



OPTIWAVE 7300 C Handbook

Non-contact Radar (FMCW) Level Meter for liquids

for distance, level, volume and mass measurement of liquids

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1.1 Intended use

This radar level transmitter measures distance, level, mass, volume and reflectivity of liquids, pastes and slurries.

It can be installed on tanks, reactors and open channels.

1.2 Certification



DANGER!

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



In accordance with the commitment to customer service and safety, the device described in this document meets the following safety requirements:

- Electromagnetic Compatibility (EMC) Directive 2004/108/EC in conjunction with EN 61326-1 (2006).
- Radio Equipment and Telecommunications Terminal Equipment (R & TTE) Directive 1999/05/EC in conjunction with ETSI EN 302 372 (2006). For more data, refer to *European Union (EU)* on page 7.
- Low-Voltage Directive 2006/95/EC in conjunction with EN 61010-1 (2001).

All devices are based on the CE marking and meet the requirements of NAMUR Guideline NE 21/07.

1.3 Electromagnetic compatibility

The device design agrees with European Standard EN 61326-1.

You can install the device on open-air tanks and tanks that are not made of metal. But refer to *Radio approvals* on page 7. This agrees with Immunity and Emissions requirements for industrial environments.



INFORMATION!

Device operation agrees with residential-class (class B) immunity and emissions requirements if the antenna is used in a closed tank made of metal.

1.4 Radio approvals

1.4.1 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 (24 GHz - 26 GHz) that is not 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 II identifier (= alert sign).

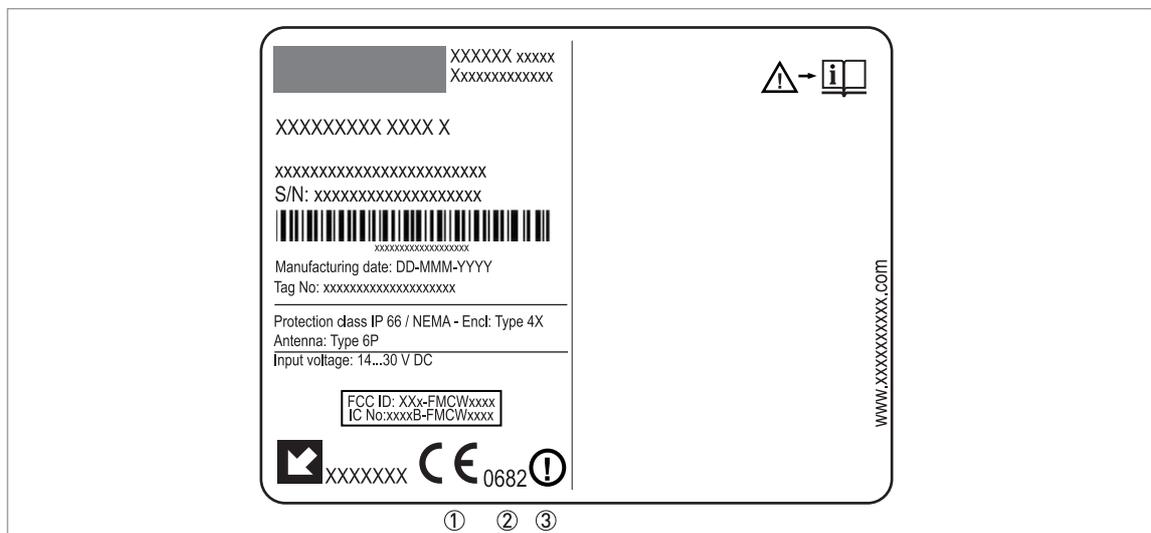


Figure 1-1: Radio approval information on the nameplate

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

According to ETSI EN 302 372 (2006-04), the radiated power outside a metallic tank is less than -30 dBm.

Refer also to the radio approval certificate on the internet site. The radio approval report is given on the CD-ROM supplied with the device.

1.4.2 U.S.A. and Canada



LEGAL NOTICE!

This device complies with Part 15 of the FCC Rules and with RSS-210 of Industry Canada.

Operation is subject to the following two conditions:

- 1. This device may not cause harmful interference, and*
- 2. This device must accept any interference received, including interference which may cause undesired operation.*

Changes or modifications made to this equipment not expressly approved by the manufacturer may void the FCC and IC authorizations to operate this equipment.

This legal information is shown on a label on the rear side of the device.

The radio approval report is given on the CD-ROM supplied with the device. You can also download it from 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!**

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

Scope of delivery - horn antenna

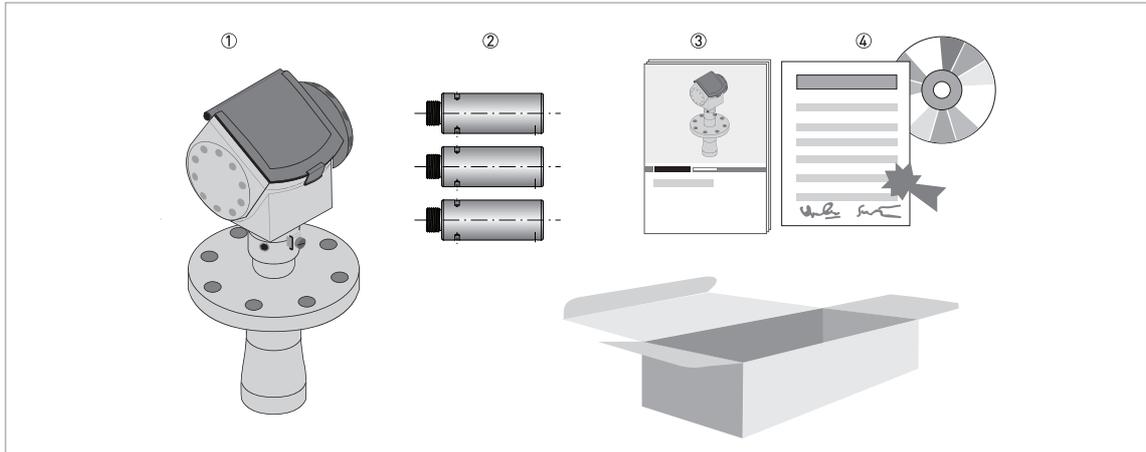


Figure 2-1: Scope of delivery - horn antenna

- ① Signal converter and antenna in compact version
- ② Antenna extensions (option)
- ③ Quick Start
- ④ CD-ROM (including Handbook, Quick Start, Technical Datasheet and related software)

Scope of delivery - Drop antenna

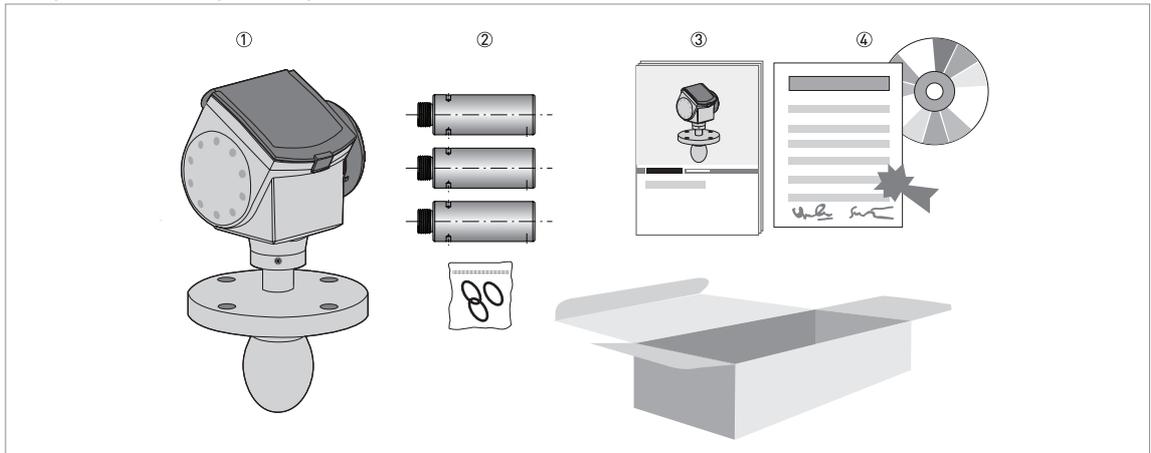


Figure 2-2: Scope of delivery - Drop antenna

- ① Signal converter and antenna in compact version
- ② Antenna extensions (option) and o-ring for each antenna extension
- ③ Quick Start
- ④ CD-ROM (including Handbook, Quick Start, Technical Datasheet, and related software)

Scope of delivery - hygienic antenna

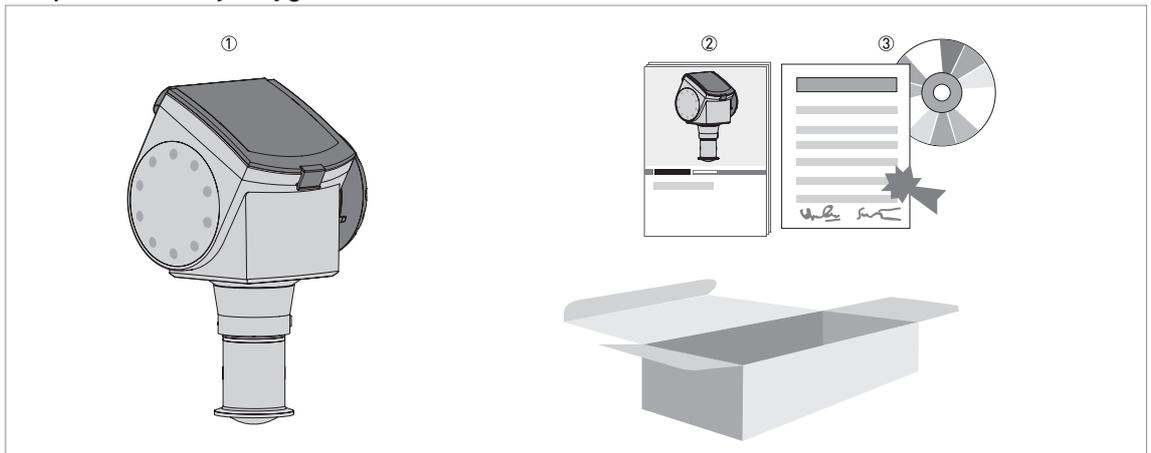


Figure 2-3: Scope of delivery - hygienic antenna

- ① Signal converter and antenna in compact version
- ② Quick Start
- ③ CD-ROM (including Handbook, Quick Start, Technical Datasheet, and related software)



INFORMATION!

No special tools or training required!

2.2 Device description

This device is a 24 GHz FMCW-radar level transmitter. It is a non-contact technology and is 2-wire loop-powered. It is designed to measure the distance, level, mass, volume and reflectivity of liquids, pastes and slurries.

Radar level transmitters use an antenna to guide a signal to the surface of the measured product. The device has many antennas available. Thus, it can measure most products even in difficult conditions. Also refer to *Technical data* on page 100.

The device has a set-up wizard, fully-potted electronic circuit boards and online help functions.

You usually will not need this Handbook to install, set up and operate the device.

If it is ordered with the applicable options, it can be certified for use in hazardous areas.

These output options are available:

- 1 output: 4...20 mA (HART)
- 2 outputs: 4...20 mA (HART) + 4...20 mA
- 4-wire FOUNDATION™ Fieldbus output (with a local HART® connection for device configuration)
- 4-wire PROFIBUS PA output (with a local HART® connection for device configuration)

These accessories are available:

- Stainless steel weather protection.
- RS232 / HART® converter (VIATOR).
- USB / HART® converter.



INFORMATION!

For more data on accessories, refer to List of accessories on page 96.

2.3 Visual Check



WARNING!

If the display screen glass is broken, do not touch.



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.

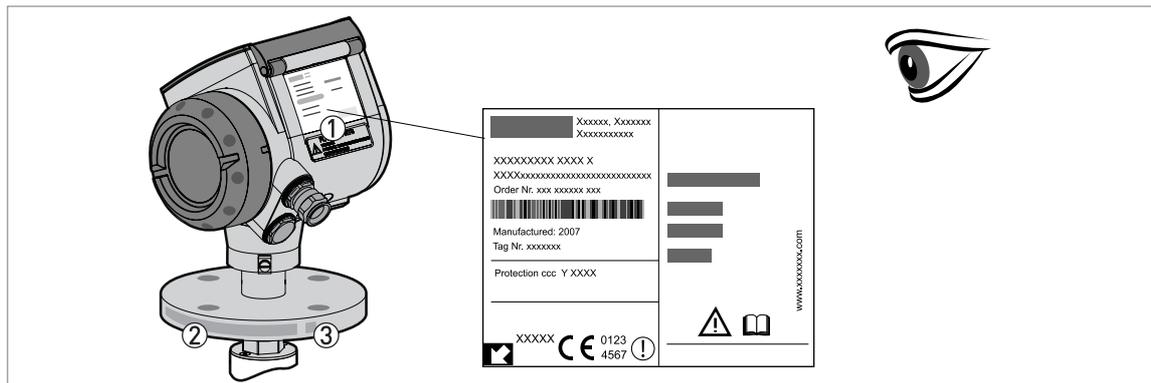


Figure 2-4: Visual check

- ① Device nameplate (for more data, refer to *Non-Ex nameplate* on page 16)
- ② Process connection data (size and pressure rating, material reference and heat number)
- ③ Gasket material data - refer to the illustration that follows



Figure 2-5: Symbols for the supplied gasket material (on the side of the process connection)

- ① EPDM
- ② Kalrez® 6375

If the device is supplied with an FKM/FPM gasket, there is no symbol on the side of the process connection.



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.



INFORMATION!

Compare the material references on the side of the process connection with the order.

2.4 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.

2.4.1 Non-Ex nameplate

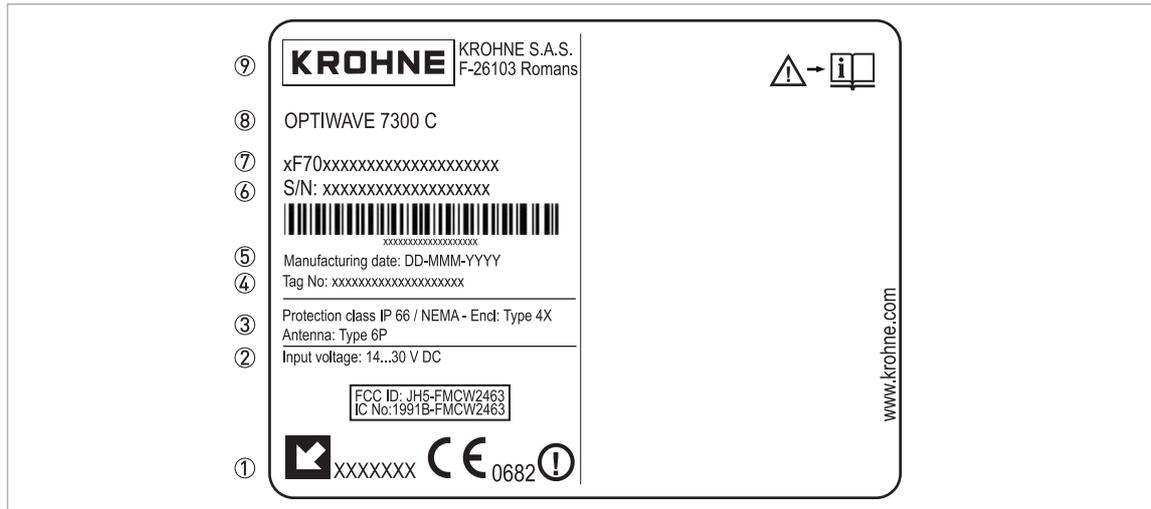


Figure 2-6: Non-Ex nameplate

- ① Indicator arrow to cable entry / cable entry size. Notified body for radio approval.
- ② Nominal voltage for operation. For further information, refer to *Non-Ex* on page 39.
- ③ Degree of ingress protection (according to EN 60529 / IEC 60529)
- ④ Customer tag number
- ⑤ Date of manufacture
- ⑥ Order number
- ⑦ Type code (defined in order)
- ⑧ Model name and number
- ⑨ Company name and address

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.

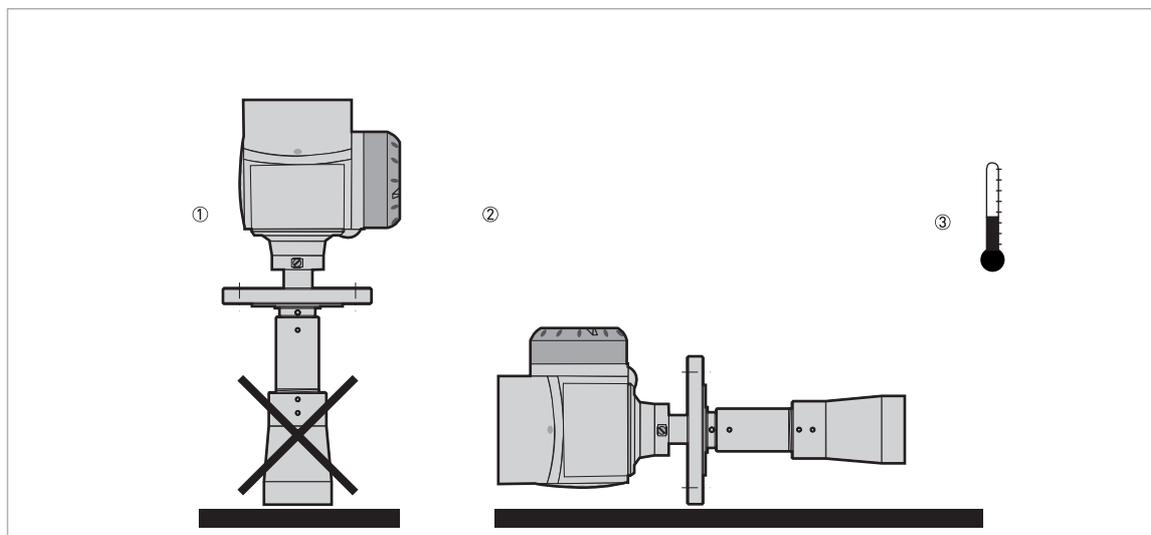


Figure 3-1: Storage conditions

- 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 packaging 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

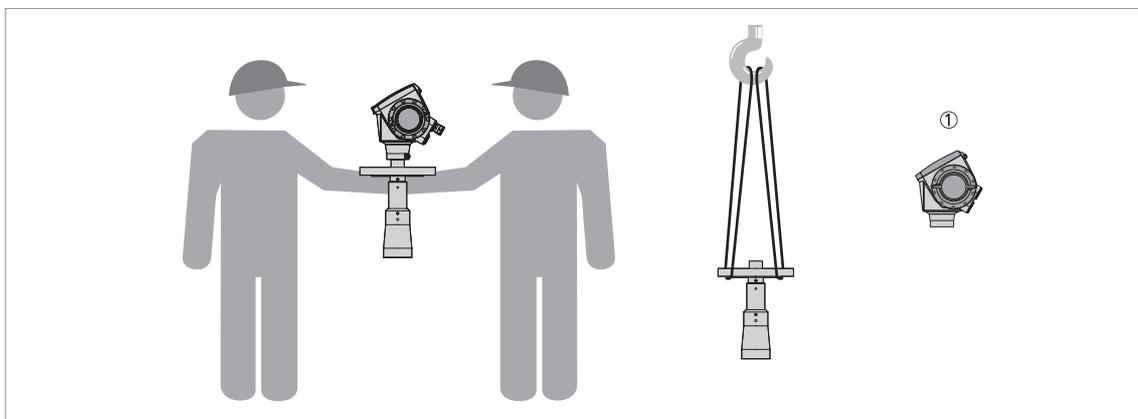


Figure 3-2: How to lift the device

① Remove the converter before you lift the device with a hoist.



WARNING!

Lift the device carefully to prevent damage to the antenna.

3.4 Pre-installation requirements



INFORMATION!

Obey the precautions that follow to make sure that the device is correctly installed.

- Make sure that there is sufficient space on all sides.
- Protect the signal converter from direct sunlight. If necessary, install the weather protection accessory.
- 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.

3.5 How to prepare the tank before you install the device



CAUTION!

To avoid measuring errors and device malfunction, obey these precautions.

3.5.1 Pressure and temperature ranges

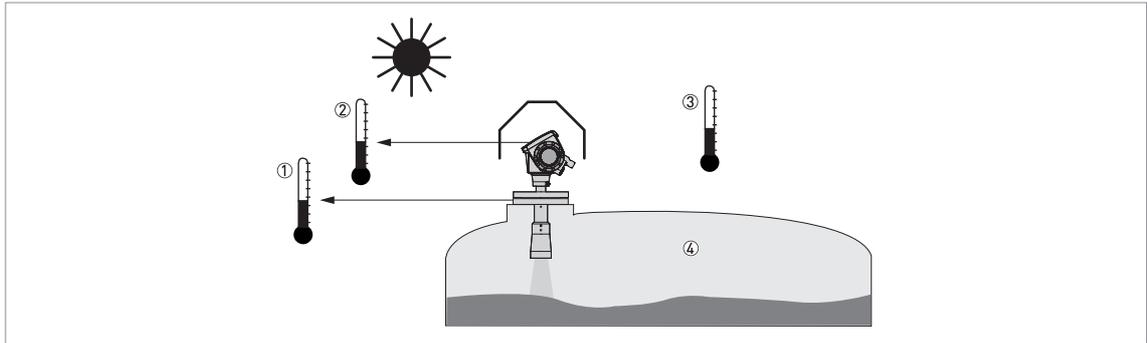


Figure 3-3: Pressure and temperature ranges

- ① Flange temperature
FKM/FPM gasket: -40...+200°C / -40...+390°F; Kalrez[®] 6375 gasket: -20...+200°C / -4...+390°F;
EPDM gasket: -50...+150°C / -58...+300°F
Depends on the antenna type. Refer to the table that follows.
Ex devices: see supplementary operating instructions
- ② Ambient temperature for operation of the display
-20...+60°C / -4...+140°F
If the ambient temperature is not between these limits, the display screen switches off automatically
- ③ Ambient temperature
Non-Ex devices: -40...+80°C / -40...+175°F
Ex devices: see supplementary operating instructions
- ④ Process pressure
Depends on the antenna type. Refer to the table that follows.



WARNING!

The process connection temperature range must agree with the temperature limits of the gasket material. The operating pressure range is subject to the process connection used and the flange temperature.

| Antenna type | Maximum process connection temperature | | Maximum operating pressure | |
|--------------|--|---------------|----------------------------|--------------|
| | [°C] | [°F] | barg | psig |
| PP Drop | +100 | +210 | 16 | 232 |
| PTFE Drop | +150 | +300 | 40 | 580 |
| Hygienic | +150 | +300 | 10 | 145 |
| Horn | +150 (+200) ① | +300 (+390) ① | 40 (100) ② | 580 (1450) ② |

① Standard max. process connection temperature: +150°C / +300°F. Optional max. process temperature: +200°C / +390°F.

② Standard max. operating pressure: 40 barg / 580 psig. Optional max. operating pressure: 100 barg / 1450 psig.

3.5.2 Theoretical data for nozzle position

**CAUTION!**

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

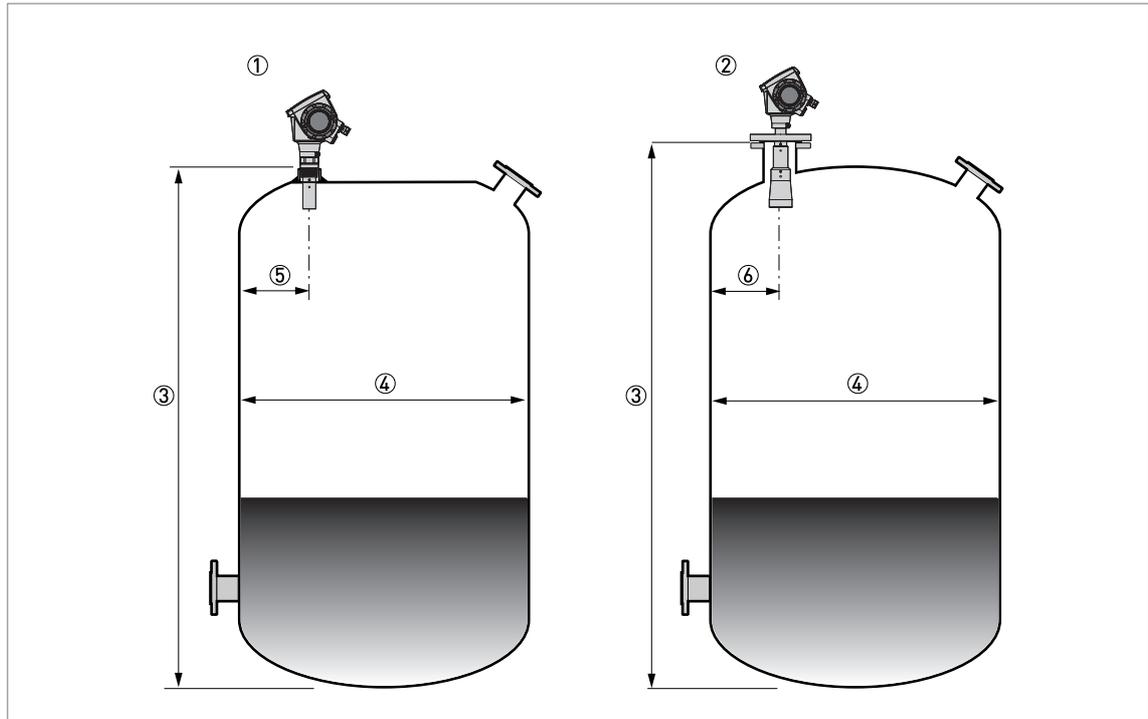


Figure 3-4: Recommended nozzle position for liquids, pastes and slurries

- ① Nozzles for DN40 or DN50 Horn antennas, or DN50 Hygienic antenna
- ② Nozzles for DN80 or DN100 Horn antennas, or DN80 Drop antenna
- ③ Tank height
- ④ Tank diameter
- ⑤ Minimum distance of nozzle from the tank wall : $1/7 \times$ tank height
Maximum distance of nozzle from the tank wall : $1/3 \times$ tank diameter
- ⑥ Minimum distance of nozzle from the tank wall : $1/10 \times$ tank height
Maximum distance of nozzle from the tank wall : $1/3 \times$ tank diameter

**INFORMATION!**

If possible, do not install 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.

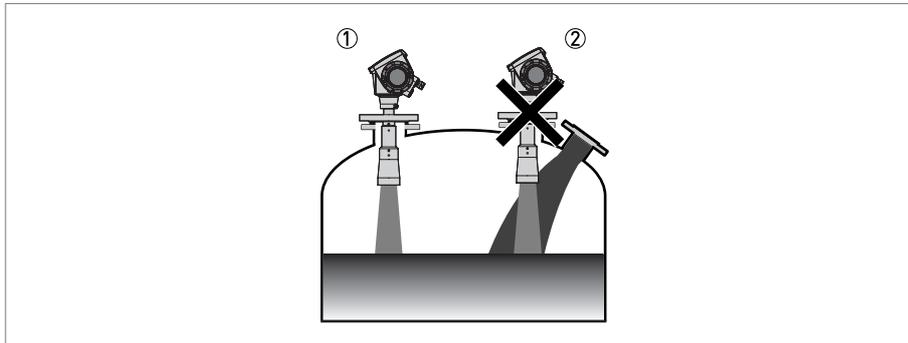


Figure 3-5: Product inlets

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

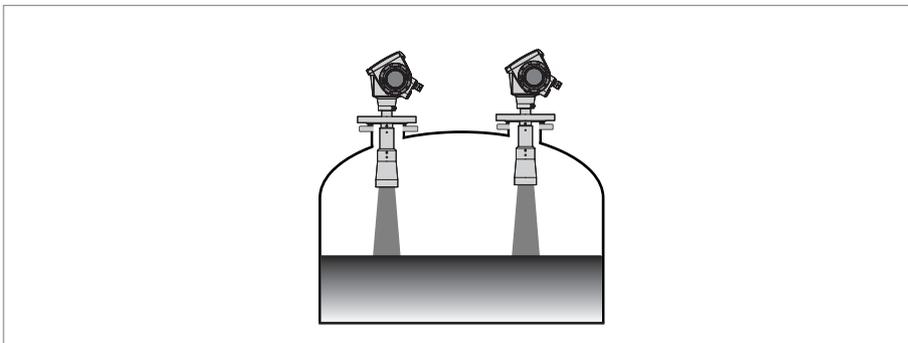


Figure 3-6: More than 1 FMCW radar level meter can be operated in a tank

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

3.5.3 Theoretical data for hygienic applications

To make the cleaning of the antenna easier, attach the device to a short socket.

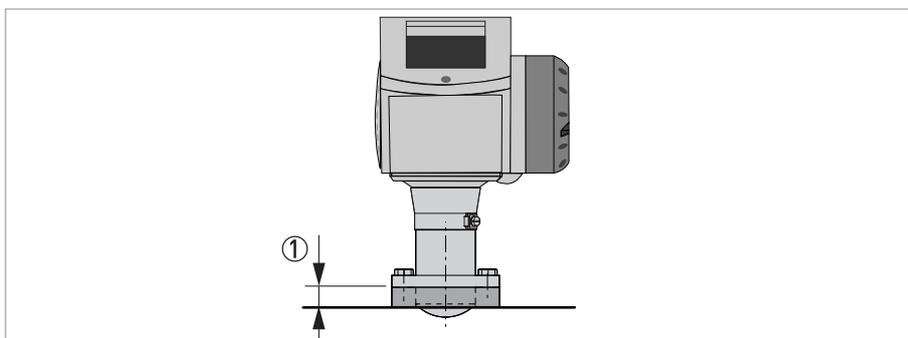


Figure 3-7: Requirements for hygienic applications

- ① Maximum height of process connection: 50 mm / 2"

3.6 Installation recommendations for liquids

3.6.1 General requirements



INFORMATION!

We recommend that you configure the device when the tank is empty.

