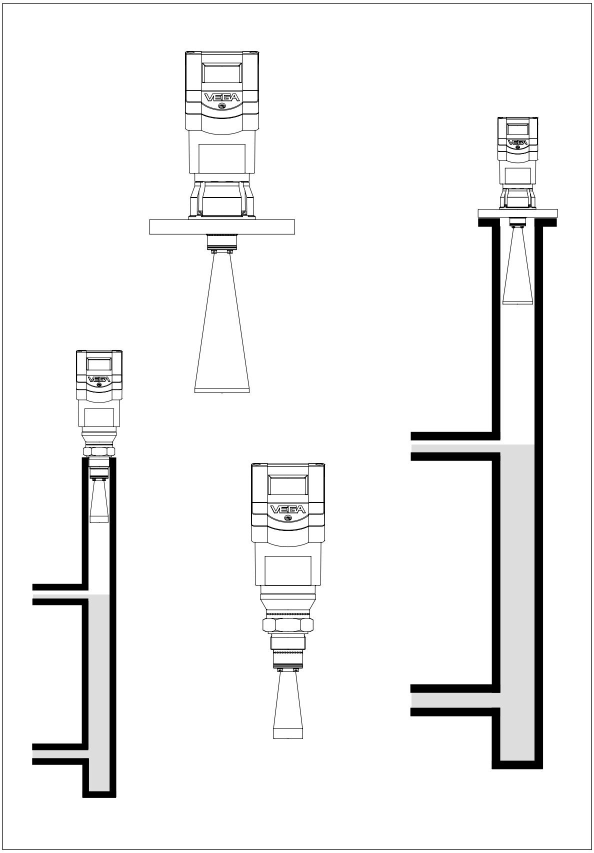
Level and Pressure

Operating Instructions

VEGAPULS 42 and 44

4 … 20 mA; HART® compact sensor



Contents

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 approval documents (yellow binder), and especially the included safety data sheet.

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.

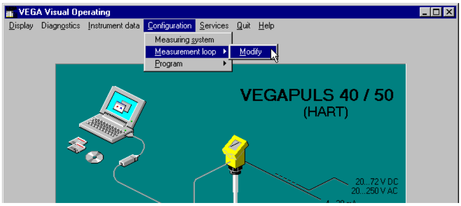
However, it is always useful, especially under difficult measurement conditions (process tanks, stirrers, filling stream, vessel installations), to carry out a sensor optimisation, see chapter "6 Setup".

Quick start with the PC

Configuration

Start the adjustment software VVO ≥2.60 with the user level "*Planning*".

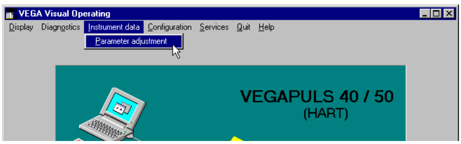
- Click to …



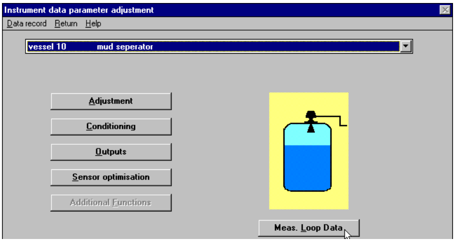
… and enter a name for the measurement loop.
- Choose under "*Application*" e.g. "***Level***".
- Confirm with "*OK*".

Adjustment

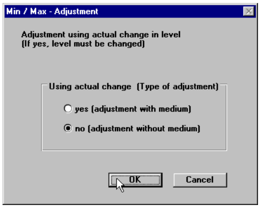
- Click to "***Instrument data/Parameter adjustment***".



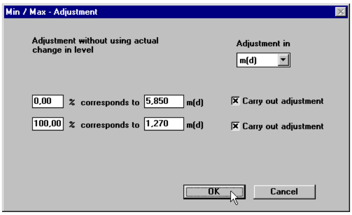
- Then click to "***Adjustment***".



- 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*".

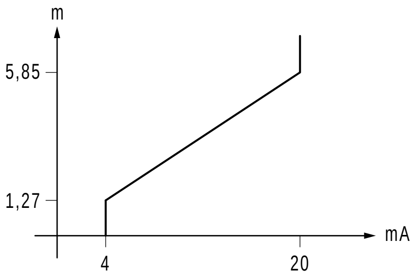


- Enter the distance of the sensor to the product surface at 0 % (empty) and at 100 % (full) in meters.
- Activate the two boxes "***Carry out adjustment***" and click to „*OK*".

You are again in the window "*Adjustment*".

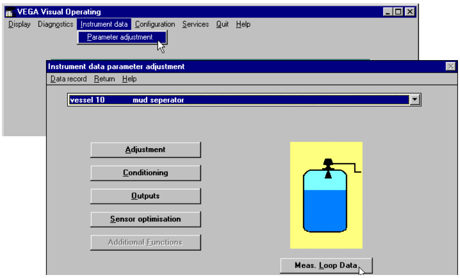
- Click in the window "*Adjustment*" to "***Quit***".

The sensor will now output at the adjusted empty distance 4 mA and at the full distance 20 mA. In the example, the sensor calibrates the span of 5.85 m to 1.27 m
to the signal range of 4 … 20 mA.



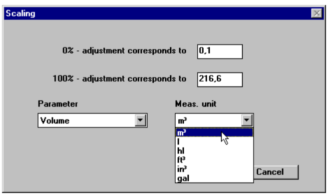
Scaling of the measured value display

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



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

The window ...

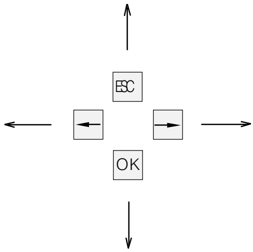


opens.

Allocate in the menu window "*Scaling*" a physical quantity 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 m^3 and at 100 % filling 216.6 m^3 in the vessel. The sensor display then indicates 0.1 m^3 (0 %) for an empty vessel and 216.6 m^3 (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
	Sensor m(d) 4.700
OK	Para- meter
OK	Adjust- ment
OK	w.out medium
OK	Adjust- ment in m(d) (Min. adjustment)
+	The display text flashes and you can choose between "feet" and "m".
OK	Confirm the adjustment with "OK".
→	Adjust- ment in m(d) — 0.0% at m (d) XX.XXX

[+] or [–] Enter 0 %.

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

[+] or [–] Enter the empty distance, e.g. 5.85 m.

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

0.0% at m (d) 5,85

Full adjustment

[→]

100.0% at m (d) XX.XXX

(Max. adjustment)

[+] or [–] Enter 100 %.

[OK] 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.

100.0% at m (d) 1,27

Scaling of measured value display

Key	Display text
	Sensor m(d) 4.700
OK	Parameter
→ OK	Adjustment – Conditioning
OK	Scaling
+ or –	0 % corresponds XXXX

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

Key	Display text
→	0 % corresponds XXXX – 100 % corresponds XXXX

[+] or [–] Enter the figure of the 100 % filling, e.g. 2166 for 216.6 m^3

Key	Display text
→	Decimal point 888.8

[+] or [–] Enter the position of the comma, so that 216.6 is displayed.

Key	Display text
→	prop. to Volume

[+] or [–] Choose the physical unit, e.g. volume.

Key	Display text
→	Unit m^3

[+] or [–] Choose the unit of measurement, e.g. m^3.

1 Product description

VEGAPULS series 40 sensors are a newly developed generation of extremely compact radar sensors for high resolution and accuracy. They are characterised by very good focussing features for applications in narrow spaces. With very modest space requirements, they were developed for measuring distances of 0 … 10 m/20 m and are the right choice for standard applications such as storage vessels, reservoirs and buffer tanks as well as process tanks.

Due to small housing dimensions and process fittings, the compact sensors are an obstrusive, and most of all, very reasonable solution for your level measurement applications. With the 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.

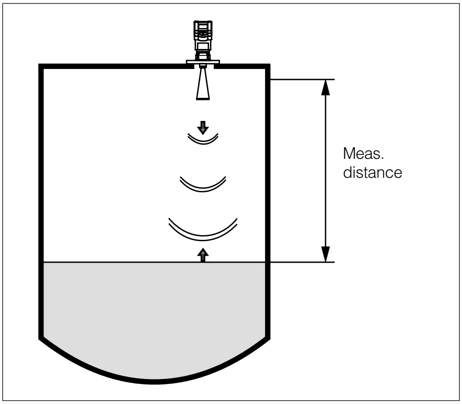
VEGAPULS 40 radar sensors are perfectly suited to two-wire technology. The supply voltage and the output signal are transmitted via one two-wire cable. As output or measuring signal, the instruments produce an analogue 4 … 20 mA output signal.

1.1 Function

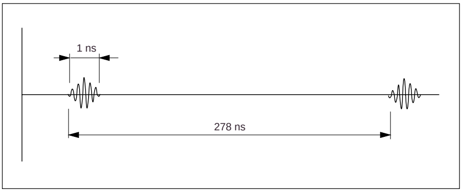
Radio **d**etecting **a**nd **r**anging: Radar. VEGAPULS radar sensors are used for non-contact, continuous distance measurement. The measured distance corresponds to a filling height and is outputted as level.

Measuring principle:

emission – reflection – reception
Tiny 24 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.

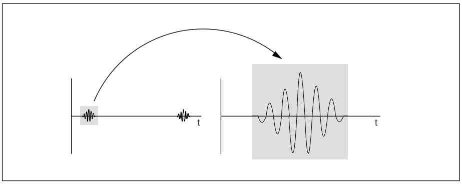


emission - reflection - reception



Pulse sequence

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



Time transformation

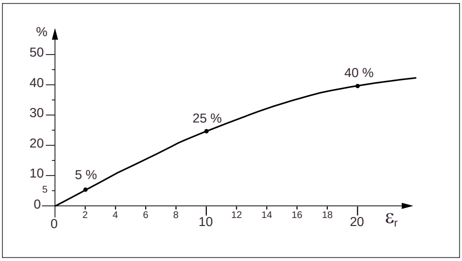
Hence, it is possible for the VEGAPULS 40 radar sensors to process the slow-motion pictures of the sensor environment precisely and in detail in cycles of 0.5 to 1 second without using time-consuming frequency analysis (e.g. FMCW, required by other radar techniques).

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 (as e.g. sound waves in air), and 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.

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 receiver. Signal running periods of less than one billionth of a second must be processed and the echo image must be evaluated in a fraction of a second.



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

All products which are electrically conductive reflect radar signals very well. Even slightly conductive products ensure a sufficient 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).

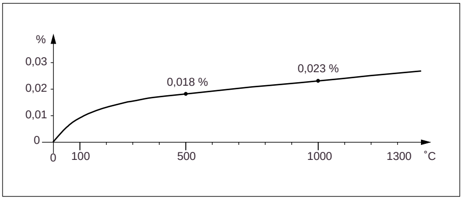
The signal reflection increases with the conductivity or with the dielectric constant of the product. Hence, virtually all products can be measured.

With standard flanges of DN 50 to DN 250, ANSI 2“ to ANSI 10“ or G $1^1/_2$ A and $1^1/_2$“ NPT, the sensor antenna systems can be adapted to the various measured products and measurement environments.

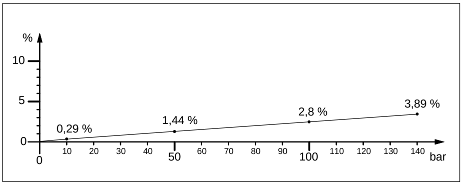
The high-quality materials can also withstand extreme chemical and physical conditions. The sensors deliver a stable, reproducible analogue or digital level signal with reliability and precision, and have a long useful life.

Continuous and reliable

Unaffected by temperature, pressure and individual gas atmospheres, VEGAPULS radar sensors are used for quick and reliable continuous level measurement of various 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 %)

VEGAPULS 40 sensors enable level measurement with radar in facilities where previously, due to high cost, it was completely out of the question.

1.2 Application features

Applications
- level measurement of liquids
- 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 (type 42). measuring range 0 … 20 m (type 44).

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

Rugged and abrasion proof
- 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 40 bar and product temperatures up to 200°C

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

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

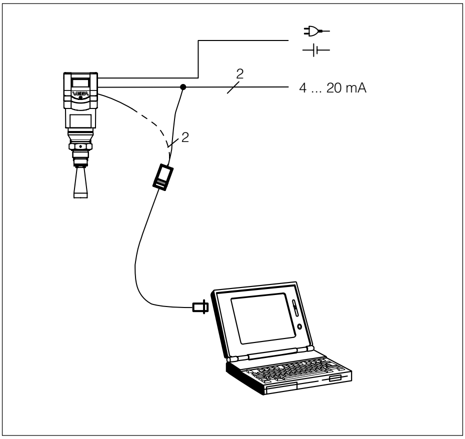
1.3 Adjustment

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

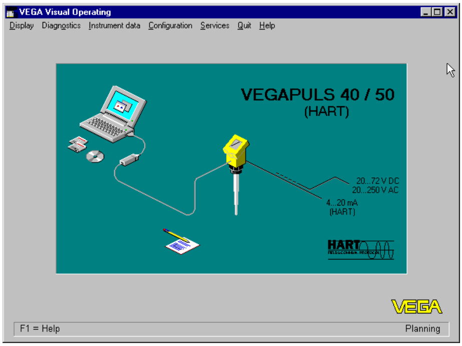
Adjustment with PC

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.

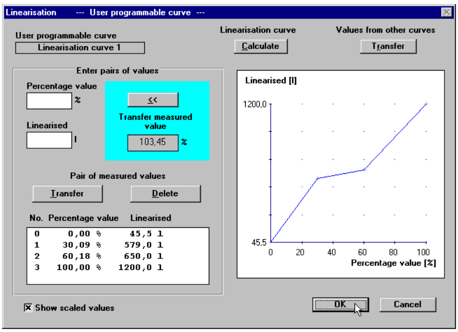


Adjustment with the PC on the analogue 4 … 20 mA signal and supply cable or directly on the sensor (four-wire sensor)

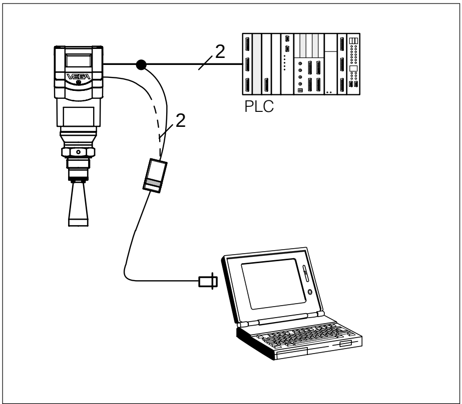
The PC can be connected at any location in the system or on the signal cable. It is connected by means of the two-wire PC interface converter VEGACONNECT 2 to the sensor or the signal cable. The adjustment and parameter data can be saved with the adjustment software on the PC and can be protected by passwords. On request, the adjustments can be quickly transferred to other sensors.



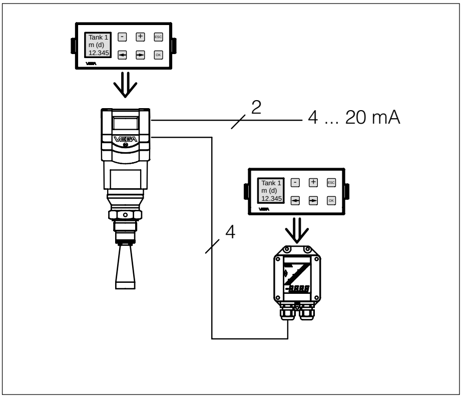
The adjustment program recognises the sensor type



Visualised input of a vessel linearisation curve



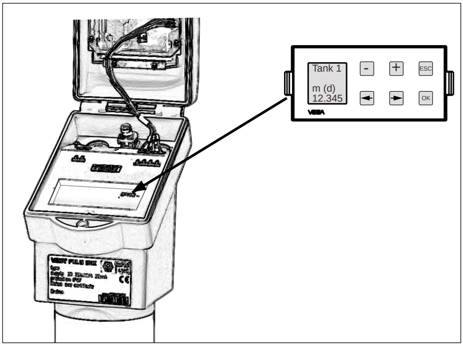
Adjustment with the PC on the 4 … 20 mA signal and supply cable or directly on the sensor (figure: a two-wire sensor)



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

Adjustment with 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.

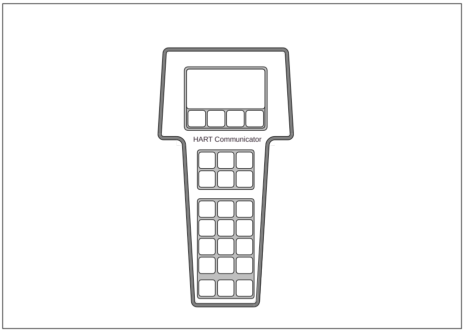


Detachable adjustment module MINICOM

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

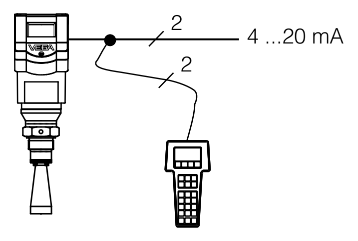
Adjustment with HART® handheld

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, so that the sensors can be adjusted with the HART® standard menus of the handheld.



HART® handheld

For adjustment, just 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.



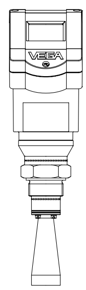
HART® handheld on the 4 … 20 mA signal cable

1.4 Antennas

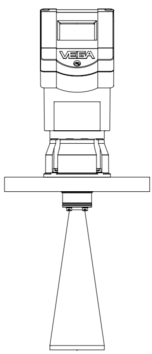
The antenna is the eye of the radar sensor. An uninitiated observer would probably not realise how carefully the antenna geometry must be adapted to the physical properties of electromagnetic fields.
The geometrical form determines focal properties and sensitivity - the same way it determines the sensitivity of a unidirectional microphone.

Four antenna systems are available for different applications and process requirements.

Horn antennas



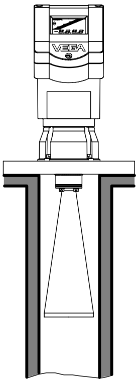
VEGAPULS 42



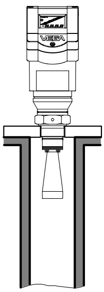
VEGAPULS 44

Horn antennas focus the radar signals very well. Manufactured of 1.4435 (stainless steel) or Hastelloy C22, they are very rugged, and are physically as well as chemically, resistant. They are suitable for pressures up to 40 bar and for product temperatures up to 150°C. The horn diameters determine the focussing of the radar signals. The antenna gain grows stronger with increasing diameter (40, 48, 75, 95 mm). The antenna gain represents the ratio of emitted energy to received echo energy.

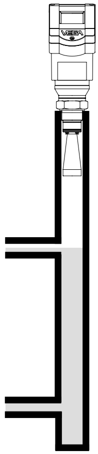
Pipe antennas



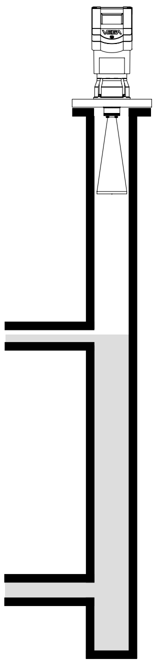
The pipe antennas on surge or bypass tubes only form a complete antenna system in conjunction with a measuring tube (which can also be curved). The measuring tube acts as a conductor for radar signals. The running period of the radar signals changes in the tube and is dependent on tube diameter. The tube inner diameter must be programmed in the sensor so that it can take the altered running time into account and deliver precise level signals. Pipe antennas are especially suitable for processes with intense product movements or products with low dielectric constant.



The antennas are characterised by very high gain. High reliability can be achieved even with products with very poor reflective features.



VEGAPULS 42 on bypass tube



VEGAPULS 44 on bypass tube

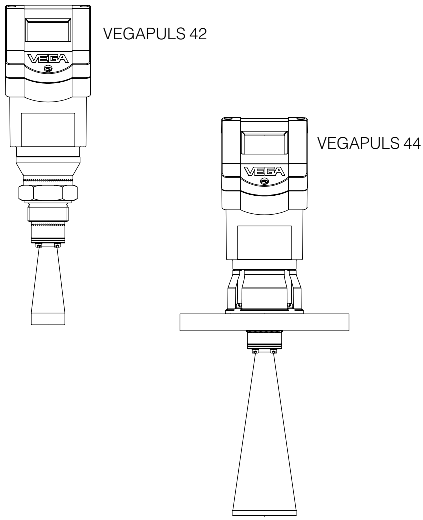
2 Types and versions

Series 40 sensors are manufactured in two basic versions, VEGAPULS 42 and VEGA-PULS 44.

VEGAPULS 42 are characterised by a G $1^{1}/_{2}$ A or $1^{1}/_{2}$“ NPT thread as process fitting. These sensors are equipped as standard versions with a ø 40 mm horn as antenna.

VEGAPULS 44 are characterised by a DIN or ANSI flanges as process fitting. In standard version they are manufactured with DN 50, 80, 100 and 150 as well as with ANSI 2“, 3“, 4“ and 6“. The bigger flanges come equipped with respectively larger antenna horns (ø 48, 75 and 95 mm).

Generally: The bigger the antenna horn, the better the focussing characteristics, and the better the antenna gain. This ensures that even a weak product echo can be detected reliably as level echo.



2.1 Survey

General features

- Application preferably for liquids in storage tanks, reservoirs and process vessels with increased accuracy requirements.
- Measuring range 0 … 10 m or 0 … 20 m.
- Ex approved in zone 1 (IEC) or zone 1 (ATEX) classification EEx ia [ia] IIC T6.
- Integrated display of measured values.

