Concentration / Moisture Measuring Systems
MicroPolar 2 (++)
LB 567

User's Guide

Hardware Manual

41988BA2

Rev. Nr.: 06, 07/2023

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 the hardware manual and the software manual.

The **hardware manual** comprises:

- mechanical components
- installation
- electrical installation
- technical data
- electrical and mechanical drawings

The **software manual** comprises:

- operation of the evaluation unit
- parameter description
- basic setup
- calibration
- error messages

The present manual is the hardware description.

Subject to change without prior notice.

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Table of Contents

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 user manual. They are identified by the following sings: DANGER, WARNING, CAUTION or NOTICE.

DANGER

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

WARNING

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

CAUTION

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

NOTICE

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

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

TIP
Contains user tips and other useful information.

Other symbols used in this documentation:

Warning: No intervention, do not alter anything

Requirement: Disconnect power

Requirement: Wear safety boots

1.2 General Information

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

Please pay attention to:

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

1.3 General Safety Instructions

IMPORTANT
The equipment housings have IP 65 protection and are suitable for outdoor applications. The units are factory tested and are delivered in a condition that permits safe and reliable operation.

NOTICE

For outdoor applications, the measuring systems must be protected from direct sunlight and rain, for example by a suitable shelter.

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 impact on the operating process to be controlled.

NOTICE

The systems may only be used in perfect technical condition and only for the intended use!

⚠ CAUTION

Only let persons work with the systems who are mandated to do this and are suitably qualified and adequately trained! Installations and modifications on the systems which may affect the operational safety are not permitted!

Ambient conditions

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

IMPORTANT
If liquid gets inside the instrument, cut off the power supply. The equipment must be inspected and cleaned by an authorized service center.

⚠ WARNING

Electrical hazards

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

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

NOTICE

Caution! Potential hazards, material damage!
Device type:

LB 567-02 MicroPolar 2 (ID no. 41988-02) and

LB 567-12 MicroPolar 2 ++ (ID no. 54563-02)

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

NOTICE

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

IMPORTANT
The LB 567 and all additional equipment must be connected to mains via grounded connection.

IMPORTANT
The concentration meter LB 567 may be installed, serviced and repaired only by qualified specialists.

Qualified persons

Qualified specialists are persons who through professional training have acquired sufficient skills in the respective field and who are familiar with the relevant national industrial safety regulations, accident prevention directions, guidelines and accepted engineering standards. They must be able to safely assess the results of their work and they must be familiar with the contents of these user manual.

Chapter 2. **General Information**

2.1 Use and Function

The MicroPolar 2 LB 567 has been designed as a concentration 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 compromised and the warranty will be lost.

Berthold Technologies is liable and guarantees only that the devices comply with its published specifications. The LB 567 may only be installed in an undamaged, dry and clean condition. Alterations and modifications to the system components are not permitted.

The LB 567 is not qualified as a "safety-related measurement".

Conformity to standards

The standards and guidelines the LB 567 complies with are itemized in these device instructions in *chapter 2.2 Frequency License* and *chapter 7.1 EC Declaration of Conformity*.

Pressure equipment directive

The FlowCell has been classified as pressure equipment acc. to art. 4 sect. 3 of guideline 2014/68/EU. Before use, check whether the case of use corresponds to this classification. In particular, the media compatibility of the components in contact with the fluid must be checked.

Protection type

The protection type of the LB 567 to IEC 60529 is max. IP 65.

The following use is inappropriate and has to be prevented:

Warning against misuse

- The use under conditions other than the terms and conditions stated by the manufacturer in their technical documentation, data sheets, operating and installation manuals and other specifications.
- The use after repair by persons not authorized by Berthold Technologies.
- The use in a damaged or corroded state.
- Operation with open or inadequately closed cover.
- Operating with insufficiently tightened adapters and cable glands.
- Operation without the manufacturer’s recommended safety precautions.
- Manipulating or bypassing existing safety facilities.

Authorized persons

Authorized persons are those who, by law, are permitted to perform the respective activity, or who have been approved by Berthold Technologies for certain activities.

2.2 Frequency License

The MicroPolar 2 complies with Part 15 of the FCC Rules[1]. These meters are compliant in terms of interference immunity and interference emission and are approved for operation. The certificate can be found in *chapter 7.2 Frequency License*.

FCC license certificate

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

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

IMPORTANT

The FCC approval applies to the standard evaluation unit LB 567 in combination with horn and spiral antenna.

The LB 567++ is not FCC approved.

IMPORTANT

The LB 567 has been manufactured in compliance with the safety requirements for microwave devices. It will be the user's responsibility to adhere to any special legal provisions regarding the use of microwaves.

IMPORTANT

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

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

[1] FCC ... Federal Communications Commission

2.3 Intended Use

The LB 567 can be used to determine the water or moisture content and the concentration of virtually any material. The following sensors and evaluation versions are available:

1. The flow cell is a tubular probe that is either installed into the existing pipeline system inline or into a bypass.
2. The horn and spiral antennas are always used in pairs. Both antennas are installed diametrically opposite on the conveyor belt or in a chute. 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.

The evaluation unit is available in two versions: The standard model MicroPolar 2 and the high dynamic version MicroPolar 2 ++. The Micro Polar 2 ++ requires a microwave signal attenuation of at least 50 dB. The MicroPolar 2 must be used for lower microwave attenuation.

During operation, the concentration meters MicroPolar 2 and MicroPolar 2 ++ emit electromagnetic radiation in the frequency range between 2.4 GHz and 2.5 GHz (range limitations depending on local regulations in your country). Microwaves are not dangerous to human beings and the environment (power radiation < 1 mW). The microwaves are emitted directed from the microwave window; the product is not altered by the microwaves.

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, for example, salt content must be nearly constant.

2.4 Explanation of Terms

Attenuation	Weakening of microwave signals, microwaves measuring effect.
EVU	**Ev**aluation **U**nit
Factory setting	In the factory setting all parameters have been set to default values. In most cases this considerably facilitates the calibration of the instrument. Despite factory setting, calibration **always** has to be performed.
FlowCell	Tubular probe for simple integration into the existing pipeline system.
HF cable	**H**igh **f**requency cable
Microwaves	Designation for electromagnetic waves in a specific frequency range.
Phase	Phase or phase shift, microwave measuring effect.
Quad cable	Combination of four HF cables of equal length in a corrugated tube.
Softkeys	Software associated keys.
TC	**T**emperature **c**ompensation

Chapter 3. **System Description**

3.1 Principle of Measurement

As the microwaves pass through the product, their propagation velocity is slowed down (= phase shift) and their intensity is attenuated (= attenuation). Figure 3-1 illustrates the principle of measurement: Compared to a reference signal, the propagation velocity of microwaves passing through the product is slowed down (phase shift) and their intensity (attenuation) is reduced.

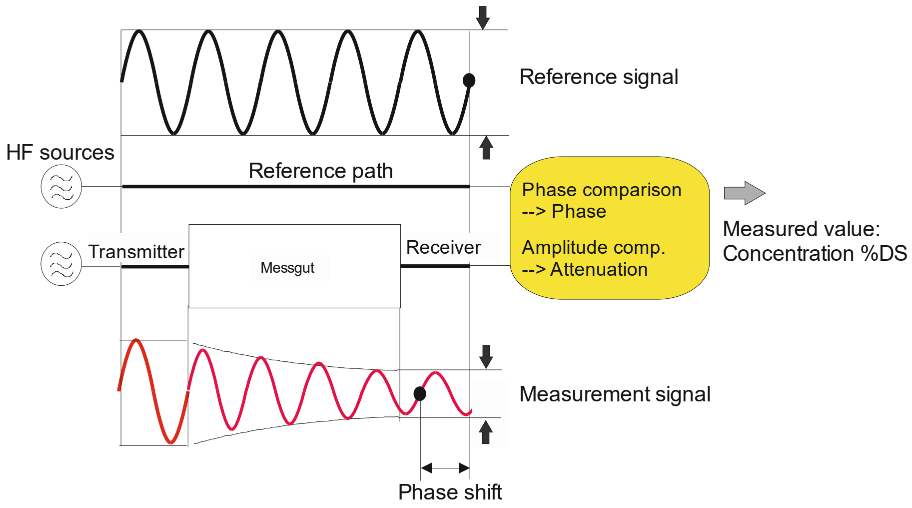


Figure 3-1: Schematic diagram: Change in microwave by product

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

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

3.2 Calculation of Measured Values

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

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

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

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

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

where:

Measured value Concentration / Moisture / Dry matter

A, C Coefficients of the respective calibration function

The LB 567 allows you to calibrate, display and output two concentrations: Con1 and Con2. You have to enter the calibration coefficients separately for concentration 1 and 2. For more information please refer to the Software Manual.

Limitations

- Weakly bound water can be detected depending on the strength of the binding. Thus, the measuring effect may be dependent on the grain size distribution and the chemical properties of the product being measured, provided this changes the binding of water to the solid matter.
- Walls made of plastic, rubber or insulation materials with fairly low dielectricity hardly affect the measurement and are calibrated at a constant level.
- Ice and crystal water cannot be measured because the water molecules cannot rotate freely (ice and crystal water 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 *chapters 4.3.3 Installing the Horn Antenna*).

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.

3.3 Temperature Compensation

Temperature compensation (TC) is required for fluctuating product temperature. It is generally advisable to provide a temperature compensation, i.e. a temperature signal (0/4...20 mA or PT100) to be connected to the evaluation unit and, optionally, to enable the compensation in the evaluation unit. The evaluation unit is designed so that the required TC's can be calculated automatically. The variation in temperature where TC becomes absolutely essential is dependent on the product and on the water content. In the first approximation, ± 2° C should be set as fluctuation limit.

For example, if the product temperature is measured via the PT100 input, then Eq. 3-1 is expanded as follows:

$$\textbf{Measured value} = A \cdot \text{Phase} + D \cdot T_{meas} + C \qquad \textbf{Eq. 3-2}$$

where:

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

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

3.4 Load Compensation

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

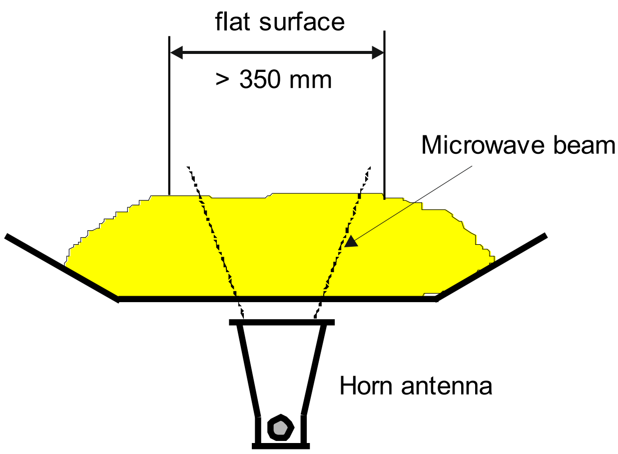


Figure 3-2: Material profile on the conveyor belt

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

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

where:

δ bulk density [g/cm³]

h material layer thickness [cm]

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

Measured value = A · Phase + G · Load + C Eq. 3-4

where:

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

A weight 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 pipes or chutes is always the same, and the material has a constant density.

3.4.1 Area Weight Compensation

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

Load = weight per unit area [g/cm^2] **Eq. 3-5**

The area weight signal supplies a 0(4)...20 mA signal.

IMPORTANT
Current input 1 must be used for this compensation.

3.4.2 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. 3-6**

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

IMPORTANT
Current input 1 must be used for this compensation.

3.4.3 Weight/Throughput Compensation

If the material cross-section is rectangular (see Figure 3-3), the weight per area [g/cm²] is proportional to the weight per length [kg/m]. Thus, the load compensation becomes linear; it is calculated as follows:

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

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

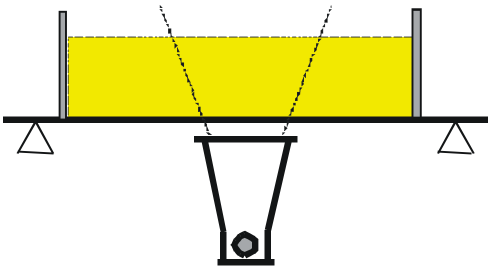


Figure 3-3: Rectangular material cross-section with weighing system

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 into the evaluation unit 0(4)…20 mA signal via the second current input. The compensation is then calculated according to:

$$\textbf{Load} = \frac{\textbf{Throughput [T/h]}}{\textbf{Belt speed [m/s]}} \qquad \textbf{Eq. 3-8}$$

IMPORTANT

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

3.4.4 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 *chapters 3.4.3*. The compensation is then calculated according to:

Load = layer thickness [cm] · weight [kg]   Eq. 3-9

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

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

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

3.5 Throughput Calculation and Output

For pipeline applications, the LB 567 allows you to calculate the throughput (mass flow) and to output the result via a current output.

The calculation is based on the microwave measured value; if this value correlates with the product density, one can calculate the throughput, if some additional information is available. The additional information needed is: internal pipe diameter/cross section and the product speed. The product speed has to be fed via current input.

For details, please see the *Software Manual, chapter 4.2.11 Mass Flow.*

3.6 Synchronization of the Current Input Signals

The LB 567 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.

For details, please see *chapter 4.3.5 Synchronization*.

3.7 Mechanical Components

The measuring system comprises an evaluation unit, a probe/antenna pair and one set of special high-frequency cables (short HF-cable). The evaluation unit is available in two versions: the standard model MicroPolar 2 LB 567 and the high dynamics version MicroPolar 2 ++ LB 567 (see Figure 3-4 and Figure 3-5).

Figure 3-4: Evaluation unit MicroPolar 2 (++) LB 567

The probes/antenna pairs are available in different versions, as pipeline probe and as horn and spiral antenna (see Figure 3-5 and Figure 3-6).

Figure 3-5: FlowCell LB 5660-102-00x nominal width 50 mm with V flange

The FlowCell is available in the nominal pipe sizes 50 -150 mm (50, 65, 80, 100, 125 and 150). The following connections types are available:

- Hygiene milk pipe screw connection DIN 11853-1
- V flange EN 1092-1/11

Figure 3-6: From left: Horn and spiral antenna

3.7.1 Evaluation Units

The evaluation units comprise the evaluation computer and the microwave unit. The microwaves are generated, received and analyzed in the microwave unit. Signal processing and communication take place in the evaluation computer. 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.

Differences between MicroPolar 2 ++ und MicroPolar 2

The MicroPolar 2 ++ evaluation unit has an additional HF amplifier module in comparison to the standard model. Otherwise, the evaluation units differ only in their application.

MicroPolar 2 ++

The high dynamics version MicroPolar 2 ++ permits higher product attenuations. Larger measuring paths can be irradiated, i.e. FlowCells with larger nominal diameters can be used. Which type of evaluation unit is used depends on the product attenuation. MicroPolar 2 is used up to an attenuation of 70 dB; MicroPolar 2 ++ is used for higher attenuations. The MicroPolar 2 ++ generally requires an attenuation of 50 dB. If this attenuation is not reached, the software displays an error message.

An RS232 interface is included on the bottom side of the instrument.

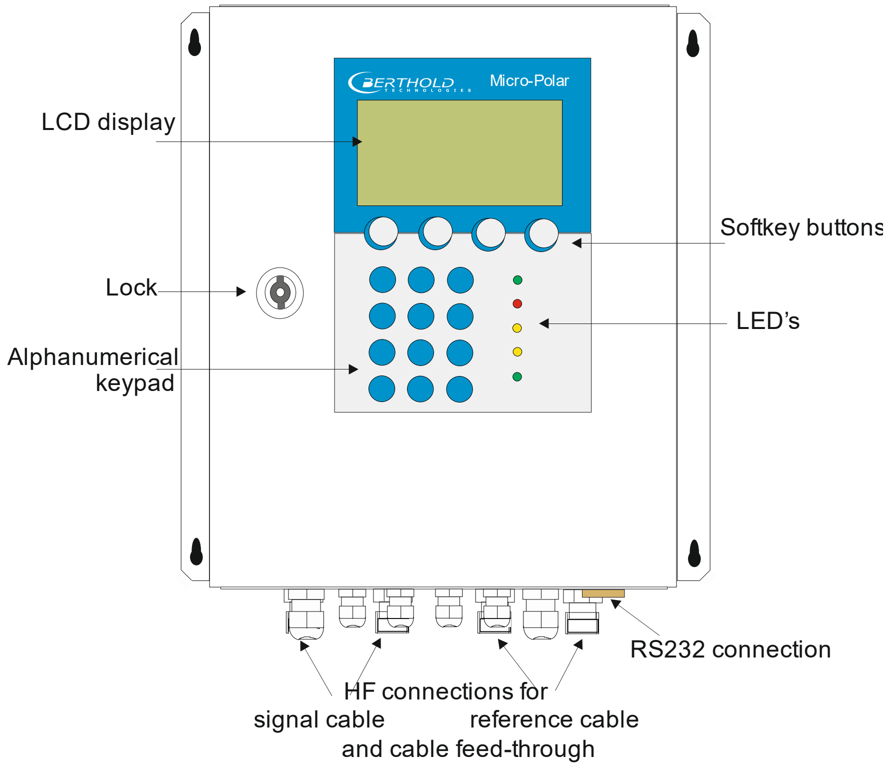


Figure 3-7: Evaluation unit – front view

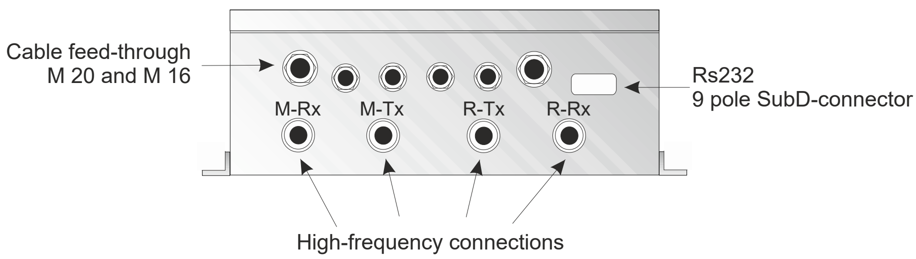


Figure 3-8: Evaluation unit – bottom view

Interpretation of LEDs

Five LEDs on the instrument front panel indicate the current device status.

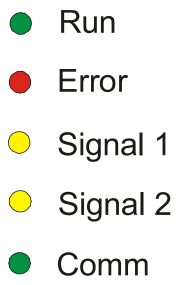


Figure 3-9: LEDs on the front panel of the evaluation unit

LED	Function
Run	<u>On:</u> Device in measurement mode <u>Flashes + ERROR LED off:</u> Device in warning state, on hold or low load state. A display message with error code indicates the cause (see *Software Manual, chapter 11. 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 11. Error Lists and Device States).* Canceled after reset or if error has been eliminated.
Signal 1	Display depending on the selected function of relay 1, possible functions: Error, alarm min., alarm max., measurement stopped, low load
Signal 2	Display depending on the selected function of relay 2, possible functions: Error, alarm min., alarm max., measurement stopped, low load
Comm	Communication active, e.g. via RS232 and RS485

Terminal block

The electrical connections of the LB 567 are located on a connector strip in the wall cabinet. The terminal block can be accessed from the front by opening the cover of the housing. There, you also find the power cut-off switch and the fuses. The high-frequency terminals are located on the outside of the housing. All other elements, especially the voltage-carrying elements (on the motherboard) are provided with a protective cover.

3.7.2 Flow Cell

The FlowCell is available in the nominal sizes of 50 to 150 mm (see fig. 3-11). As connection, the versions V flange EN 1092-1/11 or Hygiene milk pipe screw connection DIN 11853-1 are available. For technical data please see chapter 6.2 Technical Data Sensors.

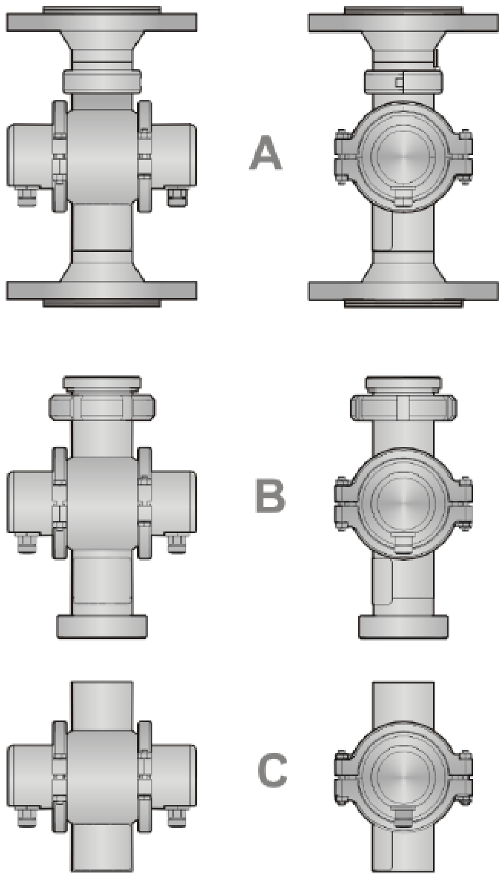


Figure 3-11: FlowCell versions

A: with V flange EN 1092-1/11
B: with Hygiene milk pipe screw connection DIN 11853-1
C: with welding pipe

The FlowCell consists of a sturdy stainless steel body. The microwave transmitter and receiver are firmly welded to the outside of the pipe. The entire product pipe is PTFE-coated and thus meets the special requirements for use in food for use in food.

There are no objects that extend into the pipe (e.g. a measuring sensor). Depending on the version, the FlowCell can be mounted with the V flange or milk pipe screw connection to the piping. For the versions with V flange, ASA adapter flanges are available as accessory.

The FlowCell has two HF ports to feed in and output the microwave signals. The input and output can be allocated as needed

(M-Tx, M-Rx). The microwave signals transmit the product over the entire pipeline cross-section.

For all versions, the following accessories are available:

1. Pipe-mounted PT100 or Inline PT100
2. Conductivity measuring device
3. Sampling valve (combination with 1. and 2. possible)

Overview accessories (see also chapter 6.2)**:**

Conductivity measuring device

Inline PT100

Pipe-mounted PT100

Sampling valve

Combination
Conductivity measuring
device with Sampling valve

Combination
Inline PT100 with
Sampling valve

3.7.3 Horn and Spiral Antennas

Various types of microwave antennas are available for moisture measurements on conveyor belts or chutes, taking into account the different geometries of the respective application. Each antenna pair consists of a transmitter and a receiver which are connected to the evaluation unit via an RF 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 inclined 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 Figure 3-11. 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 Figure 3-11).
If dust deposits may occur, these windows should be cleaned regularly. Dust depositions distort the results relative to their area weight and their water contents The antennas do not contain any electronic components; however, they should be protected against mechanical damage.

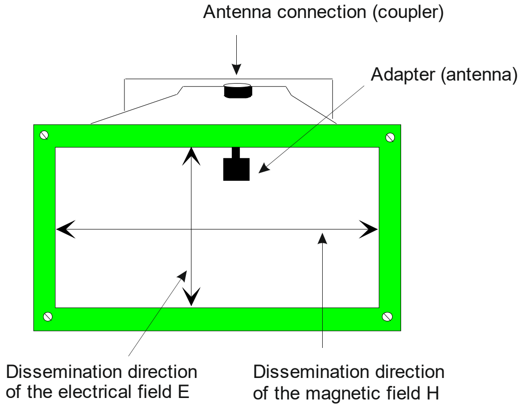


Figure 3-11: Left: Horn antenna Right: Horn antenna with a view through the window

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 3-12: Spiral antenna

3.7.4 Measuring Chute

For bulk goods, Berthold Technologies delivers a measuring chute complete with assembly plate and antenna fixtures. The chute is made of plastic PP-H or PVDF.

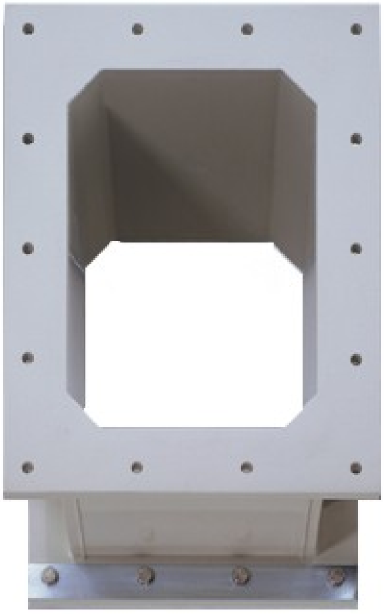


Figure 3-13: Measuring chute made of PP

The horn antennas are mounted on an assembly plate, see Figure 3-14. The plastic chute is fixed to the assembly plate.

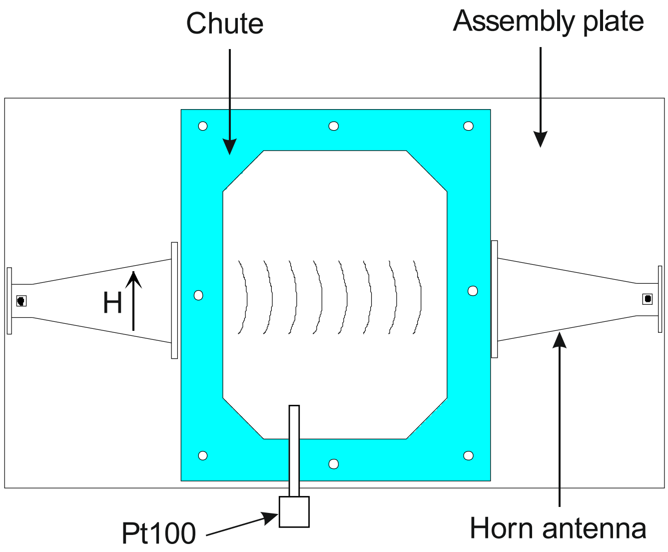


Figure 3-14: Assembly plate with chute and horn antennas

3.7.5 High-frequency Cable

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

HF cables change their conductivity (for microwaves) with temperature and would therefore produce measurement errors with varying ambient temperature. This error is compensated for by enabling the automatic 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 has to match the length of the sum of the signal cables.

Two different HF cable types of different lengths are available:

Version 1: The so-called HF-cable quad: It consists of four single HF-cables of equal length, whose ends are terminated by one HF-connector (N-type). Available cable lengths: 2, 4, 6 and 10 m (see Figure 3-15).

The reference line of the HF cable is short-circuited using an N-connector (see Figure 3-16).

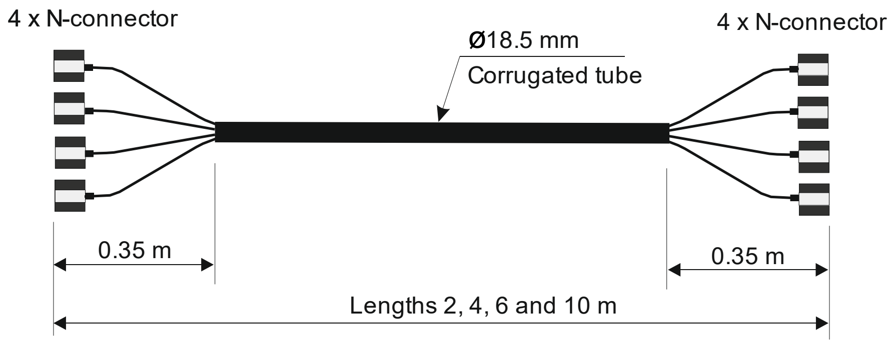


Figure 3-15: HF cable quad

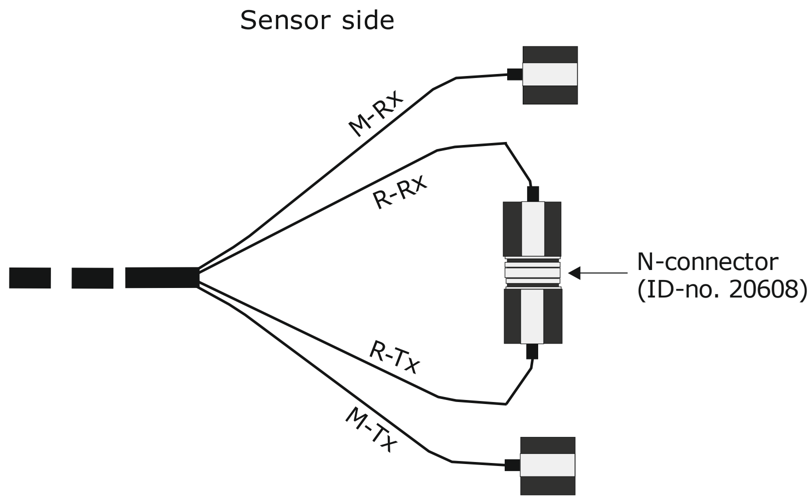


Figure 3-16: HF cable quad probe side: The ends of the reference line R-Rx and R-Tx are short-circuited using an N-connector.

Version 2: It consists of a single HF-cable whose ends are terminated by an HF-connector (N-type). Available lengths: 0.5, 1, 1.5, 2, 2.5, 3, 3.5 and 4 m (see Figure 3-17).

For the horn and spiral antennas (conveyor belt and chute application), only the HF cable is used. One cable each connects the evaluation unit with the antenna. A third cable serves as reference line; its cable length corresponds to the sum of the lengths of both antenna cables.

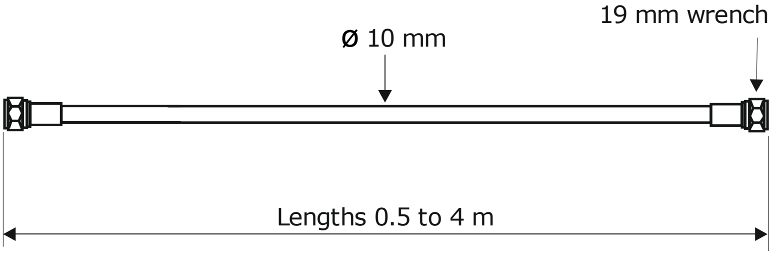


Figure 3-17: HF cable

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

HINWEIS

During assembly, ensure that the end of the corrugated tube is bent down on the probe side. By doing so, the ingress of fluids into the corrugated tube is prevented.

Hygienic HF-cable

For use in hygienic applications a hygienic HF-Quad-Cable is available. It provides a complete sealing against fluids.

It is available in 2 or 4 m length.

3.8 Assembly on a Pipeline

The evaluation unit is installed close to the FlowCell to keep the HF cable between evaluation unit and probe as short as possible. The shorter the cable connection, the better the stability of the measurement. The standard length is 2 m and the maximum length of the HF cable is 10 m.

The FlowCell is integrated into the existing pipeline system or in a bypass. The orientation of the FlowCell can either be vertical or horizontal. To avoid possible sedimentary deposits, vertical installation in a riser is preferred (see Figure 3-18).

The installation should preferably be close to a sample sampling point to ensure representative sampling for calibration.

A representative temperature signal (current signal or PT100) should be connected to the evaluation unit for product temperature compensation.

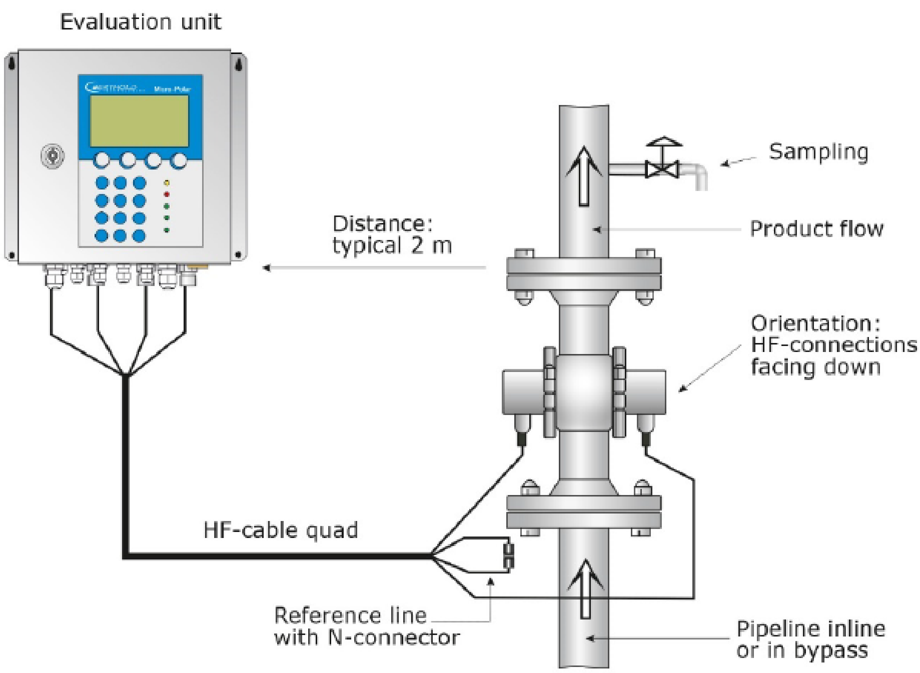


Figure 3-18: Typical measurement arrangement on a pipeline

3.9 Conveyor Measurement Configuration

The antenna pair and the height sensor (if required) are mounted on a stable frame. The transmitting antenna has to be installed below the receiving antenna above the belt. The height sensor is installed before the moisture measurement, viewed in the conveying direction. The microwave measuring system irradiates the product. Oblique irradiation is a better choice only in exceptional cases. The evaluation unit is installed in the direct vicinity of the horn antennas in order to limit the length of the antenna cables to 2 m each, if possible. The shorter the cable connections between antennas and evaluation unit, the better the stability of the measurement. See also Figure 3-19 and the installation proposal in *chapter 8.5 Installation Proposal on the Conveyor Belt*.

The height sensor is available as an accessory.

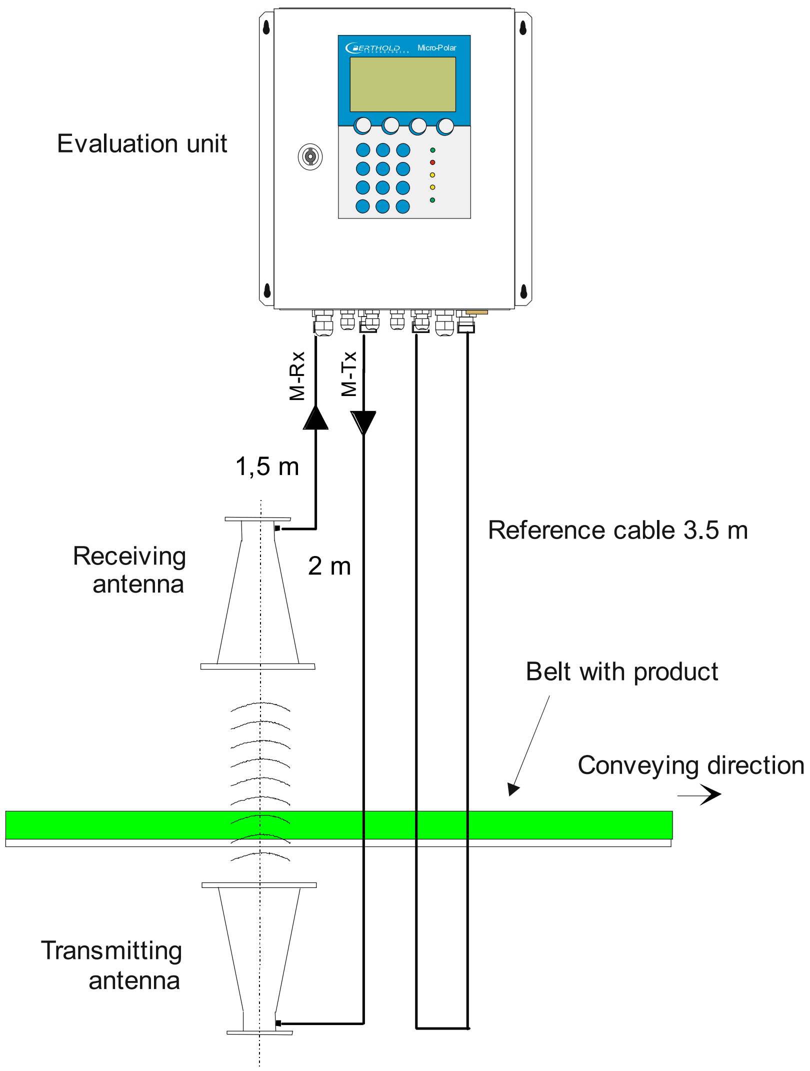


Figure 3-19: Typical measurement configuration on a conveyor belt with horn antennas

3.10 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 are mounted on the fixtures foreseen for that purpose 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. The shorter the cable connections between horn antennas and evaluation unit, the better the stability of the measurement.

