

## Contents

|                                               | page |
|-----------------------------------------------|------|
| About this document                           | 3    |
| For your safety                               | 4    |
| Product description                           | 6    |
| Technical data                                | 11   |
| Setup - the most important steps              | 32   |
| Mounting                                      | 33   |
| Connecting to power supply                    | 47   |
| Access protection, IT security                | 52   |
| Set up with the display and adjustment module | 54   |
| Setup with smartphone/tablet (Bluetooth)      | 83   |
| Set up with PC/notebook                       | 85   |
| Menu overview                                 | 89   |
| Diagnosis, asset management and service       | 101  |
| Dismount                                      | 119  |
| Certificates, approvals and certifications    | 120  |
| Supplement                                    | 121  |





## About this document

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### Function

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

### Target group

This instruction manual is directed to trained personnel. The contents of this manual must be made available to the qualified personnel and implemented.

### Symbols used



**Information, note, tip:** This symbol indicates helpful additional information and tips for successful work.



**Note:** This symbol indicates notes to prevent failures, malfunctions, damage to devices or plants.



**Caution:** Non-observance of the information marked with this symbol may result in personal injury.



**Warning:** Non-observance of the information marked with this symbol may result in serious or fatal personal injury.



**Danger:** Non-observance of the information marked with this symbol results in serious or fatal personal injury.



#### Ex applications

This symbol indicates special instructions for Ex applications.



#### List

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



#### Sequence of actions

Numbers set in front indicate successive steps in a procedure.



#### Disposal

This symbol indicates special instructions for disposal.

## For your safety

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### Authorised personnel

All operations described in this documentation must be carried out only by trained and authorized personnel.

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

### Appropriate use

NivoRadar 8500 is a sensor for continuous level measurement.

You can find detailed information about the area of application in chapter "*Product description*".

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

### Warning about incorrect use

Inappropriate or incorrect use of this product can give rise to application-specific hazards, e.g. vessel overfill through incorrect mounting or adjustment. Damage to property and persons or environmental contamination can result. Also, the protective characteristics of the instrument can be impaired.

### General safety instructions

This is a state-of-the-art instrument complying with all prevailing regulations and directives. The instrument must only be operated in a technically flawless and reliable condition. The operating company is responsible for the trouble-free operation of the instrument. When measuring aggressive or corrosive media that can cause a dangerous situation if the instrument malfunctions, the operating company has to implement suitable measures to make sure the instrument is functioning properly.

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

For safety and warranty reasons, any invasive work on the device beyond that described in this instructions manual may be carried out only by personnel authorised by us. Arbitrary conversions or modifications are explicitly forbidden. For safety reasons, only the accessory specified by us must be used.

To avoid any danger, the safety approval markings and safety tips on the device must also be observed.

The low transmitting power of the radar sensor is far below the internationally approved limits. No health impairments are to be expected with intended use. The band range of

## For your safety

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the measuring frequency can be found in chapter "*Technical data*".

### Mode of operation - Radar signal

Country or region specific settings for the radar signals are determined via the mode. The operating mode must be set in the operating menu via the respective operating tool at the beginning of the setup.



#### **Caution:**

Operating the device without selecting the relevant mode constitutes a violation of the regulations of the radio approvals of the respective country or region.

### Installation and operation in the USA and Canada

This information is only valid for USA and Canada. Hence the following text is only available in the English language.

Installations in the US shall comply with the relevant requirements of the National Electrical Code (NEC - NFPA 70) (USA).

Installations in Canada shall comply with the relevant requirements of the Canadian Electrical Code (CEC Part I) (Canada).

A Class 2 power supply unit has to be used for the installation in the USA and Canada.

## Product description

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### Configuration

#### Scope of delivery

The scope of delivery encompasses:

- Radar sensor, possibly with accessories
- Information sheet "*PINs and Codes*" (with SIL, IT security, Bluetooth versions) with:
  - Bluetooth access code
  - Device code
- Information sheet "*Access protection*" (with SIL, IT security, Bluetooth versions) with:
  - Bluetooth access code
  - Emergency Bluetooth unlock code
  - Device code
  - Emergency device code
- Documentation
  - Quick setup guide
  - Instructions for optional instrument components
  - Ex-specific "*Safety instructions*" (with Ex versions)
  - Safety Manual (with SIL version)
  - Radio licenses
  - If necessary, further certificates



#### Information:

Optional instrument features are also described in this instructions. The respective scope of delivery results from the order specification.

#### Type label

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

- Instrument type
- Information about approvals
- Configuration information
- Technical data
- Serial number of the instrument
- QR code for device identification
- Numerical code for Bluetooth access (optional)
- Manufacturer information

#### Documents and software

Further information can be found on our homepage.

There you will find the documentation and further information about the device.

#### Electronics design

The instrument contains two different electronics in its housing chambers:

- The Modbus electronics for power supply and communication with the Modbus-RTU
- The sensor electronics for the actual measuring tasks

## Product description

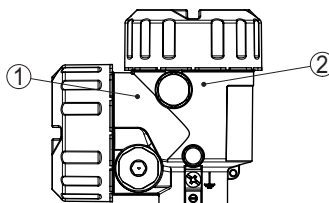


Fig. 1: Position of Modbus and sensor electronics

- 1 Modbus electronics
- 2 Sensor electronics

## Principle of operation

### Application area

The NivoRadar 8500 is a radar sensor for continuous level measurement of liquids under different process conditions.

### Antenna system

The instrument is available with high temperature horn antenna.

### Functional principle

The instrument emits a continuous, frequency-modulated radar signal through its antenna. The emitted signal is reflected by the medium and received by the antenna as an echo with modified frequency. The frequency change is proportional to the distance and is converted into the level.

## Adjustment

### Local adjustment

On-site adjustment of the device is carried out via the integrated display and adjustment unit.



#### Note:

The housing with display and adjustment unit can be rotated by 360° for optimum readability and operability.

### Wireless adjustment

Devices with integrated Bluetooth module can be adjusted wirelessly via standard adjustment tools:

- Smartphone/tablet (iOS or Android operating system)
- PC/notebook (Windows operating system)

## Product description

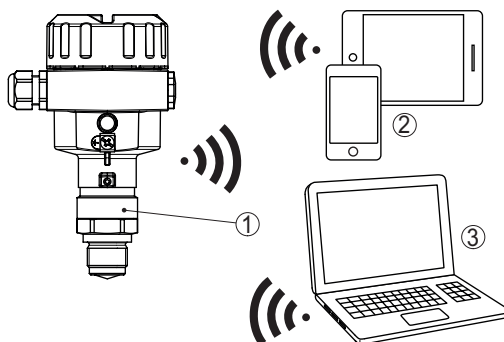


Fig. 2: Wireless connection to standard operating devices with integrated Bluetooth LE

- 1 Sensor
- 2 Smartphone/Tablet
- 3 PC/Notebook

## Adjustment via the signal cable

The adjustment via the signal cable is carried out via an RS 485/USB interface adapter and a PC/notebook using DTM/ PACTware.

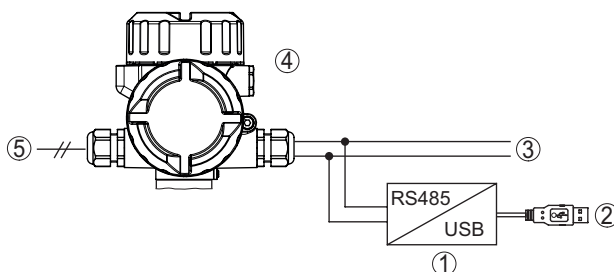


Fig. 3: Connection of the PC via the interface adapter to the RS 485 cable

- 1 Interface adapter RS 485/USB
- 2 USB cable to the PC
- 3 RS 485 cable
- 4 Sensor
- 5 Voltage supply

## Packaging, transport and storage

### Packaging

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 consists of environment-friendly, recyclable cardboard. For special versions, PE foam or PE foil is also

## Product description

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used. Dispose of the packaging material via specialised recycling companies.

### Transport

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.

### Transport inspection

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.

### Storage

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 "*Technical data - Ambient conditions*"
- Relative moisture 20 ... 85 %

### Storage and transport temperature

### Lifting and carrying

With instrument weights of more than 18 kg (39.68 lbs) suitable and approved equipment must be used for lifting and carrying.

### Accessories

The instructions for the listed accessories can be found in the download area on our homepage.

### Display and adjustment module

The display and adjustment module is used for measured value indication, adjustment and diagnosis.

The integrated Bluetooth module (optional) enables wireless adjustment via standard adjustment devices.

### Welded socket, threaded and hygienic adapter

Welded sockets are used to connect the devices to the process.

Threaded and hygienic adapters enable simple adaptation of devices with standard threaded fittings to process-side hygiene connections.

## Product description

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### Flanges

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.

## Technical data

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### Technical data

#### Note for approved instruments

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The technical data in the respective safety instructions which are included in delivery 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.

All approval documents can be downloaded from our homepage.

#### Materials and weights

---

##### Materials, wetted parts

Horn antenna

- |                      |                             |
|----------------------|-----------------------------|
| – Antenna horn       | 316L, 1.4848                |
| – Impedance cone     | Ceramic (99.7 % $Al_2O_3$ ) |
| – Seal up to +450 °C | Graphite                    |

##### Materials, non-wetted parts

Housing

- |                                       |                                                                  |
|---------------------------------------|------------------------------------------------------------------|
| – Aluminium die-cast housing          | Aluminium die-casting AlSi10Mg, powder-coated (Basis: Polyester) |
| – Stainless steel housing             | 316L                                                             |
| – Cable gland, blind plug cable gland | PA, stainless steel, brass                                       |
| – Sealing, cable gland                | NBR                                                              |
| – Inspection window housing cover     | Glass                                                            |
| – Ground terminal                     | 316L                                                             |

Weights

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

#### Torques

---

Max. torque, thread with integrated antenna system

- |       |                       |
|-------|-----------------------|
| – G1½ | 200 Nm (147.5 lbf ft) |
|-------|-----------------------|

Flange

- |          |                                                                                               |
|----------|-----------------------------------------------------------------------------------------------|
| – Torque | According to the current standards or at least according to the specifications on the flange. |
|----------|-----------------------------------------------------------------------------------------------|

Max. torque for NPT cable glands and Conduit tubes

- |                                     |                      |
|-------------------------------------|----------------------|
| – Aluminium/Stainless steel housing | 50 Nm (36.88 lbf ft) |
|-------------------------------------|----------------------|

## Technical data

### Torque housing locking

- Recommended torque locking screw 1 Nm (1.475 lbf ft)
- Max. torque locking screw 2 Nm (0.738 lbf ft)

## Input variable

### Measured variable

The measured quantity is the distance between the end of the sensor antenna and the medium surface. The reference plane for the measurement and the usable measuring range are dependent on the antenna system.

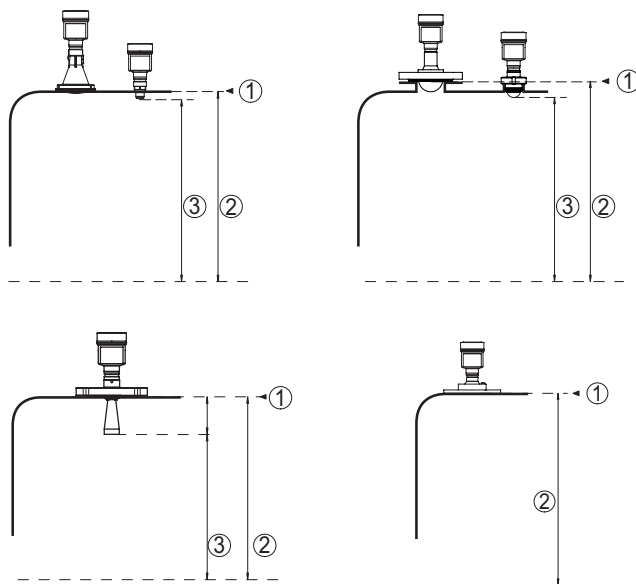


Fig. 4: Data of the input variable

- 1 Reference plane (depending on the antenna system)
- 2 Measured variable, max. measuring range
- 3 Utilisable measuring range (depending on the antenna version)

Max. measuring range 120 m (393.7 ft)

Recommended measuring range, depending on the antenna version and size<sup>1)2)</sup>

<sup>1)</sup> With good reflection conditions, larger measuring ranges are also possible.

<sup>2)</sup> The specified values correspond to the default values on delivery.

## Technical data

| Size    | Recommended measuring range up to |
|---------|-----------------------------------|
| ø 40 mm | 30 m (98.42 ft)                   |
| ø 48 mm |                                   |
| ø 75 mm | 120 m (393.7 ft)                  |

blocking distance<sup>1)</sup>

- |                 |                     |
|-----------------|---------------------|
| - Modes 1, 2, 4 | 0 mm (0 in)         |
| - Mode 3        | ≥ 250 mm (9.843 in) |

### Switch-on phase

|                                                |                          |
|------------------------------------------------|--------------------------|
| Run-up time $t$ ( $U_B \geq 24 \text{ V DC}$ ) | $\leq 15 \text{ s}^{2)}$ |
| Starting current for run-up time               | $\leq 3.6 \text{ mA}$    |

### Output variable

## Output

- |                        |                                                                   |
|------------------------|-------------------------------------------------------------------|
| – Physical layer       | Digital output signal according to standard EIA-485               |
| – Bus specifications   | Modbus Application Protocol V1.1b3, Modbus over serial line V1.02 |
| – Data protocols       | Modbus RTU, Modbus ASCII, Levelmaster                             |
| Max. transmission rate | 57.6 Kbit/s                                                       |

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

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<sup>3)</sup>

- |                                           |                                                            |
|-------------------------------------------|------------------------------------------------------------|
| - Min. distance to internal installations | > 200 mm (7.874 in)                                        |
| - Reflector                               | Flat plate reflector                                       |
| - False reflections                       | Biggest false signal, 20 dB smaller than the useful signal |

<sup>1)</sup> Depending on the operating conditions

<sup>2)</sup> Reference conditions:  $U_p = 24$  V DC, ambient temperature 20 °C (68 °F)

3) In case of deviations from reference conditions, the offset due to installation can be up to  $\pm 4$  mm. This offset can be compensated by the adjustment.

## Technical data

|                                 |                                            |
|---------------------------------|--------------------------------------------|
| Deviation with liquids          | ≤ 1 mm (meas. distance > 0.25 m/0.8202 ft) |
| Non-repeatability <sup>1)</sup> | ≤ 1 mm                                     |
| blocking distance               | 150 mm (5.906 in)                          |

## Variables influencing measurement accuracy

|                                    |                         |
|------------------------------------|-------------------------|
| Temperature drift - Digital output | < 3 mm/10 K, max. 10 mm |
|------------------------------------|-------------------------|

## Characteristics and performance data

|                                    |                            |
|------------------------------------|----------------------------|
| Measuring frequency                | W-band (80 GHz technology) |
| Measuring cycle time <sup>2)</sup> | approx. 200 ms             |
| Step response time <sup>3)</sup>   | ≤ 3 s                      |
| Beam angle <sup>4)</sup>           |                            |
| – ø 40 mm                          | 7°                         |
| – ø 48 mm                          | 6°                         |
| – ø 75 mm                          | 3°                         |

Emitted HF power (depending on the parameter setting)<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/cm²          |

## Ambient conditions

|                                            |                                  |
|--------------------------------------------|----------------------------------|
| Ambient, storage and transport temperature | -40 ... +80 °C (-40 ... +176 °F) |
|--------------------------------------------|----------------------------------|

## Process conditions - Temperature

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

<sup>1)</sup> Already included in the meas. deviation

<sup>2)</sup> With operating voltage  $U_b \geq 24$  V DC

<sup>3)</sup> Time span after a sudden distance change from 1 m to 5 m until the output signal reaches 90 % of the final value for the first time (IEC 61298-2). Valid with operating voltage  $U_b \geq 24$  V DC

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

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

## Technical data

| Antenna material                                                              | Process seal | Process temperature (measured on the process fitting) |
|-------------------------------------------------------------------------------|--------------|-------------------------------------------------------|
| Antenna horn: 316L, impedance cone: ceramic (99.7 % $\text{Al}_2\text{O}_3$ ) | Graphite     | -196 ... +450 °C (-321 ... +842 °F)                   |

## Derating, ambient temperature

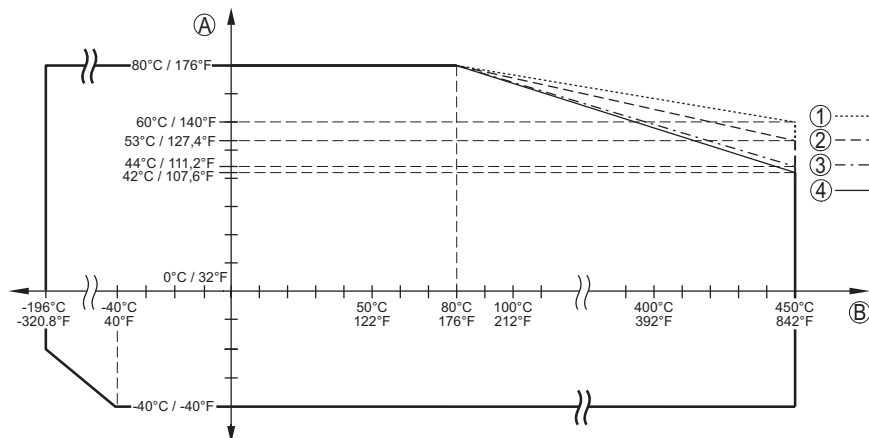


Fig. 5: Derating ambient temperature, horn antenna up to +450 °C (+842 °F)

- A Ambient temperature
- B Process temperature
- 1 Aluminium housing
- 2 -
- 3 -
- 4 Stainless steel housing (electropolished)

## Process conditions - Pressure

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

up to +450 °C (+842 °F)      -1 ... 160 bar (-100 ... 16000 kPa/-14.5 ... 2320 psig)

## Mechanical environmental conditions

### Vibration resistance (Tested according to IEC 60068-2-6, 5 ... 200 Hz)

| Antenna version | Housing         | Vibration resistance |
|-----------------|-----------------|----------------------|
| Thread          | Aluminium       | 5 g                  |
|                 | Stainless steel | 2 g                  |

## Technical data

| Antenna version | Housing         | Vibration resistance |
|-----------------|-----------------|----------------------|
| Flange          | Aluminium       | 5 g                  |
|                 | Stainless steel | 2 g                  |

## Shock resistance (Tested according to IEC 60068-2-27)

| Housing         | Shock resistance                                 |
|-----------------|--------------------------------------------------|
| Aluminium       | 10 g/11 ms, 30 g/6 ms, 50 g/2.3 ms <sup>1)</sup> |
| Stainless steel |                                                  |

## Electromechanical data - version IP66/IP67

|                                              |                                             |
|----------------------------------------------|---------------------------------------------|
| Cable gland                                  | M20 x 1.5 or ½ NPT                          |
| Wire cross-section (spring-loaded terminals) |                                             |
| – Massive wire, stranded wire                | 0.2 ... 2.5 mm <sup>2</sup> (AWG 24 ... 14) |
| – Stranded wire with end sleeve              | 0.2 ... 1.5 mm <sup>2</sup> (AWG 24 ... 16) |

## Interface to the external display and adjustment unit

|                   |                                |
|-------------------|--------------------------------|
| Data transmission | Digital (I <sup>2</sup> C-Bus) |
| Connection cable  | 4-wire, shielded               |
| Cable length      | ≤ 50 m (164.0 ft)              |

## Integrated clock

|                            |                |
|----------------------------|----------------|
| Date format                | Day.Month.Year |
| Time format                | 12 h/24 h      |
| Time zone, factory setting | CET            |
| Max. rate deviation        | 10.5 min/year  |

## Additional output parameter - Electronics temperature

|                                        |                                       |
|----------------------------------------|---------------------------------------|
| Range                                  | -40 ... +85 °C (-40 ... +185 °F)      |
| Resolution                             | < 0.1 K                               |
| Deviation                              | ± 3 K                                 |
| Availability of the temperature values |                                       |
| – Indication                           | Via the display and adjustment module |
| – Output                               | Via the respective output signal      |

<sup>1)</sup> For hygienic fittings with clamp connection, use suitable, stable tension clamps to ensure the vibration resistance.

## Technical data

### Voltage supply

|                            |               |
|----------------------------|---------------|
| Operating voltage          | 8 ... 30 V DC |
| Max. power consumption     | 520 mW        |
| Reverse voltage protection | Integrated    |

### Potential connections and electrical separating measures in the instrument

|                                 |                                                      |
|---------------------------------|------------------------------------------------------|
| Electronics                     | Non-floating                                         |
| Reference voltage <sup>1)</sup> | 500 V <sub>eff</sub>                                 |
| Conductive connection           | Between ground terminal and metallic process fitting |

### Electrical protective measures

| Housing material                   | Version        | Protection acc. to IEC 60529 | Protection acc. to NEMA |
|------------------------------------|----------------|------------------------------|-------------------------|
| Aluminium                          | Single chamber | IP66/IP68 (0.2 bar)          | Type 6P                 |
|                                    | Double chamber | IP66/IP68 (0.2 bar)          | Type 6P                 |
| Stainless steel (electro-polished) | Single chamber | IP66/IP68 (0.2 bar)          | Type 6P                 |
|                                    |                | IP66/IP68 (0.2 bar)/IP69     | Type 6P                 |

Connection of the feeding power supply unit      Networks of overvoltage category III

Altitude above sea level

- by default      up to 2000 m (6562 ft)
- with connected overvoltage protection      up to 5000 m (16404 ft)

Pollution degree (with fulfilled housing protection)      4

Protection rating (IEC 61010-1)      III

## Radio astronomy stations

Certain restrictions on the use of NivoRadar 8500 outside closed vessels result from the radio license. You can find these restrictions in the accompanying document "*Information sheet Radio licenses*". Some of these restrictions have to do with 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          |

<sup>1)</sup> Galvanic separation between electronics and metal housing parts

## Technical data

| Country | Name of the Station | Geographic Latitude | Geographic Longitude |
|---------|---------------------|---------------------|----------------------|
| 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          |

## Device communication Modbus

In the following, the necessary device-specific details are shown. You can find further information of Modbus on [www.modbus.org](http://www.modbus.org).

