



## OPTIWAVE 7500 C Handbook

Radar (FMCW) Level Transmitter for high-precision storage of liquids

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## 1.1 Software history

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

Data about software revisions is shown in menu 1.1.0 IDENT. For more data, refer to *Function description* on page 60. If it is not possible to refer to the device menu, record the serial number of the device (given on the device nameplate) and speak to the supplier.

Release date	Printed circuit assembly	Firmware revision	Hardware revision	Changes and compatibility	Documentation
YYYY-MM-DD	Converter	1.00.0x	400xxxxx01	—	HB OPTIWAVE 7500 R01
	Sensor	1.00.0x	400xxxxx01		
	HMI (LCD display option)	1.00.0x	400xxxxx01		

## 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.*



**CAUTION!**

**SIL-qualified devices:**

*For more data, refer to the Safety Manual.*

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

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

## 1.3 Certification

**DANGER!**

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

**INFORMATION!**

*For SIL-approved devices; please refer to the safety manual.*

**CE marking****The device meets the essential requirements of the EU Directives:**

- Electromagnetic Compatibility (EMC) directive
- The safety part of the Low-Voltage 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 21, NE 43, NE 53 and NE 107.

## 1.4 Electromagnetic compatibility

The device agrees with Electromagnetic Compatibility Directive.

You can install the device on tanks, open vessels or channels, but the type of antenna must agree with the location of the device. For more data, refer to *Radio approvals* on page 9.

**INFORMATION!**

*This agrees with Immunity and Emissions requirements for industrial environments.*





**TLPR (Tank Level Probing Radar) devices only**

Use approved personnel to install the device. The device and the tank agree with the RED (Radio Equipment Directive) if you obey the instructions that follow:

- 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.

For data about how to install EMI/RFI shielding gaskets, refer to the instructions supplied with this accessory.

**LPR (Level Probing Radar) devices only**

Use approved personnel to install the device. If the device is operated in the open air (outdoors), it agrees with the RED (Radio Equipment Directive) if you obey these instructions:



- The antenna must always point downwards. The boresight direction of the antenna must be vertical. No other angles are permitted.
- Install the device more than 4 km / 2.485 mi away from radio astronomy sites.
- If the device is 4...40 km / 2.485...24.855 mi away from radio astronomy sites, do not install the device more than 15 m / 49.21 ft above the ground.

**CAUTION!**

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

**Radio quiet zones: locations of radio astronomy sites (stations) in Europe and northern Eurasia**

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

## 1.5.2 U.S.A.

**INFORMATION!**

**LPR (Level Probing Radar)** equipment are devices for the measurement of level in the open air or in a closed space (a metallic tank etc.). **TLPR (Tank Level Probing Radar)** equipment are devices for the measurement of level in a closed space only.

This level transmitter is approved to be used outside metallic tanks. If you use the device in the open air, read the device nameplate to make sure that the device can be used for your application:

Antenna type	Order code	Permitted for:
PEEK / Lens Ø40 mm / 1.5"	VFDFxxxxxxxxxxxx3xx...	LPR + TLPR
PEEK / Lens Ø70 mm / 2.75"	VFDFxxxxxxxxxxxx4xx...	LPR + TLPR

**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 the manufacturer may void the FCC authorizations to operate this equipment.

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

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

The Product Marketing Name (PMN) of this device is "Optiwave x500 series".

This level transmitter is approved to be used outside metallic tanks. If you use the device in the open air, read the device nameplate to make sure that the device can be used for your application. Only the antenna that follows is permitted for open-air applications:

- VFDFxxxxxxxxxxxx3xx...
- VFDFxxxxxxxxxxxx4xx...



### 1.5.3 Canada



#### **INFORMATION!**

**LPR (Level Probing Radar)** equipment are devices for the measurement of level in the open air or in a closed space (a metallic tank etc.). **TLPR (Tank Level Probing Radar)** equipment are devices for the measurement of level in a closed space only.

This level transmitter is approved to be used outside metallic tanks. If you use the device in the open air, read the device nameplate to make sure that the device can be used for your application:

Antenna type	Order code	Permitted for:
PEEK / Lens Ø20 mm / ¾"	VDFDxxxxxxxxxxxx1xx...	TLPR
PEEK / Lens Ø25 mm / 1"	VDFDxxxxxxxxxxxx2xx...	TLPR
PEEK / Lens Ø40 mm / 1.57"	VDFDxxxxxxxxxxxx3xx...	LPR
PEEK / Lens Ø70 mm / 2.75"	VDFDxxxxxxxxxxxx4xx...	LPR



#### **LEGAL NOTICE!**

*This device complies with Industry Canada licence-exempt RSS standard(s).*

*Operation is subject to the following conditions:*

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

*This device and the handbook complies with the requirements of RSS-Gen. Operation is subject to the conditions that follow:*

- 1. The installation of the LPR/TLPR device shall be done by trained installers, in strict compliance with the manufacturer's instructions.*
- 2. The use of this device is on a "no-interference, no-protection" basis. That is, the user shall accept operations of high-powered radar in the same frequency band which may interfere with or damage this device. However, devices found to interfere with primary licensing operations will be required to be removed at the user's expense.*
- 3. The TLPR device shall be installed and operated in a completely enclosed container to prevent RF emissions, which can otherwise interfere with aeronautical navigation.*
- 4. LPR devices: Ensure a vertically downward orientation of the transmit antenna and a installation only at fixed locations.*
- 5. The installer / user of this device shall ensure that it is at least 10 km from the Dominion Radio Astrophysical Observatory (DRAO) near Penticton, British Columbia. The coordinates of the DRAO are latitude 49° 19' 15" N and longitude 119° 37' 12" W. For devices not meeting this 10 km separation (e.g. those in the Okanagan Valley, British Columbia) the installer / user must coordinate with, and obtain the written concurrence of, the Director of the DRAO before the equipment can be installed or operated. The Director of the DRAO may be contacted at 250-497-2300 (tel.) or 250-497-2355 (fax). Alternatively, the Manager, Regulatory Standards, Industry Canada, may be contacted.*

The Product Marketing Name (PMN) of this device is "Optiwave x500 series".

This level transmitter is approved to be used outside metallic tanks. If you use the device in the open air, read the device nameplate to make sure that the device can be used for your application. Only the antenna that follows is permitted for open-air applications:

- VFDFxxxxxxxxxxxx3xx...
- VFDFxxxxxxxxxxxx4xx...

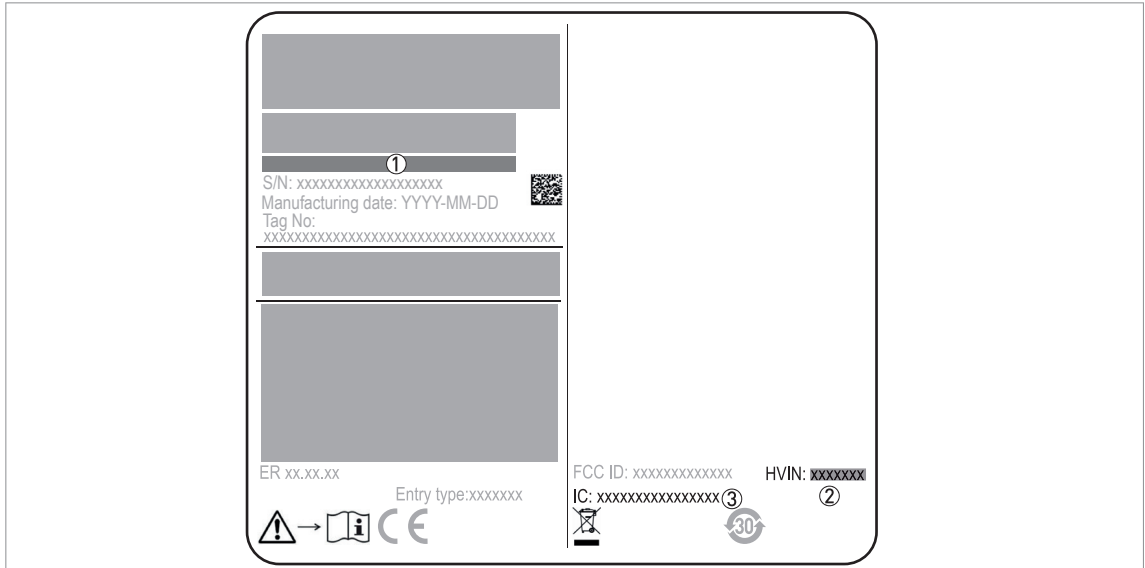


Figure 1-3: IC number

- ① Type code (defined in order)
- ② HVIN (Hardware Version Identification Number). This number gives the radar signal frequency (80G = 80 GHz), the location of the device (T=TLPR or L=LPR) and the type of signal converter (compact [C])  
 TLPR device: HVIN: 80G-T-C  
 LPR device: HVIN: 80G-L-C
- ③ IC number  
 TLPR device: 1991D-FMCW80G74T-A  
 LPR device: 1991D-FMCW80G74L-A

## 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.*

### Scope of delivery



**Figure 2-1: Scope of delivery**

- ① Signal converter and antenna in the ordered version
- ② Antenna extensions (option)
- ③ Quick start
- ④ Certificates and calibration report (if the device has the appropriate options)
- ⑤ DVD-ROM (including handbook, quick start, technical data sheet and related software)
- ⑥ Bar magnet
- ⑦ Handle (for removal of the optional display module)
- ⑧ Wrench (for removal of the device covers)

## 2.2 Device description

This device is a 80 GHz FMCW-radar level transmitter. It is a non-contact technology and is 2-wire loop-powered. It is designed to measure the distance, level, mass, volume and reflectivity of liquids, pastes and slurries. For more data about the measuring principle,.

Radar level transmitters use an antenna to emit a signal to the surface of the measured product. The device has many antennas available. Thus, it can measure most products even in difficult conditions. Also refer to *Technical data* on page 98.

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

The signal converter is attached directly to the process connection and the antenna. The illustration that follows shows the types of antenna.

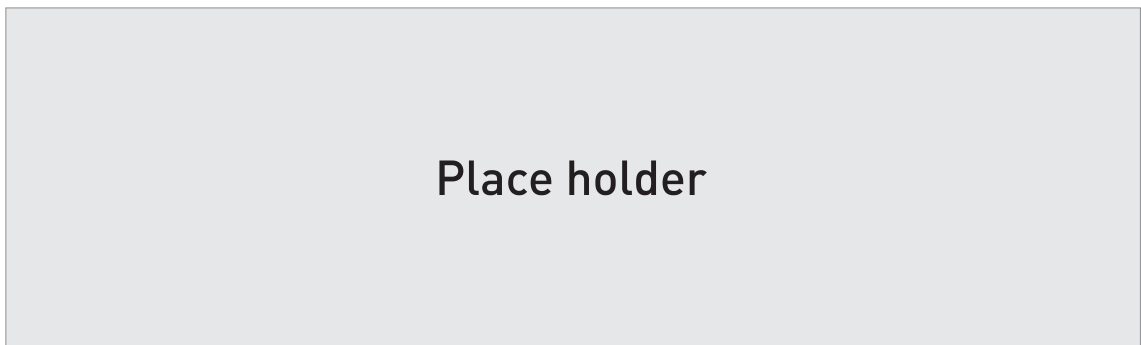


Figure 2-2: Types of antenna

① Lens antennas (available antenna sizes: Ø20 mm (0.75"), Ø25 mm (1"), Ø40 mm (1.5") and Ø70 mm (2.75") made of PEEK)

### These accessories are available:

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



### **INFORMATION!**

*For more data on accessories.*

## 2.3 Visual Check



**WARNING!**

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



**INFORMATION!**

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



Figure 2-3: Visual check

- ① Device nameplate (for more data refer to *Nameplate (examples)* on page 21)
- ② Process connection data (size and pressure rating, material reference and heat number)
- ③ Gasket material data – refer to the illustration that follows



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

- ① EPDM
- ② Kalrez® 6375

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



**INFORMATION!**

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



**INFORMATION!**

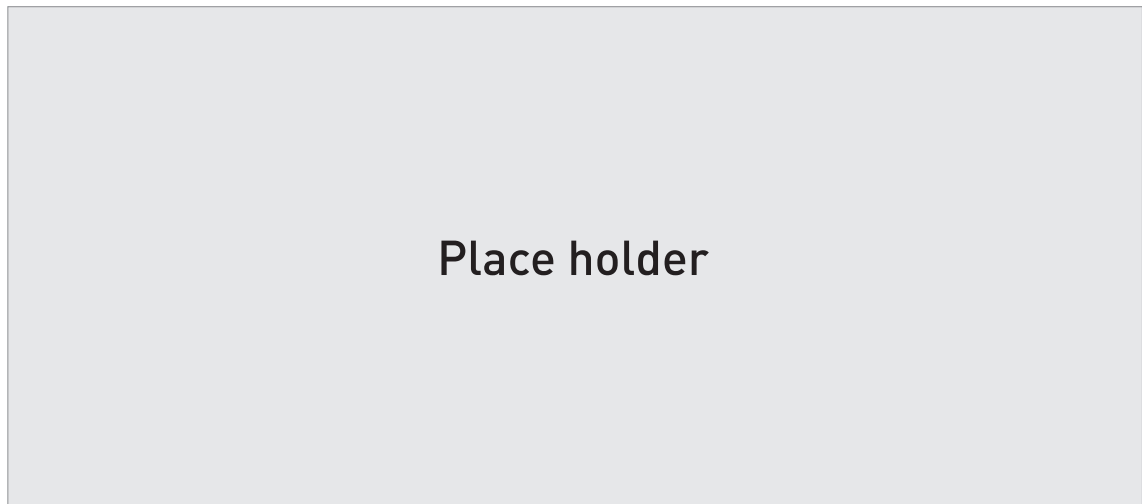
*Compare the material references on the side of the process connection with the order.*

## 2.4 Nameplates

**INFORMATION!**

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

### 2.4.1 Nameplate (examples)



**Figure 2-5: Non-Ex nameplate attached to the housing**

- ① Cable entry size
- ② Hardware revision / Software revision (according to NAMUR NE 53)
- ③ Signal output (analog, HART®, fieldbus, etc.), input voltage and maximum current (fieldbus options: basic current)
- ④ Degree of ingress protection (according to EN 60529 / IEC 60529)
- ⑤ Customer tag number
- ⑥ Date of manufacture
- ⑦ Order number
- ⑧ Type code (defined in order)
- ⑨ Model name and number. C = compact version.
- ①① Company logo, name and postal address  
Country of manufacture / Company web address

### 3.1 General notes on installation

**INFORMATION!**

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

**INFORMATION!**

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

**INFORMATION!**

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

### 3.2 Storage

**WARNING!**

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

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

### 3.3 Transport

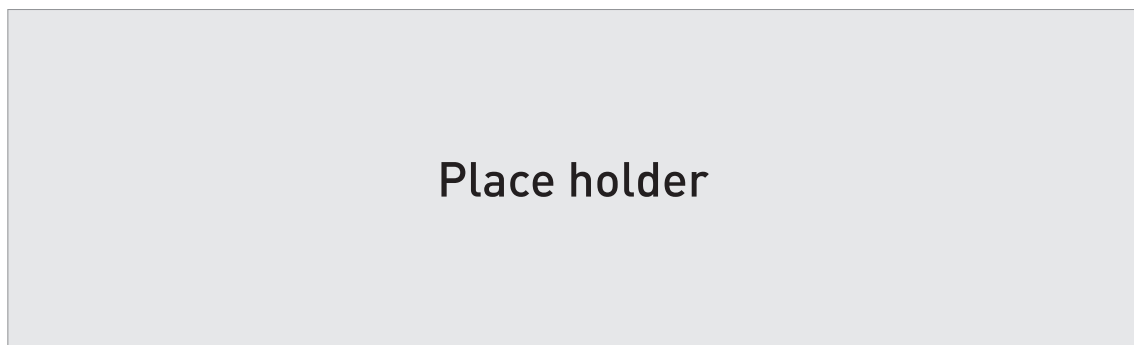


Figure 3-1: How to lift the device

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

**WARNING!**

Lift the device carefully to prevent damage to the antenna.

### 3.4 Pre-installation requirements

**INFORMATION!**

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

- Make sure that there is sufficient space on all sides.

- Protect the signal converter from direct sunlight. If necessary, install the weather protection accessory.
- Do not subject the signal converter to heavy vibrations. The devices are tested for vibration and agree with EN 50178 and IEC 60068-2-6.

### 3.5 Pressure and temperature ranges

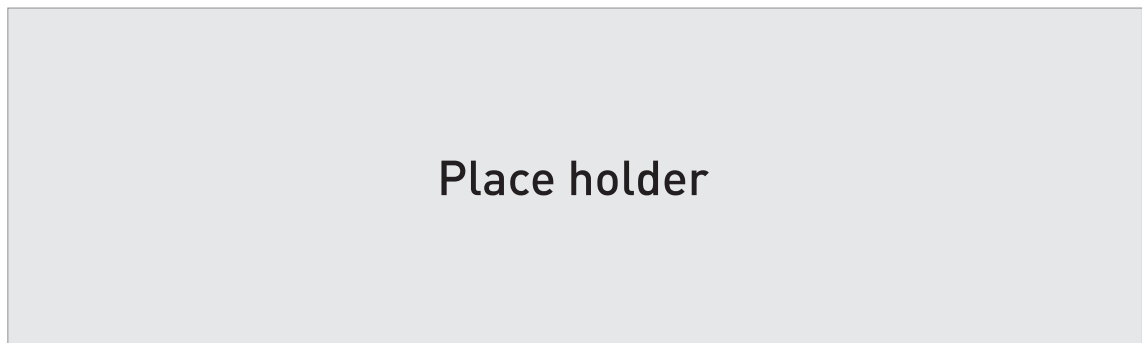


Figure 3-2: Pressure and temperature ranges

- ① Temperature at the process connection  
Non-Ex devices: The temperature range depends on the type of antenna, process connection and the seal material. Refer to the table that follows.  
Devices with Hazardous Location approvals: see supplementary instructions
- ② Ambient temperature for operation of the display  
-20...+70°C / -4...+158°F  
If the ambient temperature is not between these limits, then this condition can stop the display. The device continues to operate.
- ③ Ambient temperature  
Non-Ex devices: -40...+80°C / -40...+185°F  
Devices with Hazardous Location approvals: see supplementary instructions



**WARNING!**

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

For more data on pressure ratings,.

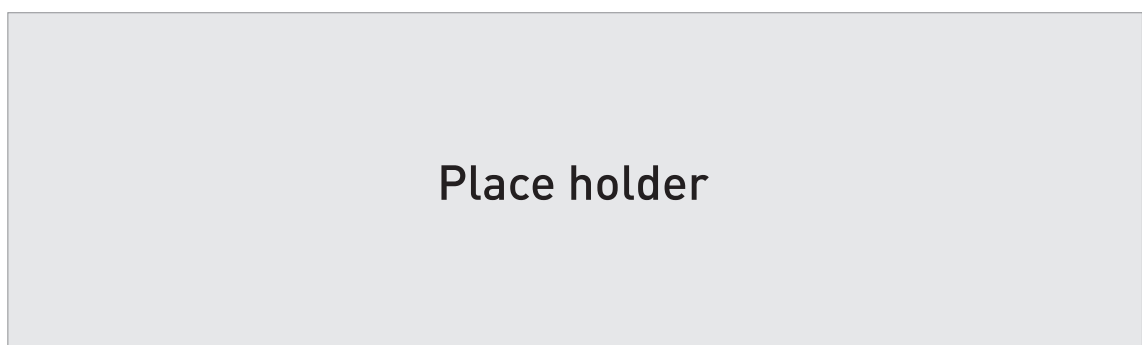


Figure 3-3: Ambient temperature / flange temperature, flange and threaded connection, in °C

## 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.

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

### 3.6.1 General notes

**CAUTION!**

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

Point the cable entries on the housing in the direction of the nearest tank wall.

### 3.6.2 Tanks with conical bottoms

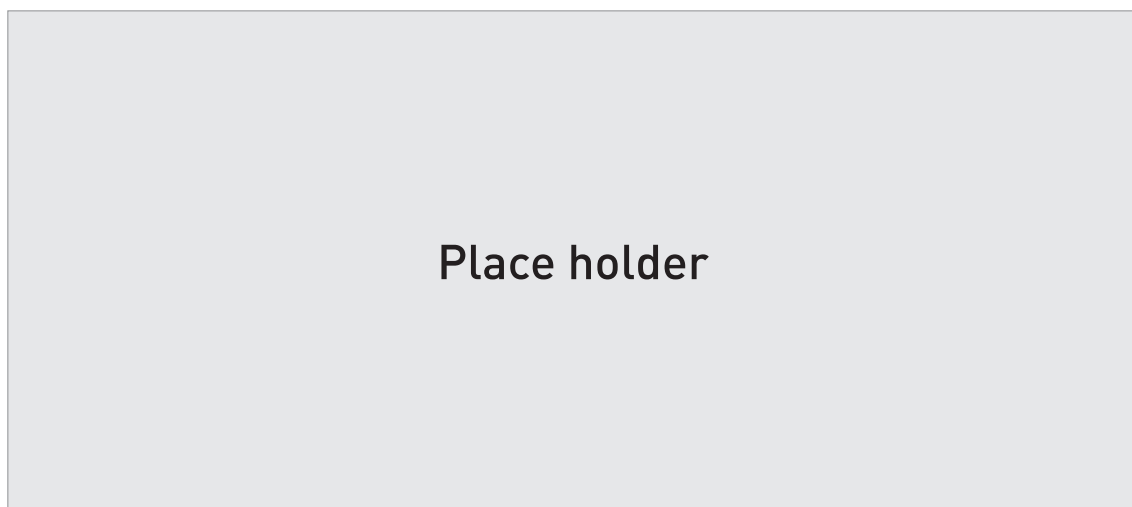


Figure 3-4: Tanks with dish-shaped or conical bottoms

Dish-shaped or conical bottoms have an effect on the measuring range. The device cannot measure to the bottom of the tank.

- ① Axis of radar beam
- ② Minimum level reading

## 3.7 Mounting restrictions

**CAUTION!**

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

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



### 3.7.1 General data for TLPD devices

**CAUTION!**

Do not install the device above objects in the tank (ladder, supports etc). Objects in the tank can cause parasitic signals. If there are parasitic signals, the device will not measure correctly. If it is not possible to install the device on another part of the tank, do an empty spectrum scan.

**INFORMATION!**

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

### 3.7.2 Obstacles in the tank

Obstacles in the tank can cause parasitic signals. They have an effect on the performance of the device.

**CAUTION!**

If there are parasitic signals, the device will not measure correctly. Parasitic signals are caused by:

- Objects in the tank.
- Sharp corners that are perpendicular to the path of the radar beam.

Do an Empty Spectrum recording (refer to **Operation**) to remove parasitic signals with a filter.

**CAUTION!**

Do not put the device near to the product inlet. If the product that enters the tank touches the antenna, the device will measure incorrectly. If the product fills the tank directly below the antenna, the device will also measure incorrectly.

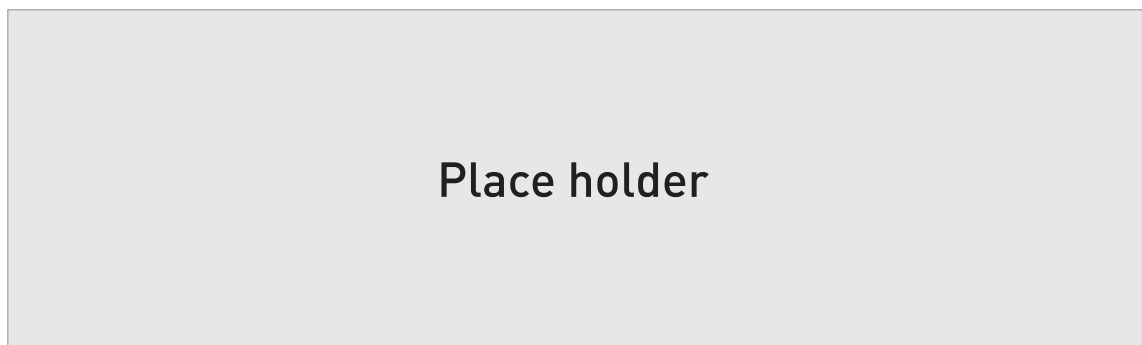


Figure 3-5: Product inlets

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

**CAUTION!**

Do not put the device near to the product inlet. If the product that enters the tank touches the antenna, the device will measure incorrectly. If the product fills the tank directly below the antenna, the device will also measure incorrectly.

### 3.7.3 Process connections

#### Requirements for flange connections

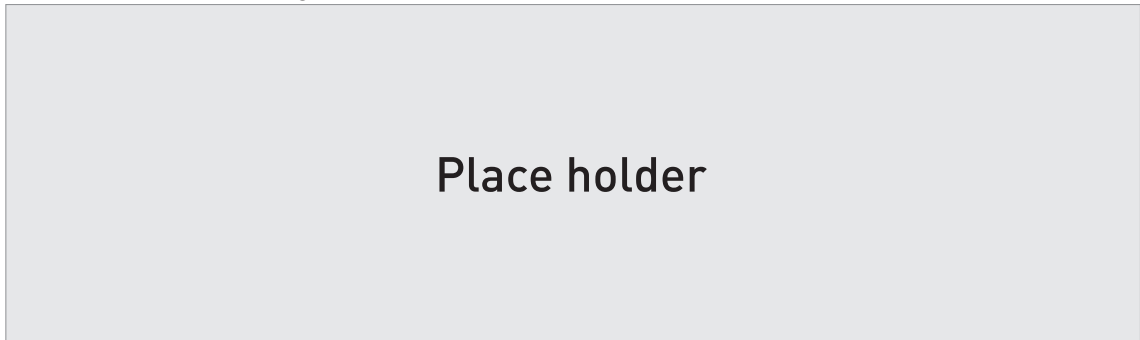


Figure 3-6: Flange connection

#### Equipment needed:

- Device
- Flange gasket (not supplied)
- Wrench (not supplied)



- Make sure the flange on the nozzle is level.
- Make sure that you use the applicable gasket for the flange dimensions and the process.
- Align the gasket correctly on the flange facing of the nozzle.
- Lower the antenna carefully into the tank.
- Make sure that you point the device in the correct direction. Refer to "Point the device in the correct direction" in this section.
- Tighten the flange bolts.
- ➡ Refer to local rules and regulations for the correct torque to apply to the bolts.

#### Equipment needed:

- Device
- Gasket for G 1½ connection (not supplied)
- Thread seal tape (PTFE) for 1½ NPT connection (not supplied)
- 50 mm / 2" wrench (not supplied)



#### **WARNING!**

*Do not tighten the connection to a torque more than 40 N·m / 29.5 lb·ft. If the connection is too tight, this will damage the thread.*

*To prevent damage to the antenna, make sure that the minimum diameter of the hole for a 1½ NPT or 2 NPT thread connection is not less than 43.4 mm / 1.71".*



- Make sure the tank connection is level.
- **ISO 228-1 (G) connection:** Make sure that you use the applicable gasket for the connection dimensions and the process.
- **ISO 228-1 (G) connection:** Align the gasket correctly.
- **NPT connection:** Wind the thread seal tape around the process connection in agreement with good engineering practice.
- Lower the antenna carefully into the tank.

