OPTIWAVE 6300 C **Handbook**

Non-contact Radar (FMCW) Level Meter

for distance, level and volume measurement of solids

KROHNE

■ IMPRINT

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1.1 Intended use

This radar level transmitter measures distance, level, mass, volume and reflectivity of granulates and powders.

It can be installed on silos and bunkers.

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:

- EMC Directive 2004 / 108 / EC and 93 / 68 / EEC in conjunction with EN 61326-1 (2006).
- Low-Voltage Directives 2006 / 95 / EC and 93 / 68 / EEC in conjunction with EN 61010-1 (2001).

All devices are based on the CE marking and meet the requirements of NAMUR Guideline NE 21 / 04.

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 silo made of metal.

1.4 Radio approvals

1.4.1 European Union (EU)

$\boxed{\S}$ *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).
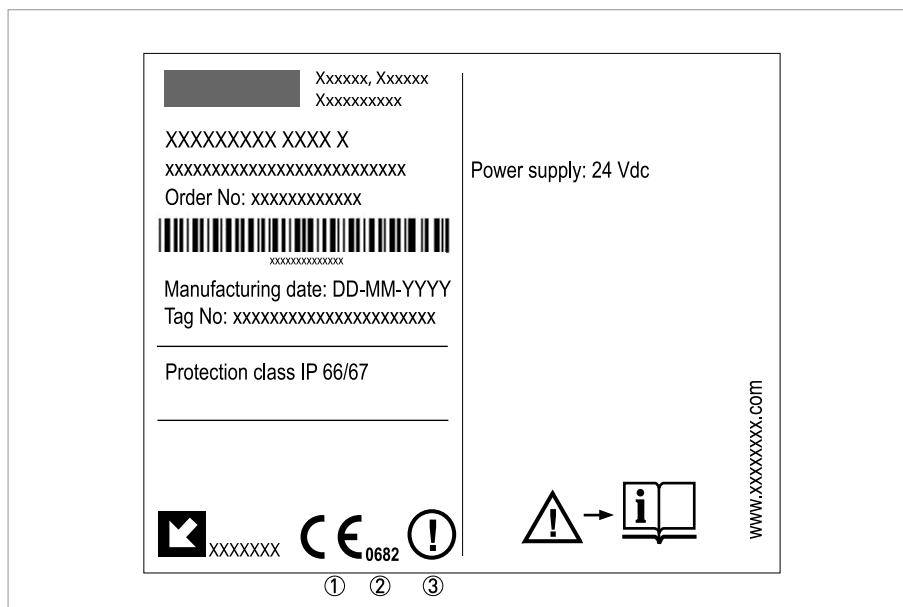
Figure 1-1: Radio approval information on the nameplate

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

According to EN 300 440 (2001-09), the radiated power outside a metallic silo 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.

§

LEGAL NOTICE!
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
1. This device may not cause harmful interference, and

2. this device must accept any interference received, including interference which may cause undesired operation.

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.

We draw your attention to the fact that data transmission over the Internet (e.g. when communicating by e-mail) may involve gaps in security. It is not possible to protect such data completely against access by third parties.

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

1.5.2 Disclaimer

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

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

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

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

1.5.3 Product liability and warranty

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

1.5.4 Information concerning the documentation

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

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

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

1.5.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.

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

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

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

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

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

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

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

LEGAL NOTICE!
This note contains information on statutory directives and standards.

- HANDLING
  This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.
  ➲ RESULT
  This symbol refers to all important consequences of the previous actions.

1.6 Safety instructions for the operator

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

2.1 Scope of delivery

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

🛈 *INFORMATION!*
Check the packing list to check if you received completely all that you ordered.

🛈 *INFORMATION!*
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.
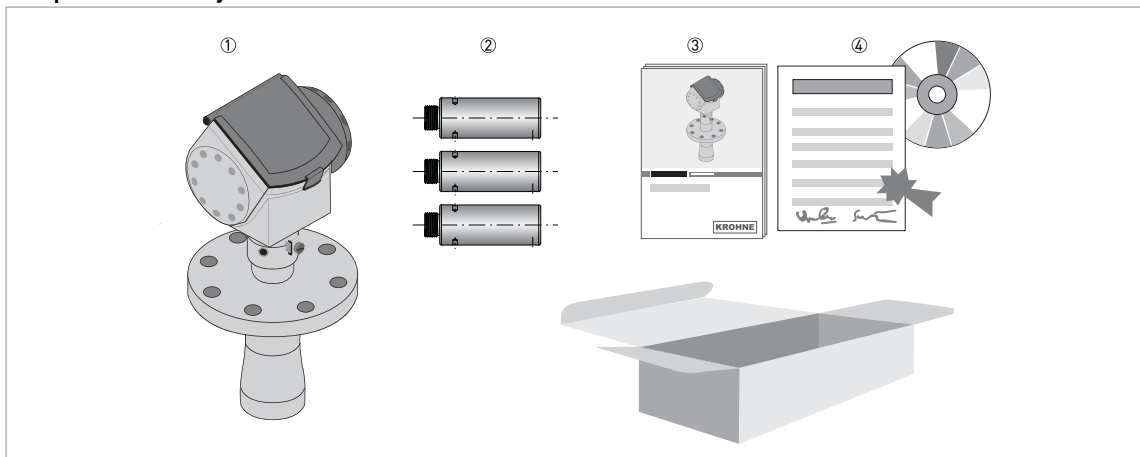
Scope of delivery - horn antenna

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

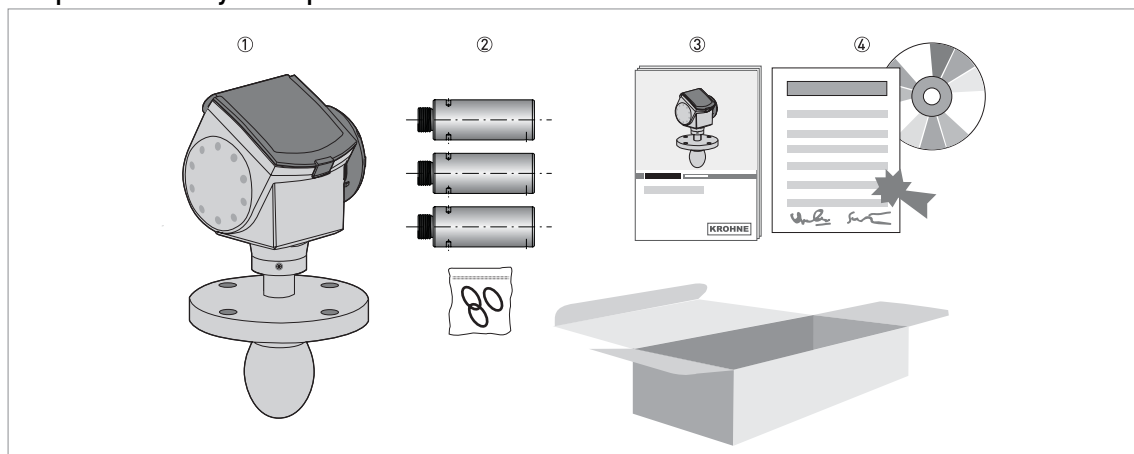Figure 2-2: Scope of delivery - Drop antenna

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)

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 granulates and powders.

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 88.

The device has a setup wizard, fully-potted electronic circuit boards and online help functions. It has a 4...20 mA+HART output (a second output is optional) and an optional local display. You usually will not need this Handbook to install, setup and operate the device.

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

These accessories are available:

• stainless steel weather protection.

• RS232/HART® converter (VIATOR).

• USB/HART® converter.

• 2° PP slanted flange

INFORMATION!
For more data on accessories, refer to List of accessories on page 84.

2.3 Visual Check

⚠️ *WARNING!*
If the display screen glass is broken, do not touch.

ℹ️ *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 2-3: Visual check

① Device nameplate (for more data, refer to *Non-Ex nameplate* on page 15)
② Process connection data (size and pressure rating, material reference and heat number)

ℹ️ *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.

ℹ️ *INFORMATION!*
Compare the material reference 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
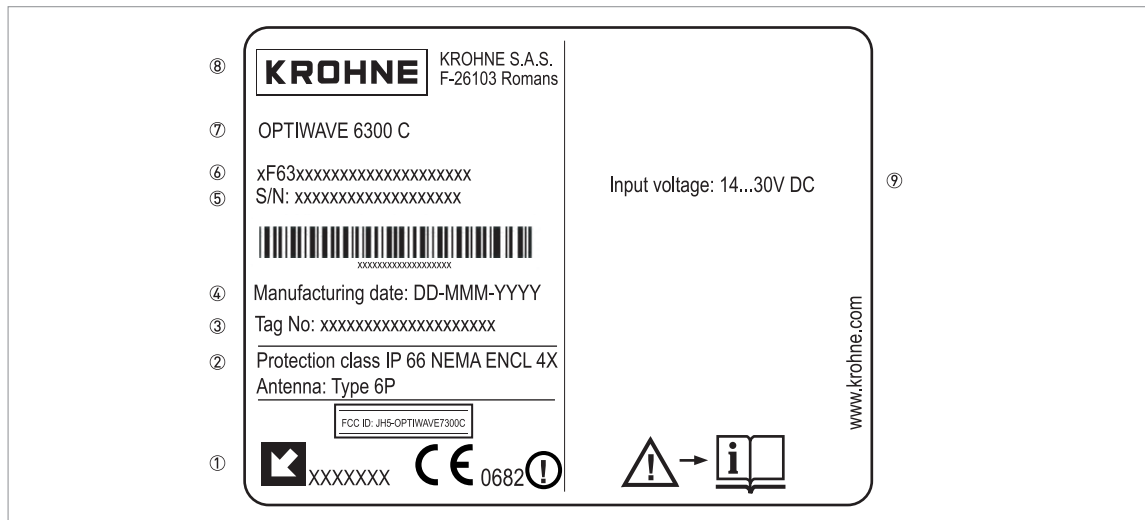
Figure 2-4: Non-Ex nameplate

① Indicator arrow to cable entry / cable entry size. Notified body for radio approval.
② Degree of ingress protection (according to EN 60529 / IEC 529)
③ Customer tag number
④ Date of manufacture
⑤ Order number
⑥ Type code (defined in order)
⑦ Model name and number
⑧ Company name and address
⑨ Nominal voltage for operation. For further information, refer to *Non-Ex* on page 31.

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.*
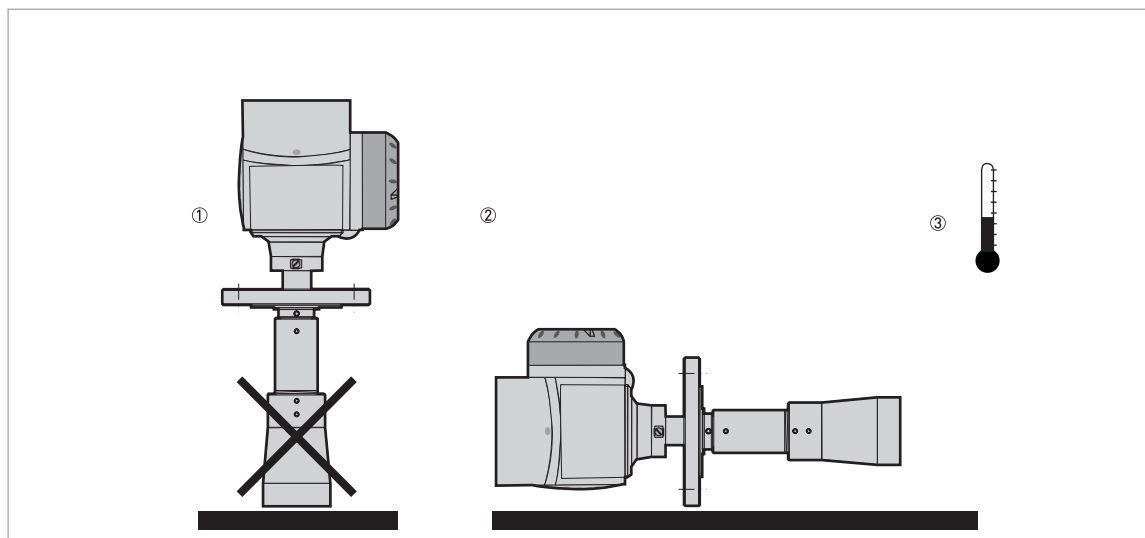
Figure 3-1: Storage conditions

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.
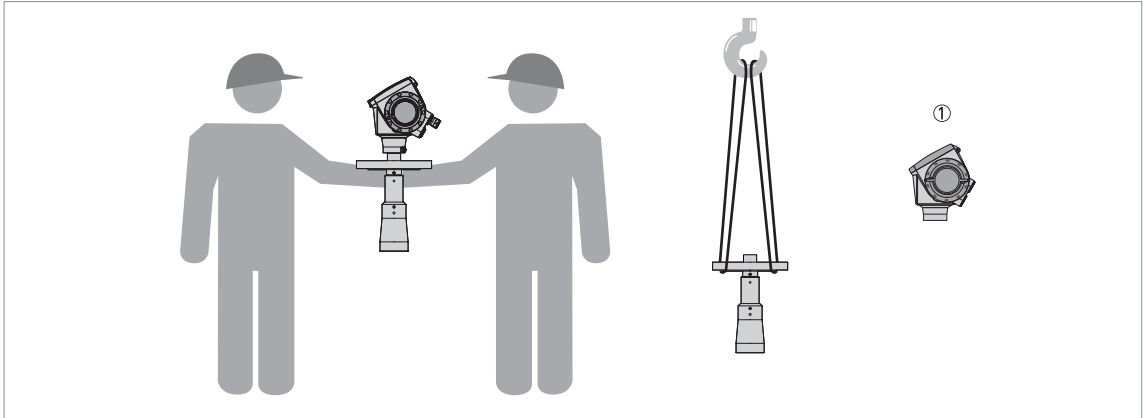- Store the device in its original packing.

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

ℹ️ *INFORMATION!*
The following precautions must be taken to make sure it is correctly installed.

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

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

3.5 How to prepare the silo before you install the device

⚠️ *CAUTION!*
To avoid measuring errors and device malfunction, obey these precautions.

3.5.1 Pressure and temperature ranges

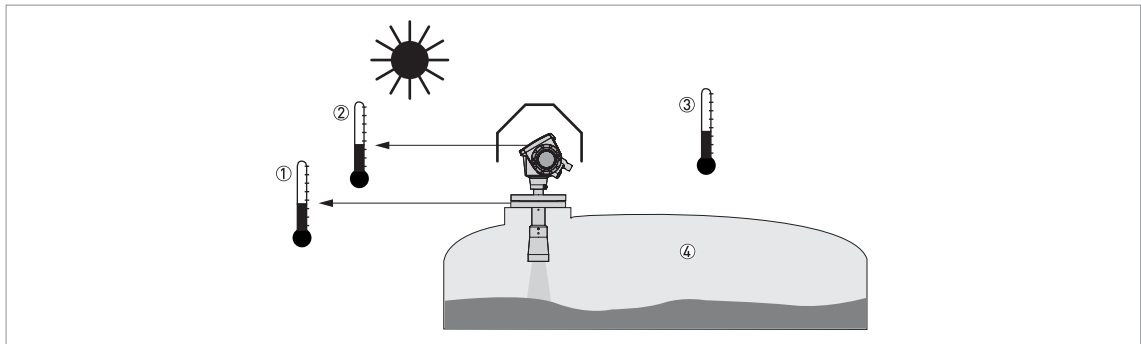Figure 3-3: Pressure and temperature ranges

① Flange temperature
   FKM/FPM gasket: -40...200°C / -40...390°F; Kalrez® 6375 gasket: -20...200°C / -4...390°F;
   EPDM gasket: -40...+150°C / -40...+300°F
   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
   PP Drop antenna option: -1...16 bar / -14.5...232 psig
   All other antenna options: -1...40 bar / -14.5...580 psig

⚠️ *WARNING!*
Maximum process connection temperature:
PTFE Drop antenna option: +150°C / +300°F
PP Drop antenna option: +100°C / 210°F

3.5.2 Theoretical data for nozzle position

⚠️ **CAUTION!**
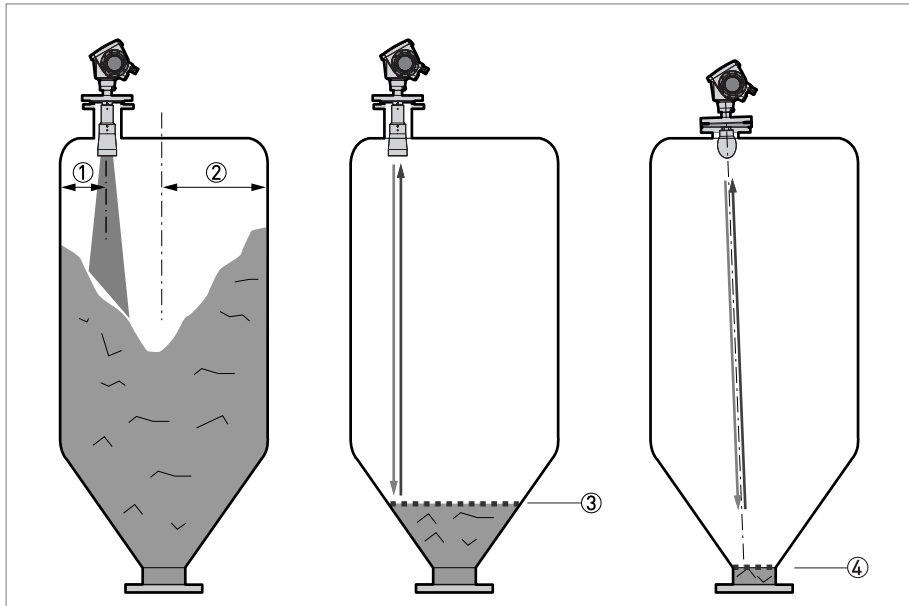*Follow these recommendations to make sure that the device measures correctly.*

Figure 3-4: Recommended nozzle position for solids

① Position of the process fitting from the silo wall, r/2 (for DN80 or DN100 Horn antennas, and DN80 or DN150 Drop antennas)
② Radius of the silo, r
③ The minimum measured level for a device without a 2° slanted PP flange option
④ The minimum measured level for a device with a 2° slanted PP flange option

ℹ️ **INFORMATION!**
If possible, do not install a nozzle on the silo centerline.

