- 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 ± 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 ≤ 1 mm (for example, when using a ball valve or intermediate flanges with single pipe sections)
- Diameter should be constant over the complete length

5.7 Measurement setup - Flow

Mounting

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) [7]
- Requirements from approvals for flow measurement, e.g. MCERTS

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

[7] The value given takes into account the block distance. At smaller distances, the measuring accuracy is reduced, see " Technical data".

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

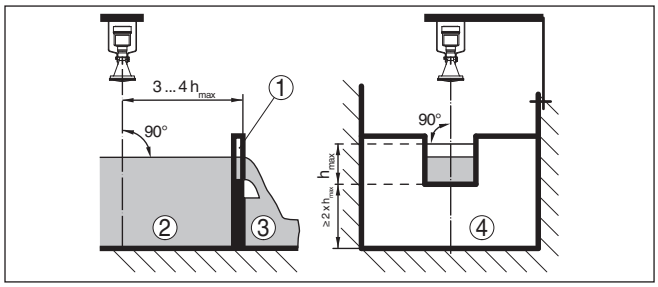


Fig. 44: Flow measurement with rectangular flume: $h_{max.}$ = max. filling of the rectangular flume

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

Khafagi-Venturi flume

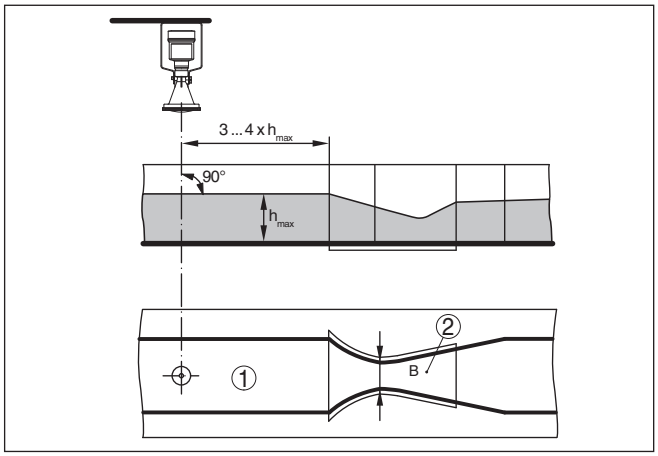


Fig. 45: Flow measurement with Khafagi-Venturi flume: $h_{max.}$ = max. filling of the flume; B = tightest constriction in the flume

1 Position sensor
2 Venturi flume

6 Connecting to power supply

6.1 Preparing the connection

Safety instructions

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 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

Keep in mind the following additional factors that influence the operating voltage:

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

Connection cable

The instrument is connected with standard two-wire cable without shielding. If electromagnetic interference is expected which is above the test values of EN 61326-1 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).

Shielded cable generally necessary in HART multidrop mode.

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.

Note:
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.

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

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

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

Cable screening and grounding

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

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

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

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

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

6.2 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

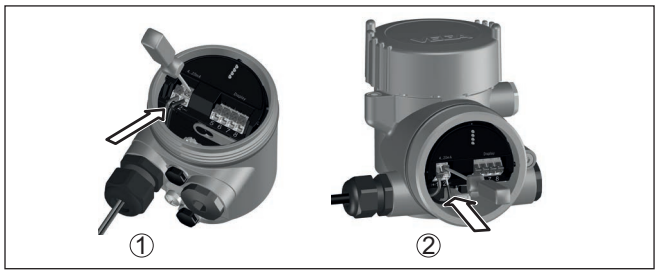


Fig. 46: Connection steps 5 and 6

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.

