Operating Instructions

VEGAPULS SR 68

4 … 20 mA/HART two-wire

Document ID:
38294

Radar

Contents

38294-EN-110209

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.

1 **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 SR 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 overfill 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 necessary occupational safety measures with the current valid rules and regulations and also take note of new regulations.

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

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

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 applicable NAMUR recommendations.

2.7 Radio approval for Europe

The instrument is approved according to EN 302372-1/2 (2006-04) for use in closed vessels.

2.8 Radio approval for USA/Canada

The instrument is in conformity with part 15 of the FCC regulations. Take note of the following two regulations:

- The device must not generate interference emissions, and
- The device must be insensitive to interfering immissions, including those that may cause undesirable operating conditions.

Modifications not expressly approved by the manufacturer will lead to expiry of the operating licence according to FCC/IC.

The instrument is in conformity with RSS-210 of the IC regulations.

The instrument may only be operated in closed vessels made of metal, concrete, or fibre-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 Structure

Type label

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

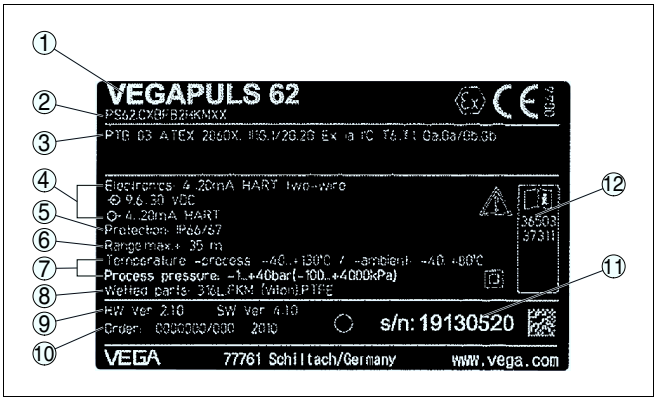

Fig. 1: Structure of the type label (example)

1 *Instrument type*
2 *Product code*
3 *Approvals*
4 *Electronics*
5 *Protection rating*
6 *Measuring range*
7 *Process and ambient 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 call up the order data, operating instructions manuals, sensor data for the service DTM as well as the test certificate (depending on the instrument). To do this, open under 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 2.1.1
- Software from 4.4.0
- Modification status electronics from -25

Scope of delivery

The scope of delivery encompasses:

- Radar sensor
- Documentation
  - this operating instructions manual

- Safety Manual (SIL) (optional)
- Test certificate measuring accuracy (optional)
- Operating instructions manual "*Indicating and adjustment module*" (optional)
- Supplementary instructions "*GSM/GPRS 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

The instrument is designed for level measurement of bulk solids even under difficult process conditions. Its mechanical construction and electronics are specially optimised for such applications. Many application possibilities can be found in the food processing industry, in plastics processing and steel production as well as in the building industry.

The instrument is particularly suitable for average-size silos and vessels.

The instrument is also suitable for applications in liquids.

The use of the instrument is possible with products with an ε_r value ≥1.5. The reachable value depends on the measurement conditions, the antenna system, the standpipe or bypass.

Functional principle

The antenna of the radar sensor emits short radar pulses with a duration of approx. 1 ns. These pulses are reflected by the product and received by the antenna as echoes. The 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 appropriately dealt with.

Storage

Up to the time of installation, the packages must be left closed and stored according to the orientation and storage markings on the outside.

Unless otherwise indicated, the packages must be stored only under the following conditions:

- Not in the open
- Dry and dust free
- Not exposed to corrosive media
- Protected against solar radiation
- Avoiding mechanical shock and vibration

Storage and transport temperature

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

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 a four-wire, screened standard cable up to 50 m long.

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 T61 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 supplementary instructions "*PLICSMOBILE T61*" (Document-ID 36849).

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).

Flanges

Flanges are available in different versions according to the following standards: DIN 2501, EN 1092-1, ANSI B 16.5, JIS B 2210-1984, GOST 12821-80.

You will find additional information in the supplementary instructions manual "*Flanges according to DIN-EN-ASME-JIS*" (Document-ID 31088).

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).

Antenna impedance cone

The antenna impedance cone is used for optimum transmission of microwaves and for sealing against the process.

You find further information in the operating instructions "*Antenna impedance cone VEGAPULS 62 and 68*" (Document-ID 31381).

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 active measuring component, process 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 with an antenna whose diameter is larger than the process fitting (thread, flange). In such cases the antenna must 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).

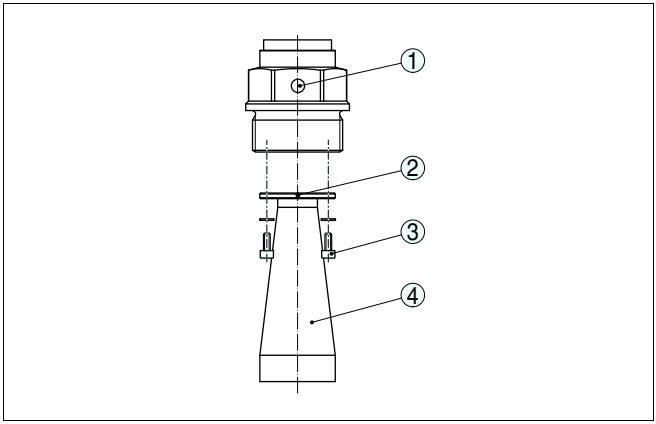

Fig. 2: Dismounting of the horn antenna

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

4.3 Mounting instructions

Polarisation plane

The emitted radar impulses of the radar sensor are electromagnetic waves. The polarisation plane 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.

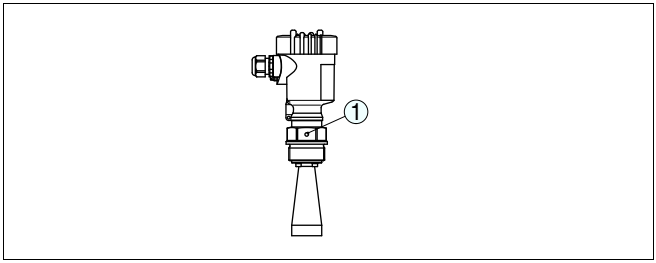

Fig. 3: Position of the polarisation level

1 Marking hole

Mounting position

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

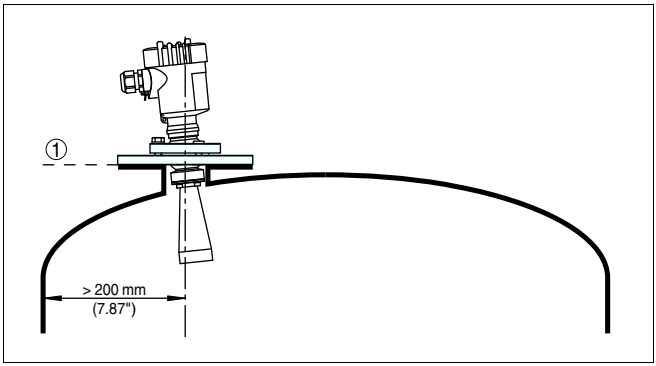

Fig. 4: Mounting of the radar sensor on round vessel tops

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 interferred. 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.

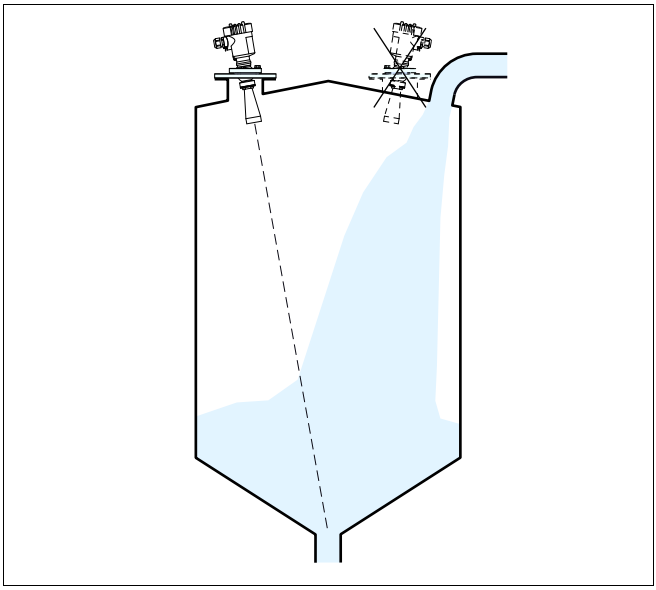

Fig. 5: Mounting of the radar sensor with inflowing medium

Socket

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

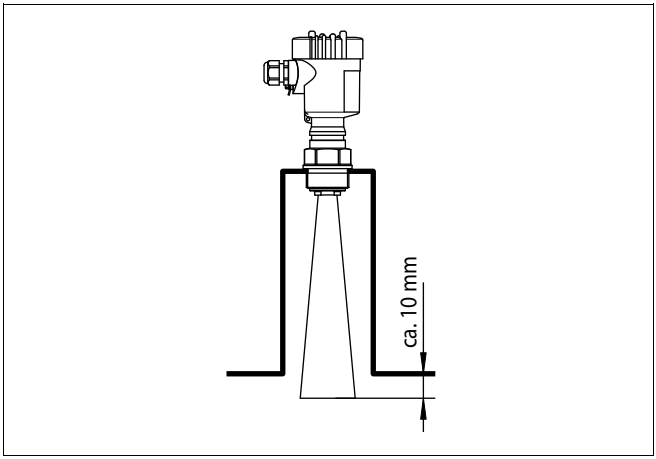

Fig. 6: Recommended socket mounting with horn antenna

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.

