐
│ 1 | - | Calibrate Conc | 07.05 –13:25 │
│                                 │
│   █Sampling█                    │
│   Tuning                        │
│   View                          │
│                                 │
│  ◢◄    ▲     ▼      ▶           │
└─────────────────────────────────┘
```

➢ SAMPLING

```
┌─────────────────────────────────┐
│ 1 |  1/1  | Sample # 1  | 07.05 –13:25 │
│                                 │
│   Next sample                   │
│   Active              Yes       │
│   Measured value    65.50%      │
│   █Lab value          0.00 %█   │
│   Advanced                      │
│  ◄    DEL   ▲ ▼      √           │
└─────────────────────────────────┘
```

➢ LAB VALUE

```
┌─────────────────────────────────┐
│ 1 |  1/1  | Sample # 1  | 07.05 –13:25 │
│   Lab Value                     │
│                                 │
│   0.00|          %              │
│                                 │
│                                 │
│  ESC  ..?..  DEL  ..√..          │
└─────────────────────────────────┘
```

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

```
┌─────────────────────────────────┐
│ 1 |  1/1  | Sample # 1  | 07.05 –13:25 │
│                                 │
│   █Next sample█                 │
│   Active              Yes       │
│   Measured value    65.50%      │
│   Lab value         72.40 %     │
│   Advanced                      │
│  ◄    DEL   ▲ ▼      √           │
└─────────────────────────────────┘
```

➢ 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)

5.4 Calibration

Proceed as described in *chapter 6.4*.

Chapter 6. **Calibration and Options**

6.1 **Configuration Phi/Att Ratio Plausibility**

As described in *chapter 3.2.10 Phase Measurement*, the plausibility is determined via Phi Offset for all applications.

Alternatively, the plausibility can also be determined via the Phi/Att ratio.

From the main menu, you get in the Profi mode to the display to the left via | SETUP | CONFIGURATION | PLAUSIBILITY | PHASE MEASURE |

```
1 | - | Phase measure | 07.05 – 13:25

  Phi offset max.        0.00°
  Sigma max            500.00
  Phi/Att             Enabled
  Phi/Att ratio          0.00
  Auto set               OFF

  ◁     ▲     ▼     ▷
```
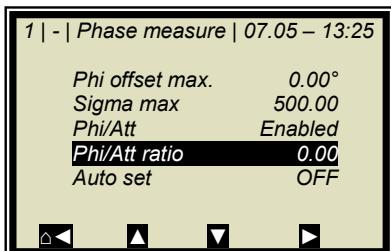
Check and correct your settings using the parameters displayed to the left.

➢ PHI/ATT RATIO

If you know the ratio value, enter it here; go to *chapter 6.1.1 Phi/Att Ratio*.

```
1 | - | Phase measure | 07.05 – 13:25

  Phi/Att ratio

  0.00




 ESC    ?    ▲▼    √
```
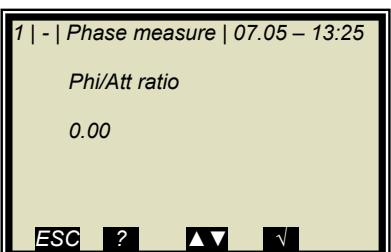
Delete default value with **DEL** and enter new value and confirm with **√**.

6.1.1 Phi/Att Ratio

If you do not know the ratio value, you have the following options:

1. Carry out a process recording, see *chapter 6.1.2 Process Recording*. Prerequisite for this is that during the recording the process is moved across the entire concentration range.
2. If the process recording is currently not possible or if the concentration range is small anyway ($< \pm 5\%$), then enter **Phi/Att = 1** as start value.

Subsequent adjustment of the process recording is possible.

6.1.2 Process Recording

Prerequisite: You are in the Profi mode and

chapter   **4. Configuration**

                5.1 Scintillation Counter Calibration

                5.2 System Adjust

have been completed.

The process recording is used to determine the ratio of Phase and Attenuation (Phi/Att), a parameter from the plausibility analysis for correct evaluation of the phase.

If you know the ratio already from other measurements, you may enter it directly on the PLAUSIBILITY menu (see *chapter 3.2.10 Phase Measure*); in this case, that process need not be recorded.

IMPORTANT

The measurement takes place automatically; you only have to start and stop it again. During measurement, please keep in mind:
- Do not stop the measurement
- Do not change the concentration erratically (max. 1 %).
- Cover the entire measuring range, if possible
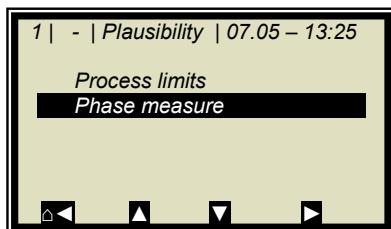
Starting from the main menu, you get in the Profi mode to the display to the left by selecting
| SETUP | CONFIGURATION | PLAUSIBILITY |

➢ PHASE MEASUREMENT

```
1 |  -  | Plausibility | 07.05 – 13:25

    Process limits
    Phase measure



   ◁    ▲    ▼    ▷
```

```
1 | - |Phase Measure | 07.05 –13:25

    Phi offset max.      170.00°
    Sigma max.           500.00
    Phi/Att              Disabled
    Phi/Att ratio        0.00
    Auto set             OFF

   ◁    ▲    ▼    ▷
```

➢ AUTO SET

```
1 | - |Phase Measure | 07.05 –13:25

    Auto set
    Off
    On



 ESC    ?      ▲▼        √
```

➢ ON
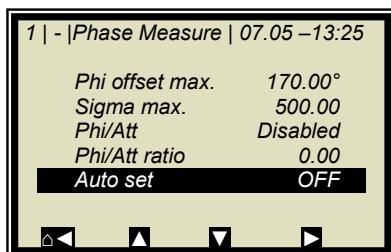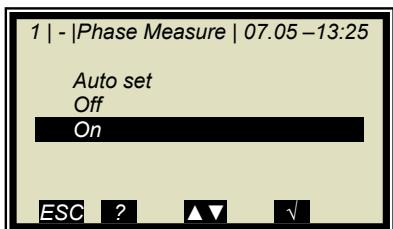
```
1 | - |Phase Measure | 07.05 –13:25

    Phi offset max.      170.00°
    Sigma max.           500.00
    Phi/Att             Disabled
    Phi/Att ratio           5.32
    Auto set                  ON

  ⌂◄       ▲        ▼        ►
```
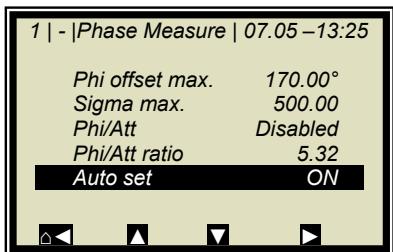
Stop logging:

You have the option to stop logging by turning the logging off. The logging is held and starts again only after it is turned on again.

Start new logging:

Prerequisite: Logging is turned off. Stop and start the measurement before you start a new log. The result of older logs will be deleted.

After recording and turning off the automatic recording you still have to enable the Plausibility Phi/Att.

Carry out sampling while the process recording is running.

Do not forget to turn off the process recording in the same way as described above!

6.2 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**.
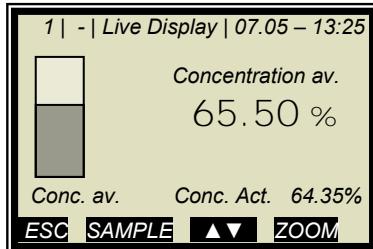
The display reading is now compared with the analysis value of the lab sample. The difference has to be entered as offset with the correct algebraic sign.

Calculation:

Analysis value – display = offset   **Eg. 6-1**

Push **ESC** to go to the main menu.

