



OPTIWAVE 6300 C Handbook

24 GHz Non-contact Radar (FMCW) Level Meter

for distance, level, volume and mass measurement of solids

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1.1 Software history

Data about software revisions is shown in the Supervisor menu. Go to **Test > Information > Device ID**. For more data, refer to *Function description* on page 47. If it is not possible to refer to the device menu, record the serial number of the device (given on the device nameplate) and speak to the supplier.

Release date (back end) [YYYY-MM-DD]	Back end	Front end	DTM revision	Hardware	NE 53 level
2010-03-01	2.0.2.00	1.0.0.28	1.0.0.35	4000659201	1
2010-05-01	2.0.2.01	1.0.0.28	1.0.0.35	4000659201	3
2012-03-05	2.0.2.02	1.0.0.28	1.0.0.36	4000659201	3
2012-03-05	2.0.2.03	1.0.0.28	1.0.0.36	4000659201	3
2013-01-22	2.0.2.04	1.0.0.28	1.0.0.37 ①	4000659201	3

① If your computer uses the Windows XP operating system, install DTM revision V 1.0.0.36. If your computer uses the Windows 7 operating system, install DTM revision V 1.0.0.37.

1.2 Intended use

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

It can be installed on silos, hoppers and bunkers.

1.3 Certification



DANGER!

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



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

- Electromagnetic Compatibility (EMC) Directive 2004/108/EC in conjunction with EN 61326-1 (2013).
- Radio Equipment and Telecommunications Terminal Equipment (R & TTE) Directive 1999/05/EC in conjunction with ETSI EN 302 372-2 (2011) and ETSI EN 302 729-2 (2011). For more data, refer to *European Union (EU)* on page 7.
- Low-Voltage Directive 2006/95/EC in conjunction with EN 61010-1 (2001).

All devices are based on the CE marking and meet the requirements of NAMUR Guideline NE 21 and NE 43.

1.4 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.

1.5 Radio approvals

1.5.1 European Union (EU)



LEGAL NOTICE!

This level transmitter is intended for installation in closed metallic tanks and open-air installations. 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...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).

Refer to EN 302372 and EN 302729 for installation conditions.

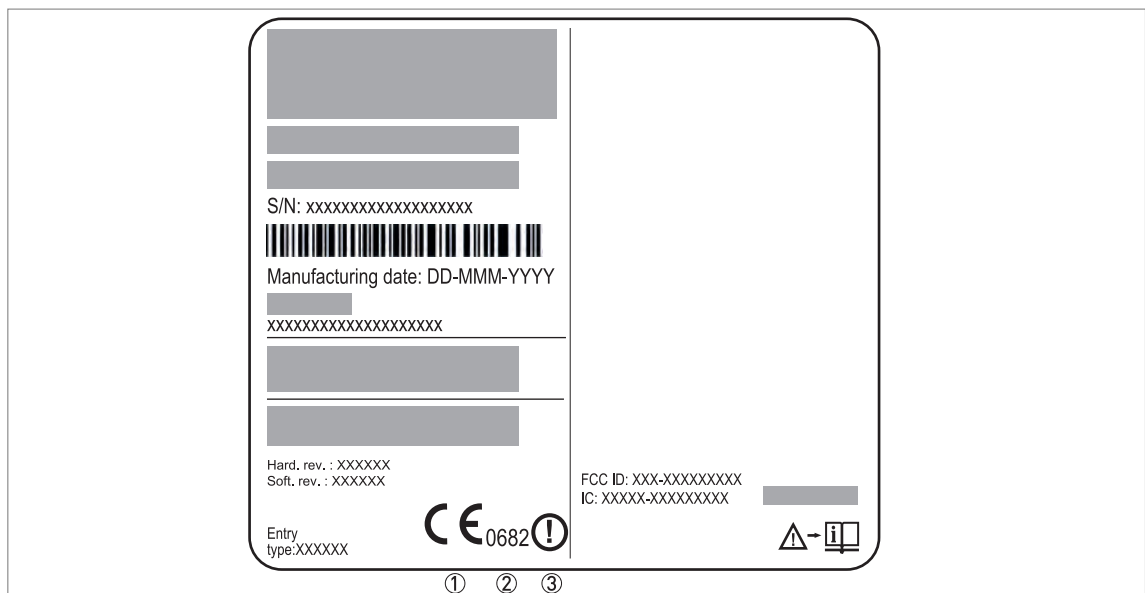


Figure 1-1: Radio approval information on the nameplate

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

According to ETSI EN 302 372-2 [2011], the radiated power outside a metallic silo is less than -30 dBm.

The radio approval report is given on the DVD-ROM supplied with the device.

The device agrees with the ETSI EN 302 729 standard for Level Probing Radar (LPR) equipment

It is possible to use the device in open-air installations, but the R&TTE Directive (1999/5/EC) and the related standards must be approved in the country where the device is installed.

At this time, the R&TTE Directive is approved in the countries that follow: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Liechtenstein, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom, Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia, Slovakia, Romania and Bulgaria.

Use approved personnel to install the device. Obey these instructions:



- Install the device in a permanent location. The device must point down at a constant angle.
- Install the device more than 4 km / 2.485 mi away from radio astronomy sites.
- If the device is 4...40 km / 2.485...24.855 mi away from radio astronomy sites, do not install the device more than 15 m / 49.21 ft above the ground.



CAUTION!

If it is necessary to install the device less than 4 km / 2.485 mi from radio astronomy sites, you must get the approval of the national regulatory authority before installation (e.g. ANFR (France), Bundesnetzagentur (Germany), Ofcom (United Kingdom) etc.).

Locations of radio astronomy sites (stations) in Europe and northern Eurasia

Country	Name of the station	Location	
		Latitude, φ	Longitude, λ
Finland	Metsähovi	60°13'04" N	24°23'37" E
	Tuorla	60°24'56" N	22°26'31" E
France	Plateau de Bure	44°38'01" N	05°54'26" E
	Floirac	44°50'10" N	00°31'37" W
Germany	Effelsberg	50°31'32" N	06°53'00" E
Hungary	Penc	47°47'22" N	19°16'53" E
Italy	Medicina	44°31'14" N	11°38'49" E
	Noto	36°52'34" N	14°59'21" E
	Sardinia	39°29'50" N	09°14'40" E
Latvia	Ventspils	57°33'12" N	21°51'17" E
Poland	Kraków – Fort Skala	50°03'18" N	19°49'36" E
	Torun – Piwnice	52°54'48" N	18°33'30" E
Russia	Dmitrov	56°26'00" N	37°27'00" E
	Kalyazin	57°13'22" N	37°54'01" E
	Pushchino	54°49'00" N	37°40'00" E
	Zelenchukskaya	43°49'53" N	41°35'32" E
Spain	Yebes	40°31'27" N	03°05'22" W
	Robledo	40°25'38" N	04°14'57" W
Switzerland	Bleien	47°20'26" N	08°06'44" E
Sweden	Onsala	57°23'45" N	11°55'35" E

Country	Name of the station	Location	
		Latitude, φ	Longitude, λ
UK	Cambridge	52°09'59" N	00°02'20" E
	Darnhall	53°09'22" N	02°32'03" W
	Jodrell Bank	53°14'10" N	02°18'26" W
	Knockin	52°47'24" N	02°59'45" W
	Pickmere	53°17'18" N	02°26'38" W

For more data, refer to this page (in English) on the website for the Committee on Radio Astronomy Frequencies (CRAF): <http://www.craf.eu/raobs.htm>.

1.5.2 U.S.A. and Canada



LEGAL NOTICE!

This device complies with Part 15 of the FCC Rules and with RSS-210 of Industry Canada. Operation is subject to the following two conditions:

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

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

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

The radio approval report is given on the DVD-ROM supplied with the device.

1.6 Safety instructions from the manufacturer

1.6.1 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 copyright. Contributions from third parties are identified as such. Reproduction, processing, dissemination and any type of use beyond what is permitted under copyright requires written authorisation from the respective author and/or the manufacturer.

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

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

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

1.6.2 Disclaimer

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

1.6.3 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 or 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.

1.6.4 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 icons as shown below.

1.6.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.



DANGER!

This warning 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.

1.7 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!

Do a check of the packing list to make sure that you have all the elements given in the order.

Scope of delivery – horn antenna

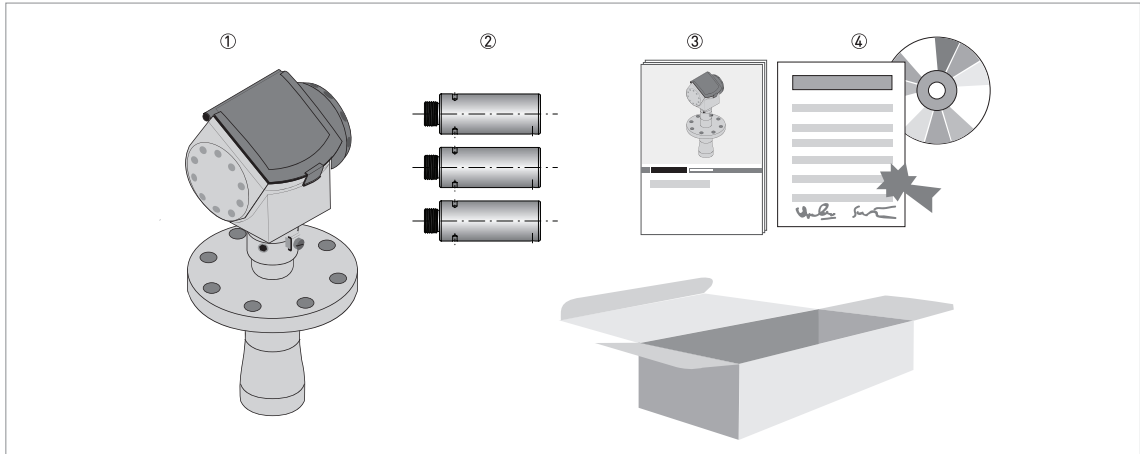


Figure 2-1: Scope of delivery – horn antenna

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

Scope of delivery – Drop antenna

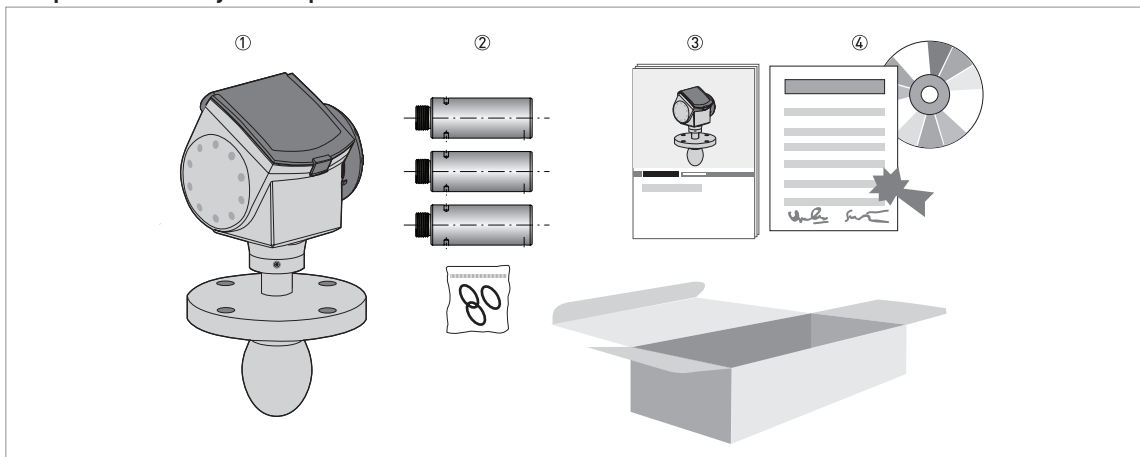


Figure 2-2: Scope of delivery – Drop antenna

- ① Signal converter and antenna in compact version
- ② Antenna extensions (option) and O-ring for each antenna extension
- ③ Quick Start
- ④ DVD-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 emit 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 80.

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

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

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

These output options are available:

- 1 output: 4...20 mA (HART)
- 2 outputs: 4...20 mA (HART) + 4...20 mA

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 113.

2.3 Visual Check



WARNING!

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



INFORMATION!

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

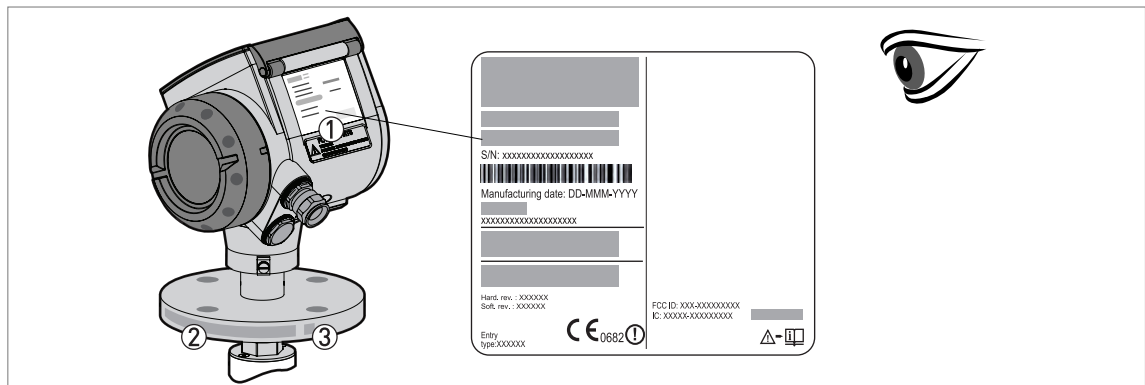


Figure 2-3: Visual check

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

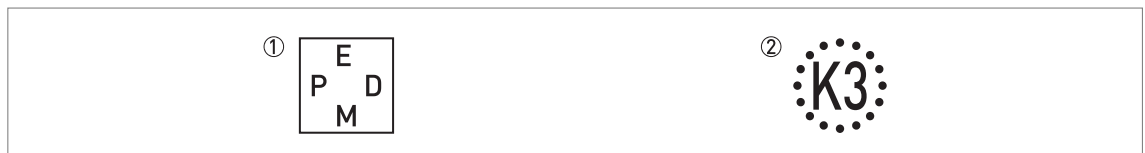


Figure 2-4: Symbols for the supplied gasket material (on the side of the process connection)

- ① EPDM
- ② Kalrez® 6375

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



INFORMATION!

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



INFORMATION!

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

2.4 Nameplates



INFORMATION!

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

2.4.1 Non-Ex nameplate

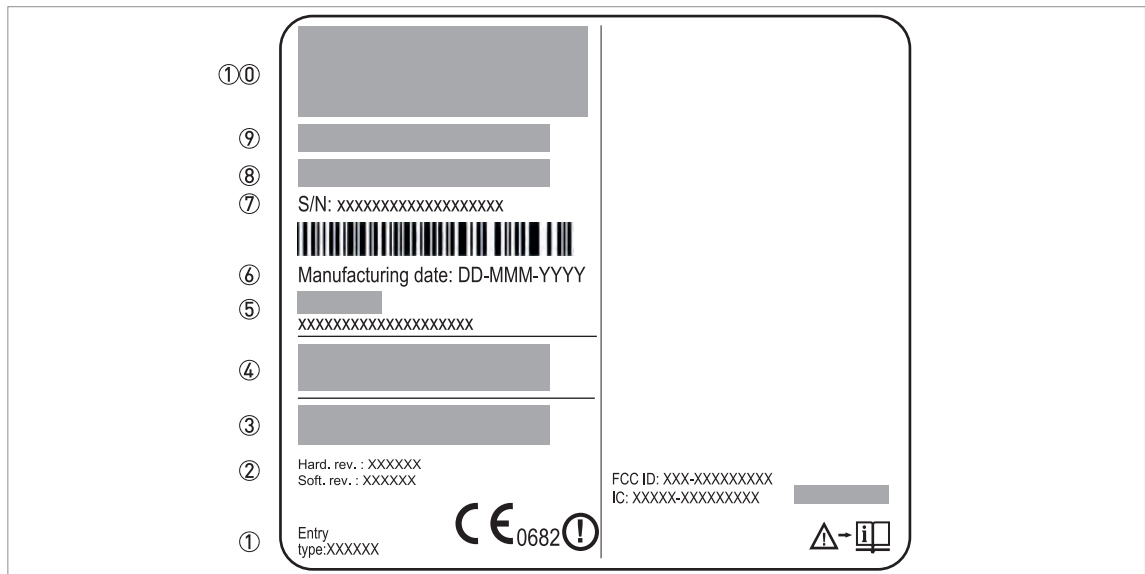


Figure 2-5: Non-Ex nameplate

- ① Indicator arrow to cable entry / cable entry size. Notified body for radio approval.
- ② Hardware revision / Software revision
- ③ Nominal voltage for operation. For further information, refer to *Non-Ex devices* on page 31.
- ④ Degree of ingress protection (according to EN 60529 / IEC 60529)
- ⑤ Customer tag number
- ⑥ Date of manufacture
- ⑦ Order number
- ⑧ Type code (defined in order)
- ⑨ Model name and number
- ①⑩ Company name and address

3.1 General notes on installation



INFORMATION!

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



INFORMATION!

Do a check of the packing list to make sure that you have all the elements given in the order.



INFORMATION!

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

3.2 Storage



WARNING!

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

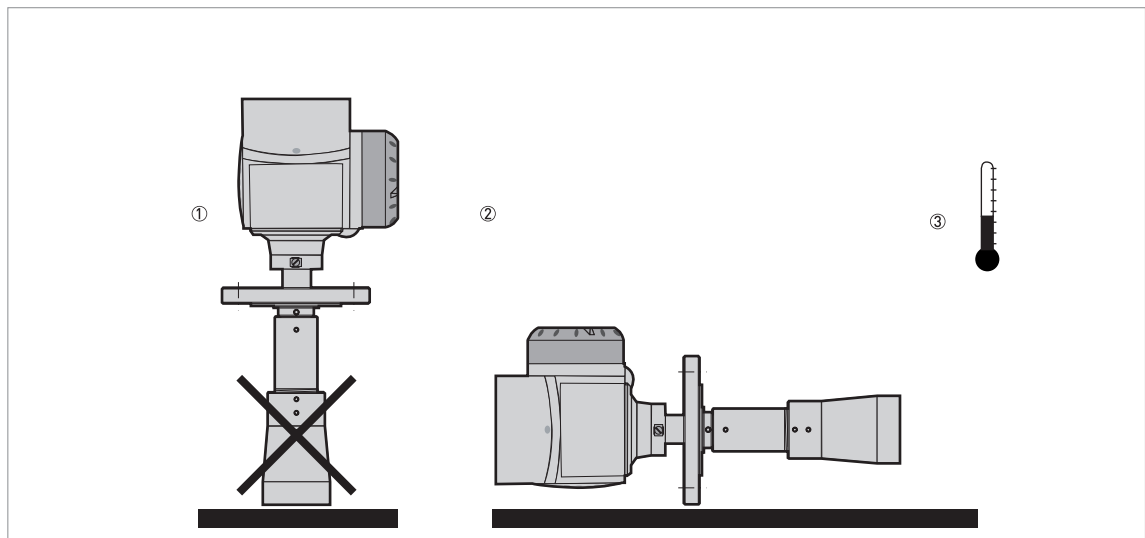


Figure 3-1: Storage conditions

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

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

3.3 Transport

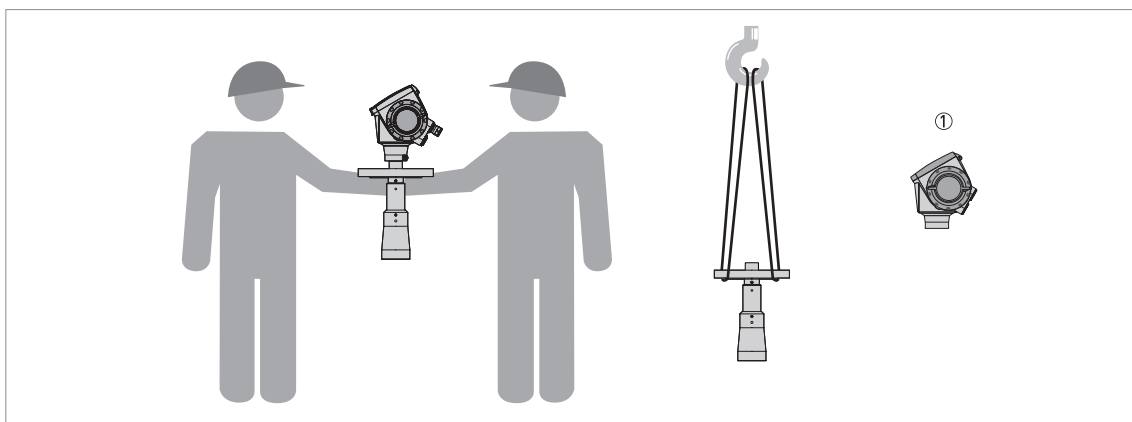


Figure 3-2: How to lift the device

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



WARNING!

Lift the device carefully to prevent damage to the antenna.

3.4 Pre-installation requirements



INFORMATION!

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

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

3.5 How to prepare the silo before you install the device



CAUTION!

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

3.5.1 Pressure and temperature ranges

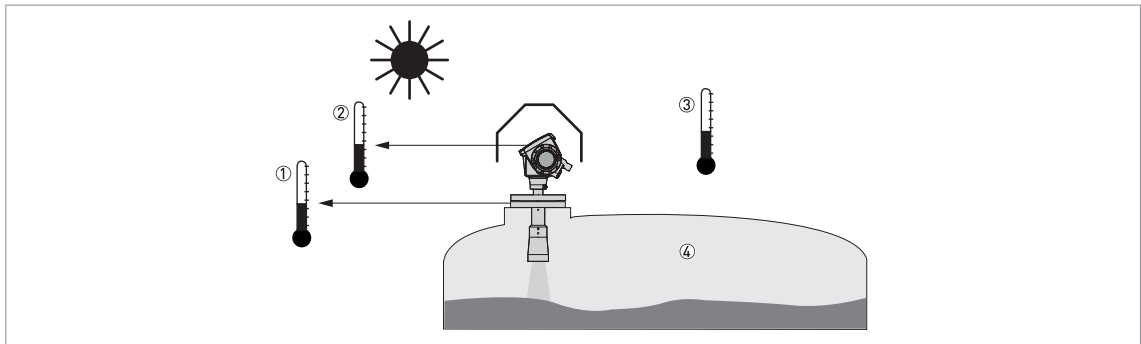


Figure 3-3: Pressure and temperature ranges

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



WARNING!

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

Antenna type	Maximum process connection temperature		Maximum operating pressure	
	[°C]	[°F]	[barg]	[psig]
PP Drop	+100	+210	16	232
PTFE Drop	+150	+300	40	580
Horn / Sheet metal horn	+200	+390	40	580

3.5.2 Recommended mounting position

**CAUTION!**

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

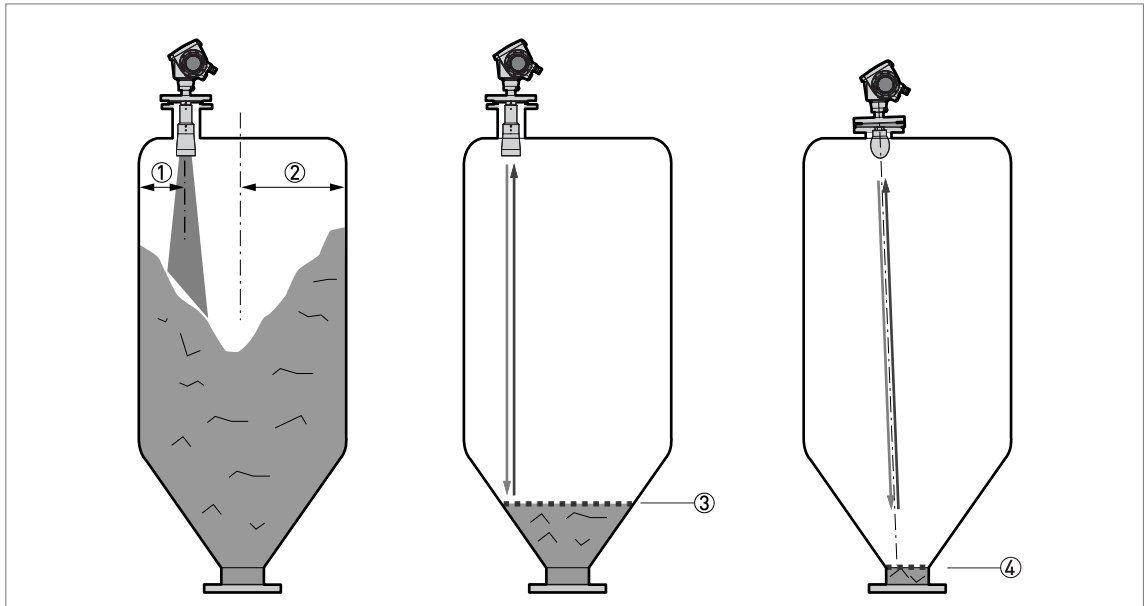


Figure 3-4: Recommended nozzle position for solids

- ① Position of the process fitting from the silo wall, $r/2$ (for DN80, DN100, DN150 or DN200 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

**INFORMATION!**

If possible, do not install a nozzle on the silo centerline.

