



DRAFT

OPTIWAVE 1010 Handbook

2-wire / 6 GHz Radar (FMCW) Level Meter

for continuous measuring of clean liquids in the BM 26 Advanced (Magnetic Level Indicator)

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1	Safety instructions	6
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1.1	Software history	6
1.2	Intended use	6
1.3	Certification	7
1.4	Radio approvals	7
1.4.1	European Union (EU).....	7
1.4.2	U.S.A. and Canada.....	8
1.5	Safety instructions from the manufacturer	9
1.5.1	Copyright and data protection	9
1.5.2	Disclaimer	9
1.5.3	Product liability and warranty	10
1.5.4	Information concerning the documentation.....	10
1.5.5	Warnings and symbols used.....	11
1.6	Safety instructions for the operator.....	11
2	Device description	12
<hr/>		
2.1	Scope of delivery.....	12
2.2	Device description	13
2.3	Visual Check	14
2.4	Nameplates	15
2.4.1	Nameplate (example).....	15
3	Installation	16
<hr/>		
3.1	General notes on installation	16
3.2	Storage	16
3.3	Transport	17
3.4	Pre-installation requirements	17
3.5	Pressure and temperature ranges	17
3.6	Recommended mounting position	20
3.7	Mounting restrictions	20
3.8	Stilling wells	21
3.9	How to attach the weather protection to the device	22
4	Electrical connections	23
<hr/>		
4.1	Safety instructions.....	23
4.2	Electrical installation: 2-wire, loop-powered	23
4.3	Electrical connection for current output	24
4.3.1	Non-Ex devices	24
4.3.2	Devices for hazardous locations.....	24
4.4	Protection category	24
4.5	Networks	25
4.5.1	General information.....	25
4.5.2	Point-to-point connection.....	25
4.5.3	Multi-drop networks	26

5 Start-up	27
<hr/>	
5.1 How to start the device	27
5.1.1 Start-up checklist	27
5.1.2 How to start the device	27
5.2 Operating concept	27
5.3 Remote communication with PACTware™	28
5.3.1 General notes	28
5.3.2 Software installation	28
5.4 Remote communication with the AMS™ Device Manager	29
6 Operation	30
<hr/>	
6.1 Software configuration	30
6.1.1 General notes	30
6.1.2 Procedure	30
6.2 How to load settings from the device to PACTware™	31
6.3 Menu overview	32
6.4 Device settings	33
6.4.1 Supervisor access rights	33
6.4.2 How to change device settings	33
6.4.3 Data about menu items and parameters (online Help)	34
6.4.4 Basic parameters	35
6.4.5 Signal output	36
6.4.6 Import / export	36
6.4.7 Application	37
6.4.8 HART	38
6.5 Status and error messages	39
6.5.1 Device status	39
6.5.2 Error handling	40
7 Service	44
<hr/>	
7.1 Periodic maintenance	44
7.2 Service warranty	44
7.3 Spare parts availability	44
7.4 Availability of services	44
7.5 Returning the device to the manufacturer	45
7.5.1 General information	45
7.5.2 Form (for copying) to accompany a returned device	46
7.6 Disposal	46
8 Technical data	47
<hr/>	
8.1 Measuring principle	47
8.2 Technical data	48
8.3 Minimum power supply voltage	53
8.4 Pressure ratings	54
8.5 Dimensions and weights	55

9 Description of HART interface	58
9.1 General description	58
9.2 Software description	58
9.3 Connection variants.....	58
9.3.1 Point-to-Point connection - analogue / digital mode.....	59
9.3.2 Multi-Drop connection (2-wire connection)	59
9.4 HART® device variables	59
9.5 Field Communicator 375/475 (FC 375/475)	59
9.5.1 Installation	59
9.5.2 Operation.....	60
9.6 Asset Management Solutions (AMS).....	60
9.6.1 Installation	60
9.6.2 Operation.....	60
9.6.3 Parameter for the basic configuration	60
9.7 Field Device Tool / Device Type Manager (FDT / DTM)	61
9.7.1 Installation	61
9.7.2 Operation.....	61
9.8 Process Device Manager (PDM).....	61
9.8.1 Installation	61
9.8.2 Operation.....	61
9.9 HART® menu tree for Basic-DD	62
9.9.1 Overview Basic-DD menu tree (positions in menu tree).....	62
9.9.2 Basic-DD menu tree (details for settings).....	62
9.10 HART® menu tree for AMS.....	62
9.10.1 Overview AMS menu tree (positions in menu tree).....	62
9.10.2 AMS menu tree (details for settings).....	63
9.11 HART® menu tree for PDM	64
9.11.1 Overview PDM menu tree (positions in menu tree).....	64
9.11.2 PDM menu tree (details for settings)	65
10 Appendix	67
10.1 Order code	67
10.2 Spare parts	70
10.3 Accessories.....	71
10.4 Glossary	72
11 Notes	75

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

Release date	Printed circuit assembly	Firmware revision	Hardware revision	Changes and compatibility	Documentation
YYYY-MM-DD	Converter and sensor board	1.00.xx	400xxxxx01	-	HB OPTIWAVE 1010 R01

1.2 Intended use



CAUTION!

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



INFORMATION!

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

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

This radar level transmitter can only be used if it is correctly installed and aligned on a bypass chamber or a stilling well. The bypass chamber or stilling well must be metallic and electrically conductive. The stilling well must be installed in a metal or reinforced concrete tank to prevent radio frequency interference.

1.3 Certification

**DANGER!**

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



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

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

All devices are based on the CE marking and meet the requirements of NAMUR Guideline NE 21, NE 43 and NE 53.

1.4 Radio approvals

1.4.1 European Union (EU)

**LEGAL NOTICE!**

This level transmitter is intended for installation in closed tanks. It meets the requirements of the R & TTE (Radio Equipment and Telecommunications Terminal Equipment) Directive 1999/05/EC for use in the member countries of the EU.

An industry agreement includes approval for use of the frequency band (5.7...6.7 GHz) in industrial environments.

According to article 6.4 of the R&TTE Directive, the product is marked by the CE sign + notified body number (0682) + Class II identifier (= alert sign).

Refer to EN 302372 for installation conditions.

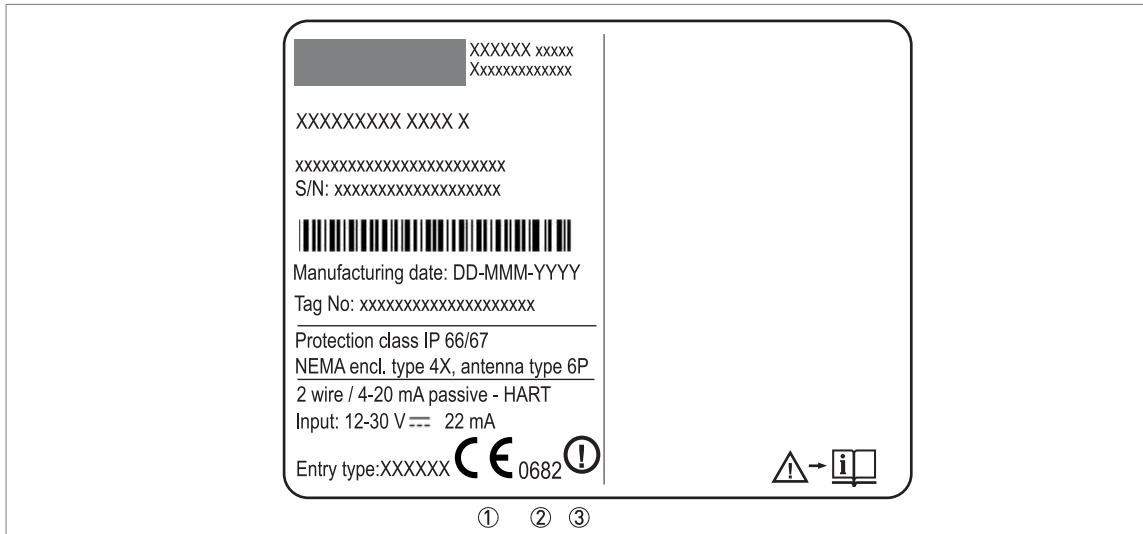


Figure 1-1: Radio approval information on the nameplate

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

According to ETSI EN 302 372 (2006-04), the radiated power outside a metallic tank is less than -30 dBm.

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

1.4.2 U.S.A. and Canada



LEGAL NOTICE!

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

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

Français: Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage, et
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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

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

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

1.5 Safety instructions from the manufacturer

1.5.1 Copyright and data protection

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

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

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

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

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

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

1.5.2 Disclaimer

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

1.5.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation 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.

1.5.4 Information concerning the documentation

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

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

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

1.5.5 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.

1.6 Safety instructions for the operator



WARNING!

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

2.1 Scope of delivery

**INFORMATION!**

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

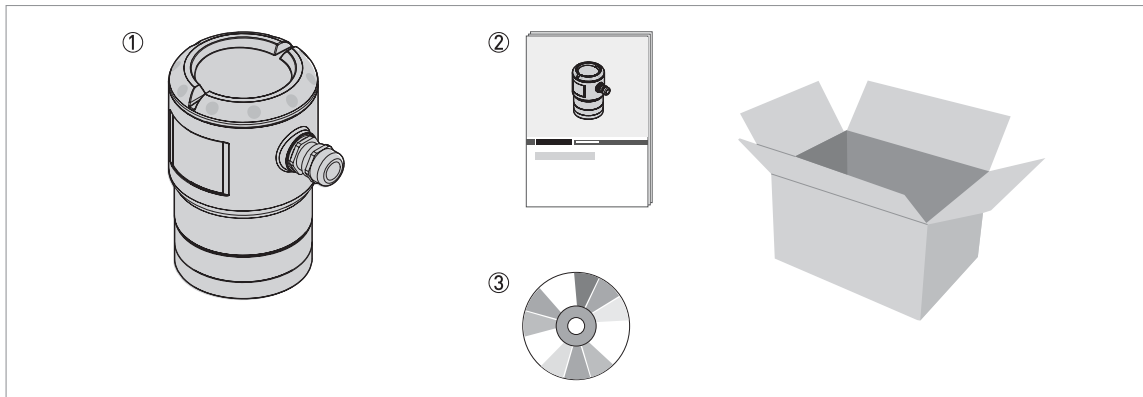


Figure 2-1: Scope of delivery

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

2.2 Device description

OPTIWAVE 1010 is an FMCW radar designed for use with the BM 26 Advanced (a magnetic level indicator or MLI), bypass chamber or stilling well. If the device is used with an MLI, it measures the distance to the float. If the device is used with a bypass chamber or stilling well, it measures the distance to the surface of the liquid. Radar is a non-contact technology. For more data about the measuring principle, refer to *Measuring principle* on page 47.

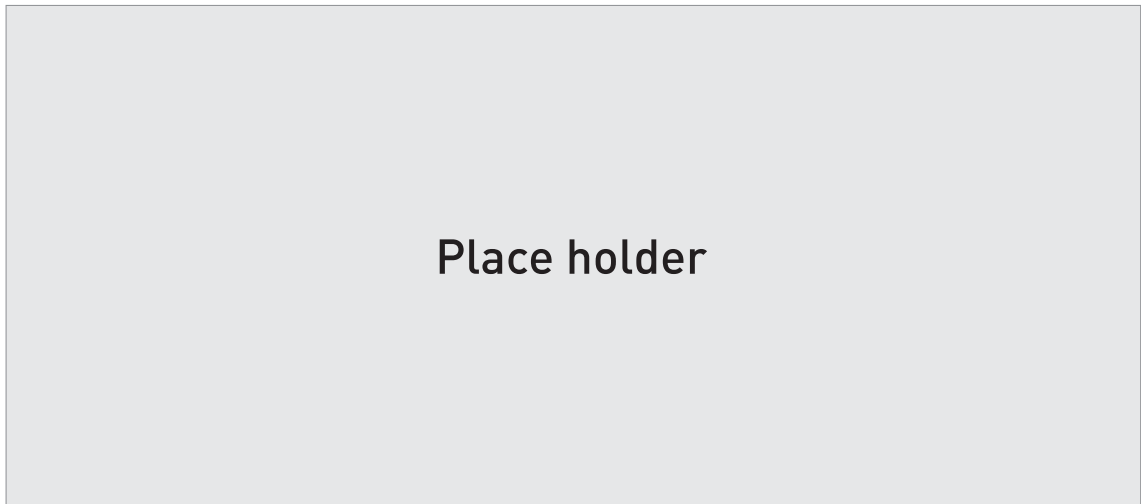


Figure 2-2: Radar level transmitter mounted on a magnetic (bypass) level indicator

2.3 Visual Check

**INFORMATION!**

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

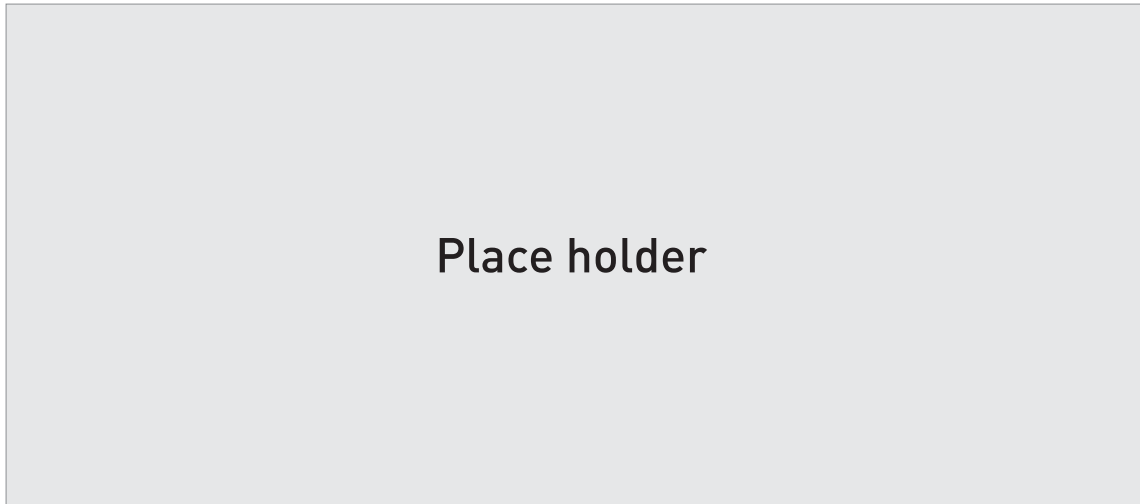


Figure 2-3: Visual check

- ① Device nameplate (for more data)
- 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.

2.4 Nameplates



INFORMATION!

