

# Moisture, dry substance and concentration

Microwave measurements



## MicroPolar – Microwave measurement technology



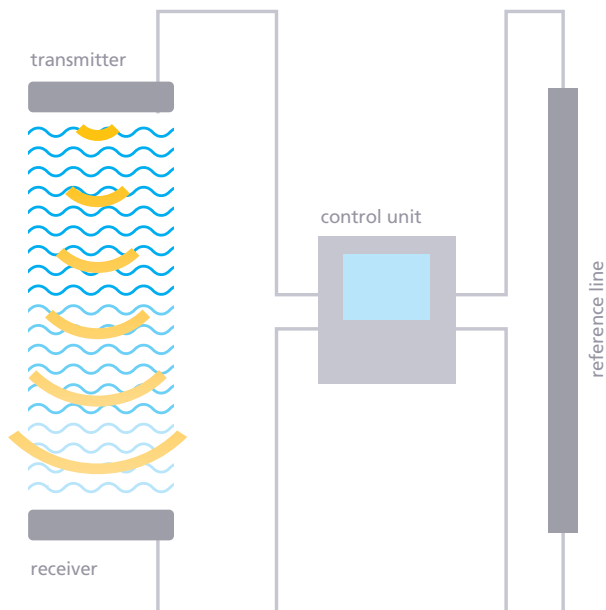
### Areas of application

The microwave measurement technology from Berthold Technologies is used to measure the concentration, dry substance or moisture content in the most varied types of products during ongoing production - either on conveyor belts, in chutes, in pipes or in vessels.

Our microwave systems can be used across a wide range of very different industries such as the food industry, power stations, mines and papers mills as well as many more. The selection of sensors and technical features such as dynamics, frequency etc. is correspondingly large in order to be able to meet the requirements of such multifaceted industries.

MicroPolar offers measuring capabilities for:

- bulk materials
- suspensions
- liquids
- pastes
- powders
- granulates



## The measuring principle

Microwaves penetrate the material to be measured. The dielectric constant of the material indicates the influence on the microwaves. The dielectric constant of water is 20 times larger in comparison to other materials. This results in a strong interaction of the microwaves with water which we then measure as attenuation and phase shift. In this way the water content can be very accurately determined.

The multi-frequency technology used by Berthold Technologies guarantees very stable and reliable measurements which are not affected by interfering reflections or resonances.

The integrated reference line provides for reliable compensation of ambient influences. MicroPolar works with very weak microwave power (typically ca. 0.1 mW) which means that the material being measured is not heated or altered in any way.



## Advantages

### ■ Cost-optimised production due to real-time measurements

The online monitoring of production allows trends to be identified, and alterations to be made when necessary. Significant cost savings as well as improvements in production quality are the result. For many of our customers, the investment in the system had paid for itself in less than one year.

### ■ Representative, exact and reliable

Factors such as colour, viscosity, inhomogeneities or dust do not influence the measurement performance. The entire cross section of the material is constantly measured. Moreover the multi-frequency technology and the use of a reference line also result in particularly stable as well as representative results.

### ■ Non-contact measurement

The majority of our sensors do not come into contact with the material being measured; the sensors are not subject to any wear and tear. No servicing or type of special cleaning of the system is required.

