

Sonicont USN4SP

Ultrasonic level transmitter / level switch

Non-contact measurement of filling levels
in liquids, pastes and coarse bulk materials

Technical manual
01.18

Applications

Non-contact level and volume measurement or
flow measurement at open channels and measuring weirs
for

- Water and waste water sector
- Process industry
- Environmental technology
- Storage tanks, storage bunkers, silos

Main features

Wide range of applications

- Measuring ranges up to 8m in liquids and bulk materials
- Wide process temperature range -40°C to $+85^{\circ}\text{C}$
- High protection class IP65 / IP67
- Wide environmental temperature range -20°C to $+70^{\circ}\text{C}$

High accuracy – characteristic deviation $\leq 0,2\%$ of measuring
range

Integrated evaluation electronic

- Graphic display, keyboard
- 4x PNP switch output
- 1x current output 0/4...20mA – voltage output 0...10V
- Measure data memory for more than 500.000 measuring
values
- Battery powered data logger function
- Bluetooth-Interface
- Connector plug M12

High operating comfort

- Enclosure and display rotatable for optimal operability in
each installation position
- High contrast high brightness TFT-LCD display for best
readability
- 3-key operation without additional assistance with tactile
feedback
- Easy handling by clear menu navigation
- Extensive diagnostic functions for system analysis



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1 System description

1.1 Intended use

The device is an electronic level transmitter / level switch for monitoring, control as well as continuous measurement of filling levels in liquids, pastes and coarse bulk materials. Additional application fields are volume or flow measurement.

The operational reliability of the device is ensured only at the intended use.

1.2 Field of application

Due to the device construction with

- Measuring ranges of 2m / 5m / 8m
- Process temperatures from -40°C to $+85^{\circ}\text{C}$
- Process materials PVDF / CrNi-steel / EPDM

as well as the availability of extensive equipment and functionality

- Predefined vessel types for fast commissioning
- Predefined linearization curves for volume and flow measurement
- Integrated error signal suppression for adaption the installation situation
- Integrated compensation of the process temperature
- Limit value function for two-point control
- Pump control function
- Impulse output function for quantity counter
- Error indication function for error monitoring

the device is especially suitable for the use for

- Level and volume measurement
- Flow measurement at open channels and measuring weirs

for

- Water and waste water sector
- Process industry
- Environmental technology
- Storage tanks, storage bunkers, silos

The device is suitable for demanding measuring requirements.

Due to its high accuracy and the high flexibility of configuration, the device can be suited a wide variety of applications.

The robust design and the high-quality workmanship turns the device into a very high quality product, which even the most adverse environmental conditions cannot affect, whether low temperatures when used outdoors, high shock and vibration or aggressive media.

A captive laser marking of the type label ensures the identifiability throughout the entire lifetime of the device.

Obviously is the optional marking of a measurement point designation resp. TAG, a customer label or of a neutral type label, of course also per laser marking.

A LABS-free resp. silicone-free version, a factory calibration with calibration certificate and a customer specific configuration resp. preset is also optionally available like a material test certificate EN10204 3.1.

Customer specific special versions can be realized on request, e.g.

- software adaption (menu navigation, special functions, etc.),
- changed terminal assignment resp. connector orientation,
- design adaption of the user surface,
- special designs for the process connection

1.3 System components

The device consists on the components:

- Sensor tip with ultrasonic sensor and temperature sensor.
- Process connection, for installation into the container cover or a bracket.
- Terminal enclosure, rotatable by 300° , for protection of the integrated signal processing electronic and for the electrical connection.

The components cannot be separated by the user.

1.4 Function

1.4.1 Measuring principle

The transducer of the ultrasonic sensor transmits ultrasonic pulses to the product surface. These pulses are reflected by product surface and received back by the transducer as echoes.

The running time of the ultrasonic pulses from emission to reception is proportional to the distance and hence the level.

Because the running time of the ultrasonic pulses is highly dependent on the environmental temperature, the temperature dependent change of sound velocity must be compensated. A temperature sensor, which is integrated in the ultrasonic sensor, is used for the temperature measurement.

