

## **Appendix H:                    User Manual**

Please refer to the following pages.

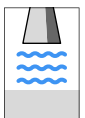
## Operating Instructions

### VEGAPULS 66

4 ... 20 mA/HART two-wire



Document ID:  
36519



Radar

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**Safety instructions for Ex areas**



Please note the Ex-specific safety information for installation and operation in Ex areas. These safety instructions are part of the operating instructions manual and come with the Ex-approved instruments.

# 1 About this document

## 1.1 Function

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

## 1.2 Target group

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

## 1.3 Symbolism used



### Information, tip, note

This symbol indicates helpful additional information.



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

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

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



### Ex applications

This symbol indicates special instructions for Ex applications.



### List

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



### Action

This arrow indicates a single action.



### Sequence

Numbers set in front indicate successive steps in a procedure.

## 2 For your safety

### 2.1 Authorised personnel

All operations described in this operating instructions manual must be carried out only by trained specialist 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 on the application range 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 misuse

Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel overflow or damage to system components through incorrect mounting or adjustment.

### 2.4 General safety instructions

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

During the entire duration of use, the user is obliged to determine the compliance of the required 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.

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

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

## 2.5 CE conformity

The device fulfills the legal requirements of the applicable EC guidelines. By attaching the CE mark, VEGA provides a confirmation of successful testing. You can find the CE conformity declaration in the download area of [www.vega.com](http://www.vega.com).

## 2.6 Fulfillment of NAMUR recommendations

The device fulfills the requirements of the concerned NAMUR recommendation. You can find detailed information in the download section under [www.vega.com](http://www.vega.com).

## 2.7 Radio approval for Europe

The instrument is approved according to EN 302372-2:2006-08 for use in closed vessels.

## 2.8 Radio approval for USA/Canada

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

- this device may not cause harmful interference, and
- this device must accept any interference received, including interference that may cause undesired operation.

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

This device complies with IC RSS-210.

This device is only allowed to operate within closed tanks or containers made of metal, concrete or glass-fiber reinforced plastic.

## 2.9 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:

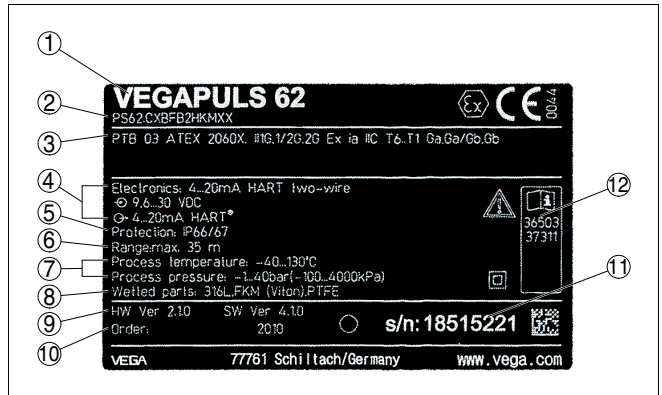


Fig. 1: Structure of the type label (example)

- 1 Instrument type
- 2 Product code
- 3 Approvals
- 4 Electronics
- 5 Protection rating
- 6 Measuring range
- 7 Process temperature, process pressure
- 8 Material, wetted parts
- 9 Hardware and software version
- 10 Order number
- 11 Serial number of the instrument
- 12 ID numbers, instrument documentation

**Serial number**

The serial number on the type label of the instrument allows you to have the order data, operating instructions manuals, sensor data for the service DTM as well as the test certificate (depending on the instrument) displayed via [www.vega.com](http://www.vega.com), "VEGA Tools" and "serial number search".

**Scope of the operating instructions manual**

This operating instructions manual applies to the following instrument versions:

- Hardware from 2.0.1
- Software from 4.1.0

**Scope of delivery**

The scope of delivery encompasses:

- Radar sensor
- Documentation
  - this operating instructions manual
  - Safety Manual (SIL) VEGAPULS 66 (optional)



- Operating instructions manual "*Indicating and adjustment module*" (optional)
- Operating instructions "*Radio module*" (optional)
- Supplementary instructions manual "*Heating for indicating and adjustment module*" (optional)
- Supplementary instructions manual "*Plug connector for continuously measuring sensors*" (optional)
- Ex-specific "*Safety instructions*" (with Ex versions)
- if necessary, further certificates

### 3.2 Principle of operation

#### Application area

A special version of VEGAPULS 66 is available for each area of application. The version with **Horn antenna** is particularly suitable for measurement of liquids and solids under extremely difficult process conditions such as buildup, condensate and foam generation as well as vigorous 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.

#### 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 running 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 according to DIN EN 24180.

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

#### Transport

Transport must be carried out under 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 reported.

#### 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 %

#### Indicating and adjustment module

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

You can find further information in the operating instructions "*Indicating and adjustment module PLICSCOM*" (Document-ID 27835).

#### Interface adapter

The interface adapter VEGACONNECT enables the connection of communication-capable instruments to the USB interface of a PC. For parameter adjustment of these instruments, an adjustment software such as PACTware with VEGA-DTM is required.

You can find further information in the operating instructions "*Interface adapter VEGACONNECT*" (Document-ID 32628).

#### External indicating and adjustment unit

VEGADIS 61 is an external indicating and adjustment unit for sensors with single chamber housing and double chamber housing Ex d.

It is suitable for measured value indication and adjustment of plics® sensors and is connected to the sensor with an up to 50 m long, four-wire, screened standard cable.

You can find further information in the operating instructions "*VEGADIS 61*" (Document-ID 27720).

#### External indicating and adjustment unit with HART protocol

VEGADIS 62 is suitable for measured value indication and adjustment of sensors with HART protocol. It is looped into the 4 ... 20 mA/HART signal cable.

You can find further information in the operating instructions "*VEGADIS 62*" (Document-ID 36469).

#### External radio unit

The PLICSMOBILE T 61 is an external GSM/GPRS radio unit for transmission of measured values and for remote parameter adjustment of plics® sensors. The adjustment is carried out via PACTware/DTM by using the integrated USB connection.

You can find further information in the operating instructions "*PLICSMOBILE T 61*" (Document-ID 32865).

**Protective cover**

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

You will find additional information in the supplementary instructions manual "*Protective cover*" (Document-ID 34296).

**Electronics module**

The electronics module VEGAPULS series 60 is a replacement part for radar sensors of VEGAPULS series 60. A separate 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).

## 4 Mounting

### 4.1 General instructions

#### Screwing in

With instruments with threaded process fitting, suitable tools must be applied for tightening the hexagon.



**Warning:**

The housing must not be used to screw the instrument in! Applying tightening force can damage internal parts of the housing.

#### Moisture

Use the recommended cables (see chapter "*Connecting to power supply*") and tighten the cable gland.

You can give your instrument additional protection against moisture penetration by leading the connection cable downward in front of the cable entry. Rain and condensation water can thus drain off. This applies mainly to outdoor mounting as well as installation in areas where high humidity is expected (e.g. through cleaning processes) or on cooled or heated vessels.

#### Suitability for the process conditions

Make sure that all parts of the instrument exposed to the process, in particular the antenna, seal and process fitting, are suitable for the existing process conditions. These include above all the process pressure, process temperature as well as the chemical properties of the medium.

You can find the specifications in chapter "*Technical data*" or on the type label.

### 4.2 Mounting instructions

#### Polarisation plane

The emitted radar impulses of the radar sensor are electromagnetic waves. The polarisation level 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 plane is marked on the process fitting of the instrument.

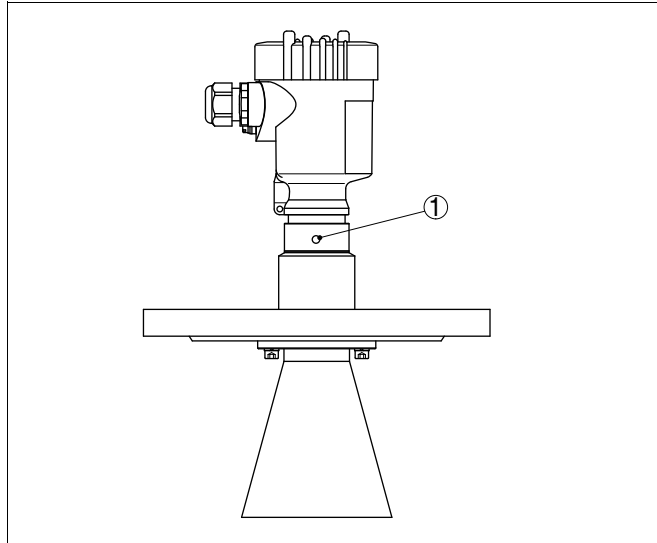


Fig. 2: Position of the polarisation plane of VEGAPULS 66

1 Marking hole

### Mounting 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 keep this distance you should carry out a false echo storage before setup. This applies mainly if buildup on the vessel wall is expected. In this case, we recommend repeating a false echo storage later with existing buildup.