ℹ️ **INFORMATION!**
If it is necessary to measure to the bottom of the silo, a 2° slanted flange option is available for all antennas. For more data, refer to Installation recommendations for solids on page 21.

⚠️ **CAUTION!**
Do not put the device near to the product inlet. If the product that enters the silo touches the antenna, the device will measure incorrectly. If the product fills the silo directly below the antenna, the device will also measure incorrectly.
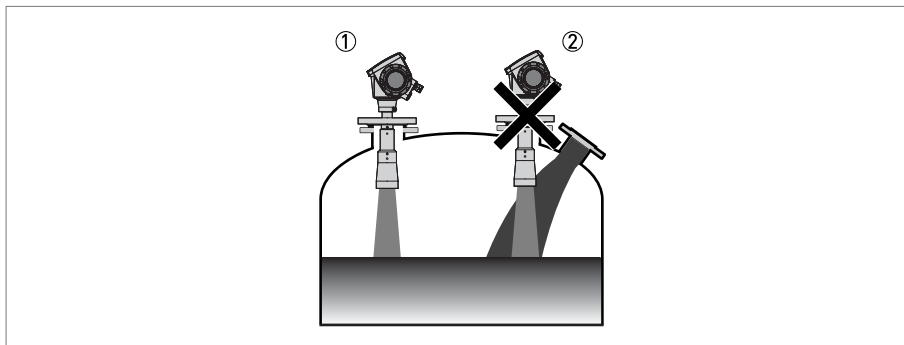
Figure 3-5: Product inlets
① The device is in the correct position.
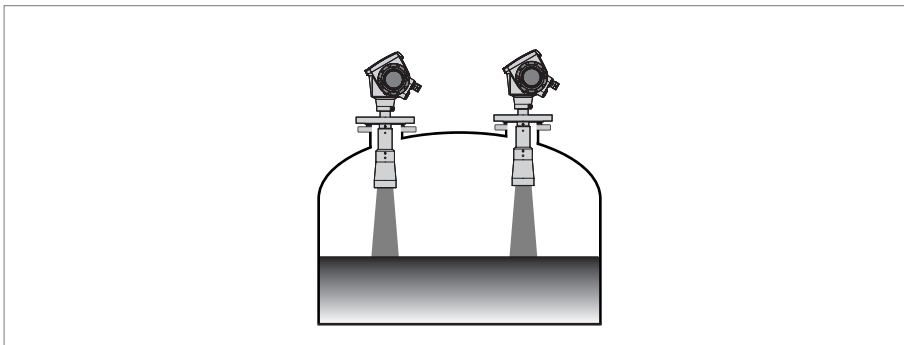② The device is too near to the product inlet.

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

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

3.6 Installation recommendations for solids

CAUTION!
Do not install the device above objects in the silo (ladder, supports etc.). Objects in the silo can cause parasite radar signals. If there are parasite radar signals, the device will not measure correctly.
If it is not possible to install the device on another part of the silo, do an empty spectrum scan.
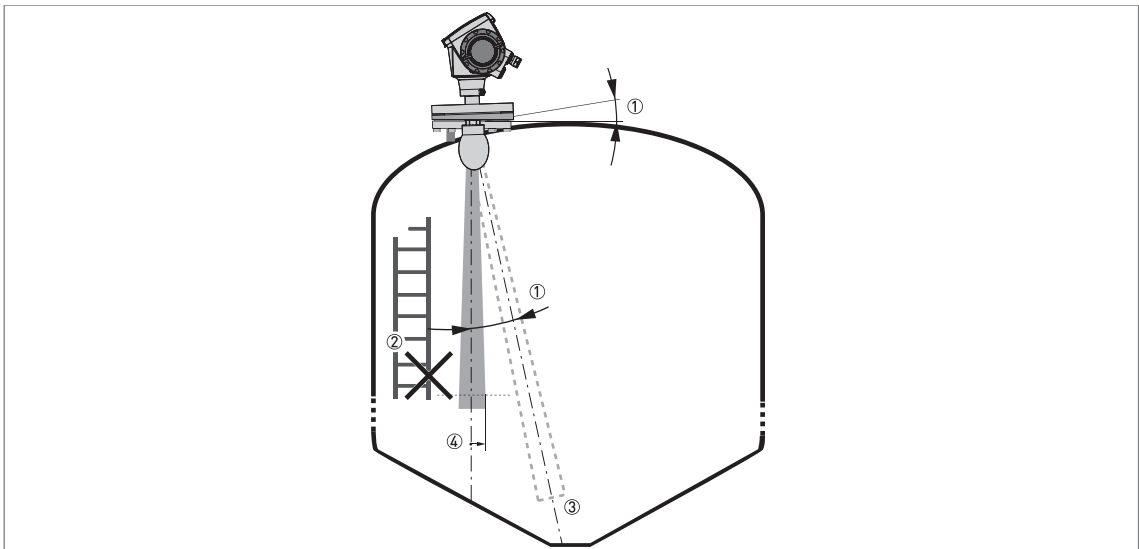
INFORMATION!
We recommend that you configure the device when the silo is empty.

INFORMATION!
For the best device performance, the antenna should be silo-intrusive. Refer to the illustration that follows.

Figure 3-7: General installation recommendations

① The level transmitter can continue to measure to the bottom of the silo if you tilt the device as shown in the illustration (a 2° slanted flange option is available for all antennas)

② If there are too many objects in the radar footprint, do an empty spectrum scan. For more data, refer to *How to use the empty spectrum function to filter parasite signals* on page 64.

③ Conical silo bottoms. For fine adjustment of the device, refer to *How to measure correctly in silos with curved or conical bottoms* on page 65.

④ 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°)
Radius of radar footprint (DN150 Drop antenna): increments of 35 mm/m or 0.42¨/ft (2°)

3.7 How to install the device on the silo

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)

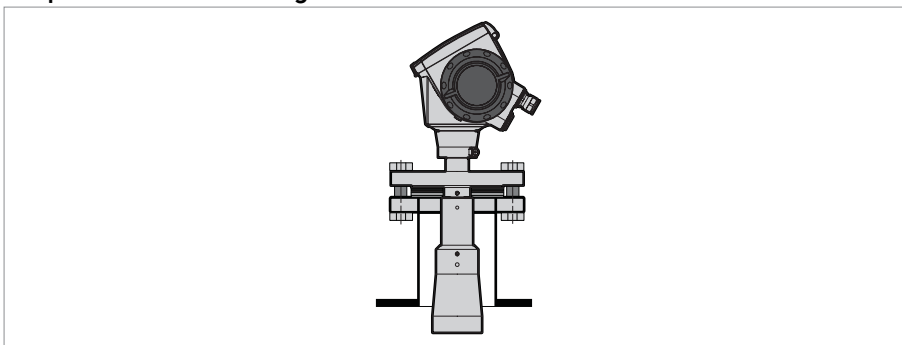#### Requirements for flange connections

Figure 3-8: Flange connection

- Make sure the flange on the nozzle is level.
- Make sure that you use the applicable gasket for the flange dimensions and the process.
- Align the gasket correctly on the flange facing of the nozzle.
- Lower the antenna carefully into the silo.
- Tighten the flange bolts.
- ➲   Refer to local rules and regulations for the correct torque to apply to the bolts.
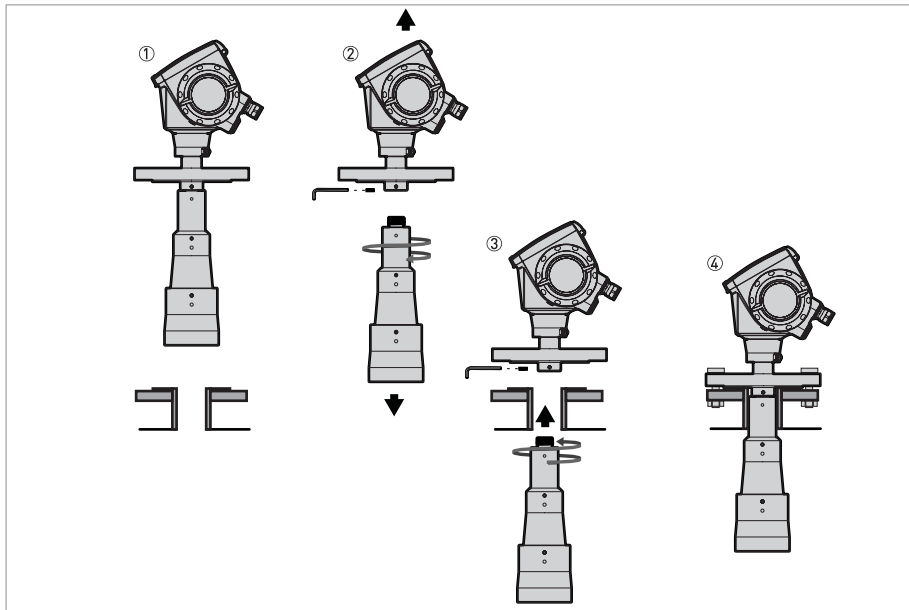
Figure 3-9: How to attach the device if the antenna is smaller than the process connection

Equipment needed (not supplied):

• 3 mm Allen wrench

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 silo 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.
• Remove the antenna from the housing.
• Align the gasket correctly on the flange facing of the nozzle.
• Lower the antenna carefully into the silo. Do not attach to the silo yet.
• Attach the antenna and the antenna locking screw
• Lower the antenna carefully into the silo. Tighten the flange bolts.
• Attach the antenna from inside the silo.

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)
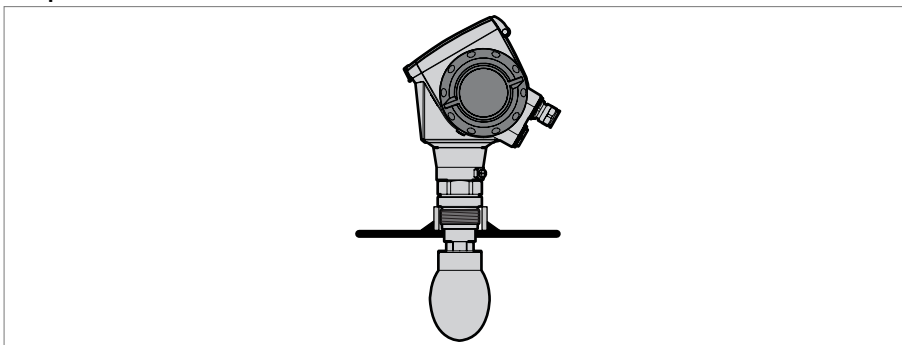
Requirements for threaded connections

Figure 3-10: Threaded connection

If the process connection is larger than the antenna

- Make sure the silo 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 silo.
- 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.
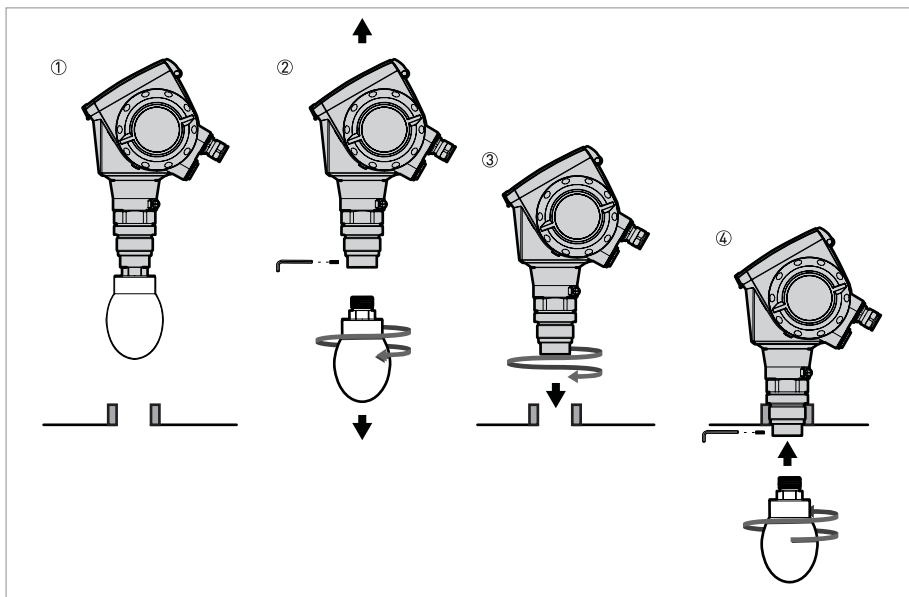
Figure 3-11: How to attach the device if the antenna is smaller than the process connection

Equipment needed (not supplied):

• 3 mm Allen wrench

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 silo can always hear you.

If the process connection is smaller than the antenna:

• Make sure the silo connection is level.
• Remove the antenna locking screw.
• Remove the antenna from the housing.
• Align the gasket correctly. Turn the threaded connection on the housing to attach the device to the process connection. Tighten the connection.
• Attach the antenna from inside the silo. Attach the antenna locking screw.

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

• Make sure the silo 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 silo.
• If necessary, turn the threaded connection on the housing to attach the device to the plate.
• Tighten the connection.

3.7.3 How to attach antenna extensions

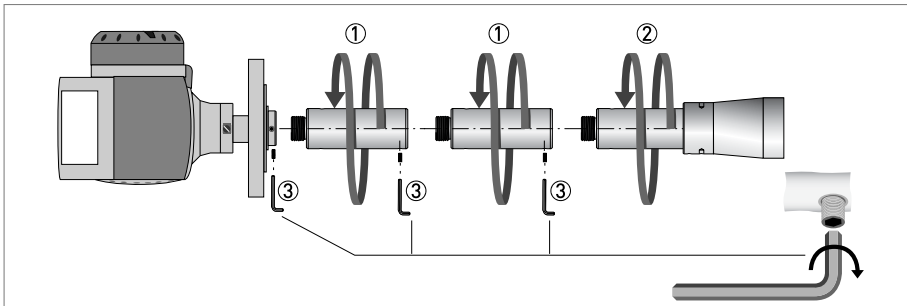**Horn antenna - antenna extensions**

Figure 3-12: Horn antenna - how to attach antenna extensions

- 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 the program mode. Use the display screen or PACTware™.
- ➲ Antenna extension = antenna extension length x number of extensions

- If you attach more extensions than were initially ordered, change the blocking distance value in the user interface.
- ➲ Minimum blocking distance = antenna length + (antenna extension length x number of extensions) + 0.1 m / 4¨

Drop antenna - antenna extensions

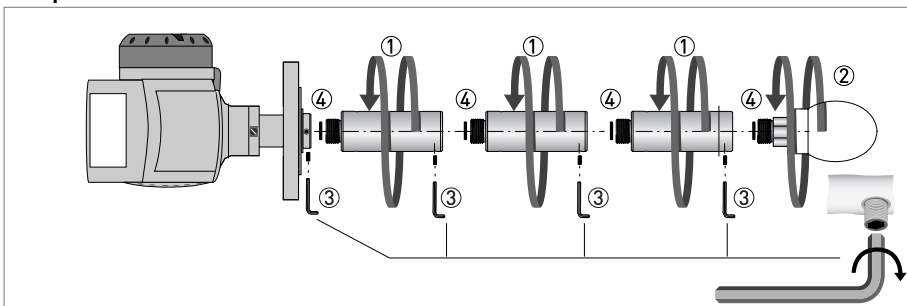Figure 3-13: Drop antenna - how to attach antenna extensions

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.

• 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.
• 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 the program mode. Use the display screen or PACTware™.
➲   Antenna extension = antenna extension length x number of extensions

• If you attach more extensions than were initially ordered, change the blocking distance value in the user interface.
➲   Minimum blocking distance = antenna length + (antenna extension length x number of extensions) + 0.1 m / 4¨

3.7.4 How to turn or remove the signal converter

INFORMATION!
The converter turns 360°. Remove the signal converter before you lift the device with a hoist.

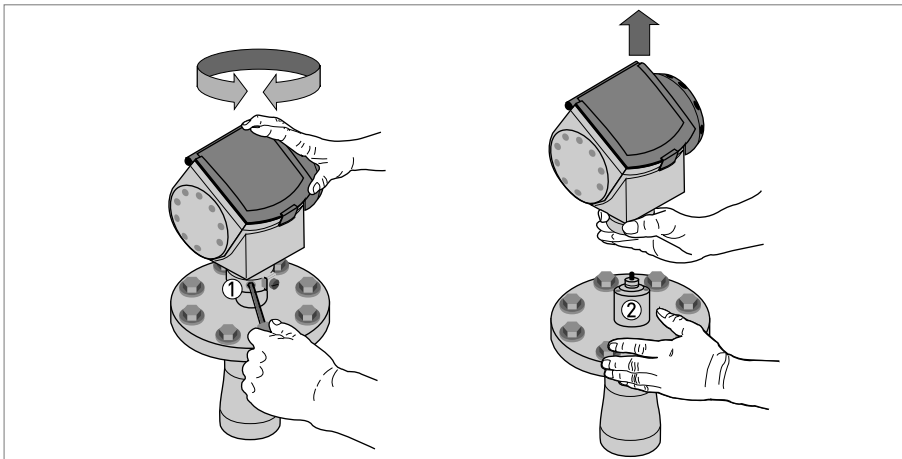**Figure 3-14: How to turn or remove the signal converter**
Tool: 5 mm Allen wrench

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.
- Remove 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.