1.4.2 Signal processing

The running time determined level is processed by the integrated evaluation electronic according to the respective preferences:

- The measuring value is monitored by four PNP switch outputs for exceedance of limit values.
- The measuring value is converted into a continuous current signal 0/4...20mA or voltage signal 0...10V.
- The measuring value is diagrammed at the high brightness and high contrast TFT-LCD display, whereby it can be selected between different display styles (digital value / manometer / chart / bar graph).
- All settings can be changed comfortable and easy by a 3-key operation without additional assistance with tactile feedback.

The device includes numerous functions to the adaption to nearly each measuring task:

- The interference echo suppression function ensures that interference echoes (e.g. from edges, welded joints and installations) are not interpreted as a level signal.
- Integrated unit conversion
- Peak value memory minimum – maximum
- Error memory for fast failure analysis
- Various flexible switch functions
- Error indication function to switch output, current/voltage output and display
- Simulation of the switch outputs and the current/voltage output

In the internal ring memory more than 500.000 measuring values can be recorded durable.

At the data logger function these measuring values are marked with a battery powered time stamp. By the Bluetooth interface recorded measuring values can be downloaded.

2 Safety notes

2.1 Operational safety

The device is safely built and tested according to state-of-the-art technology and has left the factory in perfect condition as regards technical safety.

The device meets the legal requirements of all relevant EU directives. This is confirmed by attaching the CE mark.

This measuring device meets article 4 (3) of the EU directive 2014/68/EU (pressure equipment device directive) and is designed and produced in good engineer practice.

2.2 Installation, connection, commissioning, operation

Installation, electrical connection, commissioning and operation of the device must be made by a qualified and authorized expert according to the information's in this technical manual and the relevant standards and rules. This expert must have read and understood this technical manual and especially the safety notes.

The device may only be used within the permitted operation limits that are listed in this technical manual. Every use besides these limits as agreed can lead to serious dangers.

The materials of the device must be checked for compatibility with the respective application requirements (contacting materials, process temperature) before use. An unsuitable material can lead to damage, abnormal behavior or destruction of the device and to the resulting dangers.

The sensors may not be used as sole device for prevention of dangerous conditions in machines and plants.

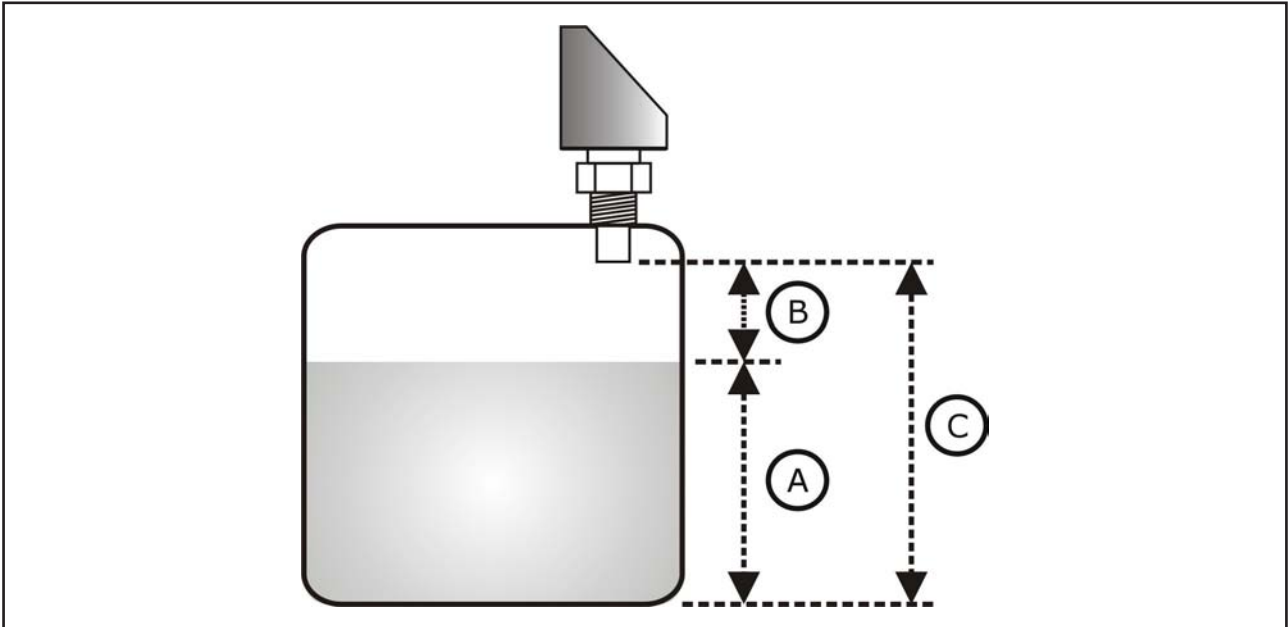
Using the device in a manner that does not fall within the scope of its intended use, disregarding this instruction, using under-qualified personnel, or making unauthorized alterations releases the manufacturer from liability for any resulting damage. This renders the manufacturer's warranty null and void.

