OPTIWAVE 1010 Handbook

Radar (FMCW) Level Transmitter for bypass chambers and magnetic level indicators (BM 26 Advanced)

KROHNE

IMPRINT

1.1 Software history

"Firmware revision" and "Hardware revision" agree with NAMUR NE 53. These revisions each have a series of numbers used to record the revision status of embedded software (firmware) and hardware in electronic equipment assemblies. They give data on the type of changes made and the effect that changes have on compatibility.

Data about software revisions is shown in the DTM for PACTware™. For more data, refer to *Information* on page 52. If it is not possible to refer to data in the software, record the serial number of the device (given on the device nameplate) and speak to the supplier.

Release date	Printed circuit assembly	Firmware revision	Hardware revision	Changes and compatibility	Documentation
2015-05-27	Converter and sensor board	8.11.00	1.00.00	—	MA OPTIWAVE 1010 R01 + R02
2016-09-28	Converter and sensor board	8.13.00	1.00.00	800 MHz frequency sweep	MA OPTIWAVE 1010 R03
		8.14.00		1 GHz frequency sweep	

1.2 Intended use

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.

This radar level transmitter measures distance and level of liquids or the top of a float. It does not touch the measured product.

This radar level transmitter can only be used if it is correctly installed and aligned on a bypass chamber. The bypass chamber must be metallic and electrically conductive.

1.3 Certification

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

CE marking

The device meets the essential requirements of the EU Directives:

- Electromagnetic Compatibility (EMC) directive
- Low Voltage (LVD) directive
- Radio Equipment (RED) directive
- For devices used in hazardous locations: ATEX directive

The manufacturer certifies successful testing of the product by applying the CE marking. For more data about the EU Directives and European Standards related to this device, refer to the EU Declaration of Conformity. You can find this documentation on the DVD-ROM supplied with the device or it can be downloaded free of charge from the website (Download Center).

All devices are based on the CE marking and meet the requirements of NAMUR Recommendations NE 43, NE 53 and NE 107.

1.4 Electromagnetic compatibility

This radar level transmitter meets the requirements of the harmonized standard EN 61326-1:

- Emissions: class A and class B
- Immunity: basic, industrial and controlled environments

1.5 Radio approvals

1.5.1 European Union (EU)

LEGAL NOTICE!
This level transmitter is intended for installation in closed tanks. It meets the requirements of the Radio Equipment Directive (RED) 2014/53/EU for use in the member countries of the EU.

An industry agreement includes approval for use of the frequency band (4.7...7 GHz) in industrial environments.

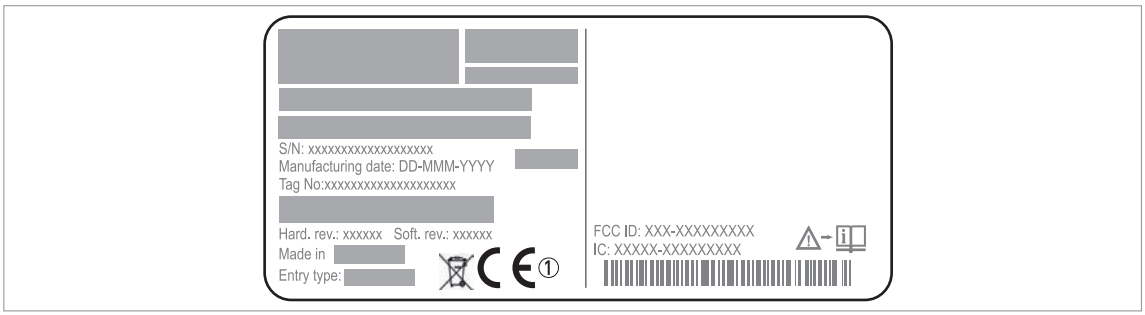

Figure 1-1: Radio approval information on the nameplate

① CE sign

According to ETSI EN 302 372-2 (2011), the radiated power outside a metallic tank is less than -41.3 dBm.

CAUTION!
Obey the regulations in Annex B of ETSI EN 302 372-1 to prevent the emission of radar signals and radar signal interference.

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

Obey these precautions when you install the device:

General installation requirements for tank level probing radar (TLPR) systems:

- TLPR (Tank Level Probing Radar) are required to be installed at a permanent fixed position at a closed (not open) metallic tank or reinforced concrete tank, or similar enclosure structure made of comparable attenuating material;
- flanges and attachments of the TLPR equipment shall provide the necessary microwave sealing by design;
- sight glasses shall be coated with a microwave proof coating when necessary (i.e. electrically conductive coating);
- manholes or connection flanges at the tank shall be closed to ensure a low-level leakage of the signal into the air outside the tank;
- whenever possible, mounting of the TLPR equipment shall be on top of the tank structure with the orientation of the antenna to point in a downward direction;
- installation and maintenance of the TLPR equipment shall be performed by professionally trained individuals only.

1.5.2 U.S.A.

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LEGAL NOTICE!

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

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

Changes or modifications made to this equipment not expressly approved by KROHNE may void the FCC authorization to operate this equipment.
This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This legal information is shown on the device nameplate.

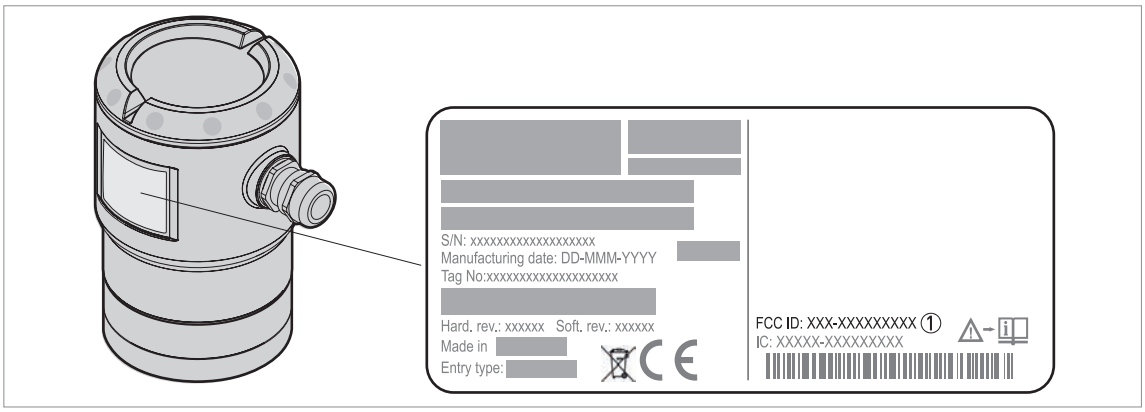

Figure 1-2: FCC ID number label

① FCC ID: Q6BFMCW06G10

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

1.5.3 Canada

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LEGAL NOTICE!

This device complies with Industry Canada licence-exempt RSS 210. Operation is subject to the following two conditions:

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

Changes or modifications made to this equipment not expressly approved by KROHNE may void the IC authorization to operate this equipment.

This legal information is shown on the device nameplate.

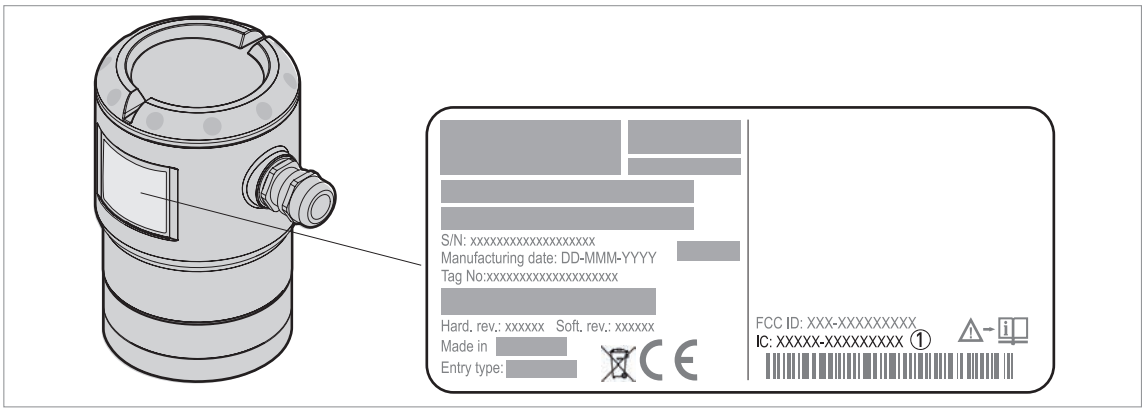

Figure 1-3: IC number label

① IC number: 1991D-FMCW06G10

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

1.6 Safety instructions from the manufacturer

1.6.1 Copyright and data protection

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

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

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

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

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 can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

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

1.6.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.

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

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

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

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

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

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

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

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

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

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

1.7 Safety instructions for the operator

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

2.1 Scope of delivery

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

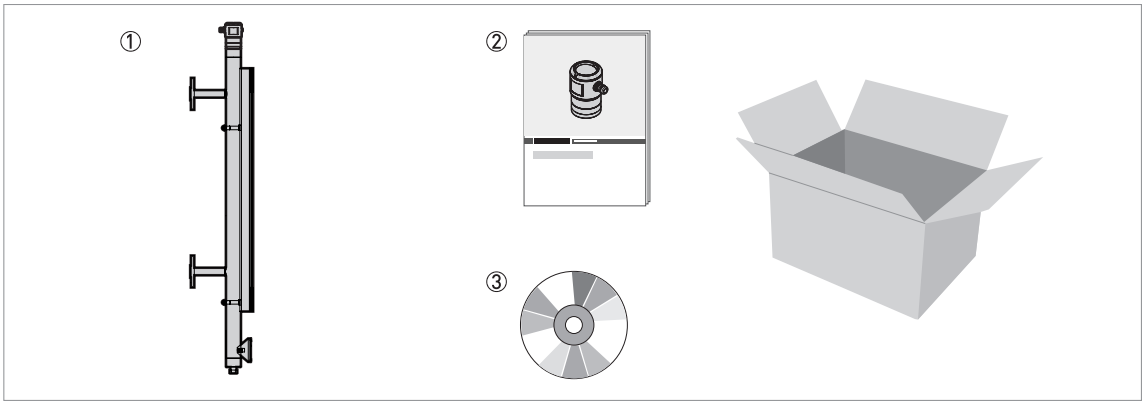

Figure 2-1: Scope of delivery

① Device and measuring chamber
② Quick Start
③ DVD-ROM (including Handbook, Quick Start, Technical Datasheet and related software)

2.2 Device description

OPTIWAVE 1010 is an FMCW radar designed for use with the BM 26 Advanced (a magnetic level indicator or MLI) or a bypass chamber. If the device is used with an MLI, it measures the distance to the float. If the device is used with a bypass chamber, it measures the distance to the surface of the liquid. Radar is a non-contact technology. For more data about the measuring principle, refer to *Measuring principle* on page 68.

INFORMATION!
You must use a float with BM26 Advanced magnetic level indicators that have the indicator column, MS 40 limit switch or LT 40 analog transmitter options. If the device is installed on a bypass chamber and the dielectric constant of the liquid is less than 3, you must use a float.

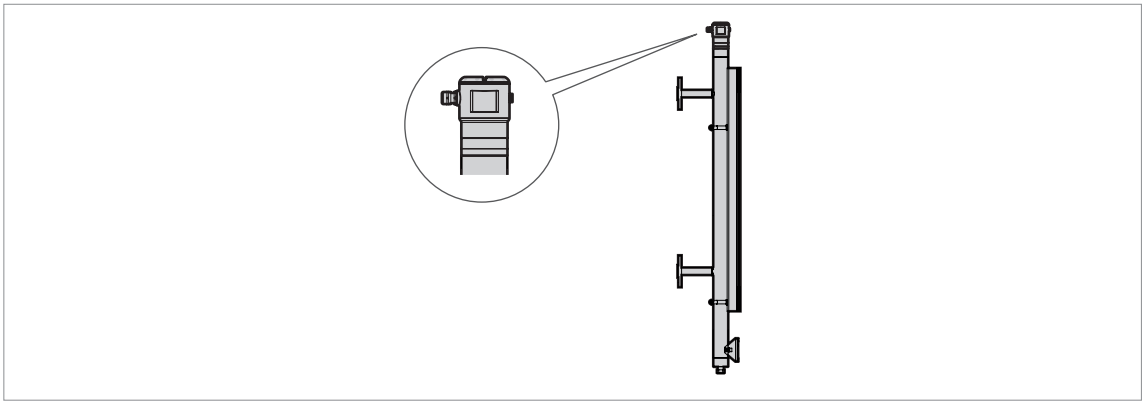

Figure 2-2: Radar level transmitter mounted on a magnetic (bypass) level indicator

2.3 Visual Check

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

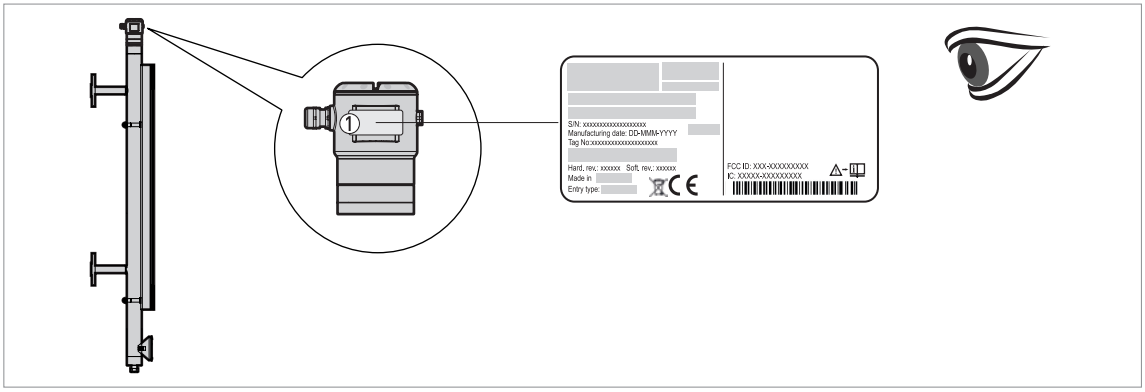

Figure 2-3: Visual check

① Device nameplate (for more data, refer to *Nameplate (example)* on page 16)

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

2.4 Nameplates

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

2.4.1 Nameplate (example)

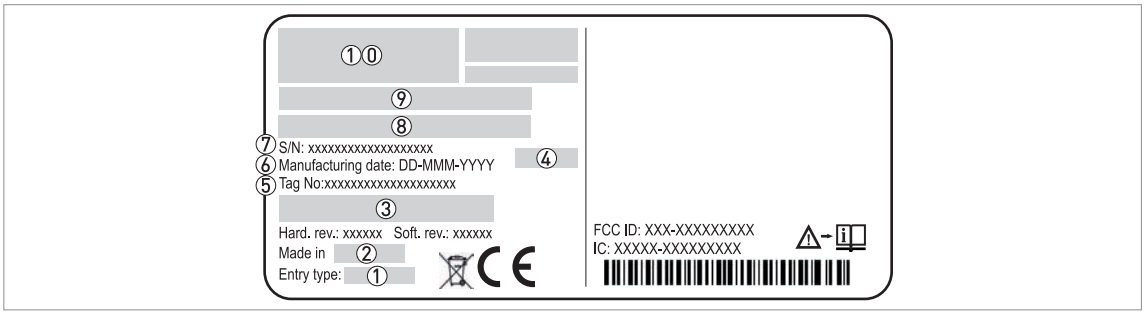

Figure 2-4: Non-Ex nameplate attached to the housing

① Cable entry size
② Country of manufacture
③ Input / output option
④ Degree of ingress protection (according to EN 60529 / IEC 60529)
⑤ Customer tag number
⑥ Date of manufacture
⑦ Serial number
⑧ Type code (defined in order)
⑨ Model name and number
⑩ Company name and address

3.1 General notes on installation

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

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

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

3.2 Storage

INFORMATION!
For more data about the magnetic level indicator, refer to the handbook for the BM 26 Basic / Advanced.

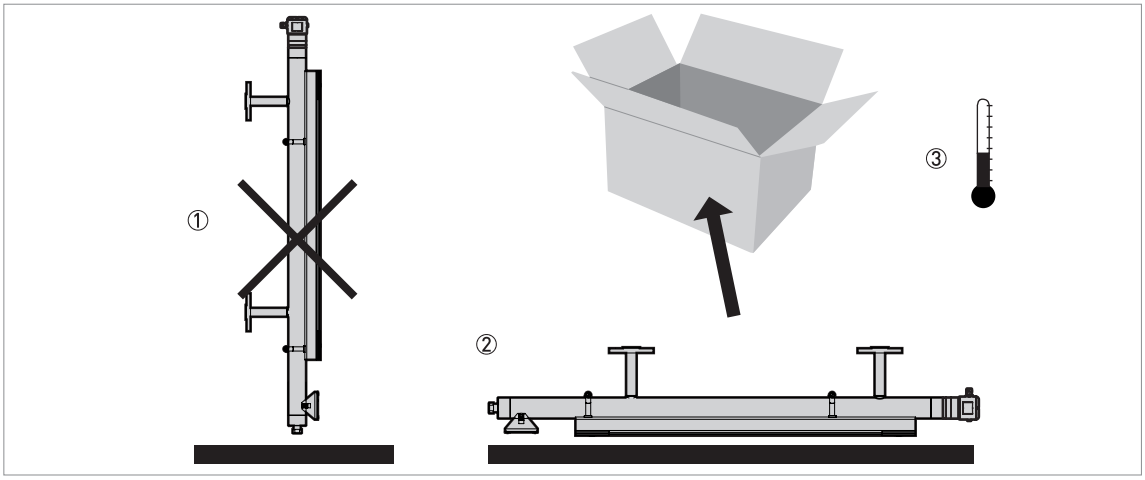

Figure 3-1: Storage conditions

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

- Store the device in a dry and dust-free location.
- Store the device in its original packing.

3.3 Transport

WARNING!
OPTIWAVE1010 attached to a magnetic level indicator
The indicator column is made of Pyrex® glass. If you do not lift the device carefully, you can cause damage to the magnetic level indicator.

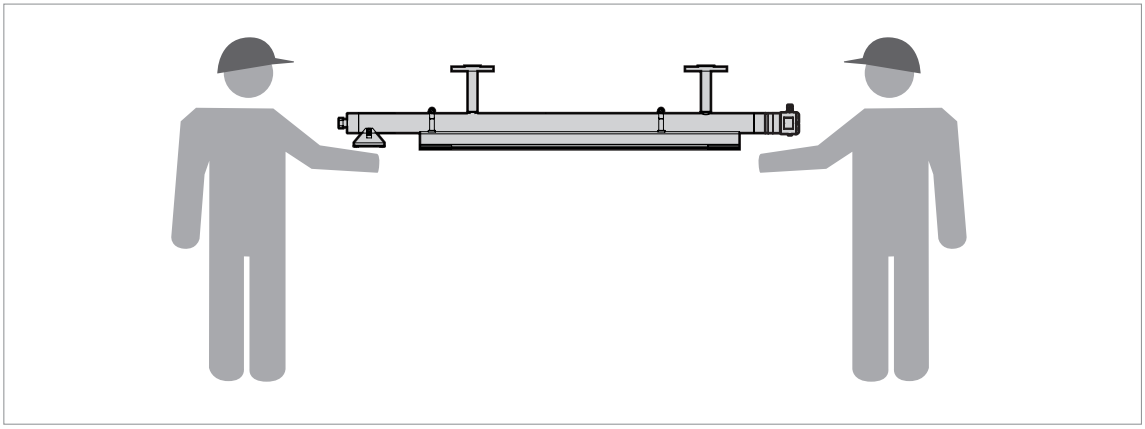

Figure 3-2: Transportation

Depending on the version, the device will weight approx. 6.7...9.8 kg / 14.8...21.6 lb.

INFORMATION!
For more data about the magnetic level indicator, refer to the handbook for the BM 26 Basic / Advanced.

3.4 Pre-installation requirements

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

- Make sure that there is sufficient space on all sides.
- Protect the signal converter from direct sunlight.
- Do not subject the signal converter to heavy vibrations.

3.5 Pressure and temperature ranges

DANGER!
If the ambient temperature is more than +70° C / +158° F, there is a risk of injury if you touch the device. Use a protective cover or metallic grid to prevent injury.

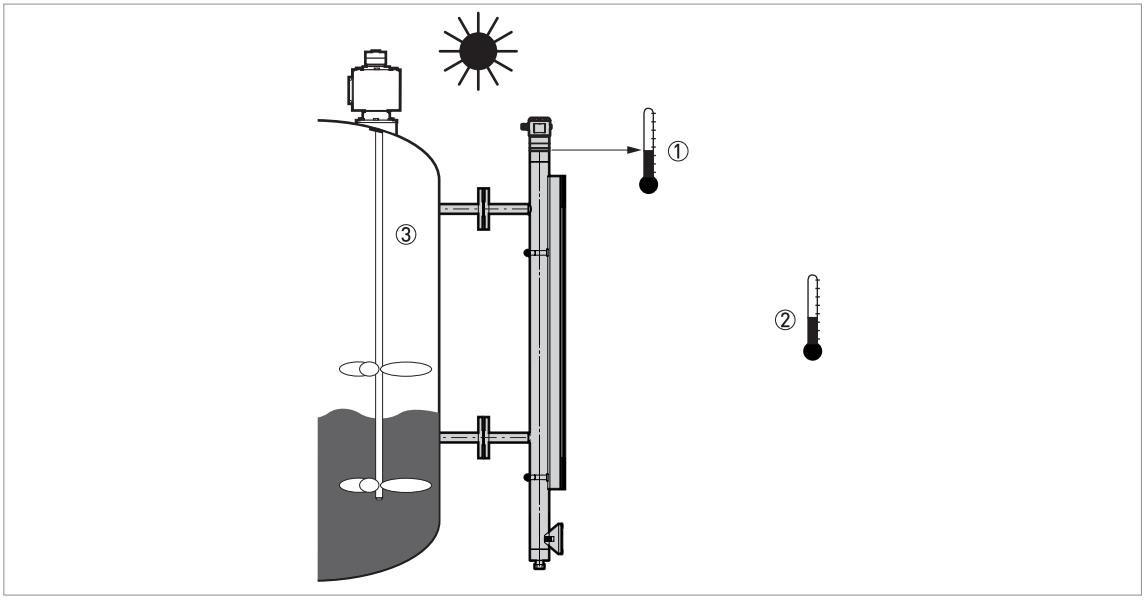

Figure 3-3: Pressure and temperature ranges

① Bypass chamber temperature
Non-Ex devices: Depends on the device versions and the seal material. Refer to the table that follows.
Ex devices: see supplementary operating instructions
② Ambient temperature
Non-Ex devices: -40...+85°C / -40...+185°F
Ex devices: see supplementary operating instructions
③ Process pressure
Depends on the type of seal and process connection. Refer to the table that follows.