6.3 Wiring plan, single chamber housing

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

Electronics and connection compartment

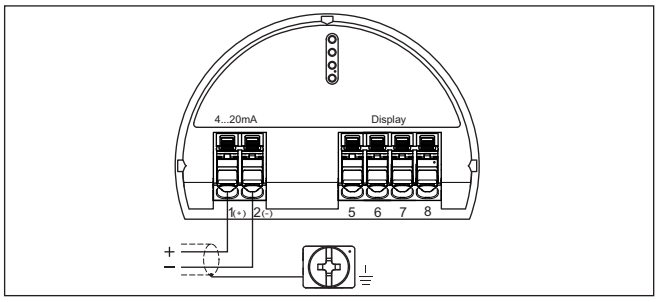


Fig. 47: Electronics and connection compartment - single chamber housing

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

6.4 Wiring plan, double chamber housing

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

Electronics compartment

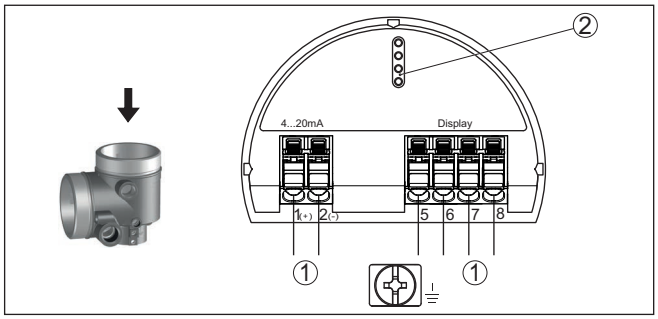


Fig. 48: Electronics compartment - double chamber housing

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

Connection compartment

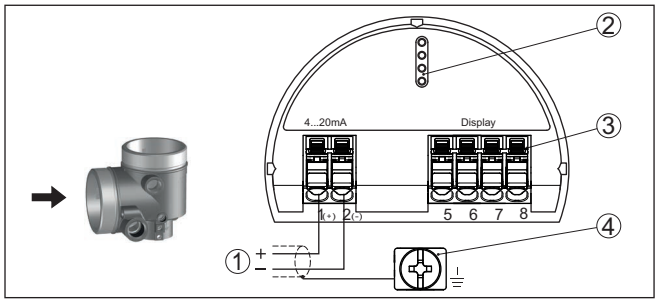


Fig. 49: Connection compartment - double chamber housing

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

6.5 Wiring plan - version IP66/IP68, 1 bar

Wire assignment, connection cable

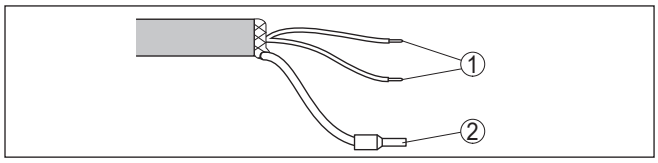


Fig. 50: Wire assignment in permanently connected connection cable

1 Brown (+) and blue (-) to power supply or to the processing system
2 Shielding

6.6 Switch-on phase

After connection to the power supply, the device carries out a self-test:

- Internal check of the electronics
- Output signal is set to failure

The current measured value is then output on the signal cable.

7 Access protection, IT security

7.1 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).

7.2 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, it must first be deactivated 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 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 legitimation. The storage and transmission of the device codes is always encrypted (SHA 256 algorithm).

7.3 Storing the codes in myVEGA

If the user has a " *myVEGA*" account, then the Bluetooth access code as well as the device code are additionally stored in his account under " *PINs and Codes*". This greatly simplifies the use of additional adjustment tools, as all Bluetooth access and device codes are automatically synchronized when connected to the " *myVEGA*" account

7.4 IT Security (IEC 62443-4-2)

The device in version with IT security (IEC 62443-4-2) provides protection against the following threats:

- Data manipulation (violation of integrity)
- Denial of Service DoS (violation of availability)
- Spying (breach of confidentiality)

For this purpose, the device has proven safety functions:

- User authentication
- Event memory (logging)
- Integrity check of the firmware
- Resource management
- Data backup for recovery

Note:
Observe the requirements from the documents " *Cyber Security according to IEC 62443-4-2*" as well as the " *Component Requirements*" for the VEGAPULS 6X. They must be fulfilled in order for the staggered security strategy of the device to take effect as intended. You can find the documents on our homepage or via " *myVEGA*.".

8 Functional safety (SIL)

8.1 Objective

Background

In case of dangerous failures, processing facilities and machines can cause risks for persons, environment and property. The risk of such failures must be judged by the plant operator. Dependent thereon are measures for risk reduction through error prevention, error detection and fault control.

Plant safety by risk reduction

The part of plant safety depending on the correct functioning of safety-related components for risk reduction is called functional safety. Components used in such safety-instrumented systems (SIS) must therefore execute their intended function (safety function) with a defined high probability.

Standards and safety levels

The safety requirements for such components are described in the international standards IEC 61508 and 61511, which set the standard for uniform and comparable judgement of instrument and plant (or machine) safety and hence contribute to worldwide legal certainty. We distinguish between four safety levels, from SIL1 for low risk to SIL4 for very high risk (SIL = Safety Integrity Level), depending on the required degree of risk reduction.

8.2 SIL qualification

Properties and requirements

When developing instruments that can be used in safety-instrumented systems, the focus is on avoiding systematical errors as well as determining and controlling random errors.

Here are the most important characteristics and requirements from the perspective of functional safety according to IEC 61508 (Edition 2):

- Internal monitoring of safety-relevant circuit parts
- Extended standardization of the software development
- In case of failure, switching of the safety-relevant outputs to a defined safe state
- Determination of the failure probability of the defined safety function
- Reliable parameterization with non-safe user environment
- Proof test

Safety Manual

The SIL qualification of components is specified in a manual on functional safety (Safety Manual). Here, you can find all safety-relevant characteristics and information the user and the planner need for planning and operating the safety-instrumented system. This document is attached to each instrument with SIL rating and can be also found on our homepage via the search.

Identification SIL device

Functional safety (SIL) is a feature of the device configuration.

A SIL device can be identified as follows:

- SIL logo on the type label
- Safety Manual in the scope of delivery

- Device configuration (order confirmation, device search)

8.3 Application area

The instrument can be used for point level detection or level measurement of liquids and bulk solids in safety-instrumented systems (SIS) according to IEC 61508 and IEC 61511. Take note of the specifications in the Safety Manual.

The following output is permissible for this:

- Current output (I) - 4 … 20 mA/HART

Note:
The second current output (II) does not fulfil the requirements of safety instrumented systems (SIS). In this context, it is for informational use only.

8.4 Safety concept of the parameterization

Tool for operation and parameterization

The following tools are permissible for parameter adjustment of the safety function with the current status:

- Adjustment app
- DTM suitable for the device in conjunction with an adjustment software according to the FDT/DTM standard, e. g. PACTware

Note:
The change of safety-relevant parameters is only possible with active connection to the instrument (online mode)

Safe parameterization

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

Safety-relevant parameters

In SIL applications, the parameters must be protected against unintentional or unauthorised operation. For this reason, the SIL version of the device is delivered in a locked state.

The following safety-relevant parameters must be verified after a change.

- Type of medium
- Application
- Distance A (max. value)
- Distance B (min. value)
- Damping
- Current output
- Reaction when malfunctions occur
- False signal suppression
- Behaviour with echo loss

The parameter settings of the measuring point must be documented. A list of the safety-relevant parameters can be stored and printed additionally by the PACTware/DTM.

Information:
When shipped with a specific parameter adjustment, the instruments are accompanied by a list with the values deviating from the default setting.

