Operating Instructions

Radar sensor for continuous level measurement of liquids

VEGAPULS 66

Two-wire 4 … 20 mA/HART

Document ID: 36519

Contents

Safety instructions for Ex areas

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

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1 About this document

1.1 Function

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

1.2 Target group

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

1.3 Symbols used

Document ID
This symbol on the front page of this instruction refers to the Document ID. By entering the Document ID on www.vega.com you will reach the document download.

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.

→ **Action**
This arrow indicates a single action.

1 **Sequence of actions**
Numbers set in front indicate successive steps in a procedure.

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

2   For your safety

2.1   Authorised personnel

All operations described in this documentation must be carried out only by trained, qualified personnel authorised by the plant operator.

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

2.2   Appropriate use

VEGAPULS 66 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 the operating instructions manual as well as possible supplementary instructions.

2.3   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.

2.4   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 operator 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 operator has to implement suitable measures to make sure the instrument is functioning properly.

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

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

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

To avoid any danger, the safety approval markings and safety tips on the device must also be observed and their meaning read in this operating instructions manual.

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

2.5 EU conformity

The device fulfils the legal requirements of the applicable EU directives. By affixing the CE marking, we confirm the conformity of the instrument with these directives.

The EU conformity declaration can be found on our homepage.

Electromagnetic compatibility
Instruments in four-wire or Ex-d-ia version are designed for use in an industrial environment. Nevertheless, electromagnetic interference from electrical conductors and radiated emissions must be taken into account, as is usual with class A instruments according to EN 61326-1. If the instrument is used in a different environment, the electromagnetic compatibility to other instruments must be ensured by suitable measures.

2.6 NAMUR recommendations

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

The device fulfils the requirements of the following NAMUR recommendations:

● NE 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.

2.7 Radio license for Europe

The instrument was tested according to the latest issue of the following harmonized standards:

● EN 302372 - Tank Level Probing Radar

It is hence approved for use inside closed vessels in countries of the EU.

Use is also approved in EFTA countries, provided the respective standards have been implemented.

For operation inside of closed vessels, points a to f in annex E of EN 302372 must be fulfilled.

2.8 Radio license for USA

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

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

● This device may not cause interference, and
● This device must accept any interference, including interference that may cause undesired operation of the device

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

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

2.9 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 (ANSI/NFPA 70).

Installations in Canada shall comply with the relevant requirements of the Canadian Electrical Code

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

2.10 Environmental instructions

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

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

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

3 Product description

3.1 Configuration

Type label

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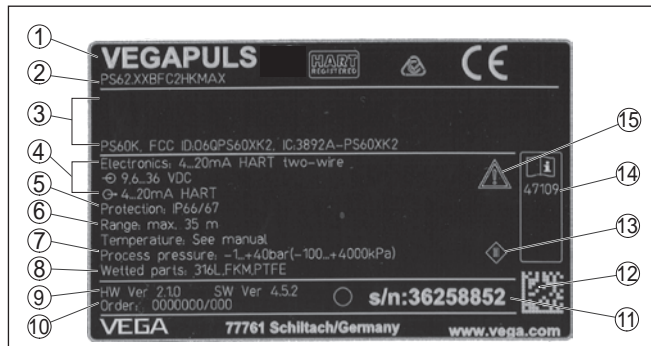

Fig. 1: Layout of the type label (example)

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

Serial number - Instrument search

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

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

Move to "www.vega.com" and enter in the search field the serial number of your instrument.

Alternatively, you can access the data via your smartphone:

- Download the VEGA Tools app from the "*Apple App Store*" or the "*Google Play Store*"
- Scan the Data Matrix code on the type label of the instrument or
- Enter the serial number manually in the app

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Scope of this operating instructions

This operating instructions manual applies to the following instrument versions:

● Hardware version from 2.1.0
● Software version from 4.5.3

Scope of delivery

The scope of delivery encompasses:

● Radar sensor
● Documentation
  – Quick setup guide VEGAPULS 66
  – Instructions for optional instrument features
  – Ex-specific "*Safety instructions*" (with Ex versions)
  – If necessary, further certificates

● **Information:**
ⓘ Optional instrument features are also described in this operating instructions manual. The respective scope of delivery results from the order specification.

3.2 Principle of operation

Application area

The VEGAPULS 66 is a radar sensor for continuous level measurement of liquids under difficult process conditions. It is suitable for applications in storage tanks, process vessels or standpipes. The instrument can be used universally thanks to the different antenna versions.

The version with horn antenna is particularly suitable for the measurement of liquids and bulk solids under extremely difficult process conditions such as buildup, condensation and foam generation as well as strong product movement.

With the version without antenna, the antenna system is formed in conjunction with a measuring tube (surge or bypass tube). This version is particularly suitable for measurement of solvents and liquid gases.

The instrument can be used with products with an ε_r value ≥1.8. The actually achievable value depends on the measuring conditions, the antenna system, the standpipe or bypass.

Functional principle

The antenna of the radar sensor emits short radar pulses with a duration of approx. 1 ns. These pulses are reflected by the product and received by the antenna as echoes. The transit time of the radar pulses from emission to reception is proportional to the distance and hence to the level. The determined level is converted into an appropriate output signal and outputted as measured value.

3.3 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 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
● Storage and transport temperature see chapter "*Supplement - Technical data - Ambient conditions*"
● Relative humidity 20 … 85 %

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.

3.4 Accessories and replacement parts

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

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

VEGACONNECT
The interface adapter VEGACONNECT enables the connection of communication-capable instruments to the USB interface of a PC.

VEGADIS 81
The VEGADIS 81 is an external display and adjustment unit for VEGA plics® sensors.

VEGADIS adapter
The VEGADIS adapter is an accessory part for sensors with double chamber housings. It enables the connection of VEGADIS 81 to the sensor housing via an M12 x 1 plug.

VEGADIS 82
VEGADIS 82 is suitable for measured value indication and adjustment of sensors with HART protocol. It is looped into the 4 … 20 mA/HART signal cable.

PLICSMOBILE T81	The PLICSMOBILE T81 is an external GSM/GPRS/UMTS radio unit for transmission of measured values and for remote parameter adjustment of HART sensors.

PLICSMOBILE 81	PLICSMOBILE 81 is an internal GSM/GPRS/UMTS radio unit for HART sensors for transmitting measured values and for remote parameterization.

Overvoltage protection

The overvoltage arrester B81-35 is used instead of the terminals in the single or double chamber housing.

Protective cover

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

Electronics module

Electronics module "VEGAPULS series 60" is a replacement part for radar sensors of VEGAPULS series 60. A different version is available for each type of signal output.

You can find further information in the operating instructions "*Electronics module VEGAPULS series 60*" (Document-ID 36801).

Supplementary electronics for double chamber housing

The supplementary electronics is a replacement part for 4 … 20 mA/HART sensors with double chamber housing.

4 Mounting

4.1 General instructions

Screwing in

On devices with a threaded fitting, the hexagon on the process fitting must be tightened with a suitable wrench.

See chapter "*Dimensions*" for wrench size.

⚠ **Warning:**
The housing or the electrical connection may not be used for screwing in! Depending on the device version, tightening can cause damage, e. g. to the rotation mechanism of the housing.

Protection against moisture

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 the degree of contamination specified in chapter "*Technical data*" meets the existing ambient conditions.

⚠ **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*" as well as on the type label.

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

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You can find detailed information on the materials and process conditions in chapter "*Technical data*" as well as on the type label.

4.2 Mounting instructions

Polarisation

The emitted radar impulses of the radar sensor are electromagnetic waves. The polarisation is the direction of the electrical wave component. By turning the instrument in the connection flange or mounting boss, the polarisation can be used to reduce the effects of false echoes.

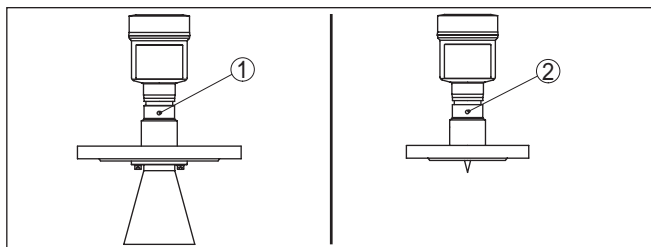The position of the polarisation is marked on the process fitting of the instrument.

Fig. 2: Position of the polarisation

1   Marking with version with horn antenna
2   Marking with version without horn antenna

Installation position

When mounting the VEGAPULS 66, keep a distance of at least 500 mm (19.69 in) to the vessel wall. If the sensor is installed in the center of dished or round vessel tops, multiple echoes can arise. These can, however, be suppressed by an appropriate adjustment (see chapter "*Setup*").

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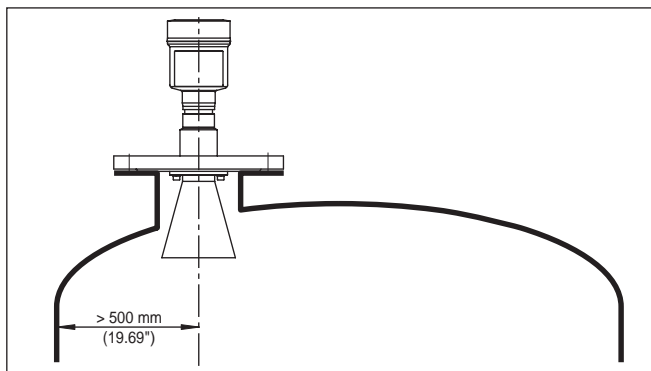

> 500 mm
(19.69")

Fig. 3: Mounting on round vessel tops

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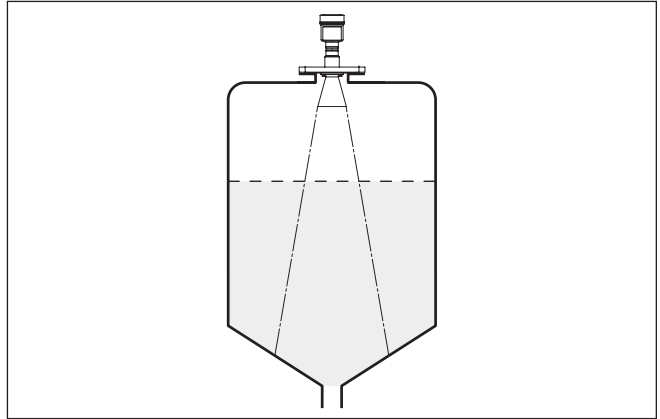

Fig. 4: Vessel with conical bottom

Inflowing medium

Do not mount the instruments in or above the filling stream. Make sure that you detect the product surface, not the inflowing product.
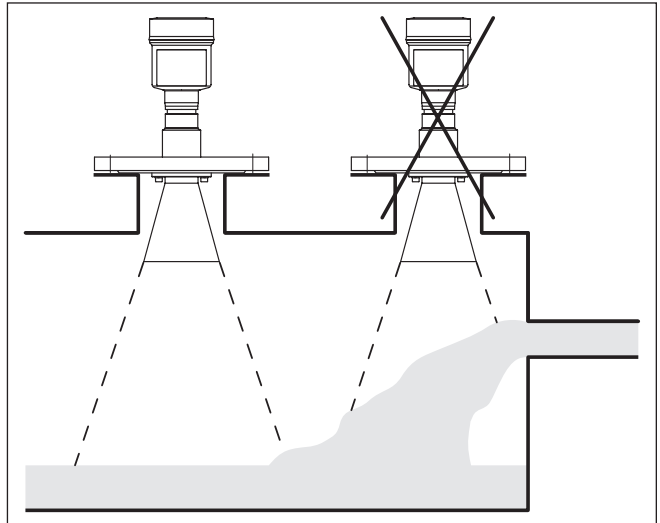

Fig. 5: Mounting of the radar sensor with inflowing medium

Mounting socket

The socket piece should be dimensioned in such a way that the antenna end protrudes at least 10 mm (0.4 in) out of the socket.
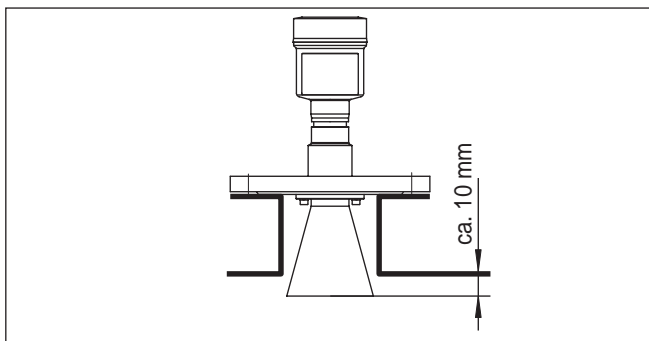
Fig. 6: Recommended socket mounting

If the socket height cannot be maintained, an antenna extension will be necessary. This prevents from false reflections of the socket piece.

Fig. 7: Tube extension

Tip:
VEGAPULS 66 is optionally also available with antenna extension. The antenna length can thus be selected such that the antenna end protrudes 10 mm (0.4 in) out of the socket.

Sensor orientation

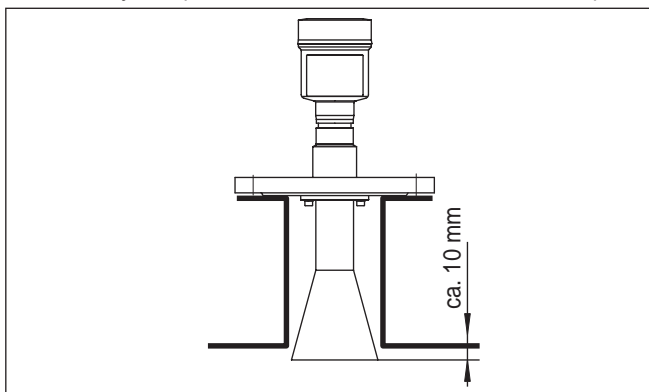In liquids, direct the sensor as perpendicular as possible to the product surface, to an achieve optimum measurement.
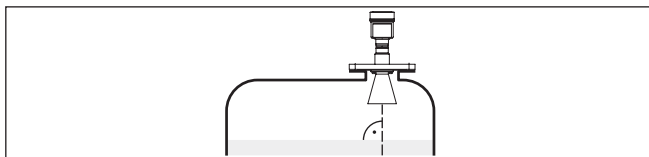

Fig. 8: Alignment in liquids

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.
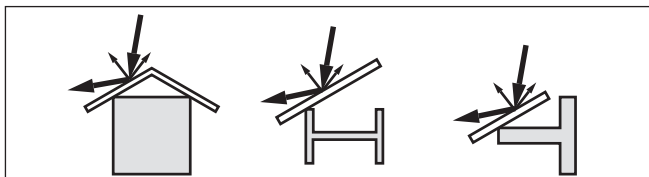
Fig. 9: Cover flat, large-area profiles with deflectors

Agitators

If there are agitators in the vessel, 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. 10: Agitators

Foam generation

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

If foam is causing measurement errors, the largest possible radar antenna should be used.

