

# Operating Instructions

Radar sensor for continuous level  
measurement of bulk solids

## NCR-80

Two-wire 4 - 20 mA/HART



***BIN MASTER.***

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### **Safety instructions for Ex areas**

Take note of the Ex specific safety instructions for Ex applications. These instructions are attached as documents to each instrument with Ex approval and are part of the operating instructions manual.

# 1 About this document

## 1.1 Function

This operating instructions manual provides all the information you need for mounting, connection and setup as well as important instructions for maintenance and fault rectification. Please read this information before putting the instrument into operation and keep this manual accessible in the immediate vicinity of the device.

## 1.2 Target group

This operating instructions manual is directed to trained specialist personnel. The contents of this manual should be made available to these personnel and put into practice by them.

## 1.2 Symbols used



### Information, tip, note

This symbol indicates helpful additional information.



**Caution:** If this warning is ignored, faults or malfunctions can result.



**Warning:** If this warning is ignored, injury to persons and/or serious damage to the instrument can result.



**Danger:** If this warning is ignored, serious injury to persons and/or destruction of the instrument can result.



### Ex applications

This symbol indicates special instructions for Ex applications.



### List

The dot set in front indicates a list with no implied sequence.



### Action

This arrow indicates a single action.



### Sequence of actions

Numbers set in front indicate successive steps in a procedure.



### Battery disposal

This symbol indicates special information about the disposal of batteries and accumulators.

## **2 For your safety**

### **1.1 Authorized personnel**

All operations described in this operating instructions manual must be carried out only by trained specialist personnel authorized by the plant operator.

During work on and with the device the required personal protective equipment must always be worn.

### **2.2 Appropriate use**

Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.

### **2.3 Warning about incorrect use**

Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel overfill or damage to system components through incorrect mounting or adjustment. Also the protective characteristics of the instrument can be influenced.

### **2.4 General safety instructions**

This is a state-of-the-art instrument complying with all prevailing regulations and guidelines. The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for the trouble-free operation of the instrument.

During the entire duration of use, the user is obliged to determine the compliance of the necessary occupational safety measures with the current valid rules and regulations and also take note of new regulations.

The safety instructions in this operating instructions manual, the national installation standards as well as the valid safety regulations and accident prevention rules must be observed by the user.

For safety and warranty reasons, any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorized by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden.

The safety approval markings and safety tips on the device must also be observed.

Depending on the instrument version, the emitting frequencies are in the C, K or W band range. The low emitting frequencies are far below the internationally approved limit values. When used correctly, the device poses no danger to health.

## 2.5 CE conformity

The device fulfils the legal requirements of the applicable EC guidelines. By affixing the CE marking, we confirm successful testing of the product.

## 2.6 NAMUR recommendations

NAMUR is the automation technology user association in the process industry in Germany. The published NAMUR recommendations are accepted as the standard in field instrumentation.

The device fulfils the requirements of the following NAMUR recommendations:

- NE 43 – Signal level for malfunction information from measuring transducers
- NE 53 – Compatibility of field devices and display/adjustment components
- NE 107 – Self-monitoring and diagnosis of field devices

For further information see [www.namur.de](http://www.namur.de).

## 2.7 Radio license for Europe

The instrument meets the LPR (Level Probing Radar) radio standard EN 302729-1/2.

It is approved for unrestricted use inside and outside of closed vessels in countries of the EU and EFTA that have implemented this standard.

For operation outside of closed vessels, the following conditions must be fulfilled:

- The installation must be carried out by trained qualified personnel
- The instrument must be stationary mounted and the antenna directed vertically downward
- The mounting location must be at least 4 km away from radio astronomy stations, unless special permission was granted by the responsible national approval authority
- When installed within 4 to 40 km of a radio astronomy station, the instrument must not be mounted higher than 15 m above the ground.

You can find a list of the respective radio astronomy stations in chapter “*Supplement*”.

## 2.8 Radio license for USA

This approval is only valid for USA. Hence the following text is only available in the English language.

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

- This device may not cause interference, and

- This device must accept any interference, including interference that may cause undesired operation of the device

This device is approved for unrestricted use only inside closed, stationary vessels made of metal or concrete.

For operation outside of closed vessels, the following conditions must be fulfilled:

- This device shall be installed and maintained to ensure a vertically downward orientation of the transmit antenna's main beam. Furthermore, the use of any mechanism that does not allow the main beam of the transmitter to be mounted vertically downward is prohibited.
- This device shall be installed only at fixed locations. The LPR device shall not operate while being moved or while inside a moving container.
- Hand-held applications are prohibited.
- Marketing to residential consumers is prohibited.

Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

## **2.9 Radio license for Canada**

This approval is only valid for Canada. Hence the following texts are only available in the English/French language.

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

- This device may not cause interference, and
- This device must accept any interference, including interference that may cause undesired operation of the device
- Installation of LPR device shall be done by trained installers, in strict compliance with the manufacturer's instructions
- The use of this device is on a "no-interference, no-protection" basis. That is, the user shall accept operations of high-powered radar in the same frequency band which may interfere with or damage this device. However, level probing devices found to interfere with primary licensing operations will be required to be removed at the user's expense
- This device shall be installed and maintained to ensure a vertically downward orientation of the transmit antenna's main beam
- This device shall be installed only at fixed locations. The LPR device shall not operate while being moved or while inside a moving container

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:

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

- L'installation de l'appareil LPR doit être faite par des installateurs expérimentés dans le respect des instructions du fabricant
- Cet appareil s'utilise en "non-interférence, non-protection". Ceci veut dire que l'utilisateur accepte le fonctionnement de radars de haute puissance agissant dans la même bande de fréquence et pouvant interférer avec cet appareil ou l'endommager. Toutefois, les appareils de test de niveau qui interfèrent avec les opérations primaires de prise de licence devront être retirés aux frais de l'utilisateur.
- Cet appareil doit être installé et entretenu de manière à assurer une orientation verticale vers le bas du faisceau principal de l'antenne de transmission
- Cet appareil ne doit être installé qu'à des emplacements fixes. L'appareil LPR ne doit pas fonctionner pendant qu'il se déplace ou se trouve dans un conteneur en mouvement

## 2.10 Environmental instructions

Protection of the environment is one of our most important duties. That is why we have introduced an environment management system with the goal of continuously improving company environmental protection. The environment management system is certified according to DIN EN ISO 14001.

Please help us fulfill this obligation by observing the environmental instructions in this manual:

- Chapter "*Packaging, transport and storage*"
- Chapter "*Disposal*"

## 3 Product description

### 3.1 Configuration

The type label contains the most important data for identification and use of the instrument:

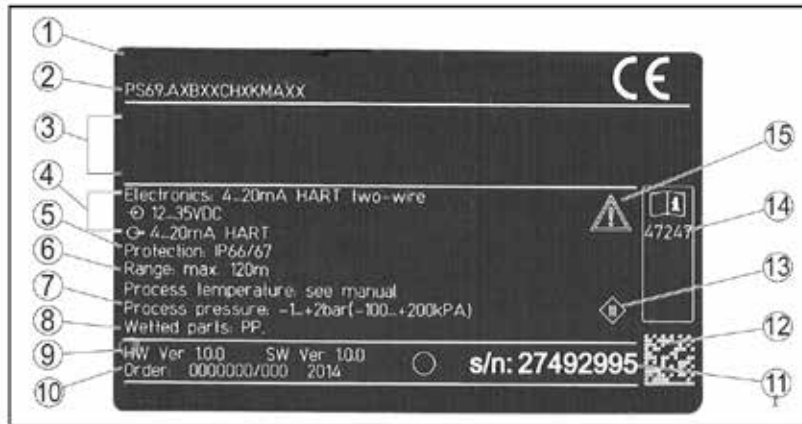


Fig. 1: Layout of the type label (example)

- 1 Instrument type
- 2 Product code
- 3 Approvals
- 4 Voltage supply and signal output, electronics
- 5 Protection rating
- 6 Measuring range
- 7 Process and ambient temperature, process pressure
- 8 Material, wetted parts
- 9 Hardware and software version
- 10 Order number
- 11 Serial number of the instrument
- 12 Data matrix code for smartphone app
- 13 Symbol of the device protection class
- 14 ID numbers, instrument documentation
- 15 Reminder to observe the instrument documentation
- 16 Notified authority for CE marking
- 17 Approval directive

The type label contains the serial number of the instrument. With it you can find the following instrument data:

- Product code (HTML)
- Delivery date (HTML)
- Order-specific instrument features (HTML)
- Operating instructions and quick setup guide at the time of shipment (PDF)
- Order-specific sensor data for an electronics exchange (XML)
- Test certificate (PDF) - optional

This operating instructions manual applies to the following instrument versions:

- Hardware version from 1.0.0
- Software version from 1.1.0

The scope of delivery encompasses:

- Radar sensor
- Hexagon socket wrench (for instruments with swivel holder)
- Documentation
  - Quick setup guide
  - Instructions for optional instrument features
  - Ex-specific “Safety instructions” (with Ex versions)
  - If necessary, further certificates
- DVD “DTM Collection”, included therein
  - PACTware
  - DTM Collection
  - Instrument master files (GSD) for Profibus PA
  - FDT certificates



**Information:**

In this operating instructions manual, the optional instrument features are described. The respective scope of delivery results from the order specification.

## 3.2 Principle of operation

The NCR-80 is a radar sensor for continuous level measurement of bulk solids even under the most difficult process conditions and in very large measuring ranges.

It is ideal for use in high, slender silos with poorly reflecting bulk solids such as fly-ash, plastic granules or wood chips as well as internal installations that cause strong false echoes. This is made possible by its functional principle, a distance measurement through frequency shifting with an especially small beam angle.

The instrument is available with different antenna systems and accessories for virtually all applications and processes:

- Plastic horn antenna or metal-jacketed lens antenna
- Optional or integrated rinsing air connection
- Swivelling holder with seal against the process

The instrument emits a continuous radar signal through its antenna. This signal is frequency modulated in the form of a sawtooth wave. The emitted signal is reflected by the medium and received by the antenna as an echo.

The frequency of the received signal always deviates from the actual emitting frequency. The frequency difference is proportional to the distance and thus to the filling height. This difference is calculated via special algorithms in the sensor electronics. The determined filling height is then converted into a corresponding output signal and outputted as the measured value.

### 3.3 Packaging, transport and storage

Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test based on ISO 4180.

The packaging of standard instruments consists of environment friendly, recyclable cardboard. For special versions, PE foam or PE foil is also used. Dispose of the packaging material via specialised recycling companies.

Transport must be carried out in due consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device.

The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

Up to the time of installation, the packages must be left closed and stored according to the orientation and storage markings on the outside.

Unless otherwise indicated, the packages must be stored only under the following conditions:

- Not in the open
- Dry and dust free
- Not exposed to corrosive media
- Protected against solar radiation
- Avoiding mechanical shock and vibration
- Storage and transport temperature see chapter *"Supplement - Technical data - Ambient conditions"*
- Relative humidity 20–85%

### 3.4 Accessories and replacement parts

The display and adjustment module BINDISC is used for measured value indication, adjustment and diagnosis. It can be inserted into the sensor and removed at any time.

You can find further information in the operating instructions "Display and adjustment module BINDISC."

The protective cover protects the sensor housing against soiling and intense heat from solar radiation.

You will find additional information in the supplementary instructions manual *“Protective cover”*.

Screwed flanges are available in different versions according to the following standards: DIN 2501, EN 1092-1, BS 10, ASME B 16.5, JIS B 2210-1984, GOST 12821-80.

You can find additional information in the supplementary instructions manual *“Flanges according to DIN-EN-ASME-JIS”*.

For mounting the instrument with plastic horn antenna to a socket, two flange versions are available: the combi compression flange and the adapter flange.

You can find additional information in chapter *“Mounting”* of this operating instruction.

A mounting strap is available for mounting the instrument with plastic horn antenna to the wall or ceiling.

You can find additional information in chapter *“Mounting”* of this operating instruction.

The supplementary electronics is a replacement part for sensors with double chamber housing and 4–20 mA/HART - two-wire.

You can find further information in the operating instructions *“Supplementary electronics for 4–20 mA/HART - two-wire.”*

## 4 Mounting

### 4.1 General instructions

Protect your instrument against moisture ingress through the following measures:

- Use the recommended cable (see chapter “*Connecting to power supply*”)
- Tighten the cable gland
- Loop the connection cable downward in front of the cable gland

This applies particularly to:

- Outdoor mounting
- Installations in areas where high humidity is expected (e.g. through cleaning processes)
- Installations on cooled or heated vessels

Make sure that all parts of the instrument exposed to the process are suitable for the existing process conditions.

These are mainly:

- Active measuring component
- Process fitting
- Process seal

Process conditions are particularly:

- Process pressure
- Process temperature
- Chemical properties of the medium
- Abrasion and mechanical influences

You can find detailed information on the process conditions in chapter “*Technical data*” as well as on the type label.

### Metric threads

In the case of instrument housings with metric thread, the cable glands are screwed in at the factory. They are sealed with plastic plugs as transport protection. You have to remove these plugs before electrical connection.

### NPT thread

In the case of instrument housings with self-sealing NPT threads, it is not possible to have the cable entries screwed in at the factory. The free openings for the cable glands are therefore covered with red dust protection caps as transport protection. The dust protection caps do not provide sufficient protection against moisture.

Prior to setup you have to replace these protective caps with approved cable glands or close the openings with suitable blind plugs.

The mounting position and orientation of the sensor must take into account the limitations in chapter “*For your safety*”, “*Radio approval for USA*” “*Radio approval for Canada*” of this operating instructions.

## 4.2 Mounting versions, plastic horn antenna

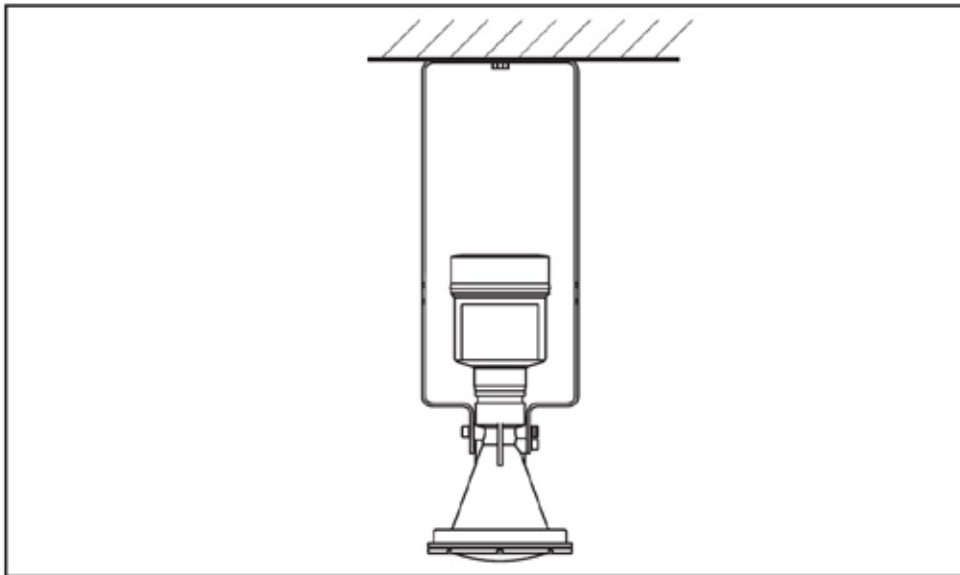
The optional mounting strap allows simple mounting of the instrument on a wall, ceiling or boom. Especially in the case of open vessels, this is a simple and effective way to align the sensor to the surface of the bulk solid material.

The following versions are available:

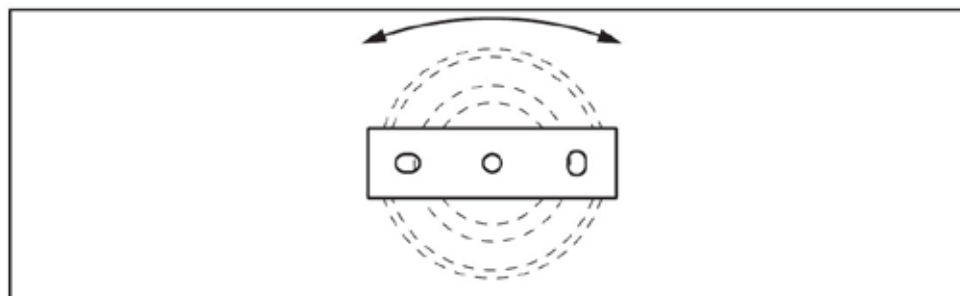
- Length 300 mm
- Length 170 mm

The instrument is normally mounted vertically with a bracket on the ceiling.

This allows swiveling the sensor up to 180° for optimal orientation and rotating for optimal connection.

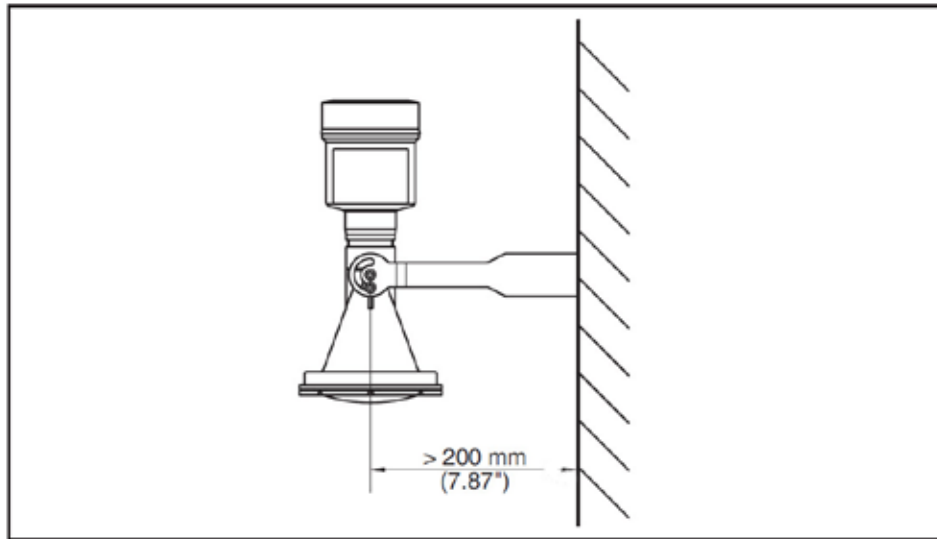


*Fig. 2: Ceiling mounting via the mounting strap with length 300 mm*

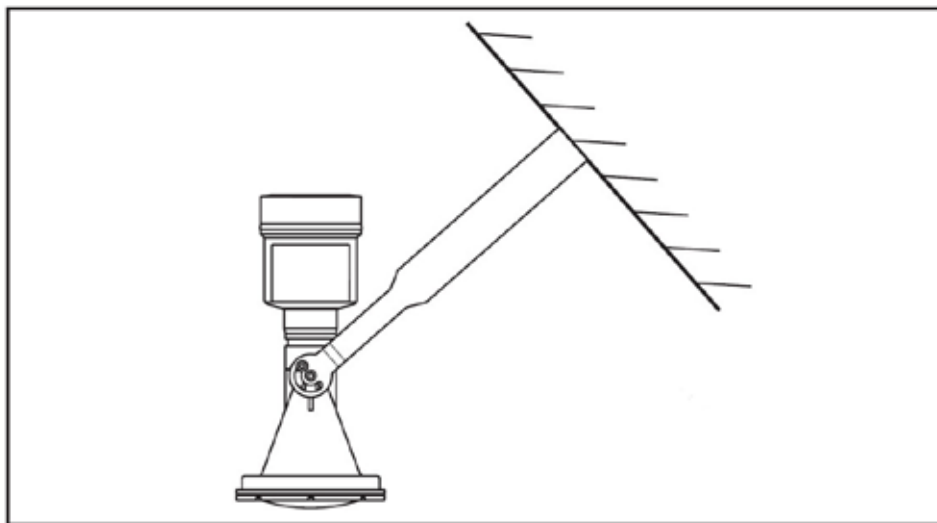


*Fig. 3: Rotating with ceiling mounting*

As an alternative the strap mounting is carried out horizontally or obliquely.



*Fig. 4: Wall mounting horizontally via the mounting strap with length 170 mm*

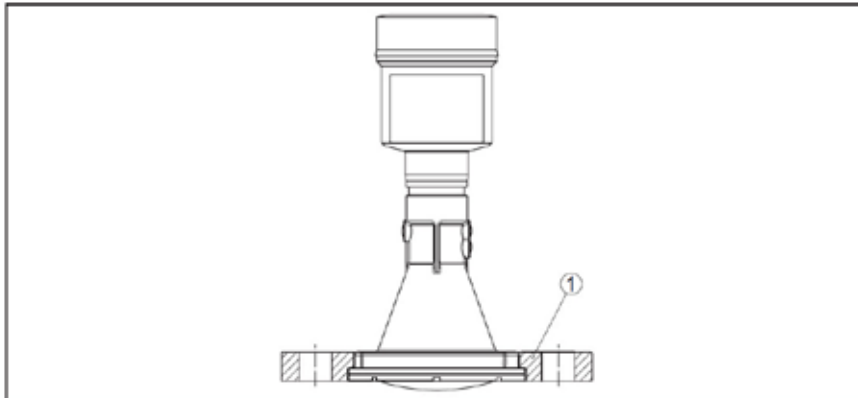


*Fig. 5: Wall mounting with inclined wall via the mounting strap with length 300 mm*

Two versions are available for mounting the instrument on a socket:

- Combi compression flange fitting to DN 80 (ASME 3" and JIS 80)
- Adapter flange from DN 100 (ASME 4" or JIS 100)

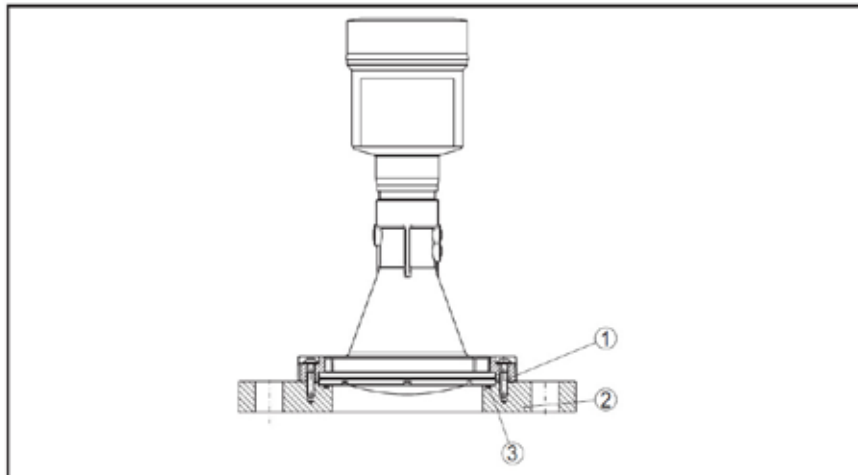
The combi compression flange is suitable for different flange standards and can be used for simple applications. It comes unassembled and not sealed against the radar sensor and can thus only be used unpressurized. It can be retrofitted on instruments with single chamber housing, retrofitting to a double chamber housing is not possible.



*Fig. 6: Combi compression flange*

*1 Combi compression flange*

The adapter flange is available in different flange sizes. It is permanently connected with the radar sensor and sealed.



*Fig. 7: Adapter flange*

*1 Connection screw*

*2 Adapter flange*

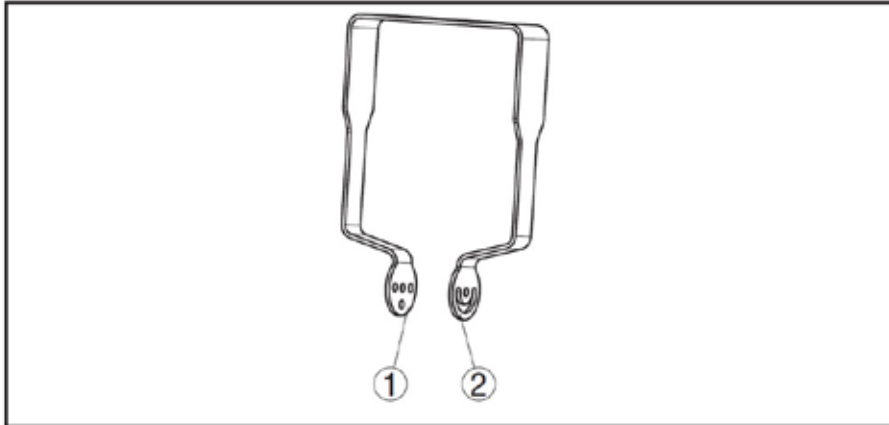
*3 Process seal*

You can find drawings of these mounting options in chapter “Dimensions”.

### **4.3 Mounting preparations, mounting strap**

The mounting strap is supplied unassembled (optionally) and must be screwed to the sensor before setup with three hexagon socket screws M5 x 10 and spring washers. Max. torque, see chapter “Technical data”. Required tools: Allen wrench size 4.