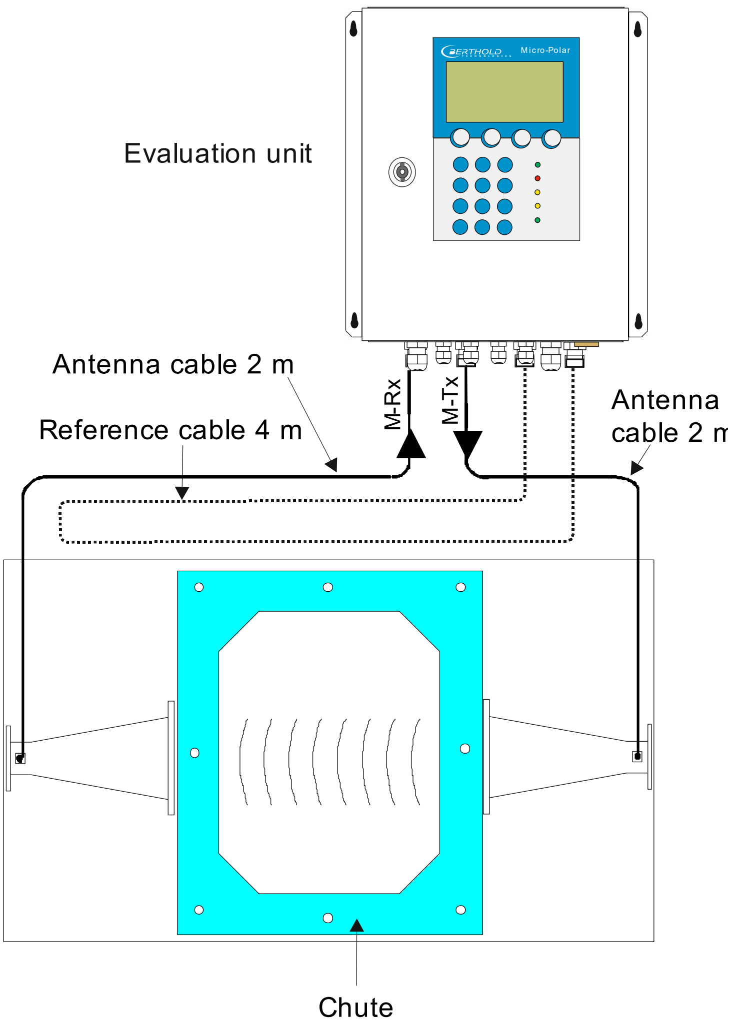


Figure 3-20: Typical system setup at a measuring chute with sample values

Chapter 4. **Getting Started**

4.1 Transport

NOTICE

Warning: Possible material damage!
System parts may get damaged during transportation!

Transport all components in their original packaging.
Protect parts against shocks.
In particular, the plastic rods of the container probes and the horn antennas must be protected against mechanical shock! For the horn antennas, there is a risk that the coupling pins may get bent and the function can be severely impaired.

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 25 kg, depending on the version. We recommend, therefore, that you wear safety boots.

4.2 Commissioning the Flow Cell

4.2.1 Installing the Flow Cell

⚠ WARNING

Danger of injury from leaking operating medium.

The FlowCell must be mounted correctly.

In particular, the correct tightening torque for the flange screws must be observed.

Requirements for the hygienic installation of the FlowCell:

- The mounting position must guarantee self-draining properties.
- The device has been developed for Cleaning in Place (CIP) applications and must not be dismantled for cleaning.
- Do not use cleaning equipment which are scraping or abrasive to avoid damage of product contact surfaces.
- Do not use aggressive cleaning agents or chemical which can affect the product contact surface.
- The customer is obligated to clean the FlowCell appropiately before it comes into contact with food.
- To meet the requirements for EHEDG certification, the sensor must be connected with process connections in accordance with the EHEDG position paper entitled "Easy Cleanable Pipe Couplings and Process Connections" (www.ehedg.org).

Note the following points when installing the flow cell:

- The FlowCell is integrated at a suitable location in the pipeline system. Keep in mind that material sampling directly behind the flow cell should be possible for calibration.
- The FlowCell should be installed in a vertical riser, if possible. It must be ensured that material deposits cannot form on the pipe walls and no bubble formation occurs in the product.

  When aligned horizontally, the drainability of the pipeline has to be respected. To ensure this, the FlowCell must be mounted acc. to fig. 4-2.
- There should be a straight pipe section of at least 300 mm and equal nominal width before and after the FlowCell to ensure a fairly homogeneous flow profile and to rule out possibly occurring microwave reflections in the pipeline. Also, not fittings must be installed in these pipe sections.

- No gas inclusions should be present in the product. If gas bubbles cannot be ruled out, a pressure of at least 4 bar is required in the pipeline to minimize the influence of gas bubbles. Please observe the max. permissible operating pressure, see *chapter 6.2 Technical Data Sensors*.
- The high-frequency cables should preferably be connected to the FlowCell from below to prevent flowing water from getting to the connection sockets.
- The signal and reference cable should as far as possible follow the same path to make sure both cables are exposed to the same temperature and should not come into contact with hot pipelines. We recommend installing the HF cable through a single protection tube. If you are working with the HF cable quad, this function is taken over in good approximation by the corrugated tube.

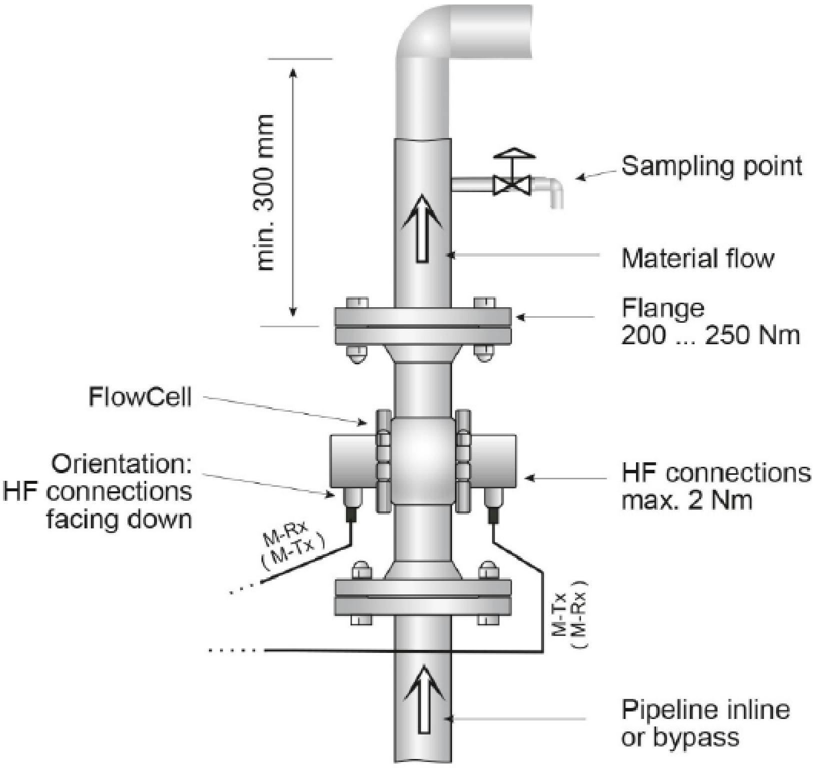


Abb. 4-1: Installation in a vertical riser

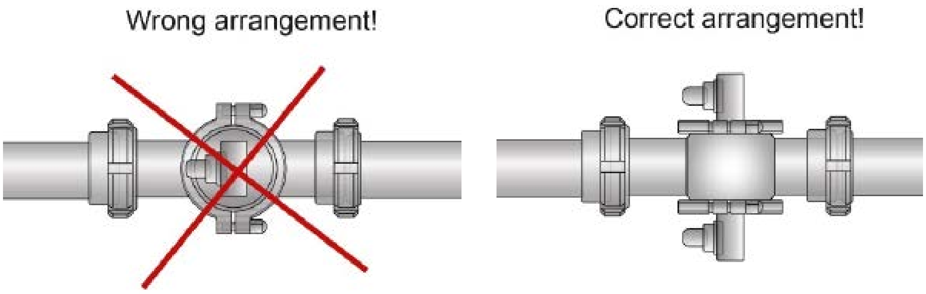


Abb. 4-2: Horizontal installation: The drainability of the pipeline must be respected. To ensure this, the FlowCell must not be rotated.

4.2.2 Installing the Evaluation Unit

Note the following points when installing the evaluation unit:

- Position the evaluation unit depending on the length of the HF cable in the vicinity of the microwave probe.
- The evaluation unit has to be protected against vibrations. In some cases, it is advisable to set up the evaluation unit on a stand separated from the pipeline system.
- For instrument installation you should foresee a cutoff device to allow easy and quick disconnection of the device from the power supply.
- Provide an automatic separating device (line circuit breaker) that disconnects the unit from power within 0.03 seconds in case of failure. The separating device must be matched to the cable cross-section of the supply line, but at least it must be designed for 1 A continuous current.
- When installing the evaluation unit on a crystallizer, use a distance rail to minimize the thermal radiation and conduction. See Figure 4-3:
- For outdoor applications, the evaluation unit must be protected from direct sunlight and rain, for example by a suitable shelter.

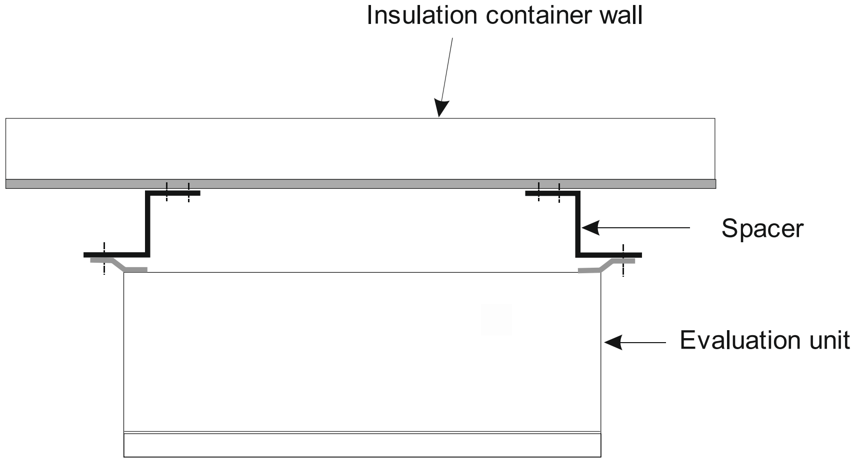


Figure 4-3: View from above: Installation of the evaluation unit on a hot container wall

4.2.3 Connecting the HF Cable

The flow cell is connected with the evaluation unit via the HF cables. Two different options are available:

Version 1:	1 x HF cable quad and 1 x N-connector
Version 2:	2 x HF cables (as signal cable)
	1 x HF cable (as reference cable)

The decision for a certain cable version is taken by Berthold Technologies in the planning stage. It is subject to the application and the desired distance between evaluation unit and flow cell.

Prerequisite for a correct measurement is the correct installation of cables! Please keep in mind:

TIP

Make sure the cable does not get into contact with hot pipes over the entire length (corrugated tube and single cable section after splitting), e.g. direct contact with the device wall (not insulated). This will ensure that all individual cables are exposed to the same ambient conditions and that the compensation of the cable drift works properly.

NOTICE

Never bend the HF cable! The bending radius should not be less than 100 mm. Fix the HF cable with cable binders or other suitable means, so that the cable cannot slip anymore!

Version 1

The HF cable quad and the HF connectors on the evaluation unit are labeled. Connect the flow cell to the evaluation unit as shown in Figure 4-4; only cables with identical labeling can be combined. The two connections on the flow cell are not labeled, the assignment of both cable connectors M-Tx and M-Rx is arbitrary. Connect the cable connectors R-Tx and R-Mx with the N-connector (short-circuited).

Version 2

Connect the flow cell to the evaluation unit as shown in Figure 4-5; make sure that the reference cable (ring line) is connected to R-Tx and R-Mx.

The reference cable must be as long as the sum of both signal cables.

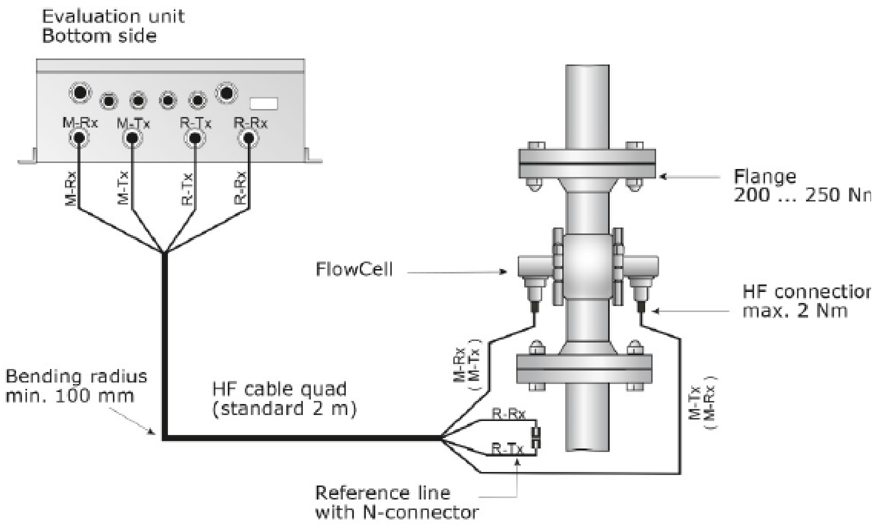


Figure 4-4: Flow cell connection, version 1

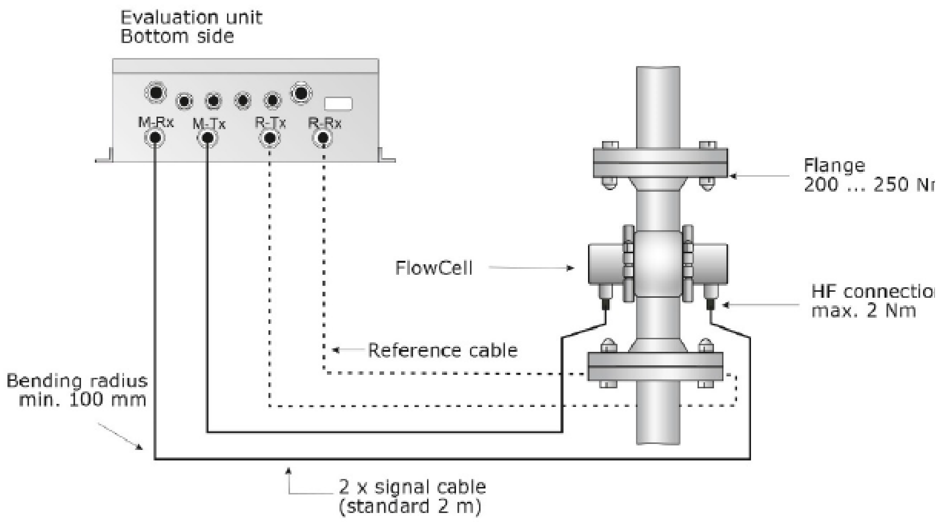


Figure 4-5: Flow cell connection, version 2

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.**

Check occasionally 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 with plastic caps and the cable connectors have to be protected against moisture and dirt.

4.3 Commissioning the Conveyor Belt

4.3.1 Components

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

- a pair of horn antennas (see *chapter 3.7.3*) or
- a pair of spiral antennas (see *chapter 3.7.3*)
- an evaluation unit
- two HF antenna cables and one HF reference cable

If **load compensation** is required due to varying bulk density (at constant moisture) or layer thickness, the corresponding compensation signals are passed into the evaluation unit via current inputs. The compensation devices must meet certain conditions, which are described in this chapter. Possible compensation devices are:

- Layer thickness sensor
- Belt weigher

4.3.2 Measuring Geometry and Conditions

Bulk goods are conveyed on a belt. The material first passes the layer thickness sensor or the belt weigher to determine the layer thickness or the weight and then (or simultaneously) the microwave measuring path to measure the moisture content. If the belt weigher is set up more than 5 m before or after the microwave measuring path, one has to check whether the belt weigher signal has to be synchronized (see *chapter 3.6 Synchronization of the Input Signals*).

To make sure that the compensation and microwave measurements always measure the same material, the product surface must be as flat as possible over a width of at least 350 mm (500 mm if a belt is reinforced with steel ropes). The following descriptions explain this measuring condition.

1. Measuring condition: Required material profile

The product surface must be flat over a **width of at least 350 mm** (see Figure 4-6). No gaps or slots in the product This is absolutely essential to ensure that the microwave irradiation field always sees the same material layer and the layer thickness sensor correlates with the microwave measurement.

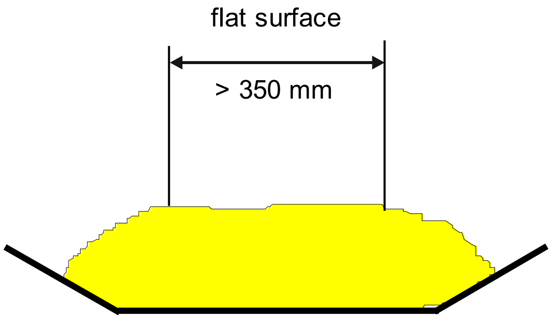


Figure 4-6:
Flat surface in the beam range

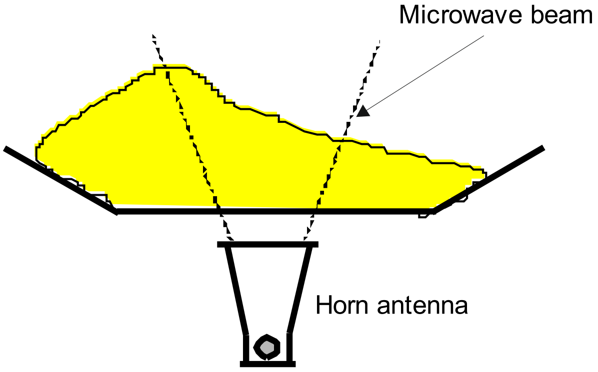


Figure 4-7:
Case study 1:
The microwaves continuously irradiate a different material layer.

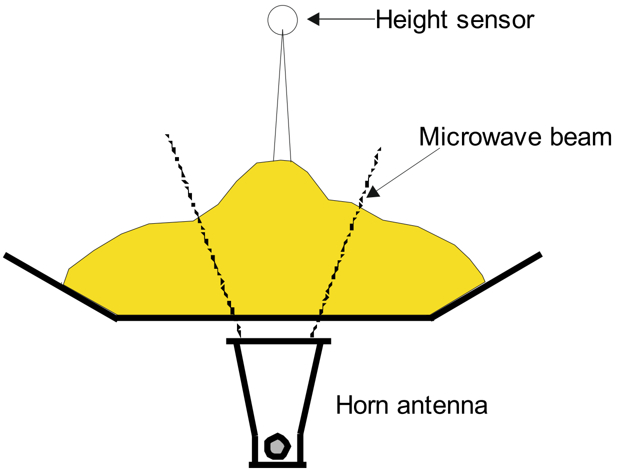


Figure 4-8:
Case study 2:
Height sensor and microwave measurement do not see the same material layer, thus both measurements do not correlate with each other.

If **a weighing system** is used for **compensation**, then the material cross-section at the weighing system must be rectangular (see Figure 4-9). See explanation in *chapter 3.4.3*.

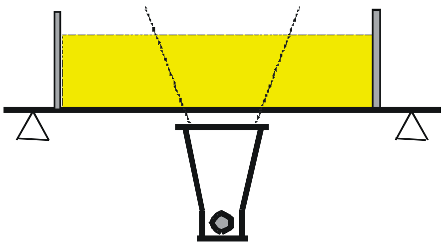


Figure 4-9: Rectangular material cross-section with weighing system

2. Measuring condition: Homogeneous load on the belt

The product must be homogeneous. If the product is not mixed or is asymmetrical on the belt, the moisture reading is not representative and the sampling (e.g. for calibration) can be incorrect, see Figure 4-10.

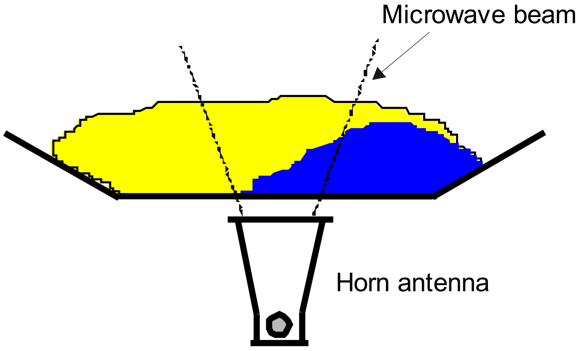


Figure 4-10: Two different products (e.g. through different moistures) cannot be mixed and filled asymmetrically.

3. Measuring condition: electrically conductive materials

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

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

Steel-enforced belts are a special case, 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:

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

where:

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

4.3.3 Installing the Horn Antennas

The antenna pair and the height sensor (if required) are mounted on a stable frame. The transmitting antenna has to be installed below the receiving antenna above the belt. The height sensor is installed before the moisture measurement, viewed in the conveying direction. See also Figure 4-11 and *chapter 8.5 Installation Proposal on the Conveyor Belt*.

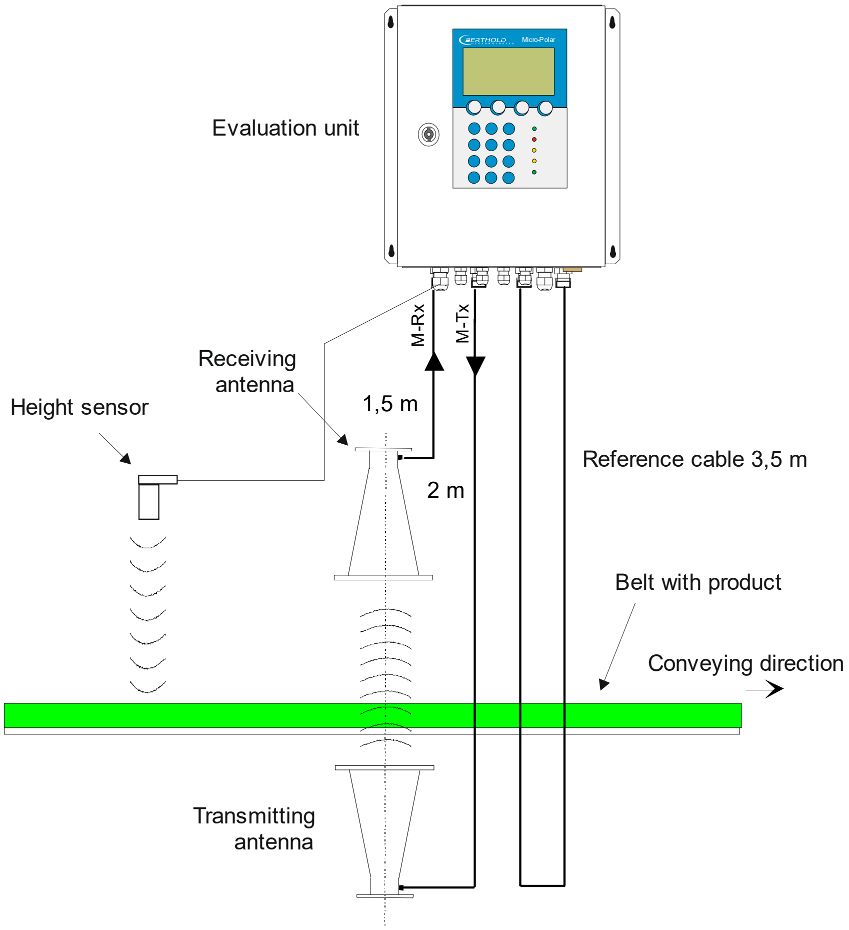


Figure 4-11: Installation of the horn antennas and height sensor on a non steel reinforced belt (with sample values)

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 always be installed below, the receiving antenna, above the conveyor belt. Depending on the layer thickness and the water content, less radiation will then get outside the material flow.
- 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 antennae 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. Firmly tighten the cable connector with the spigot nut. 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 area weight measurement is available.

Exception: Oblique transmission

Typically, the horn antennae 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 Figure 4-13) will be specified by Berthold Technologies.

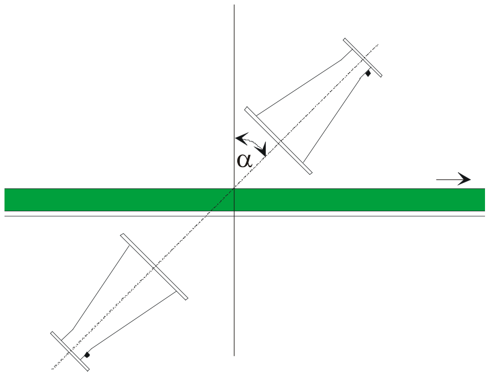


Figure 4-12: Setup for oblique transmission. The angle will be defined by Berthold Technologies

Oblique irradiation is a better choice only in exceptional cases. In case of strong reflection, the interference of the reflected wave can be reduced.

A too large angle α would cause refraction and the transmitted waves may propagate aside the receiving antenna.

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 Figure 4-13 and 4-14.

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).

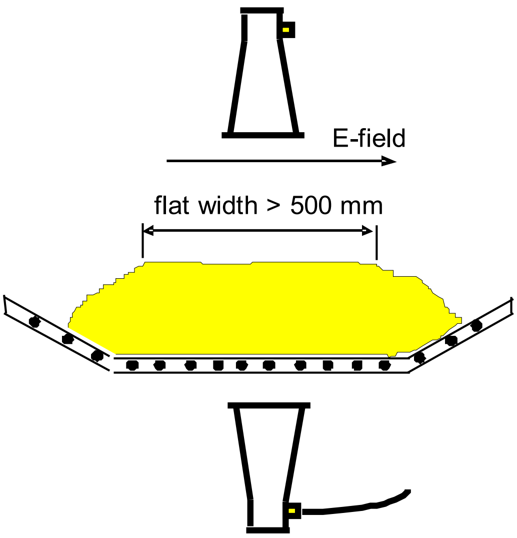


Figure 4-13: Setup of the horn antennas with steel-reinforced conveyor belt

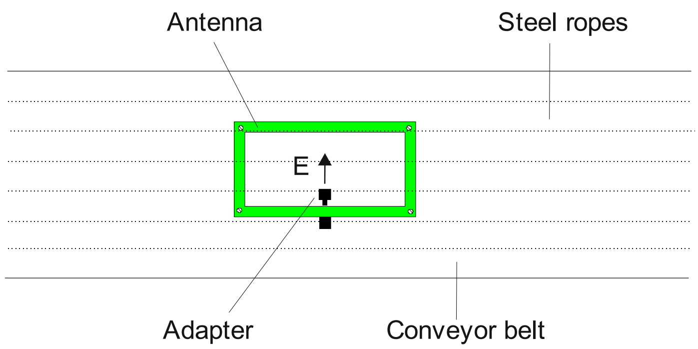


Figure 4-14: Alignment of the antenna on a belt with parallel running steel ropes

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.

4.3.4 Installing the Spiral Antennas

The antenna pair and the height sensor (if required) are mounted on a stable frame. The transmitting antenna has to be installed below the receiving antenna above the belt. The height sensor is installed before the moisture measurement, viewed in the conveying direction. See Figure 4-15:

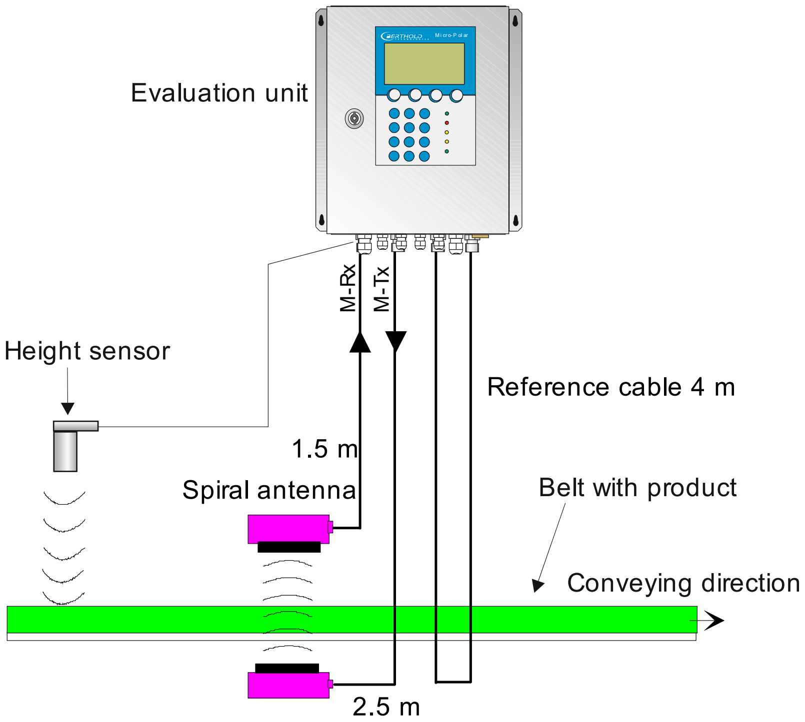


Figure 4-15: Measurement setup on a conveyor belt with spiral antennas. (with sample values)

Setup of the Spiral Antennas

- Install both antennas in diametrically opposite locations
- Typical antenna distances are approx. 10 to 70 cm.
- The connection may face any direction.
- The spiral antennas must be installed at a 90° angle to the material.
- The spiral antennas should be installed at least 10 cm above the max. loading level.
- Select the installation site of the spiral antennas such that they will not be affected by dirt.
- The length of the reference path normally corresponds to the sum of the length of both antenna cables and has to follow the same way as long as possible.

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

4.3.5 Synchronization

If a weight/throughput signal for load 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. 4-2**

where:

v = belt speed [m/s]

Max. distance

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

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

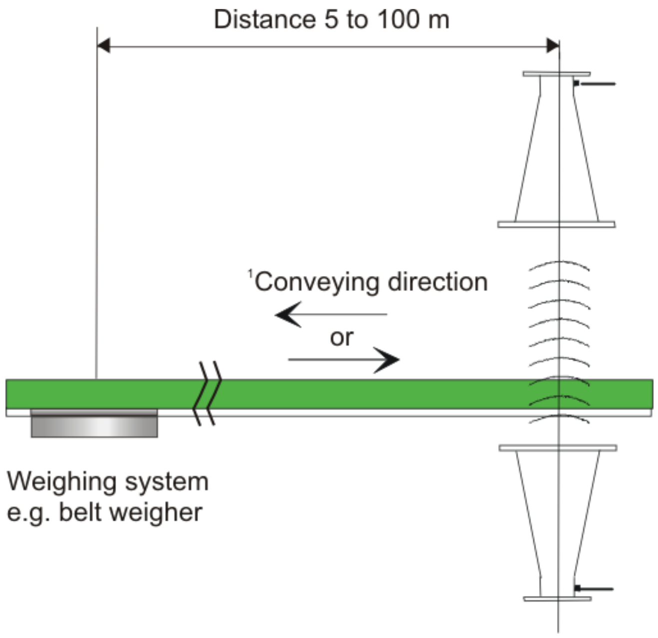


Figure 4-16: Synchronized belt weigher signal

[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.

4.3.6 Installing the Evaluation Unit

Installation of the evaluation unit as described in chapter 4.2.2.

4.3.7 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.

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.

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.

Check occasionally 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.

4.4 Commissioning the Chute

The moisture measurement on a chute is done using a fully assembled measurement configuration with horn antennas. See also *Figure 3-20 Typical measurement setup*.

4.4.1 Components

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

- a pair of horn antennas (see *chapter 3.7.4*)
- a measuring chute, including assembly plate and horn antenna holders
- an evaluation unit
- Two HF antenna cable, one HF reference cable and two RF angle connectors

4.4.2 Measuring Geometry and Conditions

1. Measuring condition: electrically conductive materials

No metals or other materials with high conductivity must be set up 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

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. In some cases, it is advisable to accumulate the product, for example by using a slider installed below the chute.

3. Measuring condition: Bulk density

The bulk density must not change with constant moisture.

A varying level in the feeder chute could be a possible cause for the bulk density variation. Please take possible influence factors into account. The measuring error resulting from bulk density variations is proportional to the change.

4. 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 Figure 4-17.

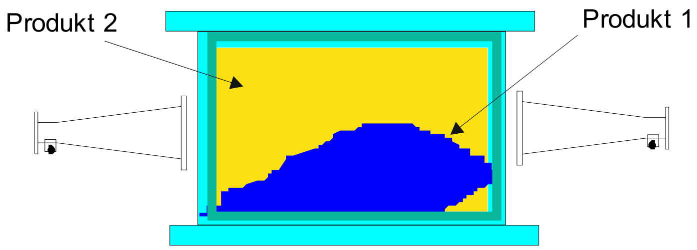


Figure 4-17: Two different products (e.g. through different moistures) cannot be mixed and filled asymmetrically.

4.4.3 Installation

The measuring chute and the horn antennas with their holders are usually mounted on the assembly plate by Berthold Technologies, see *chapter 8.6 Installation Proposal Measuring Chute*.

The measuring chute with assembly plate is installed into the conveyor flow at a suitable location. There must be no chute tapering and fixtures before and after the measuring chute on a length of at least 400 mm. In individual cases, the inlet and outlet pipes can be shortened, the design is done in the project planning stage.

Assemble the components in accordance with the dimensional drawing in *chapter 8.6 Installation Proposal Measuring Chute*. All mounting holes for brackets and measuring chute are provided on the assembly plate so that the measuring path is 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 a stable and vibration-free mounting of the assembly plate. 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 towards the H-field, see Figure 3-14 in *chapter 3.7.4 Measuring Chute*.

The terminals of the horn antennas should preferably point downwards, so that they are better protected.

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

4.4.4 Installing the Evaluation Unit

Installation of the evaluation unit as described in *chapter 4.2.2*.

4.4.5 Connecting the HF Cable

Connection of the HF cables as described in *chapter 4.2.3*.

4.5 Connecting the Evaluation Unit

⚠ WARNING

Electrical hazards:

Disconnect power to rule out any contact with live parts during installation and servicing.
Turn off power before opening the instrument.
NEVER work on open and live instruments.

NOTICE

Caution! Potential hazards, material damage!
Device type:

LB 567-02 MicroPolar 2 (ID no. 41988-02) and

LB 567-12 MicroPolar 2 ++ (ID no. 54563-02)

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

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

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

4.5.1 Pin Configuration of the Connector Strip

The connector strip of the evaluation unit includes the following terminals:

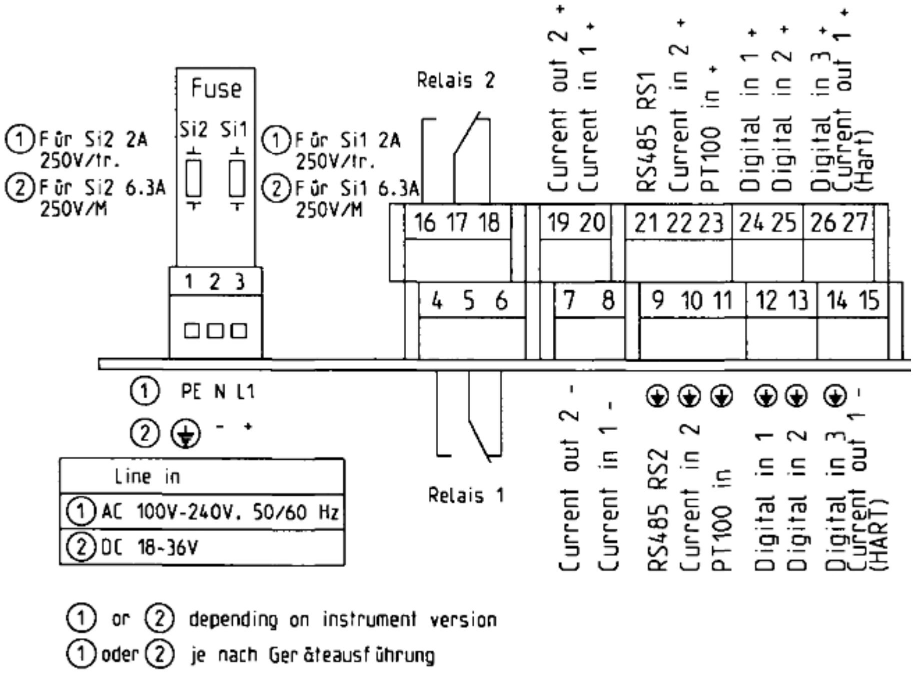


Figure 4-18:
LB 567 wiring diagram

Power supply: Terminals 3 (L1, +), 2 (N, -) and 1 (PE, ⏚)

For MicroPolar 2, depending on device type, see name plate on the housing outer wall.
1.) 100…240 V AC, 50/60 Hz
2.) 24 V DC: 18…36 V, no reverse polarity protection

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

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

Input as 0/4 - 20 mA signal. For example, for temperature compensation or reference signal recording.