### Parameters for the bus communication

The NivoRadar 8500 is preset with the following default values:

| Parameter            | Configurable Values           | Default Value |
|----------------------|-------------------------------|---------------|
| Baud Rate            | 1200, 2400, 4800, 9600, 19200 | 9600          |
| Start Bits           | 1                             | 1             |
| Data Bits            | 7, 8                          | 8             |
| Parity               | None, Odd, Even               | None          |
| Stop Bits            | 1, 2                          | 1             |
| Address range Modbus | 1 ... 255                     | 246           |

Start bits and data bits cannot be modified.

### General configuration of the host

The data exchange with status and variables between field device and host is carried out via register. For this, a configuration in the host is required. Floating point numbers with short prevision (4 bytes) according to IEEE 754 are transmitted with individually selectable order of the data bytes (byte transmission order). This "*Byte transmission order*" is determined in the parameter "*Format Code*". Hence the RTU knows the registers of the NivoRadar 8500 which must be contacted for the variables and status information.

| Format Code | Byte transmission order |
|-------------|-------------------------|
| 0           | ABCD                    |
| 1           | CDAB                    |
| 2           | DCBA                    |
| 3           | BADC                    |

## Technical data

### Modbus register

#### Holding Register

The Holding registers consist of 16 bit. They can be read and written. Before each command, the address (1 byte), after each command, a CRC (2 byte) is sent.

| Register Name                        | Register Number | Type | Configurable Values                         | Default Value | Unit |
|--------------------------------------|-----------------|------|---------------------------------------------|---------------|------|
| Address                              | 200             | Word | 1 ... 255                                   | 246           | –    |
| Baud Rate                            | 201             | Word | 1200, 2400, 4800, 9600, 19200, 38400, 57600 | 9600          | –    |
| Parity                               | 202             | Word | 0 = None, 1 = Odd, 2 = Even                 | 0             | –    |
| Stopbits                             | 203             | Word | 1 = One, 2 = Two                            | 1             | –    |
| Delay Time                           | 206             | Word | 10 ... 250                                  | 50            | ms   |
| Byte Oder<br>(Floating point format) | 3000            | Word | 0, 1, 2, 3                                  | 0             | –    |

#### Input register

The input registers consist of 16 bits. They can only be read. The address (1 byte) is sent before each command, a CRC (2 bytes) after each command. PV, SV, TV and QV can be set via the sensor DTM.

| Register Name | Register Number | Type  | Note                                                                                                                                                     |
|---------------|-----------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Status        | 100             | DWord | Bit 0: Invalid Measurement Value PV<br>Bit 1: Invalid Measurement Value SV<br>Bit 2: Invalid Measurement Value TV<br>Bit 3: Invalid Measurement Value QV |
| PV Unit       | 104             | DWord | Unit Code                                                                                                                                                |
| PV            | 106             |       | Primary Variable in Byte Order CDAB                                                                                                                      |
| SV Unit       | 108             | DWord | Unit Code                                                                                                                                                |
| SV            | 110             |       | Secondary Variable in Byte Order CDAB                                                                                                                    |
| TV Unit       | 112             | DWord | Unit Code                                                                                                                                                |
| TV            | 114             |       | Third Variable in Byte Order CDAB                                                                                                                        |
| QV Unit       | 116             | DWord | Unit Code                                                                                                                                                |
| QV            | 118             |       | Quarternary Variable in Byte Order CDAB                                                                                                                  |
|               |                 |       |                                                                                                                                                          |
| Status        | 1300            | DWord | See Register 100                                                                                                                                         |

## Technical data

| Register Name | Register Number | Type  | Note                                                    |
|---------------|-----------------|-------|---------------------------------------------------------|
| PV            | 1302            |       | Primary Variable in Byte Order of Register 3000         |
| SV            | 1304            |       | Secondary Variable in Byte Order of Register 3000       |
| TV            | 1306            |       | Third Variable in Byte Order of Register 3000           |
| QV            | 1308            |       | Quarternary Variable in Byte Order of Register 3000     |
|               |                 |       |                                                         |
| Status        | 1400            | DWord | See Register 100                                        |
| PV            | 1402            |       | Primary Variable in Byte Order CDAB                     |
| Status        | 1412            | DWord | See Register 100                                        |
| SV            | 1414            |       | Secondary Variable in Byte Order CDAB                   |
| Status        | 1424            | DWord | See Register 100                                        |
| TV            | 1426            |       | Third Variable in Byte Order CDAB                       |
| Status        | 1436            | DWord | See Register 100                                        |
| QV            | 1438            |       | Quarternary Variable in Byte Order CDAB                 |
|               |                 |       |                                                         |
| Status        | 2000            | DWord | See Register 100                                        |
| PV            | 2002            | DWord | Primary Variable in Byte Order ABCD (Big Endian)        |
| SV            | 2004            | DWord | Secondary Variable in Byte Order ABCD (Big Endian)      |
| TV            | 2006            | DWord | Third Variable in Byte Order ABCD (Big Endian)          |
| QV            | 2008            | DWord | Quarternary Variable in Byte Order ABCD (Big Endian)    |
|               |                 |       |                                                         |
| Status        | 2100            | DWord | See Register 100                                        |
| PV            | 2102            | DWord | Primary Variable in Byte Order DCBA (Little Endian)     |
| SV            | 2104            | DWord | Secondary Variable in Byte Order DCBA (Little Endian)   |
| TV            | 2106            | DWord | Third Variable in Byte Order ABCD DCBA (Little Endian)  |
| QV            | 2108            | DWord | Quarternary Variable in Byte Order DCBA (Little Endian) |
|               |                 |       |                                                         |
| Status        | 2200            | DWord | See Register 100                                        |
| PV            | 2202            | DWord | Primary Variable in Byte Order BACD (Middle Endian)     |

## Technical data

| Register Name | Register Number | Type  | Note                                                    |
|---------------|-----------------|-------|---------------------------------------------------------|
| SV            | 2204            | DWord | Secondary Variable in Byte Order BACD (Middle Endian)   |
| TV            | 2206            | DWord | Third Variable in Byte Order BACD (Middle Endian)       |
| QV            | 2208            | DWord | Quarternary Variable in Byte Order BACD (Middle Endian) |

## Unit Codes for Register 104, 108, 112, 116

| Unit Code | Measurement Unit  |
|-----------|-------------------|
| 32        | Degree Celsius    |
| 33        | Degree Fahrenheit |
| 40        | US Gallon         |
| 41        | Liters            |
| 42        | Imperial Gallons  |
| 43        | Cubic Meters      |
| 44        | Feet              |
| 45        | Meters            |
| 46        | Barrels           |
| 47        | Inches            |
| 48        | Centimeters       |
| 49        | Millimeters       |
| 111       | Cubic Yards       |
| 112       | Cubic Feet        |
| 113       | Cubic Inches      |

## Modbus RTU commands

### FC3 Read Holding Register

With this command, any number (1-127) of holding registers is read out. The start register, from which the readout should start, and the number of registers are transmitted.

|          | Parameter           | Length  | Code/Data        |
|----------|---------------------|---------|------------------|
| Request: | Function Code       | 1 Byte  | 0x03             |
|          | Start Address       | 2 Bytes | 0x0000 to 0xFFFF |
|          | Number of Registers | 2 Bytes | 1 to 127 (0x7D)  |

## Technical data

|           | Parameter      | Length    | Code/Data |
|-----------|----------------|-----------|-----------|
| Response: | Function Code  | 1 Byte    | 0x03      |
|           | Byte Count     | 2 Bytes   | 2*N       |
|           | Register Value | N*2 Bytes | Data      |

### FC4 Read Input Register

With this command, any number (1-127) of input registers is read out. The start register, from which the readout should start, and the number of registers are transmitted.

|           | Parameter           | Length    | Code/Data        |
|-----------|---------------------|-----------|------------------|
| Request:  | Function Code       | 1 Byte    | 0x04             |
|           | Start Address       | 2 Bytes   | 0x0000 to 0xFFFF |
|           | Number of Registers | N*2 Bytes | 1 to 127 (0x7D)  |
| Response: | Function Code       | 1 Byte    | 0x04             |
|           | Byte Count          | 2 Bytes   | 2*N              |
|           | Register Value      | N*2 Bytes | Data             |

### FC6 Write Single Register

This function code is used to write to a single Holding Register.

|           | Parameter           | Length  | Code/Data        |
|-----------|---------------------|---------|------------------|
| Request:  | Function Code       | 1 Byte  | 0x06             |
|           | Start Address       | 2 Bytes | 0x0000 to 0xFFFF |
|           | Number of Registers | 2 Bytes | Data             |
| Response: | Function Code       | 1 Byte  | 0x04             |
|           | Start Address       | 2 Bytes | 2*N              |
|           | Register Value      | 2 Bytes | Data             |

### FC8 Diagnostics

With this function code different diagnostic functions are triggered or diagnostic values read out.

|          | Parameter         | Length    | Code/Data |
|----------|-------------------|-----------|-----------|
| Request: | Function Code     | 1 Byte    | 0x08      |
|          | Sub Function Code | 2 Bytes   |           |
|          | Data              | N*2 Bytes | Data      |

## Technical data

|           | Parameter         | Length    | Code/Data |
|-----------|-------------------|-----------|-----------|
| Response: | Function Code     | 1 Byte    | 0x08      |
|           | Sub Function Code | 2 Bytes   |           |
|           | Data              | N*2 Bytes | Data      |

### Implemented function codes:

| Sub Function Code | Name                   |
|-------------------|------------------------|
| 0x00              | Return Data Request    |
| 0x0B              | Return Message Counter |

With sub function codes 0x00 only one 16 bit value can be written.

### FC16 Write Multiple Register

This function code is used to write to several Holding Registers. In a request, it can only be written to registers that are in direct succession.

|           | Parameter           | Length    | Code/Data        |
|-----------|---------------------|-----------|------------------|
| Request:  | Function Code       | 1 Byte    | 0x10             |
|           | Start Address       | 2 Bytes   | 0x0000 to 0xFFFF |
|           | Number of Registers | 2 Bytes   | 0x0001 to 0x007B |
|           | Byte Count          | 1 Byte    | 2*N              |
|           | Register Value      | N*2 Bytes | Data             |
| Response: | Function Code       | 1 Byte    | 0x10             |
|           | Start Address       | 2 Bytes   | 0x0000 to 0xFFFF |
|           | Number of Registers | 2 Bytes   | 0x01 to 0x7B     |

### FC17 Report Sensor ID

With this function code, the sensor ID on Modbus is queried.

|           | Parameter            | Length | Code/Data |
|-----------|----------------------|--------|-----------|
| Request:  | Function Code        | 1 Byte | 0x11      |
| Response: | Function Code        | 1 Byte | 0x11      |
|           | Byte Number          | 1 Byte |           |
|           | Sensor ID            | 1 Byte |           |
|           | Run Indicator Status | 1 Byte |           |

## Technical data

### FC43 Sub 14, Read Device Identification

With this function code, the Device Identification is queried.

|           | Parameter             | Length | Code/Data                          |
|-----------|-----------------------|--------|------------------------------------|
| Request:  | Function Code         | 1 Byte | 0x2B                               |
|           | MEI Type              | 1 Byte | 0x0E                               |
|           | Read Device ID Code   | 1 Byte | 0x01 to 0x04                       |
|           | Object ID             | 1 Byte | 0x00 to 0xFF                       |
| Response: | Function Code         | 1 Byte | 0x2B                               |
|           | MEI Type              | 1 Byte | 0x0E                               |
|           | Read Device ID Code   | 1 Byte | 0x01 to 0x04                       |
|           | Confirmity Level      | 1 Byte | 0x01, 0x02, 0x03, 0x81, 0x82, 0x83 |
|           | More follows          | 1 Byte | 00/FF                              |
|           | Next Object ID        | 1 Byte | Object ID number                   |
|           | Number of Objects     | 1 Byte |                                    |
|           | List of Object ID     | 1 Byte |                                    |
|           | List of Object length | 1 Byte |                                    |
|           | List of Object value  | 1 Byte | Depending on the Object ID         |

## Levelmaster commands

The NivoRadar 8500 is also suitable for connection to the following RTUs with Levelmaster protocol. The Levelmaster protocol is often called "Siemens" "Tank protocol".

| RTU                       | Protocol    |
|---------------------------|-------------|
| ABB Totalflow             | Levelmaster |
| Kimray DACC 2000/3000     | Levelmaster |
| Thermo Electron Autopilot | Levelmaster |

## Parameters for the bus communication

The NivoRadar 8500 is preset with the default values:

| Parameter  | Configurable Values           | Default Value |
|------------|-------------------------------|---------------|
| Baud Rate  | 1200, 2400, 4800, 9600, 19200 | 9600          |
| Start Bits | 1                             | 1             |
| Data Bits  | 7, 8                          | 8             |

## Technical data

| Parameter                 | Configurable Values | Default Value |
|---------------------------|---------------------|---------------|
| Parity                    | None, Odd, Even     | None          |
| Stop Bits                 | 1, 2                | 1             |
| Address range Levelmaster | 32                  | 32            |

The Levelmaster commands are based on the following syntax:

- Capital letters are at the beginning of certain data fields
- Small letters stand for data fields
- All commands are terminated with "<cr>" (carriage return)
- All commands start with "Uuu", whereby "uu" stands for the address (00-31)
- "\*" can be used as a joker for any position in the address. The sensor always converts this in its address. In case of more than one sensor, the joker must not be used, because otherwise several will answer
- Commands that modify the instrument return the command with "OK". "EE-ERROR" replaces "OK" if there was a problem changing the configuration

## Report Level (and Temperature)

|           | Parameter                      | Length              | Code/Data                                                                                                                                                                                                  |
|-----------|--------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Request:  | Report Level (and Temperature) | 4 characters ASCII  | Uuu?                                                                                                                                                                                                       |
| Response: | Report Level (and Temperature) | 24 characters ASCII | UuuDlll.llFtttEeeeeWwwww<br>uu = Address<br>llll = PV in inches<br>ttt = Temperature in Fahrenheit<br>eeee = Error number (0 no error, 1 level data not readable)<br>wwwww = Warning number (0 no warning) |

PV in inches will be repeated if "Set number of floats" is set to 2. Hence 2 measured values can be transmitted. PV value is transmitted as first measured value, SV as second measured value.



### Information:

The max. value for the PV to be transmitted is 999.99 inches (corresponds to approx. 25.4 m).

If the temperature should be transmitted in the Levelmaster protocol, then TV must be set in the sensor to temperature.

PV, SV and TV can be adjusted via the sensor DTM.

## Technical data

### Report Unit Number

|           | Parameter                      | Length             | Code/Data |
|-----------|--------------------------------|--------------------|-----------|
| Request:  | Report Unit Number             | 5 characters ASCII | U**N?     |
| Response: | Report Level (and Temperature) | 6 characters ASCII | UuuNnn    |

### Assign Unit Number

|           | Parameter          | Length             | Code/Data                  |
|-----------|--------------------|--------------------|----------------------------|
| Request:  | Assign Unit Number | 6 characters ASCII | UuuNnn                     |
| Response: | Assign Unit Number | 6 characters ASCII | UuuNOK<br>uu = new Address |

### Set number of Floats

|           | Parameter            | Length             | Code/Data |
|-----------|----------------------|--------------------|-----------|
| Request:  | Set number of Floats | 5 characters ASCII | UuuFn     |
| Response: | Set number of Floats | 6 characters ASCII | UuuFOK    |

If the number is set to 0, no level is returned

### Set Baud Rate

|           | Parameter     | Length                  | Code/Data                                                                                                                                              |
|-----------|---------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Request:  | Set Baud Rate | 8 (12) characters ASCII | UuuBbbbb[b][pds]<br>Bbbbb[b] = 1200, 9600 (default)<br>pds = parity, data length, stop bit (optional)<br>parity: none = N, even = E (default), odd = O |
| Response: | Set Baud Rate | 11 characters ASCII     |                                                                                                                                                        |

Example: U01B9600E71

Change instrument on address 1 to baudrate 9600, parity even, 7 data bits, 1 stop bit

### Set Receive to Transmit Delay

|          | Parameter                     | Length             | Code/Data                                                      |
|----------|-------------------------------|--------------------|----------------------------------------------------------------|
| Request: | Set Receive to Transmit Delay | 7 characters ASCII | UuuRmmm<br>mmm = milliseconds (50 up to 250), default = 127 ms |

## Technical data

|           | Parameter                     | Length             | Code/Data |
|-----------|-------------------------------|--------------------|-----------|
| Response: | Set Receive to Transmit Delay | 6 characters ASCII | UuuROK    |

## Report Number of Floats

|           | Parameter               | Length             | Code/Data                                             |
|-----------|-------------------------|--------------------|-------------------------------------------------------|
| Request:  | Report Number of Floats | 4 characters ASCII | UuuF                                                  |
| Response: | Report Number of Floats | 5 characters ASCII | UuuFn<br>n = number of measurement values (0, 1 or 2) |

## Report Receive to Transmit Delay

|           | Parameter                        | Length             | Code/Data                                                         |
|-----------|----------------------------------|--------------------|-------------------------------------------------------------------|
| Request:  | Report Receive to Transmit Delay | 4 characters ASCII | UuuR                                                              |
| Response: | Report Receive to Transmit Delay | 7 characters ASCII | UuuRmmm<br>mmm = milliseconds (50 up to 250),<br>default = 127 ms |

## Error codes

| Error Code | Name                                             |
|------------|--------------------------------------------------|
| EE-Error   | Error While Storing Data in EEPROM               |
| FR-Error   | Error in Frame (too short, too long, wrong data) |
| LV-Error   | Value out of limits                              |

## Technical data

### Configuration of typical Modbus hosts

#### Fisher ROC 809

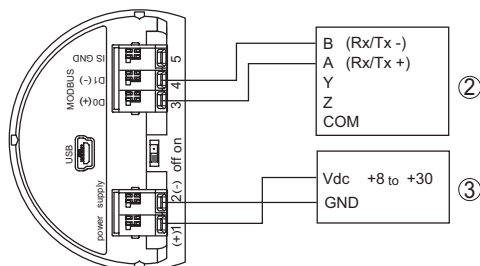


Fig. 6: Connection of NivoRadar 8500 to RTU Fisher ROC 809

- 1 NivoRadar 8500
- 2 RTU Fisher ROC 809
- 3 Voltage supply

#### Parameters for Modbus Hosts

| Parameter                  | Value Fisher ROC 809 | Value ABB Total Flow | Value Fisher Thermo Electron Autopilot | Value Fisher Bristol ControlWave Micro | Value Scada-Pack |
|----------------------------|----------------------|----------------------|----------------------------------------|----------------------------------------|------------------|
| Baud Rate                  | 9600                 | 9600                 | 9600                                   | 9600                                   | 9600             |
| Floating Point Format Code | 0                    | 0                    | 0                                      | 2 (FC4)                                | 0                |
| RTU Data Type              | Conversion Code 66   | 16 Bit Modicon       | IEE Fit 2R                             | 32-bit registers as 2 16-bit registers | Floating Point   |
| Input Register Base Number | 0                    | 1                    | 0                                      | 1                                      | 30001            |

The basic number of the input registers is always added to the input register address of NivoRadar 8500.

This results in the following constellations:

- Fisher ROC 809 - Register address for 1300 is address 1300
- ABB Total Flow - Register address for 1302 is address 1303
- Thermo Electron Autopilot - Register address for 1300 is address 1300
- Bristol ControlWave Micro - Register address for 1302 is address 1303
- ScadaPack - Register address for 1302 is address 31303

## Dimensions

The following dimensional drawings are only an extract of the possible versions.

## Technical data

### Aluminium housing with protection rating IP66/IP68 (0.2 bar)

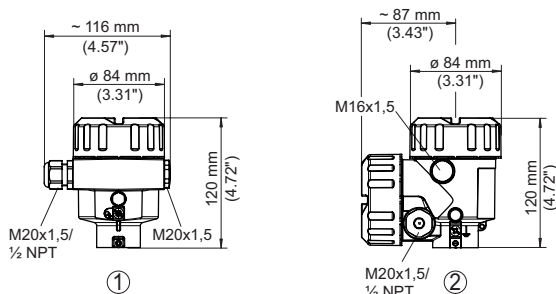


Fig. 7: Housing versions with protection rating IP66/IP68 (0.2 bar), (with integrated display and adjustment module the housing is 18 mm/0.71 in higher)

- 1 Aluminium - single chamber
- 2 Aluminium - double chamber

### Stainless steel housing (electropolished) in protection rating IP66/IP68 (0.2 bar)

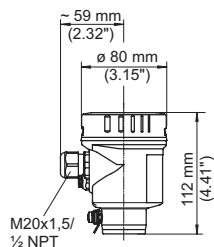


Fig. 8: Housing versions with protection rating IP66/IP68 (0.2 bar), (with integrated display and adjustment module the housing is 18 mm/0.71 in higher)

Technical data

Thread with horn antenna 450 °C version

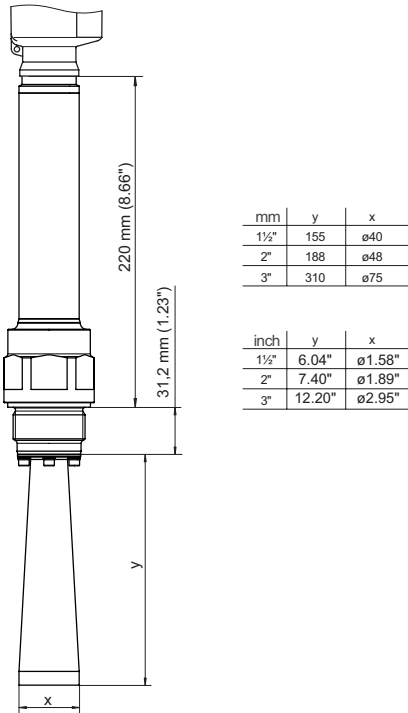


Fig. 9: NivoRadar 8500, thread with horn antenna 450 °C version

## Technical data

### Flange with horn antenna 450 °C version

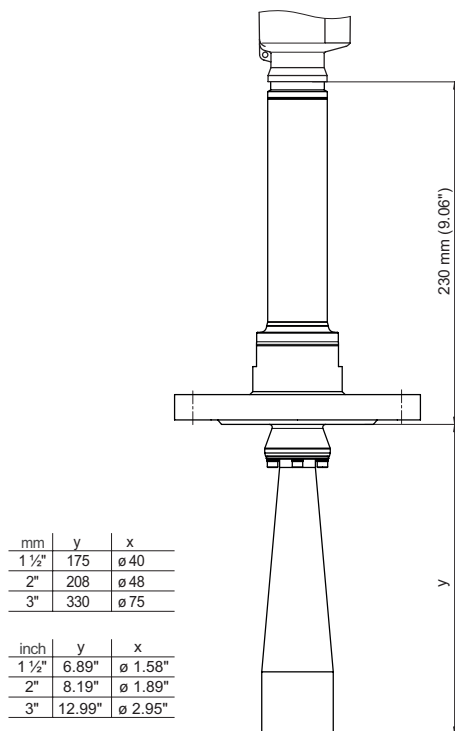


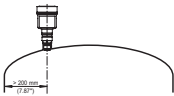
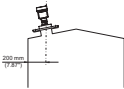
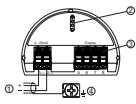
Fig. 10: NivoRadar 8500, flange with horn antenna 450 °C version

Setup - the most important steps

Prepare

| What?           | How?                                          |
|-----------------|-----------------------------------------------|
| Identify sensor | Scan QR code on type label, check sensor data |

Mount and connect sensor

| Liquids                                                                                                                      | Bulk solids                                                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
|  |  |
| Connection technology                                                                                                        | Wiring plan                                                                                                                          |
|                                             |                                                     |

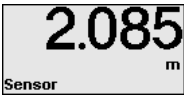
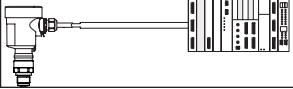
Select adjustment

| Display and adjustment module                                                     | Adjustment app <sup>1)</sup>                                                      |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
|  |  |

Parameterize sensor

| Liquids                                                                             | Bulk solids                                                                         |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Enter medium type, application, vessel height, adjustment and mode                  |                                                                                     |
|  |  |

Check measured value

| Indicators                                                                          | Output                                                                               |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |

<sup>1)</sup> Download via Apple App Store, Google Play Store, Baidu Store

## Mounting

### Protection against moisture

#### General instructions

Protect your instrument against moisture ingress through the following measures:

- Use a suitable connection cable (see chapter "*Connecting to power supply*")
- Tighten the cable gland or plug connector
- Lead the connection cable downward in front of the cable entry or plug connector

This applies mainly to outdoor installations, in areas where high humidity is expected (e.g. through cleaning processes) and on cooled or heated vessels.