There are two different variants of screwing the strap to the sensor, see following illustration:



*Fig. 8: Mounting strap for screwing to the sensor*

- 1 For angle of inclination in steps*
- 2 For angle of inclination, infinitely variable*

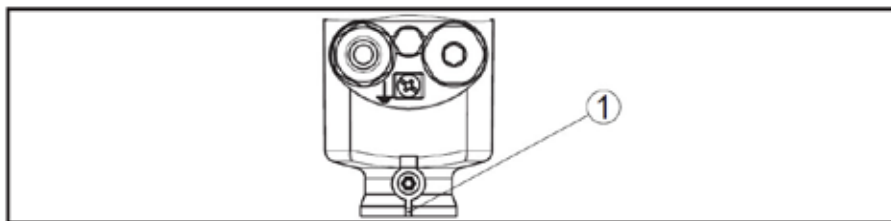
Depending on the selected variant, the sensor can be rotated in the strap:

- Single chamber housing
  - Angle of inclination in three steps  $0^\circ$ ,  $90^\circ$  and  $180^\circ$
  - Angle of inclination  $180^\circ$ , infinitely variable
- Double chamber housing
  - Angle of inclination  $90^\circ$ , infinitely variable
  - Angle of inclination in two steps  $0^\circ$  and  $90^\circ$

## 4.4 Mounting instructions

Radar sensors for level measurement emit electromagnetic waves. The polarization is the direction of the electrical component of these waves.

The polarization direction is marked by a nose on the housing, see following drawing:



*Fig. 9: Position of the polarization*

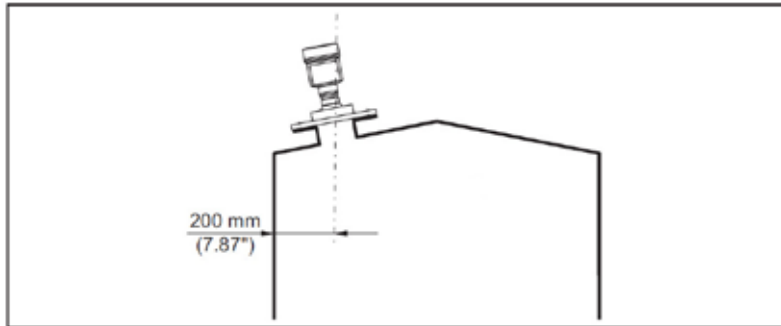
- 1 Nose for marking the direction of polarization*

### Information:



When the housing is rotated, the direction of polarization changes and hence the influence of the false echo on the measured value. Please keep this in mind when mounting or making changes later.

Mount the sensor at least 200 mm (7.874 in) away from the vessel wall.



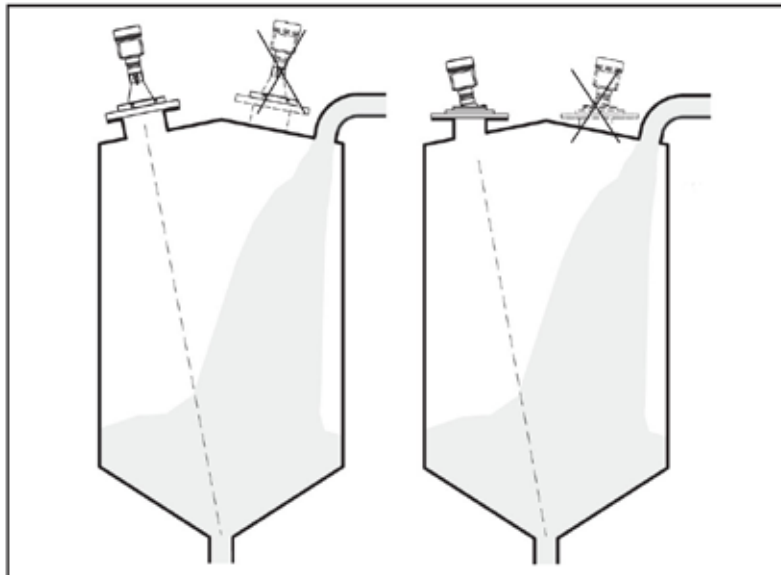
*Fig. 10: Mounting the radar sensor on the vessel top*

If you cannot maintain this distance, you should carry out a false signal suppression during setup. This applies particularly if buildup on the vessel wall is expected. In such cases, we recommend repeating the false signal suppression at a later date with existing buildup.

The instrument should not be mounted too close to the inflowing medium, as the radar signal could be disrupted.

### **Silo with filling from top**

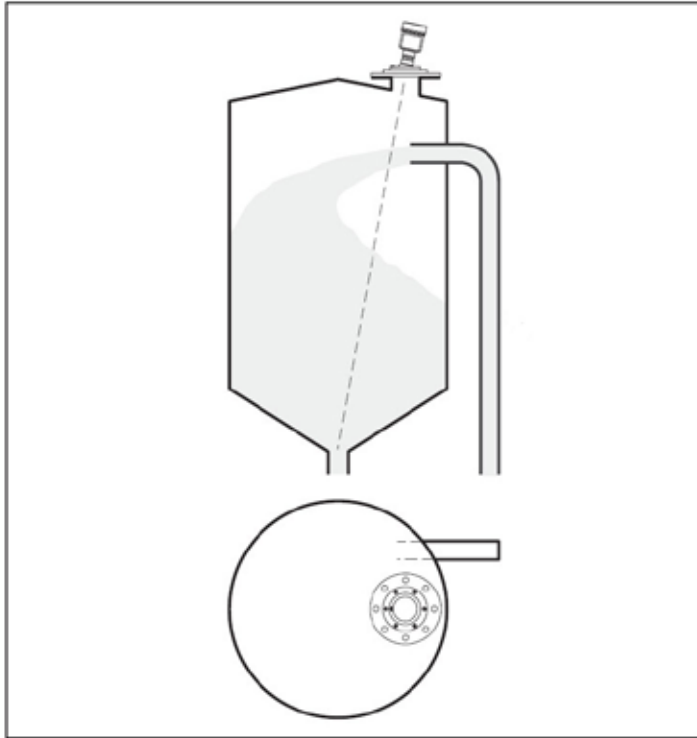
The optimal mounting position is opposite the filling aperture. To avoid heavy soiling, the distance to any filter or dust exhauster should be as large as possible.



*Fig. 11: Mounting of the radar sensor with inflowing medium*

### **Silo with lateral filling**

In bulk solids silos with lateral pneumatic filling the instrument should not be mounted above the filling stream, as the radar signal will be disrupted. The optimal mounting position is to the side of the filling aperture. To avoid heavy soiling, the distance to any filter or dust exhauster should be as large as possible.

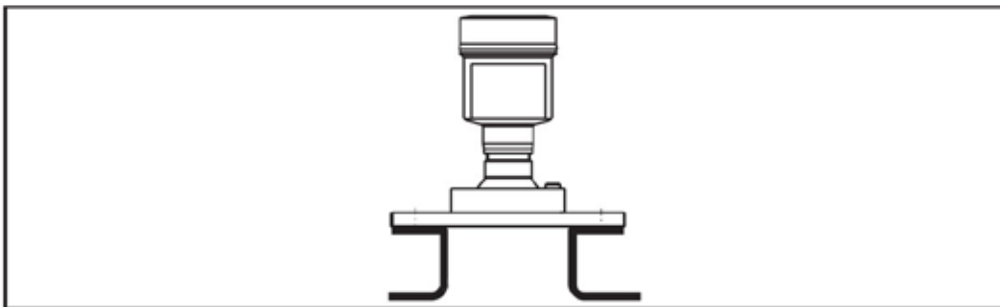


*Fig. 12: Mounting of the radar sensor with inflowing medium*

**Information:**



The mounting socket should be as short as possible and its end rounded. This reduces false echoes from the vessel mounting socket.



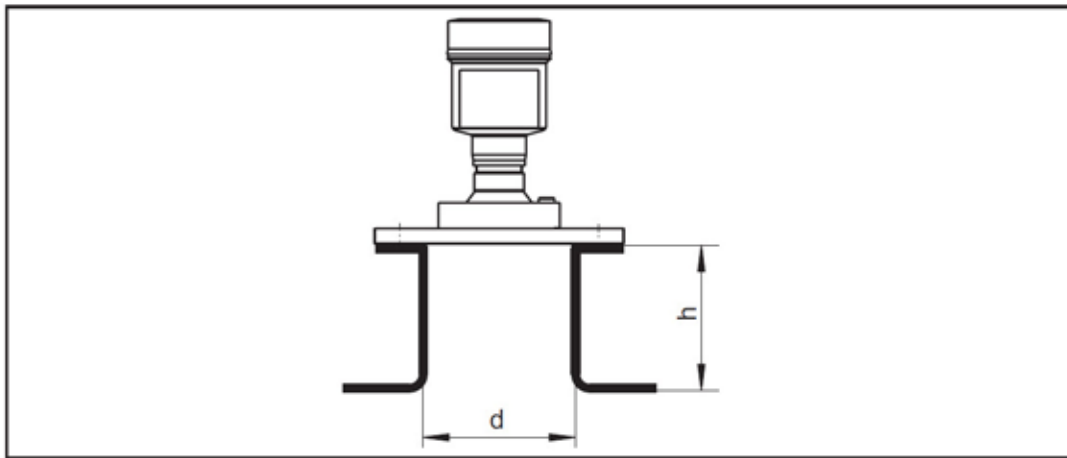
*Fig. 13: Recommended socket mounting*

If the medium has good reflective properties, you can also mount the NCR-80 on longer sockets. Approximate socket heights are shown in the following illustration.

**Information:**



When mounting on longer sockets, we recommend carrying out a false signal suppression (see chapter “*Parameter adjustment*”).

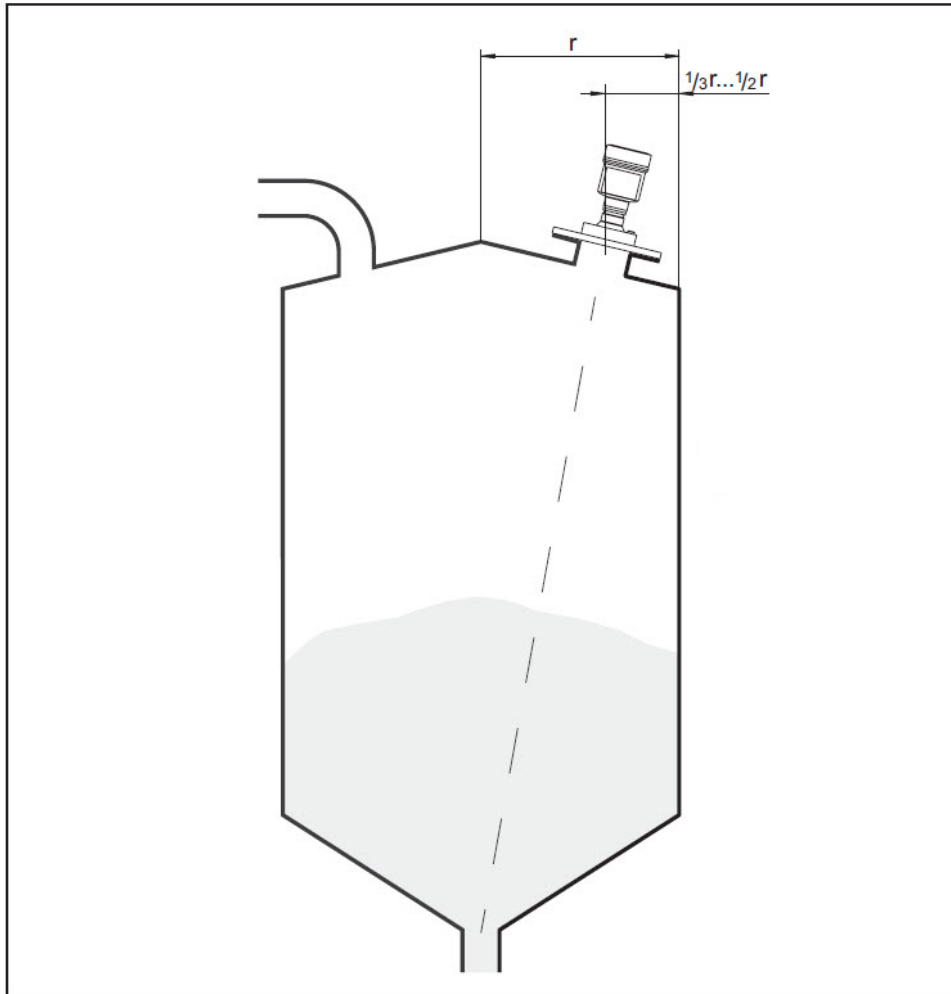


The below charts specify the max. pipe socket length  $h$  depending on the diameter  $d$ .

Socket diameter $d$	Socket length $h$
80 mm	$\leq 200$ mm
100 mm	$\leq 300$ mm
150 mm	$\leq 500$ mm

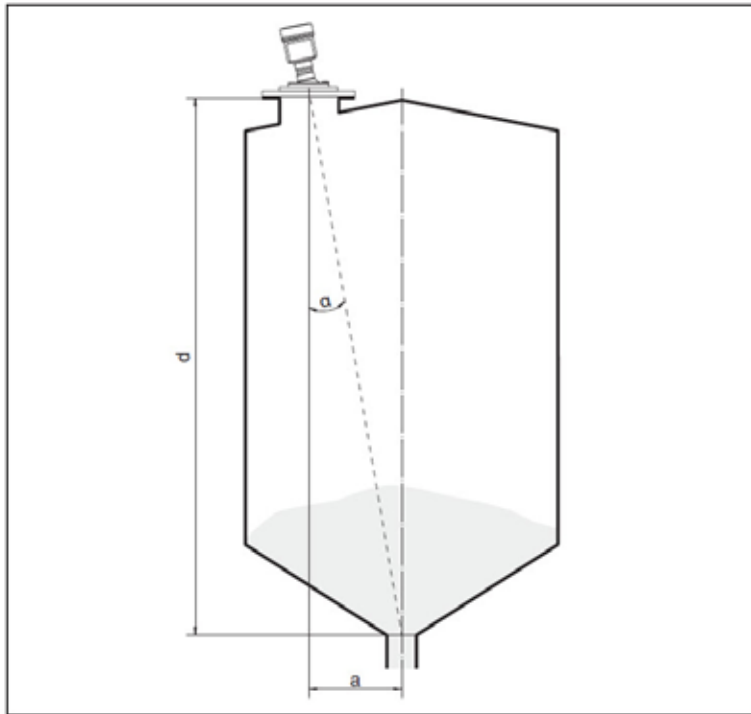
Socket diameter $d$	Socket length $h$
3"	$\leq 7.87$
4"	$\leq 11.8$
5"	$\leq 19.7$

In order to measure as much of the vessel volume as possible, the sensor should be aligned so that the radar signal reaches the lowest level in the vessel. In a cylindrical silo with conical outlet, the sensor is mounted anywhere from one third to one half of the vessel radius from the outside wall (see following drawing).



*Fig. 15: Mounting position and orientation*

With the help of an optional swiveling holder, the sensor can be easily aligned to the vessel center. The necessary angle of inclination depends on the vessel dimensions. It can be easily checked with a suitable bubble tube or mechanic's level on the sensor.



*Fig. 16: Proposal for installation after orientation NCR-80*

The following table shows the necessary angle of inclination. It depends on the measuring distance and the distance “a” between vessel center and installation position.

Distance d (m)	2°	4°	6°	8°	10°
2	0.1	0.1	0.2	0.3	0.4
4	0.1	0.3	0.4	0.6	0.7
6	0.2	0.4	0.6	0.8	1.1
8	0.3	0.6	0.8	1.1	1.4
10	0.3	0.7	1.1	1.4	1.8
15	0.5	1	1.6	2.1	2.6
20	0.7	1.4	2.1	2.8	3.5
25	0.9	1.7	2.6	3.5	4.4
30	1	2.1	3.2	4.2	5.3
35	1.2	2.4	3.7	4.9	6.2
40	1.4	2.8	4.2	5.6	7.1
45	1.6	3.1	4.7	6.3	7.9
50	1.7	3.5	5.3	7	8.8
60	2.1	4.2	6.3	8.4	10.5
70	2.4	4.9	7.3	9.7	12.2

Distance d (m)	2"	4"	6"	8"	10"
80	2.8	5.6	8.4	11.1	13.9
90	3.1	6.3	9.4	12.5	15.6
100	3.5	7	10.5	13.9	17.4
110	3.8	7.7	11.5	15.3	19.1
120	4.2	8.4	12.5	16.7	20.8

### Example:

In a vessel 20 m high, the installation position of the sensor is 1.4 m from the vessel center.

The necessary angle of inclination of  $4^\circ$  can be read out from this table.

Proceed as follows to adjust the angle of inclination with the swiveling holder:

1. Loosen the terminal screws of the swivel holder by one turn. Use a hexagon socket wrench, size 5.

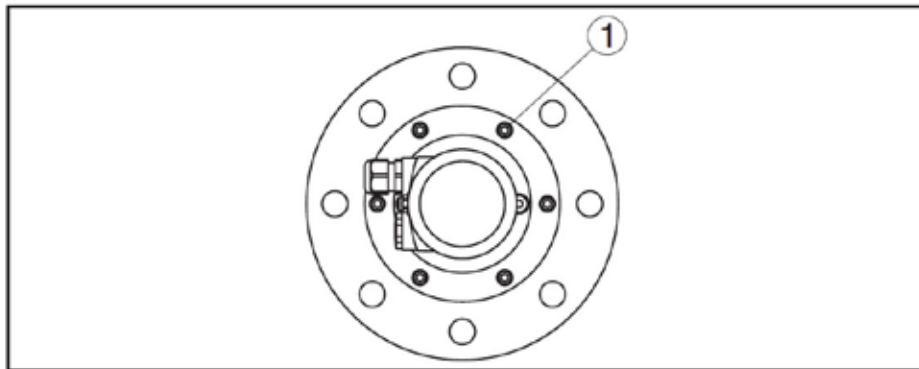


Fig. 17: NCR-80 with swiveling holder

1 Terminal screws (6 pcs.)

2. Align the sensor, check angle of inclination

### Information:

The max. angle of inclination of the swiveling holder is approx.  $10^\circ$

3. Re-tighten the terminal screws, max. torque "Dimensions" see chapter "Technical data".

The mounting location of the radar sensor should be a place where no other equipment or fixtures cross the path of the radar signals.

Vessel installations, such as e.g. ladders, limit switches, heating spirals, struts, etc., can cause false echoes and impair the useful echo. Make sure when planning your measuring point that the radar sensor has a "clear view" to the measured product.

In case of existing vessel installations, a false signal suppression should be carried out during setup.

If large vessel installations such as struts or supports cause false echoes, these can be attenuated through supplementary measures. Small, inclined sheet metal baffles above the installations scatter the radar signals and prevent direct interfering reflections.



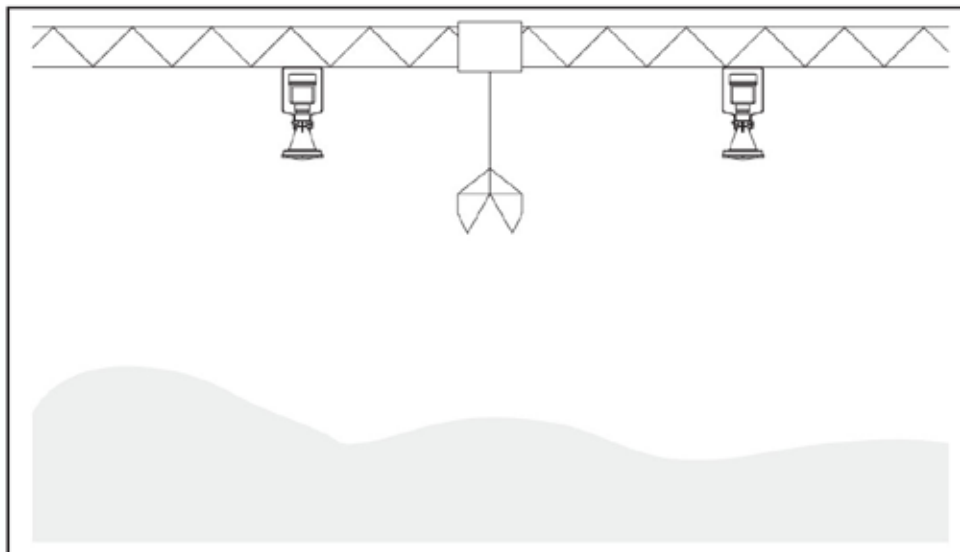
*Fig. 18: Cover flat, large-area profiles with deflectors*

Large material heaps are best measured with several instruments, which can be mounted on e.g. traverse cranes. For this type of application it is advantageous to orient the sensor perpendicular to the bulk solid surface.

The sensors do not influence each other.

**Information:**

**i** Keep in mind that for these applications, the sensors are designed for relatively slow level changes. If the sensor is used on a movable boom, the max. measuring rate must be observed (see chapter “Technical data”).

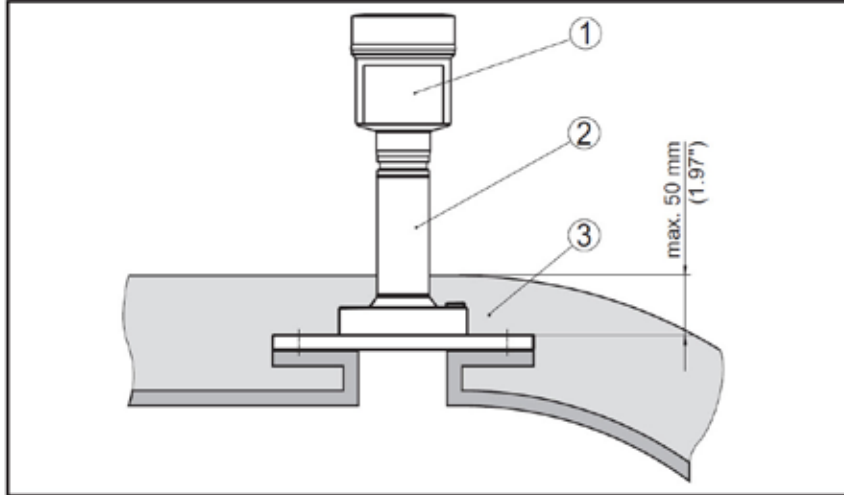


*Fig. 19: Radar sensors on traverse crane*

Instruments for a temperature range up to 200° C have a spacer between process fitting and electronics housing. This spacer is used to thermally decouple the electronics from the high process temperatures.

**Information:**

**i** The spacer may only be incorporated up to a maximum of 50 mm into the vessel insulation. Only then is a reliable temperature decoupling guaranteed.

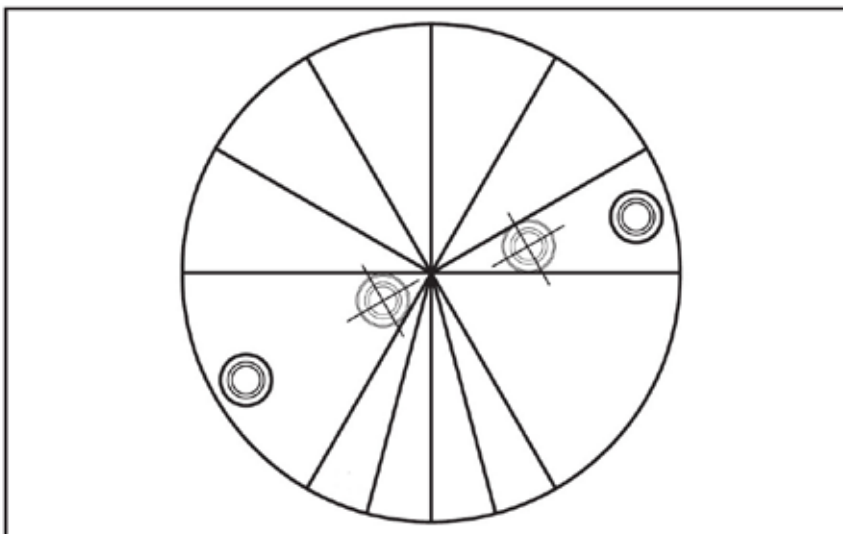


*Fig. 20: Mounting the instrument on insulated vessels.*

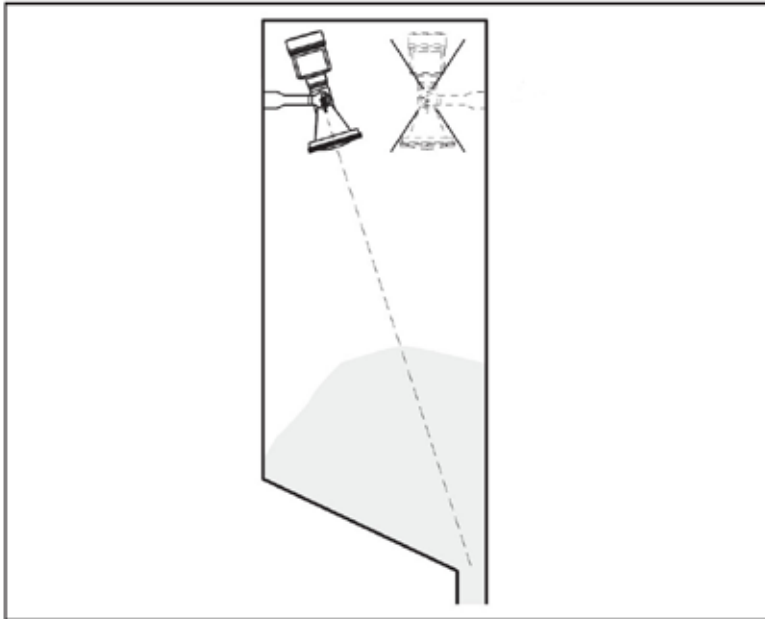
- 1 Electronics housing
- 2 Spacer
- 3 Vessel insulation

The walls of multiple-chamber silos are often made of profile material, e.g. profile sheeting, to ensure the required stability. If the radar sensor is mounted very close to a heavily structured vessel wall, substantial interfering reflections can be generated. Thus the sensor should be mounted at the largest possible distance from the separating wall.