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

Output as 4 - 20 mA signal. Output options: Concentrations (1 / 2), current input signals (1 / 2), PT100 signal, mass flow

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

Output as 0/4 - 20 mA signal. Output options same as for current input no. 1.

PT100 (terminals 23+ and 11-)

Connection for temperature measurement. In the case of the container probe, connect the two cable ends of the PT100; polarization is not relevant.

Digital input 1: DI1 (terminals 24+ and 12-)
Only for potential-free contacts! Configuration options:

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

Digital input 2: DI2 (terminals 25+ and 13-)
Only for potential-free contacts! 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-)
Only for potential-free contacts! 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)
Changeover contacts (SPDT), insulated, configuration option:

- No function
- Error message
- Stop measurement
- Limit value min. and max.
- Below load limit

RS485 interface (terminals 21 (RS1) and 9 (RS2)) and
RS232 interface (on instrument underside)

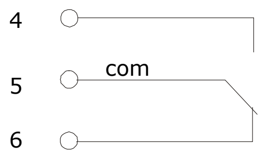
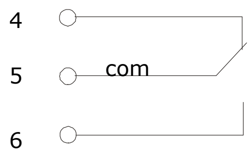
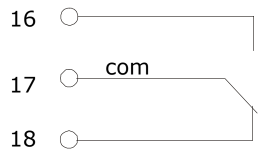
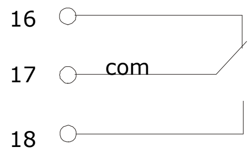
Serial data interface for output of the live data (all readings for every sweep (measuring cycle), the protocol and data logs.
Data format: Data transfer rate 38400 baud, 8 data bits, 1 stop bit, no parity, no handshake

4.5.2 Digital Outputs, Relay

The status of the measurement is output via two relays:

- Error
- Alarm (alarm min. and max.)
- Measurement stopped
- Below load

The respective switching state is also signaled via LEDs on the front panel (LEDs signal 1 and 2).

Relay no.	Error, alarm, no product, measurement stopped, Below load, currentless condition	Normal
1		
2		

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

Chapter 5. **Service instructions**

5.1 General Information

A malfunction of the measuring system is not always due to a defect in the instrument. Often the error is caused by incorrect operation, improper 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 display, indicating operator errors and defects of the electronics.

Defective modules of the evaluation unit cannot usually be repaired but must be replaced. The microwave module is firmly bolted to a screening hood and must not be opened.

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

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

5.2 Wear Parts

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

The PEEK Microwave windows of the FlowCell and the measuring chute may be subject to abrasion over the course of time. A slight to average abrasion affects the measurement only very little and can be compensated for by performing a new calibration. Therefore, check the parts subject to wear in intervals of approx. 2 years. In case of heavy wear, the Microwave windows of the FlowCell and the measuring chute can be replaced on site.

Replacing the Microwave windows of the FlowCell

1. Open the fixing clamp (see fig. 5-1, item 1).
2. Remove the antenna (see fig. 5-1, item 2), the microwave window (see fig. 5-1, item 3) and the sealing O- rings.
3. Attach the new microwave window, the new sealing O-rings and the antenna to the FlowCell with the fixing clamp according to fig. 5-2. HNBR o-ring must be used instead of EPDM o-ring once a fat/grease content of 8 % is exceeded.

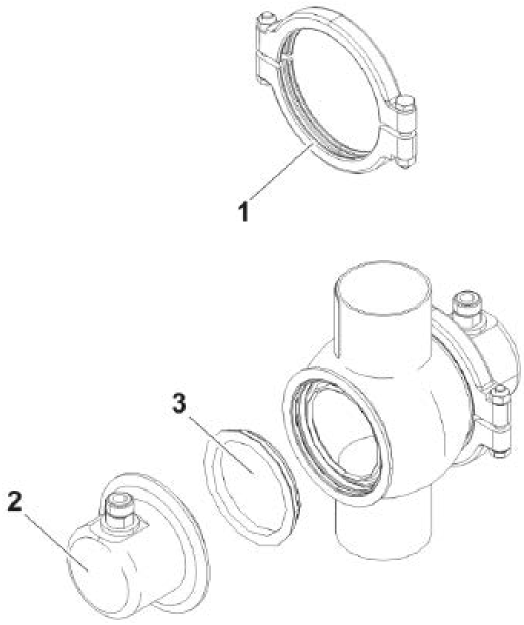


Figure 5-2: Antenna and Microwave window

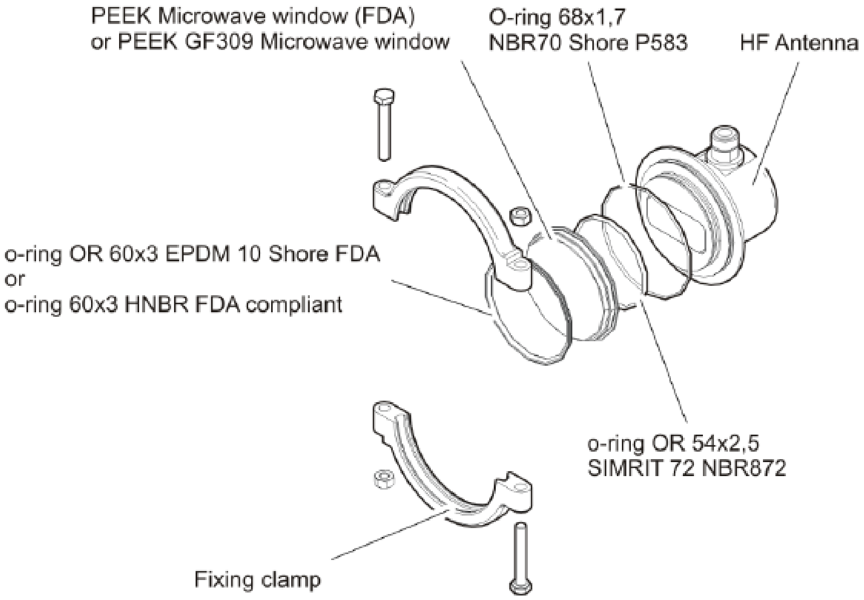


Figure 5-2: Assembly Microwave window

NOTICE	It is recommended to always change the complete set of sealing O-rings.

NOTICE	HNBR o-ring must be used instead of EPDM o-ring once a fat/grease content of 8 % is exceeded.

Microwave windows set for FlowCell	
ID no. 66624-S	2 pieces of PEEK Microwave windows with 6 sealing O-rings
ID no. 66625-S	2 pieces of PEEK Microwave windows GF30 glass fibre reinforced with 6 sealing O-rings
ID no. 75514-S	2 pieces of PEEK EHEDG Microwave windows with 8 sealing O-rings

5.3 Instrument Cleaning

Clean all system components exclusively with a damp cloth with no chemical cleaning agent. Parts coming into contact with the product (during regular operation) can be cleaned with warm water, taking into account the temperature limits, see *chapter 6.2 Technical Data Sensors*.

5.4 Battery

If the measuring system LB 567 is a long time without power supply (power failure or disconnected from the mains supply), the system clock is powered by the lithium battery on the motherboard.
If the battery voltage is no longer sufficient, the error message CODE 14 "Battery voltage" appears after a restart of the evaluation unit. After acknowledging the error message, the unit continues to work properly; however, the date and time should be checked and corrected, if necessary. Measurement data that are output via a serial interface can be fatally damaged by incorrect date and time information. We recommend changing the batteries immediately.
The service life of the battery, even under continuous stress, is approximately 8 years. Replacement of batteries must be carried out in a device disconnected from mains.
Battery type: 3 Volt lithium cell (button cell), type CR2032

5.5 Fuse Replacement

The mains fuses of the LB 567 are located in the wall housing. Replace the fuses only if the instrument is disconnected from mains.
Use only fuses with the correct rating, see *chapter 6.1*

NOTICE

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

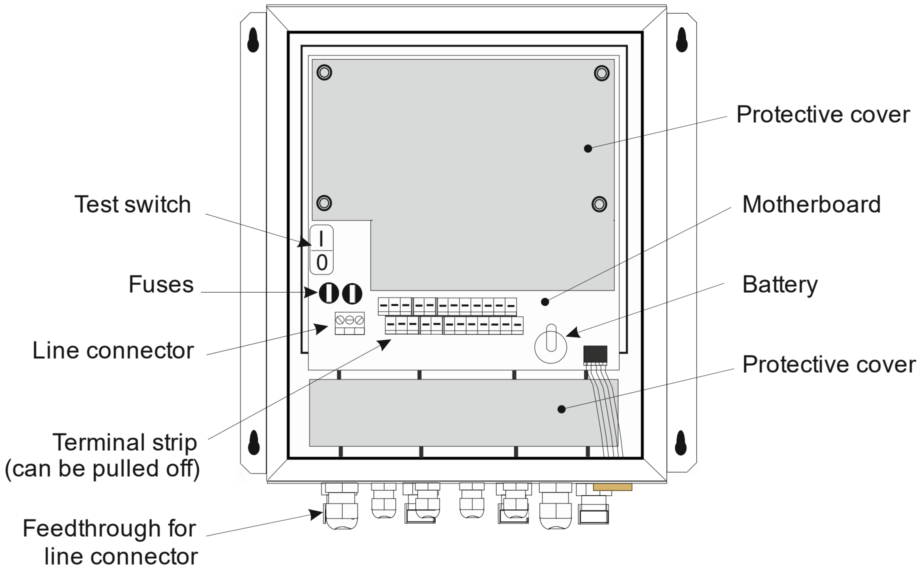


Figure 5-3: View with open housing wall MicroPolar 2

Chapter 6. **Technical Data**

General specifications	
Method	Microwave transmission measurement
Transmission power	< 1 mW (< 0 dBm) coaxial line power
Application	Concentration / moisture measurement in pipelines, 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 8* HxWxD: 400 x 338 x 170 mm
Protection type	IP 65
Weight	approx. 8.0 kg
Ambient conditions during operation	Relative humidity: max. 85 %, short-term up to 100 %, no condensation Altitude: max. 2000 m MicroPolar 2: -20 ... +50 °C (253...323 K) MicroPolar 2 ++: -20 ... +45 °C (253...318 K)
Ambient conditions during storage	-20 ... +70 °C (253...343 K) Relative humidity: max. 85 %, short-term up to 100 %, no condensation
Achievable accuracy	≤ 0.1 weight % (standard deviation) depending on product and sensor
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 device type: 1.) 100 ... 240 V AC, 50/60 Hz 2.) 24 V DC: 18 ... 36 V, reverse polarity protection
Power consumption	max. (48/60) VA (AC/DC), depending on configuration
Fuses	2 x 2.0 A / 250 V / T at 100 … 240 V AC; ID no. 4403 or 2 x 6.3 A / 250 V / M at 18 … 36 V DC; ID no. 4408
Battery type	3 V Lithium button cell, type CR2032 ID no. 17391
Measured value	e.g. concentration, moisture content
Inputs and outputs	
Cable cross-section	min. 1.0 mm² (mains supply)
Cable feed-through	2 x M20x1.5 for cable 5...14 mm (depending on application) 4 x M16x1.5 for cable 5 ...8 mm (depending on application)
Sensor connection	Inputs and outputs for signal and reference channel, 50 Ω N-socket
HF cable HF cable	Cable lengths: 2, 4, 6 and 10 m; 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 ground 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 measured value or temperature output
PT100 connection	Measuring range: -50 ... +200 °C (223 ... 473 K); measurement tolerance: < 0.4 °C

Digital input	3 x digital inputs (DI1..3), for floating connectors (do not connect to a power supply). Configuration options: DI1: none, measurement start/stop DI2: none, measurement hold, product selection DI3: none, sampling, product selection Function description: 1. Measurement (Start/Stop), open: Measurement stopped, closed: Measurement started and/or measurement running 2. Hold measurement, open: measurement running, closed: measurement stopped, i.e. average values and current output are held 3. Product selection via a DI: open: Product 1 (P1), closed: P2 Product selection via two DI's: DI2 & DI3 open: P1 DI2 closed & DI3 open: P2 DI2 open & DI3 closed: P3 DI2 & DI3 closed: P4 4. Start sampling: open: no actions, closed: single measurement starts
Relay outputs	2 x relays (SPDT), insulated Configuration options: - Collective failure message - Stop measurement - Limit value (min. and max.) - Low load Load capacity: AC: max. 400VA DC: max. 90W AC/DC: max. 250V, max. 2A, non-inductive ≥ 150V: voltage must be grounded The cable used at the relay output must correspond to a mains cable. Restrictions at 24 V AC/DC (DC: 18 ...36 V; AC: 24 V +5 %, -20 %) mains supply, if the ground conductor is not connected to terminal 1 (PE): AC: max. 50 V DC: max. 70 V
Serial interfaces	RS232 on the bottom side RS485 via terminal strip Data format: 38400 Bd, no handshake, 8 data bits, 1 stop bit, no parity

6.2 Technical Data Sensors

FlowCell	
Application	Microwave FlowCell with various nominal diameters and flanges for concentration measurement on pipelines
Material	Inline housing made of stainless steel 1.4404 polished (AISI 316L) Mikrowave windows made of PEEK Product touching sealing made of EPDM
Process coupling	Two versions: 1. Hygiene milk pipe screw connection DIN 11853-1 EHEDG certified 2. Flange according to EN 1092-1/11 (V flange) FDA-approved materials Optional adapter for the V flange version with ASA flange
Process pressure	up to 16 bar (relative)
Temperature range	Product temperature: 10...130 °C (283...403 K) , temporarily up to 140 Ambient temperature: -20...60 °C (253...333 K) Storage temperature: 10...80 °C (283...353 K)
Connections	2 x HF connections: N female, 50 Ω for HF cable with max. 10 m length
Versions	Nominal pipe widths from 50 ... 150 mm
Dimensions	See dimensional drawings in chapter 8.

Overview FlowCells with V flange

Designation	ID no.	Nominal width [mm]	Flange	Pressure [bar]
LB 5660-102-00x	66744-001	50	DN 50 / PN 16	16
LB 5660-202-00x	66744-002	65	DN 65 / PN 16	
LB 5660-302-00x	66744-003	80	DN 80 / PN 16	
LB 5660-402-00x	66744-004	100	DN 100 / PN 16	
LB 5660-502-00x	66744-005	125	DN 125 / PN 16	
LB 5660-602-00x	66744-006	150	DN 150 / PN 16	
LB 5660-402-200 FlowCell Vfl. FDA Immersion cap	66744-031	100	DN 100	
LB 5660-502-200 FlowCell Vfl. FDA Immersion cap	66744-032	125	DN 125	
LB 5660-602-200 FlowCell Vfl. FDA Immersion cap	66744-033	150	DN 150	

Overview FlowCells with Hygiene milk pipe screw connection

Designation	ID no.	Nominal width [mm]	Pressure [bar]
LB 5660-112-00x	66744-013	50	16
LB 5660-212-00x	66744-014	65	
LB 5660-312-00x	66744-015	80	
LB 5660-412-00x	66744-016	100	
LB 5660-512-00x	66744-017	125	
LB 5660-612-00x	66744-018	150	
LB 5660-412-200 G-BS-M Immersion cap (hygienic)	66744-034	100	
LB 5660-512-200 G-BS-M Immersion cap (hygienic)	66744-035	125	
LB 5660-612-200 G-BS-M Immersion cap (hygienic)	66744-036	150	

Overview FlowCells with welding pipe

Designation	ID no.	Nominal width [mm]	Pressure [bar]
LB 5660-132-00X	66744-025	50	
LB 5660-232-00X	66744-026	65	
LB 5660-332-00X	66744-027	80	
LB 5660-432-00X	66744-028	100	
LB 5660-532-00X	66744-029	125	
LB 5660-632-00X	66744-030	150	16
LB 5660-432-200 Immersion cap (hygienic)	66744-037	100	
LB 5660-532-200 Immersion cap (hygienic)	66744-038	125	
LB 5660-532-200 Immersion cap (hygienic)	66744-039	150	

Overwiew Microwave windows set

The microwave windows of the FlowCell are available in a reinforced glass fibres design for applications with a high grade of abrasion. This design is not approved for the food sector.

ID no.	Description
66624-S	2 pieces of PEEK Microwave windows with 6 sealing O-rings
66625-S	2 pieces of PEEK Microwave windows GF30 glass fibre reinforced with 6 sealing O-rings

NOTICE

Probes with PEEK EHEDG Microwave windows can only be used from a nominal width of DN100.

Overview ASA flange adapter

Designation	ID no.
ASA flange adapter set for Flow Cell 50	62324
ASA flange adapter set for Flow Cell 65	62319
ASA flange adapter set for Flow Cell 80	62328
ASA flange adapter set for Flow Cell 100	62331
ASA flange adapter set for Flow Cell 150	62335
The kit consists of two adapters, screws and two seals.	

Overview Inline housing, FDA

for temperature or conductivity sensors or sampling valve

Designation	VFL	G-BS/M
	Id.-Nr.	Id.-Nr.
Inline housing for Flowcell 50	67078	67084
Inline housing for Flowcell 65	67079	67085
Inline housing for Flowcell 80	67080	67086
Inline housing for Flowcell 100	67081	67087
Inline housing for Flowcell 125	67082	67088
Inline housing for Flowcell 150	67083	67089

Overview surface temperature sensor DN 50

Self-adhesive PT100 temperature sensor with fixing material

Connection cable 10 m, 4-wire (loose ends)

Temperature range: -50 - +200 °C

Designation	Id.-Nr.
Self-adhesive temperature sensor for DN 50	66655
Self-adhesive temperature sensor for DN 65	66656
Self-adhesive temperature sensor for DN 80	66657
Self-adhesive temperature sensor for DN 100	66658
Self-adhesive temperature sensor for DN 125	66659
Self-adhesive temperature sensor for DN 150	66660

Overview sensors

Designation	Id.-Nr.
Conductivity sensor hygienic, Clamp-flange Inductive conductivity measuring device for liquid media in hygienic applications Measurement range: 0-999 mS/cm Process connection: Clamp-flange Process pressure: Max. 16 bar Power supply: 18-36 V DC, max. 190 mA Output: 4-20 mA	66693
Temperature sensor EHEDG, Clamp-flange PT100 temperature sensor for hygienic applica- tions Measurement range: -50 - +250 °C Length 20 mm, diameter 4 mm Process connection: Clamp-flange With connection cable 10 m (loose ends)	66694

Overview Sampling valve and accessories

Designation	Id.-Nr.
Sampling valve aseptic, Clamp-flange Aseptic Inline Sampling valve Stainless steel 1.4404 (AISI 316L), bellows PTFE Discharge port S-DN 10 without flushing connection Process connection: Clamp-flange	66738
Clamp-blind flange Clamp-blind flange for Inline housing DN 50- 150 Stainless steel 1.4306 (AISI 304L)	66737
Clamp coupling 1 piece Clamp coupling for Inline housing DN 50-150 Stainless steel 1.4306 (AISI 304L)	66736

6.3 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 8.4.1*
Accessories antenna fixture (ID no.: 10805)	
Material	Galvanized steel
Weight	3.8 kg
Dimensions	See dimensional drawings in *chapter 8.4.1*

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 8.4.2*

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. 57957 2. Polyvinylidene fluoride (PVDF), ID no. on request
Components	- Chute - Assembly plate - two brackets - two HF angle connectors - Fastening material
Weight	Only the chute: Version 1: approx. 10 Kg Version 2: on request Measuring chute, complete: Version 1: approx. 33 Kg Version 2: on request
Temperature range	Environment: 0...60 °C (253...333 K) Storage: 10...80 °C (283...353 K) Product temperature: Version 1: 10...90 °C (283...363 K) Version 2: 10 … 140 °C (283 … 413 K)
Assembly plate, brackets	Material: Stainless steel, galvanized steel
Dimensions	See dimensional drawings in *chapter 8.6*

6.5 Technical Data HF Cable

HF cable Quad	
Material	Corrugated tube: Polyamide (PA6) Cable sheath: Polyethylene (PE)
Protection type	IP 66
Temperature	In operation: -30 ... +70 °C When installing: -20 ... +70 °C

Cable length [m]	ID no.
2	43431
4	43432
6	43433
8	43434
10	43435

HF-Kabel Quad, hygienic	
Material	Corrugated tube: Polyamide (PA6) Cable sheath: Polyethylene (PE)
Protection type	IP 66
Temperature	In operation: -30 ... +70 °C When installing: -20 ... +70 °C

Cable length [m]	ID no.
2	67048
4	67049

HF cable Quad (solid cable)	
Material	Cable sheath: Polyethylene (PE)
Protection type	IP 68 when unscrewed
Temperature	In operation: -40 ... +85 °C When installing: -40 ... +85 °C
Attenuation coefficient	about 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 Format of Serial Data Output RS232 and RS485

Headline

Date·Time→State→Status→Synchronizer→Product→Att→Phi→R2→Tint→IN1→IN2→PT100→
C→Cm→C2→C2m→MF1→MF2

Following lines

01.01.2005·00:00:00→0000→0→0→1→0.43→5.30→0.07→0.00→0.0→0.0→0.0→0.0→
1 2 3 4 5 6 7 8 9 10 11 12 13

75.36→75.00→0.00→0.00→0.000→0.000¶
14 15 16 17 18 19

Column no.	Description	Format
1	Date and time	DD.MM.YY·HH:MM:SS
2	State	4 digits, HEX
3	Status: Information about the quality of the last measurement	0 : Measurement OK < 0 : Error
4	Product synchronization	5: not active 1: still asynchronous 0: all values synchronous -1: Error -2: Time too short for syn. -3: Speed outside range
5	Product number	X (1 to 4)
6	Attenuation [dB]	X.XX
7	Phase [°/GHz]	X.XX
8	Dispersion of the phase regression	X.XX
9	Correlation of the phase regression	X.XX
10	Device temperature [temperature unit]	X.X
11	Current input 1 [unit of current input]	X.X
12	Current input 2 [unit of current input]	X.X
13	PT100 temperature [temperature unit]	X.X
		[...] with selection of the unit g/cm³
14	Concentration 1 live	X.XX [X.XXXX]
15	Concentration 1 averaged	X.XX [X.XXXX]
16	Concentration 2 live	X.XX [X.XXXX]
17	Concentration 2 averaged	X.XX [X.XXXX]
18	Mass flow for concentration 1	X.XXX
19	Mass flow for concentration 2	X.XXX

Special characters

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

Chapter 7. **Certificates**

7.1 EC Declaration of Conformity

BERTHOLD TECHNOLOGIES GmbH & Co.KG

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

CERTIFICATE OF COMPLIANCE

EL Class I

Date of issue: 1 August 2023

Valid until: 31 December 2024

EHEDG hereby declares that the product

microwave sensor FlowCell, type LB5660 with planar and immersion cap windows made of PEEK and EPDM O-ring for ball housings diameter 68 mm

from

Berthold Technologies GmbH & Co.KG, Calmbacher Straße 22 , 75323 Bad Wildbad, Germany

has/have been evaluated for compliance and meets/meet the current criteria for Hygienic Equipment Design of the EHEDG

Certificate No. EHEDG-C2300049

Signed ______________________ *President EHEDG*
Hein Timmerman

Signed ______________________ *EHEDG Certification Officer*
Karlijn Faber

EHEDG
Karspeldreef 8
1101 CJ Amsterdam
Netherlands

7.2 Frequency License

TCB

GRANT OF EQUIPMENT AUTHORIZATION

Certification

Issued Under the Authority of the Federal Communications Commission

By:

TCB

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

Date of Grant: 02/10/2016

Application Dated: 10/07/2015

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

Attention: Dirk Moermann , Dr.

NOT TRANSFERABLE

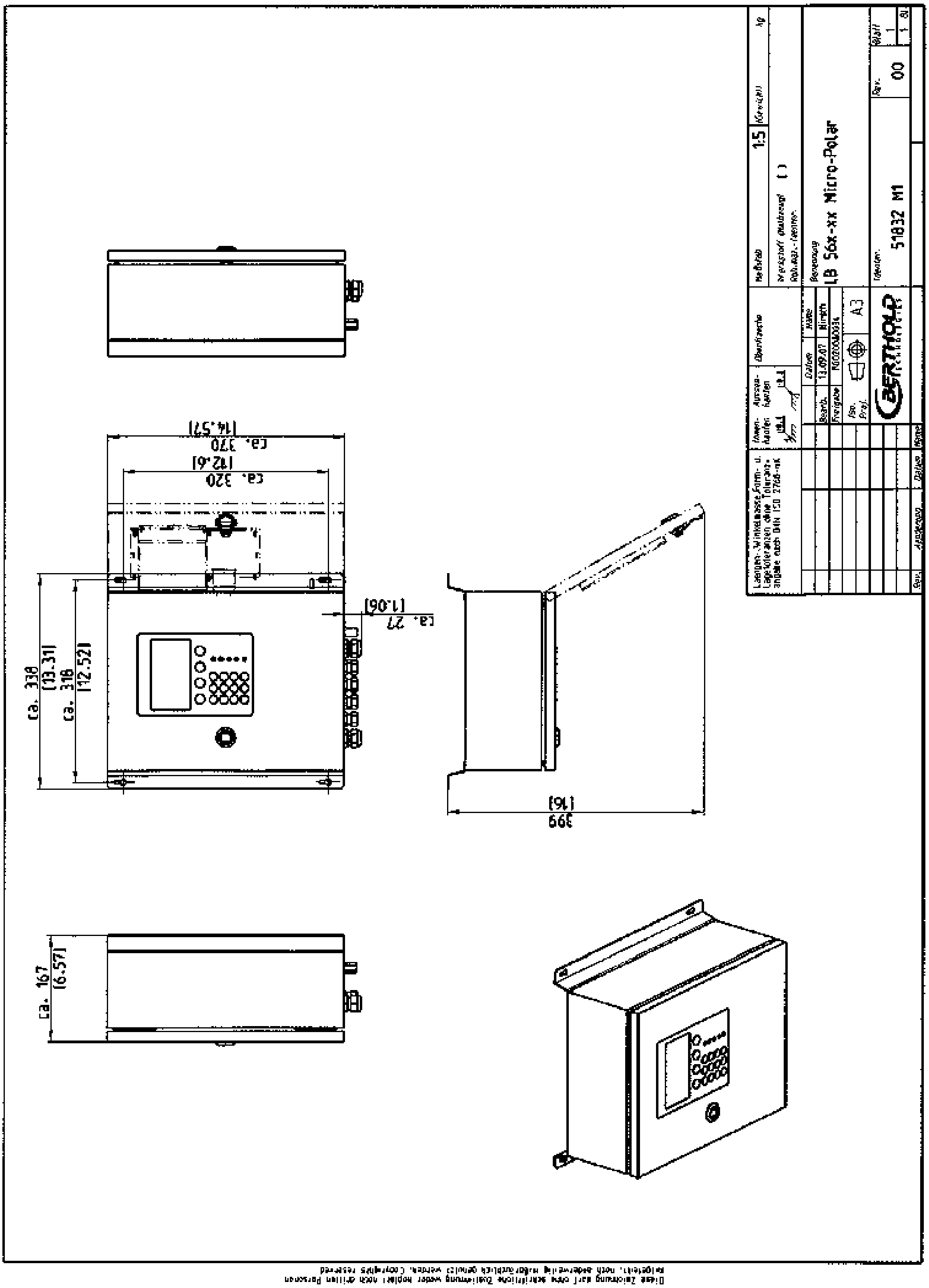
EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

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

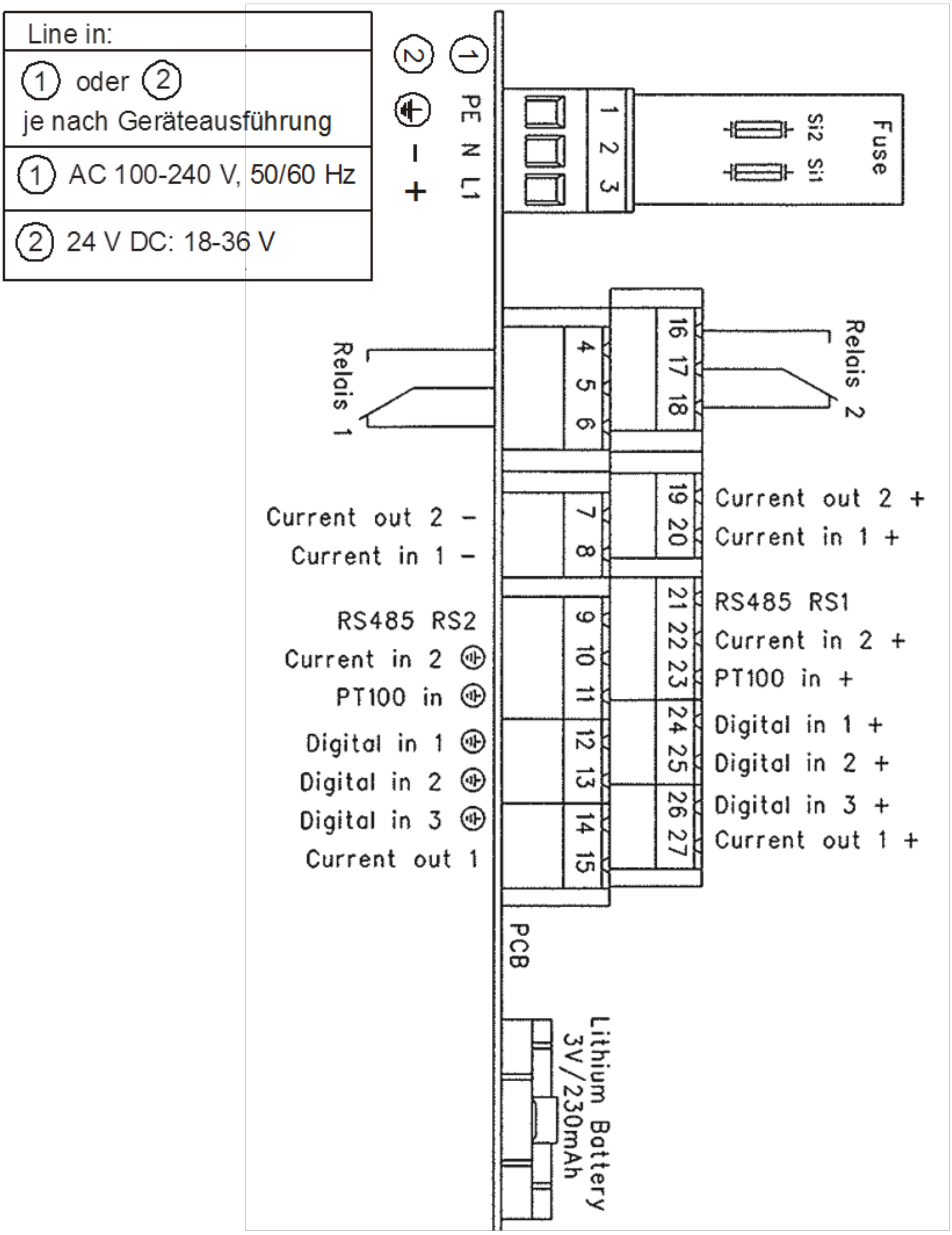
Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	15F	3101.0 - 3881.0	7E-7		