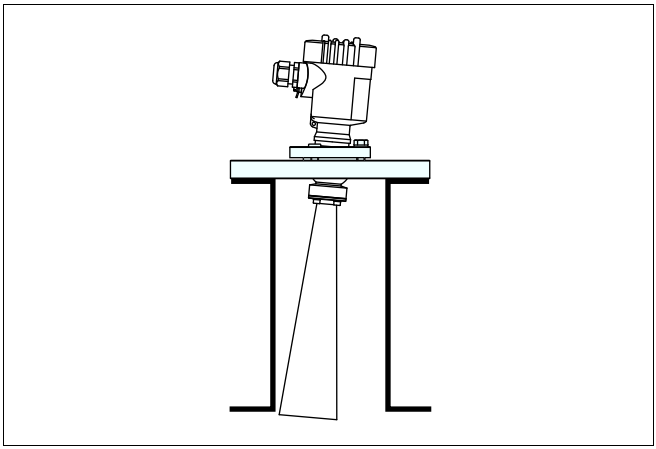

Fig. 7: Distance between antenna and socket with horn antenna

If the medium has good reflective properties, VEGAPULS SR 68 with horn antenna 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.

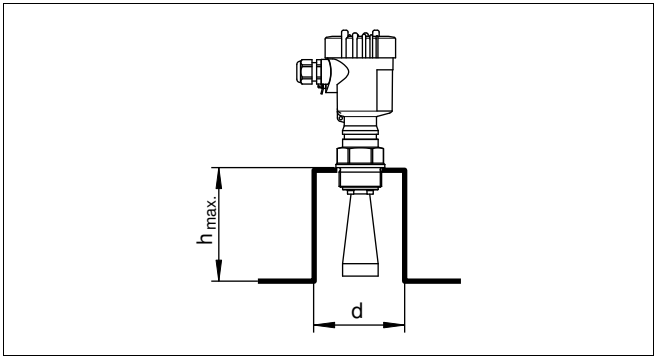

Fig. 8: Deviating socket dimensions

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.

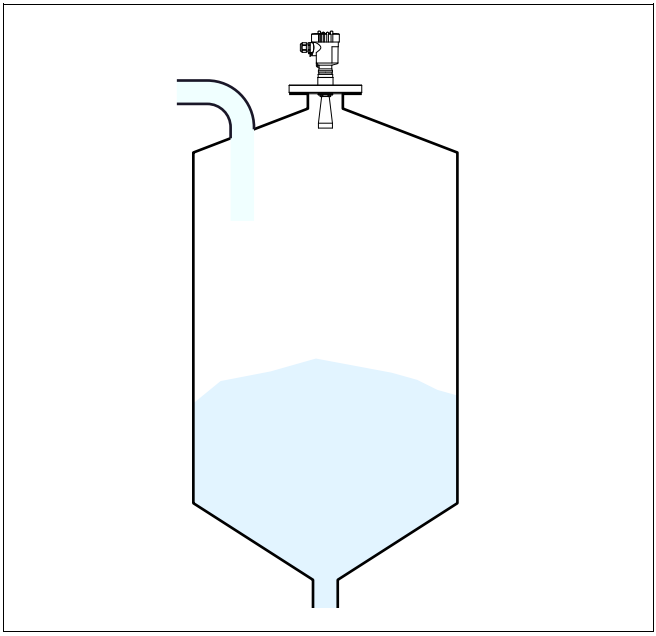

Fig. 9: Orientation

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.

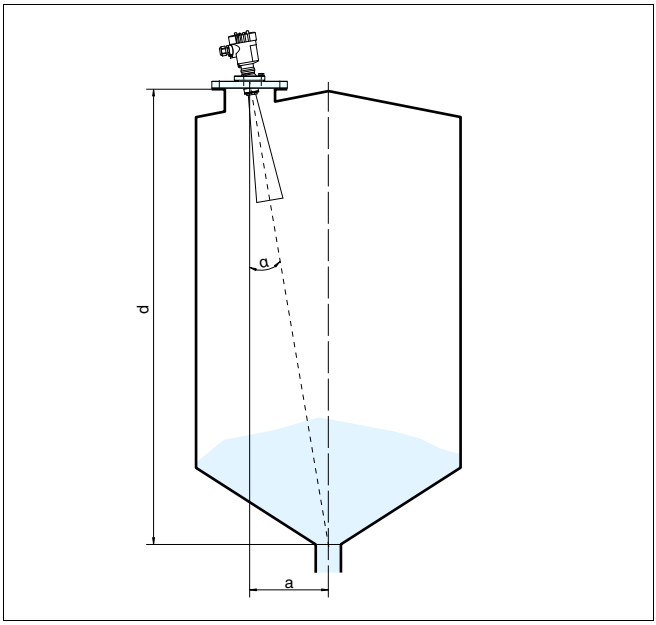

Fig. 10: Proposal for installation after orientation VEGAPULS SR 68

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

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.

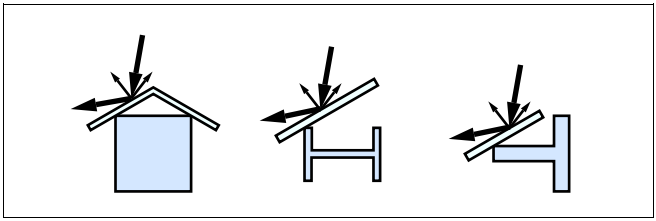

Fig. 11: Cover smooth profiles with deflectors

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.

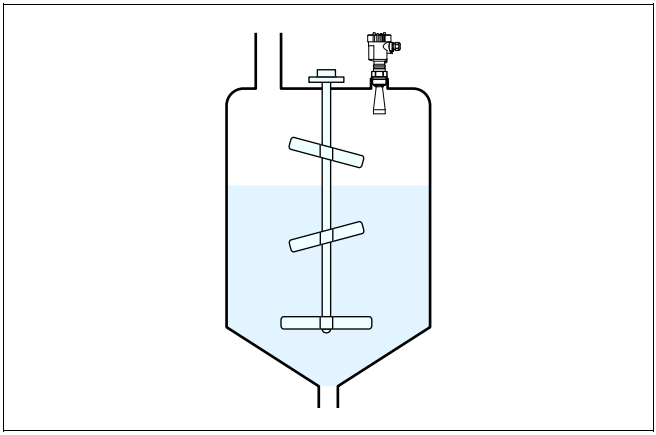

Fig. 12: Agitators

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 infuence of the sensors is not possible.

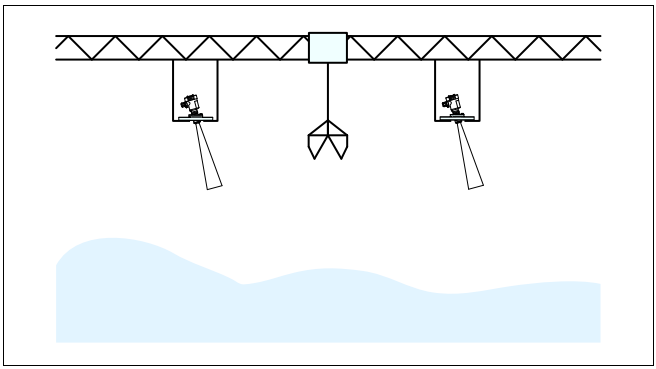

Fig. 13: Radar sensors on traverse crane

Information:
Keep in mind that for these applications, the sensors are designed for relatively slow level changes. When using VEGAPULS SR 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. Ths distance piece is used for thermal decoupling of the electronics against high process temperatures.

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

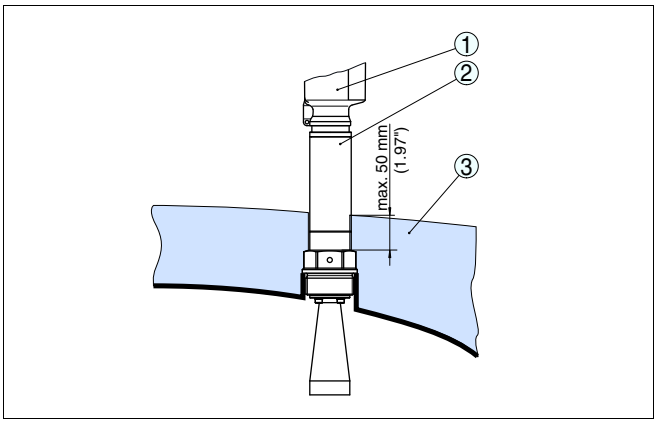

Fig. 14: Mounting of the instrument with insulated vessels.

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 aluminium or stainless steel housing.

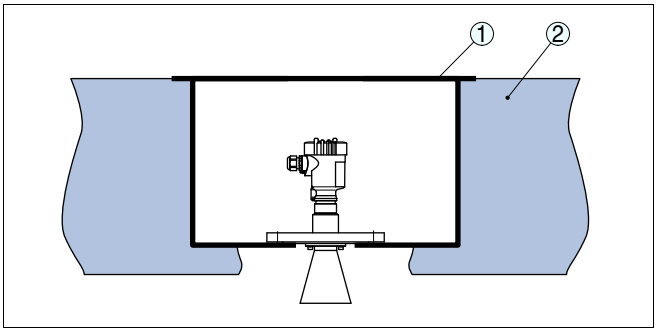

Fig. 15: Mounting of the instrument in an subsurface enclosure

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.