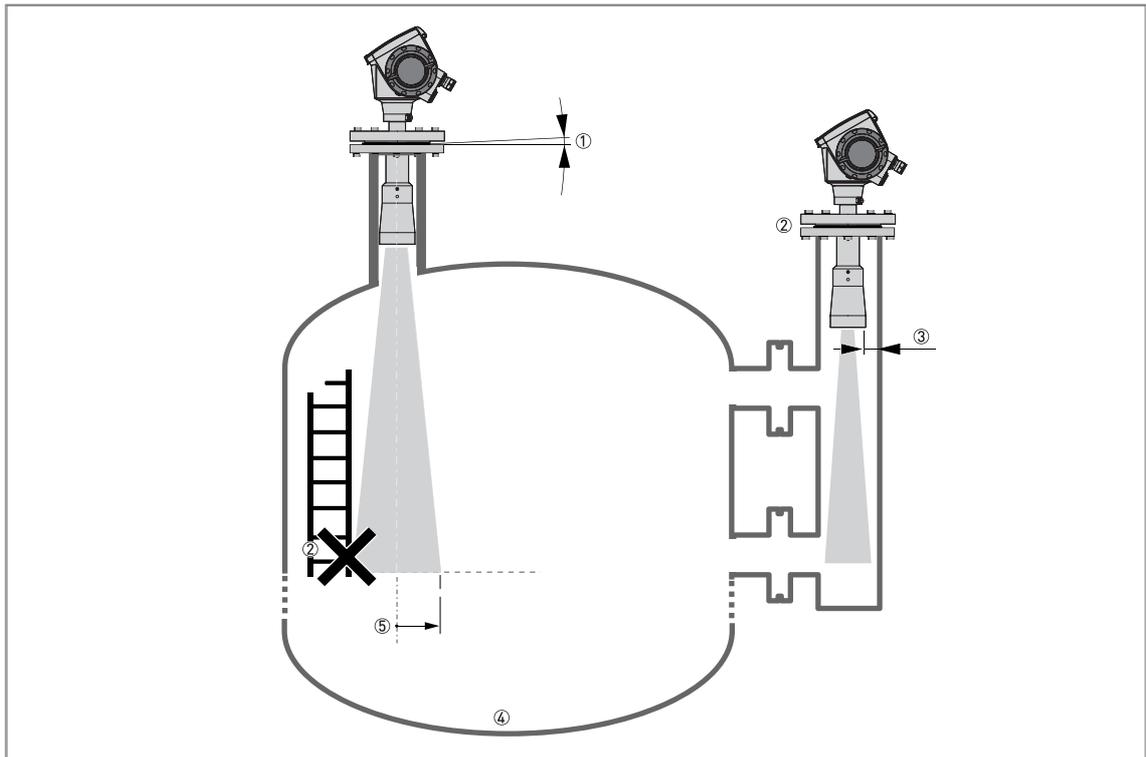


Figure 3-8: General Installation recommendations

- 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 (for more data, refer to *How to use the empty spectrum function to filter parasite signals* on page 76) or install a bypass chamber or stilling well
- ③ 2.5 mm / 0.1" max. for high-dielectric constant liquids
- ④ Curved and conical tank bottoms. For fine adjustment of the device, refer to *How to measure correctly in tanks with curved or conical bottoms* on page 77.
- ⑤ Radius of radar footprint (DN40 Horn antenna): increments of 180 mm/m or 2.15"/ft (10°)
 Radius of radar footprint (DN50 Horn antenna or DN50 Hygienic antenna): increments of 130 mm/m or 1.55"/ft (7.5°)
 Radius of radar footprint (DN80 Horn antenna): increments of 90 mm/m or 1.1"/ft (5°)
 Radius of radar footprint (DN100 Horn antenna and DN80 Drop antenna): increments of 70 mm/m or 0.83"/ft (4°)

3.6.2 Standpipes

Use a standpipe if:

- There is highly conductive foam in the tank.
- The liquid is very turbulent or agitated.
- There are too many other objects in the tank.
- The device is measuring a liquid (petro-chemicals) in a tank with a floating roof.

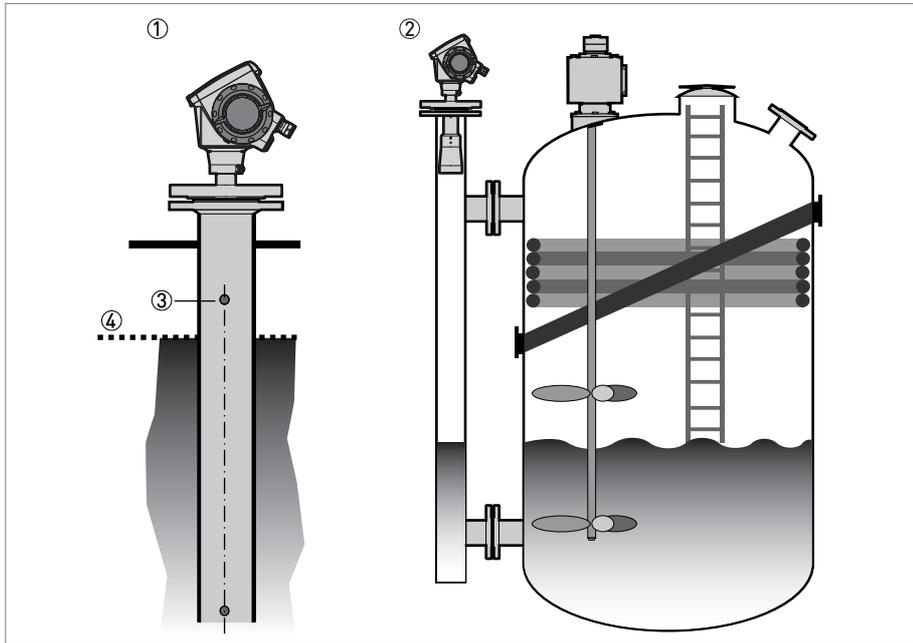


Figure 3-9: Installation recommendations for standpipes (stilling wells and bypass chambers)

- ① Stilling well
- ② Bypass chamber
- ③ Air circulation hole
- ④ Level of the liquid



CAUTION!

Installation requirements

- The standpipe must be electrically conductive.
- The inside diameter of the standpipe must not be more than 5 mm / 0.2" over the diameter of the antenna (for a high-dielectric constant liquid).
- The standpipe must be straight. There must be no sudden changes in internal diameter greater than 1 mm / 0.04".
- The standpipe must be vertical.
- Recommended surface roughness: $\leq \pm 0.1 \text{ mm} / 0.004''$.
- Stilling well only: The bottom of the stilling well must be open.
- Make sure that there are no deposits at the bottom of the standpipe.
- Make sure that there is liquid in the standpipe.

Stilling wells - general notes



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.
- Drill 1 or more liquid circulation holes in the stilling well (if there is more than 1 liquid in the tank).
- ➡ These holes help the liquid to move freely between the stilling well and the tank.
- Deburr the holes.

Stilling wells: floating roofs

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

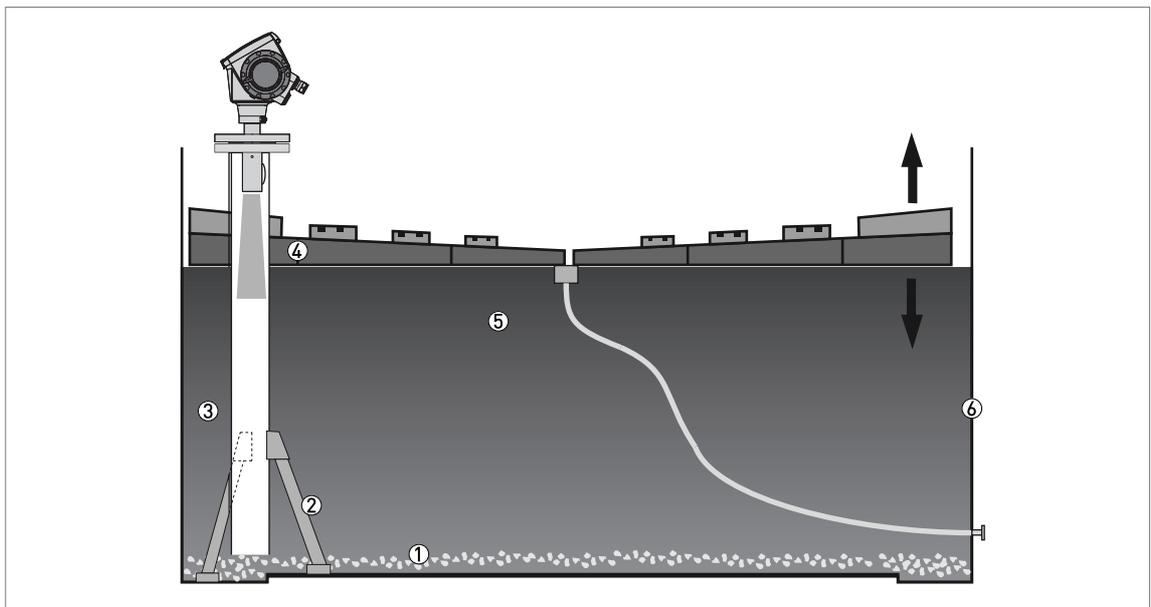


Figure 3-10: Floating roofs

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

Stilling wells: 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.

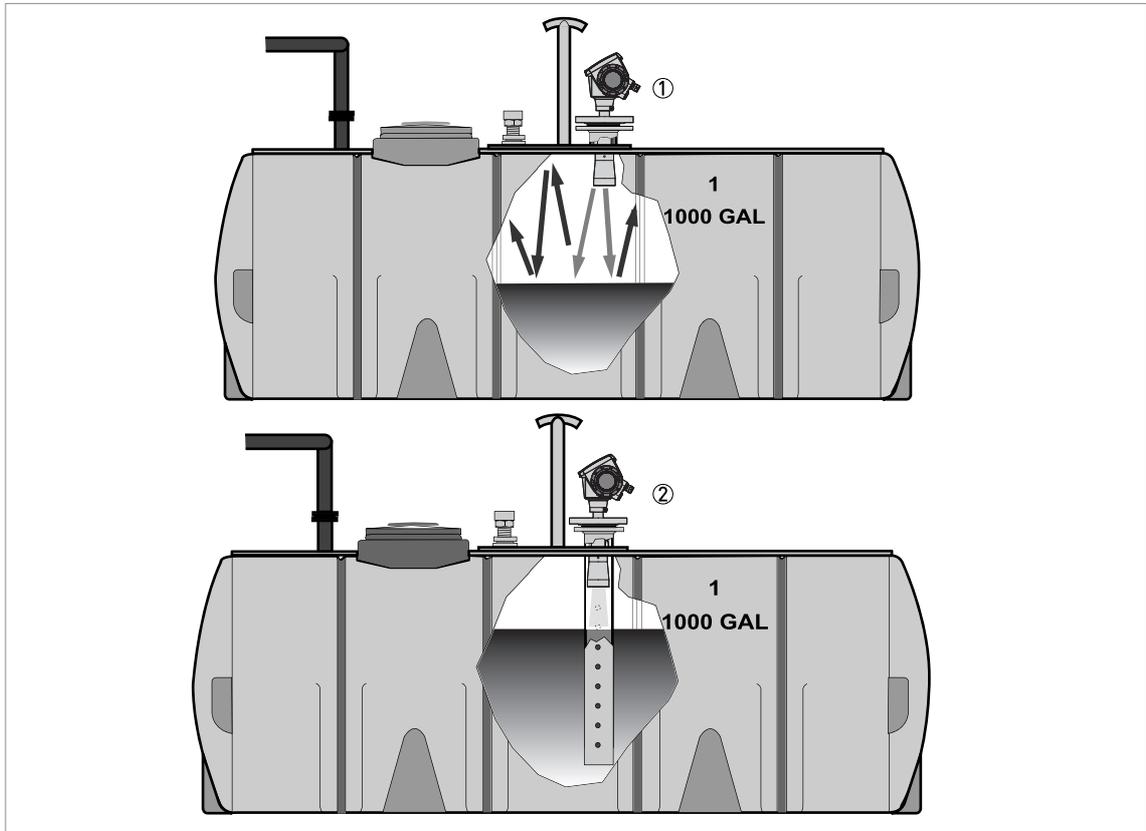


Figure 3-11: Horizontal cylindrical tanks

- 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 **Supervisor > Advanced Setup > Installation Setup** to keep the effects of multiple reflections to a minimum. For more data, refer to Function description on page 56 (C. Advanced Setup).*

Bypass chambers

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.

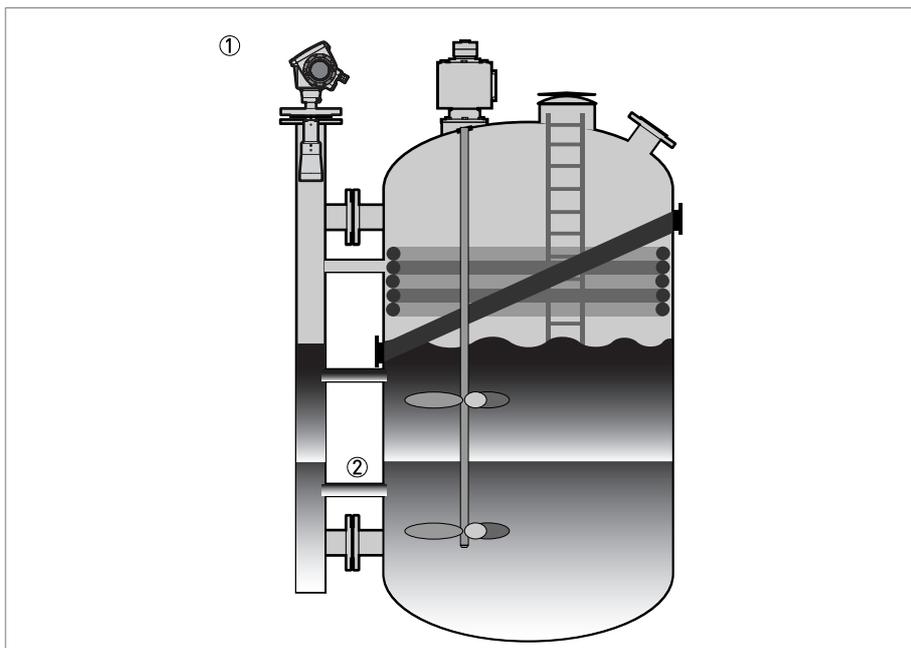


Figure 3-12: Installation recommendations for bypass chambers that contain more than one liquid

- ① Bypass chamber
- ② Additional process connection

3.7 How to install the device on the tank

3.7.1 How to install a device with a flange connection

Equipment needed:

- Device
- Gasket (not supplied)
- Nuts and bolts (not supplied)
- Wrench (not supplied)

Requirements for flange connections

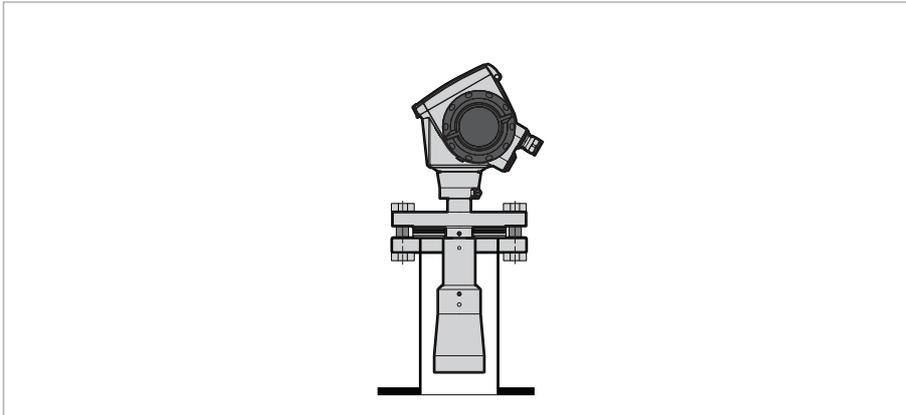


Figure 3-13: Flange connection



If the process connection is larger than the antenna:

- 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.

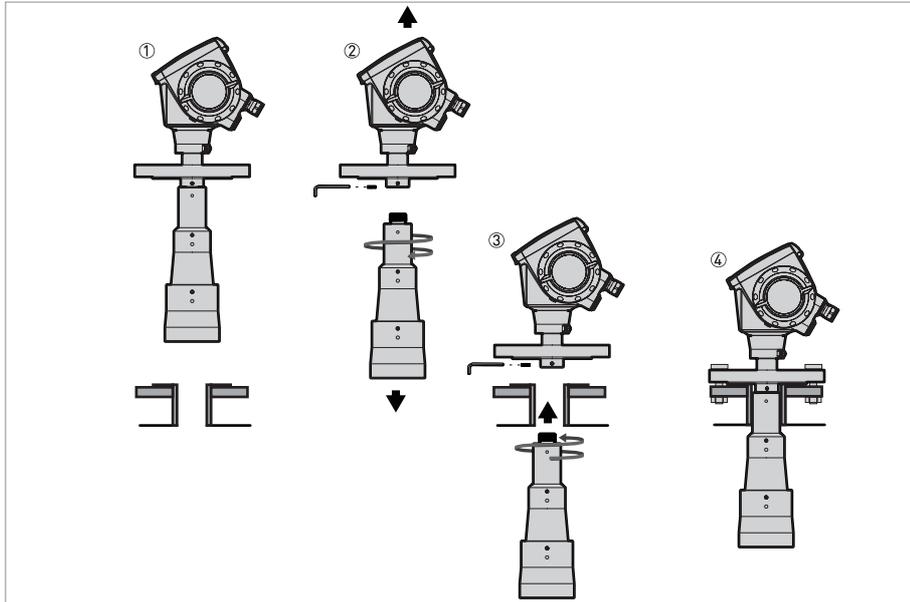


Figure 3-14: How to attach the device if the antenna is smaller than the process connection

Equipment needed:

- 3 mm Allen wrench (not supplied)

**WARNING!**

If you attach the antenna in a closed space, make sure that there is a good airflow in the area. Make sure that a person not in the tank can always hear you.

**If the process connection is smaller than the antenna:**

- Make sure the flange on the nozzle is level.
- Remove the antenna locking screw from the part below the flange.
- Remove the antenna from the part below the flange.
- Align the gasket correctly on the flange facing of the nozzle.
- Put the device carefully on the tank flange. Do not attach the device flange to the tank yet.
- Attach the antenna to the device inside the tank. Go to the top of the tank.
- Lift the device a small distance. Attach the antenna locking screw to the part below the flange. Tighten the antenna locking screw.
- Put the device carefully on the tank flange. Tighten the flange bolts.

3.7.2 How to install a device with a threaded connection**Equipment needed:**

- Device
- Gasket for G 1½ connection (not supplied)
- 50 mm / 2" wrench (not supplied)

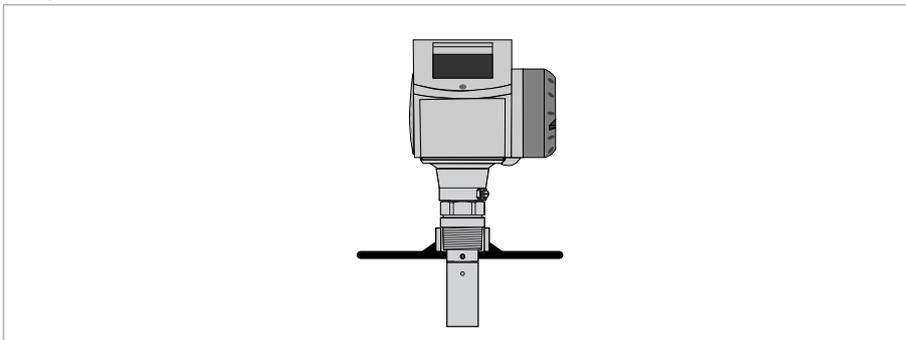
Requirements for threaded connections

Figure 3-15: Threaded connection

**If the process connection is larger than the antenna**

- Make sure the tank connection is level.
- Make sure that you use the applicable gasket for the connection dimensions and the process.
- 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.

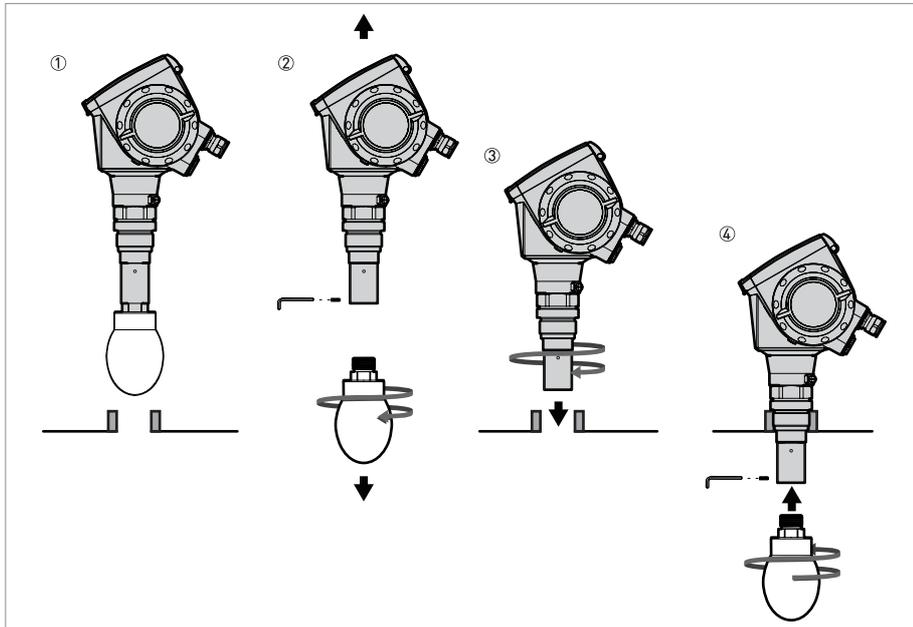


Figure 3-16: How to attach the device if the antenna is smaller than the process connection

Equipment needed:

- 3 mm Allen wrench (not supplied)



WARNING!

If you attach the antenna in a closed space, make sure that there is a good airflow in the area. Make sure that a person not in the tank can always hear you.



INFORMATION!

If the process connection is smaller than the antenna, we recommend that you use an antenna extension. It is possible that there is not sufficient space to tighten the antenna locking screw.



If the process connection is smaller than the antenna:

- Make sure the tank connection is level.
- Remove the antenna locking screw from the antenna extension.
- Remove the antenna from the antenna extension.
- Align the gasket correctly.
- Put the device carefully on the tank process connection. Do not attach the threaded connection to the tank yet.
- Attach the antenna to the antenna extension from inside the tank.
- Go to the top of the tank. Lift the device a small distance.
- Attach the antenna locking screw to the antenna extension. Tighten the antenna locking screw.
- Attach the device to the tank process connection. Tighten the connection.



If the process connection of the device is smaller than the process connection on the tank:

- Make sure the tank connection is level.
- Use a plate with a slot or a different applicable procedure to adapt the device to the tank.
- Align the gasket correctly.
- Lower the antenna carefully into the tank.
- If necessary, turn the threaded connection on the housing to attach the device to the plate.
- Tighten the connection.

3.7.3 How to install a device with a hygienic connection



INFORMATION!

To make the cleaning of the antenna easier, attach the device to a short socket.

BioControl[®]

Equipment needed:

- Device
- Gasket
- Flange bolts (not supplied)
- Wrench (not supplied)

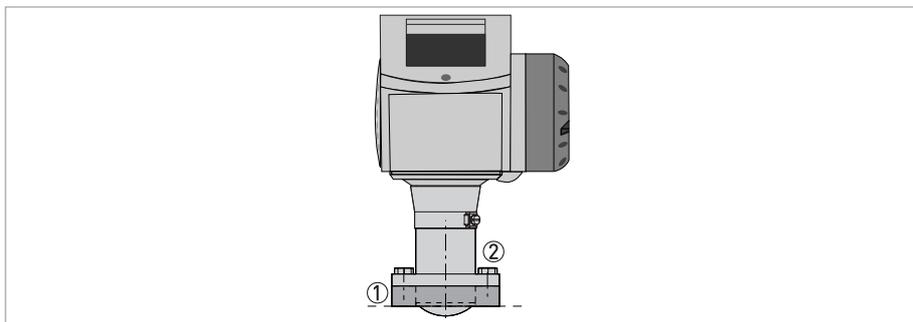


Figure 3-17: BioControl[®] connection

- ① BioControl[®] connection on the tank
- ② Flange bolts



How to attach a device with a Biocontrol[®] 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.

Tri-Clamp®

Equipment needed:

- Device
- Gasket (not supplied)
- Band clamp (not supplied)

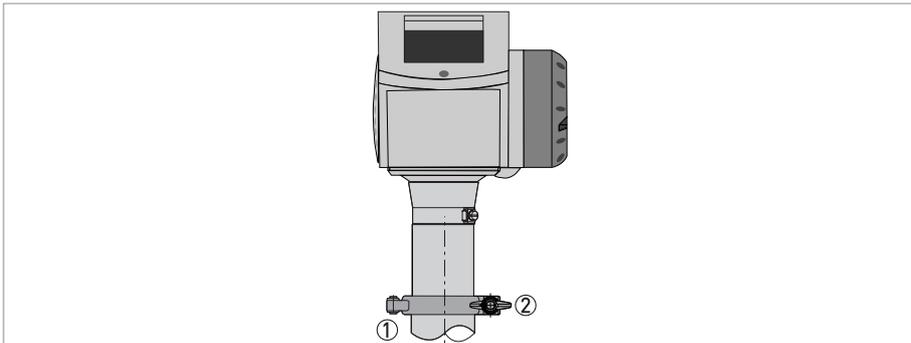


Figure 3-18: Tri-Clamp® connection

- ① Tank socket
- ② Band clamp



How to attach a device with a Tri-Clamp® connection

- Make sure the tank connection is level.
- Make sure that you use the applicable gasket for the connection dimensions and the process.
- Align the gasket correctly.
- Lower the antenna carefully into the tank.
- Attach the band clamp to the process connection.
- Tighten the band clamp.

DIN 11851

Equipment needed:

- Device
- Gasket (not supplied)
- DIN 11851 nut

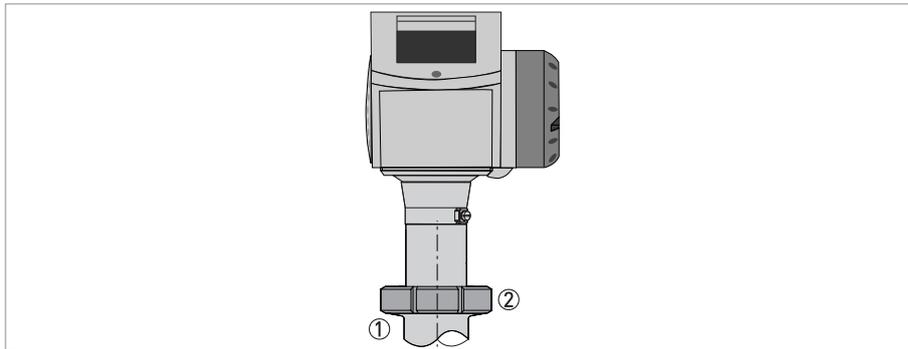


Figure 3-19: DIN 11851 connection

- ① Tank socket
- ② Nut for DIN 11851 connection



How to attach a device with a DIN 11851 connection

- Make sure the tank connection is level.
- Make sure that you use the applicable gasket for the connection dimensions and the process.
- Align the gasket correctly.
- Lower the antenna carefully into the tank.
- Turn the nut on the device process connection to attach the device to the tank.
- Tighten the connection.
- ➡ Refer to local rules and regulations for the correct torque to apply to the connection.

SMS

Equipment needed:

- Device
- Gasket (not supplied)
- SMS nut

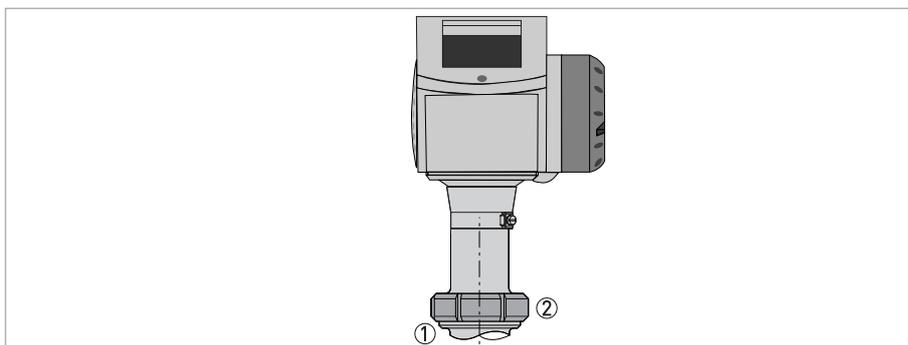


Figure 3-20: SMS connection

- ① Tank socket
- ② Nut for SMS connection



How to attach a device with a SMS connection

- Make sure the tank connection is level.
- Make sure that you use the applicable gasket for the connection dimensions and the process.
- Align the gasket correctly.
- Lower the antenna carefully into the tank.
- Turn the nut on the device process connection to attach the device to the tank.
- Tighten the connection.
- ➔ Refer to local rules and regulations for the correct torque to apply to the connection.

3.7.4 How to attach antenna extensions

Horn antenna - antenna extensions

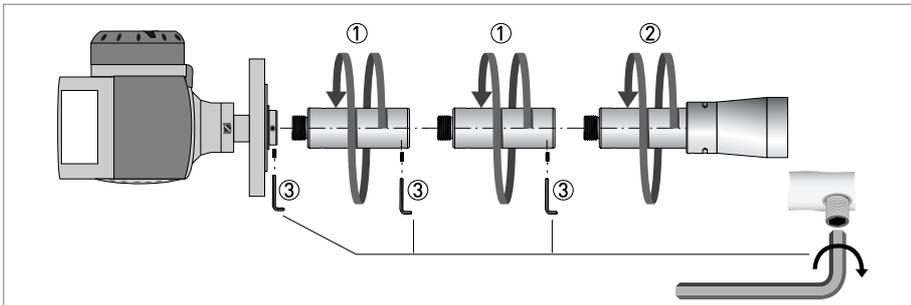


Figure 3-21: Horn antenna - how to attach antenna extensions

Equipment needed:

- 3 mm Allen wrench (not supplied)



- Attach the antenna extensions ① below the flange.
- Attach the antenna ②.
- Make sure the antenna extensions are fully engaged.
- Use a 3 mm Allen wrench to tighten the locking screws ③.
- If you attach more or less extensions than were initially ordered, change the antenna extension value in **Supervisor** mode. Go to **Supervisor > Advanced setup > Installation > Antenna Extension**.
- ➔ Use the display screen or HART® communication (PACTware™). Antenna extension = antenna extension length × number of extensions.
- If you changed the antenna extension value in **Supervisor** mode, also change the blocking distance value. Go to **Supervisor > Advanced setup > Installation > Blocking Distance**.
- ➔ Use the display screen or HART® communication (PACTware™). Minimum blocking distance = antenna length + (antenna extension length × number of extensions) + 0.1 m / 4".

Drop antenna - antenna extensions

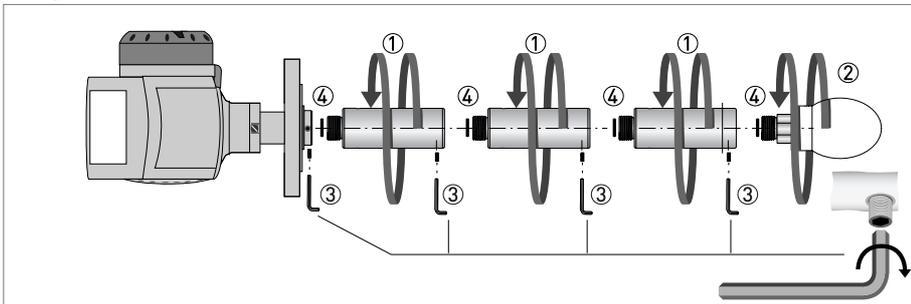


Figure 3-22: Drop antenna - how to attach antenna extensions

**INFORMATION!**

Drop antenna: Antenna extensions can only be attached below flanges without the PP/PTFE flange plate option

**CAUTION!**

Drop antenna: Make sure that there are not more than 5 antenna extensions attached to a device with a Drop antenna. If there are more than 5 antenna extensions, the device will not measure correctly.