Unlock adjustment

For each parameter change, the device must be unlocked via the device code (see chapter " *Parameter adjustment, setup steps - Lock adjustment*"). The device status is indicated in the respective adjustment tool by the symbol of an unlocked or locked padlock.

Unsafe device status

Warning:
If adjustment is enabled, the safety function must be considered as unreliable. This applies until the parameterisation is terminated correctly. If necessary, other measures must be taken to maintain the safety function.

Change parameters

All parameters changed by the operator are automatically stored temporarily so that they can be verified in the next step.

Verify parameters/Lock adjustment

After setup, the modified parameters must be verified (confirm the correctness of the parameters). To do this, you first have to enter the device code. Here the adjustment is locked automatically. Then you carry out a comparison of two character strings. You must confirm that the character strings are identical. This is used to check the character presentation.

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

Then, all modified parameters that have to be confirmed are listed. After this process is terminated, the safety function is again ensured.

Incomplete process

Warning:
If the described process was not carried out completely or correctly (e.g. due to interruption or voltage loss), the instrument remains in an unlocked, and thus unsafe, status.

Instrument reset

Warning:
When the device is reset to default settings, all of the safety-relevant parameters are reset. Therefore, these must be checked or readjusted afterwards.

8.5 First setup

8.5.1 Overview

The initial setup serves to check the device version and the current parameters under the existing measurement conditions. This determines whether this constellation is suitable for providing qualified measurement data for safety-related instrumentation.

SIL To fulfil the requirements for SIL conformity, we recommend carrying out the first setup via the function " *Verify and lock (inclusive setup assistant)*". This function is available in the adjustment app as well as PACTware/DTM (see previous chapter " *Safety concept of the parameter adjustment, tools for adjustment and parameterisation*").

8.5.2 Setup process

Operating sequence SIL A parameter change with SIL qualified instruments must always be carried out as follows:

- Unlock adjustment
- Change parameters
- Function test, if necessary
- Lock adjustment and verify modified parameters

The process is run by the setup wizard in the adjustment app or PACTware/DTM.

The meaning and handling of the individual steps are described in the chapter " *Security concept for parameter adjustment*".

Function test

Information:
The central part of the initial setup is the function test. When running through the setup assistant, the device decides on the basis of its evaluation results which options of the function test are available in the individual case.

The VEGAPULS 6X basically offers the following function test options:

Option of the function test	Medium	Level
	Without medium	Empty vessel
	With medium	Current level
	With medium	Controlling defined levels

The individual options are described in the following chapter.

8.6 Function test

8.6.1 Function test without medium - empty vessel

Description

Here, the user must start a measurement to determine the echo quality in an empty vessel. Based on these data, the device calculates over the entire measuring range whether an adequate output signal is available for every level when filling with medium later.

8.6.2 Function test with medium - any level

Description

Here, the user must start a measurement to evaluate the echo quality of the medium at the current level. Based on these data, the device calculates over the entire measuring range whether an adequate output signal is available for every other level.

8.6.3 Function test with medium - move to defined levels

Description

Here, the user must active perform a function test by moving to defined levels. Is then checking by several measurements whether the respective output signal corresponds to the actual level.

Information:
This option is always available regardless of the result of the check by the device.

Procedure

In this function test, you test the safety function of the device when it is installed in the vessel with original medium.

For this purpose, you should know the current filling height of the vessel as well as the min. and max. levels respectively for 4 and 20 mA. You then can calculate the respective output current.

Measure the output current of the device with a suitable multimeter and compare the measured output current with the calculated output current.

Interruption

If you have to interrupt the function test, you can leave the device in the respective situation. As long as the device is supplied with voltage, the display and adjustment module remains in the currently set adjustment menu.

If you carry out the function test by means of the " *PACTware*" software, you can store the previously performed tests and continue from there later on.

Completion

If you click " *Complete*" the function test is completed, the parameters are verified and the operation of the device is blocked.

Information:
When operated via PACTware/DTM, a setup protocol is provided. It includes all test results for archiving in your system documentation.

Function test

Proceed as follows for the function test, depending on the mode:

Monitoring upper limit value:

1. Raise the level to directly below the switching point
2. Observe holding time of 1 minute, compare measured value with the calculated current value
3. Lower the level to directly above the switching point
4. Observe holding time of 1 minute, compare measured value with the calculated current value

Monitoring lower limit value:

1. Lower the level to directly above the switching point

2. Observe holding time of 1 minute, compare measured value with the calculated current value
3. Raise the level to directly below the switching point
4. Observe holding time of 1 minute, compare measured value with the calculated current value

Range monitoring:

1. Move to level immediately above the upper range limit
2. Observe holding time of 1 minute, compare measured value with the calculated current value
3. Move to three levels within the range limits (upper, middle, lower value)
4. Observe holding time respectively of 1 minute, compare measured values with the calculated current values
5. Move to level immediately below the lower range limit
6. Observe holding time of 1 minute, compare measured value with the calculated current value

Result:
The measured output current must in all cases correspond to the output current calculated for the respective level.

Note:
You have to determine the permissible deviation of the values yourself. This deviation depends on the the accuracy requirements of your measurement loop. For this, determine the permissible tolerance for the deviation.

8.7 Parameter adaptations after the first setup

In the case of further parameter adjustments after initial setup, the device checks the current checksum (CRC) of the parameters respectively. This determines whether qualified measurement data are still available for safety-oriented instrumentation.

Note:
If the current checksum is identical to the last checksum, the setup assistant no longer needs to be run through. In this case, the parameter adjustment is completed by simply " *Verify and lock*".

