OPTIWAVE 15XX **Handbook**

80 GHz radar (FMCW) level and flow transmitters

KROHNE

IMPRINT

CONTENTS

1.1 Software history

"Firmware revision" agrees with NAMUR NE 53. It is a series of numbers used to record the revision status of embedded software (firmware) in electronic equipment assemblies. It gives data on the type of changes made and the effect that changes have on compatibility.

1		Downwards compatible changes and fault repair with no effect on operation (e.g. spelling mistakes on display)
2-_		Downwards compatible hardware and/or software change of interfaces:
	H	HART®
	P	Profibus
	F	FOUNDATION fieldbus
3-_		Downwards compatible hardware and/or software change of inputs and outputs:
	CO	Current output
	SO	Status output
	LS	Limit switch
	CI	Current input
	D	Display

Table 1-1: Changes and effect on compatibility

Release date	Printed circuit assembly	Software		Electronic revision	Hardware revision	Changes and compatibility	Documentation
2024-03-20	Main	Main	1.0.2	ER1.0.0_	4008475901g	—	MA OPTIWAVE 15XX R01
		Sensor	1.0.1				
		Bluetooth	1.0.2				

Table 1-2: Software history

1.2 Intended use

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

It can be installed on tanks, reactors, open channels, open water, silos, hoppers and bunkers.

CAUTION!
Responsibility for the use of the measuring devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.

INFORMATION!
The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose.

WARNING!
This equipment generates and radiates radio-frequency energy. In order to comply with ICNIRP radio-frequency radiation-exposure limits for general public, this equipment has to be installed and operated while maintaining a minimum body to antenna distance of 0.2 m / 0.66 ft.

1.3 Certification

Product marking

Figure 1-1: Examples of marking logo

The manufacturer certifies successful testing of the product by applying the conformity mark on the device.

This device fulfils the statutory requirements of the relevant directives.

For more information on the directives, standards and the approved certifications, please refer to the declaration of conformity supplied with the device or downloadable from the manufacturer's website.

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

Other approvals and standards

• **EU:** Radio Equipment Directive, Electromagnetic Compatibility Directive, the safety part of the Low Voltage Directive and ATEX Directive (Ex-approved devices)

• **UK:** Radio Equipment Regulations, Electromagnetic Compatibility Regulations, the safety part of the Electrical Equipment (Safety) Regulations and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations

• NAMUR Recommendations NE 21, NE 43, NE 53 and NE 107

1.4 Radio approvals

1.4.1 European Union (EU) and United Kingdom (UK)

Applications

LPR (Level Probing Radar) devices measure level in the open air or in a closed space (a metallic tank etc.). You can use LPR devices for TLPR applications. The LPR devices meet the requirements of the RED (Radio Equipment Directive) for use in the member countries of the EU. The LPR devices also meet the requirements of the Radio Equipment Regulations (RER) for use in the UK

This level transmitter is approved to be used outside metallic tanks. If the device is correctly operated in the open air (outdoors), it agrees with the Radio Equipment Directive (RED).

Radio approval data on the nameplate
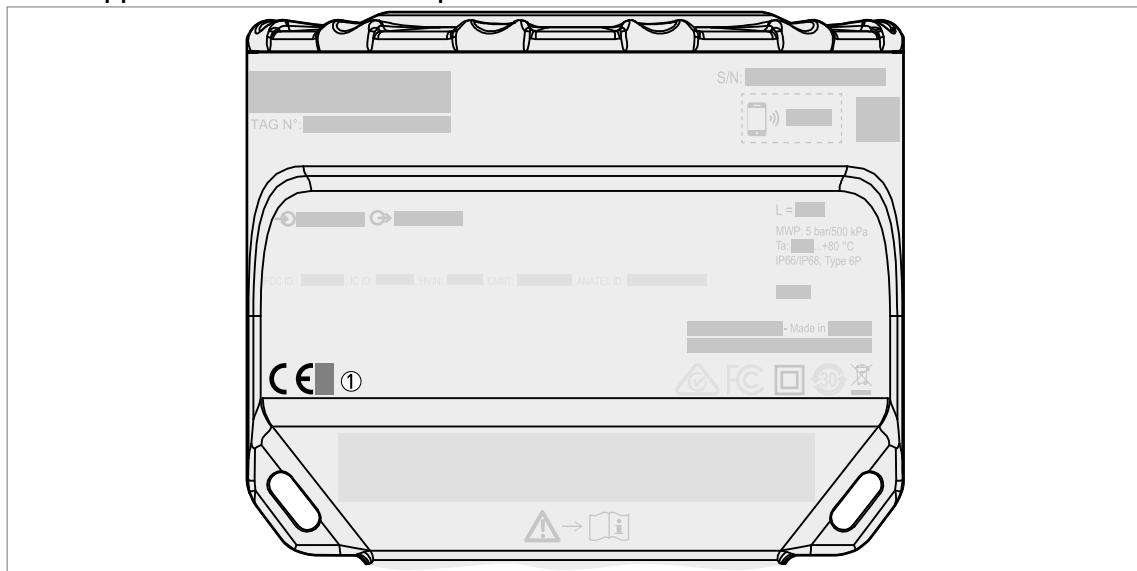
Figure 1-2: Radio approval data on the nameplate – European Union and United Kingdom

① CE or UKCA marking (as applicable)

Regulations

If the device is correctly operated in the open air (outdoors), it agrees with the EU Radio Equipment Directive (RED) and the UK Radio Equipment Regulations.

- Use approved personnel to install the device.
- The antenna must always point downwards. The boresight direction of the antenna must be vertical. No other angles are permitted.
- 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) etc.).

Country	Name of the station	Location	
		Latitude, φ	Longitude, λ
Finland	Metsähovi	60°13'04" N	24°23'37" E
France	Plateau de Bure	44°38'01" N	05°54'26" E
Germany	Effelsberg	50°31'32" N	06°53'00" E
Italy	Sardinia	39°29'50" N	09°14'40" E
Spain	Yebes	40°31'27" N	03°05'22" W
	Pico Veleta	37°03'58" N	03°23'34" W
Sweden	Onsala	57°23'45" N	11°55'35" E

Table 1-3: Radio quiet zones: locations of radio astronomy sites (stations) in Europe and northern Eurasia

1.4.2 U.S.A.

Applications

LPR (Level Probing Radar) devices measure level in the open air or in a closed space (a metallic tank etc.). You can use LPR devices for TLPR applications.

This level transmitter is approved to be used outside metallic tanks.

Radio approval data on the nameplate
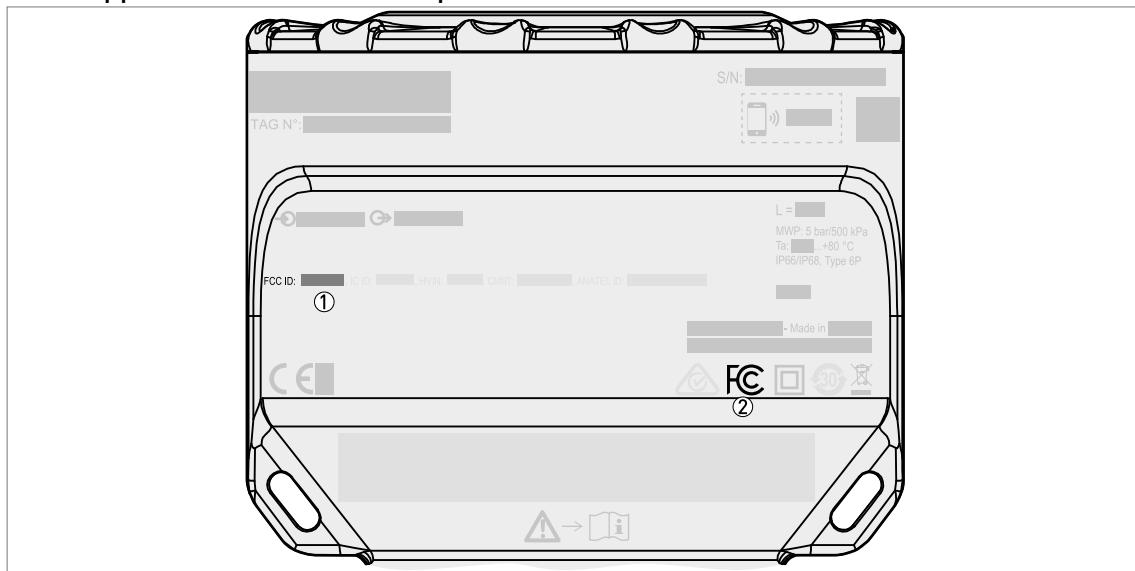
Figure 1-3: Radio approval data on the nameplate – U.S.A.
① FCC ID: 2AV6KH
② FCC sign

Regulations

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

§ *LEGAL NOTICE!*
1. This device may not cause harmful interference, and

2. This device must accept any interference received, including interference which may cause un-desired operation.

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

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

The Product Marketing Name (PMN) of this device is "OPTIWAVE 15XX series".

1.4.3 Canada

Applications

LPR (Level Probing Radar) devices measure level in the open air or in a closed space (a metallic tank etc.). You can use LPR devices for TLPR applications.

This level transmitter is approved to be used outside metallic tanks.

§ *LEGAL NOTICE!*
1. this device may not cause harmful interference, and

2. this device must accept any interference received, including interference that may cause unde-sired operation.

Radio approval data on the nameplate
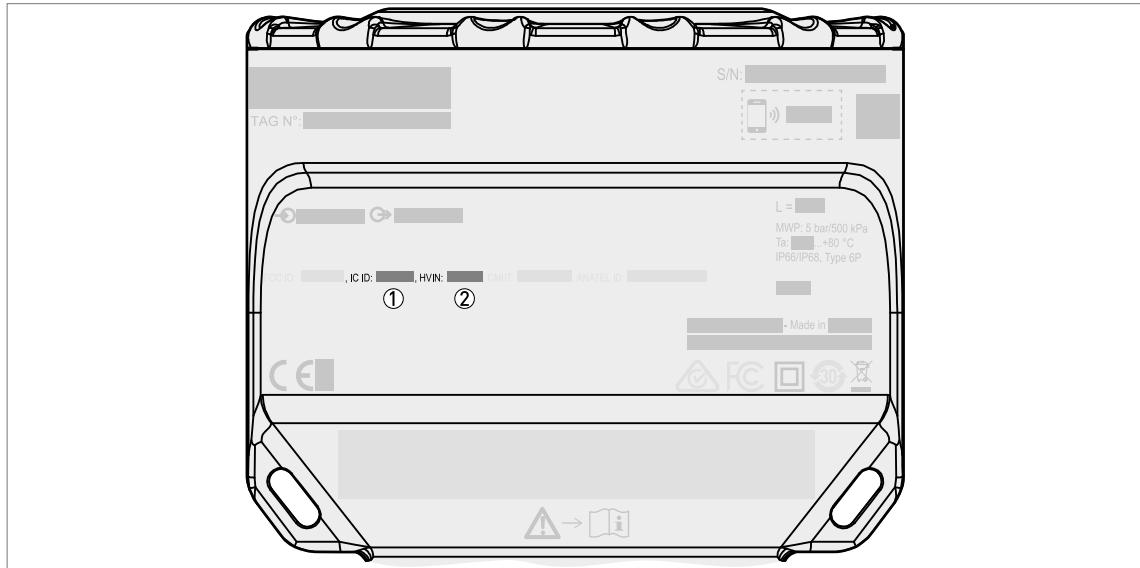
Figure 1-4: Radio approval data on the nameplate - Canada

① IC-ID number: 1991B-H
② HVIN (Hardware Version Identification Number): 01

Regulations

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following conditions:

§ *LEGAL NOTICE!*
1. This device may not cause harmful interference, and

2. This device must accept any interference received, including interference which may cause un-desired operation.

§ *LEGAL NOTICE!*
This device and the handbook comply with the requirements of RSS-Gen. Operation is subject to the conditions that follow:

1. The installation of the device shall be done by trained installers, in strict compliance with the manufacturer's instructions.

2. The use of this device is on a "no-interference, no-protection" basis. That is, the user shall accept operations of high-powered radar in the same frequency band which may interfere with or damage this device. However, devices found to interfere with primary licensing operations will be required to be removed at the user's expense.

3. Ensure a vertically downward orientation of the transmit antenna and an installation only at fixed locations.

4. The installer / user of this device shall ensure that it is at least 10 km from the Dominion Radio Astrophysical Observatory (DRAO) near Penticton, British Columbia. The coordinates of the DRAO are latitude 49°19'15" N and longitude 119°37'12" W. For devices not meeting this 10 km separation (e.g. those in the Okanagan Valley, British Columbia) the installer / user must coordinate with, and obtain the written concurrence of, the Director of the DRAO before the equipment can be installed or operated. The Director of the DRAO may be contacted at 250-497-2300 (tel.) or 250-497-2355 (fax). Alternatively, the Manager, Regulatory Standards, Industry Canada,

may be contacted.

The Product Marketing Name (PMN) of this device is "OPTIWAVE 15XX series".

1.5 Conformity to environmental standards

KROHNE's Quality and Sustainable Development Policy agrees with International Standards ISO 9001, ISO 14001 and ISO 45001. One of the principles of this policy is environmental protection. This is how we protect the environment:

- we use an environment management system that agrees with ISO 14001,
- we use eco-design principles (e.g., product packaging, disposal etc.), and
- we supply recycling data for each device to recycling agencies (the data agrees with the EU's WEEE directive). For more data, refer to *Disassembly and recycling* on page 83.

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.

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

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

1.6.2 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 cannot 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

> **ℹ** *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.*

> **ℹ** *INFORMATION!*
> *Do a check of the packing list to make sure that you have all the elements given in the order.*

> **ℹ** *INFORMATION!*
> *Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.*
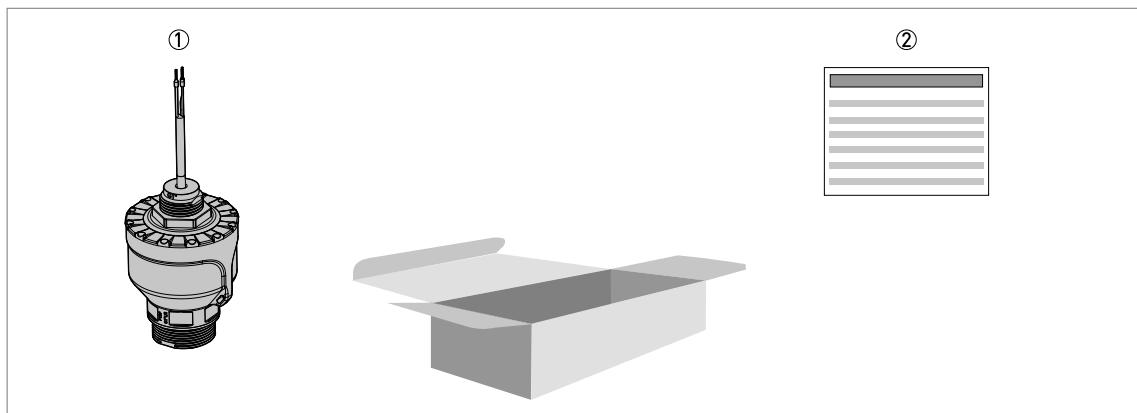
Figure 2-1: Scope of delivery
① Device in the version as ordered (FKM/FPM gasket included with G threaded connection)
   IP68 housing option: G 1 nut attached to the thread at the top of the housing
② Product documentation
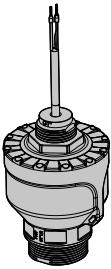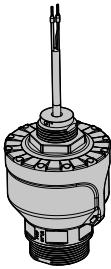
2.2 Device description

2.2.1 General information

This device is an 80 GHz FMCW-radar level and flow transmitter. It is an enclosed device in a plastic housing that is particularly ideal for applications where the device may be submerged for several days. It is designed to measure the distance, level, volume and reflectivity of liquids, pastes and slurries and granulates. It can also measure the volumetric flow rate of liquids.

2.2.2 Device versions

The device comes in two versions based on the size of the antenna, the accuracy and the measuring range of the device.

	1520	1540
Measuring range	10 m / 32.8 ft	15 m / 49.2 ft
Accuracy	± 5 mm / ± 0.19¨	± 2 mm / ± 0.08¨
Antenna size	DN40 / 1½¨	
Housing	IP68 (extended ingress protection) / suspended cable / no display	
Process connection	G 1 1/2 or 1 1/2 NPT	

2.3 Nameplate (example)

INFORMATION!
*Look at the device nameplate to ensure that the device is delivered according to your order.
Check for the correct supply voltage printed on the nameplate.*
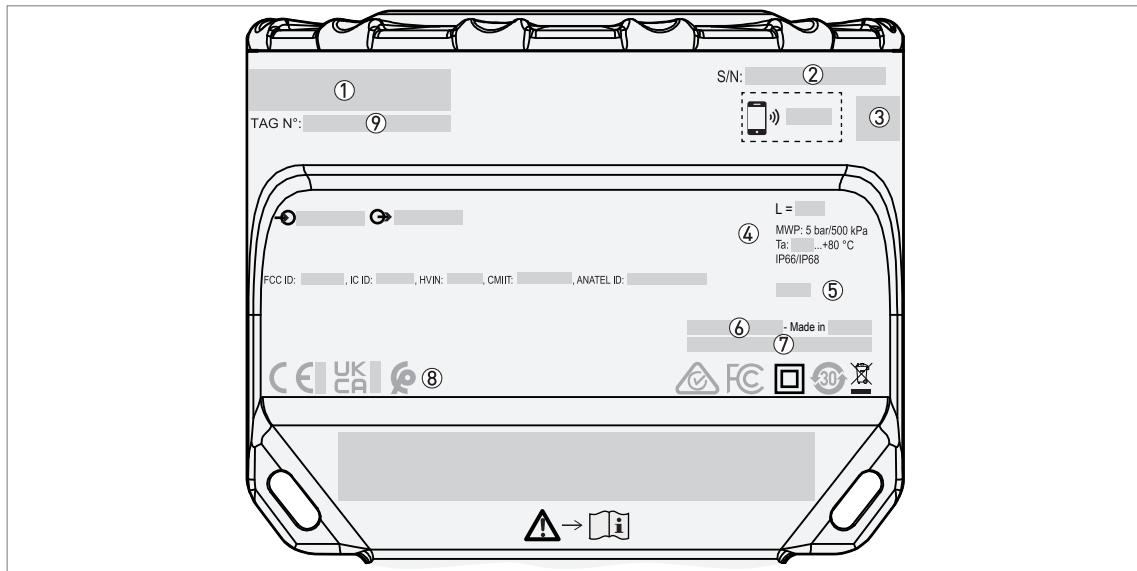
Figure 2-2: Nameplate – general information

① Model name and number
② Serial number
③ Data Matrix code (AutoID). Use a mobile device to scan this Data Matrix code to download technical data, documentation and software.
④ Measuring range, maximum working pressure (MWP), ambient temperature range (Ta) and degree of ingress protection (according to IEC 60529)
⑤ Date of manufacture
⑥ Company address and country of manufacture
⑦ Name and address of the UK importer (if applicable)
⑧ CE, UKCA or CMIM marking (if applicable)
⑨ Customer tag number

Auto ID according to DIN specifications

The auto ID code (data matrix) guides you directly to the PICK server (Product Information Center KROHNE).
Scan the auto ID code on the device nameplate to download all product specific information.

• Handbooks, quick starts and supplementary instructions
• Conformity and radio approval certificates
• Calibration certificates
• Digital nameplates
• Etc.
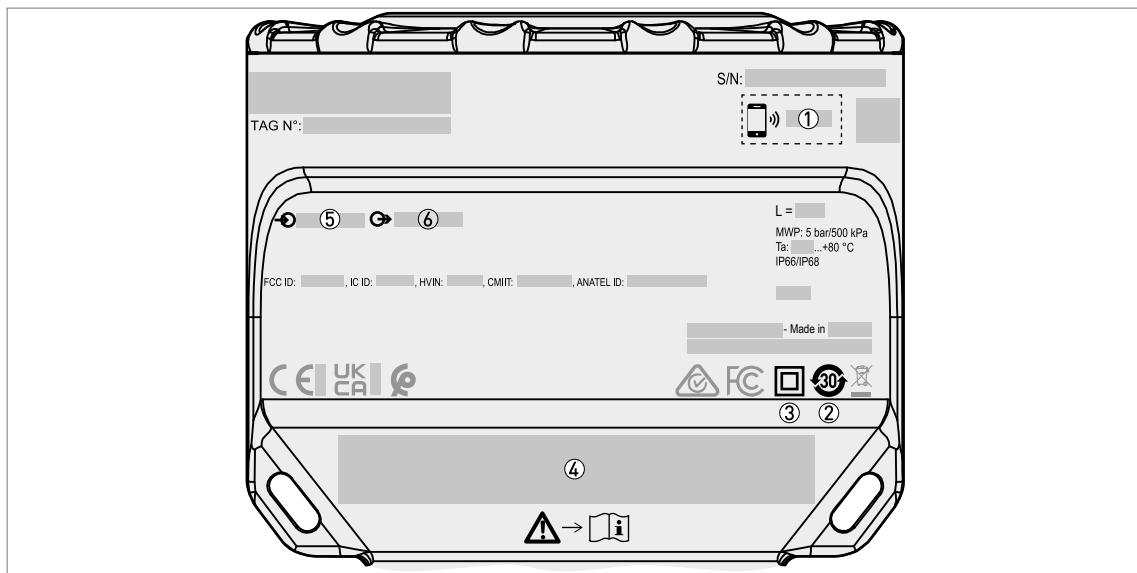
Figure 2-3: Nameplate – electrical information

① Bluetooth code for DTM (PACTware) and OPTICHECK Level Mobile (application for mobile devices)
② Symbol to show that the device agrees with China RoHS (Chinese Government regulation to prevent contamination of the environment from materials used in the manufacture of electronic devices). The value given on the symbol is the time in years that the device is guaranteed to be environmentally safe.
③ Symbol: Class 2 electrical equipment with double insulation
④ WARNING: Potential electrostatic charging hazard – see instructions
⑤ Input voltage and maximum current
⑥ Signal output (analogue or HART®)

Symbol	Description
⊶	Electrical input
⟼	Electrical output
── ─ ─	Direct current (DC)
▣	Class 2 electrical equipment with double insulation
⚠→📖	For more data, refer to the handbook
📱))）	The device can communicate with mobile devices (e.g., Bluetooth® wireless technology).
🗑	Do not recycle electronic and electrical equipment at the end of the life with other waste materials. Disposal must be carried out in accordance with legislation applicable in your country.

Table 2-1: Symbols used on the nameplate

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

- Store the device in a dry and dust-free location.
- Keep the converter out of the sunlight.
- Storage temperature: -40...+80°C / -40...+176°F
- Store the device in its original packing.

3.3 Transport

Transport the device in its original packing until you install it.

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.
- Heat sources (sunlight, adjacent system components etc.) can increase the internal temperature of the device and cause damage. Make sure that the sensor temperature shown on the user interface is not more than +80°C / +176°F. The maximum permitted surface temperature is +80°C / +176°F. If it is necessary to decrease the temperature, install the weather protection cover.
- Protect the device from abrasive materials (e.g. sand, salt etc.) and corrosion. If necessary, install the weather protection cover.
- Make sure that objects (for example, loose rubble in quarries) do not hit the device.
- The devices are tested for their resistance to vibrations. For more data, refer to *Technical data* on page 88.
- The device housing and all wetted parts are made of PVDF. Make sure that the ambient conditions and the measured product are compatible with PVDF.

3.5 Pressure and temperature ranges
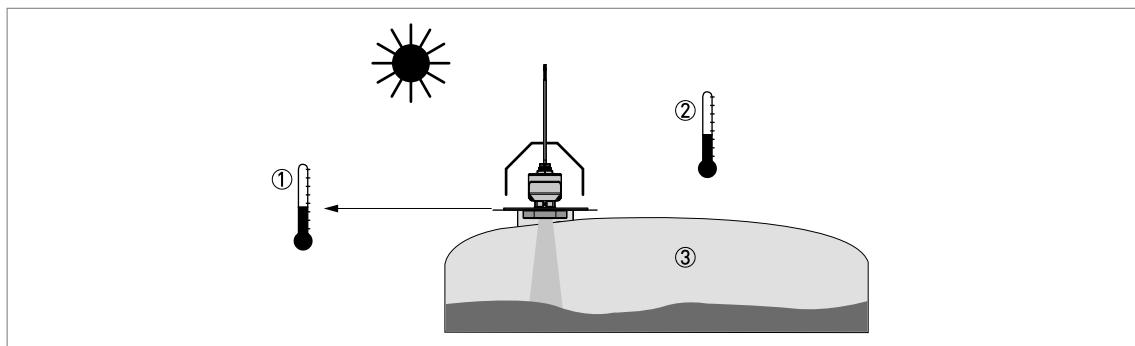
Figure 3-1: Pressure and temperature ranges

① Temperature at the process connection
  Non-Ex devices: -25...+80°C / -13...+176°F
  Devices with Hazardous Location approvals: see supplementary instructions
② Ambient temperature
  Non-Ex devices: -25...+80°C / -13...+176°F
  Devices with Hazardous Location approvals: see supplementary instructions
③ Process pressure
  -1...5 bar / -14.5...72.5 psi

3.6 Installation - general requirements

⚠ **CAUTION!**
Follow these recommendations to make sure that the device measures correctly. They have an effect on the performance of the device.

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

3.6.1 Types of installation

Accessories are available for installation of the device on a nozzle, wall, tube or other support.

⚠ **CAUTION!**
Use brackets that are supplied by the manufacturer to prevent measurement errors.

Socket
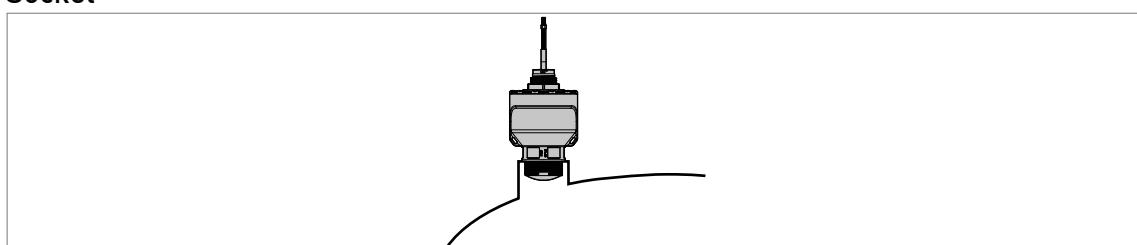
Figure 3-2: Threaded socket (NPT or G)

Equipment needed:

- **ISO 228-1 (G) connection:** FKM/FPM gasket (supplied with the device)
- **NPT connection:** PTFE threaded seal tape (not supplied)

- 52-mm open wrench or adjustable wrench (optional, not supplied)

- Put the device on the socket.
- Attach the device and tighten it to 10 N·m / 7.38 lbf·ft.
- Do a check to make sure that the tank is sealed.

Low-pressure flange installed on a nozzle

Figure 3-3: Installation of a device with a low-pressure flange (accessory)
① Device installed on the top of a low-pressure flange
② Device installed on the bottom of a low-pressure flange

Select a low-pressure flange that is compatible with the threaded connection on the device and is the correct size for the flange on the nozzle.

Orientation system installed on a nozzle

Figure 3-4: Installation of a device with an orientation system (max. tilt 30°)
① Device with the orientation system for level measurement of piles or silo contents
② Device with the orientation system and the purging system option

The orientation system has a low-pressure flange. Select an orientation system accessory that is compatible with the threaded connection on the device and is the correct size for the flange on the nozzle. For dimensional data, refer to *Dimensions and weights* on page 97. For part references, refer to *Accessories* on page 113.