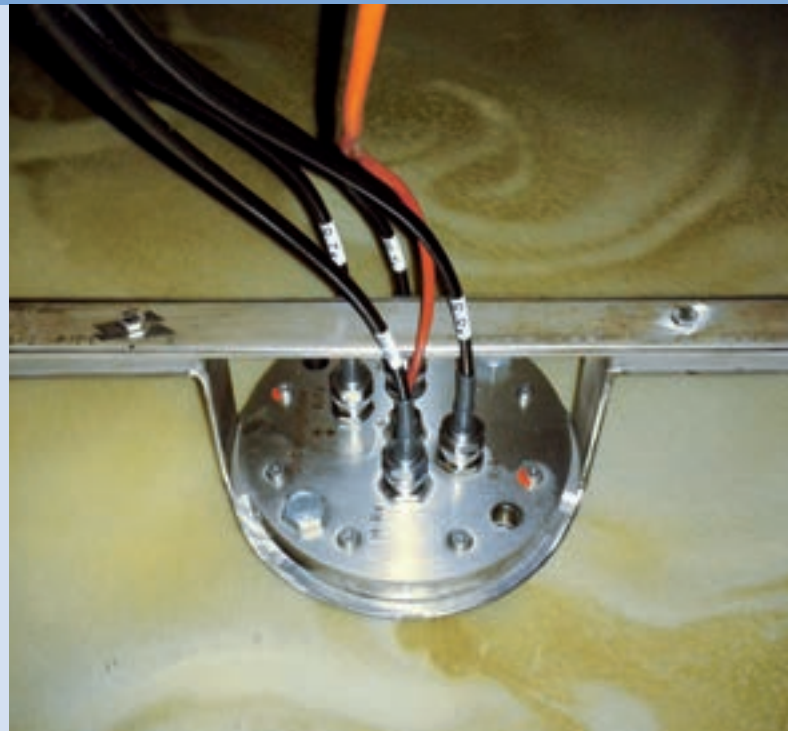
### ■ Very easy to use

MicroPolar can be very easily integrated into already existing production lines. The analyzer is equipped with a large display and user-friendly software. On-site calibration is also possible with this device.

# Measuring suspensions, solutions and pastes



Determining the dry substance in a wastewater pipe – LB 566 with flow cell.



Concentration measurement of a soap solution – LB 566 with container probe.

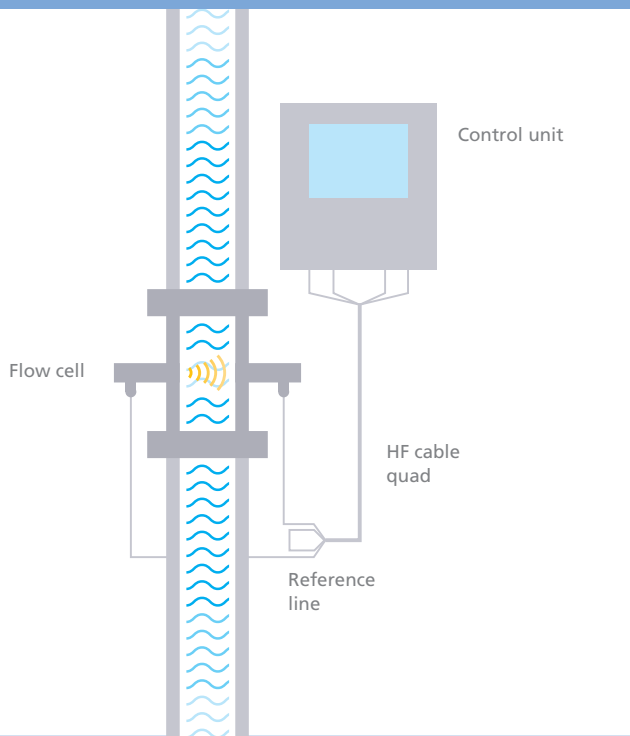
## MicroPolar – an excellent system

MicroPolar measures the density, concentration, dry substance or water content in fluids, suspensions, pastes or powders online.

This excellent system is typically used in power stations (flue-gas desulfurization), in wastewater treatment plants as well as in the chemical, food and pulp & paper industries. The measurements are carried out either in the pipes or in the vessels. The sensors used are very robust and guarantee long functional stability. MicroPolar works extremely accurately and reliably over many years. The high system dynamics also allows measurements even in the case of pipes with large diameters.

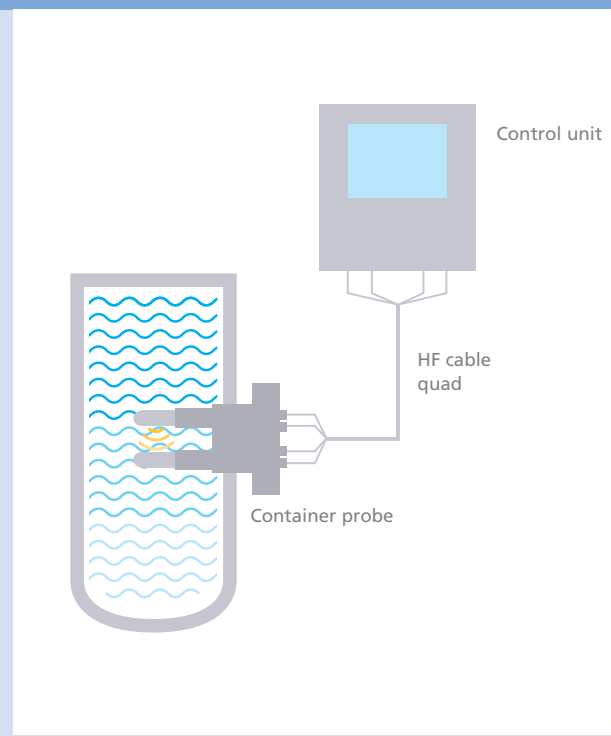
## Greater efficiency, process stability and quality:

- The precise measurement of the dry substance enables production closer to the process limits. This increases the throughput while reducing the production costs per unit.
- Real-time monitoring of the production allows for a fast and directed adaption of the parameters or processes - this reduces the volume of defective products.
- The online monitoring of the water content ensures compliance with regulations and standards, as in the food industry for example.