**INFORMATION!**

If it is necessary to measure to the bottom of the silo, a 2° slanted PP 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.

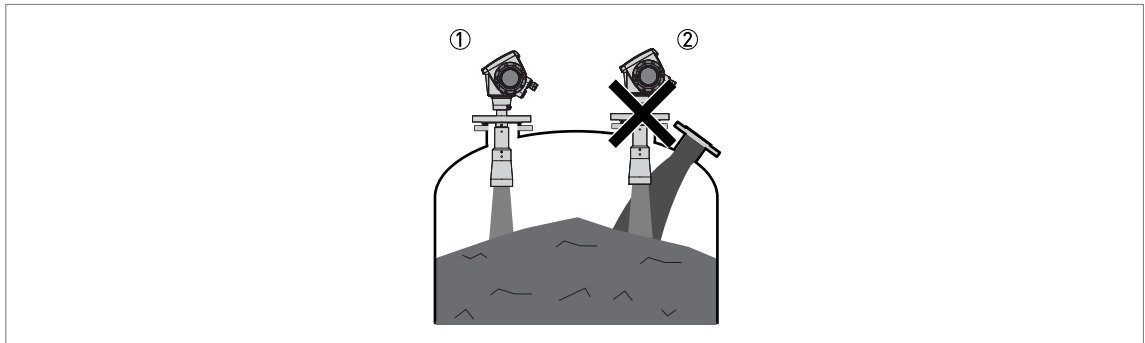


Figure 3-5: Product inlets

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

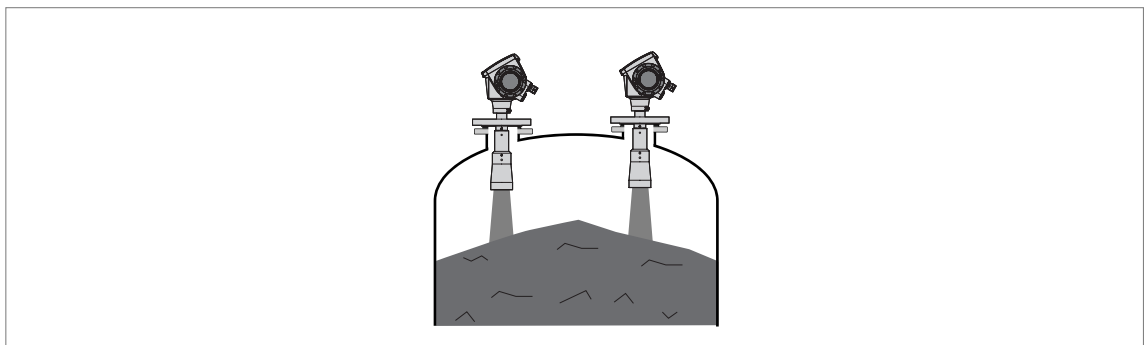


Figure 3-6: More than 1 FMCW radar level meter can be operated in a silo

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.

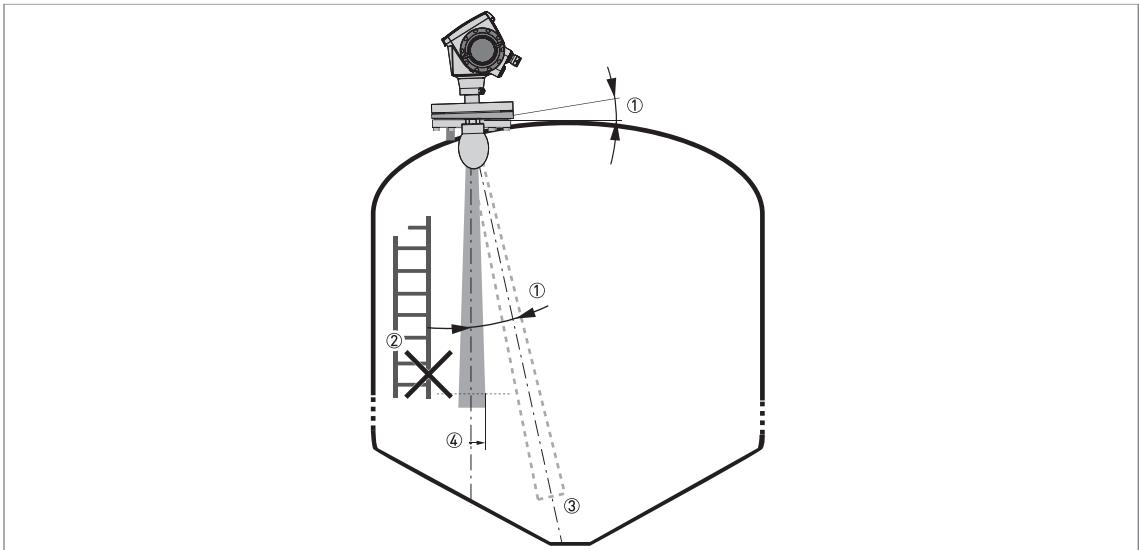


Figure 3-7: General installation recommendations

- 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 We recommend that you do an empty spectrum recording if there are too many obstacles in the radar beam. For more data, refer to *How to make a filter to remove radar signal interference* on page 62.
- 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 63.
- ④ Beam radius (DN80 horn antenna): increments of 90 mm/m or 1.1"/ft (5°)
 Beam radius (DN100 horn antenna or DN80 Drop antenna): increments of 70 mm/m or 0.83"/ft (4°)
 Beam radius (DN150 horn antenna): increments of 52.5 mm/m or 0.63"/ft (3°)
 Beam radius (DN150 Drop antenna or DN200 horn 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

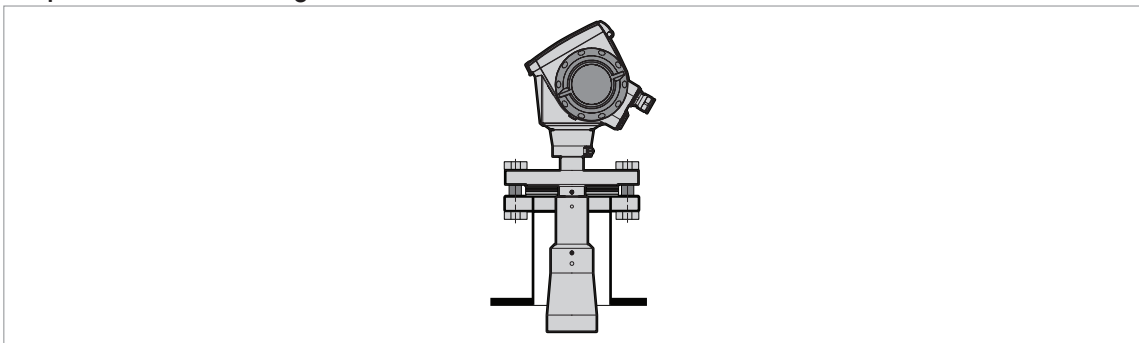


Figure 3-8: Flange connection



If the antenna is smaller than the process 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.

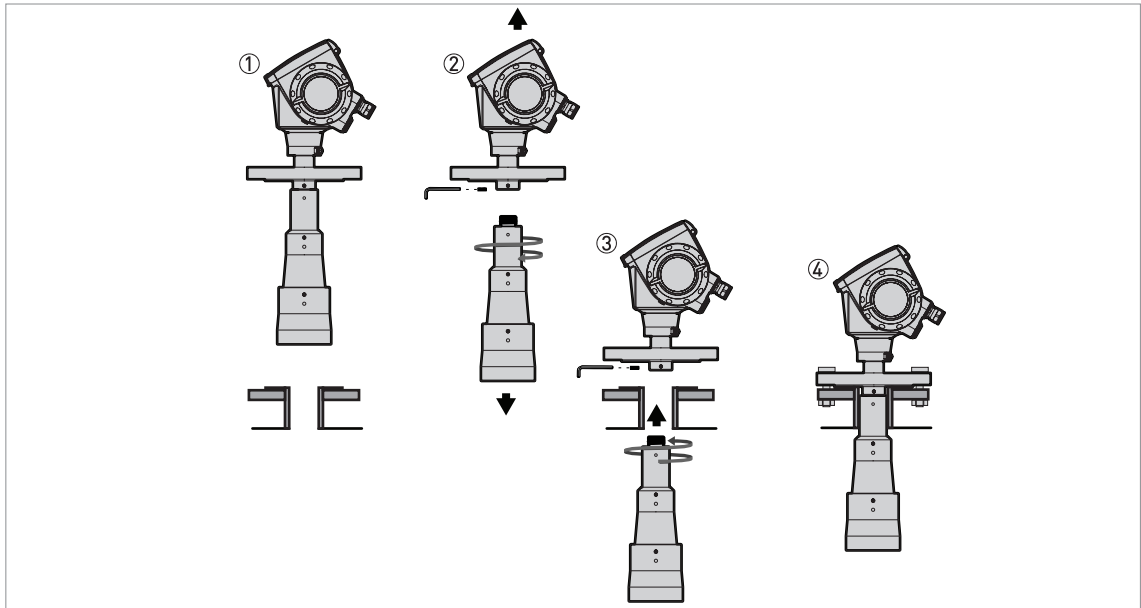


Figure 3-9: How to attach the device if the antenna is larger than the process connection

Equipment needed:

- 3 mm Allen wrench (not supplied)



WARNING!

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



If the antenna is larger than the process connection:

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

3.7.2 How to install a device with a threaded connection

Equipment needed:

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

Requirements for threaded connections

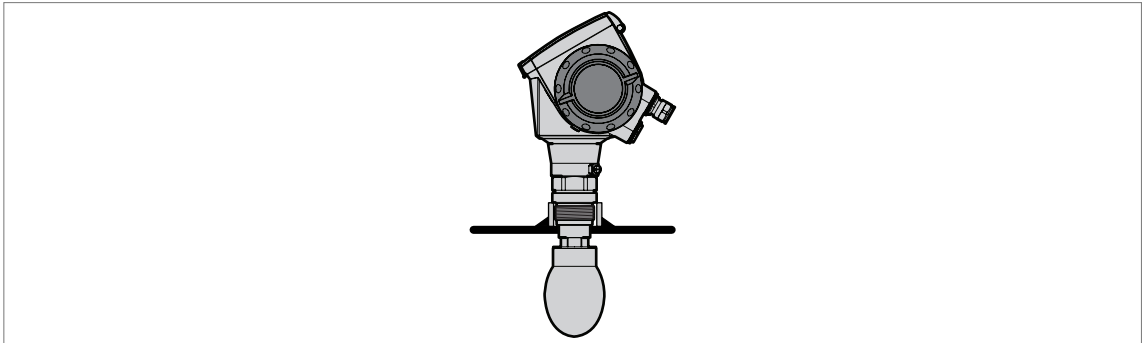


Figure 3-10: Threaded connection



If the antenna is smaller than the process connection:

- 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.

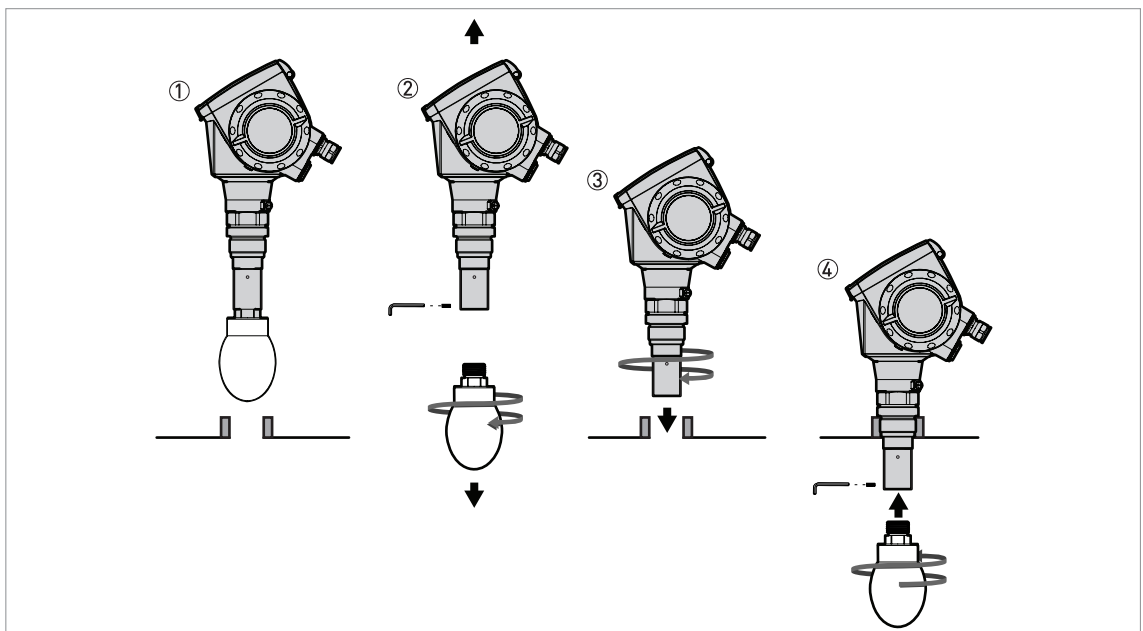


Figure 3-11: How to attach the device if the antenna is larger than the process connection

Equipment needed:

- 3 mm Allen wrench (not supplied)

**WARNING!**

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

**INFORMATION!**

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

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

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

**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.

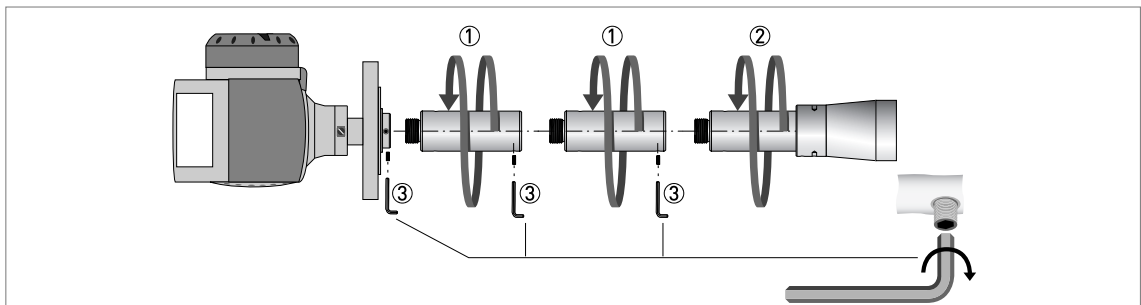
3.7.3 How to attach antenna extensions**Horn antenna - antenna extensions**

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

Equipment needed:

- 3 mm Allen wrench (not supplied)



- Attach the antenna extensions ① below the flange.
 - Attach the antenna ②.
 - Make sure the antenna extensions are fully engaged.
 - Use a 3 mm Allen wrench to tighten the locking screws ③.
 - If you attach more or less extensions than were initially ordered, change the antenna extension value in **Supervisor** mode. Go to **Supervisor > Advanced setup > Installation > Antenna Extension**.
- ➡ Use the display screen or HART® communication (PACTware™). Antenna extension = antenna extension length × number of extensions.
- If you changed the antenna extension value in **Supervisor** mode, also change the blocking distance value. Go to **Supervisor > Advanced setup > Installation > Blocking Distance**.
- ➡ Use the display screen or HART® communication (PACTware™). Minimum blocking distance = antenna length + (antenna extension length × number of extensions) + 0.3 m / 12".

Drop antenna - antenna extensions

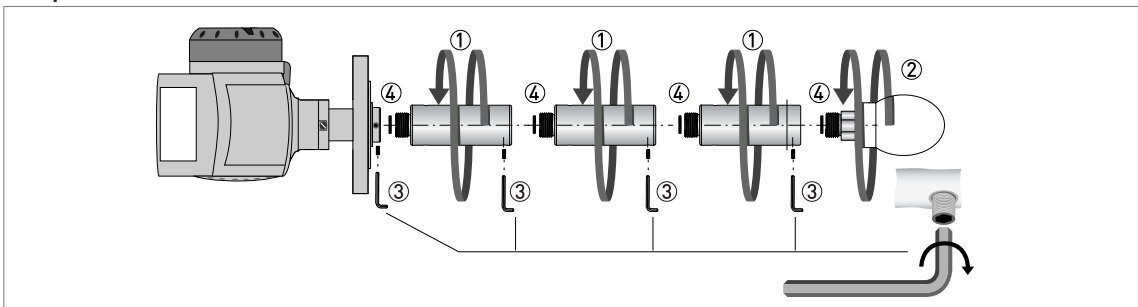


Figure 3-13: Drop antenna - how to attach antenna extensions



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.

Make sure that you put an O-ring ④ into the groove at the top of each antenna extension.

Equipment needed (not supplied):

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



- Remove the O-rings from the plastic sachet supplied with the device. Put an O-ring ④ into the groove at the top of each antenna extension.
- Attach the antenna extensions ① below the flange.
- Attach the antenna ②. Tighten the antenna with a torque wrench to a torque of 200 Nm ±10 Nm.
- Make sure the antenna extensions are fully engaged.
- Use a 3 mm Allen wrench to tighten the locking screws ③.
- If you attach more or less extensions than were initially ordered, change the antenna extension value in **Supervisor** mode. Go to **Supervisor > Advanced setup > Installation > Antenna Extension**.

- Use the display screen or HART[®] communication (PACTware[™]). Antenna extension = antenna extension length × number of extensions.
- If you changed the antenna extension value in **Supervisor** mode, also change the blocking distance value. Go to **Supervisor > Advanced setup > Installation > Blocking Distance**.
- Use the display screen or HART[®] communication (PACTware[™]). Minimum blocking distance = antenna length + (antenna extension length × number of extensions) + 0.3 m / 12".

3.7.4 How to turn or remove the signal converter



INFORMATION!

The converter turns 360°. The converter can be removed from the process connection assembly under process conditions.

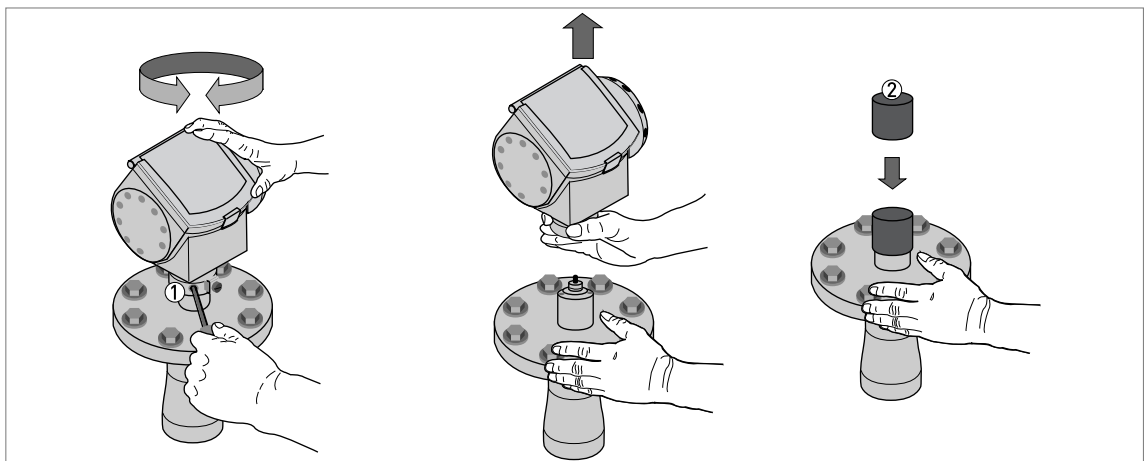


Figure 3-14: How to turn or remove the signal converter

- ① Tool: 5 mm Allen wrench (not supplied)
- ② Cover for the wave guide hole on top of the process connection assembly (not supplied)



CAUTION!

If you remove the converter, put a cover on the wave guide hole on top of the process connection assembly.

When the converter is attached to the process connection assembly, tighten the lock screw.

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 89.

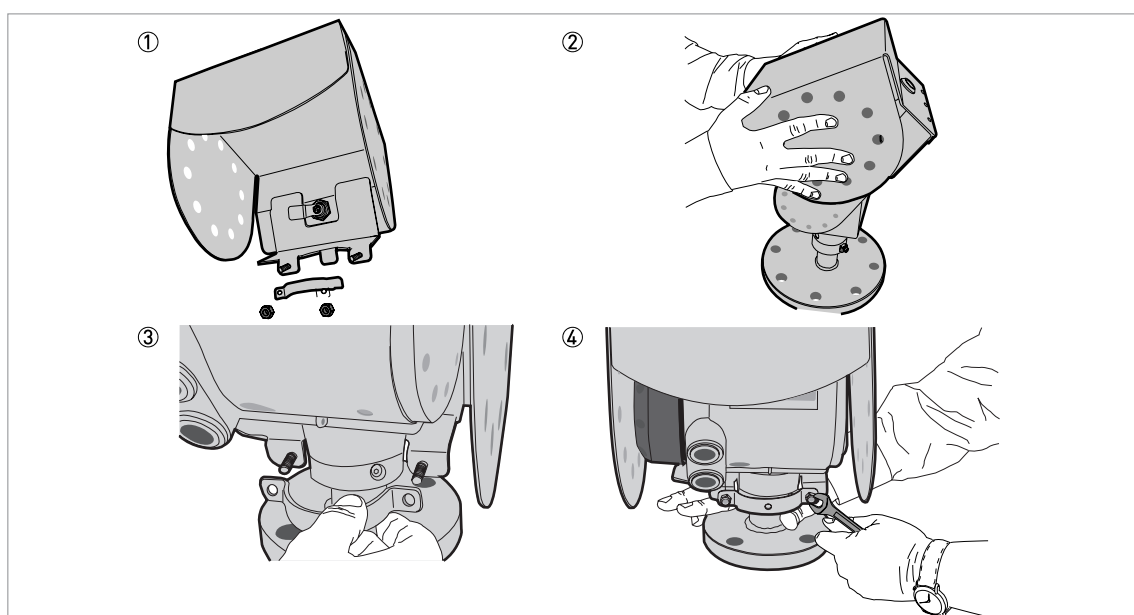


Figure 3-15: Installation of the weather protection



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

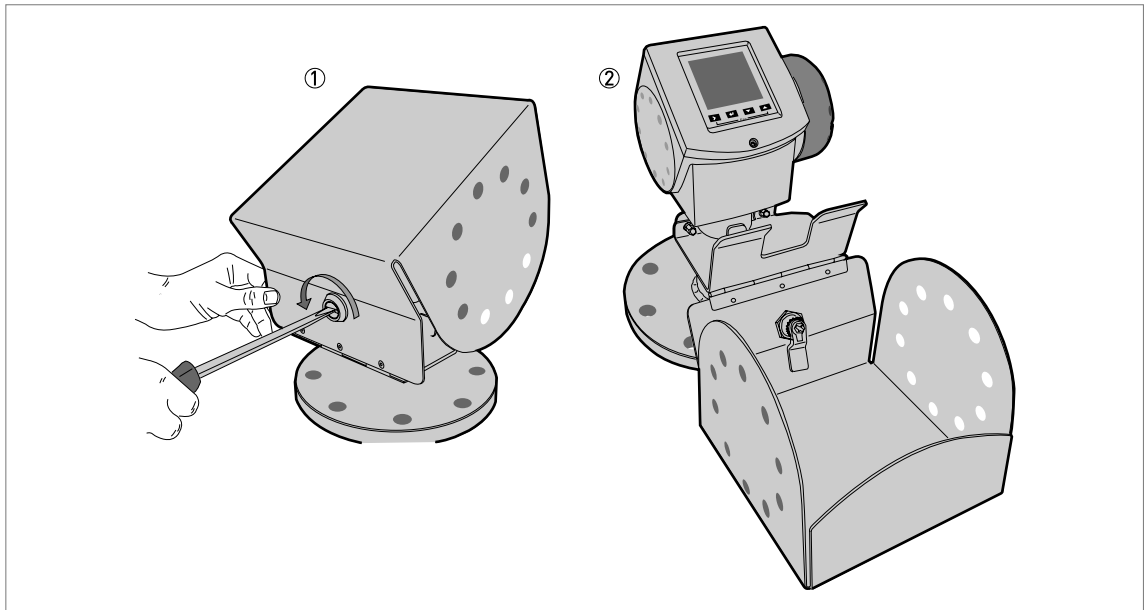


Figure 3-16: How to open the weather protection

- 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

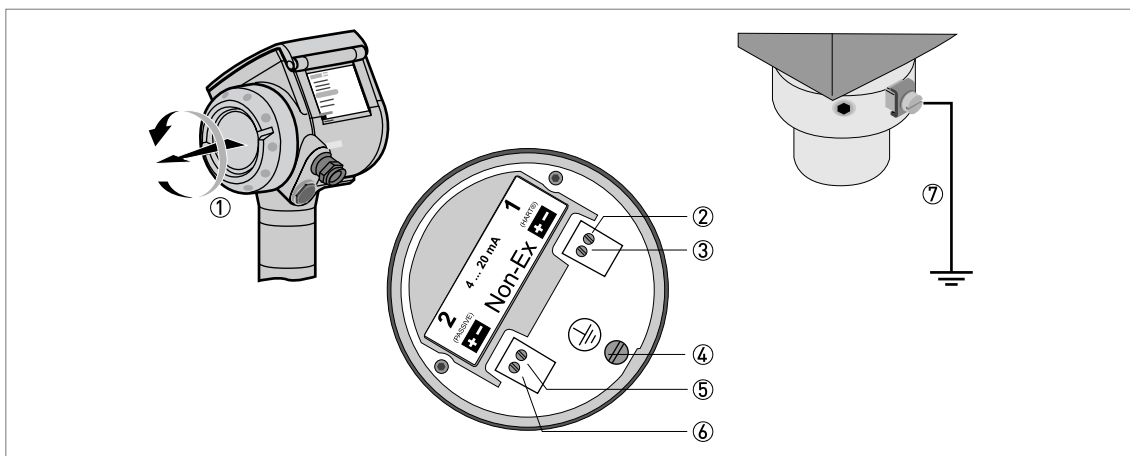


Figure 4-1: Electrical installation

- 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 - (option)
- ⑥ Output 2: current output + (option)
- ⑦ Grounding terminal between the process connection and the converter

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.

