



BM 702 A Handbook

2-wire non-contact Radar (FMCW) level meter

Software: PC-CAT 2 for Windows 5.0.0
Firmware: 7.44

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1.1 Software history

Introduction	Signal converter		User program			Instructions	
	Mth./year	Hardware	Firmware	Hardware	Operating system	Software	Device
Test version for field tests							
12/08	BM 702 A	7.44PRE06	PC	Windows 95/98/2000/NT/XP/Vista	PC-CAT 2 for Windows 5.0.0.116	-	Online help
Series version for BM 702 A							
09/09	BM 702 A	7.44	PC	Windows 95/98/2000/NT/XP/Vista	PC-CAT 2 for Windows 5.0.0	09/09	Online help

1.2 Intended use

This radar level meter measures distance, level, mass and volume of liquids, pastes and slurries. It can be installed on tanks and reactors.

1.3 Certification

CE marking



The device fulfils the statutory requirements of the following EC directives and harmonized standards:

- EMC Directive 2004/108/EC: EN 61326-2-3:2006
- ATEX Directive 94/9/EC: EN 60079-0:2006, EN 60079-11:2007, EN 60079-26:2007
- R&TTE Directive 1995/5/EC: EN 302 372-2 V1.1.1

The manufacturer certifies successful testing of the product by applying the CE marking.



DANGER!

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

1.4 European Union (EU)



LEGAL NOTICE!

This level transmitter is intended for installation in closed metallic tanks. It meets the requirements of the R & TTE (Radio Equipment and Telecommunications Terminal Equipment) Directive 1999/05/EC for use in the member countries of the EU.

The device operates using a frequency band that is not fully harmonized within the EU.

According to article 6.4 of the R&TTE Directive, the product is marked by the CE sign + notified body number (0682) + Class 2 identifier (= alert sign).

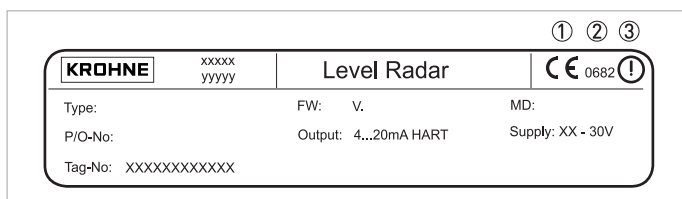


Figure 1-1: Radio approval information on the nameplate

- ① CE sign
- ② Notified body number (0682 = CETECOM)
- ③ Class 2 identifier

Refer also to the radio approval certificate on the internet site.

1.5 Safety instructions from the manufacturer

1.5.1 Copyright and data protection

The contents of this document have been created with great care. Nevertheless, we provide no guarantee that the contents are correct, complete or up-to-date.

The contents and works in this document are subject to German copyright. Contributions from third parties are identified as such. Reproduction, processing, dissemination and any type of use beyond what is permitted under copyright requires written authorisation from the respective author and/or the manufacturer.

The manufacturer tries always to observe the copyrights of others, and to draw on works created in-house or works in the public domain.

The collection of personal data (such as names, street addresses or e-mail addresses) in the manufacturer's documents is always on a voluntary basis whenever possible. Whenever feasible, it is always possible to make use of the offerings and services without providing any personal data.

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We hereby expressly prohibit the use of the contact data published as part of our duty to publish an imprint for the purpose of sending us any advertising or informational materials that we have not expressly requested.

1.5.2 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect, incidental, punitive and consequential damages.

This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.

1.5.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation and operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

1.5.4 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of underneath icons.

1.5.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.



DANGER!

This information refers to the immediate danger when working with electricity.



DANGER!

This warning refers to the immediate danger of burns caused by heat or hot surfaces.



DANGER!

This warning refers to the immediate danger when using this device in a hazardous atmosphere.



DANGER!

These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator's plant.



WARNING!

Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator's plant.



CAUTION!

Disregarding these instructions can result in damage to the device or to parts of the operator's plant.



INFORMATION!

These instructions contain important information for the handling of the device.



LEGAL NOTICE!

This note contains information on statutory directives and standards.



• **HANDLING**

This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

➡ **RESULT**

This symbol refers to all important consequences of the previous actions.

1.6 Safety instructions for the operator



WARNING!

*In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.
This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.*

2.1 Scope of delivery



INFORMATION!

Inspect the cartons carefully for damage or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.



INFORMATION!

Check the packing list to check if you received completely all that you ordered.



INFORMATION!

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

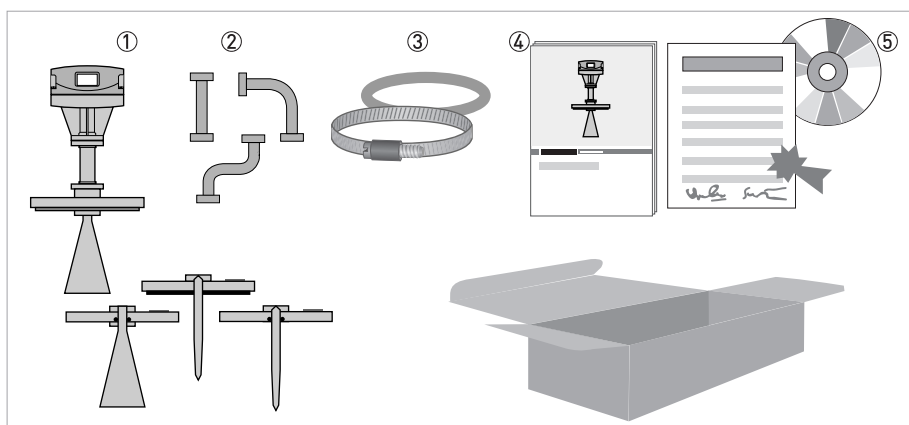


Figure 2-1: Scope of delivery

- ① Signal converter and antenna as ordered
- ② Antenna extensions (option)
- ③ Shielding material with tightening strap
- ④ Product documentation
- ⑤ CD-ROM (including related software)



INFORMATION!

Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

2.2 Device description

Most of the device versions are delivered in fully assembled condition. The modular design allows maximum flexibility.

The system consists of:

- Converter
- Flange
- Antenna (Wave-Stick or horn antenna)

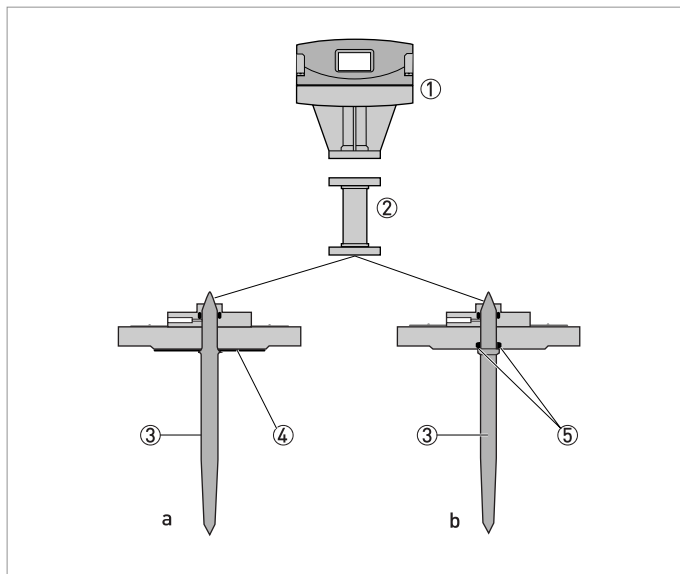


Figure 2-2: Versions with Wave-Stick

a = Wave-Stick with plate (PTFE)

b = Wave-Stick without plate (PP or PTFE)

- ① Converter
- ② High-temperature distance piece (option)
- ③ Wave-Stick
- ④ Flange plate
- ⑤ Gasket

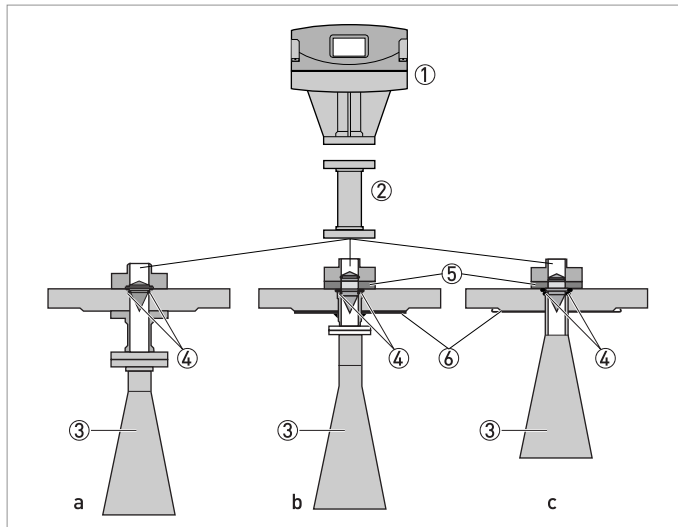


Figure 2-3: Versions with horn antenna

a = horn antenna with LP flange system

b = horn antenna with V96 flange system (Hastelloy® flange plate)

c = horn antenna with V96 flange system (Titanium or Tantalum flange plate)

- ① Converter
- ② High-temperature distance piece (option)
- ③ Horn antenna
- ④ Gasket
- ⑤ Separation (Metaglass®)
- ⑥ Flange plate

2.3 Nameplates



INFORMATION!

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

2.3.1 Non-Ex nameplate

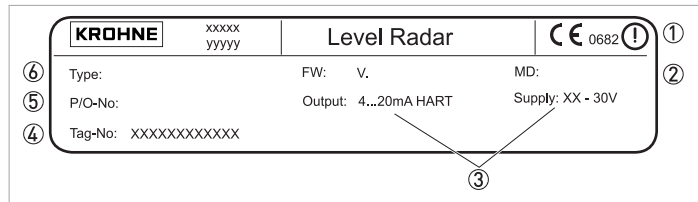


Figure 2-4: Non-Ex nameplate

- ① Notified body for radio approval.
- ② Date of manufacture
- ③ Electrical data: supply voltage and output
- ④ Customer tag number
- ⑤ Production order number
- ⑥ Model name and number

2.3.2 Ex nameplate

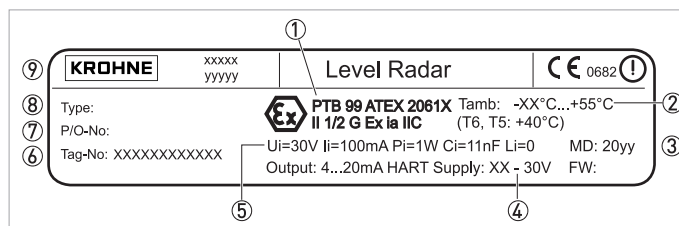


Figure 2-5: Non-Ex nameplate

- ① ATEX certification agency code and equipment approval categories
- ② Ambient temperature and temperature classes
- ③ Date of manufacture
- ④ Electrical data: supply voltage and output
- ⑤ Intrinsically-safe circuit data
- ⑥ Customer tag number
- ⑦ Production order number
- ⑧ Model name and number
- ⑨ Company logo and information



DANGER!

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

3.1 Notes on installation



INFORMATION!

Inspect the cartons carefully for damage or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.



INFORMATION!

Check the packing list to check if you received completely all that you ordered.



INFORMATION!

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

3.2 Storage



WARNING!

Do not keep the device in a vertical position. This will damage the antenna and the device will not measure correctly.

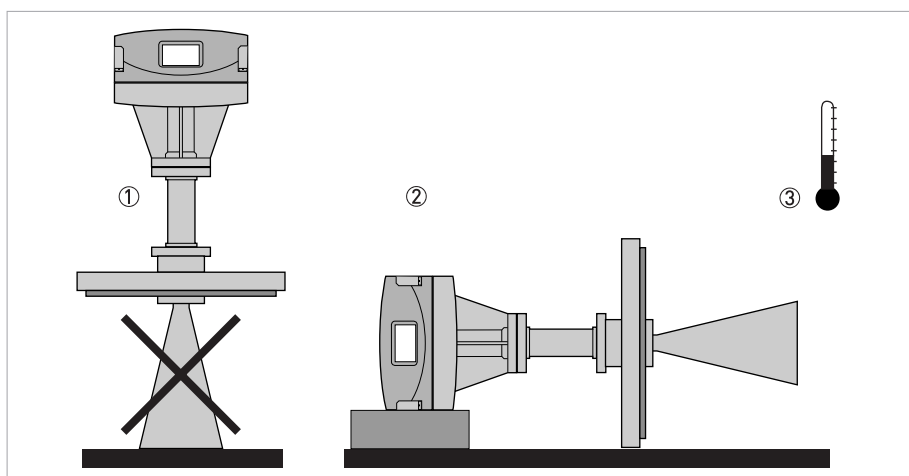


Figure 3-1: Storage conditions

- ① When you put the device into storage, do not keep it in a vertical position.
- ② Put the device on its side. We recommend that you use the packing in which it was delivered.
- ③ Storage temperature range: -40...+85°C / -40...+185°F

- Store the device in a dry and dust-free location.
- Keep the converter out of the sunlight.
- Store the device in its original packing.