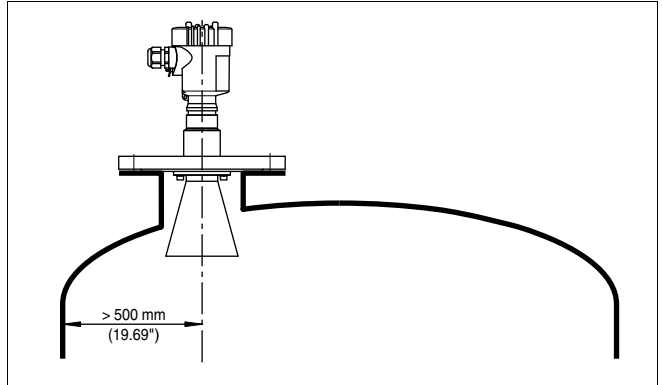


Fig. 3: Mounting on round vessel tops

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

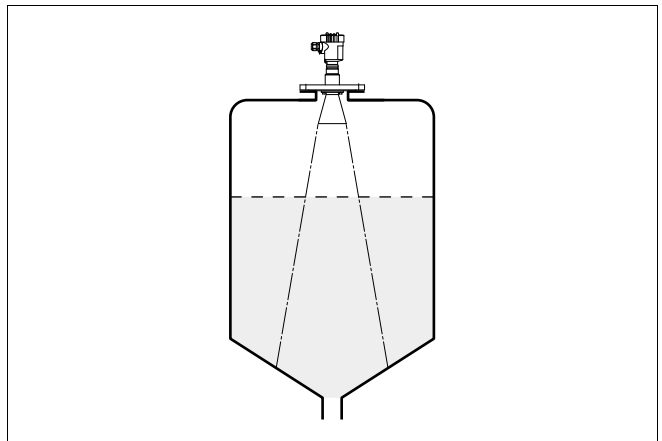


Fig. 4: Vessel with conical bottom

**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.

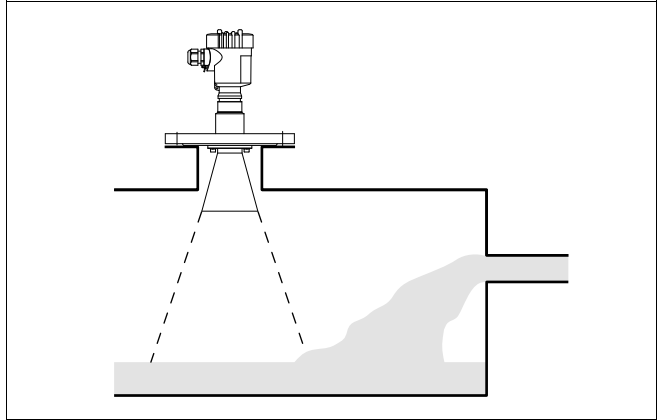


Fig. 5: Mounting of the radar sensor with inflowing medium

### 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.

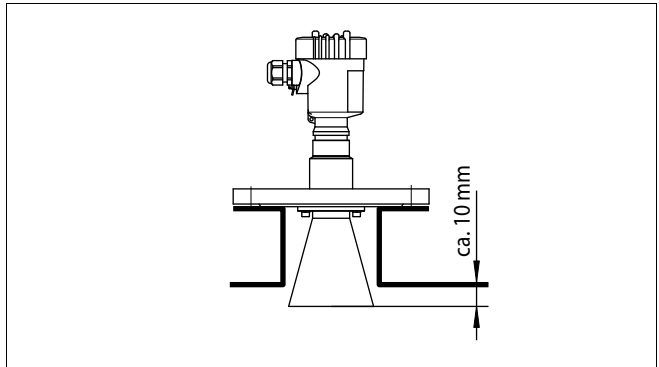


Fig. 6: Recommended socket mounting

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

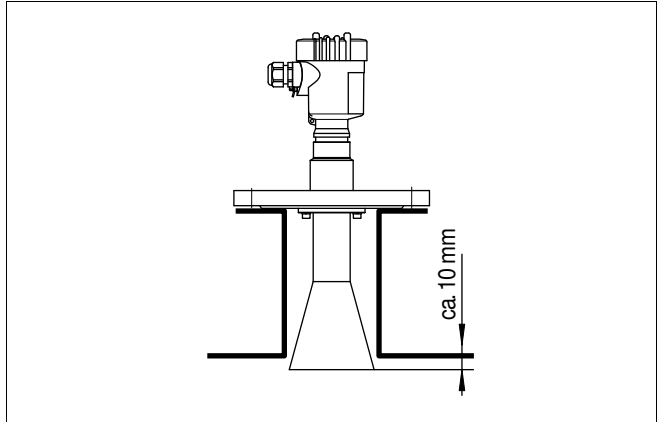


Fig. 7: Tube extension



**Tip:**

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

**Orientation of the sensor**

Align the sensor in liquids as vertical as possible to the product surface to achieve optimum measurement.

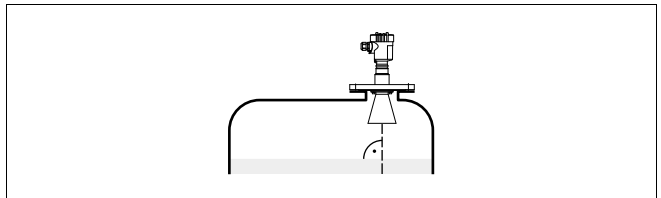


Fig. 8: Alignment in liquids

**Vessel installations**

The mounting location of the radar sensor should be a place where no other equipment or fixtures cross the path of the microwave 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 site that the radar sensor has a "clear view" to the measured product.

In case of existing vessel installations, a false echo storage 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.

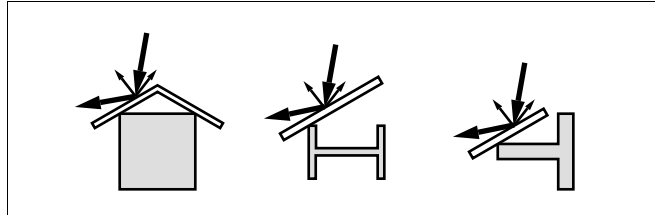


Fig. 9: Cover smooth profiles with deflectors

### Agitators

If there are agitators in the vessel, a false echo storage 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.

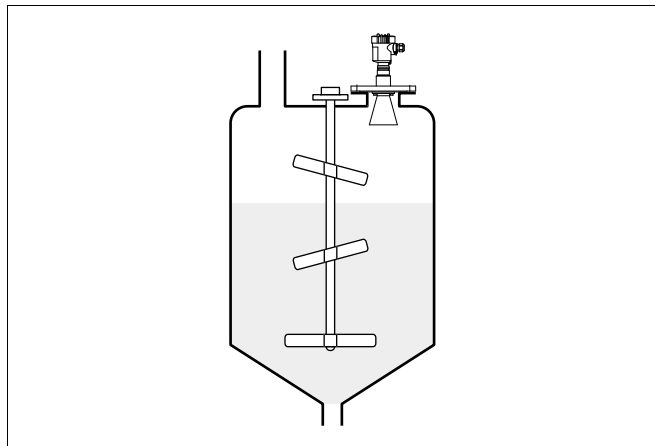


Fig. 10: Agitators

### 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 foams are causing measurement errors, the biggest 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.

**Measurement in a surge pipe**

When using a surge pipe in a vessel, influences from vessel installations and turbulences can be excluded. Under these prerequisites, the measurement of products with low dielectric values ( $\epsilon_r$  value  $\geq 1.6$ ) is possible. In very adhesive products, measurement in a surge pipe is not recommended.

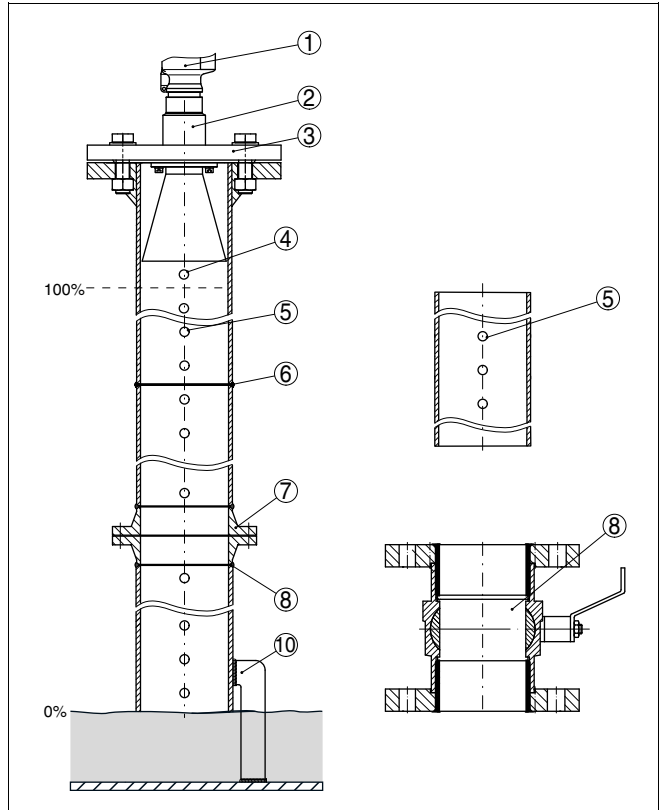


Fig. 11: Configuration surge pipe

- 1 Radar sensor
- 2 Marking of the polarisation direction
- 3 Thread or flange on the instrument
- 4 Vent hole
- 5 Holes
- 6 Weld joint
- 7 Welding neck flange
- 8 Ball valve with complete opening
- 9 Fastening of the surge pipe

**Instructions for orientation:**

- Note marking of the polarisation plane on the sensor

- With threaded fitting, the marking is on the hexagon, with flange connection between the two flange holes
- All holes in the surge pipe must be in one plane with this marking

#### 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
- The tube diameter must be at least DN 40 or 1½" with antenna size 40 mm (1½")
- For the parameter adjustment, select "*Application standpipe*" and enter the tube diameter to compensate errors due to running time shift
- A false signal suppression with integrated sensor is recommended but not mandatory
- The measurement through a ball valve with complete run is possible

#### Constructional requirements on the surge pipe:

- Material metal, smoother inner tube
- 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 level
- In case of a extension with a welding neck flange or pipe collar as well as when a ball valve is used, the inner surfaces should be aligned and accurately joined together
- Gap size with junctions  $\leq 0.1$  mm
- 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
- Surge pipes must extend all the way down to the requested min. level, as measurement is only possible within the tube.
- Diameter of holes  $\leq 5$  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

#### Measurement in the by-pass

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

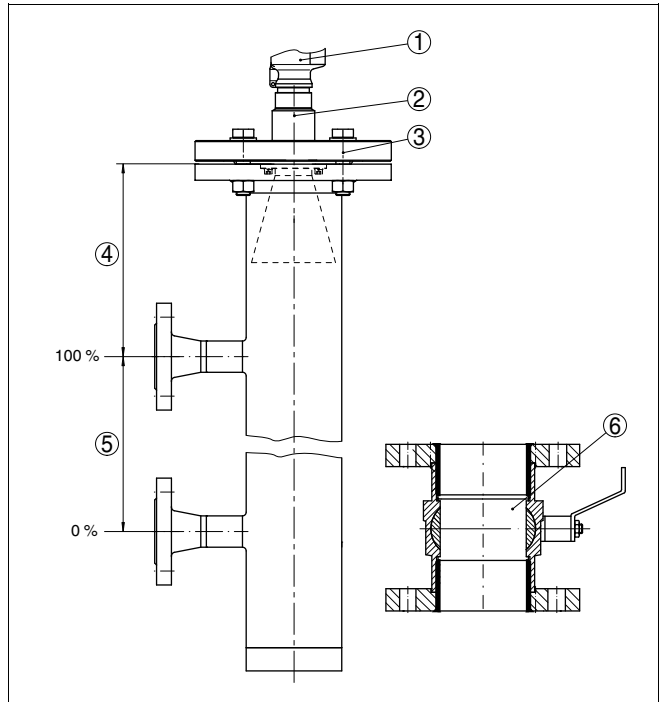


Fig. 12: Configuration bypass

- 1 Radar sensor
- 2 Marking of the polarisation direction
- 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 for orientation:**

- Note marking of the polarisation plane on the sensor
- With threaded fitting, the marking is on the hexagon, with flange connection between the two flange holes
- The pipe connections to the vessel must be in one plane with this marking

**Instructions for the measurement:**

- The 100 % point must not be above the upper tube connection to the vessel
- The 0 % point must not be below the lower tube connection to the vessel
- Min. distance sensor reference plane to the upper edge upper tube connection > 300 mm
- The tube diameter must be at least DN 40 or 1½" with antenna size 40 mm (1½")

- For the parameter adjustment, select "*Application standpipe*" and enter the tube diameter to compensate errors due to running time shift
- A false signal suppression with integrated sensor is recommended but not mandatory
- The measurement through a ball valve with complete run is possible

#### Constructional requirements on the bypass pipe:

- Material metal, smoother inner tube
- 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 level
- Gap size with junctions  $\leq 0.1$  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

#### 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. This distance piece is used for thermal decoupling of the electronics against high process temperatures.



#### Information:

The distance piece must only be incorporated up to max. 50 mm in the vessel installation. Only then, a reliable temperature decoupling is guaranteed.

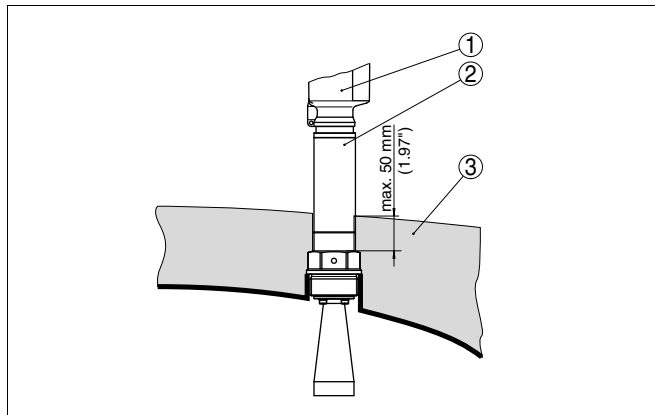


Fig. 13: Mounting of the instrument with insulated vessels.

