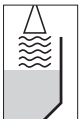
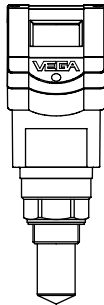


Operating Instructions

VEGAPULS 41

4 ... 20 mA; HART® compact sensor



Contents

Safety information 3
 Note Ex area 3

Quick start

Quick start with the PC 4
 Quick start with adjustment module MINICOM..... 5

1 Product description

1.1 Function 7
 1.2 Application features 9
 1.3 Adjustment 10
 1.4 Type survey 12
 1.5 Antennas 14

2 Mounting and installation

2.1 General installation instructions 15
 2.2 Measurement of liquids 18
 2.3 Measurement in standpipe (surge or bypass tube) 19
 2.4 False echoes 24
 2.5 Common installation mistakes 26

3 Electrical connection

3.1 Connection and connection cable 29
 3.2 Connection of the sensor 31
 3.3 Connection of the external indicating instrument
 VEGADIS 50 35
 3.4 Configuration of measuring systems 36

4 Setup

4.1 Adjustment media	44
4.2 Adjustment with PC	44
4.3 Adjustment with adjustment module MINICOM	46
4.4 Adjustment with HART® handheld	52

5 Diagnosis

5.1 Simulation	57
5.2 Error codes	57

6 Technical data

6.1 Technical data	58
6.2 Approvals	63
6.3 Dimensions	64

Safety information

Please read this manual carefully, and also take note of country-specific installation standards (e.g. the VDE regulations in Germany) as well as all prevailing safety regulations and accident prevention rules.

For safety and warranty reasons, any internal work on the instruments, apart from that involved in normal installation and electrical connection, must be carried out only by qualified VEGA personnel.

**Note Ex area**

Please note the attached safety instructions containing important information on installation and operation in Ex areas.

These safety instructions are part of the operating instructions manual and come with the Ex approved instruments.

Quick start

In the majority of applications, the radar sensor displays the distance to the product surface immediately after the power supply is switched on. You only have to carry out the empty and full adjustment, so that at your required empty and full distances, 4 mA and 20 mA, respectively, are outputted.

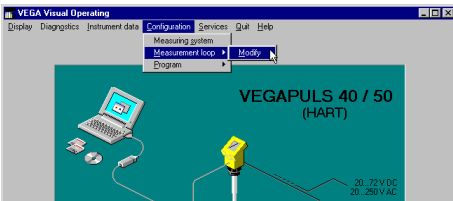
However, it is always useful, especially under difficult measuring conditions (process tanks, stirrers, filling stream, vessel installations), to carry out a sensor optimisation, see chapter "5 Setup".

Quick start with the PC

Configuration

Start the adjustment software VVO ≥ 2.70 with the user level "Planning".

- Click to ...

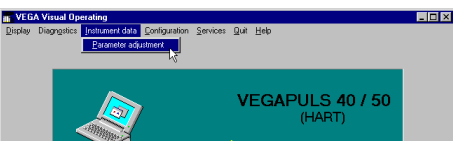


... and enter a name for the measurement loop.

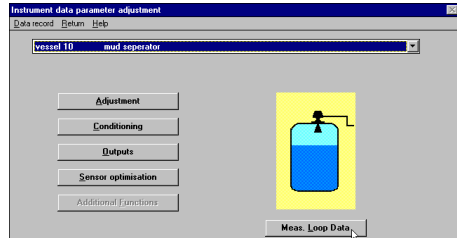
- Choose under "Application" e.g. "Level".
- Confirm with "OK".

Adjustment

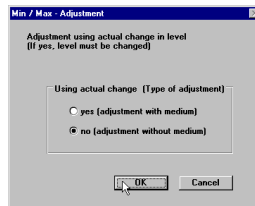
- Click to "Instrument data/Parameter adjustment".



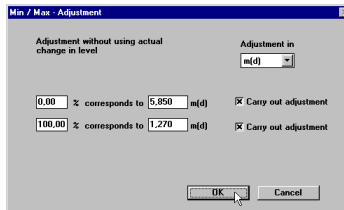
- Then click to "Adjustment".



- Click in the window "Adjustment" to "Min/Max adjustment" and choose "no (adjustment without medium)" in the following window "Min/Max-Adjustment".



- Click to "OK".

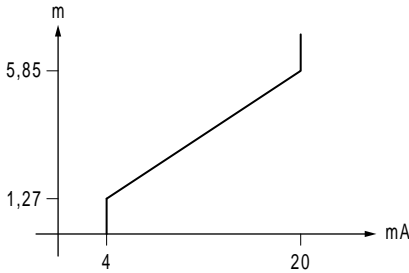


- Enter the distance from the sensor to the product surface at 0 % (empty) and at 100 % (full) in meters.
- Activate the two boxes "Carry out adjustment" and click to "OK".

You are again in the window "Adjustment".

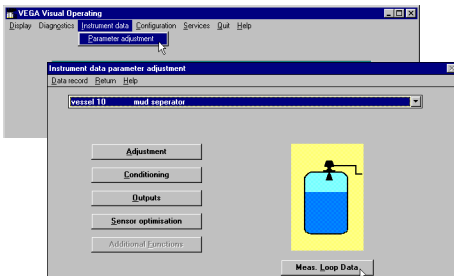
- Click in the window "Adjustment" to "Quit".

The sensor then outputs at the adjusted empty distance 4 mA and at the full distance 20 mA. In the example, the sensor outputs the product distance span, 5.85 m to 1.27 m, as a signal in the range 4 ... 20 mA.



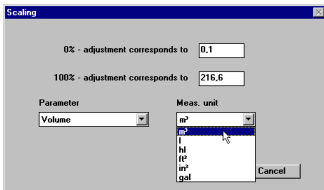
Scaling of the measured value display

- Click to "Instrument data/Parameter adjustment/Conditioning".



- Click in the window "Conditioning" to "Scaling".

The window ...

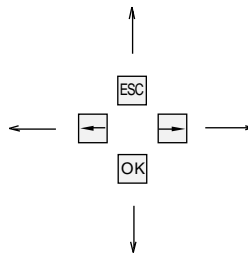


opens.

Allocate in the menu window "Scaling" a physical unit and the unit of measurement to the 0 % and 100 % values. Here, you inform the sensor, e.g. that at 0 % filling there are still 0.1 m³ and at 100 % filling 216.6 m³ in the vessel. The sensor display then shows 0.1 m³ (0 %) for an empty vessel and 216.6 m³ (100 %) for a full vessel.

Quick start with adjustment module MINICOM

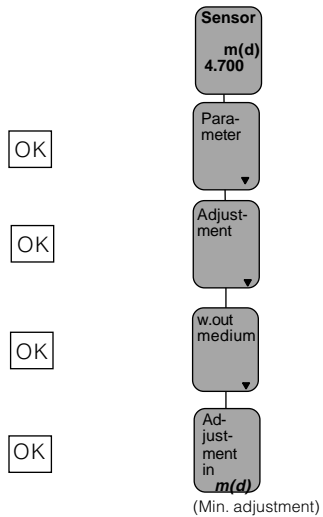
In the menu field you can move with these keys to the left, right, top and bottom.



Empty adjustment

Key

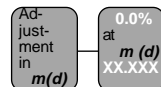
Display text



The display text flashes and you can choose between "feet" and "m".



Confirm the adjustment with "OK".



or Enter 0 %.

The 0 % value is allocated to the following distance and the distance indication flashes.

or Enter the empty distance, e.g. 5.85 m.

The value pair 0 % and 5.85 m is written into the sensor.



Full adjustment



(Max. adjustment)

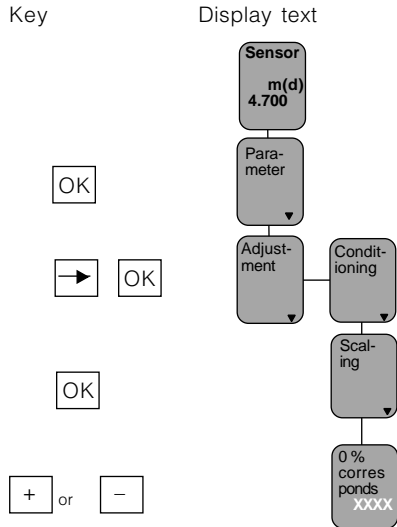
or Enter 100 %.

The 100 % value is allocated to the following distance and the distance indication flashes.

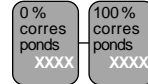
or Enter the distance with full vessel, e.g. 1.27 m.



Scaling of measured value display



Enter the figure for the filling at 0 %, e.g. 0001.



or Enter the figure of the 100 % filling, e.g. 2166 for 216.6 m³.



or Enter the position of the comma, so that 216.6 is displayed.



or Choose the physical quantity, e.g. volume.



or Choose the unit, e.g. m³.

1 Product description

Radar sensors usually come with horn or rod antennas. PTFE rod antennas are suitable for many applications with chemically aggressive liquids, but are unsuitable for small vessels due to their length. Also the reception efficiency of the rod antenna is lower than that of the (less resistant) horn antenna. The two new radar sensors, VEGAPULS 43 with DN 50 and DN 80 process connections and the described VEGAPULS 41 with 1½" process connection, perfectly round out the instrument series. Horn and rod antennas that protrude into the vessel belong to the past. The antenna of VEGAPULS 41 consists of a small 40 mm TFM-PTFE cone that is suitable for chemically aggressive environments. PTFE (polytetrafluoroethylene) has been known as the „Mercedes“ of plastic materials for many years. These plastics do not become brittle or age and are suitable for temperatures up to 150°C. They are resistant to virtually all chemical media, such as e.g. amines, ketones, esters, acids (sulphuric acid, phosphoric acid, hydrochloric acid, nitric acid), alkalis (caustic soda), oxidants, fuels and oils. The only limits to these materials are applications with fluorine under high pressure or with liquid alkali metals (sodium or potassium), where adverse reactions may occur. The cone acts like a lens that focuses short (0.15 mW) radar pulses into the beam and sends them towards the product. During the pulse breaks, the cones operate like a unidirectional microphone with optimum reception efficiency. The intelligent, extremely fast electronics converts the radar echo into a precise image of the environment and level, which is outputted as a 4 ... 20 mA or Profibus signal.

Due to their small housing dimensions and process fittings, the compact sensors are unobtrusive and, above all, cost-effective monitors of your product levels. With their integrated display, they enable high-precision level measurements and can be used for applications in which the advantages of non-contact measurement could never before be realized.

VEGAPULS radar sensors are perfectly adapted to two-wire technology. The supply voltage and the output signal are transmitted via one two-wire cable. The instruments produce an analogue 4 ... 20 mA signal as output, i.e. measuring signal.

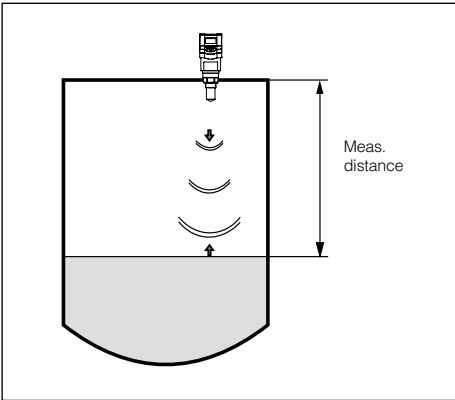
1.1 Function

Radio detecting and ranging: Radar. VEGAPULS radar sensors are used for non-contact, continuous distance measurement. The measured distance corresponds to a filling height and is outputted as level.

Measuring principle:

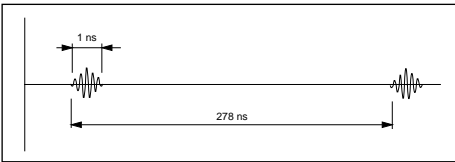
emission – reflection – reception

Extremely small 26 GHz radar signals are emitted from the antenna of the radar sensor as short pulses. The radar impulses reflected by the sensor environment and the product are received by the antenna as radar echoes. The running period of the radar impulses from emission to reception is proportional to the distance and hence to the level.



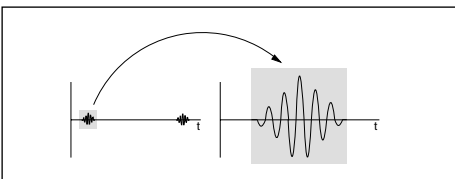
emission - reflection - reception

The radar impulses are emitted by the antenna system as pulse packages with a pulse duration of 1 ns and pulse intervals of 278 ns; this corresponds to a pulse package frequency of 3.6 MHz. In the impulse intervals, the antenna system operates as a receiver. Signal running periods of less than one billionth of a second must be processed and the echo image evaluated in a fraction of a second.



Pulse sequence

VEGAPULS radar sensors can achieve this through a special time transformation procedure which spreads out the more than 3.6 million echo images per second into a quasi slow-motion picture, then freezes and processes them.



Time transformation

Hence, it is possible for the radar sensors to process the slow-motion pictures of the sensor environment precisely and in detail in cycles of 0.5 to 1 second without using time-consuming frequency analysis (e.g. FMCW, required by other radar techniques).

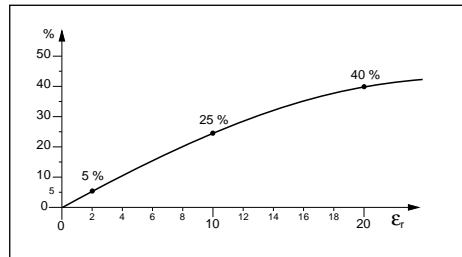
Virtually all products can be measured

Radar signals display physical properties similar to those of visible light. According to the quantum theory, they propagate through empty space. Hence, they are not dependent on a conductive medium (air), and they spread out like light at the speed of light. Radar signals react to two basic electrical properties:

- the electrical conductivity of a substance
- the dielectric constant of a substance.

All products which are electrically conductive reflect radar signals very well. Even slightly conductive products provide a sufficiently strong reflection for a reliable measurement.

All products with a dielectric constant ϵ_r of more than 2.0 reflect radar impulses sufficiently (note: air has a dielectric constant ϵ_r of 1). Signal reflectivity grows stronger with increasing conductivity or increasing dielectric constant of the product. Hence, virtually all products can be measured.



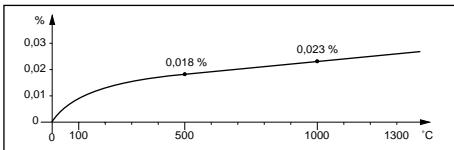
Reflected radar power dependent on the dielectric constant of the measured product

With standard flanges of DN 50 to DN 150, ANSI 2" to ANSI 6" or G 1½ A and 1½" NPT, the sensor antenna systems can be adapted to various products and measuring environments.

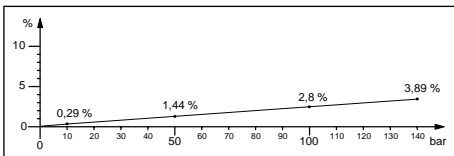
The high-quality materials can also withstand extreme chemical and physical conditions. The sensors deliver stable, reproducible analogue or digital level signals with reliability and precision and have a long useful life.

Continuous and reliable

Unaffected by temperature, pressure and individual gas atmospheres, VEGAPULS radar sensors are used for quick and reliable continuous level measurement of widely varying products.



Temperature influence: Temperature error absolutely zero (e.g. at 500°C 0.018 %)



Pressure influence: Error with pressure increase very low (e.g. at 50 bar 1.44 %)

1.2 Application features

Applications

- level measurement of any liquid
- measurement also in vacuum
- all slightly conductive materials and all substances with a dielectric constant > 2.0 can be measured
- measuring range 0 ... 10 m.

Two-wire technology

- power supply and output signal on one two-wire cable (Loop powered)
- 4 ... 20 mA output signal or HART® output signal.

Rugged and abrasionproof

- non-contact
- high-resistance materials

Exact and reliable

- accuracy 0.05 %.
- resolution 1 mm
- unaffected by noise, vapours, dusts, gas compositions and inert gas stratification
- unaffected by varying density and temperature of the medium
- measurement in pressures up to 3 bar and product temperatures up to 150°C.

Communicative

- integrated measured value display
- optional display module separate from sensor
- adjustment with detachable adjustment module, pluggable in the sensor or in the external display
- adjustment with HART® handheld
- adjustment with the PC.

Approvals

- CENELEC, ATEX, PTB, FM, CSA, ABS, LRS, GL, LR, FCC.

1.3 Adjustment

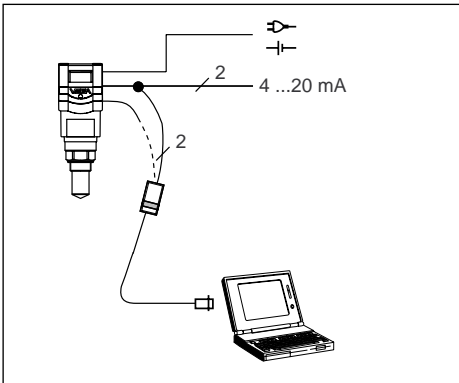
Each measuring situation is unique. For that reason, every radar sensor needs some basic information on the application and the environment, e.g. which level means "empty" and which level "full". Beside this "empty and full adjustment", many other settings and adjustments are possible with VEGAPULS radar sensors.

The adjustment and parameter setting of radar sensors are carried out with

- the PC
- the detachable adjustment module MINI-COM
- the HART® handheld

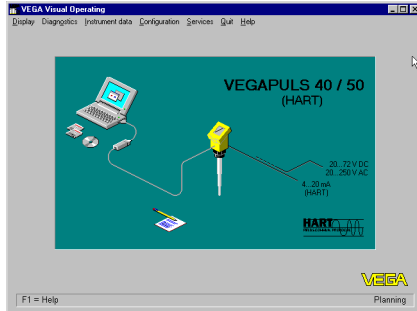
Adjustment with the PC

The setup and adjustment of the radar sensors is generally done on the PC with the adjustment program VEGA Visual Operating (VVO) under Windows®. The program leads quickly through the adjustment and parameter setting by means of pictures, graphics and process visualisations.

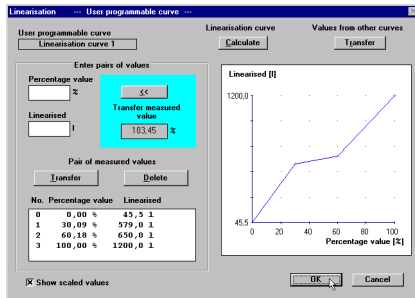


Adjustment with the PC on the analogue 4 ... 20 mA signal and supply cable or directly on the sensor (four-wire sensor)

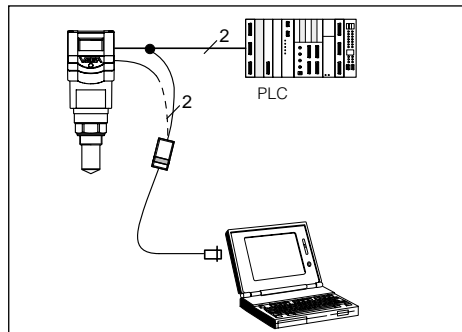
The PC can be connected at any measuring site in the system or directly to the signal cable. It is connected by means of the two-wire PC interface converter VEGACONNECT 3 to the sensor or the signal cable. The adjustment and parameter data can be saved with the adjustment software on the PC and can be protected by passwords. On request, the adjustments can be quickly transferred to other sensors.