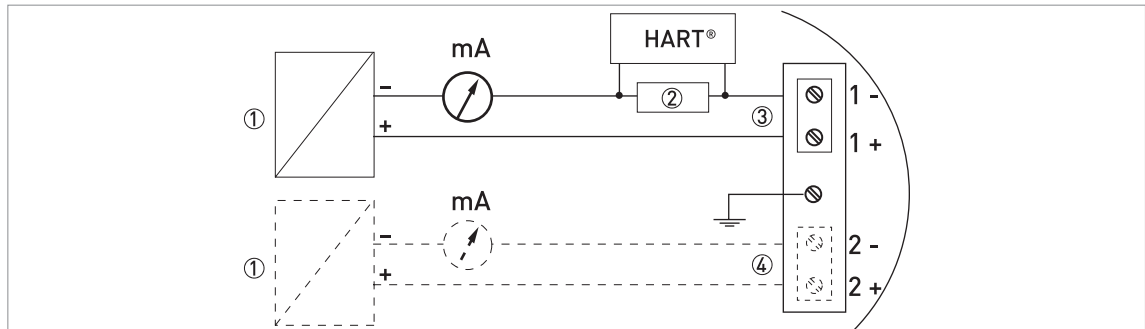
4.2.1 Non-Ex devices

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 Devices for hazardous locations***DANGER!***

For electrical data for device operation in hazardous locations, refer to the related certificates of compliance and supplementary instructions (ATEX, IECEx, FM, CSA etc.). You can find this documentation on the DVD-ROM delivered with the device or it can be downloaded free of charge from the website (Download Center).

4.3 Protection category



INFORMATION!

The device fulfils all requirements per protection category IP66 / IP67. It also fulfils all requirements per NEMA type 4X (housing) and type 6P (antenna).



DANGER!

Make sure that the cable gland is watertight.

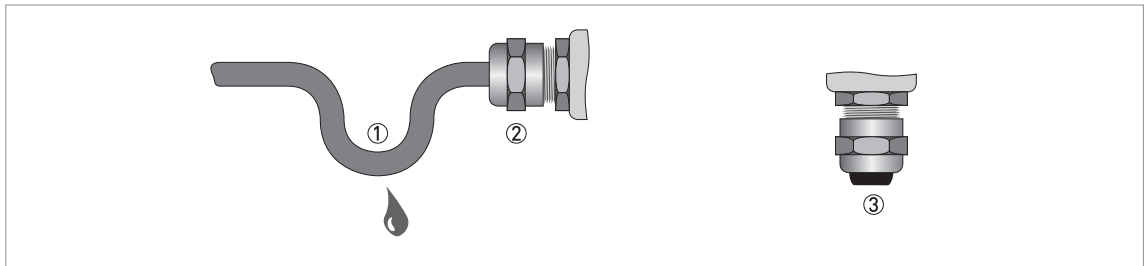


Figure 4-3: How to make the installation agree with protection category IP 67



- Make sure that the gaskets are not damaged.
- Make sure that the electrical cables are not damaged.
- Make sure that the electrical cables agree with the national electrical code.
- The cables are in a loop in front of the device ① so water does not go into the housing.
- Tighten the cable feedthroughs ②.
- Close unused cable feedthroughs with dummy plugs ③.

4.4 Networks

4.4.1 General information

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

The device output is factory-set to communicate point-to-point. To change the communication mode from **point-to-point** to **multi-drop**, refer to *Network configuration* on page 57.

4.4.2 Point-to-point connection

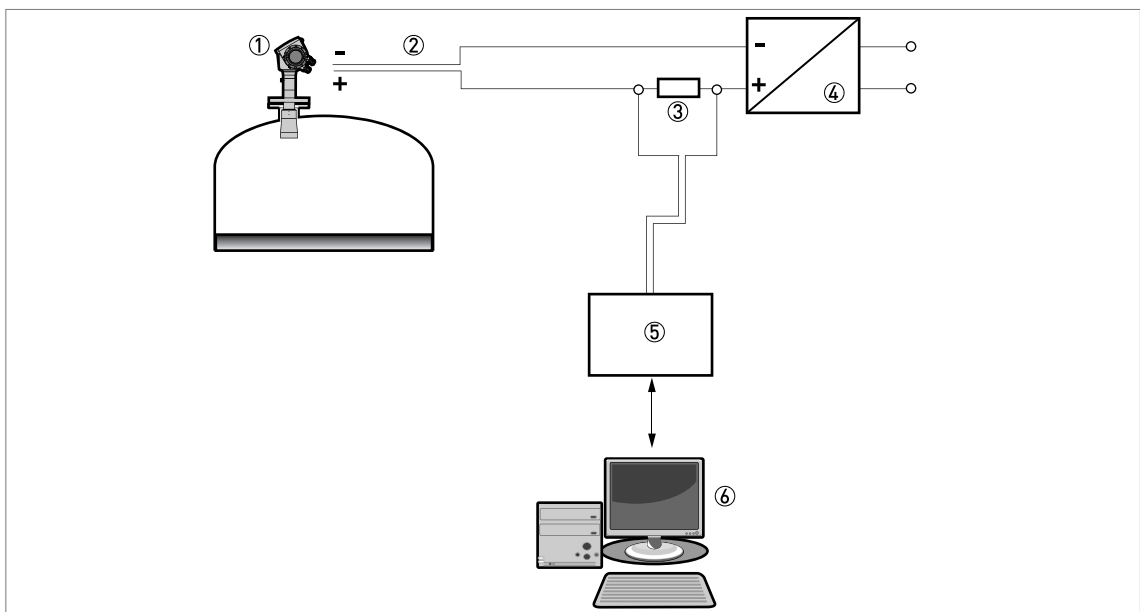


Figure 4-4: Point-to-point connection (non-Ex)

- 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

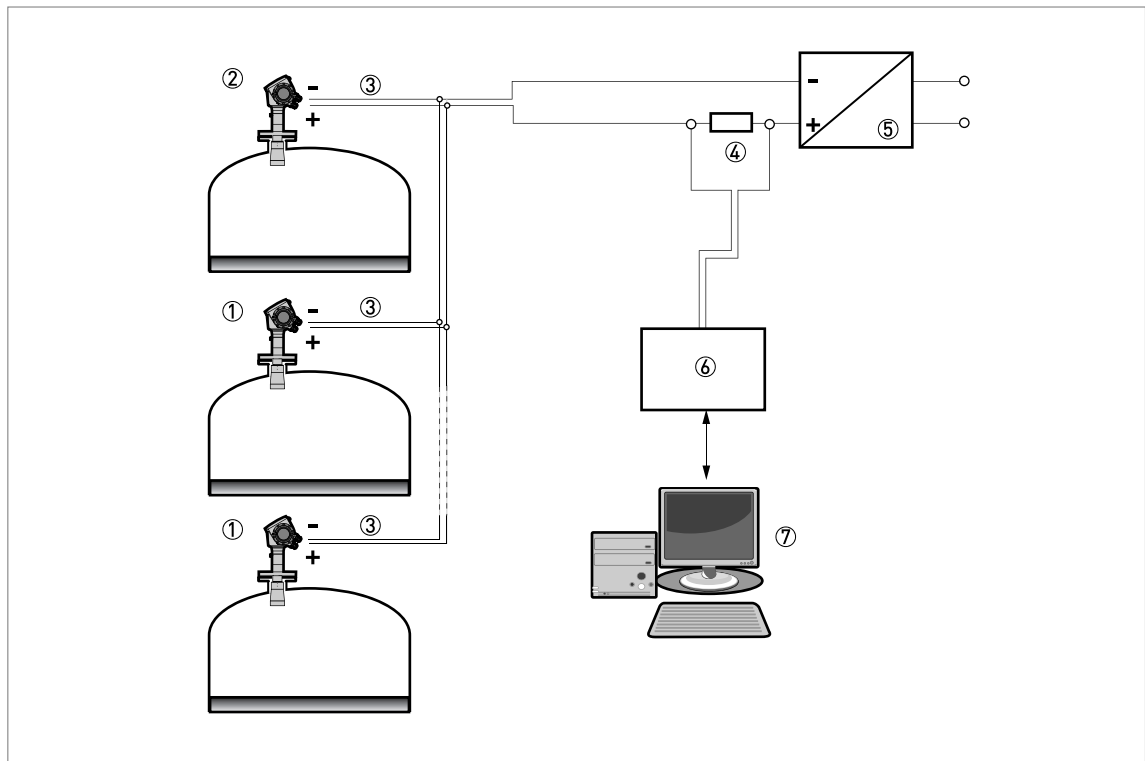


Figure 4-5: Multi-drop network (non-Ex)

- 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? Use the applicable electrical cables with the cable glands.

**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 website. It is also supplied on the DVD-ROM delivered with the device.
- A connection to a system or PC with AMST™. You can download the Device Description (DD) file from the website. It is also supplied on the DVD-ROM delivered with the device.
- A connection to a HART® Field Communicator. You can download the Device Description (DD) file from the website. It is also supplied on the DVD-ROM delivered with the device.

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 (gray text cannot be selected)
- ④ [▲] / [▼]: scroll up/scroll down
- ⑤ Keypad buttons (refer to the table below)

5.3.2 Keypad buttons

Keypad button	Description
	Right [▶]
	Enter [←]
	Down [▼]
	Up [▲]
	Esc (Escape) [▶] + [▲]

For data on keypad functions, refer to *Operator mode* on page 39.

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. Push [➤] 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 on page 47.

5.4 Remote communication with PACTware™

PACTware™ displays measurement information clearly on a computer (PC) 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 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 DVD-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.com>.



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® 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 DVD-ROM supplied with the device. You can also download it from our website.

6.1 User modes

Operator	This mode displays measurement data. For more data, refer to <i>Operator mode</i> on page 39.
Supervisor	Use this mode to view parameters, commission the device, create tables for volume or mass measurement, change critical values to measure in difficult process conditions. To get access to the supervisor menu, refer to <i>Protection of the device settings</i> on page 57. For more data on menu items, refer to <i>Function description</i> on page 47.

6.2 Operator mode





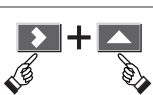
The operator can choose what information to display.

This section shows you:

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

Some data (volume, mass etc.) will only be available if the device is correctly configured by the supervisor, as described below.

Functions of keypad buttons in operator mode

Keypad button	Description	Normal function	"Hot key" function
	Right	Change display style ①	Enter program mode ②
	Enter	—	Enter signal screen editing mode ③
	Down	Change measurement parameter ④	The screen shown at this time becomes the default screen ②
	Up	Change measurement parameter ④	Display language will change to English ⑤
	Esc (Escape)	—	—

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

② Push this button for 1 second

③ Push this button after the selection of the signal screen. For more data, refer to "Operation: How to make the device follow the correct level or interface signal".

④ Level, distance, volume etc.

⑤ Push this button for 3 seconds. Push the button again and it will go back to the original language.

Screens in operator mode

Text and image screen	Go to	% current output screen	Go to	Text screen	Go to
[▲]		[▲]		[▲]	
Level	[>]	Level	>	Level	> (Text and image)
[▲]/[▼]		[▲]/[▼]		[▲]/[▼]	
Distance	[>]	Distance	[>]	Distance	[>] (Text and image)
[▲]/[▼]		[▲]/[▼]		[▲]/[▼]	
Volume ①	[>]	Volume ①	[>]	Volume ①	[>] (Text and image)
[▲]/[▼]		[▲]/[▼]		[▲]/[▼]	
Mass ②	[>]	Mass ②	[>]	Mass ②	[>] (Text and image)
[▲]/[▼]		[▲]/[▼]		[▲]/[▼]	
Ullage volume ①	[>]	Ullage volume ①	[>]	Ullage volume ①	[>] (Text and image)
[▼]		[▼]		[▲]/[▼]	
Back to the top of the list		Back to the top of the list		Reflectivity	
				[▲]/[▼]	
				Signal screen ③	
				[▼]	
				Back to the top of the list	

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

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

③ This screen shows a graph of discrete radar reflection signals against distance. This graph is used to monitor reflections measured by the device. Push [>] 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 47 (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 47 (Table C. Advanced setup).
- Save **Quick Links** for items that you use regularly. For more data about quicklinks (menu items A.2 to A.6), refer to *Function description* on page 47 (Table A. Quick setup).
- Error finding and troubleshooting procedures are described in the **Test** menu. For more data, refer to *Function description* on page 47 (Table B. Test).

6.3.2 How to get access to the supervisor mode



Do the steps that follow:

- Push the [➤] button for one second.
 - ➡ This displays the login screen.
- Push the [▲] or [▼] buttons to select **Supervisor** from the list.
- Push the [↵] 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 47 (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 gray text.

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

6.3.3 Menu overview

A Quick Setup

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

B Test

B.1	Test
B.2	Information

C Advanced Setup

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

① Optional

6.3.4 Keypad functions

Menu navigation

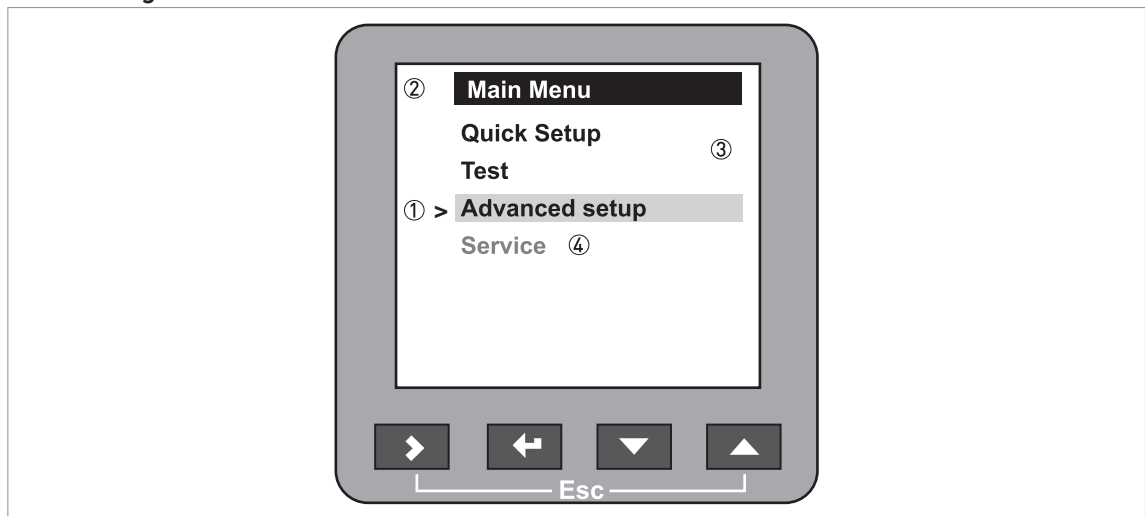


Figure 6-1: Menu navigation

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

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

Function of keypad buttons in the menu lists

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

Lists of parameters in menu items

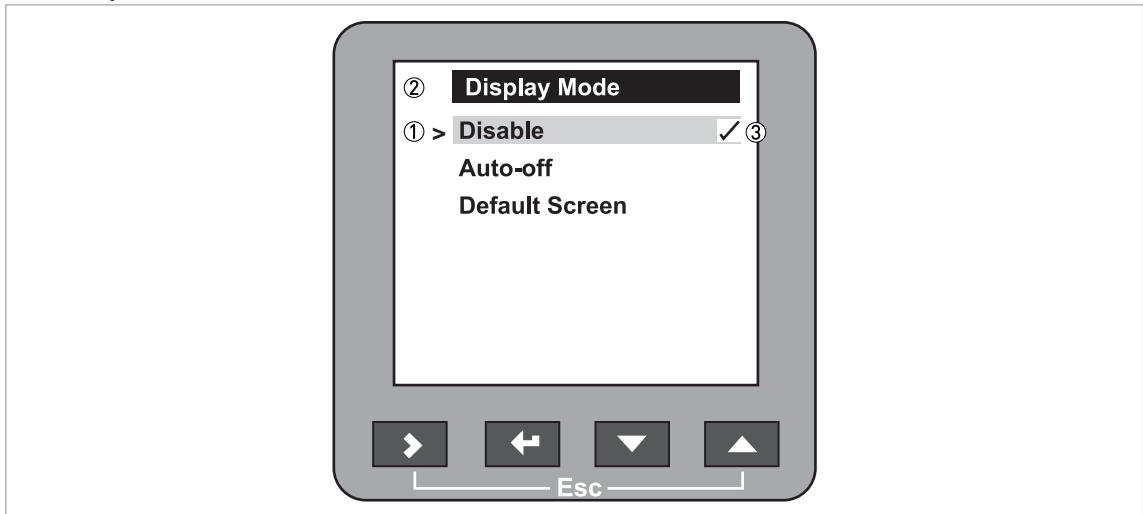


Figure 6-2: Lists of parameters in menu items

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

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

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

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

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

Values in menu items

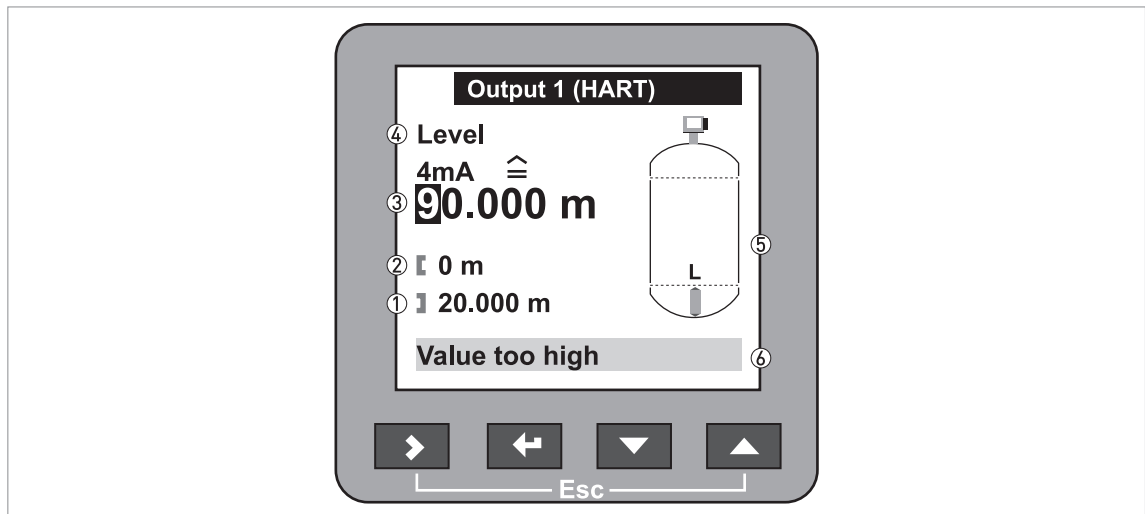


Figure 6-3: Values in menu items

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

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





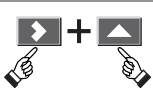
Function of keypad buttons in menu items that have values

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

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

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

Hotkey functions in supervisor mode

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

① Make a selection from the Advanced Setup menu list

② Push this button for 3 seconds

How to save settings



- When you have changed parameters in all the necessary menu items, push [←] to accept the new parameter.
- Push [→] 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
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A.1 Setup Mode

A.1.1		Complete	This follows the steps given in the Installation, Empty Spectrum, Conversion and Outputs setup modes.		
A.1.2		Installation	Follow this procedure to describe the silo and the product.		
	1	Installation Type	The silo material.	Metal / concrete silo, Plastic silo, Free Air Application	Metal silo
	2	Tank Height / Measuring Range	"Tank Height" is the distance from the silo connecting flange face/thread stop to the silo bottom. "Measuring Range" (for "Free Air Application" only) is the maximum distance that a device must measure.	min-max: 0.20...80 m / 0.66...262 ft	20 m
	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 "Medium slope". If the surface has a steep slope, select "Steep slope".	Medium slope, Flat surface, Steep slope	Medium slope
	4	Blocking Distance	A zone given by the user where it is not possible to measure. We recommend a minimum blocking distance of 300 mm / 12" below the antenna.	min-max: antenna extension [C.1.6] + 50 mm / 2"...tank height [C.1.2] ①	②
	5	Settings summary			
	6	Current changes must be saved or cancelled before proceeding		Save, Cancel ③	
A.1.3		Empty Spectrum	Fixed and moving objects in the tank cause interference signals. Put them through this filter to correctly measure the 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, e.g. agitators, 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

Menu No.	Step	Function	Function description	Selection list	Default
	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	Average
	6	Empty spect. recording is in progress	...	...	...
	7	Empty spectrum graph	...	...	...
	8	Do you want to save the spectrum?	If you save this data, the device will use it when it measures the silo contents.	Save, Cancel ③	Save
A.1.4		Conversion	Follow this procedure to set the device up to display readings in volume, mass or user-defined units.		
Sub-menu		Conversion submenu [Volume]			
	1	Do you want to use free unit?	Select "No".	Yes, No	No
	2	Table Length Unit		m, cm, mm, inch, ft, Free Unit	m
	3	Please select Volume / Mass	Select "Volume".	Volume	
	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	Volume Table	A table that converts product level to product volume. Push[▲] or [▼] to select a line and push [▶] to change values automatically supplied by the device.		
Sub-menu		Conversion submenu [Mass]			
	1	Do you want to use free unit?	Select "No".	Yes, No	No
	2	Table Length Unit		m, cm, mm, inch, ft, Free Unit	m
	3	Please select Volume / Mass	Select "Mass".	Mass	
	4	Do you want to use the density of the product?		Yes, No	Yes
	5	Product Density		min-max: 0...20000 kg/m3	0

Menu No.	Step	Function	Function description	Selection list	Default
	6	Tank Shape	The Wizard adds this step if you select "Yes" in step 4. This sub-procedure uses the information given here to find the volume. You have to type in the tank shape, height, width and length.	...	...
	7	Conversion Unit	The conversion unit is given as a volume if the product density is given. If not, choose a mass unit.	m3, L, US gal, GB gal, ft3, bbl or Tons, kg, US Tons, GB Tons	m3 or Tons
	8	Mass Table	A table that converts product level to product mass. If you selected "Yes" in step 4, make entries in the table in volume units. Push [▲] or [▼] to select a line and push [➤] to change values automatically supplied by the device.		
Sub-menu		Conversion submenu [Free Unit]	If you cannot find the units or silo shape in the menu, you can customize the conversion table.		
	1	Do you want to use free unit?	Select "Yes".	Yes, No	No
	2	Custom. Length Unit	A non-standard length unit for the conversion table. This is defined by the supervisor.		LEN_FREE_
	3	Custom. Length Ratio	The conversion factor between the length unit selected in C.5.1.4 (length unit) and C.5.1.7 (customer length unit). This ratio is a multiple of 1 mm.	min-max: 1...99999	1
	4	Custom. Conv. Unit	A non-standard conversion unit for the conversion table. This is defined by the supervisor.		CO_FR_UN
	5	No. of Entries	The number of lines in the conversion table.	min-max: 0...50	2
	6	Volume/Mass Table	A table that converts product level to another physical parameter. Push [▲] or [▼] to select a line and push [➤] to change values automatically supplied by the device.		
	...	Current changes must be saved or cancelled before proceeding		Save, Cancel ③	Save
A.1.5		Outputs	Follow this procedure to describe the output characteristics.		
	1	Output 1: Output Function	Select an output function to scale the current values (output 1). This is not displayed in the operator mode.	Level, Distance, Volume (Mass), Ullage Volume (Ullage Mass), Reflection	Level
	2	Output 1 (HART): <Function> 4 mA	This assigns a measurement value to 4 mA (output 1).	min-max: 0...20 m / 0...65.62 ft	0 m / 0 ft
	3	Output 1 (HART): <Function> 20 mA	This assigns a measurement value to 20 mA (output 1).	min-max: 0...90 m / 0...295.29 ft	Depends on the output function

