

# Operating Instructions

Radar sensor for continuous level measurement of bulk solids

## NCR-80

Modbus and Levelmaster Protocol



Document ID: 47252



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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 manual.

Editing status: 2016-06-30  
925-0340 Rev A

# 1 About this document

## 1.1 Function

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

## 1.2 Target group

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

## 1.3 Symbols used



### Information, tip, note

This symbol indicates helpful additional information.



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



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



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



### Ex applications

This symbol indicates special instructions for Ex applications.



### List

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



### Action

This arrow indicates a single action.



### Sequence of actions

Numbers set in front indicate successive steps in a procedure.



### Battery disposal

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

## 2 For your safety

### 2.1 Authorised personnel

All operations described in this operating instructions manual must be carried out only by trained specialist personnel authorised by the plant operator.

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

### 2.2 Appropriate use

VEGAPULS 69 is a sensor for continuous level measurement.

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

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

### 2.3 Warning about incorrect use

Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel overfill or damage to system components through incorrect mounting or adjustment. Also the protective characteristics of the instrument can be influenced.

### 2.4 General safety instructions

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

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

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

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

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

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

## 2.5 CE conformity

The device fulfils the legal requirements of the applicable EC guidelines. By affixing the CE marking, we confirm successful testing of the product.

You can find the CE Certificate of Conformity in the download section of our homepage.

## 2.6 NAMUR recommendations

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

The device fulfils the requirements of the following NAMUR recommendations:

- NE 21 – Electromagnetic compatibility of equipment
- NE 53 – Compatibility of field devices and display/adjustment components
- NE 107 – Self-monitoring and diagnosis of field devices

For further information see [www.namur.de](http://www.namur.de).

## 2.7 Radio license for Europe

The instrument meets the LPR (Level Probing Radar) radio standard EN 302729-1/2.

It is approved for unrestricted use inside and outside of closed vessels in countries of the EU and EFTA that have implemented this standard.

For operation outside of closed vessels, the following conditions must be fulfilled:

- The installation must be carried out by trained qualified personnel
- The instrument must be stationary mounted and the antenna directed vertically downward
- The mounting location must be at least 4 km away from radio astronomy stations, unless special permission was granted by the responsible national approval authority
- When installed within 4 to 40 km of a radio astronomy station, the instrument must not be mounted higher than 15 m above the ground.

You can find a list of the respective radio astronomy stations in chapter "*Supplement*".

## 2.8 Radio license for USA

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

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

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

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

For operation outside of closed vessels, the following conditions must be fulfilled:

- This device shall be installed and maintained to ensure a vertically downward orientation of the transmit antenna's main beam. Furthermore, the use of any mechanism that does not allow the main beam of the transmitter to be mounted vertically downward is prohibited.
- This device shall be installed only at fixed locations. The LPR device shall not operate while being moved or while inside a moving container.
- Hand-held applications are prohibited.
- Marketing to residential consumers is prohibited.

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

## 2.9 Radio license for Canada

This approval is only valid for Canada. Hence the following texts are only available in the English/French language.

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following conditions:

- This device may not cause interference, and
- This device must accept any interference, including interference that may cause undesired operation of the device
- Installation of LPR device shall be done by trained installers, in strict compliance with the manufacturer's instructions
- The use of this device is on a "no-interference, no-protection" basis. That is, the user shall accept operations of high-powered radar in the same frequency band which may interfere with or damage this device. However, level probing devices found to interfere with primary licensing operations will be required to be removed at the user's expense
- This device shall be installed and maintained to ensure a vertically downward orientation of the transmit antenna's main beam
- This device shall be installed only at fixed locations. The LPR device shall not operate while being moved or while inside a moving container

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- L'appareil ne doit pas produire de brouillage, et
- L'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement
- L'installation de l'appareil LPR doit être faite par des installateurs expérimentés dans le respect des instructions du fabricant
- Cet appareil s'utilise en "non-interférence, non-protection". Ceci veut dire que l'utilisateur accepte le fonctionnement de radars de

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haute puissance agissant dans la même bande de fréquence et pouvant interférer avec cet appareil ou l'endommager. Toutefois, les appareils de test de niveau qui interfèrent avec les opérations primaires de prise de licence devront être retirés aux frais de l'utilisateur.

- Cet appareil doit être installé et entretenu de manière à assurer une orientation verticale vers le bas du faisceau principal de l'antenne de transmission
- Cet appareil ne doit être installé qu'à des emplacements fixes. L'appareil LPR ne doit pas fonctionner pendant qu'il se déplace ou se trouve dans un conteneur en mouvement

## 2.10 Environmental instructions

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

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

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



## 3 Product description

### 3.1 Configuration

#### Type label

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

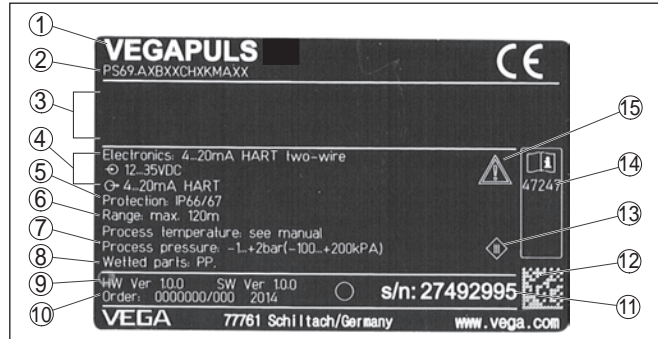


Fig. 1: Layout of the type label (example)

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

#### Serial number - Instrument search

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

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

Go to "[www.vega.com](http://www.vega.com)", "VEGA Tools" and "Instrument search". Enter the serial number.

Alternatively, you can access the data via your smartphone:

- Download the smartphone app "VEGA Tools" from the "Apple App Store" or the "Google Play Store"

- Scan the Data Matrix code on the type label of the instrument or
- Enter the serial number manually in the app

### Electronics design

The instrument contains two different electronics in its housing chambers:

- The Modbus electronics for power supply and communication with the Modbus-RTU
- The sensor electronics for the actual measuring tasks

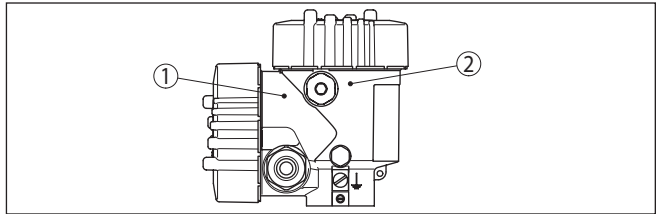


Fig. 2: Position of Modbus and sensor electronics

- 1 Modbus electronics
- 2 Sensor electronics

### Scope of this operating instructions manual

This operating instructions manual applies to the following instrument versions:

- Hardware version from 1.0.0
- Software version from 1.1.0

### Scope of delivery

The scope of delivery encompasses:

- Radar sensor
- Hexagon socket wrench (for instruments with swivel holder)
- Documentation
  - Quick setup guide VEGAPULS 69
  - Instructions for optional instrument features
  - Ex-specific "Safety instructions" (with Ex versions)
  - If necessary, further certificates
- DVD "DTM Collection", included therein
  - PACTware
  - DTM Collection
  - Instrument master files (GSD) for Profibus PA
  - FDT certificates



#### Information:

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

### Application area

## 3.2 Principle of operation

The VEGAPULS 69 is a radar sensor for continuous level measurement of bulk solids even under the most difficult process conditions and in very large measuring ranges.

It is ideal for use in high, slender silos with poorly reflecting bulk solids such as fly-ash, plastic granules or wood chips as well as internal installations that cause strong false echoes. This is made possible by its functional principle, a distance measurement through frequency shifting with an especially small beam angle.

The instrument is available with different antenna systems and accessories for virtually all applications and processes:

- Plastic horn antenna or metal-jacketed lens antenna
- Optional or integrated rinsing air connection
- Swivelling holder with seal against the process

### Functional principle

The instrument emits a continuous radar signal through its antenna. This signal is frequency modulated in the form of a sawtooth wave. The emitted signal is reflected by the medium and received by the antenna as an echo.

The frequency of the received signal always deviates from the actual emitting frequency. The frequency difference is proportional to the distance and thus to the filling height. This difference is calculated via special algorithms in the sensor electronics. The determined filling height is then converted into a corresponding output signal and outputted as the measured value.

## 3.3 Packaging, transport and storage

### Packaging

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

The packaging 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 %

**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 and removed at any time.

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

**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, the adjustment software PACTware with VEGA-DTM is required.

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

**Protective cap**

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**

Screwed flanges are available in different versions according to the following standards: DIN 2501, EN 1092-1, BS 10, ASME 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*".

**Flanges with plastic horn antenna**

For mounting the instrument with plastic horn antenna to a socket, two flange versions are available: the combi compression flange and the adapter flange

You can find additional information in chapter "*Mounting*" of this operating instruction.

**Mounting strap with plastic horn antenna**

A mounting strap is available for mounting the instrument with plastic horn antenna to the wall or ceiling.

You can find additional information in chapter "*Mounting*" of this operating instruction.

**Electronics module**

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

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

**Supplementary electronics for Modbus**

The supplementary electronics is a replacement part for sensors with signal output Modbus.

You can find further information in the operating instructions "*Supplementary electronics for Modbus*" (Document-ID 41864).

## 4 Mounting

### 4.1 General instructions

#### Protection against moisture

Protect your instrument against moisture ingress through the following measures:

- Use the recommended cable (see chapter "Connecting to power supply")
- Tighten the cable gland
- Loop the connection cable downward in front of the cable gland

This applies particularly to:

- Outdoor mounting
- Installations in areas where high humidity is expected (e.g. through cleaning processes)
- Installations on cooled or heated vessels

#### Suitability for the process conditions

Make sure that all parts of the instrument exposed to the process are suitable for the existing process conditions.

These are mainly:

- Active measuring component
- Process fitting
- Process seal

Process conditions are particularly:

- Process pressure
- Process temperature
- Chemical properties of the medium
- Abrasion and mechanical influences

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

#### 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. The dust protection caps do not provide sufficient protection against moisture.

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

#### Radio license for USA/Canada

The mounting position and orientation of the sensor must take into account the limitations in chapter "For your safety", "Radio approval for USA" "Radio approval for Canada" of this operating instructions.

## 4.2 Mounting versions, plastic horn antenna

### Mounting strap

The optional mounting strap allows simple mounting of the instrument on a wall, ceiling or boom. Especially in the case of open vessels, this is a simple and effective way to align the sensor to the surface of the bulk solid material.

The following versions are available:

- Length 300 mm
- Length 170 mm

### Mounting strap - Ceiling mounting

The instrument is normally mounted vertically with a bracket on the ceiling.

This allows swivelling the sensor up to 180° for optimal orientation and rotating for optimal connection.

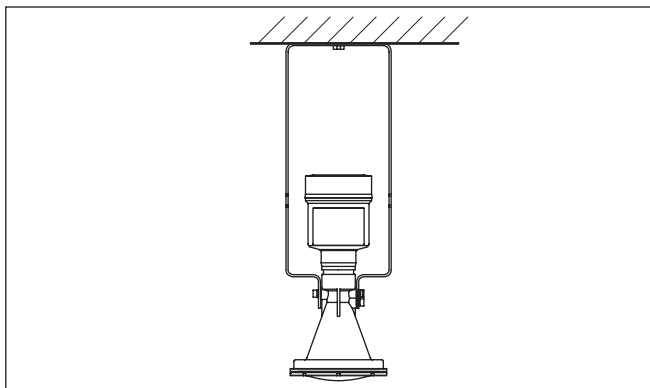


Fig. 3: Ceiling mounting via the mounting strap with length 300 mm

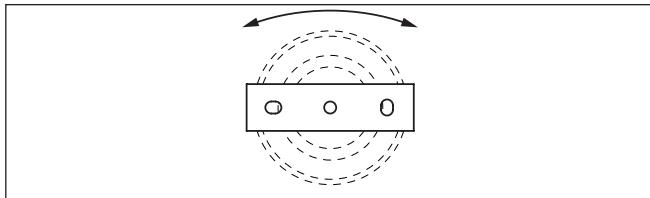


Fig. 4: Rotating with ceil mounting

### Mounting strap - Wall mounting

As an alternative the strap mounting is carried out horizontally or obliquely.

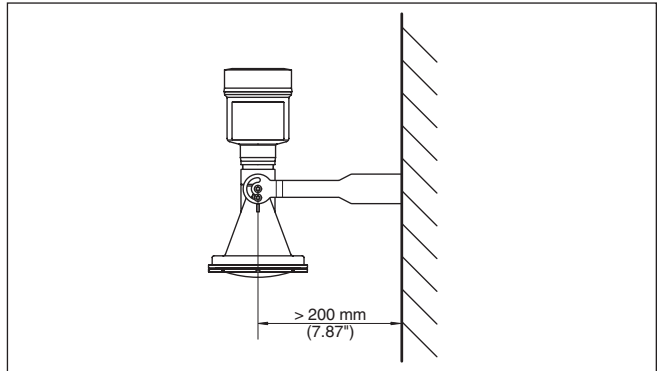


Fig. 5: Wall mounting horizontally via the mounting strap with length 170 mm

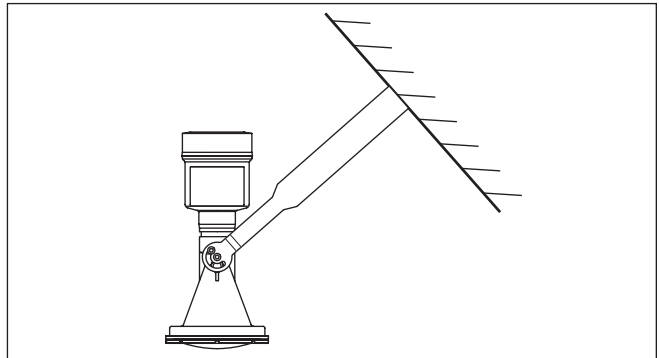


Fig. 6: Wall mounting with inclined wall via the mounting strap with length 300 mm

## Flange

Two versions are available for mounting the instrument on a socket:

- Combi compression flange fitting to DN 80 (ASME 3" and JIS 80)
- Adapter flange from DN 100 (ASME 4" or JIS 100)

The combi compression flange is suitable for different flange standards and can be used for simple applications. It comes unassembled and not sealed against the radar sensor and can thus only be used unpressurized. It can be retrofitted on instruments with single chamber housing, retrofitting to a double chamber housing is not possible.



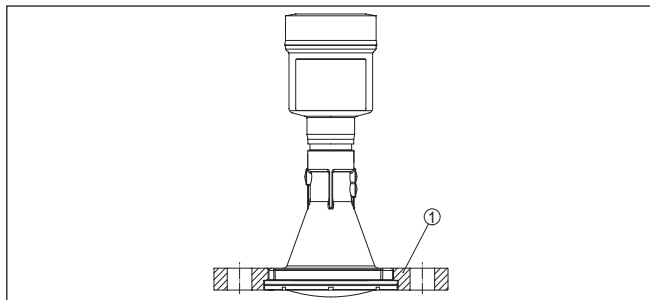


Fig. 7: Combi compression flange

1 Combi compression flange

The adapter flange is available in different flange sizes. It is permanently connected with the radar sensor and sealed.

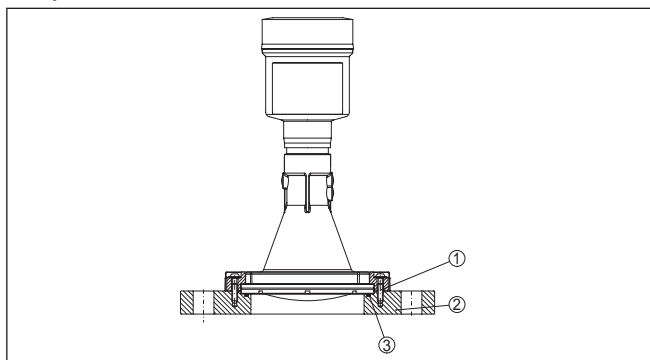


Fig. 8: Adapter flange

1 Connection screw  
2 Adapter flange  
3 Process seal

You can find drawings of these mounting options in chapter "Dimensions".

### 4.3 Mounting preparations, mounting strap

The mounting strap is supplied unassembled (optionally) and must be screwed to the sensor before setup with three hexagon socket screws M5 x 10 and spring washers. Max. torque, see chapter "Technical data". Required tools: Allen wrench size 4.

There are two different variants of screwing the strap to the sensor, see following illustration:

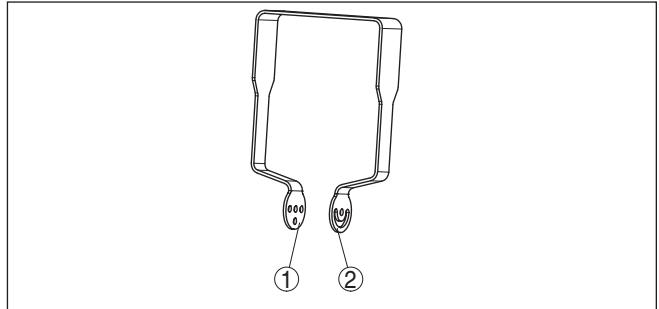


Fig. 9: Mounting strap for screwing to the sensor

- 1 For angle of inclination in steps
- 2 For angle of inclination, infinitely variable

Depending on the selected variant, the sensor can be rotated in the strap:

- Single chamber housing
  - Angle of inclination in three steps 0°, 90° and 180°
  - Angle of inclination 180°, infinitely variable
- Double chamber housing
  - Angle of inclination 90°, infinitely variable
  - Angle of inclination in two steps 0° and 90°

#### 4.4 Mounting instructions

##### Polarisation

Radar sensors for level measurement emit electromagnetic waves. The polarization is the direction of the electrical component of these waves.

The polarization direction is marked by a nose on the housing, see following drawing:

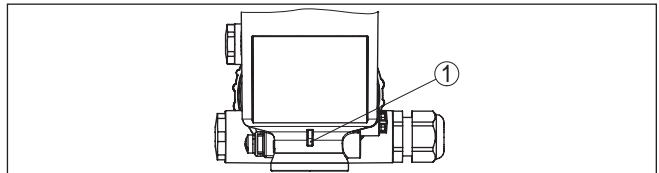


Fig. 10: Position of the polarisation

- 1 Nose for marking the direction of polarisation



##### Information:

When the housing is rotated, the direction of polarization changes and hence the influence of the false echo on the measured value. Please keep this in mind when mounting or making changes later.

##### Installation position

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

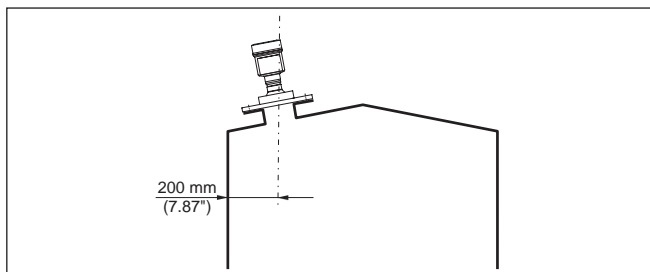


Fig. 11: Mounting the radar sensor on the vessel top

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.

### Inflowing medium

The instrument should not be mounted too close to the inflowing medium, as the radar signal could be disrupted.

#### Silo with filling from top

The optimal mounting position is opposite the filling aperture. To avoid heavy soiling, the distance to any filter or dust exhauster should be as large as possible.