Aluminium housing for non-Ex and Ex ia-approved devices

Version	Seal	Distance piece	Bypass chamber temperature		Process pressure	
			[°C]	[°F]	[barg]	[psig]
Metapeek	FKM/FPM with Metapeek	without	-40...+100	-40...+212	-1...16	-14.5...232
	Kalrez® 6375 with Metapeek	without	-20...+100	-4...+212		
	EPDM with Metapeek	without	-40...+100	-40...+212		
Metaglas® and distance piece	FKM/FPM with Metaglas®	with	-40...+150	-40...+302	-1...40	-14.5...580
	Kalrez® 6375 with Metaglas®	with	-20...+150	-4...+302		
	EPDM with Metaglas®	with	-40...+150	-40...+302		

Stainless steel housing for non-Ex , Ex ia-, Ex db- and Ex tb-approved devices

Version	Seal	Distance piece	Bypass chamber temperature		Process pressure	
			[°C]	[°F]	[barg]	[psig]
Metaglas®	FKM/FPM with Metaglas®	without	-40...+120	-40...+248	-1...40	-14.5...580
	Kalrez® 6375 with Metaglas®	without	-20...+120	-4...+248		
	EPDM with Metaglas®	without	-40...+120	-40...+248		

Ambient temperature / process temperature, in °C

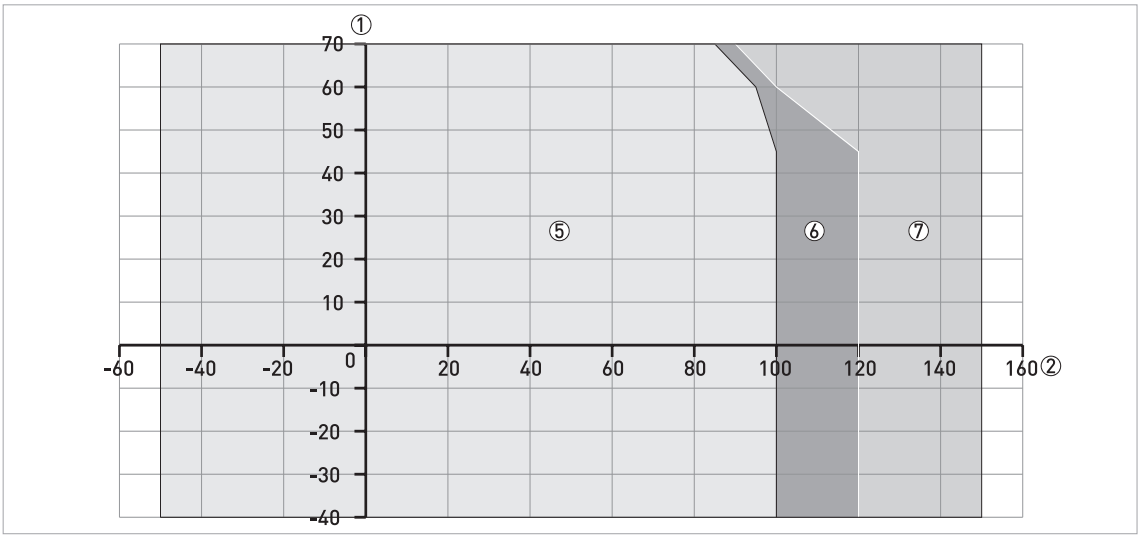

Figure 3-4: Ambient temperature / process temperature, in °C

Ambient temperature / process temperature, in °F

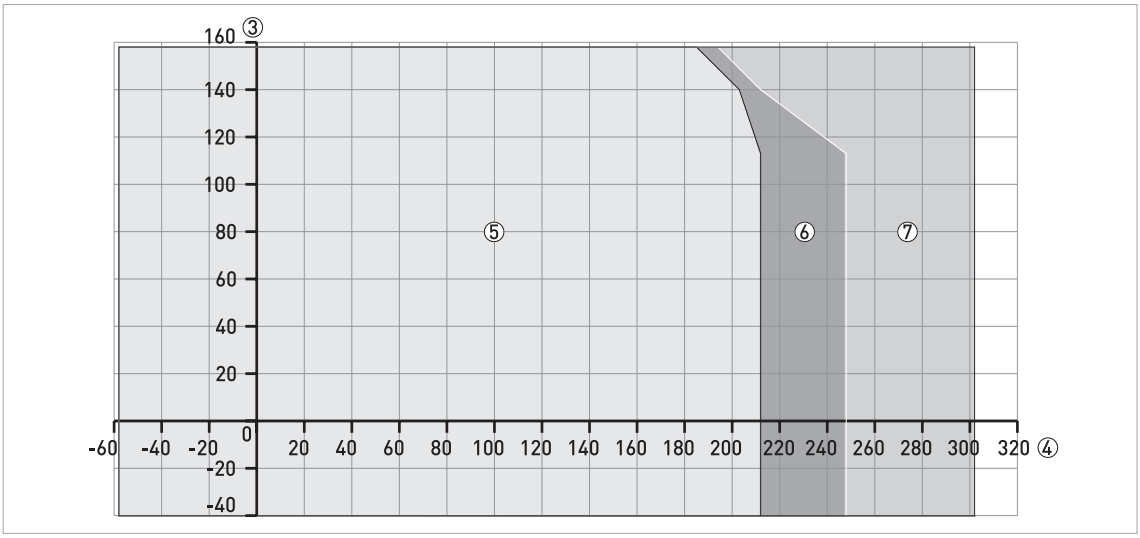

Figure 3-5: Ambient temperature / process temperature, in °F

① Maximum ambient temperature, °C
② Maximum process temperature, °C
③ Maximum ambient temperature, °F
④ Maximum process temperature, °F
⑤ Device with aluminium housing
⑥ Device with stainless steel housing
⑦ Device with aluminium housing and distance piece

The maximum ambient temperature for non-Ex devices is +85°C / +185°F. The process connection temperature must agree with the temperature limits of the gasket material.

3.6 Recommended mounting position

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

CAUTION!
Make sure that the cable glands are aligned with the process connections of the bypass chamber.

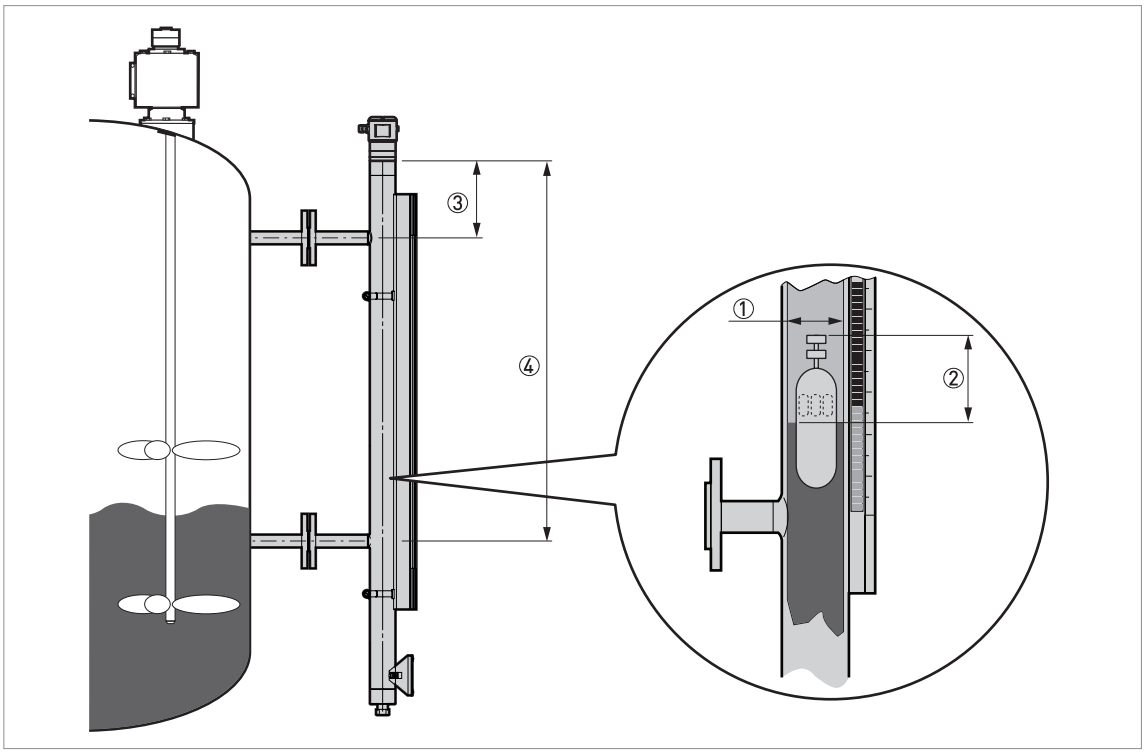

Figure 3-6: Recommended mounting position

① Internal tube diameter. Min. ... Max.: 38...56 mm / 1.50...2.20"
② Float offset (the distance between the surface of the liquid and the radar target on top of the float). Min. ... Max.: 0...200 mm / 0...7.87".
③ Distance to top process connection (bypass chamber) = minimum distance (refer to the "basic parameters" menu in the DTM)
④ Distance to bottom process connection (bypass chamber) = maximum distance (refer to the "basic parameters" menu in the DTM)

3.7 Mounting restrictions

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

WARNING!
If the device uses a float to measure the level of the liquid, slowly pressurize the bypass chamber. A float can damage the PEEK cone of the radar level transmitter at the top of the bypass chamber.

CAUTION!
If there are parasitic signals, the device will not measure correctly. Parasitic signals are caused by sudden changes in bypass chamber diameter in the path of the radar beam.

3.8 How to attach the weather protection to the device

The device and the weather protection option are supplied assembled in the same box. If you send an order for the weather protection after delivery of the device, obey the instructions that follow:

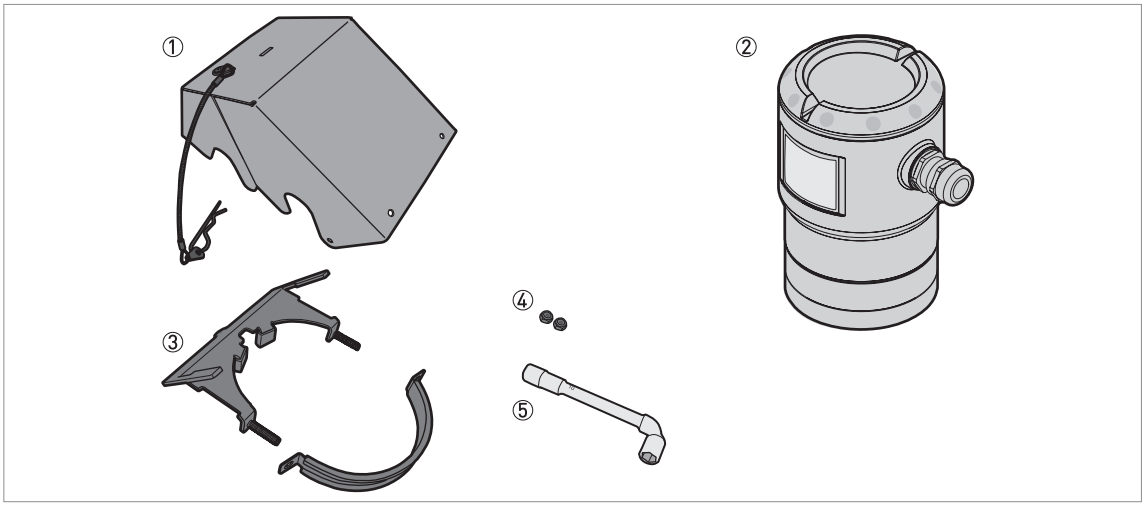

Figure 3-7: Equipment needed

① Weather protection cover (with an R-clip to hold the cover on the clamp)
② Device
③ Weather protection clamp (2 parts)
④ 10 mm socket wrench (not supplied)
⑤ 2 locking nuts

Part 1: How to attach the weather protection to the device

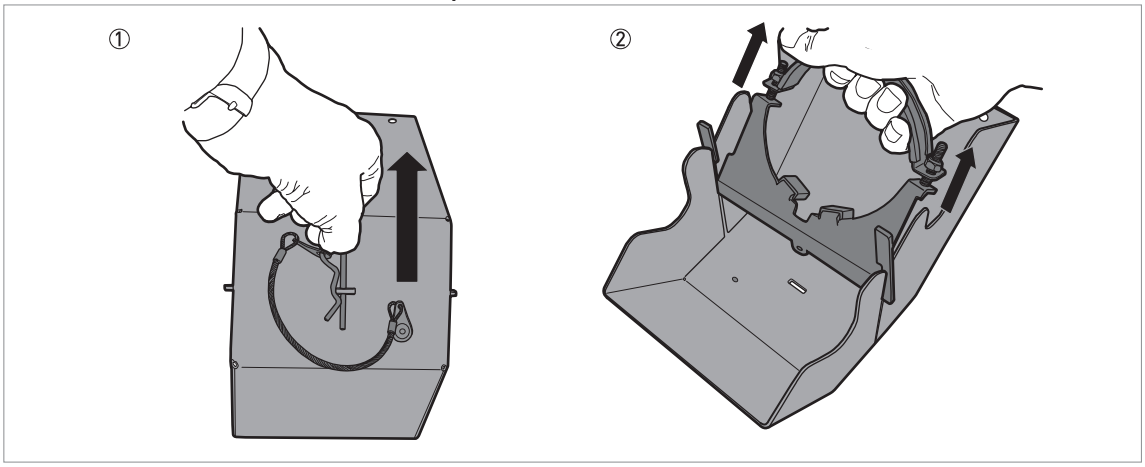

Figure 3-8: Part 1: How to attach the weather protection to the device

① Remove the R-clip from the hole at the front of the weather protection cover.
② Remove the weather protection clamp from the weather protection cover.

Part 2: How to attach the weather protection to the device

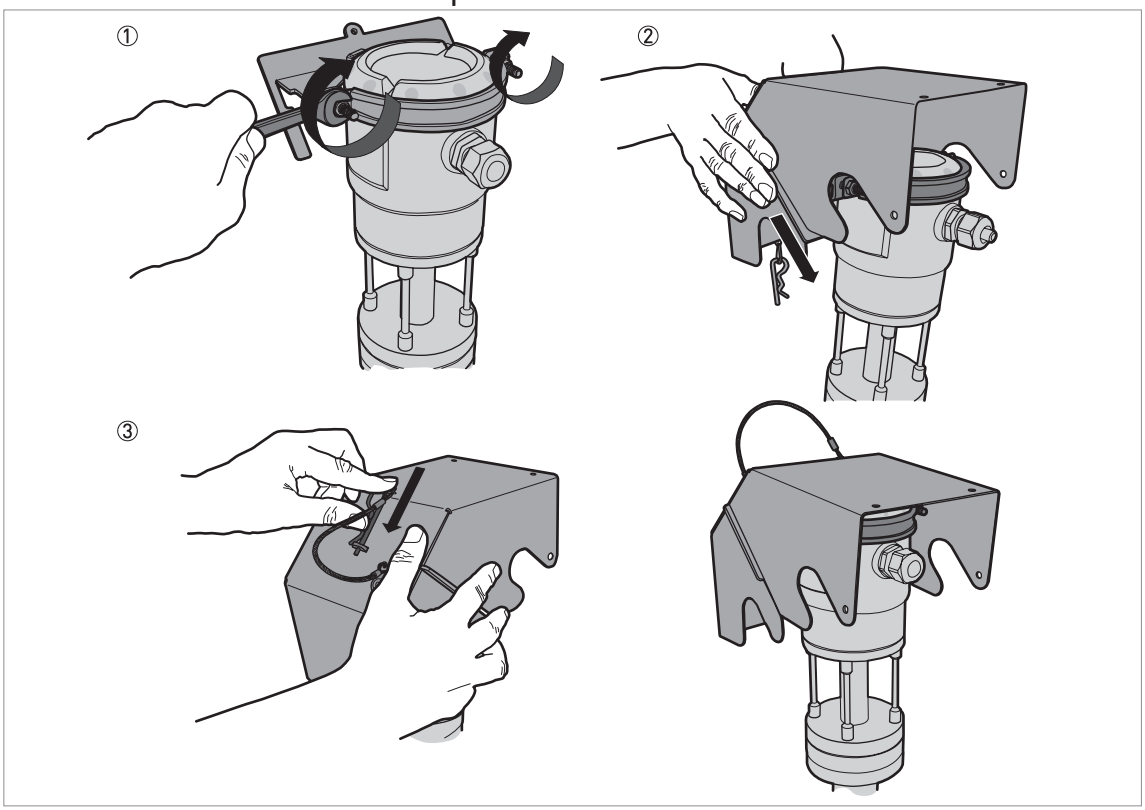

Figure 3-9: Part 2: How to attach the weather protection to the device

CAUTION!
Make sure that the opening at the rear of the weather protection is aligned with the cable entry.

① Put the weather protection clamp around the top of the device. Attach the two locking nuts to the threads on the weather protection clamp. Tighten the locking nuts with a 10 mm socket

wrench.
② Lower the weather protection cover onto weather protection clamp until the hole for the lock is in the slot at the front of the cover.
③ Put the R-clip into the hole at the front of the weather protection cover.
➲ End of the procedure.

For more data about the overall dimensions of the weather protection, refer to *Dimensions and weights* on page 76.

3.9 How to open the weather protection

If your device has the weather protection option, obey the instructions that follow to get access to the housing cover and the terminals compartment.

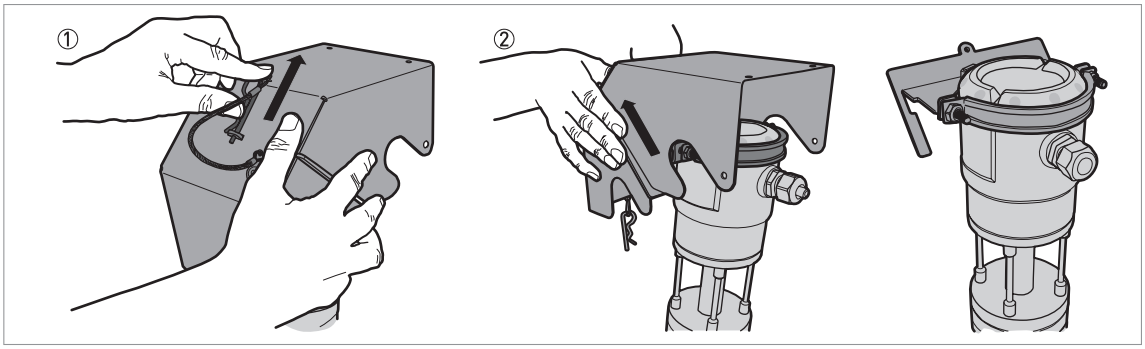

Figure 3-10: How to open the weather protection

CAUTION!
Do not remove the safety cable.

① Remove the R-clip from the hole at the front of the weather protection cover.
② Remove the weather protection cover.
➲ End of the procedure.

4.1 Safety instructions

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

DANGER!
Observe the national regulations for electrical installations!

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

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

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

4.2 Electrical installation: 2-wire, loop-powered

Terminals for electrical installation

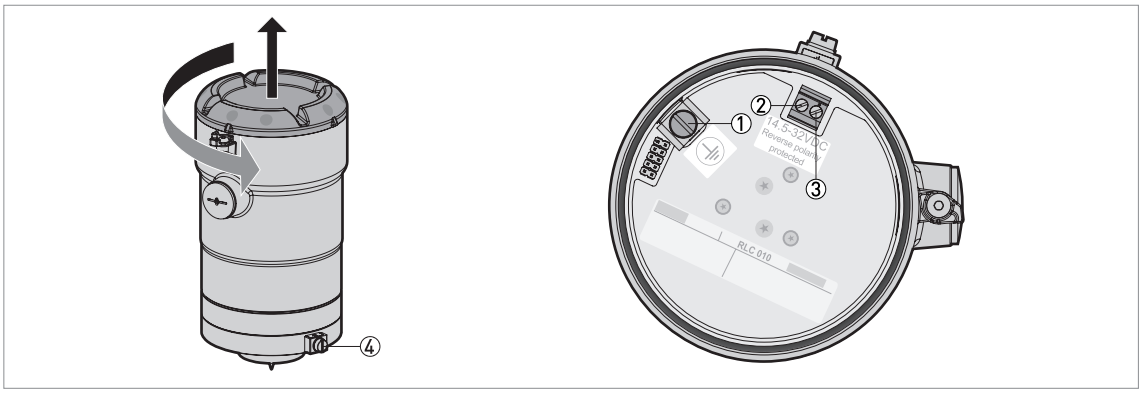

Figure 4-1: Terminals for electrical installation

① Grounding terminal in the housing (if the electrical cable is shielded)
② Current output terminal – polarity insensitive
③ Current output terminal – polarity insensitive
④ External ground connection

INFORMATION!
Electrical power to the output terminal energizes the device. The output terminal is also used for HART® communication.

CAUTION!
Use the applicable electrical cables with the cable glands. Attach the ferrite choke (supplied with the device) to the electrical cable to prevent parasitic signals.