Equipment needed (not supplied):

- Torque wrench 200 Nm (for the H30 head of the Drop antenna sub-assembly)
- 3 mm Allen wrench



- Remove the o-rings from the plastic sachet supplied with the device. Put an o-ring ④ into the groove at the top of each antenna extension.
- Attach the antenna extensions ① below the flange.
- Attach the antenna ②. Tighten the antenna with a torque wrench to a torque of 200 Nm ± 10 Nm.
- Make sure the antenna extensions are fully engaged.
- Use a 3 mm Allen wrench to tighten the locking screws ③.
- If you attach more or less extensions than were initially ordered, change the antenna extension value in **Supervisor** mode. Go to **Supervisor > Advanced setup > Installation > Antenna Extension**.
- ➡ Use the display screen or HART® communication (PACTware™). Antenna extension = antenna extension length \times number of extensions.
- If you changed the antenna extension value in **Supervisor** mode, also change the blocking distance value. Go to **Supervisor > Advanced setup > Installation > Blocking Distance**.
- ➡ Use the display screen or HART® communication (PACTware™). Minimum blocking distance = antenna length + (antenna extension length \times number of extensions) + 0.1 m / 4".

3.7.5 How to turn or remove the signal converter



INFORMATION!
The converter turns 360°.

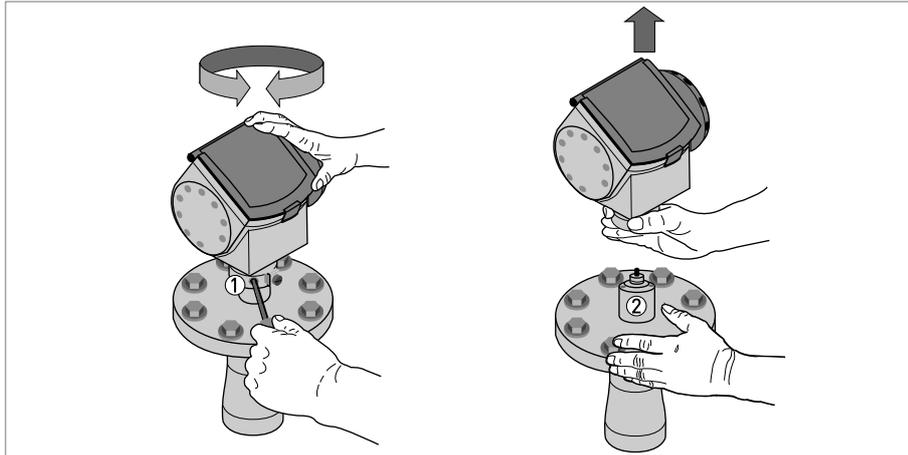


Figure 3-23: How to turn or remove the signal converter

Tool: 5 mm Allen wrench



How to turn the signal converter

- Loosen the housing locking screw ① with a 5 mm Allen wrench.
- Turn the housing to the correct position.
- Tighten the housing locking screw.



CAUTION!

If you remove the housing, put a cover on the wave guide hole in the flange assembly ②.



How to remove the signal converter

- Loosen the housing locking screw ① with a 5 mm Allen wrench.
- Lift the housing.
- Tighten the housing locking screw ①.



How to attach the signal converter

- Loosen the housing locking screw ① with a 5 mm Allen wrench.
- Attach the housing to the flange system ②.
- Tighten the housing locking screw ①.

3.7.6 How to attach the weather protection to the device

Equipment needed:

- Device.
- Weather protection (option).
- 10 mm wrench (not supplied).

The overall dimensions of the weather protection are on page 110.

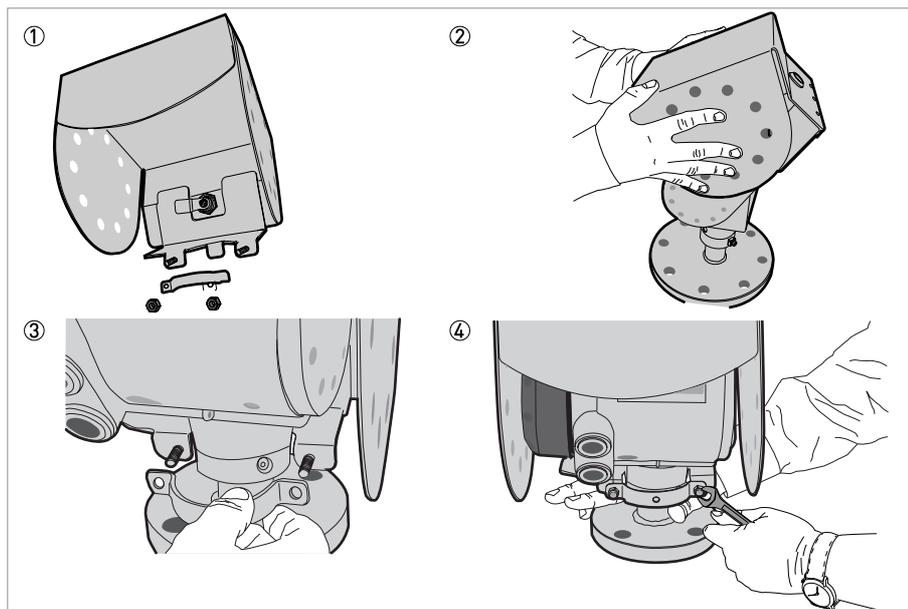


Figure 3-24: Installation of the weather protection



- Loosen the bracket nuts on the weather protection.
- Remove the bracket.
- Lower the weather protection onto the device.
- Turn the weather protection so that the keyhole points forward.
- Attach the bracket.
- Lift the weather protection to the top of the housing support pillar.
- Hold the weather protection in the correct position and tighten the bracket nuts.

3.7.7 How to open the weather protection

Equipment needed:

- Weather protection attached to the device.
- Large slotted tip screwdriver (not supplied).

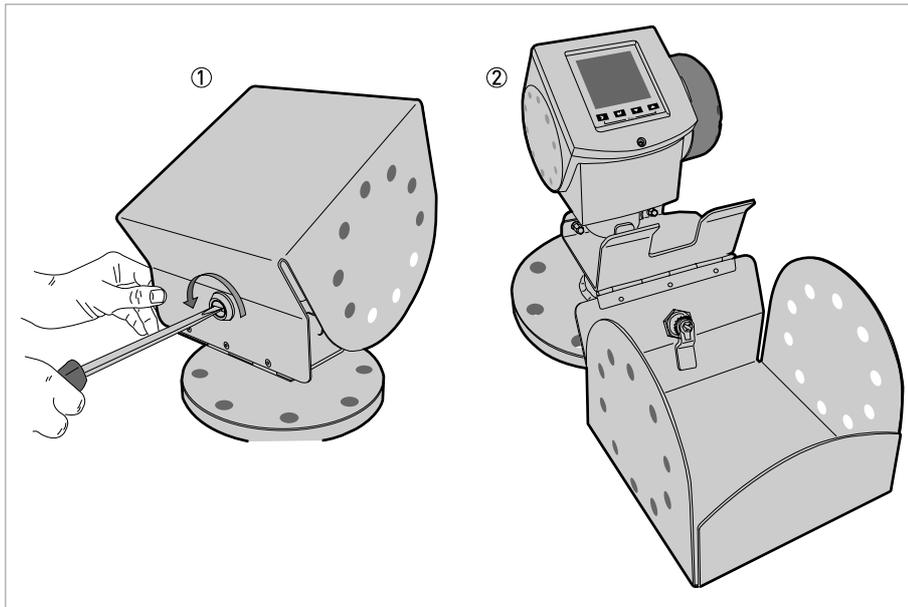


Figure 3-25: How to open the weather protection

- ① Weather protection in its closed position
- ② Weather protection in its open position. Minimum clearance in front of the device: 300 mm / 12".



- Put a large slotted tip screwdriver into the keyhole at the front of the weather protection.
- Turn the screwdriver counterclockwise.
- Pull the top of weather protection up and forward.
- ➡ This will open the weather protection.

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: outputs 1 and 2

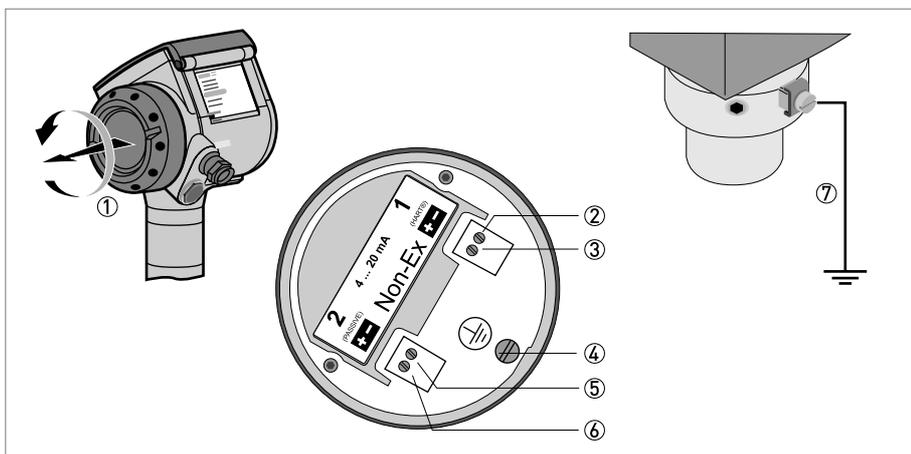


Figure 4-1: Electrical installation

- ① Terminal compartment cover
- ② Output 1: current output -
- ③ Output 1: current output +
- ④ Grounding terminal in the housing
- ⑤ Output 2: current output -
- ⑥ Output 2: current output +
- ⑦ Grounding terminal between the process connection and the converter

**INFORMATION!**

Output 1 energizes the device and is used for HART[®] communication. If the device has the second current output option, use a separate power supply to energize output 2.

**Procedure:**

- Remove the housing terminal compartment cover ①.
- Connect the wires to the device. Obey the national electrical codes.
- Make sure that the polarity of the wires is correct.
- Attach the ground to ④ or ⑦. Both terminals are technically equivalent.

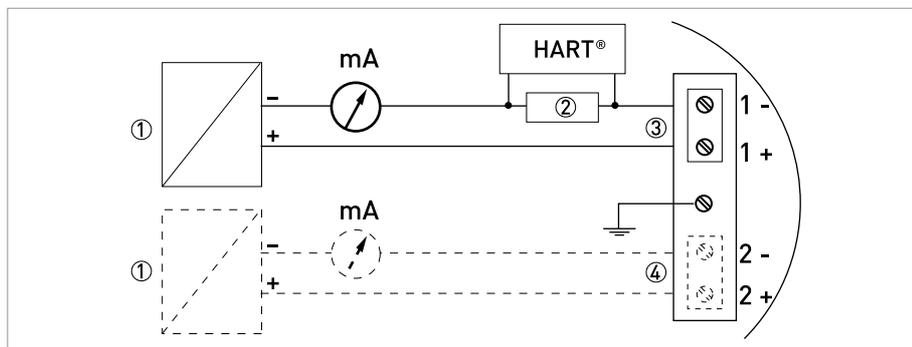
4.2.1 Non-Ex

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

- ① Power supply
- ② Resistor for HART[®] communication
- ③ Output 1: 14...30 VDC for an output of 22 mA at the terminal
- ④ Output 2: 10...30 VDC for an output of 22 mA at the terminal

4.2.2 Ex i**DANGER!**

For electrical data for Ex i applications, refer to the Ex supplements. You can find this documentation on the CD-ROM delivered with the device or it can be downloaded free of charge from the website (Downloadcenter).

4.2.3 Ex d**DANGER!**

For electrical data for Ex d applications, refer to the Ex supplements. You can find this documentation on the CD-ROM delivered with the device or it can be downloaded free of charge from the website (Downloadcenter).

4.2.4 PROFIBUS PA

For electrical data for PROFIBUS PA networks, refer to the PROFIBUS PA supplement. You can find this documentation on the CD-ROM delivered with the device or it can be downloaded free of charge from the website (Downloadcenter).

4.2.5 FOUNDATION Fieldbus

For electrical data for FOUNDATION Fieldbus networks, refer to the FOUNDATION Fieldbus supplement. You can find this documentation on the CD-ROM delivered with the device or it can be downloaded free of charge from the website (Downloadcenter).

4.3 Protection category



INFORMATION!

The device fulfills all requirements per protection class IP 66/67 (equivalent to NEMA type 4X (housing) and type 6P (antenna)).



DANGER!

Make sure that the cable gland is watertight.

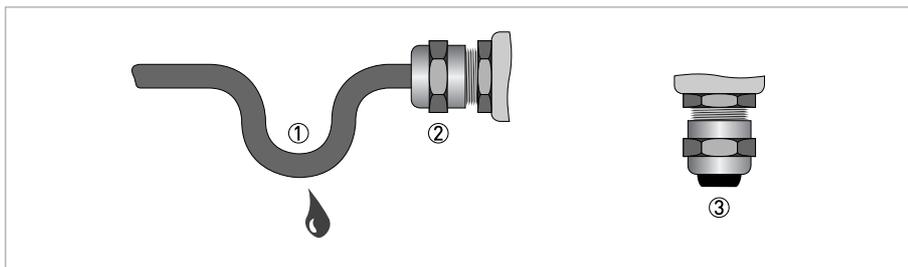


Figure 4-3: How to make the installation agree with protection category IP 67



- 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.
- Close unused cable feedthroughs with dummy plugs ③.

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 point-to-point. It can also operate in a multi-drop network of up to 15 devices.

The device output is factory-set to communicate point-to-point. To change the communication mode from **point-to-point** to **multi-drop**, refer to *Network configuration* on page 71.

4.4.2 Point-to-point connection

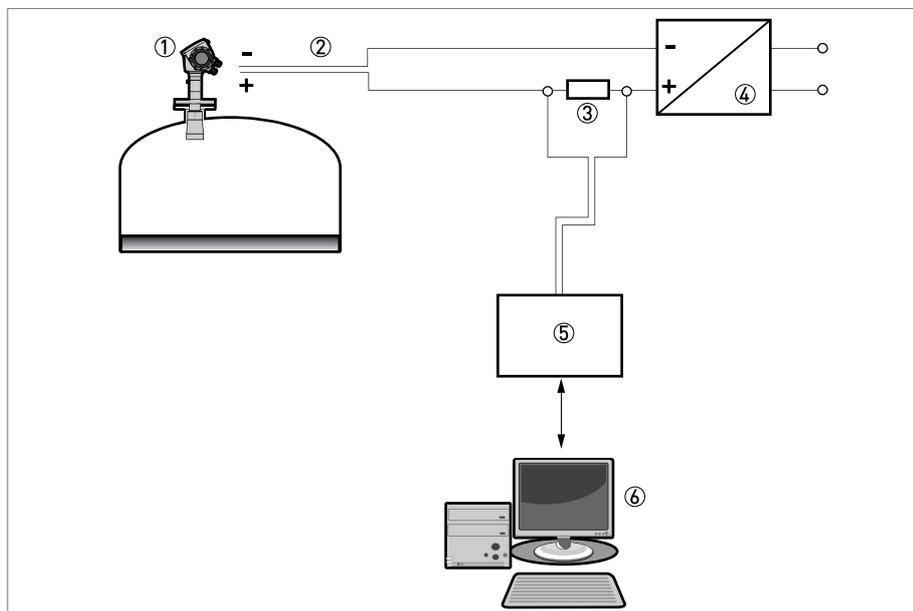


Figure 4-4: Point-to-point connection (non-Ex)

- 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

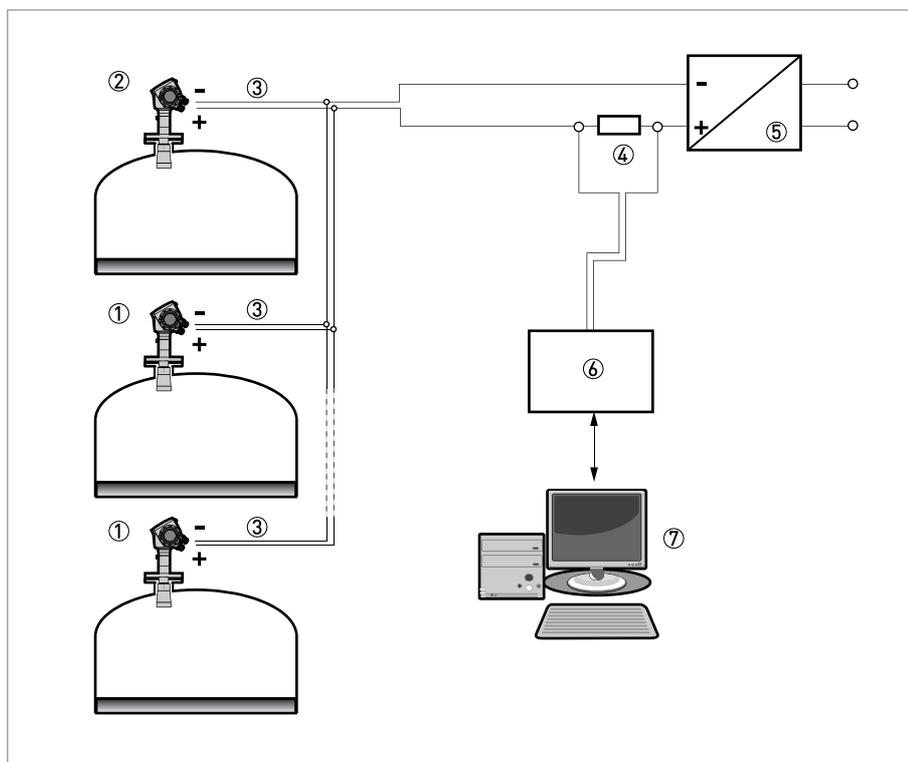


Figure 4-5: Multi-drop network (non-Ex)

- 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

4.4.4 Fieldbus networks

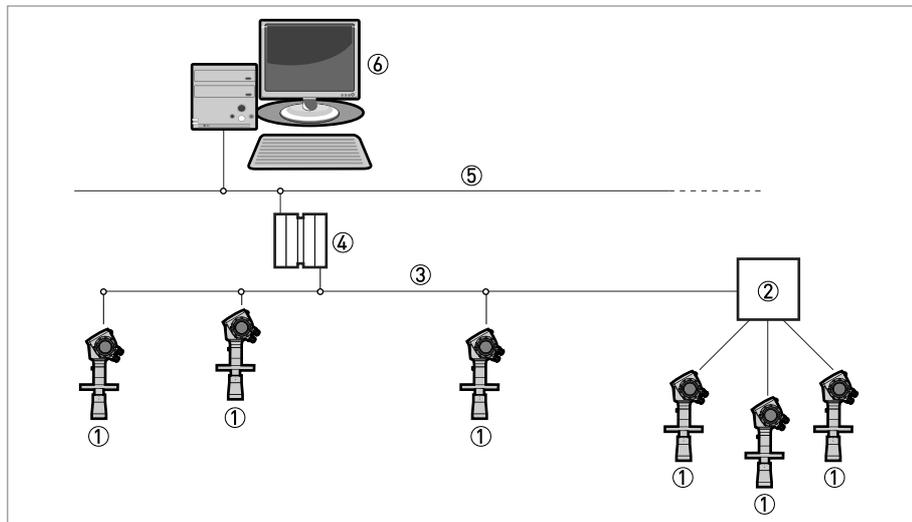


Figure 4-6: FOUNDATION Fieldbus™ network (non-Ex)

- ① Field device
- ② Junction box
- ③ H1 network
- ④ H1/HSE converter
- ⑤ High Speed Ethernet (HSE)
- ⑥ Workstation

**INFORMATION!**

*It is necessary to have a separate power supply to energize devices with the FOUNDATION™ Fieldbus output option (4-wire device with local HART® connection). The **FF** terminal is connected to a Fieldbus Power Hub. The **24 VDC** terminal energizes the device. The power supply is not shown in the illustration.*

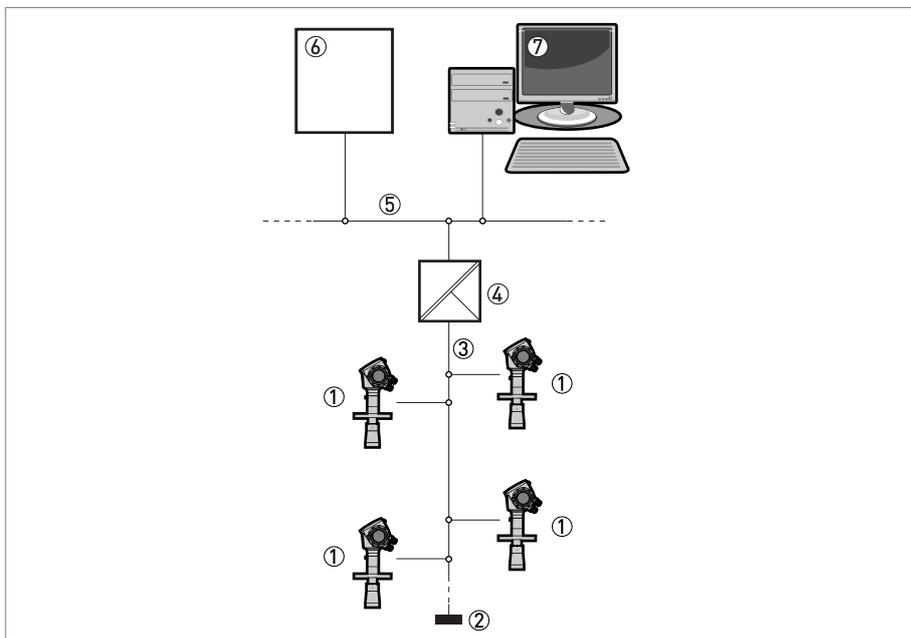


Figure 4-7: PROFIBUS PA/DP network (non-Ex)

- ① Field device
- ② Bus termination
- ③ PROFIBUS PA bus segment
- ④ Segment coupler (PA/DP link)
- ⑤ PROFIBUS DP bus line
- ⑥ Control system (PLC / Class 1 master device)
- ⑦ Engineering or operator workstation (Control tool / Class 2 master device)



INFORMATION!

It is necessary to have a separate power supply to energize devices with the PROFIBUS PA output option (4-wire device with local HART® connection). The PROFIBUS PA terminal is connected to a segment coupler. The 24 VDC terminal energizes the device. The power supply is not shown in the illustration.

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.

5.2 Operating concept

You can read measurements and configure the device with:

- A digital display screen (optional).
- A connection to a system or PC with PACTware™. You can download the Device Type Manager (DTM) file from the internet site.
- A connection to a system or PC with AMST™. You can download the Device Description (DD) file from the internet site.
- A connection to a HART® Handheld Communicator.

5.3 Digital display screen

5.3.1 Local display screen layout

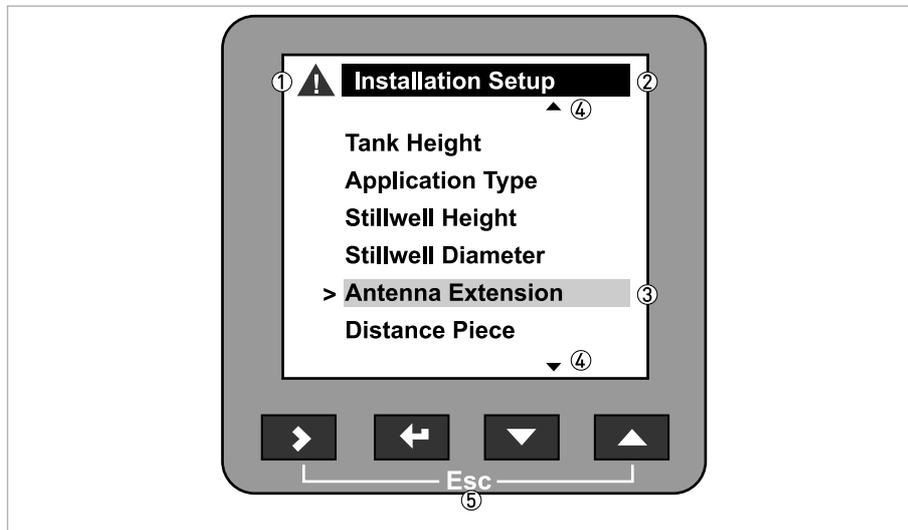


Figure 5-1: Local display screen layout

- ① Error icon
- ② Tag number or menu name
- ③ Selected menu item (grey text cannot be selected)
- ④ \triangle ∇ : scroll up/scroll down
- ⑤ Keypad buttons (refer to the table below)

5.3.2 Keypad buttons

| Keypad button | Description |
|---------------|--------------|
| | Right |
| | Return |
| | Down |
| | Up |
| | Esc (Escape) |

For data on keypad functions, refer to *Operator mode* on page 49.

5.3.3 Help screens

When you are in supervisor mode, the local display helps you to configure the device. If you do not touch any keys after 30 seconds, a help message is displayed. This will explain what the menu is and what the parameters do. Press > and \triangle (Esc) at the same time to go back to the menu. If you do not touch the display for another 30 seconds, the message is shown again.

5.3.4 How to start the device



- Connect the converter to the power supply.
- Energize the converter.
- ➡ After 30 seconds the screen will display "booting up", "starting up" and then the default screen will appear.
- The device will display readings.
- ➡ Measurements agree with specifications given in the customer order.

**CAUTION!**

If the manufacturer received information about the installation, the device will display readings correctly. If not, refer to the quick setup procedures.

5.4 Remote communication with PACTware™

PACTware™ displays measurement information clearly and lets you configure the device from a remote location. It is an Open Source, open configuration software for all field devices. It uses Field Device Tool (FDT) technology. FDT is a communication standard for sending information between the system and the field device. This standard agrees with IEC PAS 62453. Field devices are easily integrated. Installation is supported by a user-friendly Wizard.

Install these software programs and equipment:

- Microsoft® .NET Framework version 1.1 or later.
- PACTware.
- HART® converter (USB, RS232...).
- The Device Type Manager for the device.

The software and installation instructions are given on the CD-ROM supplied with the device.

You can also download the latest version of PACTware™ and the DTM from our internet site.

Refer also to the PACTware™ consortium site at <http://www.pactware.de>.

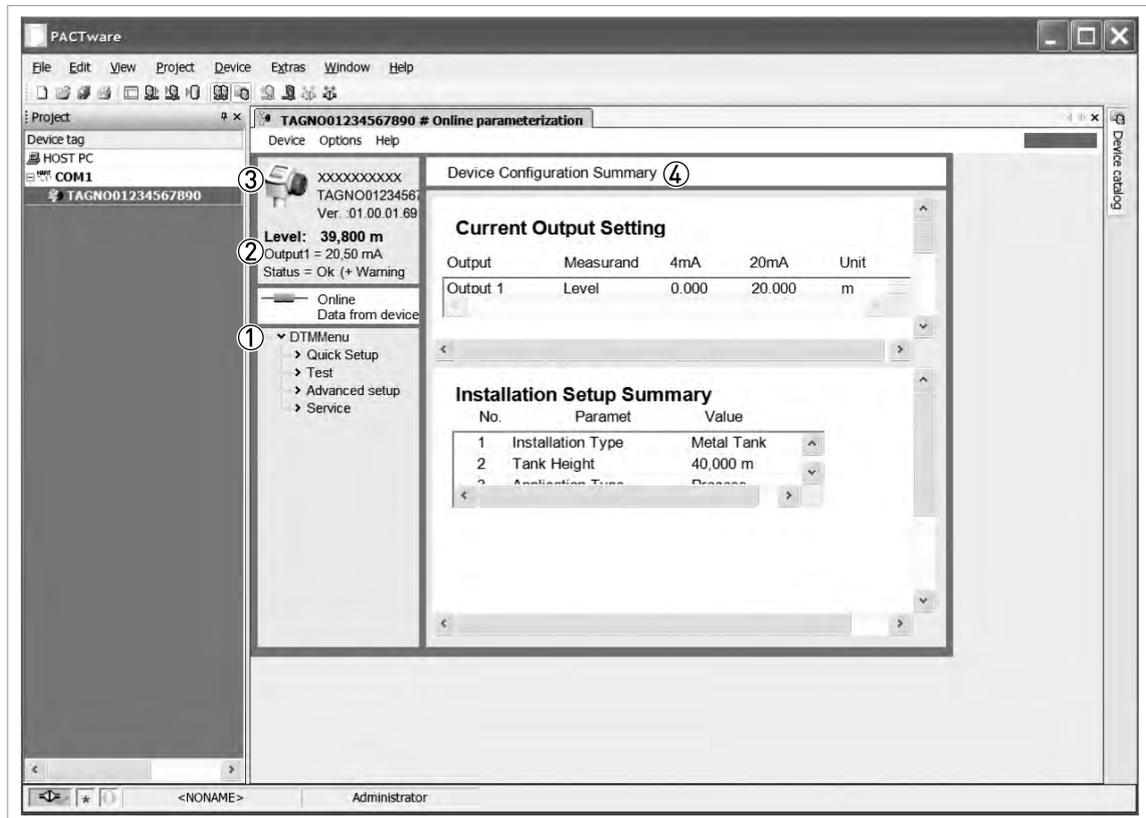


Figure 5-2: Screen from the PACTware™ user interface

- ① DTM menu
- ② Basic measurement information: level, current output and device status
- ③ Information for device identification
- ④ Configuration summary

5.5 Remote communication with the AMS™ Device Manager

The AMS™ Device Manager is an industrial Plant Asset Management (PAM) software tool. Its role is to:

- Store configuration information for each device.
- Support HART® and Fieldbus FOUNDATION™ devices.
- Store and read process data.
- Store and read diagnostic status information.
- Help plan preventive maintenance to reduce a plant's downtime to a minimum.

The DD file is given on the CD-ROM supplied with the device. You can also download it from our internet site.

6.1 User modes

There are 3 modes of operation:

- Operator.
- Supervisor.
- Service.

6.2 Operator mode

The operator can choose what information to display.

This section shows you:

- What each button does in operator mode.
- What special function each button has if it is pressed for more than 1 second.
- How to move from one screen of information to another.

Some data will only be available if the device is correctly configured by the supervisor, as described below.

Functions of keypad buttons in operator mode

| Keypad button | Description | Normal function | Hotkey function |
|---|--------------|--|--|
|  | Right | Change display style ① | Enter program mode ② |
|  | Enter | - | - |
|  | Down | Scroll down the list of measurement parameters ③ | The screen shown at this time becomes the default screen ② |
|  | Up | Scroll up the list of measurement parameters ③ | Display language will change to English ④ |
|  | Esc (Escape) | - | - |

① Value, value and picture, or value and bar graph

② Press this button for 1 second

③ Level, distance, volume etc.

④ Press this button for 3 seconds. Press the button again and it will go back to the original language.

Screens in operator mode

| Text and image screen | Go to | % current output screen | Go to | Text screen | Go to |
|-----------------------------|-------|-----------------------------|-------|-----------------------------|--------------------|
| △ | | △ | | △ | |
| Level | > | Level | > | Level | > (Text and image) |
| △ ▽ | | △ ▽ | | △ ▽ | |
| Distance | > | Distance | > | Distance | > (Text and image) |
| △ ▽ | | △ ▽ | | △ ▽ | |
| Volume ① | > | Volume ① | > | Volume ① | > (Text and image) |
| △ ▽ | | △ ▽ | | △ ▽ | |
| Mass ② | > | Mass ② | > | Mass ② | > (Text and image) |
| △ ▽ | | △ ▽ | | △ ▽ | |
| Ullage volume ① | > | Ullage volume ① | > | Ullage volume ① | > (Text and image) |
| ▽ | | ▽ | | △ ▽ | |
| Back to the top of the list | | Back to the top of the list | | Reflectivity | |
| | | | | △ ▽ | |
| | | | | Signal screen ③ | |
| | | | | ▽ | |
| | | | | Back to the top of the list | |

① This data is only available if you created a volume table. Refer to the conversion quick setup menu in supervisor mode.

② This data is only available if you created a mass table. Refer to the conversion quick setup menu in supervisor mode.