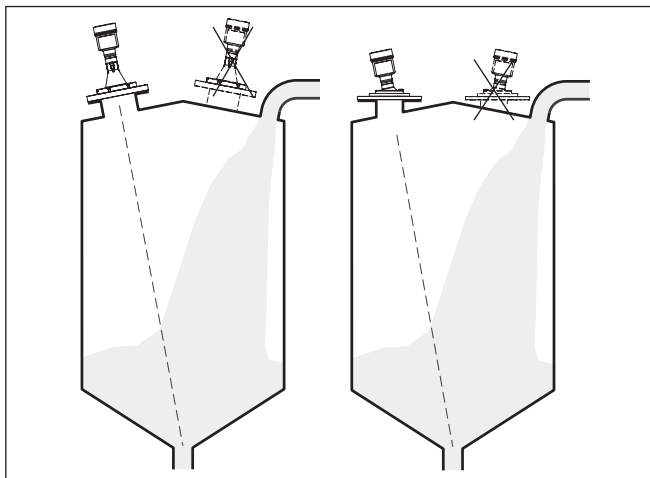


Fig. 12: Mounting of the radar sensor with inflowing medium

#### Silo with lateral filling

In bulk solids silos with lateral pneumatic filling the instrument should not be mounted above the filling stream, as the radar signal will be disrupted. The optimal mounting position is to the side of the filling aperture. To avoid heavy soiling, the distance to any filter or dust exhauster should be as large as possible.

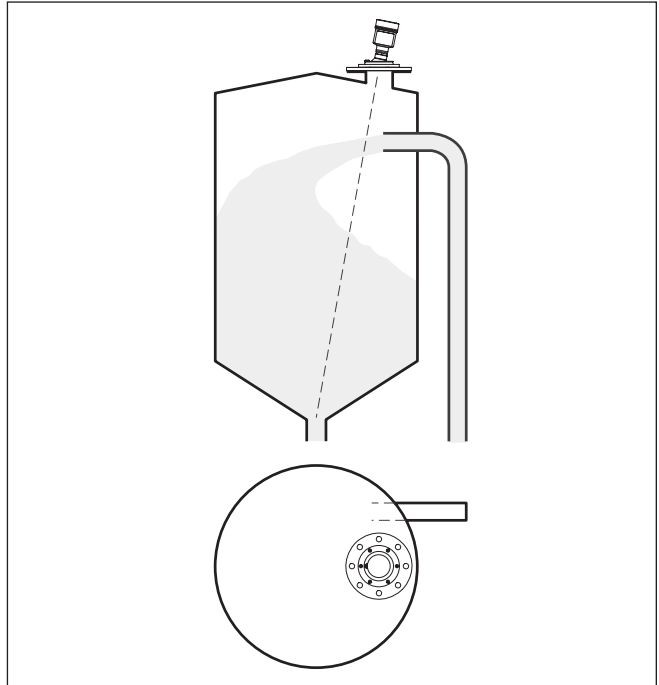


Fig. 13: Mounting of the radar sensor with inflowing medium

**Type of socket**



**Information:**

The mounting socket should be as short as possible and its end rounded. This reduces false echoes from the vessel mounting socket.

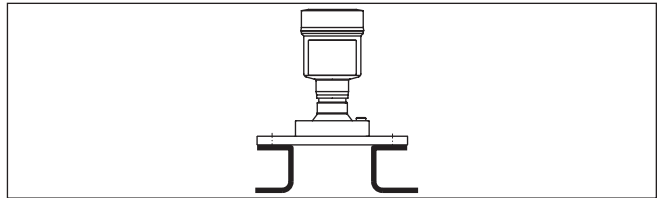


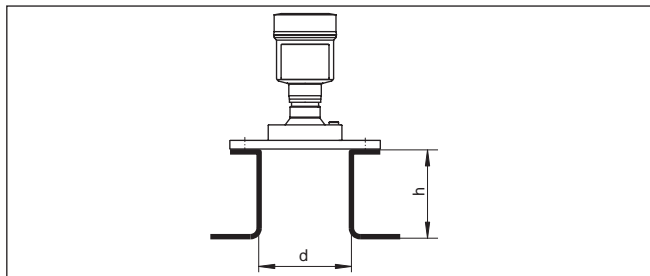
Fig. 14: Recommended socket mounting

If the medium has good reflective properties, you can also mount the VEGAPULS 69 on longer sockets. Approximate socket heights are shown in the following illustration.



**Information:**

When mounting on longer sockets, we recommend carrying out a false signal suppression (see chapter "Parameter adjustment").



The below charts specify the max. pipe socket length  $h$  depending on the diameter  $d$ .

Socket diameter $d$	Socket length $h$
80 mm	$\leq 200$ mm
100 mm	$\leq 300$ mm
150 mm	$\leq 500$ mm

Socket diameter $d$	Socket length $h$
3"	$\leq 7.87$ in
4"	$\leq 11.8$ in
6"	$\leq 19.7$ in

### Orientation

In order to measure as much of the vessel volume as possible, the sensor should be aligned so that the radar signal reaches the lowest level in the vessel. In a cylindrical silo with conical outlet, the sensor is mounted anywhere from one third to one half of the vessel radius from the outside wall (see following drawing).

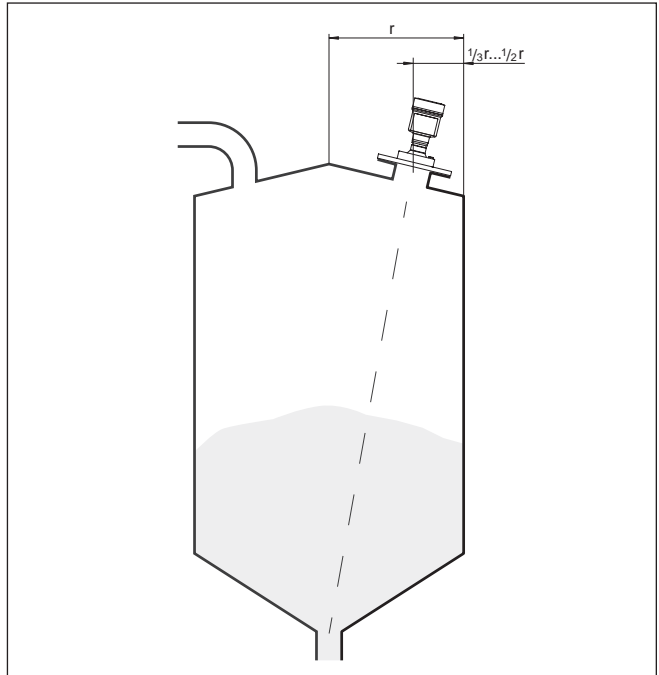


Fig. 16: Mounting position and orientation

With the help of an optional swivelling holder, the sensor can be easily aligned to the vessel centre. The necessary angle of inclination depends on the vessel dimensions. It can be easily checked with a suitable bubble tube or mechanic's level on the sensor.

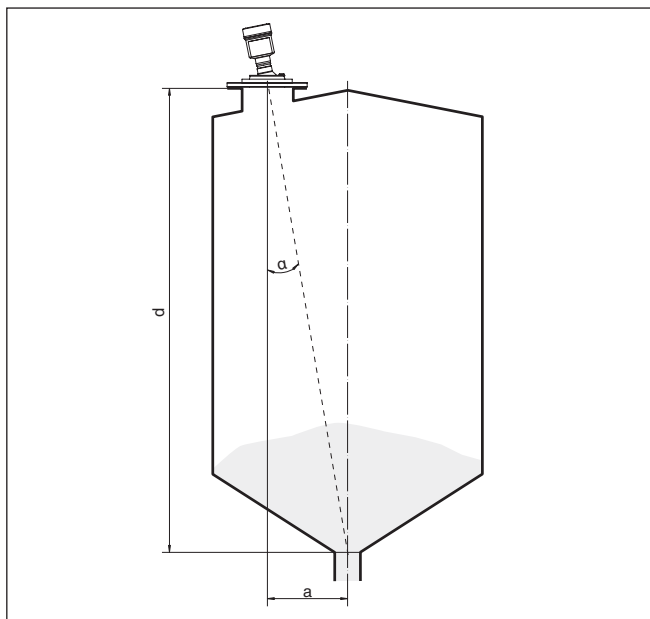


Fig. 17: Proposal for installation after orientation VEGAPULS 69

The following table shows the necessary angle of inclination. It depends on the measuring distance and the distance "a" between vessel centre and installation position.

Distance d (m)	2°	4°	6°	8°	10°
2	0.1	0.1	0.2	0.3	0.4
4	0.1	0.3	0.4	0.6	0.7
6	0.2	0.4	0.6	0.8	1.1
8	0.3	0.6	0.8	1.1	1.4
10	0.3	0.7	1.1	1.4	1.8
15	0.5	1	1.6	2.1	2.6
20	0.7	1.4	2.1	2.8	3.5
25	0.9	1.7	2.6	3.5	4.4
30	1	2.1	3.2	4.2	5.3
35	1.2	2.4	3.7	4.9	6.2
40	1.4	2.8	4.2	5.6	7.1
45	1.6	3.1	4.7	6.3	7.9
50	1.7	3.5	5.3	7	8.8
60	2.1	4.2	6.3	8.4	10.5
70	2.4	4.9	7.3	9.7	12.2

Distance d (m)	2°	4°	6°	8°	10°
80	2.8	5.6	8.4	11.1	13.9
90	3.1	6.3	9.4	12.5	15.6
100	3.5	7	10.5	13.9	17.4
110	3.8	7.7	11.5	15.3	19.1
120	4.2	8.4	12.5	16.7	20.8

**Example:**

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

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

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

1. Loosen the terminal screws of the swivel holder by one turn. Use a hexagon socket wrench, size 5.

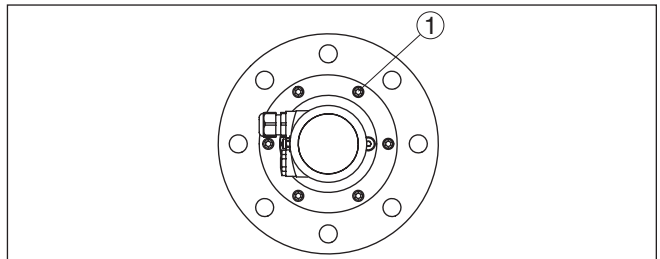


Fig. 18: VEGAPULS 69 with swivelling holder

1 Terminal screws (6 pcs.)

2. Align the sensor, check angle of inclination

**Information:**

The max. angle of inclination of the swivelling holder is approx. 10°

3. Re-tighten the terminal screws, max. torque see chapter "Technical data".

**Vessel installations**

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

Vessel installations, such as e.g. ladders, limit switches, heating spirals, struts, etc., can cause false echoes and impair the useful echo. Make sure when planning your measuring point that the radar sensor has a "clear view" to the measured product.

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

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

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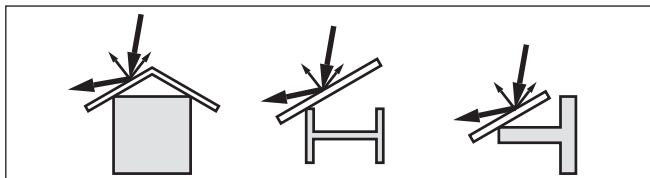


Fig. 19: Cover flat, large-area profiles with deflectors

## Material heaps

Large material heaps are best measured with several instruments, which can be mounted on e.g. traverse cranes. For this type of application it is advantageous to orient the sensor perpendicular to the bulk solid surface.

The sensors do not influence each other.



### Information:

Keep in mind that for these applications, the sensors are designed for relatively slow level changes. If the sensor is used on a movable boom, the max. measuring rate must be observed (see chapter "Technical data").

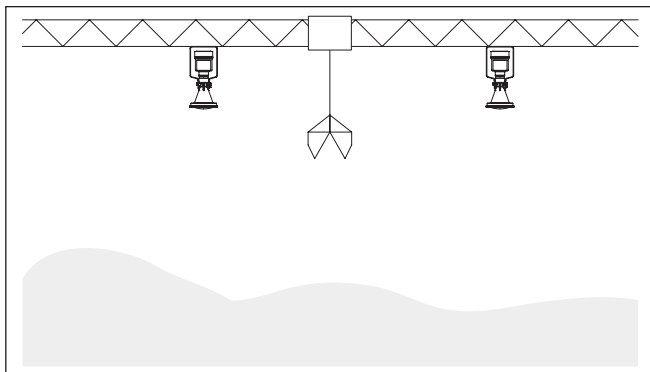


Fig. 20: Radar sensors on traverse crane

## Mounting in the vessel insulation

Instruments for a temperature range up to 200° C have a spacer between process fitting and electronics housing. This spacer is used to thermally decouple the electronics from the high process temperatures.



### Information:

The spacer may only be incorporated up to a maximum of 50 mm into the vessel insulation. Only then is a reliable temperature decoupling guaranteed.

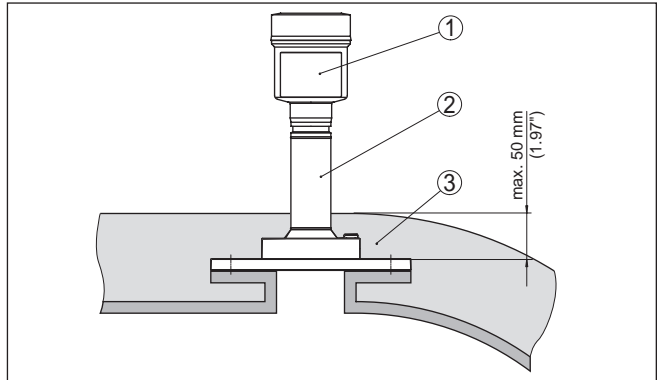


Fig. 21: Mounting the instrument on insulated vessels.

- 1 Electronics housing
- 2 Spacer
- 3 Vessel insulation

### Mounting in multiple chamber silo

The walls of multiple-chamber silos are often made of profile material, e.g. profile sheeting, to ensure the required stability. If the radar sensor is mounted very close to a heavily structured vessel wall, substantial interfering reflections can be generated. Thus the sensor should be mounted at the largest possible distance from the separating wall.

The best mounting location is on the outer wall of the silo, with the sensor pointing towards the discharge opening in the silo centre. This can be accomplished, for example, with the mounting strap.

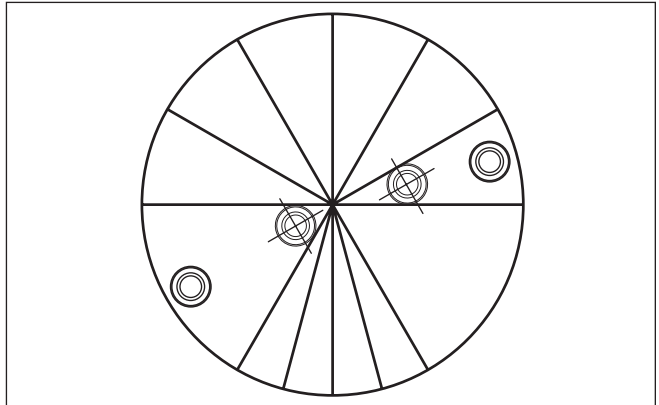


Fig. 22: Installation and orientation in multiple chamber silos

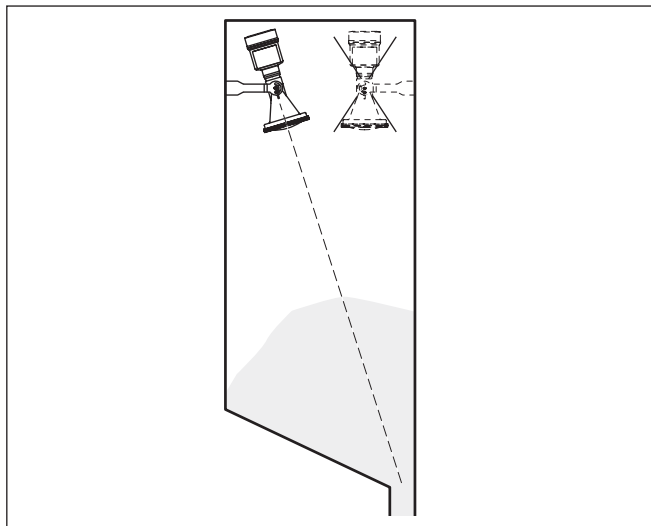


Fig. 23: Installation and orientation in multiple chamber silos

### Dust deposits - Rinsing air connection

To avoid heavy buildup and dust on the antenna, the sensor should not be mounted close to the dust exhauster inside the vessel.

To protect the sensor against buildup, particularly in case of strong condensation, air rinsing is recommended.

### Metal-jacketed lens antenna

The VEGAPULS 69 with metal-jacketed lens antenna is equipped with a rinsing air connection as a standard feature, see following graphics.

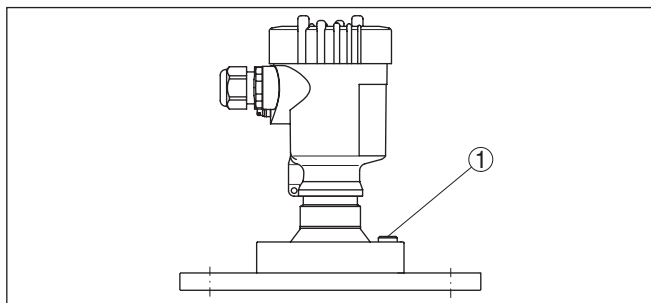
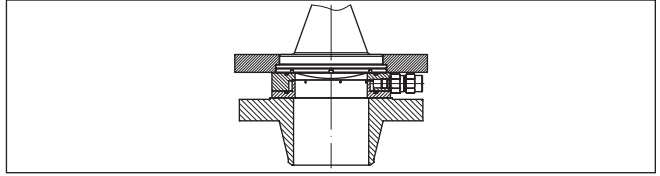


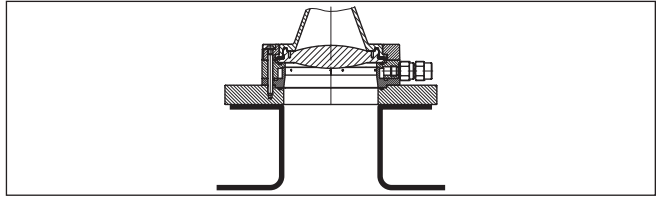
Fig. 24: Rinsing air connection on metal-jacketed lens antenna

### Plastic horn antenna

The VEGAPULS 69 with plastic horn antenna is optionally available with a rinsing air connection. The mechanical configuration differs according to the flange version, see following graphics.



*Fig. 25: Rinsing air connection with compression flange*



*Fig. 26: Rinsing air connection with adapter flange*

You can find details on the rinsing air connection in chapter "*Technical data*".

## 5 Connecting to power supply and bus system

### 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 personnel authorised by the plant operator.
- If overvoltage surges are expected, overvoltage arresters should be installed.

#### Voltage supply

The instrument requires an operating voltage of 8 ... 30 V DC. Operating voltage and digital bus signal are carried on separate two-wire connection cables.

#### Connection cable

The instrument is connected with standard two-wire, twisted cable suitable for RS 485. If electromagnetic interference is expected which is above the test values of EN 61326 for industrial areas, screened cable should be used.

Use cable with round cross section 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.

#### 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.

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

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

#### Cable screening and grounding

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.

## 5.2 Connection

### Connection technology

The voltage supply and signal output are connected via the spring-loaded terminals in the housing.

Connection to the display and adjustment module or to the interface adapter is carried out via contact pins in the housing.



#### Information:

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

### Connection procedure

Proceed as follows:

1. Unscrew the housing lid
2. Loosen compression nut of the cable gland and remove blind plug
3. Remove approx. 10 cm (4 in) of the cable mantle (signal output), strip approx. 1 cm (0.4 in) insulation from the ends of the individual wires
4. Insert the cable into the sensor through the cable entry



Fig. 27: Connection steps 5 and 6

5. Insert the wire ends into the terminals according to the wiring plan



**Information:**

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

6. Check the hold of the wires in the terminals by lightly pulling on them
7. Connect the screen to the internal ground terminal, connect the outer ground terminal to potential equalisation in case of power supply via low voltage
8. Connect the lead cable for power supply in the same way according to the wiring plan, in addition connect the ground conductor to the inner ground terminal when powered with mains voltage.
9. Tighten the compression nut of the cable glands. The seal ring must completely encircle the cables
10. Screw the housing lid back on

The electrical connection is finished.