Procedure: Electrical connection and how to attach the ferrite choke to the electrical cable

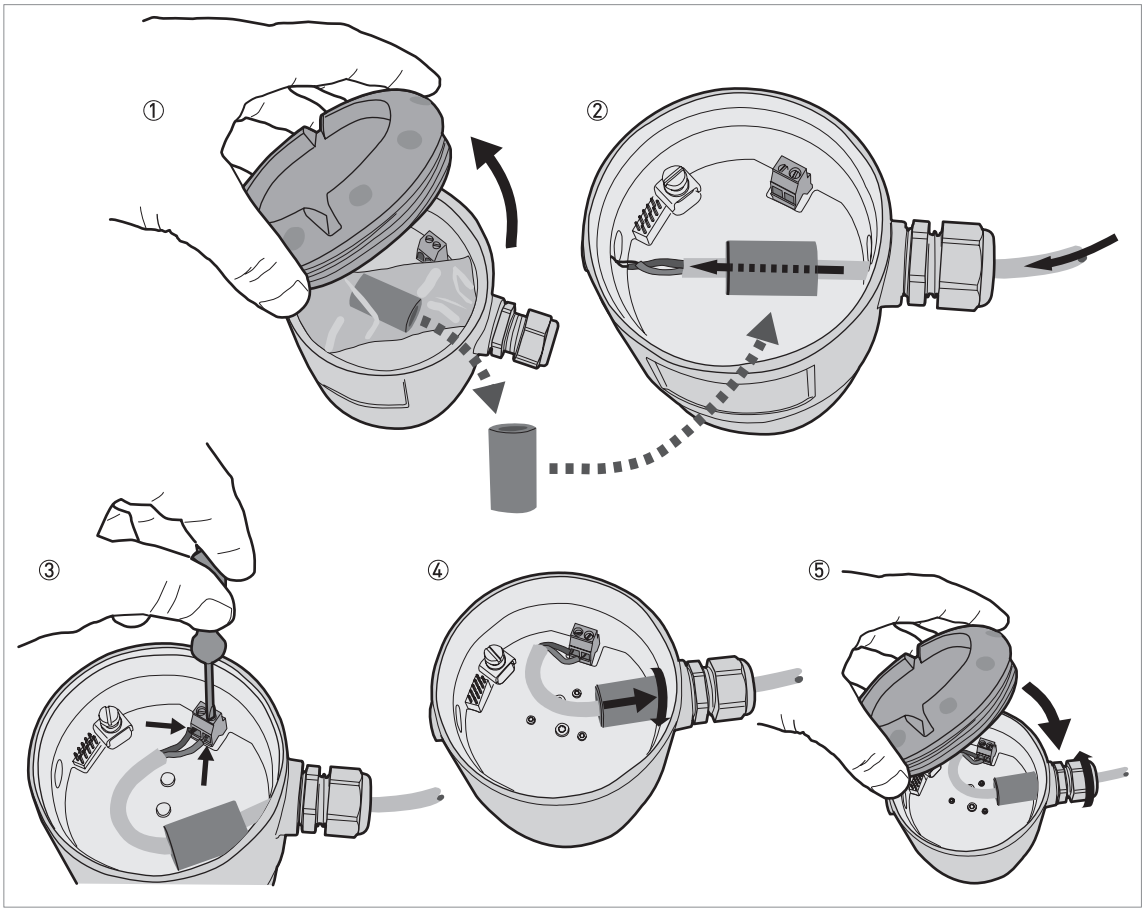

Figure 4-2: Procedure: Electrical connection and how to attach the ferrite choke to the electrical cable

Equipment needed:

- Small slotted tip screwdriver (not supplied)
- OPTIWAVE 1010 level transmitter attached to a BM 26 Advanced bypass level indicator
- Ferrite choke. This part is supplied in a transparent plastic bag in the housing.
- Electrical cable (not supplied)

Procedure

① Remove the housing cover. Remove the transparent plastic bag and open it.
② Put the electrical cable into the opening of the cable gland. Then put the electrical cable into the opening of the ferrite choke.
③ Put the electrical wires in the connector terminals. Tighten the terminal screws with a small slotted-tip screwdriver. Make sure that the electrical wires agree with the terminals.
④ Put the ferrite choke in the opening of the cable entry. Turn the ferrite choke until it is fully engaged.
⑤ Tighten the cable gland. Attach the housing cover.
➲ End of the procedure.

4.3 Electrical connection for current output

4.3.1 Non-Ex devices

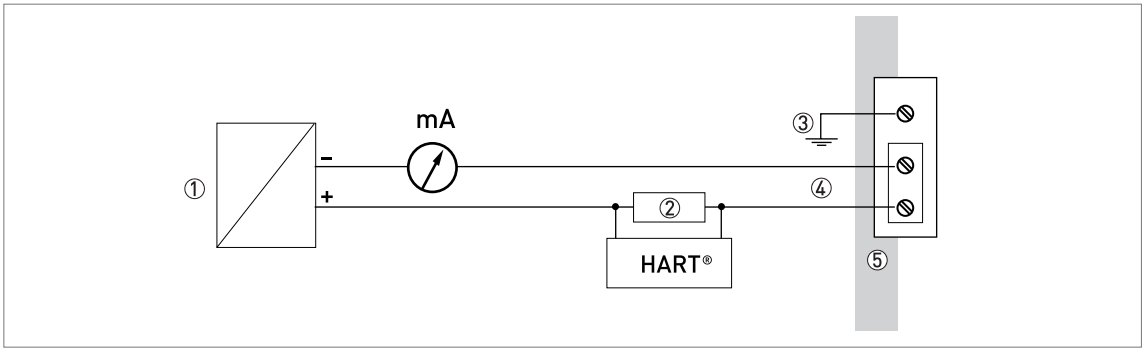

Figure 4-3: Electrical connections for non-Ex devices

① Power supply
② Resistor for HART® communication
③ Optional connection to the grounding terminal
④ Output: 14.5...32 VDC for an output of 22 mA at the terminal
⑤ Device

INFORMATION!
Electrical polarity has no effect on device operation.

4.3.2 Devices for hazardous locations

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

4.4 Protection category

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

DANGER!
Make sure that the cable gland is watertight.

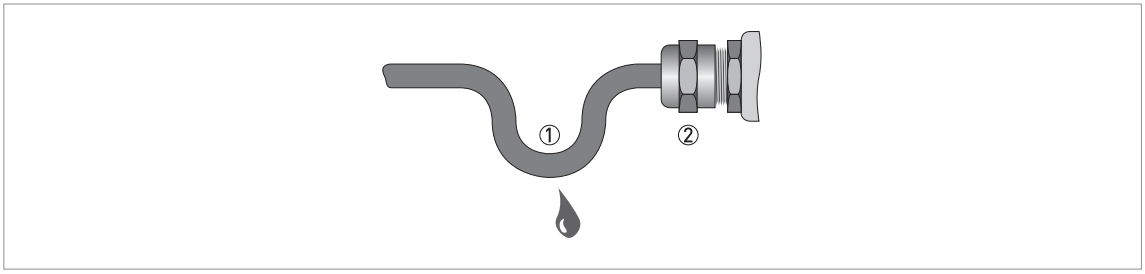

Figure 4-4: How to make the installation agree with protection category IP67

- Make sure that the gaskets are not damaged.
- Make sure that the electrical cable is not damaged.
- Make sure that the electrical cable agrees with the national electrical code.
- Make a loop of cable in front of the device ① to prevent leakage into the housing.
- Tighten the cable feedthrough ②.

4.5 Networks

4.5.1 General information

The device uses the HART® communication protocol. This protocol agrees with the HART® Communication Foundation standard. The device can be connected point-to-point. It can also operate in a network with a device address from 1 to 63.

The device output is factory-set to communicate point-to-point. To change the communication mode from **point-to-point** to **multi-drop**, refer to *HART* on page 58.

4.5.2 Point-to-point connection

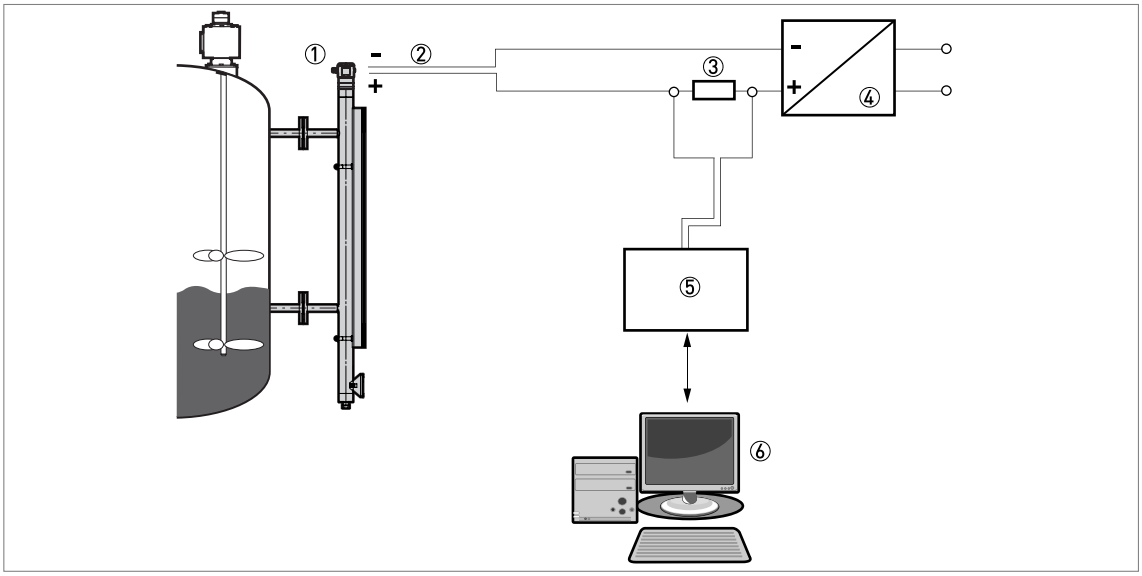

Figure 4-5: Point-to-point connection (non-Ex)

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

4.5.3 Multi-drop networks

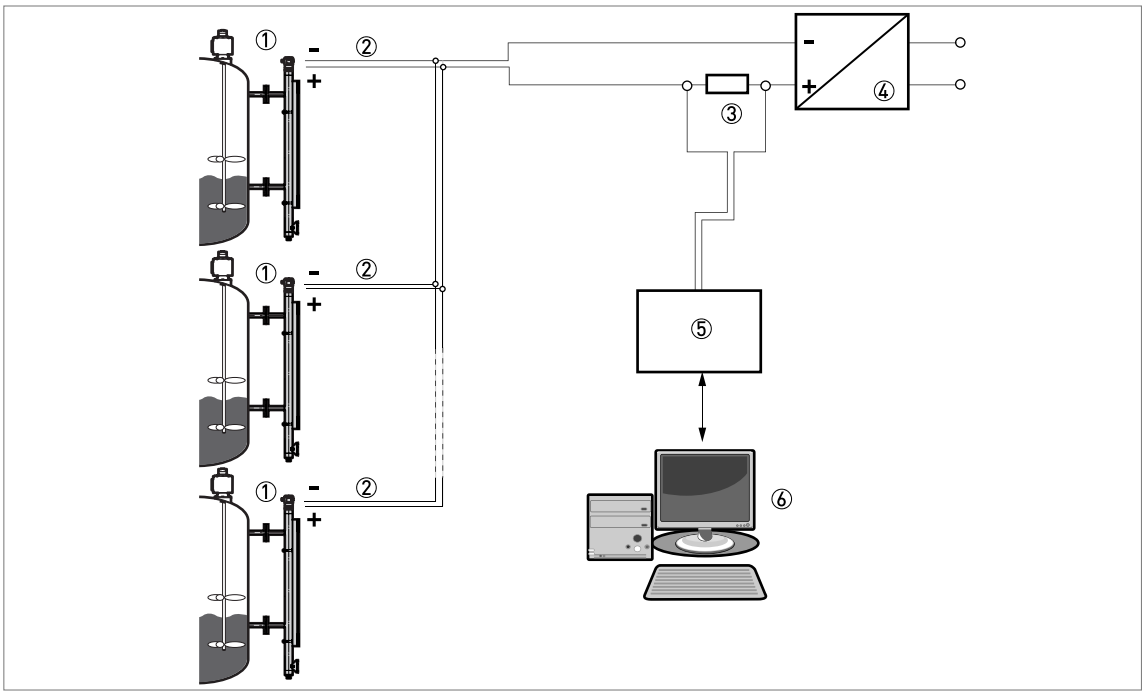

Figure 4-6: Multi-drop network (non-Ex)

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

5.1 How to start the device

5.1.1 Start-up checklist

Do a check of the device's condition before you energize the device:

- Are all the wetted components (PEEK element, matching element and gaskets) resistant to the product in the tank?
- Does the information on the device nameplate agree with the operating data?
- **If the device is supplied with a magnetic (bypass) level indicator:** Did you correctly install the magnetic level indicator adjacent to the tank?
- **If the device is supplied with a magnetic (bypass) level indicator:** Did you remove the float lock pin from the side process connection at the bottom of the bypass chamber?
- Do the electrical connections agree with the national electrical codes? Use the applicable electrical cables with the cable glands.

DANGER!
Before you energize the device, make sure that the supply voltage is correct.

DANGER!
Safe operation in hazardous locations
Make sure that the installation and the wiring of the device agree with the related Ex standards and regulations. Make sure that the device has the applicable Ex approval for the hazardous location. For more data, refer to the related Ex certificate of conformity and the supplementary instructions.

5.1.2 How to start the device

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

INFORMATION!
The manufacturer sets the parameters for your application in the factory. The 0% level (empty) is aligned with the center of the bottom process connection and the 100% level (full) is aligned with the center of the top process connection. You can use the HART communication protocol to change these parameters.

5.2 Operating concept

You can read measurements and configure the device with:

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

For more data about how to use the DTM in PACTware, refer to *Operation* on page 41. For more data about the menu tree for the Basic-DD, AMS and PDM, refer to *Description of HART interface* on page 78.

5.3 Remote communication with PACTware™

5.3.1 General notes

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

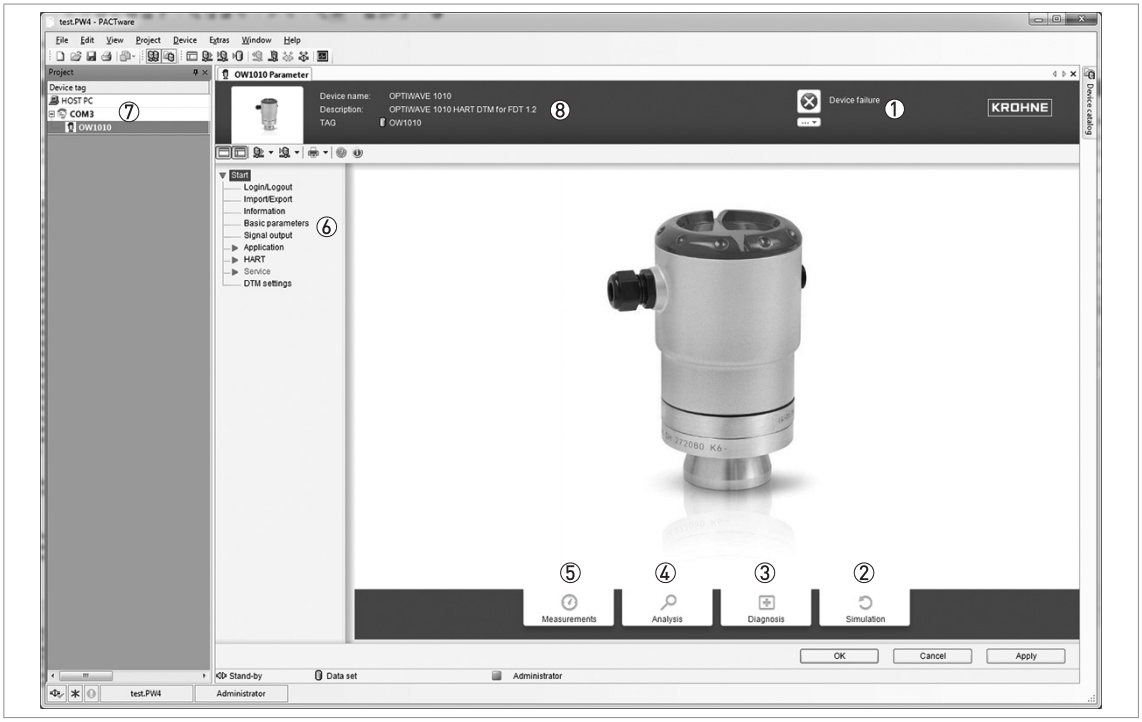

Figure 5-1: Start window for the DTM in PACTware™

① Status display
② Button for **Simulation** window
③ Button for **Diagnosis** window
④ Button for **Analysis** window
⑤ Button for **Measurements** window
⑥ DTM menu list (Login/Logout, Import/Export, Information, Basic parameters, Current output, Application, HART, Service, DTM settings)
⑦ **Project** window
⑧ Data for device identification

There are 4 buttons at the bottom of the **Start** window: **Measurements**, **Analysis**, **Diagnosis** and **Simulation**. You can use these buttons to do the tasks that follow:

- **Measurements:** Monitor level and distance data. For more data, refer to *Measurements window* on page 35.
- **Analysis:** Monitor change and rate of change in level, distance, current output, temperature of the electronics and device status. It is also possible to monitor spectrum values. For more data, refer to *Analysis window* on page 36.
- **Diagnosis:** Do a check of the device's condition (error messages etc.). For more data, refer to *Diagnosis window* on page 38.
- **Simulation:** Simulate measured data to make sure that the device operates correctly. For more data, refer to *Simulation window* on page 40.

5.3.2 Software installation

Equipment needed

- A computer
- One of these two solutions: ① the DVD-ROM delivered with the device or ② a high-speed Internet connection
- A web browser, if it is necessary to download files from the Internet

Software needed

- Microsoft® .NET Framework 2.0 or a later version
- PACTware™ 4.1 or a later version
- Device Type Manager (DTM) for the OPTIWAVE 1010 radar level transmitter

This software is supplied on the DVD-ROM delivered with the device. It can also be downloaded from the "Download center: Software" web page on the manufacturer's website.

Installation procedure

① Install Microsoft® .NET Framework 2.0.
② Install PACTware™ 4.1 or later version.
③ Install the OPTIWAVE 1010 DTM on your workstation or your portable computer. Follow the instructions in the Installation wizard.
④ Plug the HART modem into your computer (Serial or USB HART® modem). If you are using a USB® HART modem, you must install the Driver for the USB HART® modem first. Make sure that the location of the port for the HART® modem is clearly identified.
⑤ Start the PACTware™ program.
➲ End of the procedure.

5.3.3 Measurements window

Use this data to monitor level and distance.

You can do one of these three procedures to open the Measurements window:

- Open the window from the **Start** window. Click on **Start** in the DTM menu and then click on the **Measurements** button at the bottom of the **Start** window.
- Open the window from the main toolbar. Click on **Device > Measured value > Measurements**.
- Open the window from the **Project** window. Right click on the device (**OPTIWAVE 1010**) in the project list, then click on **Measured value > Measurements**.

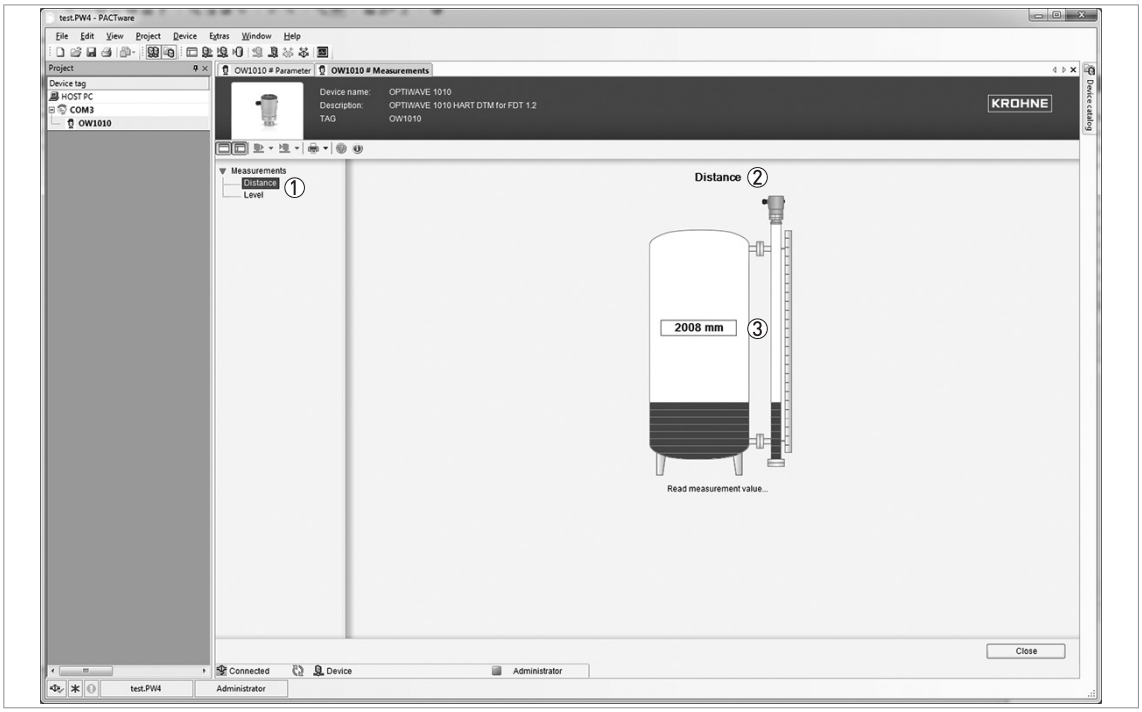

Figure 5-2: DTM: Measurement screen

① Measurements menu. Make a selection from the measurement parameters (distance or level).
② Measurement parameter
③ Measurement and measurement units

5.3.4 Analysis window

Use this data to monitor change and rate of change in level, distance, current output, temperature of the electronics and device status. It is also possible to monitor spectrum values.

You can do one of these three procedures to open the Analysis window:

- Open the window from the **Start** window. Click on **Start** in the DTM menu and then click on the **Analysis** button at the bottom of the **Start** window.
- Open the window from the main toolbar. Click on **Device > Measured value > Analysis**.
- Open the window from the **Project** window. Right click on the device (**OPTIWAVE 1010**) in the project list, then click on **Measured value > Analysis**.