- Turn the threaded connection on the antenna to attach the device to the process connection.
- Make sure that you point the device in the correct direction. Refer to "Point the device in the correct direction" in this section.
- Tighten the connection to the correct torque (not more than 40 N·m / 29.5 lb·ft).

### 3.8 How to turn or remove the display module (option)

If there is an object adjacent to the device that makes it difficult to read the display, you can rotate the display in increments of 90°.

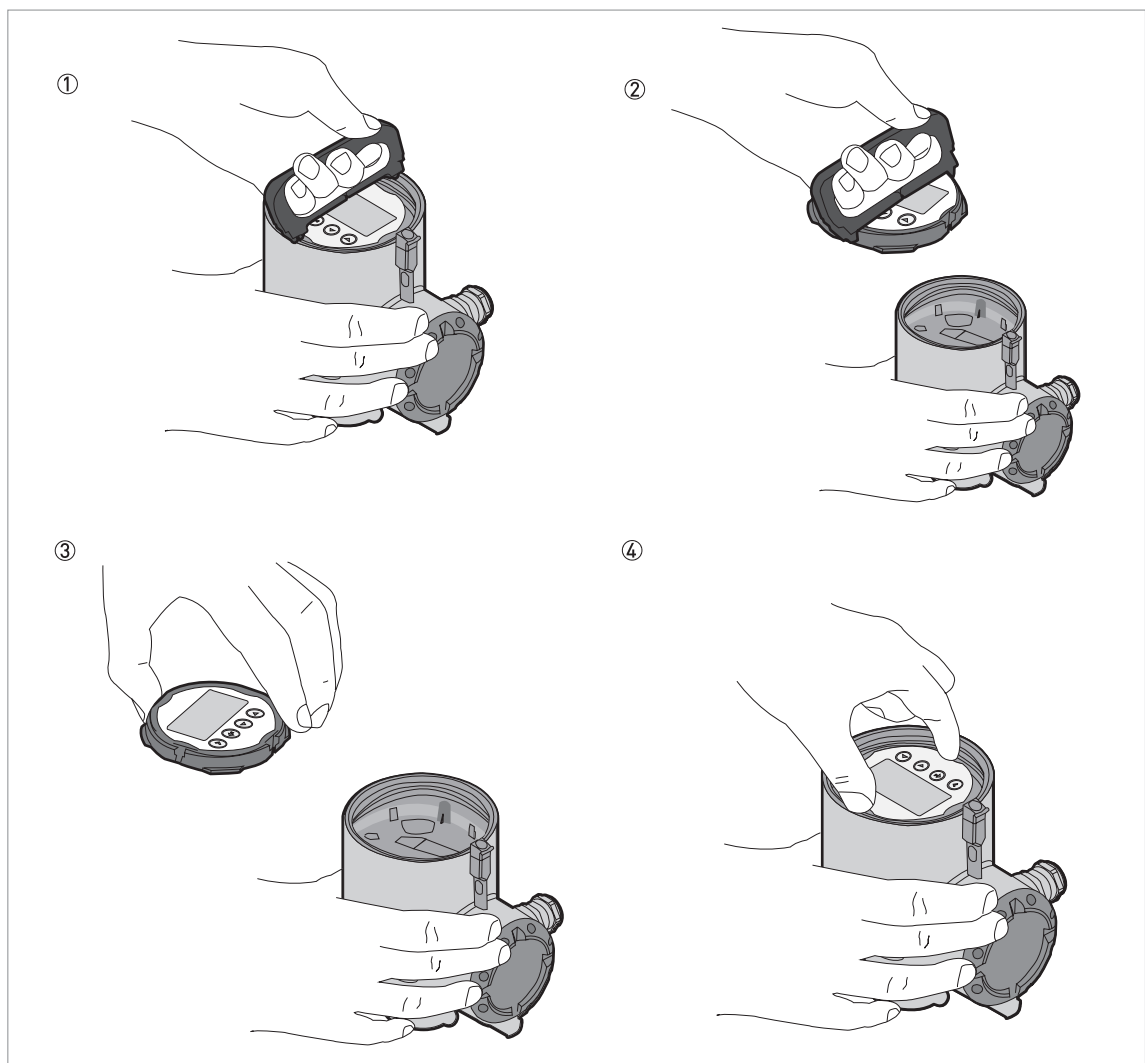


Figure 3-7: How to turn or remove the display module (option)

- ① Tool: Wrench (for removal of the device covers)
- ② Tool: Handle (for removal of the display module)



#### Follow this procedure:

- Disconnect the power supply from the device.
- Remove the housing cover with the wrench ①.

- Use the handle to remove the display module.
- First put the handle on side "a" and then on side "b" of the display, and then carefully remove the display ② from housing. Remove the handle from the display module first on side "a" and then on side "b". Turn it into the favoured position ③.
- Turn the display module until it points to the user.
- Push the display onto the clips in the housing ④, until they make a click.
- Make sure that the housing cover has a gasket. Attach the cover on the housing and tighten it by hand.

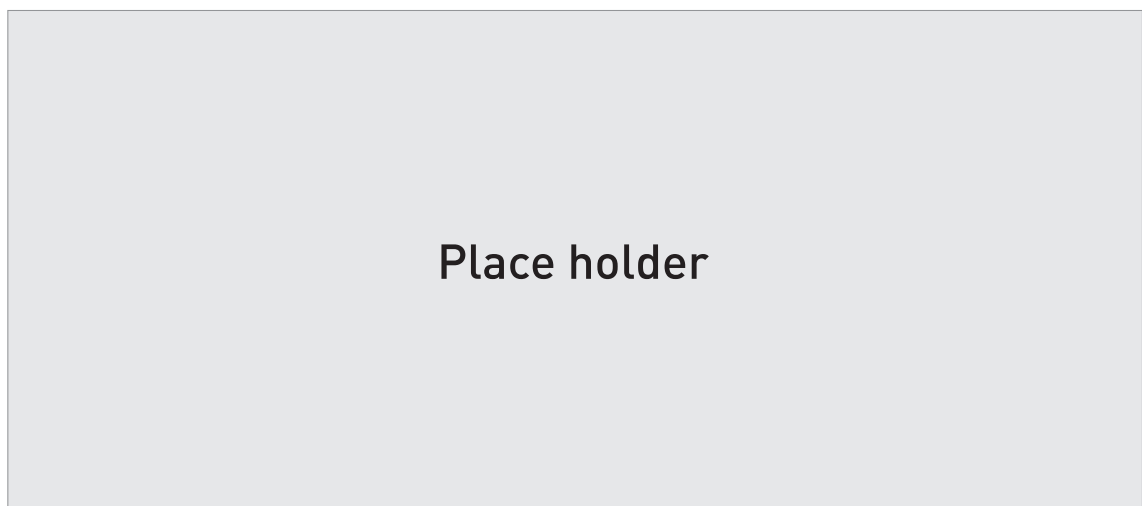
**INFORMATION!**

*Before you close the housing cover, refer to How to turn or remove the display module (option) on page 27.*

### 3.9 How to turn or remove the signal converter

**INFORMATION!**

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



**Figure 3-8: How to turn or remove the signal converter**

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

**CAUTION!**

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

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

## 3.10 Weather protection

### 3.10.1 How to attach the weather protection to the device

#### Place holder

Figure 3-9: Equipment needed to assemble the weather protection

- ① Weather protection cover (with a split pin to hold the cover on the clamp)
- ② Device
- ③ Weather protection clamp (2 parts)
- ④ 2 locking nuts
- ⑤ 10 mm socket wrench (not supplied).

The overall dimensions of the weather protection are on page 105.

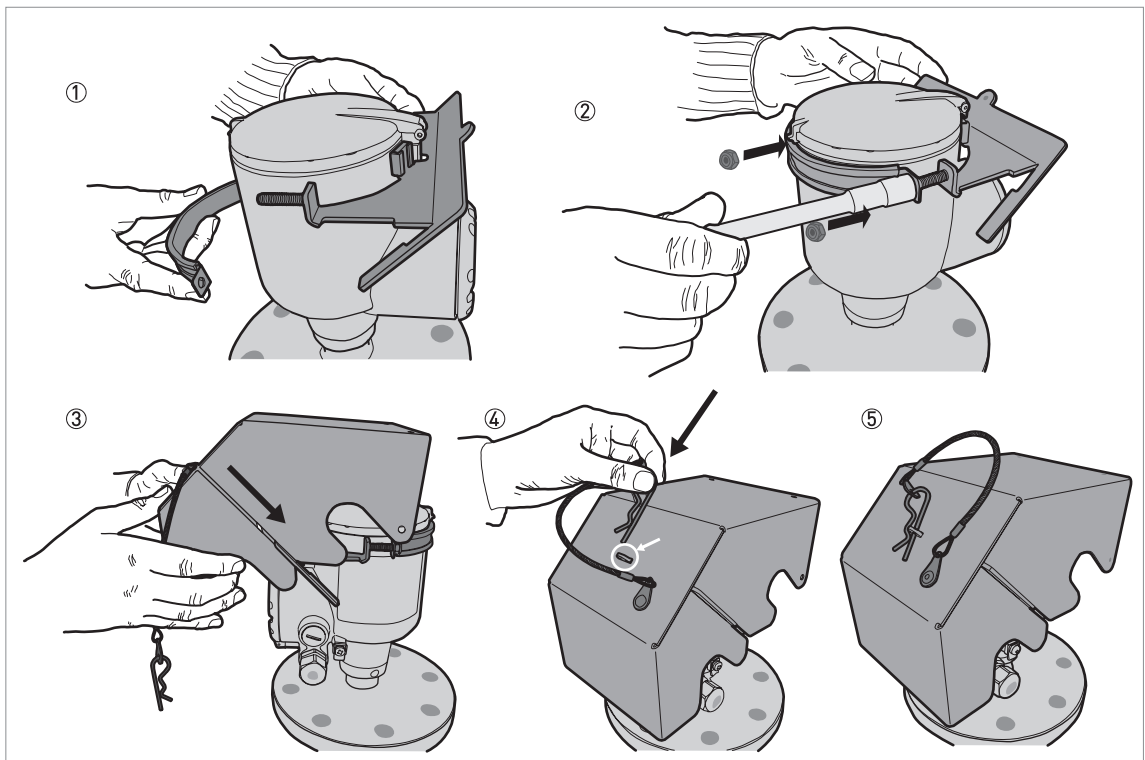


Figure 3-10: Installation of the weather protection



- 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.

- 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.
- Put the R-clip into the hole at the front of the weather protection cover.
- End of the procedure.

### 3.10.2 How to open the weather protection

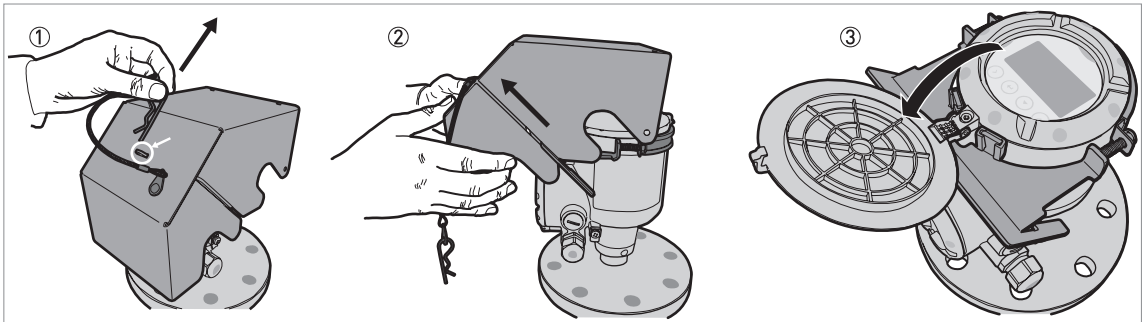


Figure 3-11: How to open the weather protection



- ① Remove the R-clip from the hole at the front of the weather protection cover.
- ② Remove the weather protection cover.
- ➔ Lift the display screen cover.

## 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

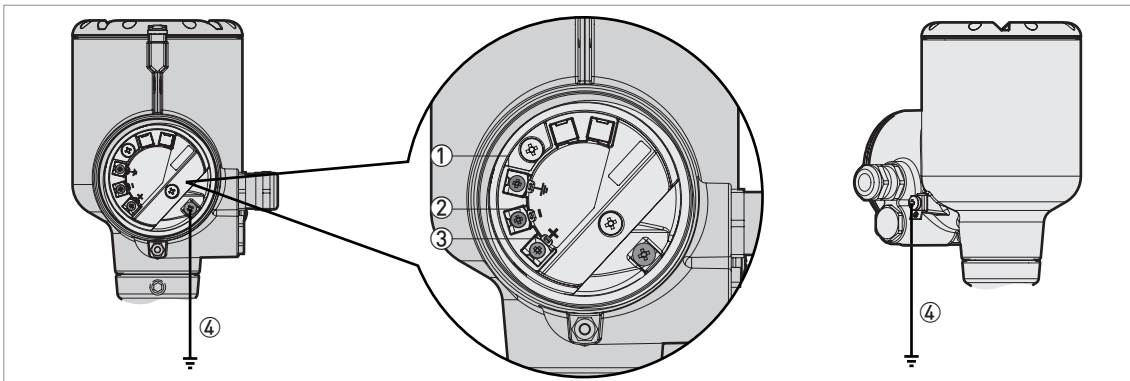


Figure 4-1: Terminals for electrical installation

- ① Grounding terminal in the housing (if the electrical cable is shielded)
- ② Current output -
- ③ Current output +
- ④ Location of the external grounding terminal (at the bottom of the converter)



**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.
- Make sure that the current is not more than 5 A or that there is 5 A-rated fuse in the electrical circuit that energizes the device.



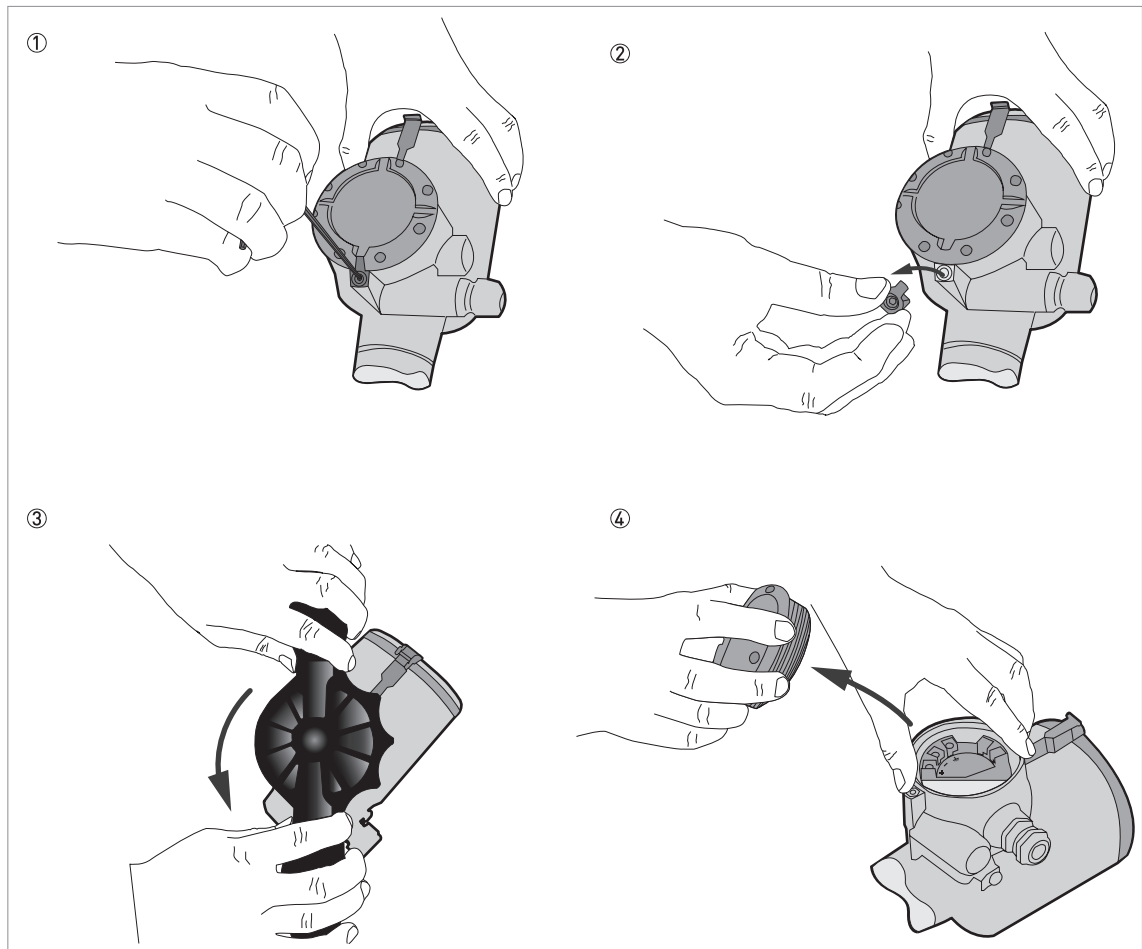


Figure 4-2: How to open the terminal compartment cover

#### Equipment needed:

- 3 mm Allen wrench (not supplied)
- Cover wrench (supplied).



#### Procedure

- ① Loosen the lock screw with a 3 mm Allen wrench (not supplied).
- ② Remove the cover stop.
- ③ Turn the cover counterclockwise with the cover wrench (supplied).
- ④ Remove the cover.

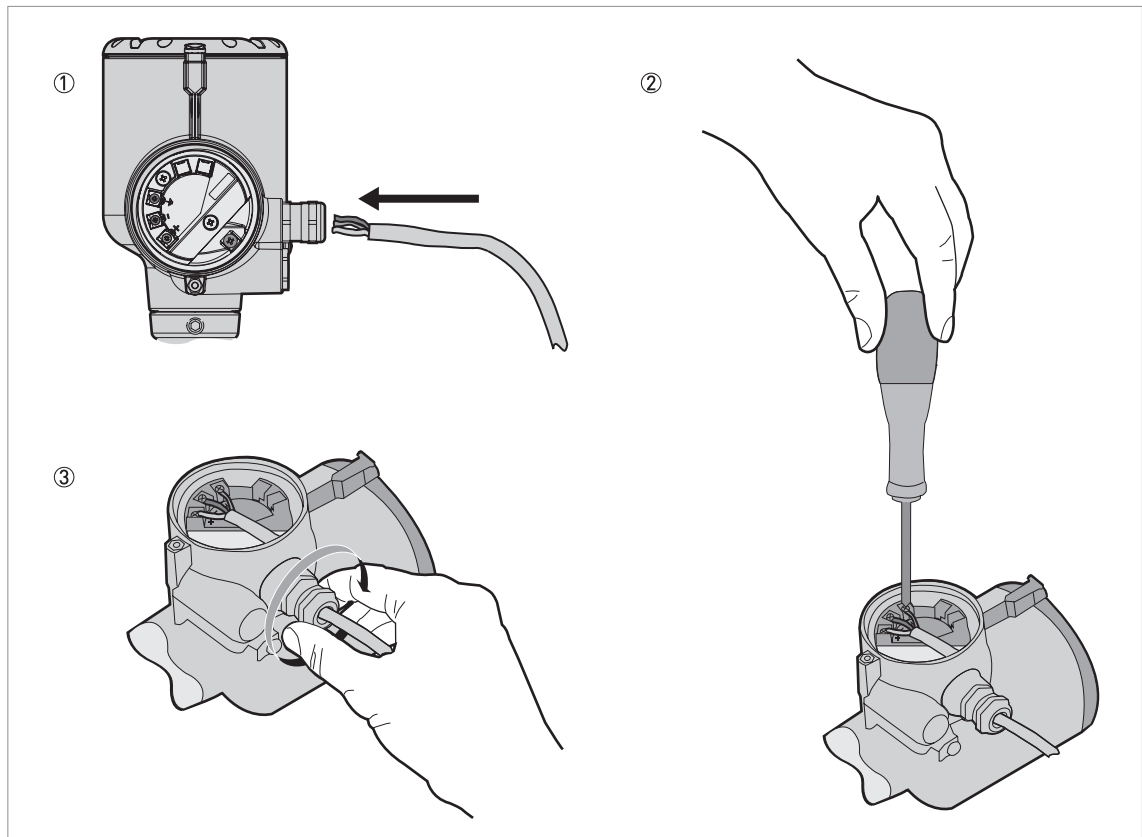


Figure 4-3: Procedure for electrical installation

**Equipment needed:**

- Small Phillips screwdriver (not supplied)



**Procedure**

- ① Connect the electrical wires to the connector.

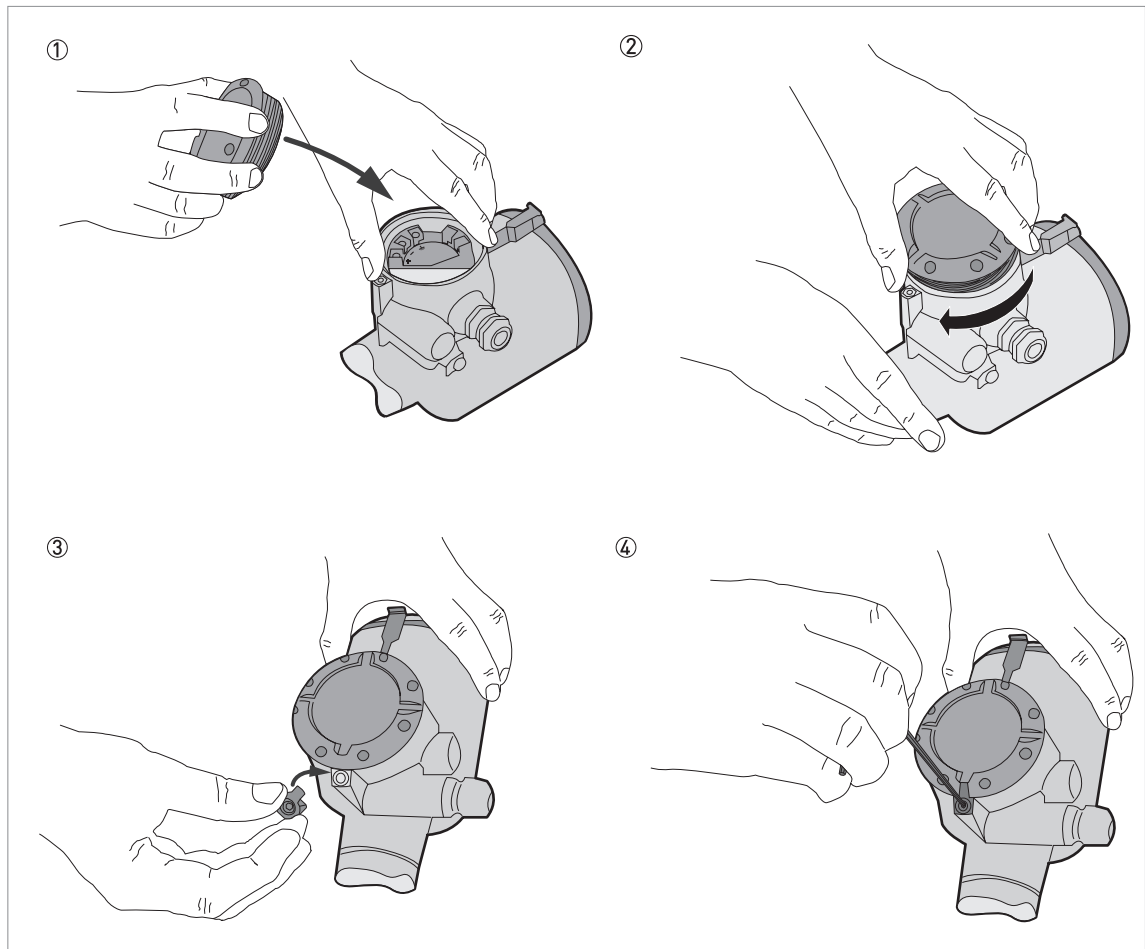


Figure 4-4: How to close the terminal compartment cover

**Equipment needed:**

- 3 mm Allen wrench (not supplied)



- ① Put the cover on the housing and turn the cover clockwise until it is fully engaged.
- ② Tighten the lock screw with a 3 mm Allen wrench (not supplied).

### 4.3 Electrical connection for current output

#### 4.3.1 Non-Ex devices

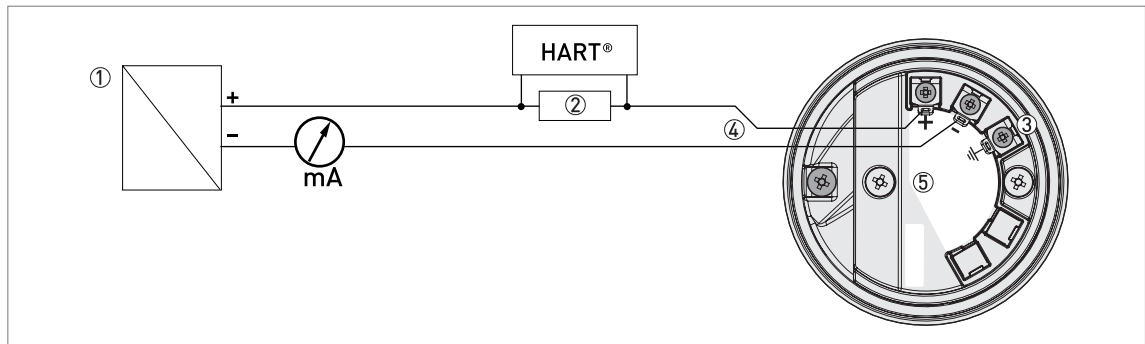


Figure 4-5: Electrical connections for non-Ex devices

- ① Power supply
- ② Resistor for HART® communication
- ③ Optional connection to the grounding terminal
- ④ Output: 12...30 VDC for an output of 22 mA at the terminal
- ⑤ Device

#### 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.



**DANGER!**

Make sure that the cable gland is watertight.

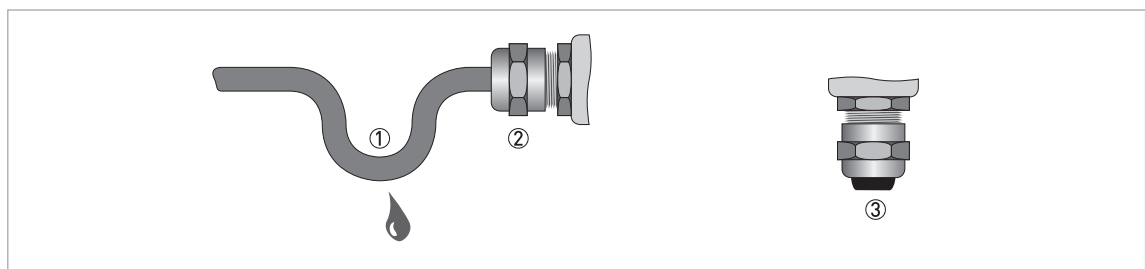


Figure 4-6: How to make the installation agree with protection category IP67



- Make sure that the gaskets are not damaged.
- Make sure that the electrical cables are not damaged.