3.7.5 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 94.

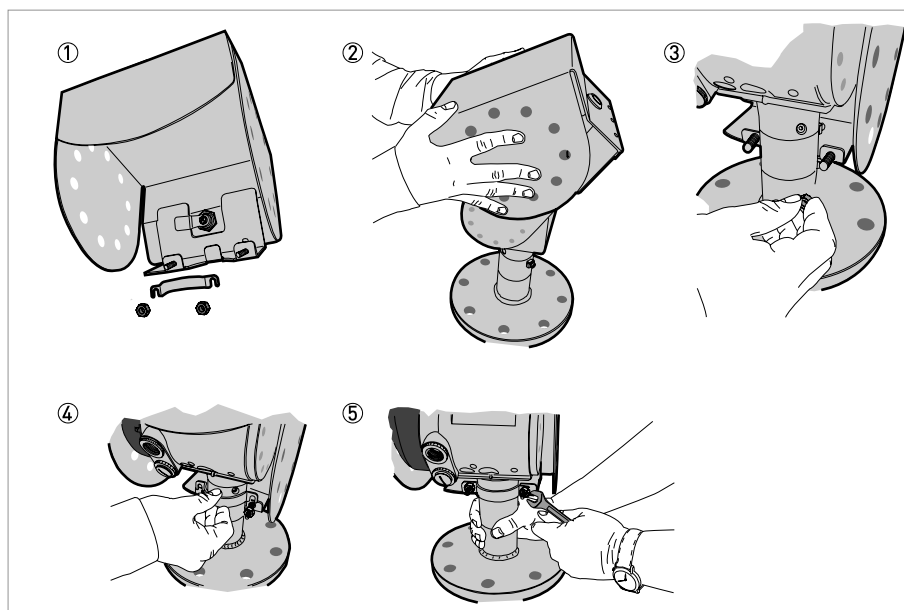Figure 3-15: Installation of the weather protection

- 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.

3.7.6 How to open the weather protection

Equipment needed:

• Weather protection.

• Large slotted tip screwdriver (not supplied).

Figure 3-16: How to open the weather protection
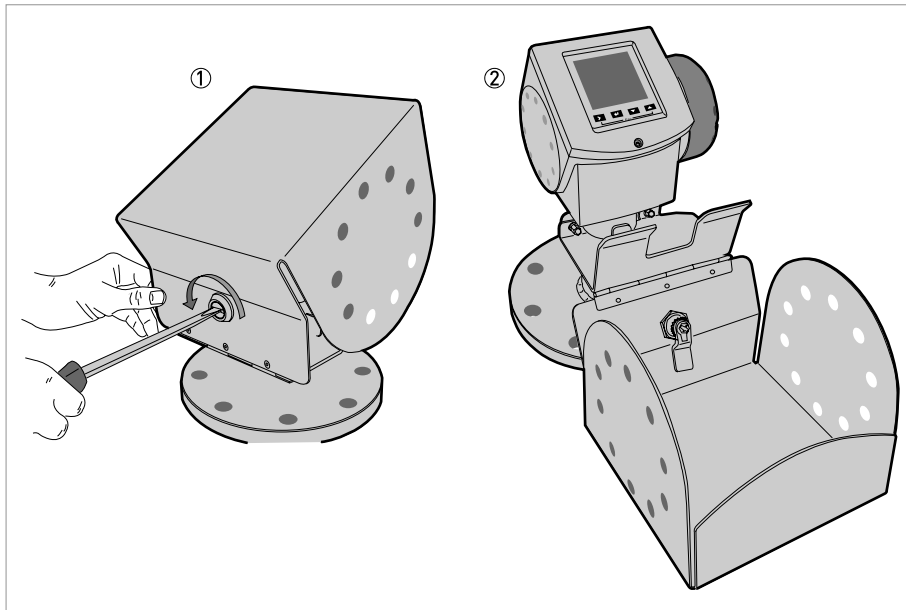
① Weather protection in its closed position
② Weather protection in its open position. Minimum clearance in front of the device: 300 mm / 12˝.

• 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
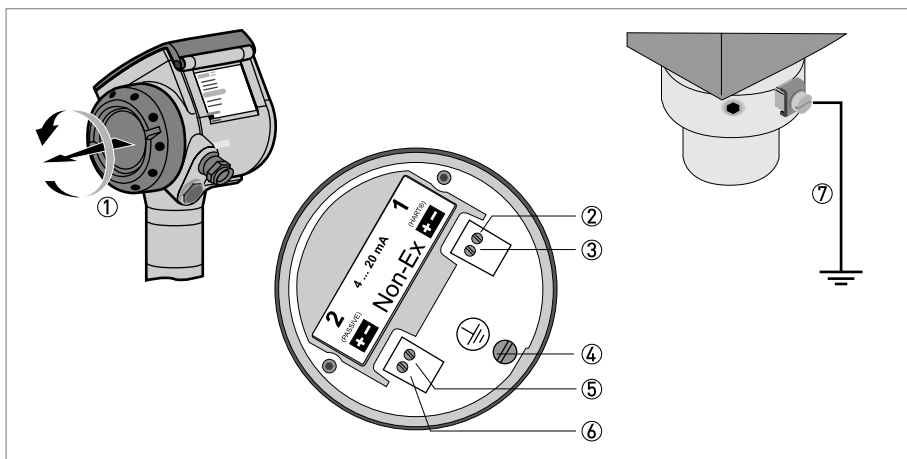
Figure 4-1: Electrical installation

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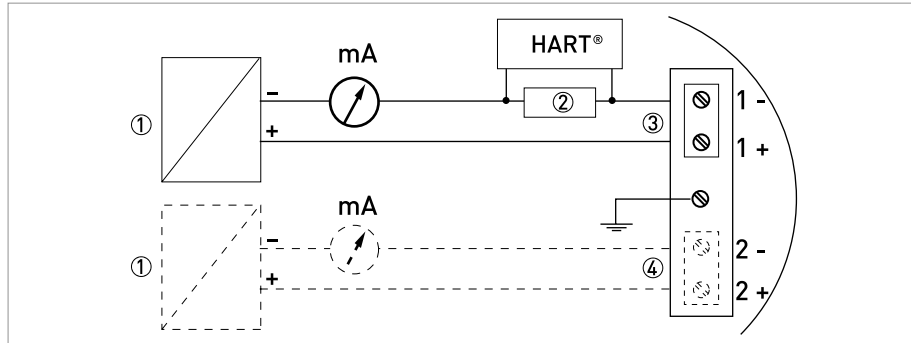
Figure 4-2: Electrical connections for non-Ex devices

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).

4.3 Protection category

INFORMATION!
The device fulfills all requirements per protection class IP 66/67 (equivalent to NEMA 6-6X).

DANGER!
Make sure the cable gland is watertight.
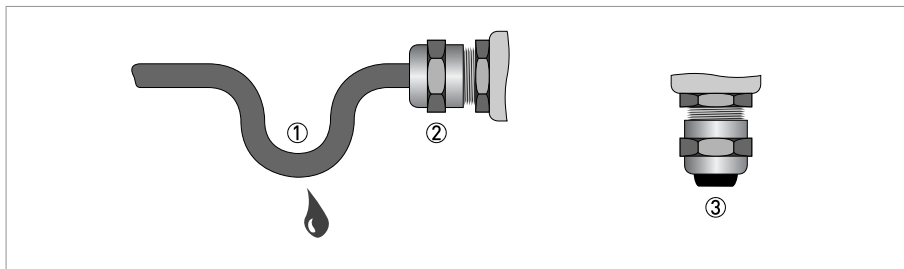
Figure 4-3: How to make the installation agree with protection category IP 67

- 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.

Output 1 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 59.

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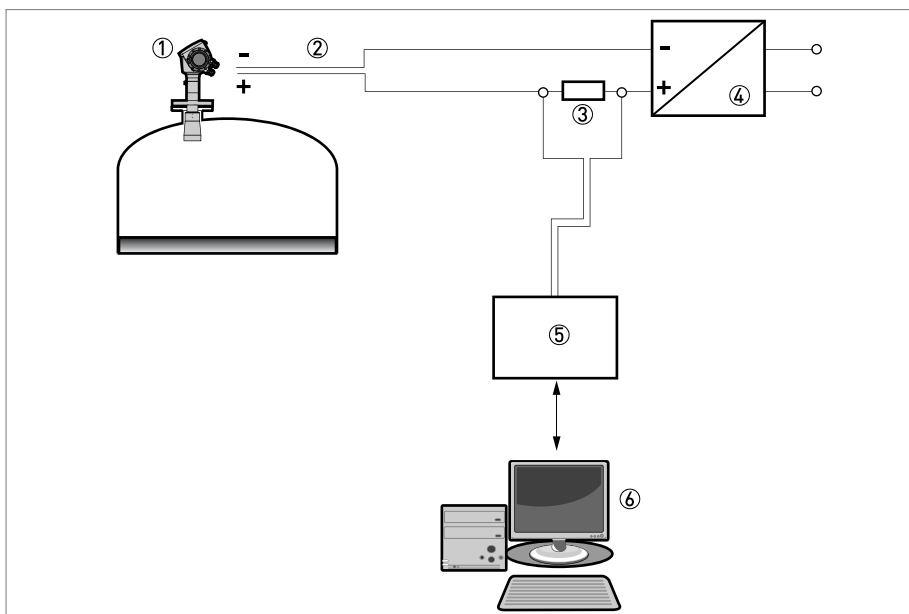
Figure 4-4: Point-to-point connection (non-Ex)

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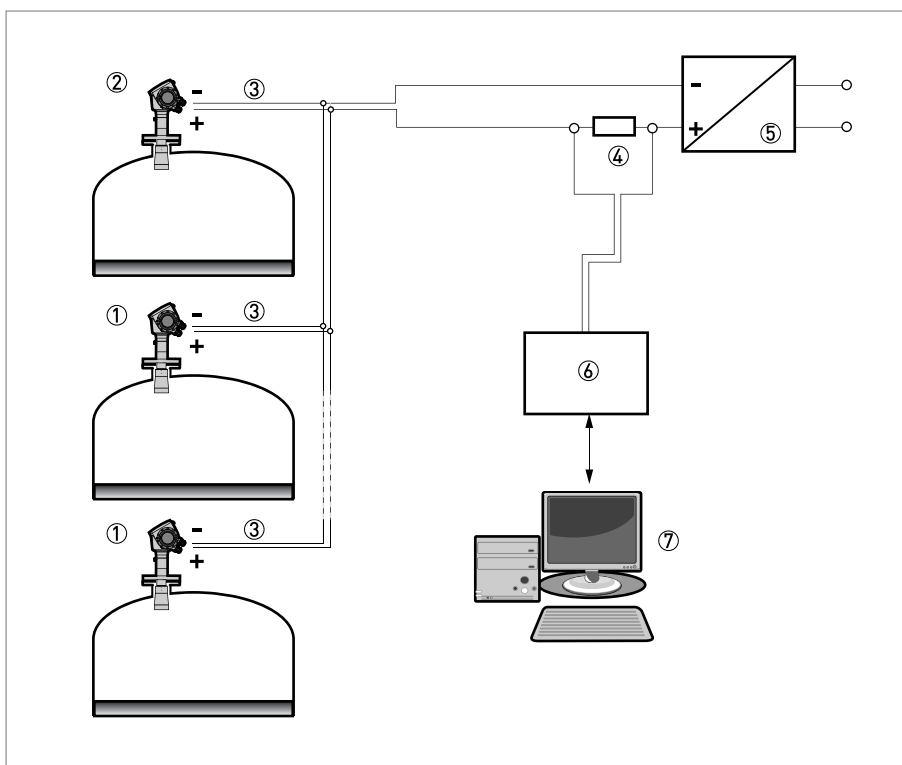
Figure 4-5: Multi-drop network (non-Ex)

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

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 silo?
- Does the information on the signal converter nameplate agree with the operating data?
- Did you correctly install the device on the silo?
- 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 AMS™. 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
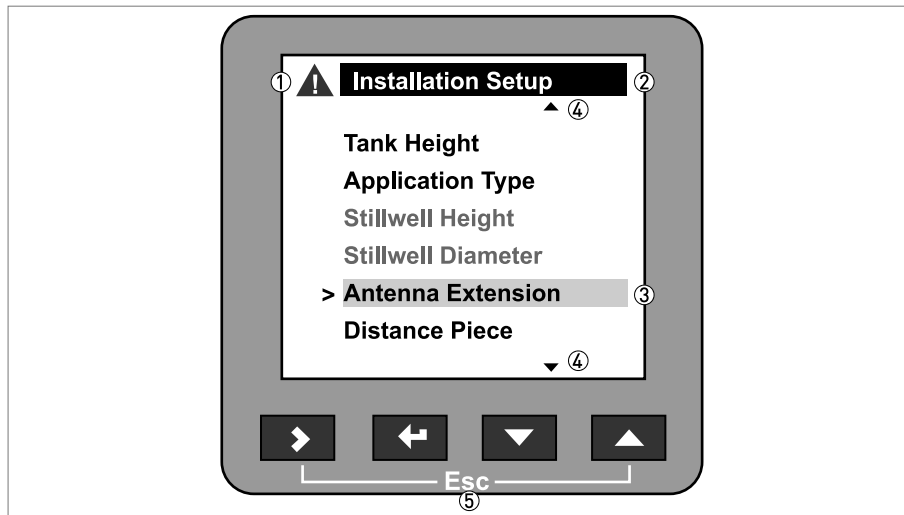
Figure 5-1: Local display screen layout

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

5.3.2 Push-button functions

Push button	Description
☞ ▶	Left
☞ ↵	Return
☞ ▼	Down
☞ ▲	Up
▶ + ▲	Esc (Escape)

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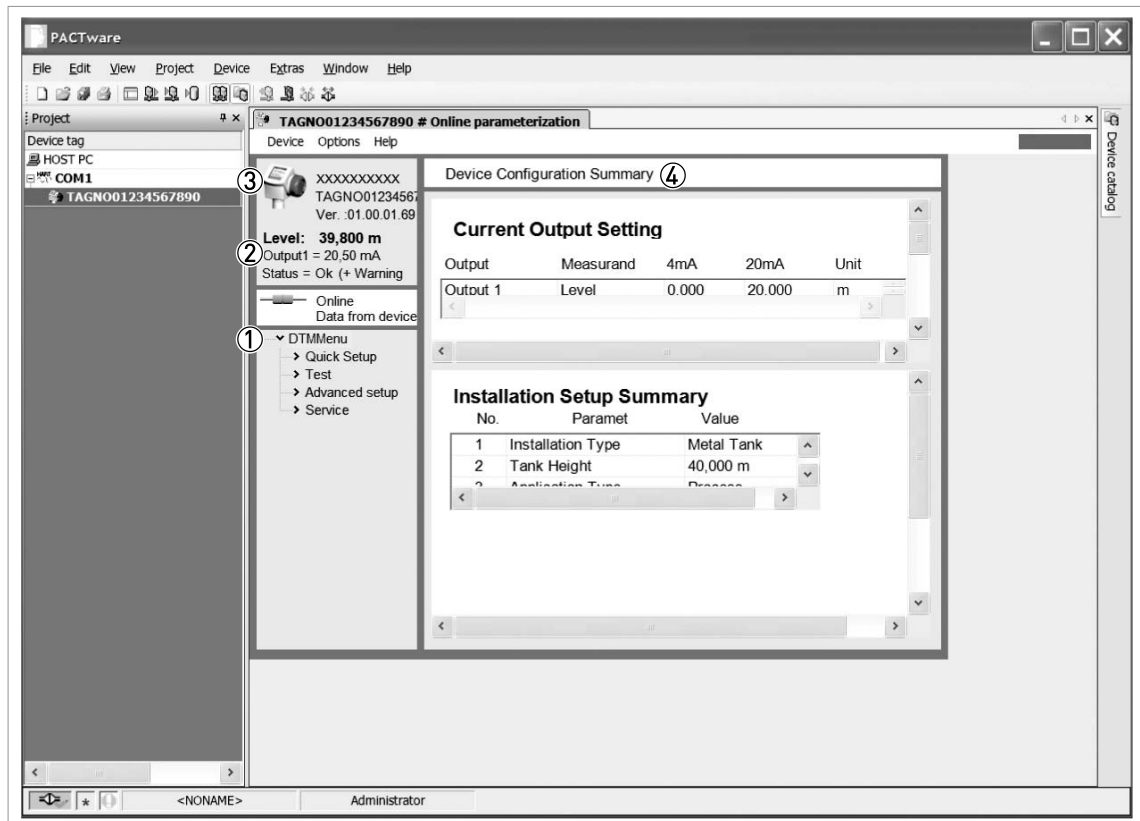
Figure 5-2: Screen from the PACTware™ user interface

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 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.

