

Appendix H: User Manual

Please refer to the following pages.

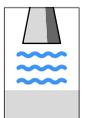
Operating Instructions

VEGAPULS 68

4 ... 20 mA/HART two-wire



Document ID:
36535



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 68 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.

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.

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:

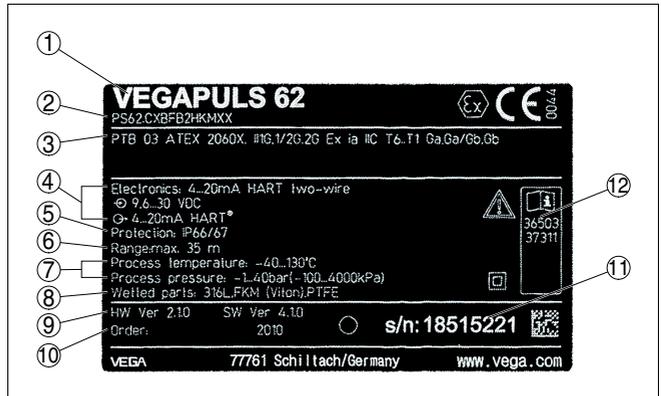


Fig. 1: Structure of the type label (example)

- 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, "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 68 (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 version of VEGAPULS 68 is available for each area of application.

The version with horn antenna is particularly suitable for small silos and vessels for measurement of virtually all bulk solids. The version with parabolic antenna is particularly suitable for large silos and vessels with up to 75 m (246 ft) measuring distance and for measurement of bulk solids with low ϵ_r value

The instrument is also suitable for applications in liquids.

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 %

3.4 Accessories and replacement parts

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 preparations - Horn antenna

The instrument is also available in versions where the antenna has a bigger diameter than the process fitting (thread, flange). The antenna must therefore be disconnected from the process fitting before mounting. Proceed as follows:

- 1 Loosen the hexagon screws (3) on the antenna socket with an Allen wrench (size 3)
- 2 Remove the antenna (4)

**Note:**

The plastic conemust not be pulled out of the antenna socket.

- 3 Insert the antenna from below into the vessel socket and secure it against falling off
- 4 Retighten the antenna with hexagon screws to the antenna socket; torque max. 10 Nm (7.5 lbf ft)

**Note:**

The radar sensor with rinsing air connection or antenna extension is provided with a notch on the antenna socket. This notch must correspond to the marking on the hexagon of the process fitting (the marking specifies the position of the polarisation level of the radar signal).

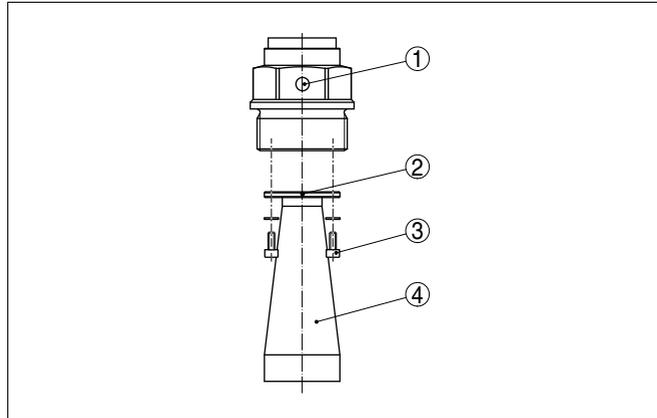


Fig. 2: Dismounting of the horn antenna

- 1 Marking of the polarisation plane
- 2 Notch at the antenna socket
- 3 Hexagon screws on the antenna socket
- 4 Antenna

4.3 Mounting preparations - Parabolic antenna

The instrument is also available in versions where the antenna has a diameter larger than the process fitting (thread, flange). With such versions the antenna must be disconnected from the process fitting before mounting. Proceed as follows:

- 1 Clamp VEGAPULS 68 with the flange, e.g. in a bench vice
- 2 Hold the connection piece (3) with a wrench (width across flats 22) on the flattenings
- 3 Loosen counter nut (2) completely with a wrench (width across flats 36) in the antenna direction
- 4 Loosen compression nut (1) completely with a wrench (width across flats 41) in the antenna direction
- 5 Remove the parabolic antenna (4) axially
- 6 Mount sensor flange to the adapter flange and clamp it
- 7 Check, if the O-ring seal is available on the connection piece and if it is not damaged.

**Note:**

A damaged O-ring seal must be replaced: FKM (Viton) article no. 2.28248, FFKM (Kalrez 6375) article no. 2.27351

- 8 Remount the parabolic antenna (4)
- 9 Fasten compression nut (1) with a wrench (width across flats 41), torque max. 50 Nm
- 10 Fasten counter nut (2) with a wrench (width across flats 36), torque max. 40 Nm

**Note:**

Take note for the version with rinsing air connection that the holes in the antenna and in the process fitting correspond. This ensures a sufficient air flow (the air is led through the holes to the feed system. A rinsing of the parabolic antenna in total is not intended).

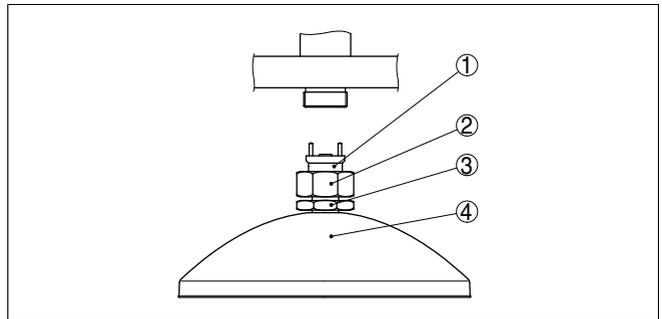


Fig. 3: Dismounting, parabolic antenna

- 1 Compression nut
- 2 Locknut
- 3 Connection piece
- 4 Parabolic antenna

4.4 Mounting instructions

Horn and parabolic antenna

The illustrations with the following mounting instructions show a radar sensor with horn antenna. The mounting instructions apply analogously also to the version with parabolic antenna.

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.

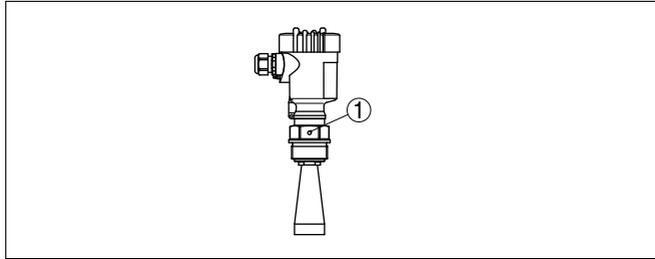


Fig. 4: Position of the polarisation level

1 Marking hole

Mounting position

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

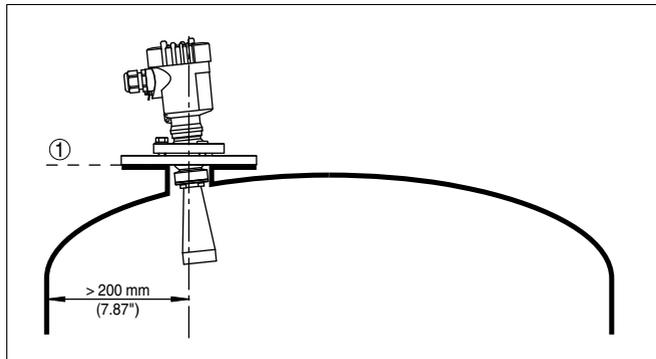


Fig. 5: Mounting of the radar sensor on round vessel tops

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.

Inflowing medium

Mounting should not be too close to the inflowing material as the microwave signal will be interfered. The optimum mounting position is on the opposite of the filling. To avoid strong pollution, the distance to the filter or dust extraction must be as big as possible.

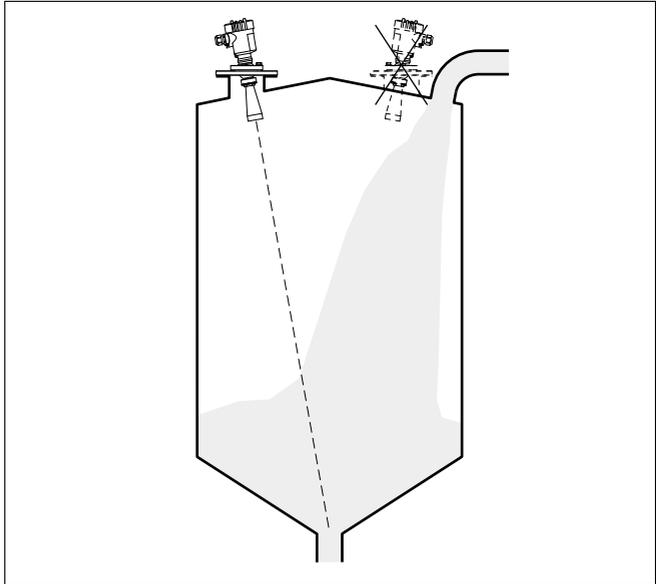


Fig. 6: Mounting of the radar sensor with inflowing medium

Socket

The socket piece should be dimensioned in such a way that the antenna end protrudes slightly out of the socket.