The best mounting location is on the outer wall of the silo, with the sensor pointing towards the discharge opening in the silo center. This can be accomplished, for example, with the mounting strap.



*Fig. 21: Installation and orientation in multiple chamber silos*



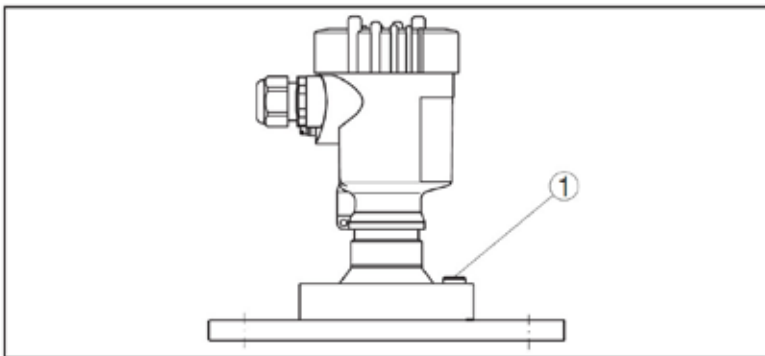
*Fig. 22: Installation and orientation in multiple chamber silos*

To avoid heavy buildup and dust on the antenna, the sensor should not be mounted close to the dust exhaustor inside the vessel.

To protect the sensor against buildup, particularly in case of strong condensation, air rinsing is recommended.

#### **Metal-jacketed lens antenna**

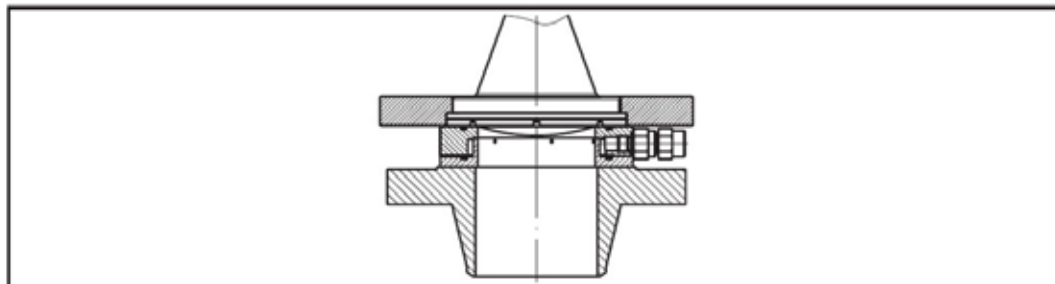
The NCR-80 with metal-jacketed lens antenna is equipped with a rinsing air connection as a standard feature, see following graphics.



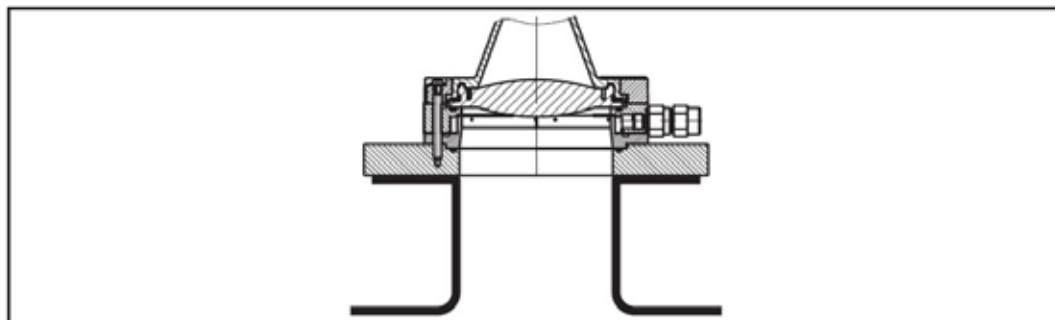
*Fig. 23: Rinsing air connection on metal-jacketed lens antenna*

#### **Plastic horn antenna**

The NCR-80 with plastic horn antenna is optionally available with a rinsing air connection. The mechanical configuration differs according to the flange version, see following graphics.



*Fig. 24: Rinsing air connection with compression flange*



*Fig. 25: Rinsing air connection with adapter flange*

You can find details on the rinsing air connection in chapter “*Technical data*”.

## 5 Connecting to power supply

### 5.1 Preparing the connection

Always keep in mind the following safety instructions:

**Warning:**



Connect only in the complete absence of line voltage.

- The electrical connection must only be carried out by trained personnel authorized by the plant operator.
- If overvoltage surges are expected, overvoltage arresters should be installed.

Power supply and current signal are carried on the same two-wire cable. The operating voltage can differ depending on the instrument version.

The data for power supply are specified in chapter “Technical data”. Provide a reliable separation between the supply circuit and the mains circuits according to DIN EN 61140 VDE 0140-1. Keep in mind the following additional factors that influence the operating voltage:

- Lower output voltage of the power supply unit under nominal load (e.g. with a sensor current of 20.5 mA or 22 mA in case of fault)
- Influence of additional instruments in the circuit (see load values in chapter “*Technical data*”)

The instrument is connected with standard two-wire cable without screen. If electromagnetic interference is expected which is above the test values of EN 61326-1 for industrial areas, screened cable should be used.

Screened cable generally necessary in HART multi drop mode.

Use cable with round cross section for instruments with housing and cable gland. To ensure the seal effect of the cable gland (IP protection rating), find out which cable outer diameter the cable gland is suitable for.

Use a cable gland fitting the cable diameter.

#### **Metric threads**

In the case of instrument housings with metric thread, the cable glands are screwed in at the factory. They are sealed with plastic plugs as transport protection.

You have to remove these plugs before electrical connection.

#### **NPT thread**

In the case of instrument housings with self-sealing NPT threads, it is not possible to have the cable entries screwed in at the factory. The free openings for the cable glands are therefore covered with red dust protection caps as transport protection.

Prior to setup you have to replace these protective caps with approved cable glands or close the openings with suitable blind plugs.

With plastic housing, the NPT cable gland or the Conduit steel tube must be screwed without grease into the threaded insert.

Max. torque for all housings, see chapter *“Technical data”*.

If screened cable is required, the cable screen must be connected on both ends to ground potential. In the sensor, the screen is connected directly to the internal ground terminal. The ground terminal on the outside of the housing must be connected to the ground potential (low impedance).



In Ex systems, the grounding is carried out according to the installation regulations.

In electroplating plants as well as plants for cathodic corrosion protection it must be taken into account that significant potential differences exist. This can lead to unacceptably high currents in the cable screen if it is grounded at both ends.

### **Information:**



The metallic parts of the instrument (process fitting, sensor, concentric tube, etc.) are connected with the internal and external ground terminal on the housing. This connection exists either directly via the conductive metallic parts or, in case of instruments with external electronics, via the screen of the special connection cable.

You can find specifications on the potential connections inside the instrument in chapter *“Technical data”*.

## **5.2 Connecting**

The voltage supply and signal output are connected via the spring-loaded terminals in the housing.

Connection to the display and adjustment module or to the interface adapter is carried out via contact pins in the housing.

### **Information:**



The terminal block is pluggable and can be removed from the electronics. To do this, lift the terminal block with a small screwdriver and pull it out. When reinserting the terminal block, you should hear it snap in.

Proceed as follows:

1. Unscrew the housing lid
2. If a display and adjustment module is installed, remove it by turning it slightly to the left.
3. Loosen compression nut of the cable gland and remove blind plug
4. Remove approx. 10 cm (4 in) of the cable mantle, strip approx. 1 cm (0.4 in) of insulation from the ends of the individual wires
5. Insert the cable into the sensor through the cable entry



Fig. 26: Connection steps 5 and 6 - Double chamber housing



Fig. 27: Connection steps 5 and 6 - Double chamber housing

6. Insert the wire ends into the terminals according to the wiring plan

**i Information:** Solid cores as well as flexible cores with wire end sleeves are inserted directly into the terminal openings. In case of flexible cores without end sleeves, press the terminal from above with a small screwdriver, the terminal opening is then free. When the screwdriver is released, the terminal closes again.

You can find further information on the max. wire cross-section under *Technical data - Electromechanical data*

7. Check the hold of the wires in the terminals by lightly pulling on them

8. Connect the screen to the internal ground terminal, connect the external ground terminal to potential equalization

9. Tighten the compression nut of the cable entry gland. The seal ring must completely encircle the cable
  10. Reinsert the display and adjustment module, if one was installed
  11. Screw the housing lid back on
- The electrical connection is finished.

## 5.3 Wiring plan, single chamber housing

The following illustration applies to the non-Ex as well as to the Ex-ia version.

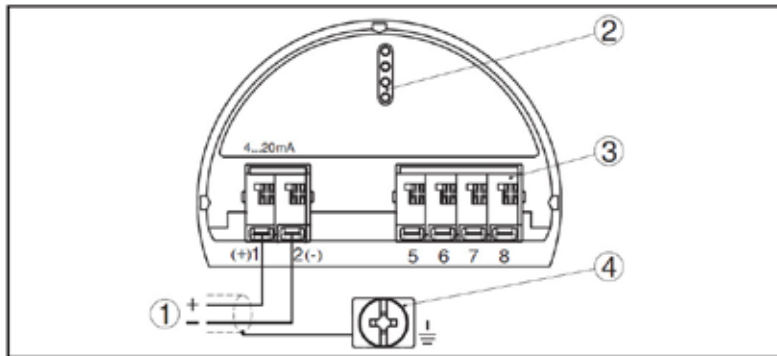


Fig. 28: Electronics and terminal compartment, single chamber housing

- 1 Voltage supply, signal output
- 2 For display and adjustment module or interface adapter
- 3 For external display and adjustment unit
- 4 Ground terminal for connection of the cable screen

## 5.4 Wiring plan, double chamber housing

The following illustrations apply to the non-Ex as well as to the Ex-ia version.

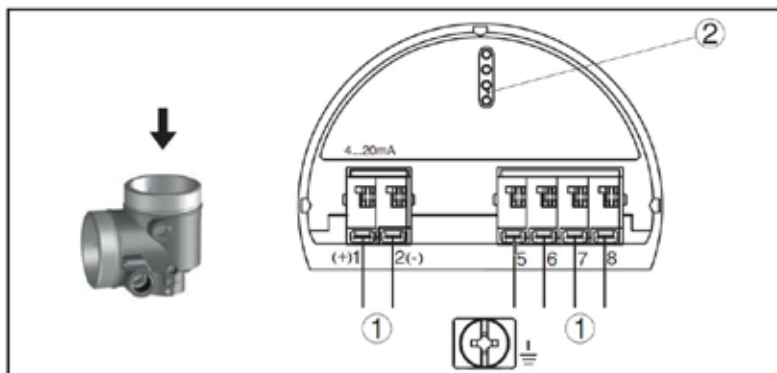


Fig. 29: Electronics compartment, double chamber housing

- 1 Internal connection to the terminal compartment
- 2 For display and adjustment module or interface adapter

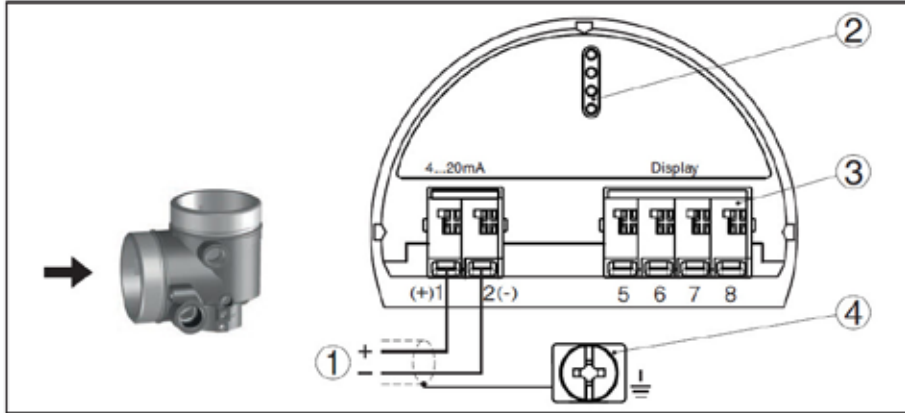


Fig. 30: Terminal compartment, double chamber housing

- 1 Voltage supply, signal output
- 2 For display and adjustment module or interface adapter
- 3 For external display and adjustment unit
- 4 Ground terminal for connection of the cable screen

**i** **Information:** Parallel use of an external display and adjustment unit and a display and adjustment module in the terminal compartment is not supported.

To make a second measured value available for use, you can use the supplementary electronics - additional current output.

Both current outputs are passive and need a power supply.

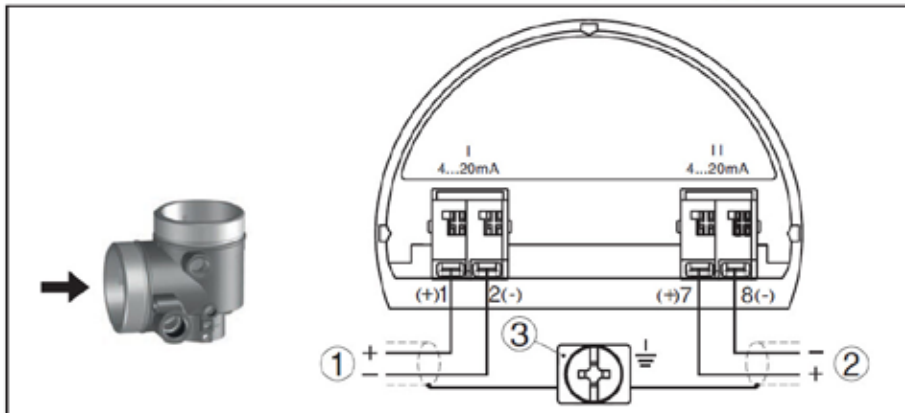


Fig. 31: Terminal compartment, double chamber housing, supplementary electronics - additional current output

- 1 First current output (I) - Voltage supply and signal output (HART)
- 2 Second current output (II) - Voltage supply and signal output (without HART)
- 3 Ground terminal for connection of the cable screen

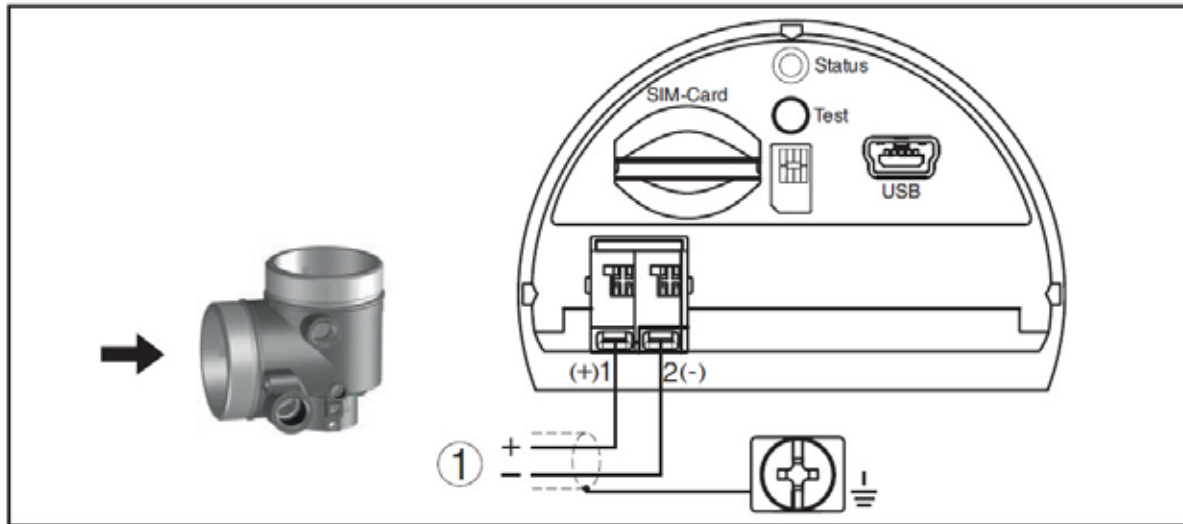


Fig. 32: Terminal compartment - Radio module PLICSMOBILE  
1 Voltage supply

You can find detailed information on connection in the supplementary instructions “PLICSMOBILE GSM/GPRS radio module”.

## 5.5 Double chamber housing Ex d

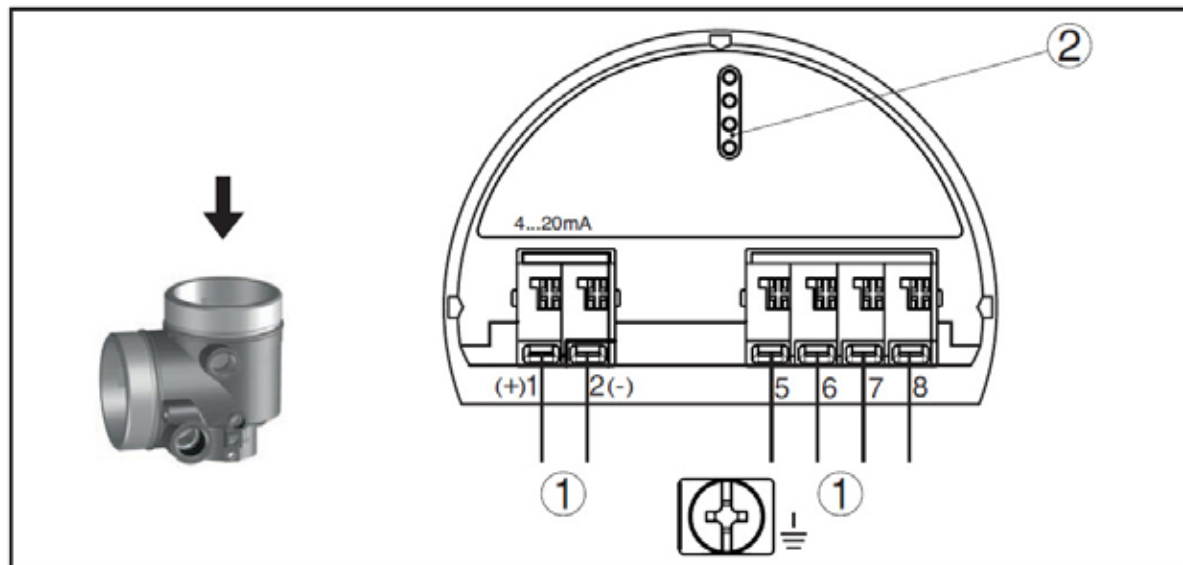


Fig. 33: Electronics compartment, double chamber housing Ex d  
1 Internal connection to the terminal compartment  
2 For display and adjustment module or interface adapter

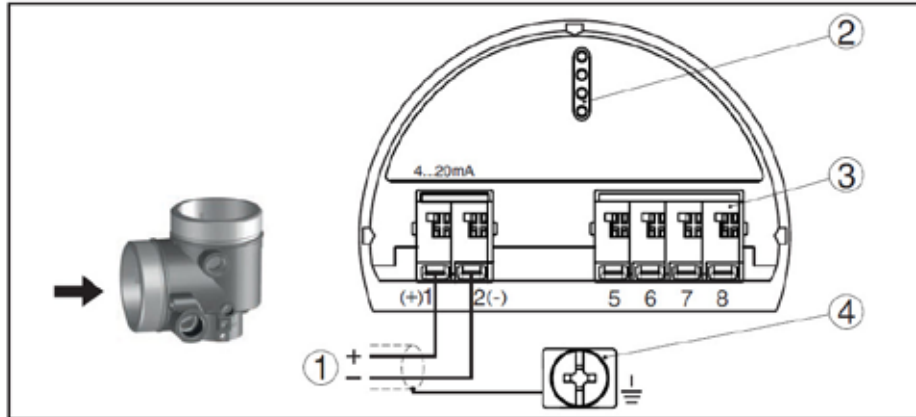


Fig. 34: Terminal compartment, double chamber housing

- 1 Voltage supply, signal output
- 2 For display and adjustment module or interface adapter
- 3 For external display and adjustment unit
- 4 Ground terminal for connection of the cable screen



**Information:**

Parallel use of an external display and adjustment unit and a display and adjustment module in the terminal compartment is not supported.

## 5.6 Wiring plan, double chamber housing Ex d ia

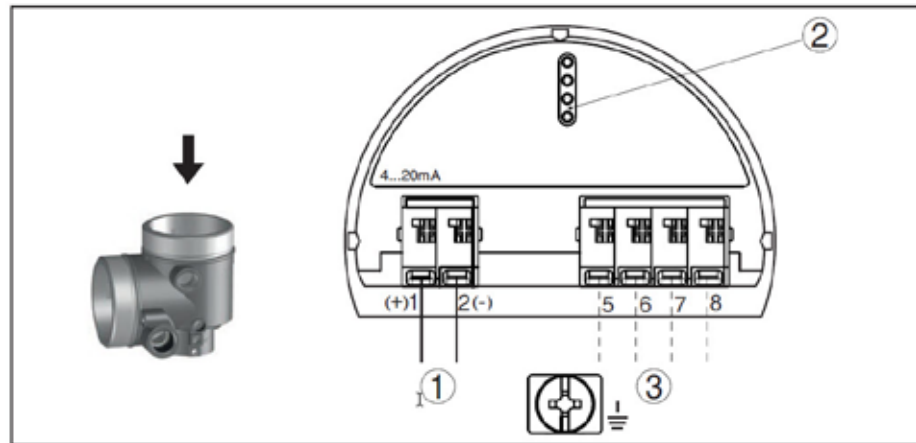


Fig. 35: Electronics compartment, double chamber housing Ex d ia

- 1 Internal connection to the terminal compartment
- 2 For display and adjustment module or interface adapter
- 3 Internal connection to the plug connector for external display and adjustment unit (optional)



**Note:**

HART multi-drop mode is not possible when using an Ex-d-ia instrument.

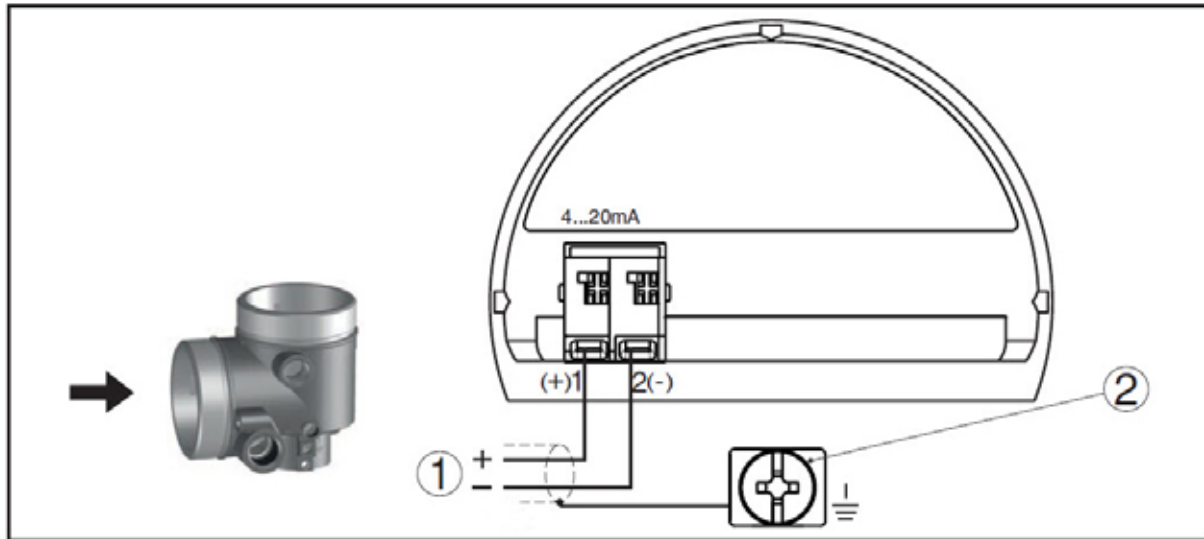


Fig. 36: Terminal compartment, double chamber housing Ex d ia

- 1 Voltage supply, signal output
- 2 Ground terminal for connection of the cable screen

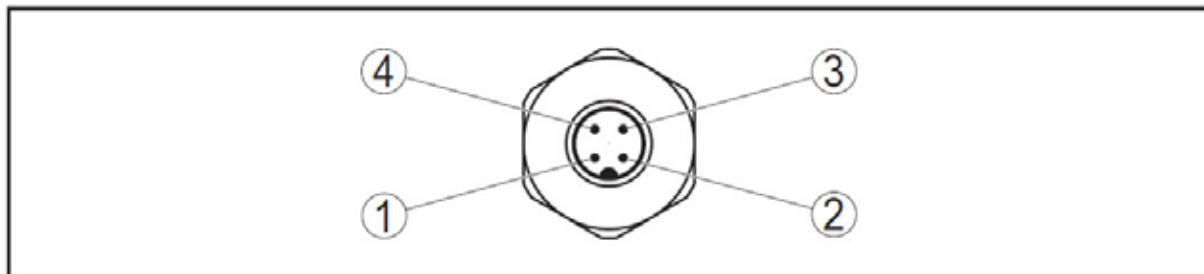
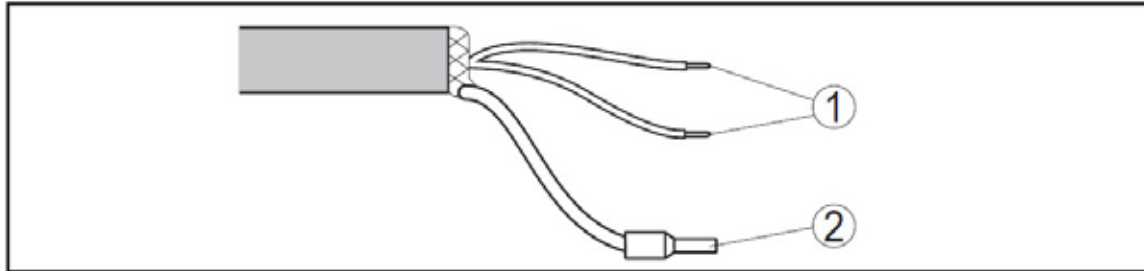


Fig. 37: Top view of the plug connector

- 1 Pin 1
- 2 Pin 2
- 3 Pin 3
- 4 Pin 4

Contact pin	Color connection cable in the sensor	Terminal, electronics module
Pin 1	Brown	5
Pin 2	White	6
Pin 3	Blue	7
Pin 4	Black	8

## 5.7 Wiring plan - version IP 66/IP 68, 1 bar



*Fig. 40: Wire assignment in permanently connected connection cable  
1 brown (+) and blue (-) to power supply or to the processing system  
2 Shielding*

## 5.8 Switch-on phase

After connecting the instrument to power supply or after a voltage recurrence, the instrument carries out a self-check for approx. 30 s:

- Internal check of the electronics
- Indication of the instrument type, hardware and software version, measurement loop name on the display or PC
- Indication of the status message "F 105 Determine measured value" on the display or PC
- The output signal jumps to the set fault current

As soon as a plausible measured value is found, the corresponding current is outputted to the signal cable. The value corresponds to the actual level as well as the settings already carried out, e.g. factory setting.