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

The diameter of the outer sheath of the electrical cable (for the power supply and current output) must be 6...10 mm or 0.24...0.39".

## 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 have a polling address of 1 to 63 in a multi-drop network.

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

### 4.5.2 Point-to-point connection

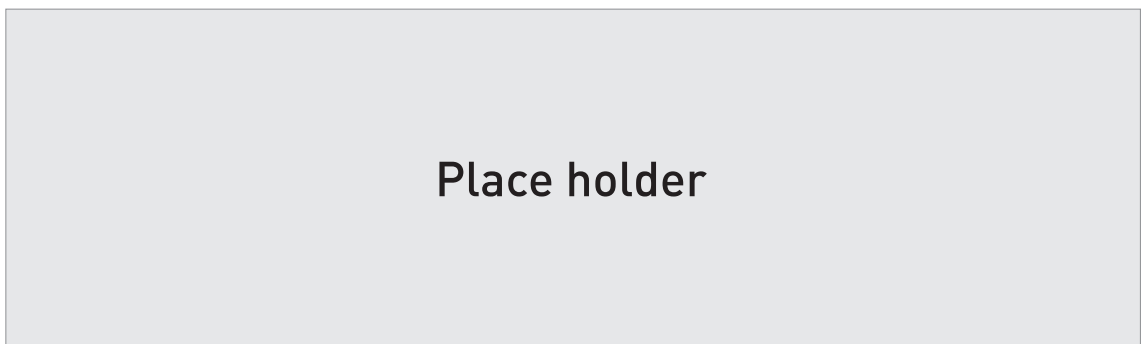
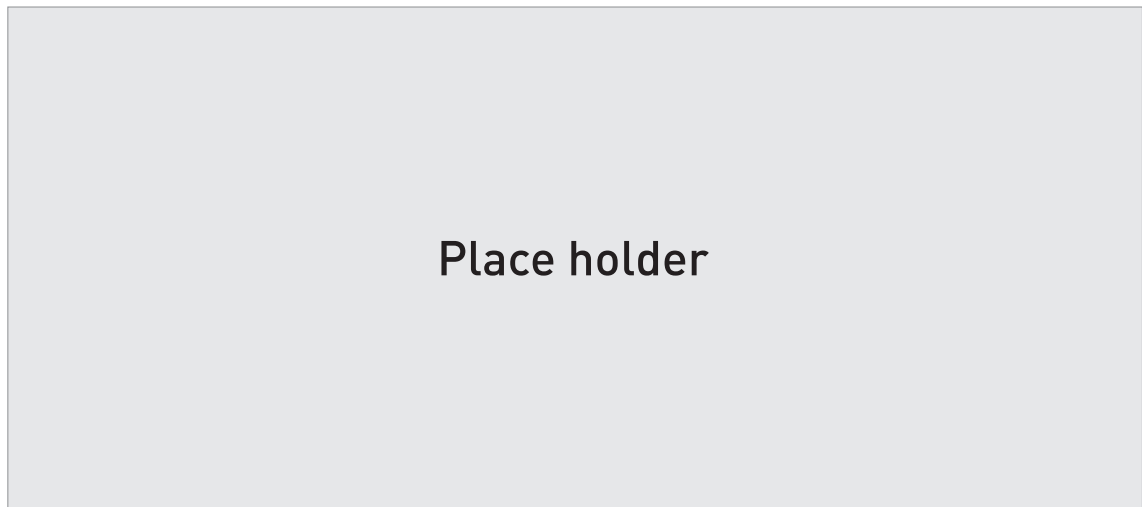


Figure 4-7: Point-to-point connection (non-Ex)

- 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 4-8: 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 Start-up checklist

### Check these points before you energize the device:

- Are all the wetted components (antenna, flange and gaskets) chemically resistant to the product in the tank?
- Does the information on the signal converter nameplate agree with the operating data?
- Did you correctly install the device on the tank?
- Do the electrical connections agree with the national electrical codes? Use the applicable electrical cables with the cable glands.



### **DANGER!**

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

## 5.2 How to start the device



- Connect the converter to the power supply.
- Energize the converter.
- ➔ **Devices with the LCD display option only:** After 10 seconds the screen will display "Optiwave 7500" and the logo of the supplier. After 40 seconds the default screen will appear. The device will show measurement data. Measurements agree with specifications given in the customer order.



### **INFORMATION!**

*This chapter and the start of the chapter that follows tell you what data is given on the device display in display mode and how to change device settings in configuration mode. If you know about how this device operates, you can ignore this data. Continue with the quick setup procedures. For more data about these procedures,.*

## 5.3 Operating concept

### You can read measurements and configure the device with:

- A digital display screen (optional).
- A connection to a system or PC with PACTware™. You can download the Device Type Manager (DTM) file from the website. It is also supplied on the DVD-ROM delivered with the device.
- A connection to a system or PC with 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.

## 5.4 Digital display screen

### 5.4.1 Display screen layout

#### Display in normal mode



Figure 5-1: Display screen layout in normal mode (measurement data)

- ① Current output percentage (bar graph)
- ② Device status (NAMUR NE 107 symbols)
- ③ Device tag name
- ④ Keypad operation indicator (shown when you push a button or operate the keypad with a bar magnet)
- ⑤ Measurement value and units
- ⑥ Keypad buttons with Hall effect sensors (sensors sensitive to large changes in magnetic field strength)

If you remove the housing cover, you can push the buttons on the keypad. If you cannot remove the housing cover, you can operate the keypad with a bar magnet.

The output percentage bar graph is only shown if you set "One Value and Bar" or "Two Values and Bar" in menu items C6.4.1 **Function** (1st Meas. page) or C6.5.1 **Function** (2nd Meas. Page). If menu item C6.4.2 1st Value Variable (1st Meas. page) is set to "Level", then the device shows "Level" as the current output percentage in normal mode (refer to item ① in the illustration).



### Display in program mode



Figure 5-2: Display screen layout in program mode

- ① Menu number or menu item number
- ② Location (menu) of sub-menu or menu item
- ③ Menu item name

## 5.4.2 Keypad buttons

### Functions of keypad buttons

Keypad button	Symbol	Function
[Right]	[>]	<b>Normal mode:</b> Enter Program mode <b>Configuration mode:</b> <b>Menu:</b> Enter the sub-menu or menu item <b>Menu item:</b> Move cursor one digit to the right (this includes the decimal point). If the cursor is on the last digit, a push of this button will move the cursor to the first digit.
[Return / Escape]	[←]	<b>Normal mode:</b> None <b>Configuration mode:</b> <b>Menu:</b> Exit the menu. If you are in the top level menu (R), the device goes back to normal mode. <b>Menu item:</b> Exit the menu item.
[Down]	[▼]	<b>Normal mode:</b> Change screen (measurement pages 1 and 2 and the status message page) <b>Configuration mode:</b> Decrease value or change parameter
[Up]	[▲]	<b>Normal mode:</b> Change screen (measurement pages 1 and 2 and the status message page) <b>Configuration mode:</b> Increase value or change parameter

For more data on keypad functions,.

### How to push the keypad buttons with your hand

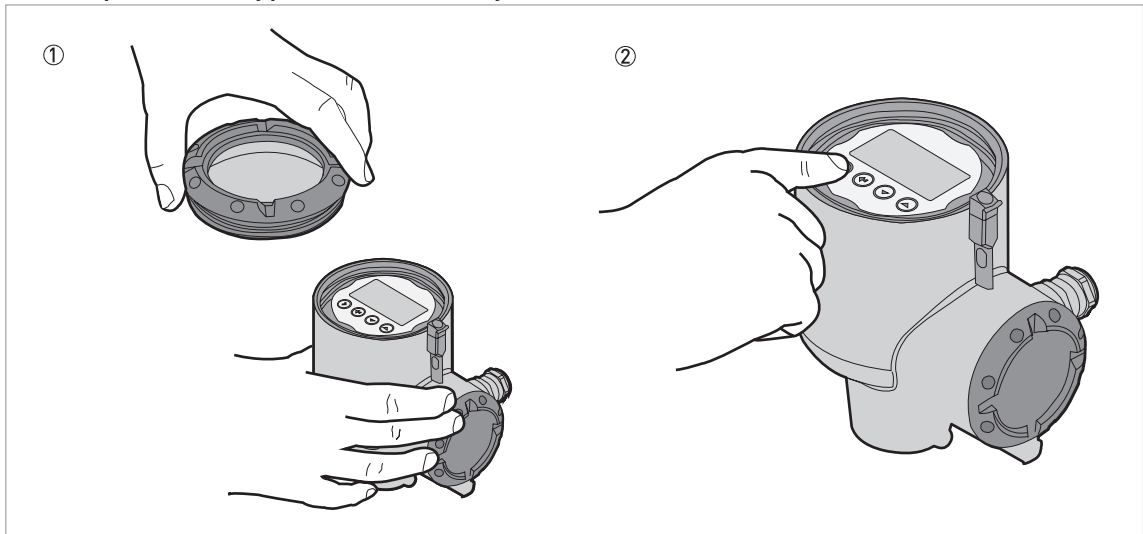


Figure 5-3: How to push the keypad buttons with your hand

- ① Display housing cover
- ② Keypad

### Equipment needed

- Wrench for the housing cover (supplied)
- 2.5 mm Allen wrench (not supplied)



- Undo the housing cover locking screw with a 2.5 mm Allen wrench.
- Remove the housing cover with the wrench supplied with the device.
- Push the buttons on the keypad.
- ➔ This will operate the device. Refer also to the table at the start of this section.

### How to operate the keypad buttons with a bar magnet

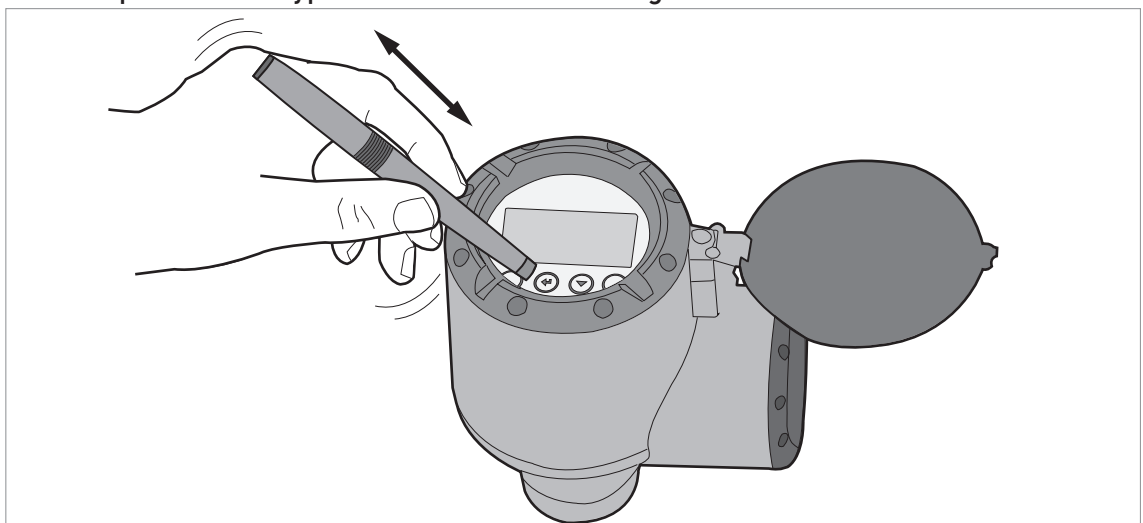


Figure 5-4: How to operate the keypad buttons with a bar magnet

- ① Display housing cover
- ② Keypad
- ③ Bar magnet

### Equipment needed

- Bar magnet (supplied)



#### **INFORMATION!**

*It is not necessary to remove the display housing cover to do this procedure.*



- Hold the bar magnet near to a keypad button.
- ➔ The keypad button will operate. If you must operate the button more than one time, remove the bar magnet and then hold it near to the button again.

## 5.5 Remote communication with PACTware™

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

### Install these software programs and equipment:

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

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

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

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

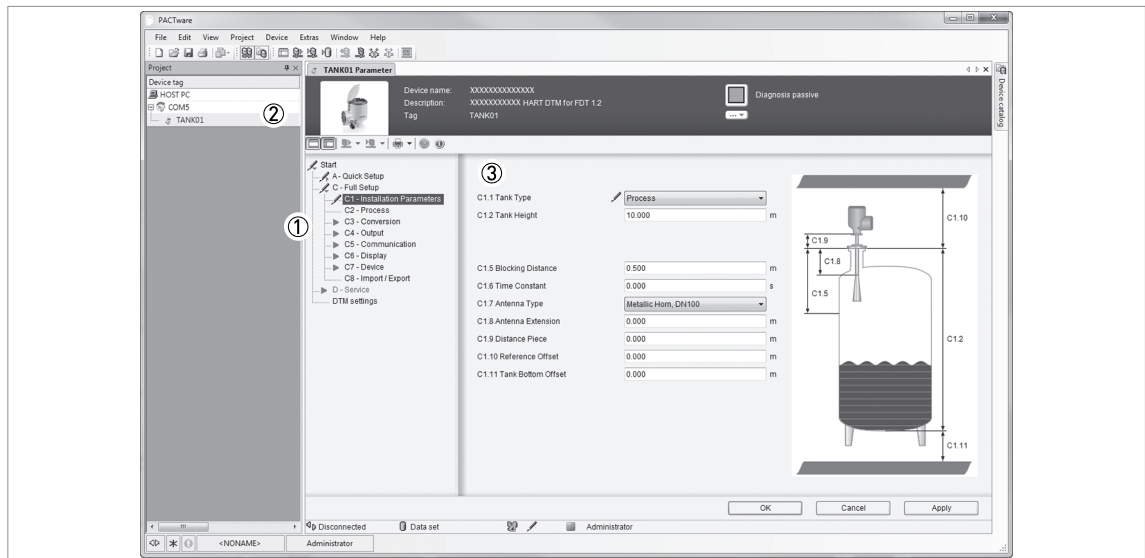


Figure 5-5: Screen from the PACTware™ user interface

- ① DTM menu
- ② Information for device identification
- ③ Installation parameters menu and menu items

## 5.6 Remote communication with the AMS™ Device Manager

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

- Store configuration information for each device.
- Store and read process data.
- Store and read diagnostic status information.
- Help plan preventive maintenance to reduce a plant's downtime to a minimum.

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

## 6.1 User modes

<b>Normal mode</b>	This mode shows measurement data and status messages. For more data,.
<b>Program mode</b>	Use this mode to read and change parameters, commission the device, create tables for volume or mass measurement, and change critical values to measure in difficult process conditions. To change settings in Program mode, you must use the device with the correct security level (user, operator or expert). For more data about menu items,.

All users can read the settings in Program mode, but only users with "Operator" and "Expert" security levels can change settings. For more data about security levels,.

## 6.2 Normal mode

This mode shows measurement data. Use the display keypad to change the type of measurement data shown on the screen (on 2 "measurement data pages") and to read the device status message page.

There are 5 options to show the measurement data on the display screen. Refer to the illustration that follows:

### Measurement data options

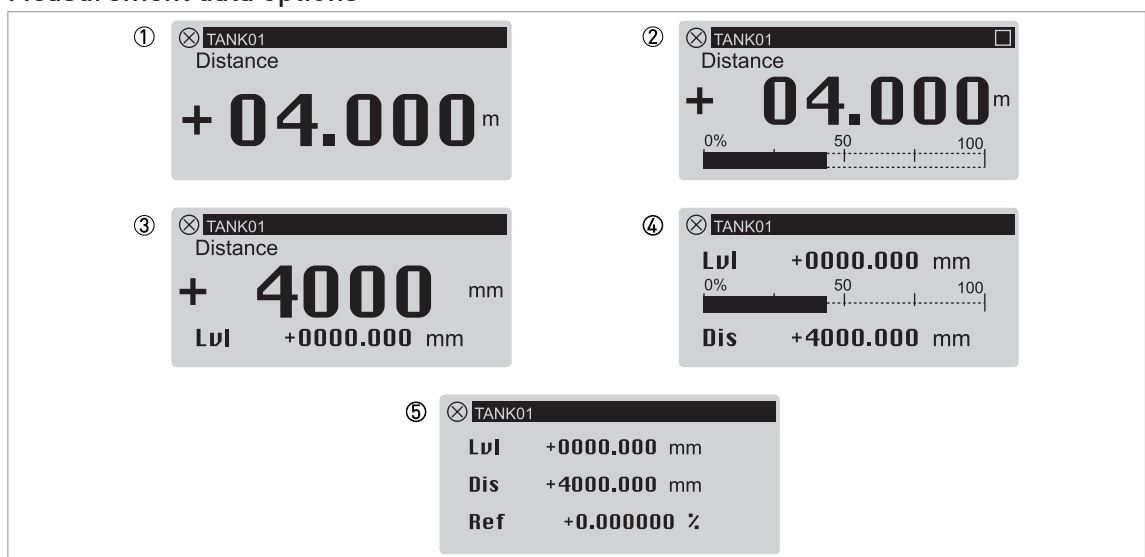


Figure 6-1: Measurement data options in normal mode

- ① One value
- ② One value and current output (%) bar
- ③ Two values
- ④ Two values and current output (%) bar
- ⑤ Three values

**INFORMATION!**

Go to **C6.4.1 Function** or **C6.5.1 Function (Full Setup > Display > 1st Measur. Page** or **Full Setup > Display > 2nd Measur. Page)** in Program mode to change the layout of the display screen.

Users of all security levels can change this setting.

Measurement data includes different measurement types (level, distance volume, ullage volume, mass etc.). Some measurement types will only be available if you entered the correct parameters in Program mode.

**Measurement data format errors**

Figure 6-2: Error symbol: the number of digits and decimal places is not sufficient for the measurement data

① Error symbol: the number of digits and decimal places is not sufficient for the measurement data. It is possible that the length units must be changed from "mm" to "m".

In this example, the device measures a distance of 10 m, but C7.5.1 Length Unit is set to mm and menu C6.4.5 Format 1st Value is set to X.XXXX (five digits with four decimal places). This is not sufficient to measure 10 m.

You can change the number of digits and decimal places in the measurement values shown in normal mode.

**INFORMATION!**

Go to **C6.4.5 Format 1st value**, **C6.4.7 Format 2nd value**, **C6.4.9 Format 3rd value**, **C6.5.5 Format 1st value**, **C6.5.7 Format 2nd value** or **C6.5.9 Format 3rd value (Full Setup > Display > 1st Measur. Page** or **Full Setup > Display > 2nd Measur. Page)** in Program mode to change the number of digits and decimal places. If there is a large change in a measurement value, set the related menu item to "Automatic".

**Volume measurement**

You must make a conversion table (strapping table) to show measurement data as a volume or a mass. Go to C3.2 Input table (**Full Setup > Conversion**) to make the strapping table. For more data,.

**Functions of keypad buttons (normal mode)**

Keypad button	Symbol	Function
[Right]	[>]	Enter Program mode
[Return / Escape]	[←]	—
[Down]	[▼]	Change screen (measurement pages 1 and 2, and the status message page)
[Up]	[▲]	Change screen (measurement pages 1 and 2 and the status message page)

## 6.3 Program mode

### 6.3.1 General notes

Change the settings of your device in **Program** mode. Data about the menus is given. You can:

- Use the **A Quick Setup** menu to change the display language, change the tag name, log in to change settings, do standard setup and empty recording procedures.
- Use the **B Test** menu to run diagnostic tests, read measurement and spectrum data.
- Use the **C Full Setup** menu to change settings. You can set up a conversion table for volume or mass measurement, change current output values, use the device as a limit switch, change HART® settings, change how the measurement data is shown in normal mode, read device identification data, change critical parameters for difficult process conditions, change the password, change measurement units or reset the device to factory default settings.



#### **CAUTION!**

*If you did not supply all installation data to the supplier before the delivery, the standard setup procedure in the Quick Setup menu is mandatory.*



#### **INFORMATION!**

*It is not possible to enter the **D Service** menu. This menu is for factory calibration and approved personnel only.*

### 6.3.2 Protection of the device settings (security levels)

The settings of this device have three levels of data protection: "User", "Operator" and "Expert". "Expert" is the highest level of protection. It is necessary to enter a different password for "Operator" and "Expert" security levels. There is no password for the "User" security level.

#### Security levels and applicable functions in program mode

Security level	Default password	Applicable functions in program mode (overview)
Expert	0058	<ul style="list-style-type: none"> <li>• Read: Measurement data and error messages available at the "User" security level (normal mode and menu items B2 Actual Values and C7.3.1 Message View)</li> <li>• Change: All sub-menus in menus A Quick Setup, B Test and C Full Setup</li> </ul> <p><b>NOTE:</b> You can change the password for the "Expert" security level in menu item C7.2.2 Change Password. Refer to the INFORMATION! note that follows.</p>

Operator	0009	<ul style="list-style-type: none"> <li>• Read: Measurement data and error messages available at the "User" security level (normal mode and menu items B2 Actual Values and C7.3.1 Message View)</li> <li>• Change: Binary Output (C4.3)</li> <li>• Change: All HART® settings (C5) – but not C5.1.1 Current Loop Mode</li> </ul> <p><b>NOTE:</b> You can change the password for the "Operator" security level in menu item C7.2.2 Change Password. Refer to the INFORMATION! note that follows.</p>
User	—	<ul style="list-style-type: none"> <li>• Read: Measurement data and error messages (normal mode and menu items B2 Actual Values and C7.3.1 Message View)</li> <li>• Read: All settings in menus A Quick Setup, B Test and C Full Setup</li> <li>• Change: All settings in menu C6 Display (language, backlight on/off, screen contrast and measurement data display options (normal mode, pages 1 and 2)) and C7.5 Units (length, volume, mass and custom units)</li> <li>• Change: Security level. Go to menu item A3 Login or C7.2.1 Login to change from "User" to "Operator" or "Expert" security levels</li> </ul>

If your security level is too low, the display will show a "lock" symbol adjacent to menu items in Program mode. If it is necessary to change this setting, go to menu item menu item A3 Login or C7.2.1 Login and set the device to the correct security level.



Figure 6-3: Lock symbol

① Lock symbol. If the display shows this symbol, you cannot change the setting.



### How to change the password

- Push [➤] to enter Program Mode.
- Push 2 × [▼], [➤], 5 × [▼], [➤], [▼] and [➤] to go to the menu item C7.2.1 Login.
- Push [➤] to enter the menu item.
- Enter the password used at this time for a given security level ("Operator" or "Expert"). If it is the default password, refer to the table at the start of this section.
- Push [←] and [▼] to go to the menu item C7.2.2 Change Password.
- Push [➤] to enter the menu item.
- Enter the password used at this time for the security level set at the start of this procedure. If it is the default password, refer to the table at the start of this section.
- Enter the new password.
- ➡ If you change the password for the "Operator" security level, then the first three digits must be zero (000x). The last digit can be a number (1...9) or a letter (A...F). If you change the password for the "Expert" security level, then the first two digits must be zero (00xx). The last two digits can be a number (1...9) or a letter (A...F).
- Enter the new password again.
- Push 6 × [←] to go back to normal mode.



- End of the procedure.

**INFORMATION!**

Each security level has a four-digit hexadecimal password.

The first three digits of the password for the "Operator" security level must be zero (000x). The last digit can be a number (1...9) or a letter (A...F).

The first two digits of the password for the "Expert" security level must be zero (00xx). The last two digits can be a number (1...9) or a letter (A...F).

**INFORMATION!**

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

**INFORMATION!**

If you de-energize and then energize the device, the security level will go back to "User".

### 6.3.3 How to get access to the Quick Setup menu

The Quick Setup menu contains the menu items that are necessary for most configurations of the device. The menu items are divided into 2 groups: "Standard Setup" and "Empty Spectrum". The "Standard Setup" group lets the user (with security level "expert") set the tank height, tank type (process, storage etc.), output variable, output current range, 0% range, 100% range, error function and error delay. "Empty Spectrum" is a procedure that finds interference signals in the tank and uses a filter to remove them from the measurement data.

**Do the steps that follow:**

- Push [➤] to enter Program Mode.
- Push [➤], 2 x [▼] to go to the menu item A3 Login.
- Enter the password used at this time for the "Expert" security level. If it is the default password, refer to *Protection of the device settings (security levels)* on page 47.
- Push [←], [▼] and [➤] to go to the menu item A4.1 Standard Setup.
- Push [➤]. Do the basic configuration of the device in the "Standard Setup" menu. For more data on the procedure, refer to *Standard Setup* on page 79. Push [←] at the end of each step of the procedure to continue to the next step.
- Push [▼] and [➤] to go to the menu item A4.2.1 Record Spectrum.
- Push [➤] to start the empty spectrum recording procedure. For more data, Push [←] at the end of each step of the procedure to continue to the next step.

**CAUTION!**

If you did not supply all installation data to the supplier before the delivery, the standard setup procedure in the Quick Setup menu is mandatory.