**Information:**

The terminal blocks are pluggable and can be removed from the housing insert. To do this, lift the terminal block with a small screwdriver and pull it out. When inserting the terminal block again, you should hear it snap in.

### 5.3 Wiring plan, double chamber housing

#### Overview

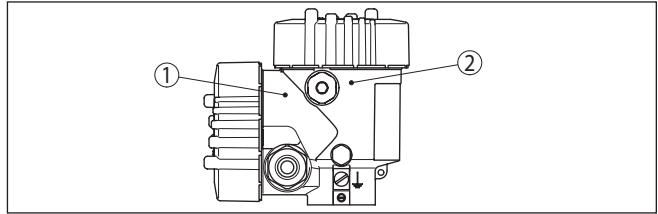


Fig. 28: Position of connection compartment (Modbus electronics) and electronics compartment (sensor electronics)

- 1 Terminal compartment
- 2 Electronics compartment

#### Electronics compartment

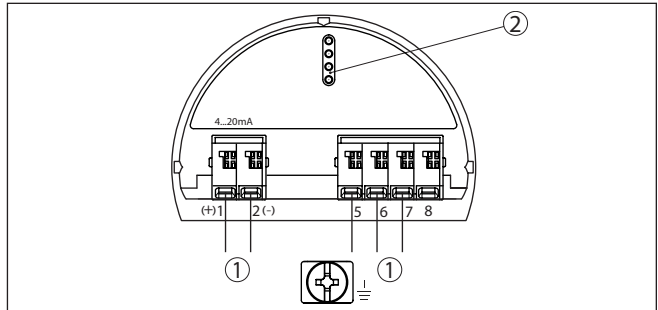


Fig. 29: Electronics compartment, double chamber housing

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



#### Information:

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

#### Terminal compartment

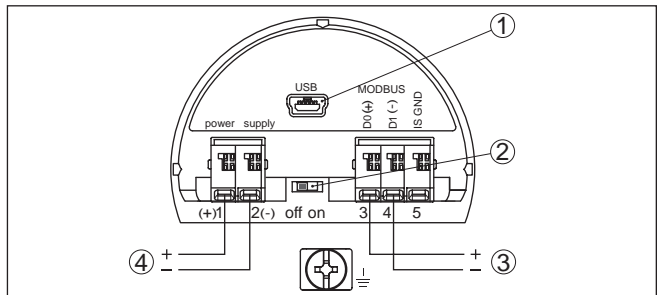


Fig. 30: Terminal compartment

- 1 USB interface
- 2 Slide switch for integrated termination resistor (120 Ω)
- 3 Modbus signal
- 4 Voltage supply

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Terminal	Function	Polarity
1	Voltage supply	+
2	Voltage supply	-
3	Modbus signal D0	+
4	Modbus signal D1	-
5	Function ground when installing according to CSA (Canadian Standards Association)	

### 5.4 Double chamber housing with DISADAPT

#### Electronics compartment

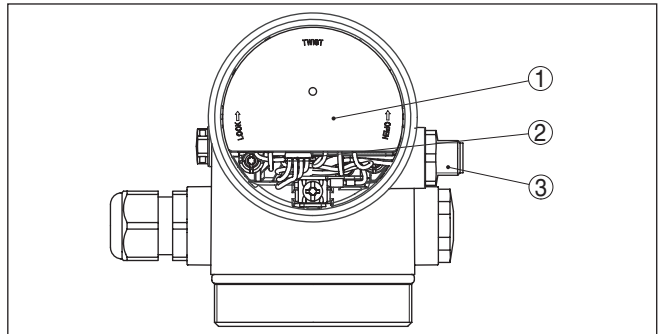


Fig. 31: View to the electronics compartment with DISADAPT for connection of the external display and adjustment unit

- 1 DISADAPT
- 2 Internal plug connection
- 3 Plug connector M12 x 1

#### Assignment of the plug connector

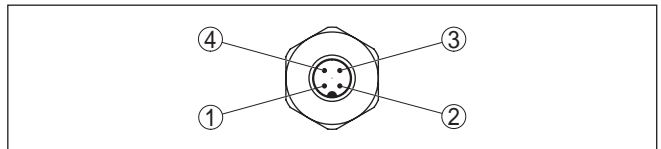


Fig. 32: View to the plug connector M12 x 1

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

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

## 5.5 Switch-on phase

After VEGAPULS 69 is connected to the bus system, the instrument carries out a self-test for approx. 30 seconds. The following steps are carried out:

- Internal check of the electronics
- Indication of the instrument type, hardware and software version, measurement loop name on the display or PC
- Indication of the status message "*F 105 Determine measured value*" on the display or PC
- Status byte goes briefly to fault value

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

## 6 Set up the sensor with the display and adjustment module

### 6.1 Adjustment volume

The display and adjustment module is only used for parameter adjustment of the sensor, i.e. for adaptation to the measurement task.

The parameter adjustment of the Modbus interface is carried out via a PC with PACTware. You can find the procedure in chapter "Set up sensor and Modbus interface with PACTware".

### 6.2 Insert display and adjustment module

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

Proceed as follows:

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

Disassembly is carried out in reverse order.

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



Fig. 33: Insertion of the 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

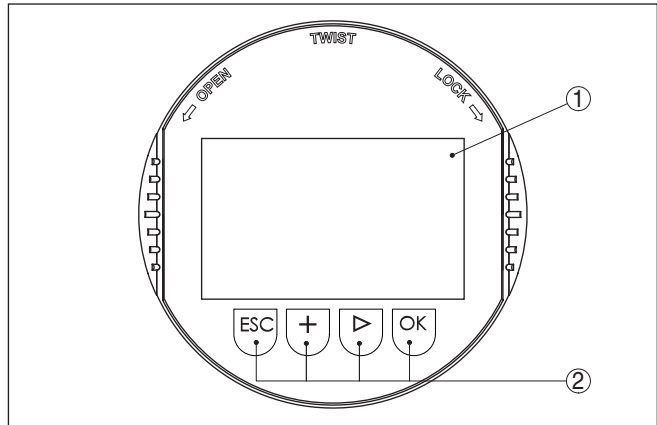


Fig. 34: Display and adjustment elements

- 1 LC display
- 2 Adjustment keys

#### Key functions

- **[OK]** key:
  - Move to the menu overview
  - Confirm selected menu
  - Edit parameter
  - Save value
- **[->]** key:
  - Change measured value presentation
  - Select list entry
  - Select menu items in the quick setup menu
  - 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.

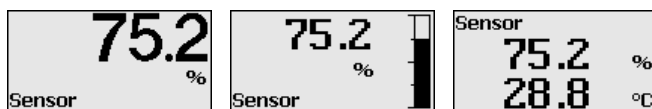
## 6.4 Measured value indication - Selection national language

### Measured value indication

With the **[->]** key you move between three different indication modes. In the first view, the selected measured value is displayed in large digits.

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

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



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

### Selection of national language

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



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

## 6.5 Parameter adjustment - Quick setup

To quickly and easily adapt the sensor to the application, select the menu item *"Quick setup"* in the start graphic on the display and adjustment module.



Select the individual steps with the **[->]** key.

After the last step, *"Quick setup terminated successfully"* is displayed briefly.



### Information:

The echo curve of setup is stored automatically during the quick setup.

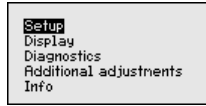
The return to the measured value indication is carried out through the **[->]** or **[ESC]** keys or automatically after 3 s

You can find *"Extended adjustment"* in the next sub-chapter.

## 6.6 Parameter adjustment - Extended adjustment

### Main menu

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



**Setup:** Settings, e.g., for measurement loop name, units, application, adjustment, signal output

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

**Diagnostics:** Information, for example, on device status, peak value, simulation, echo curve

**Additional adjustments:** Date/Time, reset, copy function, scaling, current output, false signal suppression, linearization, HART mode, special parameters

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

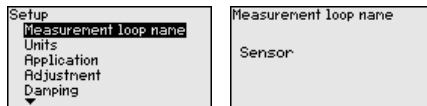
In the main menu item "Setup", the individual submenu items should be selected one after the other and provided with the correct parameters to ensure optimum adjustment of the measurement. The procedure is described in the following.

### Setup - Measurement loop name

Here you can assign a suitable measurement loop name. Push the "OK" key to start the editing. With the "+" key you change the sign and with the "->" key you jump to the next position.

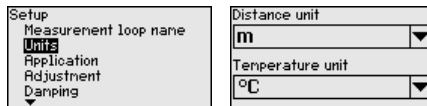
You can enter names with max. 19 characters. The character set comprises:

- Capital letters from A ... Z
- Numbers from 0 ... 9
- Special characters + - / \_ blanks



### Setup - Units

In this menu item you select the distance unit and the temperature unit.



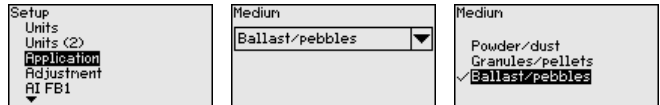
For the distance units you can choose between m, in and ft and for the temperature units °C, °F and K.

### Setup - Application

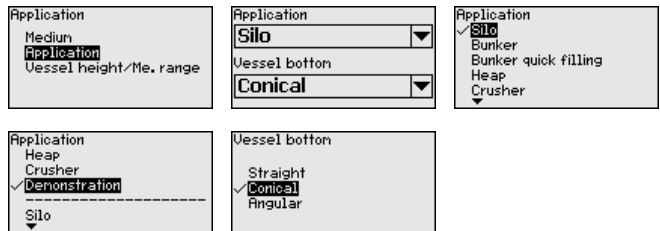
With this menu item, the sensor can be optimally adapted to the application, the installation location or the measurement conditions. It includes selection options for medium, application as well as vessel height/measuring range.

**Medium:**

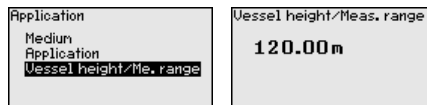
Every medium has a different reflective behaviour. With this selection, the sensor can be perfectly adapted to the medium and measurement reliability, particularly with media with poor reflective properties, is considerably increased.

**Application:**

Depending on the type of bulk solids application, material cones and additional echoes from the vessel wall or bottom can become further interfering factors. Through this selection, the sensor is adapted perfectly to the application.

**Vessel height/Measuring range:**

The VEGAPULS 69 is a bulk solids radar sensor for high, slender vessels. It covers a measuring range up to 120 m. This menu item lets you limit the active measuring range in which the instrument searches for level echoes.

**Information:**

The min. adjustment must be carried out independently of this.

The following features form the basis of the applications:

**Silo (slender and high):**

- Vessel of metal: weld joints
- Process/measurement conditions:
  - Filling aperture too close to the sensor
  - System noise in completely empty silo increased
- Properties, sensor:
  - Stable measured values through higher averaging
  - False signal suppression during setup recommended, required for automatic false signal suppression

- Automatic false signal suppression with partly filled vessel<sup>1)</sup>

**Bunker (large-volume):**

- Vessel of concrete or metal:
  - Structured vessel walls
  - Installations present
- Process/measurement conditions:
  - Large distance to the medium
  - Large angles of repose
- Properties, sensor:
  - Mean averaging
  - High measured value jumps are accepted

**Bunker with fast filling:**

- Vessel of concrete or metal, also multiple chamber silo:
  - Structured vessel walls
  - Installations present
- Process/measurement conditions:
  - Measured value jumps, e.g. through truck loading
  - Large distance to the medium
  - Large angles of repose
- Properties, sensor:
  - Lower averaging
  - Very high measured value jumps are accepted

**Heap:**

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

**Crusher:**

- Vessel: installations, wear and protective facilities available
- Process/measurement conditions:
  - Measured value jumps, e.g. through truck loading
  - Fast reaction time
  - Large distance to the medium
- Properties, sensor:
  - Little averaging
  - Max. reaction speed, very high measured value jumps are accepted

<sup>1)</sup> The instrument recognizes if a manual false signal suppression was carried out with empty vessel and high system noise. An automatic false signal suppression is then carried out if a product echo was detected at the beginning of the filling process.



**Demonstration:**

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

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

**Setup - Adjustment**

Since the radar sensor is a distance measuring instrument, the distance from the sensor to the product surface is measured. To indicate the actual level, an allocation of the measured distance to the percentage height must be carried out.

To perform the adjustment, enter the distance with full and empty vessel, see the following example:

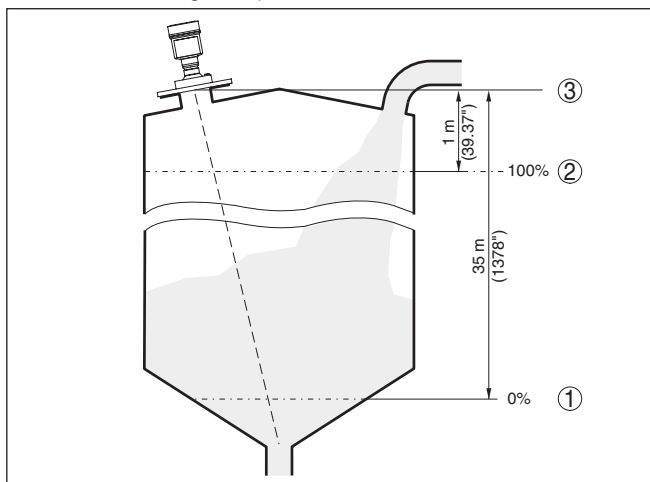


Fig. 35: Parameter adjustment example min./max. adjustment

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

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

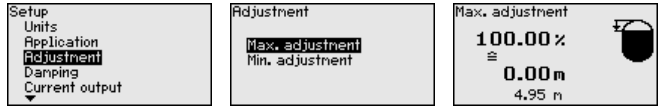
The actual product level during this adjustment is not important, because the min./max. adjustment is always carried out without changing the product level. These settings can be made ahead of time without the instrument having to be installed.

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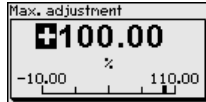
### Setup - Max. adjustment

Proceed as follows:

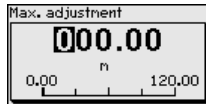
1. Select with **[>]** the menu item Max. adjustment and confirm with **[OK]**.



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



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

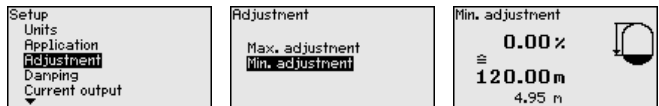


4. For the full vessel, enter the distance value in m matching the percentage value.
5. Save settings with **[OK]** and move with **[ESC]** and **[>]** to Min. adjustment.

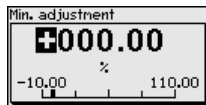
### Setup - Min. adjustment

Proceed as follows:

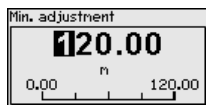
1. Select with **[>]** the menu item "Min. adjustment" and confirm with **[OK]**.



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



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



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

**Setup - Damping**

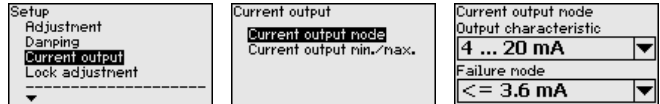
To damp process-dependent measured value fluctuations, set an integration time of 0 ... 999 s in this menu item.



The default setting is a damping of 0 s.

**Setup - Current output mode**

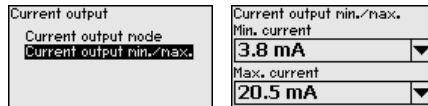
In the menu item "*Current output mode*" you determine the output characteristics and reaction of the current output in case of failure.



The default setting is output characteristics 4 ... 20 mA, failure mode < 3.6 mA.

**Setup - Current output Min./Max.**

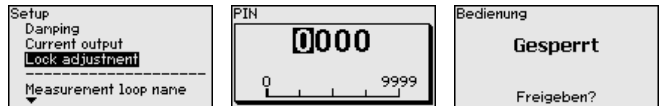
In the menu item "*Current output Min./Max.*", you determine the reaction of the current output during operation.



The default setting is min. current 3.8 mA and max. current 20.5 mA.

**Lock/unlock setup - Adjustment**

In the menu item "*Lock/unlock adjustment*" you safeguard the sensor parameters against unauthorized or unintentional modifications.



With active PIN, only the following adjustment functions are possible without entering a PIN:

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

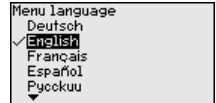
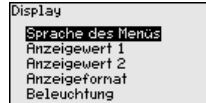
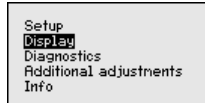
Releasing the sensor adjustment is also possible in any menu item by entering the PIN.

**Caution:**

With active PIN, adjustment via PACTware/DTM and other systems is also blocked.

**Display - Menu language**

This menu item enables the setting of the requested national language.



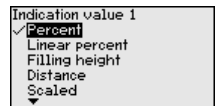
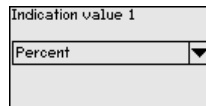
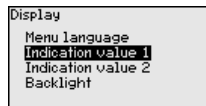
The following languages are available:

- German
- English
- French
- Spanish
- Russian
- Italian
- Dutch
- Portuguese
- Japanese
- Chinese
- Polish
- Czech
- Turkish

In the delivery status, the VEGAPULS 69 is set to the ordered national language.

**Display - Displayed value 1 and 2**

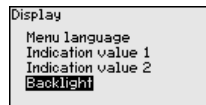
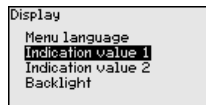
In this menu item you can define the way measured values are indicated on the display.



The default setting for the display value is "Percent".

**Display - Backlight**

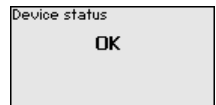
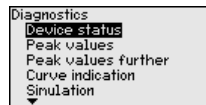
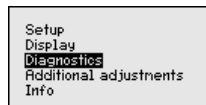
The display and adjustment module has a backlight for the display. In this menu item you can switch the lighting on or off. You can find the required operating voltage in chapter "Technical data".



In delivery status, the lighting is switched on.

**Diagnostics - Device status**

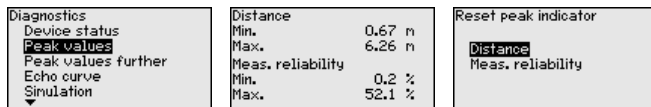
In this menu item, the device status is displayed.



**Diagnosis - Peak value**

The min. and max. measured value, the measurement certainty as well as the min. and max. electronics temperature are stored in the sensor. The values are displayed in menu item "Peak value" or "Further peak values".

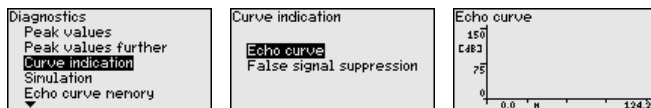
A reset menu is opened with the **[OK]** key in the respective peak value window:



With the **[OK]** key in the reset menu, the peak values are reset to the current measured value.