9 Set up with the display and adjustment module

9.1 Insert display and adjustment module

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

Proceed as follows:

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

Disassembly is carried out in reverse order.

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

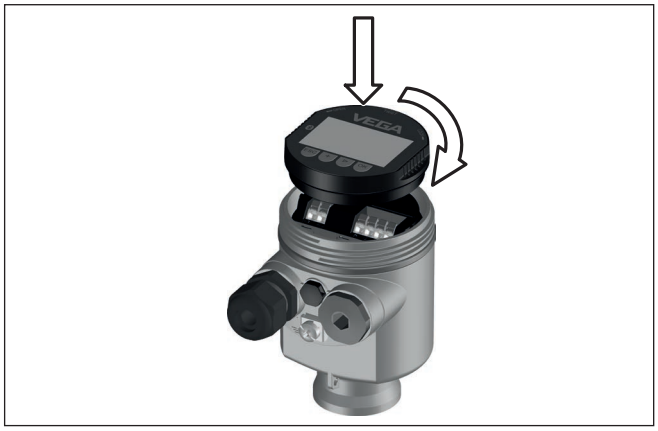


Fig. 51: Installing the display and adjustment module in the electronics compartment of the single chamber housing

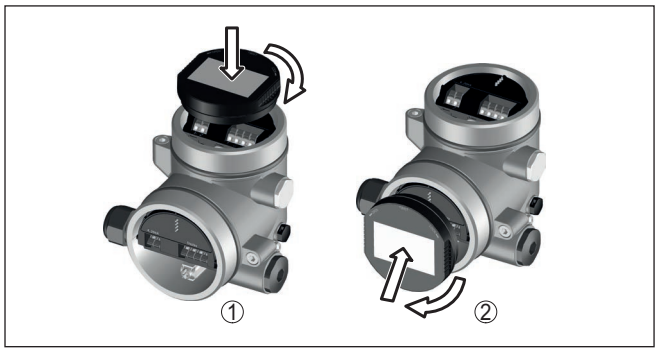


Fig. 52: Installing the display and adjustment module in the double chamber housing

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.

9.2 Adjustment system

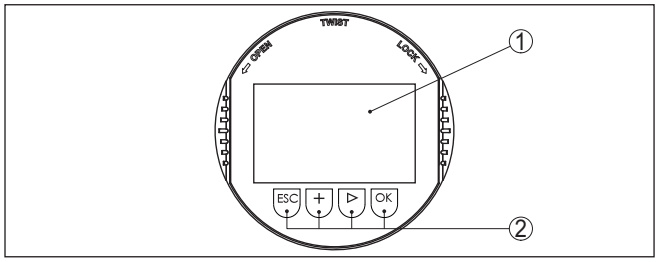


Fig. 53: Display and adjustment elements

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.

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.

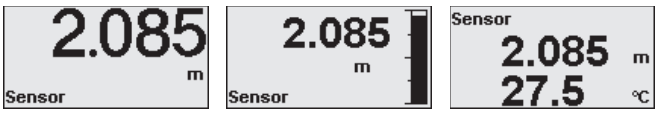
When the ***[OK]*** and ***[ESC]*** keys are pressed simultaneously for more than 5 s, the display returns to the main menu. The menu language is then switched over to " *English*".

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.

9.3 Measured value indication - Selection of national language

Measured value indication

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

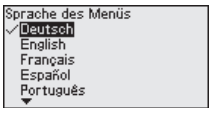


With the " ***OK***" key you move to the menu overview.

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.



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.

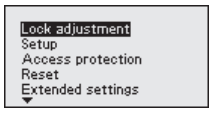
9.4 Parameterization

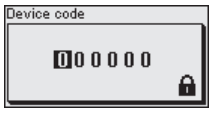
9.4.1 Lock/Unlock adjustment

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 in the unlocked state and can be locked if required.





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 PACTware/DTM and other systems is also blocked.

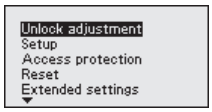
Releasing the sensor adjustment is also possible in any menu item by entering the device code.

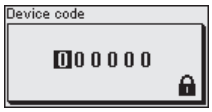
Lock/Unlock adjustment (SIL)

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

Information:
The SIL version of the device is delivered in locket state.

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.



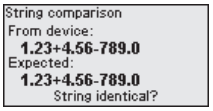


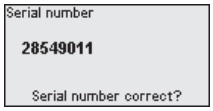
Information:
If the device code has been changed and forgotten, the enclosed information sheet " *Access Protection*" provides an emergency device code.

Character string comparison and serial number:
You first have to carry out the character string comparison. This is used to check the character respresentation.

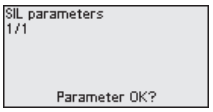
Confirm if the two character strings are identical. The verification texts are provided in German and in the case of all other menu languages, in English.

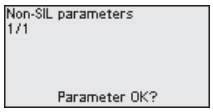
Afterwards you confirm that the serial number of your instrument was carried over correctly. This is used to check device communication.





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.



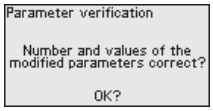


In this case, you have to carry out a function test.

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

SIL 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 PACTware/DTM and other systems is also blocked.

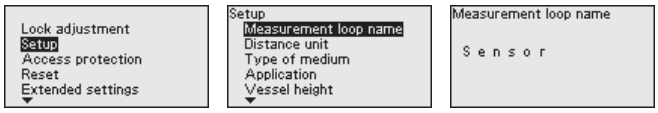
9.4.2 Setup

Measurement loop name

Here you can assign a suitable measurement loop name.