### 6.3.4 Keypad functions

#### Menu navigation







Figure 6-4: Menu navigation

- ① Menu number or menu item number
- ② Location (menu) of sub-menu or menu item
- ③ Menu item name

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

#### Functions of buttons for menu navigation

Button	Description	Function
	Right	<ul style="list-style-type: none"> <li>• Go down a menu level (for example, from menu C1 to sub-menu C1.1).</li> <li>• Enter the menu item.</li> </ul>
	Enter / Esc (Escape)	<ul style="list-style-type: none"> <li>• Go up a menu level (for example, from sub-menu C1.1 to menu C1).</li> <li>• Go to Normal mode. If you changed settings in Program mode, you must save or cancel your new settings. For more data, refer to <i>How to save settings changed in program mode</i> on page 53.</li> </ul>
	Down	<ul style="list-style-type: none"> <li>• Scroll down the menu list (for example, from menu C1 to menu C2).</li> <li>• Scroll down the sub-menu list (for example, from sub-menu C2.1 to sub-menu C2.2).</li> </ul>
	Up	<ul style="list-style-type: none"> <li>• Scroll up the menu list (for example, from menu C2 to menu C1).</li> <li>• Scroll up the sub-menu list (for example, from sub-menu C2.2 to sub-menu C2.1).</li> </ul>

## Lists of parameters in menu items

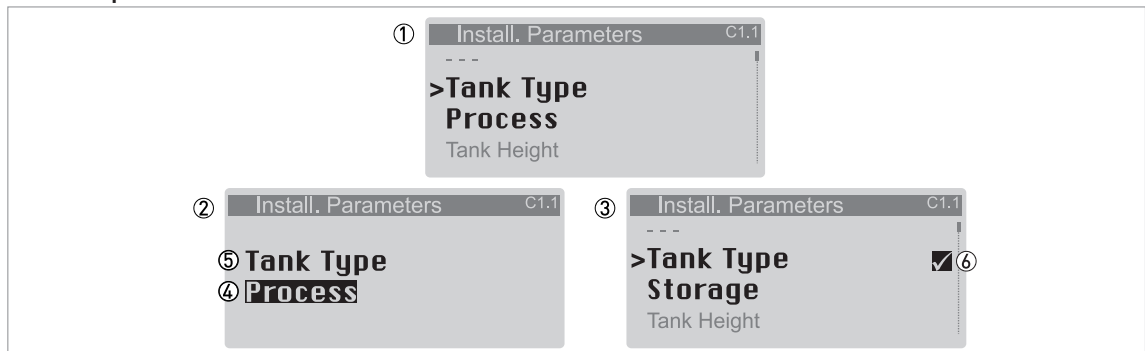


Figure 6-5: Lists of parameters in menu items

- ① Menu item with parameter stored at this time (first screen). Push [>] to enter the menu item.
- ② Push [▲] or [▼] to change the parameter
- ③ Push [←] to set the new parameter and go back to the menu level
- ④ Parameter
- ⑤ Menu item name
- ⑥ A "tick" symbol shows that there is a new setting (the new setting is not saved at this time)

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

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

Button	Description	Function
	Right	—
	Enter / Esc (Escape)	Select the parameter and go back to the menu
	Down	Move down the list
	Up	Move up the list

## Values in menu items

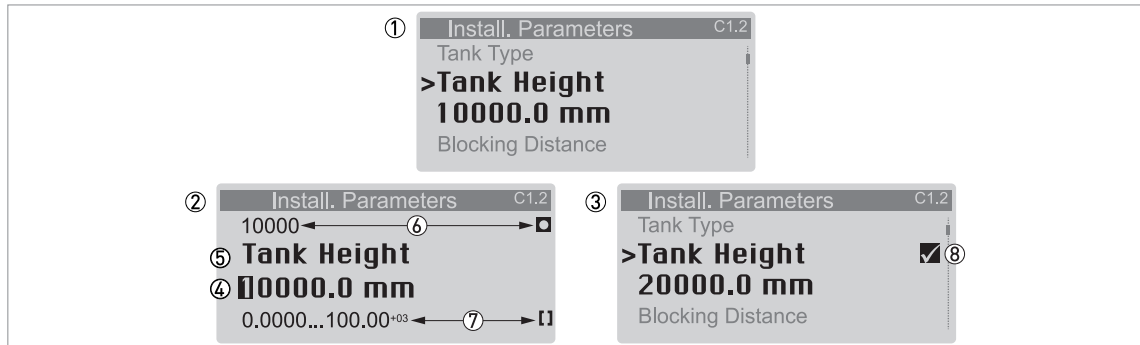


Figure 6-6: Values in menu items

- ① Menu item with values stored at this time (first screen). Push [➤] to enter the menu item. A cursor shows on the first digit.
- ② Push [➤] again and again to move the cursor. Push [▲] or [▼] to change the value of the digit. If the digit is part of a number, then make a selection from 0...9. If the digit is part of a custom unit name, then refer to the tables at the end of this section for a list of the available characters. If the cursor is on the decimal point, you can change the position of the decimal point.
- ③ Push [↵] to set the new parameter and go back to the menu level
- ④ Make a selection: put the cursor on a digit or the decimal point.
- ⑤ Menu item name
- ⑥ The factory default value (left side) and factory default symbol (right side)
- ⑦ The minimum and maximum values (min./max.) for this menu item (left side) and min./max. symbol (right side)
- ⑧ A "tick" symbol shows that there is a new setting (the new setting is not saved at this time)

This is what you see when you select a menu item that has a value.

**INFORMATION!**

If menu items have values that you can change, very large and very small values can be written as a value with an exponent ( $b^n$ ). For example, if the value shown on the display is  $100.00^{+03}$ , this value is equal to  $100 \times 10^3$  or 100000.

The functions of the buttons are given in the table that follows:

## Function of buttons in menu items that have values

Button	Description	Function
	Right	<ul style="list-style-type: none"> <li>• Enter the menu item and see the value stored at this time.</li> <li>• Enter the menu item configuration level to change the value.</li> <li>• Move the cursor to the next digit on the right. If the cursor is on the last digit, push [➤] again to go back to the first digit. You can also put the cursor on the decimal point.</li> </ul>
	Enter / Esc (Escape)	Accept the value and go back to the sub-menu.
	Down	If the cursor is on a number, this button decreases the digit value. If the cursor is on the decimal point, this button moves the decimal point to the left (this decreases the value by a factor of 10).
	Up	If the cursor is on a number, this button increases the digit value. If the cursor is on the decimal point, this button moves the decimal point to the right (this increases the value by a factor of 10).

**INFORMATION!****Values in menu items**

If the digit is part of a custom unit name, then refer to the list of available characters that follows:

**Numbers**

0	1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---	---

**Lower case letters**

a	b	c	d	e	f	g	h	i	j
k	l	m	n	o	p	q	r	s	t
u	v	w	x	y	z				

**Upper case letters**

A	B	C	D	E	F	G	H	I	J
K	L	M	N	O	P	Q	R	S	T
U	V	W	X	Y	Z				

**Special characters**

^	~	_	-	/	.				
---	---	---	---	---	---	--	--	--	--

### 6.3.5 How to save settings changed in program mode



- When you have changed parameters in all the necessary menu items, push [↵] to accept the new parameter.
- Push [↵] again and again to go back to the "Save Configuration?" screen.
- The device will ask you to save or cancel your settings. Push [▲] or [▼] to make a selection from **Yes**, **No** or **Back**. **Back** makes the display go back to Program mode. If this screen is set to "Yes" or "No", push [↵] to accept (Yes) or reject (No) the new settings.
- ➡ If you push [↵] when the screen is set to "Yes" or "No", the display goes back to normal mode.

6.3.6 Menu overview

Menu overview: A – Quick Setup

Normal	Program					
	Menu A		Submenus			
> ←	↓ ↑	> ←	↓ ↑	> ←	↓ ↑	> ←
	A Quick Setup		A1 Language			
			A2Tag			
			A3 Login			
			A4 Application Assistant	A4.1 Standard Setup		A4.1.1.1 Length Unit
					A4.1.2.1 Tank Type	
					A4.1.2.2 Tank Height	
					A4.1.2.2 Stillwell Height	
					A4.1.2.3 Stillwell Diameter	
					A4.1.3.1 Current Out. 1 Var.	
					A4.1.3.2 0% Range	
					A4.1.3.3 100% Range	
			A4.1.3.4 Current Out. Range			
			A4.1.3.5 Error Function			
			A4.1.3.6 Error Delay			
		A4.2 Empty Spectrum / A4.2.1 Record Spectrum		A4.2.1.1 Empty Spectrum Type		
			A4.2.1.2 Partial Distance			
			A4.2.1.3 Partial Distance			
			A4.2.1.4 Start Recording?			
			A4.2.1.5 Empty Spectrum			
			A4.2.1.6 Empty Spectrum Graph			
		A4.2.1.7 Save Spectrum?				
		A4.2.1.8 Empty Spectrum Enable				

## Menu overview: B – Test

Normal	Program								
	Menu B		Submenus						
> ←	↓ ↑	> ←	↓ ↑	> ←	↓ ↑	> ←	↓ ↑ >		
	B Test		B1 Simulation		B1.1 Set Value		B1.1.1 Sensor Value		
								B1.1.2 Level	
								B1.1.3 Distance	
								B1.1.4 Reflection	
								B1.1.5 Level Lin.	
								B1.1.6 Volume	
								B1.1.7 Mass	
								B1.1.8 Distance Lin.	
								B1.1.9 Ullage Volume	
								B1.1.10 Ullage Mass	
						B1.2 Output		B1.2.1 Current Output 1	
				B2 Actual Values		B2.1 Operating Time			
							B2.2 Time/Date		
							B2.3 Sensor Value		
							B2.4 Level		
							B2.5 Distance		
							B2.6 Reflection		
							B2.7 Level Lin.		
							B2.8 Volume		
							B2.9 Mass		
							B2.10 Distance Lin.		
							B2.11 Ullage Volume		
							B2.12 Ullage Mass		
							B2.13 Sensor Temp.		
							B2.14 Converter Temp.		
				B3 Power Spectrum		B3.1 Request Spectrum Pressure			
							B3.2 Power Spectrum		
			B4 Corrected Spectrum		B4.1 Request Spectrum				
						B4.2 Corrected Spectrum			
			B5 Empty Spectrum		B5.1 Request Spectrum				
						B5.2 Empty Spectrum			

Menu overview: C – Full Setup

Normal	Program					
	Menu C		Submenus			
> ←	↓ ↑	> ←	↓ ↑	> ←	↓ ↑	> ← ↓ ↑ >
	C Setup		C1 Install Parameters		C1.1 Tank Type	
					C1.2 Tank Height	
					C1.3 Stillwell Height	
					C1.4 Stillwell Diameter	
					C1.5 Blocking Distance	
					C1.6 Time Constant	
					C1.7 Antenna Type	
					C1.8 Antenna Extension	
					C1.9 Distance Piece	
					C1.10 Reference Offset	
					C1.11 Tank Bottom Offset	
	C Setup		C2 Process		C2.1 Tracking Velocity	
					C2.2 Epsilon R Product	
					C2.3 Epsilon R Gas	
					C2.4 Measuring Mode	
					C2.5 Overfill Detection	
					C2.6 Overfill Threshold	
					C2.7 Mult. Refl. Enable	
					C2.8 Empty Spectrum Enable	
					C2.9 Min Peak req.	
					C2.10 Min Plaus. Window	
	C Setup		C3 Conversion		C3.1 Edit Table	C3.1.1 Erase Table?
						C3.1.2 Select Conversion
					C3.2 Input Table	C3.2.2 Point
						C3.2.4 Level
						C3.2.5 Conv. Value



Normal	Program						
	Menu C		Submenus				
> ←	↓ ↑	> ←	↓ ↑	> ←	↓ ↑	> ←	↓ ↑ >
	C Setup		C4 Output		C4.1 Current Output 1		C4.1.1 Current Out. 1 Var.
							C4.1.2 0% Range
							C4.1.3 100% Range
							C4.1.4 Current Out. Range
							C4.1.5 Error Function
							C4.1.6 Error Delay
							C4.1.7 Low Error Current
							C4.1.8 High Error Current
							C4.1.9.2 Trimming / 4mA Trimming
							C4.1.9.5 Trimming / 20mA Trimming

Normal	Program					
	Menu C		Submenus			
> ←	↓ ↑	> ←	↓ ↑	> ←	↓ ↑	> ← ↓ ↑ >
	C Setup		C5 Communication		C5.1.2 HART	C5.1.1 Current Loop Mode C5.1.2.1 Identification / Polling Address C5.1.2.2 Identification / Tag C5.1.2.3 Identification / Long Tag C5.1.2.4 Identification / Manufacturer ID C5.1.2.5 Identification / Device Type C5.1.2.6 Identification / Device ID C5.1.2.7 Identification / Universal Revision C5.1.2.8 Identification / Device Revision C5.1.2.9 Identification / Software Revision C5.1.2.10 Identification / Hardware Revision C5.1.3.1 Device Information / Descriptor C5.1.3.1 Device Information / Message C5.1.3.1 Device Information / Date C5.1.3.1 Device Information / Cfg. Change Counter C5.1.4.1 HART Variables / Current Out. 1 Var. C5.1.4.2 HART Variables / HART sec./CO2 Var. C5.1.4.3 HART Variables / Tertiary Var. C5.1.4.4 HART Variables / Quarternary Var.
	C Setup		C6 Display		C6.1 Language	
					C6.2 Backlight	
					C6.3 Contrast	

Normal	Program						
	Menu C		Submenus				
> ←	↓ ↑	> ←	↓ ↑	> ←	↓ ↑	> ←	↓ ↑ >
					C6.4 1st Meas. page		C6.4.1 Function C6.4.2 1st Value Variable C6.4.3 0% Range C6.4.4 100% Range C6.4.5 Format 1st Value C6.4.6 2nd Value Variable C6.4.7 Format 2nd Value C6.4.8 3rd Value Variable C6.4.9 Format 3rd Value
					C6.5 2nd Meas. page		C6.5.1 Function C6.5.2 1st Value Variable C6..3 0% Range C6.5.4 100% Range C6.5.5 Format 1st Value C6.5.6 2nd Value Variable C6.5.7 Format 2nd Value C6.5.8 3rd Value Variable C6.5.9 Format 3rd Value
	C Setup		C7 Device		C7.1 Information		C7.1.1 Tag C7.1.2 Serial Number C7.1.3 Device Name C7.1.4 V Number C7.1.5 Electronic Revision C7.1.6 Software Revision C7.1.7 Electronic serial No. C7.1.8 Production Date C7.1.9 Calibration Date C7.1.10 SIL Mode C7.1.11 Custody Transfer Mode C7.1.12 WHG Mode C7.1.13 API-2350 Mode
			C7 Device		C7.2 Security		C7.2.1 Login C7.2.2 Change Password C7.2.3 Reset Passwords
					C7.3 Errors		C7.3.1 Message C7.3.2.1 Error-Mapping / Sensor: Information
					C7.4 Real Time Clock		C7.4.1 Set Time C7.4.2 Set Time

Normal	Program						
	Menu C		Submenus				
> ←	↓ ↑	> ←	↓ ↑	> ←	↓ ↑	> ←	↓ ↑ >
					C7.5 Units		C7.5.1 Length Unit
							C7.5.2.1 Cst. Length / Text
							C7.5.2.2 Cst. Length / Offset
							C7.5.2.3 Cst. Length / Factor
							C7.5.3 Volume
							C7.5.4.1 Cst. Volume / Text
							C7.5.4.2 Cst. Volume / Offset
							C7.5.4.1 Cst. Volume / Factor
							C7.5.5 Mass
							C7.5.6.1 Cst. Mass / Text
							C7.5.6.2 Cst. Mass / Offset
							C7.5.6.3 Cst. Mass / Factor
					C7.6 Factory Default		C7.6.1 Reset to Fact. Def.?

6.3.7 Function description

A – Quick Setup menu

Menu No.	Function	Function description	Selection list	Default
A1	Language	Make a selection to show the measurement data and settings in one of the languages stored in in the device.  <b>Minimum security level to change the setting:</b> User	English, French, German, Italian, Japanese, Chinese (simplified), Portuguese, Russian, Spanish, Czech, Polish, Turkish	English
A2	Tag	You can see the TAG name here. The tag name can be a maximum of 8 characters long and it can have numbers, upper-case and lower-case letters and special characters. For more data, , refer to <i>Keypad functions</i> on page 50 (values in menu items).  <b>Minimum security level to change the setting:</b> Operator	Refer to "Function description"	00000000
A3	Login	Enter the appropriate password here to change settings. If you do not enter the password, you can only change settings for the "user" security level. For more data, refer to <i>Protection of the device settings (security levels)</i> on page 47.	4-digit hexadecimal password	Refer to "Function description"
<b>A4 Application Assistant</b>				

Menu No.	Function	Function description	Selection list	Default
A4.1	Standard Setup	<p>This starts a quick set-up procedure applicable to most applications. You can set the length unit, installation specifications (tank type, tank height, still well height, still well diameter etc.) and current output specifications (0% range, 1000% range, error function etc.). For more data about the functions, refer to Table C – Full Setup, in this section. For more data about the procedure, refer to <i>Standard Setup</i> on page 79.</p> <p><b>Minimum security level to do the procedure:</b> Expert</p>		
A4.2		<p>Fixed and moving objects in the tank cause interference signals. Put them through this filter to correctly measure the tank contents. This menu item starts a quick set-up procedure. We recommend that the tank is empty or only filled to the minimum level before you do the procedure. We also recommend that if you installed the device on a tank that has equipment with parts that move (e.g. agitators), start the equipment. Set the <b>Save Spectrum?</b> step to "Yes", <b>Empty Spectrum Enable</b> step to "Enable" at the end the procedure and set the Save Configuration? screen to "Yes" to use the data. For more data about the procedure, refer to <i>Empty spectrum recording</i> on page 82. Refer also to "How to make a filter to remove radar signal interference" on page 87.</p> <p><b>Minimum security level to do the procedure:</b> Expert</p>		

## B – Test menu

Menu No.	Function	Function description	Selection list	Default
----------	----------	----------------------	----------------	---------

## B1 Simulation

B1.1 Set Value				
B1.1.2	Level	<p>This sets the device to a given test level value. This procedure sends an output signal that agrees with the test reading. Output will change to the selected value, independent of the measurement data.</p> <p>When you push [←] to confirm the value, the display shows the question "Start Simulation?" Push [▼] or [▲] to set the display to "Yes". Push [←] again to start the test.</p> <p><b>Minimum security level to do the procedure:</b> User</p>	<p>min-max: -4900.0...+5100.0 m / - 1076...+16732 ft</p>	+0 m

Menu No.	Function	Function description	Selection list	Default
B1.1.3	Distance	<p>This sets the device to a given test distance value. This procedure sends an output signal that agrees with the test reading. Output will change to the selected value, independent of the measurement data.</p> <p>When you push [←] to confirm the value, the display shows the question "Start Simulation?" Push [▼] or [▲] to set the display to "Yes". Push [←] again to start the test.</p> <p><b>Minimum security level to do the procedure:</b> User</p>	min-max: -4900.0...+5100.0 m / - 1076...+16732 ft	+20.0 m
B1.1.4	Reflection	<p>This sets the device to a given test reflection value. This procedure sends an output signal that agrees with the test reading. Output will change to the selected value, independent of the measurement data.</p> <p>When you push [←] to confirm the value, the display shows the question "Start Simulation?" Push [▼] or [▲] to set the display to "Yes". Push [←] again to start the test.</p> <p><b>Minimum security level to do the procedure:</b> User</p>	min-max: 0...100%	0%
B1.1.5	Level Lin.	<p>This sets the device to a given test level value (linearized). This menu item is only available if you set up a linearization table in menu item <b>C3.1 Edit Table</b>. This procedure sends an output signal that agrees with the test reading. Output will change to the selected value, independent of the measurement data.</p> <p>When you push [←] to confirm the value, the display shows the question "Start Simulation?" Push [▼] or [▲] to set the display to "Yes". Push [←] again to start the test.</p> <p><b>Minimum security level to do the procedure:</b> User</p>	min-max: -4900.0...+5100.0 m / - 1076...+16732 ft	+0 m
B1.1.6	Volume	<p>This sets the device to a given test volume value. This menu item is only available if you set up a conversion (volume) table in menu item <b>C3.1 Edit Table</b>. This procedure sends an output signal that agrees with the test reading. Output will change to the selected value, independent of the measurement data.</p> <p>When you push [←] to confirm the value, the display shows the question "Start Simulation?" Push [▼] or [▲] to set the display to "Yes". Push [←] again to start the test.</p> <p><b>Minimum security level to do the procedure:</b> User</p>	min-max: 0...1.00 <sup>+06</sup> m <sup>3</sup>	+0 m <sup>3</sup>

Menu No.	Function	Function description	Selection list	Default
B1.1.7	Mass	<p>This sets the device to a given test mass value. This menu item is only available if you set up a conversion (mass) table in menu item <b>C3.1 Edit Table</b>. This procedure sends an output signal that agrees with the test reading. Output will change to the selected value, independent of the measurement data.</p> <p>When you push [←] to confirm the value, the display shows the question "Start Simulation?" Push [▼] or [▲] to set the display to "Yes". Push [←] again to start the test.</p> <p><b>Minimum security level to do the procedure:</b> User</p>	min-max: 0...10.000 <sup>+09</sup> kg	0 kg
B1.1.8	Distance Lin.	<p>This sets the device to a given test distance value (linearized). This menu item is only available if you set up a linearization table in menu item <b>C3.1 Edit Table</b>. This procedure sends an output signal that agrees with the test reading. Output will change to the selected value, independent of the measurement data.</p> <p>When you push [←] to confirm the value, the display shows the question "Start Simulation?" Push [▼] or [▲] to set the display to "Yes". Push [←] again to start the test.</p> <p><b>Minimum security level to do the procedure:</b> User</p>	min-max: -4900.0...+5100.0 m	+0 m
B1.1.9	Ullage Volume	<p>This sets the device to a given test ullage volume value. This menu item is only available if you set up a conversion (volume) table in menu item <b>C3.1 Edit Table</b>. This procedure sends an output signal that agrees with the test reading. Output will change to the selected value, independent of the measurement data.</p> <p>When you push [←], the display shows the question "Start Simulation?" Push [▼] or [▲] to set the display to "Yes". Push [←] again to start the test.</p> <p><b>Minimum security level to do the procedure:</b> User</p>	min-max: 0...1.00 <sup>+06</sup> m <sup>3</sup>	①

Menu No.	Function	Function description	Selection list	Default
B1.1.10	Ullage Mass	<p>This sets the device to a given test ullage mass value. This menu item is only available if you set up a conversion (mass) table in menu item <b>C3.1 Edit Table</b>. This procedure sends an output signal that agrees with the test reading. Output will change to the selected value, independent of the measurement data.</p> <p>When you push [←] to confirm the value, the display shows the question "Start Simulation?" Push [▼] or [▲] to set the display to "Yes". Push [←] again to start the test.</p> <p><b>Minimum security level to do the procedure:</b> User</p>	min-max: 0...10.000 <sup>+09</sup> kg	①
<b>B1.2 Output</b>				
B1.2.1	Current Output 1	<p>This sets analogue output 1 to a test value [mA]. Output will change to the selected value, independent of the measured value.</p> <p>When you push [←] to confirm the value, the display shows the question "Start Simulation?" Push [▼] or [▲] to set the display to "Yes". Push [←] again to start the test.</p> <p><b>Minimum security level to do the procedure:</b> User</p>	3.6...21.5 mA	21.5 mA

## B2 Actual Values

B2.1	Operating Time [s]	This is the total time that the device is energized in seconds.	Read only	—
B2.4	Level	This menu item shows the level readings measured at this time. This measurement data is shown with the units set in menu <b>C7.5 Units</b> .	Read only	—
B2.5	Distance	This menu item shows the distance readings measured at this time. This measurement data is shown with the units set in menu <b>C7.5 Units</b> .	Read only	—
B2.6	Reflection	This menu item shows the percentage of the emitted radar signal which makes a reflection on the surface of the tank or silo contents and is received by the device.	Read only	—
B2.7	Level Lin.	This menu item shows the level readings (linearized) measured at this time. This measurement data is shown with the units set in menu <b>C7.5 Units</b> . This menu item is only available if you set up a linearization table in menu item <b>C3.1 Edit Table</b> .	Read only	—
B2.8	Volume	This menu item shows the volume readings measured at this time. This measurement data is shown with the units set in menu <b>C7.5 Units</b> . This menu item is only available if you set up a conversion (volume) table in menu item <b>C3.1 Edit Table</b> .	Read only	—



Menu No.	Function	Function description	Selection list	Default
B2.9	Mass	This menu item shows the mass readings measured at this time. This measurement data is shown with the units set in menu <b>C7.5 Units</b> . This menu item is only available if you set up a conversion (mass) table in menu item <b>C3.1 Edit Table</b> .	Read only	—
B2.10	Distance Lin.	This menu item shows the distance readings (linearized) measured at this time. This measurement data is shown with the units set in menu <b>C7.5 Units</b> . This menu item is only available if you set up a linearization table in menu item <b>C3.1 Edit Table</b> .	Read only	—
B2.11	Ullage Volume	This menu item shows the ullage volume readings measured at this time. This measurement data is shown with the units set in menu <b>C7.5 Units</b> . This menu item is only available if you set up a conversion (volume) table in menu item <b>C3.1 Edit Table</b> .	Read only	—
B2.12	Ullage Mass	This menu item shows the ullage mass readings measured at this time. This measurement data is shown with the units set in menu <b>C7.5 Units</b> . This menu item is only available if you set up a conversion (mass) table in menu item <b>C3.1 Edit Table</b> .	Read only	—
B2.13	Sensor Temp.	Temperature of the sensor (antenna) electronics block.	Read only	—
B2.14	Converter Temp.	Temperature of the converter electronics block. Operation of display can stop if the temperature is below -20°C / -4°F or above +70°C / +158°F.	Read only	—

### B3 Power Spectrum

B3.2	Power Spectrum	This menu item shows the uncorrected spectra of the radar signal which makes a reflection on the surface of the tank or silo contents and is received by the device. This data is shown as a graph of the percentage of the full-scale signal against distance.	Read only	—
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### B4 Corrected Spectrum

B4.2	Corrected Spectrum	This menu item shows the corrected spectra of the radar signal which makes a reflection on the surface of the tank or silo contents and is received by the device. This is the result of the spectra from an empty tank or silo subtracted from the power spectra. This data is shown as a graph of the percentage of the full-scale signal against distance.	Read only	—
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### B5 Empty Spectrum

Menu No.	Function	Function description	Selection list	Default
B5.2	Empty Spectrum	This menu item shows the spectra of the radar signal which makes a reflection at the bottom of an empty tank (or a partially full tank, if it is not possible to remove all the tank contents). This data is shown as a graph of the percentage of the full-scale signal against distance.	Read only	—

① The maximum value in the conversion table

## C – Full Setup menu

Menu No.	Function	Function description	Selection list	Default
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### C1 Install Parameters

C1.1	Tank Type	The conditions in which the device is used. If the surface of the product is flat, select "Storage". If the surface of the product is disturbed, select "Process". If the surface of the product is agitated with vortices and foam, select "Agitator". If the device is installed in a still well, select "Still Well".  <b>Minimum security level to change the setting:</b> Expert	Agitator, Still Well, Process, Storage	Process
C1.2	Tank Height	Tank height is the distance from the flange face/thread stop of the process connection to the tank bottom. If you use the device for an LPR (open-air) application, this value is the maximum distance that the device must measure (the measuring range). If you set menu item C1.1 Tank Height to "Still Well", this menu item is not available.  <b>Minimum security level to change the setting:</b> Expert	min-max: 0.0...100.00 <sup>+03</sup> mm / 0...196.85 ft	10000 mm / 32.808 ft
C1.3	Still Well Height	The height of the still well. This menu item is available if you set "Still Well" in menu item C.1.1 Tank Type.  <b>Minimum security level to change the setting:</b> Expert	min-max: 500.0...100.00 <sup>+03</sup> mm / 1.6404...328.08 ft	10000 mm / 32.808 ft
C1.4	Still Well Diameter	The inner diameter of the still well. This menu item is available if you set "Still Well" in menu item C.1.1 Tank Type.  <b>Minimum security level to change the setting:</b> Expert	min-max: 22.0...999.0 mm / 866.14 <sup>-03</sup> ...39.331"	100 mm / 3.937"
C1.5	Blocking Distance	The distance from the flange facing or the thread stop to the top limit of the measuring range (a zone given by the user where it is not possible to measure). We recommend a minimum blocking distance of 100 mm / 4" below the bottom of the antenna. If the distance is less than the blocking distance, the device continues to show the blocking distance on the display screen.  <b>Minimum security level to change the setting:</b> Expert	min-max: 75.0...5000.0 mm / 2.9528...196.85"	500 mm / 19.685"