## Measurement set-up on the pipe

The flow cell is integrated into the existing pipe system. Since the microwave transmitter and receiver are attached on opposite sides of the flow cell, the entire cross section of the material is measured. A highly representative measurement can be guaranteed as a result.



## Measurement set-up on the vessel

The container probe is integrated into the side of the vessel, meaning that the product circulates around the transmitter and receiver antenna. The microwaves are emitted in a focused way and penetrate the entire area between the antennas. This allows for a stable and precise measurement.

### Measuring without safety concerns

The measurements are absolutely non-intrusive, the transmission power of the microwaves is a thousand times lower than that of a mobile phone.

### Examples of successful applications of MicroPolar:

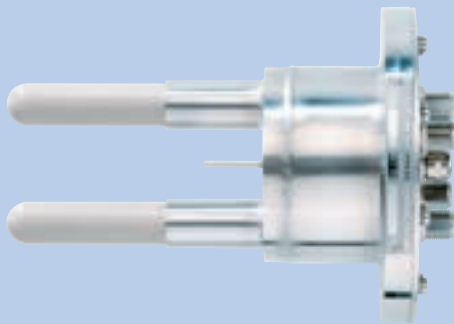
- butter
- milk of lime
- silica
- curd and cream cheese
- caramel
- tar
- water in oil/oil in water
- sewage sludge

# Sensors



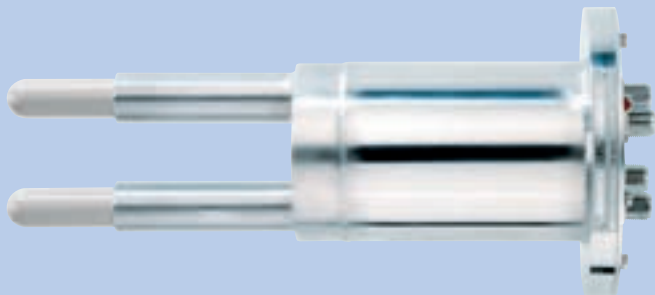
## Flow Cell

- measures the entire cross section of the pipe
- robust design
- a variety of designs for the nominal diameters of the different pipes DN 50...150
- internal lining made of abrasion-resistant Teflon
- no deposits
- easy to clean



## Container probe

- Pt100 for temperature compensation
- extremely abrasion-resistant polymer material
- integrated reference line
- various flanges available



## Container probe with flushing device

- extremely abrasion-resistant polymer
- integrated reference line
- integrated flushing device
- various flanges available

## Monitoring the water content of dairy products

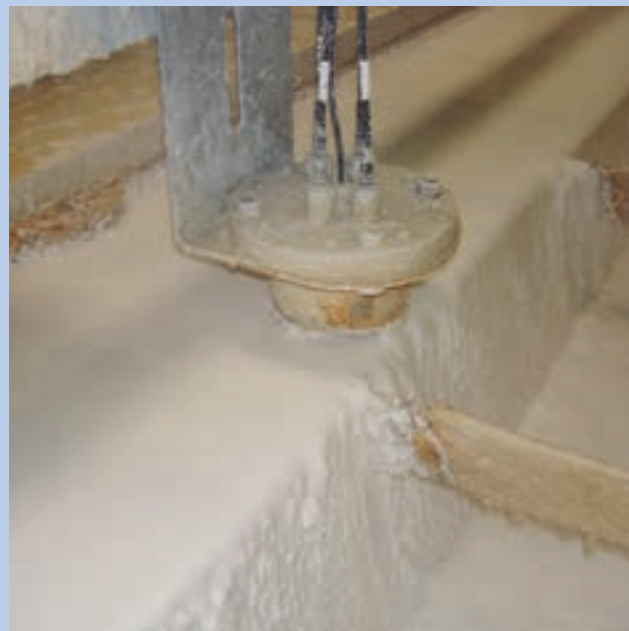
The online water-content measurement in the case of cream cheese, for example, allows for optimal control of the separator. The water content can be controlled exactly and compliance with legal regulations is guaranteed.



Water-content measurement in a dairy plant – LB 566 with flow cell

## Concentration measurement of milk of lime

MicroPolar monitors the dry substance of milk of lime or limestone suspension during ongoing operation. The mixture ratio can be set to the optimal level - the prerequisite for an efficient process flow.



Concentration measurement of milk of lime, installed in a sugar factory – LB 566 with container probe.