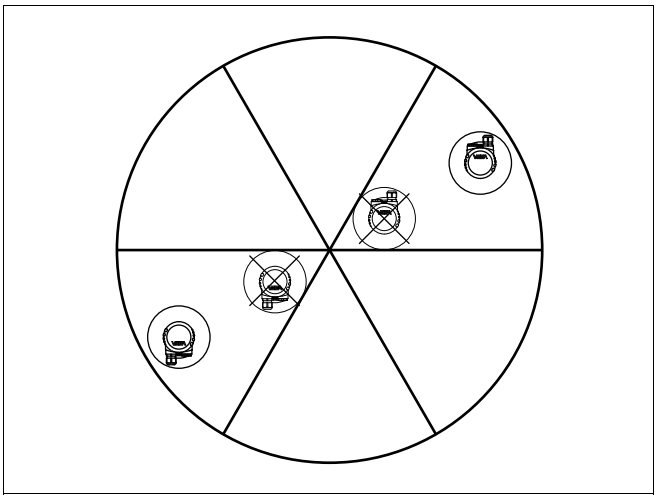

Fig. 16: Mounting of VEGAPULS SR 68 in multiple chamber silos

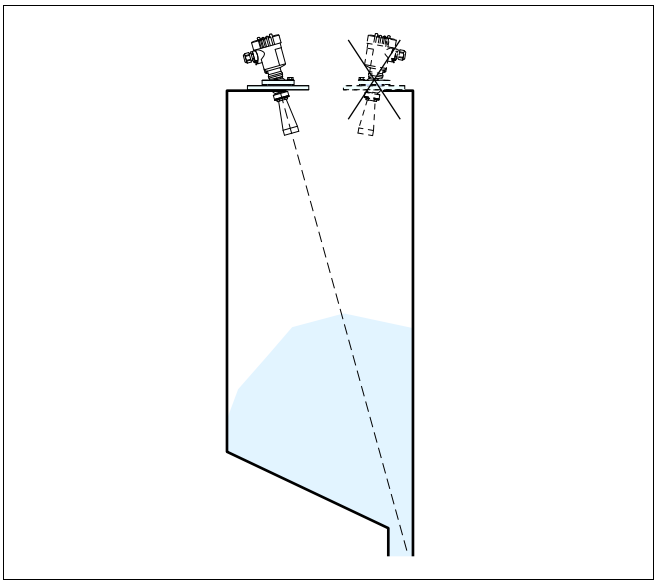

Fig. 17: Orientation of VEGAPULS SR 68 for emptying in the silo center

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 deposits in the antenna system, VEGAPULS SR 68 is available with a rinsing air connection. The air is distributed via channels in the antenna system and keeps it largely free of dust.

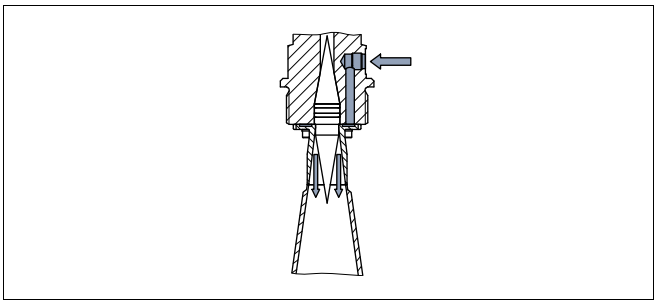

Fig. 18: Purging air connection with horn antenna

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 the following additional influences for the operating voltage in mind:

- 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 SR 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.

For instruments with housing and cable gland, 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*"

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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. Considerable 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. 19: 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. To do this, 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

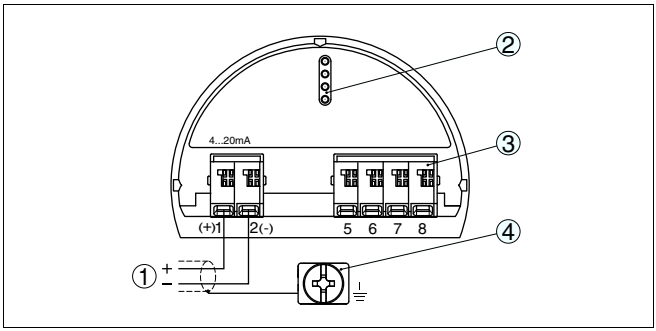


Fig. 20: Electronics and connection compartment, single chamber housing

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

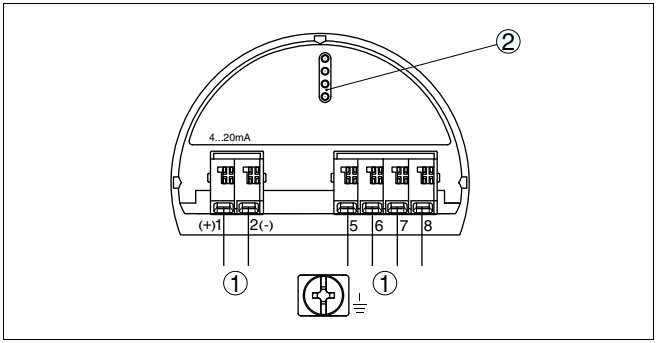


Fig. 21: Electronics compartment, double chamber housing

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

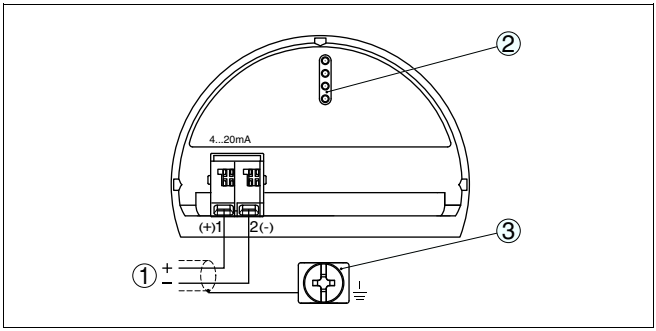


Fig. 22: Connection compartment, double chamber housing

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

Radio module PLICSMOBILE integrated in the connection compartment

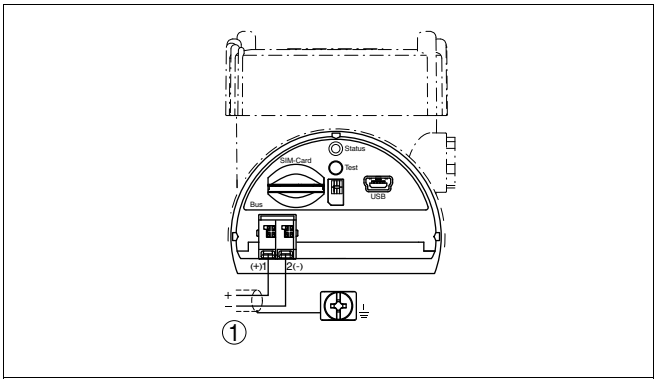


Fig. 23: CConnection of the voltage supply of the radio module

1 Voltage supply

You can find detailed information for connection in the supplementary instructions "*PLICSMOBILE GSM/GPRM radio module*".

5.5 Wiring plan with double chamber housing Ex d

Electronics compartment

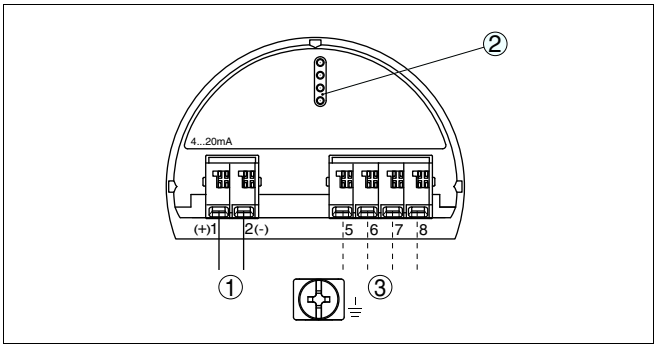


Fig. 24: Electronics compartment, double chamber housing

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

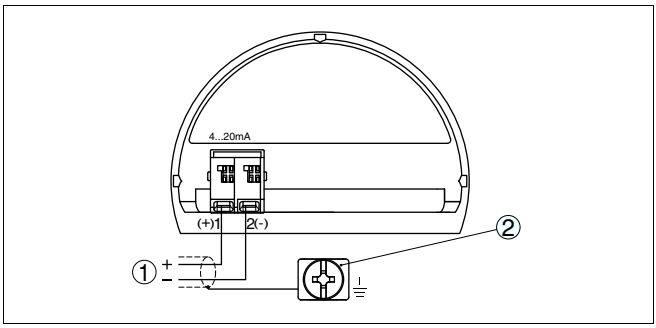


Fig. 25: Connection compartment with double chamber housing Ex d

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

Plug M12 x 1 for VEGADIS 61

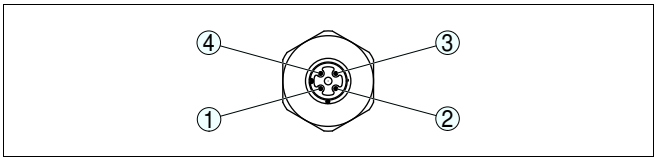


Fig. 26: Top view of the plug connector

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

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

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

Wire assignment connection cable

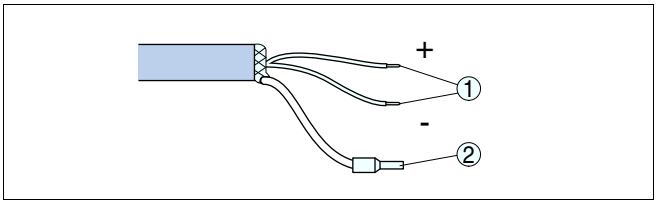


Fig. 27: Wire assignment fix-connected connection cable

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 s:

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

As soon as a plausible measured value is found, 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.