Survey

	VEGAPULS … 42	44
Signal output		
– active (4 … 20 mA)	•	•
– passive (4 … 20 mA loop powered)	•	•
Voltage supply		
– two-wire technology (voltage supply and signal output via one two-wire cable)	•	•
– four-wire technology (voltage supply separate from the signal cable)	•	•
Process fitting		
– G 1$^1/_2$ A; 1$^1/_2$" NPT	•	–
– DN 50; ANSI 2"	–	•
– DN 80; ANSI 3"	–	•
– DN 100; ANSI 4"	–	•
– DN 150; ANSI 6"	–	•
Adjustment		
– PC	•	•
– adjustment module in the sensor	•	•
– adjustment module in external indicating instrument	•	•
– HART® handheld	•	•
Measuring range max.		
– ø 40 mm horn	10 m	–
– ø 48 mm horn	15 m	15 m
– ø 75 mm horn	20 m	20 m
– ø 95 mm horn	20 m	20 m

Type code

PS 42 .XX X X X XXX X X

- K - Plastic housing PBT, M20 x 1,5 cable entry
- N - Plastic housing PBT, $^{1}/_{2}$“ NPT cable entry
- A - Aluminium housing, M20 x 1,5 cable entry
- D - Aluminium housing, $^{1}/_{2}$“ NPT cable entry in Exd connection housing

- V - Seal of the antenna system: Viton
- A - Seal of the antenna system: Kalrez

- G - Process fitting G 1$^{1}/_{2}$ A
- N - Process fitting 1$^{1}/_{2}$“ NPT
- ABC- Process fitting DN 50 PN 16
- BBE- Process fitting DN 80 PN 16
- CBG- Process fitting DN 100 PN 16
- DBG- Process fitting DN 150 PN 16
- ARC- Process fitting ANSI 2“ 150 psi
- BRE- Process fitting ANSI 3“ 150 psi
- CRG- Process fitting ANSI 4“ 150 psi
- DRG- Process fitting ANSI 6“ 150 psi
- YYY- Process fitting on request

- X - without display
- A - with integrated display

- X - without adjustment module MINICOM
- B - with adjustment module MINICOM (mounted)

- B - 20 … 72 V DC; 20 … 250 V AC; 4 … 20 mA, HART® (four-wire)
- D - Two-wire (loop powered), 4 … 20 mA, HART®
- E - Supply via signal conditioning instrument
- G - Segment coupler for Profibus PA

- XX - FTZ (standard telecommunication approval Germany)
- AX - Approval in Ex-Zone 1, EEx ia IIC T6
- CX - Approval in Ex-Zone 0, EEx ia IIC T6
- BX - Approval in Ex-Zone 1 (Exd connection housing)
- DX - Approval in Ex-Zone 0 (Exd connection housing)

- Type 42: with screw-on process fitting
- Type 44: instrument series with flange process fitting

- PS: Series 40 radar sensors

2.2 Configuration of measuring systems

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

On the following pages you will see various measuring systems, each consisting of a different instrument configuration (several also with signal conditioning).

Measuring systems in two-wire technology:

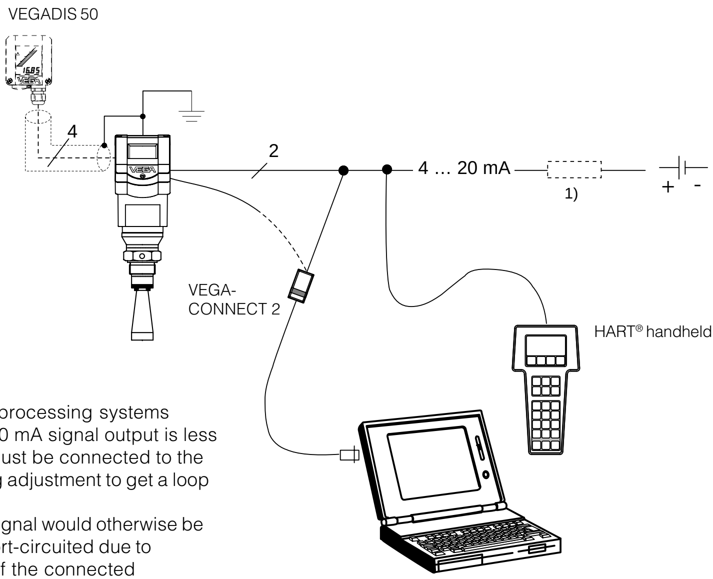
- 4 … 20 mA shown without processing unit, *(bottom)*
- 4 … 20 mA on active PLC, *(page 18)*
- 4 … 20 mA in Ex area on active PLC *(Ex ia page 20, Ex d PAGE 23)*
- 4 … 20 mA in Ex area on passive PLC, *(page 21)*
- 4 … 20 mA in Ex area on VEGADIS 371 Ex indicating instrument, *(page 22)*

Measuring systems in four-wire technology:

- 4 … 20 mA shown without signal conditioning instrument, *(non Ex page 19, Ex d page 23)*

Measuring systems with VEGAPULS 42 or 44 connected to any 4 … 20 mA signal processing unit

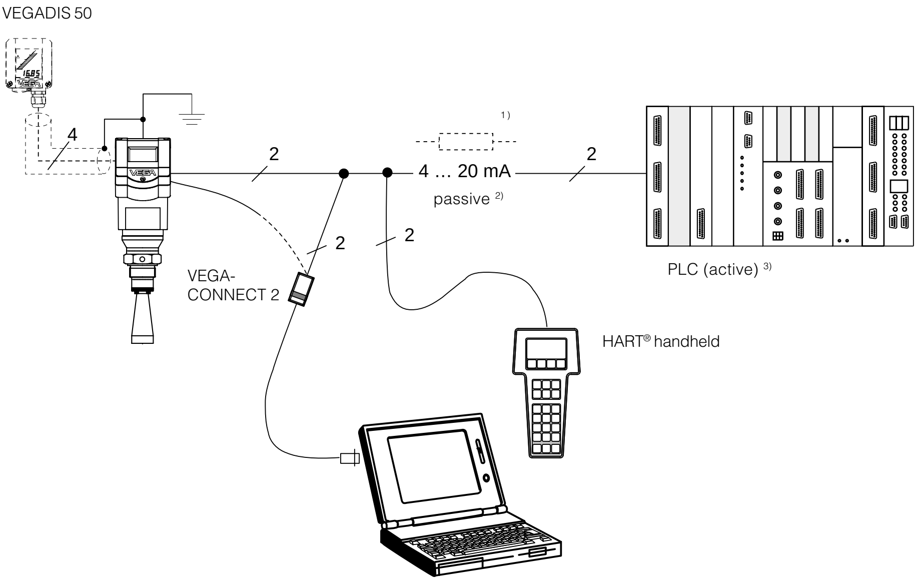
- Two-wire technology (loop powered), supply and output signal via one two-wire cable.
- Output signal 4 … 20 mA (passive).
- Optional external indicating instrument with analogue and digital display (can be mounted up to 25 m separated from the sensor).
- Adjustment with PC, HART® handheld or the adjustment 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. Communication with the PC would not be ensured.

Measuring system with VEGAPULS 42 or 44 on active PLC

- Two-wire technology, supply by 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 separated 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).



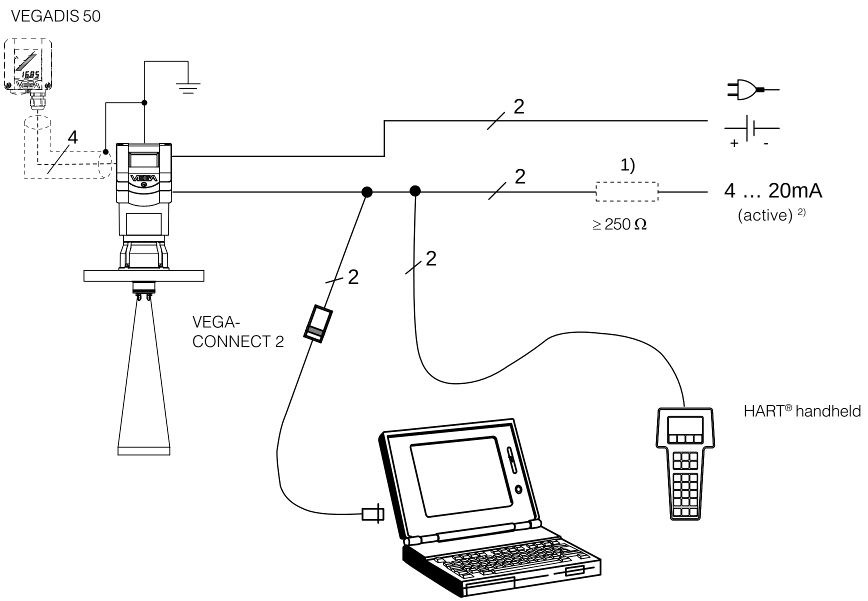
1) If the resistance of the processing systems connected to the 4 … 20 mA signal output is less than 250 Ω, a resistor must be connected to the connection cable during adjustment to get a loop resistance of 250 Ω.
The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient resistance of the connected processing system. 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 42 or 44 in four-wire technology

- Four-wire technology, supply and output signal via two separate two-wire cables.
- Output signal 4 … 20 mA active.
- Optional external indicating instrument with analogue and digital display (can be mounted up to 25 m separated 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).
- Max. resistance on the signal output (load) 500 Ω.

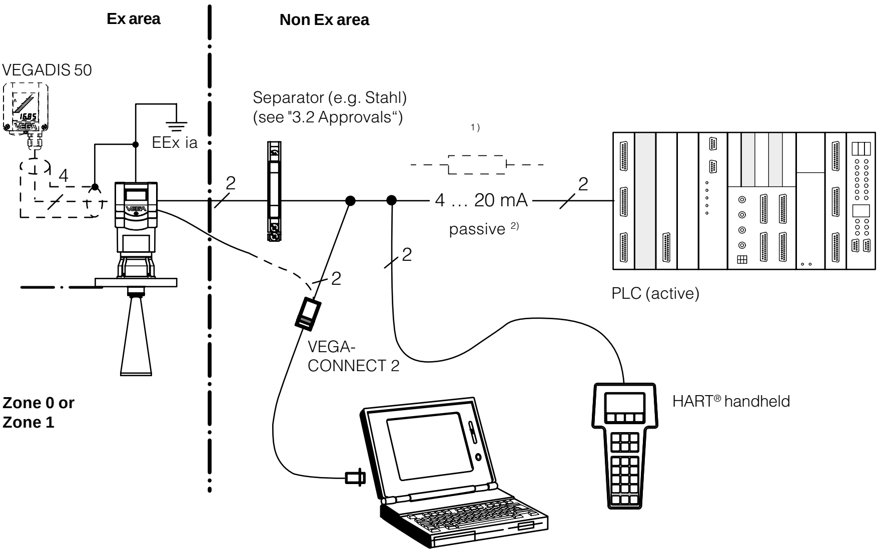


[1] If the resistance of the processing systems connected to the 4 … 20 mA signal output is less than 250 Ω, a resistor must be connected to the connection cable during adjustment to get a loop resistance of 250 Ω.
The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient resistance of the connected processing system. 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 to the processing system (e.g. display) like a current source.

Measuring system with VEGAPULS 42 or 44 via separator in Ex area on active PLC

- Two-wire technology (loop powered), 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 separated 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).

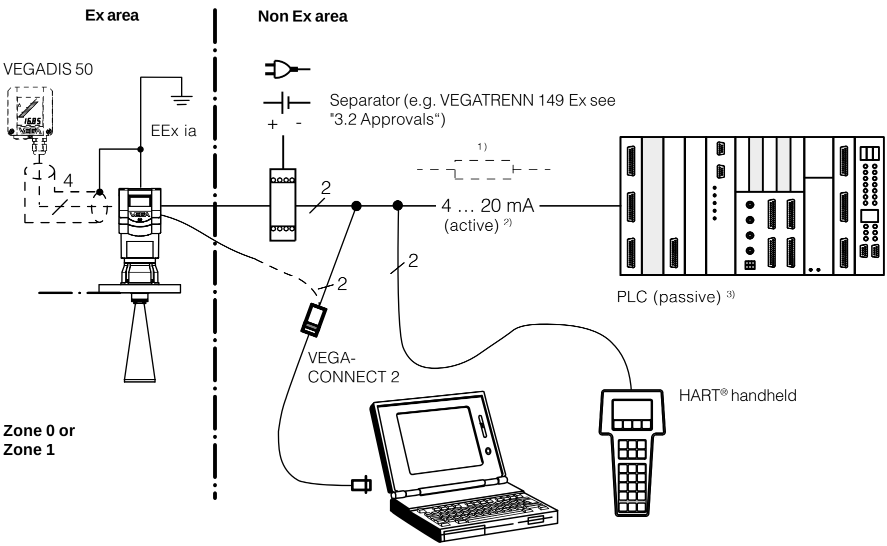


1) If the resistance of the processing systems connected to the 4 … 20 mA signal output is less than 250 Ω, a resistor must be connected to the connection cable during adjustment to get a loop resistance of 250 Ω.
The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient resistance of the connected processing system. 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. The PLC operates active, i.e. as current or voltage source.

Measuring system with VEGAPULS 42 or 44 via separator (Smart-Transmitter) on passive PLC

- 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 separated 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).



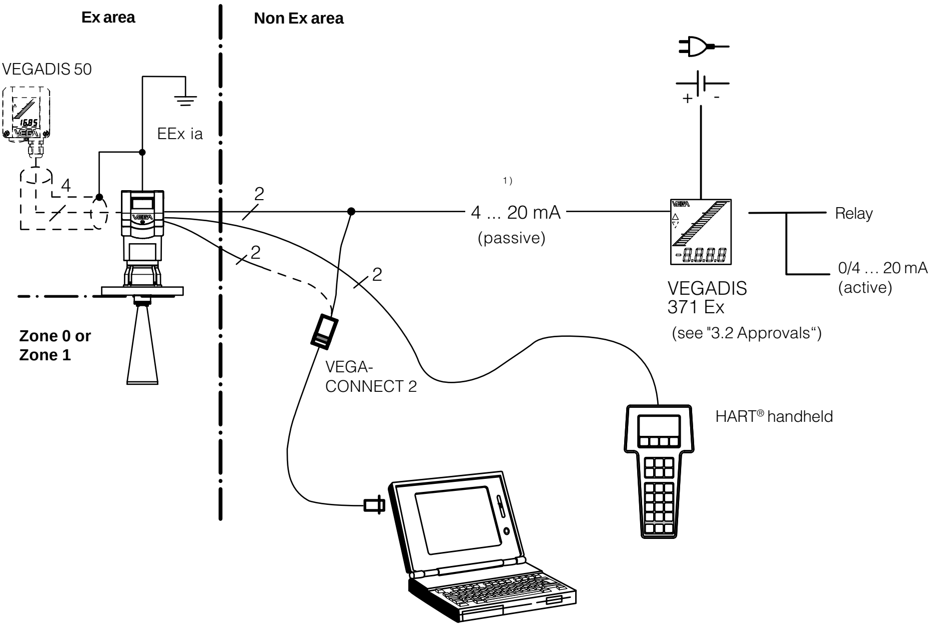
1) If the resistance of the processing systems connected to the 4 … 20 mA signal output is less than 250 Ω, a resistor must be connected to the connection cable during adjustment to get a loop resistance of 250 Ω.
The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient resistance of the connected processing system. 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 (source). 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) to the PLC.

Measuring system with VEGAPULS 42 or 44 on VEGADIS 371 Ex indicating instrument with current and relay output

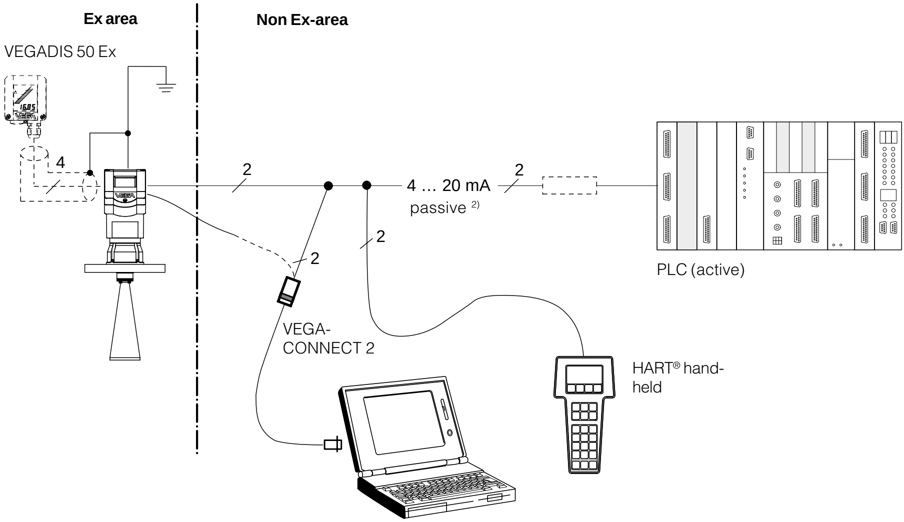
- Two-wire technology (loop powered), intrinsically safe ia supply via the signal cable of the VEGADIS 371 Ex indicating instrument for operation of the sensor in Ex zone 1 or Ex zone 0.
- Optional external indicating instrument with analogue and digital display (can be mounted up to 25 m separated from 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. Communication with the PC would not be ensured.

VEGAPULS 42 Ex or 44 Ex (loop powered) with pressure-tight encapsulated terminal compartment on active PLC

- Two-wire technology, supply via the signal cable of active PLC on Exd connection housing 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 (can be mounted up to 25 m separated 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).

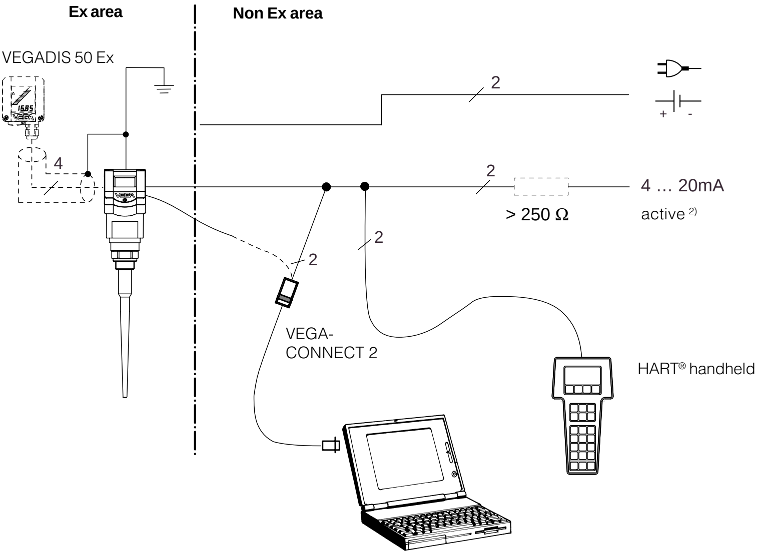


1) If the resistance of the processing systems connected to the 4 … 20 mA signal output is less than 250 Ω, a resistor must be connected to the connection cable during adjustment to get a loop resistance of 250 Ω.
The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient resistance of the connected processing system. 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 42 Ex or 44 Ex with pressure-tight encapsulated connection compartment in four-wire technology

- Four-wire technology, supply and output signal via two separate two-wire cables for use 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 separated 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 of 250 Ω.
The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient resistance of the connected processing system. Communication with the PC or the HART® handheld would not be ensured.

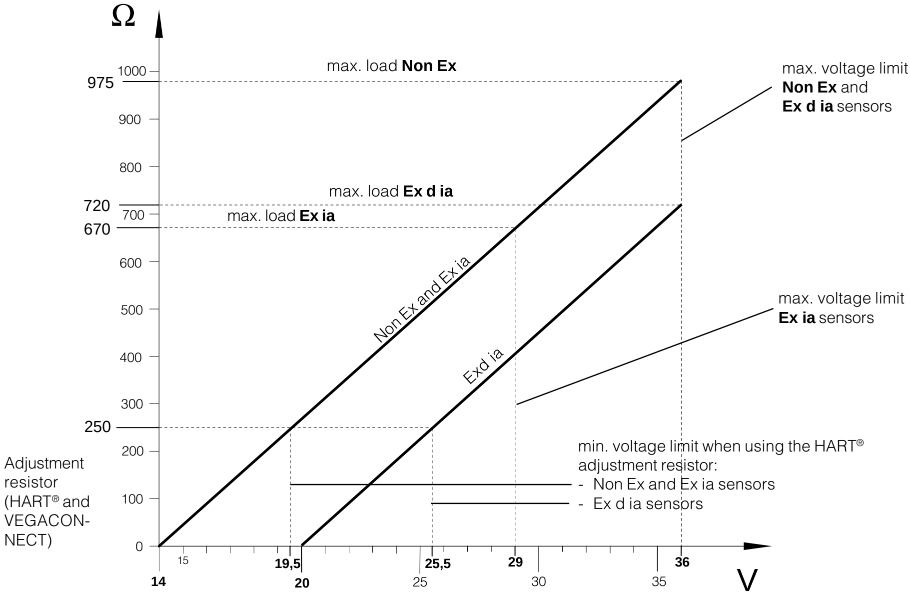
2) 4 … 20 mA active means that the sensor delivers a level-dependent current of 4 … 20 mA (source). The measuring signal of the sensor reacts electrically to the processing system (e.g. display) like a current source.

3 Technical data

3.1 Technical data

Power supply

Supply voltage	
- four-wire sensor	24 V DC (20 … 72 V DC) 230 V AC (20 … 250 V AC), 50/60 Hz fuse 0.2 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 Ex d ia sensor	24 V DC (20 … 36 V DC)
Current consumption	
- four-wire sensor	max. 60 mA
- two-wire sensor	max. 22.5 mA
Power consumption	
- four-wire sensor	max. 200 mW, 1.2 VA
- two-wire sensor	55 … 810 mW
Load	
- four-wire sensor	max. 500 Ohm
- two-wire sensor	see diagram



Measuring range [1)]

VEGAPULS 42 (ø 40 mm horn)	
- optional	0 … 10 m
ø 48 mm horn	0 … 15 m
ø 75, 95 mm horn	0 … 20 m
VEGAPULS 44	
- DN 50, ANSI 2“	0 … 15 m
- DN 80, 100, ANSI 3“, 4“, 6“	0 … 20 m
Standpipe measurement in DN 50 standpipe	
- VEGAPULS 42	0 … 20 m
- VEGAPULS 44	0 … 20 m
Standpipe measurement in DN 100 standpipe	
- VEGAPULS 42	0 … 20 m
- VEGAPULS 44	0 … 20 m

Output signal

4 … 20 mA current signal	in two or four-wire technology
Integration time	0 … 999 seconds (adjustable)
Load	
- 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

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 0/4 … 20 mA output signal (measuring signal) is led in a cable separate from the supply voltage.

Measured value display (optional)

Liquid-crystal display	
- in the sensor	scalable output of measured values as graph and digital value
- powered externally from the sensor	scalable output of measured values as graph and digital value. Measured value display 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 [2)]
(typical values under reference conditions, all statements relate to the nominal measuring range)

Characteristics	linear
Deviation in characteristics including linearity, reproducibility and hysteresis (determined acc. to the limit point method)	< 0.05 %
Linearity	better than 0.05 %
Average temperature coefficient of the zero signal	0.06 %/10 K
Resolution in general	max. 1 mm
Resolution of the output signal	0.01 % or 1 mm

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	24 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)	
- VEGAPULS 42	22°
optional	18°, 10° and 8° when using bigger coupling horn deviating from nominal size
- VEGAPULS 44	
DN 50, ANSI 2“	18°
DN 80, ANSI 3“	10°
DN 100, ANSI 4“	8°
DN 150, ANSI 6“	8°
Adjustment time (response time)	> 1 s (depending on parameter setting)
Influence of the process temperature	not measurable at 0 bar; 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 (depending on parameter setting)
Radar emitted power (average)	0.717 µW
Received average emitted power [3)]	
- distance 1 m	0.5 … 1.5 nW pro cm^2 (0.5 … 1.5 x $10^{-9}W/cm^2$)
- distance 5 m	0.02 … 0.6 nW pro 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 the sensor requires to output the correct level (with max. 10% deviation) after a quick level change.
3) Average emitted power reaching an object (electromagnetic energy) per cm^2 directly in front of the antenna. The received emitted power depends on the antenna version and the distance.