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

A.2 Quick Link 1

		Quick Link 1	Direct link to an item in the Advanced Setup menu	Go to a function in the Advanced Setup menu and push [➤] for 1 second. You can store up to 5 functions in this way.	Error Records
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A.3 Quick Link 2

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 push [➤] for 1 second. You can store up to 5 functions in this way.	Measurement Quality
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Menu No.	Step	Function	Function description	Selection list	Default
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A.4 Quick Link 3

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 push [>] for 1 second. You can store up to 5 functions in this way.	Language
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A.5 Quick Link 4

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 push [>] for 1 second. You can store up to 5 functions in this way.	Length Unit
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A.6 Quick Link 5

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 push [>] for 1 second. You can store up to 5 functions in this way.	Display Mode
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- ① This range depends on other user functions
- ② This value depends on other user functions
- ③ This step is ignored if you use the "Complete" setup mode
- ④ Optional

B. Test

Menu No.	Function	Function description	Selection list	Default
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B.1 Test

B.1.1	Show Output 1	This displays analogue output 1 value [mA].	Read only	
B.1.2	Set Output 1	This sets analogue output 1 to a test value [mA] selected from a list. Output will change to the selected value, independent of the measured value.	3.6, 4, 6, 8, 10, 12, 14, 16, 18, 20 or 22 mA	4 mA
B.1.3	Show Output 2	This displays analogue output 2 value [mA].	Read only	
B.1.4	Set Output 2	This sets analogue output 2 to a test value [mA] selected from a list. Output will change to the selected value, independent of the measured value.	3.6, 4, 6, 8, 10, 12, 14, 16, 18, 20 or 22 mA	4 mA
B.1.5	Internal Test	This initiates the hardware test. The device displays the results.	Read only	

B.2 Information

B.2.1	Outputs	Analogue output settings. This includes assigned functions, 4 ... 20 mA scale settings, error handling and HART® parameters.	Read only	
B.2.2	15 Min Log	A log of output values for the last 15 minutes. A log is taken every 10 seconds and displayed on a graph.	Read only	

Menu No.	Function	Function description	Selection list	Default
B.2.3	Device ID	This displays device order no, V-no, service no, Ex approval, Main CPU version, Companion CPU version and DSP version.	Read only	
B.2.4	Quick Setup Sum.	A summary of the parameters entered in the quick setup menu	Read only	
B.2.5	TAG number	The TAG number can be seen and updated here	?	TAGNO0123 4567890
	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 push [←] 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	Custom. Length Unit	Non-standard length unit for the conversion table. This is defined by the supervisor. Go to Supervisor > Advanced Setup > Device Setup > Display Settings > Custom. Length Unit or follow the procedure in the Conversion setup menu.	Read only	
B.2.9	Custom. Conv. Unit	Non-standard conversion unit for the conversion table. This is defined by the supervisor. Go to Supervisor > Advanced Setup > Device Setup > Display Settings > Custom. Conv. Unit or follow the procedure in the Conversion setup menu.	Read only	

C. Advanced setup

Menu No.	Function	Function description	Selection list	Default
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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 / Measuring Range	"Tank height" is the distance from the silo connecting flange face/thread stop to the silo bottom. "Measuring range" (for "Free Air Application" only) is the maximum distance that the device must measure.	min-max: 0.20...80 m / 0.66...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 "Medium slope". If the surface has a steep slope, select "Steep slope".	Flat surface, Medium slope, Steep slope	Medium slope
C.1.4	Stillwell Height	Not available. For liquid applications only.	n/a	n/a

Menu No.	Function	Function description	Selection list	Default
C.1.5	Stillwell Diameter	Not available. For liquid applications only.	n/a	n/a
C.1.6	Antenna Extension	Optional antenna extension. These are attached between the flange and the antenna. Each part is 105 mm / 4.1" long.	min-max: 0...5000.00 mm / 0...196.85"	0 mm / 0"
C.1.7	Distance Piece	Optional distance piece between the converter and the process connection.	min-max: 0...5000.00 mm / 0...196.85"	0 mm / 0"
C.1.8	Overfill Detection	If this function is switched on, the device will monitor the level even if it is in the blocking distance. The displayed output stays fixed at the blocking distance, but an error message will warn the user that the silo is overfilling.	Yes, No	No
C.1.9	Blocking Distance	The distance from the flange to the top limit of the measuring range (a zone given by the user where it is not possible to measure). We recommend a minimum blocking distance of 300 mm / 12" below the antenna. If the distance is less than the blocking distance, the device continues to display the blocking distance.	min-max: antenna extension (C.1.6) + 50 mm / 2"...tank height (C.1.2)	0.5 m / 1.6 ft
C.1.10	Reference Offset	Offset relating to a reference location (distance). This value is positive when the reference location is above the device flange face and negative if below. For more data, refer to <i>Distance measurement</i> on page 58.	min-max: -tank height...50 m / -tank height...164.05 ft	0 m / 0 ft
C.1.11	Tank Bottom Offset	Offset relating to a reference location (level). The device reference point for this parameter is the bottom of the 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. For more data, refer to <i>Level measurement</i> on page 59.	min-max: -tank height...3000 m / -tank height...9843 ft	0 m / 0 ft
C.1.12	Time Constant	Using this function, the device processes several measurement readings to filter out disturbances. Increasing the time constant will smoothen the integrated readings, decreasing will roughen the readings.	min-max: 1...100 sec (seconds)	3 sec
C.1.13	Measuring Mode	This menu item is set by default to "Direct Measuring" to measure the level of most tank contents. The device uses the largest radar signal to monitor level. If it is possible there will be an interference signal in the measurement zone that is larger than the level signal, select "Direct Plus" mode. If you select "Direct Plus" mode, the device locks on the level signal and monitors changes in level. If the device then finds larger reflections in the silo, it will only monitor the largest signal in a small search zone around the first reflection found and ignore all other reflections. The interference signal must not be near to the level signal.	Direct Measuring, Direct Plus	Direct Measuring
C.1.14	Product Er	Not available. For liquid applications only.	n/a	n/a

Menu No.	Function	Function description	Selection list	Default
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 silo, 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 silo with a small convex or flat roof can also cause multiple reflections.	Yes, No	No
C.1.17	Empty Spect. OnOff	This function starts and stops interference signal filter. Interference signals are the result of fixed and moving obstacles inside the silo. If you must do a spectrum analysis, record an empty spectrum first. Go to the "Empty Spectrum" menu (A.1.3.0) in the Quick Setup list.	On, Off	Off
C.1.19	Units For Tables	Sub-menu for volume and mass conversion operations.		
C.1.19.1	Table Length Unit	The length unit used in the conversion table. If "Free Unit" is selected, the device uses the unit name in menu item C.5.1.7.	m, cm, mm, inch, ft, Free Unit	m
C.1.19.2	Conversion Unit	The volume or mass unit used in the conversion table. If "Free Unit" is selected, the device uses the unit name in menu item C.5.1.9.	m ³ , L, US gal, GB gal, ft ³ , bbl, Tons, Kg, US Tons, GB Tons, Free Unit	m ³
C.1.20	Product Density	A value greater than 0 that is used with a volume conversion table to start the mass calculation. This menu item is not available if you have selected a mass unit.	0...20000 kg/m ³	0
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. Push [←]. Type in the level and corresponding volume / mass values.	Number of entries min.-max: 0...50	No table. Table units are selected in menu items C.1.19.1 and C.1.19.2.
C.1.22	Linearisation Table	The device uses this table to increase on-site accuracy. Give the number of entries plotted. Fill the silo. Make a reference measurement and type in the correct value next to the device reading. For more data, refer to <i>Linearisation</i> on page 58.	Number of entries min.-max: 0...50	0

C.3 Output 1 (HART)

C.3.1	Output Function	Select an output function to scale the current values. This is not displayed in the operator mode.	Level, Distance, Volume (Mass), Ullage Volume (Ullage Mass), Reflection	Level
C.3.2	4 mA Setting	Give a measurement value to 4 mA.	min.-max: ①	0 m / 0 ft
C.3.3	20 mA Setting	Give a measurement value to 20 mA.	min.-max: ②	Depends on the output function
C.3.4	Output Range	Sets the effective range of output 1 either with or without over-run.	min.-max: 3.8...20.5 mA (NAMUR), 4...20 mA	4...20 mA

Menu No.	Function	Function description	Selection list	Default
C.3.5	Error Handling	This sets the behaviour of current output 1 if an error occurs. Hold means that the output current stays at the value where the error occurred. Hold is not available if 3.8...20.5 mA (NAMUR) is the output range.	3.6 mA, 22 mA, Hold	22 mA
	Error Handling Delay	The time after which the current output changes to an error value. It shows that there is a measurement error.	min.-max: 0...900 sec (seconds)	10 sec
C.3.6	HART Address	Any HART® address greater than 0 will activate HART® multidrop mode. The current output stays constant at 4 mA.	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. ③	Level, Distance, Volume (Mass), Ullage Volume (Ullage Mass), Reflection	Level
C.4.2	4 mA Setting	Give a measurement value to 4 mA. ③	min.-max: ①	0 m / 0 ft
C.4.3	20 mA Setting	Give a measurement value to 20 mA. ③	min.-max: ②	Depends on the output function
C.4.4	Output Range	Sets the effective range of output 2 either with or without over-run. ③	min.-max: 3.8...20.5 mA (NAMUR), 4...20 mA	4...20 mA
C.4.5	Error Handling	This sets the behaviour of current output 2 if an error occurs. Hold means that the output current stays at the value where the error occurred. Hold is not available if 3.8...20.5 mA (NAMUR) is the output range. ③	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. ③	Read only	Refer to function C.3.5

C.5 Device Setup

C.5.1	Display Settings	To display the information you need, refer to these menu items.		
C.5.1.1	Language	Information can be displayed in any of the 9 languages stored in the device. If it is necessary to change the display quickly to English, push [▲] for 3 seconds in operator mode.	English, French, German, Italian, Japanese, Chinese (simplified), Portuguese, Russian, Spanish	
C.5.1.2	Display Mode	The display screen status will change after the time given in C.5.1.3. (time delay). Disable switches off this functionality, Auto-Off switches off the display and Default Screen will show the selected default screen. To set to the default screen, push [▼] for 1 second in the operator mode.	Disable, Auto-Off, Default Screen	Disable
C.5.1.3	Time Delay	The time after which the display will switch to the status set in C.5.1.2 (Display Mode).	1, 3, 5, 10 (minutes)	1
	Contrast	The contrast control for the display screen. You can select a shade of gray between light gray (level 1) and black (level 9).	Level 1, Level 2, Level 3, Level 4, Level 5, Level 6, Level 7, Level 8, Level 9	Level 5
C.5.1.4	Length Unit	The length unit displayed in operator mode.	m, cm, mm, inch, ft, ft-inch-1/16inch, ft-inch-1/32inch, Free Unit	m

Menu No.	Function	Function description	Selection list	Default
C.5.1.5	Volume Unit	The volume unit displayed in operator mode.	m3, L, US gal, GB gal, ft3, bbl	m3
C.5.1.6	Mass Unit	The mass unit displayed in operator mode.	Tons, Kg, US Tons, GB Tons	Kg
C.5.1.7	Custom. Length Unit	A non-standard length unit for the conversion table. This is defined by the supervisor.		LEN_FREE_
C.5.1.8	Custom. Length Ratio	The conversion factor between the length unit selected in C.5.1.4 (Length Unit) and C.5.1.7 (Custom. Length Unit). This ratio is a multiple of 1 mm.	min.-max: 1...99999	1
C.5.1.9	Custom. Conv. Unit	A non-standard conversion unit for the conversion table. This is defined by the supervisor.		CO_FR_UN
C.5.2	Passwords	To change user passwords, refer to these menu items.		
C5.2.2	Supervisor	This changes the supervisor password. Push the keypad buttons up to 6 times in any order. This will be the new password. To confirm the change, enter the new password a second time.		[>], [←], [▼], [▲], [>], [←]

C.6 Reset

C.6.2	Clear Error Record	Erase the error record in menu item B.2.6. Push [←] to confirm.		
C.6.3	Restart	If the device is not functioning properly, this menu item will restart the device. Push [←] to confirm.		

- ① Units and range depend on the output function, length unit and volume unit selected. See also the table of data dependencies for the 4 mA settings in this section.
- ② Units and range depend on the output function, length unit and volume unit selected. See also the table of data dependencies for the 20 mA settings in this section.
- ③ This function is applicable only to a device that has two outputs

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

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

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

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

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

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

③ RO = Reference Offset [C1.10].

6.4 Further information on device configuration

6.4.1 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 (push 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". Push [➤] and [▲] at the same time and type in the new 6-character password again.
- Push [➤] and [▲] (Esc) at the same time to go back to the "save settings" window.
- Select **Save** and push [↵].
- ➡ 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.

6.4.2 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 push [↵] to confirm (see the caution below).
- Push the Escape buttons ([>] + [▲]) until you get the save/cancel screen.
- Select save.
- Push [↵].
- ➡ 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 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 push [↵] to confirm.
- Push the Escape buttons ([>] + [▲]) until you get the save/cancel screen.
- Select save.
- Push [↵].
- ➡ 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**).

6.4.3 Linearisation

You can use the **Linearisation Table** (menu item C.1.22) 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). Push [↵].
- ➡ This shows the linearisation table with default values.
- Push [➤] 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.
- Push [↵].
- Push [➤] and [▲] (Esc) at the same time to exit to the "save settings" window.
- Select **Save** and push [↵].
- ➡ The device will go back to operator mode.

6.4.4 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 you 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 you give a distance for the 4 and 20 mA current output settings.



CAUTION!

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

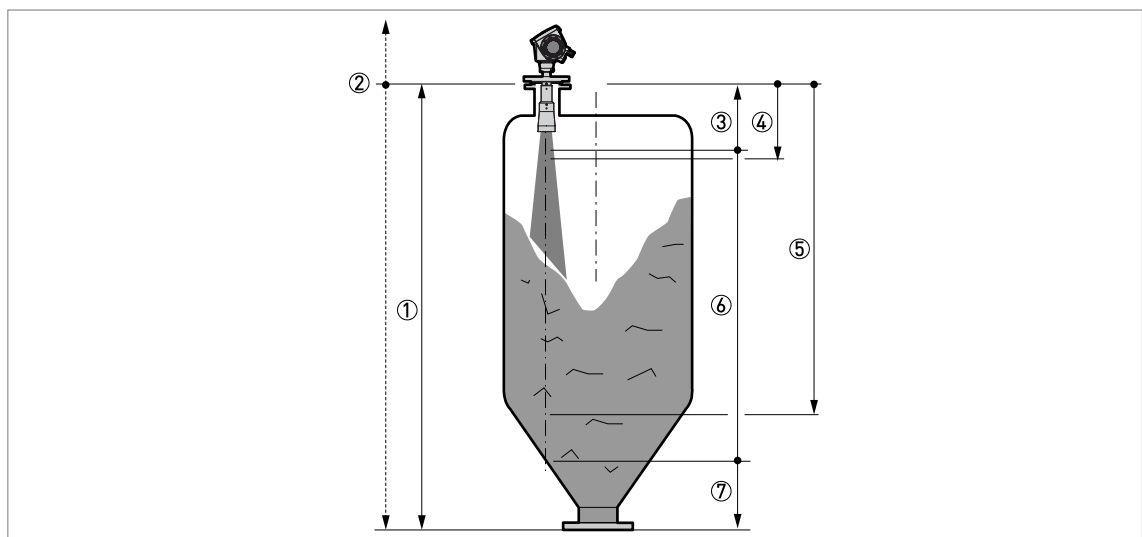


Figure 6-4: Distance measurement

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

For more data about the menu items, refer to *Function description* on page 47, table C. Advanced setup.

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

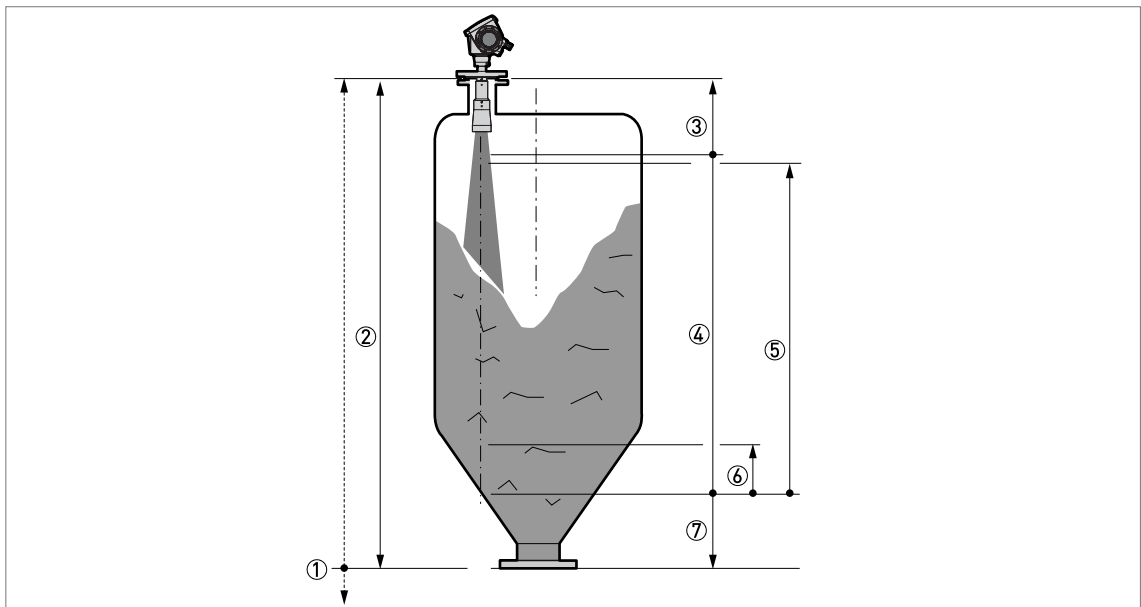


Figure 6-5: Level measurement

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

For more data about the menu items, refer to *Function description* on page 47, table C. Advanced setup.

6.4.6 How to configure the device to measure volume or mass

The device can be configured to measure volume or mass. You can set up a strapping table in the conversion table in the device's **Quick Setup** menu.



How to create a volume or mass table.

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

The device creates a table of up to 50 pairs of data (level – volume or level – mass). The reference point for the table is the 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.

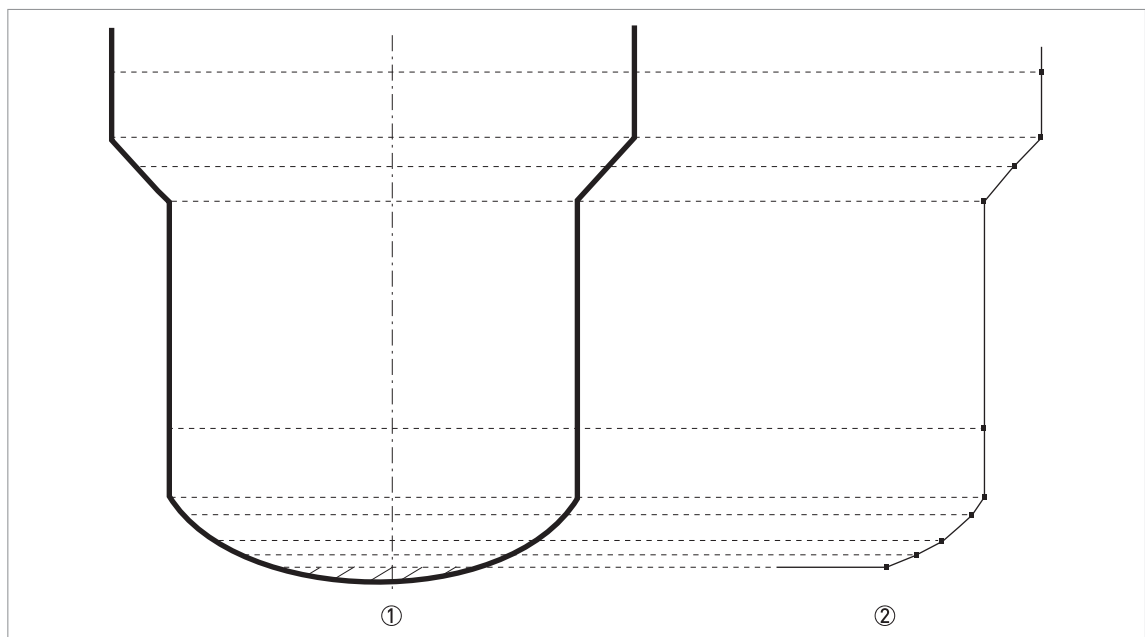


Figure 6-6: A plot of points for a volume or mass table

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

6.4.7 How to make a filter to remove radar signal interference

If the device measures level in a silo that contains obstructions (ladder, supports etc.), these objects can cause radar signal interference (parasitic signals). You can use the empty spectrum function (menu item A.1.3) in the Quick Setup menu to make a filter to remove radar signal interference.



INFORMATION!

We recommend that you do an empty spectrum scan when the silo is empty and all the moving parts are in operation..

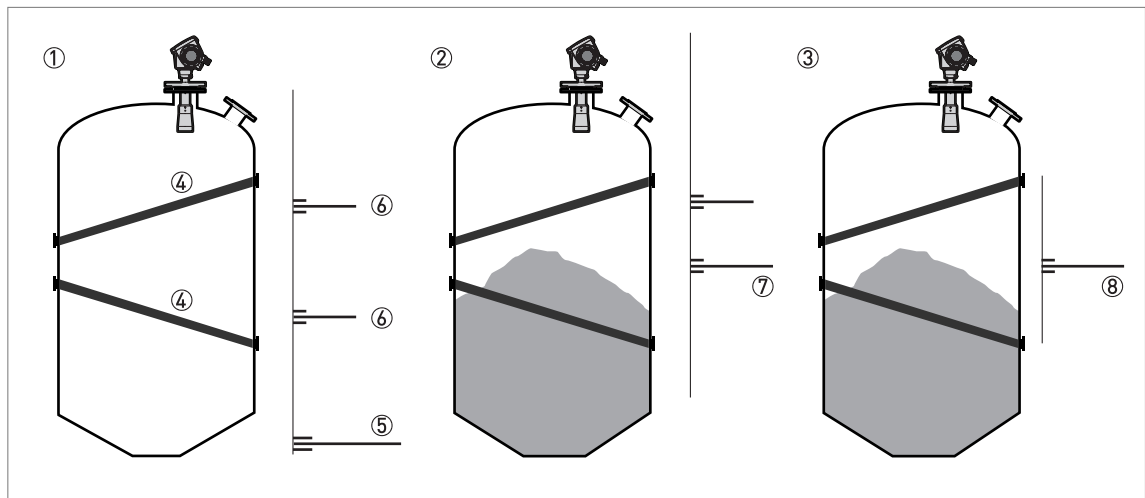


Figure 6-7: How to make a filter to remove radar signal interference

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



- Get access to the **Main Menu** of the supervisor mode.
- ➔ For more data, refer to *How to get access to the supervisor mode* on page 41.
- Go to **Main Menu > Quick Setup > Setup Mode > Empty Spectrum**.
- Is the tank completely full? Select **Yes** or **No** and then push [←].
- ➔ 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 push [←].
- Is your tank partially filled or completely empty? Select **Partially filled** or **Empty** and then push [←].
- Do you want to use the average value or the maximum value? Select **Average** or **Maximum** and then push [←].
- ➔ 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.
- Push [←]. Do you want to save the spectrum. Select **Yes** or **No** and then push [←].

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



INFORMATION!

For more data on empty spectrum scans, refer to Function description on page 47 – table A. Quick Setup (menu item A.1.3).

6.4.8 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.
- Push [➤] 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).
- Push [⬅].
- Push [➤] and [▲] (Esc) at the same time to exit to the "save settings" window.
- Select **Save** and push [⬅].
- The device will go back to operator mode.

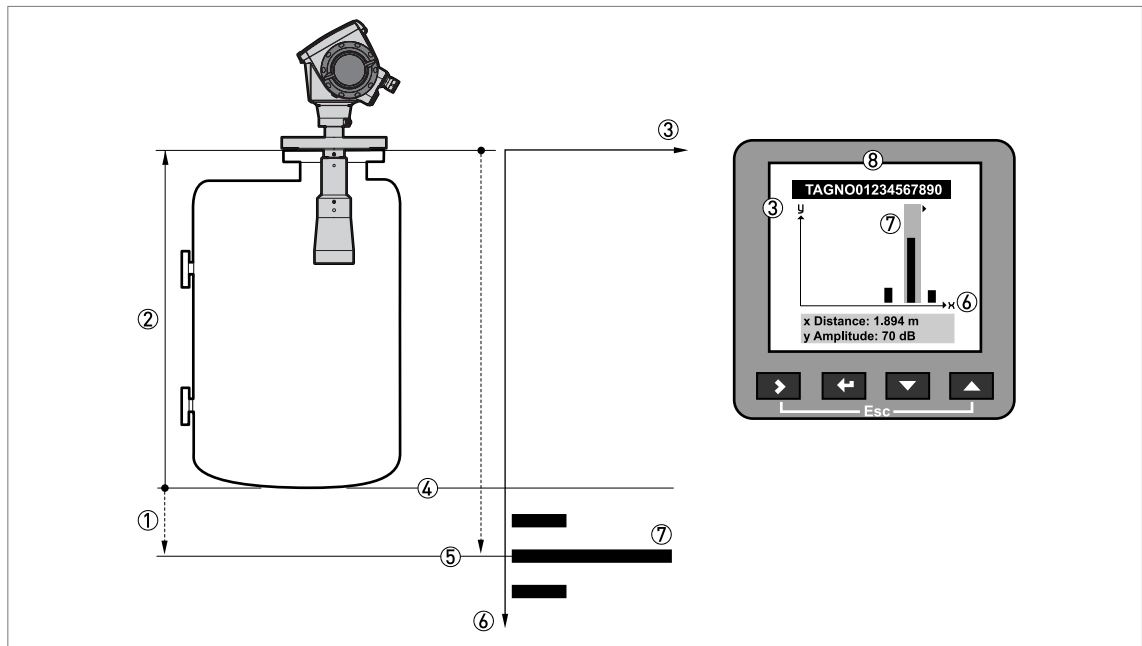


Figure 6-8: Signal screen and the silo bottom reflection

- 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 47*, 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.

