Operating Instructions

VEGAPULS 65

Foundation Fieldbus

Document ID: 28452

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Safety instructions for Ex areas

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

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1 About this document

1.1 Function

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

1.2 Target group

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

1.3 Symbols used

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

Information, 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.

SIL applications
This symbol indicates instructions for functional safety which must be taken into account particularly for safety-relevant applications.

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

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

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

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

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2 For your safety

2.1 Authorised personnel

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

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

2.2 Appropriate use

VEGAPULS 65 is a sensor for continuous level measurement.

You can find detailed information about the area of application in chapter "*Product description*".

Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.

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.

2.3 Warning about incorrect use

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. Thus damage to property, to persons or environmental contamination can be caused. Also the protective characteristics of the instrument can be influenced.

2.4 General safety instructions

This is a high-tech instrument requiring the strict observance of standard regulations and guidelines. The user must take note of the safety instructions in this operating instructions manual, the country-specific installation standards as well as all prevailing safety regulations and accident prevention rules. For safety reasons, only the accessory specified by the manufacturer must be used.

Depending on the model, the emitting frequencies of all radar sensors are either in the C or K band range. The low transmitting power lies far below the internationally permitted limit values. When the instrument is used correctly, it presents no danger to human health. It may be operated without restriction outside of closed metallic vessels.

The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for the trouble-free operation of the instrument. When measuring aggressive or corrosive media that can cause a dangerous situation if the instrument malfunctions, the operator has to implement suitable measures to make sure the instrument is functioning properly.

During the entire duration of use, the user is obliged to determine the compliance of the necessary occupational safety measures with the

current valid rules and regulations and also take note of new regulations.

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

2.5 Safety label on the instrument

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

2.6 EU conformity

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

You can find the EU conformity declaration on our website under www.vega.com/downloads.

2.7 Fulfillment of NAMUR recommendations

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

The device fulfils the requirements of the following NAMUR recommendations:

- NE 21 – Electromagnetic compatibility of equipment
- NE 43 – Signal level for fault information from measuring transducers
- NE 53 – Compatibility of field devices and display/adjustment components

For further information see www.namur.de.

2.8 Radio license for Europe

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

- EN 302372 - Tank Level Probing Radar

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

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

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

2.9 FCC and IC conformity (only for USA/Canada)

VEGAPULS 65 is FCC and IC approved:

- FCC ID: O6QPULS6566
- IC: 3892A-PS6566

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

VEGAPULS 65 is in conformity with part 15 of the FCC regulations. Take note of the respective operating regulations:

- This device may not cause interference, and
- The device must be resistant to interference signals, including such that may cause undesired operating states of the device

The instrument was tested and meets the limit values for a digital instrument of class B, according to part 15 of the FCC regulations. The limit values are predefined to ensure protection against interfering emissions during operation in industrial environments.

The instrument can generate, use and emit high frequency energy and can generate interfering emissions if not used as described in the operator's manual. Because interfering emissions have to be reckoned with when the instrument is used in residential areas, the user must make sure necessary countermeasures are implemented.

2.10 Installation and operation in the USA and Canada

This information is only valid for USA and Canada. Hence the following text is only available in the English language.

Installations in the US shall comply with the relevant requirements of the National Electrical Code (ANSI/NFPA 70).

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

2.11 Environmental instructions

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

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

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

3 Product description

3.1 Configuration

Scope of delivery

The scope of delivery encompasses:

- Radar sensor
- Documentation
  - Quick setup guide VEGAPULS 65
  - Instructions for optional instrument features
  - Ex-specific "*Safety instructions*" (with Ex versions)
  - If necessary, further certificates

Information:
In this operating instructions manual, the optional instrument features are described. The respective scope of delivery results from the order specification.

Constituent parts

The VEGAPULS 65 consists of the components:

- Process fitting with antenna system
- Housing with electronics, optionally available with plug connector, optionally available with connection cable
- Housing cover, optionally available with display and adjustment module PLICSCOM

The components are available in different versions.

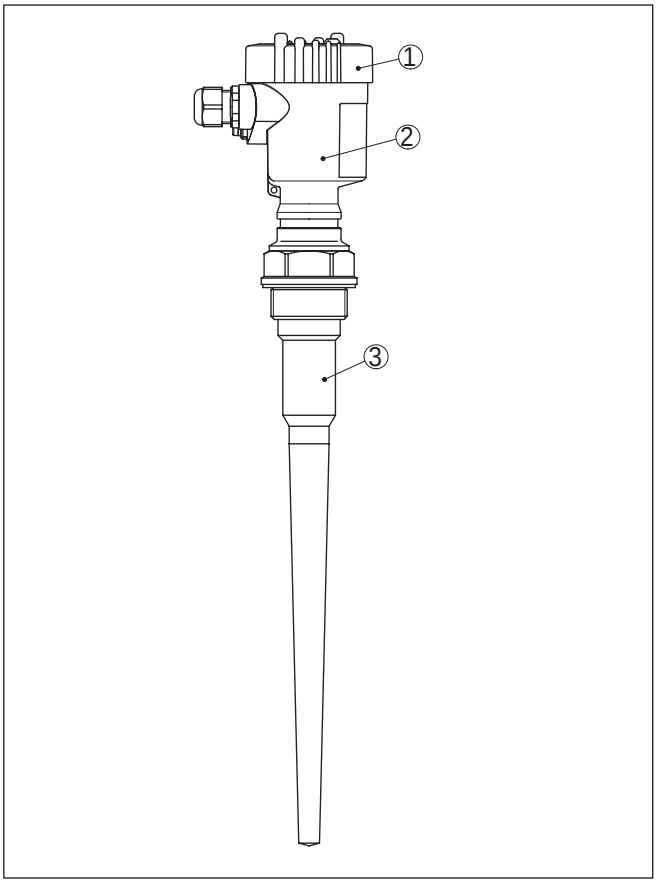

Fig. 1: VEGAPULS 65 - threaded version with plastic housing

1 Housing cover with integrated PLICSCOM (optional)
2 Housing with electronics
3 Process fitting with antenna system

Type label

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

- Instrument type
- Article and serial number device
- Article numbers, documentation
- Technical data: Approvals, antenna type, process fitting, process seal/temperature, signal output, voltage supply, protection, protection class

With the serial number, you can access the delivery data of the instrument via "www.vega.com", "*VEGA Tools*" and "*Instrument search*". You can find the serial number on the inside of the instrument as well as on the type label on the outside.

Scope of this operating instructions

This operating instructions manual applies to the following instrument versions:

- Hardware version ≤ 1.10
- Software version ≤ 3.90

3.2 Principle of operation

Application area

VEGAPULS 65 is a radar sensor in C-band technology (emitting frequency approx. 6 GHz) for continuous level measurement. It is particularly suitable for vessels with small process fitting that contain corrosive liquids under simple to difficult process conditions.

Functional principle

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

Power supply and bus communication

Power is supplied via the H1 Fieldbus. A two-wire cable according to Fieldbus specification serves as carrier of both power and digital data for multiple sensors. This cable can be operated in two versions:

- via an H1 interface card in the control system and additional power supply
- via a Linking device with HSE (High speed Ethernet) and additional power supply according to IEC 61158-2

DD/CFF

The DD (Device Descriptions) and CFF (capability files) necessary for planning and configuration of your FF (Foundation Fieldbus) communication network are available in the download area of the VEGA homepage www.vega.com under "*Services - Downloads - Software - Foundation Fieldbus*". The appropriate certificates are also available there. A CD with the appropriate files and certificates can be ordered via e-mail under info@de.vega.com or by phone from one of the VEGA agencies under the order number "DRIVER.S".

The backlight of the display and adjustment module is powered by the sensor. Prerequisite is a certain level of operating voltage.

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

The optional heating requires its own operating voltage. You can find detailed information in the supplementary instructions manual "*Heating for display and adjustment module*". This function is generally not available for approved instruments.

3.3 Packaging, transport and storage

Packaging

Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test based on ISO 4180.

The packaging 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 in due consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device.

Transport inspection

The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

Storage

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

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

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

Storage and transport temperature

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

Lifting and carrying

With instrument weights of more than 18 kg (39.68 lbs) suitable and approved equipment must be used for lifting and carrying.

3.4 Accessories and replacement parts

PLICSCOM

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

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

- Smartphone/tablet (iOS or Android operating system)
- PC/notebook with Bluetooth USB adapter (Windows operating system)

You can find further information in the operating instructions "*Display and adjustment module PLICSCOM*" (Document-ID 36433).

VEGACONNECT

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).

VEGADIS 81

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

For sensors with double chamber housing the interface adapter "*VEGADIS adapter*" is also required for VEGADIS 81.

You can find further information in the operating instructions "*VEGADIS 81*" (Document-ID 43814).

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

Electronics module

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

You can find further information in the operating instructions "*Electronics module VEGAPULS series 60*" (Document-ID 30176).

Antenna impedance cone

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

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

4 Mounting

4.1 General instructions

Installation position

Select an installation position you can easily reach for mounting and connecting as well as later retrofitting of a display and adjustment module. The housing can be rotated by 330° without the use of any tools. You can also install the display and adjustment module in four different positions (each displaced by 90°).

Screwing in

Warning:
With threaded versions, the housing must not be used to screw in the instrument! Applying tightening forces on the housing can damage its internal parts.

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 gland. 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.

To maintain the housing protection, make sure that the housing lid is closed during operation and locked, if necessary.

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

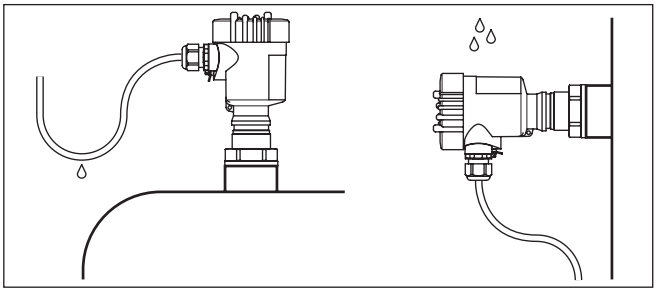

Fig. 2: Measures against moisture ingress

Cable entries - NPT thread
Cable glands

Metric threads
In the case of instrument housings with metric thread, the cable glands are screwed in at the factory. They are sealed with plastic plugs as transport protection.

You have to remove these plugs before electrical connection.

NPT thread
In the case of instrument housings with self-sealing NPT threads, it is not possible to have the cable entries screwed in at the factory. The free openings for the cable glands are therefore covered with red dust protection caps as transport protection.

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

Measuring range

The reference plane for the measuring range of the sensors is the lower edge of the flange or the seal surface of the thread.

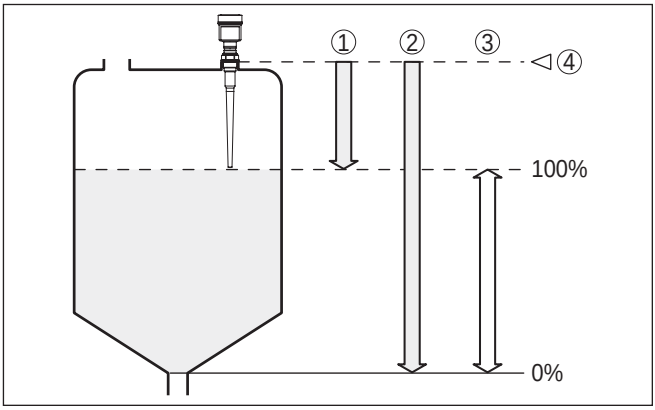

Fig. 3: Measuring range (operating range) and max. measuring distance

1 full
2 empty (max. measuring distance)
3 Measuring range

Information:
If the medium reaches the antenna, buildup can form on it and cause faulty measurements later on.

Polarisation plane

The emitted radar impulses of VEGAPULS 65 are electromagnetic waves. The polarisation plane is the direction of the electrical share. Their position is marked on the instrument.