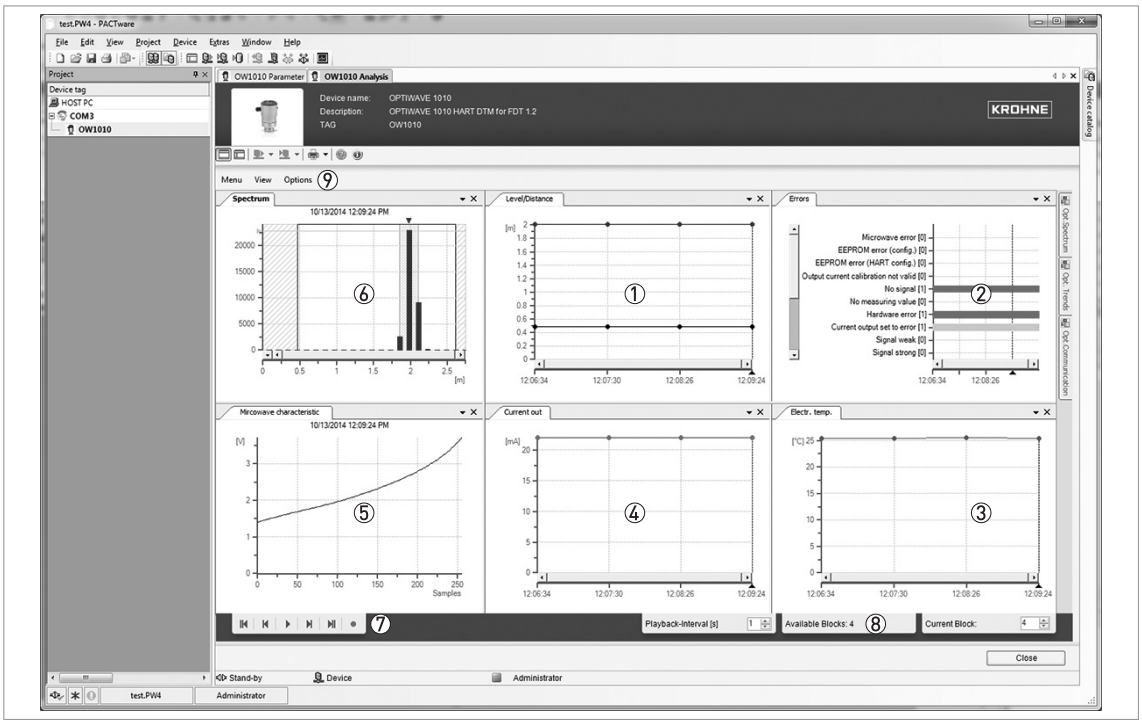

Figure 5-3: DTM: Analysis screen

① Graph: Level or distance [m] against time [time after the device was energized]
② Graph: Device status against time [time after the device was energized]
③ Graph: Electronics block temperature (°C or °F) against time [time after the device was energized]
④ Graph: Current output (mA) against time [time after the device was energized]
⑤ Graph: Microwave characteristic (V) against the number of measurement samples
⑥ Graph: Spectrum (signal strength) against distance (metres or inches)
⑦ Controls to record blocks of measurement data
In this sequence from left to right: go to the first data block, go to the data block before this data block, play / stop, go to the data block after this data block, go to the last data block, and record / stop
⑧ Data about the blocks
In this sequence from left to right: time to see each data block when you push the [play] button, number of data blocks recorded, data block shown at this time
⑨ Data display options. There are three menus: Menu, View and Options.
Menu: use this menu to delete, save or load data
View: use this menu to show data as graphs in PACTware™
Spectrum options: show the distance or the spectrum lines
Trend options (level/distance; errors, electronics block temperature and current output): Change the number of points shown on the graph, change graph display settings (plotted curves, plotted points and colours of plotted curves).
Communication options: the time to get data from the device and the number of times the software will try to get data from the device before it shows an error message

INFORMATION!

To record data in Imperial / USCS units (ft, °F etc.) in the analysis window, go to HART menu on the "Parameters" window and change the length unit to ***ft (feet)*** *or* ***in (inches)****.*

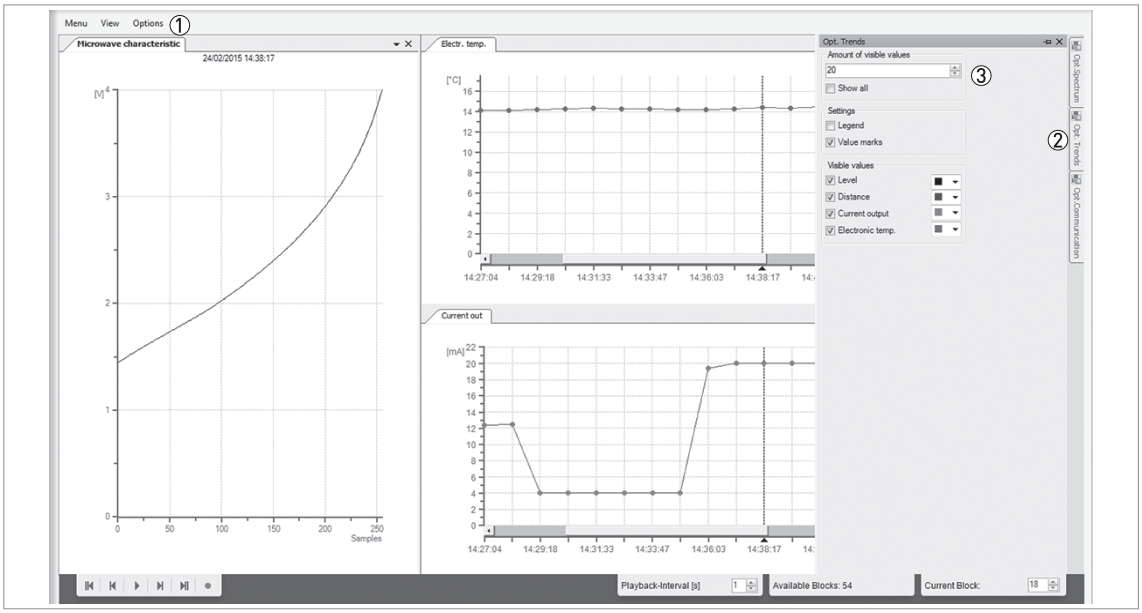

Figure 5-4: Options for the analysis screen

① Options menu for data shown on graphs
② Tab for Trend graph options. Put the cursor on the tab to see the options. There are also tabs for spectrum and communication options.
③ Options for trend graphs: Change the number of points shown on the graph, change graph display settings (plotted curves, plotted points and colours of plotted curves)

By default, each graph will be shown on a separate tab.

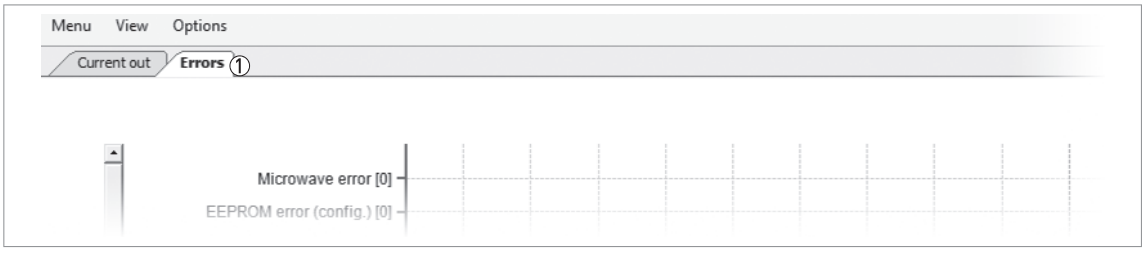

Figure 5-5: Analysis screen: graphs in tab mode

① Tab for error data

How to put two or more graphs on one tab:

- Put your cursor on a tab.
- Click and hold the mouse button down and pull the tab on another tab. The software will show a symbol to show you where you can put the graph on the tab.
- Make a selection from the available positions on the screen.
- Release the mouse button.

➲ End of the procedure. The graph will appear in its new position.

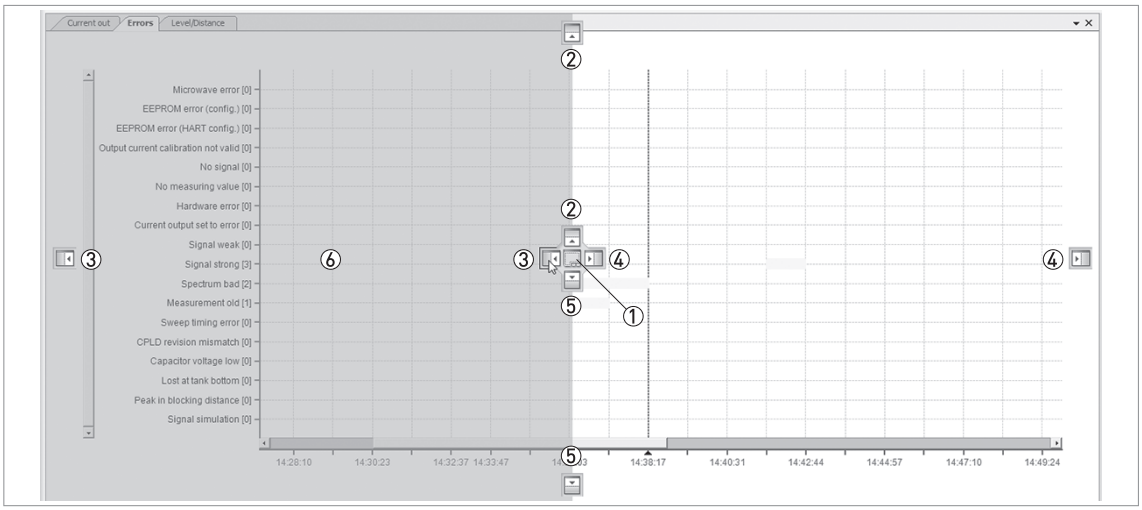

Figure 5-6: How to put two or more graphs on one tab

① Graph position symbol: create another tab for this graph
② Graph position symbol: move this graph to the top
③ Graph position symbol: move this graph to the left side
④ Graph position symbol: move this graph to the right side
⑤ Graph position symbol: move this graph to the bottom
⑥ In this example, the user clicks on the graph position symbol ③ and the graph is shown on the left side on the same tab

5.3.5 Diagnosis window

Use this data to do a check of the device's condition (error messages etc.).

You can do one of these three procedures to open the Diagnosis window:

- Open the window from the **Start** window. Click on **Start** in the DTM menu and then click on the **Diagnosis** button at the bottom of the **Start** window.
- Open the window from the main toolbar. Click on **Device > Diagnosis**.
- Open the window from the **Project** window. Right click on the device (**OPTIWAVE 1010**) in the project list, then click on **Diagnosis**.

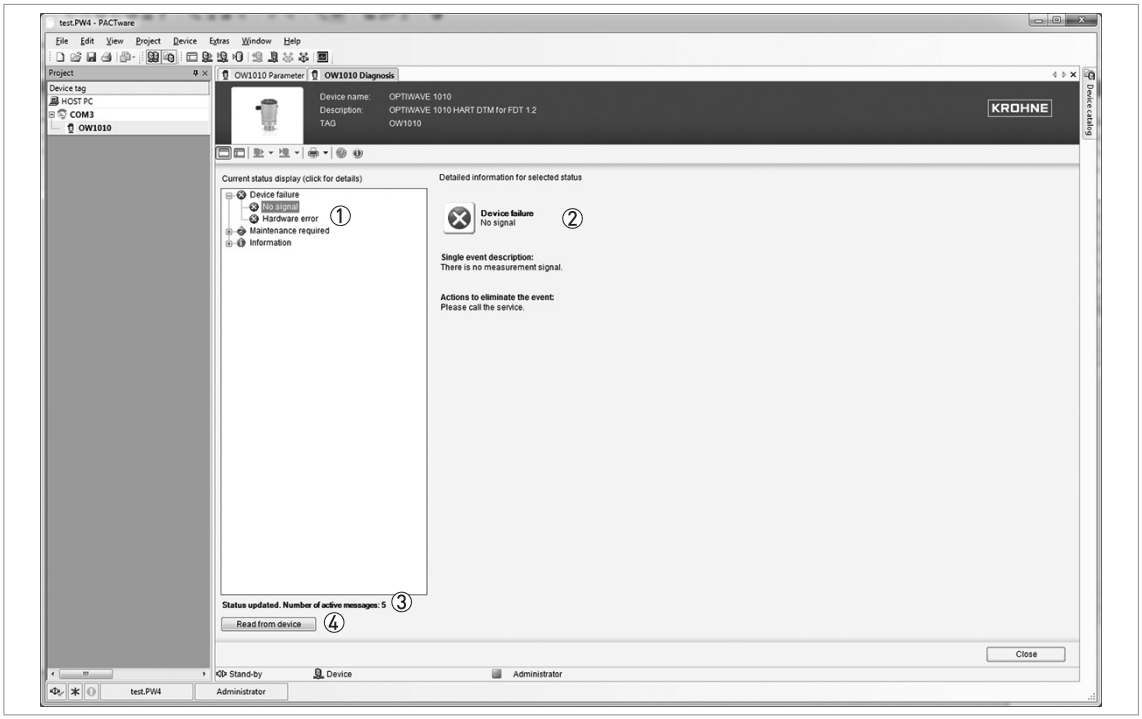

Figure 5-7: DTM: Diagnosis screen

① Summary: status of the device since the last check. Click on the list for more data about an applicable error
② Data about the applicable error and the recommended solution
③ Number of errors found by the device since the last check
④ Button to update the device status

5.3.6 Simulation window

Use this window to simulate measured data to make sure that the device operates correctly.

You can do one of these three procedures to open the Simulation window:

- Open the window from the **Start** window. Click on **Start** in the DTM menu and then click on the **Simulation** button at the bottom of the **Start** window.
- Open the window from the main toolbar. Click on **Device > Simulation**.
- Open the window from the **Project** window. Right click on the device (**OPTIWAVE 1010**) in the project list, then click on **Simulation**.

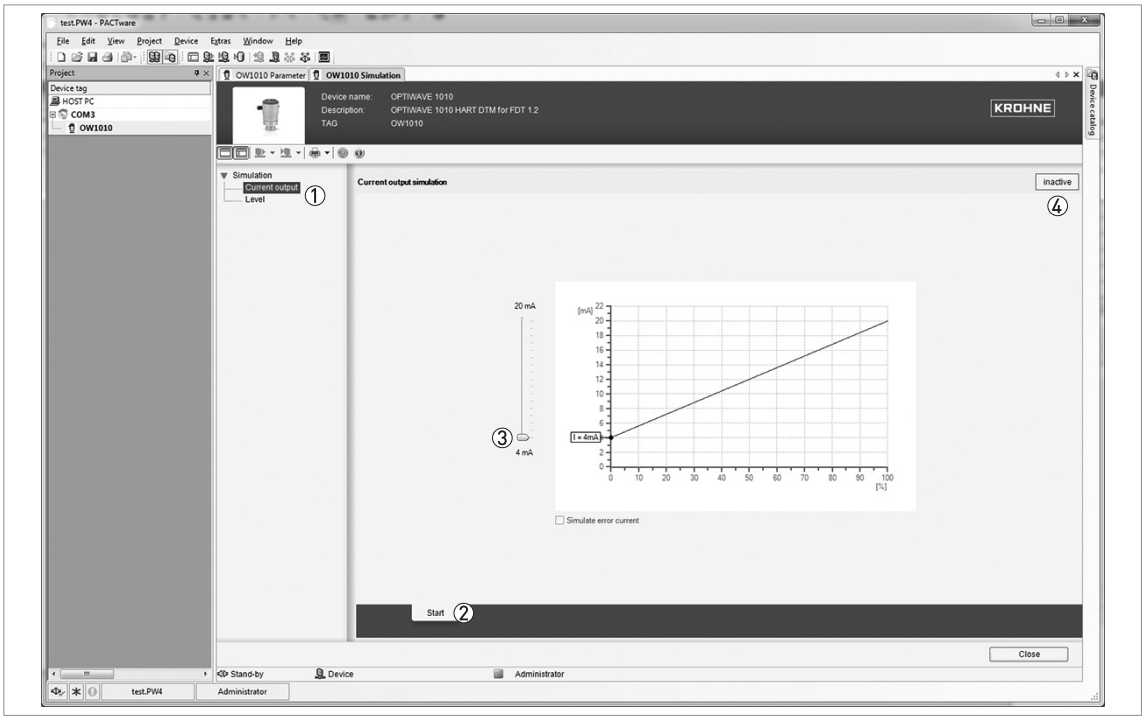

Figure 5-8: DTM: Simulation screen

① Use this menu to simulate changes in level or in current output
② "Start simulation" button
③ Slider control to increase or decrease the simulated value
④ Simulation status: active (on) / inactive (off)

6.1 Software configuration

6.1.1 General notes

This section gives the procedures to change, save, send and receive settings with PACTware™.

Before the program can send data to and receive data from the device, it is necessary to add elements to a project structure. The project structure is built in the Project window. The Project window is on the left side of the PACTware™ window.

This procedure will open the communication port, but does not start the communication with the device. For more data; refer to *Procedure* on page 41.

6.1.2 Procedure

INFORMATION!
This procedure will open the communication port, but DOES NOT start the communication with the device.

- HOST PC is shown in the Project window. Go to the main toolbar and click on the View menu button. Click on "Device catalog F3" to open the Device Catalog pane.
- Double click on “HART Communication” in the Device Catalog window. The "COMx" element is added below "HOST PC” in the project structure.
- Click on "OK" to save changes or "Cancel" to cancel the new configuration.
- Double click on the "OPTIWAVE 1010" item in the Device Catalog window. This step will add the device DTM to the project structure in the Project pane.

➲ The software is correctly configured for device communication, but the port is not open and the device cannot communicate with the software at this time.

- (a) Double click on the "OPTIWAVE 1010" element in the project structure (Project window), or (b) Right click on "OPTIWAVE 1010" element in the project structure (Project window) and select "Parameter" in the drop-down list box.

➲ This step will open the OPTIWAVE 1010 Parameter (configuration) window.

- Right click on the "OPTIWAVE 1010" element in the Project window and select "Connect" in the drop-down list box.

➲ End of the procedure.

6.2 How to load settings from the device to PACTware™

If the device operates with settings that are not used in PACTware™ for that device, you can use the "Load from device" function to send the device settings to PACTware™.

CAUTION!
Make sure that the settings in the DTM and the device are regularly synchronized. If you do not synchronize the settings, it is possible that settings in the DTM and the device are different. This difference can have an effect on the performance of the device.

INFORMATION!
Multi-drop networks: *Set the device address with the DTM. For more data, refer to HART on page 58.*

There are 3 alternative procedures.

Procedure 1: Click on "Load from device" in the Device menu

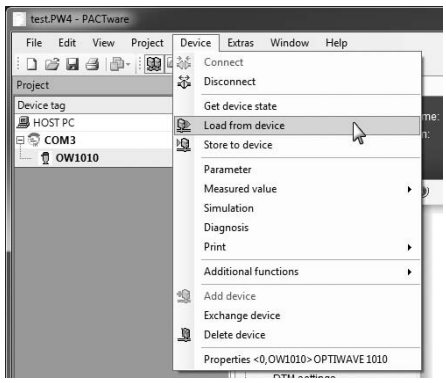

Figure 6-1: Click on "Load from device" in the Device menu

- Click on the Device button in the main toolbar.
- Click on "Load from device" in the list.

➲ End of the procedure.

Procedure 2: Click on the "Load from Device" icon in the main toolbar

Figure 6-2: Click on the "Load from Device" icon in the main toolbar

- Click on this icon (you can find this icon below the main toolbar).

➲ End of the procedure.

Procedure 3: Right click on the "OPTIWAVE 1010" element in the Project window

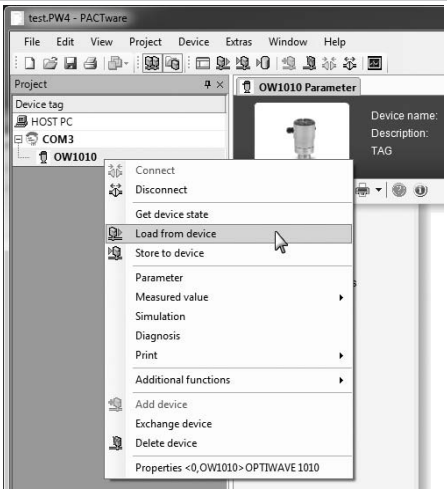

Figure 6-3: Right click on the "OPTIWAVE 1010" element in the Project window

- Right click on the "OPTIWAVE 1010" element in the Project window.
- Click on "Load from device" in the list.

➲ End of the procedure.

6.3 How to store settings to the device from PACTware™

If PACTware™ has settings that the device must use to operate correctly, you can use the "Store to device" function to send the new settings to the device.

CAUTION!
Make sure that the settings in the DTM and the device are regularly synchronized. If you do not synchronize the settings, it is possible that settings in the DTM and the device are different. This difference can have an effect on the performance of the device.

INFORMATION!
Multi-drop networks: *Set the device address with the DTM. For more data, refer to HART on page 58.*

There are 3 alternative procedures.

Procedure 1: Click on "Store to device" in the Device menu

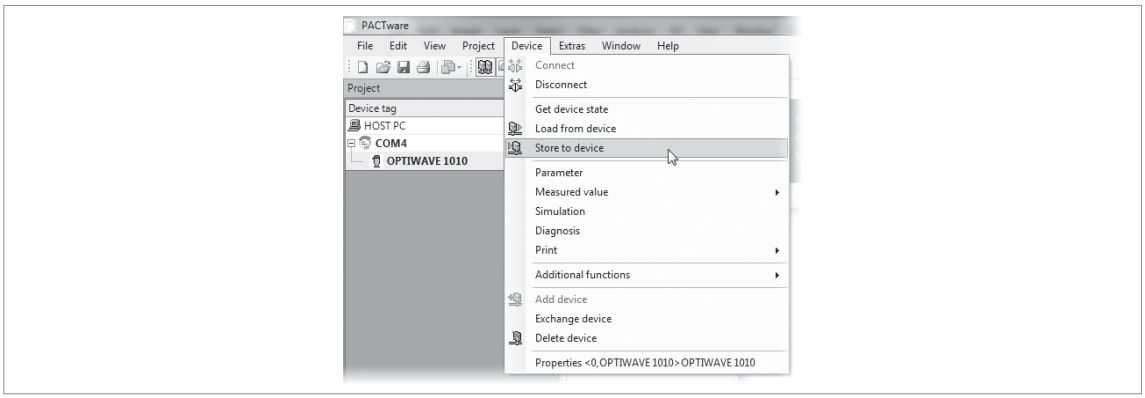

Figure 6-4: Click on "Store to device" in the Device menu

- Click on the Device button in the main toolbar.
- Click on "Store to device" in the list.