3 Installation

The correct function of the device within the specific technical data can only be guaranteed, if the permitted process and environmental temperatures (see chapter „Technical data“) will not be exceeded.

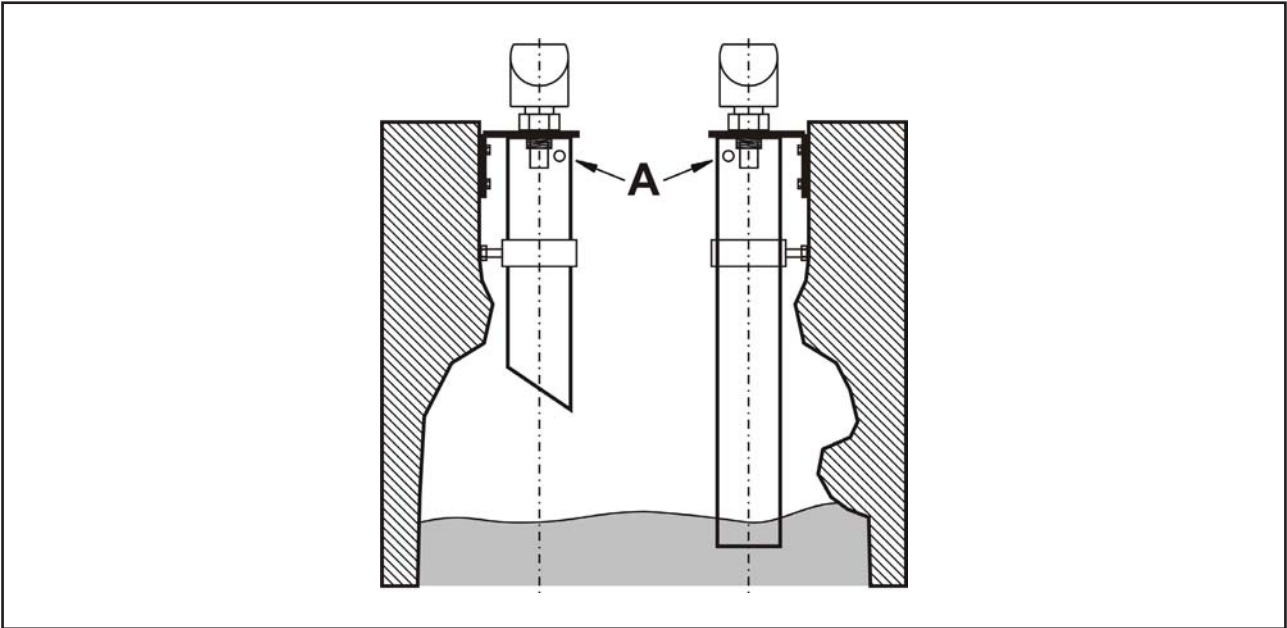
3.1 Installation place

3.1.1 Level measurement



- Do not install the sensor in the middle of the tank (C). We recommend leaving a distance between the sensor and the tank wall (A) measuring 1/6 of the tank diameter. In vessels with conical bottom it can be advantageous to mount the sensor in the center of the vessel, as measurement is then possible down to the lowest point of the vessel bottom.
- Use a protective cover, in order to protect the device from direct sun or rain (B).
- Avoid measurements through the filling curtain (D). Through the action of filling, stirring and other processes in the vessel, dense foams which considerably damp the emitted signals may form on the product surface. If foams are causing measurement errors, the sensor should be used in a standpipe.
- If there are strong air currents in the vessel, e.g. due to strong winds in outdoor installations or air turbulence, e.g. by cyclone extraction, the device should be mounted in a standpipe.