The adjustment program recognises the sensor type



Visualised input of a vessel linearisation curve



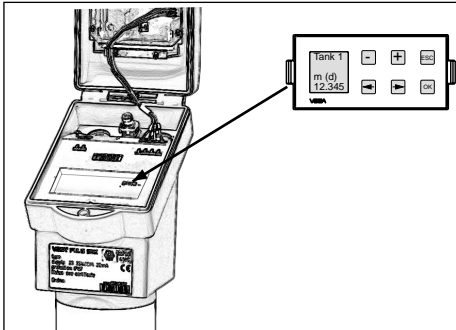
Adjustment with the PC on the 4 ... 20 mA signal and supply cable or directly on the sensor (figure: a two-wire sensor)

Note:

The adjustment program VVO must be available in the version 2.70 or higher.

Adjustment with the adjustment module MINICOM

With the small (3.2 cm x 6.7 cm) 6-key adjustment module with display, the adjustment can be carried out in clear text dialogue. The adjustment module can be plugged into the radar sensor or into the optional, external indicating instrument.

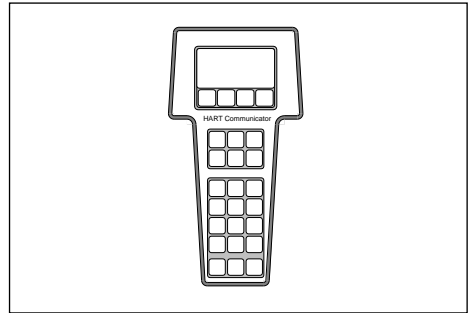


Detachable adjustment module MINICOM

Unauthorised sensor adjustments can be prevented by removing the adjustment module.

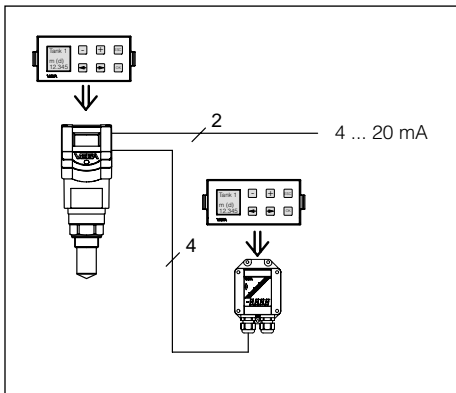
Adjustment with the HART® handheld

Series 40 with 4 ... 20 mA output signal can also be adjusted with the HART® handheld. A special DDD (Data Device Description) is not necessary - the sensors can be adjusted with the HART® standard menus of the handheld.

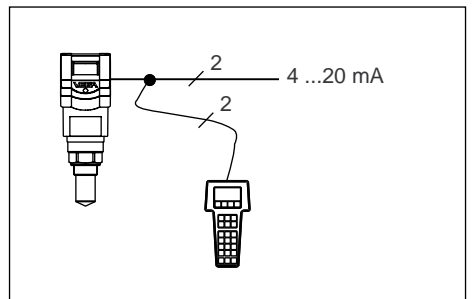


HART® handheld

To make adjustments, simply connect the HART® handheld to the 4 ... 20 mA output signal cable or insert the two communication cables of the HART® handheld into the adjustment jacks on the sensor.



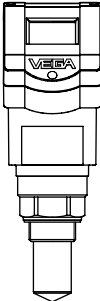
Adjustment with detachable adjustment module. The adjustment module can be plugged into the radar sensor or into the external indicating instrument VEGADIS 50.



HART® handheld on the 4 ... 20 mA signal cable

1.4 Type survey

VEGAPULS 41 sensors are manufactured with process connection G 1½ A or 1½" NPT.



Features

- Application preferably for liquids in storage tanks and process vessels with increased accuracy requirements.
- Measuring range 0 ... 10 m
- Ex approved in Zone 1 (IEC) or Zone 1 (ATEX) classification mark
EEx ia [ia] IIC T6.
- Integrated measured value display.

Survey

Signal output

- active (4 ... 20 mA)
- passive (4 ... 20 mA, loop powered)

Process connection

- G 1½ A, 1½" NPT

Adjustment

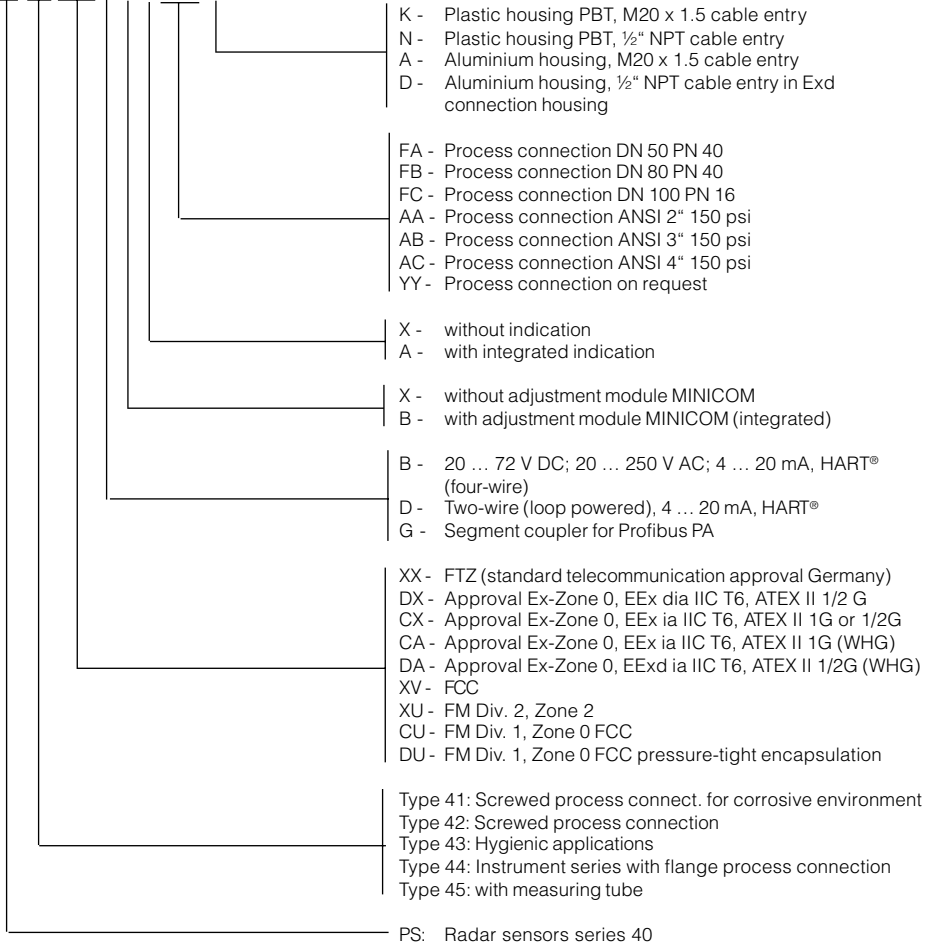
- PC
- adjustment module in the sensor
- adjustment module in the external indicating instrument
- HART® handheld

Measuring range

- 0 ... 10 m
-

Type code

PS 41 .XX X X X XXX X



1.5 Antennas

The antenna is the eye of the radar sensor. An uninitiated observer would probably not realise how carefully the antenna geometry must be adapted to the physical properties of electromagnetic fields. VEGAPULS 41 radar sensors are equipped with a completely encapsulated antenna that can be cleaned as easily as a smooth vessel wall. The previously used horn and rod antennas are gone. Only a small, cone-shaped bulge protrudes into the process vessel. The small cone acts like a lens that focuses the radar signals into a high-frequency beam. The relative dielectric constant of the small 140° PTFE cone represents the calculation index of the lens. The visible part of the antenna at the front of the cone, however, does not give a clue as to how precisely the geometrical form of the antenna has to be adapted to the physical properties of electromagnetic waves. The shape governs the focusing of the waves and hence the sensitivity, much like it governs the sensitivity of a unidirectional microphone. The production of such an electromagnetic lens requires much empirical knowledge in the areas of high-frequency applications and material science.

PTFE is commonly found in hygienic applications. The small plastic cone of the VEGAPULS 41 radar sensor, operating as antenna, consists of a TFM-PTFE material. This is a fluorothermoplast, which has further distinct advantages compared to PTFE, such as, e.g., reduced load deformation, denser polymer structure as well as a smoother surface ($R_a < 0.8 \mu\text{m}$). The other known advantages of PTFE, such as, e.g., high temperature resistance (up to 150°C), high chemical resistance as well as resistance to brittleness and ageing are still there or have even been enhanced. Perfluorelastomere and fluorthermoplaste are resistant to virtually all chemical media such as, e.g., amines, ketones, esters, acids (sulphuric acid, phosphoric acid, hydrochloric acid, nitric acid), alkalis (caustic soda), oxidants, fuels and oils. Beside their use in the chemical industry, these materials are being applied more and more in sterilisation and pharmaceutical technologies. The only limits to these materials are in applications with fluorine under high pressure or with liquid alkali metals (sodium or potassium), where explosive reactions may occur.

2 Mounting and installation

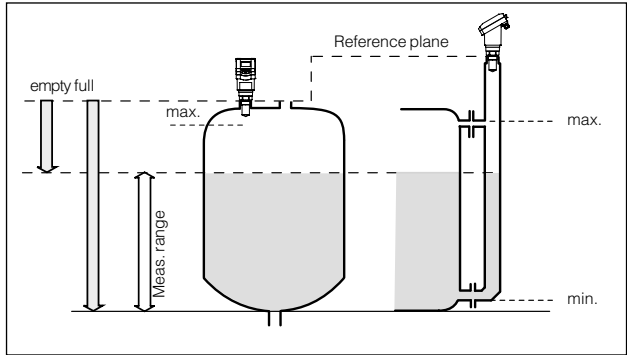
2.1 General installation instructions

Measuring range

The reference plane for the measuring range of the sensor is the lower edge of the flange.

Keep in mind that in measuring environments where the medium can reach the sensor flange, buildup can form on the antenna, possibly causing measurement errors.

Note: The use of series 40 sensors for solids is restricted.

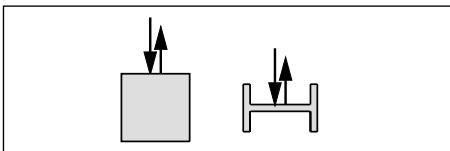


Measuring range (operating range) and max. measuring distance
 Note: Use of the sensors for applications with solids is limited.

False echoes

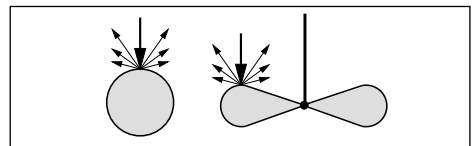
Flat obstructions and struts cause strong false echoes. They reflect the radar signal with high energy density.

Interfering surfaces with rounded profiles scatter the radar signals into the surrounding space more diffusely and thus generate false echoes with a lower energy density. Hence, those reflections are less critical than those from a flat surface.

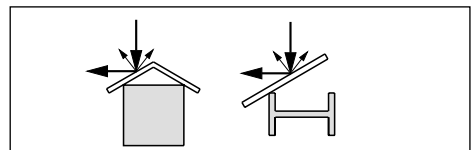


Profile with smooth interfering surfaces cause large false signals

If flat obstructions in the range of the radar signals cannot be avoided, we recommend diverting the interfering signals with a deflector. The deflector prevents the interfering signals from being directly received by the radar sensor. The signals are then so low-energy and diffuse that they can be filtered out by the sensor.



Round profiles diffuse radar signals



A deflector causes signal scattering

Emission cone and false echoes

The radar signals are focused by the antenna system. The signals leave the antenna in a conical path similar to the beam pattern of a spotlight. This emission cone depends on the antenna used.

Any object in this beam cone causes a reflection of the radar signals. Within the first few meters of the beam cone, tubes, struts or other installations can interfere with the measurement. At a distance of 6 m, the false echo of a strut has an amplitude nine times greater than at a distance of 18 m.

At greater distances, the energy of the radar signal distributes itself over a larger area, thus causing weaker echoes from obstructing surfaces. The interfering signals are therefore less critical than those at close range.

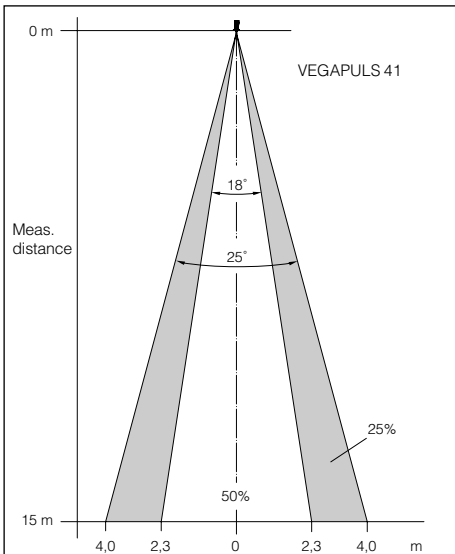
If possible, orient the sensor axis perpendicularly to the product surface and avoid vessel installations (e.g. pipes and struts) within the emission cone.

The illustrations of the emission cones are simplified and represent only the main beam - a number of weaker beams also exist. Under difficult measuring conditions, the alignment of the antenna must be such that the lowest possible false echo values appear. Only giving attention to the size of the useful echo is not adequate when measuring conditions are unfavourable.

In a difficult measuring environment, searching for a mounting location with the lowest possible false echo intensity will bring the best results. In most cases, the useful echo will then be present with sufficient strength. With the adjustment software VVO on the PC, you can have a look at the echo image and optimise the mounting location.

If possible, provide a "clear view" to the product inside the emission cone and avoid vessel installations in the first third of the emission cone.

Optimum measuring conditions exist when the emission cone reaches the measured product perpendicularly and when the emission cone is free from obstructions.

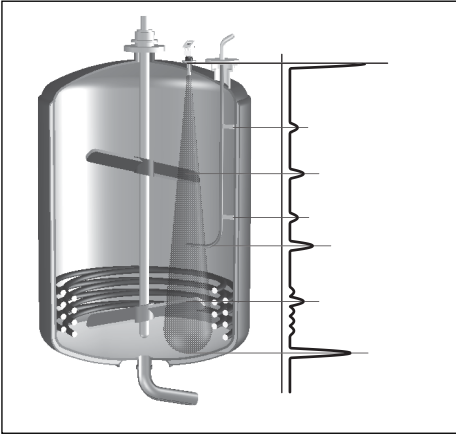


Emission cone of a DN 50 flange antenna

Examples of vessel echoes

The following vessel images show a typical echo pattern in a vessel. This is the example of a process vessel with a slow double-bladed stirrer. In the lower part, the vessel is equipped with heating spirals. A thin, angled inlet tube terminates in the vessel centre between the stirrer blades.

Empty vessel

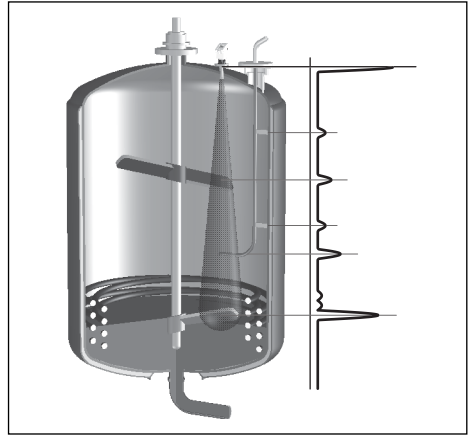


In an empty vessel, you see the echoes of the vessel installations around the emission cone. Beside the large bottom echo, you see a number of additional false echoes. The false echoes of the vessel installations are saved during a false echo recording. For this reason, the false echo recording must be done in an empty vessel.

False echoes from the top down:

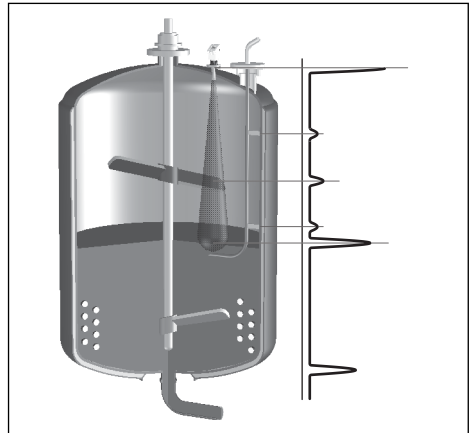
- first inlet tube fastening
- upper stirrer blade
- second inlet tube fastening
- angled inlet tube
- upper heating tubes
- lower stirrer blade
- remaining heating tubes
- vessel bottom

¼ filling



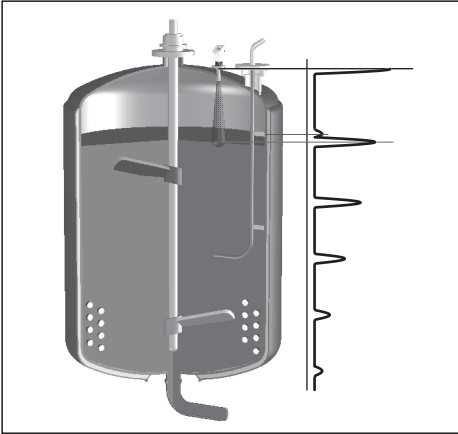
After filling, the bottom echo is replaced by the product echo.

½ filling



The product echo moves to the centre of the meas. range. At the end of the meas. range, you now see an echo at a position where the bottom echo previously was in the empty vessel. This echo is a multiple echo of the product echo and is located at twice the distance of the product echo.

Filled vessel



In a completely filled vessel, you see additional multiple echoes at two, three or four times the distance of the product surface echo.

2.2 Measurement of liquids

Most commonly, the mounting of radar sensors is done on short DIN socket pieces. The lower side of the instrument flange is the reference plane for the measuring range. The socket piece should be as short as possible, max. 70 mm.

When mounting on dished vessel tops, the antenna length should at least correspond to the length of the sockets.

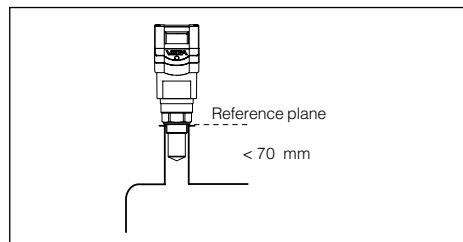
On dished vessel tops, please do not mount the instrument in the centre or close to the vessel wall.

Dished tank tops can act as paraboloidal reflectors. If the radar sensor is placed in the focal point of the parabolic tank, the radar sensor receives amplified false echoes. The radar sensor should be mounted outside the focal point. Parabolically amplified echoes are thereby avoided.

Horn antenna directly on the vessel top

If the stability of the vessel will allow it (sensor weight), flat mounting directly on the vessel top is a good and economical solution. The top side of the vessel is the reference plane.

The screwed antenna is used mainly on very small vessels. The antenna fits into even the smallest vessel connection openings (1½" socket). The socket must not be longer than 70 mm.



Screwed antenna on 1½" threaded socket

2.3 Measurement in standpipe (surge or bypass tube)

General instructions

Pipe antennas are preferred in vessels which contain many installations, e.g. heating tubes, heat exchangers or fast-running stirrers. Measurement is then possible where the product surface is very turbulent, and vessel installations can cause no false echoes.