Ambient conditions

Vessel pressure	
- VEGAPULS 42	-1 … 16 bar
- VEGAPULS 44	-1 … 40 bar
Ambient temperature on the housing	-40°C … +80°C
Process temperature (flange temperature)	-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 Ex

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 number	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

Process fittings

VEGAPULS 42	G 1$^1/_2$ A, 1$^1/_2$" NPT screw-on antenna with ø 40 mm antenna horn (antenna horns of ø 48 … 95 mm can be retrofitted as option)
VEGAPULS 44	DN 50, DN 80, DN 100, DN 150, ANSI 2", 3", 4" and 6" (horn antenna)

Connection cable

Two-wire sensors	supply and signal via one two-wire cable
Four-wire sensor	supply and signal separate
Cross-section area of conductor	generally 2.5 mm^2
Ground connection	max. 4 mm^2
Cable entry	
- ia terminal compartment	2 x M20 x 1.5 (cable diameter 5 … 9 mm)
- Exd terminal compartment	2 x $^1/_2$" NPT EEx d (cable diameter 3.1 … 8.7 mm or 0.12 … 0.34 inch)

Materials

Housing	PBT (Valox) or aluminium die-casting (GD-AlSi 10 Mg)
EEx d connection compartment	aluminium ingot casting (GK-AlSi 7 Mg)
Process fitting	1.4435
Antenna (wetted parts)	1.4435 and PTFE
Antenna seal with horn and pipe antenna	
- standard	Viton
- option	Kalrez, Viton for low temperature

Weights

VEGAPULS 42	1.5 … 3.6 kg
VEGAPULS 44	
- DN 50	5.8 … 6.5 kg
- DN 80	7.6 … 8.4 kg
- DN 100	8.6 … 9.4 kg
- DN 150	13.5 … 14.2 kg
- ANSI 2"	5.2 … 5.7 kg
- ANSI 3"	6.9 … 7.5 kg
- ANSI 4"	10.5 … 11.1 kg
- ANSI 6"	14.6 … 15.4 kg

CE conformity CE

VEGAPULS 42/44 radar sensors meet the protective regulations of EMC (89/336/EWG) and NSR (73/23/EWG). The conformity has been judged acc. to the following standards:

EMC	Emission	EN 50 081 - 1: 1992; EN 50 041: 1997
	Susceptibility	EN 50 082 - 2: 1995; EN 50 020: 1994
NSR		EN 61 010 - 1: 1993

3.2 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

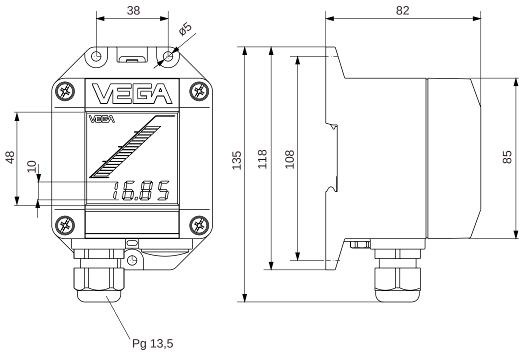
Safety barrier:
- Stahl 9001/01/280/110/10
- CEAG GHG 11 1 9140 V0728
- Typ 9130 (VEGA)
- Stahl 9001/51/280/110/14
- MTL 787 S+
- CEAG CS 3/420-106

Pressure-tight encapsulated in Ex area

Series 42/44 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).

3.3 Dimensions

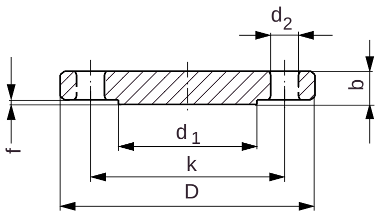
External indicating instrument VEGADIS 50



Note:
The cable diameter of the connection cable should be at least 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

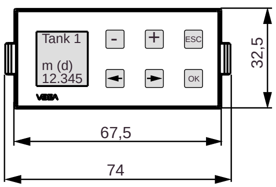
Flange dimensions acc. to ANSI



D = outer flange diameter
b = flange thickness
k = diameter of hole circle
d_1 = seal ledge diameter
f = seal ledge thickness $^1/_{16}$" = approx. 1.6 mm
d_2 = diameter of holes

Size	Flange			Seal ledge	Holes	
	D	b	k	d_1	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



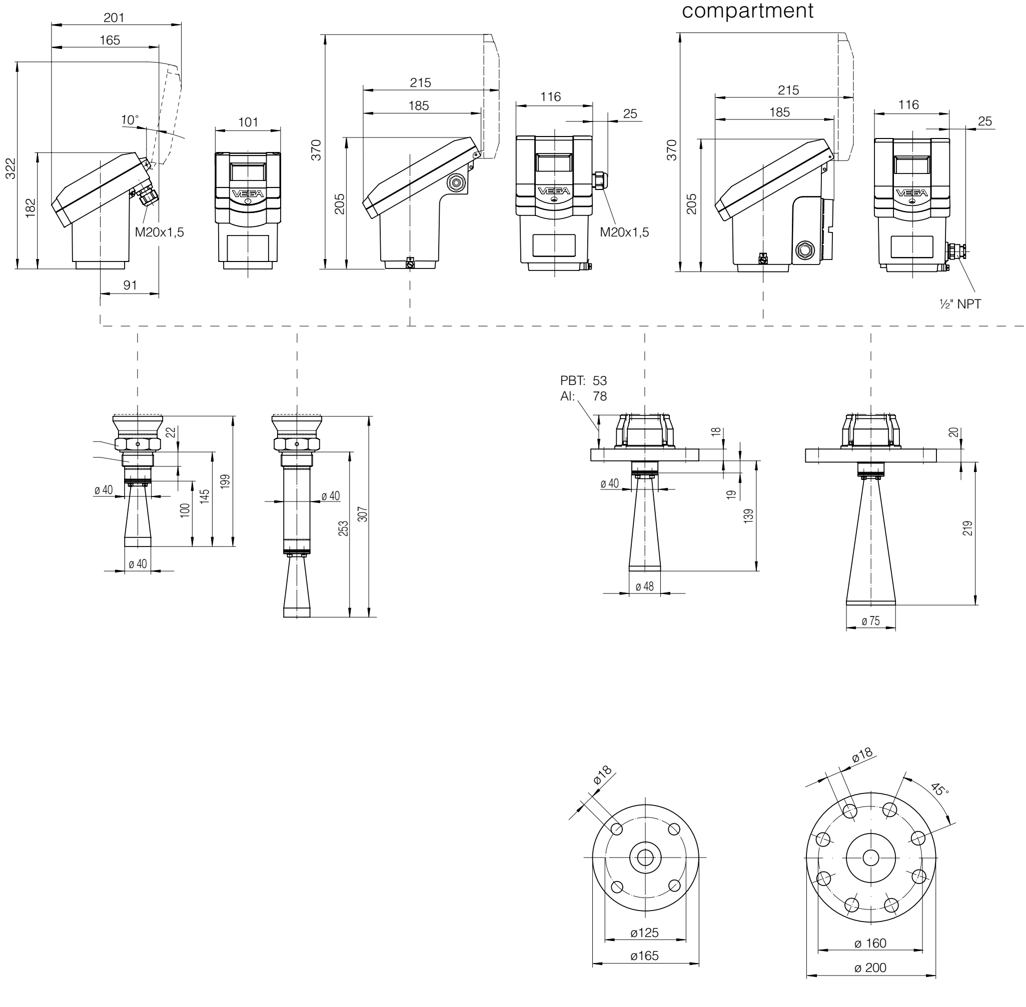
Adjustment module for insertion into series 50 sensors or into the external indicating instrument VEGADIS 50

Sensors

PBT

Aluminium

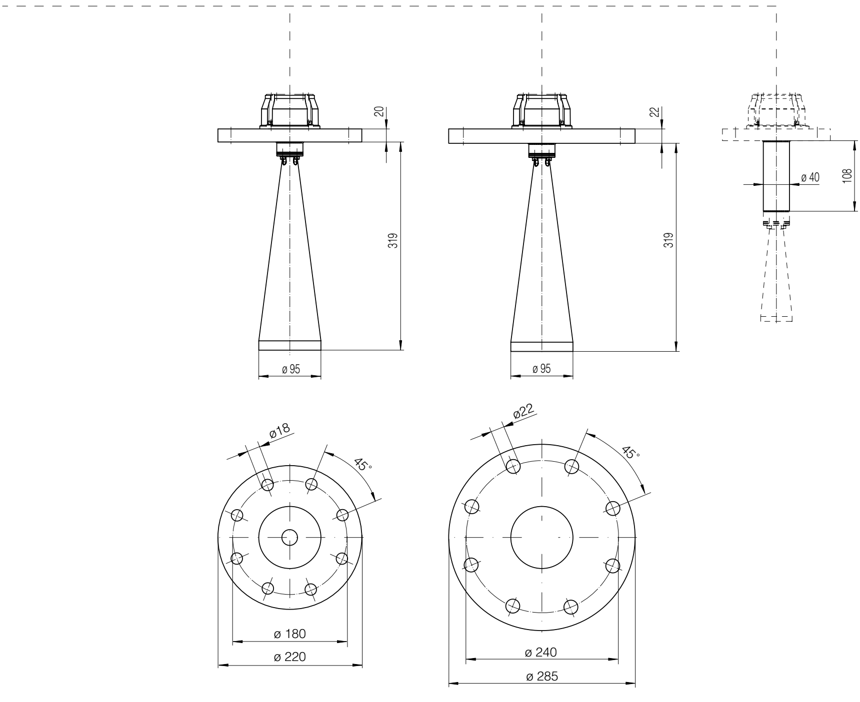
Aluminium with Exd terminal compartment



DN 50 PN 16

DN 80 PN 16

Sensor type	Version	max. socket length	with antenna extension
VEGAPULS 42	Standard	140 mm	250 mm
VEGAPULS 44	DN50/ANSI 2“	135 mm	245 mm
	DN 80/ANSI 3“	210 mm	325 mm
	DN 100/ANSI 4“	310 mm	425 mm
	DN 150/ANSI 6“	310 mm	425 mm



DN 100 PN 16

DN 150 PN 16

4 Mounting and installation

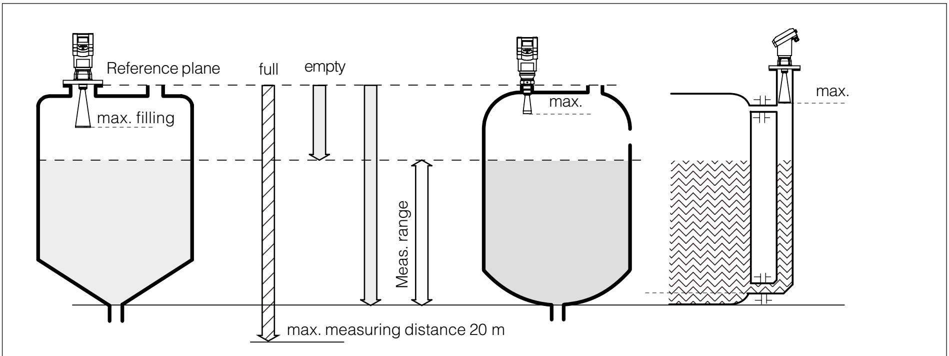
4.1 General installation instructions

Measuring range

The reference plane for the measuring range of the sensors is the flange face or the seal shoulder of the thread (VEGAPULS 42). For measurements in surge or bypass tubes (pipe antenna) the max. measuring distance is reduced.

Keep in mind that in measuring environments where the medium can reach the sensor flange, buildup can occur on the antenna which can cause measurement errors.

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

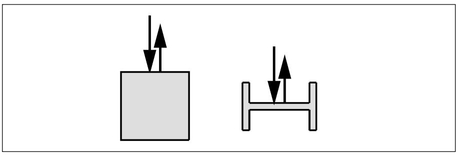


Measuring range (operating range) and max. measuring distance
Note: Use of the sensors for applications with solids is limited.

Interfering reflections

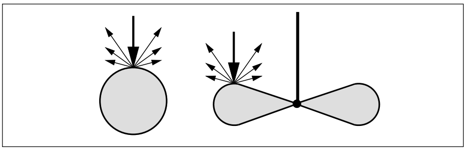
Flat obstructions and struts cause large interfering reflections. They reflect the radar signal with high energy density.

Round profile interfering surfaces scatter the radar signals in all directions and thus cause interfering reflections of lower energy density. Hence, they are less critical than reflections from a flat surface.

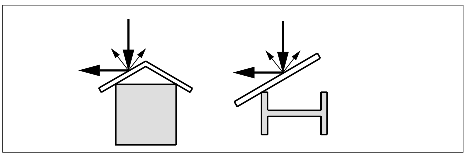


Profile with smooth interfering surfaces cause large false signals

If flat obstructions in the range of the radar signals cannot be avoided, we recommend diverting the interfering signals with a deflector. Due to this scattering, the interfering signals will be low in amplitude and so diffuse that they can be filtered out by the sensor.



Round profiles diffuse radar signals



A deflector causes signal scattering

Emission cone and interfering reflections

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. The form and intensity of the emission cone depend 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.

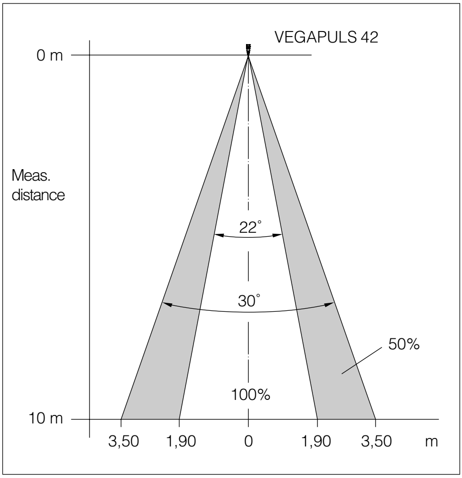
If possible, orient the sensor axis perpendicularly to the product surface and avoid vessel installations (e.g. pipes and struts) within the 100 % area of the emission cone.

The following illustrations of the emission beams are simplified and represent only the main beam - a number of weaker beams also exist. Therefore in practical application, the antenna has to be oriented so that the lowest possible false echo signal strength is achieved. Only giving attention to a large useful echo is not always adequate under difficult measuring conditions.

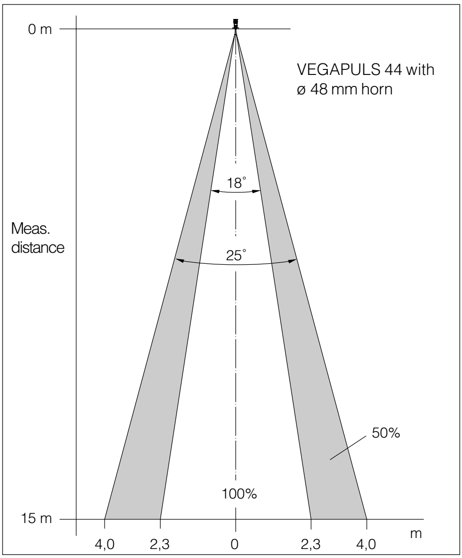
In a difficult measurement environment, searching for a mounting location with the lowest possible false echo intensity will bring the best results. In most cases, the useful echo will then be present with sufficient strength. With the adjustment software VVO on the PC, you can have a look at the echo image and optimise the mounting location (see chapter "6.2 Adjustment with the PC – Sensor optimisation – Echo curve“).

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.

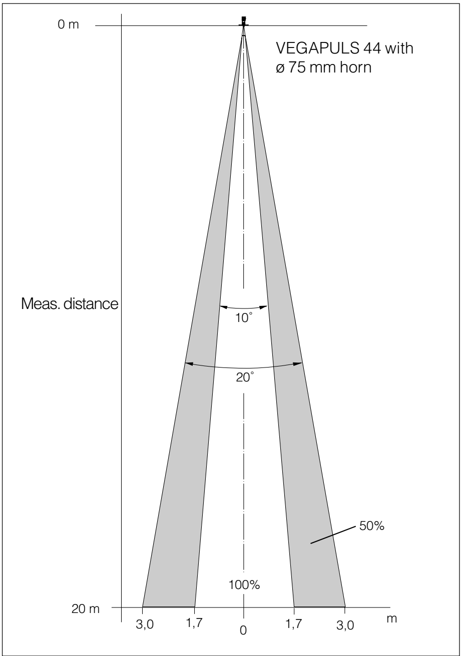
Optimum measuring conditions exist when the emission cone reaches the measured product perpendicularly and when the emission cone is free of obstructions.



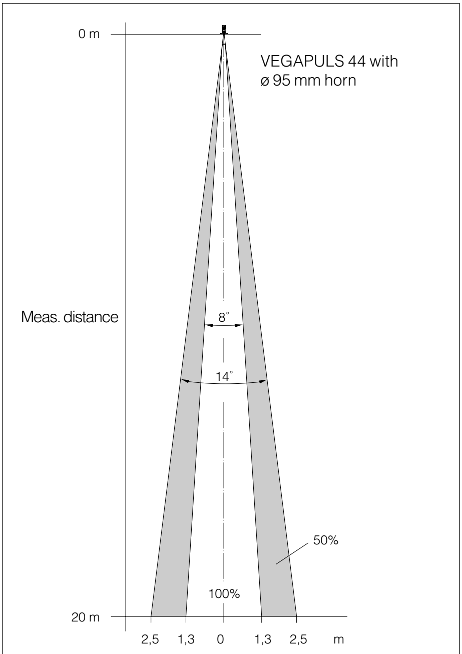
Emission cone of a VEGAPULS 42 with screw-on antenna and with ø 40 mm horn



Emission cone of a DN 50 flange antenna



Emission cone of a DN 80 flange antenna

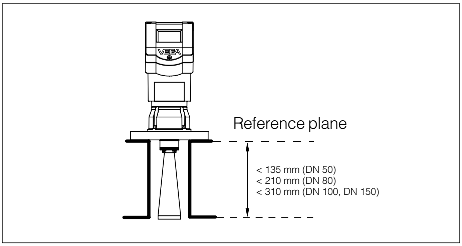


Emission cone of a DN 100 and DN 150 flange antenna

4.2 Measurement of liquids

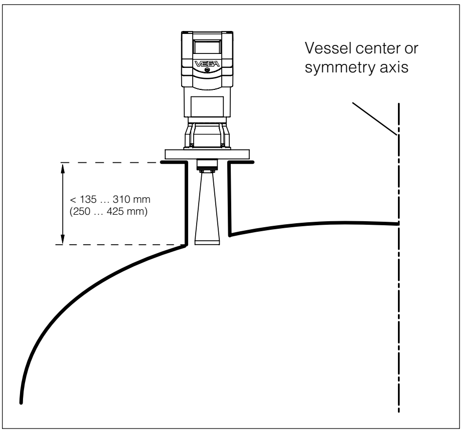
Horn antenna

Horn antenna on DIN socket piece
In most cases, 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 antenna should always protrude out of the flange pipe.
When the DIN socket piece is longer, please make sure that the horn antenna is not covered completely by the socket. It is better if the antenna protrudes slightly out of the socket.



Mounting on DIN socket piece

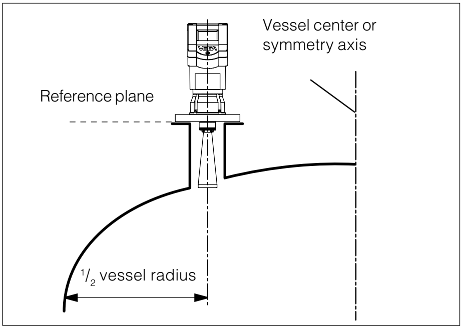
When mounting on dished vessel tops, the antenna length should at least correspond to the length of the longer sockets.



Mounting on a dished vessel top; max. socket length depending on flange size and, if applicable, on the length of the antenna extension (see "3.3 Dimensions").

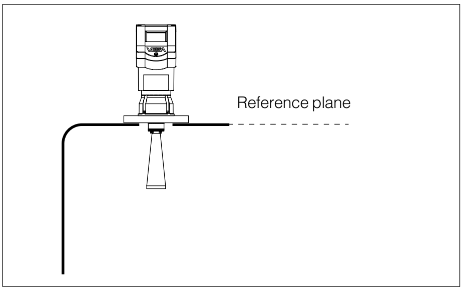
On dished tank ends, please do not mount the instrument in the centre or close to the vessel wall, but approx. $^1/_2$ vessel radius from the centre or from the vessel wall.

Dished tank ends 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 can be thereby avoided.



Mounting on dished tank ends

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.

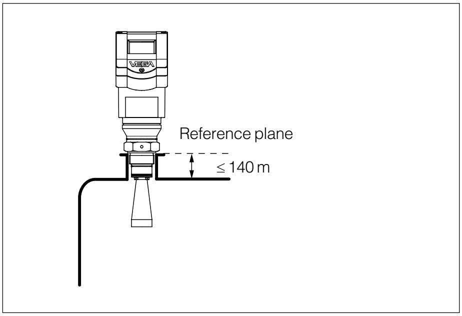


Mounting directly on the flat vessel top

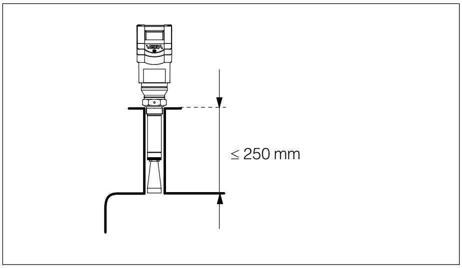
Screw-on antenna

Screw-on antenna on socket piece
The screwed antenna is mainly used on small vessels. The antenna fits on small vessel openings down to 1$^1/_2$“ socket.

The socket must not be longer than 140 mm (when using the longer antenna, not longer than 250 mm).



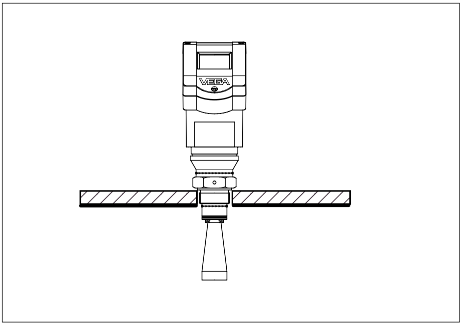
Screw-on antenna on socket piece 1$^1/_2$“



Screw-on antenna with antenna extension on socket piece

Screw-on antenna directly in vessel opening

As an alternative to socket mounting, the screw-on antenna can be mounted in round vessel openings (holes).