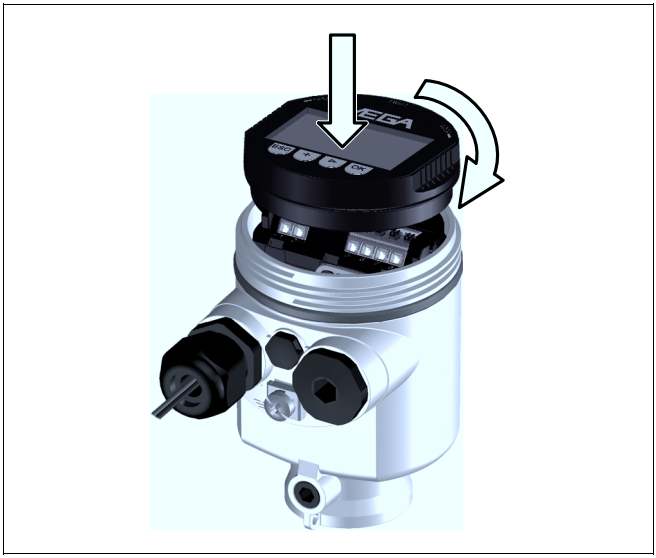


Fig. 28: Insert indicating and adjustment module

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

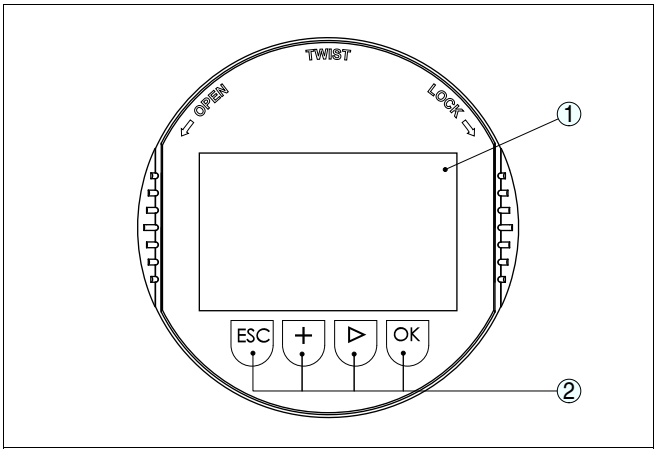


Fig. 29: Indicating and adjustment elements

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.

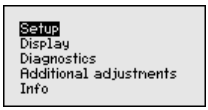
6.3 Parameter adjustment

Through 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: Settings, for example language, measured value display, lighting

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

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

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

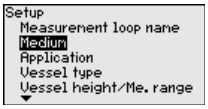
In the main menu point "*Setup*", the individual submenu points should be selected subsequently and provided with the correct parameters to ensure the optimum adjustment of the measurement. The procedure is described in the following.

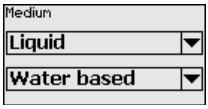
Setup

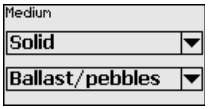
Setup/Medium

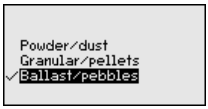
Each medium has different reflection properties. With liquids, further interfering factors are fluctuation product surface and foam generation. With bulk solids, these are dust generation, material cone and additional echoes from the vessel wall.

To adapt the sensor to these different measuring conditions, the selection "*Liquid*" or "*Bulk solid*" should be made in this menu item.









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

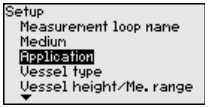
Enter the requested parameters via the appropriate keys, save your settings with ***[OK]*** and jump to the next menu item with the ***[ESC]*** and the ***[->]*** key.

Setup

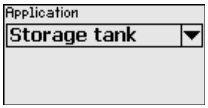
Setup/Application

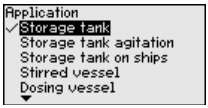
In addition to the medium, also the application or the application place can influence the measurement.

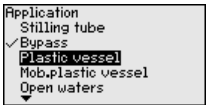
With this menu item, the sensor can be adapted to the applications. The adjustment possibilities depend on the selection "*Liquid*" or "*Bulk solid*" under "*Medium*".

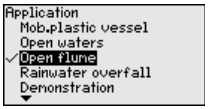


The following options are available when "*Liquid*" is selected:

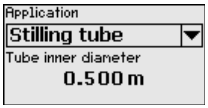


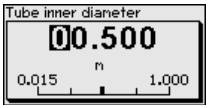






The selection "*Standpipe*" opens a new window in which the inner diameter of the applied standpipe is entered.





The following features form the basis of the applications:

Storage tank:

- Setup: large-volumed, upright cylindrical, spherical
- Product speed: slow filling and emptying
- Process/measurement conditions
  - Condensation
  - Smooth product surface
  - Max. requirement to the measurement accuracy

Storage tanke with product circulation:

- Setup: large-volumed, upright cylindrical, spherical
- Product speed: slow filling and emptying
- Vessel: small laterally mounted or large top mounted stirrer
- Process/measurement conditions
  - Relatively smooth product surface
  - Max. requirement to the measurement accuracy
  - Condensation
  - Slight foam generation
  - Overfilling possible

Storage tank on ships (Cargo Tank):

- Product speed: slow filling and emptying
- Vessel:
  - Installations in the bottom section (bracers, heating spirals)
  - High sockets 200 … 500 mm, also with large diameters
- Process/measurement conditions:
  - Condensation, buildup by movement
  - Max. requirement on measurement accuracy from 95 %

Stirrer vessel (reactor):

- Setup: all vessel sizes possible
- Product speed:
  - Fast to slow filling possible
  - Vessel is very often filled and emptied
- Vessel
  - Socket available
  - Large agitator blades of metal
  - Vortex breakers, heating spirals
- Process/measurement conditions
  - Condensation, buildup by movement
  - Strong spout generation
  - Very agitated surface, foam generation

Dosing vessel:

- Setup: all vessel sizes possible
- Product speed:
  - Fast filling and emptying
  - Vessel is very often filled and emptied
- Vessel: narrow installation situation
- Process/measurement conditions
  - Condensation, buildup on the antenna

- Foam generation

Standpipe:

- Product speed: very fast filling and emptying
- Vessel
  - Vent hole
  - Joins like flanges, weld joints
  - Shifting of the running time in the tube
- Process/measurement conditions
  - Condensation
  - Buildup

Bypass:

- Product speed:
  - Fast up to slow filling with short up to long bypass tube possible
  - Often the level is hold via a control facility
- Vessel
  - Lateral outlets and inlets
  - Joins like flanges, weld joints
  - Shifting of the running time in the tube
- Process/measurement conditions
  - Condensation
  - Buildup
  - Separation of oil and water possible
  - Overfilling into the antenna possible

Plastic tank:

- Vessel
  - Measurement fix mounted or integrated
  - Measurement depending on the application through the vessel top
  - With empty vessel, the measurement can be carried out through the bottom
- Process/measurement conditions
  - Condensation on the plastic ceiling
  - In outside facilities water and snow on the vessel top possible

Transportable plastic tank:

- Vessel
  - Material and thickness different
  - Measurement through the vessel top
- Process/measurement conditions
  - Measured value jump with vessel change

Open water (gauge measurement):

- Gauge rate of change: slow gauge change
- Process/measurement conditions

- Distance sensor to water surface to big
- Extreme damping of output signal due to wave generation
- Ice and condensation on the antenna possible
- Spiders and insect nestle in the antennas
- Floating material and animals sporadically on the water surface

Open flume (flow measurement):

- Gauge rate of change: slow gauge change
- Process/measurement conditions
  - Ice and condensation on the antenna possible
  - Spiders and insect nestle in the antennas
  - Smooth water surface
  - Exact measurement result required
  - Distance to the water surface normally relatively high

Rain water overfall (weir):

- Gauge rate of change: slow gauge change
- Process/measurement conditions
  - Ice and condensation on the antenna possible
  - Spiders and insect nestle in the antennas
  - Turbulent water surface
  - Sensor flooding possible

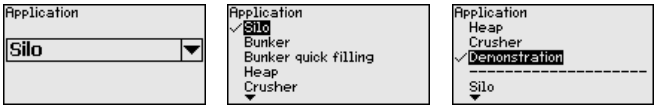
Demonstration:

- Adjustment for all applications which are not typically level measurement
- Sensor accepts all measured value changes within the measuring range immediately
- Typical applications
  - Instrument demonstration
  - Object recognition/monitoring (additional settings required)

Caution:
If a separation of liquids with different ε_r values occurs in the vessel, for example through condensation, the radar sensor can detect under certain circumstances only the medium with the higher dielectric value. Keep in mind that layer interfaces can cause faulty measurements.

