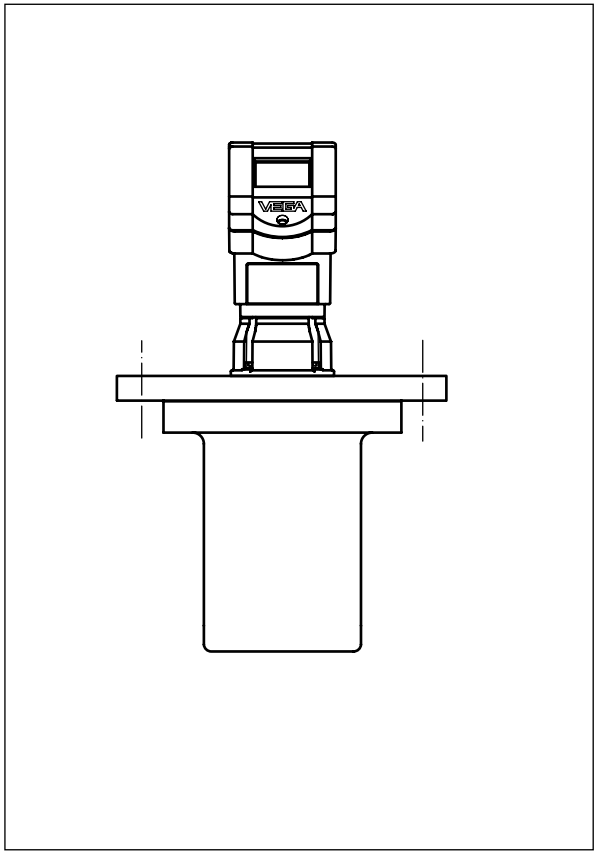
Level and Pressure

Operating Instructions

VEGAPULS 54K enamel



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.

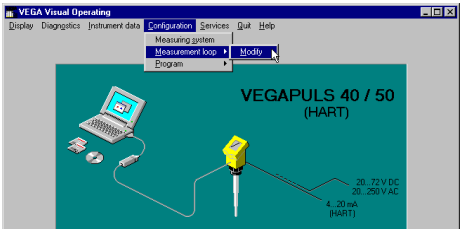
However, it is always useful, especially under arduous conditions (process tanks, stirrers, filling stream, vessel installations), to carry out a sensor optimisation, see chapter "6 Setup".

Quick start with the PC

Configuration

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

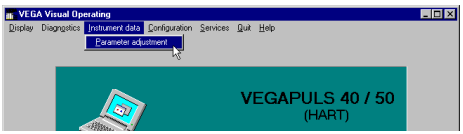
- Click to …



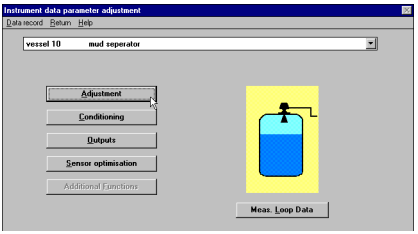
… and enter a name for the measurement loop.
- Choose under "*Application*" e.g. "*Level*".
- Confirm with "*OK*".

Adjustment

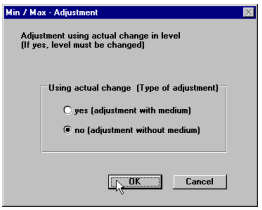
- Click to "*Instrument data/Parameter adjustment*".



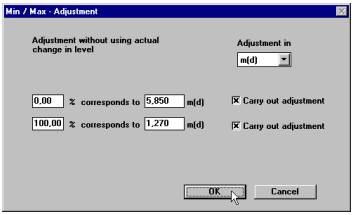
- Then click to "*Adjustment*".



- 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*".

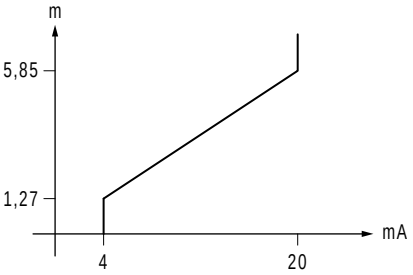


- Enter the distance of the sensor to the product surface at 0 % (empty) and at 100 % (full) in meters.
- Activate the two boxes "*Carry out adjustment*" and click to "*OK*".

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

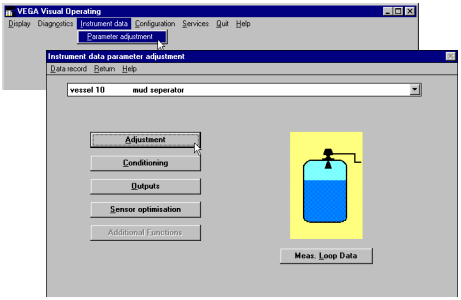
- Click in the window "*Adjustment*" to "*Quit*".

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



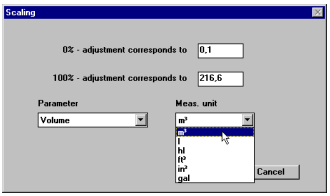
Scaling of the measured value display

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



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

The window ...

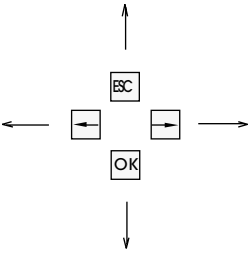


opens.

Allocate in the menu window "*Scaling*" a physical 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 liters in the vessel. The sensor display then shows 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.

Full adjustment

[→]

(Max. adjustment)

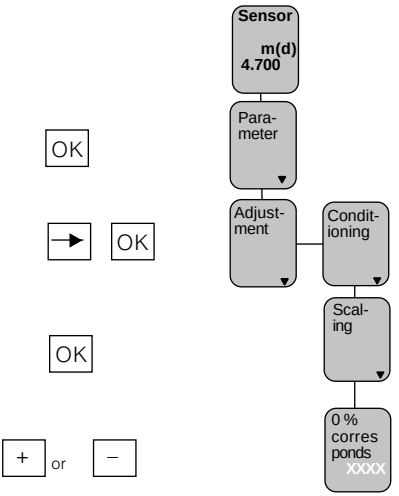
[+] or [–] Enter 100 %.

[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.

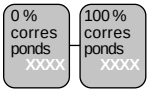
Scaling of measured value display

Key Display text



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

[→]



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

[→]

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

[→]

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

[→]

[+] or [–] Choose the unit, e.g. m³.

1 Product description

VEGAPULS series 50 sensors are a newly developed generation of very compact, small radar sensors.

Due to the small housing dimensions and process fittings, the compact sensors are very reasonably priced instruments for your level measurement applications. With the integrated display and the many features of the "big brothers“ of VEGAPULS series 81, they can be now used for applications where previously the non-contact principle of radar measurement could not be used due to high costs.

The VEGAPULS 54 radar sensor implements two-wire technology very effectively, but, it is also available as a four-wire version where the output signal and the power supply are led in separate circuits. In the two-wire version, the supply voltage and the output signal are transmitted via one two-wire cable. In both versions this sensor provides an analogue 4 ... 20 mA output signal as output or measuring signal.

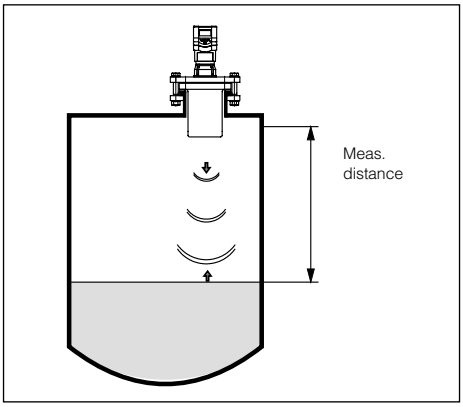
In the enamelled version, the sensors have exceptional chemical resistance, and represent an ideal level detecting solution for corrosive processes.

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

1.1 Function

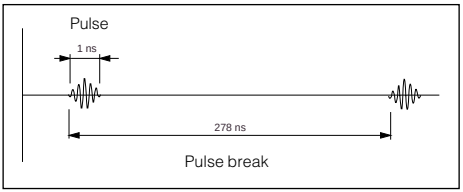
Meas. principle:

emission – reflection – reception
Smallest 5.8 GHz radar signals are emitted from the antenna of the radar sensor as short pulses. The radar impulses reflected by the sensor environment and the product are received by the antenna as radar echoes. The running period of the radar impulses from emission to reception is proportional to the distance and, hence, to the level.



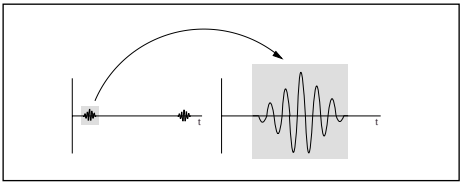
emission - reflection - reception

The radar impulses are emitted by the antenna system as impulse packets with a pulse duration of 1 ns and pulse intervals of 278 ns; this corresponds to a pulse package frequency of 3.6 MHz. During 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.



Pulse sequence

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



Time transformation

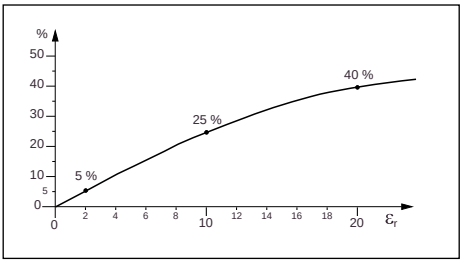
Hence, it is possible for the VEGAPULS 50 radar sensors to process the slow-motion pictures of the sensor environment precisely and in detail in cycles of 0.5 to 1 second without using time-consuming frequency analysis (e.g. FMCW, required by other radar techniques).

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 signal react to two basic electrical properties:
- the electrical conductivity of a substance
- the dielectric constant of a substance.

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



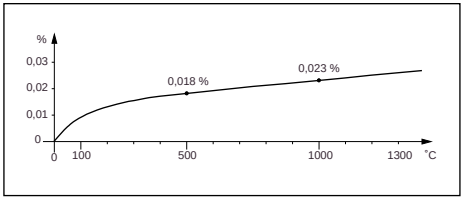
Reflected radar power dependent on the dielectric constant of the measured product

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

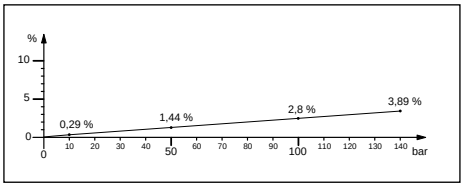
As process fitting, standard flanges of DN 150, DN 200, ANSI 6“ or ANSI 8“ are used. Due to a high quality enamel coating, the sensors withstand even extreme chemical and physical conditions. The sensors deliver stable, reproducible analogue or digital level signals with reliability and precision, and have a long useful life.

Continuous and reliable

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



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



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

VEGAPULS 50 enable level measurement with radar sensors on systems where they were previously not used due to high costs.

1.2 Application features

Applications
- level measurement of liquids, limited use in solids
- measurement also in vacuum
- all slightly conductive materials and all substances with a dielectric constant > 2.0 can be measured
- measuring range 0 … 20 m

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

Rugged and abrasionproof
- non-contact
- high resistance materials

Exact and reliable
- resolution 1 mm
- unaffected by noise, vapours, dusts, gas compositions and inert gas stratification
- unaffected by varying density and temperature of the medium
- measurement of pressures up to -1 … 16 bar and product temperatures of -40°C … 200°C

Communicative
- integrated display of measured value
- optional display module separate from sensor
- connection to all BUS systems: Interbus S, Modbus, Siemens 3964R, Profibus DP, Profibus FMS, ASCII
- adjustment from the PLC level with the PC
- adjustment with HART® handheld
- adjustment with detachable adjustment module, pluggable in the sensor or in the external display

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

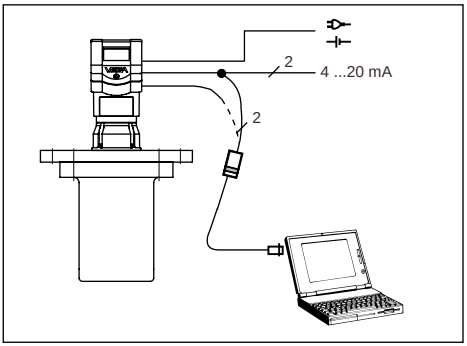
1.3 Adjustment

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 the radar sensors are carried out with
- the PC
- the detachable adjustment module MINI-COM
- the HART®- handheld

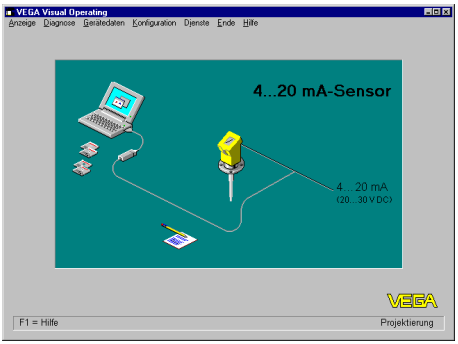
Adjustment with PC

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.

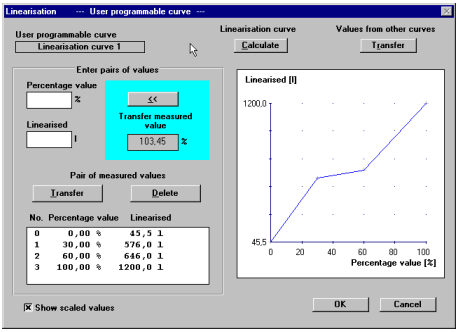


Adjustment with the PC on the analogue 4 … 20 mA signal and supply cable or directly on the sensor (four-wire sensor)

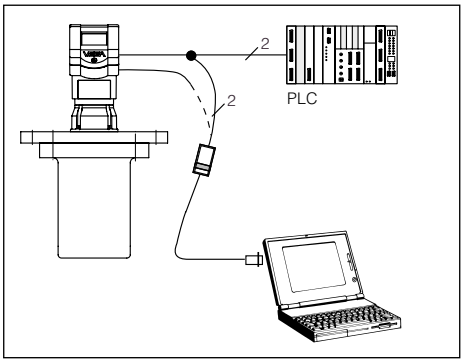
The PC can be connected to any individual position of the system or the signal cable. It is connected by means of the two-wire PC interface converter VEGACONNECT 2 to the sensor or the signal cable. The adjustment and parameter data can be saved with the adjustment software on the PC and can be protected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



The adjustment program recognises the sensor type



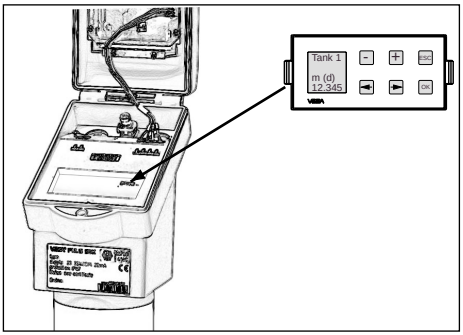
Visualised input of a vessel linearisation curve



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

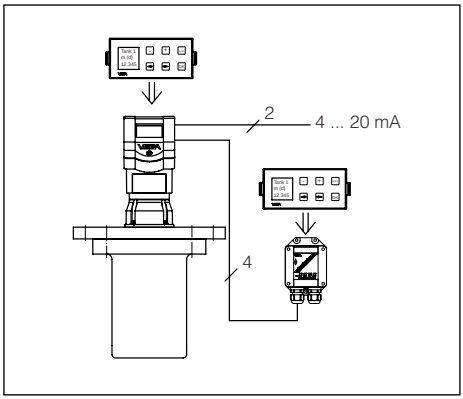
Adjustment with adjustment module MINICOM

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

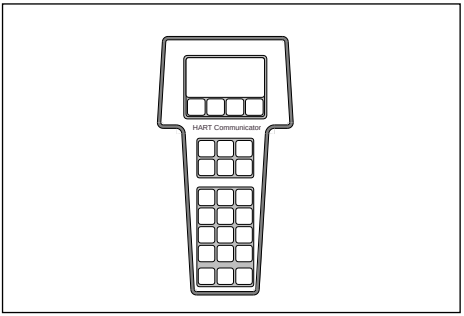
Unauthorised sensor adjustments can be prevented by removing the adjustment module.