```
1 |  - | Live Display | 07.05 – 13:25

                 Concentration av.
                 65.50 %

Conc. av.      Conc. Act.   64.35%
ESC   SAMPLE   ▲ ▼   ZOOM
```

```
1 |   - |  LB 568 | 07.05 – 13:25

Live Display
Diagnostic
Setup
Access level           Basic
Language               English

STOP        ▲        ▼        ▶
```

➢ SETUP

```
1 |   - | Setup | 07.05 – 13:25

Configuration
Calibration
Input / Output
Product

 ◁   ▲    ▼    ▶
```

➢ CALIBRATION

```
1 |   - | Calibration | 07.05 – 13:25

System adjust
Calibrate conc

 ◁   ▲    ▼    ▶
```

➢ CALIBRATE CONC

```
1 | - | Calibrate Conc | 07.05 –13:25

   Sampling
   Tuning
   View
```

➢ TUNING

```
1 | - | Tuning | 07.05 –13:25

   Factor              1.00000
   Offset                0.000
```
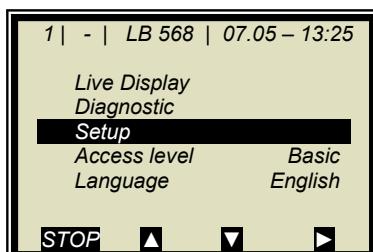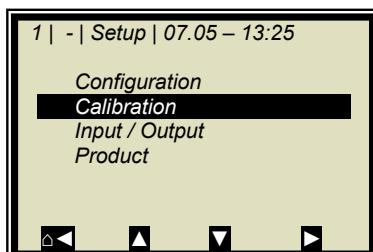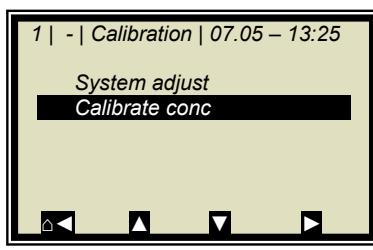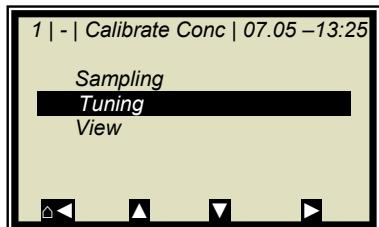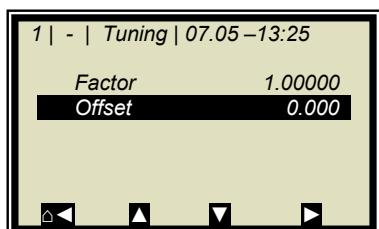
➢ OFFSET

Calculation formula see *chapter 3.2.14 Calibrate Concentration.*

```
1 | - | Tuning | 07.05 –13:25

   Offset

   0.000 |

ESC    ?   DEL    √
```
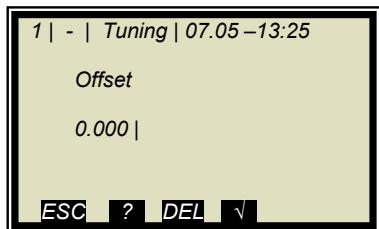
Enter the calculated offset value, confirm with √ button and push the Home button ◻◀ four times to return to the main menu.

```
1 |  - |  LB 568 |  07.05 – 13:25

   Live Display
   Diagnostic
   Setup
   Access level          Basic
   Language              English
STOP      ▲      ▼      ▶
```
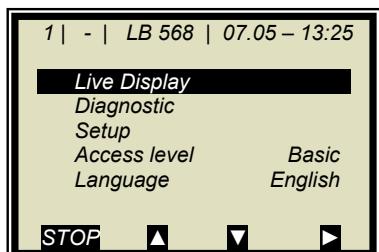
Select

➢ LIVE DISPLAY

to get back to the display.

```
1 | - | Live Display | 07.05 – 13:25

                          Av. av.
               75.50 %

Conc. av.      Conc. Act.   64.35%
ESC   SAMPLE    ▲▼   ZOOM
```
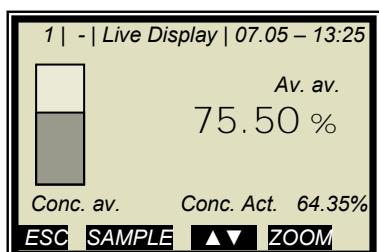
The reading value should now correspond to the actual value.

6.3 Output of the Start-up Log

```
1 |  -  | Diagnostic  |  07.05 – 13:25


     Data log
     Error log
     Info
     Print setup


   ◁◄      ▲      ▼      ►
```
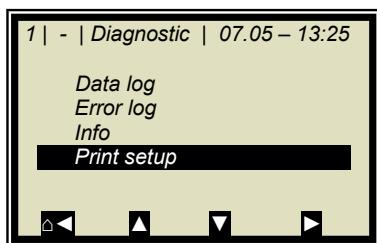
Starting from the main menu, you get in the Profi mode to the display to the left by selecting | DIAGNOSTIC |

➢ PRINT SETUP

```
1 | - | Print setup|   07.05 –13:25



       Print setup now?




    X                    √
```
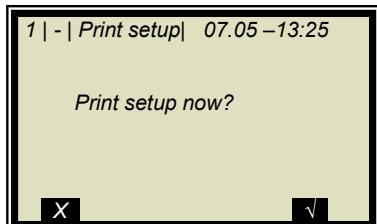
Push ☑ button to print the log via RS232. Push ☒ to go back one page without printout.

> The start-up log includes all adjustable parameters, data of the system adjustment, calibration data and entries of the sample table.

For further information on the start-up log see *chapter 9. Start-up Log.*

6.4 Calibration

A variety of setup options exists for calibration. For details see *chapter 3.2.18 Calibration*. In addition, the default settings are displayed, which are usually the best choice.

Prerequisite: You are in the Profi mode and

chapter   **4. Configuration**

                5.1 Scintillation Counter Calibration

                5.2 System Adjust

                5.3 Sampling

have been completed.

6.4.1 Calibration with One Concentration
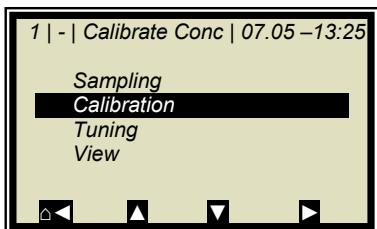
```
1 | - | Calibrate Conc | 07.05 –13:25

   Sampling
   Calibration
   Tuning
   View

   ◁    ▲    ▼    ▷
```

Starting from the main menu, you get in the Profi mode to the display to the left by selecting
| SETUP **|** CALIBRATION **|** CALIBRATE CONC **|**

➢ CALIBRATION

```
1 | - | Calibration | 07.05 – 13:25

   Cal. order            Linear
   Cal. base        Attenuation
   Coefficients
   Start calibr.

   ◁    ▲    ▼    ▷
```

➢ CAL ORDER

```
1 | - | Calibration | 07.05 – 13:25

   Cal. order


   Linear
   Quadratic

   ◁    ▲    ▼    ▷
```

➢ LINEAR

Standard for all applications: Linear

Quadratic calibration is possible only for a calibration with three and more samples.

```
1 | - | Calibration | 07.05 – 13:25

   Cal. order          Linear
   Cal. base       Attenuation
   Coefficients
   Start calibr.

   �◀    ▲    ▼    ▶
```

➤ CAL. BASE

```
1 | - | Calibration | 07.05 – 13:25
   Cal. base

   Phase
   Attenuation
   Both

   ◀    ▲    ▼    ▶
```

➤ PHASE (Phase measurement)

Standard for conveyor belt applications: Attenuation
Standard for chute applications: Phase
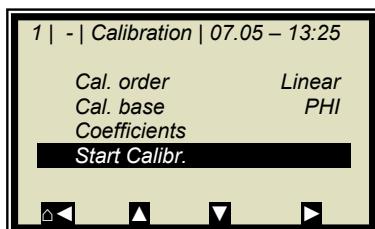
> The calibration base is selected depending on the number of samples and their raw data. Initial calibration should be as simple as possible, since calibration can be optimized any time.
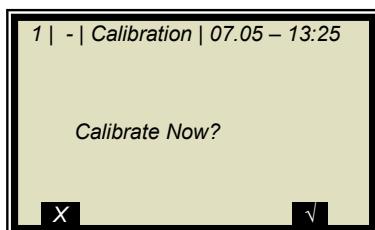
```
1 | - | Calibration | 07.05 – 13:25

   Cal. order          Linear
   Cal. base             PHI
   Coefficients
   Start Calibr.