Due to the concentration of the radar signal within the measuring tube, even products with small dielectric constants ($\epsilon_r = 1.6$ up to 3) can be reliably measured in surge or bypass tubes.

Surge pipes which are open at the bottom must extend over the full measuring range (i.e. down to 0% level), as measurement is only possible within the tube. The tube inner diameter should be max. 100 mm or correspond to the size of the antenna horn.

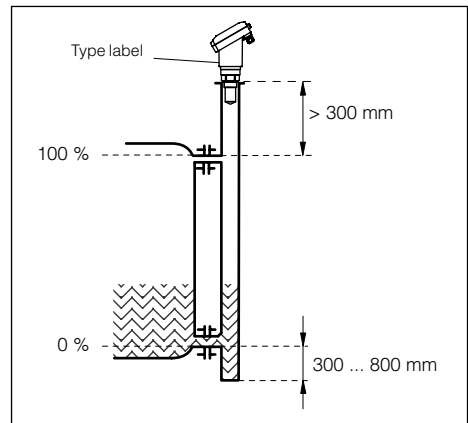
Make sure the required upper vent hole in the surge pipe is aligned with the sensor type label.

As an alternative to a surge pipe in the vessel, a pipe antenna system outside the vessel in a bypass tube is also possible. The surge and bypass tubes must generally be made of metal. For plastic tubes, a closed, conductive jacket is always required. When using a metal tube with plastic inner coating, make sure that the thickness of the coating is minimal (approx. 2 ... 4 mm).

Align the sensor such that the type label lies on one axis with the tube holes or the tube connection openings. The polarisation of the radar signal enables a considerably stabler measurement with this alignment.

When mounting a VEGAPULS 41 sensor on a bypass tube (e.g. on a previous floating or displacer unit), the radar sensor should be placed approx. 300 mm or more from the upper tube connection.

For products with small dielectric constants (< 4), a much longer bypass tube than would otherwise be required by the lower tube connection should be used. Products with small dielectric constants are partly penetrated by the radar signals, allowing the tube bottom to produce a stronger echo than the product (when the bypass tube is nearly empty). By extending the tube downward, some liquid remains at the bottom even when the vessel is completely empty.



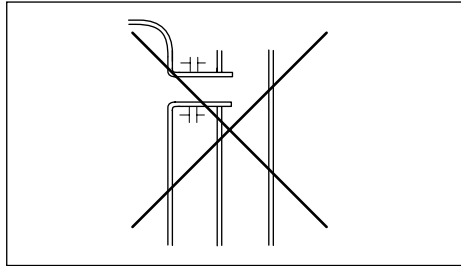
Tube flange system as bypass tube

If enough liquid (300 ... 800 mm) remains in the blind lower end of the tube, the portion of the signal that penetrates the liquid and reflects from the tube bottom is sufficiently damped - the sensor can then easily distinguish it from the echo of the liquid surface. A deflection plate located at the bottom of a vertical pipe has a similar function. It deflects echoes coming from the vessel bottom, thereby separating them from measurement signal echoes.

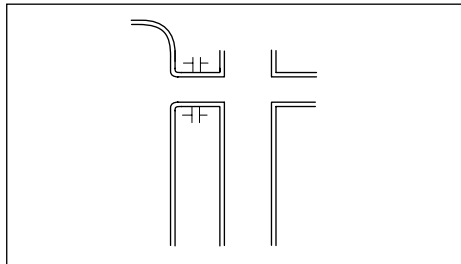
Connections to the bypass tube

The connections to the bypass tubes must be fashioned in such a way that only minimal reflections are caused by the walls of the connecting tubes. This is especially important for the breather connection in the upper part of the tube. Observe the following points:

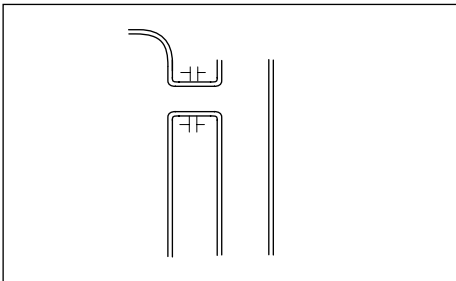
- Use small openings for the connection.
- The diameter of the connecting tubes should not exceed 1/3 of the bypass diameter.
- The tube connections must not protrude into the bypass.
- Large welding beads in the tubes should be avoided.
- Additional connections to the bypass tube are more suitable if they lie on the same plane as the upper and lower vessel connection (superimposed or displaced by 180°).



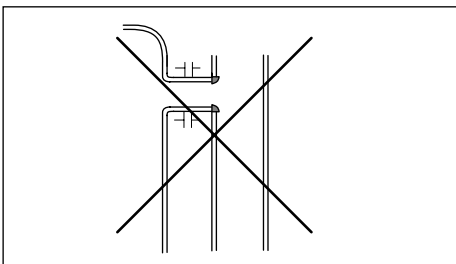
Tube connection protrudes



Additional connection in the bypass tube in one plane



Optimum connection to the bypass tube



Welding beads too large

Use of guide tubes

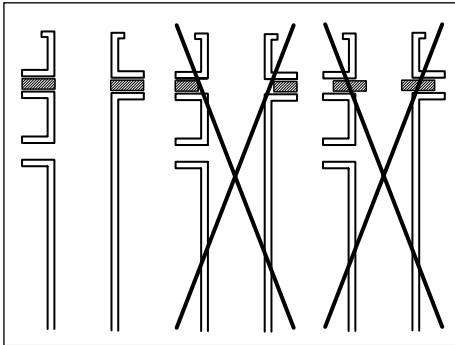
In case of very rough inner surfaces in existing bypass tubes (e.g. due to corrosion), large tube openings as well as bypass tubes with more than 100 mm inner diameter, the use of a guide tube inside the existing bypass tube is recommended. This reduces the noise level and increases reliability considerably. The flange of the guide tube can be easily mounted as a sandwich flange between vessel and sensor flange.

Seals on tube connections and tube extensions

Microwaves are very sensitive to gaps in flange connections. If connections are made without proper care, distinct false echoes as well as increased signal noise can result.

Observe the following points:

- The seal used should correspond to the tube inner diameter.
- If possible, conductive seals such as conductive PTFE or graphite should be used.
- There should be as few seal positions as possible in the guide tube.



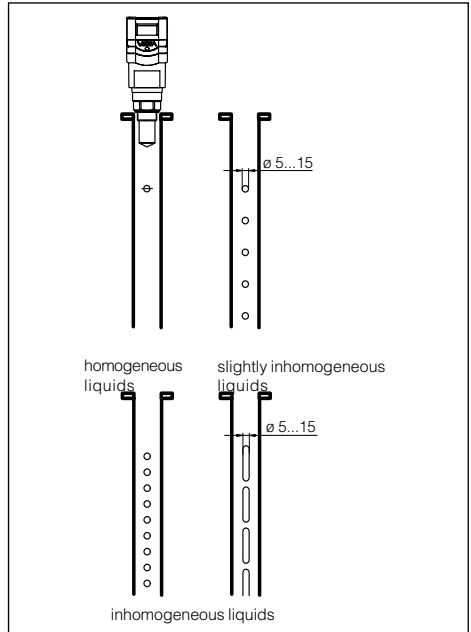
Flange connections on bypass tubes

Adhesive products

In non-adhesive or slightly adhesive products, use a surge pipe with a nominal width of e.g. 50 mm. VEGAPULS 41 radar sensors with 26 GHz technology are for the most part insensitive to buildup in the measuring tube. However, buildup should not block the measuring tube.

For products with stronger buildup, the selection of a DN 80 to max. DN 100 standpipe or surge pipe can make the measurement possible despite buildup. With products that are extremely adhesive, measurement in a standpipe is not possible at all.

Standpipe measurement of inhomogeneous products



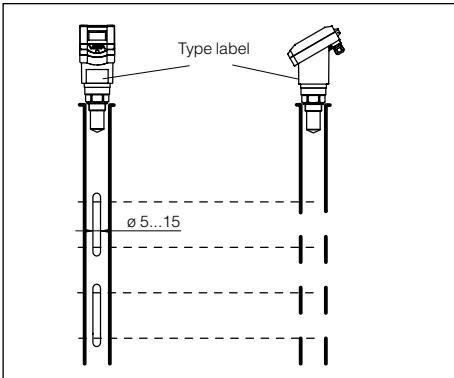
Openings in a surge pipe for mixing of inhomogeneous products

If you want to measure inhomogeneous products or stratified products in a surge pipe, it must have holes, elongated holes or slots. These openings ensure that the liquid is mixed and corresponds to the liquid in the vessel.

The more inhomogeneous the measured product, the closer the openings should be spaced.

Due to radar signal polarisation, the holes or slots must be positioned in two rows offset by 180°. The radar sensor must then be mounted so that the type label of the sensor is aligned with the rows of holes.

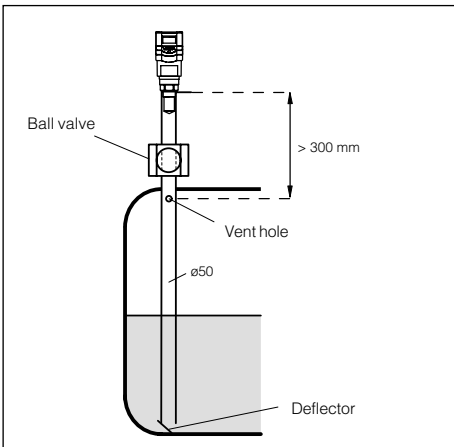
Every wider slot causes a false echo. The slots should therefore not exceed a width of 10 mm in order to keep the signal-to-noise ratio at a minimum. Round slot ends are better than rectangular ones.



Row of holes in one axis with the type label

Surge pipe with ball valve

If a ball valve is mounted in the surge pipe, maintenance and servicing can be carried out without opening the vessel (e.g. if it contains liquid gas or toxic products).



Tube antenna system with ball valve cutoff in measuring tube

A prerequisite for trouble-free operation is a ball valve throat that corresponds to the pipe diameter and provides a flush surface with the pipe inner wall. The valve must not have any rough edges or constrictions in its channel. The distance to the sensor flange should be min. 300 mm.

Guidelines for standpipe construction

The measuring pipe must be smooth inside (average roughness $Rz \leq 30$). Use stainless steel tubing (drawn or welded lengthwise) for construction of the measuring pipe. Extend the measuring pipe to the required length with welding neck flanges or with connecting sleeves. Make sure that no shoulders or projections are created during welding. Before welding, join pipe and flange with their inner surfaces flush and exactly fitting.

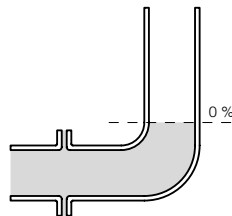
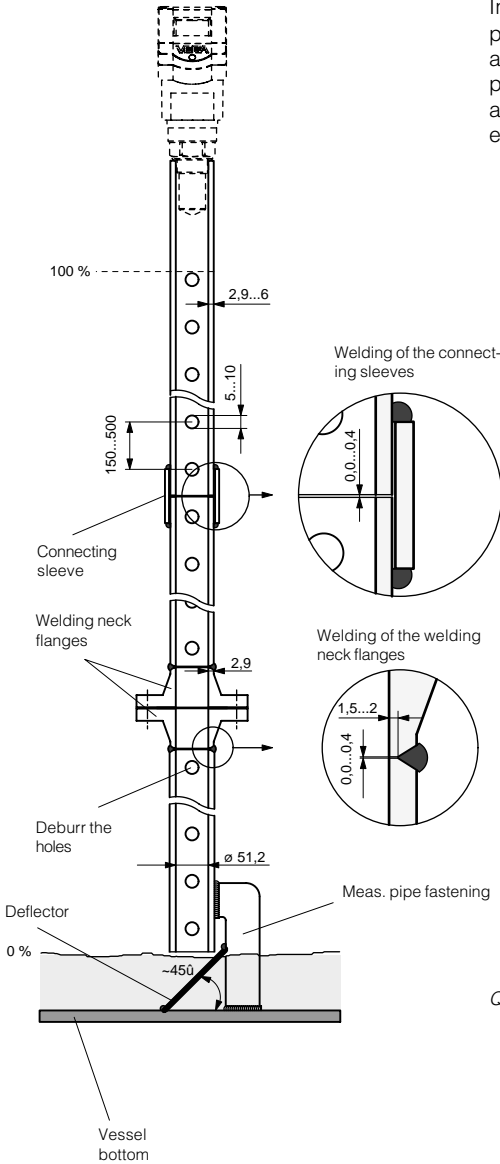
Avoid welding through the pipe wall. The pipe must remain smooth inside. Roughness or welding beads on the inner surfaces must be carefully removed and burnished, as they cause false echoes and encourage product adhesion.

If the vessel contains agitated products, fasten the measuring pipe to the vessel bottom. Provide additional fastenings for longer measuring pipes.

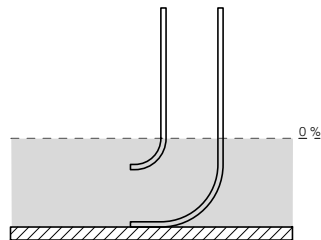
When measuring products with lower dielectric values (< 4), a part of the radar signal penetrates the medium. If the vessel is nearly empty, a stronger signal echo can be caused by the vessel bottom than by the product surface. With a deflector on the measuring pipe end, the radar signals are scattered. This ensures that in nearly empty vessels or with products of low dielectric value, the measured product is detected, not the vessel bottom.

Thanks to the deflector, only the useful signal is received. Thus, in a nearly empty vessel, the measurement value can be clearly detected and the 0 % level reliably outputted.

Instead of a deflector, the standpipe or surge pipe can be equipped with a quadrant pipe at the end. This reflects the radar signals that penetrate the medium diffusely to the side and reduces strong echoes from the tube end or the vessel bottom.



Quadrant pipe on the bypass tube end



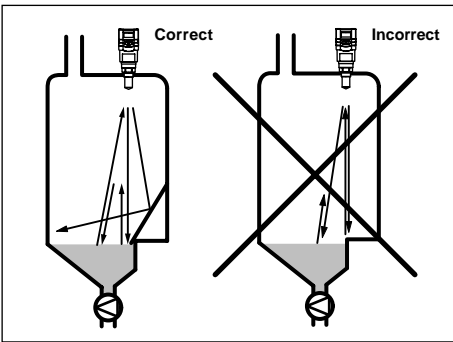
Quadrant pipe on the standpipe end

2.4 False echoes

The installation location of the radar sensor must be selected such that no installations or inflowing material cross the radar impulses. The following examples and instructions show the most frequent measuring problems and how to avoid them.

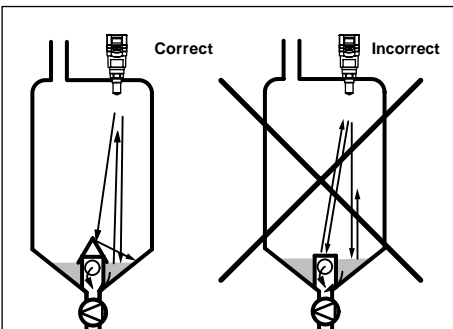
Vessel protrusions

Vessel forms with flat protrusions can, due to their strong false echoes, make measurement very difficult. Shields above these flat protrusions scatter the false echoes and guarantee a reliable measurement.



Vessel protrusions (ledge)

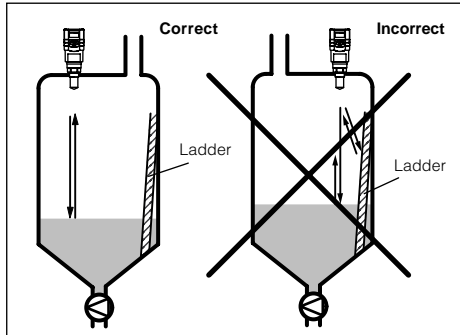
Intake pipes, i.e. for the mixing of materials - with a flat surface directed towards the sensor - should be covered with a sloping shield that will scatter false echoes.



Vessel protrusions (intake pipe)

Vessel installations

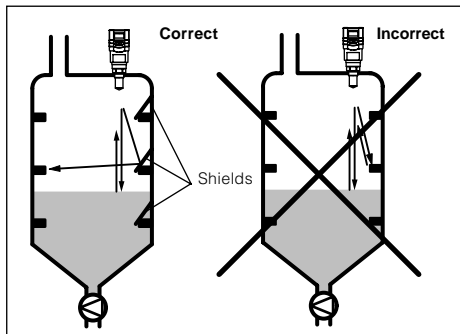
Vessel installations such as, for example, a ladder, often cause false echoes. Make sure when planning your measuring location that the radar signals have free access to the measured product.



Vessel installations

Struts

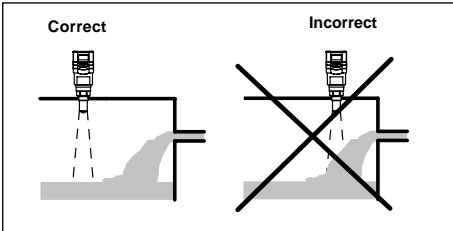
Struts, like other vessel installations, can cause strong false echoes that are superimposed on the useful echoes. Small shields effectively hinder a direct false echo reflection. These false echoes are scattered and diffused in the area and are then filtered out as "echo noise" by the measuring electronics.



Struts

Inflowing material

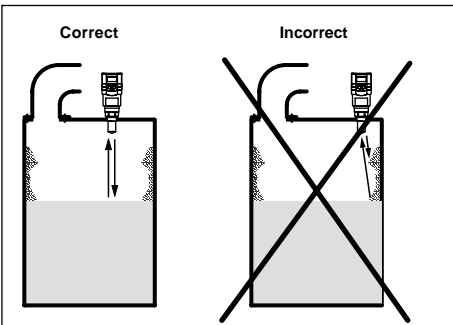
Do not mount the instrument in or above the filling stream. Ensure that you detect the product surface and not the inflowing material.



Inflowing material

Buildup

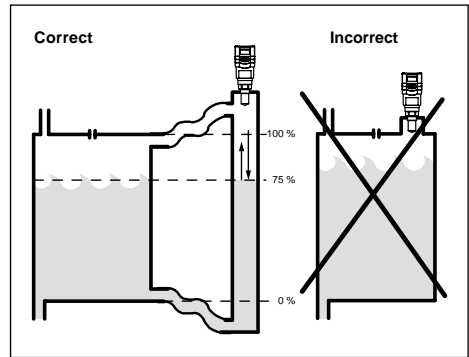
If the sensor is mounted too close to the vessel wall, buildup and adhesions of the measured product to the vessel wall cause false echoes. Position the sensor at a sufficient distance from the vessel wall. Please also note chapter "3.1 General installation instructions".



Buildup

Strong product movements

Strong turbulence in the vessel, e.g. caused by powerful stirrers or strong chemical reactions, can seriously interfere with the measurement. A surge or bypass tube (see illustration) of sufficient size always enables reliable and problem-free measurement even if strong turbulence occurs in the vessel, provided there is no buildup of the product in the tube.