➲ End of the procedure.

Procedure 2: Click on the "Store to device" icon in the main toolbar

Figure 6-5: Click on the "Store to device" icon in the main toolbar

- Click on this icon (you can find this icon below the main toolbar).

➲ End of the procedure.

Procedure 3: Right click on the "OPTIWAVE 1010" element in the Project window

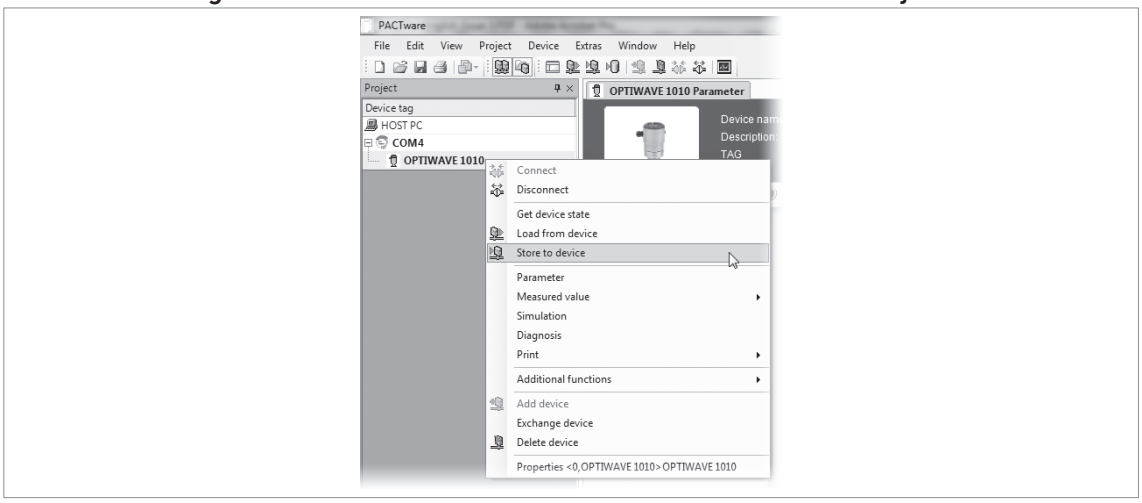

Figure 6-6: Right click on the "OPTIWAVE 1010" element in the Project window

- Right click on the "OPTIWAVE 1010" element in the Project window.
- Click on "Store to device" in the list.

➲ End of the procedure.

6.4 Menu overview

Login/Logout

It is necessary to use a password in this menu. Give a 6-digit code. This menu permits the supervisor to set and lock device settings that are available to the supervisor and change the supervisor password. The default password is **123412**.

This menu also permits personnel approved by the manufacturer to change device settings in the service menu.

Import/Export

You can save all device settings to a workstation (Parameter menus: export). This data can then be used to reset the device to its initial settings if an unwanted change is made. If you want to operate other devices with the same settings, you can also load this data into other devices (Parameter menus: import).

You can also save measurement data in a .DAT file to a workstation.

Information

Read only. This menu gives data about the version of the hardware and software, the device serial number and the customer order number.

Basic parameters

The device must be attached to a bypass chamber to operate correctly. The manufacturer usually sets the values for the minimum distance, the maximum distance, the float offset and the internal diameter of the tube in the factory.

If the device does not have the correct settings in this menu, then these values can have an effect on the performance of the device. If you make an incorrect selection of the float, go to **Application > Float offset calculation** in the DTM menu to calculate the new float offset value.

Current output

You can make a selection from the parameters in the output function, output current range and error delay lists.

Application

Use this menu to change how the device operates when there are difficult process conditions. Only approved personnel can change these parameters. The supervisor can give the time constant, maximum tracing speed and multiple reflections to identify the correct signal and follow it as level changes.

Float offset calculation

If the device does not have the correct float in the bypass chamber, then the float offset value in the **Basic parameters** menu is incorrect. An incorrect float offset value can have an effect on the measurement data. Go to **Application > Float offset calculation** in the DTM menu to calculate the new float offset value. Follow the procedure.

HART

Use this menu to change the tag name and read data (Device ID, Field device revision etc.) that agrees with the HART® specification. You can also change the units of the measured values.

Service

This menu contains advanced device settings. It is locked with a password. The handbook does not include data about the service menu.

DTM settings

Use this menu to change how the status display shows data at the top of the DTM window.

6.5 How to change device settings

CAUTION!
If you change the device settings, the DTM saves this data in the workstation. It does not send the changes to the device. For more data about how to send changes to the device, refer to How to store settings to the device from PACTware™ on page 44.

At the bottom right of the window there are 3 buttons. This function obeys FDT guidelines for certification of the DTM.

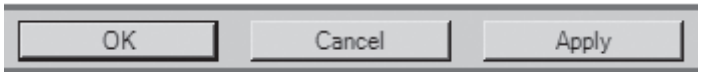

Figure 6-7: "OK" or "Apply" updates the device settings data in the computer

When you change the value or parameter of a menu item, a pencil symbol is shown adjacent to the changed value:

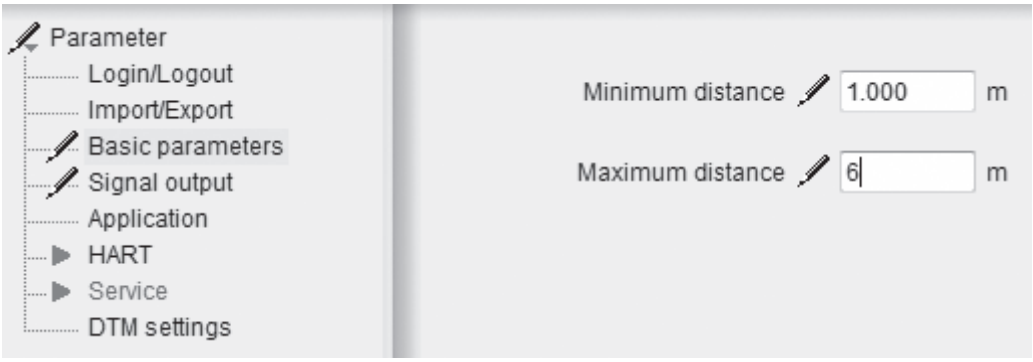

Figure 6-8: Pencil symbol: changed value

If the value is too large or too small, a red exclamation mark is shown adjacent to the incorrect value:

Figure 6-9: Exclamation mark (!): the value is too large or too small

6.6 Data about parameters (online Help)

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

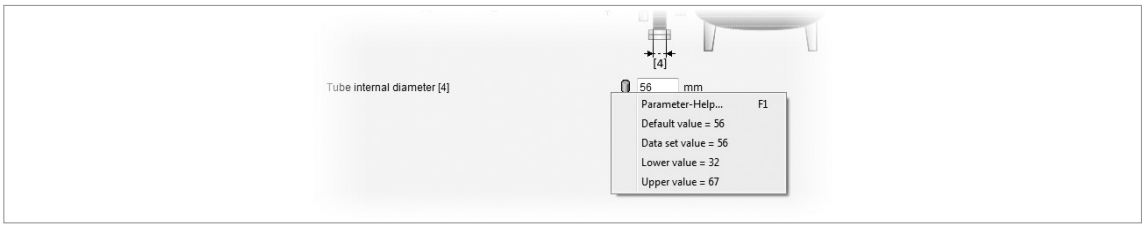

Figure 6-10: Data about parameters – values

6.7 Device settings

6.7.1 Password protection for device settings

To change the device settings in the DTM, it is necessary to enter the correct password and log in as a "Supervisor". If you do not log in, you can only read the device settings.

Figure 6-11: Login/Logout menu

Procedure: How to log in as a supervisor

- (a) Double click on the "OPTIWAVE 1010" element in the project structure (Project pane) or (b) Right click on "OPTIWAVE 1010" element in the project structure (Project pane) and select "Parameter" in the drop-down list box.
- Click on "Login/Logout".
- Click on the **Select action** menu and set it to "Login as Supervisor".
- Enter the password (the default password is **123412**).
- Push the "Execute" button.
- The device settings are unlocked.

➲ The device settings are unlocked. You can change the device settings. End of the procedure.

Procedure: How to change the supervisor password

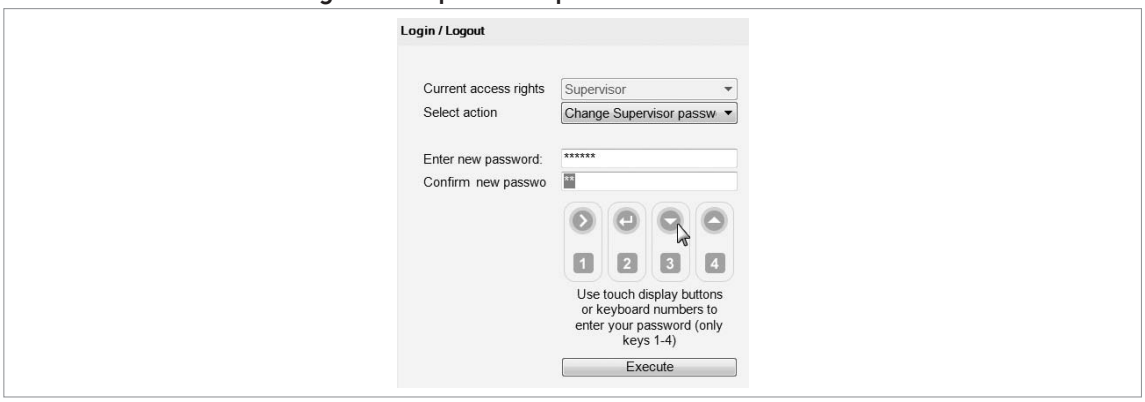

Figure 6-12: Procedure: How to change the supervisor password

- (a) Double click on the "OPTIWAVE 1010" element in the project structure (Project pane) or (b) Right click on "OPTIWAVE 1010" element in the project structure (Project pane) and select "Parameter" in the drop-down list box.
- Click on "Login/Logout".
- Click on the **Select action** menu and set it to "Change supervisor password".
- Use the [>], [↵], [▼] and [▲] buttons on the DTM window or the [1], [2], [3] and [4] buttons on the computer keyboard to enter the new 6-digit password.
- Enter the new 6-digit password again.
- Push the "Execute" button.

➲ You changed the password. End of the procedure.

INFORMATION!
*It is also necessary to do this procedure when you click on the **Select action** menu and set it to "enable Supervisor password".*

Procedure: How to disable the supervisor password

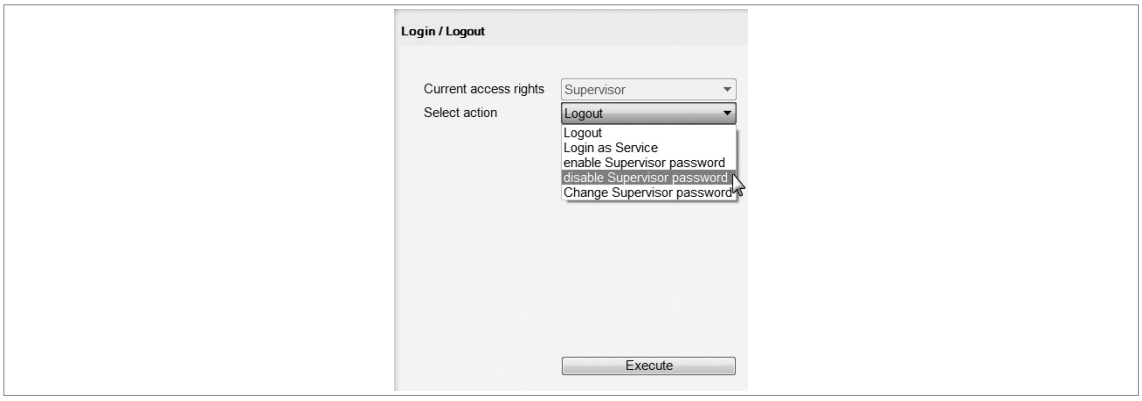

Figure 6-13: Procedure: How to disable the supervisor password

- (a) Double click on the "OPTIWAVE 1010" element in the project structure (Project pane) or (b) Right click on "OPTIWAVE 1010" element in the project structure (Project pane) and select "Parameter" in the drop-down list box.
- Click on "Login/Logout".
- Click on the **Select action** menu and set it to "disable Supervisor password".
- Push the "Execute" button.

➲ You removed the password protection. End of the procedure.

6.7.2 Import / Export

You can use the import /export function to do 2 procedures:

- Import device configuration data from a CFG or a DAT file. You can then transmit the data to the device (Store to device).
- Export device configuration data (parameters etc.) in a CFG file. You can use this data for the configuration of other devices.

INFORMATION!
You can save measurement data in a DAT file when you use the "Record" function in the Analysis Values menu. For more data, refer to the "Analysis values" section.

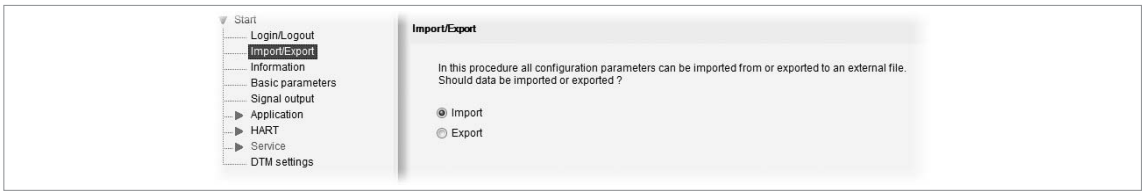

Figure 6-14: Import / export function

Export device configuration data

- Click on "Import / Export" in the menu list.
- Click on the **Export** button.
- Click on the **>>** button.
- Enter a file name and click on the **Save** button.
- Enter comments and supplementary data in the "File Comment" and "Please enter comment for export file" boxes.
- Click on the "tick" button at the bottom of the window to complete the procedure and make a CFG file.

CAUTION!

Only the settings in the DTM will be saved to the CFG file. Make sure that the settings in the DTM and the device are regularly synchronized. If you do not synchronize the settings, it is possible that settings in the DTM and the device are different. For more data about the procedure to transmit the data to the device, refer to How to store settings to the device from PACTware™ on page 44. For more data about the procedure to get the data from the device, refer to *How to load settings from the device to PACTware™ on page 42*.

Import device configuration data

- Click on "Import / Export" in the menu list.
- Click on the **Import** button.
- Click on the **>>** button.
- Find the CFG or DAT file and click on the **Open** button.
- Make a selection from the list. If you want basic settings data only, click in the "Configuration Data" tick box, but not the "Service Data" tick box. If you want basic and advanced settings data, click on the two tick boxes and enter the service password.
- Click on the **>>** button.
- Click on the "tick" button at the bottom of the window to complete the procedure.

INFORMATION!

Only approved personnel can use the service password. For more data, please speak to your supplier.

6.7.3 Information

This is a read only menu that gives data in the list that follows:

- Firmware version
- Configuration changed counter
- Software revision
- Hardware revision
- Complete device serial number
- Electronic serial number
- Electronics and housing serial number
- Sales order number

6.7.4 Basic parameters

CAUTION!
The device must be attached to a bypass chamber or magnetic level indicator to operate correctly.

CAUTION!
The manufacturer enters the process conditions (density, type of product, operational temperature and pressure) in the device settings at the factory. These data are given in the customer order. Incorrect data will have an effect on the performance of the device.

Use the **Basic parameters** menu to change how the device operates in the bypass chamber. The supervisor can enter the data that follows:

(1) Minimum distance — This is the distance from the matching element to the top point on the scale. The top point is the center of the top process connection of the bypass chamber. This value is set at the factory but you can change it on-site.

(2) Maximum distance — This is the distance from the matching element to the bottom point on the scale. The end point is the center of the bottom process connection of the bypass chamber. This value is set at the factory but you can change it on-site.

(3) Float offset — This value is set at the factory. If the device does not measure the level of the product in the bypass chamber correctly, it is possible that the product density used to calculate the float offset is incorrect. If you make an incorrect selection of the float, go to **Application > Float offset calculation** in the DTM menu to calculate the new float offset value For more data about this procedure, refer to *Application* on page 56.

(4) Tube internal diameter — This value is set at the factory and must not be changed.

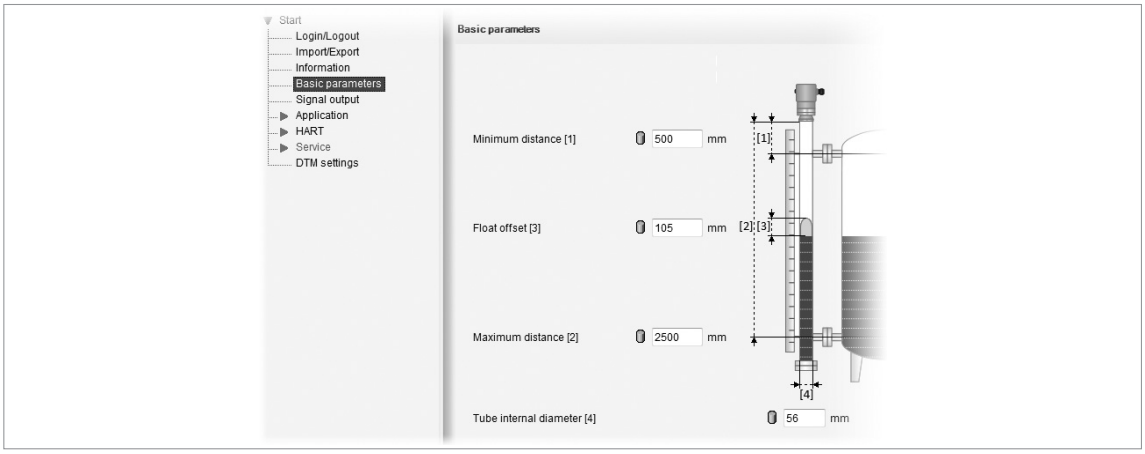

Figure 6-15: Basic parameters menu

6.7.5 Current output

Use the **Current output** menu to specify the type of data that the current output must supply. The supervisor can set the output function (level or distance), the output range and the error delay. The "scaling min." and the "scaling max." values are set in the **Basic parameters** menu.

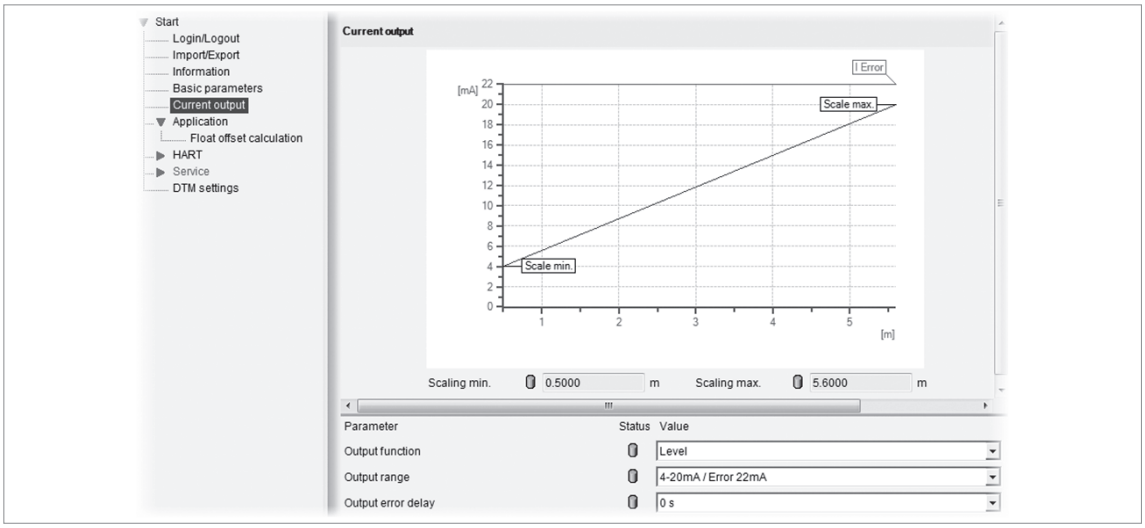

Figure 6-16: Current output menu

Function description

Function	Function description	Selection list or range of values	Default
Output function	Select an output function to scale the current values in relation to a given point (the top process connection (distance measurement) or the bottom process connection (level measurement) in the bypass chamber.	Distance, Level	Level
Output range	This menu item sets the limits of the electrical current range to 1 of the 2 available options: standard limits (4...20 mA) or NAMUR NE 43-compliant limits (3.8...20.5 mA). It also tells the device what to do if an error occurs. For example, if you set **Output range** to "4-20mA / Error 22mA" and **Output function** to "Level" and the tank is too full, the current output will change to an error value of 22 mA. If you set **Output range** to "4-20mA/ hold" and the device senses a measurement error, the value will stop at the last correct measurement.	4-20mA / Error 22mA, 4-20mA / Error 3.6mA, 3.8-20.5mA / Error 22mA, 3.8-20.5mA / Error 3.6mA, 4-20mA / hold	4-20mA/ Error 22mA
Output error delay	The time after which the current output changes to an error value. The error value shows that there is a measurement error. min= minutes and s= seconds.	0 s, 10 s, 20 s, 30 s, 1 min, 2 min, 5 min, 10 min, 15 min	0 s

Function	Function description	Selection list or range of values	Default
Scaling min.	This menu item gives the start point on the scale. The position of the start point in the bypass chamber agrees with the minimum distance if **Output function** is set to "distance". The position of the start point in the bypass chamber agrees with the maximum distance if **Output function** is set to "level". The electrical current value (4 mA) of the start point is set in **Output range** in the **Current output** menu. The level or distance value of the start point is always zero.	Read only.	
Scaling max.	This menu item gives the end of the scale. The position in the bypass chamber agrees with the minimum distance if **Output function** is set to "level". The position in the bypass chamber agrees with the maximum distance if **Output function** is set to "distance". The electrical current value (20 mA) of the end point is set in **Output range** in the **Current output** menu.	Read only.	

6.7.6 Application

Use the **Application** menu to specify how the device monitors the level of the product in the bypass chamber. The supervisor can give the time constant, maximum tracing velocity and multiple reflections to identify the correct signal and follow it as level changes.