## 6 Set up with the display and adjustment module

### 6.1 Insert display and adjustment module

The display and adjustment module can be inserted into the sensor and removed again at any time. You can choose any one of four different positions - each displaced by 90°. It is not necessary to interrupt the power supply.

Proceed as follows:

1. Unscrew the housing lid
2. Place the display and adjustment module on the electronics in the desired position and turn it to the right until it snaps in
3. Screw housing lid with inspection window tightly back on

Disassembly is carried out in reverse order.

The display and adjustment module is powered by the sensor, an additional connection is not necessary.



*Fig. 41: Installing the display and adjustment module in the electronics compartment of the single chamber housing*



*Fig. 42: Installing the display and adjustment module in the double chamber housing*

*1 In the electronics compartment*

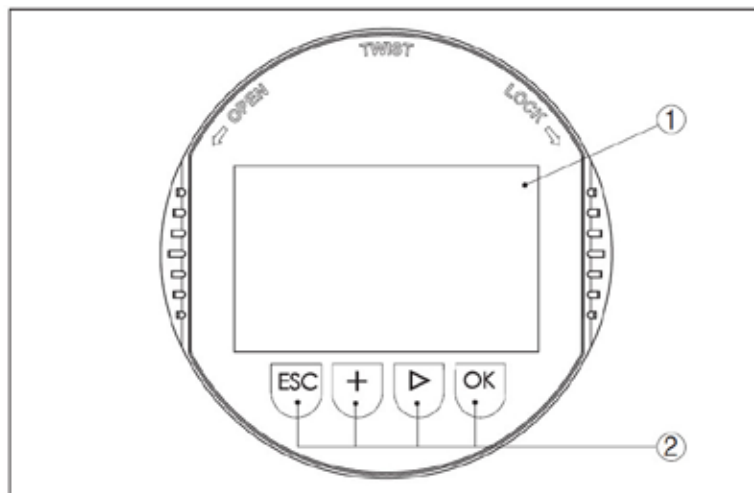
*2 In the terminal compartment*



**Note:**

If you intend to retrofit the instrument with a display and adjustment module for continuous measured value indication, a higher lid with an inspection glass is required.

## 6.2 Adjustment system



*Fig. 43: Display and adjustment elements*

*1 LC display*

*2 Adjustment keys*

- **[OK]** key:
  - Move to the menu overview
  - Confirm selected menu
  - Edit parameter
  - Save value
- **[->]** key:
  - Change measured value presentation
  - Select list entry
  - Select menu items in the quick setup menu
  - Select editing position
- **[+]** key:
  - Change value of the parameter
- **[ESC]** key:
  - Interrupt input
  - Jump to next higher menu

The instrument is operated via the four keys of the display and adjustment module. The individual menu items are shown on the LC display. You can find the functions of the individual keys in the previous illustration.

When the **[+]** and **[->]** keys are pressed quickly, the edited value, or the cursor, changes one value or position at a time. If the key is pressed longer than 1 s, the value or position changes continuously.

When the **[OK]** and **[ESC]** keys are pressed simultaneously for more than 5 s, the display returns to the main menu. The menu language is then switched over to “English”.

Approx. 60 minutes after the last pressing of a key, an automatic reset to measured value indication is triggered. Any values not confirmed with **[OK]** will not be saved.

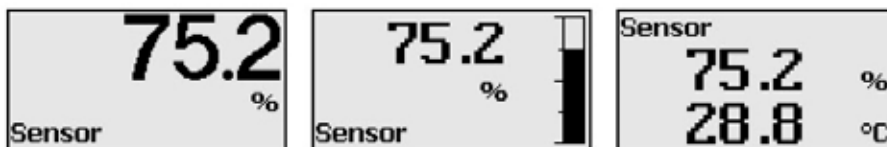
## 6.3 Measured value indication - Selection national language

With the **[->]** key you move between three different indication modes.

In the first view, the selected measured value is displayed in large digits.

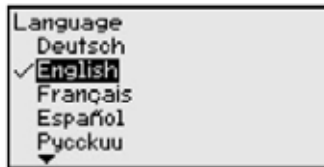
In the second view, the selected measured value and a corresponding bar graph presentation are displayed.

In the third view, the selected measured value as well as a second selectable value, e.g. the temperature of the electronics, are displayed.



During the initial setup of an instrument shipped Ex works, use the “**OK**” key to get to the menu “National language”.

This menu item is used to select the national language for further parameter adjustment. You can change the selection via the menu item “*Setup - Display, Menu language*”.



With the “**OK**” key you move to the main menu.

## 6.4 Parameter adjustment - Quick setup

To quickly and easily adapt the sensor to the application, select the menu item “Quick setup” in the start graphic on the display and adjustment module.



Select the individual steps with the **[→]** key.

After the last step, “Quick setup terminated successfully” is displayed briefly.



### Information:

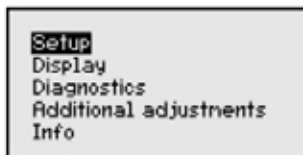
The echo curve of setup is stored automatically during the quick setup.

The return to the measured value indication is carried out through the **[→]** or **[ESC]** keys or automatically after 3 s

You can find “*Extended adjustment*” in the next sub-chapter.

## 6.5 Parameter adjustment - Extended adjustment

The main menu is divided into five sections with the following functions:



**Setup:** Settings, e.g., for measurement loop name, units, application, adjustment, signal output

**Display:** Settings, e.g., for language, measured value display, lighting

**Diagnostics:** Information, for example, on device status, peak value, simulation, echo curve

**Additional adjustments:** Date/Time, reset, copy function, scaling, current output, false signal suppression, linearization, HART mode, special parameters

**Info:** Instrument name, hardware and software version, calibration date, instrument features

In the main menu item “*Setup*”, the individual submenu items should be selected one after the other and provided with the correct parameters to ensure optimum adjustment of the measurement.

The procedure is described in the following.

Here you can assign a suitable measurement loop name. Push the “**OK**” key to start the editing. With the “+” key you change the sign and with the “->” key you jump to the next position.

You can enter names with max. 19 characters. The character set comprises:

- Capital letters from A ... Z
- Numbers from 0 ... 9
- Special characters + - / \_ blanks

Setup Measurement loop name Units Application Adjustment Damping ▼	Measurement loop name  Sensor
--	-------------------------------------

In this menu item you select the distance unit and the temperature unit.

Setup Measurement loop name Units Application Adjustment Damping ▼	Distance unit m ▼ Temperature unit °C ▼
--	--

For the distance units you can choose between m, in and ft and for the temperature units °C, °F and K.

With this menu item, the sensor can be optimally adapted to the application, the installation location or the measurement conditions. It includes selection options for medium, application as well as vessel height/measuring range.

### Medium:

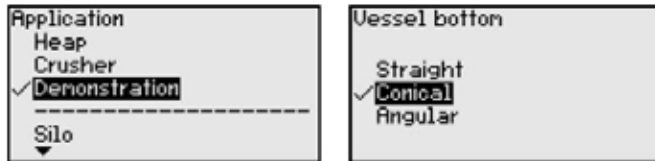
Every medium has a different reflective behavior. With this selection, the sensor can be perfectly adapted to the medium and measurement reliability, particularly with media with poor reflective properties, is considerably increased.

Setup Units Units (2) Application Adjustment AI FB1 ▼	Medium Ballast/pebbles ▼	Medium Powder/dust Granules/pellets ✓ Ballast/pebbles
---	-----------------------------	--

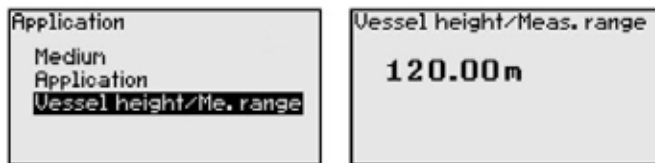
### Application:

Depending on the type of bulk solids application, material cones and additional echoes from the vessel wall or bottom can become further interfering factors. Through this selection, the sensor is adapted perfectly to the application.

Application Medium Application Vessel height/Me. range	Application Silo ▼ Vessel bottom Conical ▼	Application ✓ Silo Bunker Bunker quick filling Heap Crusher ▼
---	---	---

**Vessel height/Measuring range:**

The NCR-80 is a bulk solids radar sensor for high, slender vessels. It covers a measuring range up to 120 m. This menu item lets you limit the active measuring range in which the instrument searches for level echoes.

**Information:**

The min. adjustment must be carried out independently of this.

The following features form the basis of the applications:

**Silo (slender and high):**

- Vessel of metal: weld joints
- Process/measurement conditions:
  - Filling aperture too close to the sensor
  - System noise in completely empty silo increased
- Properties, sensor:
  - Stable measured values through higher averaging
  - False signal suppression during setup recommended, required for automatic false signal suppression
  - Automatic false signal suppression with partly filled vessel<sup>1)</sup>

**Bunker (large-volume):**

- Vessel of concrete or metal:
  - Structured vessel walls
  - Installations present
- Process/measurement conditions:
  - Large distance to the medium
  - Large angles of repose
- Properties, sensor:
  - Mean averaging
  - High measured value jumps are accepted

**Bunker with fast filling:**

- Vessel of concrete or metal, also multiple chamber silo:
  - Structured vessel walls
  - Installations present
- Process/measurement conditions:
  - Measured value jumps, e.g. through truck loading

<sup>1)</sup> The instrument recognizes if a manual false signal suppression was carried out with empty vessel and high system noise. An automatic false signal suppression is then carried out if a product echo was detected at the beginning of the filling process.

- Large distance to the medium
- Large angles of repose
- Properties, sensor:
  - Lower averaging
  - Very high measured value jumps are accepted

**Heap:**

- Sensor mounting on movable conveyor belts
- Detection of the heap profile
- Height detection during filling
- Process/measurement conditions:
  - Measured value jumps, e.g. by the profile of the heap or traverses
  - Large angles of repose
  - Measurement near the filling stream
- Properties, sensor:
  - Mean averaging
  - High measured value jumps are accepted

**Crusher:**

- Vessel: installations, wear and protective facilities available
- Process/measurement conditions:
  - Measured value jumps, e.g. through truck loading
  - Fast reaction time
  - Large distance to the medium
- Properties, sensor:
  - Little averaging
  - Max. reaction speed, very high measured value jumps are accepted

**Demonstration:**

- Adjustment for all applications which are not typically level measurement
  - Instrument demonstration
  - Object recognition/monitoring (additional settings required)
- Properties, sensor:
  - Sensor accepts all measured value changes within the measuring range immediately
  - High sensitivity to interference, because virtually no averaging

Enter the requested parameters via the appropriate keys, save your settings with **[OK]** and jump to the next menu item with the **[ESC]** and the **[->]** key.

Since the radar sensor is a distance measuring instrument, the distance from the sensor to the product surface is measured. To indicate the actual level, an allocation of the measured distance to the percentage height must be carried out.

To perform the adjustment, enter the distance with full and empty vessel, see the following example:

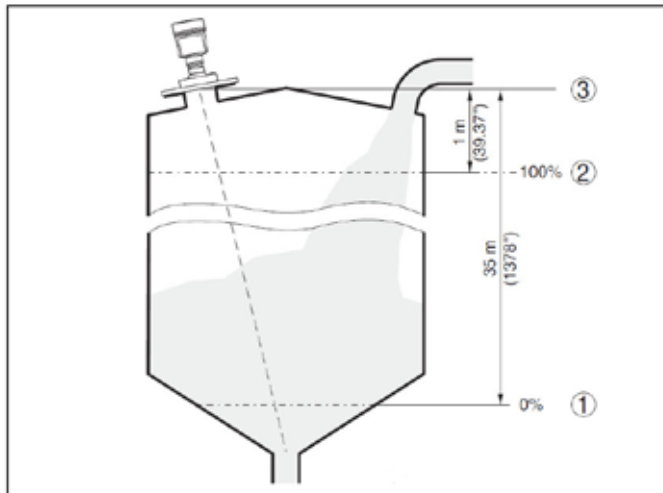


Fig. 44: Parameter adjustment example min./max. adjustment

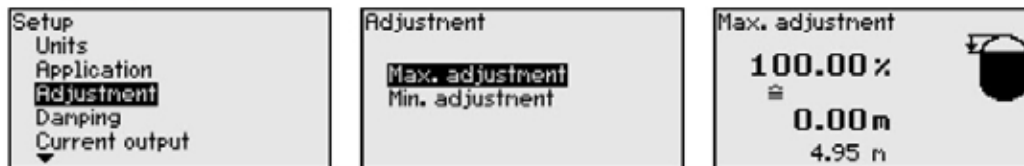
- 1 Min. level = max. measuring distance
- 2 Max. level = min. measuring distance
- 3 Reference plane

If these values are not known, an adjustment with the distances of e.g. 10 % and 90 % is possible. Starting point for these distance specifications is always the sealing surface of the thread or flange. You can find specifications on the reference plane in chapter "Technical data". The actual level is calculated on the basis of these settings.

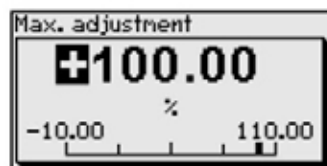
The actual product level during this adjustment is not important, because the min./max. adjustment is always carried out without changing the product level. These settings can be made ahead of time without the instrument having to be installed.

Proceed as follows:

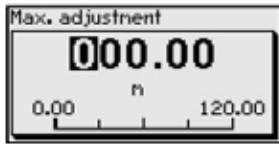
1. Select with **[>]** the menu item Max. adjustment and confirm with **[OK]**.



2. Prepare the percentage value for editing with **[OK]** and set the cursor to the requested position with **[>]**.



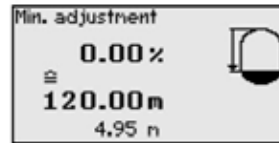
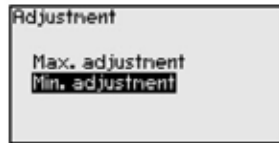
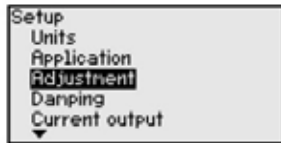
3. Set the requested percentage value with **[+]** and save with **[OK]**.  
The cursor jumps now to the distance value.



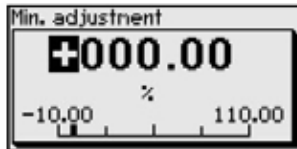
4. For the full vessel, enter the distance value in m matching the percentage value.
5. Save settings with **[OK]** and move with **[ESC]** and **[->]** to Min. adjustment.

Proceed as follows:

1. Select with **[->]** the menu item “Min. adjustment” and confirm with **[OK]**.

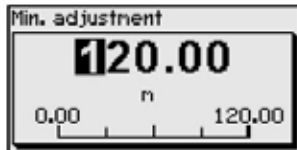


2. Edit the percentage value with **[OK]** and set the cursor to the requested position with **[->]**.



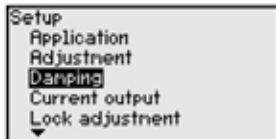
3. Set the requested percentage value with **[+]** and save with **[OK]**.

The cursor jumps now to the distance value.



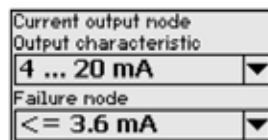
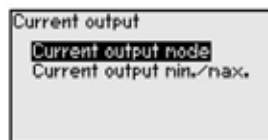
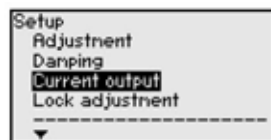
4. Enter the suitable distance value in m for the empty vessel (e.g. distance from the sensor to the vessel bottom) corresponding to the percentage value.

To damp process-dependent measured value fluctuations, set an integration time of 0 ... 999 s in this menu item.



The default setting is a damping of 0 s.

In the menu item “Current output mode” you determine the output characteristics and reaction of the current output in case of failure.



The default setting is output characteristics 4 ... 20 mA, failure mode < 3.6 mA.

In the menu item “Current output Min./Max.”, you determine the reaction of the current output during operation.

Current output Current output node <b>Current output min./max.</b>	Current output min./max. Min. current 3.8 mA Max. current 20.5 mA
--	---

The default setting is min. current 3.8 mA and max. current 20.5 mA.

In the menu item “Lock/unlock adjustment” you safeguard the sensor parameters against unauthorized or unintentional modifications.

Setup Damping Current output <b>Lock adjustment</b> ----- Measurement loop name	PIN 0000 0 9999	Bedienung <b>Gesperrt</b>  Freigegeben?
--	-----------------------	--

With active PIN, only the following adjustment functions are possible without entering a PIN:

- Select menu items and show data
- Read data from the sensor into the display and adjustment module.

Releasing the sensor adjustment is also possible in any menu item by entering the PIN.

### Caution:



With active PIN, adjustment via PACTware/DTM and other systems is also blocked.

This menu item enables the setting of the requested national language.

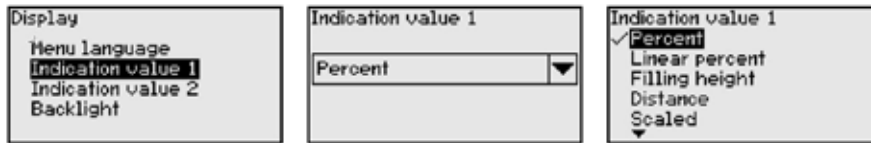
Setup <b>Display</b> Diagnostics Additional adjustments Info	Display <b>Sprache des Menüs</b> Anzeigewert 1 Anzeigewert 2 Anzeigeformat Beleuchtung	Menu language Deutsch ✓ <b>English</b> Français Español Pyockuu
--	---	--

The following languages are available:

- German
- English
- French
- Spanish
- Russian
- Italian
- Dutch
- Portuguese
- Japanese
- Chinese
- Polish
- Czech
- Turkish

In the delivery status, the NCR-80 is set to the ordered national language.

In this menu item you can define the way measured values are indicated on the display.



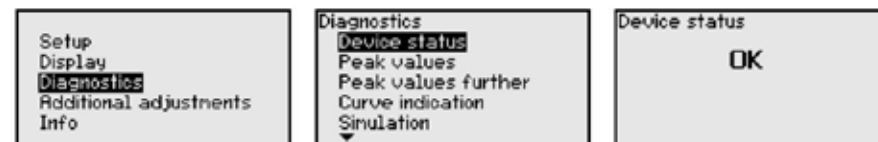
The default setting for the display value is “Percent”.

The display and adjustment module has a backlight for the display. In this menu item you can switch the lighting on or off. You can find the required operating voltage in chapter “Technical data”.



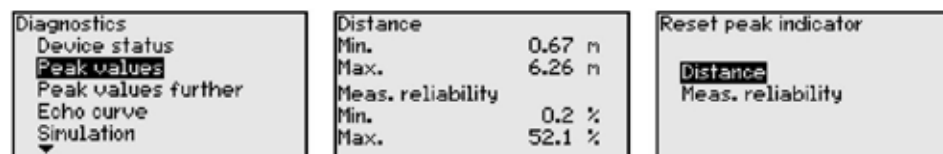
In delivery status, the lighting is switched on.

In this menu item, the device status is displayed.



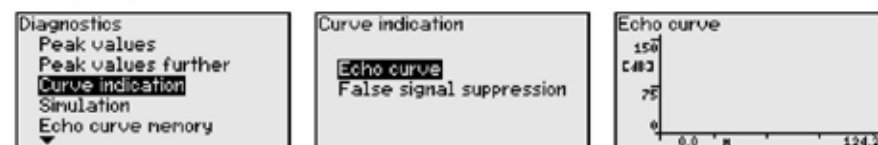
The min. and max. measured value, the measurement certainty as well as the min. and max. electronics temperature are stored in the sensor. The values are displayed in menu item “Peak value” or “Further peak values”.

A reset menu is opened with the **[OK]** key in the respective peak value window:



With the **[OK]** key in the reset menu, the peak values are reset to the current measured value.

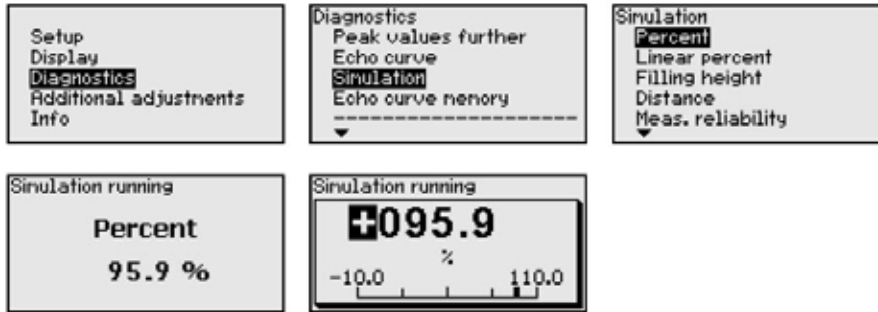
The “Echo curve” shows the signal strength of the echoes over the measuring range in dB. The signal strength enables an evaluation of the quality of the measurement.



The selected curve is continuously updated. A submenu with zoom functions is opened with the **[OK]** key:

- “X-Zoom”: Zoom function for the meas. distance
- “Y-Zoom”: 1, 2, 5 and 10x signal magnification in “dB”
- Unzoom”: Reset the presentation to the nominal measuring range without magnification

In this menu item you can simulate measured values via the current output. This allows the signal path to be tested, e.g. through downstream indicating instruments or the input card of the control system.



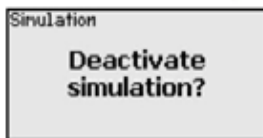
Select the requested simulation variable and set the requested value.



### Caution:

During simulation, the simulated value is outputted as 4 ... 20 mA current value and as digital HART signal. The status message within the context of the asset management function is "Maintenance".

To deactivate the simulation, you have to push the **[ESC]** key and confirm the message



with the **[OK]** key.



### Information:

The sensor terminates the simulation automatically after 60 minutes.

The function "Setup" allows the echo curve to be saved at the time of setup.

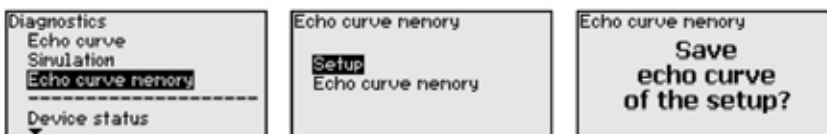


### Information:

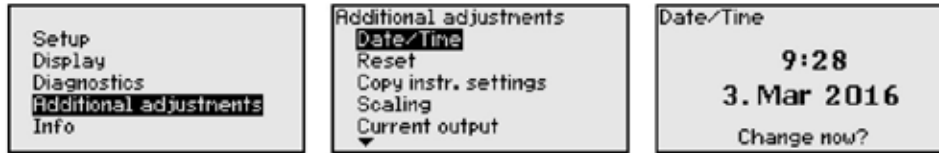
This is generally recommended, however, for use of the Asset Management functions it is absolutely necessary. Saving should be carried out with a very low level.