As an alternative, sensors with guided microwave can be used. These are unaffected by foam generation and are best suited for such applications.

Mounting in the vessel insulation

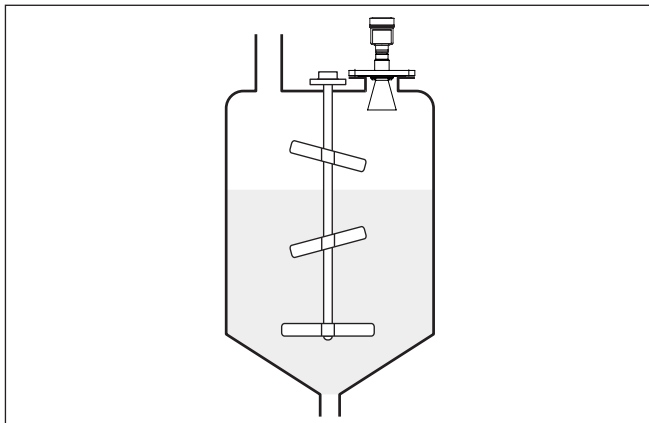Instruments for a temperature range up to 250 °C or up to 450 °C have a distance piece between process fitting and electronics housing. Ths distance piece is used for thermal decoupling of the electronics against high process temperatures.

● **Information:**
ℹ The spacer may only be incorporated up to a maximum of 50 mm into the vessel insulation. Only then is a reliable temperature decoupling guaranteed.
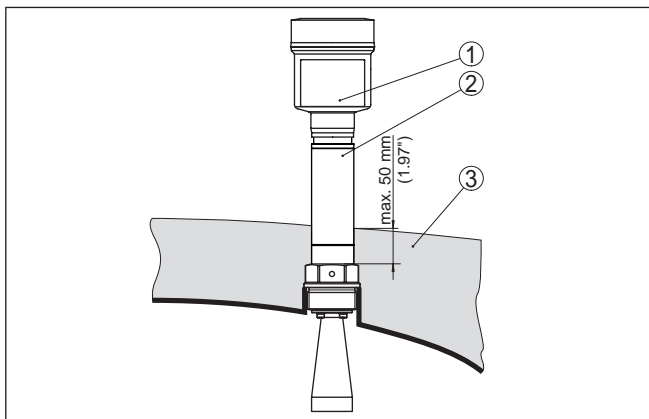
Fig. 11: Mounting the instrument on insulated vessels.

1 Electronics housing
2 Spacer
3 Vessel insulation

4.3 Measurement setup - Pipes

Measurement in a surge pipe

By using a surge pipe in the vessel, the influence of vessel installations and turbulence can be excluded. Under these prerequisites, the measurement of products with low dielectric values (ε_r value ≤ 1.6) is possible.

Note the following illustrations and instructions for measurement in a surge pipe.

● **Information:**
ℹ Measurement in a surge pipe is not recommended for extremely adhesive products.

Configuration surge pipe

Fig. 12: Configuration surge pipe VEGAPULS 66

1 Radar sensor
2 Polarisation marking
3 Thread or flange on the instrument
4 Vent hole
5 Holes
6 Welding connection through U-profile
7 Ball valve with complete opening
8 Surge pipe end
9 Reflector sheet
10 Fastening of the surge pipe

Surge pipe extension
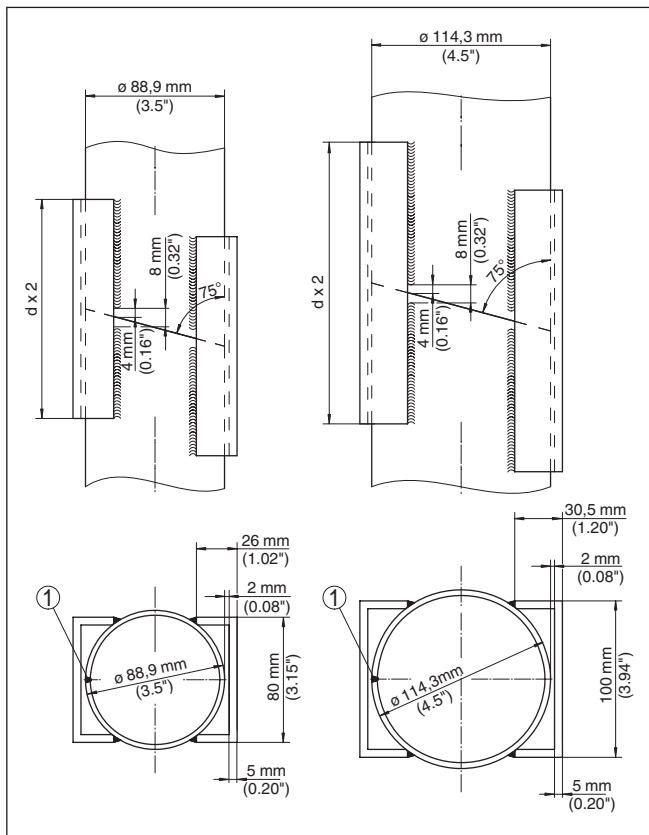
Fig. 13: Welding connection with surge pipe extension for different example diameters

1   Position of the welded joint with longitudinally welded pipes
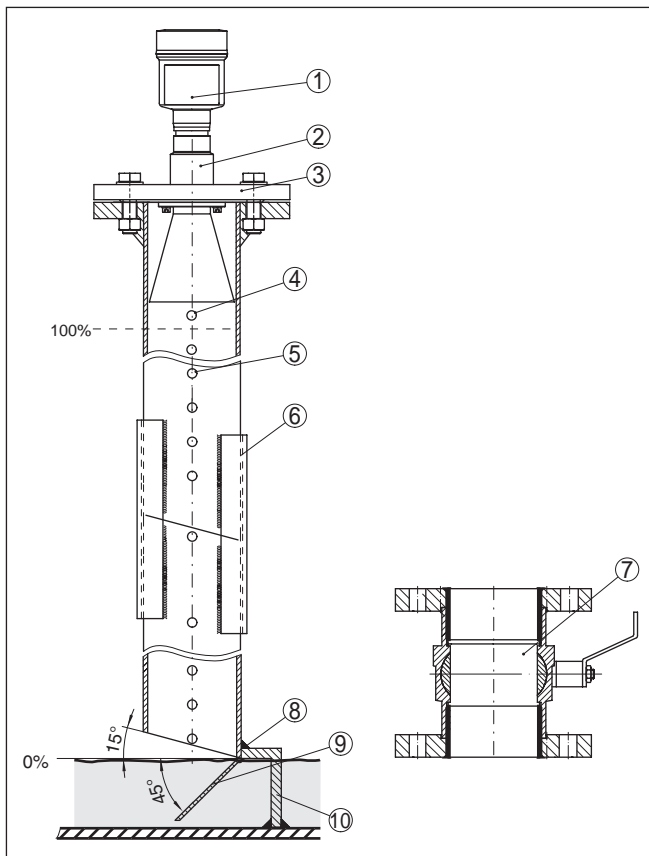
Instructions and requirements, surge pipe

Instructions of orientation of the polarisation:
- Note marking of the polarisation on the sensor
- With threaded versions, the marking is on the hexagon, with flange versions between two flange holes
- The marking must be in one plane with the holes in the surge pipe

Instructions for the measurement:
- The 100 % point must be below the upper vent hole and the antenna edge
- The 0 % point is the end of the surge pipe
- During parameter adjustment, select "*Application standpipe*" and enter the tube diameter to compensate for errors due to running time shift
- A false signal suppression with the installed sensor is recommended but not mandatory

- The measurement through a ball valve with unrestricted channel is possible

Constructive requirements:
- Material metal, smooth inner surface
- Preferably pultruded or straight beaded stainless steel tube
- Welded joint should be straight and lie in one axis with the holes
- Flanges are welded to the tube according to the orientation of the polarisation
- When using a ball valves, align the transitions on the inside and fix accurately
- Gap size with junctions ≤ 0.1 mm
- Surge pipes must extend all the way down to the requested min. level, as measurement is only possible within the tube
- Diameter of holes ≤ 5 mm, any number OK, on one side or completely through
- The antenna diameter of the sensor should correspond to the inner diameter of the tube
- Diameter should be constant over the complete length

Instructions for surge pipe extension:
- The ends of the extension tubes must be bevelled and exactly aligned
- Welded connection via external U profiles according to illustration above. Length of the U profiles should be at least double the tube diameter
- Do not weld through the pipe wall. The surge pipe must remain smooth inside. Roughness and beads on the inside caused by unintentional penetration should be removed since they cause strong false echoes and encourage buildup
- An extension via welding neck flanges or pipe collars is not recommended.

Measurement in the bypass tube

An alternative to measurement in a surge pipe is measurement in a bypass tube outside of the vessel.

Configuration bypass
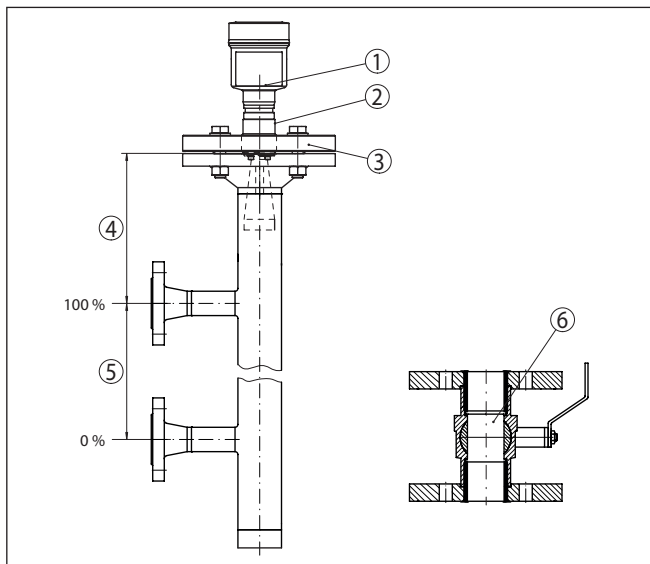
Fig. 14: Configuration bypass

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
● With threaded versions, the marking is on the hexagon, with flange versions between two flange holes
● 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 > 300 mm
● During parameter adjustment, select "*Application standpipe*" and enter the tube diameter to compensate for errors due to running time shift
● A false signal suppression with the installed sensor is recommended but not mandatory
● The measurement through a ball valve with unrestricted channel is possible

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 ≤ 0.1 mm, for example, when using a ball valve or intermediate flanges with single pipe sections
- The antenna diameter of the sensor should correspond to the inner diameter of the tube
- Diameter should be constant over the complete length

5 Connecting to power supply

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

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

Provide a reliable separation between the supply circuit and the mains circuits according to DIN EN 61140 VDE 0140-1.

Power the instrument via an energy-limited circuit acc. to IEC 61010-1, e.g. via Class 2 power supply unit.

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

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

Connection cable An approved, three-wire installation cable with PE conductor is required for voltage supply with mains voltage.

The 4 … 20 mA current output is connected with standard two-wire cable without screen. If electromagnetic interference is expected which is above the test values of EN 61326-1 for industrial areas, screened cable should be used.

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).

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.

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

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

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

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

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

5.2 Connecting

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.

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

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

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Fig. 15: 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

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

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

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

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

5.3   Wiring plan, single chamber housing

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

VEGA

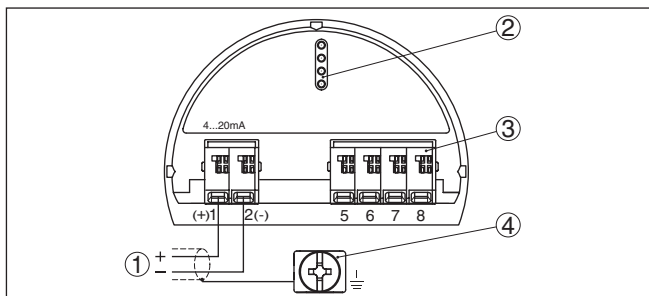**Electronics and connection compartment**

Fig. 16: 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

5.4   Wiring plan, double chamber housing

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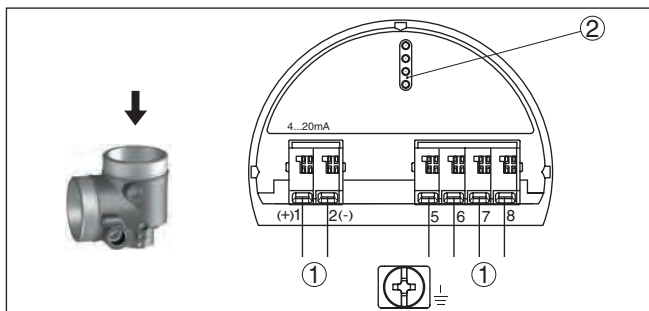
Electronics compartment

Fig. 17: Electronics compartment - double chamber housing

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

Connection compartment

Fig. 18: 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

**Connection compart-
ment - Radio module
PLICSMOBILE 81**

Fig. 19: Connection compartment - Radio module PLICSMOBILE 81

1   Voltage supply

You can find detailed information for connection in the operating instructions "*PLICSMOBILE*".

VEGA

5.5 Wiring plan, Ex-d-ia double chamber housing

Electronics compartment
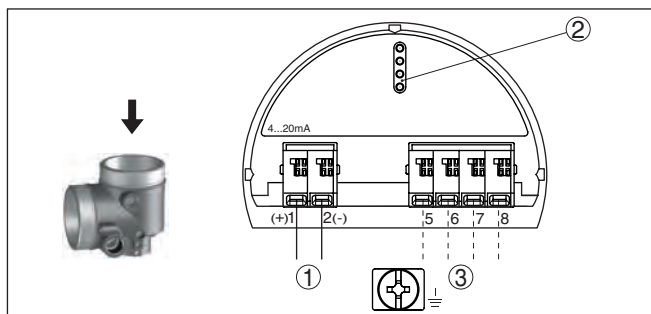
Fig. 20: Electronics compartment - Ex-d-ia double chamber housing

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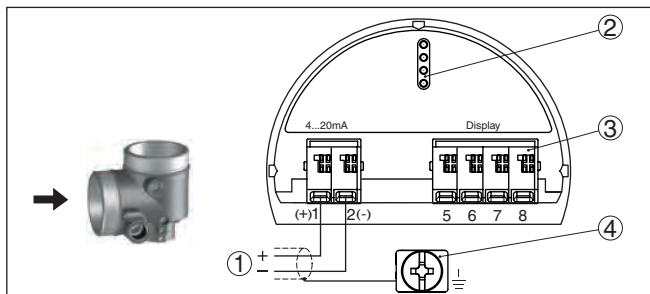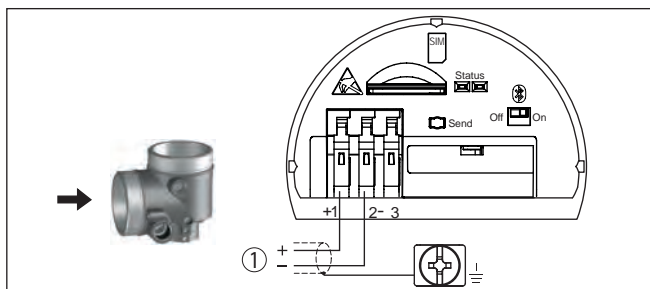*2 For display and adjustment module or interface adapter*
*3 Internal connection to the plug connector for external display and adjust-
  ment unit (optional)*

● **Note:**
  HART multidrop mode is not possible when using an Ex-d-ia instru-
  ment.