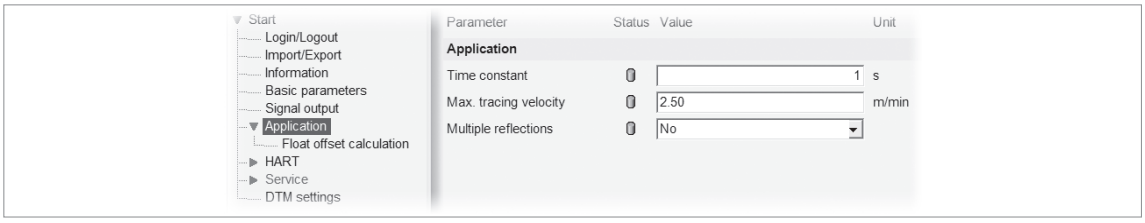

Figure 6-17: Application menu

Function description

Function	Function description	Selection list or range of values	Default
Time constant	Using this function, the device processes several measurement readings to filter out disturbances. Increasing the time constant will smoothen the integrated readings, decreasing will roughen the reading. s = seconds.	min-max: 0....100 s	1 s
Max. tracing velocity	This value must agree with the maximum rate of change of the level of the product in the bypass chamber.	min-max: 0.01...10.00 m/min	2.50 m/min
Multiple reflections	Multiple signal reflections will cause the device to display smaller level readings. If this function is in operation, the device looks for the first signal peak at a distance larger than the minimum distance. This signal peak is then used to measure the product. If this function is not in operation, the device looks for the largest signal at a distance larger than the minimum distance.	No, Yes	No

6.7.7 Application: Float offset calculation

If the device has the float option, the manufacturer uses data supplied in the customer order to enter the device settings. If the data (product density etc.) are correct, the device will measure level correctly. If the data is incorrect, the float offset value in the **Basic parameters** menu of the DTM is incorrect. If the float offset value is incorrect, this can have an effect on the performance of the device.

If the device does not measure level correctly, use the DTM to calculate the new float offset value. Do the procedure that follows.

- Go to **Application > Float offset calculation**.
- Push the **>>** button at the bottom of the window.
- Make a selection from the float types (Ti L=472, Ti L=292 or 316L L=297).
- Enter the density of the product in the bypass chamber. Make sure that the density of the product agrees with the density range of the float. For more data about the density ranges for the floats, refer to the table below.
- Push the **>>** button at the bottom of the window.

➲ The DTM calculates the float offset and shows the value on the window.

- Push the **>>** button at the bottom of the window to accept the value.

➲ The device changes the float offset value in the Basic Parameter menu to the new value.

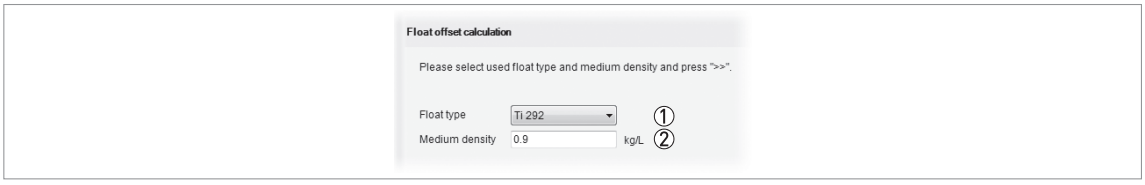

Figure 6-18: Float offset calculation procedure

① Float type
② Density of the product in the bypass chamber

Floats: density ranges

Float type	Part reference	Density range	
		[kg/L]	[lb/ft³]
Ti L=472 (length is 472 mm / 18.58")	MZ 4003777806	0.58...0.81	36.21...50.57
Ti L=292 (length is 292 mm / 11.50")	MZ 4003777805	0.81...0.98	50.57...61.18
316L L=297 (length is 297 mm / 11.69")	MZ 4003777804	0.98...1.20	61.18...74.91

INFORMATION!
Enter the density value in kg/L only.

6.7.8 HART

This menu lists all the data necessary for use in a HART® network. The supervisor can enter the tag name, the device address, the long tag name, the descriptor, a message, the date, the final assembly number and the number of request preambles. The supervisor can also set the length unit.

INFORMATION!
*If you change the length unit in the **HART** menu, this will also change the length units in the **Basic Parameters** and **Application** menus.*

INFORMATION!
*To record data in Imperial / USCS units (ft, °F etc.) in the analysis window, go to HART menu on the "Parameters" window and change the length unit to **ft (feet)** or **in (inches)**.*

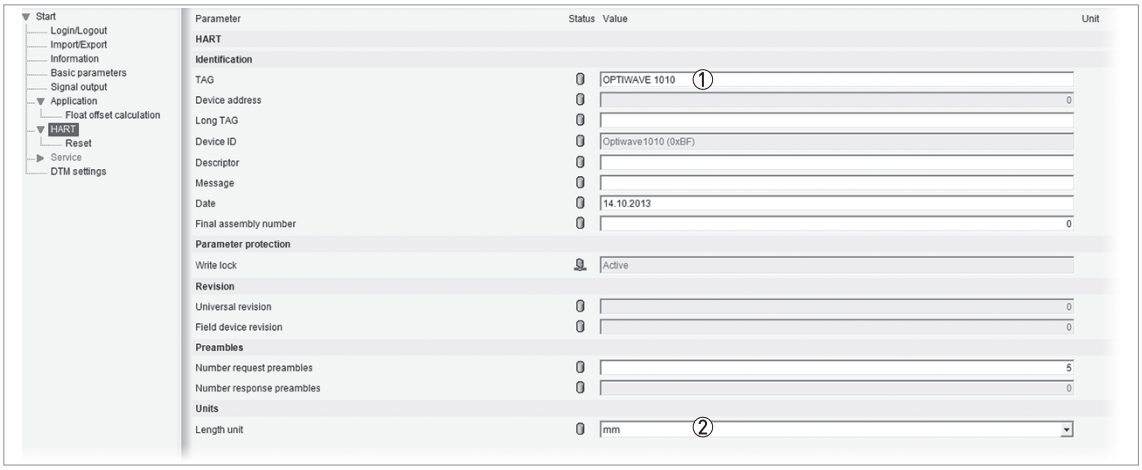

Figure 6-19: HART menu

① Tag name
② Length unit

6.7.9 DTM settings

This is the menu for the device status display at the top of the DTM window. Use this menu to start and stop status checks of the device and change the interval between checks.

Figure 6-20: DTM settings menu

① Status display (device status)
② Last recorded measurement
③ Menu item: status display enabled (on) / disabled (off)
④ Menu item: update interval

INFORMATION!
Click on the button below the device status symbol to change from distance to level measurement.

Function description

Function	Function description	Selection list or range of values	Default
Status display	This menu item starts and stops device status checks. If the device operates correctly, the status display at the top right side of the window will show a green screen with a tick symbol. If the device is not connected to the computer or this menu item is set to "disabled", the status display will show a gray screen.	Enabled, Disabled	Enabled
Update interval	This menu item changes the interval between device status checks. s = seconds	min-max: 15...3600 s	30 s

6.8 Status and error messages

6.8.1 Device status

Error data is given if you use PACTware™ software with the appropriate DTM on a PC. The software will show a symbol on the bottom left of the window if one or more error conditions are found. This data agrees with NAMUR Recommendation NE 107 (Self-Monitoring and Diagnosis of Field Devices) and VDI/VDE 2650.

Types of error message

NE 107 status	Type of error	Description
Failure	Error	If an error message is shown on the **Diagnosis** screen in the DTM, the current output goes to the error signal value set in "Output range" in the **Current output** menu.
Out of specification	Warning	If a warning message is shown, there is no effect on the current output value.
Maintenance		

NE 107 symbol shown	NE 107 Status	Description	Error type	Possible errors
	Failure	The device does not operate correctly. The fault message stays on.	Hardware error	Microwave error
			Hardware error	EEPROM error (Config.)
			Hardware error	EEPROM error (HART)
			Hardware error	Output current calibration not valid
			Error	No signal
			Error	No measuring value
			Error	Hardware error
			Error	Current output set to error
	Function check	The device operates correctly, but the measured value is incorrect. This fault message is only temporary. This symbol is shown when the user configures the device with the DTM or a HART® Communicator.	—	—
	Out of specification	It is possible that the measured value is unstable if the operating conditions do not agree with the device specification.	Warning	Signal weak
			Warning	Signal strong
			Warning	Spectrum quality bad
			Warning	Measurement old
	Maintenance	The device does not operate correctly because of bad environmental conditions (e.g. build-up on the antenna). The measured value is correct, but maintenance is necessary a short time after this symbol is shown.	Warning	Sweep timing error
			Warning	CPLD revision mismatch
			Warning	Capacitor voltage low
	Information	This status message is shown at the same time as the error "no measuring value".	Information	Peak lost in tank bottom
			Information	Peak lost in blocking distance

For data on errors, refer to *Error handling* on page 61.

6.8.2 Error handling

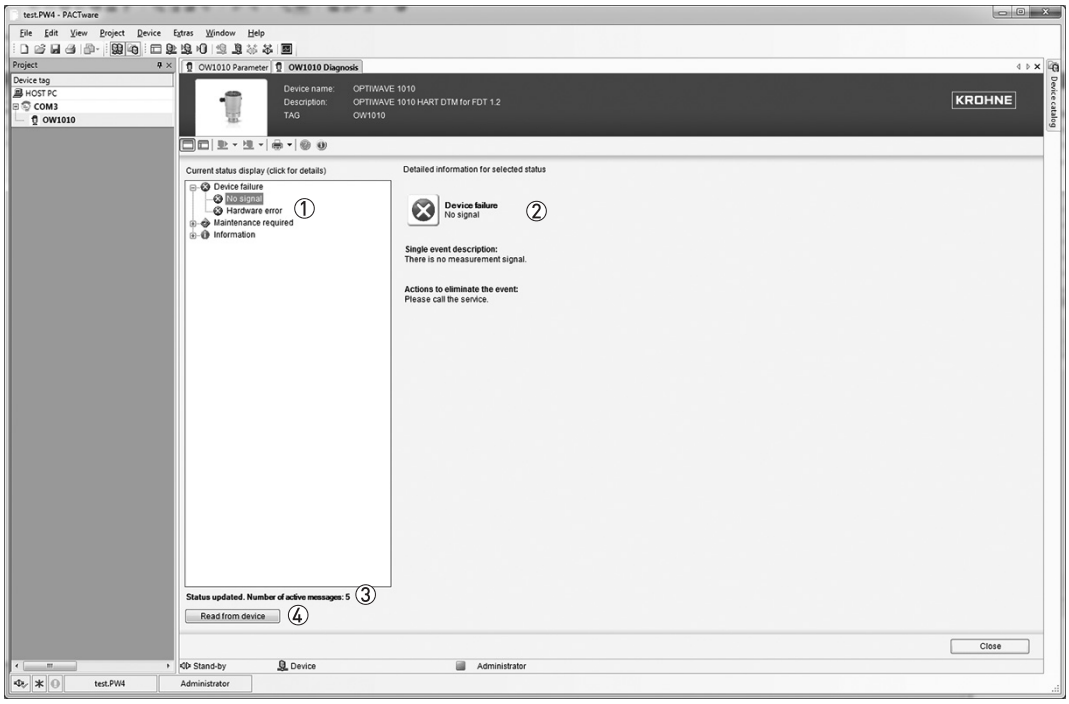

Figure 6-21: DTM: Diagnosis screen

① Summary: status of the device since the last check. Click on the list for more data about an applicable error
② Data about the applicable error and the recommended solution
③ Number of errors found by the device since the last check
④ Button to update the device status

Description of errors and corrective actions

Error Message	Cause	Corrective action
Failure (NE 107 status signal)		
Microwave error	The device's hardware is defective.	Replace the signal converter. For more data, refer to *Service warranty* on page 63.
EEPROM error (Config.)	The device's hardware is defective.	Replace the signal converter. For more data, refer to *Service warranty* on page 63.
EEPROM error (HART)	The device's hardware is defective.	Replace the signal converter. For more data, refer to *Service warranty* on page 63.
Output current calibration not valid	The current output is not calibrated.	Speak to the supplier to get the calibration procedure.
No signal (level lost)	The device's hardware is defective.	Replace the signal converter. For more data, refer to *Service warranty* on page 63.
No measuring value	The signal peak is not 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.	Do a check of the device, the bypass chamber, the tank and the process. If necessary, install the device correctly or speak to the supplier.

Error Message	Cause	Corrective action
Hardware error	The device will send this error message if there is a microwave error, EEPROM error (Config.), EEPROM error (HART) or the current output is not calibrated.	—

Out of specification (NE 107 status signal)

Signal weak	The signal amplitude is less than the average value. This can occur if the liquid boils or if there is foam in the bypass chamber. If this error occurs frequently, the device will possibly show the "No measuring value" error message. ①	If this error occurs frequently, it is possible that you must install a float with a radar target (if there is no float supplied with the device).
Signal strong	This error can occur if there is a large change in signal amplitude. ①	No corrective action is necessary.
Spectrum quality bad	The quality of the spectrum is poor. If this message is temporarily shown, this will not affect the performance of the device. If this message is continuously shown, the measured values can be incorrect. The error message "Measurement old" will then be shown. Possible causes are low reflectivity of the liquid (if there is no float in the bypass chamber) or the inner surface of the bypass chamber is dirty.	Do a check of the device, bypass chamber and the process. Change the device settings. If necessary, contact the supplier.
Measurement old	This is a temporary error message. If the device cannot get a measurement in this time limit, the displayed measurement is no longer correct. The voltage is possibly too low. If the device continues to show the message "Spectrum quality bad", then this message is also shown.	Do a check of the voltage at the device terminals. Refer also to the error message "Spectrum quality bad".

Maintenance (NE 107 status signal)

Sweep timing error	It is possible that the device's hardware is defective.	If this error message continues or occurs regularly, replace the signal converter.
CPLD revision mismatch	The CLPD software was not updated or the device's hardware is defective.	Replace the converter. For more data, refer to *How to replace the signal converter* on page 64.
Capacitor voltage low	It is possible that the device's hardware is defective.	Do a check of the power supply at the device terminals. Make sure that voltage values are in the specified limits. If the voltage is correct, replace the signal converter.

Information

Current output set to error	The device current output is at its error value. The error value is set in the **Current output** menu. For more data, refer to *Current output* on page 54.	Do a check of the "Diagnosis" screen in the DTM to find the problem. Then refer to the other errors shown in this list. For more data, refer to *Diagnosis window* on page 38.
Peak lost in tank bottom	The tank is possibly empty. The device will display the tank bottom measurement.	If you fill the tank, the device will measure again.
Peak lost in blocking distance	The level is in the blocking distance. There is a risk that the product will overflow and/or cover the device.	Remove some of the product until the level is below the blocking distance.

① This error message does not have an effect on the current output signal

7.1 Periodic maintenance

No maintenance is necessary.

7.2 How to replace device components

7.2.1 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 the supplier for inspection and/or repairs.

INFORMATION!
The converter housing can be detached from the process connection assembly under process conditions.

Servicing by the customer is limited by warranty to:

- The removal and installation of the housing. For more data, refer to *How to replace the signal converter* on page 64.

For more data on how to prepare the device before you send it back to the supplier, refer to *Returning the device to the manufacturer* on page 66.

7.2.2 How to replace the signal converter

Equipment needed:

- 5 mm Allen wrench (not supplied)
- OPTIWAVE 1010 level transmitter attached to a BM 26 Advanced bypass level indicator
- New housing and electronics block. For more data, refer to *Spare parts* on page 86. Speak to your supplier to get a new housing and electronics block.
- Ferrite choke. For more data, refer to *Electrical installation: 2-wire, loop-powered* on page 26.
- Handbooks for all devices

CAUTION!
Make sure that you record device settings. For more data about how to save device settings, refer to Import / Export on page 50.

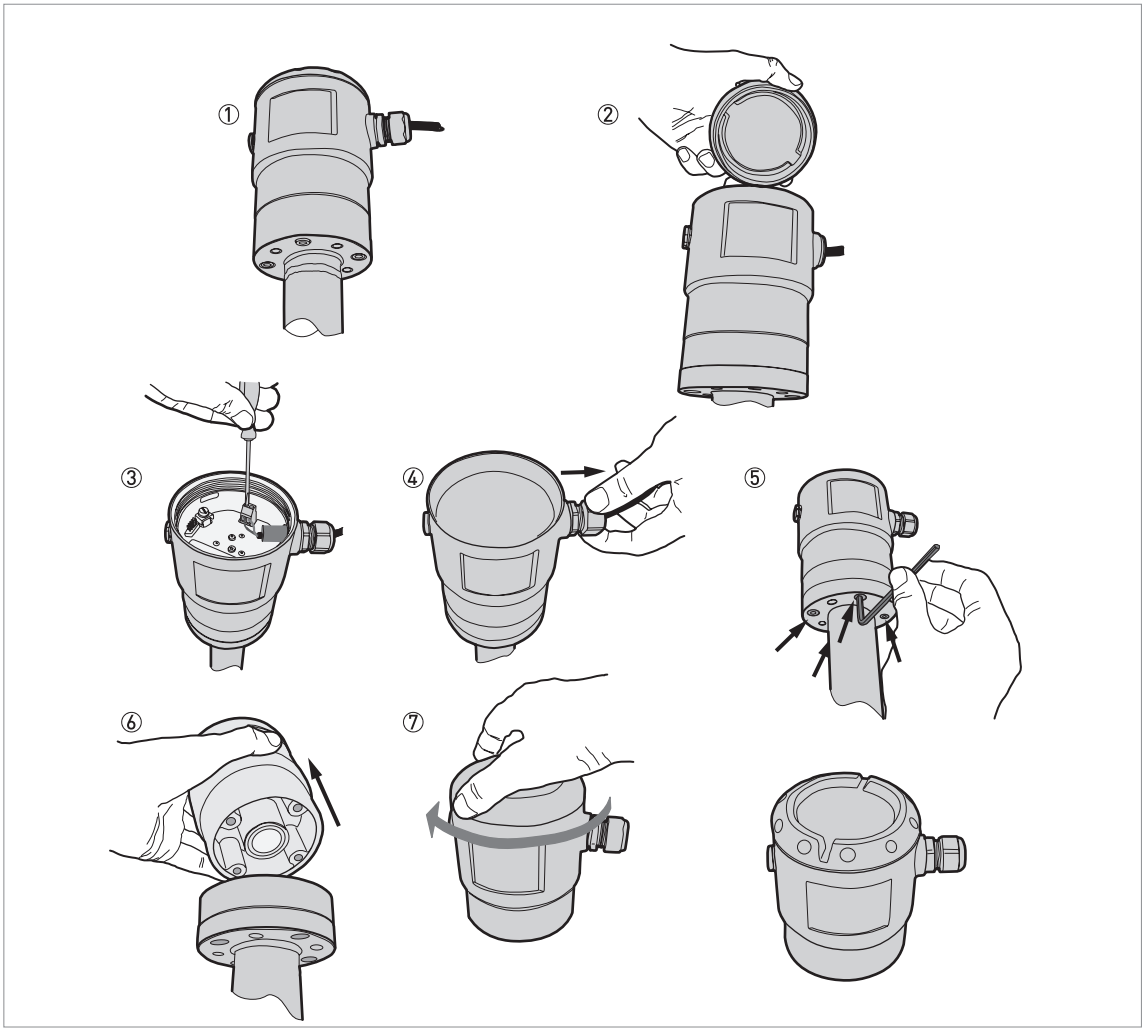

Figure 7-1: How to remove the signal converter

How to remove the signal converter

① De-energize the device.
② Remove the housing cover.
③ Disconnect the electrical wires from the terminal block.
④ Loosen the cable gland and remove the electrical wire from the housing.
⑤ Use a 5 mm Allen wrench to remove the four bolts shown in the illustration.
⑥ Remove the signal converter.
⑦ Attach the housing cover.
➲ End of the procedure.

How to attach the signal converter

① Remove the housing cover.
② Attach the signal converter. Use a 5 mm Allen wrench to attach the four bolts at the bottom of the level transmitter.
③ Loosen the cable gland and put the electrical cable into opening of the cable gland. Then put the electrical cable into the opening of the ferrite choke (supplied with the new housing and electronics block).
④ Put the electrical wires in the connector terminals. Tighten the terminal screws with a small slotted-tip screwdriver. Put the ferrite choke in the opening of the cable entry. Turn the ferrite choke until it is fully engaged.
⑤ Attach the housing cover.
➲ End of the procedure.

WARNING!
If the device has the aluminium housing option with a distance piece, remove the housing and the distance piece. Do not remove the distance piece from the housing.

INFORMATION!
For more data about the electrical connection procedure and the ferrite choke, refer to Electrical installation: 2-wire, loop-powered on page 26.

INFORMATION!
If you want use the configuration set in the device before you replaced the housing, you must load the CFG file that you saved before you did this procedure. For more data about how to load and use device settings, refer to Import / Export on page 50 or refer to *How to load settings from the device to PACTware™ on page 42.*

7.3 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.

7.4 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.

7.5 Returning the device to the manufacturer

7.5.1 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.

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

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

CAUTION!
If the device has been operated with toxic, caustic, 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 is safe to handle and stating the product used.*

7.5.2 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:
Tel. no.:		Fax no. and/or Email address:
Manufacturer's order no. or serial no.:		
The device has been operated with the following medium:		
This medium is:		radioactive
		water-hazardous
		toxic
		caustic
		flammable
		We checked that all cavities in the device are free from such substances.
		We have flushed out and neutralized all cavities in the device.
We hereby confirm that there is no risk to persons or the environment through any residual media contained in the device when it is returned.		
Date:		Signature:
Stamp:		

7.6 Disposal

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

Separate collection of WEEE (Waste Electrical and Electronic Equipment) in the European Union:

According to the directive 2012/19/EU, 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.