Menu No.	Function	Function description	Selection list	Default
C1.6	Time Constant	Using this function, the device processes several measurement readings to filter out disturbances. Increasing the time constant will smoothen the integrated readings, decreasing will roughen the readings. s = seconds.  <b>Minimum security level to change the setting:</b> Expert	min-max: 0...100.0 sec (seconds)	0 s
C1.7	Antenna Type	The type of antenna attached to the device. If you change the antenna, this setting will have an effect on C1.2 Tank Height and C1.5 Blocking Distance. For more data, <Antenna Selection>.  <b>Minimum security level to change the setting:</b> Expert	Metallic Horn (DN40), Metallic Horn (DN50), Metallic Horn (DN65), Metallic Horn,(DN80), Metallic Horn (DN100), Metallic Horn (DN200), Drop (PP, DN80), Drop (PP, DN150); Drop (PTFE, DN80), Drop (PTFE, DN150); Drop (PEEK, DN80), Drop (PEEK, DN150) Hygienic (PEEK, DN50)	Metallic Horn (DN100)
C1.8	Antenna Extension	Optional antenna extension. These are attached between the flange and the antenna. Each segment is 105 mm / 4.1" long.  <b>Minimum security level to change the setting:</b> Expert	min-max: 0.0...10000 mm / 0.0...393.7"	0 mm / 0"
C1.9	Distance piece	Optional distance piece between the converter and the process connection. This is for the high-temperature version of the device. Each segment is 105 mm / 4.1" long.  <b>Minimum security level to change the setting:</b> Expert	min-max: 0.0...2000 mm / 0.0...78.74"	0 mm / 0"
C1.10	Reference Offset	Offset relating to a reference location (distance). This value is positive when the reference location is above the device flange face and negative if below. For more data, <Distance>.  <b>Minimum security level to change the setting:</b> Expert	min-max: -5000.0+0...+5000.0 m / - 16404...+164404 ft	0 m / 0 ft
C1.11	Tank Bottom Offset	Offset relating to a reference location (level). The device reference point for this parameter is the bottom of the tank (set in menu item C1.2 Tank Height). This value is positive when the reference location is below the tank bottom and negative if above. For more data, <Level>.  <b>Minimum security level to change the setting:</b> Expert	min-max: - 5000.0+0...+5000.0 mm / -16404...+164404 ft	0 m / 0 ft
C2 Process				
C2.1	Tracking Velocity	This menu item sets the maximum rate of change of level in metres per minute or feet per minute. The measured value cannot change faster than the tracing velocity.  <b>Minimum security level to change the setting:</b> Expert	min-max: 1.2 <sup>+03</sup> ...60.0 <sup>+06</sup> m/min / 3.937 <sup>+03</sup> ...196.85 ft	60.0 <sup>-03</sup> m 196.85 <sup>-03</sup> ft/min

Menu No.	Function	Function description	Selection list	Default
C2.2	Epsilon R Product	The device automatically calculates the level based on the product $\epsilon_r$ . If you select "TBF Full" or "TBF Auto" in menu item C2.4 Measuring Mode, you can change this value manually to adjust readings.  <b>Minimum security level to change the setting:</b> Expert	1.1...20	2.0
C2.3	Epsilon R Gas	A major parameter for radar level measurement devices. If the gas is not air, set the $\epsilon_r$ value to the $\epsilon_r$ value of the gas.  <b>Minimum security level to change the setting:</b> Expert	1.0...20	1.0
C2.4	Measuring Mode	The device uses the dielectric constant ( $\epsilon_r$ ) of the tank contents to monitor level. In "Direct" mode (if the dielectric constant is high), the level signal is a reflection on the surface of the tank contents. If the dielectric constant is low, the device uses "TBF Auto" or "TBF Full" mode. The device in "TBF" mode uses the radar reflection on the bottom of the tank (the signal goes through the tank contents). The tank must have a flat bottom for the device to operate correctly in TBF mode. This menu item is set by default to "Direct" for tank contents with an $\epsilon_r > 1.8$ . If $\epsilon_r$ is very low ( $< 1.6$ ), use "TBF Full". If $\epsilon_r$ is low ( $\epsilon_r = 1.5 \dots 1.7$ ), use "TBF Auto" mode. "TBF Auto" is an automatic mode that lets the device make a selection between "Direct" mode and "TBF" mode. If you use "TBF Full" or "TBF Auto", enter the dielectric constant in menu item C2.2 Epsilon R Product. Refer also to "Measuring principle" on page 98.  <b>Minimum security level to change the setting:</b> Expert	Direct, TBF Partial, TBF Full	Direct
C2.5	Overfill Detection	If this function is in operation, the device will monitor the level even if it is in the blocking distance. The output shown on the display screen stays fixed at the blocking distance, but an error message will warn the user that the tank is too full.  <b>Minimum security level to change the setting:</b> Expert	Disabled, Enabled	Disabled
C2.6	Overfill Threshold	If you have set 2.5 Overfill Detection to "Enabled", this menu item will be available. If the device cannot easily measure in the blocking distance (see menu item C1.5), then you can change the overfill threshold. This value is a percentage of the radar signal amplitude. To enter the correct value, we recommend that you speak or write to your supplier.  <b>Minimum security level to change the setting:</b> Expert	min-max: 0.0...100.0%	9.6602%

Menu No.	Function	Function description	Selection list	Default
C2.7	Mult. Refl. Enable	<p>Multiple reflections will cause the device to display smaller level readings. Installation of the device on a manhole or at the centre of a dome roof, and high dielectric products (<math>\epsilon_r &gt; 5</math>) can cause multiple reflections. A very calm surface or a tank with a small convex or flat roof can also cause multiple reflections.</p> <p>If this function is in operation, the device looks for the first signal peak below the process connection. This signal peak is then used to measure the level of the tank contents. If this function is not in operation, the device looks for the largest signal below the process connection.</p> <p><b>Minimum security level to change the setting:</b> Expert</p>	Disabled, Enabled	Disabled
C2.8	Empty Spectrum Enable	<p>This function starts and stops the interference signal filter. Interference signals are the result of fixed and moving obstacles inside the tank. If you must do a spectrum analysis, record an empty spectrum first. Do the "Empty Spectrum" procedure (menu A4.2) in the Quick Setup menu.</p> <p><b>Minimum security level to change the setting:</b> Expert</p>	Disabled, Enabled	Disabled

### C3 Conversion

C3.1 Edit Table				
C3.1.1	Erase Table?	<p>Before you can make a conversion table, you must delete the data that is stored in the device at this time. If you set this menu item to "No" you will go back to menu C3.1. If you set it to "Yes", you will go to menu item C3.1.2 Select Conversion.</p> <p><b>Minimum security level to change the setting:</b> Expert</p>	Yes, No	No
C3.1.2	Select Conversion	<p>If you must make a volume conversion table, set this menu item to "Volume". If you must make a mass conversion table, set this menu item to "Mass". If you must make a linearization table to make sure that the readings always agree with reference measurements, set this menu item to "Linearization".</p> <p><b>Minimum security level to change the setting:</b> Expert</p>	Volume, Mass, Linearization	Volume
C3.2 Input Table				
C3.2.2	Point	<p>This adds a point on the conversion table. Each time you enter this menu item, this number will automatically increment by 1 point. If it is necessary to change the data for a point, change the point number. When you push [←], you go to menu item C3.2.4 Level.</p> <p><b>Minimum security level to do the procedure:</b> Expert</p>	min-max: 001...050	001

Menu No.	Function	Function description	Selection list	Default
C3.2.4	Level	Enter the level value for the point given in C3.2.2. Push [←] to confirm the level value and go to C3.2.5 Conv. Value.  <b>Minimum security level to do the procedure:</b> Expert	min-max: 0.0...100.0 <sup>+03</sup> mm / 0.0...3937.0 <sup>..</sup>	0.0 mm / 0.0 <sup>..</sup>
C3.2.5	Conv. Value	Enter the conversion value (volume, mass or linearization) for the point given in C3.2.2. Push [←] to confirm the conversion value and go back to menu C3.2.  <b>Minimum security level to do the procedure:</b> Expert	min-max: Volume: 0.0...100.0 <sup>+09</sup> m <sup>3</sup> / 0.0...26.417 <sup>+12</sup> gal Mass: 0.0...100.0 <sup>+09</sup> kg / 0.0...220.46 <sup>+09</sup> lb Linearization: 0.0...100.0 <sup>+12</sup> mm / 0.0...3.937 <sup>+12..</sup>	Volume:0.0 m <sup>3</sup> / 0.0 gal Mass:0.0 kg / 0.0 lb Linearization: 0.0 mm / 0.0 <sup>..</sup>

## C4 Output

C4.1 Current Output 1				
C4.1.1	Current Out. 1 Var.	Make a selection from the available output functions to scale the current output values. This is not shown in the normal mode.  <b>Minimum security level to change the setting:</b> Expert	Level, Sensor Value, Reflection, Lin. Distance, Lin. Level, Distance	Distance
C4.1.2	0% Range	Give a measurement value to 0% output (refer also to C4.1.1 Current Out. 1 Var for the output function). This is the minimum loop current (this does not include the error current). The parameter set in menu item <b>C.4.1.4 Current Out. Range</b> has an effect on this current value.  <b>Minimum security level to change the setting:</b> Expert	min-max: -4.9 <sup>+06</sup> ...+5.1 <sup>+06</sup> mm / - 192.91 <sup>+03</sup> ...+200.79 <sup>+03..</sup>	0.0 mm
C4.1.3	100% Range	Give a measurement value to 100% output (refer also to C4.1.1 Current Out. 1 Var for the output function). This is the maximum loop current (this does not include the error current). The parameter set in menu item <b>C.4.1.4 Current Out. Range</b> has an effect on this current value.  <b>Minimum security level to change the setting:</b> Expert	min-max: -4.9 <sup>+06</sup> ...+5.1 <sup>+06</sup> mm / - 192.91 <sup>+03</sup> ...+200.79 <sup>+03..</sup>	10000 mm
C4.1.4	Current Out. Range	This menu item sets the limits of the output current range to 1 of 4 available options: standard limits (4...20 mA), NAMUR NE 43-compliant limits (3.8...20.5 mA), reversed standard limits and reversed NAMUR NE 43-compliant limits. You use standard limits when you want the 0% output to be 3.8 or 4 mA and the 100% output to be 20 mA or 20.5 mA. You use reversed limits when you want the 0% output to be 20 mA or 20.5 mA and 100% output to be 3.8 mA or 4 mA.  <b>Minimum security level to change the setting:</b> Expert	4-20 mA, 3.8-20.5 mA (NAMUR), 4-20 mA (reversed), 3.8-20.5 mA (reversed)	4-20 mA

Menu No.	Function	Function description	Selection list	Default
C4.1.5	Error Function	This sets the behaviour of current output 1 if an error occurs. If this menu item is set to "Off", no signal is given (this parameter is not available if menu item C4.1.4 is set to "3.8-20.5 mA" (NAMUR) or "3.8-20.5 mA (reversed)"). If this menu item is set to "Hold", the output current stays at the value where the error occurred (this parameter is not available if menu item C4.1.4 is set to "3.8-20.5 mA" (NAMUR) or "3.8-20.5 mA (reversed)"). If this menu item is set to "Low", the output current changes to 3.5 mA (default value) if an error occurs. If this menu item is set to "High", the output current changes to 21.5 mA (default value) if an error occurs.  <b>Minimum security level to change the setting:</b> Expert	Off, Low, High, Hold	Low
C4.1.7	Low Error Current	This menu item is available if C4.1.5 Error Function is set to "Low". You can change the value to which the current output will change if an error occurs.  <b>Minimum security level to change the setting:</b> Expert	min-max: 3.5...3.6 mA	3.5 mA
C4.1.8	High Error Current	This menu item is available if C4.1.5 Error Function is set to "High". You can change the value to which the current output will change if an error occurs.  <b>Minimum security level to change the setting:</b> Expert	min-max: 21.0...21.5 mA	21.5 mA
C4.1.9 Trimming				
C4.1.9.1	4mA Trimming	Use this menu item if the current output of the device is set to 4 mA, but the measured loop current is not 4 mA. Enter the measured value.  <b>Minimum security level to change the setting:</b> Expert	min-max: 0.0...25.0 mA	4 mA
C4.1.9.2	20mA Trimming	Use this menu item if the current output of the device is set to 20 mA, but the measured loop current is not 20 mA. Enter the measured value.  <b>Minimum security level to change the setting:</b> Expert	min-max: 0.0...25.0 mA	20 mA

## C5 Communication

C5.1 HART				
C5.1.1	Current Loop Mode	Set this menu item to "On" if the "Primary Variable" for current output 1 must also be transmitted as a 4...20 mA signal. If this menu item is set to "Off", this stops the 4...20 mA signal and starts HART® multi-drop mode.  <b>Minimum security level to change the setting:</b> Expert	On, Off	On
C5.1.2 Identification				

Menu No.	Function	Function description	Selection list	Default
C5.1.2.1	Polling Address	A polling address more than 0 will start HART® multidrop mode. If you start HART® multidrop mode, the current output stays constant at 4 mA.  <b>Minimum security level to change the setting:</b> Operator	000...063	0
C5.1.2.2	Tag	Use this menu item to change the Tag name. It can have a maximum of 8 characters. For more data about the characters available, refer to <i>Keypad functions</i> on page 50 ,(values in menu items).  <b>Minimum security level to change the setting:</b> Operator	—	TANK01
C5.1.2.3	Long Tag	Use this menu item to change the long Tag name. It can have a maximum of 32 characters. For more data about the characters available, refer to <i>Keypad functions</i> on page 50 ,(values in menu items).  <b>Minimum security level to change the setting:</b> Operator	—	—
C5.1.2.4	Manufacturer ID	This is the manufacturer ID number given to the supplier by the HART Foundation.	Read Only	—
C5.1.2.5	Device Type	This is the device type number given to the supplier by the HART Foundation.	Read Only	—
C5.1.2.6	Device ID	This is the device ID number given to the supplier by the HART Foundation. This shows that the HART Foundation registered the HART® device description (DD) file.	Read Only	—
C5.1.2.7	Universal Revision	This is the version of the HART protocol used by the device.	Read Only	—
C5.1.2.8	Device Revision	This is the revision number for the HART® device description.	Read Only	—
C5.1.2.9	Software Revision	This is the revision number for the device software.	Read Only	—
C5.1.2.10	Hardware Revision	This is the revision number for the device hardware.	Read Only	—
C5.1.3 Device Information				
C5.1.3.1	Descriptor	You can give a short description (16 characters maximum) of the device in this menu item.  <b>Minimum security level to change the setting:</b> Operator	—	—
C5.1.3.2	Message	You can give more data in this menu item (32 characters maximum).  <b>Minimum security level to change the setting:</b> Expert	—	—
C5.1.3.3	Date	You can enter the date in this menu item (Format: Year-Month-Day / YYYY-MM-DD)	—	2014-01-01
C5.1.3.4	Cfg. Change Counter	This function counts the number of changes to the HART® device settings	Read Only	—
C5.1.4 HART Variables				



Menu No.	Function	Function description	Selection list	Default
C5.1.4.1	Current Out. 1 Var.	This is the first measurement type shown on HART® controllers. Make a selection from the list.  <b>Minimum security level to change the setting:</b> Expert	Distance, Level, Sensor Value, Reflection	Distance
C5.1.4.2	HART/sec./CO2 Var.	This is the second measurement type shown on HART® controllers. Make a selection from the list.  <b>Minimum security level to change the setting:</b> Expert	Distance, Level, Sensor Value, Reflection	Level
C5.1.4.2	Tertiary Var.	This is the third measurement type shown on HART® controllers. Make a selection from the list.  <b>Minimum security level to change the setting:</b> Operator	Distance, Level, Sensor Value, Reflection	Reflection
C5.1.4.2	Quaternary Var.	This is the fourth measurement type shown on HART® controllers. Make a selection from the list.  <b>Minimum security level to change the setting:</b> Operator	Distance, Level, Sensor Value, Reflection	Sensor Value
<b>C6 Display</b>				
C6.1	Language	Data can be shown in one of the languages stored in the device. Make a selection from the list.  <b>Minimum security level to change the setting:</b> User	English, German, French, Italian Portuguese, Spanish, Czech, Polish, Chinese (simplified), Japanese, Russian, Turkish	English
C6.2	Backlight	If you set this menu item to "Enabled", a light comes on when you push a button on the display keypad and if the loop current is more than 6 mA.  <b>Minimum security level to change the setting:</b> User	Disabled, Enabled	Disabled
C6.3	Contrast	The contrast control for the display screen. You can select a shade of grey between light grey (-10) and black (+10).  <b>Minimum security level to change the setting:</b> User	min-max: -10...+10	0
<b>C6.4 1st Meas. Page</b>				
C6.4.1	Function	This menu item changes the configuration of data shown on the display screen in normal mode. There are two measurement pages available to show readings in normal mode. This setting is for the first page.  <b>Minimum security level to change the setting:</b> User	One Value, One Value & Bar, Two Values, Two Values & Bar, Three Values	One Value & Bar
C6.4.2	1st Value Variable	This changes the measurement type of the first value on the measurement page.	Distance, Level, Reflection, Sensor Value	Distance
C6.4.3	0% Range	This is the 0% value given to the bar graph indicator in normal mode. The range is related to the measurement type set in C6.4.2 1st Value Variable. This menu item is only available if you set C6.4.1 Function to "One Value & Bar" or "Two Values & Bar".	Refer to "Function description".	Refer to "Function description".

Menu No.	Function	Function description	Selection list	Default
C6.4.4	100% Range	This is the 100% value given to the bar graph indicator in normal mode. The range is related to the measurement type set in C6.4.2 1st Value Variable. This menu item is only available if you set C6.4.1 Function to "One Value & Bar" or "Two Values & Bar".  <b>Minimum security level to change the setting:</b> User	Refer to "Function description".	Refer to "Function description".
C6.4.5	Format 1st Value	You can change the number of decimal places that are shown for the first value on the measurement page in normal mode. For example, if you set this menu item to "X.XX", the value shown will be corrected to 2 decimal places. If you set this menu item to "Automatic", the device will adjust the number of decimal places automatically.  <b>Minimum security level to change the setting:</b> User	X, X.X, X.XX, X.XXX, X.XXXX, X.XXXXX, X.XXXXXXX, Automatic	X.XXX
C6.4.6	2nd Value Variable	This changes the measurement type of the second value on the measurement page. This menu item is only available if you set C6.4.1 Function to "Two Values", "Two Values & Bar" or "Three Values".  <b>Minimum security level to change the setting:</b> User	Distance, Level, Reflection, Sensor Value	Level
C6.4.7	Format 2nd Value	You can change the number of decimal places that are shown for the second value on the measurement page in normal mode. For example, if you set this menu item to "X.XX", the value shown will be corrected to 2 decimal places. If you set this menu item to "Automatic", the device will adjust the number of decimal places automatically.  <b>Minimum security level to change the setting:</b> User	X, X.X, X.XX, X.XXX, X.XXXX, X.XXXXX, X.XXXXXXX, Automatic	X.XXX
C6.4.8	3rd Value Variable	This changes the measurement type of the third value on the measurement page. This menu item is only available if you set C6.4.1 Function to "Three Values".  <b>Minimum security level to change the setting:</b> User	Distance, Level, Reflection, Sensor Value	Reflection
C6.4.9	Format 3rd Value	You can change the number of decimal places that are shown for the second value on the measurement page in normal mode. For example, if you set this menu item to "X.XX", the value shown will be corrected to 2 decimal places. If you set this menu item to "Automatic", the device will adjust the number of decimal places automatically.  <b>Minimum security level to change the setting:</b> User	X, X.X, X.XX, X.XXX, X.XXXX, X.XXXXX, X.XXXXXXX, Automatic	X.XXX
<b>C6.5 2nd Meas. Page</b>				

Menu No.	Function	Function description	Selection list	Default
C6.5.1	Function	This menu item changes the configuration of data shown on the display screen in normal mode. There are two measurement pages available to show readings in normal mode. This setting is for the second page.  <b>Minimum security level to change the setting:</b> User	One Value, One Value & Bar, Two Values, Two Values & Bar, Three Values	Three Values
C6.5.2	1st Value Variable	This changes the measurement type of the first value on the measurement page.  <b>Minimum security level to change the setting:</b> User	Distance, Level, Reflection, Sensor Value	Distance
C6.5.3	0% Range	This is the 0% value given to the bar graph indicator in normal mode. The range is related to the measurement type set in C6.4.2 1st Value Variable. This menu item is only available if you set C6.4.1 Function to "One Value & Bar" or "Two Values & Bar".  <b>Minimum security level to change the setting:</b> User	Refer to "Function description".	Refer to "Function description".
C6.5.4	100% Range	This is the 100% value given to the bar graph indicator in normal mode. The range is related to the measurement type set in C6.4.2 1st Value Variable. This menu item is only available if you set C6.4.1 Function to "One Value & Bar" or "Two Values & Bar".  <b>Minimum security level to change the setting:</b> User	Refer to "Function description".	Refer to "Function description".
C6.5.5	Format 1st Value	You can change the number of decimal places that are shown for the first value on the measurement page in normal mode. For example, if you set this menu item to "X.XX", the value shown will be corrected to 2 decimal places. If you set this menu item to "Automatic", the device will adjust the number of decimal places automatically.  <b>Minimum security level to change the setting:</b> User	X, X.X, X.XX, X.XXX, X.XXXX, X.XXXXX, X.XXXXXXX, Automatic	X.XXX
C6.5.6	2nd Value Variable	This changes the measurement type of the second value on the measurement page. This menu item is only available if you set C6.4.1 Function to "Two Values", "Two Values & Bar" or "Three Values".  <b>Minimum security level to change the setting:</b> User	Distance, Level, Reflection, Sensor Value	Level
C6.5.7	Format 2nd Value	You can change the number of decimal places that are shown for the second value on the measurement page in normal mode. For example, if you set this menu item to "X.XX", the value shown will be corrected to 2 decimal places. If you set this menu item to "Automatic", the device will adjust the number of decimal places automatically.  <b>Minimum security level to change the setting:</b> User	X, X.X, X.XX, X.XXX, X.XXXX, X.XXXXX, X.XXXXXXX	X.XXX

Menu No.	Function	Function description	Selection list	Default
C6.5.8	3rd Value Variable	This changes the measurement type of the third value on the measurement page. This menu item is only available if you set C6.4.1 Function to "Three Values".  <b>Minimum security level to change the setting:</b> User	Distance, Level, Reflection, Sensor Value	Reflection
C6.5.9	Format 3rd Value	You can change the number of decimal places that are shown for the second value on the measurement page in normal mode. For example, if you set this menu item to "X.XX", the value shown will be corrected to 2 decimal places. If you set this menu item to "Automatic", the device will adjust the number of decimal places automatically.  <b>Minimum security level to change the setting:</b> User	X, X.X, X.XX, X.XXX, X.XXXX, X.XXXXX, X.XXXXXXX, Automatic	X.XXX

## C7 Device

C7.1 Information				
C7.1.1	Tag	Use this menu item to change the Tag name. It can have a maximum of 8 characters. For more data about the characters available, refer to <i>Keypad functions</i> on page 50 ,(values in menu items).	TANK01	—
C7.1.2	Serial Number	This is the device fabrication number	Ready only	—
C7.1.3	Device Name	This gives the device family name and model code.	Ready only	—
C7.1.4	C7.1.4 V Number	This is the manufacturer's option code for device configuration.	Ready only	—
C7.1.5	Electronic Revision	This is the hardware revision number. This number agrees with NAMUR NE 53 Guidelines.	Ready only	—
C7.1.6	C7.1.6 Software Revision	This is the software revision number. This number agrees with NAMUR NE 53 Guidelines.	Ready only	—
C7.1.7	Electronic serial No.	This is the hardware fabrication number. This number agrees with NAMUR NE 53 Guidelines.	Ready only	—
C7.1.8	Production Date	This the date that the manufacturer finished the device. The date format is: Year-Month-Day.	Ready only	—
C7.1.9	Calibration Date	This the date that the manufacturer calibrated the device. The date format is: Year-Month-Day.	Ready only	—
C7.2 Security				
C7.2.1	Login	Enter the appropriate password here to change settings. If you do not enter the password, you can only change settings for the "user" security level. For more data and the default passwords for the "operator" and "expert" security levels, refer to <i>Protection of the device settings (security levels)</i> on page 47.	4-digit hexadecimal password	Refer to "Function description"

Menu No.	Function	Function description	Selection list	Default
C7.2.2	Change Password	This changes the password for the "operator" and "expert" security levels. For the procedure to change the password, refer to <i>Protection of the device settings (security levels)</i> on page 47 (How to change the password).	4-digit hexadecimal password	Refer to "Function description"
C7.2.3	Reset Passwords	This makes the passwords for the "operator" and "expert" security levels go back to the default passwords.	—	E8EC
C7.2.4	Unlock Extended Range	This menu item can only be unlocked at the factory.	—	—
C7.2.5	Unlock SIL	This menu item can only be unlocked at the factory.	—	—
<b>C7.3 Errors</b>				
C7.3.1	Message View	A log of device errors. Scroll down the list and push [➤] to show the error details. The error will have a letter code ("F", "S", "M", "C" and "I") that agrees with NAMUR NE 107 Guidelines.	Ready only	—
C7.3.2 Error-Mapping				
C7.3.2.1	Sensor: Information	This permits you to change the error code that is given to an incident.  <b>Minimum security level to change the setting:</b> User	None, Information (I), Maintenance Request (M), Out of Specification (S), Function Check (C), Failure (F)	Information
C7.5 Units				
C7.5.1	Length Unit	The length unit shown in normal mode. If you set this menu item to "Cst." (custom length unit), enter values in menu items C7.5.2.1 thru C7.5.2.3.  <b>Minimum security level to change the setting:</b> User	m, cm, mm, ft, in, Cst.	m
C7.5.2 Cst. Length				
C7.5.2.1	Text	Enter a text (8 characters maximum) for the custom length unit.	—	Cst.
C7.5.2.2	Offset	Enter an offset value.	—	0.0 m
C7.5.2.3	Factor	Enter an offset factor. Multiply the value in C7.5.4.3 Offset by this offset factor to change m (metres) to the custom length unit.	—	1.0
C7.5.3	Volume	The volume unit shown in normal mode if you made a volume table in the C3 Conversion menu. If you set this menu item to "Cst. Volume" (custom volume unit), enter values in menu items C7.5.4.1 thru C7.5.4.3.  <b>Minimum security level to change the setting:</b> User	m <sup>3</sup> , L, hL, in <sup>3</sup> , ft <sup>3</sup> , gal, ImpGal, yd <sup>3</sup> , bbl, bbl (beer, US), Cst. Volume	m <sup>3</sup>
C7.5.4 Cst. Volume				
C7.5.4.1	Text	Enter a text (8 characters maximum) for the custom volume unit.	—	Cst.
C7.5.4.2	Offset	Enter an offset value.	—	0.0 m <sup>3</sup>

Menu No.	Function	Function description	Selection list	Default
C7.5.4.3	Factor	Enter an offset factor. Multiply the value in C7.5.4.3 Offset by this offset factor to change m <sup>3</sup> (cubic metres) to the custom volume unit.	—	1.0
C7.5.5	Mass	The mass unit shown in normal mode if you made a mass table in the C3 Conversion menu. If you set this menu item to "Cst. Mass" (custom mass unit), enter values in menu items C7.5.6.1 thru C7.5.6.3.  <b>Minimum security level to change the setting:</b> User	kg, t, lb, tn.sh., tn.l., Cst. Mass	
C7.5.6 Cst. Mass				
C7.5.6.1	Text	Enter a text (8 characters maximum) for the custom volume unit.	—	Cst.
C7.5.6.2	Offset	Enter an offset value.	—	0.0kg
C7.5.6.3	Factor	Enter an offset factor. Multiply the value in C7.5.4.3 Offset by this offset factor to change kg (kilogram) to the custom mass unit.	—	1.0
<b>C7.6 Factory Default</b>				
C7.6.1	Reset to Fact. Def.?	If you set this menu item to "YES", the device goes back to its initial settings (set by the manufacturer in the factory).  <b>Minimum security level to change the setting:</b> Expert	Yes, No	No
<b>C7.7 Proof Test (for use in SIL mode)</b>				
C7.7.1	①	<b>Unsaved parameters will be lost!</b> If you have made changes to the settings before this test and you did not go back to normal mode to save the settings, this data will not be saved. Push [←] to continue.  <b>Minimum security level to do the procedure:</b> User	Ready only	—
C7.7.2	②	<b>Run Proof Test?</b> This menu item starts a proof test to make sure that the device can be used in SIL mode. Push [←] to continue.	Yes, No	No
C7.7.3 Proof Test				
C7.7.3.1	③	<b>Proof Test is running...</b> At the end of the test, push [←] to continue.	—	—
C7.7.3.2	④	<b>Device will be reset now!</b> Push [←] to continue. This will restart the device. End of the "Proof Test" procedure.	—	—

### 3. Service menu

Menu No.	Function	Function description	Selection list	Default
3.0.0	SERVICE	Advanced settings. The settings in this menu are protected with a password. Only approved personnel can change the parameters in this menu. For more data, speak or write to your local sales office.		