Connection compartment
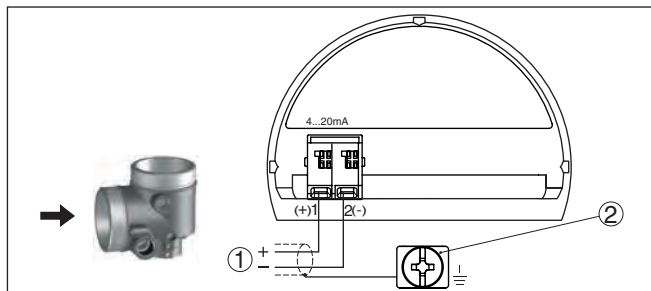
Fig. 21: Connection compartment - Ex-d-ia double chamber housing

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

**Plug M12 x 1 for external
display and adjustment
unit**
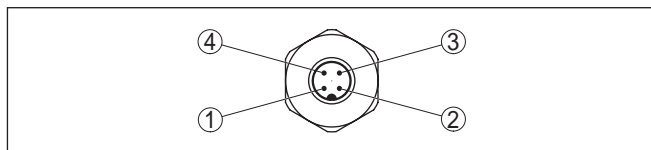
Fig. 22: Top view of the plug connector

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

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

5.6 Double chamber housing with VEGADIS-Adapter

Electronics compartment
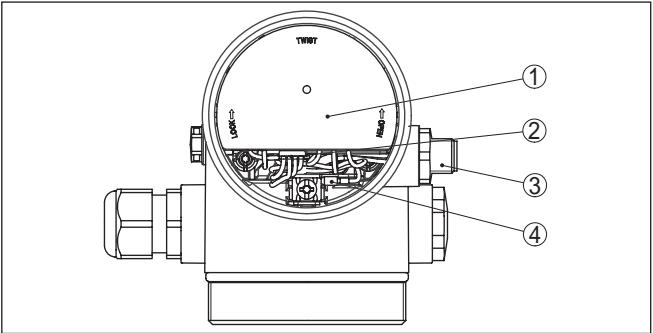

Fig. 23: View to the electronics compartment with VEGADIS adapter for connection of the external display and adjustment unit

1 VEGADIS adapter
2 Internal plug connection
3 Plug connector M12 x 1

Assignment of the plug connector
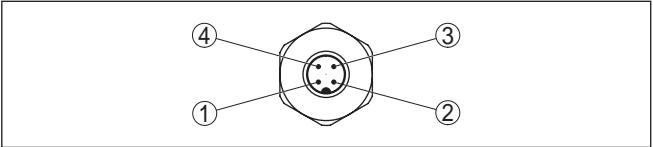
Fig. 24: View to the plug connector M12 x 1

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

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

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

**Wire assignment, con-
nection cable**
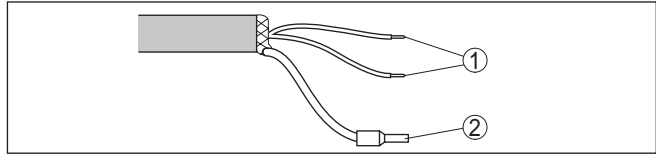
Fig. 25: Wire assignment in permanently connected connection cable

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

5.8 Switch-on phase

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

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

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

6 Set up with the display and adjustment module

6.1 Insert display and adjustment module

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

Proceed as follows:

1. Unscrew the housing lid

2. Place the display and adjustment module on the electronics in the desired position and turn it to the right until it snaps in.

3. Screw housing lid with inspection window tightly back on

Disassembly is carried out in reverse order.

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

Fig. 26: Installing the display and adjustment module in the electronics compartment of the single chamber housing
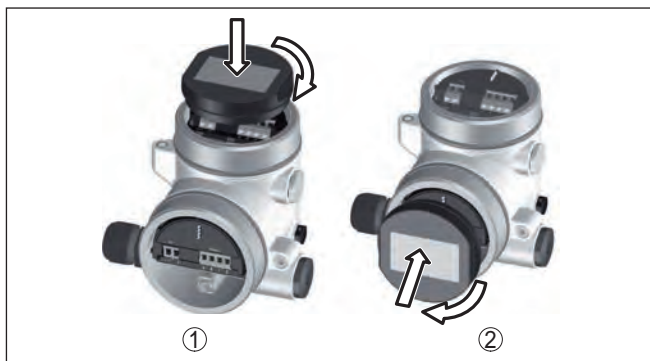
Fig. 27: Installing the display and adjustment module in the double chamber housing

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.

6.2 Adjustment system

Fig. 28: 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

Operating system - Keys direct

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.
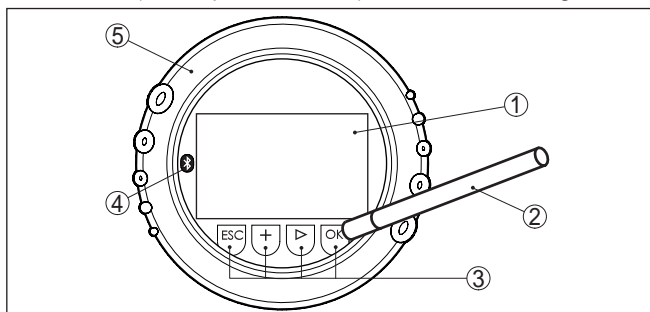
Fig. 29: Display and adjustment elements - with adjustment via magnetic pen
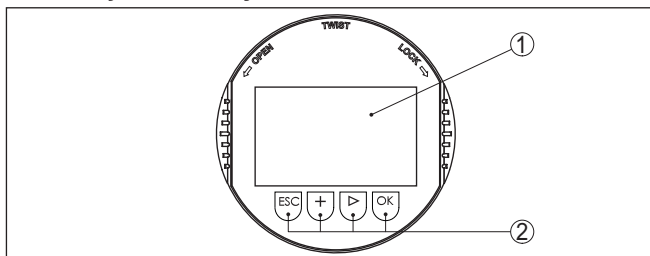
1 LC display
2 Magnetic pen
3 Adjustment keys
4 Bluetooth symbol
5 Lid with inspection window

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.

6.3 Measured value indication - Selection of national language

Measured value indication

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

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

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

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

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

Selection of national language

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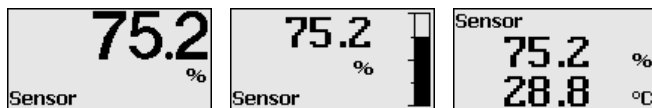

With the "*OK*" key you move to the main menu.

6.4 Parameter adjustment

The instrument is adapted to the application conditions via the parameter adjustment. The parameter adjustment is carried out with an adjustment menu.

Main menu

The main menu is divided into five sections with the following functions:
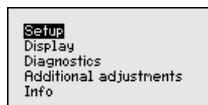
Setup: Settings, e.g., for measurement loop name, medium, application, vessel, adjustment, signal output

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

Diagnosis: Information, e.g. on instrument status, pointer, measurement reliability, simulation, echo curve

Further settings: Instrument unit, false signal suppression, linearisation curve, reset, date/time, reset, copy function

Info: Instrument name, hardware and software version, date of manufacture, instrument features

Information:
In this operating instructions manual, the instrument-specific parameters in the menu sections "*Setup*", "*Diagnosis*" and "*Additional settings*" are described. The general parameters in these menu sections are described in the operating instructions manual "*Display and adjustment module*".

In the operating instructions manual "*Display and adjustment module*" you can also find the description of menu sections "*Display*" and "*Info*".

In the main menu item "*Setup*", the individual submenu items should be selected one after the other and provided with the correct parameters to ensure optimum adjustment of the measurement. The procedure is described in the following.

Setup - Measurement loop name

In the menu item "*Sensor TAG*" you edit a twelve-digit measurement loop designation.

You can enter an unambiguous designation for the sensor, e.g. the measurement loop name or the tank or product designation. In digital systems and in the documentation of larger plants, a singular designation must be entered for exact identification of individual measuring points.

The available digits include:

● Letters from A … Z
● Numbers from 0 … 9
● Special characters +, -, /, -
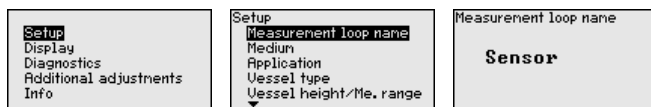
Setup - Medium

Every medium has different reflective properties. With liquids, there are additional interfering factors such as turbulent product surface and foam generation. With bulk solids, the additional interfering factors are dust generation, angle of repose and secondary echoes from the vessel wall.

To adapt the sensor to these different measuring conditions, the selection "*Liquid*" or "*Bulk solid*" should be made in this menu item.
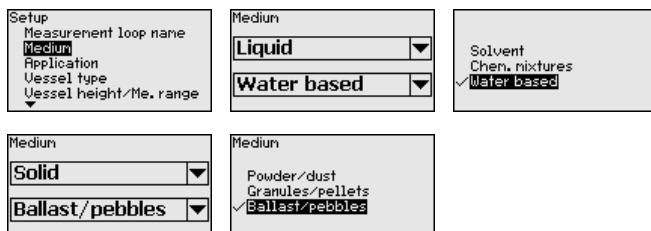
Through this selection, the sensor is optimally adapted to the product, and measurement reliability, particularly in products with poor reflective properties, is considerably increased.

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

Setup - Application

In addition to the medium, also the application, i.e. the measuring site, can influence the measurement.

With this menu item, the sensor can be adapted to the applications. The adjustment possibilities depend on the selection "*Liquid*" or "*Bulk solid*" under "*Medium*".

Setup
  Measurement loop name
  Medium
  Application
  Vessel type
  Vessel height/Me. range
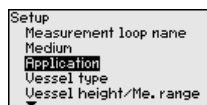
The following options are available when "*Liquid*" is selected:

Application	Application	Application
✓**Storage tank**	Stilling tube	Mob.plastic vessel
Storage tank agitation	✓Bypass	Open waters
Storage tank on ships	**Plastic vessel**	✓**Open flume**
Stirred vessel	Mob.plastic vessel	Rainwater overfall
Dosing vessel	Open waters	Demonstration
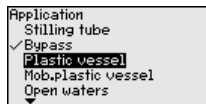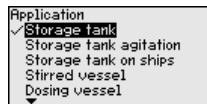
The selection "*Standpipe*" opens a new window in which the inner diameter of the applied standpipe is entered.

Application	Tube inner diameter
Stilling tube ▼	**0̲0̲.500**
Tube inner diameter	m
0.500 m	0.015 1.000
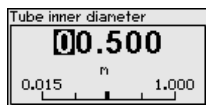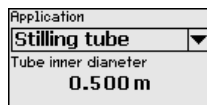
Following the characteristics of the applications and the metrological features of the sensor are described.

● **Note:**
Probably the operation of the instrument in the following applications is subject to national restrictions in respect to the radio license (see chapter "*For your safety*"):

● Plastic tank
● Transportable plastic tank
● Open water
● Open flume
● Rain water spillover

Storage tank:
● Vessel:
  – Large volume
  – Upright cylindrical, horizontal round
● Process/measurement conditions:
  – Condensation
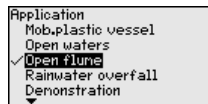 – Smooth product surface
  – High requirements on measurement accuracy
  – Slow filling and emptying
● Properties, sensor:
  – Low sensitivity to sporadic false echoes
  – Stable and reliable measured values through averaging
  – High measurement accuracy
  – No short reaction time of the sensor required

Storage tank, circulation:
● Setup: large-volumed, upright cylindrical, spherical
● Medium speed: slow filling and emptying
● Installations: small, laterally mounted or large, top mounted stirrer

- Process/measurement conditions:
  - Relatively smooth product surface
  - High requirements on measurement accuracy
  - Condensation
  - Slight foam generation
  - Overfilling possible
- Properties, sensor:
  - Low sensitivity to sporadic false echoes
  - Stable and reliable measured values through averaging
  - High measurement accuracy, because not set for max. speed
  - False signal suppression recommended

Storage tank on ships:
- Medium speed: slow filling and emptying
- Vessel:
  - Installations in the bottom section (bracers, heating spirals)
  - High sockets 200 … 500 mm, also with large diameters
- Process/measurement conditions:
  - Condensation, buildup by movement
  - Max. requirement on measurement accuracy from 95 %
- Properties, sensor:
  - Low sensitivity to sporadic false echoes
  - Stable and reliable measured values through averaging
  - High measurement accuracy
  - False signal suppression required

Stirrer vessel:
- Vessel:
  - Mounting socket
  - Large agitator blades of metal
  - Vortex breakers, heating spirals
- Process/measurement conditions:
  - Condensation, buildup by movement
  - Strong spout generation
  - Very agitated surface, foam generation
  - Fast to slow filling and emptying
  - Vessel is filled and emptied very often
- Properties, sensor:
  - Higher measurement speed through less averaging
  - Sporadic false echoes are suppressed

Dosing vessel:
- Setup: all vessel sizes possible
- Medium speed:
  - Fast filling and emptying
  - Vessel is filled and emptied very often
- Vessel: tight installation situation
- Process/measurement conditions:
  - Condensation, buildup on the antenna
  - Foam generation
- Properties, sensor:
  - Measurement speed optimized by virtually no averaging
  - Sporadic false echoes are suppressed

– False signal suppression recommended

Standpipe:
● Medium speed: very fast filling and emptying
● Vessel:
  – Vent hole
  – Joins like flanges, weld joints
  – Shifting of the running time in the tube
● Process/measurement conditions:
  – Condensation
  – Buildup
● Properties, sensor:
  – Measurement speed optimized through little averaging
  – Entering the tube inside diameter takes the running time shift into consideration
  – Echo detection sensitivity reduced

Bypass:
● Medium speed:
  – Fast up to slow filling with short up to long bypass tube possible
  – Often the level is hold via a control facility
● Vessel:
  – Lateral outlets and inlets
  – Joins like flanges, weld joints
  – Shifting of the running time in the tube
● Process/measurement conditions:
  – Condensation
  – Buildup
  – Separation of oil and water possible
  – Overfilling into the antenna possible
● Properties, sensor:
  – Measurement speed optimized through little averaging
  – Entering the tube inside diameter takes the running time shift into consideration
  – Echo detection sensitivity reduced
  – False signal suppression recommended

Plastic tank:
● Process/measurement conditions:
  – Condensation on the plastic ceiling
  – In outdoor facilities, water and snow on vessel top possible
  – Measurement through the vessel top, if appropriate to the application
● Properties, sensor:
  – False signals outside the vessel are not taken into consideration
  – False signal suppression recommended

Transportable plastic tank:
● Process/measurement conditions:
  – Material and thickness different
  – Measured value jump with vessel change
  – Measurement through the vessel top, if appropriate to the application

- Properties, sensor:
  - Quick adaptation to changing reflection conditions due to vessel change required
  - False signal suppression required

Open water:
- Process/measurement conditions:
  - Slow gauge change
  - Extreme damping of output signal due to wave generation
  - Ice and condensation on the antenna possible
  - Floating debris sporadically on the water surface
- Properties, sensor:
  - Stable and reliable measured values through frequent averaging
  - Insensitive in the close range

Open flume:
- Process/measurement conditions:
  - Slow gauge change
  - Ice and condensation on the antenna possible
  - Smooth water surface
  - Exact measurement result required
- Properties, sensor:
  - Stable and reliable measured values through frequent averaging
  - Insensitive in the close range

Rain water spillover:
- Rate of level change: slow level change
- Process/measurement conditions:
  - Ice and condensation on the antenna possible
  - Spiders and insects build nests in the antennas
  - Turbulent water surface
  - Sensor flooding possible
- Properties, sensor:
  - Stable and reliable measured values through frequent averaging
  - Insensitive in the close range

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

⚠ **Caution:**
If liquids with different dielectric constants separate in the vessel, for example through condensation, the radar sensor can detect under certain circumstances only the medium with the higher dielectric

constant. Keep in mind that layer interfaces can cause faulty measurements.