Push button functions in operator mode

Push button	Description	Normal function	"Hot key" 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 when you press this button for 1 second
③ level, distance, volume etc.
④ when you 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 ①	
				△ ▽	
				Signal screen ③	
				▽	
				Back to the top of the list	

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

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

③ shows a graph of discrete radar reflection signals against distance. This is used to view 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 46 (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 46 (Table C. Advanced setup).
- Save **quicklinks** for items that you use regularly. For more data about quicklinks (menu items A.2 to A.6), refer to *Function description* on page 46 (Table A. Quick setup).
- Error finding and troubleshooting procedures are described in the **test** menu. For more data, refer to *Function description* on page 46 (Table B. Test).

6.3.2 How to get access to the supervisor mode

Do the steps that follow:

- Press the push button **>** for one second.
- ➲   This displays the login screen.

- Press the push buttons △ or ▽ to select **supervisor** from the list.
- Press the push button ↵.
- ➲   The screen displays where to type in the password.

- Type in the password. The factory-set password is **>** ↵ ▽ △ **>** ↵.
- ➲   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 46 (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: contrast)
A.4	quick link 3 (default: language)
A.5	quick link 4 (default: length unit)
A.6	quick link 5 (default: display)

B test

B.1	test
B.2	information

C advanced setup

C.1	installation setup
C.2	I/O ①
C.3	output 1 (HART)
C.4	output 2 (passive) ②
C.5	device setup
C.6	reset

① input/output options. This menu is not available at this time.

② optional

6.3.4 Push-button functions

Menu navigation
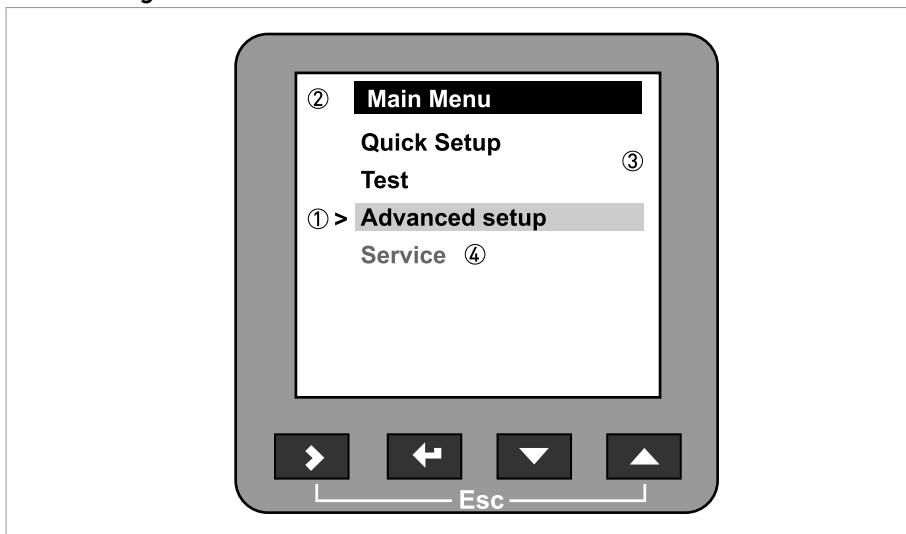
Figure 6-1: Menu navigation
① Menu selection bar
② Header bar
③ Menu list
④ Menu item that is not available (in grey text)

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

Functions of push-buttons in the menu lists

Push 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
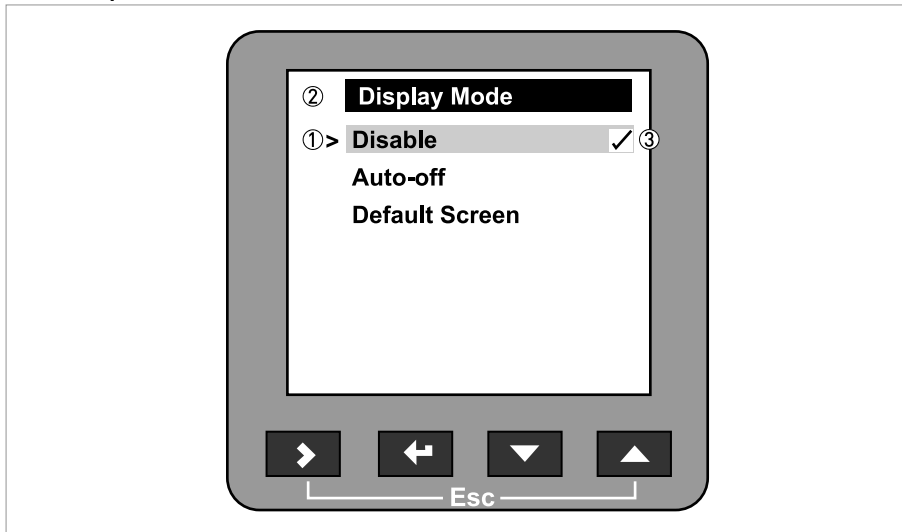
Figure 6-2: Lists of parameters in menu items

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 push-buttons are given in the table that follows:

Function of push-buttons in menu items that have a list of parameters

Push 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
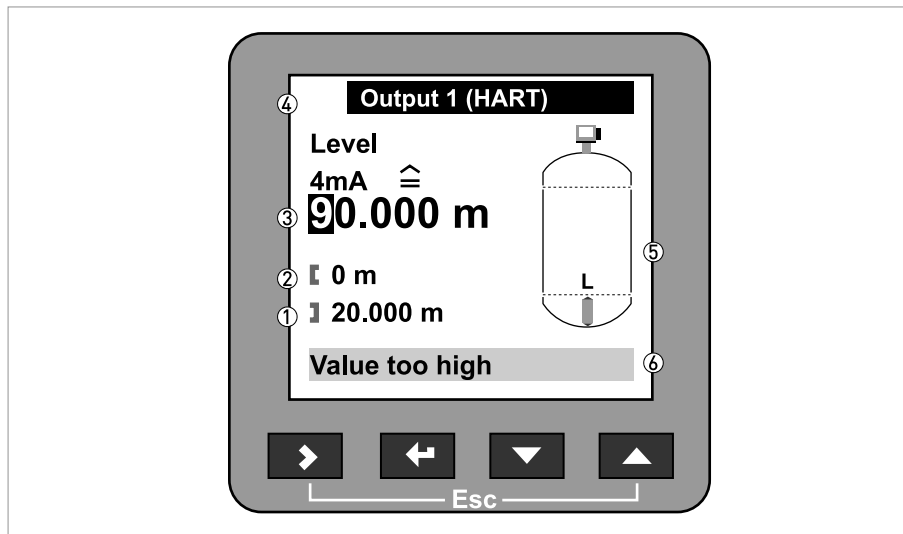
Figure 6-3: Values in menu items

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 push-buttons are given in the table that follows:
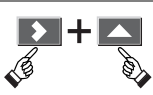
Function of push-buttons in menu items that have values

Push 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 push-buttons for 1 second, you can use these hotkey functions:

Hotkey functions in supervisor mode

Push 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 select a menu item from the Advanced Setup menu list
② press this push-button for 3 seconds

How to save settings

- When you have changed parameters in all the necessary menu items, press ↵ to accept the new parameter.
- Press > and △ 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 application, installation, conversion and output setup modes.		
A.1.2		installation	Follow this procedure to describe the silo and the product.		
	1	installation type	The silo material.	metal / concrete silo; plastic silo; free air application	metal silo
	2	tank height	The distance from the silo connecting flange face/thread stop to the silo bottom.	min-max: 0.20…80 m / 0.54…262 ft	20 m

Menu No.	Step	Function	Function description	Selection list	Default
	3	application type	The conditions in which the device is used. If the surface of the product is flat, select "flat surface". If there is a slightly uneven surface, select "slant surface". If the surface has a steep slope, select "big slope".	slant surface; flat surface; big slope	slant surface
	4	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	①
	5	settings summary			
	6	save / cancel		save, cancel ②	
A.1.3		empty spectrum	Fixed and moving objects in the tank cause interference signals. Put them through this filter to correctly measure the silo contents.		
	1	do you have a completely filled tank?	If the silo is full, it is not possible to complete this procedure. The silo must be partially filled or empty.	yes; no	yes
	2	are all moving parts in the tank in motion?	We recommend that you switch on moving equipment to filter all interference signals.	yes; no	yes
	3	is your tank partially filled or empty?	If the silo is partially filled, the device must include the silo contents when it filters the signal.	partially filled; empty	partially filled
	4	distance	If the silo 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 silos which contain fixed objects only. Use the maximum value for silos which contain many objects or moving objects.	average; maximum	0.1 m / 0.33 ft
	6	empty spectrum recording is in progress	…	…	…
	7	empty spectrum graph	…	…	…

Menu No.	Step	Function	Function description	Selection list	Default
	8	do you want to save the spectrum?	If you save this data, the device will use it when it measures the silo contents.	save, cancel ②	save
A.1.4		conversion	Follow this procedure to set the device up to display readings in volume, mass or user-defined units.		
sub-menu		conversion submenu [volume]			
	1	free unit		yes, no	no
	2	table length unit		m, cm, mm, inch, ft, free unit	m
	3	conversion wizard		volume	
	4	tank shape	This sub-procedure uses the information given here to find the volume. You have to type in the silo shape, height, width and length.	…	…
	5	conversion unit	The displayed unit in operator mode.	m³, L, US gal, GB gal, ft³, bbl	m³
	6	conversion table	A table that converts product level to product volume.		
sub-menu		conversion submenu [mass]		–	
	1	free unit		yes, no	no
	2	table length unit		m, cm, mm, inch, ft, free unit	m
	3	conversion wizard		mass	
	4	type in product density?		yes, no	yes
	5	product density		min-max: 0…20000 kg/m3	0
	6	tank shape	This sub-procedure uses the information given here to find the volume. You have to type in the silo 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.	m³, L, US gal, GB gal, ft³, bbl or Tons, kg, US Tons, GB Tons	m³ or Tons
	8	conversion table	A table that converts product level to product mass.		
sub-menu		conversion submenu [free unit]	If you cannot find the units or silo shape in the menu, you can customize the conversion table.	–	

Menu No.	Step	Function	Function description	Selection list	Default
	1	free unit		yes, no	no
	2	customer length unit	A non-standard length unit for the conversion table. This is defined by the supervisor.		LEN_FREE_
	3	customer 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	customer conversion unit	A non-standard conversion unit for the conversion table. This is defined by the supervisor.		CO_FR_UN
	5	No. Of LVM Entries	The number of lines in the conversion table.	min-max: 0…50	2
	6	conversion table	A table that converts product level to another physical parameter.		
	…	save / cancel		save, cancel ②	save
A.1.5		outputs	Follow this procedure to describe the output characteristics.	-	
	1	output 1: function	Select an output function to scale the current values. This is not displayed in the operator mode.	level, distance, volume (mass), ullage volume, reflection	level
	2	output 1: 4 mA setting	This assigns a measurement value to 4 mA.	min.-max: 0…20 m / 0…65.62 ft	0 m / 0 ft
	3	output 1: 20 mA setting	This assigns a measurement value to 20 mA.	min.-max: 0…90 m / 0…295.29 ft	depends on the output function
	5	output 1: 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
	6	output 1: error handling	This sets the behaviour of current output 1 if an error occurs.	3.6 mA, 22 mA, Hold (4…20 mA range only)	22 mA
	7	output 1: HART® address	Any HART® address greater than 0 will activate HART® multidrop mode. Current output stays constant at 4 mA.	min.-max: 0…15	0
	8	output 2: function ③	Select an output function to scale the current values. This is not displayed in the operator mode.	level, distance, volume (mass), ullage volume, reflection	level
	9	output 2: 4 mA setting ③	This assigns a measurement value to 4 mA.	min.-max: 0…20 m / 0…65.62 ft	0 m / 0 ft

Menu No.	Step	Function	Function description	Selection list	Default
	10	output 2: 20 mA setting ③	This assigns a measurement value to 20 mA.	min.-max: 0…90 m / 0…295.29 ft	depends on the output function
	11	output 2: output range ③	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
	12	output 2: error handling ③	This sets the behaviour of current output 2 if an error occurs.	3.6 mA, 22 mA, Hold (4…20 mA range only)	22 mA
	13	settings summary		read only	
		save / cancel		save, cancel ②	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 depends on other user functions
② step ignored if complete setup selected
③ 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	

Menu No.	Function	Function description	Selection list	Default
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 minute 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 identification	This displays device order no, V-no, service no, firmware 1 version, firmware 2 version, firmware 3 version and Ex approval details.	read only	
B.2.4	quick setup summary	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	?	TAGNO0012 34567890
	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 ↵ 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	
B.2.7	customer 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 > customer length unit** or follow the conversion quick setup procedure.	read only	
B.2.9	customer conversion unit	Non-standard conversion unit for the conversion table. This is defined by the supervisor. Go to **supervisor > advanced setup > device setup > display settings > customer conversion unit** or follow the conversion quick setup procedure.	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 silo for the device.	metal / concrete silo, plastic silo, free air application	metal / concrete silo
C.1.2	tank height	The distance from the silo connecting flange face/thread stop down to the bottom of the silo.	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 "flat surface". If there is a slightly uneven surface, select "slant surface". If the surface has a steep slope, select "big slope".	flat surface, slant surface, big slope	slant surface
C.1.4	stillwell height	Not available. For liquid applications only.	n/a	n/a
C.1.5	stillwell diameter	Not available. For liquid applications only.	n/a	n/a
C.1.6	antenna extension	Optional antenna extension for the device. 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 silo 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.	min-max: -tank height…50 m / -tank height…164.05 ft	0 m / 0 ft

Menu No.	Function	Function description	Selection list	Default
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 silo (set in menu item C.1.2.0). This value is positive when the reference location is below the silo bottom and negative if above.	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 seconds	3 seconds
C.1.13	measuring mode	The device uses the dielectric constant of the tank contents to monitor level. If ε_r is low, select "TBF partial" mode. If Er 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. For other uses, select "direct measuring".	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

Menu No.	Function	Function description	Selection list	Default
C.1.17	empty spectrum on/off	This function starts and stops interference signal filter. Interference signals are the result of fixed and moving obstacles inside the silo. If you must use do a spectrum analysis, record an empty spectrum first. This is done in the Quick setup menu under empty spectrum (A.1.3.0).	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
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/m3	0
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 ↵. Type in the level and corresponding volume/ mass values.	Number of entries min.-max: 0…50	0. 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 silo. Make a reference measurement and type in the correct value next to the device reading.	Number of entries min.-max: 0…50	0
C.2	I/O	For fieldbus. Not yet available.		
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, reflection	level
C.3.2	4 mA setting	Give a measurement value to 4 mA.	min.-max: depends on other functions. Refer to the dependency tables below.	0 m / 0 ft
C.3.3	20 mA setting	Give a measurement value to 20 mA.	min.-max: depends on other functions. Refer to the dependency tables below.	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	Sets the behaviour of current output 1 if an error occurs.	3.6 mA, 22 mA, Hold	22 mA

Menu No.	Function	Function description	Selection list	Default
	error handling delay	The time after which the device shows there is a measurement error.	min.-max: 0…900 seconds	10 seconds
C.3.6	HART address	Any HART® address greater than 0 will activate HART® multidrop mode. The current output stays constant at 4 mA.	min.-max: 0…15	0
C.4	output 2 (passive)			
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, reflection	level
C.4.2	4 mA setting	Give a measurement value to 4 mA.	min.-max: depends on other functions. Refer to the dependency tables below.	0 m / 0 ft
C.4.3	20 mA setting	Give a measurement value to 20 mA.	min.-max: depends on other functions. Refer to the dependency tables below.	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	Sets the behaviour of current output 2 if an error occurs.	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	10 seconds
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		English, French, German, Italian, Japanese, Mandarin, Portuguese, Russian, Spanish	Factory set
C.5.1.2	display mode	The display screen status will change after the time given in C.5.1.3. (time delay). **None** switches off this functionality, **Auto-off** switches off the display automatically and **Default screen** will show the selected default screen. To reset 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 minute

Menu No.	Function	Function description	Selection list	Default
	contrast menu	The contrast control for the display screen. You can select a shade of grey between light grey (level 1) and black (level 9).	min.-max: level 1...9	level 5
C.5.1.4	length unit	The length unit displayed in operator mode.	m, cm, mm, inch, ft, ft+inch+1/18inch, ft+inch+1/32inch, free unit	m
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	customer length unit	A non-standard length unit for the conversion table. This is defined by the supervisor.		LEN_FREE_
C.5.1.8	customer 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
C.5.1.9	customer conversion unit	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 push buttons up to six 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.		