- 1 Electronics housing
- 2 Distance piece
- 3 Vessel insulation



## 5 Connecting to power supply

### 5.1 Preparing the connection

#### Safety instructions

Always keep in mind the following safety instructions:

- Connect only in the complete absence of line voltage
- If overvoltages are expected, install overvoltage arresters

#### Voltage supply

Power supply and current signal are carried on the same two-wire cable. The voltage supply range 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 VDE 0106 part 101.

Keep in mind the following additional influences on the operating voltage:

- Output voltage of the power supply unit can be lower under nominal load (with a sensor current of 20.5 mA or 22 mA in case of fault message)
- Influence of additional instruments in the circuit (see load values in chapter "*Technical data*")

#### Connection to signal conditioning instruments

The signal conditioning instruments VEGAMET and VEGASCAN have digital sensor recognition. When connecting VEGAPULS 66, an up-to-date software version of the signal conditioning instrument is required for the signal conditioning instrument. For a software update go to "Software" under "[www.vega.com/downloads](http://www.vega.com/downloads)".

#### Connection cable

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

Use cable with round cross-section. A cable outer diameter of 5 ... 9 mm (0.2 ... 0.35 in) ensures the seal effect of the cable gland. If you are using cable with a different diameter or cross-section, exchange the seal or use a suitable cable gland.

We generally recommend the use of screened cable for HART multidrop mode.

#### Cable gland ½ NPT

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

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

## Cable screening and grounding

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

If potential equalisation currents are expected, the connection on the processing side must be made via a ceramic capacitor (e. g. 1 nF, 1500 V). The low frequency potential equalisation currents are thus suppressed, but the protective effect against high frequency interference signals remains.



### Warning:

Within galvanic plants as well as vessels with cathodic corrosion protection there are considerable potential differences. Considerably equalisation currents can be caused via the cable screen when the screen is earthed on both ends. To avoid this, the cable screen must only be connected to ground potential on one side of the switching cabinet in such applications. The cable screen must **not** be connected to the internal ground terminal in the sensor and the outer ground terminal on the housing **not** to the potential equalisation!



### Information:

The metal parts of the instrument (antenna, transmitter, concentric tube, etc.) are conductive connected with the inner and outer ground terminal on the housing. This connection exists either directly metallic or with instruments with external electronics via the screen of the special connection cable. You can find specifications to the potential connections within the instrument in chapter "*Technical data*".

## 5.2 Connection

### Connection technology

The connection of the voltage supply and the signal output is carried out via the spring-loaded terminals in the housing.

The connection to the indicating and adjustment module or to the interface adapter is carried out via contact pins in the housing.

### Connection procedure

Proceed as follows:

- 1 Unscrew the housing cover
- 2 If an indicating and adjustment module is installed, remove it by turning it slightly to the left.
- 3 Loosen compression nut of the cable entry
- 4 Remove approx. 10 cm (4 in) of the cable mantle, strip approx. 1 cm (0.4 in) of insulation from the ends of the individual wires



- 5 Insert the cable into the sensor through the cable entry



Fig. 14: Connection steps 5 and 6

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



**Information:**

Solid cores as well as flexible cores with cable end sleeves are inserted directly into the terminal openings. In case of flexible cores without end sleeves, press the terminal head with a small screwdriver; the terminal opening is freed. When the screwdriver is released, the terminal closes again.

- 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 outer ground terminal to potential equalisation
- 9 Tighten the compression nut of the cable entry. The seal ring must completely encircle the cable
- 10 Screw the housing cover on

The electrical connection is finished.



**Information:**

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

### 5.3 Wiring plan, single chamber housing



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

#### Electronics and connection compartment

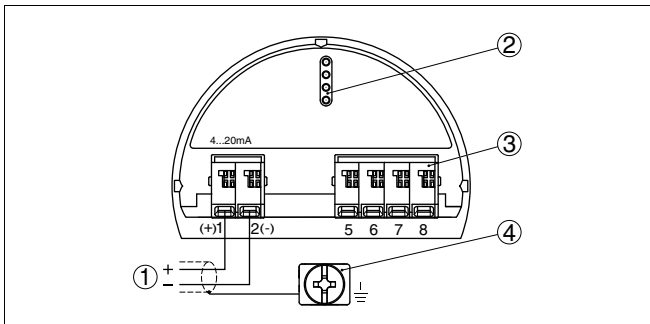


Fig. 15: Electronics and connection compartment with single chamber housing

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

### 5.4 Wiring plan, double chamber housing



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

#### Electronics compartment

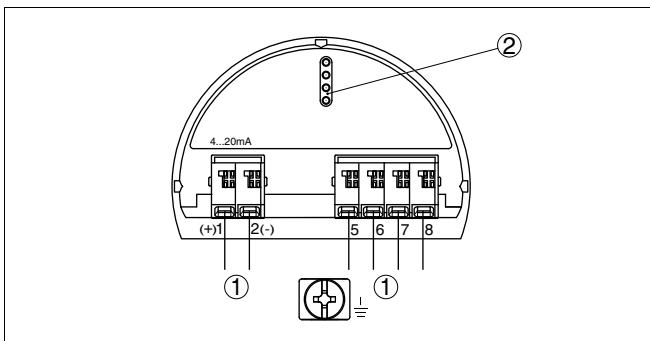


Fig. 16: Electronics compartment, double chamber housing

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

**Information:**

The connection of an external indicating and adjustment unit is not possible with this double chamber housing.

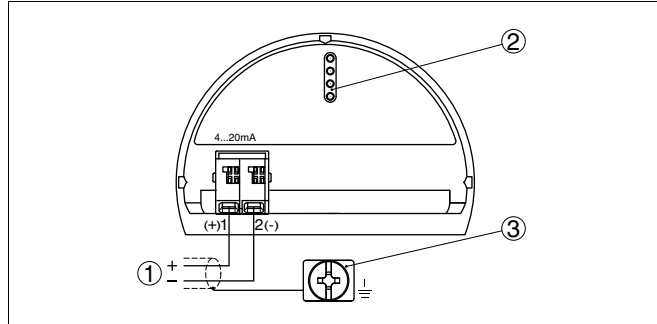
**Connection compartment**

Fig. 17: Connection compartment, double chamber housing

- 1 Voltage supply/Signal output
- 2 For indicating and adjustment module or interface adapter
- 3 Ground terminal for connection of the cable screen

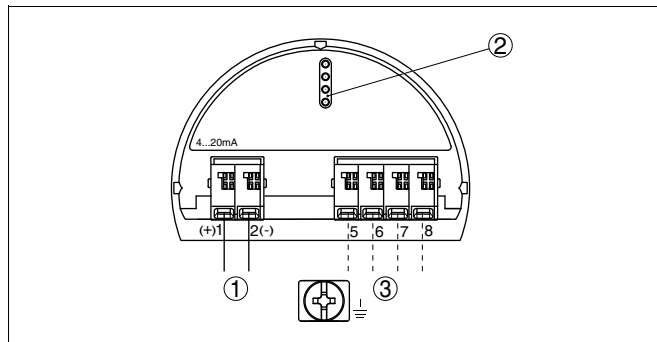
**5.5 Wiring plan with double chamber housing Ex d****Electronics compartment**

Fig. 18: Electronics compartment, double chamber housing

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

**Connection compartment**

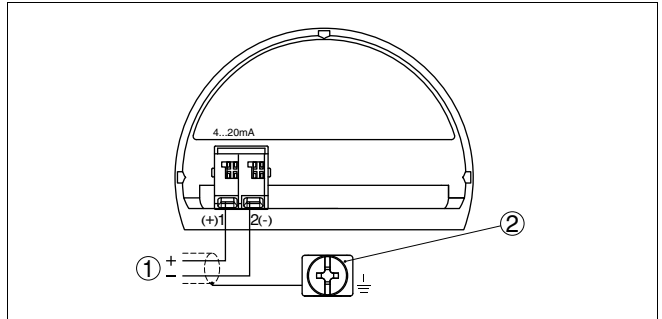


Fig. 19: Connection compartment double chamber housing Ex d

- 1 Voltage supply/Signal output
- 2 Ground terminal for connection of the cable screen

**5.6 Wiring plan - version IP 66/IP 68, 1 bar**

**Wire assignment connection cable**

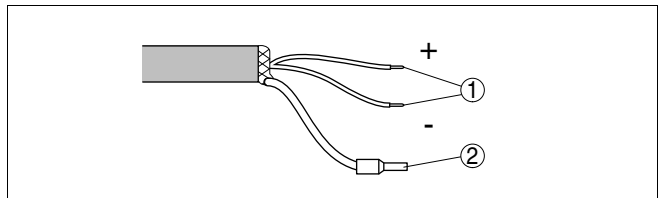


Fig. 20: Wire assignment fix connected connection cable

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

**5.7 Switch on phase**

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

- Internal check of the electronics
- Indication of the instrument type, the software version as well as the measurement loop name
- Output signal jumps to the adjusted error current until a plausible measured value is found

Then the corresponding current is outputted to the signal cable. The value corresponds to the actual level as well as the settings already carried out, e.g. factory setting.

## 6 Set up with the indicating and adjustment module

### 6.1 Insert indicating and adjustment module

#### Mount/Dismount indicating and adjustment module

The indicating and adjustment module can be inserted into the sensor and removed again at any time. It is not necessary to interrupt the power supply.

Proceed as follows:

- 1 Unscrew the housing cover
- 2 Place the indicating and adjustment module in the desired position on the electronics (you can choose any one of four different positions - each displaced by 90°)
- 3 Press the indicating and adjustment module onto the electronics and turn it to the right until it snaps in.
- 4 Screw housing cover with inspection window tightly back on

Removal is carried out in reverse order.

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

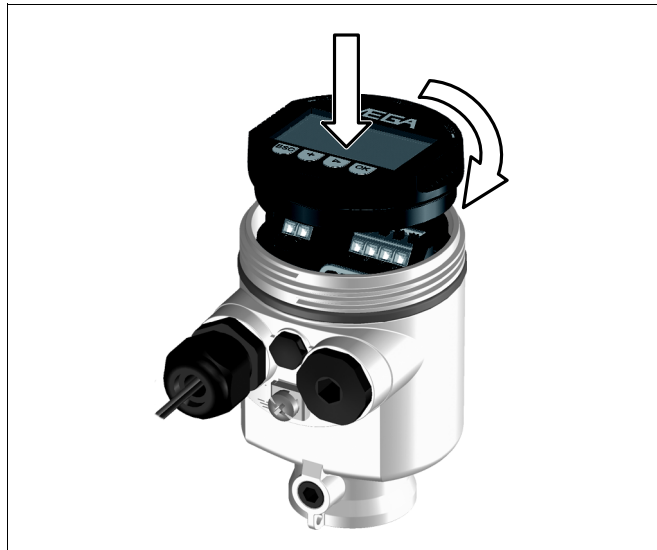


Fig. 21: Insert indicating and adjustment module



#### Note:

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

## 6.2 Adjustment system

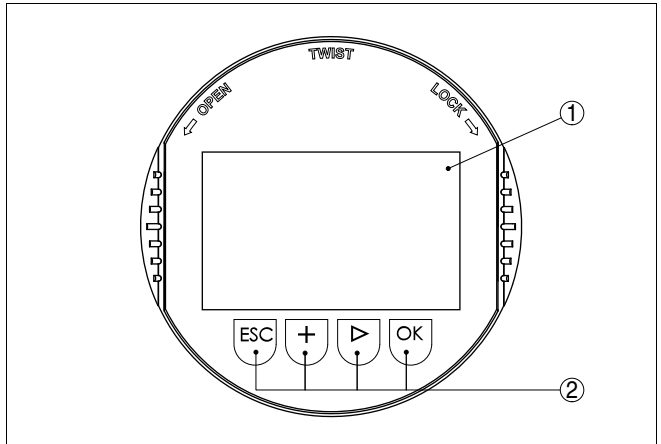


Fig. 22: Indicating and adjustment elements

- 1 LC display
- 2 Adjustment keys

### Key functions

- **[OK]** key:
  - Move to the menu overview
  - Confirm selected menu
  - Edit parameter
  - Save value
- **[->]** key:
  - Presentation change measured value
  - Select list entry
  - Select editing position
- **[+]** key:
  - Change value of the parameter
- **[ESC]** key:
  - interrupt input
  - Jump to next higher menu

### Adjustment system

The sensor is adjusted via the four keys of the indicating and adjustment module. The LC display indicates the individual menu items. The functions of the individual keys are shown in the above illustration. Approx. 10 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 Parameter adjustment

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

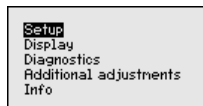


#### Information:

In this operating instructions manual, the instrument-specific parameters are described. Further general parameters are described in the operating instructions manual "*Indicating and adjustment module*".