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

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



The following features form the basis of the applications:

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Silo (slim and high):

- Vessel of metal: weld joints
- Process/measurement conditions:
  - Filling too close to the sensor
  - System noise with completely empty silo increased
  - Automatic false signal suppression with partly filled vessel

Bunker (large-volumed):

- Vessel of concrete or metal:
  - Structured vessel walls
  - Installations present
- Process/measurement conditions:
  - Large distance to the medium
  - Large angles of repose

Bunker with fast filling:

- Vessel of concrete or metal, also multiple chamber silo:
  - Structured vessel walls
  - Installations present
- Process/measurement conditions:
  - Measured value jumps, e.g. by truck loading
  - Large distance to the medium
  - Large angles of repose

Heap:

- Sensor mounting on movable conveyor belts
- Detection of the heap profile
- Height detection during filling
- Process/measurement conditions:
  - Measured value jumps, e.g. by the profile of the heap or traverses
  - Large angles of repose
  - Measurement near the filling stream

Crusher:

- Vessel: installations, wear and protective facilities available
- Process/measurement conditions:
  - Measured value jumps, e.g. by truck loading
  - Fast reaction time
  - Large distance to the medium

Demonstration:

- Adjustment for all applications which are not typically level measurement
- Sensor accepts all measured value changes within the measuring range immediately
- Typical applications
  - Instrument demonstration
  - Object recognition/monitoring (additional settings required)

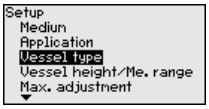
Through this selection, the sensor is adapted optimally to the application or the location and measurement reliability under the various basic conditions is increased considerably.

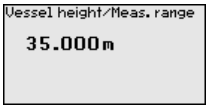
Enter the requested parameters via the appropriate keys, save your settings with ***[OK]*** and jump to the next menu item with the ***[ESC]*** and the ***[->]*** key.

Setup/Vessel height, measuring range

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

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

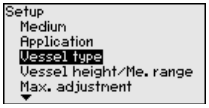


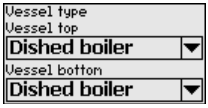


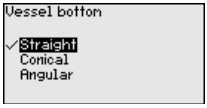
Enter the requested parameters via the appropriate keys, save your settings with ***[OK]*** and jump to the next menu item with the ***[ESC]*** and the ***[->]*** key.

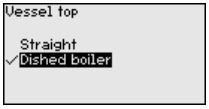
Setup/Vessel form

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









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

Setup/Adjustment

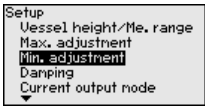
Because a radar sensor is a distance measuring instrument, the distance from the sensor to the product surface is measured. To have the real product level displayed, an allocation of the measured distance to the percentage height must be made. To carry out this adjustment, the distance is entered with 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.

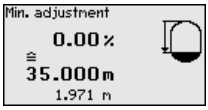
The real product level during this adjustment is not important, because the min./max. adjustment is always carried out without changing the product level. These settings can be made ahead of time without the instrument having to be installed.

Setup/Min. adjustment

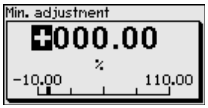
Proceed as follows:

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

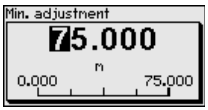




2 Edit the percentage value with ***[OK]*** and set the cursor to the requested position with ***[->]***.



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



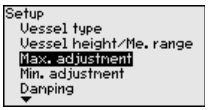
4 Enter the suitable distance value in m for the empty vessel (e.g. distance from the sensor to the vessel bottom) corresponding to the percentage value.

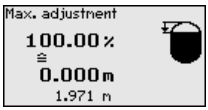
5 Save settings with ***[OK]*** and move with ***[ESC]*** and ***[->]*** to the max. adjustment.

Setup/Max. adjustment

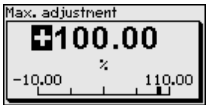
Proceed as follows:

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

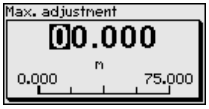




2 Prepare the percentage value for editing with ***[OK]*** and set the cursor to the requested position with ***[->]***.



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

Further settings/False signal suppression

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

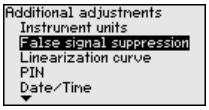
- High sockets
- Vessel installations such as struts
- Agitators
- Buildup or welded joints on vessel walls

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

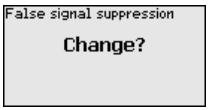
This should be done with a low level so that possible interfering reflections can be detected.

Proceed as follows:

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

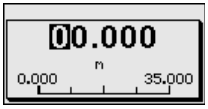


2 Confirm again with ***[OK]***.



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.



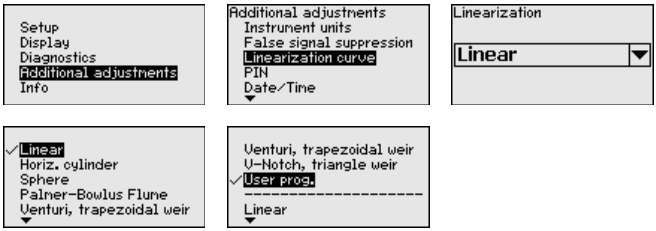
5 All interfering signals in this section are detected by the sensor and stored after confirming with ***[OK]***.

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:
Note the following if the instrument with corresponding approval is used as part of an overfill protection system according to WHG:

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

When a reset is carried out, all settings (with only a few exceptions) are 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

Menu	Menu item	Default value
	Vesell height/ Measuring range	Recommended measuring range, see "*Technical data*" in the supplement
	Min. adjustment	Recommended measuring range, see "*Technical data*" in the supplement
	Max. adjustment	0,000 m(d)
	Damping	0.0 s
	Current output mode	4 … 20 mA, < 3.6 mA
	Current output Min./Max.	Min. current 3.8 mA, max. current 20.5 mA
	Lock 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
	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

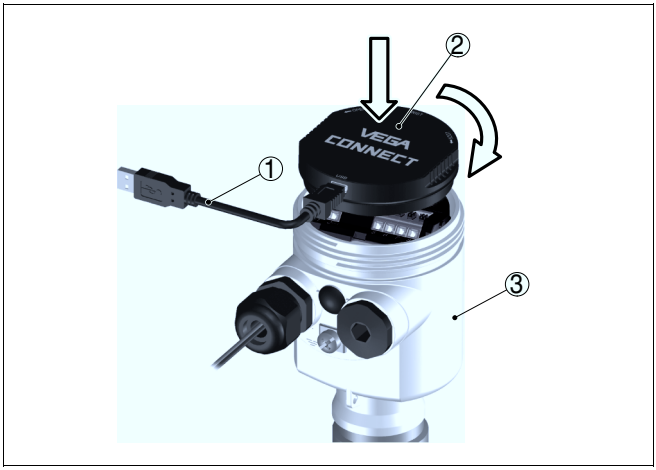


Fig. 30: Connection of the PC directly to the sensor via the interface adapter

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

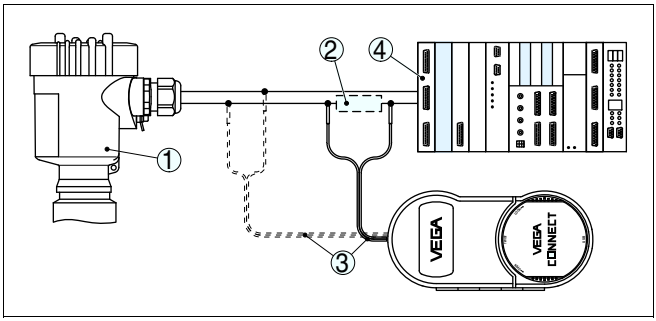


Fig. 31: Connecting the PC via HART to the signal cable

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 (dashed line in the previous illustration).

7.2 Parameter adjustment with PACTware

Prerequisites

For parameter adjustment of the sensor via a Windows PC, the configuration software PACTware and a suitable instrument driver (DTM) according to FDT standard are required. The up-to-date PACTware version as well as all available DTMs are compiled in a DTM Collection. The DTMs can also be integrated in other frame applications according to FDT standard.

Note:

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

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

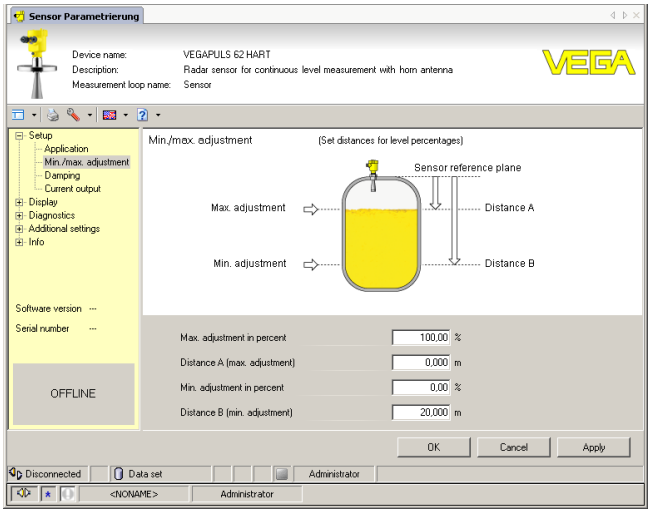


Fig. 32: Example of a DTM view

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 the data are available for multiple use or service purposes.

8 Set up with other systems

8.1 DD adjustment programs

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

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 exmaple 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 our or reset.

Event memory

The instrument also has an integrated event memory with time stamp. Up to 500 events are automatically stored in the sensor and are delete protected. Each entry contains date/time, event time, event description and value.

Event types are, for example, parameter modifications, 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 also has an integrated echo curve memory in which echo curves can be stored for diagnostic 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: up to 10 echo curves can be stored in a ring buffer in this memory section.