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

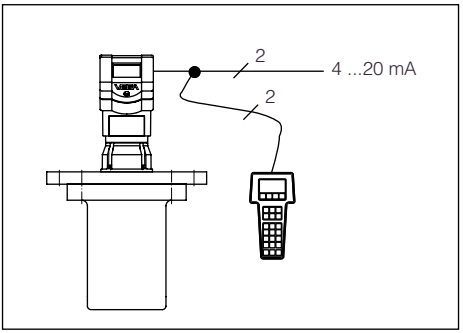
Adjustment with HART® handheld

Series 50 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.

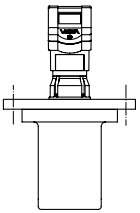


HART® handheld on the 4 … 20 mA signal cable

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.

Horn antenna



The horn antenna is the classical radar antenna in level measurement. The antenna focuses the radar signals very well. Fabricated of 1.4571 (stainless steel) with enamel coating or Hastelloy C22, the antenna is physically, as well as chemically resistant, and is well suited for pressures up to 16 bar at product temperatures up to 200°C.

2 Configuration of measuring systems

A measuring system consists of a sensor with 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 including signal conditioning).

Measuring systems in two-wire technology:

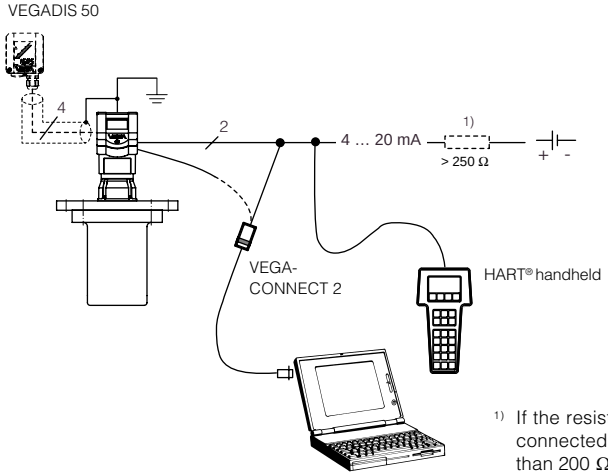
- 4 … 20 mA shown without processing unit, *(bottom)*
- 4 … 20 mA on active PLC, *(page 14)*
- 4 … 20 mA on active PLC (Ex area), *(page 15)*
- 4 … 20 mA on passive PLC, *(page 16)*
- 4 … 20 mA on VEGADIS 371 Ex indicating instrument, *(page 17)*

Measuring systems in four-wire technology:

- 4 … 20 mA shown without signal conditioning instrument, (page *18)*

Measuring systems with VEGAPULS 54K on individual voltage source

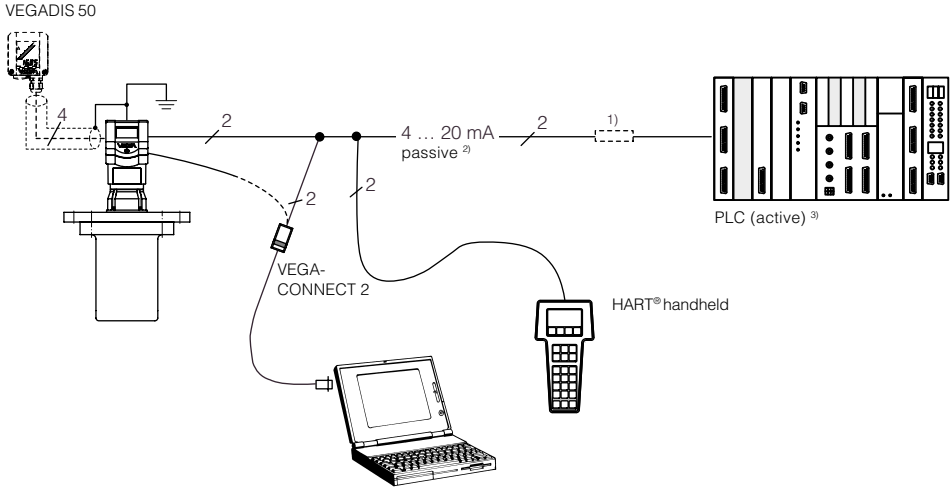
- Two-wire technology (loop powered), supply and output signal via one two-wire cable.
- Output signal 4 … 20 mA (passive).
- Optional external indicating instrument with analogue and digital display (can be mounted up to 25 m separated from the sensor).
- Adjustment with PC, HART® handheld or the adjustment module MINICOM (can be plugged in the sensor or in 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 200 Ω, a resistor of 250 Ω to 350 Ω must be connected to the connection cable during adjustment.
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 54K on active PLC

- Two-wire technology, supply by active PLC.
- Output signal 4 … 20 mA (passive).
- Display of measured value 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 in the sensor or in the external indicating instrument).



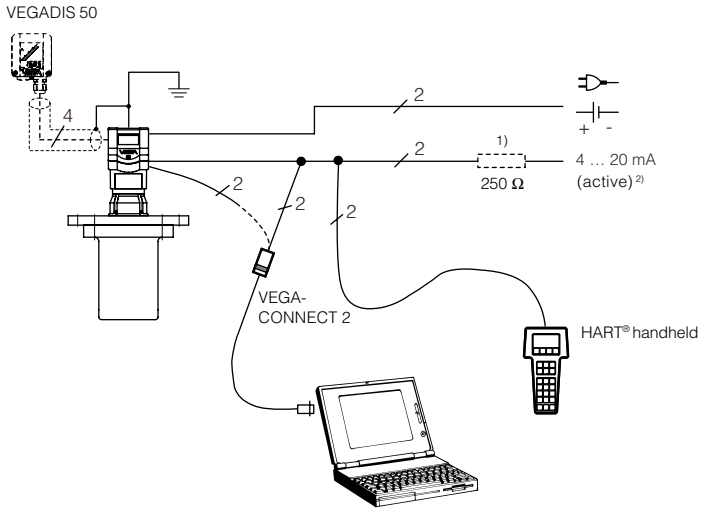
1) If the resistance of the processing systems connected to the 4 … 20 mA signal output is less than 200 Ω, a resistor of 250 Ω to 350 Ω must be connected to the connection cable during adjustment.
The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient 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) on the PLC.

3) 4 … 20 mA active means, that the PLC delivers level dependent a current of 4 … 20 mA. The PLC reacts electrically like a current source.

Measuring system with VEGAPULS 54K 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 in the sensor or in the external indicating instrument VEGADIS 50).
- Max. resistance on the signal output (load) 500 Ω.

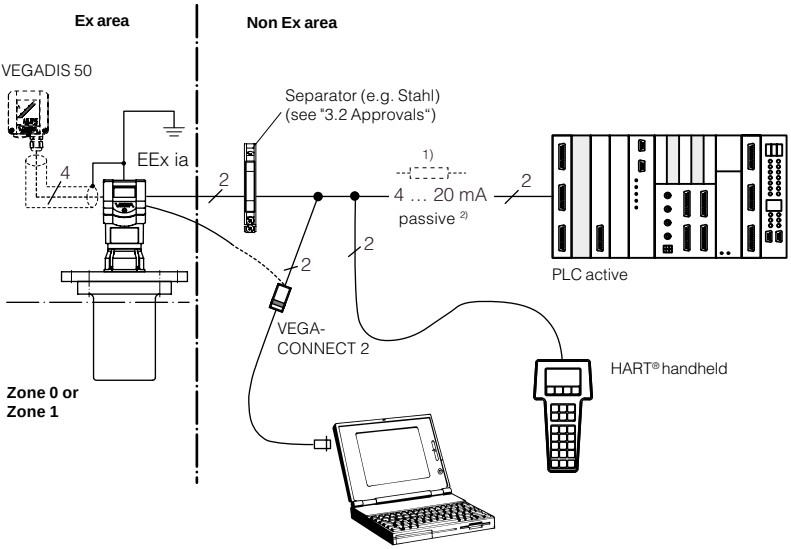


1) If the resistance of the processing systems connected to the 4 … 20 mA signal output is less than 200 Ω, a resistor of 250 Ω to 350 Ω must be connected to the connection cable during adjustment.
The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient 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 54K 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 converts the non intrinsically safe PLC circuit into an intrinsically safe circuit, so that the sensor can be used in Ex zone 1.
- Optionally 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 in the sensor or in the external indicating instrument VEGADIS 50).

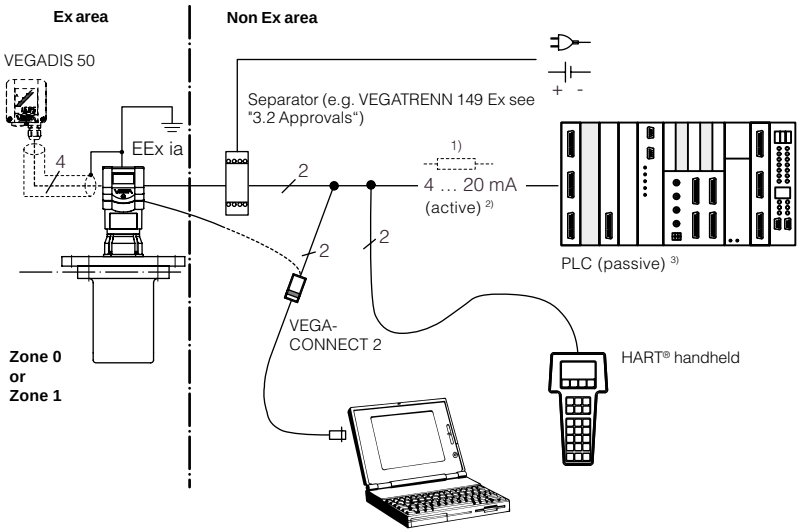


1) If the resistance of the processing systems connected to the 4 … 20 mA signal output is less than 200 Ω, a resistor of 250 Ω to 350 Ω must be connected to the connection cable during adjustment.
The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient 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) on the PLC. The PLC operates actively, i.e. as current or voltage source.

Measuring system with VEGAPULS 54K 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.
- 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 in the sensor or in the external indicating instrument VEGADIS 50).



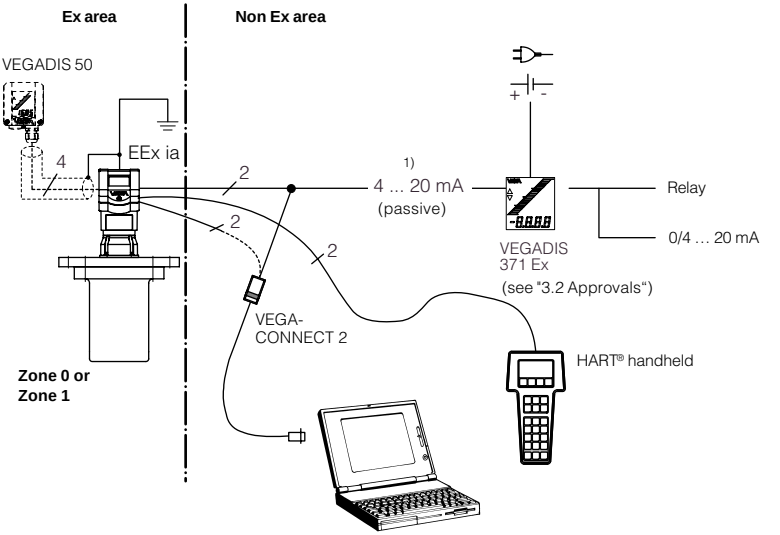
1) If the resistance of the processing systems connected to the 4 … 20 mA signal output is less than 200 Ω, a resistor of 250 Ω to 350 Ω must be connected to the connection cable during adjustment.
The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient 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 . 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) on the PLC.

Measuring system with VEGAPULS 54K on VEGADIS 371 Ex indicating instrument with current and relay output

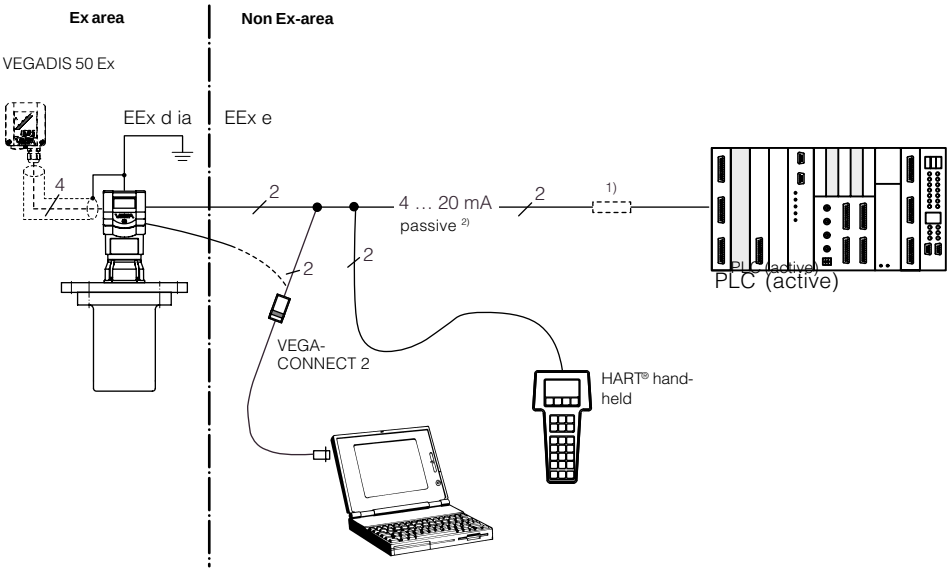
- Two-wire technology (loop powered), intrinsically safe ia supply via the signal cable of the VEGADIS 371 Ex indicating instrument for operation of the sensor in Ex zone 1.
- Optional external indicating instrument with analogue and digital display (can be mounted up to 25 m separated from the sensor).
- Adjustment with PC, HART® handheld or adjustment module MINICOM (can be plugged in the sensor or in 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 200 Ω, a resistor of 250 Ω to 350 Ω must be connected to the connection cable during adjustment.
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 54K 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 terminal housing for operation in Ex zone 1 (VEGAPULS …K Ex) or Ex zone 0 (VEGAPULS …K Ex0).
- Output signal 4 … 20 mA (passive).
- Display of measured value 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 in the sensor or in the external indicating instrument VEGADIS 50).

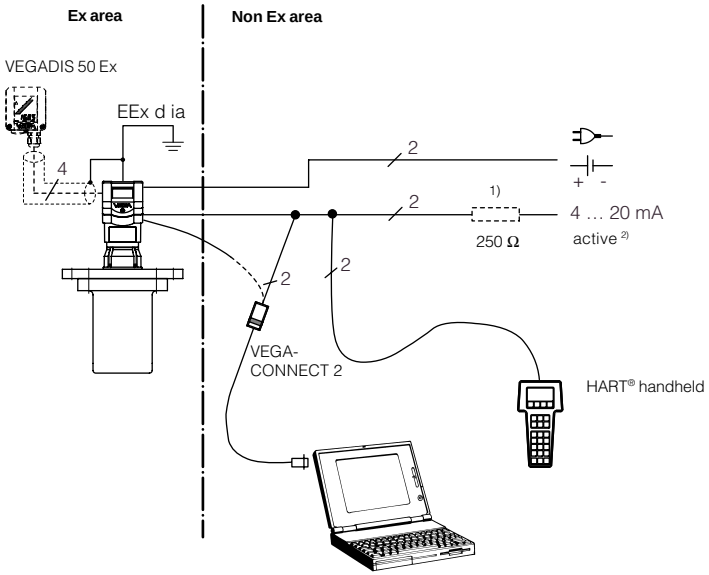


1) If the resistance of the processing systems connected to the 4 … 20 mA signal output is less than 200 Ω, a resistor of 250 Ω to 350 Ω must be connected to the connection cable during adjustment.
The digital adjustment signal would otherwise be severely damped or short-circuited due to insufficient 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) on the PLC.

VEGAPULS 54K Ex with pressure-tight encapsulated terminal compartment in four-wire technology

- Four-wire technology, supply and output signal via two separate two-wire cable for the use in Ex zone 1 (VEGAPULS …K Ex) or Ex zone 0 (VEGAPULS …K 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 in the sensor or in 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 200 Ω, a resistor of 250 Ω to 350 Ω must be connected to the connection cable during adjustment.
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.