### Diagnoses - Curve indication

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

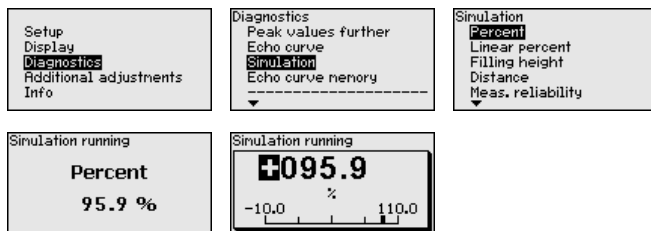


The selected curve is continuously updated. A submenu with zoom functions is opened with the **[OK]** key:

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

### Diagnosis - Simulation

In this menu item you can simulate measured values via the current output. This allows the signal path to be tested, e.g. through downstream indicating instruments or the input card of the control system.



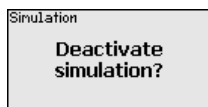
Select the requested simulation variable and set the requested value.



#### Caution:

During simulation, the simulated value is outputted as 4 ... 20 mA current value and as digital HART signal. The status message within the context of the asset management function is "Maintenance".

To deactivate the simulation, you have to push the **[ESC]** key and confirm the message



with the **[OK]** key.



**Information:**

The sensor terminates the simulation automatically after 60 minutes.

**Diagnostics - Echo curve memory**

The function "Setup" allows the echo curve to be saved at the time of setup.

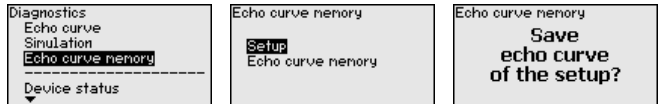


**Information:**

This is generally recommended, however, for use of the Asset Management functions it is absolutely necessary. Saving should be carried out with a very low level.

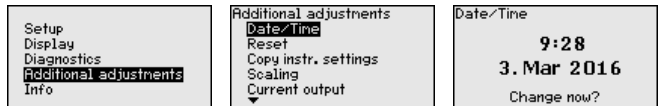
The function "Echo curve memory" allows up to ten individual echo curves to be stored, for example to detect the measurement behaviour of the sensor in different operating conditions.

With the adjustment software PACTware and the PC, the stored echo curves can be displayed with high resolution and used to recognize signal changes over time. In addition, the echo curve saved during setup can also be displayed in the echo curve window and compared with the current echo curve.



**Additional adjustments - Date/Time**

In this menu item, the internal clock of the sensor is set to the requested time and time format. At the time of shipment from factory, the instrument is set to CET (Central European Time).

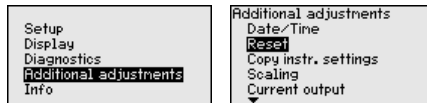


**Additional adjustments - Reset**

During a reset, the parameter settings carried out by the user are reset to the default values (see below table).

Proceed as follows:

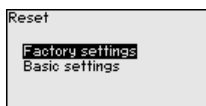
1. Select with [->] under "Additional adjustments" the menu item "Reset" and confirm with [OK].



2. Confirm with [OK] and select the requested reset function with [->]



3. Confirm with [OK], for approx. 5 s the message "Resetting" is displayed, then the selection window appears.

**Caution:**

For the duration of the reset, the set trouble signal is outputted via the current output. Within the context of the asset management function, the message "Maintenance" is outputted.

The following reset functions are available:

**Delivery status:** Restores the parameter settings at the time of shipment from the factory, incl. the order-specific settings. Any created false signal suppression, user-programmable linearization curve as well as measured value and echo curve memory is deleted. The event and parameter modification memories remain unaffected.

**Basic settings:** Resets the parameter settings, incl. special parameters, to the default values of the respective instrument. Any stored false signal suppression or user programmable linearisation curve, as well as the measured value memory, is deleted. Order-related settings are not taken over into the current parameters after this reset.

The following table shows the scope of the reset function and the default values of the instrument:

Menu	Menu item	Default value
Setup	Measurement loop name	Sensor
	Units	Distance in m Temperature in °C
	Application	Medium: Crushed stones/gravel Application: Silo Vessel bottom: Flat Vessel height/Measuring range: 120 m
	Min. adjustment	120 m
	Max. adjustment	0,000 m(d)
	Damping	0.0 s
	Current output mode	Output characteristics: 4 ... 20 mA Failure mode: < 3.6 mA ▼
	Current output Min./Max.	Min. current: 3.8 mA Max. current: 20.5 mA
Display	Displayed value 1	Filling height
	Displayed value 2	Temperature
	Backlight	Switched off

Menu	Menu item	Default value
Additional adjustments	Date/Time	Time format: 24 h
	Scaling size	Volume l
	Scaling format	100.00 lin %, 100 l 0.00 lin %, 0 l
	Current output 1 and 2 size	Lin %
	Current output 1 and 2 adjustment	100.00 %, 100 l 0.00 %, 0 l
	Linearization	Linear
	HART mode	HART address: 0 Loop current mode: Analogue current output

**Additional adjustments - Copy instrument settings**

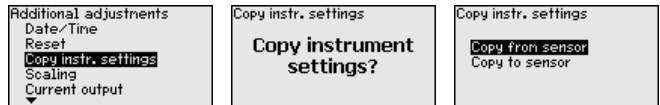
The instrument settings are copied with this function. The following functions are available:

**Read from sensor:** Read data from sensor and store into the display and adjustment module

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

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

- All data of the menu "Setup" and "Display"
- The menu items "Reset, Date/Time" in the menu "Additional settings"
- The user-programmable linearization curve



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



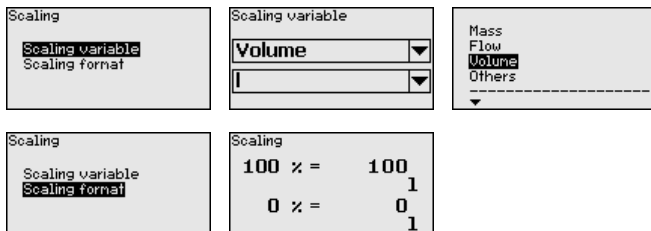
**Note:**

Before the data are saved in the sensor, a safety check is carried out to determine if the data match the sensor. In the process the sensor type of the source data as well as the target sensor are displayed. If the data do not match, a fault message is outputted or the function is blocked. The data are saved only after release.

**Additional settings - Scaling**

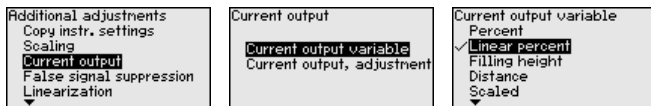
In the menu item "Scaling" you define the scaling variable and the scaling format for the indication of the level measured value for 0 % and 100 % on the display, for example as volume in l.





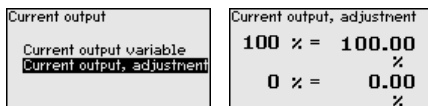
### Additional settings - Current output (size)

In menu item "*Current output, variable*" you specify which measured variable the current output refers to.



### Additional settings - Current output (adjustment)

In menu item "*Current output, adjustment*" you can assign a respective measured value to the current output.



### Additional adjustments - False signal suppression

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

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



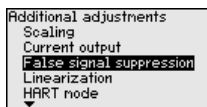
#### Note:

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

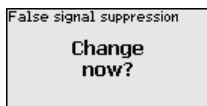
This should be done with the lowest possible level so that all potential interfering reflections can be detected.

Proceed as follows:

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



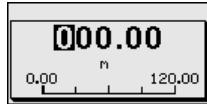
2. Confirm again with **[OK]**.



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



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



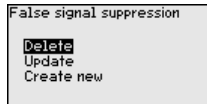
5. All interfering signals in this section are detected by the sensor and stored after confirming with **[OK]**.



**Note:**

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

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

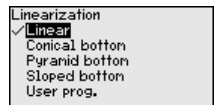
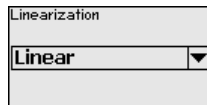
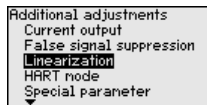


**Delete:** An already created false signal suppression will be completely deleted. This is useful if the saved false signal suppression no longer matches the metrological conditions in the vessel.

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

**Additional adjustments - Linearization**

A linearization is necessary for all vessels in which the vessel volume does not increase linearly with the level. Corresponding linearization curves are preprogrammed for these vessels. They represent the correlation between the level percentage and vessel volume. The linearization applies to the measured value indication and the current output.



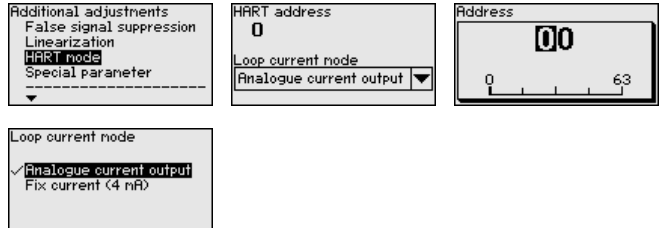
**Additional adjustments - HART mode**

In this menu item you specify the HART mode and enter the address for multidrop mode.

In the mode "*Fixed current output*" up to 63 sensors can be operated on one two-wire cable (Multidrop operation). An address between 0 and 63 must be assigned to each sensor.

If you select the function "*Analogue current output*", a 4 ... 20 mA signal is output in multidrop mode.

In the mode "*Fixed current (4 mA)*" a fixed 4 mA signal is output independently of the actual level.



The default setting is "*Analogue current output*" and the address "00".

### Additional adjustments - Special parameters

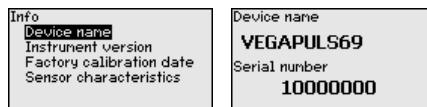
In this menu item you gain access to the protected area where you can enter special parameters. In exceptional cases, individual parameters can be modified in order to adapt the sensor to special requirements.

Change the settings of the special parameters only after having contacted our service staff.



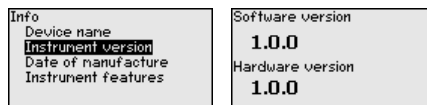
### Info - Instrument name

In this menu item, you can read out the instrument name and the instrument serial number:



### Info - Instrument version

In this menu item, the hardware and software version of the sensor is displayed.



### Info - Factory calibration date

In this menu item, the date of factory calibration of the sensor as well as the date of the last change of sensor parameters are displayed via the display and adjustment module or via the PC.

Info Device name Instrument version <b>Factory calibration date</b> Sensor characteristics	Factory calibration date <b>5. Aug 2015</b> Last change <b>28. Sep 2015</b>
--	--

**Info - Sensor characteristics**

In this menu item, the features of the sensor such as approval, process fitting, seal, measuring range, electronics, housing and others are displayed.

Info Device name Instrument version Factory calibration date <b>Sensor characteristics</b>	Sensor characteristics <b>Display now?</b>
--	---

**6.7 Saving the parameter adjustment data**

**Backup on paper**

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

**Backup in the display and adjustment module**

If the instrument is equipped with a display and adjustment module, the data in the sensor can be saved in the display and adjustment module. The procedure is described in the menu "*Additional adjustments*" in the menu item "*Copy device settings*". The data remain there permanently even if the sensor power supply fails.

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

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

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

## 7 Setting up sensor and Modbus interface with PACTware

### 7.1 Connect the PC

**To the sensor electronics** Connection of the PC to the sensor electronics is carried out via the interface adapter VEGACONNECT.

Scope of the parameter adjustment:

- Sensor electronics



Fig. 36: Connection of the PC directly to the sensor via the interface adapter

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

**To the Modbus electronics**

Connection of the PC to the Modbus electronics is carried out via a USB cable.

Scope of the parameter adjustment:

- Sensor electronics
- Modbus electronics



Fig. 37: Connecting the PC via USB to the Modbus electronics  
 1 USB cable to the PC

**To the RS 485 cable**

Connection of the PC to the RS 485 cable is carried out via a standard interface adapter RS 485/USB.

Scope of the parameter adjustment:

- Sensor electronics
- Modbus electronics



**Information:**

For parameter adjustment, it is absolutely necessary to disconnect from the RTU.

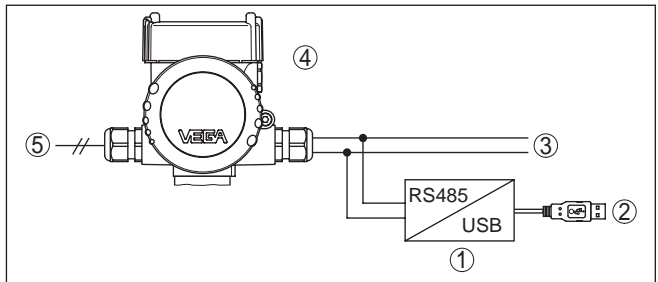


Fig. 38: Connection of the PC via the interface adapter to the RS 485 cable

- 1 Interface adapter RS 485/USB
- 2 USB cable to the PC
- 3 RS 485 cable
- 4 Sensor
- 5 Voltage supply

**7.2 Parameter adjustment**

**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 Collec-

tion. 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.

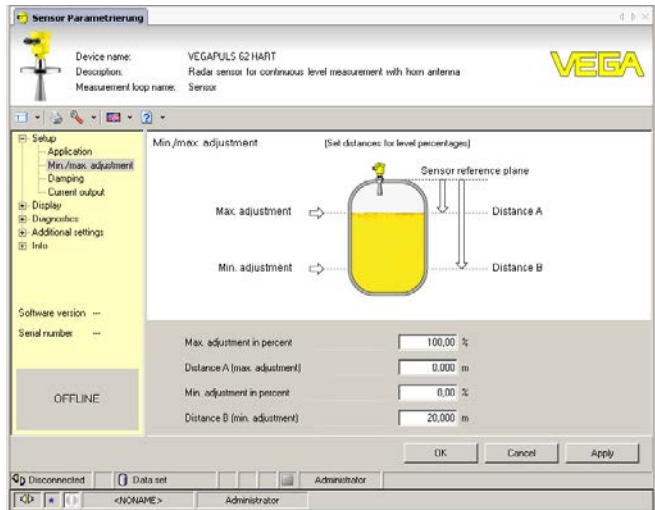


Fig. 39: Example of a DTM view

## 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](http://www.vega.com/downloads) and "Software". The full version is available on CD from the agency serving you.

### 7.3 Set instrument address

The VEGAPULS 69 requires an address for participating as a Slave in the Modbus communication. The address setting is carried out via a PC with PACTware/DTM or Modbus RTU.

The default settings for the address are:

- Mobus: 246
- Levelmaster: 31



#### Note:

The setting of the instrument address can only be carried out online.

#### Via PC through Modbus electronics

Start the project assistant and wait until the project tree has been set up. Then, in the project tree, go to the symbol for the Modbus gateway. Select with the right mouse key "*Parameter*", then "*Online parameter adjustment*" and start the DTM for the Modbus electronics.

In the menu bar of the DTM, go to the list arrow next to the symbol for "*Screwdriver*". Select the menu item "*Change address in the instrument*" and set the requested address.

#### Via PC through RS 485 cable

In the device catalogue, select the option "*Modbus Serial*" under "*Driver*". Double click on this driver and integrate it into the project tree.

Open the device manager on your PC and find out which COM interface the USB/RS 485 adapter is located on. Then go to the symbol "*Modbus COM.*" in the project tree. Select "*Parameter*" with the right mouse key and start the DTM for the USB/RS 485 adapter. Enter the COM interface no. from the device manager under "*Basic settings*".

Select with the right mouse key "*Additional functions*" and "*Instrument search*". The DTM then searches for the connected Modbus participants and integrates them into the project tree. Now, in the project tree, go to the symbol for the Modbus gateway. Select with the right mouse key "*Parameter*", then "*Online parameter setting*" and start the DTM for the Modbus electronics.

In the menu bar of the DTM, go to the list arrow next to the symbol for "*Screwdriver*". Select the menu item "*Change address in the instrument*" and set the requested address.

Then move again to the symbol "*Modbus COM.*" in the project tree. Select with the right mouse key "*Additional functions*" and "*Change DTM addresses*". Enter here the modified address of the Modbus gateway.

#### Via Modbus-RTU

The instrument address is set in register no. 200 of the Holding Register (see chapter "*Modbus register*" in this operating instructions manual).

The procedure depends on the respective Modbus-RTU and the configuration tool.



## **7.4 Saving the parameter adjustment data**

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

## 8 Diagnosis, asset management and service

### 8.1 Maintenance

If the instrument is used correctly, no maintenance is required in normal operation.

In some applications, buildup on the antenna system can influence the measuring result. Depending on the sensor and application, take measures to avoid heavy soiling of the antenna system. If necessary, clean the antenna system in certain intervals.

### 8.2 Measured value and event memory

The instrument has several memories which are available for diagnostic purposes. The data remain there even in case of voltage interruption.

#### Measured value memory

Up to 100,000 measured values can be stored in the sensor in a ring memory. Each entry contains date/time as well as the respective measured value. Storable values are for example:

- Distance
- Filling height
- Percentage value
- Lin. percent
- Scaled
- Current value
- Meas. certainty
- Electronics temperature

When the instrument is shipped, the measured value memory is active and stores distance, measurement certainty and electronics temperature every 3 minutes.

The requested values and recording conditions are set via a PC with PACTware/DTM or the control system with EDD. Data are thus read out and also reset.

#### Event memory

Up to 500 events are automatically stored with a time stamp in the sensor (non-deletable). Each entry contains date/time, event type, event description and value. Event types are for example:

- Modification of a parameter
- Switch-on and switch-off times
- Status messages (according to NE 107)
- Error messages (according to NE 107)

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

#### Echo curve memory

The echo curves are stored with date and time and the corresponding echo data. The memory is divided into two sections:

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

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

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

- PC with PACTware/DTM
- Control system with EDD

### 8.3 Asset Management function

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

#### Status messages

The status messages are divided into the following categories:

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

and explained by pictographs:

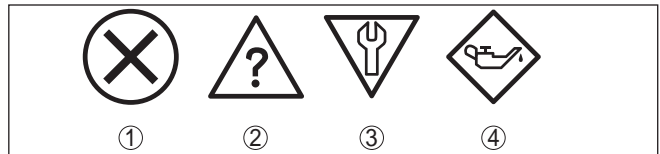


Fig. 40: Pictographs of the status messages

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

**Failure:** Due to a malfunction in the instrument, a failure message is outputted.

This status message is always active. It cannot be deactivated by the user.

**Function check:** The instrument is in operation, the measured value is temporarily invalid (for example during simulation).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

**Out of specification:** The measured value is unstable because the instrument specification is exceeded (e.g. electronics temperature).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

**Maintenance:** Due to external influences, the instrument function is limited. The measurement is affected, but the measured value is

still valid. Plan in maintenance for the instrument because a failure is expected in the near future (e.g. due to buildup).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

## Failure

The following table shows the error codes in the status message "Failure" and gives information on the reason and rectification. Keep in mind that some information is only valid with four-wire instruments.