3.3 Transport

**WARNING!**

- Depending on the version, the device will weight approx. 5...30 kg / 11...66 lbs. To carry, use both hands to lift the device carefully by the converter housing. If necessary, lift the device with a hoist.
- When handling the device, avoid hard blows, jolts, impact, etc. to prevent damage.

3.4 Pre-installation requirements

**INFORMATION!**

The following precautions must be taken to make sure it is correctly installed.

- Make sure that there is adequate space on all sides.
- Protect the signal converter from direct sunlight and install the weather protection accessory if necessary.
- Do not subject the signal converter to heavy vibrations. The devices are tested for vibration and agree with EN 50178 and IEC 60068-2-6.

To make sure that you install the device quickly, easily and safely, prepare the installation as given in the instructions that follow.

3.5 Theoretical data for nozzle position



CAUTION!

Follow these recommendations to make sure that the device measures correctly.

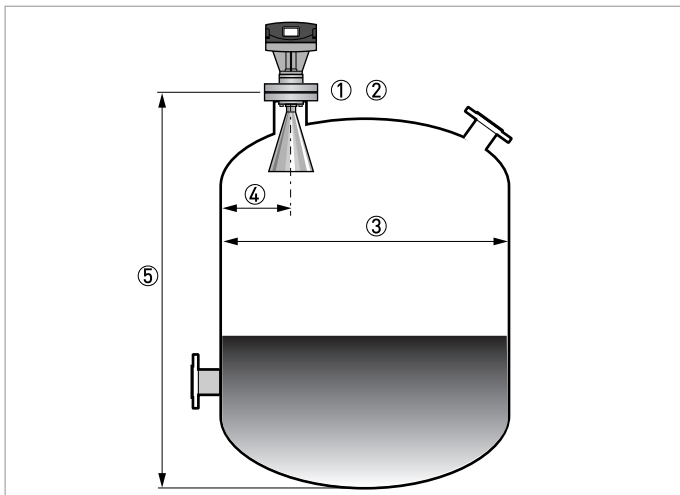


Figure 3-2: Recommended nozzle position for liquids, pastes and slurries

- ① Nozzles for DN150 or Wave-Stick antennas
- ② Nozzles for DN200 antennas
- ③ Tank diameter
- ④ Minimum distance of nozzle from the tank wall depending on:
 - ① $1/7$ x tank height
 - ② $1/10$ x tank height
 Maximum distance of nozzle from the tank wall depending on:
 - ① $1/3$ x tank diameter
 - ② $1/3$ x tank diameter
- ⑤ Tank height



INFORMATION!

If possible, do not put a nozzle on the tank centerline.



CAUTION!

Do not put the device near to the product inlet. If the product that enters the tank touches the antenna, the device will measure incorrectly. If the product fills the tank directly below the antenna, the device will also measure incorrectly.

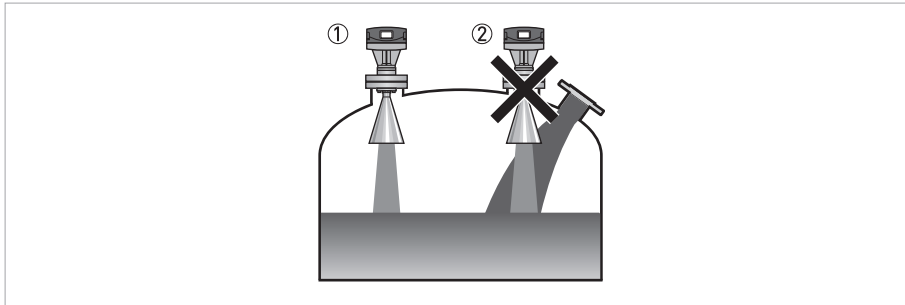


Figure 3-3: Product inlets

- ① The device is in the correct position.
- ② The device is too near to the product inlet.

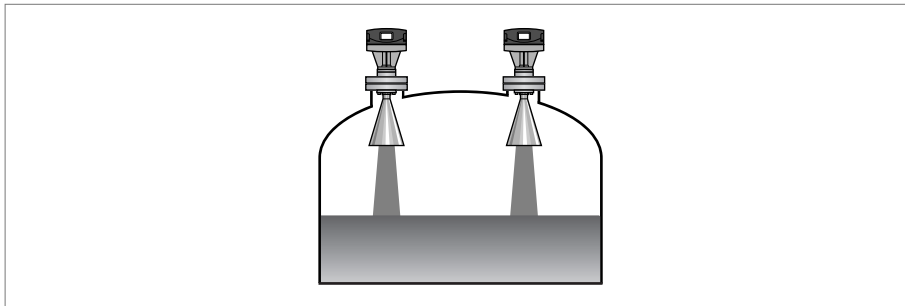


Figure 3-4: More than 1 FMCW radar level meter can be operated in a tank

More than 1 FMCW radar level meter can be operated in a tank.

3.6 Installation recommendations for liquids

3.6.1 General requirements

We recommend that you prepare the installation when the tank is empty.

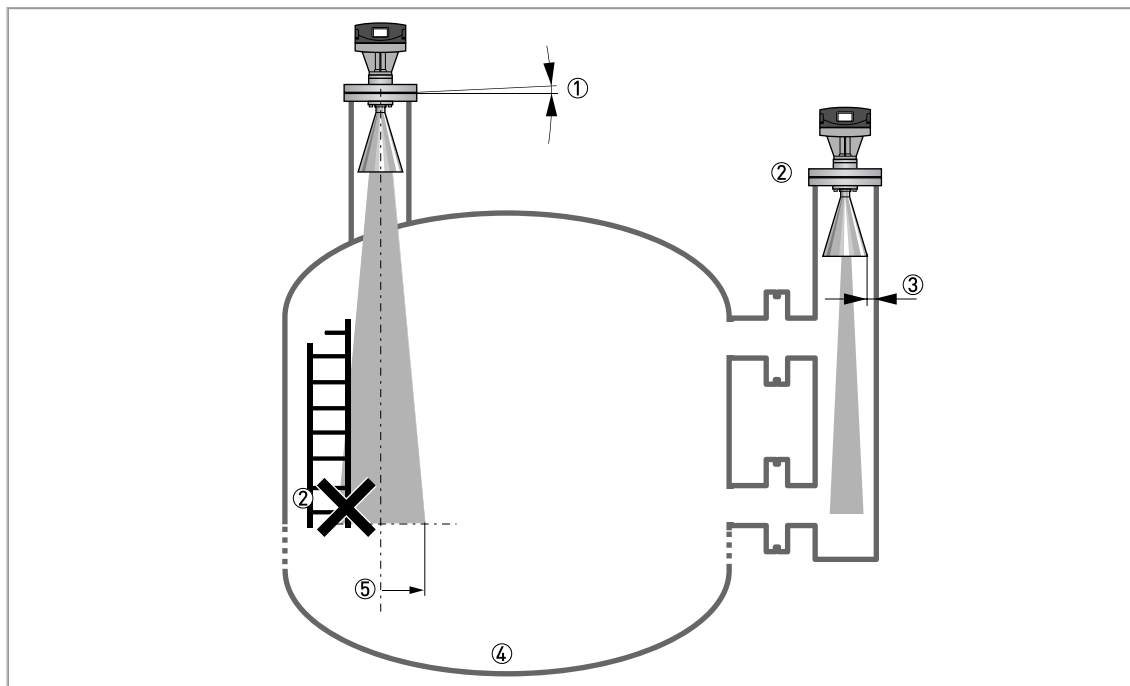


Figure 3-5: General Installation recommendations

- ① Do not tilt the device more than 2°.
- ② If there are too many obstacles in the radar beam, do an empty spectrum scan (refer to **Operation**) or install a bypass chamber or stilling well.
- ③ ≤5 mm / 0.2" max. for high-dielectric constant liquids
- ④ Curved and conical tank bottoms. Refer to **Operation** for fine adjustment of the device.
- ⑤ Radius of radar footprint (DN80 Horn antenna): increments of 300 mm/m or 12"/ft (16°)
 Radius of radar footprint (DN100 Horn antenna): increments of 220 mm/m or 9"/ft (12°)
 Radius of radar footprint (DN150 Horn antenna): increments of 140 mm/m or 5.5"/ft (8°)
 Radius of radar footprint (DN200 Horn antenna): increments of 100 mm/m or 4"/ft (6°)

3.6.2 Installation in stilling wells

Use a stilling well if:

- There is highly conductive foam in the tank.
- The liquid is very turbulent or agitated.
- There are too many other obstacles near to the area where you want to install the device.
- There is an applications with a tank with a floating roof.

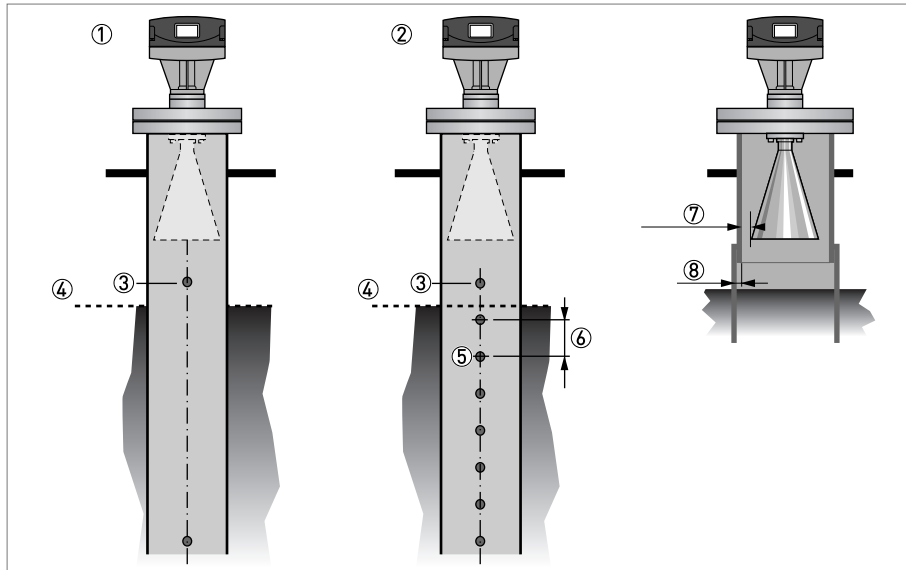


Figure 3-6: Installation recommendations for stilling wells

- ① Basic requirements for a stilling well
- ② Recommendations for tanks that have no foam
- ③ Air circulation hole (max. $\varnothing 10$ mm / 0.4")
- ④ Maximum level of the liquid
- ⑤ Liquid circulation holes (max. $\varnothing 10$ mm / 0.4")
- ⑥ Distance between holes ≥ 50 mm / 2"
- ⑦ Clearance between the antenna and the wall of the stilling well ≤ 5 mm / 0.2"
- ⑧ Sudden change in well diameter ≤ 1 mm / 0.04"



CAUTION!

Installation requirements

- The stilling well must be electrically conductive.
- The inside diameter of the stilling well must not be more than 10 mm / 0.4" over the diameter of the antenna.
- The stilling well must be straight.
- The stilling well must have a surface roughness of $\pm \leq 0.1$ mm / 0.004" or better.
- There must be no sudden changes in internal diameter greater than 1 mm / 0.04".



Installation in tanks containing one liquid and foam

- Drill a pressure equalization hole in the stilling well above the maximum level.
- Deburr the hole.



Installation in tanks containing one liquid or more without foam

- Drill a pressure equalization hole in the stilling well above the maximum level of the top liquid.
- These holes help the liquid to move freely between the stilling well and the tank.
- Deburr the holes.

Floating roofs

If the device must be installed on a tank with a floating roof, install it in a stilling well.