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

2.4.1 Nameplate (example)

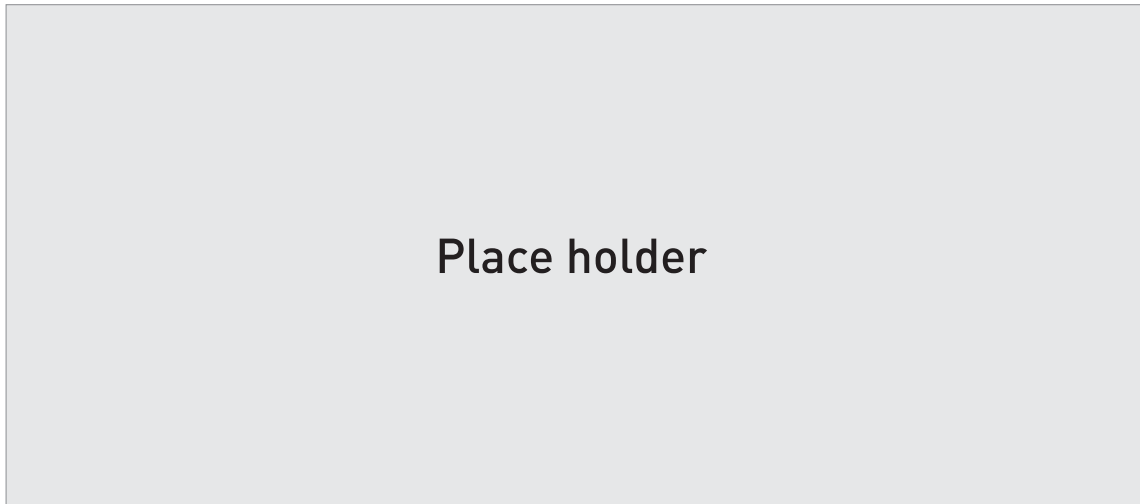


Figure 2-5: Non-Ex nameplate attached to the housing

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

3.1 General notes on installation



INFORMATION!

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



INFORMATION!

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



INFORMATION!

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

3.2 Storage



WARNING!

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

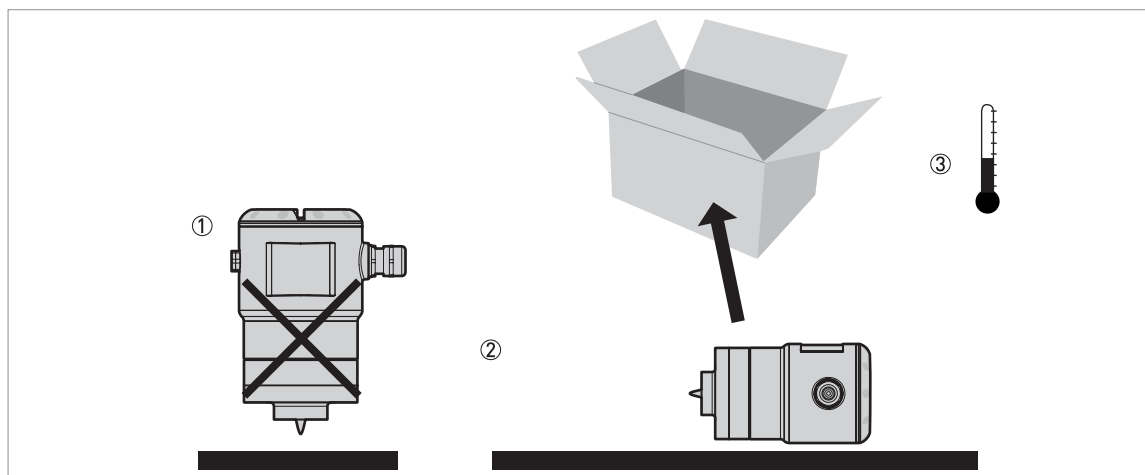


Figure 3-1: Storage conditions

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

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

3.3 Transport

**WARNING!**

- Depending on the version, the device will weight approx. $x...xx$ kg / $xx...xx$ lb. To carry, use both hands to lift the device carefully by the converter housing. If necessary, lift the device with a hoist.
- When handling the device, avoid hard blows, jolts, impact, etc. to prevent damage.

3.4 Pre-installation requirements

**INFORMATION!**

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

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

3.5 Pressure and temperature ranges

**DANGER!**

If the ambient temperature is more than $+70^{\circ}\text{C}$ / $+158^{\circ}\text{F}$, there is a risk of injury if you touch the device. Use a protective cover or metallic grid to prevent injury.

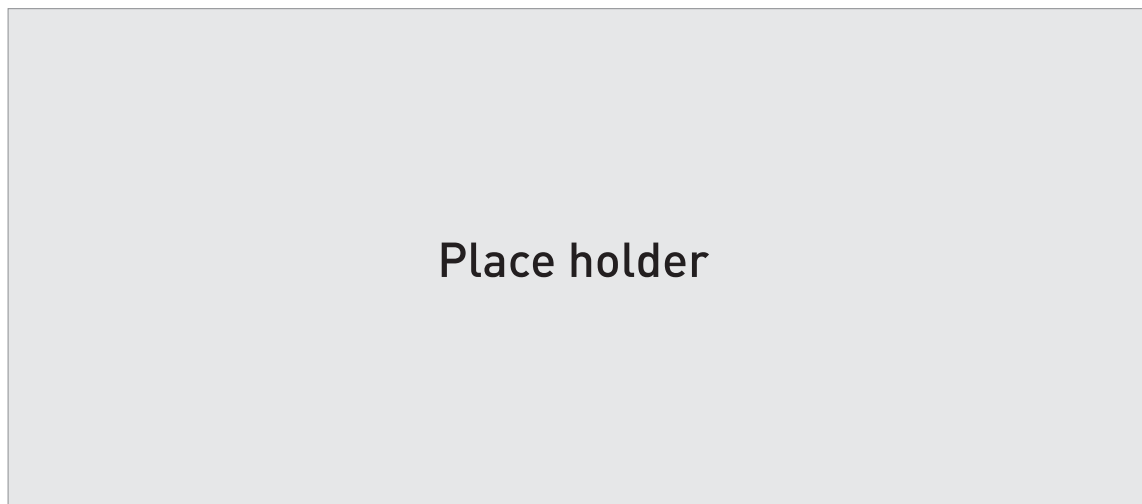


Figure 3-2: Pressure and temperature ranges

- ① Flange temperature
Non-Ex devices: Depends on the device versions (standard, HP and HT/HP versions) and the seal material. Refer to the table that follows.
Ex devices: see supplementary operating instructions
- ② Ambient temperature
Non-Ex devices: $-40...+80^{\circ}\text{C}$ / $-40...+176^{\circ}\text{F}$
Ex devices: see supplementary operating instructions
- ③ Process pressure
Depends on the type of antenna and process connection. Refer to the table that follows.

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

Version	Seal	Temperature extension	Process connection temperature		Process pressure	
			[°C]	[°F]	[barg]	[psig]
Standard	FKM/FPM with PEEK	without	-30...+100	-22...+212	-1...16	-14.5...232
	Kalrez® 6375 with PEEK	without	-20...+100	-4...+212		
	EPDM with PEEK	without	-40...+100	-40...+212		
HP ①	FKM/FPM with Metaglas®	without	-30...+100	-22...+212	-1...40	-14.5...580
	Kalrez® 6375 with Metaglas®	without	-20...+100	-4...+212		
	EPDM with Metaglas®	without	-40...+100	-40...+212		
HT or HT/HP ①	FKM/FPM with Metaglas®	with	-30...+150	-22...+302	-1...40	-14.5...580
	Kalrez® 6375 with Metaglas®	with	-20...+150	-4...+302		
	EPDM with Metaglas®	With	-40...+120	-40...+248		

① HP = high-pressure version. HT = high-temperature version. HT/HP = high-pressure / high-temperature version.

Stainless steel housing for non-Ex and Ex d-approved devices

Version	Seal	Temperature extension	Process connection temperature		Process pressure	
			[°C]	[°F]	[barg]	[psig]
Standard	FKM/FPM with Metaglas®	without	-30...+150	-22...+302	-1...40	-14.5...580
	Kalrez® 6375 with Metaglas®	without	-20...+150	-4...+302		
	EPDM with Metaglas®	without	-40...+120	-40...+248		

For more data on pressure ratings, refer to *Pressure ratings* on page 54

Ambient temperature / flange temperature, flange and threaded connection, in °C

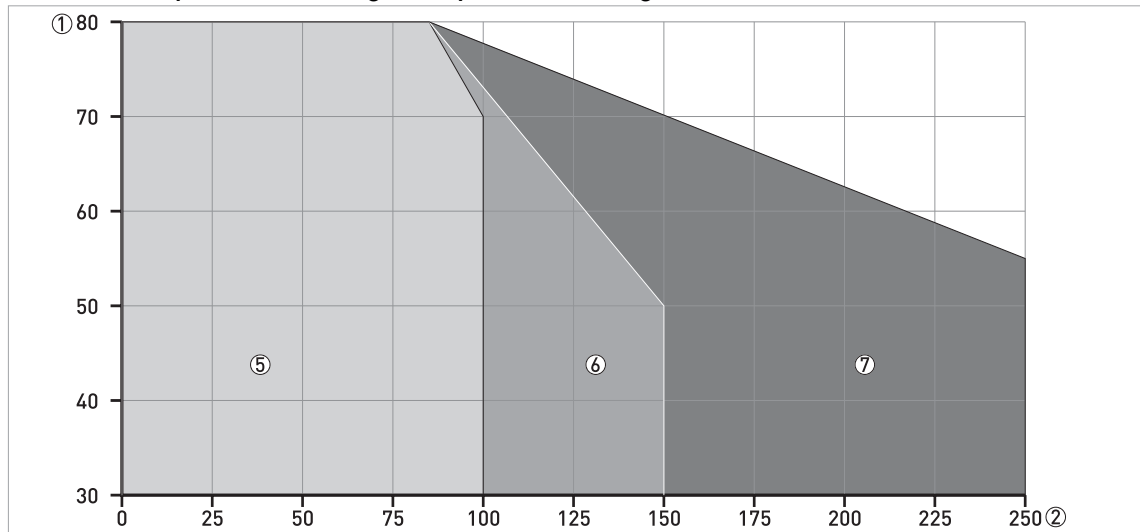


Figure 3-3: Ambient temperature / flange temperature, flange and threaded connection, in °C

Ambient temperature / flange temperature, flange and threaded connection, in °F

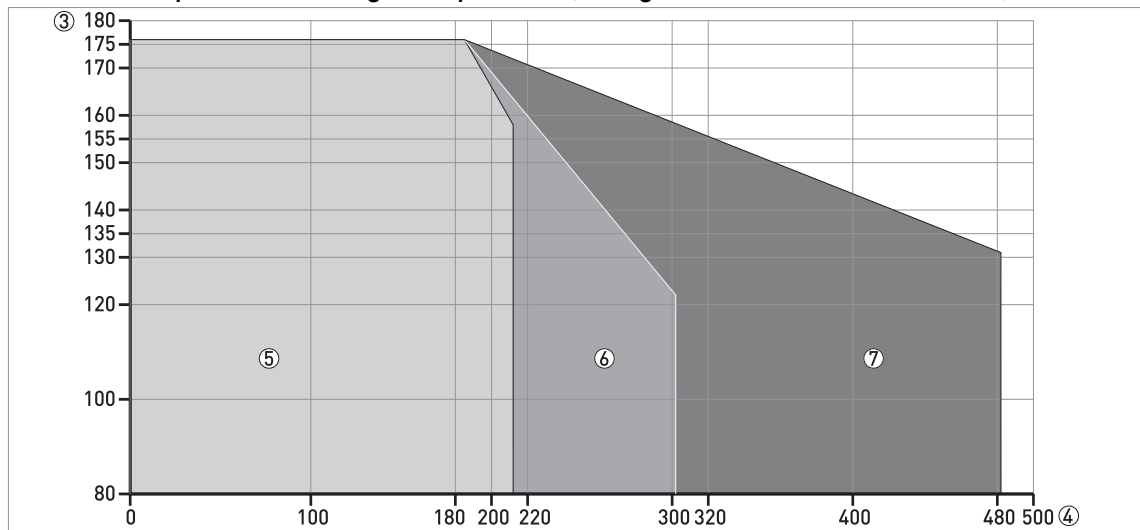


Figure 3-4: Ambient temperature / flange temperature, flange and threaded connection, in °F

- ① Maximum ambient temperature, °C
- ② Maximum flange temperature, °C
- ③ Maximum ambient temperature, °F
- ④ Maximum flange temperature, °F
- ⑤ Metallic Horn antennas

There is no change (de-rating) in ambient temperature below 0°C / 0°F. The process connection temperature must agree with the temperature limits of the gasket material. For pressure rating data,.

3.6 Recommended mounting position



CAUTION!

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



CAUTION!

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

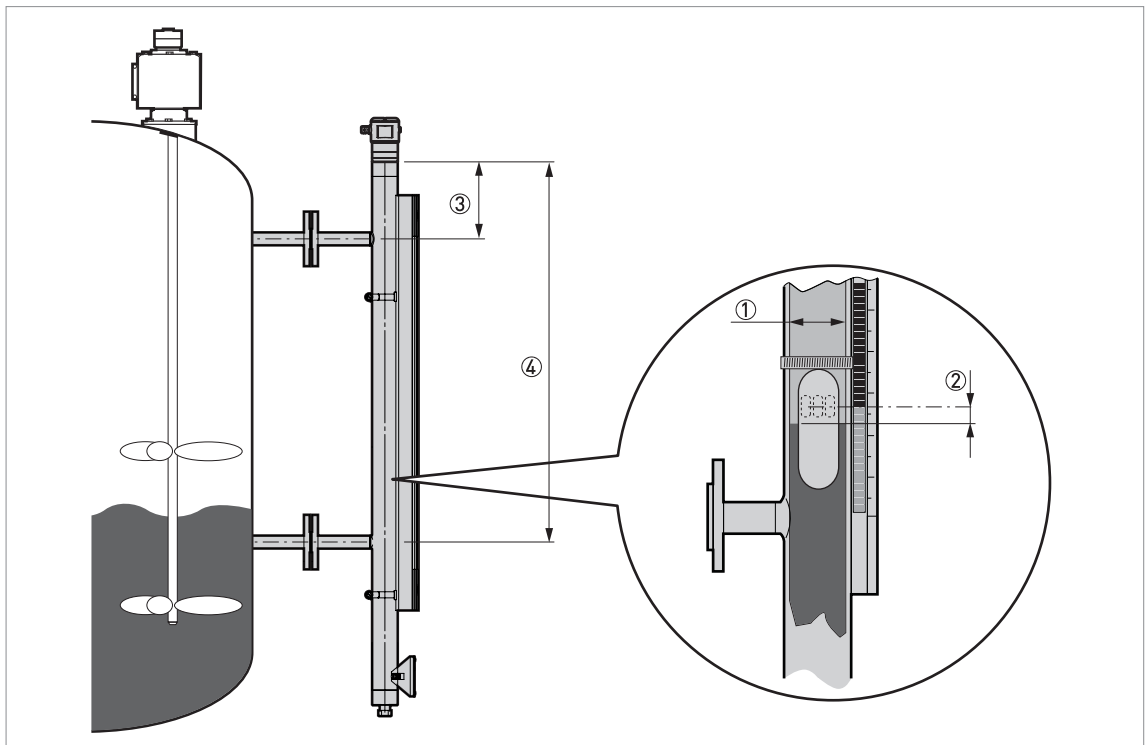


Figure 3-5: Recommended mounting position

- ① Internal tube diameter. Min. / Max.: 32...67 mm / 1.26...2.64"
- ② Float offset. Min. / Max.: 0...150 mm / 0...5.91"
- ③ Distance to top process connection (bypass chamber). Min. / Max.: 0...800 mm / 0...2.64"
- ④ Distance to bottom process connection (bypass chamber). Min. / Max.: 32...67 mm / 1.26...2.64"

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.