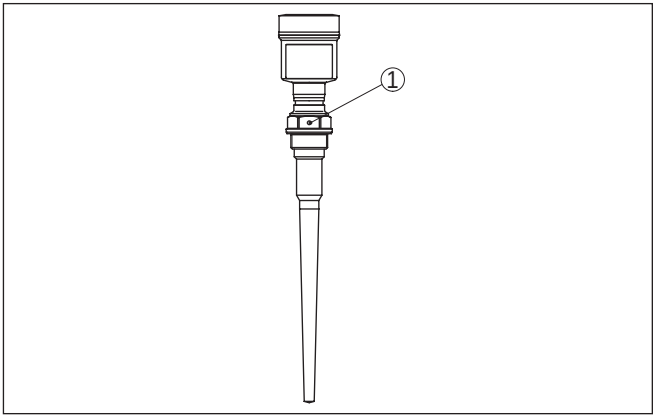

Fig. 4: Position of the polarisation plane of VEGAPULS 65

1 Marking hole

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Suitability for the process conditions

Make sure that all parts of the instrument coming in direct contact with the process, especially the sensor element, process seal and process fitting, are suitable for the existing process conditions, such as process pressure, process temperature as well as the chemical properties of the medium.

You can find the specifications in chapter "*Technical data*" and on the nameplate.

Suitability for the ambient conditions

The instrument is suitable for standard and extended ambient conditions acc. to DIN/EN/IEC/ANSI/ISA/UL/CSA 61010-1.

4.2 Mounting instructions

Sealing to the process

The VEGAPULS 65 with flange and encapsulated antenna system, the PTFE washer of the antenna encapsulation serves also as process seal.

However, PTFE-plated flanges have a preload loss over time at high temperature changes.

Note:
Therefore, use disc springs to compensate for this preload loss during mounting. They are included in the scope of delivery of the instrument and are intended for the flange screws.

To seal effectively, the following requirements must be fulfilled:

1. Make sure the number of flange screws corresponds to the number of flange holes
2. Use of disc springs as previously described

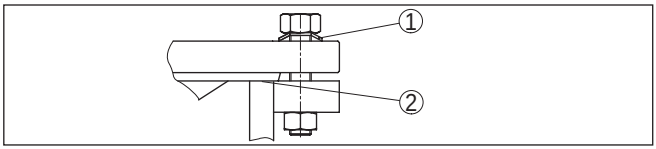


Fig. 5: Use of disc springs

1 Disc spring
2 Sealing surface

3. Tighten screws with the necessary torque (see chapter "*Technical data*", "*Torques*")

Note:
We recommend re-tightening the screws at regular intervals, depending on process pressure and temperature. Recommended torque, see chapter "*Technical data*", "*Torques*".

Installation position

When mounting the VEGAPULS 65, keep a distance of at least 500 mm (19.69 in) to the vessel wall. If the sensor is installed in the center of dished or round vessel tops, multiple echoes can arise. These can, however, be suppressed by an appropriate adjustment (see chapter "*Setup*").

If you cannot maintain this distance, you should carry out a false signal suppression during setup. This applies particularly if buildup on

the vessel wall is expected. In such cases, we recommend repeating the false signal suppression at a later date with existing buildup.

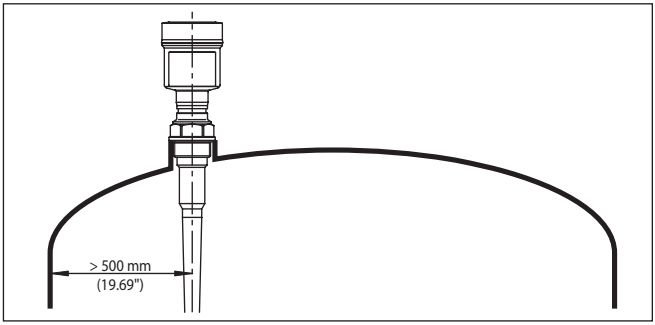


Fig. 6: Mounting on round vessel tops

1 Reference plane
2 Vessel center or symmetry axis

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

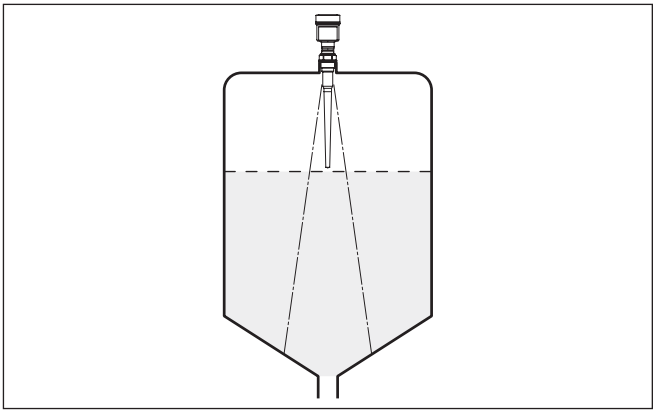


Fig. 7: Vessel with conical bottom

Inflowing medium

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

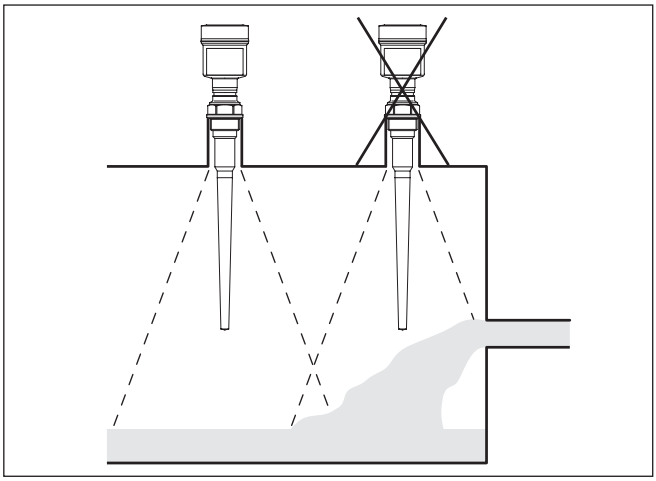


Fig. 8: Inflowing liquid

Mounting socket

The active part of the antenna, i.e. the conical antenna part should protrude completely out of the socket.

To meet the different socket dimensions, sensors for socket lengths up to 50, 100 and 250 mm (2, 4, 10 in) are available.

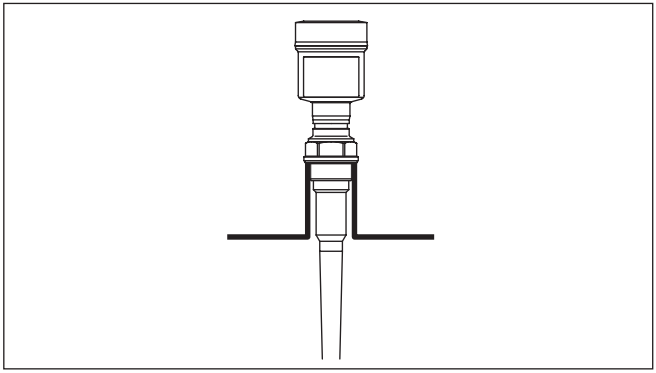


Fig. 9: Recommended socket mounting

In case of very big socket diameters, the active antenna part can be slightly recessed in the socket. The following rule applies to the standard version of VEGAPULS 65: Socket diameter corresponds to max. socket height.

Sensor orientation

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

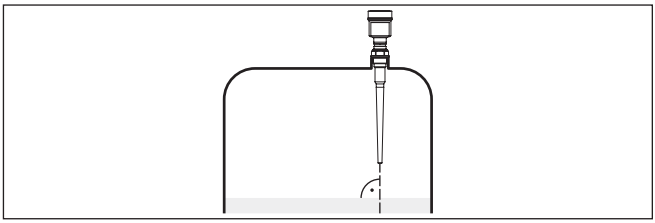


Fig. 10: Alignment in liquids

Vessel installations

The mounting location of the radar sensor should be a place where no other equipment or fixtures cross the path of the microwave signals.

Vessel installations such as for example, ladders, limit switches, heating spirals, struts etc. can cause false echoes that interfere with the useful echo. Make sure when planning your measuring site that the radar signals have a "clear view" to the measured product.

In case of existing vessel installations, a false signal suppression should be carried out during setup.

If large vessel installations such as struts or supports cause false echoes, these can be attenuated through supplementary measures. Small, inclined sheet metal baffles above the installations scatter the radar signals and prevent direct interfering reflections.

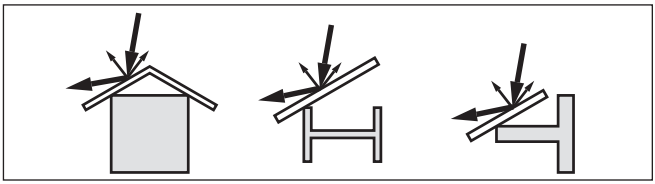


Fig. 11: Cover flat, large-area profiles with deflectors

Agitators

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

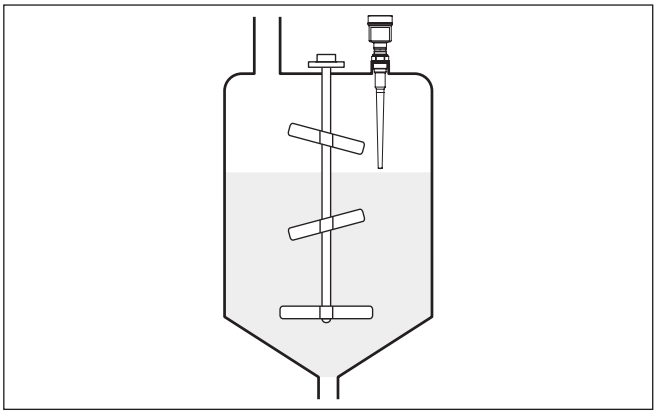


Fig. 12: Agitators

Foam generation

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

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

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

5 Connecting to power supply

5.1 Preparing the connection

Safety instructions

Always keep in mind the following safety instructions:

Warning:
Connect only in the complete absence of line voltage.

- The electrical connection must only be carried out by trained, qualified personnel authorised by the plant operator.
- If overvoltage surges are expected, overvoltage arresters should be installed.

Voltage supply

The instrument requires a operating voltage of 9 … 32 V DC. Operating voltage and the digital bus signal are carried on the same two-wire connection cable. Power is supplied via the H1 power supply.

Connection cable

Connection is carried out with screened cable according to Fieldbus specification.

Make sure that the cable used has the required temperature resistance and fire safety for max. occurring ambient temperature

Use cable with round cross section for instruments with housing and cable gland. To ensure the seal effect of the cable gland (IP protection rating), find out which cable outer diameter the cable gland is suitable for.

Use a cable gland fitting the cable diameter.

Make sure that the entire installation is carried out according to the Fieldbus specification. In particular, make sure that the bus is terminated with suitable terminating resistors.

Caution:
No grease should be used when screwing the NPT cable gland or steel tube into the threaded insert. Standard grease can contain additives that corrode the connection between threaded insert and housing. This would influence the stability of the connection and the tightness of the housing.

Cable screening and grounding

In systems with potential equalisation, connect the cable screen directly to ground potential at the power supply unit, in the connection box and at the sensor. The screen in the sensor must be connected directly to the internal ground terminal. The ground terminal outside on the housing must be connected to the potential equalisation (low impedance).

In systems without potential equalisation, connect the cable screen directly to ground potential at the power supply unit and at the sensor. In the connection box or T-distributor, the screen of the short stub to the sensor must not be connected to ground potential or to another cable screen. The cable screens to the power supply unit and to the next distributor must be connected to each other and also connected to ground potential 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.

The total capacitance of the cable and of all capacitors must not exceed 10 nF in Ex applications.

Take note of the corresponding installation regulations for Ex applications. In particular, make sure that no potential equalisation currents flow over the cable screen. In case of grounding on both sides this can be achieved by the use of a capacitor or a separate potential equalisation.