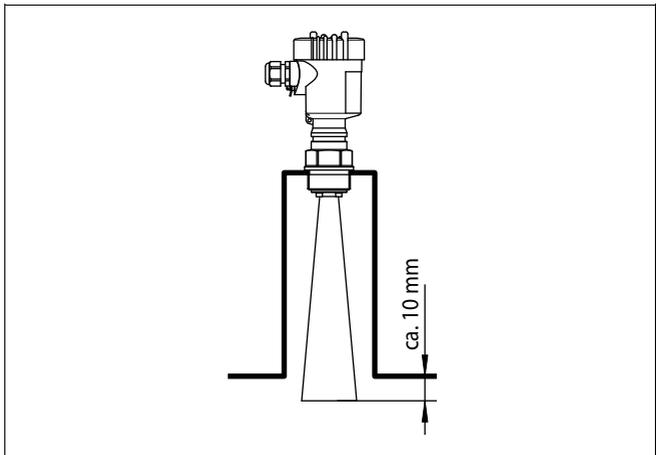


Fig. 7: Recommended socket mounting

When using a swivelling holder, keep in mind that the distance between antenna and socket gets smaller as the inclination of the sensor increases. Additional false reflections may be generated which can influence the measuring result at close range.

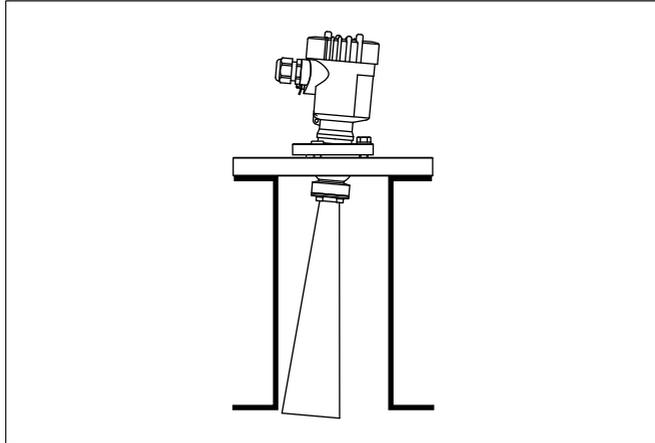


Fig. 8: Distance between antenna and socket

If the medium has good reflective properties, VEGAPULS 68 can also be mounted on a longer socket piece. Recommended values for socket heights are specified in the following illustration. You must carry out a false echo storage afterwards.

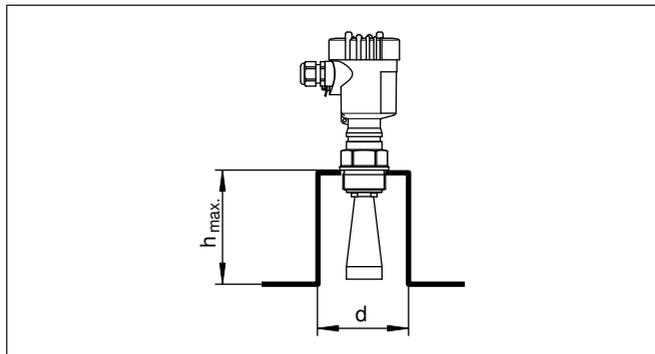


Fig. 9: Deviating socket dimensions

Socket diameter d	Socket length h
40 mm	100 mm
50 mm	150 mm
80 mm	250 mm
100 mm	500 mm
150 mm	800 mm

Socket diameter d	Socket length h
1½"	3.9 in
2"	5.9 in
3"	9.8 in
4"	19.7 in
6"	31.5 in



Tip:

The instrument is also optionally available with an antenna extension. The antenna length can be selected (either ex works or later) to allow the antenna to protrude slightly out of the end of the mounting socket. Due to the antenna extension however, disturbing reflections are generated in the close-up range. This can lead to an increase in the required minimum distance, especially with poorly reflecting media such as plastic powder. In practice, a cleanly constructed mounting socket, if necessary with rounded edges, introduces fewer disturbing influences than an antenna extension.

Orientation

To measure as much of the vessel volume as possible, the sensor should be aligned so that the measuring beam reaches the lowest level in the vessel. In a cylindrical silo with conical outlet, the easiest way is to mount the instrument in the center of the silo.

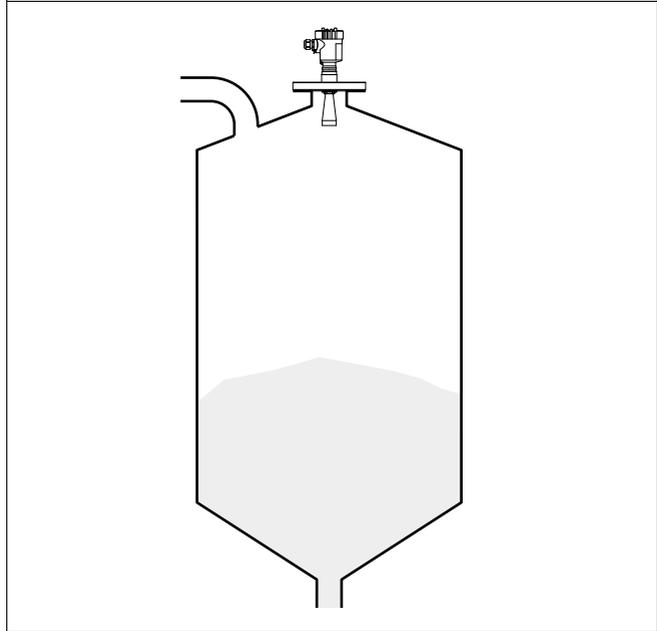


Fig. 10: Orientation

If mounting in the center of the silo is not possible, the sensor can be directed to the vessel center by means of an optional swivelling holder. The following description gives an overview on the determination of the necessary angle of inclination.

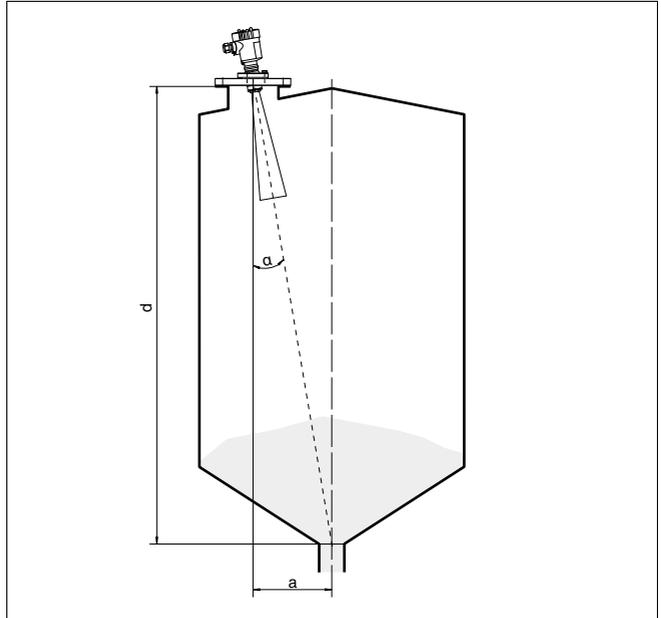


Fig. 11: Proposal for installation after orientation VEGAPULS 68

The angle of inclination depends on the vessel dimensions. It can be easily checked with a suitable level or water level on the sensor.

The following chart specifies the distance "a" between installation position and vessel centre dependent on the measuring distance for inclination angles of 2° ... 10°.