#### Main menu

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



**Setup:** Settings, for example, to measurement loop name, medium, application, vessel, adjustment, signal output

**Display:** Language setting, settings for the measured value indication as well as lighting

**Diagnostics:** Information, for example to the instrument status, pointer, reliability, simulation, echo curve

**Further settings:** Unit, false signal suppression, linearisation curve, reset, date/time, reset, HART mode

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

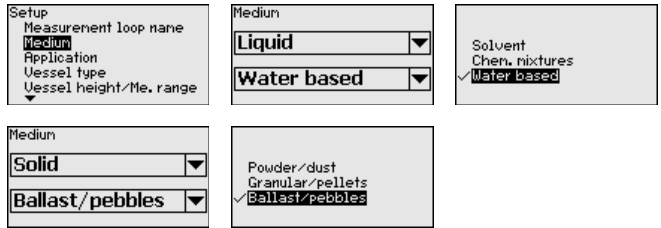
In the main menu point "*Setup*", the individual submenu points should be selected subsequently and provided with the correct parameters to ensure the optimum adjustment of the measurement. The procedure is described in the following.

#### Setup Setup

#### Setup/Medium

Each medium has different reflection properties. With liquids, further interfering factors are fluctuation product surface and foam generation. With bulk solids, these are dust generation, material cone and additional 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.



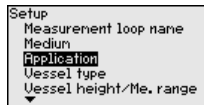
Through this selection, the sensor is adapted perfectly to the product and measurement reliability, particularly in products with poor reflective properties, is considerably increased.

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.

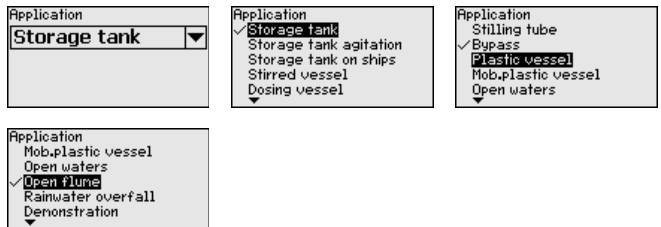
**Setup/Application**

In addition to the medium, also the application or the application place 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".



The following options are available when "Liquid" was selected:



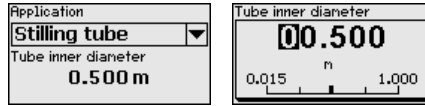
**Caution:**

If in the vessel, there is a separation of liquids with different  $\epsilon_r$  value, for example by condensation, the radar sensor can detect under certain circumstances only the medium with the higher dielectric value. Keep in mind that interfaces can cause faulty measurements.

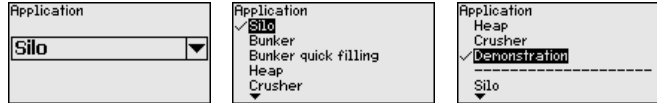
If you want to measure the total height of both liquids reliably, please contact our service department or use an instrument specially designed for interface measurement.



The selection "Standpipe" opens a new window in which the inner diameter of the applied standpipe is entered.



The following options are available when "Bulk solid" is selected:



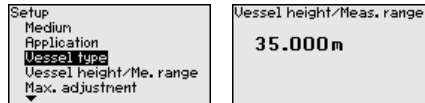
Through this selection, the sensor is adapted optimally to the application or the location and measurement reliability under the various basic conditions is increased considerably.

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**

With this selection, the operating range of the sensor is adapted to the vessel height and the reliability with different frame conditions is increased considerably.

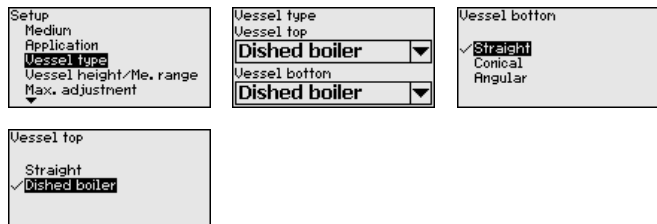
Independent from this, the min. adjustment must be carried out.



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 form**

Also the vessel form can influence the measurement apart from the medium and the application. To adapt the sensor to these measurement conditions, this menu item offers you different options for vessel bottom and ceiling in case of 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/Adjustment**

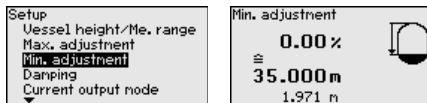
As a radar sensor is a distance measuring instrument, the distance from the sensor to the product surface is measured. To have the real product level displayed, an allocation of the measured distance to the percentage height must be made. To carry out this adjustment, the distance is entered with full and empty vessel. If these values are not known, an adjustment with the distance values, e.g. 10 % and 90 % is also possible. Starting point for these distance specifications is always the seal surface of the thread or flange. By means of these settings, the real level is calculated.

The real 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.

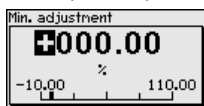
**Setup/Min. adjustment**

Proceed as follows:

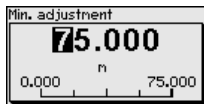
- 1 Select the menu item "Setup" with **[->]** and confirm with **[OK]**. Now select with **[->]** the menu item "Min. adjustment" and confirm with **[OK]**.



- 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.

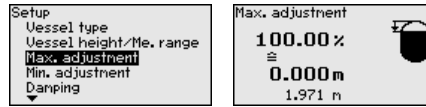


- 4 Enter the suitable distance value in m for the empty vessel (e.g. distance from the sensor to the vessel bottom) corresponding to the percentage value.
- 5 Save settings with **[OK]** and move with **[ESC]** and **[->]** to the max. adjustment.

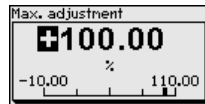
**Setup/Max. adjustment**

Proceed as follows:

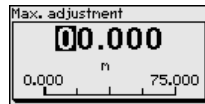
- 1 Select with **[->]** the menu item max. adjustment and confirm with **[OK]**.



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



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



- 4 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]**

**Further settings**

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

- High sockets
- Vessel installations such as struts
- Agitators
- Buildup or welded joints on vessel walls

**Note:**

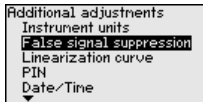
A false signal suppression detects, marks and saves these false signals so that they are no longer taken into account for level measurement.

This should be done with a low level so that possible interfering reflections can be detected.

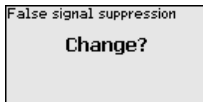
Proceed as follows:

- 1 Select the menu item "Additional settings" with **[->]** and confirm with **[OK]**. With **[->]** you have to select the menu item "False signal suppression" and confirm with **[OK]**.

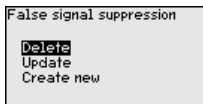
**Further settings/False signal suppression**



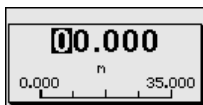
2 Confirm again with **[OK]**.



3 Confirm again with **[OK]** and select with **[->]** "Create new".



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



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

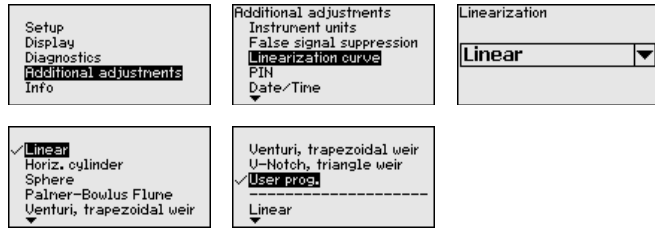


**Note:**

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

**Further settings/Linearization curve**

A linearization is necessary for all vessels in which the vessel volume does not increase linearly with the level - e.g. in 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.



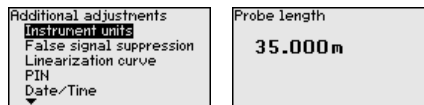
### Caution:

If the instrument is used as part of an overflow protection system according to WHG (Water Resources Act), please note the following:

If a linearisation curve is selected, the measuring signal is no longer compulsorily linear proportional to the level. This must be taken into consideration by the user, particularly when adjusting the switching point on the level switch.

### Additional settings/Sensor length

With radar sensors with standpipe antenna, the sensor length is already preset in this menu item. When shortening the standpipe antenna afterwards, this value must be corrected respectively.



### Additional settings - Reset

With a reset, all settings despite a few exceptions will be reset. The exceptions are: PIN, language, lighting, SIL and HART mode.



The following reset functions are available:

**Delivery status:** Restoring the parameter settings at the time of shipment from the factory incl. the order-specific settings. A created false signal suppression, user-programmable linearization curve as well as the measured value memory will be deleted.

**Basic settings:** Resetting the parameter settings incl. special and laboratory parameters to the default values of the respective instrument. A created false signal suppression, user programmable linearization curve as well as the measured value memory will be deleted.

**Setup:** Resetting of the parameter settings to the default values of the respective instrument in the menu item Setup. Order-related settings remain but are not taken over into the current parameters. User-generated false signal suppression, user-programmed linearization curve, measured value memory as well as event memory remain untouched. The linearization is set to linear.

**False signal suppression:** Deleting a previously created false signal suppression. The false signal suppression created in the factory remains active.

**Peak values distance:** Resetting the measured min. and max. distances to the actual measured value.

The following table shows the default values of the instrument. Depending on the instrument version, not all menu items are available or 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 boiler end Vessel top, dished boiler end
	Vessel height/ Measuring range	Recommended measuring range, see " <i>Technical data</i> " in the supplement
	Min. adjustment	Recommended measuring range, see " <i>Technical data</i> " 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 operation	Released
Display	Language	According to order
	Displayed value	Distance
	Display unit	m
	Scaling size	Volume l

Menu	Menu item	Default value
	Scaling	0.00 lin %, 0 l 100.00 lin %, 100 l
	Lighting	Switched off
Further settings	Distance unit	m
	Temperature unit	°C
	Probe length	Length of the standpipe Ex factory
	Linearisation curve	linear
	HART mode	Standard Address 0

## 6.4 Saving the parameter adjustment data

It is recommended noting the adjusted data, e.g. in this operating instructions manual and archive them afterwards. They are hence available for multiple use or service purposes.