If you want to measure the total height of both liquids reliably, please contact our service department or use an instrument specially designed for interface measurement.

Setup - Vessel form

Apart from the medium and the application, the vessel form itself can influence the measurement. To adapt the sensor to these measuring conditions, this menu item offers different options for vessel bottom and ceiling for certain applications.
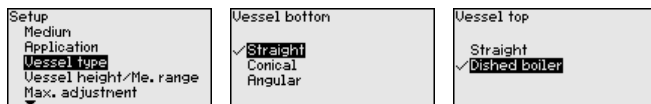
Enter the requested parameters via the appropriate keys, save your settings with *[OK]* and jump to the next menu item with the *[ESC]* and the *[->]* key.

Setup - Vessel height, measuring range

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

The min. adjustment must be carried out independently of this.
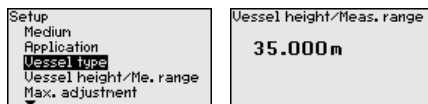
Enter the requested parameters via the appropriate keys, save your settings with *[OK]* and jump to the next menu item with the *[ESC]* and the *[->]* key.

Setup - Adjustment

Since the radar sensor is a distance measuring instrument, it is the distance from the sensor to the product surface that is measured. To indicate the actual level, the measured distance must be assigned to a certain height percentage.

To perform the adjustment, enter the distance with full and empty vessel, see the following example:
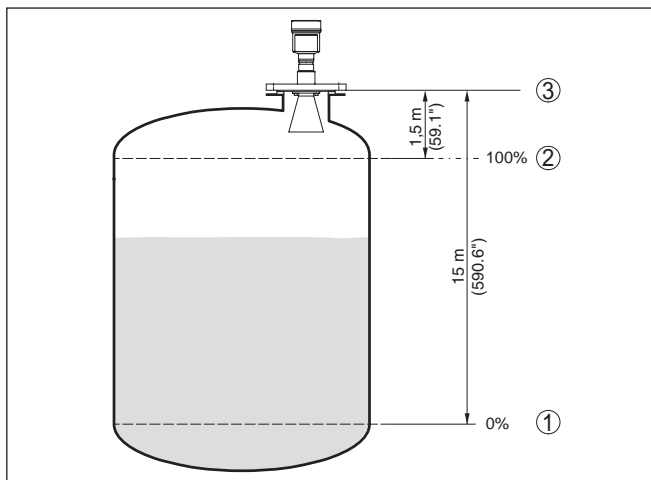
Fig. 30: Parameterisation example, Min./max. adjustment

1   Min. level = max. measuring distance
2   Max. level = min. measuring distance

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

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

Setup - Min. adjustment

Proceed as follows:

1. Select the menu item "*Setup*" with *[->]* and confirm with *[OK]*. Now select with *[->]* the menu item "*Min. adjustment*" and confirm with *[OK]*.
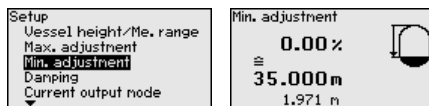
2. Edit the percentage value with *[OK]* and set the cursor to the requested position with *[->]*.

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

```
Min. adjustment
 75.000
      m
0.000        75.000
```

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

5. Save settings with *[OK]* and move with *[ESC]* and *[->]* to the max. adjustment.

Setup - Max. adjustment   Proceed as follows:

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

```
Setup
 Vessel type
 Vessel height/Me. range
 Max. adjustment
 Min. adjustment
 Damping
```
```
Max. adjustment
 100.00 %
   ≙
  0.000 m
   1.971 m
```
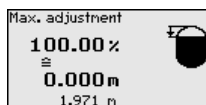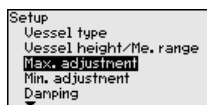
2. Prepare the percentage value for editing with *[OK]* and set the cursor to the requested position with *[->]*.
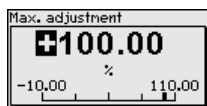
```
Max. adjustment
 100.00
     %
-10.00        110.00
```
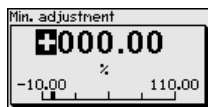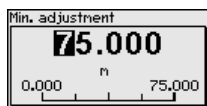
3. Set the requested percentage value with *[+]* and save with *[OK]*. The cursor jumps now to the distance value.

```
Max. adjustment
 00.000
      m
0.000        75.000
```

4. Enter the appropriate distance value in m (corresponding to the percentage value) for the full vessel. Keep in mind that the max. level must lie below the min. distance to the antenna edge.

5. Save settings with *[OK]*

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

```
Setup
 Display
 Diagnostics
 Additional adjustments
 Info
```
```
Setup
 Max. adjustment
 Min. adjustment
 Damping
 Current output mode
 Current output min./max.
```
```
Integration time
   0 s
```
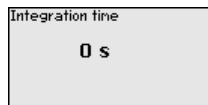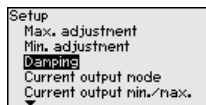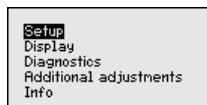
Depending on the sensor type, the factory setting is 0 s or 1 s.

Setup - Current output, mode   In the menu item "*Current output mode*" you determine the output characteristics and reaction of the current output in case of fault.

```
Setup
 Display
 Diagnostics
 Additional adjustments
 Info
```
```
Setup
 Measurement loop name
 Medium
 Application
 Vessel type
 Vessel height/Me. range
```
```
Current output mode
 Output characteristics
 4 … 20 mA     ▼
 Failure mode
 < 3.6 mA      ▼
```
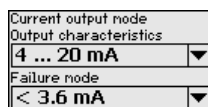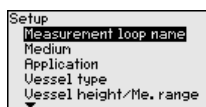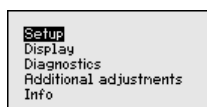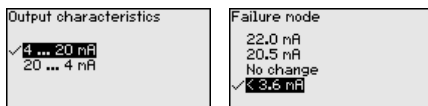
The default setting is output characteristics 4 … 20 mA, fault mode
< 3.6 mA.

Setup - Current output Min./Max.

In the menu item "*Current output Min./Max.*", you determine the reaction of the current output during operation.
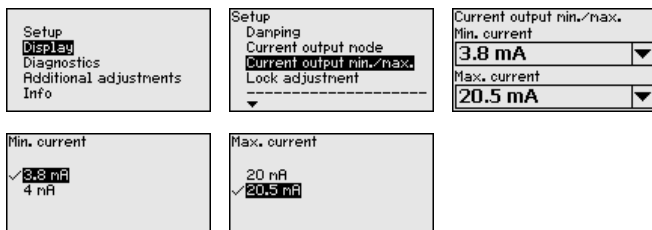
The default setting is min. current 3.8 mA and max. current 20.5 mA.

Setup - Lock adjustment

In this menu item, the PIN is activated/deactivated permanently. Entering a 4-digit PIN protects the sensor data against unauthorized access and unintentional modifications. If the PIN is activated permanently, it can be deactivated temporarily (i.e. for approx. 60 min.) in any menu item.
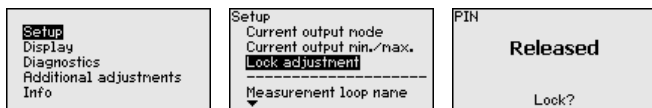
Only the following functions are permitted with activated PIN:

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

⚠ **Caution:**
When the PIN is active, adjustment via PACTware/DTM as well as other systems is also blocked.

In delivery status, the PIN is "*0000*".

Display - Language

This menu item enables the setting of the requested national language.
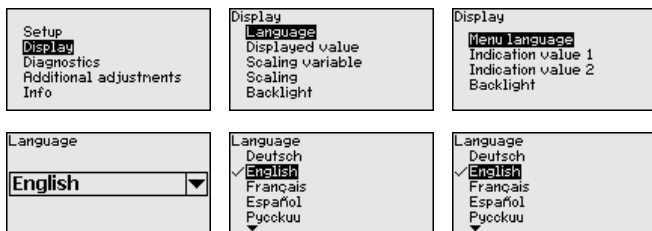
In delivery status, the sensor is set to the ordered national language.

Display - Indicated value   In this menu item you can define the indication of the measured value on the display.
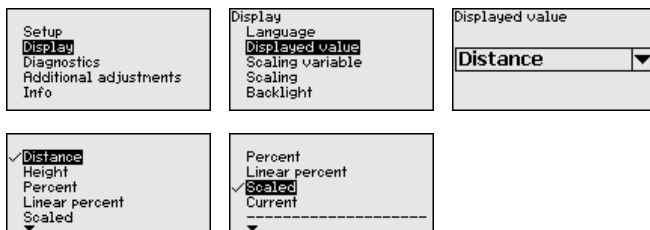
The default setting for the indicated value is e.g. "Distance" on radar sensors.

Display - Backlight   The optionally integrated background lighting can be switched on via the adjustment menu. This function depends on the level of the supply voltage, see operating instructions of the respective sensor.

To maintain the function of the device, the lighting is temporarily switched off if power supply is insufficient.
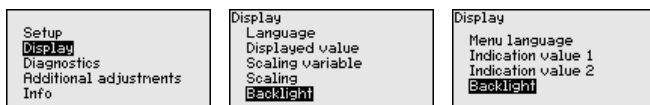
In delivery status, the lighting is switched on.

Diagnostics - Device status   In this menu item, the device status is displayed.
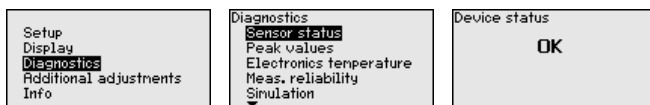
Diagnostics - Peak values (distance)   The respective min. and max. measured distance values are saved in the sensor. The values are displayed in the menu item "*Peak values*".
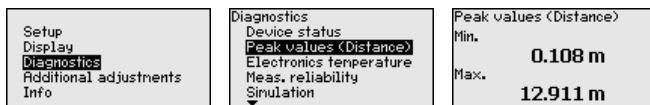
Diagnosis - Electronics temperature   The respective min. and max. measured values of the electronics temperature are saved in the sensor. These values as well as the current temperature value are displayed in the menu item "*Peak values*".
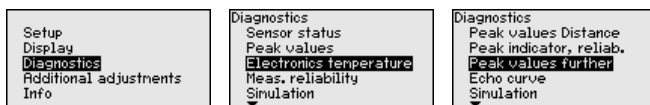
```
Electronics temperature
Actual      28.30 °C
Min.        20.40 °C
Max.        32.20 °C
```

Diagnosis - Measurement reliability

When non-contact level sensors are used, the measurement can be influenced by the respective process conditions. In this menu item, the measurement reliability of the level echo is displayed as a dB value. Measurement reliability equals signal strength minus noise. The higher the value, the more reliable the measurement. A well functioning measurement normally has a value > 10 dB.

```
Setup                 Diagnostics              Meas. reliability
Display               Peak values (Distance)
Diagnostics           Electronics temperature      15 dB
Additional adjustments Meas. reliability
Info                  Simulation
                      Curve indication
```

Diagnosis - 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.

```
Setup                 Diagnostics              Simulation
Display               Electronics temperature
Diagnostics           Meas. reliability            Start
Additional adjustments Simulation               simulation?
Info                  Curve indication
                      ------------------
```

```
Percent               Simulation running       Simulation running
Current               Percent                  ▣094.1
Distance                                            %
                      94.1 %               -10.0        110.0
```

How to start the simulation:

1. Push *[OK]*

2. Select the requested simulation variable with *[->]* and confirm with *[OK]*.

3. With *[OK]* you start the simulation, first of all the actual measured value is displayed in %

4. Start the editing mode with *[OK]*

5. Set the requested numerical value with *[+]* and *[->]*.

6. Push *[OK]*

● **Note:**
ℹ During simulation, the simulated value is output as 4 … 20 mA current value and digital HART signal.

How to interrupt the simulation:

→ Push *[ESC]*

● **Information:**
ℹ The simulation is automatically terminated 10 minutes after the last pressing of a key.

Diagnosis - Curve indication

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

Setup	Diagnostics	Curve indication
Display	Meas. reliability	
Diagnostics	Simulation	Echo curve
Additional adjustments	Curve indication	False signal suppression
Info	Echo curve memory	
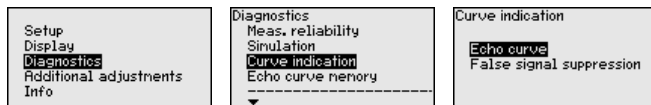
The "*False signal suppression*" displays the saved false echoes (see menu "*Additional settings*") of the empty vessel with signal strength in "dB" over the entire measuring range.

A comparison of echo curve and false signal suppression allows a more detailed statement about measurement reliability.