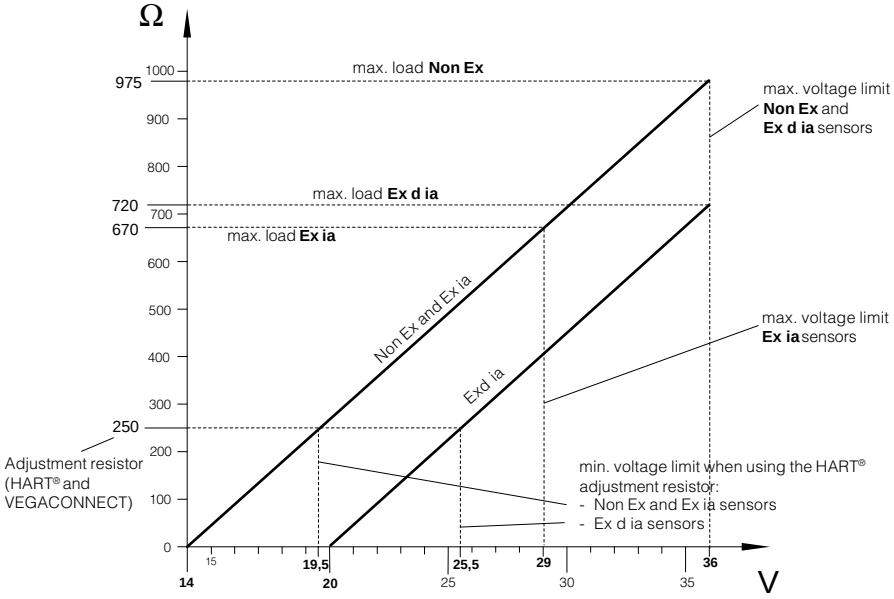
2) 4 … 20 mA active means that the sensor delivers a level-dependent current of 4 … 20 mA (source). The measuring signal of the sensor reacts electrically to the processing system (e.g. display) like a current source.

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 load diagram



Measuring range [1]

Standard	0 … 20 m

Output signal

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

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 separate cable 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

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)	< 0.1 %
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
Adjustment time	> 2 s (depending on the parameter setting)

[1] Min. distance of the antenna to the medium 5 cm
[2] 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

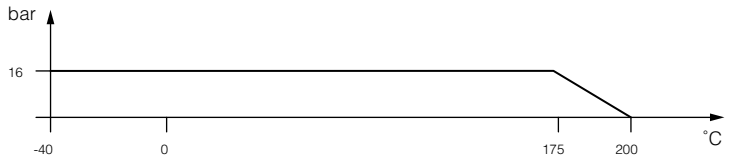
Characteristics [1)]

(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	5.8 GHz (USA 6.3 GHz)
Intervals	
- two-wire sensor (4 … 20 mA)	1 s
- four-wire sensor	0.5 s
Beam angle (at –3 dB)	
- VEGAPULS 54 with DN 150	20°
- VEGAPULS 54 with DN 200	16°
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

Ambient conditions

Ambient temperature on the housing	-20°C … +60°C
Process temperature (flange temperature)	-40°C … +200°C
Process pressure/Vessel pressure	see diagram



Storage and transport temperature	-40°C … +80°C
Protection	IP 66 and IP 67
Protection class	
- two-wire sensor	II
- four-wire sensor	I
Overvoltage category	III

[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

Ex technical data

For comprehensive data see attached approval documents (yellow folder)

Classification	
- EEx d ia	pressure-tight encapsulation
- EEx ia	intrinsically safe in conjunction with a safety barrier or separator

Intrinsically safe version

Ex version	
- classification mark	II 2G EEx ia IIC T6
- Ex approved	Zone 1 (ATEX) Zone 1 (CENELEC; PTB, IEC)
Ex0 version	
- classification mark	II 1G EEx ia IIC T6
- Ex approved	Zone 0, Zone 1 (ATEX) Zone 0, Zone 1 (CENELEC, PTB, IEC)

Pressure-tight encapsulated version

Ex version	
- classification mark	II 2G EEx d ia IIC T6
- Ex approved	Zone 1 (ATEX) Zone 1 (CENELEC; PTB, IEC)
Ex0 version	
- classification mark	II 1/2G EEx d ia IIC T6
- Ex approved	Zone 0, Zone 1 (ATEX) Zone 0, Zone 1 (CENELEC, PTB, IEC)
Permissible ambient temperature on the housing	
- T6	-40°C ... +42°C
- T5	-40°C ... +58°C
- T4, T3	-40°C ... +60°C
Permissible ambient temperature on the antenna system	
- T6	-40°C ... +80°C
- T5	-40°C ... +95°C
- T4	-40°C ... +130°C
- T3	-40°C ... +150°C

Process fittings

DN 150 and DN 200 (horn antenna) ANSI 6“ and ANSI 8“ (horn antenna) Torque of the flange screws	
- DN 150, ANSI 6“	40 Nm
- DN 200, ANSI 8“	50 Nm

Connection cables

Two-wire sensors	supply and signal via one two-wire cable
Four-wire sensor	supply and signal separately
Electrical connection	- spring terminal connection (max. 2.5 mm^2) - plug connection (protected by screw)
Cable entry	
- ia terminal compartment	2 x M20 x 1.5 (cable diameter 5 … 9 mm) or 2 x $^1/_2$" NPT (cable diameter 3.6 … 8.6 mm or 0.12 … 0.34 inch)
- Ex d terminal compartment	1 x $^1/_2$" NPT EEx d (cable diameter 3.6 … 8.6 mm or 0.12 … 0.34 inch)
Ground connection	max. 4 mm^2

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/Antenna	enamel/PTFE
Antenna seal	special PTFE seal for enamelled vessel

Weights

DN 150	27 kg
DN 200	41 kg
ANSI 6"	33 kg
ANSI 8"	48 kg

CE conformity CE

VEGAPULS 54 radar sensor meets 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

Sensors in EEx ia (intrinsically safe) version require for application in Ex areas special separators or safety barriers. The separators or safety barriers provide intrinsically safe (ia) circuits. Below, a selection of instruments that work reliably together with the sensors. The resistance of the signal cable must not exceed 15 Ω per wire.

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

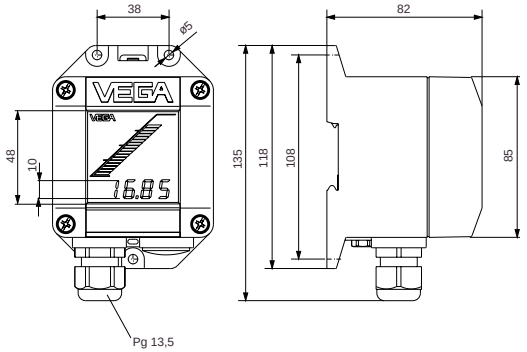
Safety barrier:
- Stahl 9001/01/280/110/10
- CEAG GHG 11 1 9140 V0728
- Type 9130 (VEGA)
- Stahl 9001/51/280/110/14
- MTL 787 S+
- CEAG CS 3/420-106

Pressure-tight encapsulated in Ex area

Sensors in EEx d ia 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

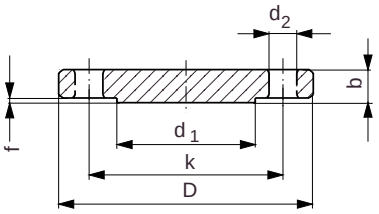
External indicating instrument VEGADIS 50



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

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

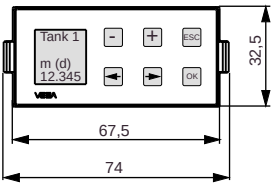
Flange dimensions acc. to ANSI



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

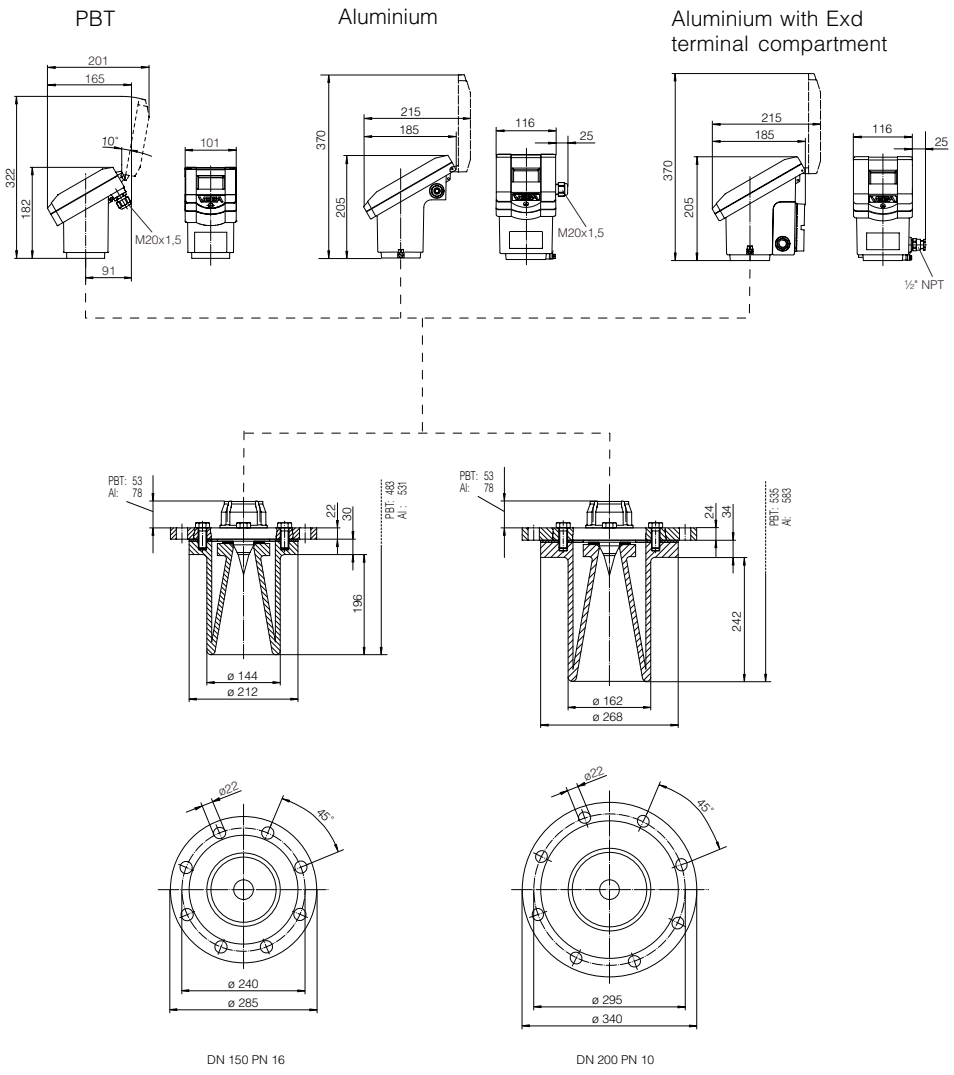
Size	Flange			Seal ledge	Holes	
	D	b	k	d_1	No.	d_2
2" 150 psi	152.4	20.7	120.7	91.9	4	19.1
3" 150 psi	190.5	25.5	152.4	127.0	4	19.1
4" 150 psi	228.6	25.5	190.5	157.2	8	19.1
6" 150 psi	279.4	27.0	241.3	215.9	8	22.4

Adjustment module MINICOM



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

VEGAPULS 54K enamel



DN 150 PN 16

DN 200 PN 10

3.4 Type code

VEGAPULS 54 K EX.XX X X X X X X 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

- 1 - Measurement in a standpipe (d = 50 mm)
- 5 - Socket length up to 50 mm, rod antenna of PP
- 3 - Socket length to 100 mm, rod antenna PPS (type 51/52), PTFE (type 53)
- 9 - Socket length to 250 mm, rod antenna PPD (type 51/52), PTFE (type 53)

- F - Process fitting DN 150 PN 16
- M - DN 250 PN 16 enamel
- W - Process fitting ANSI 3" 150 psi
- P - Process fitting ANSI 4" 150 psi
- V - Process fitting ANSI 6" 150 psi
- O - ANSI 6" 300 psi
- Q - ANSI 8" 150 psi enamel
- Y - Other process fittings

- X - without display
- A - with integrated display

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

- A - 20 … 72 V DC; 20 … 250 V AC; 4 … 20 mA (four-wire)
- B - 20 … 72 V DC; 20 … 250 V AC; 4 … 20 mA, HART® (four-wire)
- C - Two-wire (loop powered), 4 … 20 mA
- D - Two-wire (loop powered), 4 … 20 mA, HART®
- E - Supply via signal conditioning instrument
- G - Segment coupler for Profibus PA
- P - 90 … 250 V AC (only in USA)
- N - 20 … 36 V DC, 24 V AC (only in USA)
- Z - Supply via signal conditioning instrument (only in USA)

- .X - FTZ (standard telecommunication approval Germany)
- EX.X - Use in Ex-Zone 1 (only for two-wire sensors)
- EX0.X - Use in Ex-Zone 0 (only for two-wire sensors)
- EX0.A - Use in Ex-Zone 0 (only for two-wire sensors) WHG
- .U - FCC approval (US)
- EX.U - FM, CLASS 1, DIV 1; FCC (US)

- K - Analogue 4 … 20 mA output signal (two-wire or four-wire technology)
- V - Digital output signal (two-wire technology)
- P - Profibus

- Instrument series with horn antenna (stainless steel or enamel)
- Measuring technology (PULS for radar)

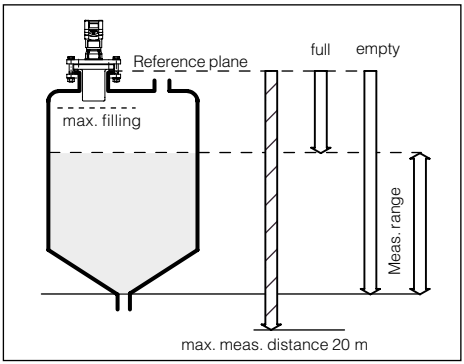
4 Mounting and installation

4.1 General installation instructions

Measuring range

The reference plane for the measuring range of the sensors is the enamelled sensor seal shoulder, against which the enamelled vessel seal is placed. The measuring range is 0 … 20 m. For measurement in surge or bypass tubes (pipe antenna) the max. measuring distance decreases by approx. 0.5 m.

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

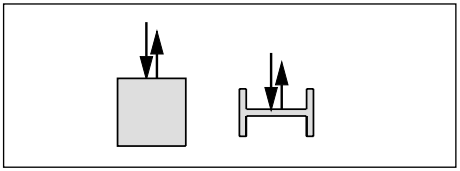


Measuring range (operating range) and max. measuring distance
Note: Use of the sensors for applications with solids is limited.

False reflections

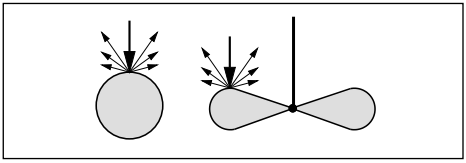
Flat obstructions and struts cause large false reflections. They reflect the radar signal with high energy density.

Round profile interfering surfaces cause a diffuse reflection of the radar signals and cause false reflections with lower energy density. Hence, they are less critical than reflections from a flat surface.

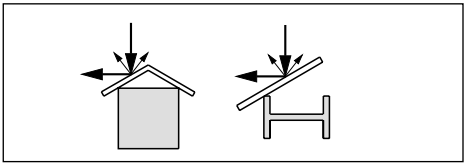


Profile with smooth interfering surfaces cause large false signals

If flat obstructions in the range of the radar signals cannot be avoided, it is recommended to divert 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

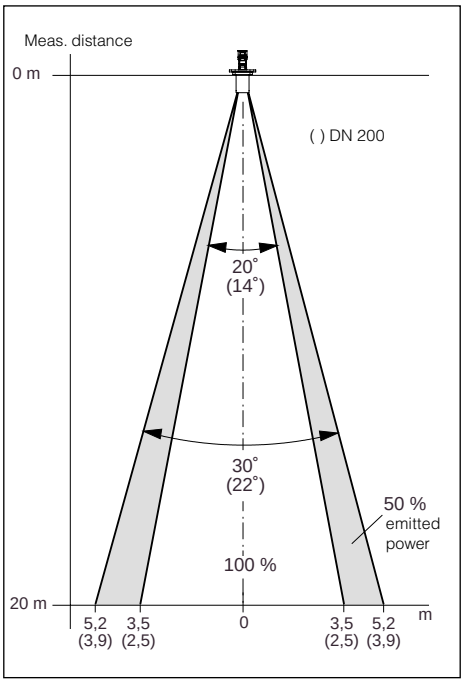


A deflector causes signal scattering

Emission cone and false reflections

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

Any object in this emission cone causes a reflection of the radar signals. Within the first few meters of the emission 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.