If the instrument is equipped with an indicating and adjustment module, the data in the sensor can be saved in the indicating and adjustment module. The procedure is described in the operating instructions manual "*Indicating and adjustment module*" in the menu item "*Copy sensor data*". The data remain there permanently even if the sensor power supply fails.

The following data or settings for adjustment of the indicating 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 linearization curve

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

## 7 Setup with PACTware

### 7.1 Connecting the PC

Via the interface adapter directly on the sensor



Fig. 23: Connection of the PC directly to the sensor via the interface adapter

- 1 USB cable to the PC
- 2 Interface adapter VEGACONNECT 4
- 3 Sensor



**Information:**

The interface adapter VEGACONNECT 3 or additional previous versions are not suitable for connection to the sensor.



### Via the interface adapter and HART

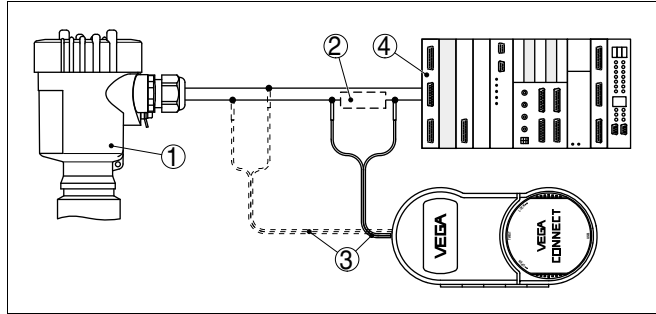


Fig. 24: Connecting the PC via HART to the signal cable

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



#### Note:

With power supply units with integrated HART resistance (internal resistance approx. 250  $\Omega$ ), 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 limitation resistance. In such cases, the interface converter can be connected parallel to the 4 ... 20 mA cable (in the previous illustration dashed).

## 7.2 Parameter adjustment with PACTware

### Prerequisites

As an alternative to the indicating and adjustment module, the sensor can also be configured via a Windows PC. For this purpose, the configuration software PACTware and a suitable instrument driver (DTM) according to the FDT standard are required. The actual PACTware version as well as all available DTMs are compiled in a DTM Collection. Furthermore the DTMs can be integrated in other frame applications according to the 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. The latest instrument software can be also downloaded 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.

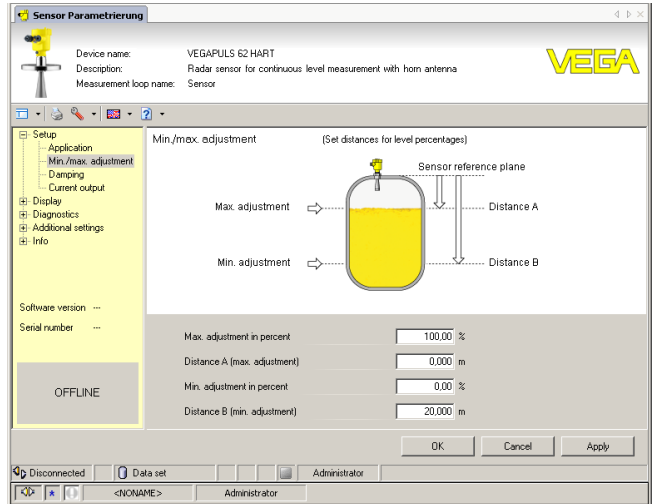


Fig. 25: Example of a DTM view

**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 free-of-charge download under <http://www.vega.com>. The full version is available on CD from the agency serving you.

**7.3 Saving the parameter adjustment data**

We recommend documenting or saving the parameter adjustment data via PACTware. That way they 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.

A free-of-charge download of these files is available via Internet. Move via [www.vega.com](http://www.vega.com) and "Downloads" to "Software".

### 8.2 Communicator 375, 475

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

A free-of-charge download of these files is available via Internet. Move via [www.vega.com](http://www.vega.com) and "Downloads" to "Software".

## 9 Diagnosis, fault rectification and service

### 9.1 Maintenance

When the device is used correctly, no maintenance is required in normal operation.

### 9.2 Measured value and event memory

#### Measured value memory

The instrument has an integrated measured value memory with time stamp. Up to 100,000 measured values can be saved in the sensor in a ringing memory. Each entry contains date/time as well as the respective measured value.

Stored values are for example sensor value, level, current value, reliability and electronics temperature. The data remain even in case of voltage interruption.

Via a PC with PACTware/DTM or the control system with EDD, the requested values and recording conditions are stipulated. Data are also read out or reset.

#### Event memory

The instrument has an integrated event memory with time stamp. Up to 500 events which cannot be deleted are stored in the sensor. Each entry contains date/time, event time, event description and value.

Event types are for example modification of a parameter, status and error messages as well as switch on and switch off times. The data remain also in case of voltage interruption.

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

#### Echo curve memory

The instrument has an integrated echo curve memory in which echo curves can be stored for diagnosis purposes. The echo curves are stored with date and time as well as the corresponding echo data. The data remain even in case of voltage interruption. The memory is divided into two sections:

**Echo curve of the setup:** here you can store the echo curve as a reference during setup. This echo curve can be used for example to detect changes of the installation conditions or buildup on the antenna.

**Echo curve memory:** in this memory section up to 10 echo curves can be stored in the sensor in a ring buffer.

Via a PC with PACTware/DTM or the control system with EDD, the requested values and recording conditions are stipulated. Data are also read out or reset. The echo curve during the setup can be stored alternatively also via the indicating and adjustment module.

### 9.3 Error messages according to NE 107

The instrument has a self-monitoring and diagnosis according to NE 107 and VDI/VDE 2650. The following status messages can be outputted:

**Failure:** Due to a malfunction in the instrument, a failure message is outputted. This status message is activated in the delivery status and cannot be deactivated by the user.

**Function check:** The instrument is in operation, the measured value is temporarily invalid (for example during simulation). This status message is activated in the delivery status and cannot be deactivated by the user.

**Out of specification:** The measured value is unstable because the instrument specification was exceeded (for example electronics temperature). This status message is deactivated in the delivery status and must be activated via PACTware/DTM and PC.

**Maintenance:** Due to external influences, the instrument function is limited. The measurement is influenced, however the measured value is still valid. Plan instrument for maintenance because failure must be expected in the near future (for example due to buildup). This status message is activated in the delivery status and must be activated via PACTware/DTM and PC.

Error codes and text messages are displayed via the indicating and adjustment module, PACTware/DTM as well as EDD in the control system. Information to the error statistics is displayed in the menu diagnosis under "Device status" in the indicating and adjustment module as well as PACTware/DTM.

#### Failure (failure)

The following table shows the codes and text messages of the status message "Failure" and provides information on causes as well as corrective measures.

Code Text message	Cause	Removal
F013 no measured value available	<ul style="list-style-type: none"> <li>● Sensor does not detect an echo during operation</li> <li>● Antenna system contaminated or defective</li> </ul>	<ul style="list-style-type: none"> <li>● Check or correct installation and/or parameter adjustment</li> <li>● Clean or exchange process component or antenna</li> </ul>
F017 Adjustment span too small	<ul style="list-style-type: none"> <li>● Adjustment not within specification</li> </ul>	<ul style="list-style-type: none"> <li>● Change adjustment according to the limit values (difference between min. and max. <math>\geq 10</math> mm)</li> </ul>

<b>Code Text message</b>	<b>Cause</b>	<b>Removal</b>
F025 Error in the linearization table	<ul style="list-style-type: none"> <li>● Index markers are not continuously rising, for example unlogical value pairs</li> </ul>	<ul style="list-style-type: none"> <li>● Check linearization table</li> <li>● Delete table/Create new</li> </ul>
F036 No operable software	<ul style="list-style-type: none"> <li>● Failed or interrupted software update</li> </ul>	<ul style="list-style-type: none"> <li>● Repeat software update</li> <li>● Check electronics version</li> <li>● Exchange the electronics</li> <li>● Send instrument for repair</li> </ul>
F040 Error in the electronics	<ul style="list-style-type: none"> <li>● Hardware defect</li> </ul>	<ul style="list-style-type: none"> <li>● Exchange the electronics</li> <li>● Send instrument for repair</li> </ul>
F080	<ul style="list-style-type: none"> <li>● General software error</li> </ul>	<ul style="list-style-type: none"> <li>● Separate operating voltage briefly</li> </ul>
F105 Determine measured value	<ul style="list-style-type: none"> <li>● The instrument is still in the start phase, the measured value could not yet be determined</li> </ul>	<ul style="list-style-type: none"> <li>● Wait for the warm-up phase</li> <li>● Duration depending on the version and parameter adjustment up to approximately 3 min.</li> </ul>
F125 Unpermissible electronics temperature	<ul style="list-style-type: none"> <li>● Temperature of the electronics in the not specified section</li> </ul>	<ul style="list-style-type: none"> <li>● Check ambient temperature</li> <li>● Isolate electronics</li> <li>● Use instrument with higher temperature range</li> </ul>
F260 Error in the calibration	<ul style="list-style-type: none"> <li>● Error in the calibration carried out in the factory</li> <li>● Error in the EEPROM</li> </ul>	<ul style="list-style-type: none"> <li>● Exchange the electronics</li> <li>● Send instrument for repair</li> </ul>
F261 Error in the configuration	<ul style="list-style-type: none"> <li>● Error during setup</li> <li>● False signal suppression faulty</li> <li>● Error when carrying out a reset</li> </ul>	<ul style="list-style-type: none"> <li>● Repeat setup</li> <li>● Repeat reset</li> </ul>
F264 Installation/Setup error	<ul style="list-style-type: none"> <li>● Adjustment not within the vessel height/measuring range</li> <li>● Max. measuring range of the instrument not sufficient</li> </ul>	<ul style="list-style-type: none"> <li>● Check or correct installation and/or parameter adjustment</li> <li>● Use an instrument with bigger measuring range</li> </ul>
F265 Measurement function disturbed	<ul style="list-style-type: none"> <li>● Sensor does no longer carry out a measurement</li> <li>● Operating voltage too low</li> </ul>	<ul style="list-style-type: none"> <li>● Check operating voltage</li> <li>● Carry out a reset</li> <li>● Separate operating voltage briefly</li> </ul>

**Function check**

The following table shows the codes and text messages of the status message "*Function check*" and provides information on causes as well as corrective measures.

Code Text message	Cause	Removal
C700 Simulation	<ul style="list-style-type: none"> <li>● Simulation active</li> </ul>	<ul style="list-style-type: none"> <li>● Finish simulation</li> <li>● Wait for the automatic end after 60 mins.</li> </ul>

**Out of specification**

The following table shows the codes and text messages of the status message "*Out of specification*" and gives instructions for the reason and removal.

Code Text message	Cause	Removal
S600 Unpermissible electronics temperature	<ul style="list-style-type: none"> <li>● Temperature of the electronics in the not specified section</li> </ul>	<ul style="list-style-type: none"> <li>● Check ambient temperature</li> <li>● Isolate electronics</li> <li>● Use instrument with higher temperature range</li> </ul>

**Maintenance (maintenance requirement)**

The following table shows the codes and text messages of the status message "*Maintenance*" and provides information on causes as well as corrective measures.