Echo curve	False signal suppression
120 [dB] 60 0	120 [dB] 60 0
0.0 M 30.0	0.0 30.0
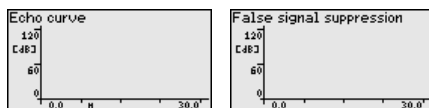
The selected curve is continuously updated. A submenu with zoom functions is opened with the *[OK]* key:

- "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

Diagnostics - Echo curve memory

The function "*Echo curve memory*" makes it possible to save the echo curve at the time of setup. This is generally recommended, and it is absolutely necessary if you want to use the Asset Management functions. If possible, the curve should be saved with a low level in the vessel.

With the adjustment software PACTware and a PC, a high resolution echo curve can be displayed and used to recognize signal changes during operation. In addition, the echo curve of setup can be displayed in the echo curve window and compared with the current echo curve.

Setup	Diagnostics	Echo curve memory
Display	Simulation	Save
Diagnostics	Curve indication	echo curve
Additional adjustments	Echo curve memory	of the setup?
Info	Device status	
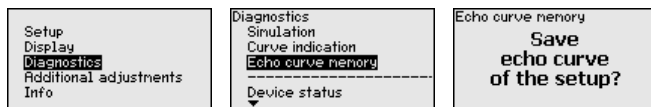
Additional adjustments - Instrument units

In this menu item you select the measured variable of the system and the temperature unit.

Setup	Additional adjustments	Distance unit
Display	Instrument units	m
Diagnostics	False signal suppression	
Additional adjustments	Linearization curve	Temperature unit
Info	PIN	°C
	Date/Time	
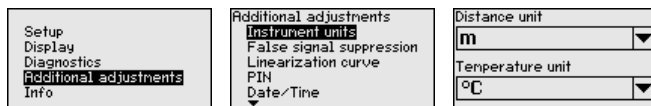
Additional settings - False signal suppression

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

- High mounting sockets
- Vessel internals such as struts

- Agitators
- Buildup or welded joints on vessel walls

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

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

Proceed as follows:

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

```
Additional adjustments
 Instrument units
 False signal suppression
 Linearization curve
 PIN
 Date/Time
 ▼
```

```
False signal suppression

Create new
```

```
 [0]0.000
        m
 0.000        35.000
```
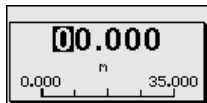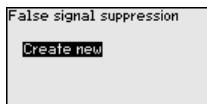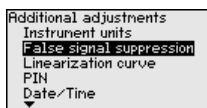
2. Confirm 3-times with *[OK]* and enter the actual distance from the
sensor to the product surface.

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

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

```
False signal suppression

 Delete
 Update
 Create new
```
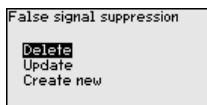
Delete: An already created false signal suppression will be com-
pletely deleted. This is useful if the saved false signal suppression no
longer matches the metrological conditions in the vessel.

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

Additional settings - Linearization

A linearization is necessary for all vessels in which the vessel volume does not increase linearly with the level - e.g. a horizontal cylindrical or spherical tank - and the indication or output of the volume is required. Corresponding linearization curves are preprogrammed for these vessels. They represent the correlation between the level percentage and vessel volume.

By activating the appropriate curve, the volume percentage of the vessel is displayed correctly. If the volume should not be displayed in percent but e.g. in l or kg, a scaling can be also set in the menu item "*Display*".
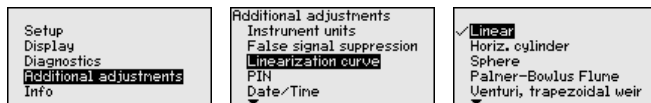
Enter the requested parameters via the appropriate keys, save your settings and jump to the next menu item with the *[ESC]* and *[->]* key.

⚠ **Caution:**
Note the following if instruments with appropriate approval are used as part of an overfill protection system according to WHG:

If a linearisation curve is selected, the measuring signal is no longer necessarily linear to the filling height. This must be considered by the user especially when setting the switching point on the limit signal transmitter.

Additional settings - PIN

Entering a 4-digit PIN protects the sensor data against unauthorized access and unintentional modification. In this menu item, the PIN is displayed or edited and changed. However, this menu item is only available if adjustment is enabled in the menu "*Setup*".
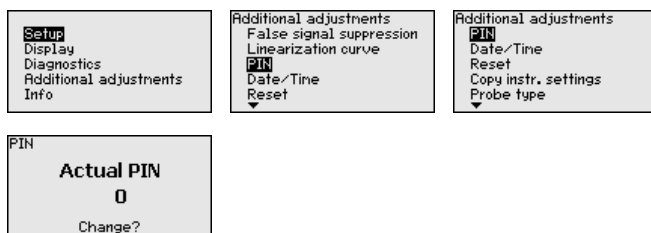
In delivery status, the PIN is "*0000*".

Additional settings - Date/ Time

In this menu item, the internal clock of the sensor is set.
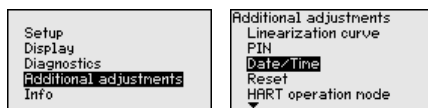
Additional settings - Reset

After a reset, certain parameter adjustments made by the user are reset.

```
Additional adjustments
   PIN
   Date/Time
   Reset
   HART operation mode
   Copy sensor settings
```
```
Reset

   Select
   reset?
```
```
Reset
   Factory settings
   Basic settings
   Setup
   False signal suppression
   Peak val. measurement
```
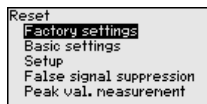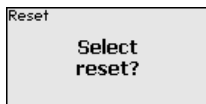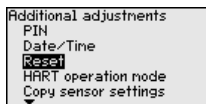
The following reset functions are available:

Delivery status: Restores the parameter settings at the time of shipment from the factory, incl. order-specific settings. Any stored false signal suppression or user-programmed linearisation curve, as well as the measured value memory, are deleted.

Basic settings: Restores the parameter settings, incl. special parameters, to the default values of the respective instrument. Any stored false signal suppression or user-programmed linearisation curve, as well as the measured value memory, are deleted.

Setup: Restores the parameter settings made in the menu item Setup to the default values of the respective instrument. False signal suppression, user-programmed linearisation curve, measured value memory and event memory remain untouched. The linearisation is set to linear.

False signal suppression: Deletes a previously created false signal suppression. The false signal suppression created at the factory remains active.

Peak values, measured value: Resets the measured min. and max. distances to the current measured value.

The following table shows the default values of the instrument. Depending on the instrument version, not all menu items are available or some may be differently assigned:

Menu	Menu item	Default value
Setup	Measurement loop name	Sensor
	Medium	Liquid/Water
		Bulk solids/Crushed stones, gravel
	Application	Storage tank
		Silo
	Vessel form	Vessel bottom, dished form
		Vessel top, dished form
	Vessel height/Measuring range	Recommended measuring range, see "*Technical data*" in the supplement.
	Min. adjustment	Recommended measuring range, see "*Technical data*" in the supplement.
	Max. adjustment	0,000 m(d)
	Damping	0.0 s
	Current output mode	4 … 20 mA, < 3.6 mA
	Current output, min./max.	Min. current 3.8 mA, max. current 20.5 mA
	Lock adjustment	Released

Menu	Menu item	Default value
Display	Language	Like order
	Displayed value	Distance
	Display unit	m
	Scaling size	Volume
		l
	Scaling	0.00 lin %, 0 l
		100.00 lin %, 100 l
	Backlight	Switched on
Additional adjustments	Distance unit	m
	Temperature unit	°C
	Probe length	Length of standpipe ex factory
	Linearisation curve	Linear
	HART mode	Standard
		Address 0

Additional settings - HART mode

The sensor offers the HART modes standard and Multidrop. In this menu item you specify the HART mode and enter the address for Multidrop.
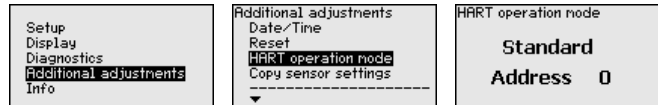
The mode "standard" with the fixed address 0 means outputting the measured value as a 4 … 20 mA signal.

In Multidrop mode, up to 63 sensors can be operated on one two-wire cable. An address between 1 and 63 must be assigned to each sensor.[1]

The default setting is standard with address 0.

Additional settings - Copy instrument settings

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

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

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

● All data of the menu "*Setup*" and "*Display*"
● In the menu "*Additional settings*" the items "*Distance unit, temperature unit and linearization*"
● The values of the user-programmable linearisation curve

---

[1] The 4 … 20 mA signal of the sensor is switched off. The sensor uses a constant current of 4 mA. The measuring signal is transmitted exclusively as a digital HART signal.

VEGAPULS 66 • Two-wire 4 … 20 mA/HART

| Setup
Display
Diagnostics
Additional adjustments
Info | Additional adjustments
Reset
HART operation mode
Copy instr. settings
─────────────
Instrument units | Copy instr. settings

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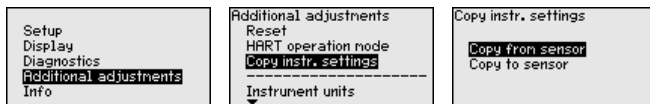
The copied data are permanently saved in an EEPROM memory in the display and adjustment module and remain there even in case of power failure. From there, they can be written into one or more sensors or kept as backup for a possible sensor exchange.

The type and the volume of the copied data depend on the respective sensor.

Note:
Before the data are stored in the sensor, a check is carried out to determine if the data fit the sensor. If the data do not fit, a fault signal is triggered or the function is blocked. When data are being written into the sensor, the display shows which instrument type the data originate from and which TAG-no. this sensor had.

Info - Instrument name In this menu, you read out the instrument name and the instrument serial number:

| Setup
Display
Diagnostics
Additional adjustments
Info | Info
Device name
Instrument version
Date of manufacture
Instrument features |
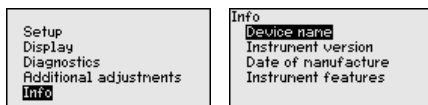
Info - Instrument version In this menu item, the hardware and software version of the sensor is displayed.

| Setup
Display
Diagnostics
Additional adjustments
Info | Info
Device name
Instrument version
Date of manufacture
Instrument features |
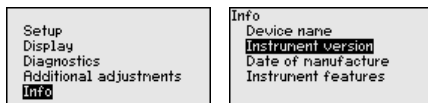
Info - Date of manufacture In this menu item, the date of factory calibration of the sensor as well as the date of the last change of sensor parameters are displayed via the display and adjustment module or via the PC.

| Setup
Display
Diagnostics
Additional adjustments
Info | Info
Device name
Instrument version
Date of manufacture
Instrument features |
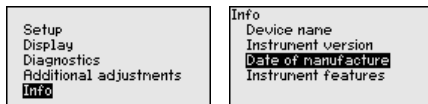
Instrument features In this menu item, the features of the sensor such as approval, process fitting, seal, measuring range, electronics, housing and others are displayed.

| Setup
Display
Diagnostics
Additional adjustments
Info | Info
Device name
Instrument version
Date of manufacture
Instrument features | Instrument features

Display now? |

VEGA
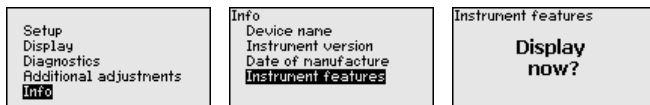
6.5 Saving the parameterisation data

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*".

7 Setup with PACTware

7.1 Connect the PC

Via the interface adapter directly on the sensor
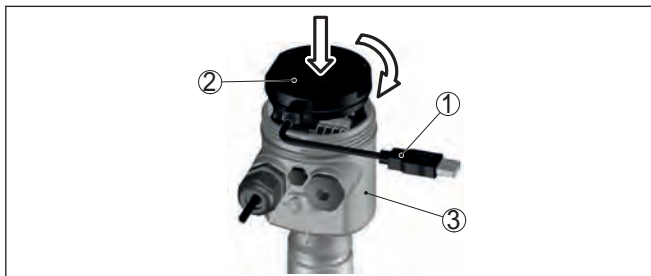
Fig. 31: Connection of the PC directly to the sensor via the interface adapter

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

Via the interface adapter and HART
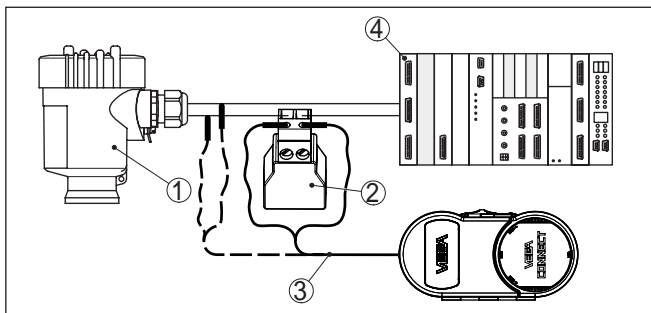
Fig. 32: Connecting the PC via HART to the signal cable

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

● **Note:**
ℹ With power supply units with integrated HART resistance (internal resistance approx. 250 Ω), an additional external resistance is not necessary. This applies, e.g. to the VEGA instruments VEGATRENN 149A, VEGAMET 381, VEGAMET 391. Common Ex separators are also usually equipped with a sufficient current limiting resistance. In such cases, the interface converter can be connected parallel to the 4 … 20 mA cable (dashed line in the previous illustration).

7.2 Parameter adjustment with PACTware

Prerequisites

For parameter adjustment of the instrument via a Windows PC, the configuration software PACTware and a suitable instrument driver

(DTM) according to FDT standard are required. The latest PACTware version as well as all available DTMs are compiled in a DTM Collection. The DTMs can also be integrated into other frame applications according to FDT standard.

Note:
To ensure that all instrument functions are supported, you should always use the latest DTM Collection. Furthermore, not all described functions are included in older firmware versions. You can download the latest instrument software from our homepage. A description of the update procedure is also available in the Internet.

Further setup steps are described in the operating instructions manual "*DTM Collection/PACTware*" attached to each DTM Collection and which can also be downloaded from the Internet. Detailed descriptions are available in the online help of PACTware and the DTMs.
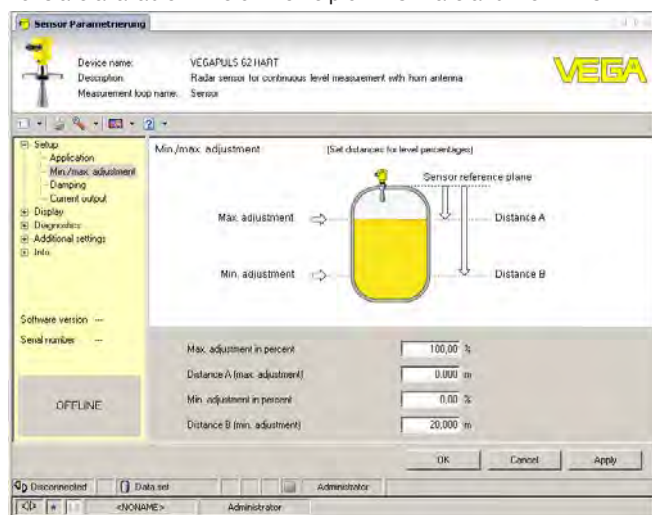
Fig. 33: Example of a DTM view

Standard/Full version

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

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

The standard version is available as a download under www.vega.com/downloads and "*Software*". The full version is available on CD from the agency serving you.