Emission cone of a rod antenna (independent of the process fitting)

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

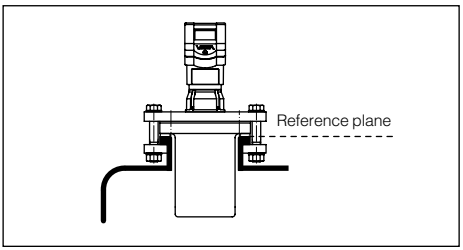
If possible, orient the sensor axis perpendicularly to the product surface and avoid vessel installations (e.g. pipes and struts) within the 100 % area of the emission cone.

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

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

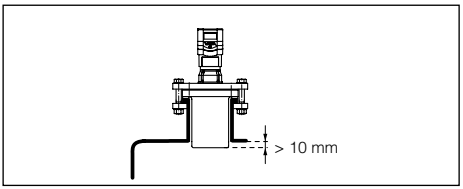
4.2 Measurement of liquids

Horn antenna on DIN socket piece
Usually, 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.



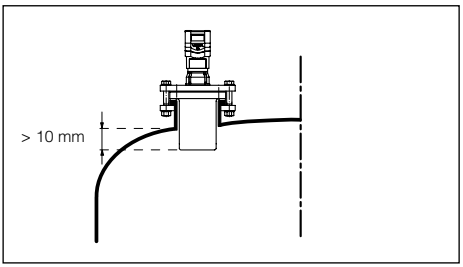
Mounting on short DIN socket piece

When the DIN socket piece is longer, please note that the horn antenna must protrude at least 10 mm out of the socket.



Mounting on longer DIN socket piece

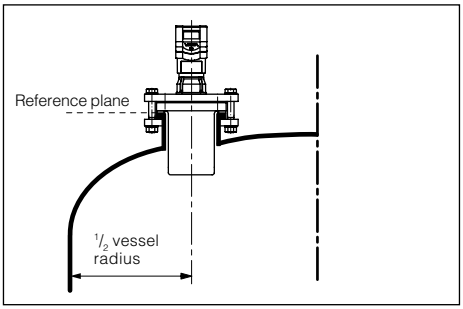
When mounting on dished vessel tops, the antenna must also protrude at least 10 mm (long socket side).



Mounting on a dished vessel top

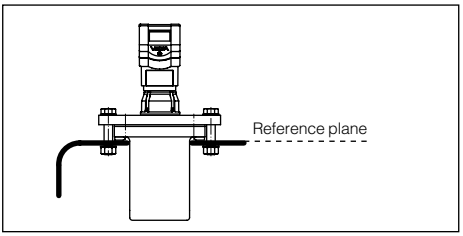
On dished tank ends, please do not mount the instrument in the centre or close to the vessel wall, but approx. $^1/_2$ vessel radius from the centre or from the vessel wall.

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



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 would be a good and economical solution. The top side of the vessel is the reference plane.



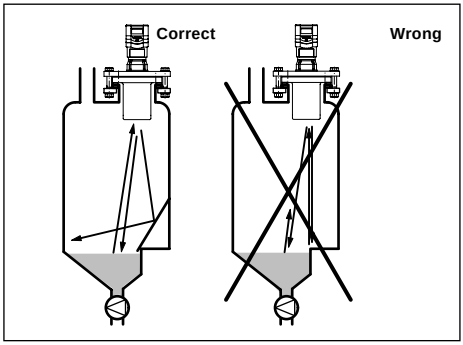
Mounting directly on the flat vessel top

4.3 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.

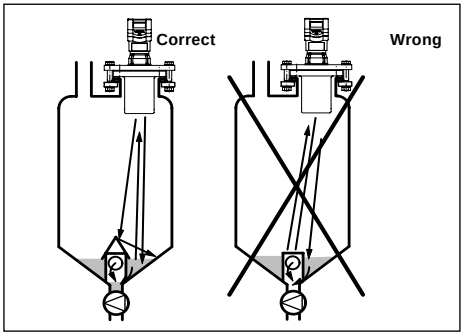
Vessel protrusions

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)

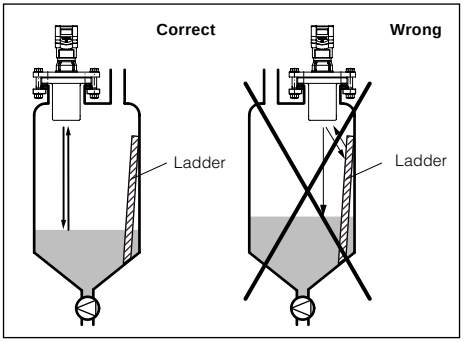
Intake pipes, i.e. for the mixing of materials - with a flat surface directed towards the sensor - should be covered with a sloping shield that will scatter false echoes.



Vessel protrusions (intake pipe)

Vessel installations

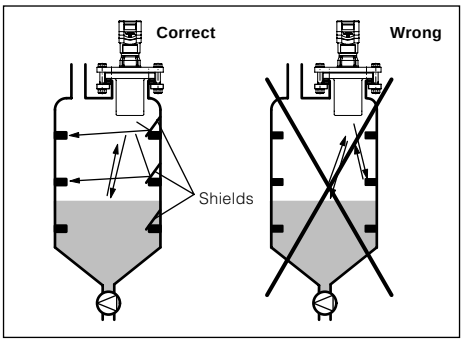
Vessel installations such as, for example, a ladder often cause false echoes. Make sure when planning your measuring location that the radar signals have free access to the measured product.



Vessel installations

Struts

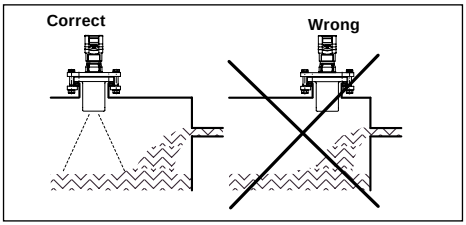
Struts, like other vessel installations, can cause strong false echoes that are superimposed on the useful echoes. Small shields effectively hinder a direct false echo reflection. These false echoes are scattered and diffused in the area and are then filtered out as "echo noise“ by the measuring electronics.



Struts

Inflowing material

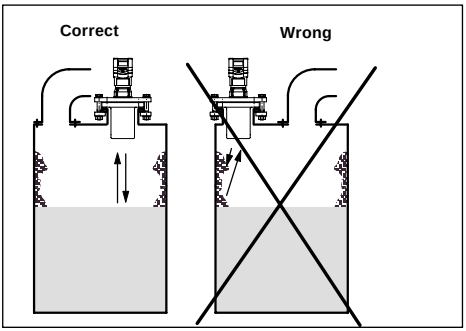
Do not mount the instrument in or above the filling stream. Ensure that you detect the product surface and not the inflowing material.



Inflowing material

Buildup

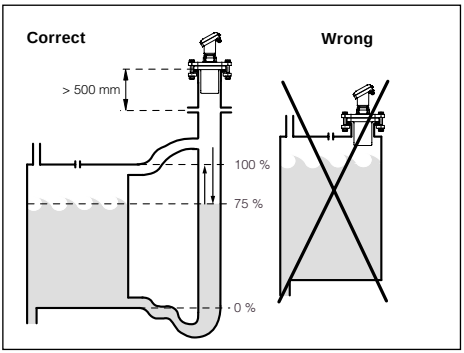
If the sensor is mounted too close to the vessel wall, buildup and adhesions of the measured product to the vessel wall cause false echoes. Position the sensor at a sufficient distance from the vessel wall. Please also note chapter "4.1 General installation instructions".



Buildup

Strong product movements

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



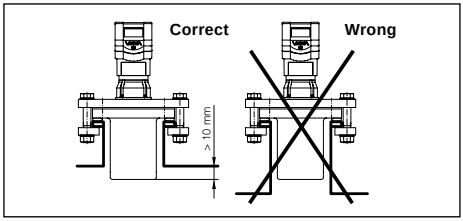
Strong product movements

Products tending to slight buildup can be detected by using a measuring tube with 150 mm nominal width or more. In such a measuring tube, buildup does not cause any problems.

4.4 Common installation mistakes

Socket piece too long

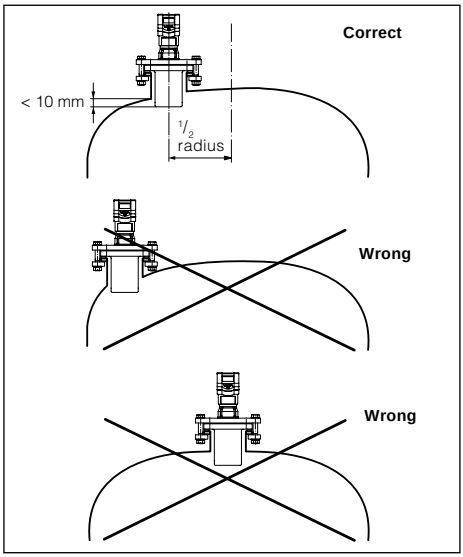
If the sensor is mounted in a socket extension that is too long, strong false reflections are caused, aggravating the measurement. Make sure that the horn antenna protrudes at least 10 mm out of the socket piece.



Correct and wrong socket length

Parabolic effects on dished boiler head or arched vessel tops

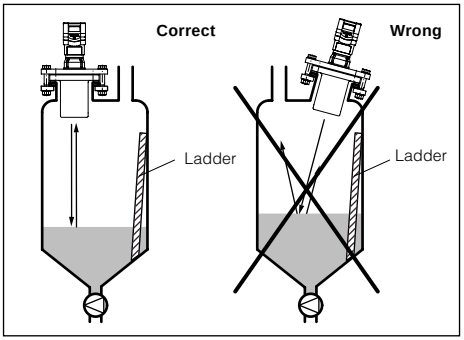
Round or parabolic tank tops act like a parabolic mirror on the radar signals. If the radar sensor is placed at the focal point of such a parabolic tank top, the sensor receives amplified false echoes. The optimum mounting is generally in the range of half the vessel radius from the centre.



Mounting on a vessel with parabolic tank top

Wrong orientation to the product

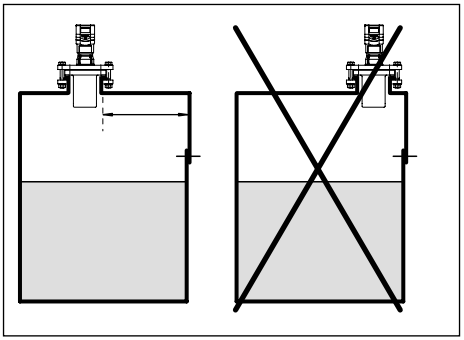
Weak measuring signals are caused if the sensor is not directly oriented at the product surface. Orient the sensor axis perpendicularly to the product surface to achieve optimum measuring results.



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

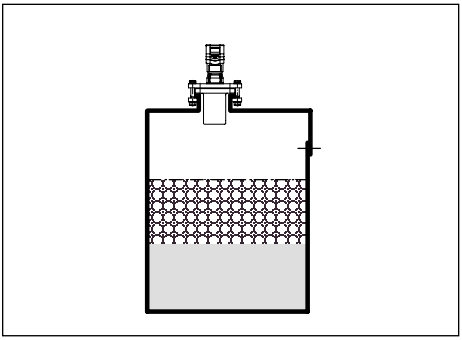


Sensor too close to the vessel wall

In case of good reflection conditions (liquids without vessel installations), we recommend selecting the sensor distance such 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

Thick, dense and creamy foam on the product can cause wrong measurements. Take measures to avoid foam, measure in a bypass tube or use another measuring technology, e.g. capacitive electrodes or hydrostatic pressure transmitters.



Foam generation

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 with low voltage.

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

Connection

A standard two or four-wire cable (sensors with separate supply) with max. 2.5 mm^2 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. Ground the cable screening preferably on the sensor.

It is a good idea to ground the cable screening on both ends. 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. If ground equalisation cables are not available, grounding on both ends can be carried out such that one earth side (e.g. in the switching cabinet) is connected via a capacitor (e.g. 0.1 µF; 250 V) to the ground potential. Use a very low-resistance ground 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) must not be connected. Please note the special installation regulations (DIN 0165).

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

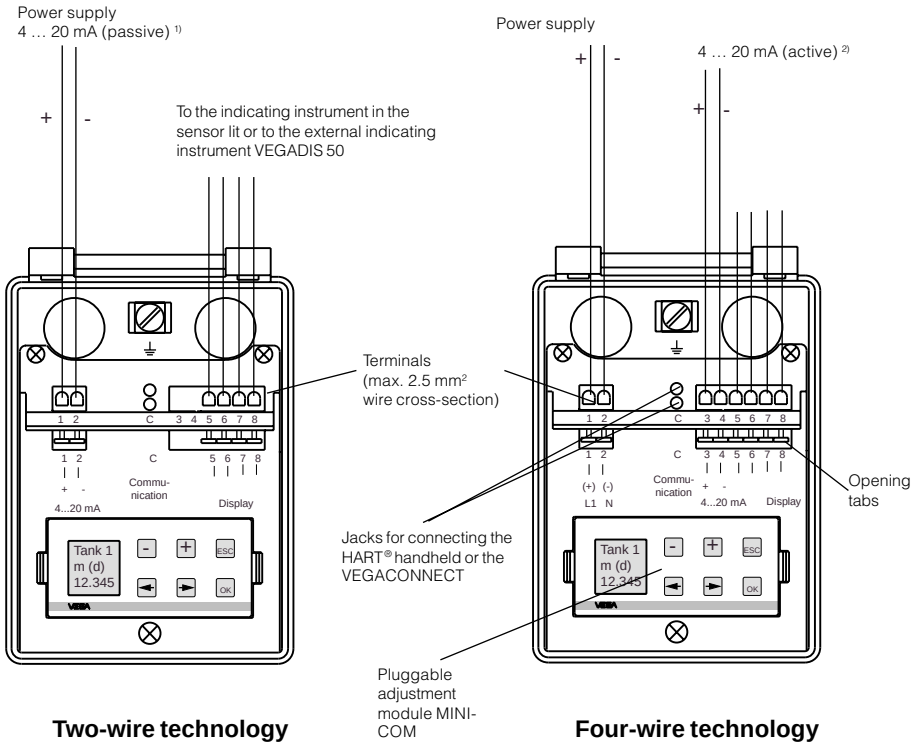
On VEGAPULS 54 sensors, the earth conductor terminal is galvanically connected to the flange.

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 lit 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 pulling lightly on them.



Two-wire technology
(loop powered)

Four-wire technology
(separate supply)

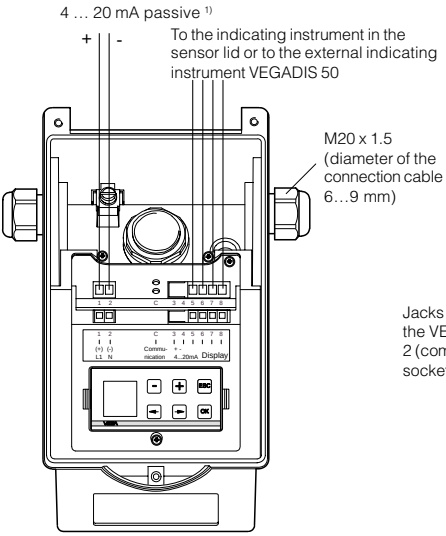
1) 4 … 20 mA passive means that the sensor consumes a level dependent current of 4 … 20 mA (consumer).