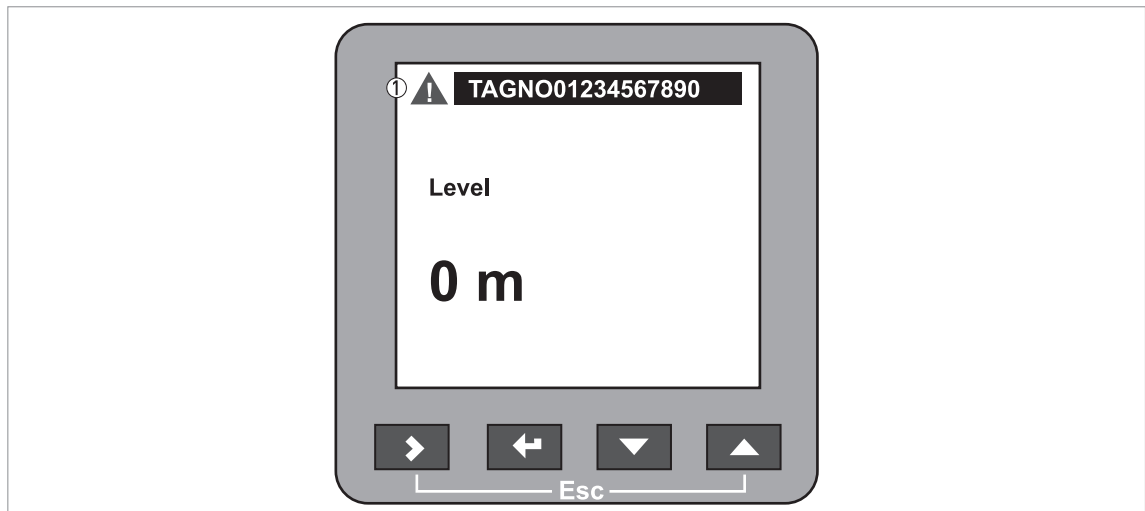


Figure 6-9: Indication of errors

① Error/ warning symbol

Enter the supervisor mode to either:

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



How to check the measurement quality

- Enter supervisor mode.
- Go to **Test > Information > Measurement Quality**.
- ➡ This shows the status of device errors at this time. A "tick" symbol next to an error in the list shows that this error is active and may have an unwanted effect on the device.
- For solutions to the problem, refer to *Error handling* on page 68.



Figure 6-10: Measurement quality in supervisor mode

- ① Type of error.
- ② Error "active"



How to find the error records

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

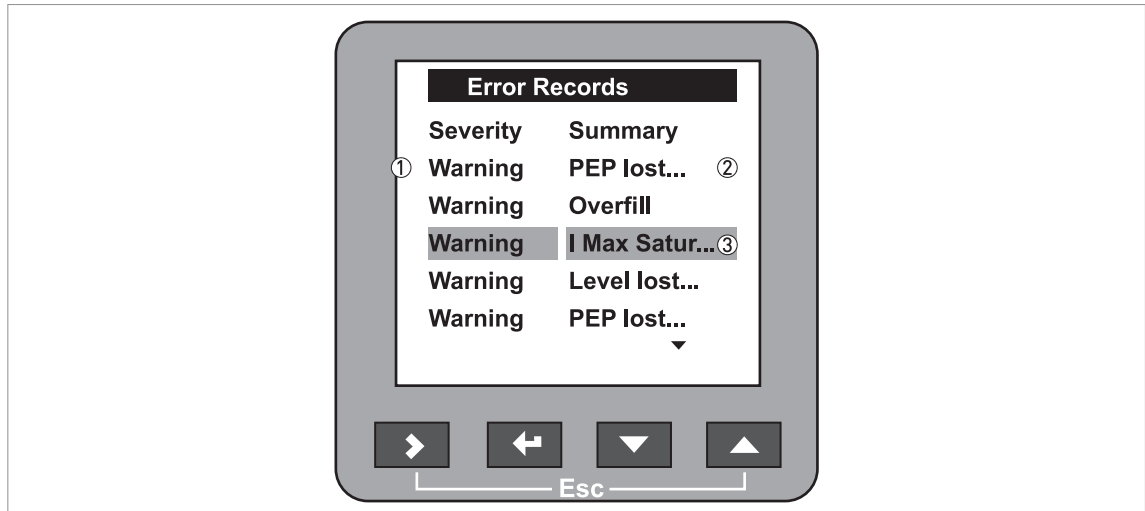


Figure 6-11: Error records in supervisor mode

- 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 push [←] 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 68.



Figure 6-12: Description of the error

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

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

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

6.6.2 Error handling

Types of error message

Type of error	Error code	Description
Error	E	If an error message is displayed in the error record (menu item B.2.6), the measured value is not correct. The output current goes to the value set in menu items C.3.5 Error Handling (Output 1) and C.4.5 Error Handling (Output 2). For more data, refer to <i>Function description</i> on page 47, table C. Advanced Setup.
Warning	W	If a warning message continues, the measured value will no longer be correct.

Description of errors and corrective actions

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

Current output

Current output saturated at maximum value	W	The output is at its maximum output value (20 or 20.5 mA) because the measured value is now out of the measurement range.	Fill the 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

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

Self Test has failed	E	The device's self-test failed. This can occur if the ambient temperature is not between -40...+80°C / -40...+175°F.	Energize the device when the ambient temperature is between -40...+80°C / -40...+175°F. If the device does not operate correctly, contact the supplier.
		One of the electronic boards is defective.	Replace the electronics block. For more data, refer to <i>Replacement of the complete electronic module</i> on page 74.

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

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 overflow)	W	The level is in the blocking distance. There is a risk that the product will overflow and/or cover the device.	Remove some of the product until the level is below the blocking distance.
Measurement is lost in the tank bottom	W	The silo is possibly empty. The device will display the tank 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 (DIN 28011 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 63.

Electronics failures

Microwave check failed	E	A microwave board check failed.	If the problem continues, contact the supplier or replace the electronics block. For more data, refer to <i>Replacement of the complete electronic module</i> on page 74.
Peripheral Failure	E	Hardware peripheral devices on the DSP board failed.	If the problem continues, contact the supplier or replace the electronics block. For more data, refer to <i>Replacement of the complete electronic module</i> on page 74.

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

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 62. 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 (application type, installation type, 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 62. 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 62. If necessary, contact the supplier.

Software error

Unable to load DSP firmware	E	The DSP Firmware did not download correctly to the DSP board.	Restart the device. If the problem continues, contact the supplier or replace the electronics block. For more data, refer to <i>Replacement of the complete electronic module</i> on page 74.
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7.1 Periodic maintenance

In normal operational conditions, no maintenance is necessary. If it is necessary, maintenance must be done by approved personnel (the manufacturer or personnel approved by the manufacturer).



INFORMATION!

For more data about regular inspections and maintenance procedures for devices with Ex and other approvals, refer to the related supplementary instructions.

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 complete electronic module.
- The removal and installation of the terminal module.
- The removal and installation of the HMI cover.

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

Use only authorized service staff to repair the device.

7.4.2 Replacement of the display cover

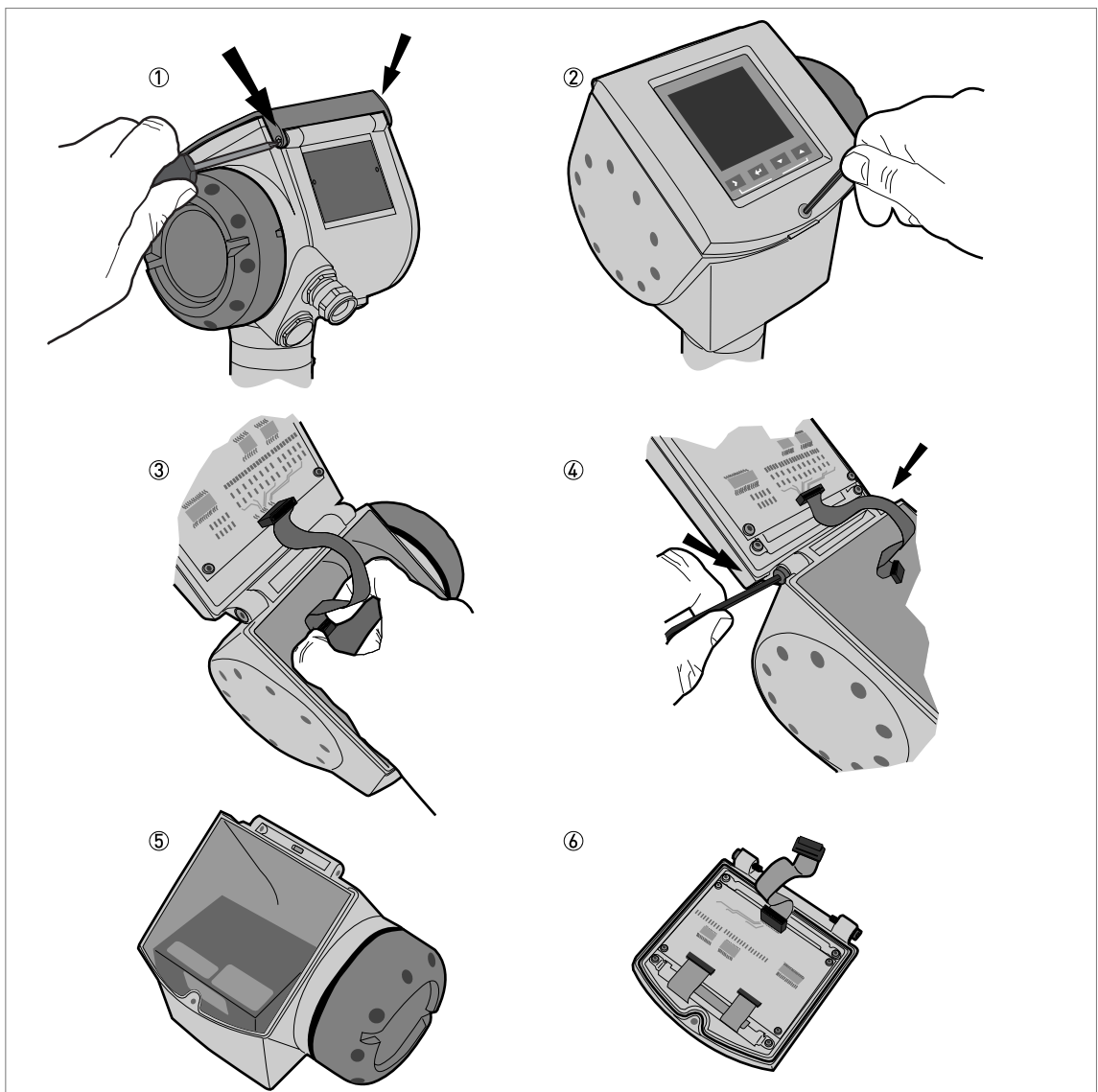


Figure 7-1: Removal of the device display cover

Equipment needed (not supplied):

- TORX T8 wrench.
- 3 mm Allen wrench (for steps 2 and 4).

**WARNING!**

Disconnect the power supply

**How to remove the display**

- ① Remove the 2 small screws on the hinge of the blue sun cover with a TORX T8 wrench. 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 small screws that keep the sun cover attached to the housing.

7.4.3 Replacement of the complete electronic module

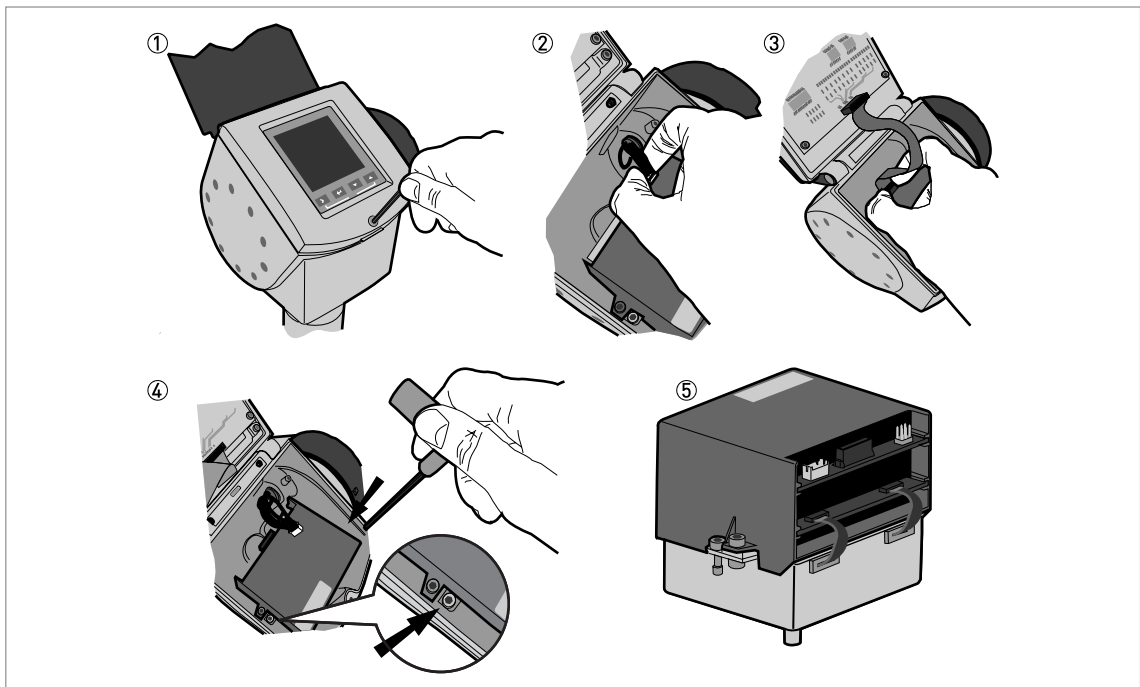


Figure 7-2: Removal of the complete electronic module

Equipment needed (not supplied):

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

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

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

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

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

7.4.4 Replacement of the terminal module

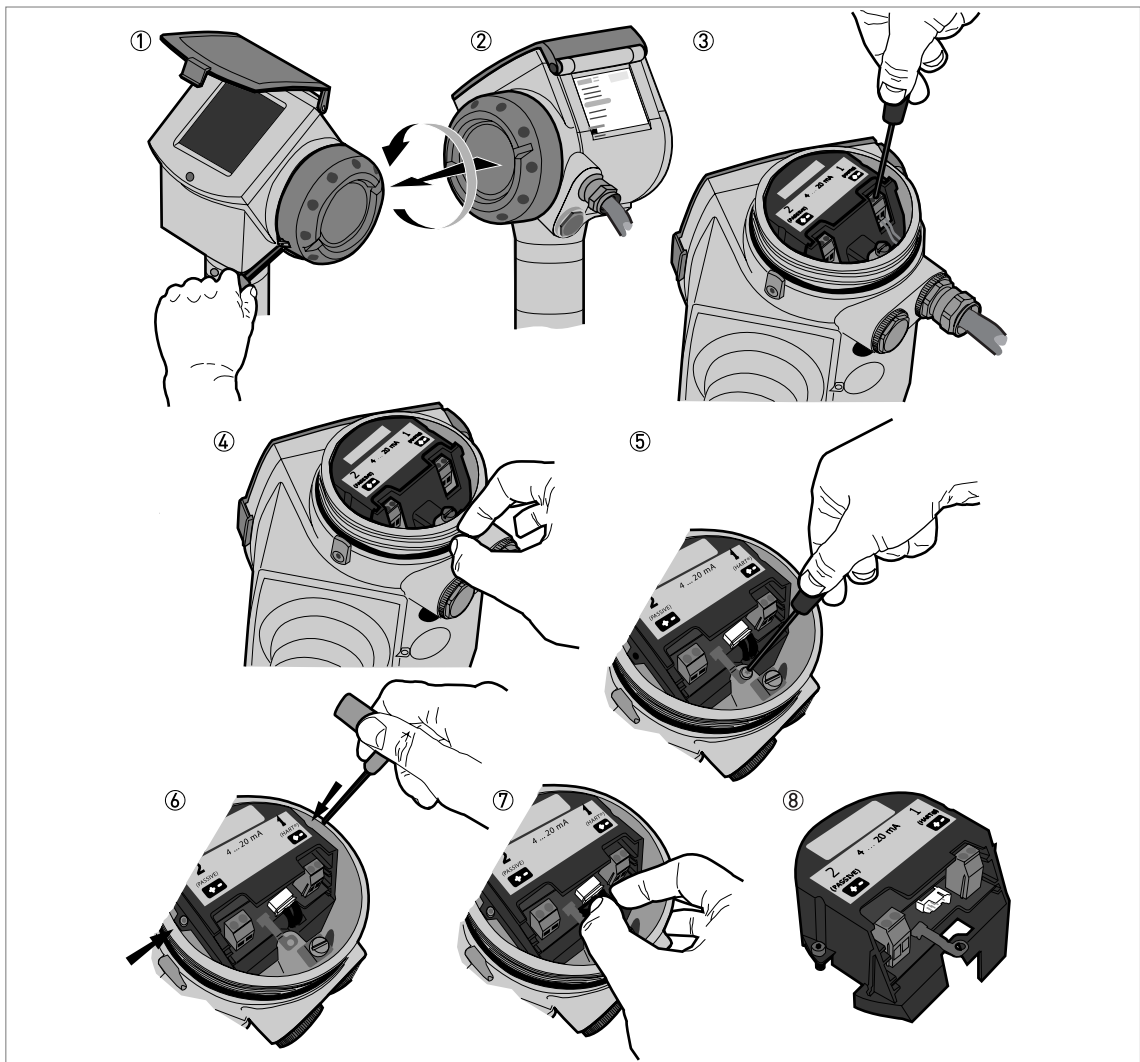


Figure 7-3: Removal of the terminal module

Equipment needed (not supplied):

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

**WARNING!**

Disconnect the power supply.

**How to remove the terminal module**

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

**WARNING!**

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

**How to attach the terminal module**

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

7.5 Spare parts availability

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

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

7.6 Availability of services

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



INFORMATION!

For more precise information, please contact your local sales office.

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 the personnel, the 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 neutralising, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that it 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:	radioactive		
	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 from 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 transmitted frequency and the received 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.

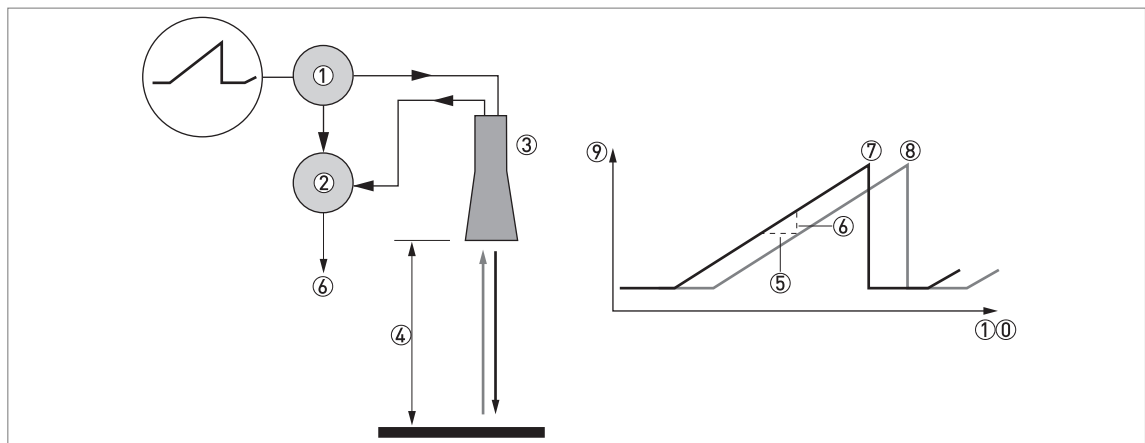


Figure 8-1: Measuring principle of FMCW radar

- 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 sales office.
- Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Download Center).

Measuring system

Measuring principle	2-wire loop-powered level transmitter; K-band (24...26 GHz) FMCW radar
Application range	Level measurement of powders and granulates
Primary measured value	Δf (change in frequency) between the emitted and received signal
Secondary measured value	Distance, level, volume, mass and reflectivity

Design

Construction	The measurement system consists of a measuring sensor (antenna) and a signal converter which is only available in a compact version
Standard	Antenna purging system for horn antenna (supplied with a ¼ NPTF connection – for horn antenna only)
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	Distance piece (for process temperature: +150...+200°C / +300...+390°F)
	Weather protection
	Antenna extensions of 105 mm / 4.1" length (max. length for Drop antenna versions: 525 mm / 20.7")
	2° slanted PP flange (for all antennas)
Max. measuring range	Discs (low-pressure flanges) with bolt hole dimensions and positions that agree with DN80...200 in PN2.5...40 or 3"...8" in 150 lb for devices with the G 1½ threaded connection. Max. pressure: 1 barg / 14.5 psig at +20°C / +68°F.
	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"
Min. dead zone	Antenna extension length + antenna length + 0.3 m / 12"
Beam angle of antenna	Horn / Sheet metal horn DN80 / 3": 10°
	Horn / Sheet metal horn DN100 / 4": 8°
	Sheet metal horn DN150 / 6": 6°
	Sheet metal horn DN200 / 8": 4°
	Drop DN80 / 3": 8°
	Drop DN150 / 6": 4°
Display and user interface	
Display	LCD display
	9 lines, 160 × 160 pixels in 8-step grayscale with 4-button keypad
Interface languages	English, German, French, Italian, Spanish, Portuguese, Japanese, Simplified Chinese and Russian

Measurement accuracy

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

Operating conditions

Temperature	
Ambient temperature	-40...+80°C / -40...+175°F (according to the temperature limits of the gasket material. Refer to "Materials" in this table.) Ex: see supplementary operating instructions or approval certificates
Storage temperature	-40...+85°C / -40...+185°F
Flange temperature	Horn / Sheet metal horn antenna: Standard: -50...+150°C / -58...+300°F Option: -50...+200°C / -58...+390°F (the process connection temperature must agree with the temperature limits of the gasket material. Refer to "Materials" in this table.) Ex: see supplementary operating instructions or approval certificates
	Drop antenna (PTFE): -50...+150°C / -58...+300°F (the process connection temperature must agree with the temperature limits of the gasket material. Refer to "Materials" in this table.) Ex: see supplementary operating instructions or approval certificates
	Drop antenna (PP): -40...+100°C / -40...+210°F (the process connection temperature must agree with the temperature limits of the gasket material. Refer to "Materials" in this table.) Ex: see supplementary operating instructions or approval certificates
Pressure	
Operating pressure	Drop antenna (PP): -1...16 barg / -14.5...232 psig; subject to process connection used and flange temperature
	Drop antenna (PTFE): -1...40 barg / -14.5...580 psig; subject to process connection used and flange temperature
	Horn / Sheet metal horn antenna: Standard: -1...40 barg / -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	IP66/67 equivalent to NEMA type 4X (housing) and type 6P (antenna)
Maximum rate of change	10 m/min / 33 ft/min

Installation conditions

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

Materials

Housing	Standard: Polyester-coated aluminium
	Option: Stainless steel (1.4404 / 316L) ①
Wetted parts, including antenna	Horn / Sheet metal horn antenna: Stainless steel (1.4404 / 316L)
	Drop antenna: PTFE; PP – a PP or PTFE flange plate protection option is also available
Process connection	Stainless steel (1.4404 / 316L) – a PP or PTFE flange plate protection option is also available for the Drop antenna
Gaskets (and o-rings for the sealed antenna extension option)	PTFE Drop antenna: FKM/FPM (-40...+150°C / -40...+300°F); Kalrez® 6375 (-20...+150°C / -4...+300°F); EPDM (-50°C...+150°C / -58...+300°F) ②
	PP Drop antenna: FKM/FPM (-40...+100°C / -40...+210°F); Kalrez® 6375 (-20...+100°C / -4...+210°F); EPDM (-40°C...+100°C / -40...+210°F) ②
	Horn / Sheet metal horn antenna: FKM/FPM (-40...+200°C / -40...+390°F); Kalrez® 6375 (-20...+200°C / -4...+390°F); EPDM (-50°C...+150°C / -58...+300°F) ②
Feedthrough	Standard: PEI (-50...+200°C / -58...+390°F – max. range. The feedthrough temperature limits must agree with the temperature limits of the gasket material and antenna type. If the distance piece option is not attached, the maximum temperature is 150°C / 300°F.)
	Option: Metaglas® (-30...+200°C / -22...+390°F – max. range. The feedthrough temperature limits must agree with the temperature limits of the gasket material and antenna type. If the distance piece option is not attached, the maximum temperature is 150°C / 300°F.) ③
Weather protection (Option)	Stainless steel (1.4301 / 304)