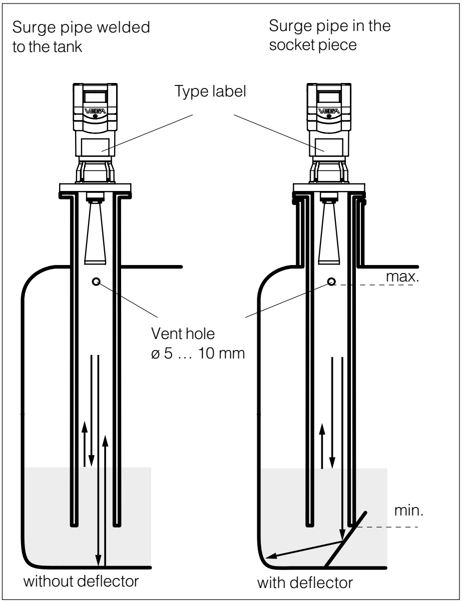
Screw-on antenna directly in vessel opening

4.3 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 cannot cause false echoes.

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



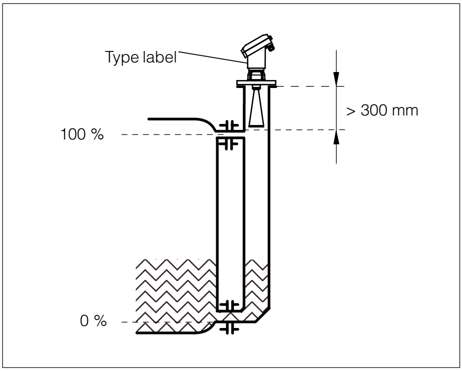
Pipe antenna systems in the tank

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.

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

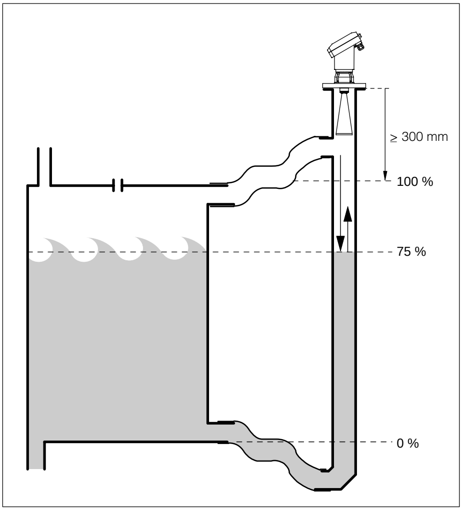
As an alternative to a surge pipe in the vessel, a pipe antenna system outside the vessel in a bypass tube is also possible.
The surge and bypass tubes must generally be made of metal. For plastic tubes, a closed, conductive jacket is always required. For metal tubes with plastic inner coating, make 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.

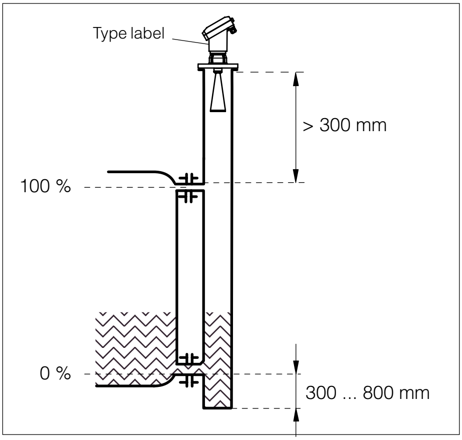


Tube flange system as bypass tube

When mounting the 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 max. level.



Extended bypass tube on a vessel with turbulent product movements



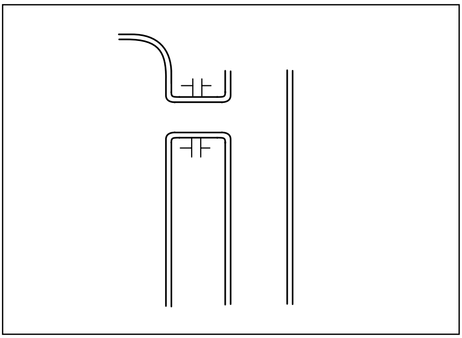
Tube flange system as bypass tube

For products with small dielectric constants (< 4), a much longer bypass tube should be used than required by the lower tube connection. Products with small dielectric constants are partly penetrated by the radar signals, so that the tube bottom delivers a stronger echo than the product (when the bypass tube is nearly empty). Due to the extension of the lower tube end, sufficient liquid will remain even when the vessel is emptied.

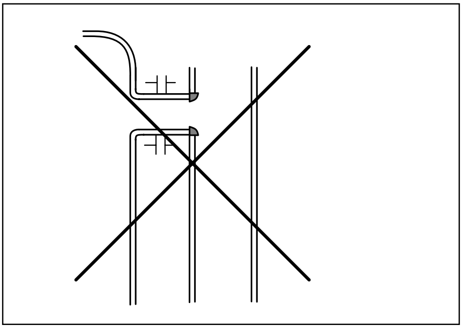
With a liquid quantity of 300 … 800 mm in the blind lower end of the tube, the portion of the signal that penetrates the liquid and reflects from the tube bottom is sufficiently damped - the sensor can then easily distinguish it from the echo of the liquid surface. If not enough liquid remains, a deflection plate located at the bottom of a vertical pipe can provide the same function. It deflects the signal reflected from the tube end sideways into the standard tube opening.

Connections to the bypass tube

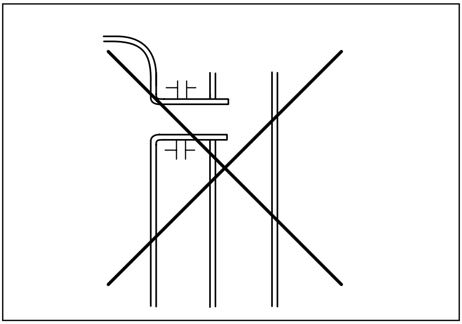
The connections to the bypass tubes must be fashioned in such a way that only minimal reflections are caused by the walls of the connecting tubes. This is especially important for the breather connection in the upper part of the tube. Observe the following points:
- Use small openings for the connection.
- The diameter of the connecting tubes should not exceed 1/3 of the bypass diameter.
- The tube connections must not protrude into the bypass.
- Big weld joints in the tubes should be avoided.
- Additional connections to the bypass tube must lie in the same plane as the breather openings (superimposed or displaced by 180°).



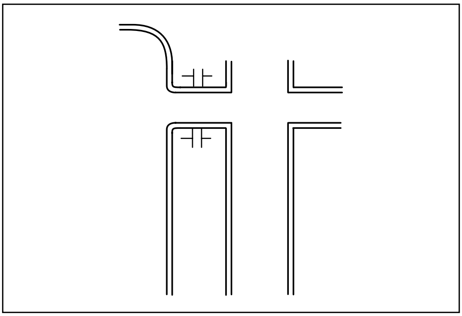
Optimum connection to the bypass tube



Strong welding on the tube connection



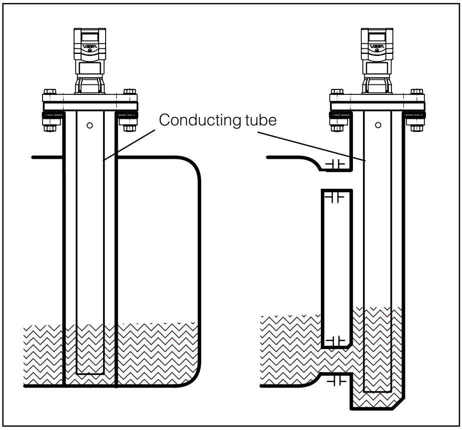
Tube connection protrudes



Additional connection to the bypass tube in one plane

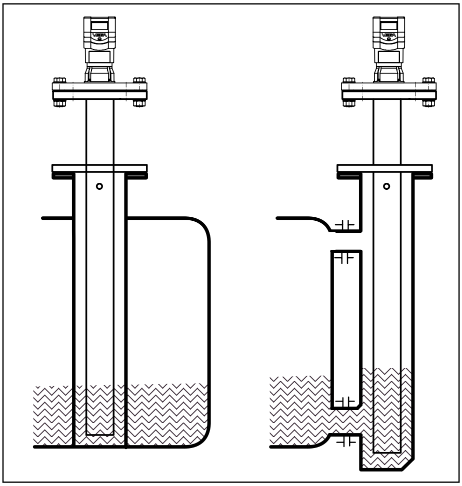
Use of conducting tubes

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



Conducting tube in existing surge or bypass tube

To increase the min. distance, the conducting tube can protrude out of the surge or bypass tube. For this purpose, a plain flange can be welded at the required position on the outside of the extended conducting tube. In both cases, an adequate breather hole must be provided.

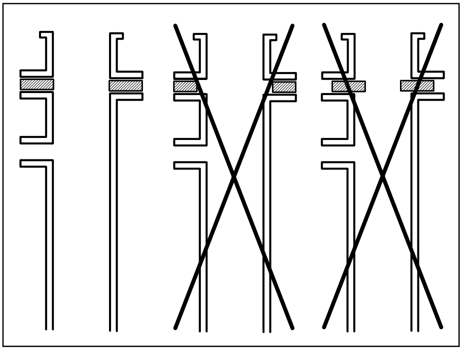


Extended conducting tube

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:

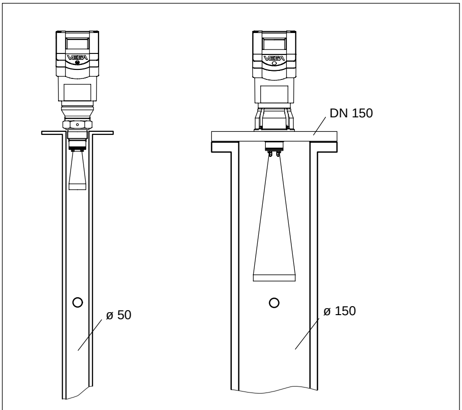
- The seal used should correspond to the tube inner diameter.
- If possible, conductive seals such as conductive PTFE or graphite should be used.
- There should be as few seal positions as possible on the conducting tube.



Flange connections on bypass tubes

Adhesive products

For nonadhesive or slightly adhesive products, choose a surge pipe with a nominal width of e.g. 50 mm. VEGAPULS 42 and 44 radar sensors with 24 GHz technology are relatively insensitive to buildup in the tube. Nevertheless, buildup must not be allowed to plug up the tube completely.

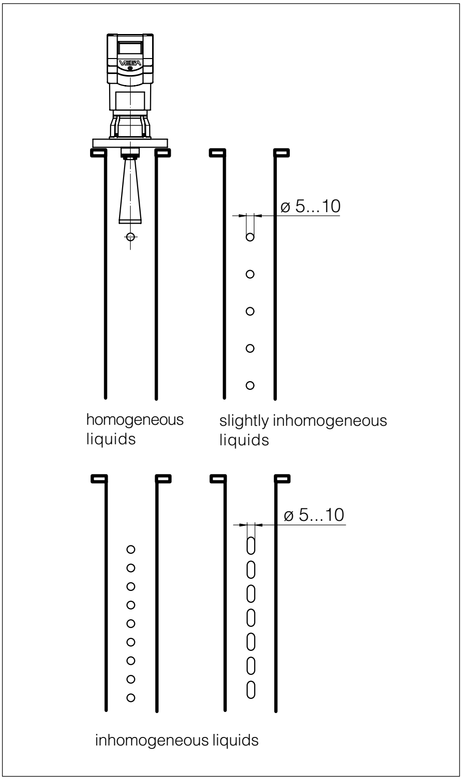


Pipe antenna with DN 50, DN 80, DN 100

For adhesive products, the use of a DN 80 to max. DN 100 stand/surge pipe can enable measurement in spite of buildup. Products that cause excessive buildup cannot be measured in a standpipe.

Standpipe measurement 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.

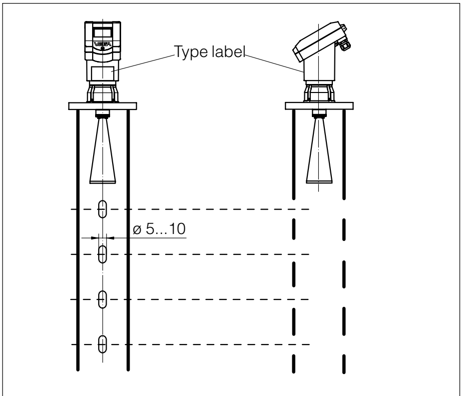


Openings in a surge pipe for mixing of inhomogeneous products

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.

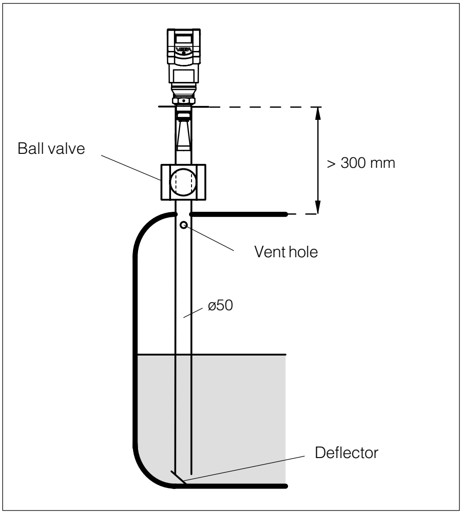


VEGAPULS 44: Rows of holes on one axis with the type label

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

Surge pipe with ball valve

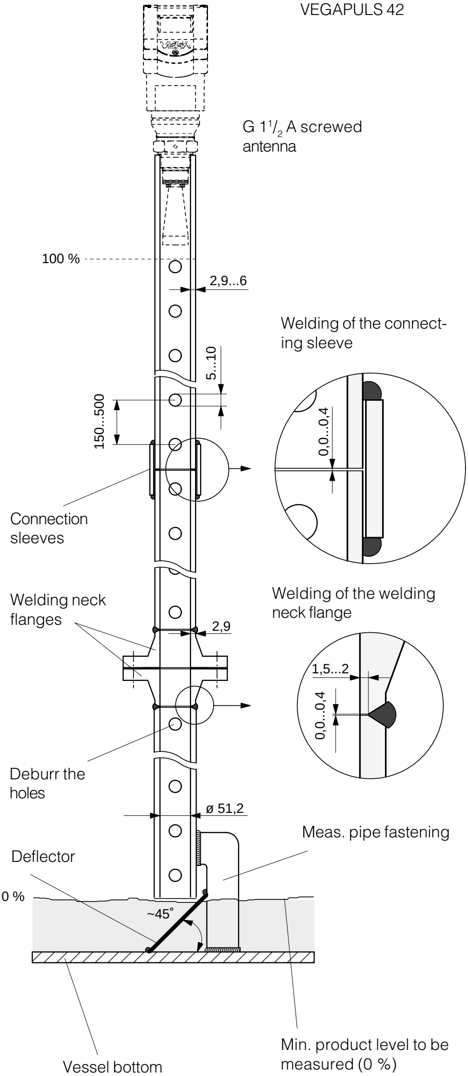
If a ball valve is mounted in the surge pipe, maintenance and servicing can be carried out without opening the vessel (e.g. if it contains liquid gas or toxic products).



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, and should be located at least 300 mm from the sensor flange.

Guidelines for standpipe construction



Radar sensors for measurement on surge or bypass pipes are routinely mounted in flange sizes DN 50, DN 80, DN 100 and DN 150. The radar sensor with a DN 50 flange forms a functional measuring system only in conjunction with a measuring pipe.

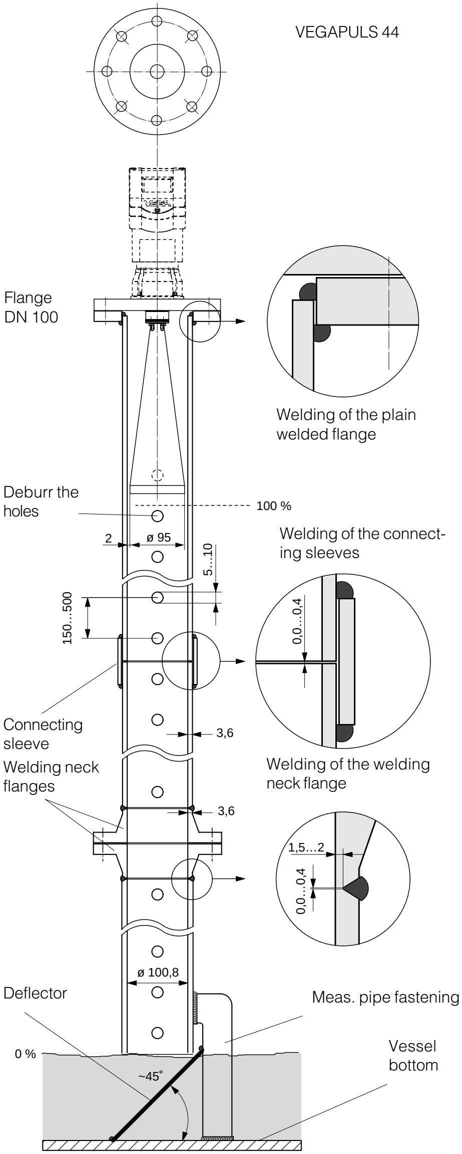
The illustration on the left shows the constructional features of a measuring pipe (surge or bypass tube) as exemplified by a sensor with DN 50 flange.

The measuring pipe must be smooth inside (average roughness Rz ≤ 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.

The following illustration shows the constructional features of a measuring pipe as exemplified by a radar sensor with DN 100 flange.

Radar sensors with flanges DN 80, DN 100 and DN 150 are equipped with a horn antenna. With these sensors, a plain welded flange can also be used on the sensor end instead of a welding neck flange.

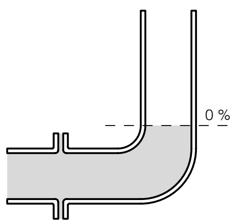


If the vessel contains agitated products, fasten the measuring pipe to the vessel bottom. Provide additional fastenings for longer measuring pipes.

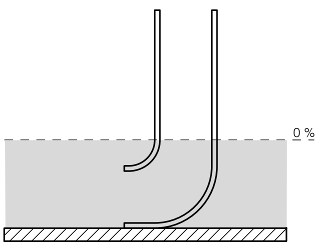
When measuring products with lower dielectric values (< 4), a part of the radar signal penetrates the medium. If the vessel is nearly empty, an echo is generated by the medium and the vessel bottom. In some cases, the vessel bottom generates a stronger signal echo than the product surface. With a deflector on the measuring pipe end, the radar signals are scattered. In nearly empty vessels and products with low dielectric value, the medium then generates a stronger echo than the vessel bottom.

Thanks to the deflector, only the useful signal is received in a nearly empty vessel - the correct measured value is thus transmitted and the 0 % level reliably detected.

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 vessel bottom.



Quadrant pipe on the bypass tube end

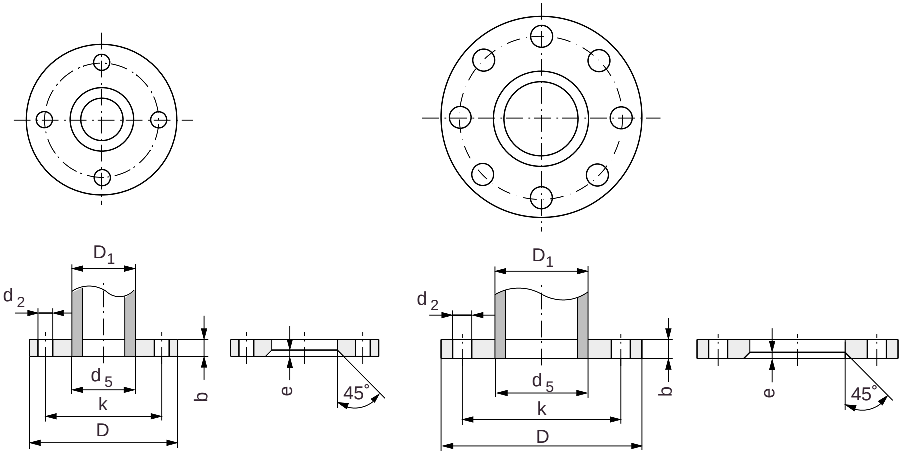


Quadrant pipe on the standpipe end

Examples of flange and pipe dimensions

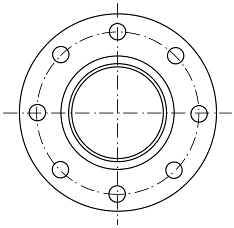
The following shows a few examples of flanges and stainless steel pipes.

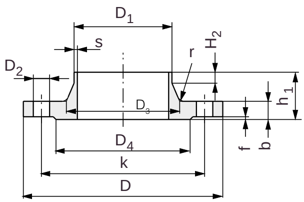
Plain welded flanges ND 6



Tube		Flange					Screws			Weight
NW	D_1	d_5	D	b	e	k	No.	Thread	d_2	kg
80	88.9	90.2	200	20	7	160	8	M16	18	3.79
100	108 114.3	109.6 115.9	220	20	7	180	8	M16	18	4.20 4.03
150	159 168.3	161.1 170.5	285	22	7	240	8	M20	22	6.72 6.57

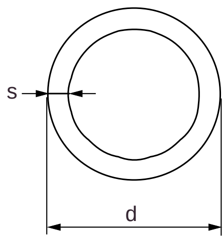
Welding neck flanges ND 16





Tube		Flange				Neck						Screws		
NW	D_1	D	b	k	h_1	D_3	s	r	H_2	D_4	f	No.	Thread	D_2
50	57 60.3	165	18	125	45	72 75	2.9	6	8	102	3	4	M16	18
80	88.9	200	20	160	50	105	3.2	8	10	138	3	8	M16	18
100	108 114.3	220	20	180	52	125 131	3.6	8	12	158	3	8	M16	18
150	159 168.3	285	22	240	55	175 184	4.5	10	12	212	3	8	M20	22

Examples of pipe dimensions (drawn stainless steel pipe)



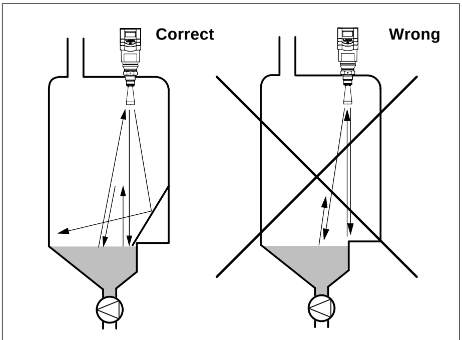
d (ø outer)	s	kg/m	DN
57.00	2.90	3.493	50
88.90	3.20	7.112	80
108.00	3.60	9.411	100
114.30	3.60	9.979	100
159.00	4.50	17.409	150

4.4 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.