③ This screen shows a graph of discrete radar reflection signals against distance. This graph is used to monitor reflections measured by the device. Press > to move the cursor from one signal peak to another.

6.3 Supervisor mode

6.3.1 General notes

Configure your device in **Supervisor** mode. You can:

- Use the **Quick Setup** menus to configure your device quickly. For more data about quick setup menus, refer to *Function description* on page 56 (Table A. Quick setup).
- Use the **Advanced Setup** menu to find single items for device configuration. For more data about menu items, refer to *Function description* on page 56 (Table C. Advanced setup).
- Save **Quick Links** for items that you use regularly. For more data about quicklinks (menu items A.2 to A.6), refer to *Function description* on page 56 (Table A. Quick setup).
- Error finding and troubleshooting procedures are described in the **Test** menu. For more data, refer to *Function description* on page 56 (Table B. Test).

6.3.2 How to get access to the supervisor mode



Do the steps that follow:

- Press the > button for one second.
- ➡ This displays the login screen.
- Press the Δ or ∇ buttons to select **supervisor** from the list.
- Press the ← button.
- ➡ The screen displays where to type in the password.
- Type in the password. The factory-set password is > ← ∇ Δ > ←.
- ➡ The device displays the message "Login successful" and then the main menu for supervisor mode.

You can change the password for the supervisor mode (menu item C.5.2.2). For more data, refer to *Function description* on page 56 (Table C. Advanced setup).

The main menu shows:

- Quick Setup menu.
- Test menu.
- Advanced Setup menu.

You cannot select "Service menu" in supervisor mode. Menus that can be selected are in black text. Menus that cannot be selected are in grey text.

If you go back to operator mode, you will have access to the supervisor mode, without password security, for 30 minutes.

6.3.3 Menu overview

A Quick Setup

| | |
|-----|---|
| A.1 | Setup Mode |
| A.2 | Quick Link 1 (default: Error Records) |
| A.3 | Quick Link 2 (default: Measurement Quality) |
| A.4 | Quick Link 3 (default: Language) |
| A.5 | Quick Link 4 (default: Length Unit) |
| A.6 | Quick Link 5 (default: Display Mode) |

B Test

| | |
|-----|-------------|
| B.1 | Test |
| B.2 | Information |

C Advanced Setup

| | |
|-----|----------------------|
| C.1 | Installation Setup |
| C.3 | Output 1 (HART) |
| C.4 | Output 2 (Passive) ① |
| C.5 | Device Setup |
| C.6 | Reset |

① Optional

6.3.4 Keypad functions

Menu navigation

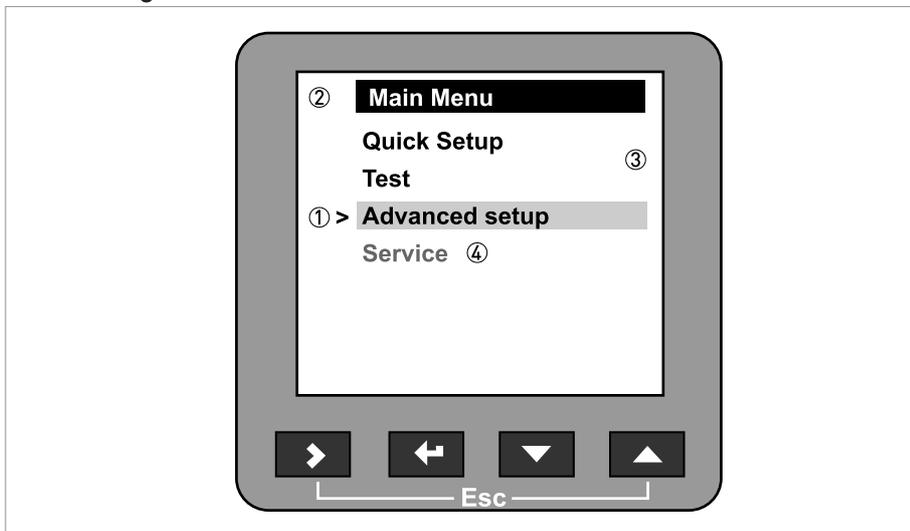


Figure 6-1: Menu navigation

- ① Menu selection bar
- ② Header bar
- ③ Menu list
- ④ Menu item that is not available (in grey text)

This is what you see when you are in the list of menus in supervisor mode. The functions of the buttons are given in the table that follows:

Function of keypad buttons in the menu lists

| Keypad button | Description | Function |
|---------------|--------------|--|
| | Right | Go to the next menu level |
| | Enter | - |
| | Down | Move the menu selection bar down the list |
| | Up | Move the menu selection bar up the list |
| | Esc (Escape) | Go back to the menu level you were on before |

Lists of parameters in menu items

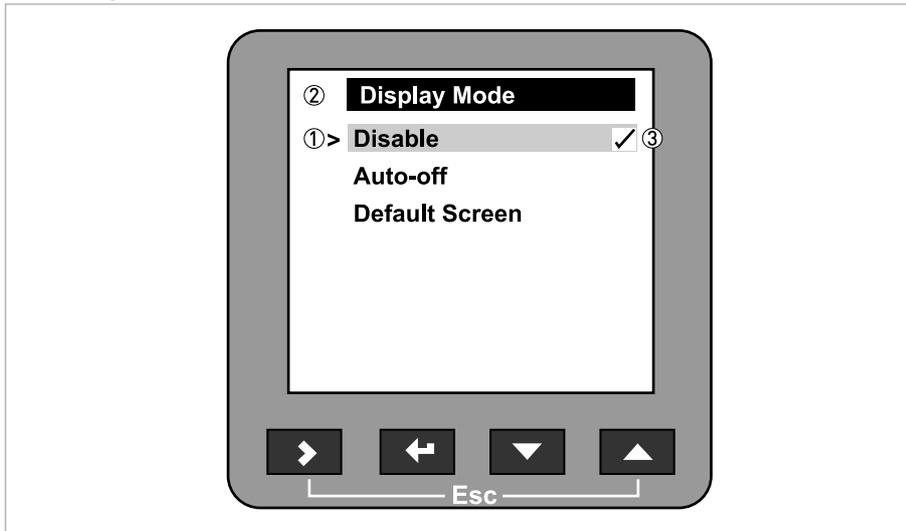


Figure 6-2: Lists of parameters in menu items

- ① Parameter selection bar
- ② Menu name
- ③ Parameter used at this time

This is what you see when you choose a menu item that has a list of parameters. The functions of the buttons are given in the table that follows:

Function of keypad buttons in menu items that have a list of parameters

| Keypad button | Description | Function |
|---------------|--------------|--|
| | Right | - |
| | Enter | Select the parameter and go back to the menu |
| | Down | Move the menu selection bar down the list |
| | Up | Move the menu selection bar up the list |
| | Esc (Escape) | Go back to the menu ① |

① This does not confirm that you selected a new parameter

Values in menu items

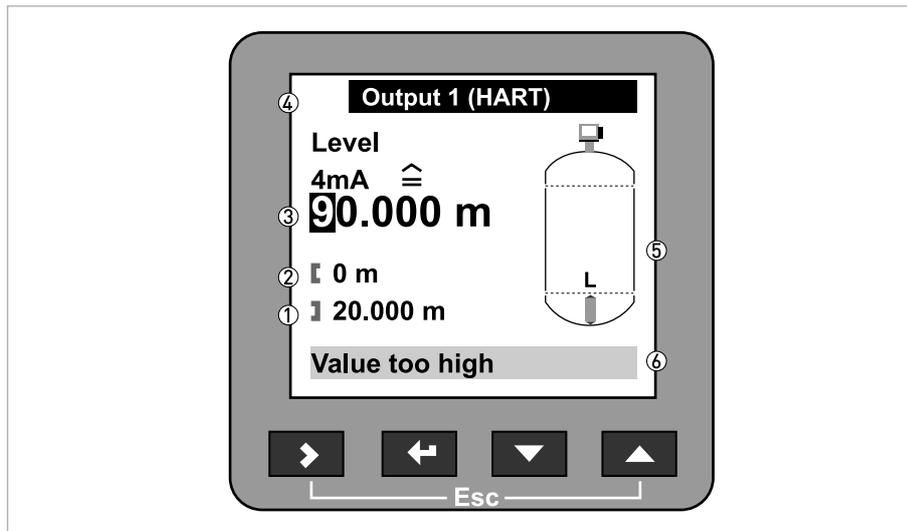


Figure 6-3: Values in menu items

- ① Maximum value
- ② Minimum value
- ③ Cursor on the digit to be changed
- ④ Menu name
- ⑤ Illustration of menu item
- ⑥ Error message

This is what you see when you choose a menu item that has a value. The functions of the buttons are given in the table that follows:

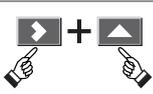
Function of keypad buttons in menu items that have values

| Keypad button | Description | Function |
|---------------|--------------|--|
| | Right | Move the cursor to the next digit on the right |
| | Enter | Select the parameter and go back to the menu |
| | Down | Decrease the digit value |
| | Up | Increase the digit value |
| | Esc (Escape) | Go back to the menu ① |

- ① This does not confirm that you selected a new parameter

If you press the buttons for 1 second, you can use these hotkey functions:

Hotkey functions in supervisor mode

| Button | Description | Function |
|---|--------------|--|
|  | Right | Create a quick link ① |
|  | Enter | - |
|  | Down | - |
|  | Up | Screen displays information in English ② |
|  | Esc (Escape) | Go back to the operator mode |

① Make a selection from the Advanced Setup menu list

② Press this button for 3 seconds

How to save settings



- When you have changed parameters in all the necessary menu items, press \leftarrow to accept the new parameter.
- Press $>$ and \triangle at the same time to go back to the **Save settings** screen.
- The device will ask you to save or cancel your settings. Select **Save** to accept the new settings or **Cancel** to reject them.
- ➡ The display goes back to operator mode.

6.3.5 Function description

A. Quick setup

| Menu No. | Step | Function | Function description | Selection list | Default |
|----------|------|-------------------------------|---|--|------------|
| A.0 | | Quick Setup | | | |
| A.1 | | Setup Mode | | | |
| A.1.1 | | Complete | This follows the steps given in the Installation, Empty Spectrum, Conversion and Outputs setup modes. | | |
| A.1.2 | | Installation | Follow this procedure to describe the tank and the product. | | |
| | 1 | Installation Type | The tank material. | Metal Tank, Plastic Tank, Free Air Application | Metal Tank |
| | 2 | Tank Height / Measuring Range | "Tank Height" is the distance from the tank connecting flange face/thread stop to the tank bottom. "Measuring Range" (for "Free Air Application" only) is the maximum distance that the device must measure. | min-max: 0.20...80 m / 0.54...262 ft | 20 m |

| Menu No. | Step | Function | Function description | Selection list | Default |
|----------|------|--|---|--|---|
| | 3A | Application Type | <p>The conditions in which the device is used. If the surface of the product is flat, select "Storage". If the surface of the product is disturbed, select "Process". If the surface of the product is agitated with vortexes and foam, select "Agitator". If the device is installed in a still well, select "...+Stillwell".</p> <p>The conditions in which the device is used. For free air applications only. If the surface of the product is flat, select "No Disturbance". If the surface of the product is disturbed, select "Medium Disturbance". If there are bubbles on the surface of the product and also vortexes and foam, select "Heavy Disturbance".</p> | <p>Process, Storage, Agitator, Process+Stillwell, Storage+Stillwell, Agitator+Stillwell</p> <p>No Disturbance, Medium Disturbance, Heavy Disturbance</p> | <p>Process or Process+Stillwell</p> <p>No Disturbance</p> |
| | 4A | Stillwell Diameter | The inner diameter of the stillwell. Step 4 is available if you set "...+Stillwell" in step 3. | min-max: 8...200 mm / 0.31...7.88" | 100 mm / 3.94" |
| | 4B | Stillwell Height | The height of the stillwell. Step 4 is available if you set "...+Stillwell" in step 3. | min-max: 0...80 m / 0...196.86 ft | 10 m / 32.81 ft |
| | 5 | Blocking Distance | A zone given by the user where it is not possible to measure. We recommend at least 100 mm / 4" below the antenna. | antenna extension [C.1.6]...tank height [C.1.2] ① | ② |
| | 6 | Settings summary | | | |
| | 7 | Current changes must be saved or cancelled before proceeding | | Save, Cancel ③ | |
| A.1.3 | | Empty Spectrum | Fixed and moving objects in the tank cause interference signals. Put them through this filter to correctly measure the tank contents. | | |
| | 1 | Do you have a completely filled tank? | If the tank is full, it is not possible to complete this procedure. The tank must be partially filled or empty. | Yes, No | Yes |
| | 2 | Are all moving parts in the tank, e.g. agitators, in motion? | We recommend that you switch on agitators and other moving equipment to filter all interference signals. | Yes, No | Yes |

| Menu No. | Step | Function | Function description | Selection list | Default |
|----------|------|---|---|---------------------------------|------------------|
| | 3 | Is your tank partially filled or empty? | If the tank is partially filled, the device must include the tank contents when it filters the signal. | Partially Filled, Empty | Partially Filled |
| | 4 | Distance | If the tank is partially filled, type in a distance shorter than that between the flange and the tank contents. | min-max: 0...tank height | 10 m / 32.808 ft |
| | 5 | Do you want to consider Average or Maximum value for recording? | Use the average value for tanks which contain fixed objects only. Use the maximum value for tanks which contain many objects or moving objects. | Average, Maximum | Average |
| | 6 | Empty spect. recording is in progress | ... | ... | ... |
| | 7 | Empty spectrum graph | ... | ... | ... |
| | 8 | Do you want to save the spectrum? | If you save this data, the device will use it when it measures the tank contents. | Save, Cancel ③ | Save |
| A.1.4 | | Conversion | Follow this procedure to set the device up to display readings in volume, mass or user-defined units. | | |
| Submenu | | Conversion submenu [Volume] | | | |
| | 1 | Do you want to use free unit? | Select "No". | Yes, No | No |
| | 2 | Table Length Unit | | m, cm, mm, inch, ft, Free Unit | m |
| | 3 | Please select Volume / Mass | Select "Volume". | Volume, Mass | |
| | 5 | Tank Shapes | This sub-procedure uses the information given here to find the volume. You have to type in the tank shape, height, width and length. | ... | ... |
| | 6 | Conversion Unit | The displayed unit in operator mode. | m3, L, US gal, GB gal, ft3, bbl | m3 |
| | 7 | Volume Table | A table that converts product level to product volume. Press Δ or ∇ to select a line and press > to change values automatically supplied by the device. | | |
| Submenu | | Conversion submenu [Mass] | | - | |
| | 1 | Do you want to use a free unit? | | Yes, No | No |
| | 2 | Table Length Unit | | m, cm, mm, inch, ft, Free Unit | m |

| Menu No. | Step | Function | Function description | Selection list | Default |
|----------|------|--|---|---|------------------------|
| | 3 | Please select Volume / Mass | Select "Mass". | Mass | |
| | 4 | Do you want to use the density of the product? | | Yes, No | Yes |
| | 5 | Product Density | The Wizard adds this step if you select "Yes" in step 4. | min-max: 0...20000 kg/m ³ | 0 |
| | 6 | Tank Shapes | The Wizard adds this step if you select "Yes" in step 4. This sub-procedure uses the information given here to find the volume. You have to type in the tank shape, height, width and length. | ... | ... |
| | 7 | Conversion Unit | The conversion unit is given as a volume if the product density is given. If not, choose a mass unit. | m ³ , L, US gal, GB gal, ft ³ , bbl or Tons, kg, US Tons, GB Tons | m ³ or Tons |
| | 8 | Mass Table | A table that converts product level to product mass. If you selected "Yes" in step 4, make entries in the table in volume units. Press Δ or ∇ to select a line and press > to change values automatically supplied by the device. | | |
| Submenu | | Conversion submenu [Free Unit] | If you cannot find the units or tank shape in the menu, you can customize the conversion table. | - | |
| | 1 | Do you want to use a free unit? | Select "Yes". | Yes, No | No |
| | 2 | Custom. Length Unit | A non-standard length unit for the conversion table. This is defined by the supervisor. | | LEN_FREE_ |
| | 3 | Custom. Length Ratio | The conversion factor between the length unit selected in C.5.1.4 (length unit) and C.5.1.7 (customer length unit). This ratio is a multiple of 1 mm. | min-max: 1...99999 | 1 |
| | 4 | Custom. Conv. Unit | A non-standard conversion unit for the conversion table. This is defined by the supervisor. | | CO_FR_UN |
| | 5 | No. of Entries | The number of lines in the conversion table. | min-max: 0...50 | 2 |
| | 6 | Volume/Mass Table | A table that converts product level to another physical parameter. Press Δ or ∇ to select a line and press > to change values. | | |

| Menu No. | Step | Function | Function description | Selection list | Default |
|----------|------|--|---|---|--------------------------------|
| | ... | Current changes must be saved or cancelled before proceeding | | Save, Cancel ③ | Save |
| A.1.5 | | Outputs | Follow this procedure to describe the output characteristics. | - | |
| | 1 | Output 1: Output Function | Select an output function to scale the current values (output 1). This is not displayed in the operator mode. | Level, Distance, Volume (Mass), Ullage Volume (Ullage Mass), Reflection | Level |
| | 2 | Output 1 (HART): <Function> 4 mA | This assigns a measurement value to 4 mA (output 1). | min.-max: 0...20 m / 0...65.62 ft | 0 m / 0 ft |
| | 3 | Output 1 (HART): <Function> 20 mA | This assigns a measurement value to 20 mA (output 1). | min.-max: 0...90 m / 0...295.29 ft | Depends on the output function |
| | 4 | Output Range | This sets the effective range of output 1 with or without over-run. | 3.8...20.5 mA (NAMUR), 4...20 mA | 4...20 mA |
| | 5 | Error Handling | This sets the behaviour of current output 1 if an error occurs. Hold means that the output current stays at the value where the error occurred. Hold is not available if 3.8...20.5 mA (NAMUR) is the output range. | 3.6 mA, 22 mA, Hold (4...20 mA range only) | 22 mA |
| | 6 | Output 1 (HART): HART Address | Any HART® address greater than 0 will activate HART® multidrop mode. Current output stays constant at 4 mA. If the device is in an Fieldbus network, set the HART® address to 1 . | min.-max: 0...15 | 0 |
| | 7 | Output Function 2 ④ | Select an output function to scale the current values (output 2). This is not displayed in the operator mode. | Level, Distance, Volume (Mass), Ullage Volume (Ullage Mass), Reflection | Level |
| | 8 | Output 2 (Passive): <Function> 4 mA ④ | This assigns a measurement value to 4 mA (output 2). | min.-max: 0...20 m / 0...65.62 ft | 0 m / 0 ft |
| | 9 | Output 2 (Passive): <Function> 20 mA ④ | This assigns a measurement value to 20 mA (output 2). | min.-max: 0...90 m / 0...295.29 ft | Depends on the output function |
| | 10 | OP2 Output Range ④ | This sets the effective range of output 2 with or without over-run. | 3.8...20.5 mA (NAMUR), 4...20 mA | 4...20 mA |

| Menu No. | Step | Function | Function description | Selection list | Default |
|----------|------|--|---|--|---------------------|
| | 11 | OP2 Error Handling ④ | This sets the behaviour of current output 2 if an error occurs. Hold means that the output current stays at the value where the error occurred. Hold is not available if 3.8...20.5 mA (NAMUR) is the output range. | 3.6 mA, 22 mA, Hold (4...20 mA range only) | 22 mA |
| | 12 | Settings summary | | Read only | |
| | | Current changes must be saved or cancelled before proceeding | | Save, Cancel | Save |
| A.2 | | Quick Link 1 | Direct link to an item in the Advanced Setup menu | Go to a function in the Advanced Setup menu and press > for 1 second. You can store up to 5 functions in this way. | Error Records |
| A.3 | | Quick Link 2 | Direct link to an item in the Advanced Setup menu | Go to a function in the Advanced Setup menu and press > for 1 second. You can store up to 5 functions in this way. | Measurement Quality |
| A.4 | | Quick Link 3 | Direct link to an item in the Advanced Setup menu | Go to a function in the Advanced Setup menu and press > for 1 second. You can store up to 5 functions in this way. | Language |
| A.5 | | Quick Link 4 | Direct link to an item in the Advanced Setup menu | Go to a function in the Advanced Setup menu and press > for 1 second. You can store up to 5 functions in this way. | Length Unit |
| A.6 | | Quick Link 5 | Direct link to an item in the Advanced Setup menu | Go to a function in the Advanced Setup menu and press > for 1 second. You can store up to 5 functions in this way. | Display Mode |

① This range depends on other user functions

② This value depends on other user functions

③ This step is ignored if you use the "Complete" setup mode

④ Optional

B. Test

| Menu No. | Function | Function description | Selection list | Default |
|----------|---------------------|---|---|--------------------------|
| B.0 | Test | | | |
| B.1 | Test | This checks the device outputs and performs common device tests. | | |
| B.1.1 | Show Output 1 | This displays analogue output 1 value [mA]. | Read only | |
| B.1.2 | Set Output 1 | This sets analogue output 1 to a test value [mA] selected from a list. Output will change to the selected value, independent of the measured value. | 3.6, 4, 6, 8, 10, 12, 14, 16, 18, 20 or 22 mA | 4 mA |
| B.1.3 | Show Output 2 | This displays analogue output 2 value [mA]. | Read only | |
| B.1.4 | Set Output 2 | This sets analogue output 2 to a test value [mA] selected from a list. Output will change to the selected value, independent of the measured value. | 3.6, 4, 6, 8, 10, 12, 14, 16, 18, 20 or 22 mA | 4 mA |
| B.1.5 | Internal Test | This initiates the hardware test. The device displays the results. | Read only | |
| B.2 | Information | A summary of information relating to the device | | |
| B.2.1 | Outputs | Analogue output settings. This includes assigned functions, 4 ... 20 mA scale settings, error handling and HART® parameters. | Read only | |
| B.2.2 | 15 Min Log | A log of output values for the last 15 minutes. A log is taken every 10 seconds and displayed on a graph. | Read only | |
| B.2.3 | Device ID | This displays device order no, V-no, service no, Ex approval, Main CPU version, Companion CPU version and DSP version. | Read only | |
| B.2.4 | Quick Setup Sum. | A summary of the parameters entered in the quick setup menu | Read only | |
| B.2.5 | TAG number | The TAG number can be seen and updated here | ? | TAGN00 1234567 890 |
| | Temperature | Temperature of the electronics block. The display will automatically switch off if the temperature is below -20°C / -4°F or above +60°C / +140°F. | Read only | |
| B.2.6 | Error Records | A log of device errors. Scroll down the list and press \leftarrow to display the error details. Opening a log will remove the error icon if it appeared in operator mode. | Read only | |
| | Measurement Quality | Status of device errors at this time. A "tick" symbol next to an error in the list shows that this error is active and may have an unwanted effect on the device. | Read only | |

| Menu No. | Function | Function description | Selection list | Default |
|----------|---------------------|--|----------------|---------|
| B.2.7 | Custom. Length Unit | Non-standard length unit for the conversion table. This is defined by the supervisor. Go to Supervisor > Advanced Setup > Device Setup > Display Settings > Custom. Length Unit or follow the procedure in the Conversion setup menu. | Read only | |
| B.2.9 | Custom. Conv. Unit | Non-standard conversion unit for the conversion table. This is defined by the supervisor. Go to Supervisor > Advanced Setup > Device Setup > Display Settings > Custom. Conv. Unit or follow the procedure in the Conversion setup menu. | Read only | |

C. Advanced setup

| Menu No. | Function | Function description | Selection list | Default |
|----------|-------------------------------|---|--|------------------------------|
| C.0 | Advanced Setup | Select single menu items to fine-tune the device. | | |
| C.1 | Installation Setup | | | |
| C.1.1 | Installation Type | The installation on the tank for the device. | Metal Tank, Plastic Tank, Free Air Application | Metal Tank |
| C.1.2 | Tank Height / Measuring Range | "Tank height" is the distance from the tank connecting flange face/thread stop to the tank bottom. "Measuring range" (for "Free Air Application" only) is the maximum distance that the device must measure. | min-max: 0.20...80 m / 0.54...262 ft | 20 m / 65.61 ft |
| C.1.3 | Application Type | The conditions in which the device is used. If the surface of the product is flat, select "Storage". If the surface of the product is disturbed, select "Process". If the surface of the product is agitated with vortexes and foam, select "Agitator". If the device is installed in a still well, select "...+Stillwell". | Process, Storage, Agitator, Process+Stillwell, Storage+Stillwell, Agitator+Stillwell | Process or Process+Stillwell |
| | | The conditions in which the device is used. For free air applications only. If the surface of the product is flat, select "No Disturbance". If the surface of the product is disturbed, select "Medium Disturbance". If there are bubbles on the surface of the product and also vortexes and foam, select "Heavy Disturbance". | No Disturbance, Medium Disturbance, Heavy Disturbance | No Disturbance |
| C.1.4 | Stillwell Height | The height of the stillwell. This is available if you set "...+Stillwell" in item C.1.3 Application Type. | min-max: 0...80 m / 0...196.86 ft | 10 m / 32.81 ft |

| Menu No. | Function | Function description | Selection list | Default |
|----------|--------------------|--|--|----------------|
| C.1.5 | Stillwell Diameter | The inner diameter of the stillwell. This is available if you set "...+Stillwell" in item C.1.3 Application Type. | min-max: 8...200 mm / 0.31...7.88" | 100 mm / 3.94" |
| C.1.6 | Antenna Extension | Optional antenna extension. These are attached between the flange and the antenna. Each part is 105 mm / 4.1" long. | min-max: 0...5000.00 mm / 0...196.85" | 0 mm / 0" |
| C.1.7 | Distance Piece | Optional distance piece between the converter and the process connection. | min-max: 0...5000.00 mm / 0...196.85" | 0 mm / 0" |
| C.1.8 | Overfill Detection | If this function is switched on, the device will monitor the level even if it is in the blocking distance. The displayed output stays fixed at the blocking distance, but an error message will warn the user that the tank is overfilling. | Yes, No | No |
| C.1.9 | Blocking Distance | The distance from the flange to the top limit of the measuring range. If the distance is less than the blocking distance, the device continues to display the blocking distance. | min-max: 0.220 m...tank height / 0.72 ft...tank height | 0.3 m / 1 ft |
| C.1.10 | Reference Offset | Offset relating to a reference location (distance). This value is positive when the reference location is above the device flange face and negative if below. For more data, refer to <i>Distance measurement</i> on page 72. | min-max: -tank height...50 m / -tank height...164.05 ft | 0 m / 0 ft |
| C.1.11 | Tank Bottom Offset | Offset relating to a reference location (level). The device reference point for this parameter is the bottom of the tank (set in menu item C.1.2.0). This value is positive when the reference location is below the tank bottom and negative if above. For more data, refer to <i>Level measurement</i> on page 73. | min-max: -tank height...3000 m / -tank height...9843 ft | 0 m / 0 ft |
| C.1.12 | Time Constant | Using this function, the device processes several measurement readings to filter out disturbances. Increasing the time constant will smoothen the integrated readings, decreasing will roughen the readings. | min-max: 1...100 sec (seconds) | 3 sec |

| Menu No. | Function | Function description | Selection list | Default |
|----------|----------------------|--|--|----------------------------|
| C.1.13 | Measuring Mode | The device uses the dielectric constant (ϵ_r) of the tank contents to monitor level. This menu item is set by default to "Direct Measuring" for tank contents with an $\epsilon_r > 1.6$. If ϵ_r is low, select "TBF Partial" mode. If ϵ_r is very low (< 1.5), select "TBF Full". If you want the device to measure level using the first radar signal it finds, select "Option 1". If you want the device to measure level but ignore all the radar signals stored in the empty spectrum scan, select "Option 2". "Option 3" is not yet available. | Direct Measuring, TBF Partial, TBF Full, Option 1, Option 2, Option 3 | Direct Measuring |
| C.1.14 | Product Er | The device automatically calculates the level based on the product ϵ_r . If you select "TBF Partial" or "TBF Full" in item C.1.13, you can change this value manually to adjust readings. | min-max: 1.01...99.90 | 4 |
| C.1.15 | Tracing Velocity | This function sets the maximum rate of change of level. The measured value cannot change faster than the tracing velocity. | min-max: 0.001...10.000 m/min / 0.003...32.8 ft/min | 0.5 m/min / 1.64 ft/min |
| C.1.16 | Multiple Reflections | Multiple reflections will cause the device to display smaller readings. Objects in the tank, sharp corners, installation of the device on a large nozzle or at the centre of a dome roof can cause multiple reflections. A very calm surface or a tank with a small convex or flat roof can also cause multiple reflections. | Yes, No | No |
| C.1.17 | Empty Spect. OnOff | This function starts and stops interference signal filter. Interference signals are the result of fixed and moving obstacles inside the tank. If you must do a spectrum analysis, record an empty spectrum first. Go to the "Empty Spectrum" menu (A.1.3.0) in the Quick Setup list. | On, Off | Off |
| C.1.19 | Units For Tables | Sub-menu for volume and mass conversion operations. | | |
| C.1.19.1 | Table Length Unit | The length unit used in the conversion table. If "Free Unit" is selected, the device uses the unit name in menu item C.5.1.7. | m, cm, mm, inch, ft, Free Unit | m |
| C.1.19.2 | Conversion Unit | The volume or mass unit used in the conversion table. If "Free Unit" is selected, the device uses the unit name in menu item C.5.1.9. | m3, L, US gal, GB gal, ft3, bbl, Tons, Kg, US Tons, GB Tons, Free Unit | m3 |

| Menu No. | Function | Function description | Selection list | Default |
|----------|----------------------|---|---|---|
| C.1.20 | Product Density | A value greater than 0 that is used with a volume conversion table to start the mass calculation. This menu item is not available if you have selected a mass unit. | 0...20000 kg/m ³ | 0 kg/m ³ |
| C.1.21 | Volume / Mass Table | The device uses this table to display volume and mass readings. Give the number of entries on the table. Press \leftarrow . Type in the level and corresponding volume / mass values. | Number of entries min.-max: 0...50 | No table. Table units are selected in menu items C.1.19.1 and C.1.19.2. |
| C.1.22 | Linearisation Table | The device uses this table to increase on-site accuracy. Give the number of entries plotted. Fill the tank. Make a reference measurement and type in the correct value next to the device reading. For more data, refer to <i>Linearisation</i> on page 72. | Number of entries min.-max: 0...50 | 0 |
| C.3 | Output 1 (HART) | | | |
| C.3.1 | Output Function | Select an output function to scale the current values. This is not displayed in the operator mode. | Level, Distance, Volume (Mass), Ullage Volume (Ullage Mass), Reflection | Level |
| C.3.2 | 4 mA Setting | Give a measurement value to 4 mA. | min.-max: ① | 0 m / 0 ft |
| C.3.3 | 20 mA Setting | Give a measurement value to 20 mA. | min.-max: ② | Depends on the output function |
| C.3.4 | Output Range | Sets the effective range of output 1 either with or without over-run. | min.-max: 3.8...20.5 mA (NAMUR), 4...20 mA | 4...20 mA |
| C.3.5 | Error Handling | This sets the behaviour of current output 1 if an error occurs. Hold means that the output current stays at the value where the error occurred. Hold is not available if 3.8...20.5 mA (NAMUR) is the output range. | 3.6 mA, 22 mA, Hold | 22 mA |
| | Error Handling Delay | The time after which the current output changes to an error value. It shows that there is a measurement error. | min.-max: 0...900 sec (seconds) | 10 sec |
| C.3.6 | HART Address | Any HART [®] address greater than 0 will activate HART [®] multidrop mode. The current output stays constant at 4 mA. If the device is in an Fieldbus network, set the HART [®] address to 1. | min.-max: 0...15 | 0 |
| C.4 | Output 2 (Passive) | | | |

| Menu No. | Function | Function description | Selection list | Default |
|----------|----------------------|--|--|--------------------------------|
| C.4.1 | Output Function | Select an output function to scale the current values. This is not displayed in the operator mode. | Level, Distance, Volume (Mass), Ullage Volume (Ullage Mass), Reflection | Level |
| C.4.2 | 4 mA Setting | Give a measurement value to 4 mA. | min.-max: ① | 0 m / 0 ft |
| C.4.3 | 20 mA Setting | Give a measurement value to 20 mA. | min.-max: ② | Depends on the output function |
| C.4.4 | Output Range | Sets the effective range of output 2 either with or without over-run. | min.-max: 3.8...20.5 mA (NAMUR), 4...20 mA | 4...20 mA |
| C.4.5 | Error Handling | This sets the behaviour of current output 2 if an error occurs. Hold means that the output current stays at the value where the error occurred. Hold is not available if 3.8...20.5 mA (NAMUR) is the output range. | 3.6 mA, 22 mA, Hold | 22 mA |
| | Error Handling Delay | The time after which the device shows there is a measurement error. This value is set in the output 1 menu. | Read only | Refer to function C.3.5 |
| C.5 | Device Setup | This menu covers all items directly related to the display of information and access to the supervisor menu. | | |
| C.5.1 | Display Settings | To display the information you need, refer to these menu items. | | |
| C.5.1.1 | Language | Information can be displayed in any of the 9 languages stored in the device. If it is necessary to change the display quickly to English, press Δ for 3 seconds in operator mode. | English, French, German, Italian, Japanese, Mandarin, Portuguese, Russian, Spanish | |
| C.5.1.2 | Display Mode | The display screen status will change after the time given in C.5.1.3. (time delay). Disable switches off this functionality, Auto-Off switches off the display and Default Screen will show the selected default screen. To set to the default screen, press ∇ for 1 second in the operator mode. | Disable, Auto-Off, Default Screen | Disable |
| C.5.1.3 | Time Delay | The time after which the display will switch to the status set in C.5.1.2 (Display Mode). | 1, 3, 5, 10 (minutes) | 1 |
| | Contrast | The contrast control for the display screen. You can select a shade of grey between light grey (level 1) and black (level 9). | Level 1, Level 2, Level 3, Level 4, Level 5, Level 6, Level 7, Level 8, Level 9 | Level 5 |
| C.5.1.4 | Length Unit | The length unit displayed in operator mode. | m, cm, mm, inch, ft, ft-inch-1/16inch, ft-inch-1/32inch, Free Unit | m |

| Menu No. | Function | Function description | Selection list | Default |
|----------|----------------------|--|---------------------------------|-----------|
| C.5.1.5 | Volume Unit | The volume unit displayed in operator mode. | m3, L, US gal, GB gal, ft3, bbl | m3 |
| C.5.1.6 | Mass Unit | The mass unit displayed in operator mode. | Tons, Kg, US Tons, GB Tons | Kg |
| C.5.1.7 | Custom. Length Unit | A non-standard length unit for the conversion table. This is defined by the supervisor. | | LEN_FREE_ |
| C.5.1.8 | Custom. Length Ratio | The conversion factor between the length unit selected in C.5.1.4 (Length Unit) and C.5.1.7 (Custom. Length Unit). This ratio is a multiple of 1 mm. | min.-max: 1...99999 | 1 |
| C.5.1.9 | Custom. Conv. Unit | A non-standard conversion unit for the conversion table. This is defined by the supervisor. | | CO_FR_UN |
| C.5.2 | Passwords | To change user passwords, refer to these menu items. | | |
| C5.2.2 | Supervisor | This changes the supervisor password. Press the keypad buttons up to 6 times in any order. This will be the new password. To confirm the change, enter the new password a second time. | | >←▽△>← |
| C.6 | Reset | To reset the device to default settings, refer to these menu items. | | |
| C.6.2 | Clear Error Record | Erase the error record in menu item B.2.6. Press ← to confirm. | | |
| C.6.3 | Restart | If the device is not functioning properly, this menu item will restart the device. Press ← to confirm. | | |

① Units and range depend on the output function, length unit and volume unit selected. See also the table of data dependencies for the 4 mA settings in this section.