### Technical data

	Flow cell	Container probe
Material	Stainless steel, PTFE lining	Polymer rod, stainless steel
Mounting	Flange in accordance with DIN and ASA, nominal pipe diameter of 50 ... 150 mm Fittings either with threads or clamp connector	Various flanges in accordance with DIN and ASA
Process pressure	Up to 20 bar (relative), depending on nominal diameter and flange type	Up to 16 bar, depending on sensor version
Temperature range	Inside temperature: 10...130 °C (50 ... 266 °F) Ambient temperature (Operation and storage): –20 ... 60 °C (–4 ... +140 °F)	Inside temperature: 10 ... 120 °C (50 ... 248 °F) Ambient temperature (Operation and storage): –20 ... 60 °C (–4 ... +140 °F)
Connections	2 x HF connections, max. cable length: 10 m (LB 566 (++)), 4 m (LB 567 (++))	4 x HF connections, max. cable length: 10 m (LB 566 (++)), 4 m (LB 567 (++))
Variants	Explosion protection in accordance with ATEX (Option) II 3 G Ex nAc IIC T1-T6 II 3 G Ex nAc IIB T1-T6 II 3 D Ex tc IIIC T130 °C	With flushing device With Pt100 temperature compensation

# Measuring bulk materials



Moisture measurement of wood chips – LB 568 with horn antennas and radiometric area weight compensation.

## MicroPolar

The MicroPolar measures the moisture of different bulk materials online. The measurement takes place on:

- conveyor belt
- bunker or silo
- chute

The used microwave technology allows for the non-contact measurement of the entire cross section of the material leading to precise and representative real-time data for quality control and process optimization.

Typical areas of application are in the mining industry, in biomass power plants, coking plants as well as in chemical plants, in the building materials and construction industry and in the pulp and paper industries.

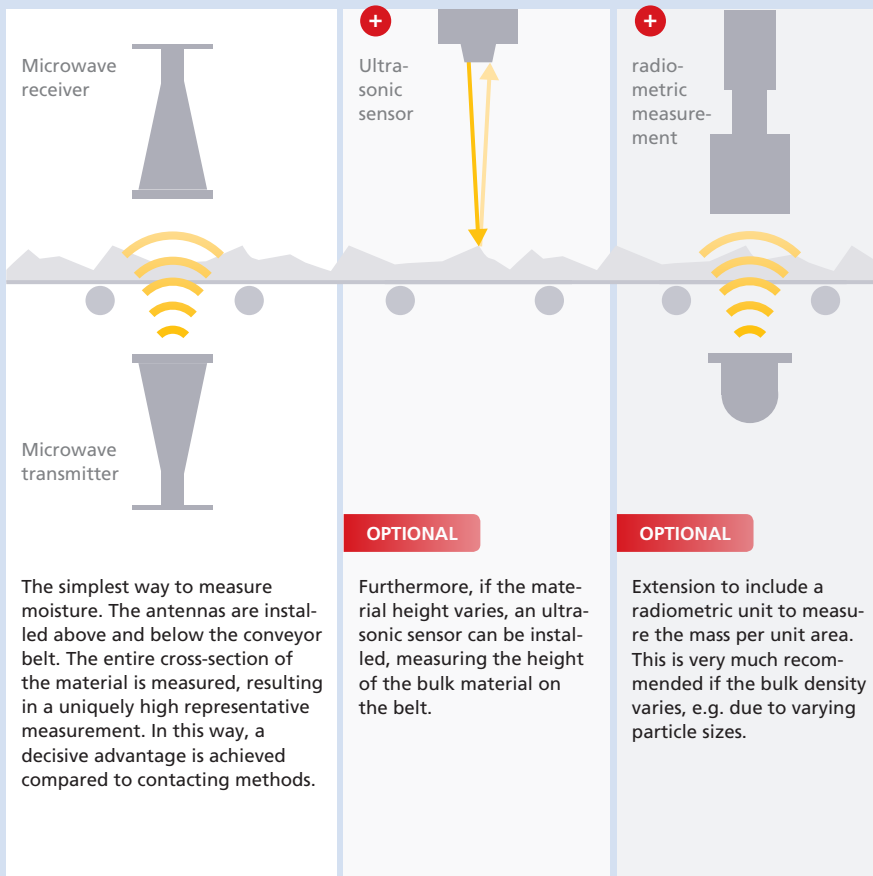
## An excellent system

The antennas do not come into contact with the bulk material and for this reason they are never subject to any wear and tear. The high dynamics also allow for measurements of high material layers.

The system offers the possibility of compensating for varying material heights by means of a separate height sensor (e.g. ultrasonic). In the case of varying bulk densities, a radiometric area-weight compensation can be connected optionally.