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

9.3 Error messages according to NE 107

The instrument has self-monitoring and diagnosis according to NE 107 and VDI/VDE 2650. Status messages are outputted on the device status. Detailed messages are visible under diagnosis via DTM, indicating and adjustment module and EDD. The messages are divided into the following categories:

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

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

Out of specification: The measured value is unstable because the instrument specification is exceeded (e.g. electronics temperature). This status message is always inactive and can be activated via DTM and EDD. The error codes and text messages are dispayed via the indicating and adjustment module as well as DTM and EDD in the control system. Additional information on error statstics is displayed in the menu Diagnosis under "Device status" in the indicating and adjustment module as well as in the DTM and EDD.

Maintenance: Due to external influences, the instrument function is limited. The measurement is affected but 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 always inactive and can be activated via DTM and EDD. The error codes are dispayed via the indicating and adjustment module as well as DTM and EDD in the control system. Additional information on error statstics is displayed in the menu Diagnosis under "Device status" in the indicating and adjustment module as well as in the DTM and EDD.

Failure

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

Code Text message	Cause	Removal
F013 no measured value available	• Sensor does not detect an echo during operation • Antenna system contaminated or defective	• Check or correct installation and/or parameter adjustment • Clean or exchange process component or antenna
F017 Adjustment span too small	• Adjustment not within specification	• 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	• Index markers are not continuously rising, for examle unlogical value pairs	• Check linearization table • Delete table/Create new
F036 No operable software	• Failed or interrupted software update	• Repeat software update • Check electronics version • Exchange of the electronics • Send instrument for repair
F040 Error in the electronics	• Hardware defect	• Exchange of the electronics • Send instrument for repair
F080	• General software error	• Separate operating voltage briefly
F105 Determine measured value	• The instrument is still in the start phase, the measured value could not yet be determined	• Wait for the warm-up phase • Duration depending on the version and parameter adjustment up to approximately 3 min.
F113 Communication error	• EMC interferences • Transmission error with the external communication with 4-wire power supply unit	• Remove EMC influences • Exchange 4-wire power supply unit or electronics
F125 Unpermissible electronics temperature	• Temperature of the electronics in the non-specified section	• Check ambient temperature • Isolate electronics • Use instrument with higher temperature range
F260 Error in the calibration	• Error in the calibration carried out in the factory • Error in the EEPROM	• Exchange of the electronics • Send instrument for repair
F261 Error in the configuration	• Error during setup • False signal suppression faulty • Error when carrying out a reset	• Repeat setup • Repeat reset
F264 Installation/Setup error	• Adjustment not within the vessel height/measuring range • Max. measuring range of the instrument not sufficient	• Check or correct installation and/or parameter adjustment • Use an instrument with bigger measuring range

Code Text message	Cause	Removal
F265 Measurement function disturbed	• Sensor does no longer carry out a measurement • Operating voltage too low	• Check operating voltage • Carry out a reset • Separate operating voltage briefly

Function check

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

Code Text message	Cause	Removal
C700 Simulation	• Simulation active	• Finish simulation • Wait for the automatic end after 60 mins.

Out of specification

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

Code Text message	Cause	Removal
S600 Unpermissible electronics temperature	• Temperature of the electronics in the non-specified section	• Check ambient temperature • Isolate electronics • Use instrument with higher temperature range
S601 Overfilling	• Danger of vessel overfilling	• Make sure that there is no further filling • Check level in the vessel

Maintenance

The following table shows the error codes and text messages in 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	• With the reset to delivery status, the data could not be restored	• Repeat reset • Load XML file with sensor data into the sensor
M501 Error in the non-active linearization table	• Hardware error EEPROM	• Exchange of the electronics • Send instrument for repair
M502 Error in the diagnosis memory	• Hardware error EEPROM	• Exchange of the electronics • Send instrument for repair
M503 Reliability too low	• The echot/noise ratio is the small for a reliable measurement	• Check installation and process conditions • Clean the antenna • Change polarisation direction • Use instrument with higher sensitivity
M504 Error on an device interface	• Hardware defect	• Check connections • Exchange of the electronics • Send instrument for repair
M505 No echo available	• Level echo can no longer be detected	• Clean the antenna • Use a more suitable antenna/sensor • Remove possible false echoes • Optimize sensor position and orientation

9.4 Fault rectification

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 according to the instrument via the indicating and adjustment module or PACTware/DTM
4 … 20 mA signal missing	Electrical connection faulty	Check connection according to chapter "*Connection steps*" and if necessary, correct according to chapter "*Wiring plan*"
	Voltage supply missing	Check cables for breaks; repair if necessary
	Operating voltage too low or load resistance too high	Check, adapt if necessary
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

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

The hotline is 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*", "*Firmware updates*" 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. Move with the right mouse key to the folder and select "*Extract all*". Save the extracted files, for example on the desktop.

Prepare update

Connect the sensor to power supply and provide a 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*". Activate the project assistant with "*Start*". It automatically sets up the connection to the sensor and then signals "*Search complete*".

Load software into sensor

Select the sensor in the project and move in the PACTware menu bar to "*Instrument data*". The select "*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 up to 15 min. Then the message appears ""*Software update successfully executed*".

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 way to dispose of the old instrument properly, 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
– Process seal	On site (instruments with thread: Klingersil C-4400 is attached)
– Antenna	316L, 316L electropolished, 316L Safecoat-coated
– Antenna impedance cone	PTFE (TFM 1600 PTFE), PEEK
– seal, antenna system	FKM (Viton), FFKM (Kalrez 6375), FFKM (Kalrez 2035), FFKM (Kalrez 6230 - FDA)
Materials, non-wetted parts	
– Plastic housing	plastic PBT (Polyester)
– Aluminium die casting housing	Aluminium die-casting AlSi10Mg, powder-coated - basis: Polyester
– Stainless steel housing	316L
– Seal between housing and housing cover	NBR (stainless steel housing, investment casting), silicone (Aluminium/plastic housing, stainless steel housing, electro-polished)
– Inspection window in housing cover (optional)	Polycarbonate
– Ground terminal	316L
Ohmic contact	Between ground terminal, process fitting and antenna
Process fittings	
– Pipe thread, cylindrical (ISO 228 T1)	G1½ A according to DIN 3852-A
– American pipe thread, tapered	1½ 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 (1.157 lbs/ft)
Length antenna extension max.	5.85 m (19.19 ft)
Torque for NPT cable glands and Conduit tubes	
– Plastic housing	max. 10 Nm (7.376 lbf ft)
– Aluminium/Stainless steel housing	max. 50 Nm (36.88 lbf ft)

Input variable

Measured variable

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

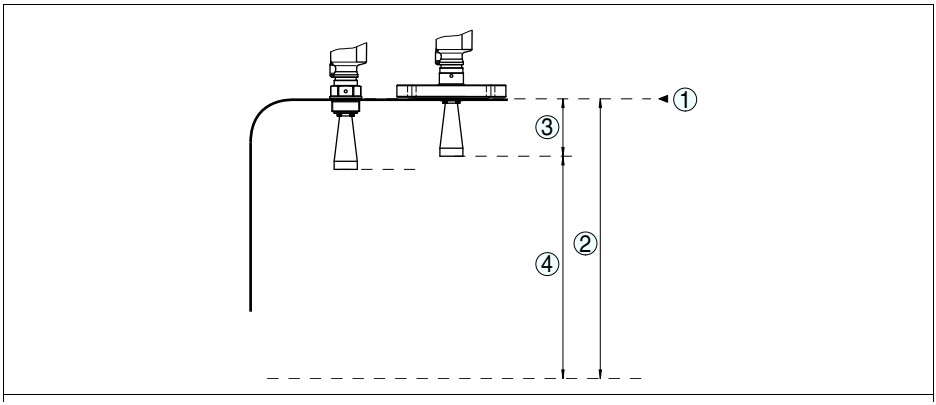


Fig. 33: Data of the input variable

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

Max. measuring range	30 m (98.43 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), 95 mm (3.74 in)	up to 30 m (98.43 ft)

Output variable

Output signal	4 … 20 mA/HART
Fulfilled HART specification	7.0
Signal resolution	0.3 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), adjustable	0 … 999 s
HART output values according to HART 7.0[1)]	
– PV (Primary Value)	Distance to the level

[1)] Default values, can be assigned individually

– 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

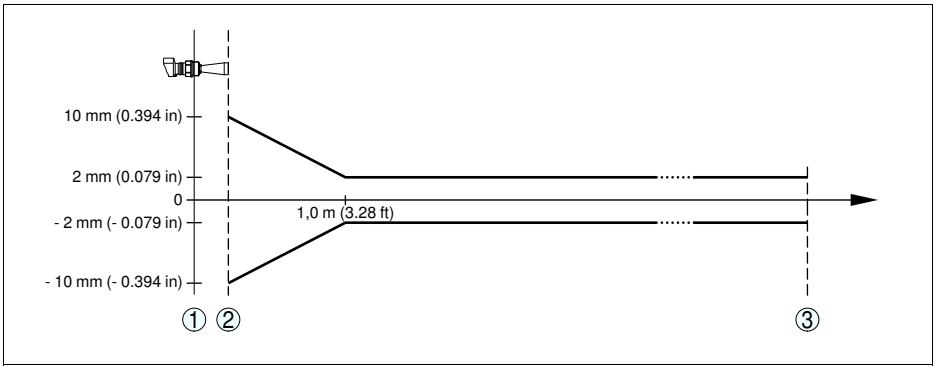


Fig. 34: Deviation under reference conditions

1 Reference plane
2 Antenna edge
3 Recommended measuring range

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

Variables influencing measurement accuracy

Specifications apply to the HART signal and the current output

Temperature drift - Digital output	±3 mm/10 K relating to the max. measuring range or max. 10 mm