#### Note:

Make sure that during installation or maintenance no moisture or dirt can get inside the instrument.

To maintain the housing protection, make sure that the housing lid is closed during operation and locked, if necessary.

### Process conditions



#### Note:

For safety reasons, the instrument must only be operated within the permissible process conditions. You can find detailed information on the process conditions in chapter "*Technical data*" of the operating instructions or on the type label.

Hence make sure before mounting 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 in particular are:

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

### Permissible process pressure (MWP) - Device

The permissible process pressure range is specified by "MWP" (Maximum Working Pressure) on the type label. The MWP takes the element of the measuring cell and processing fitting combination with the weakest pressure into consideration and may be applied permanently. The specification refers to a reference temperature of +20 °C (+68 °F). It also applies when a measuring cell with a higher measuring range than the permissible pressure range of the process fitting is installed order-related.

## Mounting

In addition, a temperature derating of the process fitting, e. g. with flanges, can limit the permissible process pressure range according to the respective standard.



### Note:

In order to prevent damage to the device, a test pressure may only exceed the specified MWP briefly by 1.5 times at reference temperature. The pressure stage of the process fitting as well as the overload resistance of the measuring cell are taken into consideration here.

### Permissible process pressure (MWP) - Mounting accessory

The permissible process pressure range is stated on the type label. The instrument should only be operated with these pressures if the mounting accessory used also fulfils these values. This should be ensured by suitable flanges, welded sockets, tension rings with Clamp connections, sealings, etc.

### Second Line of Defense

As a standard feature, the NivoRadar 8500 is separate from the process through its plastic antenna encapsulation.

Optionally, the instrument is available with a Second Line of Defense (SLOD), a second process separation. It is located as gas-tight leadthrough between the process component and the electronics. This means additional safety against penetration of the medium from the process into the instrument.

### Housing features

### Filter element

The filter element in the housing is used for ventilation of the housing.

For effective ventilation, the filter element must always be free of deposits. Therefore, mount the device so that the filter element is protected against deposits.



### Note:

Do not use a high-pressure cleaner to clean housings in standard types of protection. The filter element could be damaged and moisture could penetrate the housing.

For applications with high-pressure cleaners, the device is available with the appropriate IP69 housing protection.

## Mounting

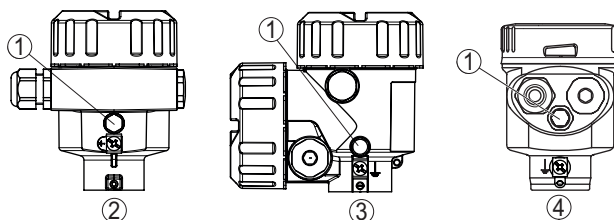


Fig. 11: Position of the filter element depending on housing

- 1 Filter element
- 2 Aluminium - single chamber
- 3 Aluminium - double chamber
- 4 Stainless steel single chamber (electropolished)

## Housing orientation

The housing of NivoRadar 8500 can be rotated completely by 360°. This enables optimal reading of the display and easy cable entry.

For housings made of electropolished stainless steel, this is done without tools.

With aluminium housings, a locking screw must be loosened for turning, see the following illustration:

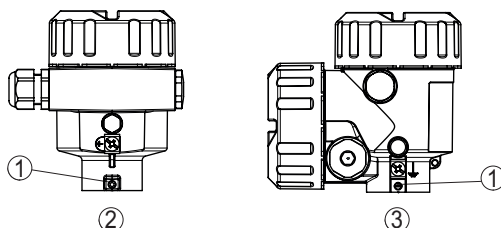


Fig. 12: Position of the locking screw depending on housing

- 1 Locking screw
- 2 Aluminium - single chamber
- 3 Aluminium - double chamber

Proceed as follows:

1. Loosen locking screw (hexagon size 2.5)
2. Turn housing into requested position
3. Re-tighten the locking screw (torque see chapter "Technical data").



### Note:

By rotating the housing, polarisation changes. For this reason, please also observe the notes on polarisation in chapter "Mounting instructions".

## Mounting

### Cover catch

With the aluminium housing, the housing cover can be secured with a screw. This protects the device against unauthorised opening of the cover.

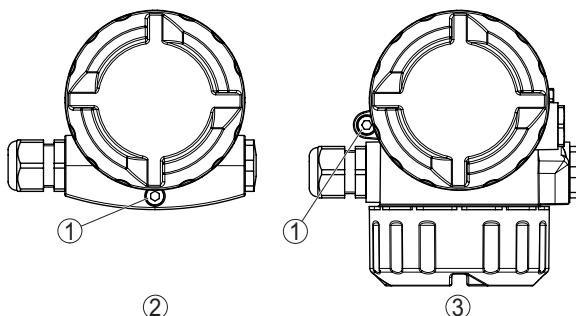


Fig. 13: Position of the safety screw depending on housing

- 1 Safety screw
- 2 Aluminium - single chamber
- 3 Aluminium - double chamber

Proceed as follows to secure the cover:

1. Screw the housing cover on tightly by hand
2. Unscrew the locking screw from the cover up to the stop using a size 4 hexagonal spanner
3. Check if the cover can no longer be turned

The housing cover is unlocked in the opposite way.



### Note:

The locking screw has two holes drilled through the head. Thus it can also be sealed.

## Mounting instructions

### Polarisation

Radar sensors for level measurement emit electromagnetic waves. The polarisation is the direction of the electrical share of these waves. It is identifiable by a mark on the housing, see the following drawing:

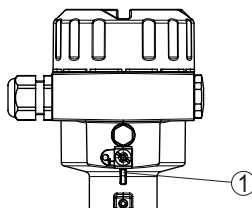


Fig. 14: Position of the polarisation

- 1 Nose for marking the direction of polarisation

## Mounting

Turning the housing changes the polarisation and thus also the effect of false echoes on the measured value.



### Note:

Therefore, pay attention to the position of the polarisation when mounting or when making subsequent changes. Fix the housing to prevent a change in the metrological properties (see chapter "Housing features").

### Mounting position - liquids

When mounting the device, keep a distance of at least 200 mm (7.874 in) from the vessel wall. If the device is installed in the center of dished or round vessel tops, multiple echoes can arise. However, these can be suppressed by an appropriate adjustment (see chapter "Setup").



### Note:

If you cannot maintain this distance, you should carry out a false signal suppression during setup. This applies especially if buildup on the vessel wall is to be expected.<sup>1)</sup>

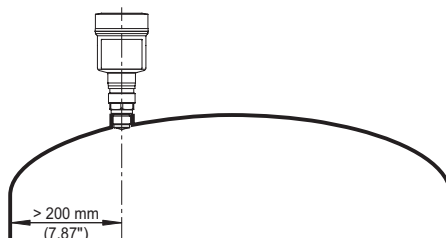


Fig. 15: Mounting of the radar sensor on round vessel tops

In vessels with conical bottom it can be advantageous to mount the device in the centre of the vessel, as measurement is then possible down to the bottom.

<sup>1)</sup> In this case, it is recommended to repeat the false signal suppression at a later time with existing buildup.

## Mounting

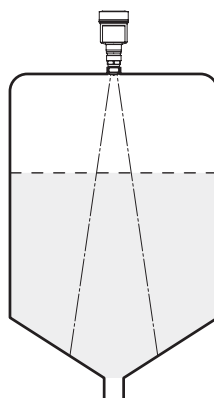


Fig. 16: Mounting of the radar sensor on vessels with conical bottom

## Reference plane

The measuring range of the NivoRadar 8500 physically begins with the antenna end.

However, the min./max. adjustment begins mathematically with the reference plane.

For the horn antenna, the reference plane is the sealing surface on the hexagon or the lower side of the flange.

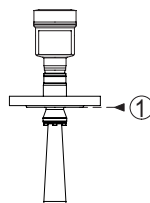


Fig. 17: Position of the reference plane

1 Reference plane

## Inflowing medium - liquids

Do not mount the instrument in or above the filling stream. Make sure that you detect the medium surface, not the in-flowing product.

## Mounting

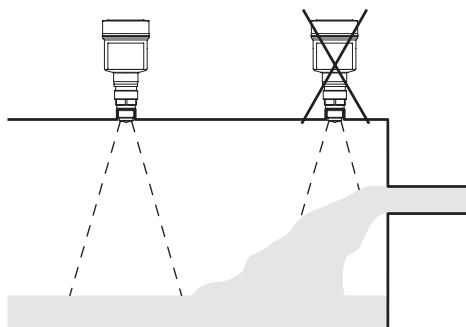


Fig. 18: Mounting of the radar sensor with inflowing medium

### Socket mounting - short nozzles

For nozzle mounting, the nozzle should be as short as possible and its end rounded. This reduces false reflections from the nozzle.

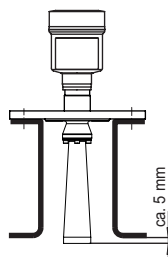


Fig. 19: Recommended socket mounting - horn antenna

### Socket mounting - longer nozzles

If the reflective properties of the medium are good, you can mount NivoRadar 8500 on sockets longer than the antenna. The socket end should be smooth and burr-free, if possible also rounded.



#### Note:

When mounting on a longer socket piece, we recommend to carry out a false signal suppression (see chapter "*Parameter adjustment*"). This adapts the device to the metrological properties of the socket.

You will find recommended values for socket heights in the following illustration or the table. The values come from typical applications. Deviating from the proposed dimensions, also longer sockets are possible, however the local conditions must be taken into account.

Mounting

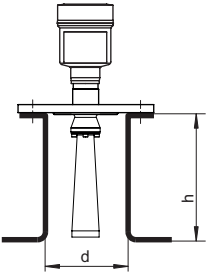


Fig. 20: Socket mounting with deviating socket dimensions - horn antenna

Horn antenna

| Socket diameter "d" |     | Socket length "h" |           | Recommended antenna diameter |     |
|---------------------|-----|-------------------|-----------|------------------------------|-----|
| 40 mm               | 1½" | ≤ 100 mm          | ≤ 3.9 in  | 40 mm                        | 1½" |
| 50 mm               | 2"  | ≤ 150 mm          | ≤ 5.9 in  | 48 mm                        | 2"  |
| 80 mm               | 3"  | ≤ 300 mm          | ≤ 11.8 in | 75 mm                        | 3"  |

Mounting in the vessel insulation

Instruments for a temperature range from 200 °C have a spacer for temperature decoupling. It is located between process fitting and electronics housing.



Note:

Incorrect installation of the device can render this temperature decoupling ineffective. Damage to the electronics can be the result.

Hence ensure effective temperature decoupling. Include the spacer in the vessel insulation only up to max. 40 mm, see the following figure.

## Mounting

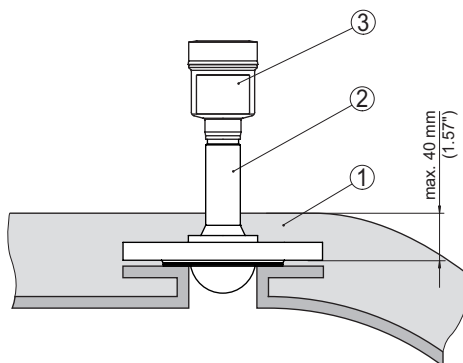


Fig. 21: Mounting the instrument on insulated vessels

- 1 Vessel insulation
- 2 Distance piece for temperature decoupling
- 3 Electronics housing

## Vessel installations

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. 22: Cover flat, large-area profiles with deflectors

## Alignment - Liquids

In liquids, direct the device as perpendicular as possible to the medium surface to achieve optimum measurement results.

## Mounting

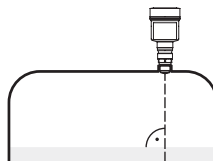


Fig. 23: Alignment in liquids

### Agitators

Agitators in the vessel can reflect the measurement signal and thus lead to undesired incorrect measurements.



**Note:**

To avoid this, a false signal suppression should be carried out with the agitators in motion. This ensures that the interfering reflections from the agitators are saved with the blades in different positions.

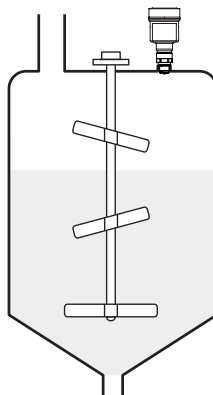


Fig. 24: Agitators

### Foam generation

Through the action of filling, stirring and other processes in the vessel, compact foams which considerably damp the emitted signals may form on the medium surface.



**Note:**

If foams lead to measurement errors, you should use the biggest possible radar antennas or as an alternative, sensors with guided radar.

### Measurement in the bypass tube

#### Measuring rigs - bypass

A bypass consists of a standpipe with lateral process fittings. It is attached to the outside of a container as a communicating vessel.

## Mounting

The NivoRadar 8500 in 80 GHz technology is suitable as standard for non-contact level measurement in such a bypass.

### Configuration bypass

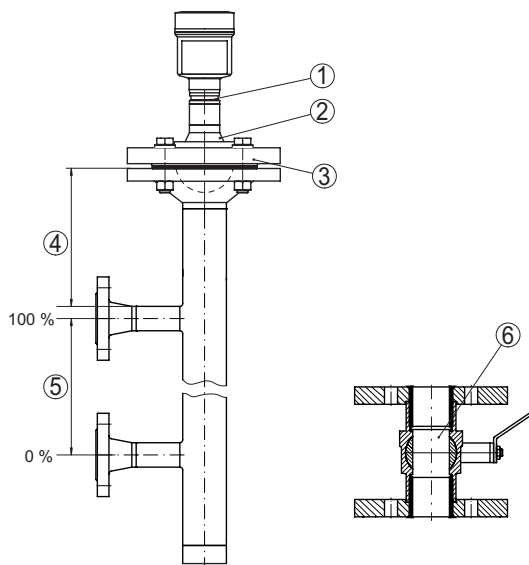


Fig. 25: Configuration bypass

- 1 Radar sensor
- 2 Polarisation marking
- 3 Instrument flange
- 4 Distance sensor reference plane to upper tube connection
- 5 Distance of the tube connections
- 6 Ball valve with complete opening

### Instructions and requirements, bypass

#### Instructions of orientation of the polarisation:

- Note marking of the polarisation on the sensor
- The marking must be in one plane with the tube connections to the vessel

#### Instructions for the measurement:

- The 100 % point may not be above the upper tube connection to the vessel
- The 0 % point may not be below the lower tube connection to the vessel
- Min. distance, sensor reference plane to upper edge of upper tube connection > 200 mm
- The antenna diameter of the sensor should correspond to the inner diameter of the tube

## Mounting

- A false signal suppression with the installed sensor is recommended but not mandatory
- The measurement through a ball valve with unrestricted channel is possible
- The deviation can increase in the area of the connecting tube to the container  $\pm 200$  mm

### Constructional requirements on the bypass pipe:

- Material metal, smooth inner surface
- In case of an extremely rough tube inner surface, use an inserted tube (tube in tube) or a radar sensor with tube antenna
- Flanges are welded to the tube according to the orientation of the polarisation
- Gap size with junctions  $\leq 1$  mm (for example, when using a ball valve or intermediate flanges with single pipe sections)
- Diameter should be constant over the complete length

### Measurement setup - Flow

In general, the following must be observed while mounting the device:

- Mounting the sensor on the upstream or inlet side
- Installation in the centre of the flume and vertical to the liquid surface
- Distance to the overfall orifice or Venturi flume
- Distance to the max. height of the orifice or flume for optimum accuracy:  $> 250$  mm (9.843 in)<sup>1)</sup>
- Requirements from approvals for flow measurement, e.g. MCERTS

## Mounting

### Flume

#### Predefined curves:

A flow measurement with these standard curves is very easy to set up, as no dimensional information of the flume is required.

- Palmer-Bowlus flume ( $Q = k \times h^{1.86}$ )
- Venturi, trapezoidal weir, rectangular flume ( $Q = k \times h^{1.5}$ )
- V-Notch, triangular overfall ( $Q = k \times h^{2.5}$ )

#### Channel with dimensions according to ISO standard:

When selecting these curves, the dimensions of the flume must be known and entered via the assistant. As a result, the accuracy of the flow measurement is higher than with the specified curves.

- Rectangular flume (ISO 4359)
- Trapezoidal flume (ISO 4359)

<sup>1)</sup> The value given takes into account the block distance. At smaller distances, the measuring accuracy is reduced, see "Technical data".

## Mounting

- U-shaped flume (ISO 4359)
- Triangular overfall thin-walled (ISO 1438)
- Rectangular flume thin-walled (ISO 1438)
- Rectangular weir broad crown (ISO 3846)

### Flow formula:

If the flow formula of your flume is known, you should select this option, as the accuracy of the flow measurement is highest here.

- Flow formula:  $Q = k \times h^{\exp}$

### Manufacturer definition:

If you use a Parshall flume from the manufacturer ISCO, this option must be selected. This gives you a high accuracy of flow measurement with easy configuration.

Alternatively, you can also take over Q/h table values provided by the manufacturer here.

- ISCO-Parshall-Flume
- Q/h table (assignment of height with corresponding flow in a table)



### Tip:

Detailed project planning data can be found at the channel manufacturers and in the technical literature.

The following examples serve as an overview for flow measurement.

### Rectangular overfall

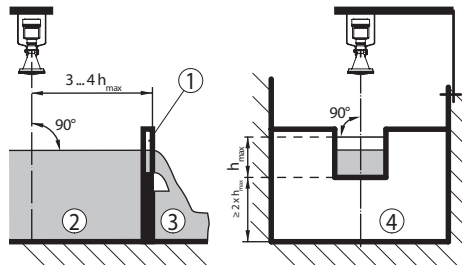


Fig. 26: Flow measurement with rectangular flume:  $h_{\max.}$  = max. filling of the rectangular flume

- 1 Overfall orifice (side view)
- 2 Upstream water
- 3 Tailwater
- 4 Overfall orifice (view from tailwater)

## Mounting

### Khafagi-Venturi flume

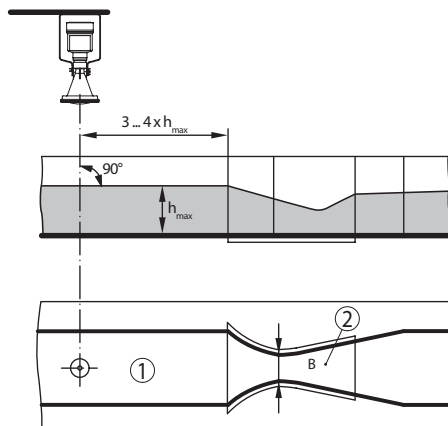


Fig. 27: Flow measurement with Khafagi-Venturi flume:  $h_{\max}$  = max. filling of the flume; B = tightest constriction in the flume

- 1 Position sensor
- 2 Venturi flume

## Connecting to power supply

### Safety instructions

#### Preparing the connection

Always keep in mind the following safety instructions:

- Carry out electrical connection by trained, qualified personnel authorised by the plant operator
- If overvoltage surges are expected, overvoltage arresters should be installed



#### Warning:

Only connect or disconnect in de-energized state.

### Voltage supply

The operating voltage and the digital bus signal are routed via separate two-wire connection cables.

The data for power supply are specified in chapter "*Technical data*".



#### Note:

Power the instrument via an energy-limited circuit (power max. 100 W) acc. to IEC 61010-1, e.g.

- Class 2 power supply unit (acc. to UL1310)
- SELV power supply unit (safety extra-low voltage) with suitable internal or external limitation of the output current

### Connection cable

The instrument is connected with standard two-wire, twisted cable suitable for RS 485. If electromagnetic interference is expected which is above the test values of EN 61326 for industrial areas, shielded cable should be used.

Use cable with round cross section for instruments with housing and cable gland. Use a cable gland suitable for the cable diameter to ensure the seal effect of the cable gland (IP protection rating).

Make sure that the entire installation is carried out according to the Fieldbus specification. In particular, make sure that the bus is terminated with suitable terminating resistors.

### Cable glands

#### 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.

## Connecting to power supply

---

### Cable screening and grounding

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

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

Make sure that the cable screen and grounding are carried out according to Fieldbus specification. We recommend to connect the cable screening to ground potential on both ends.

In systems with potential equalisation, connect the cable screening directly to ground potential at the power supply unit and the sensor. The cable screening in the sensor must be connected directly to the internal ground terminal. The ground terminal outside on the housing must be connected to the potential equalisation (low impedance).

### Connecting

#### Connection technology

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.