   ◀    ▲    ▼    ▶
```

➤ START CALIBRATION

```
1 | - | Calibration | 07.05 – 13:25




   Calibrate Now?


   X                    √
```

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

```
1 | - | Calibration | 07.05 – 13:25




   Calibrated!


                       OK
```
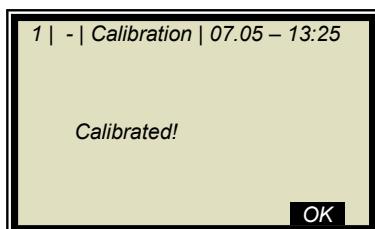
OK takes over the calibration and changes to the next display.

> When calculating the new coefficients, the factor will be reset to 1 and the offset to 0.

```
1 |  - | Calibration | 07.05 – 13:25



                            Lab
                                    ▶
```
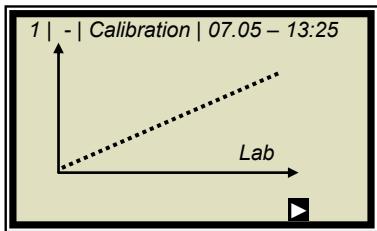
The curve to the left shows the characteristic curve lab vs. measured value.

▶

```
1 |  - | Calibration | 07.05 – 13:25

    Correlation Lab/Meas value

    0.998726

                            OK
```
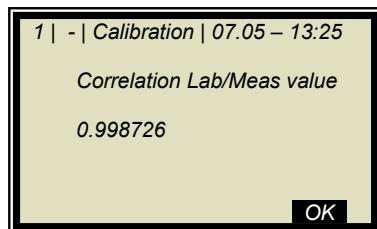
The correlation indicates the average deviation of the characteristic curve from the sample series.

OK

```
1 |  - | Calibration | 07.05 – 13:25


    Calibration
    OK?

    X                        √
```
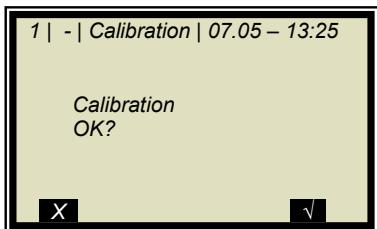
Upon confirmation, the calibration menu appears again; from there you get back to the main menu by pushing ⬘◀ four times and the measurement can be started again.

6.4.2 Calibration with Temperature Compensation

The temperature compensation in general not used for bulk applications.

Starting from the main menu, you get in the Profi mode to the display to the left by selecting:
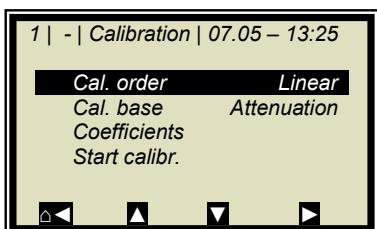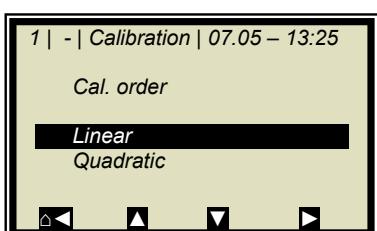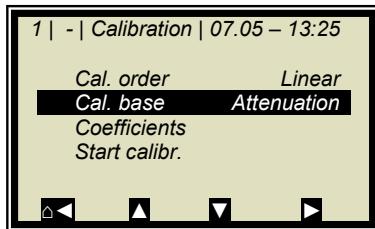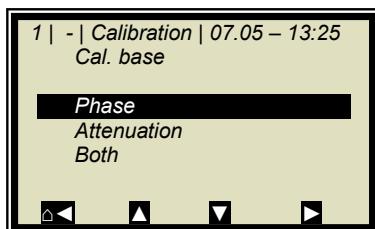| SETUP | CALIBRATION | CALIBRATE CONC |

```
1 | - | Calibrate Conc | 07.05 –13:25

    Sampling
    Calibration
    Tuning
    View

 ◄   ▲   ▼   ►
```

➢ CALIBRATION

```
1 |  - | Calibration | 07.05 – 13:25

    Cal. order          Linear
    Cal. base      Attenuation
    Coefficients
    Temp. comp.
    Loading comp.
    Start Calibr.

 ◄   ▲   ▼   ►
```

➢ TEMP. COMP.

```
1 | - | Temp. Comp. 1 | 07.05 –13:25
    Input                None
    Mode             Additive
    Order              Linear
    Reference value   0.00°C
    C_Phi 10.00000
    C_dB 10.00000
 ESC   ?   ▲▼   √
```
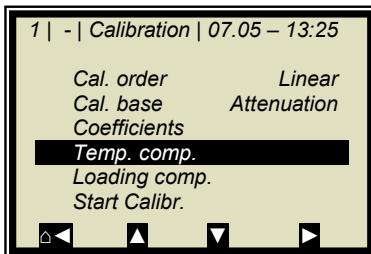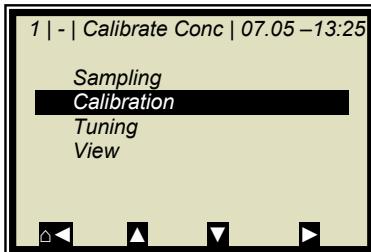
➢ INPUT

All active inputs are shown here for compensation selection. The desired input must already have been active during the sampling so that the input values in the sample table will be available for the further calibration.

```
1 | - | Calibrate Conc | 07.05 –13:25
    Input
    None
    Current In 1
    Current In 2
    PT100

 ◄   ▲   ▼   ►
```
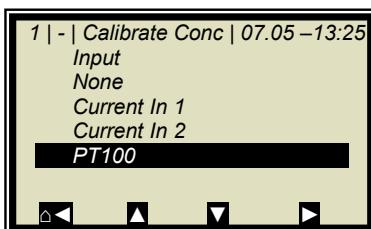
➢ PT100
The PT100 is selected as an example.

```
1 | - | Temp. Comp. 1 | 07.05 –13:25
    Input              PT100
    Mode               Additive
    Order              Linear
    Reference value    0.00°C
    C_Phi 1            0.00000
    C_dB 1             0.00000
 ESC    ?     ▲▼      √
```

The display to the left shows the default values for the mode and the order.

Standard for all applications: **Mode Additive**
                                                        Order Linear

You can select additive or multiplicative **mode** and set the **order** to linear or quadratic.

```
1 | - | Temp. Comp. 1 | 07.05 –13:25
    Input              PT100
    Mode               Additive
    Order              Linear
    Reference value    0.00°C
    C_Phi 1            0.00000
    C_dB 1             0.00000
 ESC    ?     ▲▼      √
```

➢ REF. TEMP

```
1 | - | Temp. Comp. 1 | 07.05 –13:25

    Reference value.


    0.00    |              °C

 ESC    ?    DEL    √
```

The product temperature for the system calibration or the average operating temperature is entered and confirmed as reference value.