The function "*Echo curve memory*" allows up to ten individual echo curves to be stored, for example to detect the measurement behavior of the sensor in different operating conditions.

With the adjustment software PACTware and the PC, the stored echo curves can be displayed with high resolution and used to recognize signal changes over time. In addition, the echo curve saved during setup can also be displayed in the echo curve window and compared with the current echo curve.



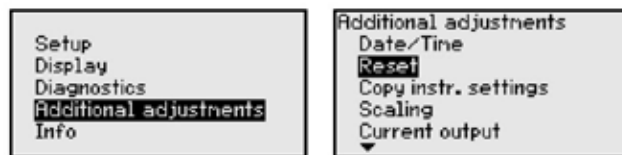
In this menu item, the internal clock of the sensor is set to the requested time and time format.



During a reset, the parameter settings carried out by the user are reset to the default values (see below table).

Proceed as follows:

1. Select with **[→]** under “Additional adjustments” the menu item “Reset” and confirm with **[OK]**.



2. Confirm with **[OK]** and select the requested reset function with **[→]**



3. Confirm with **[OK]**, for approx. 5 s the message “Resetting” is displayed, then the selection window appears.



### Caution:

For the duration of the reset, the set trouble signal is outputted via the current output. Within the context of the asset management function, the message “Maintenance” is outputted.

The following reset functions are available:

**Delivery status:** Restores the parameter settings at the time of shipment from the factory, incl. the order-specific settings. Any created false signal suppression, user-programmable linearization curve as well as measured value and echo curve memory is deleted. The event and parameter modification memories remain unaffected.

**Basic settings:** Resets the parameter settings, including special parameters, to the default values of the respective instrument. Any stored false signal suppression or user programmable linearisation curve, as well as the measured value memory, is deleted. Order-related settings are not taken over into the current parameters after this reset.

The following table shows the scope of the reset function and the default values of the instrument:

Menu	Menu item	Default value
Setup	Measurement loop name	Sensor
	Units	Distance in m Temperature in °C
	Application	Medium: Crushed stones/gravel Application: Silo Vessel bottom: Flat Vessel height/Measuring range: 120 m
	Min. adjustment	120 m
	Max. adjustment	0,000 m(d)
	Damping	0.0 s
	Current output mode	Output characteristics: 4 ... 20 mA Failure mode: < 3.6 mA ▼
	Current output Min./Max.	Min. current: 3.8 mA Max. current: 20.5 mA
Display	Displayed value 1	Filling height
	Displayed value 2	Temperature
	Backlight	Switched off
Additional adjustments	Date/Time	Time format: 24 h
	Scaling size	Volume l
	Scaling format	100.00 lin %, 100 l 0.00 lin %, 0 l
	Current output 1 and 2 size	Lin %
	Current output 1 and 2 adjustment	100.00 %, 100 l 0.00 %, 0 l
	Linearization	Linear
	HART mode	HART address: 0 Loop current mode: Analogue current output

The instrument settings are copied with this function. The following functions are available:

**Read from sensor:** Read data from sensor and store into the display and adjustment module

**Write into sensor:** Store data from the display and adjustment module back into the sensor

The following data or settings for adjustment of the display and adjustment module are saved:

- All data of the menu “Setup” and “Display”

- The menu items “Reset, Date/Time” in the menu “Additional settings”
- The user-programmable linearization curve



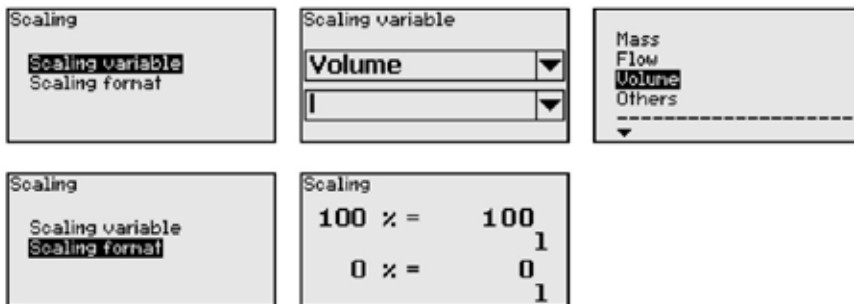
The copied data are permanently saved in an EEPROM memory in the display and adjustment module and remain there even in case of power failure. From there, they can be written into one or more sensors or kept as backup for a possible electronics exchange.

### Note:

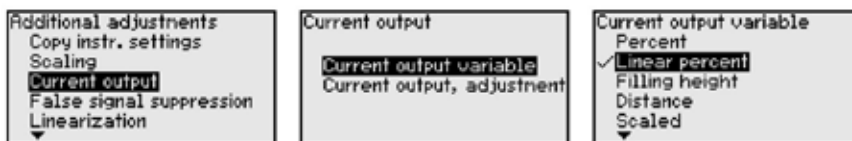


Before the data are saved in the sensor, a safety check is carried out to determine if the data match the sensor. In the process the sensor type of the source data as well as the target sensor are displayed. If the data do not match, a fault message is outputted or the function is blocked. The data are saved only after release.

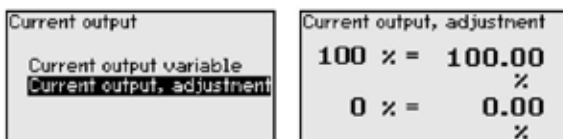
In the menu item “Scaling” you define the scaling variable and the scaling format for the indication of the level measured value for 0 % and 100 % on the display, for example as volume in l.



In menu item “Current output, variable” you specify which measured variable the current output refers to.



In menu item “Current output, adjustment” you can assign a respective measured value to the current output.



The following circumstances cause interfering reflections and can influence the measurement:

- High sockets
- Vessel internals such as struts

- Agitators
- Buildup or welded joints on vessel walls

## Note:

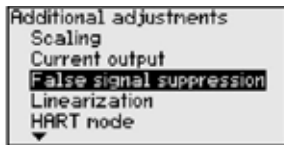


A false signal suppression detects, marks and saves these false signals so that they are no longer taken into account in the level measurement.

This should be done with the lowest possible level so that all potential interfering reflections can be detected.

Proceed as follows:

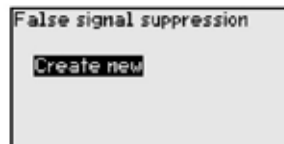
1. Select with **[→]** the menu item “False signal suppression” and confirm with **[OK]**.



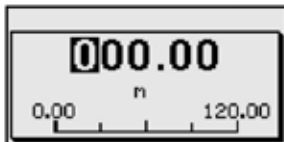
2. Confirm again with **[OK]**.



3. Confirm again with **[OK]**.



4. Confirm again with **[OK]** and enter the actual distance from the sensor to the product surface.



5. All interfering signals in this section are detected by the sensor and stored after confirming with **[OK]**.

## Note:



Check the distance to the product surface, because if an incorrect (too large) value is entered, the existing level will be saved as a false signal. The level would then no longer be detectable in this area.

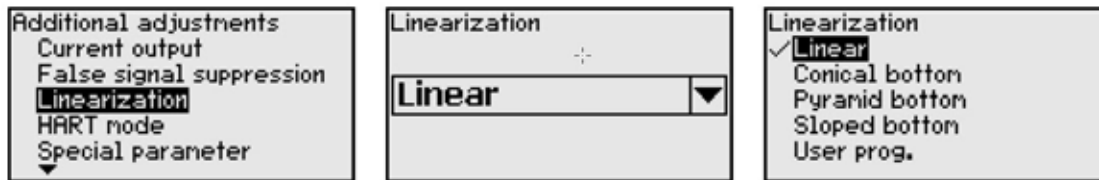
If a false signal suppression has already been saved in the sensor, the following menu window appears when selecting “False signal suppression”:



**Delete:** An already created false signal suppression will be completely deleted. This is useful if the saved false signal suppression no longer matches the metrological conditions in the vessel.

**Extend:** is used to extend an already created false signal suppression. This is useful if a false signal suppression was carried out with too high a level and not all false signals could be detected. When selecting “Extend”, the distance to the product surface of the created false signal suppression is displayed. This value can now be changed and the false signal suppression can be extended to this range.

A linearization is necessary for all vessels in which the vessel volume does not increase linearly with the level. Corresponding linearization curves are preprogrammed for these vessels. They represent the correlation between the level percentage and vessel volume. The linearization applies to the measured value indication and the current output.

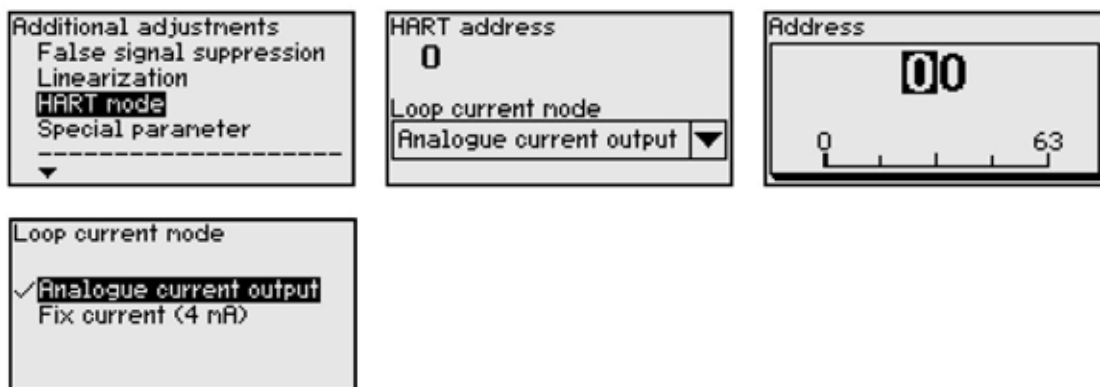


In this menu item you specify the HART mode and enter the address for multi-drop mode.

In the mode “Fixed current output” up to 63 sensors can be operated on one two-wire cable (Multi-drop operation). An address between 0 and 63 must be assigned to each sensor.

If you select the function “Analogue current output”, a 4–20 mA signal is output in multi-drop mode.

In the mode “Fixed current (4 mA)” a fixed 4 mA signal is output independently of the actual level.



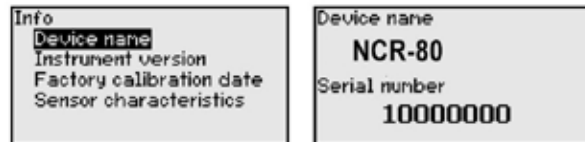
The default setting is “Analogue current output” and the address “00”.

In this menu item you gain access to the protected area where you can enter special parameters. In exceptional cases, individual parameters can be modified in order to adapt the sensor to special requirements.

Change the settings of the special parameters only after having contacted our service staff.



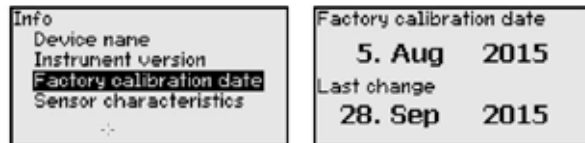
In this menu item, you can read out the instrument name and the instrument serial number:



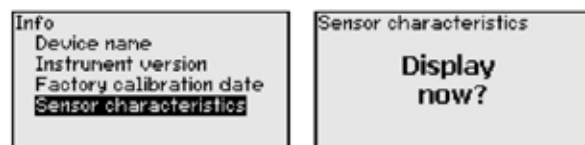
In this menu item, the hardware and software version of the sensor is displayed.



In this menu item, the date of factory calibration of the sensor as well as the date of the last change of sensor parameters are displayed via the display and adjustment module or via the PC.



In this menu item, the features of the sensor such as approval, process fitting, seal, measuring range, electronics, housing and others are displayed.



## 6.6 Saving the parameter adjustment data

We recommended noting the adjusted data, e.g. in this operating instructions manual, and archiving them afterwards. They are thus available for multiple use or service purposes.

If the instrument is equipped with a display and adjustment module, the data in the sensor can be saved in the display and adjustment module. The procedure is described in the menu “Additional adjustments” in the menu item “Copy device settings”. The data remain there permanently even if the sensor power supply fails.

The following data or settings for adjustment of the display and adjustment module are saved:

- All data of the menu “Setup” and “Display”

- In the menu *“Additional settings”* the items *“Sensor-specific units, temperature unit and linearization”*
- The values of the user programmable linearization curve

The function can also be used to transfer settings from one instrument to another instrument of the same type. If it is necessary to exchange a sensor, the display and adjustment module is inserted into the replacement instrument and the data are likewise written into the sensor via the menu item *“Copy device settings”*.

## 7 Setup with PACTware

### 7.1 Connect the PC



Fig. 45: Connection of the PC directly to the sensor via the interface adapter

- 1 USB cable to the PC
- 2 Interface adapter
- 3 Sensor

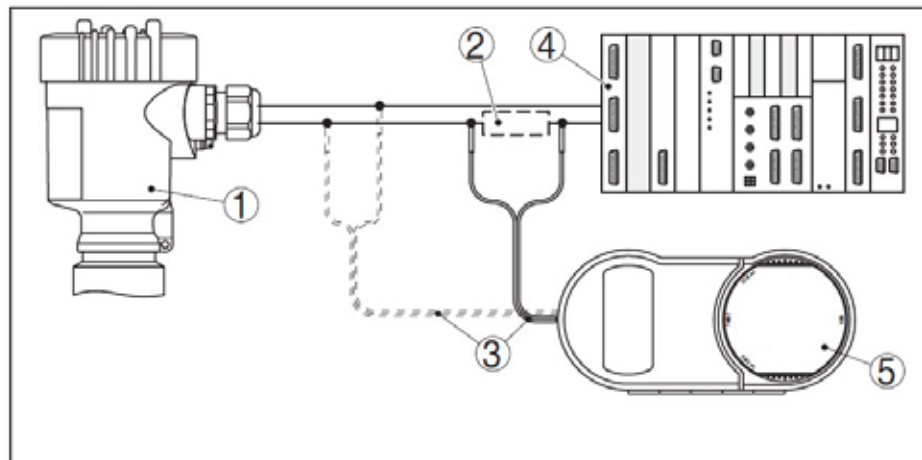


Fig. 46: Connecting the PC via HART to the signal cable

- 1 Sensor
- 2 HART resistance 250  $\Omega$  (optional depending on evaluation)
- 3 Connection cable with 2 mm pins and terminals
- 4 Processing system/PLC/Voltage supply
- 5 Interface adapter, for example

## 7.2 Parameter adjustment

For parameter adjustment of the instrument via a Windows PC, the configuration software PACTware and a suitable instrument driver (DTM) according to FDT standard are required. The latest PACTware version as well as all available DTMs are compiled in a DTM Collection. The DTMs can also be integrated into other frame applications according to FDT standard.

### Note:

**i** To ensure that all instrument functions are supported, you should always use the latest DTM Collection. Furthermore, not all described functions are included in older firmware versions. You can request the latest instrument software from our technical services department.

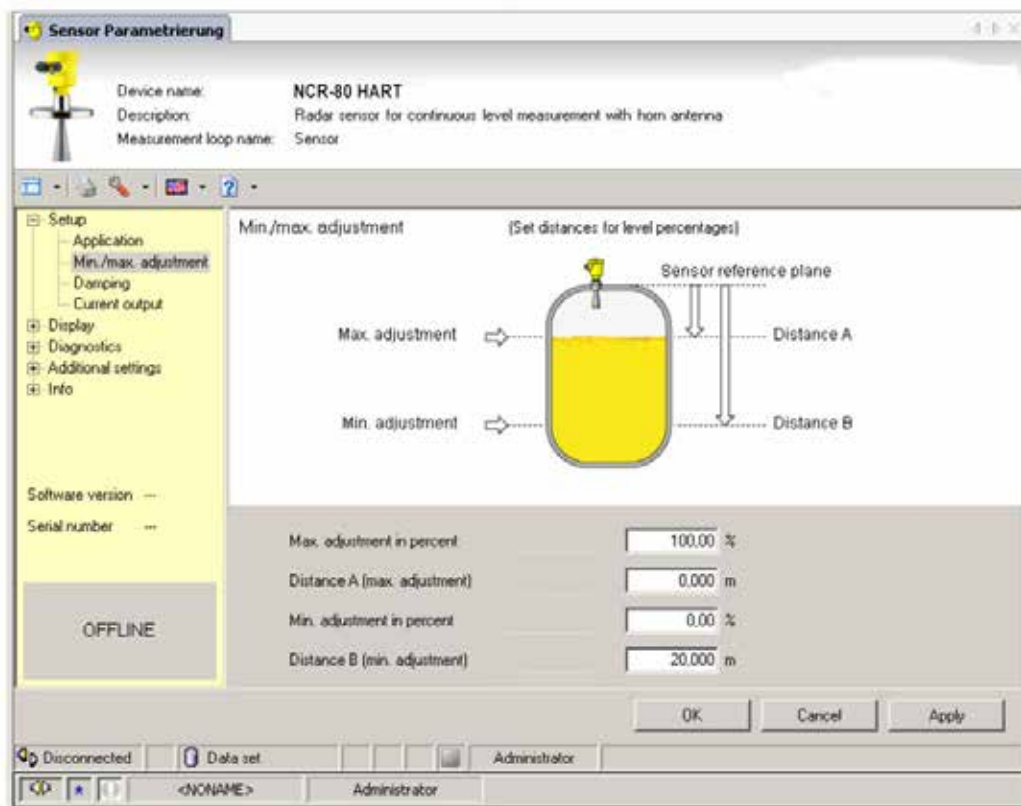


Fig. 47: Example of a DTM view

All device DTMs are available as a free-of-charge standard version and as a full version that must be purchased. In the standard version, all functions for complete setup are already included. An assistant for simple project configuration simplifies the adjustment considerably. Saving/printing the project as well as import/export functions are also part of the standard version.

In the full version there is also an extended print function for complete project documentation as well as a save function for measured value and echo curves. In addition, there is a tank calculation program as well as a multiviewer for display and analysis of the saved measured value and echo curves.

## **7.3 Saving the parameter adjustment data**

We recommend documenting or saving the parameter adjustment data via PACTware. That way the data are available for multiple use or service purposes.

## **8 Set up with other systems**

### **8.1 DD adjustment programs**

Device descriptions as Enhanced Device Description (EDD) are available for DD adjustment programs such as, for example, AMS™ and PDM.

### **8.2 Field Communicator 375, 475**

Device descriptions for the instrument are available as EDD for parameter adjustment with the Field Communicator 375 or 475.

For the integration of the EDD in the Field Communicator 375 or 475, the software “Easy Upgrade Utility” is required which is available from the manufacturer. This software is updated via the Internet and new EDDs are automatically taken over into the device catalogue of this software after they are released by the manufacturer. They can then be transferred to a Field Communicator.

## 9 Diagnosis, asset management and service

### 9.1 Maintenance

If the instrument is used correctly, no maintenance is required in normal operation.

In some applications, buildup on the antenna system can influence the measuring result. Depending on the sensor and application, take measures to avoid heavy soiling of the antenna system. If necessary, clean the antenna system in certain intervals.

### 9.2 Measured value and event memory

The instrument has several memories which are available for diagnostic purposes. The data remain there even in case of voltage interruption.

Up to 100,000 measured values can be stored in the sensor in a ring memory. Each entry contains date/time as well as the respective measured value. Storable values are for example:

- Distance
- Filling height
- Percentage value
- Lin. percent
- Scaled
- Current value
- Meas. certainty
- Electronics temperature

When the instrument is shipped, the measured value memory is active and stores distance, measurement certainty and electronics temperature every 3 minutes.

The requested values and recording conditions are set via a PC with PACTware/DTM or the control system with EDD. Data are thus read out and also reset.

Up to 500 events are automatically stored with a time stamp in the sensor (non-deletable). Each entry contains date/time, event type, event description and value. Event types are for example:

- Modification of a parameter
- Switch-on and switch-off times
- Status messages (according to NE 107)
- Error messages (according to NE 107)

The data are read out via a PC with PACTware/DTM or the control system with EDD.

The echo curves are stored with date and time and the corresponding echo data. The memory is divided into two sections:

**Echo curve of the setup:** This is used as reference echo curve for the measurement conditions during setup. Changes in the measurement conditions during operation or buildup on the sensor can thus be recognized. The echo curve of the setup is stored via:

- PC with PACTware/DTM
- Control system with EDD
- Display and adjustment module

Further echo curves: Up to 10 echo curves can be stored in a ring buffer in this memory section.

Further echo curves are stored via:

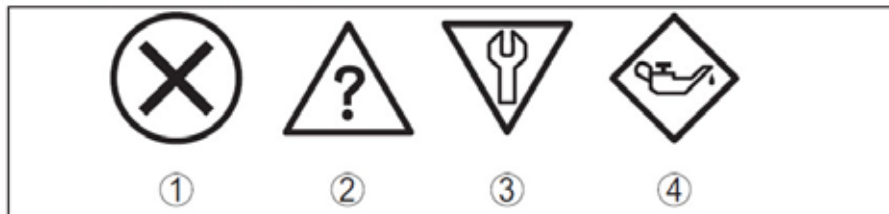
- PC with PACTware/DTM
- Control system with EDD

### 9.3 Asset Management function

The instrument features self-monitoring and diagnostics according to NE 107 and VDI/VDE 2650. In addition to the status messages in the following tables, detailed error messages are available under menu item “Diagnostics” via the display and adjustment module, PACTware/DTM and EDD.

The status messages are divided into the following categories:

- Failure
  - Function check
  - Out of specification
  - Maintenance requirement
- and explained by pictographs:



*Fig. 48: Pictographs of the status messages*

1 Failure - red

2 Out of specification - yellow

3 Function check - orange

4 Maintenance - blue

**Failure:** Due to a malfunction in the instrument, a failure message is outputted.

This status message is always active. It cannot be deactivated by the user.

**Function check:** The instrument is in operation, the measured value is temporarily invalid (for example during simulation).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

**Out of specification:** The measured value is unstable because the instrument specification is exceeded (e.g. electronics temperature).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

**Maintenance:** Due to external influences, the instrument function is limited. The measurement is affected, but the measured value is still valid. Plan in maintenance for the instrument because a failure is expected in the near future (e.g. due to buildup).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

The following table shows the error codes in the status message “*Failure*” and gives information on the reason and rectification. Keep in mind that some information is only valid with four-wire instruments.

<b>Code Text Message</b>	<b>Cause</b>	<b>Rectification</b>	<b>DevSpec State in CMD 48</b>
F013 no measured value available	<ul style="list-style-type: none"><li>– Sensor does not detect an echo during operation</li><li>– Antenna system dirty or defective</li></ul>	<ul style="list-style-type: none"><li>– Check or correct installation and/or parameter adjustment</li><li>– Clean or exchange process component or antenna</li></ul>	Bit 0 of Byte 0...5
F017 Adjustment span too small	<ul style="list-style-type: none"><li>– Adjustment not within specification</li></ul>	<ul style="list-style-type: none"><li>– Change adjustment according to the limit values (difference between min. and max. <math>\geq 10</math> mm)</li></ul>	Bit 1 of Byte 0...5
F025 Error in the linearization table	<ul style="list-style-type: none"><li>– Index markers are not continuously rising, for example illogical value pairs</li></ul>	<ul style="list-style-type: none"><li>– Check linearization table</li><li>– Delete table/Create new</li></ul>	Bit 2 of Byte 0...5
F036 No operable software	<ul style="list-style-type: none"><li>– Failed or interrupted software update</li></ul>	<ul style="list-style-type: none"><li>– Repeat software update</li><li>– Check electronics version</li><li>– Exchanging the electronics</li><li>– Send instrument for repair</li></ul>	Bit 3 of Byte 0...5
F040 Error in the electronics	<ul style="list-style-type: none"><li>– Hardware defect</li></ul>	<ul style="list-style-type: none"><li>– DevSpec State in CMD 48</li></ul>	Bit 4 of Byte 0...5
F080 General software error	<ul style="list-style-type: none"><li>– General software error</li></ul>	<ul style="list-style-type: none"><li>– Disconnect operating voltage briefly</li></ul>	Bit 5 of Byte 0...5
F105 Determine measured value	<ul style="list-style-type: none"><li>– The instrument is still in the start phase, the measured value could not yet be determined</li></ul>	<ul style="list-style-type: none"><li>– Wait for the end of the switch-on phase</li><li>– Duration depending on the version and parameter adjustment up to approximately 3 min.</li></ul>	Bit 6 of Byte 0...5
F113 Communication error	<ul style="list-style-type: none"><li>– EMC interference</li><li>– Transmission error with the external communication with 4-wire power supply unit</li></ul>	<ul style="list-style-type: none"><li>– Remove EMC influences</li><li>– Exchange 4-wire power supply unit or electronics</li></ul>	Bit 12 of Byte 0...5

Code Text Message	Cause	Rectification	DevSpec State in CMD 48
F125 Impermissible electronics temperature	<ul style="list-style-type: none"> <li>– Temperature electronics in the non-specified range</li> </ul>	<ul style="list-style-type: none"> <li>– Check ambient temperature</li> <li>– Isolate electronics</li> <li>– Use instrument with higher temperature range</li> </ul>	Bit 7 of Byte 0...5
F260 Error in the calibration	<ul style="list-style-type: none"> <li>– Error in the calibration carried out in the factory</li> </ul>	<ul style="list-style-type: none"> <li>– Exchanging the electronics</li> <li>– Send instrument for repair</li> </ul>	Bit 8 of Byte 0...5
F261 Error in the instrument settings	<ul style="list-style-type: none"> <li>– Error during setup</li> <li>– False signal suppression faulty</li> <li>– Error when carrying out a reset</li> </ul>	<ul style="list-style-type: none"> <li>– Repeat setup</li> <li>– Carry out a reset</li> </ul>	Bit 9 of Byte 0...5
F264 Installation/ Setup error	<ul style="list-style-type: none"> <li>– Adjustment not within the vessel height/ measuring range</li> <li>– Max. measuring range of the instrument not sufficient</li> </ul>	<ul style="list-style-type: none"> <li>– Check or correct installation and/or parameter adjustment</li> <li>– Use an instrument with bigger measuring range</li> </ul>	Bit 10 of Byte 0...5
F265 Measurement function disturbed	<ul style="list-style-type: none"> <li>– Sensor no longer carries out a measurement</li> <li>– Operating voltage too low</li> </ul>	<ul style="list-style-type: none"> <li>– Check operating voltage</li> <li>– Carry out a reset</li> <li>– Disconnect operating voltage briefly</li> </ul>	Bit 11 of Byte 0...5

The following table shows the error codes and text messages in the status message “*Function check*” and provides information on causes as well as corrective measures.