Distance d (m)	2°	4°	6°	8°	10°
2	0.1	0.1	0.2	0.3	0.4
4	0.1	0.3	0.4	0.6	0.7
6	0.2	0.4	0.6	0.8	1.1
8	0.3	0.6	0.8	1.1	1.4
10	0.3	0.7	1.1	1.4	1.8
15	0.5	1.0	1.6	2.1	2.6
20	0.7	1.4	2.1	2.8	3.5
25	0.9	1.7	2.6	3.5	4.4
30	1.0	2.1	3.2	4.2	5.3
35	1.2	2.4	3.7	4.9	6.2
40	1.4	2.8	4.2	5.6	7.1
45	1.6	3.1	4.7	6.3	7.9

Distance d (m)	2°	4°	6°	8°	10°
50	1.7	3.5	5.3	7	8.8
55	1.9	3.8	5.8	7.7	9.7
60	2.1	4.2	6.3	8.4	10.6
65	2.3	4.5	6.8	9.1	11.5
70	2.4	4.9	7.4	9.8	12.3

Example:

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

The necessary angle of inclination of 4° can be read out from this chart.

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

- 1 Loosen terminal screw of the swivelling holder with a fork spanner SW 13
- 2 Direct the sensor, check angle of inclination



Information:

The max. angle of inclination of the swivelling holder is approx. 15°

- 3 Tighten the terminal screw, torque max. 20 Nm.



Information:

The hexagon screws must not be loosened.

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.

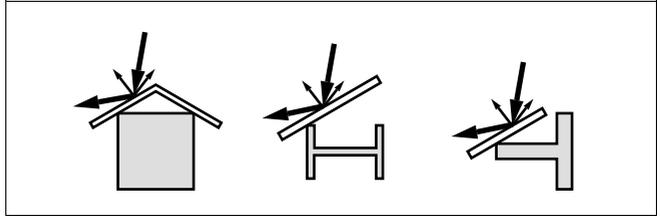


Fig. 12: Cover smooth profiles with deflectors

Agitators

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

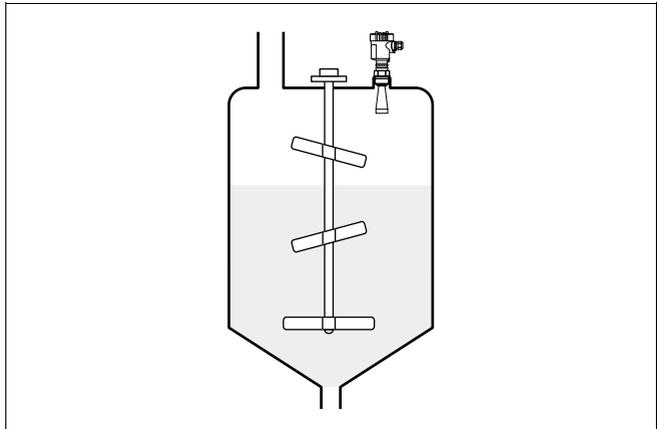


Fig. 13: Agitators

Material heaps

Large material heaps are detected with several sensors, which can be mounted on e.g. traverse cranes. For this type of application, it is best to orient the sensor toward the solid surface. A mutual influence of the sensors is not possible.

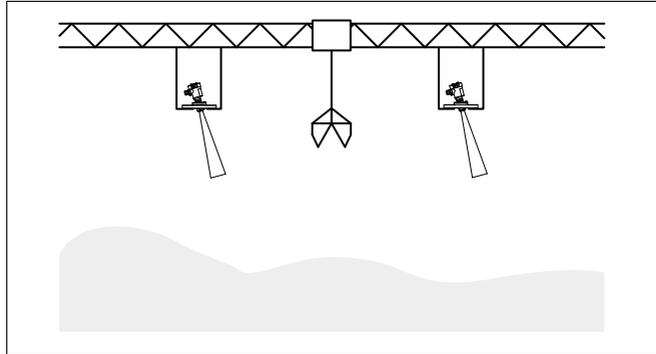


Fig. 14: Radar sensors on traverse crane



Information:

Keep in mind that for these applications, the sensors are designed for relatively slow level changes. When using VEGAPULS 68 on a movable bracket, the max. measuring rate must be observed (see chapter "Technical data").

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.

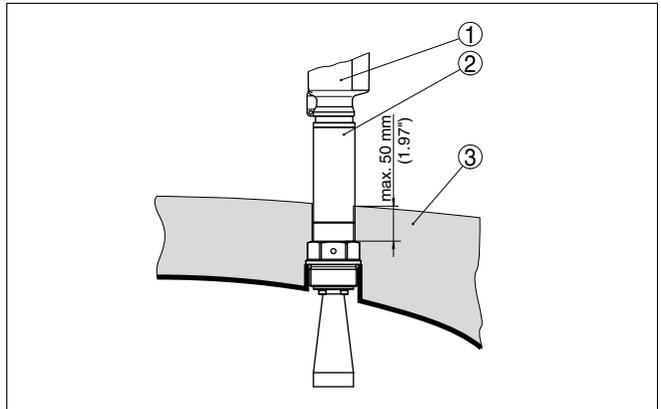


Fig. 15: Mounting of the instrument with insulated vessels.

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

Installation in subsurface enclosures

For level measurements in concrete silos, the sensors are often mounted in protective boxes. These boxes can be for example metallic, closed subsurface enclosures.

Minimal amounts of stray radiation from the sensor can be reflected and strengthened by the walls of the subsurface enclosures. In the case of sensors with plastic housings, this can lead to coupling disturbances. This is avoided by using a sensor with of aluminium or stainless steel housing.

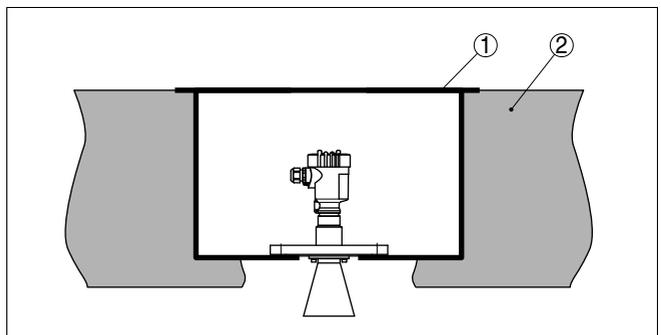


Fig. 16: Mounting of the instrument in an subsurface enclosure

- 1 Subsurface enclosure
- 2 Concrete bottom

Mounting in multiple chamber silo

The silo walls of multiple chamber silos are often made of profile walls, such as e.g. profile sheeting, to ensure the required stability. If the radar sensor is mounted very close to a heavily structured vessel wall, considerable false reflections can be generated. Hence the sensor should be mounted at a large distance from the separating wall. The optimal mounting position is on the outer wall of the silo with the sensor directed towards the emptying aperture in the silo center.

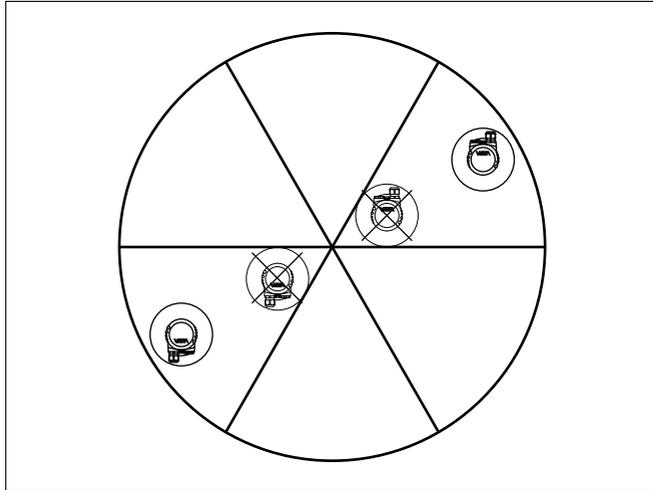


Fig. 17: Installation of VEGAPULS 68 in multiple chamber silos

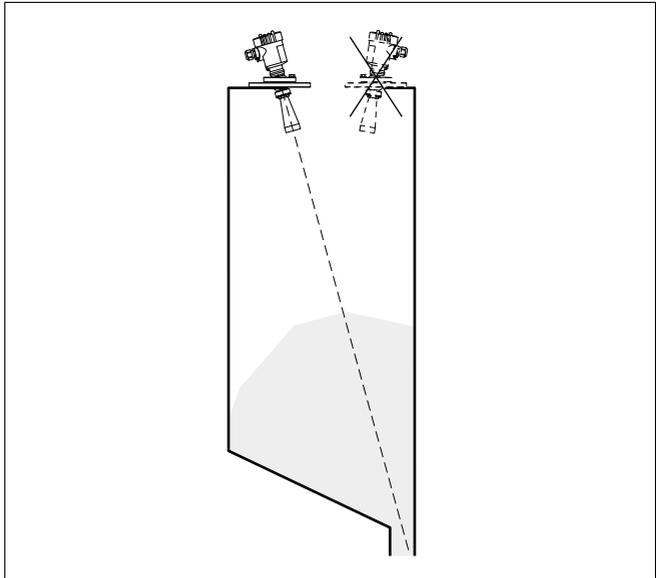


Fig. 18: Orientation of VEGAPULS 68 for emptying in the silo center

Dust layers

To avoid strong buildup and dust in the antenna system, the sensor should not be mounted directly at the dust extraction of the vessel.