## 4. Master menu

Menu No.	Function	Function description	Selection list	Default
4.0.0	MASTER	Factory settings. The settings in this menu are protected with a password. Only approved personnel can change the parameters in this menu. For more data, speak or write to your local sales office.		

## 6.4 Further information on device configuration in program mode

### 6.4.1 Standard Setup

Use this procedure (menu item A4.1 Standard Setup) to change the length unit, tank type, tank height (this includes the stilling well diameter and stilling well height if **Tank Type** is set to "Stilling Well"), current output variable, 0% range, 100% range, current output range and error function. Values and parameters that can be changed are shown between the « ... » marks in the illustrations that follow. Push the keypad buttons in the correct sequence:

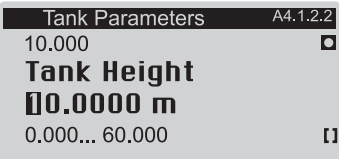
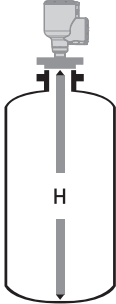
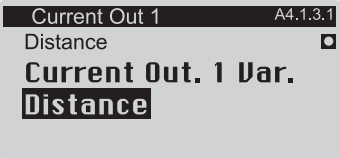
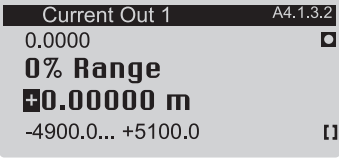
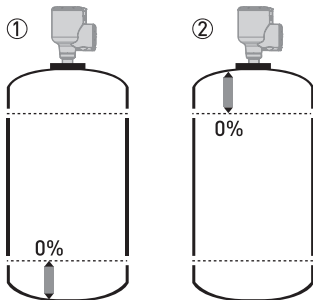


#### CAUTION!

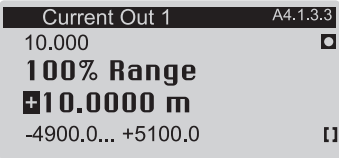
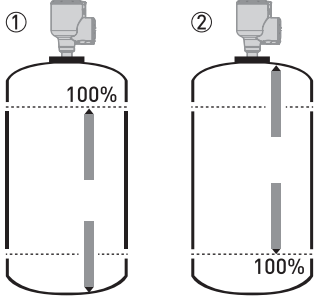

Make sure that you do this procedure before you use the device. The settings in this procedure have an effect on the performance of the device.

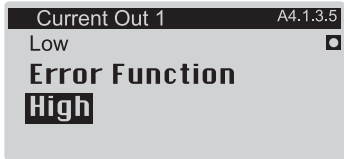

### Procedure

Screen	Steps	Description
	<ul style="list-style-type: none"> <li>• 2 × [➤], 2 × [▼] and [➤].</li> </ul>	<p>Default screen.</p> <p>Enter Program Mode and go to menu item A3 Login.</p>
	<ul style="list-style-type: none"> <li>• 2 × [➤], 5 × [▲], [➤], 8 × [▲] and [↵]</li> </ul>	<p>Enter the password used at this time for the "Expert" security level. If it is the default password, refer to <i>Protection of the device settings (security levels)</i> on page 47.</p>
	<ul style="list-style-type: none"> <li>• [▼] and 2 × [➤]</li> <li>• [▲] or [▼] for the selection of the length unit (m, Cst., in, ft, mm or cm).</li> <li>• [↵] to confirm.</li> </ul>	<p>Push these buttons to start the Standard Setup procedure.</p> <p>Length unit. Make a selection from the list of parameters.</p>
	<ul style="list-style-type: none"> <li>• [▲] or [▼] for the selection of the tank type ().</li> <li>• [↵] to confirm.</li> </ul>	<p>Tank type. Make a selection from the list of parameters. .</p>

Screen	Steps	Description
 <p>Tank Parameters A4.1.2.2 10.000 <b>Tank Height</b> <b>00.0000 m</b> 0.000... 60.000</p>	<ul style="list-style-type: none"> <li>• [➤] to change the position of the cursor.</li> <li>• [▼] to decrease the value (or move the decimal point one digit to the left) or [▲] to increase the value (or move the decimal point one digit to the right).</li> <li>• [←] to confirm.</li> </ul>	<p>Tank height. The distance from the flange face / thread stop of the tank connection down to the tank bottom. If the tank has a dish-shaped or conical bottom, the tank height is measured to a point on the tank bottom directly below the antenna.</p> 
 <p>Current Out 1 A4.1.3.1 Distance <b>Current Out. 1 Var.</b> <b>Distance</b></p>	<ul style="list-style-type: none"> <li>• [▲] or [▼] for the selection of the measurement name (Distance, Level, Sensor Value or Reflection, Volume (Mass), Ullage Volume (Ullage Volume)).</li> <li>• [←] to confirm.</li> </ul>	<p>Current output 1 variable. The manufacturer sets the current output variable (for current output 1) to "Distance" before delivery.</p> <p>If it is necessary to measure volume, ullage volume, mass or ullage mass, refer to <i>How to configure the device to measure volume or mass</i> on page 86.</p>
 <p>Current Out 1 A4.1.3.2 0.0000 <b>0% Range</b> <b>+0.00000 m</b> -4900.0... +5100.0</p>	<ul style="list-style-type: none"> <li>• [➤] to change the position of the cursor.</li> <li>• [▼] to decrease the value (or move the decimal point one digit to the left) or [▲] to increase the value (or move the decimal point one digit to the right).</li> <li>• [←] to confirm.</li> </ul>	<p>0% range. Use this step to give the 0% output setting in the tank.</p> <p>Refer to the illustrations that follow. When menu item <b>A4.1.3.1 Current Out. 1 Var.</b> is set to "Level", illustration ① shows the position of 0% output as a level above the tank bottom. When menu item <b>A4.1.3.1 Current Out. 1 Var.</b> is set to "Distance", illustration ② shows the position of 0% output as a distance below the flange facing or thread stop of the process connection.</p> 



Screen	Steps	Description
 <p>Current Out 1 A4.1.3.3 10.000 <b>100% Range</b> <b>10.0000 m</b> -4900.0... +5100.0</p>	<ul style="list-style-type: none"> <li>• [➤] to change the position of the cursor.</li> <li>• [▼] to decrease the value (or move the decimal point one digit to the left) or [▲] to increase the value (or move the decimal point one digit to the right).</li> <li>• [←] to confirm.</li> </ul>	<p>100% range. Use this step to give the 0% output setting in the tank. Refer to the illustrations that follow. Illustration ① shows the settings for level. Illustration ② shows the settings for distance.</p> <p>Refer to the illustrations that follow. When menu item <b>A4.1.3.1 Current Out. 1 Var.</b> is set to "Level", illustration ① shows the position of 100% output as a level above the tank bottom. When menu item <b>A4.1.3.1 Current Out. 1 Var.</b> is set to "Distance", illustration ② shows the position of 100% output as a distance below the flange facing or thread stop of the process connection.</p> 
 <p>Current Out 1 A4.1.3.4 4-20 mA <b>Current Out. Range</b> <b>4-20 mA</b></p>	<ul style="list-style-type: none"> <li>• [▲] or [▼] for the selection of the current output range (3.8-20.5 mA (NAMUR), 4-20 mA, 3.8-20.5 mA (reversed) or 4-20 mA (reversed)).</li> <li>• [←] to confirm.</li> </ul>	<p>Current output range. This menu item gives current output values to the measuring range between 0% and 100% values given in the "0% range" and "100% range" steps.</p> <p><b>If you set this menu item to "3.8-20.5 mA":</b></p> <ul style="list-style-type: none"> <li>• 0% Range = 3.8 mA</li> <li>• 100% Range = 20.5 mA</li> </ul> <p><b>If you set this menu item to "4-20 mA":</b></p> <ul style="list-style-type: none"> <li>• 0% Range = 4 mA</li> <li>• 100% Range = 20 mA</li> </ul> <p><b>If you set this menu item to "3.8-20.5 mA (reversed)":</b></p> <ul style="list-style-type: none"> <li>• 0% Range = 20.5 mA</li> <li>• 100% Range = 3.8 mA</li> </ul> <p><b>If you set this menu item to "4-20 mA (reversed)":</b></p> <ul style="list-style-type: none"> <li>• 0% Range = 20 mA</li> <li>• 100% Range = 4 mA</li> </ul>

Screen	Steps	Description
	<ul style="list-style-type: none"> <li>• [▲] or [▼] for the selection of the error function (Off, Hold, High or Low).</li> <li>• [←] to confirm.</li> </ul>	<p>Error Function. This sets the behaviour of current output 1 if an error occurs.</p> <p>If this menu item is set to "Off", no signal is given (this parameter is not available if menu item C4.1.4 is set to "3.8-20.5 mA" (NAMUR) or "3.8-20.5 mA (reversed)"). If this menu item is set to "Hold", the output current stays at the value where the error occurred (this parameter is not available if menu item C4.1.4 is set to "3.8-20.5 mA" (NAMUR) or "3.8-20.5 mA (reversed)"). If this menu item is set to "Low", the output current changes to 3.5 mA (default value) if an error occurs. If this menu item is set to "High", the output current changes to 21.5 mA (default value) if an error occurs.</p>
	<ul style="list-style-type: none"> <li>• 3 × [←] to confirm.</li> <li>• [▲] or [▼] for the selection of the save option (Yes, No or Back).</li> <li>• [←] to confirm.</li> </ul>	<p><b>Save Configuration?</b> screen.</p> <p>Set to "Yes" to save and use the settings and data and go back to Normal Mode. Set to "No" to cancel the changes to the device settings and go back to Normal Mode. Set to "Back" to stay in Program Mode.</p>

### 6.4.2 Empty spectrum recording

The empty spectrum recording procedure is important for the performance of the device. We recommend that the tank is empty or only filled to the minimum level before you do the procedure.

Use this procedure (menu item A4.2. Empty Spectrum) if there are fixed and moving objects in the tank that can cause parasitic signals. The device does a scan for objects that do not change their vertical positions in the tank (heating tubes, agitators, fuel assemblies etc.) and records the data. The device can then use this data to put the measurement signal through a filter (empty spectrum).

When the empty spectrum filter is on (when menu item C2.8 Empty Spectrum Enable is set to "Enable"), it will ignore the parasitic signals. Because the device records the data from the procedure, it is also not necessary to do the procedure again if you de-energize the device.



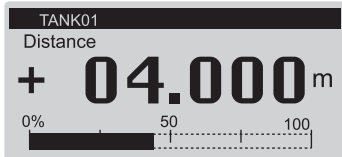
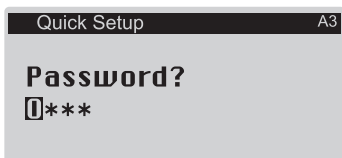
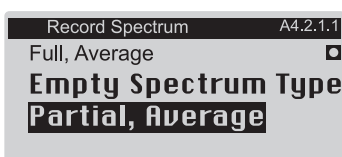
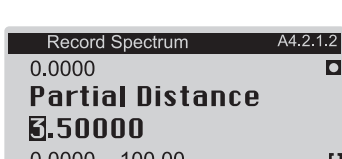
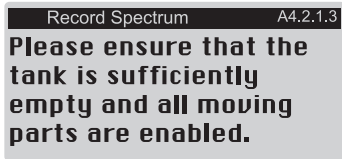
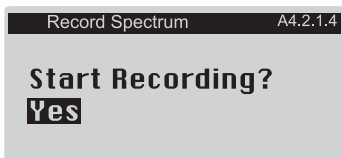
**CAUTION!**

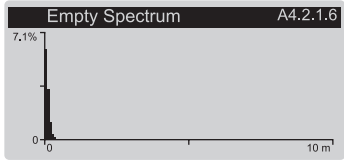
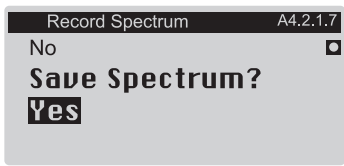
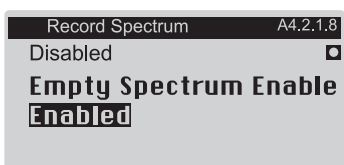

*Make sure that the tank is empty or only filled to the minimum level.*

Before you do the empty spectrum recording procedure, install the device on the tank. For more data about how to install the device, refer to *Installation* on page 22.

Values and parameters that can be changed are shown between the « ... » marks in the illustrations that follow. Push the keypad buttons in the correct sequence:

## Procedure

Screen	Steps	Description
	<ul style="list-style-type: none"> <li>• 2 × [➤], 2 × [▼] and [➤].</li> </ul>	<p>Default screen.</p> <p>Enter Program Mode and go to menu item A3 Login.</p>
	<ul style="list-style-type: none"> <li>• 2 × [➤], 5 × [▲], [➤], 8 × [▲] and [↵]</li> </ul>	<p>Enter the password used at this time for the "Expert" security level. If it is the default password, refer to <i>Protection of the device settings (security levels)</i> on page 47.</p>
	<ul style="list-style-type: none"> <li>• [▼], [➤], [▼] and 2 × [➤].</li> <li>• [▲] or [▼] for the selection of the empty spectrum type (Full (Average), Full (Max), Partial (Average), Partial (Max)).</li> <li>• [↵] to confirm.</li> </ul>	<p>Push these buttons to start the Record Spectrum (Empty Spectrum) procedure.</p> <p>Empty spectrum type. Make a selection from the list of parameters. If you can empty the tank, set this menu item to "Full, Average" or "Full, Max". If you cannot empty the tank, set this menu item to "Partial, Average" or "Partial, Max".</p>
	<ul style="list-style-type: none"> <li>• [➤] to change the position of the cursor.</li> <li>• [▼] to decrease the value (or move the decimal point one digit to the left) or [▲] to increase the value (or move the decimal point one digit to the right).</li> <li>• [↵] to confirm.</li> </ul>	<p>Partial distance. If you set <b>Empty Spectrum Type</b> to "Partial, Average" or "Partial, Max", you will have one more step to do in this procedure. You must give the distance [partial distance] of the product surface from the flange facing or thread stop of the process connection.</p>
	<ul style="list-style-type: none"> <li>• [↵] to confirm.</li> </ul>	<p>Make sure that the tank is empty or it contains not more than the minimum quantity. .</p>
	<ul style="list-style-type: none"> <li>• [▼] or [▲] to change the parameter ("No" or "Yes").</li> <li>• [↵] to confirm.</li> </ul>	<p>Start recording? Set this menu item to "Yes" to continue to the subsequent step. Set this menu item to "No" to go back to the menu.</p>

Screen	Steps	Description
	<ul style="list-style-type: none"> <li>• [↵] to confirm.</li> </ul>	Graph with the results of the empty spectrum recording.
	<ul style="list-style-type: none"> <li>• [▼] or [▲] to change the parameter ("No" or "Yes").</li> <li>• [↵] to confirm.</li> </ul>	Save spectrum? If you set the menu item to "Yes", the device will keep this empty spectrum recording. If you set the menu item to "No", the device will reject this data.
	<ul style="list-style-type: none"> <li>• [▼] or [▲] to change the parameter ("Disable" or "Enable").</li> <li>• [↵] to confirm.</li> </ul>	Empty Spectrum Enable. If you set the menu item to "Enable", the device will use the empty spectrum recording data. If you set the menu item to "Disable", the device will not use the empty recording data at this time.
	<ul style="list-style-type: none"> <li>• 4 × [↵] to confirm.</li> <li>• [▲] or [▼] for the selection of the save option (Yes, No or Back).</li> <li>• [↵] to confirm.</li> </ul>	<b>Save Configuration?</b> screen. Set to "Yes" to save and use the settings and data and go back to Normal Mode. Set to "No" to cancel the changes to the device settings and go back to Normal Mode. Set to "Back" to stay in Program Mode.

### 6.4.3 HART® network configuration



#### **INFORMATION!**

For more data, refer to *Networks* on page 37.

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



#### **CAUTION!**

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



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

- Enter Program mode.
- Push 2 × [▼], [➤], 4 × [▼], 2 × [➤], [▼] and 2 × [➤] to go to menu item C5.1.2.1 Polling Address.
- Enter a value between 001 and 063 and push [↵] to confirm.
- Push [↵] again and again to go back to the **Save Configuration** screen.
- Push [▲] or [▼] to set the screen to "Yes" and push [↵].

- The output is set to multidrop mode. The current output is set to 4 mA. This value does not change in multidrop mode.



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

- Enter Program mode.
- Push 2 × [▼], [▶], 4 × [▼], 2 × [▶], [▼] and 2 × [▶] to go to menu item C5.1.2.1 Polling Address.
- Enter the value 000 and push [↵] to confirm.
- Push [↵] again and again to go back to the **Save Configuration** screen.
- Push [▲] or [▼] to set the screen to "Yes" and push [↵].
- The output is set to point-to-point mode. The current output changes to a range of 4...20 mA or 3.8...20.5 mA (this range is set in menu item C4.1.4 Current Out. Range).

### 6.4.4 Distance measurement

#### Menu items related to distance measurement are:

- Current output 1 menu (C4.1)
- Tank Height (C1.2 – if C1.1 Tank Type is set to 'Storage', 'Process' or Agitator") or Stilling Well Height (C1.3 – if C1.1 Tank Type is set to "Stilling Well")
- Blocking Distance (C1.5)



#### **INFORMATION!**

##### **Reference Offset**

*If you move the reference point above the flange, add this value when you give a distance for the 0% Range and 100% Range settings. If you move the reference point below the flange, subtract this value when you give a distance for the 0% Range and 100% Range settings.*



#### **CAUTION!**

*If the distance for 0% Range (standard scale) is set in the blocking distance, it is possible that the device will not be able to use the full current output range.*

### 6.4.5 Level measurement

#### Menu items related to level measurement are:

- Current output 1 menu (C4.1)
- Tank Height (C1.2 – if C1.1 Tank Type is set to 'Storage', 'Process' or Agitator") or Stilling Well Height (C1.3 – if C1.1 Tank Type is set to "Stilling Well")
- Blocking Distance (C1.5)



#### **INFORMATION!**

##### **Tank Bottom Offset**

*If you move the tank bottom offset below the tank bottom (or the bottom of the stilling well), add this value when you give a level for the 0% Range and 100% Range settings. If you move the tank bottom offset above the tank bottom (or the bottom of the stilling well), subtract this value when you give a level for the 0% Range and 100% Range settings.*



#### **CAUTION!**

*If the distance for 100% Range (standard scale) is set in the blocking distance, it is possible that the device will not be able to use the full current output range.*

### 6.4.6 How to configure the device to measure volume or mass

The device can be configured to measure volume or mass. It can also be configured to a custom quantity to be measured. You can set up a strapping table in the conversion menu (C3 Conversion). Each entry is a pair of data (level – volume, level – mass or level – custom measurement). The strapping table must have a minimum of 2 entries and a maximum of 50. The reference point for the table is the bottom of the tank (as given in menu item Tank Height (C1.2) or Stilling Well Height (C1.3))



#### CAUTION!

Enter the data in numerical sequence (strapping table entry number 01, 02 etc.).



#### How to prepare a strapping table (conversion table)

- Enter Program Mode.
- Push 2 × [▲], [>], 6 × [▲], [>], 3 × [▲] and 3 × [>] to go to C7.5.1 Length Unit.
- Push [▲] and [▼] to find the length unit that you will use in the table.
- If it is necessary to make a volume table, push [←] to go back to the sub-menu level and then push 2 × [▲] and [>] to go to C7.5.3 Volume.
- Push [▲] and [▼] to find the volume unit that you will use in the table.
- Push 3 × [←] to go to the sub-menu level and then 4 × [▲], 2 × [>] to delete strapping table data that the device uses at this time (Erase Table?). Push [▲] and [▼] to set this menu item to "Yes" to delete the data.
- Push [←] and then [▲] and [▼] to make a selection from the conversion table options (volume, mass linearization).
- Push [←] to go to the sub-menu level and then [▼] and [>] to enter the first point on the table.
- Push [←] to make the strapping table.
- Enter the length value and push [←].
- Enter the conversion value and push [←] to go to the sub-menu level.
- Push [>] to enter the subsequent point (02, 03, ..., 50) on the table.
- Repeat the last 3 steps to complete the table.
- If the table is complete, push [←] again and again to go back to the "Save Configuration?" screen.
- The device will ask you to save or cancel your settings. Push [▲] or [▼] to make a selection from **Yes**, **No** or **Back**. **Back** makes the display go back to Program mode. If this screen is set to "Yes" or "No", push [←] to accept (Yes) or reject (No) the new settings.
- ➡ If you push [←] when the screen is set to "Yes", the device will store the data for the strapping table and go back to normal mode.

The device will give more accurate volume readings if you give more conversion data in these areas:

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

Refer also to the illustration that follows:

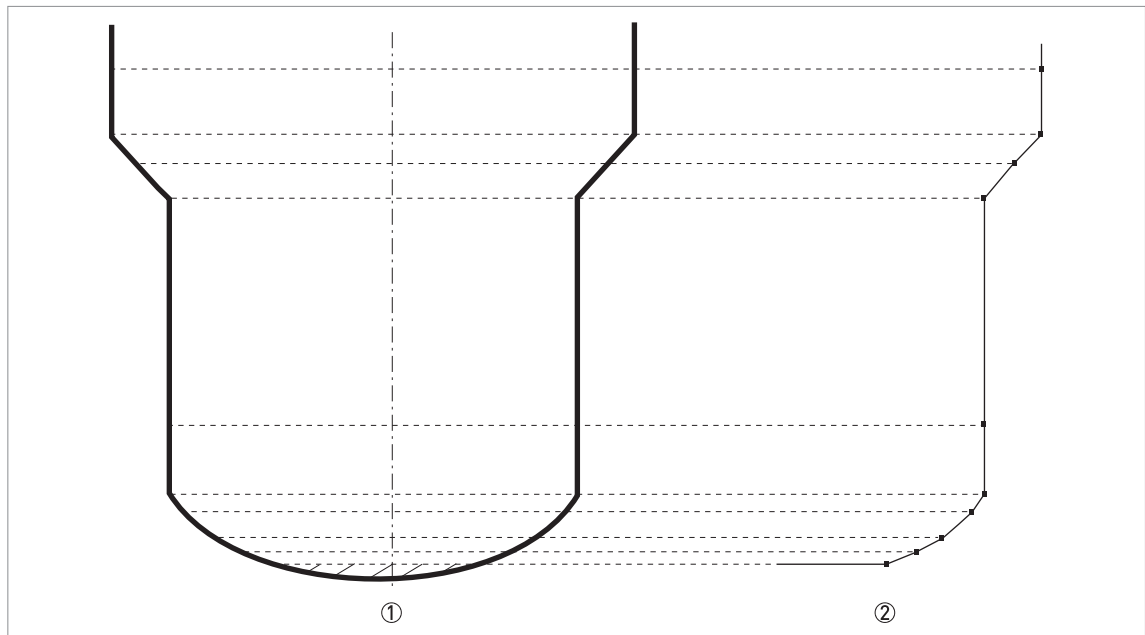


Figure 6-7: A plot of points for a volume or mass table

①  
②



#### How to delete a volume or mass table

- Enter Program Mode.
- Push 2 × [▲], [>], 2 × [▲] and 2 × [>] to go to C3.1.1 Erase Table?.
- To delete strapping table data that the device uses at this time (Erase Table?), push [▲] and [▼] to set this menu item to "Yes".
- Push [←] again and again to go back to the "Save Configuration?" screen.
- The device will ask you to save or cancel your settings. Push [▲] or [▼] to make a selection from **Yes**, **No** or **Back**. **Back** makes the display go back to Program mode. If this screen is set to "Yes" or No", push [←] to accept (Yes) or reject (No) the new settings.
- ➡ If you push [←] when the screen is set to "Yes", the device will delete the data for the strapping table and go back to normal mode.

#### 6.4.7 How to make a filter to remove radar signal interference



**INFORMATION!**



**INFORMATION!**

#### 6.4.8

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



**INFORMATION!**

### 6.5 Status messages and diagnostic data

Messages shown agree with NAMUR Guidelines NE 107. The error messages for the device are divided into status groups, each with one status signal. There are 16 status groups with fixed status signals and 8 groups with status signals that can be changed. The status groups are also divided into 4 groups: Sensor, Electronics, Configuration and Process.