```
1 | - | Temp. Comp. 1 | 07.05 –13:25
    Input              PT100
    Mode               Additive
    Order              Linear
    Reference value    80.00°C
    C_Phi 1            0.00000
    C_dB 1             0.00000
 ESC    ?     ▲▼      √
```

The coefficients, for example, C_Phi 1 and C_dB 1 are automatically calculated during calibration

ESC

Now enter the additional settings and calculate the calibration, as described in *chapter 6.4.1 Calibration with one Concentration*.

6.4.3 Calibration with Load Compensation

Usually the measuring system MicroPolar Moist LB 568 is operated with the radiometric mass per unit area compensation. In this case, perform the calibration as described below.
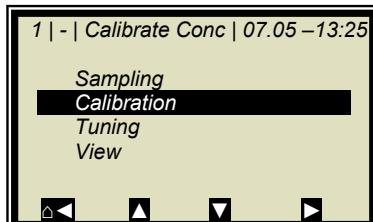
```
1 | - | Calibrate Conc | 07.05 –13:25

     Sampling
     Calibration
     Tuning
     View

   ◁    ▲    ▼    ▶
```

Starting from the main menu, you get in the Profi mode to the display to the left by selecting
| SETUP | CALIBRATION | CALIBRATE CONC |
CALIBRATION

```
1 | - | Calibration | 07.05 –13:25

     Cal. order          Linear
     Cal. base       Attenuation
     Temp. comp.
     Load comp.
     Start Calibr.

   ◁    ▲    ▼    ▶
```

➢ LOAD COMP.

```
1 | - |Load Comp | 07.05 –13:25


     Comp.Mode        disabled




   ◁    ▲    ▼    ▶
```

The required inputs must be enabled!
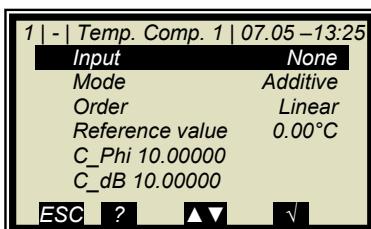
➢ COMP. MODE

```
1 | - | Load Comp. |07.0 –13:25
     Comp. Mode
     Disabled
     Radiom. MPUA
     Load (Current In 1)
     Tonnage & Speed
     Mass & Height

   ◁    ▲    ▼    ▶
```
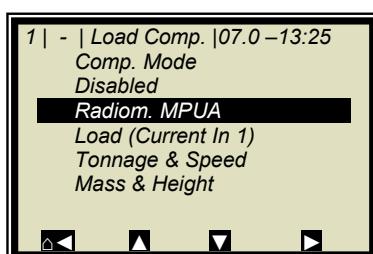
➢ RADIOM. MPUA
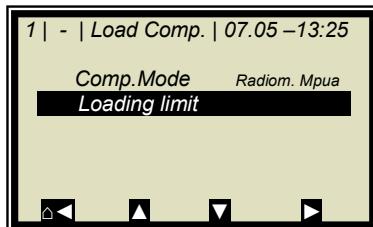
After selection, the LOADING LIMIT is displayed on the menu.

➢ LOADING LIMIT

```
1 | - | Load Comp. | 07.05 –13:25

     Comp.Mode      Radiom. Mpua
     Loading limit




   ◁    ▲    ▼    ▶
```

```
1 | - |Loading Limit|07.05 –13:25

   Min. loading          0.01




  ◁      ▲      ▼      ▶
```

➢ MIN. LOADING

```
1 | - |Loading Limit|07.05 –13:25

   Min. loading          [ ]

   0.01
   [-10 , 100000]

  ESC   ?    ▲▼      √
```
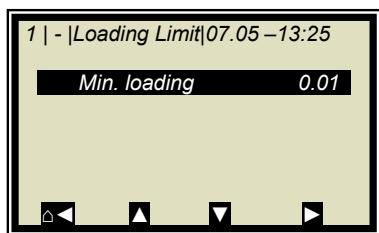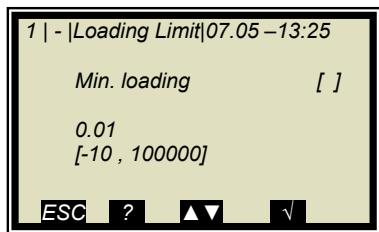
Enter minimum mass per unit area.

Push √ to confirm and three times ◁ to go back.

Now enter the additional settings and calculate the calibration, as described in *chapter 6.4.1 Calibration with one Concentration*.

6.4.4 Calibration with Two Concentrations

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

Starting from the main menu, you get in the Profi mode to the display to the left by selecting
| SETUP | CALIBRATION |

```
1 | - | Calibration | 07.05 – 13:25

    System ADJUST
    Calibrate Conc
    Advanced


   ◁    ▲    ▼    ▶
```

➢ PROFI

```
1 |  -  | Advanced | 07.05 – 13:25

    Tare values
    Num. cal. sweeps        20
    Process type
    Extended cal. mode   disabled

   ◁    ▲    ▼    ▶
```

➢ PROCESS TYPE

```
1 |  -  | Advanced | 07.05 – 13:25

    Process type
    1 Conc
    2 Conc
    Split conc

 ESC    ?    ▲▼    √
```

➢ 2 CONC

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

```
1 | - | Calibration | 07.05 – 13:25

    System adjust
    Calibrate Conc
    Calibrate Conc 2
    Advanced

   ◁    ▲    ▼    ▶
```
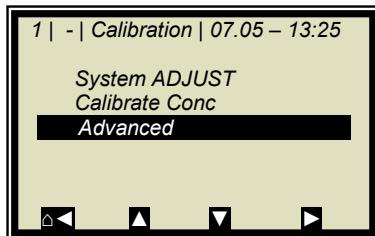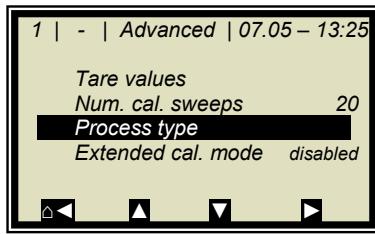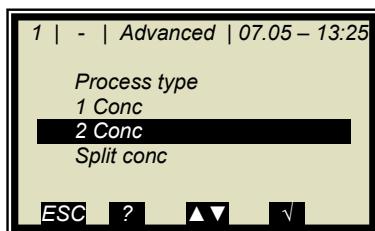
➢ CALIBRATE CONC (corresponding to concentration 1)

```
1 | - |Calibrate Conc1|07.05 –13:25

    Sampling
    Calibration
    Tuning
    View

   ◁    ▲    ▼    ▶
```

➢ SAMPLING

For both calibration there is only one sample table.

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).

```
1 | 1/4 | Sample # 1 | 07.05 –13:25

    Next sample
    Active              Yes
    Measured value    65.50%
    Lab value          0.00 %
    Advanced
  ◄   DEL   ▲▼      √
```

➢ LAB VALUE

```
1 | 1/4 | Sample # 1 | 07.05 – 13:25

    Lab value

    60.40  |              %


  ESC   ?   DEL   √
```

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

```
1 |  1/4  | Sample # 1 | 07.05 –13:25

    Next sample
    Active              Yes
    Measured value    65.50 %
    Lab value         60.40 %
    Advanced
  ◄   DEL   ▲▼      √
```

➢ NEXT SAMPLE

Continue with the next sample.