CAUTION!

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

3.8 Stilling wells

Install the device in a metal stilling well if the radar level transmitter is attached to the top of the tank and not on the top of a magnetic (bypass) level indicator or a bypass chamber.



CAUTION!

If the stilling well has liquid circulation holes, then the tank must be made of metal or reinforced concrete to prevent radio frequency interference.

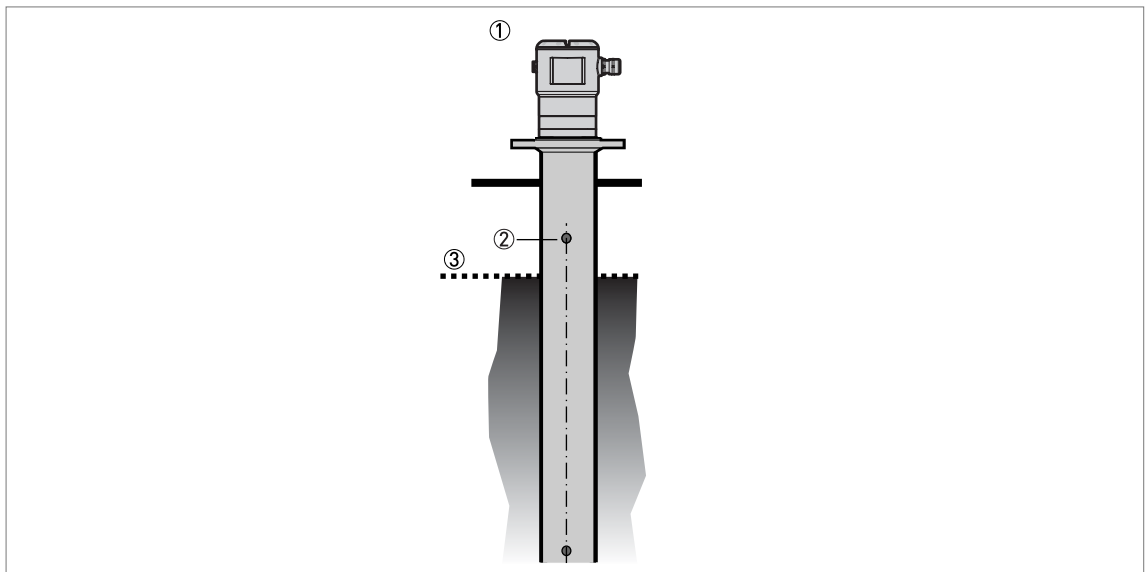


Figure 3-6: Installation recommendations for stilling wells

- ① A stilling well solution
- ② Air circulation hole
- ③ Level of the liquid



CAUTION!

Installation requirements

- *The standpipe must be electrically conductive.*
- *The standpipe must be straight. There must be no sudden changes in internal diameter greater than 1 mm / 0.04".*
- *The standpipe must be vertical.*
- *Recommended surface roughness: $<\pm 0.1$ mm / 0.004".*
- *Make sure that there are no deposits at the bottom of the standpipe.*
- *Make sure that there is liquid in the standpipe.*

General notes



Installation in tanks containing one liquid and foam

- Drill an air circulation hole (max. $\varnothing 10$ mm / 0.4") in the stilling well above the maximum level.
- Remove the burr from the hole.



Installation in tanks containing one liquid or more without foam

- Drill an air circulation hole (max. $\varnothing 10$ mm / 0.4") in the stilling well above the maximum level.
- Drill 1 or more liquid circulation holes in the stilling well (if there is more than 1 liquid in the tank).
- ➡ These holes help the liquid to move freely between the stilling well and the tank.
- Remove the burr from the hole.

3.9 How to attach the weather protection to the device

The device and the weather protection option are supplied disassembled in the same box. You must attach the weather protection when you install the device.

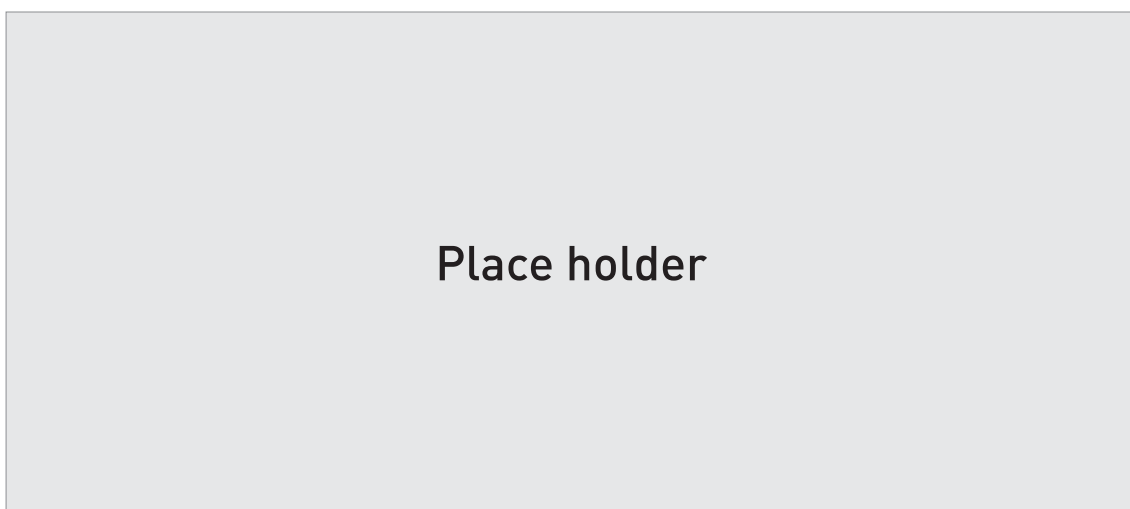


Figure 3-7: Equipment needed

- ① Device
- ② Weather protection (option).
- ③ 2 butterfly screws and spring washers. The manufacturer attaches these parts to the device before delivery.

The overall dimensions of the weather protection are.

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

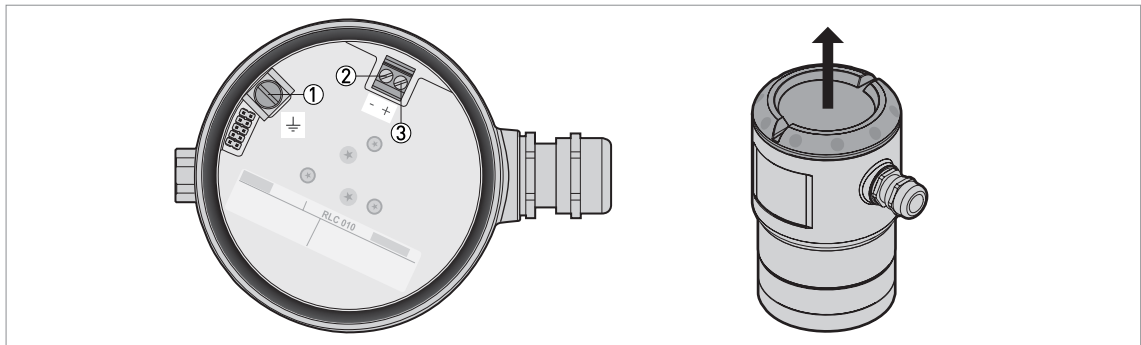


Figure 4-1: Terminals for electrical installation

- ① Grounding terminal in the housing (if the electrical cable is shielded)
- ② Current output -
- ③ Current output +



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.

4.3 Electrical connection for current output

4.3.1 Non-Ex devices

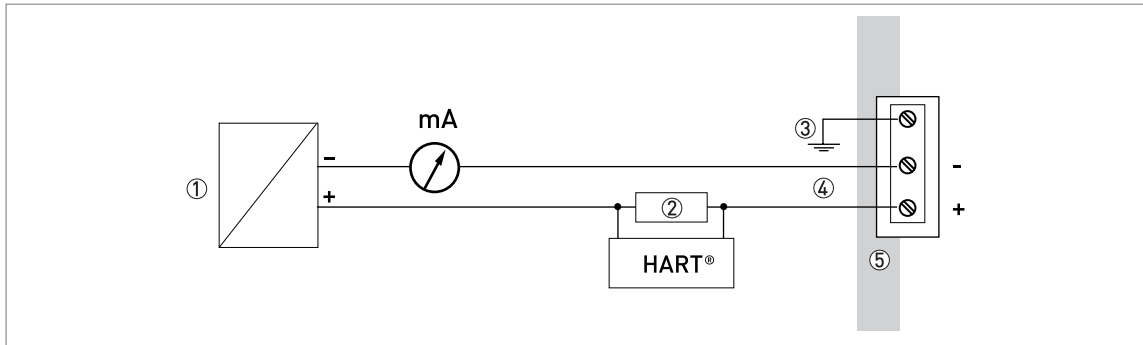


Figure 4-2: Electrical connections for non-Ex devices

- ① Power supply
- ② Resistor for HART® communication
- ③ Optional connection to the grounding terminal
- ④ Output: 14.5...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, FM, CSA, ...). 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 IP 66/67. It also fulfils all requirements per NEMA type 4X (housing) and type 6P.



DANGER!

Make sure that the cable gland is watertight.

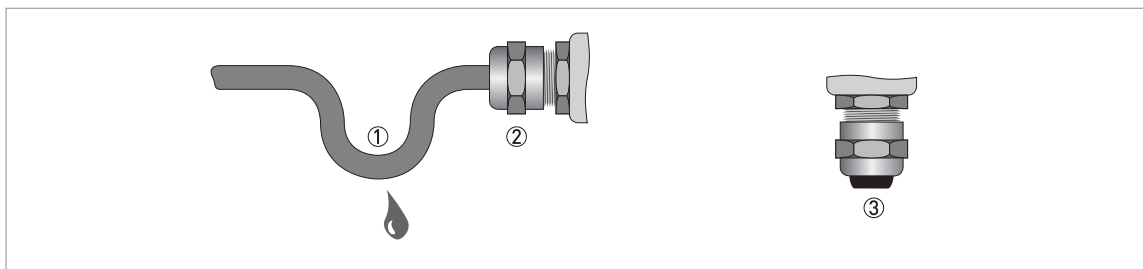


Figure 4-3: How to make the installation agree with protection category IP 67



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

4.5 Networks

4.5.1 General information

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

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

4.5.2 Point-to-point connection

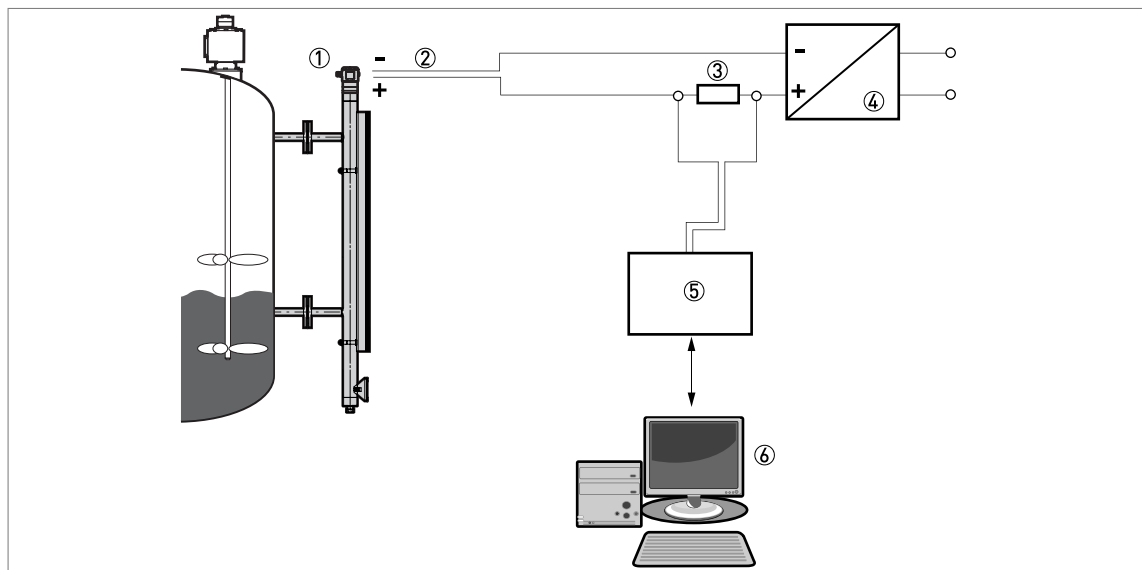


Figure 4-4: Point-to-point connection (non-Ex)

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

4.5.3 Multi-drop networks

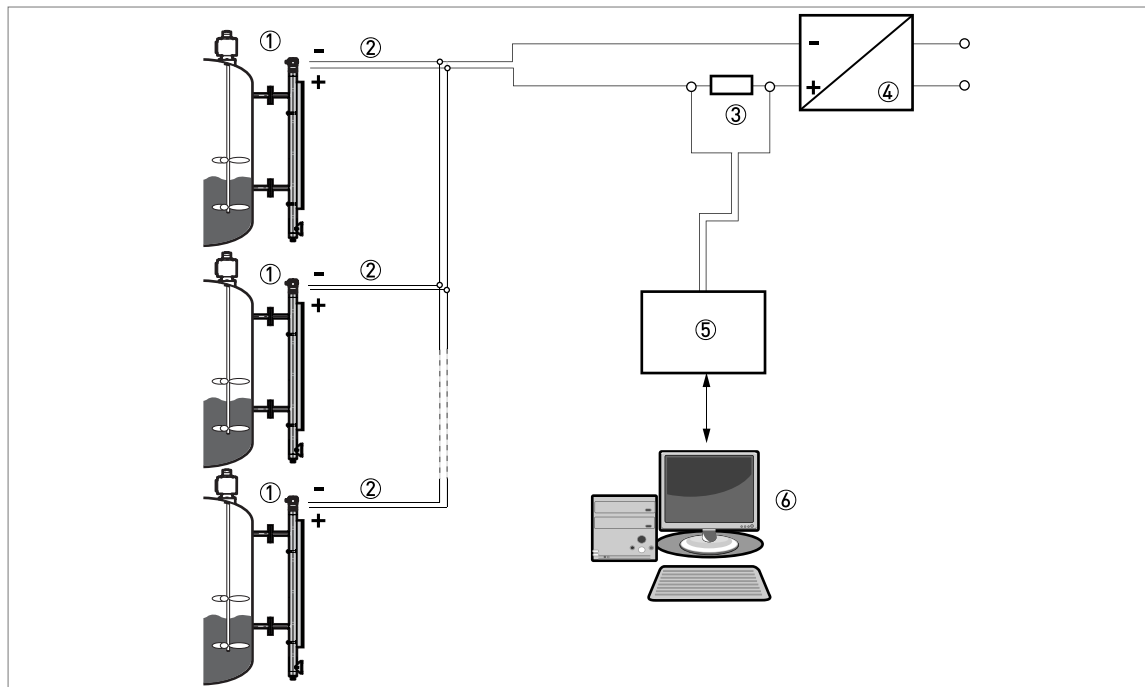


Figure 4-5: Multi-drop network (non-Ex)

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

5.1 How to start the device

5.1.1 Start-up checklist

Check these points before you energize the device:

- Are all the wetted components (PEEK element, flange and gaskets) resistant to the product in the tank?
- Does the information on the device nameplate agree with the operating data?
- **If the device is supplied with a magnetic (bypass) level indicator:** Did you correctly install the magnetic level indicator adjacent to the tank?
- **If the device is supplied without a magnetic (bypass) level indicator:** Did you correctly install the device on top of the bypass chamber or stilling well?
- Do the electrical connections agree with the national electrical codes? Use the applicable electrical cables with the cable glands.