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



**INFORMATION!**

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

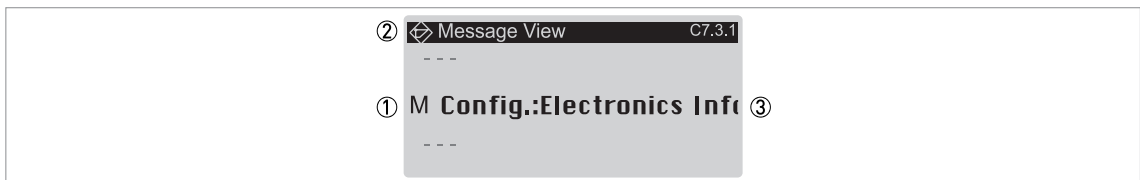


Figure 6-8: Device status and error messages

- ① Device status letter code (NAMUR NE 107). In this example, M = Maintenance required.
- ② Device status symbol (NAMUR NE 107)
- ③ Error message

#### Status messages (NAMUR NE 107)

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

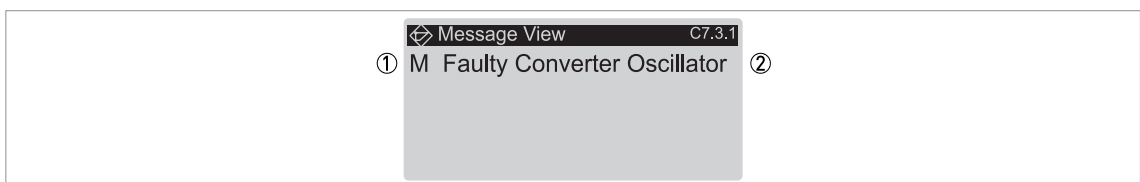




Figure 6-9: Description of the error (C7.3.1 Message View)

- ① Device status letter code (NAMUR NE 107). In this example, M = Maintenance required.  
 ② Description of error

Status type	Status group	Error message	Description	Corrective action
F	<b>Sensor</b>			
		Corrupt Sensor Parameter	The device settings do not agree with the correct process conditions	Do a check of the device settings (tank height etc.).
		No Signal	There is no signal from the antenna or the antenna signal is too weak for a long time.	Do a check the device installation. For more data about installation, refer to the handbook. If the message is shown again, speak or write to the manufacturer.
		Microwave Tuning Voltage Error	A microwave error occurred.	De-energize and then energize the device again.
		Sensor Comm. Error	Internal bus communication error or hardware failure.	If the message is shown again, speak or write to the manufacturer.
		No measurement value	The converter receives no measurement data for a long time.	
F	<b>Electronics</b>			
		Fatal Converter Error (DM) ①	An electronics or hardware failure occurred.	De-energize and then energize the device again.
		Fatal Converter Error (CO) ②	An electronics or hardware failure occurred.	If the message is shown again, speak or write to the manufacturer.
		Fatal Converter Error (Generic)	An electronics or hardware failure occurred.	
		CO Safety Reaction ③	Current Output Safety Reaction. This error message is shown if the current output is less than 3.6 mA or more than 21 mA.	
		Internal Comm. Error	Internal bus communication error.	Check the electrical connections to the power supply connection or replace the converter.
		Power Supply Error	Internal voltage is too low to energize the sensor.	
		Sensor/Conv. FW Mismatch	The sensor firmware version in the sensor does not agree with the converter firmware version.	De-energize and then energize the device again.
		Max. Number of Restarts	The device could not start the measuring mode after a given number of times that the device was de-energized and then energized again.	If the message is shown again, speak or write to the manufacturer.
		Inconsistent Parameters	Internal bus communication error.	
	Sensor Comm. Error	Internal bus communication error or hardware failure.		

Status type	Status group	Error message	Description	Corrective action
F	<b>Configuration</b>			
		Inconsistent NVRAM	Incorrect data in the parameter memory	De-energize and then energize the device again.  If the message is shown again, speak or write to the manufacturer.
		Incons. Converter Calib.	Incorrect calibration data in the converter module	Speak or write to the manufacturer.
		Incons. Sensor Calibration	Incorrect calibration data in the sensor module	
		NVRAMs Mismatch	The serial number of the display screen does not agree with the serial number of the electronics module.	Make sure that the display screen agrees with the electronic module. Go to <b>Full Setup &gt; Device &gt; Information</b> and record the data in menu items <b>C7.1.5 Electronic Revision</b> and <b>C7.1.6 Software Revision</b> . If it is necessary, speak or write to the manufacturer.
		Conv. NVRAM Layout Error	Incorrect data in the parameter memory	De-energize and then energize the device again.
		Disp. NVRAM Layout Error	Incorrect data after an update of the firmware.	If the message is shown again, speak or write to the manufacturer.
	CO Float Error ②	The device cannot use the measurement data because the device settings are incorrect.	You must make the device go back to its factory settings. Enter Program Mode. Set the device to the "Expert" security level. Go to <b>Full Setup &gt; Device &gt; Factory Default &gt; Reset to Factory Default?</b> and set this menu item to "Yes". Then go back to Normal Mode and set the "Save Configuration?" page to "Yes". De-energize and then energize the device again.  If the message is shown again, speak or write to the manufacturer.	
C	<b>Electronics</b>			
		FW Update	A firmware update of the converter module continues.	Wait for the firmware update to finish.

Status type	Status group	Error message	Description	Corrective action
C	<b>Configuration</b>			
		Sensor Sim. Active	The device simulates a measurement value that is set in menu item <b>B1.1 Set Value</b> . This measurement value can be a level, distance or reflection value. If you made a strapping table, the device can also simulate a volume or mass value.	Push "Enter" to stop the test.
		Current Out. Sim. Active	The device simulates a current output value that is set in menu item <b>B1.2 Output</b> . The current output test range is 3.6...21.5 mA.	Push "Enter" to stop the test.
		HART Sim. Active	You can use a HART® interface to simulate a measurement value in the device.	Use the HART® interface to stop the test.
		LCO Simulation Active	The device simulate a a current output value set in sub-menu B1 Simulation (distance, level, ullage volume, ullage mass, linearized distance, volume, mass or linearized level).	Push "Enter" to stop the test.
		SysMon Simulation Active	A system monitor sets the device to a simulated current output value.	Push "Enter" to stop the test.
S	<b>Sensor</b>			
		Sensor Voltage Low	The voltage supplied to the sensor is too low.	Do a check of the power supply.
		Strong Signal	The signal amplitude is too large. It is possible that the signal is saturated.	Make sure that the device installation agrees with the data in the handbook.  If the message is shown again, speak or write to the manufacturer.
		Peak Lost (Level Lost)	No signal peak was found in the Search Window for a long time (>20 s).	Make sure that the device installation agrees with the data in the handbook. . If it is necessary, change the device settings and do a new empty spectrum recording.  If the message is shown again, speak or write to the manufacturer.
		Overfill	The signal peak is in the blocking distance (refer to menu item C1.5 Blocking Distance). .	Make sure that the device settings are correct and the process conditions are in the specified limits.
		Elec. Temp. Out Of Spec.	The temperature of the sensor is not in the specified limits.	Make sure that the device is operated in the permitted ambient temperature range.
S	<b>Electronics</b>			
		Elec. Temp. Out Of Spec.	The temperature of the converter is not in the specified limits.	Make sure that the device is operated in the permitted ambient temperature range.

Status type	Status group	Error message	Description	Corrective action
S		<b>Process</b>		
		CO Undersaturation ②	The measurement value is less than the minimum value of the current output range. The current output cannot go lower than its minimum value and thus does not agree with the correct measurement value.	Do a check of the process conditions and the minimum current output value.
		CO Oversaturation ②	The measurement value is more than the maximum value of the current output range. The current output cannot go higher than its maximum value and thus does not agree with the correct measurement value.	Do a check of the process conditions and the maximum current output value.
M		<b>Sensor</b>		
		Weak Signal	The signal amplitude is too small.	Make sure that the device installation agrees with the data in the handbook.  If the message is shown again, it is possible that a different antenna must be installed. Speak or write to the manufacturer.
		Bad Measurement Quality (Old Measurement)	The measurement value is incorrect and does not change for more than 10 s.	Make sure that the device installation agrees with the data in the handbook.  Speak or write to the manufacturer.
	Empty Spectrum invalid	The empty spectrum recording does not agree with the process conditions at this time (e.g. tank height).	Do a new empty spectrum recording.	

Status type	Status group	Error message	Description	Corrective action
M	<b>Sensor Information</b>			
		Failed Sensor MCU Test	The sensor electronics does a continuous self test procedure. The test finds a fault.	De-energize and then energize the device again.  If the message is shown again, speak or write to the manufacturer.
		Failed Sensor Input Test		
		Bad Spectrum Quality	There is a large change in signal strength.	Make sure that the device installation agrees with the data in the handbook.  If the message is shown again, we recommend that you install the device in a stilling well.
		Peak Lost in Tank Bottom	The signal was lost near the tank bottom. Spherical or conical tanks can cause the device to show this status message.	The device will measure the level of tank contents if you fill the tank.  If the message is shown, speak or write to the manufacturer.
		RC-Oscillator out of bounds	The sensor electronics does a continuous self test procedure. The test finds a fault.	De-energize and then energize the device again.  If the message is shown again, speak or write to the manufacturer.
		Sensor Reference out of range		
		XCO out of bounds		
		Microwave Lock Error		
		Microwave Sweep Duration Error		
	Microwave Supply Voltage Error			

① DM = data manager

② CO = current output

③ This error message is shown if the device is in SIL mode. CO = current output.

## 7.1 Periodic maintenance

### 7.1.1 General notes

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



#### **INFORMATION!**

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

### 7.1.2 Maintenance of the O-rings for the housing covers

If the display cover ① or the terminal compartment cover ② of the housing is opened and closed, make sure that the O-rings are correctly greased or, if it is necessary, replaced. For more data about the replacement of the O-rings, refer to *Spare parts* on page 116.

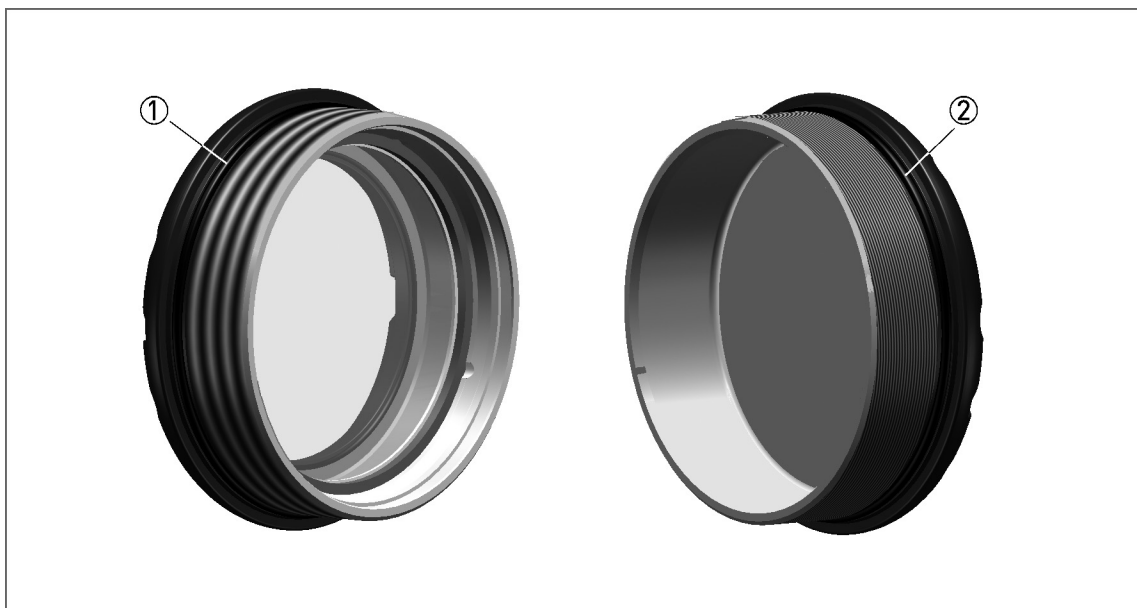


Figure 7-1: Maintenance of the O-rings

- ① Display cover
- ② Terminal compartment cover



#### **CAUTION!**

*Use multi-purpose grease that is applicable for the operating temperature range the O-ring with the properties that follow:*

- *Operating temperature range of  $-30...+130^{\circ}\text{C}$  /  $-22...+266^{\circ}\text{F}$  without a negative effect on the lubrication of the O-ring*
- *Without silicone*
- *The bonding properties must be satisfactory*
- *Lithium-saponified*
- *Water-resistant*
- *Agrees with the O-ring material*

### 7.1.3 How to clean the top surface of the device

**WARNING!**

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

**Obey these instructions:**

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

### 7.1.4 How to clean horn antennas under process conditions

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

**CAUTION!**

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

For more data, refer to the table that follows:

## 7.2 Service warranty

**WARNING!**

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

**Servicing by the customer is limited by warranty to:**

- The removal and installation of the device.
- **Compact version:** The removal and installation of the signal converter (with the weather protection, if this option is attached). For more data, refer to *How to turn or remove the signal converter* on page 28.

For more data on how to prepare the device before you send it back,, refer to *Returning the device to the manufacturer* on page 96.

## 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:	<input type="checkbox"/>	radioactive	
	<input type="checkbox"/>	water-hazardous	
	<input type="checkbox"/>	toxic	
	<input type="checkbox"/>	caustic	
	<input type="checkbox"/>	flammable	
	<input type="checkbox"/>	We checked that all cavities in the device are free from such substances.	
<input type="checkbox"/>	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  $\Delta f$  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  $\Delta f$  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 tank height and the measured distance.

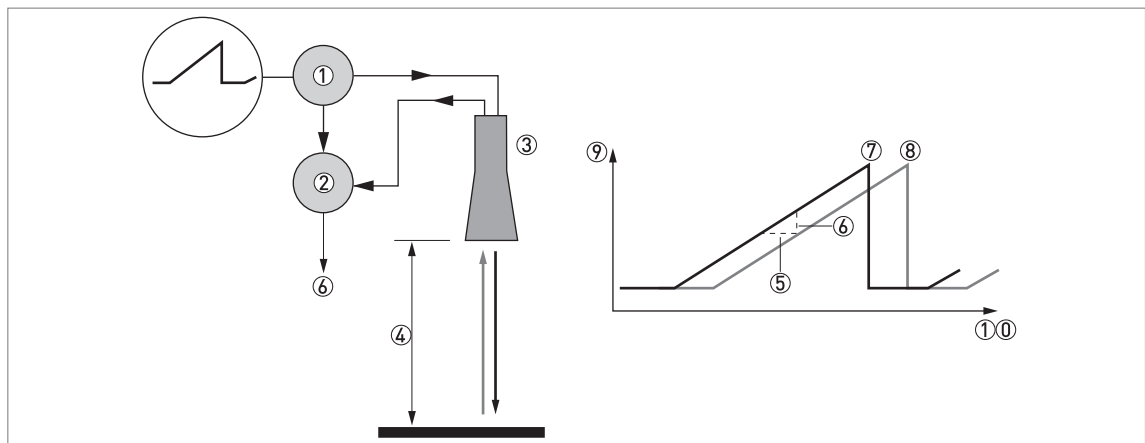


Figure 8-1: Measuring principle of FMCW radar

- ① Transmitter
- ② Mixer
- ③ Antenna
- ④ Distance to product surface, where change in frequency is proportional to distance
- ⑤ Differential time delay,  $\Delta t$
- ⑥ Differential frequency,  $\Delta f$
- 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; FMCW radar
Frequency range	W-band (78...82 GHz)
Max. transmitted power	0.3 mW EIRP (TLPR: outside of the tank; LPR: in half sphere)
Application range	Level measurement of liquids, pastes and slurries
Primary measured value	Distance and reflection
Secondary measured value	Level, volume and mass

### Design

Construction	The measurement system consists of a measuring sensor (antenna) and a signal converter
Options	Integrated LCD display (-20...+70°C / -4...+158°F); if the ambient temperature is not in these limits, then this condition can stop the display
	Weather protection
Max. measuring range	37.5 m / 123 ft (option: 100 m / 328 ft)
	Also depends on the dielectric constant of the product and the installation type. Refer also to "Antenna selection".
Min. tank height	0.3 m / 12"
Top dead zone	75 mm / 3", when tank height ≤ 37.5 m / 123 ft
	200 mm / 7.9", when tank height > 37.5 m / 123 ft
Beam angle	Convex lens, Ø25 mm: 11°
	Convex lens, Ø40 mm: 7.8°
<b>Display and user interface</b>	
Display	LCD display
	128 × 64 pixels in 8-step greyscale with 4-button keypad
Interface languages	English, French, German, Italian, Spanish, Portuguese, Chinese (simplified), Japanese, Czech, Polish and Turkish

### Measuring accuracy

Resolution	1 mm / 0.04"
Repeatability	±1 mm / ±0.04"
Accuracy	Standard: ±2 mm / ±0.8", when distance < 10 m / 33 ft; ±0.02% of measured distance, when distance > 10 m / 33 ft
Digital temperature drift	Max. ±10 mm / ±0.39" for the full temperature range
<b>Reference conditions acc. to EN 61298-1</b>	
Temperature	+15...+25°C / +59...+77°F
Pressure	1013 mbara ±50 mbar / 14.69 psia ±0.73 psi
Relative air humidity	60% ±15%

Target	Metal plate in an anechoic chamber
--------	------------------------------------

### Operating conditions

<b>Temperature</b>	
Ambient temperature	-40...+80°C / -40...+176°F Ex: see supplementary operating instructions or approval certificates
Relative humidity	0...99%
Storage temperature	-50...+85°C / -58...+185°F
Process connection temperature (higher temperature on request)	-20...+150°C / -4...+302°F (the process connection temperature must agree with the temperature limits of the gasket material. Refer to "Materials" in this table.) Ex: see supplementary operating instructions or approval certificates
<b>Pressure</b>	
Process pressure	-1...40 barg / -14.5...580 psig; subject to the process connection used and the flange temperature
<b>Other conditions</b>	
Dielectric constant ( $\epsilon_r$ )	Direct mode: $\geq 1.5$ TBF mode: $\geq 1.1$ Refer also to "Technical data: Antenna selection".
Ingress protection	IEC 60529: IP66/67 NEMA 250: NEMA type 4X (housing) and type 6P (antenna)
Maximum rate of change	10 m/min / 32.8 ft/min

### Installation conditions

Process connection size	The nominal diameter (DN) should be equal to or larger than the antenna diameter.
Process connection position	Make sure that there are not any obstructions directly below the process connection for the device. For more data, refer to <i>Installation</i> on page 22.
Dimensions and weights	For dimensions and weights data, refer to on page .

### Materials

Housing	Standard: Polyester-coated aluminium
	Option: Stainless steel (1.4404 / 316L)
Wetted parts, including antenna	PEEK – this material agrees with FDA regulations
Process connection	PEEK
Gaskets (and o-rings for the sealed antenna extension option)	BioControl®: FKM/FPM (-20...+150°C / -4...+302°F); EPDM (-20°C...+150°C / -4...+302°F) SMS, Tri-Clamp®, VARIVENT®, DIN 11851: without ①
Feedthrough	PEI (-50...+150°C / -58...+302°F – max. range. The feedthrough temperature limits must agree with the temperature limits of the gasket material and antenna type. If the distance piece option is not attached, the maximum temperature is 150°C / 300°F.)
Cable gland	Standard: none
	Options: Plastic (Non-Ex: black, Ex i-approved: blue); nickel-plated brass; stainless steel
Weather protection (Option)	Stainless steel (1.4404 / 316L)

### Process connections

Thread	G 1½ (ISO 228); 1½ NPT (ASME B1.20.1)
<b>Lens antenna, Ø25 mm</b>	
Hygienic with G 1A adaptor	BioControl® DN50; Tri-Clamp® 1½ or 2"; DIN 11851 DN40 or DN50; SMS 51; VARIVENT® Type N (DN40...150); others on request

Flange, EN 1092-1	DN25 in PN10, PN16, PN25, PN40, PN63 or PN100 (Type B1); others on request
Flange, ASME B16.5	1" in 150 lb, 300 lb or 600 lb RF; others on request
<b>Lens antenna, Ø40 mm</b>	
Hygienic	BioControl® DN50; Tri-Clamp® 2"; others on request
Flange, EN 1092-1	DN40...80 in PN10, PN16, PN25, PN40, PN63 or PN100 (Type B1); others on request
Flange, ASME B16.5	1½"...3" in 150 lb, 300 lb or 600 lb RF; others on request

### Electrical connections

Power supply	<b>Terminals output – Non-Ex / Ex i:</b> 12...30 VDC; min./max. value for an output of 21.5 mA at the terminal
	<b>Terminals output – Ex d:</b> 14...36 VDC; min./max. value for an output of 21.5 mA at the terminal
Maximum current	21.5 mA
Current output load	<b>Non-Ex / Ex i:</b> $R_L [\Omega] \leq ((U_{ext} - 12 V)/21.5 \text{ mA})$ . For more data, refer to <i>Minimum power supply voltage</i> on page 103.
	<b>Ex d:</b> $R_L [\Omega] \leq ((U_{ext} - 14 V)/21.5 \text{ mA})$ . For more data, refer to <i>Minimum power supply voltage</i> on page 103.
Cable entry	Standard: M20×1.5; Option: ½ NPT
Cable gland	Standard: none
	Options: M20×1.5 (cable diameter: 7...12 mm / 0.28...0.47"); others are available on request
Cable entry capacity (terminal)	0.5...3.31 mm <sup>2</sup> [AWG 20...12]

### Input and output

<b>Current output / HART®</b>	
Output signal	4...20 mA HART®, 4...20 mA HART® (reversed), 3.8...20.5 mA or 3.8...20.5 mA (reversed) acc. to NAMUR NE 43 ②
Resolution	±3 µA
Temperature drift	Typically 50 ppm/K
Error signal	High: 21.5 mA; Low: 3.5 mA acc. to NAMUR NE 43

### Approvals and certification

CE	This device fulfils the statutory requirements of the EC directives. The manufacturer certifies successful testing of the product by applying the CE mark.
Vibration resistance	EN 60068-2-6 and EN 60721-3-4 (1...9 Hz: 3 mm / 10...200 Hz: 1g, 10g shock ½ sinus: 11 ms)
<b>Explosion protection</b>	
ATEX (Ex ia or Ex d) DEKRA xxATEXxxxx X (pending)	II 1/2 G, 2 G Ex ia IIC T6...T2 Ga/Gb or Ex ia IIC T6...T2 Gb;
	II 1/2 D, 2 D Ex ia IIIC T90°C Da/Db or Ex ia IIIC T90°C Db IP6X;
	II 1/2 G, 2 G Ex d ia IIC T6...T2 Ga/Gb or Ex d ia IIC T6...T2 Gb;
	II 1/2 D, 2 D Ex ia tb IIIC T90°C Da/Db or Ex ia tb IIIC T90°C Db IP6X
ATEX (Ex ic) DEKRA xxATEXxxxx X (pending)	II 3 G Ex ic IIC T6...T2 Gc;
	II 3 D Ex ic IIIC T90°C Dc

IECEX IECEX DEK xx.xxxx X (pending)	Ex ia IIC T6...T2 Ga/Gb or Ex ia IIC T6...T2 Gb or Ex ic IIC T6...T2 Gc; Ex ia IIIC T90°C Da/Db or Ex ia IIIC T90°C Db or Ex ic IIIC T90°C Dc; Ex d ia IIC T6...T2 or Ex d ia IIIC T6...T2 Gb; Ex ia tb IIIC T90°C Da/Db or Ex ia tb IIIC T90°C Db
cQPSus – Dual Seal-approved (pending)	<b>NEC 500 (Division ratings)</b> XP-AIS / Cl. I / Div. 1 / Gr. ABCD / T6-T1; DIP / Cl. II, III / Div. 1 / Gr. EFG / T6-T1; IS / Cl. I, II, III / Div. 1 / Gr. ABCDEFG / T6-T1; NI / Cl. I / Div. 2 / Gr. ABCD / T6-T1 <b>NEC 505 (Zone ratings)</b> Cl. I / Zone 0 / AEx d [ia] / IIC / T6-T1; Cl. I / Zone 0 / AEx ia / IIC / T6-T1; Cl. I / Zone 2 / AEx nA / IIC / T6-T1; Zone 20 / AEx ia / IIIC / T90°C Zone 20 / AEx tb [ia] / IIIC / T90°C Hazardous (Classified) Locations, indoor/outdoor Type 4X and 6P, IP66, Dual Seal <b>CEC Section 18 (Zone ratings)</b> Cl. I, Zone 0, Ex d [ia], IIC, T6-T1; Cl. I, Zone 0, Ex ia, IIC, T6-T1; Cl. I, Zone 2, Ex nA, IIC, T6-T1 <b>CEC Section 18 and Annex J (Division ratings)</b> XP-AIS / Cl. I / Div. 1 / Gr. BCD / T6-T1 DIP / Cl. II, III / Div. 1 / Gr. EFG / T6-T1 IS / Cl. I / Div. 1 / Gr. BCD / T6-T1 NI / Cl. I / Div. 2 / Gr. ABCD / T6-T1
NEPSI GYJxxxxxx/xx (pending)	Ex ia IIC T2~T6 Gb or Ex ia IIC T2~T6 Ga/Gb DIP A20/A21 T <sub>A</sub> T90°C IP6X Ex d ia IIC T2~T6 Gb or Ex d ia IIC T2~T6 Ga/Gb DIP A20/A21 T <sub>A</sub> T90°C IP6X
DNV / INMETRO DNV 14.00xx X (pending)	Ex ia IIC T6...T3 Ga; Ex ia IIIC T70°C...T95°C Da IP6X; Ex d [ia Ga] IIC T6...T3 Ga/Gb; Ex tb [ia Da] IIIC T70°C...T95°C Db IP6X
<b>Other standards and approvals</b>	
SIL - only for 4...20 mA HART output	4...20 mA HART output only: SIL 2 – according to EN 61508 and for high/low demand mode operation
EMC	Electromagnetic Compatibility Directive 2004/108/EC
Radio approvals	<b>R &amp; TTE</b> Radio Equipment and Telecommunications Terminal Equipment Directive 1999/5/EC <b>FCC Rules</b> Part 15 <b>Industry Canada</b> RSS-211
LVD	Agrees with the safety part of the Low-Voltage Directive 2006/95/EC

NAMUR	NAMUR NE 21 Electromagnetic Compatibility (EMC) of Industrial Process and Laboratory Control Equipment
	NAMUR NE 43 Standardization of the Signal Level for the Failure Information of Digital Transmitters
	NAMUR NE 53 Software and Hardware of Field Devices and Signal Processing Devices with Digital Electronics
	NAMUR NE 107 Self-Monitoring and Diagnosis of Field Devices
CRN	This certification is applicable for all Canadian provinces and territories. For more data, refer to the website.
Construction code	Option: NACE MR 0175 / MR 0103 / ISO 15156

① Tri-Clamp® is a registered trademark of Ladish Co., Inc. BioControl® is a registered trademark of Neumo-Ehrenberg-Group.

VARIVENT® is a registered trademark of GEA Tuchenhausen GmbH.