Code Text Message	Cause	Rectification	DevSpec State in CMD 48
C70 Simulation active	<ul style="list-style-type: none"> <li>– A simulation is active</li> </ul>	<ul style="list-style-type: none"> <li>– Finish simulation</li> <li>– Wait for the automatic end after 60 mins.</li> </ul>	“Simulation Active” in “Standardized Status 0

The following table shows the error codes and text messages in the status message “*Out of specification*” and provides information on causes as well as corrective measures.

Code Text Message	Cause	Rectification	DevSpec State in CMD 48
S600 Impermissible electronics temperature	<ul style="list-style-type: none"> <li>– Temperature of the electronics in the non-specified range</li> </ul>	<ul style="list-style-type: none"> <li>– Check ambient temperature</li> <li>– Isolate electronics</li> <li>– Use instrument with higher temperature range</li> </ul>	Bit 8 of Byte 14...24

Code Text Message	Cause	Rectification	DevSpec State in CMD 48
S601 Overfilling	– Danger of vessel overfilling	– Make sure that there is no further filling – Check level in the vessel	Bit 9 of Byte 14...24
S603 Impermissible operating voltage	– Operating voltage below specified range	– Check electrical connection – If necessary, increase operating voltage	Bit 11 of Byte 14...24

The following table shows the error codes and text messages in the status message “Maintenance” and provides information on causes as well as corrective measures.

Code Text Message	Cause	Rectification	DevSpec State in CMD 48
M500 Error with the reset delivery status	– With the reset to delivery status, the data could not be restored	– Repeat reset – Load XML file with sensor data into the sensor	Bit 0 of Byte 14...24
M501 Error in the non-active linearization table	– Hardware error EEPROM	– Exchanging the electronics – Send instrument for repair	Bit 1 of Byte 14...24
M502 Error in the event memory	– Hardware error EEPROM	– Exchanging the electronics – Send instrument for repair	Bit 2 of Byte 14...24
M503 Meas. reliability too low	– The echo/noise ratio is too small for reliable measurement – Antenna dirty or defective	– Check installation and process conditions – Change polarization direction – Use instrument with higher sensitivity – Clean the antenna	Bit 3 of Byte 14...24
M504 Error on an device inter-face	– Hardware defect	– Check connections – Exchanging the electronics – Send instrument for repair	Bit 4 of Byte 14...24
M505 No echo available	– Sensor does not detect an echo during operation – Antenna dirty or defective	– Clean the antenna – Use a more suitable antenna/sensor – Remove possible false echoes – Optimize sensor position and orientation	Bit 5 of Byte 14...24
M506 Installation/ Setup error	– Error during setup	– Check or correct installation and/or parameter adjustment	Bit 6 of Byte 14...24

Code Text Message	Cause	Rectification	DevSpec State in CMD 48
M507 Error in the instrument settings	<ul style="list-style-type: none"> <li>– Error during setup</li> <li>– Error when carrying out a reset</li> <li>– False signal suppression faulty</li> </ul>	<ul style="list-style-type: none"> <li>– Carry out reset and repeat setup</li> </ul>	Bit 7 of Byte 14...24

## 9.4 Rectify faults

The operator of the system is responsible for taking suitable measures to rectify faults.

The first measures are:

- Evaluation of fault messages, for example via the display and adjustment module
- Checking the output signal
- Treatment of measurement errors

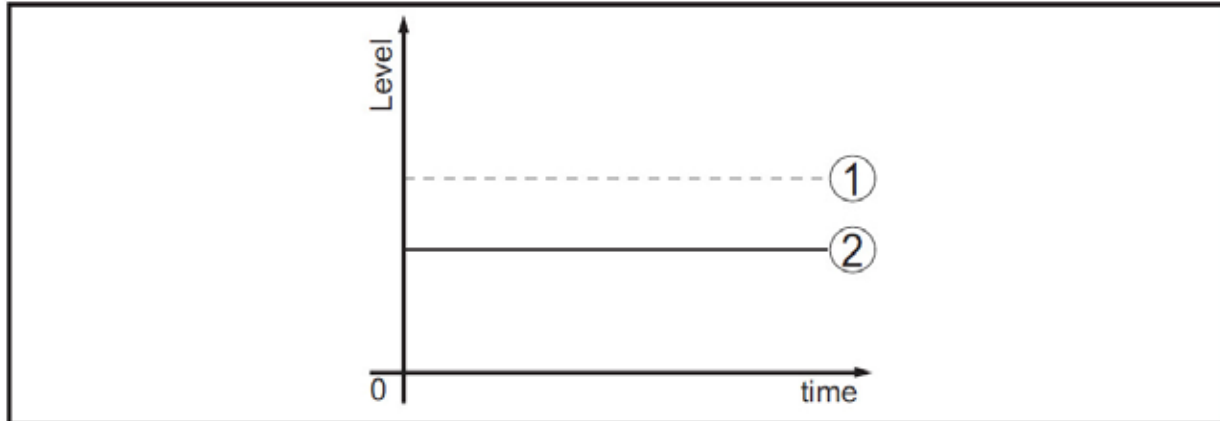
Further comprehensive diagnostics options are available with a PC with PACTware and the suitable DTM. In many cases, the reasons can be determined in this way and faults rectified. Connect a multimeter in the suitable measuring range according to the wiring plan. The following table describes possible errors in the current signal and helps to eliminate them:

Error	Cause	Rectification
4 ... 20 mA signal not stable	<ul style="list-style-type: none"> <li>– Fluctuations of the measured variable</li> </ul>	<ul style="list-style-type: none"> <li>– Set damping appropriate to the instrument via the display and adjustment module or PACTware/DTM</li> </ul>
4 ... 20 mA signal missing	<ul style="list-style-type: none"> <li>– Electrical connection faulty</li> </ul>	<ul style="list-style-type: none"> <li>– Check connection according to chapter “Connection steps” and if necessary, correct according to chapter “Wiring plan”</li> </ul>
	<ul style="list-style-type: none"> <li>– Voltage supply missing</li> </ul>	<ul style="list-style-type: none"> <li>– Check cables for breaks; repair if necessary</li> </ul>
	<ul style="list-style-type: none"> <li>– Operating voltage too low or load resistance too high</li> </ul>	<ul style="list-style-type: none"> <li>– Check, adapt if necessary</li> </ul>
Current signal greater than 22 mA or less than 3.6 mA	<ul style="list-style-type: none"> <li>– Electronics module in the sensor defective</li> </ul>	<ul style="list-style-type: none"> <li>– Exchange the instrument or send it in for repair</li> </ul>

The below tables show typical examples of application-related measurement errors with bulk solids. A distinction is made between measurement errors during:

- Constant level
- Filling
- Emptying

The images in column “*Error pattern*” show the real level as a broken line and the level displayed by the sensor as a continuous line.



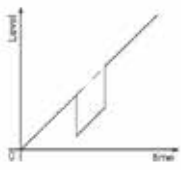
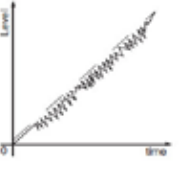
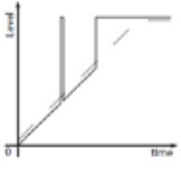
- 1 Real level
- 2 Level displayed by the sensor

Notes:

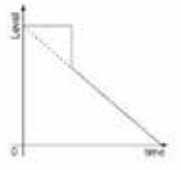
- Whenever the sensor displays a constant value, the reason could also be that the fault setting of the current output is set to “Hold value”
- If the level indication is too low, the reason could be a line resistance that is too high

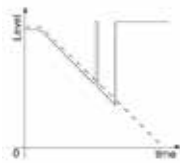
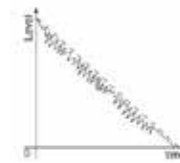
## Measurement error with constant level

Fault description	Error pattern	Cause	Rectification
1. Measured value shows a too low or too high level		– Min./max. adjustment not correct	– Adapt min./max. adjustment
		– Incorrect linearization curve	– Adapt linearization curve
2. Measured value jumps towards 100%		– Due to the process, the amplitude of the product echo decreases	– Carry out a false signal suppression
		– A false signal suppression was not carried out	
		– Amplitude or position of a false signal has changed (e.g. condensation, build-up); false signal suppression no longer matches actual conditions	– Determine the reason for the changed false signals, carry out false signal suppression, e.g. with condensation

Fault description	Error pattern	Cause	Rectification
3. Measured value jumps towards 0% during filling		– Amplitude of a multiple echo (vessel top - product surface) is larger than the level echo	– Check parameter “Application”, especially vessel top, type of medium, dished bottom, high dielectric constant, and adapt if necessary
		– The level echo cannot be distinguished from the false signal at a false signal position (jumps to multiple echo)	– Remove/reduce false signal: minimize interfering installations by changing the polarization direction – Chose a more suitable installation position
		– Transverse reflection from an extraction funnel, amplitude of the transverse reflection larger than the level echo	– Direct sensor to the opposite funnel wall, avoid crossing with the filling stream
4. Measured value fluctuates around 10 ... 20%		– Various echoes from an uneven product surface, e.g. a material cone	– Check parameter “Type of medium” and adapt, if necessary – Optimize installation position and sensor orientation
		– Reflections from the product surface via the vessel wall (deflection)	– Select a more suitable installation position, optimize sensor orientation, e.g. with a swiveling holder
5. Measured value jumps sporadically to 100% during filling		– Changing condensation or contamination on the antenna	– Carry out a false signal suppression or increase false signal suppression with condensation/contamination in the close range by editing – With bulk solids use radar sensor with purging air connection or flexible antenna cover

## Measurement error with constant level

Fault description	Error pattern	Cause	Rectification
6. Measured value remains unchanged in the close range during emptying		– False signal larger than the level echo – Level echo too small	– Eliminate false signals in the close range. Check: Antenna must protrude out of the socket Remove contamination on the antenna – Minimize interfering installations in the close range by changing the polarization direction – After eliminating the false signals, the false signal suppression must be deleted. Carry out a new false signal suppression

Fault description	Error pattern	Cause	Rectification
7. Measured value jumps sporadically to-wards 100% during emptying		– Changing condensation or contamination on the antenna	– Carry out false signal suppression or increase false signal suppression in the close range by editing – With bulk solids use radar sensor with purging air connection or flexible antenna cover
8. Measured value fluctuates around 10 ... 20%		– Various echoes from an uneven product surface, e.g. an extraction funnel – Reflections from the product surface via the vessel wall (deflection)	– Check parameter “Type of medium” and adapt, if necessary – Optimize installation position and sensor orientation

Depending on the reason for the fault and the measures taken, the steps described in chapter “Setup” must be carried out again or must be checked for plausibility and completeness

## 9.5 Exchanging the electronics module

If the electronics module is defective, it can be replaced by the user. In Ex applications, only instruments and electronics modules with appropriate Ex approval may be used.

If there is no electronics module available on site, the electronics module can be ordered through the agency serving you. The electronics modules are adapted to the respective sensor and differ in signal output or voltage supply.

The new electronics module must be loaded with the default settings of the sensor. These are the options:

- In the factory
- Or on site by the user

In both cases, the serial number of the sensor is needed. The serial numbers are stated on the type label of the instrument, on the inside of the housing as well as on the delivery note.

When loading on site, all the order data must be available (contact technical services as needed.)

### Caution:



All user-specific settings must be entered again. Hence, you have to carry out a new setup after the electronics exchange.

If you have stored the data of the parameter adjustment during the first setup of the sensor, you can transfer these to the replacement electronics module. A new setup is not necessary.

## 10 Removal

### 10.1 Removal

**Warning:**

Before dismounting, be aware of dangerous process conditions such as e.g. pressure in the vessel or pipeline, high temperatures, corrosive or toxic products etc.

Take note of chapters "*Mounting*" and "*Connecting to power supply*" and carry out the listed steps in reverse order.

### 10.2 Disposal

The instrument consists of materials which can be recycled by specialized recycling companies. We use recyclable materials and have designed the parts to be easily separable.

Correct disposal avoids negative effects on humans and the environment and ensures recycling of useful raw materials.

Materials: see chapter "*Technical data*"

If you have no way to dispose of the old instrument properly, please contact us concerning return and disposal.

**WEEE directive 2002/96/EG**

This instrument is not subject to the WEEE directive 2002/96/EG and the respective national laws. Pass the instrument directly on to a specialized recycling company and do not use the municipal collecting points. These may be used only for privately used products according to the WEEE directive.

## 11 Supplement

### 11.1 Technical data

#### Note for approved instruments

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The technical data in the respective safety instructions are valid for approved instruments (e.g. with Ex approval). These data can differ from the data listed herein, for example regarding the process conditions or the voltage supply.

#### Materials and weights

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316L corresponds to 1.4404 or 1.4435

Materials, wetted parts with metal-jacketed lens antenna

– Process fitting	316L, Alloy C22 (2.4602), Alloy 400 (2.4360)
– Process seal	On site
– Antenna	PP, PEEK
– seal, antenna system	FKM (SHS FPM 70C3 GLT), EPDM (COG AP310)

Materials, wetted parts with plastic horn antenna

– Adapter flange	PP-GF30 black
– Seal, adapter flange	FKM (COG VI500), EPDM (COG AP310)
– Antenna cone	PBT-GF 30
– Focusing lens	PP

Material, wetted parts rinsing air connection

– Rinsing air connection	PP-GFK
– Seal	FKM (COG VI500), EPDM (COG AP310)

Materials, non-wetted parts

– Compression flange	PP-GF30 black
– Mounting strap	316L
– Fixing screws, mounting strap	316L
– Fixing screws, adapter flange	304
– Plastic housing	plastic PBT (Polyester)
– Aluminium die-casting housing	Aluminium die-casting AlSi10Mg, powder-coated - basis: Polyester
– Stainless steel housing	316L
– Cable gland	PA, stainless steel, brass
– Sealing, cable gland	NBR
– Blind plug, cable gland	PA
– Seal between housing and housing lid	Silicone SI 850 R, NBR silicone-free
– Inspection window in housing cover	Polycarbonate
– Ground terminal	316L

Weights

– Instrument (depending on housing, process fitting and antenna)	approx. 2 ... 17.2 kg (4.409 ... 37.92 lbs)
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## Torques

Max. torques, threaded version

- G $\frac{3}{4}$  30 Nm (22.13 lbf ft)
- G1 $\frac{1}{2}$  200 Nm (147.5 lbf ft)

Max. torques, version plastic horn antenna

- Mounting screws, mounting strap on sensor housing 4 Nm (2.950 lbf ft)
- Flange screws, compression flange DN 80 5 Nm (3.689 lbf ft)
- Flange screws, adapter flange DN 100 7 Nm (5.163 lbf ft)

Max. torques, version metal-jacketed lens antenna

- Terminal screws for swivelling holder 8 Nm (5.9 lbf ft)

Max. torques for NPT cable glands and Conduit tubes

- Plastic housing 10 Nm (7.376 lbf ft)
- Aluminium/Stainless steel housing 50 Nm (36.88 lbf ft)

## Input variable

Measured variable

The measured quantity is the distance between the end of the sensor antenna and the product surface. The reference plane for the measurement is the lower side of the flange.

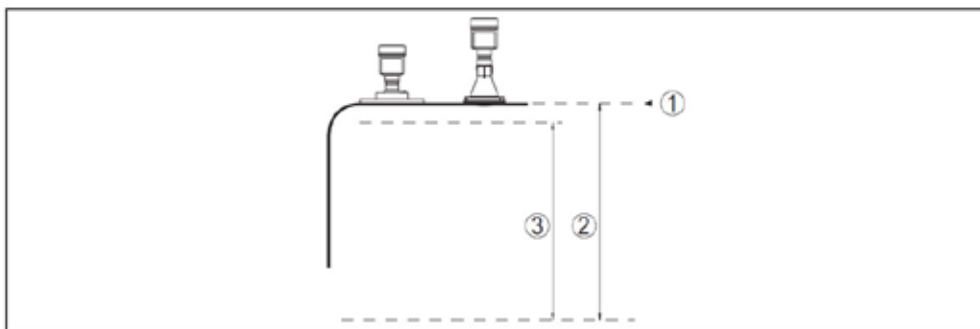


Fig. 58: Data of the input variable

1 Reference plane

2 Measured variable, max. measuring range

3 Usable measuring range (recommended min. distance see "Measuring accuracy")

Max. measuring range 120 m (393,7 ft)

## Input variable

- Output signal 4–20 mA/HART
- Range of the output signal 3.8–20.5 mA/HART (default setting)
- Signal resolution 0.3  $\mu$ A
- Resolution, digital < 1 mm (0.039 in)
- Failure signal current output (adjustable) mA-value unchanged 20.5 mA, 22 mA, < 3.6 mA

Max. output current	22 mA
Starting current	≤ 3.6 mA; ≤ 10 mA for 5 ms after switching on
Load	see load diagram under Power supply
Damping (63 % of the input variable), adjustable	0 ... 999 s
HART output values according to HART 7.0 <sup>2)</sup>	
– PV (Primary Value)	Lin. percent
– SV (Secondary Value)	Distance
– TV (Third Value)	Meas. certainty
– QV (Fourth Value)	Electronics temperature
Fulfilled HART specification	7.0
Further information on Manufacturer ID, Device ID, Device Revision	See website of HART Communication Foundation

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**Output variable - Additional current output**

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Output signal	4–20 mA
Range of the output signal	3.8–20.5 mA (default setting)
Signal resolution	0.3 µA
Failure signal current output (adjustable)	mA-value unchanged 20.5 mA, 22 mA, < 3.6 mA
Max. output current	22 mA
Starting current	≤ 3.6 mA; ≤ 10 mA for 5 ms after switching on
Load	see load diagram under Power supply
Damping (63 % of the input variable), adjustable	0 ... 999 s

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**Accuracy (according to DIN EN 60770-1)**

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Process reference conditions according to DIN EN 61298-1	
– Temperature	+18 ... +30 °C (+64 ... +86 °F)
– Relative humidity	45 ... 75 %
– Air pressure	860 ... 1060 mbar/86 ... 106 kPa (12.5 ... 15.4 psig)
Installation reference conditions	
– Min. distance to internal installations	> 200 mm (7.874 in)
– Reflector	Flat plate reflector, surface 1 x 1 m (3.281 x 3.281 ft)
– False reflections	Biggest false signal, 20 dB smaller than the useful signal
Deviation	See following diagrams

<sup>2)</sup> Default values can be assigned individually.

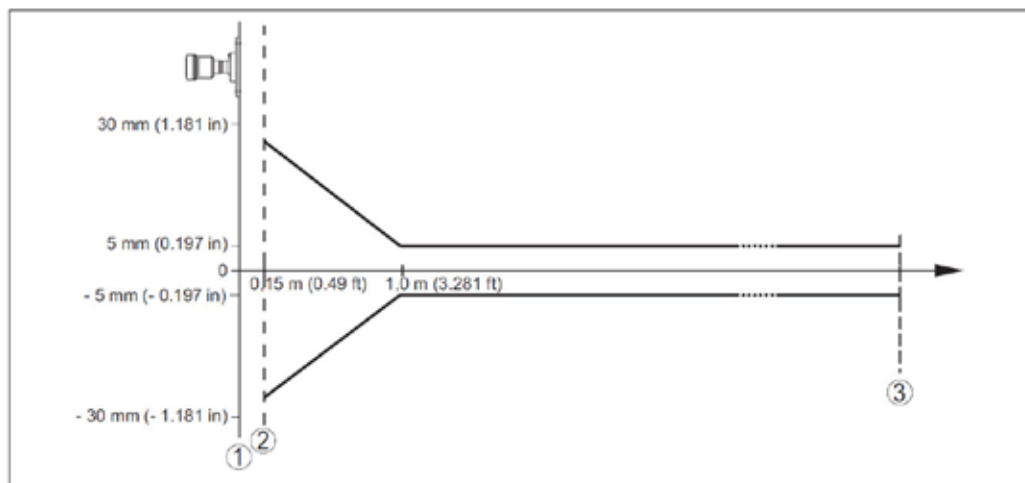


Fig. 59: Deviation under reference conditions

1 Reference plane

2 Recommended min. distance

3 Measuring range end

Repeatability

$\leq \pm 1$  mm

Deviation with bulk solids

The values depend to a great extent on the application.  
Binding specifications are thus not possible.

## Variables influencing measurement accuracy

### Specifications apply to the digital measured value

Temperature drift - Digital output  $\pm 3$  mm/10 K, max. 10 mm

### Specifications apply also to the current output

Temperature drift - Current output  $\pm 0.03$  %/10 K relating to the 16 mA span max.  $\pm 0.3$  %

Deviation on the current output through analogue/digital conversion

– Non-Ex and Ex-ia version  $< \pm 15$   $\mu$ A

– Ex-d-ia version  $< \pm 40$   $\mu$ A

## Characteristics and performance data

Measuring frequency W-band (79 GHz technology)

Measuring cycle time approx. 700 ms

Step response time<sup>3)</sup>  $\leq 3$  s

Beam angle<sup>4)</sup>

– Plastic horn antenna  $3.5^\circ$

– Metal-jacketed lens antenna  $4^\circ$

<sup>3)</sup> Time span (after a sudden measuring distance change of max. 2 m in bulk solids applications) until the output signal has taken on 90 % of the final value for the first time (IEC 61298-2).

<sup>4)</sup> Outside the specified beam angle, the energy level of the radar signal is 50% (-3 dB) less.

Emitted HF power (depending on the parameter adjustment)<sup>5)</sup>

- Average spectral transmission power density      -3 dBm/MHz EIRP
- Max. spectral transmission power density      +34 dBm/50 MHz EIRP
- Max. power density at a distance of 1 m      < 3 µW/cm<sup>2</sup>

## Ambient conditions

Ambient, storage and transport temperature      < ±15 µA

## Process conditions

For the process conditions, please also note the specifications on the type label. The lowest value always applies.

## Process temperature

Antenna lens	Seal	Process temperature (measured on the process fitting)
PEEK	FKM (SHS FPM 70C3 GLT)	-40 ... +130 °C (-40 ... +266 °F)
		-40 ... +200 °C (-40 ... +392 °F)
	EPDM (COG AP302)	-40 ... +130 °C (-40 ... +266 °F)
PP	FKM (SHS FPM 70C3 GLT)	-40 ... +80 °C (-40 ... +176 °F)
	EPDM (COG AP310)	-40 ... +80 °C (-40 ... +176 °F)

## Ambient temperature - Process temperature

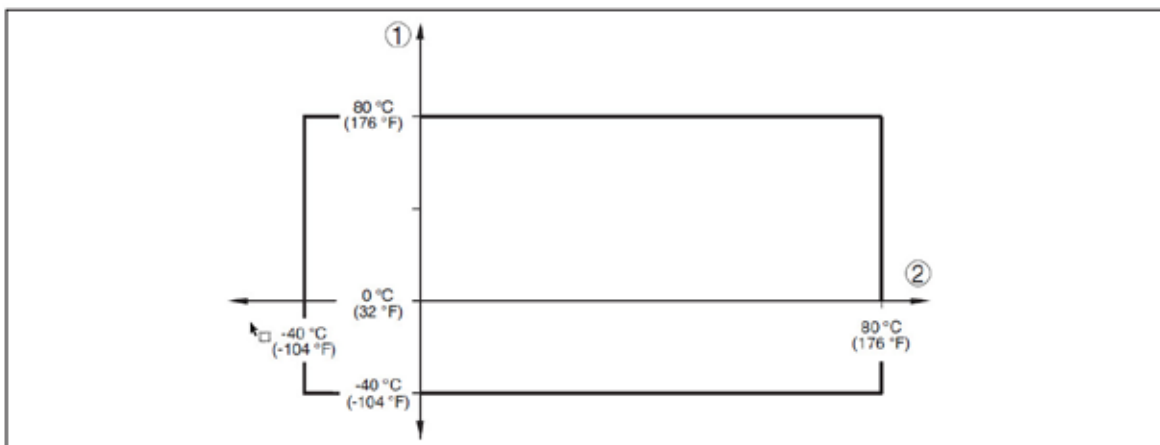


Fig. 60: Ambient temperature - Process temperature, plastic horn antenna

1 Ambient temperature

2 Process temperature

<sup>5)</sup> EIRP: Equivalent Isotropic Radiated Power.