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 m³	<20 mA setting for volume	0 m³
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 m³	<20 mA setting for ullage volume	0 m³
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 ③	Tank height + RO ④
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 TBO = Tank Bottom Offset (C.1.9). RO = Reference Offset (C1.10).
② TBO = Tank Bottom Offset (C.1.9). BD = Blocking Distance (C.1.11).
③ TBO = Tank Bottom Offset (C.1.9). RO = Reference Offset (C1.10). BD = Blocking Distance (C.1.11).
④ 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 Menu > Quick Setup**.
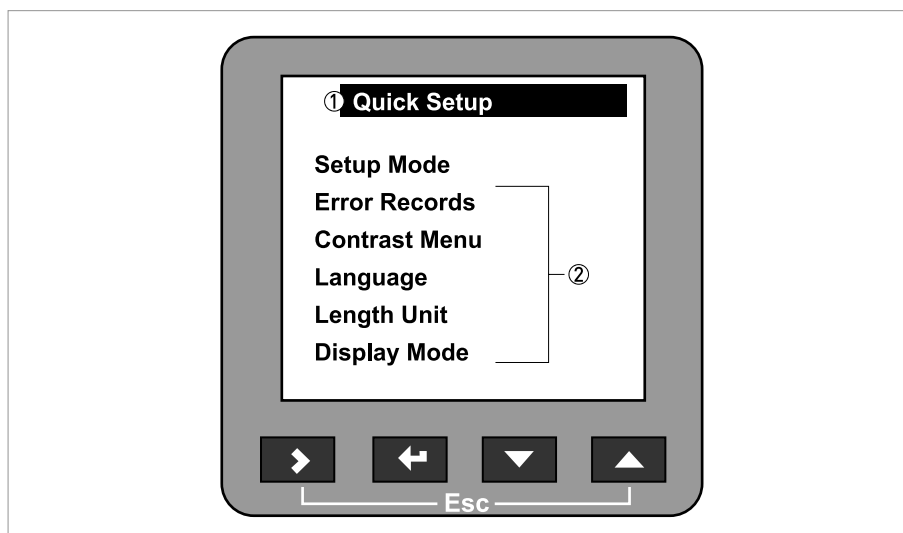

Figure 6-4: The list of quick links
① Menu name
② Quick links

How to create a Quick Link

- Go to **Supervisor Menu > Advanced Setup**.
- Select a menu item with the △ and ▽ push buttons.
- Press the **>** push button for one 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 Menu > Quick Setup**.
- Select a Quick Link with the △ and ▽ push buttons.
- Press the **>** push 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 > + △ at the same time and type in the new 6-character password again.

- Press > and △ (Esc) at the same time to go back to the "save settings" window.
- Select **Save** and press ↵.
- ➲ 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 33.

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(**>** + △) 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(**>** + △) 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 silo 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 the 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 further information, refer to *Function description* on page 46, table C. Advanced setup. This gives more data on the menu items.

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 silo 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 reference point below the silo bottom, add this value when give a level for the 4 and 20 mA current output settings. If you move the reference point above the silo 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.
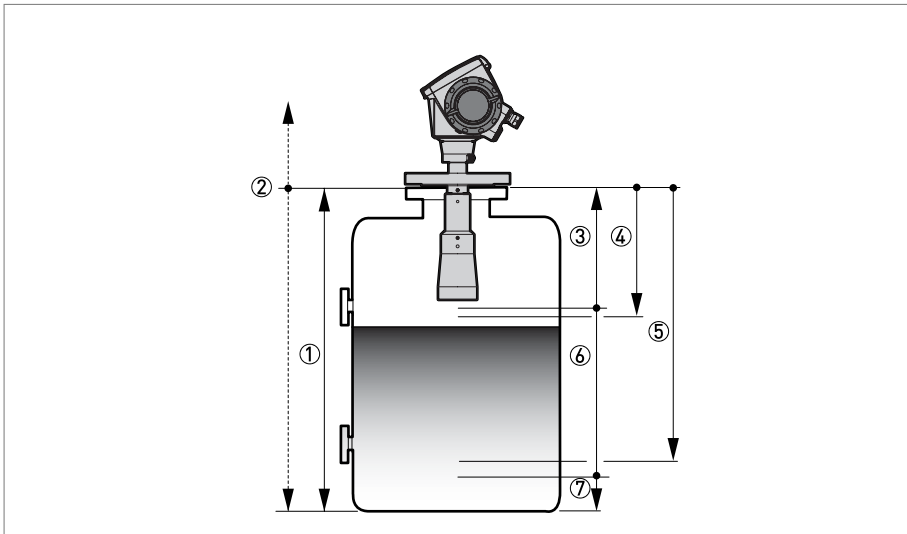
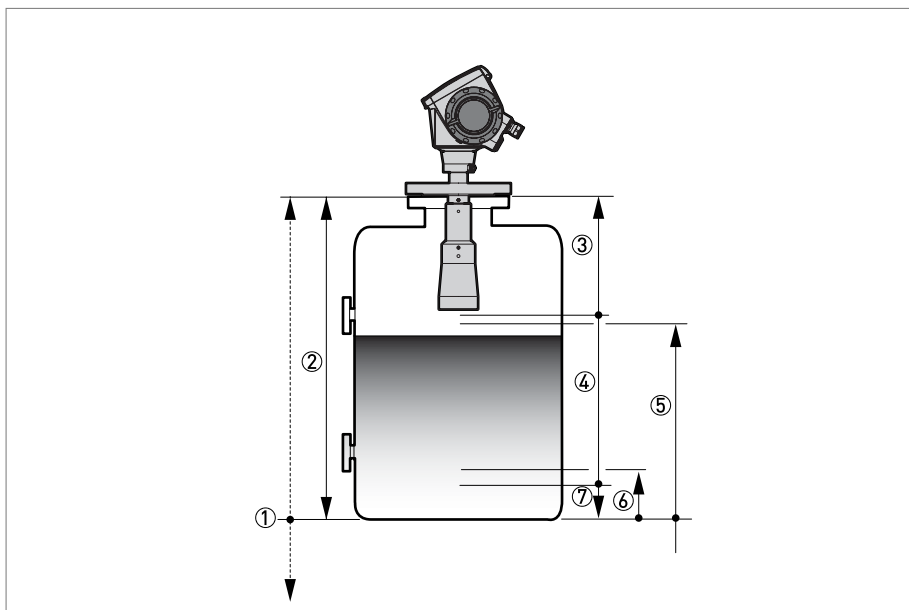**Figure 6-6: Level measurement**

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 further information, refer to *Function description* on page 46, table C. Advanced setup. This gives more data on the menu items.

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 setup 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 silo 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 silo where there are:
• *Surfaces with curves.*

• *Sudden changes in the cross section.*
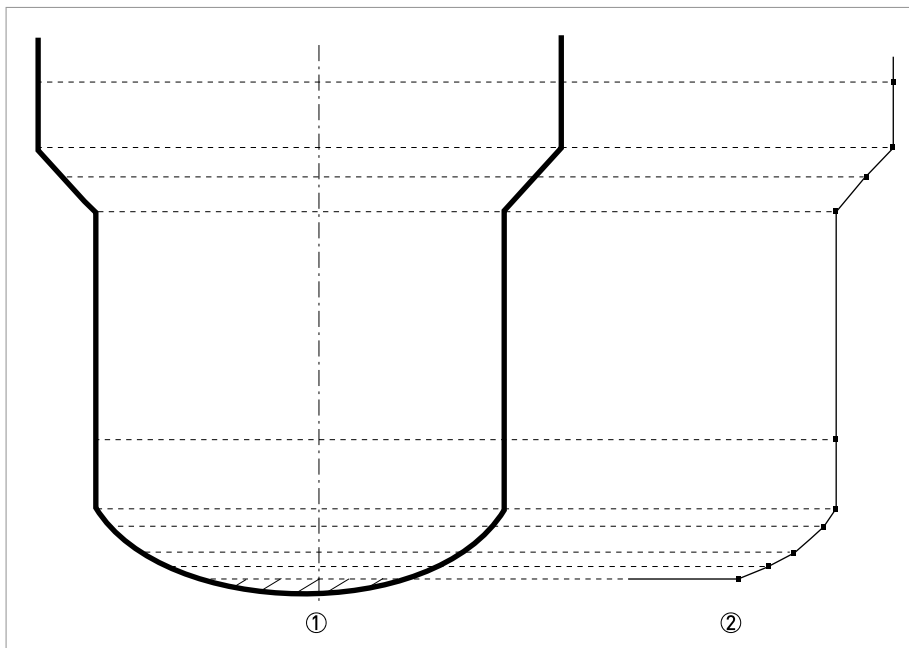
This will make volume measurement more accurate.

Figure 6-7: A plot of points for a volume or mass table
① Silo with reference points
② Silo 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 silo that contains obstructions (ladder, supports 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.

i

INFORMATION!
We recommend that you do an empty spectrum scan when the silo is empty and all the moving parts are switched on.
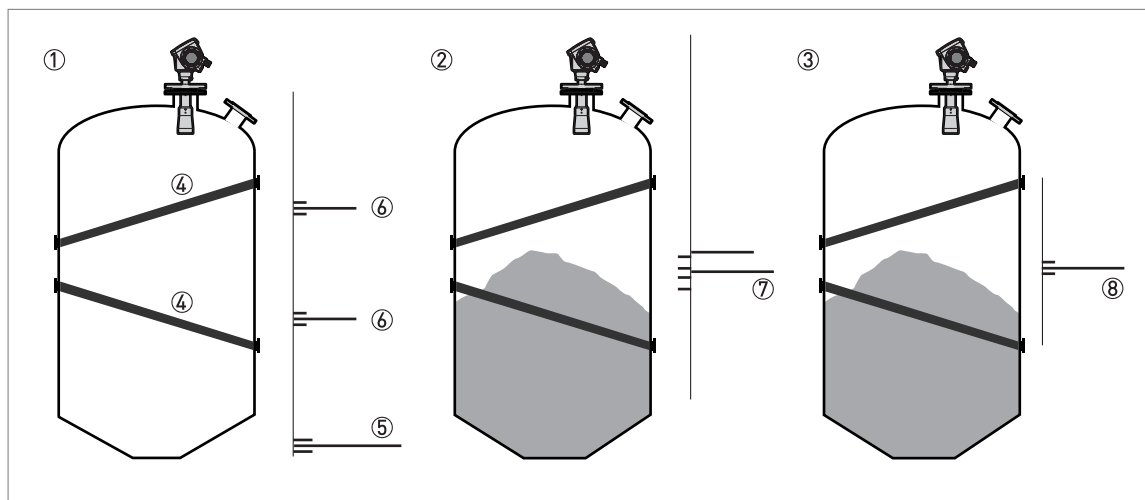

Figure 6-8: How to filter radar signal interference

① Empty silo before the empty spectrum scan (with a graph of reflections shown)
② Partially filled silo before the empty spectrum scan (with a graph of reflections shown)
③ Partially filled silo after the empty spectrum scan (with a graph of reflections shown)
④ Silo bottom signal
⑤ Support beam signals
⑥ Support beam signals (interference signals) before the empty spectrum scan
⑦ Bad (mixed) signals of the solid and the support beam before the empty spectrum scan
⑧ Good signal of the solid after the empty spectrum scan

- 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 41.

- Go to **Main Menu > Quick Setup > Setup Mode > Empty Spectrum**.
- Is the tank completely full? Select **Yes** or **No** and then press ↵.
- ➲ 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 ↵.
- Is your tank partially filled or completely empty? Select **Partially filled** or **Empty** and then press ↵.
- Do you want to use the average value or the maximum value? Select **Average** or **Maximum** and then press ↵.
- ➲ 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 ↵. Do you want to save the spectrum. Select **Yes** or **No** and then press ↵.

➥   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 46 - table A. Quick Setup (item A.1.3).

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

It is possible that the device cannot find the bottom of the silo if it is installed in a silo with a dish-shaped or conical bottom. The form of the silo 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 silo.
- 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 silo height.

- Subtract the distance to the reflection   from the true silo 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 silo 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.
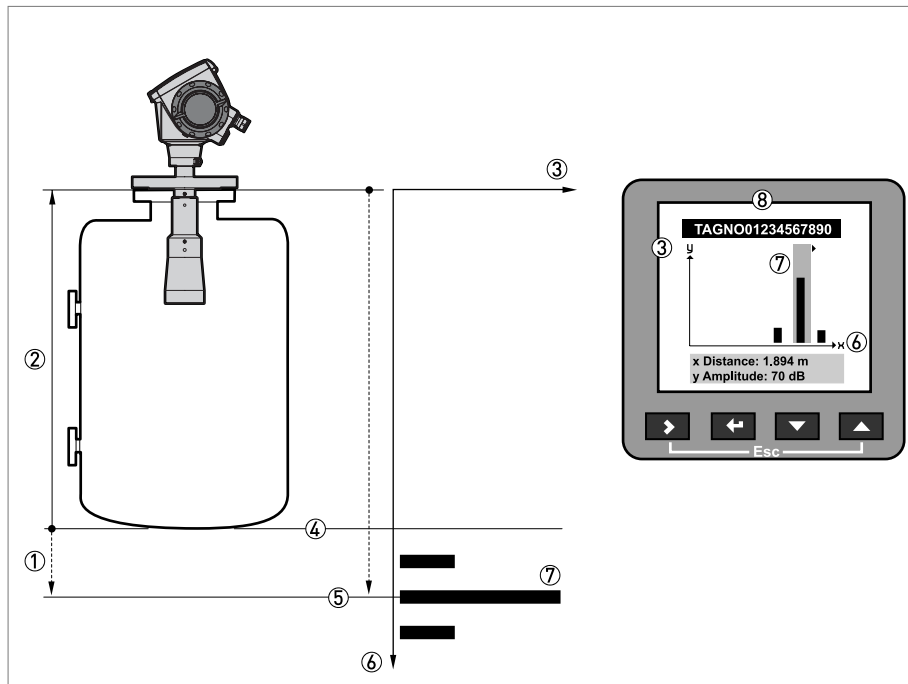
Figure 6-9: Signal screen and the silo bottom reflection

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 silo bottom
⑤ Offset position of the silo bottom
⑥ Distance of the reflection from the device flange
⑦ Delayed reflection of the silo bottom
⑧ Signal screen on the device display

INFORMATION!
For more data on menu items, refer to Function description on page 46, 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 error status

• 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 70.

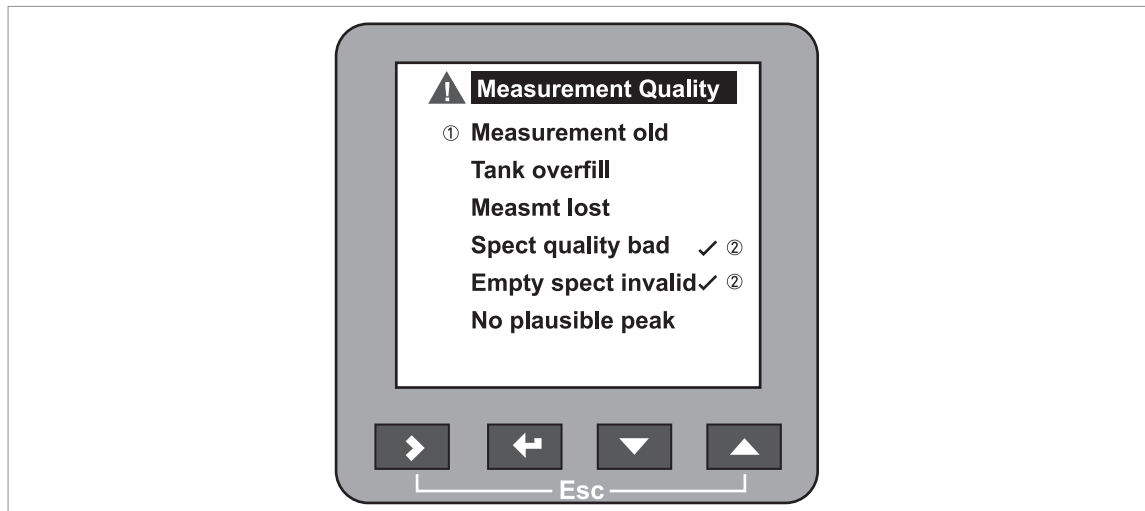Figure 6-11: Measurement quality in supervisor mode
① Type of error.
② Error "active"

How to find the error records

- Enter supervisor mode.
- Go to **Test > Information > Error records**.
- Use ∇ and $\triangle$ to scroll the error list. There are 5 error messages per page.
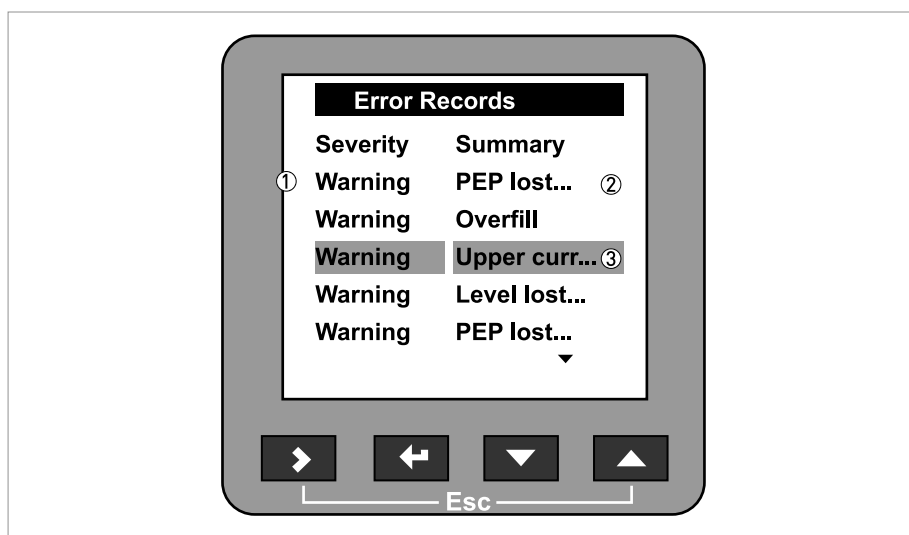
Figure 6-12: Error records in supervisor mode
① Type of error.
② Short description of the error
③ Selection bar

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 70.