Installation on a wall, ceiling or tube
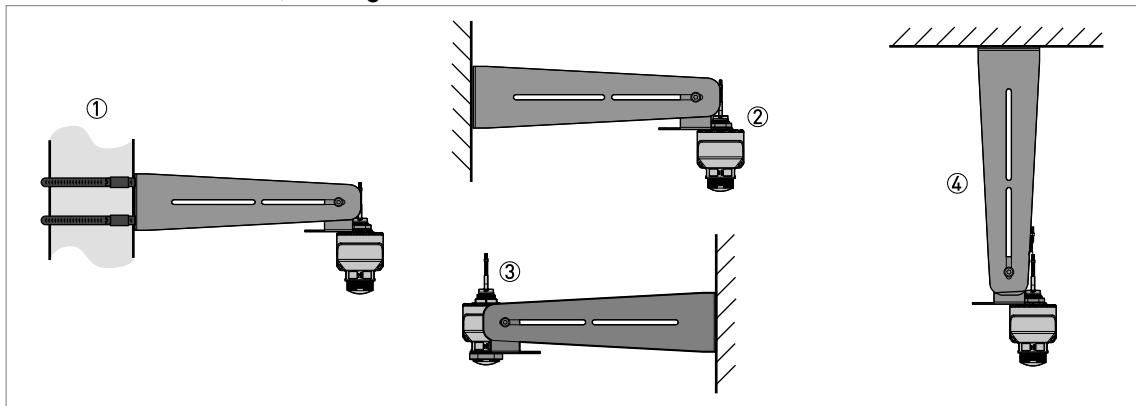
Figure 3-5: Installation on a wall, ceiling or tube with a long bracket

① Long bracket attached to a tube with a U-bolt or a metal collar (not supplied)
② Wall installation: top of the device attached to the long bracket
③ Wall installation: bottom of the device attached to the long bracket
④ Long bracket attached to the ceiling
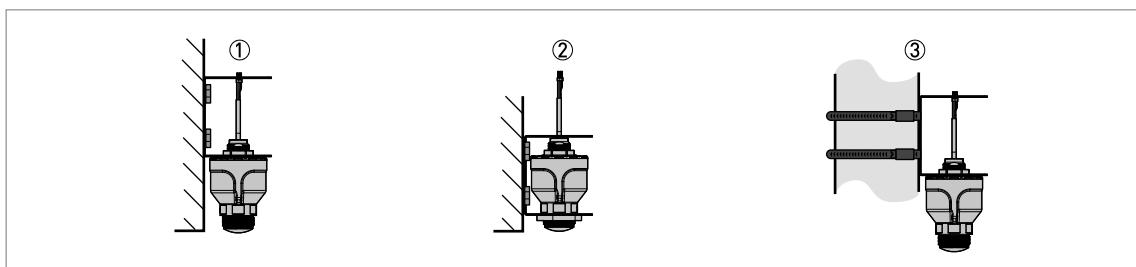
Figure 3-6: Installation on a wall or tube with a short bracket

① Wall installation: top of the device attached to the short bracket
② Wall installation: bottom of the device attached to the short bracket
③ Short bracket attached to a tube with a U-bolt or a metal collar (not supplied)

For the procedure to install the short bracket, refer to *Attaching the device on the short bracket* on page 26.

For the procedure to install the long bracket, refer to *Attaching the device on the long bracket* on page 27.

For part references, refer to *Accessories* on page 113.

Installation on a hook

Figure 3-7: Installation on a hook with an electrical cable clamp (IP68 housing option only)

For part references, refer to *Accessories* on page 113.

⚠️ *WARNING!*
Use good engineering practice to keep the mechanical loads on the electrical cable and device to a minimum.

3.6.2 Positioning the device

If there is a nozzle on the tank before installation, we recommend that the nozzle is a minimum of 200 mm / 7.9¨ from the tank wall.
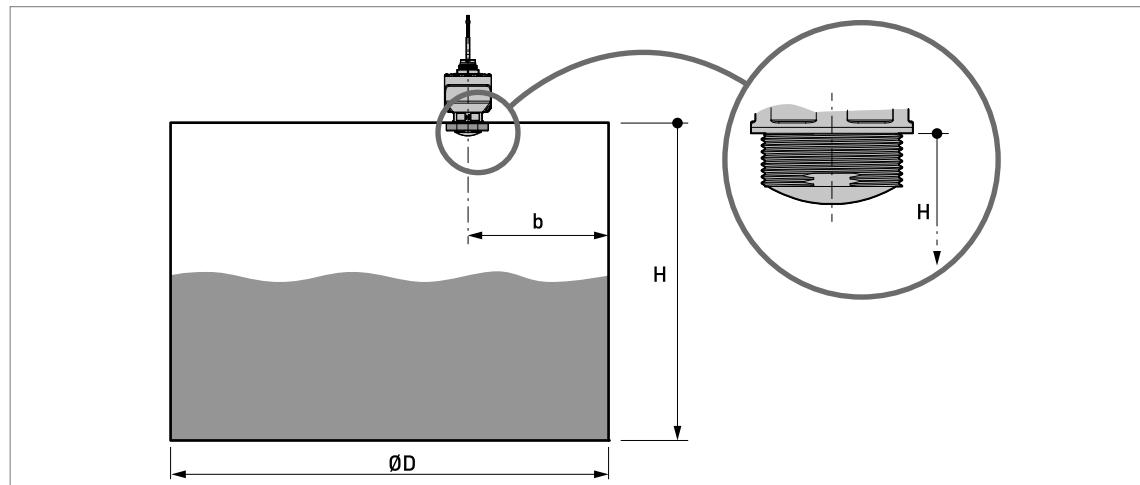
Figure 3-8: Position of the nozzle or socket on a tank

H = tank height
ØD = tank diameter
b = distance of the device from the tank wall = 1/10 x tank height

3.6.3 Containers made of non-conductive materials

⚠️ *CAUTION!*
We recommend that you do not hang and use this device above a plastic tank that has a layer of dust, condensation or a standing body of liquid on it. Dust and liquid can have an effect on the device performance.

If the device cannot go in the tank and the tank is made of a non-conductive material (plastic etc.), you can attach a support to the top of the tank without a hole in the tank roof. We recommend that you put the antenna as near as possible to the top of the tank.
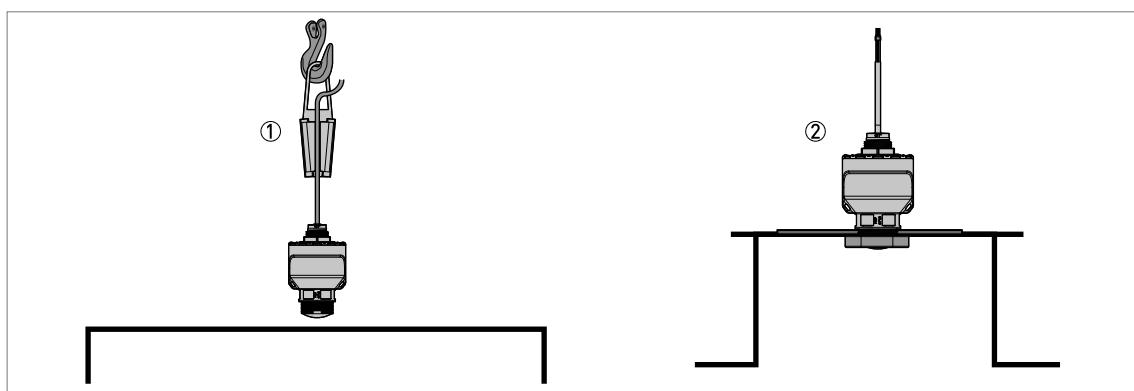
Figure 3-9: Containers made of a non-conductive material
① Device hung above a plastic tank
② Device attached to a plastic tank with a low-pressure flange

3.7 Accessories

3.7.1 Equipment needed:

- Accessory: short bracket, long bracket, weather protection cover or purging system adaptor
- 1¨ nut (supplied attached to the thread at the top of the device)
- 1 1/2¨ nut
- **ISO 228-1 (G) connection:** FKM/FPM gasket (supplied with the device)
- **NPT connection:** PTFE threaded seal tape (not supplied)
- **For the 1¨ nut:** 42-mm open wrench or adjustable wrench (not supplied)
- **For the 1 1/2¨ nut:** 65-mm open wrench or adjustable wrench (not supplied)
- 6-mm Allen wrench

3.7.2 Attaching the device on the short bracket
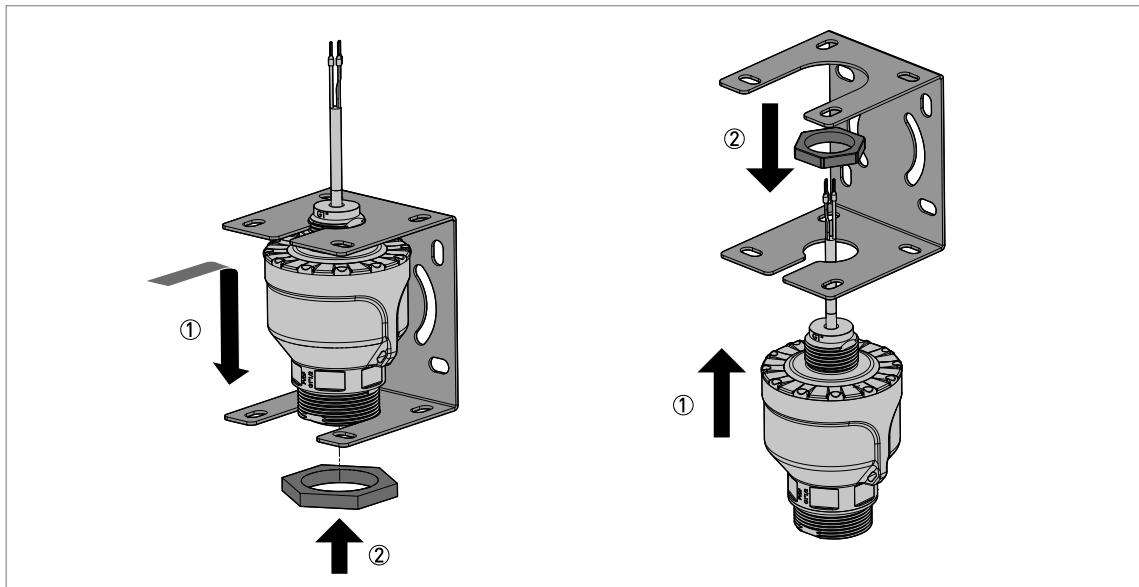
Figure 3-10: How to attach the device to the short bracket

Attaching the bottom of the device to the short bracket

- **ISO 228-1 (G) connection:** Remove the FKM/FPM gasket.
- Put the thread at the bottom of the device through the hole for 1 1/2¨ threads.
- Attach the 1 1/2¨ nut. Tighten it to 10 N·m / 7.38 lbf·ft with a 65-mm wrench.

Attaching the top of the device to the short bracket

- Remove the 1¨ nut attached to the top of the device. Put the thread at the top of the device through the hole for 1¨ threads.
- Attach the nut. Tighten it to 8 N·m / 5.90 lbf·ft with a 42-mm wrench.

3.7.3 Attaching the device on the long bracket
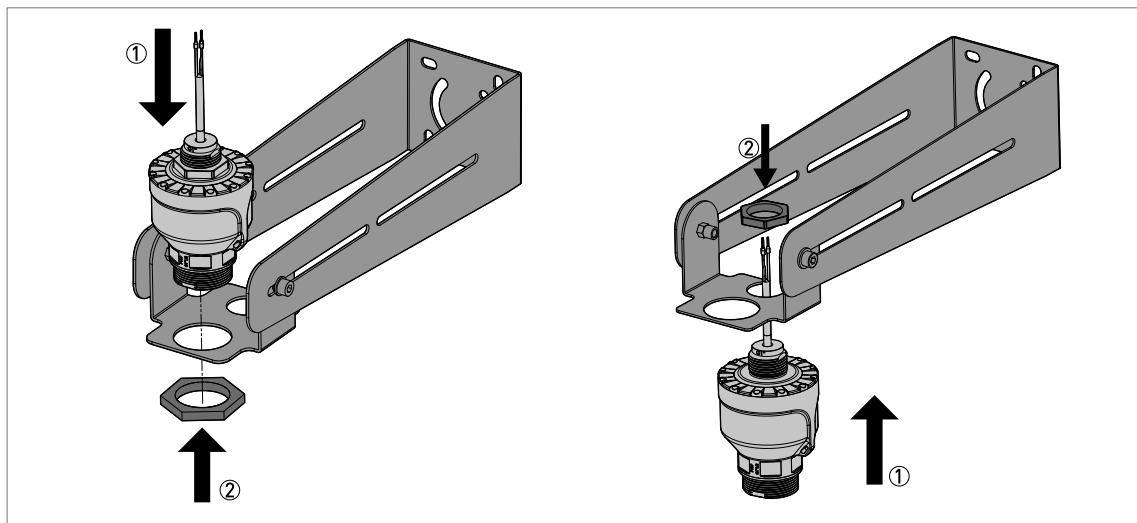
Figure 3-11: How to attach the device to the long bracket

Attaching the bottom of the device to the long bracket

• **ISO 228-1 (G) connection:** Remove the FKM/FPM gasket.
• Put the thread at the bottom of the device through the hole.
• Attach the 1 1/2¨ nut. Tighten it to 10 N·m / 7.38 lbf·ft with a 65-mm wrench.

Attaching the top of the device to the long bracket

• Loosen the 1¨ nut attached to the top of the device. Put the thread at the top of the device through the hole.
• Attach the nut. Tighten it to 8 N·m / 5.90 lbf·ft with a 42-mm wrench.

3.7.4 Changing the position of the device on the long bracket

You can change the position of the device above the product to be measured if you attach it to the long bracket. Refer to the procedure that follows:
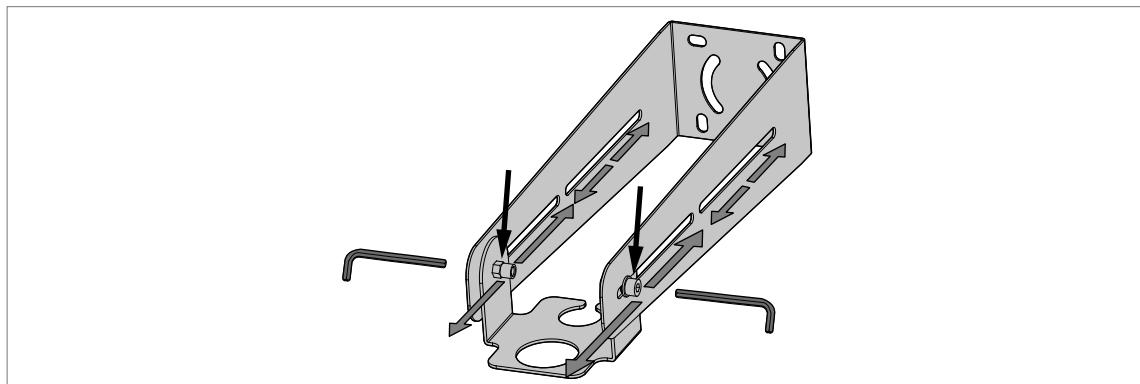
Figure 3-12: Changing the position of the device on the long bracket

- Loosen the two screws on the sides of long bracket with a 6-mm Allen wrench.
- Move the device along the slot until it is in the correct position.
- Tighten the two screws on the sides of long bracket with a 6-mm Allen wrench.

3.7.5 Attaching the weather protection cover to the device

Heat sources (sunlight, adjacent system components etc.) can increase the internal temperature of the device and cause damage. If it is necessary to decrease the internal temperature, install the weather protection cover accessory.
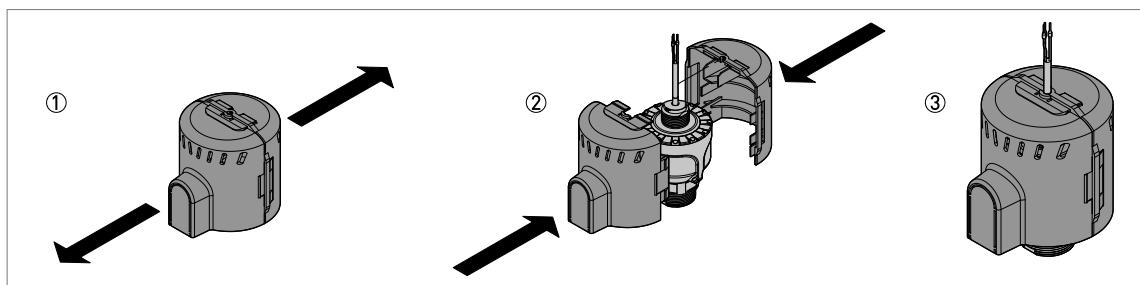
Figure 3-13: Attaching the weather protection cover to the device

① Release the clips to divide the weather protection cover into two parts.
② Put the device in between the two parts of the weather protection cover.
③ Attach the two parts of the weather protection cover so that the device is held tightly.

The overall dimensions of the weather protection cover are on page 103.

3.7.6 Purging system

You can attach a purging system adaptor to a device to clean the bottom of the device with a liquid or gas that is compatible with the device and the process. Use an adaptor that is the correct size for the selected process connection option.

ℹ️ *INFORMATION!*
The purging system adaptor has an inlet with a G 1/4 threaded connection.
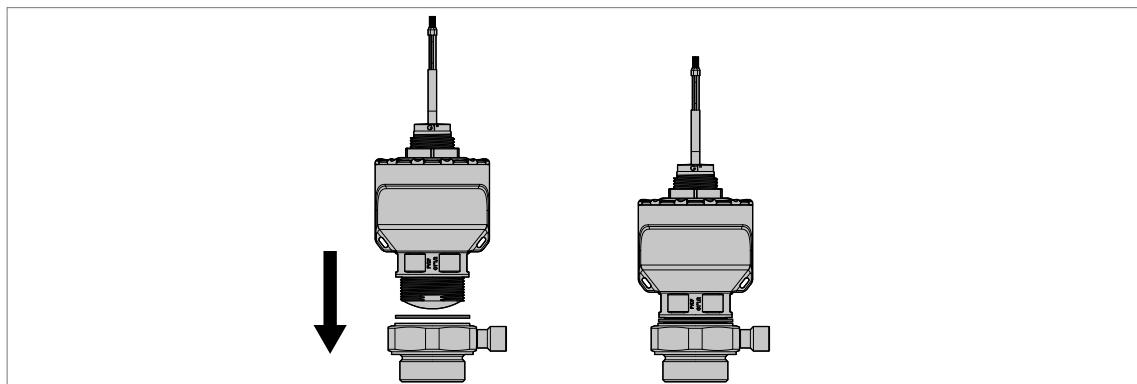
Figure 3-14: How to attach the purging system adaptor to the device

⚠️ *WARNING!*
Tighten the process connection and purging system adaptor to 10 N·m / 7.38 lbf·ft. If the connection is too tight, this will damage the thread.

- **ISO 228-1 (G) connection:** Align the gasket correctly. Put the device carefully on the purging system adaptor.
- **NPT connection:** Wind the thread seal tape around the process connection of the device in agreement with good engineering practice. Put the device carefully on the purging system adaptor.
- Attach the device to the purging system adaptor. Tighten it to 10 N·m / 7.38 lbf·ft.

ℹ️ *INFORMATION!*
If it is necessary to send an order for the purging system adaptor, refer to Process connection kits for the level transmitter on page 114.

3.8 Restrictions

3.8.1 Equipment and obstacles

The tank wall must be flat and there must not be obstacles adjacent to the nozzle or on the tank wall.

Objects in the tank or pit can cause interference signals. Do not install the device above objects in the tank (ladder, supports etc.) or pit.

⚠ *CAUTION!*
If there are interference signals, the device will not measure correctly.

If it is not possible to install the device on another part of the tank, do an empty spectrum scan to detect sources of radar signal interference and put these parasitic signals through a filter.
For more data, refer to *Empty spectrum* on page 47.
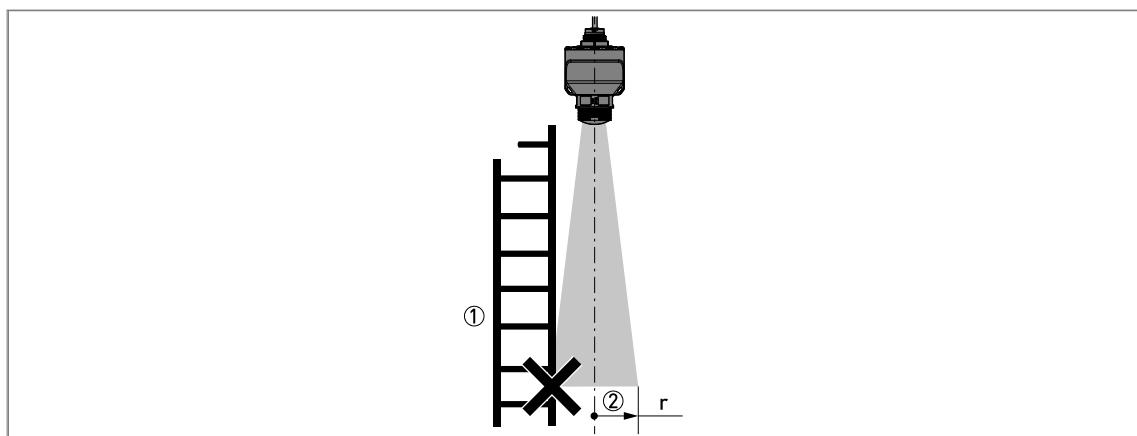
Figure 3-15: Equipment and obstacles: how to prevent measurement of interference signals
① Obstacle. Move the device away from the obstacle. If it is not possible to move the device, do an empty spectrum scan.
② Beam radius, r, of the antenna: refer to the table below
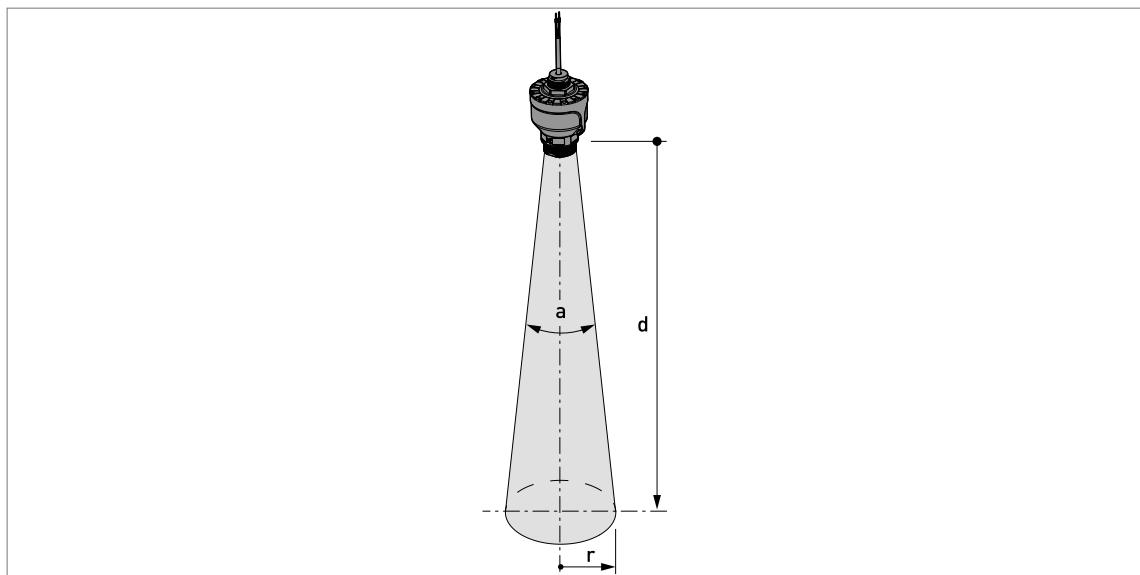
Figure 3-16: Beam angle

Antenna type	Beam angle, a	Distance below the antenna, d	Beam radius, r	Distance below the antenna, d	Beam radius, r
		[m]	[mm]	[ft]	[inch]
Lens, DN40 (1½¨)	8°	1	70	1	0.8
		2	140	2	1.6
		10	700	10	8

Table 3-1: Beam radius in mm and inches

The beam radius given in the table is the minimum free space from the centre of the beam for the device to operate correctly in a tank with obstacles. We recommend a safety factor of 3 (free space = beam radius x 3) to keep parasite signals to a minimum.

Polarisation

The device emits a radar beam that has an elliptical shape. The beam angle is larger in one direction compared to the plane perpendicular to it. This effect is known as polarisation. Point one of the two housing tag holes in the direction of the tank centerline to decrease the size of reflections from obstacles.
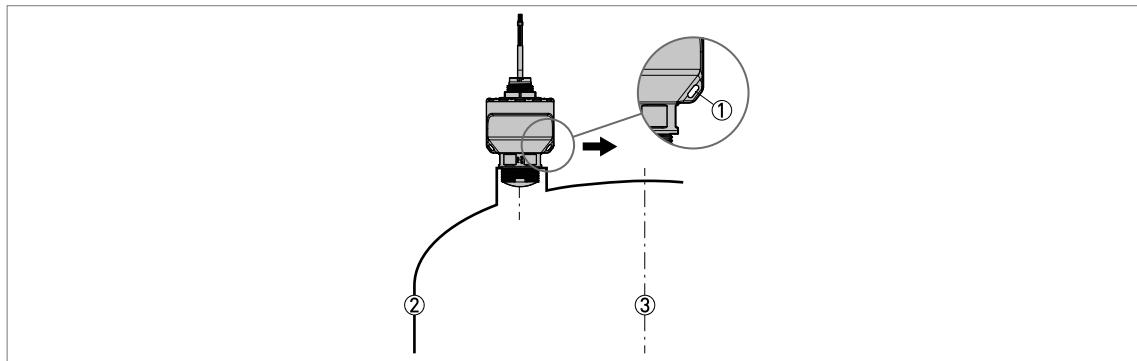
Figure 3-17: Preventing polarisation

① Tag hole
② Nearest tank wall
③ Tank centerline

3.8.2 Product inlets on tanks and silos
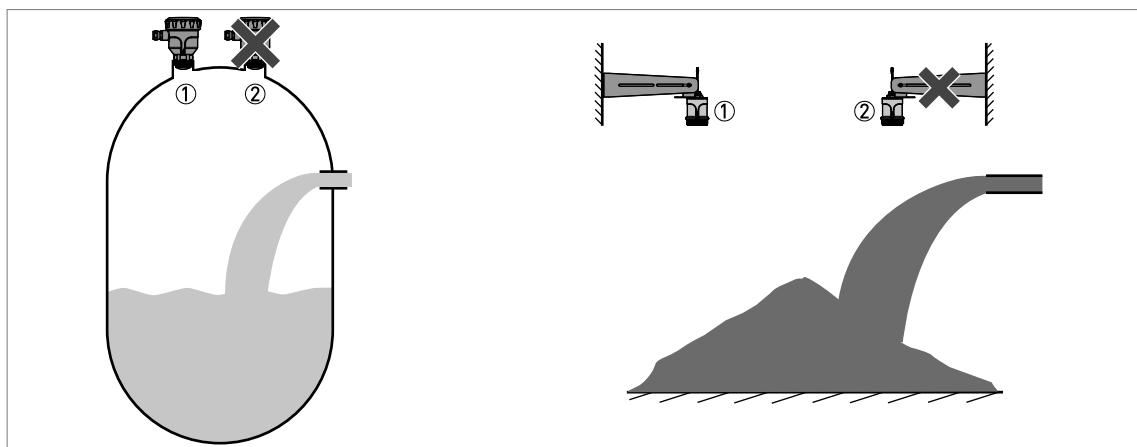
Figure 3-18: Do not put the device near to a loading inlet

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

If the inlet is too near to the device and it is not possible to move it, add an extension to the inlet pipe to prevent interference signals.
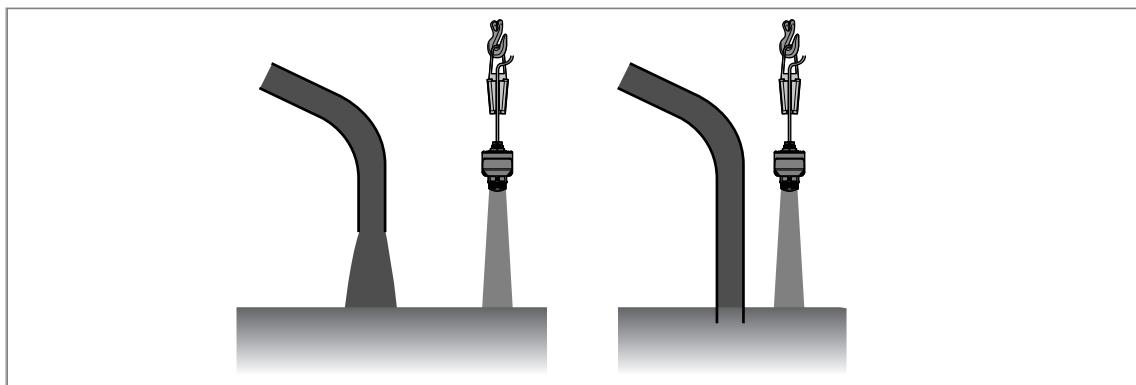
Figure 3-19: Add an extension to the inlet pipe to prevent interference signals

3.8.3 Tanks, hoppers and silos with dish-shaped or conical bottoms

If the device measures vertically, then dish-shaped or conical bottoms can prevent the device from measuring to the bottom of the tank.
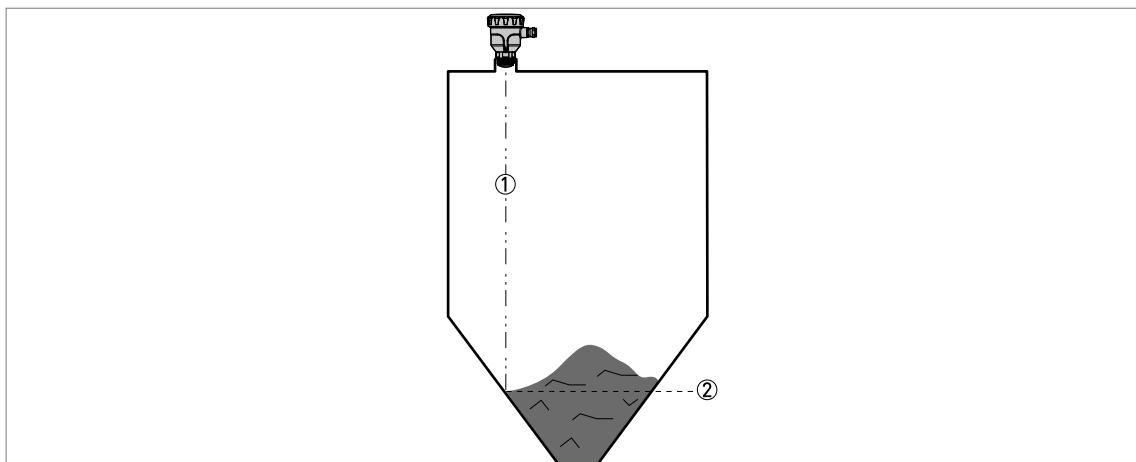
Figure 3-20: Tanks with dish-shaped or conical bottoms
① Axis of the radar beam
② Minimum level reading

You can measure to the bottom of a tank or silo if you follow these instructions:

- Select an application in the Quick Setup menu of the DTM software or mobile app that switches on the tank bottom management function (refer to the list that follows).
- Use the orientation system accessory that permits you to tilt the device a maximum of 30° from the vertical axis.