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

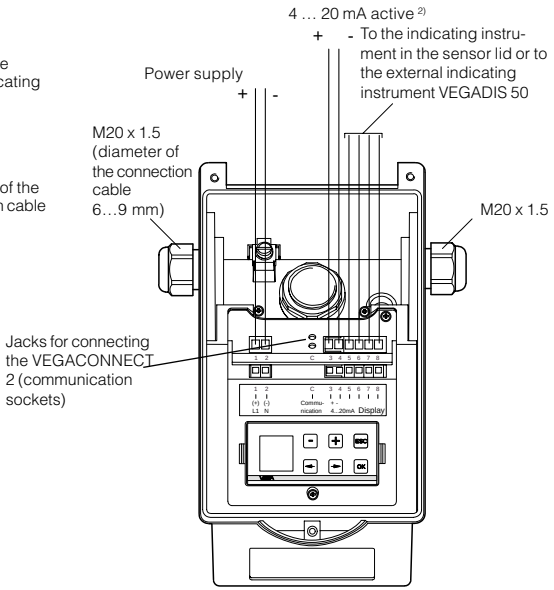
Version with aluminium housing

Two-wire technology

(loop powered)



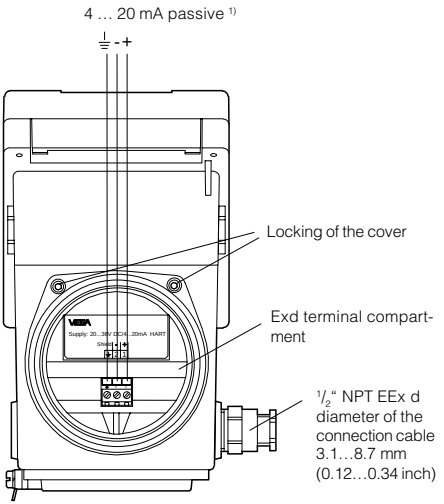
Four-wire technology



Version with aluminium housing and pressure-tight encapsulated terminal compartment

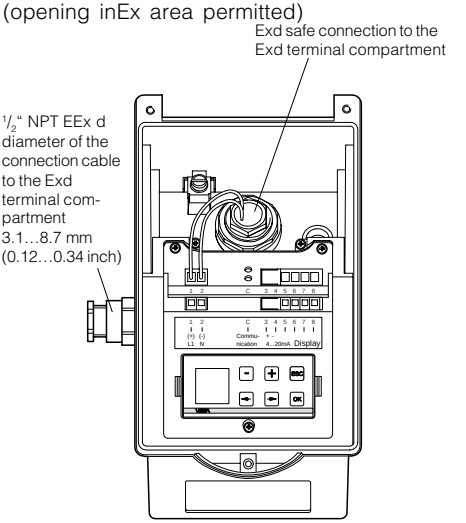
EEx d terminal compartment

(opening in Ex atmosphere not allowed)



Display terminal compartment with vessel module

(opening inEx area permitted)



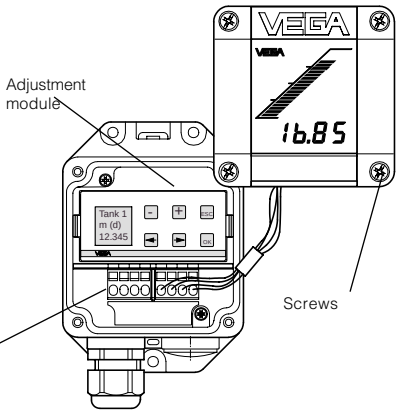
1) 4 … 20 mA passive means that the sensor consumes a level dependent current of 4 … 20 mA (consumer).

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

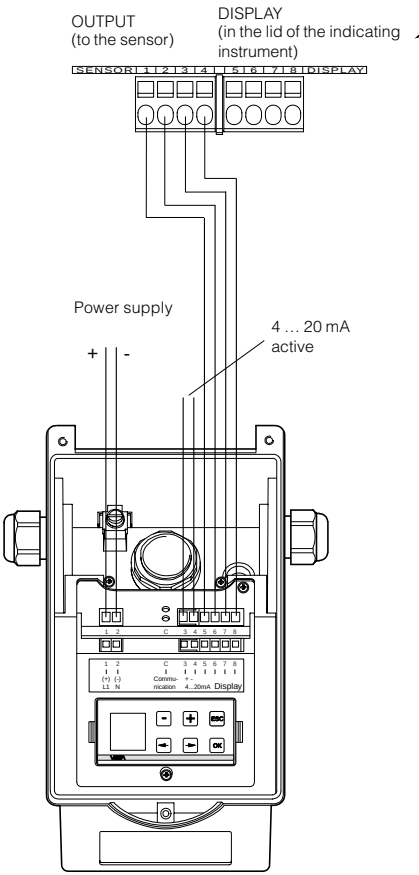
5.3 Connection of the external indicating instrument VEGADIS 50

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

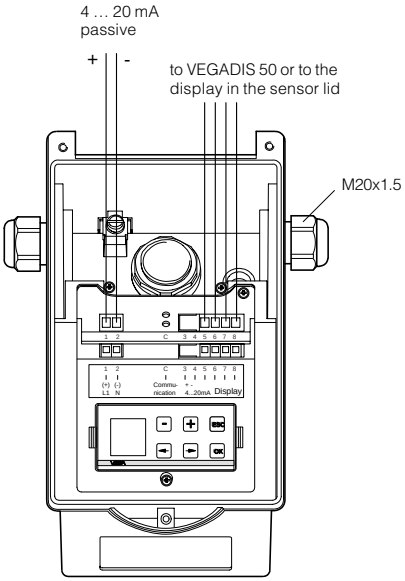
VEGADIS 50



Four-wire sensor in aluminium housing
(separate supply)



Two-wire sensor in aluminium housing
(loop powered)



6 Setup

6.1 Adjustment methods

Series 50 radar sensors can be adjusted with
- PC (adjustment program VVO)
- with detachable adjustment module MINICOM
- with HART® handheld.

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

PC
With the adjustment program VVO (VEGA Visual Operating System) on the PC you can adjust the radar sensors very comfortably. 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
VEGASON 50K radar sensors, like other HART® protocol compatible instruments, can be adjusted with the HART® handheld. A manufacturer specific DDD (Data-Device-Description) is not required. The radar sensors are adjusted with the HART® standard menus. All main functions are therefore accessible.
Functions that are rarely used, such as, for example 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

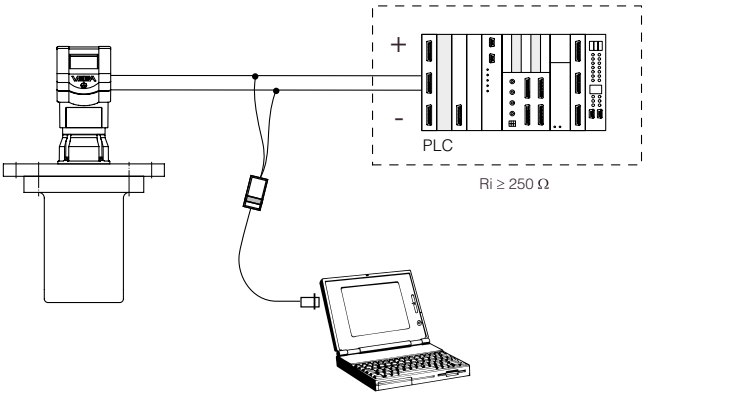
PC on the sensor
For connection of the PC to the sensor, the interface converter VEGACONNECT 2 is required, which is plugged into the provided CONNECT socket in the sensor.

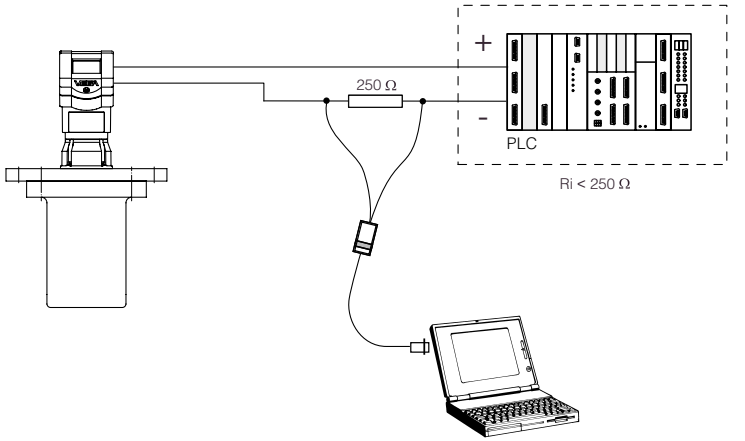
Make sure that the pins of VEGACONNECT 2 are completely inserted into the sensor sockets, as the new pins have a slightly increased resistance to insertion. The pins should be inserted up to a depth of approx. 13 mm to 15 mm.

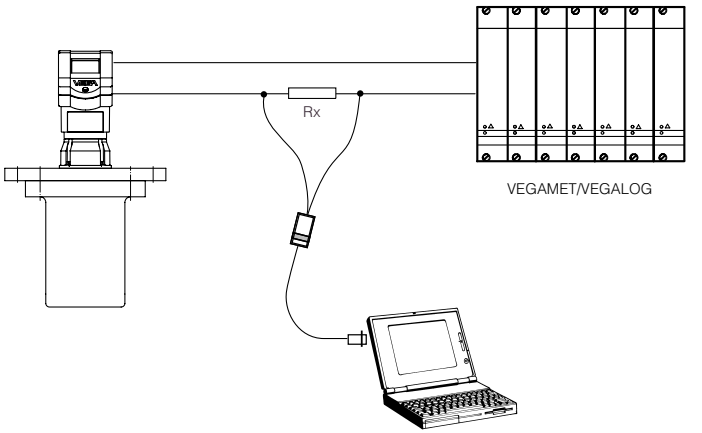
PC on the signal cable
Connect the two-wire cable of VEGACONNECT 2 to the signal cable of the sensor. If the resistance of the systems (PLC, current source etc.) connected to the signal cable is less than 250 Ω, a resistor of 250 … 350 Ω must be connected to the signal cable during adjustment (next page). The digital signals superimposed on the signal cable would 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 (VEGA Visual Operating) can be connected to the
- sensor
- signal cable.

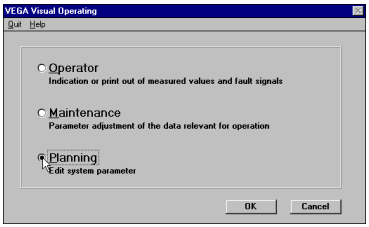
The individual adjustment steps are marked in the following with a dot.
Example:
- Choose ...
- Start ...

You have 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 (selftest) and takes then a level proportional or distance-proportional current of 4 ... 20 mA.

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

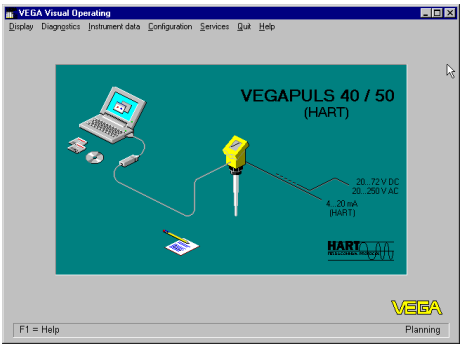


- Choose with the arrow keys or the mouse the item "*Planning*" on the entrance screen and click to "*OK*".

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 ...

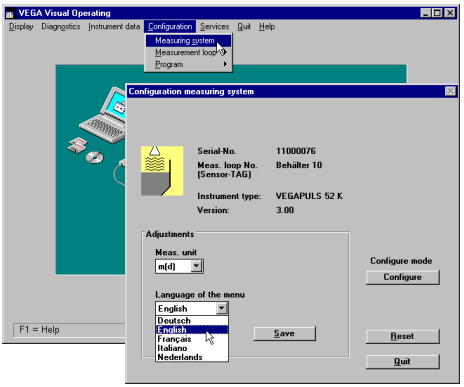


... and indicates after a few seconds if and with which sensor a connection exists.

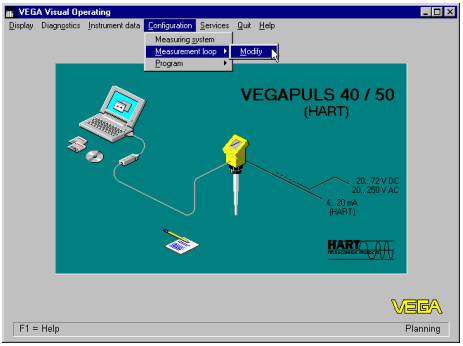
Note:
When connecting the adjustment software (VVO) to a sensor from which data has already been saved, you are asked if the saved data should be transferred to the sensor or if you want to transfer the sensor data to the database of VVO (and the available data of the current sensor will be overwritten).

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 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

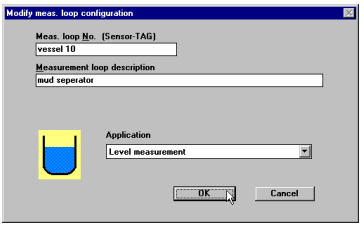


- Choose the menu "Configuration/Measurement loop“, to get further information on the sensor type, the software version of the sensor, the measuring unit, the measurement loop designation etc.
- Click to "Quit“.
- Click to the menu "Configuration/Measurement loop/Modify“. This is the first step to set up the sensor.



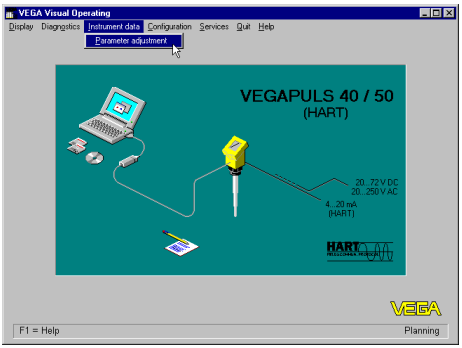
In the menu "*Modify meas. loop configuration*“ you can give a name (e.g. vessel 10) and a description (e.g. sludge separator) to the measurement loop.

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



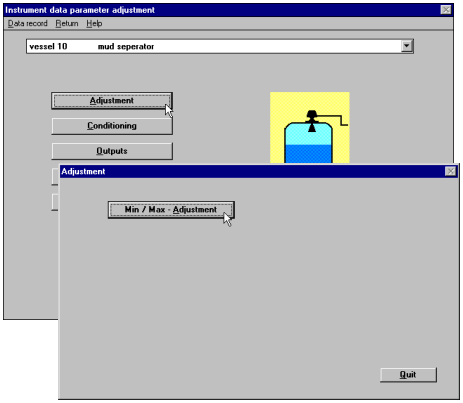
Parameter adjustment/Adjustment

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

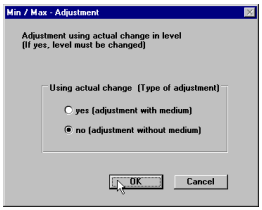


In the menu "*Instrument data/Parameter adjustment*“ you now carry out all important sensor adjustments. In the heading you now see the previously entered measurement loop name and the measurement loop description.

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

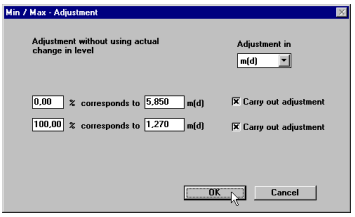


- Click to "Min/Max-Adjustment".



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.

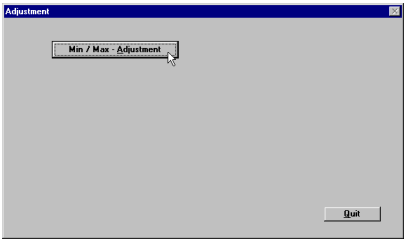
- Confirm with "*OK*".

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

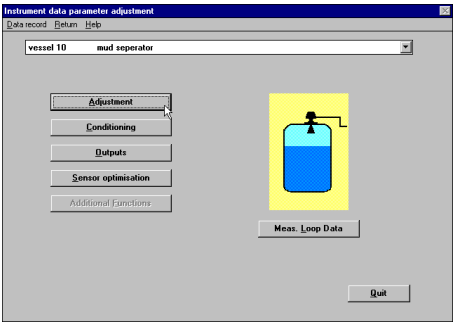
You are again in the menu "*Adjustment*". The sensor electronics has two characteristics points from which a linear proportionality between product distance and the percentage filling of the vessel is generated.

Of course, the characteristics points must not necessarily be at 0 % and 100 %, however they should be as far 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".

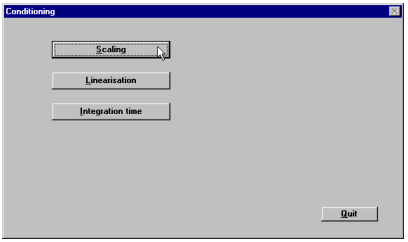


You are again in the menu window "Instrument data parameter adjustment".

Conditioning

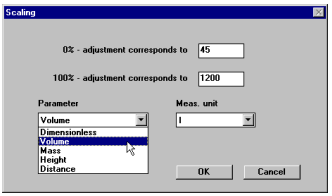
- Click to "Conditioning".

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 100 % values of the physical unit. 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.



For the 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 parameter.

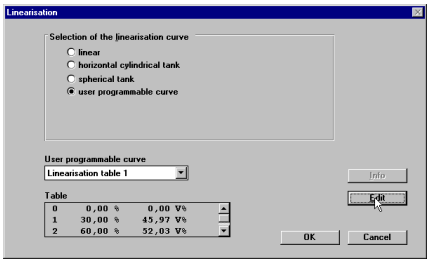
- Save the adjustments in the menu "*Scaling*" by clicking "*OK*".