5.2 Connection procedure

Proceed as follows:

1. Unscrew the housing lid
2. If a display and adjustment module is installed, remove it by turning it to the left
3. Loosen compression nut of the cable gland and remove blind plug
4. Remove approx. 10 cm (4 in) of the cable mantle, strip approx. 1 cm (0.4 in) of insulation from the ends of the individual wires
5. Insert the cable into the sensor through the cable entry
6. Lift the opening levers of the terminals with a screwdriver (see following illustration)
7. Insert the wire ends into the open terminals according to the wiring plan

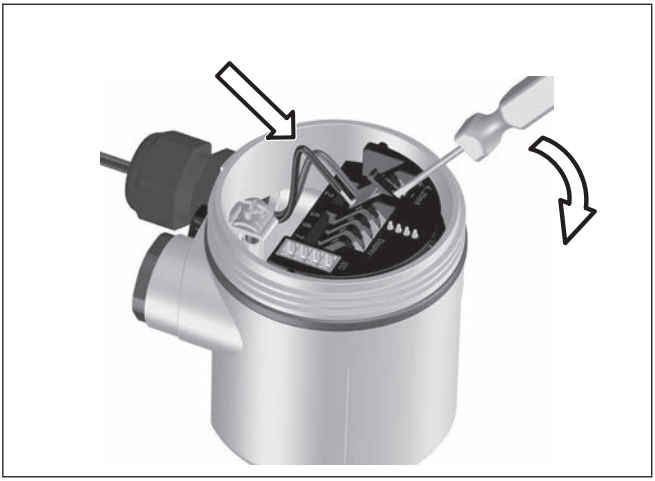


Fig. 13: Connection steps 6 and 7

8. Press down the opening levers of the terminals, you will hear the terminal spring closing
9. Check the hold of the wires in the terminals by lightly pulling on them

10. Connect the screen to the internal ground terminal, connect the external ground terminal to potential equalisation
11. Tighten the compression nut of the cable entry gland. The seal ring must completely encircle the cable
12. Screw the housing lid back on

The electrical connection is finished.

5.3 Wiring plan, single chamber housing

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

Housing overview

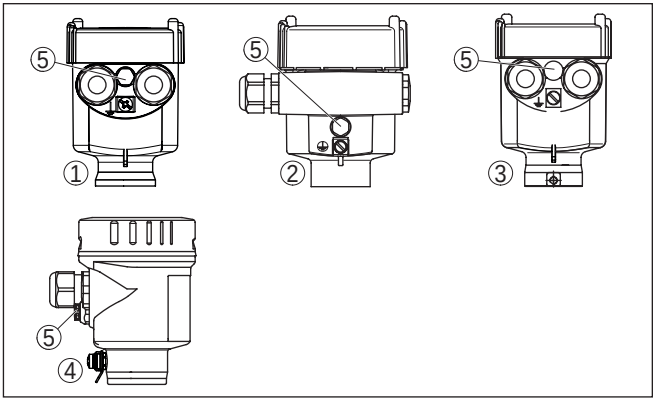


Fig. 14: Material versions, single chamber housing

1 *Plastic*
2 *Aluminium*
3 *Stainless steel (precision casting)*
4 *Stainless steel (electro-polished)*
5 *Filter element for air pressure compensation of all material versions. Blind plug with version IP 66/IP 68, 1 bar for Aluminium and stainless steel*

Electronics and connection compartment

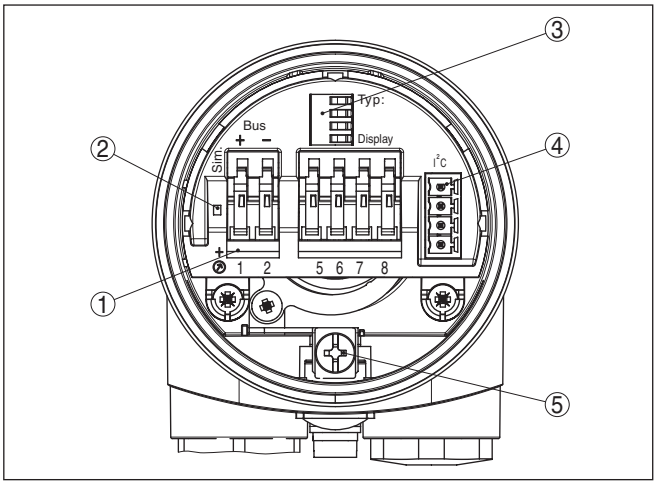


Fig. 15: Electronics and connection compartment - single chamber housing

1 Spring-loaded terminals for Foundation Fieldbus connection
2 Simulation switch ("on" = simulation mode)
3 Spring contacts for display and adjustment module
4 Interface for the external display and adjustment unit
5 Ground terminal for connection of the cable screening

Wiring plan

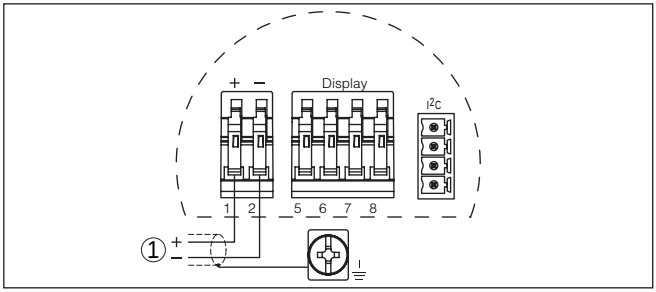


Fig. 16: Wiring plan - single chamber housing

1 Voltage supply, signal output

5.4 Wiring plan, double chamber housing

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

Housing overview

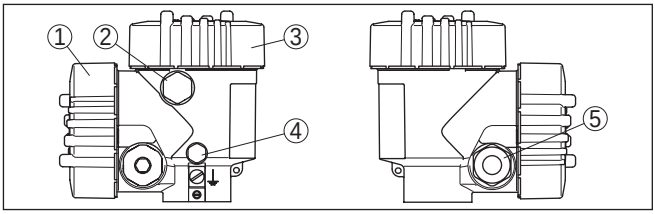


Fig. 17: Double chamber housing

1 *Housing cover - connection compartment*
2 *Blind plug or plug M12 x 1 for VEGADIS 81 (optional)*
3 *Housing cover - electronics compartment*
4 *Filter element for air pressure compensation*
5 *Cable gland*

Electronics compartment

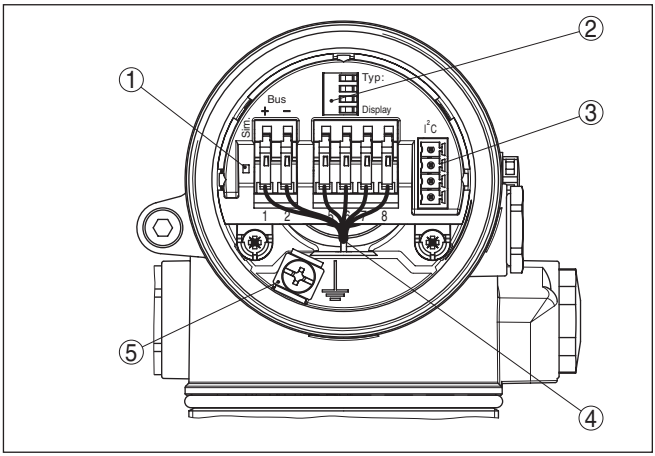


Fig. 18: Electronics compartment - double chamber housing

1 *Simulation switch ("on" = simulation mode)*
2 *Spring contacts for display and adjustment module*
3 *Interface for service*
4 *Internal connection cable to the connection compartment*
5 *Ground terminal for connection of the cable screening*

Connection compartment

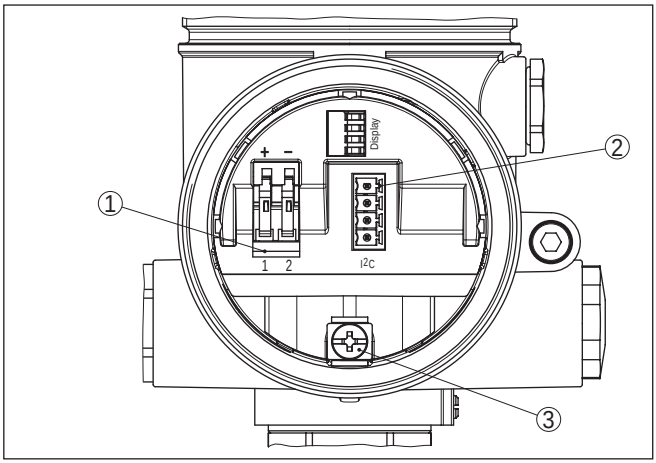


Fig. 19: Connection compartment - double chamber housing

1 Spring-loaded terminals for voltage supply
2 Plug connector for VEGACONNECT (I^2C interface)
3 Ground terminal for connection of the cable screening

Wiring plan

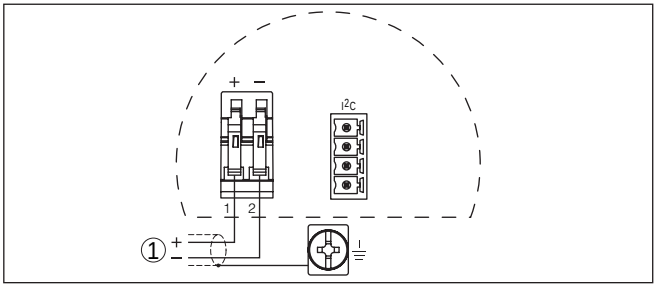


Fig. 20: Wiring plan - double chamber housing

1 Voltage supply, signal output

5.5 Wiring plan, double chamber housing Ex d

Information:
Instruments in Ex d version with hardware revision …- 01 or higher as well as with national approvals such as e.g. according to FM or CSA at a later date.

Housing overview

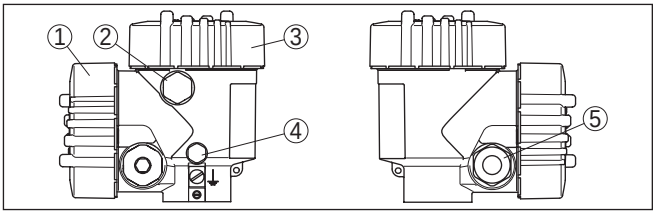


Fig. 21: Double chamber housing

1 *Housing cover - connection compartment*
2 *Blind plug or plug M12 x 1 for VEGADIS 81 (optional)*
3 *Housing cover - electronics compartment*
4 *Filter element for air pressure compensation*
5 *Cable gland*

Electronics compartment

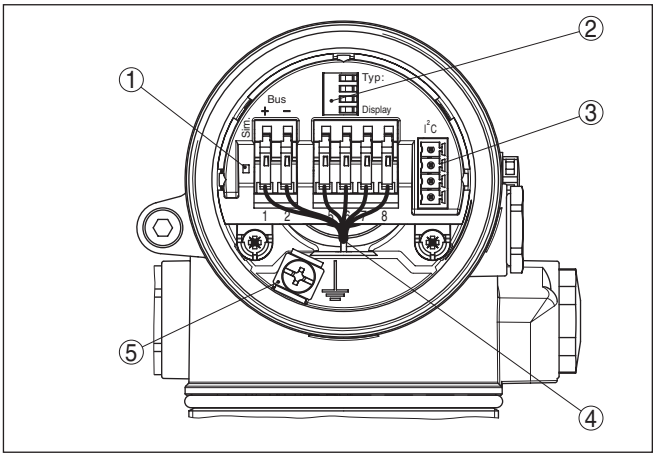


Fig. 22: Electronics compartment - double chamber housing

1 *Simulation switch ("on" = simulation mode)*
2 *Spring contacts for display and adjustment module*
3 *Interface for service*
4 *Internal connection cable to the connection compartment*
5 *Ground terminal for connection of the cable screening*

Connection compartment

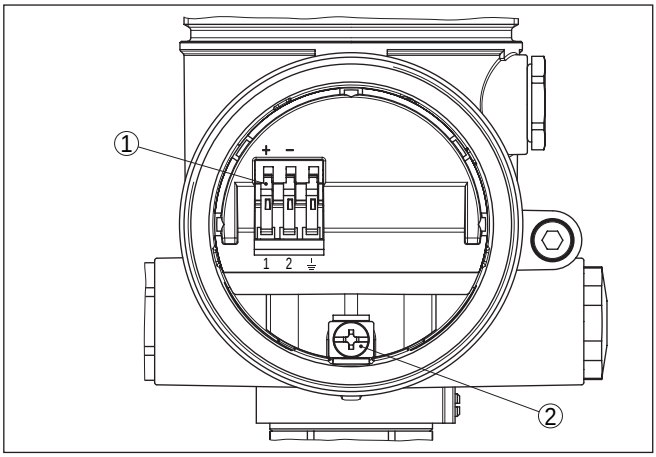


Fig. 23: Connection compartment, Ex-d-ia double chamber housing

1 Spring-loaded terminals for power supply and cable screen
2 Ground terminal for connection of the cable screening

Wiring plan

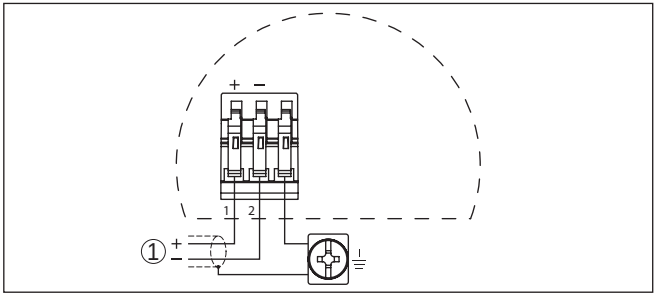


Fig. 24: Wiring plan, Ex-d-ia double chamber housing

1 Voltage supply, signal output

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

Wire assignment, connection cable

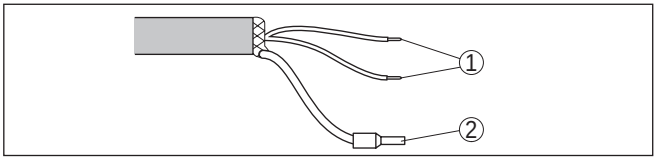


Fig. 25: Wire assignment, connection cable

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

5.7 Switch-on phase

Switch-on phase

After VEGAPULS 65 is connected to voltage supply or after voltage recurrence, the instrument carries out a self-check for approx. 30 seconds. The following steps are carried out:

- Internal check of the electronics
- Indication of the instrument type, the firmware as well as the sensor TAGs (sensor designation)
- Status byte goes briefly to fault value

Then the current measured value will be displayed and the corresponding digital output signal will be output to the cable.[1)]

[1)] The values correspond to the actual measured level as well as to the settings already carried out, e.g. default setting.