Applicable applications are:

- **Solids:** Narrow Silo, Bunker, Large Silo, and Stockpile
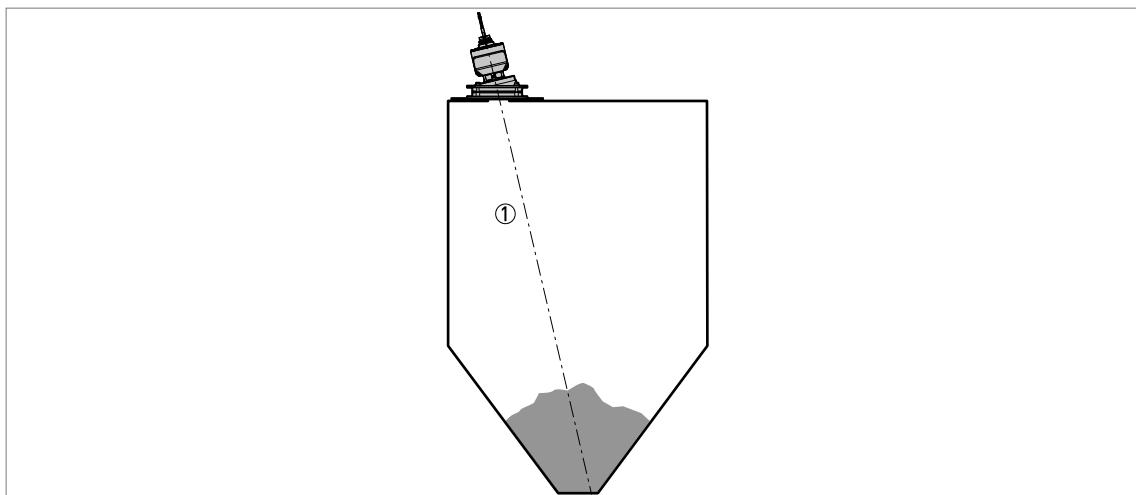
Figure 3-21: Tanks with dish-shaped or conical bottoms

① Axis of the radar beam

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 General notes

This chapter includes electrical connection data about devices with the 4...20 mA output and HART® communication options. These are 2-wire, loop-powered devices.

4.3 Electrical connection for current output
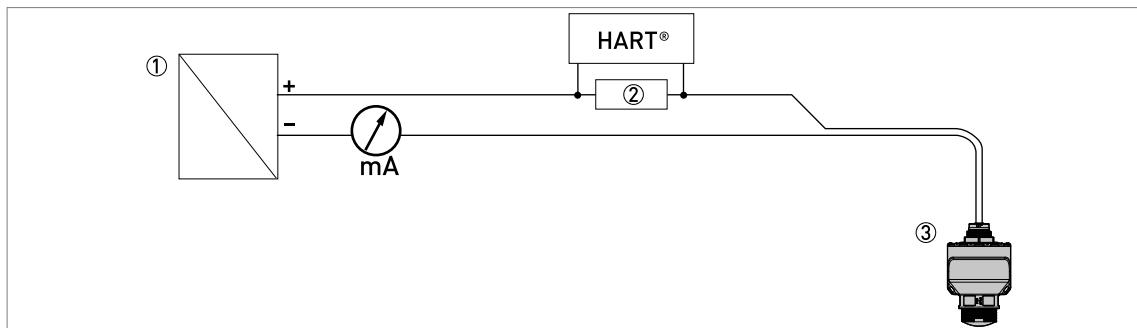
Figure 4-1: Electrical connections for non-Ex devices

① Power supply
② Resistor for HART® communication (typically 250 ohms)
③ Device

CAUTION!
Make sure that the red wire (+) is connected to the positive terminal of the power supply and the blue wire (-) is connected to the negative terminal of the power supply. Connect the drain wire to ground.

⚠️ *WARNING!*
- *Make sure that there is an external switch or circuit breaker adjacent to the device. It must disconnect the positive and negative lines in the DC circuit.*
- *You must have access to the external switch or circuit breaker, and it must be identified as the electrical safety equipment for this device.*
- *The output of the power supply must be LPS-rated (limited power source – IEC 62398-1 Annex Q) for a SELV (separated extra-low voltage) system.*
- *Use a Class 2 (UL 1310) power supply for electrical installations in the USA and Canada.*

The electrical cable is supplied with the device and cannot be replaced.
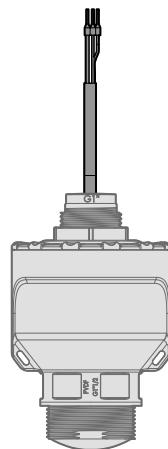
Figure 4-2: IP68 option

⚠️ *CAUTION!*
Install protection for the electrical cable, if the device is in a location where there is a risk of damage from wildlife (rats etc.).

4.4 Ingress protection

The ingress protection of the device agrees with the conditions that are necessary for IP68, as given in International Standard IEC 60529.

5.1 Start-up checklist

Check these points before you energize the device:

- Does the information on the signal converter nameplate agree with the operating data?
- Did you correctly install the device on the tank?

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

DANGER!
If the device has a Hazardous Locations approval, make sure that the device and the installation agrees with the requirements of the certificate of compliance.

5.2 Operating concept

You can read measurements and configure the device with:

- A PC or system with PACTware™ with HART Communication protocol. You can download the Device Type Manager (DTM) file from the website.
- A PC or system with PACTware™ with Bluetooth wireless technology. You can download the Device Type Manager (DTM) file from the website.
- OPTICHECK Level Mobile. You can download this mobile application from Google Play Store and Apple App Store.
- A PC or system with AMS™. You can download the Device Description (DD) file from the website.
- A HART® Field Communicator. You can download the Device Description (DD) file from the website.

5.3 2-wire HART connection to the device with PACTware

5.3.1 Equipment needed

- A computer
- HART® converter (USB or RS232)
- A web browser
- A high-speed Internet connection
- Microsoft® .NET Framework 2.0, 3.5 and 4.8
- PACTware™ 4.1 or a later version
- DTM for OPTIWAVE 15xx

5.3.2 Software installation

- Install Microsoft® .NET Framework. Follow the instructions in the installation wizard.
- Install PACTware™. Follow the instructions in the installation wizard.
- Install the **OPTIWAVE 15xx DTM**. Follow the instructions in the installation wizard.
- Plug the HART modem into your computer (Serial or USB HART® modem). If you are using a USB® HART modem, you must install the device driver for the USB HART® modem first. Make sure that the location of the port for the HART® modem is clearly identified.
- ➲ End of the procedure.

5.3.3 How to start the device

- Connect the converter to the power supply.
- Use a HART modem to connect the device to the workstation.
- Energize the converter.

5.3.4 Setup procedure

Before PACTware can send data to and receive data from the device, it is necessary to build a project in the software.

- Select **New project** on the home screen. This step opens an "Add device" window with a list.

Figure 5-1: Home screen

- Select "HART Communication" from the list.
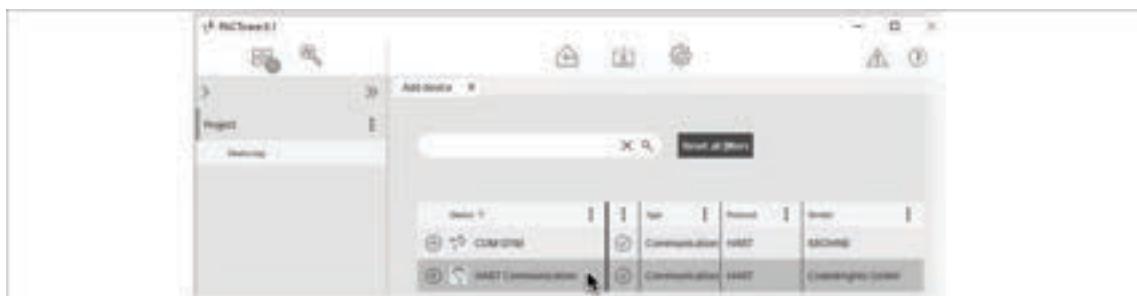
Figure 5-2: Add "HART Communication" to the PACTware project

- Make sure that the device is connected to the computer and energized.

- Right click on "COMxx" or click on the "three dots" menu icon in the project list and select "Parameter" from the context menu list.
- Make sure that the **Serial Interface** field is set to the HART modem port (refer to the illustration that follows). Click on the "Apply" button and then the "OK" button to close the Windows tab.
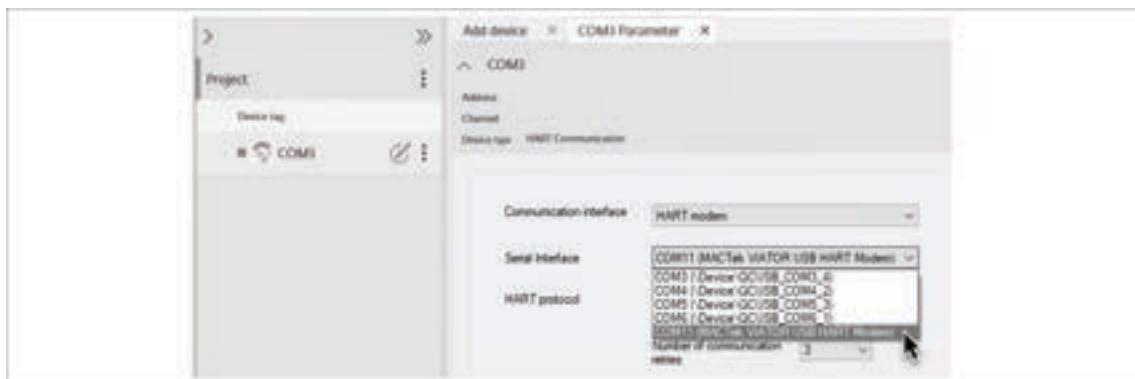
Figure 5-3: Select the HART modem port in the Serial Interface field

- Go to the column on the left side of the window and right click on "HART Communication" to show the context menu list. Select "Add device".
- Select "OPTIWAVE 15xx" from the list (double click). The tag name of the device is shown in the project list.
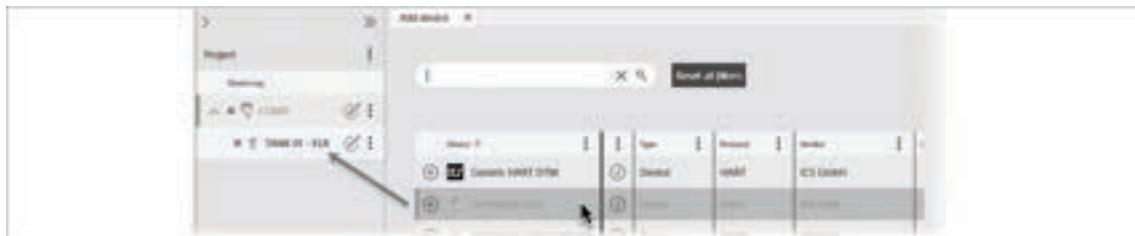
Figure 5-4: Add the device to the project list

- Go to the column on the left side of the window and right click on the tag name of the device to show the context menu list. Select "Connect". A green indicator icon is shown adjacent to the tag name.
- Go to the column on the left side of the window again and right click on the tag name of the device to show the context menu list. Select "Parameter". A tab opens that shows the device status and menus.

The device is connected to the computer at the end of this procedure. You can monitor measurements or change the device configuration.

5.4 Bluetooth wireless connection to the device with PACTware

5.4.1 Equipment needed

- A computer with Bluetooth capability or with a Bluetooth USB dongle (4.0 or later)
- Power supply for the device
- A web browser
- A high-speed Internet connection
- Microsoft® .NET Framework 2.0, 3.5 and 4.8
- PACTware™ 4.1 or a later version
- DTM for OPTIWAVE 15xx

5.4.2 Software installation

- Install Microsoft® .NET Framework. Follow the instructions in the installation wizard.
- Install PACTware™. Follow the instructions in the installation wizard.
- Install the **OPTIWAVE 15xx DTM**. Follow the instructions in the installation wizard.
- If your computer has a Bluetooth module then switch on this function in **Settings > Devices > Bluetooth and other devices**. If you do not have a Bluetooth module in the computer, then connect a Bluetooth dongle to a USB port. Make sure that the dongle is operating in Windows File Explorer.
- ➲ End of the procedure.

5.4.3 How to start the device

- Connect the converter to the power supply.
- Energize the converter.

5.4.4 Setup procedure

Before PACTware can send data to and receive data from the device, it is necessary to build a project.

INFORMATION!
Electromagnetic interference (EMI) can have an effect on Bluetooth connections to the device. If the device disconnects from the Bluetooth network, then try to connect your mobile app or DTM to the device again. If there continues to be a problem with the Bluetooth connection, start the device again.

- Select **New project** on the home screen. This step opens an "Add device" window with a list.

Figure 5-5: Home screen

- Select "COM DTM" from the list.
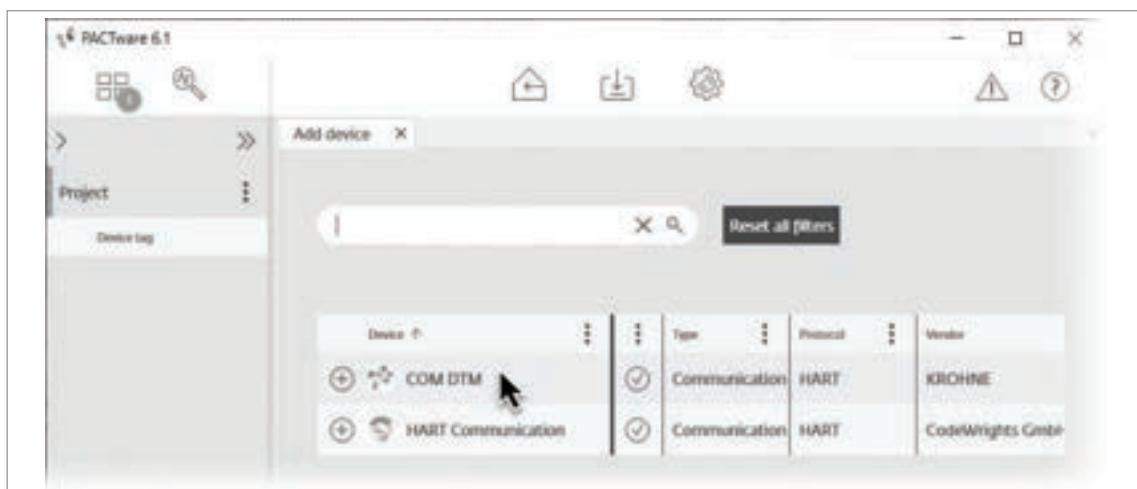
Figure 5-6: Add "COM DTM" to the PACTware project

- Go to **Settings > Devices > Bluetooth & other devices** in the Windows operating system and make sure **Bluetooth** is set to "On".
- Make sure that the device is energized.
- Select "Bluetooth" as the communication interface and click on "OK".
- Enter the Bluetooth code and push the Enter key. You can find the Bluetooth code on the device nameplate. For more data, refer to *Nameplate (example)* on page 18.
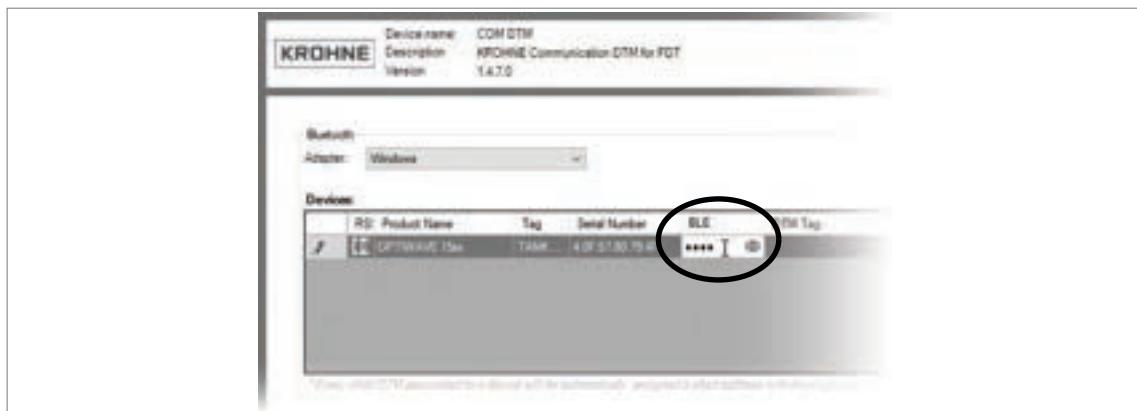
Figure 5-7: Enter the Bluetooth code

- Go to the column on the left side of the window and right click on **BLE-Windows** to show the context menu. Select "Add device".
- Select "OPTIWAVE 15xx" from the list and push the Enter key.
- Drag the cursor in the device list of the COM DTM Parameter window to the "Topology DTM children" list.

Figure 5-8: Add element to Topology DTM children list

- Go to the column on the left side of the window and right click on **TANK 01** (device tag) to show the context menu. Select "Connect".
- Go to the column on the left side of the window and right click on **TANK 01** (device tag) to show the context menu. Select "Parameter".

The device is connected to the computer. You can take readings or change the device configuration.

5.5 How to load settings from the device

5.5.1 General notes

How to load the device settings from the device to PACTware™. There are 2 alternative procedures.

5.5.2 Procedure 1

- Open the **Parameter** window.
- Click on this icon (refer to the illustration – below you can find this icon below the status bar).
- ➲ End of the procedure.
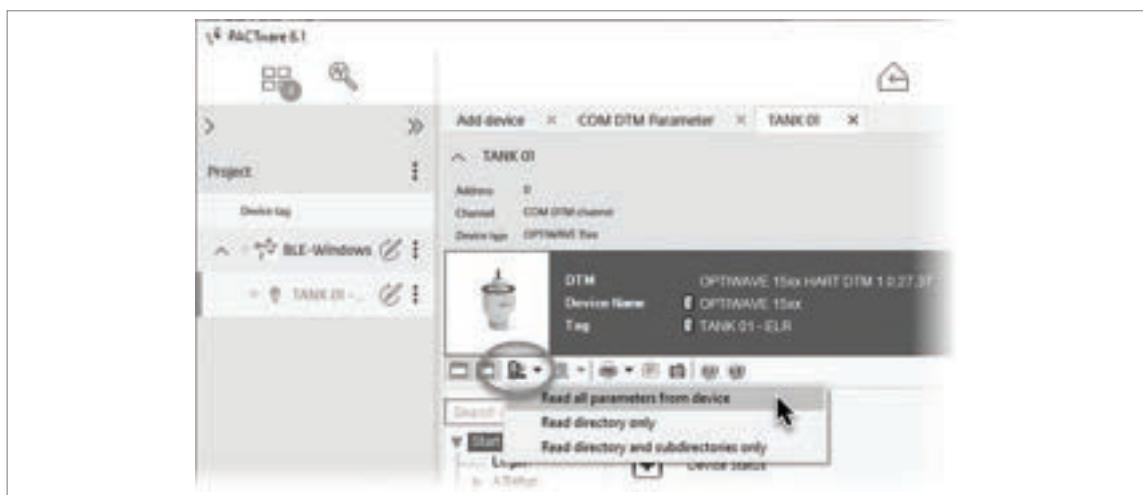
Figure 5-9: Click on the "Load from device" icon in the main toolbar (Procedure 1)

5.5.3 Procedure 2

- Open the **Parameter** window.
- Right click on the **Device tag** element (e.g., TANK 01 - ELR) in the **Project** list.
- Select **Load from device** from the list.
- ➲ End of the procedure.
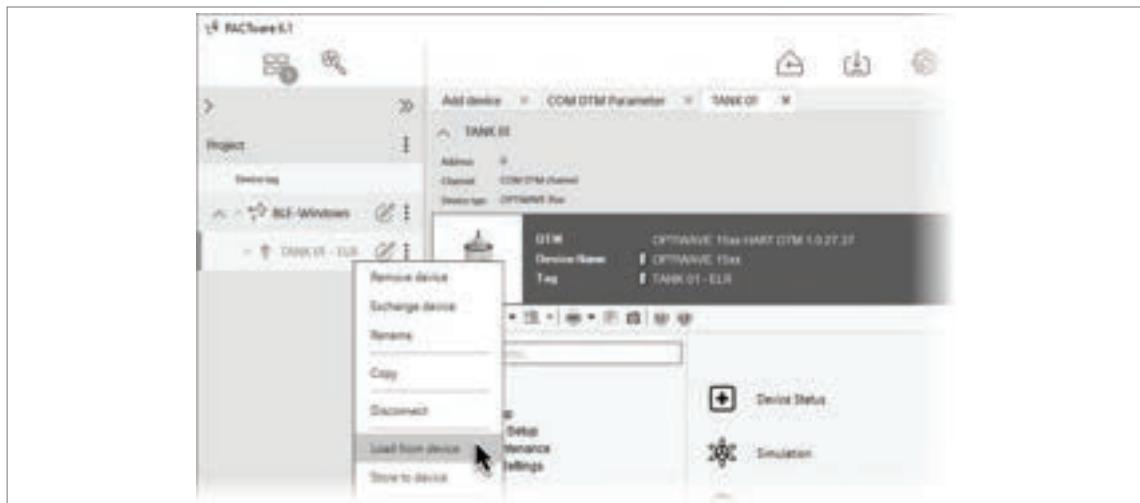
Figure 5-10: Right click on the Device tag element in the Project list (Procedure 2)

5.6 How to change device settings

5.6.1 Protection of the device settings

Security roles

This device has two security roles, "User" and "Operator", to prevent changes to settings. "Operator" is the highest security role. The highest security role lets you change all available functions in the A - Setup, C - Full Setup, F - Maintenance and DTM Settings menus.

Security roles	Access level	Default password	Applicable functions in the DTM (overview)
User	1	—	• Download configuration data from the device • Read measurement data in the **Measurement Value** window. Start, stop, save and show recordings of measurement data. • Read error messages in the **Diagnosis** window • Read all settings functions in the **C - Full Setup**, **F - Maintenance** and **DTM Settings** menus • Change Security level. Go to the **Login** menu to change from the "User" to the "Operator" security role. • Print device parameters
Operator	2	0001	• All User Role functions • Upload new parameters to the device • Set a new password for the Operator Role • Change parameters in A Setup and C Full Setup menus

Table 5-1: Security roles and applicable functions in the DTM

Password setup

The device is set by default to the "Operator" role. Protection of the device settings is possible if the user sets a password for the "Operator" role. Until this step is done, it is not possible to set the device to the "User" role to prevent changes to device parameters by personnel who are not approved.

Password setup procedure

• Click on the box "Use Password for Operator".
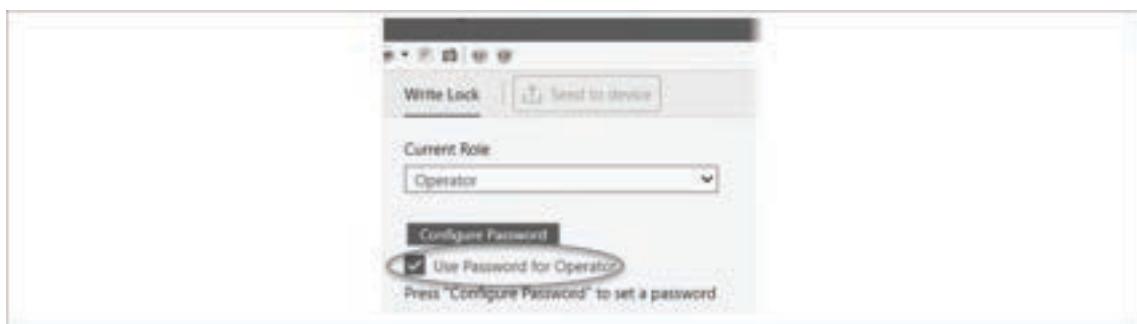
Figure 5-11: Click on the box "Use Password for Operator"

• Click on the "Configure Password" button.
• Enter the new 4-digit password. Click on the "Apply" button.

Device configuration: changing the security role

It is necessary to set the security role to "Operator" to change device parameters in the DTM.
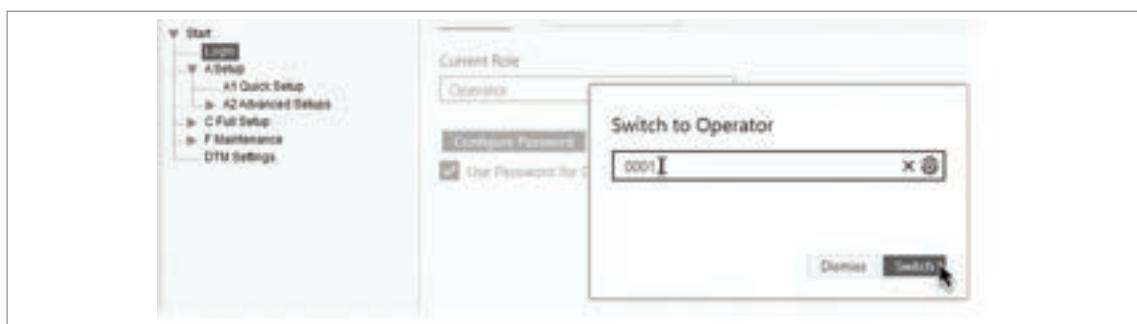
Figure 5-12: Device configuration: changing the security role to "Operator"

• Click on the **Current Role** box and select "Operator".
• Enter the Operator password to change the security role.
• Click on the "Switch" button. You can use setup procedures and other device menus in the "Operator" role.

5.6.2 Quick setup

⚠️ *CAUTION!*
Make sure that you do this procedure before you use the device. The settings in this procedure have an effect on the performance of the device.

Go to the menu item **A1 – Quick Setup** and follow the procedure.

- the type of product measured (liquid or solid),
- the type of application (storage, open channel etc.),
- the length unit,
- volume or volumetric flow rate values, if it is necessary to make a conversion table, and
- the top and bottom measuring limits.

Make sure that the security role of the device is set to "Operator" before you send data (device settings) to the device. For more data about the security role, refer to *Protection of the device settings* on page 45.