In case of extreme dust in the antenna system, VEGAPULS 68 is available with purging air connection. The air is distributed via channels in the antenna system and keeps it virtually free of dust.

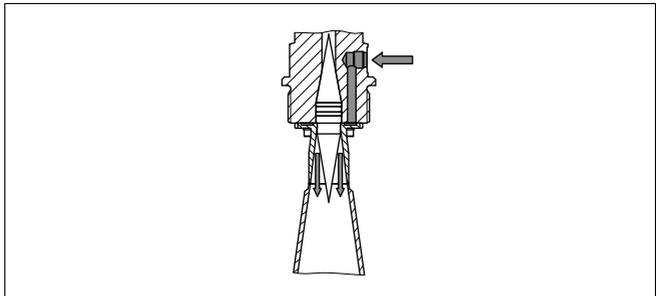


Fig. 19: Purging air connection with horn antenna

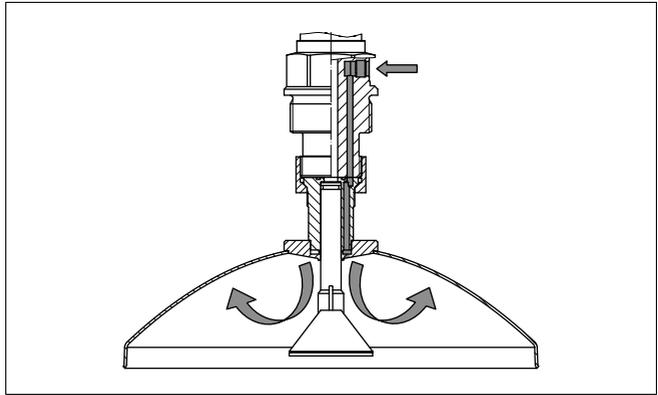


Fig. 20: Purging air connection with parabolic antenna

The practice has shown that a pressure of approx. 0.2 ... 1 bar provides a sufficient air flow (see diagram in chapter "Technical data", "Purging air connection").

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 68, 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".

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. 21: 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

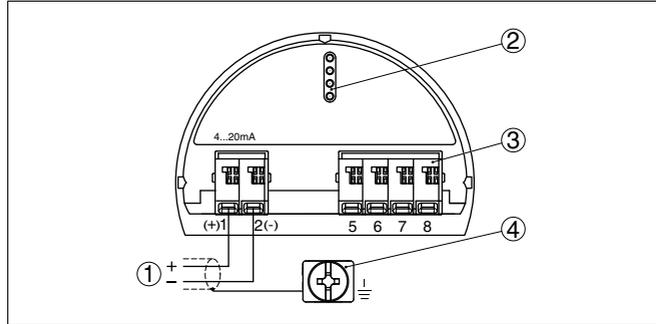


Fig. 22: Electronics and connection compartment with single chamber housing

- 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

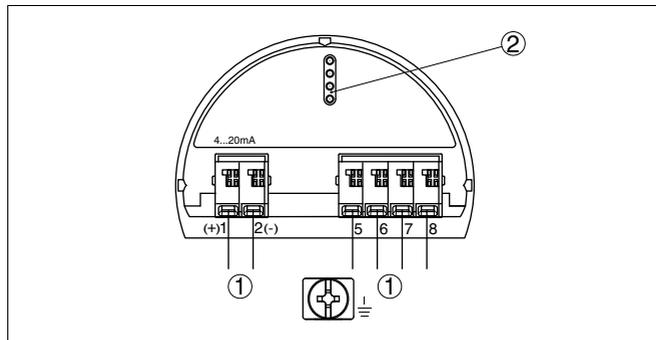


Fig. 23: Electronics compartment, double chamber housing

- 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

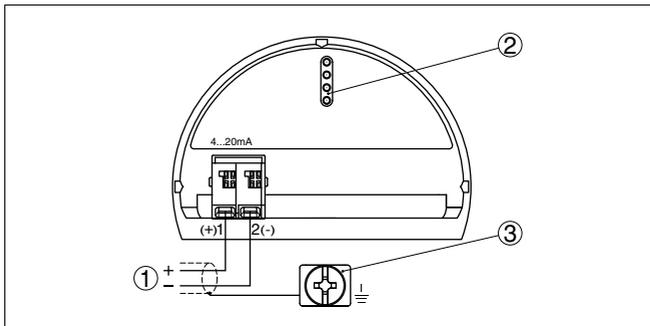


Fig. 24: Connection compartment, double chamber housing

- 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

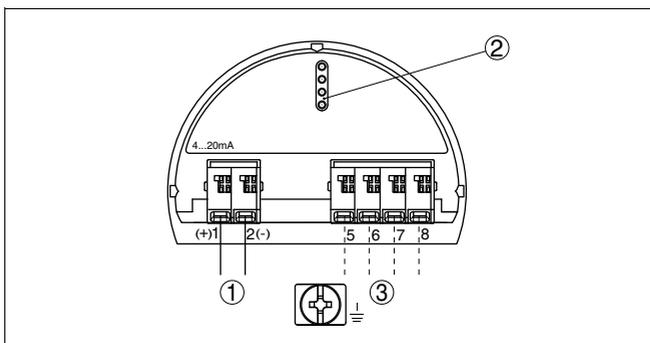


Fig. 25: Electronics compartment, double chamber housing

- 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

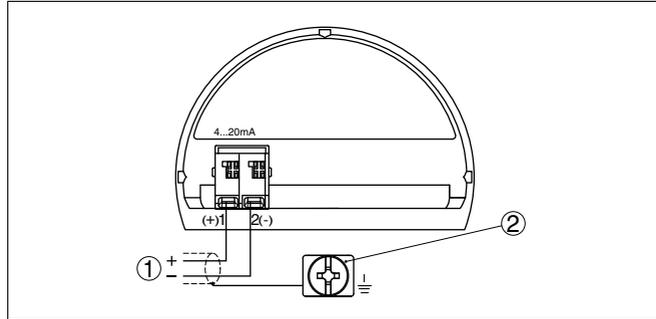


Fig. 26: Connection compartment double chamber housing Ex d

- 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

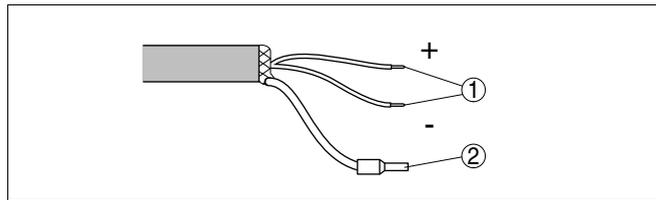


Fig. 27: Wire assignment fix connected connection cable

- 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. 28: 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

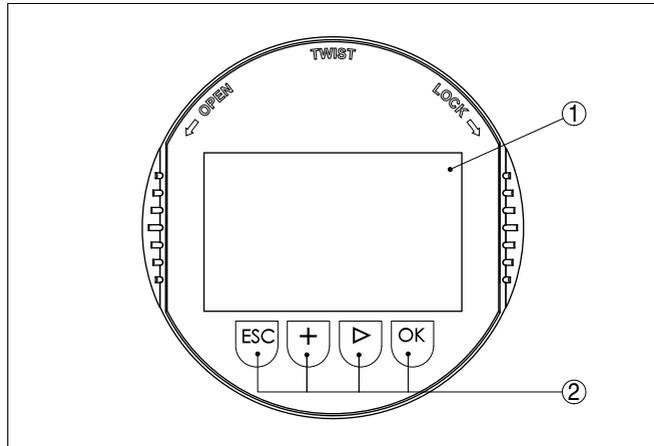


Fig. 29: Indicating and adjustment elements

- 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.

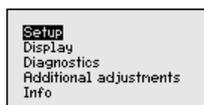


Information:

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

Diagnosis: 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.

Setup Measurement loop name Medium Application Vessel type Vessel height/Me. range	Medium Liquid Water based	Solvent Chem. mixtures <input checked="" type="checkbox"/> Water based
Medium Solid Ballast/pebbles	Powder/dust Granular/pellets <input checked="" type="checkbox"/> Ballast/pebbles	

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".