Error Records

① **Upper current output has saturated.**

Time: **:34:9:39:0** ②
Warning   ③

Esc

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**. It only includes the time when the device is energized. The error is saved in the memory of the device when it is switched off. 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 (Ouput 1) and C.4.5 Error Handling (Output 2). For more data; refer to *C. Advanced setup* on page 52.
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

Error Message	Error code	Description	Corrective action
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 silo 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 silo or remove some of the product until the level is back in the configured range.

External influences

Error Message	Error code	Description	Corrective action
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.

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 (silo overfill)	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.
Measurement is lost in the tank bottom	W	The silo is possibly empty. The device will display the silo bottom measurement.	If you fill the silo, the device will measure again.
		The device got the last valid measurement near to the silo bottom, but it can no longer find the signal. It is possible that the device cannot find the bottom of the silo if it is installed in a silo with a dish-shaped (DIN28011 or similar) or conical bottom. The form of the silo 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 silo bottom measurement.	Follow the instructions on page 65.

Electronics failures

Microwave check failed	E	A microwave board check failed.	If the problem continues, contact the supplier.
Peripheral Failure	E	Hardware peripheral devices on the DSP board failed.	If the problem continues, contact the supplier.

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 internal silo elements.	Check the device, silo and the process. Reconfigure the device and record a new empty spectrum. Follow the instructions on page 64. 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, silo and the process. Reconfigure the device and record a new empty spectrum. Follow the instructions on page 64. If necessary, contact the supplier.
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, silo and the process. Reconfigure the device and record a new empty spectrum. Follow the instructions on page 64. 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.

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 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
There is a risk of build-up in the antenna	Continuous use. Use low-pressure, low-flow dry gas to remove dust from the antenna.
There is a build-up or risk of build-up in the antenna	Purge at intervals. Use compressed air, nitrogen or another dry gas that is applicable to the process up to 6 bar / 87 psi.

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 27.
- The removal and installation of the back end and the front end assembled to the microwave board.
- 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.
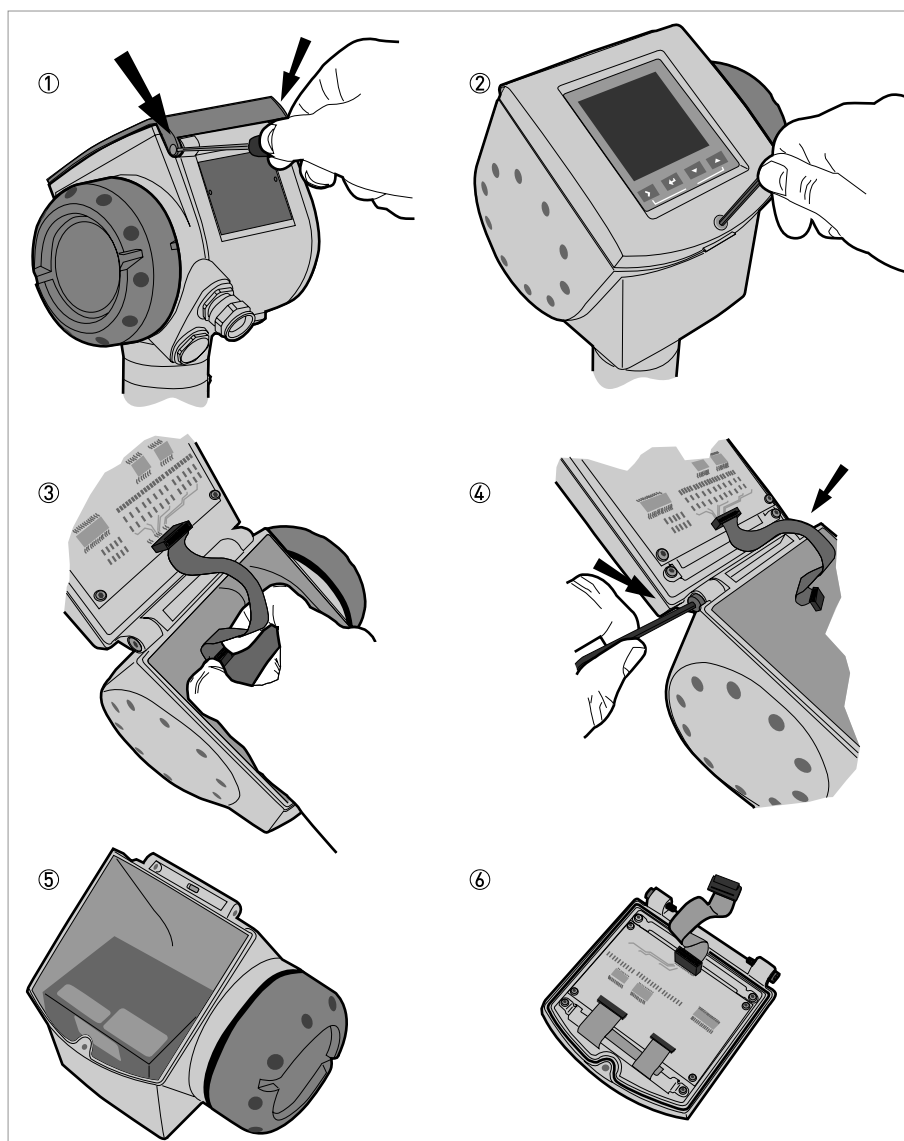
7.4.2 Replacement of the display cover

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.

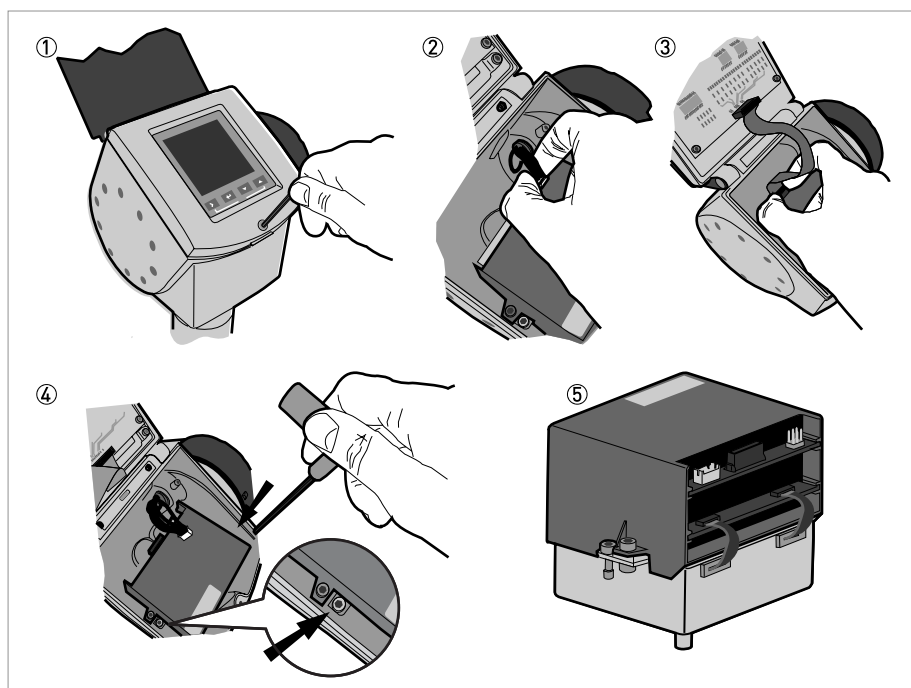### 7.4.3 Replacement of the back end and microwave unit

Figure 7-2: Removal of the back end and microwave unit

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 connector 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

> ⚠ **WARNING!**
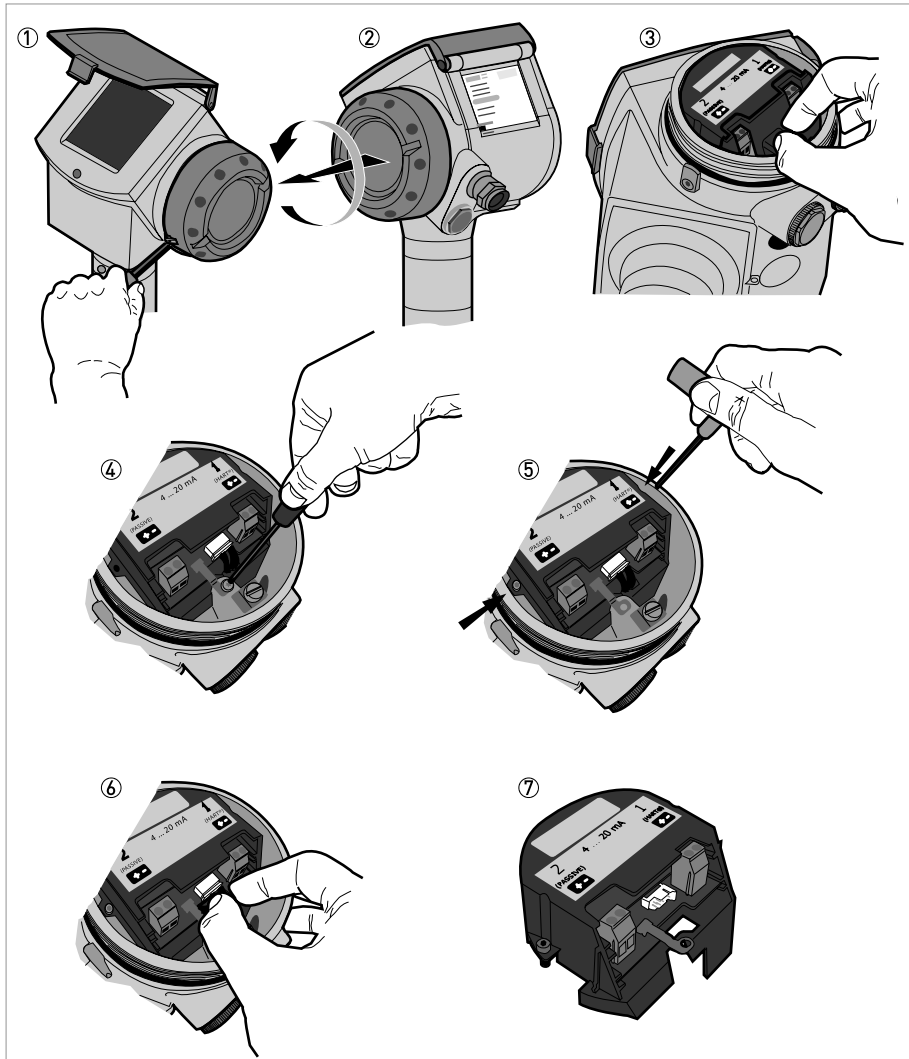> *Disconnect the power supply.*

Figure 7-3: Removal of the terminal module

Equipment needed (not supplied):

- 3 mm Allen wrench (for step 1).
- TORX T10 wrench (for step 4).
- 2.5 mm Allen wrench (for step 5).

How to remove the terminal module

① Loosen the cover stop screw on the terminal compartment cover.
② Remove the terminal compartment cover.
③ Remove the plastic terminal cover.
④ Loosen the screw for the earth terminal connection.
⑤ Loosen the 2 screws shown in the illustration.
⑥ Disconnect the wire connector from the back end electronics compartment.
⑦ 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 from the back end electronics compartment.
- 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.
- Attach the terminal compartment cover.
- Tighten the cover stop screw.

7.5 Spare parts availability

The manufacturer adheres to the basic principle that operational spare parts for each device or each important accessory part will be kept available for a period of 10 (ten) years after delivery of the last production run for that device.

Operational spare parts are defined as parts that are subject to faults in normal operation.

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:
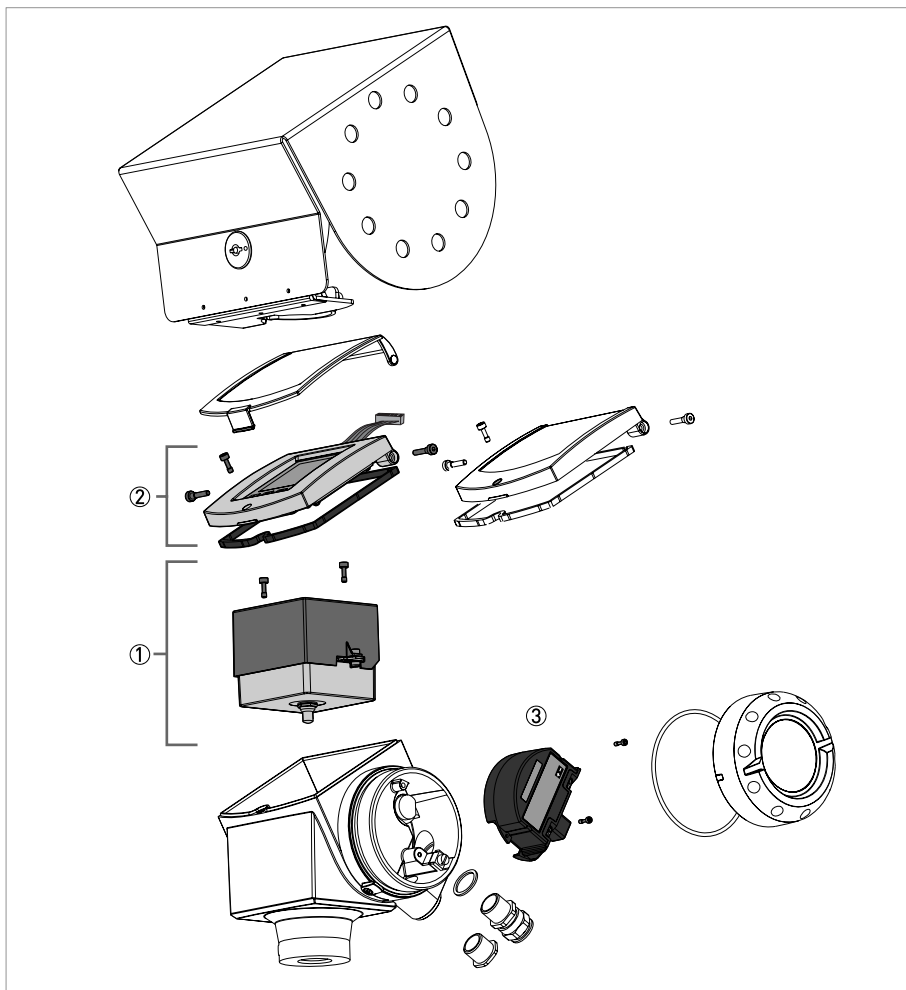
Figure 7-4: Spare parts

Part numbers for spare parts

Item number	Description	Quantity	Part reference
①	Combined backend and high-frequency modules ①	1	F2139580100
	Screws for the combined back end and HF modules	2	F3177360000
②	HMI cover and cable ②	1	XF6340000000050300
③	Terminal module with 1 output (non-Ex)	1	F2139620200
	Terminal module with 1 output (Ex ia)	1	F2139620100
	Terminal module with 1 output (Ex d [ia])	1	F2139950100
	Terminal module with 2 outputs (non-Ex)	1	F2139630200
	Terminal module with 2 outputs (Ex ia)	1	F2139630100
	Terminal module with 2 outputs (Ex d [ia])	1	F2139640100
	Screws for the terminal module	2	F3177350000

① the customer must send the original back end and HF module to the repair centre. Refer to the replacement procedure in this section.
② this reference includes the gasket and screws