Process connections

Thread	G 1½ (ISO 228); 1½ NPT (ASME B1.20.1)
Flange version	
EN 1092-1	DN80 in PN40 (Type B1), DN100...200 in PN16 or PN40 (Type B1); others on request
ASME B16.5	3"...8" in 150 lb RF, 3"...4" in 300 lb RF; others on request
JIS B2220	80...100A in 10K; others on request
Other	Others on request

Electrical connections

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

Input and output

Current output	
Output signal (Output 1)	4...20 mA HART® or 3.8...20.5 mA acc. to NAMUR NE 43 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 fulfils the statutory requirements of the EC directives. The manufacturer certifies successful testing of the product by applying the CE mark.
Explosion protection	
ATEX KEMA 04ATEX1218 X	II 1 G, 1/2 G, 2 G Ex ia IIC T6...T3;
	II 1 D, 1/2 D, 2 D Ex iaD 20 or Ex iaD 20/21 or Ex iaD 21 IP6X T70°C...T95°C;
	II 1/2 G, 2 G Ex d[ia] IIC T6...T3;
	II 1/2 D, 2 D Ex tD[iaD] A21/20 or Ex tD[iaD] A21 IP6X T70°C...T95°C
IECEX IECEX KEM 06.0025 X	Ga Ex ia IIC T6...T3; Ex iaD 20 IP6X T70°C...T95°C;
	Ga/Gb Ex d[ia] IIC T6...T3; Ex tD[iaD] A21/20 IP6X T70°C...T95°C
FM – Dual Seal-approved	NEC 500
	XP-IS / CL. I / Div. 1 / Gr. ABCD / T6-T1;
	DIP / CL. II, III / Div. 1 / Gr. EFG / T6-T1;
	IS / CL. I, II, III / Div. 1 / Gr. ABCDEFG / T6-T1;
	NI / CL. I / Div. 2 / Gr. ABCD / T6-T1
	NEC 505
	CL. I / Zone 0 / AEx d[ia] / IIC / T6-T1;
	CL. I / Zone 0 / AEx ia / IIC / T6-T1;
	CL. I / Zone 2 / AEx nA[ia] / IIC / T6-T1
	Hazardous (Classified) Locations, indoor/outdoor Type 4X and 6P, IP66, Dual Seal

CSA – Dual Seal-approved	CEC Section 18 (Zone ratings)
	Cl. I, Zone 1, Ex d, IIC (Antenna: Zone 0) T6;
	Cl. I, Zone 0, Ex ia, IIC T6;
	Cl. I, Zone 2, Ex nA, IIC T6
	CEC Section 18 and Annex J (Division ratings)
	XP-IS, Cl. I, Div. 2, Gr. ABCD; Cl. II, Div. 2, Gr. FG; Cl. III, Div. 2 T6; IS, Cl. I, Div. 1, Gr. ABCD; Cl. II, Gr. FG; Cl. III T6
NEPSI GYJ091178/79	Ex d ia IIC T3~T6 DIP A21/20 T _A T70°C~T95°C IP6X; Ex ia IIC T3~T6 DIP A21/20 T _A T70°C~T95°C IP6X
DNV / INMETRO DNV 12.0043 X	Ex ia IIC T6...T3 Ga; Ex ia IIIC T70°C...T95°C Da IP6X; Ex d [ia Ga] IIC T6...T3 Ga/Gb; Ex tb [ia Da] IIIC T70°C...T95°C Db IP6X
KGS 11-GA4BO-0325X 11-GA4BO-0326X	Ex ia IIC T6~T3; Ex iaD 20 IP6X T70°C~T95°C; Ex d[ia] IIC T6~T3; Ex tD[iaD] A21/20 IP6X T70°C~T95°C
Other standards and approvals	
EMC	Electromagnetic Compatibility Directive 2004/108/EC in conjunction with EN 61326-1 (2013)
R & TTE	Radio Equipment and Telecommunications Terminal Equipment Directive 1999/5/EC in conjunction with ETSI EN 302 372-2 (2011) and ETSI EN 302 729-2 (2011)
FCC Rules	Part 15
Industry Canada	RSS-210
LVD	Low-Voltage Directive 2006/95/EC in conjunction with EN 61010-1 (2001)
CRN	This certification is for all Canadian provinces and territories. For more data, refer to the website.
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 This option is not available for FM- or CSA-approved devices
 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

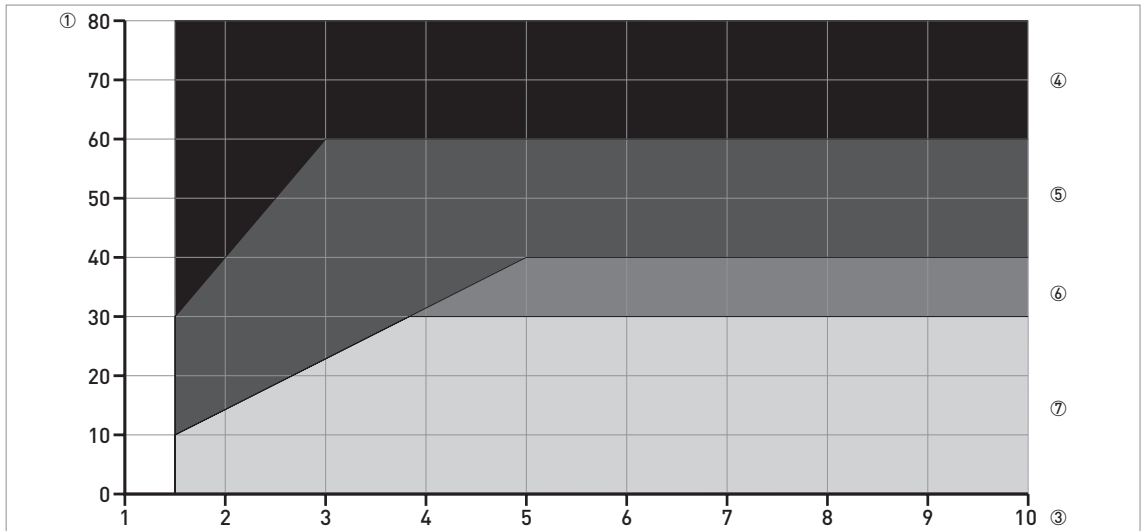


Figure 8-2: Selection of antenna for solid applications (graph of distance in m against ϵ_r)

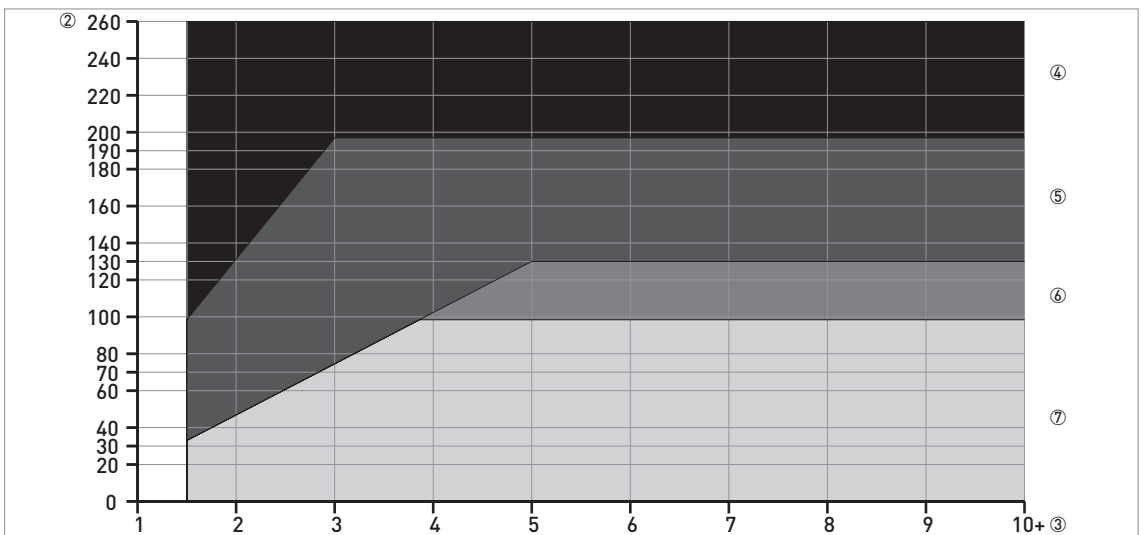


Figure 8-3: Selection of antenna for solid applications (graph of distance in ft. against ϵ_r)

- ① Distance, D [m]
- ② Distance, D [ft]
- ③ Dielectric constant (ϵ_r)
- ④ On request
- ⑤ DN150 horn, DN200 horn and DN150 Drop antenna
- ⑥ DN100 horn, DN150 horn, DN150 Drop and DN200 horn antenna
- ⑦ DN80 horn, DN80 Drop, DN100 horn, DN150 horn, DN150 Drop and DN200 horn antenna

8.4 Guidelines for maximum operating pressure



WARNING!

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

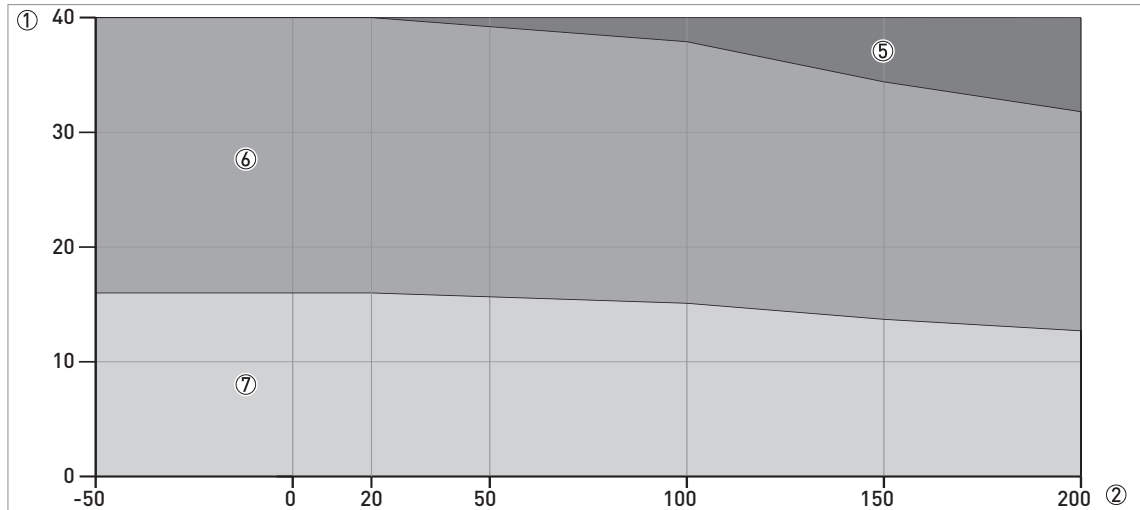


Figure 8-4: Pressure / temperature de-rating (EN 1092-1), flange and threaded connection, in °C and barg

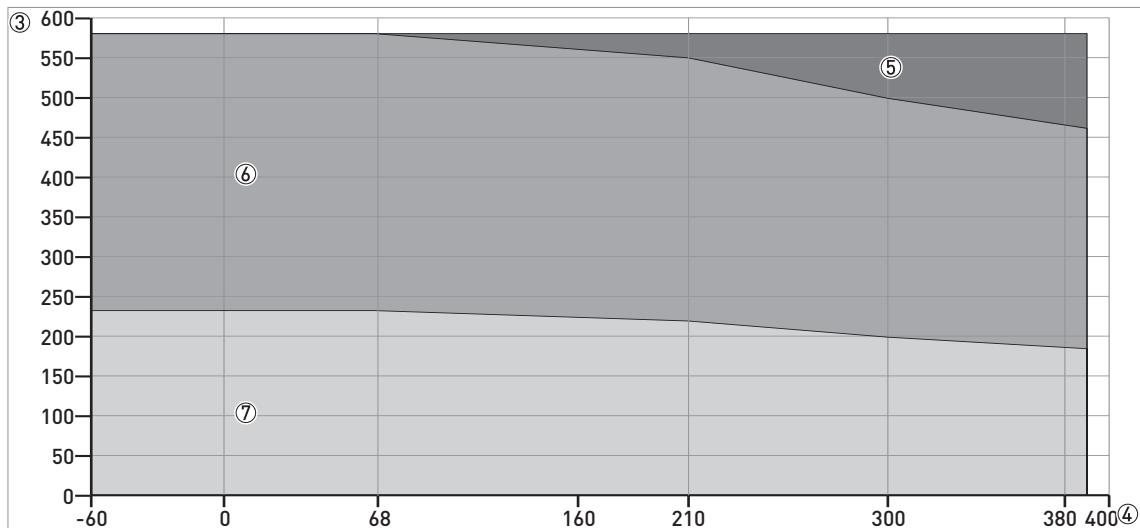


Figure 8-5: Pressure / temperature de-rating (EN 1092-1), flange and threaded connections, in °F and psig

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



INFORMATION!

CRN certification

There is a CRN certification option for devices with process connections that agree with ASME standards. This certification is necessary for all devices that are installed on a pressure vessel and used in Canada.

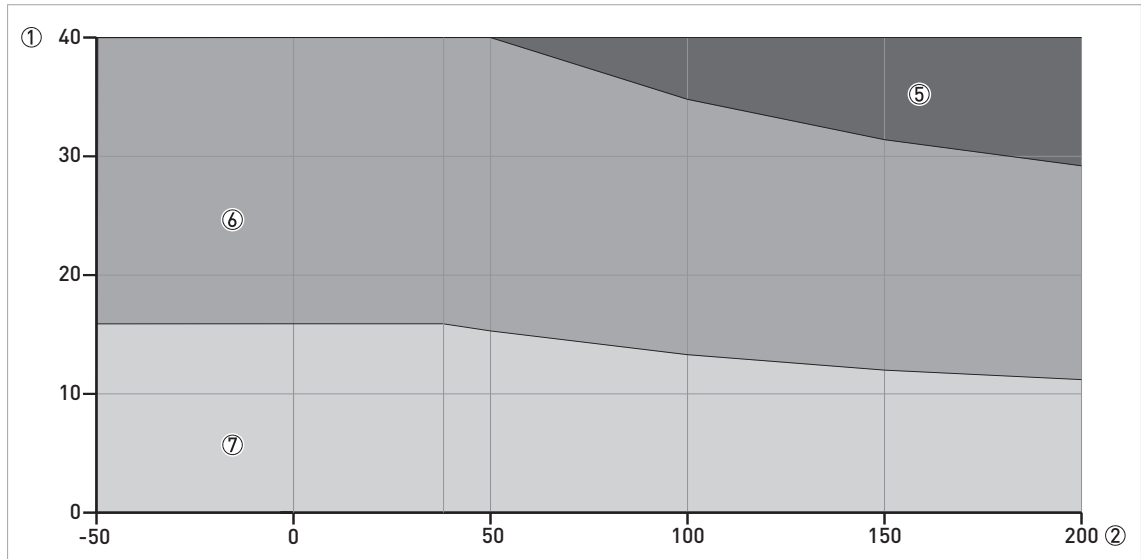


Figure 8-6: Pressure / temperature de-rating (ASME B16.5), flange and threaded connections, in °C and barg

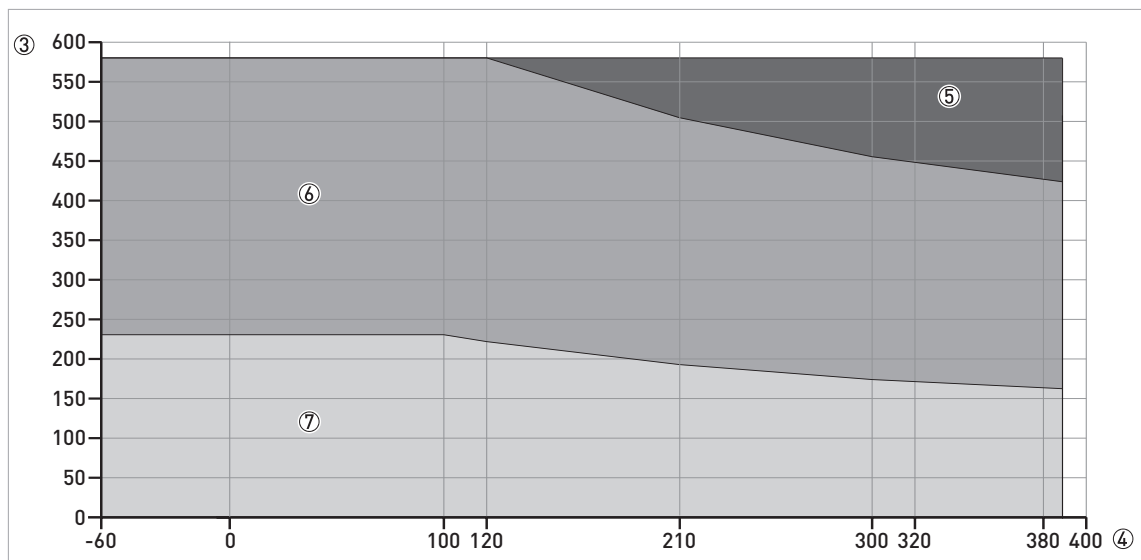


Figure 8-7: Pressure / temperature de-rating (ASME B16.5), flange and threaded connections, in °F and psig

- ① p [barg]
- ② T [°C]
- ③ p [psig]
- ④ T [°F]
- ⑤ Threaded connection, NPT (ASME B1.20.1).
- ⑥ Flange connection, Class 300
- ⑦ Flange connection, Class 150

8.5 Dimensions and weights

Housing

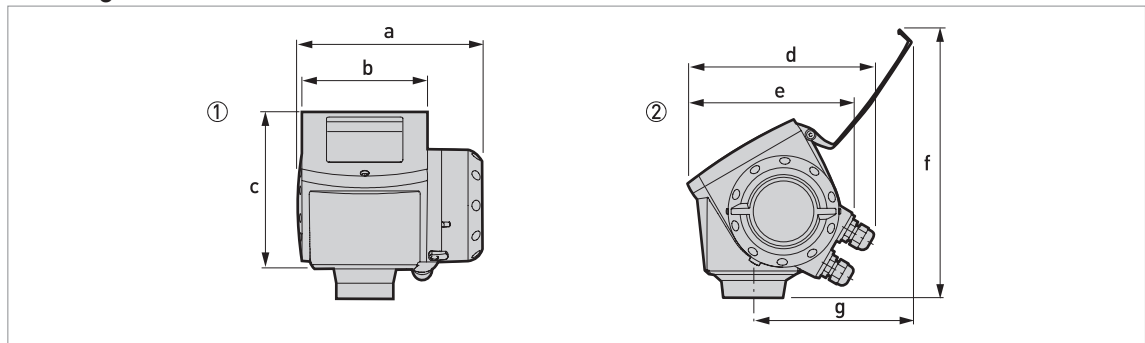


Figure 8-8: Housing dimensions

- ① Housing front view
- ② Housing side view

Dimensions and weights in mm and kg

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

① If fitted with standard cable glands

Dimensions and weights in inches and lb

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

① If fitted with standard cable glands



CAUTION!

- Cable glands are delivered on demand with non-Ex, Ex i- and Ex d-approved devices.
- The diameter of the outer sheath of the cable must be 7...12 mm or 0.28...0.47".
- Cable glands for FM- or CSA-approved devices must be supplied by the customer.
- A weather protection cover is available on request with all devices.

Weather protection

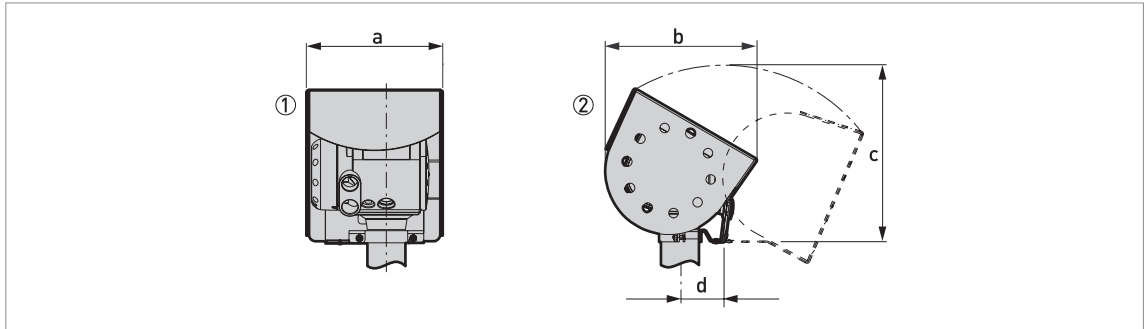


Figure 8-9: Dimensions of the weather protection option

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

Dimensions and weights in mm and kg

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

① Radius

Dimensions and weights in inches and lb

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

① Radius

DN80/3" horn antenna versions

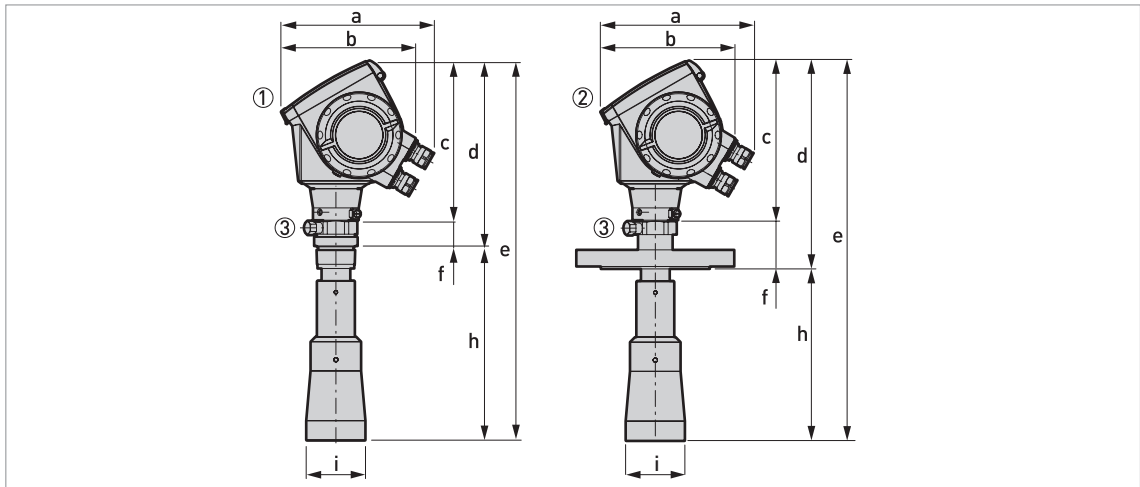


Figure 8-10: DN80/3" horn antenna versions

- ① DN80/3" horn antenna with G 1½ or 1½ NPT thread connection
- ② DN80/3" horn antenna with flange connection
- ③ Antenna purging system (supplied with ¼ NPTF 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	250	496	49	246 ②	75	6.8
Flange connection	182 ①	167	201	263 ③	480 ③	62 ③	217 ②	75	11.1...18.9

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

Dimensions and weights in inches and lb

	Dimensions [inches]								Weights [lb]
	a	b	c	d	e	f	h	Øi	
Thread connection	7.2 ①	6.5	7.9	9.8	19.5	1.9	9.7 ②	3	15
Flange connection	7.2 ①	6.5	7.9	10.4 ③	18.9 ③	2.4 ③	8.5 ②	3	24.4...41.5