② Units and range depend on the output function, length unit and volume unit selected. See also the table of data dependencies for the 20 mA settings in this section.

Data dependencies for the 4 mA settings of outputs 1 and 2

| Output function | Minimum value | Maximum value | Default |
|-----------------|---------------------|----------------------------------|------------------|
| Level | 0 m | <20 mA Setting for Level | 0 m |
| Volume | 0.00 m ³ | <20 mA Setting for Volume | 0 m ³ |
| Mass | 0.00 kg | <20 mA Setting for Mass | 0 kg |
| Distance | 0 m | <20 mA Setting for Distance | 0 m |
| Ullage Volume | 0.00 m ³ | <20 mA Setting for Ullage Volume | 0 m ³ |
| Ullage Mass | 0.00 kg | <20 mA Setting for Ullage Mass | 0 kg |

Data dependencies for the 20 mA settings of outputs 1 and 2

| Output function | Minimum value | Maximum value | Default |
|-----------------|---------------------------------|--------------------------------|--------------------------------|
| Level | >4 mA Setting for Level | Tank Height + TBO + RO ① | Tank height + TBO - BD ② |
| Volume | >4 mA Setting for Volume | Max. value in the volume table | Max. value in the volume table |
| Mass | >4 mA Setting for Mass | Max. value in the mass table | Max. value in the mass table |
| Distance | >4 mA Setting for Distance | Tank Height + TBO + RO ① | Tank height + RO ③ |
| Ullage Volume | >4 mA Setting for Ullage Volume | Max. value in the volume table | Max. value in the volume table |
| Ullage Mass | >4 mA Setting for Ullage Mass | Max. value in the mass table | Max. value in the mass table |

① RO = Reference Offset [C1.10]. TBO = Tank Bottom Offset [C.1.11].

② BD = Blocking Distance [C.1.9]. TBO = Tank Bottom Offset [C.1.11].

③ RO = Reference Offset [C1.10].

6.4 Further information on device configuration

6.4.1 Quick Links

If you frequently use a menu item, you can create a Quick Link. This lets you quickly find and configure items in the advanced setup menu. Five Quick Link memory spaces are available in the **Quick Setup** submenu. Go to **Supervisor > Quick Setup**.

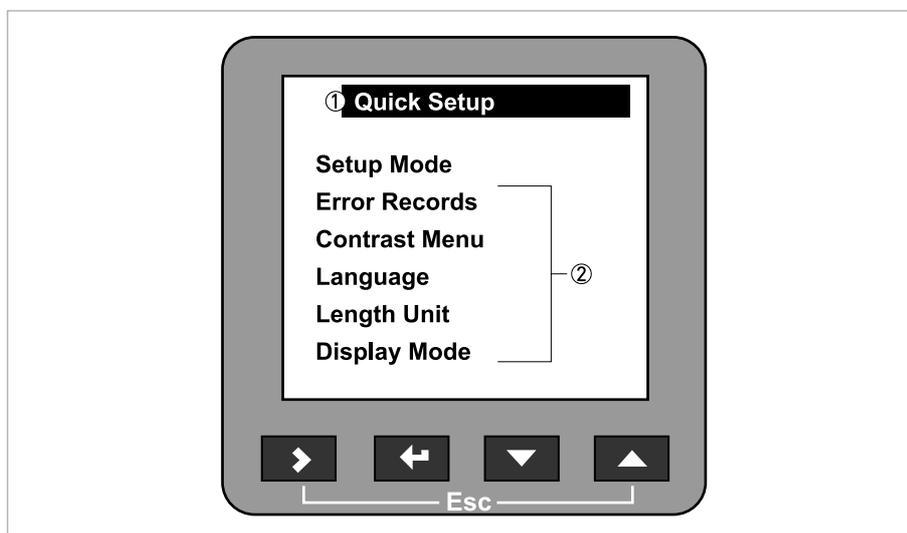


Figure 6-4: The list of quick links

① Menu name

② Quick links



How to create a Quick Link

- Go to **Supervisor > Advanced Setup**.
- Select a menu item with the Δ and ∇ buttons.
- Press the \gt button for 1 second.
- ➔ The device saves this menu item as a Quick Link. Example text: Mass Unit has been assigned to Quick Link 2



INFORMATION!

The Quick Links are saved to one of the five memory spaces. They are saved in sequence. The first Quick Link is saved to Quick Link 1, the second to Quick Link 2 and so on. If you have already saved five Quick Links, the next Quick Link will be saved to Quick Link 1.



How to open a Quick Link

- Go to **Supervisor > Quick Setup**.
- Select a Quick Link with the Δ and ∇ buttons.
- Press the \gt button.
- ➔ This opens the menu item. You can configure the device.

6.4.2 Protection of the device settings

The **Passwords** menu lets you change the supervisor password.



How to change the supervisor password

- Go to **Supervisor > Advanced setup > Device setup > Passwords > Supervisor**.
- Type in the new 6-character password (Press the 4 buttons in any sequence).
- Type in the new 6-character password again.
- ➔ If the second entry is not the same as the first, the device will display the error message "Password mismatch". Press \gt + Δ at the same time and type in the new 6-character password again.
- Press \gt and Δ (Esc) at the same time to go back to the "save settings" window.
- Select **Save** and press \leftarrow .
- ➔ The device will go back to operator mode.



INFORMATION!

Make a note of the password and keep it in a safe place. If you lose the password, please contact your supplier.

6.4.3 Network configuration



INFORMATION!

For more data, refer to Networks on page 41.

The device uses HART[®] communication to send information to HART[®]-compatible equipment. It can operate in either point-to-point or multidrop mode. The device will communicate in multidrop mode if you change the HART[®] address of output 1.



How to change from point-to-point to multidrop mode

- Enter supervisor mode.
- Go to **Advanced Setup > Output 1 (HART) > HART Address**.
- Enter a value between 1 and 15 and press **←** to confirm (see the caution below).
- Press the Escape buttons(**> + Δ**) until you get the save/cancel screen.
- Select save.
- Press **←**.
- ➡ Output 1 switches to multidrop mode. The current output is set to 4 mA. This value does not change in multidrop mode.



CAUTION!

Make sure that the HART[®] address for this device is different from others in the multidrop network.



How to change from multidrop to point-to-point mode

- Enter supervisor mode.
- Go to **Advanced Setup > Output 1 (HART) > HART Address**.
- Enter the value **0** and then press **←** to confirm.
- Press the Escape buttons(**> + Δ**) until you get the save/cancel screen.
- Select save.
- Press **←**.
- ➡ Output 1 switches to point-to-point mode. The current output changes to a range of 4...20 mA or 3.8...20.5 mA (this range is specified in **Advanced Setup > Output 1 (HART) > Output Range**).

6.4.4 Linearisation

You can use the linearisation table given in function to make sure that readings are consistently accurate.



- Go to **Supervisor > Advanced Setup > Installation Setup > Linearisation Table**.
- Type in the number of reference points (up to 50 points). Press **←**.
- ➡ This shows the linearisation table with default values.
- Press **>** to type in new data. The device reading is given on the second line **Device distance**.
- Fill the tank to any given level.
- Make an appropriate reference measurement. Type this data on the line **Real distance**.
- Repeat these steps until all the cells in the linearisation table are completed.
- Press **←**.
- Press **>** and **△** (Esc) at the same time to exit to the "save settings" window.
- Select **Save** and press **←**.
- ➡ The device will go back to operator mode.

6.4.5 Distance measurement

The device displays distance measurements when an output is set to distance. Menu items related to distance measurement are:

- Output Function (C.3.1 or C.4.1)
- Tank Height (C.1.2)
- Blocking Distance (C.1.9)

Use the flange facing as the reference point for the 4 and 20 mA current output settings. The 4 and 20 mA current output settings are the minimum and maximum points of the measurement scale. You can change the reference point from which distance is measured. Use this menu item:

- Reference Offset (C.1.10)



INFORMATION!

If you move the reference point above the flange, add this value when give a distance for the 4 and 20 mA current output settings. If you move the reference point below the flange, subtract this value when give a distance for the 4 and 20 mA current output settings.



CAUTION!

If the distance for 4 mA is set in the blocking distance, the device will not be able to use the full current output range.

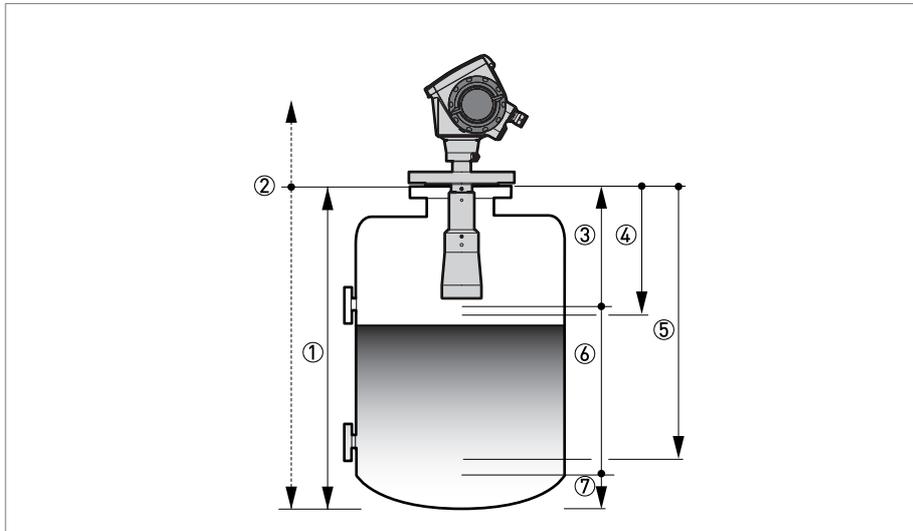


Figure 6-5: Distance measurement

- ① Tank Height [C.1.2]
- ② Reference Offset [C.1.10]
- ③ Blocking Distance [C.1.9]
- ④ 4 mA Setting [C.3.2 or C.4.2]
- ⑤ 20 mA Setting [C.3.3 or C.4.3]
- ⑥ Maximum effective measuring range
- ⑦ Non-measurement zone

For more data about the menu items, refer to *Function description* on page 56, table C. Advanced setup.

6.4.6 Level measurement

The device displays level measurements when an output is set to level. Menu items related to level measurement are:

- Output Function [C.3.1 or C.4.1]
- Tank Height [C.1.2]
- Blocking Distance [C.1.9]

Use the tank bottom as the reference point for the 4 and 20 mA current output settings. The 4 and 20 mA current output settings are the minimum and maximum points of the measurement scale. You can change the reference point from which level is measured. Use this menu item:

- Tank Bottom Offset [C.1.11]



INFORMATION!

If you move the tank bottom offset below the tank bottom, add this value when give a level for the 4 and 20 mA current output settings. If you move the tank bottom offset above the tank bottom, subtract this value when give a level for the 4 and 20 mA current output settings.



CAUTION!

If the level for the 20 mA is set in the blocking distance, the device will not be able to use the full current output range.

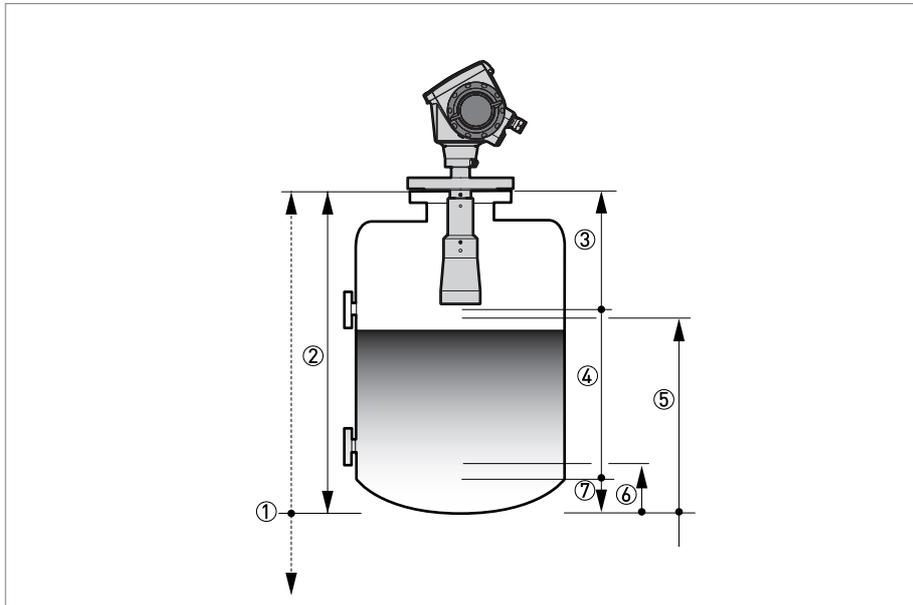


Figure 6-6: Level measurement

- ① Tank Bottom Offset [C.1.11]
- ② Tank Height [C.1.2]
- ③ Blocking Distance [C.1.9]
- ④ Maximum effective measuring range
- ⑤ 20 mA Setting [C.3.3 or C.4.3]
- ⑥ 4 mA Setting [C.3.2 or C.4.2]
- ⑦ Non-measurement zone

For more data about the menu items, refer to *Function description* on page 56, table C. Advanced setup.

6.4.7 How to configure the device to measure volume or mass

The device can be configured to measure volume or mass. The procedure for doing this is given in the device's **Quick Setup** menu.



How to create a volume or mass table.

- Go to **Supervisor > Quick setup > Setup mode > Conversion**.
- Complete all the steps in the set-up procedure.

The device creates a table of up to 50 pairs of data (level - volume or level - mass). The reference point for the table is the tank bottom (as given in menu item C.1.2 Tank height.).

**INFORMATION!**

You can also create customized length and conversion units (free units) in the **Conversion** setup procedure.

**INFORMATION!**

When you create a table, get more conversion data for parts of the tank where there are:

- Surfaces with curves.
- Sudden changes in the cross section.

This will make volume measurement more accurate.

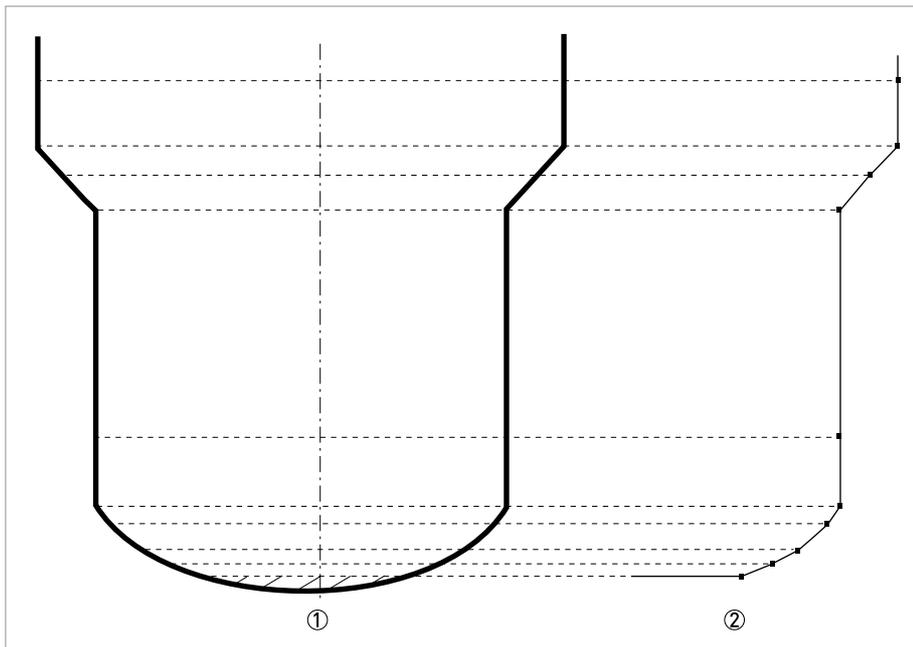


Figure 6-7: A plot of points for a volume or mass table

- ① Tank with reference points
- ② Tank model with plotted points

6.4.8 How to use the empty spectrum function to filter parasite signals

If the device measures level in a tank that contains obstructions (agitator, supports, heating pipes etc.), these objects can cause radar signal interference. You can use the empty spectrum function in the device's Quick Setup menu to filter radar signal interference.



INFORMATION!

We recommend that you do an empty spectrum scan when the tank is empty and all the moving parts (agitators etc.) are switched on.

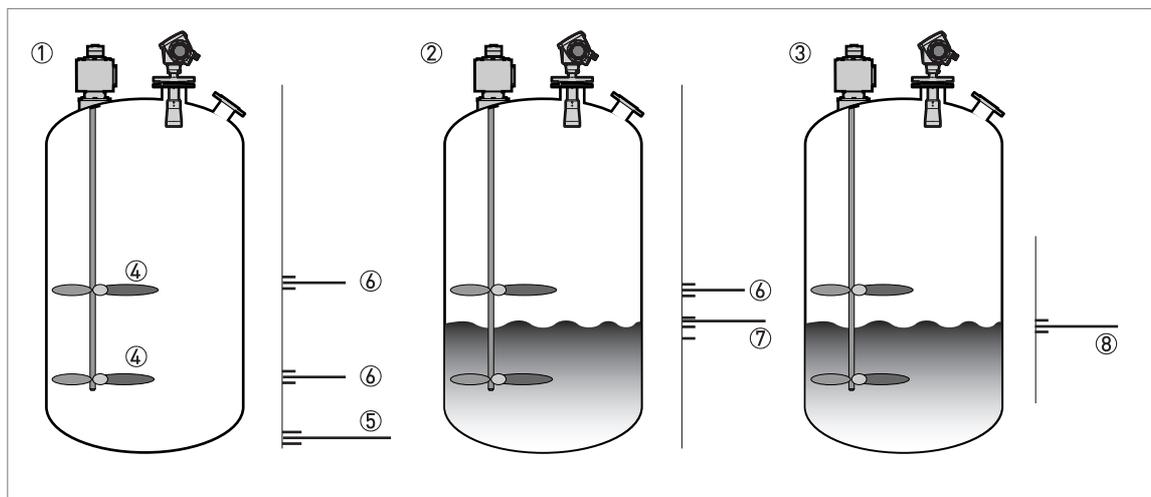


Figure 6-8: How to filter radar signal interference

- ① Empty tank before the device uses the empty spectrum scan (with a graph of reflections shown)
- ② Partially filled tank before the device uses the empty spectrum scan (with a graph of reflections shown)
- ③ Partially filled tank after the device uses the empty spectrum scan (with a graph of reflections shown)
- ④ Agitator blades location
- ⑤ Tank bottom signal
- ⑥ Agitator blades signals (interference signals) before the device does the empty spectrum scan
- ⑦ Bad quality (mixed) signals of the liquid and the agitator blades before the device does the empty spectrum scan
- ⑧ Reflected signal if the device uses the data from the empty spectrum scan. The device only uses the reflection on the surface of the liquid to measure distance.



- Get access to the **Main Menu** of the supervisor mode.
- ➔ For more data, refer to *How to get access to the supervisor mode* on page 51.
- Go to **Main Menu > Quick Setup > Setup Mode > Empty Spectrum**.
- Is the tank completely full? Select **Yes** or **No** and then press \leftarrow .
- ➔ If you select **Yes**, the device will not do the empty spectrum scan. Empty the tank and repeat the procedure.
- Are all the moving parts switched on? Select **Yes** or **No** and then press \leftarrow .
- Is your tank partially filled or completely empty? Select **Partially filled** or **Empty** and then press \leftarrow .
- Do you want to use the average value or the maximum value? Select **Average** or **Maximum** and then press \leftarrow .
- ➔ Use the maximum for tanks that have moving parts. Use the average value for tanks that do not have moving parts. The device will do an empty spectrum scan and then display the results on the signal screen.
- Press \leftarrow . Do you want to save the spectrum. Select **Yes** or **No** and then press \leftarrow .

- If you select **Yes**, the device will use the empty spectrum scan results to filter out radar signal interference.



INFORMATION!

For more data on empty spectrum scans, refer to Function description on page 56 - table A. Quick Setup (item A.1.3).

6.4.9 How to measure correctly in tanks with curved or conical bottoms

It is possible that the device cannot find the bottom of the tank if it is installed in a tank with a dish-shaped or conical bottom. The form of the tank bottom causes a delayed radar reflection and the device will display the error message "Measurement is lost in the tank bottom".

You can offset the tank bottom reference point to find the delayed radar reflection. Obey the instructions that follow:



- Empty the tank.
- Increase the tank height in menu C.1.2.
- Go to the **signal screen** in operator mode.
- You will see a graph of reflections.
- Press > to move the cursor to the reflection with the largest amplitude (given in dB).
- Make a note of the distance of the reflection measured by the device.
- The distance to the reflection will be the new tank height.
- Subtract the distance to the reflection from the true tank height.
- Go to **Supervisor > Advanced Setup > Installation Setup > Tank Bottom Offset**.
- Type in the difference you calculated as a negative value.
- A negative value will move the reference point above the tank bottom (as given in menu item C.1.2 Tank height).
- Press ←.
- Press > and △ (Esc) at the same time to exit to the "save settings" window.
- Select **Save** and press ←.
- The device will go back to operator mode.

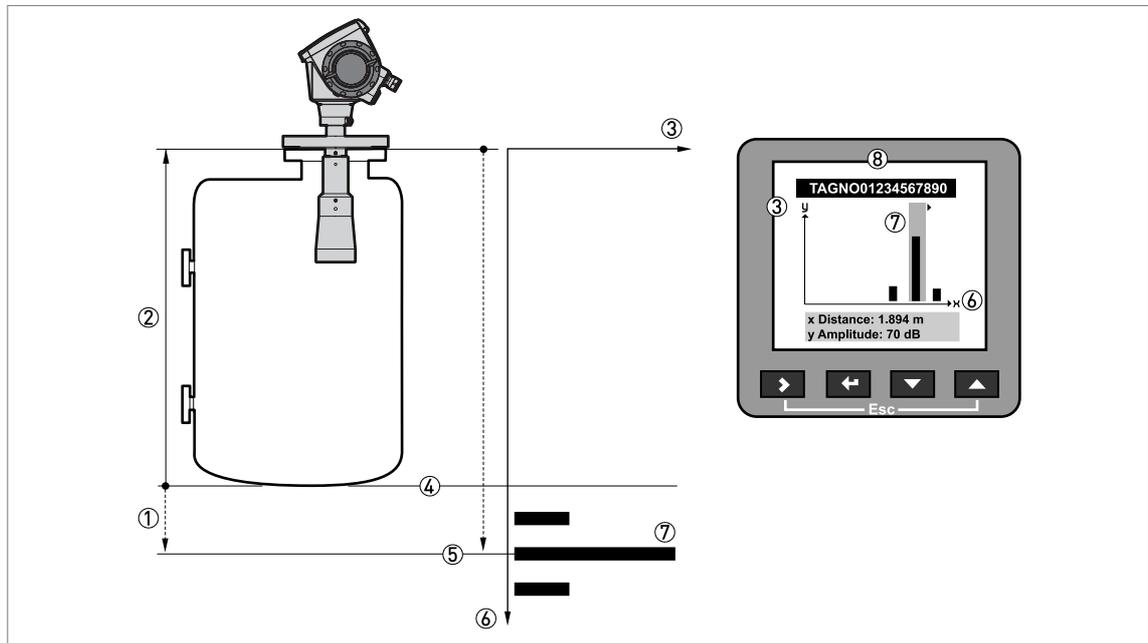


Figure 6-9: Signal screen and the tank bottom reflection

- ① Tank bottom offset (menu item C.1.11)
- ② Tank height (menu item C.1.2)
- ③ Signal amplitude (in dB)
- ④ True position of the tank bottom
- ⑤ Offset position of the tank bottom
- ⑥ Distance of the reflection from the device flange
- ⑦ Delayed reflection of the tank bottom
- ⑧ Signal screen on the device display



INFORMATION!

For more data on menu items, refer to *Function description* on page 56, table C. Advanced setup.

6.5 Service mode

Service personnel use this mode to change advanced settings, particularly for difficult applications.



CAUTION!

If you are not an authorized service technician, do not change any values in the service mode menu.

This mode is locked with a password. Only approved persons are permitted to have the password for the service menu. Please contact your local sales office for further information.

6.6 Errors

6.6.1 General information

Indication of errors

When the device senses an error condition, it displays an error symbol in the top left corner of the display screen.



Figure 6-10: Indication of errors

① Error/warning symbol

Enter the supervisor mode to either:

- Do an error status check, or
- Read the error records and get more data about the error.



How to check the measurement quality

- Enter supervisor mode.
- Go to **Test > Information > Measurement Quality**.
- ➡ This shows the status of device errors at this time. A "tick" symbol next to an error in the list shows that this error is active and may have an unwanted effect on the device.
- For solutions to the problem, refer to *Error handling* on page 82.



Figure 6-11: Measurement quality in supervisor mode

- ① Type of error.
- ② Error "active"



How to find the error records

- Enter supervisor mode.
- Go to **Test > Information > Error Records**.
- Use ▾ and ▲ to scroll the error list. There are 5 error messages per page.

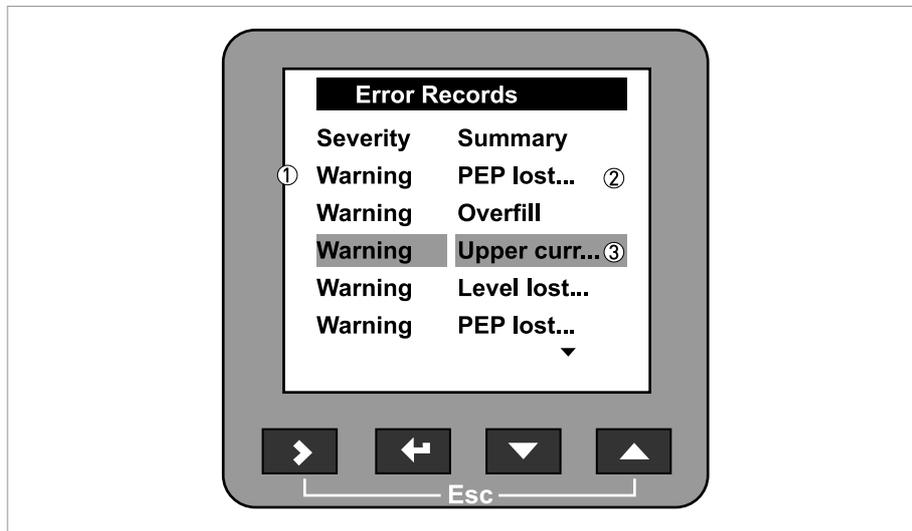


Figure 6-12: Error records in supervisor mode

- ① Type of error.
- ② Short description of the error
- ③ Selection bar



How to get more data about the error (Error Records function)

- Select an error log and press **←** to read the help text.
- Typical data is given in the illustration that follows.
- For solutions to the problem, refer to *Error handling* on page 82.