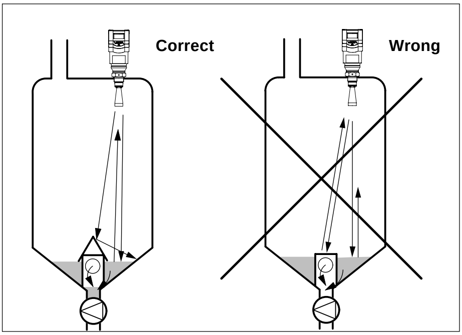
Vessel protrusions

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



Vessel protrusions (slope)

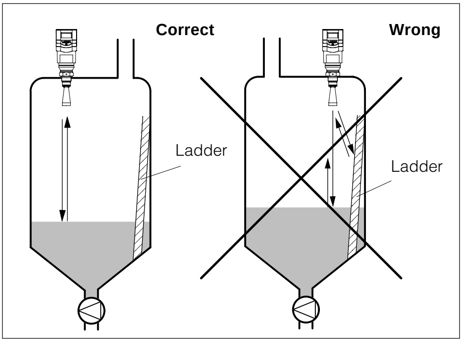
Intake pipes, i.e. for the mixing of materials - with a flat surface directed towards the sensor - should be covered with a sloping shield that will scatter false echoes.



Vessel protrusions (intake pipe)

Vessel installations

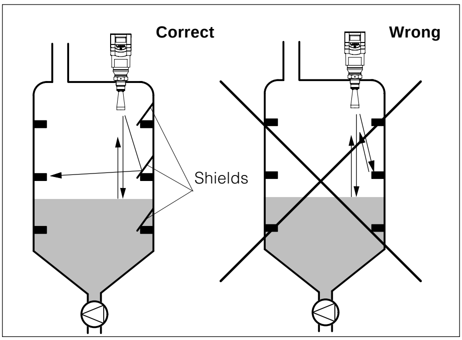
Vessel installations such as, for example, a ladder, often cause false echoes. Make sure when planning your measuring location that the radar signals have free access to the measured product.



Vessel installations

Struts

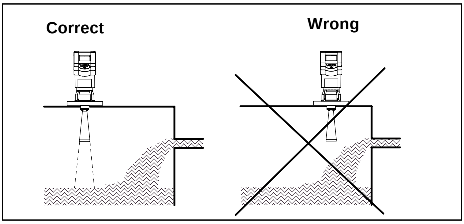
Struts, like other vessel installations, can cause strong false echoes that are superimposed on the useful echoes. Small shields effectively hinder a direct false echo reflection. These false echoes are scattered and diffused in the area and are then filtered out as "echo noise“ by the measuring electronics.



Struts

Inflowing material

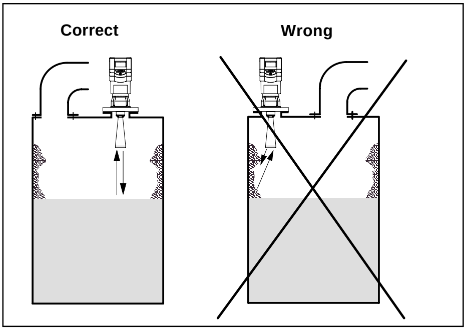
Do not mount the instrument in or above the filling stream. Ensure that you detect the product surface and not the inflowing material.



Inflowing material

Buildup

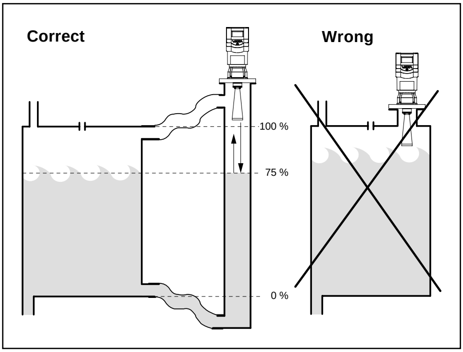
If the sensor is mounted too close to the vessel wall, buildup and adhesions of the measured product to the vessel wall will cause false echoes. Position the sensor at a sufficient distance from the vessel wall. Please also note chapter "4.1 General installation instructions“.



Buildup

Strong product movements

Strong turbulences in the vessel, e.g. caused by stirrers or intense chemical reactions, can seriously interfere with the measurement. A surge or bypass tube (see illustration) of sufficient size always allows, provided the product causes no buildup in the tube, a reliable measurement even with strong turbulence in the vessel.

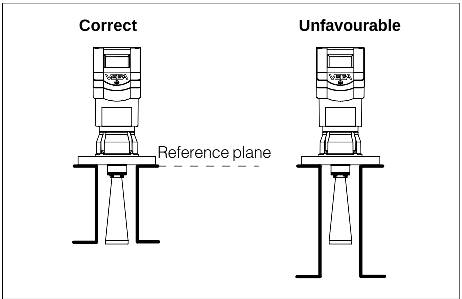


Strong product movements

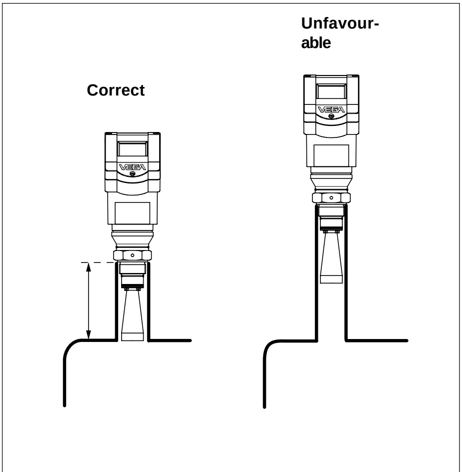
4.5 Common installation mistakes

Socket piece too long

If the sensor is mounted in a socket extension that is too long, false reflections are caused, and measurement is hindered. Make sure that the horn antenna protrudes out of the socket piece.



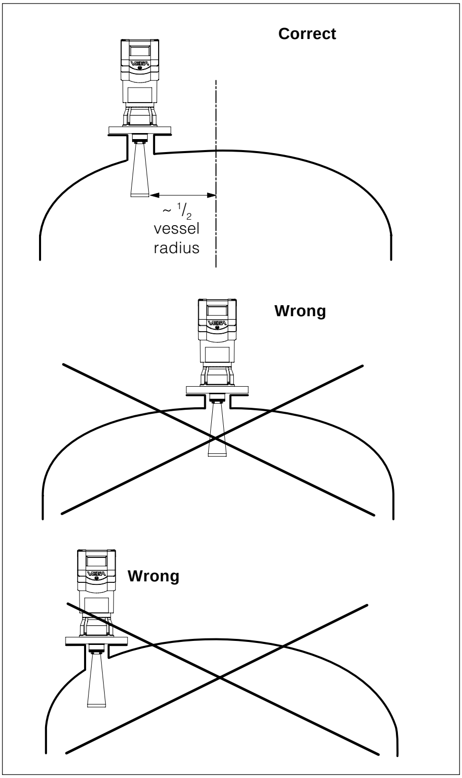
Flange antenna: Correct and unfavourable socket length



Flange antenna: Correct and unfavourable socket length

Parabolic effects on dished or arched vessel tops

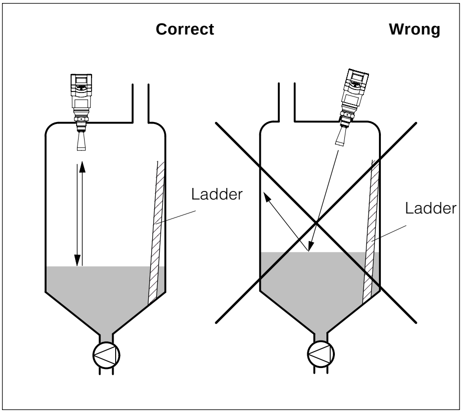
Round or parabolic tank tops act like a parabolic mirror on the radar signals. If the radar sensor is placed at the focal point of such a parabolic tank top, the sensor receives amplified false echoes. The optimum mounting position is generally in the range of half the vessel radius from the centre.



Mounting on a vessel with parabolic tank top

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

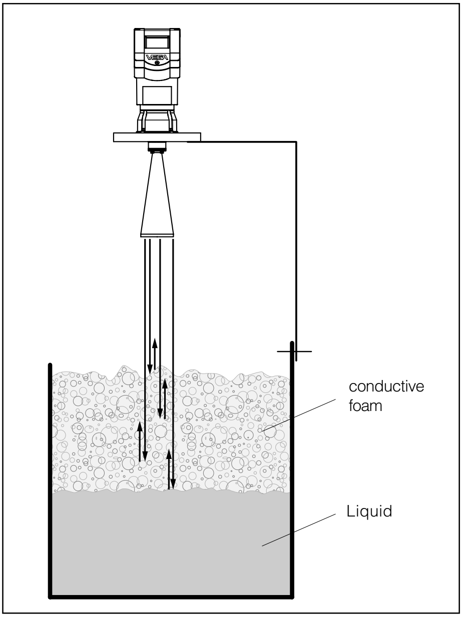
Sensor too close to the vessel wall

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 or useful echo. Please ensure sufficient distance of the sensor to the vessel wall.

In case of good reflection conditions (liquids without vessel installations), we recommend selecting the sensor distance so that 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 "4.1 General installation instructions".

Foam generation

Conductive foam is penetrated by the radar signals to different depths and generates a number of single (bubble) echoes. The signals in the foam are also damped, like heat radiation that tries to penetrate styrofoam. Thick, dense, creamy foam, and especially conductive foam, on the product surface can cause incorrect measurements.



Foam generation

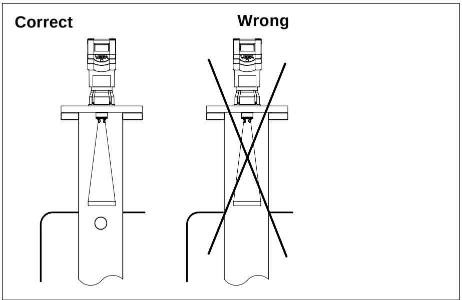
Take measures to avoid foam, measure in a bypass tube or use a different measuring technology, e.g. capacitive electrodes or hydrostatic pressure transmitters.

In many cases, VEGAPULS 54 radar sensors with 5.8 GHz operating frequency reach considerably better and more reliable measuring results in foam applications than type 40 sensors with 24 GHz technology.

Installation mistakes in the standpipe

Pipe antenna without ventilation hole

Pipe antenna systems must be provided with a ventilation hole on the upper end of the surge pipe. A missing hole will cause false measurements.

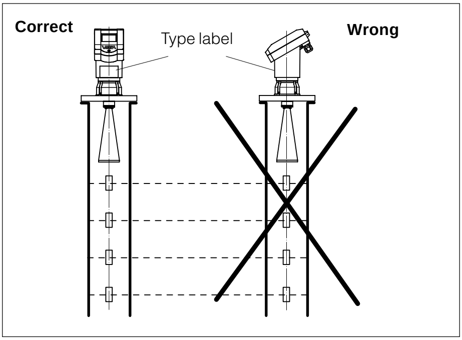


Pipe antenna: The surge pipe open to the bottom must have a ventilation or equalisation hole on top

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

5 Electrical connection

5.1 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 on low voltage.

Qualified personnel

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

Connecting and grounding

A standard two or four-wire cable (sensors with separate supply) with max. 2.5 mm² can be used for connection. Very often the "electromagnetic pollution“ by electronic actuators, energy cables and transmitting stations is so considerable that the two-wire cable or the four-wire cable should be shielded.

We recommend the use of screened cable. Screening is also a good preventative measure against future sources of interference. 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 shield on one earth side (e.g. in the switching cabinet) via a capacitor (e.g. 0.1 µF; 250 V) to the earth potential. Use a very low-resistance earth connection (foundation, plate or mains earth).

Note!
In Ex applications, grounding on both ends is not allowed due to potential transfer.

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. Please note the special installation regulations (DIN 0165).

Connection cable

Please note that the connection cables are specified for the expected operating temperatures in your systems. The cable must have an outer diameter of 5 … 9 mm (1/2 up to 1/3 inch) or Ex d housing 3.1 … 8.7 mm (0.12 … 0.34 inch). Otherwise the seal effect of the cable entry will not be ensured.

Cables for intrinsically safe circuits must be marked blue and must not be used for other circuits.

Earth conductor terminal

On all VEGAPULS 44 sensors as well as the series 42 sensors with metal thread, the earth conductor terminal is galvanically connected with the flange or the thread.

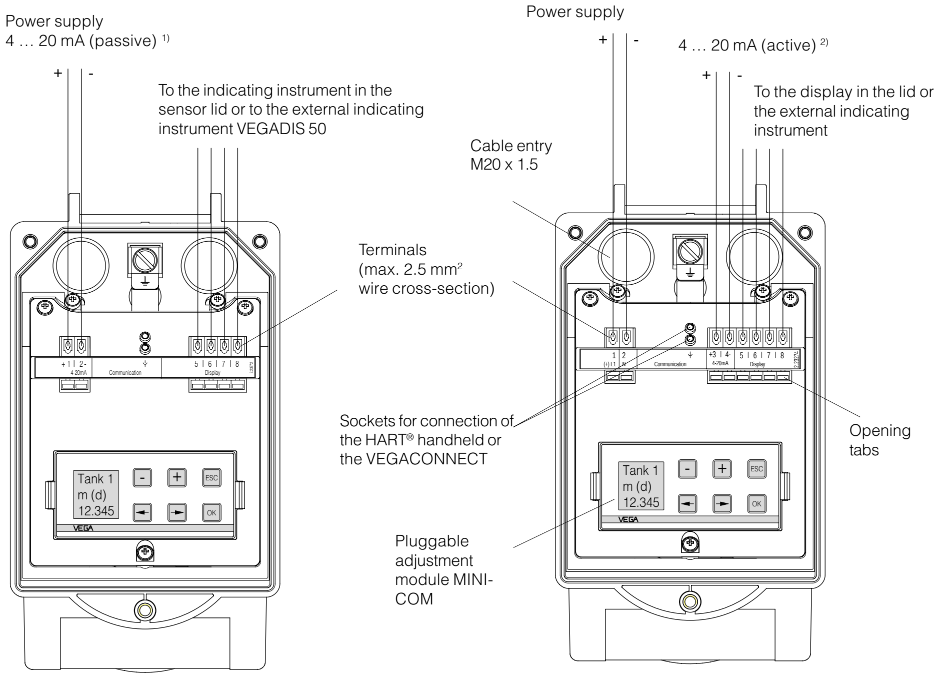
5.2 Connection of the sensor

After mounting the sensor at the measurement location according to the instructions in chapter "4 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



Two-wire technology in plastic housing
(loop powered)

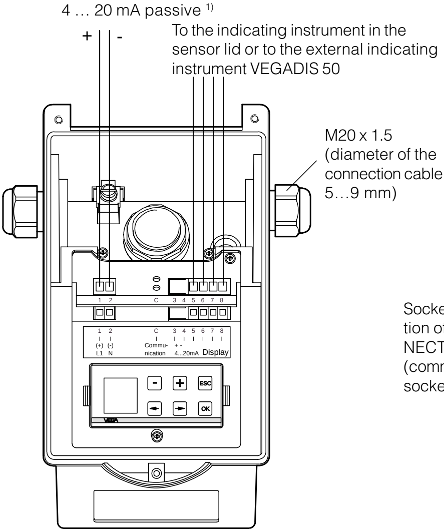
Four-wire technology in plastic housing
(separate supply)

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

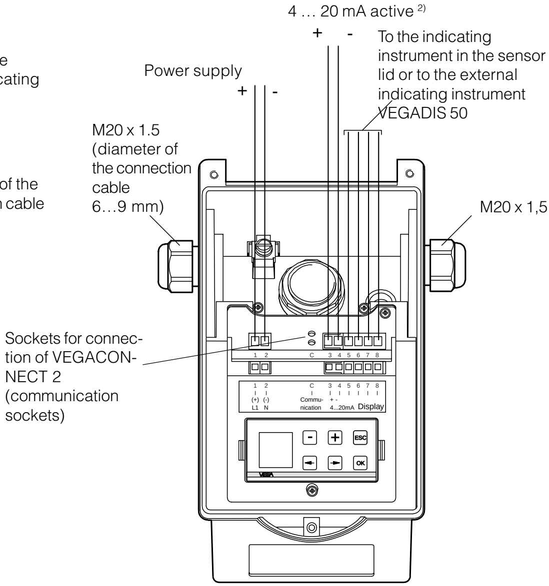
2) 4 … 20 mA active means that the sensor provides a level-dependent current of 4 … 20 mA (current source).

Version with aluminium housing

Two-wire technology
(loop powered)

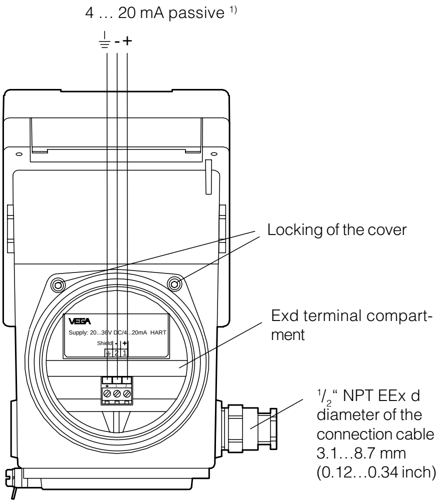


Four-wire technology

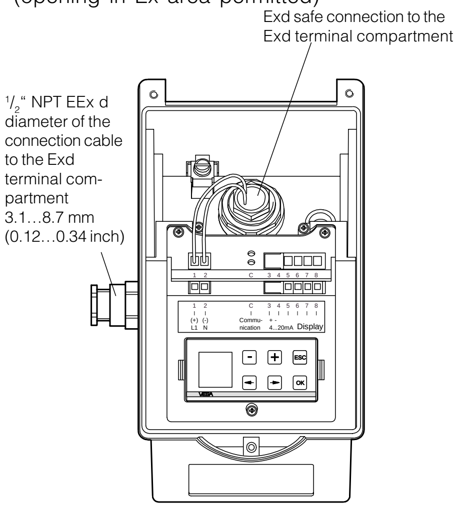


Version with aluminium housing and pressure-tight encapsulated terminal compartment

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



Display terminal compartment with adjustment module
(opening in Ex area permitted)



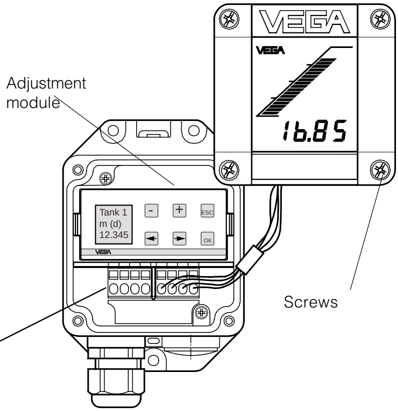
1) 4 … 20 mA passive means that the sensor consumes a level-dependent current of 4 … 20 mA (consumer).

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

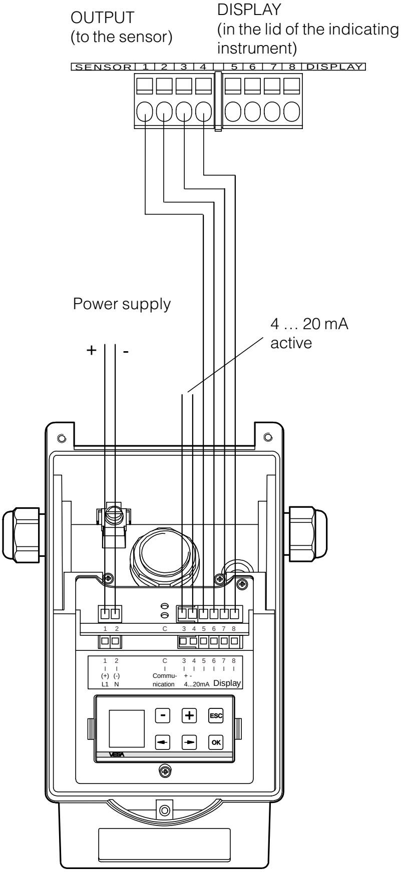
5.3 Connection of the external indicating instrument VEGADIS 50

Loosen the four screws of the housing lid on VEGADIS 50.
The connection procedure can be facilitated by attaching the housing cover during connection work with one or two screws on the right side of the housing.

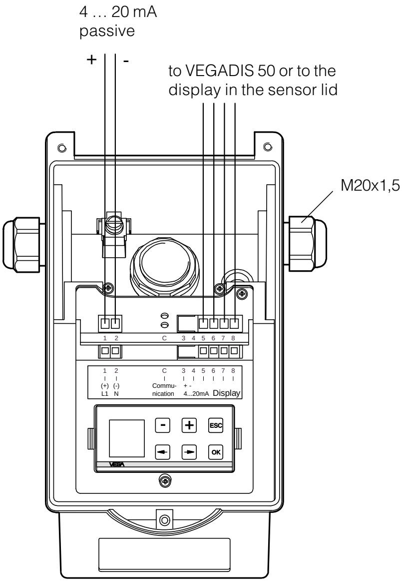
VEGADIS 50



Four-wire sensor in aluminium housing
(separate supply)



Two-wire sensor in aluminium housing
(loop powered)



6 Setup

6.1 Adjustment methods

The radar sensors can be adjusted with
- PC (adjustment program VVO)
- with detachable adjustment module MINICOM
- with HART® handheld.

The adjustment must be carried out with only one adjustment device. If, for example, you try the parameter adjustment with the MINICOM and the HART® handheld, the adjustment will not work.

PC
The adjustment program VVO (VEGA Visual Operating System) on the PC enables quick and easy adjustment of radar sensors. 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 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 42 and 44 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 accessible. Functions that are rarely used, such as, for example, the scaling of the A/D converter for the signal output or the 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.

6.2 Adjustment with PC

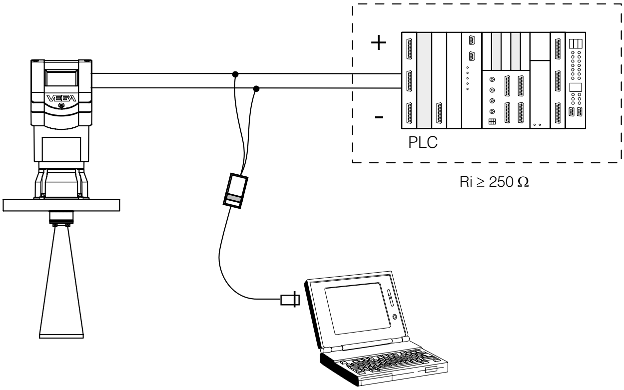
PC on the sensor
For connection of the PC to the sensor, the interface converter VEGACONNECT 2 is required. It is plugged into the provided CONNECT socket in the sensor.