The adjustments are now transferred to the sensor.

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".



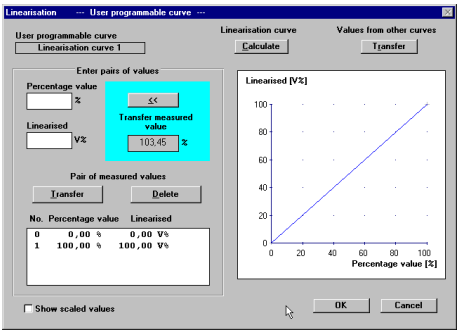
The menu window "*Linearisation*" opens.

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.

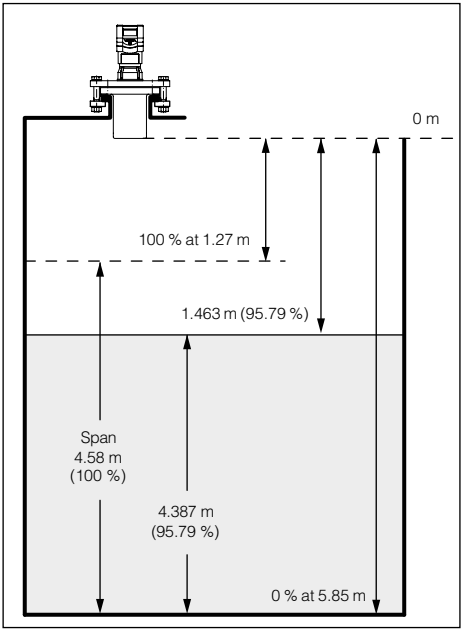
- Click to "Edit".



In the field "*Transfer measured value*" the current product distance as a percentage of the adjusted span is displayed. The measuring window or measuring span has already been adjusted with the min./max. adjustment. In our example, the measuring window is in the range of 1.270 m ... 5.85 m.

The user programmable linearisation curve is generated by index markers consisting of the value pairs "*Linearised*" and "*Percentage value*". *"Percentage value"* represents the distance value as a percentage of the adjusted span. In the example, the span is 5.85 m (min) – 1.27 m (max) = 4.58 m.

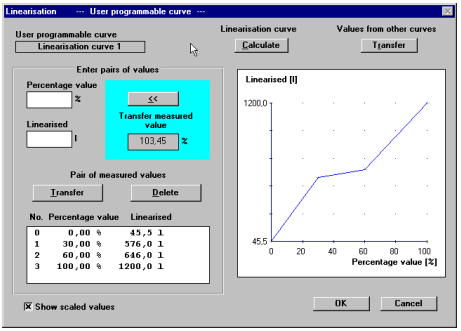
A percentage value of 95.79 % then means that 95.79 % (4.387 m) of the adjusted span of 4.85 m has been reached. The product distance is 5.85 – (4.58 • 0.9579) = 1.463 m.



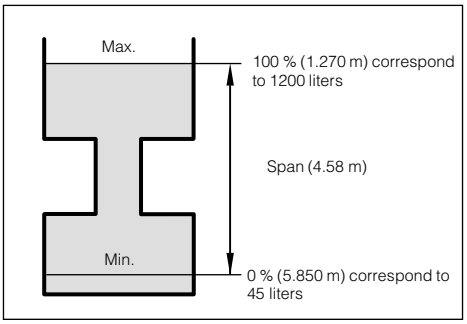
"Linearised" represents a percentage vessel volume corresponding to a certain percentage value of the level.
If the index markers or value points of your vessel are not known, you must gauge the vessel incrementally or calculate it with the vessel calculation program of VVO.

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.



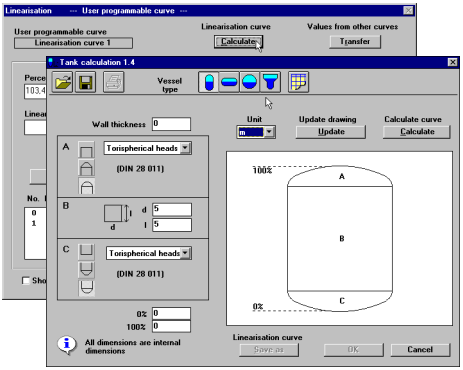
Max. 32 index markers can be entered per linearisation curve (value pairs).

Calculating the linearisation curve

(using previous tank examples)

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.

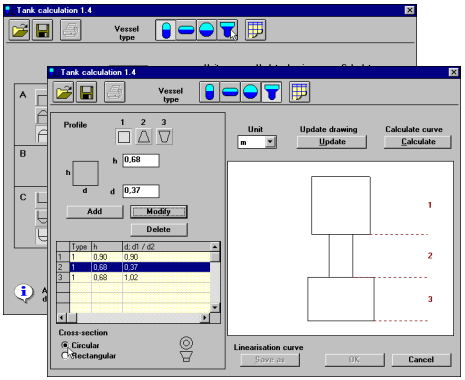
- Click to "*Calculate*".



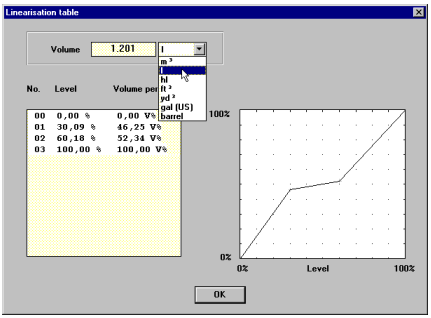
The tank calculation program starts. In the top left corner you choose the vessel type (upright tank, cylindrical tank, spherical tank, individual tank form or matrix). When choosing matrix, you can enter a user programmable linearisation curve by means of index markers. This corresponds to the entering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

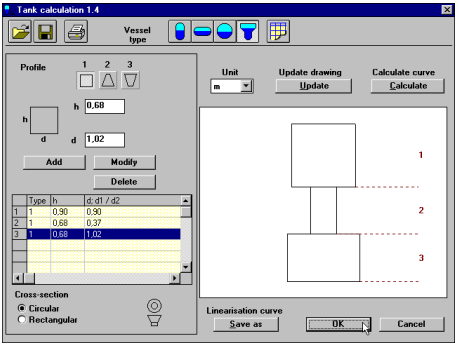


- Click to "Calculate".



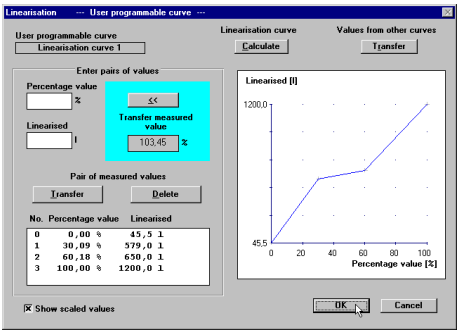
After a short calculation time, the levels as a percentage of span and the corresponding volume percentages are shown. The outputted curve shows this correlation in a diagram.

- Quit the linearisation table with "OK".



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

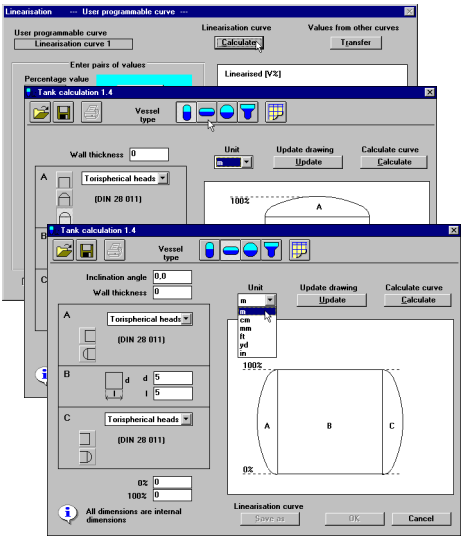
- Click to "OK" to save the tank calculation.



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.

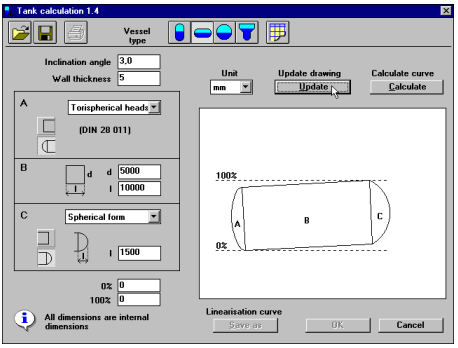
Calculate cylindrical tank

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



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

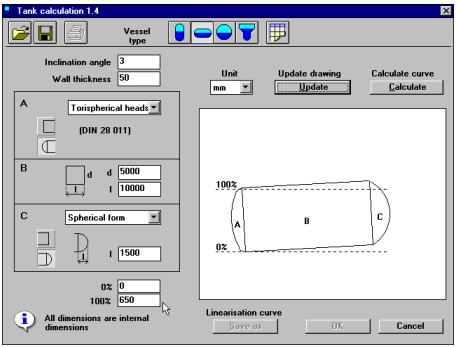
The following example shows how to enter a cylindrical tank that is inclined by 3° and has a cylinder length of 10000 mm and a diameter of 5000 mm. The cylindrical tank has a 1500 mm wide, spherical form at the right end and a dished form at the left.



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

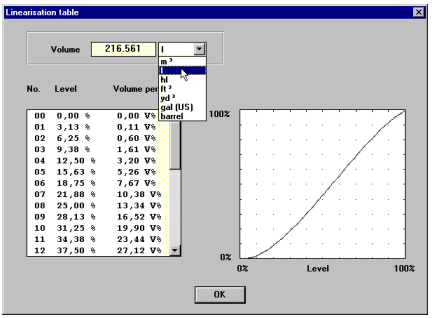
The entering of a wall thickness is only necessary for the calculation of the dished boiler end, as its mathematical calculation is based on the outer dimension.

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).



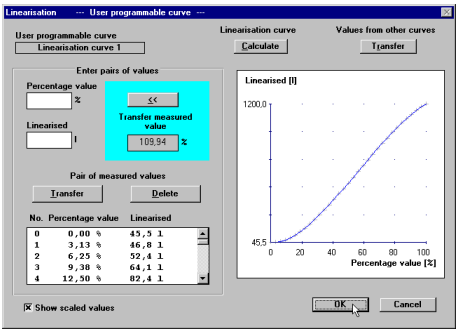
- Click to "Calculate".

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.

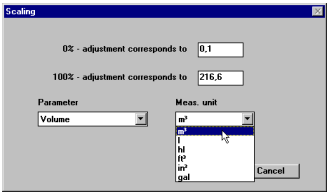


Here the calculated linearisation curve is again outputted. The volume information under "*Linearised*" now no longer corresponds to the calculated volume of the tank calculation program.

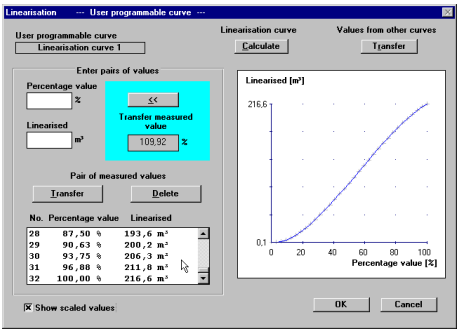
Why?

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 in 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.

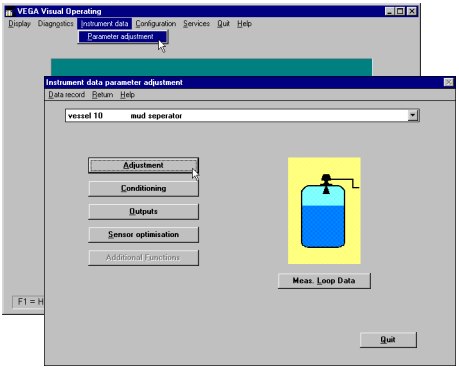
- Quit the menu with "OK“.

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

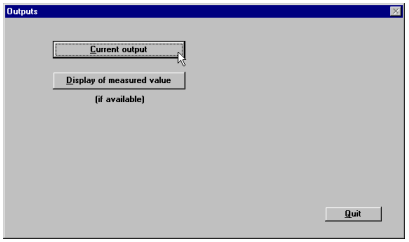
- Quit the menu window with "*OK*“.

Outputs

- Choose "*Instrument data parameter adjustment*“.



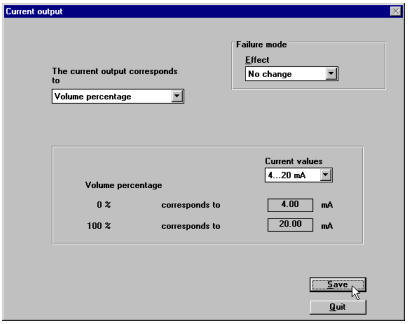
- Choose in the menu window "*Instrument data parameter adjustment*“ the menu point "Outputs“.



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

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.

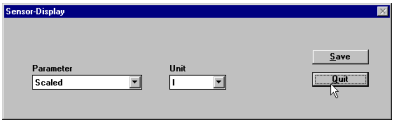


- Click to "Save", if you have made adjustments in this menu window.
- If the adjustments should remain unchanged, click to "Quit".

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

Display of measured value

- 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 of 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".

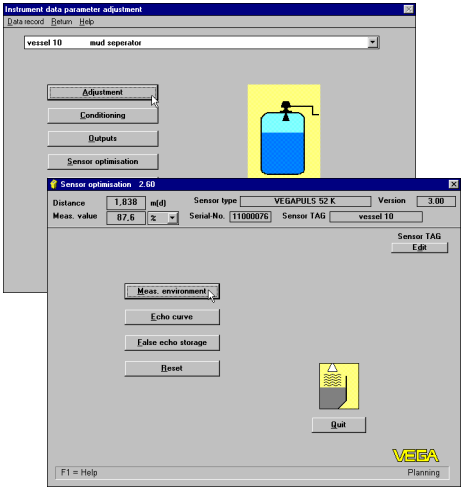
You are again in the menu window "*Instrument data parameter adjustment*".

Sensor optimisation

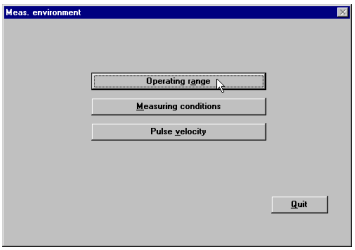
In the menu "Sensor optimisation“ you can adapt the sensor to the environment.

Meas. environment

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



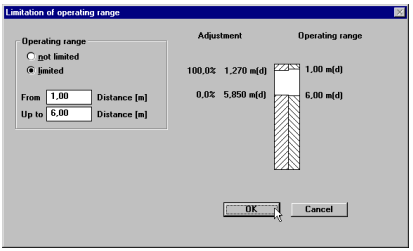
- First click to "Meas. environment“.



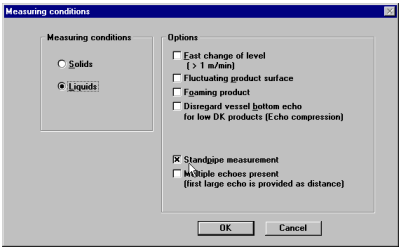
With the menu item "*Operating range*“ you can define the operating range of the sensor deviating from the "*Min/Max-Adjustment*“. As a standard feature, the operating range corresponds otherwise to the min./max. adjustment (span).

Generally, it is better, to set the operating range approx. 5 % wider than the 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.



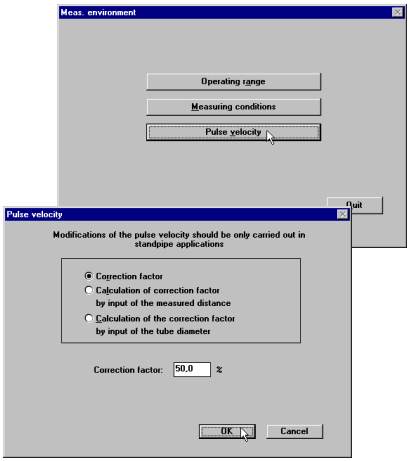
- Save the adjustments and quit the menu window "*Limitation of the operating range*“.
- Click to "Measuring condition“.
- In the menu window "*Measuring condition*“ you click on the options corresponding to your application.



- 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*".