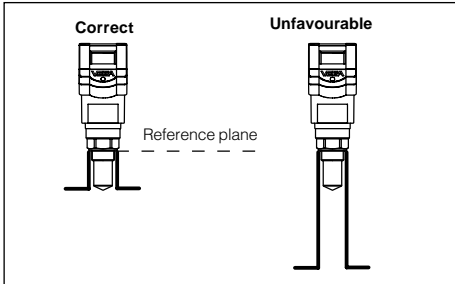


Strong product movements

2.5 Common installation mistakes

Socket piece too long

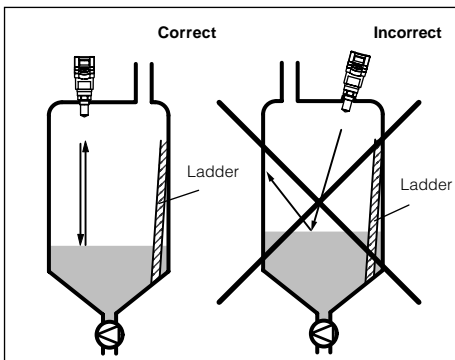
If the sensor is mounted in a socket extension that is too long, strong false echoes arise which interfere with the measurement. Make sure that the horn antenna protrudes out of the socket piece.



Flange antenna: Correct and unfavourable socket length

Wrong orientation to the product

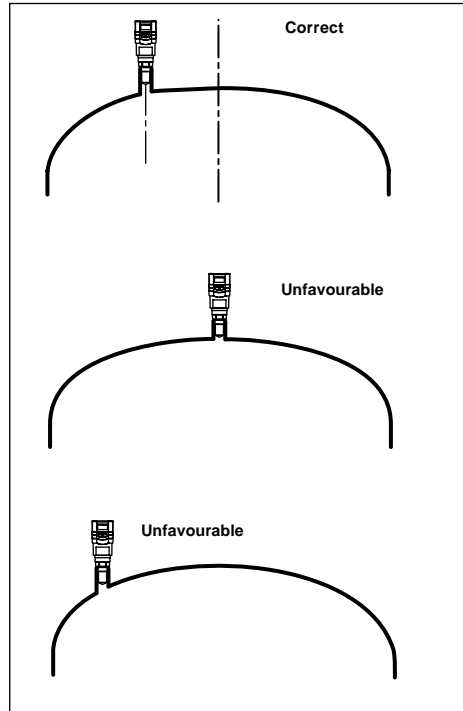
Weak measuring signals are caused if the sensor is not directly pointed at the product surface. Orient the sensor axis perpendicularly to the product surface to achieve optimum measuring results.



Direct sensor vertically to the product surface

Parabolic effects on dished or arched vessel tops

Round or parabolic tank tops act like a parabolic mirror on the radar signals. If the radar sensor is placed at the focal point of such a parabolic tank top, the sensor receives amplified false echoes. The optimum mounting location is generally in the range of half the vessel radius from the centre.



Mounting on a vessel with parabolic tank top

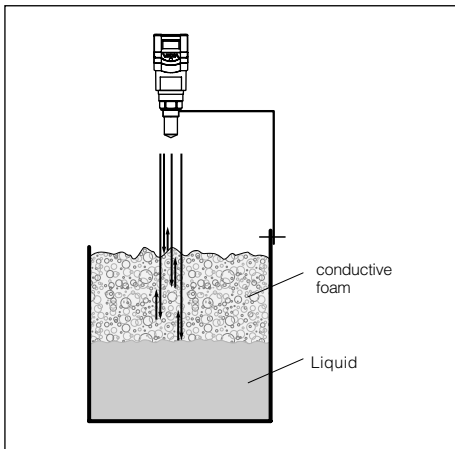
Sensor too close to the vessel wall

If the radar sensor is mounted too close to the vessel wall, strong false echoes can be caused. Buildup, rivets, screws or weld joints superimpose their echoes onto the product i.e. useful echo. Please ensure a sufficient distance from the sensor to the vessel wall.

If there are good reflection conditions (liquids without vessel installations), we recommend locating the sensor where there is no vessel wall within the inner emission cone. For products in less favourable reflection environments, it is a good idea to also keep the outer emission cone free of interfering installations. Note chapter "3.1 General installation instructions".

Foam generation

Conductive foam is penetrated by radar signals to different depths and generates a number of individual (bubble) echoes. In addition, the signals are damped in foam, which is comparable to the damping of heat radiation by Styrofoam. Thick, dense, creamy and conductive foam can cause incorrect measurements.



Foam generation

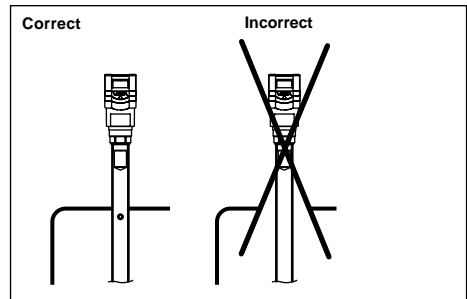
Provide preventative measures against foam or measure in a bypass tube. Check, if necessary, the possibility of using a different measuring technology, e.g. capacitive electrodes or hydrostatic pressure transmitters.

In many cases, VEGAPULS 54 radar sensors with 5.8 GHz operating frequency achieve considerably better and more reliable measuring results in foam applications than series 40 sensors with 26 GHz technology.

Standpipe installation mistakes

Pipe antenna without ventilation hole

Pipe antenna systems must be provided with a ventilation hole on the upper end of the surge pipe. If this hole is absent, incorrect measurements will result.

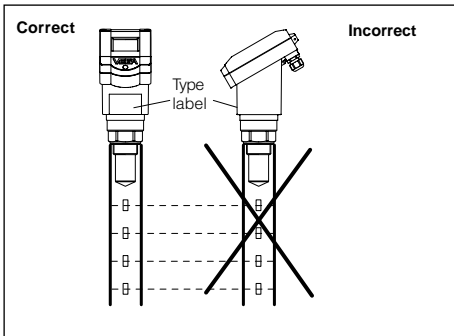


Pipe antenna: The surge pipe open to the bottom must have a ventilation or equalisation hole on top

Wrong polarisation direction

When measuring in a surge pipe, especially if there are holes or slots for mixing in the tube, it is important that the radar sensor is aligned with the rows of holes.

The two rows of holes (displaced by 180°) of the measuring tube must be in one plane with the polarisation direction of the radar signals. The polarisation direction is always in the same plane as the type label.



VEGAPULS on the surge pipe: The sensor type plate must be aligned with the rows of holes.

3 Electrical connection

3.1 Connection and connection cable

Safety information

As a rule, do all connecting work in the complete absence of line voltage. Always switch off the power supply before you carry out connecting work on the radar sensors. Protect yourself and the instruments, especially when using sensors which do not operate with low voltage.

Qualified personnel

Instruments which are not operated with protective low voltage or DC voltage must only be connected by qualified personnel.

Connection cable and screening

A standard two or four-wire cable (sensors with separate supply) with max. 2.5 mm² wire cross-section can be used for connection.

Make sure that the connection cables are specified for the expected application conditions in your systems. The cable must have an outer diameter between 5 and 9 mm (1/2 to 1/3 inch), with NPT threads, 3.6 ... 8.7 mm (0.12 to 0.34 inch) and with threaded PG cable entries, 5 ... 10.5 mm. Otherwise, the seal effect of the cable entry would not be ensured.

Quite often, the "electromagnetic pollution" caused by electronic actuators, energy cables and transmitting stations is so considerable that measures against the effects of electrical and magnetic fields can be necessary. This so-called "electromagnetic pollution" has increased considerably in the last few years, caused e.g. by fast-cycle power supply units and mobile phones, especially in the high-frequency range. VEGAPULS radar sensors take this into account. They are insensitive to electromagnetic pollution.

In critical systems, the signal cables are the source of the problem. The signal cables often act as antennas that pick up interfering signals. The 4 ... 20 mA signal lines are affected by earth equalisation currents and especially by current peaks in the ms or μ s range (more so than digital signal lines). This can be avoided with sophisticated wiring, of which screening at both ends is a major feature.

Circumspect system planning, however, will take into account possible sources of interference from electromagnetic pollution. Due to the complex interrelationships, it may be difficult to decide whether measures against such interference should be taken, and if so, which ones. And in fact, it is extremely difficult to describe in theoretical terms the actual forces at work, since the effects depend greatly on the frequency of the interfering magnetic fields: what is very effective for one frequency can have completely opposite effects for other frequencies.

Experience has shown that even some relatively simple measures can protect the signal current circuits against electromagnetic influence. As one of the more costly measures, screening usually comes at the end of any catalogue of preventive measures (interference suppression).

Wiring instructions

The signal cables should be wired close to the ground potential. Wiring in well-grounded metal cable channels is an effective protection against interference. Obviously, signal cables should not be wired directly together with high-energy cables, but should be separated from them, e.g., with sheet metal strips on the cable channels. Twisted cable (twisted pair) is especially suitable for signal circuits, as it compensates coupled voltage vectors. The distance between the outbound and the return conductor is just as important as the distance to ground when it comes to interference signal reception. For that reason, the distance between the two conductors should be as small as possible. Twisted pair cable meets this requirement. These measures are described by specialists with the expression "wiring close to the structure". To wire the signal cable still "closer to the structure", i.e. even closer to the ground potential, the signal cable can be provided with screening.

Earthing the screen only on one end is not always effective, see the following table. The table gives a simple overview of the effectiveness of the different protective measures against electromagnetic pollution. In practice, earthing of both sides is often useful. This allows the option of earthing only one end later by simply disconnecting the other earth contact points of the screen. Why? Actual interference only appears in the operating environment. Earthing only one end of the screen prevents interference, e.g. in the 100 kHz range, better than earthing both ends, especially if there is insufficient potential equalisation. However, you must make sure that no ground equalisation currents flow through the cable screening. Ground equalisation currents can be avoided by ground potential equalisation systems. When earthing on both ends, it is possible to connect the cable screen on one earth side (e.g. in the switching cabinet) via a Y_C capacitor, e.g. 10 nF; 1500 V to the earth potential. Use a very low-resistance earth connection (foundation, plate or mains earth).

Screening	magnetic fields	low-frequency electrical fields ($l < \frac{\lambda}{7}$) ($f < 1$ MHz)	high-frequency electrical fields ($l > \frac{\lambda}{7}$) ($f > 1$ MHz)	Ground currents and superimposed potential currents
none	-	-	-	-
one end	-	++	-	-
both ends	+	+	++	++

- ++good protection against electromagnetic pollution
- + protection against electromagnetic pollution
- no protection against electromagnetic pollution

Note: λ (Lambda) = $\frac{c}{f}$

c cable length
 c speed of light (300000 km/s)
 f interference frequency
 λ wave length

Example: Interference frequency approx. 100 kHz

$$l < \frac{1}{7} \cdot \frac{c}{f} = \frac{1}{7} \cdot \frac{3 \cdot 10^9 \frac{m}{s}}{100 \cdot 10^3 \frac{1}{s}} = 4285 \text{ m}$$

This means that with an interference frequency of 100 kHz up to a cable length of approx. 4000 m, earthing the screen on only one end provides better protection than earthing on both ends. However, with a cable length of more than 4000 m, earthing on both ends usually produces better results.

Ex protection

If an instrument is used in hazardous areas, the respective regulations, conformity certificates and type approvals for systems in Ex areas must be noted (e.g. DIN 0165).

Intrinsically safe circuits with more than one active instrument (instrument delivering electrical energy) are not allowed. Special installation regulations (DIN 0165) must be noted.

Note!

Due to the possibility of potential transfer, earthing on both ends is prohibited in Ex applications.

Ground terminals

On VEGAPULS 44/45 as well as on VEGAPULS 42 sensors with metal thread, the ground terminal is galvanically connected to the flange or thread.

3.2 Connection of the sensor

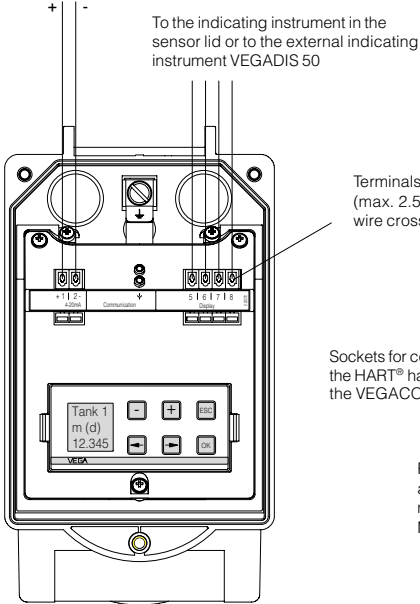
After mounting the sensor at the measurement location according to the instructions in chapter "3 Mounting and installation", loosen the closing screw on top of the sensor. The sensor lid with the optional indication display can then be opened. Unscrew the sleeve nut and slip it over the connection cable (after removing about 10 cm of insulation). The sleeve nut of the cable entry has a self-locking ratchet that prevents it from opening on its own.

Now insert the cable through the cable entry into the sensor. Screw the sleeve nut back onto the cable entry and clamp the stripped wires of the cable into the proper terminal positions.

The terminals hold the wire without a screw. Press the white opening tabs with a small screwdriver and insert the copper core of the connection cable into the terminal opening. Check the hold of the individual wires in the terminals by lightly pulling on them.

Version with plastic housing

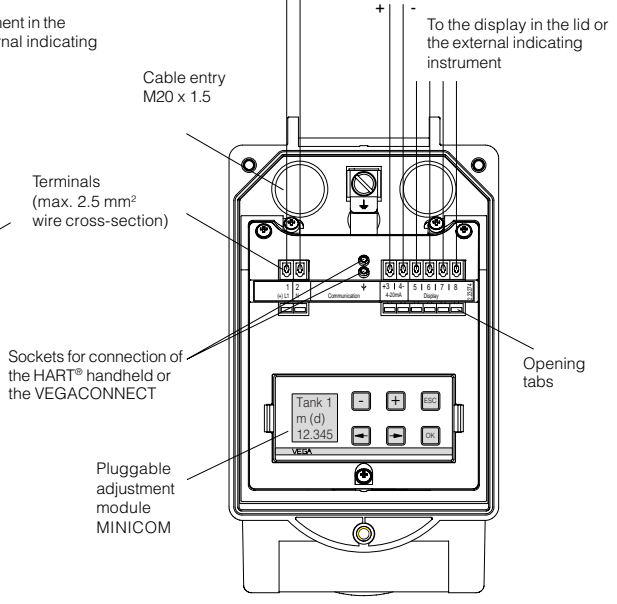
Power supply
4 ... 20 mA (passive)¹⁾



Two-wire technology in plastic housing
(loop powered)

¹⁾ 4 ... 20 mA passive means that the sensor consumes a level-dependent current of 4 ... 20 mA (consumer).

Power supply
4 ... 20 mA (active)²⁾



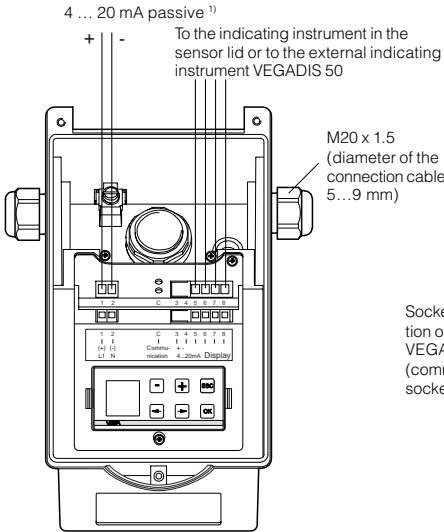
Four-wire technology in plastic housing
(separate supply)

²⁾ 4 ... 20 mA active means that the sensor provides a level-dependent current of 4 ... 20 mA (current source).

Version with aluminium housing

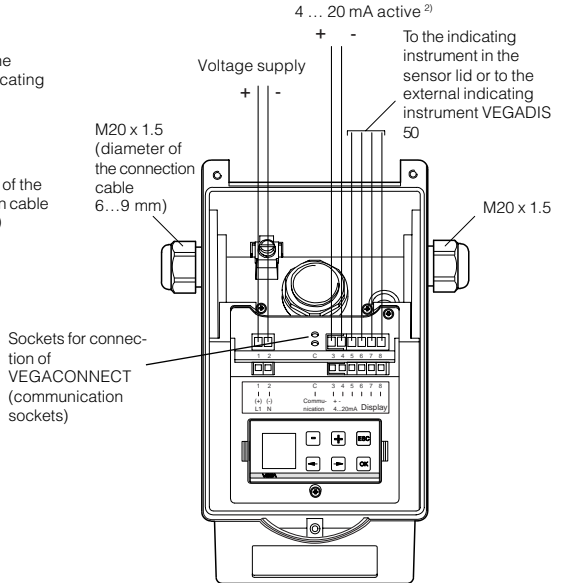
Two-wire technology

(loop powered)



¹⁾ 4 ... 20 mA passive means that the sensor consumes a level-dependent current of 4 ... 20 mA (consumer).

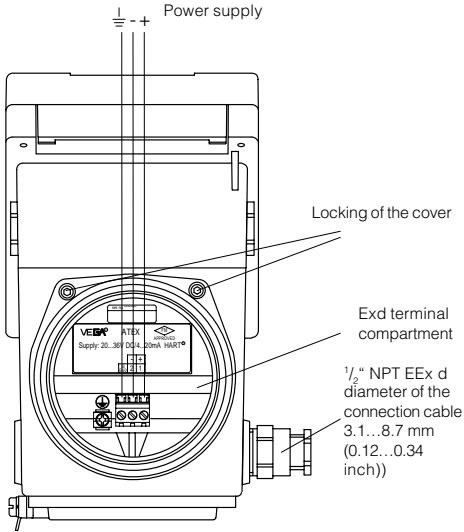
Four-wire technology



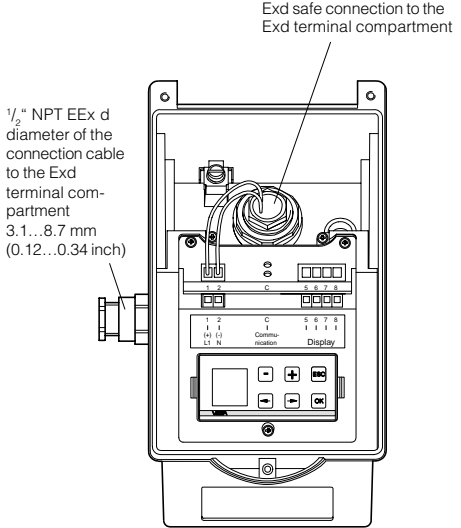
²⁾ 4 ... 20 mA active means that the sensor provides a level-dependent current of 4 ... 20 mA (current source).