Setup Measurement loop name Medium Application Vessel type Vessel height/Me. range
--

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

Application Storage tank	Application <input checked="" type="checkbox"/> Storage tank Storage tank agitation Storage tank on ships Stirred vessel Dosing vessel	Application Stilling tube <input checked="" type="checkbox"/> Bypass <input checked="" type="checkbox"/> Plastic vessel Mob.plastic vessel Open waters
Application Mob.plastic vessel Open waters <input checked="" type="checkbox"/> Open volume Rainwater overflow Demonstration		

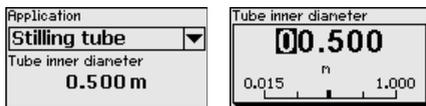


Caution:

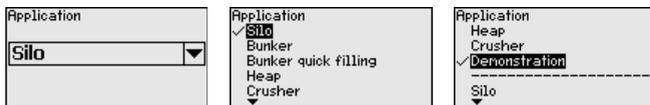
If in the vessel, there is a separation of liquids with different ϵ_r value, for example by condensation, the radar sensor can detect under certain circumstances only the medium with the higher dielectric value. Keep in mind that interfaces can cause faulty measurements.

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:



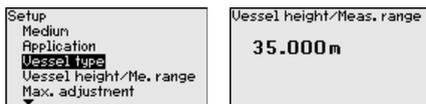
Through this selection, the sensor is adapted optimally to the application or the location and measurement reliability under the various basic conditions is increased considerably.

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.

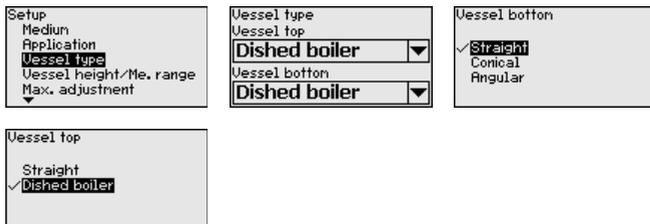
Independent from this, the min. adjustment must be carried out.



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.



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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.

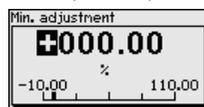
Setup/Min. adjustment

Proceed as follows:

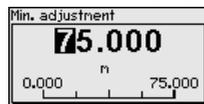
- 1 Select the menu item "Setup" with **[->]** and confirm with **[OK]**. Now select with **[->]** the menu item "Min. adjustment" and confirm with **[OK]**.



- 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.

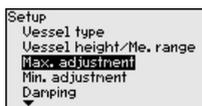


- 4 Enter the suitable distance value in m for the empty vessel (e.g. distance from the sensor to the vessel bottom) corresponding to the percentage value.
- 5 Save settings with **[OK]** and move with **[ESC]** and **[->]** to the max. adjustment.

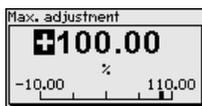
Setup/Max. adjustment

Proceed as follows:

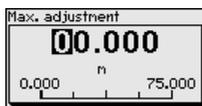
- 1 Select with **[>]** the menu item max. adjustment and confirm with **[OK]**.



- 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:

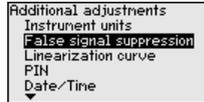
A false signal suppression detects, marks and saves these false signals so that they are no longer taken into account for level measurement.

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



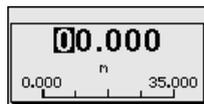
2 Confirm again with **[OK]**.



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]**.

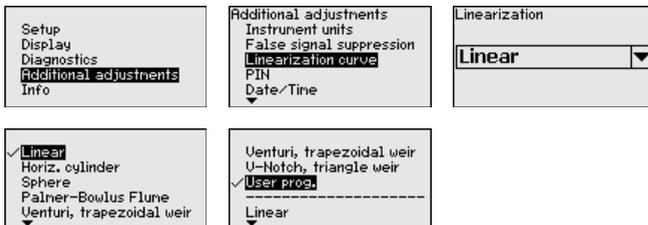


Note:

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 - 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
	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

Menu	Menu item	Default value
	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. 30: 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

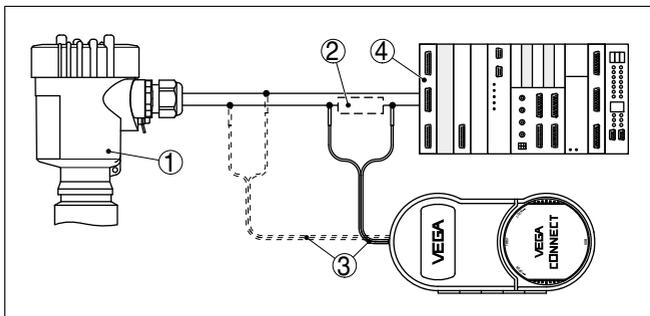


Fig. 31: Connecting the PC via HART to the signal cable

- 1 Sensor
- 2 HART resistance 250 Ω (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 Ω), an additional external resistance is not necessary. This applies, e.g. to the VEGA instruments VEGATRENN 149A, VEGAMET 381, VEGAMET 391. Common Ex separators are also usually equipped with a sufficient current 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.

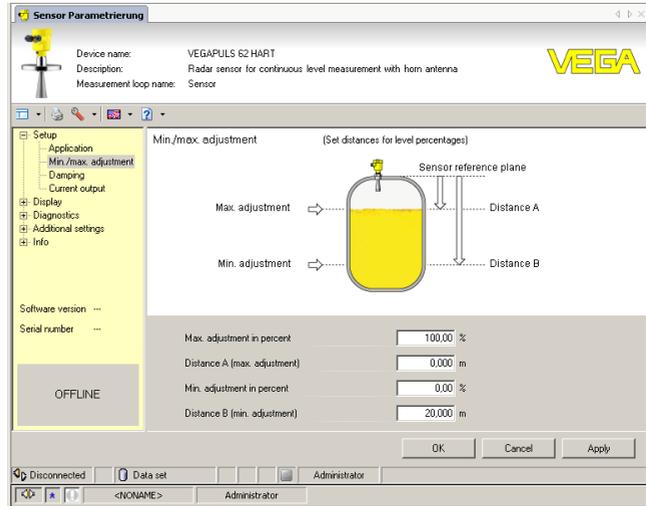


Fig. 32: Example of a DTM view

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 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 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"> ● Sensor does not detect an echo during operation ● Antenna system contaminated or defective 	<ul style="list-style-type: none"> ● Check or correct installation and/or parameter adjustment ● Clean or exchange process component or antenna
F017 Adjustment span too small	<ul style="list-style-type: none"> ● Adjustment not within specification 	<ul style="list-style-type: none"> ● Change adjustment according to the limit values (difference between min. and max. ≥ 10 mm)

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

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"> ● Simulation active 	<ul style="list-style-type: none"> ● Finish simulation ● Wait for the automatic end after 60 mins.

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"> ● Temperature of the electronics in the not specified section 	<ul style="list-style-type: none"> ● Check ambient temperature ● Isolate electronics ● Use instrument with higher temperature range

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

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

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.

Load sensor software to PC

At "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 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.

10 Dismounting

10.1 Dismounting steps

**Warning:**

Before dismounting, 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, Monell Alloy
- Process seal On site (instruments with thread: Klingersil C-4400 is attached)
- Antenna 316L, Hastelloy C22, Tantalum, 316L electropolished, stainless steel investment casting 1.4848, Monell Alloy, 316L Safecoat coated
- Antenna impedance cone PTFE (TFM 1600 PTFE), PP, PEEK, ceramic (99.7 % Al₂O₃)
- seal, antenna system FKM (Viton), FFKM (Kalrez 6375), FFKM (Kalrez 2035), FFKM (Kalrez 6230 - FDA), graphite (99.9 %)

Materials, non-wetted parts

- Housing plastic 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 fittings

- Pipe thread, cylindrical (ISO 228 T1) G $\frac{3}{4}$ A, G1 $\frac{1}{2}$ A, G2 A
- American pipe thread, tapered 1 $\frac{1}{2}$ NPT, 2 NPT
- Flanges DIN from DN 25, ANSI from 1"

Weights

- Instrument (depending on housing, process fitting and antenna) approx. 2 ... 17.2 kg (4.409 ... 37.92 lbs)
- Antenna extension 1.6 kg/m (1.1 lbs/ft)

Length antenna extension max. 5.85 m (19.19 ft)

Torque for NPT cable glands and Conduit tubes

- Housing plastic 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.