```
1 | 2/4  | Sample # 2 | 07.05 –13:25

    Next sample
    Active              Yes
    Measured value    74.35 %
    Lab value         67.80 %
    Advanced
  ◄   DEL   ▲▼      √
```

➢ ACTIVE

Disable sample

```
1 | 2/4 | Sample # 2 | 07.05 – 13:25

    Enabled

    No
    Yes

  ESC   ?   DEL   √
```

➢ NO

```
1 | 2/4 | Sample # 2 | 07.05 –13:25

   Next sample
   Active              No
   Measured value   74.35 %
   Lab value        67.80 %
   Advanced
   ◄   DEL    ▲▼      √
```
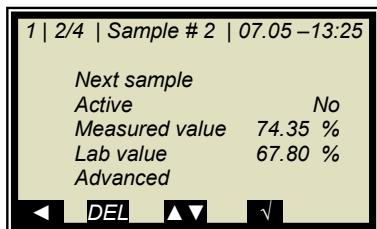
Make sure that all samples have been processed and only those samples are active which are relevant for this calibration.

Push ◄ to get to the Calibration page.
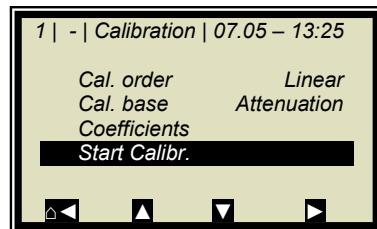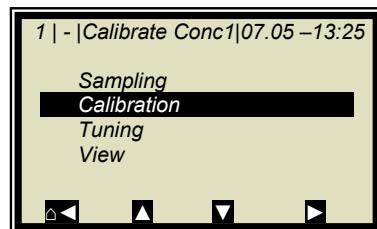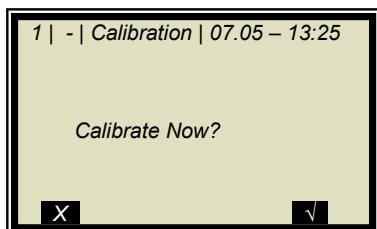
```
1 | - |Calibrate Conc1|07.05 –13:25

   Sampling
   Calibration
   Tuning
   View

   ◄    ▲     ▼     ►
```

```
1 | - | Calibration | 07.05 – 13:25

   Cal. order          Linear
   Cal. base      Attenuation
   Coefficients
   Start Calibr.

   ◄    ▲     ▼     ►
```

➢ START CALIBRATION

```
1 | - | Calibration | 07.05 – 13:25



   Calibrate Now?



   X                   √
```

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

```
1 | - | Calibration  1 | 07.05 –13:25



   Calibrated!



                      OK
```

OK takes over the calibration and changes to the next display.

```
1 | - | Calibration | 07.05 – 13:25

   Cal. order           Linear
   Cal. base        Attenuation
   Coefficients
   Start Calibr.

  ◁    ▲    ▼    ▷
```
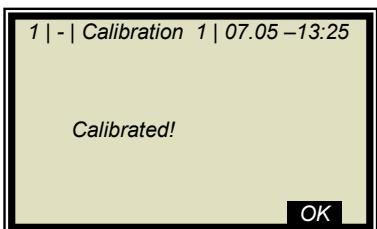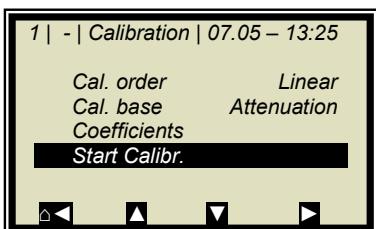
Push ◁ twice to return two pages.

```
1 | - | Calibration | 07.05 – 13:25

   System adjust
   Calibrate conc
   Calibrate conc 2
   Advanced

  ◁    ▲    ▼    ▷
```
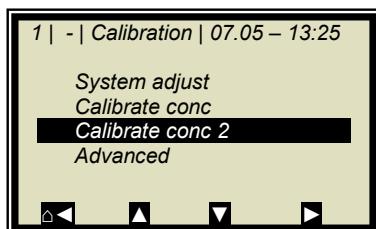
➢ CALIBRATE CONC 2
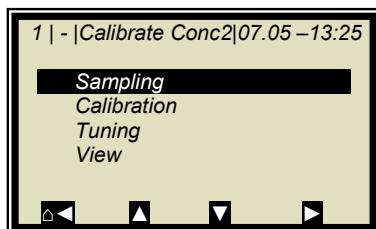
Repeat the steps as described above for concentration 2; all samples have to be enabled again in the sample table. Now you have to disable all samples which are not used for concentration 2.

```
1 | - |Calibrate Conc2|07.05 –13:25

   Sampling
   Calibration
   Tuning
   View

  ◁    ▲    ▼    ▷
```

➢ SAMPLING

6.4.5 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.

1 | - | Calibration | 07.05 – 13:25

System adjust
Calibrate conc
Advanced

➢ ADVANCED

1 | - | Advanced | 07.05 – 13:25

Tare values
Num. cal. sweeps   20
Process type
Extended cal. Mode   Disabled

➢ PROCESS TYPE

1 | - | Advanced | 07.05 – 13:25
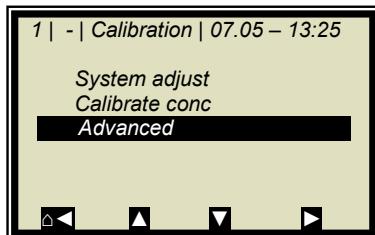
Process type
1 Conc
2 Conc
Split conc
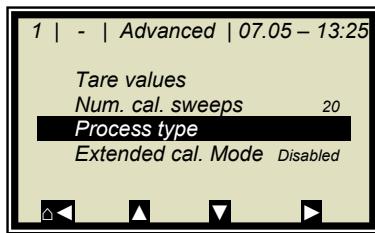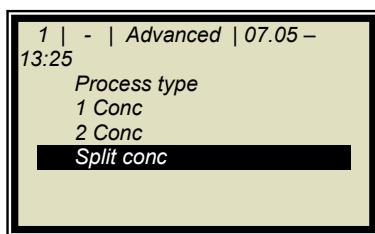
➢ SPLIT CONC
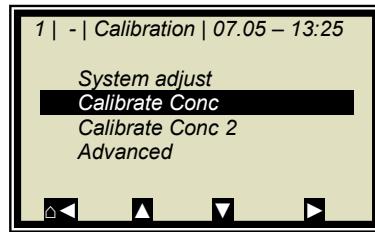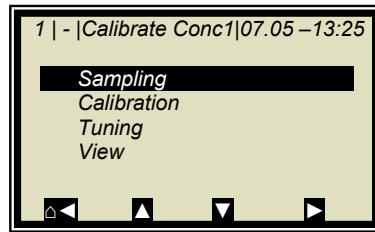
Push the [√] button to accept the selected process type and push the [◁] button once to go to the display depicted below. The displayed split value has been set by the manufacturer, but has to be adapted to the respective application.

1 | - | Advanced | 07.05 – 13:25

Tare values
Num. cal. sweeps   20
Process type   Split conc
Split value   75.00 %
Extended cal. Mode   Disabled

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.
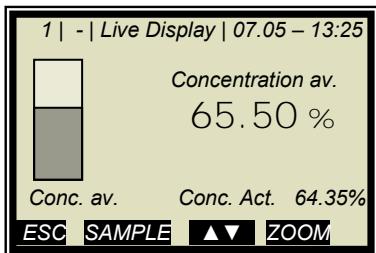
The sample measurement is carried out continuously over the entire measuring range with the display depicted to the left. See *chapter 5.3 Sampling*.

```
1 | - | Live Display | 07.05 – 13:25

              Concentration av.
              65.50 %

Conc. av.      Conc. Act.  64.35%
ESC  SAMPLE   ▲▼   ZOOM
```

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 allocation of the samples takes place automatically, for example, after the split value has been set or the lab values have been entered (e.g. after new sampling). The allocation depends on the split value and the lab value.

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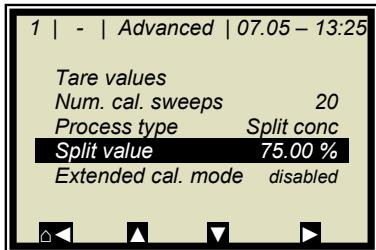
The split value to be set must correspond to the point of intersection of both calibration curves. This will be corrected automatically after the calibration (within certain limits).

```
1  |  -  | Advanced | 07.05 – 13:25

  Tare values
  Num. cal. sweeps          20
  Process type       Split conc
  Split value          75.00 %
  Extended cal. mode    disabled

  ◩◀      ▲       ▼       ▶
```

➢ SPLIT VALUE

```
1  |  -  | Advanced | 07.05 – 13:25

  Split value

  75.00    |              %

ESC  ?  DEL  √
```
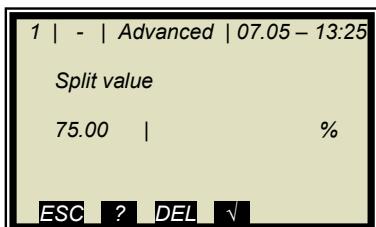
Enter the split value and confirm with ✓ .

Push ◩◀ to get to the Calibration page.