6 Set up with the display and adjustment module PLICSCOM

6.1 Short description

Function/Configuration

The display and adjustment module is used for measured value display, adjustment and diagnosis. It can be mounted in the following housing versions and instruments:

- All sensors of the plics® instrument family, in the single as well as in the double chamber housing (optionally in the electronics or connection compartment)
- External display and adjustment unit VEGADIS 61

6.2 Insert display and adjustment module

Mount/dismount display and adjustment module

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

Proceed as follows:

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

Disassembly is carried out in reverse order.

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

Fig. 26: Insert display and adjustment module

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

6.3 Adjustment system

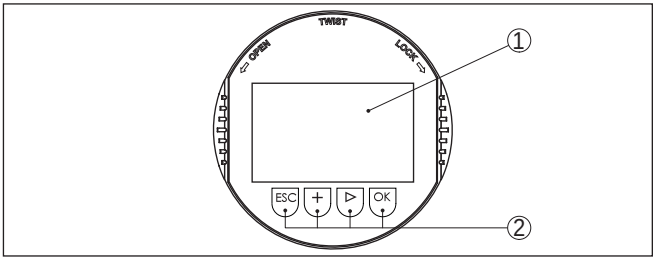


Fig. 27: Display and adjustment elements

1 *LC display*
2 *Indication of the menu item number*
3 *Adjustment keys*

Key functions

- ***[OK]*** key:
  - Move to the menu overview
  - Confirm selected menu
  - Edit parameter
  - Save value
- ***[->]*** key to select:
  - Menu change

- Select list entry
- Select editing position

- ***[+]*** key:
  - Change value of the parameter

- ***[ESC]*** key:
  - Interrupt input
  - Jump to next higher menu

Adjustment system

The instrument is operated via the four keys of the display and adjustment module. The individual menu items are shown on the LC display. You can find the functions of the individual keys in the previous illustration.

Time functions

When the ***[+]*** and ***[->]*** keys are pressed quickly, the edited value, or the cursor, changes one value or position at a time. If the key is pressed longer than 1 s, the value or position changes continuously.

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

Approx. 60 minutes after the last pressing of a key, an automatic reset to measured value indication is triggered. Any values not confirmed with ***[OK]*** will not be saved.

6.4 Setup steps

Parameterization example

The radar sensor measures the distance from the sensor to the product surface. For indication of the real level, an allocation of the measured distance to the percentage height must be carried out.

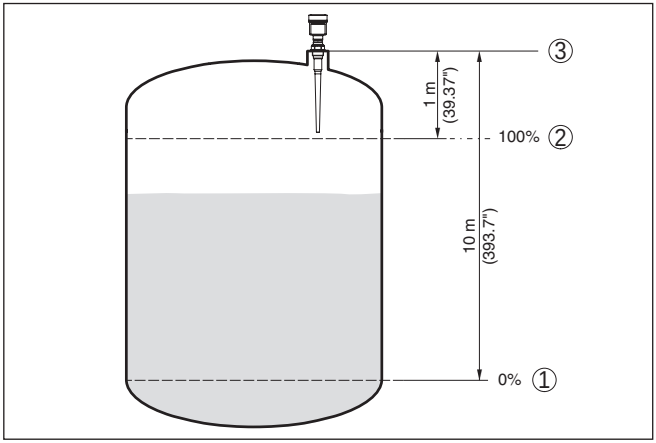


Fig. 28: Parameterization example

1 Min. level = max. measuring distance
2 Max. level = min. measuring distance
3 Reference plane

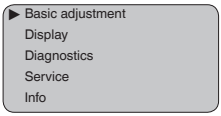
For this adjustment, the distance is entered when the vessel is full and nearly empty. If these values are not known, an adjustment with other distances, for example, 10 % and 90 % is also possible. Starting point for these distance specifications is always the seal surface of the thread or flange.

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

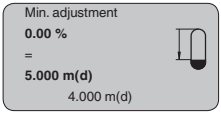
Basic adjustment - Min. adjustment

Proceed as follows:

1. Move from the measured value display to the main menu by pushing ***[OK]***.



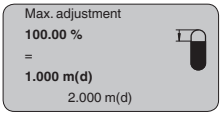
2. Select the menu item "*Basic adjustment*" with ***[->]*** and confirm with ***[OK]***. Now the menu item "*Min. adjustment*" is displayed.



3. Prepare the % value for editing with ***[OK]*** and set the cursor to the requested position with ***[->]***. Set the requested percentage value with ***[+]*** and save with ***[OK]***. The cursor jumps now to the distance value.
4. Enter the distance value in m for empty vessel (e.g. distance from the sensor to the vessel bottom) corresponding to the percentage value.
5. Save the settings with ***[OK]*** and move to "Max. adjustment" with ***[->]***.

Basic adjustment - Max. adjustment

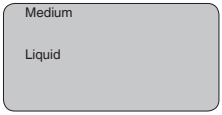
Proceed as follows:



1. Prepare the % value for editing with ***[OK]*** and set the cursor to the requested position with ***[->]***. Set the requested percentage value with ***[+]*** and save with ***[OK]***. The cursor jumps now to the distance value.
2. 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 dead band.
3. Save the settings with ***[OK]*** and move to "Medium selection" with ***[->]***.

Basic adjustment - Medium selection

Each product has different reflective properties. In addition, there are various interfering factors which have to be taken into account: agitated product surfaces and foam generation (with liquids); dust generation, material cones and echoes from the vessel wall (with solids). To adapt the sensor to these different conditions, you should first select "*Liquid*" or "*Solid*".



Information:
With VEGAPULS 65 with electronics version "*Increased safety*", "*Solid*" is preset as factory setting. However, the instrument should be used preferably in liquids. In such cases, the medium selection should be set to "*Liquid*" during setup.

According to the conductivity and the dielectric constant of liquids, the reflection properties can differ considerably. Therefore additional options such as "*Solvent*", "*Chem. mixture*" and "*Water based*" are offered below the menu item Liquid.

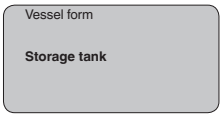
With solids, you can also choose between "*Powder/Dust*", "*Granular/Pellets*" or "*Ballast/Pebbels*".

Through this additional 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 and jump to the next menu item with the ***[->]*** key.

Basic adjustment - Vessel form

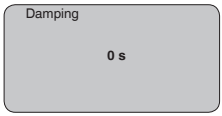
Apart from the medium, the vessel shape can also influence the measurement. To adapt the sensor to these measuring conditions, this menu item offers different options depending on whether liquid or bulk solid is selected. With "*Liquids*" these are "*Storage tank*", "*Stilling tube*", "*Open vessel*" or "*Stirred vessel*", with "*Solid*", "*Silo*" or "*Bunker*".



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

Basic adjustment - Damping

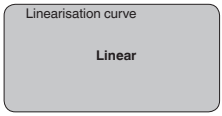
To suppress fluctuations in the measured value display, e. g. caused by an agitated product surface, a damping can be set. This time can be between 0 and 999 seconds. Keep in mind that the reaction time of the entire measurement will then be longer and the sensor will react to measured value changes with a delay. In general, a period of a few seconds is sufficient to smooth the measured value display.



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

Basic adjustment - Linearization curve

A linearisation 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 linearisation 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*".



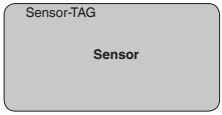
Enter the requested parameters via the appropriate keys, save your settings and jump to the next menu item with the ***[->]*** key.

Caution:
Note the following if the VEGAPULS 65 with corresponding approval is used as part of an overfill protection system according to WHG (Water Resources Act):

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

Basic adjustment - Sensor TAG

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



With this menu item, the Basic adjustment is finished and you can now jump to the main menu with the ***[ESC]*** key.

Menu section, display

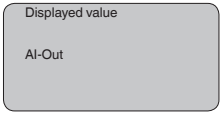
Display - Indicated value

Radar, guided microwave and ultrasonic sensors deliver the following measured values:

- SV1 (Secondary Value 1): Percentage value after the adjustment
- SV2 (Secondary Value 2): Distance value before the adjustment

- PV (Primary Value): Linearised percentage value
- AI FB1 (Out)

In the menu item "*Display*" you can define which value should be indicated on the display.



Display - Backlight

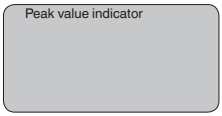
A background lighting integrated by default can be adjusted via the adjustment menu. The function depends on the height of the supply voltage. See "*Technical data/Voltage supply*".

In the default setting, the lightning is switched off.

Diagnosis - Peak value

The respective min. and max. measured values are saved in the sensor. The values are displayed in the menu item "*Peak values*".

- Min. and max. distance in m(d)
- Min. and max. temperature



Diagnosis - Measurement reliability

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

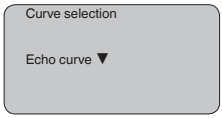
Diagnosis - Curve selection

With ultrasonic sensors, the "**Echo curve**" represents the signal strength of the echoes over the measuring range. The unit of signal strength is "dB". The signal strength enables the jusgement of the quality of the measurement.

The "**False echo curve**" displays the saved false echoes (see menu "*Service*") of the empty vessel as signal strength in "dB" over the measuring range.

Up to 3000 measured values are recorded (depending on the sensor) when starting a "**Trend curve**". Then the values can be displayed on a time axis. The oldest measured values are always deleted.

In the menu item "*Choose curve*", the respective curve is selected.



Information:
The trend recording is not activated when being shipped. It must be started by the user via the menu item "*Start trend curve*".

Diagnosis - Curve presentation

A comparison of the echo curve and the false echo curve allows a more detailled evaluation of measurement reliability. The selected curve is updated continuously. With the ***[OK]*** key, a submenu with zoom functions is opened.

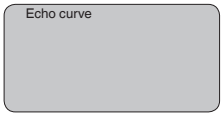
The following functions are available with "**Echo and false echo curve**":

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

In the menu item "**Trend curve**" the following are available:

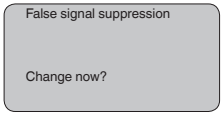
- "X-Zoom": Resolution
  - 1 minute
  - 1 hour
  - 1 day
- "Stop/Start": Interrupt a recording or start a new recording
- "Unzoom": Reset the resolution to minutes

As default setting, the recording pattern has 1 minute. With the adjustment software PACTware, this pattern can be also set to 1 hour or 1 day.



Service - False signal suppression

High sockets or vessel installations, such as e. g. struts or agitators as well as buildup and weld joints on the vessel walls, cause interfering reflections which can impair the measurement. A false echo storage detects and marks these false echoes, so that they are no longer taken into account for the level measurement. A false echo memory should be created with low level so that all potential interfering reflections can be detected.