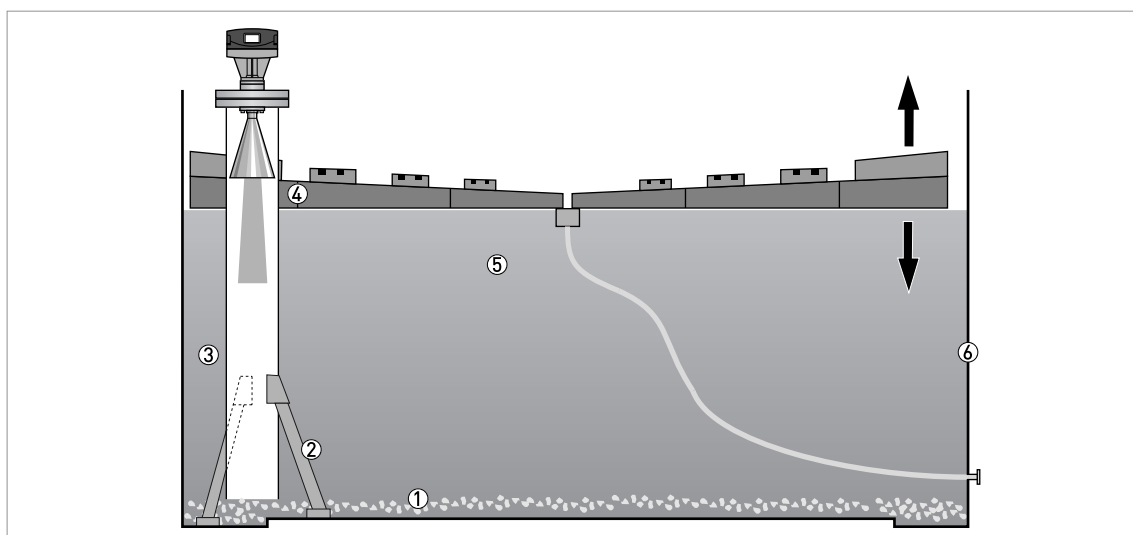


Figure 3-7: Floating roofs

- ① Sediment
- ② Support fixtures
- ③ Stilling well
- ④ Floating roof
- ⑤ Product
- ⑥ Tank

Horizontal cylindrical tanks

If the device:

- is for a horizontal cylindrical tank,
- is in a metallic tank,
- measures a product with a high dielectric constant and
- is on the centerline of the tank,

we recommend that you install it in a stilling well.

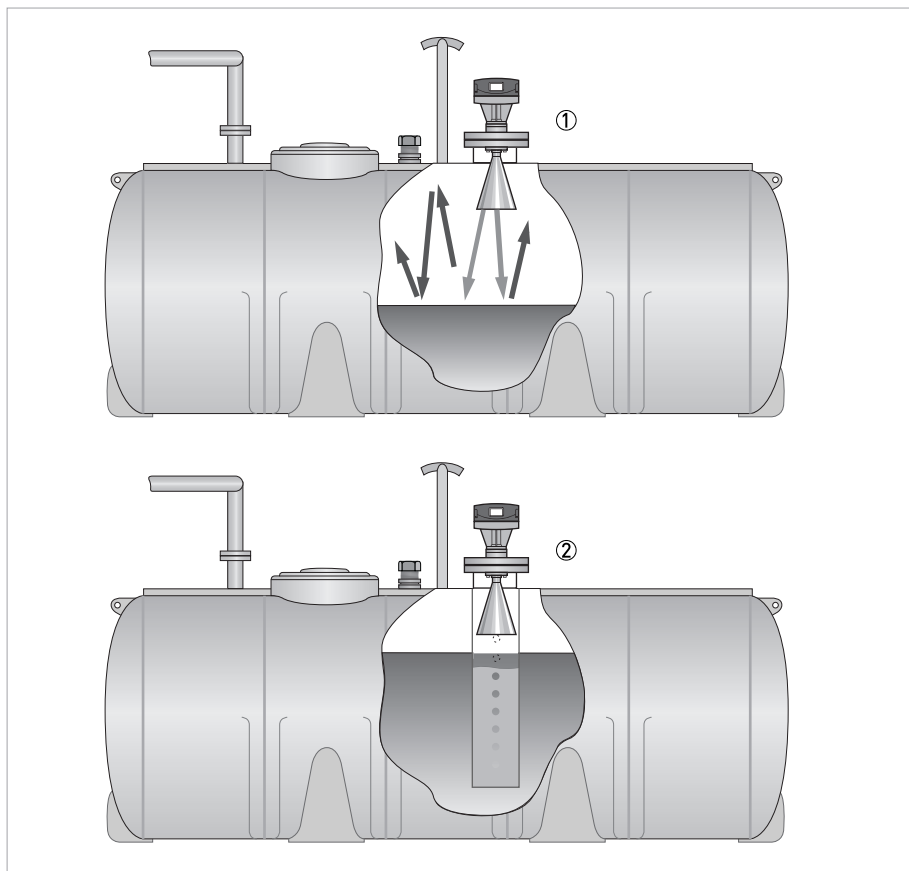


Figure 3-8: Horizontal cylindrical tanks

- ① The device is installed without a stilling well. There are multiple reflections. Refer to the CAUTION! that follows.
- ② The device is installed in a stilling well and measures correctly.



CAUTION!

*If the device is installed in horizontal cylindrical tank that contains a high dielectric constant liquid without a stilling well, do not put it on the tank centerline. This will cause multiple reflections and the device will not measure accurately. Use the **multiple reflections** function in **menu 3.0 Installation > 3.5 Application > 3.5.5 Multip.Refl.** to keep the effect of multiple reflections to a minimum. For more data, refer to "Function description" in the handbook.*

3.6.3 Bypass chambers

Install a bypass chamber next to the tank if:

- There is highly conductive foam in the tank.
- The liquid is very turbulent or agitated.
- There are too many obstacles in the tank.

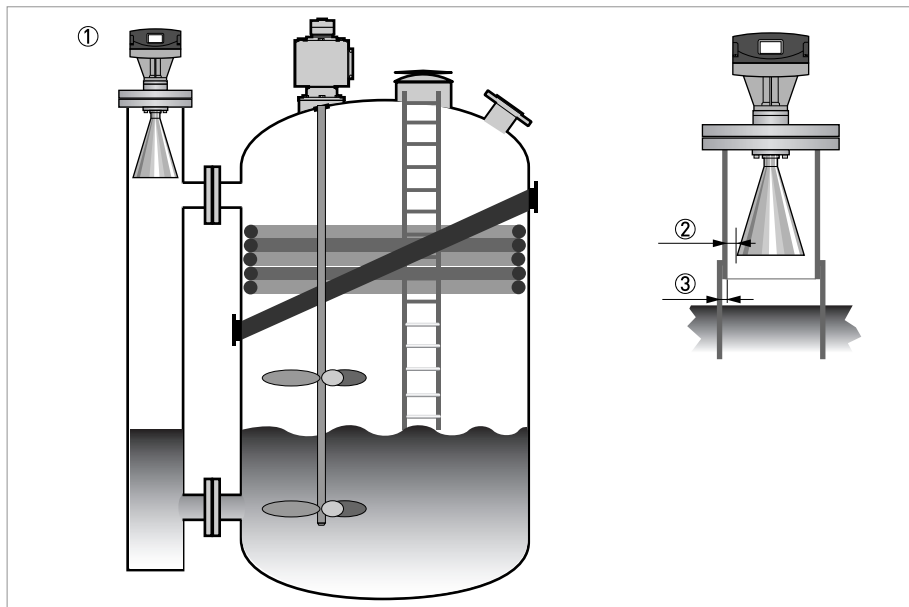


Figure 3-9: Installation recommendations for bypass chambers

- ① Bypass chamber
- ② Clearance between the antenna and the wall of the stilling well $\leq 5 \text{ mm} / 0.2''$
- ③ Sudden change in well diameter $\leq 1 \text{ mm} / 0.04''$



CAUTION!

Installation requirements

- *The bypass chamber must be electrically conductive.*
- *The inside diameter of the bypass chamber must not be more than 10 mm / 0.4" over the diameter of the antenna.*
- *The bypass chamber must be straight.*
- *The bypass chamber must have a surface roughness of $\pm \leq 0.1 \text{ mm} / 0.004''$.*
- *There must be no sudden changes in internal diameter greater than 1 mm / 0.04" .*

Installation next to tanks containing one liquid and foam

- The top process connection of the bypass chamber must be above the maximum level of liquid.
- The bottom process connection of the bypass chamber must be below the lowest measured level of liquid.

Installation next to tanks containing more than one liquid

- The top process connection of the bypass chamber must be above the maximum level of liquid.
- The bottom process connection of the bypass chamber must be below the lowest measured level of liquid.
- Additional process connections are necessary for the liquids to circulate freely along the length of the bypass chamber. These additional process connections must be separated by a distance equal to or less than the minimum level of the bottom liquid.

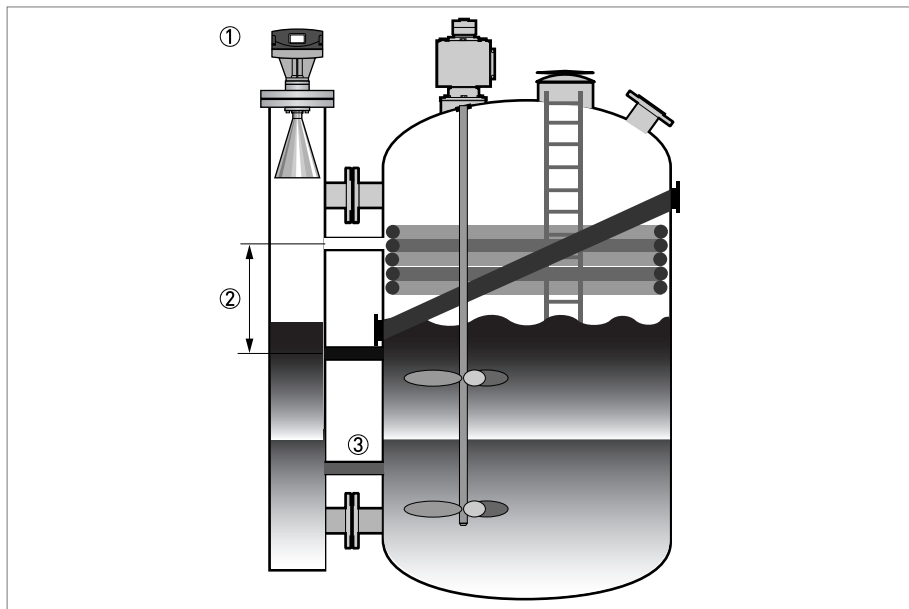


Figure 3-10: Installation recommendations for bypass chambers that contain more than one liquid

- ① Bypass chamber
- ② Distance between connections \leq the minimum level of the bottom liquid.
- ③ Additional process connection

3.7 How to keep false reflections to a minimum

**CAUTION!**

If there are false reflections, the device will not measure correctly.

False reflections are caused by:

- Objects in the tank.
- Sharp corners that are perpendicular to the path of the beam.
- Sudden changes in tank diameter in the path of the beam.

If there are too many obstacles in the path of the radar beam, do an empty spectrum scan. Alternatively, install the device on a bypass chamber or stilling well.