Version with aluminium housing and pressure-tight encapsulated terminal compartment

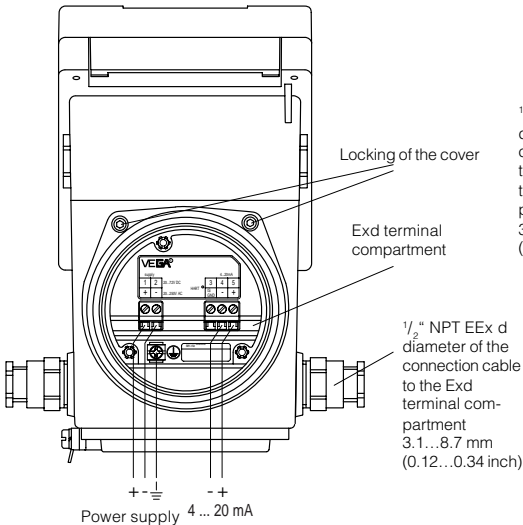
Two-wire EEx d terminal compartment
(opening in Ex atmosphere not allowed)



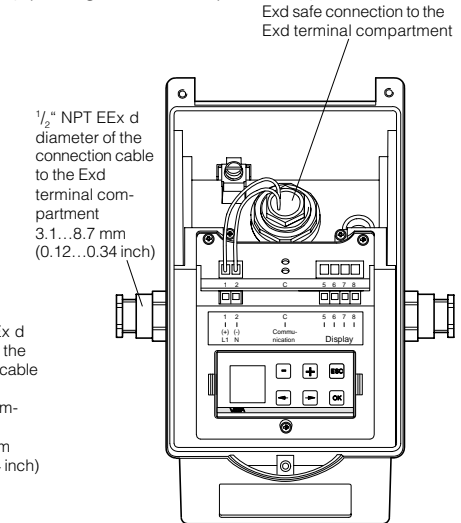
Two-wire adjustment module terminal compartment
(opening in Ex area permitted)



Four-wire EEx d terminal compartment



Four-wire adjustment module terminal compartment
(opening in Ex area permitted)

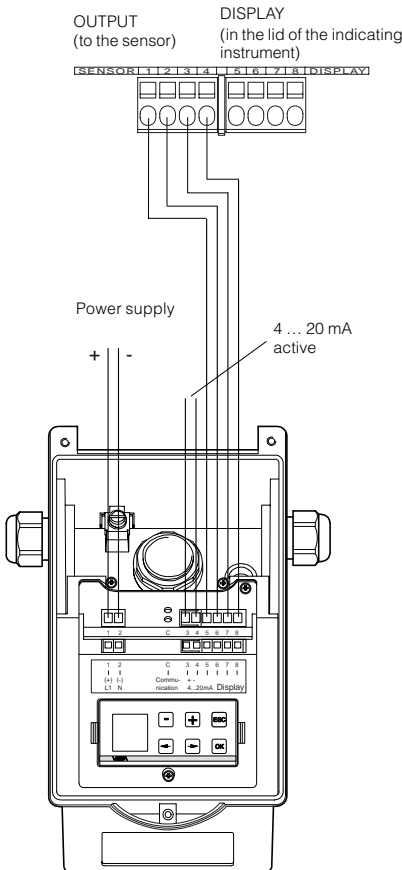


3.3 Connection of the external indicating instrument VEGADIS 50

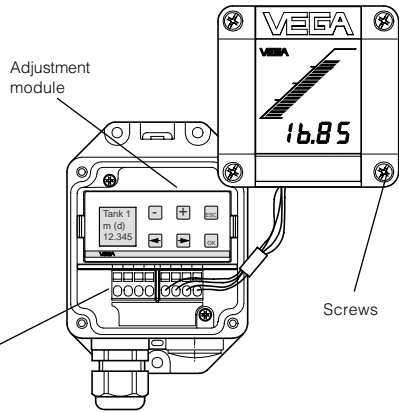
Loosen the four screws of the housing lid on VEGADIS 50.

The connection procedure can be facilitated by fixing the housing cover during connection work with one or two screws on the right of the housing.

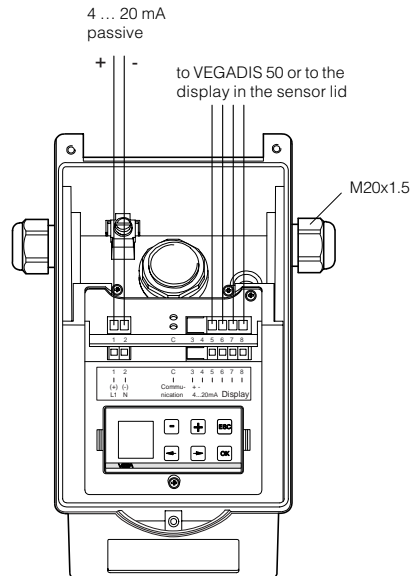
Four-wire sensor in aluminium housing (separate supply)



VEGADIS 50



Two-wire sensor in aluminium housing (loop powered)



3.4 Configuration of measuring systems

A measuring system consists of a sensor with 4 ... 20 mA signal output and a unit that evaluates and further processes the level-proportional current signal.

On the following pages, you will see a number of instrument configurations, designated as "measuring systems", some of which are shown with signal processing units.

Measuring systems in two-wire technology:

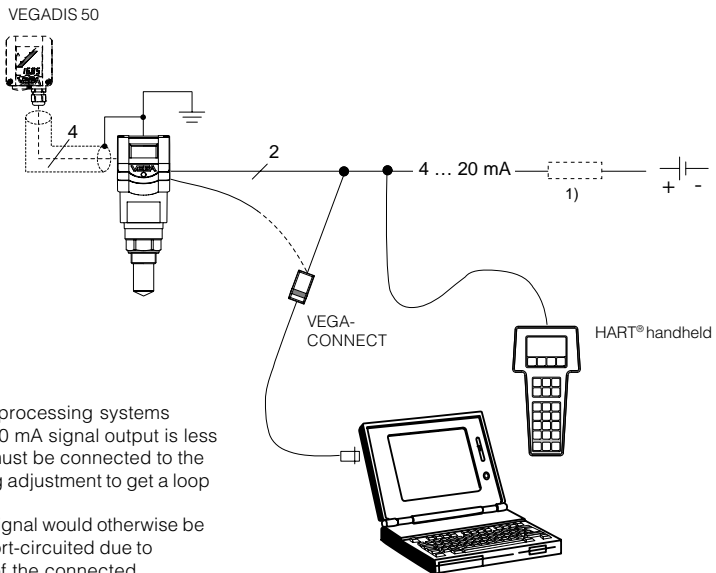
- 4 ... 20 mA shown without processing unit (*bottom*)
- 4 ... 20 mA on active PLC (*page 37*)
- 4 ... 20 mA in Ex area on active PLC (*Ex ia page 39, Ex d page 42*)
- 4 ... 20 mA in Ex area on passive PLC, (*page 40*)
- 4 ... 20 mA in Ex area on indicating instrument VEGADIS 371 Ex (*page 41*)

Measuring systems in four-wire technology:

- 4 ... 20 mA shown without signal conditioning instrument (*non-Ex page 38, Ex d page 42*)

Measuring systems with VEGAPULS 41 connected to any 4 ... 20 mA signal processing unit

- Two-wire technology (loop powered), supply and output signal via one two-wire cable.
- Output signal 4 ... 20 mA (passive).
- Optional external indicating instrument with analogue and digital display (can be mounted up to 25 m away from the sensor).
- Adjustment with PC, HART® handheld or the adjustment module MINICOM (can be plugged into the sensor or into the external indicating instrument VEGADIS 50).

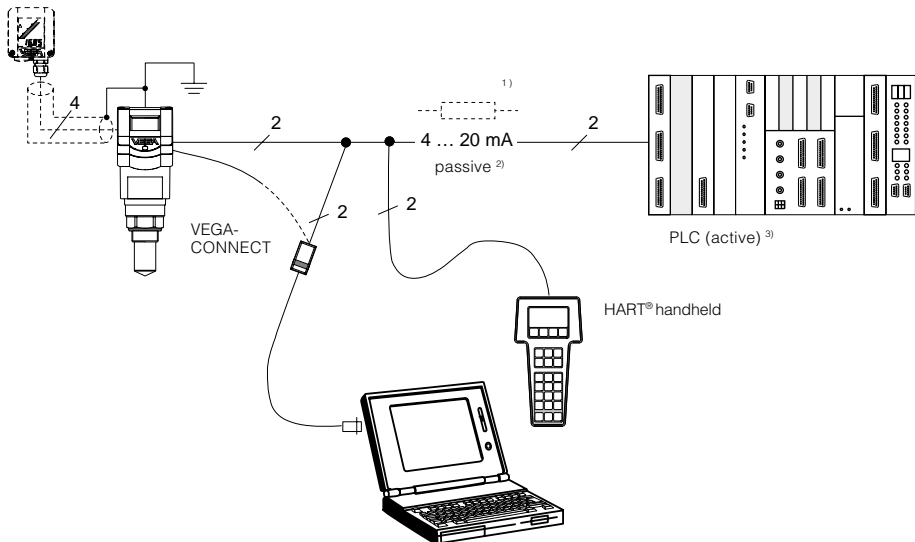


1) If the resistance of the processing systems connected to the 4 ... 20 mA signal output is less than 250 Ω , a resistor must be connected to the connection cable during adjustment to get a loop resistance of 250 Ω . The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient resistance of the connected processing system. Digital communication with the PC would not be ensured.

Measuring system with VEGAPULS 41 on active PLC

- Two-wire technology, power supply from active PLC.
- Output signal 4 ... 20 mA (passive).
- Measured value display integrated in the sensor.
- Optional external indicating instrument (can be mounted up to 25 m away from the sensor in Ex area).
- Adjustment with PC, HART® handheld or the adjustment module MINICOM (can be plugged into the sensor or into the external indication instrument).

VEGADIS 50



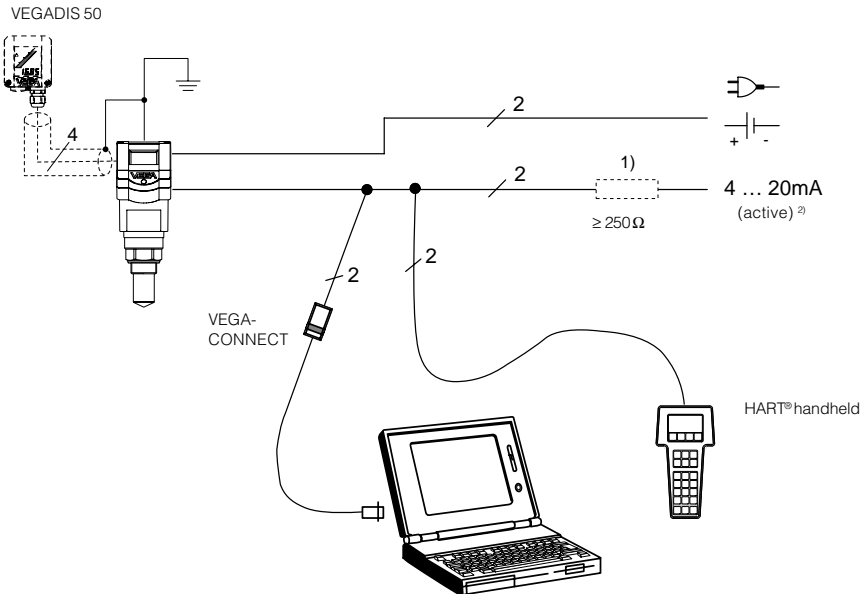
¹⁾ If the resistance of the processing systems connected to the 4 ... 20 mA signal output is less than 250 Ω, a resistor must be connected to the connection cable during adjustment to get a loop resistance of 250 Ω. The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient resistance of the connected processing system. Digital communication with the PC would not be ensured.

²⁾ 4 ... 20 mA passive means that the sensor consumes a level-dependent current of 4 ... 20 mA. The sensor reacts electrically like a varying resistor (consumer) to the PLC.

³⁾ Active means that the PLC powers the passive sensor as voltage source.

Measuring system with VEGAPULS 41 in four-wire technology

- Four-wire technology, power supply and output signal via two separate two-wire cables.
- Output signal 4 ... 20 mA active.
- Optional external indicating instrument with analogue and digital indication (can be mounted up to 25 m away from the sensor).
- Adjustment with PC, HART® handheld or adjustment module MINICOM (can be plugged into the sensor or into the indicating instrument VEGADIS 50).
- max. resistance on the signal output (load) 500 Ω.

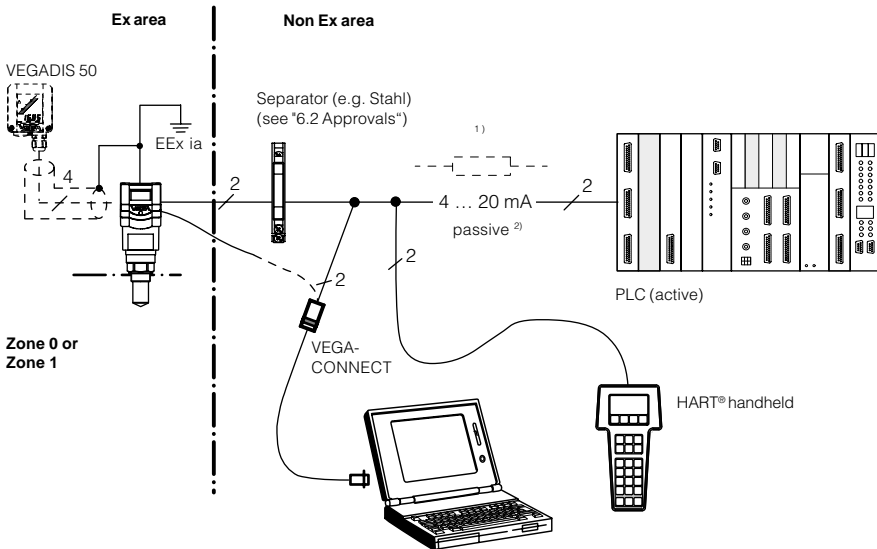


¹⁾ If the resistance of the processing systems connected to the 4 ... 20 mA signal output is less than 250 Ω, a resistor must be connected to the connection cable during adjustment to get a loop resistance of 250 Ω. The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient resistance of the connected processing system. Digital communication with the PC would not be ensured.

²⁾ 4 ... 20 mA active means that the sensor delivers a level-dependent current of 4 ... 20 mA (source). The sensor reacts electrically in the processing system (e.g. indication) like a current source.

Measuring system with VEGAPULS 41 via separator in Ex areas on active PLC (Ex ia)

- Two-wire technology (loop powered), power supply via the signal line of the PLC; output signal 4 ... 20 mA (passive).
- Separator transfers the non intrinsically safe PLC circuit to the intrinsically safe circuit, so that the sensor can be used in Ex zone 1 or Ex zone 0.
- Optional external indicating instrument with analogue and digital display (can be mounted up to 25 m away from the sensor).
- Adjustment with PC, HART® handheld or adjustment module MINICOM (can be plugged into the sensor or into the external indicating instrument VEGADIS 50).

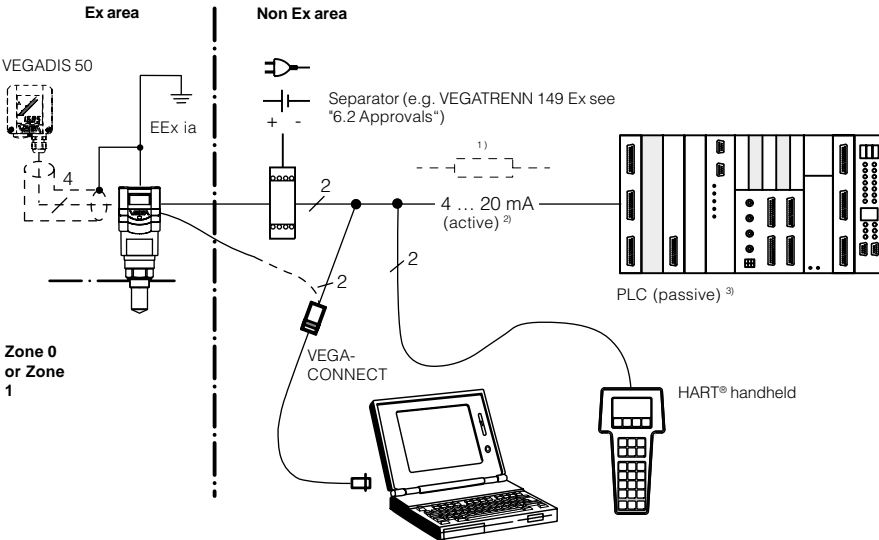


¹⁾ If the resistance of the processing systems connected to the 4 ... 20 mA signal output is less than 250 Ω, a resistor must be connected to the connection cable during adjustment to get a loop resistance of 250 Ω. The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient resistance of the connected processing system. Digital communication with the PC would not be ensured.

²⁾ 4 ... 20 mA passive means that the sensor (top) or the PLC consumes a level-dependent current of 4 ... 20 mA. The PLC reacts electrically like a varying resistor (consumer) to the PLC. The PLC operates actively, i.e. as current or voltage source.

Ex Measuring system with VEGAPULS 41 via separator (Smart-Transmitter) on passive PLC (Ex ia)

- Two-wire technology (loop powered), intrinsically safe ia supply via the signal cable of the separator for operation of the sensor in Ex zone 1 or Ex zone 0.
- Output signal sensor 4 ... 20 mA passive.
- Output signal separator 4 ... 20 mA active
- Optional external indicating instrument with analogue and digital display (can be mounted up to 25 m away from the sensor).
- Adjustment with PC, HART® handheld or adjustment module MINICOM (can be plugged into the sensor or into the external indicating instrument VEGADIS 50).



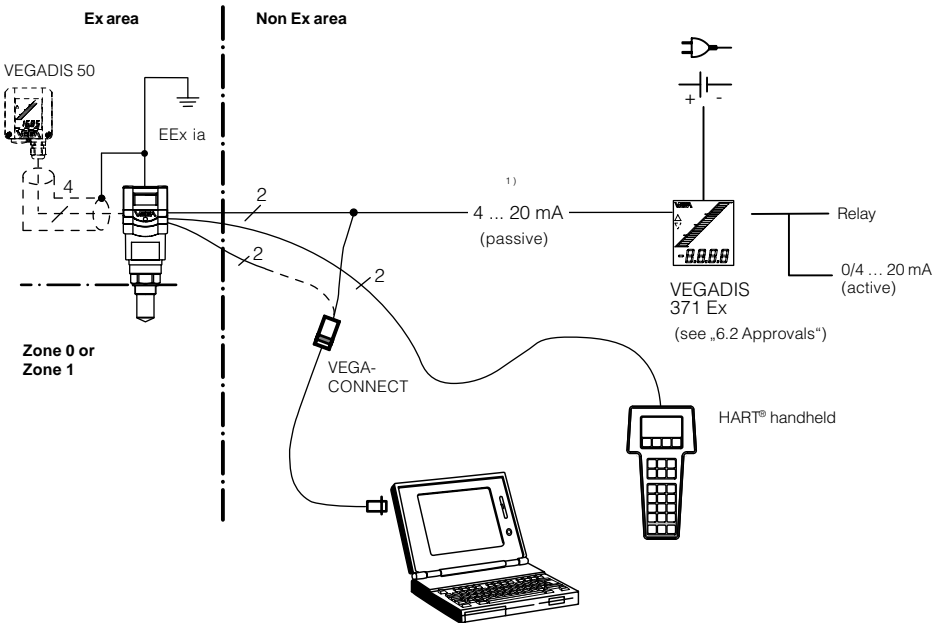
1) If the resistance of the processing systems connected to the 4 ... 20 mA signal output is less than 250 Ω, a resistor must be connected to the connection cable during adjustment to get a loop resistance of 250 Ω. The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient resistance of the connected processing system. Digital communication with the PC would not be ensured.