#### Connection procedure

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

## Connecting to power supply

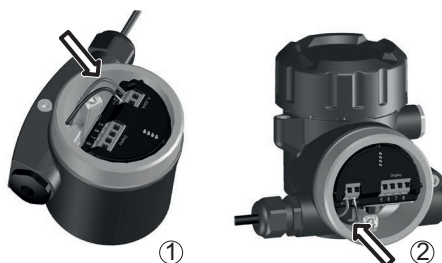


Fig. 28: Connection steps 5 and 6

- 1 Single chamber housing
- 2 Double chamber housing

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



### Note:

Fixed conductors and flexible conductors with ferrules can be inserted directly into the terminal openings. In the case of flexible conductors for opening the terminals, use a screwdriver (3 mm blade width) to push the actuator lever away from the terminal opening. When released, the terminals are closed again.

7. Check the hold of the wires in the terminals by lightly pulling on them
  8. Connect the shielding to the internal ground terminal, connect the external ground terminal to potential equalisation
  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.

Connecting to power supply

Wiring plan, double chamber housing

Electronics compart-  
ment

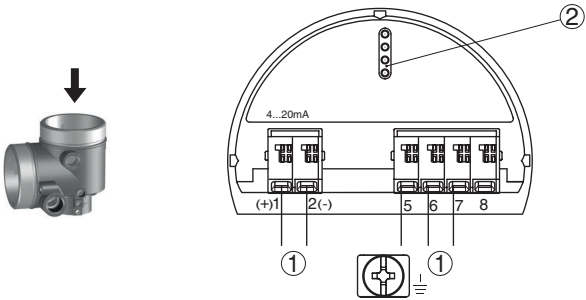


Fig. 29: Electronics compartment - double chamber housing

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



Information:

The connection of an external display and adjustment unit is not possible with the Ex d version.

Connection compart-  
ment

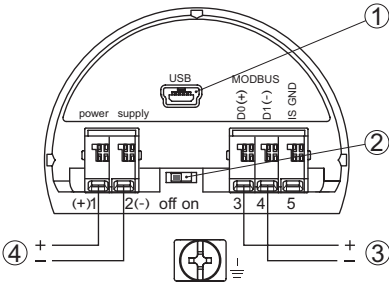


Fig. 30: Connection compartment

- 1 USB interface
- 2 Slide switch for integrated termination resistor (120 Ω)
- 3 Modbus signal
- 4 Voltage supply

| Terminal | Function         | Polarity |
|----------|------------------|----------|
| 1        | Voltage supply   | +        |
| 2        | Voltage supply   | -        |
| 3        | Modbus signal D0 | +        |
| 4        | Modbus signal D1 | -        |

## Connecting to power supply

| Terminal | Function                                                                          | Polarity |
|----------|-----------------------------------------------------------------------------------|----------|
| 5        | Function ground when installing according to CSA (Canadian Standards Association) |          |

### Switch-on phase

After connecting NivoRadar 8500 to the bus system, the device first performs a self-test:

- Internal check of the electronics
- Indication of the status message "*F 105 Determine measured value*" on the display or PC
- Status byte goes to fault value

Then the actual measured value is output to the signal cable. The value takes into account settings that have already been carried out, e.g. default setting.

## Access protection, IT security

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### Bluetooth radio interface

Devices with a Bluetooth radio interface are protected against unwanted access from outside. This means that only authorized persons can receive measured and status values and change device settings via this interface.

#### Bluetooth access code

A Bluetooth access code is required to establish Bluetooth communication via the adjustment tool (smartphone/tablet/notebook). This code must be entered once when Bluetooth communication is established for the first time in the adjustment tool. It is then stored in the adjustment tool and does not have to be entered again.

The Bluetooth access code is individual for each device. It is printed on the device housing with Bluetooth. In addition, it is supplied with the device in the information sheet "*PINs and Codes*". In addition, the Bluetooth access code can be read out via the display and adjustment unit, depending on the device version.

The Bluetooth access code can be changed by the user after the first connection is established. If the Bluetooth access code is entered incorrectly, the new entry is only possible after a waiting period has elapsed. The waiting time increases with each further incorrect entry.

#### Emergency Bluetooth unlock code

The emergency Bluetooth access code enables Bluetooth communication to be established in the event that the Bluetooth access code is no longer known. It can't be changed. The emergency Bluetooth access code can be found in information sheet "*Access protection*". If this document is lost, the emergency Bluetooth access code can be retrieved from your personal contact person after legitimation. The storage and transmission of Bluetooth access codes is always encrypted (SHA 256 algorithm).

### Protection of the parameterization

The settings (parameters) of the device can be protected against unwanted changes. The parameter protection is deactivated on delivery, all settings can be made.

For SIL devices, the parameter protection is activated in the delivery status. For settings, adjustment must be released by entering the device code.

#### Device code

To protect the parameterization, the device can be locked by the user with the aid of a freely selectable device code. The settings (parameters) can then only be read out, but not changed. The device code is also stored in the adjustment tool. However, unlike the Bluetooth access code, it must be re-entered for each unlock. When using the adjustment app

## Access protection, IT security

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or DTM, the stored device code is then suggested to the user for unlocking.

### Emergency device code

The emergency device code allows unlocking the device in case the device code is no longer known. It can't be changed. The emergency device code can also be found on the supplied information sheet "*Access protection*". If this document is lost, the emergency device code can be retrieved from your personal contact person after legitimization. The storage and transmission of the device codes is always encrypted (SHA 256 algorithm).

## Set up with the display and adjustment module

### 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.

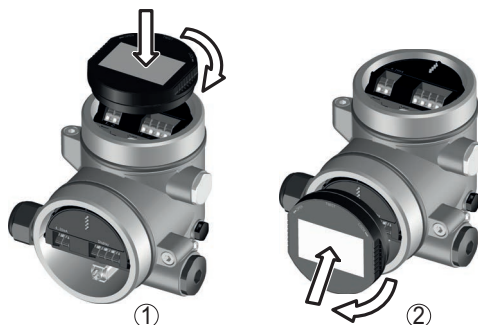


Fig. 31: Installing the display and adjustment module in the double chamber housing

- 1 In the electronics compartment
- 2 In the connection 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.

## Set up with the display and adjustment module

### Adjustment system

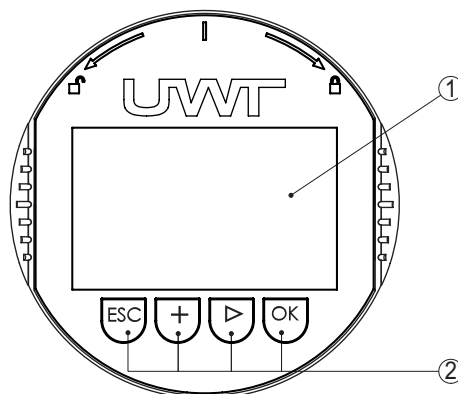


Fig. 32: Display and adjustment elements

- 1 LC display
- 2 Adjustment keys

### Key functions

- **[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
  - Select editing position
- **[+]** key:
  - Change value of the parameter
- **[ESC]** key:
  - Interrupt input
  - Jump to next higher menu

### Adjustment system

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 function of the individual keys in the previous illustration.

### Adjustment system - keys via magnetic pen

With the Bluetooth version of the display and adjustment module you can also adjust the instrument with the magnetic pen. The pen operates the four keys of the display and adjustment module right through the closed lid (with inspection window) of the sensor housing.

## Set up with the display and adjustment module

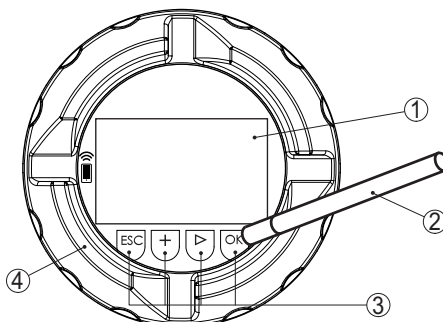


Fig. 33: Display and adjustment elements - with adjustment via magnetic pen

- 1 LC display
- 2 Magnetic pen
- 3 Adjustment keys
- 4 Lid with inspection window

### Time functions

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.

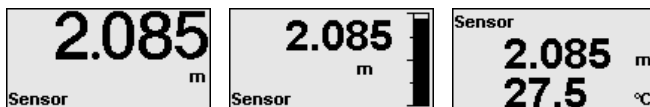
When the **[OK]** and **[ESC]** keys are pressed simultaneously for more than 5 s, the display returns to the main menu. The menu language is then switched over to "English".

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.

### Measured value indication - Selection of national language

#### Measured value indication

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



With the **"OK"** key you move to the menu overview.



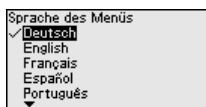
#### Note:

During the first setup, you move with the **"OK"** key to the selection menu "Menu language".

### Menu language

In this menu item, you can select the menu language for further parameterization.

## Set up with the display and adjustment module



### Information:

A later change of the selection is possible via the menu item "Setup, display, menu language".

With the "**OK**" key you move to the menu overview.

## Parameter adjustment

### Lock/Unlock adjustment

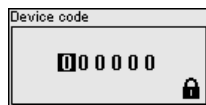
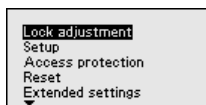
#### Lock/Unlock adjustment (non-SIL)

In this menu item you safeguard the sensor parameters against unauthorized or unintentional modifications.



### Information:

The non-SIL version of the device is delivered without activated access protection. If necessary, the access protection can be activated and the device locked.



When the adjustment is blocked, only the following adjustment functions are possible without entering the device code:

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



### Caution:

When the adjustment is blocked, the adjustment via other systems is also blocked.

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

#### Lock/Unlock adjustment (SIL)

In this menu item you safeguard the sensor parameters against unauthorized or unintentional modifications.



### Information:

The SIL version of the device is delivered in lock state.

## Set up with the display and adjustment module

### Safe parameterization:

To avoid possible errors during parameterization in a non-safe user environment, a verification procedure is used that makes it possible to detect parameterization errors reliably. For this, safety-relevant parameters must be verified before they are stored in the device. In normal operating condition, the instrument is also locked against parameter changes through unauthorized access.



### Information:

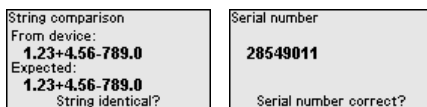
If the device code has been changed and forgotten, the enclosed information sheet "Access Protection" provides an emergency device code.

### Character string comparison and serial number:

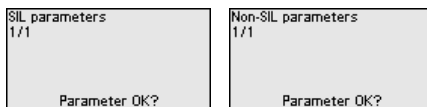
You first have to carry out the character string comparison. This is used to check the character representation.

Confirm if the two character strings are identical. The verification texts are provided in German and in the case of all other menu languages, in English.

Afterwards you confirm that the serial number of your instrument was carried over correctly. This is used to check device communication.



In the next step, the instrument checks the data of the measurement and decides by means of the evaluation results if a functions test is required. If a function test is necessary, the following message is displayed.



In this case, you have to carry out a function test.

## Set up with the display and adjustment module

### Function test:

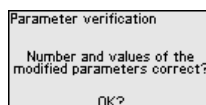
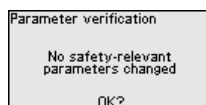
During a function test, you have to test the safety function of the instrument in the vessel with the original medium.



You can find the detailed sequence of the function test in chapter "*Functional safety (SIL)*" of the operating instructions.

### Verify parameter:

All safety-relevant parameters must be verified after a change. After the function test, all modified, safety-relevant parameters will be listed. Confirm the modified values one after the other.



If the described process of parameter adjustment was run through completely and correctly, the instrument will be locked and hence ready for operation.



Otherwise the instrument remains in the released and hence unsafe condition.



### Note:

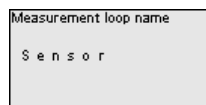
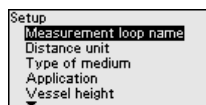
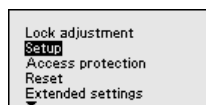
When the adjustment is blocked, the adjustment via other systems is also blocked.

### Setup

#### Measurement loop name

Here you can assign a suitable measurement loop name. You can enter names with max. 19 characters. The character set comprises:

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



#### Distance unit

In this menu item you select the distance unit of the device.

## Set up with the display and adjustment module

|                                                                                                        |                                                                          |
|--------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Setup<br>Measurement loop name<br>Distance unit<br>Type of medium<br>Application<br>Vessel height<br>▼ | Distance unit<br>mm<br><input checked="" type="checkbox"/> m<br>in<br>ft |
|--------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|

### Type of medium

This menu item allows you to adapt the sensor to the different measuring conditions of the media "*Liquid*" or "*Bulk solid*".

The corresponding application is selected in the following menu item "*Application*".

|                                                                                                        |                                |                                                                             |
|--------------------------------------------------------------------------------------------------------|--------------------------------|-----------------------------------------------------------------------------|
| Setup<br>Measurement loop name<br>Distance unit<br>Type of medium<br>Application<br>Vessel height<br>▼ | Type of medium<br>Liquids<br>▼ | Type of medium<br><input checked="" type="checkbox"/> Liquids<br>Bulk solid |
|--------------------------------------------------------------------------------------------------------|--------------------------------|-----------------------------------------------------------------------------|

### Application - liquid

With "*Liquid*", the applications are based on the following features, to which the measuring characteristic of the sensor is adjusted in particular:

|                                                                                                          |                                                                                                                                                     |                                                                                                                                                         |
|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| Setup<br>Distance unit<br>Type of medium<br>Application<br>Vessel height<br>Distance A (max. value)<br>▼ | Application<br><input checked="" type="checkbox"/> Storage tank<br>Stirred vessel<br>Dosing vessel<br>Stilling tube<br>Vessel/Collecting basin<br>▼ | Application<br>Plastic tank<br>Mobile plastic tank (IBC)<br><input checked="" type="checkbox"/> Gauge measurement<br>Flow flume<br>Pumping station<br>▼ |
|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|

| Application                                                                                          | Vessel                                                                                                 | Process/measurement conditions                                                                                                                                                                           | Further recommendations                        |
|------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| Storage tank<br>     | Large volume<br>Upright cylindrical,<br>horizontal round                                               | Slow filling and emptying<br>Smooth medium surface<br>Multiple reflections from dished vessel ceiling<br>Condensation                                                                                    | -                                              |
| Stirrer vessel<br> | Large agitator<br>blades of metal<br>Installations like<br>flow breakers,<br>heating spirals<br>Nozzle | Frequent, fast to slow filling and emptying<br>Strongly agitated surface, foam and strong vortex generation<br>Multiple reflections through dished vessel ceiling<br>Condensation, buildup on the sensor | False signal suppression with running agitator |
| Dosing vessel<br>  | Small vessels                                                                                          | Frequent and fast filling/emptying<br>Tight installation situation<br>Multiple reflections through dished vessel ceiling<br>Product buildup, condensate and foam generation                              | -                                              |

## Set up with the display and adjustment module

| Application                                                                                                                            | Vessel                                                       | Process/measurement conditions                                                                                                                                                                       | Further recommendations                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Standpipe<br>                                         | Standpipe in the vessel                                      | Tubes with different diameters and openings for product mixing<br>Welded connections or mechanical joints with very long tubes                                                                       | Orientation of the polarisation direction<br>False signal suppression                                                                                         |
| Bypass<br>                                            | Bypass tube outside the vessel<br>Typical lengths: up to 6 m | Tubes with different diameters<br>Lateral connections to the vessel                                                                                                                                  | Orientation of the polarisation direction<br>False signal suppression                                                                                         |
| Vessel/Collecting basin<br>                           | Large volume<br>Upright cylindrical or rectangular           | Slow filling and emptying<br>Smooth medium surface<br>Condensation                                                                                                                                   | -                                                                                                                                                             |
| Plastic tank (measurement through the vessel top)<br> |                                                              | Measurement through the tank top, if appropriate to the application<br>Condensation on the plastic ceiling<br>In outdoor facilities, water and snow on vessel top possible                           | When measuring through the tank top: False signal suppression<br>When measuring through the tank top (outdoor areas): Protective roof for the measuring point |
| Transportable plastic tank (IBC)<br>                 | Small vessels                                                | Material and thickness different<br>Measurement through the vessel top, if appropriate to the application<br>Changed reflection conditions as well as jumps in measured values when changing vessels | When measuring through the tank top: False signal suppression<br>When measuring through the tank top (outdoor areas): Protective roof for the measuring point |
| Gauge measurement, waters<br>                       |                                                              | Slow gauge change<br>Extreme damping of output signal in case of wave generation<br>Ice and condensation on the antenna possible<br>Floating debris sporadically on the water surface                | -                                                                                                                                                             |

Set up with the display and adjustment module

| Application                                                                                                              | Vessel                                                             | Process/measurement conditions                                                                                                                                                                                     | Further recommendations  |
|--------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Flow measurement flume/<br>Overfall<br> |                                                                    | Slow gauge change<br>Smooth to agitated water surface<br>Measurement often from a short distance with the demand for accurate measurement results<br>Ice and condensation on the antenna possible                  | -                        |
| Pumping station/<br>Pump shaft<br>      |                                                                    | Partly strongly agitated surface<br>Installations such as pumps and ladders<br>Multiple reflections through flat vessel ceiling<br>Dirt and grease deposits on shaft wall and sensor<br>Condensation on the sensor | False signal suppression |
| Overflow basin (RÜB)<br>                | Large volume<br>Partly installed underground                       | Partly strongly agitated surface<br>Multiple reflections through flat vessel ceiling<br>Condensation, dirt deposits on the sensor<br>Flooding of the sensor antenna                                                | -                        |
| Demonstration<br>                       | Applications for non-typical level measurements, e.g. device tests | Instrument demonstration<br>Object recognition/monitoring<br>Fast position changes of a measuring plate during functional test                                                                                     | -                        |

Application - bulk solid

With "Bulk solid", the applications are based on the following features, to which the measuring characteristic of the sensor is adjusted in particular:

|                         |
|-------------------------|
| Setup                   |
| Distance unit           |
| Type of medium          |
| Application             |
| Vessel height           |
| Distance A (max. value) |

|                           |
|---------------------------|
| Anwendung                 |
| ✓ Silo (schlank und hoch) |
| Bunker (großvolumig)      |
| Brücher                   |
| Halde                     |
| Demonstration             |

|                           |
|---------------------------|
| Anwendung                 |
| ✓ Silo (schlank und hoch) |
| Bunker (großvolumig)      |
| Brücher                   |
| Halde                     |
| Demonstration             |

## Set up with the display and adjustment module

| Application                                                                                         | Vessel                                                                  | Process/measurement conditions                                                                                                                                                                                                                                                                                                                                     | Further recommendations                                                     |
|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Silo<br>            | Slim and high<br>Upright cylindrical                                    | Interfering reflections due to weld seams on the vessel<br>Multiple echoes/diffuse reflections due to unfavourable pouring positions with fine grain<br>Varying pouring positions due to outlet funnel and filling cone                                                                                                                                            | False signal suppression<br>Alignment of the measurement to the silo outlet |
| Bunker<br>          | Large volume                                                            | Large distance to the medium<br>Steep angles of repose, unfavourable pouring positions due to outlet funnel and filling cone<br>Diffuse reflections due to structured vessel walls or internals<br>Multiple echoes/diffuse reflections due to unfavourable pouring positions with fine grain<br>Changing signal conditions when large amounts of material slip off | False signal suppression                                                    |
| Crusher<br>         |                                                                         | Measured value jumps and varying pouring positions, e.g. due to truck filling<br>Fast reaction time<br>Large distance to the medium<br>Interfering reflections from fixtures or protective devices                                                                                                                                                                 | False signal suppression                                                    |
| Heap<br>           | Large volume<br>Upright cylindrical or rectangular                      | Measured value jumps, e.g. through heap profile and traverses<br>Large angles of repose, varying pouring positions<br>Measurement near the filling stream<br>Sensor mounting on movable conveyor belts                                                                                                                                                             | -                                                                           |
| Demonstration<br> | Applications that are not typical level measurements, e.g. device tests | Instrument demonstration<br>Object recognition/monitoring<br>Measured value verification with higher measuring accuracy with reflection without bulk solids, e.g. via a measuring plate                                                                                                                                                                            | -                                                                           |

### Vessel height

Through this selection the operating range of the sensor is adapted to the vessel height. Hence the measurement reliability is increased considerably under different basic conditions.

## Set up with the display and adjustment module

|                                                                                                                      |                                     |                                                     |
|----------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------------------------------------------|
| Setup<br>Type of medium<br>Application<br><b>Vessel height</b><br>Distance A (max. value)<br>Distance B (min. value) | Vessel height<br><br><b>30.00 m</b> | Vessel height<br><br><b>030.00</b><br>0.00 m 120.00 |
|----------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------------------------------------------|



### Note:

Regardless of this, the min. adjustment must also be carried out (see following section).

## Adjustment

Since the radar sensor is a distance measuring instrument, it is the distance from the sensor to the medium surface that is measured. To indicate the actual level, the measured distance must be assigned to a certain height percentage (min./max. adjustment).

During adjustment, enter the respective measuring distance when the vessel is full and empty (see the following examples):

### Liquids:

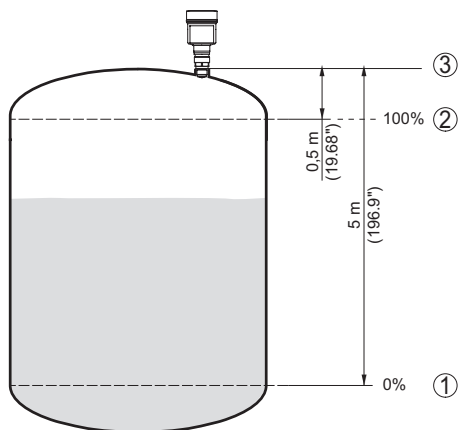


Fig. 34: Parameterisation example min./max. adjustment - liquids

- 1 Min. level = max. meas. distance (distance B)
- 2 Max. level = min. meas. distance (distance A)
- 3 Reference plane

## Set up with the display and adjustment module

### Bulk solids:

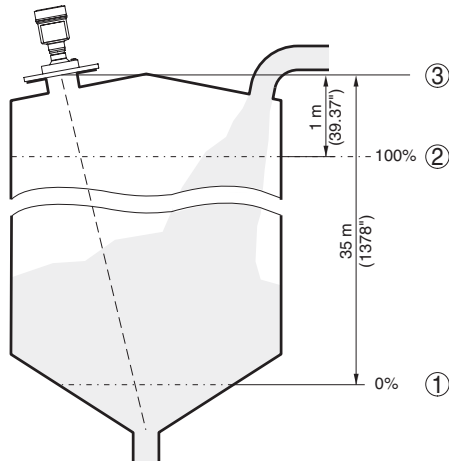


Fig. 35: Parameterisation example min./max. adjustment - bulk solids

- 1 Min. level = max. meas. distance (distance B)
- 2 Max. level = min. meas. distance (distance A)
- 3 Reference plane

If these values are not known, and adjustment can for example be carried out with the distances of 10 % and 90 %.