DANGER!

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



DANGER!

Make sure that the device and the installation agrees with the requirements of the Ex certificate of compliance.

5.1.2 How to start the device



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



INFORMATION!

The OPTIWAVE 1010 is set up for your application when it is attached to the top of the BM 26 Advanced Magnetic (Bypass) Level Indicator at the factory. The 0% level (empty) is aligned with the center of the bottom process connection and the 100% level (full) is aligned with the center of the top process connection. You can use the HART communication protocol to change these parameters.

5.2 Operating concept

You can read measurements and configure the device with:

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

For more data about how to use the DTM in PACTware, For more data about the menu tree for the Basic-DD, AMS and PDM,

5.3 Remote communication with PACTware™

5.3.1 General notes

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



Figure 5-1: Start page for PACTware™

5.3.2 Software installation

Equipment needed

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

Software needed

- Microsoft® .NET Framework 1.1 or a later version
- PACTware™ 4.0 or a later version
- Device Type Manager (DTM) for the OPTIWAVE 1010 radar level transmitter

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



Installation procedure

- ① Install Microsoft® .NET Framework 1.1.
- ② Install PACTware™ 4.0 or later version.
- ③ Install the OPTIWAVE 1010 DTM on your workstation or your portable computer. Follow the instructions in the Installation wizard.
- ④ Plug the HART modem into your computer (Serial or USB HART® modem). If you are using a USB® HART modem, you must install the Driver for the USB HART® modem first. Make sure that the location of the port for the HART® modem is clearly identified.
- ⑤ Start the PACTware™ program.
- ➡ End of the procedure.

5.4 Remote communication with the AMS™ Device Manager

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

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

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

6.1 Software configuration

6.1.1 General notes

How to configure the software for device communication.

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

This procedure will open the communication port, but does not start the communication with the device.

6.1.2 Procedure



INFORMATION!

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



- HOST PC is shown in the Project pane. Go to the main toolbar and click on the View menu button. Click on "Device catalog F3" to open the Device Catalog pane.
- Double click on "HART Communication" in the Device Catalog pane. The "COM4" element is added below "HOST PC" in the project structure.
- Click on "OK" to save changes or "Cancel" to cancel the new configuration.
- Double click on the "OPTIWAVE 1010" item in the Device Catalog pane. This step will add the device DTM to the project structure in the Project pane.
- ➔ The software is correctly configured for device communication, but the port is not open and the device cannot communicate with the software at this time.
- [a] Double click on the "OPTIWAVE 1010" element in the project structure (Project pane), or [b] Right click on "OPTIWAVE 1010" element in the project structure (Project pane) and select "Parameter" in the drop-down list box.
- ➔ This step will open the OPTIWAVE 1010 Parameter (configuration) window.
- Right click on the "OPTIWAVE 1010" element in the Project pane and select "Connect" in the drop-down list box.
- ➔ The software is correctly configured for device communication and the port is open, but the device cannot communicate with the software at this time. End of the procedure.

6.2 How to load settings from the device to PACTware™

There are 3 alternative procedures.

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

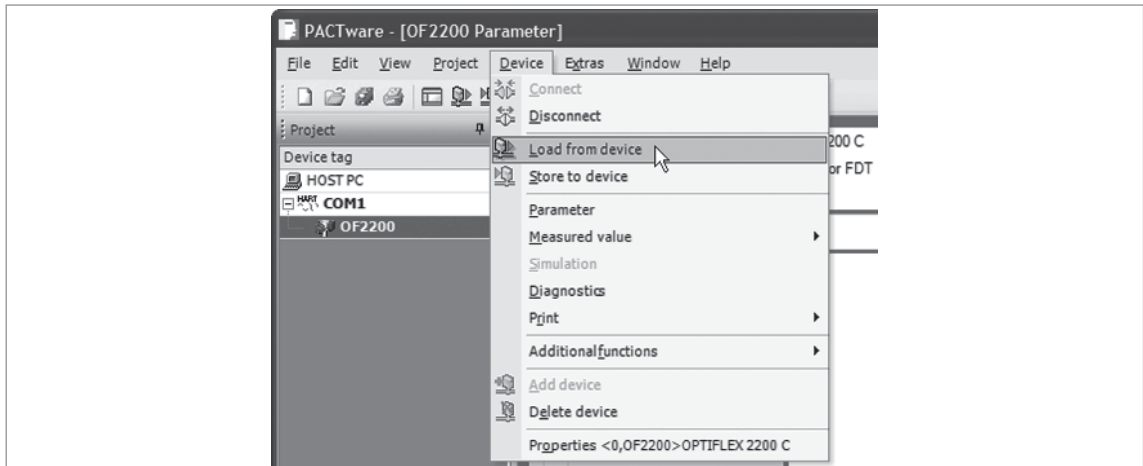


Figure 6-1: Click on "Load from Device" in the Device menu



- Click on the Device button in the main toolbar.
- Select "Load from device" from the list.
- ➡ End of the procedure.

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



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



- Click on this icon (you can find this icon below the main toolbar).
- ➡ End of the procedure.

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

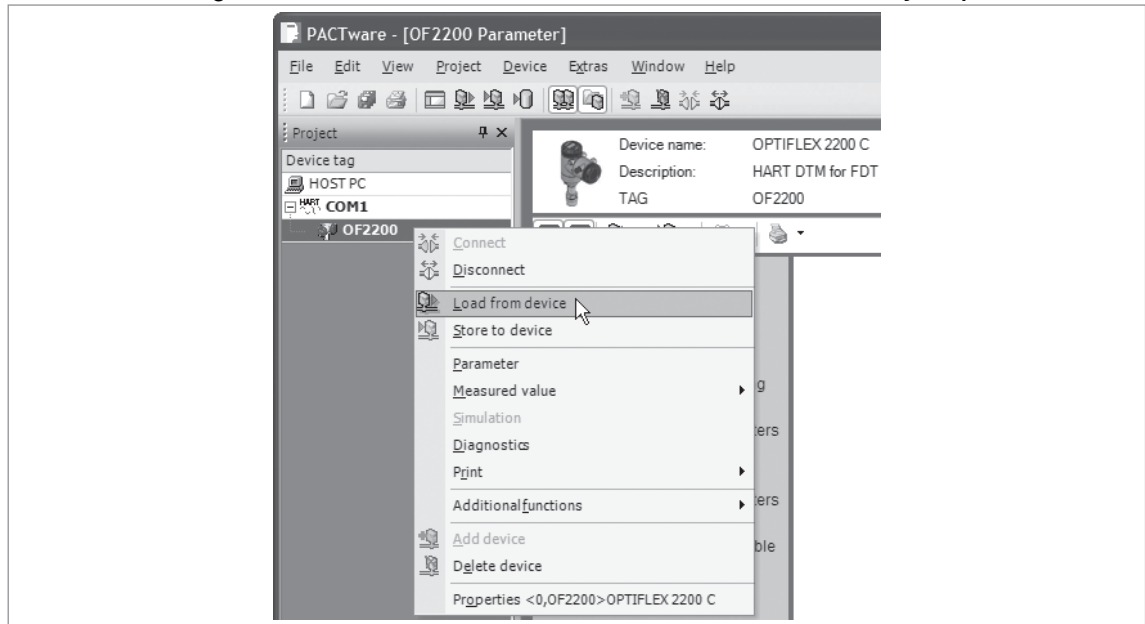


Figure 6-3: Right click on the "OPTIWAVE 1010" element in the Project pane



- Right click on the "OPTIWAVE 1010" element in the Project pane.
- Select "Load from device" from the list.
- ➡ End of the procedure.

6.3 Menu overview

- Login/Logout
- Import/Export
- Basic parameters
- Signal output
- Application
- HART
- Service
- DTM settings

The service menu is password locked. This menu is for qualified service personnel only.

6.4 Device settings

6.4.1 Supervisor access rights

It is necessary to have "Supervisor" access rights to change device settings.

The device configuration is locked (write protected). To unlock the configuration and change device settings, you need to log in as a "Supervisor". If you do not log in as a Supervisor, you can only read the device configuration.



Procedure

- (a) Double click on the "OPTIWAVE 1010" element in the project structure (Project pane) or (b) Right click on "OPTIWAVE 1010" element in the project structure (Project pane) and select "Parameter" in the drop-down list box.
- Click on the **Log In / Log Out** menu and select "Supervisor".
- Enter the password (the default password is **123412**).
- The device configuration is unlocked. Change the device settings. Refer to the handbook for more data on menu items and their parameters.
- ➔ End of the procedure.

6.4.2 How to change device settings



CAUTION!

If you change the device settings, the DTM saves the device configuration in the computer database. It does not send the changes to the device. For more data about how to store the new settings to the device,.

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

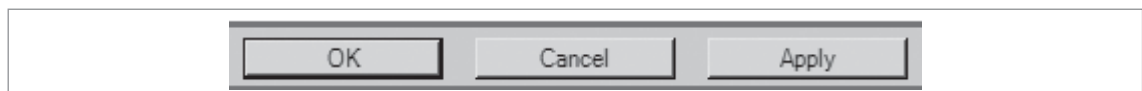


Figure 6-4: Use "OK" or "Apply" to update the computer database

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

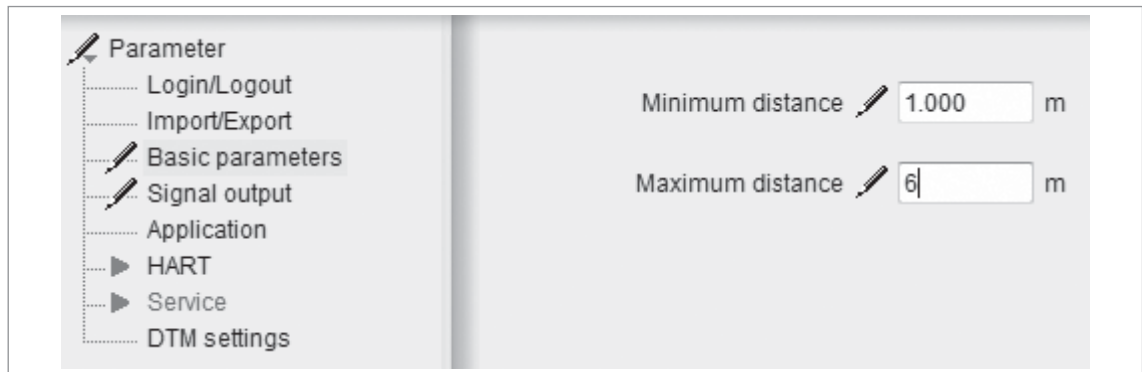


Figure 6-5: Pencil symbol: changed value

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

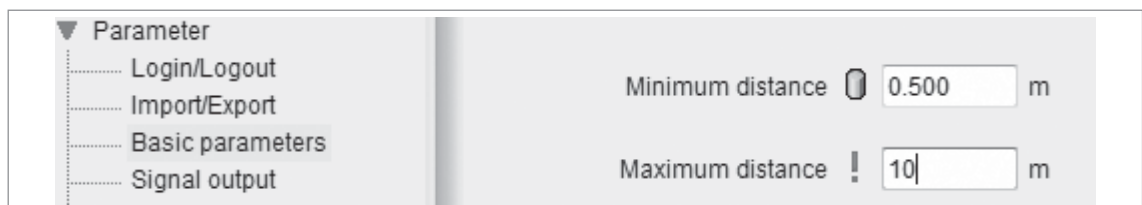


Figure 6-6: Exclamation mark (!): the value is too large or too small

6.4.3 Data about menu items and parameters (online Help)

More data is available for menu items in the **Basic Parameters**, **Signal output**, **Application** and **HART** menus.

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

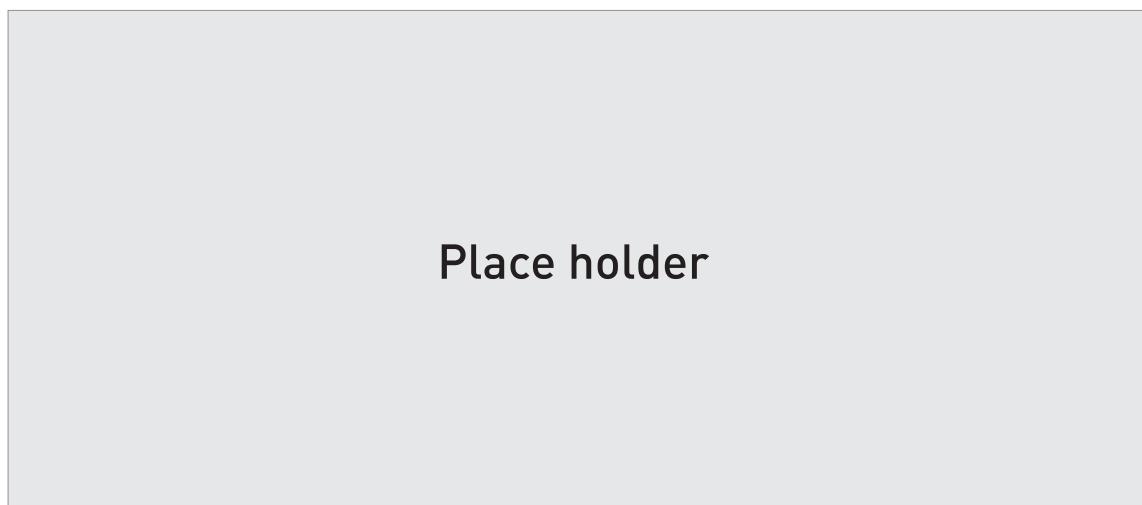


Figure 6-7: Data about parameters – part1: tooltip

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

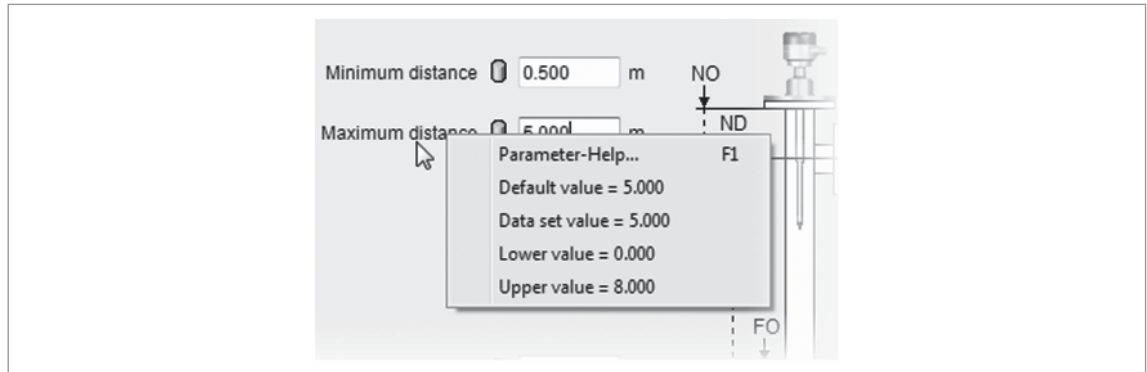


Figure 6-8: Data about parameters – part 2: values

6.4.4 Basic parameters

Use the "basic parameters" menu to specify the basic configuration of the device. The supervisor can specify the minimum distance (NO), maximum distance (ND), float offset (FO) and tube internal diameter (PD).