⚠️ *CAUTION!*
Changes to the settings are saved in the software when you click on the [√] button, but the software does not send the data to the device. To send the new device settings to the device, refer to How to send settings to the device (store to the device) on page 51.

5.6.3 Empty spectrum

If the device measures level in a tank that contains obstructions (agitator, supports, heating pipes etc.), these objects can cause radar signal interference (parasitic signals). The device has an **empty spectrum** function (signal filter) to remove radar signal interference.

If there is a high level of radar signal interference, you can use the empty spectrum tools (menu item A2.1) in the **Setup** menu to make a better signal filter.

ℹ️ *INFORMATION!*
We recommend that you do an empty spectrum scan when the tank is empty and all the moving parts (agitators etc.) are in operation.

Signal filter configuration procedure
- Make sure that the tank is empty and all the moving parts (agitators etc.) are in operation.
- Go to the menu item **A2.1 – Empty Spectrum**.
- ➲ The device will automatically start a scan of the tank and send the data to the software.

- Look at the signal spectrum on the signal amplitude - distance graph and identify objects in the tank that cause parasitic signals (measure the locations of objects from the top of tank and compare with the position of the related signal). Calculate the positions of the minimum and maximum limits for the empty spectrum signal filter (distance from the device).
- Click on the **New Spectrum** button and give the distance from the device zero point to the minimum limit of the signal filter. Enter this value in the **Empty Spectrum - Distance Start** field.
- Give the distance from minimum limit of the signal filter (Empty Spectrum - Distance Start) to the maximum limit. Enter this value in the **Empty Spectrum - Length** field.
- Push the confirm button to use the signal filter with your parameters.
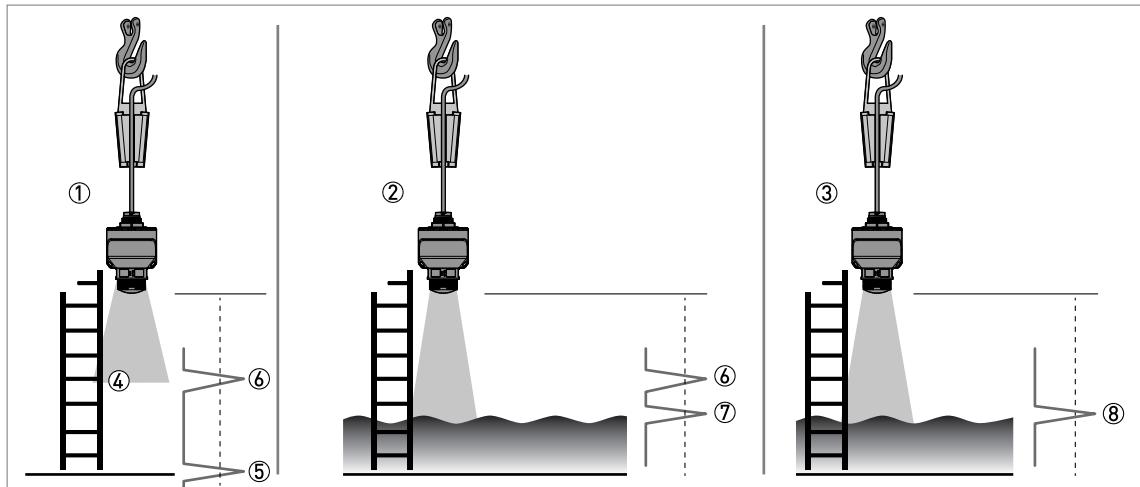
Figure 5-13: How to make a filter to remove radar signal interference

① Empty tank before the device uses the empty spectrum scan
② Partially filled tank before the device uses the empty spectrum scan
③ Partially filled tank after the device uses the empty spectrum scan
④ Obstruction, e.g. ladder
⑤ Tank bottom signal
⑥ Ladder signal (interference signal) before the device does the empty spectrum scan
⑦ Signal from the liquid before the device does the empty spectrum scan
⑧ Signal if the device uses the data from the empty spectrum scan. The device only uses the reflection on the surface of the liquid to measure distance.

Other signal filter functions

- **Read from the device:** receive empty spectrum data from the device (one scan)
- **Cyclic read:** receive empty spectrum data from the device (continuous scan - the signal filter only uses the newest data)
- **Extend spectrum:** changes the length of the zone where the signal filter is used
- **Delete Part:** this function removes part of the signal filter
- **Delete All** this function removes all of the signal filter

5.6.4 How to change current output parameters

You can use the **Current Output** function (menu item A2.2) in the **Setup** menu to change:

- the current output variable e.g., level, distance etc.
- the 0% and 100% measuring limits for the selected variable
- the current output range (4...20 mA or 3.8...20.5 mA) and error value

Push "Send to Device" to send changed parameters to the device.

5.6.5 Conversion table

You can use the **Quick Setup** (menu item A1) procedure in the **Setup** menu to make a conversion table to change length values into:

- corrected length (level, distance etc.),
- volume, or
- volumetric flow rate

INFORMATION!
*You can also use the **Conversion Table** (menu item A2.3) procedure to change conversion table values. **Strapping table** is an equivalent term for conversion table.*

Follow the procedure given in **A1 Quick Setup**. There are three methods to make a conversion table: a user-defined table, predefined table and custom formula.

User-defined table

Enter values in a level-conversion table manually or import the level-conversion values from a CSV file.

Predefined table

If the device must measure volume, then you can select a tank shape and enter the tank dimensions. Available tank shape options include:

- Cylindrical horizontal tank with flat ends
- Cylindrical horizontal tank with dish-shaped ends
- Cylindrical horizontal tank with hemispherical ends
- Cylindrical vertical tank with flat top and bottom
- Cylindrical vertical tank with flat top and bottom
- Cylindrical vertical tank with dish-shaped top and bottom
- Cylindrical vertical tank with hemispherical top and bottom
- Cylindrical vertical tank with flat top and conical bottom
- Cylindrical vertical tank with flat top and sloped bottom
- Spherical tank
- Rectangular vertical tank with flat top and bottom
- Rectangular vertical tank with flat top and pyramidal bottom
- Rectangular vertical tank with flat top and sloped bottom

If the device must measure volumetric flow rate, then you can select an open channel type that agrees with a standard (e.g., Parshall – ISO 9826) and enter the dimensions shown in the procedure. Available open channel types for flow rate measurement include:

- Venturi Rectangular – ISO 4359
- Venturi Trapezoidal – ISO 4359
- Venturi U – ISO 4359
- V Notch – ISO 1438
- Rectangular Notch – ISO 1438
- Parshall – ISO 9826

Custom formula (volumetric flow rate in an open channel)

This option is applicable to an open channel with an exponential cross section. Use this formula:

- $Q = K \times h^Z$

Where "Q" is flow rate and "h" is hydraulic head.

5.6.6 Procedure: changing device settings

This procedure only changes and saves the device configuration in the computer database. It does not send the changes to the device. For more data, refer to *How to send settings to the device (store to the device)* on page 51 to send the new parameters to the device.

⚠️ *CAUTION!*
There are 3 buttons at the bottom right of the window. These buttons are used only to update the computer database. If you click on "OK" or "Apply", no data is sent to the device. This function obeys FDT guidelines for certification of the DTM.

Figure 5-14: Use OK or Apply to update the computer database

When you change the value of a menu item, a pencil symbol shows adjacent to the changed value:
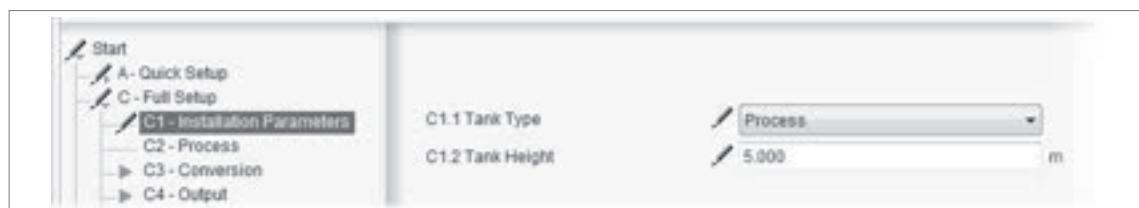
Figure 5-15: Pencil symbol: changed value

If the value is too large or too small, a red exclamation mark shows adjacent to the incorrect value:
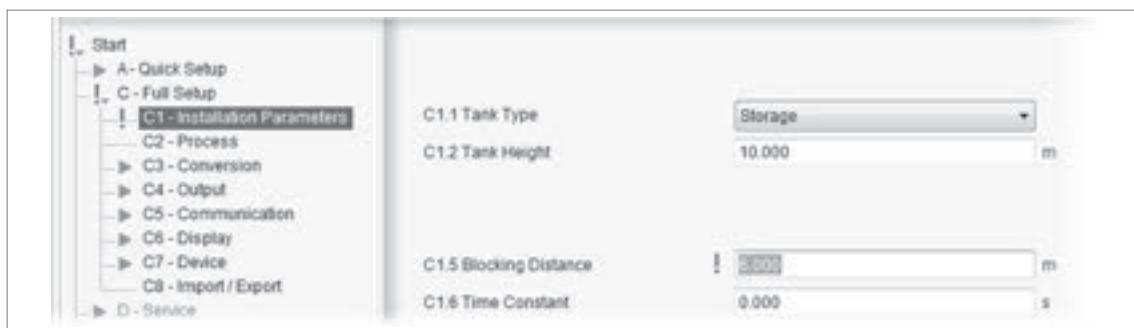
Figure 5-16: Exclamation mark: the value is too large or too small

5.6.7 Data about menu items and parameters (online Help)

Put the mouse pointer on a box in the menu. A tooltip gives a description of the menu item.

Right click on the box for data about parameters. A tooltip shows the default value, data set value (new value), minimum value and maximum value of the menu item.

5.7 How to send settings to the device (store to the device)

5.7.1 General notes

This chapter shows how to store the new parameters from PACTware™ to the device. Changes to the device configuration are saved in the software, but the device cannot use the new settings until you send the new parameters to the device.

5.7.2 Procedure 1

- Open the **Parameter** window.
- Click on this icon (refer to the illustration below – you can find this icon below the status bar).
- ➲   End of the procedure.
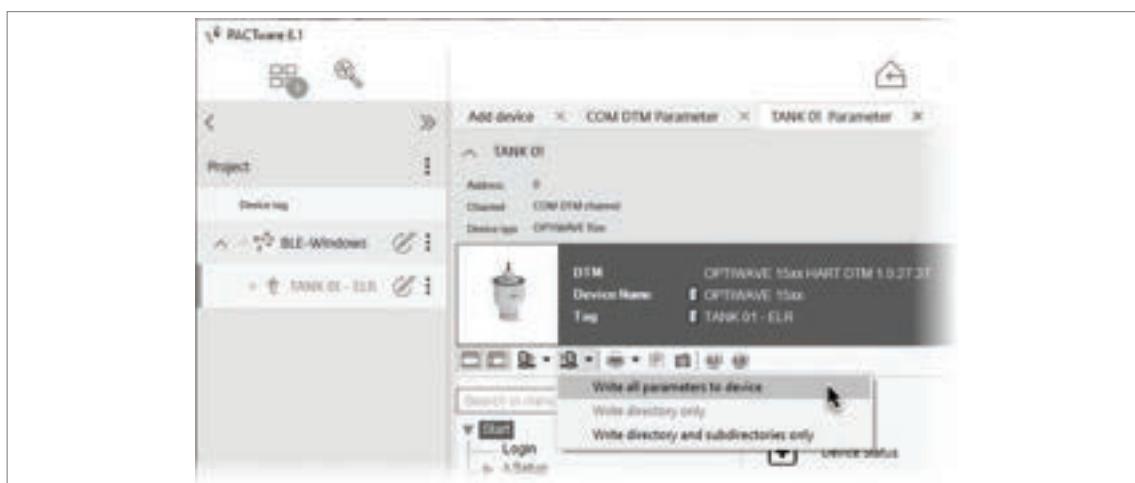
Figure 5-17: Click on the "Store to device" icon

5.7.3 Procedure 2

- Right click on the **Device tag** element (e.g., TANK 01 - ELR) in the **Project** list.
- Select **Store to device** from the list.
- ⮞ PACTware™ uploads the new device parameters to the device.

5.8 Bluetooth connection to the device with the OPTICHECK Level Mobile app

5.8.1 Equipment needed

- Radar level transmitter with the Bluetooth option
- Mobile device (smartphone or tablet) with an up-to-date version of the Android or iOS operating system
- OPTICHECK Level Mobile app (available from PICK, GooglePlay or Apple App Store)

5.8.2 Device setup

Follow the instructions given in the OPTICHECK Level Mobile app setup assistant. Use the Quick Setup menu to configure the device. For more data, refer to *Description of Bluetooth interface* on page 110.

INFORMATION!
Electromagnetic interference (EMI) can have an effect on Bluetooth connections to the device. If the device disconnects from the Bluetooth network, then try to connect your mobile app or DTM to the device again. If there continues to be a problem with the Bluetooth connection, start the device again.

5.9 Menu overview

A Setup		
	A1 Quick Setup	
		Tag
		Medium Type
		Application Type
		Current Output
	A2 Advanced Setup	
		Empty Spectrum
		Current Output
		Conversion

Table 5-2: A – Setup

B Simulation		
	B1 Set Value	
		Variable Simulated

Table 5-3: B – Test

C Full Setup		
	C1 Install. Parameters	
		Tank Type
		Tank Height
		Blocking Distance
		Dead Band
		Time Constant
		Tank Bottom Offset
	C2 Process	
		Tracking Velocity
		Mult. Refl. Enable
		Min Peak req.
		Min Plaus. Window
		Error Delay
		Empty Spectrum Enable
	C3 Current Output	
		Current Out. Var.
		100% Range
		0% Range
		Current Out. Range
		Fast Setup
	C4 HART Communication	
		HART Variables
			Primary Var. ①
			Secondary Var.

			Tertiary Var.
			Quaternary Var.
		Identification	
			Short Tag
			Tag
			Descriptor
			Message
			Date
			Number Response Preamble
		Loop Current Mode	
			Loop Current Mode
		Device Address	
			HART Address
	C5 Display		
		Language ①	
		Backlight ①	
		Contrast ①	
		1st Page	
			Variable
			Format
		2nd Page	
			Line Number
			1st Variable
			1st Variable - Display Format
			2nd Variable
			2nd Variable - Display Format
			3rd Variable
			3rd Variable - Display Format
		Units	
			Local Display Length Unit
			Local Display Flow Unit ①
			Local Display Volume Unit
			Local Display Level Conversion Unit ①
			Local Display Totalisers Unit
			Local Display Temperature Unit
		Operator Password Enable ①	
		Operator Password ①	
	C6 Device		
		Units	
			Length Unit
			Flow Unit
			Volume Unit
			Level Conversion Unit
			Totalisers Unit

		Temperature Unit
	Factory Defaults	
	Device Restart	
	Status Groups	
C7 Totaliser		
	Totaliser1 Function	
	Totaliser1 Preset	
	Low Flow Cut Off	
	Totaliser1 Set	
	Totaliser1 Start	
	Totaliser1 Stop	
	Totaliser1 Reset	
C8 Bluetooth		
	Bluetooth Power	
	Bluetooth Password	
C9 Import / Export		

Table 5-4: C – Full Setup

① Available for the display screen option only

F Maintenance
F1 PICK
F2 Device Snapshot
F3 Event Log
F4 Device Identification
F5 Device Information

Table 5-5: F – Maintenance

5.10 Function description

A – Setup menu

This menu has a set of procedures that permits you to quickly select the parameters applicable to your application.

Menu No.	Function	Function description	Selection list	Default
A1 Quick Setup				
A1.1 Quick Setup Procedure				
A1.1.1	Tag	You can see the TAG name here. This name is used to identify the device in lists in software and on identification plates attached to the device. The tag name can be a maximum of 32 characters long and it can have numbers, upper-case and lower-case letters and special characters.		TANK01
A1.1.2	Medium Type	Select the state of the material to be measured.	Liquid, Solid	Liquid
A1.1.3	Application Type	Select that option that agrees with where you want to use the device.	**Liquid:** Storage, Agitator, Process, Open Channel, Plastic, Pumping Station, Open Air, IBC, Demo **Solid:** Narrow Silo, Bunker, Large Silo, Crusher, Heap, Conveyor Belt, Stock Piles, Demo	
A1.1.4 Current Output Procedure				
	Length Unit	Select the unit for the measuring range.	ft, m, in, cm, mm	mm
	Distance to the bottom (0%)	Enter the distance from the bearing surface of the process connection to the lowest point to be measured in the tank or silo. The lowest point is equivalent to 0% (minimum level). The device uses this "0%" value to calculate the tank height.	The maximum value depends on the device version.	
	Measuring range (0% to 100%)	Enter the distance between the lowest point (0% - minimum level) and the highest point (100% - maximum level) to be measured in the tank or silo.	The maximum measuring range depends on the device version.	

Menu No.	Function	Function description	Selection list	Default
A.2 Advanced Setup Procedures				
A2.1	Empty Spectrum	Fixed and moving objects in the tank cause interference signals that can have an effect on device performance. Put them through this filter to correctly measure the tank contents. This menu item gives all the necessary tools to scan for interference signals, apply a signal filter, and correct or delete the signal filter. We recommend that the tank is empty or only filled to the minimum level before you do the procedure. We also recommend that if you installed the device on a tank that has equipment with parts that move (e.g. agitators), start the equipment. This menu item shows a measurement signal graph with the measurement parameters set at this time. These measurement parameters include: zero, blocking distance, plausibility window, threshold, tank height, dead band, max. peak distance, last peak distance, limits and TBM enlargement. This menu item also permits you to scan the tank for a new spectrum or select or delete part of the spectrum.		
A2.2	Current Output	This menu item has a graph that shows how current output is related to the measured value. It also shows the set error value (3.6 mA, 22 mA or stay at the last value measured when the error occurred (Hold). The user can change the measured variable (for example. level, distance and volume) and the 0% and 100% range values.		
A2.3	Conversion table	Use this function to create a conversion (strapping) table to convert level to volume, flow rate or a corrected level. These values can be given by the user manually or from a set of values given in a CSV file. There is also a selection of tank types, shapes and open channel flow profiles available in the software to help the user to quickly and accurately input a set of values.		

Table 5-6: A – Quick Setup menu

B – Simulation menu

This menu can be found in these the menus of these software programs:

- **PACTware / DTM:** Project > COMXX > OPTIWAVE15XX (Tag Name) > Simulation
- **OPTICHECK Level Mobile App:** Main menu > Diagnostics > Simulation

Menu No.	Function	Function description	Selection list	Default

B1 Simulation

B1.1 Set Value				
	Reflection	This function sets the device output to a simulated reflection value (% of radar signal received by the device). This procedure changes and sends an output signal that agrees with a simulated value specified by the operator. The device does not use the measurement data for the simulation. If you use the DTM to simulate an output value, then: - move the slider control to the specified value, or - click on the blue value below the slider control to open a box. Enter the specified value. The device automatically goes to back to Normal mode if it detects that the computer DTM software or mobile application is not connected to the device.	min-max: 0...100%	①
	Level	This function sets the device output to a simulated level value. Make sure that menu item C4.1.1 Current Out. 1 Var. is set to "Level" before the device simulates a level value. This procedure changes and sends an output signal that agrees with a simulated value specified by the operator. The device does not use the measurement data for the simulation. If you use the DTM to simulate an output value, then: - move the slider control to the specified value, or - click on the blue value below the slider control to open a box. Enter the specified value. The device automatically goes to back to Normal mode if it detects that the computer DTM software or mobile application is not connected to the device.	min-max: 0...(Tank height - Blocking Distance)	①

Menu No.	Function	Function description	Selection list	Default
	Distance	This function sets the device output to a simulated distance value. Make sure that menu item C4.1.1 Current Out. 1 Var. is set to "Distance" before the device simulates a distance value. This procedure changes and sends an output signal that agrees with a simulated value specified by the operator. The device does not use the measurement data for the simulation. If you use the DTM to simulate an output value, then: - move the slider control to the specified value, or - click on the blue value below the slider control to open a box. Enter the specified value. The device automatically goes to back to Normal mode if it detects that the computer DTM software or mobile application is not connected to the device.	min-max: Blocking Distance...Tank height	①
	Conversion	This function sets the device output to a simulated conversion (volume, flow rate or corrected level) value. This parameter is only available if you set up a conversion table in menu item **A1 Quick Setup** or **A2.3 Conversion Table**. This procedure changes and sends an output signal that agrees with a simulated value specified by the operator. The device does not use the measurement data for the simulation. If you use the DTM to simulate an output value, then: - move the slider control to the specified value, or - click on the blue value below the slider control to open a box. Enter the specified value. The device automatically goes to back to Normal mode if it detects that the computer DTM software or mobile application is not connected to the device.		①

Menu No.	Function	Function description	Selection list	Default
	Ullage Conversion	This function sets the device output to a simulated conversion (ullage volume or corrected distance) value. This parameter is only available if you set up a conversion table in menu item **A1 Quick Setup** or **A2.3 Conversion Table**. This procedure changes and sends an output signal that agrees with a simulated value specified by the operator. The device does not use the measurement data for the simulation. If you use the DTM to simulate an output value, then: - move the slider control to the specified value, or - click on the blue value below the slider control to open a box. Enter the specified value. The device automatically goes to back to Normal mode if it detects that the computer DTM software or mobile application is not connected to the device.		①
	Totaliser1	This function sets the device output to a simulated total (volumetric flow) value. Make sure that menu item C3.1 Current Out. Var. is set to "Totaliser1". This procedure changes and sends an output signal that agrees with a simulated value specified by the operator. The device does not use the measurement data for the simulation. If you use the DTM to simulate an output value, then: - move the slider control to the specified value, or - click on the blue value below the slider control to open a box. Enter the specified value. The device automatically goes to back to Normal mode if it detects that the computer DTM software or mobile application is not connected to the device.		

Menu No.	Function	Function description	Selection list	Default
	Temperature	This function sets the device output to a simulated temperature value. Make sure that menu item C3.1 Current Out. Var. is set to "Temperature" before the device simulates a total value. This procedure changes and sends an output signal that agrees with a simulated value specified by the operator. The device does not use the measurement data for the simulation. If you use the DTM to simulate an output value, then: - move the slider control to the specified value, or - click on the blue value below the slider control to open a box. Enter the specified value. The device automatically goes to back to Normal mode if it detects that the computer DTM software or mobile application is not connected to the device.		
	Current Output (mA)	This function sets the device output to a simulated current value in milliamperes (mA). This procedure changes and sends an output signal that agrees with a simulated value specified by the operator. The device does not use the measurement data for the simulation. If you use the DTM to simulate an output value, then: - move the slider control to the specified value, or - click on the blue value below the slider control to open a box. Enter the specified value. The device automatically goes to back to Normal mode if it detects that the computer DTM software or mobile application is not connected to the device.		
	Current Output (%)	This function sets the device output to a simulated current as a percentage of the measuring range. This procedure changes and sends an output signal that agrees with a simulated value specified by the operator. The device does not use the measurement data for the simulation. If you use the DTM to simulate an output value, then: - move the slider control to the specified value, or - click on the blue value below the slider control to open a box. Enter the specified value. The device automatically goes to back to Normal mode if it detects that the computer DTM software or mobile application is not connected to the device.		

Table 5-7: B – Simulation menu

① The default value is the measured value at the time that you start the simulation

C – Full Setup menu

Menu No.	Function	Function description	Selection list	Default

C1 Install. Parameters

Menu No.	Function	Function description	Selection list	Default
C1.1	Tank Type	The conditions in which the device is used. **Liquid:** If the surface of the product is flat, select "Storage". If the surface of the product is disturbed, select "Process". If the surface of the product is agitated with vortexes and foam, select "Agitator". **Solid:**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".	Liquid: Storage, Process, Agitator Solid: Flat surface, Medium slope, Steep slope	Storage ①
C1.2	Tank Height	Tank height is the distance from the bearing surface of the threaded connection to the tank bottom. This value can also be the maximum distance that the device must measure (the measuring range). Calculated from the Quick Setup menu as: Distance to the bottom (0%)	min-max: 1520: 0.0...10000.0 mm / 0.0...32.80 ft / 0.0...393.7¨ 1540: 0.0...15000.0 mm / 0.0...49.21 ft / 0.0...590.5¨	②
C1.3	Blocking Distance	The distance from the bearing surface of the process connection 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 100 mm / 4¨ below the bottom of the antenna. If the distance is less than the blocking distance, the device continues to show the blocking distance on the display screen.	min-max: 1520: 0.0...10000.0 mm / 0.0...32.80 ft / 0.0...393.7¨ 1540: 0.0...15000.0 mm / 0.0...49.21 ft / 0.0...590.5¨	—
C1.4	Dead Band	This parameter makes the device ignore reflections in a specified area immediately below the process connection. We recommend that this value is 50 mm / 2¨ less than the value in menu item **1.3 Blocking Distance**.	min-max: 1520: 0.0...10000.0 mm / 0.0...32.80 ft / 0.0...393.7¨ 1540: 0.0...15000.0 mm / 0.0...49.21 ft / 0.0...590.5¨	—
C1.5	Time Constant	A signal conditioning tool to smoothen measurements over a period of time. This prevents sudden changes in slow, stable processes. s = seconds.	min-max: 0....100 s	3 s
C1.7	Tank Bottom Offset	Move the "zero" point for level measurements. This point is set in menu item C1.2 Tank Height. A positive value moves the point down. A negative value moves the point up.	min-max: -99999...+3000000 m / -328.0807...9842.5197 ft -3936.9685...118110.2362¨	As specified in the customer order

C2 Process

Menu No.	Function	Function description	Selection list	Default
C2.1	Tracking Velocity	The maximum configured limit for the rate of change of level of the measured product in metres per minute. The measured value cannot change faster than the tracking velocity.	min-max: 0.020...60.000 m/min	0.5000 m/min

Menu No.	Function	Function description	Selection list	Default
C2.2	Multiple Reflection	Multiple reflections are caused by unusual shapes below the device. Multiple reflections will cause the device to display smaller level readings. Installation of the device on a manhole or at the centre of a dome roof, and high dielectric products (εr >5) can cause multiple reflections. A very calm surface or a tank with a small convex or flat roof can also cause multiple reflections. If this function is in operation, the device looks for the first signal peak below the process connection. This signal peak is then used to measure the level of the tank contents. If this function is not in operation, the device looks for the largest signal below the process connection.	Off, On	Off ①
C2.3	Min Peak req.	A minimum threshold measured in dB. A signal larger than this value is identified as the level signal.	min-max: 0...192 dB	Liquid: 60 dB Solid: 54 dB
C2.4	Min Plaus. Window	The minimum length of the zone in which the device will look for the level signal.	min-max: 10.0...100000.0 mm / 0.0328...328.084 ft 0.3937...3937.0079¨	1000.0 mm / 3.2808 ft 39.3701¨
C2.5	Error Delay	The time after which the current output changes to an error value when the device senses a measurement error. Min= minutes and Sec= seconds.	0 Sec, 10 Sec, 20 Sec, 30 Sec, 1 Min, 2 Min, 5 Min, 15 Min	30 Sec
C2.6	Empty Spectrum	Select "Yes" to use a signal filter to remove interference signals. Also do the "Empty Spectrum" procedure (Quick Setup menu) to detect and filter interference signals.	On, Off	On

C3 Current Output

Menu No.	Function	Function description	Selection list	Default
C3.1	Current Out. Var.	Select the current output variable. The output can agree with how full the tank is (e.g., level, volume etc.) or how empty it is (e.g., distance, ullage volume etc.). Other variables include temperature, total volume (when the device measures volumetric flow rate) and reflection (the strength of the reflected signal in relation to the initial signal strength).	Reflection, Level, Distance, Conversion (e.g., Volume or Volumetric Flow Rate), Ullage Conversion (Ullage Volume), Temperature, Totaliser 1, Global Totaliser	Level
C3.2	100% Range	The value of the parameter selected in C3.1 Current Out. Var. for the maximum current output.	②	②
C3.3	0% Range	The value of the parameter selected in C3.1 Current Out. Var. for the minimum current output.	②	②
C3.4	Current Out. Range	Select the current output range (e.g. 4-20mA)	4-20mA/hold CO value, 4-20/22mA Error current, 4-20/3.6mA Error current, 3.8-20.5/22mA Error current, 3.8-20.5/3.6mA Error current	4-20/3.6mA Error current