2) 4 ... 20 mA active means that the separator delivers a level-dependent current of 4 ... 20 mA. The separator reacts electrically to the PLC like a current source.

3) 4 ... 20 mA passive means that the PLC consumes a level-dependent current of 4 ... 20 mA. The PLC reacts electrically like a varying resistor (consumer).

Measuring system with VEGAPULS 41 on VEGADIS 371 Ex indicating instrument with current and relay output (Ex ia)

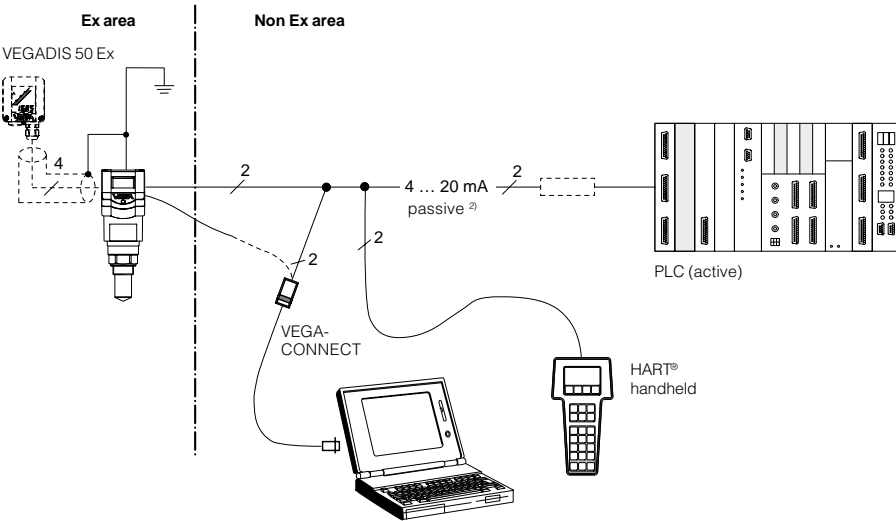
- Two-wire technology (loop powered), intrinsically safe ia supply via the signal cable of the VEGADIS 371 Ex indicating instrument for operation of the sensor in Ex zone 1 or Ex zone 0.
- Optional external indicating instrument with analogue and digital display (can be mounted up to 25 m away from the sensor).
- Adjustment with PC, HART® handheld or adjustment module MINICOM (can be plugged into the sensor or into the external indicating instrument VEGADIS 50).



- ¹⁾ If the resistance of the processing systems connected to the 4 ... 20 mA signal output is less than 250 Ω, a resistor must be connected to the connection cable during adjustment to get a loop resistance of 250 Ω. The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient resistance of the connected processing system. Digital communication with the PC would not be ensured.

Ex **VEGAPULS 41 Ex (loop powered) with pressure-tight encapsulated connection compartment in four-wire technology (Ex d)**

- Two-wire technology, supply and output signal via two separate two-wire cables for operation in Ex-Zone 1 (VEGAPULS ...Ex) or Ex-Zone 0 (VEGAPULS ...Ex0).
- Output signal 4 ... 20 mA (passive).
- Measured value display integrated in the sensor.
- Optional external indicating instrument with analogue and digital display (can be mounted up to 25 m away from the sensor in Ex area).
- Adjustment with PC, HART® handheld or adjustment module MINICOM (can be plugged into the sensor or into the external indicating instrument VEGADIS 50).



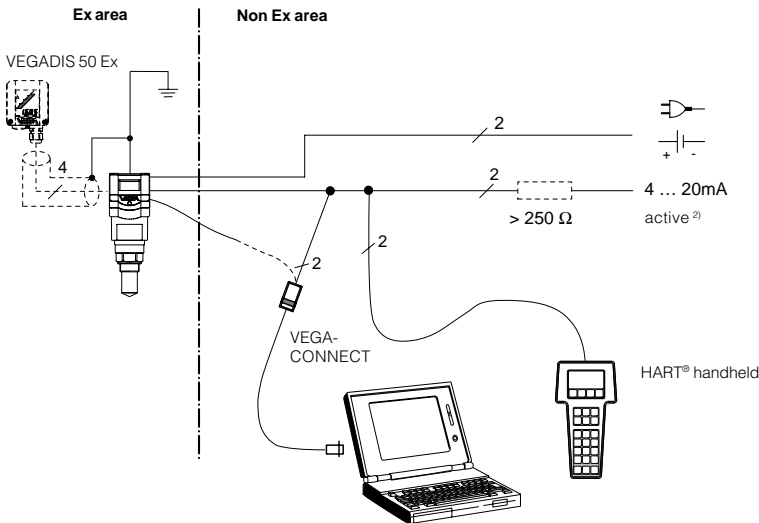
1) If the resistance of the processing systems connected to the 4 ... 20 mA signal output is less than 250 Ω, a resistor must be connected to the connection cable during adjustment to get a loop resistance between 250 Ω. The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient resistance of the connected processing system. Digital communication with the PC or the HART® handheld would not be ensured.

2) 4 ... 20 mA passive means that the sensor consumes a level-dependent current of 4 ... 20 mA. The sensor reacts electrically like a varying resistor (consumer) to the PLC.



VEGAPULS 41 Ex with pressure-tight encapsulated connection compartment in four-wire technology (Ex d)

- Four-wire technology, supply and output signal via two separate two-wire cables for operation in Ex-Zone 1 (VEGAPULS ...Ex) or Ex-Zone 0 (VEGAPULS ...Ex0).
- Output signal 4 ... 20 mA (active).
- Optional external indicating instrument with analogue and digital display (can be mounted up to 25 m away from the sensor in Ex area).
- Adjustment with PC, HART® handheld or adjustment module MINICOM (can be plugged into the sensor or into the external indicating instrument VEGADIS 50).
- Load max. 500 Ω.



¹⁾ If the resistance of the processing systems connected to the 4 ... 20 mA signal output is less than 250 Ω, a resistor must be connected to the connection cable during adjustment to get a loop resistance between 250 Ω. The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient resistance of the connected processing system. Digital communication with the PC or the HART® handheld would not be ensured.

²⁾ 4 ... 20 mA active means that the sensor delivers a level-dependent current of 4 ... 20 mA (source). The measuring signal of the sensor reacts electrically to the processing system (e.g. display) like a current source.

4 Setup

4.1 Adjustment media

- Radar sensors can be adjusted with the
- PC (adjustment program VVO ≥ 2.70)
- detachable adjustment module MINICOM
- HART® handheld.

The adjustment must be carried out with only one adjustment device. If, for example, you attempt to adjust the parameters with the MINICOM and the HART® handheld at the same time, the adjustment will not work.

PC

With the adjustment program VVO (VEGA Visual Operating System) in version ≥ 2.70 on the PC, you can adjust the radar sensors quickly and conveniently. The PC communicates via the interface adapter VEGACONNECT 2 with the sensor. During the process, a digital adjustment signal is superimposed on the signal and supply cable. The adjustment can be carried out directly on the sensor or at any desired location along the signal cable.

Adjustment module MINICOM

With the adjustment module MINICOM, you adjust directly in the sensor or in the external indicating instrument VEGADIS 50. With a dialogue text display and 6 keys, the module offers the same adjustment functionality as the adjustment software VVO.

HART® handheld

VEGAPULS 41 radar sensors, like other HART® protocol compatible instruments, can be adjusted with the HART® handheld. A manufacturer-specific DDD (Data-Device-Description) is not required. The radar sensors are adjusted with the HART® standard menus. All main functions are therefore accessible.

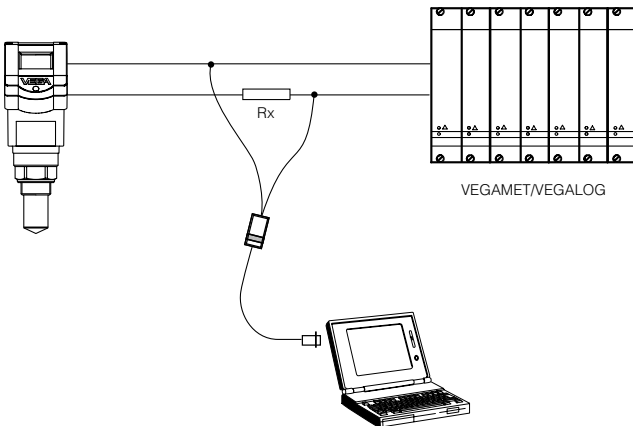
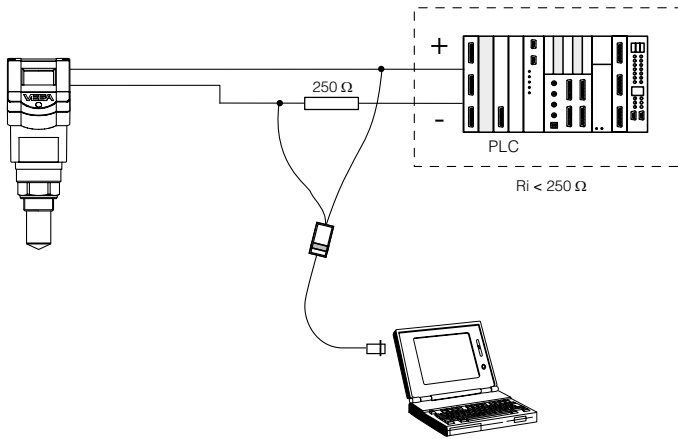
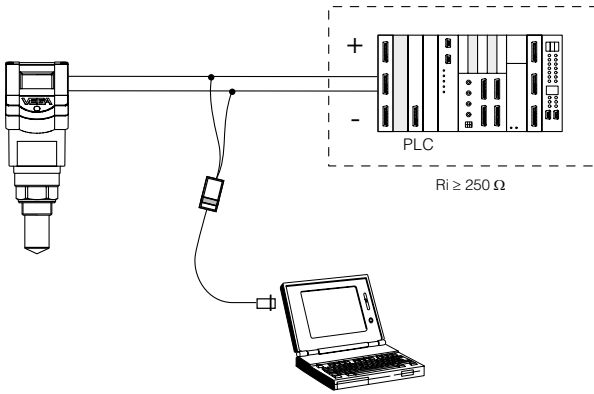
Functions that are rarely used, such as, for example, scaling of the A/D converter for signal output or adjustment with medium, are not possible or are blocked with the HART® handheld. These functions must be carried out with the PC or the MINICOM.

4.2 Adjustment with PC

The adjustment with the PC and the adjustment program VVO is not described in these operating instructions, but in the manual „VEGA Visual Operating (VVO)“. Beside information on the adjustment of the radar sensors, you will also find in that manual further information covering all the adjustment functions possible with the PC.

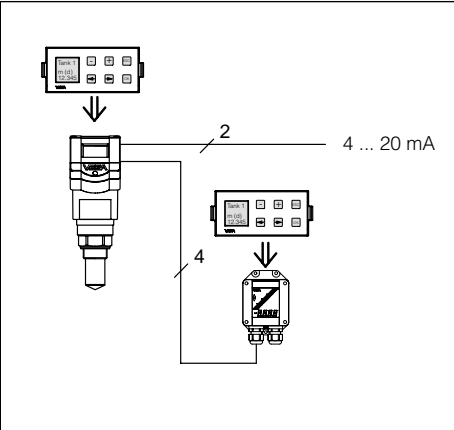
When using a sensor in conjunction with a VEGA signal conditioning instrument, use a communication resistor according to the following schedule:

VEGA signal conditioning instr.	Rx
VEGAMET 513, 514, 515, 602	50 ... 100 Ohm
VEGAMET 614 VEGADIS 371	no additional resistor necessary
VEGAMET 601	200 ... 250 Ohm
VEGASEL 643	150 ... 200 Ohm
VEGAMET 513 S4, 514 S4 515 S4, VEGALOG EA card	100 ... 150 Ohm



4.3 Adjustment with adjustment module MINICOM

Much like with the PC, you can set up and operate the sensor with the small, detachable adjustment module MINICOM. The adjustment module is simply plugged into the sensor or into the external indicating instrument (optional).



The adjustment module, like the adjustment program VVO on the PC, provides adjustment options for all sensor versions. There are some differences with MINICOM, however. It is not possible to enter your own linearisation curve.

You carry out all adjustment steps with the 6 keys of the adjustment module. A small display shows you, apart from the measured value, a short message on the menu item or the value entered in a menu item.

The volume of information of the small display, however, cannot be compared with that of the adjustment program VVO, but you will soon get used to it and be able to carry out your adjustments quickly and efficiently with the small MINICOM.

Error codes:

- E013 No valid measured value
 - Sensor in the warm-up phase
 - Loss of the useful echo
- E017 Adjustment span too small
- E036 Sensor program not operating
 - Sensor must be reprogrammed (service)
 - Fault signal also appears during programming
- E040 Hardware failure, electronics defective

Adjustment steps

On the following pages you will find the complete menu schematic of the adjustment module MINICOM.

Set up the sensor in the numbered sequence:

1. Measuring tube adjustments (only for measurement in a standpipe)
2. Operating range
3. Adjustment
4. Conditioning
5. Meas. conditions
6. False echo storage (only required when errors occur during operation).
7. Indication of the useful and noise level
8. Outputs

Short explanations to the setup steps 1 ... 8 follow.

1. Measurement in a standpipe

Adjustment is only necessary if the sensor is mounted in a standpipe (surge or bypass tube). When measuring in a standpipe, do a sounding of the distance and correct the measured value display (which can differ several percent from the sounded value) according to the sounding. From then on, the sensor corrects running time shift of the radar signal and displays the correct value of the level in the standpipe (measuring tube).

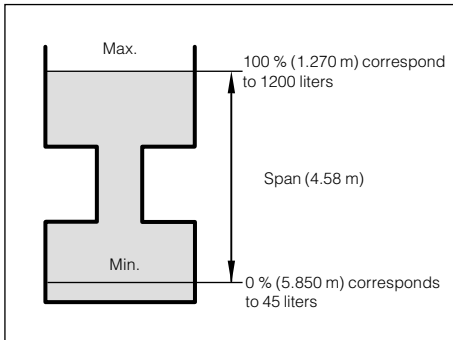
2. Operating range

Without special adjustment, the operating range corresponds to the measuring range. Generally, it is useful to choose a slightly wider range (approx. 5 %) for the operating range than for the measuring range.

Example:

Min./max. adjustment: 1.270 ... 5.850 m;
adjust operating range to approx.
1.000 ... 6.000 m.

3. Adjustment



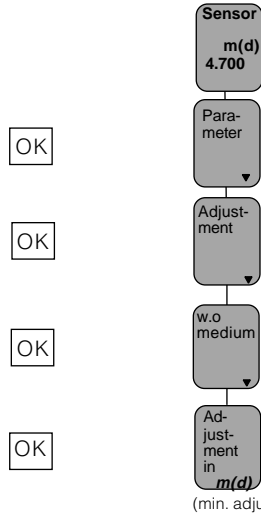
Under the menu item "Adjustment" you inform the sensor of the measuring range it should operate in.

You can carry out the adjustment with or without medium. Generally, you will carry out the adjustment without a filling/emptying cycle.

Adjustment without medium

(adjustment independent of the level)

Key adjustment Display indication



OK

OK

OK

OK

+

OK

→

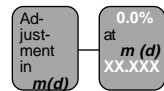
+ or -

OK

(min. adjustment)

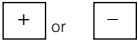
The distance indication flashes and you can choose "feet" and "m".

Confirm the adjustment with "OK".



With "+" and "-" you adjust the percentage value for the min. value (example 0.0 %).

The entered percentage value is written in the sensor and the min. distance value corresponding to that percentage value flashes.



With the "+" or "-" key you can assign a level distance (example 5.85 m) to the previously adjusted percentage value. If you do not know the distance, you have to do a sounding.



The adjusted product distance is written in the sensor and the display stops flashing.

You thereby adjusted the lower product distance as well as the percentage filling value corresponding to the lower product distance.

Note:

For level detection outside the operating range, the operating range must be corrected accordingly in the menu "Sensor optimisation/Operating range".



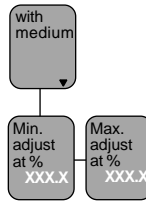
(max. adjustment)

Now you make the max. adjustment (upper product distance) (example: 100 % and 1.270 m product distance). First, enter the percentage value and then the product distance corresponding to that percentage value.

Note:

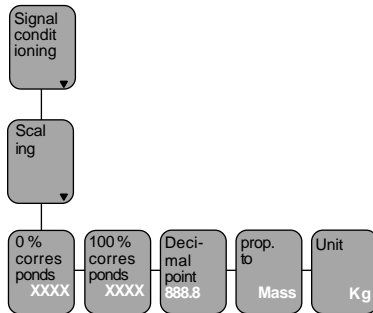
The difference between the adjustment values of the lower product distance and the upper product distance should be as big as possible, preferably at 0 % and 100 %. If the values are very close together, e.g. lower product distance at 40 % (3.102 m) and upper product distance at 45 % (3.331 m), the measurement will be less accurate. A characteristic curve is generated from the two points. Even the smallest deviations between actual product distance and entered product distance will considerably influence the slope of the characteristic curve. If the adjustment points are too close together, small errors inflate to considerably larger ones when the 0 % or the 100 % value is outputted.

Adjustment with medium



Fill the vessel e.g. to 10 % and enter 10 % in the menu "Min. adjust" with the "+" and "-" keys. Then fill the vessel, e.g. to 80 % or 100 % and enter 80 % or 100 % in the menu "Max. adjust" with the "+" and "-" keys.

4. Conditioning



Under the menu item "Conditioning", you assign a product distance at 0 % and at 100 % filling. Then, you enter the parameter and the physical unit as well as the decimal point.

Enter in the menu window "0 % corresponds" the numerical value of the 0 % filling. In the example of the adjustment with the PC and the adjustment software VVO, this would be 45 for 45 liters.

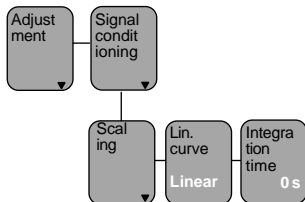
- Confirm with "OK".

With the "→" key you switch to the 100 % menu. Enter here the numerical value of your parameter corresponding to a 100 % filling. In the example 1200 for 1200 liters.

- Confirm with "OK".

If necessary, choose a decimal point. However, note that only max. 4 digits can be displayed. In the menu "*prop. to*" you choose the physical quantity (mass, volume, distance...) and in the menu "*Unit*" the physical unit (kg, l, ft³, gal, m³ ...).

Linearisation:



A linear correlation between the percentage value of the product distance and percentage value of the filling volume has been preset. With the menu "Lin. curve" you can choose between linear, spherical tank and cylindrical tank. The generation of a customized linearisation curve is only possible with the PC and the adjustment program VVO.

5. Meas. conditions

(see menu plan no. 5)

Choose "Liquid" or "Solid" and the options corresponding to your application.

6. False echo storage

A false echo storage is always useful when unavoidable false echo sources (e.g. struts) must be minimised. By creating a false echo storage, you authorise the sensor electronics to record the false echoes and save them in an internal database. The sensor electronics treats these (false) echoes differently from the useful echoes and filters them out.

7. Useful level, noise level

In the menu



you get important information on the signal quality of the product echo. The higher the "S-N" value, the more reliable the measurement (menu plan MINICOM).