Code Text message	Cause	Rectification	DevSpec State in CMD 48
F013 no measured value available	<ul style="list-style-type: none"> <li>– Sensor does not detect an echo during operation</li> <li>– Antenna system dirty or defective</li> </ul>	<ul style="list-style-type: none"> <li>– Check or correct installation and/or parameter adjustment</li> <li>– Clean or exchange process component or antenna</li> </ul>	Bit 0 of Byte 0...5
F017 Adjustment span too small	<ul style="list-style-type: none"> <li>– Adjustment not within specification</li> </ul>	<ul style="list-style-type: none"> <li>– Change adjustment according to the limit values (difference between min. and max. <math>\geq 10</math> mm)</li> </ul>	Bit 1 of Byte 0...5
F025 Error in the linearization table	<ul style="list-style-type: none"> <li>– Index markers are not continuously rising, for example illogical value pairs</li> </ul>	<ul style="list-style-type: none"> <li>– Check linearization table</li> <li>– Delete table/Create new</li> </ul>	Bit 2 of Byte 0...5
F036 No operable software	<ul style="list-style-type: none"> <li>– Failed or interrupted software update</li> </ul>	<ul style="list-style-type: none"> <li>– Repeat software update</li> <li>– Check electronics version</li> <li>– Exchanging the electronics</li> <li>– Send instrument for repair</li> </ul>	Bit 3 of Byte 0...5
F040 Error in the electronics	<ul style="list-style-type: none"> <li>– Hardware defect</li> </ul>	<ul style="list-style-type: none"> <li>– Exchanging the electronics</li> <li>– Send instrument for repair</li> </ul>	Bit 4 of Byte 0...5
F080 General software error	<ul style="list-style-type: none"> <li>– General software error</li> </ul>	<ul style="list-style-type: none"> <li>– Disconnect operating voltage briefly</li> </ul>	Bit 5 of Byte 0...5
F105 Determine measured value	<ul style="list-style-type: none"> <li>– The instrument is still in the start phase, the measured value could not yet be determined</li> </ul>	<ul style="list-style-type: none"> <li>– Wait for the end of the switch-on phase</li> <li>– Duration depending on the version and parameter adjustment up to approximately 3 min.</li> </ul>	Bit 6 of Byte 0...5
F113 Communication error	<ul style="list-style-type: none"> <li>– EMC interference</li> <li>– Transmission error with the external communication with 4-wire power supply unit</li> </ul>	<ul style="list-style-type: none"> <li>– Remove EMC influences</li> <li>– Exchange 4-wire power supply unit or electronics</li> </ul>	Bit 12 of Byte 0...5

Code Text message	Cause	Rectification	DevSpec State in CMD 48
F125 Impermissible electronics temperature	<ul style="list-style-type: none"> <li>– Temperature of the electronics in the non-specified range</li> </ul>	<ul style="list-style-type: none"> <li>– Check ambient temperature</li> <li>– Isolate electronics</li> <li>– Use instrument with higher temperature range</li> </ul>	Bit 7 of Byte 0...5
F260 Error in the calibration	<ul style="list-style-type: none"> <li>– Error in the calibration carried out in the factory</li> <li>– Error in the EEPROM</li> </ul>	<ul style="list-style-type: none"> <li>– Exchanging the electronics</li> <li>– Send instrument for repair</li> </ul>	Bit 8 of Byte 0...5
F261 Error in the instrument settings	<ul style="list-style-type: none"> <li>– Error during setup</li> <li>– False signal suppression faulty</li> <li>– Error when carrying out a reset</li> </ul>	<ul style="list-style-type: none"> <li>– Repeat setup</li> <li>– Carry out a reset</li> </ul>	Bit 9 of Byte 0...5
F264 Installation/Setup error	<ul style="list-style-type: none"> <li>– Adjustment not within the vessel height/measuring range</li> <li>– Max. measuring range of the instrument not sufficient</li> </ul>	<ul style="list-style-type: none"> <li>– Check or correct installation and/or parameter adjustment</li> <li>– Use an instrument with bigger measuring range</li> </ul>	Bit 10 of Byte 0...5
F265 Measurement function disturbed	<ul style="list-style-type: none"> <li>– Sensor no longer carries out a measurement</li> <li>– Operating voltage too low</li> </ul>	<ul style="list-style-type: none"> <li>– Check operating voltage</li> <li>– Carry out a reset</li> <li>– Disconnect operating voltage briefly</li> </ul>	Bit 11 of Byte 0...5

### Function check

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

Code Text message	Cause	Rectification	DevSpec State in CMD 48
C700 Simulation active	<ul style="list-style-type: none"> <li>– A simulation is active</li> </ul>	<ul style="list-style-type: none"> <li>– Finish simulation</li> <li>– Wait for the automatic end after 60 mins.</li> </ul>	"Simulation Active" in "Standardized Status 0"

### Out of specification

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

Code Text message	Cause	Rectification	DevSpec State in CMD 48
S600 Impermissible electronics temperature	<ul style="list-style-type: none"> <li>– Temperature of the electronics in the non-specified range</li> </ul>	<ul style="list-style-type: none"> <li>– Check ambient temperature</li> <li>– Isolate electronics</li> <li>– Use instrument with higher temperature range</li> </ul>	Bit 8 of Byte 14...24

Code Text message	Cause	Rectification	DevSpec State in CMD 48
S601 Overfilling	– Danger of vessel overfilling	– Make sure that there is no further filling – Check level in the vessel	Bit 9 of Byte 14...24
S603 Impermissible operating voltage	– Operating voltage below specified range	– Check electrical connection – If necessary, increase operating voltage	Bit 11 of Byte 14...24

### Maintenance

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

Code Text message	Cause	Rectification	DevSpec State in CMD 48
M500 Error with the reset delivery status	– With the reset to delivery status, the data could not be restored	– Repeat reset – Load XML file with sensor data into the sensor	Bit 0 of Byte 14...24
M501 Error in the non-active linearization table	– Hardware error EEPROM	– Exchanging the electronics – Send instrument for repair	Bit 1 of Byte 14...24
M502 Error in the event memory	– Hardware error EEPROM	– Exchanging the electronics – Send instrument for repair	Bit 2 of Byte 14...24
M503 Meas. reliability too low	– The echo/noise ratio is too small for reliable measurement – Antenna dirty or defective	– Check installation and process conditions – Change polarisation direction – Use instrument with higher sensitivity – Clean the antenna	Bit 3 of Byte 14...24
M504 Error on an device interface	– Hardware defect	– Check connections – Exchanging the electronics – Send instrument for repair	Bit 4 of Byte 14...24
M505 No echo available	– Sensor does not detect an echo during operation – Antenna dirty or defective	– Clean the antenna – Use a more suitable antenna/sensor – Remove possible false echoes – Optimize sensor position and orientation	Bit 5 of Byte 14...24
M506 Installation/Setup error	– Error during setup	– Check or correct installation and/or parameter adjustment	Bit 6 of Byte 14...24

Code Text message	Cause	Rectification	DevSpec State in CMD 48
M507 Error in the instrument settings	<ul style="list-style-type: none"> <li>– Error during setup</li> <li>– Error when carrying out a reset</li> <li>– False signal suppression faulty</li> </ul>	<ul style="list-style-type: none"> <li>– Carry out reset and repeat setup</li> </ul>	Bit 7 of Byte 14...24

## 8.4 Rectify faults

### Reaction when malfunction occurs

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

### Procedure for fault rectification

The first measures are:

- Evaluation of fault messages, for example via the display and adjustment module
- Checking the output signal
- Treatment of measurement errors

Further comprehensive diagnostics options are available with a PC with PACTware and the suitable DTM. In many cases, the reasons can be determined in this way and faults rectified.

### Check the 4 ... 20 mA signal

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

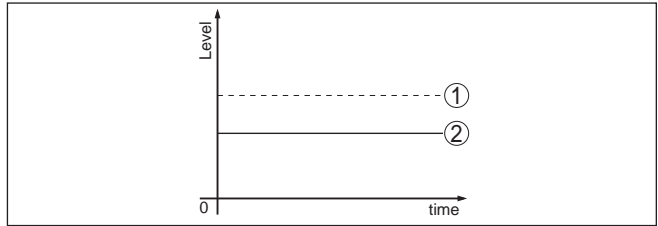
Error	Cause	Rectification
4 ... 20 mA signal not stable	<ul style="list-style-type: none"> <li>– Fluctuations of the measured variable</li> </ul>	<ul style="list-style-type: none"> <li>– Set damping appropriate to the instrument via the display and adjustment module or PACTware/DTM</li> </ul>
4 ... 20 mA signal missing	<ul style="list-style-type: none"> <li>– Electrical connection faulty</li> </ul>	<ul style="list-style-type: none"> <li>– Check connection according to chapter "<i>Connection steps</i>" and if necessary, correct according to chapter "<i>Wiring plan</i>"</li> </ul>
	<ul style="list-style-type: none"> <li>– Voltage supply missing</li> </ul>	<ul style="list-style-type: none"> <li>– Check cables for breaks; repair if necessary</li> </ul>
	<ul style="list-style-type: none"> <li>– Operating voltage too low or load resistance too high</li> </ul>	<ul style="list-style-type: none"> <li>– Check, adapt if necessary</li> </ul>
Current signal greater than 22 mA or less than 3.6 mA	<ul style="list-style-type: none"> <li>– Electronics module in the sensor defective</li> </ul>	<ul style="list-style-type: none"> <li>– Exchange the instrument or send it in for repair</li> </ul>

### Treatment of measurement errors with bulk solids

The below tables show typical examples of application-related measurement errors with bulk solids. A distinction is made between measurement errors during:

- Constant level
- Filling
- Emptying

The images in column "*Error pattern*" show the real level as a broken line and the level displayed by the sensor as a continuous line.



- 1 Real level
- 2 Level displayed by the sensor

Notes:

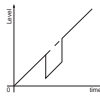
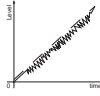
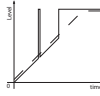
- Whenever the sensor displays a constant value, the reason could also be that the fault setting of the current output is set to "Hold value"
- If the level indication is too low, the reason could be a line resistance that is too high

**Measurement error with constant level**

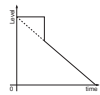
Fault description	Error pattern	Cause	Rectification
1. Measured value shows a too low or too high level		- Min./max. adjustment not correct	- Adapt min./max. adjustment
		- Incorrect linearization curve	- Adapt linearization curve
2. Measured value jumps towards 100 %		- Due to the process, the amplitude of the product echo decreases	- Carry out a false signal suppression
		- A false signal suppression was not carried out	
		- Amplitude or position of a false signal has changed (e.g. condensation, buildup); false signal suppression no longer matches actual conditions	- Determine the reason for the changed false signals, carry out false signal suppression, e.g. with condensation

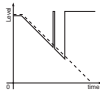
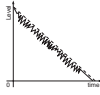


## Measurement error during filling

Fault description	Error pattern	Cause	Rectification
3. Measured value jumps towards 0 % during filling		- Amplitude of a multiple echo (vessel top - product surface) is larger than the level echo	- Check parameter "Application", especially vessel top, type of medium, dished bottom, high dielectric constant, and adapt if necessary
		- The level echo cannot be distinguished from the false signal at a false signal position (jumps to multiple echo)	- Remove/reduce false signal: minimize interfering installations by changing the polarization direction - Chose a more suitable installation position
		- Transverse reflection from an extraction funnel, amplitude of the transverse reflection larger than the level echo	- Direct sensor to the opposite funnel wall, avoid crossing with the filling stream
4. Measured value fluctuates around 10 ... 20 %		- Various echoes from an uneven product surface, e.g. a material cone	- Check parameter "Type of medium" and adapt, if necessary - Optimize installation position and sensor orientation
		- Reflections from the product surface via the vessel wall (deflection)	- Select a more suitable installation position, optimize sensor orientation, e.g. with a swiveling holder
5. Measured value jumps sporadically to 100 % during filling		- Changing condensation or contamination on the antenna	- Carry out a false signal suppression or increase false signal suppression with condensation/contamination in the close range by editing - With bulk solids use radar sensor with purging air connection or flexible antenna cover

## Measurement error during emptying

Fault description	Error pattern	Cause	Rectification
6. Measured value remains unchanged in the close range during emptying		- False signal larger than the level echo - Level echo too small	- Eliminate false signals in the close range. Check: Antenna must protrude out of the socket - Remove contamination on the antenna - Minimize interfering installations in the close range by changing the polarization direction - After eliminating the false signals, the false signal suppression must be deleted. Carry out a new false signal suppression

Fault description	Error pattern	Cause	Rectification
7. Measured value jumps sporadically towards 100 % during emptying		<ul style="list-style-type: none"> <li>- Changing condensation or contamination on the antenna</li> </ul>	<ul style="list-style-type: none"> <li>- Carry out false signal suppression or increase false signal suppression in the close range by editing</li> <li>- With bulk solids use radar sensor with purging air connection or flexible antenna cover</li> </ul>
8. Measured value fluctuates around 10 ... 20 %		<ul style="list-style-type: none"> <li>- Various echoes from an uneven product surface, e.g. an extraction funnel</li> <li>- Reflections from the product surface via the vessel wall (deflection)</li> </ul>	<ul style="list-style-type: none"> <li>- Check parameter "Type of medium" and adapt, if necessary</li> <li>- Optimize installation position and sensor orientation</li> </ul>

**Reaction after fault rectification**

Depending on the reason for the fault and the measures taken, the steps described in chapter "Setup" must be carried out again or must be checked for plausibility and completeness.

**24 hour service hotline**

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

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

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

**8.5 Exchanging the electronics module**

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



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

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

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

- In the factory
- Or on site by the user

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

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



**Caution:**

All user-specific settings must be entered again. Hence, you have to carry out a new setup after the electronics exchange.

If you have stored the data of the parameter adjustment during the first setup of the sensor, you can transfer these to the replacement electronics module. A new setup is no more necessary.

## 8.6 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](http://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](http://www.vega.com).

## 8.7 How to proceed if a repair is necessary

You can find an instrument return form as well as detailed information about the procedure in the download area of our homepage: [www.vega.com](http://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](http://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 power 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 parts to be easily separable.

Correct disposal avoids negative effects on humans and the environment and ensures recycling of useful raw materials.

Materials: see chapter "*Technical data*"

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

**WEEE directive 2002/96/EG**

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

## 10 Supplement

### 10.1 Technical data

#### Note for approved instruments

The technical data in the respective safety instructions are valid for approved instruments (e.g. with Ex approval). These data can differ from the data listed herein, for example regarding the process conditions or the voltage supply.

#### Materials and weights

316L corresponds to 1.4404 or 1.4435

Materials, wetted parts with metal-jacketed lens antenna

- Process fitting 316L, Alloy C22 (2.4602), Alloy 400 (2.4360)
- Process seal On site
- Antenna PP, PEEK
- seal, antenna system FKM (SHS FPM 70C3 GLT), EPDM (COG AP310)

Materials, wetted parts with plastic horn antenna

- Adapter flange PP-GF30 black
- Seal, adapter flange FKM (COG VI500), EPDM (COG AP310)
- Antenna cone PBT-GF 30
- Focussing lense PP

Material, wetted parts rinsing air connection

- Rinsing air connection PP-GFK
- Seal FKM (COG VI500), EPDM (COG AP310)

Materials, non-wetted parts

- Compression flange PP-GF30 black
- Mounting strap 316L
- Fixing screws, mounting strap 316L
- Fixing screws, adapter flange 304
- Plastic housing plastic PBT (Polyester)
- Aluminium die-casting housing Aluminium die-casting AlSi10Mg, powder-coated - basis: Polyester
- Stainless steel housing 316L
- Cable gland PA, stainless steel, brass
- Sealing, cable gland NBR
- Blind plug, cable gland PA
- Seal between housing and housing lid Silicone SI 850 R, NBR silicone-free
- Inspection window in housing cover (optional) Polycarbonate
- Ground terminal 316L

Weights

- Instrument (depending on housing, process fitting and antenna) approx. 2 ... 17.2 kg (4.409 ... 37.92 lbs)

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**Torques**

Max. torques, threaded version

- G $\frac{3}{4}$  30 Nm (22.13 lbf ft)
- G $1\frac{1}{2}$  200 Nm (147.5 lbf ft)

Max. torques, version plastic horn antenna

- Mounting screws, mounting strap on sensor housing 4 Nm (2.950 lbf ft)
- Flange screws, compression flange DN 80 5 Nm (3.689 lbf ft)
- Flange screws, adapter flange DN 100 7 Nm (5.163 lbf ft)

Max. torques, version metal-jacketed lens antenna

- Terminal screws for swivelling holder 8 Nm (5.9 lbf ft)

Max. torques for NPT cable glands and Conduit tubes

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

**Input variable**

Measured variable

The measured quantity is the distance between the end of the sensor antenna and the product surface. The reference plane for the measurement is the lower side of the flange.

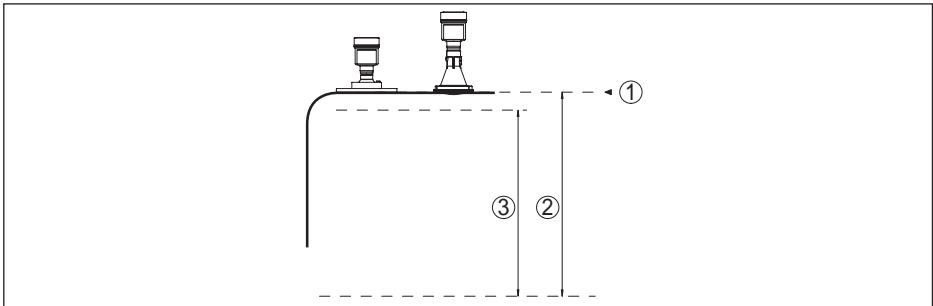


Fig. 50: Data of the input variable

- 1 Reference plane
- 2 Measured variable, max. measuring range
- 3 Useable measuring range (recommended min. distance see "Measuring accuracy")

Max. measuring range 120 m (393,7 ft)

**Output variable**

Output

- Physical layer Digital output signal according to standard EIA-485
- Bus specifications Modbus Application Protocol V1.1b3, Modbus over serial line V1.02
- Data protocols Modbus RTU, Modbus ASCII, Levelmaster

Max. transmission rate

57.6 Kbit/s

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## Accuracy (according to DIN EN 60770-1)

Process reference conditions according to DIN EN 61298-1

- Temperature	+18 ... +30 °C (+64 ... +86 °F)
- Relative humidity	45 ... 75 %
- Air pressure	860 ... 1060 mbar/86 ... 106 kPa (12.5 ... 15.4 psig)

Installation reference conditions

- Min. distance to internal installations	> 200 mm (7.874 in)
- Reflector	Flat plate reflector, surface 1 x 1 m (3.281 x 3.281 ft)
- False reflections	Biggest false signal, 20 dB smaller than the useful signal

Deviation

See following diagrams

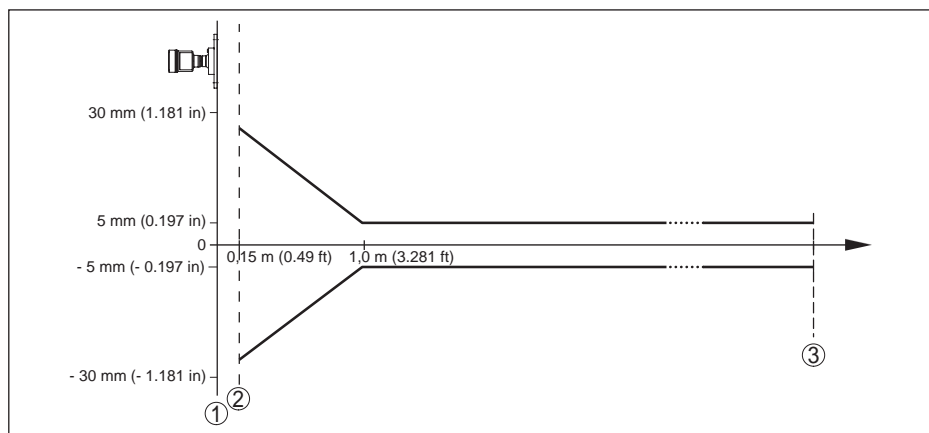


Fig. 51: Deviation under reference conditions

- 1 Reference plane
- 2 Recommended min. distance
- 3 Measuring range end

Repeatability	$\leq \pm 1$ mm
Deviation with bulk solids	The values depend to a great extent on the application. Binding specifications are thus not possible.

## Variables influencing measurement accuracy

Temperature drift - Digital output	$\pm 3$ mm/10 K, max. 10 mm
------------------------------------	-----------------------------

## Characteristics and performance data

Measuring frequency	W-band (79 GHz technology)
Measuring cycle time approx.	700 ms
Step response time <sup>2)</sup>	$\leq 3$ s

<sup>2)</sup> Time span (after a sudden measuring distance change of max. 2 m in bulk solids applications) until the output signal has taken on 90 % of the final value for the first time (IEC 61298-2).