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

DN100/4" horn antenna versions

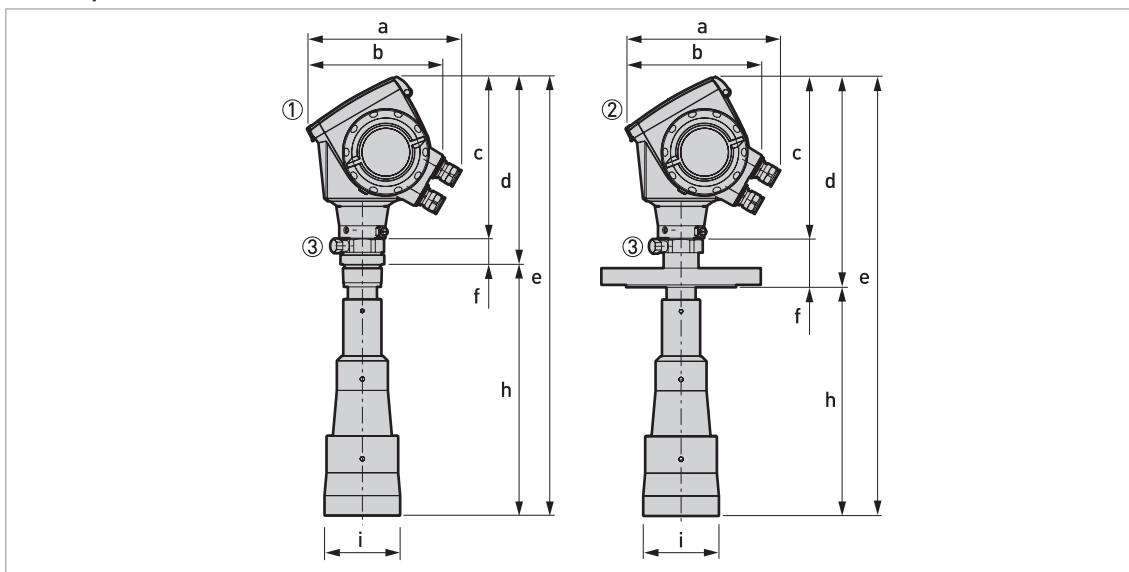


Figure 8-11: DN100/4" horn antenna versions

- ① DN100/4" horn antenna with G 1½ or 1½ NPT thread connection
- ② DN100/4" horn antenna with flange connection
- ③ Antenna purging system (supplied with ¼ NPTF 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	250	565	49	315 ②	95	7.2
Flange connection	182 ①	167	201	263 ③	549 ③	62 ③	286 ②	95	11.6...28.2

① If fitted with standard cable glands

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

③ With distance piece option: add 71 mm to this dimension

Dimensions and weights in inches and lb

	Dimensions [inches]								Weights [lb]
	a	b	c	d	e	f	h	Øi	
Thread connection	7.2 ①	6.5	7.9	9.8	22.2	1.9	12.4 ②	3.7	15.8
Flange connection	7.2 ①	6.5	7.9	10.4 ③	21.6 ③	2.4 ③	11.3 ②	3.7	25.6...62.2

① If fitted with standard cable glands

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

③ With distance piece option: add 2.8" to this dimension

Sheet metal horn antenna versions

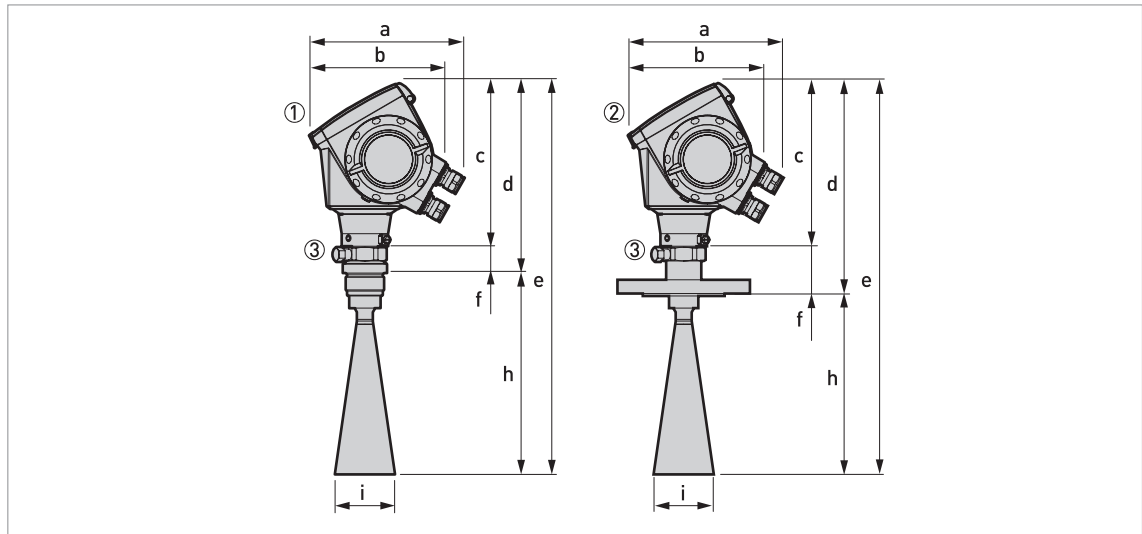


Figure 8-12: DN80/3", DN100/4", DN150/6" and DN200/8" sheet metal horn antenna versions

- ① Sheet metal horn antenna (DN80/3", DN100/4", DN150/6" or DN200/8") with G 1½ or 1½ NPT thread connection
- ② Sheet metal horn antenna (DN80/3", DN100/4", DN150/6" or DN200/8") with flange connection
- ③ Antenna purging system (supplied with ¼ NPTF connection)

Dimensions and weights in mm and kg

		Dimensions [mm]								Weights [kg]
		a	b	c	d	e	f	h	Øi	
Thread connection	DN80/3"	182 ①	167	201	250	499	49	249 ②	75	4.9
	DN100/4"	182 ①	167	201	250	568	49	318 ②	95	5.1
	DN150/6"	182 ①	167	201	250	736	49	486 ②	144	5.5
	DN200/8"	182 ①	167	201	250	894	49	644 ②	190	6.1
Flange connection	DN80/3"	182 ①	167	201	262 ③	483 ③	62 ③	221 ②	75	9.2
	DN100/4"	182 ①	167	201	262 ③	552 ③	62 ③	290 ②	95	9.5
	DN150/6"	182 ①	167	201	262 ③	720 ③	62 ③	458 ②	144	14.4
	DN200/8"	182 ①	167	201	262 ③	878 ③	62 ③	616 ②	190	15.0

① If fitted with standard cable glands

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

③ With distance piece option: add 71 mm to this dimension

Dimensions and weights in inches and lb

		Dimensions [inches]								Weights [lb]
		a	b	c	d	e	f	h	Øi	
Thread connection	DN80/3"	7.2 ①	6.5	7.9	9.8	19.6	1.9	9.8 ②	3.0	10.8
	DN100/4"	7.2 ①	6.5	7.9	9.8	22.4	1.9	12.5 ②	3.7	11.1
	DN150/6"	7.2 ①	6.5	7.9	9.8	29.0	1.9	19.1 ②	5.7	12.2
	DN200/8"	7.2 ①	6.5	7.9	9.8	35.2	1.9	25.4 ②	7.5	13.4
Flange connection	DN80/3"	7.2 ①	6.5	7.9	10.3 ③	19.0 ③	2.4 ③	8.7 ②	3.0	20.2
	DN100/4"	7.2 ①	6.5	7.9	10.3 ③	21.7 ③	2.4 ③	11.4 ②	3.7	20.8
	DN150/6"	7.2 ①	6.5	7.9	10.3 ③	28.3 ③	2.4 ③	18.0 ②	5.7	31.6
	DN200/8"	7.2 ①	6.5	7.9	10.3 ③	34.6 ③	2.4 ③	24.3 ②	7.5	32.9

① If fitted with standard cable glands

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

③ With distance piece option: add 2.8" to this dimension

DN80/3" Drop antenna versions

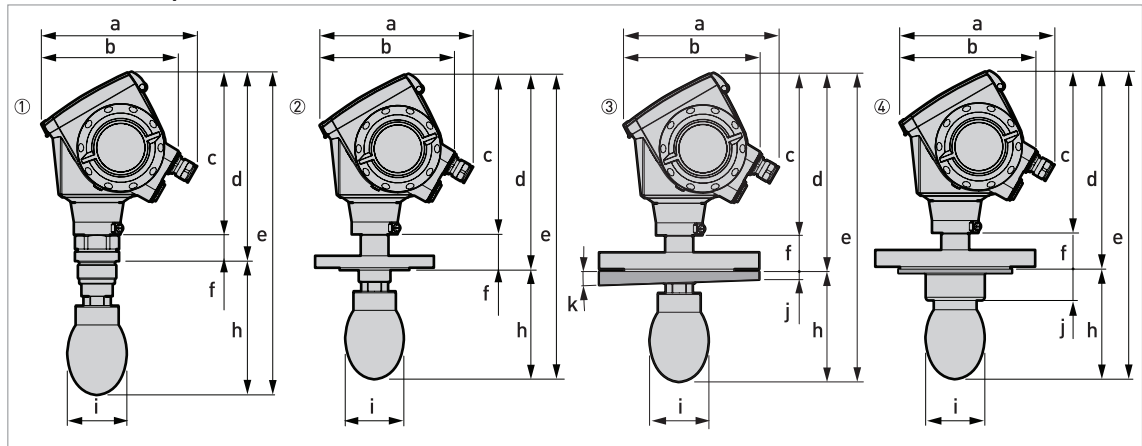


Figure 8-13: DN80/3" Drop antenna versions

- ① DN80/3" Drop antenna with G 1½ or 1½ NPT thread connection
- ② DN80/3" Drop antenna with flange connection
- ③ DN80/3" Drop antenna with 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 × length 105 mm are available. Do not attach more than 5 antenna extensions.

Dimensions and weights in inches and lb

	Dimensions [inches]										Weights [lb]
	a	b	c	d	e	f	h	Øi	j	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 × length 4.1" available. Do not attach more than 5 antenna extensions.

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

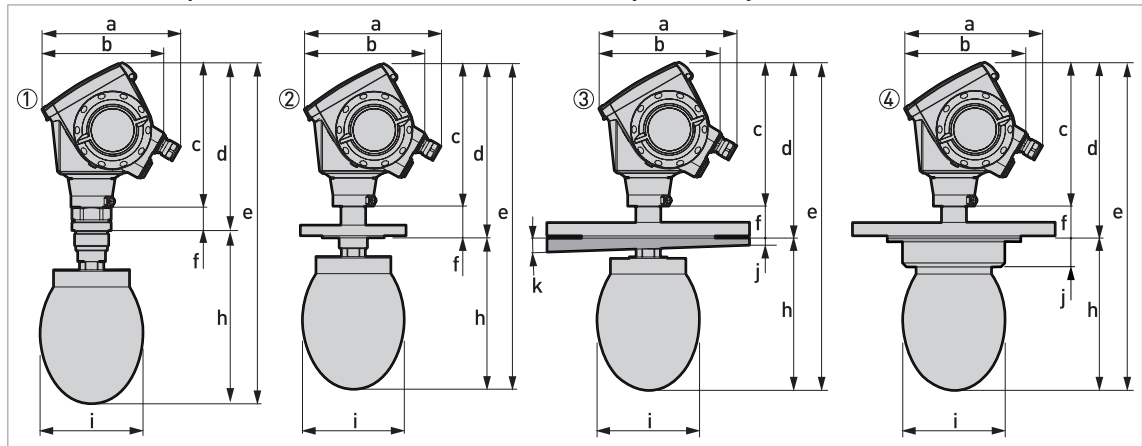


Figure 8-14: DN150/6" Drop antenna versions (PP material option only)

- 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	—	28.2

① If fitted with standard cable glands

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

Dimensions and weights in inches and lb

	Dimensions [inches]										Weights [lb]
	a	b	c	d	e	f	h	Øi	j	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	—	62.2

① If fitted with standard cable glands

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

9.1 General description

The HART® Protocol is an open digital communication protocol for industry. It is free to use by anyone. It is included in the software embedded in signal converters of HART-compatible devices.

There are 2 classes of devices which support the HART® Protocol: operating devices and field devices. There are 2 classes of operating devices (Master): PC-supported workstations (Primary Master) and manual control units (Secondary Master). These can be used in control centres and other locations. HART® field devices include sensors, converters and actuators. Field devices include 2-wire and 4-wire devices, and also intrinsically-safe versions for use in hazardous areas.

There are 2 primary operation modes for HART-compatible devices: point-to-point mode and multi-drop mode.

If the device is used in point-to-point mode, the HART® Protocol uses the Bell 202 Frequency Shift Keying (FSK) standard to put a digital signal on top of the 4...20 mA signal. The connected device sends and receives digital signals that agree with the HART® Protocol, and sends analog signals at the same time. Only 1 device can be connected to the signal cable.

If the device is used in multi-drop mode, the network only uses a digital signal that agrees with the HART® Protocol. The loop current is set to 4 mA. You can connect a maximum of 15 devices to the signal cable.

An FSK or HART® modem is included in field devices and manual control units. It is necessary to have an external modem for PC-supported workstations. The external modem is connected to the serial interface.

9.2 Software history



INFORMATION!

In the table below, "x" is a placeholder for possible multi-digit alphanumeric combinations, depending on the available version.

Release date	Devices	HART®	
		Device Revision	DD Revision
2008-03	All revisions	1	2

HART® identification codes and revision numbers

Manufacturer ID:	0x45
Device:	0xE5
Device Revision:	1
DD Revision	2
HART® Universal Revision:	5
FC 375/475 system SW.Rev.:	≥ 1.8
AMS version:	≥ 7.0
PDM version:	-
FDT version:	≥ 1.2

9.3 Connection variants

The signal converter is a 2-wire device with 4...20 mA current output and HART® interface.

- **Multi-Drop Mode is supported**
In a Multi-Drop communication system, more than 1 device is connected to a common transmission cable.
- **Burst Mode is not supported**

There are two ways of using the HART® communication:

- as Point-to-Point connection and
- as Multi-Drop connection with 2-wire connection.

9.3.1 Point-to-Point connection - analogue / digital mode

Point-to-Point connection between the signal converter and the HART® Master.

The current output of the device is passive.

Also refer to *Point-to-point connection* on page 33.

9.3.2 Multi-Drop connection (2-wire connection)

Up to 15 devices may be installed in parallel (this signal converter and other HART® devices).

For an illustration of multi-drop networks, refer to *Multi-drop networks* on page 34.

For data on communication in multi-drop mode, refer to *Network configuration* on page 57.

9.4 HART® device variables

HART® device variable	Code	Type
level	0	linear
distance	1	linear
level conversion	2	linear
level mass	3	linear
reflection	4	linear
distance conversion	5	linear
distance mass	6	linear

The HART® dynamic variables PV (Primary Variable), SV (Secondary Variable), TV (Third Variable) and QV (Fourth Variable) can be assigned to any of the device variables.

The HART® dynamic variable PV is always connected to the HART® current output which is, for example, assigned to level measurement.

9.5 Field Communicator 375/475 (FC 375/475)

The Field Communicator is a hand terminal from Emerson Process Management that is designed to configure HART® and Foundation Fieldbus devices. Device Descriptions (DDs) are used to integrate different devices into the Field Communicator.

9.5.1 Installation



CAUTION!

The Field Communicator cannot be used to correctly configure, operate or read data from the device unless the Device Description (DD) file is installed.

System and software requirements for the Field Communicator

- System card that includes the "Easy Upgrade Option"
- Field Communicator Easy Upgrade Programming Utility
- HART® Device Description file

For more data, refer to the Field Communicator User's Manual.

9.5.2 Operation



INFORMATION!

The Field Communicator will not give you access to the service menu. A simulation is only possible for current outputs.

The Field Communicator and the device's local display use almost the same procedures to operate the signal converter. The online help for each menu item refers to the function number given to each menu item on the local device display. Protection of settings is the same as on the device's local display.

The Field Communicator always saves a complete configuration for communication with AMS.

For more data, refer to *HART*® menu tree for Basic-DD on page 102.

9.6 Asset Management Solutions (AMS)

The Asset Management Solutions Device Manager (AMS) is a PC program from Emerson Process Management which is designed to configure and manage *HART*®, PROFIBUS and Foundation-Fieldbus devices. Device Descriptions (DDs) are used to integrate different devices into the AMS.

9.6.1 Installation

Please read the README.TXT file in the Installation Kit.

If the Device Description has not been installed at this time, install the Installation Kit *HART*® AMS. This .EXE file is given on the DVD-ROM supplied with the device. You can also download the file from our website.

For installation data, refer to the "AMS Intelligent Device Manager Books Online" section "Basic AMS Functionality > Device Configurations > Installing Device Types > Procedures > Install device types from media".

9.6.2 Operation



INFORMATION!

*For more data, refer to *HART*® menu tree for AMS on page 104.*

9.6.3 Parameter for the basic configuration

Due to AMS requirements and conventions, there are differences when operating the signal converter with AMS and operating using the local keyboard. The service menu parameters are not supported and simulation is only possible for current outputs. The online help for each parameter contains its function number as a reference to the local device display.

9.7 Field Device Tool / Device Type Manager (FDT / DTM)

A Field Device Tool Container (FDT Container) is a PC program used to configure *HART*® devices. To configure a device, an FDT container uses the applicable Device Type Manager (DTM).

9.7.1 Installation

Before you operate the device, the Device Type Manager (Device DTM) must be installed in the Field Device Tool Container. This .msi file is given on the DVD-ROM supplied with the device. You can also download the file from our website. For installation and configuration data, refer to the documentation that is supplied with the Device DTM on the DVD-ROM or in the "Downloads" section of the website.

9.7.2 Operation

The DTM and the device's local display use almost the same procedures to operate the signal converter. For more data, refer to *Operation* on page 39.

9.8 HART[®] menu tree for Basic-DD

Abbreviations of the following tables:

- ^{Opt} Optional, depending on device version and configuration
- Rd Read only

9.8.1 Overview Basic-DD menu tree (positions in menu tree)

1 Process Variables	1 Measurements	
	2 Input/Outputs	1 Output1 2 Output2
2 HART Variables		
3 Access Rights		
4 Test	1 Test	
	2 Information	1 Output 1
		2 Ouput 2 ^{Opt}
		3 Device ID
4 Quick Setup Summary		
5 Save Device Parameters		
6 Configuration Variables	1 Installation Parameters	Units for Tables
	2 Empty Spectrum Recording	
	3 Output1	
	4 Output2	
	5 Reset	
7 Service Variables	1 Service Parameters	
	2 Calibration Parameters	
	3 Maintenance Info	

9.8.2 Basic-DD menu tree (details for settings)

1 Process Variables

1 Measurements	1 Distance Rd / 2 Level Rd	
2 Input/Outputs	1 Output1	1 PV is Rd / 2 Distance I1 Rd / 3 %Distance Rd
	2 Output2 ^{Opt}	1 SV is Rd / 2 Level I2 ^{Rd, Opt} / 3 %Level ^{Rd, Opt}

2 HART variables

1 Manufacturer Rd	
2 Model Rd	
3 Field Software Version	1 Main CPU Version Rd / 2 Comp. CPU Version Rd / 3 DSP Version Rd
4 Dev id Rd	
5 Polling Address	

3 Access Rights

1 Supervisor Password ①
2 Service Password

4 Test

1 Test	1 Distance I1 / 2 Set Output1 / 3 Level I2 ^{Opt} / 4 Set Output2 ^{Opt} / 5 Internal Test	
2 Information	1 Output 1	1 PV is Rd / 2 Distance 4 mA Rd / 3 Distance 20 mA Rd / 4 Output Range Rd / 5 Error Handling Rd / 6 Polling Address Rd
	2 Output 2 ^{Opt}	1 SV is Rd / 2 Distance 4 mA ^{Rd, Opt} / 3 Distance 20 mA ^{Rd, Opt} / 4 Output Range ^{Rd, Opt} / 5 Error Handling ^{Rd, Opt}
	3 Device ID	1 Order Number Rd / 2 Version Number Rd / 3 Service Number Rd / 4 Ex Approval Rd / 5 Main CPU Version Rd / 6 Comp. CPU Version Rd / 7 DSP Version Rd
	4 Quick Setup Summary	1 Tank Type Rd / 2 Application Type Rd / 3 Tank Height Rd / 4 Blocking Distance Rd
	5 TAG Number	
	6 Custom. Length Unit Rd	
	7 Custom. Length Ratio Rd	
	8 Custom. Conv. Unit Rd	

5 Save Device Parameters

6 Configuration Variables

1 Installation Parameters	1 Tank Type / 2 Tank Height / 3 Application Type / 4 Antenna Extension / 5 Distance Piece / 6 Overfill Detection / 7 Blocking Distance / 8 Reference Offset / 9 Tank Bottom Offset / Time Constant / Measuring Mode / Product Er / Tracing Velocity / Multiple Reflections / Empty Spectrum On/Off / Length Unit / Custom. Length Unit / Custom. Length Ratio / Custom. Conv. Unit / Volume Unit / Mass Unit / Product Density / Volume/Mass Table / Linearisation / Delete Tables	
	Units for Tables	1 Table Length Unit / 2 Conversion Unit
2 Empty Spectrum Recording		
3 Output1	1 Primary Function / 2 Secondary Function / 3 Tertiary Function / 4 Fourth Function / 5 Distance 4 mA / 6 Distance 20 mA / 7 Output Range / 8 Error Handling / 9 Polling Address	
4 Output2 ^{Opt}	1 Distance 4 mA ^{Opt} / 2 Distance 20 mA ^{Opt} / 3 Output Range ^{Opt} / 4 Error Handling ^{Opt}	
5 Reset	1 Customer Reset / 2 Device Restart	

7 Service Variables

1 Service Parameters	
2 Calibration Parameters	
3 Maintenance Info	1 Service Number Rd / 2 Service Date Rd / 3 Operator Rd

① If it is necessary to change the settings, enter the password. The default password is 123412.

9.9 HART[®] menu tree for AMS

Abbreviations of the following tables:

- ^{Opt} Optional, depending on device version and configuration
- Rd Read only

9.9.1 Overview AMS menu tree (positions in menu tree)

Configure/Setup	Installation Parameters 1
	Installation Parameters 2
	Output Selection
	Primary Output Setting
	Secondary Output Setting
	Service
	HART
	Device
Device Diagnostics	Overview
	Critical
	Informational
Process Variables	
Calibration Management	
Methods	Access Right
	Diagnostics and Test
	Calibrate
	Tables
	Reset

9.9.2 AMS menu tree (details for settings)

Configure/Setup

Installation Parameters 1	Tank Type / Application Type / Tank Height / Measuring Range ^{Opt} / Stillwell Height ^{Opt} / Stillwell Diameter ^{Opt} / Blocking Distance / Antenna Extension / Distance Piece / Tank Bottom Offset / Measuring Mode / Product Er / Tracing Velocity / Multiple Reflections / Empty Spectrum... / Time Constant / Reference Offset / Overfill Detection
Installation Parameters 2	Length Unit / Volume Unit / Mass Unit / Table Length Unit / Conversion Unit ^{Opt} / Custom. Length Unit / Custom. Length R... / Custom. Conv. Unit / Product Density ^{Opt} / Output2 Status ^{Opt} / Conversion Flag ^{Opt}

Output Selection	Output Functions	Primary Function / Secondary Function / Tertiary Function / Fourth Function
	Output 1	Output Range / Error Handling / Error Handling Delay
	Output 2	Output Range / Error Handling
Primary Output Setting (Output1 Loop)	4 mA Setting	Distance 4 mA / Level 4 mA ^{Opt} / Volume 4 mA ^{Opt} / Ullage Volume 4 mA ^{Opt} / Mass 4 mA ^{Opt} / Ullage Mass 4 mA ^{Opt} / Reflection 4 mA ^{Opt}
	20 mA Setting	Distance 20 mA / Level 20 mA ^{Opt} / Volume 20 mA ^{Opt} / Ullage Volume 20 mA ^{Opt} / Mass 20 mA ^{Opt} / Ullage Mass 20 mA ^{Opt} / Reflection 20 mA ^{Opt}
Secondary Output Setting (Output2 (Passive) Loop)	4 mA Setting	Distance 4 mA / Level 4 mA ^{Opt} / Volume 4 mA ^{Opt} / Ullage Volume 4 mA ^{Opt} / Mass 4 mA ^{Opt} / Ullage Mass 4 mA ^{Opt} / Reflection 4 mA ^{Opt}
	20 mA Setting	Distance 20 mA / Level 20 mA ^{Opt} / Volume 20 mA ^{Opt} / Ullage Volume 20 mA ^{Opt} / Mass 20 mA ^{Opt} / Ullage Mass 20 mA ^{Opt} / Reflection 20 mA ^{Opt}
Service	Service Parameters	Minimum Peak ^{Cust} / Overfill threshold ^{Cust} / Minimum Window ^{Cust} / Sweep Frequency ^{Cust}
	Calibration Parameters	Offset Converter ^{Cust} / Offset Flange syst... ^{Cust} / Correction Factor ^{Cust}
	Maintenance Info	Service Number ^{Cust} / Service Date ^{Cust} / Operator ^{Cust}
HART	TAG Number / Manufacturer Rd / Model Rd / Dev id Rd / Polling Address	
Device	Order Number Rd / Version Number Rd / Ex Approval Rd / Service Number Rd	
	Field Software Version	Main CPU Version Rd / Comp. CPU Version Rd / DSP Version Rd

Device Diagnostics

Overview (General)	Primary variable out of limits Rd / Non-primary variable out of limits Rd / Primary variable analog output saturated Rd / Primary variable analog output fixed Rd / Cold start Rd / Configuration changed Rd / Field device malfunction Rd
Critical (Errors)	Spectrum Quality Bad Rd / Spectrum Invalid Rd / No Peak Plausible Rd / Temperature Out Of Range Rd / Self Test Failed Rd / Microwave Check Failed Rd / Peripheral Failure Rd / DSPFirmwareLoadError Rd

Informational (Warning)	Upper Current output1 has saturated Rd / Upper Current output2 has saturated Rd / Lower Current output1 has saturated Rd / Lower Current output2 has saturated Rd / Measurement Old / Measurement Tank Overfill Rd / Measurement Tank Bottom Rd / Measurement Terminated Rd
-------------------------	--

Process variables

Level Rd / Distance Rd / Reflection Rd	
Primary Output	Primary Function Rd / Distance I1 Rd / %Distance Rd
Secondary Output	Secondary Function Rd / Level I2 Rd / %Level Rd

Calibration Management

Define Test...	
Enter Test Data...	
Calibration Status...	
Calibration History...	