Ampl.: means amplitude of the level echo in dB (useful level)

S-N: means Signal-Noise, i.e. the useful level minus the level of the background noise

The bigger the "S-N" value (difference between the amplitudes of the useful signal level and the noise level), the better the measurement:

> 50 dB	Measurement excellent
40 ... 50 dB	Measurement very good
20 ... 40 dB	Measurement good
10 ... 20 dB	Measurement satisfactory
5 ... 10 dB	Measurement sufficient
< 5 dB	Measurement poor

Example:

Ampl. = 68 dB

S-N = 53 dB

68 dB – 53 dB = 15 dB

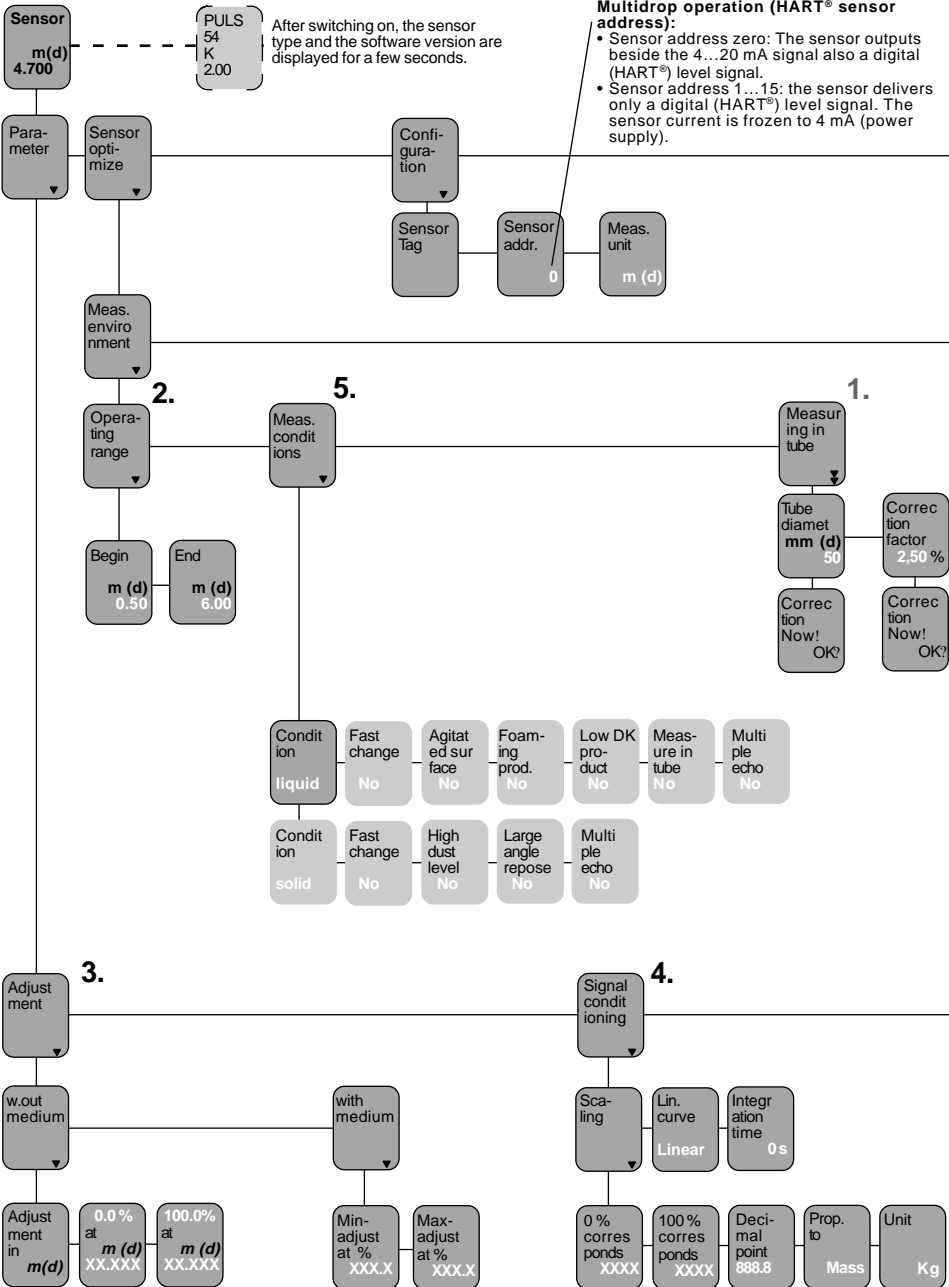
This means that the noise level is only 68 dB – 53 dB = 15 dB.

A 15 dB noise level with a 53 dB higher signal level would ensure a high degree of measurement reliability.

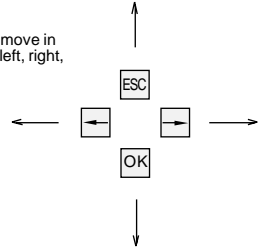
8. Outputs

Under the menu "Outputs" you determine, for example, whether the current output should be inverted, or which unit of measurement should be shown on the sensor display.

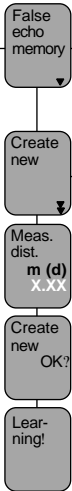
Menu schematic for the adjustment module MINICOM



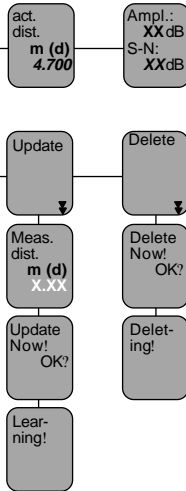
With these keys you move in the menu field to the left, right, top and bottom



6.



7.

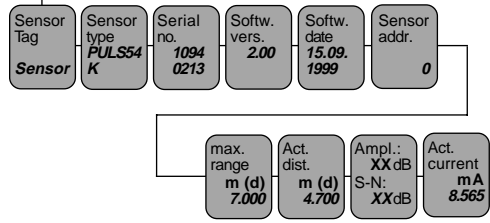


Add'l functions

Info

Reset to de fault
Reset Now!
OK?
Reset ing!

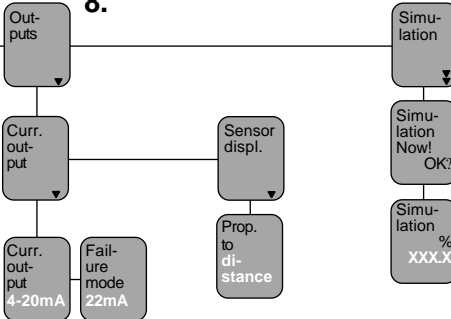
Language English



Simulation:

One hour after the last simulation adjustment, the sensor returns automatically to normal operating mode.

8.



Act. dist. m X,XX
Menu items in bolt print provide sensor and measured value information and cannot be modified in this position.

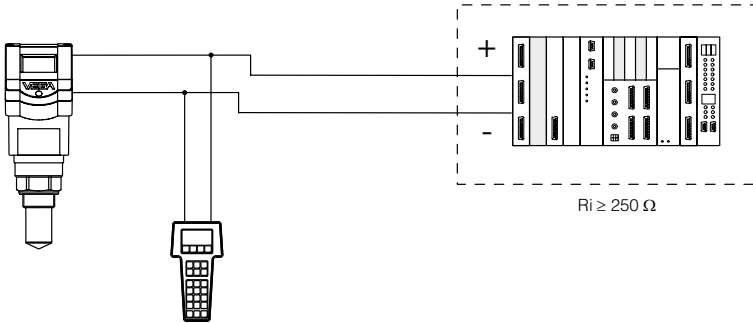
High dust level No
Light grey menu fields are only displayed if required (dependent on the adjustments in other menus).

Fast change Yes
White menu items can be modified with the "+" or "-" key and saved with the "OK" key.

4.4 Adjustment with HART® handheld

With any HART® handheld you can set up the VEGAPULS series 40K radar sensors like all other HART® compatible sensors. A special DDD (Data Device Description) is not necessary.

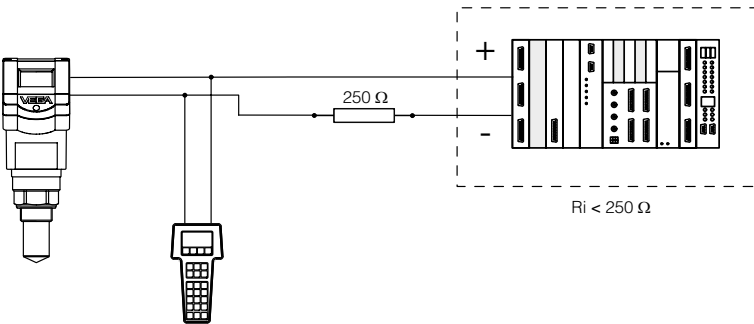
Just connect the HART® handheld to the signal cable, after having connected the sensor to power supply.



Note:

If the resistance of the power supply is less than 250 Ohm, a resistor must be connected into the signal/connection loop during adjustment.

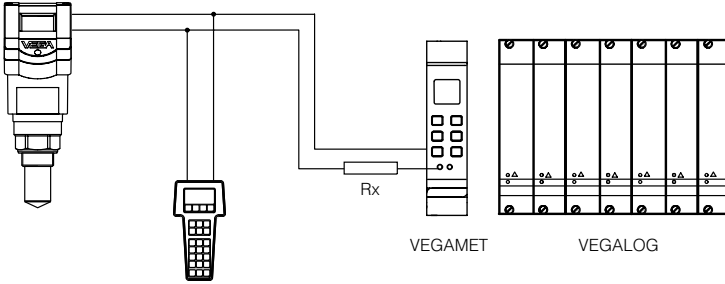
The digital adjustment and communication signals would otherwise be short-circuited due to insufficient resistance of the supply current source or the processing system, and as a result, communication with the sensor would not be ensured.



Connection to a VEGA signal conditioning instrument

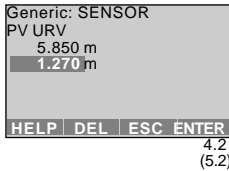
If you operate a HART® compatible sensor on a VEGA signal conditioning instrument, you have to connect the sensor via a resistor (see following table) during HART® adjustment. This resistor, together with the internal resistance of the instruments, provides the value of 250 ohm required for the HART® instrument. An inherent system load resistance allows a corresponding reduction of Rx.

VEGA signal conditioning instr.	Rx
VEGAMET 513, 514, 515, 602	50 ... 100 Ohm
VEGAMET 614 VEGADIS 371	no additional resistor required
VEGAMET 601	200 ... 250 Ohm
VEGASEL 643	150 ... 200 Ohm
VEGAMET 513 S4, 514 S4 515 S4, VEGALOG EA card	100 ... 150 Ohm



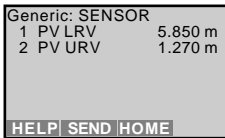
The most important adjustment steps

On the following pages, you will find a menu schematic for the HART® handheld in conjunction with VEGAPULS 42 and 44 sensors. The most important adjustment steps are marked in the menu schematic with the letters A ... E. After entering a parameter, first press the key "ENTER". The adjustment is thereby saved in the handheld, but not in the sensor itself.

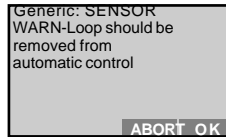


4.2
(5.2)

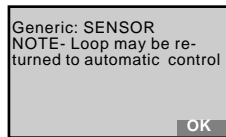
After having pressed "ENTER", press "SEND" (here in the example for min. adjustment).



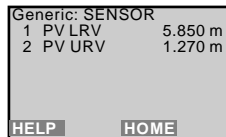
After pressing "SEND", a warning is displayed which informs you that you are about to modify the configuration and that, for safety reasons, you should switch your system over to manual operation.



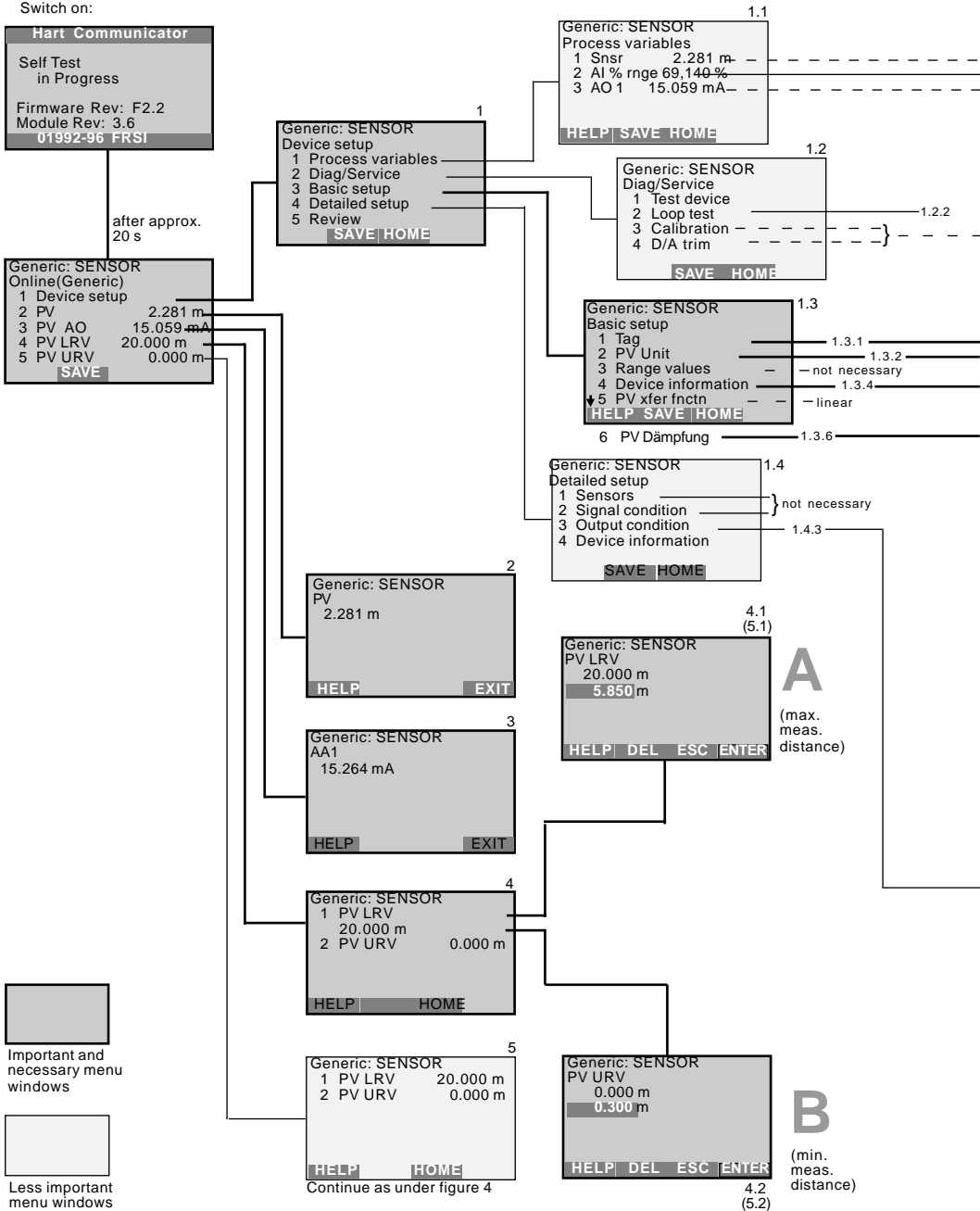
Press "OK" and the adjustment will now be transferred to the sensor. After a short time, you are asked to switch your system over from manual to automatic operation. Confirm with "OK".





You now see the adjustment that was just carried out.



HART® menu schematic



 Important and necessary menu windows

 Less important menu windows

Generic: SENSOR
PV
2.281 m
HELP EXIT

1.1.2
Generic: SENSOR
PV % rng
45.390 %
HELP EXIT

1.1.3
Generic: SENSOR
A01
8.264 mA
HELP EXIT

1.2.2
Generic: SENSOR
Choose analog output level
1 4mA
2 20mA
3 Other
4 End
ABORT ENTER

Individual current values for test purposes (measured value simulation).
See also menu window 1.4.3.1 on the next page

Switch off control

1.3.1
Generic: SENSOR
Tag
SENSOR
SENSOR
HELP DEL ESC ENTER

The following menu windows are not supported by the sensor. Saving of adjustments carried out here is not possible.

The adjustment of actual "empty" or "full" measured values should be carried out in the menu window 4.1 and 4.2. Enter there the meas. distance with empty vessel as zero and the meas. distance with full vessel as end.

1.3.2
Generic: SENSOR
PV Snrs unit
m
m
bbl
in
cm
ESC ENTER

1.3.4
Generic: SENSOR
Device information
1 Distributor ——— 1.3.4.1
2 Model ——— 1.3.4.2
3 Dev id ——— 1.3.4.3 — Sensor serial number
4 Tag ——— 1.3.4.4 — like menu 1.3.1
5 Date 01/01/97 ——— 1.3.4.5
HELP SAVE HOME
6 Write protect None ——— 1.3.4.6
7 Descriptor ——— 1.3.4.7
8 Message ——— 1.3.4.8
9 PV Snrs s/n ——— 1.3.4.9
Final asbly num ——— 1.3.4.10
Revision #'s ——— 1.3.4.11

D → see next page

1.3.6
Generic: SENSOR
PV Damp
0.000 s
0.000 s
HELP DEL ESC ENTER

1.4.3
Generic: SENSOR
Output condition
1 Analog output
2 HART output
SAVE HOME

see next page

1.4.3.2
Generic: SENSOR
HART output
1 Poll addr 0
2 Num req preams 0
3 Burst mode
4 Burst option
HELP SAVE HOME

1.4.3.2
Generic: SENSOR
Poll addr
0
0
HELP DEL ESC ENTER

Multidrop operation (sensor address):

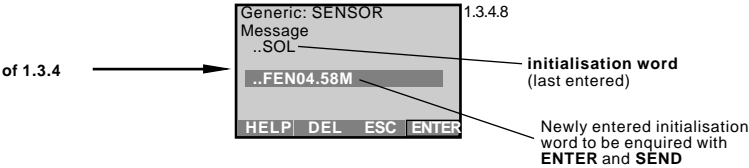
The sensor outputs beside the 4 ... 20 mA signal also a digital (HART®) level signal:
• Enquiry address zero, the sensor consumes a level dependent 4 ... 20 mA current and delivers a digital (HART®) level signal.
• Enquiry address 1 ... 15, the sensor delivers a digital (HART®) level signal and the sensor current is frozen to 4 mA (power supply).
The 4 ... 20 mA signal is no longer available.