```
1 | - | Calibration | 07.05 – 13:25

    System adjust
    Calibrate conc
    Calibrate conc 2
    Advanced

   ◢◄      ▲      ▼      ▶
```

➢ CALIBRATE CONC

```
1 | - |Calibrate Conc2|07.05 –13:25

    Sampling
    Calibration
    Tuning
    View

   ◢◄      ▲      ▼      ▶
```
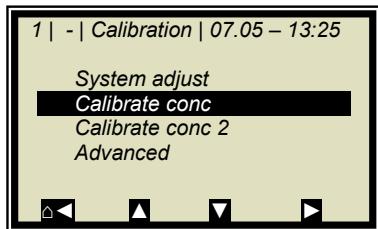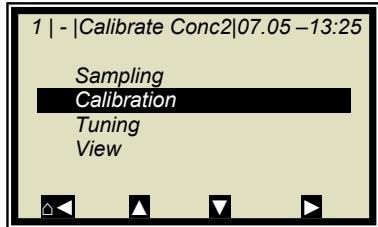
➢ CALIBRATION

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

6.4.6 Extended Calibration Mode

It is possible to select an extended calibration mode that replaces all other calibration calculations including temperature and loading compensation. Calibration is performed using the following formula:

Measured value = A1·Phase + B1·Attenuation + C

+ D·PT100 + E·Input1 +F·Input2

+ G·Radiom. Mpua   Eg. 6-2

where:

Measured value	Concentration / Moisture / Dry mass
A1	Phase coefficient
B1	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 radiom. Mpua

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

Upon delivery of this device, this calibration mode is disabled (default setting). Activation is carried out on the PROFI menu:

```
1 |  - | Calibration | 07.05 – 13:25

   System adjust
   Calibrate conc
   Advanced


   ◁    ▲    ▼    ▷
```

Starting from the main display, you get to the display depicted to the left via | SETUP | CALIBRATION |

➢ ADVANCED

```
1 |  -  | Advanced | 07.05 – 13:25

   Tare values
   Num. cal. sweeps        20
   Process type        1 Conc.
   Extended cal. mode    disabled