Beam angle<sup>3)</sup>

- Plastic horn antenna 3.5°
- Metal-jacketed lens antenna 4°

Emitted HF power (depending on the parameter adjustment)<sup>4)</sup>

- Average spectral transmission power density -3 dBm/MHz EIRP
- Max. spectral transmission power density +34 dBm/50 MHz EIRP
- Max. power density at a distance of 1 m < 3  $\mu$ W/cm<sup>2</sup>

**Ambient conditions**

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

**Process conditions**

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

**Process temperature**

Antenna lens	Seal	Process temperature (measured on the process fitting)
PEEK	FKM (SHS FPM 70C3 GLT)	-40 ... +130 °C (-40 ... +266 °F)
		-40 ... +200 °C (-40 ... +392 °F)
	EPDM (COG AP302)	-40 ... +130 °C (-40 ... +266 °F)
PP	FKM (SHS FPM 70C3 GLT)	-40 ... +80 °C (-40 ... +176 °F)
	EPDM (COG AP310)	-40 ... +80 °C (-40 ... +176 °F)

**Ambient temperature - Process temperature**

<sup>3)</sup> Outside the specified beam angle, the energy level of the radar signal is 50% (-3 dB) less.

<sup>4)</sup> EIRP: Equivalent Isotropic Radiated Power.



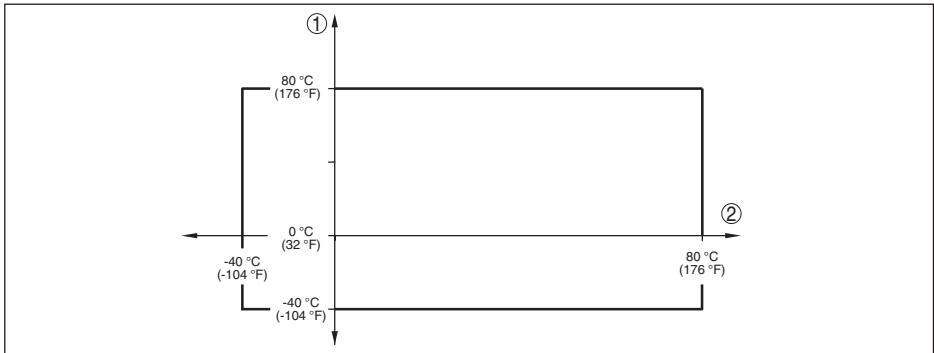


Fig. 52: Ambient temperature - Process temperature, plastic horn antenna

- 1 Ambient temperature
- 2 Process temperature

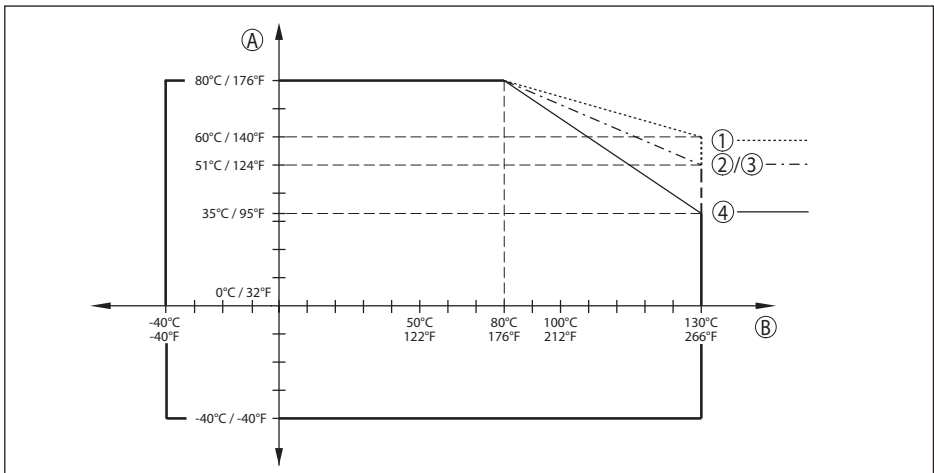


Fig. 53: Ambient temperature - Process temperature, metal-jacketed lens antenna up to +130 °C (266 °F)

- A Ambient temperature
- B Process temperature
- 1 Aluminium housing
- 2 Plastic housing
- 3 Stainless steel housing, precision casting
- 4 Stainless steel housing, electropolished

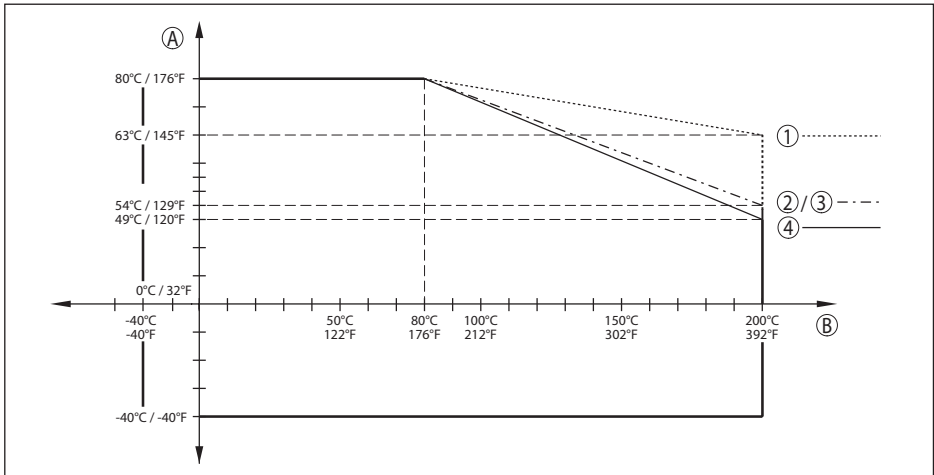


Fig. 54: Ambient temperature - Process temperature, metal-jacketed lens antenna up to +200 °C (392 °F)

- A Ambient temperature
- B Process temperature
- 1 Aluminium housing
- 2 Plastic housing
- 3 Stainless steel housing, precision casting
- 4 Stainless steel housing, electropolished

**Vessel pressure**

Vessel pressure

- Metal-jacketed lens antenna -1 ... 3 bar (-100 ... 300 kPa/-14.5 ... 43.5 psig)
- Plastic horn antenna -1 ... 2 bar (-100 ... 200 kPa/-14.5 ... 29.1 psig)
- Plastic horn antenna - Version with adapter flange from DN 100 PP or PP-GF 30 -1 ... 1 bar (-100 ... 100 kPa/-14.5 ... 14.5 psig)

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

**Mechanical stresses**

Vibration resistance - Metal jacketed lens antenna 4 g at 5 ... 200 Hz according to EN 60068-2-6 (vibration with resonance)

Vibration resistance - Plastic horn antenna

- With adapter flange 2 g at 5 ... 200 Hz according to EN 60068-2-6 (vibration with resonance)
- with mounting strap 1 g at 5 ... 200 Hz according to EN 60068-2-6 (vibration with resonance)

Shock resistance 100 g, 6 ms according to EN 60068-2-27 (mechanical shock)

**Data on rinsing air connection**

Recommended max. pressure with continuous rinsing 1 bar (14.50 psig)

Max. permissible pressure 6 bar (87.02 psig)  
 Air quality Filtered  
 Air volume, depending on pressure

Metal-jacketed lens antenna	Air volume	
	Without reflux valve	With reflux valve
Pressure		
0.2 bar (2.9 psig)	1.7 m <sup>3</sup> /h	-
0.4 bar (5.8 psig)	2.5 m <sup>3</sup> /h	-
0.6 bar (8.7 psig)	2.9 m <sup>3</sup> /h	0.8 m <sup>3</sup> /h
0.8 bar (11.6 psig)	3.3 m <sup>3</sup> /h	1.5 m <sup>3</sup> /h
1 bar (14.5 psig)	3.6 m <sup>3</sup> /h	2 m <sup>3</sup> /h
1.2 bar (17.4 psig)	3.9 m <sup>3</sup> /h	2.3 m <sup>3</sup> /h
1.4 bar (20.3 psig)	4 m <sup>3</sup> /h	2.7 m <sup>3</sup> /h
1.6 bar (23.2 psig)	4.3 m <sup>3</sup> /h	3 m <sup>3</sup> /h
1.8 bar (20.3 psig)	4.5 m <sup>3</sup> /h	3.5 m <sup>3</sup> /h
2 bar (23.2 psig)	4.6 m <sup>3</sup> /h	4 m <sup>3</sup> /h

Plastic horn antenna	Air volume	
	Without reflux valve	With reflux valve
Pressure		
0.2 bar (2.9 psig)	3.3 m <sup>3</sup> /h	-
0.4 bar (5.8 psig)	5 m <sup>3</sup> /h	-
0.6 bar (8.7 psig)	6 m <sup>3</sup> /h	1 m <sup>3</sup> /h
0.8 bar (11.6 psig)	-	2.1 m <sup>3</sup> /h
1 bar (14.5 psig)	-	3 m <sup>3</sup> /h
1.2 bar (17.4 psig)	-	3.5 m <sup>3</sup> /h
1.4 bar (20.3 psig)	-	4.2 m <sup>3</sup> /h
1.6 bar (23.2 psig)	-	4.4 m <sup>3</sup> /h
1.8 bar (20.3 psig)	-	4.8 m <sup>3</sup> /h
2 bar (23.2 psig)	-	5.1 m <sup>3</sup> /h

#### Connection

- Thread G $\frac{1}{8}$
- Seal with metal jacketed lens antenna Threaded plug of 316Ti

Reflux valve - (optional, is absolutely necessary for Ex applications)

- Material 316Ti
- Thread G $\frac{1}{8}$
- Seal FKM (SHS FPM 70C3 GLT), EPDM (COG AP310)
- For connection G $\frac{1}{8}$
- Opening pressure 0.5 bar (7.25 psig)
- Nominal pressure stage PN 250

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

## Options of the cable entry

- Cable entry M20 x 1.5, ½ NPT
- Cable gland M20 x 1,5; ½ NPT (cable ø see below table)
- Blind plug M20 x 1.5; ½ NPT
- Closing cap ½ NPT

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

## Wire cross-section (spring-loaded terminals)

- Massive wire, stranded wire 0.2 ... 2.5 mm<sup>2</sup> (AWG 24 ... 14)
- Stranded wire with end sleeve 0.2 ... 1.5 mm<sup>2</sup> (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 mm<sup>2</sup> (AWG 20)
- Wire resistance < 0.036 Ω/m
- Tensile strength < 1200 N (270 lbf)
- Standard length 5 m (16.4 ft)
- Max. length 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**

Display element Display with backlight

## Measured value indication

- Number of digits 5
- Size of digits W x H = 7 x 13 mm

Adjustment elements 4 keys

**Protection rating**

- unassembled IP 20
- mounted in the housing without lid IP 40

**Materials**

- Housing ABS
- Inspection window Polyester foil

**Interface to the external display and adjustment unit**

- Data transmission Digital (I<sup>2</sup>C-Bus)
- Connection cable Four-wire

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

**Integrated clock**

- Date format Day.Month.Year
- Time format 12 h/24 h
- Time zone Ex factory CET
- Rate deviation max. 10.5 min/year

**Additional output parameter - Electronics temperature**

## Output of the temperature values

- Analogue Via the current output
- Digital Via the digital output signal - depending on the electronics version
- Range -40 ... +85 °C (-40 ... +185 °F)
- Resolution < 0.1 K
- Accuracy ±3 K

**Voltage supply**

- Operating voltage 8 ... 30 V DC
- Power consumption < 500 mW
- Reverse voltage protection Integrated

**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](http://www.vega.com), "VEGA Tools" and "Instrument search" as well as in the download area.

## 10.2 Radio astronomy stations

Certain restrictions on the use of VEGAPULS 69 outside closed vessels result from the radio license. You can find these restrictions in chapter "*Radio license for Europe*". Some of these restrictions have to do radio astronomy stations. The following table states the geographic positions of radio astronomy stations in Europe:

Country	Name of the Station	Geographic Latitude	Geographic Longitude
Finland	Metsähovi	60°13'04" N	24°23'37" E
France	Plateau de Bure	44°38'01" N	05°54'26" E
Germany	Effelsberg	50°31'32" N	06°53'00" E
Italy	Sardinia	39°29'50" N	09°14'40" E
Spain	Yebes	40°31'27" N	03°05'22" W
	Pico Veleta	37°03'58" N	03°23'34" W
Sweden	Onsala	57°23'45" N	11°55'35" E

## 10.3 Basics Modbus

### Bus description

The Modbus protocol is a communication protocol for the communication between instruments. It is based on a Master/Slave or Client/Server architecture. By means of Modbus, a Master and several Slaves can be connected. Each bus participant has an unambiguous address and can send messages to the bus. This is initiated by the Master, the addressed Slave answers. For data transfer, the versions serial (EIA-485) as well as the mode RTU are available. In the RTU and ASCII mode interesting here, data will be transmitted in binary form. The telegram consists generally of the address, the function, the data as well as the transmission check.

### Bus architecture

In the version Modbus RTU, up to 32 participants can be connected to the bus. The length of the twisted two-wire cable can be up to 1200 m. The bus must be terminated on both sides at the last bus participant with a terminating resistor of 120 Ohm. The resistor is already integrated in the VEGAPULS 69 and is activated/deactivated via a slide switch.

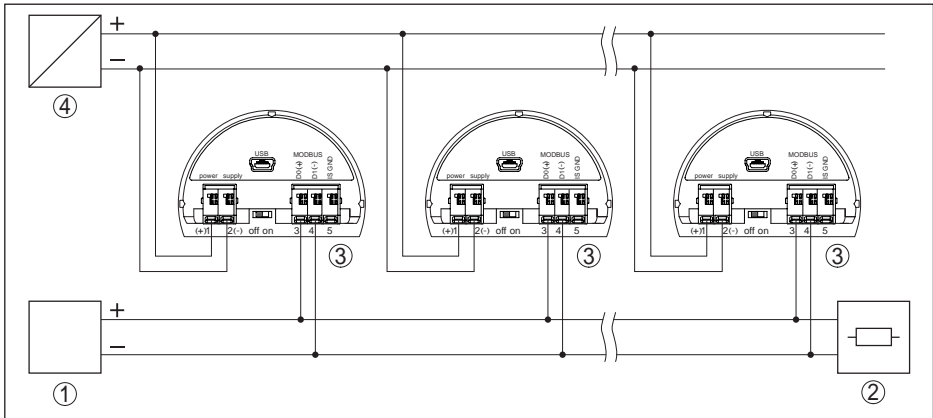


Fig. 55: Bus architecture Modbus

- 1 RTU
- 2 Connection resistor
- 3 Bus participant
- 4 Voltage supply

## Protocol description

The VEGAPULS 69 is suitable for connection to the following RTUs with Modbus RTU or ASCII protocol.

RTU	Protocol
ABB Totalflow	Modbus RTU, ASCII
Bristol ControlWaveMicro	Modbus RTU, ASCII
Fisher ROC	Modbus RTU, ASCII
ScadaPack	Modbus RTU, ASCII
Thermo Electron Autopilot	Modbus RTU, ASCII

## Parameters for the bus communication

The VEGAPULS 69 is preset with the default values:

Parameter	Configurable Values	Default Value
Baud Rate	1200, 2400, 4800, 9600, 19200	9600
Start Bits	1	1
Data Bits	7, 8	8
Parity	None, Odd, Even	None
Stop Bits	1, 2	1
Address range Modbus	1 ... 255	246

Start bits and data bits cannot be modified.

## General configuration of the host

The data exchange with status and variables between field device and host is carried out via register. For this, a configuration in the host is required. Floating point numbers with short precision (4 bytes) according to IEEE 754 are transmitted with individually selectable order of the data bytes (byte transmission order). This "*Byte transmission order*" is determined in the parameter "*Format Code*". Hence the RTU knows the registers of the VEGAPULS 69 which must be contacted for the variables and status information.

Format Code	Byte transmission order
0	ABCD
1	CDAB
2	DCBA
3	BADC

## 10.4 Modbus register

### Holding Register

The Holding registers consist of 16 bit. They can be read and written. Before each command, the address (1 byte), after each command, a CRC (2 byte) is sent.

Register Name	Register Number	Type	Configurable Values	Default Value	Unit
Address	200	Word	1 ... 255	246	-
Baud Rate	201	Word	1200, 2400, 4800, 9600, 19200	9600	-
Parity	202	Word	0 = None, 1 = Odd, 2 = Even	0	-
Stopbits	203	Word	1 = None, 2 = Two	1	-
Delay Time	206	Word	10 ... 250	50	ms
Byte Oder (Floating point format)	3000	Word	0, 1, 2, 3	0	-

### Input register

The input registers consist of 16 bits. They can only be read out. Before each command, the address (1 byte) is sent, after each command a CRC (2 bytes) is sent.

PV, SV, TV and QV can be adjusted via the sensor DTM.

Register Name	Register Number	Type	Note
Status	100	DWord	Bit 0: Invalid Measurement Value PV Bit 1: Invalid Measurement Value SV Bit 2: Invalid Measurement Value TV Bit 3: Invalid Measurement Value QV
PV Unit	104	DWord	Unit Code
PV	106		Primary Variable in Byte Order CDAB
SV Unit	108	DWord	Unit Code



Register Name	Register Number	Type	Note
SV	110		Secondary Variable in Byte Order CDAB
TV Unit	112	DWord	Unit Code
TV	114		Third Variable in Byte Order CDAB
QV Unit	116	DWord	Unit Code
QV	118		Quarternary Variable in Byte Order CDAB
Status	1300	DWord	See Register 100
PV	1302		Primary Variable in Byte Order of Register 3000
SV	1304		Secondary Variable in Byte Order of Register 3000
TV	1306		Third Variable in Byte Order of Register 3000
QV	1308		Quarternary Variable in Byte Order of Register 3000
Status	1400	DWord	See Register 100
PV	1402		Primary Variable in Byte Order CDAB
Status	1412	DWord	See Register 100
SV	1414		Secondary Variable in Byte Order CDAB
Status	1424	DWord	See Register 100
TV	1426		Third Variable in Byte Order CDAB
Status	1436	DWord	See Register 100
QV	1438		Quarternary Variable in Byte Order CDAB
Status	2000	DWord	See Register 100
PV	2002	DWord	Primary Variable in Byte Order ABCD (Big Endian)
SV	2004	DWord	Secondary Variable in Byte Order ABCD (Big Endian)
TV	2006	DWord	Third Variable in Byte Order ABCD (Big Endian)
QV	2008	DWord	Quarternary Variable in Byte Order ABCD (Big Endian)
Status	2100	DWord	See Register 100
PV	2102	DWord	Primary Variable in Byte Order DCBA (Little Endian)
SV	2104	DWord	Secondary Variable in Byte Order DCBA (Little Endian)
TV	2106	DWord	Third Variable in Byte Order ABCD DCBA (Little Endian)
QV	2108	DWord	Quarternary Variable in Byte Order DCBA (Little Endian)
Status	2200	DWord	See Register 100
PV	2202	DWord	Primary Variable in Byte Order BACD (Middle Endian)
SV	2204	DWord	Secondary Variable in Byte Order BACD (Middle Endian)
TV	2206	DWord	Third Variable in Byte Order BACD (Middle Endian)
QV	2208	DWord	Quarternary Variable in Byte Order BACD (Middle Endian)

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**Unit Codes for Register 104, 108, 112, 116**

Unit Code	Measurement Unit
32	Degree Celsius
33	Degree Fahrenheit
40	US Gallon
41	Liters
42	Imperial Gallons
43	Cubic Meters
44	Feet
45	Meters
46	Barrels
47	Inches
48	Centimeters
49	Millimeters
111	Cubic Yards
112	Cubic Feet
113	Cubic Inches

**10.5 Modbus RTU commands****FC3 Read Holding Register**

With this command, any number (1-127) of holding registers can be read out. The start register, from which the readout should start, and the number of registers are transmitted.