Chapter 8. **Technical Drawings**

8.1 Dimensions Drawings Evaluation Unit Wall Housing

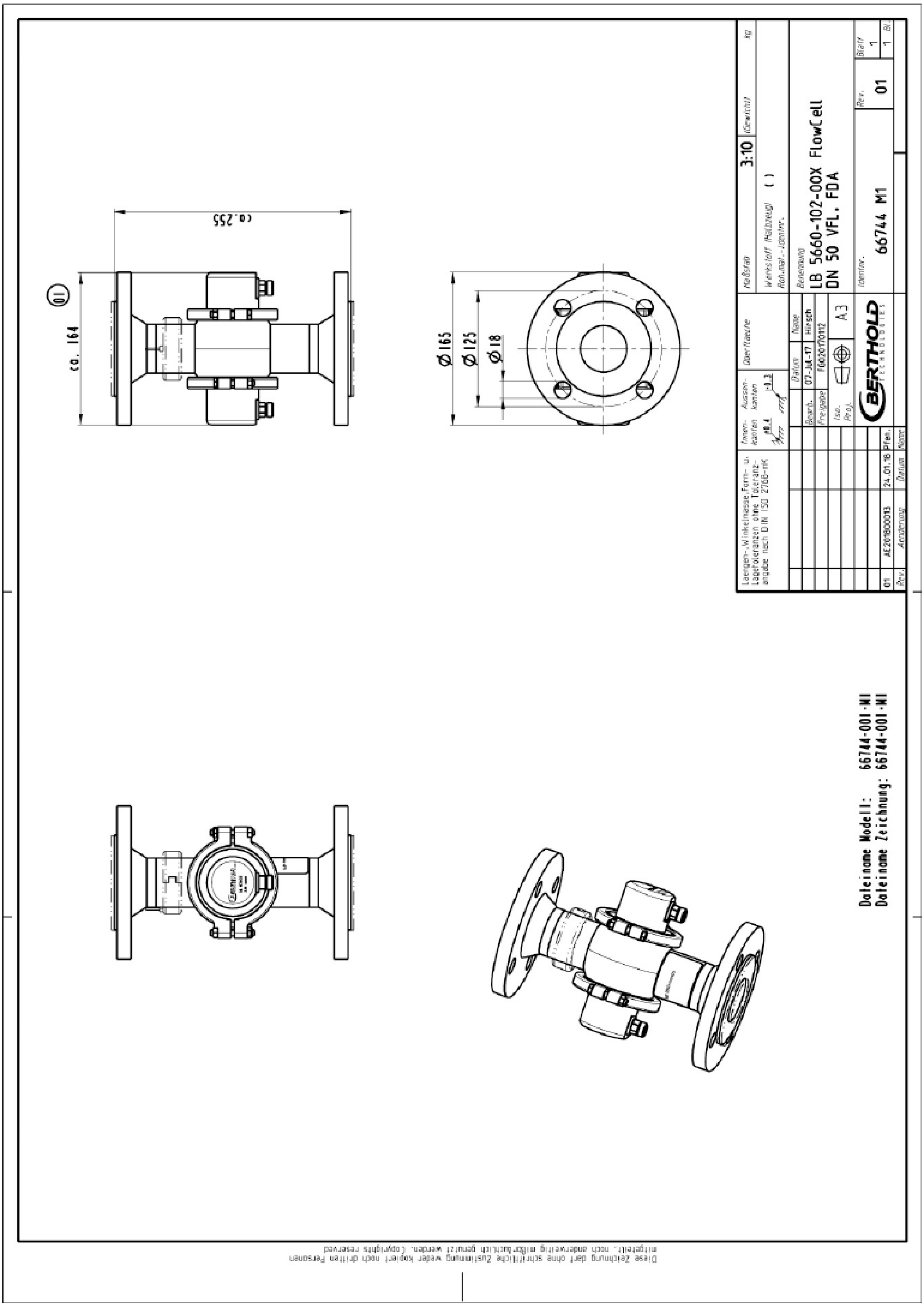


8.2 Electrical Wiring Diagram

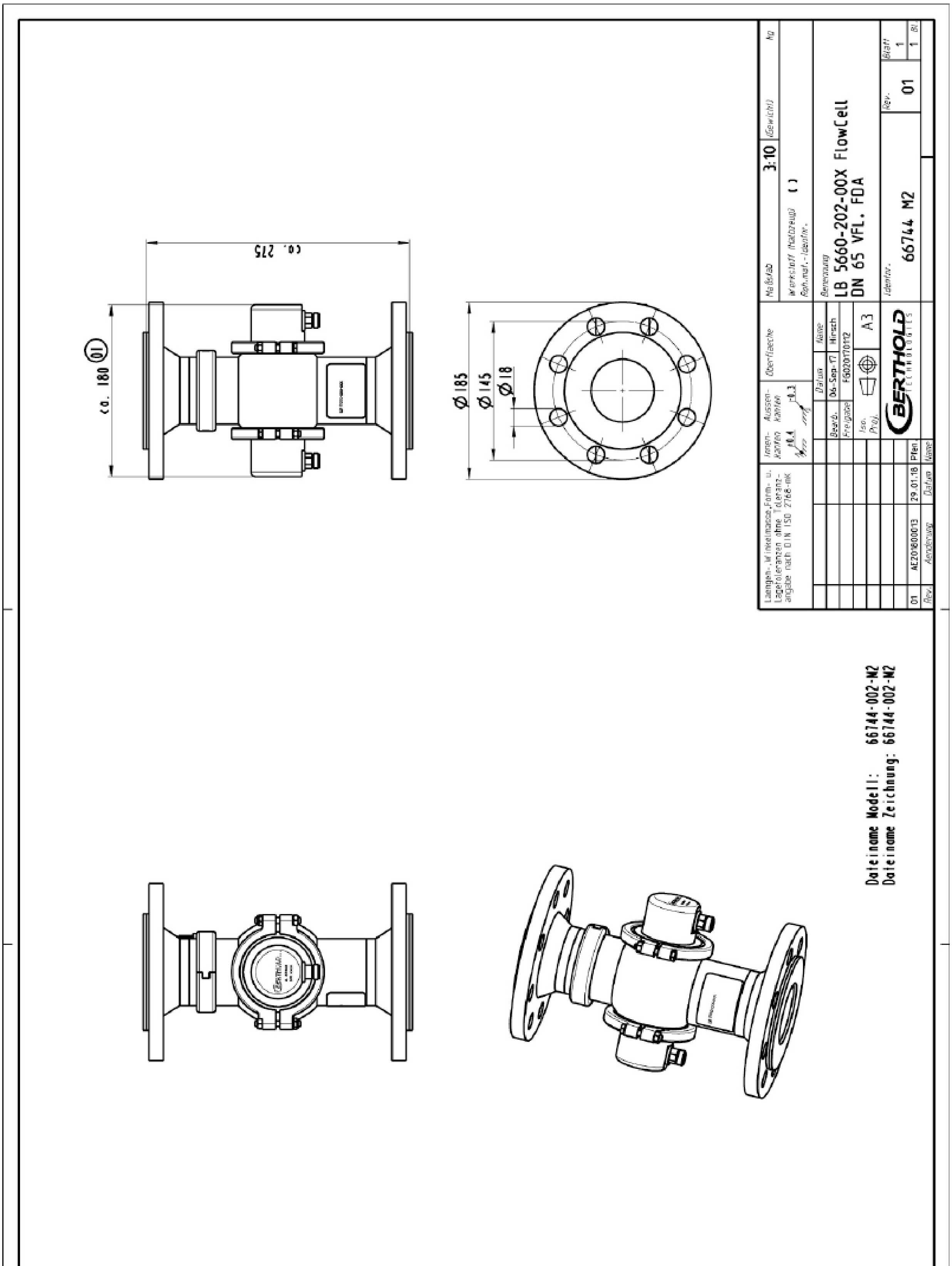


8.3 Dimensional Drawings FlowCell

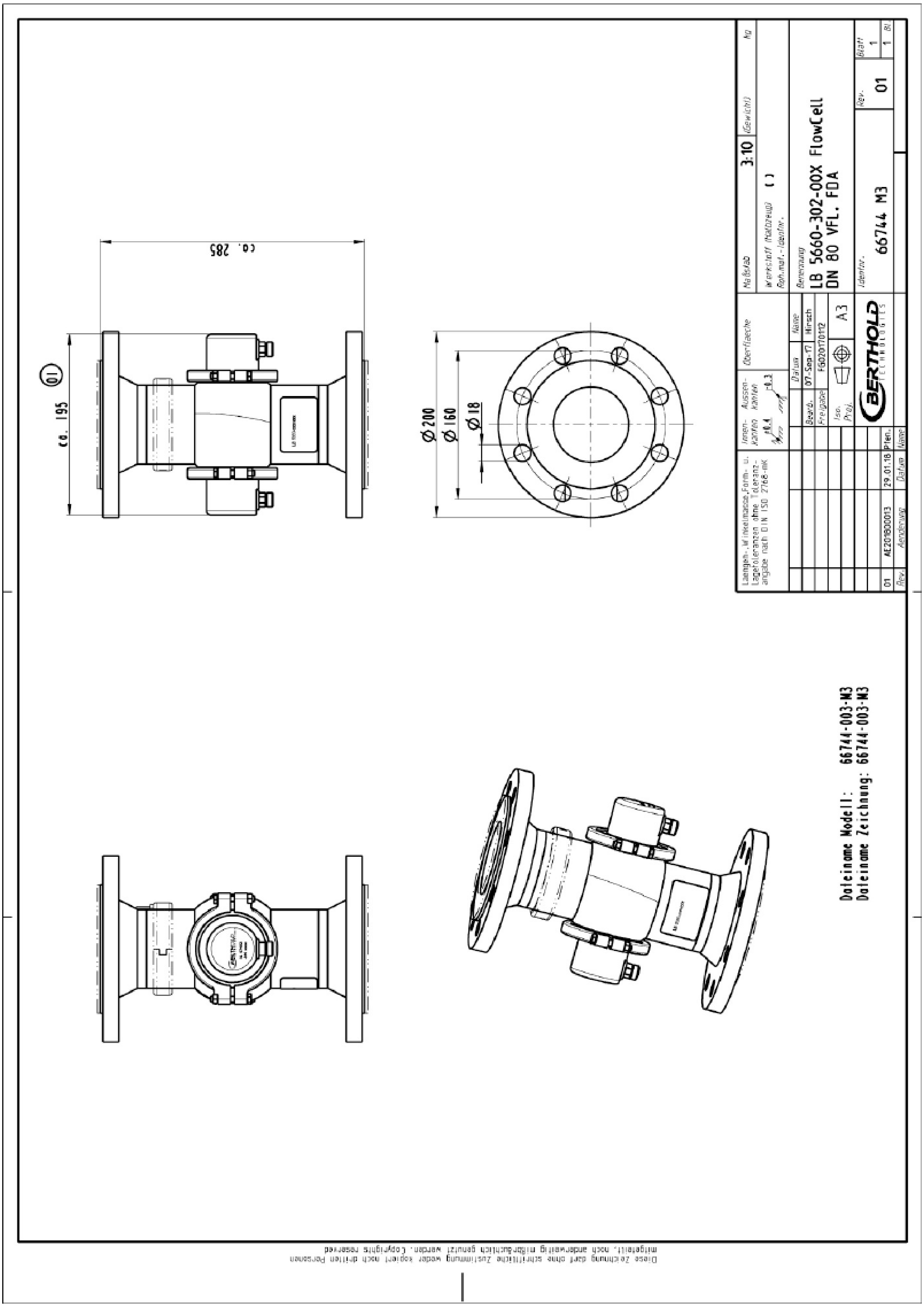
8.3.1 Type LB 5660-102-00X FlowCell DN 50 Flange, FDA



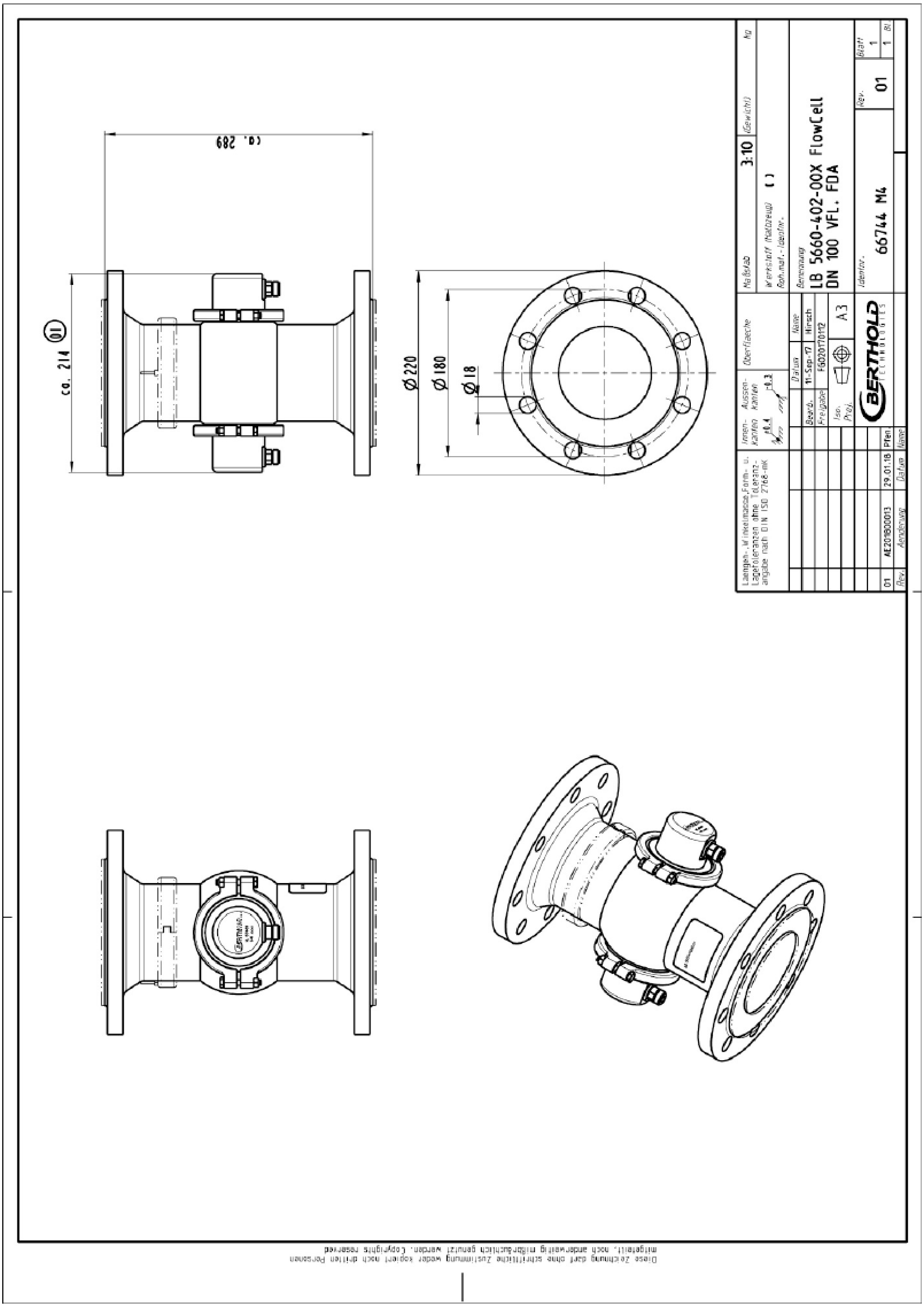
8.3.2 Type LB 5660-202-00X FlowCell DN 65 Flange, FDA



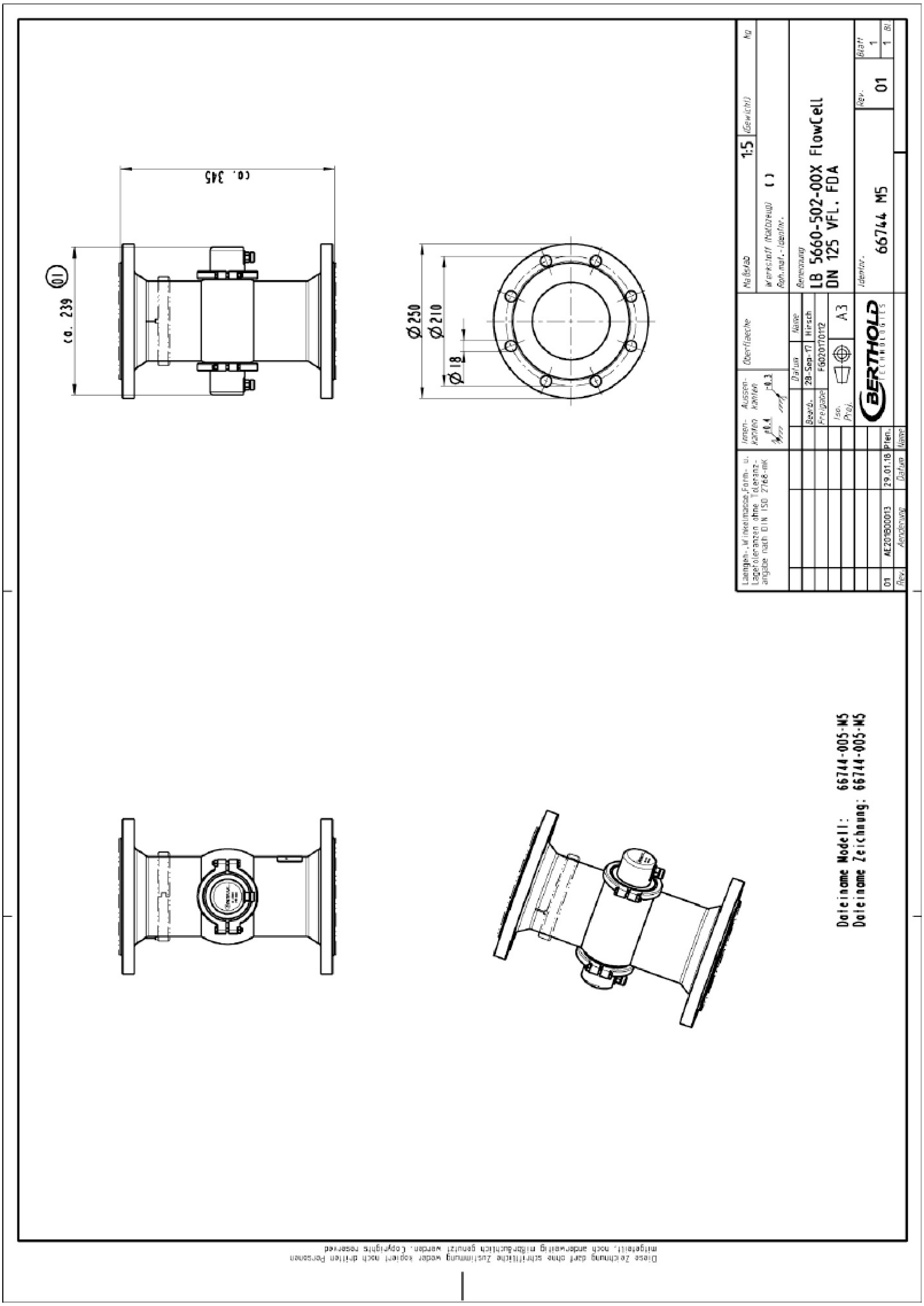
8.3.3 Type LB 5660-302-00X FlowCell DN 80 Flange, FDA



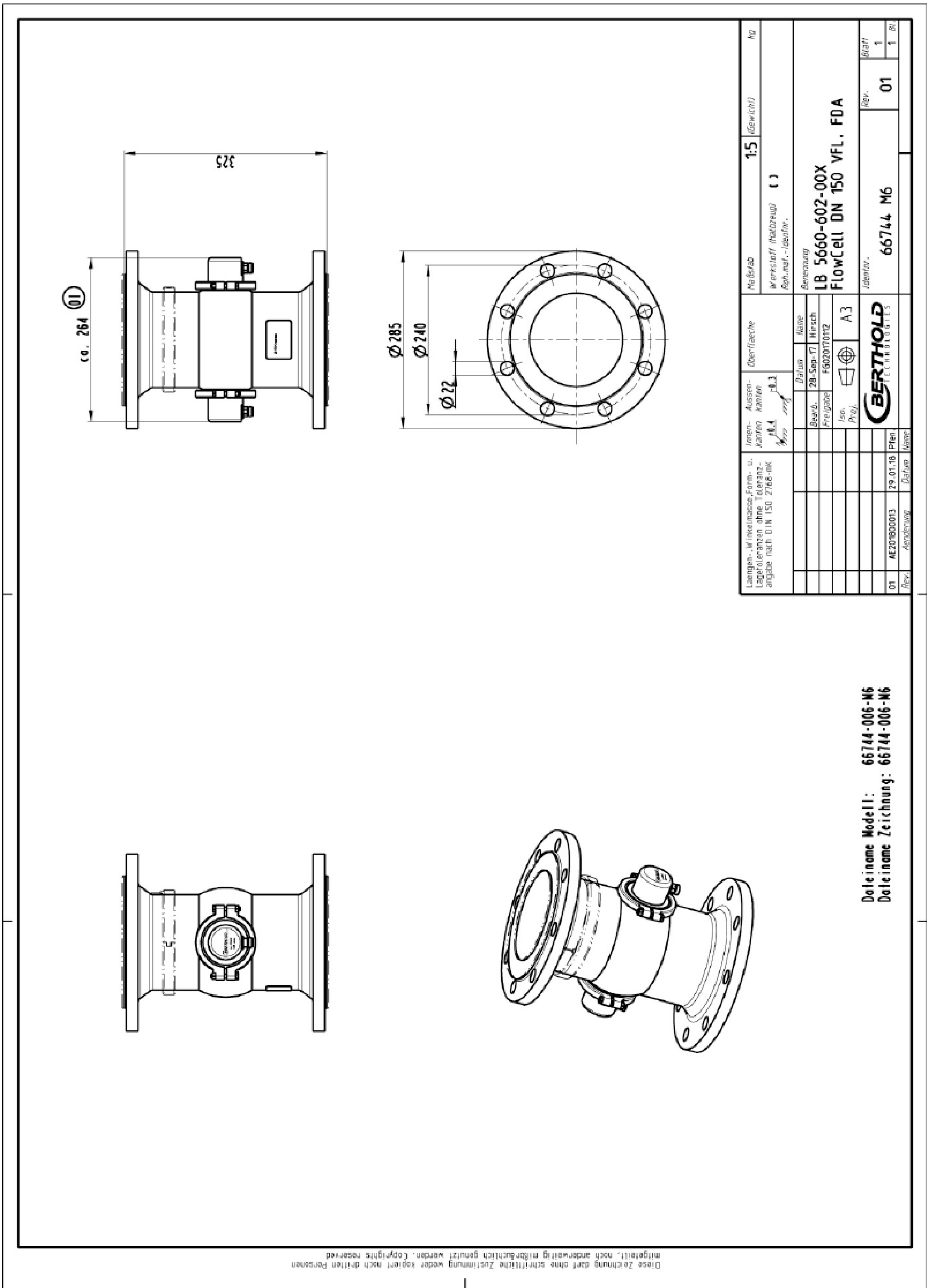
8.3.4 Type LB 5660-402-00X FlowCell DN 100 Flange, FDA



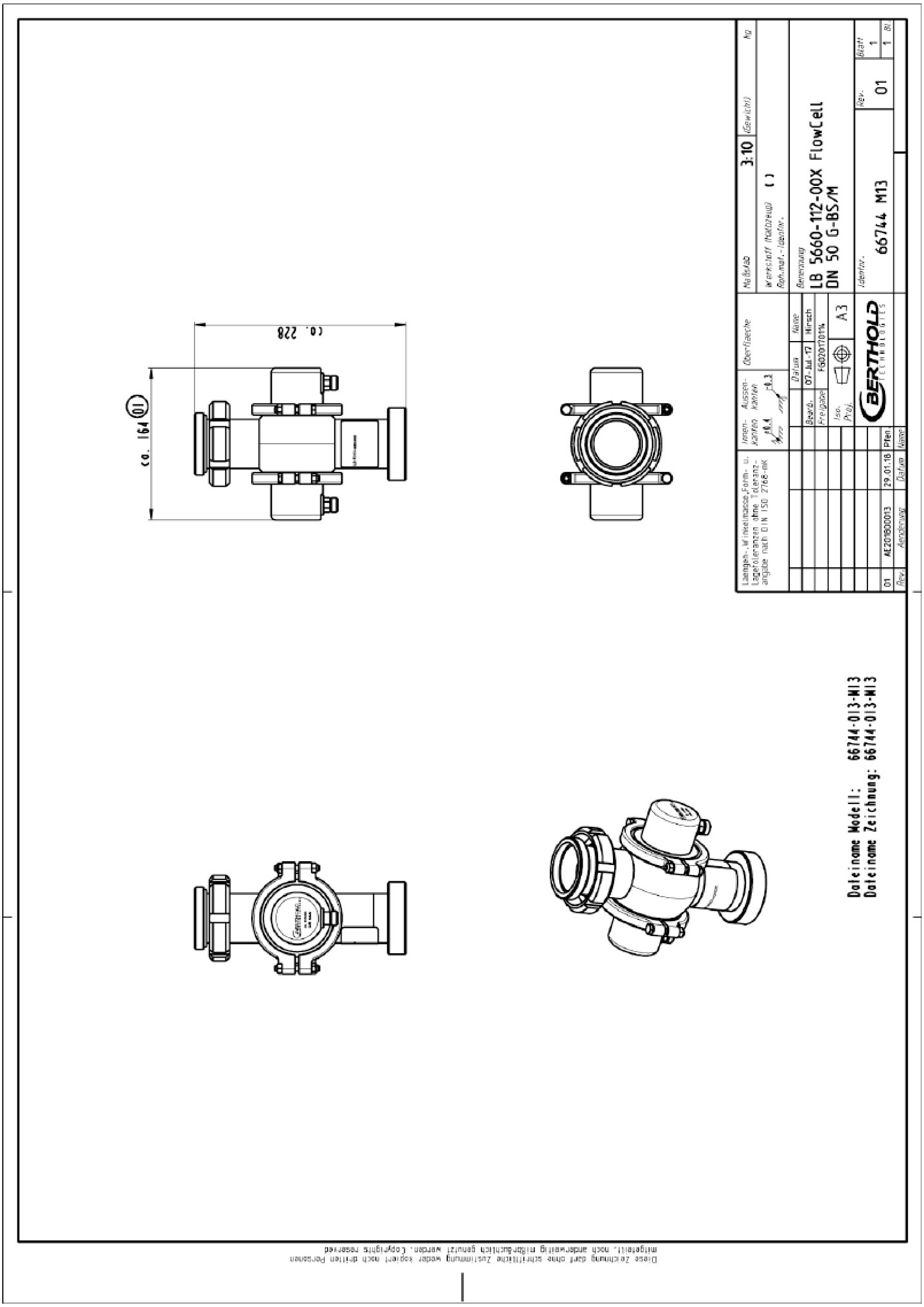
8.3.5 Type LB 5660-502-00X FlowCell DN 125 Flange, FDA



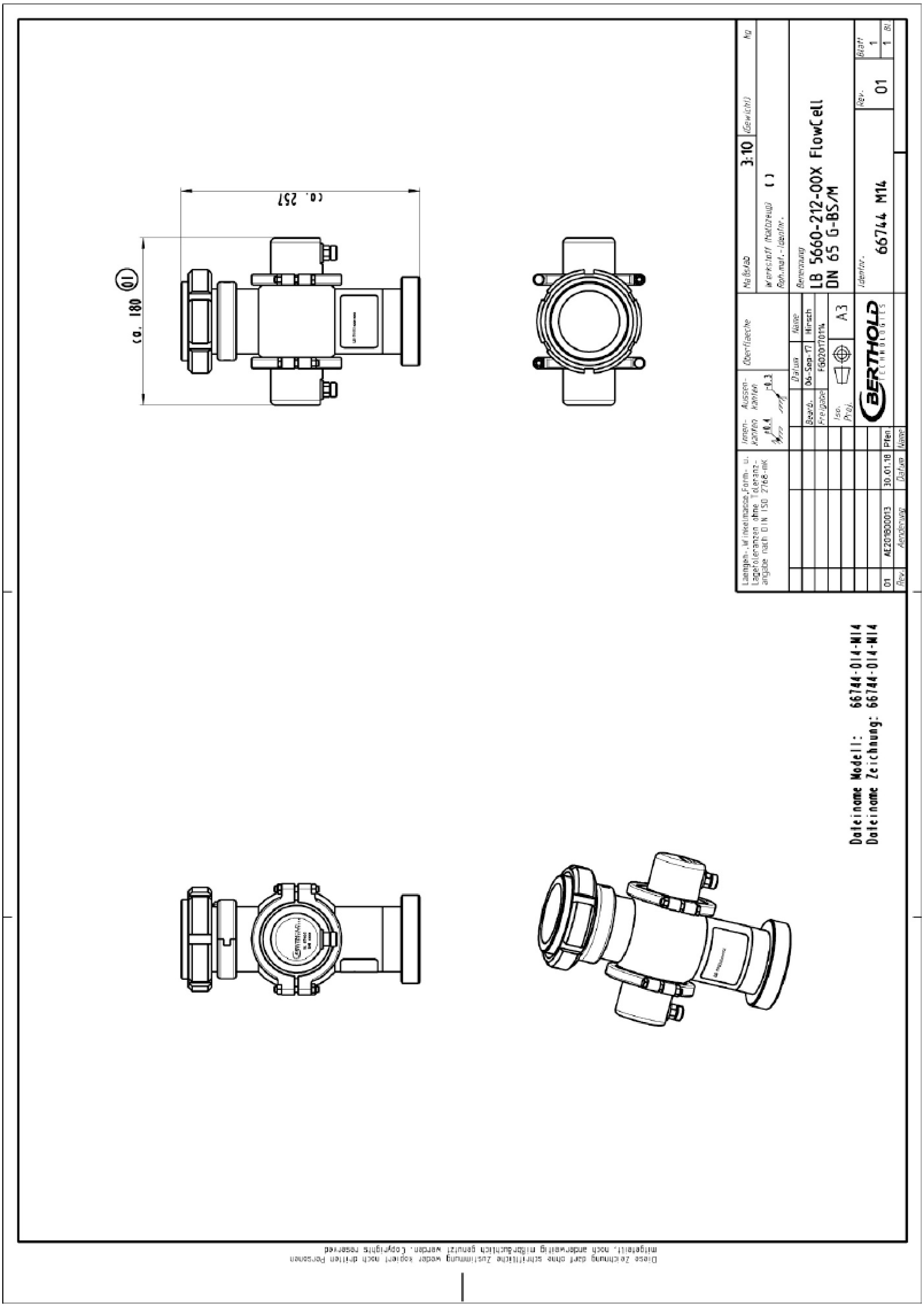
8.3.6 Type LB 5660-602-00X FlowCell DN 150 Flange, FDA



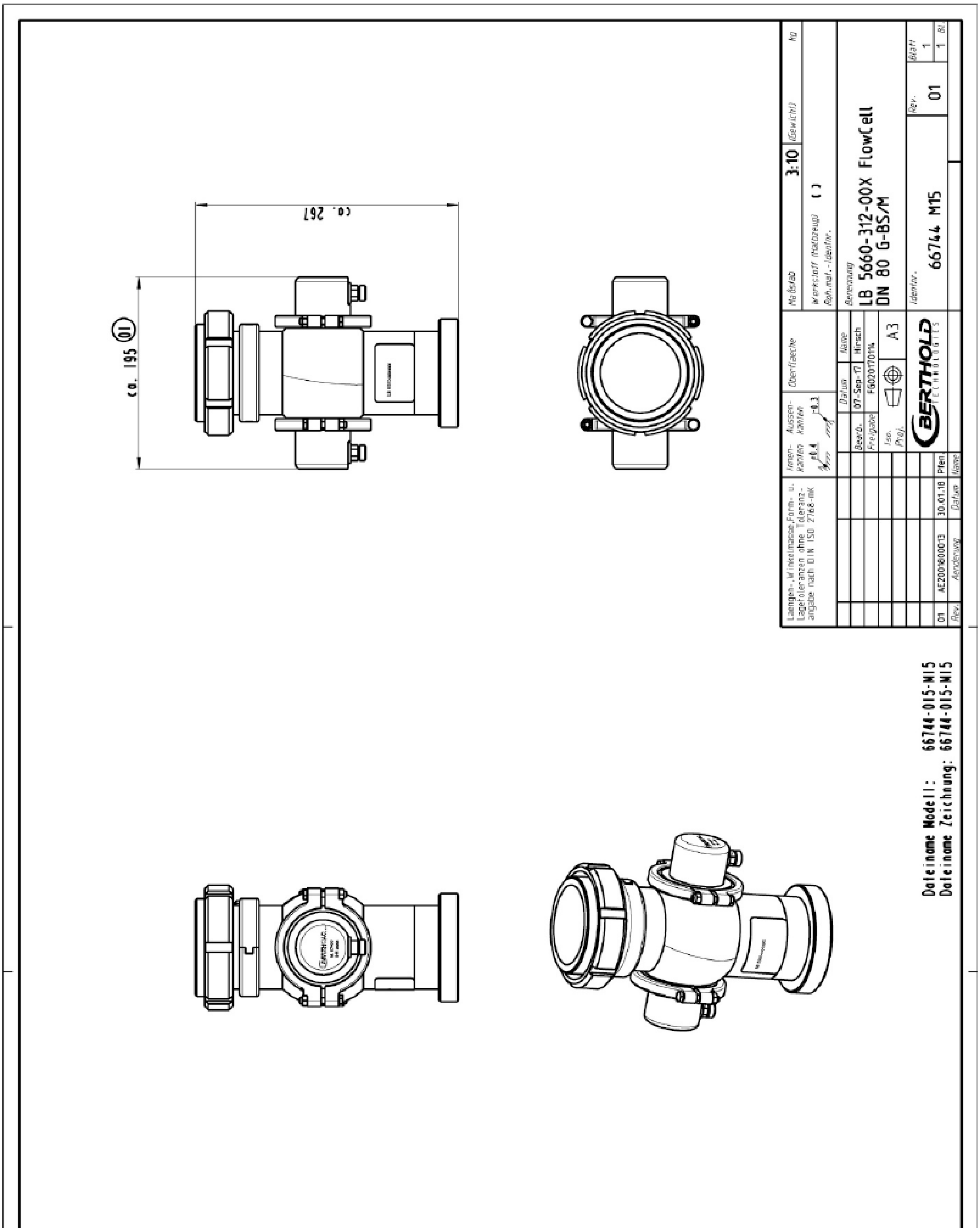
8.3.7 Type LB 5660-112-00X FlowCell DN 50 G-BS/M



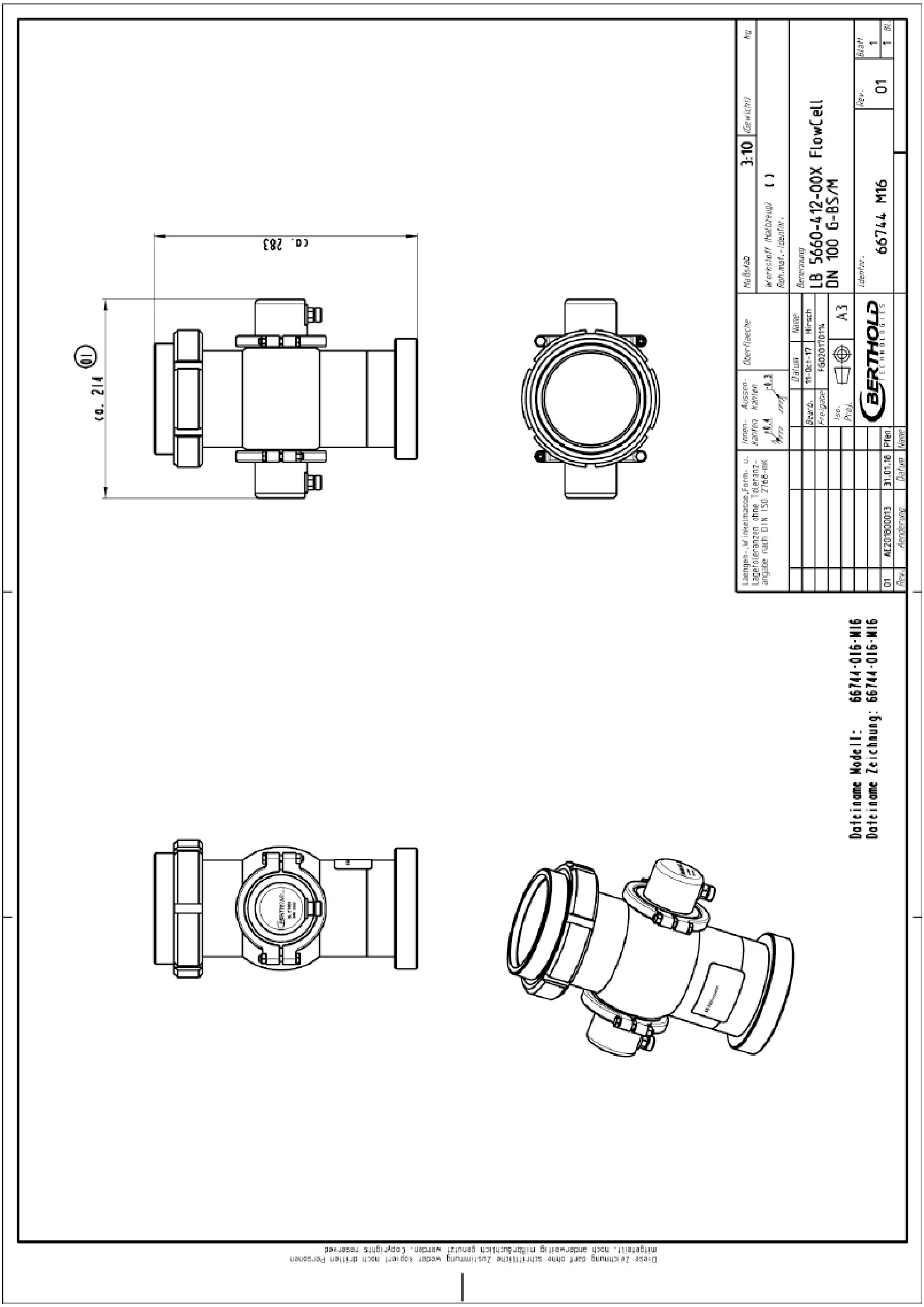
8.3.8 Type LB 5660-212-00X FlowCell DN 65 G-BS/M



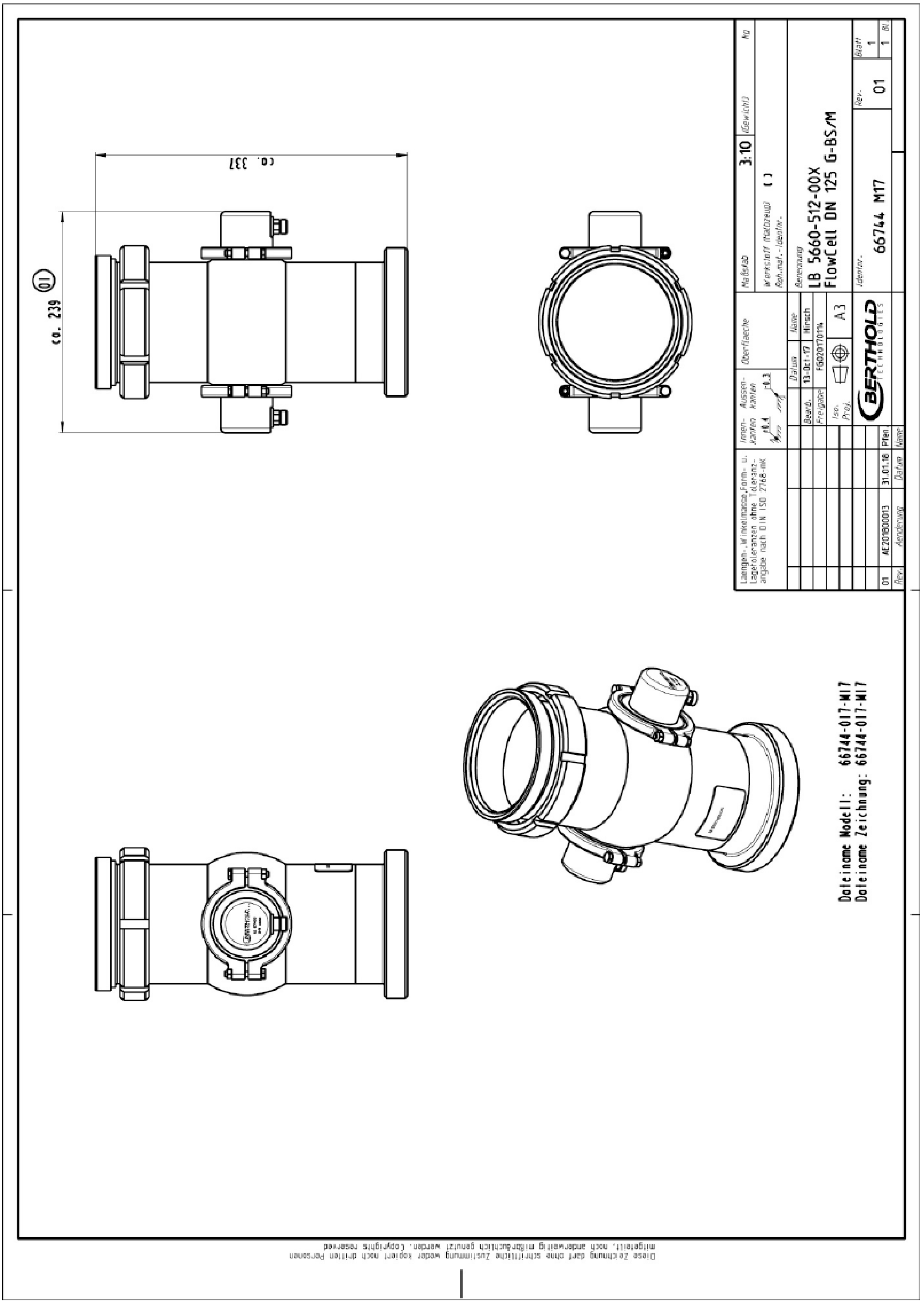
8.3.9 Type LB 5660-312-00X FlowCell DN 80 G-BS/M