Figure 6-13: Description of the error

- ① Description of the error
- ② Time since error occurred in Days:Hours:Minutes:Seconds
- ③ Type of error

The time since the error occurred is measured in **Days:Hours:Minutes:Seconds**. The error is saved in the permanent memory of the device at intervals of 1 hour. It only includes the time when the device is energized. The counter continues when the device is switched back on.

The error symbol is no longer displayed after you read the error record.

6.6.2 Error handling

Types of error message

| Type of error | Error code | Description |
|---------------|------------|---|
| Error | E | If an error message is displayed in the error record (menu item B.2.6), the measured value is not correct. The output current goes to the value set in menu items C.3.5 Error Handling (Output 1) and C.4.5 Error Handling (Output 2). For more data, refer to <i>C. Advanced setup</i> on page 63. |
| Warning | W | If a warning message continues, the measured value will no longer be correct. |

Description of errors and corrective actions

| Error Message | Error code | Description | Corrective action |
|---------------|------------|-------------|-------------------|
|---------------|------------|-------------|-------------------|

Current output

| | | | |
|---|---|---|--|
| Current output saturated at maximum value | W | The output is at its maximum output value (20 or 20.5 mA) because the measured value is now out of the measurement range. | Fill the tank or remove some of the product until the level is back in the configured range. |
| Current output saturated at minimum value | W | The output is at its minimum output value (4 or 3.8 mA) because the measured value is now out of the measurement range. | Fill the tank or remove some of the product until the level is back in the configured range. |

External influences

| | | | |
|---|---|--|---|
| Temperature out of range for NAND Flash | W | The ambient temperature is outside the given range. This can cause loss or corruption of data. | Switch off the device until the ambient temperature is back in the given range. If the problem continues, contact the supplier. |
|---|---|--|---|

Self-test manager

| | | | |
|----------------------|---|---|---|
| Self Test has failed | E | The device's self-test failed. This can occur if the ambient temperature is not between -40...+80°C / -40...+175°F. | Energize the device when the ambient temperature is between -40...+80°C / -40...+175°F. If the device does not operate correctly, contact the supplier. |
| | | One of the electronic boards is defective. | Replace the electronics block. For more data, refer to <i>Replacement of the complete electronic module</i> on page 90. |

Measuring status

| | | | |
|---|---|--|---|
| Measurement is old | W | This is a temporary error message. If the device cannot get a measurement in this time limit, the displayed measurement is no longer correct. The voltage is possibly too low. If the device continues to show the message "spectrum quality is bad", then this message is also shown. | Check the voltage at the device terminals. Refer also to the error message "Spectrum quality is bad". |
| Level has reached the blocking distance (tank overflow) | W | The level is in the blocking distance. There is a risk that the product will overflow and/or cover the device. | Remove some of the product until the level is below the blocking distance. |

| Error Message | Error code | Description | Corrective action |
|--|------------|---|--|
| Measurement is lost in the tank bottom | W | The tank is possibly empty. The device will display the tank bottom measurement. | If you fill the tank, the device will measure again. |
| | | The device got the last valid measurement near to the tank bottom, but it can no longer find the signal. It is possible that the device cannot find the bottom of the tank if it is installed in a tank with a dish-shaped (DIN 28011 or similar) or conical bottom. The form of the tank bottom causes a delayed radar reflection and the device will display the error message "Measurement is lost in the tank bottom". The device will display the tank bottom measurement. | Follow the instructions on page 77. |

Electronics failures

| | | | |
|------------------------|---|--|---|
| Microwave check failed | E | A microwave board check failed. | If the problem continues, contact the supplier or replace the electronics block. For more data, refer to <i>Replacement of the complete electronic module</i> on page 90. |
| Peripheral Failure | E | Hardware peripheral devices on the DSP board failed. | If the problem continues, contact the supplier or replace the electronics block. For more data, refer to <i>Replacement of the complete electronic module</i> on page 90. |

Peak and spectrum

| | | | |
|---------------------------|---|--|---|
| Spectrum quality is bad | W | The quality of the spectrum is poor. If this message is temporarily shown, this will not affect the performance of the device. If this message is continuously shown, the measured values can be incorrect. The error message "Measurement is old" will then be displayed. Possible causes are foam, vortices, turbulent product surface and internal tank elements. | Check the device, tank and the process. Reconfigure the device and record a new empty spectrum. Follow the instructions on page 76. If necessary, contact the supplier. |
| Empty spectrum is invalid | W | The Empty Spectrum stored in the device does not agree with the installation. If you change the device configuration (tank height etc.), this message will be displayed. The recorded empty spectrum will not be used by the device while this error message is displayed. | Check the device, tank and the process. Reconfigure the device and record a new empty spectrum. Follow the instructions on page 76. If necessary, contact the supplier. |

| Error Message | Error code | Description | Corrective action |
|---------------------------------|------------|---|---|
| Plausible peak is not available | W | The signal peak is not found within the measuring window that filters the signals received by the antenna. The measurement is not correct. The device will automatically increase this window to find the correct signal. | Check the device, tank and the process. Reconfigure the device and record a new empty spectrum. Follow the instructions on page 76. If necessary, contact the supplier. |

Software error

| | | | |
|-----------------------------|---|---|---|
| Unable to load DSP firmware | E | The DSP Firmware did not download correctly to the DSP board. | Restart the device. If the problem continues, contact the supplier or replace the electronics block. For more data, refer to <i>Replacement of the complete electronic module</i> on page 90. |
|-----------------------------|---|---|---|

7.1 Periodic maintenance

No maintenance is necessary.

7.2 How to clean the top surface of the device



WARNING!

Do not let more than 5 mm / 0.2" of dust collect on the top surface of the device. This is a possible source of ignition in a potentially explosive atmosphere.



DANGER!

Risk of electrostatic discharge from the blue plastic sun cover.



Obey these instructions:

- Keep the thread of the terminal compartment cover clean.
- If dirt collects on the device, clean it. Wipe the plastic sun cover with a damp cloth.

7.3 How to clean horn antennas under process conditions

If it is possible that there will be build-up, a purging option is available for horn antennas.



WARNING!

Purge the antenna with a dry gas or liquid that is applicable to the process.



CAUTION!

Purge the antenna at intervals to make sure that the inner surface of the antenna stays clean and the device measures accurately.

For more data, refer to the table that follows:

How to use the purge

| Process conditions | How to use the purge |
|---|--|
| The device is colder than other elements in the process. It is possible that there will be condensation on the antenna. | Continuous use. Use low-pressure gas to remove condensation from the antenna. |
| There is a risk of build-up in the antenna | Purge at intervals. Use compressed air, nitrogen or another gas that is applicable to the process up to 6 bar / 87 psi. |
| There is a build-up or risk of build-up in the antenna | Purge at intervals. Use a liquid (hot water, solvent or another liquid that is applicable to the process) to melt the liquid that has crystallized on the antenna. |

7.4 How to replace device components

7.4.1 Service warranty

Maintenance is not necessary for most applications.

Servicing by the customer is limited by warranty to

- The removal and installation of the signal converter housing. For more data, refer to *How to turn or remove the signal converter* on page 35.
- The removal and installation of the complete electronic module.
- The removal and installation of the terminal module.
- The removal and installation of the HMI cover.

This housing can be detached from the flange system under process conditions.

Use only authorized service staff to repair the device.

7.4.2 Replacement of the display cover

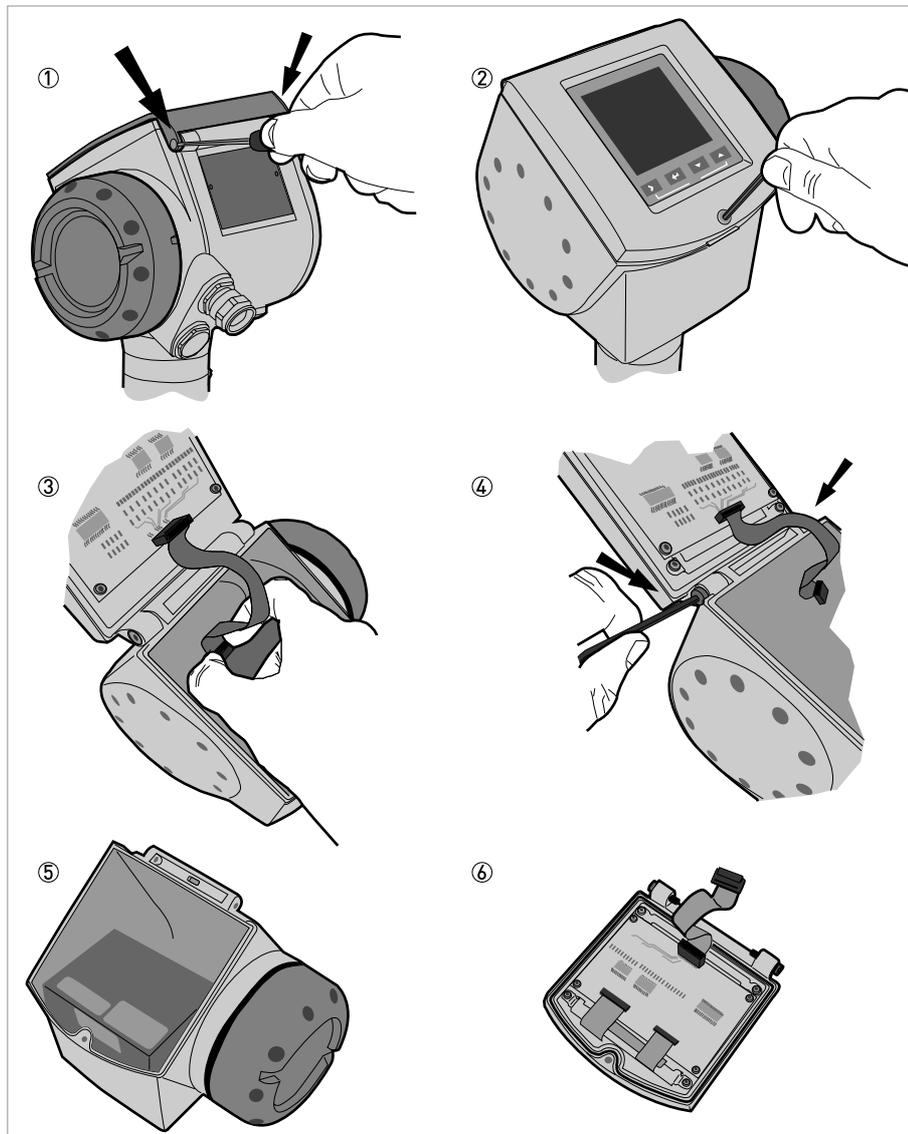


Figure 7-1: Removal of the device display cover

Equipment needed (not supplied):

- Slotted tip screwdriver.
- 3 mm Allen wrench (for steps 2 and 4).

**WARNING!**

Disconnect the power supply

**How to remove the display**

- ① Remove the 2 pins on the blue sun cover with a slotted tip screwdriver. Remove the sun cover.
- ② Loosen the screw on the display screen cover. Open the display.
- ③ Disconnect the ribbon cable from the back end electronics block.
➡ Keep the ribbon cable connected to the display screen cover.
- ④ Remove the 2 screws that keep the display attached to the housing.
- ⑤ Keep the remaining assembly and put it into storage. Make sure that the top of the housing has a protective cover.
- ⑥ Send the display to an authorized agent for maintenance.

**How to attach the display**

- Attach the display. Attach the 2 housing screws.
- Connect the ribbon cable to the back end electronics block.
➡ Make sure the connector is correctly turned. Do not use force to connect the ribbon cable.
- Close the display. Tighten the screw on the display.
- Attach the sun cover. Attach the 2 pins that keep the sun cover attached to the housing.

7.4.3 Replacement of the complete electronic module

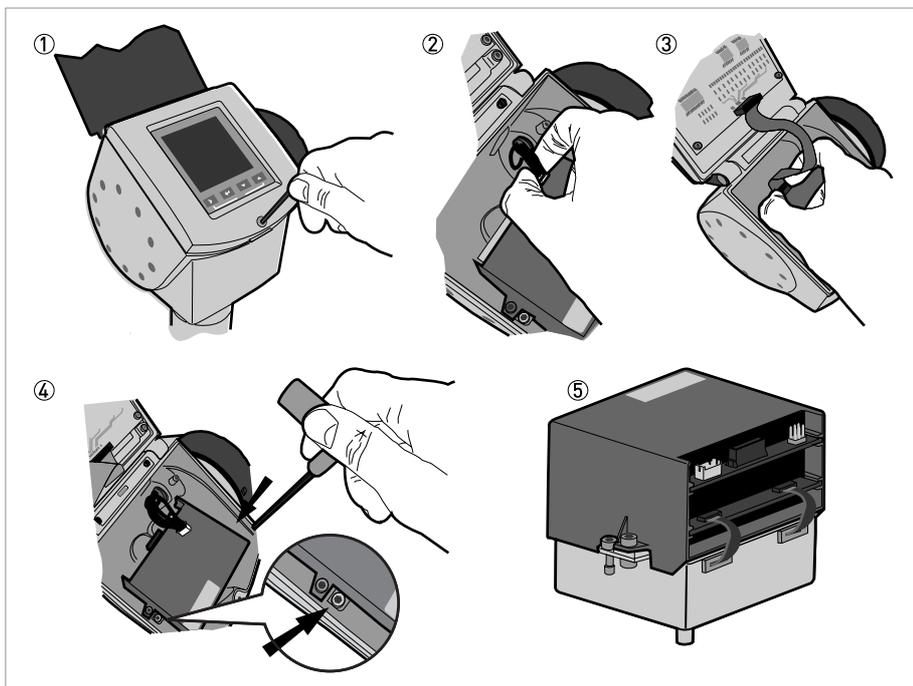


Figure 7-2: Removal of the complete electronic module

Equipment needed (not supplied):

- 3 mm Allen wrench (for steps 1 and 4).

**How to remove the back end and microwave unit**

- ① Loosen the screw on the display. Open the display.
- ② Disconnect the power supply connector from the electronics block.
- ③ Disconnect the display ribbon cable from the back end electronics block.
- ④ Loosen the 2 screws shown in the illustration.
- ➔ Do not loosen the other screws. You will disassemble the electronics block into 2 pieces. It is then difficult to remove these pieces from the housing.
- ⑤ Remove the back end and microwave unit from the housing. Send the electronics block to an authorized agent for maintenance.

**How to attach the back end and microwave unit**

- Open the display.
- Put the electronics block into the housing. Make sure that the wave guide engages in the mating part.
- Tighten the 2 screws to attach the electronics block to the bottom of the housing.
- Connect the display ribbon cable to the back end electronics block.
- Connect power supply connector to the back end electronics block.
- Close the display. Tighten the screw on the display.

7.4.4 Replacement of the terminal module

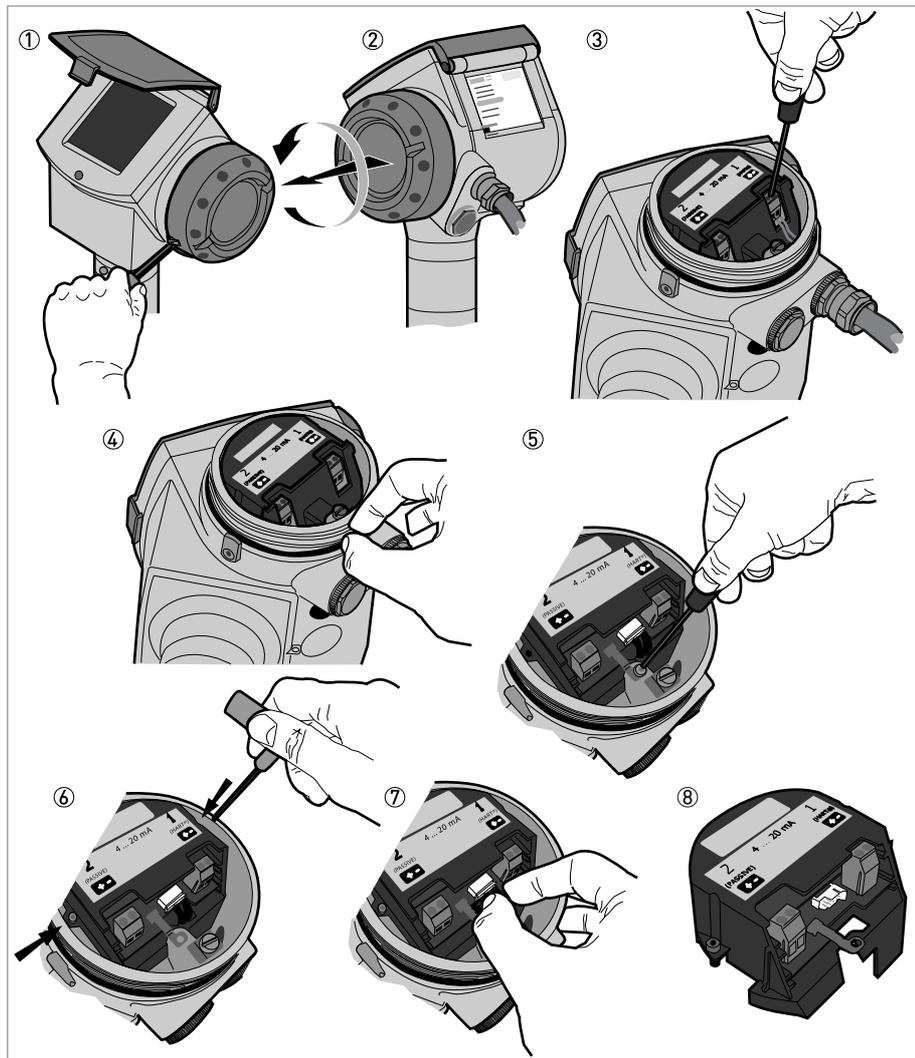


Figure 7-3: Removal of the terminal module

Equipment needed (not supplied):

- 2.5 mm Allen wrench for Aluminium (painted) housings; 3 mm Allen wrench for Stainless Steel housings (for step 1).
- Small slotted tip screwdriver (for step 3).
- TORX T10 wrench (for step 5).
- 2.5 mm Allen wrench (for step 6).

**WARNING!**

Disconnect the power supply.

**How to remove the terminal module**

- ① Loosen the cover stop screw on the terminal compartment cover.
- ② Remove the terminal compartment cover.
- ③ Disconnect the 2 wires from the power supply.
- ④ Remove the plastic terminal cover.
- ⑤ Loosen the screw for the earth terminal connection.
- ⑥ Loosen the 2 screws shown in the illustration.
- ⑦ Disconnect the wire connector from the terminal module.
- ⑧ Remove the terminal block from the housing. Send it to an authorized agent for maintenance.

**WARNING!**

If you do not push the wires away from the screw holes when you attach the terminal block, there is a risk of damage to the wires.

**How to attach the terminal module**

- Connect the wire connector to the terminal module.
- Push the wires into the slot below the connector on the terminal block.
- Turn the terminal block one time to twist the wires.
- Put the terminal block into the housing. Make sure that you push the wires away from the screw holes.
- Attach the terminal block to the housing with 2 screws supplied.
- Attach the earth terminal connection to the housing with the screw supplied.
- Attach the plastic terminal cover.
- Connect the 2 wires from the power supply. Make sure that the polarity of the wires is correct.
- Attach the terminal compartment cover.
- Tighten the cover stop screw.

7.5 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.

7.5.1 List of spare parts

We supply spare parts and accessories for this device. When you order a spare part or accessory, please give the reference numbers that follow:

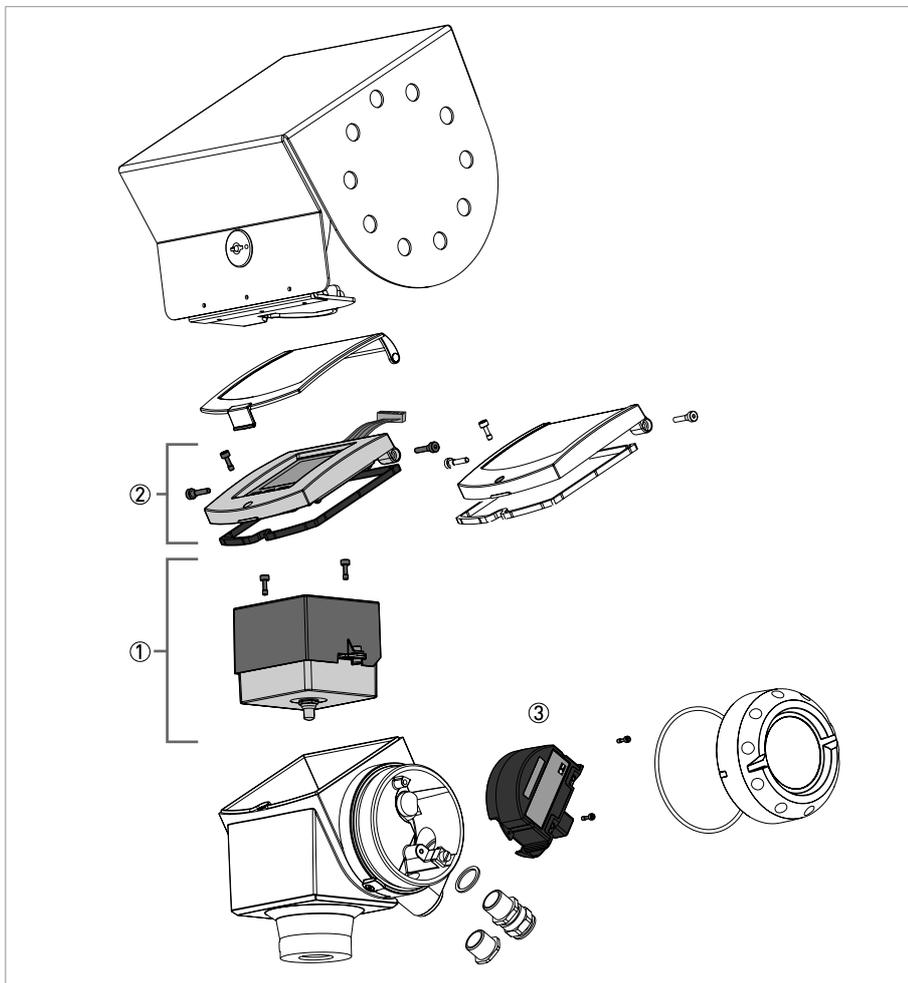


Figure 7-4: Spare parts

Part numbers for spare parts

| Item number | Description | Quantity | Part reference |
|--------------------------------|--|-------------|--------------------|
| ① | Complete electronic module ① | 1 | XF7040000000040000 |
| | Screws for the combined back end and HF modules | 2 | F3177360000 |
| ② | HMI cover and cable (aluminium housing) ② | 1 | XF7040000000050100 |
| | HMI cover and cable (stainless steel housing) ② | 1 | XF70400000000F0100 |
| ③ | Terminal module with 1 output (non-Ex) | 1 | XF7040000000031000 |
| | Terminal module with 1 output (ATEX - Ex ia) | 1 | XF7042000000031000 |
| | Terminal module with 1 output (FM/CSA - IS) | 1 | XF7046000000031000 |
| | Terminal module with 1 output (IECEX - Ex ia) | 1 | XF704M000000031000 |
| | Terminal module with 1 output (IECEX - Ex d[ia]) ③ | 1 | XF704N0000000E1000 |
| | Terminal module with 1 output (NEPSI - Ex ia) | 1 | XF704E000000031000 |
| | Terminal module with 1 output (ATEX - Ex d[ia]) | 1 | XF70430000000E1000 |
| | Terminal module with 1 output (FM/CSA - XP) | 1 | XF70470000000E1000 |
| | Terminal module with 1 output (NEPSI - Ex dia) | 1 | XF704F0000000E1000 |
| | Terminal module with 2 outputs (non-Ex) | 1 | XF7040000000032000 |
| | Terminal module with 2 outputs (ATEX - Ex ia) | 1 | XF7042000000032000 |
| | Terminal module with 2 outputs (FM/CSA - IS) | 1 | XF7046000000032000 |
| | Terminal module with 2 outputs (IECEX - Ex ia) | 1 | XF704M000000032000 |
| | Terminal module with 2 outputs (IECEX - Ex d[ia]) | 1 | XF704N0000000E2000 |
| | Terminal module with 2 outputs (NEPSI - Ex ia) | 1 | XF704E000000032000 |
| | Terminal module with 2 outputs (ATEX - Ex d[ia]) | 1 | XF70430000000E2000 |
| | Terminal module with 2 outputs (FM/CSA - XP) | 1 | XF70470000000E2000 |
| | Terminal module with 2 outputs (NEPSI - Ex dia) | 1 | XF704B0000000E2000 |
| | Terminal module with FOUNDATION Fieldbus output ④ | 1 | XF704000000003A000 |
| | Terminal module with PROFIBUS PA output ④ | 1 | XF704000000003D000 |
| Screws for the terminal module | 2 | F3177350000 | |

① The customer must send the original electronic module to the repair centre. Refer to the replacement procedure in this section.

② This reference includes the gasket and screws

③ pending

④ 4-wire + local HART

7.5.2 List of accessories



Figure 7-5: Accessories

Part numbers for accessories

| Item number | Description | Quantity | Part reference |
|-------------|--|----------|--------------------|
| ① | Plastic sun cover | 1 | XF704000000000000A |
| | Pins for the plastic sun cover | 2 | F317990000 |
| ② | Stainless steel weather protection | 1 | XF7040000000000001 |
| ③ | Blind cover (with a gasket and screws) | 1 | XF704000000000000B |
| | Gasket for the blind cover | 1 | F3177420000 |
| | Hinge screws for the blind cover | 2 | F3177340000 |
| | Lock screw for the blind cover | 1 | F3177360000 |
| ④ | Wiring compartment cover (with a gasket) | 1 | XF7040000000000004 |
| | Gasket for the wiring compartment cover | 1 | F5091150000 |
| n/a | Converter VIATOR RS232 / HART® ① | 1 | XF704000000000000C |
| | Converter USB / HART® ① | 1 | XF704000000000000D |

① This accessory is for HART® or PACTware™ communication

7.6 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.

7.7 Returning the device to the manufacturer

7.7.1 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.*

7.7.2 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: | | | |

7.8 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.

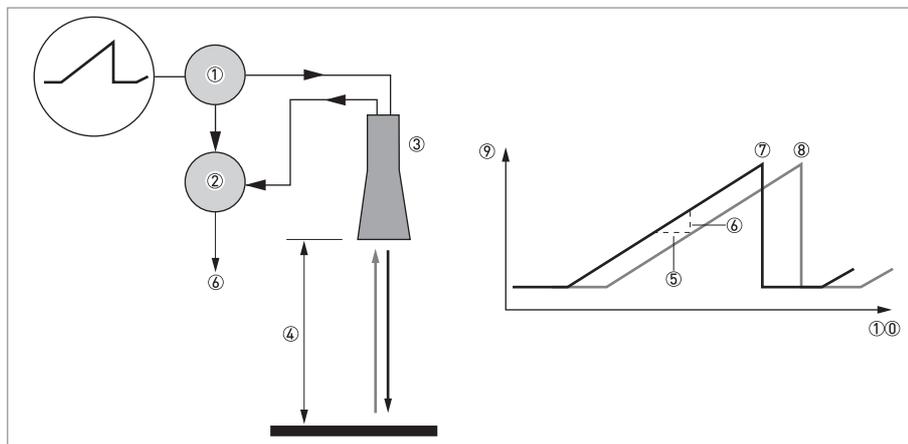


Figure 8-1: Measuring principle of FMCW radar

- 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 (Download Center).