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



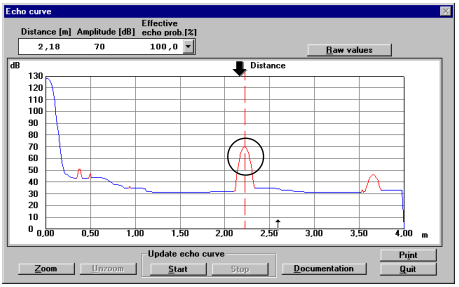
Furthermore, in the menu window "*Pulse velocity*", it is possible to enter a correction factor for the pulse velocity of the radar signal, which is normally the speed of light.

- Quit this menu with "*Quit*" in case you don't want to make any changes.
- With "*OK*" you save the adjustments made.
- Click in the menu window "*Meas. environment*" to "*Quit*".

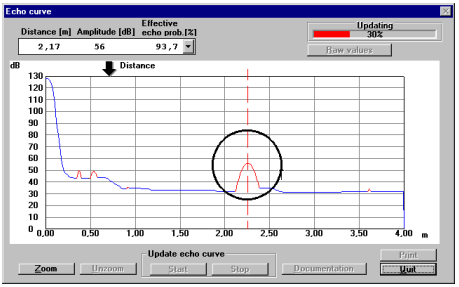
You are again in the menu window "*Sensor optimisation*".

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 the echo curve) can help localise and reduce the size of the false echoes. In the following illustration, you see the echo curve with a false echo nearly as large as the product echo (before correction of the sensor orientation, i.e. directing it at the product surface).



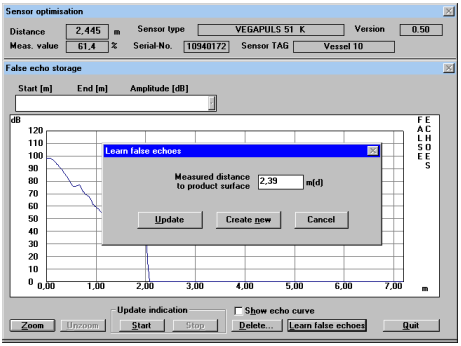
In the next illustration, you see the echo curve after optimum directing of the sensor at the product surface (sensor axis perpendicular to the product surface). The false echo, e.g. caused by a strut, is now reduced by more than 10 dB and will no longer influence the measurement.



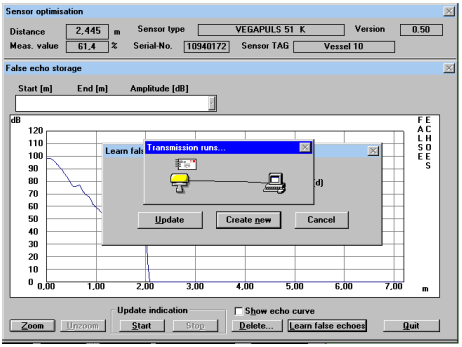
- Quit the menu "Echo curve" with "Quit".

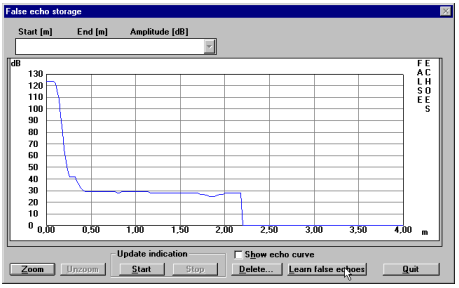
With the menu item "*False echo storage*" in the menu "*Sensor optimisation*" you can authorise the sensor to save false echoes. The sensor electronics then saves the false echoes in an internal database and assigns them a lower degree of significance than the useful echoes.

- Click in the menu window to "*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".

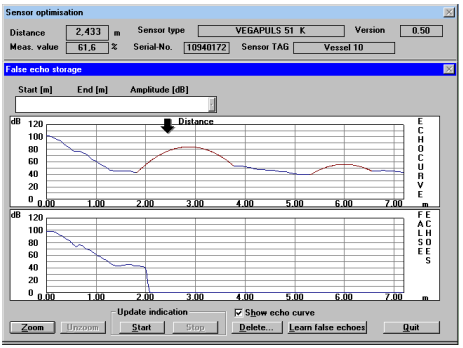


You hereby authorise the sensor to mark all echoes before the product echo as false echoes. This prevents the sensor from erroneously detecting a false echo as level echo.





- Click to "Show echo curve".



The echo curve and the false echo indication are shown.

- Quit the menu with "Quit".

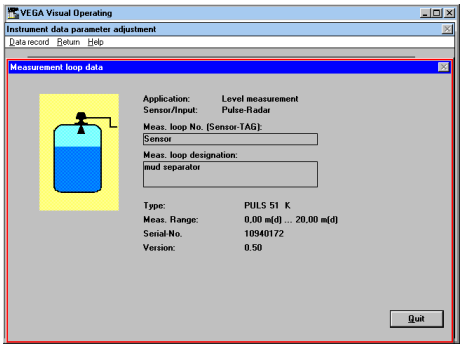
You are again in the menu window "Sensor optimisation".

With the menu item "*Reset*" you reset all options of the menu "*Sensor optimisation*" back to the basic adjustment.

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

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

- Click to the menu item "Meas. Loop Data".



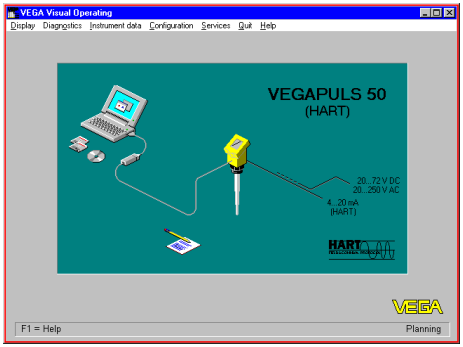
In the window "Measurement Loop Data" all sensor characteristics data are shown.

Interface parameter adjustment and Display of measured value

See manual "VEGA Visual Operating".

Simulation

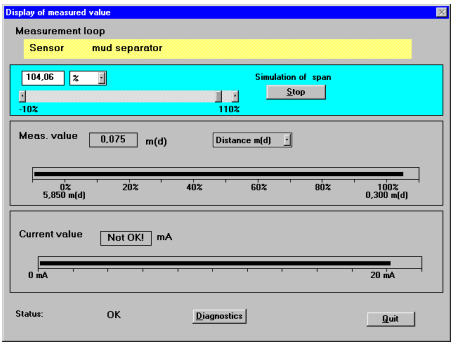
- Click to the menu "Diagnostics/Simulation".



The menu window "*Display of measured value*" opens. In this menu window you can also set the filling of 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.

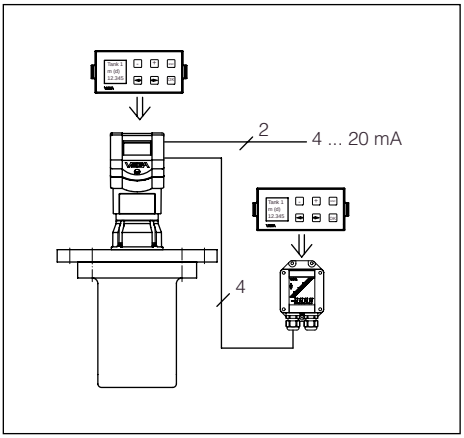
Note:
One hour after the last simulation adjustment, the sensor automatically returns to standard operating mode. The display of measured value flashes during simulation.

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 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. The adjustment with MINICOM, however, is different. It is not possible to enter your own linearisation curve. This has to be done on the PC.

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 will 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 62 and 63 you will find the complete menu schematic of the adjustment module MINICOM.
Setup 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 standpipe

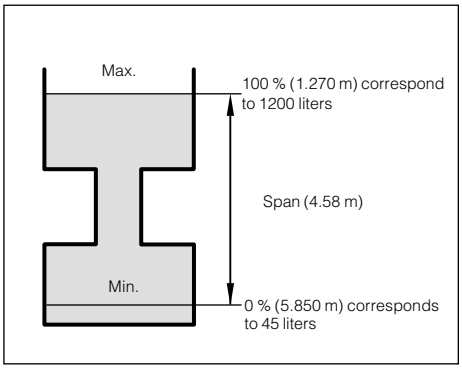
Adjustment is only necessary, if the sensor is mounted in a standpipe (surge or bypass tube). When measuring in a standpipe, do a sounding of the distance and correct the display of measured value (which can differ several percent from the sounded value) according to the sounding. From then on, the sensor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

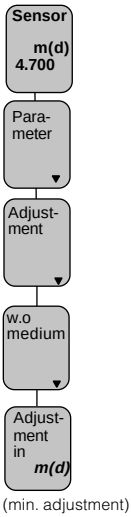
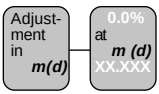
3. Adjustment



Under the menu item "*Adjustment*" you inform the sensor with which measuring range it should operate.

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 a filling/emptying cycle.

Adjustment without medium
(adjustment independent of the level)

Key	Display text
	
OK	
OK	
OK	
OK	
	(min. adjustment)
+	The distance indication flashes and you can choose "feet" and "m".
OK	Confirm the adjustment with "*OK*".
→	
+ 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 for 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 respectively in the menu "*Sensor optimisation/Operating range*".

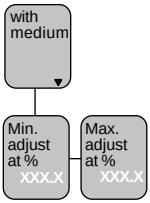
[→] 

(max. adjustment)

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

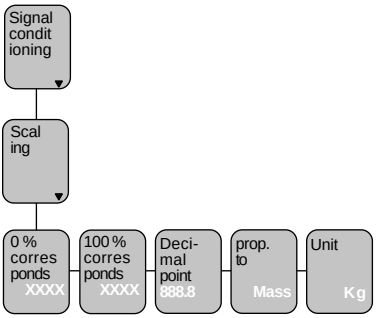
Note:
The difference between the adjustment values of the lower product distance and the upper product distance should be as big as possible, preferably at 0 % and 100 %. If the values are very close together, e.g. lower product distance indication at 40 % (3.102 m) and upper product distance adjustment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

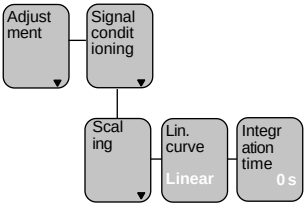
- Confirm with "*OK*".

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 parameter (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)

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 plan MINICOM).

Ampl.: means amplitude of the level echo in dB (useful level)
S-N: means Signal-Noise, i.e. the useful level minus the level of the background noise

The bigger the "S-N" value (difference between the amplitudes of useful level and 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

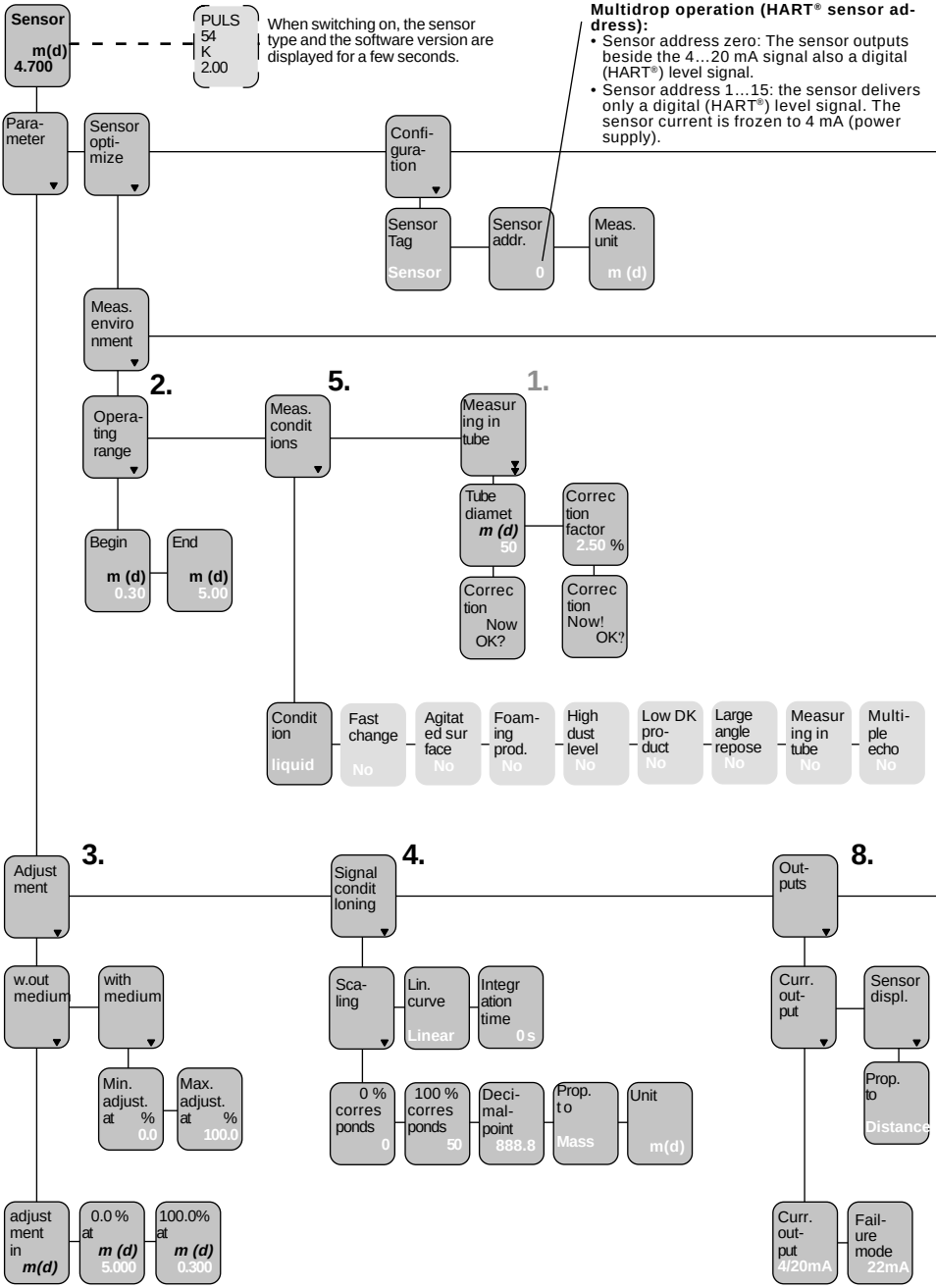
This means that the noise level is only 68 dB – 53 dB = 15 dB.

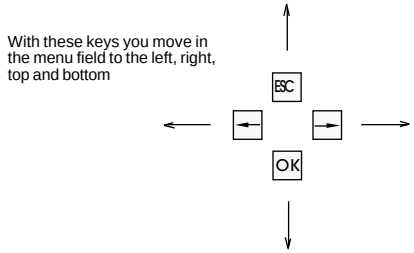
A 15 dB noise level with a 53 dB higher signal level would provide very high measurement reliability.

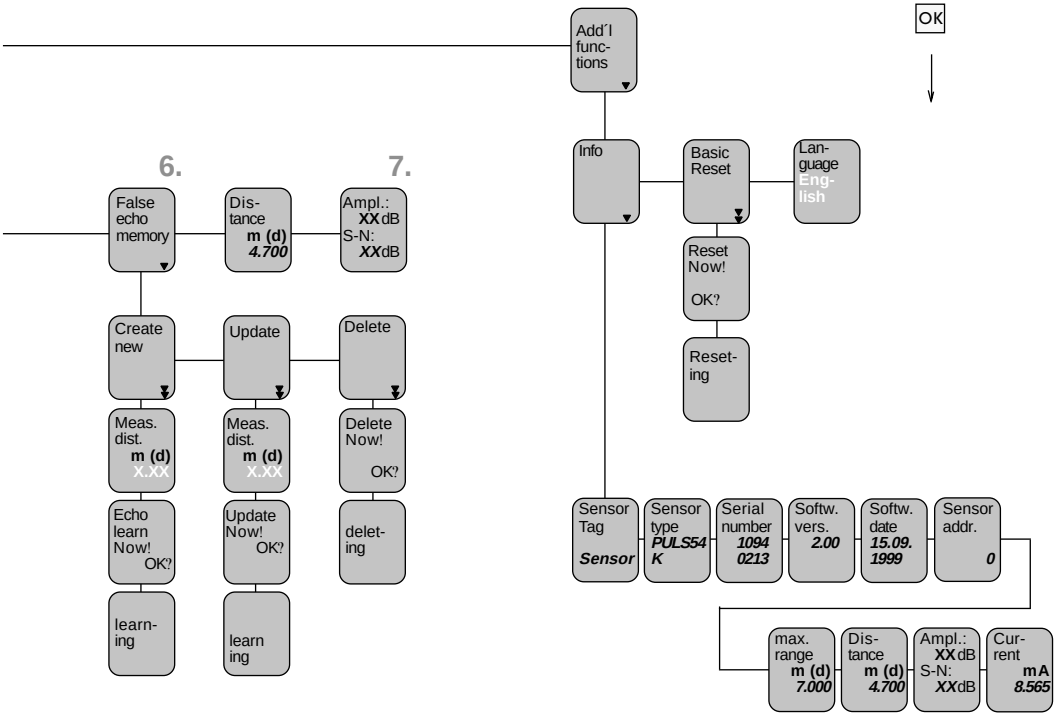
8. Outputs

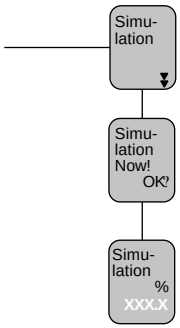
Under the menu "Outputs" you determine, for example, if the current output should be inverted, or which unit of measurement should be shown on the sensor display.