For more data about float offset,.

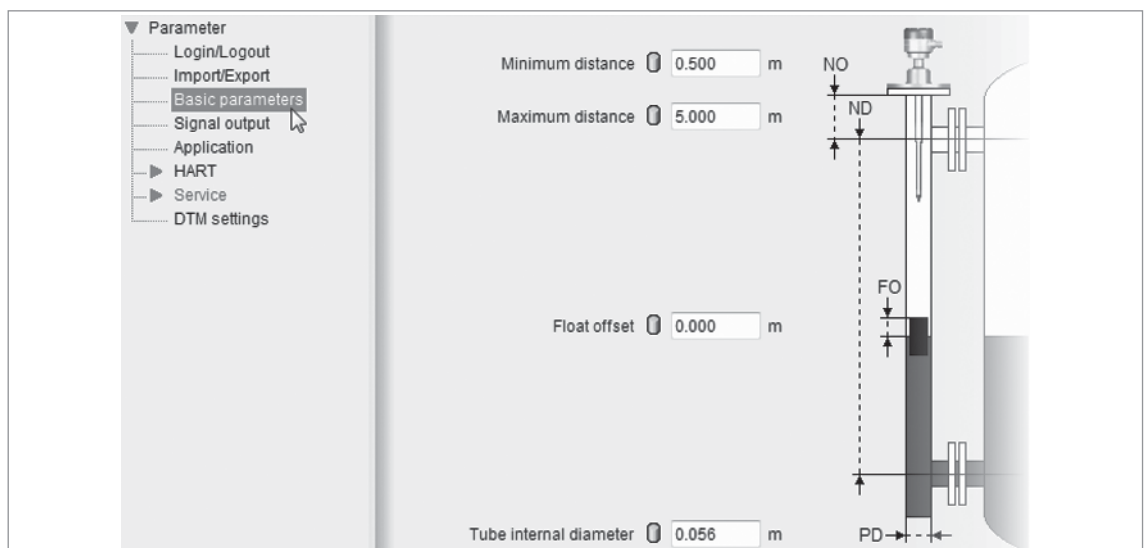


Figure 6-9: Basic parameters menu

6.4.5 Signal output

Use the "signal output" pane to specify the type of data that the current output must supply. The supervisor can set the measurement function (e.g. level, distance etc.), the output range, the error delay, minimum distance (NO) and maximum distance (ND).



INFORMATION!

Minimum distance (NO) and maximum distance (ND) is also given in the "basic parameter" menu.

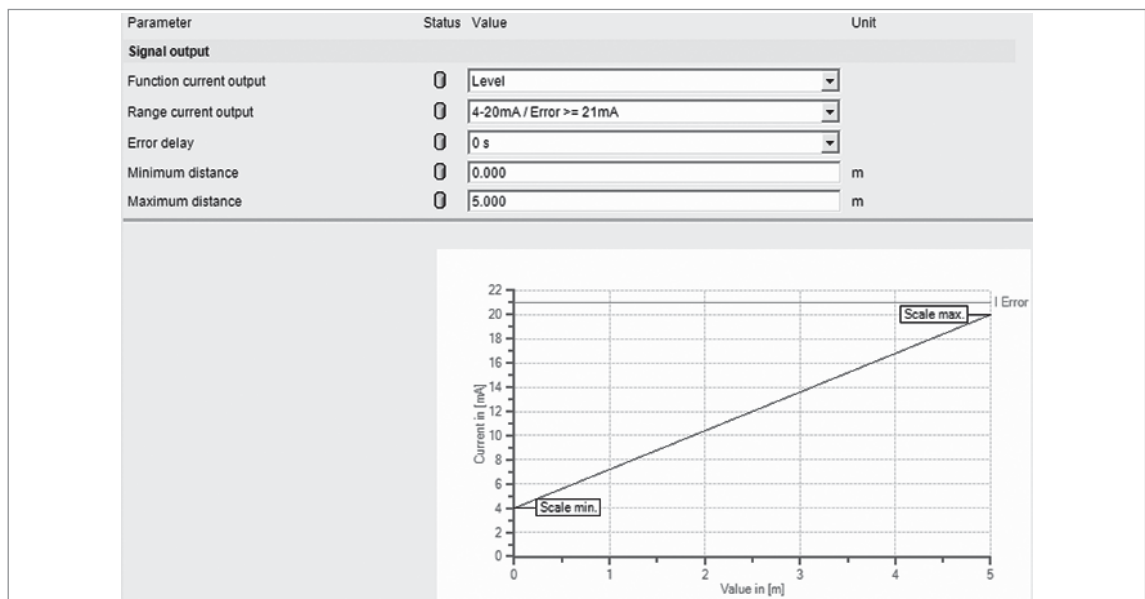


Figure 6-10: Signal output menu

6.4.6 Import / export

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

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



INFORMATION!

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



Figure 6-11: Import / export function



Export device configuration data

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



Import device configuration data

- Click on "Import / Export" in the menu list.
- Click on the **Import** button.
- Click on the >> button.
- Find the file and click on the **Open** button.
- Enter comments and supplementary data in the "File Comment" and "...comment for export file" boxes.
- Click on the "tick" button to complete the procedure.

6.4.7 Application

Use the "application" menu to specify how the device monitors level. The supervisor can give the time constant, maximum tracing speed, multiple reflections and minimum peak to identify the correct signal and follow it as level changes.

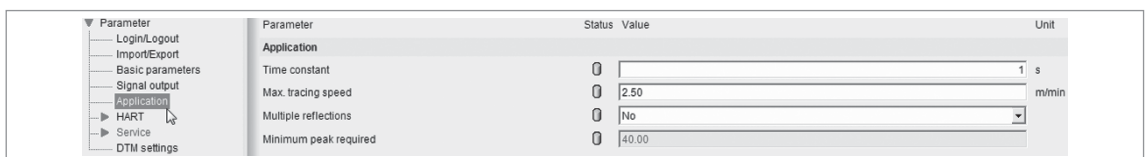


Figure 6-12: Application menu

6.4.8 HART

This menu lists all the data necessary for use in a HART® network. The supervisor can specify the tag name, device address, descriptor, date, message, W-Preamble, length unit and use a write lock to prevent changes to the data.

Parameter	Status	Value
HART		
TAG	<input type="checkbox"/>	OPTIWAVE 1010
Device address	<input type="checkbox"/>	0
Descriptor	<input type="checkbox"/>	
Date	<input type="checkbox"/>	14.10.2013
Message	<input type="checkbox"/>	
W-Preamble	<input type="checkbox"/>	5
Write lock	<input type="checkbox"/>	Inactive
Units		
Length unit	<input type="checkbox"/>	m

Figure 6-13: HART menu





6.5 Status and error messages

6.5.1 Device status

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

Types of error message

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

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

For data on errors, refer to *Error handling* on page 40.

6.5.2 Error handling



Figure 6-14: Error record screen in the DTM for PACTware™

Description of errors and corrective actions

Error Message	Cause	Corrective action
---------------	-------	-------------------

Failure (NE 107 status signal)

Microwave error	The device's hardware is defective.	Replace the signal converter. For more data, refer to <i>Service warranty</i> on page 44.
EEPROM error (Config.)		
EEPROM error (HART)		
Output current calibration not valid		
No signal		
No measuring value		
Hardware error		
Current output set to error		

Out of specification (NE 107 status signal)

Signal weak	The signal amplitude is less than the average value. This can occur if the liquid is agitated or if there is foam in the tank. If this error occurs frequently, the device will possibly show the "No measuring value" error message. ①	If this error occurs frequently, it is possible that you must install a float with a radar target (if there is no float supplied with the device).
Signal strong	This error can occur if there is a large change in signal amplitude. ①	No corrective action is necessary.
Spectrum quality bad	The quality of the spectrum is poor. If this message is temporarily shown, this will not affect the performance of the device. If this message is continuously shown, the measured values can be incorrect. The error message "Measurement old" will then be shown. Possible causes are foam, vortices, turbulent product surface and internal tank elements.	Do a check of the device, tank and the process. Change the device settings. If necessary, contact the supplier.

Error Message	Cause	Corrective action
Measurement old	This is a temporary error message. If the device cannot get a measurement in this time limit, the displayed measurement is no longer correct. The voltage is possibly too low. If the device continues to show the message "Spectrum quality bad", then this message is also shown.	Do a check of the voltage at the device terminals. Refer also to the error message "Spectrum quality bad".

Maintenance (NE 107 status signal)

Sweep timing error		
CPLD revision mismatch		
Capacitor voltage low		

Information

Peak lost in tank bottom		
Peak lost in blocking distance	The level is in the blocking distance. There is a risk that the product will overflow and/or cover the device.	Remove some of the product until the level is below the blocking distance.
Device reset	The device detected an internal error (watchdog timer issue).	Record the data that is in menu item 2.2.2 DIAGNOSTIC (Configuration mode / Supervisor menu). Speak to the supplier.
Current Output Drift	The current output is not calibrated.	Speak to the supplier to get the calibration procedure.
	Hardware error.	Replace the device.
Temperature out of range	The ambient temperature is outside the given range. This can cause loss or corruption of data.	Measure the ambient temperature. De-energize the device until the ambient temperature is back in the given range. If the temperature does not stay in the correct range, make sure that there is insulation around the signal converter. If this error occurs 2 times, replace the device.
Converter memory failure	The device's hardware is defective.	Replace the signal converter.
Converter Voltage failure	The device's hardware is defective.	Replace the signal converter.
Internal Communication	The device's hardware or software is defective. The converter cannot transmit signals to or receive signals from the antenna electronics.	De-energize the device. Make sure that the signal cable engages in the terminal and the screw connection is tight. Energize the device. If the problem continues, replace the signal converter.
Overfill	The level is in the blocking distance. There is a risk that the product will overflow and/or cover the antenna.	Use a different procedure to measure the level in the tank. Remove some of the product until the level is below the blocking distance.
		If a viscous product touched the antenna: <ul style="list-style-type: none"> remove the device and clean the antenna, or If the device has a purging option, use the purging system to clean the antenna.
Peak Lost (Level Lost)	The signal peak is not found within the measuring window that filters the signals received by the antenna. The measurement is not correct. The device will automatically increase this window to find the correct signal.	Do a check of the device, tank and the process. Reconfigure the device and record a new empty spectrum. Follow the instructions on page . If necessary, speak to the supplier.
Sensor no Signal	The device's hardware is defective.	Replace the signal converter.

Error Message	Cause	Corrective action
Sensor Microwave failure	The device's hardware is defective.	Replace the signal converter.
Sensor Memory failure	The device's hardware is defective.	Replace the signal converter.
Sensor Voltage failure	The device's hardware is defective.	Do a check of the power supply at the device terminals. Make sure that voltage values are in the specified limits in menu item 2.2.2 DIAGNOSTIC (Configuration mode / Supervisor menu). If the voltage is correct, replace the signal converter.
Sensor Not compatible	The software version of the sensor is not compatible with the software version of the signal converter.	Go to menu 1.1.0 IDENT. in Configuration mode. Record the version numbers of the device software given in menu items 1.1.2, 1.1.3 and 1.1.4. Give this data to the supplier.
	Defective wiring.	

Out of specification (NE 107 status signal)

Temperature Out of Range	The ambient temperature is outside the given range. This can cause loss or corruption of data.	Measure the ambient temperature. De-energize the device until the ambient temperature is back in the given range. If the temperature does not stay in the correct range, make sure that there is insulation around the signal converter. If this error occurs 2 times, replace the device.
Overflow	The level is in the blocking distance. There is a risk that the product will overflow and/or cover the device.	Remove some of the product until the level is below the blocking distance.
Peak Lost	The signal peak is not found within the measuring window that filters the signals received by the antenna. The measurement is not correct. The device will automatically increase this window to find the correct signal.	Do a check of the device, tank and the process and make sure that the data agrees with the device configuration. If necessary, record a new empty spectrum. Follow the instructions on page . If necessary, speak to the supplier.

Maintenance (NE 107 status signal)

Empty Spectrum Invalid	The empty spectrum stored in the device does not agree with the installation. If you change the device configuration (tank height etc.), this message will be shown. The recorded empty spectrum will not be used by the device while this error message is shown. ①	Record a new empty spectrum. Follow the instructions on page .
Signal Weak	The signal amplitude is less than the average value. This can occur if the liquid is agitated or if there is foam in the tank. If this error occurs frequently, the device will possibly show the "Peak Lost (Level Lost)" error message. ①	If this error occurs frequently, it is possible that you must install the device in a stilling well or use a different antenna type.
Signal Strong	This error can occur if there is a large change in signal amplitude. ①	No corrective action is necessary.
Bad Measurement Quality	The measurement is incorrect and continues to be incorrect after more than 10 s. This error can occur if the tank contents are immediately below the antenna. ①	Record the process with the PACTware™ software tool to find the cause of the problem. If necessary, speak to the supplier.
Temperature <-35°C / -31°F	The process connection or the ambient temperature is less than -35°C / -31°F. This temperature is near to the minimum limit for device operation. ①	Measure the ambient temperature. De-energize the device until the ambient temperature is back in the given range. If the temperature does not stay in the correct range, make sure that there is insulation around the signal converter.

Error Message	Cause	Corrective action
Temperature >+75°C / +167°F	The ambient temperature is more than +75°C / +167°F. This temperature is near to the maximum limit for device operation. ①	Measure the ambient temperature. De-energize the device until the ambient temperature is back in the given range. If the temperature does not stay in the correct range, make sure that there is insulation around the signal converter.

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

7.1 Periodic maintenance

No maintenance is necessary.

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.



INFORMATION!

The converter housing (compact or remote version) can be detached from the process connection assembly under process conditions.

Servicing by the customer is limited by warranty to:

- **Device with a flanged process connection:** The removal and installation of the device. For more data.
- **Device with a welded process connection:** The removal and installation of the circuit boards. For more data.

For more data on how to prepare the device before you send it back to the supplier, refer to *Returning the device to the manufacturer* on page 45.

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



CAUTION!