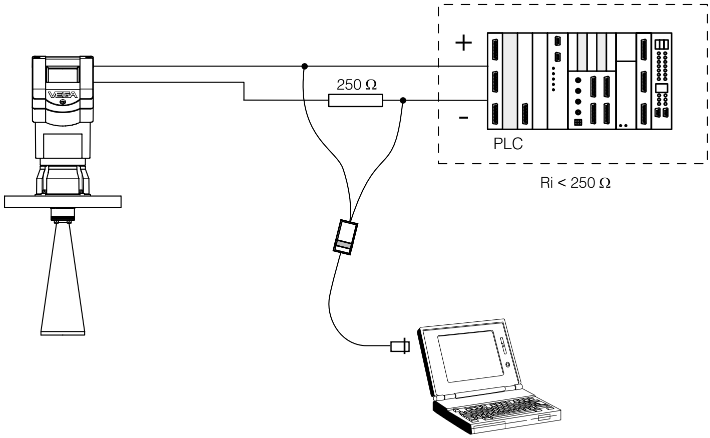
Make sure that the pins of VEGACONNECT 2 are completely inserted into the sensor sockets, as the new pins have a slightly increased resistance to insertion. The pins should be inserted up to a depth of approx. 13 mm to 15 mm.

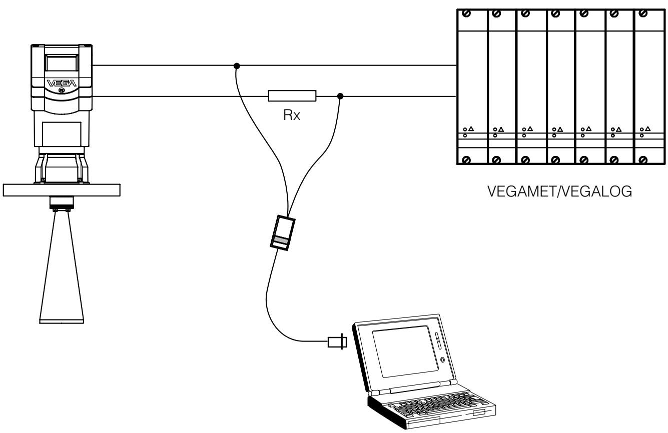
PC on the signal cable
Connect the two-wire cable of VEGACONNECT 2 to the signal cable of the sensor. If the resistance of the systems (PLC, current source etc.) connected to the signal cable is less than 250 Ω, a resistor of 250 … 350 Ω must be connected to the signal cable during adjustment (next page). The digital signals superimposed on the signal cable would otherwise be considerably damped or even short-circuited due to insufficient system resistance, resulting in faulty communication 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


+
-
PLC
Ri ≥ 250 Ω


+
250 Ω
-
PLC
Ri < 250 Ω


Rx
VEGAMET/VEGALOG

Adjustment with the PC

In chapter "2.2 Configuration of measuring systems“, connection of the PC to different measuring systems is shown. The PC with the adjustment program VVO version ≥2.60 (VEGA Visual Operating) can be connected to the
- sensor
- signal cable.

Note:
Please note that for adjustment of VEGAPULS 42 and 44 sensors, the adjustment program VVO version 2.60 or higher is required.

In the following setup and adjustment instructions you will find information on the following topics and adjustment points:

- Configuration
  - configuration info
  - create new/modify measurement loop
- Parameter adjustment 1
  - measurement loop info
  - adjustment
  - conditioning/scaling
- Sensor optimisation
  - meas. environment/operating range
  - meas. environment/meas. conditions
  - meas. environment/sound velocity
  - echo curve
  - false echo storage
- Parameter adjustment 2 (optional)
  - linearisation
  - defining the linearisation curve by incremental filling
  - calculating the linearisation curve
  - calculating a cylindrical tank
  - parameter adjustment current output and sensor display
- Simulation

Configuration and parameter adjustment

During the setup of the sensor you are confronted with two terms: "Configuration“ and "Parameter adjustment“. The meas. system is first set up with a configuration and then with a parameter adjustment.

Configuration
The term "Configuration“ means the basic adjustments of the meas. system. You inform the meas. system about the application (level measurement, gauge, distance …), the measurement loop name and the DCS output address of the sensors. The configuration represents an electronic wiring and labelling of your sensor or, in other words, telling the system which sensor for what application and where.

Parameter adjustment
After the configuration, you carry out the parameter adjustment for each individual sensor. This means adjusting the sensors to the respective operating range and adapting them to the specific application. You inform the sensor which product distance (which level) is "empty“ and which "full“. This is called adjustment. Here you choose in which physical unit (volume, mass) and unit of measurement (m^3, gal, liters …) the adjusted measured value should be outputted. In the submenu "Sensor optimisation“, you inform the sensor electronics about the actual environment, such as e.g. quick changes of the measured value, foam generation, gas stratification, solid or liquid.

Before starting the setup:
Do not be confused by the many pictures, adjustment steps and menus on the following pages. Just carry out the setup with the PC step by step and you will soon no longer need the following instructions. Actions, like entering a value or making a choice, are indicated in the following by a large black dot, like this:
- Choose …
- Start …
- Click to …

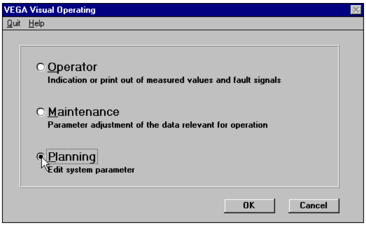
By this convention, the actions to be carried out are clearly separated from supplementary information in the following adjustment instructions.

You have already connected the PC with the adjustment software VVO to your measuring system.

- Now switch on the power supply of the connected sensor.

In the first 10 … 15 seconds the sensor starts to draw a current of approx. 22 mA (self-test) and immediately after, a level-proportional, i.e., distance-proportional current of 4 … 20 mA.

- Switch on the PC and start the adjustment software VVO.

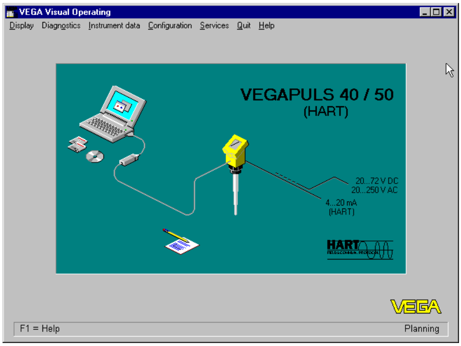


- Choose with the arrow keys or the mouse the item "*Planning*" on the entrance screen and click to "*OK*".

You are asked for the user identification.

- Enter under name "**VEGA**".
- Also enter "**VEGA**" under password.

The adjustment program VEGA Visual Operating (VVO), called in the following VVO, gets into contact with the connected sensor …



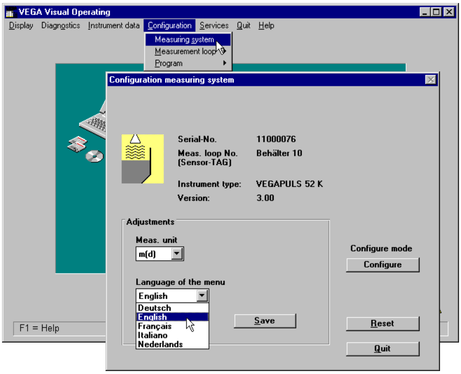
… and indicates after a few seconds if and with which sensor a connection exists.

Note:
When connecting the adjustment software (VVO) to a sensor from which data has already been saved, you are asked if the saved data should be transferred to the sensor or if you want to transfer the sensor data to the database of VVO (and the available data of the current sensor will be overwritten).

If you don't get communication with the sensor, check the following:
- Is the sensor being supplied with sufficient voltage (min. 14 V)?
- When VEGACONNECT 2 is connected to the signal cable, is the resistance of signal cable, processing system and load resistance 250 … 350 Ω?
- Did you inadvertently use a VEGACONNECT instead of the new VEGACONNECT 2?
- Did you connect VEGACONNECT 2 to COM1 on the PC?

Configuration

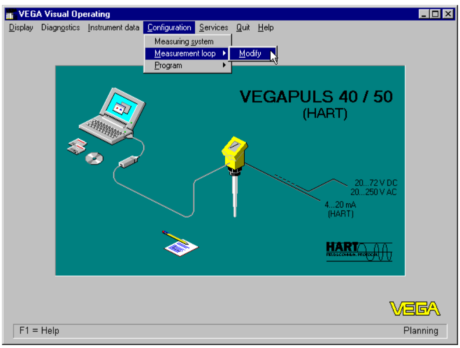
Configuration info



- Choose the menu "Configuration/Measurement loop“, to get further information on the sensor type, the software version of the sensor, the measuring unit, the measurement loop designation etc.
- Click to "*Quit*“.

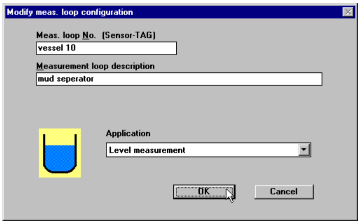
Create new/modify measurement loop

- Click to the menu *"Configuration/Measurement loop/Modify“*. This is the first step in setting up the sensor.



In the menu "*Modify meas. loop configuration*“ you can give a name (e.g. vessel 10) and a description (e.g. sludge separator) to the measurement loop.

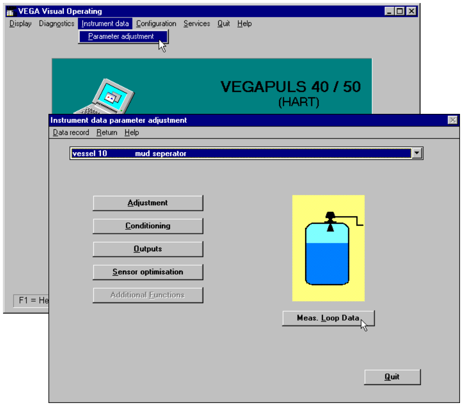
- Now enter in this menu whether a level, a distance or a gauge should be measured and click to "*OK*“.



Parameter adjustment 1

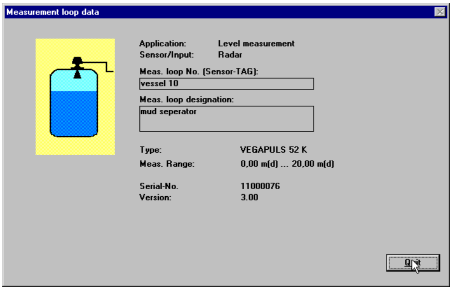
Meas. loop data

- Click to the menu item "*Instrument data/ Parameter adjustment*“.



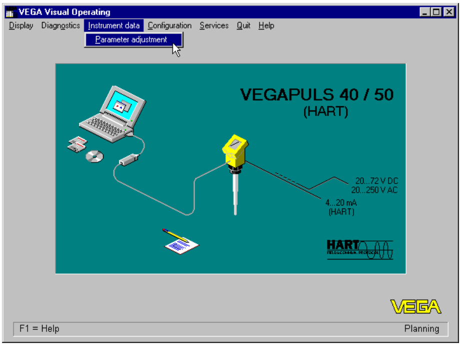
You are now in the initial menu window „*Instrument data parameter adjustment*“.

- Click to the menu item "*Meas. loop data*“.



In the window *"Measurement loop data"*, all sensor data are displayed.

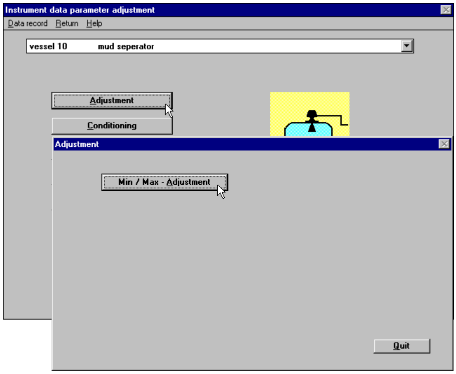
Adjustment



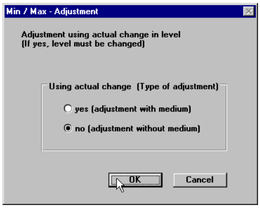
- Now choose the menu "***Parameter adjustment***".

In the menu "*Instrument data/Parameter adjustment*" you now carry out all important sensor adjustments. In the heading you now see the previously entered measurement loop name and the measurement loop description.

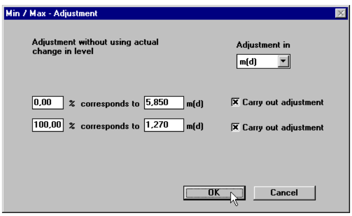
- Choose in the menu window "*Instrument data parameter adjustment*" "***Adjustment***".



- Click to "***Min/Max-Adjustment***".



You can carry out the min./max. adjustment with medium or without medium. Generally you will carry out the adjustment without medium. When you want to carry out the adjustment with medium, you have to carry out the min. adjustment with emptied vessel and the max. adjustment with filled vessel.



It is convenient and quick to carry out the adjustment without medium, as shown in the example.

- Choose if you want to carry out the adjustment in *meters* (m) or in *feet* (ft).
- Enter a distance for the upper and lower level and the extent of filling in % corresponding to each distance.

In the example, the 0 % filling is at a product distance of 5.850 m and the 100 % filling at a product distance of 1.270 m.

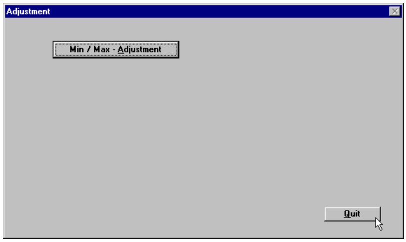
- Confirm with "*OK*".

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

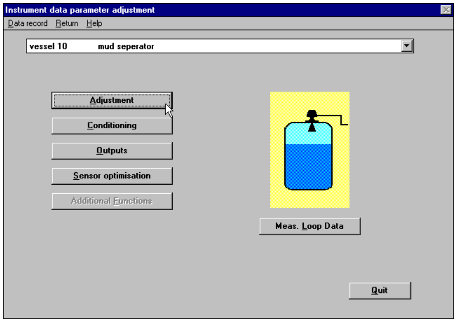
You are again in the menu "*Adjustment*". The sensor electronics has two characteristics points from which a linear proportionality between product distance and the percentage of filling of the vessel is generated.

Of course, the characteristics points must not necessarily be at 0 % and 100 %, however they should be as far apart as possible (e.g. at 20 % and at 80 %). The difference between the characteristics points for the min./max. adjustment should be at least 50 mm product distance. If the characteristics points are too close together, the possible measuring error increases. Ideal would be to carry out the adjustment, as shown in the example, at 0 % and at 100 %.

In the menu "*Instrument data/Parameter adjustment/Conditioning/Linearisation*", you can enter later, if necessary, a correlation between product distance and % extent of filling other than linear.



- Click in the menu "*Adjustment*" to "***Quit***".

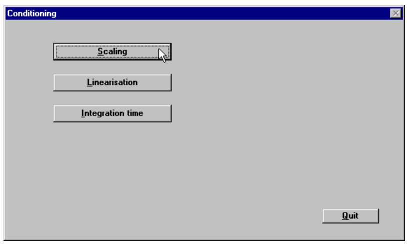


You are again in the menu window "*Instrument data parameter adjustment*".

Conditioning/Scaling

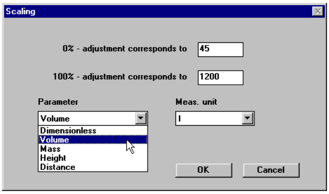
- Click to "*Conditioning*".

The menu window "*Conditioning*" opens.



- Click to "***Scaling***".

In the menu "*Scaling*“, you allocate a unit of measurement and a numerical value to the 0 % and the 100 % values of the physical quantity. You thereby inform the sensor, e.g. that at 0 % filling there are still 45 liters and at 100 % filling 1200 liters in the vessel. The sensor display then shows with empty vessel (0 %) 45 liters and with full vessel (100 %) 1200 liters.



As physical quantity you can choose *"dimensionless* (plain numbers), *volume, mass, height and distance“* and assign an appropriate unit of measurement (e.g. l, hl). The sensor display then shows the measured value in the selected physical quantity and unit.

- Save the adjustments in the menu "*Scaling*“ by clicking **"***OK***“**.

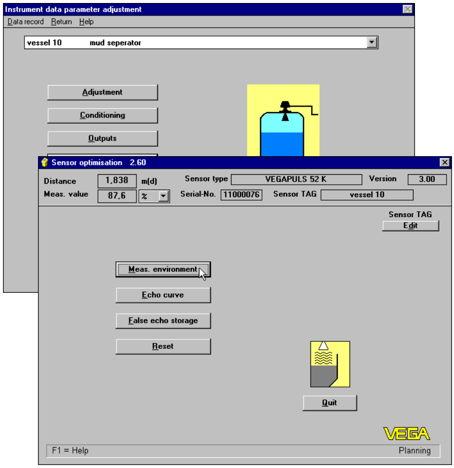
The adjustments are now transferred to the sensor.

Sensor optimisation

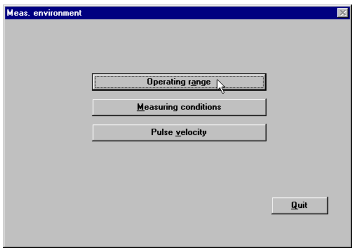
In the menu "*Sensor optimisation*" you adapt the sensor to the specific meas. environment.

Meas. environment/Operating range

- Choose in the menu window "*Instrument data parameter adjustment*“ the menu item **"***Sensor optimisation***“**.



- First click to **"***Meas. environment***“**.

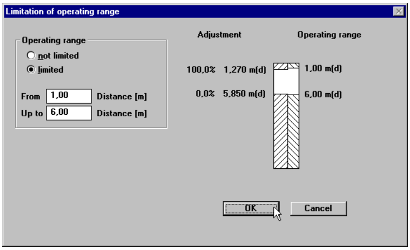


- Click in the menu window "*Meas. environment*“ to "***Operating range***“.

With the menu item "*Operating range*", you can define the operating range of the sensor deviating from the "*Min/Max adjustment*". By default, the operating range corresponds otherwise to the min./max. adjustment, i.e. the span.

Generally, it is better to choose the operating range approx. 5 % bigger than the adjusted measuring range (span) determined by the min./max. adjustment.
In the example:
- Min. adjustment to 1.270 m,
- Max. adjustment to 5.85 m.

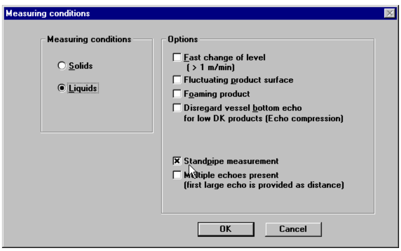
In the example you would have set the operating range from 1 m to 6 m.



- Save the adjustments and quit the menu window "*Limitation of the operating range*".

Meas. environment/Meas. conditions

- Click to "***Measuring conditions***".
- In the menu window "***Measuring conditions***" you click on the options corresponding to your application.

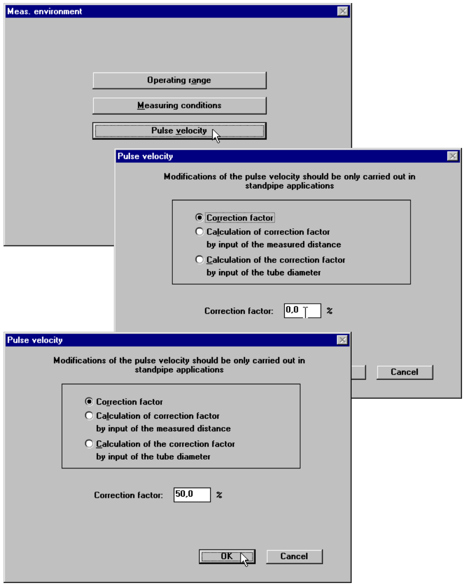


- Confirm with "*OK*".

After a few seconds during which the adjustments are permanently saved in the sensor, you are again in the window "*Meas. environment*".

Meas. conditions/Pulse velocity

In the menu item "*Pulse velocity*" adjustments are only necessary when measuring in a surge or bypass tube (standpipe). When measuring in a standpipe, a shift of the running time of the radar signal (dependent on the inner diameter of the standpipe) occurs. To take this running time shift into account, it is necessary to inform the sensor in the menu of the tube inner diameter.

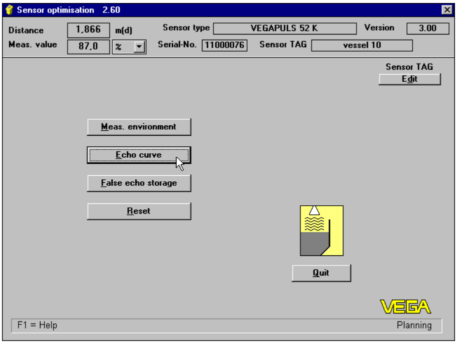


In the menu point "*Pulse velocity*", it is additionally possible to set manually a correction factor for the pulse velocity (light velocity) of the radar signal.

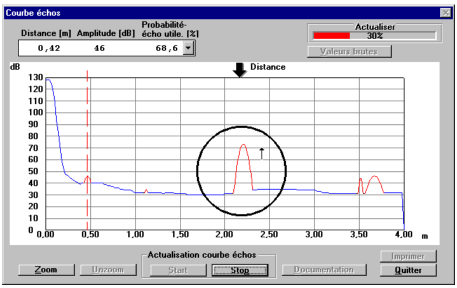
- If you want to make no adjustments, quit this menu with "*Quit*".
- With "*OK*" you save the adjustments made.
- Click in the menu window „*Meas. environment*" to "*Quit*".

You are again in the menu window „*Sensor optimisation*".

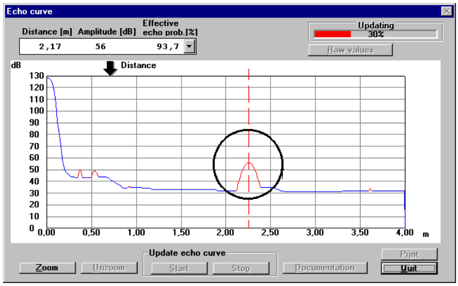
Echo curve



With the menu item "*Echo curve*" in the menu window "Sensor optimisation", you can see the course and the strength of the detected radar echo. If, due to vessel installations, you expect strong false echoes, a correction (if possible) of the mounting location and orientation (during simultaneous monitoring of he echo curve) can help localise and reduce the size of the false echoes. In the following illustration, you see the echo curve with the false echo nearly as large as the product echo (before correction of the sensor orientation, i.e. pointing it directly at the product surface).

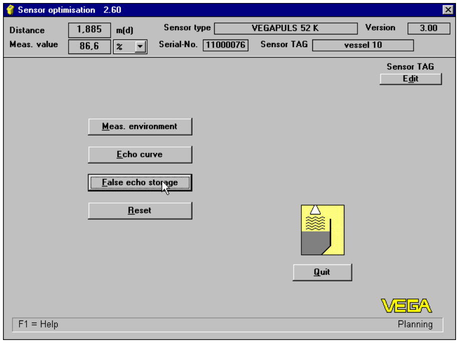


In the next illustration, you see the echo curve after optimum directing of the sensor to the product surface (sensor axis perpendicular to the product surface). The false echo, e.g. caused by a strut, is now reduced by more than 10 dB and will no longer influence the measurement.