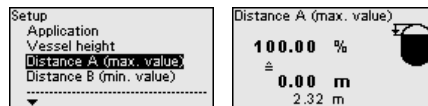
The starting point for these distance specifications is always the reference plane, e.g. the sealing surface of the thread or flange. Information on the reference plane can be found in the chapters "*Mounting instructions*" resp. "*Technical data*". The actual filling height is then calculated on the basis of these entries.

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.

### Distance A (max. value)

Proceed as follows:

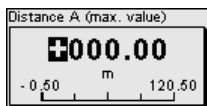
1. Select with **[→]** the menu item Distance A (max. value) and confirm with **[OK]**.



2. Edit the distance value with **[OK]** and set the cursor to the requested position with **[→]**.

## Set up with the display and adjustment module

- Adjust the requested distance value for 100 % with **[+]** and store with **[OK]**.

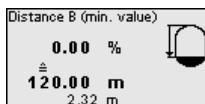
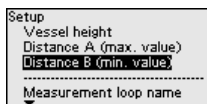


- Move with **[ESC]** and **[->]** to the min. adjustment

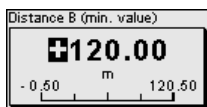
### Distance B (min. value)

Proceed as follows:

- Select with **[->]** the menu item "Distance B (min. value)" and confirm with **[OK]**.



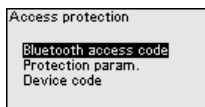
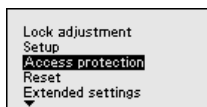
- Edit the distance value with **[OK]** and set the cursor to the requested position with **[->]**.
- Set the requested distance value for 0 % (e.g. distance from the sensor up to the vessel bottom) with **[+]** and save with **[OK]**. The cursor now jumps to the distance value.



## Access protection

### Bluetooth access code

This menu item enables to change the factory-preset Bluetooth access code to your personal Bluetooth access code.



### Note:

You can find the individual factory Bluetooth access code of the device on the information sheet supplied "PINs and Codes".

### Protection of the parameterization

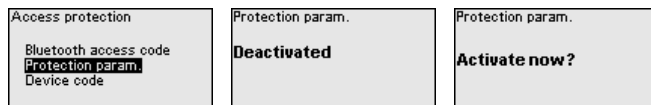
This menu item allows you to protect the sensor parameters from unwanted or unintended changes. To activate the protection, you must define and enter a 6-digit device code.

## Set up with the display and adjustment module



### Note:

For SIL devices, the protection of the parameterisation is activated ex works. These devices have an individual device code. You will find it in the information sheet supplied "*PINs and Codes*".



When protection is activated, the individual menu items can still be selected and displayed. However, the parameters can no longer be changed.

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

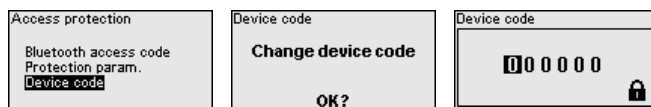


### Note:

When the parameter adjustment is protected, the adjustment via other systems is also blocked.

## Device code

This menu item allows you to change the device code. It is only displayed if the parameterisation protection has been activated beforehand.



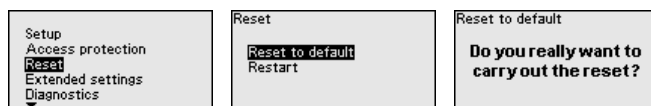
### Note:

The changed device code is also effective for operation via other systems.

## Reset

### Reset

During a reset, parameter settings made by the user are reset to the values of the factory settings. You can find the values in chapter "*Menu overview*".



### Information:

The language and Bluetooth access code are not reset, a currently running simulation however is aborted.

### Reset - Factory settings:

- Restoring the factory and order-specific parameter settings

## Set up with the display and adjustment module

- Resetting a user-set measuring range to the recommended measuring range (see chapter "Technical data")
- Deleting a created false signal suppression, a user-programmable linearisation curve as well as the measured value and echo curve memory<sup>1)</sup>

### Reset - Restart:

Is used to restart the device without switching off the operating voltage.



### Note:

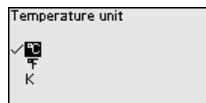
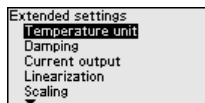
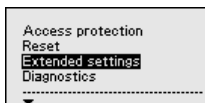
For the duration of the reset, the device changes its behaviour from the normal measuring operation. Therefore, observe the following for downstream systems:

- The current output outputs the set false signal
- The Asset-Management function outputs the message "Maintenance" aus

### Extended settings

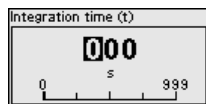
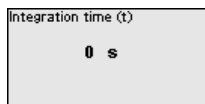
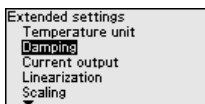
#### Temperature unit

In this menu item you select the temperature unit of the device.



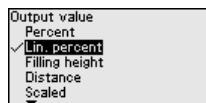
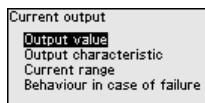
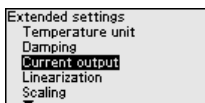
#### Damping

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



#### Current output - Output value

In this menu item you determine which measured value is output via the respective current output:



The following selection possibilities are available:

- Percent
- Linearized percent
- Filling height
- Distance
- Scaled
- Measurement reliability

<sup>1)</sup> The event and parameter change memories are maintained.

## Set up with the display and adjustment module

- Electronics temperature
- Measuring rate
- Operating voltage

### Current output - Initial/Final value characteristics

Here you determine which heights of the output value belong to the current values 4 mA and 20 mA .

|                                                                                                                                               |                                                           |                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------|
| Current output<br>Output value<br><b>Initial value characteristics</b><br>End value characteristics<br>Output characteristic<br>Current range | Initial value characteristics<br>0 %<br>$\pm$<br>0.0 0 dB | Initial value characteristics<br>0000.00<br>dB<br>- 999.99 999.99 |
| Current output<br>Output value<br>Initial value characteristics<br><b>End value characteristics</b><br>Output characteristic<br>Current range | End value characteristics<br>100 %<br>$\pm$<br>100.0 0 dB | End value characteristics<br>100.00<br>dB<br>- 999.99 999.99      |



#### Note:

This menu item is only available if one of the following output values was selected for the current output:

- Measurement reliability
- Electronics temperature
- Measuring rate
- Operating voltage

### Current output - Output characteristics

In the menu item "*Current output - Output characteristic*" you select for 0 ... 100 % output value if the characteristic of the current output rises (4 ... 20 mA) or falls (20 ... 4 mA).

|                                                                                                                                                               |                                                    |                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Current output<br>Initial value characteristics<br>End value characteristics<br><b>Output characteristic</b><br>Current range<br>Behaviour in case of failure | Output characteristic<br>0...100 % $\pm$ 4...20 mA | Output characteristic<br><input checked="" type="checkbox"/> 0...100 % $\pm$ 4...20 mA<br>0...100 % $\pm$ 20...4 mA |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|

### Current output - Current range

In the menu item "*Current output - Current range*" you determine the range of the current output as 4 ... 20 mA or 3.8 ... 20.5 mA.

|                                                                                                                              |                                 |                                                                                    |
|------------------------------------------------------------------------------------------------------------------------------|---------------------------------|------------------------------------------------------------------------------------|
| Current output<br>End value characteristics<br>Output characteristic<br><b>Current range</b><br>Behaviour in case of failure | Strombereich<br>3,8 ... 20,5 mA | Strombereich<br><input checked="" type="checkbox"/> 3,8 ... 20,5 mA<br>4 ... 20 mA |
|------------------------------------------------------------------------------------------------------------------------------|---------------------------------|------------------------------------------------------------------------------------|

### Current output - Reaction in case of fault

In the menu item "*Current output - Behaviour in case of failure*" you set the behaviour of the current output in case of failures as  $\leq 3.6$  mA or  $\geq 21$  mA resp. the last measured value.

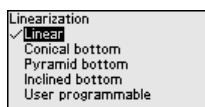
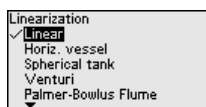
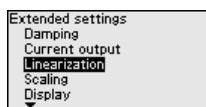
|                                                                                                                 |                                               |                                                                                                                                |
|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Current output<br>Output characteristic<br>Current range<br><b>Behaviour in case of failure</b><br>Output value | Behaviour in case of failure<br>$\leq 3,6$ mA | Behaviour in case of failure<br><input checked="" type="checkbox"/> $\leq 3,6$ mA<br>$\geq 21$ mA<br>Last valid measured value |
|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|

## Set up with the display and adjustment module

### Linearisation

Linearisation is required for all vessels where the vessel volume does not increase linearly with the level and the display or output of the volume is desired. The same applies to flow measuring constructions and the relationship between flow and level.

Corresponding linearisation curves are stored for these measurement situations. They indicate the relationship between the percentage level and the vessel volume or flow rate. The selection depends on the selected linearisation type liquid or bulk solid.



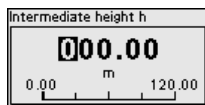
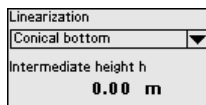
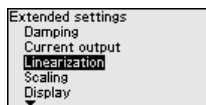
#### Note:

The selected linearisation applies to the measured value indication and the signal output.

Depending on the medium and the vessel bottom, the intermediate height is also entered, see next menu item.

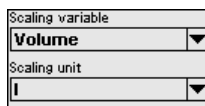
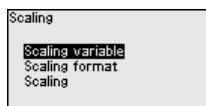
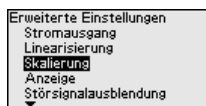
### Linearization - Intermediate height

The intermediate height is the beginning of the cylindrical area, e.g. for vessels with conical bottoms.



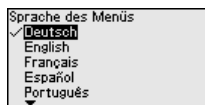
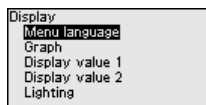
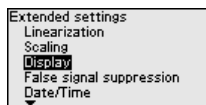
### Scaling

In the menu item "Scaling" you define the scaling variable and unit as well as the scaling format. By doing so, it is for example the indication of the level measured value for 0 % and 100 % on the display as volume in l is possible.



### Display - Menu language

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



The following languages are available:

- German
- English
- French

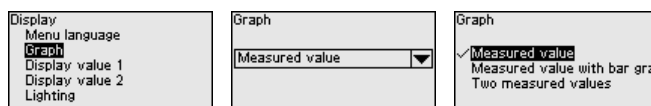
## Set up with the display and adjustment module

- Spanish
- Portuguese
- Italian
- Dutch
- Russian
- Chinese
- Japanese
- Polish
- Czech
- Turkish

### Display - Presentation

With the **[→]** key you move between three different indication modes:

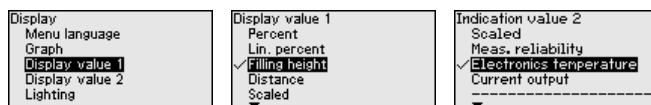
- Measured value in large font
- Measured value and corresponding bargraph presentation
- Measured value as well as second selectable value, e.g. electronics temperature



During the initial setup of an instrument shipped with factory settings, use the **"OK"** key to get to the menu *"National language"*.

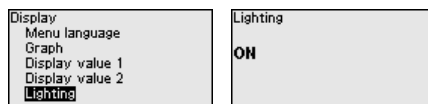
### Display - Displayed value 1, 2

In this menu item, you determine which measured values is displayed.



### Display - Lighting

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"*.



#### Note:

If the power supply is currently insufficient, the lighting is temporarily switched off (maintaining the device function).

### False signal suppression

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

## Set up with the display and adjustment module

- High mounting nozzles
- Vessel internals such as struts
- Agitators
- Buildup or welded joints on vessel walls

A false signal suppression detects, marks and saves these false signals to ensure that they are ignored in the level measurement.



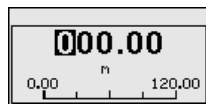
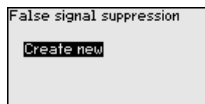
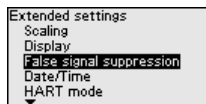
### Note:

The false signal suppression should be done with the lowest possible level so that all potential interfering reflections can be detected.

### Create new:

Proceed as follows:

1. Select with **[->]** the menu item "False signal suppression" and confirm with **[OK]**.



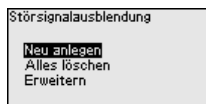
2. Confirm 2-times with **[OK]** and enter the actual distance from the sensor to the product surface.
3. All interfering signals in this range are detected by the sensor and stored after being confirmed with **[OK]**.



### Note:

Check the distance to the medium 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 all:

An false signal suppression that has already been created is completely deleted.

→ This is useful if the applied false signal suppression no longer matches the metrological conditions of the vessel.

### Extend:

A false signal suppression that has already been created is extended. The distance to the medium surface of the created

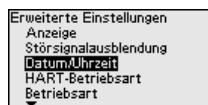
## Set up with the display and adjustment module

false signal suppression is displayed. This value can now be changed and the false signal suppression can be extended to this area.

→ This is useful if a false signal suppression was carried out when the level was too high and thus not all false signals could be detected.

### Date/Time

In this menu item, the internal clock of the sensor is set to the desired time.



#### Note:

The device is set to CET (Central European Time) at the factory.

### HART mode

In this menu item you specify the HART mode and enter the address for multidrop mode.

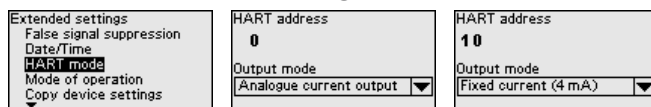
#### HART address 0:

In the menu item "Output mode" the "Analogue current output" is displayed and a 4 ... 20 mA signal output.

#### HART address deviation from 0:

In the menu item "Output mode" "Fixed current (4 mA)" is displayed and independent of the actual level a fixed 4 mA signal output. The level is output digitally via the HART signal.

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

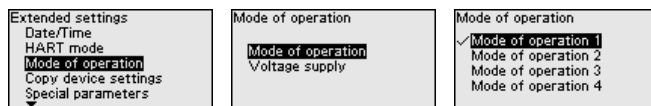


### Mode

This menu item contains operational settings of the sensor.

#### Mode:

Country or region-specific settings for the radar signals are determined via the operating mode.



- Mode 1: EU, Albania, Andorra, Azerbaijan, Australia, Belarus, Bosnia and Herzegovina, Canada, Liechtenstein, Moldova,

## Set up with the display and adjustment module

Monaco, Montenegro, New Zealand, Northern Macedonia, Norway, San Marino, Saudi Arabia, Serbia, South-Africa, Switzerland, Turkey, Ukraine, United Kingdom, USA

- Mode of operation 2: Brazil, Japan, South Korea, Taiwan, Thailand
- Mode of operation 3: India, Malaysia
- Mode of operation 4: Russia, Kazakhstan



### Note:

Depending on the operating mode, metrological properties of the device can change (see chapter "*Technical data, input variable*").

### Voltage supply:

The power supply determines whether the sensor is in operation permanently or only in accordance with certain requirements.

|                                                                     |                                                                                                        |
|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| Mode of operation<br><br>Mode of operation<br><b>Voltage supply</b> | Voltage supply<br><br><input checked="" type="checkbox"/> Permanent voltage supply<br>Non-perm. supply |
|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|

### Copy instrument settings

The following functions are available:

|                                                                                                               |                                                          |                                                                       |
|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------------|
| Extended settings<br>HART mode<br>Mode of operation<br><b>Copy device settings</b><br>Special parameters<br>▼ | Copy device settings<br><br><b>Copy device settings?</b> | Copy instr. settings<br><br><b>Copy from sensor</b><br>Copy to sensor |
|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------------|

### Load from sensor:

Store data from sensor in the display and adjustment module

### Write to sensor:

Store data from display and adjustment module in the sensor

The following device settings are copied:

- Measurement loop name
- Application
- Units
- Adjustment
- Damping
- Current output
- Linearisation
- Scaling
- Indication
- PV adjustment
- Mode
- Diagnostic behaviour

The copied data are permanently saved in an EEPROM memory in the display and adjustment module and remain there

## Set up with the display and adjustment module

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.



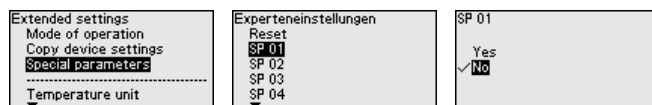
### Note:

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.

## Special parameters

Special parameters are used to adapt the sensor to special requirements. However, this is only necessary in rare cases.

However, only change the special parameters after consulting our service staff.



The special parameters can be reset to factory settings with "Reset".



### Note:

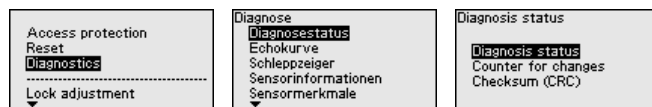
The special parameters are described in a separate section at the end of the chapter "Parameter adjustment".

## Diagnostics

### Diagnosis status

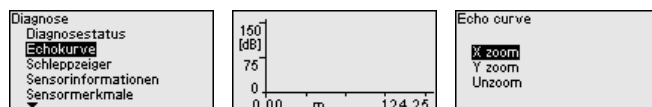
The following is displayed in this menu item:

- Diagnosis status (device status OK or error messages)
- Change counter (number of the parameter changes)
- Current checksum CRC (checksum for plausibility of the set parameters) with date of the last change
- Checksum (CRC) of the last SIL locking with date



## Echo curve

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



## Set up with the display and adjustment module

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

### Measured values/peak indicator

The following min./max. values saved by the sensor are displayed in the menu item "Measured values/Peak indicator":

- Distance
- Measurement reliability
- Measuring rate
- Electronics temperature
- Operating voltage

The **[OK]** key opens a reset function in the respective peak indicator window:

|                                                                                                          |                                                                   |                                                           |
|----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|-----------------------------------------------------------|
| Diagnose<br>Diagnosestatus<br>Echokurve<br><b>Schleppzeiger</b><br>Sensorinformationen<br>Sensormerkmale | Distance<br>Currently 2.32 m<br>Minimal 2.32 m<br>Maximum 16.27 m | Distance<br><b>Reset peak indicator</b><br><br><b>OK?</b> |
|----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|-----------------------------------------------------------|

With the **[OK]** key, the peak indicator are reset to the actual measured values.

### Diagnostic behaviour

In this menu item, you define what the signal output outputs in the event of an echo loss. For this purpose, the time after an echo loss until a fault message is selected.

|                                                                                                                    |                                                                                                                                            |                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| Diagnostics<br>Echo curve<br>Peak indicator<br><b>Diagnostic behaviour</b><br>Sensor information<br>Sensor details | Behaviour in case of loss of ec<br><input checked="" type="checkbox"/> Last valid measured value<br>Maintenance message<br>Failure message | Delay of fault signal<br><div style="border: 1px solid black; padding: 5px; text-align: center;"> <b>0015</b><br/>         1 s 3600       </div> |
|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|

### Sensor information

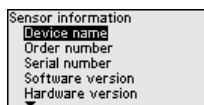
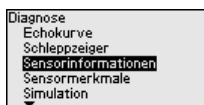
In this menu item the following information of the instrument can be read out:

- Device name
- Order and serial number
- Hardware and software version
- Device Revision
- Factory calibration date

as well as additionally depending on the device version:

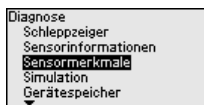
- Instrument address
- Loop Current Mode
- Fieldbus Profile Rev.
- Expanded Device Type
- Sensor acc. to SIL
- Sensor acc. to WHG
- Bustype ID

## Set up with the display and adjustment module



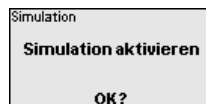
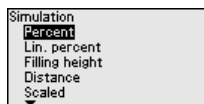
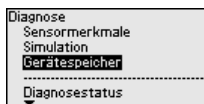
### Sensor characteristics

The menu item "Sensor characteristics" delivers sensor characteristics such as approval, process fitting, seal, measuring range etc.



### Simulation

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:

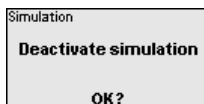
During simulation, the simulated value is output as 4 ... 20 mA current value and as digital HART signal. The status message within the context of the asset management function is "Maintenance".



#### Note:

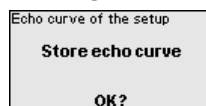
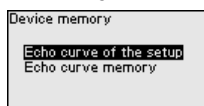
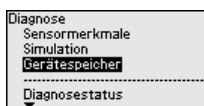
The sensor terminates the simulation automatically after 60 minutes.

To deactivate the simulation manually in advance, you have to push the **[ESC]** key and confirm the message with the **[OK]** key.



### Device memory

The menu item Device memory offers the following functions:



## Set up with the display and adjustment module

### Echo curve of the setup:

With the function "*Echo curve of the setup*" it is possible to store the echo curve at the time of the setup. Storage should be carried out at the lowest possible level.



### Note:

This is generally recommended, even mandatory, for using the asset management functionality.

### Echo curve memory:

The function "*Echo curve memory*" allows up to ten individual echo curves to be stored, for example to detect the measurement behaviour 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.

### Special parameters

#### SP01 - Activate measuring range start limiting

Measuring range start limiting is activated here. The appropriate distance value is set in the special parameter SP02.

→ Jumps in the measured value to a changing false signal in the close range can thus be prevented.



### Note:

However, activation also means that the sensor no longer accepts the level echo in the event of overfilling above the measuring range begin. A measured value jump to a multiple echo may occur here.

#### SP02 - Manual limitation of the measuring range begin

Here, an individual limitation of the measuring range begin takes place independent of the 100 % adjustment. The entered distance value in "*m*" must always be between the sensor reference point and the maximum level.

→ Echoes between the sensor reference point and this value will not be detected.

#### SP03 - Reliability on the vessel bottom resp. the measuring range

This is an additional distance value "*m*" that is added to the special parameter SP24 to reliably detect the zero point in case of insufficient reflections at the bottom of the vessel.

→ The echo detection below the 0 % adjustment is intended to support the reliable detection of an echo when the vessel is completely empty.

#### SP04 - Correction of the propagation speed

This parameter in "%" is used for correction of a running time shift or a modified spreading speed of the radar signal.