If the device has been operated with toxic, caustic, flammable or water-endangering products, you are kindly requested:

- *to check and ensure, if necessary by rinsing or 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

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

7.6 Disposal

**CAUTION!**

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

8.1 Measuring principle

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

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

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

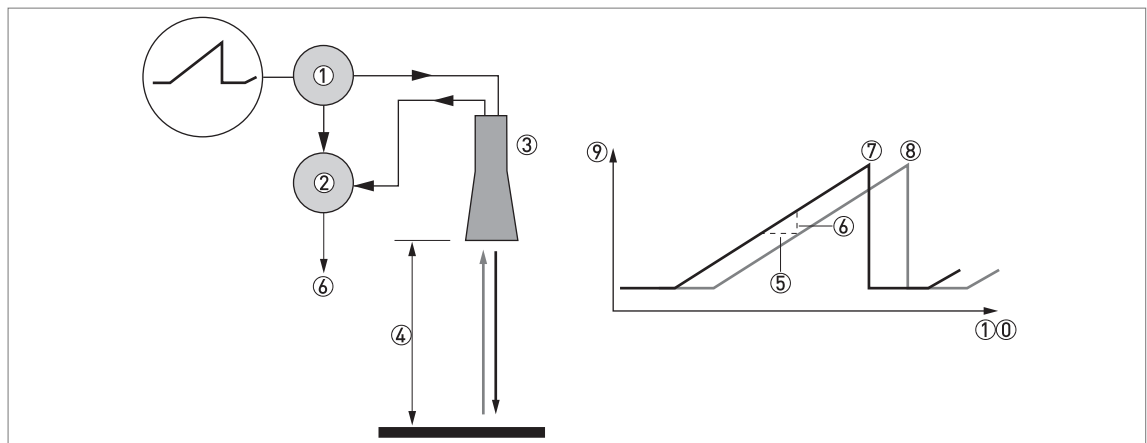


Figure 8-1: Measuring principle of FMCW radar

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

8.2 Technical data



INFORMATION!

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

Measuring system

Measuring principle	2-wire loop-powered level transmitter; C-band (6 GHz) FMCW radar
Application range	Level measurement of clean liquids
Primary measured value	Distance and reflection
Secondary measured value	Level and volume

Design

Construction	The measurement system consists of a wave guide connection and a signal converter
Options	Weather protection
Measuring range	0...5.3 m / 0...17.4 ft (max. 8 m / 26.2 ft on request)
Top dead zone	Minimum value: 300 mm / 11.8" from the process connection
User interface	
User interface	PACTware™

Measuring accuracy

Repeatability	±1 mm / ±0.04"
Accuracy	±10 mm / ±0.4"
Reference conditions acc. to EN 61298-1	
Temperature	+15...+25°C / +59...+77°F
Pressure	1013 mbara ±50 mbar / 14.69 psia ±0.73 psi
Relative air humidity	60% ±15%
Target	Metal plate in an anechoic chamber

Operating conditions

Temperature	
Ambient temperature	-40...+80°C / -40...+176°F Ex: see supplementary operating instructions or approval certificates
Storage temperature	-40...+85°C / -40...+185°F
Process connection temperature (higher temperature on request)	Standard: with a Kalrez® 6375 gasket: -20...+100°C / -4...+212°F with a FKM/FPM gasket: -30...+100°C / -22...+212°F with a EPDM gasket: -40...+100°C / -40...+212°F ①
	High temperature version (HT) with Metaglas® process seal: with a Kalrez® 6375 gasket: -20...+150°C / -4...+302°F with a FKM/FPM gasket: -30...+150°C / -22...+212°F with a EPDM gasket: -40...+130°C / -40...+266°F ②
	The process connection temperature must agree with the temperature limits of the gasket material. Ex: see supplementary operating instructions or approval certificates
Pressure	
Process pressure	Standard (PEEK): -1...16 barg / -14.5...232 psig. For more data, refer to <i>Pressure ratings</i> on page 54.
	With Metaglas®: -1...40 barg / -14.5...580 psig. For more data, refer to <i>Pressure ratings</i> on page 54.
Other conditions	
Dielectric constant (ϵ_r)	≥1.8
Ingress protection	IEC 60529: IP 66/67
	NEMA 250: NEMA type 4X (housing) and type 6P (antenna)
Maximum rate of change	3 m/min / 9.8 ft/min

Installation conditions

Pipe internal diameter ③	Standard: Ø42.2
	Option: Ø60.3
Dimensions and weights	For dimensions and weights data, refer to <i>Dimensions and weights</i> on page 55.

Materials

Housing	Standard: Polyester-coated aluminium
	Option: Stainless steel (1.4404 / 316L)
Wetted materials	Standard: Stainless steel (1.4404 / 316L) wave guide connection with a FKM/FPM, EPDM or Kalrez® 6375 O-ring gasket
	Option: Hastelloy® C-22® (2.4602) wave guide connection with a FKM/FPM, EPDM or Kalrez® 6375 O-ring gasket
Feedthrough	Standard: PEEK process seal with O-ring gasket
	Option (high-temperature version): Metaglas® process seal with O-ring gasket
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

Welded version	
Pipe sizes	Stainless steel (1.4404 / 316L): Ø42.4×2; Ø60.3×2; Ø60.3×2.77; Ø60.3×3.9
	Hastelloy® C-22® (2.4602) : Ø42.4×2; Ø60.3×2; Ø60.3×2.77; Ø60.3×3.9
Flange version	
EN 1092-1	DN40...80 (Form B1, B2, C, D, E or F) in PN16 / 40; others are available on request
ASME B16.5	1½...3" (RF or FF) in 150 lb / 300 lb; others are available on request
JIS	40...80A in 10K

Electrical connections

Power supply	14.5...30 VDC; min./max. value for an output of 22 mA at the terminal
Maximum current	22 mA
Current output load	$R_L [\Omega] \leq ((U_{ext} - 14.5 \text{ V})/22 \text{ mA})$. For more data, refer to <i>Minimum power supply voltage</i> on page 53.
Cable entry	Standard: M20×1.5; Option: ½ NPT
Cable gland	Standard: none
	Options: M20×1.5 (cable diameter: 6...10 mm / 0.2...0.39"); others are available on request
Cable entry capacity (terminal)	0.5...2.5 mm ²

Input and output

Current output / HART®	
Output signal	4...20 mA HART® or 3.8...20.5 mA acc. to NAMUR NE 43 ④
Resolution	±3 µA
Temperature drift	Typically 50 ppm/K (150 ppm/K maximum)
Digital temperature drift	Max. ±15 mm / 0.6" for the full temperature range
Error signal	High: 22 mA; Low: 3.6 mA acc. to NAMUR NE 43 ⑤

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 / IEC 61298-3 10-82.2 Hz: 0.15 mm; 82.2-1000 Hz: 20 m/s ²

Explosion protection		
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	
cFMus – Dual Seal-approved (pending)	NEC 500 (Division ratings)	
	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	
	NEC 505 (Zone ratings)	
	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	
	CEC Section 18 (Zone ratings)	
	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	
	CEC Section 18 and Annex J (Division ratings)	
	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 (pending)	Ex ia IIC T2~T6 Gb or Ex ia IIC T2~T6 Ga/Gb DIP A20/A21 T _A T90°C IP6X
		Ex d ia IIC T2~T6 Gb or Ex d ia IIC T2~T6 Ga/Gb DIP A20/A21 T _A T90°C IP6X

Other standards and approvals	
EMC	Electromagnetic Compatibility Directive 2004/108/EC in conjunction with EN 61326-1 (2006)
Radio approvals	R & TTE Radio Equipment and Telecommunications Terminal Equipment Directive 1999/5/EC in conjunction with ESTI EN 302 372 (2006)
	FCC Rules Part 15
	Industry Canada RSS-210
LVD	Low-Voltage Directive 2006/95/EC in conjunction with EN 61010-1 (2001)
NAMUR	NAMUR NE 21 Electromagnetic Compatibility (EMC) of Industrial Process and Laboratory Control Equipment
	NAMUR NE 43 Standardization of the Signal Level for the Failure Information of Digital Transmitters
	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
WHG Z-xx.xx-xxx	In conformity with the German Federal Water Act, §9
CRN	This certification is applicable for all Canadian provinces and territories. For more data, refer to the website.
Construction code	Option: NACE MR0175 / ISO 15156; NACE MR0103

- ① Kalrez® is a registered trademark of DuPont Performance Elastomers L.L.C. The process connection temperature must agree with the temperature limits of the gasket material.
- ② Metaglas® is a registered trademark of Herberts Industrieglas, GMBH & Co., KG. The process connection temperature must agree with the temperature limits of the gasket material.
- ③ This is the internal diameter of the magnetic level indicator (MLI), bypass chamber or stilling well
- ④ HART® is a registered trademark of the HART Communication Foundation
- ⑤ Only the 3.6 mA error signal is applicable to SIL-approved devices

8.3 Minimum power supply voltage

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

Non-Ex and Hazardous Location approved (Ex i / IS) devices

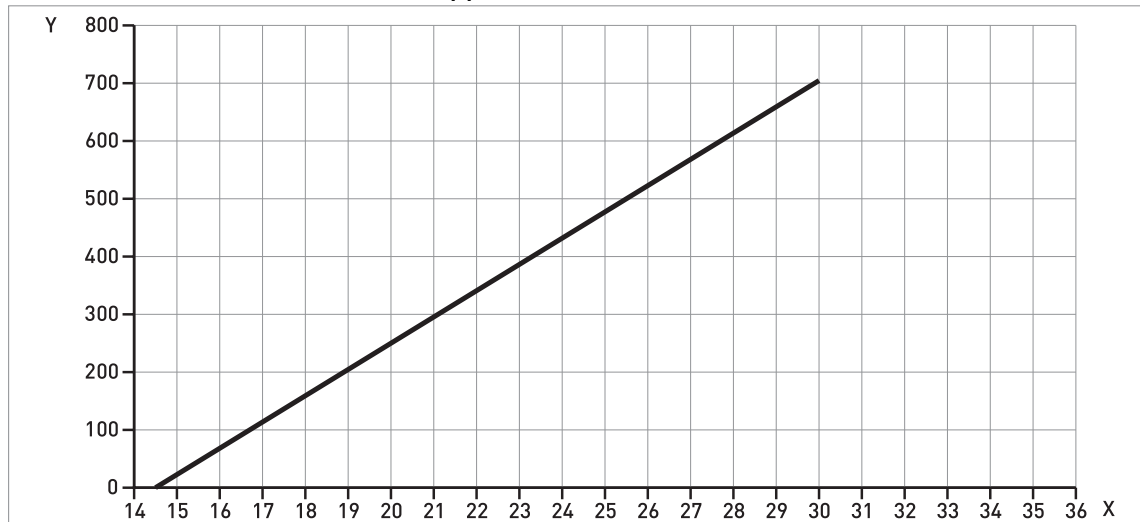


Figure 8-2: Minimum power supply voltage for an output of 22 mA at the terminal (Non-Ex and Hazardous Location approval (Ex i / IS))

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

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

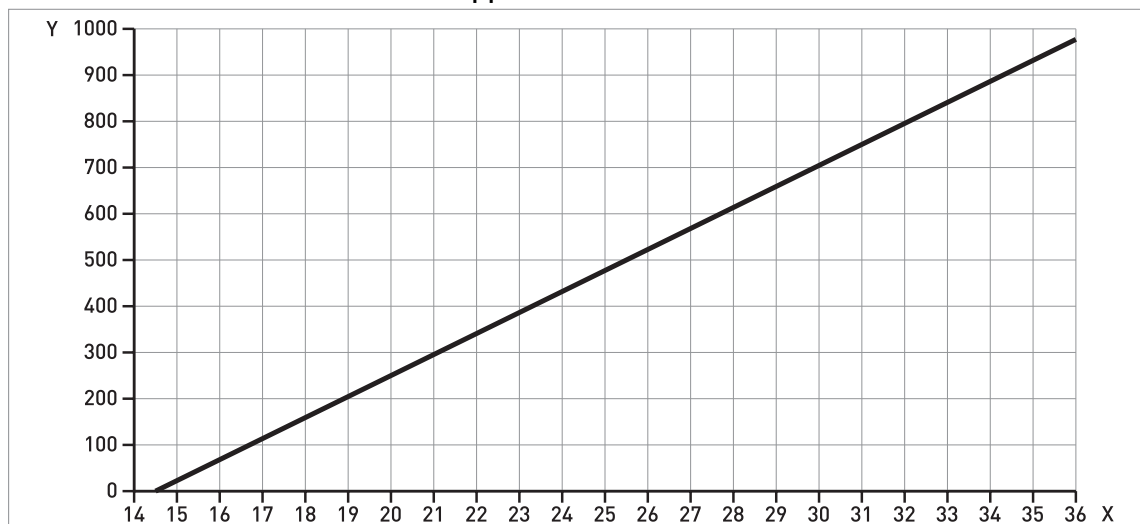


Figure 8-3: Minimum power supply voltage for an output of 22 mA at the terminal (Hazardous Location approval (Ex d / XP/NI))

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

8.4 Pressure ratings

This data is only applicable to the flanged version of the device.



WARNING!

Make sure that the devices are used within their operating limits. This will depend on the device version, feedthrough material and process seal material.