   ◁    ▲    ▼    ▷
```

➢ EXTENDED CAL. MODE

```
1 |  -  | Advanced  | 07.05 – 13:25

   Extended cal. mode
   Disabled
   Enabled



   ESC   ?    ▲▼    √
```
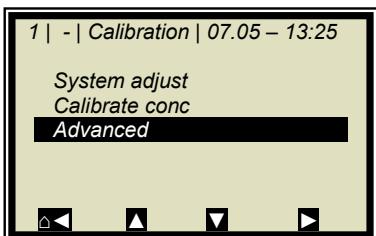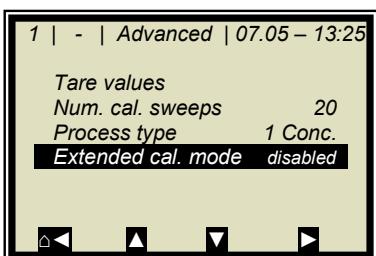
➢ ENABLE

Confirm selection with √ .

1 | - | Calibrate Conc | 07.05 –13:25

Sampling
Calibration
Tuning
View
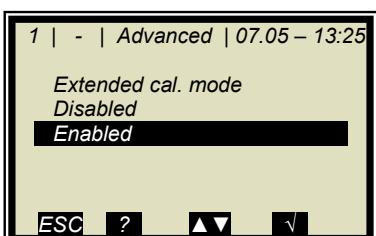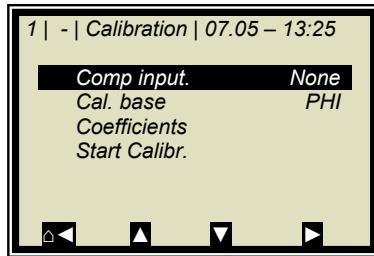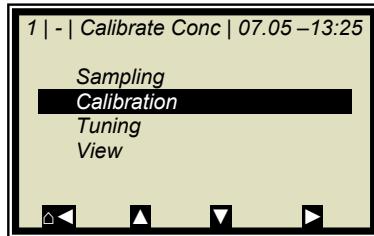
The **Setup and Calculation** of the calibration is carried out on the following menu:

Starting from the main menu, you get to the display to the left by selecting
| SETUP | CALIBRATION | CALIBRATE CONC |

➢ CALIBRATION

1 | - | Calibration | 07.05 – 13:25

Comp input.   *None*
Cal. base   *PHI*
Coefficients
Start Calibr.

Comp input:
   Here you can select the analog inputs (PT100, current input 1 and 2) that are needed for compensation. The following parameters can be set:
   - None
   - Mpua
   - Mpua + Input 1
   - Mpua + Input 2
   - Mpua + PT00
   - Mpua + Input 1 + Input 2
   - Mpua + Input 1 + PT100
   - Mpua + Input 2 + PT100
   - Mpua + Input 1 + Input 2 + PT100
   - Input 1
   - Input 1 + Input 2
   - Input 1 + PT100
   - Input 1 + Input 2 + PT100
   - Input 2
   - Input 2 + PT100
   - PT100

Cal. base
   The following parameters can be set:
   - Phase
   - Attenuation
   - Both (phase and attenuation)

Coefficients:
   On this display, you can edit all calibration coefficients.

Start Calibr.
   Starts the calibration using the parameters you have set earlier.

6.5 Typical Calibration Coefficients/Start Values

For applications on the conveyor belt and in the measuring chute it holds:

For dry mass measurement, A1 and B1 must be negative.

Without loading compensation:

$$A1 = \frac{1}{Mpua_{[g/cm^2]}} \quad \text{or} \qquad \text{Eg. 6-3}$$

$$B1 = \frac{6}{Mpua_{[g/cm^2]}} \qquad \text{Eg. 6-4}$$

C: Concentration/moisture value during system calibration

The Mpua can be calculated from Eq. 3-1 in the *Hardware Manual, chapter 3.3 Load Compensation*.

With loading compensation using the mass per unit area:

A1 = 1 **or** B1 = 6 for moisture measurement
C: Concentration/moisture value during system calibration

With loading compensation using current input 1:

Example of compensation signals:
- Mass flow, for example via a belt weigher
- Material thickness, e.g. via distance measurement

$$A1 = \frac{Nominal\,load\,(Current\,In1)}{Mpua_{[g/cm^2]}} \quad \text{or} \qquad \text{Eg. 6-5}$$

$$B1 = 6 \cdot \frac{Nominal\,load\,\,(Current\,In1)}{Mpua_{[g/cm^2]}} \qquad \text{Eg. 6-6}$$

C: Concentration/moisture value during system calibration

The Mpua can be calculated from Eq. 3-1 in the *Hardware Manual, chapter 3.3 Load Compensation*.

Chapter 7. **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.

Basic
On the Basic level you can make essential entries, and stop and start the system.

Profi
The Profi mode allows additional entries in the Process type menu, Calibration menu and opens the Service menu.

Service
The service level is reserved to service personnel.

You have to enter a password to change from the access level "Read only" to "Basic" or "Profi".
At the time of delivery, this password is

PASS1

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

Changing from Profi to Basic or vice versa is possible without password.

🔆 **TIP**
Depending on the access level, some menu items are hidden.

7.1 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 LED's light up after power on**, press 0 (zero) and keep it depressed for 8 seconds.
Device powers up in the "Basic mode". You can now enter a new password (in the Profi mode).

i IMPORTANT

Review your process before you turn off the device. The current outputs drop to 0 mA.

Chapter 8. **Error Lists and Device States**

> The LED's indicate the device state. After the error has been remedied, the LED's are reset to the normal status.

8.1 Hardware Error and Warning Messages

Code	Error	Possible cause
14	Battery voltage	Battery is nearly empty, replace immediately See Hardware Manual chapter 5.4
20	HF temperature out of range	Check the operating temperature of the evaluation unit, permissible range -20 to 45 °C
21	Warning! Ambient temperature too high!	Check the operating temperature of the evaluation unit, permissible range -20 to 45 °C
32	Parameter memory incorrect	Compatibility check after software download: A general reset has to be performed.
39	HF hardware error	Troubled cable connection between motherboard and HF module. Check connector on the motherboard. Warning! 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 department.		

8.2 Input Error

Error	Probable cause
Value too large	Input value too large
Value too small	Input value too small
Table is empty	Sample table has been selected without previous sampling
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.
Sample table full	You have tried to measure more than 20 samples.

8.3 Measurement Error and Error Messages

Code	Error	Possible cause
50	Sigma of phase is too large	The measured phase exceeds the permissible limit value.
52	Attenuation too high	The measured attenuation exceeds the permissible max. value.
54	No system calibration done	The system calibration has not yet been carried out.
56	Phase Offset too large	The measured phase exceeds the permissible limit value of Phase Offset
60	Current input 1 out of range	The enabled current input has not yet been calibrated or is not used.
61	Current input 2 out of range	The enabled current input has not yet been calibrated or is not used.
62	PT100 temperature out of range	The enabled PT100 input has not yet been calibrated or is not used.
70	Concentration out of range	The concentration lies outside the process limits.
71	Concentration 2 out of range	The concentration lies outside the process limits.

Code	Error	Possible cause
72	Loading value 1 smaller than minimum load	Minimum load not reached, with respect to concentration 1.
73	Loading value 2 smaller than minimum load	Minimum load not reached, with respect to concentration 2.
74	Load comp. disabled. Current input upper and lower limit invalid	The current input has exceeded the upper or lower limit.
75	Synchronization time too long	Review settings for synchronization, see chapter 7.3 in the Hardware Manual.
76	Synchronization: Speed out of range	Review settings for synchronization, see chapter 7.3 in the Hardware Manual.
77	Wait for synchronous value	The measurement has not yet been synchronized, please wait.
90	Current input 1 out of range	The concentration calculated on the basis of the current lies outside the current range.
91	Current input 2 out of range	The concentration calculated on the basis of the current lies 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.
For all other error messages, please contact the Berthold Technologies service.		

After the error has been eliminated, the measurement returns to the status before the error has occurred. An acknowledgment is not required.

8.4 Device States

Error state:

This condition is indicated by the error codes 50 to 56, 60 to 62 and 70 to 73 (see table above). The evaluation unit shows the following behavior:

LED's: RUN flashing, ERROR on, signal 1 and 2, depending on configuration.

Current outputs: Error Current

Display: Error message with error code

Warning state:

This condition is indicated by the error codes 14, 21, 90 and 91 (see table above). The evaluation unit shows the following behavior:

LED's: RUN flashing, ERROR off, signal 1 and 2, no correlation.

Current outputs: live

Display: Error message with error code

Hold state:

Measurement was stopped via digital input. The evaluation unit shows the following behavior:

The mean concentration value is frozen. The measurement continues, however, so that a measurement fault may trigger the error condition also in the Hold state.

LED's: RUN flashing, ERROR off, signal 1 and 2 depending on configuration.

Current outputs: frozen

Display: No display message

Chapter 9. **Start-up Log**

The log can be output via RS232. The output takes place in menu | DIAGNOSITIC | PRINT SETUP |.

The serial interface RS232 has the following connection settings:
Data transfer rate 38400 baud, 8 data bits, no parity, 1 stop bit

The log is stored to a TXT file using a terminal program. For the presentation (e.g. in Excel®), the following data format has to be taken into account.

Separator: Tabulator
Decimal separator: .
Thousand separator   ,

The following code list helps you to interpret the start-up log, see example of a log in chapter 9.1.

Parameters	*Code*	*Information*
Log type		*Log type:*
	0	*Disabled*
	1	*Single*
	2	*Continuous*
	3	*Stop at error*
Log time		*Log time:*
	0	*15 minutes*
	1	*1 hour*
	2	*4 hours*
	3	*8 hours*
	4	*1 day*
	5	*3 days*
Measuring mode		*Measuring mode:*
	0	*Continuous*
	1	*Batch*
Start mode		*Start mode (Start/Stop):*
	0	*Keyboard*
	1	*External*
Wave band selection		*Frequency band selection:*
	0	*Full range*
	1	*Standard*
	2	*Resonance scan*
	3	*Specific*

Parameters	*Code*	*Information*
Extended calibration mode	*0* *1*	*Extended Cal mode:* *Off* *On*