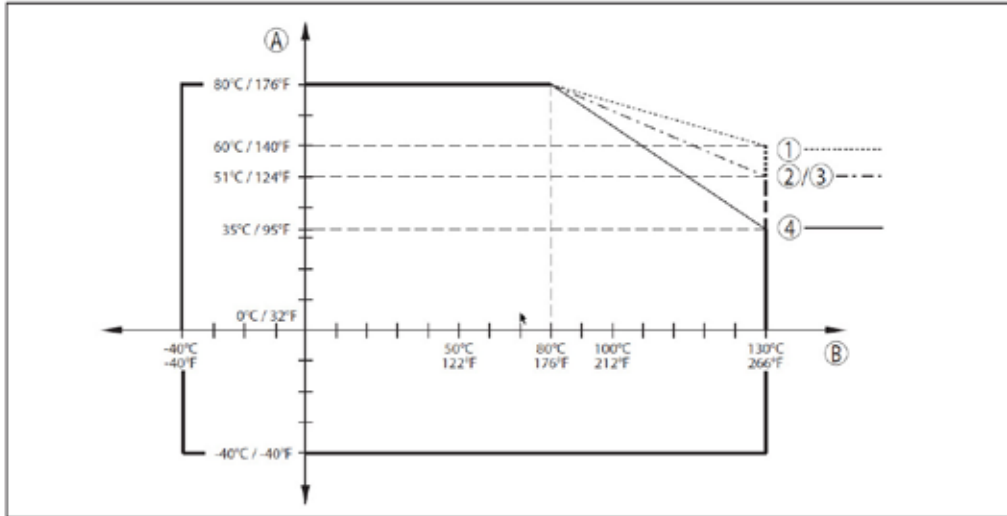


Fig. 61: Ambient temperature - Process temperature, metal-jacketed lens antenna up to +130 °C (266 °F)

A Ambient temperature

B Process temperature

1 Aluminium housing

2 Plastic housing

3 Stainless steel housing, precision casting

4 Stainless steel housing, electropolished

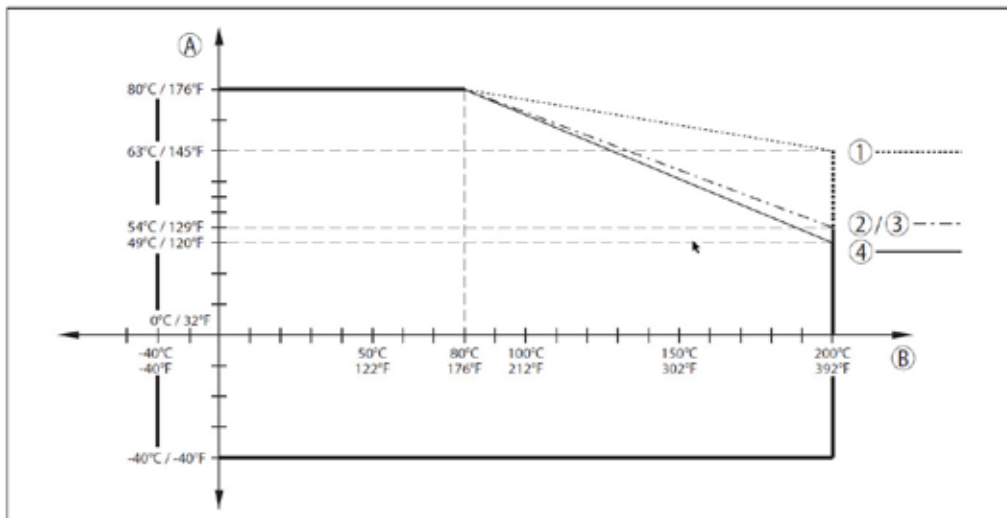


Fig. 62: Ambient temperature - Process temperature, metal-jacketed lens antenna up to +200 °C (392 °F)

A Ambient temperature

B Process temperature

1 Aluminium housing

2 Plastic housing

3 Stainless steel housing, precision casting

4 Stainless steel housing, electropolished

## Vessel

### Vessel pressure

- Metal-jacketed lens antenna -1 ... 3 bar (-100 ... 300 kPa/-14.5 ... 43.5 psig)
- Plastic horn antenna -1 ... 2 bar (-100 ... 200 kPa/-14.5 ... 29.1 psig)
- Plastic horn antenna - Version with adapter flange from DN 100 PP or PP-GF 30 -1 ... 1 bar (-100 ... 100 kPa/-14.5 ... 14.5 psig)

Vessel pressure relating to the flange nominal pressure stage

see supplementary instructions manual  
“Flanges according to DIN-EN-ASME-JIS”

### Mechanical stresses

Vibration resistance - Metal jacketed lens antenna

4 g at 5 ... 200 Hz according to EN 60068-2-6 (vibration with resonance)

Vibration resistance - Plastic horn antenna

– With adapter flange

2 g at 5 ... 200 Hz according to EN 60068-2-6 (vibration with resonance)

– with mounting strap

1 g at 5 ... 200 Hz according to EN 60068-2-6 (vibration with resonance)

Shock resistance

100 g, 6 ms according to EN 60068-2-27 (mechanical shock)

### Data on rinsing air connection

Recommended max. pressure with continuous rinsing

1 bar (14.50 psig)

Max. permissible pressure

6 bar (87.02 psig)

Air quality

Filtered

Air volume, depending on pressure

Metal-jacketed lens antenna	Air volume	
	Without reflux valve	With reflux valve
Pressure		
0.2 bar (2.9 psig)	1.7 m <sup>3</sup> /h	-
0.4 bar (5.8 psig)	2.5 m <sup>3</sup> /h	-
0.6 bar (8.7 psig)	2.9 m <sup>3</sup> /h	0.8 m <sup>3</sup> /h
0.8 bar (11.6 psig)	3.3 m <sup>3</sup> /h	1.5 m <sup>3</sup> /h
1 bar (14.5 psig)	3.6 m <sup>3</sup> /h	2 m <sup>3</sup> /h
1.2 bar (17.4 psig)	3.9 m <sup>3</sup> /h	2.3 m <sup>3</sup> /h
1.4 bar (20.3 psig)	4 m <sup>3</sup> /h	2.7 m <sup>3</sup> /h
1.6 bar (23.2 psig)	4.3 m <sup>3</sup> /h	3 m <sup>3</sup> /h
1.8 bar (20.3 psig)	4.5 m <sup>3</sup> /h	3.5 m <sup>3</sup> /h
2 bar (23.2 psig)	4.6 m <sup>3</sup> /h	4 m <sup>3</sup> /h

Plastic horn antenna	Air volume	
Pressure	Without reflux valve	With reflux valve
0.2 bar (2.9 psig)	3.3 m³/h	-
0.4 bar (5.8 psig)	5 m³/h	-
0.6 bar (8.7 psig)	6 m³/h	1 m³/h
0.8 bar (11.6 psig)	-	2.1 m³/h
1 bar (14.5 psig)	-	3 m³/h
1.2 bar (17.4 psig)	-	3.5 m³/h
1.4 bar (20.3 psig)	-	4.2 m³/h
1.6 bar (23.2 psig)	-	4.4 m³/h
1.8 bar (20.3 psig)	-	4.8 m³/h
2 bar (23.2 psig)	-	5.1 m³/h

#### Connection

- Thread G $\frac{1}{8}$
- Seal with metal jacketed lens antenna Threaded plug of 316Ti

#### Reflux valve - (optional, is absolutely necessary for Ex applications)

- Material 316Ti
- Thread G $\frac{1}{8}$
- Seal FKM (SHS FPM 70C3 GLT), EPDM (COG AP310)
- For connection G $\frac{1}{8}$
- Opening pressure 0.5 bar (7.25 psig)
- Nominal pressure stage PN 250

#### Electromechanical data - version IP 66/IP 67 and IP 66/IP 68; 0.2 bar

##### Options of the cable entry

- Cable entry M20 x 1.5,  $\frac{1}{2}$  NPT
- Cable gland M20 x 1.5;  $\frac{1}{2}$  NPT (cable  $\varnothing$  see below table)
- Blind plug M20 x 1.5;  $\frac{1}{2}$  NPT
- Closing cap  $\frac{1}{2}$  NPT

Material cable gland	Material seal insert	Cable diameter				
		4.5 ... 8.5 mm	5 ... 9 mm	6 ... 12 mm	7 ... 12 mm	10 ... 14 mm
PA	NBR	–	•	•	–	•
Brass, nickel-plated	NBR	•	•	•	–	–
Stainless steel	NBR	–	•	•	–	•

#### Wire cross-section (spring-loaded terminals)

- Massive wire, stranded wire 0.2 ... 2.5 mm² (AWG 24 ... 14)
- Stranded wire with end sleeve 0.2 ... 1.5 mm² (AWG 24 ... 16)

## Electromechanical data - version IP 66/IP 68 (1 bar)

### Options of the cable entry

- Cable gland with integrated connection cable M20 x 1.5 (cable:  $\varnothing$  5 ... 9 mm)
- Cable entry  $\frac{1}{2}$  NPT
- Blind plug M20 x 1.5;  $\frac{1}{2}$  NPT

### Connection cable

- Wire cross-section 0.5 mm<sup>2</sup> (AWG 20)
- Wire resistance < 0.036  $\Omega$ /m
- Tensile strength < 1200 N (270 lbf)
- Standard length 5 m (16.4 ft)
- Max. length 180 m (590.6 ft)
- Min. bending radius 25 mm (0.984 in) with 25 °C (77 °F)
- Diameter approx. 8 mm (0.315 in)
- Color - Non-Ex version Black
- Color - Ex-version Blue

## Display and adjustment module

Display element Display with backlight

### Measured value indication

- Number of digits 5
- Size of digits W x H = 7 x 13 mm

Adjustment elements 4 keys

### Protection rating

- unassembled IP 20
- mounted in the housing without lid IP 40

### Materials

- Housing ABS
- Inspection window Polyester foil

## Interface to the external display and adjustment unit

Data transmission Digital (I<sup>2</sup>C-Bus)

Connection cable Four-wire

Sensor version	Configuration, connection cable			
	Cable length	Standard cable	Special cable	Screened
4 ... 20 mA/HART	50 m	•	–	–
Profibus PA, Foundation Fieldbus	25 m	–	•	•

## Integrated clock

Date format Day.Month.Year

Time format 12 h/24 h

Time zone Ex factory CET  
Rate deviation max. 10.5 min/year

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**Additional output parameter - Electronics temperature**

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Output of the temperature values

– Analogue Via the current output  
– Digital Via the digital output signal -  
depending on the electronics version

Range -40 ... +85 °C (-40 ... +185 °F)

Resolution < 0.1 K

Accuracy ±3 K

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**Voltage supply**

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Operating voltage UB

– Non-Ex instrument 12 ... 35 V DC  
– Ex-d instrument 12 ... 35 V DC  
– Ex ia instrument 12 ... 30 V DC  
– Ex-d-ia instrument 17 ... 35 V DC

Operating voltage UB - illuminated display and adjustment module

– Non-Ex instrument 18 ... 35 V DC  
– Ex-d instrument 18 ... 35 V DC  
– Ex ia instrument 18 ... 30 V DC  
– Ex-d-ia instrument Due to the barrier, no lighting possible

Reverse voltage protection Integrated

Permissible residual ripple - Non-Ex, Ex-ia instrument

– for 12 V < UB < 18 V ≤ 0.7 V<sub>eff</sub> (16 ... 400 Hz)  
– for 18 V < UB < 35 V ≤ 1.0 V<sub>eff</sub> (16 ... 400 Hz)

Permissible residual ripple - Ex-d-ia instrument

– for 18 V < UB < 35 V ≤ 1 V<sub>eff</sub> (16 ... 400 Hz)

Load resistor

– Calculation (UB - U<sub>min</sub>)/0.022 A  
– Example - Non-Ex instrument with UB = 24 V DC (24 V - 12 V)/0.022 A = 545 Ω

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**Electrical protective measures**

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Protection rating

Housing material	Version	IP-protection class	NEMA protection
Plastic	Single chamber	IP 66/IP 67	Type 4X
	Double chamber	IP 66/IP 67	Type 4X

Housing material	Version	IP-protection class	NEMA protection
Aluminium	Single chamber	IP 66/IP 68 (0.2 bar) IP 68 (1 bar)	Type 6P -
	Double chamber	IP 66/IP 68 (0.2 bar) IP 68 (1 bar)	Type 6P -
Stainless steel, electro- polished	Single chamber	IP 66/IP 68 (0.2 bar)	Type 6P -
Stainless steel, precision casting	Single chamber	IP 66/IP 68 (0.2 bar) IP 68 (1 bar)	Type 6P -
	Double chamber	IP 66/IP 68 (0.2 bar) IP 68 (1 bar)	Type 6P -

Protection rating (IEC 61010-1) III

## Approvals

Instruments with approvals can have different technical specifications depending on the version.

## 11.2 Radio astronomy stations

Certain restrictions on the use of NCR-80 outside closed vessels result from the radio license. You can find these restrictions in chapter "Radio license for Europe". Some of these restrictions have to do radio astronomy stations. The following table states the geographic positions of radio astronomy stations in Europe:

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

## 11.3 Dimensions

The following dimensional drawings represent only an extract of all possible versions.

## Plastic housing

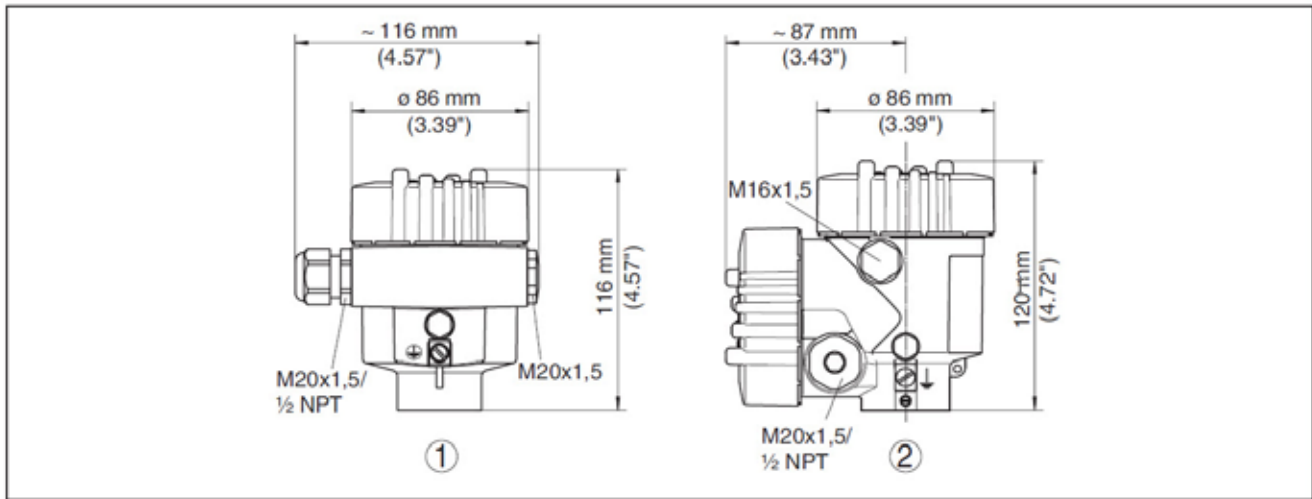


Fig. 63: Housing versions with protection rating IP 66/IP 67 - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

- 1 Single chamber version
- 2 Double chamber version

## Aluminium housing

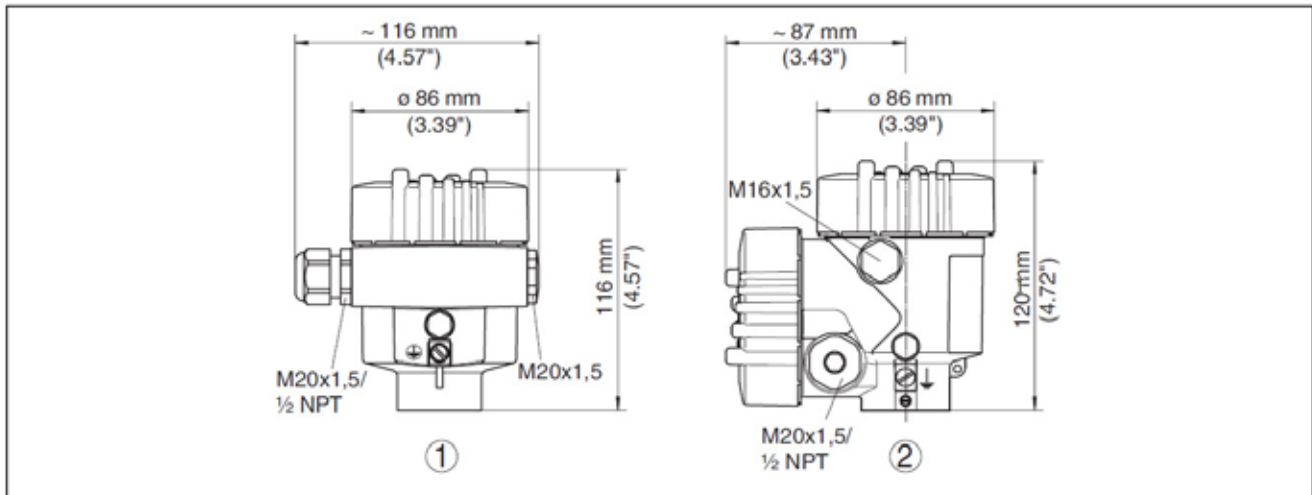


Fig. 64: Housing versions with protection rating IP 66/IP 68 (0.2 bar) - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

- 1 Single chamber version
- 2 Double chamber version

## Aluminium housing with protection rating IP 66/IP 68 (1 bar)

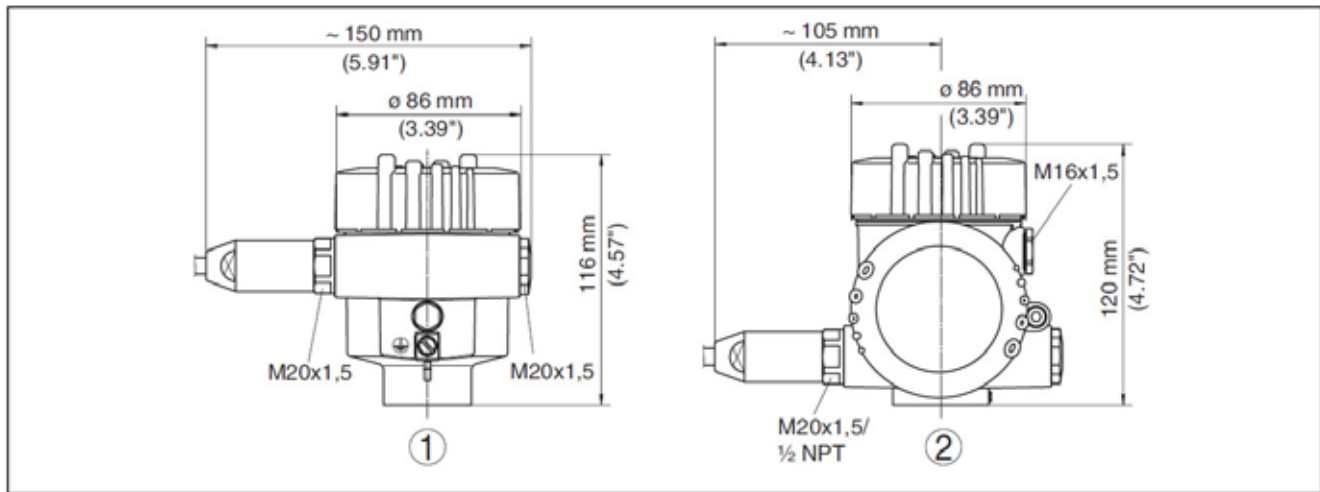


Fig. 65: Housing version with protection rating IP 66/IP 68 (1 bar) - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

- 1 Single chamber version
- 2 Double chamber version

## Stainless steel housing

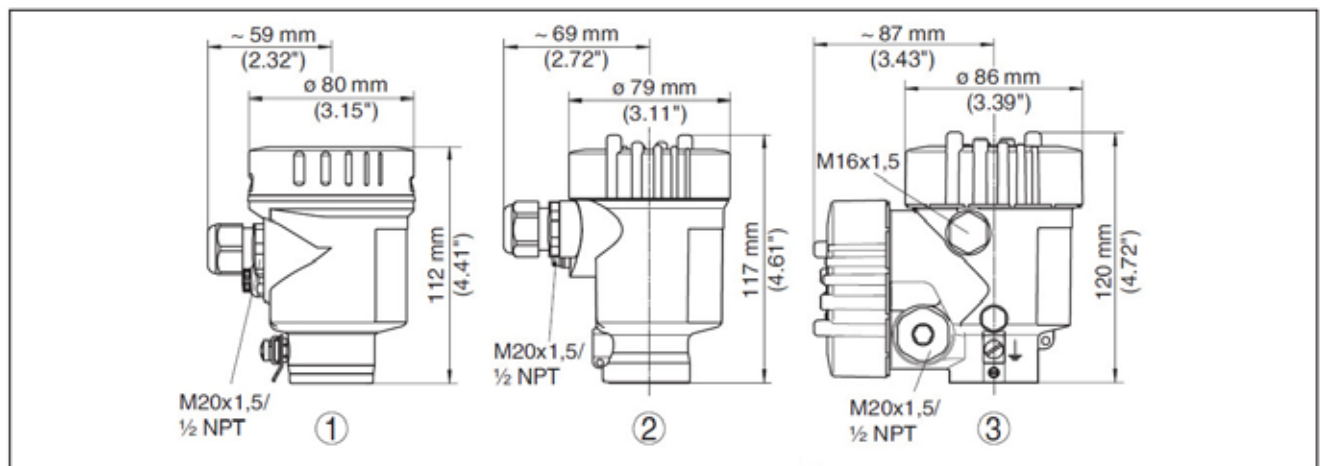


Fig. 66: Housing versions with protection rating IP 66/IP 68 (0.2 bar) - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

- 1 Single chamber version, electropolished
- 2 Single chamber version, precision casting
- 3 Double chamber version, precision casting

## Stainless steel housing with protection rating IP 66/IP 68, 1 bar

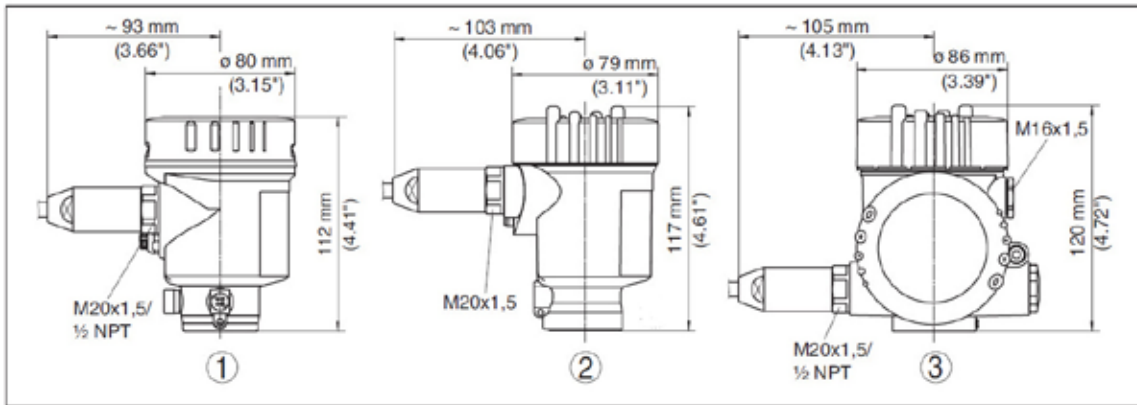


Fig. 67: Housing version with protection rating IP 66/IP 68 (1 bar) - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

- 1 Single chamber version, electropolished
- 2 Single chamber version, precision casting
- 3 Double chamber version, precision casting