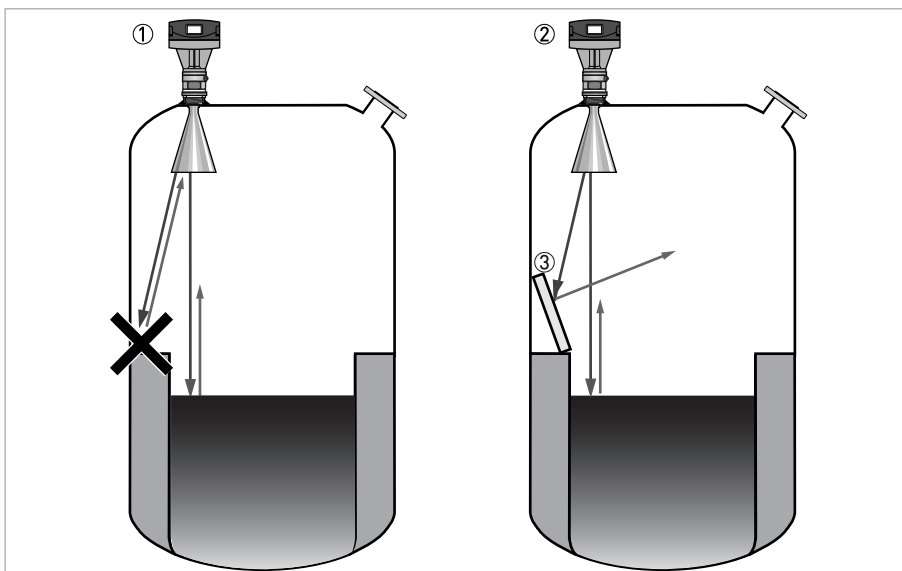
False reflections

Figure 3-11: False reflections and deflector plates

- ① Sharp corners and sudden changes in tank diameter can cause the device to measure incorrectly
- ② Install a deflector plate to prevent false reflections
- ③ Deflector plate

3.8 How to install the device on the tank

3.8.1 How to install a device with a flange connection

Equipment needed:

- Device
- Gasket (not supplied)

Requirements for flange connections

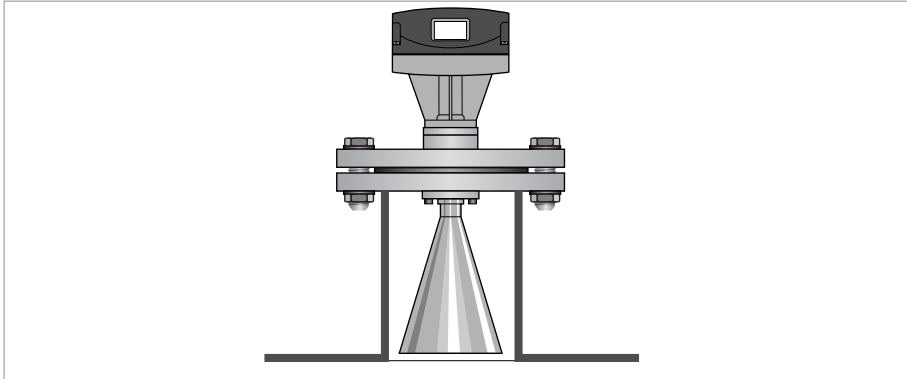


Figure 3-12: Flange connection



- Make sure the flange on the nozzle is level.
- Make sure that you use the applicable gasket for the flange dimensions and the process.
- Align the gasket correctly on the flange facing of the nozzle.
- Lower the antenna carefully into the tank.
- Tighten the flange bolts.
- ➔ Refer to local rules and regulations for the correct torque to apply to the bolts.

3.8.2 How to install a device with a threaded connection

Equipment needed:

- Device
- Gasket for G1½ or 1½NPT connection (not supplied)

Requirements for threaded connections

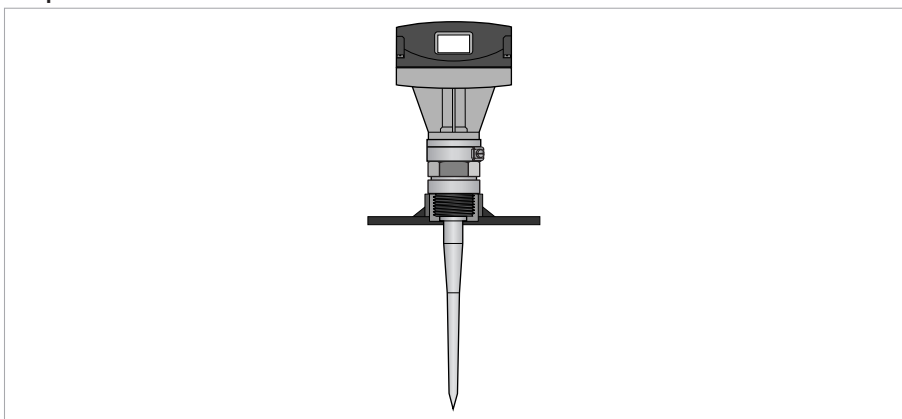


Figure 3-13: Threaded connection



- Make sure the tank connection is level.
- Make sure that you use the applicable gasket for the connection dimensions and the process.
- Make sure the tank connection is larger than the antenna.
- If the tank connection is smaller than the antenna, remove the antenna from the housing.
- ➔ Either provide the means to adapt the device to a larger process connection on the tank (for example, a plate with a slot), or use the same process connection, but remove the antenna from the device before installation and attach it from inside the tank.
- Align the gasket correctly.
- Lower the antenna carefully into the tank.
- Turn the threaded connection on the housing to attach the device to the process connection.
- Tighten the connection.
- ➔ Refer to local rules and regulations for the correct torque to apply to the connection.
- If the tank connection is smaller than the antenna, attach the antenna from inside the tank.

3.8.3 Field assembly

In general all device versions are delivered in fully assembled condition. However if a device should be delivered in parts, or parts are subsequently replaced, the following procedure should be noted.



INFORMATION!

For any necessary field assembly all parts are included with the delivery (stud bolts, washers, etc.).

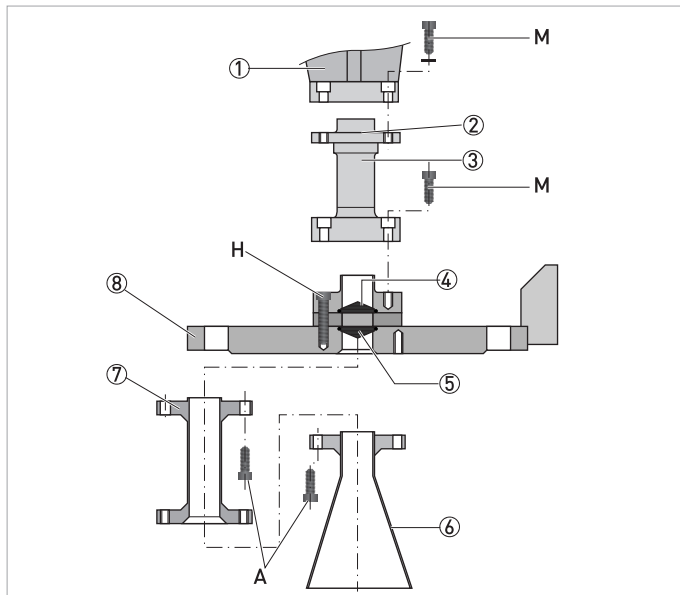


Figure 3-14: Field assembly of device

- ① Signal converter
- ② O-ring
- ③ Distance piece for high-temperature version (option)
- ④ Upper Teflon® plug
- ⑤ Lower Teflon® plug
- ⑥ Antenna
- ⑦ Antenna extension (option)
- ⑧ Connecting flange of device



- Bolt the Wave-Guide window (flange mount) or distance piece ③, if supplied loose, to the device.
- Torque for the sets of 4 Allen screws **M** (key size 5 mm) is max. 8 Nm / 5.8 ft lbf.
Caution: Ensure the upper Teflon® plug ④ is kept absolutely dry and clean! Moisture and dirt will impair the functionality of the device!



- Bolt antenna extension ⑦ to the antenna ⑥.
- Torque for the 3 stud bolts **A** is max. 8 Nm / 5.8 ft lbf.
Caution: Do not detach bolts **H**!

3.8.4 Antenna purging system (option for horn antenna)

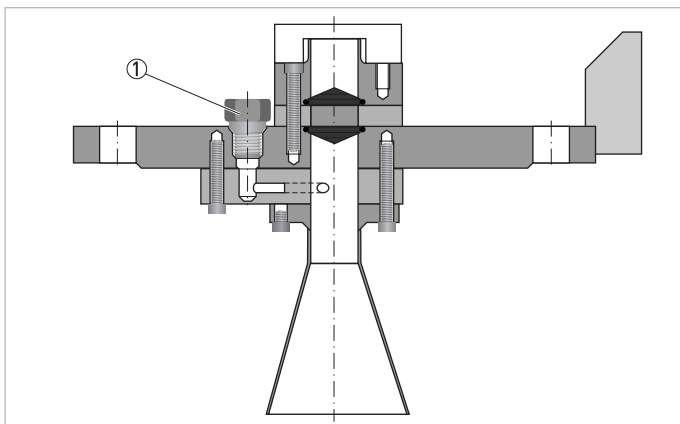


Figure 3-15: Installation of purging system

① Screw plug



- Remove screw plug ¼" R ① and screw in screwed tube joint, e.g. Ermeto ¼" R.

**DANGER!***Consult Ex specifications relating to the purging circuit (provided by customer)!*

4.1 Safety instructions



DANGER!

All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!



DANGER!

Observe the national regulations for electrical installations!



DANGER!

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.



WARNING!

Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.



INFORMATION!

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

4.2 Electrical installation of output

4.2.1 Electrical connection

To open the signal converter, use a screwdriver and release the four visible screws on top of the housing.



INFORMATION!

The polarity of the 4...20 mA connection is arbitrary.

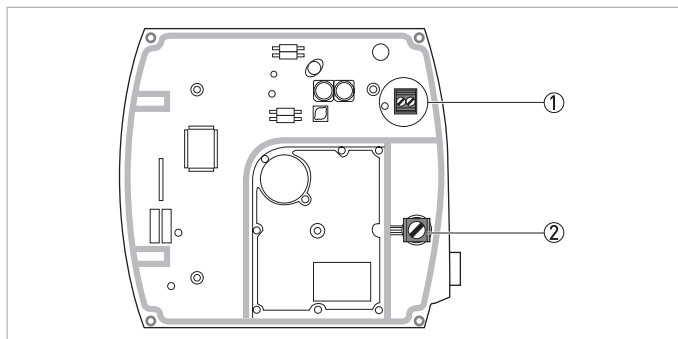


Figure 4-1: Terminal assignment

- ① Terminal current output (polarity independent)
- ② Grounding terminal in the housing

4.2.2 Non-Ex

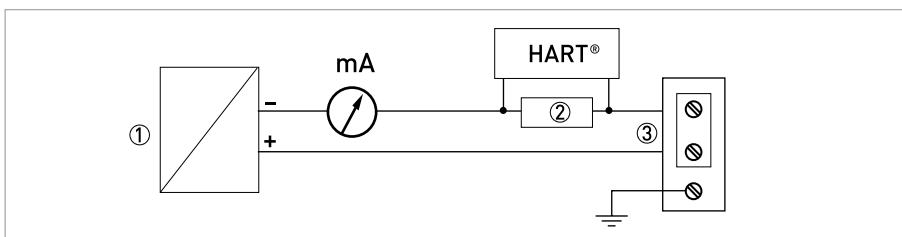


Figure 4-2: Electrical connections for non-Ex devices

- ① Power supply
- ② Resistor for HART® communication
- ③ 14.5...30 VDC for an output of 22 mA at the terminal

4.2.3 Ex i

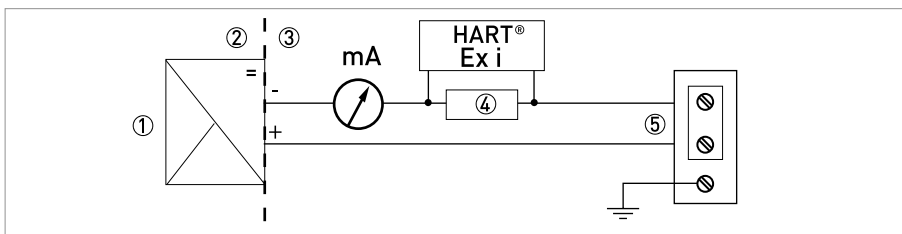


Figure 4-3: HART® connection to the Ex i circuit with a resistor

- ① Intrinsically-safe power supply
- ② Zone non-Ex
- ③ Zone Ex
- ④ Resistor for HART® communication
- ⑤ 14.5...30 VDC for an output of 22 mA at the terminal



INFORMATION!

If the barrier has a HART® terminal, you can connect HART® devices directly to the barrier without a resistor.

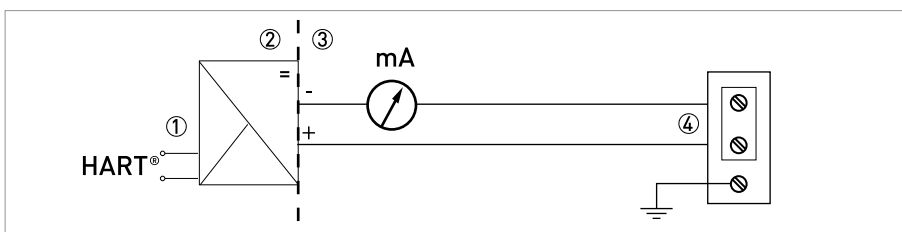


Figure 4-4: HART® connection to the Ex i barrier without a resistor

- ① Intrinsically-safe power supply
- ② Zone non-Ex
- ③ Zone Ex
- ④ 14.5...30 VDC for an output of 22 mA at the terminal

4.3 Protection category

**INFORMATION!**

The device fulfills all requirements per protection class IP66/67 (equivalent to NEMA6-6X).

**DANGER!**

Make sure the cable gland is watertight.