Methods

Access Rights	Supervisor / Service
Save Parameters	
Diagnostics and Test	Internal Test / Set Output1 / Set Output2
Calibrate	Output1 Lower / Output1 Upper / Output2 Lower / Output2 Upper
Tables	Volume/Mass Table / Linearisation Table / Delete Tables
Empty Spectrum Recording	
Reset	Customer Reset / Factory Reset / Device Restart

10.1 Order code

Make a selection from each column to get the full order code. The characters of the order code highlighted in light grey describe the standard.

VF63	4	OPTIFLEX 6300 C 24 GHz Non-contact Radar (FMCW) level meter for solids
		Approval
	0	Without
	2	ATEX Ex ia IIC T3...T6 + DIP ①
	3	ATEX Ex d[ia] IIC T3...T6 + DIP ①
	6	FM IS CL I/II/III, DIV 1, GPS A-G; CL I, Zone 0, AEx ia IIC T3...T6
	7	FM XP-IS/DIP CL I/II/III, DIV 1, GPS A-G; CL I, Zone 0, AEx d [ia] IIC T3...T6
	B	INMETRO Ex ia IIC T3...T6 + DIP ①
	C	INMETRO Ex d ia IIC T3...T6 + DIP ①
	E	NEPSI Ex ia IIC T3 ~ T6 + DIP ①
	F	NEPSI Ex d ia IIC T3 ~ T6 + DIP ①
	H	CSA IS CL I/II/III, DIV 1, GPS A-G; CL I, Zone 0, Ex ia IIC T3...T6
	K	CSA XP-IS/DIP CL I/II/III, DIV 2, GPS A-D, F, G; CL I, Zone 0, Ex d IIC T3...T6
	M	IECEx Ex ia IIC T2...T6 + DIP ①
	N	IECEx Ex d ia IIC T2...T6 + DIP ①
	R	KGS Ex ia IIC T3 – T6 + DIP ①
	S	KGS Ex d[ia] IIC T3 – T6 + DIP ①
		Material of Process Connection / Antenna type and material (pressure)
	0	316L (1.4404) / Horn 316L (40 barg / 580 psig) – Drop PTFE (40 barg / 580 psig) – Drop PP (16 barg / 232 psig)
		Antenna type
	6	Horn DN80 (Ø75 mm / 2.95") long with purging system / max +200°C (+392°F)
	G	Horn DN100 (Ø95 mm / 3.74") long with purging system / max +200°C (+392°F)
	P	Drop PTFE DN80 (Ø75 mm / 2.95") long / max +150°C (+302°F)
	S	Drop PP DN80 (Ø75 mm / 2.95") long / max +100°C (+212°F)
	T	Drop PP DN150 (Ø144 mm / 5.67") long / max +100°C (+212°F)
	V	Sheet metal horn DN80 (Ø75 mm / 2.95") long + purging system / max +200°C (+392°F)
	W	Sheet metal horn DN100 (Ø95 mm / 3.74") long + purging system / max +200°C (+392°F)
	X	Sheet metal horn DN150 (Ø140 mm / 5.51") long + purging system / max +200°C (+392°F)
	Y	Sheet metal horn DN200 (Ø190 mm / 7.48") long + purging system / max +200°C (+392°F)
VF63	4	Order code (complete this code on the pages that follow)

					<p>Antenna extension</p> <p>0 Without</p> <p>1 Extension 105 mm (4.13")</p> <p>2 Extension 210 mm (8.27")</p> <p>3 Extension 315 mm (12.40")</p> <p>4 Extension 420 mm (16.54")</p> <p>5 Extension 525 mm (20.67")</p> <p>6 Extension 630 mm (24.80") ②</p> <p>7 Extension 735 mm (28.94") ②</p> <p>8 Extension 840 mm (33.07") ②</p> <p>A Extension 945 mm (37.21") ②</p> <p>B Extension 1050 mm (41.34") ②</p> <p>Flange plate protection</p> <p>P Flange plate protection (PP) DN80, DN100, 3", 4", 80A, 100A ③</p> <p>R Flange plate protection (PP) DN150, 6", 8" ③</p> <p>S Flange plate protection (PTFE) DN80, DN100, 3", 4", 80A, 100A ③</p> <p>T Flange plate protection (PTFE) DN150, 6", 8" ③</p>
					<p>Feedthrough / Temperature / Sealing</p> <p>Non-Ex devices with a Drop antenna</p> <p>X Standard / -40...+150°C (-40...+302°F) / FKM/FPM</p> <p>Y Standard / -50...+150°C (-58...+302°F) / EPDM</p> <p>Other devices</p> <p>0 Standard / -40...+150°C (-40...+302°F) / FKM/FPM</p> <p>1 Standard / -20...+150°C (-4...+302°F) / Kalrez 6375</p> <p>2 Metaglas® / -30...+150°C (-22...302°F) / FKM/FPM</p> <p>3 Metaglas® / -20...+150°C (-4...+302°F) / Kalrez 6375</p> <p>4 Standard / -50...+150°C (-58...302°F) / EPDM</p> <p>5 Metaglas® / -30...+150°C (-22...+302°F) / EPDM</p> <p>F Standard / -40...+200°C (-40...+392°F) / FKM/FPM with distance piece included</p> <p>G Standard / -20...+200°C (-4...+392°F) / Kalrez 6375 with distance piece included</p> <p>H Metaglas® / -30...+200°C (-22...+392°F) / FKM/FPM with distance piece included</p> <p>K Metaglas® / -20...+200°C (-4...392°F) / Kalrez 6375 with distance piece included</p>
					<p>Process connection EN</p> <p>0 Without</p> <p>3 G 1½A ISO 228 ④</p> <p>7 DN80 PN40 Type B1 EN 1092-1</p> <p>8 DN100 PN16 Type B1 EN 1092-1</p> <p>A DN100 PN40 Type B1 EN 1092-1</p> <p>B DN150 PN16 Type B1 EN 1092-1</p> <p>C DN150 PN40 Type B1 EN 1092-1</p> <p>D DN200 PN16 Type B1 EN 1092-1</p> <p>E DN200 PN40 Type B1 EN 1092-1</p>
VF63	4				Order code [complete this code on the pages that follow]

10.2 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:

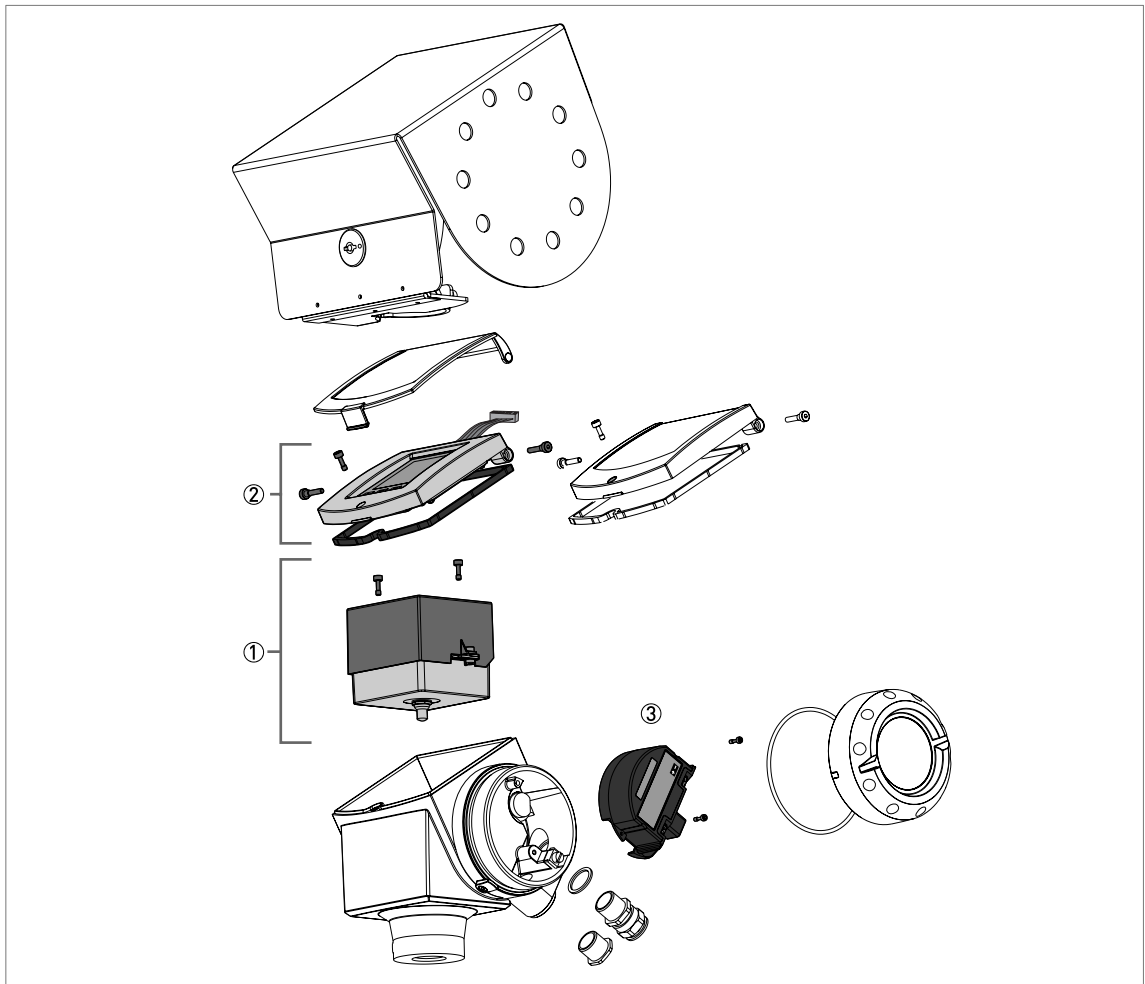


Figure 10-1: Spare parts

Part numbers for spare parts

Item number	Description	Quantity	Part reference
①	Complete electronic module ①	1	XF634000000040000
	Screws for the combined back end and HF modules	2	F3177360000
②	HMI cover and cable (aluminium housing) ②	1	XF6340000000050100
	HMI cover and cable (stainless steel housing) ②	1	XF63400000000F0100

Item number	Description	Quantity	Part reference
③	Terminal module with 1 output (non-Ex)	1	XF634000000031000
	Terminal module with 1 output (ATEX – Ex ia)	1	XF6342000000031000
	Terminal module with 1 output (ATEX – Ex d[ia])	1	XF63430000000E1000
	Terminal module with 1 output (FM – IS)	1	XF6346000000031000
	Terminal module with 1 output (FM – XP)	1	XF63470000000E1000
	Terminal module with 1 output (CSA – IS)	1	XF634H000000031000
	Terminal module with 1 output (CSA – XP)	1	XF634K0000000E1000
	Terminal module with 1 output (IECEX – Ex ia)	1	XF634M000000031000
	Terminal module with 1 output (IECEX – Ex d[ia])	1	XF634N0000000E1000
	Terminal module with 1 output (NEPSI – Ex ia)	1	XF634E000000031000
	Terminal module with 1 output (NEPSI – Ex d ia)	1	XF634F0000000E1000
	Terminal module with 1 output (INMETRO – Ex ia)	1	XF634B000000031000
	Terminal module with 1 output (INMETRO – Ex d ia)	1	XF634C0000000E1000
	Terminal module with 1 output (KGS – Ex ia)	1	XF634R000000031000
	Terminal module with 1 output (KGS – Ex d[ia])	1	XF634S0000000E1000
③	Terminal module with 2 outputs (non-Ex)	1	XF6340000000032000
	Terminal module with 2 outputs (ATEX – Ex ia)	1	XF6342000000032000
	Terminal module with 2 outputs (ATEX – Ex d[ia])	1	XF63430000000E2000
	Terminal module with 2 outputs (FM – IS)	1	XF6346000000032000
	Terminal module with 2 outputs (FM – XP)	1	XF63470000000E2000
	Terminal module with 2 outputs (CSA – IS)	1	XF634H000000032000
	Terminal module with 2 outputs (CSA – XP)	1	XF634K0000000E2000
	Terminal module with 2 outputs (IECEX – Ex ia)	1	XF634M000000032000
	Terminal module with 2 outputs (IECEX – Ex d[ia])	1	XF634N0000000E2000
	Terminal module with 2 outputs (NEPSI – Ex ia)	1	XF634E000000032000
	Terminal module with 2 outputs (NEPSI – Ex d ia)	1	XF634F0000000E2000
	Terminal module with 2 outputs (INMETRO – Ex ia)	1	XF634B000000032000
	Terminal module with 2 outputs (INMETRO – Ex di a)	1	XF634C0000000E2000
	Terminal module with 2 outputs (KGS – Ex ia)	1	XF634R000000032000
	Terminal module with 2 outputs (KGS – Ex d[ia])	1	XF634S0000000E2000
③	Terminal module with FOUNDATION fieldbus output (non-Ex) ③	1	XF634000000003A000
	Terminal module with FOUNDATION fieldbus output (ATEX – Ex ia) ③	1	XF634200000003A000
③	Terminal module with PROFIBUS PA output (non-Ex) ③	1	XF634000000003D000
	Terminal module with PROFIBUS PA output (ATEX – Ex ia) ③	1	XF634200000003D000
③	Screws for the terminal module	2	F3177350000

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

② This reference includes the gasket and screws

③ 4-wire + local HART

10.3 List of accessories

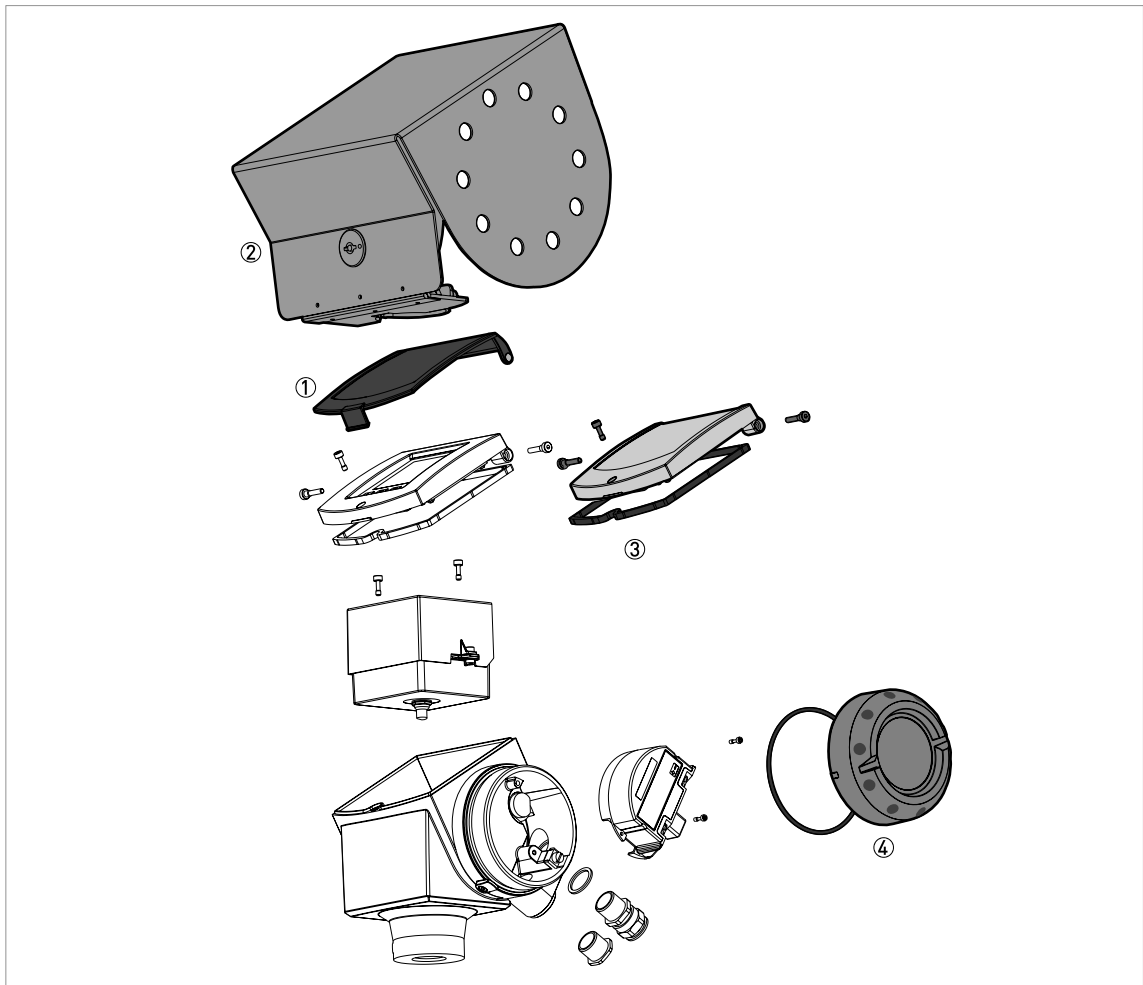


Figure 10-2: Accessories

Part numbers for accessories

Item number	Description	Quantity	Part reference
①	Plastic sun cover	1	XF6340000000000000A
	Pins for the plastic sun cover	2	F3179990000
②	Stainless steel weather protection	1	XF63400000000000001
③	Blind cover (with a gasket and screws)	1	XF6340000000000000B
	Gasket for the blind cover	1	F3177420000
	Hinge screws for the blind cover	2	F3177340000
	Lock screw for the blind cover	1	F3177360000

Item number	Description	Quantity	Part reference
④	Wiring compartment cover (with a gasket)	1	XF6340000000000004
	Gasket for the wiring compartment cover	1	F5091150000
n/a	Converter VIATOR RS232 / HART® ①	1	XF634000000000000C
	Converter USB / HART® ①	1	XF634000000000000D
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" 150 lb flange	1	F3190220000
	2" 300 lb flange	1	F3190220100
	3" 150 lb flange	1	F3190220200
	3" 300 lb flange	1	F3190220300
	4" 150 lb flange	1	F3190220400
	4" 300 lb flange	1	F3190220500
	6" 150 lb flange	1	F3190220600
	6" 300 lb flange	1	F3190220700
	8" 150 lb flange	1	F3190220800
	40A 10K flange	1	F3190230000
	50A 10K flange	1	F3190230100
	80A 10K flange	1	F3190230200
	100A 10K flange	1	F3190230300
n/a	Disc (low-pressure flange). Bolt hole positions and dimensions agree with DN80 PN2.5...40 / 3" 150 lb. ②	1	XF70000010
	Disc (low-pressure flange). Bolt hole positions and dimensions agree with DN100 PN2.5...40 / 4" 150 lb. ②	1	XF70000011
	Disc (low-pressure flange). Bolt hole positions and dimensions agree with DN125 PN2.5...40 / 5" 150 lb. ②	1	XF70000012
	Disc (low-pressure flange). Bolt hole positions and dimensions agree with DN150 PN2.5...40 / 6" 150 lb. ②	1	XF70000013
	Disc (low-pressure flange). Bolt hole positions and dimensions agree with DN200 PN2.5...40 / 8" 150 lb. ②	1	XF70000014

① This accessory is for HART® or PACTware™ communication

② This accessory is for devices with the G 1½ threaded connection. The scope of supply includes the 316L stainless steel disc, a screw and a gasket. Max. pressure: 1 barg / 14.5 psig at 20°C / 68°F.

10.4 Glossary

D

Dead zone	Non-measurement zone below the process connection.
Dielectric constant	An electrical property of the product to be measured used in Radar measurement. Also known as ϵ_r , DK and relative permittivity. Defines the strength of the wave reflected back to the device's signal converter.
Direct Plus	Direct Plus mode is an alternative measurement mode. If it is possible there will be an interference signal in the measurement zone that is larger than the level signal, select "Direct Plus" mode. If you select "Direct Plus" mode, the device locks on the level signal and monitors changes in level. If the device then finds larger reflections in the silo, it will only monitor the largest signal in a small search zone around the first reflection found and ignore all other reflections. The interference signal must not be near to the level signal.
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.
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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).
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H

Hazardous area	An area with a potentially explosive atmosphere. Trained personnel can install and use a device in this area. The device must be ordered with the appropriate options. The device requires approvals (ATEX, IECEx, FM, CSA, NEPSI etc.) related to site specifications. You can find more data about hazardous areas in the Ex Manuals and Ex Certificates of Compliance.
Horn (cone) antenna	A common antenna for most applications. It is used for the controlled emission and collection of radar signals.

I

Interference signals	False radar reflections.
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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 measurement signal 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.

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.

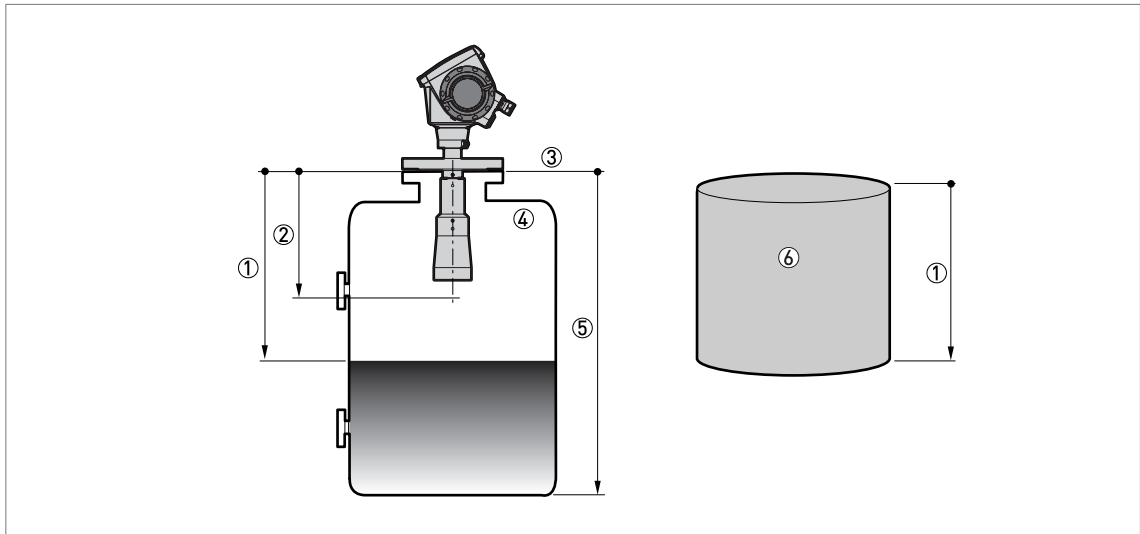


Figure 10-3: Measurement definitions: distance

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

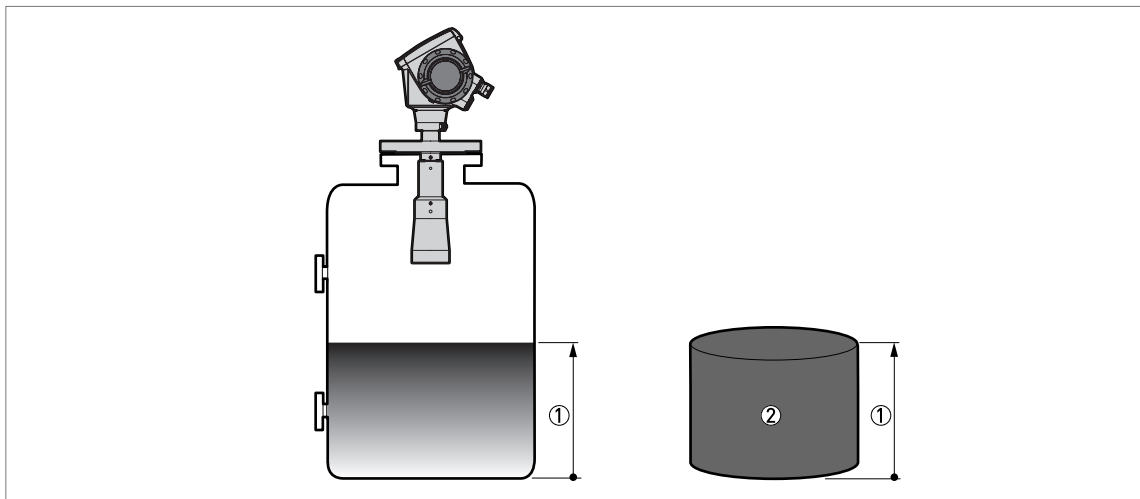


Figure 10-4: Measurement definitions: level

- 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 assemblies
- Pressure transmitters
- Analysis products
- Products and systems for the oil & gas industry
- Measuring systems for the marine industry

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