Proceed as follows:

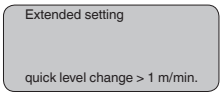
1. Move from the measured value display to the main menu by pushing ***[OK]***.

2. Select the menu item "*Service*" with ***[->]*** and confirm with ***[OK]***. Now the menu item "*False signal suppression*" is displayed.
3. Confirm "*False signal suppression - Change now*" with ***[OK]*** and select in the below menu "*Create new*". Enter the actual distance from the sensor to the product surface. All false signals in this area are detected by the sensor and saved 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 a false signal. The level would then no longer be detectable in this area.

Service - Extended setting

The menu item "*Extended setting*" offers the possibility to optimise VEGAPULS 65 for applications in which the level changes very quickly. To do this, select the function "*Quick level change > 1 m/min.*".



Note:
Since with the function "*Quick level change > 1 m/min.*" the generation of an average value of the signal processing is considerably reduced, false reflections by agitators or vessel installations can cause measured value fluctuations. A false signal suppression is thus recommended.

Service - Simulation

In this menu item you simulate a user-defined level or pressure value via the current output. This allows you to test the signal path, e.g. through connected indicating instruments or the input card of the control system.

The following simulation variables are available:

- Percent
- Current
- Pressure (with pressure transmitters)
- Distance (with radar and guided microwave)

With Profibus PA sensors, the selection of the simulated value is made via the "Channel" in the menu "*Basic adjustments*".

How to start the simulation:

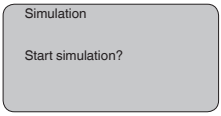
1. Push ***[OK]***
2. Select the requested simulation variable with ***[->]*** and confirm with ***[OK]***.
3. Set the requested numerical value with ***[+]*** and ***[->]***.
4. Push ***[OK]***

The simulation is now running, with 4 … 20 mA/HART a current is output and with Profibus PA or Foundation Fieldbus a digital value.

How to interrupt the simulation:

→ Push ***[ESC]***

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



Service - Reset

Basic adjustment
If the "*Reset*" is carried out, the sensor resets the values of the following menu items to the reset values (see table):[2)]

Function	Reset value
Max. adjustment	0 m(d)
Min. adjustment	30 m(d) (VEGAPULS 61, 63, 65) 35 m(d) (VEGAPULS 62, 66) 70 m(d) (VEGAPULS 68)
Medium	Liquid
Vessel form	not known
Damping	0 s
Linearisation	Linear
Sensor-TAG	Sensor
Displayed value	AI-Out
Extended settings	None
Unit of measurement	m(d)

The values of the following menu items are *not* reset to the reset values (see table) with "**Reset**":

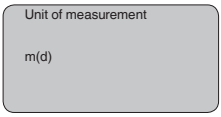
Function	Reset value
Language	No reset

Default setting
Like basic adjustment, but in addition, special parameters are reset to default values.[3)]

Peak value indicator
The min. and max. distance values are reset to the actual value.

Service - Adjustment unit

In this menu item you select the internal arithmetic unit of the sensor.

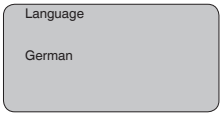


[2)] Sensor-specific basic adjustment.
[3)] Special parameters are parameters which are set customer-specifically on the service level with the adjustment software PACTware.

Service - Language

The sensor is already set to the ordered national language. In this menu item you can change the language. The following languages are available as of software version 3.50:

- Deutsch
- English
- Français
- Espanõl
- Pycckuu
- Italiano
- Netherlands
- Japanese
- Chinese



Service - Copy sensor data

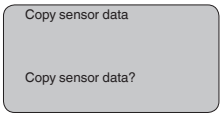
This function enables reading out parameter adjustment data as well as writing parameter adjustment data into the sensor via the display and adjustment module. A description of the function is available in the operating instructions manual "*Display and adjustment module*".

The following data are read out or written with this function:

- Measured value presentation
- Adjustment
- Medium
- Standpipe inner diameter[4)]
- Vessel form
- Damping
- Linearisation curve
- Sensor-TAG
- Displayed value
- Unit of measurement
- Language

The following safety-relevant data are **not** read out or written:

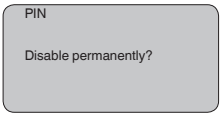
- PIN



Service - PIN

In this menu item, the PIN is activated/deactivated permanently. Entering a 4-digit PIN protects the sensor data against unauthorized access and unintentional modifications. If the PIN is activated permanently, it can be deactivated temporarily (i.e. for approx. 60 min.) in any menu item. The instrument is delivered with the PIN set to 0000.

4) With standpipe versions.



Only the following functions are permitted with activated PIN:

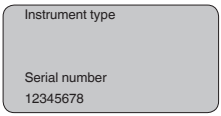
- Select menu items and show data
- Read data from the sensor into the display and adjustment module

Menu section, info

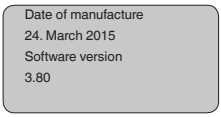
Info

In this menu item the most important sensor information can be displayed:

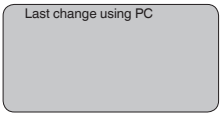
- Instrument type
- Serial number: 8-digit number, e.g. 12345678



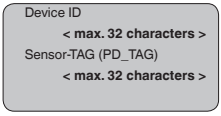
- Date of manufacture: Date of the factory calibration
- Software version: Edition of the sensor software



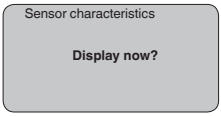
- Date of last change using PC: Date of the last change of sensor parameters via PC



- Device-ID
- Sensor-TAG



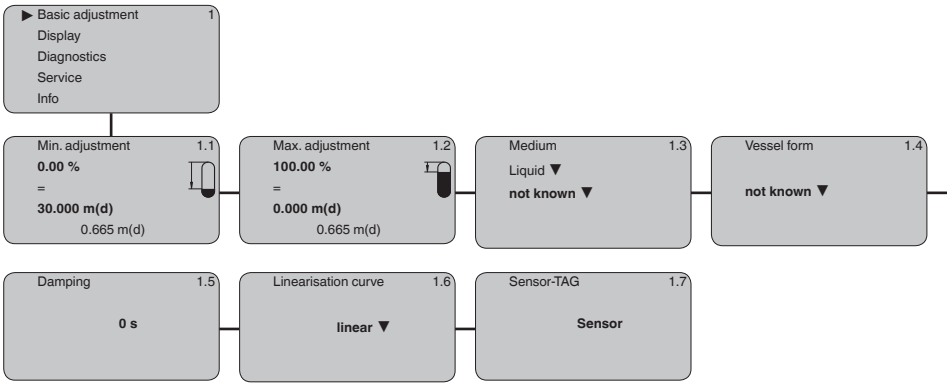
- Sensor details, e.g. approval, process fitting, seal, measuring cell, measuring range, electronics, housing, cable entry, plug, cable length etc.



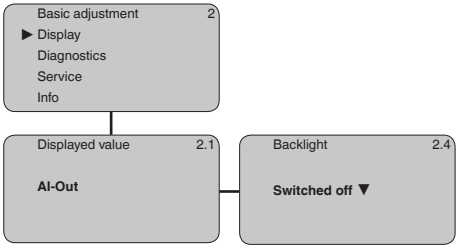
6.5 Menu schematic

Information:
Depending on the version and application, the light-coloured menu windows are not always available or offer nor selection possibility.

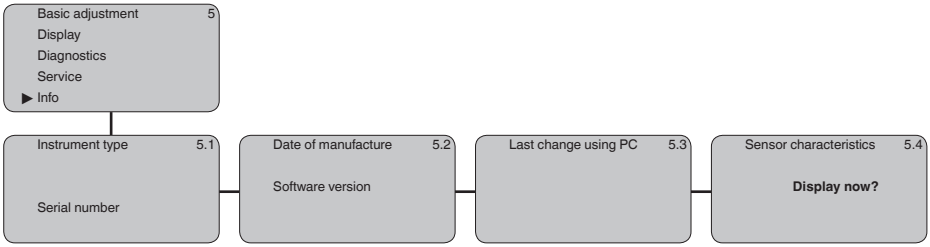
Basic adjustment



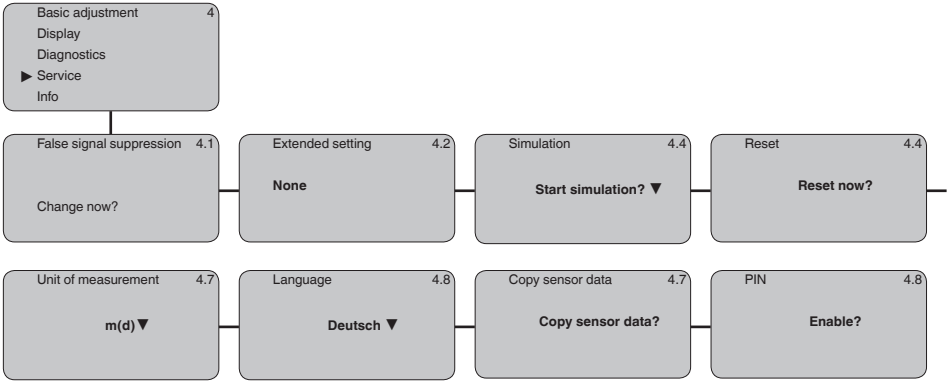
Display



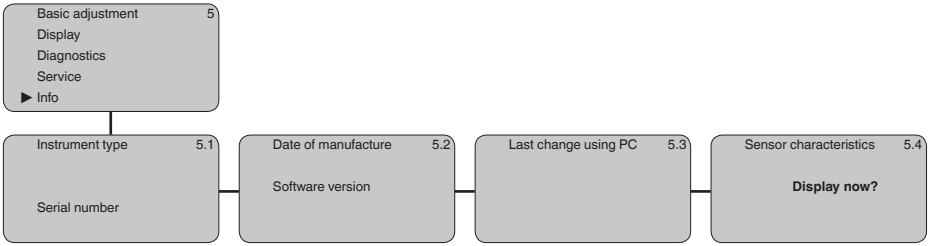
Info



Service



Info



6.10 Saving the parameterisation data

We recommended writing down the adjustment data, e.g. in this operating instructions manual, and archiving them afterwards. They are thus available for multiple use or service purposes.

If VEGAPULS 65 is equipped with a display and adjustment module, the most important data can be read out of the sensor into the display and adjustment module. The procedure is described in the operating instructions manual "*Display and adjustment module*" in the menu item "*Copy sensor data*". The data remain there permanently even if the sensor power supply fails.

If it is necessary to exchange the sensor, the display and adjustment module is inserted into the replacement instrument and the data are written into the sensor under the menu item "*Copy sensor data*".