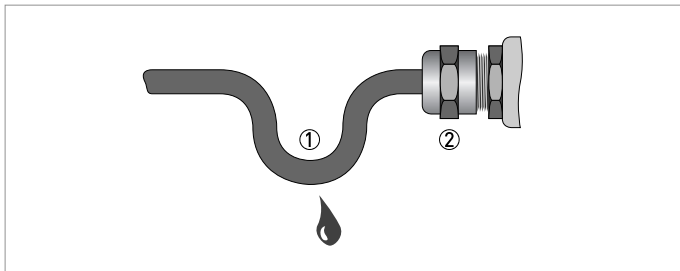


Figure 4-5: How to make the installation agree with protection category IP67



- Make sure that the gaskets are not damaged.
- Make sure that the electrical cables are not damaged.
- Make sure that the electrical cables agree with the national electrical code.
- The cables are in a loop in front of the device ① so water does not go into the housing.
- Tighten the cable feedthroughs ②.

4.4 Networks

4.4.1 General information

The device uses the HART[®] communication protocol. This protocol agrees with the HART[®] Communication Foundation standard. The device can be connected either via point-to-point or operate in a multi-drop network of up to 15 devices.

The output is factory-set to communicate point-to-point.

4.4.2 Point-to-point connection

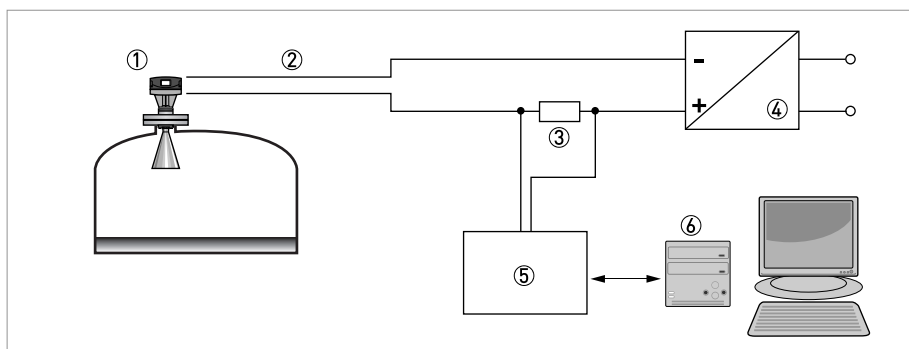


Figure 4-6: Point-to-point connection (non-Ex)

- ① Address of the device (0 for point-to-point connection)
- ② 4...20 mA + HART[®]
- ③ Resistor for HART[®] communication
- ④ Power supply
- ⑤ HART[®] converter
- ⑥ HART[®] communication software

4.4.3 Multi-drop networks

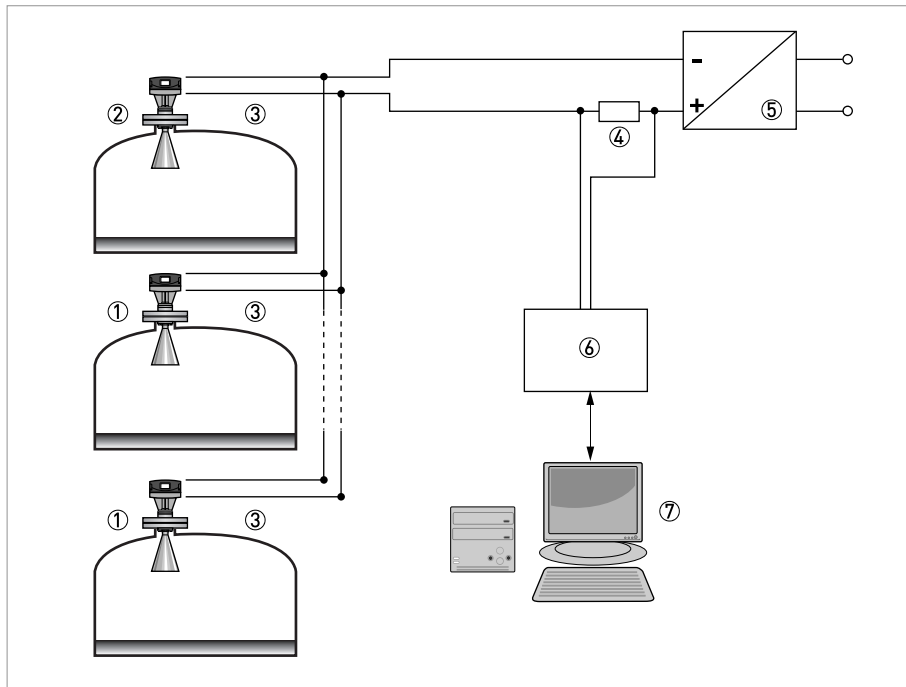


Figure 4-7: Multi-drop network (non-Ex)

- ① Address of the device (n+1 for multidrop networks)
- ② Address of the device (1 for multidrop networks)
- ③ 4 mA + HART®
- ④ Resistor for HART® communication
- ⑤ Power supply
- ⑥ HART® converter
- ⑦ HART® communication software

5.1 Start-up checklist

Check these points before you energize the device:

- Are all the wetted components (antenna, flange and gaskets) resistant to the product in the tank?
- Does the information on the signal converter nameplate agree with the operating data?
- Did you correctly install the device on the tank?
- Do the electrical connections agree with the national electrical codes?



DANGER!

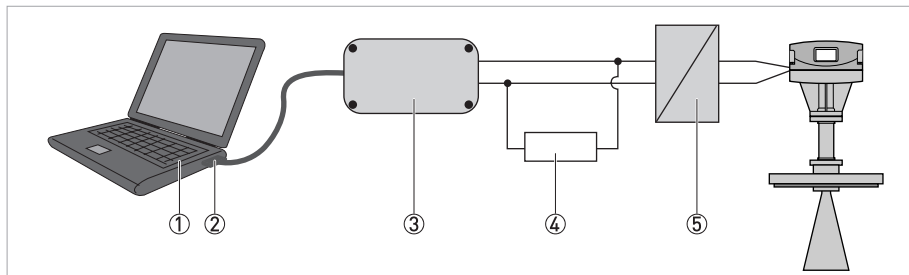
Before you energize the device, make sure that the supply voltage and polarity are correct.



DANGER!

Make sure that the device and the installation agrees with the requirements of the Ex certificate of compliance.

6.1 Setting parameters via program PC-CAT 2 for Windows 5.0.0



- ① PC
- ② RS232 / USB
- ③ HART®-Adapter
- ④ Load: $\geq 250 \Omega$
- ⑤ Isolation amplifier

With the program PC-CAT 2 for Windows, version 5.0.0.116 or higher, you can configure the devices in a very comfortable way from a PC. Connect the non-intrinsically safe side of the isolation amplifier over a load between 250Ω and 350Ω to the HART® adapter and connect it with a serial port of the PC or a USB port.

The used isolation amplifier must be HART® compatible.

6.2 Display and operating elements (optional)

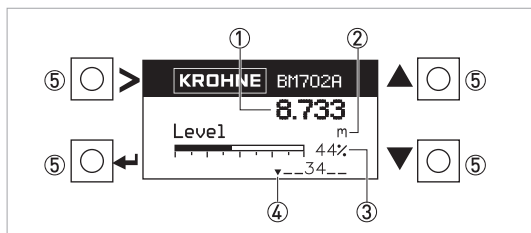


Figure 6-1: Display and operating elements (optional)

- ① Numeric display, measured values
- ② Alphanumeric display, function/unit
- ③ Bargraph indication
- ④ 6 Markers to display measurement status
- ⑤ 4 keys for configuration and error interrogation

Key	Description	Functionality
→	Cursor key	<ul style="list-style-type: none"> • Selects the configuration menu. • Branches the menu to the next lower level. • Shifts the cursor* to the next column on the right.
↓ or ↑	Select key	<ul style="list-style-type: none"> • Branches the menu to the next digit on the same level. • Changes the content (digit, text character) at the cursor* position.
←	Enter key	<ul style="list-style-type: none"> • Branches the menu to the next higher level. • Stores newly entered parameters. • Executes displayed functions. • Selects special functions (e.g. error memory).

* The cursor position is signalled by inverted representation of the character at the appropriate place.

Table 6-1: Description of key functionality

6.3 Description of status markers



INFORMATION!

This function is only available for version with local display.

The markers below the local display only show information about the status of measurement and are no error displays!

1	<p>No current measured value: The device is searching for a new value. If the search for a plausible level fails for a certain time, "No Measurand" appears as error display.</p>
2	<p>Signal too weak: Mean of reflected microwaves is very low. Gain is automatically stepped up, if possible.</p>
3	<p>Poor spectrum: Brief showing of this marker has no significance. If permanently on, this may result in uncertain (incorrect) measured values or the error message "No Measurand".</p>
4	<p>No measured value as yet: Evaluable measured values not available after the device has been started up. Measured value automatically set to the level of the tank bottom. This marker disappears when the first valid measured value is obtained.</p>
5	<p>Tank bottom: In tanks with dished bottom, for example, the measuring signal can "disappear" if measurements are carried out near the bottom. The measured value is then automatically set to the level of the tank bottom.</p>
6	<p>Measurement frozen: Device is in the block distance detection</p>

6.4 Configuration menu (version 7.44)

**INFORMATION!**

The default settings are marked in **bold** in the table.

No.	Function (Fct.)	Settings	Description
1.0	Operation		
1.1	Display		
1.1.1	Fct. Display		Identical with Fct. 3.2.1
1.1.2	Unit Length		Identical with Fct. 3.2.2
1.1.3	Unit Convers		Identical with Fct. 3.2.3
2.0	Test		
2.1	Hardware		
2.1.1	Master		Master hardware test.
2.1.2	Display		Display hardware test.
2.1.3	Status		Status information for service.
2.2	Cur.Output I		
2.2.1	Value I	Value display	Display of actual value of the current output.
2.2.2	Test I	Select: 3.6 mA / 4 mA / 6 mA / ... / 20 mA / 22 mA	Output of selected value to the current output. With safety query.
2.4	Firmware		
2.4.1	Master	Display	Display of master firmware version.
3.0	Installation		
3.1	Basis Param.		
3.1.1	Tank Height	Select unit: m / cm / mm / inch / ft Enter: 0.50...30.00 [m]	Enter tank height. For detailed information refer to <i>Function description</i> on page 40. The unit entered here is also used for all other length entries.
3.1.2	Block Dist.	Enter: 0.10 [m]...tank height	Enter block distance = nonmeasurable range below bottom edge of flange. For detailed information refer to <i>Function description</i> on page 40.
3.1.3	Antenna	Select: Standard / Wave stick	Select antenna type. "Wave stick" for all Wave-Stick versions, except type "SW" for stillwells. All other = "Standard".
3.1.4	Ant. Extens.	Enter: 0.00 [m]...tank height	Enter length of antenna extension (not for Wave-Stick: set to 0)
3.1.5	Dist. Piece	Enter: 0...2000 [mm]	Enter length of distance piece above flange (high temp. version = 120 mm).
3.1.6	Stillwell	Select: No / Yes If "Yes": enter 25...200 [mm]	Selection: without or with still well. With still well: enter inside diameter in [mm] (compensates different wave speeds in still wells)
3.1.7	Ref. Offset	Enter: -10.00... 0 ...+10.00 [m]	Reference offset is added to measured distance values.
3.1.8	Tkb. Offset	Enter: -100.00... 0 ...+100.00 [m]	Tank bottom offset is added to measured level values.