Code Text message	Cause	Removal
M500 Error with the reset delivery status	<ul style="list-style-type: none"> <li>● With the reset to delivery status, the data could not be restored</li> </ul>	<ul style="list-style-type: none"> <li>● Repeat reset</li> <li>● Load XML file with sensor data into the sensor</li> </ul>
M501 Error in the non-active linearization table	<ul style="list-style-type: none"> <li>● Hardware error EEPROM</li> </ul>	<ul style="list-style-type: none"> <li>● Exchange the electronics</li> <li>● Send instrument for repair</li> </ul>
M502 Error in the diagnosis memory	<ul style="list-style-type: none"> <li>● Hardware error EEPROM</li> </ul>	<ul style="list-style-type: none"> <li>● Exchange the electronics</li> <li>● Send instrument for repair</li> </ul>

Code Text message	Cause	Removal
M503 Reliability too low	<ul style="list-style-type: none"> <li>The echot/noise ratio is the small for a reliable measurement</li> </ul>	<ul style="list-style-type: none"> <li>Check installation and process conditions</li> <li>Clean the antenna</li> <li>Change polarisation direction</li> <li>Use instrument with higher sensitivity</li> </ul>
M504 Error on an device interface	<ul style="list-style-type: none"> <li>Hardware defect</li> </ul>	<ul style="list-style-type: none"> <li>Check connections</li> <li>Exchange the electronics</li> <li>Send instrument for repair</li> </ul>

### 9.4 Rectify malfunctions

**Reaction when malfunctions occur**

The operator of the system is responsible for taking suitable measures to remove interferences.

**Fault rectification**

The first measures to be taken are to check the output signal as well as to evaluate the error messages via the indicating and adjustment module. Further comprehensive diagnostics can be carried out on a PC with the software PACTware and the suitable DTM. In many cases, the causes can be determined this way and faults rectified.

**Checking the 4 ... 20 mA signal**

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

Error	Cause	Removal
4 ... 20 mA signal not stable	Level fluctuations	Set damping via the indicating and adjustment module
4 ... 20 mA signal missing	Electrical connection faulty	Check connection according to chapter " <i>Connection steps</i> " and if necessary, correct according to chapter " <i>Wiring plan</i> "
	Voltage supply missing	Check cables for breaks; repair if necessary
	Operating voltage too low or load resistance too high	Check, adapt if necessary



Error	Cause	Removal
Current signal greater than 22 mA or less than 3.6 mA	Oscillator in the sensor defective	Exchange the instrument or send it in for repair

### Reaction after fault rectification

Depending on the failure reason and measures taken, the steps described in chapter "Set up" must be carried out again, if necessary.

### 24 hour service hotline

However, should these measures not be successful, call the VEGA service hotline in urgent cases under the phone no. **+49 1805 858550**.

The hotline is available to you 7 days a week round-the-clock. Since we offer this service world-wide, the support is only available in the English language. The service is free of charge, only the standard telephone costs will be charged.

## 9.5 Exchanging the electronics module

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



In Ex applications only one instrument and one electronics module with respective Ex approval may be used.

If there is no electronics module available on site, the electronics module can be ordered via the agent serving you. The electronics modules are adapted to the respective sensor and differ in the signal output or the 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, inside the housing as well as on the delivery note.

When loading on site, first of all the order data must be downloaded from the Internet (see operating instructions manual "Oscillator").

## 9.6 Software update

The following components are required to update the sensor software:

- Sensor
- Voltage supply
- Interface adapter VEGACONNECT 4
- PC with PACTware

- Current sensor software as file

**Caution:**

Keep in mind that a software update can lead to expiry of the approvals. You can find detailed information on our homepage [www.vega.com](http://www.vega.com).

**Load sensor software to PC**

At "[www.vega.com/downloads](http://www.vega.com/downloads)" go to "*Software*". Select under "*plics sensors and instruments*" the respective instrument series and software version. Load the zip file via the right mouse key with "*Save target as*" e.g. on the desktop of your PC. Extract all files available in the zip file, e.g. to the desktop.

**Prepare update**

Connect the sensor to power supply and provide connection from the PC to the instrument via the interface adapter. Start PACTware and move via the menu *Project* to the *VEGA project assistant*. Select "*USB*" and "*Set instruments online*". Provide connection to the sensor via "*Start*" until the message "*Search complete*" is displayed.

**Load software into sensor**

Move in the PACTware menu bar to "*Instrument data*", "*Additional functions*" and "*Software update*". PACTware now checks the actual hardware and software version of the sensor and displays the data. This process takes approx. 60 s.

Push the button "*Update software*" and select the previously extracted XML file. Then the software update can be started. The additional files are installed automatically. Depending on the sensor, this procedure lasts approximately 15 min.

## 9.7 How to proceed in case of repair

If a repair is necessary, please proceed as follows:

You can download a return form (23 KB) from our Internet homepage [www.vega.com](http://www.vega.com) under: "*Downloads - Forms and certificates - Repair form*".

By doing this you help us carry out the repair quickly and without having to call back for needed information.

- 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
- Please ask the agency serving you for the address of your return shipment. You can find the competent agency on our website [www.vega.com](http://www.vega.com).

## 10 Dismounting

### 10.1 Dismounting steps

**Warning:**

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

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

### 10.2 Disposal

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

**WEEE directive 2002/96/EG**

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

Correct disposal avoids negative effects to persons and environment and ensures recycling of useful raw materials.

Materials: see chapter "*Technical data*"

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

## 11 Supplement

### 11.1 Technical data

#### General data

---

316L corresponds to 1.4404 or 1.4435

##### Materials, wetted parts

- Process fitting 316L, Hastelloy C22 plated, PP
- Process seal On site
- Antenna 316L, Hastelloy C22
- Antenna impedance cone PTFE (TFM 1600 PTFE), ceramic (99.7 %  $Al_2O_3$ )
- seal, antenna system FKM (Viton), FFKM (Kalrez 6375), FEP - Viton coated, EPDM, PTFE, graphite (99.9 %) and ceramic

##### Materials, non-wetted parts

- Plastic housing plastic PBT (Polyester)
- Aluminium die-casting housing Aluminium die-casting AlSi10Mg, powder-coated - basis: Polyester
- Stainless steel housing 316L
- Seal between housing and housing cover NBR (stainless steel housing, investment casting), silicone (Aluminium/plastic housing, stainless steel housing, electro-polished)
- Inspection window in housing cover (optional) Polycarbonate
- Ground terminal 316L

Process fitting Flanges DIN from DN 50, ANSI from 2"

Weight (depending on housing, process fitting and antenna) approx. 6.3 ... 136 kg (13.89 ... 299.8 lbs)

##### Torque for NPT cable glands and Conduit tubes

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

---

#### Input variable

Measured variable The measured quantity is the distance between process fitting of the sensor and product surface. The reference plane is the seal surface on the hexagon or the lower side of the flange.

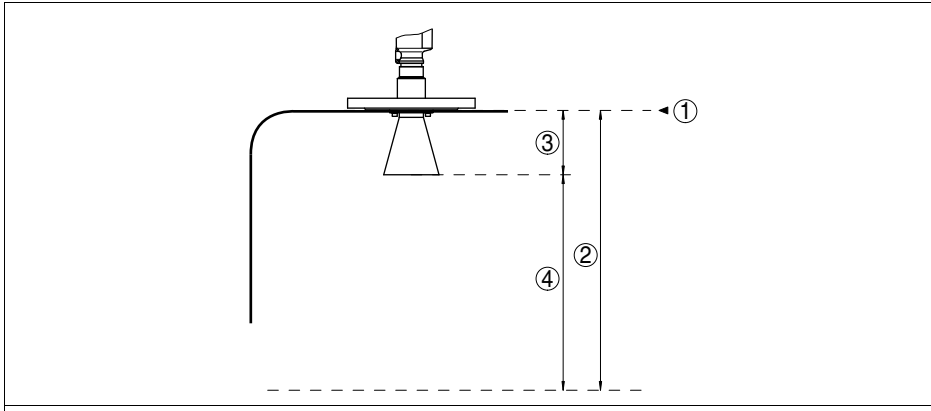


Fig. 26: Data of the input variable

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

Max. measuring range	35 m (114.83 ft)
Recommended measuring range	up to 35 m (114.83 ft)

### Output variable

Output signal	4 ... 20 mA/HART
Cycle time measuring cycle approx.	
– Standard electronics	0.5 s
– Electronics with increased sensitivity	1 s
Signal resolution	0.3 $\mu$ A
Residual ripple	$\pm 0.4$ $\mu$ A
Failure signal current output (adjustable)	mA-value unchanged 20.5 mA, 22 mA, < 3.6 mA
Max. output current	22 mA
Starting current	$\leq 3.6$ mA; $\leq 10$ mA for 5 ms after switching on
Load	see load diagram under Power supply
Damping (63 % of the input variable)	0 ... 999 s, adjustable
HART output values according to HART 7.0 <sup>1)</sup>	
– PV (Primary Value)	Distance to the level
– SV (Secondary Value)	Level as percentage value
– TV (Third Value)	Linearised percentage value
– QV (Fourth Value)	Scaled measured value
Resolution, digital	< 1 mm (0.039 in)

<sup>1)</sup> Default values, can be assigned individually

**Accuracy (similar 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 installations > 200 mm (7.874 in)
- Reflector Corner reflector
- False reflections Largest false echo 20 dB smaller than the useful echo

Deviation with liquids

See following diagrams

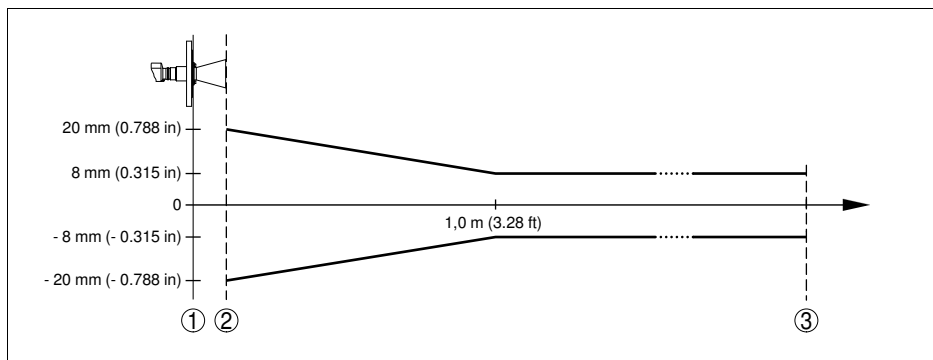


Fig. 27: Deviation under reference conditions

- 1 Reference plane
- 2 Antenna edge
- 3 Recommended measuring range

- Reproducibility  $\leq \pm 1$  mm
- Deviation with bulk solids The values are considerably application-dependent. Firm specifications are hence not possible.
- Deviation under EMC influence  $\leq \pm 30$  mm

**Variables influencing measurement accuracy**

- Temperature drift  $\pm 0.03$  %/10 K relating to the 16 mA span max.  
 $\pm 0.3$  %
- Temperature drift - Digital output  $\pm 3$  mm/10 K relating to the max. measuring range  
or max. 10 mm
- Deviation on the current output by analogue/  
digital conversion  $< \pm 15$   $\mu$ A
- Deviation on the current output by strong,  
high frequency electromagnetic fields within  
EN 61326  $< \pm 100$   $\mu$ A

Additional deviation through strong, high frequency electromagnetic fields acc. to EN 61326 <math>\leq \pm 50 \text{ mm}</math>

### Influence of the superimposed gas and pressure to the accuracy

The spreading speed of the radar impulses in gas or vapour above the medium is reduced by high pressures. This effect depends on the 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 high, 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	0.00 %	0.22 %	1.2 %	2.4 %	4.9 %
	200 °C/392 °F	-0.01 %	0.13 %	0.74 %	1.5 %	3.0 %
	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 %	76.0 %

### Characteristics and performance data

Frequency	C-band (6 GHz technology)
Meas. interval approx.	1 s
Beam angle <sup>2)</sup> , depending on the antenna system	
– without horn antenna	38°
– $\varnothing$ 75 mm (2.953 in)	38°
– $\varnothing$ 96 mm (3.78 in)	30°
– $\varnothing$ 146 mm (5.748 in)	20°
– $\varnothing$ 196 mm (7.717 in)	17°

<sup>2)</sup> Outside the specified beam angle, the energy of the radar signal has a level of -3 dB (50 %)

- ø 242 mm (9.528 in) 14°
- Step response time<sup>3)</sup> > 1 s (dependent on the parameter setting)
- Max. level change 1 m/min.
- Emitted HF power of the antenna system
  - Pulse peak power < 10 mW
  - Pulse duration < 1 ns
  - Average power < 25 µW
  - Average power with 1 m distance < 1 µW/cm<sup>2</sup>

**Ambient conditions**

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

**Process conditions**

For the process conditions, you also have to note the specifications on the type label. Always the lowest value is applicable.