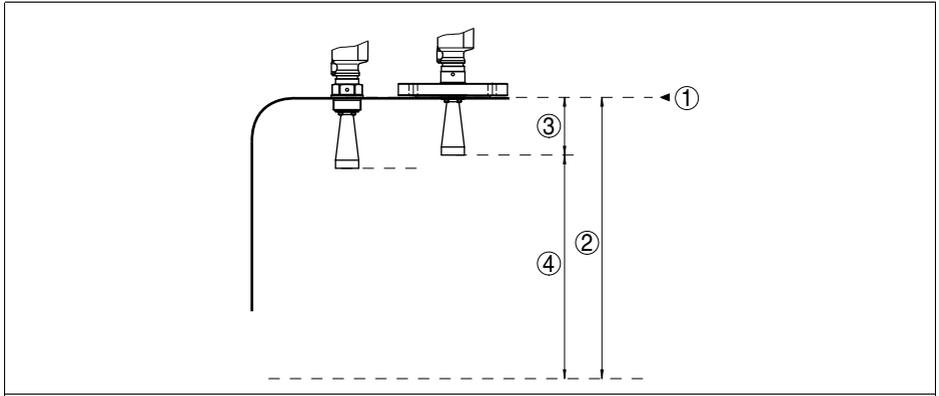


Fig. 33: Data of the input variable

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

Max. measuring range	75 m (246.1 ft)
Recommended meas. range depending on the antenna diameter	
– ø 40 mm (1.575 in)	up to 15 m (49.21 ft)
– ø 48 mm (1.89 in)	up to 20 m (65.62 ft)
– ø 75 mm (2.953 in)	up to 40 m (131.2 ft)
– ø 95 mm (3.74 in)	up to 50 m (164 ft)
– Parabolic antenna	up to 75 m (246.1 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 µA
Residual ripple	±0.4 µA
Failure signal current output (adjustable)	mA-value unchanged 20.5 mA, 22 mA, < 3.6 mA
Max. output current	22 mA
Starting current	≤ 3.6 mA; ≤ 10 mA for 5 ms after switching on

Load	see load diagram under Power supply
Damping (63 % of the input variable)	0 ... 999 s, adjustable
HART output values according to HART 7.0 ¹⁾	
– 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)

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

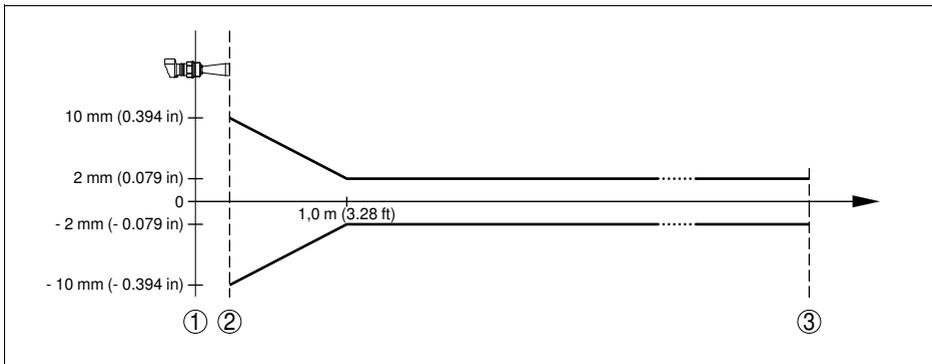


Fig. 34: Deviation under reference conditions

- 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.

¹⁾ Default values, can be assigned individually

Deviation under EMC influence $\leq \pm 30$ mm

Variables influencing measurement accuracy

Temperature drift	± 0.03 %/10 K relating to the 16 mA span max. ± 0.3 %
Temperature drift - Digital output	± 3 mm/10 K relating to the max. measuring range or max. 10 mm
Deviation on the current output by analogue/digital conversion	$< \pm 15$ μ A
Deviation on the current output by strong, high frequency electromagnetic fields within EN 61326	$< \pm 100$ μ A
Additional deviation through strong, high frequency electromagnetic fields acc. to EN 61326	$< \pm 50$ mm

Characteristics and performance data

Frequency	K-band (26 GHz technology)
Beam angle ²⁾	
– Horn antenna \varnothing 40 mm (1.575 in)	22°
– Horn antenna \varnothing 48 mm (1.89 in)	18°
– Horn antenna \varnothing 75 mm (2.953 in)	10°
– Horn antenna \varnothing 95 mm (3.74 in)	8°
– Parabolic antenna	4°
Step response time ³⁾	> 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	< 2 ns
– Average power	< 25 μ W
– Average power with 1 m distance	< 1 μ W/cm ²

Ambient conditions

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

Process conditions

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

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

Seal	Antenna impedance cone	Process temperature (measured on the process fitting)
FKM (Viton)	PFFE	-40 ... +130 °C (-40 ... +266 °F)
	PFFE	-20 ... +200 °C (-4 ... +392 °F)
	PP	-40 ... +80 °C (-40 ... +176 °F)
	PEEK	-40 ... +200 °C (-40 ... +392 °F)
FFKM (Kalrez 6375)	PFFE	-20 ... +130 °C (-4 ... +266 °F)
	PFFE	-20 ... +200 °C (-4 ... +392 °F)
	PP	-15 ... +80 °C (+5 ... +176 °F)
	PEEK	-20 ... +250 °C (-4 ... +482 °F)
FFKM (Kalrez 2035)	PFFE	-15 ... +130 °C (5 ... +266 °F)
	PTFE	-15 ... +200 °C (5 ... +392 °F)
	PEEK	-15 ... +210 °C (5 ... +410 °F)
FFKM (Kalrez 6230)	PFFE	-15 ... +130 °C (5 ... +266 °F)
	PTFE	-15 ... +200 °C (5 ... +392 °F)
	PEEK	-15 ... +250 °C (5 ... +482 °F)
Graphite	Ceramic	-200 ... +450 °C (-328 ... +842 °F)

Vessel pressure - horn antenna

- Antenna impedance cone PTFE -1 ... 40 bar/-100 ... 4000 kPa (-14.5 ... 580 psi)
- Antenna impedance cone PEEK -1 ... 100 bar/-100 ... 10000 kPa (-14.5 ... 1450 psi)
- Antenna impedance cone ceramic -1 ... 160 bar/-100 ... 16000 kPa (-14.5 ... 2320 psi)

Vessel pressure - parabolic antenna

-1 ... 6 bar/-100 ... 6000 kPa (-14.5 ... 870 psi)

Vessel pressure relating to the flange nominal stage

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

Vibration resistance⁴⁾

- Horn antenna mechanical vibrations with 4 g and 5 ... 100 Hz
- Parabolic antenna mechanical vibrations with 1 g and 5 ... 100 Hz

Data on rinsing air connection

Pressure max.	6 bar (87.02 psig)
Air quantity without reflux valve	
- 0.2 bar (2.9 psig)	2.0 m ³ /h
- 0.5 bar (7.25 psig)	3.5 m ³ /h

⁴⁾ Tested according to the guidelines of German Lloyd, GL directive 2.

- 1 bar (14.5 psig) 4.5 m³/h
- 1.5 bar (21.76 psig) 5 m³/h
- 2 bar (29.0 psig) 5.5 m³/h

Thread G1½ A

Catch

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

Reflux valve - unmounted (as option with non-Ex version, included in the scope of delivery with Ex version)

- Material 316Ti
- Seal FKM (Viton), FFKM (Kalrez 6375)
- for tube diameter 6 mm
- opening pressure 0.5 bar (7.25 psig)
- Nominal pressure stage PN 250

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

Cable entry/plug⁵⁾

- Single chamber housing
 - 1 x cable gland M20 x 1.5 (cable: ø 5 ... 9 mm), 1 x blind stopper M20 x 1.5
 - or:
 - 1 x closing cap M20 x 1.5; 1 x blind stopper M20 x 1.5
 - or:
 - 1 x closing cap ½ NPT, 1 x blind plug ½ NPT
 - or:
 - 1 x plug (depending on the version), 1 x blind stopper M20 x 1.5
- Double chamber housing
 - 1 x cable entry M20 x 1.5 (cable: ø 5 ... 9 mm), 1 x blind stopper M20 x 1.5; 1 x blind stopper M16 x 1.5 or optional⁶⁾ 1 x plug M12 x 1 for external indicating and adjustment unit
 - or:

⁵⁾ Depending on the version M12 x 1, according to ISO 4400, Harting, 7/8" FF.
⁶⁾ 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 optionally⁷⁾ 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 optionally⁸⁾ 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 mm² (AWG 24 ... 14)
- Cord with cable end sleeve 0.2 ... 1.5 mm² (AWG 24 ... 16)

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

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 mm² (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

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

⁷⁾ Only with Ex d version

⁸⁾ Only with Ex d version

- Housing ABS
- Inspection window Polyester foil

Integrated clock

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

Electronics temperature measurement

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

Voltage supply

- 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

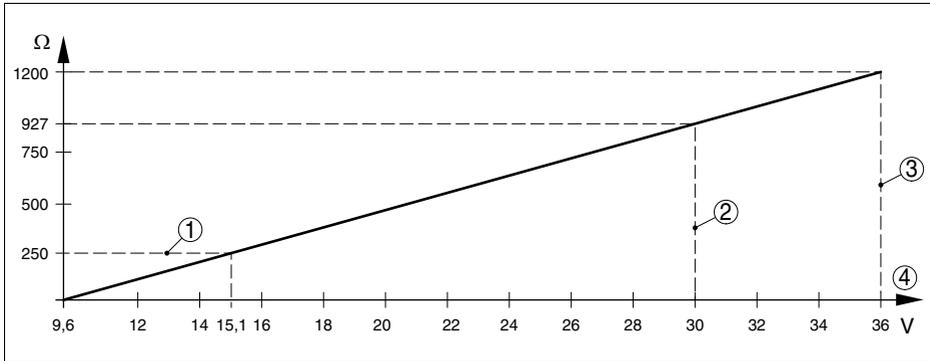


Fig. 35: Voltage diagram

- 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)⁹⁾
- 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.