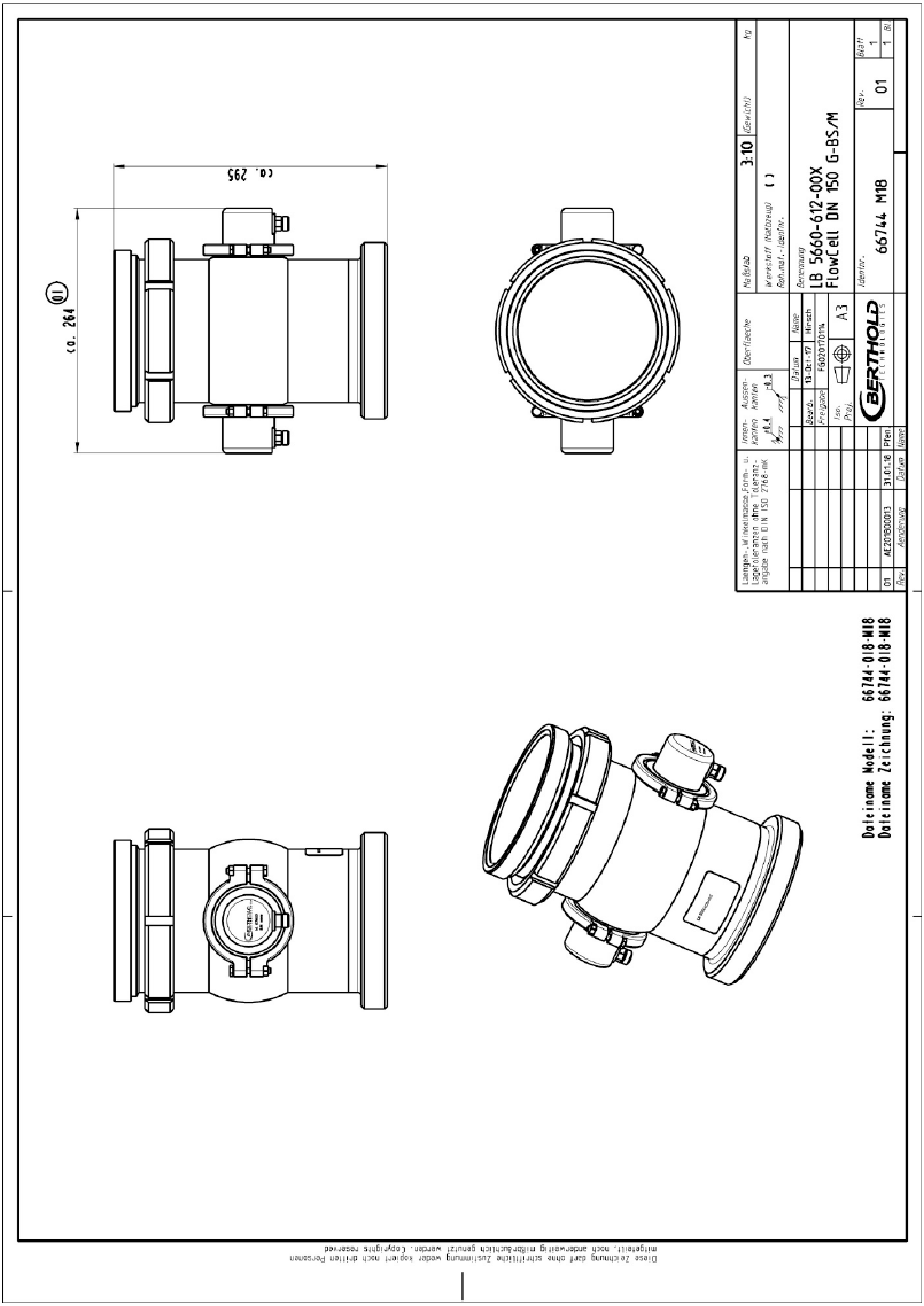
8.3.10 Type LB 5660-412-00X FlowCell DN 100 G-BS/M



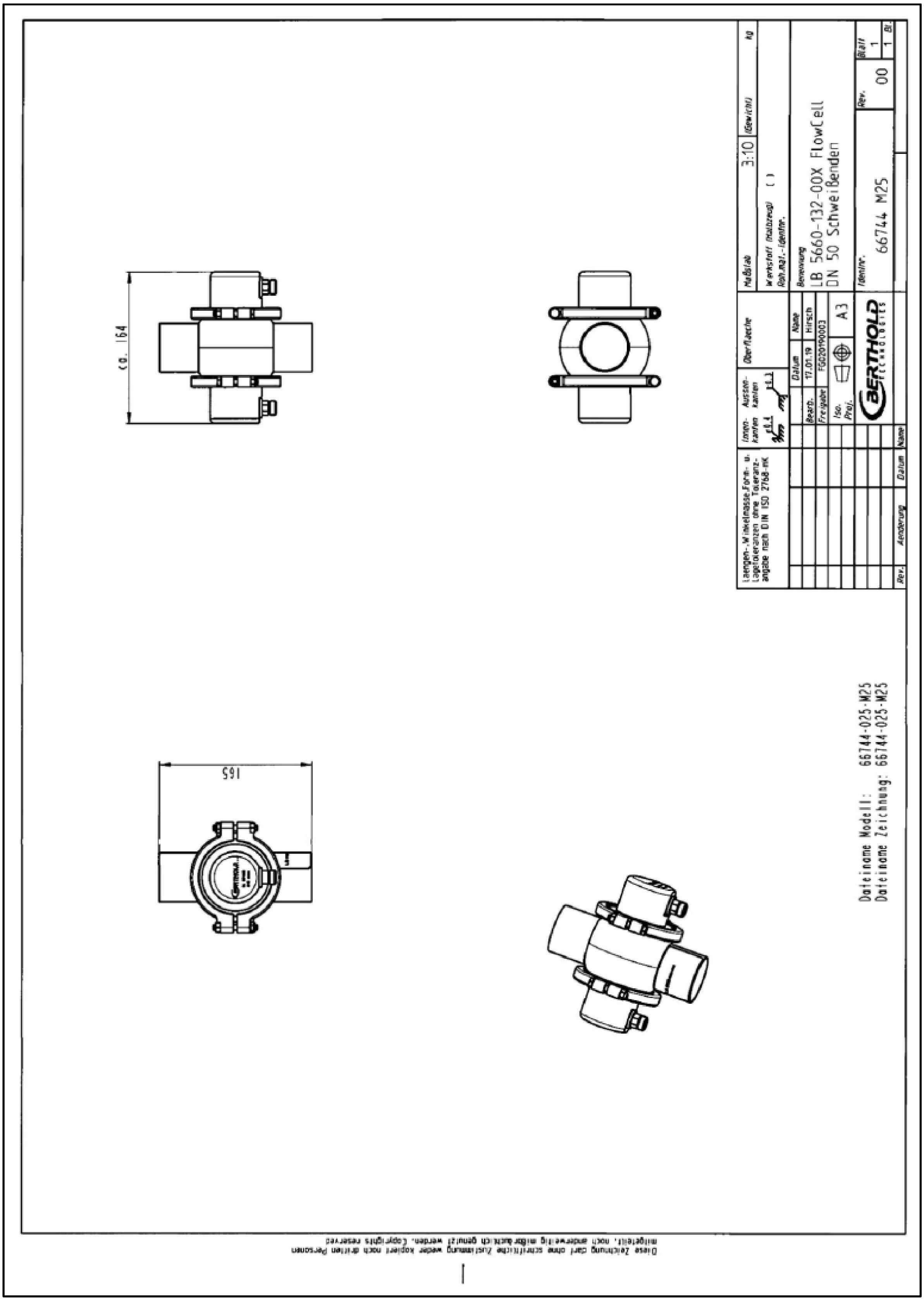
8.3.11 Type LB 5660-512-00X FlowCell DN 125 G-BS/M



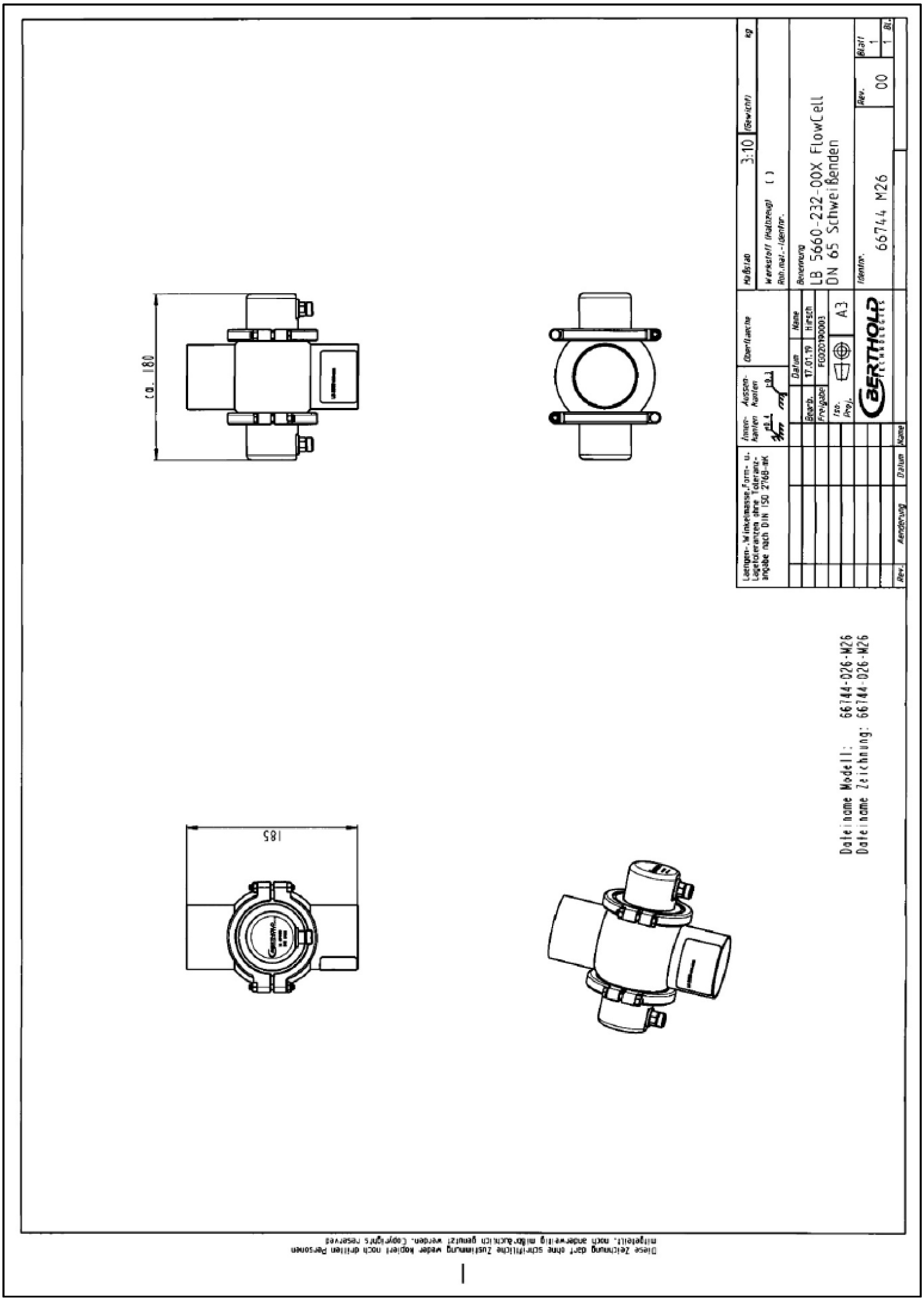
8.3.12 Type LB 5660-612-00X FlowCell DN 150 G-BS/M



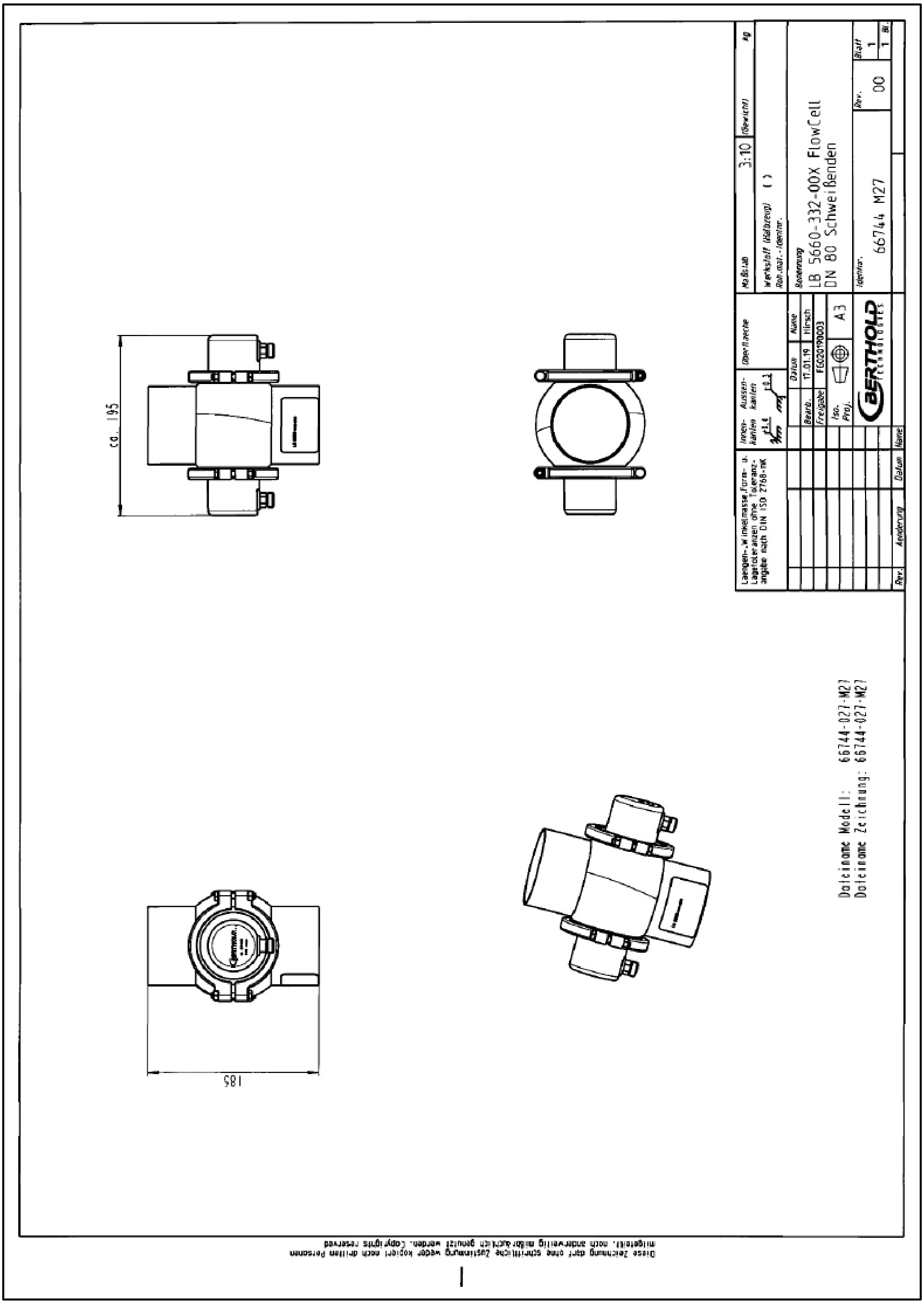
8.3.13 Type LB 5660-132-00X DN 50



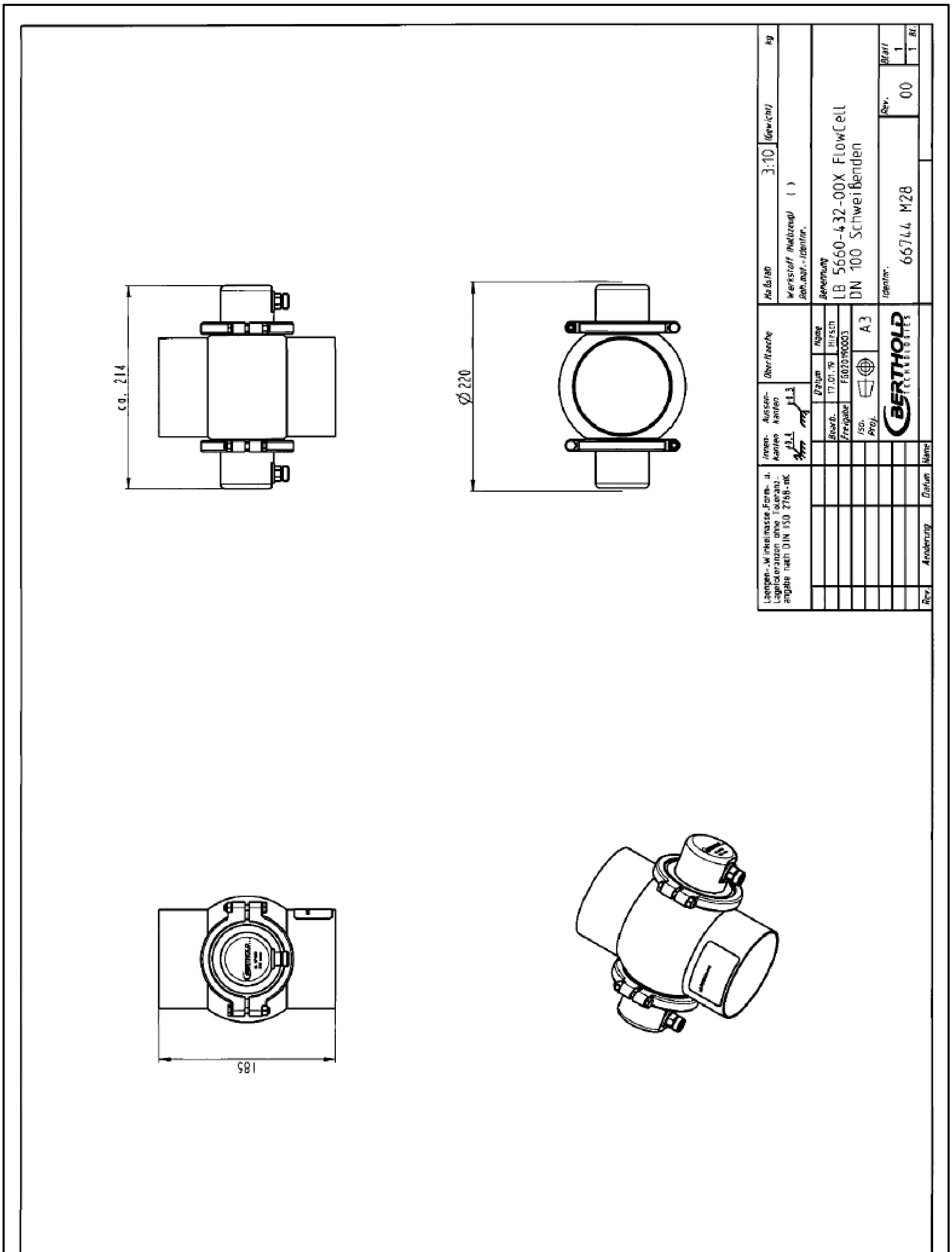
8.3.14 Type LB 5660-232-00X DN 65



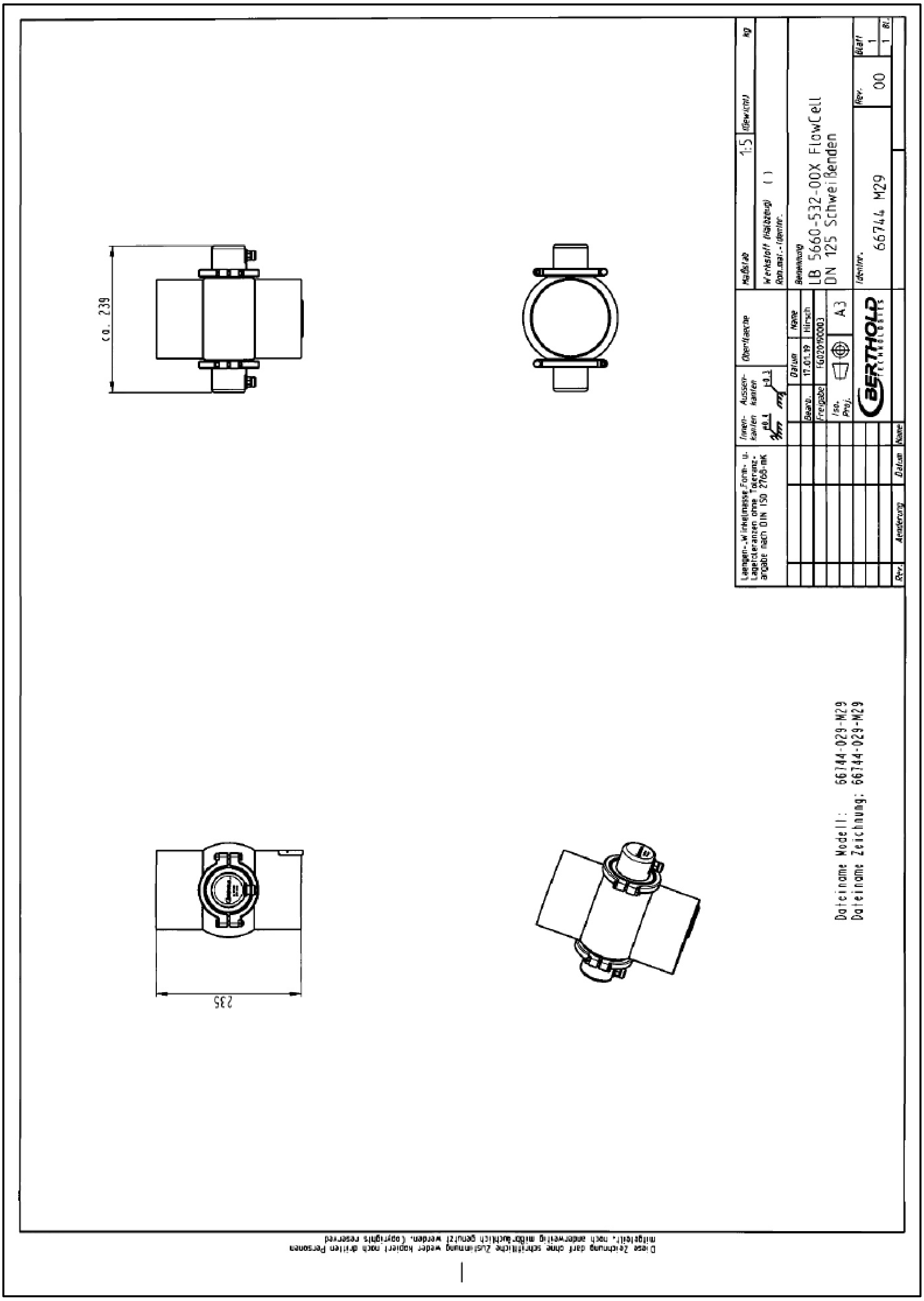
8.3.15 Type LB 5660-332-00X DN 80



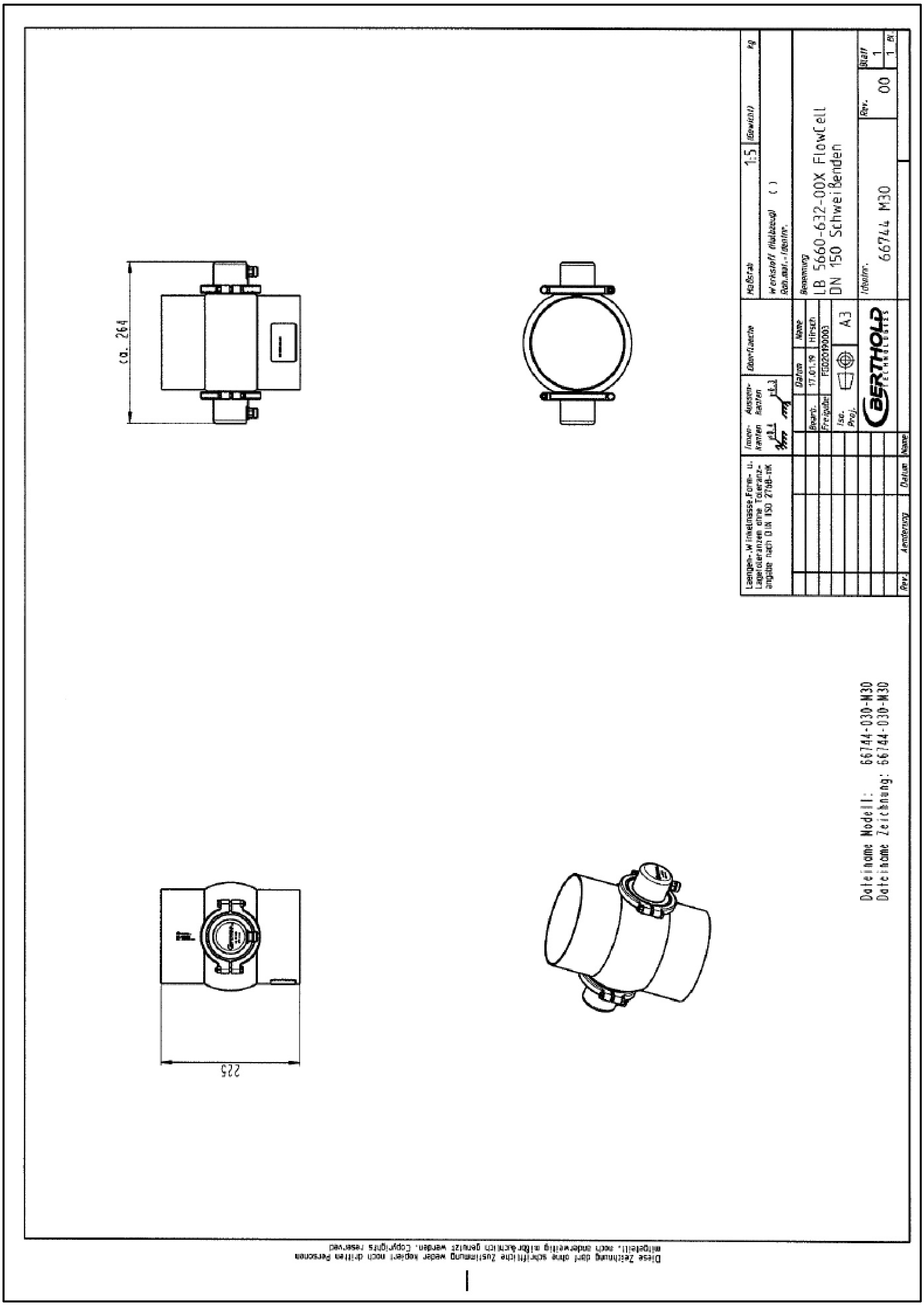
8.3.16 Type LB 5660-432-00X DN 100



8.3.17 Type LB 5660-532-00X DN 125

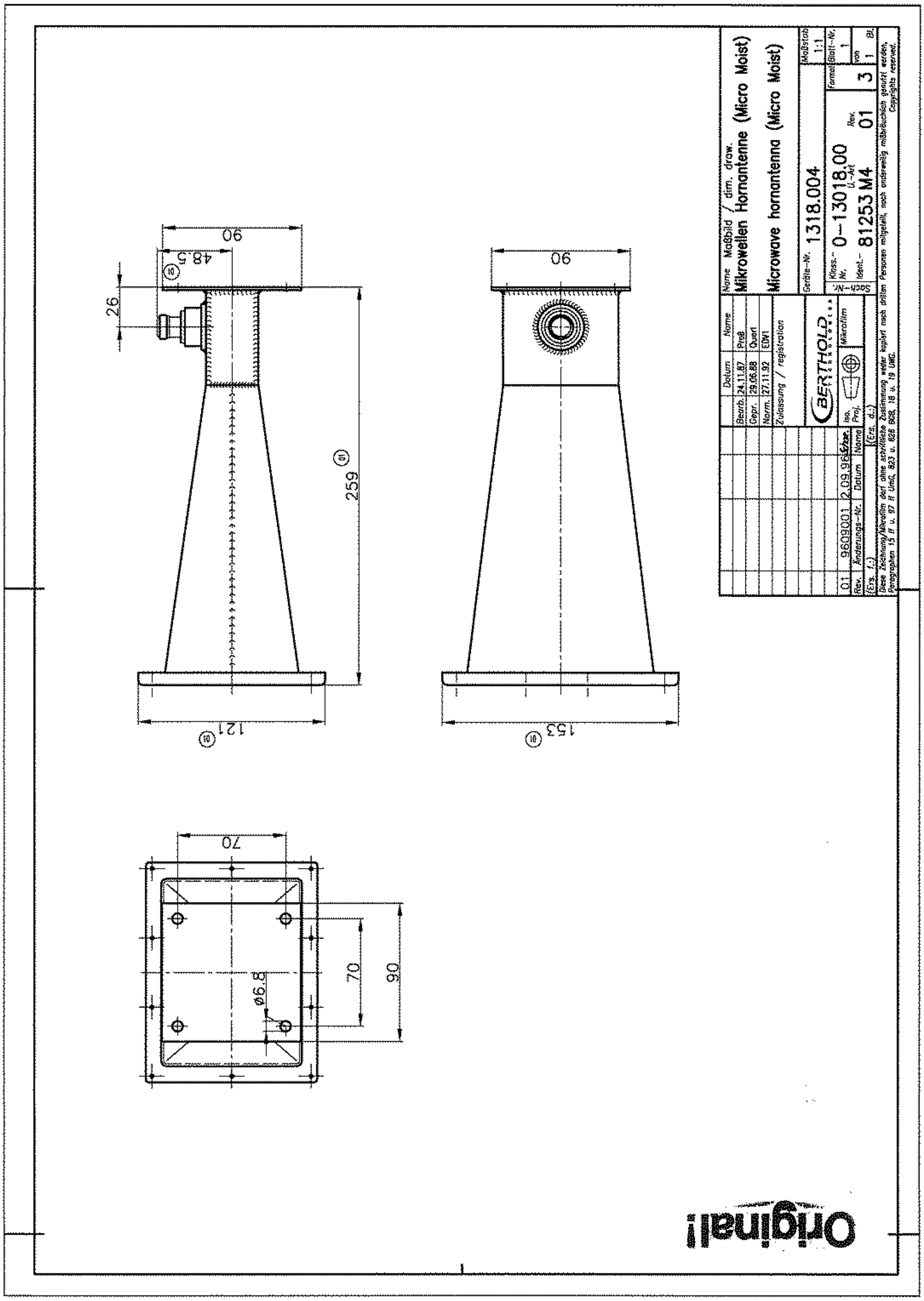


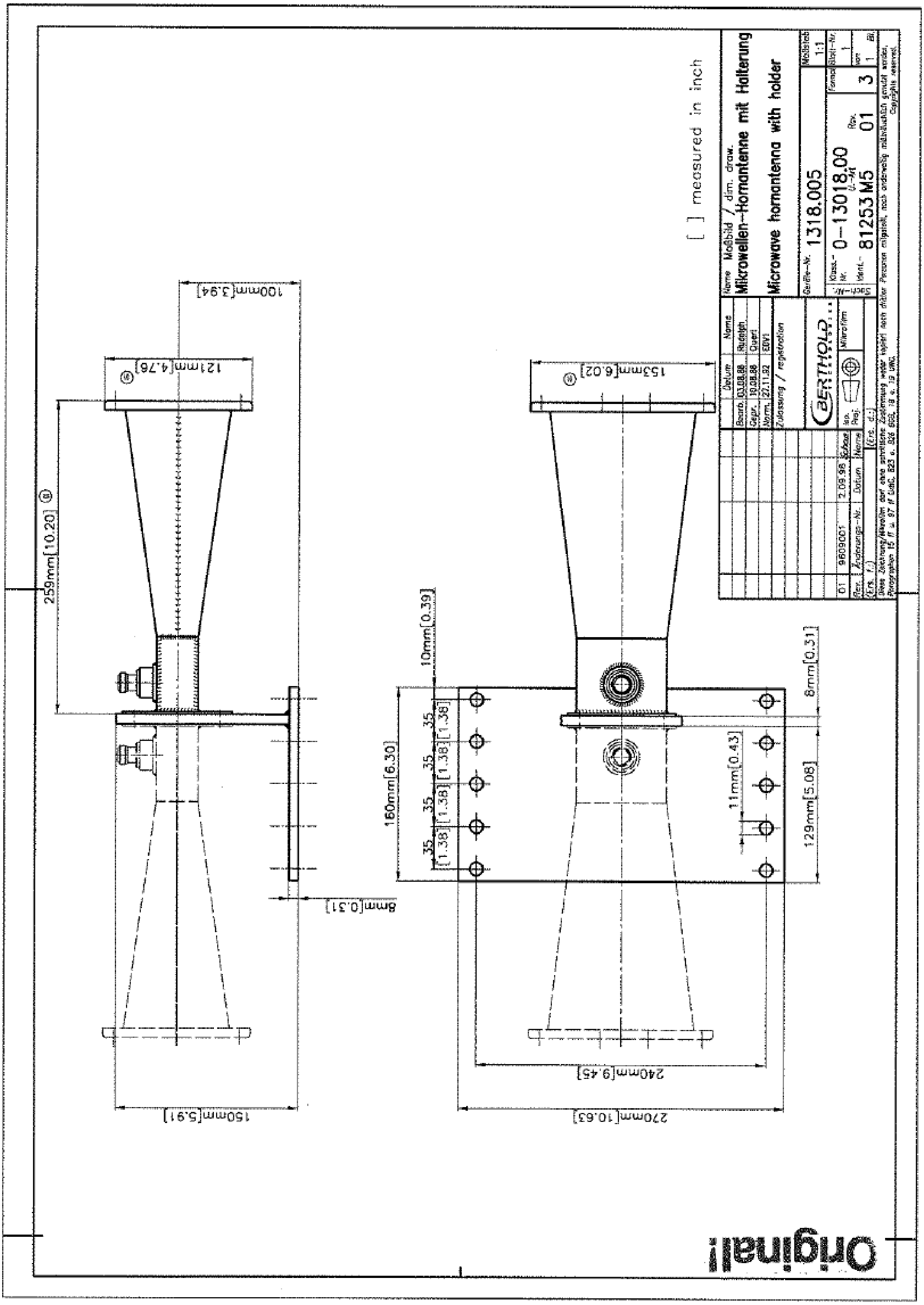
8.3.18 Type LB 5660-632-00X DN 150



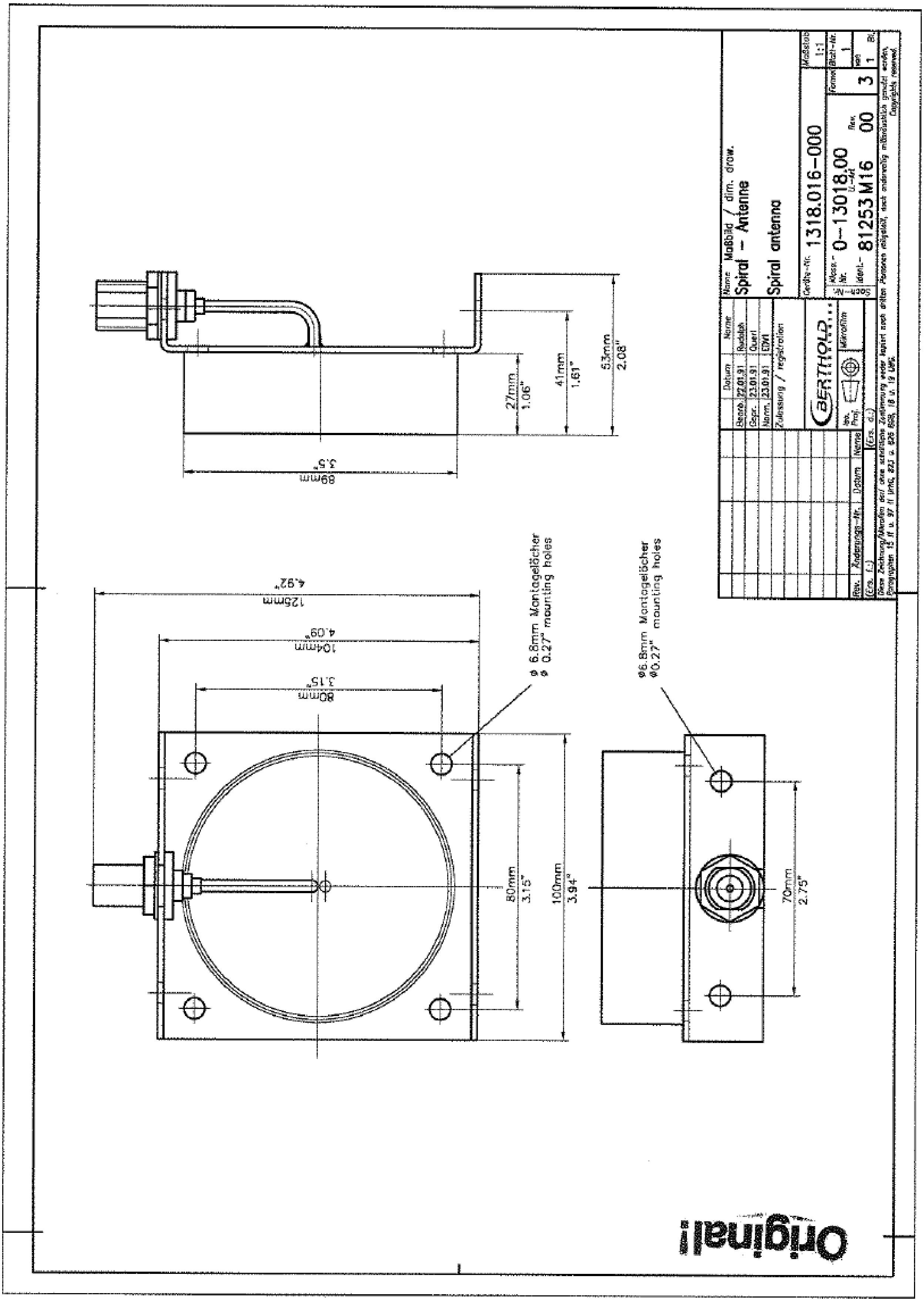
8.4 Dimensional Drawings Horn and Spiral Antennae