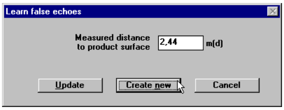
- Quit the menu "*Echo curve*" with "*Quit*".

False echo storage

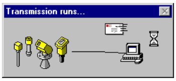


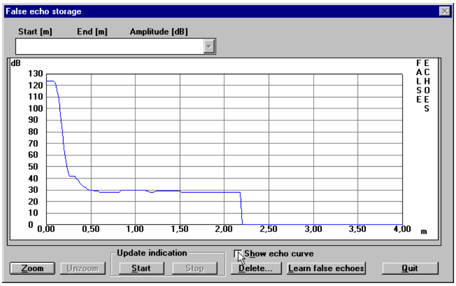
With the menu item "*False echo storage*" in the menu "*Sensor optimisation*", you can authorise the sensor to save false echoes. The sensor electronics then saves the false echoes in an internal database and assigns them a lower level of importance than the useful echo.

- Click in the menu window "*Sensor optimisation*“ to the menu item **"*False echo storage*“**.
- Now click in the opening menu window "*False echo storage*“ to **"*Learn false echoes*“**. The small window "*Learn false echoes*“ opens.
- Enter here the verified product distance and click to **"*Create new*“**.

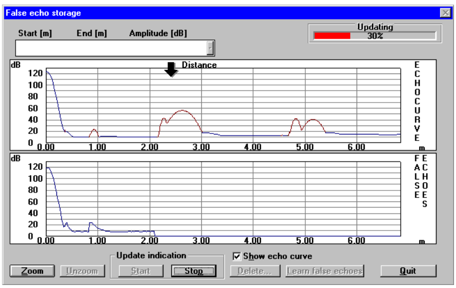


You hereby authorise the sensor to mark all echoes before the product echo as false echoes. This prevents the sensor from erroneously detecting a false echo as level echo.





- Click to **"*Show echo curve*“**.



The echo curve and the false echo marking are shown.

- Quit the menu with **"*Quit*“**.

You are again in the menu window "*Sensor optimisation*“.

With the menu item "*Reset*“ you reset all options in the menu "*Sensor optimisation*“ to default.

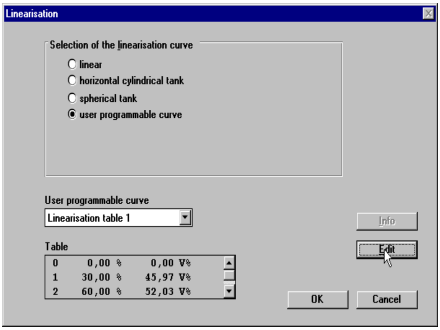
- Quit the menu window "*Sensor optimisation*“ with **"*Quit*“**.

Linearisation

If, in your vessel, there is a correlation other than linear between product distance and the % value of the filling, choose the menu item "*Linearisation*“ in the menu window "*Conditioning*“.

- Click to "***Linearisation***“.

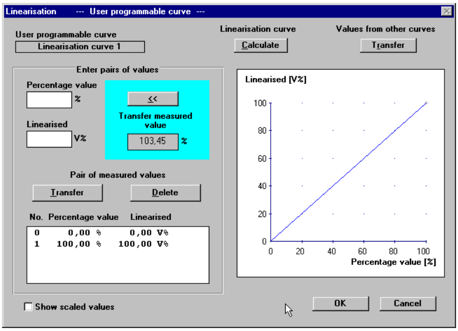
The menu window "*Linearisation*“ opens.



A linear correlation between product distance (in %) and filling volume (in %) has been preset. Beside the two programmed linearisation curves "*Cylindrical tank*“ and "*Spherical tank*“ you can also enter "*user programmable curves*“. Linear means that there is a linear correlation between level and volume.

User programmable linearisation curves

- Click to "*User programmable curve*" to enter your own vessel geometry or a user programmable filling curve.
- Click to "*Edit*".

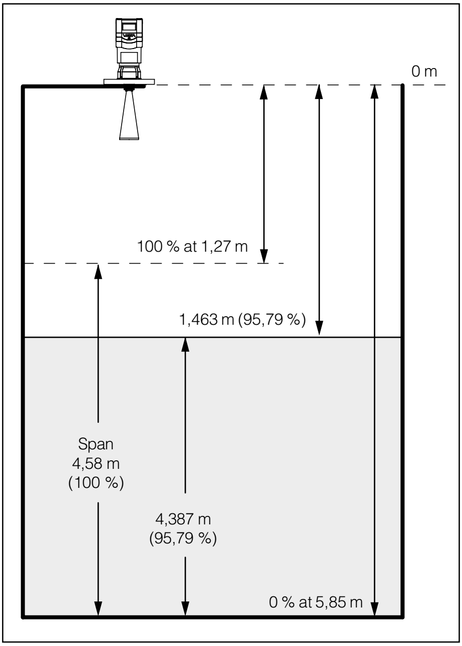


The user-programmable linearisation curve is generated by index markers. Each index marker consists of a value pair. A value pair is composed of a value "*Linearised*" and a value "*Percentage value*". *"Percentage value"* represents the percentage value of level. "*Linearised*" represents the percentage of vessel volume at a certain percentage value of the level.

In the field "*Transfer measured value*" the current level as a percentage of the adjusted span is displayed. The measuring span has already been adjusted with the min./max. adjustment. In the example, the span is 4.58 m and is between 5.85 m (empty) and 1.27 m (full), see the following illustration.

5.85 m meas. distance correspond to 0 % level. 1.27 m meas. distance correspond to 100 % level. The span is therefore 4.58 m (5.85 m – 1.27 m = 4.58 m).

A percentage value of 95.79 % then means that 4.387 of the adjusted span (4.58 m) has been reached:
4.58 • 0.9579 = 4.387 m.

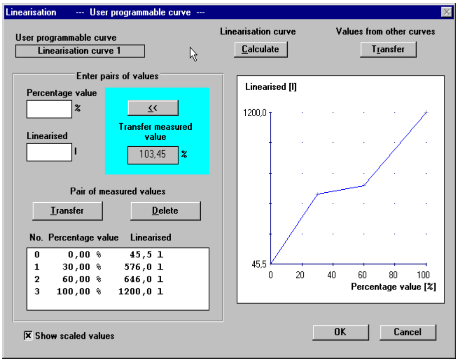


The distance (product distance) outputted by the sensor, if you have chosen "*Distance*", is then:
5.85 – (4.58 • 0.9579) = 1.463 m.
If the index markers or value points of your vessel are not known, you must gauge the vessel incrementally or calculate it with the vessel calculation program of VVO.

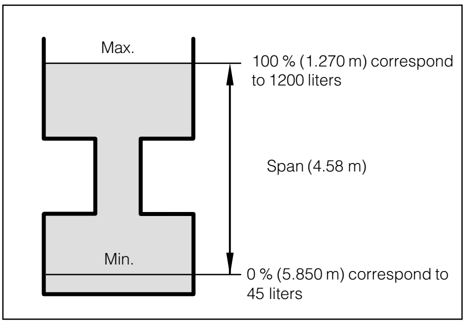
Defining the linearisation curve by incremental filling

In the characteristics of the example, you see four index markers or value pairs. There is always a linear interpolation between the index markers. The example vessel consists of three cylindrical segments of different height and diameter. The middle segment has a considerably smaller diameter.

- Click in the check box "***Show scaled values***", to have the selected unit of measurement displayed on the y-axis (left bottom part in the menu window).



Index marker 1 is at 0 % filling (*percentage value [%]*), corresponding in the example to an actual distance to the product surface of 5.850 m (empty vessel). The volume value is 45 liters (fluid remaining in the vessel). Index marker 2 is at a filling level of 30 % (30 % of the meas. distance of 1.270 m … 5.850 m). At a filling level of 30 %, there are 576 liters in the vessel (in our example).
Index marker 3 is at a filling level of 60 %. At this filling level there are 646 liters in the vessel.
Index marker 4 is at a filling level of 100 % (product distance 1.270 m), where 1200 liters are in the vessel.



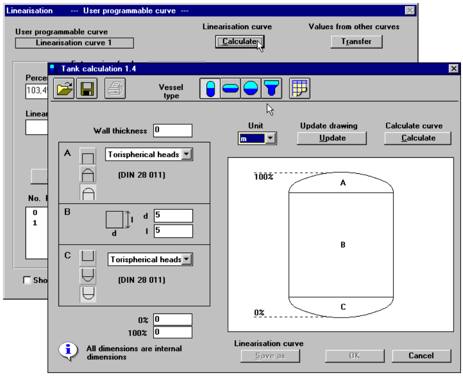
Max. 32 index markers can be entered per linearisation curve (value pairs).

Calculating the linearisation curve

(use previous tank example)

In the menu window "*Linearisation -- user programmable curve* --" you can start the vessel calculation program. With the vessel calculation program you can calculate (using dimensions from the technical drawings of the vessel) the correlation of filling height to filling volume. If the curve is defined this way, gauging by incremental filling is not necessary - your sensor can then output volume as a function of level.

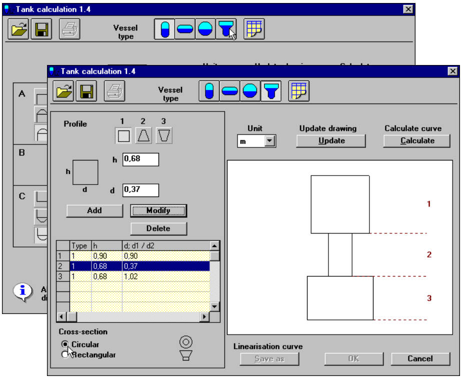
- Click to "*Calculate*".



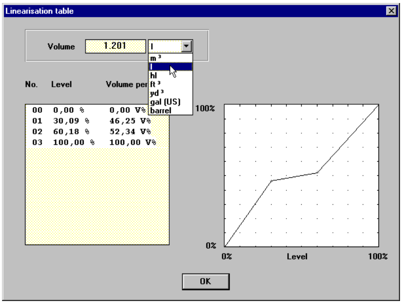
The tank calculation program starts. In the top left corner you choose the vessel type (upright tank, cylindrical tank, spherical tank, individual tank form or matrix). When choosing matrix, you can enter a user programmable linearisation curve by means of index markers. This corresponds to the entering of value pairs (linearisation points), as previously described.

In the following example, the tank calculation program calculates the linearisation curve of a vessel corresponding to the vessel in the previous gauging example.

- Click to "*individual tank form*" and choose three round tank segments with the dimensions 0.88 m • 0.9 m (height by diameter), 0.66 m • 0.47 m and 0.66 m • 1.12 m (this tank form corresponds to the tank form of the gauging example).

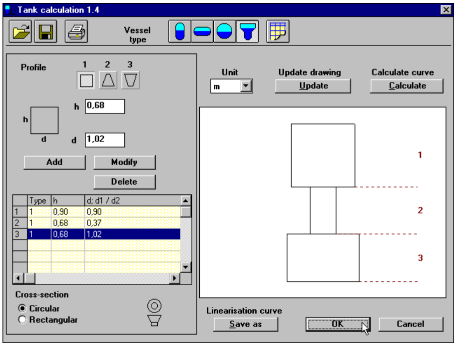


- Click to "*Calculate*".



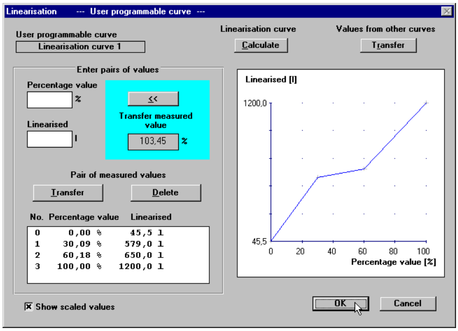
After a short calculation time, the levels as a percentage of span and the corresponding volume percentages are shown. The outputted curve shows this correlation in a diagram.

- Quit the linearisation table with „*OK*".



You are again in the menu window "*Tank calculation*".

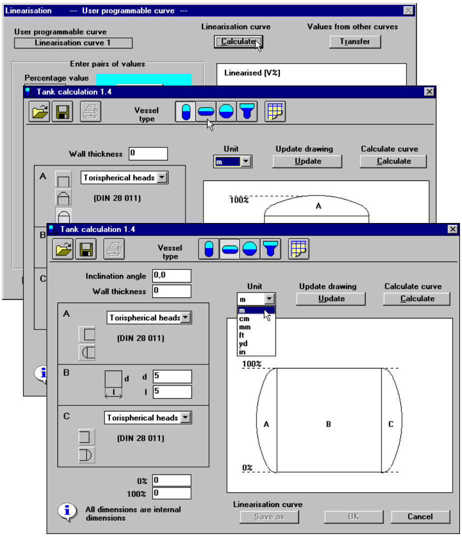
- Click to „*OK*" to save the tank calculation.



You are again in the menu window "*Linearisation -- user programmable curve --*". The volume percentages, with the corresponding level percentages, are shown as scaled values (liters in this example), if you have clicked in the check box in the bottom left corner of the window.

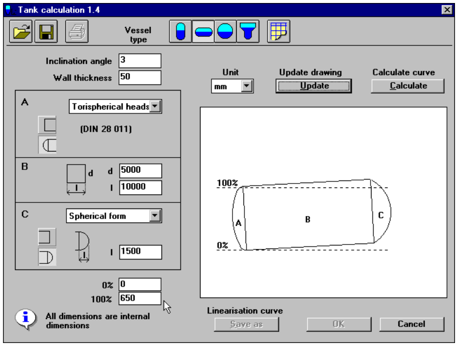
Calculate cylindrical tank

- Click in the menu window "*Linearisation -- user programmable curve --*" to "*Calculate*" and in the menu window "*Tank calculation*" to the symbol for cylindrical tanks.



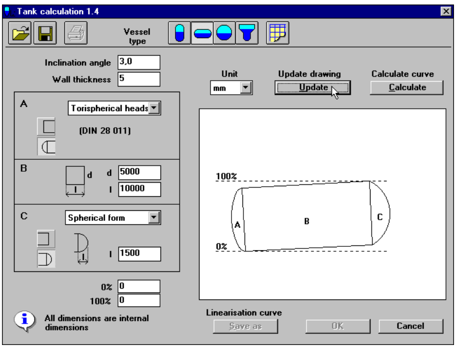
The entering of a wall thickness is only necessary for the calculation of the dished boiler end as its mathematical calculation is based on the outer dimension.

The calculation program calculates by means of the vessel inner dimensions the vessel volume. Above the information *"All dimensions are internal dimensions*", you will find two fields with the percentage values 0 % and 100 %. Here you can shift the 100 % line or the 0 % line. In the example, the 100 % filling line was defined at a distance of 650 mm from the upper vessel edge (inside).



- Choose the "***Meas. unit***", e.g. mm, that should apply to the entered vessel dimensions.

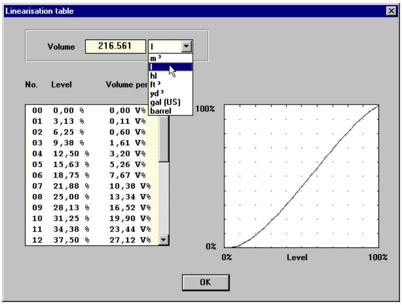
The following example shows how to enter a cylindrical tank that is inclined by 3° and has a cylinder length of 10000 mm and a diameter of 5000 mm. The cylindrical tank has a 1500 mm wide, spherical form at the right end and a dished tank form at the left.



In the bottom left corner in the menu window "*Tank calculation*" you find the information "*All dimensions are internal dimensions*".

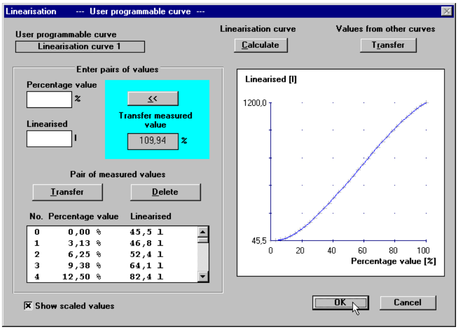
- Click to "*Calculate*".

You will get the calculated linearisation table after a short calculation time. By means of 32 linearisation points, a function correlating vessel volume to filling height is outputted. The example vessel has a filling of 216561 liters at the 100 % line or of 216.6 m^3. It is possible to output the volume value in barrels, gallons, cubic yards or cubic feet.



There is a linear interpolation between the linearisation points.

- Click to "*OK*" and you are again in the menu window "*Tank calculation*".
- Again click in the menu window "*Tank calculation*" to "*OK*" and you are in the linearisation menu.

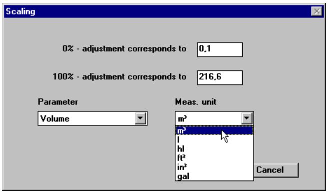


Here the calculated linearisation curve is again outputted. The volume information under "*Linearised*" now no longer corresponds to the calculated volume of the tank calculation program.

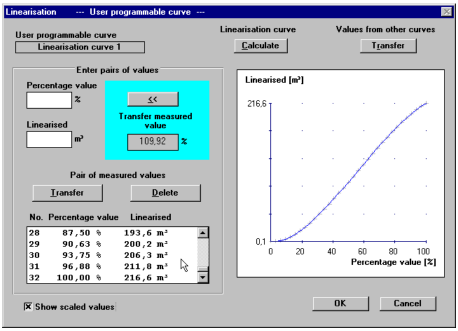
Why?

In the menu "*Scaling*" (Instrument data/Conditioning/Scaling) you entered earlier that at 0 % filling there are 45 liters in the tank and at 100 % filling 1200 liters. The geometry of the calculated cylindrical tank was accordingly scaled down to a size that indeed evaluates to a volume of only 1200 liters. The modified linearisation curve was then applied to the volume data that you entered in the menu "*Scaling*".

If the true content of the calculated vessel should be outputted, the volume that was determined by the tank calculation program must be entered in the menu "*Scaling*".



The sensor then outputs the actual filling volume calculated from the entered vessel dimensions.



- Quit the menu with "*OK*".
- Confirm with "*OK*" and your individual linearisation curve is saved in the sensor.

Again in the menu window "*Conditioning*", you can enter with the menu item "*Integration time*" a measured value integration. This is recommended for agitated product surfaces, to prevent rapid fluctuation of the output signal and the measured value indication. The standard setting is an integration time of 0 seconds.

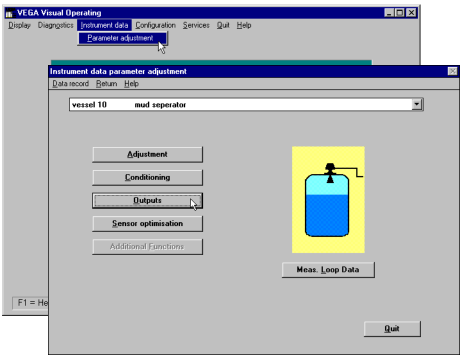
- Quit the menu with "*OK*".

You are again in the menu window "*Instrument data parameter adjustment*".

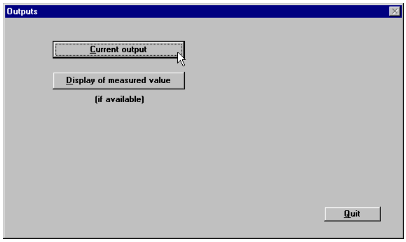
- Quit the menu window with "*OK*".

Parameter adjustment for current output and sensor display

- Choose "*Instrument data parameter adjustment*".



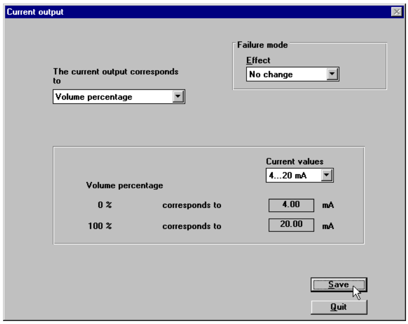
- Choose in the menu window "*Instrument data parameter adjustment*" the menu item „*Outputs*".



You are in the menu window "*Outputs*".

Parameter adjustment current output

With the menu item "*Current output*" you choose the menu window "*Current output*". Here you can adjust the signal condition of the 4 … 20 mA output signal.

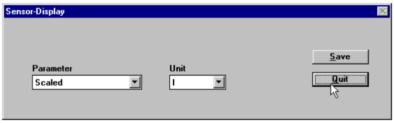


- Click to "*Save*", if you have made adjustments in this menu window.
- If the adjustments should remain unchanged, click to "*Quit*".

You are again in the menu window "*Outputs*".

Parameter adjustment sensor display

- Click in the menu window "*Outputs*" to the menu item "***Display of measured value***".



The menu window "*Sensor-Display*" opens. Here you can once again adjust the sensor display.

- Choose "***Scaled***", if the display should show your previous adjustments. In the example a level of 45 … 1200 liters would be displayed.
- Choose "***Volume percent***", if the level of 45 … 1200 liters should be displayed as percentage value of 0 … 100 %.
- Choose "***Distance***", to have the actual distance to the product surface displayed (in m).
- Choose "***Percent***", if you want to have the product distance from 1.270 to 5.850 m displayed as percentage value of 0 … 100 %.

With "***Save***" the adjustment is transferred to the sensor.

- Click in the window "*Sensor-Display*" to "***Quit***".
- Click in the window "Outputs" to "***Quit***".

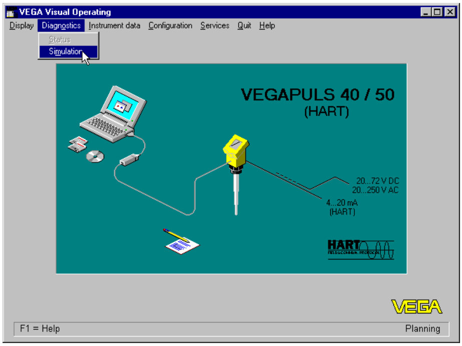
You are again in the menu window "*Instrument data parameter adjustment*".

Interface parameter adjustment
and
Display of measured value

See manual "VEGA Visual Operating".

Simulation

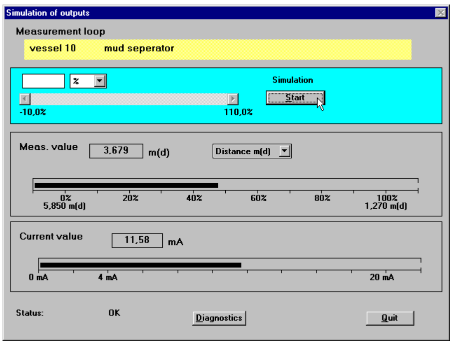
- Click to the menu "***Diagnostics/Simulation***".



The menu window "*Display of measured value*" opens. In this menu window you can also set the filling height in the vessel or the signal current and the indication display to any value (simulate measured value).