## Measurement set-up on the conveyor belt



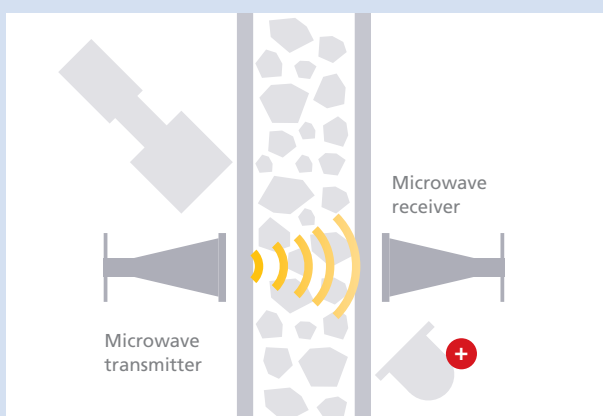
### A strong combination

Combine all three technologies in order to monitor both- the moisture as well as the bulk density. The density signal is provided by a second current output parallel to the moisture. In this way, for example, the loading of trucks or the feeding of furnaces can be optimally regulated.

Examples of the successful use of MicroPolar:

- wood chips and pellets
- wood fibres
- sand
- carbon in fly ash
- lignite and coal
- sand-lime brick
- fertilizer
- hay and straw
- coking coal
- bauxite
- phosphate
- tobacco
- calcium carbonate
- starch pellets and starch
- gypsum
- clay mass
- cereals
- chip board shavings
- sugar beet chips
- potato cuttings
- granulated furnace slag and foundry sand
- bentonite

## Measurement set-up on the chute



### OPTIONAL

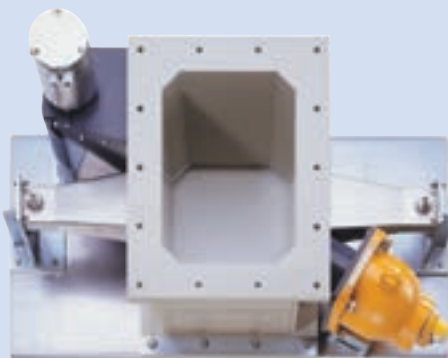
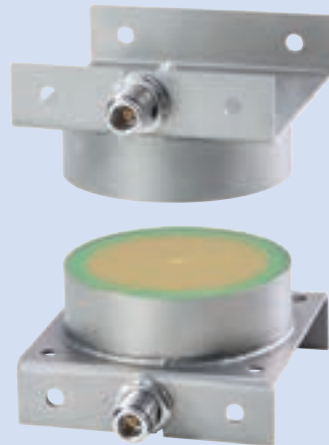
If the bulk density varies, an additional radiometric measuring unit should be installed. As a result, a density-independent moisture signal can be obtained, ensuring the highest possible precision for optimal process control.

# Antennas and measuring chute

## Live measurement ensures optimal process control

The precise monitoring of the moisture content at the loading and unloading stage ensures compliance with the delivery conditions. It allows for optimal process control with a cost-efficient use of energy in the case of burning and drying processes and reduces the reject volume due to live measuring during production.

The installation of the system is simple and can be done without process downtime. The system works reliably and is not adversely influenced by dust, temperature or colour.



### Horn antenna

- optimal focussing of the microwaves
- robust design
- through casting resin perfectly sealed microwave window, protects against moisture, dust and damage to the sensor unit
- high shock resistance
- vibration resistance

### Spiral antenna

- small and compact design
- perfect alternative for applications in areas with confined space
- robust design
- widely spread microwave field

### Measuring chute

- complete measurement set (radiometric system as an option)
- easy to integrate into the plant
- robust design
- optimal integration of the measuring components
- for inside temperatures of up to 140 °C
- optimal for low-volume material flows because the material can be collected until there is a certain amount within the microwave field.

## Technical data

### Horn antenna

Material	Stainless steel, microwave window made of polycarbonate
Ambient temperature (operation and storage)	-20 ... 60 °C (-4 ... +140 °F)
Connection	1 x HF connection, max. cable length: 4 m (LB 567, LB 568)

### Spiral antenna

Material	Stainless steel, polymer
Ambient temperature (operation and storage)	-20 ... 60 °C (-4 ... +140 °F)
Connection	1 x HF connections, max. cable length: 4 m (LB 567, LB 568)

### Measuring chute

Chute material variants	1. Polypropylene homopolymer (PP-H) 2. Polyvinylidene fluoride (PVDF)
Chute components	- chute set up - mounting plate - brackets - two HF angle connectors - fixing material
Temperature range	Ambient temperature (operation and storage): 0 ... 60 °C (32 ... 140 °F) Inside temperature: PP-H - chute: > 0 ... 90 °C (32 ... 194 °F) PVDF - chute: > 0 ... 140 °C (32 ... 284 °F)