8.1 Measuring principle

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

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

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

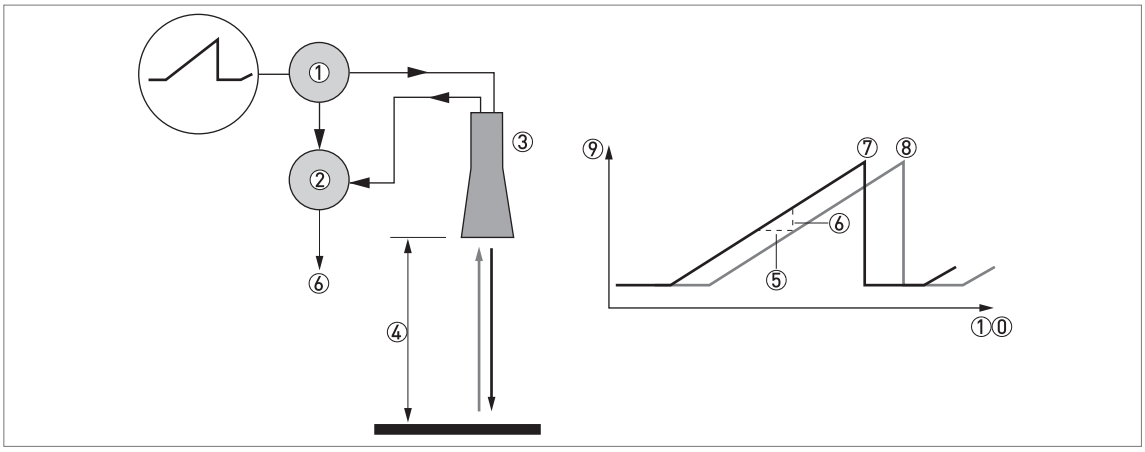

Figure 8-1: Measuring principle of FMCW radar

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

8.2 Technical data

INFORMATION!

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

Measuring system

Measuring principle	2-wire loop-powered level transmitter; C-band (6 GHz) FMCW radar
Application range	Level indication of liquids in applications up to 40 barg / 580 psig
Primary measured value	Distance to the surface of the liquid (or the top of the float, if the liquid has a low dielectric constant)
Secondary measured value	Level of the liquid in the bypass chamber

Design

Construction	The measurement system consists of a bypass chamber, a signal converter and an optional float
Measuring range	0.3...5.6 m / 0.98...18.4 ft (max. 8 m / 26.2 ft)
Top dead zone	Minimum value: 300 mm / 11.8¨ from the matching element
User interface	
User interface	PACTware™

Measuring accuracy

Repeatability	±2 mm / ±0.08¨
Accuracy	Standard: ±10 mm / ±0.4¨ without calibration or with a 2-point calibration Option: ±5 mm / ±0.2¨ with a 5-point calibration¨ ①
Influence of temperature on the bypass chamber	0.01 mm/1 m of distance/°C (relative to +25°C) / 0.000216¨/1 ft of distance/°F (relative to +77°F)
Reference conditions acc. to DIN EN 61298-1	
Temperature	+18...+30°C / +64...+86°F
Pressure	860...1060 mbara / 12.5...15.4 psia
Relative air humidity	45...75%
Target	A special float with a target is installed in the bypass chamber and used to calibrate the device

Operating conditions

Temperature	
Ambient temperature	-40...+85°C / -40...+185°F Ex: see supplementary operating instructions or approval certificates
Storage temperature	-40...+85°C / -40...+185°F

Process temperature	**Standard aluminium version with Metapeek process seal:** with a Kalrez® 6375 gasket: -20...+100°C / -4...+212°F with a FKM/FPM gasket: -40...+100°C / -40...+212°F with a EPDM gasket: -40...+100°C / -40...+212°F ②
	Aluminium version with distance piece and Metaglas® process seal: with a Kalrez® 6375 gasket: -20...+150°C / -4...+302°F with a FKM/FPM gasket: -40...+150°C / -40...+302°F with a EPDM gasket: -40...+150°C / -40...+302°F ③
	Stainless steel version with Metaglas® process seal: with a Kalrez® 6375 gasket: -20...+120°C / -4...+248°F with a FKM/FPM gasket: -40...+120°C / -40...+248°F with a EPDM gasket: -40...+120°C / -40...+248°F ③
	The process connection temperature must agree with the temperature limits of the gasket material. Ex: see supplementary operating instructions or approval certificates
Pressure	
Process pressure	**Standard (with Metapeek):** -1…16 barg / -14.5…232 psig
	With Metaglas®: -1…40 barg / -14.5…580 psig
Other conditions	
Minimum dielectric constant (ε_r)	Not applicable. If ε_r <3, a float with a target is used.
Ingress protection	IEC 60529: IP66/67
Maximum rate of change	10 m/min / 32.8 ft/min
Measurement update rate	Typically 2 measurement cycles/s

Installation conditions

Dimensions and weights	For dimensions and weights data, refer to *Dimensions and weights* on page 76 and the handbook for the BM 26 Basic / Advanced.

Materials

Housing	Standard: Polyester-coated aluminium
	Option: Stainless steel (1.4408 / 316)
Wetted materials	Standard: Stainless steel (1.4404 / 316L) bypass chamber / magnetic level indicator with a PEEK cone in the matching element and a FKM/FPM, EPDM or Kalrez® 6375 O-ring
Process seal	Standard Aluminium: Metapeek process seal with O-ring
	Aluminium version with distance piece: Metaglas® process seal with O-ring
	Stainless steel version: Metaglas® process seal with O-ring
Cable gland	Standard: none
	Options: Plastic (Non-Ex: black, Ex ia-approved: blue); nickel-plated brass; stainless steel
Weather protection (option)	Stainless steel (1.4404 / 316L)

Process connections

The device is welded to the top of the bypass chamber of the magnetic level indicator. For more data about the process connections of the magnetic level indicator, refer to the handbook for the BM 26 Basic / Advanced.

Electrical connections

Power supply	**Non-Ex, Ex db- and Ex tb-approved devices** 14.5…32 VDC; min./max. value for an output of 22 mA at the terminals
	Ex ia-approved devices 14.5…30 VDC; min./max. value for an output of 22 mA at the terminals
Maximum current	22 mA
Current output load	R_L [Ω] ≤ ((U_{ext} -14.5 V)/22 mA). For more data, refer to *Minimum power supply voltage* on page 74.
Cable entry	Standard: M20×1.5; Option: ½ NPT
Cable gland	Standard: none
	Options: M20×1.5 (cable diameter: 6...10 mm / 0.2...0.39"); others are available on request
Cable entry capacity (terminal)	0.5…2.5 mm²

Input and output

Current output / HART®	
Output signal	4…20 mA HART® or 3.8…20.5 mA acc. to NAMUR NE 43 ④
Resolution	±3 µA
Analog temperature drift	Typically 50 ppm/K (150 ppm/K maximum)
Digital temperature drift	Typically ±5 mm / 0.2" – max. 15 mm / 0.59" for the full temperature range
Error signal	High: 22 mA; Low: 3.6 mA acc. to NAMUR NE 43

Approvals and certification

CE	The device meets the essential requirements of the EU Directives. The manufacturer certifies successful testing of the product by applying the CE marking.
	For more data about the EU Directives and European Standards related to this device, refer to the EU Declaration of Conformity. You can find this documentation on the DVD-ROM supplied with the device or it can be downloaded free of charge from the website (Download Center).
Vibration resistance	EN 60068-2-6 / IEC 61298-3 10-82.2 Hz: 0.15 mm; 82.2-1000 Hz: 20 m/s²
Explosion protection	
ATEX (Ex ia or Ex db or Ex tb) KIWA 15ATEX0022 X	II 1/2 G Ex ia IIC Tx Ga/Gb; ⑤
	II 2 D Ex ia IIIC T120°C Db (stainless steel housing only);
	II 1/2 G Ex db IIC T6...T4 Ga/Gb (stainless steel housing only);
	II 2 D Ex tb IIIC T120°C Db (stainless steel housing only)
IECEx (Ex ia or Ex db or Ex tb) IECEx KIW 15.0012 X	Ex ia IIC Tx Ga/Gb; ⑤
	Ex ia IIIC T120°C Db (stainless steel housing only);
	Ex db IIC T6...T4 Ga/Gb (stainless steel housing only);
	Ex tb IIIC T120°C Db (stainless steel housing only)

Other standards and approvals	
EMC	Electromagnetic Compatibility (EMC) directive
Radio approvals	**EU** Radio Equipment directive
	FCC Rules Part 15
	Industry Canada License-exempt RSS-210
LVD	Essential requirements of Low-Voltage (LVD) directive
NAMUR	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
Construction code	Option: NACE MR0175 / ISO 15156; NACE MR0103

① For more data, refer to the "Measuring accuracy" section in this chapter

② Kalrez® is a registered trademark of DuPont Performance Elastomers L.L.C. The process connection temperature must agree with the temperature limits of the gasket material.

③ Metaglas® is a registered trademark of Herberts Industrieglas, GMBH & Co., KG. The process connection temperature must agree with the temperature limits of the gasket material.

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

⑤ Tx = T6...T4 (without a distance piece) or T6...T3 (with a distance piece)

8.3 Measuring accuracy

Use these graphs to find the measuring accuracy for a given distance from the transmitter.

Measuring accuracy without calibration or after 2-point calibration (with a 2-point calibration certificate)

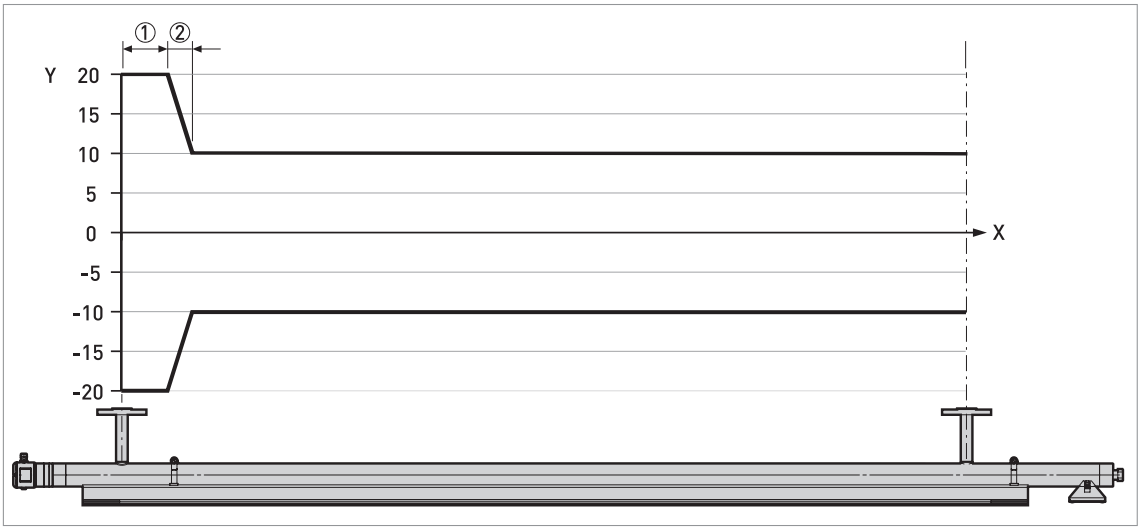

Figure 8-2: Measuring accuracy / distance from the process connections of the bypass chamber, in mm

X: Distance from the top process connection [mm]
Y: Accuracy [+yy mm / -yy mm]
①: 200 mm
②: Float offset. Refer to the "Basic parameters" menu in the DTM for the float offset value.

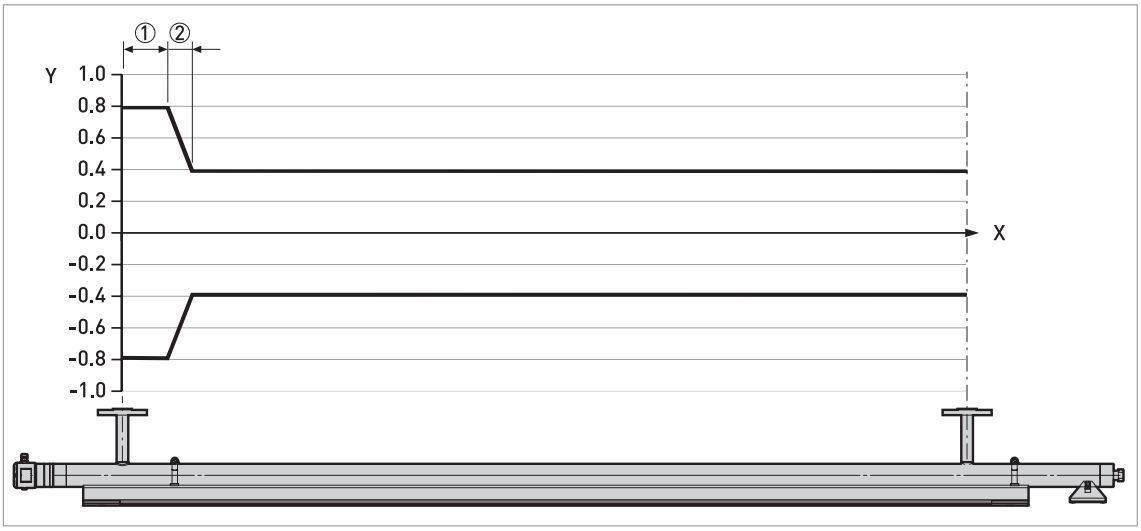

Figure 8-3: Measuring accuracy / distance from the process connections of the bypass chamber, in inches

X: Distance from the top process connection [inches]
Y: Accuracy [+yy" / -yy"]
①: 7.9"
②: Float offset. Refer to the "Basic parameters" menu in the DTM for the float offset value.

Measuring accuracy after 5-point calibration (with a 5-point calibration certificate)

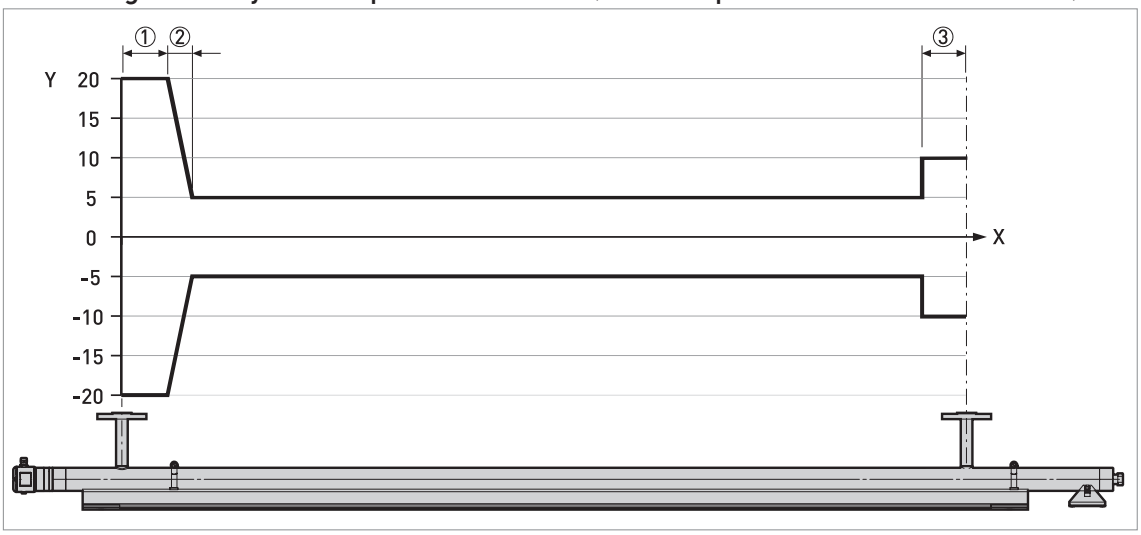

Figure 8-4: Measuring accuracy / distance from the process connections of the bypass chamber, in mm

X: Distance from the top process connection [mm]
Y: Accuracy [+yy mm / -yy mm]
①: 200 mm
②: Float offset. Refer to the "Basic parameters" menu in the DTM for the float offset value.
③: 200 mm

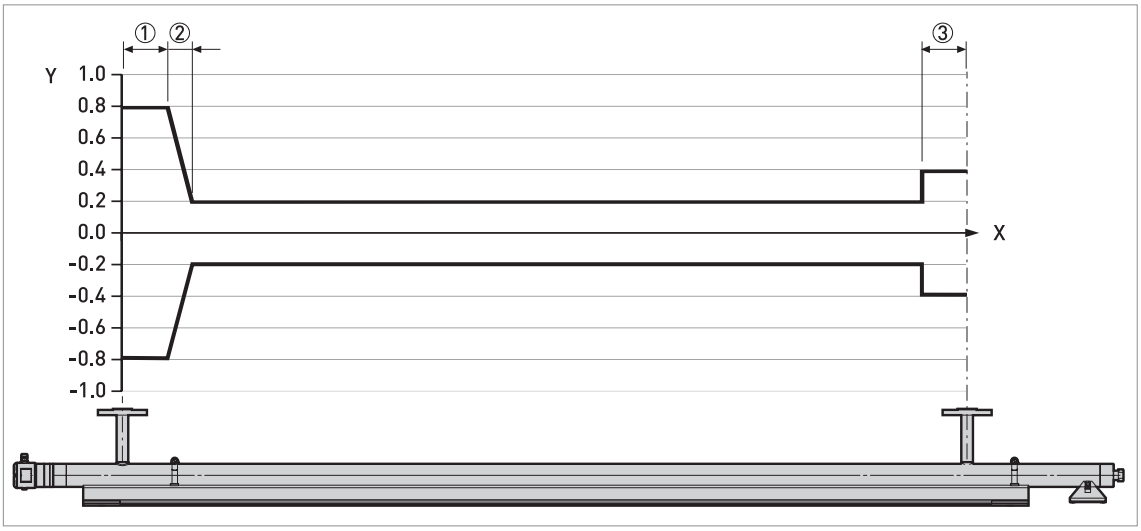

Figure 8-5: Measuring accuracy / distance from the process connections of the bypass chamber, in inches

X: Distance from the top process connection [inches]
Y: Accuracy [+yy" / -yy"]
①: 7.9"
②: Float offset. Refer to the "Basic parameters" menu in the DTM for the float offset value.
③: 7.9"

8.4 Minimum power supply voltage

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

Non-Ex devices or devices with a Hazardous Location approval (Ex db / Ex tb)

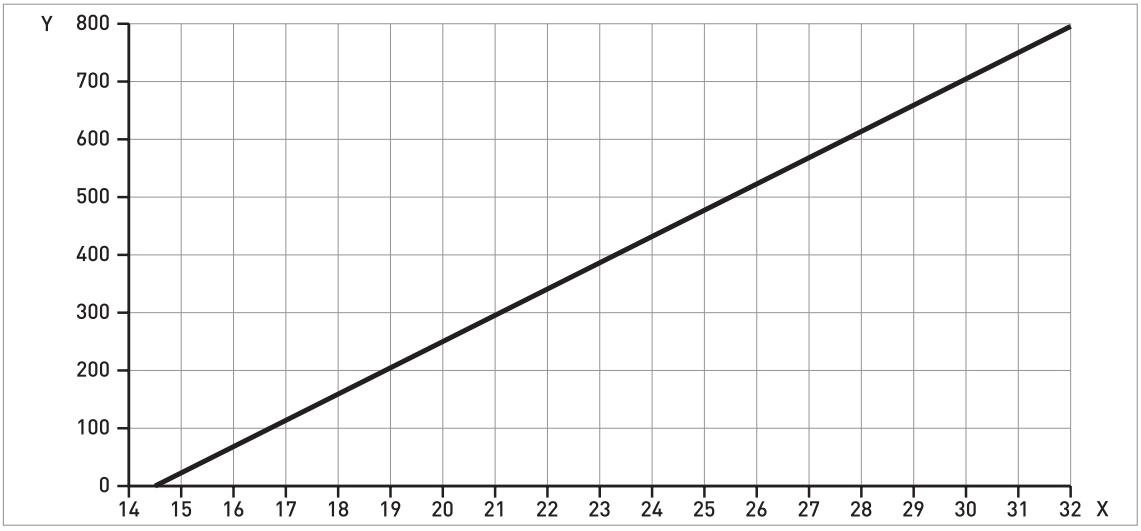

Figure 8-6: Minimum power supply voltage for an output of 22 mA at the terminal (Non-Ex devices or devices with a Hazardous Location approval (Ex db / Ex tb))

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

Devices with a Hazardous Location approval (Ex ia)

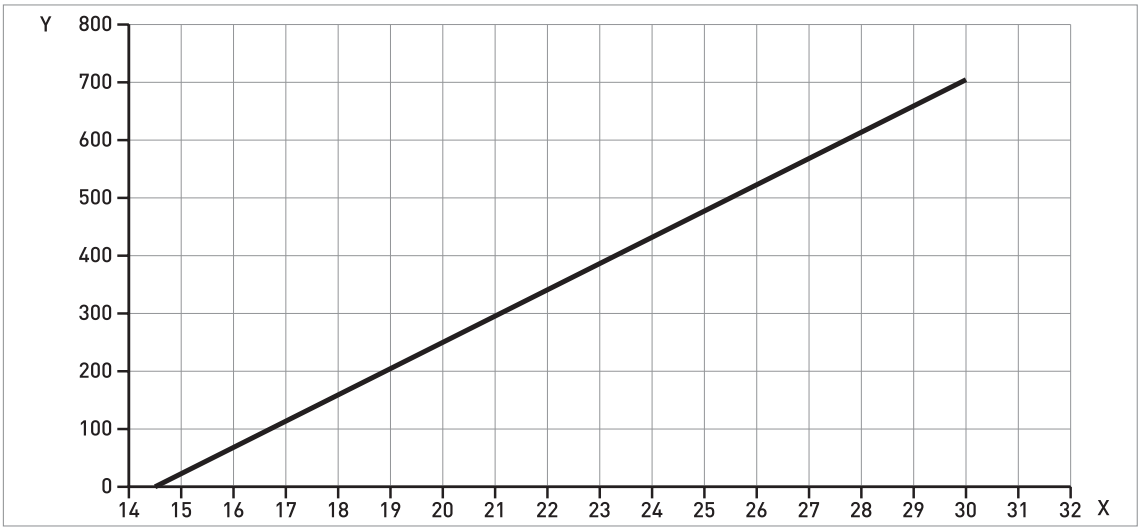

Figure 8-7: Minimum power supply voltage for an output of 22 mA at the terminal (devices with a Hazardous Location approval (Ex ia))