Additional deviation through strong, high frequency electromagnetic fields acc. to EN 61326	<±50 mm

Specifications apply also to the current output

Temperature drift - Current output	±0.03 %/10 K relating to the 16 mA span max. ±0.3 %
Deviation on the current output by analogue/ digital conversion	<±15 µA
Deviation on the current output by strong, high frequency electromagnetic fields within EN 61326	<±150 µA

Characteristics and performance data

Frequency	K-band (26 GHz technology)
Measuring cycle time approx.	700 ms
Step response time[2)]	≤ 3 s
Tracking speed of the measuring window max.	1 m/min
Beam angle[3)]	
– Horn antenna ø 40 mm (1.575 in)	22°
– Horn antenna ø 48 mm (1.89 in)	18°
– Horn antenna ø 75 mm (2.953 in)	10°
– Horn antenna ø 95 mm (3.74 in)	8°
Emitted HF power (depending on the parameter adjustment)[4)]	
– Average spectral transmission power density	-14 dBm/MHz EIRP
– Max. spectral transmission power density	+43 dBm/50 MHz EIRP
– Max. power density in a distance of 1 m	< 1 µW/cm²

Ambient conditions

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

Process conditions

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

2) Time span after a sudden measuring distance change by max. 0.5 m in liquid applications, max 2 m with bulk solids applications, until the output signal has taken for the first time 90 % of the final value (IEC 61298-2).

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

4) EIRP: Equivalent Isotropic Radiated Power

Seal	Antenna impedance cone	Process temperature (measured on the process fitting)
FKM (Viton)	PTFE	-40 … +130 °C (-40 … +266 °F)
FFKM (Kalrez 6375)	PFFE	-20 … +130 °C (-4 … +266 °F)
	PEEK	-20 … +250 °C (-4 … +482 °F)
FFKM (Kalrez 2035)	PFFE	-15 … +130 °C (5 … +266 °F)
	PEEK	-15 … +210 °C (5 … +410 °F)
FFKM (Kalrez 6230)	PFFE	-15 … +130 °C (5 … +266 °F)
	PEEK	-15 … +250 °C (5 … +482 °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)

Vessel pressure relating to the flange nominal stage: see supplementary instructions manual "*Flanges according to DIN-EN-ASME-JIS*"

Vibration resistance[5)]

- Horn antenna: mechanical vibrations with 4 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
- 1 bar (14.5 psig): 4.5 m^3/h
- 1.5 bar (21.76 psig): 5 m^3/h
- 2 bar (29.0 psig): 5.5 m^3/h

Thread: G⅛ 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

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

– 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/plug[6]

– 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 optional[7]1 x plug M12 x 1 for external indicating and adjustment unit

or:

- 1 x closing cap ½ NPT, 1 x blind stopper ½ NPT, 1 x blind stopper M16 x 1.5 or optionally[8]1 x plug M12 x 1 for external indicating and adjustment unit

or:

- 1 x plug (depending on the version), 1 x blind stopper M20 x 1.5; 1 x blind stopper M16 x 1.5 or optionally[9]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)

6) Depending on the version M12 x 1, according to ISO 4400, Harting, 7/8" FF.
7) Only with Ex d version
8) Only with Ex d version
9) Only with Ex d version

– 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	
– 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	≤ 0.7 V_{eff} (16 … 400 Hz)
– for 18 $V_{< U_N}$ < 36 V	≤ 1.0 V_{eff} (16 … 400 Hz)

Permissible residual ripple - Ex-d-ia instrument

– for 18 $V_{< U_N}$ < 36 V	≤ 1 V_{eff} (16 … 400 Hz)
Load	see diagram

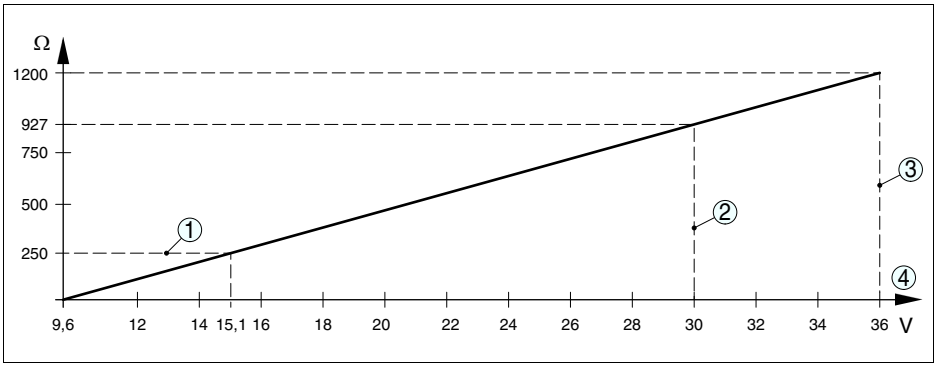


Fig. 35: Voltage diagram

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)[10]
– 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.

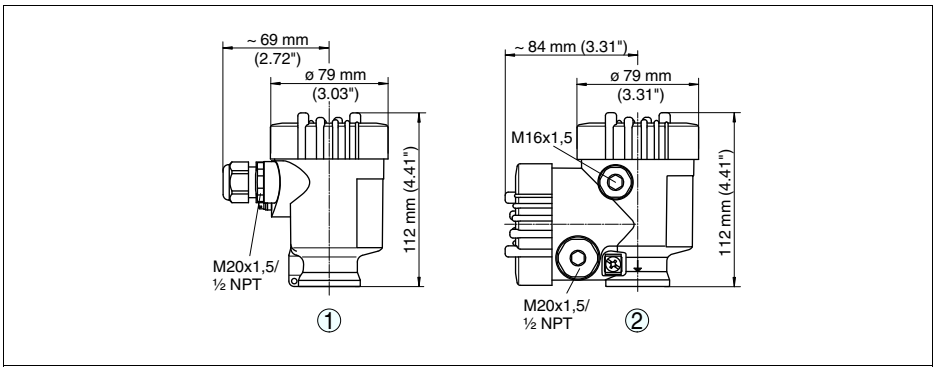
For these instruments, the corresponding approval documents have to be taken into account. These are part of the delivery or can be downloaded under www.vega.com via "*VEGA Tools*" and "*serial number search*" as well as via "*Downloads*" and "*Approvals*".

[10] The prerequisites for maintaining the protection rating are a suitable cable as well as correct mounting.

11.2 Dimensions

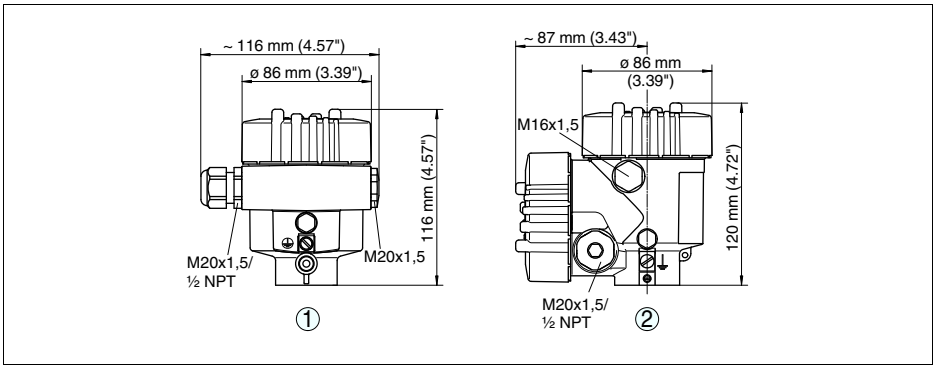
The following dimensional drawings represent only an extract of the possible versions. Detailed dimensional drawings can be downloaded on www.vega.com under "*Downloads*" and "*Drawings*".

Plastic housing



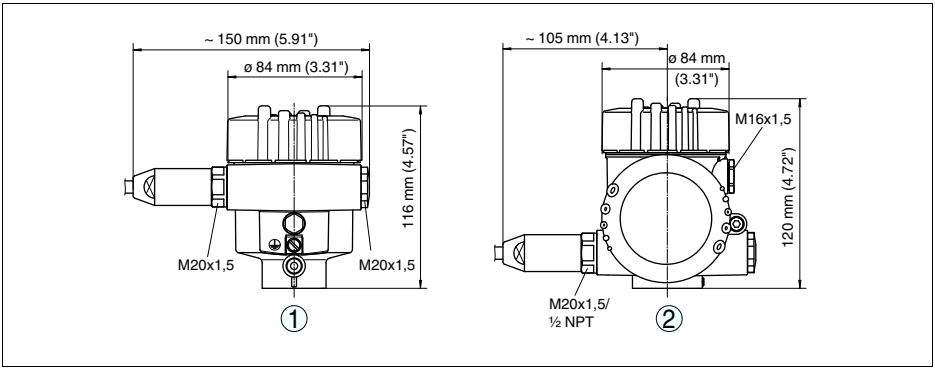
1 Single chamber version
2 Double chamber version