Menu No.	Function	Function description	Selection list	Default

C4 HART Communication

C4.1 HART Variables				
C4.1.1	Primary Var.	Select a quantity (e.g. level) to be measured for the 1st line of measurement data shown on a HART interface. Make a selection from the list.	Reflection, Level, Distance, Conversion, Ullage Conversion, Totaliser 1, Temperature ③	Distance
C4.1.2	Secondary Var.	Select a quantity (e.g. level) to be measured for the 2nd line of measurement data shown on a HART interface. Make a selection from the list.	Reflection, Level, Distance, Conversion, Ullage Conversion, Totaliser 1, Temperature, Global Totaliser ③	Level
C4.1.3	Tertiary Var.	Select a quantity (e.g. level) to be measured for the 3rd line of measurement data shown on a HART interface. Make a selection from the list.	Reflection, Level, Distance, Conversion, Ullage Conversion, Totaliser 1, Temperature, Global Totaliser ③	Reflection
C4.1.4	Quaternary Var.	Select a quantity (e.g. level) to be measured for the 4th line of measurement data shown on a HART interface. Make a selection from the list.	Reflection, Level, Distance, Conversion, Ullage Conversion, Totaliser 1, Temperature, Global Totaliser ③	Temperature
C4.2 Identification				
C4.2.1	Short Tag	Device name shown on the HART interface. Maximum number of characters: 8	Available characters include: @, A-Z, [, \,], ^, _, !, $, %, &, ', (,), *, +, -, /, 0-9, :, ;, <, =, >, ?,	TANK 01
C4.2.2	Tag	Device name shown on the HART interface. Maximum number of characters: 32	Available characters include: @, A-Z, [, \,], ^, _, !, $, %, &, ', (,), *, +, -, /, 0-9, :, ;, <, =, >, ?,	TANK 01 - ELR
C4.2.3	Descriptor	Short description shown on the HART interface Maximum number of characters: 16	Available characters include: @, A-Z, [, \,], ^, _, !, $, %, &, ', (,), *, +, -, /, 0-9, :, ;, <, =, >, ?,	
C4.2.4	Message	Message shown on the HART interface. Maximum number of characters: 32	Available characters include: @, A-Z, [, \,], ^, _, !, $, %, &, ', (,), *, +, -, /, 0-9, :, ;, <, =, >, ?,	
C4.2.5	Date	Date shown on the HART interface. (format: Year-Month-Day)	—	2023-01-01
C4.2.6	Number Response Preamble	The number of preamble bytes to permit the device to detect response messages.	2...20	5
C4.3 Loop Current Mode				
C4.3.1	Loop Current Mode	Set this menu item to "Enabled" if the "Primary Variable" for current output 1 must also be transmitted as a 4...20mA signal. If this menu item is set to "Off", this stops the 4...20mA signal and starts HART® multi-drop mode.	On, Off	On

Menu No.	Function	Function description	Selection list	Default
C4.4 Device Address				
C4.4.1	Device Address	"0" = device in a point-to-point network. From "1" to "63" = device with a unique address in a multidrop network. If you start HART® multi-drop mode, the current output stays constant at 4mA. This function is not available when you use DTM software with the device is HART communication mode.	0...63	0

C5 Display (option)

Menu No.	Function	Function description	Selection list	Default
C5.1 Screen				
C5.1.1	Language	Select the language for the optional device display screen. 12 language options.	English, German, French, Italian, Portuguese, Spanish, Czech, Polish, Simplified Chinese, Japanese, Russian, Turkish	English ①
C5.1.2	Backlight	On/off control for backlight on the optional device display screen.	Off, On	On
C5.1.3	Contrast	Contrast control for characters shown on the optional device display screen. Range 0-9. "0" = lowest contrast. "9" = highest contrast.	0...9	5
C5.2 1st Page				
C5.2.1	Variable	Select the variable (e.g. level) for the first page of measurement data on the device display screen.	Reflection, Level, Distance, Conversion, Ullage Conversion, Totaliser 1, Temperature, Global Totaliser ④	Level
C5.2.2	Format	Select the number of decimal places of values for the 1st page of measurement data on the device display screen. For example, if you set this menu item to "X.XX", the value shown will be corrected to 2 decimal places. If you set this menu item to "Auto", the device will adjust the number of decimal places automatically.	X, X.X, X.XX, X.XXX, X.XXXX, X.XXXXX, X.XXXXXX, Auto	Auto
C5.3 2nd Page				
C5.3.1	Line Number	Number of lines of measurement data shown on the second page.	1, 2, 3	2
C5.3.2	1st Variable	Select the variable (e.g. level) for the first line on the second page of measurement data on the device display screen.	Reflection, Level, Distance, Conversion, Ullage Conversion, Totaliser 1, Temperature, Global Totaliser ④	Distance
C5.3.3	1st Variable - Display Format	Select the number of decimal places of values for the first line on the second page of measurement data on the device display screen. For example, if you set this menu item to "X.XX", the value shown will be corrected to 2 decimal places. If you set this menu item to "Auto", the device will adjust the number of decimal places automatically.	X, X.X, X.XX, X.XXX, X.XXXX, X.XXXXX, X.XXXXXX, Auto	Auto
C5.3.4	2nd Variable	Select the variable (e.g. level) for the second line on the second page of measurement data on the device display screen.	Reflection, Level, Distance, Conversion, Ullage Conversion, Totaliser 1, Temperature, Global Totaliser ④	Level

Menu No.	Function	Function description	Selection list	Default
C5.3.5	2nd Variable - Display Format	Select the number of decimal places of values for the second line on the second page of measurement data on the device display screen. For example, if you set this menu item to "X.XX", the value shown will be corrected to 2 decimal places. If you set this menu item to "Auto", the device will adjust the number of decimal places automatically.	X, X.X, X.XX, X.XXX, X.XXXX, X.XXXXX, X.XXXXXX, Auto	Auto
C5.3.6	3rd Variable	Select the variable (e.g. level) for the third line on the second page of measurement data on the device display screen.	Reflection, Level, Distance, Conversion, Ullage Conversion, Totaliser 1, Temperature, Global Totaliser ④	Temperature
C5.3.7	3rd Variable - Display Format	Select the number of decimal places of values for the third line on the second page of measurement data on the device display screen. For example, if you set this menu item to "X.XX", the value shown will be corrected to 2 decimal places. If you set this menu item to "Auto", the device will adjust the number of decimal places automatically.	X, X.X, X.XX, X.XXX, X.XXXX, X.XXXXX, X.XXXXXX, Auto	Auto
C5.4 Units				
C5.4.1	Local Display Length Unit	Select a length unit. This is the unit shown when the measurement variable on the display screen is set to "Level" or "Distance".	m, cm, mm, ft, in	mm
C5.6.2	Local Display Flow Unit	Select a volumetric flow rate unit. This is the unit shown when the measurement variable on the display screen is set to "Conversion" and you created a level-volume flow table in A1 Quick Setup or A2.3 Conversion table.	m³/s, m³/min, m³/h, L/s, L/min, L/h, ft³/s, ft³/min, ft³/h	L/s
C5.4.3	Local Display Volume Unit	Select a volume unit. This is the unit shown when the measurement variable on the display screen is set to "Conversion" or "Ullage Conversion" and you created a level-volume table in A1 Quick Setup or A2.3 Conversion table.	m³, L, ft³, gal, gal(UK), bbl	L
C5.4.4	Local Display Level Conversion Unit	Select a conversion unit. This is the unit shown when the measurement variable on the display screen is set to "Conversion" or "Ullage Conversion" and you created a level-corrected level table in A1 Quick Setup or A2.3 Conversion table.	m, cm, mm, ft, in	mm
C5.4.5	Local Display Totalisers Unit	Select a totaliser unit. This is the unit shown when the measurement variable on the display screen is set to "Totaliser 1" or "Global Totaliser" and you created a level-volume flow table in A1 Quick Setup or A2.3 Conversion table.	m³, L, ft³, gal, gal(UK), bbl	L
C5.4.6	Local Display Temperature Unit	Select a temperature unit. This is the unit shown when the measurement variable on the display screen is set to "Temperature".	°C, °F, K, °Ra	°C
C5.7	Operator Password Enable	If you set this function to "disable", then it is not necessary to enter the operator password to change parameters.	Enabled, Disabled	Enabled

Menu No.	Function	Function description	Selection list	Default

C6 Device

C6.1 Units				
C6.1.1	Length Unit	Select a length unit for menu items that use length for the device configuration.	m, cm, mm, ft, in	mm
C6.1.2	Flow Unit	Select a volumetric flow rate unit for menu items that use volumetric flow rate for the device configuration. This is the unit shown if you created a level-volume flow table in A1 Quick Setup or A2.3 Conversion table.	m³/s, m³/min, m³/h, L/s, L/min, L/h, ft³/s, ft³/min, ft³/h	L/s
C6.1.3	Volume Unit	Select a volume unit for menu items that use volume for the device configuration. This is the unit shown if you created a level-volume table in A1 Quick Setup or A2.3 Conversion table.	m³, L, ft³, gal, gal(UK), bbl	L
C6.1.4	Level Conversion Unit	Select a level conversion unit for menu items that use corrected level for the device configuration. This is the unit shown if you created a level-corrected level table in A1 Quick Setup or A2.3 Conversion table.	m, cm, mm, ft, in	mm
C6.1.5	Totalisers Unit	Select a totalisers unit for menu items that use total volume for the device configuration. This is the unit shown if you created a level-volume flow table in A1 Quick Setup or A2.3 Conversion table.	m³, L, ft³, gal, gal(UK), bbl	L
C6.1.6	Temperature Unit	Select a temperature unit for menu items that use temperature for the device configuration.	°C, °F, K, °Ra	°C
C6.2	Factory Defaults	Click on the "Reset" button to change the device parameters to the initial values set by the manufacturer at the factory.	Reset	—
C6.3	Device Restart	Click on the "Execute" button to start the device again. The device automatically disconnects from PACTware and the mobile app. Connect the software to the device again after approximately 30 seconds.	Execute	—
C6.4	Status Groups	This menu item gives a list of all possible events and the effect they have on the device status that agree with NAMUR Recommendation NE 107. It also gives a list of events (active events) that are related to the device status at this time.	Refer to "Status messages and diagnostic data" in the "Operation" chapter.	—

C7 Totaliser 1

C7.1	Totaliser1 Function	This function specifies how the totaliser operates: Incremental = Totaliser 1 function will increase the total volume value when Totaliser1 starts. Decremental = Totaliser 1 function will decrease the total volume value when Totaliser1 starts.	Incremental, Decremental	Incremental
C7.2	Totaliser1 Preset	This function specifies the maximum limit for the totaliser: Incremental (C7.1) = Sets the maximum volume value for the volume counter (Totaliser 1). Decremental (C7.1) = Not applicable.	$0.00...1 \times 10^{15}$ L / $0.00...3.5 \times 10^{12}$ ft³ / refer to C6.1 for other units	1000.00 L / 35.31466 ft³ /

Menu No.	Function	Function description	Selection list	Default
C7.3	Low Flow Cut Off	This function temporarily stops Totaliser 1 if the volumetric flow rate is less than the value set in this menu item.	$0.00...1 \times 10^{15}$ L / $0.00...3.5 \times 10^{12}$ ft³ / refer to C6.1 for other units	0.000 L / 0.000 ft³
C7.4	Totaliser1 Set	The start value for Totaliser 1. Incremental (C7.1) = Totaliser 1 counts up from this value. Decremental (C7.1) = Totaliser 1 counts down from this value.	$0.00...1 \times 10^{15}$ L / $0.00...3.5 \times 10^{12}$ ft³ / refer to C6.1 for other units	0.00 L / 0.000 ft³ /
C7.5	Totaliser1 Start	Click on the "Execute" button to start the Totaliser 1 counter.	Execute	—
C7.6	Totaliser1 Stop	Click on the "Execute" button to stop the Totaliser 1 counter.	Execute	—
C7.7	Totaliser1 Reset	Click on the "Execute" button to reset the Totaliser 1 counter to the initial values given in C7.2 Totaliser1 Preset and C7.4 Totaliser 1 Set.	Execute	—

C8 Bluetooth

	Function	Function description	Selection list	Default
	Bluetooth Power	You can change the strength of the Bluetooth signal if you are a long distance from the device. The parameters agree with an approximate distance. Objects and equipment that cause interference can have an effect on this value.	Off, Weak, Standard, Max	Standard
	Bluetooth Password	You can change the code for the Bluetooth password. If the new Bluetooth password is not the same as the code on the device nameplate, then record the data in your device documentation. The initial password is a 4-digit code (0-9). Maximum number of characters: 16	Available characters include: @, A-Z, [, \,], ^, _, !, $, %, &, ', (,), *, +, -, /, 0-9, :, ;, <, =, >, ?	—

C9 Import / Export

	Function	Function description	Selection list	Default
	Import	A procedure to load parameters from an ECFG file into the software	—	—
	Export	A procedure to save parameters from the software to an ECFG file.	—	—

Table 5-8: C – Full Setup menu

① If no value or parameter is specified in the customer order

② This depends on the device version and the parameter specified in the customer order

③ "Conversion" and "Ullage Conversion" are available if you created a level-volume or level-flow table in A1 Quick Setup or A2.3 Conversion table.

④ "Conversion" and "Ullage Conversion" are available if you created a level-volume or level-flow table in A1 Quick Setup or A2.3 Conversion table.

F – Maintenance menu

Menu No.	Function	Function description	Selection list	Default
F1	PICK	This page gives a link to the Product Information Centre KROHNE (PICK) website. If the device is connected to a DTM or a mobile device (e.g., phone, tablet etc.), then the software will automatically enter the device data on this page to go to the website to download device documentation, software and certificates.	Open in browser	—
F2	Device Snapshot	Download all data about the device configuration and device performance at this time. You can share this data as a XLSX.GPG encrypted file with the after-sales service department of the supplier.	Get from the device	—
F3	Event Log	This menu item gives a list of all events that occurred with the type of event (NAMUR NE 107), the start of the event (date / time), the end of the event (date / time), and a short description of the event.	—	—
		Refresh events Click on the " ... " and then "Refresh events" buttons to load the events from the device that occurred before this time.	—	—
		Load more logs Click on the " ... " and then "Load more logs" buttons to load new events from the device.	—	—
		Export to CSV Click on the " ... " and then "Export to CSV" buttons to save a CSV file of all the selected events.	—	—
F4 Device Identification				
F4.1	Tag	Device name shown on the DTM status bar. You can change this text.	—	TANK 01 - ELR
F4.2	V Number	Manufacturer's order code for your device. Read only.	—	As specified in the customer order
F4.3	Serial Number	Device serial number. Use this serial number to find technical documents and software for your device on the Product Information Centre KROHNE (PICK) website. Read only.	—	As specified in the customer order
F4.4	Electronic Revision	The hardware revision number installed on your device. This number agrees with NAMUR NE 53 Guidelines. Read only.	—	As specified in the customer order
F4.5	Main Firmware	The main firmware version installed on your device. Read only.	—	As specified in the customer order
F4.6	Sensor Firmware	The sensor firmware version installed on your device Read only.	—	As specified in the customer order
F4.7	BLE Firmware	The Bluetooth LE firmware version installed on your device. Read only.	—	As specified in the customer order
F4.8	Local Display Firmware	The local display firmware version installed on the local display attached to your device. Read only.	—	As specified in the customer order

Menu No.	Function	Function description	Selection list	Default
F4.9	Production Date	The date of manufacture for your device. YYYY-MM-DD date format agrees with International Standard ISO 8601.	—	As specified in the customer order
F5 Device Information				
F5.1	Quick Setup - Application Type	This is the application type that you selected in menu A1 Quick Setup. Read only.	—	—
F5.2	① - Distance to the Bottom (0%)	The distance to the lowest point to be measured in the tank or silo. This agrees with a level of 0%. Read only.	—	—
F5.3	② - Measuring range (0% to 100%)	The distance between the lowest point (level - 0%) and the highest point (level - 100%) to be measured in the tank or silo. Read only.	—	—
F5.4	Minimum Flow Height	The minimum flow height at which the volumetric flow rate is measured. The functions Totaliser 1 and Global Totaliser do not operate below this level.	—	—
F5.5	Maximum Tank Height	The maximum tank height depends on the device version. Read only.	—	—

Table 5-9: F – Maintenance menu

5.11 Status messages and diagnostic data

Device status and error messages are shown on a device status page in Normal mode and in menu item "F3 Event Log" in the Maintenance menu. Messages shown agree with NAMUR Guidelines NE 107.

Each status message (or status signal) has a special symbol which agrees with the NAMUR Guidelines. This symbol is shown with the message.

INFORMATION!
The status group name and the status signal (F/S/M/C) are shown. For more data, refer to the table that follows.

Symbol	Letter	Message	Description and effect
⊗	F	Failure	No measurement is possible.
⚠	S	Out of specification	Measurements are available but they are not sufficiently accurate. Do a check.
◇	M	Maintenance required	Measurements continue to be accurate, but this could change after a short time.
▽	C	Function check	A test function is on. The value shown does not agree with the correct measured value.
ⓘ	I	Information	This status message does not have an effect on device measurements.

Table 5-10: Status messages (NAMUR NE 107)

DTM: device status symbol

If the device status changes, the device shows a status symbol in the top right corner of the status bar:
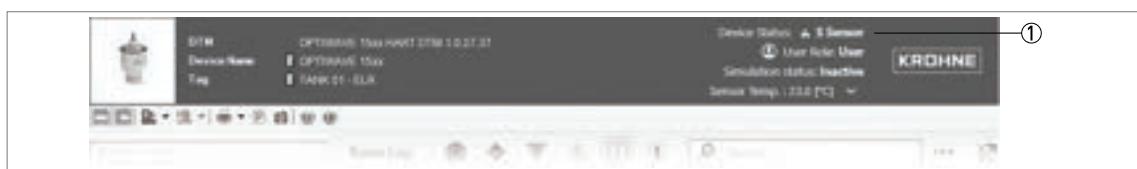
Figure 5-18: Device status: DTM status bar
① Device status symbol (NAMUR NE 107)

DTM: device status messages

Device status and error messages are shown in menu item "F3 Event Log" in the F - Maintenance menu. The top level of this menu item shows a list of short status messages.
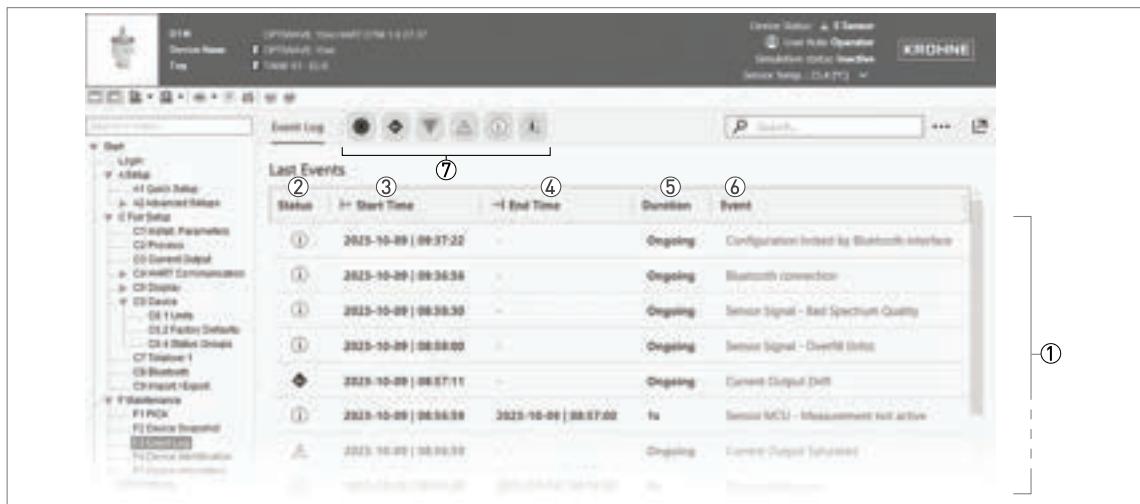
Figure 5-19: DTM: device status messages

① List of changes in device status - scroll to see the complete list
② Status group - type of change in device status (e.g., failure, out of specification, maintenance required, function check or information)
③ Date / time of the start of the event
④ Date / time of the end of the event
⑤ Time between the start and end of the event
⑥ Description of the change in device status
⑦ Buttons that show or hide events by status group

If the device shows an error message, refer to the table that follows for more data and to find a solution to a problem.

Description of errors and corrective actions

Status type	Error message	Description	Corrective action
F	**Sensor**		
	Sensor: Voltage 5V not correct	The device hardware is defective.	De-energize and then energize the device again. If the message is shown again, tell the supplier.
	Sensor: Voltage 3V not correct (Error)	The device hardware is defective.	De-energize and then energize the device again. If the message is shown again, tell the supplier.
	Sensor EEPROM error	The device hardware is defective.	De-energize and then energize the device again. If the message is shown again, tell the supplier.
	Sensor ROM error	The device hardware is defective.	De-energize and then energize the device again. If the message is shown again, tell the supplier.
	Microwave Flash error	The device firmware is defective.	De-energize and then energize the device again. If the message is shown again, tell the supplier.
	Acquisition failure	The device hardware is defective.	De-energize and then energize the device again. If the message is shown again, tell the supplier.
	Microwave Flash configuration error	The device hardware is defective.	De-energize and then energize the device again. If the message is shown again, tell the supplier.
	Microwave global error	The device hardware is defective.	De-energize and then energize the device again. If the message is shown again, tell the supplier.
	Microwave measurement error	The device hardware is defective.	De-energize and then energize the device again. If the message is shown again, tell the supplier.
	Microwave calibration error	The device hardware is defective.	De-energize and then energize the device again. If the message is shown again, tell the supplier.
	Microwave miscellaneous error	The device hardware is defective.	De-energize and then energize the device again. If the message is shown again, tell the supplier.

Status type	Error message	Description	Corrective action
F	Sensor no signal (Error)	The device hardware is defective.	De-energize and then energize the device again. If the message is shown again, tell the supplier.
	Sensor temp. out of range (Error)	The temperature of the sensor is not in the specified limits.	Make sure that the device operates in the permitted ambient temperature range.
	Peak lost (Error)	No signal peak was found in the Search Window for a time equal to the parameter given in menu item C2.5 Error Delay (Full Setup menu).	Make sure that the device installation agrees with the data in the handbook. The antenna must be in the correct position and not installed above objects in the tank. If it is necessary, change the device settings and do a new empty spectrum recording. If the message is shown again, tell the supplier.
	Overfill (Error)	The signal peak is in the blocking distance (refer to menu item C1.3 Blocking Distance in the Full Setup menu). There is a risk that the tank is too full	Make sure that the device settings are correct and the process conditions are in the specified limits.
	Microwave configuration error	A microwave error occurred.	De-energize and then energize the device again. If the message is shown again, tell the supplier.
	Microwave calibration data writing error	A microwave error occurred.	De-energize and then energize the device again. If the message is shown again, tell the supplier.

Status type	Error message	Description	Corrective action
F	**Electronics**		
	Converter EEPROM error	Converter EEPROM memory failure. The device hardware is defective.	De-energize and then energize the device again. If the message is shown again, tell the supplier.
	Converter RAM error	Converter RAM memory failure. The device hardware is defective.	De-energize and then energize the device again. If the message is shown again, tell the supplier.
	Converter ROM error	Converter ROM memory failure. The device hardware is defective.	De-energize and then energize the device again. If the message is shown again, tell the supplier.
	Converter voltage error	Converter ROM memory failure.	De-energize and then energize the device again. If the message is shown again, tell the supplier.
	Internal communication error	Internal bus communication error.	De-energize and then energize the device again. If the message is shown again, tell the supplier.
	Sensor version not compatible	The software version of the sensor is not compatible with the software version of the signal converter.	If the message is shown, tell the supplier.
	Measurement old	If the device does not measure for more than 30 seconds, then this error is set.	Make sure that the device installation agrees with the data in the handbook. If the message is shown again, tell the supplier.
	Dynamic variable (PV) configuration error	The device cannot show the measurement as the data is not available to calculate a current output value that agrees with the selected variable (e.g., volume). It is possible that there is no data in the conversion table.	Change the measurement variable or make a new conversion table.
	Converter reference voltage error	The device hardware is defective.	De-energize and then energize the device again. If the message is shown again, tell the supplier.

Status type	Error message	Description	Corrective action
C	**Sensor**		
	Sensor simulation active	The device simulates a measurement value that is set in menu items **B1.1 Variable Simulated** and **B1.2 Variable Value**. This measurement value can be a level, distance, temperature or reflection value. If you made a conversion table, the device can also simulate volume or flow value.	DTM: In the Simulation tab, click on "Stop simulation".
			Mobile App: In **Diagnostics > Simulation**, push the **Stop** button.
	Current output simulation active	The device simulates a current output that is set in menu items **B1.1 Variable Simulated** and **B1.2 Variable Value**.	DTM: In the Simulation tab, click on "Stop simulation".
			Mobile App: In **Diagnostics > Simulation**, push the **Stop** button.
S	**Sensor**		
	Sensor temperature out of specification (Warning)	The ambient temperature is outside the given range. This can cause loss or corruption of data.	Measure the ambient temperature. De-energize the device until the ambient temperature is back in the given range. If the temperature does not stay in the correct range, make sure that there is insulation around the signal converter. If this error occurs a few times, replace the device or change its location.
	Peak lost (Warning)	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. No signal peak was found in the Search Window for a time equal to the parameter given in menu item C2.5 Error Delay (Full Setup menu).	Do a check of the device, tank and the process. Reconfigure the device and record a new empty spectrum.
	Overfill (Warning)	The signal peak is in the blocking distance (refer to menu item C1.3 Blocking Distance in the Full Setup menu). There is a risk that the tank is too full	Make sure that the device settings are correct and the process conditions are in the specified limits. Use a different procedure to measure the level in the tank. Remove some of the product until the level is below the blocking distance.
	Current output saturated	The loop current is at the minimum or maximum limit of the output range. The loop current stays at the minimum or maximum value if the tank contents go outside the output range.	Make sure that the device settings are applicable to the process.
	Sensor no signal (Warning)	The signal amplitude is less than the average value. This can occur if the liquid is agitated or if there is a foam in the tank. If this message occurs frequently, the device will possibly show the "Peak Lost" message.	If this error occurs frequently, it is possible that you must install the device in a different location or use a larger antenna.

Status type	Error message	Description	Corrective action
S	Sensor: Voltage 5V not correct (Warning)	The voltage is too low.	De-energize and then energize the device again. If the message is shown again, then the device will not be as accurate as the value given in the technical data.
M	**Sensor**		
	Empty spectrum invalid	The empty spectrum stored in the device does not agree with the installation. If you change the device configuration (tank height etc.), then this message will be shown.	Record a new empty spectrum.
	Signal too weak	The signal amplitude is too low. This problem can occur if the liquid is agitated or if there is foam in the tank. If this message occurs frequently, the device will possibly show the "Peak Lost" message.	If this error occurs frequently, it is possible that you must install the device in a different location or use a larger antenna.
	Signal too strong	This error can occur if there is a large change in signal amplitude.	No corrective action is necessary.
	Bad measurement quality	The measurement is incorrect and continues to be incorrect after more than 10 s. This error can occur if the tank contents are immediately below the antenna.	Check your installation (If necessary, speak to the supplier)
	Current output drift	The current output is not calibrated.	Perform a current output calibration.
	Conversion table values are not in numerical sequence	At least one point of the Conversion table is not correct. Values in the conversion table are not in numerical sequence. The value must increase on each new line.	Enter values in a new conversion table in menu A1 Quick Setup or menu A2.3 Conversion Table.
	Dynamic variable - configuration issue detected	The device cannot show the measurement as the data is not available to calculate a current output value that agrees with the selected variable (e.g., volume). It is possible that there is no data in the conversion table.	Change the measurement variable or make a new conversion table.
	Microwave calibration data reading error	Calibration of the microwave signal is in progress. The device detected an error.	Repeat the operation. If the message is shown again, tell the supplier.
I	**Sensor Diagnosis**		
	Spectrum quality bad	There is a large change in signal strength.	Check your installation. Make sure that the device installation agrees with the data in the handbook. If the message is shown again, we recommend that you install the device in a stilling well or use a device with a larger antenna.
	Peak lost in tank bottom	The signal was lost near the tank bottom. Spherical or conical tanks can cause the device to show this status message.	Do a check of the device, tank and the process. If it necessary, reconfigure the device and record a new empty spectrum.