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

8.5 Dimensions and weights

Device versions

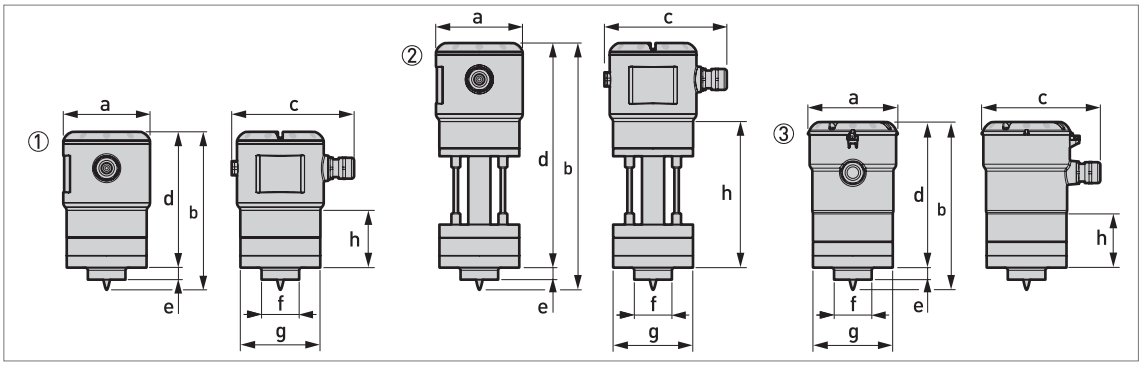

Figure 8-8: Device versions

① Non-Ex or Ex ia-approved device (aluminium housing – standard version)
② Non-Ex or Ex ia-approved device (aluminium housing – with distance piece)
③ Non-Ex, Ex ia- Ex db- or Ex tb-approved device (stainless steel housing)

Device versions: Dimensions in mm and inches

Dimensions	Device versions					
	Aluminium: non-Ex or Ex ia-approved (standard)		Aluminium: non-Ex or Ex ia-approved (with distance piece)		Stainless steel: non-Ex, Ex ia, Ex db or Ex tb-approved	
	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]
a	98	3.86	98	3.86	99.5	3.92
b	178	7.01	278	10.94	189	7.44
c	138	5.43	138	5.43	133	5.24
d	153	6.02	253	9.96	164	6.46
e	14	0.55	14	0.55	14	0.55
f	42.4	1.67	42.4	1.67	42.4	1.67
g	90	3.54	90	3.54	90	3.54
h	64.5	2.54	164	6.47	60	2.36

Weather protection

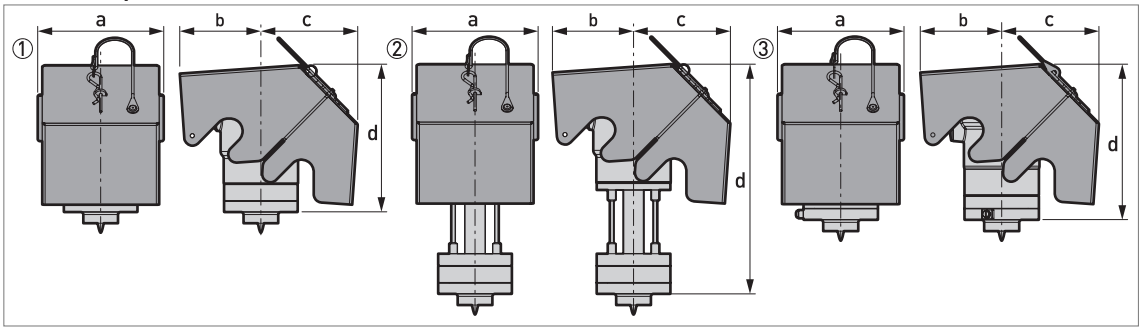

Figure 8-9: Device versions with the weather protection option

① Non-Ex or Ex ia-approved device (aluminium housing – standard version)
② Non-Ex or Ex ia-approved device (aluminium housing – with distance piece)
③ Non-Ex, Ex ia- Ex db- or Ex tb-approved device (stainless steel housing)

Devices with weather protection: Dimensions in mm and inches

Dimensions	Devices with weather protection					
	Aluminium: non-Ex or Ex ia-approved (standard)		Aluminium: non-Ex or Ex ia-approved (with distance piece)		Stainless steel: non-Ex, Ex ia, Ex db or Ex tb-approved	
	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]
a	154	6.06	154	6.06	154	6.06
b	119	4.69	119	4.69	98	3.86
c	136	5.35	136	5.35	118	4.65
d	183	7.20	272	10.71	186	7.32

Weights

Type of device	Weights							
	Aluminium				Stainless steel			
	without weather protection		with weather protection		without weather protection		with weather protection	
	[kg]	[lb]	[kg]	[lb]	[kg]	[lb]	[kg]	[lb]
Non-Ex / intrinsically-safe (Ex ia)								
Standard	2.54	5.61	3.87	8.53	—	—	—	—
With distance piece	3.52	7.76	4.85	10.69	—	—	—	—
Non-Ex / intrinsically-safe (Ex ia) / Explosion proof (Ex db) / Protected by enclosure (Ex tb)								
Standard	—	—	—	—	3.85	8.49	5.18	11.42

9.1 General description

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

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

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

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

If the device is used in multi-drop mode, the network only uses a digital signal that agrees with the HART® Protocol. The loop current is set to 4 mA. You can connect a maximum of 63 devices to the signal cable.

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

9.2 Software description

HART® identification codes and revision numbers

Manufacturer ID:	0x45
Device:	0xBF
Device Revision:	1
DD Revision	1
HART® Universal Revision:	6
FC 475 system SW.Rev.:	≥ 3.8
AMS version:	≥ 12.0
PDM version:	≥ 8.1
FDT version:	1.2

9.3 Connection variants

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

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

There are two ways of using the HART® communication:

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

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

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

The current output of the device is passive.

Also refer to *Point-to-point connection* on page 30.

9.3.2 Multi-Drop connection (2-wire connection)

The device can operate in a network with a device address from 1 to 63.

For an illustration of multi-drop networks, refer to *Multi-drop networks* on page 31.

9.4 HART® device variables

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

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

9.5 Field Communicator 475 (FC 475)

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

9.5.1 Installation

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

System and software requirements for the Field Communicator

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

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

9.5.2 Operation

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

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

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

For more data, refer to *HART*® menu tree for Basic-DD on page 81.

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

9.6.1 Installation

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

9.6.2 Operation

The DTM and the device's local display use almost the same procedures to operate the signal converter. For more data, refer to *Operation* on page 41.

9.7 HART® menu tree for Basic-DD

Abbreviations of the following tables:

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

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

Process Variables	Measured Values Overview	Level
		Distance
		Elec temp
	Output, HART Dynamic Vars	Primary
		Secondary
		Tertiary
		Current Output
	Output (Chart)	Bar View
		Scope
Diag/Service	Status	Standard
		Device Specific
	Test/reset	
Basic setup	Basic setup	Units
		Range values
Detailed setup	Sensors	Basic Param.
		Application
		Service
	Output	Current Output
		Dynamic Variables Mapping
	Device Information	Manufacturer, Model
		Identification
		Parameter Protection
	HART output	Identification
		Preambles
		Revision ①

① 's

9.7.2 Basic-DD menu tree (details for settings)

Process Variables

Measured Values Overview	Level	Level Value[Rd] / Level Data Quality[Rd] / Level Limit Status[Rd]
	Distance	Distance Value[Rd] / Distance Data Quality[Rd] / Distance Limit Status[Rd]
	Elec temp	Temperature Value[Rd] / Temperature Data Quality[Rd] / Temperature Limit Status[Rd]

Output, HART Dynamic Vars	Primary	PV Value[Rd] / PV Data Quality[Rd] / PV Limit Status[Rd]
	Secondary	SV Value[Rd] / SV Data Quality[Rd] / SV Limit Status[Rd]
	Tertiary	TV Value[Rd] / TV Data Quality[Rd] / TV Limit Status[Rd]
	Current Output	PV % range[Rd] / PV Loop current[Rd]
Output (Chart)	Bar View	Level[Rd] / Distance[Rd] / Elect temp[Rd] / Current[Rd]
	Scope View	Level[Rd] / Distance[Rd] / Elect temp[Rd] / Current[Rd]

Diag/Service

Status	Standard	Device status / Write protect	
	Device Specific	Device failures	device_specific_status_0[Rd] / device_specific_status_1[Rd]
		Device Warning Maintenance Required	device_specific_status_3[Rd]
		Device Warning Out of Specification	device_specific_status_2[Rd]
		Info	device_specific_status_4[Rd]
Test/reset	Loop test / Device reset / Reset Configuration Changed Flag		
Spectrum view			

Basic setup

Tag / Long Tag / PV is[Rd] / PV (value)[Rd] / PV (damping value)	
Units	Length Unit / Elect temp unit
Range values	PV LRV[Rd] / PV URV[Rd] / Minimum Distance / Maximum Distance / Float Offset / Tube internal diameter

Detailed setup

Sensors	Basic Param.	Minimum Distance / Maximum Distance / Float Offset / Float Offset Calculation / Tube internal diameter
	Application	Time constant / Tracing Velocity / Multiple Reflection
	Service ①	Minimum Peak / Min. Plaus. Wind. / Offset / Corr. Factor / Device Calibration
Output	Current Output	PV is[Rd] / PV LRV[Rd] / PV URV[Rd] / PV Settings / Output Range / Output Error Delay / Loop current mode / Loop test
	Dynamic Variables Mapping	SV is / TV is
Device Information	Manufacturer, Model	Manufacturer[Rd] / Model[Rd] / Firmware version[Rd]
	Identification	Descriptor / Message / Date / Final asmbly num / cfg chng count[Rd] / Software rev[Rd] / Hardware rev[Rd] / Snsr s/n[Rd] / CPU s/n[Rd] / Elect. s/n[Rd] / Elect. + Housing s/n[Rd] / Sales Order Nber[Rd]
	Parameter Protection	Write protect[Rd] / Access Level HART[Rd] / Set Access Level / Chge/Activ. Pwd
HART output	Identification	Poll addr / Tag / Long tag / Dev id[Rd]
	Preambles	Num req preams[Rd] / Num resp preams[Rd]
	Revision	Universal rev[Rd] / Fld dev rev[Rd]

① This menu is only available if the menu item "Set Access Level" is set to "Service". Go to Detailed Setup > Device Information > Parameter Protection to find the menu item "Set Access Level".

10.1 Order code

The measuring system has 2 parts:

- The OPTIWAVE 1010 radar (FMCW) level transmitter. Give the order code – refer to the table that follows.
- The BM26 Advanced (magnetic level indicator (MLI) or bypass chamber). Give the order code – refer to the table for the **Advanced version (with OPTIWAVE 1010)** in the BM26 Basic/Advanced technical data sheet

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

VF01	4	**OPTIWAVE 1010 6 GHz Radar (FMCW) Level Transmitter for bypass chambers and magnetic level indicators (BM 26 ADVANCED)**			
		Converter version (Housing material – protection class)			
		1	OPTIWAVE 1010: Compact version (Aluminium – IP66 / IP67)		
		2	OPTIWAVE 1010: Compact version (Stainless steel – IP66 / IP67)		
		3	OPTIWAVE 1010: Compact version (Aluminium – IP66/67) with distance piece for electronic spare parts only		
			Approval ①		
			0	Without	
			1	ATEX II 1/2 G Ex ia IIC Tx Ga/Gb + II 2 D Ex ia IIIC T120°C ②	
			2	ATEX II 1/2 G Ex db IIC T6…T4 Ga/Gb + II 2 D Ex tb IIIC T120°C Db ③	
			6	IECEx Ex ia IIC Tx Ga/Gb + Ex ia IIIC T120°C Db ④	
			7	IECEx Ex db IIC T6…T4 Ga/Gb + Ex tb IIIC T120°C Db ⑤	
				Other approval	
				0	Without
				B	EAC Russia ⑥
				C	EAC Belarus ⑥
				K	EAC Kazakhstan ⑥
VF01	4				**Order code (complete this code on the pages that follow)**

					Process seal – Temperature / Pressure / Material / Remarks (material to be checked by the customer)															
					0	Without														
					1	-40°C...+100°C (-40°F...+212°F) / -1...16 barg (-14.5...232 psig) / FKM/FPM / aluminium housing and Metapeek process seal														
					2	-40°C...+100°C (-40°F...+212°F) / -1...16 barg (-14.5...232 psig) / EPDM / aluminium housing and Metapeek process seal														
					3	-20°C...+100°C (-4°F...+212°F) / -1...16 barg (-14.5...232 psig) / Kalrez® 6375 / aluminium housing and Metapeek process seal														
					5	-40°C...+150°C (-40°F...+302°F) / -1...40 barg (-14.5...580 psig) / FKM/FPM / aluminium housing, Metaglas® process seal and distance piece														
					6	-40°C...+150°C (-40°F...+302°F) / -1...40 barg (-14.5...580 psig) / EPDM / aluminium housing, Metaglas® process seal and distance piece														
					7	-20°C...+150°C (-4°F...+302°F) / -1...40 barg (-14.5...580 psig) / Kalrez® 6375 / aluminium housing, Metaglas® process seal and distance piece														
					A	-40°C...+120°C (-40°F...+248°F) / -1...40 barg (-14.5...580 psig) / FKM/FPM / stainless steel housing and Metaglas® process seal														
					B	-40°C...+120°C (-40°F...+248°F) / -1...40 barg (-14.5...580 psig) / EPDM / stainless steel housing and Metaglas® process seal														
					C	-20°C...+120°C (-4°F...+248°F) / -1...40 barg (-14.5...580 psig) / Kalrez® 6375 / stainless steel housing and Metaglas® process seal														
						Antenna: Matching element / Material														
						0	Without													
						1	Metallic Horn for tube Ø42.4 × 2 / 316L													
							0	0	0	0	**Output**									
											1	2-wire / 4...20mA passive HART								
												Cable entry / Cable gland								
												1	M20×1.5 / Without							
												2	M20×1.5 / Plastic							
												3	M20×1.5 / Nickel-plated brass							
												4	M20×1.5 / Stainless steel							
												A	½ NPT (nickel-plated brass) / Without							
												B	½ NPT (stainless steel) / Without							
													Housing (Orientation / Display / Weather protection)							
													A	Vertical / Without / Without						
													D	Vertical / Without / With						
														0	**Version**					
															0	KROHNE (RAL 9006 / RAL 5005)				
															6	KROHNE USA (FCC)				
															A	KMIC L (for liquid applications)				
																0	0	0	**Calibration certificate**	
																			0	Without
																			1	Calibration certificate 2 factory default points
																			2	Calibration certificate 5 factory default points for accuracy ±5 mm (±0.2")
VF01	4						0	0	0	0	1			0		0	0	0		**Order code (complete this code on the pages that follow)**

																			TAG Number		
																			0	Without	
																			2	Tag No. on stainless steel plate (18 characters max.)	
																				Other constructions	
																				0	Without
																				1	NACE design (MR 0175 / MR 0103 / ISO 15156)
VF01	4						0	0	0	0	1			0		0	0	0				**Order code**

① For more data, refer to the Technical data section (Approvals and certification)
② The dust approval is only applicable to the stainless steel housing. The bypass chamber or BM 26 Advanced must be approved for ATEX applications.
③ For the stainless steel housing only. The bypass chamber or BM 26 Advanced must be approved for ATEX applications.
④ The dust approval is only applicable to the stainless steel housing.
⑤ For the stainless steel housing only
⑥ Pending

10.2 Spare parts

We supply spare parts for this device. When you send an order for a spare part, use the reference numbers in the table that follows.

Other spare parts

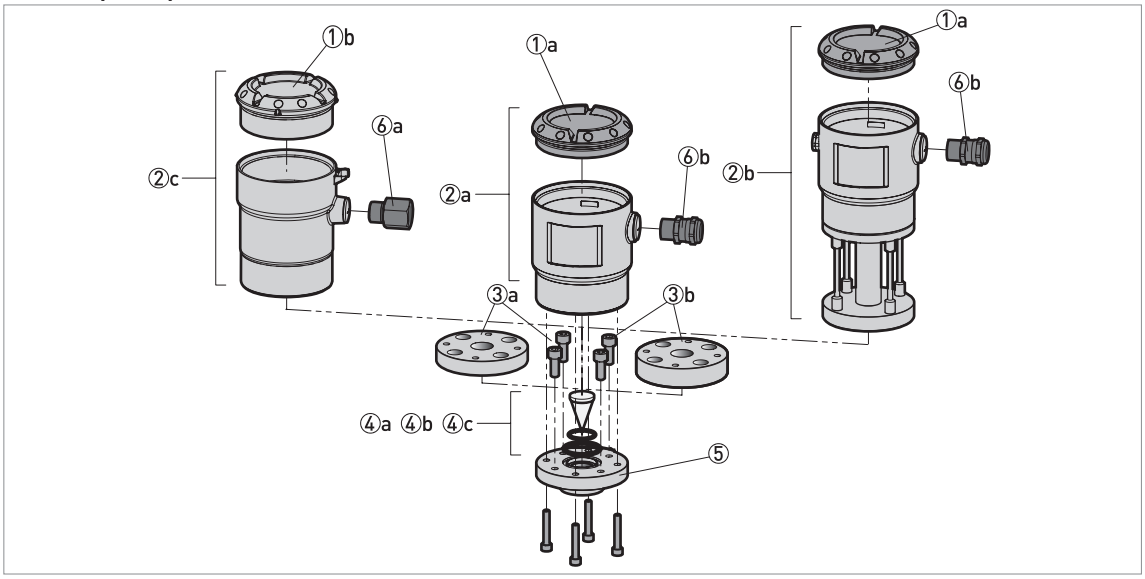

Figure 10-1: Other spare parts

① 1a. Aluminium housing cover and O-ring
1b. Stainless steel housing cover and O-ring
② 2a. Aluminium housing and electronics (this includes the housing cover and 4 screws)
2b. Aluminium housing, electronics and temperature extension (this includes the housing cover and 4 screws)
2c. Stainless steel housing and electronics (this includes the housing cover and 4 screws)
③ 3a. Metapeek seal PN16 (this includes 4 screws)
3b. Metaglas seal PN40 (this includes 4 screws)
④ 4a. PEEK cone with FKM/FPM O-rings
4b. PEEK cone with Kalrez O-rings
4c. PEEK cone with EPDM O-rings
⑤ 316/316L matching element for Ø42 mm welded connection (BM 26 Advanced)
⑥ Cable gland
6a. M20×1.5 / ½ NPT nickel-plated brass adaptor (non-Ex, Ex i and Ex d)
6b. M20×1.5 black (non-Ex)
6c. thru 6f. Refer to the table that follows

Item		Description	Quantity	Part reference
①	a	Aluminium housing cover and O-ring	1 + 1	XF01010100
	b	Stainless steel housing cover and O-ring	1 + 1	XF01010200
②	a	Aluminium housing and electronics (this includes the housing cover and 4 screws)	1	XF01020100
	b	Aluminium housing, electronics and temperature extension (this includes the housing cover and 4 screws)	1	XF01020200
	c	Stainless steel housing and electronics (this includes the housing cover and 4 screws)	1	XF01020300
③	a	Metapeek seal PN16 (this includes 4 screws)	1 seal + 4 screws	XF01040100
	b	Metaglas® seal PN40 (this includes4 screws)	1 seal + 4 screws	XF01040200

Item		Description	Quantity	Part reference
④	a	PEEK cone with FKM/FPM O-rings	1 cone + 2 O-rings	XF01050100
	b	PEEK cone with Kalrez® 6375 O-rings	1 cone + 2 O-rings	XF01050200
	c	PEEK cone with EPDM O-rings	1 cone + 2 O-rings	XF01050300
⑤	—	316/316L matching element for Ø42 mm welded connection	1	XF01060100
⑥	a	M20×1.5 / ½ NPT nickel-plated brass adaptor (non-Ex, Ex i and Ex d)	5	XF01070100
	b	M20×1.5 black (non-Ex)	10	XF01070200
	c	M20×1.5 blue (Ex i)	10	XF01070300
	d	M20×1.5 nickel-plated brass (non-Ex, Ex i and Ex d)	5	XF01070400
	e	M20×1.5 stainless steel (non-Ex, Ex i and Ex d)	2	XF01070500
	f	M20×1.5 / ½ NPT stainless steel adaptor (non-Ex, Ex i and Ex d)	2	XF01070600

10.3 Accessories

We supply accessories for this device. When you send an order for accessories, please give the reference numbers that follow:

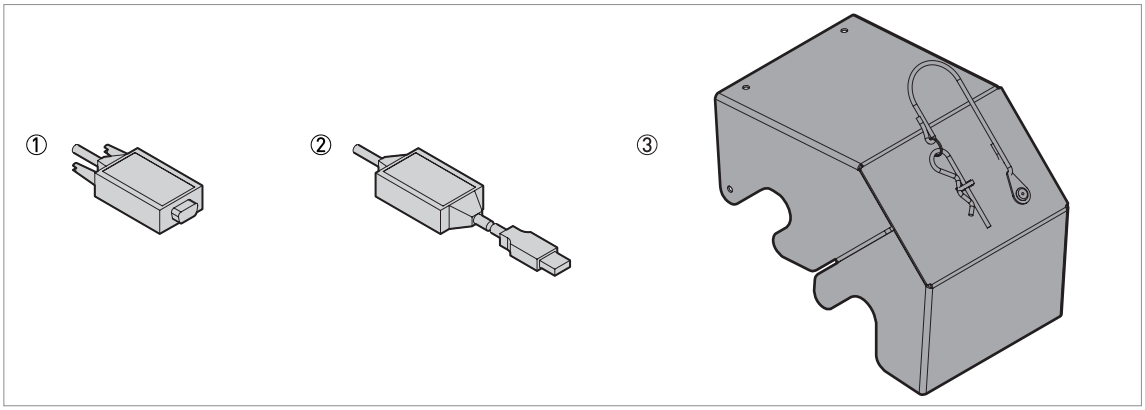

Figure 10-2: Accessories

① Viator RS232 / HART converter
② Viator USB / HART converter
③ 316L stainless steel weather protection

Item	Description	Quantity	Part reference
①	Viator RS232 / HART converter	1	XF50020600
②	Viator USB / HART converter	1	XF50020700
③	316L stainless steel weather protection	1	XF50050800

10.4 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 matching element to the surface of the measured product (measurement without a float) or the target on top of the float in the bypass chamber. 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 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).

I

Interference signals (parasitic signals) False radar reflections.

L

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

M

Matching element The part of the device that is welded to the top of the magnetic level indicator. It is used for the controlled emission and collection of radar signals.

O

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

P

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

R

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

S

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

Supervisor Users who can configure the device in supervisor mode. They cannot configure the device in service mode.

KROHNE – Process instrumentation and measurement solutions

- Flow
- Level
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