## Set up with the display and adjustment module

### SP05/06 - Factor for noise averaging rising/falling

→ This compensates for measurement deviations due to longer distances in standpipes or a higher permittivity of the atmosphere in the vessel (e.g. for gases and vapours especially at high pressures).

The noise averaging is a temporal, floating average value formation of all signals received by the sensor. The set factor determines the number of averaged echo curves as a Basis 2 exponent (example: factor 2 corresponds to the averaging of  $2^2$  [= 4] echo curves).

→ Used for false signals caused by sporadic echoes, e.g. from agitator blades. The false signals are given a lower relevance or amplitude by a larger value of SP05. They are thus more strongly suppressed in their evaluation.

→ Use for level echoes with changing amplitude, e.g. due to a turbulent medium surface. The level echoes receive a greater relevance or constant amplitude through a larger value of SP06. They are thus increased in their evaluation.



#### Note:

A higher factor for noise averaging can lead to a longer reaction time or a delay of the measured value update.

### SP07 - Deactivate filter function "Smooth raw value curve"

This parameter is always switched on ex-factory. It acts as a digital filter over the raw value curve depending on the selected application.

→ In principle, it causes an improvement in measurement reliability.



#### Note:

Therefore, switching off only makes sense in very special applications that need to be clarified.

### SP08 - Offset detection curve for echo analysis

The detection curve runs above the echo curve with a defined distance (offset). Only the echoes that exceed the detection curve are detected and processed.

This special parameter in "dB" influences the sensitivity of the device against all echoes in the measuring range.

→ An increase of the dB value reduces the sensitivity of the echo detection and signal analysis.



#### Note:

This affects the level echo to the same extent. Therefore, the application is only used with very strong false signals and simultaneously good reflection properties of the medium.

### SP09 - Minimum measurement reliability for level echo selection

The measurement reliability is the difference between echo amplitude and detection curve. This parameter defines the

## Set up with the display and adjustment module

### SP10 - Additional reliability of false signal storage

required min. measurement reliability in "dB" an echo must have within the focussing range to be accepted as level echo.  
 → By entering a minimum measurement reliability, false signals below this value are not accepted as a level echo.

This parameter increases the already created false signal suppression by the input value in "dB" over the entire, stored false signal range. It is used when it is expected that false signals such as those from product buildup, condensate formation or agitators will increase in amplitude.

→ An increase of the value avoids that such a false signal is accepted as level echo.



#### Note:

An increase is useful for very heavily fluctuating or amplitude-increasing false signals. It is advised against reducing the value of the default setting.

### SP12 - Activate "Summarize echoes" function

This function is used to activate and select the function "Summarize echoes". It consists of the individual parameters "SP13 - Amplitude difference with function "Summarize echoes"" and "SP14 - Echo distance for function "Summarize echoes"".

→ This helps to suppress measured value jumps resulting from material cones or emptying hoppers in bulk solids applications when filling and emptying.

### SP13 - Amplitude difference in "Summarize echoes" function

This parameter in "dB" determines how great the maximum amplitude difference between two adjacent echoes may be in order to summarize them.

### SP14 - Echo distance for "Summarize echoes" function

This parameter in "m" entered here determines how great the distance between the end of the first echo and the start of the second echo may be at the maximum in order for them to be summarized.

### SP15 - Activate "First large echo" function

When this parameter is activated, the first echo not saved as a false echo with sufficiently great amplitude is selected as a product echo.

→ This is useful for very large multiple reflections by e.g. a round vessel lid.

### SP16 - Minimum amplitude "First large echo"

This parameter in "dB" determines how much smaller the useful echo amplitude may be compared to the largest echo so that it is evaluated as the first large echo and thus as a product echo

→ Up to this value, a relatively weak reflection signal of the medium is thus output as a measured value.

## Set up with the display and adjustment module

### **SP17 - Wide focussing range**

This parameter determines the measuring window width "m" around the currently measured level echo. Only within this focusing range are changes (location, amplitude, number of echoes) accepted for evaluating the current level.

→ If this value is increased, very rapid level changes, e.g. due to collapsing material heaps or surge-like filling/emptying, are accepted even in an extended range.

### **SP18 - Minimum measurement reliability outside focussing range**

The measurement reliability is the difference in "dB" between echo amplitude and detection curve. This parameter defines the required min. measurement reliability an echo must have outside the focussing range to be accepted as useful echo.

→ This is useful to obtain the measured value also in case of sporadic loss of the level signal, e. g. with foam generation.

### **SP19 - Time for opening the focussing range**

If no more reflection can be detected within the focussing range, a measuring window opens. This parameter defines the time in "s" until it opens. This can be the case, for example, in the event of a level change without an evaluable reflection signal or in the event of an echo outside the focussing range with a greater useful echo probability.

→ As a result, on reaching this echo with high useful echo probability, this is evaluated as a useful echo and output as the current level.

### **SP22 - Measured value offset**

The reference plane for the measurement with radar sensors is the lower edge of the flange or the sealing surface of the thread. The sensors are calibrated to this reference plane at the factory. This parameter enables an adaptation of this factory setting, e.g. to subsequently attached mounting facilities such as adapter flanges, threaded adapters, etc.

→ A possible offset error (constant error of the measured distance over the entire measuring range) is compensated for by this input.

### **SP24 - Factor for additional reliability at the measuring range end**

This value in "%" is additional safety below the 0 % adjustment related to the measuring range.

→ It supports the detection of an echo when the vessel is completely empty, even with unfavourable vessel bottom shapes.

### **SP HART - HART signal**

This parameter serves to activate/deactivate the HART signal in the output.

### **SP SIL - Safety Integrity Level function**

This parameter serves to activate/deactivate the Safety Integrity Level function.

## Set up with the display and adjustment module

---

### Save parameter adjustment data

#### On paper

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

#### In the display and adjustment module

If the instrument is equipped with a display and adjustment module, the parameter adjustment data can be saved therein. The procedure is described in menu item "*Copy device settings*".

## Setup with smartphone/tablet (Bluetooth)

### System requirements

### Preparations

Make sure that your smartphone/tablet meets the following system requirements:

- Operating system: iOS 13 or newer
- Operating system: Android 5.1 or newer
- Bluetooth 4.0 LE or newer

Download the adjustment app from the "Apple App Store", "Google Play Store" or "Baidu Store" to your smartphone or tablet.

Make sure that the Bluetooth function of the display and adjustment module is activated. For this, the switch on the bottom side must be set to "On".

Factory setting is "On".

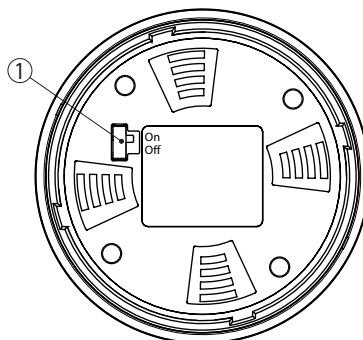


Fig. 36: Activate Bluetooth

- 1 Switch  
 On = Bluetooth active  
 Off = Bluetooth not active

### Connecting

### Connecting

Start the adjustment app and select the function "Setup". The smartphone/tablet searches automatically for Bluetooth-capable instruments in the area.

The message "Connecting ..." is displayed.

The devices found are listed and the search is automatically continued.

Select the requested instrument in the device list.

### Authenticate

When establishing the connection for the first time, the operating tool and the sensor must authenticate each other. After the first correct authentication, each subsequent connection is made without a new authentication query.

## Setup with smartphone/tablet (Bluetooth)

### Enter Bluetooth access code

For authentication, enter the 6-digit Bluetooth access code in the next menu window. You can find the code on the information sheet "*Pins and Codes*" in the device packaging.

For the very first connection, the adjustment unit and the sensor must authenticate each other.

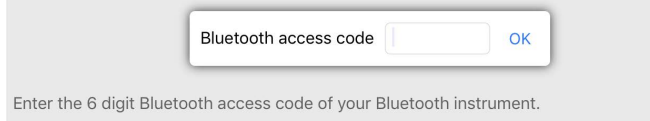


Fig. 37: Enter Bluetooth access code



#### Note:

If an incorrect code is entered, the code can only be entered again after a delay time. This time gets longer after each incorrect entry.

The message "*Waiting for authentication*" is displayed on the smartphone/tablet.

### Connected

After connection, the sensor adjustment menu is displayed on the respective adjustment tool.

If the Bluetooth connection is interrupted, e.g. due to a too large distance between the two devices, this is displayed on the adjustment tool. The message disappears when the connection is restored.

### Change device code

Parameter adjustment of the device is only possible if the parameter protection is deactivated or the adjustment released. When delivered, parameter protection is deactivated by default and can be activated at any time.

It is recommended to enter a personal 6-digit device code. To do this, go to menu "*Extended functions*", "*Access protection*", menu item "*Protection of the parameter adjustment*".

### Parameter adjustment

### Enter parameters

The sensor adjustment menu is divided into two areas, which are arranged next to each other or one below the other, depending on the adjustment tool.

- Navigation section
- Menu item display

The selected menu item can be recognized by the colour change.

Enter the requested parameters and confirm via the keyboard or the editing field. The settings are then active in the sensor. Close the app to terminate connection.

## Set up with PC/notebook

### System requirements

#### Preparations (Bluetooth)

Make sure that your PC/notebook meets the following system requirements:

- Operating system: Windows 10 or newer
- DTM Collection
- Bluetooth 4.0 LE or newer

Make sure that the Bluetooth function of the display and adjustment module is activated. For this, the switch on the bottom side must be set to "On".

Factory setting is "On".

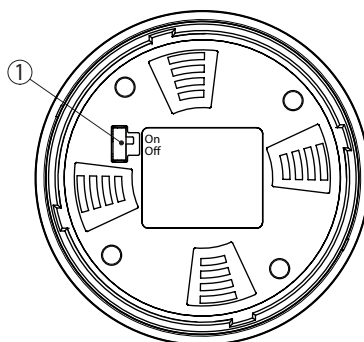


Fig. 38: Activate Bluetooth

- 1 Switch  
 On = Bluetooth active  
 Off = Bluetooth not active

### Activate Bluetooth connection



Activate the Bluetooth connection via the project assistant.

#### Note:

Older systems do not always have an integrated Bluetooth LE. In these cases, a Bluetooth USB adapter is required. Activate the Bluetooth USB adapter using the Project Wizard.

After activating the integrated Bluetooth or the Bluetooth USB adapter, devices with Bluetooth are found and created in the project tree.

### Connecting

#### Connecting (Bluetooth)

Select the requested device for the online parameter adjustment in the project tree.

### Authenticate

When establishing the connection for the first time, the operating tool and the device must authenticate each other. After the first correct authentication, each subsequent connection is made without a new authentication query.

## Set up with PC/notebook

### Enter Bluetooth access code

For authentication, enter in the next menu window the 6-digit Bluetooth access code:

Fig. 39: Enter Bluetooth access code

You can find the code on the outside of the device housing and on the information sheet "*PINs and Codes*" in the device packaging.



#### Note:

If an incorrect code is entered, the code can only be entered again after a delay time. This time gets longer after each incorrect entry.

The message "*Waiting for authentication*" is displayed on the PC/notebook.

### Connected

After connection, the device DTM appears.

If the connection is interrupted, e.g. due to a too large distance between device and adjustment tool, this is displayed on the adjustment tool. The message disappears when the connection is restored.

### Change device code

Parameter adjustment of the device is only possible if the parameter protection is deactivated or the adjustment released. When delivered, parameter protection is deactivated by default and can be activated at any time.

It is recommended to enter a personal 6-digit device code. To do this, go to menu "*Extended functions*", "*Access protection*", menu item "*Protection of the parameter adjustment*".

## Set up with PC/notebook

### To the Modbus electronics

#### Connect the PC

Connection of the PC to the Modbus electronics is carried out via a USB cable.

Scope of the parameter adjustment:

- Sensor electronics
- Modbus electronics

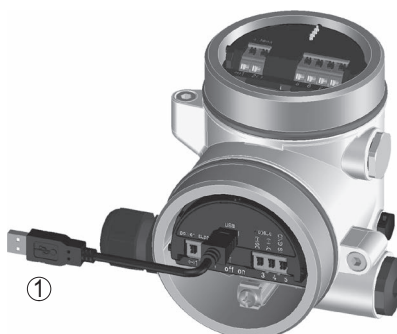


Fig. 40: Connecting the PC via USB to the Modbus electronics

1 USB cable to the PC

### To the RS 485 cable

Connection of the PC to the RS 485 cable is carried out via a standard interface adapter RS 485/USB.

Scope of the parameter adjustment:

- Sensor electronics
- Modbus electronics



#### Information:

For parameter adjustment, it is absolutely necessary to disconnect from the RTU.

## Set up with PC/notebook

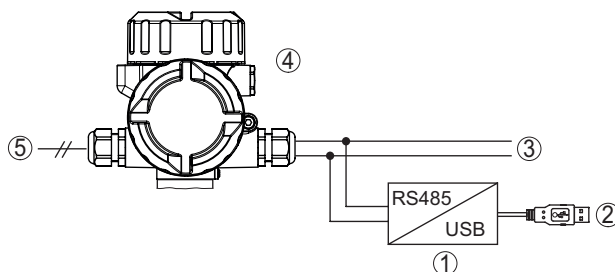


Fig. 41: Connection of the PC via the interface adapter to the RS 485 cable

- 1 Interface adapter RS 485/USB
- 2 USB cable to the PC
- 3 RS 485 cable
- 4 Sensor
- 5 Voltage supply

### Parameter adjustment

The further setup steps with detailed descriptions can be found in the online help of PACTware and the DTMs.



#### Note:

Keep in mind that for the setup of device, the current version of the DTM Collection must be used.

The latest DTM Collection and PACTware version can be downloaded free of charge via the Internet.

### Save parameter adjustment data

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

## Menu overview

### Display and adjustment module

#### Lock/Unlock adjustment

| Menu item              | Parameter | Selection    | Default setting                                                           |
|------------------------|-----------|--------------|---------------------------------------------------------------------------|
| Lock/Unlock adjustment |           | Lock, unlock | SIL and Security:<br>locked<br><br>Neither SIL, nor<br>Security: released |

#### Setup

| Menu item               | Parameter                | Selection                                                                                                                                                                                                                                                                         | Default setting                                       |
|-------------------------|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| Measurement loop name   |                          |                                                                                                                                                                                                                                                                                   | Sensor                                                |
| Distance unit           | Distance unit            | mm, m, in, ft                                                                                                                                                                                                                                                                     | m                                                     |
| Type of medium          | Type of medium           | Liquid                                                                                                                                                                                                                                                                            | Liquid <sup>1)</sup>                                  |
|                         |                          | Bulk solid                                                                                                                                                                                                                                                                        | Bulk solid <sup>2)</sup>                              |
| Application             | Application - liquid     | Storage tank, agitator tank, dosing tank, standpipe, tank/collection basin, plastic tank (measurement through tank top), mobile plastic tank (IBC), level measurement in waters, flow measurement flume/overflow, pump station/pump shaft, combined sewer overflow, demonstration | Storage tank <sup>3)</sup>                            |
|                         | Application - bulk solid | Silo, bunker, crusher, heap, demonstration                                                                                                                                                                                                                                        | Silo <sup>4)</sup>                                    |
| Vessel height           |                          |                                                                                                                                                                                                                                                                                   | Recommended meas. range, see chapter "Technical data" |
| Distance A (max. value) | Max. value               |                                                                                                                                                                                                                                                                                   | Max. adjustment<br>100 % corresponds to 0,000 m       |
| Distance B (min. value) | Min. value               |                                                                                                                                                                                                                                                                                   | Min. adjustment<br>0 % corresponds to 120,000 m       |

<sup>1)</sup> Plastic horn antenna, thread with integrated antenna system, flange with encapsulated antenna system

<sup>2)</sup> Flange with lens antenna

<sup>3)</sup> Plastic horn antenna, thread with integrated antenna system, flange with encapsulated antenna system

<sup>4)</sup> Flange with lens antenna

## Menu overview

### Access protection

| Menu item         | Parameter                          | Selection                          | Default setting                                                       |
|-------------------|------------------------------------|------------------------------------|-----------------------------------------------------------------------|
| Access protection | Bluetooth access code              | Bluetooth access code              |                                                                       |
|                   | Protection of the parameterization | Protection of the parameterization | SIL and Security: activated<br>Neither SIL, nor Security: deactivated |
|                   | Device code                        | Device code                        |                                                                       |

### Reset

| Menu item | Parameter | Selection                          | Default setting |
|-----------|-----------|------------------------------------|-----------------|
| Reset     | Reset     | Reset to factory settings, Restart | -               |

### Extended settings

| Menu item        | Parameter                        | Selection                                                                                                                                          | Default setting                       |
|------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| Temperature unit |                                  | °C, °F, K                                                                                                                                          | °C                                    |
| Damping          | Integration time                 | 0 ... 999 s                                                                                                                                        | 0 s                                   |
| Current output   | Output value                     | Percent, linearized percent, filling height, distance, scaled, measurement reliability, electronics temperature, measuring rate, operating voltage | Percent                               |
|                  | Output characteristics           | 0 ... 100 % correspond to 4 ... 20 mA                                                                                                              | 0 ... 100 % correspond to 4 ... 20 mA |
|                  |                                  | 0 ... 100 % correspond to 20 ... 4 mA                                                                                                              |                                       |
|                  | Current range                    | 4 ... 20 mA                                                                                                                                        | 4 ... 20 mA                           |
|                  |                                  | 3.8 ... 20.5 mA                                                                                                                                    |                                       |
|                  | Reaction when malfunctions occur | ≤ 3.6 mA, ≥ 21 mA, last valid measured value                                                                                                       | ≤ 3.6 mA                              |
| Linearisation    | Linearization type - liquid      | Linear, cylindrical tank, spherical tank, Venturi, trapezoidal weir, rectangular weir, Palmer-Bowlus flume, V-Notch, triangular overfall           | Linear                                |
|                  | Linearization type - bulk solids | Linear, conical bottom, pyramid bottom, sloping bottom                                                                                             | Linear                                |
|                  | Intermediate height "h"          |                                                                                                                                                    |                                       |

## Menu overview

| Menu item                | Parameter                | Selection                                                                                                                                                                                                                                                                                                                                                                                                                     | Default setting                           |
|--------------------------|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Scaling                  | Scaling size             | Scaling size (dimensionless, mass, volume, height, pressure, flow, others)                                                                                                                                                                                                                                                                                                                                                    | Dimensionless                             |
|                          |                          | Scaling unit (unit selection depending on scaling size, user-defined)                                                                                                                                                                                                                                                                                                                                                         | -                                         |
|                          | Scaling format           | #, ##, ###, ####, #####                                                                                                                                                                                                                                                                                                                                                                                                       | #                                         |
|                          | Scaling                  | Scaling                                                                                                                                                                                                                                                                                                                                                                                                                       | 100 % correspond to<br>0 % correspond to  |
| Indication               | Menu language            | German, English, French, Spanish, Portuguese, Italian, Dutch, Russian, Chinese, Japanese, Turkish, Polish, Czech                                                                                                                                                                                                                                                                                                              | Language is set with the first operation. |
|                          | Presentation             | One measured value, measured value and bargraph, two measured values                                                                                                                                                                                                                                                                                                                                                          | One measured value                        |
|                          | Displayed values 1, 2    | Percent, linearized percent, filling height, distance, scaled, measurement reliability, electronics temperature, current output, current output 2                                                                                                                                                                                                                                                                             | Percent                                   |
|                          | Backlight                | On, Off                                                                                                                                                                                                                                                                                                                                                                                                                       | On                                        |
| False signal suppression | False signal suppression | Create new, expand, delete all                                                                                                                                                                                                                                                                                                                                                                                                | -                                         |
| Date/Time                | Date/Time                | Date                                                                                                                                                                                                                                                                                                                                                                                                                          | Actual date                               |
|                          |                          | Format: 24 h, 12 h                                                                                                                                                                                                                                                                                                                                                                                                            | 24 h                                      |
|                          |                          | Time                                                                                                                                                                                                                                                                                                                                                                                                                          | Actual time                               |
| HART mode                | HART address             | 0 ... 63                                                                                                                                                                                                                                                                                                                                                                                                                      | 0                                         |
|                          | Output mode              | Analogue current output with HART, fix current (4 mA) with HART                                                                                                                                                                                                                                                                                                                                                               | Analogue current output with HART         |
| Mode                     | Mode                     | Mode 1: EU, Albania, Andorra, Azerbaijan, Australia, Belarus, Bosnia and Herzegovina, Canada, Liechtenstein, Moldavia, Monaco, Montenegro, Morocco, New Zealand, Northern Macedonia, Norway, San Marino, Saudi Arabia, Serbia, South-Africa, Switzerland, Turkey, Ukraine, United Kingdom, USA<br>Mode of operation 2: Brazil, Japan, South Korea, Taiwan, Thailand<br>Mode of operation 3: India, Malaysia<br>Mode 4: Russia | Mode 1                                    |
|                          |                          |                                                                                                                                                                                                                                                                                                                                                                                                                               |                                           |
|                          | Voltage supply           | Permanent voltage supply<br>Not permanent voltage supply                                                                                                                                                                                                                                                                                                                                                                      | Permanent voltage supply                  |

## Menu overview

| Menu item                | Parameter                                                                                           | Selection                         | Default setting |
|--------------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------|-----------------|
| Copy instrument settings |                                                                                                     | Read from sensor, store in sensor | -               |
| Special parameters       | See separate menu overview at the end of the chapter "Menu overview" of the operating instructions. |                                   |                 |

## Reset

| Menu item | Parameter | Selection                          | Default setting |
|-----------|-----------|------------------------------------|-----------------|
| Reset     | Reset     | Reset to factory settings, Restart | -               |

## Diagnostics

| Menu item              | Parameter                | Selection/Display                                                                                | Default setting           |
|------------------------|--------------------------|--------------------------------------------------------------------------------------------------|---------------------------|
| Diagnosis status       | Diagnosis status         | Diagnosis status                                                                                 | -                         |
|                        |                          | Change counter                                                                                   | -                         |
|                        |                          | Checksum (CRC) current                                                                           | Date parameter adjustment |
|                        |                          | Checksum (CRC) last SIL locking                                                                  | Date last SIL locking     |
| Echo curve             |                          | Echo curve                                                                                       | Indication of echo curve  |
| Peak indicator         | Distance                 | Current value, min. distance, max. distance                                                      | Actual value              |
|                        | Measurement reliability  | Current value, min. measurement reliability, max. measurement reliability                        | Actual value              |
|                        | Measuring rate           | Current value, min. meas. rate, max. meas. rate                                                  | Actual value              |
|                        | Electronics temperature  | Current value, min. electronics temperature, max. electronics temperature                        | Actual value              |
|                        | Operating voltage        | Current value, min. operating voltage, max. operating voltage                                    | Actual value              |
| Diagnostic behaviour   | Behaviour with echo loss | Last measured value, maintenance message, fault signal                                           | Last measured value       |
|                        | Time until fault signal  | Time until fault signal                                                                          |                           |
| Sensor information     |                          | Device name, serial number, hardware/software version, device revision, factory calibration date | -                         |
| Sensor characteristics |                          |                                                                                                  | Configuration features    |