### Option ultrasonic sensor (overall package including bracket and connection cable)

Measurement range	100 ... 1000 mm
Set-up	Teach-in
Power supply	15 ... 30 V DC, max. 55 mA
Output signal	4 ... 20 mA / 20 ... 4 mA
Protection class	IP67

### Option radiometric measurement

Radiation source	Cs-137, typ. 10 mCi, capsuled in accordance with the highest safety standard ISO 66646
Shielding	Type LB 7440 / LB 7445 housing made of stainless steel, lead-filled

### Detector

Variants	1. With collimator axial, for frontal irradiation 2. With collimator radial, for irradiation from the side
Scintillator Ø x length [mm]	CsI 40 x 50
Material	Stainless steel
Protection class	IP 66 / 67
Ambient temperature (operation and storage)	-20...50 °C (-4... +122 °F)
Power supply	Powered from the evaluation unit



Moisture measurement of phosphate - LB 567 with horn antennas in combination with an ultrasonic height sensor in order to compensate for the varying bulk material heights.



Moisture measurement of bales of straw identification of wet spots – LB 567 with horn antennas.

# MicroPolar control units

The heart of our measuring systems is the control unit. This is the result of a massive amount of experience and know-how. We offer this unit in three designs differing from each other in terms of frequency, frequency range and dynamics. This enables us to use the ideal technology, depending on the respective application and requirements. LB 566, LB 567 or LB 568 – our selection guide on the next page tells you which system is the right one for your particular application. Or talk to our experienced sales engineers.

## High Dynamic Version "MicroPolar ++"

The control unit is also available in a "High Dynamic Version" with an enhanced dynamic range. With this unit, better measuring results are achieved, in particular when large pipe diameters and large water contents cause a strong attenuation.



- Easy-to-use menu
- Different user levels depending on the particular purpose
- Automatic calibration
- Laboratory values are entered directly into the device, automatic correlation of the calibration curve
- Sample-taking function
- Up to 4 calibration curves can be saved
- Plausibility test: Continuous comparison of reference value with the measured value

## Memory Tool

Document all parameter settings, for example, commissioning protocols, on this external data storage device. The memory tool allows for an easy data export, protecting against unintended parameter adjustments. The data log is particularly suitable for the visualisation of process sequences. The memory tool is available as an accessory to the MicroPolar.