7 Set up with PACTware and other adjustment programs

7.1 Connect the PC

VEGACONNECT directly on the sensor

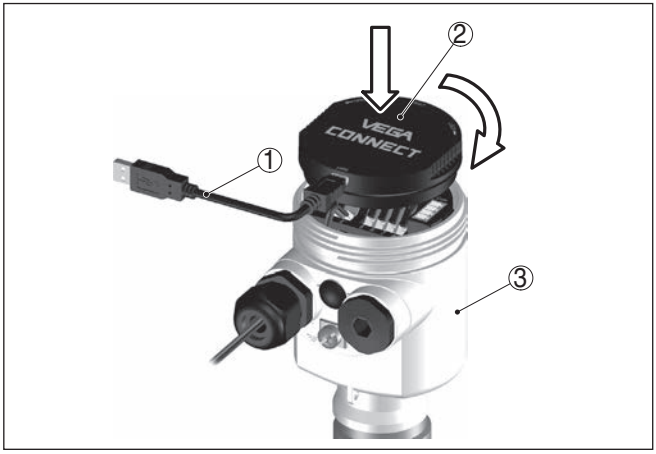


Fig. 29: Connection of the PC via VEGACONNECT directly to the sensor

1 USB cable to the PC
2 VEGACONNECT
3 Sensor

VEGACONNECT externally

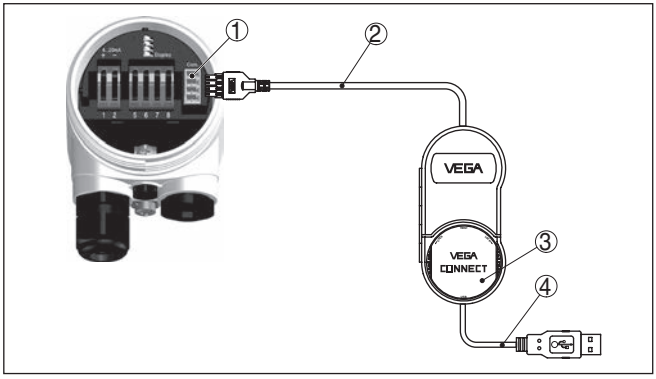


Fig. 30: Connection via VEGACONNECT externally

1 I^2C bus (com.) interface on the sensor
2 I^2C connection cable of VEGACONNECT
3 VEGACONNECT
4 USB cable to the PC

Necessary components:

- VEGAPULS 65
- PC with PACTware and suitable VEGA DTM

- VEGACONNECT
- Power supply unit or processing system

7.2 Parameter adjustment with PACTware

Prerequisites

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

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

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

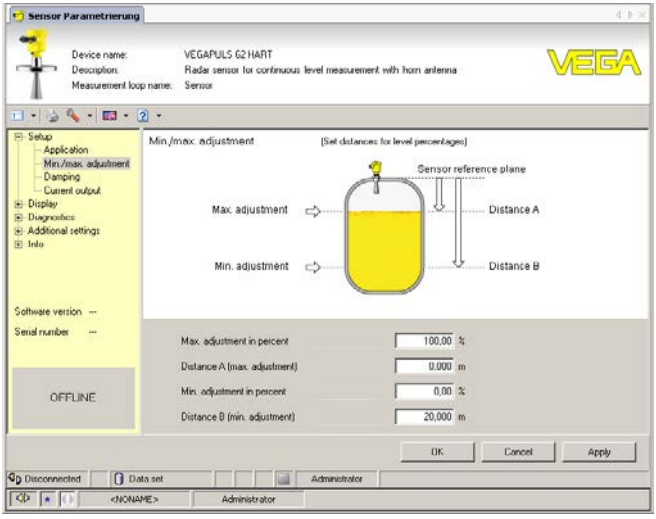


Fig. 31: Example of a DTM view

Standard/Full version

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

In the full version there is also an extended print function for complete project documentation as well as a save function for measured value

and echo curves. In addition, there is a tank calculation program as well as a multiviewer for display and analysis of the saved measured value and echo curves.

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

7.3 Parameter adjustment with AMS™

For VEGA sensors, instrument descriptions for the adjustment program AMS™ are available as DD. The instrument descriptions are already implemented in the current version of AMS™. For older versions of AMS™, a free-of-charge download is available via our website www.vega.com.

7.4 Saving the parameterisation data

It is recommended to document or save the parameter adjustment data. That way they are available for multiple use or service purposes.

The VEGA DTM Collection and PACTware in the licensed, professional version provide suitable tools for systematic project documentation and storage.

8 Maintenance and fault rectification

8.1 Maintenance

Maintenance

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

Cleaning

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

Take note of the following:

- Use only cleaning agents which do not corrode the housings, type label and seals
- Use only cleaning methods corresponding to the housing protection rating

8.2 Rectify faults

Reaction when malfunction occurs

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

Causes of malfunction

VEGAPULS 65 offers maximum reliability. Nevertheless, faults can occur during operation. These may be caused by the following, e.g.:

- Sensor
- Process
- Voltage supply
- Signal processing

Fault rectification

The first measures to be taken are to check the output signals as well as to evaluate the error messages via the display and adjustment module. The procedure is described below. 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 and the faults rectified this way.

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 manned 7 days a week round-the-clock. Since we offer this service worldwide, the support is only available in the English language. The service is free, only standard call charges are incurred.

Checking Foundation Fieldbus

The following table describes possible errors and helps to remove them:

Error	Cause	Rectification
When an additional instrument is connected, the H1 segment fails.	Max. supply current of the segment coupler exceeded	Measure the current consumption, reduce size of segment

Error	Cause	Rectification
Measured value on the display and adjustment module does not correspond to the value in the PLC	The menu item "*Display - Display value*" is not set to "*AI-Out*"	Check values and correct, if necessary
Instrument does not appear during connection setup	Profibus DP cable pole-reversed	Check cable and correct, if necessary
	Incorrect termination	Check termination at the beginning and end points of the bus and terminate, if necessary, according to the specification
	Instrument not connected to the segment	Check and correct, if necessary

In Ex applications, the regulations for the wiring of intrinsically safe circuits must be observed.

Error messages via the display and adjustment module

Error	Cause	Rectification
E013	no measured value available	Sensor in boot phase Sensor does not find an echo, e.g. due to faulty installation or wrong parameter adjustment
E017	Adjustment span too small	Carry out a fresh adjustment and increase the distance between min. and max. adjustment
E036	no operable sensor software	Carry out a software update or send instrument for repair
E041, E042, E043	Hardware error, electronics defective	Exchange the instrument or send it in for repair
E113	Communication conflict	Exchange the instrument or send it in for repair

Reaction after fault rectification

Depending on the reason for the fault and the measures taken, the steps described in chapter "*Set up*" may have to be carried out again.

8.3 Exchanging the electronics module

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

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

If there is no electronics module available on site, one can be ordered from the VEGA agency serving you.

Sensor serial number

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

- At the factory by VEGA
- Or on site by the user

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

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

Assignment

The electronics modules are adapted to the respective sensor and distinguish also in the signal output or power supply.

8.4 Software update

The following components are required to update the instrument software:

- Instrument
- Voltage supply
- Interface adapter VEGACONNECT
- PC with PACTware
- Current instrument software as file

You can find the current instrument software as well as detailed information on the procedure in the download area of our homepage: www.vega.com.

Caution:
Instruments with approvals can be bound to certain software versions. Therefore make sure that the approval is still effective after a software update is carried out.

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

8.5 How to proceed if a repair is necessary

You can find an instrument return form as well as detailed information about the procedure in the download area of our homepage: www.vega.com.

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

If a repair is necessary, please proceed as follows:

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

9 Dismount

9.1 Dismounting steps

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

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

9.2 Disposal

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

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

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

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

10 Supplement

10.1 Technical data

General data	
316L corresponds to 1.4404 or 1.4435	
Materials, wetted parts	
– Process fitting - thread	PVDF, 316L
– Seal - thread PVDF	FKM (Viton)
– Seal - thread 316L	Klingersil C-4400
– Process fittings Clamp and slotted nut	316L
– Process fitting - flange	Flange plating PTFE
– Antenna for sockets 50 mm (1.969 in)	PVDF, PTFE
– Antenna for sockets 100 mm (3.937 in) and 250 mm (9.843 in)	PTFE
Materials, non-wetted parts	
– Housing	Plastic PBT (polyester), Alu die-casting, powder-coated, 316L
– Seal between housing and housing lid	Silicone SI 850 R, NBR silicone-free
– Inspection window housing cover	Polycarbonate (UL-746-C listed), glass[5)]
– Ground terminal	316Ti/316L
– Cable gland	PA, stainless steel, brass
– Sealing, cable gland	NBR
– Blind plug, cable gland	PA
Conductive connection	Between ground terminal and metallic process fitting
Torque of the flange screws (min.)	60 Nm (44.25 lbf ft)
Weight	
– Process fitting - thread, depending on thread size and housing material	2 … 2.8 kg (4.409 … 6.173 lbs)
– Process fitting - flange, depending on flange size and housing material	4.2 … 15.4 kg (9.259 … 33.95 lbs)

Torques	
Max. torques, threaded version	
– G1½	30 Nm (22.13 lbf ft)
Required torque of the flange screws	60 Nm (44.25 lbf ft)
Recommended torque for tightening the flange screws	60 … 100 Nm (44.25 … 73.76 lbf ft)
Max. torque for NPT cable glands and Conduit tubes	
– Plastic housing	10 Nm (7.376 lbf ft)
– Aluminium/Stainless steel housing	50 Nm (36.88 lbf ft)

[5)] Glass with Aluminium and stainless steel precision casting housing

Output variable	
Output	
– Signal	digital output signal, Foundation Fieldbus protocol
– Physical layer	according to IEC 61158-2
Cycle time	min. 1 s (dependent on the parameter setting)
– Damping (63 % of the input variable)	0 … 999 s, adjustable
– Met NAMUR recommendation	NE 43
Channel Numbers	
– Channel 1	Primary value
– Channel 2	Secondary value 1
– Channel 3	Secondary value 2
Transmission rate	31.25 Kbit/s
Current value	10 mA, ±0.5 mA
Resolution, digital	> 1 mm (0.039 in)

Input variable	
Measured variable	distance between process fitting and product surface
Min. distance from antenna end	50 mm (1.969 in)
Measuring range	up to 30 m (98.43 ft)

Reference conditions to measurement accuracy (according to DIN EN 60770-1)	
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)
Other reference conditions	
– Reflector	Ideal reflector, e.g. metal plate 2 x 2 m
– False reflections	Biggest false signal, 20 dB smaller than the useful signal

Characteristics and performance data	
Measuring frequency	C-band (6 GHz technology)
Beam angle -3 dB	24°
Step response or adjustment time[6)]	> 1 s (dependent on the parameter setting)
Max. level change	Adjustable up to 1 m/min. (dependent on the parameter settings)
Max. emitted HF power of the antenna system	
– Pulse peak power approx.	0.1 mW
– Pulse duration	< 2 ns
– SAR value[7)]	0.471 mW/kg

[6)] Time to output the correct level (with max. 10 % deviation) after a sudden level change.
[7)] At the aperture of a horn antenna with ø 150 mm

Deviation (according to DIN EN 60770-1)

Deviation with liquids[8]	≤ 8 mm (meas. distance > 1.0 m/3.28 ft)
Deviation with bulk solids	The values depend to a great extent on the application. Binding specifications are thus not possible.

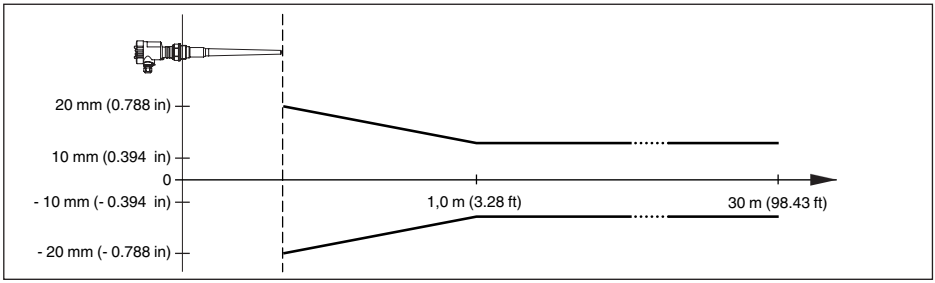


Fig. 32: Deviation VEGAPULS 65

Influence of the ambient temperature to the sensor electronics[9]

Average temperature coefficient of the zero signal (temperature error)	< 0.03 %/10 K

Influence of the superimposed gas and pressure on measurement accuracy

The spreading speed of the radar impulses in gas or vapour above the product is reduced by high pressures. This effect depends on the superimposed gas or vapour and increases with low temperatures. The following table shows the deviation caused by some typical gases or vapours. The stated values refer to the distance. Positive values mean that the measured distance is too high, negative values that the measured distance is too small.

Gas phase	Temperature	1 bar/14.5 psig	10 bar/145 psig	50 bar/725 psig
Air/Nitrogen	20 °C/68 °F	0.00 %	0.22 %	1.2 %
Air/Nitrogen	200 °C/392 °F	0.00 %	0.13 %	0.74 %
Hydrogen	20 °C/68 °F	-0.01 %	0.10 %	0.61 %
Hydrogen	200 °C/392 °F	-0.02 %	0.05 %	0.37 %
Water (saturated steam)	100 °C/212 °F	0.20 %	-	-
Water (saturated steam)	180 °C/356 °F	-	2.1 %	-

Ambient conditions

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

[8] Incl. non-linearity, hysteresis and non-repeatability.
[9] Relating to the nominal measuring range, in the temperature range -40 … +80 °C .