7.3 Saving the parameterisation data

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

8 Set up with other systems

8.1 DD adjustment programs

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

The files can be downloaded at www.vega.com/downloads under "*Software*".

8.2 Field Communicator 375, 475

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

Integrating the EDD into the Field Communicator 375 or 475 requires the "Easy Upgrade Utility" software, which is available from the manufacturer. This software is updated via the Internet and new EDDs are automatically accepted into the device catalogue of this software after they are released by the manufacturer. They can then be transferred to a Field Communicator.

9   Diagnosis, asset management and service

9.1   Maintenance

Maintenance

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

Cleaning

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

Take note of 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

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

- Distance
- Filling height
- Percentage value
- Lin. percent
- Scaled
- Current value
- 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.

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. The memory is divided into two sections:

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

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

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

● PC with PACTware/DTM
● Control system with EDD

9.3 Asset Management function

The instrument features self-monitoring and diagnostics according to NE 107 and VDI/VDE 2650. In addition to the status messages in the following tables there are more detailed error messages available under the menu item "*Diagnostics*" via the display and adjustment module.

Status messages

The status messages are divided into the following categories:

● Failure
● Function check
● Out of specification
● Maintenance requirement

and explained by pictographs:
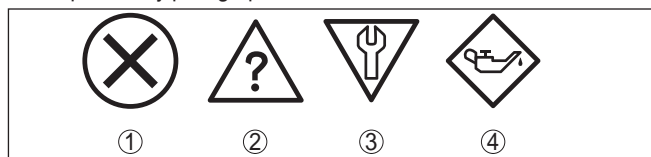
Fig. 34: Pictographs of the status messages

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

Failure: Due to a malfunction in the instrument, a fault message 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.

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

This status message is inactive by default.

Failure

Code Text message	Cause	Rectification	DevSpec State in CMD 48
F013 no measured value available	Sensor does not detect an echo during operation Antenna system dirty or defective	Check or correct installation and/or parameter settings Clean or exchange process component or antenna	Bit 0 of Byte 0 … 5
F017 Adjustment span too small	Adjustment not within specification	Change adjustment according to the limit values (difference between min. and max. ≥ 10 mm)	Bit 1 of Byte 0 … 5
F025 Error in the linearization table	Index markers are not continuously rising, for example illogical value pairs	Check linearisation table Delete table/Create new	Bit 2 of Byte 0 … 5
F036 No operable software	Failed or interrupted software update	Repeat software update Check electronics version Exchanging the electronics Send instrument for repair	Bit 3 of Byte 0 … 5
F040 Error in the electronics	Hardware defect	Exchanging the electronics Send instrument for repair	Bit 4 of Byte 0 … 5
F080 General software error	General software error	Disconnect operating voltage briefly	Bit 5 of Byte 0 … 5
F105 Determine measured value	The instrument is still in the start phase, the measured value could not yet be determined	Wait for the end of the switch-on phase Duration up to approx. 3 minutes depending on the version and parameter settings	Bit 6 of Byte 0 … 5
F113 Communication error	EMC interference	Remove EMC influences	Bit 12 of Byte 0 … 5
F125 Impermissible electronics temperature	Temperature of the electronics in the non-specified range	Check ambient temperature Insulate electronics Use instrument with higher temperature range	Bit 7 of Byte 0 … 5
F260 Error in the calibration	Error in the calibration carried out in the factory Error in the EEPROM	Exchanging the electronics Send instrument for repair	Bit 8 of Byte 0 … 5
F261 Error in the instrument settings	Error during setup False signal suppression faulty Error when carrying out a reset	Repeat setup Carry out a reset	Bit 9 of Byte 0 … 5

Code Text message	Cause	Rectification	DevSpec State in CMD 48
F264 Installation/Setup error	Adjustment not within the vessel height/measuring range Max. measuring range of the instrument not sufficient	Check or correct installation and/or parameter settings Use an instrument with bigger measuring range	Bit 10 of Byte 0 … 5
F265 Measurement function disturbed	Sensor no longer carries out a measurement Operating voltage too low	Check operating voltage Carry out a reset Disconnect operating voltage briefly	Bit 11 of Byte 0 … 5

Function check

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

Out of specification

Code Text message	Cause	Rectification	DevSpec State in CMD 48
S600 Impermissible electronics temperature	Temperature of the electronics in the non-specified range	Check ambient temperature Insulate electronics Use instrument with higher temperature range	Bit 5 of Byte 14 … 24
S601 Overfilling	Danger of vessel overfilling	Make sure that there is no further filling Check level in the vessel	Bit 6 of Byte 14 … 24

Tab. 6: Error codes and text messages, information on causes as well as corrective measures

Maintenance

Code Text message	Cause	Rectification	DevSpec State in CMD 48
M500 Error during the reset "delivery status"	The data could not be restored during the reset to delivery status	Repeat reset Load XML file with sensor data into the sensor	Bit 0 of Byte 14 … 24
M501 Error in the non-active linearisation table	Hardware error EEPROM	Exchanging the electronics Send instrument for repair	Bit 1 of Byte 14 … 24
M502 Error in the diagnostics memory	Hardware error EEPROM	Exchanging the electronics Send instrument for repair	Bit 2 of Byte 14 … 24

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Code Text message	Cause	Rectification	DevSpec State in CMD 48
M503 Measurement reliability too low	The echo/noise ratio is too small for reliable measurement	Check installation and process conditions Clean the antenna Change polarisation direction Use instrument with higher sensitivity	Bit 3 of Byte 14 … 24
M504 Error at a device interface	Hardware defect	Check connections Exchanging the electronics Send instrument for repair	Bit 4 of Byte 14 … 24
M505 No echo available	Level echo can no longer be detected	Clean the antenna Use a more suitable antenna/sensor Remove possible false echoes Optimize sensor position and orientation	Bit 7 of Byte 14 … 24

Tab. 7: Error codes and text messages, information on causes as well as corrective measures

9.4 Rectify faults

Reaction when malfunction occurs

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

Fault rectification

The first measures are:

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

A smartphone/tablet with the VEGA Tools 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.

4 … 20 mA signal

Connect a multimeter in the suitable measuring range according to the wiring plan. The following table describes possible errors in the current signal and helps to eliminate them:

Error	Cause	Rectification
4 … 20 mA signal not stable	Fluctuating measured value	Set damping
4 … 20 mA signal missing	Electrical connection faulty	Check connection, correct, if necessary
	Voltage supply missing	Check cables for breaks; repair if necessary
	Operating voltage too low, load resistance too high	Check, adapt if necessary
Current signal greater than 22 mA, less than 3.6 mA	Sensor electronics defective	Replace device or send in for repair depending on device version

The tables below give typical examples of application-related measurement errors.

The images in column "*Error description*" show the actual level as a dashed line and the output level as a solid line.
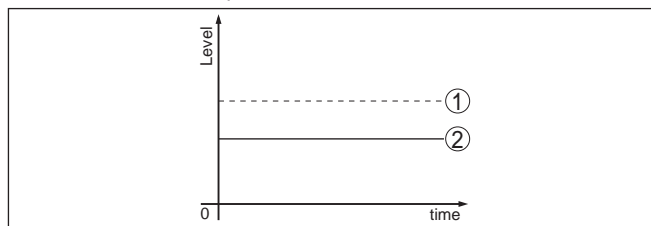
1   *Real level*
2   *Level displayed by the sensor*
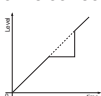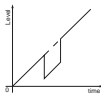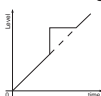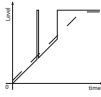
Note:
If the output level is constant, the cause could also be the fault setting of the current output to "*Hold value*".
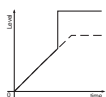
If the level is too low, the reason could be a line resistance that is too high

Measurement error with constant level

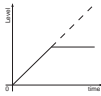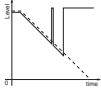| Fault description	Cause	Rectification
Measured value shows a too low or too high level	Min./max. adjustment not correct	Adapt min./max. adjustment
	Incorrect linearisation curve	Adapt linearisation curve
	Installation in a bypass tube or standpipe, hence running time error (small measurement error 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 %	Multiple echo (vessel top, product 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 %	Due to the process, the amplitude of the level echo sinks 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, buildup); false signal suppression no longer matches actual conditions	Determine the reason for the changed false signals, carry out false signal suppression, e.g. condensation.

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Measurement error during filling

Fault description	Cause	Rectification
Measured value remains unchanged during filling	False signals in the close range too big or level echo too small Strong foam or spout generation Max. adjustment not correct	Eliminate false signals in the close range Check measurement situation: Antenna must protrude out of the socket, installations Remove contamination on the antenna In case of interferences due to installations in the close range: Change polarisation direction Create a new false signal suppression Adapt max. adjustment
Measured value remains in the area of the bottom during filling	Echo from the tank bottom larger than the level echo, for example, with products with ε_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	Turbulence on the product surface, quick filling	Check parameters, change if necessary, e.g. in dosing vessel, reactor
Measured value jumps towards 0 % during filling	Amplitude of a multiple echo (vessel top - product surface) is larger than the level echo	Check parameter "Application", especially vessel top, type of medium, dished bottom, high dielectric constant, and adapt if necessary.
	The level echo cannot be distinguished from the false signal at a false signal position (jumps to multiple echo)	In case of interferences due to installations in the close range: Change polarisation direction Chose a more suitable installation position
Measured value jumps towards 100 % during filling	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
Measured value jumps sporadically to 100 % during filling	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.

Fault description	Cause	Rectification
Measured value jumps to ≥ 100 % or 0 m distance	Level echo is no longer detected in the close range due to foam generation or false signals in the close range. The sensor goes into overfill protection mode. The max. level (0 m distance) as well as the status message "Overfilling" are output.	Check measuring site: Antenna must protrude out of the socket Remove contamination on the antenna 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	False signal larger than the level echo Level echo too small	Eliminate false signal in the close range. Check: Antenna must protrude from the socket Remove contamination on the antenna In case of interferences due to installations in the close range: Change polarisation direction 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	Echo from the tank bottom larger than the level echo, for example, with products with ε_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	Varying condensation or contamination on the antenna	Carry out false signal suppression or increase false signal suppression in the close range by editing With bulk solids, use radar sensor with purging air connection

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.

24 hour service hotline Should these measures not be successful, please call in urgent cases the VEGA service hotline under the phone no. **+49 1805 858550**.

The hotline is also available outside normal working hours, seven days a week around the clock.

Since we offer this service worldwide, the support is provided in English. The service itself is free of charge, the only costs involved are the normal call charges.

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9.5   Exchanging the electronics module

If the electronics module is defective, it can be replaced by the user.

In Ex applications, only instruments and electronics modules with appropriate Ex approval may be used.

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

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

● In the factory
● Or on site by the user

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

When loading on site, the order data must first be downloaded from the Internet (see operating instructions "*Electronics module*").

Caution:
All application-specific settings must be entered again. That's why you have to carry out a fresh setup after exchanging the electronics.

If you saved the parameter settings during the first setup of the sensor, you can transfer them to the replacement electronics module. A fresh setup is then not necessary.

9.6   Software update

The device software can be updated in the following ways:

● Interface adapter VEGACONNECT
● HART signal
● Bluetooth

Depending on the method, the following components are required:

● Instrument
● Voltage supply
● Interface adapter VEGACONNECT
● Display and adjustment module PLICSCOM with Bluetooth function
● PC with PACTware/DTM and Bluetooth USB adapter
● 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: www.vega.com.

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.

You can find detailed information in the download area at www.vega.com.

9.7 How to proceed if a repair is necessary

You can find an instrument return form as well as detailed information about the procedure in the download area of our homepage: www.vega.com. By doing this you help us carry out the repair quickly and without having to call back for needed information.

In case of repair, proceed as follows:

● Print and fill out one form per instrument
● Clean the instrument and pack it damage-proof
● Attach the completed form and, if need be, also a safety data sheet outside on the packaging
● Ask the agency serving you to get the address for the return shipment. You can find the agency on our home page www.vega.com.

10 Dismount

10.1 Dismounting steps

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

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

10.2 Disposal

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

WEEE directive
The instrument does not fall in the scope of the EU WEEE directive. Article 2 of this Directive exempts electrical and electronic equipment from this requirement if it is part of another instrument that does not fall in the scope of the Directive. These include stationary industrial plants.

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

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

11 Supplement

11.1 Technical data

Note for approved instruments

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.