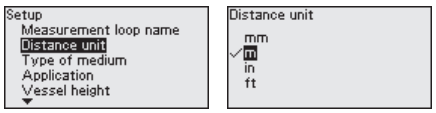
You can enter names with max. 19 characters. The character set comprises:

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



Distance unit

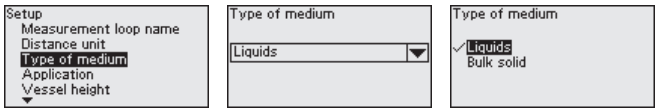
In this menu item you select the distance unit of the device.



Type of medium

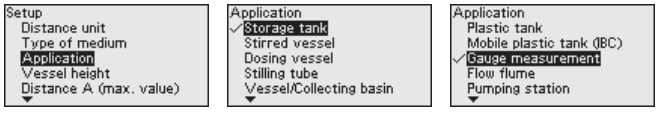
This menu item allows you to adapt the sensor to the different measuring conditions of the media " *Liquid*" or " *Bulk solid*".

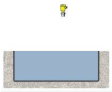
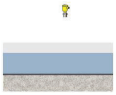
The corresponding application is selected in the following menu item " *Application*".



Application - liquid

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



Application	Vessel	Process/measurement conditions	Further recommendations
Storage tank 	Large volume Upright cylindrical, horizontal round	Slow filling and emptying Smooth medium surface Multiple reflections from dished vessel ceiling Condensation	-
Stirrer vessel 	Large agitator blades of metal Installations like flow breakers, heating spirals Nozzle	Frequent, fast to slow filling and emptying Strongly agitated surface, foam and strong vortex generation Multiple reflections through dished vessel ceiling Condensation, buildup on the sensor	False signal suppression with running agitator
Dosing vessel 	Small vessels	Frequent and fast filling/emptying Tight installation situation Multiple reflections through dished vessel ceiling Product buildup, condensate and foam generation	-
Vessel/Collecting basin 	Large volume Upright cylindrical or rectangular	Slow filling and emptying Smooth medium surface Condensation	-
Plastic tank (measurement through the vessel top) 		Measurement through the tank top, if appropriate to the application Condensation on the plastic ceiling In outdoor facilities, water and snow on vessel top possible	When measuring through the tank top: False signal suppression When measuring through the tank top (outdoor areas): Protective roof for the measuring point
Transportable plastic tank (IBC) 	Small vessels	Material and thickness different Measurement through the vessel top, if appropriate to the application Changed reflection conditions as well as jumps in measured values when changing vessels	When measuring through the tank top: False signal suppression When measuring through the tank top (outdoor areas): Protective roof for the measuring point
Gauge measurement, waters 		Slow gauge change Extreme damping of output signal in case of wave generation Ice and condensation on the antenna possible Floating debris sporadically on the water surface	-

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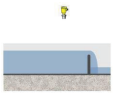
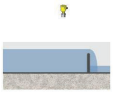
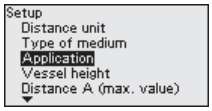
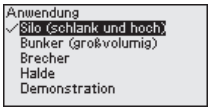
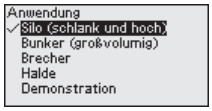
Application	Vessel	Process/measurement conditions	Further recommendations
Flow measurement flume/Overfall 		Slow gauge change Smooth to agitated water surface Measurement often from a short distance with the demand for accurate measurement results Ice and condensation on the antenna possible	-
Pumping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

Application - bulk solid

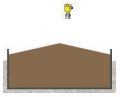
With " *Bulk solid*", the applications are based on the following features, to which the measuring characteristic of the sensor is adjusted in particular:





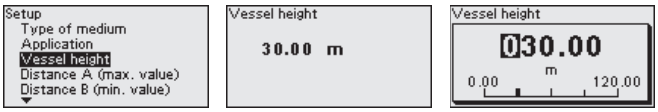


Application	Vessel	Process/measurement conditions	Further recommendations
Silo 	Slim and high Upright cylindrical	Interfering reflections due to weld seams on the vessel Multiple echoes/diffuse reflections due to unfavourable pouring positions with fine grain Varying pouring positions due to outlet funnel and filling cone	False signal suppression Alignment of the measurement to the silo outlet

Application	Vessel	Process/measurement conditions	Further recommendations
Bunker 	Large volume	Large distance to the medium Steep angles of repose, unfavourable pouring positions due to outlet funnel and filling cone Diffuse reflections due to structured vessel walls or internals Multiple echoes/diffuse reflections due to unfavourable pouring positions with fine grain Changing signal conditions when large amounts of material slip off	False signal suppression
Crusher 		Measured value jumps and varying pouring positions, e.g. due to truck filling Fast reaction time Large distance to the medium Interfering reflections from fixtures or protective devices	False signal suppression
Heap 	Large volume Upright cylindrical or rectangular	Measured value jumps, e.g. through heap profile and traverses Large angles of repose, varying pouring positions Measurement near the filling stream Sensor mounting on movable conveyor belts	-
Demonstration 	Applications that are not typical level measurements, e.g. device tests	Instrument demonstration Object recognition/monitoring 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.