### Technical data

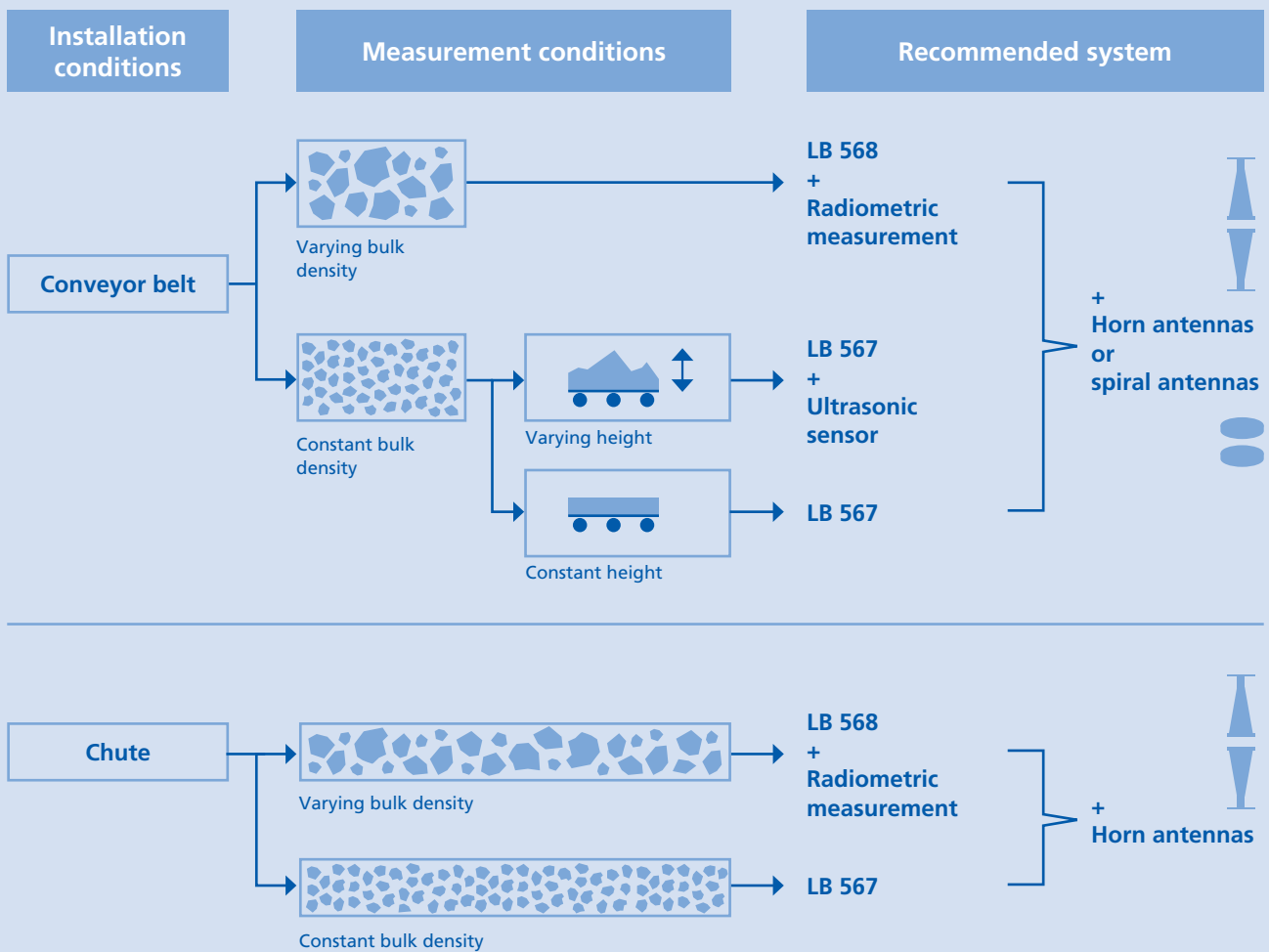
MicroPolar control units	
Method	Microwave transmission measurement
Transmitting power	<10 mW (<10 dBm), coaxial output power, depends on the particular type
Housing	Wall mounted housing made of stainless steel LB 566: HxWxD: 300x323x140 mm LB 566 ++ / LB 567 ++ / LB 568: 400x338x170 mm
Protection class	IP 65
Ambient temperature	Operation: - LB 566 (++) : -20 ... 60 °C (-4 ... 140 °F) - LB 567: -20...50 °C (-4 ... 122 °F) - LB 567 ++, LB 568: -20 ... 45 °C (-4 ... 113 °F) Storage: All versions: -20 ... 60 °C (4 ... 140 °F) Operation and storage without condensation
Achievable precision	≤ 0.1 weight % (standard deviation)
Power supply	All versions: 100 ... 240 V AC, 50/60 Hz LB 566 ++, LB 567 (++) , LB 568: 24 V DC LB 566: 24 V AC /DC
Power consumption	Max. (48/60) VA (AC/DC)
Software languages	English, German, French
Inputs and outputs	
Sensor connection	Inputs and outputs for HF cable (measurement and reference channel)
Current input	2 x current input 0/4...20 mA: Impedance 50 Ω, 1x insulated, 1x device earth e.g. temperature compensation, loading height compensation
Current output	Current output 1: 4 ... 20 mA, max. impedance 800 Ω , insulated, for measured value Current output 2: 0/4 ... 20 mA, max. impedance 800 Ω , insulated, e.g. for temperature, density etc.
Pt100 connection	Measurement range: -50 ... 200 °C (-58 ... 392 °F) for temperature compensation
Digital input	3 x digital inputs, functions: Start/Stop measurement, keep measurement, product range, test sample
Relay outputs	2 x relays, SPST, insulated, functions: Collective malfunction notification, pause measurement, threshold value (min. and max.), loading shortfall
Serial interface	For general data output (set-up, commissioning protocol, measured value) and software update All versions: RS232 (connection to memory tool or PC) LB 566 (++) , LB 567 (++) : RS485



MicroPolar installation in a power station for measuring the concentration of a limestone suspension