General data

316L corresponds to 1.4404 or 1.4435

Materials, wetted parts

– Process fitting	316L, Alloy C22 (2.4602) plated, PP
– Process seal	On site
– Antenna	316L, Alloy C22 (2.4602)
– Antenna impedance cone	PTFE, ceramic (99.7 % AL_2O_3)
– Seal, antenna system	FKM (A+P GLT FPM 70.16-06), FFKM (Kalrez 6375), silicone FEP coated (A+P FEP-O-SEAL), EPDM (A+P 70.10-02), PTFE, graphite (99.9 %) and ceramic

Materials, non-wetted parts

– Plastic housing	Plastic PBT (Polyester)
– Electronics housing	
– Housing	Plastic PBT (polyester), Alu die-casting, powder-coated, 316L
– Cable gland	PA, stainless steel, brass
– Sealing, cable gland	NBR
– Blind plug, cable gland	PA
– Seal between housing and housing lid	Silicone SI 850 R, NBR silicone-free
– Inspection window housing cover	Polycarbonate (UL-746-C listed), glass[2]
– Ground terminal	316L
Conductive connection	Between ground terminal, process fitting and antenna
Process fitting	Flanges DIN from DN 50, ASME from 2"

Weights

– Instrument, depending on housing, process fitting and antenna	approx. 6.3 … 136 kg (13.89 … 299.8 lbs)
– Antenna extension	1.9 kg/m (1.374 lbs/ft)
Length antenna extension max.	5.85 m (19.19 ft)

Torques

Max. torques for NPT cable glands and Conduit tubes

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

[2] Glass with Aluminium and stainless steel precision casting housing

Input variable

Measured variable   The measured quantity is the distance between the
                                     end of the sensor antenna and the product surface. The
                                     reference plane for the measurement is the lower side of
                                     the flange.
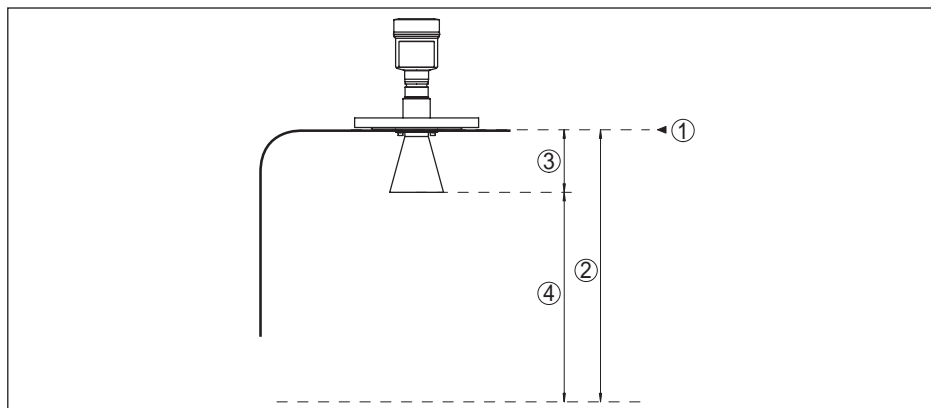
Fig. 35: Data of the input variable

1   Reference plane
2   Measured variable, max. measuring range
3   Antenna length
4   Utilisable measuring range

Max. measuring range   35 m (114.83 ft)

Recommended measuring range

– Antenna ø 75 mm (2.953 in), ø 95 mm   up to 20 m (65.62 ft)
  (3.74 in)

– Antenna ø 145 mm (5.5708 in),   up to 35 m (114.83 ft)
  ø 195 mm (7.577 in), ø 240 mm
  (9.448 in)

Output variable

Output signal   4 … 20 mA/HART

Range of the output signal   3.8 … 20.5 mA/HART (default setting)

Signal resolution   0.3 µA

Resolution, digital   1 mm (0.039 in)

Fault signal, current output (adjustable)   mA-value unchanged 20.5 mA, 22 mA, < 3.6 mA

Max. output current   22 mA

Load   See load resistance under Power supply

Starting current   ≤ 3.6 mA; ≤ 10 mA for 5 ms after switching on

Damping (63 % of the input variable),   0 … 999 s
adjustable

HART output values according to HART 7.0[3)]

– PV (Primary Value)	Distance
– SV (Secondary Value)	Percent
– TV (Third Value)	Lin. percent
– QV (Fourth Value)	Scaled
Fulfilled HART specification	7.0
Further information on Manufacturer ID, Device ID, Device Revision	See website of HART Communication Foundation

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	
– 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
Deviation with liquids	≤ 8 mm (meas. distance > 1.0 m/3.28 ft)
Non-repeatability[4)]	≤ 1 mm
Deviation with bulk solids	The values depend to a great extent on the application. Binding specifications are thus not possible.
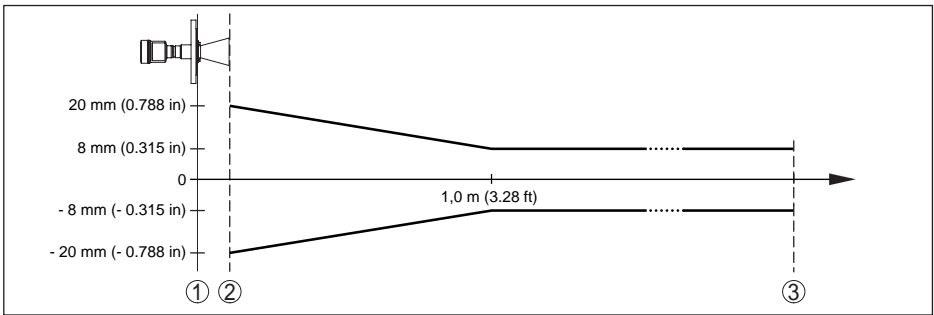
Fig. 36: Deviation under reference conditions

1   Reference plane
2   Antenna edge
3   Recommended measuring range

Variables influencing measurement accuracy

Specifications apply to the digital measured value

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

Specifications apply also to the current output

[3)]   Default values can be assigned individually.
[4)]   Already included in the meas. deviation

Temperature drift - Current output	< 0.03 %/10 K relating to the 16 mA span or ≤ 0.3 %
Deviation in the current output due to digital/analogue conversion	< 15 µA

Additional deviation through electromagnetic interference

– According to NAMUR NE 21	< 80 µA
– According to EN 61326-1	None
– According to IACS E10 (shipbuilding)/ IEC 60945	< 250 µA

Influence of the superimposed gas and pressure on measurement accuracy

The propagation speed of the radar impulses in gas or vapour above the medium is reduced by high pressure. This effect depends on the type of superimposed gas or vapour and is especially large at low temperatures.

The following table shows the resulting deviation for some typical gases and vapours. The specified values refer to the distance. Positive values mean that the measured distance is too large, negative values that the measured distance is too small.

Gas phase	Temperature	Pressure				
		1 bar (14.5 psig)	10 bar (145 psig)	50 bar (725 psig)	100 bar (1450 psig)	200 bar (2900 psig)
Air	20 °C/68 °F	0 %	0.22 %	1.2 %	2.4 %	4.9 %
	200 °C/392 °F	-0.01 %	0.13 %	0.74 %	1.5 %	3 %
	400 °C/752 °F	-0.02 %	0.08 %	0.52 %	1.1 %	2.1 %
Hydrogen	20 °C/68 °F	-0.01 %	0.10 %	0.61 %	1.2 %	2.5 %
	200 °C/392 °F	-0.02 %	0.05 %	0.37 %	0.76 %	1.6 %
	400 °C/752 °F	-0.02 %	0.03 %	0.25 %	0.53 %	1,1 %
Steam (saturated steam)	100 °C/212 °F	0.26 %	-	-	-	-
	180 °C/356 °F	0.17 %	2.1 %	-	-	-
	264 °C/507 °F	0.12 %	1.44 %	9.2 %	-	-
	366 °C/691 °F	0.07 %	1.01 %	5.7 %	13.2 %	76 %

Characteristics and performance data

Measuring frequency	C-band (6 GHz technology)
Measuring cycle time approx.	350 ms
Step response time[5]	≤ 3 s

Beam angle (depending on the antenna system)[6]

– without horn antenna	38°
– ø 75 mm (2.953 in)	38°
– ø 96 mm (3.78 in)	30°
– ø 146 mm (5.748 in)	20°

[5] Time span after a sudden measuring distance change by max. 0.5 m in liquid applications, max 2 m with bulk solids applications, until the output signal has taken for the first time 90 % of the final value (IEC 61298-2).
[6] Outside the specified beam angle, the energy level of the radar signal is 50% (-3 dB) less.

− ø 196 mm (7.717 in)	17°
− ø 242 mm (9.528 in)	14°

Emitted HF power (depending on the parameter setting)[7]

− Average spectral transmission power density	-31 dBm/MHz EIRP
− Max. spectral transmission power density	+24 dBm/50 MHz EIRP
− Specific absorption rate (SAR)	0.47 mW/kg

Ambient conditions

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

Process conditions

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

Seal	Antenna impedance cone	Process temperature (measured on the process fitting)
FKM (A+P GLT FPM 70.16-06)	PFFE	-40 … +150 °C (-40 … +302 °F)
FFKM (Kalrez 6375)	PFFE	-20 … +150 °C (-4 … +302 °F)
Silicone FEP coated (A+P FEP-O-Seal)	PFFE	-40 … +150 °C (-40 … +302 °F)
EPDM (A+P 70.10-02)	PFFE	-40 … +150 °C (-40 … +302 °F)
Graphite	Ceramic	-60 … +250 °C (-76 … +482 °F)
	Ceramic	-60 … +400 °C (-76 … +752 °F)

Vessel pressure relating to the antenna cone

− PTFE	-1 … 40 bar (-100 … 4000 kPa/-14.5 … 580 psi) with PN 40
− Ceramic	-1 … 160 bar (-100 … 16000 kPa/-14.5 … 2321 psi) with PN 160
Vessel pressure relating to the flange nominal pressure stage	see supplementary instructions manual "*Flanges according to DIN-EN-ASME-JIS*"
Vibration resistance	4 g at 5 … 200 Hz according to EN 60068-2-6 (vibration with resonance)
Shock resistance	100 g, 6 ms according to EN 60068-2-27 (mechanical shock)

Data on rinsing air connection

Pressure	max. 6 bar (87.02 psi)

Air volume, depending on pressure (recommended range)

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[7] EIRP: Equivalent Isotropic Radiated Power.

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Pressure	Without reflux valve	With reflux valve
0.1 bar (1.45 psi)	4.2 m³/h	-
0.2 bar (2.9 psi)	-	2.0 m³/h
0.55 bar (7.98 psi)	-	4.2 m³/h
1.2 bar (7.25 psi)	10,2 m³/h	7.2 m³/h

Thread   G¼
Closure
  ‒ with non-Ex   Dust protection cover of PE
  ‒ with Ex   Threaded plug of 316Ti
2 reflux valves - enclosed unassembled (with non-Ex optional, with Ex included in the scope of delivery)
  ‒ Material   316Ti
  ‒ Seal   FKM (A+P GLT FPM 70.16-06), FFKM (Kalrez 6375)
  ‒ for tube diameter   10 mm
  ‒ Opening pressure   0.5 bar (7.252 psi)
  ‒ Nominal pressure stage   PN 250

Electromechanical data - version IP 66/IP 67 and IP 66/IP 68; (0.2 bar)
Options of the cable entry
  ‒ Cable entry   M20 x 1.5; ½ NPT
  ‒ Cable gland   M20 x 1.5; ½ NPT (cable ø see below table)
  ‒ Blind plug   M20 x 1.5; ½ NPT
  ‒ Closing cap   ½ NPT

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

Wire cross-section (spring-loaded terminals)
  ‒ Massive wire, stranded wire   0.2 … 2.5 mm² (AWG 24 … 14)
  ‒ Stranded wire with end sleeve   0.2 … 1.5 mm² (AWG 24 … 16)

Electromechanical data - version IP 66/IP 68 (1 bar)
Options of the cable entry
  ‒ Cable gland with integrated connection cable   M20 x 1.5 (cable: ø 5 … 9 mm)
  ‒ Cable entry   ½ NPT
  ‒ Blind plug   M20 x 1.5; ½ NPT

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Connection cable

–	Wire cross-section	0.5 mm² (AWG 20)
–	Wire resistance	< 0.036 Ω/m
–	Tensile strength	< 1200 N (270 lbf)
–	Standard length	5 m (16.4 ft)
–	Max. length	180 m (590.6 ft)
–	Min. bending radius	25 mm (0.984 in) with 25 °C (77 °F)
–	Diameter	approx. 8 mm (0.315 in)
–	Colour - Non-Ex version	Black
–	Colour - Ex-version	Blue

Interface to the external display and adjustment unit

Data transmission	Digital (I²C-Bus)
Connection cable	Four-wire

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

Integrated clock

Date format	Day.Month.Year
Time format	12 h/24 h
Time zone, 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

Output of the temperature values

–	Indication	Via the display and adjustment module
–	Analogue	Via the current output, the additional current output
–	Digital	Via the digital output signal (depending on the electronics version)

Voltage supply

Operating voltage U_B

–	Non-Ex instrument	9.6 … 35 V DC
–	Ex-ia instrument	9.6 … 30 V DC
–	Ex-d-ia instrument	15 … 35 V DC

VEGAPULS 66 • Two-wire 4 … 20 mA/HART

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Operating voltage U_B with lighting switched on

 − Non-Ex instrument   16 … 35 V DC
 − Ex-ia instrument   16 … 30 V DC
 − Ex-d-ia instrument   No lighting possible (integrated ia barrier)

Reverse voltage protection   Integrated

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

 − for 9.6 V < U_B < 14 V   ≤ 0.7 V_{eff} (16 … 400 Hz)
 − for 18 V < U_B < 36 V   ≤ 1 V_{eff} (16 … 400 Hz)

Permissible residual ripple - Ex-d-ia instrument

 − for 18 V < U_B < 36 V   ≤ 1 V_{eff} (16 … 400 Hz)

Load resistor

 − Calculation $(U_B - U_{min})$/0.022 A
 − Example - Non-Ex instrument with   (24 V - 9.6 V)/0.022 A = 655 Ω
   U_B= 24 V DC

Potential connections and electrical separating measures in the instrument

Electronics   Not non-floating
Reference voltage[8)]   500 V AC
Conductive connection   Between ground terminal and metallic process fitting

---

Overvoltage protection

Highest continuous operating voltage 35 V DC
Max. permissible input current   500 mA
Response voltage   > 500 V
Discharge current   < 10 kA (8/20 µs)

Electrical protective measures

Housing material	Version	Protection acc. to IEC 60529	Protection acc. to NEMA
Plastic	Single chamber	IP 66/IP 67	Type 4X
	Double chamber	IP 66/IP 67	Type 4X
Aluminium	Single chamber	IP 66/IP 68 (0.2 bar) IP 68 (1 bar)	Type 6P -
	Double chamber	IP 66/IP 68 (0.2 bar) IP 68 (1 bar)	Type 6P -
Stainless steel (electro-polished)	Single chamber	IP 66/IP 68 (0.2 bar)	Type 6P
Stainless steel (precision casting)	Single chamber	IP 66/IP 68 (0.2 bar) IP 68 (1 bar)	Type 6P -
	Double chamber	IP 66/IP 68 (0.2 bar) IP 68 (1 bar)	Type 6P -

[8)] Galvanic separation between electronics and metal housing parts

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

Approvals

For devices with approvals, the relevant approval documents must be observed. All approval documents can be downloaded by entering the serial number of your device in the search field on www.vega.com or via the general download area.

11.2 Dimensions

The following dimensional drawings represent only an extract of all possible versions. Detailed dimensional drawings can be downloaded at www.vega.com/downloads under "*Drawings*".