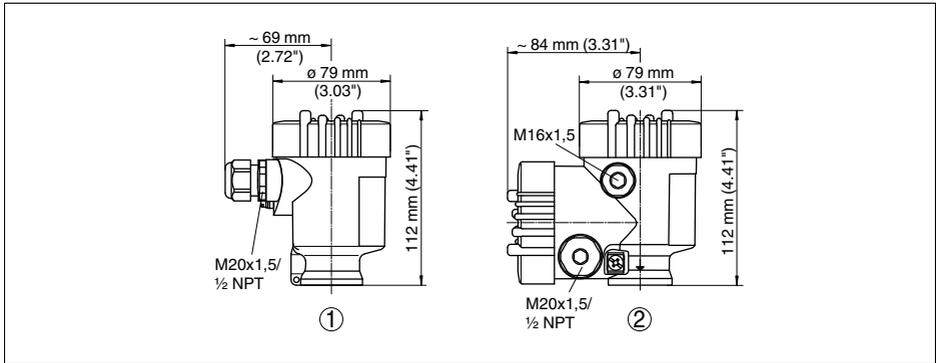
For these instruments, the corresponding approval documents have to be taken into account. These are part of the delivery or can be downloaded under www.vega.com via "VEGA Tools" and "serial number search" as well as via "Downloads" and "Approvals".

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

11.2 Dimensions

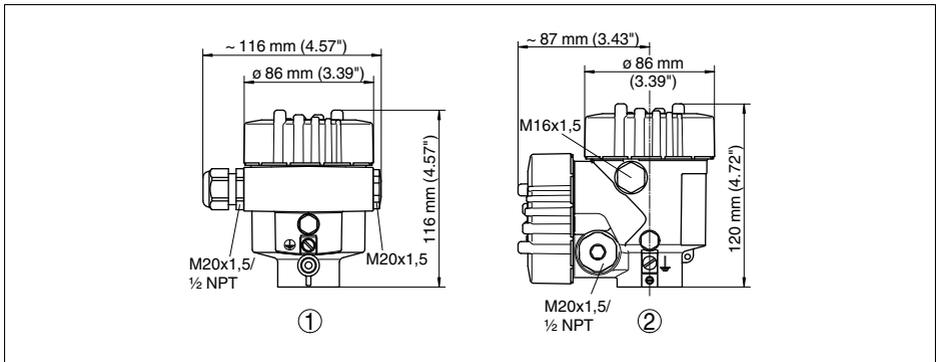
The following dimensional drawings represent only an extract of the possible versions. Detailed dimensional drawings can be downloaded on www.vega.com under "Downloads" and "Drawings".

Housing plastic



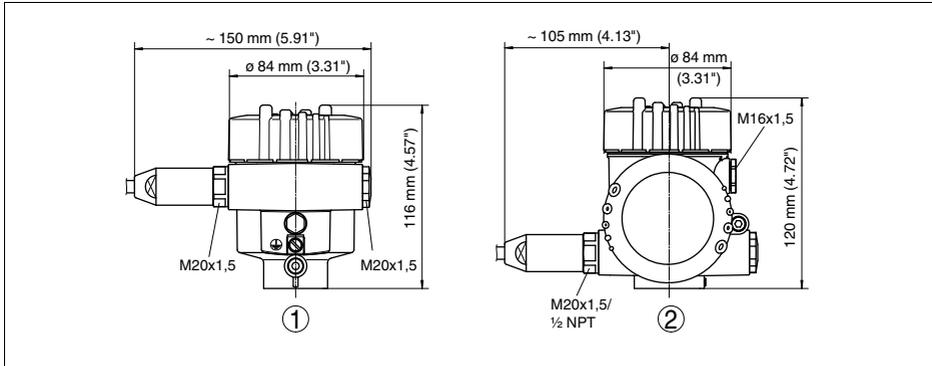
- 1 Single chamber version
- 2 Double chamber version

Aluminium housing



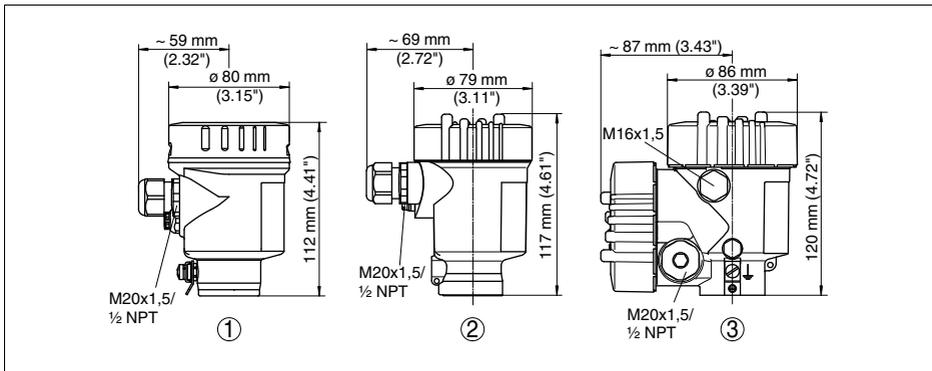
- 1 Single chamber version
- 2 Double chamber version

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



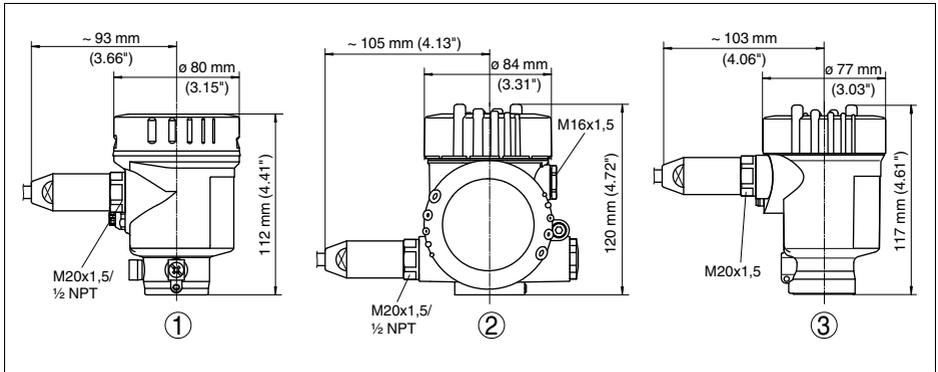
- 1 Single chamber version
- 2 Double chamber version

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 68 - horn antenna in threaded version