7.5.2 List of accessories

Figure 7-5: Accessories

Part numbers for accessories

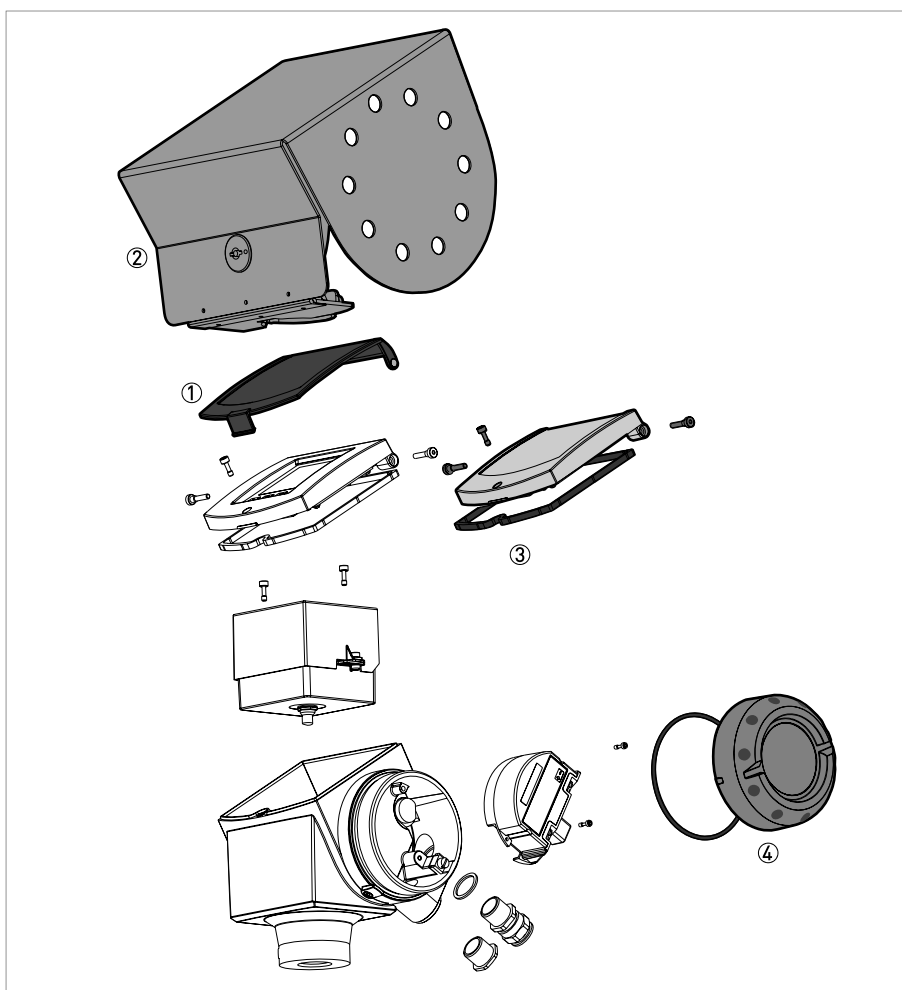| Item number	Description	Quantity	Part reference
①	Plastic sun cover	1	F3179980000
	Pins for the plastic sun cover	2	F3179990000
②	Stainless steel weather protection	1	F2096340000
③	Blind cover (with a gasket and screws)	1	F3177240100
	Gasket for the blind cover	1	F3177420000
	Hinge screws for the blind cover	2	F3177340000
	Lock screw for the blind cover	1	F3177360000
④	Wiring compartment cover	1	F3177260100
	Gasket for the wiring compartment cover	1	F5091150000
n/a	Converter VIATOR RS232 / HART® ①	1	F50919500000
	Converter USB / HART® ①	1	F50779300000
n/a	2° PP slanted flange accessory for:		
	DN80 PN40 flange	1	F3190190000
	DN100 PN16 flange	1	F3190190100
	DN100 PN40 flange	1	F3190190200
	DN150 PN16 flange	1	F3190190300
	DN150 PN40 flange	1	F3190190400
	2¨ 150LBS flange	1	F3190220000
	2¨ 300LBS flange	1	F3190220100
	3¨ 150LBS flange	1	F3190220200
	3¨ 300LBS flange	1	F3190220300
	4¨ 150LBS flange	1	F3190220400
	4¨ 300LBS flange	1	F3190220500
	6¨ 150LBS flange	1	F3190220600
	6¨ 300LBS flange	1	F3190220700
	8¨ 150LBS flange	1	F3190220800
	40A 10K flange	1	F3190230000
	50A 10K flange	1	F3190230100
	80A 10K flange	1	F3190230200
	100A 10K flange	1	F3190230300

① 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.
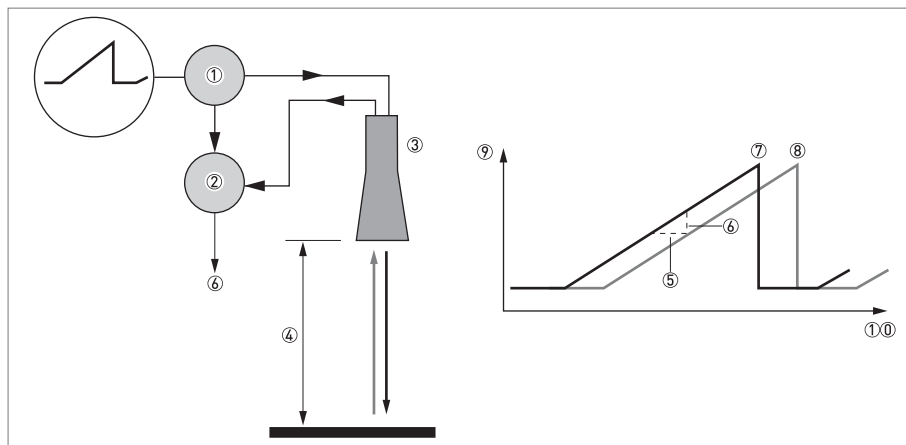

Figure 8-1: Measuring principle of FMCW radar

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 (Downloadcenter).*

Measuring system

Measuring principle	2-wire loop-powered level transmitter; K-band FMCW radar
Application range	Level measurement of powders and granulates
Primary measured value	Δf (change in frequency) between the emitted and received signal
Secondary measured value	Distance, level, volume 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
Standard	Antenna purging system for horn antenna (supplied with ¼ NPTF connection)
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
	PTFE/PP flange plate protection (for Drop antenna without antenna extensions only)
Accessories	Weather protection
	Antenna extensions of 105 mm / 4.1¨ length (Max. length for Drop antenna versions: 525 mm / 20.7¨. On request for antennas made of Hastelloy® C-22.)
	2° PP slanted flange (for all antennas)
Max. measuring range	80 m / 260 ft
	Depends on the antenna option, dielectric constant of the product and installation type. Refer also to "Antenna selection".
Min. tank height	0.2 m / 8¨
Dead zone	Antenna extension length + antenna length + 0.3 m / 12¨
Beam angle of antenna	Horn DN80 / 3¨: 10°
	Horn DN100 / 4¨: 8°
	Drop DN80 / 3¨: 8°
	Drop DN150 / 6¨: 4°
Display and user interface	
Display	LCD display
	9 lines, 160 x 160 pixels in 8-step greyscale with 4-button keypad
Interface languages	English, German, French, Italian, Spanish, Portuguese, Japanese, Chinese (Mandarin) and Russian

Measurement accuracy

Resolution	1 mm / 0.04¨
Repeatability	±5 mm / ±0.2¨
Accuracy	±10 mm / ±0.4¨, when distance < 10 m / 33 ft; ±0.1% 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 mbar abs. ±20 mbar / 14.69 psig ±0.29 psig
Relative air humidity	60% ±15%
Target	metal plate in an anechoic chamber

Operating conditions

Temperature	
Ambient temperature	–40…+80°C / –40…+175°F (according to the temperature limits of the gasket material. Refer to "Materials" in this table.) Ex i: see supplementary operating instructions or approval certificates
Storage temperature	–40…+85°C / –40…+185°F
Flange temperature	**Horn antenna:** –40…+200°C / –40…+390°F (according to the temperature limits of the gasket material. Refer to "Materials" in this table.) Ex i: see supplementary operating instructions or approval certificates
	Drop antenna (PTFE): –40…+150°C / –40…+300°F (according to the temperature limits of the gasket material. Refer to "Materials" in this table.) Ex i: see supplementary operating instructions or approval certificates
	Drop antenna (PP): –40…+100°C / –40…+210°F (according to the temperature limits of the gasket material. Refer to "Materials" in this table.) Ex i: see supplementary operating instructions or approval certificates
Thermal shock resistance	<40°C/s / <72°F/s
Pressure	
Operating pressure	**Drop antenna (PP):** –1…16 bar / –14.5…232 psig; subject to process connection used and flange temperature
	All other antennas: –1…40 bar / –14.5…580 psig; subject to process connection used and flange temperature
Other conditions	
Dielectric constant (εr)	≥1.5
Vibration resistance	IEC 60068-2-6 and EN 50178 (10…57 Hz: 0.075 mm / 57…150 Hz:1g)
Protection category	IP 67 equivalent to NEMA 6-6X
Maximum rate of change	10 m/min / 33 ft/min

Installation conditions

Process connection size	The process connection should be larger than the antenna diameter.
	If the process connection on the instrument is smaller than the antenna, either: - provide the means to adapt the instrument to a larger process connection on the silo (for example, a plate with a slot), or - use the same process connection, but remove the antenna from the instrument before installation and fit it from inside the silo
Process connection position	Make sure that there are not any obstructions directly below the process connection for the instrument
Dimensions and weights	Refer to "Technical data: Dimensions and weights"

Materials

Housing	Standard: Aluminium
	Option: Stainless steel (1.4404 / 316L)
Wetted parts, including antenna	Standard for Horn antenna: Stainless steel (1.4404 / 316L)
	Option for Horn antenna: Hastelloy® C-22 (2.4602) ①
	Standard for Drop antenna: PTFE; PP - a PP or PTFE flange plate option is also available
Process fitting	Standard: Stainless steel (1.4404 / 316L) - a PP or PTFE flange plate option is also available for Drop antenna
	Option: Hastelloy® C-22 (2.4602)
Gaskets	FKM/FPM (-40…+200°C / -40…+390°F); Kalrez® 6375 (-20…+200°C / -4…+390°F); EPDM (-40°C…+150°C / -40…+300°F) ②
Feedthrough	Standard: PEI (-40…+200°C / -40…+390°F)
	Option: Metaglas® (-30…+200°C / -22…+390°F - for horn antennas only) ③
Weather protection (Option)	Stainless steel (1.4301 / 304)

Process connections

Thread	G 1½; NPT 1½
Flange version	
EN	DN80…150 in PN40 / PN16
ASME	3¨…8¨ in 150 lbs / 300 lbs
JIS	80…100A in 10K

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	M20x1.5; NPT ½
	G ½ (not for FM- and CSA-approved devices)
	M25x1.5 (for stainless steel housings only)
Cable gland	Standard: none
	Options: M20x1.5 (for non-Ex and Ex -approved devices with M20x1.5 and M25x1.5 cable entries); others are available on request
Cable entry capacity (terminal)	0.5…1.5 mm²

Input and output

Output signal (Output 1)	4…20 mA HART® or 3.8…20.5 mA acc. to NAMUR NE 43 ④
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 25 ppm/K
Error signal	High: 22 mA; Low: 3.6 mA acc. to NAMUR NE 43

Approvals and certification

CE	This device fufills the statutory requirements of the EC directives. The manufacturer certifies successful testing of the product by applying the CE mark.
Explosion protection	
ATEX	ATEX II G 1, 1/2, 2 Ex ia IIC T6...T3;
	ATEX II D 1, 1/2, 2 Ex iaD 20 or Ex iaD 20/21 or Ex iaD 21 IP6X T65°C...T90°C;
	ATEX II G 1/2, 2 Ex d [ia] IIC T6...T3;
	ATEX II D 1/2, 2 Ex tD[iaD] A21/20 or Ex tD[iaD] A21 IP6X T65°C...T90°C
IECEx (pending)	Zone 0 Ex ia IIC T6...T3; Ex iaD 20 IP6X T65°C...T 90°C
FM or CSA - Dual Seal-approved (available in Q4/2009)	**NEC 500/ CEC:**
	Cl. I, Div. 1, Gr. ABCD (IS);
	Cl. I, Div. 1, Gr. ABCD (FM only) (XP);
	Cl. I, Div. 2, Gr. ABCD (XP/NI);
	Cl. II, Div. 1, Gr. EFG; Cl. III (FM only) (XP);
	Cl. II, Div. 1, Gr. EFG; Cl. III (IS);
	Cl. II/III, Div . 2, Gr. FG (XP/NI)
	NEC 505/ CEC:
	Cl. I, Zone 0 AEx ia Gr. IIC (CSA: Ex ia) (IS);
	Cl. I, Zone 1 AEx d [ia] Gr. IIC (XP);
	Cl. I, Zone 2, AEx nA [ia], Gr. IIC (CSA: Ex nA [ia]) (IS)
Other standards and approvals	
EMC	EMC Directive 2004 / 108 / EC and 93 / 68 / EEC in conjunction with EN 61326-1 (2006).
LVD	Low-Voltage Directives 2006 / 95 / EC and 93 / 68 / EEC 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

① Hastelloy® is a registered trademark of Haynes International, Inc.

② Kalrez® is a registered trademark of DuPont Performance Elastomers L.L.C.

③ Metaglas® is a registered trademark of Herberts Industrieglas, GMBH & Co., KG

④ HART® is a registered trademark of the HART Communication Foundation

8.3 Antenna selection

This graph shows which antenna to select for the application based on:

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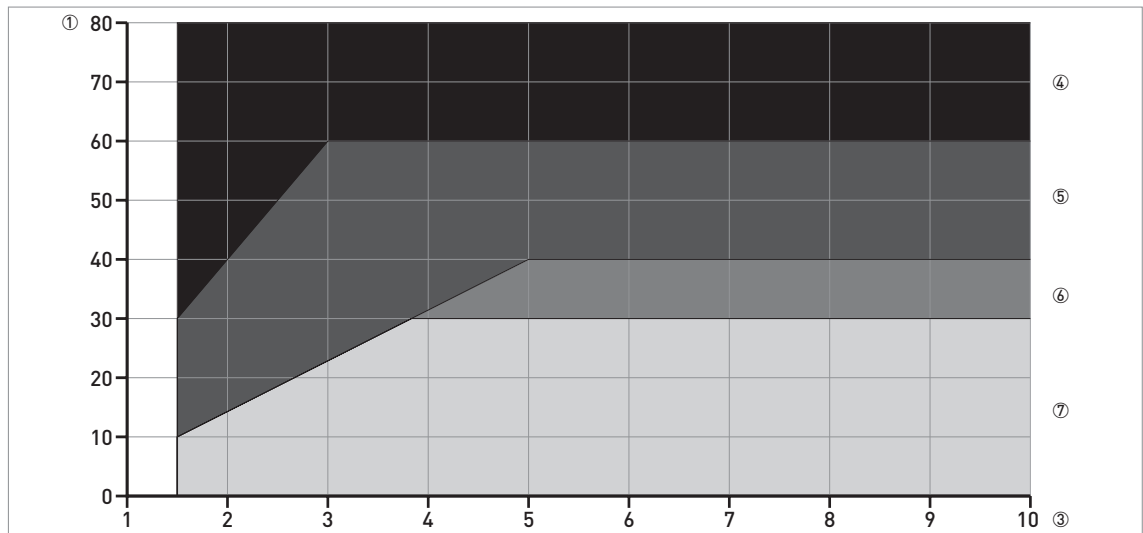

Figure 8-2: Selection of antenna for solid applications (graph of distance in m against ε_r)
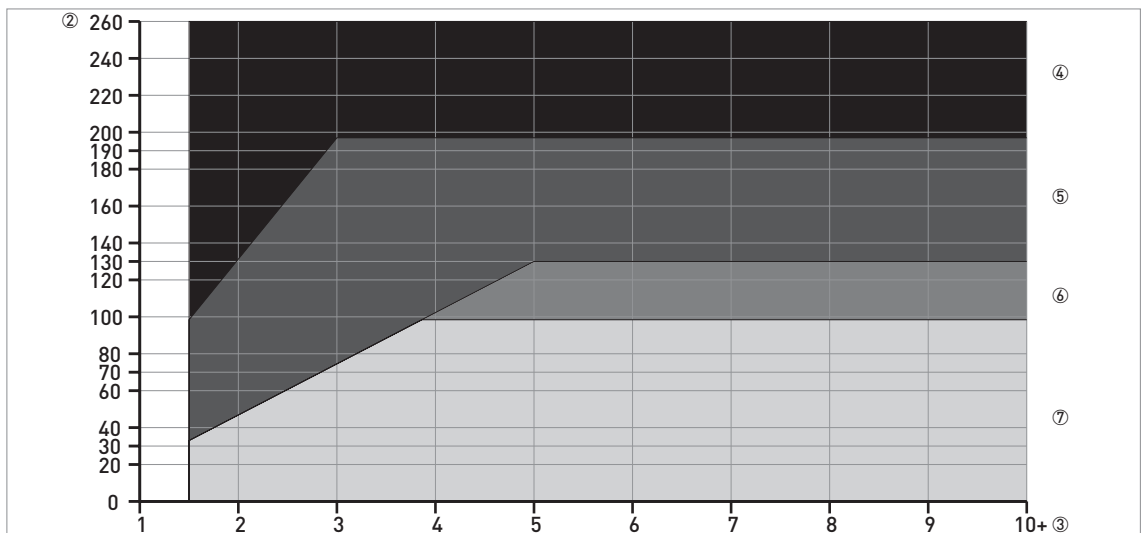

Figure 8-3: Selection of antenna for solid applications (graph of distance in ft. against ε_r)

① Distance, D [m]
② Distance, D [ft]
③ Dielectric constant (ε_r)
④ On request
⑤ DN 150 Drop antenna
⑥ DN 100 horn and DN 150 Drop antenna
⑦ DN 80 horn, DN 80 Drop, DN 100 horn and DN 150 Drop antenna
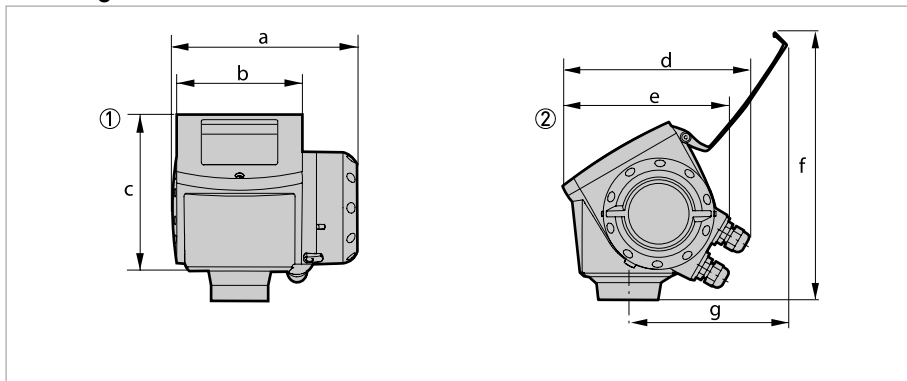
8.4 Dimensions and weights