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Process conditions

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

Vessel pressure

– Screwed part PVDF	-100 … 300 kPa/-1 … 3 bar (-14.5 … 43.5 psig)
– Screwed part and flange 316L	-100 … 1600 kPa/-1 … 16 bar (-14.5 … 232 psig)

Process temperature (measured on the process fitting)

– Process fitting, thread PVDF	-40 … +130 °C (-40 … +266 °F)
– Other process fittings	-40 … +150 °C (-40 … +302 °F)
Vibration resistance	mechanical vibrations with 4 g and 5 … 100 Hz[10)]

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

Options of the cable entry

– Cable entry	M20 x 1.5; ½ NPT
– Cable gland	M20 x 1.5; ½ NPT
– Blind plug	M20 x 1.5; ½ NPT
– Closing cap	½ NPT

Wire cross-section (spring-loaded terminals)

– Massive wire, stranded wire	0.2 … 2.5 mm² (AWG 24 … 14)
– Stranded wire with end sleeve	0.2 … 1.5 mm² (AWG 24 … 16)

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

Options of the cable entry

– Cable gland with integrated connection cable	M20 x 1.5 (cable: ø 5 … 9 mm)
– Cable entry	½ NPT
– Blind plug	M20 x 1.5; ½ NPT

Connection cable

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

Display and adjustment module

Voltage supply and data transmission	through the sensor
Indication	LC display in dot matrix

[10)] Tested according to the guidelines of German Lloyd, GL directive 2.

Adjustment elements	4 keys
Protection rating	
– unassembled	IP 20
– Mounted into the sensor without cover	IP 40
Ambient temperature - Display and adjustment module	-20 … +70 °C (-4 … +158 °F)
Material	
– Housing	ABS
– Inspection window	Polyester foil

Voltage supply

Operating voltage	
– Non-Ex instrument	9 … 32 V DC
– Ex-ia instrument	9 … 24 V DC
– Ex-d-ia instrument	16 … 32 V DC
Operating voltage with illuminated display and adjustment module	
– Non-Ex instrument	12 … 32 V DC
– Ex-ia instrument	12 … 24 V DC
– Ex-d-ia instrument	Lighting not possible
Power supply by/max. number of sensors	
– Fieldbus	max. 32 (max. 10 with Ex)

Potential connections and electrical separating measures in the instrument

Electronics	Not non-floating
Reference voltage[11)]	500 V AC
Conductive connection	Between ground terminal and metallic process fitting

Electrical protective measures

Protection rating

Housing material	Version	IP-protection class	NEMA protection
Plastic	Single chamber	IP 66/IP 67	Type 4X
	Double chamber	IP 66/IP 67	Type 4X
Aluminium	Single chamber	IP 66/IP 68 (0.2 bar) IP 68 (1 bar)	Type 6P Type 6P
	Double chamber	IP 66/IP 67 IP 66/IP 68 (0.2 bar) IP 68 (1 bar)	Type 4X Type 6P Type 6P
Stainless steel (electro-polished)	Single chamber	IP 66/IP 68 (0.2 bar)	Type 6P

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

Housing material	Version	IP-protection class	NEMA protection
Stainless steel (precision casting)	Single chamber	IP 66/IP 68 (0.2 bar) IP 68 (1 bar)	Type 6P Type 6P
	Double chamber	IP 66/IP 67 IP 66/IP 68 (0.2 bar) IP 68 (1 bar)	Type 4X Type 6P Type 6P

Connection of the feeding power supply unit	Networks of overvoltage category III
Altitude above sea level	
– by default	up to 2000 m (6562 ft)
– with connected overvoltage protection	up to 5000 m (16404 ft)
Pollution degree[12)]	4
Protection class	II (IEC 61010-1)

Approvals

Instruments with approvals can have different technical specifications depending on the version.

For that reason the associated approval documents of these instruments have to be carefully noted. They are part of the delivery or can be downloaded under www.vega.com, "*Instrument search (serial number)*" as well as in the general download area.

10.2 Foundation Fieldbus

Block diagram, measured value processing

The following illustration shows the Transducer Block and Function block in simplified form.

12) When used with fulfilled housing protection

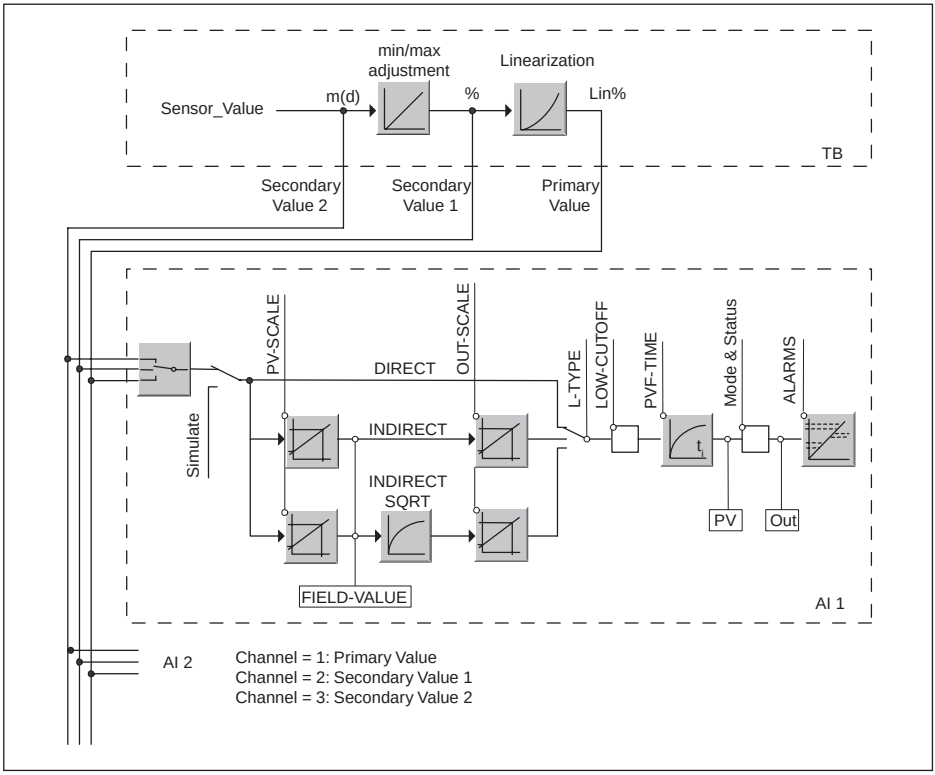

Fig. 33: VEGAPULS 65 measured value processing

Diagram, adjustment

The following illustration shows the function of the adjustment.

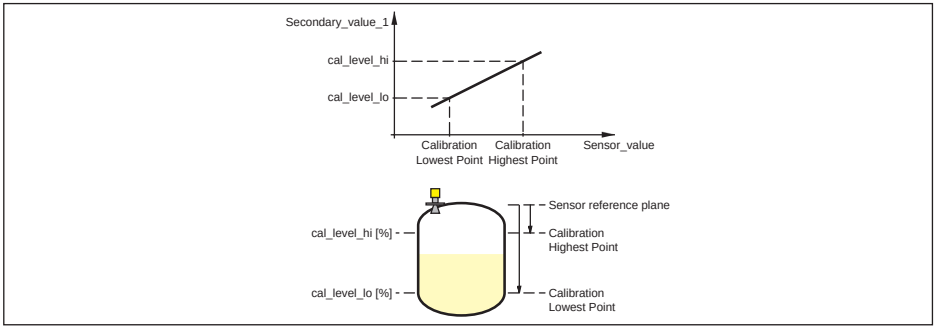

Fig. 34: Adjustment VEGAPULS 65

Parameter list

The following list contains the most important parameters and their meaning:

- primary_value
  - Process value after min/max-adjustment and linearization. Selected as input to AIFB by setting 'Channel' = 1. Unit derives from 'Primary_value_unit'
- primary_value_unit
  - Selected unit code for "primary_value"
- secondary_value_1
  - Value after min/max-adjustment (level + level offset). Selected as input to AIFB by setting 'Channel' = 2. Unit derives from 'Secondary_value_1_unit'
- secondary_value_1_unit
  - Selected unit code for "secondary_value_1"
- secondary_value_2
  - Sensor value + sensor offset. Selected as input to AIFB by setting 'Channel' = 3. Unit derives from 'Secondary_value_2_unit'
- secondary_value_2_unit
  - Unit code of 'Secondary_value_2'
- sensor_value
  - Raw sensor value, i.e. the uncalibrated measurement value from the sensor. Unit derives from 'Sensor_range.unit'
- sensor_range
  - 'Sensor_range.unit' refers to 'Sensor_value', 'Max/Min_peak_sensor_value', 'Cal_point_hi/lo'
- simulate_primary_value
- simulate_secondary_value_1
- simulate_secondary_value_2
- device_status
- Linearization Type
  - Possible types of linearization are: linear, user defined, cylindrical lying container, spherical container
- curve_points_1_10
  - X and Y values for the user defined linearization curve
- curve_points_11_20
  - X and Y values for the user defined linearization curve
- curve_points_21_30
  - X and Y values for the user defined linearization curve
- curve_points_31_33
  - X and Y values for the user defined linearization curve
- curve status
  - Result of table plausibility check
- SUB_DEVICE_NUMBER
- SENSOR_ELEMENT_TYPE
- display_source_selector
  - Selects the type of value, which is displayed on the indication and adjustment module
- max_peak_sensor_value
  - Holds the maximum sensor value. Write access resets to current value. Unit derives from 'Sensor_range.unit'
- min_peak_sensor_value
  - Holds the minimum sensor value. Write access resets to current value. Unit derives from 'Sensor_range.unit'
- Calibration Highest Point
  - Min./max.-adjustment: Upper calibrated point of the sensor. It refers to 'Cal_level_hi'. The unit is defined in 'Sensor_range.unit'
- Calibration Lowest Point
  - Min./max.-adjustment: Lower calibrated point of the sensor. It refers to 'Cal_level_lo'. The unit is defined in 'Sensor_range.unit'

- cal_level_hi
  - Min./max-adjustment: Level at 'Cal_point_hi'. When writing 'Cal_level_hi' and 'Cal_type' = 1 (Online) the 'Cal_point_hi' is automatically set to the current sensor value. The unit is defined in 'Level_unit'
- cal_level_lo
  - Min./max.-adjustment: Level at 'Cal_point_lo'. When writing 'Cal_level_lo' and 'Cal_type' = 1 (Online), the 'Cal_point_lo' is automatically set to the current sensor value. The unit is defined in 'Level_unit'
- cal_type
  - Min./max.-adjustment: Defines type of calibration: Dry: no influence of sensor value. Online: current sensor value determines 'Cal_point_hi/lo'
- level
  - Value after min./max.-adjustment
- level_unit
  - Unit code of 'Level', 'Level_offset', 'Cal_level_hi', 'Cal_level_lo'
- level_offset
  - Offset that is added to the 'Level' value. Unit derives from 'Level_unit'
- SENSOR_OFFSET
  - Offset that is added to the 'Sensor_value'. Unit derives from 'Sensor_range.unit'
- end_of_operation_range
  - Set up to suit the process conditions
- begin_of_operation_range
  - Set up to suit the process conditions
- product_type
  - Set up to suit the process conditions. If Special-Parameter adjustment has been utilized this parameter cannot be written
- liquids_medium_type
  - Set up to suit the process conditions. If Special-Parameter adjustment has been utilized this parameter cannot be written
- solids_medium_type
  - Set up to suit the process conditions. If Special-Parameter adjustment has been utilized this parameter cannot be written
- liquids_vessel_type
  - Set up to suit the process conditions. If Special-Parameter adjustment has been utilized this parameter cannot be written
- solids_vessel_type
  - Set up to suit the process conditions. If Special-Parameter adjustment has been utilized this parameter cannot be written
- fast_level_change
  - Set up to suit the process conditions. If Special-Parameter adjustment has been utilized this parameter cannot be written
- first_echo_factor
  - Set up to suit the process conditions.
- pulse_velocity_correction
  - Set up to suit the process conditions.
- echo_quality
  - Signal/Noise ratio
- empty_vessel_curve_corr_dist
  - Distance from the sensor to the product surface. Unit derives from 'Sensor_range.unit'
- empty_vessel_curve_corr_op_code
  - Update, create new or delete the empty vessel curve
- tube diameter
  - Set up to suit the process conditions