3.2	Display		
3.2.1	Fct. Display	Select: Level / Distance / Conversion	Select function of display (value to be displayed). For detailed information refer to <i>Function description</i> on page 40.
3.2.2	Unit Length	Select: m / cm / mm / inch / ft	Select unit for length value to be displayed (only for level and distance).
3.2.3	Unit Convers	Select: m³ / l (Liter) / US Gal / GB Gal / ft ³ / bbl / Free Unit	Select unit for conversion value to be displayed ("volume table"). For detailed information refer to <i>Function description</i> on page 40.
3.2.4	User Unit	Text entry: 10 characters	Enter user-defined unit for the conversion table.
3.2.5	Error Msg.	Select: No / Yes	Select whether error messages to be shown in display.
3.3	Signal Outp.		
3.3.1	Function I	Select: Off / Level / Distance / Conversion	Select function of the current output.
3.3.2	Range I	Select: 3.8-20.5E3.6 / 3.8-20.5E22 / 4-20mA / 4-20mA E=3.6 / 4-20mA E=22	Select range/error status for the current output (hold last value or 3.6 mA/22 mA in error status).
3.3.3	Scale 4 mA	Enter: -200.00 [m]...Scale 20 mA / 0.00 [m ³]...Scale 20 mA	Enter lower measuring range value for the current output (4 mA). For detailed information refer to <i>Function description</i> on page 40.
3.3.4	Scale 20 mA	Enter: Scale 4 mA...+200.00 [m] / Scale 4 mA...99999.99 [m ³] /	Enter full-scale range value for the current output (20 mA). See also explanatory notes.
3.3.5	Baudrate	Select: 1200 / 2400 / 4800 / 8600 / 19200 / 38400 Baud	Baud rate for service interface communication. Normally set to 38400
3.3.6	Address	0 ...15	Enter device address (for HART [®] Multidrop, when > 0).
3.4	User Data		
3.4.1	Language	Select: GB-USA / D / F / I / E / P / S	Select language for the optional display.
3.4.2	Entry Code 1	Select: No / Yes	Switch the access lockout on/off. If "Yes", for every access a 9-digit entry code on the 4 keys is necessary.
3.4.3	Code 1	Code entry: RRREEEUUU	Enter the entry code for access lockout.
3.4.4	Location	Text entry: 8 characters	Enter a device identifier.
3.5	Application		
3.5.1	Auto Tankh.	Special function	Automatic determination of tank height. For detailed information refer to <i>Function description</i> on page 40.
3.5.2	Empty Spect.	Select: Off / On / Record	Recording the profile of the empty tank (empty-tank spectrum). For detailed information refer to <i>Function description</i> on page 40.
3.5.3	Time Const.	Value: 1... 10 ...100 [s]	Enter time constant for measured-value filtering.
3.5.4	Tracing Vel.	Value: 0.01... 0.50 ...10.00 [m/min]	Enter the maximum rate of change in level that can occur in operation.
3.5.5	Multip.Refl.	Select: No / Yes	Switch the multi-reflection identifier on/off.

3.5.6	BD Detection	Select: No / Yes	Switch the block distance (overflow) identifier on/off. For detailed information refer to <i>Function description</i> on page 40.
3.5.7	Function FTB	Select: Off / Partial / Total	Select function of tank bottom tracing system. For detailed information refer to <i>Function description</i> on page 40.
3.5.8	Epsilon R	Enter: 1.1000...8.0000	Enter relative permittivity of product (only for Fct. 3.5.7).
3.5.9	Tanktype	Select: Storage Tank / Process Tank	Select tank type. "Storage Tank" = smooth product surface "Process Tank" = slightly disturbed product surface

6.5 Function description

6.5.1 Tank height

The tank height (**Fct. 3.1.1**) is defined as the distance between the top edge of the tank connecting flange and the bottom reference point. The bottom reference point is that "point" in the tank on which the microwaves of the device hit and from which they are reflected. This may be the tank bottom (symmetrical tank with flat bottom) or the non-horizontal part of the bottom (e.g. tank with dished bottom) or an additionally fitted plate. The device cannot measure below this point ("sump" in the tank).



INFORMATION!

*When the tank is completely empty and the tank bottom provides good reflections (flat, not dished bottom!), the tank height can also be automatically determined with the aid of **Fct. 3.5.1** "Auto Tankh.". Before confirming, check carefully that the proposed tank height is plausible!*

6.5.2 Block distance

The "block distance" function (**Fct. 3.1.2**) defines a zone below the top reference point in which measurements are not meant to take place. The value should be at least 10...20 cm / 3.9...7.9" greater than the length of antenna + antenna extension, or at least 20 cm / 7.9" in the case of the Wave-Stick.

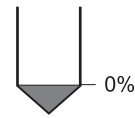
Signals within the block distance are suppressed; a rise in the tank filling above this limit (response threshold) will lead to a measuring result corresponding to a distance = block distance, when **Fct. 3.5.6** "BD Detection" is switched on.

6.5.3 Scaling of the current output

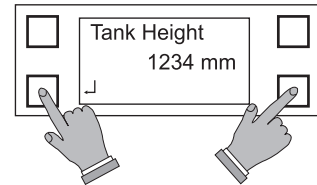
The scaling of the current output (**Fct. 3.3.3**: level 1 = 4 mA ; **Fct. 3.3.4**: level 2 = 20 mA) should if possible lie within the measuring range (between bottom reference point and response threshold).

By pressing the two upper keys (→ and ↑) or the two lower keys (← and ↓) at the same time, the 0% setting (= 4 mA) or 100% setting (= 20 mA) can be programmed according to the actual level.

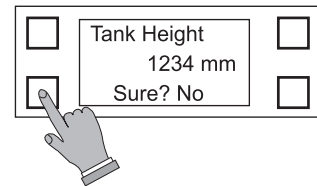
① Drain the tank completely to the 0% marking (= 4 mA).
 This example was written for the case: current output = level (default). For distance measurement the points 0% (short distance = high level) and 100% (large distance = low level) are exchanged.



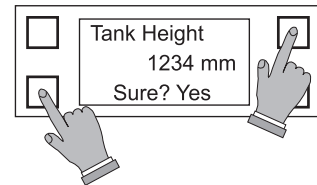
② Press the lower keys (← and ↓) down, until the asterisks on the display "Tank Height |*****" are replaced by the actual measured distance value.
 If no reliable measurement is possible "No Access" is displayed. Abort by pressing ←.



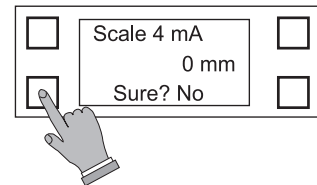
③ Then release and press ←. In the lower line: "Sure ? No" is displayed.



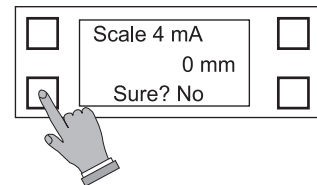
④ If this value is not plausible or the tank is not empty, abort by ←. Or accept the value by pressing ↑ ("Sure ? Yes") and then ←.



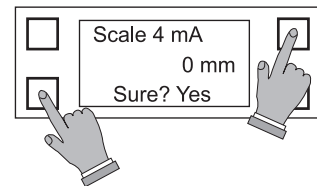
⑤ Now the tank height is set.



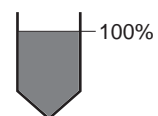
⑥ In the next step you can also enter this value as 4 mA scaling (0%). Press ←. In the lower line now: "Sure ? No" is displayed again.



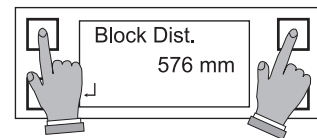
⑦ If this value shall not be stored, abort by ←. Or accept this 4 mA scaling by pressing ↑ ("Sure ? Yes") and then ←.



⑧ Fill the tank to the 100% mark. Use the same procedure for the 100% point = 20 mA only now by pressing the top keys → and ↑.
 This example was written for the case: current output = level (default). For distance measurement the points 0% (short distance = high level) and 100% (large distance = low level) are exchanged.
 If no reliable measurement is possible "No Access" is displayed. Abort by pressing ←.



⑨ First the measured distance can be taken as block distance. After this you can enter or adjust the 20 mA point (100%) according to the actual level.



6.5.4 Empty-tank spectrum

To enable the device to identify and blank out interference signals, e.g. caused by fixed and moving tank internals, the tank profile (empty-tank spectrum) needs to be recorded once only prior to (initial) start-up. For recording, the tank should be completely empty and all moving parts (e.g. agitators) switched on. If major interference through internals is not expected, recording of the empty-tank spectrum can also be dispensed with, since the factory has already carried out and stored a partial empty spectrum of the flange system.

Empty-tank spectrum recording via display

After selecting menu item **Fct. 3.5.2**, press key →. The display then shows whether the empty spectrum is currently "On" or "Off". Then press the ← key if no change is to be made, or use the ↑ key to choose between the following options:

- "On": the empty-tank spectrum is (again) switched on and taken into account for measurements.
- "Off": the empty-tank spectrum is not taken into account for measurements, but remains stored and can be switched on again at a later date.
- "Record": the existing empty-tank spectrum is to be deleted and a new one recorded.

After selecting "Record": if other parameters had previously been changed, the query "Store Yes" is first made as to whether they are to be stored. In this case, confirm by pressing ←. To record, use the ↑ key to select one of the following options:

- "Max. values": (only maximum values are taken into account when the empty-tank spectrum is recorded; useful e.g. with "difficult" agitators).
- "Average": (values are averaged; this setting can be used for most applications).

After selecting with the ↑ key, press the ← key to select "Total" or the ↑ key to select "Partial".

- When "Total" is selected, the empty-tank spectrum is recorded over the entire range (tank height).
- If the tank has not been fully drained, the empty-tank spectrum can also be recorded up to a certain distance, in which case the menu item "Partial" should be selected. When this has been selected, a query takes place by way of the ← key concerning the distance value up to which the empty-tank spectrum is to be recorded. The tank area below the current filling level is then excluded from the empty-tank recording. It is recommended to maintain a safety distance of 20...30 cm / 7.9...11.8" from the actual product distance.

Subsequently press key ← to start recording the empty-tank spectrum. The display starts with "200" and counts down to "0". The sign "Wait ..." is shown in the display. "Ready" appears after approx. 1...3 minutes. Then press key ← five times to store the recorded empty-tank spectrum, which is taken into account for measurements.

6.5.5 Tank bottom tracing mode (FTB)

The device includes an additional function for measuring reliably low levels in tanks with flat bottom and poorly reflecting products (low dielectric constant). This tank bottom tracing system (abbreviated FTB) is activated optionally in the vicinity of the tank bottom (max. 20% level) or for the whole tank area.

If the measurement jumps to the correct level only after filling above a certain level (approx. 0.3...1.0 m / 1...3.3 ft), you can activate the FTB function **Fct. 3.5.7** "Partial". The relative permittivity ϵ_r of the tank product must also be set in **Fct. 3.5.8**. If it is not known, enter the figure of 2.0. Since the exact position of the tank bottom must be known for this process, it is advisable when using the FTB to determine the tank height automatically with an empty tank, using **Fct. 3.5.1**.

Activating FTB function **Fct. 3.5.7** "Full" expands the tank bottom tracing over the total measuring range (tank height). This option is intended for tank products with very low permittivity when also at higher filling level no measurement is possible. With increasing tank heights, however, measuring accuracy is additionally affected.

6.5.6 Conversion table / volume table

A table consisting of a maximum of 50 points can be stored for non-linear or linear conversion of the level, e.g. into a volumetric value. This table, however, can only be programmed with the PC-CAT 2 program (**Fct. 3.7.2**).

6.6 Sequence for setting parameters (example)



INFORMATION!

Only for version with local display valid.

The following description refers to a storage tank. If the device no longer contains the default parameters, the keystroke combination for entering the numerical values may differ.

Activity	Keys to be actuated	Content of display after activity
Entry into configuration menu	→	Fct. 1.0 Operation
Setting the parameter: tank height	↑↑→→	Fct. 3.1.1 Tank Height
Display of default value	→	10.000 m
Input of tank height "5.30 m"	→↓→5x↑→3x↑	05.300 m
Confirm tank height and move to block distance	←↑	Fct. 3.1.2 Block Dist.
Display default value	→	0.5000 m
Enter block distance "0.60 m"	→↑	0.6000 m
Confirm block distance and move to current output configuration	←←↑↑	Fct. 3.3 Signal Outp.
Move to lower range value	→↑↑	Fct. 3.3.3 Scale 4 mA
Display default value	→	+ 00.000 m
Enter lower range value (0.4 m = 4 mA)	3x→4x↑	+ 00.400 m
Confirm lower range value and move to full-scale range value	←↑	Fct. 3.3.4 Scale 20 mA
Display default value	→	010.00 m
Enter full-scale value (4.0 m = 20 mA)	2x→↓→4x↑	004.00 m
Confirm full-scale value and move to empty tank spectrum	←←↑↑→↑	Fct. 3.5.2 Empty Spect.
Select: re-record empty spectrum	→↑↑	Record
Store changed parameters	←	Store Yes
Confirm and select: averaging	←↑	Average
Confirm and start recording; then wait for approx. 1...3 minutes!	←←	Ready
Confirm and move to tank type	←7x↑	Fct. 3.5.9 Tanktype
Display of default value	→	Process Tank
Select tank type "storage tank"	↑↑	Storage Tank
Return to measurement function with confirmation of changed parameters	5x←	Starting, then meas.val. display

7.1 Replacement of the signal converter



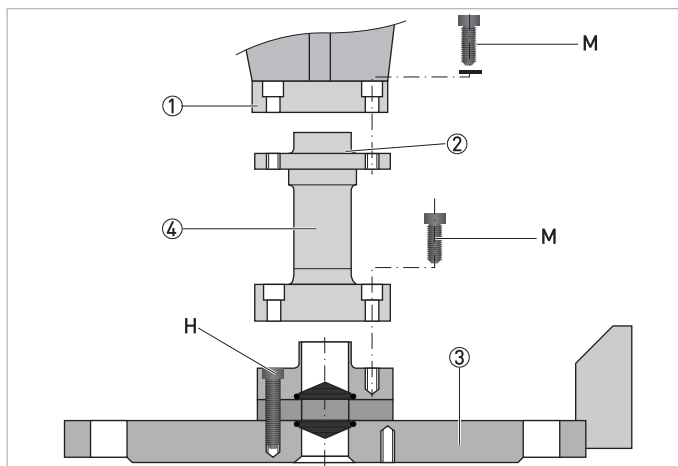
DANGER!