First of all, the actual measured value and the signal current are displayed.

- Click to "***Start***" in the turquoise window segment.



The grey scroll bar becomes active. With this scroll bar you can change the measured value to any value in the range of -10 % … 110 % and thereby simulate the filling or emptying of the vessel. In the input box of the turquoise window cutout you can enter any percentage value of filling.

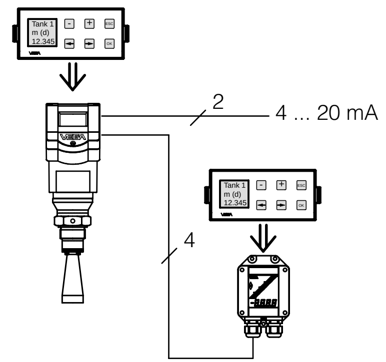
Note on the simulation mode:
One hour after the last simulation adjustment, the sensor automatically returns to standard operating mode. The display of measured value flashes during simulation.

Backup

See manual "VEGA Visual Operating".

6.3 Adjustment with adjustment module MINICOM

As with the PC, you can also adjust 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).



For the adjustment with adjustment module, all sensor versions (adjustment options), as with the PC and the adjustment program VVO, are available. There are some differences, however, with MINICOM. 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 entered value of a menu adjustment.

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 pages 80 and 81 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.

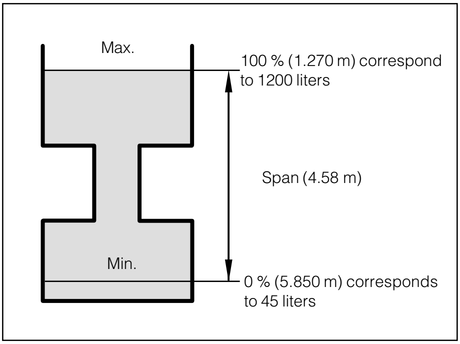
1. Measurement in a standpipe

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 display of measured value (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 use.

You can carry out the adjustment with or without medium. Generally you will carry out the adjustment without medium, as you can then adjust without an actual filling/emptying cycle.

Adjustment without medium
(adjustment independent of the level)

Key | Display indication

Sensor m(d) 4.700

OK — Para- meter

OK — Adjust- ment

OK — w.o medium

OK — Adjust- ment in m(d)

(min. adjustment)

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

OK — Confirm the adjustment with "*OK*“.

→ — Adjust- ment in m(d) | 0.0% at m (d) XX.XXX

+ or – — With "+“ and "–“ you adjust the percentage value for the min. value (example 0.0 %).

OK — The adjusted percentage value is written in the sensor and the distance of the min. value corresponding to the percentage value flashes.

+ or – — 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.

OK — 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*“.

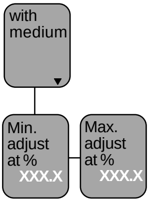
→ — 100.0% at m (d) XX.XXX

(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 the percentage value.

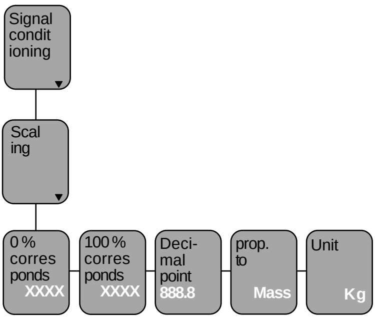
Note:
The difference between the adjustment values of the lower product distance and the upper product distance should be as big as possible, preferably at 0 % and 100 %. If the values are very close together, e.g. lower product distance indication at 40 % (3.102 m) and upper product distance adjustment at 45 % (3.331 m), the measurement will be inaccurate. 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 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.

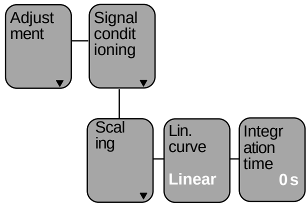
- Confirm with "*OK*".

With the "—>" key you change 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, ft^3, gal, m^3 …).

Linearisation:



A linear correlation between the percentage value of the product distance and percentage value of the filling volume is preadjusted. 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

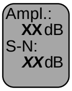
(see menu plan no. 5)
Choose „Liquid" or „Solid" and select the options corresponding to your application.

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. Signal-Noise divergence

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 schematic 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

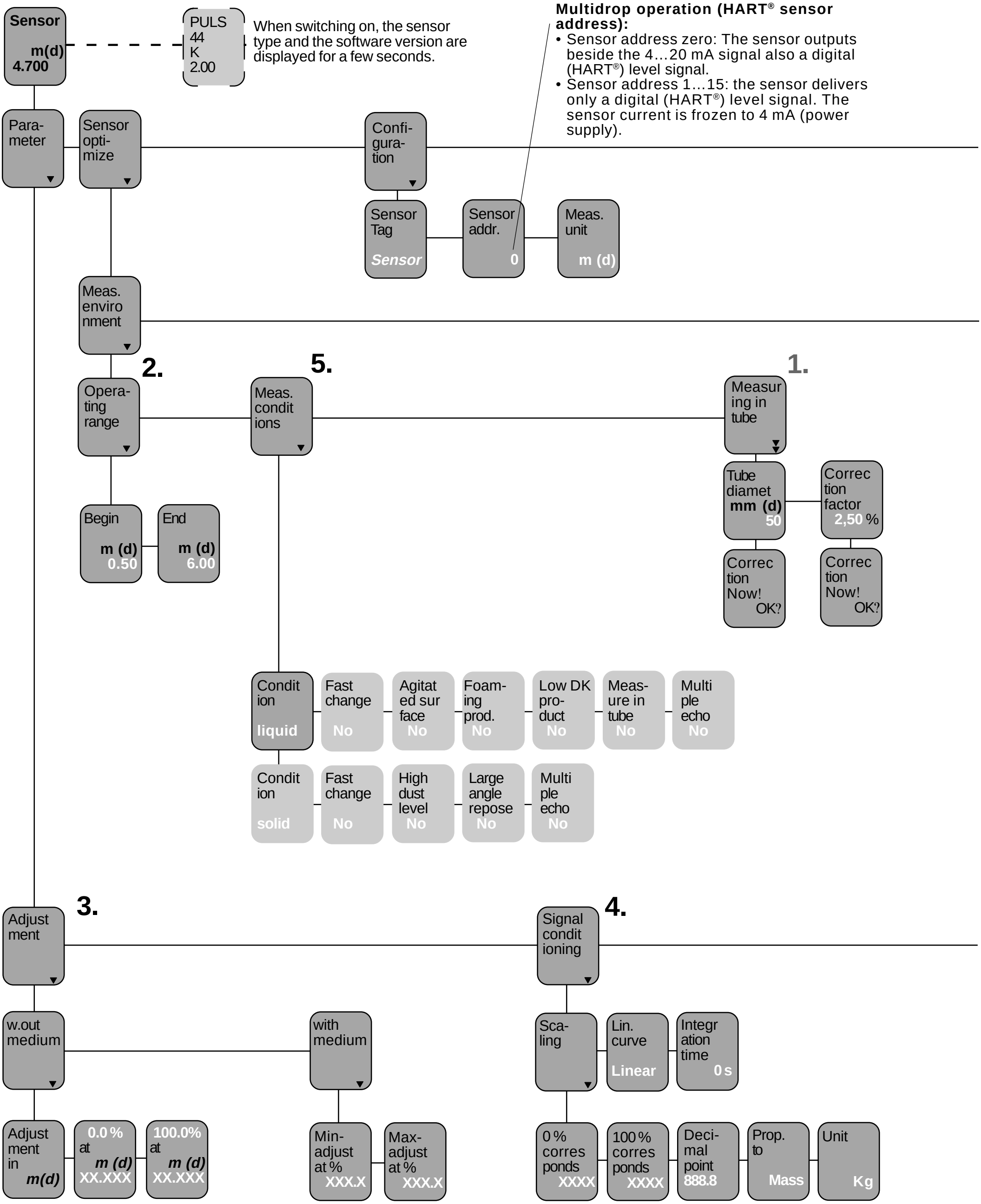
This means that the noise level is only
68 dB – 53 dB = 15 dB.

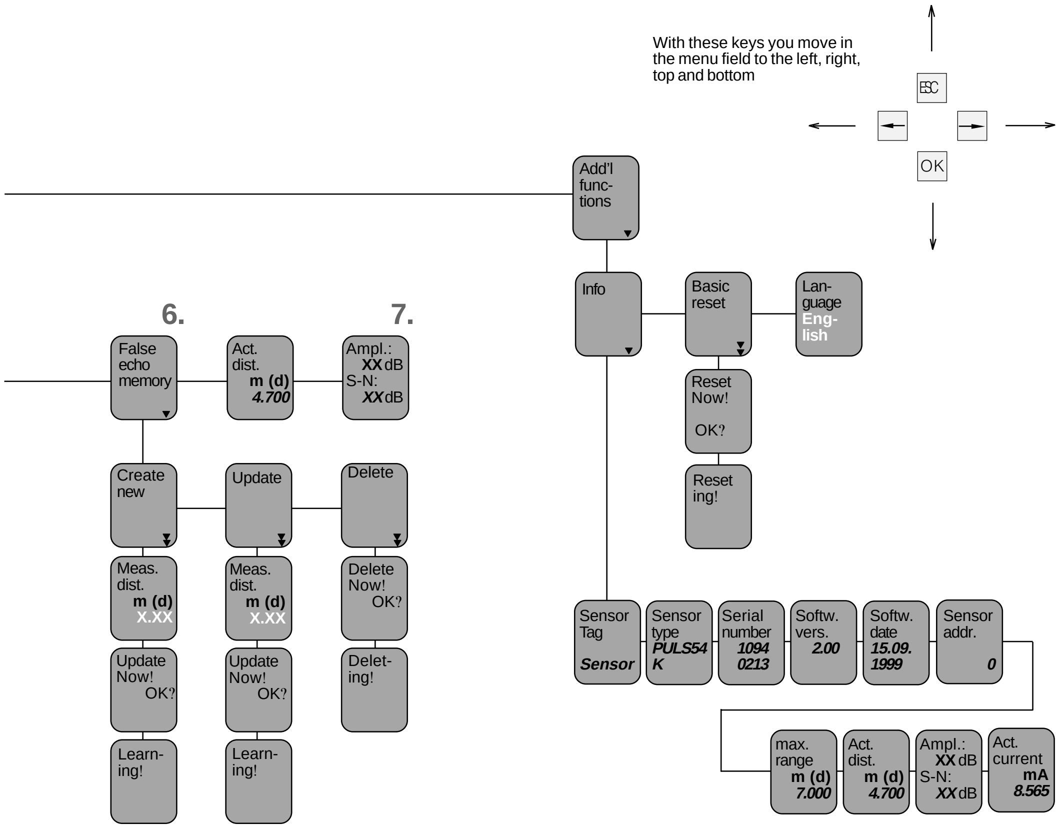
A 15 dB noise level with a 53 dB higher signal level would ensure a high degree of measurement reliability.

8. Outputs

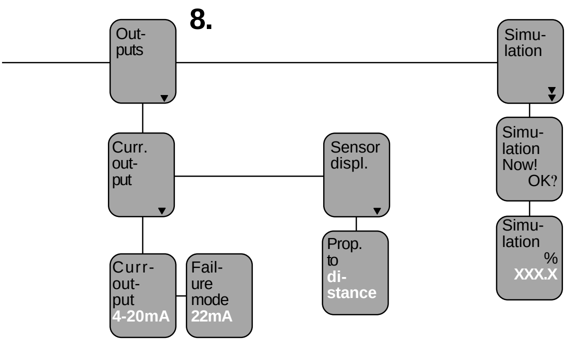
Under the menu "Outputs“ you determine, for example, if the current output should be inverted, or in which unit of measurement the measured value should appear in the sensor display.

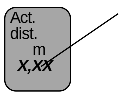
Menu schematic for the adjustment module MINICOM



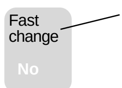


Simulation:
One hour after the last simulation adjustment the sensor returns automatically to normal operating mode.

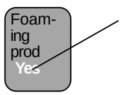




Menu items in bolt print provide sensor and measured value information and cannot be modified in this position.



Light grey menu fields are only displayed if required (dependent on the adjustments in other menus).

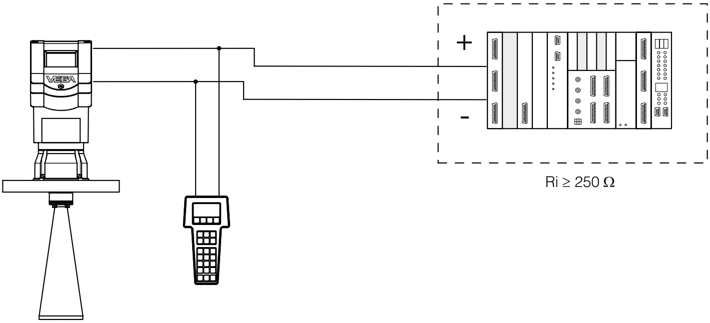


White menu items can be modified with the "+“ or "–“ key and saved with the "OK“ key.

6.4 Adjustment with HART® handheld

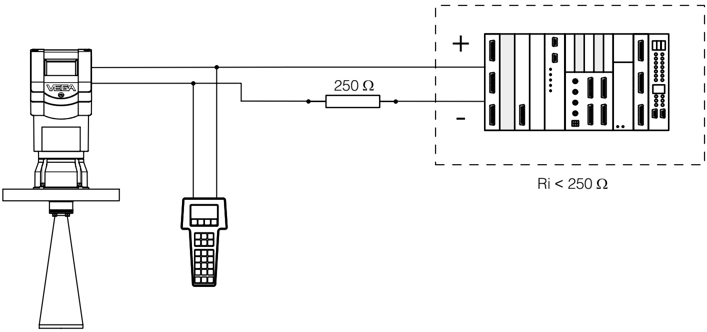
With any HART® handheld you can set up the VEGAPULS 40K radar sensors like all other HART® compatible sensors. A special DDD (Data Device Description) is not necessary.

Just connect the HART® handheld to the signal cable, after connecting 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.

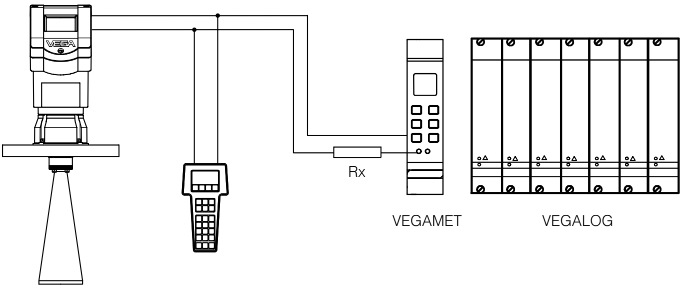
The digital adjustment and communication signals would otherwise be short-circuited due to insufficient resistance of the supply current source or the processing system, and as a result, communication with the sensor would not be ensured.



Connection to a VEGA signal conditioning instrument

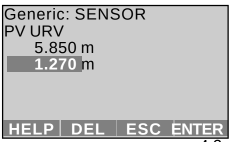
If you operate a HART® compatible sensor on a VEGA signal conditioning instrument, you have to connect the sensor via a resistor (see following table) during HART® adjustment in order to reach, together with the internal resistance of the instruments, the value of 250 Ohm required for the HART® instrument. 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



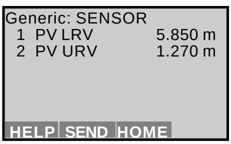
The most important adjustment steps

On the following pages you see 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. For parameter adjustment, first press the key "*ENTER*". The adjustment is thereby saved in the handheld, but not in the sensor itself.

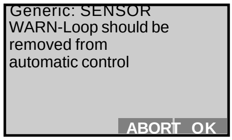


4.2
(5.2)

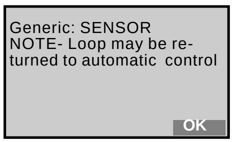
After having pressed "*ENTER*", press "*SEND*" (here in the example for the min. adjustment).



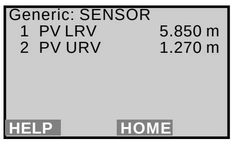
After pressing "*SEND*", a warning is displayed which informs you that you are about to modify the configuration, and that for safety reasons, you should switch your system over to manual operation.



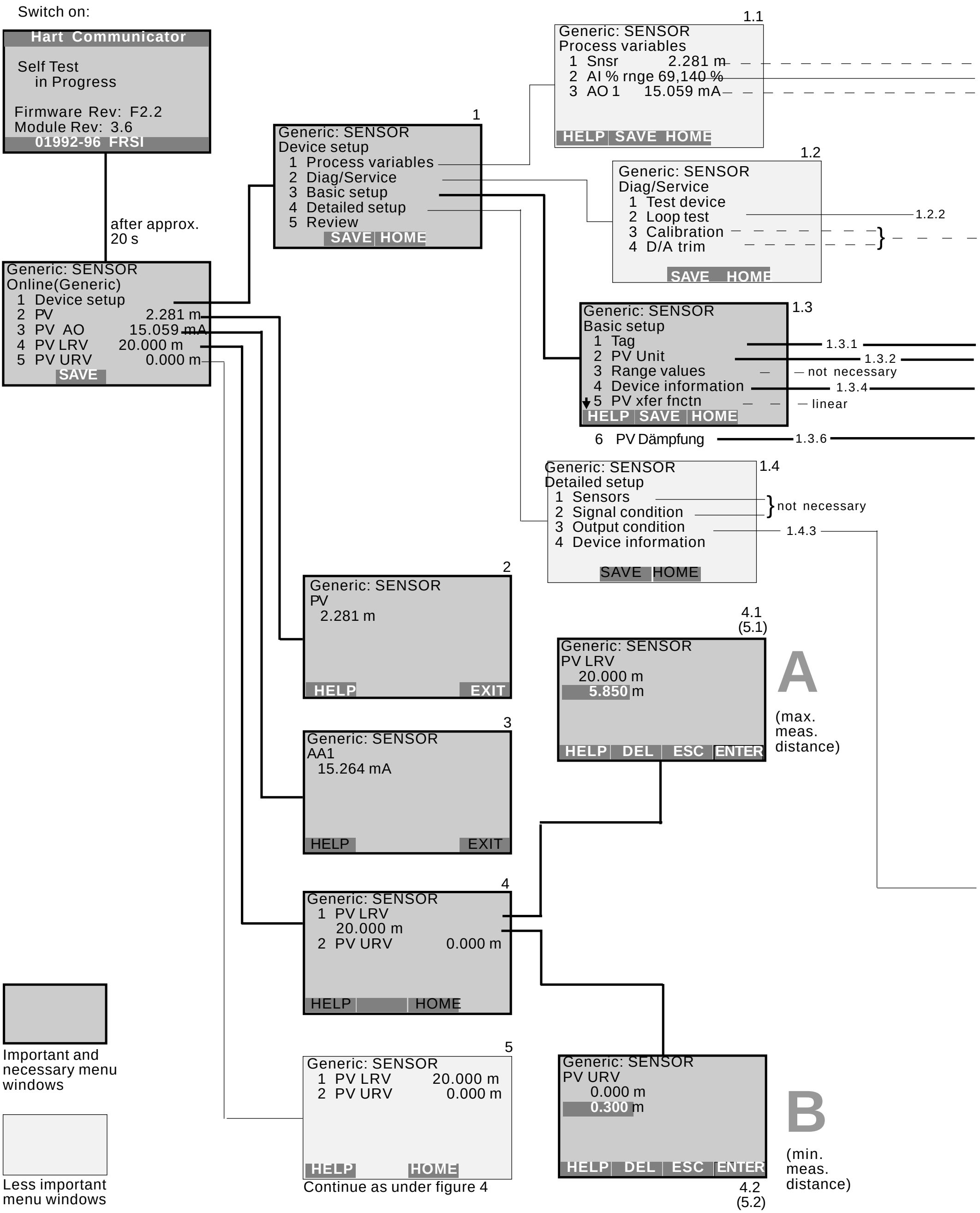
Press "*OK*" and the adjustment will now be transferred to the sensor. After a short time you are asked to switch your system over from manual to automatic operation. Confirm with "*OK*".



You see the adjustment that was just carried out.



HART® menu schematic VEGAPULS 42 and 44



Generic: SENSOR
PV
2.281 m
HELP EXIT

1.1.2
Generic: SENSOR
PV % rnge
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

Switch off control

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

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.

E

1.3.1
Generic: SENSOR
Tag
SENSOR
SENSOR
HELP DEL ESC ENTER

C

1.3.2
Generic: SENSOR
PV Snsr 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** — D
9 PV Sensr s/n — 1.3.4.9
Final asmbly num — 1.3.4.10
Revision #'s — 1.3.4.11

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 — 1.4.3.1
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

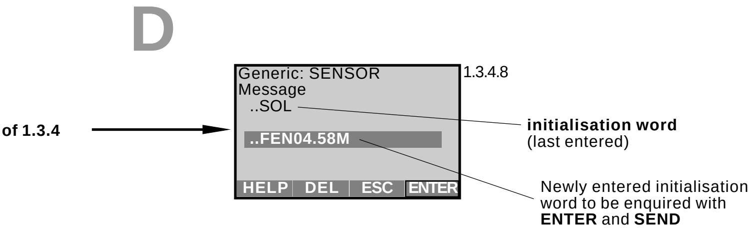
Multidrop operation (sensor address):
The sensor outputs beside the 4 … 20 mA signal also a digital (HART®) level signal:

- 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 VEGAPULS 42 and 44

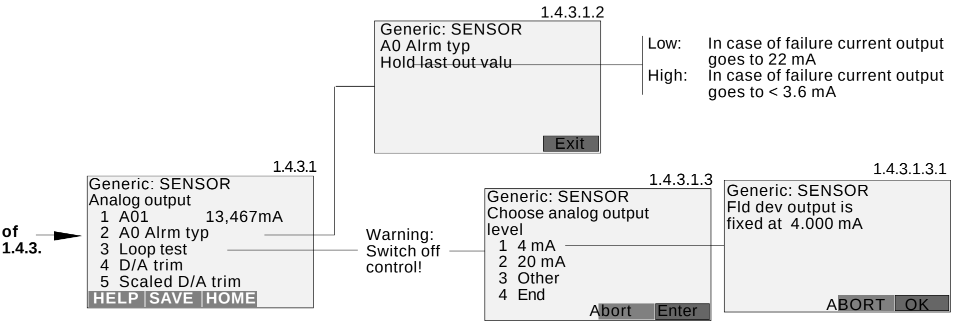
False echo storage
Normally this menu is only required for process vessels and difficult installation conditions



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.



7 Diagnostics

7.1 Simulation

For simulation of a certain 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 level 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.

7.2 Error codes

Error codes		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.

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ISO 9001

The statements on types, application, use and operating conditions of the sensors and processing systems correspond to the latest information at the time of printing.

Technical data subject to alterations

2.24 897 / May 2000