10.3 Dimensions

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

Plastic housing

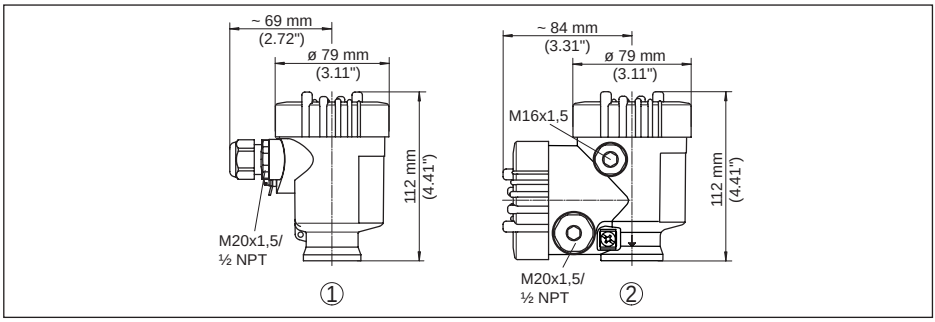

Fig. 35: Housing versions in protection IP 66/IP 67 (with integrated display and adjustment module the housing is 9 mm/0.35 in higher)

1 Plastic single chamber
2 Plastic double chamber

Aluminium housing

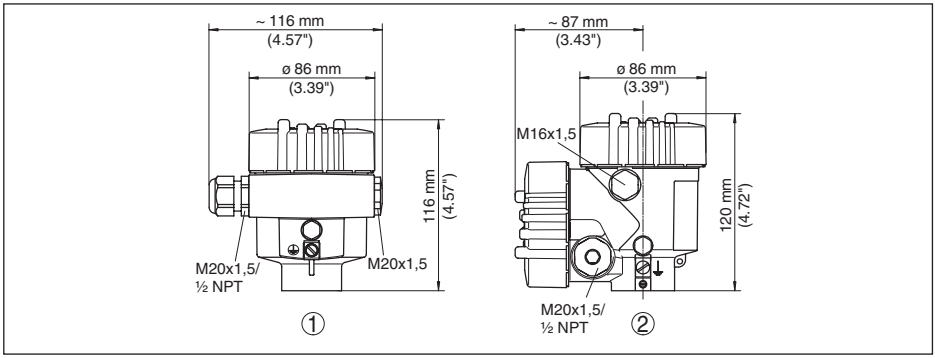

Fig. 36: Housing versions with protection rating IP 66/IP 68 (0.2 bar) (with integrated display and adjustment module the housing is 18 mm/0.71 in higher)

1 Aluminium - single chamber
2 Aluminium - double chamber

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

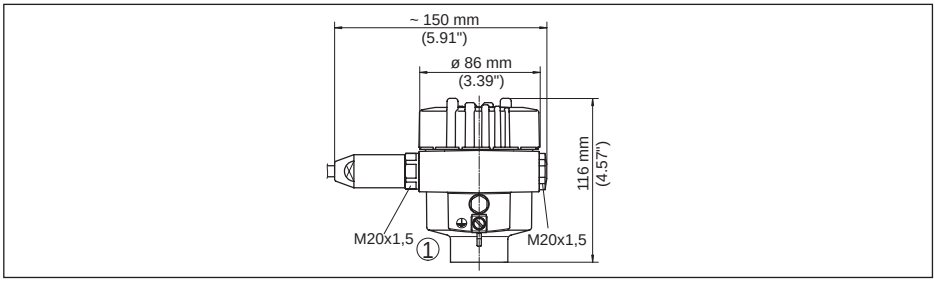

Fig. 37: Housing version with protection rating IP 66/IP 68 (1 bar), (with integrated display and adjustment module the housing is 18 mm/0.71 in higher)

1 Aluminium - single chamber

Stainless steel housing

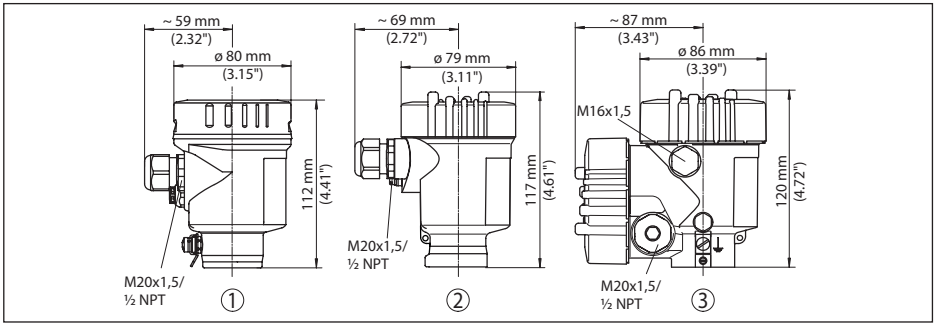

Fig. 38: Housing versions with protection rating IP 66/IP 68 (0.2 bar), (with integrated display and adjustment module the housing at position 1 is 9 mm/0.35 in higher, with position 2 18 mm/0.71 in)

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

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

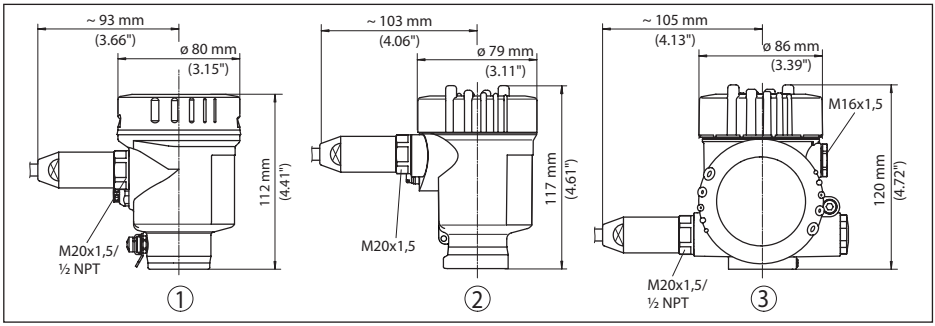

Fig. 39: Housing version with protection rating IP 66/IP 68 (1 bar), (with integrated display and adjustment module the housing is 18 mm/0.71 in higher)

1 Stainless steel single chamber (precision casting)

VEGAPULS 65, threaded version

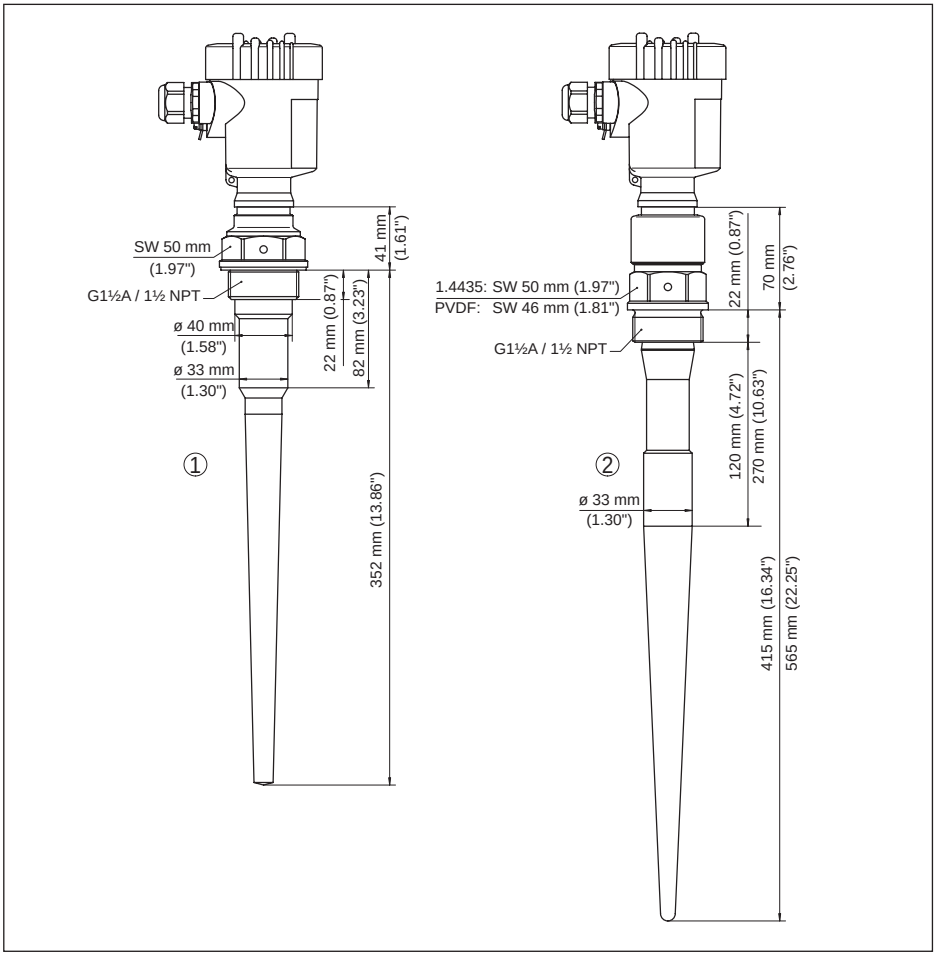

Fig. 40: VEGAPULS 65, threaded version

1 *Thread and hexagon of PVDF for sockets with 50 mm height (inactive length 82 mm, 55/64")*
2 *Thread and hexagon of PVDF or 316L for sockets with 100 mm height (inactive length 120 mm, 4 23/32") or 250 mm height (inactive length 270 mm, 10 5/8")*

VEGAPULS 65, flange version

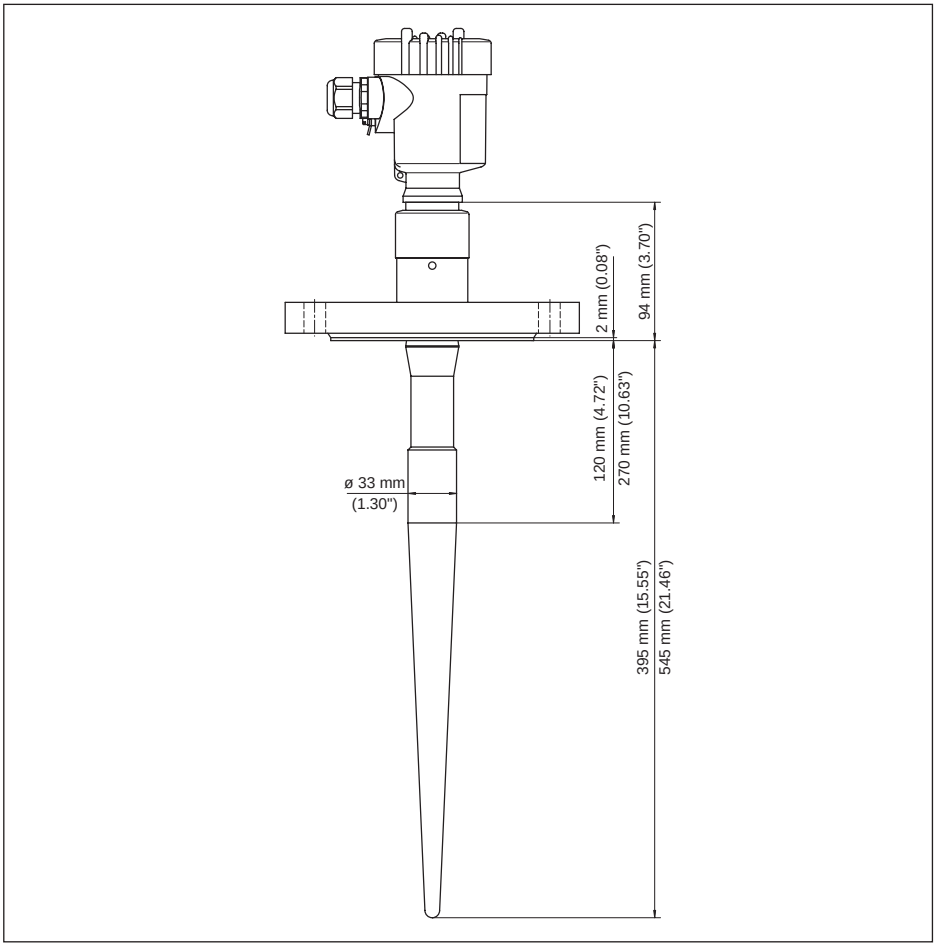

Fig. 41: VEGAPULS 65, flange version for sockets with 100 mm height (inactive length 120 mm, 4 23/32") or 250 mm height (inactive length 270 mm, 10 5/8")

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