Extended calibration input selection	*0* *1* *2* *3* *4* *5* *6* *7* *8* *9* *10* *11* *12* *13* *14* *15*	*Extended Cal input selection:* *None* *Mpua* *Mpua + Input 1* *Mpua + Input 2* *Mpua + PT00* *Mpua + Input 1 + Input 2* *Mpua + Input 1 + PT100* *Mpua + Input 2 + PT100* *Mpua + Input 1 + Input 2 + PT100* *Input 1* *Input 1 + Input 2* *Input 1 + PT100* *Input 1 + Input 2 + PT100* *Input 2* *Input 2 + PT100* *PT100*
Calibration mode	*0* *1*	*Calibration degree:* *Linear regression* *Quadratic regression*
Calibration variable	*0* *1* *2*	*Calibration basis:* *Phase* *Attenuation* *Phase and attenuation*
Temp. compensation input	*0* *1* *2* *3*	*Temp. compensation input:* *None* *Current In 1* *Current In 2* *PT100*
Temp. compensation mode	*0* *1*	*Compensation mode:* *Additive* *Multiplicative*
Temp. compensation fit	*0* *1*	*Compensation degree:* *Linear regression* *Quadratic regression*
Loading comp. selection:	*0* *1* *2* *3* *4*	*Selection of loading compensation:* *Disabled* *Radiom. MPUA* *Loading (Cin 1)* *Tonnage & Speed* *Mass & Height*
Synchronizer mode	*0* *1* *2*	*Synchronization mode:* *Disabled* *Const. velocity* *Variable velocity*
Measure configuration	*0* *1* *2*	*Process type:* *1 concentration* *2 concentrations* *Split concentration*

Parameters	Code	Information
AO Assign Code		Assignment current output:
	0	None
	1	Concentration
	2	Concentration 2
	3	Current In 1
	4	Current In 2
	5	PT100
AO Alarm select code		Error current output:
	0	22 mA
	1	3.5 mA
	2	Hold
	3	Value
Range selection		Measuring range current output:
	0	0 … 20 mA
	1	4 … 20 mA
Compensation input		Compensation input:
	0	None
	1	Current In 1
	2	Current In 2
	3	Pt100
AI Range selection		Measuring range current input:
	0	0 … 20 mA
	1	4 … 20 mA
AI Enabled[2]		Status of current input 2
DO Function		Function of the digital outputs:
	0	None
	1	Error
	2	Hold
	4	Alarm min.
	5	Alarm max.
DO Assignment		Digital output: the min./max. alarm is assigned as follows:
	0	Concentration
	1	Concentration 2
	2	Current In 1
	3	Current In 2
	4	PT100
DI Function selection		Function of the digital inputs:
	0	None
	1	Start/Stop
	2	Hold
	3	Sampling
	4	Product selection
Printout mode		Mode of data output:
	0	None
	1	Line
	2	Table
	3	Line + table

Parameters	*Code*	*Information*
Access level		*Access level:*
	0	*Read only*
	1	*Basic*
	2	*Profi*
	3	*Service*
Language		*Language selection*
	0	*English*
	1	*German*
	2	*French*

9.1 Example Start-up Log

Menu:	Start of Setup:	Start-up Log				Interpretation:
						(* only relevant for service)
Product	Entry	Product1	Product2	Prod.3	Prod.4	
Datalog	Log type :	1				Log type: see Code list
	Log time :	2				Log time: see Code list
	Number of errors :	2				Number of entries in the error log
	NTC temperature :	45.3 °C				*
	max. NTC temperature :	46.7 °C				*
	9V power supply :	7.94 V				*
Info	Tag:	-				Tag
	Device type:	LB 568				Device type :
	Unique device ID number :	4294967295				
	Serial number :	4294967295				
	Final assembly number :	000-000				
	Software version :	V1.00				
	Software release date :	31.08.2012				Software revision date
	Actual date :	01.09.2012				Date of recording
	Actual time :	18:03				Time of recording
Measurement	Measuring mode :	0				Measuring mode: see code list
	Start mode :	0				Start mode: see code list
	Filter damping value :	20				Averaging number
	Filter damping value[2] :	20				*
	Filter damping value[3] :	20				*
	Reset average :	FALSE				Reset averaging: Yes/No
Plausibility	Lower limit :	0				Min. process limit
	Upper limit :	100				Max. process limit
	Max. phase sigma :	500				Sigma max.
	Max. Phase at zero freq.(°)	170.00 °/GHz				Residual phase max.
	Correlation Phi/Att :	0				Phase/attenuation ratio
	Auto-set mode :	FALSE				Auto set: On/Off
	Unwrap algor. EPS value :	500.00 °				*
	PhiM jump corr. enable :	TRUE				Phase jump correction, enabled: Yes/No
	PhiM jump corr. variance :	150.00 °				Variance for the phase jump correction
	PhiM jump corr. filter damp :	4				Averaging number for the phase jump correction
	PhiM jump corr. filter post correction :	FALSE				*
Microwave	Ref. cable length :	4.00 m				Reference cable length
	Signal cable length :	4.00 m				Signal cable length
	Wave band selection :	1				Frequency band: see code list
	Start frequency :	0				*
	Internal Attenuation :	0				*
Marker	Marker name :	Mark1				Marker name for concentration
	Marker value :	50				Marker value for concentration
	Marker name[2] :	Mark2				Marker name for concentration 2
	Marker value[2] :	50				Marker value for concentration 2
System adjust	Nbr of sweeps for reference :	10				Number of sweeps for system calibration

Calibrate concen-tration 2	Extended calibration mode :	0	Extended Cal. mode: see Code list
	Extended calibration input selection:	0	Extended Cal input selection: see Code list
	Calibration mode :	0	Calibration degree: see code list
	Calibration variable :	1	Calibration basis: see code list
	Phase coefficients :	0	Phase coefficient A1
	Phase coefficients[2] :	0	Phase coefficient A2 Attenuation
	Attenuation coefficients :	0	Coefficient B1
	Attenuation coefficients[2] :	0	Atten. coefficient B2
	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 mpua
	Adjust factor :	1	Factor
	Adjust offset :	0	Offset
	Temp. compensation mode:	0	Compensation mode: see code list
	Temp. compensation input :	0	Compensation input: see code list
	Temp. compensation fit:	0	Compensation fit: see code list
	Temp. compensation reference :	0	Compensation reference value
	Phase coeff. for temp. comp. :	0	Comp. Phase coefficient K_Ph1
	Phase coeff. for temp.comp.[2] :	0	Comp. Phase coefficient K_Ph2
	Attenuation coeff. for temp.comp :	0	Comp. Atten. coefficient K_dB1
	Attenuation coeff. for temp.comp[2]	0	Comp. Atten. coefficient K_dB2
	Loading comp. selection :	0	Loading comp. selection: see code list
	Loading comp. lower limit :	0.01	Minimum load
	Synchronizer mode :	0	Synchronizer mode: see code list Distance to the microwave measuring path
	Current input1 distance to uWave :	0	Distance to the microwave measuring path
	Current input2 distance to uWave :	0	Distance for the radiometric measuring path
	Radiometry distance to uWave :	0	
Plausibility for concen-tration 2	Lower limit :	0	Min. process limit
	Upper limit :	100	Max. process limit

Calibrate concentration 2	Calibration mode :	0	Calibration degree: see code list
	Calibration variable :	1	Calibration basis: see code list
	Phase coefficients :	0	Phase coefficient A1
	Phase coefficients[2] :	0	Phase coefficient A2
	Attenuation coefficients :	0	Atten. coefficient B1
	Attenuation coefficients[2] :	0	Atten. coefficient B2
	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 mpua
	Adjust factor :	1	Factor
	Adjust offset :	0	Offset
	Temp. compensation mode:	0	Compensation mode: see code list
	Temp. compensation input :	0	Compensation input: see code list
	Temp. compensation fit :	0	Compensation degree: see code list
	Temp. compensation reference :	0	Compensation reference value
	Phase coeff. for temp. comp. :	0	Comp. Phase coefficient K_Ph1
	Phase coeff. for temp.comp.[2] :	0	Comp. Phase coefficient K_Ph2
	Attenuation coeff. for temp.comp :	0	Comp. Atten. coefficient K_dB1
	Attenuation coeff. for temp.comp[2]	0	Comp. Atten. coefficient K_dB2
	Loading comp. selection :	0	Loading comp. selection: see code list
	Loading comp. lower limit :	0.01	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 :	1	Assignment: see code list
	AO Upper range value :	100.00%	Upper value
	AO Lower range value :	0.00%	Lower limit
	AO Current value :	4.00 mA	Actual current
	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 Current value[2] :	4.00 mA	Actual current
	AO Alarm select code[2] :	2	Error current: see code list
	AO Error current value[2] :	22.00 mA	Error current value
Current input 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
	AI Current :	0.00 mA	Live current
Current input 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
	AI Current[2] :	0.02 mA	Live current

PT100 input	AI Enabled[3] :	0	Disabled: 0 Enabled: 1
	PT100 value :	2.8 °C	PT100 live value
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 inputs	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 :	10	Averaging of the count rate
	Cps validation mode :	1	Disabled 0 Enabled: 1
	CPS max value :	100000 cps	Maximum count rate
	CPS min value :	0 cps	Min. count rate
	HV control mode :	0	Automatic: 0 Manual: 1
	Actual HV :	450.0 V	Current 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°	Radiation angle
	Io rate :	0 cps	Zero count rate
	Selected nuclide at I null determination :	0	0 = Cs137 1 =Am241
	Io max. time :	180 s	Max. recording time for Io
	Reference measurement done (Io) :	FALSE	Reference measurement done: Yes/No
	Nuclide selection :	0	0 = Cs137 1 =Am241
	End of Setup		End

Start of Reference Data | **System adjustment data:**

Product 1:

Mean Atten.:	46.8509 dB
Phase at fm:	42.6285 deg/GHz
Phase offset:	-825.586 deg
Phase slope:	380,984 deg/GHz
Phase correlation:	0.998212
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
3.791	7387.71	7387.71	22.25
3.821	7854.85	7854.85	22.02
3.851	7854.85	7854.55	22.89
3.881	7387.71	7387.71	22.41

Start of Sample Data: | **Sampling:**

Product 1: Sample Data for Concentration 1:

Sample:	Active:	Con .(%):	Lab.(%):	AIN1:	AIN2:	Temp. (°C):	Phi. (°/GHz):	Att.(dB):	Mqua (g/cm^2):
1|17.03 - 12:37	TRUE	40	40	0	0	0	-0.35	0.02	0.00
2|17.03 - 12:37	TRUE	35	35	0	0	0	30.33	5.08	0.00
3|17.03 - 12:45	TRUE	25	25	0	0	0	59.02	18.98	0.00

Correlation factor between
lab and meas values: 1
End of Sample Data
Do not use following data!