# Selection guide

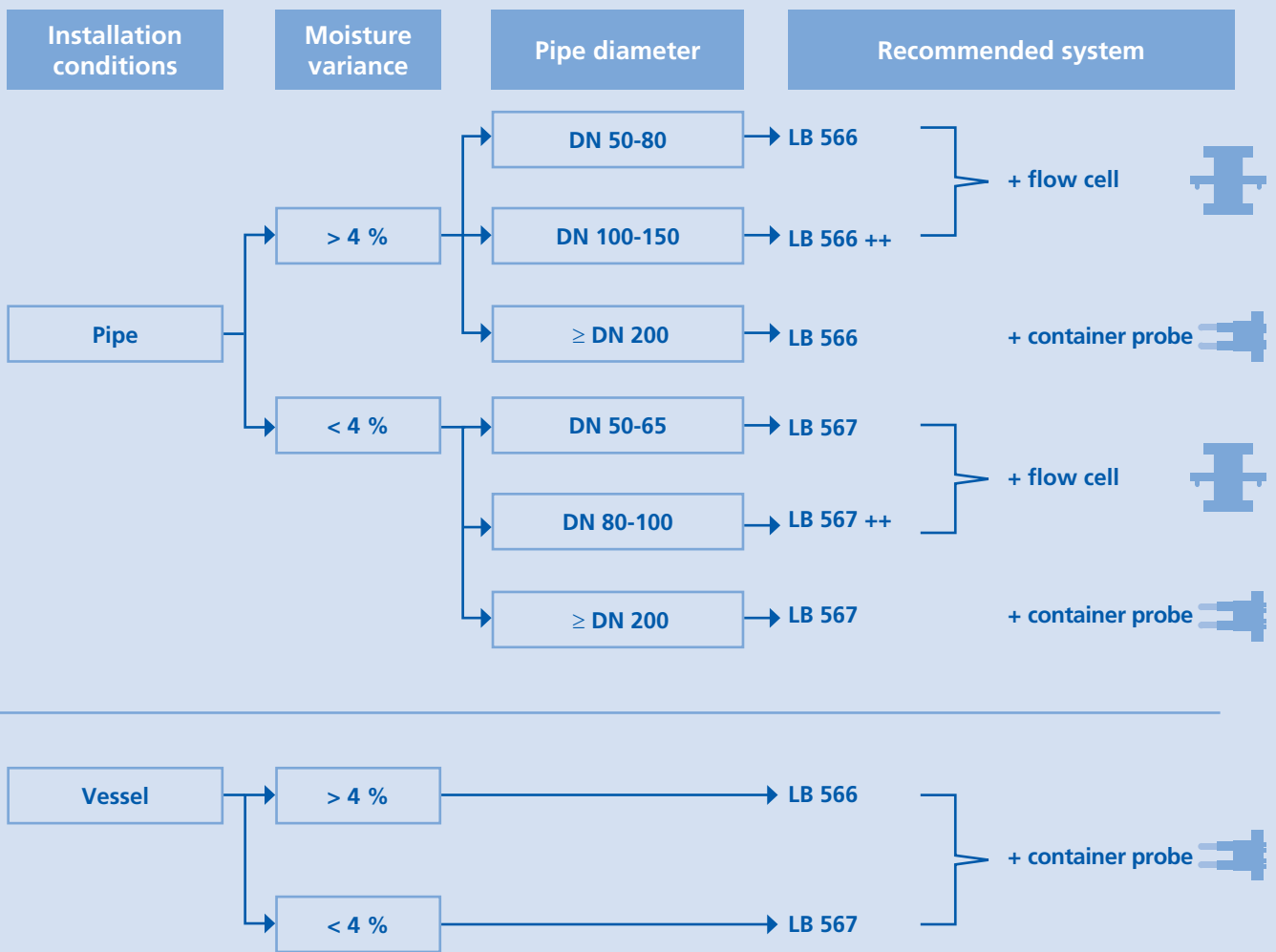
## Bulk materials



### „Quality you can trust“

BERTHOLD TECHNOLOGIES is certified in accordance with ISO 9001 and ISO 14001 and has over 30 years of experience in microwave technologies and more than 60 years of experience in radiometric measuring technologies. With our worldwide sales and service network, we can guarantee our customers fast and professional help on site.

## Liquids



### Technical Support – this goes without saying

We are happy to select the optimal system configuration for your application. Of course, this is free of charge and non-binding.



### **We are there for you! Worldwide.**

Wherever you want the moisture to be measured, our sales engineers are looking forward to giving you help and advice. We have the right system for every type of measurement task and we know how to configure it to exactly meet your needs. Our experienced sales engineers will choose the right one for you from the wide variety of possible variants that we have on offer.

We develop individual solutions for our customers, we consider complex tasks to be a challenge that we tackle with the greatest motivation in order to find the perfect solution for the individual needs of each of our customers.

Absolutely all components required for this purposes are developed and manufactured in Germany. You will always receive quality "Made in Germany".

### **Berthold – perfect solutions from a single source.**

Our engineers and service technicians are always there when and where they are needed. Thanks to our worldwide network of branch offices, we are able to guarantee you the quickest and most competent support. Our qualified personnel will be there for you in the fastest time possible, no matter where your production facilities are located.

### **That's a promise.**



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