Seal	Antenna impedance cone	Process temperature (measured on the process fitting)
FKM (Viton)	PFFE	-40 ... +150 °C (-40 ... +302 °F)
FFKM (Kalrez 6375)	PFFE	-20 ... +150 °C (-4 ... +302 °F)
FPM Viton covered (FDA approved)	PFFE	-40 ... +150 °C (-40 ... +302 °F)
EPDM (FDA approved)	PFFE	-40 ... +150 °C (-40 ... +302 °F)
Graphite	Ceramic	-110 ... +250 °C (-166 ... +482 °F)
	Ceramic	-200 ... +400 °C (-328 ... +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 stage see supplementary instructions manual "*Flanges according to DIN-EN-ASME-JIS*"

Vibration resistance mechanical vibrations with 4 g and 5 ... 100 Hz<sup>4)</sup>

**Data on rinsing air connection**

Pressure max. 6 bar (87.02 psi)

Air flow without reflux valve

<sup>3)</sup> Time span after a sudden level change until the output signal has taken for the first time 90 % of the final value (IEC 61298-2).  
<sup>4)</sup> Tested according to the guidelines of German Lloyd, GL directive 2.



- |                      |                        |
|----------------------|------------------------|
| - 0.1 bar (1.45 psi) | 4.2 m <sup>3</sup> /h  |
| - 1.2 bar (7.25 psi) | 10.2 m <sup>3</sup> /h |

## Air flow with reflux valve

- |                       |                       |
|-----------------------|-----------------------|
| - 0.2 bar (2.9 psi)   | 2.0 m <sup>3</sup> /h |
| - 0.55 bar (7.98 psi) | 4.2 m <sup>3</sup> /h |
| - 1.2 bar (17.4 psi)  | 7.2 m <sup>3</sup> /h |

Thread G $\frac{1}{4}$  A

## Catch

- |               |                             |
|---------------|-----------------------------|
| - with non-Ex | Dust protection cover of PE |
| - with Ex     | Threaded plug of 316Ti      |

## 2 reflux valves - attached (with non-Ex optional, with Ex included in the scope of delivery)

- |                          |                                 |
|--------------------------|---------------------------------|
| - Material               | 316Ti                           |
| - Seal                   | FKM (Viton), 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**Cable entry/plug<sup>5)</sup>

- |                          |   |
|--------------------------|---|
| - Single chamber housing | <ul style="list-style-type: none"> <li>● 1 x cable gland M20 x 1.5 (cable: <math>\varnothing</math> 5 ... 9 mm), 1 x blind stopper M20 x 1.5</li> </ul> or: <ul style="list-style-type: none"> <li>● 1 x closing cap M20 x 1.5; 1 x blind stopper M20 x 1.5</li> </ul> or: <ul style="list-style-type: none"> <li>● 1 x closing cap <math>\frac{1}{2}</math> NPT, 1 x blind plug <math>\frac{1}{2}</math> NPT</li> </ul> or: <ul style="list-style-type: none"> <li>● 1 x plug (depending on the version), 1 x blind stopper M20 x 1.5</li> </ul> |
| - Double chamber housing | <ul style="list-style-type: none"> <li>● 1 x cable entry M20 x 1.5 (cable: <math>\varnothing</math> 5 ... 9 mm), 1 x blind stopper M20 x 1.5; 1 x blind stopper M16 x 1.5 or optional<sup>6)</sup> 1 x plug M12 x 1 for external indicating and adjustment unit</li> </ul> or:  |

<sup>5)</sup> Depending on the version M12 x 1, according to ISO 4400, Harting, 7/8" FF.

<sup>6)</sup> Only with Ex d version

- 1 x closing cap ½ NPT, 1 x blind stopper ½ NPT, 1 x blind stopper M16 x 1.5 or optionally<sup>7)</sup> 1 x plug M12 x 1 for external indicating and adjustment unit

or:

- 1 x plug (depending on the version), 1 x blind stopper M20 x 1.5; 1 x blind stopper M16 x 1.5 or optionally<sup>8)</sup> 1 x plug M12 x 1 for external indicating and adjustment unit

Spring-loaded terminals for wire cross-section

- Massive wire, cord 0.2 ... 2.5 mm<sup>2</sup> (AWG 24 ... 14)
- Cord with cable end sleeve 0.2 ... 1.5 mm<sup>2</sup> (AWG 24 ... 16)

---

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

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Cable entry

- Single chamber housing 1 x IP 68 cable gland M20 x 1.5; 1 x blind stopper M20 x 1.5
- Double chamber housing 1 x IP 68 cable gland M20 x 1.5; 1 x blind stopper M20 x 1.5; 1 x blind stopper M16 x 1.5

Connection cable

- Wire cross-section 0.5 mm<sup>2</sup> (AWG 20)
- Wire resistance < 0.036 Ω/m
- Tensile strength < 1200 N (270 lbf)
- Standard length 5 m (16.4 ft)
- Max. length 1000 m (3280 ft)
- Min. bending radius 25 mm (0.984 in) with 25 °C (77 °F)
- Diameter approx. 8 mm (0.315 in)
- Colour - standard PE Black
- Colour - standard PUR Blue
- Colour - Ex-version Blue

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**Indicating and adjustment module**

---

- Voltage supply and data transmission through the sensor
- Indication LC display in dot matrix
- Adjustment elements 4 keys
- Protection rating
- unassembled IP 20
- mounted into the sensor without cover IP 40

Materials

<sup>7)</sup> Only with Ex d version  
<sup>8)</sup> Only with Ex d version

– Housing	ABS
– Inspection window	Polyester foil

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**Integrated clock**


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Date format	Day.Month.Year
Time format	12 h/24 h
Time zone Ex factory	CET

---

**Electronics temperature measurement**


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Resolution	1 °C (1.8 °F)
Accuracy	±1 °C (1.8 °F)

---

**Voltage supply**


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Operating voltage	
– Non-Ex instrument	9.6 ... 36 V DC
– Ex-ia instrument	9.6 ... 30 V DC
– Ex-d-ia instrument	14 ... 36 V DC
Operating voltage with lighted indicating and adjustment module	
– Non-Ex instrument	16 ... 36 V DC
– Ex-ia instrument	16 ... 30 V DC
– Ex-d-ia instrument	20 ... 36 V DC
Interpolation protection	Available
Permissible residual ripple - Non-Ex, Ex-ia instrument	
– for $9.6 V < U_N < 14 V$	$\leq 0.7 V_{\text{eff}}$ (16 ... 400 Hz)
– for $18 V < U_N < 36 V$	$\leq 1.0 V_{\text{eff}}$ (16 ... 400 Hz)
Permissible residual ripple - Ex-d-ia instrument	
– for $18 V < U_N < 36 V$	$\leq 1 V_{\text{eff}}$ (16 ... 400 Hz)
Load	see diagram

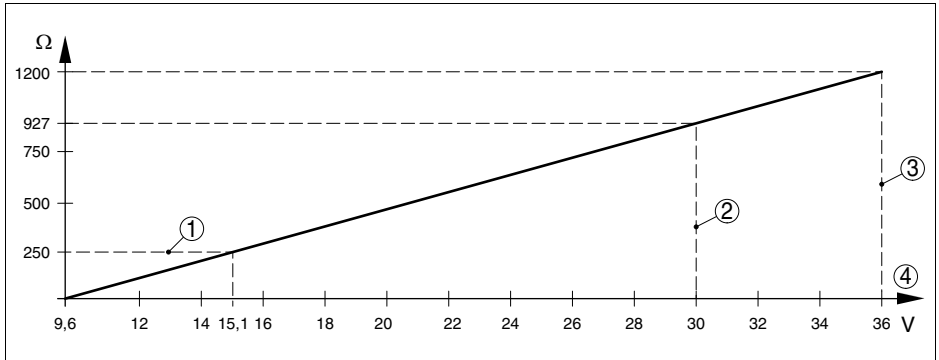


Fig. 28: Voltage diagram

- 1 HART load
- 2 Voltage limit Ex-ia instrument
- 3 Voltage limit non-Ex/Ex-d instrument
- 4 Operating voltage

**Electrical protective measures**

Protection, depending on housing version

- Plastic housing IP 66/IP 67
- Aluminium housing, stainless steel housing - investment casting, stainless steel housing - electro-polished IP 66/IP 68 (0.2 bar)<sup>9)</sup>
- Aluminium and stainless housing, investment casting (optionally available) IP 66/IP 68 (1 bar)

Overvoltage category III

Protection class II

**Approvals**

Depending on the version, instruments with approvals can have different technical data.

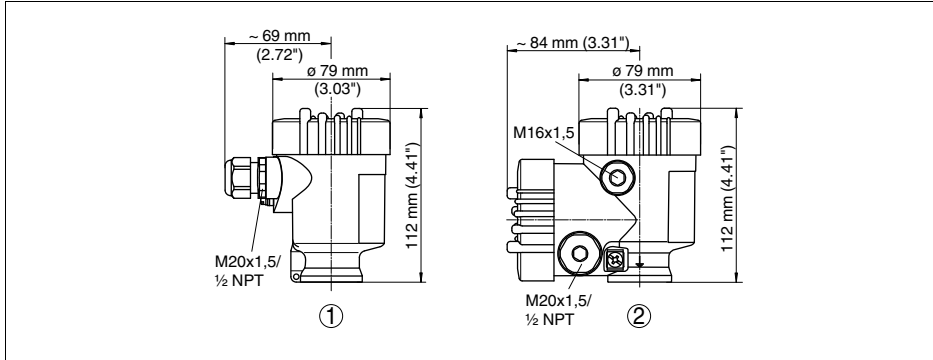
For these instruments, the corresponding approval documents have to be taken into account. These are part of the delivery or can be downloaded under [www.vega.com](http://www.vega.com) via "VEGA Tools" and "serial number search" as well as via "Downloads" and "Approvals".

<sup>9)</sup> The prerequisites for maintaining the protection rating are a suitable cable as well as correct mounting.