Before starting, note the parameters of the device and switch off the power supply!



CAUTION!

On pressurized tanks, do not on any account remove the 4 screws **H** connecting the waveguide window to the flange!



- ① Signal converter
- ② O-ring
- ③ Connecting flange
- ④ Distance piece (for high-temperature version)



- ① Disconnect all cables from the terminals in the terminal compartment.
- ② Remove the 4 Allen screws **M** (Allen key size 5 mm) and lift off the signal converter. The flange unit (incl. waveguide window) will remain tight even with pressurized tanks.
- ③ Fit the new converter.
- ④ Reconnect all cables in the terminal compartment. For detailed information refer to *Electrical installation of output* on page 29.
- ⑤ Check against the enclosed report on settings whether the factory-set parameters are correct for your application. If not, reset.
- ⑥ Record the empty spectrum. For detailed information refer to *Empty-tank spectrum* on page 42.

7.2 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are under normal operating conditions subjects to wear and tear.

7.3 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, technical support and training.



INFORMATION!

For more precise information, please contact your local representative.

7.4 Returning the device to the manufacturer

7.4.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.



CAUTION!

Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:

- *Due to statutory regulations on environmental protection and safeguarding the health and safety of our personnel, manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.*
- *This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.*



CAUTION!

If the device has been operated with toxic, caustic, flammable or water-endangering products, you are kindly requested:

- *to check and ensure, if necessary by rinsing or neutralizing, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that is safe to handle and stating the product used.*

7.4.2 Form (for copying) to accompany a returned device

Company:		Address:	
Department:		Name:	
Tel. no.:		Fax no.:	
Manufacturer's order no. or serial no.:			
The device has been operated with the following medium:			
This medium is:	water-hazardous		
	toxic		
	caustic		
	flammable		
	We checked that all cavities in the device are free from such substances.		
	We have flushed out and neutralized all cavities in the device.		
We hereby confirm that there is no risk to persons or the environment through any residual media contained in the device when it is returned.			
Date:		Signature:	
Stamp:			

7.5 Disposal



CAUTION!

Disposal must be carried out in accordance with legislation applicable in your country.

8.1 Measuring principle

A radar signal is emitted via an antenna, reflected on the product surface and received after a time t . The radar principle used is FMCW (Frequency Modulated Continuous Wave).

The FMCW-radar transmits a high frequency signal whose frequency increases linearly during the measurement phase (called the frequency sweep). The signal is emitted, reflected on the measuring surface and received with a time delay, t . Delay time, $t=2d/c$, where d is the distance to the product surface and c is the speed of light in the gas above the product.

For further signal processing the difference Δf is calculated from the actual transmit frequency and the receive frequency. The difference is directly proportional to the distance. A large frequency difference corresponds to a large distance and vice versa. The frequency difference Δf is transformed via a Fourier transformation (FFT) into a frequency spectrum and then the distance is calculated from the spectrum. The level results from the difference between tank height and measuring distance.

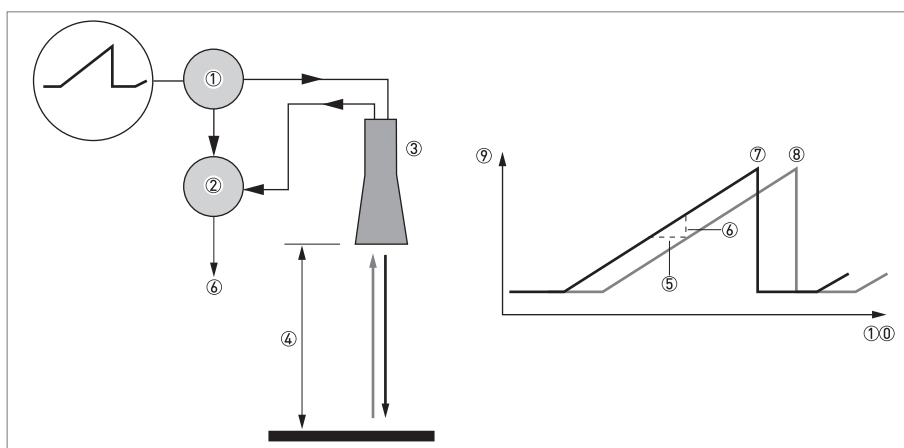


Figure 8-1: Measuring principle of FMCW radar

- ① Transmitter
- ② Mixer
- ③ Antenna
- ④ Distance to product surface, where change in frequency is proportional to distance
- ⑤ Differential time delay, Δt
- ⑥ Differential frequency, Δf
- ⑦ Frequency transmitted
- ⑧ Frequency received
- ⑨ Frequency
- ⑩ Time

8.2 Technical data



INFORMATION!

- The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local representative.
- Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Downloadcenter).

Measuring system

Measuring principle	2-wire loop-powered level transmitter; X-band FMCW radar
Application range	Level measurement of liquids, pastes and slurries
Primary measured value	Δf (change in frequency) between the emitted and received signal
Secondary measured value	Distance, level and volume

Design

Construction	The measurement system consists of a measuring sensor (horn or Wave-Stick antenna) and a signal converter which is available in a compact version.
Options	Integrated graphical display
	High-temperature version (max. +250°C / +480°F, dep. on used gaskets)
	Special version (with PFA gaskets) for low temperatures (min. -60°C / -76°F)
	Version for food application with dairy screw or Tri-clamp connection
	Antenna purging system for horn antenna (supplied with ¼ NPTF connection)
	Wave-Guide antenna
	Wave-Stick: PTFE flange plate
Accessories	Heated or cooled antenna for sticky products or high-temperature applications
	Weather protection Antenna extensions of 100 mm / 3.9" length; 90° bent; S-shaped
Max. measuring range	30 m / 98 ft
	Depends on the antenna option, dielectric constant of the product and installation type. Refer also to "Antenna selection".
Min. tank height	0.5 m / 19.7"
Min. block distance	0.2...0.5 m / 0.7...1.6 ft
Beam angle of antenna	Horn DN80 / 3", type 1: 16°
	Horn DN100 / 4", type 2: 12°
	Horn DN150 / 6", type 3: 8°
	Horn DN200 / 8", type 4: 6°
	Wave-Stick 25 mm / 1": 9°
	Wave-Guide / stilling well 25...200 mm / 1...8": Propagation only inside the stilling well
Display and user interface	
Display	Graphical display (64 x 128 pixels)
Interface languages	English, German, French, Italian, Spanish, Portuguese, Swedish
Measurement units	Lengths: m, cm, mm, inch, ft Volume: m ³ , Liter, US Gal, GB Gal, ft ³ , bbl, free unit (customer defined)

Measuring accuracy

Resolution	1 mm / 0.04"
Repeatability	≤ 0.5 x measuring error
Accuracy	Standard: ±10 mm / ±0.4", when distance ≤ 5 m / 16.4 ft or ±0.2% of measured distance, when distance > 5 m / 16.4 ft
	Option: ±5 mm / ±0.2", when distance ≤ 5 m / 16.4 ft or ±0.1% of measured distance, when distance > 5 m / 16.4 ft
Reference conditions acc. to EN 60770	
Temperature	+20°C ±5°C / +70°F ±10°F
Pressure	1013 mbar abs. ±20 mbar / 14.69 psig ±0.29 psig
Relative air humidity	60% ±15%
Target	Metal plate in an anechoic chamber

Operating conditions

Temperature	
Ambient temperature	-20...+55°C / -4...+130°F Functional range: -40...+70°C / -40...+160°F
Storage temperature	-40...+85°C / -40...+185°F
Process connection temperature	V96 flange system with horn antenna or Wave-Guide: Standard without HT distance piece (K6375 gasket): -20...+130°C / -5...+260°F (depending on the temperature limits of the gasket material. For other gasket materials see "Materials" in this table.) With HT distance piece (K6375 gasket): -20...+250°C / -5...+260°F (depending on the temperature limits of the gasket material. For other gasket materials see "Materials" in this table.) LP flange system with horn antenna or Wave-Guide: -20...+130°C / -4...+266°F (only available without HT distance piece) Wave-Stick: PTFE with or without flange plate: -20...+130°C / -5...+260°F (dep. on flange size and pressure rating. Refer to chapter "Pressure ratings".) PTFE with or without flange plate and HT distance piece: -20...+150°C / -5...+300°F (dep. on flange size and pressure rating. Refer to chapter "Pressure ratings".) PP without flange plate: -20...+100°C / -5...+210°F (only available without HT distance piece)
Thermal shock resistance	<40°C/s / <72°F/s
Pressure	
Operating pressure	V96 flange system with horn antenna or Wave-Guide: -1...40 bar / -14.5...580 psig (dep. on flange size and pressure rating. Refer to chapter "Pressure ratings".) Higher pressures on request.
	LP flange system with horn antenna, Wave-Guide or Wave-Stick without flange plate: -1...2 bar / -14.5...29 psig
	Wave-Stick with flange plate: -1...16 bar / -14.5...232 psig (dep. on temperature; Refer to chapter "Pressure ratings".)

Other conditions	
Physical properties	No effect on measurement results; for reliable measurements the relative permittivity should have the following values:
Dielectric constant (ϵ_r)	$\epsilon_r \geq 1.5$;
	$\epsilon_r < 3$: stilling well recommended;
	Wave-Stick immersed: $\epsilon_r \geq 4$
Product limitations	Liquid ammonia (NH ₃), liquid hydrogen (H ₂), liquid helium (He)
Vibration resistance	IEC 60068-2-6 and EN 50178 (10...57 Hz: 0.075 mm / 57...150 Hz:1g)
Protection category	IP66/67 equivalent to NEMA 6-6X

Installation conditions

Installation requirement	For detailed information refer to chapter "Installation".
Process connection position	Make sure that there are not any obstructions directly below the process connection for the device.
Dimensions and weights	For detailed information refer to chapter "Dimensions and weights".

Materials

Signal converter housing	Aluminium with electrostatic powder coating
	Sight window: glass
Flange system (V96 and LP), antenna, antenna extension	Standard: Stainless Steel (1.4571 / 316 Ti)
	Option: Stainless Steel (1.4435 / 316 L), Hastelloy® C4 or B2, Titanium, Tantalum
	Information on other materials on request.
Wave-Stick	Flanges: Stainless Steel (1.4571 / 316 Ti)
	Flange plate: PTFE
Gaskets	K4079 without HT distance piece: -20...+130°C / -5...+260°F K4079 with HT distance piece: -20...+250°C / -5...+480°F
	K2035 without HT distance piece: -20...+130°C / -5...+260°F K2035 with HT distance piece: -20...+210°C / -5...+410°F
	K6230 without HT distance piece: -20...+130°C / -5...+260°F K6230 with HT distance piece: -20...+210°C / -5...+410°F
	K6375 without HT distance piece: -20...+130°C / -5...+260°F K6375 with HT distance piece: -20...+250°C / -5...+480°F
	FPM without HT distance piece: -20...+130°C / -5...+260°F FPM with HT distance piece: -20...+200°C / -5...+390°F
	FPM/FEP without HT distance piece: -15...+130°C / +5...+260°F FPM/FEP with HT distance piece: -15...+200°C / +5...+390°F
	Silicone/FEP without HT distance piece: -30...+130°C / -20...+260°F Silicone/FEP with HT distance piece: -30...+200°C / -20...+390°F
	PFA without HT distance piece: -30...+130°C / -20...+260°F PFA with HT distance piece: -30...+200°C / -20...+390°F Special version: -60...+130°C / -75...+260°F
	Weather protection (Option)

Process connections

Horn antenna or Wave-Guide	DN50...200, PN6...64 ASME B16.5: 2...8", 150/300 lbs/RF
Wave-Stick	DN50...150 ASME B16.5: 2...6", G1½, 1½NPT
Dairy screw connection	DIN 11851: DN50, DN65, DN80 SMS 1145: 51 mm, 63 mm, 76 mm
Tri-clamp	ISO 2852: 2...4"