8.4.1 Horn Antenna and Horn Antenna Holder

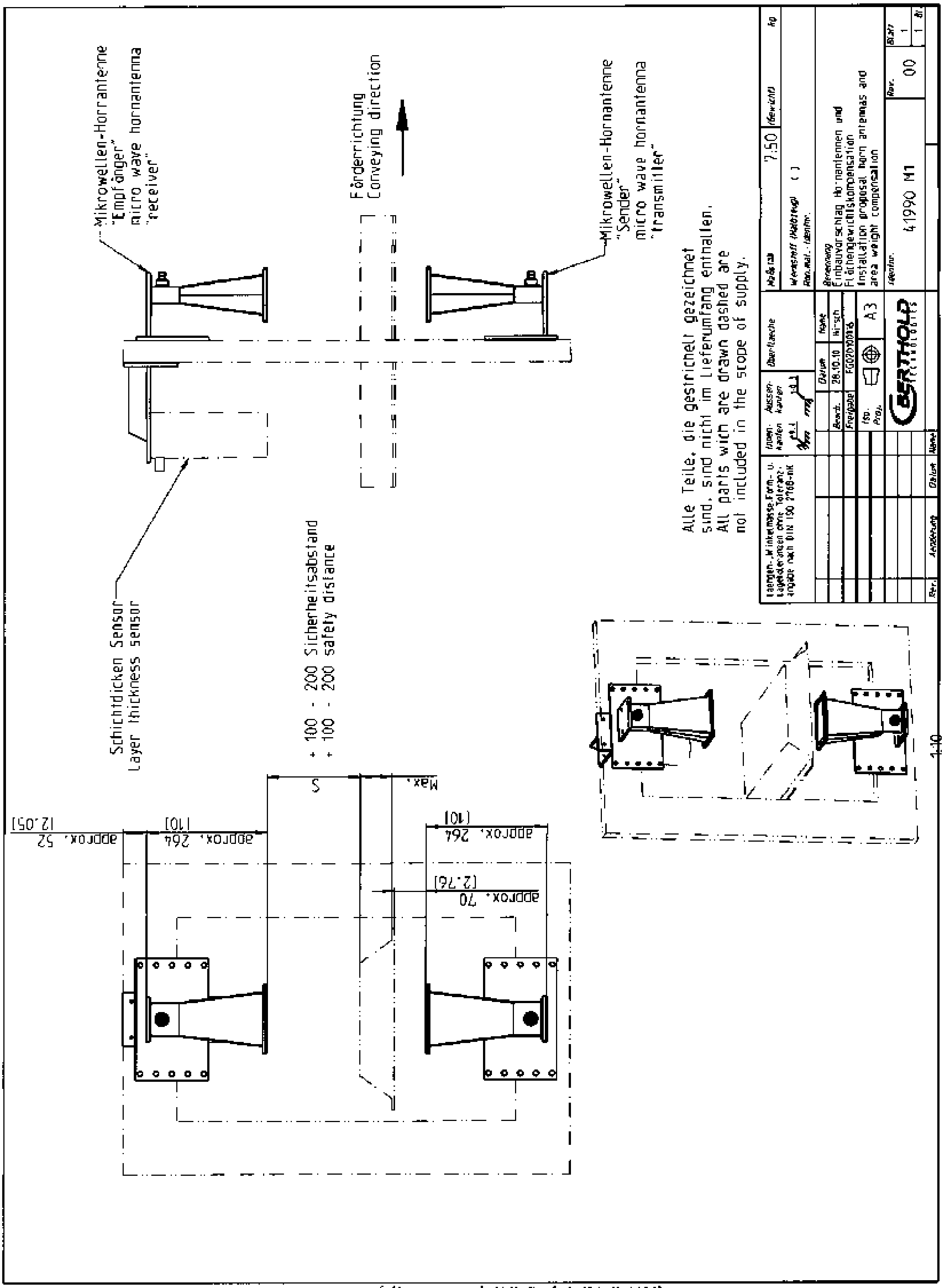



[ ] measured in inch
Maßbild / dim. draw.
Mikrowellen-Hornantenne mit Halterung
Microwave hornantenna with holder
1318.005
0-13018.00
81253 M5
01
3
1:1
100mm[3.94]
121mm[4.76]
153mm[6.02]
259mm[10.20]
10mm[0.39]
160mm[6.30]
35
[1.38]
8mm[0.31]
11mm[0.43]
129mm[5.08]
240mm[9.45]
150mm[5.91]
270mm[10.63]
Original!

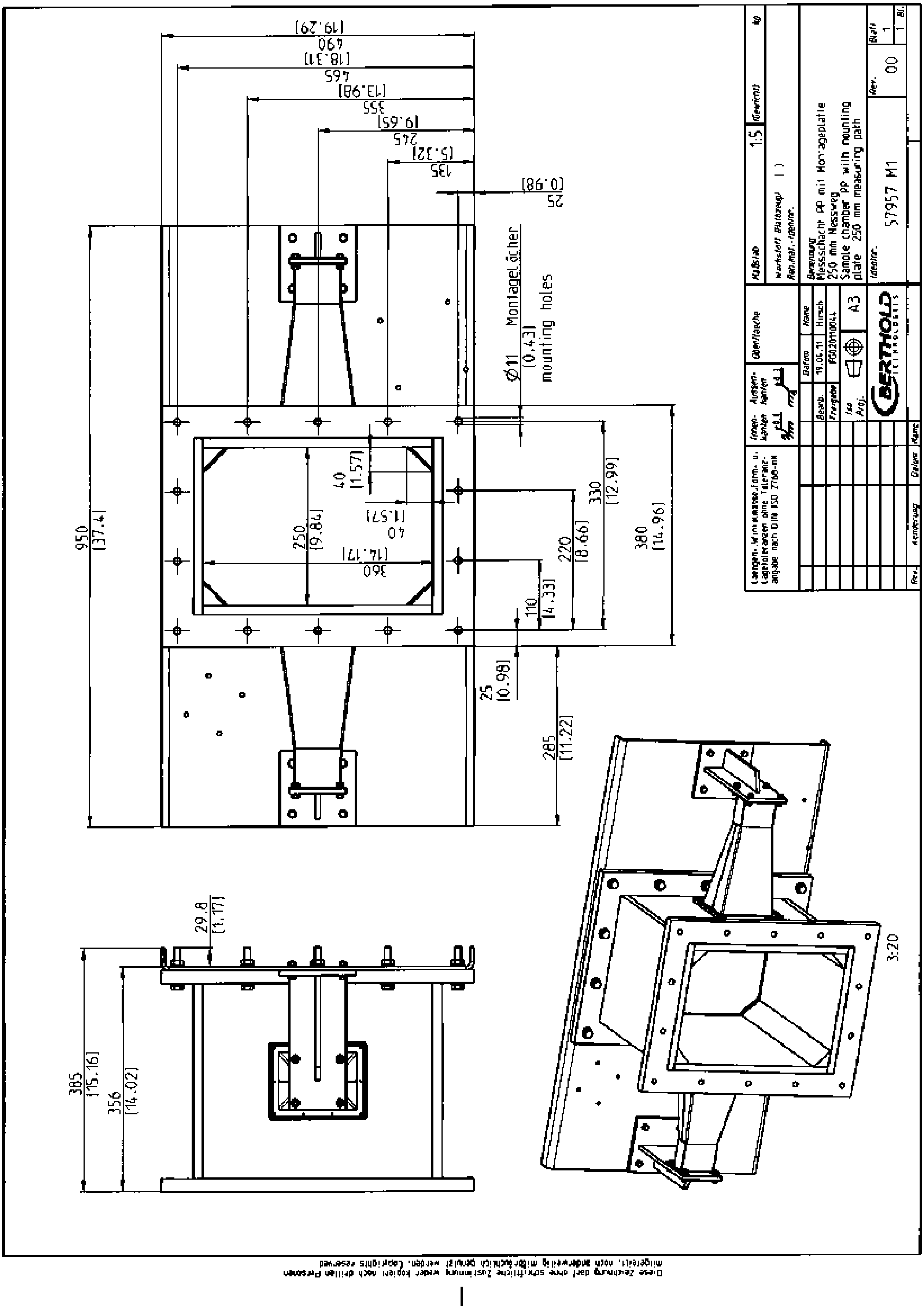
8.4.2 Spiral antenna



8.5 Installation Proposal at the Conveyor Belt



8.6 Installation Proposal at the Measuring Chute



Index

R

S

T

V

W

Notes

Notes

Concentration / Moisture Measuring Systems
MicroPolar 2 (++)
LB 567

User's Guide

Software Manual

41988BA2

Rev. Nr.: 05, 03/2018

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

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

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

The **hardware manual** comprises the

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

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

- operation
- software functions
- calibration
- error messages

The present manual is the software description.

Subject to changes without prior notice.

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www.Berthold.com	

Table of Contents

Chapter 1. **Safety Summary**

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

NOTICE

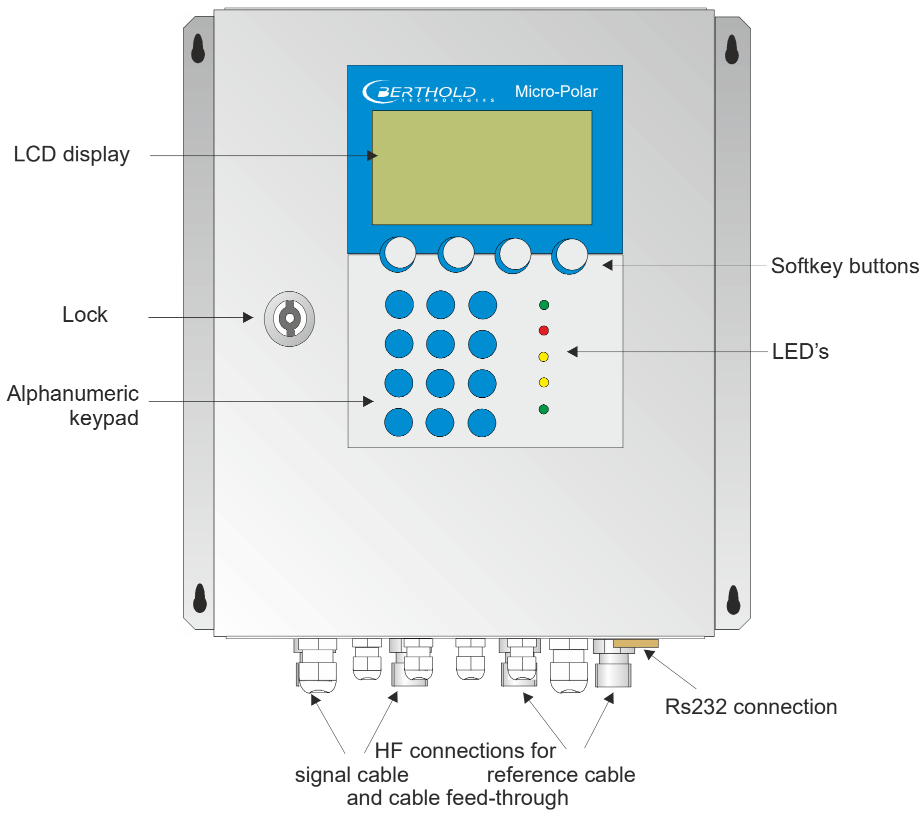
Parameter settings
Never change the installation and the parameter settings without a full knowledge of these operating instructions, as well as a full knowledge of the behavior of the connected controller and the possible influence on the operating process to be controlled.

Chapter 2. **Communication with MicroPolar 2**

The communication with MicroPolar 2 and MicroPolar 2 ++ is carried out via 4 softkey buttons. The function of the individual buttons changes relative to the position in the menu. Values and texts are entered via an alphanumeric keyboard. The instrument status is indicated by 5 LEDs.

TIP

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



Chapter 3. **Getting Started Guide**

To get started, please carry out the steps described below one after the other.
Please read *chapter 8. Start-up of the MicroPolar 2* ++ before you take the high dynamics version into operation.

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

1. Step
Configure the analog inputs as needed: Current inputs 1, 2 and PT100. *See chapter 4.2.21 Input / Output.*

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

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

3. Step
Carry out the calibration with sampling, *chapter 6. Calibration Flow Cell* or *chapter 7*. *Calibration Conveyor Belt/Chute*

Temperature compensation is required only if the phase/attenuation will be clearly influenced by the product temperature; this is dependent on the product and water content.

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

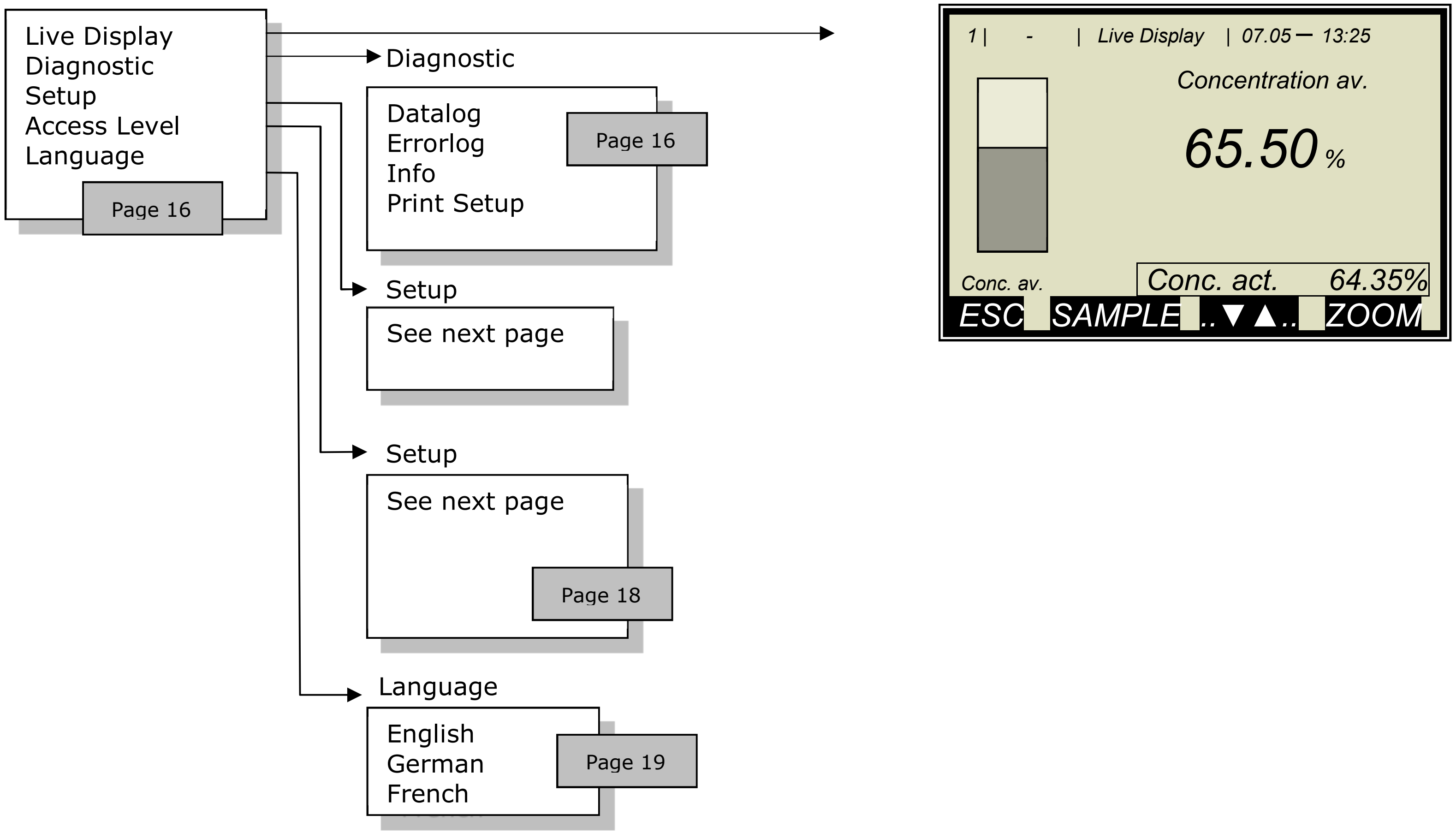
Chapter 4. **Software Functions**

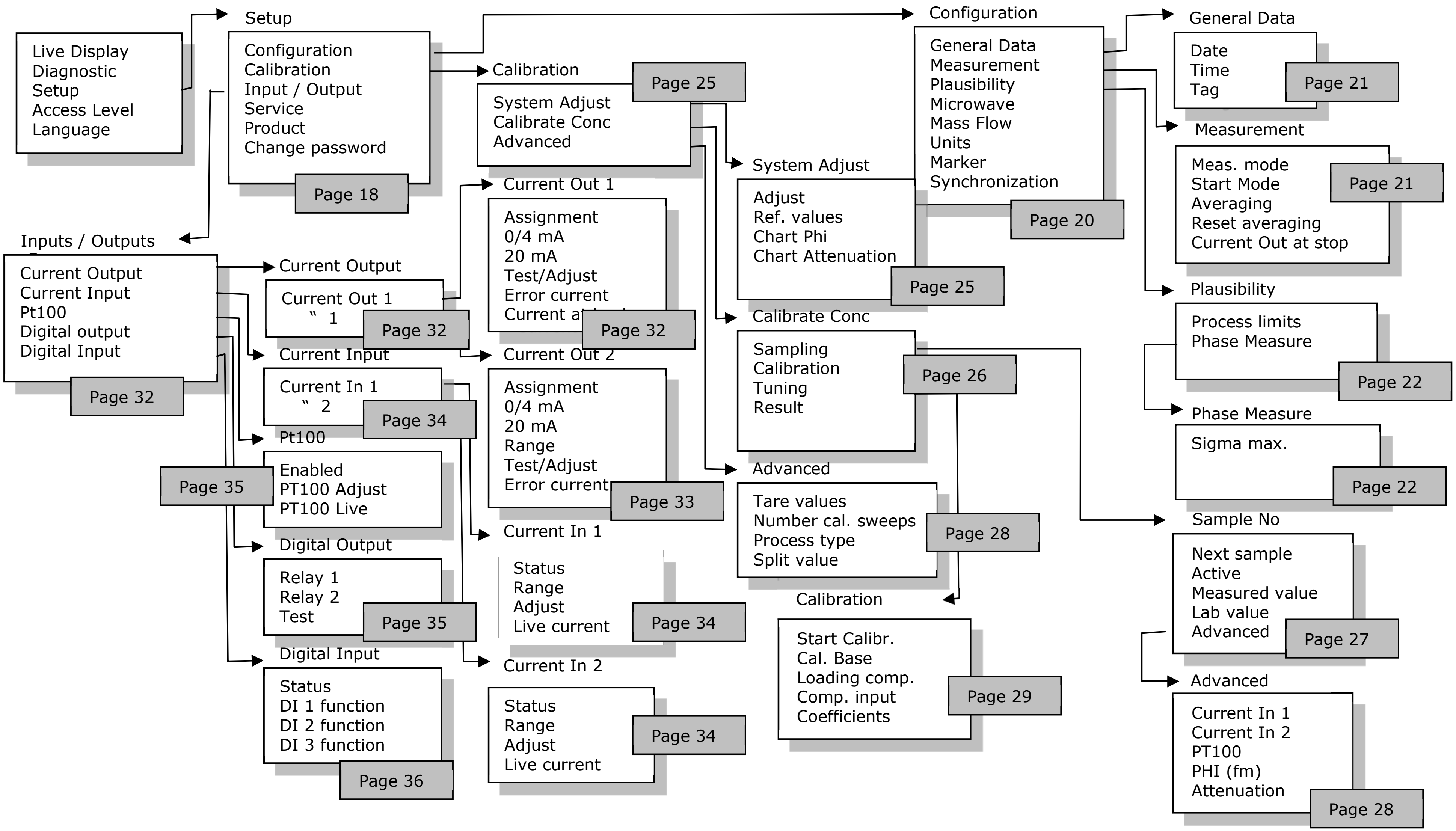
4.1 Information on the Menu Structure

The menu structure on the following pages provides an overview of all functions of the LB 567. Using the **page numbers** indicated you can look up the function of the depicted window.

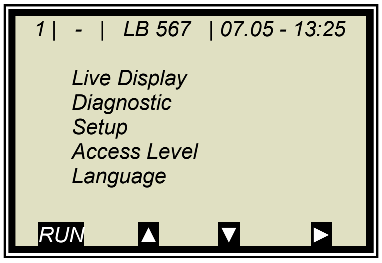
You have to enter a password to change from the **Read only** level to **User Mode**. The **Service level** is not accessible due to licensing regulations.

4.2 Menu Structure




Live Display
Diagnostic
Setup
Access Level
Language
Setup
Configuration
Calibration
Input / Output
Service
Product
Change password
Page 18
Calibration
Page 25
System Adjust
Calibrate Conc
Advanced
Configuration
General Data
Measurement
Plausibility
Microwave
Mass Flow
Units
Marker
Synchronization
Page 20
General Data
Date
Time
Tag
Page 21
Measurement
Meas. mode
Start Mode
Averaging
Reset averaging
Current Out at stop
Page 21
Plausibility
Process limits
Phase Measure
Page 22
Phase Measure
Sigma max.
Page 22
Sample No
Next sample
Active
Measured value
Lab value
Advanced
Page 27
Advanced
Current In 1
Current In 2
PT100
PHI (fm)
Attenuation
Page 28
System Adjust
Adjust
Ref. values
Chart Phi
Chart Attenuation
Page 25
Calibrate Conc
Sampling
Calibration
Tuning
Result
Page 26
Advanced
Tare values
Number cal. sweeps
Process type
Split value
Page 28
Calibration
Start Calibr.
Cal. Base
Loading comp.
Comp. input
Coefficients
Page 29
Inputs / Outputs
Current Output
Current Input
Pt100
Digital output
Digital Input
Page 32
Page 35
Current Output
Current Out 1
" 1
Page 32
Current Input
Current In 1
" 2
Page 34
Pt100
Enabled
PT100 Adjust
PT100 Live
Digital Output
Relay 1
Relay 2
Test
Page 35
Digital Input
Status
DI 1 function
DI 2 function
DI 3 function
Page 36
Current Out 1
Assignment
0/4 mA
20 mA
Test/Adjust
Error current
Page 32
Current Out 2
Assignment
0/4 mA
20 mA
Range
Test/Adjust
Error current
Page 33
Current In 1
Status
Range
Adjust
Live current
Page 34
Current In 2
Status
Range
Adjust
Live current
Page 34

4.2.1 Start Menu



Live Display
Shows the live display.

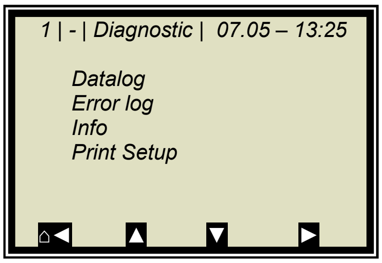
Diagnostic:
This menu item contains the submenu items data logger, error log, device information and print setup.

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

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

Language:
Select the dialog language.

4.2.2 Diagnostic



Datalog:
Datalog records the data corresponding to the contents of the serial data output RS232 and RS485 (see *Hardware Manual, chapter 6.6*).
All measured data of a measurement (sweep) are averaged over the averaging time (see below) and stored. This time is dependent on the selected log time. The contents of the datalog can be displayed on the live display, see *chapter 4.3 Trend Display*. Output as a text file is also possible by using RS232 and RS485, or the Memory Tool (optional accessory).

• Log type	Disable single continuous stop at error
• Log time	Logging period 15 minutes to 3 days
• Restart log	Clears the datalog and starts with the above setting
• Averaging time	Obtained from log time
• Print log	Printout of tables, output via RS232 and RS485, format see *chapter 6.6 Hardware Manual*

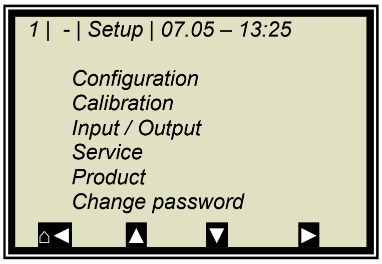
Change datalog settings:
If you change the log type from any to "single", the datalog will be cleared and you start again with the current setting. If you change all other log types and log times, the datalog will not be cleared and you continue with the new settings.
Behavior with stopped measurement:
If the measurement is stopped for some time during the datalog, then the measurement pause will be interpreted as log time in the log type "single". For all other log types, the measurement pause will be added to the log time.

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

Info:
- Tag :...
- Device type : LB 567
- Supplier : Berthold Technologies
- Manufacturer : Berthold Technologies
- Device no. : ...
- Production no. : ...-...
- Software Ver. : V...
- SW rev. date : ...

Print Setup:
Printout of the start-up protocol via RS232 and RS485.
Format, contents and example see *chapter 12. Start-up Protocol.*

4.2.3 Setup



Configuration:

Setup of

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

Calibration:

- System Adjust
- Calibrate Conc
- Advanced

Input / Output:

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

Service:

- Factory Setting
- General Reset
- Memory Tool (operation of the memory tool, optional accessory)
- Data Output (via RS232 and RS485, data contents can be selected)

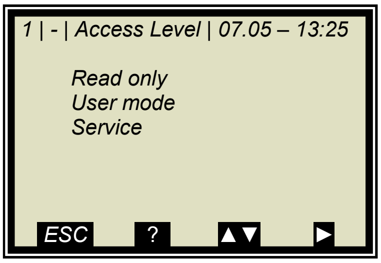
Product:

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

Change password:

The password for the User Mode access level can be changed here.
For more information, see *chapter 10. Password*.

4.2.4 Access Level



Read only:

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

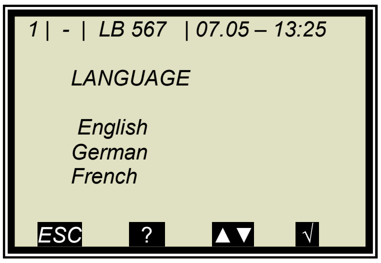
User Mode:

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

Service:

- This level is reserved for the service personnel.

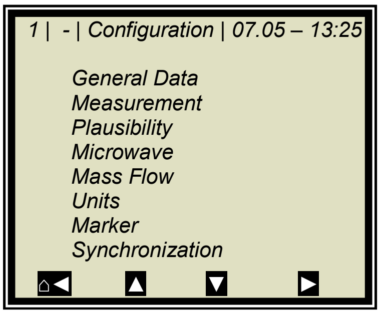
4.2.5 Language



Language:

- Select the dialog language

4.2.6 Configuration



General Data:

- Enter date, time and tag

Measurement:

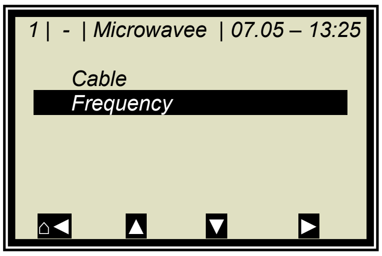
- Meas. Mode (batch/continuous)
- Start Mode (keyboard/external)
- Averaging (number of measured values used for averaging)
- Reset averaging (yes/no)
- Current output at stop

For more information, please see *chapter 4.2.8 Measurement*

Plausibility:

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

For more information please see *chapter 4.2.9 Plausibility*



Microwave:

- **Cable:** Enter the reference and signal cable length, for example, for 4 m HF cable quad, you have to enter 8 m for both lengths.

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

Mass flow:

If the density is measured in a pipeline application (unit of concentration = g/m^3 selected), the mass flow (throughput) can be output via current output 1 / 2 (in tons per hour).
Details on the mass flow see *chapter 4.2.11 Mass Flow*.

Units:

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

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

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

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

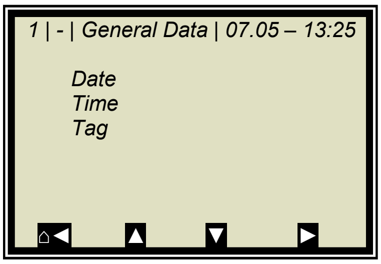
Markers:

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

Synchronization:

The current input signals can be synchronized with the microwave measurement; the current input signals will be stored temporarily. All settings are defined here.
Details on the synchronization see *chapter 4.2.12 Synchronization*.

4.2.7 General Data

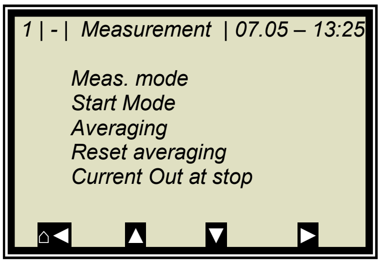


Date:
- Enter the current date

Time:
- Enter the current time

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

4.2.8 Measurement



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

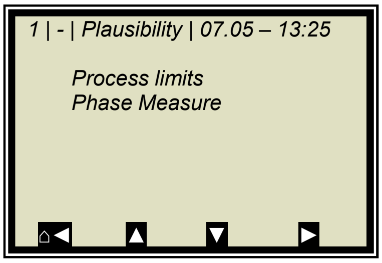
Start Mode:
The measurement device can be started or stopped via external terminals (digital input) or via keyboard.

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

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

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

4.2.9 Plausibility



Process Limits:

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

Phase Measure:

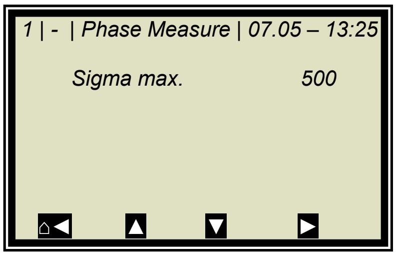
The phase is subject to a plausibility analysis. For more information, please see *chapter 2.2.10 Phase Measurement*.

4.2.10 Phase Measurement

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

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

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



Sigma max.:

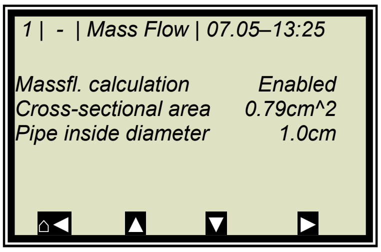
Here you set the maximum sigma of the regression Phase vs. Frequency.
During normal measurement operation, Sigma lies between 0 and 500.
Default: Sigma = 500.
With Sigma = 0 the plausibility is turned off.

4.2.11 Massflow

The MASSFLOW menu appears only if two prerequisites have been fulfilled:

1. The density unit g/cm^3 is selected for the concentration.
2. Current input 2 is enabled and m/s has been selected as unit for current input 2.

For this case, the mass flow (throughput) in tons per hour can be displayed and output via the current output, based on the density reading with indication of the pipe cross-section or the internal pipe diameter.



Massflow calculation:
Here the calculation is enabled or disabled.

Cross-sectional area:
Enter the cross-sectional area of the pipe.

Pipe inside diameter:
Enter the internal pipe diameter.

Comment: Only one entry is required: either the cross-sectional area or the internal pipe diameter, the other parameter will be calculated automatically.

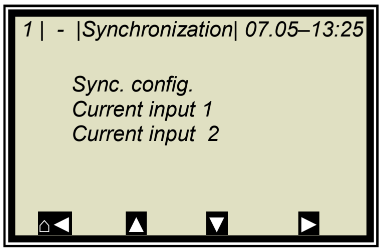
IMPORTANT
The massflow calculation is performed only at varying product speed which must be entered via current input 2.

4.2.12 Synchronization

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

Please see the measuring conditions described in *chapter 3.6 in the Hardware Manual*.

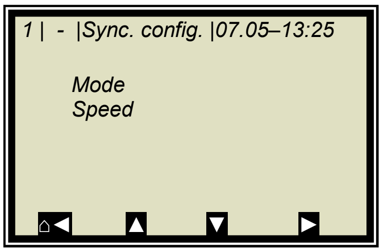
Variable conveying speed: Only one current input signal can be synchronized because current input 2 is used for the belt speed. The speed signal must be fed in via current input 2 and m/s has to be selected as the unit for current input 2.



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

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

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



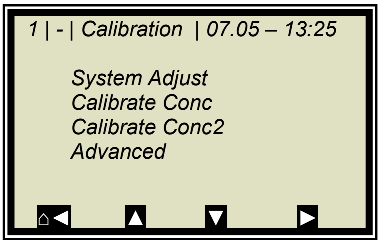
Mode:

- Disable
- Constant speed
- Variable speed

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

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

4.2.13 Calibration



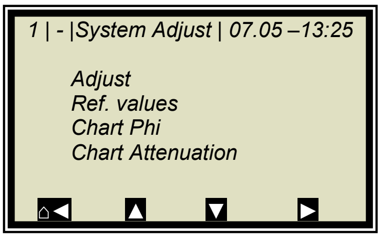
System Adjust:
System calibration is started here.
For details see *chapter 4.2.14 System Adjust*.

Calibrate Conc:
Opens the calibration menu of concentration 1.

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

Advanced:
Here you set the tare values, the number of sweeps when recording samples, the process type and the split value. For more details, see *chapter 4.2.18 Advanced*.