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:

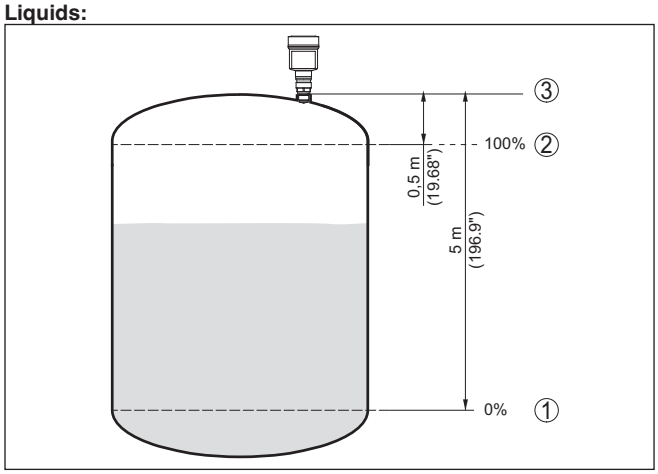


Fig. 54: Parameterisation example min./max. adjustment - liquids

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

Bulk solids:

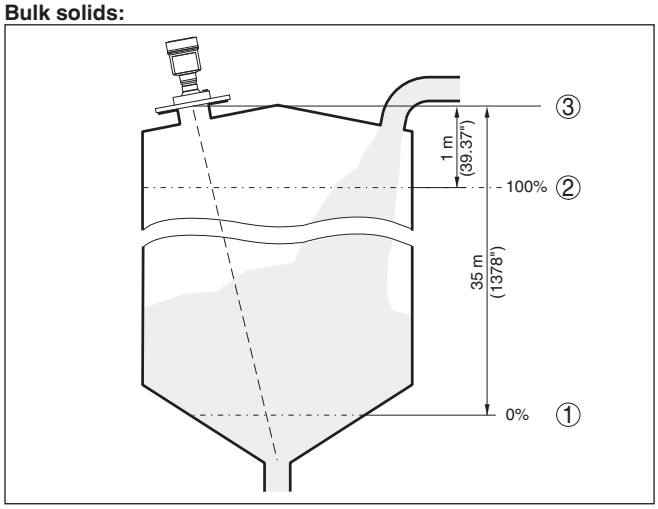


Fig. 55: Parameterisation example min./max. adjustment - bulk solids

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. Informa-

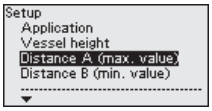
tion on the reference plane can be found in the chapters " *Mounting instructions*" resp. " *Technical data*". The actual filling height is then calculated on the basis of these entries.

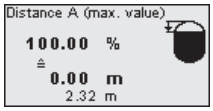
The actual product level during this adjustment is not important, because the min./max. adjustment is always carried out without changing the product level. These settings can be made ahead of time without the instrument having to be installed.

Distance A (max. value)

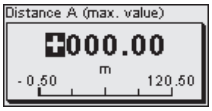
Proceed as follows:

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

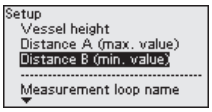


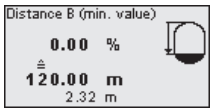
4. Move with ***[ESC]*** and ***[->]*** to the min. adjustment

Distance B (min. value)

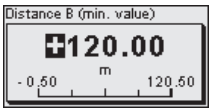
Proceed as follows:

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





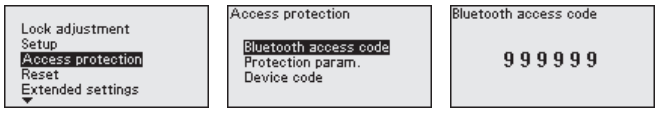
2. Edit the distance value with ***[OK]*** and set the cursor to the requested position with ***[->]***.
3. Set the requested distance value for 0 % (e.g. distance from the sensor up to the vessel bottom) with ***[+]*** and save with ***[OK]***. The cursor now jumps to the distance value.



9.4.3 Access protection

Bluetooth access code

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

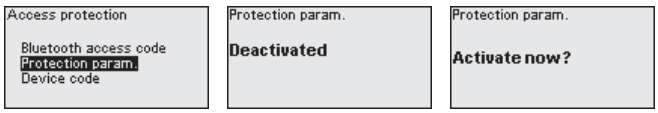


Note:
You can find the individual factory Bluetooth access code of the device on the information sheet supplied " *PINs and Codes*".

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.

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*".



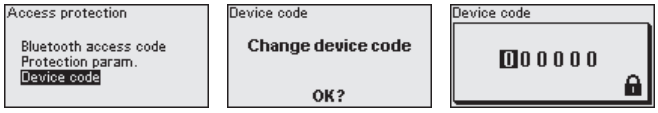
When protection is activated, the individual menu items can still be selected and displayed. However, the parameters can no longer be changed.

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

Note:
With protected parameter adjustment, adjustment via the adjustment app as well as PACTware/DTM and 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.

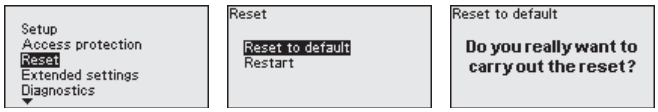


Note:
The changed device code is also effective for adjustment via the adjustment app, PACTware/DTM and other systems.

9.4.4 Reset

Reset

During a reset, parameter settings made by the user are reset to the values of the factory settings. You can fined 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
- 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 [8)]

Reset - Restart:
Is used to restart the device without switching off the supply voltage.