EN flanges

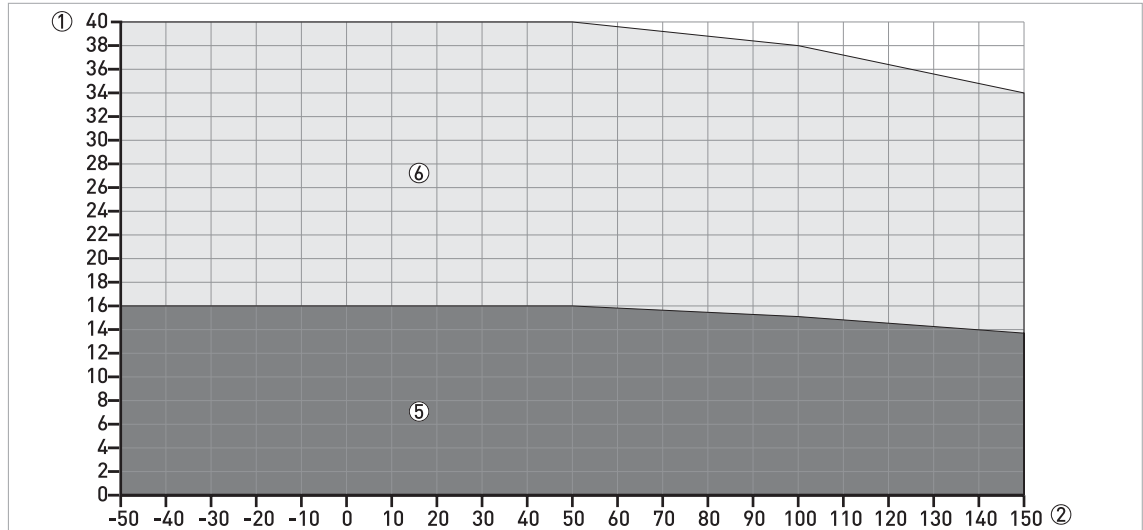


Figure 8-4: Pressure / temperature rating (EN 1092-1), flange connections, in °C and barg

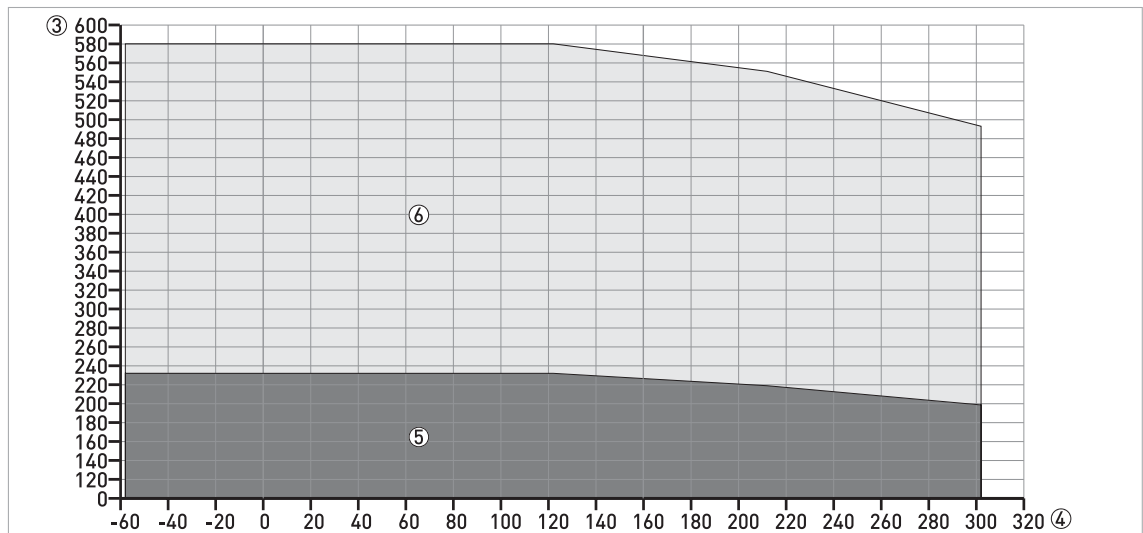


Figure 8-5: Pressure / temperature rating (EN 1092-1), flange connections, in °F and psig

- ① p [barg]
- ② T [°C]
- ③ p [psig]
- ④ T [°F]
- ⑤ Flange connection, PN16
- ⑥ Flange connection, PN40

8.5 Dimensions and weights

Device versions

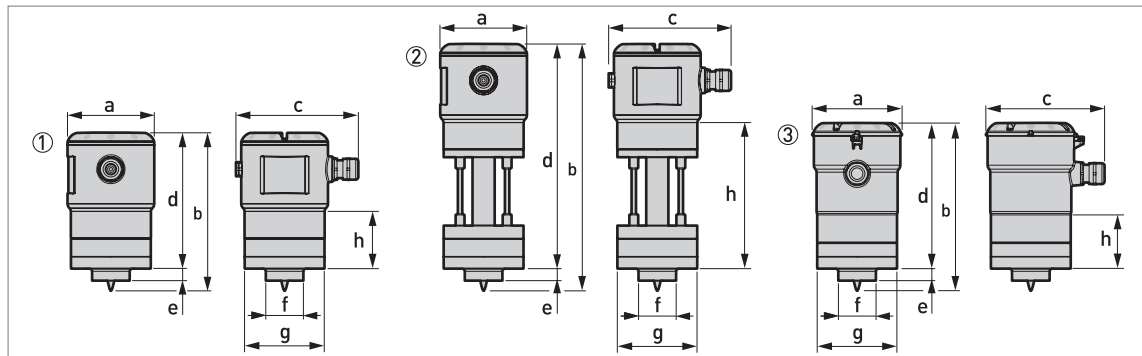


Figure 8-6: Device versions

- ① Non-Ex or Ex i-approved version (aluminium housing – standard or high-pressure (HP) version)
- ② High-temperature / high-pressure (HT/HP) version
- ③ Non-Ex or Ex d-approved version (stainless steel housing – standard version)

Device versions: Dimensions in mm and inches

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

Weather protection option

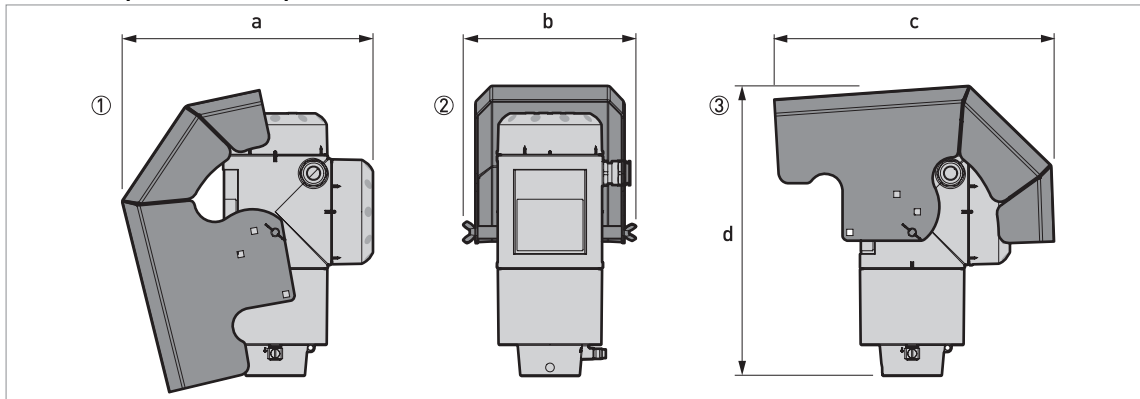


Figure 8-7: Weather protection option for Compact / Vertical and Remote versions

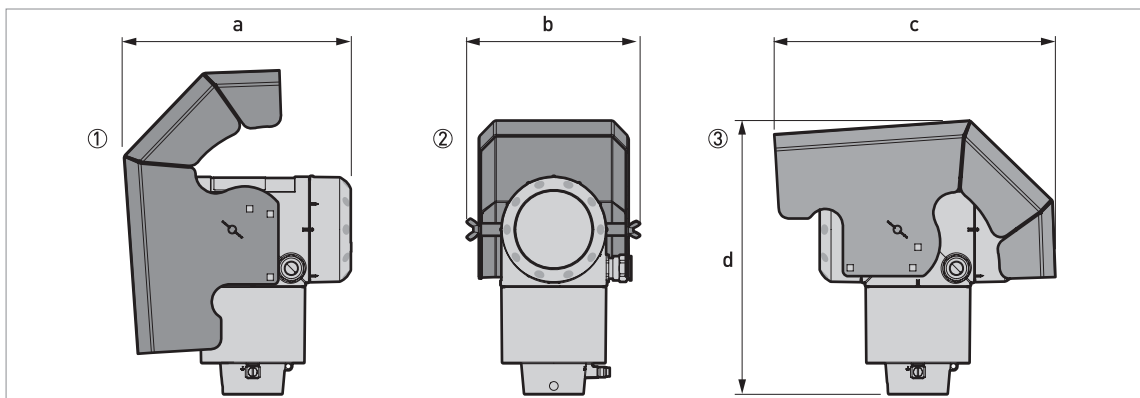


Figure 8-8: Weather protection option for Compact / Horizontal and Remote versions

- ① Left side (with weather protection open)
- ② Rear view (with weather protection closed)
- ③ Right side (with weather protection closed)

Dimensions and weights in mm and kg

Weather protection	Dimensions [mm]				Weights [kg]
	a	b	c	d	
Compact / Vertical or Remote versions	244	170	274	285	1.6
Compact / Horizontal or Remote versions	221	170	274	269	1.6

Dimensions and weights in inches and lb

Weather protection	Dimensions [inches]				Weights [lb]
	a	b	c	d	
Compact / Vertical or Remote versions	9.6	6.7	10.8	11.22	3.5
Compact / Horizontal or Remote versions	8.7	6.7	10.8	10.59	3.5

Weights

Type of device	Weights			
	Aluminium		Stainless steel	
	[kg]	[lb]	[kg]	[lb]

Non-Ex / intrinsically-safe (Ex i / IS)

Standard	x.x	x.x	x.x	x.x
High temperature	x.x	x.x	x.x	x.x

Explosion proof (Ex d / XP)

Standard	x.x	x.x	x.x	x.x
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9.1 General description

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

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

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

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

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

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

9.2 Software description

HART[®] identification codes and revision numbers

Manufacturer ID:	0x45
Device:	0xBF
Device Revision:	1
DD Revision	1
HART [®] Universal Revision:	6
FC 375/475 system SW.Rev.:	≥ 2.0
AMS version:	≥ 7.0
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.

9.3.2 Multi-Drop connection (2-wire connection)

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

For an illustration of multi-drop networks.

For data on communication in multi-drop mode.

9.4 HART® device variables

The HART® dynamic variables PV (Primary Variable), SV (Secondary Variable), TV (Third Variable) and 4V (Fourth Variable) can be assigned to any of the device variables.

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

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

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

9.5.1 Installation



CAUTION!

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

System and software requirements for the Field Communicator

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

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

9.5.2 Operation

**INFORMATION!**

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

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

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

For more data, refer to *HART®* menu tree for Basic-DD on page 62.

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 62.

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 30.

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 64.

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 Basic-DD

Abbreviations of the following tables:

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

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

9.9.2 Basic-DD menu tree (details for settings)

9.10 HART® menu tree for AMS

Abbreviations of the following tables:

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

9.10.1 Overview AMS menu tree (positions in menu tree)

Process variables	Measurements	
	Analog Output	
Device Diagnostics	Overview	
	Fatal Errors	
	Warnings (Maintenance required)	
	Warnings (Out of specifications)	
	Warnings (Function check)	
Methods	Access Right	
	Tests	
	Calibrate	
	Empty Spectrum	
	Conversion Table	
	Master reset	
Configure / Setup	Basic Setup	Basic Parameters
		Local Display
		Application
	Analog Output	Output Functions
		Output 1
	Units	
	Device	
	HART	ID
		-
	Conversion table	

9.10.2 AMS menu tree (details for settings)

Process Variables

Measurements	Level Rd / Distance Rd / Volume/Mass/Flow Rd / Ullage Volume/Mass/Flow Rd / Reflection Rd
Primary Output	Function I / Loop current Rd / PV Percent of Range Rd

Device Diagnostics

Overview	Primary variable out of limits / Non-primary variable out of limits / Primary variable analog output saturated / Primary variable analog output fixed / Cold Start / Configuration changed / Field device malfunction
Fatal Errors (Failure)	Converter EEPROM error / Converter RAM error / Converter ROM error / Sensor EEPROM error / Sensor RAM error / Sensor ROM error / Current output drift / Sensor Microwave error / Converter Voltage error / Sensor Voltage error / Internal Comm. error / Temperat. out of range / Sensor not compatible / Sensor no signal / Sensor processing failure / Peak lost error / Overfill error
Warnings (Maintenance required)	Empty spectrum invalid / Signal weak / Signal strong / Bad Measurement Quality / Temperature < -35°C / Temperature > +75°C
Warnings (Out of specification)	Peak lost / Overfill / Temperature out of range
Warnings (Function check)	Local operation on the device
Information	Spectrum quality bad / Peak lost in tank bottom / Temperature out of range for HMI

Methods

Access right	Log In/Log Out / Password Yes/No
Tests	Test Output I
Calibrate	D/A Trim
Empty Spectrum	Empty Spec. Rec.
Conversion Table	Input table / Delete table
Reset	Restart Device / Reset Factory / Rst Conf. Chged flag

Configure / Setup

Basic Setup	Basic Parameters	Tank Height / Blocking Distance / Time Constant / Stillwell Enabled / Stillwell Diameter / Stillwell Height / Antenna Extension / Antenna Type / Distance Piece / Tag
	Local Display	Display length unit / Display volume unit / Language
	Application	Tank Type / Tracking velocity / Epsilon R product / Measuring Mode / Overfill Detection / Multiple Reflection / Empty Spectrum On/Off
Analog Output	Output Functions	Function I / SV / TV / QV
	Output 1	Output Range / Output Error Delay / LRV / URV
Units	Length unit (HART) / Volume unit (HART) / Time constant	
Device	Model / Manufacturer / Fld dev rev / Software rev / Write protect / Interface option Rd / Descriptor / Message / Date / Serial number / Converter firmware number / Sensor Firmware number / HMI Firmware number	

HART	ID	Tag / Polling address / Device ID
		Universal revision / Fld dev rev Num / Num request preams
Conversion table	Number of points / Length unit Rd / Conversion unit Rd / Points (1...30 level-conversion pairs)	

9.11 HART[®] menu tree for PDM

Abbreviations of the following tables:

- ^{Opt} Optional, depending on device version and configuration
- Rd Read only
- ^{Cust} Custody lock protection
- ^{Loc} Local PDM, affects only PDM views

9.11.1 Overview PDM menu tree (positions in menu tree)

Overview: Menu Device

Communication Path
Download To Device...
Upload To PG/PC...
Update Diagnosis Status
Configuration and Test
Access Rights
watch status

Overview: Menu View

Measurements	Level Value
	Distance Value
	Ullage Value
	Reflection Value
Yt diagram	
Diag / Service	
Toolbar	
Status Bar	
Update	

Overview: PDM parameters

Configuration and Test	Info.	Identification
		Output
	Supervisor	Test
		Basic Parameters
		Signal Output
		Application
		Display
		Conversion Table
	Reset	
Access rights		
HART variables		

9.11.2 PDM menu tree (details for settings)**Device Menu****Communication Path****Download To Device...****Upload To PG/PC...****Update Diagnosis Status****Configuration and Test**

Info.	Identification	Serial Number Rd / Converter Firmware version Rd / Sensor Firmware version Rd / HMI Firmware version Rd
	Output	Function I Rd / Output Range Rd / PV URV Rd / PV LRV Rd / Output Error Delay Rd
Supervisor	Test	Test I
	Basic Parameters	Tank Height / Blocking Distance / Time Constant / Pipe Enable / Pipe Diameter / Pipe Height / Antenna Extension / Antenna Type / Distance Piece / Length Unit (HART) / Conversion Unit (HART)
	Signal Output	Function I / Output Range / PV URV / PV LRV / Output Error Delay / Current Output Calibration ①
	Application	Tank Type / Tracking Velocity / Epsilon R product / Measuring Mode / Overfill Detection / Multiple Reflection / Empty Spectrum Recording / Empty Spectrum On/Off
	Display	Language / Display Length Unit / Display Conversion Unit
	Conversion Table	Input Table / Delete Table
	Reset	Warm start (function to restart the device) / Factory Reset / Reset Configuration Changed Flag

Access rights

Access level Rd
Method Login
Method Entry Code

HART Variables

1 Poll addr / 2 Tag / 3 Hardware rev Rd / 4 Software rev Rd / 5 Descriptor / 6 Date / 7 Message / 8 Manufacturer Rd / 9 Model Rd / Dev id Rd / Universal id Rd / Fld dev rev Rd / Num req preams Rd / Num resp preams Rd / Write protect Rd / Production number Rd / Final asmbly num Rd / PV is / SV is / TV is / QV is

① Current Output Calibration is available only if the service password is used

View Menu

Measurements

Measurements	Level Value / Distance Value / Volume Value / Ullage Value / Reflection Value
Output	Level value / Loop curent / % Range

Yt diagram

Diag / Service

Standard Status	Device status	PV Analog Channel Saturated / Configuration changed
Device-specific status	Device failures	Sensor Microwave error / Current Output Drift / Sensor ROM error / Sensor RAM error / Sensor EEPROM error / Converter ROM error / Converter RAM error / Converter EEPROM error / Sensor No Signal / Sensor Not Compatible / Temperature Out of Range / Internal Communication Error / Sensor Voltage Error / Converter Voltage Error / Peak Lost Error / Overfill Error
	Device Warning (Maintenance Required)	Empty Spectrum Invalid / Signal Weak / Signal Strong / Bad Measurement Quality / Temperature Below -35°C / Temperature Above +75°C
	Device Warning (Out of Specification)	Overfill Warning / Peak Lost Warning / Temperature Out of Range Warning
	Info	First Start / Spectrum Quality Bad / Peak Lost in Tank Bottom / Temperature out of range for HMI

Toolbar

Status Bar

Update

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.