Measuring system

| | |
|--------------------------|--|
| Measuring principle | 2-wire loop-powered level transmitter; K-band (24...26 GHz) 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, volume, mass and reflectivity |

Design

| | |
|-----------------------------------|--|
| Construction | The measurement system consists of a measuring sensor (antenna) and a signal converter which is only available in a compact version |
| Options | Integrated LCD display with sun cover (-20...+60°C / -4...+140°F); if the ambient temperature is not in these limits, the display switches off |
| | 2nd current output |
| | FOUNDATION Fieldbus output (4-wire device with local HART communication) |
| | PROFIBUS PA output (4-wire device with local HART communication) |
| | PTFE/PP flange plate protection (for Drop antennas without antenna extensions only) |
| | Distance piece (for process temperature: +150...+200°C) ① |
| Accessories | Antenna purging system (supplied with ¼ NPTF connection) |
| | Weather protection |
| Max. measuring range | Antenna extensions of 105 mm / 4.1" length (Max length for Drop antenna versions: 525 mm / 20.7"; not available for the Hygienic antenna) |
| | 80 m / 260 ft |
| Min. tank height | Depends on the antenna option, dielectric constant of the product and installation type. Refer also to "Antenna selection". |
| | 0.2 m / 8" (1 m / 40" for hygienic antenna) |
| Dead zone | Antenna extension length + antenna length + 0.1 m / 4" (500 mm / 20" for hygienic antenna) |
| Beam angle of antenna | Horn DN40 / 1.5": 20° |
| | Horn DN50 / 2": 15° |
| | Horn DN80 / 3": 10° |
| | Horn DN100 / 4": 8° |
| | Drop DN80 / 3": 8° |
| | Hygienic DN50 / 2": 15° |
| Display and user interface | |
| Display | LCD display |
| | 9 lines, 160 × 160 pixels in 8-step greyscale with 4-button keypad |
| Interface languages | English, German, French, Italian, Spanish, Portuguese, Japanese, Chinese (Mandarin) and Russian |

Measuring accuracy

| | |
|--|--|
| Resolution | 1 mm / 0.04" |
| Repeatability | ±1 mm / ±0.04" |
| Accuracy | ±3 mm / ±0.12", when distance < 10 m / 33 ft; ±0.03% of measured distance, when distance > 10 m / 33 ft |
| Reference conditions acc. to EN 60770 | |
| Temperature | +20°C ±5°C / +70°F ±10°F |
| Pressure | 1013 mbara ±20 mbar / 14.69 psia ±0.29 psi |
| Relative air humidity | 60% ±15% |
| Target | Metal plate in an anechoic chamber |

Operating conditions

| | |
|--------------------------------|--|
| Temperature | |
| Ambient temperature | -40...+80°C / -40...+175°F (according to the temperature limits of the gasket material. Refer to "Materials" in this table.) Ex: see supplementary operating instructions or approval certificates |
| Storage temperature | -40...+85°C / -40...+185°F |
| Process connection temperature | Horn antenna: Standard: -50...+150°C / -58...+300°F Option: -50...+200°C / -58...+390°F (the process connection temperature must agree with the temperature limits of the gasket material. Refer to "Materials" in this table.) Ex: see supplementary operating instructions or approval certificates Drop antenna (PTFE): -50...+150°C / -58...+300°F (the process connection temperature must agree with the temperature limits of the gasket material. Refer to "Materials" in this table.) Ex: see supplementary operating instructions or approval certificates Drop antenna (PP): -40...+100°C / -40...+210°F (the process connection temperature must agree with the temperature limits of the gasket material. Refer to "Materials" in this table.) Ex: see supplementary operating instructions or approval certificates Hygienic antenna (PEEK): -20...+150°C / -4...+300°F (the process connection temperature must agree with the temperature limits of the gasket material. Refer to "Materials" in this table.) Ex: Pending |
| Thermal shock resistance | <40°C/s / <72°F/s |
| Pressure | |
| Operating pressure | Drop antenna (PP): -1...16 barg / -14.5...232 psig; subject to process connection used and flange temperature Drop antenna (PTFE): -1...40 barg / -14.5...580 psig; subject to process connection used and flange temperature Hygienic antenna (PEEK): -1...10 barg / -14.5...145 psig; subject to process connection used and flange temperature Horn antenna: Standard: -1...40 barg / -14.5...580 psig; Option: -1...100 barg / -14.5...1450 psig; subject to process connection used and flange temperature |

| Other conditions | |
|--------------------------------------|---|
| Dielectric constant (ϵ_r) | ≥ 1.5 |
| Vibration resistance | IEC 60068-2-6 and EN 50178 (10...57 Hz: 0.075 mm / 57...150 Hz:1g) |
| Protection category | IP 66/67 equivalent to NEMA type 4X (housing) and type 6P (antenna) |

Installation conditions

| | |
|-----------------------------|---|
| Process connection size | The nominal diameter (DN) should be equal to or larger than the antenna diameter. If the nominal diameter (DN) is smaller than the antenna, 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 fit it from inside the tank. |
| Process connection position | Make sure that there are not any obstructions directly below the process connection for the device. |
| Dimensions and weights | Refer to "Technical data: Dimensions and weights". |

Materials

| | |
|---|--|
| Housing | Standard: Aluminium |
| | Option: Stainless steel (1.4404 / 316L) ② |
| Wetted parts, including antenna | Standard for Horn antenna: Stainless steel (1.4404 / 316L) |
| | Option for Horn antenna: Hastelloy® C-22 (2.4602) ③ |
| | Standard for Drop antenna: PTFE; PP |
| | Option for Drop antenna: PP or PTFE flange plate protection Hygienic antenna: PEEK - this material agrees with FDA regulations |
| Process fitting | Standard for Horn and Drop antennas: Stainless steel (1.4404 / 316L) - a PP or PTFE flange plate protection option is also available for the Drop antenna Standard for Hygienic antennas: PEEK |
| | Option: Hastelloy® C-22 (2.4602) - for Horn antennas only |
| Gaskets (and o-rings for the sealed antenna extension option) | Hygienic antenna: BioControl®: FKM/FPM (-20...+150°C / -4...+300°F); EPDM (-20°C...+150°C / -4...+300°F) SMS, Tri-Clamp®, DIN 11851: without ④ |
| | PTFE Drop antennas: FKM/FPM (-40...+150°C / -40...+300°F); Kalrez® 6375 (-20...+150°C / -4...+390°F); EPDM (-50°C...+150°C / -58...+300°F) ⑤ |
| | PP Drop antennas: FKM/FPM (-40...+100°C / -40...+210°F); Kalrez® 6375 (-20...+100°C / -4...+210°F); EPDM (-40°C...+100°C / -40...+210°F) ⑤ |
| | Horn antennas: FKM/FPM (-40...+200°C / -40...+390°F); Kalrez® 6375 (-20...+200°C / -4...+390°F); EPDM (-50°C...+150°C / -58...+300°F) ⑤ |
| Feedthrough | Standard: PEI (-50...+200°C / -58...+390°F - max. range. The feedthrough temperature limits must agree with the temperature limits of the gasket material and antenna type. If the distance piece option is not attached, the maximum temperature is 150°C / 300°F.) |
| | Option: Metaglas® (-30...+200°C / -22...+390°F - max. range. The feedthrough temperature limits must agree with the temperature limits of the gasket material and antenna type. If the distance piece option is not attached, the maximum temperature is 150°C / 300°F.) ⑥ |
| Weather protection (Option) | Stainless steel (1.4301 / 304) |

Process connections

| | |
|-----------------------|--|
| Thread | G 1½; 1½ NPT |
| Flange version | |
| EN | DN40...150 in PN16, PN40, PN63 or PN100; others on request |
| ASME | 1½"...8" in 150 lb, 1½"...6" in 300 lb, 1½"...4" in 600 lb or 900 lb; others on request |
| JIS | 40...100A in 10K; others on request |
| Hygienic | BioControl [®] DN50; Tri-Clamp [®] 2"; DIN 11851 DN50; SMS 51; others on request |
| Other | Others on request |

Electrical connections

| | |
|---------------------------------|---|
| Power supply | Terminals output 1 - Non-Ex / Ex i: 14...30 VDC; min./max. value for an output of 22 mA at the terminal |
| | Terminals output 1 - Ex d: 20...36 VDC; min./max. value for an output of 22 mA at the terminal |
| | Terminals output 2 - Non-Ex / Ex i / Ex d: 10...30 VDC; min./max. value for an output of 22 mA at the terminal (additional power supply needed - output only) |
| Cable entry | M20×1.5; ½ NPT |
| | G ½ (not for FM- and CSA-approved devices. Not for stainless steel housings.) |
| | M25×1.5 (for stainless steel housings only) |
| Cable gland | Standard: none |
| | Options: M20×1.5 (for non-Ex and Ex -approved devices with M20×1.5 and M25×1.5 cable entries); others are available on request |
| Cable entry capacity (terminal) | 0.5...1.5 mm ² |

Input and output

| | |
|---|--|
| Current output | |
| Output signal (Output 1) | 4...20 mA HART [®] or 3.8...20.5 mA acc. to NAMUR NE 43 ⑦ |
| Output signal (Output 2 - optional) | 4...20 mA (no HART [®] signal) or 3.8...20.5 mA acc. to NAMUR NE 43 |
| Resolution | ±3 µA |
| Temperature drift | Typically 50 ppm/K |
| Error signal | High: 22 mA; Low: 3.6 mA acc. to NAMUR NE 43 |
| PROFIBUS PA | |
| Type | 4-wire (+ local HART) level transmitter; K-band FMCW radar |
| Function blocks | 7 (level, distance, level conversion, level mass, reflection, ullage conversion and distance mass) |
| Protocol / Communication standard | PROFIBUS PA protocol that agrees with IEC 61158-2, galvanically isolated |
| Physical layer types | Standard power signaling, bus powered, non I.S. |
| Other features | Bus interface with integrated reverse polarity protection |
| Device power supply (24 V input) | 18...30 VDC |
| Current consumption on PROFIBUS network | 20 mA |
| Output data | Level, distance, level conversion, level mass, reflection, ullage conversion or distance mass |
| Input data | None |

| | |
|--|---|
| Error current FDE | Typically 0 mA (FDE =Fault Disconnection Electronic) |
| Address range | 0...125. Default address: 126. |
| FOUNDATION Fieldbus | |
| Type | 4-wire (+ local HART) level transmitter; K-band FMCW radar |
| Function blocks | 1 × Resource Block (RB), 4 × Analog Input Blocks (RB), 1 × Transducer Block (TB) |
| Protocol / Communication standard | Foundation Fieldbus protocol that agrees with IEC 61158-2, galvanically isolated |
| ITK version | 5.1 |
| Physical layer types | Standard power signaling, bus powered, non I.S. |
| Other features | Bus interface with integrated reverse polarity protection |
| Device power supply (24 V input) | 18...30 VDC |
| Current consumption on FOUNDATION Fieldbus network | 20 mA |
| Output data | Level, distance, level conversion, level mass, reflection, ullage conversion or distance mass |
| Input data | None |
| Error current FDE | Typically 0 mA (FDE =Fault Disconnection Electronic) |
| Link Master function | Not supported |

Approvals and certification

| | |
|---|--|
| CE | This device fulfils the statutory requirements of the EC directives. The manufacturer certifies successful testing of the product by applying the CE mark. |
| Explosion protection | |
| ATEX (approval for Hygienic antennas and fieldbus outputs pending) | ATEX II 1 G, 1/2 G, 2 G Ex ia IIC T6...T3; |
| | ATEX II 1 D, 1/2 D, 2 D Ex iaD 20 or Ex iaD 20/21 IP6X T65°C...T90°C; |
| | ATEX II 1/2 G, 2 G Ex d[ia] IIC T6...T3; |
| | ATEX II 1/2 D, 2 D Ex tD[iaD] A21/20 IP6X T65°C...T90°C; |
| | ATEX II 3 G Ex nA IIC T6...T3 |
| IECEx (approval for Drop, Hygienic antenna and fieldbus outputs options pending) | Ex ia IIC T6...T3 Ga; Ex iaD 20 IP6X T65°C...T 90°C; |
| | Ex d[ia] IIC T6...T3 Ga/Gb; Ex tD[iaD] A21/20 IP6X T65°C...T 90°C (pending) |
| FM - Dual Seal-approved (approval for hygienic antenna and fieldbus output options pending) | NEC 500 |
| | XP-IS: Cl. I, Div. 1, Gr. ABCD T6; |
| | DIP: Cl. II/III, Div. 1, Gr. EFG T6; |
| | IS: Cl. I/II/III, Div. 1, Gr. ABCDEFG T6; |
| | NI: Cl. I, Div. 2, Gr. ABCD T6 |
| | NEC 505 |
| | XP-IS: Cl. I Zone 0 AEx d[ia] IIC T6...T3; |
| | IS: Cl. I Zone 0 AEx ia IIC T6...T3; |
| | NI: Cl. I Zone 2 AEx nA[ia] IIC T6...T3 |
| | Hazardous (Classified) Locations, indoor/outdoor Type 4X and 6P, IP66, Dual Seal |

| | |
|--|--|
| CSA - Dual Seal-approved (approval for Drop antenna, hygienic antenna and fieldbus output options pending) | CEC Section 18 (Zone ratings) |
| | Cl. I, Zone 1, Ex d, IIC (Probe: Zone 0) T6...T3; |
| | Cl. I, Zone 0, Ex ia, IIC T6...T3; |
| | Cl. I, Zone 2, Ex nA, IIC T6...T3 |
| | CEC Section 18 and Annex J (Division ratings) |
| | XP-IS, Cl. I, Div. 2, Gr. ABCD; Cl. II, Div. 2, Gr. FG; Cl. III, Div. 2 T6...T3; IS, Cl. I, Div. 1, Gr. ABCD; Cl. II, Gr. FG; Cl. III T6...T3 |
| NEPSI (approval for Hygienic antennas pending) | Ex dia IIC T3...T6; Ex ia IIC T3...T6 |
| CEPEL / INMETRO (pending) | BR-Ex ia IIC T3...T6; BR-Ex d[ia] IIC T3...T6 |
| Other standards and approvals | |
| EMC | Electromagnetic Compatibility Directive 2004/108/EC in conjunction with EN 61326-1 (2006) |
| R & TTE | Radio Equipment and Telecommunications Terminal Equipment Directive 1999/5/EC in conjunction with ESTI EN 302 372 (2006) |
| FCC Rules | Part 15 |
| Industry Canada | RSS-210 |
| LVD | Low-Voltage Directive 2006/95/EC in conjunction with EN 61010-1 (2001) |
| NAMUR | NAMUR NE 21 Electromagnetic Compatibility (EMC) of Industrial Process and Laboratory Control Equipment |
| | NAMUR NE 43 Standardization of the Signal Level for the Failure Information of Digital Transmitters |
| WHG (pending) | In conformity with the German Federal Water Act, §9 |
| Construction code | On request: NACE MR0175 / ISO 15156 |

① The device has a distance piece if it has the flange options that follow: 6" in 300 lb, 3"...4" in 600 lb and 1½"...4" in 900 lb

② This option is not available for FM- or CSA-approved devices

③ Hastelloy® is a registered trademark of Haynes International, Inc.

④ Tri-Clamp® is a registered trademark of Ladish Co., Inc. BioControl® is a registered trademark of Neumo-Ehrenberg-Group.

⑤ Kalrez® is a registered trademark of DuPont Performance Elastomers L.L.C.

⑥ Metaglas® is a registered trademark of Herberts Industrieglas, GMBH & Co., KG

⑦ HART® is a registered trademark of the HART Communication Foundation

8.3 Antenna selection

The graphs below show which antenna to select for the application based on:

- D , the measuring range,
- ϵ_r , is the dielectric constant of the product being measured

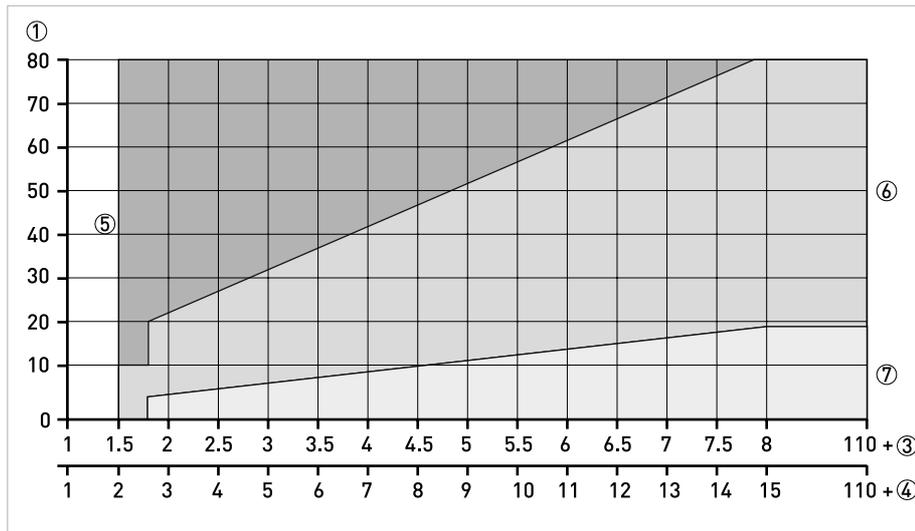


Figure 8-2: Selection of antenna for liquid applications (graph of distance in m against ϵ_r)

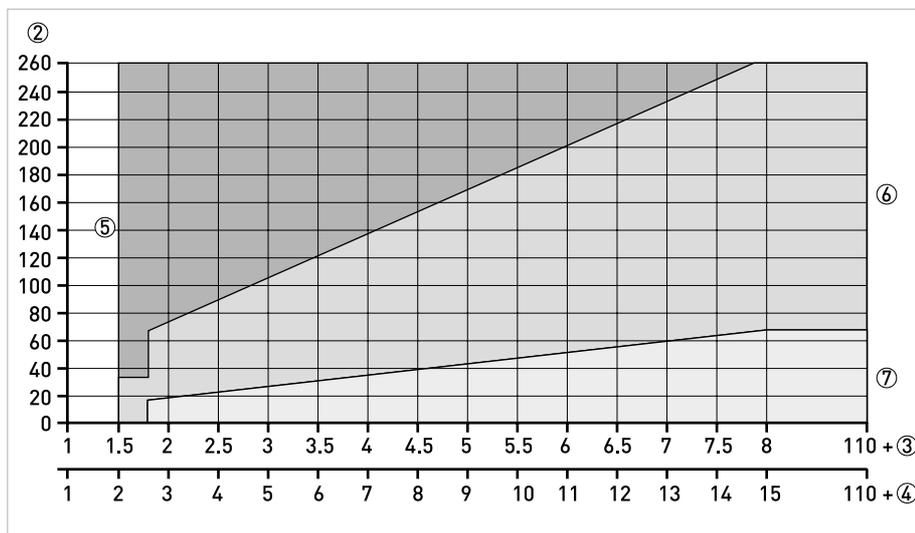


Figure 8-3: Selection of antenna for liquid applications (graph of distance in ft against ϵ_r)

- ① Distance, D [m]
- ② Distance, D [ft]
- ③ Dielectric constant (ϵ_r) range for storage/stillwell applications
- ④ Dielectric constant (ϵ_r) range for process/agitator applications
- ⑤ DN80 or DN100 Horn antenna in a still well
- ⑥ DN80 or DN100 Horn antenna with or without a still well, or DN80 Drop antenna without a still well
- ⑦ DN40, DN50, DN80 or DN100 Horn antenna with or without a still well, DN80 Drop antenna without a still well or Hygienic antenna

8.4 Guidelines for maximum operating pressure



WARNING!

Make sure that the devices are used within their operating limits.

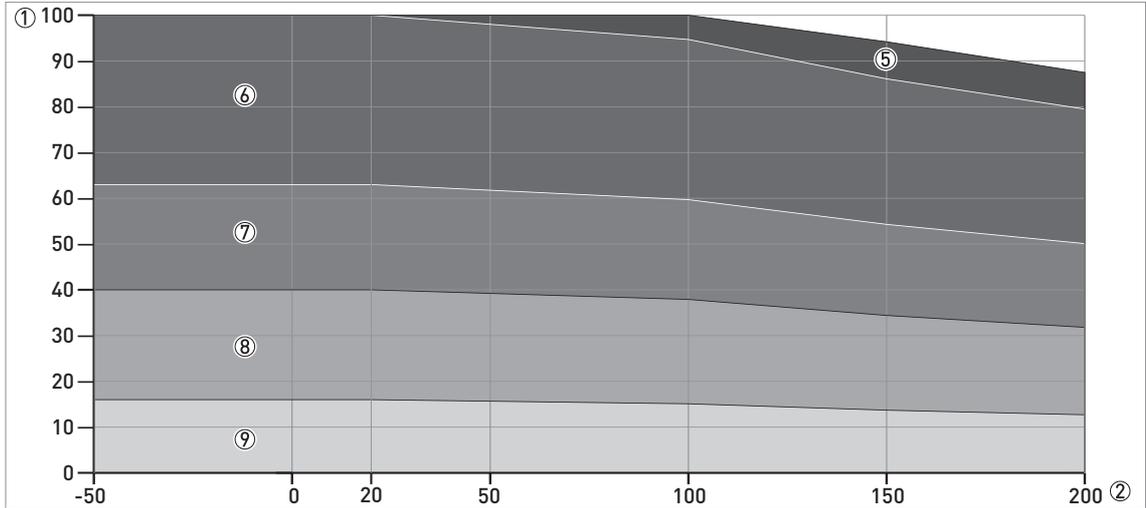


Figure 8-4: Pressure / temperature de-rating (EN 1092-1), flange and threaded connection, in °C and barg

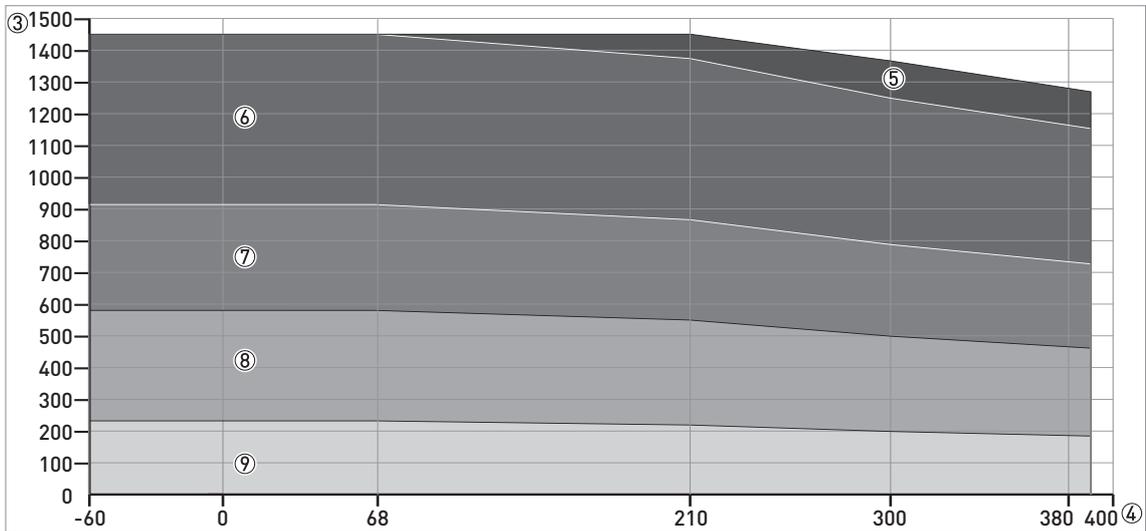


Figure 8-5: Pressure / temperature de-rating (EN 1092-1), flange and threaded connections, in °F and psig

- ① p [barg]
- ② T [°C]
- ③ p [psig]
- ④ T [°F]
- ⑤ Threaded connection, G (ISO 228-1)
- ⑥ Flange connection, PN100
- ⑦ Flange connection, PN63
- ⑧ Flange connection, PN40
- ⑨ Flange connection, PN16

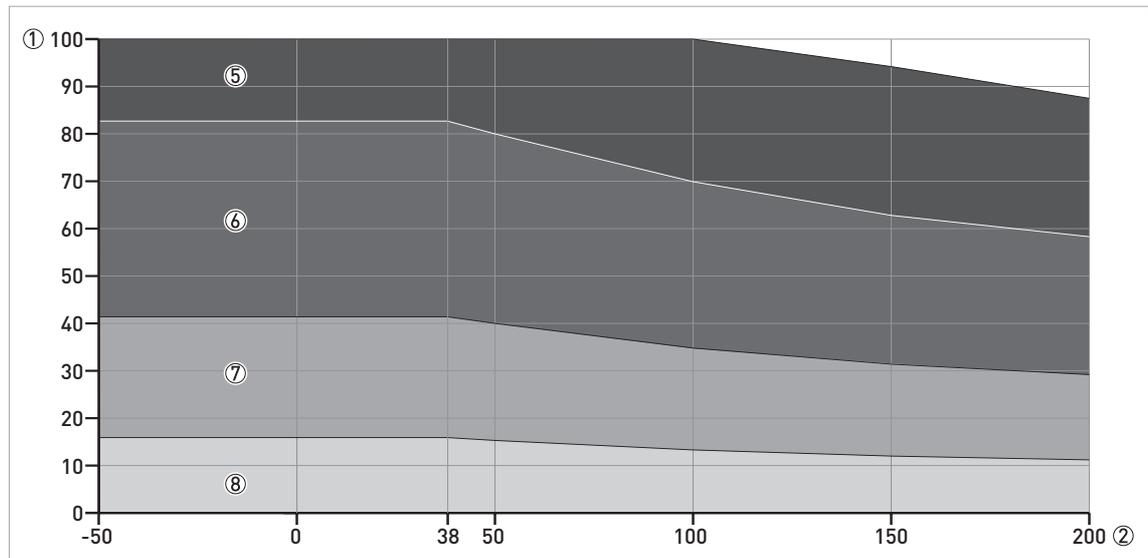


Figure 8-6: Pressure / temperature de-rating (ASME B16.5), flange and threaded connections, in °C and barg

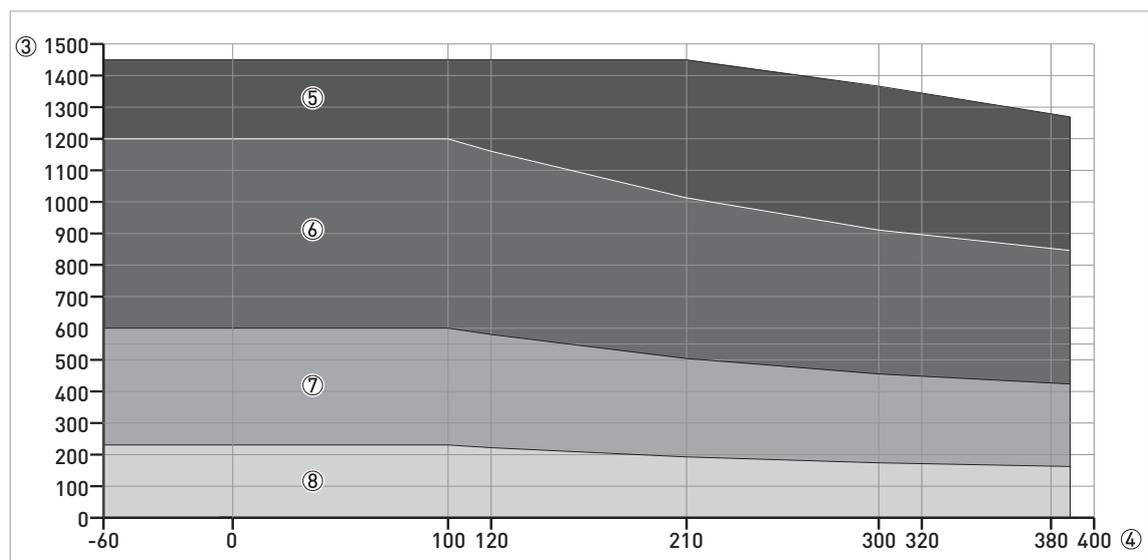


Figure 8-7: Pressure / temperature de-rating (ASME B16.5), flange and threaded connections, in °F and psig

① p [barg]

② T [°C]

③ p [psig]

④ T [°F]

⑤ Flange connection, Class 900 and Class 1500. Threaded connection, NPT (ASME B1.20.1).

⑥ Flange connection, Class 600

⑦ Flange connection, Class 300

⑧ Flange connection, Class 150

8.5 Dimensions and weights

Housing

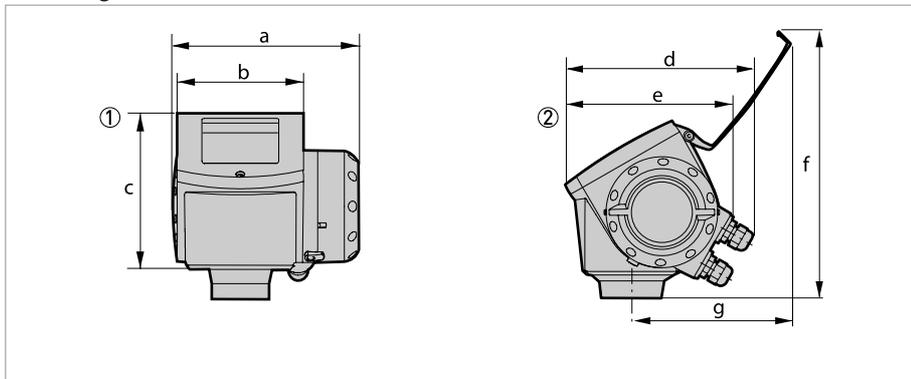


Figure 8-8: Housing dimensions

- ① Housing front view
- ② Housing side view

Dimensions and weights in mm and kg

| | Dimensions [mm] | | | | | | | Weights [kg] |
|---------|-----------------|-----|-------|-------|-----|-----|-----|--------------|
| | a | b | c | d | e | f | g | |
| Housing | 180 | 122 | 158.5 | 182 ① | 167 | 277 | 155 | 3.3 |

① If fitted with standard cable glands

Dimensions and weights in inches and lb

| | Dimensions [inches] | | | | | | | Weights [lb] |
|---------|---------------------|-----|-----|-------|-----|------|-----|--------------|
| | a | b | c | d | e | f | g | |
| Housing | 7.1 | 4.8 | 6.2 | 7.2 ① | 6.5 | 10.9 | 6.1 | 7.3 |

① If fitted with standard cable glands



CAUTION!

- Cable glands are delivered on demand with non-Ex, Ex i- and Ex d-approved devices.
- The diameter of the outer sheath of the cable must be 6...12 mm or 0.2...0.5".
- Cable glands for FM- or CSA-approved devices must be supplied by the customer.
- A weather protection cover is available on request with all devices.

Weather protection

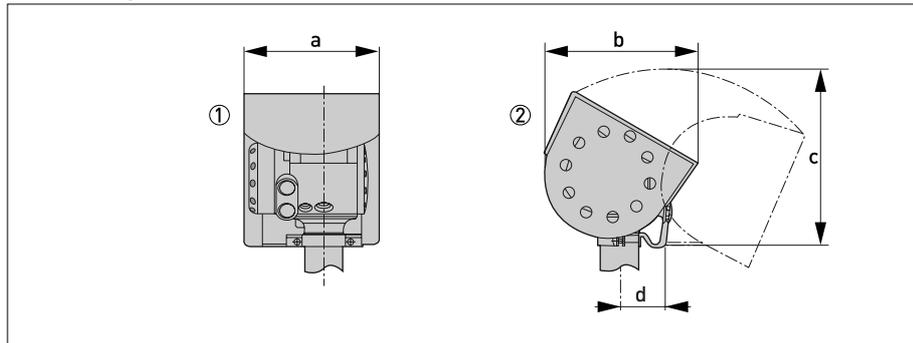


Figure 8-9: Dimensions of the weather protection option

- ① Weather protection, back view
- ② Weather protection, left side view

Dimensions and weights in mm and kg

| | Dimensions [mm] | | | | Weights [kg] |
|--------------------|-----------------|-------|-------|----|--------------|
| | a | b | c | d | |
| Weather protection | 208 | 231.5 | 268 ① | 66 | 2.9 |

① Radius

Dimensions and weights in inches and lb

| | Dimensions [inches] | | | | Weights [lb] |
|--------------------|---------------------|-----|--------|-----|--------------|
| | a | b | c | d | |
| Weather protection | 8.2 | 9.1 | 10.6 ① | 2.6 | 6.4 |

① Radius

DN40/1.5" horn antenna versions

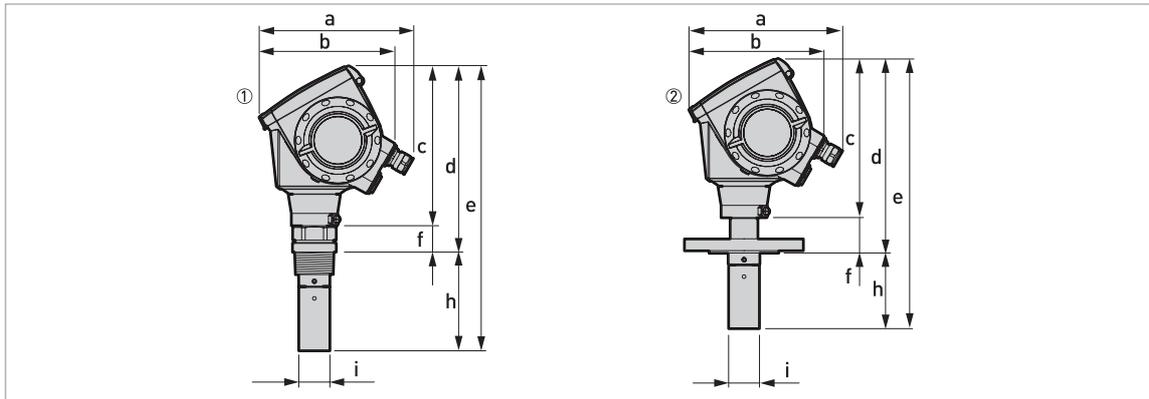


Figure 8-10: DN40 or 1.5" horn antenna versions

- ① DN40/1.5" horn antenna with G 1 1/2 or 1 1/2 NPT thread connection
- ② DN40/1.5" horn antenna with flange connection

Dimensions and weights in mm and kg

| | Dimensions [mm] | | | | | | | | Weights [kg] |
|-------------------|-----------------|-----|-----|-------|-------|------|-------|----|--------------|
| | a | b | c | d | e | f | h | Øi | |
| Thread connection | 194 ① | 170 | 201 | 233 | 359 | 32 | 126 ② | 39 | 5.1 |
| Flange connection | 194 ① | 170 | 201 | 246 ③ | 342 ③ | 45 ③ | 96 ② | 39 | 6.6...14.1 |

- ① If fitted with standard cable glands
- ② Additional antenna extensions of Ø39 × length 105 mm are available
- ③ With 1/4 NPTF purge connection option: add 17 mm to this dimension. With distance piece option: add 71 mm to this dimension.

Dimensions and weights in inches and lb

| | Dimensions [inches] | | | | | | | | Weights [lb] |
|-------------------|---------------------|-----|-----|-------|--------|-------|-------|-----|--------------|
| | a | b | c | d | e | f | h | Øi | |
| Thread connection | 7.6 ① | 6.7 | 7.9 | 9.2 | 14.1 | 1.3 | 4.9 ② | 1.5 | 11.2 |
| Flange connection | 7.6 ① | 6.7 | 7.9 | 9.7 ③ | 13.5 ③ | 1.8 ③ | 3.8 ② | 1.5 | 14.4...31.1 |

- ① If fitted with standard cable glands
- ② Additional antenna extensions of Ø1.5 × length 4.1" are available
- ③ With 1/4 NPTF purge connection option: add 0.7" to this dimension. With distance piece option: add 2.8" to this dimension.