**Request:**

Parameter	Length	Code/Data
Function Code	1 Byte	0x03
Start Address	2 Bytes	0x0000 to 0xFFFF
Number of Registers	2 Bytes	1 to 127 (0x7D)

**Response:**

Parameter	Length	Code/Data
Function Code	1 Byte	0x03
Start Address	2 Bytes	2*N
Register Value	N*2 Bytes	Data

**FC4 Read Input Register**

With this command, any number (1-127) of input registers can be read out. The start register, from which the readout should start, and the number of registers are transmitted.

**Request:**

Parameter	Length	Code/Data
Function Code	1 Byte	0x04
Start Address	2 Bytes	0x0000 to 0xFFFF
Number of Registers	N*2 Bytes	1 to 127 (0x7D)

**Response:**

Parameter	Length	Code/Data
Function Code	1 Byte	0x04
Start Address	2 Bytes	2*N
Register Value	N*2 Bytes	Data

**FC6 Write Single Register**

With this function code an individual holding register can be written.

**Request:**

Parameter	Length	Code/Data
Function Code	1 Byte	0x06
Start Address	2 Bytes	0x0000 to 0xFFFF
Number of Registers	2 Bytes	Data

**Response:**

Parameter	Length	Code/Data
Function Code	1 Byte	0x04
Start Address	2 Bytes	2*N
Register Value	2 Bytes	Data

**FC8 Diagnostics**

With this function code different diagnostic functions can be triggered or diagnostic values read out.

**Request:**

Parameter	Length	Code/Data
Function Code	1 Byte	0x08
Sub Function Code	2 Bytes	
Data	N*2 Bytes	Data

**Response:**

Parameter	Length	Code/Data
Function Code	1 Byte	0x08
Sub Function Code	2 Bytes	

Parameter	Length	Code/Data
Data	N*2 Bytes	Data

**Implemented function codes:**

Sub Function Code	Name
0x00	Return Data Request
0x0B	Return Message Counter

With sub function codes 0x00 only one 16 bit value can be written.

**FC16 Write Multiple Register**

With this function code, several holding registers can be written. Only registers can be written in an enquiry which are immediately consecutive. If there are gaps (registers do not exist) between the registers, then they cannot be written in a telegram.

**Request:**

Parameter	Length	Code/Data
Function Code	1 Byte	0x10
Start Address	2 Bytes	0x0000 to 0xFFFF
Register Value	2 Bytes	0x0001 to 0x007B
Byte Number	1 Byte	2*N
Register Value	N*2 Bytes	Data

**Response:**

Parameter	Length	Code/Data
Function Code	1 Byte	0x10
Sub Function Code	2 Bytes	0x0000 to 0xFFFF
Data	2 Bytes	0x01 to 0x7B

**FC17 Report Slave ID**

With this function code, the Slave ID can be queried.

**Request:**

Parameter	Length	Code/Data
Function Code	1 Byte	0x11

**Response:**

Parameter	Length	Code/Data
Function Code	1 Byte	0x11
Byte Number	1 Byte	
Slave ID	1 Byte	
Run Indicator Status	1 Byte	

## FC43 Sub 14, Read Device Identification

With this function code, the Device Identification can be queried.

### Request:

Parameter	Length	Code/Data
Function Code	1 Byte	0x2B
MEI Type	1 Byte	0x0E
Read Device ID Code	1 Byte	0x01 to 0x04
Object ID	1 Byte	0x00 to 0xFF

### Response:

Parameter	Length	Code/Data
Function Code	1 Byte	0x2B
MEI Type	1 Byte	0x0E
Read Device ID Code	1 Byte	0x01 to 0x04
Confirmity Level	1 Byte	0x01, 0x02, 0x03, 0x81, 0x82, 0x83
More follows	1 Byte	00/FF
Next Object ID	1 Byte	Object ID number
Number of Objects	1 Byte	
List of Object ID	1 Byte	
List of Object length	1 Byte	
List of Object value	1 Byte	Depending on the Object ID

## 10.6 Levelmaster commands

The VEGAPULS 69 is also suitable for connection to the following RTUs with Levelmaster protocol. The Levelmaster protocol is often called "*Siemens*" "*Tank protocol*".

RTU	Protocol
ABB Totalflow	Levelmaster
Kimray DACC 2000/3000	Levelmaster
Thermo Electron Autopilot	Levelmaster

### Parameters for the bus communication

The VEGAPULS 69 is preset with the default values:

Parameter	Configurable Values	Default Value
Baud Rate	1200, 2400, 4800, 9600, 19200	9600
Start Bits	1	1
Data Bits	7, 8	8
Parity	None, Odd, Even	None
Stop Bits	1, 2	1

Parameter	Configurable Values	Default Value
Address range Levelmaster	32	32

The Levelmaster commands are based on the following syntax:

- Capital letters are at the beginning of certain data fields
- Small letters stand for data fields
- All commands are terminated with "<cr>" (carriage return)
- All commands start with "Uuu", whereby "uu" stands for the address (00-31)
- "\*" can be used as a joker for any position in the address. The sensor always converts this in its address. In case of more than one sensor, the joker must not be used, because otherwise several slaves will answer
- Commands that modify the instrument return the command with "OK". "EE-ERROR" replaces "OK" if there was a problem changing the configuration

## Report Level (and Temperature)

### Request:

Parameter	Length	Code/Data
Report Level (and Temperature)	4 characters ASCII	Uuu?

### Response:

Parameter	Length	Code/Data
Report Level (and Temperature)	24 characters ASCII	UuuDIII.IIFttEeeeeWwww uu = Address III.II = PV in inches ttt = Temperature in Fahrenheit eeee = Error number (0 no error, 1 level data not readable) www = Warning number (0 no warning)

PV in inches will be repeated if "*Set number of floats*" is set to 2. Hence 2 measured values can be transmitted. PV value is transmitted as first measured value, SV as second measured value.



### Information:

The max. value for the PV to be transmitted is 999.99 inches (corresponds to approx. 25.4 m).

If the temperature should be transmitted in the Levelmaster protocol, then TV must be set in the sensor to temperature.

PV, SV and TV can be adjusted via the sensor DTM.

## Report Unit Number

### Request:

Parameter	Length	Code/Data
Report Unit Number	5 characters ASCII	U**N?

**Response:**

Parameter	Length	Code/Data
Report Level (and Temperature)	6 characters ASCII	UuuNnn

**Assign Unit Number****Request:**

Parameter	Length	Code/Data
Assign Unit Number	6 characters ASCII	UuuNnn

**Response:**

Parameter	Length	Code/Data
Assign Unit Number	6 characters ASCII	UuuNOK uu = new Address

**Set number of Floats****Request:**

Parameter	Length	Code/Data
Set number of Floats	5 characters ASCII	UuuFn

**Response:**

Parameter	Length	Code/Data
Set number of Floats	6 characters ASCII	UuuFOK

If the number is set to 0, no level is returned

**Set Baud Rate****Request:**

Parameter	Length	Code/Data
Set Baud Rate	8 (12) characters ASCII	UuuBbbbb[b][pds] Bbbbb[b] = 1200, 9600 (default) pds = parity, data length, stop bit (optional) parity: none = 81, even = 71 (default), odd = 71

**Response:**

Parameter	Length	Code/Data
Set Baud Rate	11 characters ASCII	

Example: U01B9600E71

Change instrument on address 1 to baudrate 9600, parity even, 7 data bits, 1 stop bit

## Set Receive to Transmit Delay

### Request:

Parameter	Length	Code/Data
Set Receive to Transmit Delay	7 characters ASCII	UuuRmmm mmm = milliseconds (50 up to 250), default = 127 ms

### Response:

Parameter	Length	Code/Data
Set Receive to Transmit Delay	6 characters ASCII	UuuROK

## Report Number of Floats

### Request:

Parameter	Length	Code/Data
Set Receive to Transmit Delay	4 characters ASCII	UuuF

### Response:

Parameter	Length	Code/Data
Set Receive to Transmit Delay	5 characters ASCII	UuuFn n = number of measurement values (0, 1 or 2)

## Report Receive to Transmit Delay

### Request:

Parameter	Length	Code/Data
Report Receive to Transmit Delay	4 characters ASCII	UuuR

### Response:

Parameter	Length	Code/Data
Report Receive to Transmit Delay	7 characters ASCII	UuuRmmm mmm = milliseconds (50 up to 250), default = 127 ms

## Error codes

Error Code	Name
EE-Error	Error While Storing Data in EEPROM
FR-Error	Error in Frame (too short, too long, wrong data)
LV-Error	Value out of limits



## 10.7 Configuration of typical Modbus hosts

### Fisher ROC 809

#### Wiring plan

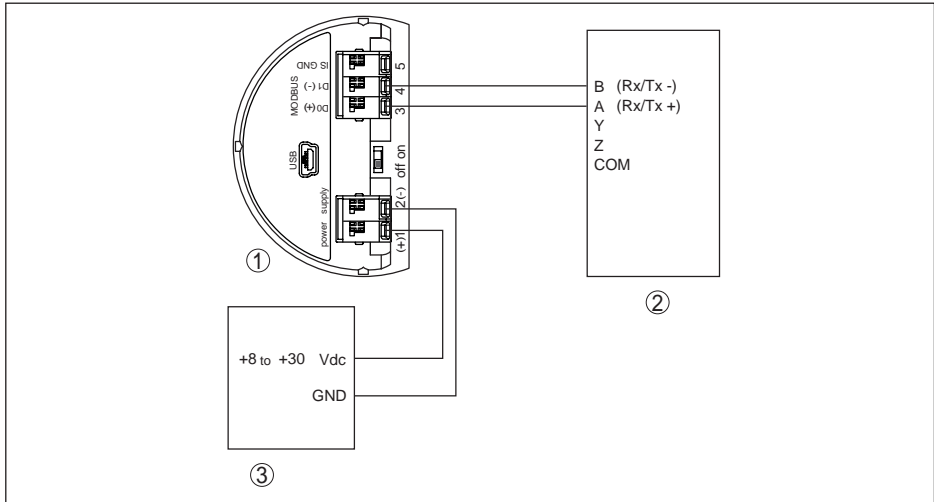


Fig. 56: Connection of VEGAPULS 69 to RTU Fisher ROC 809

- 1 VEGAPULS 69
- 2 RTU Fisher ROC 809
- 3 Voltage supply

#### Parameter

Parameter	Value
Baud Rate	9600
Floating Point Format Code	0
RTU Data Type	Conversion Code 66
Input Register Base Number	0

The basic number of the input registers is always added to the input register address of VEGAPULS 69.

Address 1300 must hence be entered as register address for RTU Fisher ROC 809.

## ABB Total Flow

### Wiring plan

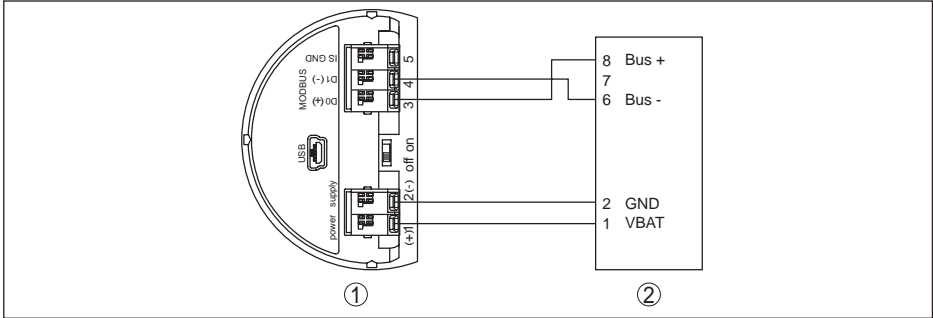


Fig. 57: Connection of VEGAPULS 69 to RTU ABB Total Flow

- 1 VEGAPULS 69
- 2 RTU ABB Total Flow

### Parameter

Parameter	Value
Baud Rate	9600
Floating Point Format Code	0
RTU Data Type	16 Bit Modicon
Input Register Base Number	1

The basic number of the input registers is always added to the input register address of VEGAPULS 69.

Address 1303 must hence be entered as register address for 1302 for RTU ABB Total Flow.

## Thermo Electron Autopilot

### Wiring plan

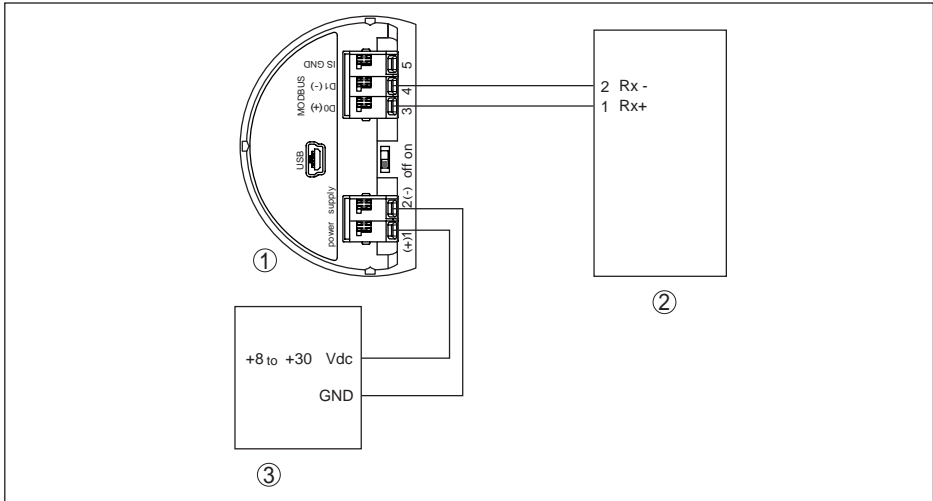


Fig. 58: Connection of VEGAPULS 69 to RTU Thermo Electron Autopilot

- 1 VEGAPULS 69
- 2 RTU Thermo Electron Autopilot
- 3 Voltage supply

### Parameter

Parameter	Value
Baud Rate	9600
Floating Point Format Code	0
RTU Data Type	IEE Fit 2R
Input Register Base Number	0

The basic number of the input registers is always added to the input register address of VEGAPULS 69.

For that reason, address 1300 must be entered as register address for 1300 for the RTU Thermo Electron Autopilot.

## Bristol ControlWave Micro

### Wiring plan

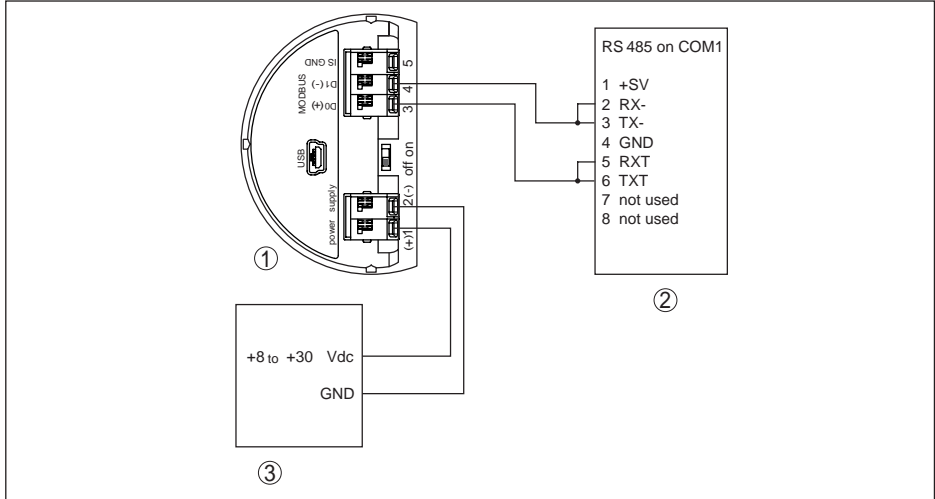


Fig. 59: Connection of VEGAPULS 69 to RTU Bristol ControlWave Micro

- 1 VEGAPULS 69
- 2 RTU Bristol ControlWave Micro
- 3 Voltage supply

### Parameter

Parameter	Value
Baud Rate	9600
Floating Point Format Code	2 (FC4)
RTU Data Type	32-bit registers as 2 16-bit registers
Input Register Base Number	1

The basic number of the input registers is always added to the input register address of VEGAPULS 69.

Address 1303 must hence be entered as register address for 1302 for RTU Bristol ControlWave Micro.

## ScadaPack

### Wiring plan

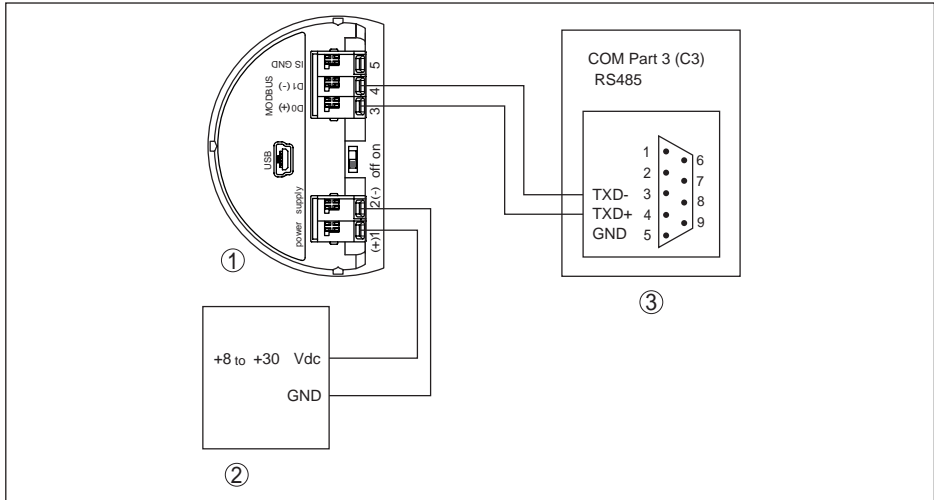


Fig. 60: Connection of VEGAPULS 69 to RTU ScadaPack

- 1 VEGAPULS 69
- 2 RTU ScadaPack
- 3 Voltage supply

### Parameter

Parameter	Value
Baud Rate	9600
Floating Point Format Code	0
RTU Data Type	Floating Point
Input Register Base Number	30001

The basic number of the input registers is always added to the input register address of VEGAPULS 69.

Address 31303 must hence be entered as register address for 1302 for RTU ScadaPack.