② HART® is a registered trademark of the HART Communication Foundation

### 8.3 Minimum power supply voltage

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

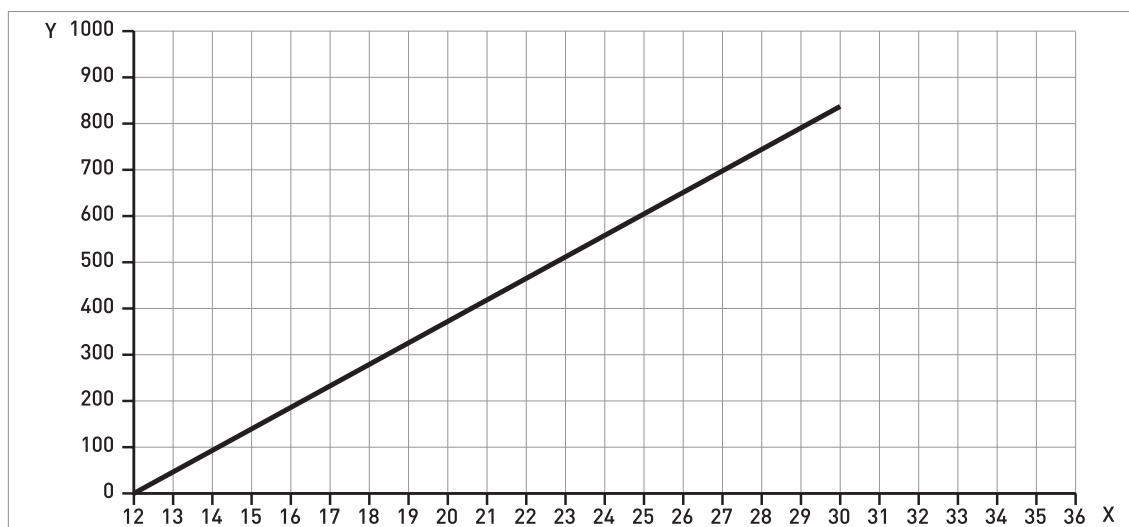


Figure 8-2: Minimum power supply voltage for an output of 22 mA at the terminal (Non-Ex and Hazardous Location approval (Ex i / IS))

X: Power supply U [VDC]

Y: Current output load R<sub>L</sub> [Ω]

Hazardous Location (Ex d / XP/NI) approved devices

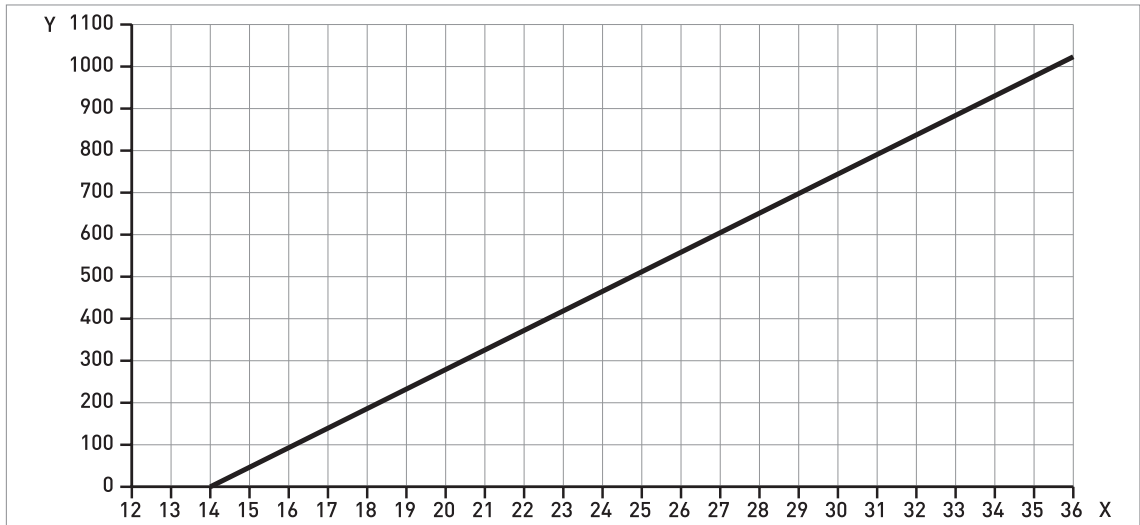


Figure 8-3: Minimum power supply voltage for an output of 22 mA at the terminal (Hazardous Location approval (Ex d / XP/NI))

X: Power supply U [VDC]  
 Y: Current output load  $R_L$  [ $\Omega$ ]

8.4 Guidelines for maximum operating pressure



**WARNING!**

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

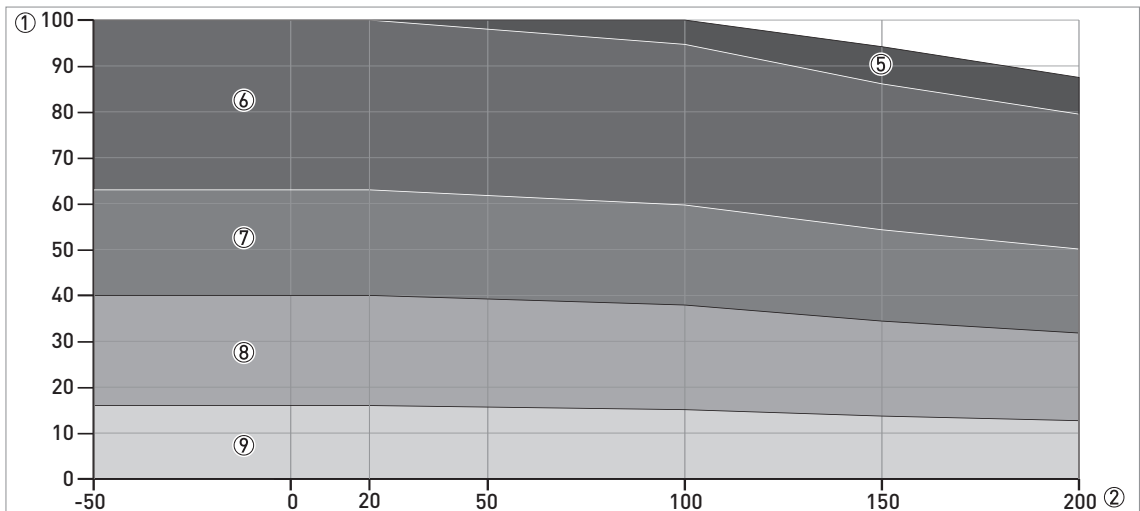


Figure 8-4: Pressure / temperature de-rating (EN 1092-1), flange and threaded connection, in °C and barg



**INFORMATION!****CRN certification**

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

## 8.5 Dimensions and weights

Type of housing	Weights			
	Aluminium housing		Stainless steel housing	
	[kg]	[lb]	[kg]	[lb]
Compact	2.1	4.6	??	??

#### Antenna option weights

Antenna options	Min./Max. weights	
	[kg]	[lb]

#### Standard options, without converter

DN50 / 2" Hygienic antenna with clamp connection	??...??	??...??
DN50 / 2" Hygienic antenna with thread connection	??...??	??...??

## 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 devices to the signal cable.

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

## 9.2 Software history



### **INFORMATION!**

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

Release date	Devices	HART®	
		Device Revision	DD Revision
2016-04	All revisions	1	1

### **HART® identification codes and revision numbers**

Manufacturer ID:	69 (0x45)
Expanded Device Type:	0x45b1
Device Revision:	1
DD Revision	1
DD Version (NAMUR)	01.11
HART® Universal Revision:	7.4
FC 475 system SW.Rev.:	≥ 3.7
AMS version:	≥ 11.1

PDM version:	≥ 6.0
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 37.

#### 9.3.2 Multi-Drop connection (2-wire connection)

Up to 63 devices may be installed in parallel (this signal converter and other HART® devices).

For an illustration of multi-drop networks, refer to *Multi-drop networks* on page 38.

### 9.4 HART® device variables

HART® device variable	Code	Type
sensor value	0	linear
level	1	linear
distance	2	linear
reflection	3	linear
level linearization ①	4	linear
volume conversion ②	5	linear
mass conversion ②	6	linear
distance linearization ①	7	linear
ullage volume conversion ②	8	linear
ullage mass conversion ②	9	linear

① This HART® device variable is available if you created a linearization table in the conversion menu

② This HART® device variable is available if you created a strapping table in the conversion menu

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.

## 9.6 Asset Management Solutions (AMS®)

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

### 9.6.1 Installation

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

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

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

### 9.6.2 Operation



**INFORMATION!**

For more data, refer to HART® menu tree for AMS on page 111.

### 9.6.3 Parameter for the basic configuration

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

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

### 9.7.1 Installation

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

### 9.7.2 Operation

The DTM and the device's local display use almost the same procedures to operate the signal converter. For more data, refer to *Operation* on page 45.

## 9.8 Process Device Manager (PDM)

The Process Device Manager (PDM) is a Siemens PC program designed to configure HART® and PROFIBUS devices. Device Descriptions (DDs) are used to integrate different devices into the PDM.

### 9.8.1 Installation

Install Device Description files supplied in the Device Install HART® PDM folder. This is necessary for each type of field device that is used with SIMATIC PDM. This folder is available for download from the website or on the DVD-ROM supplied with the device.

If you use PDM version 5.2, refer to PDM manual, section 11.1 - Install device / Integrate device into SIMATIC PDM with Device Install.

If you use PDM version 6.0, refer to PDM manual, section 13 - Integrating devices.

For more data, refer to "readme.txt". You can find this file in the Installation Kit.

## 9.8.2 Operation



### **INFORMATION!**

For more data, refer to HART® menu tree for PDM on page 111.

There can be differences between the names of menus in the SIMATIC PDM software tool and menus shown on the device display screen. Refer to the online help in SIMATIC PDM to find the function number of each menu item. This function number agrees with the function number in the device menus.

Use the same procedure for the protection of parameters in the supervisor menu.

## 9.9 HART® menu tree for AMS

### Abbreviations of the following tables:

- <sup>Opt</sup> Optional, depending on device version and configuration
- <sup>Rd</sup> Read only

### 9.9.1 Overview AMS menu tree (positions in menu tree)

### 9.9.2 AMS menu tree (details for settings)

## 9.10 HART® menu tree for PDM

### Abbreviations of the following tables:

- <sup>Opt</sup> Optional, depending on device version and configuration
- <sup>Rd</sup> Read only
- <sup>Cust</sup> Custody lock protection
- <sup>Loc</sup> Local PDM, affects only PDM views

### 9.10.1 Overview PDM menu tree (positions in menu tree)

#### Overview: Device Menu

Download To Device...	
Upload To PG/PC...	
Quick Setup	General
	Security
	Units
	Application Assistant

Full Setup	Process	Install. Parameters
		Process
		Conversion
	Output	General
		Current Output 1
	Display	General
		1st Measurement Page
		2nd Measurement Page
	Device	Information
		Security
		Units
		Log
		Factory Default
HART	Identification & Info	
Service	Calibration	Calibration
		Sensor

**Overview: View Menu**

Measured Value
Input / Outputs

**Overview: Diagnosis**

Device Status	Condensed Status (NE 107)
	Standard
	Additional
	Cluster Check
Actual Values	
Simulation	Process Variables
	Device Status
	I/O
Test / Reset	
Information	

**9.10.2 PDM menu tree (details for settings)**

**Device Menu**

Download To Device...

---

Upload To PG/PC...

---

**Quick Setup**

General	Language / Tag / Long Tag
Security	Login / Change Password / Reset Passwords / Lock Status <sup>Rd</sup> / Lock/Unlock Device / Write Protect <sup>Rd</sup> / (De)activate Write Protection / Unlock Extended Range



Units	Unit Length / Unit Volume / Unit Mass
Application Assistant	Standard Setup / Record Empty Spectrum

### Full Setup

Process	Install. Parameters	Tank Type / Tank Height / Blocking Distance / Time Constant / Antenna Type / Antenna Extension / Distance Piece / Reference Offset / Tank Bottom Offset
	Process	Tracking Velocity / Epsilon R Product / Epsilon R Gas / Measuring Mode / Overfill Detection / Overfill Threshold <sup>Opt</sup> / Mult. Refl. Enable / Empty Spectrum Enable / Min. Peak Required / Min Plausability Window
	Conversion	Select Conversion / Entry Count <sup>Rd</sup> / Conversion Table
Output	General	Type IO channel A <sup>Rd</sup> / Type IO Channel B <sup>Rd</sup>
	Current Output 1	Current Out 1 Variable / 0% Range / 100% Range / Current Out Range / Error Function / Low Error Current / High Error Current / D/A Trim PV <sup>Opt</sup>
Display	General	Language / Backlight
	1st Measurement Page	Function / 1st Value Variable / Format 1st Value / 2nd Value Variable <sup>Opt</sup> / Format 2nd Value <sup>Opt</sup> / 3rd Value Variable <sup>Opt</sup> / Format 3rd Value <sup>Opt</sup> / 0% Range <sup>Opt</sup> / 100% Range <sup>Opt</sup>
	2nd Measurement Page	Function / 1st Value Variable / Format 1st Value / 2nd Value Variable <sup>Opt</sup> / Format 2nd Value <sup>Opt</sup> / 3rd Value Variable <sup>Opt</sup> / Format 3rd Value <sup>Opt</sup> / 0% Range <sup>Opt</sup> / 100% Range <sup>Opt</sup>
Device	Information	Tag <sup>Rd</sup> / Long Tag <sup>Rd</sup> / Serial Number <sup>Rd</sup> / Manufacturer <sup>Rd</sup> / Device Name <sup>Rd</sup> / V Number <sup>Rd</sup> / Electronic Revision <sup>Rd</sup> / Field Device Revision <sup>Rd</sup> / Software Revision <sup>Rd</sup> / Hardware Revision <sup>Rd</sup> / Electronics Serial No. <sup>Rd</sup> / Production Date <sup>Rd</sup>
	Security	Login / Change Password / Reset Passwords / Lock Status <sup>Rd</sup> / Lock/Unlock Device / Write Protect <sup>Rd</sup> / (De)activate Write Protection / Unlock Extended Range
	Units	Unit Length / Unit Volume / Unit Mass
	Log	Operating Time <sup>Rd</sup> / Reset Log-Messages
	Factory Default	Reset To Fact. Default
HART	Identification & Info	Loop current Mode / Online Mode / Poll Address / Tag / Long Tag / Manufacturer <sup>Rd</sup> / Model <sup>Rd</sup> / Device Id <sup>Rd</sup> / Universal Rev <sup>Rd</sup> / Field Device Rev <sup>Rd</sup> / DD-Version <sup>Rd</sup> / Descriptor / Message / Date / Final assembly number / Configuration change count <sup>Rd</sup> / Software Rev <sup>Rd</sup> / Hardware rev <sup>Rd</sup> / Write Protect <sup>Rd</sup> / Number of request preambles <sup>Rd</sup> / Number of response preambles <sup>Rd</sup>

HART	Identification & Info	Loop current Mode / Online Mode
		Poll Address / Tag / Long Tag / Manufacturer <sup>Rd</sup> / Model <sup>Rd</sup> / Device Id <sup>Rd</sup> / Universal Rev <sup>Rd</sup> / Field Device Rev <sup>Rd</sup> / DD-Version <sup>Rd</sup> / Descriptor / Message / Date / Final assembly number / Configuration change count <sup>Rd</sup> / Software Rev <sup>Rd</sup> / Hardware rev <sup>Rd</sup> / Write Protect <sup>Rd</sup> / Number of request preambles <sup>Rd</sup> / Number of response preambles <sup>Rd</sup>

**Service**

Calibration	Calibration	Current Output 1
	Sensor	Manual Correction Offset / Manual Correction Factor / Correction Offset <sup>Rd</sup> / Correction Factor <sup>Rd</sup> / Correction Offset Extended <sup>Rd, Opt</sup> / Correction Factor Extended <sup>Rd, Opt</sup>

**View Menu**

**Measurement Value**

Sensor Value <sup>Rd</sup> / Media Level <sup>Rd</sup> / Distance <sup>Rd</sup> / Reflection <sup>Rd</sup> / Level Linearization <sup>Opt, Rd</sup> / Volume <sup>Opt, Rd</sup> / Mass <sup>Opt, Rd</sup> / Distance Linearization <sup>Opt, Rd</sup> / Ullage <sup>Opt, Rd</sup> / Ullage Mass <sup>Opt, Rd</sup>
--

**Input / Outputs**

PV <sup>Rd</sup> / PV % Range <sup>Rd</sup> / PV output current <sup>Rd</sup> / SV <sup>Rd</sup> / TV <sup>Rd</sup> / QV <sup>Rd</sup>
--

**Diagnosis**

**Device Status**

Condensed Status (NE 107)	Condensed Status (NE 107) <sup>Rd</sup> / Device Simulation Active <sup>Rd</sup>
Standard	Device Status <sup>Rd</sup> / Ext. Device Status <sup>Rd</sup> / Write Protect <sup>Rd</sup> / Device Diagnostic Status 0 <sup>Rd</sup> / Device Diagnostic Status 1 <sup>Rd</sup> / AO Saturated <sup>Rd</sup> / AO Fixed <sup>Rd</sup>
Additional	Device Status Simulation <sup>Rd</sup> / Failure (F) <sup>Rd</sup> / Function Check (C) <sup>Rd</sup> / Out of Specification (S) <sup>Rd</sup> / Maintenance Required (M) <sup>Rd</sup> / Electronics Information <sup>Rd</sup> / Sensor Information <sup>Rd</sup>
Cluster Check	Cluster Number <sup>Rd</sup> / Failed Cluster Check <sup>Rd</sup>

**Actual Values**

Operating Time <sup>Rd</sup> / Sensor Value <sup>Rd</sup> / Media Level <sup>Rd</sup> / Distance <sup>Rd</sup> / Reflection <sup>Rd</sup> / Level Linearization <sup>Rd, Opt</sup> / Volume <sup>Rd, Opt</sup> / Mass <sup>Rd, Opt</sup> / Distance Linearization <sup>Rd, Opt</sup> / Ullage Volume <sup>Rd, Opt</sup> / Ullage Mass <sup>Rd, Opt</sup> / Sensor Temp <sup>Rd</sup> / Converter Temp <sup>Rd</sup>
---

**Simulation**

Process Variables	Simulation Values
Device Status	Enable/Disable Status Simulation / Status Simulation <sup>Opt</sup>
I/O	Loop Test

**Test / Reset**

Device Reset / Reset Configuration Changed Flag
Information
Tag <sup>Rd</sup> / Long Tag <sup>Rd</sup> / Serial Number <sup>Rd</sup> / Manufacturer <sup>Rd</sup> / Device Name <sup>Rd</sup> / V Number <sup>Rd</sup> / Electronic Revision <sup>Rd</sup> / Field Device Revision <sup>Rd</sup> / Software Revision <sup>Rd</sup> / Hardware Revision <sup>Rd</sup> / Electronics Serial No. <sup>Rd</sup> / Production Date <sup>Rd</sup> / Calibration Date <sup>Rd</sup> / Operating Time <sup>Rd</sup>

### 10.1 Order code

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

### 10.2 Spare parts

We supply spare parts for this device. When you send an order for a mechanical spare part, use the reference numbers in the table that follows. When you send an order for an electronic spare part, refer to *Order code* on page 116 and use the VFDE order code.

#### Mechanical spare parts

XF74	4	0	0	0	<b>OPTIFLEX 7400 C 80 GHz Non-contact Radar (FMCW) level meter for lhygienic applications</b>
					<b>Pressure / Temperature / Sealing</b>
				0	Without
				1	40 bar / -40°C...+150°C (-40°F...+302°F) / FKM, FPM - for the Metallic Horn antenna and Wave Guide
				5	40 bar / -50°C...+130°C (-58°F...+266°F) / EPDM - for the Metallic Horn antenna and Wave Guide
				6	40 bar / -20°C...+150°C (-4°F...+302°F) / Kalrez 6375 - for the Metallic Horn antenna and Wave Guide
				A	40 bar / -60°C...+130°C (-76°F...+266°F) / PFA - for the Metallic Horn antenna and Wave Guide
				D	40 bar / -40°C...+200°C (-40°F...+392°F) / FKM (Viton) - for the Metallic Horn antenna and Wave Guide
				K	40 bar / -20°C...+250°C (-4°F...+482°F) / Kalrez 6375 - for the Metallic Horn antenna and Wave Guide
				R	16 bar / -20°C...+100°C (-4°F...+212°F) / PP - for the PP Wave Horn antenna
				T	40 bar / -50°C...+150°C (-58°F...+302°F) / PTFE - for the PTFE Wave Horn antenna
					<b>Material and Antenna</b>
				0	Without
				1	316L / Metallic horn (sheet metal) DN80 (3")
				2	316L / Metallic horn (sheet metal) DN100 (4")
				3	316L / Metallic horn (sheet metal) DN150 (6")
				4	316L / Metallic horn (sheet metal) DN200 (8")
				G	PP / Wave Horn, maximum socket length 200 mm / 7.9"
				H	PTFE / Wave Horn, maximum nozzle length 200 mm / 7.9"
				L	316L / Metallic wave guide ≤1 m (3.28 ft)
				M	316L / Metallic wave guide ≤1.5 m (4.92 ft)
				N	316L / Metallic wave guide ≤2 m (6.56 ft)
				P	316L / Metallic wave guide ≤2.5 m (8.2 ft)
				R	316L / Metallic wave guide ≤3 m (9.84 ft)
				S	316L / Metallic wave guide ≤3.5 m (11.48 ft)
				T	316L / Metallic wave guide ≤4 m (13.12 ft)
				U	316L / Metallic wave guide ≤4.5 m (14.76 ft)
				V	316L / Metallic wave guide ≤5 m (16.4 ft)
				W	316L / Metallic wave guide ≤5.5 m (18.04 ft)
				X	316L / Metallic wave guide ≤6 m (19.68 ft)
<b>XF74</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>Order code (complete this code on the pages that follow)</b>





## Other spare parts

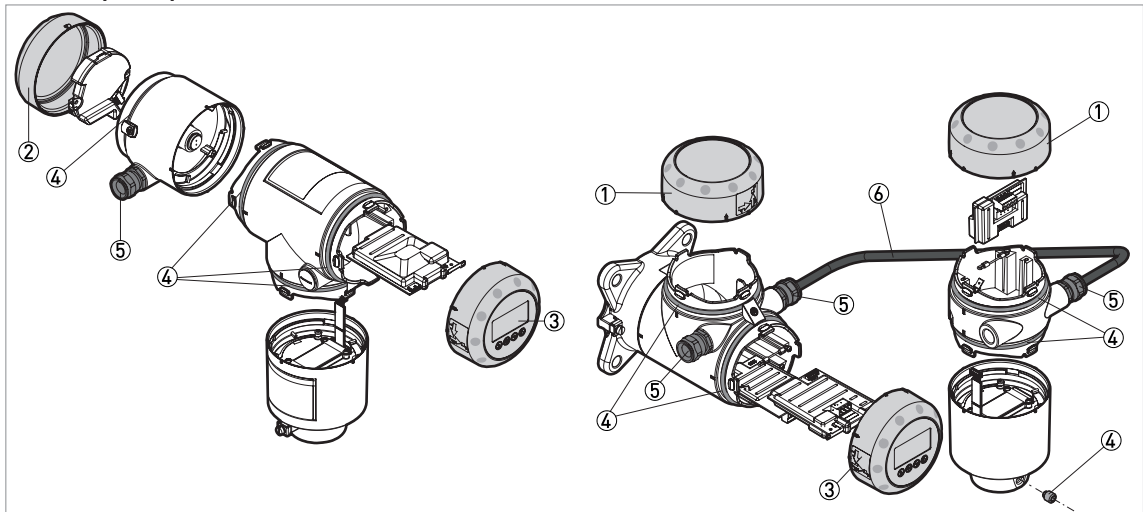


Figure 10-1: Other spare parts

- ① Cover without LCD display
- ② Cover for Ex d module
- ③ Cover with LCD display
- ④ Set of fasteners for housing (lock screw, gaskets)
- ⑤ Cable gland
- ⑥ Signal cable (Non-Ex: grey, Ex: blue)

**DANGER!**

Remote version: Make sure that replacement signal cables for Ex-approved devices are supplied by the manufacturer. Use of this signal cable is mandatory.

Item	Description	Quantity	Part reference
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## Housing

①	Cover without LCD display (HMI), aluminium	1	XF50010100
	Cover without LCD display (HMI), stainless steel	1	XF50011100
②	Cover for Ex d module, aluminium ①	1	XF50010200
	Cover for Ex d module, stainless steel ①	1	XF50011200
③	Cover with LCD display (English / German / French / Italian), aluminium	1	XF50010300
	Cover with LCD display (English / German / French / Italian), stainless steel	1	XF50011300
	Cover with LCD display (English / Spanish / French / Portuguese), aluminium	1	XF50010400
	Cover with LCD display (English / Spanish / French / Portuguese), stainless steel	1	XF50011400
	Cover with LCD display (English / Russian / Chinese / Japanese), aluminium	1	XF50010500
	Cover with LCD display (English / Russian / Chinese / Japanese), stainless steel	1	XF50011500
④	Set of fasteners for housing (lock screw, gaskets)	1 screw, 10 gaskets	XF50010900

## Cable gland / cable entry

Item	Description	Quantity	Part reference
⑤	Cable gland / M20×1.5, plastic; black, non-Ex	10	XF50030100
	Cable gland / M20×1.5, plastic, blue, Ex i	10	XF50030200
	Cable gland / M20×1.5, nickel-plated brass, Ex d	5	XF50030300
	Cable gland / M20×1.5, stainless steel, Ex d	2	XF50030400
	Cable gland / M20×1.5, nickel-plated brass, non-Ex / Ex i	5	XF50030500
	Cable gland / M20×1.5, stainless steel, non-Ex / Ex i	2	XF50030600
	Cable entry / ½ NPT, nickel-plated brass, non-Ex / Ex i	5	XF50030700
	Cable entry / ½ NPT, nickel-plated brass, Ex d	5	XF50030800
	Cable entry / ½ NPT, nickel-plated brass, cFMus	5	XF50030900
	Cable entry / ½ NPT, stainless steel, non-Ex / Ex i	2	XF50031000
	Cable entry / ½ NPT, stainless steel, Ex d	2	XF50031100
	Cable entry / ½ NPT, stainless steel, cFMus	2	XF50031200

### Options for remote version

⑥	Signal cable 10 m / 32.8 ft (non-Ex: grey) ②	1	XF50040100
	Signal cable 25 m / 82 ft (non-Ex: grey) ②	1	XF50040200
	Signal cable 50 m / 164 ft (non-Ex: grey) ②	1	XF50040300
	Signal cable 75 m / 246 ft (non-Ex: grey) ②	1	XF50040400
	Signal cable 100 m / 328 ft (non-Ex: grey) ②	1	XF50040500
	Signal cable 10 m / 32.8 ft (Ex: blue) ③	1	XF50040600
	Signal cable 25 m / 82 ft (Ex: blue) ③	1	XF50040700
	Signal cable 50 m / 164 ft (Ex: blue) ③	1	XF50040800
	Signal cable 75 m / 246 ft (Ex: blue) ③	1	XF50040900
	Signal cable 100 m / 328 ft (Ex: blue) ③	1	XF50041000

① Ex d-approved devices only

② For the remote version

③ For the remote version. Make sure that replacement signal cables for Ex-approved devices are supplied by the manufacturer. Use of this signal cable is mandatory.

## 10.3 Accessories

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

Item	Description	Quantity	Part reference
①	HMI Service tool (English / German / French / Italian) ①	1	XF74010600
	HMI Service tool (English / Spanish / French / Portuguese) ①	1	XF74010700
	HMI Service tool (English / Russian / Chinese / Japanese) ①	1	XF74010800
	HMI Service tool (English / Czech / Polish / Turkish) ①	1	XF74xxxxxx
②	Viator RS232 / HART converter	1	XF74020600
③	Viator USB / HART converter	1	XF74020700
④	EMI/RFI shielding gasket	1	XF74050600

① If the device does not have the LCD display option, use this accessory to change the device configuration



## 10.4 Glossary

### 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** False radar reflections.

### L

**Level** See the diagrams at the end of this section.

### M

**Mass**

### 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**

### S

**Signal converter** A set of electronic components in the device that send the measurement signal through some signal filters.

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

**U****Ullage volume**

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

**V****Volume**









## KROHNE – Process instrumentation and measurement solutions

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