Status type	Error message	Description	Corrective action
I	Spectrum transfer in progress	Synchronisation of the empty spectrum data between the device and the software is in progress.	No corrective action is necessary.
	Measurement inactive	The device cannot measure the level of the tank contents.	Do a check of the device, tank and the process. If it is necessary, reconfigure the device and record an empty spectrum.
	Microwave to calibrate	It is necessary to calibrate the microwave signal.	Tell your supplier that your device has this status message.
	Totalizer 1 stopped	The totalizer feature is not running.	Start the totalizer (menu item C7.5 Totaliser 1 Start).
	Quick Setup executed successfully	The operator finished the Quick Setup procedure.	No corrective action is necessary.
	Radar SOC update in progress	The radar SOC firmware update is in progress.	If this message is shown, tell the supplier.
	Totalizer 1 Overflow	The totalizer counter is at its preset value.	Reset the totalizer counter (menu item C7.7 Totaliser 1 Reset).
	Configuration locked by Local Display	A change to the device parameters is in progress. An operator is logged in with the optional device display screen. It is not possible to make changes with another software tool at the same time.	Log out from the device configuration menu and go back to the measurement screen.
	Configuration locked by HART	A change to the device parameters is in progress. An operator is logged in with a HART software tool. It is not possible to make changes with another software tool at the same time.	Log out from the HART DTM.
	Configuration locked by Bluetooth	A change to the device parameters is in progress. An operator is logged in with a Bluetooth software tool. It is not possible to make changes with another software tool at the same time.	Log out from the smartphone app or the Bluetooth DTM.
	Sensor Temperature out of specification (Info)	The ambient temperature is outside the given range. This can cause loss or corruption of data.	Measure the ambient temperature. De-energize the device until the ambient temperature is back in the given range. If the temperature does not stay in the correct range, make sure that there is insulation around the signal converter.
	Peak Lost (Info)	No signal peak was found in the Search Window for a time equal to the parameter given in menu item C2.5 Error Delay (Full Setup menu).	Do a check of the device, tank and the process. Reconfigure the device and record a new empty spectrum.
		The signal was lost near the tank bottom. Spherical or conical tanks can cause the device to show this status message.	
	Overfill (Info)	The level is in the blocking distance. There is a risk that the product will overflow and/or cover the antenna. The signal peak is in the blocking distance (refer to menu item C1.3 Blocking Distance in the Full Setup menu). There is a risk that the tank is too full.	Use a different procedure to measure the level in the tank. Remove some of the product until the level is below the blocking distance. Make sure that the device settings are correct and the process conditions are in the specified limits.

Status type	Error message	Description	Corrective action
I	Sensor: Voltage 5V not correct (Info)	The voltage is too low.	De-energize and then energize the device again. If the message is shown again, then the device will not be as accurate as the value given in the technical data.
	Sensor no signal (Info)	The signal amplitude is too low. This problem can occur if the liquid is agitated or if there is a foam in the tank. If this message occurs frequently, the device will possibly show the "Peak Lost" message.	If this error occurs frequently, it is possible that you must install the device in a different location or use a larger antenna.
	Loop Current Fixed	The current output does not change when the device measures in a point-to-point network and has an analogue output (e.g. 4...20 mA or 3.8...20.5 mA).	Do a check of the device configuration including the parameters and values set for the current output. Make sure that the Loop Current Mode (menu item C4.3.1) is set to "Enabled".
	Bluetooth ROM memory error	The device hardware is defective.	De-energize and then energize the device again. If the message is shown again and it is necessary to use Bluetooth communication, tell the supplier.

Table 5-11: Description of errors and corrective actions

6.1 Periodic maintenance

6.1.1 General notes

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.*

It is not necessary to clean the top of the device.

6.1.2 How to clean the device

If dirt collects on the device, then clean it with a damp cloth. Use only water.

6.2 Service warranty

> **WARNING!**
> *Only approved personnel can do an inspection of the device and repairs. If you find a problem, send the device back to your supplier for inspection and/or repairs.*

Servicing by the customer is limited by warranty to:

• The removal and installation of the device.

For more data on how to prepare the device before you send it back, refer to *Returning the device to the manufacturer* on page 81.

6.3 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.

6.4 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.

6.5 Returning the device to the manufacturer

6.5.1 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.

WARNING!
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.*

WARNING!
If the device has been operated with toxic, caustic, radioactive, 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.*

6.5.2 Form (for copying) to accompany a returned device

⚠️ *CAUTION!*
To avoid any risk for our service personnel, this form has to be accessible from outside of the packaging with the returned device.

Company:	Address:
Department:	Name:
Telephone number: Fax number:	Email address:
Manufacturer order number or serial number:	
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 caused by any residual media contained in this device when it is returned.

Date:	Signature:
Stamp:	

6.6 Disposal

§ *LEGAL NOTICE!*
Disposal must be carried out in accordance with legislation applicable in your country.

Separate collection of WEEE (Waste Electrical and Electronic Equipment):

According to the directive 2012/19/EU or UK Regulation 2013 No. 3113, the monitoring and control instruments marked with the WEEE symbol and reaching their end-of-life **must not be disposed of with other waste**.
The user must dispose of the WEEE to a designated collection point for the recycling of WEEE or send them back to our local organisation or authorised representative.

6.7 Disassembly and recycling

6.7.1 General notes

This section shows you how to handle the device if it is unserviceable (i.e. it is at the end of its product life cycle) or if it must be discarded. Information given in this section agrees with the EU Directive 2012/19/EU on waste electrical and electronic equipment (WEEE) and the EU Directive 2008/98/EC on waste (Waste Framework Directive). Refer to the data and obey the instructions that follow to disassemble and prepare components for waste treatment.

CAUTION!
Before you disassemble the device for disposal and recycling, make sure that the device is unserviceable.

INFORMATION!
The device does not contain dangerous gases or materials. If there is contamination from the process, refer to Returning the device to the manufacturer on page 81.

6.7.2 Product description

Product name and data

Type	OPTIWAVE
Model	15xx C (Compact)
Usage	Level measurement

Weight

Total weight	0.7 kg / 1.54 lb
Weight of parts (percentage of total weight)	Aluminium:
	7.1%
	Steel:
	0.4%
	Plastic:
	54.5%
	Cable:
	33.4% ①
	Electronics:
	4.2%

Dimensions

Volume	0.451 dm³ / 27.52 in³

Table 6-1: Product description

① For a cable length of 5 m / 16.4 ft. The cable is made of plastic, copper and steel.

6.7.3 Processing materials and components

> **INFORMATION!**
> *Words in **bold text** refer to electrical and electronic equipment.*

Recyclable materials and components

Material	Percentage of total weight	Total weight	
	[%]	**[kg]**	**[lb]**
Stainless steel	0.4	0.052	0.115
Aluminium	7.1		

Table 6-2: Materials and components which can be recycled

Materials and components that must be disassembled for recycling

Material	Weight		Description
	[kg]	**[lb]**	
Printed circuit board (PCB)	0.040	0.088	area: ~37.78 cm² / 5.856 in²
Electrolytic capacitor	N/A	N/A	The PCBs in the electronics block have electrolytic capacitors that have a total volume of ~22.373 cm³ / 3.468 in³
Battery	N/A	N/A	—
LCD screen (device) area > 100 cm² / > 15.5 in²	N/A	N/A	—
Plastic that contains brominated flame retardants	N/A	N/A	—
Noble / precious metal	N/A	N/A	—
Silicon	0.092	0.203	Potting
Signal converter	N/A	N/A	—
Aluminium	0.049	0.108	Antenna

Table 6-3: Materials and components that must be disassembled for recycling

6.7.4 Parts description

> **INFORMATION!**
> *Numbers in parentheses (xx) refer to item numbers in the parts list.*

> **INFORMATION!**
> *Words in **bold text** refer to electrical and electronic equipment.*
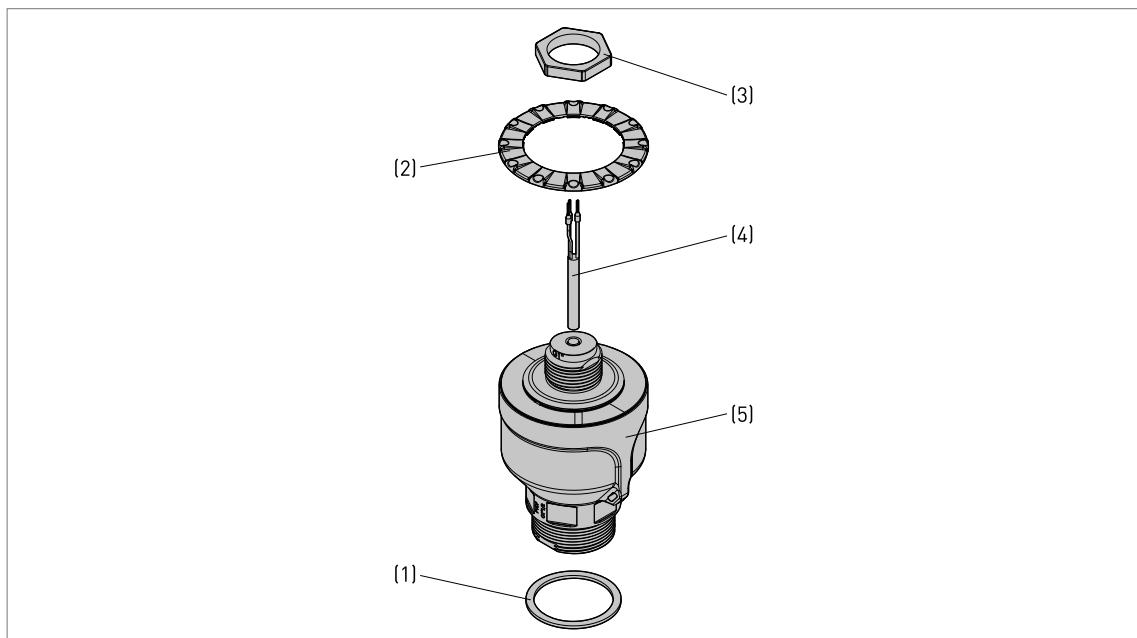
Figure 6-1: Parts of the device (refer to the "Parts list" table)

Item	Description	Material
(1)	Gasket ①	FPM / FKM
(2)	Blue ring	PA12
(3)	Nut ②	PA6.6
(4)	Electrical cable	copper + polyethylene + PUR + steel
(5)	Level transmitter assembly (housing, electronics and antenna)	PVDF + aluminium + EPDM + PA6

Table 6-4: Parts list

① For devices with an ISO 228-1 (G) thread on the process connection
② This part is available in different sizes (1" or 1 1/2") for the top and the bottom thread on the housing.

6.7.5 Tools and equipment

- Diagonal pliers (not supplied)
- Adjustable wrench (not supplied)

6.7.6 Removing the electrical cable

DANGER!
De-energize the device before you disconnect the electrical cable.

- Position the diagonal pliers on the electrical cable (4) immediately above the housing.
- Cut the electrical cable. Put the electrical cable in a container for recycling.

6.7.7 Disassembling the device

- Remove the nuts (3) from the threads on the device.
- Remove the blue plastic ring (2) from the clips.
- **ISO228-1 (G) connection:** Remove the FKM/FPM gasket.
  ➲　End of the procedure.

7.1 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 Fast Fourier Transform (FFT) into a frequency spectrum and then the distance is calculated from the spectrum. The level results from the difference between the tank height and the measured distance.
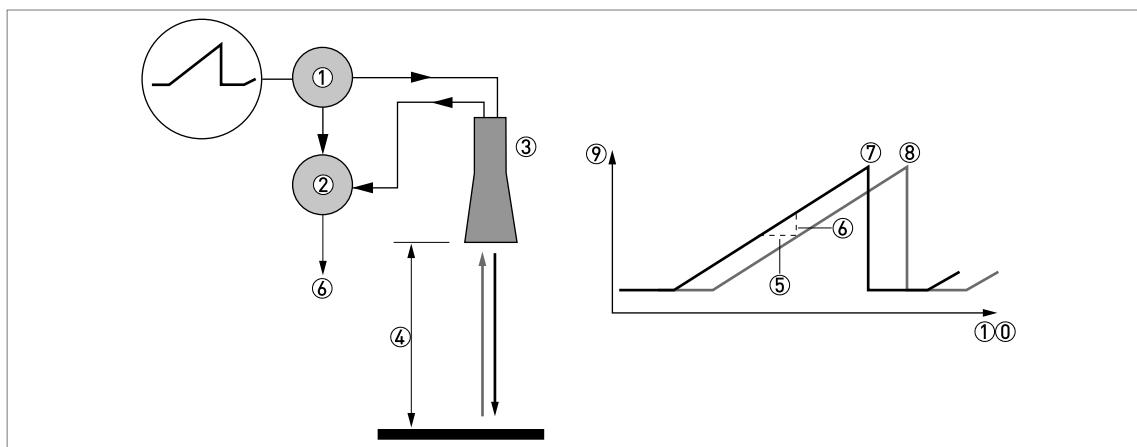

Figure 7-1: Measuring principle of FMCW radar

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

7.2 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 (Downloadcenter).*

	1520	1540

Measuring system

Measuring principle	2-wire loop-powered level and flow transmitter; FMCW radar
Frequency range	W-band (77...81 GHz)
Max. radiated power (EIRP)	< +34 dBm according to ETSI EN 302 729, 47 CFR Part 15 (FCC) and RSS-211 (ISED)
Application range	Level measurement of liquids, pastes, slurries and granulates
Primary measured value	Distance
Secondary measured value	Level, volume and flow rate

Design

Construction	The measurement system consists of a measuring sensor (antenna) and a signal converter.	
Antenna size	DN40 (1½")	
Options	Electrical cable supplied with the housing, length Standard: 5 m / 16.4 ft Optional: 10 m / 32.8 ft, 25 m / 82.0 ft, other length (on request)	
Accessories	316L low-pressure flange disc for NPT (ASME B1.20.1) option	
	316L low-pressure flange disc for G (ISO 228-1) option	
	Cable clamp - for a device suspended from a ceiling or an overhang	
	Purging system adaptor with G 1/4 inlet ①	
	Weather protection cover	
	Stainless-steel long bracket (adjustable transmitter position)	
	Stainless-steel short bracket	
	Orientation system (max. tilt 30°) with 316L low-pressure flange disc (atmospheric pressure)	
	Stainless-steel tag plate (18 characters max.)	
Max. measuring range	10 m / 32.8 ft	15 m / 49.2 ft
Min. tank height	0.2 m / 12"	
Recommended minimum blocking distance	0.1 m / 4"	
Beam angle	8°	

	1520	1540
User interfaces		
Remote operation	OPTICHECK Level Mobile app - wireless Bluetooth	
	PACTware™ with the OPTIWAVE 15XX Device Type Manager (DTM) - wireless Bluetooth	
	PACTware™ with the OPTIWAVE 15XX Device Type Manager (DTM) - HART	
	AMS Trex™ from Emerson Process - HART DD	
	PDM from Siemens - HART DD	
Interface languages	**DTM (HART), DTM (Bluetooth) and Mobile App**: English, French, German and Chinese (simplified)	
	DD (HART): English	

Measuring accuracy

Resolution	1 mm / 0.04¨	
Repeatability	±1 mm / ±0.04¨	
Accuracy, liquids when distance ≤ 10 m / 33 ft	±5 mm / ±0.19¨, when distance > 0.2 m / 0.65 ft	±2 mm / ±0.08¨, when distance > 0.4 m / 1.31 ft
Accuracy, liquids when distance > 10 m / 33 ft	—	±0.02% of measured distance. For more data, refer to *Measuring accuracy* on page 95.
Accuracy, bulk solids	Variable. This value depends on the product measured and the application.	
Temperature drift (analogue)	Typically 50 ppm/K	
Temperature drift (digital)	< 3 mm/10 K ②	
Reference conditions according to EN 61298-1		
Temperature	+15...+25°C / +59...+77°F	
Pressure	1013 mbara ±50 mbar / 14.69 psia ±0.73 psi	
Relative air humidity	60% ±15%	
Target	Metal plate in an anechoic chamber	

Operating conditions

Temperature	
Ambient temperature	-25...+80°C / -13...+176°F Ex: see supplementary operating instructions or approval certificates
Relative humidity	RH4% to RH99%
Storage temperature	-40...+80°C / -40...+176°F
Process connection temperature	-25...+80°C / -13...+176°F
Pressure	
Process pressure	-1...5 bar / -14.5...72.5 psi
Other conditions	
Dielectric constant (ε_r)	≥ 2
Ingress protection	**IEC 60529** IP66/67/IP68 – IP68 test conditions: 48 hours at a pressure of 4 bar / 58 psi

	1520	1540
ESD protection	±8 kV according to DNVGL-CG-0339	
UV resistance	UL 746C - rating f1 (applicable to outdoor operation); ISO 4892-2 - method B; UL 1581 Sec.1200 (electrical cable)	
Flammability rating	UL 94 (enclosure, connectors and insulation material); UL 2556 VW1 (electrical cable and wires); IEC 60332-1-2	
Measuring cycle time	≥ 250 ms	
Maximum rate of change	60 m/min / 196 ft/min	

Installation conditions

Process connection size	The nominal diameter (DN) should be equal to or larger than the antenna diameter.
Process connection position	Make sure that there are not any obstructions directly below the process connection for the device. For more data, refer to *Installation* on page 20.
Dimensions and weights	For dimensions and weights data, refer to *Dimensions and weights* on page 97.

Materials

Main components	
Housing	PVDF
Wetted parts, including antenna	PVDF
Process connection	PVDF
Gasket	FKM/FPM (-15...+80°C / -5...+176°F) - only for devices with a G (ISO 228-1) threaded connection
Outer sheath, electrical cable	Polyurethane (PUR)
Housing seal, eletrical cable	EPDM ③
Accessories	
Weather protection cover (option)	ASA
Long bracket	Stainless steel (316Ti) with PVC-U nut
Short bracket	Stainless steel (316Ti) with PVC-U nut
Cable clamp	Galvanised carbon steel (clamping jaws: fibreglass-reinforced PA)

Process connections

Thread	G 1 1/2 A (ISO 228); 1 1/2 NPT (ASME B1.20.1)

Electrical connections

Power supply	**Terminals output – Non-Ex / Ex mb:** 12...35 V DC; min./max. value for an output of 22 mA at the terminal
	Terminals output – Ex i: 12...30 V DC; min./max. value for an output of 22 mA at the terminal
Maximum current	22 mA
Current output load	R_L [Ω] ≤ ((U_{ext} -12 V)/22 mA). For more data, refer to *Minimum power supply voltage* on page 94.
IEC 61010-1 electrical data	Overvoltage category III / Maximum altitude: 5000 m above mean sea level / Pollution degree 4 / Outdoor use
Cable entry	N/A - integrated electrical cable
Cable gland	N/A - integrated electrical cable
Electrical cable diameter	6.4 mm ±0.2 mm / 0.252¨ ±0.008¨

	1520	1540

Input and output

Current output		
Output signal	Standard: 4…20 mA	
	Options: 3.8…20.5 mA according to NAMUR NE 43; 4…20 mA (reversed); 3.8…20.5 mA (reversed) according to NAMUR NE 43	
Output type	Passive	
Resolution	±1 μA	
Error signal	High: 21.5 mA; Low: 3.5 mA according to NAMUR NE 43	

HART®		
Description	Digital signal transmitted with the current output signal (HART® protocol)	
Version	7.7	
Load	≥ 250 Ω	
Multi-drop operation	Yes. Current output = 4 mA. Enter Program mode to change the polling address (1…63).	
Device drivers	Available for AMS Trex™, PDM, FDT/DTM	
HART® registered	Yes	

Bluetooth® interface		
Description	The interface offers wireless connectivity to the device via Bluetooth® Low Energy 5.2	
Frequency range	R-band (2400…2483.5 MHz)	
Max. emitted power	+6.5 dBm	
Apps	OPTICHECK Level Mobile app – available for Google Android™ and Apple® iOS	
	OPTIWAVE 15xx DTM – available for PACTware™ on Microsoft Windows	
	Supported mobile devices must have at least the following features: - Bluetooth® Low Energy 4.0 interface or higher For the minimal supported versions of Google Android™ or Apple® iOS refer to the latest version of the OPTICHECK Level Mobile app available in "Google Play™ store" or "Apple App Store".	
Effective range	50 m / 164 ft at the maximum power setting (in reference conditions)	
Signal encryption	Proprietary PACE protocol based on ECDH	
Functionality	Display status, measurement & diagnostic data	
	Device parametrization and guided configuration wizards	
	Advanced diagnostic methods	

Approvals and certification

CE / UKCA	The device meets the essential requirements of the EU Directives and UK Regulations. The manufacturer certifies successful testing of the product by applying the CE or UKCA marking.	
	For more data about the European Standards and UK Designated Standards related to this device, refer to the EU and the UKCA Declarations of Conformity. You can download this document free of charge from the website (Download Center).	
Vibration resistance	IEC 60721-3-4 / IEC 60068-2-6 (class 4M7 / ±5 mm / 9…200 Hz); EN 61298-3 (10…58 Hz: ±0.15 mm / 58….1000 Hz: 3g)	
Shock resistance	IEC 60068-2-27 (class 4M7: 25g shock ½ sinus: 6ms)	

	1520	1540
Conformity to sanitary regulations (wetted parts)	Regulation (EC) No 1935/2004, Commission Regulation (EC) No 2023/2006, Commission Regulation (EU) No 10/2011	
	FDA 21 CFR 177.2510	
	GB 4806.10	
Explosion protection		
ATEX (Ex ia, Ex idb ia or Ex ia tb) EU Type Approval - pending UKEX (Ex ia, Ex idb ia or Ex ia tb) UK Type Approval - pending	II 1/2 G Ex ia IIC T6...T3 Ga/Gb;	
	II 1/2 D Ex ia IIIC T85°C...T*°C Da/Db; ④	
	II 1/2 G Ex db ia IIC T6...T3 Ga/Gb;	
	II 1/2 D Ex ia tb IIIC T85°C...T*°C Da/Db ④	
ATEX (Ex ic) Type Approval - pending	II 3 G Ex ic IIC T6...T3 Gc;	
	II 3 D Ex ic IIIC T85°C...T*°C Dc ④	
IECEx - pending	Ex ia IIC T6...T3 Ga/Gb;	
	Ex ia IIIC T85°C...T*°C Da/Db; ④	
	Ex db ia IIC T6...T3 Ga/Gb;	
	Ex ia tb IIIC T85°C...T*°C Da/Db; ④	
	Ex ic IIC T6...T3 Gc;	
	Ex ic IIIC T85°C...T*°C Dc ④	
cQPSus - pending	**Division ratings**	
	XP-IS, Class I, Div 1, GPS ABCD, T6...T3;	
	DIP, Class II/III, Div 1, GPS EFG, T85°C...T*°C; ④	
	IS, Class I, Div 1, GPS ABCD, T6...T3;	
	IS, Class II/III, Div 1, GPS EFG, T85°C...T*°C; ④	
	NI, Class I, Div 2, GPS ABCD, T6...T3;	
	NI, Class II/III, Div 2, GPS FG, T85°C...T*°C ④	
	Zone ratings	
	Class I, Zone 1, AEx db ia [ia Ga] IIC T6...T3 Gb (US) – antenna suitable for Zone 0; Ex db ia [ia Ga] IIC T6...T3 Gb (Canada) – antenna suitable for Zone 0;	
	Class I, Zone 0, AEx ia IIC T6...T3 Ga (US); Ex ia IIC T6...T3 Ga (Canada);	
	Zone 20, AEx ia IIIC T85°C...T*°C Da (US); Ex ia IIIC T85°C...T*°C Da (Canada); ④	
	Zone 21, AEx ia tb [ia Da] IIIC T85°C...T*°C Db (US) – antenna suitable for Zone 20 Ex ia tb [ia Da] IIIC T85°C...T*°C Db (Canada) – antenna suitable for zone 20 ④	
NEPSI - pending	Ex ia IIC T3~T6 Ga/Gb;	
	Ex d ia IIC T3~T6 Ga/Gb;	
	Ex iaD 20/21 T85...T*; ④	
	Ex iaD 20/21 tD A21 IP6X T85°C...T*°C ④	
EAC-EX - pending	Ga/Gb Ex ia IIC T6...T3 X;	
	Da/Db Ex ia IIIC T85°C...T*°C X; ④	
	Ga/Gb Ex db ia IIC T6...T3 X;	
	Da/Db Ex ia tb IIIC T85°C...T*°C X ④	

	1520	1540
Type approvals – ships and other offshore units		
DNV-GL - pending	Location Classes - temperature: D, humidity: B, vibration: A, EMC: B, and enclosure: C	
Other standards and approvals		
Electromagnetic compatibility	**EU**: Electromagnetic Compatibility directive (EMC)	
	UK: Electromagnetic Compatibility Regulations	
Radio approvals	**EU**: Radio Equipment directive (RED)	
	UK: Radio Equipment Regulations	
	FCC Rules: 47 CFR Part 15	
	Industry Canada: RSS-211	
Electrical safety	**EU**: Agrees with the safety part of the Low Voltage directive (LVD)	
	UK: Agrees with the safety part of the Electrical Equipment (Safety) Regulations	
	USA and Canada: Agrees with NEC and CEC requirements for installation in ordinary locations	
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	
	NAMUR NE 53 Software and Hardware of Field Devices and Signal Processing Devices with Digital Electronics	
	NAMUR NE 107 Self-Monitoring and Diagnosis of Field Devices	

Table 7-1: Technical data

① This option can also be attached to the orientation system

② If the device operates in a hot and humid area, then there can be a small, permanent measurement offset (max. 5 mm / 0.20¨). If it is necessary to correct this measurement offset, then tell the supplier.

③ EPDM is not compatible with mineral oils

④ T* = 150 or 200. For more data, refer to the related Ex approval certificate.

7.3 Minimum power supply voltage

Use these graphs to find the minimum power supply voltage for a given current output load.

**Non-Ex and Hazardous Location approved (Ex mb) devices**

Figure 7-2: Minimum power supply voltage for an output of 22 mA at the terminals (Non-Ex and Hazardous Location approval (Ex mb))

X: Power supply U [V DC]
Y: Current output load R_L [Ω]

Hazardous Location approved (Ex i / IS) devices

Figure 7-3: Minimum power supply voltage for an output of 22 mA at the terminals (Hazardous Location approval (Ex i / IS))

X: Power supply U [V DC]
Y: Current output load R_L [Ω]

7.4 Measuring accuracy

Use these graphs to find the measuring accuracy for a given distance from the transmitter. For a distance more than 10 m / 32.8 ft, refer to *Technical data* on page 88 (measuring accuracy).