4.2.14 System Adjust



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

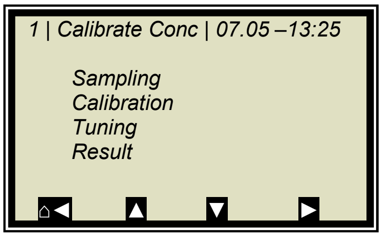
Ref. values:
Upon completion of the reference measurement, the reference values for phase, attenuation, slope and Sigma can be output.

Chart Phi:
Shows the phase versus the frequency.

Chart Atten.:
Shows the attenuation versus the frequency.

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

4.2.15 Calibrate Concentration



Sampling:

Shows all measured samples and entered lab values.

Calibration:

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

For more information, see *chapter 4.2.19 Calibration*.

Tuning:

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

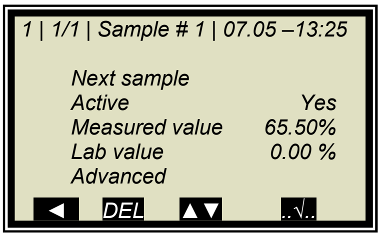
Eq. 4-1:

Corrected display = Display * Factor + Offset

Result:

Presentation of calibration curve, display of correlation and coefficients.

4.2.16 Sampling



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

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

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

Next sample:
Continue with the next sample.

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

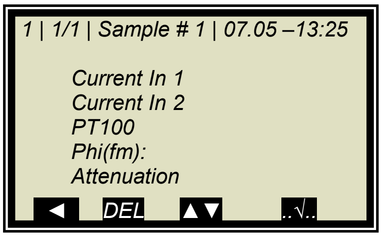
Measured value:
Display of the measured values, calculated with the actual coefficient.

Lab value:
Entry position for the lab value.

Advanced:
Switches to the next data page.

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

4.2.17 Sample Data (expanded)



Current In 1:
Editable display of the first compensation input.

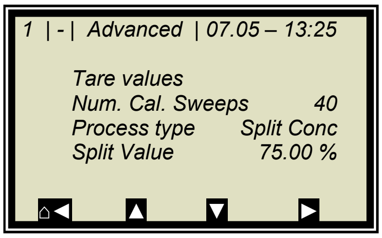
Current In 2:
Editable display of the second compensation input.

PT100:
Editable display of the PT100 input.

Phi(fm):
Not editable display of the measured phase.

Attenuation:
Not editable display of the measured attenuation.

4.2.18 Advanced



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

Eq. 4-2 and 4-3

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

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

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

Process Type:
Select the operation mode:

- one concentration [1 measuring range]
- two concentrations [2 measuring ranges]
- split concentration [1 measuring range with switching point (split value) for coefficient switchover].

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

4.2.19 Calibration

Calibration is performed using the following formula:

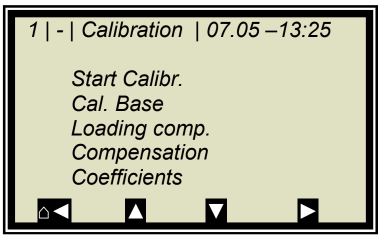
Eq. 4-4

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

where:

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

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



Start Calibr.

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

Cal. Base

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

- Phase
- Attenuation
- Phase and attenuation

Default: Attenuation

Loading compensation:

The loading compensation can be selected here. After the selection, the required analog inputs are used automatically. A selection in the **Comp input** menu is then no longer necessary/possible.
For details see *chapter 4.2.20 Loading Compensation*.

Compensation

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

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

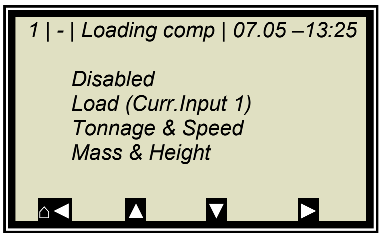
Coefficients:

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

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

4.2.20 Loading Compensation

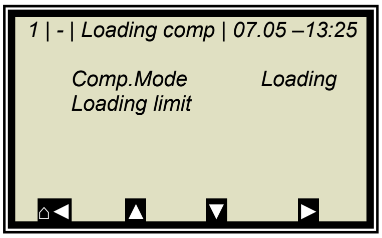
At least one analog input must be active so that the LOADING COMPENSATION menu is displayed. Some modes require two analog inputs for display/selection.



Comp. Mode:

The following parameters can be set:

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



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

Loading limit:

Enter the minimum load; if this value is not reached, the evaluation unit changes the device status.
The device status for this mode is described in *chapter 11.4 Device States*.

Compensation mode Loading (Cin 1):

The following units can be used as a compensation signal:

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

Signal input

via current input 1

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

Compensation mode Tonnage & Speed (throughput & speed):

Signal input

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

Units

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

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

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

Signal input

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

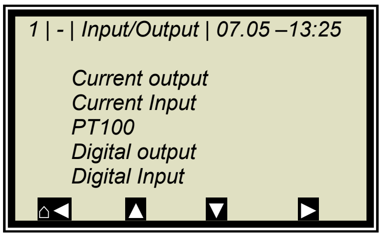
Units

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

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

See additional explanation in the *Hardware Manual, chapter 3.4 Loading Compensation.*

4.2.21 Inputs / Outputs



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

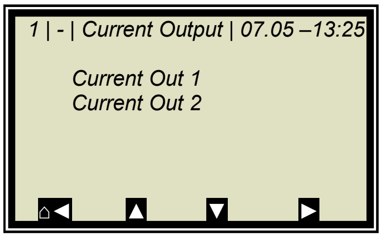
Current Input:
Activation level of current input, calibration and display of the live current signal.

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

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

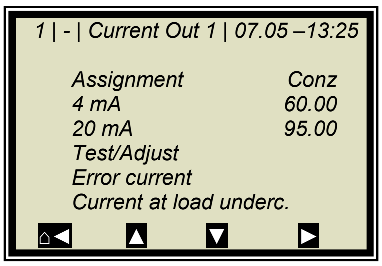
Digital Input:
Status control and assignment of the digital inputs.

4.2.22 Current Output



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

4.2.23 Current Out 1



Assignment:
The following signals can be assigned to the current output:

- None
- Concentration
- Concentration 2 (if active)
- Current input 1 or 2 (if active)
- PT100 (if active)

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

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

TIP
Current output 1 only 4 – 20mA possible

If the current output limit is exceeded, the measurement switches to the warning state, *see chapter* 11.4 *Device States.*

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

IMPORTANT
The measurement should be stopped for test function.

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

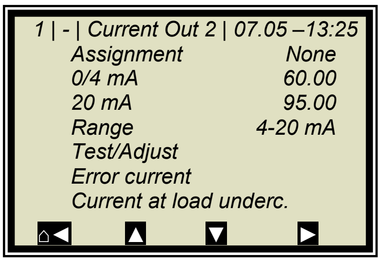
Error current:
If the measurement switches to the fault state, a fault current is output via the current output; this can be set here.

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

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

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

4.2.24 Current Out 2



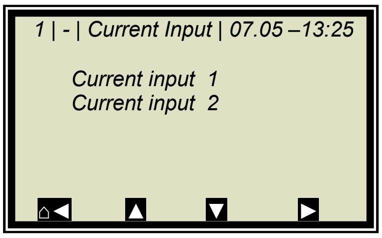
All functions same as current output 1

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

Range:
Change the current output

- 0 – 20mA
- 4 – 20mA

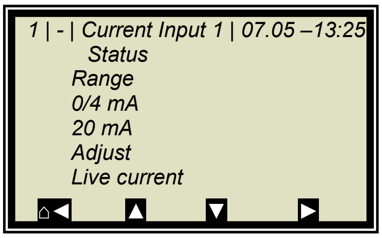
4.2.25 Current input



Current In 1:
When selected, change to the activation and calibration menu.

Current In 2:
As described above.

4.2.26 Current Input 1



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

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

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

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

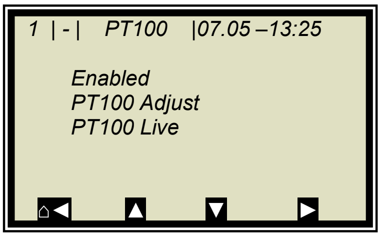
Adjust:
Follow the instructions on the display.

Live current:
Display of the live current signal.

4.2.27 Current Input 2

Settings correspond to current input 1.

4.2.28 PT100



Enabled:

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

IMPORTANT

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

PT100 Adjust:

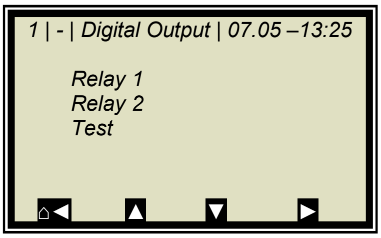
You need a 100 Ohm and a 138.5 Ohm resistance. Follow the instructions on the display.

PT100 Live:

Display of the live temperature.

Set and enabled same as input 1.

4.2.29 Digital Output



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

Relay 1:

Different functions can be assigned to relay 1:

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

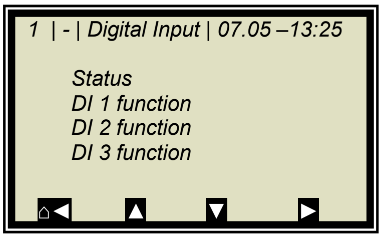
Function	Description
None	Relay and LED function disabled
Error	In case of error, relay and LED will be set.
Hold	If Hold function is enabled, relay and LED will be set.
Alarm min.	The relay switches if the value falls below the limit value to be set.
Alarm max.	The relay switches if the value exceeds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

Relay 2:
Same assignments possible as above.

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

4.2.30 Digital Input

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



Status:
Shows the status of the input circuit
- open/closed

DI 1 Function
The following functions can be assigned to DI 1:
- None
- Start (external start)

DI 2 Function
The following functions can be assigned to DI 2:
- None
- Hold (averaging is stopped)
- Product (external product selection)

DI 3 Function
Assignments for DI 3:
- None
- Sample (external control of sampling)
- Product (external product selection)

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

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

Sample means that sampling is started by closing the contact.

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

TIP

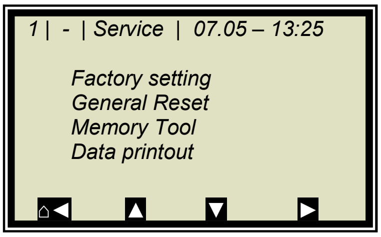
If you select a product for the first time (product 2 to 4), all settings and contents of the current product will be copied to the new product, including:

- Configuration data
- System adjust
- Calibration data (including sampling table)
- Input/Output definitions

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

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

4.2.31 Service



Factory setting and General reset:

See table on the next side.

Memory Tool:

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

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

NOTICE

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

Data printout:

All measured values are output for each measurement via the serial data interfaces RS232 and RS485. The output can be set as follows:

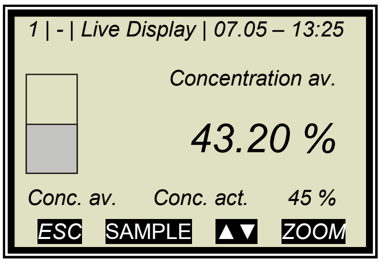
- None (disabled)
- Row (data transfer, see *Hardware Manual, chapter 6.6*)
- Table (microwave data for each frequency point)
- Row and table

"Row" is defaulted.

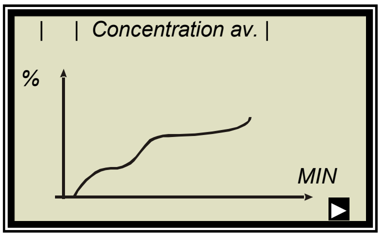
	Factory setting	General reset
Language selection	unchanged	unchanged
Access level	unchanged	default: User mode
Measurement	stopped	stopped
Password	unchanged	default: PASS1
Product selection	unchanged	all products deleted
Error log	not deleted	deleted
Data log	not deleted, default settings	deleted, default 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 Units	default	default
Calibration coefficients	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 12.1 Example Start-up Protocol*

4.3 Trend Display



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



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

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

NOTICE

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

Chapter 5. **Configuration**

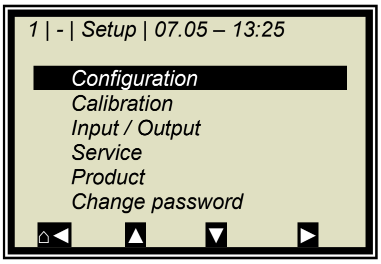
Before doing any calibration work, you have to enable and configure the required analog inputs and check and, if necessary, correct the configuration parameters.

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

The measuring system includes two separate floating current outputs.

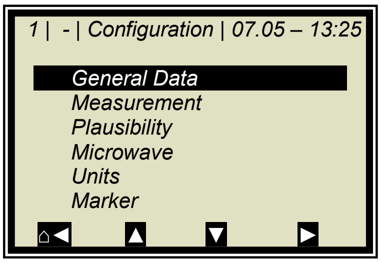
5.1 Configuration Setup

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

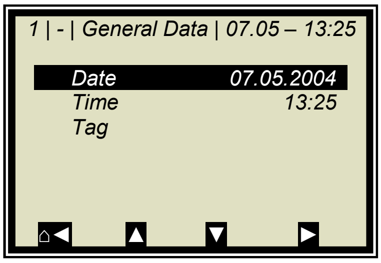


➢ CONFIGURATION

5.1.1 General Data

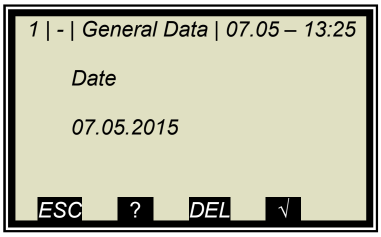


➢ GENERAL DATA



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

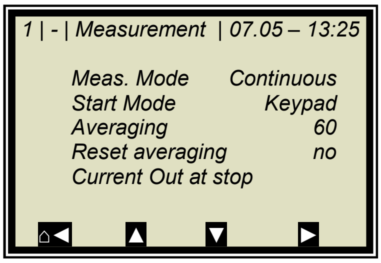
➢ DATE



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

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

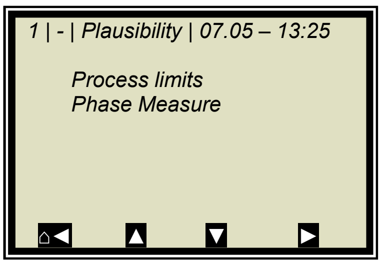
5.1.2 Measurement



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

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

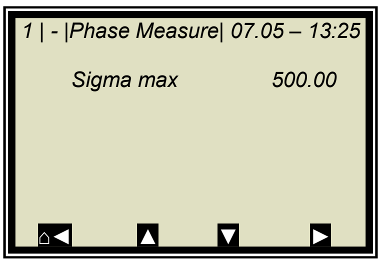
5.1.3 Plausibility



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

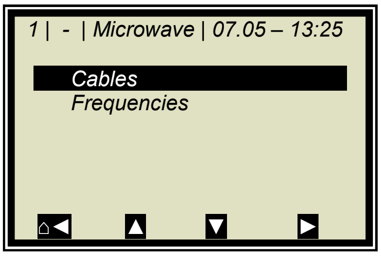
The process limits are independent of the current output limits.

➢ PHASENMESSUNG

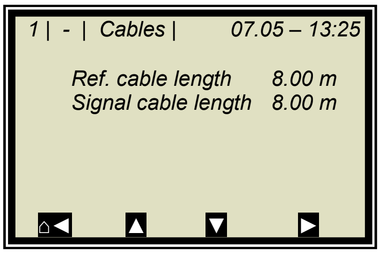


In the normal measurement mode **Sigma** is between 0 and 500. Therefore, Sigma_{max} = 500 is a good choice for most applications. Higher Sigma values usually indicate a fault, such as continuous air bubbles which have to be eliminated.

5.1.4 Microwave



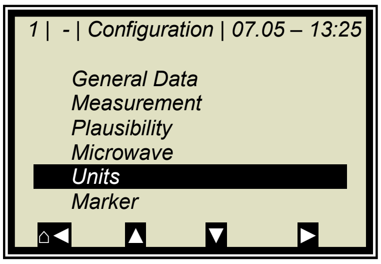
➢ CABLES



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

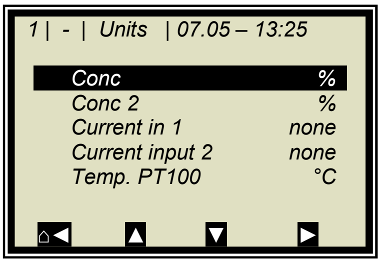
Example: For a 4 m long HF quad cable, enter 8 m for the reference and signal cable length. The input value corresponds to twice the quad cable length.

5.1.5 Units



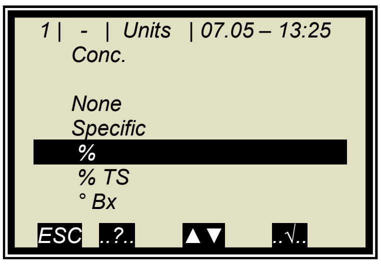
Set the units to the desired dimension.

➢ UNITS



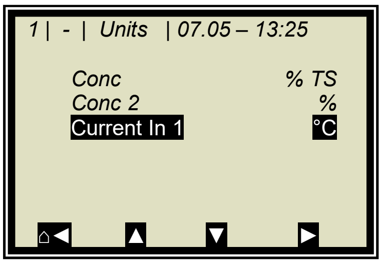
The units of the concentrations (conc 1 and 2) and those of the enabled analog inputs can be selected.

➢ CONC / CONC 2

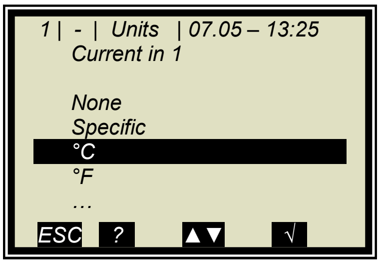


Different units can be set for both concentrations.

➢ %



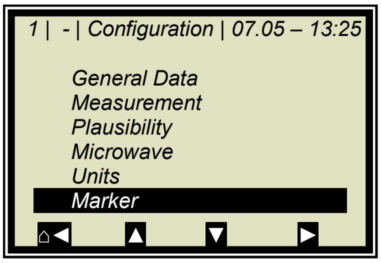
➢ CURRENT IN 1



➢ °C

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

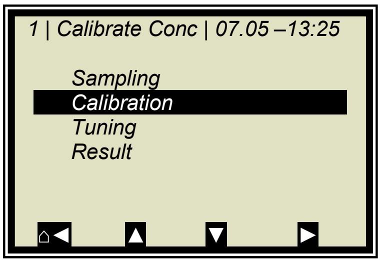
5.1.6 Marker



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

➢ MARKERS

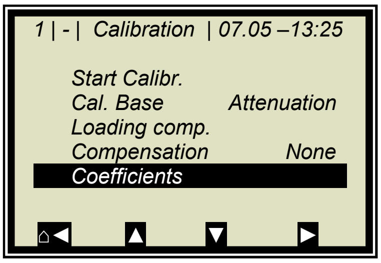
5.2 Start Calibration Coefficients



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

ESC | SETUP | CALIBRATION | CALIBRATE CONC |

- CALIBRATION

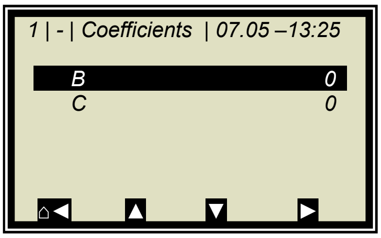


- COEFFICIENTS

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

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

where:
B, C: Calibration coefficients



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

C = average measuring range value (concentration value)

B = 0

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

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

Chapter 6. **Calibration Flow Cell**

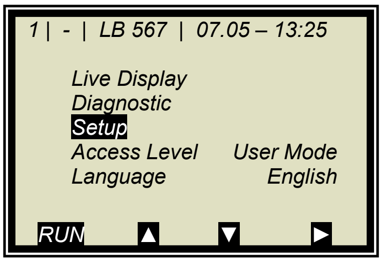
Note: The measuring system must have reached normal operating temperature (approx. 45 min. warm-up time)).

The flow cell must be completely filled with product.

The measuring system has to operate at a normal throughput and/or material flow and the usual material under actual operating conditions.

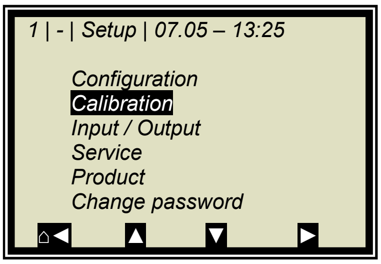
Prerequisite: **Chapter 5 Configuration** have been completed.

6.1 System Adjust

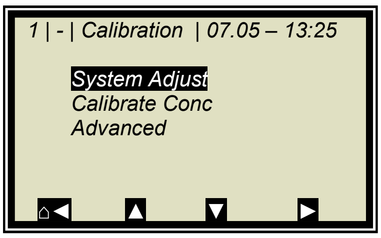


Starting from the main menu:

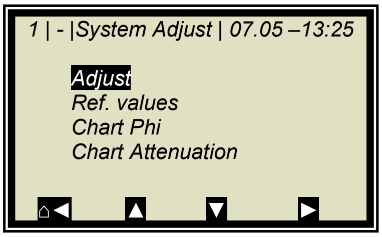
- ➢ SETUP



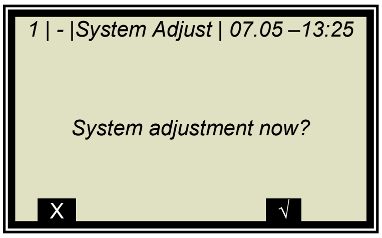
- ➢ CALIBRATION



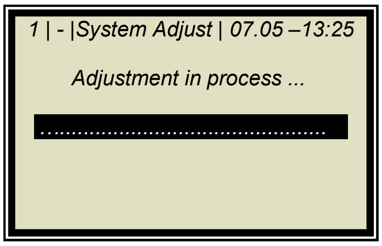
- ➢ SYSTEM ADJUST



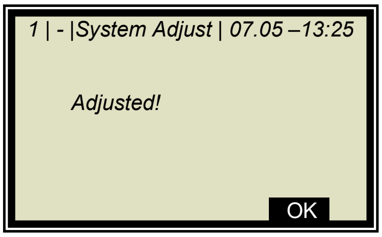
➢ ADJUST



Confirm

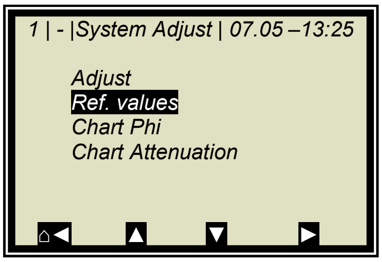


System adjustment is in process.



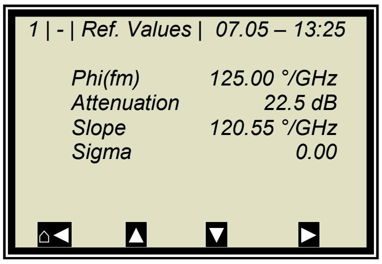
Push **OK** to confirm and push ⌂◀ three times to return to the main menu.

6.1.1 Verifying the Reference Values



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

➢ REFERENCE VALUES

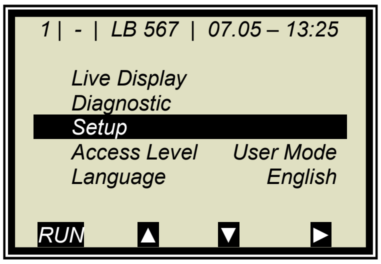


Limits of important parameters for the reference measurement:

Sigma:	<200 (reliable microwave irradiation)
Attenuation:	<60 dB (Cables connected properly, product irradiatable)

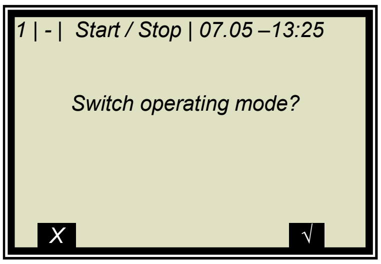
6.2 Sampling

For temperature compensation, the product temperature must be entered via one of the analog inputs and in addition the corresponding input has to be enabled. If not, the product temperature is not stored in the device during sampling.

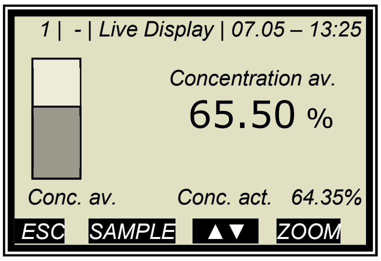


If the measuring system is not yet in the measurement mode, start the measurement now.

Push *RUN* to start the measuring system.

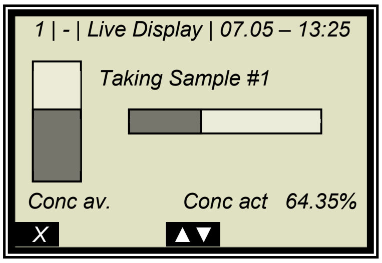


Push √ to confirm the safety prompt and the device switches to the measurement mode.



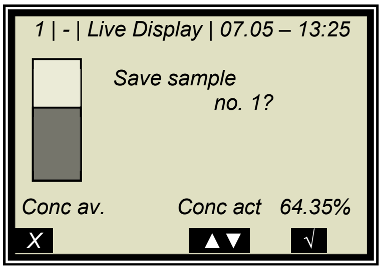
The display to the left appears if you push RUN.

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



Sampling is in process......

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



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

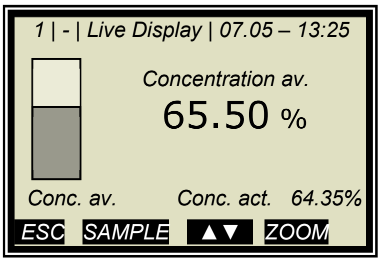
The process previously described must be repeated for each additional sample.

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

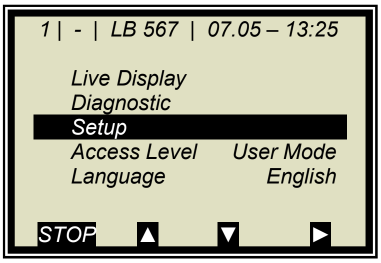
The minimum number of samples required is dependent on the selected calibration modes. If the sample size is too low, an error message is displayed after you have attempted to run a calibration.

About six samples suffice for a rough calculation of the calibration coefficients, provided the concentration differs by at least 5%. At least 15 samples are required for fine calibration and temperature compensation.

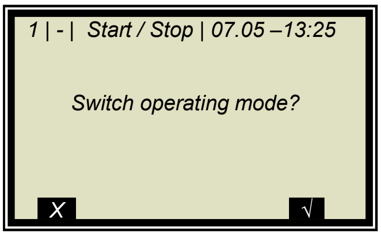
6.2.1 Entering the Lab Values



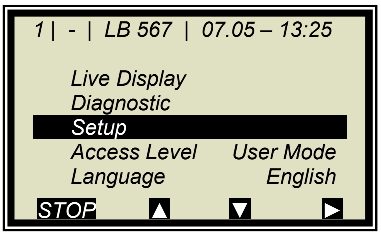
Push ESC to go to the main menu. A measurement can be stopped only in the main menu.



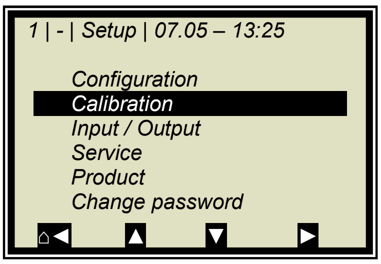
Push STOP to stop the measuring system.



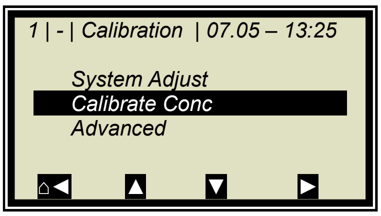
Push √ to confirm the prompt and the measurement switches to the *STOP* mode.



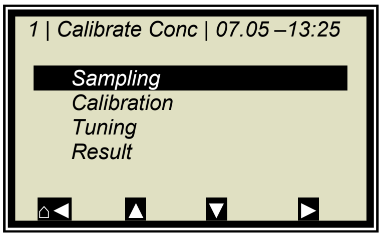
- ➢ SETUP



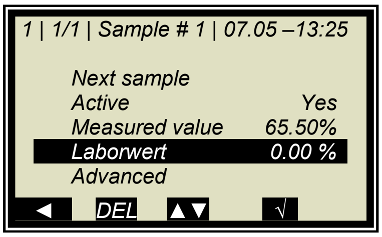
- ➢ CALIBRATION



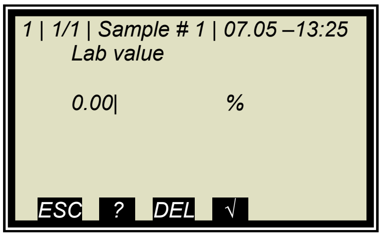
- ➢ CALIBRATE CONC



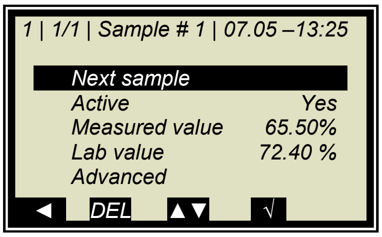
➢ SAMPLING



➢ LAB VALUE



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



➢ NEXT SAMPLE

and repeat the step described above with the next sample.

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

6.3 Calibration

Proceed as described in *chapter 9.1.*

Chapter 7. **Calibration Conveyor Belt/Chute**

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

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

7.1 System Adjust

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

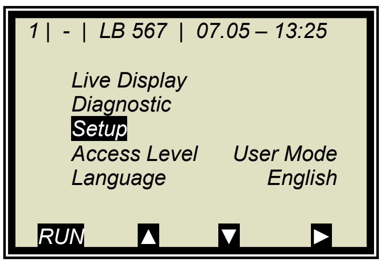
a) microwave reference measurement on an empty belt and/or chute (regular case)

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

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

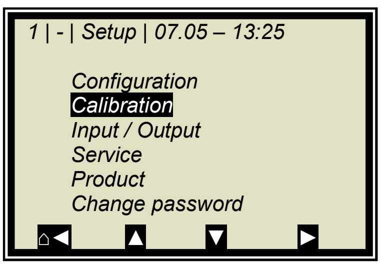
Normally, the reference measurement is carried out with empty belt or chute. The belt (chute) should **run empty, clean and dry**.

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

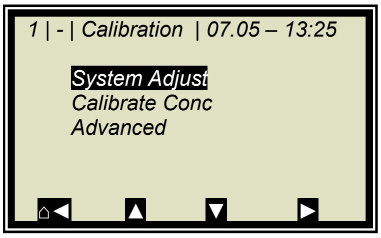


Starting from the main menu:

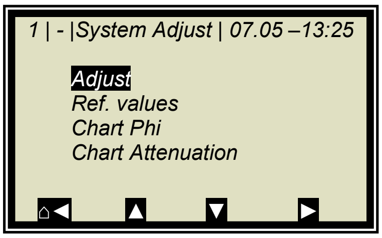
- ➢ SETUP



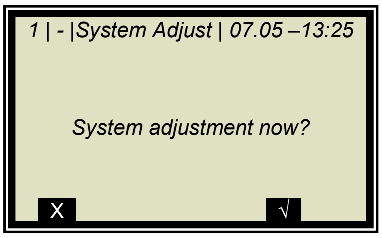
- ➢ CALIBRATION



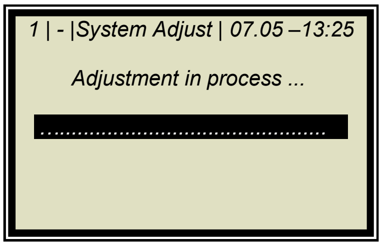
➢ SYSTEM ADJUST



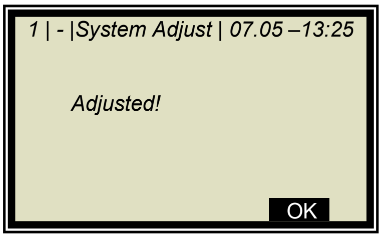
➢ ADJUST



Confirm



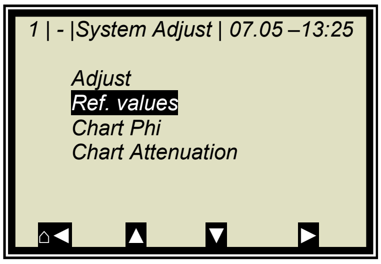
System adjustment is in process.



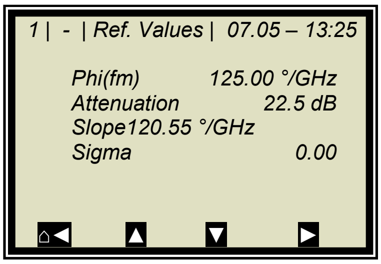
Push **OK** to confirm and push ⌂◀ three times to return to the main menu.

7.1.1 Verifying the Reference Values

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



➢ REFERENCE VALUES



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

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

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

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

7.1.2 Tare Measurement

Prerequisite:

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

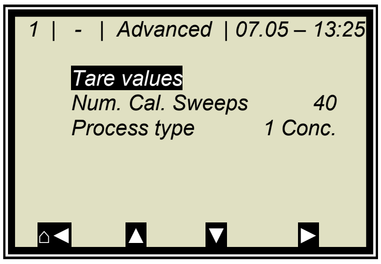
Following the reference measurement with full belt or chute, carry out a tare measurement with empty, clean and running belt. The measuring system is in the measurement mode. Please write down the following values from the live display:

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

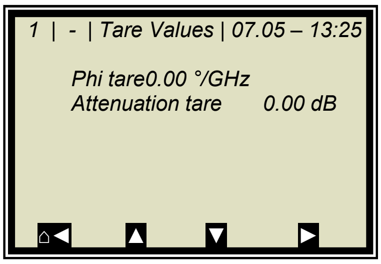
Typical values with empty belt/chute; of particular importance are:

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

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



➢ TARE VALUES

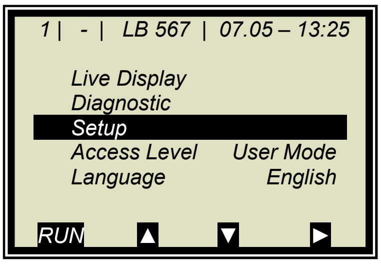


Enter the last recorded values of Phi(fm) and attenuation, taking into account the algebraic sign "- ".

7.2 Sampling

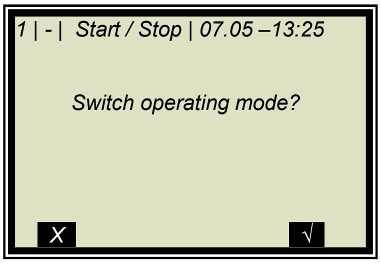
Before sampling, you have to enable the desired compensation inputs and check the calibration Only the measured values of the activated inputs are stored in the sample table.

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



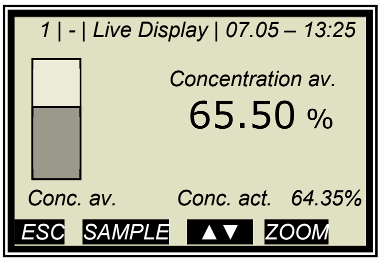
Push RUN to start the measuring system.

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



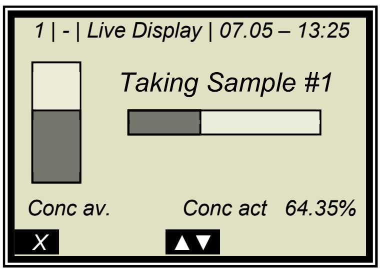
Watch the behavior of the microwave measurement with running full and empty belt, especially Sigma and Phi(fm) to ensure that not too many measurements will be rejected with empty belt or with maximum belt load.

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



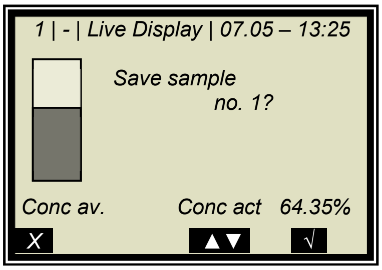
The display to the left appears if you push RUN.

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



Sampling is in process......