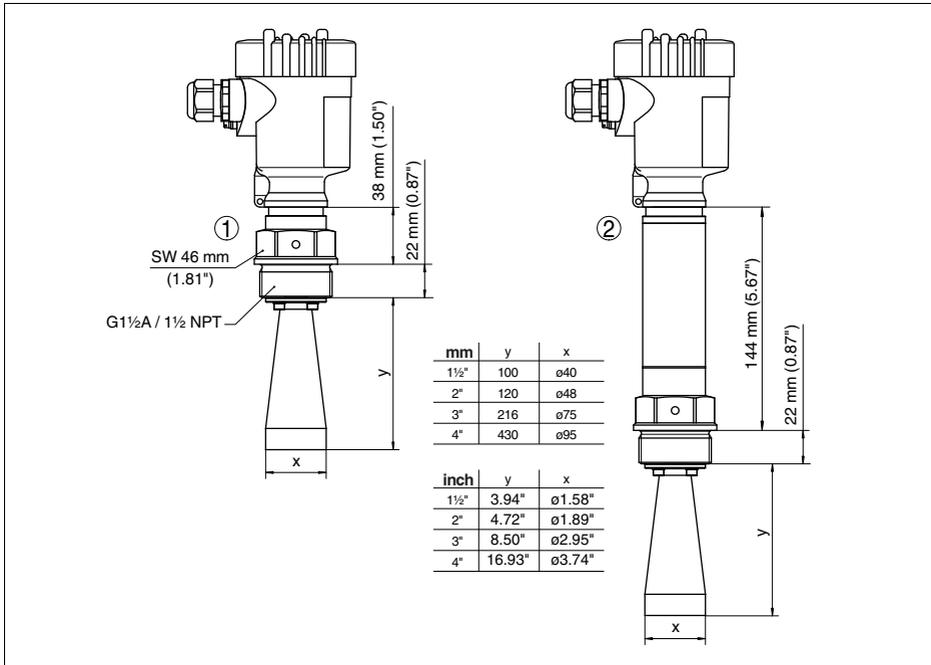


Fig. 41: Radar sensor with horn antenna in threaded version

- 1 Standard
- 2 With temperature adapter up to 250 °C

VEGAPULS 68 - horn antenna in flange version

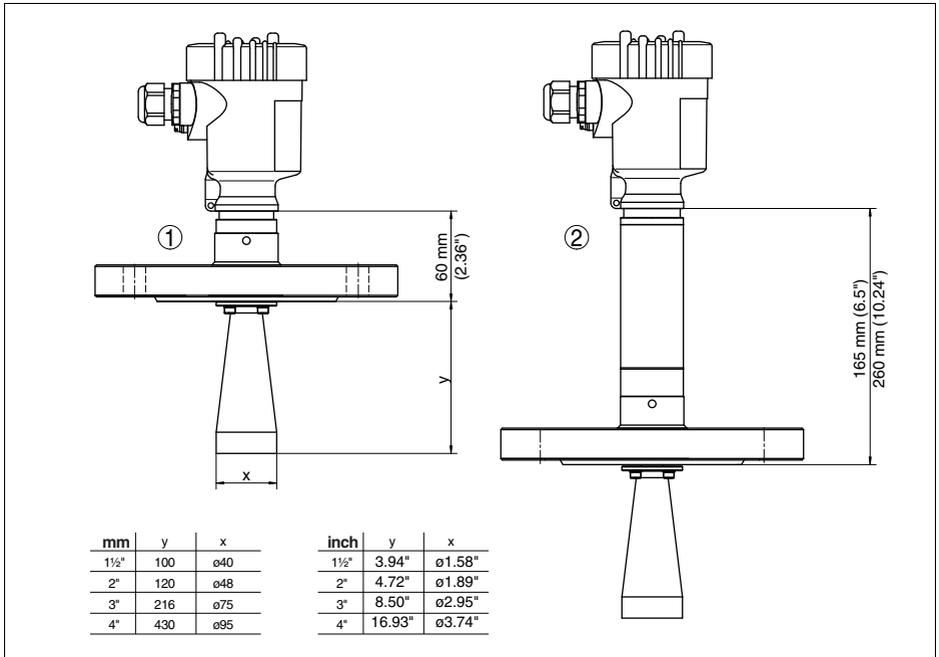


Fig. 42: Radar sensor with horn antenna in flange version

- 1 Standard
- 2 With temperature adapter up to 250 °C/450 °C

VEGAPULS 68 - horn antenna and swivelling holder

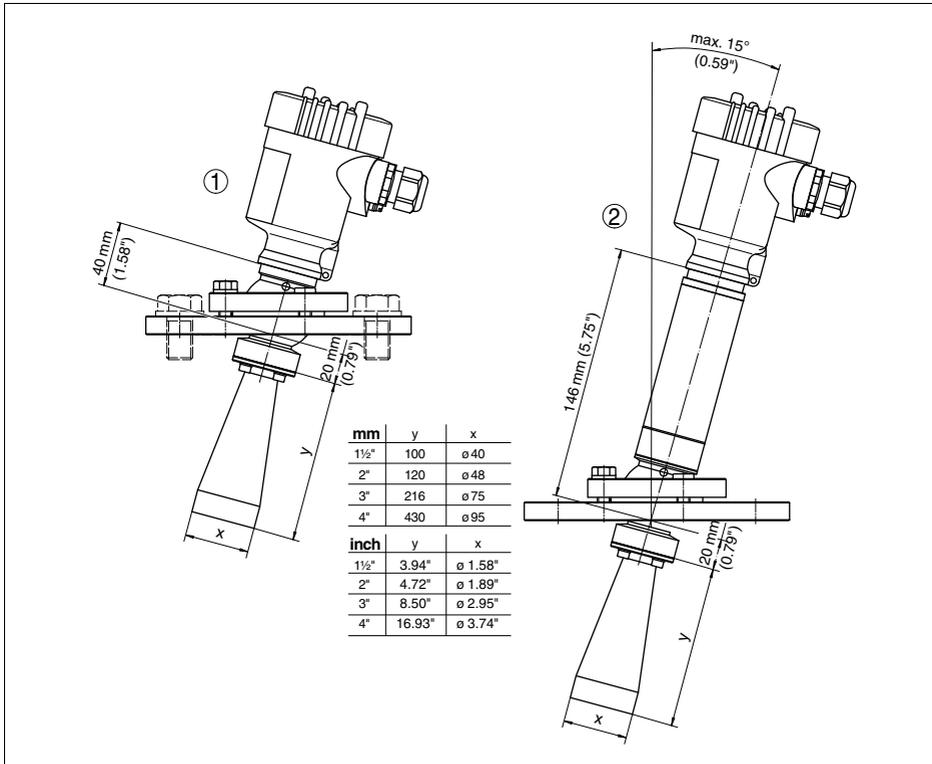


Fig. 43: Radar sensor with horn antenna and swivelling holder

- 1 Standard
- 2 With temperature adapter up to 250 °C

VEGAPULS 68 - parabolic antenna and swivelling holder

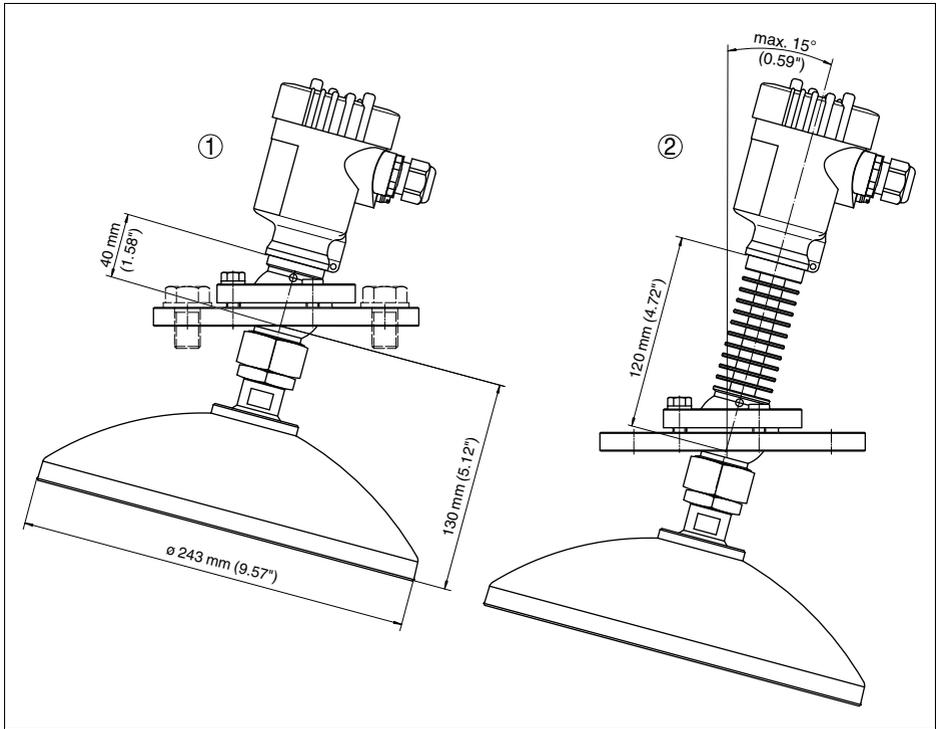


Fig. 44: Radar sensor with parabolic antenna and swivelling holder

- 1 Standard
- 2 With temperature adapter up to 200 °C

11.3 Industrial property rights

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Printing date:

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