## 11.2 Dimensions

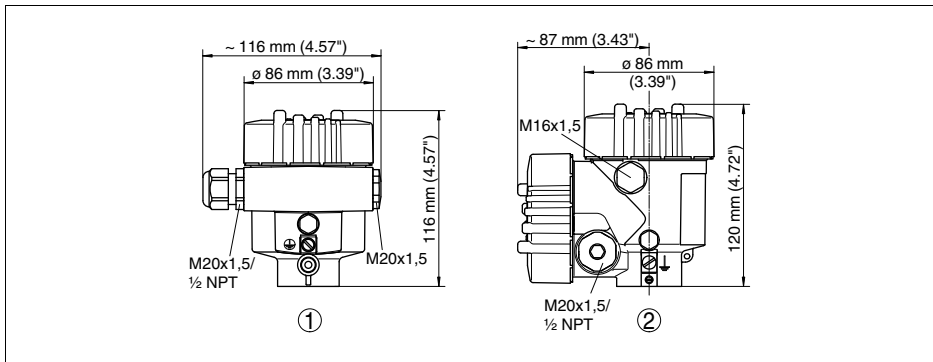
The following dimensional drawings represent only an extract of the possible versions. Detailed dimensional drawings can be downloaded on [www.vega.com](http://www.vega.com) under "Downloads" and "Drawings".

### Plastic housing



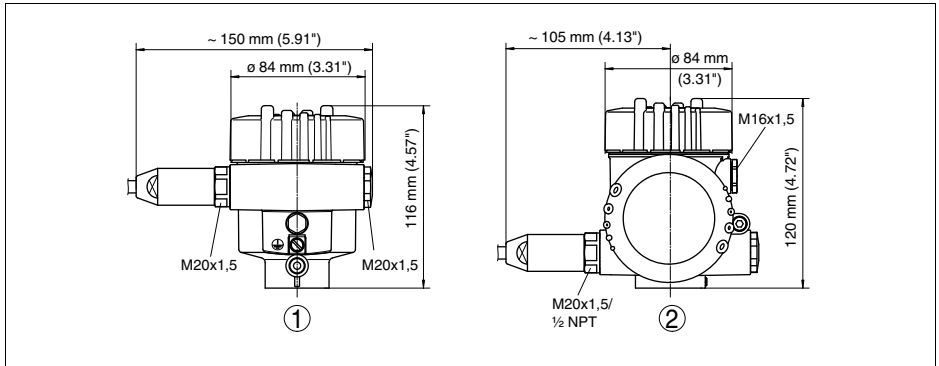
- 1 Single chamber version
- 2 Double chamber version

### Aluminium housing



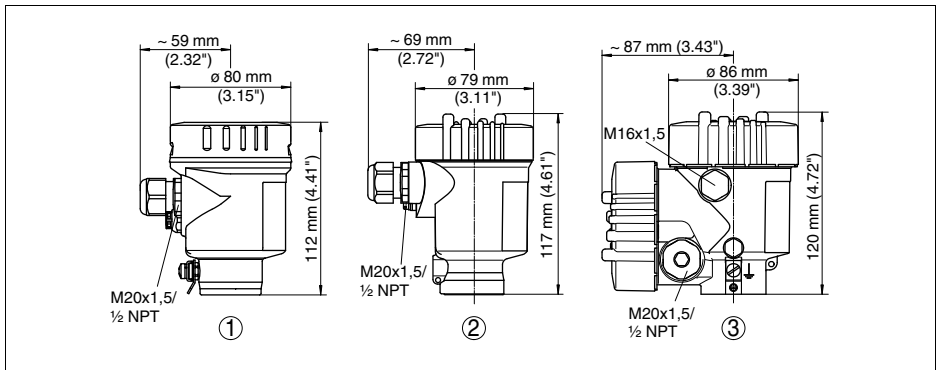
- 1 Single chamber version
- 2 Double chamber version

**Aluminium housing in protection rating IP 66/IP 68 (1 bar)**



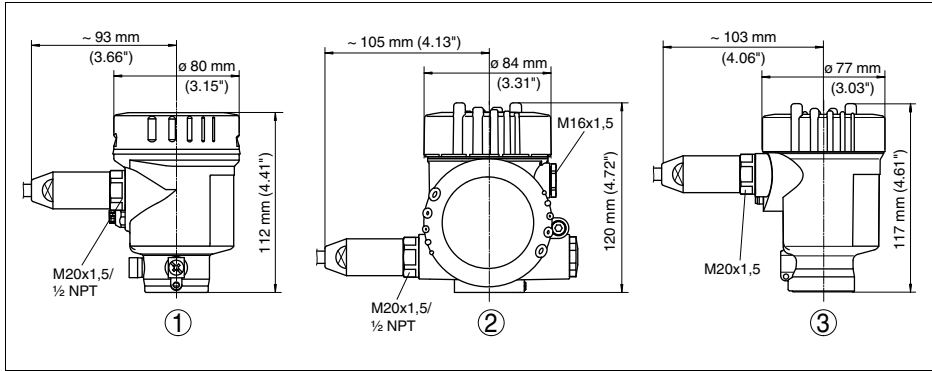
- 1 Single chamber version
- 2 Double chamber version

**Stainless steel housing**



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

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



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

**VEGAPULS 66 - standard version**

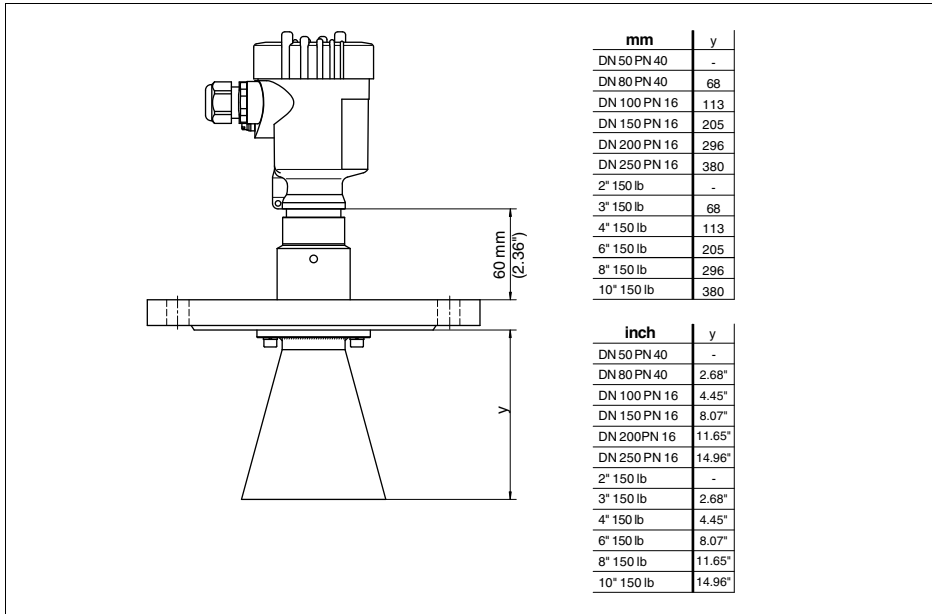


Fig. 34: VEGAPULS 66 - standard version

VEGAPULS 66 - standard version with rinsing air connection

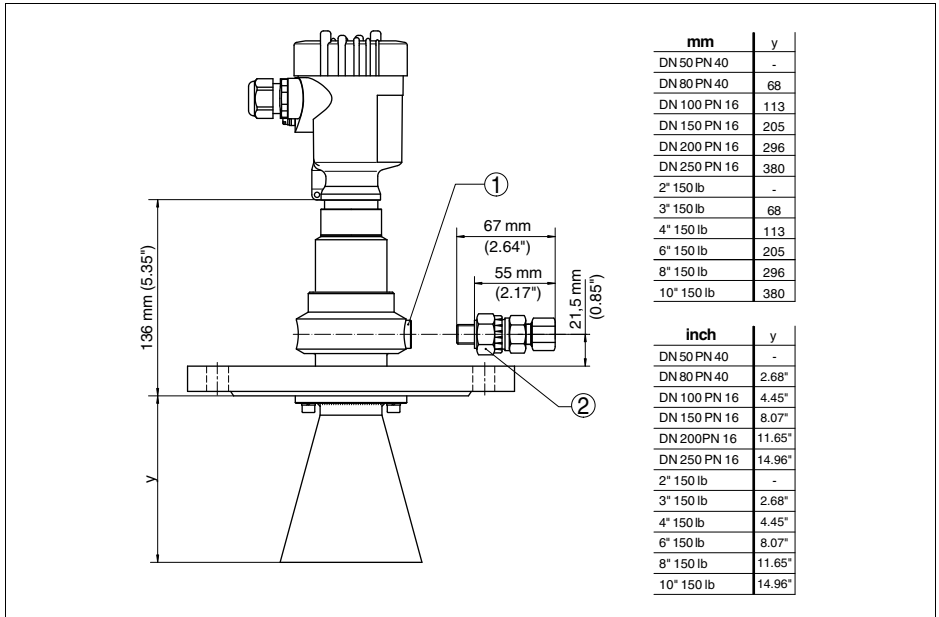


Fig. 35: VEGAPULS 66 - standard version with rinsing air connection

- 1 Rinsing air connection G $\frac{1}{4}$  A for mounting of a suitable adapter
- 2 Reflux valve - attached (with non-Ex optionally available, with Ex in the scope of delivery), for tube diameters 10 mm



## VEGAPULS 66 - high temperature versions

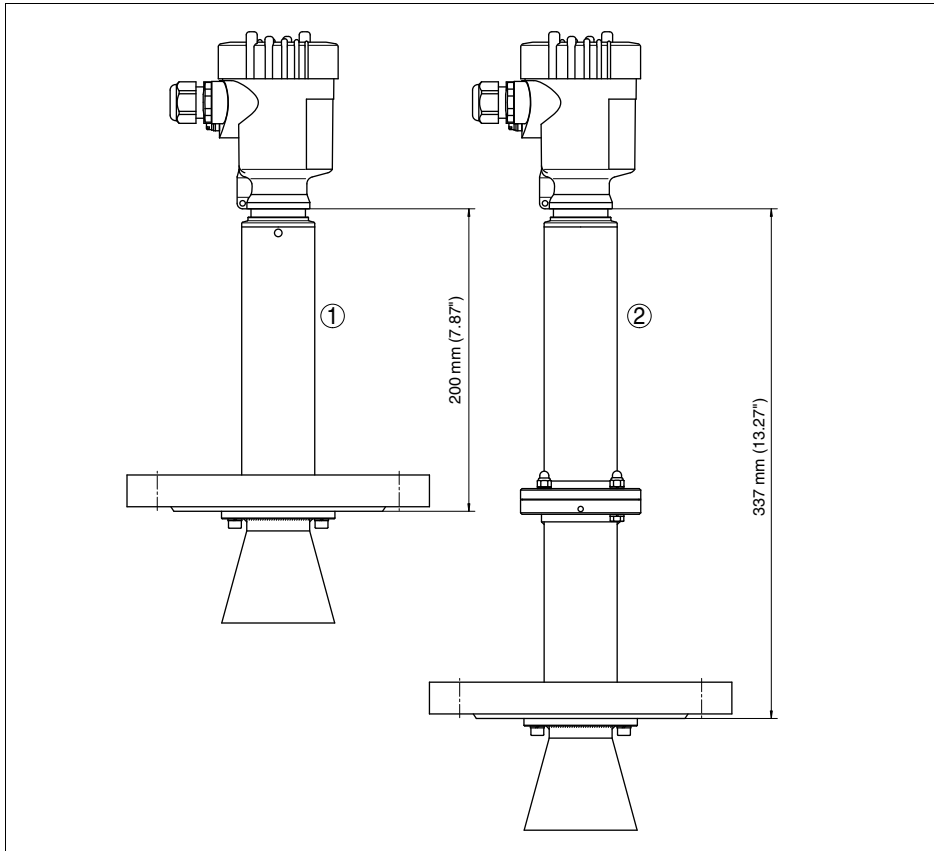


Fig. 36: VEGAPULS 66 - high temperature version

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

### 11.3 Industrial property rights

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

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