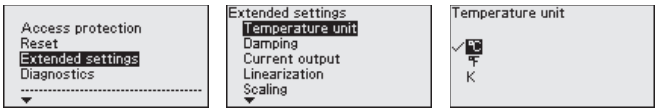
Note:
For the duration of the reset, the device changes its behaviour from the normal measuring operation. Therefore, observe the following for downstream systems:

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

9.4.5 Extended settings

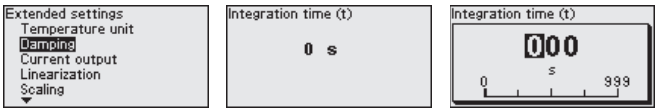
Temperature unit

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



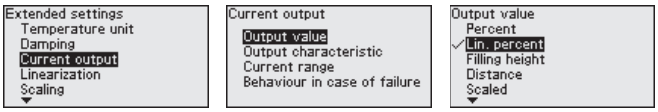
Damping

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:

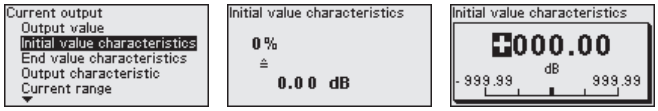
- Percent
- Linearized percent
- Filling height
- Distance
- Scaled

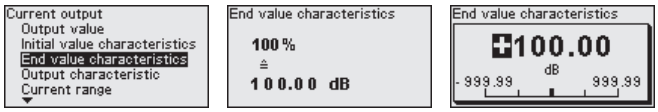
8) The event and parameter change memories are maintained.

- Measurement reliability
- 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 .



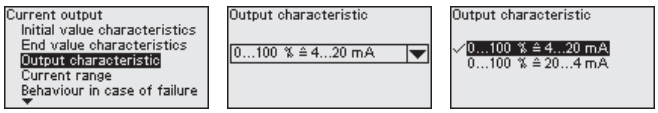


Note:
This menu item is only available if one of the following output values was selected for the current output:

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

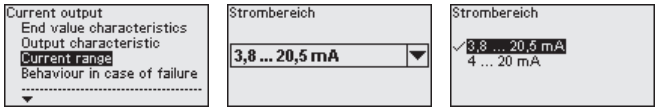
Current output - Output characteristics

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).



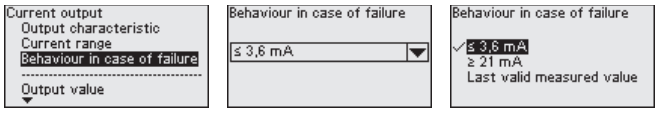
Current output - Current range

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 - 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 ≤ 3.6 mA or ≥ 21 mA resp. the last measured value.

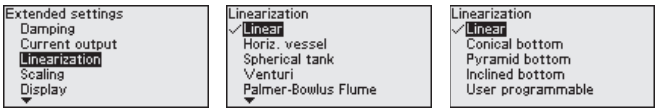


Linearisation

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.

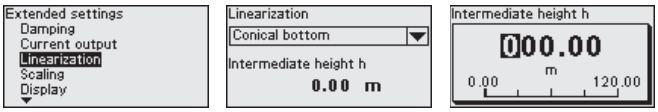


Note:
The selected linearisation applies to the measured value indication and the signal output.

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

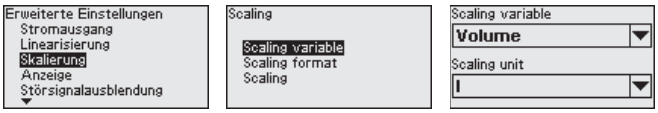
Linearization - Intermediate height

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



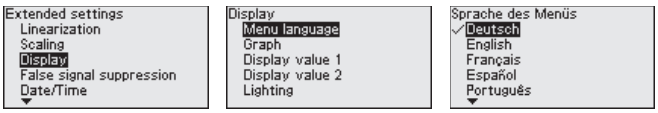
Scaling

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:

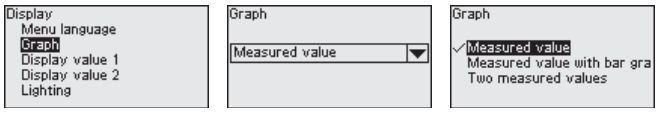
- German
- English
- French
- Spanish
- Portuguese
- Italian
- Dutch
- Russian
- Chinese
- Japanese

- Turkish

Display - Presentation

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

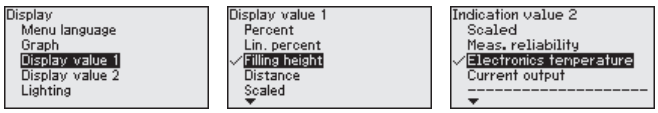
- Measured value in large font
- Measured value and corresponding bargraph presentation
- Measured value as well as second selectable value, e.g. electronics temperature



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

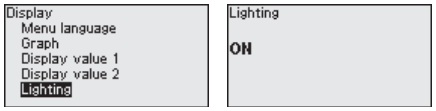
Display - Displayed value 1, 2

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:

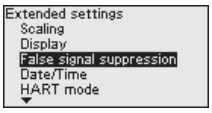
- High mounting nozzles
- Vessel internals such as struts
- Agitators
- Buildup or welded joints on vessel walls

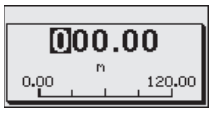
A false signal suppression detects, marks and saves these false signals to ensure that they are ignored in the level measurement.

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]***.

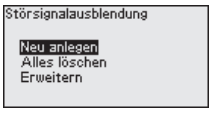




2. Confirm 3-times with ***[OK]*** and enter the actual distance from the sensor to the product surface.
3. All interfering signals in this range are detected by the sensor and stored after being confirmed with ***[OK]***.

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.

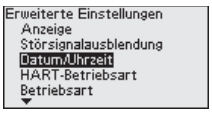
→ This is useful if the applied false signal suppression no longer matches the metrological conditions of the vessel.

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

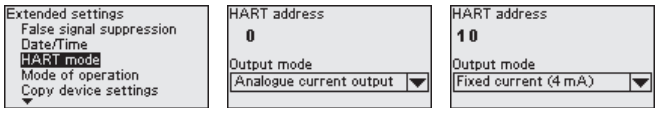
HART mode

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.