VF01	4	OPTIWAVE 1010 Non-Contact Radar (FMCW) Level Meter
		Converter version (Housing material – protection class)
	1	OPTIWAVE 1010: Compact version (Aluminium – IP 66/67)
	2	OPTIWAVE 1010: Compact version (Stainless steel – IP 66/67)
		Approval ①
	0	Without
	1	ATEX Ex ia IIC T3...T6 + DIP ②
	2	ATEX Ex d ia IIC T3..T6 + DIP ②
	4	ATEX Ex ic IIC T3...T6 + DIP ②
	6	IECEX Ex ia IIC T3...T6 + DIP ②
	7	IECEX Ex d ia IIC T3...T6 + DIP ②
	8	IECEX Ex ic IIC T3...T6 + DIP ②
	A	cFMus IS CL I/II/III, DIV 1, GPS A-G; CL I, Zone 0/20, Ex ia IIC/IIIC T3...T6
	B	cFMus XP-IS/DIP CL I/II/III, DIV 1, GPS A-G (A not for CAN); CL I, Zone 0/20, Ex d/tb IIC/IIIC T3...T6
	C	cFMus NI CL I/II/III, DIV 2, GPS A-G; CL I, Zone 2, Ex nA IIC T3...T6
	L	NEPSI Ex ia IIC T3 ~ T6 + DIP ②
	M	NEPSI Ex d ia IIC T3 ~ T6 + DIP ②
		Other approval
	0	Without
	4	CRN (Canadian Registration Number)
	A	WHG
		Process seal – Temperature / Pressure / Material / Remarks (material to be checked by the customer)
	0	Without
	1	-40°C...+100°C [-40°F...+212°F] / -1...16 barg [-14.5...232 psig] / FKM/FPM
	2	-50°C...+100°C [-58°F...+212°F] / -1...16 barg [-14.5...232 psig] / EPDM
	3	-20°C...+100°C [-4°F...+212°F] / -1...16 barg [-14.5...232 psig] / Kalrez® 6375
	5	-40°C...+150°C [-40°F...+302°F] / -1...40 barg [-14.5...580 psig] / FKM/FPM ③
	6	-50°C...+150°C [-58°F...+302°F] / -1...40 barg [-14.5...580 psig] / EPDM ③
	7	-20°C...+150°C [-4°F...+302°F] / -1...40 barg [-14.5...580 psig] / Kalrez® 6375 ③
VF01	4	Order code (complete this code on the pages that follow)

									Antenna (Antenna type / Material)
								0	Without
								1	Metallic Horn for pipe $\varnothing 42.4 \times 2 / 316L$
								2	Metallic Horn for pipe $\varnothing 60.3 \times 2 / 316L$
								3	Metallic Horn for pipe $\varnothing 60.3 \times 2.77 / 316L$
								4	Metallic Horn for pipe $\varnothing 0.3 \times 3.9 / 316L$
								5	Metallic Horn for BM26A
								A	Metallic Horn for pipe $\varnothing 42.4 \times 2 / HC22$
								B	Metallic Horn for pipe $\varnothing 60.3 \times 2 / HC22$
								C	Metallic Horn for pipe $\varnothing 60.3 \times 2.77 / HC22$
								D	Metallic Horn for pipe $\varnothing 60.3 \times 3.9 / HC22$
								0	Process connection: Size / Pressure rating / Flange face finish
								0	0
								0	Without
									EN / DIN Flanges – EN 1092-1 ④
								G	E
								1	DN40 PN16 – Type B1
								G	G
								1	DN40 PN40 – Type B1
								H	E
								1	DN50 PN16 – Type B1
								H	G
								1	DN50 PN40 – Type B1
									ASME B16.5 / ANSI Flanges ④
								G	1
								A	1½" 150 lb RF (Raised Face)
								G	2
								A	1½" 300 lb RF (Raised Face)
								H	1
								A	2" 150 lb RF (Raised Face)
								H	2
								A	2" 300 lb RF (Raised Face)
								L	1
								A	3" 150 lb RF (Raised Face)
								L	2
								A	3" 300 lb RF (Raised Face)
									JIS B2220 Flanges
								G	U
								P	40A JIS 10K RF (Raised Face)
								H	U
								P	50A JIS 10K RF (Raised Face)
								L	U
								P	80A JIS 10K RF (Raised Face)
									Alternative flange face finish
								2	Type B2, EN 1092-1 (surface roughness must be specified in the order)
								3	Type C, EN 1092-1 (Tongue)
								4	Type D, EN 1092-1 (Groove)
								5	Type E, EN 1092-1 (Spigot)
								6	Type F, EN 1092-1 (Recess)
								B	FF, ASME B16.5 (Flat face)
VF01	4							0	Order code (complete this code on the pages that follow)

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 67 and use the VF01 order code.

Other spare parts

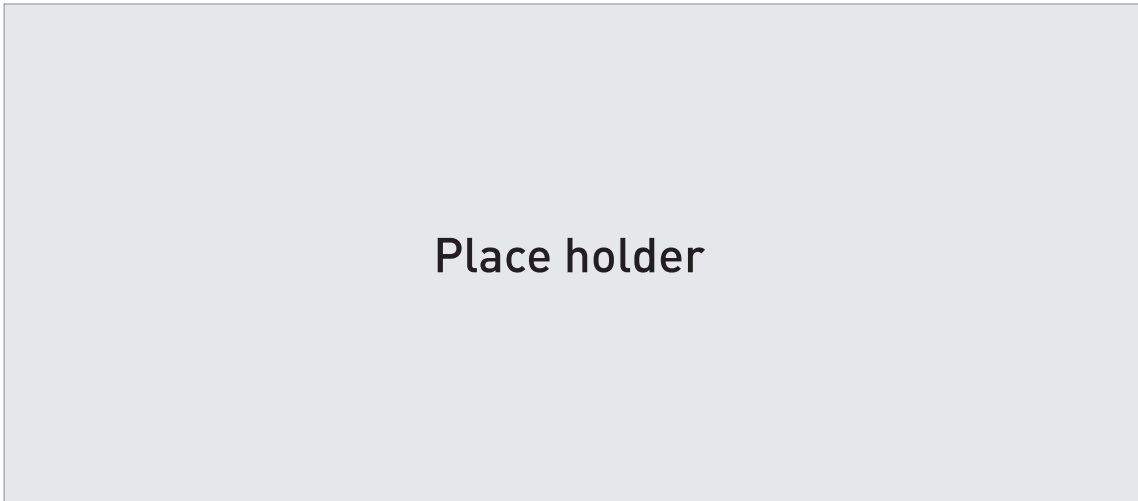


Figure 10-1: Other spare parts

- ① Cover
- ② Cover for Ex d module
- ③ Set of fasteners for housing (lock screw, gaskets)
- ④ Cable gland



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
①	Cover	1	XF01xxxxxx
②	Cover for Ex d module ①	1	XF01xxxxxx
③	Set of fasteners for housing (lock screw, gaskets)	1 screw, 10 gaskets	XF01xxxxxx
④	Cable gland / M20×1.5; Plastic; Black; Non-Ex	1	XF01xxxxxx
	Cable gland / M20×1.5; Plastic; Blue; Ex i	1	XF01xxxxxx
	Cable gland / M20×1.5; Brass; Ex d	1	XF01xxxxxx
	Cable gland / M20×1.5; Stainless Steel	1	XF01xxxxxx

① Ex d-approved devices only

10.3 Accessories

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

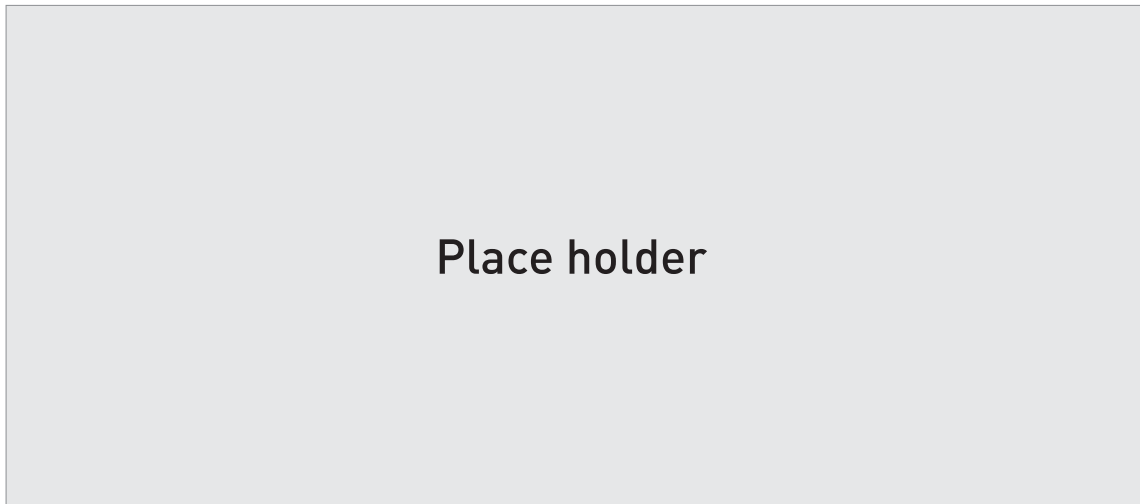


Figure 10-2: Accessories

- ① Viator RS232 / HART converter
- ② Viator USB / HART converter

Item	Description	Quantity	Part reference
①	Viator RS232 / HART converter	1	XF01xxxxxx
②	Viator USB / HART converter	1	XF01xxxxxx

10.4 Glossary

D

Dead zone	Non-measurement zone.
Dielectric constant	An electrical property of the product to be measured used in Radar measurement. Also known as ϵ_r , DK and relative permittivity. Defines the strength of the wave reflected back to the device's signal converter.
Distance	The distance from the face of flange to the level (1 product) or the surface of the top product (2 or more products). See the diagrams at the end of this section.
DTM	Device Type Manager. A driver for use in the PACTware™ program. All data and functions of the device are included in it.

E

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

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

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

I

Interference signals	False radar reflections.
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L

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

M

Mass	Total mass of tank contents.
-------------	------------------------------

O**Operators**

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

P**PACTware™**

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

R**Radar reflection**

Signal reflected from the surface of the tank contents.

S**Signal converter**

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

Supervisor

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

U**Ullage volume**

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

V**Volume**

Total volume of tank contents.

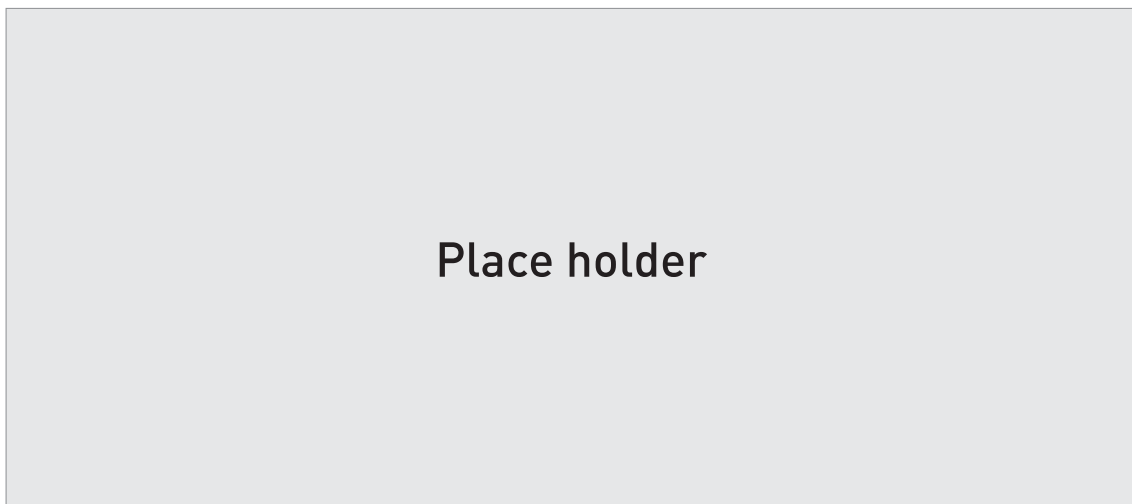


Figure 10-3: Measurement definitions: distance

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

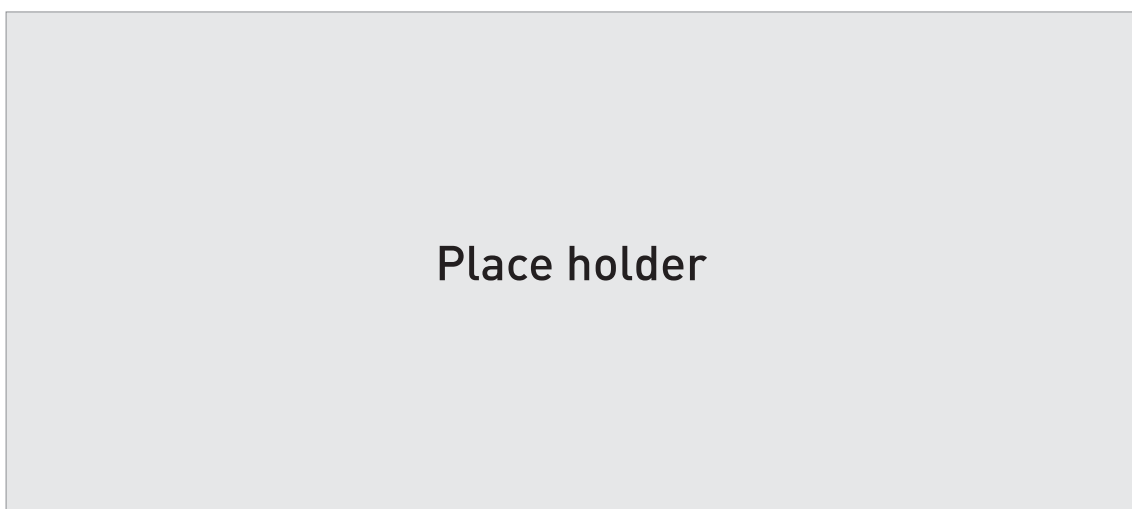


Figure 10-4: Measurement definitions: level

- ① Level
- ② Volume or mass





KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature assemblies
- Pressure transmitters
- Analysis products
- Products and systems for the oil & gas industry
- Measuring systems for the marine industry

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