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



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

> The process previously described must be repeated for each additional sample.
>
> The assumed moisture of the samples should be distributed over the entire measuring range and the moisture should not vary too much during each sampling step.
>
> The measuring system has to operate at a normal conveyor belt throughput and the usual material under actual operating conditions.
>
> The minimum number of samples required is dependent on the selected calibration modes. If the sample size is too small, an error message is displayed after you have attempted to run a calibration.
>
> Approximately six samples suffice for a rough calculation of the calibration coefficients, provided the moisture differs by at least 5%. At least 15 samples are required for a fine calibration.

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

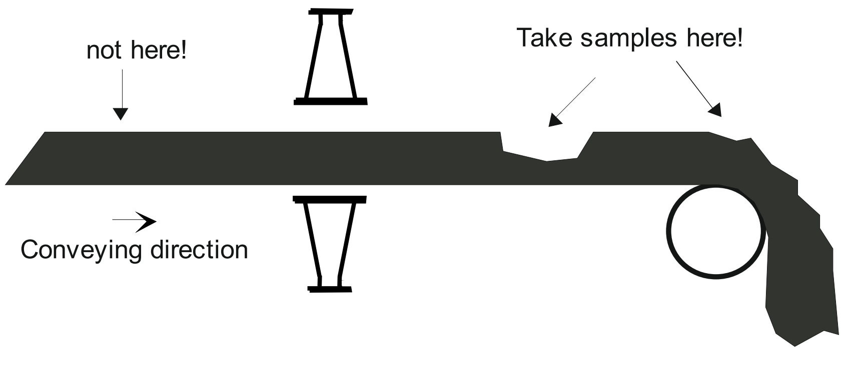


Figure 7-1: Sampling point on the conveyor belt

7.2.1 Entering the Lab Values

Proceed as described in *chapter 6.2.1*.

7.3 Calibration

Proceed as described in *chapter 9.1.*

Chapter 8. **Start-up of MicroPolar 2 ++**

System adjustment and calibration are carried out in just the same way for MicroPolar 2 ++, as they are for the standard system MicroPolar 2. However, please keep in mind that the ++ unit requires a minimum attenuation of 50 dB over the entire concentration range and during system adjustment. When falling below, the measurement is not precise anymore.

The total attenuation is calculated as follows:

$dB_{total} = dB_{adjust} + dB_{live} + 0.4 \times$ signal cable length **Eq. 8-1**

where:

dB_{total}:	Total attenuation
$dB_{adjustment}$:	Attenuation during system calibration
dB_{live}:	Current attenuation in the measurement mode
Signal cable length:	e.g. 4 m HF-cable quad results in 8 m signal cable length (to and from)

The evaluation unit monitors the entire attenuation automatically and reports a falling below by an error message (error no. 55).

Remedy when falling short of the attenuation:

If the required overall attenuation is not reached, you have the option to install a 10 dB fixed attenuator into the transmitting branch (see Fig. 8-1). The standard model MicroPolar 2 should be used if the attenuation is clearly below the required value.

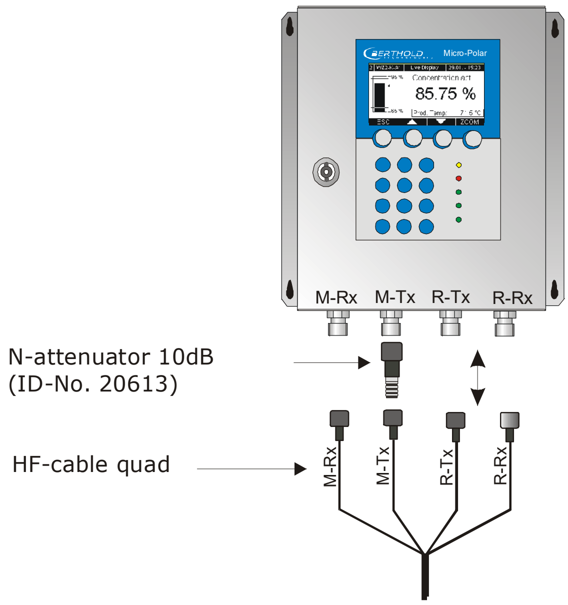


Figure 8-1: Assembly of the 10 dB attenuator

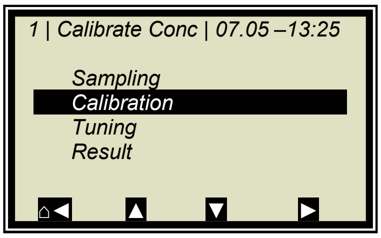
Chapter 9. **Calibration and Advanced**

9.1 Calibration

Prerequisite:
The steps described in chapter

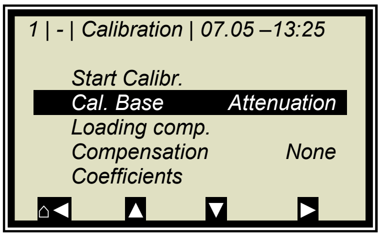
5.	**Configuration**
6.1 or 7.1	**System Calibration**
6.2 or 7.2	**Sampling**

have been completed.

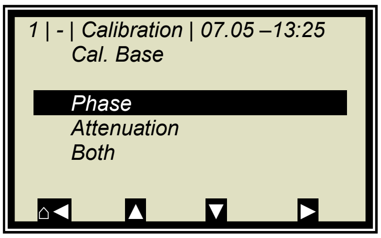


Starting from the main menu, go to the display shown on the left via:
| SETUP **|** CALIBRATION **|** CALIBRATE CONC **|**

- ➢ CALIBRATION



- ➢ CAL. BASE

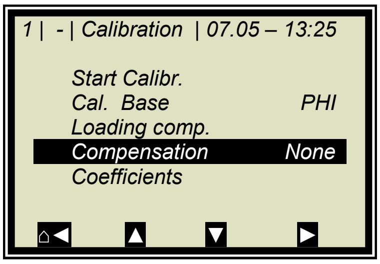


- ➢ PHASE (Phase measurement)

Standard for all applications: Phase

Set the desired compensation:

If **loading compensation** is required (for conveyor belt and chute applications), you have to define the parameters as described in *chapter 9.1.1*.



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

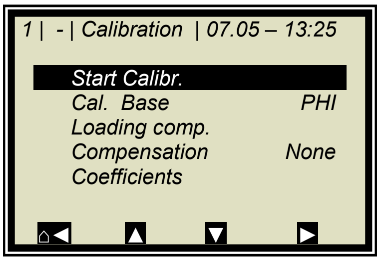
➢ COMPENSATION

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

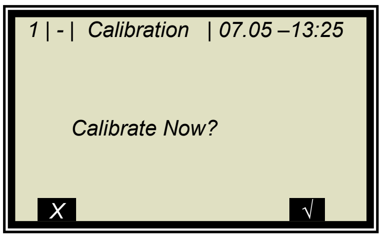
- None
- In1
- In1 + In2
- In1 + PT100
- In1 + In2 + PT100
- In2
- In2 + PT100
- PT100

Select "None" if no compensation is required.

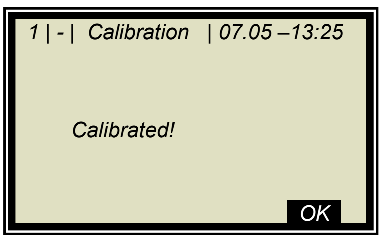
The automatic calculation of the calibration coefficients starts as soon as you have set the parameters for the compensation.



➢ START CALIBRATION

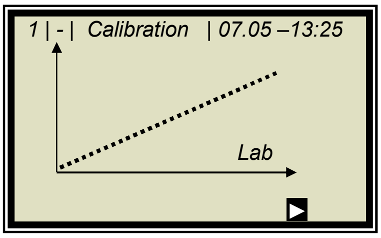


Push the √ button to start the calibration; push X to go back one page without calibration.



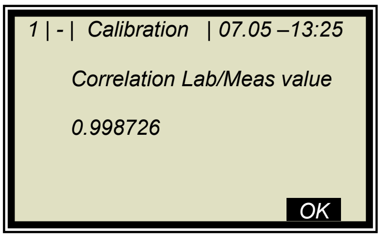
OK accepts the calibration and changes to the next display.

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



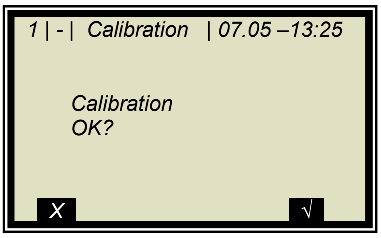
The graph on the left shows the measured value versus the lab value.

▶



Output of the correlation between measured value and lab value.

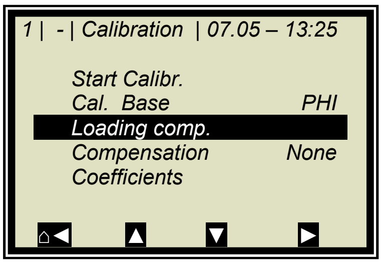
OK



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

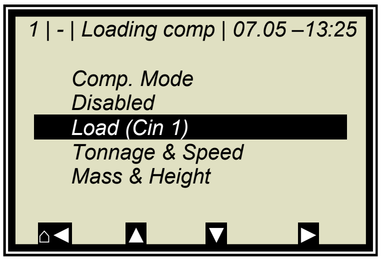
9.1.1 Calibration with Load Compensation

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



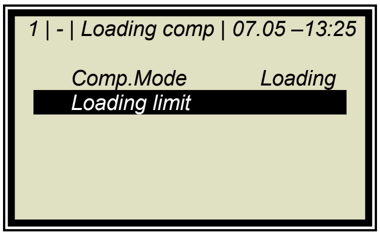
➢ LOAD COMP.

Select the desired compensation mode. For details see *chapter 4.2.20 Loading Compensation*.



In the case of compensation of the material layer thickness, e.g. with the ultrasonic sensor, select:

➢ LOADING (CIN 1)



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

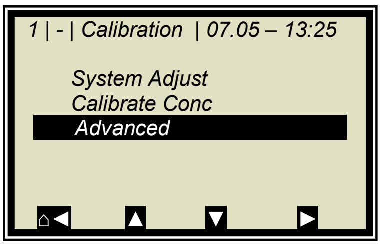
➢ LOADING LIMIT

Enter here for our example a minimum thickness of approximately 2 cm.
With such small layer thicknesses of the measurement error is too large for a proper measurement.

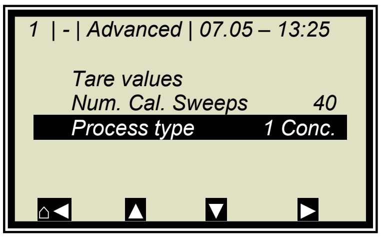
9.1.2 Calibration with Two Concentrations

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

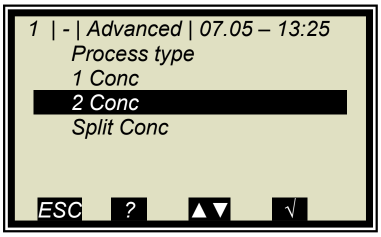
Starting from the main menu, go to the display shown on the left via
| SETUP | CALIBRATION |



➢ ADVANCED

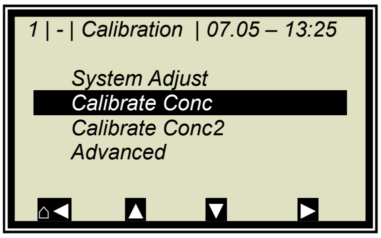


➢ PROCESS TYPE

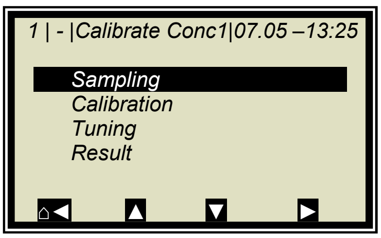


➢ 2 CONC

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



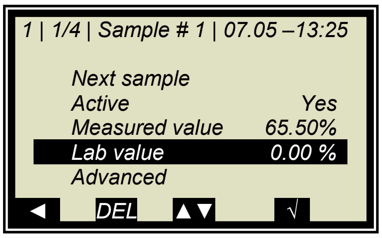
➢ CALIBRATE CONC (corresponding to concentration 1)



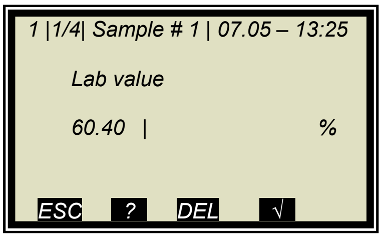
➢ SAMPLING

There is only one sample table for both calibrations.

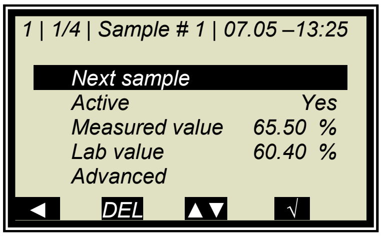
The lab values have to be entered for all samples used for calibration of concentration 1. All other samples have to be disabled (Active: Yes/No).



- LAB VALUE

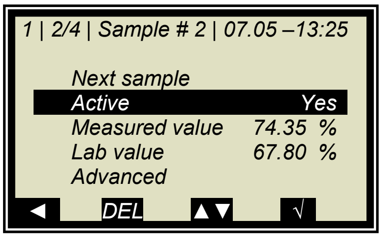


Delete default value with DEL and enter new value and confirm with √



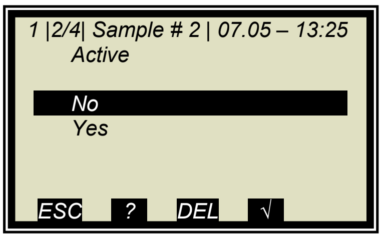
- NEXT SAMPLE

Continue with next sample

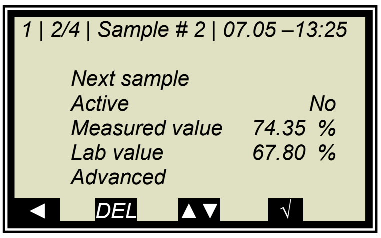


- ACTIVE

Disable sample

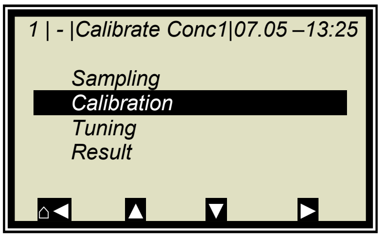


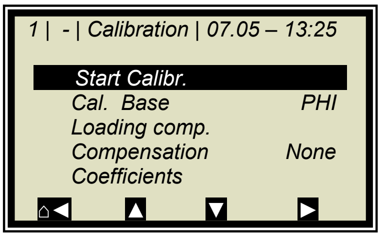
- NO



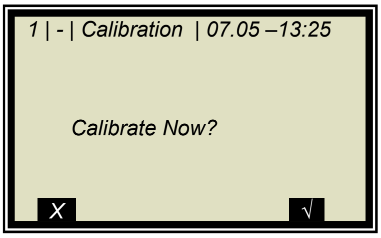
Make sure that all samples have been processed and only those samples are active which are relevant for this calibration.

Push ◀ to get to the Calibration page.

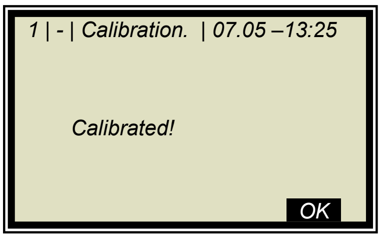




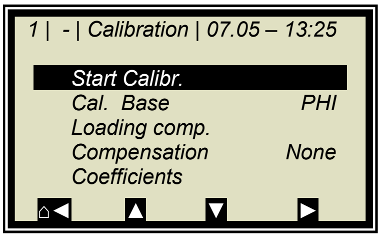
- ➢ START CALIBRATION



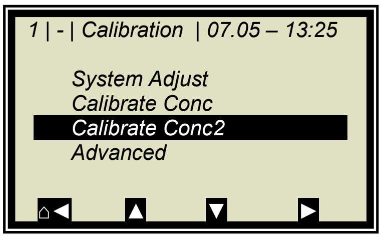
Push the √ button to start the calibration; push X to go back one page without calibration.



OK accepts the calibration and changes to the next display.

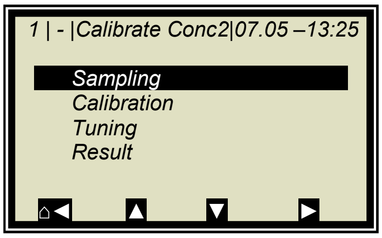


Push ⌂◀ twice to return two pages.



- CALIBRATE CONC 2

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

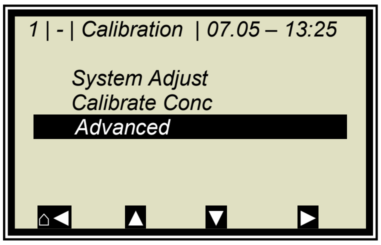


- SAMPLING

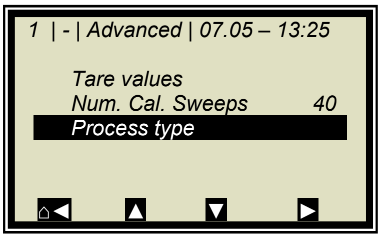
9.1.3 Calibration with Split Value

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

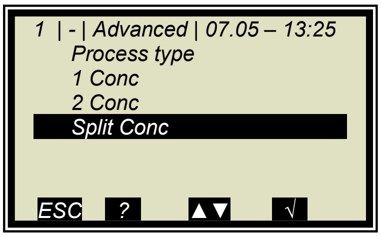
Conc 1 for the lower and conc 2 for the upper measuring range can be output only together via current output.



- ADVANCED

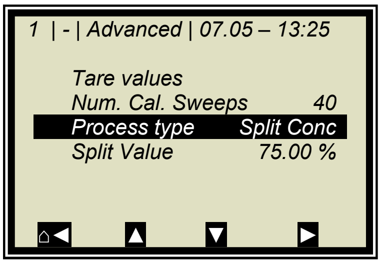


- PROCESS TYPE

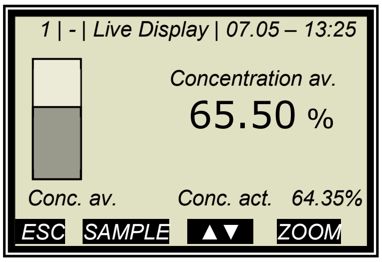


- SPLIT CONC

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



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



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

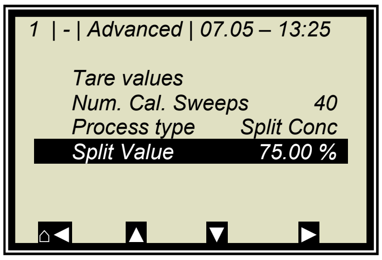
After completion of sampling, the individual samples will be enabled or disabled during input of the laboratory values, relative to the set split values. All samples smaller or equal to the split value will be assigned to the lower concentration range and all samples above to the upper concentration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

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

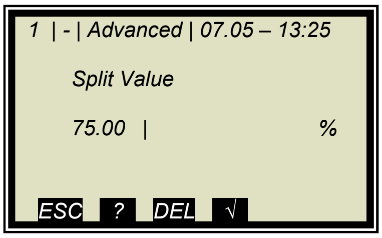
IMPORTANT

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

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

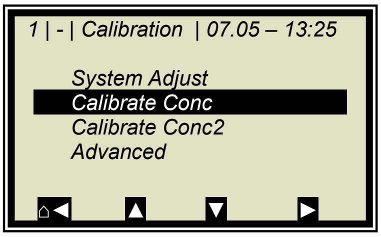


- SPLIT VALUE

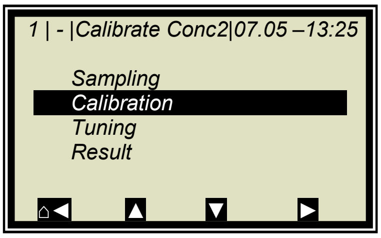


Enter the split value and confirm with √ .

Push ⌂◄ to get to the Calibration page.



➢ CALIBRATE CONC



➢ CALIBRATION

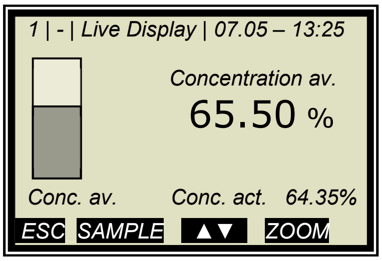
The lower concentration is now calibrated. Then select CONC2 and repeat the calibration process.
Go back to the main menu and start the measurement.

9.2 Adjusting the Calibration

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

Below please find an example for an offset adjustment.

The display to the left appears if you push RUN.

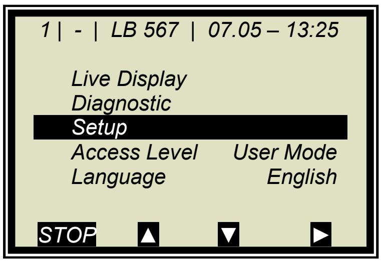


The display reading is now compared with the analysis value of the lab sample. The difference has to be entered as offset with the correct algebraic sign.

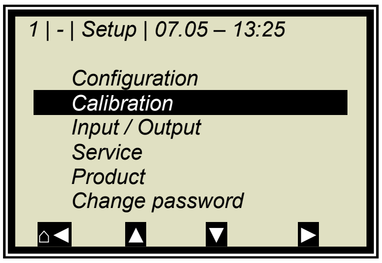
Calculation:

Analysis value – Display = Offset **Eq. 9-1**

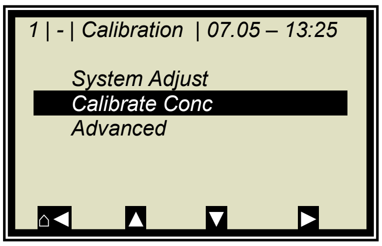
Push ESC to return to the main menu.



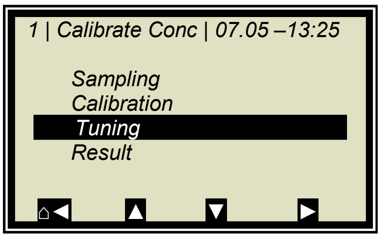
➢ SETUP



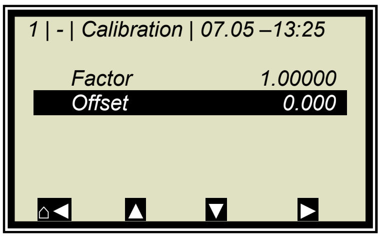
➢ CALIBRATION



➢ CALIBRATE CONC

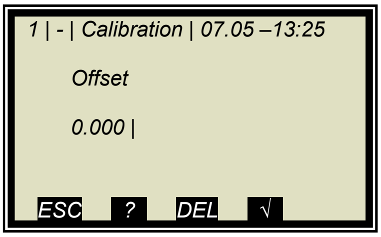


➢ TUNING

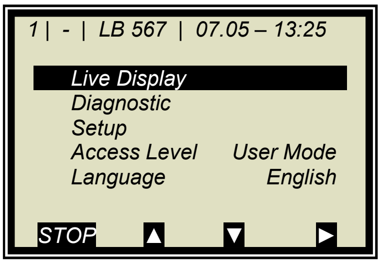


➢ OFFSET

Calculation formulas see *chapter 4.2.15 Calibrate Concentration*.



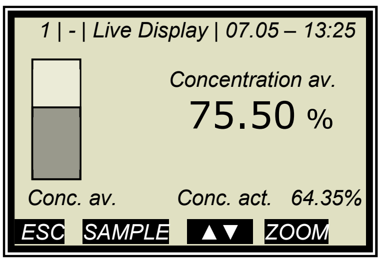
Enter the calculated offset value, confirm with √ button and push the Home button ⌂◀ four times to return to the main menu.



Select

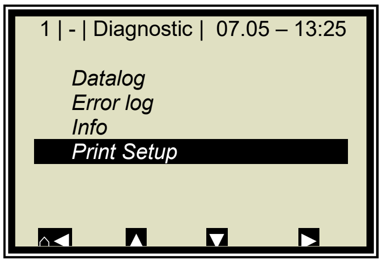
➢ LIVE DISPLAY

to get back to the display.



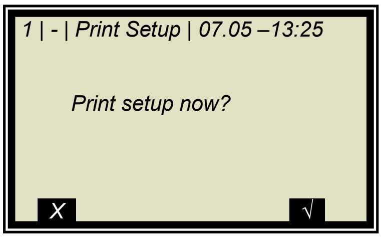
The reading value should now correspond to the actual value.

9.3 Output of the Start-up Protocol



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

- PRINT SETUP



Push the √ button to print the setup via RS232 and RS485. Push X to go back one page without printout.

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

For further information on the start-up protocol see *chapter 12*. Start-up Protocol

9.4 Typical Calibration Coefficients/Start Values

C: Concentration value at system calibration

For applications with flow cell nominal width DN 50 and without temperature compensation

A = - 0.19 to determine the concentration of dry matter

A = - 0.19 to determine the concentration of moisture

Chapter 10. **Password**

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

The access levels are as follows.

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

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

Service
The service level is reserved to service personnel.

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

PASS1

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

10.1 Password Forgotten

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

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

Chapter 11. **Error Lists and Device States**

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

11.1 Power failures

Code	***Error***	***Probable cause / correction***
10	24V power fail	*Please contact the Berthold Technologies Service.*
11	9V power fail	*Please contact the Berthold Technologies Service.*
12	5V power fail	*Please contact the Berthold Technologies Service.*
13	3V power fail	*Please contact the Berthold Technologies Service.*
14	Battery fail	*Battery power is low, replace immediately,* *see Hardware Manual, chapter 5.4*

11.2 Temperature errors

Code	***Error***	***Probable cause / correction***
20	Attention: Ambient temperature too high!	*Check operating temperature of the evaluation unit, permissible range: -20 to 50° C or 45° C*
21	RF temperature out of range	*Check operating temperature of the evaluation unit, permissible range: -20 to 50° C or 45° C*

11.3 Hardware errors

Code	***Error***	***Probable cause / correction***
30	Program memory corrupted	*Please contact the Berthold Technologies Service.*
31	Data memory corrupted	*Please contact the Berthold Technologies Service.*
32	Parameter memory corrupted	*Compatibility check after software download: A general reset must be carried out.*
33	I2C-bus communica-tion	*Please contact the Berthold Technologies Service.*
34	DAC update failure	*Please contact the Berthold Technologies Service.*
35	LCD contrast	*Please contact the Berthold Technologies Service.*
36	LCD controller	*Please contact the Berthold Technologies Service.*
37	Keypad error	*Please contact the Berthold Technologies Service.*
38	RF communication er-ror	*Please contact the Berthold Technologies Service.*
39	RF hardware failure	*Faulty cable connection between the motherboard and HF unit. Check con-nector on the mother-board.* *Caution! First, disconnect the evaluation unit from the power supply!*
40	I/O communication er-ror	*Please contact the Berthold Technologies Service.*
41	I/O module error	*Please contact the Berthold Technologies Service.*
42	RF Board startup error	*Please contact the Berthold Technologies Service.*

11.4 Sensor errors

Code	***Error***	***Probable cause / correction***
50	Phase variance too high	*The measured phase exceeds the allowed Sigma limit.*
53	No product	*The evaluation unit is in the Offline state (no product present).*
54	No system adjustment available	The system calibration has not yet been carried out.
55	Insertion loss underrun	See Software Manual, chapter 8

11.5 Analog input range errors

Code	***Error***	***Probable cause / correction***
60	Current input 1 out of range	The enabled current input has not yet been calibrated or is not occupied.
61	Current input 2 out of range	The enabled current input has not yet been calibrated or is not occupied.
62	Pt100 temperature out of range	The enabled PT100 input has not yet been calibrated or is not yet occupied.

11.6 Measurement range errors

Code	***Error***	***Probable cause / correction***
70	Concentration out of range	The concentration is outside the process limits.
71	Concentration 2 out of range	Concentration 2 is outside the process limits.
72	Loading value 1 below the limit	Below the minimum load for concentration 1
73	Loading value 2 below the limit	Below the minimum load for concentration 1
74	Loading comp. disabled. Cur. Input upper & lower value invalid	Current input is outside the range.
75	Sync. time too long	*Review settings for synchronization, see chapter 7.3 in Hardware Manual.*
76	Synchronization: speed out of range	*Review settings for synchronization, see chapter 7.3 in Hardware Manual.*
77	Waiting for sync. value	*The measurement has not yet been synchronized, please wait.*

11.7 Auxiliary measurement errors

Code	***Error***	***Probable cause / correction***
78	Mass flow 1 calc. disabled. Product speed invalid	*Please contact the Berthold Technologies Service.*
79	Mass flow 1 calc. disabled. Density invalid	*Please contact the Berthold Technologies Service.*
80	Mass flow 2 calc. disabled. Product speed invalid	*Please contact the Berthold Technologies Service.*
81	Mass flow 2 calc. disabled. Density invalid	*Please contact the Berthold Technologies Service.*

11.8 Analog output range errors

Code	***Error***	***Probable cause / correction***
90	Current output 1 out of range	The concentration calcu-lated on the basis of the current is outside the cur-rent range
91	Current output 2 out of range	The concentration calcu-lated on the basis of the current is outside the cur-rent range

11.9 Watchdog error

Code	***Error***	***Probable cause / correction***
92	*Watchdog*	*Please contact the Berthold Technologies Service.*

11.10 System errors

Code	***Error***	***Probable cause / correction***
120	*No time / date setting*	*Please enter the date and the time.*

11.11 Density errors

Code	***Error***	***Probable cause / correction***
150	Density calc.: Radio-metric MPUA out of range	*Check the measured value of the radiometric MPUA*
151	Density calc.: Height signal out of range	*Check the measured value of the layer thickness sensor*

11.12 Input Error

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

11.13 Device States

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

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

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

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

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

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

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

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

Chapter 12. **Start-up Protocol**

The log can be output via RS232 and RS485. The printout takes place on the menu | DIAGNOSTIC | PRINT SETUP |.

The serial interfaces RS232 and RS485 have the following port settings:
Data transfer rate 38400 Bd, 8 data bits, no parity, 1 stop bit

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

Separator: Tabulator
Decimal separator: .
Thousand separator ,

The following code list helps you to interpret the start-up protocol, see example in *chapter 12.1*.

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

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

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

12.1 Example of Start-up Protocol

Menu: Product	Start of Setup: Start-up Protocol Entry	Product1	Prod-uct2	Prod. 3	Prod. 4	Interpretation: (* Only relevant for service)
Data log	Log type :	0				Log type: see code list
	Log time:	2				Log time: see code list
	Number of errors :	0				Number of entries in the error log
	NTC temperature :	45.3 °C				*
	max. NTC temperature :	46.7 °C				*
	9V power supply :	8.94 V				*
Info	Tag :	-				Tag
	Device type :	LB 567				Device type
	Unique device ID number :	761				
	Serial number :	4294967000				
	Final assembly number :	000-000				
	Software version :	3.00				
	Software release date :	02.02.2016				Software revision date
	Actual date :	10.02.2016				Date of logging
	Actual time :	12:15				Time of logging
Measure-ment	Measuring mode :	0				Measuring mode: see code list
	Start mode :	0				Start mode: see code list
	Filter damping value[2] :	60				Averaging Current output
	Filter damping value[3] :	40				Averaging number when sampling
	Reset average :	FALSE				Reset Averaging: Yes/No
Plausibility	Lower limit :	0.00				Min. process limit:
	Upper limit :	100.00				Max. process limit
	Raw data average value	15				*
	Max. phase sigma :	500				Sigma max.
	Phi slope filter damp:	-15 dB				*
Microwave	Ref. cable length :	4.00 m				Reference cable length
	Meas. cable length :	4.00 m				Signal cable length
	Wave band selection :	1				*
	Start frequency :	0				*
	Frequency step :	3				*
	Nbr of freq. points :	25				*
	Internal Attenuation :	0				
Marker	Marker name :	Mark1				Marker name for concentration
	Marker value :	75.00 %				Marker value for concentration
	Marker name[2] :	Mark2				Marker name for concentration 2
	Marker value[2] :	75.00 %				Marker value for concentration 2
System ad-just	Nbr of sweeps for reference :	1				*
EVU type	HF amplifier mode :	0				*
	Minimal insertion loss :	50.00 dB				*

Calibrate Conc	Calibration input selection :	0	Exp. Cal. input selection: see code list
	Calibration mode	0	*
	Calibration variable :	1	Calibration basis: see code list
	Phase coefficients :	0	Phase coefficient A
	Attenuation coefficients :	0	Attenuation Coefficient B
	Constant coefficient :	0	Constant C
	d coefficient	0	Comp-coefficient for PT100 input
	e coefficient	0	Comp-coefficient for current input 1
	f coefficient	0	Comp-coefficient for current input 2
	g coefficient	0	Comp-coefficient for loading
	Adjust factor :	1	Factor
	Adjust offset :	0	Offset
	Massflow calculation mode:	0	Throughput calculation: see code list
	Loading comp. Selection:	0	Loading compensation: see code list
	Loading comp. Lower limit:	0	Value for minimum load
Synchroni-zation	Synchronizer mode:	0	Synchronization: see code list
	Current input1 distance to uWave	0	Distance of sensors
	Current input1 distance to uWave	0	Distance of sensors
Calibrate Conc 2	Calibration input selection :	0	Exp. Cal. input selection: see code list
	Lower limit :	0.00 %	Min. process limit (plausibility for Conc 2)
	Upper limit :	100.00 %	Max. process limit (plausibility for Conc 2)
	Calibration mode :	0	*
	Calibration variable :	0	Calibration basis: see code list
	Phase coefficients :	0	Phase coefficient A
	Attenuation coefficients :	0	Attenuation Coefficient B
	Constant coefficient :	0	Constant C
	d coefficient	0	Comp-coefficient for PT100 input
	e coefficient	0	Comp-coefficient for current input 1
	f coefficient	0	Comp-coefficient for current input 2
	g coefficient	0	Comp-coefficient for loading
	Adjust factor :	1	Factor
	Adjust offset :	0	Offset
	Massflow calculation mode:	0	Throughput calculation: see code list
	Loading comp. Selection:	0	Loading compensation: see code list
	Loading comp. Lower limit:	0	Value for minimum load
Advanced	Tare Phase (°/GHz) :	0.00 °/GHz	
	Tare Attenuation (dB) :	0.00 dB	
	Measure configuration :	0	Process type: see code list
	Range split value :	75	Split value
Current output 1	AO Assign code :	0	Assignment: see code list
	AO Upper range value :	100	Upper value
	AO Lower range value :	0	Lower limit
	AO Alarm select code :	2	Error current: see code list
	AO Error current value :	22.00 mA	Error current value
Current output 2	AO Assign code[2] :	0	Assignment: see code list
	AO Upper range value[2] :	100	Upper value
	AO Lower range value[2] :	0	Lower limit
	Range selection[2] :	1	Range
	AO Alarm select code[2] :	2	Error current: see code list
	AO Error current value[2] :	22.00 mA	Error current value

Current output 1	AI Enabled :	0	Disabled: 0 Enabled:1
	AI Range selection :	1	Range: see code list
	AI Upper range value :	100	Upper value
	AI Lower range value :	0	Lower limit
	Analog input filter constant :	15	*
Current output 2	AI Enabled[2] :	0	Disabled: 0 Enabled: 1
	AI Range selection[2] :	1	Range: see code list
	AI Upper range value[2] :	100	Upper value
	AI Lower range value[2] :	0	Lower limit
	Analog input filter constant :	15	*
PT100 input	AI Enabled[3] :	0	Disabled: 0 Enabled: 1
Relay 1	DO Function :	1	Function: see code list
	DO Assignment :	0	Assignment: see code list
	DO Threshold :	0.00%	*
	DO Hysteresis :	5.00%	*
Relay 2	DO Function[2] :	2	Function: see code list
	DO Assignment[2] :	0	Assignment: see code list
	DO Threshold[2] :	0.00%	*
	DO Hysteresis[2] :	5.00%	*
Digital Input	DI Function selection :	0	Function digital input 1: see code list
	DI Function selection[2] :	0	Function digital input 2: see code list
	DI Function selection[3] :	0	Function digital input 3: see code list
	Printout mode :	1	Data output: see code list
	Access level :	2	Access level: see code list
	Language :	1	Language: see code list
	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 sigma:	0.24575

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

Start of Sample Data:

Sampling:

Product 1: Sample Data for Concentration 1:

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

Correlation factor between
lab and meas values: 1

End of Sample Data

Do not use following data!

12.2 Sampling

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

Notes

Notes