OFF: Sensor signals measured values only on request
ON: Sensor signals measured values unrequested

Continuation HART® menu schematic

False echo storage
 Normally this menu is only required for process vessels and difficult installation conditions

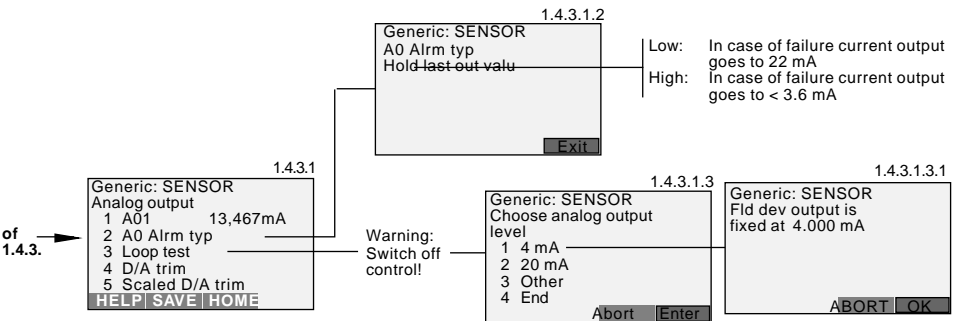
D



available initialisation words:

- ..SOL Meas. conditions solid
- ..LIQ Meas. condition liquid
- ..FED Delete false echo storage
- ..FEN04.58M False echo, e.g. at 4.58 m create new
- ..FEN48.67FT False echo, e.g. at 48.67 ft create new
- ..FEU03.68M Extend false echo storage:
 add a new false echo to the false echo storage at 3.68 m
- ..FEU36.05FT add a new false echo to the false echo storage at 36.05 ft

Note:
 After entering the initialisation word, press "ENTER" and then "SEND".
 Confirm the message to change over to manual operation with "OK" and the message to switch over to automatic operation again with "OK".
 Only then is the adjustment written into the sensor and made active.



5 Diagnosis

5.1 Simulation

To simulate a certain level of filling, you can call up the function "Simulation" in the adjustment module MINICOM, in the software program VVO or in the HART® handheld.

You simulate a vessel filling and thereby a certain sensor current. Please note that connected instruments, such as e.g. a PLC, react according to their adjustments and will probably activate alarms or system functions. One hour after the last simulation adjustment, the sensor returns automatically to standard operating mode.

5.2 Error codes

Display	Meaning	Rectification
E013	No valid measured value - Sensor in the warm-up phase - Loss of the useful echo	Message is displayed during warm-up phase If the message remains, a false echo storage must be made with the adjustment module MINICOM in the menu "sensor optimisation" or better, with the PC and VVO. If the message still remains, carry out a new adjustment.
E017	Adjustment span too small	Carry out a readjustment. Make sure that the difference between min. and max. adjustment is at least 10 mm.
E036	Sensor software does not run	- Sensor must be programmed with new software (service) - Message appears during a software update.
E040	Hardware failure/Electronics defective	Check all connection cables. Contact our service department.

6 Technical data

6.1 Technical data

Power supply

Supply voltage

- four-wire sensor (non Ex and Ex d ia) 24 V DC (20 ... 72 V DC)
230 V AC (20 ... 250 V AC), 50/60 Hz
fuse 0.315 A TR
- two-wire sensor 24 V DC (14 ... 36 V DC)
- two-wire Ex ia sensor 24 V DC (14 ... 29 V DC)
- two-wire Exd ia sensor 24 V DC (20 ... 36 V DC)

Permissible residual ripple of the supply voltage with two-wire sensors

- 0 ... 125 Hz 1 V_{ss}
- 125 Hz ... 500 Hz 1.0 ... 0.01 V_{ss} declining linearly
- 500 Hz ... 10 kHz 0.01 V_{ss}

Current consumption

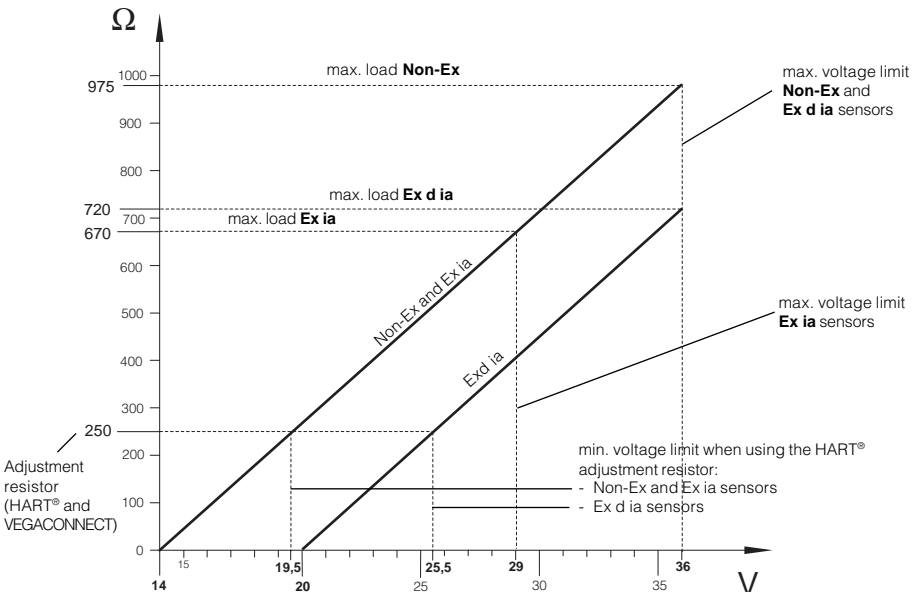
- four-wire sensor max. 130 mA
- two-wire sensor max. 22.5 mA

Power consumption

- four-wire sensor max. 21 W, 7.7 VA
- two-wire sensor 55 ... 810 mW

Load

- four-wire sensor max. 500 Ohm
- two-wire sensor see diagram



Parameter and measuring range ¹⁾

Parameter	distance between product surface and process connection (e.g. lower flange side of the sensor)
Measuring range	0 ... 10 m

Output signal

Signal output	4 ... 20 mA current signal in two-wire or four-wire technology; the HART [®] signal is modulated to the 4 ... 20 mA signal.
---------------	--------------------------------------------------------------------------------------------------------------------------------------

Resistor/Load of the signal cable	
- 4 ... 20 mA two-wire	
Non-Ex:	max 975 Ω
Ex d ia:	max. 720 Ω
Ex ia:	max. 670 Ω
- 4 ... 20 mA four-wire	500 Ω

Integration time	
- analogue 4 ... 20 mA	0 ... 999 seconds

Two-wire technology 4 ... 20 mA:
 The analogue 4 ... 20 mA output signal (measuring signal) is transmitted together with the power supply via one two-wire cable.

Four-wire technology 4 ... 20 mA:
 Separate power supply. The analogue 4 ... 20 mA output signal (measuring signal) is transmitted in a cable separate from power supply.

Measured value display (optional)

Liquid crystal indication	
- in the sensor	scalable output of measured values as graph and number
- in the external instrument powered by the sensor	scalable output of measured values as graph and number. The display unit can be mounted up to 25 m away from the sensor.

Adjustment

- PC and adjustment software VEGA Visual Operating
- adjustment module MINICOM
- HART[®] handheld

¹⁾ Min. distance of the antenna to the medium 5 cm

Accuracy ¹⁾

(typical values under reference conditions, all statements relate to the nominal measuring range)

Characteristics	linear
Accuracy (deviation in characteristics incl. linearity, repeatability and hysteresis, determined acc. to the limit point method)	< 0.05 %; max. 2 mm
Average temperature coefficient of the zero signal (temperature error)	0.06 %/10 °K
General resolution	max. 1 mm
Resolution of the output signal	1.6 µA or 0.01 %

Characteristics ¹⁾

(typical values under reference conditions, all statements relate to the nominal measuring range)

Min. span between full and empty	> 10 mm (recommended > 50 mm)
Frequency	26 GHz technology
Intervals	
- two-wire sensor (4 ... 20 mA)	1 s
- two-wire sensor (digital)	0.6 s
- four-wire sensor	0.5 s
Beam angle (at -3 dB)	22°
Adjustment time (response time) ²⁾	> 1 s (dependent on parameter adjustment)
Influence of the process temperature	at 0 bar cannot be measured; at 5 bar 0.004 %/10 °K; at 40 bar 0.03 %/10 °K
Influence of the process pressure	0.0265 %/bar
Adjustment time ²⁾	> 1 s (dependent on parameter adjustment)
Emitted radar power (average)	0.717 µW
Received average emitted power ³⁾	
- distance 1 m	0.4 ... 3.2 nW per cm ² (0.4 ... 3.2 x 10 ⁻⁹ W/cm ²)
- distance 5 m	0.02 ... 0.13 nW per cm ²

¹⁾ Similar to DIN 16 086, reference conditions acc. to IEC 770, e.g. temperature 15 °C ... 35 °C; moisture 45 % ... 75 %; pressure 860 mbar ... 1060 mbar

²⁾ The adjustment time (also actuating time, response time or adjustment period) is the time required by the sensor to output the correct level (with max. 10% deviation) after a sudden level change.

³⁾ Average emitted power (electromagnetic energy) received by a body per cm² directly in front of the antenna. The received emitted power depends on the antenna version and the distance.

Ambient conditions

Vessel pressure	-100 ... 300 kPa (-1 ... 3 bar)
Ambient temperature on the housing	
- 4 ... 20 mA two-wire sensor	-40 °C ... +80 °C
- 4 ... 20 mA four-wire sensor	-40 °C ... +80 °C
- 4 ... 20 mA four-wire sensor Ex d ia	-40 °C ... +60 °C
Process temperature (flange temperature)	-20 °C ... +150 °C (option -40 °C ... +150 °C)
Storage and transport temperature	-60 °C ... +80 °C
Protection	IP 66 and IP 67
Protection class	
- two-wire sensor	II
- four-wire sensor	I
Overvoltage category	III

Ex technical data

For comprehensive data, see attached approval documents (yellow folder)

Intrinsically safe version

- classification ia intrinsically safe in conjunction with a separator or safety barrier
- classification number II 2G EEx ia II T6
- Ex approved Zone 1 (ATEX)
Zone 1 (CENELEC, PTB, IEC)

or

- classification number II 1G EEx ia IIC T6
- Ex-approved Zone 0, Zone 1 (ATEX)
Zone 0, Zone 1 (CENELEC, PTB, IEC)

Pressure-tight encapsulated version

- classification d pressure-tight encapsulated housing (Ex d)
- classification number II 2G EEx d ia IIC T6
- Ex approved Zone 1 (ATEX)
Zone 1 (CENELEC; PTB, IEC)

or

- classification mark II 1/2G EEx d ia IIC T6
- Ex approved Zone 0, Zone 1 (ATEX)
Zone 1 (CENELEC; PTB, IEC)

Permissible ambient temperature on the housing

- T6 -40°C ... +55°C
- T5 -40°C ... +70°C
- T4, T3 -40°C ... +85°C
- T2, T1 -40°C ... +70°C

Permissible ambient temperature on the antenna system when used in Ex areas

- T6 -40°C ... +85°C
- T5 -40°C ... +100°C
- T4 -40°C ... +135°C
- T3 -40°C ... +150°C

WHG approvals

VEGAPULS 41 radar sensors are approved as part of an overfill protection system for stationary vessels storing water-endangering liquids.

Process connections

VEGAPULS 41	thread G 1½ A or 1½" NPT antenna as horn with ø 40 mm
-------------	----------------------------------------------------------

Materials

Housing	PBT (Valox) or Aluminium die casting (GD-AISI 10 Mg)
Connection housing (EExd version)	Aluminium mould casting (GK-AISI 7 Mg)
Process flange	PVDF
Antenna (wetted parts)	TFM-PTFE

Connection cables

Two-wire sensors	power supply and signal via one two-wire cable
Four-wire sensor	power supply and signal separated
Electrical connection	
- cable entry	for Aluminium and plastic housing: one cable entry (four-wire, two cable entries) and spring-loaded terminal connection up to max. 2.5 mm ² wire cross-section
- plug connection	optional for plastic housing: four-pole, polarity reversal-proof screwed plug connection (four-wire, two plug connections)
Cable entry	
- ia terminal compartment	1 ... 2 x M20 x 1.5 (cable ø 5 ... 9 mm) or 1 ... 2 x ½" NPT EEx d (cable ø 3.1 ... 8.7 mm or 0.12 ... 0.34 inch)
- Exd terminal compartment (pressure-tight encapsulated)	1 x ½" NPT EEx d (cable ø 3.1 ... 8.7 mm or 0.12 ... 0.34 inch)
Ground connection	max. 4 mm ²
Intermediate housing between process flange and housing	1.4435

Weights

Weights dependent on housing materials and Ex concepts.	
VEGAPULS 41	2.0 ... 3.1 kg

CE conformity

VEGAPULS series 40 radar sensors meet the protective regulations of EMC (89/336/EWG) and NSR (73/23/EWG). Conformity has been judged acc. to the following standards:

EMC	Emission	EN 61 326: 1997/A1: 1998 (class B)
	Susceptibility	EN 61 326: 1997/A1: 1998
ATEX		EN 50 020: 1994
		EN 50 018: 1994
		EN 50 014: 1997
NSR		EN 61 010 - 1: 1993

6.2 Approvals

When using radar sensors in Ex areas or on ships, the instruments must be suitable and approved for the explosion zones and applications.

The suitability is checked by the approval authorities and is certified in approval documents.

Please note the attached approval documents when using a sensor in Ex area.

Test and approval authorities

VEGAPULS radar sensors are tested and approved by the following monitoring, test and approval authorities:

- **PTB**
(Physikalisch Technische Bundesanstalt - Physical Technical Approval Authority)
- **FM**
(Factory Mutual Research)
- **ABS**
(American Bureau of Shipping)
- **LRS**
(Lloyds Register of Shipping)
- **GL**
(German Lloyd)
- **CSA**
(Canadian Standards Association)

Intrinsically safe in Ex environment

Series 40 sensors in EEx ia (intrinsically safe) version require for use in Ex areas special separators or safety barriers. The separators or safety barriers provide intrinsically safe (ia) circuits. Below, a selection of instruments with which series 40 sensors work reliably.

Separator and signal conditioning instrument:

- VEGADIS 371 Ex
- A puissance 3 PROFSI 37-24070A
- VEGAMET 614 Ex
- Apparatebau Hundsbach
AH MS 271-B41EEC 010

Separator:

- VEGATRENN 149 Ex...
- Stahl 9303/15/22/11
- CEAG GHG 124 3111 C1206

Separator, safety barrier:

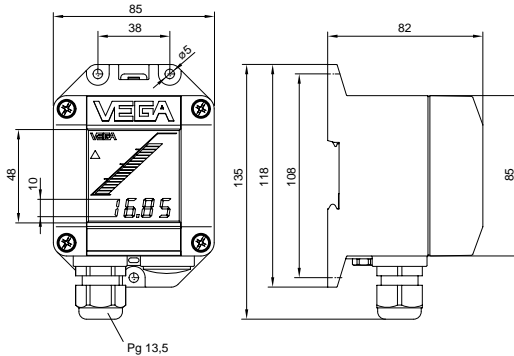
- Stahl 9001/01/280/110/10
- CEAG GHG 11 1 9140 V0728
- Type 9130 (VEGA)
- Stahl 9001/51/280/110/14
- MTL 787 S+
- CEAG CS 3/420-106

Pressure-tight encapsulated in Ex area

Series 40 sensors in EEx d ia (pressure-tight encapsulated) version can be used in Ex areas without special safety barriers due to their pressure-tight encapsulated terminal compartment (provided the appropriate installation regulations are observed).

6.3 Dimensions

External indicating instrument VEGADIS 50

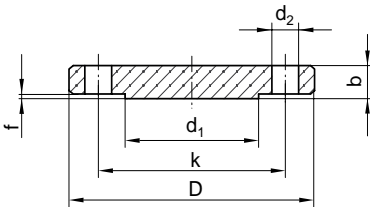


Note:

The cable diameter of the connection cable should be min. 5 mm and max. 9 mm. Otherwise the seal effect of the cable entry would not be ensured.

Mounting on carrier rail 35 x 7.5 acc. to EN 50 022 or flat screwed

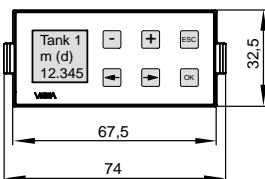
Flange dimensions acc. to ANSI (RF)



- D = outer flange diameter
- b = flange thickness
- k = diameter of hole circle
- d₁ = seal ledge diameter
- f = seal ledge thickness
- ¹/₁₆" = approx. 1.6 mm
- d₂ = diameter of holes

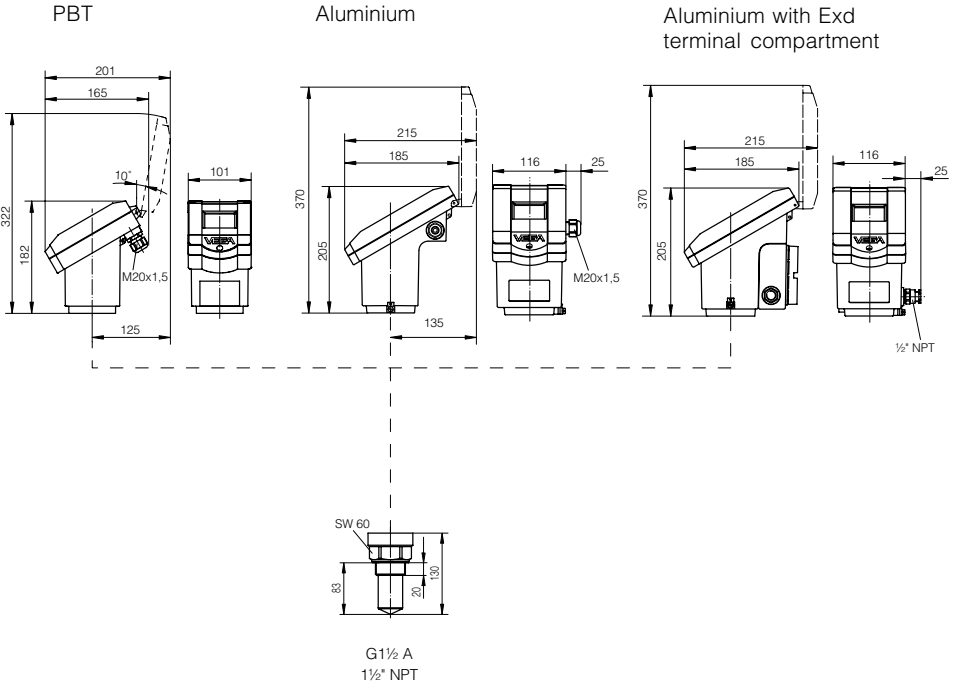
Size	Flange			Seal ledge d ₁	Holes	
	D	b	k		No.	d ₂
2" 150 psi	152.4	20.7	120.7	91.9	4	19.1
3" 150 psi	190.5	25.5	152.4	127.0	4	19.1
4" 150 psi	228.6	25.5	190.5	157.2	8	19.1
6" 150 psi	279.4	27.0	241.3	215.9	8	22.4

Adjustment module MINICOM



Adjustment module for insertion into sensors or into the external indicating instrument VEGADIS 50

Sensor dimensions



HiTECH

Technologies, Inc.

**A TECHNOLOGY FOR
EVERY LEVEL APPLICATION**

***HiTECH* Technologies, Inc.**

301 Oxford Valley Road - Building 505
Yardley, PA 19067-7706

Tel: 215. 321. 6012; Fax: 215. 321. 6067

Tech Support (Toll Free) 866-DrLevel or 888-NIVELCO

Email: info@DrLevel.com or info@hitechtech.com

Web Site: www.DrLevel.com or www.hitechtech.com