## Menu overview

| Menu item     | Parameter               | Selection/Display                                                                                                                                                                    | Default setting |
|---------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Simulation    | Measured value          | Percent, linearized percent, filling height, distance, scaled, measurement reliability, electronics temperature, measuring rate, operating voltage, current output, current output 2 | Percent         |
| Device memory | Echo curve of the setup | Save echo curve of setup                                                                                                                                                             | -               |
|               | Echo curve memory       | Echo curve memory                                                                                                                                                                    |                 |

## Adjustment app and PACTware/DTM

### Lock/Unlock adjustment

| Menu item              | Parameter | Selection    | Default setting                                                           |
|------------------------|-----------|--------------|---------------------------------------------------------------------------|
| Lock/Unlock adjustment |           | Lock, unlock | SIL and Security:<br>locked<br><br>Neither SIL, nor<br>Security: released |

### Setup

| Menu item             | Parameter      | Selection     | Default setting          |
|-----------------------|----------------|---------------|--------------------------|
| Measurement loop name |                |               | Sensor                   |
| Distance unit         | Distance unit  | mm, m, in, ft | m                        |
| Type of medium        | Type of medium | Liquid        | Liquid <sup>1)</sup>     |
|                       |                | Bulk solid    | Bulk solid <sup>2)</sup> |

<sup>1)</sup> Plastic horn antenna, thread with integrated antenna system, flange with encapsulated antenna system

<sup>2)</sup> Flange with lens antenna

## Menu overview

| Menu item               | Parameter                | Selection                                                                                                                                                                                                                                                                         | Default setting                                       |
|-------------------------|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| Application             | Application - liquid     | Storage tank, agitator tank, dosing tank, standpipe, tank/collection basin, plastic tank (measurement through tank top), mobile plastic tank (IBC), level measurement in waters, flow measurement flume/overflow, pump station/pump shaft, combined sewer overflow, demonstration | Storage tank <sup>1)</sup>                            |
|                         | Application - bulk solid | Silo, bunker, crusher, heap, demonstration                                                                                                                                                                                                                                        | Silo <sup>2)</sup>                                    |
| Vessel height           |                          |                                                                                                                                                                                                                                                                                   | Recommended meas. range, see chapter "Technical data" |
| Distance A (max. value) | Max. value               |                                                                                                                                                                                                                                                                                   | Max. adjustment 100 % corresponds to 0,000 m          |
| Distance B (min. value) | Min. value               |                                                                                                                                                                                                                                                                                   | Min. adjustment 0 % corresponds to 120,000 m          |

## Access protection

| Menu item         | Parameter                          | Selection                          | Default setting |
|-------------------|------------------------------------|------------------------------------|-----------------|
| Access protection | Bluetooth access code              | Bluetooth access code              |                 |
|                   | Protection of the parameterization | Protection of the parameterization |                 |
|                   | Device code                        | Device code                        |                 |

## Reset

| Menu item | Parameter | Selection                          | Default setting |
|-----------|-----------|------------------------------------|-----------------|
| Reset     | Reset     | Reset to factory settings, Restart | -               |

## Extended settings

| Menu item | Parameter                          | Selection | Default setting |
|-----------|------------------------------------|-----------|-----------------|
| Units     | Temperature unit of the instrument | °C, °F    | °C              |

<sup>1)</sup> Plastic horn antenna, thread with integrated antenna system, flange with encapsulated antenna system

<sup>2)</sup> Flange with lens antenna

## Menu overview

| Menu item      | Parameter                        | Selection                                                                                                                                          | Default setting                       |
|----------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| Damping        | Integration time                 | 0 ... 999 s                                                                                                                                        | 1 s                                   |
| Current output | Output value                     | Percent, linearized percent, filling height, distance, scaled, measurement reliability, electronics temperature, measuring rate, operating voltage | Percent                               |
|                | Initial value - Characteristic   | Initial value - characteristics (4 mA)                                                                                                             | 4 mA correspond to                    |
|                | Final value - Characteristic     | End value - characteristics (20 mA)                                                                                                                | 20 mA correspond to                   |
|                | Output characteristics           | 0 ... 100 % correspond to 4 ... 20 mA                                                                                                              | 0 ... 100 % correspond to 4 ... 20 mA |
|                |                                  | 0 ... 100 % correspond to 20 ... 4 mA                                                                                                              |                                       |
|                | Current range                    | 4 ... 20 mA                                                                                                                                        | 4 ... 20 mA                           |
|                |                                  | 3.8 ... 20.5 mA                                                                                                                                    |                                       |
| Linearisation  | Linearization type - liquid      | Linear, cylindrical tank, spherical tank, Venturi, trapezoidal weir, rectangular weir, Palmer-Bowlus flume, V-Notch, triangular overfall           | Linear                                |
|                | Linearization type - bulk solids | Linear, conical bottom, pyramid bottom, sloping bottom                                                                                             | Linear                                |
|                | Intermediate height "h"          |                                                                                                                                                    | -                                     |
| Scaling        | Scaling size                     | Dimensionless, mass, volume, height, pressure, flow, others                                                                                        | Dimensionless                         |
|                | Scaling unit                     | Unit selection depending on scaling size, user-defined                                                                                             | -                                     |
|                | Name of the unit                 |                                                                                                                                                    | -                                     |
|                | Scaling format                   | #, #.#, #.##, #.###, #.####                                                                                                                        | #                                     |
|                | Scaling                          | 100 % correspond to<br>0 % correspond to                                                                                                           | 100 L<br>0 L                          |

## Menu overview

| Menu item                | Parameter                                                            | Selection                                                                                                                                                                                                                                                                                                                                                                                                            | Default setting          |
|--------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Indication               | Menu language (PLICSCOM)                                             | German, English, French, Spanish, Portuguese, Italian, Dutch, Russian, Chinese, Japanese, Turkish, Polish, Czech, Turkish                                                                                                                                                                                                                                                                                            | Order-specific           |
|                          | Presentation                                                         | One measured value, measured value and bargraph, two measured values                                                                                                                                                                                                                                                                                                                                                 | One measured value       |
|                          | Displayed values 1, 2                                                | Percent, linearized percent, filling height, distance, scaled, measurement reliability, electronics temperature, current output, current output 2                                                                                                                                                                                                                                                                    | Percent                  |
|                          | Backlight                                                            | On, Off                                                                                                                                                                                                                                                                                                                                                                                                              | On                       |
| False signal suppression | False signal suppression                                             | Create new, extend, delete area, delete all                                                                                                                                                                                                                                                                                                                                                                          | -                        |
| HART variables           | HART variables                                                       | Primary Value (PV)                                                                                                                                                                                                                                                                                                                                                                                                   | Linearized percent       |
|                          |                                                                      | Secondary Value (SV)                                                                                                                                                                                                                                                                                                                                                                                                 | Distance                 |
|                          |                                                                      | Tertiary Value (TV)                                                                                                                                                                                                                                                                                                                                                                                                  | Measurement reliability  |
|                          |                                                                      | Quarternary Value (QV)                                                                                                                                                                                                                                                                                                                                                                                               | Electronics temperature  |
|                          |                                                                      | LONG-TAG                                                                                                                                                                                                                                                                                                                                                                                                             |                          |
|                          |                                                                      | MESSAGE                                                                                                                                                                                                                                                                                                                                                                                                              | MSG                      |
| Date/Time                | Date/Time                                                            | Date                                                                                                                                                                                                                                                                                                                                                                                                                 | Actual date              |
|                          |                                                                      | Format: 24 h, 12 h                                                                                                                                                                                                                                                                                                                                                                                                   | 24 h                     |
|                          |                                                                      | Time                                                                                                                                                                                                                                                                                                                                                                                                                 | Actual time              |
| Mode                     | Mode                                                                 | Mode 1: EU, Albania, Andorra, Azerbaijan, Australia, Belarus, Bosnia and Herzegovina, Canada, Liechtenstein, Moldavia, Monaco, Montenegro, New Zealand, Northern Macedonia, Norway, San Marino, Saudi Arabia, Serbia, South-Africa, Switzerland, Turkey, Ukraine, United Kingdom, USA<br>Mode of operation 2: Brazil, Japan, South Korea, Taiwan, Thailand<br>Mode of operation 3: India, Malaysia<br>Mode 4: Russia | Mode 1                   |
|                          | Energy supply                                                        | Permanent power supply, non-permanent power supply                                                                                                                                                                                                                                                                                                                                                                   | Permanent voltage supply |
| Special parameters       | See separate menu overview at the end of the chapter "Menu overview" |                                                                                                                                                                                                                                                                                                                                                                                                                      |                          |

## Menu overview

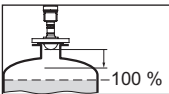
### Diagnostics

| Menu item       | Parameter                         | Selection/Display                                                                                                                                                                            | Default setting          |
|-----------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Status          | Diagnosis status                  | Diagnosis status                                                                                                                                                                             | -                        |
|                 | Status parameter adjustment       | Change counter, modification date, checksum (CRC) current, date checksum current, checksum (CRC) last SIL locking, date last SIL locking                                                     | -                        |
|                 | Measured value status             | Percent, linearized percent, filling height, distance, scaled, measurement reliability                                                                                                       | -                        |
|                 | Status outputs                    | Current output                                                                                                                                                                               | -                        |
|                 | HART Device Status                | Field device malfunction, Configuration changed, Cold start, More status available, Analog output fixed, Analog output saturated, Non-primary variable of limits, Primary variable of limits | -                        |
|                 | Status additional measured values | Electronics temperature, measuring rate, operating voltage                                                                                                                                   | -                        |
| Echo curve      |                                   | Echo curve                                                                                                                                                                                   | Indication of echo curve |
| Peak indicator  | Distance                          | Current value, min. distance, max. distance                                                                                                                                                  | Actual value             |
|                 | Measurement reliability           | Current value, min. measurement reliability, max. measurement reliability                                                                                                                    |                          |
|                 | Measuring rate                    | Current value, min. meas. rate, max. meas. rate                                                                                                                                              |                          |
|                 | Electronics temperature           | Current value, min. electronics temperature, max. electronics temperature                                                                                                                    |                          |
|                 | Operating voltage                 | Current value, min. operating voltage, max. operating voltage                                                                                                                                |                          |
| Measured values | Measured values                   | Percent, linearized percent, filling height, distance, scaled, measurement reliability                                                                                                       |                          |
|                 | Additional measured values        | Electronics temperature, measuring rate, operating voltage                                                                                                                                   |                          |
|                 | Outputs                           | Current output, Primary Value (PV), Secondary Value (SV), Tertiary Value (TV), Quarternary Value (QV)                                                                                        |                          |

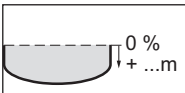
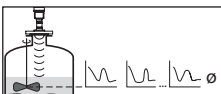
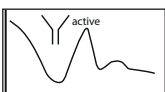
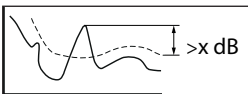
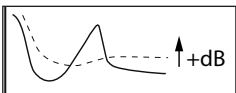
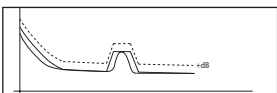
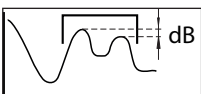
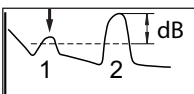
## Menu overview

| Menu item                   | Parameter                                                     | Selection/Display                                                                                                                                                                                                                                | Default setting                                             |
|-----------------------------|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| Diagnostic behaviour        | Echo loss                                                     | Behaviour in case of echo loss, time until fault signal                                                                                                                                                                                          | Output fault current                                        |
|                             | Electronics temperature - Behaviour outside the specification | Outside the specification, output fault current                                                                                                                                                                                                  |                                                             |
|                             | Status signals                                                | Activation of: Function control, Outside the specification, Maintenance required                                                                                                                                                                 | Function check, outside specification, maintenance required |
| Sensor information          |                                                               | Device name, order code, serial number, hardware/software version, Device Revision, factory calibration date, device address, Loop current mode, Fieldbus Profile Rev., Expanded Device Type, sensor acc. to SIL, sensor acc. to WHG, Bustype ID | -                                                           |
| Sensor characteristics      |                                                               |                                                                                                                                                                                                                                                  | Configuration features                                      |
| Simulation                  | Measured value                                                | Percent, linearized percent, filling height, distance, scaled, measurement reliability, electronics temperature, measuring rate, operating voltage, current output                                                                               | Percent                                                     |
| Measured value memory (DTM) |                                                               |                                                                                                                                                                                                                                                  |                                                             |
| Device memory               | Echo curve of the setup                                       | Save echo curve of setup                                                                                                                                                                                                                         | -                                                           |
|                             | Echo curve memory                                             | Echo curve memory                                                                                                                                                                                                                                |                                                             |
|                             | Measured value memory                                         | Measured value memory                                                                                                                                                                                                                            |                                                             |
|                             | Event memory                                                  | Event memory                                                                                                                                                                                                                                     |                                                             |
| Function test               |                                                               | Start proof test, start device test                                                                                                                                                                                                              |                                                             |

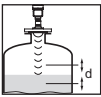
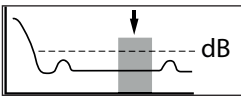
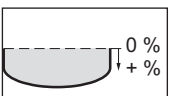
## Special parameters

| Parameter | Designation                                                                         | Presentation                                                                        | Default setting        |
|-----------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------|
| SP1, SP2  | Activate measuring range start limiting<br>Manual limiting of measuring range start |  | Deactivated<br>0.000 m |

## Menu overview

| Parameter | Designation                                              | Presentation                                                                        | Default setting |
|-----------|----------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------|
| SP3       | Safety on the vessel bottom or measuring range end       |    | 1.000 m         |
| SP4       | Correction of the propagation speed                      |    | 0.0 %           |
| SP5, SP6  | Factor for noise averaging rising                        |    | 2               |
|           | Factor for noise averaging falling                       |                                                                                     | 2               |
| SP7       | Deactivate filter function<br>"Smooth raw value curve"   |    | Deactivated     |
| SP8       | Offset detection curve for echo analysis                 |    | 8 dB            |
| SP9       | Minimum measurement reliability for level echo selection |    | 0 dB            |
| SP10      | Additional reliability for false signal storage          |    | 3 dB            |
| SP12      | Activate "Summarize echoes" function                     |  | Deactivated     |
| SP13      | Amplitude difference in "Summarize echoes" function      |                                                                                     | 12 dB           |
| SP14      | Echo distance for "Summarize echoes" function            |                                                                                     | 0.500 m         |
| SP15      | Activate function measurement of the "first large echo"  |  | Deactivated     |
| SP16      | Minimum amplitude function "First large echo"            |                                                                                     | 12 dB           |

## Menu overview

| Parameter | Designation                                              | Presentation                                                                      | Default setting                                      |
|-----------|----------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------|
| SP17      | Wide focussing range                                     |  | 240 m                                                |
| SP18      | Minimum measurement reliability outside focusing range   |  | 6 dB                                                 |
| SP19      | Time for opening the focussing range                     |  | 0 s                                                  |
| SP22      | Measured value offset                                    |  | 0.000 m                                              |
| SP24      | Factor for additional reliability at measuring range end |  | 0.0 %                                                |
| SP HART   | Activate/Deactivate HART                                 |                                                                                   | Activated                                            |
| SP SIL    | Activate/Deactivate SIL                                  |                                                                                   | Activated <sup>1)</sup><br>Deactivated <sup>2)</sup> |

<sup>1)</sup> SIL versions

<sup>2)</sup> Non-SIL versions (cannot be activated)

## Diagnosis, asset management and service

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### Maintenance

#### Maintenance

If the device is used properly, no special maintenance is required in normal operation.

### Precaution measures against buildup



#### Note:

In some applications, product buildup on the antenna system can influence the measurement 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.

### Cleaning

The cleaning helps that the type label and markings on the instrument are visible.



#### Note:

Unsuitable cleaning agents and methods can damage the device. To avoid this, observe the following:

- Use only cleaning agents which do not corrode the housings, type label and seals
- Use only cleaning methods corresponding to the housing protection rating

### Measured value and event memory

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

### Measured value memory

Up to 100,000 measured values are 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
- Measurement reliability
- Electronics temperature

When the instrument is shipped, the measured value memory is active and stores distance, measurement reliability 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.

## Diagnosis, asset management and service

---

### Event memory

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.

### Echo curve memory

The echo curves are stored with date and time and the corresponding echo data.

#### 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. Additional echo curves are stored via:

- PC with PACTware/DTM
- Control system with EDD

### 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 there are more detailed error messages available under the menu item "*Diagnostics*" via the respective adjustment module.

### Status messages

The status messages are divided into the following categories:

- Failure
- Function check
- Out of specification
- Maintenance required

and explained by pictographs:

## Diagnosis, asset management and service

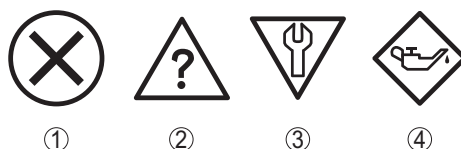


Fig. 42: Pictographs of the status messages

- 1 Failure - red
- 2 Out of specification - yellow
- 3 Function check - orange
- 4 Maintenance required - blue

### Malfunction (Failure):

Due to a malfunction in the instrument, a fault signal is output.

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

### Function check:

The instrument is being worked on, the measured value is temporarily invalid (for example during simulation).

This status message is inactive by default.

### Out of specification:

The measured value is unreliable because an instrument specification was exceeded (e.g. electronics temperature).

This status message is inactive by default.

### Maintenance required:

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.

## Failure

| Code<br>Text message                | Cause                                                                                | Rectification                                                                                             | DevSpec<br>State in CMD 48       |
|-------------------------------------|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|----------------------------------|
| F013<br>no measured value available | Sensor does not detect an echo during operation<br>Antenna system dirty or defective | Check or correct installation and/or parameter settings<br>Clean or exchange process component or antenna | Byte 5, Bit 0 of<br>Byte 0 ... 5 |
| F017<br>Adjustment span too small   | Adjustment not within specification                                                  | Change adjustment according to the limit values (difference between min. and max. $\geq 10$ mm)           | Byte 5, Bit 1 of<br>Byte 0 ... 5 |

## Diagnosis, asset management and service

| Code<br>Text message                          | Cause                                                                                                            | Rectification                                                                                                                   | DevSpec<br>State in CMD 48       |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| F025<br>Error in the linearization table      | Values are not continuously rising, for example illogical value pairs                                            | Check linearization table<br>Delete table/Create new                                                                            | Byte 5, Bit 2 of<br>Byte 0 ... 5 |
| F036<br>No operable software                  | Failed or interrupted software update                                                                            | Repeat software update<br>Check electronics version<br>Exchanging the electronics<br>Send instrument for repair                 | Byte 5, Bit 3 of<br>Byte 0 ... 5 |
| F040<br>Error in the electronics              | Hardware defect                                                                                                  | Exchanging the electronics<br>Send instrument for repair                                                                        | Byte 5, Bit 4 of<br>Byte 0 ... 5 |
| F080<br>General software error                | General software error                                                                                           | Disconnect operating voltage briefly                                                                                            | Byte 5, Bit 5 of<br>Byte 0 ... 5 |
| F105<br>Determine measured value              | The instrument is still in the switch-on phase, the measured value could not yet be determined                   | Wait for the end of the switch-on phase<br><br>Duration up to approx. 3 minutes depending on the version and parameter settings | Byte 5, Bit 6 of<br>Byte 0 ... 5 |
| F113<br>Communication error                   | EMC interference                                                                                                 | Remove EMC influences                                                                                                           | Byte 4, Bit 4 of<br>Byte 0 ... 5 |
| F125<br>Impermissible electronics temperature | Temperature of the electronics in the non-specified range                                                        | Check ambient temperature<br>Insulate electronics<br>Use instrument with higher temperature range                               | Byte 5, Bit 7 of<br>Byte 0 ... 5 |
| F260<br>Error in the calibration              | Error in the calibration carried out in the factory<br>Error in the EEPROM                                       | Exchanging the electronics<br>Send instrument for repair                                                                        | Byte 4, Bit 0 of<br>Byte 0 ... 5 |
| F261<br>Error in the instrument settings      | Error during setup<br>False signal suppression faulty<br>Error when carrying out a reset                         | Repeat setup<br>Carry out a reset                                                                                               | Byte 4, Bit 1 of<br>Byte 0 ... 5 |
| F264<br>Installation/Set-up error             | Adjustment not within the vessel height/measuring range<br>Max. measuring range of the instrument not sufficient | Check or correct installation and/or parameter settings<br>Use an instrument with bigger measuring range                        | Byte 4, Bit 2 of<br>Byte 0 ... 5 |
| F265<br>Measurement function disturbed        | Sensor no longer carries out a measurement<br>Operating voltage too low                                          | Check operating voltage<br>Carry out a reset<br>Disconnect operating voltage briefly                                            | Byte 4, Bit 3 of<br>Byte 0 ... 5 |

## Diagnosis, asset management and service

| Code<br>Text message                       | Cause                                                                                                 | Rectification                                            | DevSpec<br>State in CMD 48 |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------|----------------------------|
| F267<br>No executable sensor software      | Sensor cannot start                                                                                   | Exchanging the electronics<br>Send instrument for repair | -                          |
| F268<br>False signal suppression not valid | False signal suppression was applied under other measuring conditions                                 | Create a new false signal suppression                    |                            |
|                                            | No false signal suppression available                                                                 | Create a new false signal suppression                    |                            |
| F269<br>Measurement function insecure      | Measurement reliability of the level echo too low (change to another echo pending)                    | Check or correct installation and/or parameter settings  |                            |
|                                            | Amplitude difference level echo for false signal suppression too low (change to another echo pending) | Check or correct installation and/or parameter settings  |                            |
|                                            | Amplitude difference level echo to another echo too low (change to another echo pending)              | Check or correct installation and/or parameter settings  |                            |

## Function check

| Code<br>Text message      | Cause                  | Rectification                                                  | DevSpec<br>State in CMD 48                     |
|---------------------------|------------------------|----------------------------------------------------------------|------------------------------------------------|
| C700<br>Simulation active | A simulation is active | Finish simulation<br>Wait for the automatic end after 60 mins. | "Simulation Active" in "Standardized Status 0" |

## Out of specification

| Code<br>Text message                          | Cause                                                                  | Rectification                                                                                                                       | DevSpec<br>State in CMD 48       |
|-----------------------------------------------|------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| S600<br>Impermissible electronics temperature | Temperature of the processing electronics in the non-specified section | Check ambient temperature<br>Insulate electronics<br>Use instrument with higher temperature range                                   | Byte 23, Bit 0 of Byte 14 ... 24 |
| S601<br>Overfilling                           | Level echo in the close range not available                            | Reduce level<br>100 % adjustment: Increase value<br>Check mounting socket<br>Remove possible interfering signals in the close range | Byte 23, Bit 1 of Byte 14 ... 24 |

## Diagnosis, asset management and service

| Code<br>Text message                    | Cause                                   | Rectification                                                           | DevSpec<br>State in CMD 48 |
|-----------------------------------------|-----------------------------------------|-------------------------------------------------------------------------|----------------------------|
| S603<br>Impermissible operating voltage | Operating voltage below specified range | Check electrical connection<br>If necessary, increase operating voltage |                            |

## Maintenance

| Code<br>Text message                                     | Cause                                                                                     | Rectification                                                                                                                       | DevSpec<br>State in CMD 48          |
|----------------------------------------------------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| M500<br>Error during the reset "delivery status"         | The data could not be re-stored during the reset to delivery status                       | Repeat reset<br>Load XML file with sensor data into the sensor                                                                      | Byte 24, Bit 0 of<br>Byte 14 ... 24 |
| M501<br>Error in the non-active line-<br>arisation table | Hardware error EEPROM                                                                     | Exchanging the electronics<br>Send instrument for repair                                                                            | Byte 24, Bit 1 of<br>Byte 14 ... 24 |
| M504<br>Error at a device interface                      | Hardware defect                                                                           | Check connections<br>Exchanging the electronics<br>Send instrument for repair                                                       | Byte 24, Bit 4 of<br>Byte 14 ... 24 |
| M505<br>No echo available                                | Sensor does not detect an echo during operation<br>Antenna dirty or defective             | Clean the antenna<br>Use a more suitable antenna/sensor<br>Remove possible false echoes<br>Optimize sensor position and orientation | Byte 24, Bit 5 of<br>Byte 14 ... 24 |
| M506<br>Installation/Set-up error                        | Error during setup                                                                        | Check or correct installation and/or parameter settings                                                                             | Byte 24, Bit 6 of<br>Byte 14 ... 24 |
| M507<br>Error in the instrument settings                 | Error during setup<br>Error when carrying out a re-set<br>False signal suppression faulty | Carry out reset and repeat setup                                                                                                    | Byte 24, Bit 7 of<br>Byte 14 ... 24 |

## Echo curve

### Overview

Via the adjustment software PACTware with a PC the echo curve of the connected sensor can be displayed under the menu item "Diagnosis".