## NCR-80, plastic horn antenna with compression flange

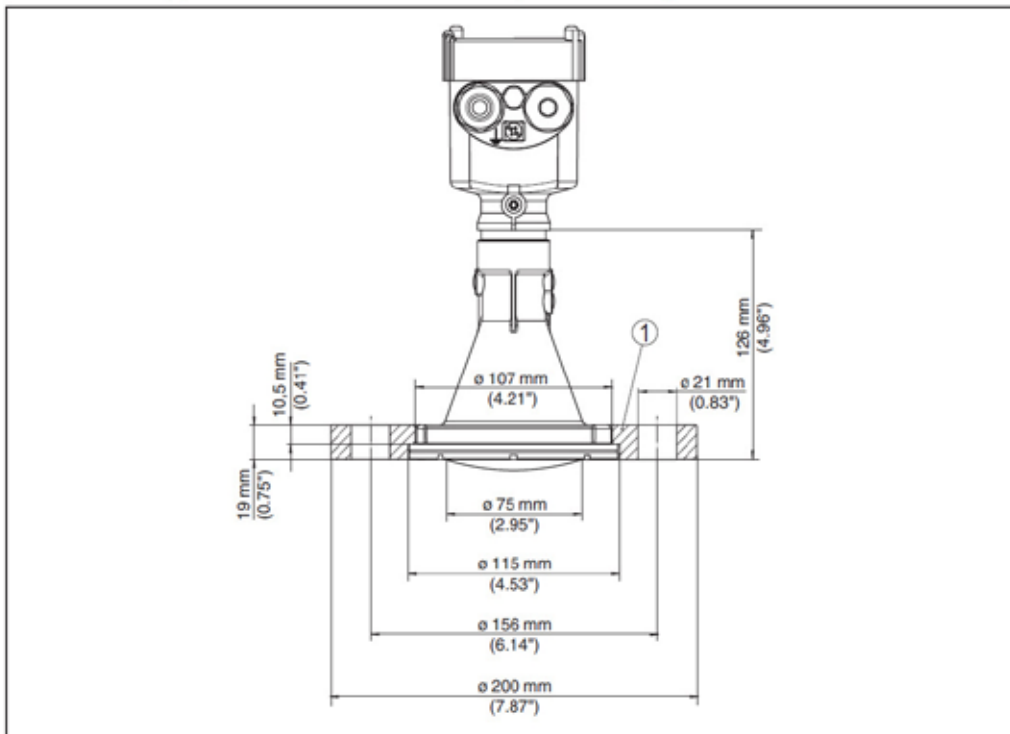


Fig. 68: Radar sensor with compression flange

- 1 Compression flange

## NCR-80, plastic horn antenna with compression flange and rinsing connection

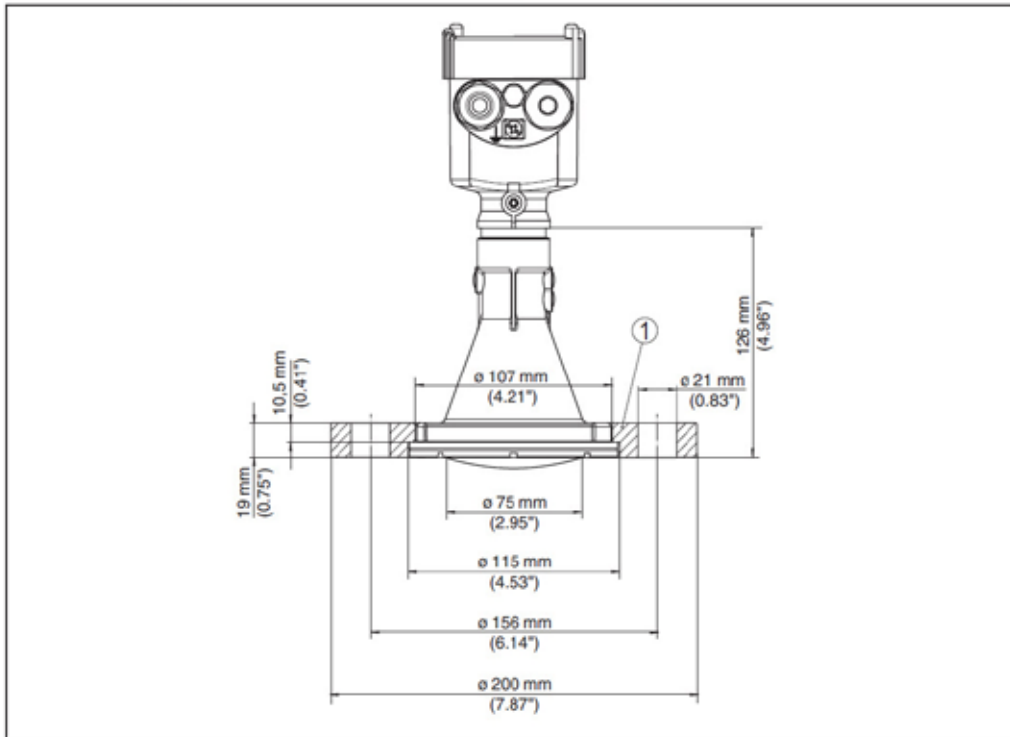


Fig. 69: Radar sensor with compression flange and rinsing connection

- 1 Compression flange
- 2 Reflux valve
- 3 Rinsing connection

## NCR-80, plastic horn antenna with adapter flange

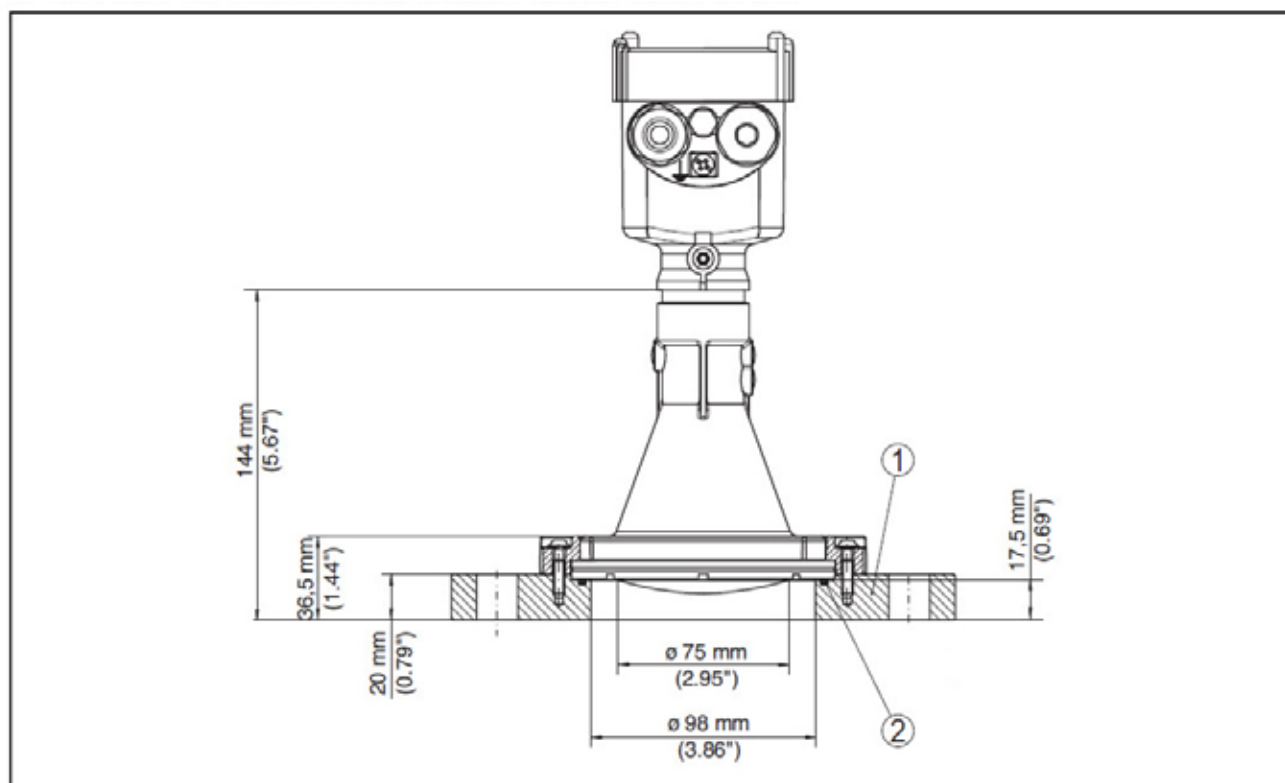


Fig. 70: Radar sensor with adapter flange

1 Adapter flange

2 Process seal

## NCR-80, plastic horn antenna with adapter flange and rinsing connection

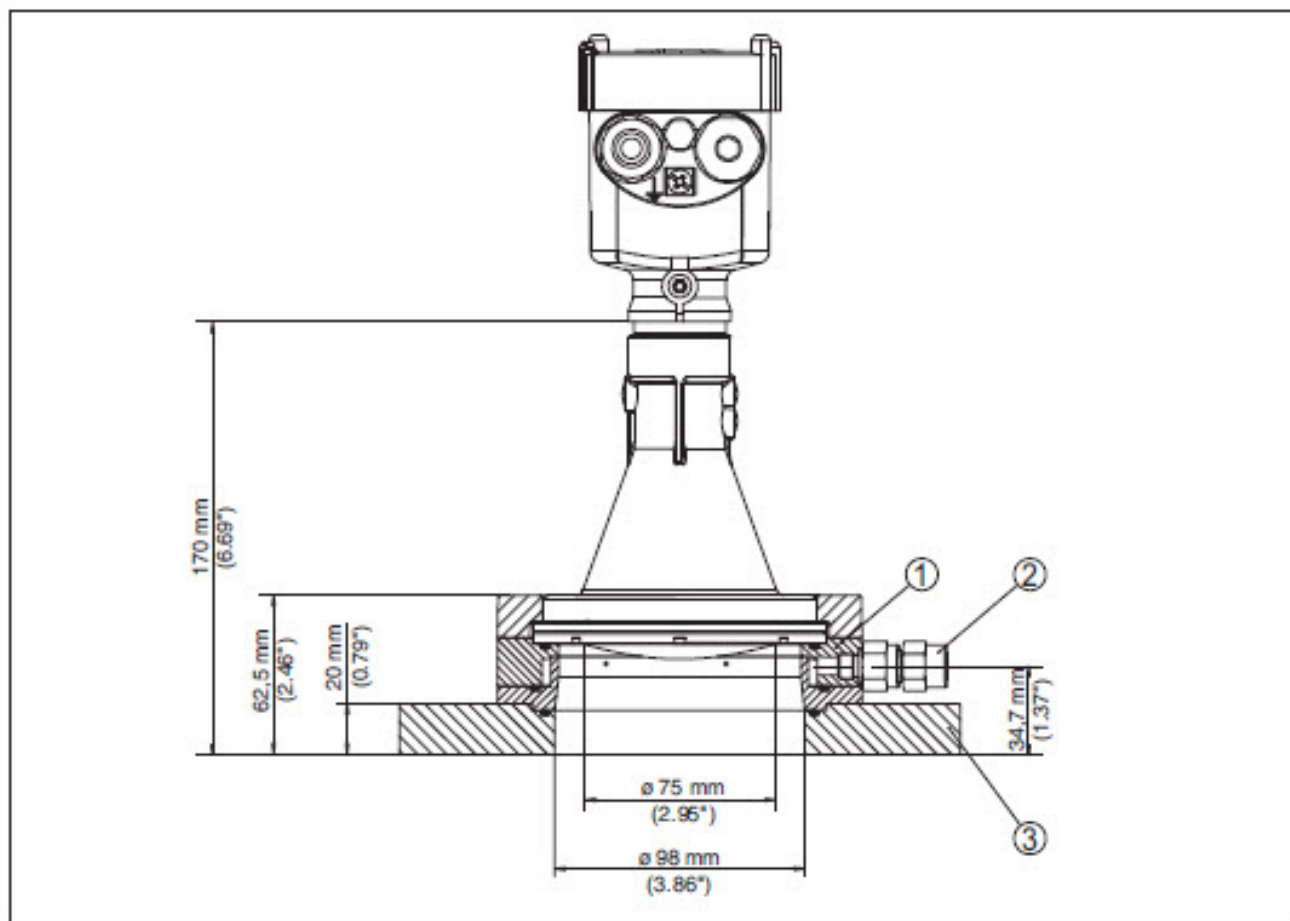


Fig. 71: NCR-80, adapter flange and rinsing connection

- 1 Rinsing air connection
- 2 Reflux valve
- 3 Adapter flange

## NCR-80, plastic horn antenna with adapter flange and rinsing connection

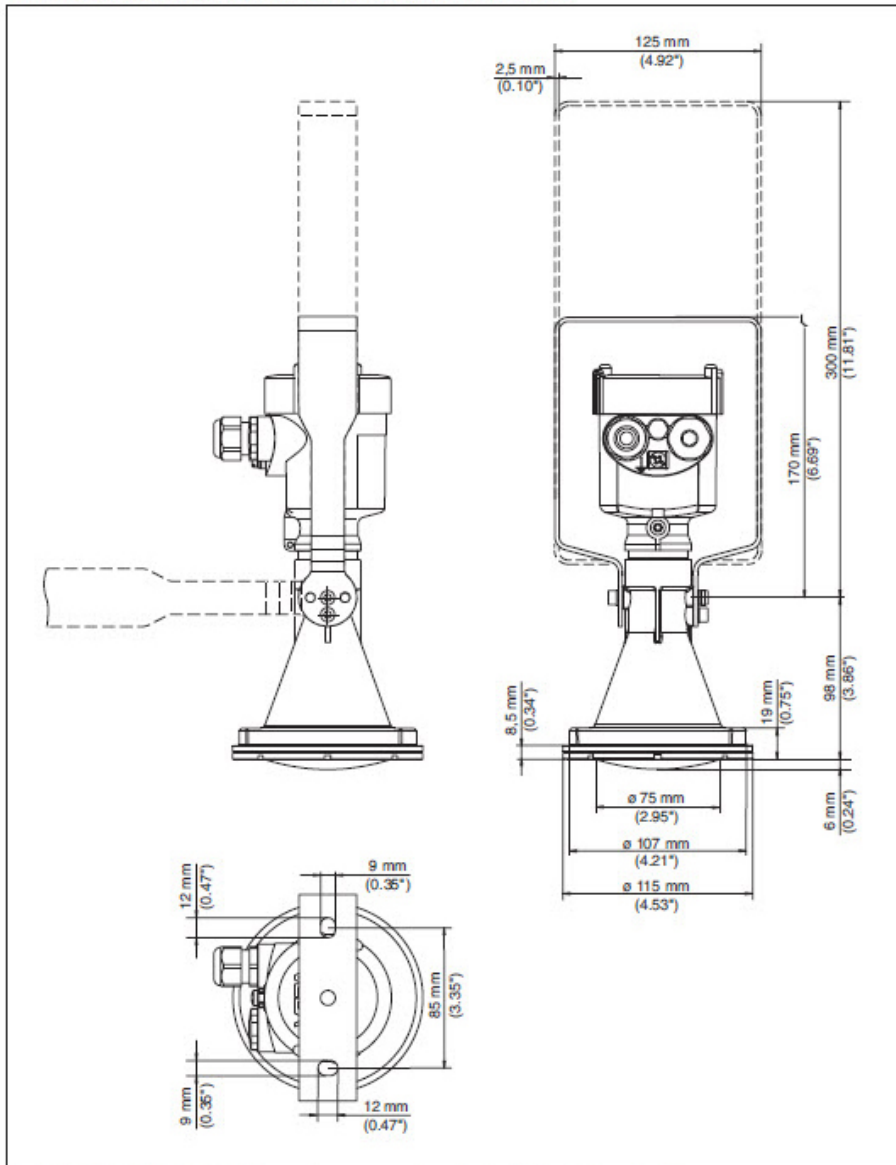


Fig. 72: NCR-80, plastic horn antenna, mounting strap in 170 or 300 mm length

## NCR-80, metal-jacketed lens antenna

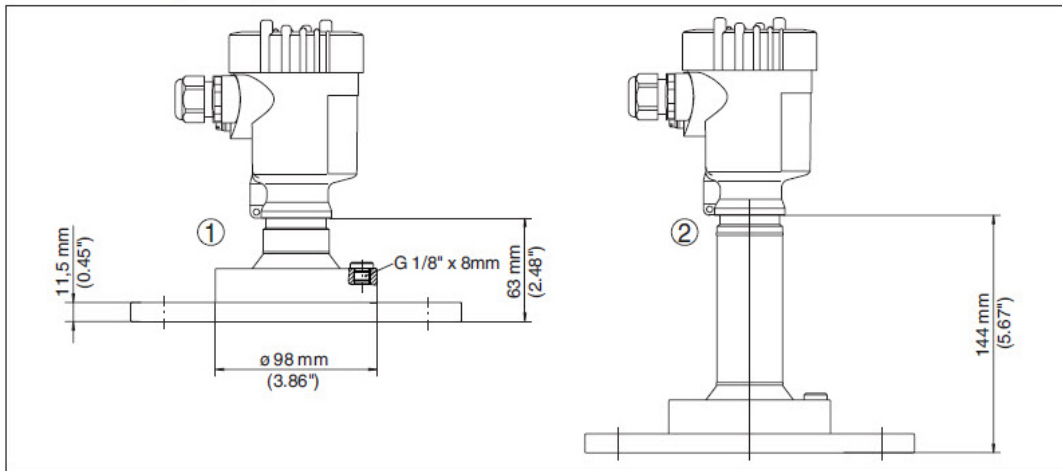


Fig. 73: NCR-80, metal-jacketed lens antenna. Flange thickness acc. to drawing, flange dimensions acc. to DIN/ASME/JIS.

- 1 Version up to 130 °C (266 °F)
- 2 Version up to 200 °C (392 °F)

## NCR-80, metal-jacketed lens antenna with rinsing connection

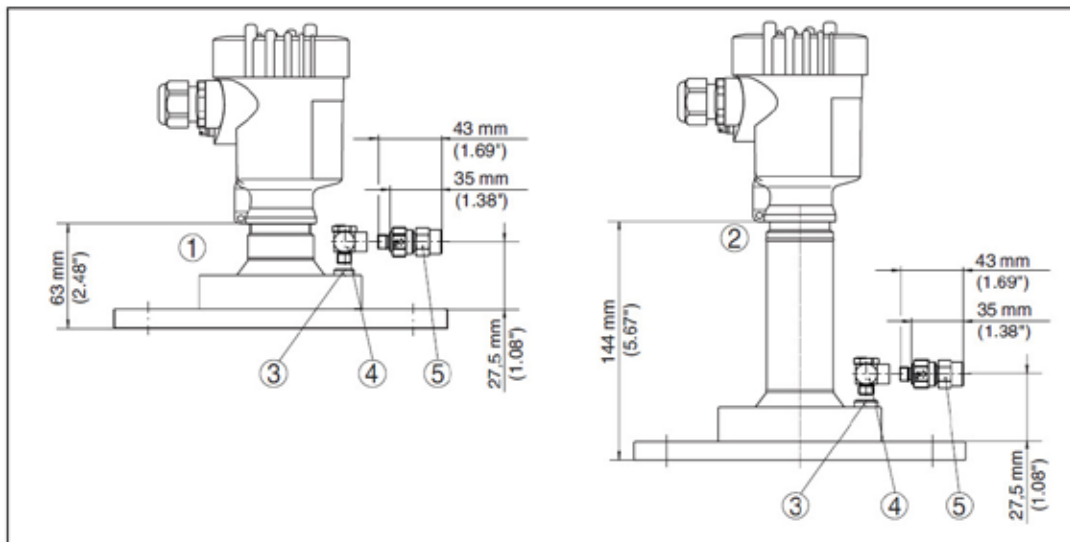


Fig. 74: NCR-80, metal-jacketed lens antenna with rinsing connection

- 1 Version up to 130 °C (266 °F)
- 2 Version up to 200 °C (392 °F)
- 3 Blind plug
- 4 90° angle joint
- 5 Reflux valve

## NCR-80, metal-jacketed lens antenna with swiveling mount

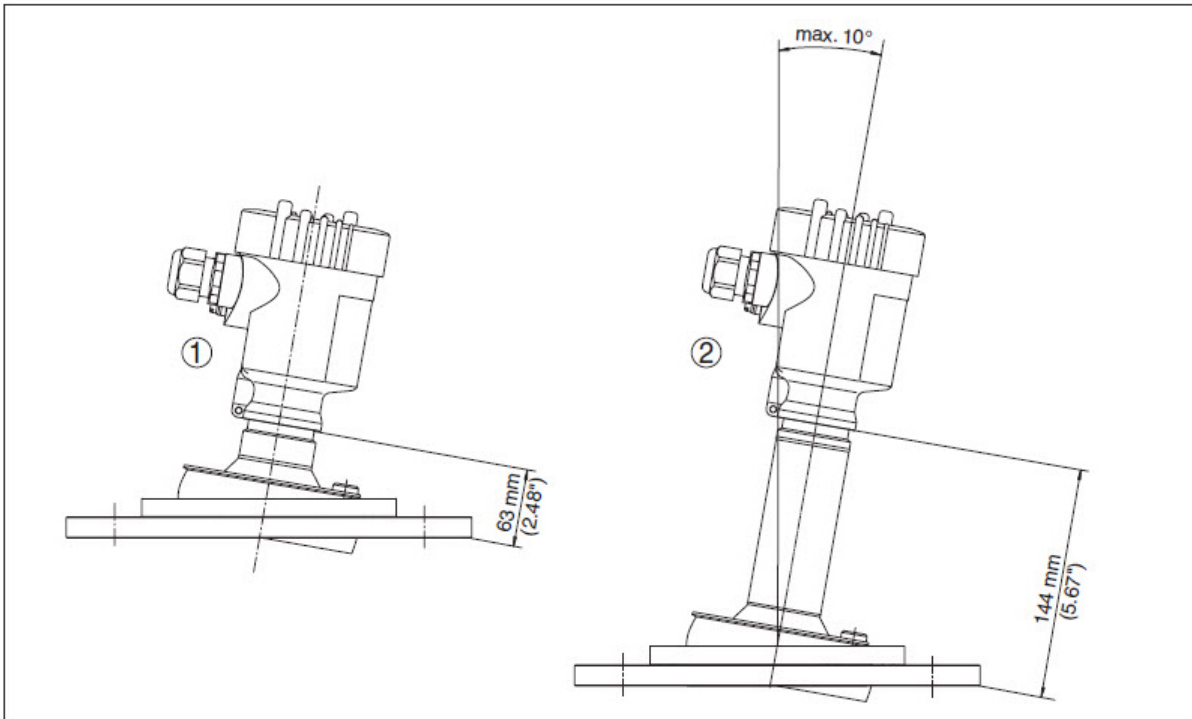


Fig. 75: NCR-80, metal-jacketed lens antenna and swiveling mount

- 1 Version up to 130 °C (266 °F)
- 2 Version up to 200 °C (392 °F)

## NCR-80, metal-jacketed lens antenna with swiveling mount and rinsing connection

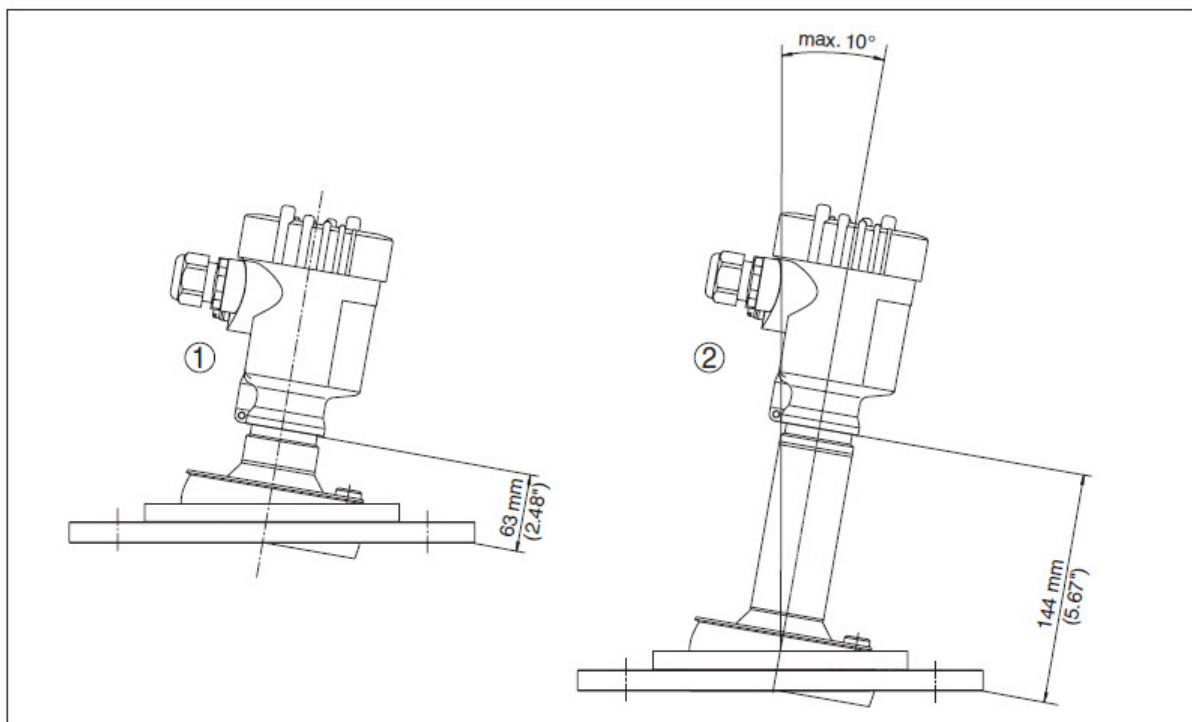


Fig. 76: NCR-80 metal-jacketed lens antenna with swiveling mount and rinsing connection

- 1 Version up to 130 °C (266 °F)
- 2 Version up to 200 °C (392 °F)
- 3 Blind plug
- 4 90° angle joint
- 5 Reflux valve

All statements concerning scope of delivery, application, practical use and operating conditions of the sensors and processing systems correspond to the information available at the time of printing.

Subject to change without prior notice.

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