Electrical connections

Power supply	Non-Ex / Ex i: 14.5...30 VDC
Cable entry	M20x1.5; ½NPT
	G½
Cable gland	Standard: M20x1.5
	Options: ½NPT, G½ adapter
Cable entry capacity (terminal)	0.5...1.5 mm ² / AWG 20...16
U-clamp terminals (for PA and FE)	Max. 4 mm ² / AWG 12

Output

Description of the used abbreviations	U_{ext} = external voltage; R_L = load + resistance
Current output	
Output data	Distance, level and volume
Measuring range	4...20 mA HART® or 3.8...20.5 mA acc. to NAMUR NE 43 ①
Load	Minimal 0 Ω; max. $R_L = ((U_{\text{ext.}} - 14.5 \text{ VDC}) / 22 \text{ mA})$
Temperature drift	≤ 150 ppm/K
Error signal	Acc. to NAMUR NE 43
	High value: 22 mA
	Low value: 3.6 mA
HART®	
Description	HART® protocol via current output
	HART® version: V5
Load	≥ 250 Ω at HART® test point; Note maximum load for current output!
Multidrop operation	Yes, current output = 4 mA
	Multidrop address adjustable in operation menu 1...15

Approvals and certifications

CE	This device fulfils the statutory requirements of the EC directives. The manufacturer certifies successful testing of the product by applying the CE marking.
ATEX	ATEX II 1/2 G Ex ia IIC T6...T1
	ATEX Directive 94/9/EC: EN 60079-0:2006, EN 60079-11:2007, EN 60079-26:2007
Other standards and approvals	
EMC	EMC Directive 2004/108/EC: EN 61326-2-3:2006
R&TTE	R&TTE Directive 1995/5/EC: EN 302 372-2 V1.1.1

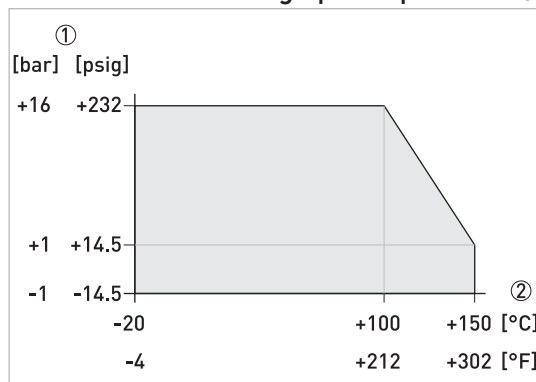
① HART® is a registered trademark of the HART Communication Foundation.

8.3 Pressure ratings

V96 flange system with horn antenna or Wave-Guide:
max. allowable operating pressure

Nominal diameter		Flange rated pressure							
		PN16		PN25		PN40		PN64	
DN	inches	bar	psig	bar	psig	bar	psig	bar	psig
80	3	16	232	-	-	40	580	64	928
100	4	16	232	-	-	38	551	55	797
150	6	16	232	-	-	34	493	47	681
200	8	16	232	25	362	32	464	45	652

Wave-Stick with flange plate: pressure / temperature rating



- ① Pressure in [bar] or [psig]
- ② Temperature in [°C] or [°F]

8.4 Antenna selection

The graph below shows which antenna to select for the application.

Graph of tank height / measuring range against dielectric constant ϵ_r

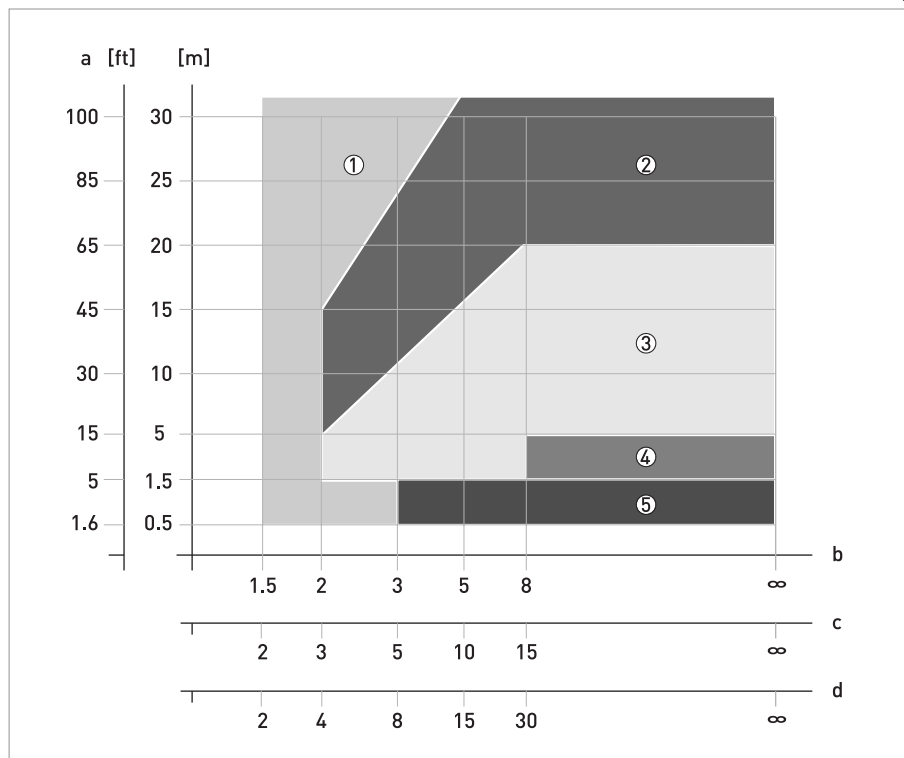


Figure 8-2: Selection of antenna

a = tank height / measuring range [ft / m]

b = ϵ_r for storage tanks with smooth product surface

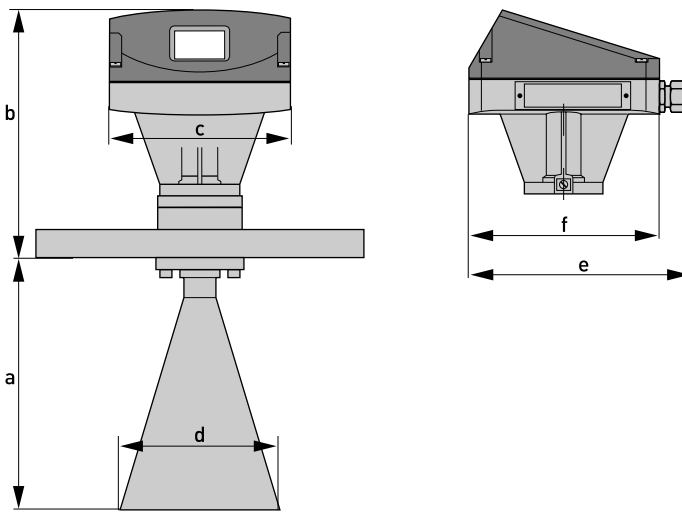
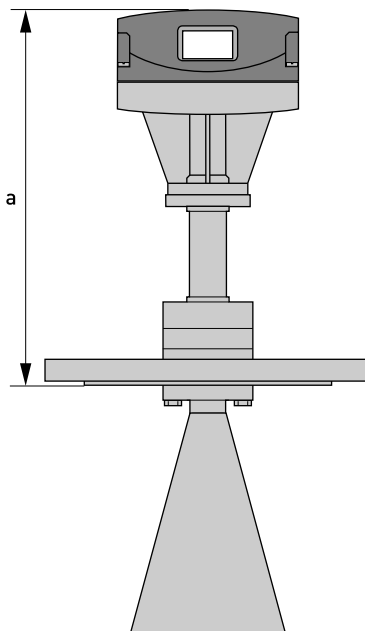
c = ϵ_r for process tanks or foam

d = ϵ_r for agitator tanks with vortex

- ① Stilling well* (not for agitator tanks)
- ② Stilling well* (not for agitator tanks) or antenna type 4
- ③ Stilling well* (not for agitator tanks); Wave-Stick or antenna type 3 and type 4
- ④ Stilling well* (not for agitator tanks); antenna type 2, type 3 and type 4 or Wave-Stick
- ⑤ Stilling well* (not for agitator tanks) or Wave-Stick

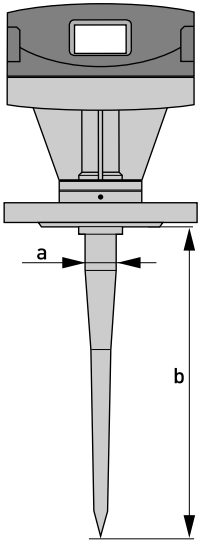
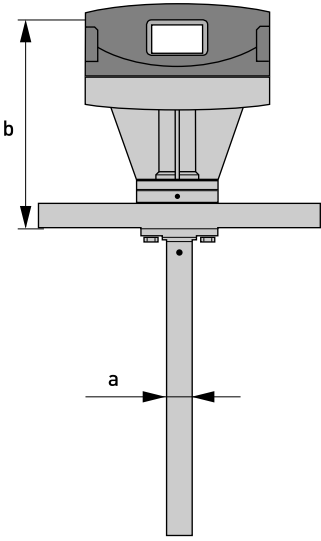
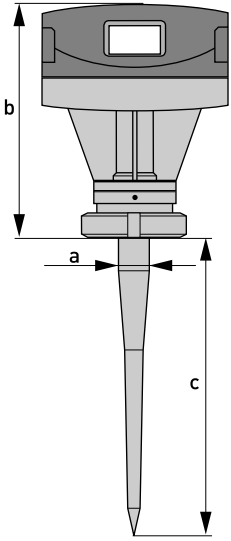
* Stilling well is equal to Wave-Guide antenna and bypass chamber

8.5 Dimensions

Horn antenna	High-temperature version
	
b = 215 mm / 8.5"	a = 355 mm / 14"
c = 155 mm / 6.1"	
e = 198 mm / 7.8"	
f = 172 mm / 6.8"	
For dimensions of a and Ød, see table below.	

Nominal size		Antenna	Dimensions [mm]				Approx. weight
DN [mm]	ASME [inches]	Type	Ød	a (SS 1.4571/ SS 316 Ti)	a (Hastelloy® C4)	a (Titanium, Tantalum)	[kg]
80	3	1	80	110	145	110	9
100	4	2	100	148	177	146	10
150	6	3	140	223	250	220	16
200	8	4	200	335	360	332	21

Nominal size		Antenna	Dimensions [inches]				Approx. weight
DN [mm]	ASME [inches]	Type	Ød	a (SS 1.4571/ SS 316 Ti)	a (Hastelloy® C4)	a (Titanium, Tantalum)	[lbs]
80	3	1	3.15	4.33	5.71	4.33	20
100	4	2	3.94	5.83	6.97	5.75	22
150	6	3	5.51	8.78	9.84	8.66	35
200	8	4	7.87	13.19	14.17	13.07	46

Wave-Stick	Wave-Guide	Wave-Stick Dairy screw connection
		
<p>a = Ø25 mm / Ø1.0"</p>	<p>a = Ø30 mm / Ø1.2"</p>	<p>a = Ø25 mm / Ø1.0"</p>
<p>b = ≥270 mm / 10.6"</p>	<p>b = 215 mm / 8.5"</p>	<p>b = 205 mm / 8.1"</p>
		<p>c = ≥270 mm / 10.6"</p>
<p>Weight: approx. 6 kg / 13.2 lbs (DN50)</p>	<p>Weight: approx. 7 kg / 15.4 lbs (DN50, 1 m / 3.9")</p>	<p>Weight: approx. 4.4 kg / 8.8 lbs</p>

9.1 Parameter check list

BM 702 A		Vers.:	Device no.:	
Menu	modified at			
Fct.	Configuration parameters (extract)			
3.1.1	Tank height:			
3.1.2	Block distance:			
3.1.3	Antenna:			
3.1.4	Antenna extension:			
3.1.5	Distance piece:			
3.1.6	Stillwell / diameter:			
3.1.7	Reference offset:			
3.1.8	Tank bottom offset:			
3.3.1	Current output function:			
3.3.2	Current output range / error:			
3.3.3	Min. current scale:			
3.3.4	Max. current scale:			
3.5.2	Empty spectrum:			
3.5.3	Time constant:			
3.5.4	Tracing velocity:			
3.5.5	Multiple reflections (yes / no):			
3.5.6	Block distance ident (yes / no):			
3.5.7	Function FTB:			
3.5.8	Epsilon R (ϵ_r):			
3.5.9	Tank type:			







KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature meters
- Pressure meters
- Analysis products
- Measuring systems for the oil and gas industry
- Measuring systems for sea-going tankers

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KROHNE