## 10.8 Dimensions

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

**Housing**

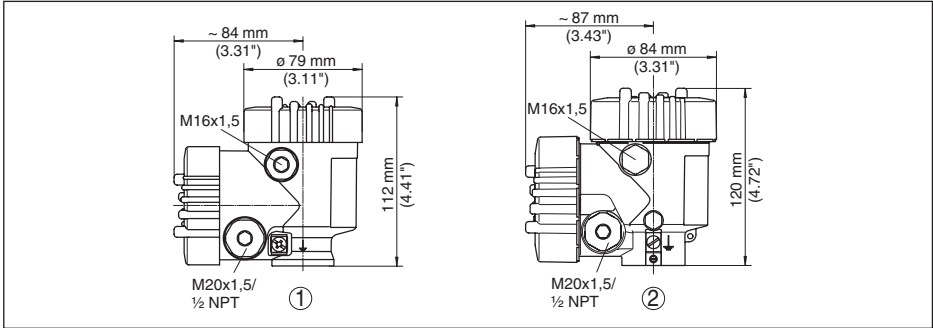


Fig. 61: Dimensions of housing - with integrated display and adjustment module the housing is 9 mm/0.35 inches higher

- 1 Plastic housing
- 2 Aluminium/Stainless steel housing

**VEGAPULS 69, plastic horn antenna with compression flange**

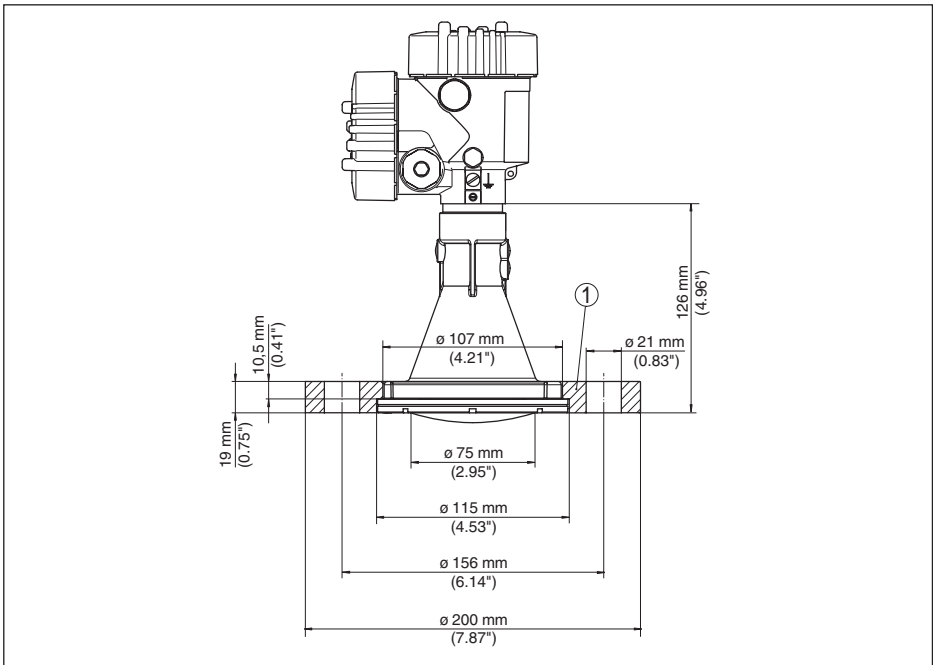


Fig. 62: Radar sensor with compression flange

- 1 Compression flange

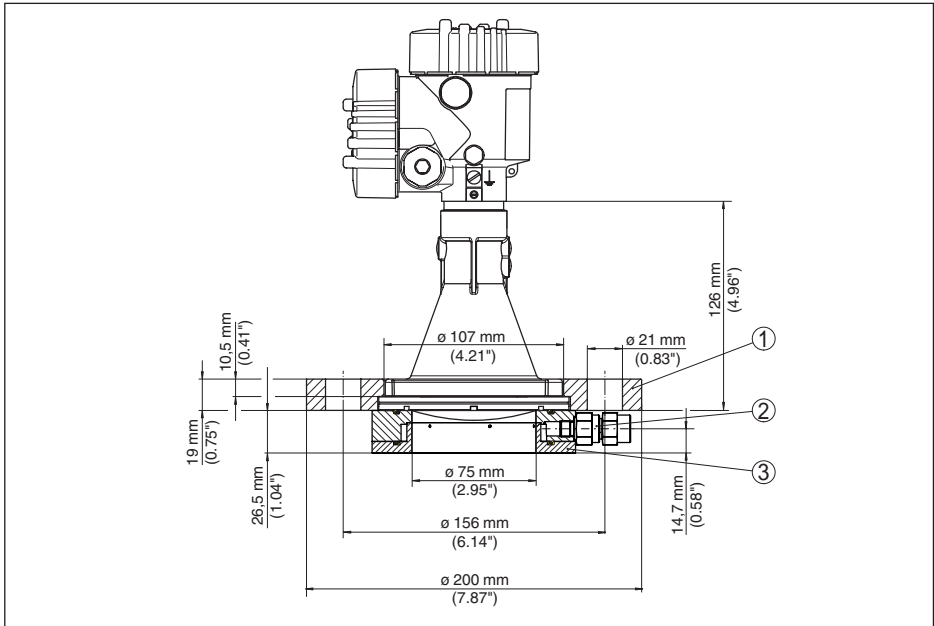
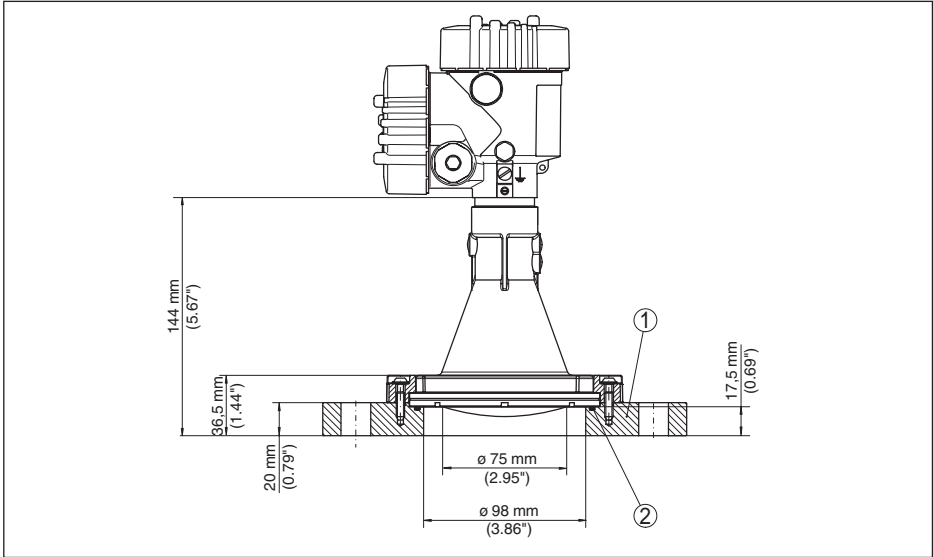
**VEGAPULS 69, plastic horn antenna with compression flange and rinsing connection**


Fig. 63: Radar sensor with compression flange and rinsing connection

- 1 Compression flange
- 2 Reflux valve
- 3 Rinsing connection

**VEGAPULS 69, plastic horn antenna with adapter flange**



*Fig. 64: Radar sensor with adapter flange*



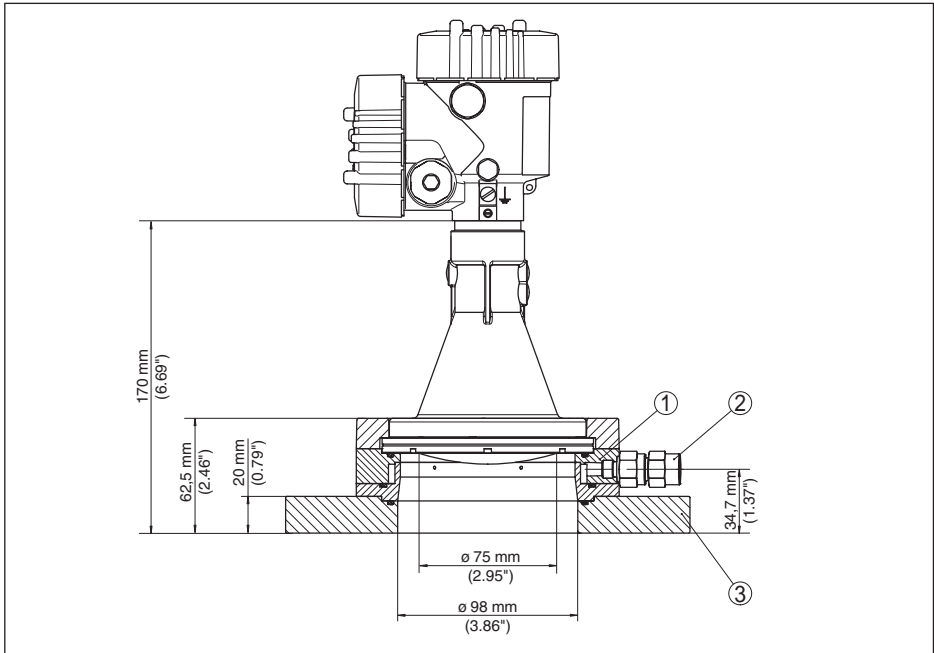
**VEGAPULS 69, plastic horn antenna mit adapter flange und rinsing connection**


Fig. 65: VEGAPULS 69, adapter flange and air flushing ring

- 1 Air flushing ring
- 2 Reflux valve
- 3 Adapter flange

**VEGAPULS 69, plastic horn antenna with mounting strap**

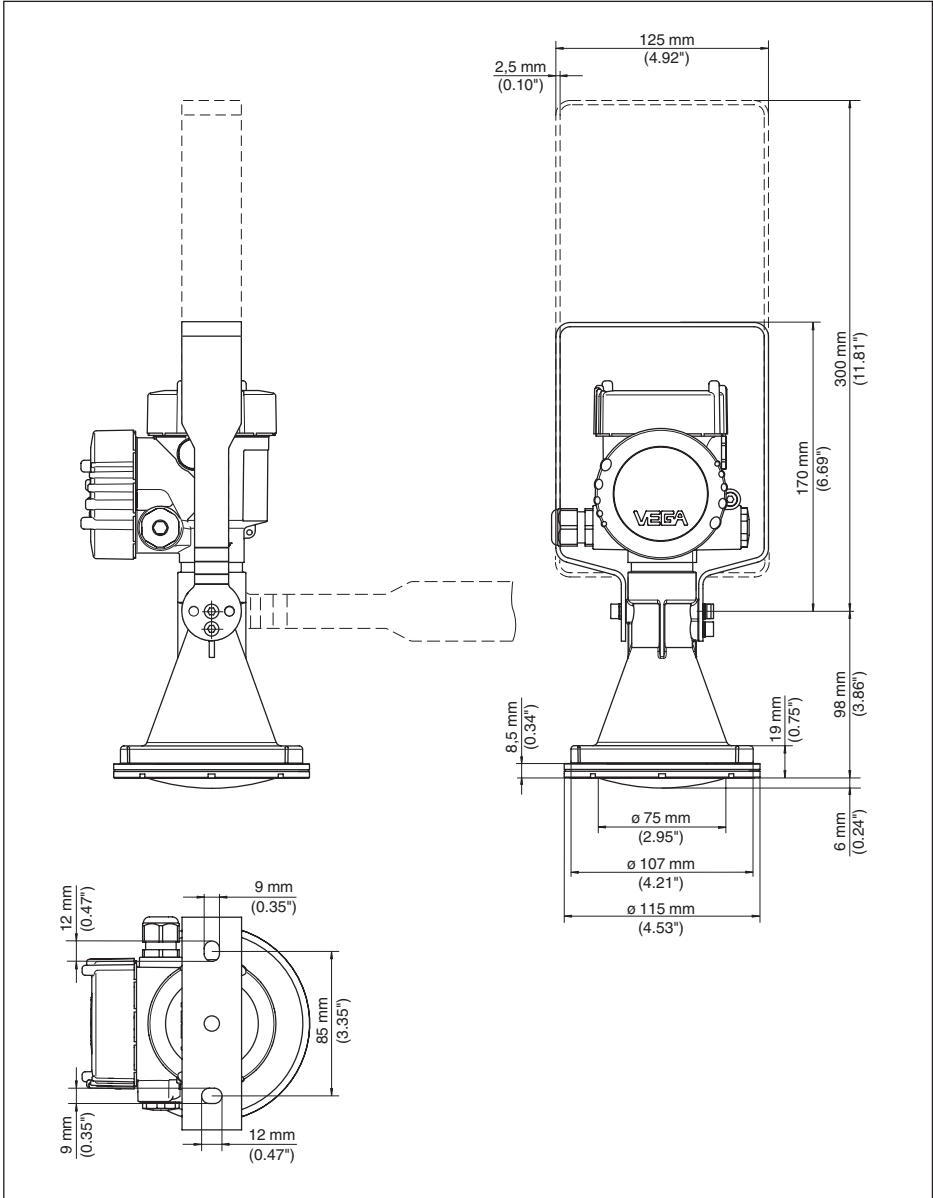


Fig. 66: VEGAPULS 69, plastic antenna and mounting strap in 170 or 300 mm length

### VEGAPULS 69, metal-jacketed lens antenna

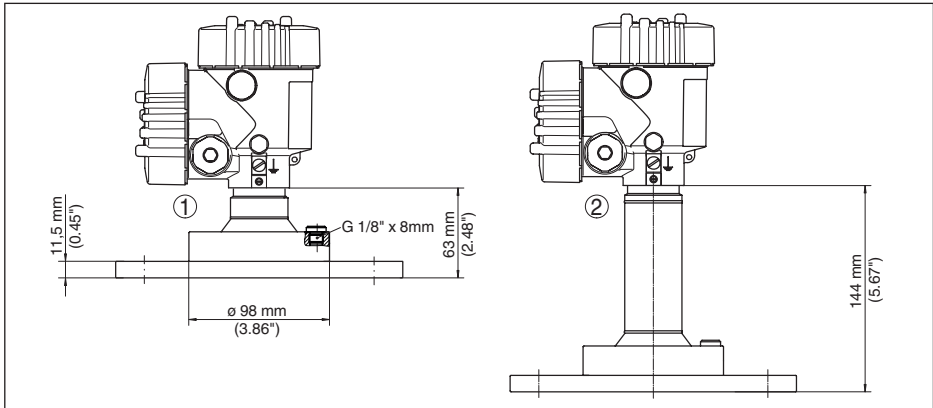


Fig. 67: VEGAPULS 69, metal-jacketed lens antenna. Flange thickness acc. to drawing, flange dimensions acc. to DIN/ASME/JIS.

- 1 Version up to 130 °C (266 °F)
- 2 Version up to 200 °C (392 °F)

### VEGAPULS 69, metal-jacketed lens antenna with rinsing connection

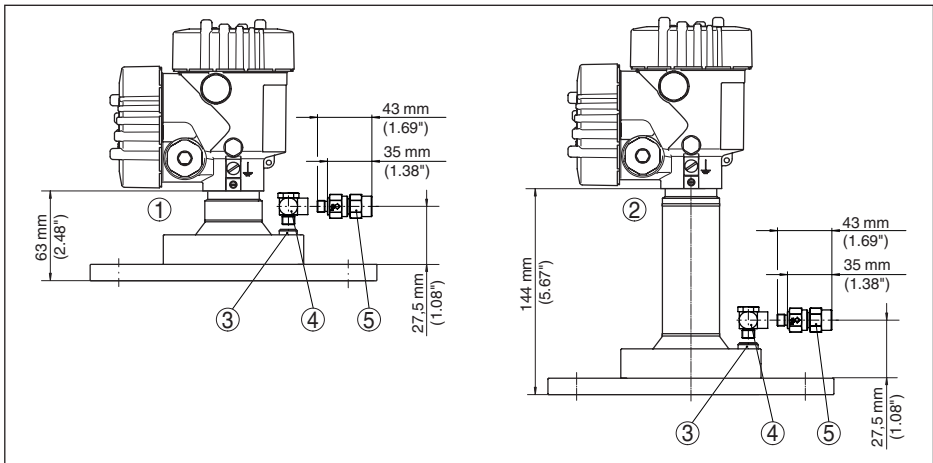
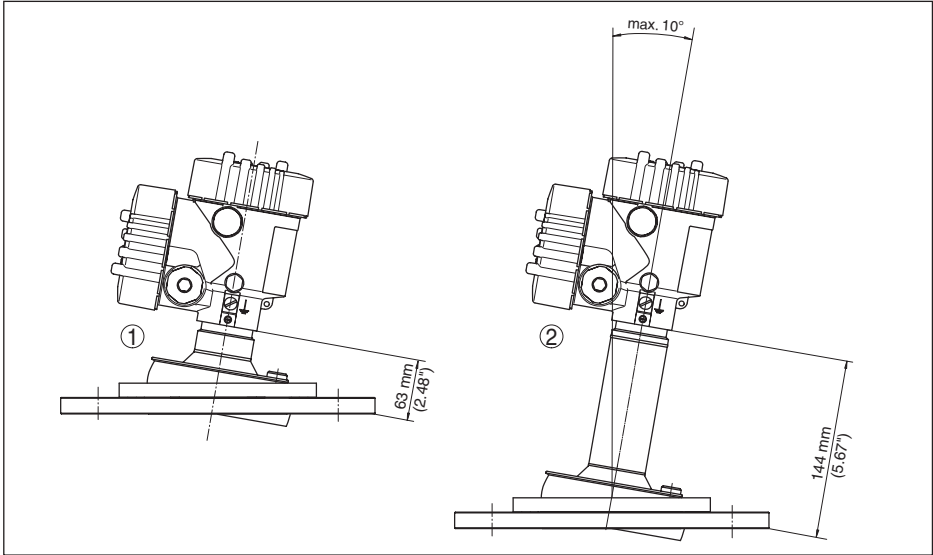


Fig. 68: VEGAPULS 69, metal-jacketed lens antenna in flange version with rinsing connection

- 1 Version up to 130 °C (266 °F)
- 2 Version up to 200 °C (392 °F)
- 3 Blind plug
- 4 90° angle joint
- 5 Reflux valve

**VEGAPULS 69, metal-jacketed lens antenna with swivelling holder**



*Fig. 69: VEGAPULS 69, metal-jacketed lens antenna and swivelling holder*

- 1 Version up to 130 °C (266 °F)
- 2 Version up to 200 °C (392 °F)

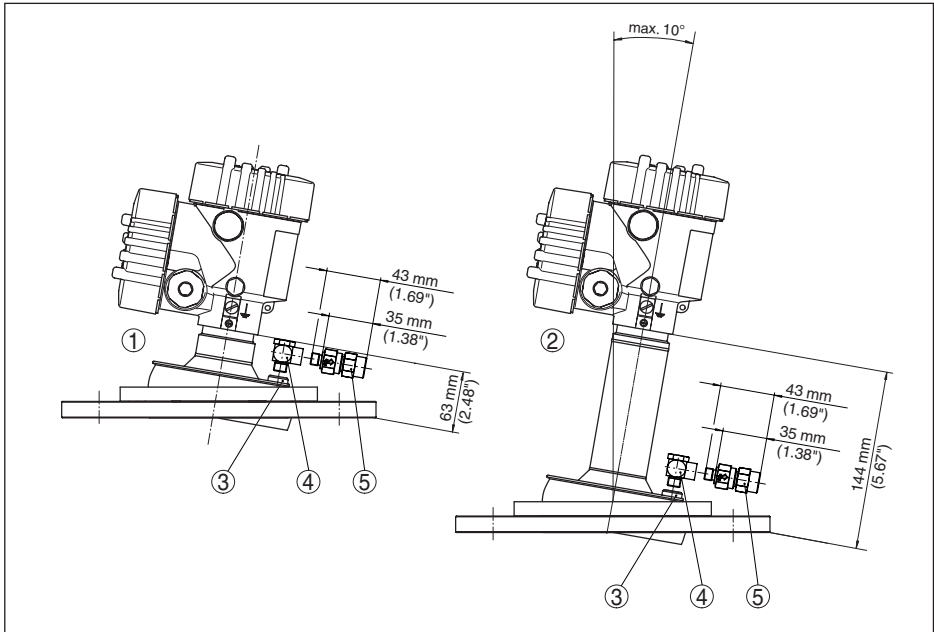
**VEGAPULS 69, metal-jacketed lens antenna with swivelling holder and rinsing connection**


Fig. 70: VEGAPULS 69, metal-jacketed lens antenna with swivelling holder and rinsing connection

- 1 Version up to 130 °C (266 °F)
- 2 Version up to 200 °C (392 °F)
- 3 Blind plug
- 4 90° angle joint
- 5 Reflux valve

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47252-EN-160701

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