Aluminium housing



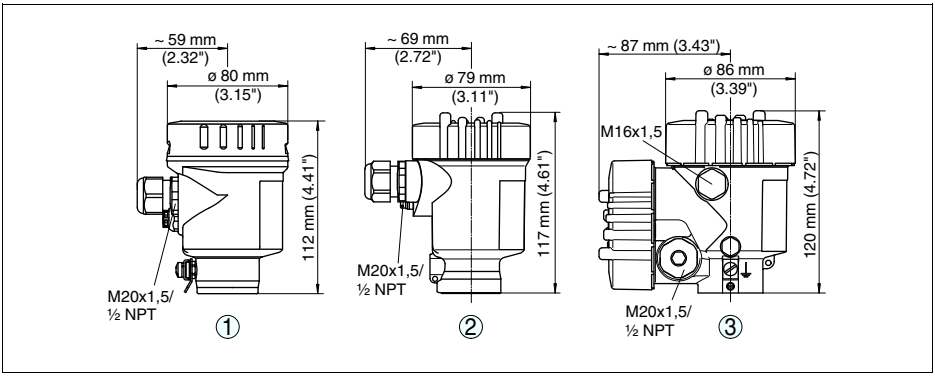
1 Single chamber version
2 Double chamber version

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



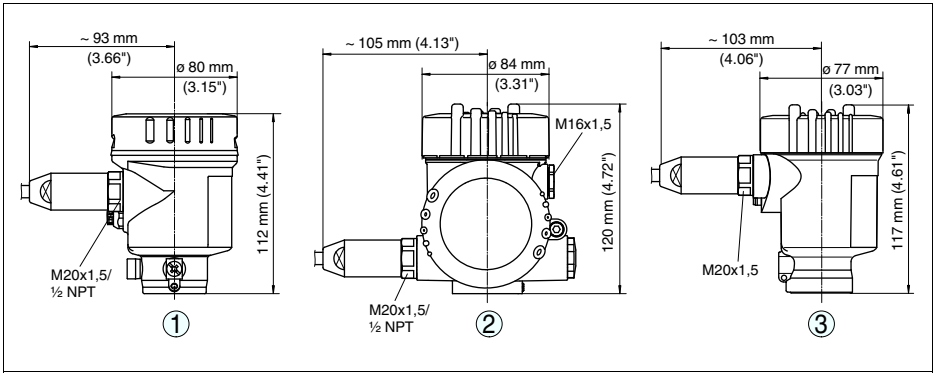
1 *Single chamber version*
2 *Double chamber version*

Stainless steel housing



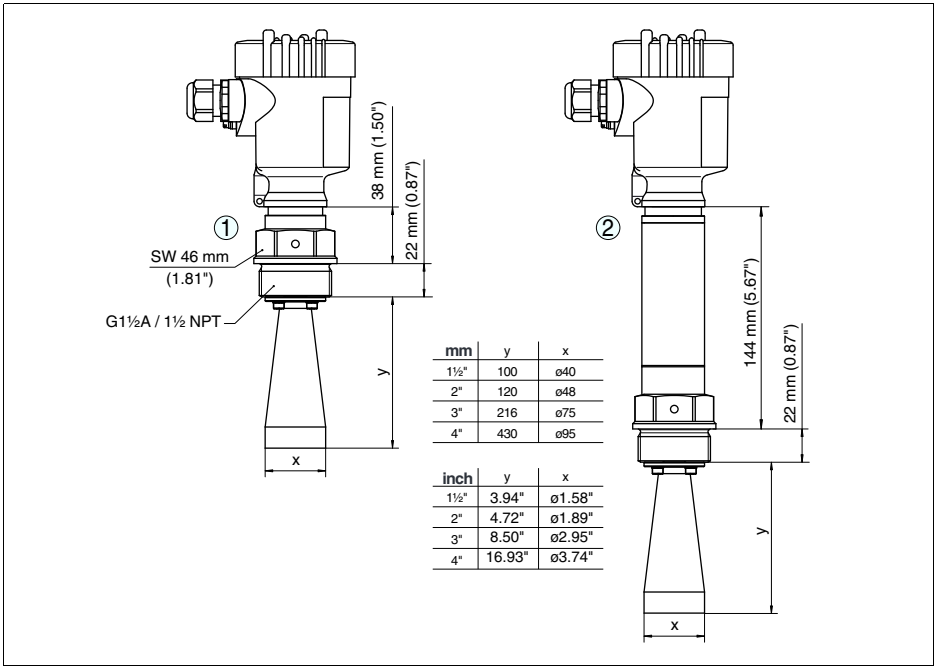
1 *Single chamber version, electropolished*
2 *Single chamber version, precision casting*
2 *Double chamber version, precision casting*

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



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

VEGAPULS SR 68 - horn antenna in threaded version



mm	y	x
1½"	100	ø40
2"	120	ø48
3"	216	ø75
4"	430	ø95

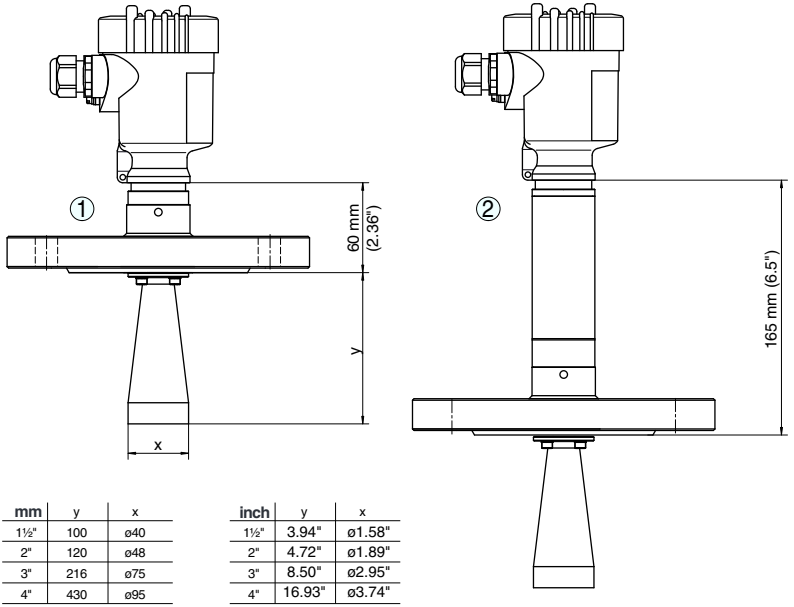
inch	y	x
1½"	3.94"	ø1.58"
2"	4.72"	ø1.89"
3"	8.50"	ø2.95"
4"	16.93"	ø3.74"

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

1 Standard

2 With temperature adapter up to 250 °C

VEGAPULS SR 68 - horn antenna in flange version



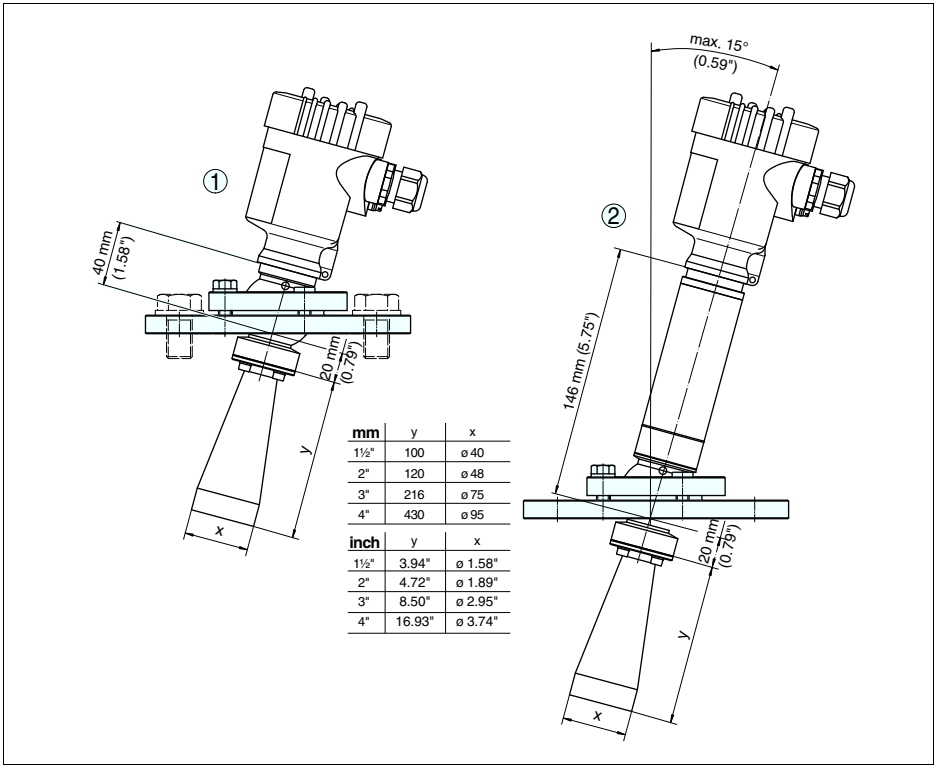
mm	y	x
1½"	100	ø40
2"	120	ø48
3"	216	ø75
4"	430	ø95

inch	y	x
1½"	3.94"	ø1.58"
2"	4.72"	ø1.89"
3"	8.50"	ø2.95"
4"	16.93"	ø3.74"

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

1 Standard
2 With temperature adapter up to 250 °C

VEGAPULS SR 68 - horn antenna and swivelling holder



mm	y	x
1½"	100	ø 40
2"	120	ø 48
3"	216	ø 75
4"	430	ø 95

inch	y	x
1½"	3.94"	ø 1.58"
2"	4.72"	ø 1.89"
3"	8.50"	ø 2.95"
4"	16.93"	ø 3.74"

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

1 Standard
2 With temperature adapter up to 250 °C

11.3 Industrial property rights

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