OPTIWAVE 1520
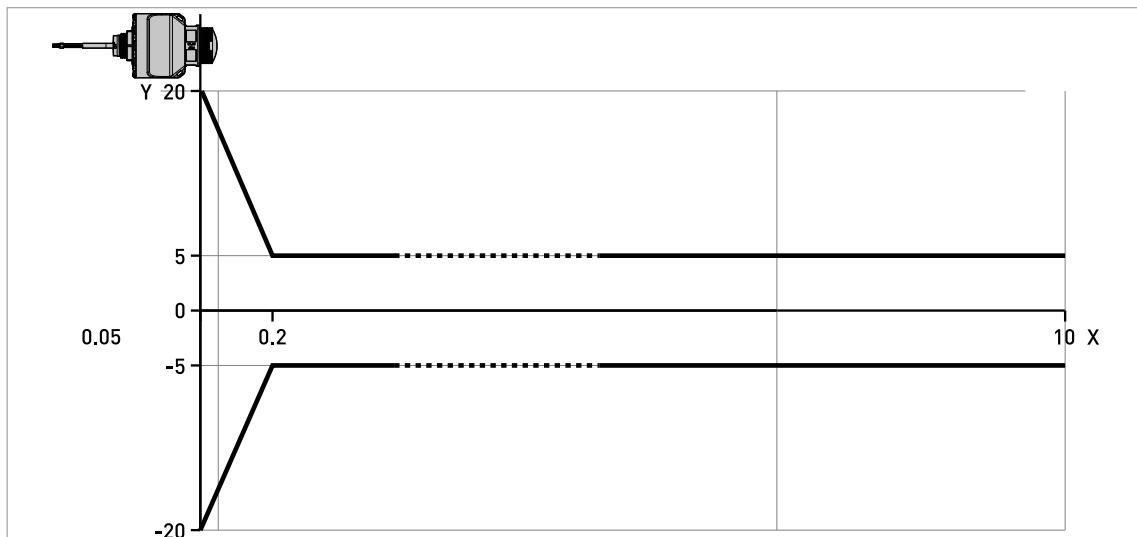
Figure 7-4: Graph of accuracy in mm against measuring distance in m

X: Measuring distance from the bearing surface of the threaded connection [m]
Y: Accuracy [+yy mm / -yy mm]
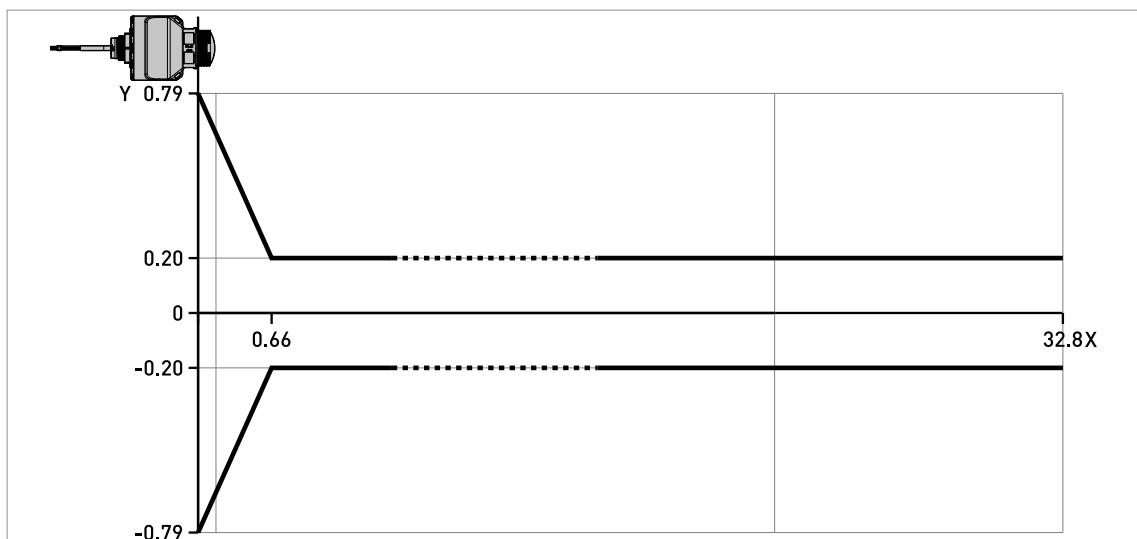
Figure 7-5: Graph of accuracy in inches against measuring distance in ft

X: Measuring distance from the bearing surface of the threaded connection [ft]
Y: Accuracy [+yy inches / -yy inches]

OPTIWAVE 1540
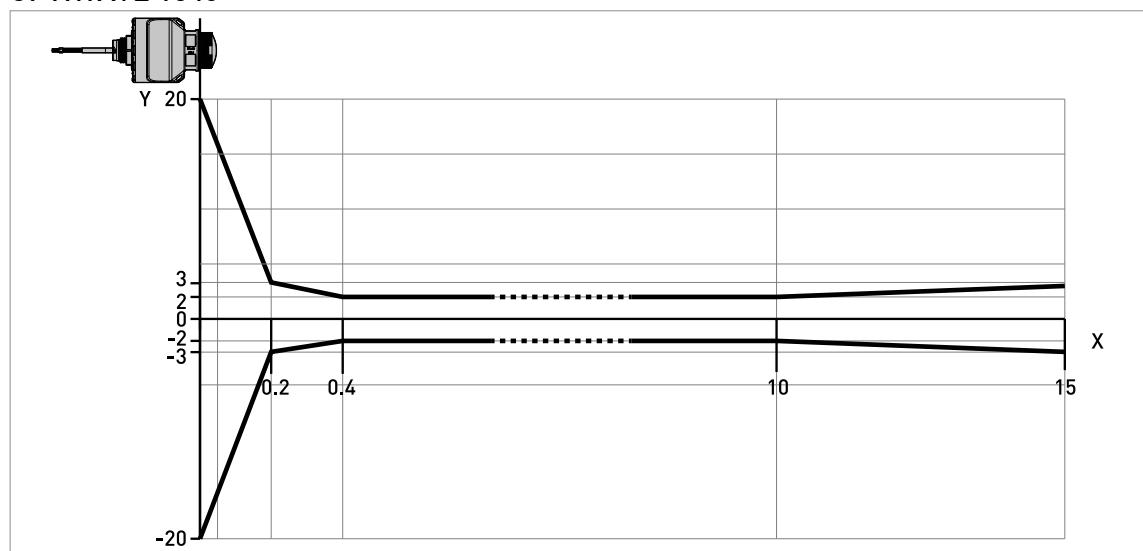
Figure 7-6: Graph of accuracy in mm against measuring distance in m

X: Measuring distance from the bearing surface of the threaded connection [m]
Y: Accuracy [+yy mm / -yy mm]
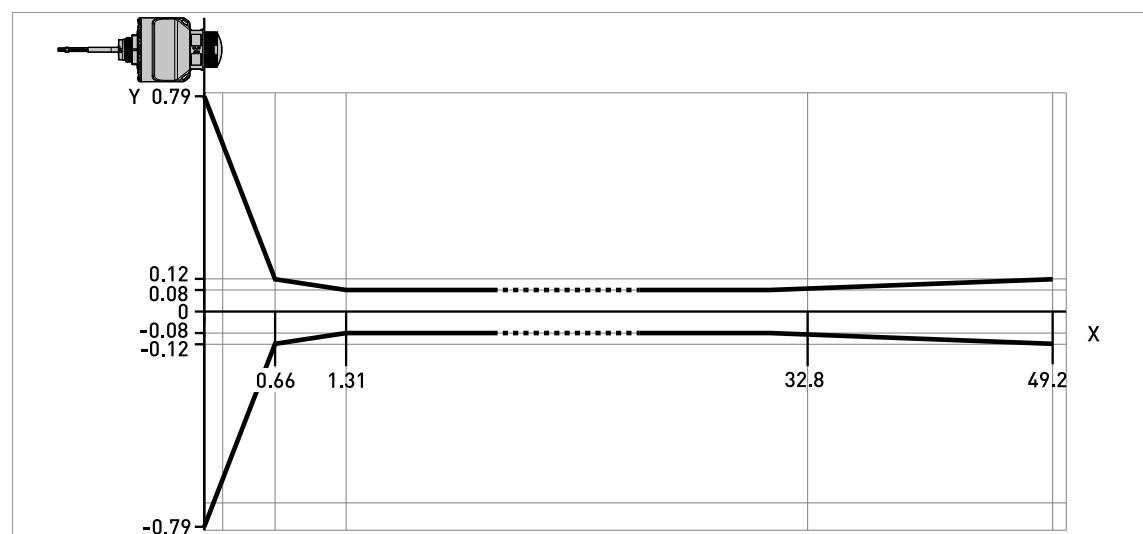
Figure 7-7: Graph of accuracy in inches against measuring distance in ft

X: Measuring distance from the bearing surface of the threaded connection [ft]
Y: Accuracy [+yy inches / -yy inches]

7.5 Dimensions and weights

7.5.1 OPTIWAVE 1520 or 1540
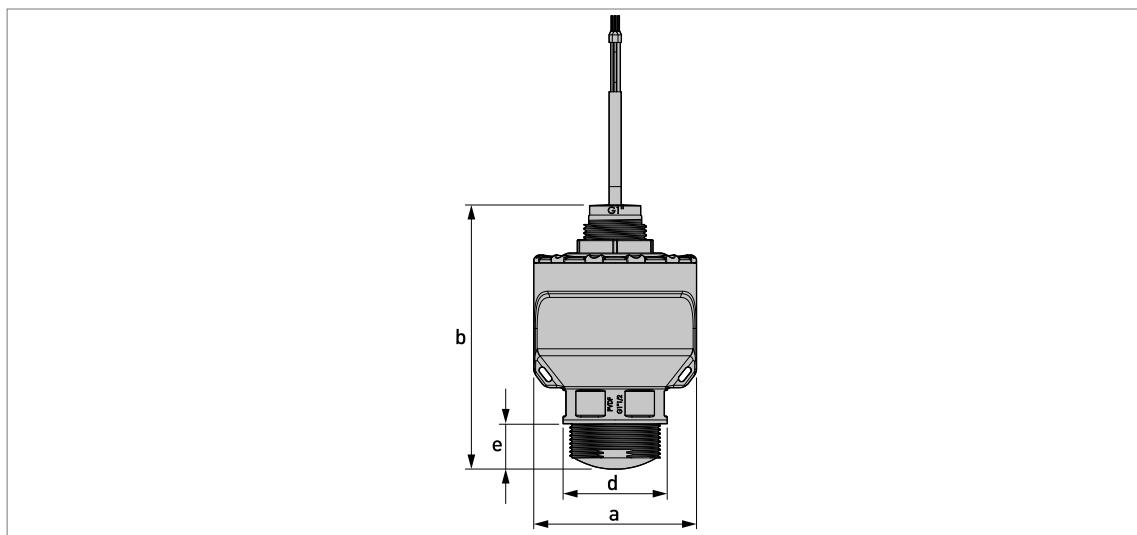
Figure 7-8: OPTIWAVE 1520 or 1540 with DN40 / 1½¨ Lens antenna

INFORMATION!
- *A weather protection cover is available as an accessory with all devices.*

Dimensions							
a		b		d		e	
[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
86	3.39	139	5.47	55	2.17	28	1.10

Table 7-2: Dimensions in mm and inches

7.5.2 Cable clamp (accessory)
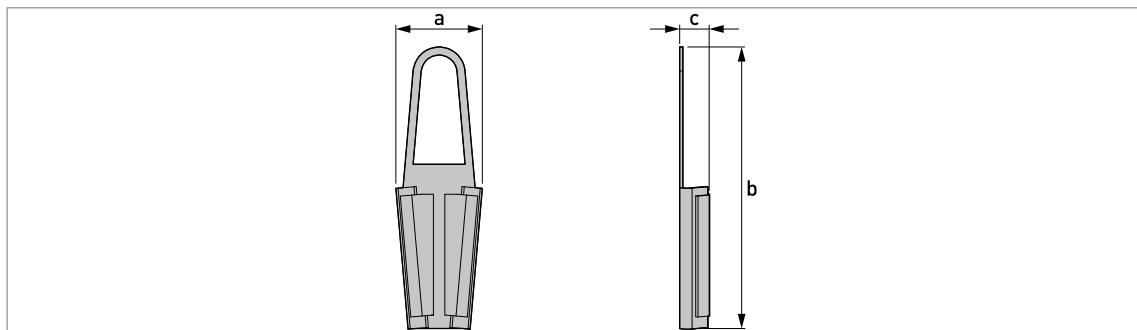

Figure 7-9: Cable clamp (accessory)

Dimensions					
a		b		c	
[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
54	2.13	174	6.85	18.4	0.72

Table 7-3: Dimensions in mm and inches

7.5.3 Long bracket (accessory)
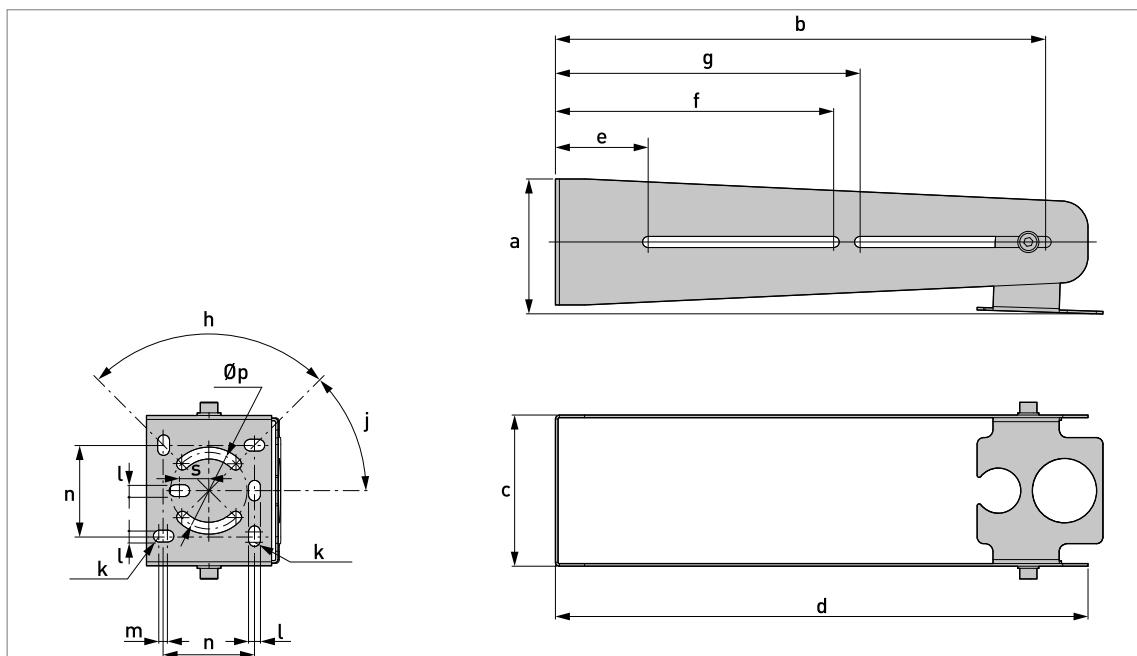
Figure 7-10: Long bracket (accessory)

Dimensions [mm]														
a	b	c	d	e	f	g	h	j	k	l	m	n	Øp	s
102	370	114	402	70	210	230	90°	45°	R4.5	9	6.5	69	57	22.5

Table 7-4: Dimensions in mm

Dimensions [inch]														
a	b	c	d	e	f	g	h	j	k	l	m	n	Øp	s
4.02	14.57	4.49	15.83	2.76	8.27	9.06	90°	45°	R0.18	0.35	0.26	2.72	2.24	0.89

Table 7-5: Dimensions in inches

7.5.4 Short bracket (accessory)
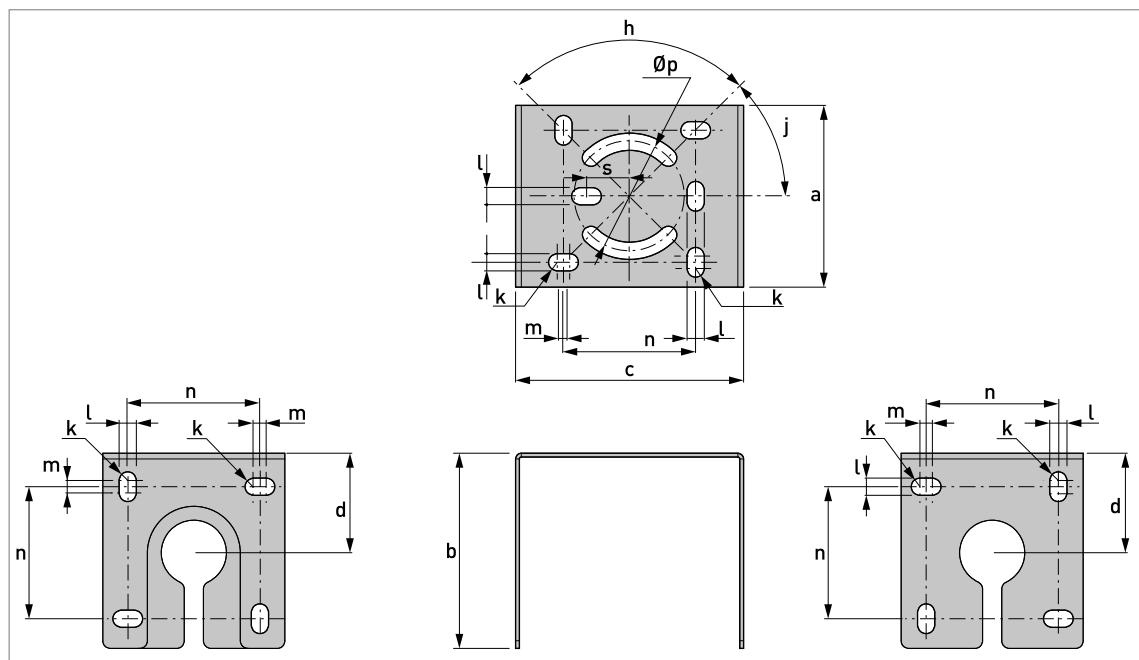
Figure 7-11: Short bracket (accessory)

Dimensions [mm]											
a	b	c	d	h	j	k	l	m	n	Øp	s
95	102	119	52	90°	45°	R4.5	9	6.5	69	57	22.5

Table 7-6: Dimensions in mm

Dimensions [inch]											
a	b	c	d	h	j	k	l	m	n	Øp	s
3.74	4.02	4.69	2.05	90°	45°	R0.18	0.35	0.26	2.72	2.24	0.89

Table 7-7: Dimensions in inches

7.5.5 Purging system (accessory)
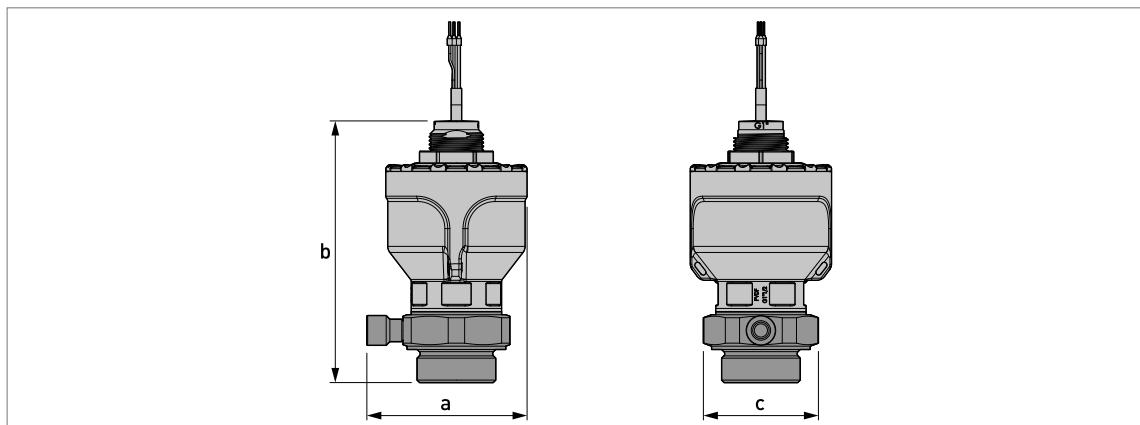

Figure 7-12: Purging system (accessory)

Process connection	Dimensions					
	a		b		c	
	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
G 1 / 1 NPT	97.5	3.84	158	6.22	70	2.76

Table 7-8: Dimensions in mm and inches

7.5.6 Orientation system (accessory)
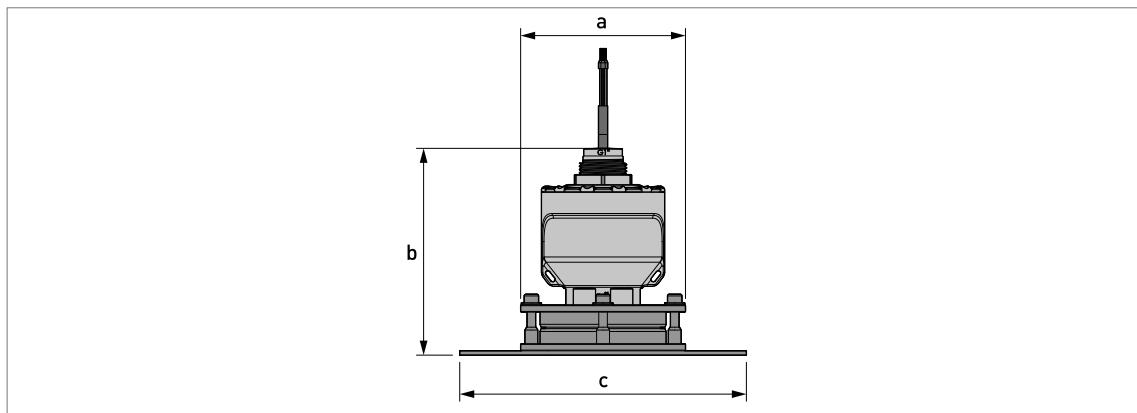
Figure 7-13: Orientation system (accessory)

Dimensions					
Øa		b		Øc	
[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
115	4.53	144	5.67	①	①

Table 7-9: Dimensions in mm and inches

① DN80 PN01 = 200 mm / 7.87¨. DN100 PN01 = 235 mm / 9.25¨. DN125 PN01 = 270 mm / 10.63¨. DN150 PN01 = 300 mm / 11.81¨. DN200 PN01 = 345 mm / 13.58¨. NPS 3 Class 150 = 200 mm / 7.87¨. NPS 4 Class 150 = 235 mm / 9.25¨. NPS 5 Class 150 = 270 mm / 10.63¨. NPS 6 Class 150 = 300 mm / 11.81¨. NPS 8 Class 150 = 345 mm / 13.58¨.

7.5.7 Weather protection cover (accessory)
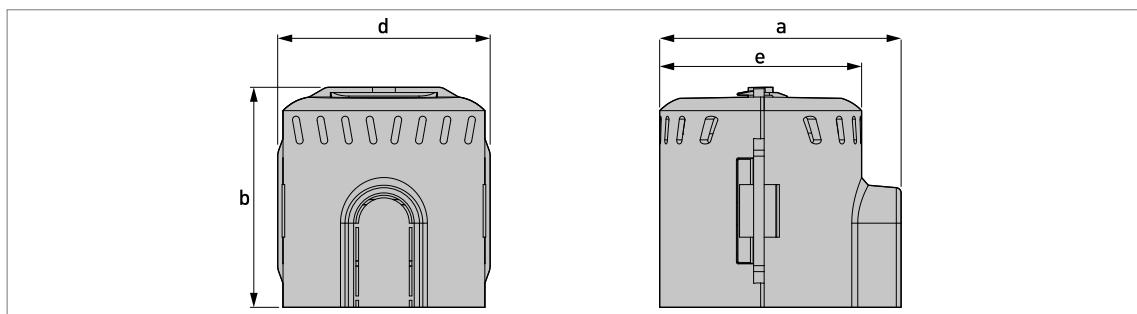
Figure 7-14: Weather protection cover (accessory)
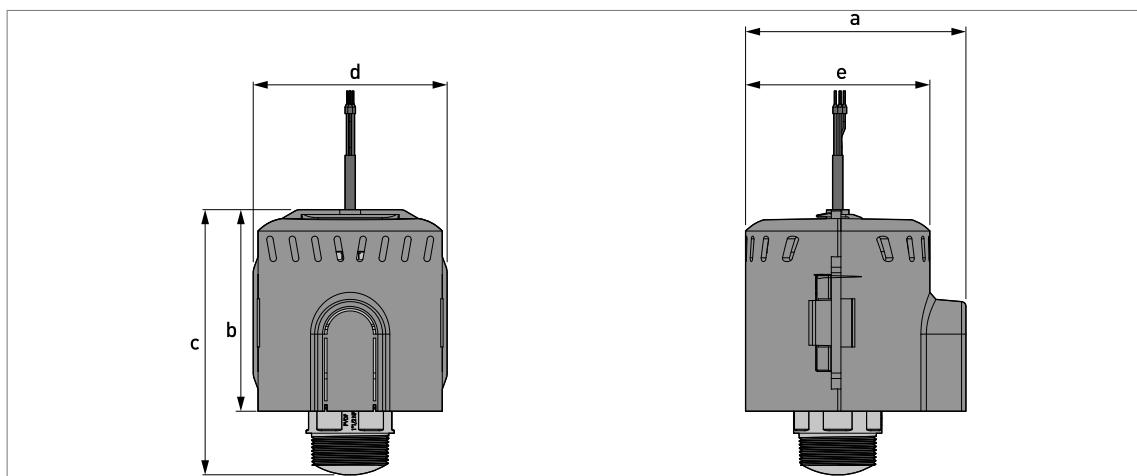
Figure 7-15: Weather protection cover attached to the device

Device	Dimensions										Weights	
	a		b		c		d		e			
	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[kg]	[lb]
Weather protection cover	137.5	5.41	125.5	4.94	—	—	121	4.76	115	4.53	0.22	0.49
OPTIWAVE 1520 / 1540 with weather protection cover	137.5	5.41	125.5	4.94	165.1	6.50	121	4.76	115	4.53	0.66	1.45

Table 7-10: Dimensions in mm and inches / weights in kg and lb

7.5.8 Weights

Type of housing	Weights	
	[kg]	[lb]
Device with IP68-certified housing and DN40 antenna	0.44	0.97
Accessory		
Cable clamp	0.155	0.34
Weather protection cover	0.22	0.49
Long bracket	1.30	2.87
Short bracket	0.363	0.80
Nut (PVC-U) for the bracket accessories	0.043	0.09

Table 7-11: Weights in kg and lb

8.1 General description

The open HART® protocol, which can be used freely, is integrated into the signal converter for communication.

Devices which support the HART® protocol are classified as either operating devices or field devices. When it comes to operating devices (Master), both manual control units (Secondary Master) and PC-supported workstations (Primary Master) are used in, for example, a control centre.

HART® field devices include flow sensors, signal converters and actuators. The field devices range from 2-wire to 4-wire to intrinsically safe versions for use in hazardous areas.

The HART® data are superimposed over the analogue 4...20 mA signal via FSK modem.

This way, all of the connected devices can communicate digitally with one another via the HART® protocol while simultaneously transmitting the analogue signals.

When it comes to the field devices and secondary masters, the FSK or HART® modem is integrated, whereas with a PC communication takes place via an external modem which must be connected to the serial interface. There are, however, other connection variants which can be seen in the following connection diagrams.

8.2 Software history

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

Release date	Electronic revision (ER)	HART®	
		Device revision	DD revision
03/2024	ER1.x.x_	1	2

Table 8-1: Software history for HART® interface

Manufacturer ID:	69 (0x45)
Extended Device Type:	0x45A6
Device revision:	1
DD revision:	2
HART® Universal Revision:	7

Table 8-2: HART® identification codes and revision numbers

8.3 Connection variants

This transmitter is a 2-wire device which has a 4...20 mA current output and HART$^®$ interface.

- **Multi-drop mode is supported**
  In a multi-drop communication system, more than 2 devices are connected to a common transmission cable.
- **Burst mode is not supported**
  In the Burst mode a slave device transfers cyclic pre-defined response telegrams, to get a higher rate of data transfer.

INFORMATION!

For detailed information about the electrical connection of the transmitter for HART$^®$, refer to the section "Electrical connection".

There are two ways of using the HART$^®$ communication:

- as Point-to-Point connection and
- as multi-drop connection, with 2-wire connection.

8.3.1 Point-to-point connection

A single-loop circuit connects the transmitter to the workstation with HART communication software in point-to-point mode.

Do the procedure that follows to set the device to point-to-point mode:

- Set Loop Current Mode (C4.3.1) to "On".
- Set Device Address (C4.4.1) to 0.
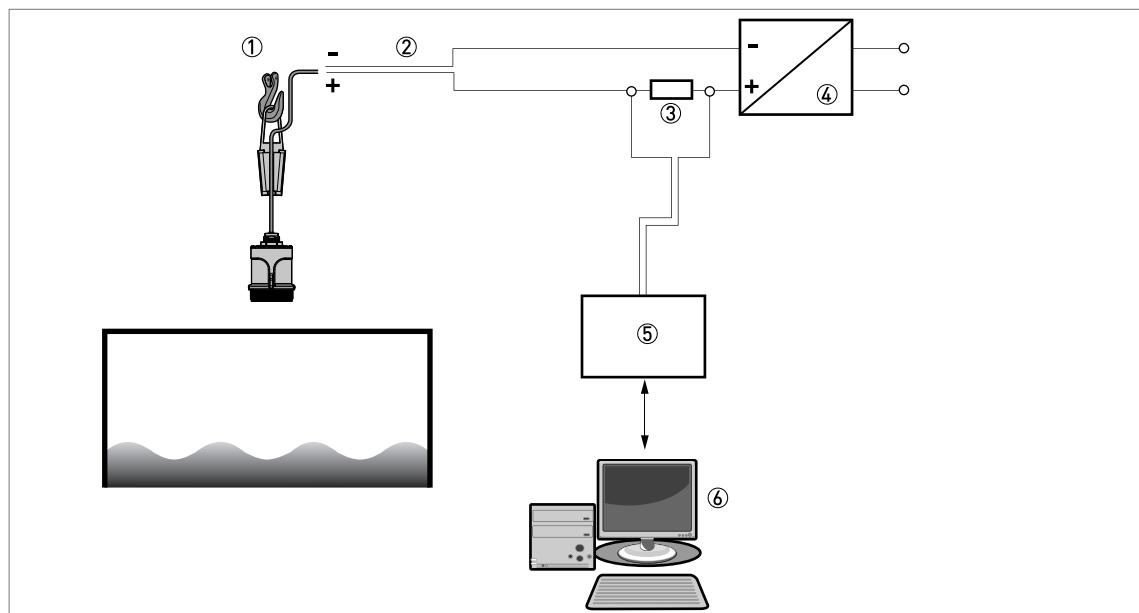
**Figure 8-1: Point-to-point connection (non-Ex)**

① Address of the device (0 for point-to-point connection)
② 4...20 mA + HART®
③ Resistor for HART® communication (typically 250 ohms)
④ Power supply
⑤ HART® converter
⑥ HART® communication software

8.3.2 Multi-drop connection

The HART protocol$^{®}$ permits communication with more than one device in multi-drop mode. A maximum of 63 devices can be installed in parallel (this transmitter and other HART$^{®}$ devices).