Plastic housing
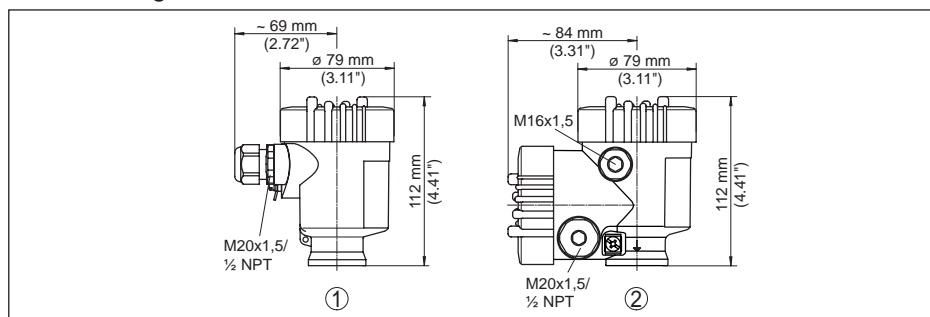
Fig. 37: Housing versions in protection IP 66/IP 67 (with integrated display and adjustment module the housing is 9 mm/0.35 in higher)

1 Plastic single chamber
2 Plastic double chamber

Aluminium housing
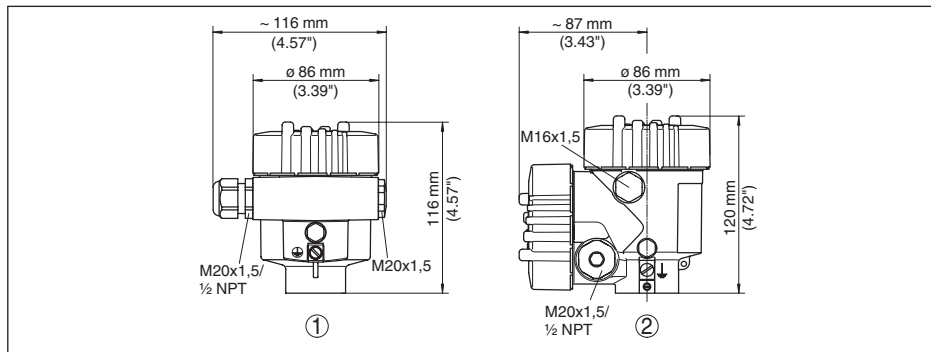
Fig. 38: Housing versions with protection rating IP 66/IP 68 (0.2 bar), (with integrated display and adjustment module the housing is 18 mm/0.71 in higher)

1   Aluminium - single chamber
2   Aluminium - double chamber

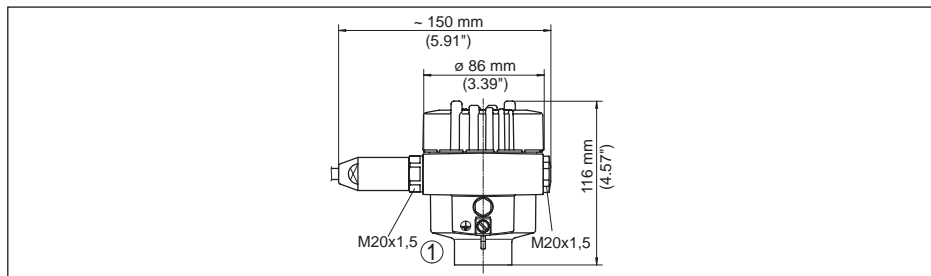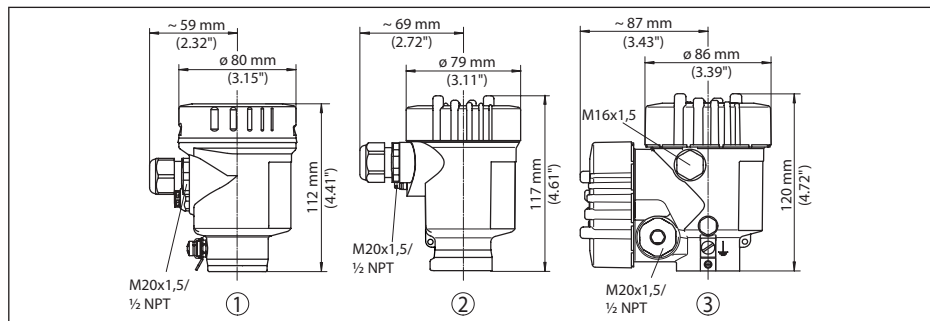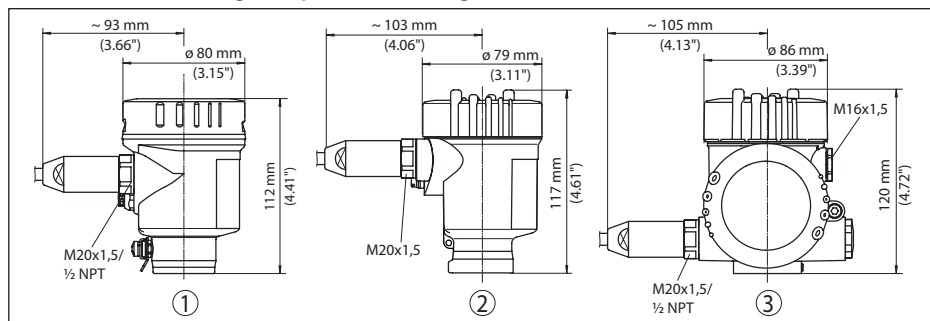**Aluminium housing with protection rating IP 66/IP 68, 1 bar**

Fig. 39: Housing version with protection rating IP 66/IP 68 (1 bar), (with integrated display and adjustment module the housing is 18 mm/0.71 in higher)

1   Aluminium - single chamber

Stainless steel housing

Fig. 40: Housing versions with protection rating IP 66/IP 68 (0.2 bar), (with integrated display and adjustment module the housing is 18 mm/0.71 in higher)

1   *Stainless steel single chamber (electropolished)*
2   *Stainless steel single chamber (precision casting)*
3   *Stainless steel double chamber housing (precision casting)*

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

Fig. 41: Housing version with protection rating IP 66/IP 68 (1 bar), (with integrated display and adjustment module the housing is 18 mm/0.71 in higher)

1   *Stainless steel single chamber (precision casting)*

VEGAPULS 66, standard version

mm	y
DN 50 PN 40	-
DN 80 PN 40	68
DN 100 PN 16	113
DN 150 PN 16	205
DN 200 PN 16	296
DN 250 PN 16	380
2" 150 lb	-
3" 150 lb	68
4" 150 lb	113
6" 150 lb	205
8" 150 lb	296
10 " 150 lb	380

inch	y
DN 50 PN 40	-
DN 80 PN 40	2.68"
DN 100 PN 16	4.45"
DN 150 PN 16	8.07"
DN 200PN 16	11.65"
DN 250 PN 16	14.96"
2" 150 lb	-
3" 150 lb	2.68"
4" 150 lb	4.45"
6" 150 lb	8.07"
8" 150 lb	11.65"
10" 150 lb	14.96"
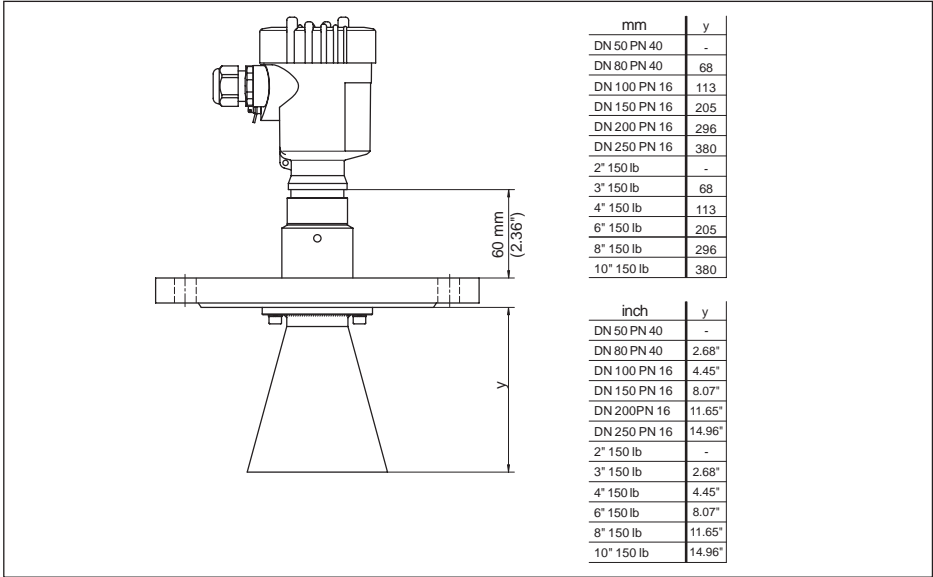
Fig. 42: VEGAPULS 66, standard version

VEGAPULS 66, standard version with rinsing air connection

mm	y
DN 50 PN 40	-
DN 80 PN 40	68
DN 100 PN 16	113
DN 150 PN 16	205
DN 200 PN 16	296
DN 250 PN 16	380
2" 150 lb	-
3" 150 lb	68
4" 150 lb	113
6" 150 lb	205
8" 150 lb	296
10" 150 lb	380

inch	y
DN 50 PN 40	-
DN 80 PN 40	2.68"
DN 100 PN 16	4.45"
DN 150 PN 16	8.07"
DN 200PN 16	11.65"
DN 250 PN 16	14.96"
2" 150 lb	-
3" 150 lb	2.68"
4" 150 lb	4.45"
6" 150 lb	8.07"
8" 150 lb	11.65"
10" 150 lb	14.96"
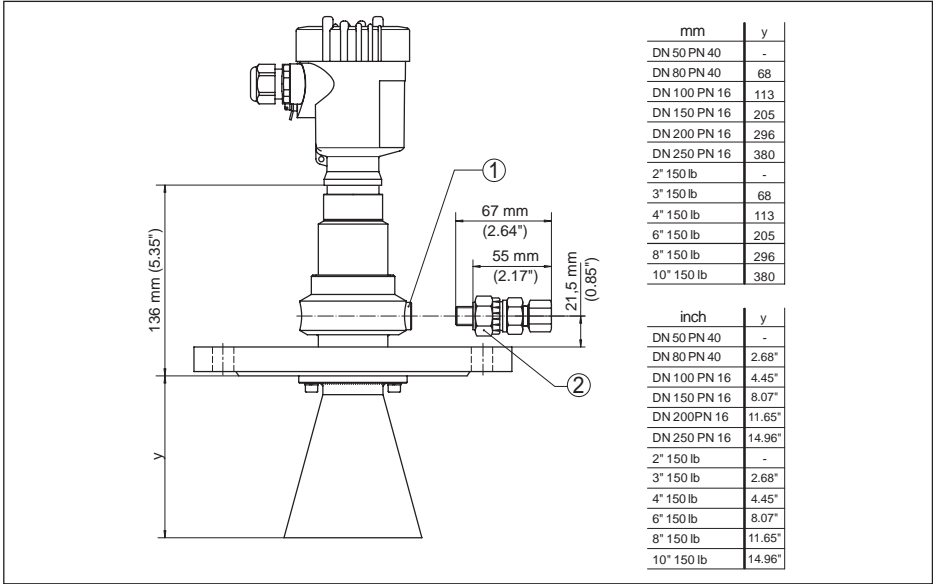
Fig. 43: VEGAPULS 66, standard version with rinsing air connection

1   *Rinsing air connection G¼ for mounting of a suitable adapter*
2   *Reflux valve - enclosed unassembled (with non-Ex optionally available, with Ex in the scope of delivery), for tube diameters 10 mm*

VEGAPULS 66, version with horn antenna
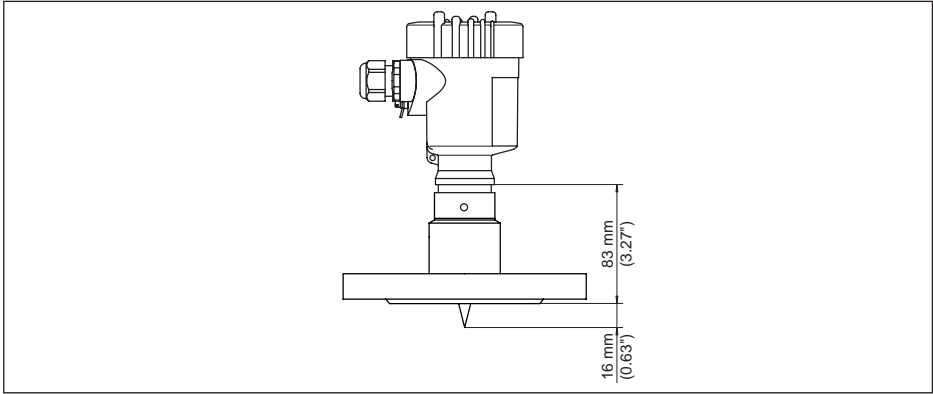
Fig. 44: VEGAPULS 66, version with horn antenna

VEGAPULS 66, high temperature versions
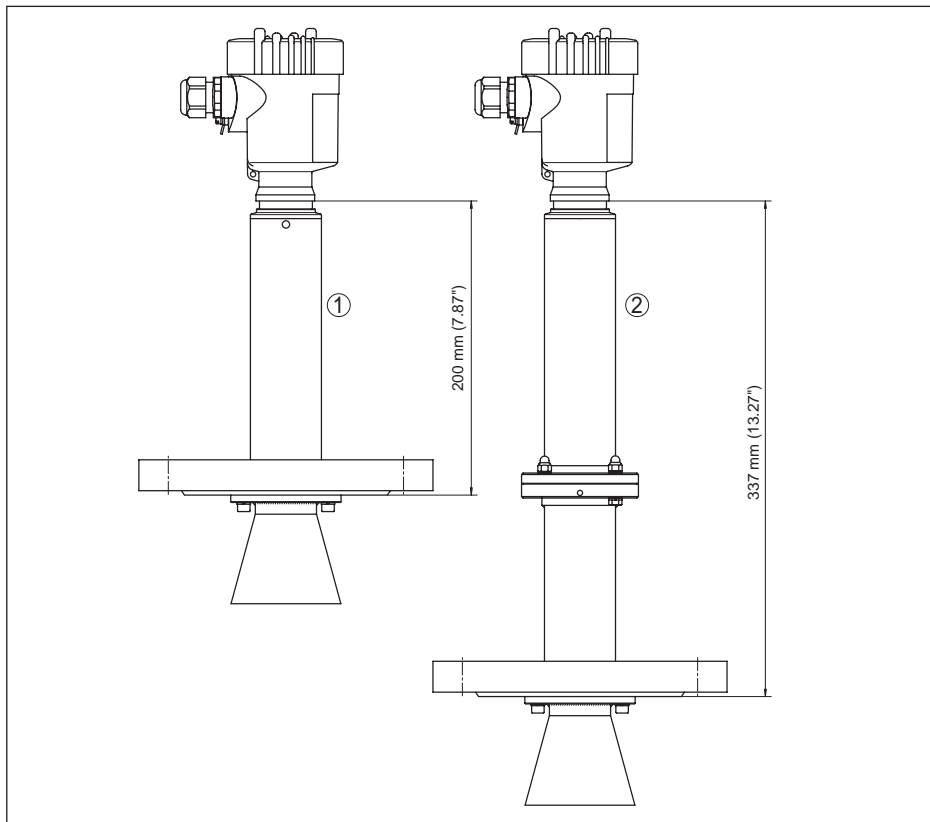
Fig. 45: VEGAPULS 66, high temperature version

1   For process temperatures up to 250 °C (482 °F)
2   For process temperatures up to 400 °C (752 °F)

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11.3   Industrial property rights

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