The echo curve enables a detailed assessment of the characteristics of a level measurement with the NivoRadar 8500.

## Diagnosis, asset management and service

The following chapters show the basic course of the echo curve and describe the menu functions.

### Echo curve presentation and description

The desired individual curves are displayed on the screen in the "Echo curve" diagram. The toolbar above is used to control the presentation and navigation.

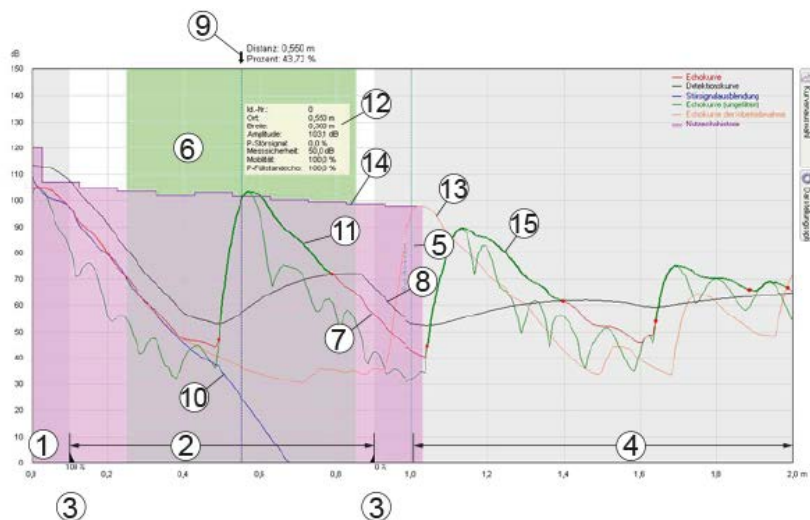


Fig. 43: Areas in the echo curve window

- 1 Sensor reference plane (0 m)/Extended presentation area
- 2 Measuring range
- 3 Adjustment range
- 4 Safety area at the measuring range end
- 5 Vessel height
- 6 Focussing range
- 7 Echo curve
- 8 Detection curve
- 9 Distance and percentage value arrow
- 10 False signal suppression
- 11 Detected echo with initial and end point
- 12 Echo data of the selected echo
- 13 Echo curve of the setup
- 14 Useful echo history
- 15 Echo curve unfiltered

## Diagnosis, asset management and service

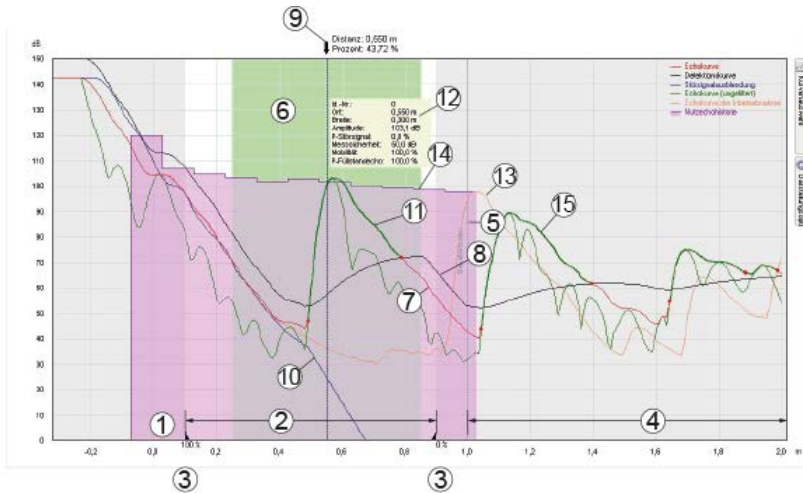


Fig. 44: Areas in the echo curve window with presentation option "Extended presentation area"

### Distance and percentage value arrow

The distance arrow marks the level echo detected by the sensor. In the case of an ideal echo (flat, well-reflecting medium surface), it points to the centre of the echo.

→ A "black" arrow means: The level echo is currently visible to the sensor. A "white" arrow means: The level echo has disappeared from the marked position.

### Echo curve

The echo curve shown in red is the basis for echo detection. It shows the course and amplitude of detected echoes.

→ Considered echoes are marked in green.

### Detection curve

The detection curve shown in black follows the echo curve. It determines the sensitivity threshold of the sensor and thus in which range echoes are detected.

### False signal suppression

The false signal suppression shown in blue represents the false signal profile stored in the sensor.

→ Echoes with an amplitude below this curve are marked as false signals.

### Echo curve of the setup

A high-resolution echo curve stored by the user during setup.

→ It can be used to detect signal changes over the operating time.

### High resolution

The maximum number of scanning points available in the sensor is displayed.

## Diagnosis, asset management and service

→ The high-resolution display of the echo curve is necessary for a meaningful assessment of the echo curve.

### Extended presentation area

The entire reading area considered by the sensor, including all securities, is displayed.

→ The extended presentation area must be selected for a meaningful assessment of the echo curve.

### Focussing range

The focussing range is a measuring window that the radar sensor places symmetrically around the distance of the currently measured level echo.

→ Only within the focussing range are changes (location, amplitude, number of echoes) accepted for evaluating the current level.

### Echo data of the selected echo

Detected echoes within the measuring range are displayed by means of a green line and two red dots for echo start and end.

→ For each of these echoes, the echo data is determined.

### Echo curve unfiltered

The green curve corresponds to the echo curve, but without upstream filter functions.

→ The unfiltered echo curve is not influenced by the application parameters.

### Useful echo history

The curve shown in purple shows the minimum level echo amplitude depending on the distance with a resolution of 0.1 m.

### Adjustment functions

#### Toolbar echo curve

In the upper left section, date and time of the actually shown curve are displayed. On the right, you can find the two toolbar symbols described below:

| Symbol                                                                              | Function                                                              | Additional information                                                                                       |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
|  | Hold curves: Freeze currently displayed curves, brighter presentation | Additional presentation of the currently read curve (changes in the curve are thus immediately recognisable) |
|  | Standard view: Exit zoomed view, presentation of the unzoomed area    |                                                                                                              |

### Curve selection

The adjustment element "Curve selection" at the right edge of the window enables the following curve views:

## Diagnosis, asset management and service

| Designation              | Additional information                                                              |
|--------------------------|-------------------------------------------------------------------------------------|
| Echo curve               | Clicking with left mouse button on echo provides indication of associated echo data |
| Detection curve          |                                                                                     |
| False signal suppression |                                                                                     |
| Echo curve unfiltered    | Is only visible in the service login and                                            |
| Useful echo history      |                                                                                     |
| Echo curve of the setup  |                                                                                     |

### Presentation options

The adjustment element "*Presentation options*" at the right edge of the window enables the display of additional analysis aids:

| Designation                | Function                                                                           | Additional information                                                                            |
|----------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| High resolution            | Loading and presenting the curves with the maximum number of measured value points | Slightly slower updating of the echo curve in the echo curve window due to the larger data volume |
| Extended presentation area | Presentation of additional distance safety areas of the sensor                     |                                                                                                   |
| Focussing range            | Measuring window that the sensor places symmetrically around the level echo.       |                                                                                                   |
| Show echo data             | Tabular presentation of the echo data in the lower area of the window              |                                                                                                   |

### Additional functions and information

#### Additional adjustment options

A short click with the right mouse button in the echo curve opens a pop-up menu with these adjustment options:

| Designation   | Function                                                           | Additional information |
|---------------|--------------------------------------------------------------------|------------------------|
| Zoom settings | Manual input of the desired zoom range                             |                        |
| Unzoom        | Leaving the zoomed presentation, presentation of the unzoomed area |                        |

## Diagnosis, asset management and service

| Designation    | Function                                                                         | Additional information                  |
|----------------|----------------------------------------------------------------------------------|-----------------------------------------|
| Load recording | Loading curves from a previous service record <sup>1)</sup>                      | Function only in offline mode available |
| Print view     | Printing the echo curve and exporting it as a pdf file                           |                                         |
| Info           | Display of information about the device from which the echo curves were recorded |                                         |

Pressing and holding the mouse buttons in the echo curve results in further functions:

| Designation        | Function | Additional information                                                     |
|--------------------|----------|----------------------------------------------------------------------------|
| Right mouse button | Shifting | By shifting the mouse, the displayed presentation area is shifted as well. |
| Left mouse button  | Zoom     | Shifting the mouse sets the zoom range.                                    |

The offline mode offers the possibility to display curves from the echo curve memory. In this mode, a toolbar with additional symbols appears:

| Symbol                                                                              | Function                          |
|-------------------------------------------------------------------------------------|-----------------------------------|
|    | Stop                              |
|  | Replay                            |
|  | To the beginning of the recording |
|  | To the previous recording         |

<sup>1)</sup> Note: The DTM version, the measuring principle and the device version of the recordings must match the current DTM

## Diagnosis, asset management and service

| Symbol                                                                            | Function                    |
|-----------------------------------------------------------------------------------|-----------------------------|
|  | To the next recording       |
|  | To the end of the recording |
|  | Load recording from device  |

### Additional information echo data

Below the echo curve, the detected echoes are listed in tabular form with additional information.

| Designation             | Meaning                                                                 | Additional information                                                    |
|-------------------------|-------------------------------------------------------------------------|---------------------------------------------------------------------------|
| ID                      | Ident number assigned by the sensor to the detected echo                |                                                                           |
| Location                | Distance from the sensor reference plane to the echo                    |                                                                           |
| Amplitude               | Echo amplitude of the respective echo in dB                             |                                                                           |
| Width                   | Width of the respective echo                                            |                                                                           |
| P-false signal          | False echo probability                                                  | Measure for the compliance of an echo with a stored false signal curve    |
| Measurement reliability | Usable amplitude of an echo in dB                                       |                                                                           |
| Mobility                | Indication of whether and how far the echo moves in a certain direction | -100 %: Certainly not moved; +100 % certainly moved sufficiently          |
| P-level echo            | Level echo probability                                                  | Level echo probability is the result of the echo assessment in the sensor |

### Rectify faults

#### Reaction when malfunction occurs

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

## Diagnosis, asset management and service

### Fault rectification

The first measures are:

- Evaluation of fault messages
- Checking the output signal
- Treatment of measurement errors

A smartphone/tablet with the adjustment app or a PC/notebook with the software PACTware and the suitable DTM offer you further comprehensive diagnostic possibilities. In many cases, the causes can be determined in this way and the faults eliminated.

### Treatment of measurement errors

The below tables show typical examples of application-related measurement errors with liquids. The measurement errors are differentiated according to the following:

- 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.

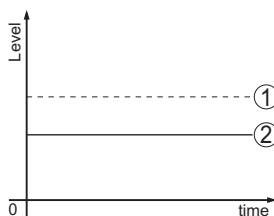


Fig. 45: Display of error images

- 1 Real level
- 2 Level displayed by the sensor



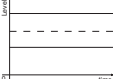
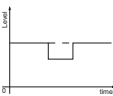
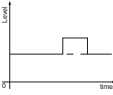
#### Note:

If the output level is constant, the cause could also be the fault setting of the current output to "*Hold value*".

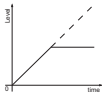
If the level is too low, the reason could be a line resistance that is too high

## Diagnosis, asset management and service

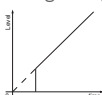
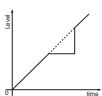
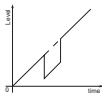
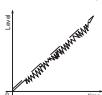
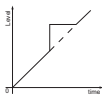
### Measurement error with constant level

| Fault description                                                                                                                     | Cause                                                                                                                                            | Rectification                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Measured value shows a too low or too high level<br> | Min./max. adjustment not correct                                                                                                                 | Adapt min./max. adjustment                                                                                                             |
|                                                                                                                                       | Incorrect linearization curve                                                                                                                    | Adapt linearization curve                                                                                                              |
|                                                                                                                                       | Installation in a bypass tube or stand-pipe, hence running time error (small measurement error close to 100 %/ large error close to 0 %)         | Check parameter "Application" with respect to vessel form, adapt if necessary (bypass, standpipe, diameter).                           |
| Measured value jumps towards 0 % (liquids only)<br>  | Multiple echo (vessel top, medium surface) with amplitude higher than the level echo.                                                            | Check parameter "Application", especially vessel top, type of medium, dished bottom, high dielectric constant, and adapt if necessary. |
| Measured value jumps towards 100 %<br>               | Due to the process, the amplitude of the level echo sinks<br>A false signal suppression was not carried out                                      | Carry out a false signal suppression                                                                                                   |
|                                                                                                                                       | 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.                        |

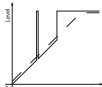
### Measurement error during filling

| Fault description                                                                                                                      | Cause                                                                                                                               | Rectification                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Measured value remains unchanged during filling<br> | False signals in the close range too big or level echo too small<br>Strong foam or vortex generation<br>Max. adjustment not correct | Eliminate false signals in the close range<br>Check measurement situation: Antenna must protrude out of the nozzle, installations<br>Remove contamination on the antenna<br>In case of interferences due to installations in the close range: Change polarisation direction<br>Create a new false signal suppression<br>Adapt max. adjustment |

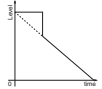
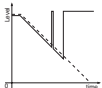
## Diagnosis, asset management and service

| Fault description                                                                                                                                                                    | Cause                                                                                                                                     | Rectification                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Measured value remains in the area of the bottom during filling<br>                                 | Echo from the tank bottom larger than the level echo, for example, with products with $\rho_r < 2.5$ oil-based, solvents                  | Check parameters Medium, Vessel height and Floor form, adapt if necessary                                                                      |
| Measured value remains momentarily unchanged during filling and then jumps to the correct level<br> | Turbulence on the medium surface, quick filling                                                                                           | Check parameters, change if necessary, e.g. in dosing vessel, reactor                                                                          |
| Measured value jumps towards 0 % during filling<br>                                                 | Amplitude of a multiple echo (vessel top - medium 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).                         | In case of interferences due to installations in the close range: Change polarisation direction<br>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.                                                             |
| Measured value fluctuates around 10 ... 20 % (only bulk solids)<br>                               | Various echoes from an uneven medium surface, e.g. a material cone                                                                        | Check parameter "Material Type" and adapt, if necessary<br>Optimize installation position and sensor orientation                               |
|                                                                                                                                                                                      | Reflections from the medium surface via the vessel wall (deflection)                                                                      | Select a more suitable installation position, optimize sensor orientation, e.g. with a swivelling holder                                       |
| Measured value jumps towards 100 % during filling<br>                                             | Due to strong turbulence and foam generation during filling, the amplitude of the level echo sinks. Measured value jumps to false signal. | Carry out a false signal suppression                                                                                                           |

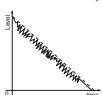
## Diagnosis, asset management and service

| Fault description                                                                                                                              | Cause                                                                                                          | Rectification                                                                                                                                                                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Measured value jumps sporadically to 100 % during filling<br> | Varying 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.<br><br>With bulk solids, use radar sensor with purging air connection.          |
| Measured value jumps to $\geq 100$ % or 0 m distance<br>      | Level echo is no longer detected at close range due to foam generation or interference signals at close range. | Check measuring point: Antenna should protrude out of the threaded mounting socket, possible false echoes through flange socket.<br><br>Remove contamination on the antenna<br>Use a sensor with a more suitable antenna |

## Measurement error during emptying

| Fault description                                                                                                                                        | Cause                                                                                                                    | Rectification                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Measured value remains unchanged in the close range during emptying<br> | False signal larger than the level echo<br>Level echo too small                                                          | Eliminate false signal in the close range. Check: Antenna must protrude from the nozzle.<br><br>Remove contamination on the antenna<br><br>In case of interferences due to installations in the close range: Change polarisation direction<br><br>After eliminating the false signals, the false signal suppression must be deleted. Carry out a new false signal suppression. |
| Measured value jumps towards 0 % during emptying<br>                  | Echo from the tank bottom larger than the level echo, for example, with products with $\rho_r < 2.5$ oil-based, solvents | Check parameters Medium type, Vessel height and Floor form, adapt if necessary                                                                                                                                                                                                                                                                                                 |
| Measured value jumps sporadically towards 100 % during emptying<br>   | Varying condensation or contamination on the antenna                                                                     | Carry out false signal suppression or increase false signal suppression in the close range by editing.<br><br>With bulk solids, use radar sensor with purging air connection.                                                                                                                                                                                                  |

## Diagnosis, asset management and service

| Fault description                                                                                                                                    | Cause                                                                   | Rectification                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|-----------------------------------------------------------|
| Measured value fluctuates around 10 ... 20 % (only bulk solids)<br> | Various echoes from an uneven medium surface, e.g. an extraction funnel | Check parameter "Type of medium" and adapt, if necessary. |
|                                                                                                                                                      | Reflections from the medium surface via the vessel wall (deflection)    | Optimize installation position and sensor orientation.    |

### Reaction after fault rectification

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.

### 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, one can be ordered from the agency serving you.

### Software update

The following components are required to update the instrument software:

- Instrument
- Voltage supply
- HART modem
- PC with PACTware/DTM
- Current instrument software as file

You can find the current instrument software as well as detailed information on the procedure in the download area of our homepage.

You can find information about the installation in the download file.



### Caution:

Instruments with approvals can be bound to certain software versions. Therefore make sure that the approval is still effective after a software update is carried out.

Further information can be found on our homepage.

## Diagnosis, asset management and service

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### How to proceed if a repair is necessary

If a repair should be necessary, please contact your contact person.

## Dismount

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### Dismounting steps

To remove the device, carry out the steps in chapters "Mounting" and "Connecting to power supply" in reverse.



#### Warning:

When dismantling, pay attention to the process conditions in vessels or pipelines. There is a risk of injury, e.g. due to high pressures or temperatures as well as aggressive or toxic media. Avoid this by taking appropriate protective measures.

### Disposal



Pass the instrument on to a specialised recycling company and do not use the municipal collecting points.

Remove any batteries in advance, if they can be removed from the device, and dispose of them separately.

If personal data is stored on the old device to be disposed of, delete it before disposal.

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

## Certificates, approvals and certifications

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### Radio licenses

#### **Radar:**

The device has been tested and approved in accordance with the current edition of the applicable country-specific norms or standards.

The confirmations as well as regulations for use can be found in the document "*Information sheet Radio licenses*" supplied or on our homepage.

### Approvals for Ex areas

Approved versions for use in hazardous areas are available or in preparation for the device or the device series.

You can find the relevant documents on our homepage.

### Approvals as overfill protection

Approved versions for use as part of an overfill protection system are available or in preparation for the device or the device series.

The corresponding approvals can be found on our homepage.

### Conformity

The device complies with the legal requirements of the applicable country-specific directives or technical regulations. We confirm conformity with the corresponding labelling.

The corresponding conformity declarations can be found on our homepage.

### 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 21 – Electromagnetic compatibility of equipment
- NE 43 – Signal level for fault 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).

## Supplement

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### **Licensing information for open source software**

Open source software components are also used in this device. A documentation of these components with the respective license type, the associated license texts, copyright notes and disclaimers can be found on our homepage.

### **Trademark**

All the brands as well as trade and company names used are property of their lawful proprietor/originator.





Printing date:

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

**Technical support**

Please contact your local sales partner (address at [www.uwtgroup.com](http://www.uwtgroup.com)).  
Otherwise please contact us:

UWT GmbH  
Westendstraße 5  
87488 Betzigau  
Germany

Phone + 49 (0) 831 57 123 0  
[info@uwtgroup.com](mailto:info@uwtgroup.com)  
[www.uwtgroup.com](http://www.uwtgroup.com)