Do the procedure that follows to set the device to multi-drop mode:

- Set Loop Current Mode (C4.3.1) to "Off".
  ➲ The current output changes to and stays constant at 4 mA.

- Set Device Address (C4.4.1) to a value between 1 and 63 (HART polling address). Make sure that there is no other HART$^{®}$ device that has this polling address in the circuit.
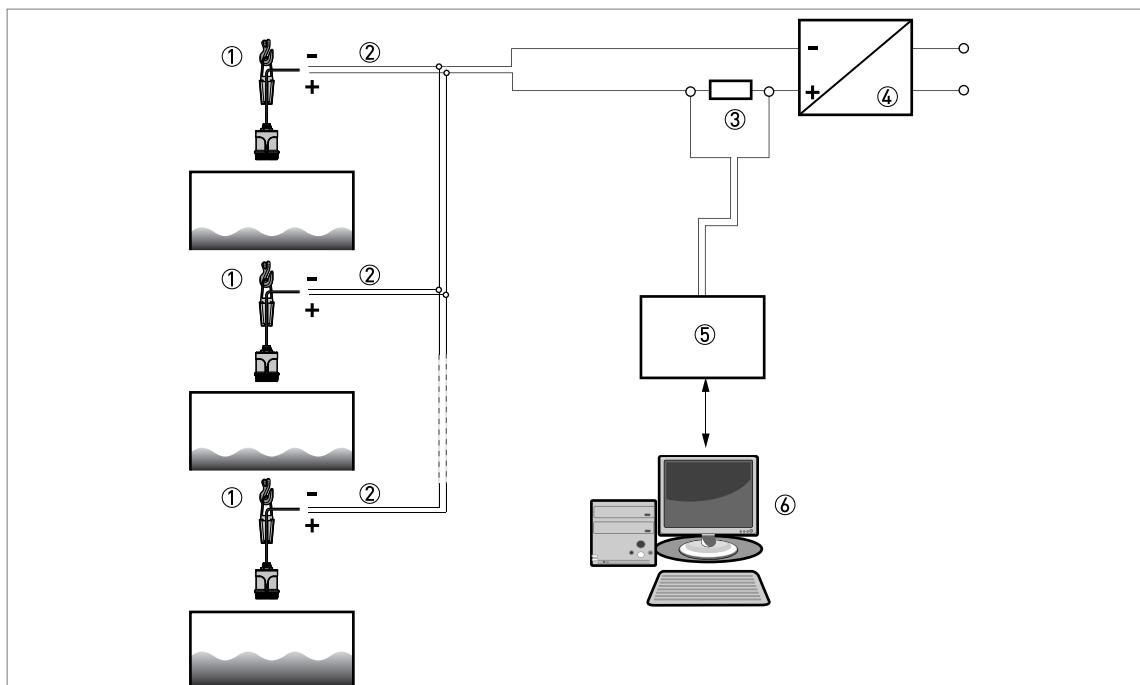

Figure 8-2: Multi-drop network (non-Ex)

① Address of the device (each device must have a different address in multi-drop networks)
② 4 mA + HART®
③ Resistor for HART® communication (typically 250 ohms)
④ Power supply
⑤ HART® converter
⑥ HART® communication software

8.4 Inputs/outputs and HART dynamic variables and device variables

The transmitter has 8 measurement-related values available for device monitoring. The measured values are identified as HART$^®$ device variables and can be connected to HART$^®$ dynamic variables.

Code = device variable code

HART$^®$ device variable	Code	Type	Description
Reflection	0	linear	
Level	1	linear	
Distance	2	linear	
Conversion	3	linear	This option is available if you make a conversion table to change measurement data to corrected level, volume or volumetric flow rate.
Ullage Conversion	4	linear	This option is available if you make a conversion table to change measurement data to corrected distance or ullage volume.
Totaliser 1	5	totaliser	This option is available if you made a level-volumetric flow rate table (strapping table) in the Setup menu.
Temperature	6	linear	
Global Totaliser	7	totaliser	This option is available if you made a level-volumetric flow rate table (strapping table) in the Setup menu.

PV = Primary Variable; SV = Secondary Variable; TV = Tertiary Variable; QV = Quaternary Variable

The HART$^®$ dynamic variable PV is always connected to the HART$^®$ current output.

A totaliser device variable can thus not be assigned to the dynamic variable PV because the PV is always connected to the HART$^®$ current output.

The transmitter is equipped with a Bluetooth® interface.
This interface provides wireless access to the transmitter for convenient parametrisation and service diagnosis via standard mobile devices, such as smartphones or tablet computers.

The interface is accessed by:

- The KROHNE OPTICHECK Level Mobile app, which is available for Google Android™ and Apple® iOS operation systems.
- PACTware™ with the OPTIWAVE 15XX Device Type Manager (DTM) for wireless Bluetooth® connections.

9.1 Introduction

9.1.1 Functionality

The OPTICHECK Level Mobile app offers the following functionality:

- Display device status (NE107 status, error messages and counter measures)
- Display and visualise measurement values
- Device parametrisation
- Guided configuration wizards (e.g. for Quick Setup procedures), making a conversion table (strapping table) and setting up the current output)
- Advanced diagnostic methods (device snapshot)
- Full device backup and restore
- Available for Google Android™ and Apple® iOS

PACTware™ with the OPTIWAVE 15XX DTM for Bluetooth® connections offers the same functionality. This software for Microsoft® Windows® can be downloaded free of charge from the website (Downloadcenter) or the PICK server.

9.1.2 Software installation and set up

INFORMATION!
Make sure that you selected the "Bluetooth enabled" option on the order form. If you did not select this option, then contact the supplier.

OPTICHECK Level Mobile app

- Prepare the field device for a Bluetooth® connection.
- Install the OPTICHECK Level Mobile app on your mobile device.
- Open the OPTICHECK Level Mobile app.
  - A list of available devices is displayed.
  - Select the appropriate device and establish a connection by entering the device-specific Bluetooth® password.
- Use the app to access the functionality of the device via a wireless connection.

For more data, refer to the Quick Start (document).

PACTware with OPTIWAVE 15XX DTM (Bluetooth)

- Prepare the field device for a Bluetooth® connection.
- Install PACTware™ with OPTIWAVE 15XX DTM on your workstation.
- Open PACTware™ and set up the software to communicate with the field device.
- Use the app to access the functionality of the device via a wireless connection.

For more data, refer to *Bluetooth wireless connection to the device with PACTware* on page 40.

9.2 Security considerations

Remote access to the transmitter via Bluetooth® requires additional security mechanisms. The existing perimeter security (i.e. limited physical access) is no longer sufficient, because wireless connections do not require physical access to the transmitter.

The converter is equipped with a multi-layered wireless security concept. It offers a high level of protection and can be adapted to the needs of the application. It consists of the following mechanisms:

- **Bluetooth® access level:**
  Enable or disable the Bluetooth® interface.
- **Password-based authentication:**
  A password must be entered before a wireless connection is established (C8 Bluetooth > Bluetooth Password). For more data, refer to *Function description* on page 56.
- **Firewall:**
  Prevents denial-of-service attacks via the wireless interface.
- **Encryption:**
  Data exchanged via the wireless link is protected against interception and manipulation using strong encryption (proprietary PACE protocol based on ECDH).

9.3 Field device setup

The Bluetooth® interface is a device option. If the Bluetooth® option was not selected in the customer order, contact your supplier to set the Bluetooth module to "on".

9.3.1 Configuration of mobile device for Bluetooth communication

If you use the OPTICHECK Level Mobile app to connect to the transmitter, do the procedure that follows:

- Energize the transmitter.
- Unlock your mobile device (smartphone, tablet etc.).
- Tap on **Settings**, then **Bluetooth**. Set the Bluetooth toggle button to "on". If it is the first connection, pair the mobile device with the transmitter.
- Go back to the **Settings** menu. Tap on **Location**. Set the Location toggle button to "on".
- Open the OPTICHECK Level mobile app.
- Tap on the device in the **Discovered devices** list with the correct tag name and serial number.
- ➮ The Bluetooth security code window will open.

- Enter the Bluetooth password. The initial Bluetooth password is shown on the nameplate. For more data, refer to *Nameplate (example)* on page 18.

9.3.2 Configuration of a workstation for Bluetooth communication (DTM)

You can use a workstation with PACTware™ / DTM software in wireless Bluetooth mode to communicate with the transmitter. For more data about installation and device configuration, refer to *Bluetooth wireless connection to the device with PACTware* on page 40.

9.3.3 Password for Bluetooth communication (C8)

The Bluetooth password prevents all communication with the transmitter that is not approved by the plant surpervisor.

The initial Bluetooth password is shown on the nameplate. For more data, refer to *Nameplate (example)* on page 18.

CAUTION!
After you have made the first connection to the transmitter, we recommend that you immediately change the password to have good network security. Make sure that the password is only known by approved personnel.

You can change the password in menu C8 Bluetooth > Bluetooth Password. Make sure that you log on the software with the "Operator" security role before you change the password.

The password must agree with the rules that follow:

- Letters and numbers (a...z, A...Z, 0...9) including these characters @, [, \,], ^, _, !, $, %, &, ', (,), *, +, -, /, :, ;, <, =, > and ?
- Minimum length: 4 characters
- Maximum length: 16 characters

Spaces after the last character are ignored. We also recommend that you:

- select a different password for each device,
- make sure that the password agrees with the computer network security regulations of your company, and
- change the password immediately if there is a risk that persons other than approved personnel know the password.

9.4 Installation of the OPTICHECK Level Mobile app

The OPTICHECK Level Mobile app is available for supported devices on Google Play™ and App Store®.

- Make sure that your mobile device is connected to the internet.
- Open the app store (Google Play™ for Android™ devices or App Store for Apple® devices)
- Enter "OPTICHECK Level Mobile" in the search field. Select the app from the app store list.
- Tap on the **Install** button. When the mobile device completes the download, tap on the **Open** button to start the app.

For more data about the configuration of the mobile device for Bluetooth communication, refer to *Configuration of mobile device for Bluetooth communication* on page 111.

10.1 Accessories

10.1.1 General items
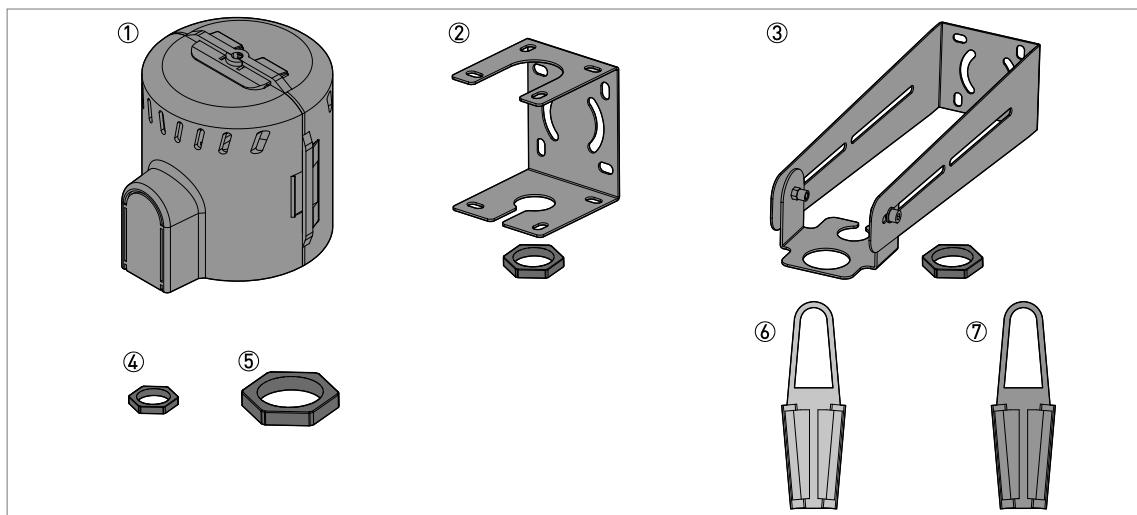
Figure 10-1: Accessories: general items

① Weather protection cover

Item	Description	Quantity	Part reference
①	Weather protection cover / ASA	1	XFDM000003
②	Short bracket / 316Ti stainless steel ①	1	XFDM000001
③	Long bracket (adjustable transmitter position) / 316Ti ①	1	XFDM000002
④	G 1 nut / 316L stainless steel	1	XFDG000002
⑤	G 3 nut / 316L stainless steel	1	XFDG000012
⑥	Electrical cable clamp / galvanised carbon steel	1	XFDG000006
⑦	Electrical cable clamp / 304 stainless steel	11	XFDG000007

Table 10-1: Accessories: general items

① This accessory is supplied with a G 1 1/2 nut (PVC)

## 10.1.2 Process connection kits for the level transmitter
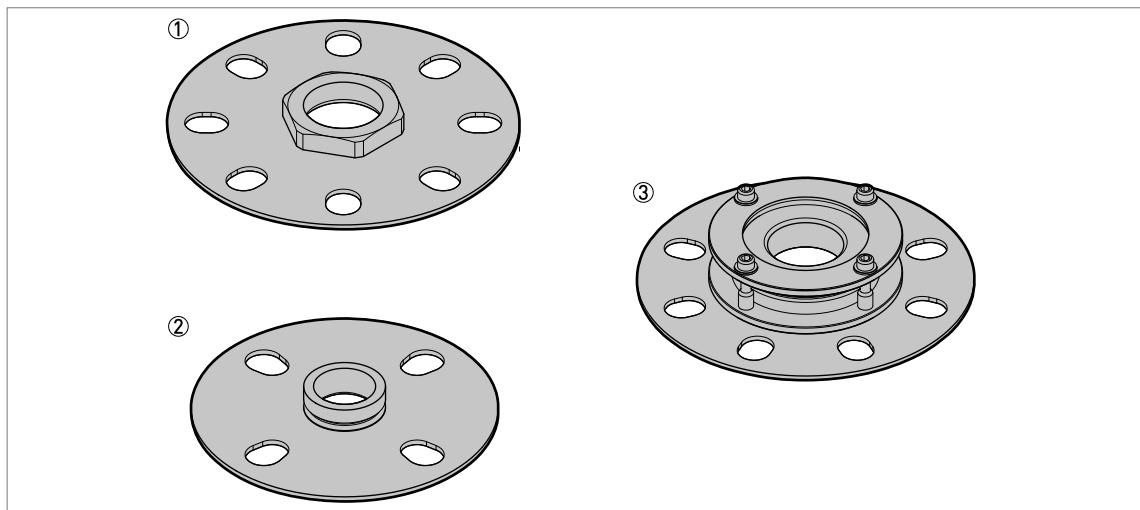
Figure 10-2: Accessories: process connection kits for the level transmitter

① 316L low-pressure flange disc for G (ISO 228) option
② 316L low-pressure flange disc for NPT (ASME B1.20.1) option
③ Orientation system (max. tilt 30°) with 316L low-pressure flange disc (atmospheric pressure)

Item	Description	Bolt hole dimensions agree with:	Quantity	Part reference
①	316L low-pressure flange disc (max. 1 bar at +20°C) for G 1 1/2 threaded connection option	DN80 PN2.5...PN40 (EN) / NPS 3 Class 150 (ASME) ①	1	XF70000010
		DN100 PN2.5...PN40 (EN) / NPS 4 Class 150 (ASME) ①		XF70000011
		DN150 PN2.5...PN40 (EN) / NPS 6 Class 150 (ASME) ①		XF70000013
		DN200 PN2.5...PN40 (EN) / NPS 8 Class 150 (ASME) ①		XF70000014
②	316L low-pressure flange disc (max. 14.5 psi at +68°F) for 1 1/2 NPT threaded connection option	DN80 PN2.5...PN40 (EN) / NPS 3 Class 150 (ASME) ①	1	XF70000N10
		DN100 PN2.5...PN40 (EN) / NPS 4 Class 150 (ASME) ①		XF70000N11
		DN150 PN2.5...PN40 (EN) / NPS 6 Class 150 (ASME) ①		XF70000N13
		DN200 PN2.5...PN40 (EN) / NPS 8 Class 150 (ASME) ①		XF70000N14
③	Orientation system (max. tilt 30°) with 316L low-pressure flange disc (atmospheric pressure) for G 1 1/2 threaded connection option	DN80 PN2.5...PN40 (EN) / NPS 3 Class 150 (ASME) ①	1	XF70000061
		DN100 PN2.5...PN40 (EN) / NPS 4 Class 150 (ASME) ①		XF70000062
		DN150 PN2.5...PN40 (EN) / NPS 6 Class 150 (ASME) ①		XF70000063
		DN200 PN2.5...PN40 (EN) / NPS 8 Class 150 (ASME) ①		XF70000064

Item	Description	Bolt hole dimensions agree with:	Quantity	Part reference
③	Orientation system (max. tilt 30°) with 316L low-pressure flange disc (atmospheric pressure) for 1 1/2 NPT threaded connection option	DN80 PN2.5...PN40 (EN) / NPS 3 Class 150 (ASME) ①	1	XF70000N61
		DN100 PN2.5...PN40 (EN) / NPS 4 Class 150 (ASME) ①		XF70000N62
		DN150 PN2.5...PN40 (EN) / NPS 6 Class 150 (ASME) ①		XF70000N63
		DN200 PN2.5...PN40 (EN) / NPS 8 Class 150 (ASME) ①		XF70000N64

Table 10-2: Accessories: process connection kits for the level transmitter

① NPS = Nominal Pipe Size. For more data about the dimensions of ASME flanges, refer to the ASME B16.5 standard.

### 10.1.3 Purging system adaptor
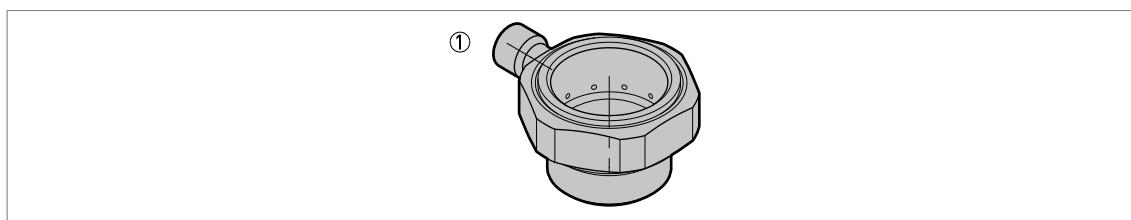
Figure 10-3: Accessories: purging system adaptor

① Purging system adaptor for G (ISO 228) or NPT (ASME B1.20.1) thread connection on level transmitter

Item	Description	Quantity	Part reference
①	Purging system adaptor for G 1 1/2 transmitter process connection	1	XF70000068
	Purging system adaptor for 1 /12 NPT transmitter process connection		XF70000N68

Table 10-3: Accessories: purging system adaptor

10.2 Glossary

D

Dead zone — Non-measurement zone.

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

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

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

F

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

H

Hazardous area   An area with a potentially explosive atmosphere. Trained personnel can
                                  install and use a device in this area. The device must be ordered with the
                                  appropriate options. The device requires approvals (ATEX, IECEx, cQPSus,
                                  NEPSI etc.) related to site specifications. You can find more data about
                                  hazardous areas in the Ex Manuals and Ex Certificates of Compliance.

I

Interference signals   False radar reflections usually caused by equipment in the tank.

L

Lens antenna   An antenna with a small convex or concave surface.

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

P

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

R

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

S

Signal converter   A set of electronic components in the device that send the measurement
                                  signal through some signal filters. They identify and measure the level of
                                  the tank contents.

U

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

V

Volume   Total volume of tank contents.
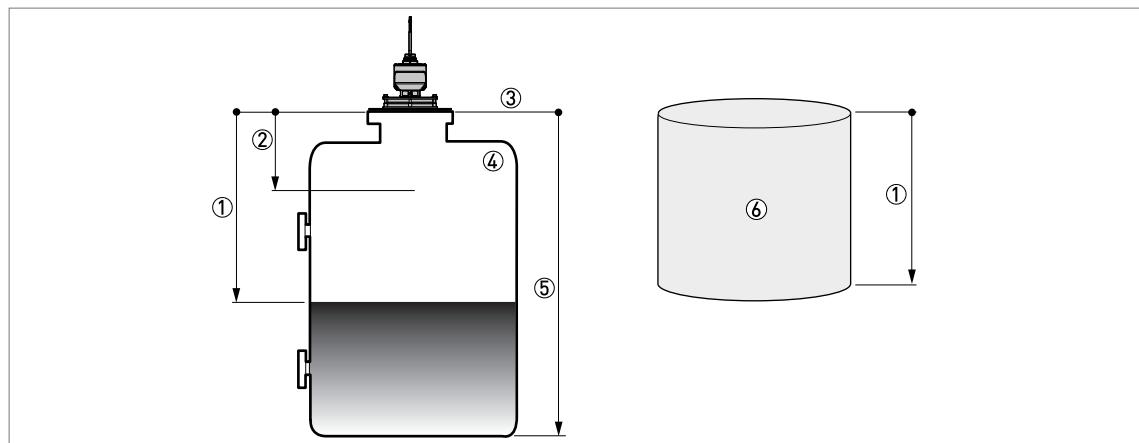
Figure 10-4: Measurement definitions: distance

① Distance
② Blocking distance
③ Flange facing
④ Gas (Air)
⑤ Tank height
⑥ Ullage volume
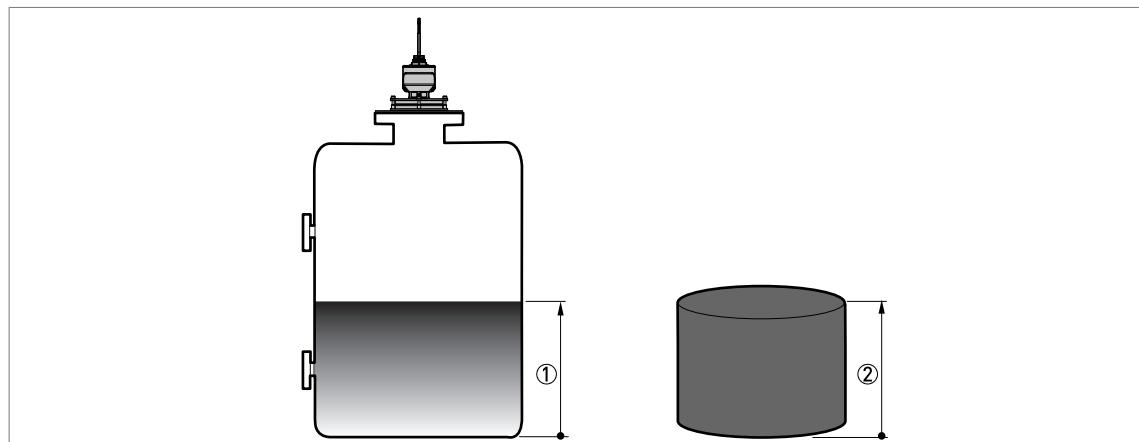
Figure 10-5: Measurement definitions: level

① Level
② Volume
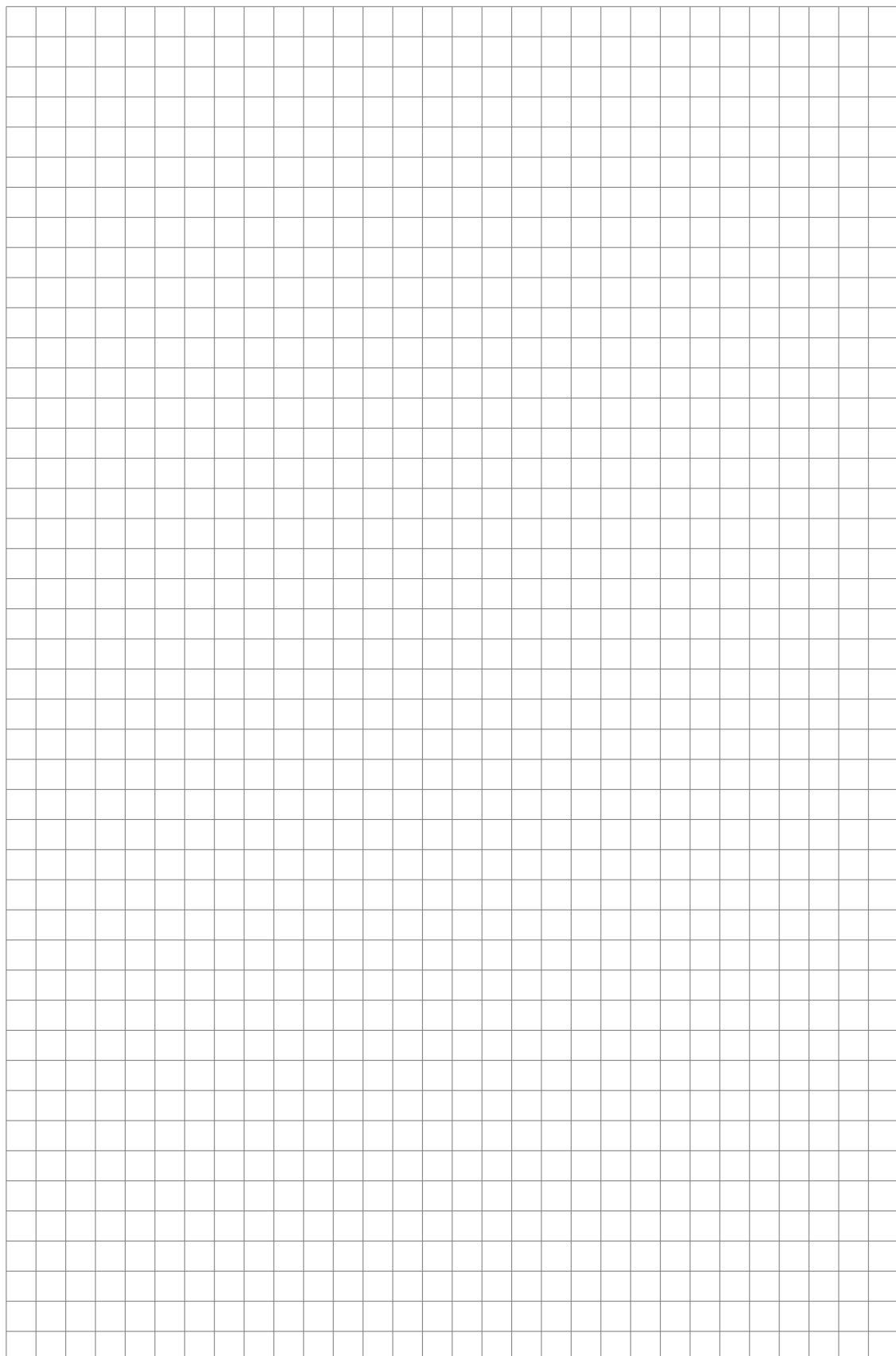
KROHNE – Products, Solutions and Services

- Process instrumentation for flow, level, temperature, pressure measurement and process analytics
- Flow metering, monitoring, wireless and remote metering solutions
- Engineering, commissioning, calibration, maintenance and training services

Head Office KROHNE Messtechnik GmbH
Ludwig-Krohne-Str. 5
47058 Duisburg (Germany)
Tel.: +49 203 301 0
Fax: +49 203 301 10389
info@krohne.de

The current list of all KROHNE contacts and addresses can be found at:
www.krohne.com

KROHNE