DN50/2" horn antenna versions

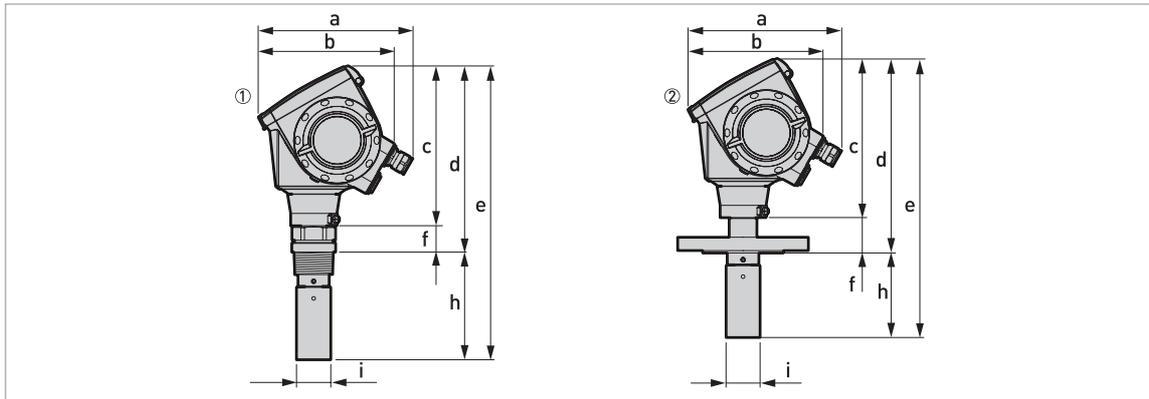


Figure 8-11: DN50/2" horn antenna versions

- ① DN50/2" horn antenna with G 1 1/2 or 1 1/2 NPT thread connection
 ② DN50/2" horn antenna with flange connection

Dimensions and weights in mm and kg

| | Dimensions [mm] | | | | | | | | Weight [kg] |
|-------------------|-----------------|-----|-----|-------|-------|------|-------|----|-------------|
| | a | b | c | d | e | f | h | Øi | |
| Thread connection | 182 ① | 167 | 201 | 234 | 370 | 32 | 136 ② | 43 | 5.3 |
| Flange connection | 182 ① | 167 | 201 | 246 ③ | 353 ③ | 45 ③ | 107 ② | 43 | 6.8...14.3 |

① If fitted with standard cable glands

② Additional antenna extensions of Ø39 × length 105 mm are available

③ With 1/4 NPTF purge connection option: add 17 mm to this dimension. With distance piece option: add 71 mm to this dimension.

Dimensions and weights in inches and lb

| | Dimensions [inches] | | | | | | | | Weights [lb] |
|-------------------|---------------------|-----|-----|-------|--------|-------|-------|-----|--------------|
| | a | b | c | d | e | f | h | Øi | |
| Thread connection | 7.2 ① | 6.5 | 7.9 | 9.2 | 14.5 | 1.3 | 5.3 ② | 1.7 | 11.6 |
| Flange connection | 7.2 ① | 6.5 | 7.9 | 9.7 ③ | 13.9 ③ | 1.8 ③ | 4.2 ② | 1.7 | 14.8...31.5 |

① If fitted with standard cable glands

② Additional antenna extensions of Ø1.5 × length 4.1" are available

③ With 1/4 NPTF purge connection option: add 0.7" to this dimension. With distance piece option: add 2.8" to this dimension.

DN80/3" horn antenna versions

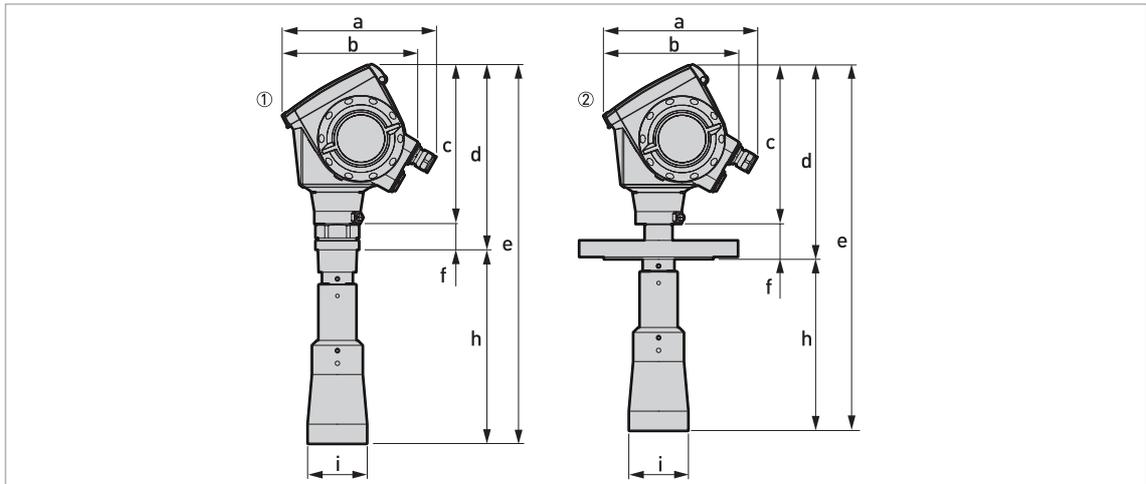


Figure 8-12: DN80/3" horn antenna versions

- ① DN80/3" horn antenna with G 1½ or 1½ NPT thread connection
- ② DN80/3" horn antenna with flange connection

Dimensions and weights in mm and kg

| | Dimensions [mm] | | | | | | | | Weights [kg] |
|-------------------|-----------------|-----|-----|-------|-------|------|-------|----|--------------|
| | a | b | c | d | e | f | h | Øi | |
| Thread connection | 182 ① | 167 | 201 | 233 | 479 | 32 | 246 ② | 75 | 6.8 |
| Flange connection | 182 ① | 167 | 201 | 246 ③ | 463 ③ | 45 ④ | 217 ② | 75 | 11.1...18.9 |

- ① If fitted with standard cable glands
- ② Additional antenna extensions of Ø39 × length 105 mm are available
- ③ With ¼ NPTF purge connection option: add 17 mm to this dimension. With distance piece option: add 71 mm to this dimension.
- ④ #With ¼ NPTF purge connection option: add 17 mm to this dimension. With distance piece option: add 71 mm to this dimension.

Dimensions and weights in inches and lb

| | Dimensions [inches] | | | | | | | | Weights [lb] |
|-------------------|---------------------|-----|-----|-------|--------|-------|-------|----|--------------|
| | a | b | c | d | e | f | h | Øi | |
| Thread connection | 7.2 ① | 6.5 | 7.9 | 9.2 | 18.9 | 1.3 | 9.7 ② | 3 | 15 |
| Flange connection | 7.2 ① | 6.5 | 7.9 | 9.7 ③ | 18.2 ③ | 1.8 ③ | 8.5 ② | 3 | 24.4...41.5 |

- ① If fitted with standard cable glands
- ② Additional antenna extensions of Ø1.5 × length 4.1" are available
- ③ With ¼ NPTF purge connection option: add 0.7" to this dimension. With distance piece option: add 2.8" to this dimension.

DN100/4" horn antenna versions

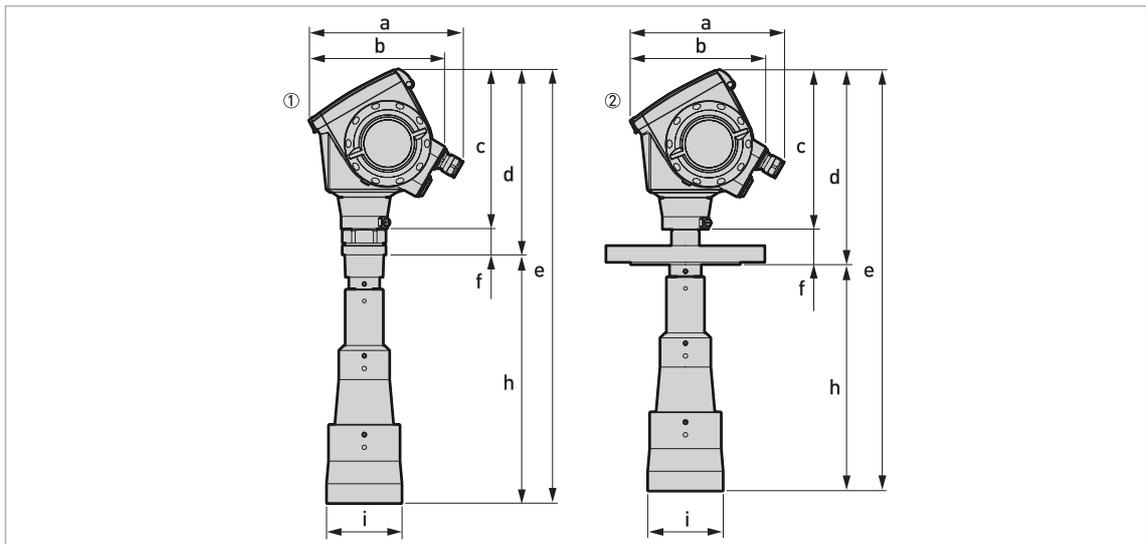


Figure 8-13: DN100/4" horn antenna versions

- ① DN100/4" horn antenna with G 1½ or 1½ NPT thread connection
 ② DN100/4" horn antenna with flange connection

Dimensions and weights in mm and kg

| | Dimensions [mm] | | | | | | | | Weights [kg] |
|-------------------|-----------------|-----|-----|-------|-------|------|-------|----|--------------|
| | a | b | c | d | e | f | h | Øi | |
| Thread connection | 182 ① | 167 | 201 | 233 | 548 | 32 | 315 ② | 95 | 7.2 |
| Flange connection | 182 ① | 167 | 201 | 246 ③ | 532 ③ | 45 ③ | 286 ② | 95 | 11.6...28.2 |

① If fitted with standard cable glands

② Additional antenna extensions of Ø39 × length 105 mm are available

③ With ¼ NPTF purge connection option: add 17 mm to this dimension. With distance piece option: add 71 mm to this dimension.

Dimensions and weights in inches and lb

| | Dimensions [inches] | | | | | | | | Weights [lb] |
|-------------------|---------------------|-----|-----|-------|--------|-------|--------|-----|--------------|
| | a | b | c | d | e | f | h | Øi | |
| Thread connection | 7.2 ① | 6.5 | 7.9 | 9.2 | 21.6 | 1.3 | 12.4 ② | 3.7 | 15.8 |
| Flange connection | 7.2 ① | 6.5 | 7.9 | 9.7 ③ | 20.9 ③ | 1.8 ③ | 11.3 ② | 3.7 | 25.6...62.2 |

① If fitted with standard cable glands

② Additional antenna extensions of Ø1.5 × length 4.1" are available

③ With ¼ NPTF purge connection option: add 0.7" to this dimension. With distance piece option: add 2.8" to this dimension.

DN80/3" Drop antenna versions

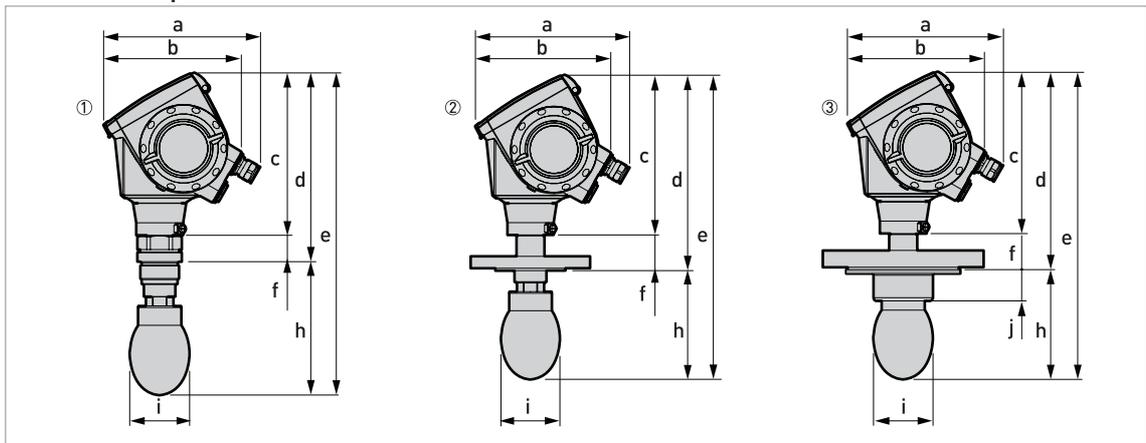


Figure 8-14: DN80/3" Drop antenna versions

- ① DN80/3" Drop antenna with G 1½ or 1½ NPT thread connection
- ② DN80/3" Drop antenna with flange connection
- ③ DN80/3" Drop antenna, with PP or PTFE flange plate protection option

Dimensions and weights in mm and kg

| | Dimensions [mm] | | | | | | | | | Weights [kg] |
|---|-----------------|-----|-----|-----|-----|----|----------|----|----|--------------|
| | a | b | c | d | e | f | h | Øi | j | |
| Thread connection | 182 ① | 167 | 201 | 234 | 399 | 33 | 165 ② | 74 | - | 5.7...6.1 |
| Flange connection | 182 ① | 167 | 201 | 246 | 383 | 45 | 137 ② | 74 | - | 6.3...26 |
| Flange connection with flange plate protection option | 182 ① | 167 | 201 | 246 | 383 | 45 | 137 | 74 | 39 | 6.6...26.8 |

① If fitted with standard cable glands

② Additional antenna extensions of Ø39 × length 105 mm are available. Do not attach more than 5 antenna extensions.

Dimensions and weights in inches and lb

| | Dimensions [inches] | | | | | | | | | Weights [lb] |
|---|---------------------|-----|-----|-----|------|-----|----------|-----|-----|--------------|
| | a | b | c | d | e | f | h | Øi | j | |
| Thread connection | 7.2 ① | 6.5 | 7.9 | 9.2 | 15.7 | 1.3 | 6.5 ② | 2.9 | - | 12.6...13.4 |
| Flange connection | 7.2 ① | 6.5 | 7.9 | 9.7 | 15.1 | 1.8 | 5.4 ② | 2.9 | - | 13.9...57.3 |
| Flange connection with flange plate protection option | 7.2 ① | 6.5 | 7.9 | 9.7 | 15.1 | 1.8 | 5.4 | 2.9 | 1.5 | 13.9...59.1 |

① If fitted with standard cable glands

② Additional antenna extensions of Ø1.5 × length 4.1" available. Do not attach more than 5 antenna extensions.

DN50/2" Hygienic antenna versions

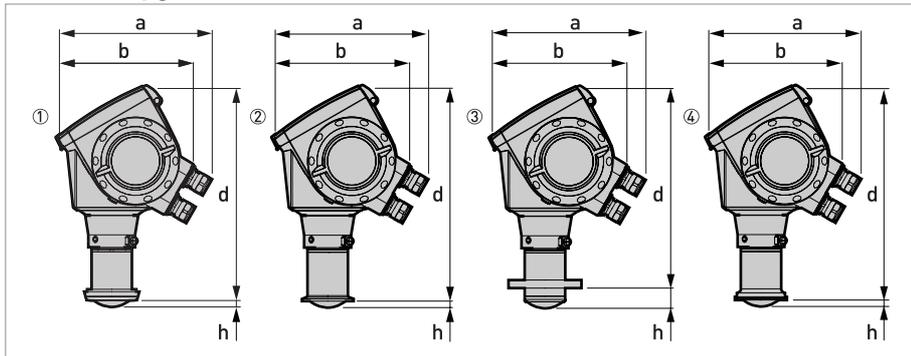


Figure 8-15: DN50/2" Hygienic antenna versions

- ① DN50/2" Hygienic antenna with DIN 11851 connection
- ② DN50/2" Hygienic antenna with Tri-Clamp® connection
- ③ DN50/2" Hygienic antenna with Neumo BioControl® connection
- ④ DN50/2" Hygienic antenna with SMS connection

Dimensions and weights in mm and kg

| | Dimensions [mm] | | | | Weights [kg] |
|------------------------------|-----------------|-----|-----|----|--------------|
| | a | b | d | h | |
| DIN 11851 connection | 182 ① | 167 | 264 | 8 | 3.8 |
| Tri-Clamp® connection | 182 ① | 167 | 264 | 8 | 3.7 |
| Neumo BioControl® connection | 182 ① | 167 | 247 | 25 | 4.0 |
| SMS connection | 182 ① | 167 | 264 | 8 | 3.8 |

① If fitted with standard cable glands

Dimensions and weights in inches and lb

| | Dimensions [inches] | | | | Weights [lb] |
|------------------------------|---------------------|-----|------|-----|--------------|
| | a | b | d | h | |
| DIN 11851 connection | 7.2 ① | 6.5 | 10.4 | 0.3 | 8.4 |
| Tri-Clamp® connection | 7.2 ① | 6.5 | 10.4 | 0.3 | 8.2 |
| Neumo BioControl® connection | 7.2 ① | 6.5 | 9.7 | 1.0 | 8.8 |
| SMS connection | 7.2 ① | 6.5 | 10.4 | 0.3 | 8.4 |

① If fitted with standard cable glands

9.1 Order form

You can help us to assist you as quickly as possible by giving us a few items of information.

Then just fax them to us. Your personal KROHNE consultant will contact you within 24 hours.

9.1.1 Device data

| | | | |
|---------------------------------------|---|--|---|
| Connection type | <input type="checkbox"/> Flange | <input type="checkbox"/> Threaded | Specify standard and size: |
| | <input type="checkbox"/> Hygienic | | |
| Connection material | <input type="checkbox"/> 316L | <input type="checkbox"/> Hastelloy® C-22 | <input type="checkbox"/> With PP or PTFE flange plate protection ① |
| Antenna type and material | <input type="checkbox"/> Horn, 316L | <input type="checkbox"/> Horn, HC-22 | <input type="checkbox"/> Drop, PTFE |
| | <input type="checkbox"/> Drop, PP | <input type="checkbox"/> Hygienic, PEEK | |
| Antenna extensions for high nozzles ② | <input type="checkbox"/> Without | <input type="checkbox"/> With | Specify number: |
| Feedthrough/Sealing ③ | <input type="checkbox"/> Standard/ FKM/FPM (-40...+200°C) | <input type="checkbox"/> Standard/ Kalrez® 6375 (-20...+200°C) | <input type="checkbox"/> Standard/ EPDM (-50...+150°C) |
| | <input type="checkbox"/> Metaglas®/ FKM/FPM (-30...+200°C) | <input type="checkbox"/> Metaglas®/ Kalrez® 6375 (-20...+200°C) | <input type="checkbox"/> Metaglas®/ EPDM (-30...+150°C) |
| Outputs | <input type="checkbox"/> 1 output 4...20 mA/HART® | <input type="checkbox"/> 2 outputs 4...20 mA/HART® + 4...20 mA | <input type="checkbox"/> PROFIBUS PA (4-wire + local HART®) |
| | <input type="checkbox"/> FOUNDATION Fieldbus (4-wire + local HART®) | | |
| Display | <input type="checkbox"/> Without | <input type="checkbox"/> With | Specify language: |
| Approvals | <input type="checkbox"/> No Ex | <input type="checkbox"/> ATEX Ex ia | <input type="checkbox"/> ATEX Ex d[ia] |
| | <input type="checkbox"/> WHG ④ | <input type="checkbox"/> FM IS Class 1 Div. 1 (Dual Seal) | <input type="checkbox"/> FM XP-IS Class 1 Div. 1 (Dual Seal) |
| | <input type="checkbox"/> CSA IS Class 1 Div. 1 (Dual Seal) | <input type="checkbox"/> CSA XP-IS Class 1 Div. 2 (Dual Seal) | <input type="checkbox"/> IECEx Ex ia |
| | <input type="checkbox"/> IECEx Ex d[ia] ④ | <input type="checkbox"/> NEPSI Ex ia | <input type="checkbox"/> NEPSI Ex dia |
| | <input type="checkbox"/> ATEX Ex nA | <input type="checkbox"/> INMETRO BR-Ex ia ④ | <input type="checkbox"/> INMETRO BR-Ex d[ia] ④ |

① For devices with the Drop antenna option

② None for devices with the HC-22, flange plate protection and hygienic antenna options. Max. 5 antenna extensions for devices with the Drop antenna option. Max. 10 antenna extensions for devices with the horn antenna option.

③ If the device does not have the distance piece option, maximum process temperature is 150°C / 302°F. If the device has the distance piece option, maximum process temperature is 200°C / 392°F. The temperature limits for the feedthrough and gasket materials must agree with the temperature limits of the antenna type.

④ Pending

9.1.2 Rating data

| | |
|--|--|
| Product name: | |
| Operating pressure: | |
| Rated pressure: | |
| Process connection temperature: | |
| Ambient temperature: | |
| Operating density: | |
| Measurand (level, volume,...): | |
| Tank height: | |
| Comments (indoors, exposed to weather, ...): | |

9.1.3 Contact data

| | |
|-------------------|--|
| Company: | |
| Contact person: | |
| Telephone number: | |
| Fax number: | |
| E-mail: | |

9.2 Glossary

D

Dead zone

Non-measurement zone.

Dielectric constant

An electrical property of the product to be measured used in Radar measurement. Also known as ϵ_r , DK and relative permittivity. Defines the strength of the wave reflected back to the device's signal converter.

Distance

The distance from the face of flange to the level (1 product) or the surface of the top product (2 or more products). See the diagrams at the end of this section.

Drop antenna

A new generation of antenna made of PP or PTFE. It has an ellipsoidal shape for a more precise emission of radar signals.

DTM

Device Type Manager. A driver for use in the PACTware™ program. All data and functions of the device are included in it.

E

Electromagnetic compatibility

Defines how much a device influences or is influenced by other devices that generate electromagnetic fields during operation. Refer to European standard EN 61326-1 for further details.

F

FMCW

Frequency-modulated continuous-wave radar technology. The signal is continuously present, but the frequency is modulated, usually in successive linear ramps over time (frequency sweeps).

H

| | |
|----------------------------|--|
| Hazardous area | An area with a potentially explosive atmosphere. Trained personnel can install and use a device in this area. The device must be ordered with the appropriate options. The device requires approvals (ATEX, IEC Ex, FM, CSA, NEPSI etc.) related to site specifications. You can find more data about hazardous areas in the Ex Manuals and Ex Certificates of Compliance. |
| Horn (cone) antenna | A common antenna for most applications. It is used for the controlled emission and collection of radar signals. |
| Hygienic antenna | An antenna made of a material that agrees with FDA regulations. It can be supplied with common hygienic process connection options (Tri-Clamp®, BioControl®, SMS, ...). |

I

| | |
|-----------------------------|--------------------------|
| Interference signals | False radar reflections. |
|-----------------------------|--------------------------|

L

| | |
|--------------|--|
| Level | Height from the bottom of the tank (user-defined) to the surface of the top product (Tank height – distance). See the diagrams at the end of this section. |
|--------------|--|

M

| | |
|-------------|------------------------------|
| Mass | Total mass of tank contents. |
|-------------|------------------------------|

O

| | |
|------------------|--|
| Operators | Users who can choose how to display measurements. They cannot configure the device in supervisor mode. |
|------------------|--|

P

| | |
|------------------|--|
| PACTware™ | Software that operates and configures field devices from a remote workstation. It is not necessary to use fieldbus software or programs developed by the manufacturer. |
|------------------|--|

R

| | |
|-------------------------|---|
| Radar reflection | Signal reflected from the surface of the tank contents. |
|-------------------------|---|

S

| | |
|-------------------------|--|
| Signal converter | A set of electronic components in the device that send the measurement signal through some signal filters. They identify and measure the level of the tank contents. |
| Supervisor | Users who can configure the device in supervisor mode. They cannot configure the device in service mode. |

T**TBF**

Tank Bottom Following (TBF) mode is an alternative measurement mode. It allows the device to measure tank contents with low dielectric constants. TBF mode uses the reflection of the tank bottom to indirectly measure the level of the tank contents.

U**Ullage volume**

Unfilled volume. See the diagrams at the end of this section.

V**Volume**

Total volume of tank contents.

W**Waveguide**

A PTFE component that is used to guide the emitted radar waves correctly into the horn antenna.

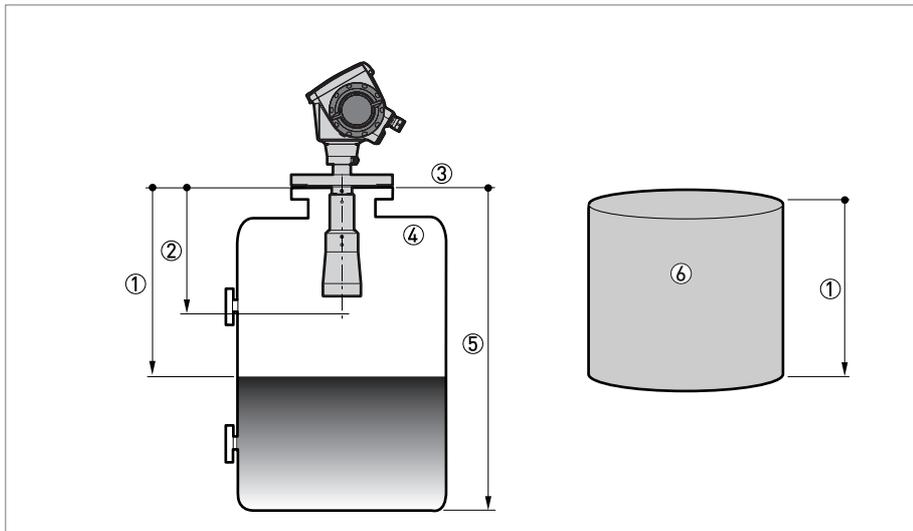


Figure 9-1: Measurement definitions: distance

- ① Distance
- ② Dead zone
- ③ Flange facing
- ④ Gas (Air)
- ⑤ Tank height
- ⑥ Ullage volume or mass

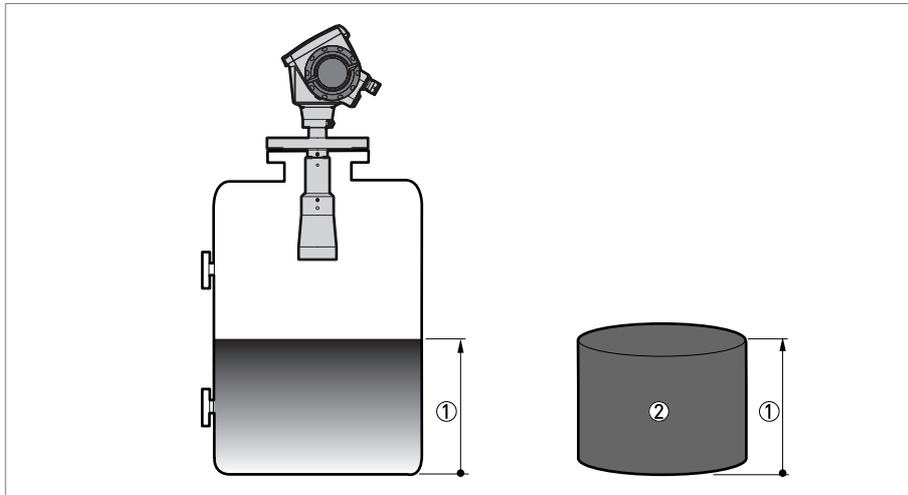
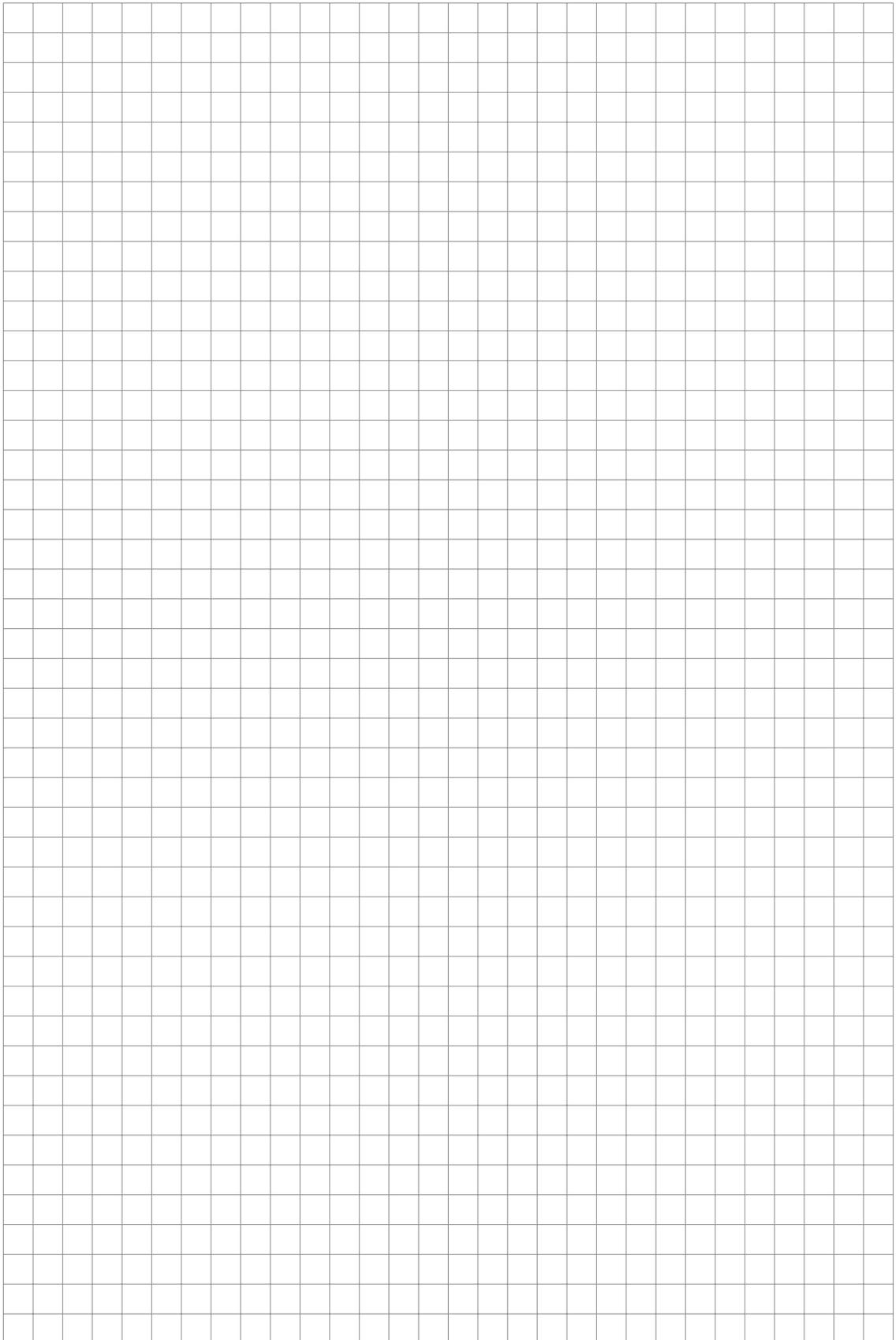


Figure 9-2: Measurement definitions: level

- ① Level
- ② Volume or mass





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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