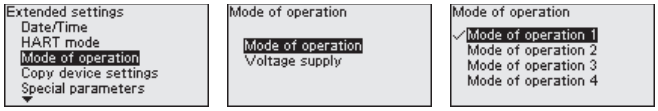
In the mode " *Fixed current*" up to 63 sensors can be operated on one two-wire cable (Multidrop operation). An address between 0 and 63 must be assigned to each sensor.



Mode

This menu item contains operational settings of the sensor.

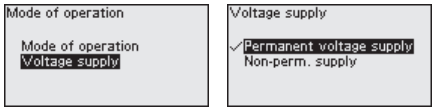
Mode:
Country specific settings for the radar signals are determined via the operating mode.



- Mode 1: EU, Albania, Andorra, Azerbaijan, Australia, Belarus, Bosnia and Herzegovina, Canada, Liechtenstein, Moldavia, Monaco, Montenegro, New Zealand, Northern Macedonia, Norway, San Marino, Saudi Arabia, Serbia, Switzerland, Turkey, Ukraine, United Kingdom, USA
- Mode of operation 2: Brazil, Japan, South Korea, Taiwan, Thailand
- Mode of operation 3: India, Malaysia, South Africa
- Mode of operation 4: Russia, Kazakhstan

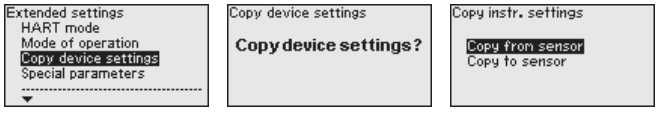
Note:
Depending on the operating mode, metrological properties of the device can change (see chapter " *Technical data, input variable*").

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



Copy instrument settings

The following functions are available:



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 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*".

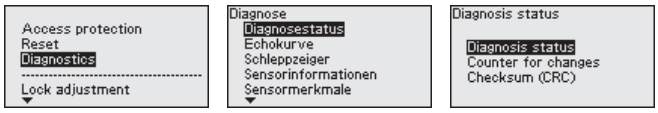
Note:
The special parameters are described in a separate section at the end of the chapter " *Parameter adjustment*".

9.4.6 Diagnostics

Diagnosis status

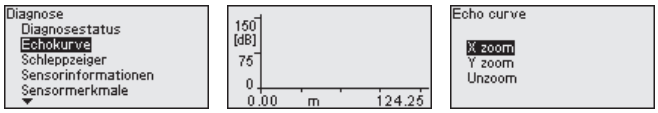
The following is displayed in this menu item:

- 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.



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

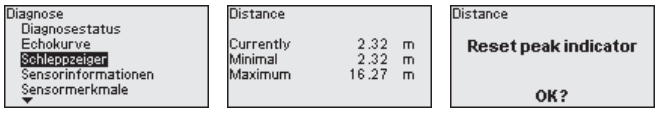
- "X-Zoom": Zoom function for the meas. distance
- "Y-Zoom": 1, 2, 5 and 10x signal magnification in " *dB*"
- "Unzoom": Reset the presentation to the nominal measuring range without magnification

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

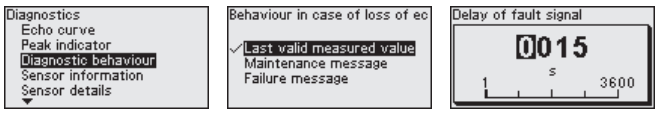
The ***[OK]*** key opens a reset function in the respective peak indicator window:



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.



Sensor information

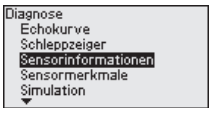
In this menu item the following information of the instrument can be read out:

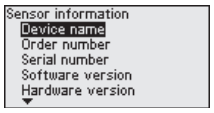
- Device name
- Order and serial number
- Hardware and software version
- Device Revision

- Factory calibration date

as well as additionally depending on the device version:

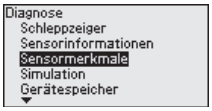
- Instrument address
- Loop Current Mode
- Fieldbus Profile Rev.
- Expanded Device Type
- Sensor acc. to SIL
- Sensor acc. to WHG
- Bustype ID





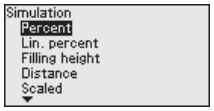
Sensor characteristics

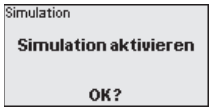
The menu item " *Sensor characteristics*" delivers sensor characteristics such as approval, process fitting, seal, measuring range etc.



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.



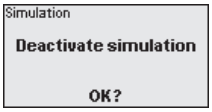


Select the requested simulation variable and set the requested value.

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*".

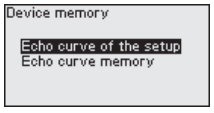
Note:
The sensor terminates the simulation automatically after 60 minutes.

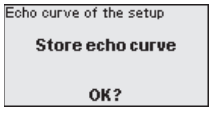
To deactivate the simulation manually in advance, you have to push the ***[ESC]*** key and confirm the message with the ***[OK]*** key.



Device memory

The menu item Device memory offers the following functions:





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.

9.4.7 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.

→ 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).

SP05/06 - Factor for noise averaging rising/falling

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 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.

SP10 - Additional reliability of false signal storage

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.

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/deaxctivate the HART signal in the output.

SP SIL - Safety Integrity Level function

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

9.5 Save parameter adjustment data

On paper

We recommended writing down the adjustment data, e.g. in this operating 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*".