Housing

Figure 8-4: 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 lbs

	Dimensions [inches]							Weights [lbs]
	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
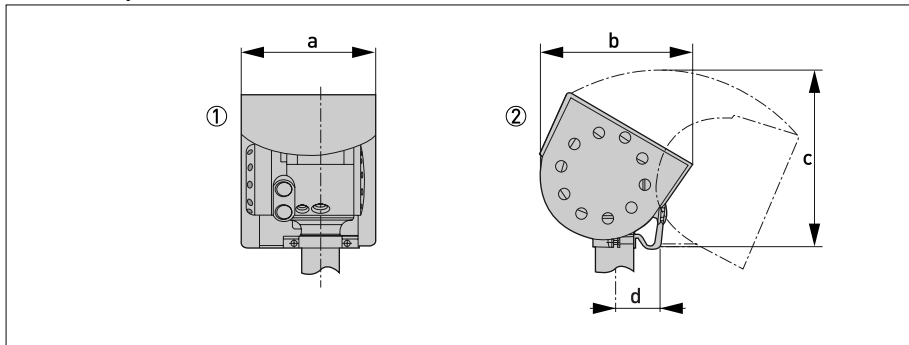

Figure 8-5: Dimensions of the weather protection option

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 lbs

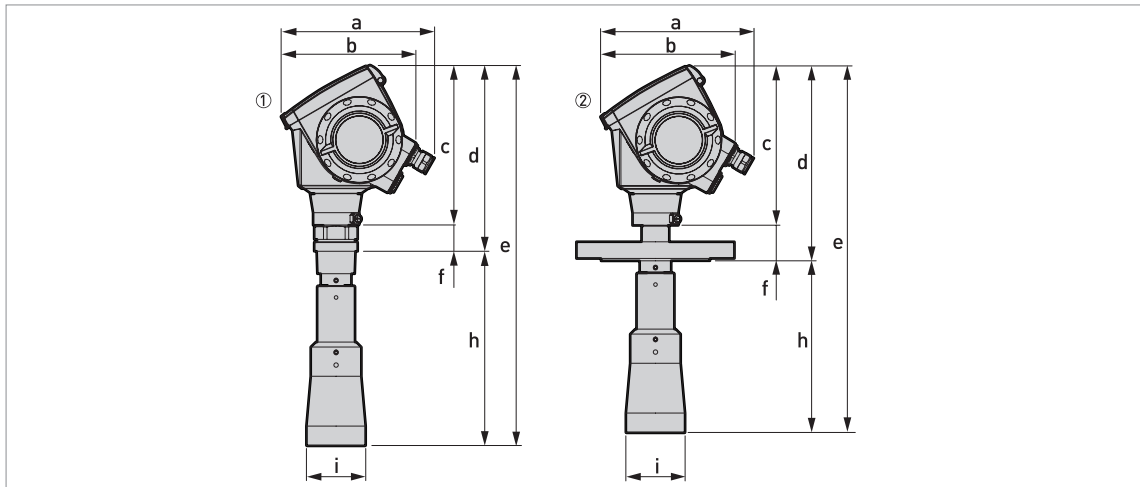|	Dimensions [inches]				Weights [lbs]
	a	b	c	d	
Weather protection	8.2	9.1	10.6 ①	2.6	6.4

① radius

DN80/3¨ horn antenna versions

Figure 8-6: DN80/3¨ horn antenna versions

① DN80/3¨ horn antenna with G1½ or 1½NPT 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	5.5
Flange connection	182 ①	167	201	246	463	45	217 ②	75	6.9…26.2

① if fitted with standard cable glands
② additional antenna extensions of Ø39 x length 105 mm are available

Dimensions and weights in inches and lbs

	Dimensions [inches]								Weights [lbs]
	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	12.1
Flange connection	7.2 ①	6.5	7.9	9.7	18.2	1.8	8.5 ②	3	15.2…57.8

① if fitted with standard cable glands
② additional antenna extensions of Ø1.5 x length 4.1¨ are available
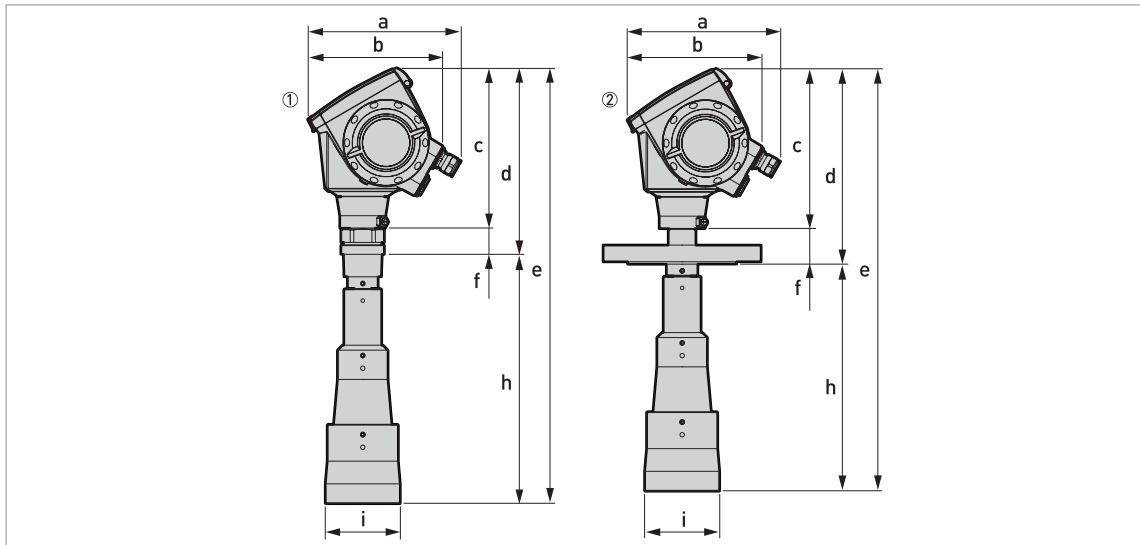
DN100/4¨ horn antenna versions

Figure 8-7: DN100/4¨ horn antenna versions

① DN100/4¨ horn antenna with G1½ or 1½NPT 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	6.5
Flange connection	182 ①	167	201	246	532	45	286 ②	95	7.9…27.2

① if fitted with standard cable glands

② additional antenna extensions of Ø39 x length 105 mm are available

Dimensions and weights in inches and lbs

	Dimensions [inches]								Weights [lbs]
	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	14.3
Flange connection	7.2 ①	6.5	7.9	9.7	20.9	1.8	11.3 ②	3.7	17.4…60

① if fitted with standard cable glands

② additional antenna extensions of Ø1.5 x length 4.1¨ are available
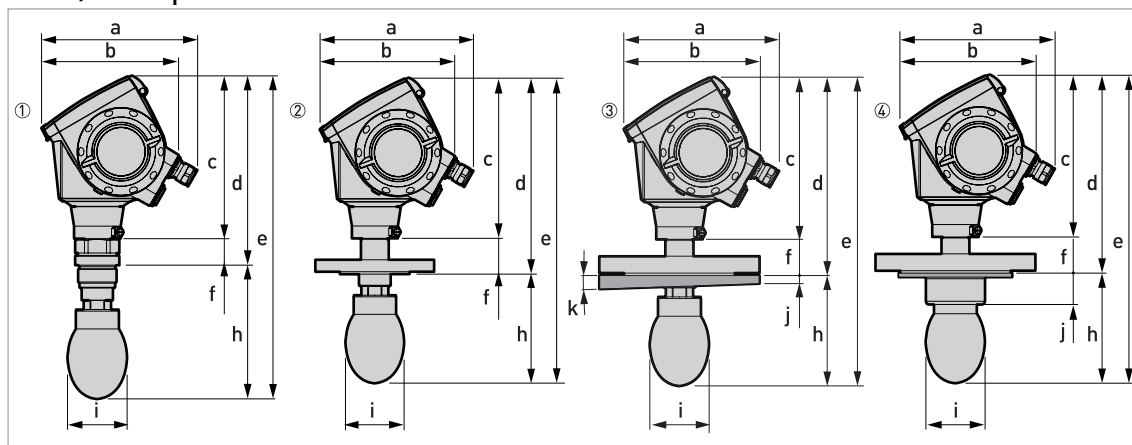
DN80/3¨ Drop antenna versions

Figure 8-8: DN80/3¨ Drop antenna versions

① DN80/3¨ Drop antenna with G1½ or 1½NPT thread connection
② DN80/3¨ Drop antenna with flange connection
③ DN80/3¨ Drop antenna with slanted flange connection (PP material option only)
④ 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	k	
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 slanted flange option	182 ①	167	201	246	383	45	137 ②	74	10	2°	6.4…26.6
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 x length 105 mm are available. Do not attach more than 5 antenna extensions.

Dimensions and weights in inches and lbs

	Dimensions [inches]										Weights [lbs]
	a	b	c	d	e	f	h	Øi	j	k	
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 slanted flange option	7.2 ①	6.5	7.9	9.7	15.1	1.8	5.4 ②	2.9	0.4	2°	14.1…58.6
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 x length 4.1¨ available. Do not attach more than 5 antenna extensions.

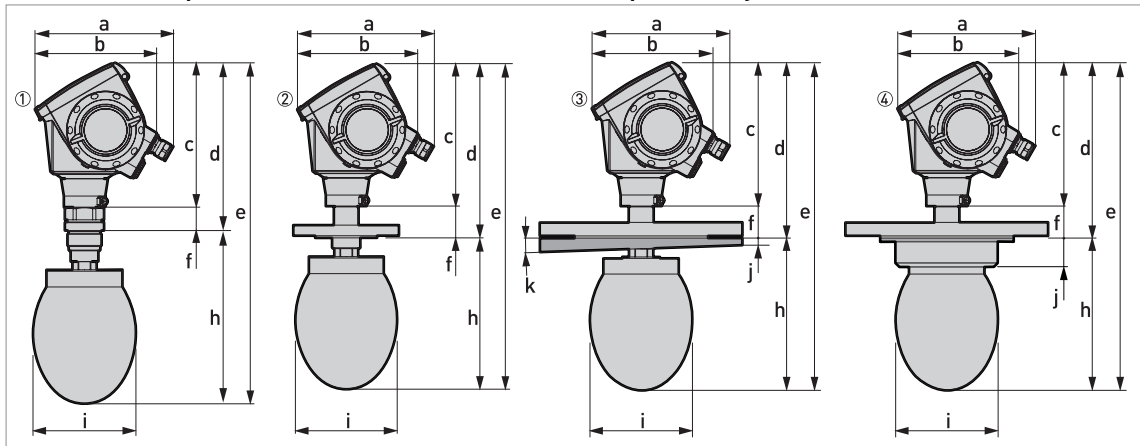### DN150/6¨ Drop antenna versions (PP material option only)

Figure 8-9: DN150/6¨ Drop antenna versions (PP material option only)

① DN150/6¨ Drop antenna with flange connection
② DN150/6¨ Drop antenna with thread connection
③ DN150/6¨ Drop antenna with slanted flange connection
④ DN150/6¨ Drop antenna, with flange plate protection option

Dimensions and weights in mm and kg

	Dimensions [mm]										Weights [kg]
	a	b	c	d	e	f	h	Øi	j	k	
Thread connection	182 ①	167	201	234	476	33	242 ②	144	-	-	7.4
Flange connection	182 ①	167	201	246	460	45	214 ②	144	-	-	8…27.3
Flange connection with slanted flange option	182 ①	167	201	246	460	45	214 ②	144	10	2°	8.1…27.9
Flange connection with flange plate protection option	182 ①	167	201	246	460	45	214	144	39	-	-

① if fitted with standard cable glands
② additional antenna extensions of Ø39 x length 105 mm are available. Do not attach more than 5 antenna extensions.

Dimensions and weights in inches and lbs

	Dimensions [inches]										Weights [lbs]
	a	b	c	d	e	f	h	Øi	j	k	
Thread connection	7.2 ①	6.5	7.9	9.2	18.7	1.3	9.5 ②	5.7	-	-	16.3
Flange connection	7.2 ①	6.5	7.9	9.7	18.1	1.8	8.4 ②	5.7	-	-	17.6…60.2
Flange connection with slanted flange option	7.2 ①	6.5	7.9	9.7	18.1	1.8	8.4 ②	5.7	0.4	2°	17.8…61.5
Flange connection with flange plate protection option	7.2 ①	6.5	7.9	9.7	18.1	1.8	8.4	5.7	1.5	-	-

① if fitted with standard cable glands
② additional antenna extensions of Ø1.5 x length 4.1¨ are available. Do not attach more than 5 antenna extensions.

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	☐ Flange	☐ Threaded	Specify size:
Connection material	☐ 316 L	☐ Hastelloy® C-22	
Feedthrough/Sealing	☐ Standard/ FKM/FPM (-40...+200°C)	☐ Standard/ Kalrez® 6375 (-20...+200°C)	☐ Standard/ EPDM (-40...+150°C)
	☐ Metaglas®/ FKM/FPM (-30...+200°C)	☐ Metaglas®/ Kalrez® 6375 (-20...+200°C)	☐ Metaglas®/ EPDM (-30...+150°C)
Outputs	☐ 1 output 4...20 mA/ HART®	☐ 2 outputs 4...20 mA HART® + 4...20 mA	
Display	☐ Without	☐ With	Specify language:
Approvals	☐ No Ex	☐ ATEX II G 1, 1/2, 2 Ex ia IIC T6...T3	☐ ATEX II G 1/2, 2 Ex d[ia] IIC T6...T3
		☐ ATEX II D 1, 1/2, 2 Ex iaD or Ex iaD 20/21 or Ex iaD 21 IP6X T65°C...T90°C	☐ ATEX II D 1/2, 2 Ex tD[iaD] A21/20 or Ex tD[iaD] A21 IP6X T65°C...90°C

9.1.2 Rating data

Product name:	
Operating pressure:	
Rated pressure:	
Process connection temperature:	
Ambient temperature:	
Operating density:	
Viscosity:	
Measurand (level, volume,...):	
Silo 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 εr, 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

Horn (cone) antenna
A common antenna for most applications. It is used for the controlled emission and collection of radar signals.

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.

I

Interference signals
False radar reflections.

L

Level
Height from the bottom of the silo (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 silo 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 silo contents.

S

Signal converter	A set of electronic components in the device that send the reflected measurement pulse through some signal filters. They identify and measure the level of the silo 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 silo contents with low dielectric constants. TBF mode uses the reflection of the silo bottom to indirectly measure the level of the silo contents.

U

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

V

Volume	Total volume of silo contents.

W

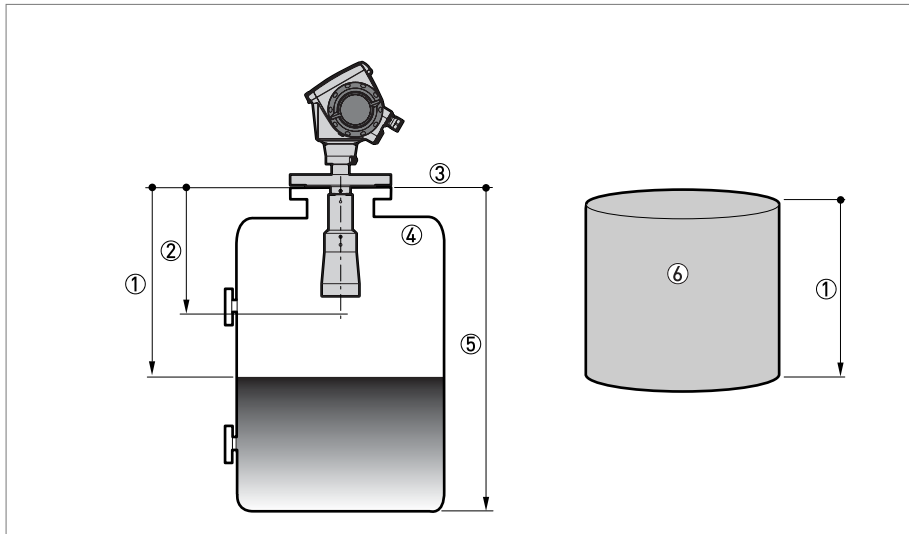|	
Waveguide	A PTFE component that is used to guide the emitted radar waves correctly into the horn antenna.

Figure 9-1: Measurement definitions: distance

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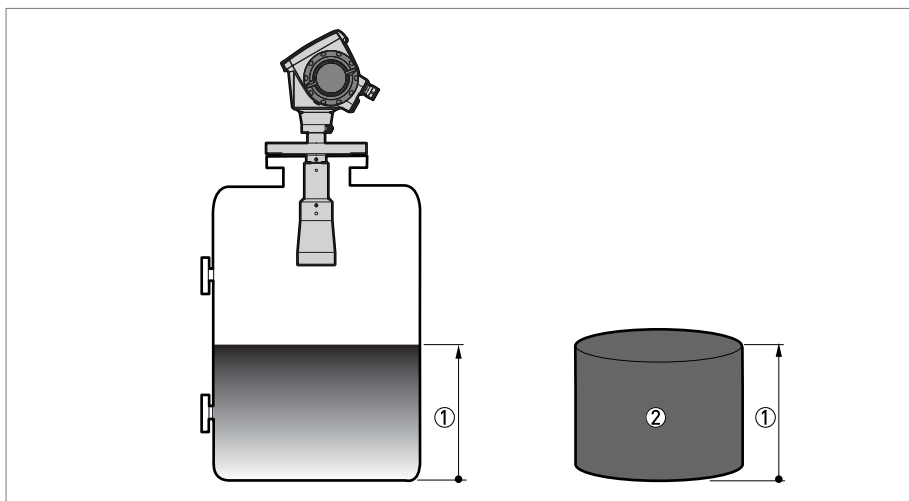④ Gas (Air)
⑤ Tank height
⑥ Ullage volume or mass

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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www.krohne.com

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