Menu schematic for the adjustment module MINICOM





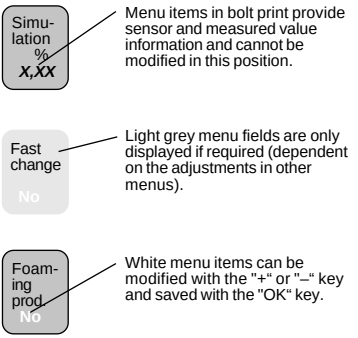




Simulation:
One hour after the last simulation adjustment the sensor returns automatically to normal operating made.

Error codes:

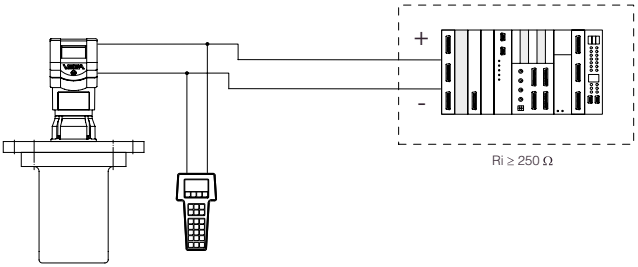
E013	No valid measured value - Sensor in the warm-up phase - Loss of the useful echo
E017	Adjustment span too small
E036	Sensor program not operating - Sensor must be programmed (service) - Fault signal also appears during programming
E040	Hardware failure



6.4 Adjustment with HART® handheld

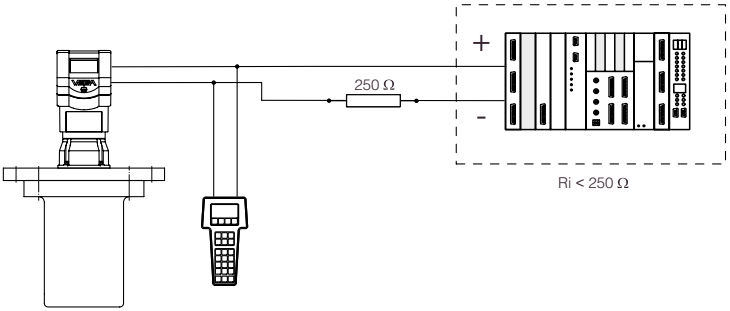
With any HART® handheld, you can set up the VEGASON series 54K radar sensors like all other HART® compatible sensors. A special DDD (Data Device Description) is not necessary.

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



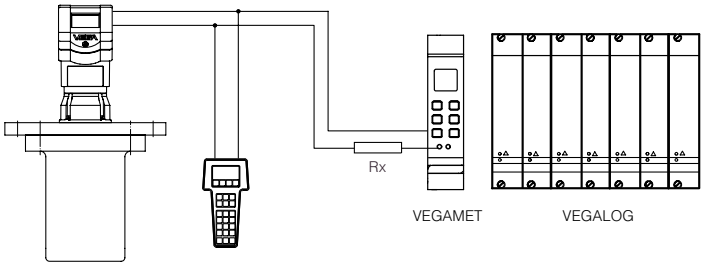
Note:
If the resistance of the power supply is less than 250 Ohm, a resistor must be connected into the signal/connection loop during adjustment.

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



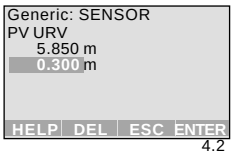
Connection to a VEGA signal conditioning instrument
If you operate a HART® compatible sensor on a VEGA signal conditioning instrument, you have to connect the sensor via a resistor (see following table) during HART® adjustment, to reach together with the internal resistance of the instruments the value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



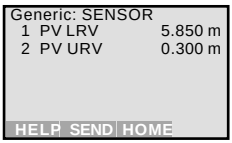
The most important adjustment steps

On the following pages you see a menu schematic for the HART® handheld in conjunction with VEGAPULS 54K 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.

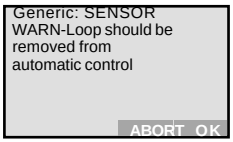


4.2
(5.2)

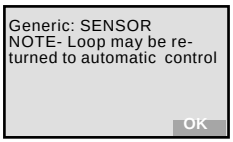
After having pressed "*ENTER*", press "*SEND*" (here in the example for the min. adjustment).



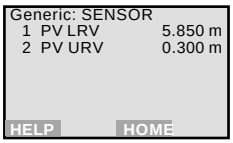
After pressing "*SEND*", a warning is displayed, which informs you that you are about to modify the configuration, and for safety reasons, you should switch your system over to manual operation.



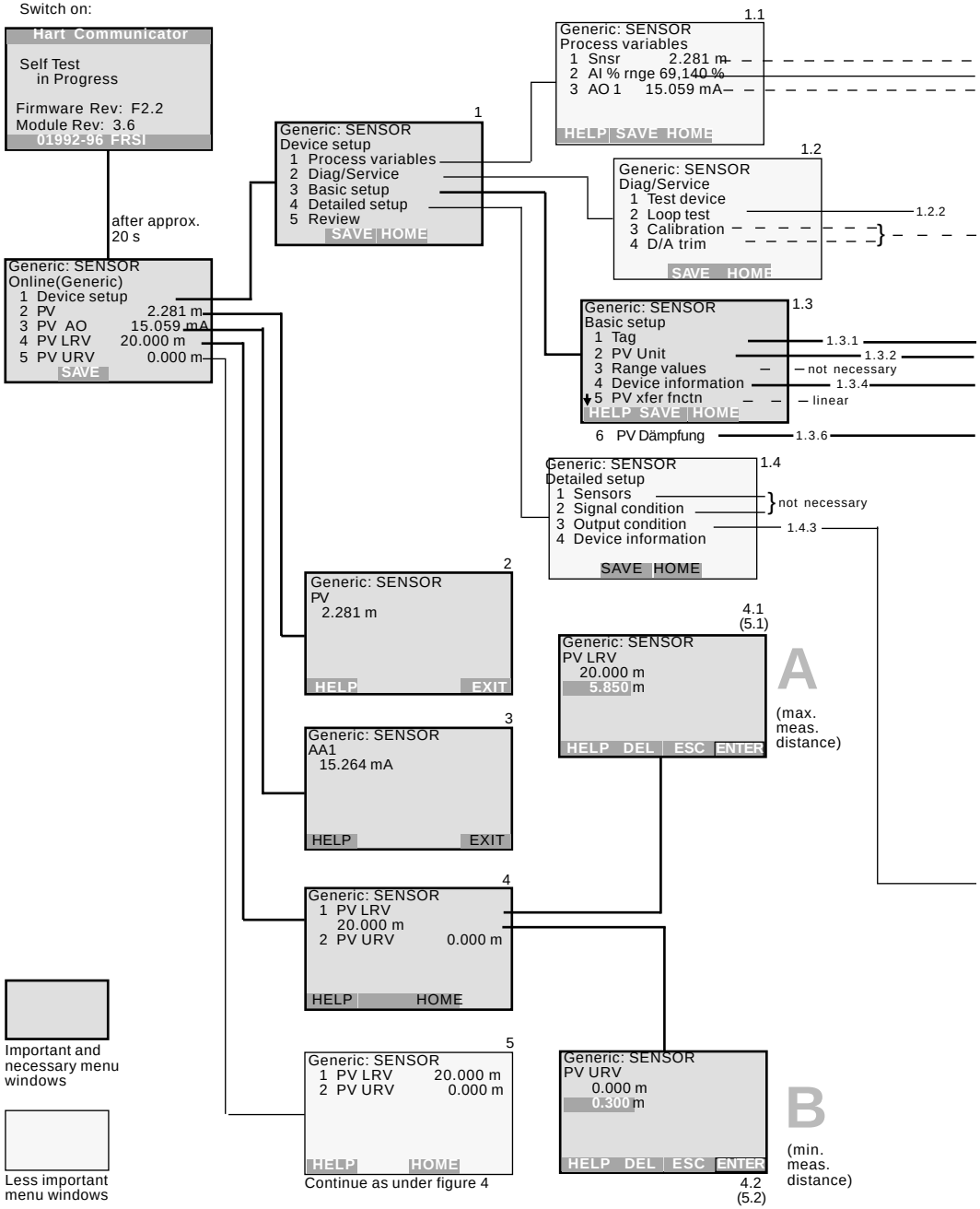
Press “OK” and the adjustment will now be transferred to the sensor. After a short time you are asked to switch your system over from manual to automatic operation. Confirm with “OK”.

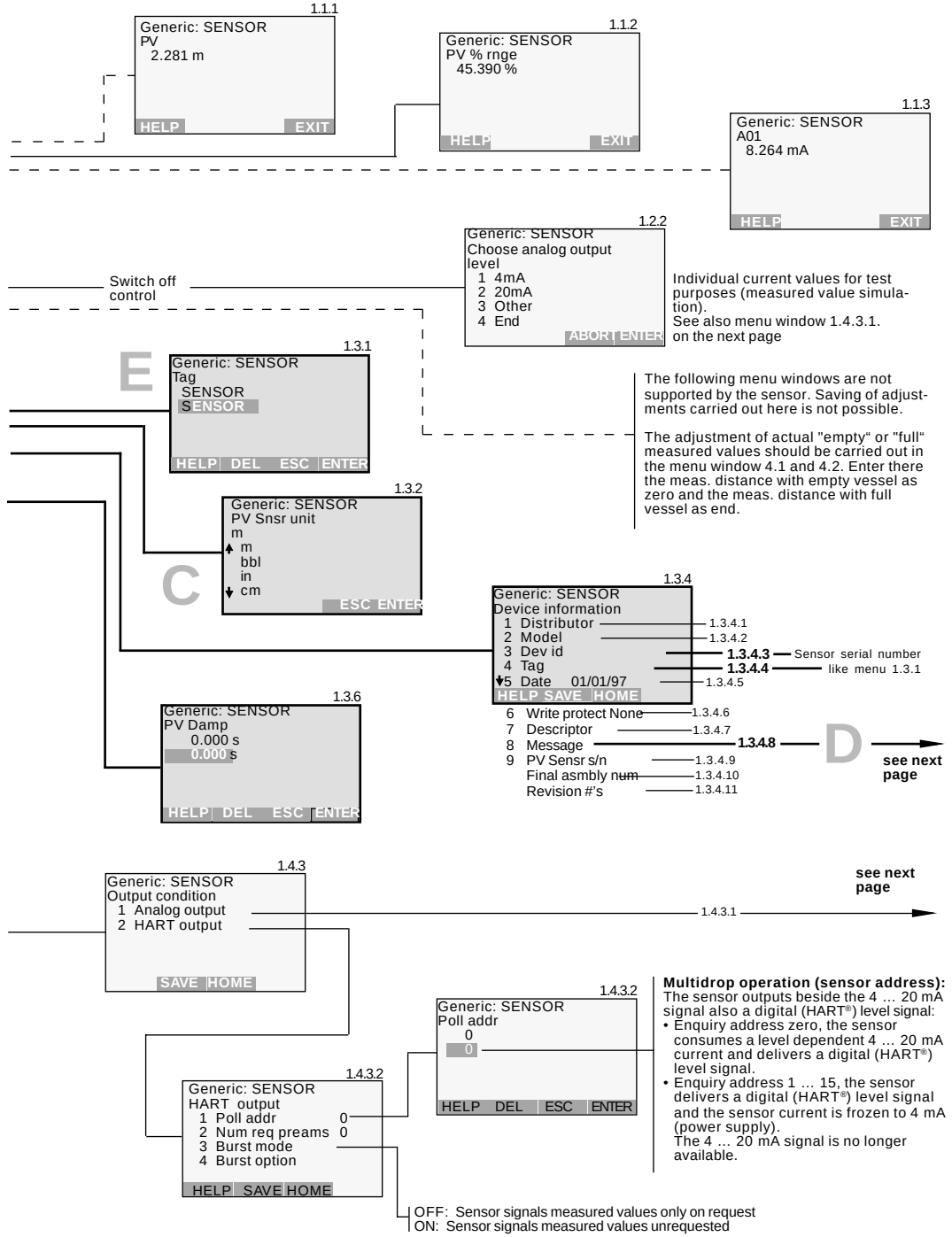


You see the adjustment that was just carried out.



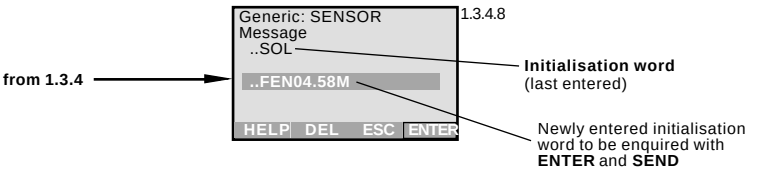
HART® menu schematic VEGAPULS 54K




1.1.1
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
ABOR ENTER
Individual current values for test purposes (measured value simulation).
See also menu window 1.4.3.1.
on the next page
Switch off control
E
1.3.1
Generic: SENSOR
Tag
SENSOR
SENSOR
HELP DEL ESC ENTER
The following menu windows are not supported by the sensor. Saving of adjustments carried out here is not possible.
The adjustment of actual "empty" or "full" measured values should be carried out in the menu window 4.1 and 4.2. Enter there the meas. distance with empty vessel as zero and the meas. distance with full vessel as end.
1.3.2
Generic: SENSOR
PV Snsr unit
m
m
bbl
in
cm
ESC ENTER
C
1.3.4
Generic: SENSOR
Device information
1 Distributor 1.3.4.1
2 Model 1.3.4.2
3 Dev id 1.3.4.3 Sensor serial number
4 Tag 1.3.4.4 like menu 1.3.1
5 Date 01/01/97 1.3.4.5
HELP SAVE HOME
6 Write protect None 1.3.4.6
7 Descriptor 1.3.4.7
8 Message 1.3.4.8
9 PV Sensr s/n 1.3.4.9
Final asmbly num 1.3.4.10
Revision #'s 1.3.4.11
D
see next page
1.3.6
Generic: SENSOR
PV Damp
0.000 s
0.000 s
HELP DEL ESC ENTER
1.4.3
Generic: SENSOR
Output condition
1 Analog output
2 HART output
SAVE HOME
see next page
1.4.3.1
1.4.3.2
Generic: SENSOR
Poll addr
0
0
HELP DEL ESC ENTER
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
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 54K

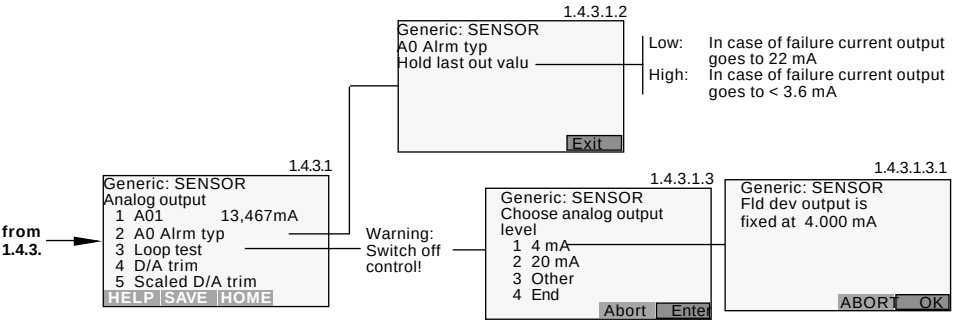
D



available initialisation words:

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

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



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 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 reprogrammed 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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