- Make sure that equipment (E) such as limit switches, temperature sensors, etc. are not located within the emitting angle α . In particular, symmetrical equipment (F) such as heating coils, baffles etc. can influence measurement. If large vessel installations such as struts or supports cause false echoes, these can be attenuated through supplementary measures. Small, inclined sheet metal or plastic baffles above the installations scatter the ultrasonic signals and avoid direct false echoes.
- Align the sensor so that it is vertical to the product surface (G).
- Never install two ultrasonic measuring devices in a tank, as the two signals may affect each other.
- To estimate the detection range, use the 3 dB emitting angle α , which can be found in the chapter "Technical Data - Input". This radius of the detection range at an arbitrary distance L_x can be calculated by the following term: $r_x = \tan(\alpha / 2) * L_x$
Example values for L_x and r_x can be found in the chapter "Technical Data - Input".

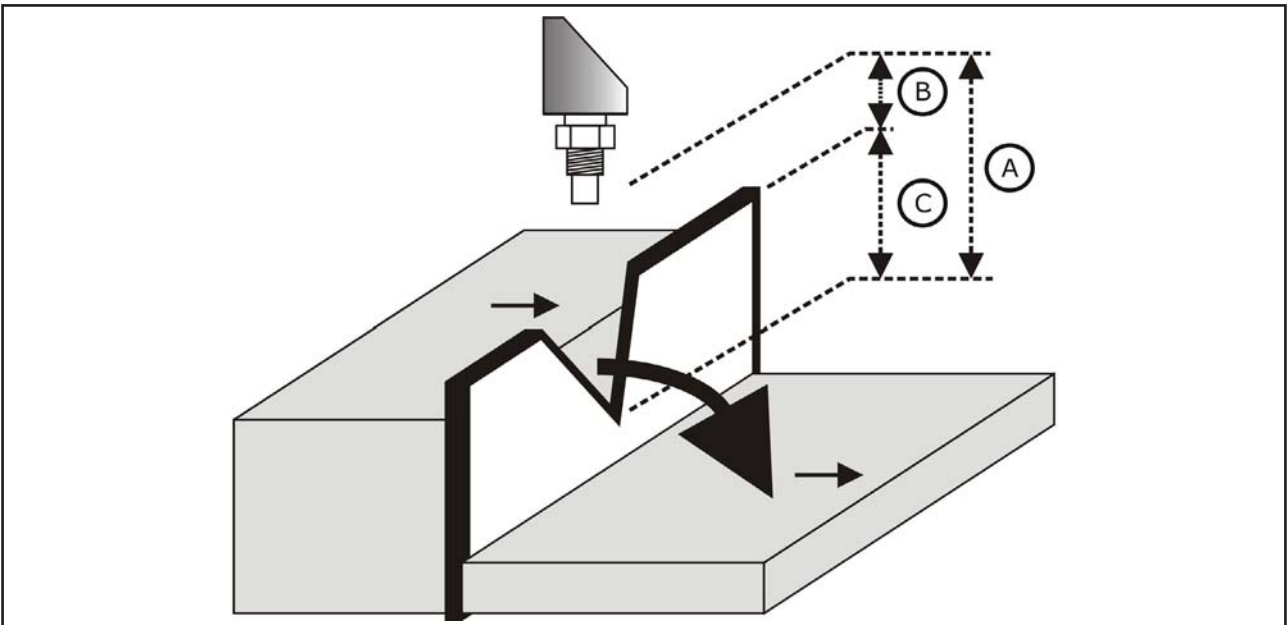
3.1.2 Installation in narrow shafts



- In narrow shafts with strong interference echoes, we recommend using a stand pipe resp. an ultrasound guide pipe (e.g. PE or PVC wastewater pipe) with a minimum diameter of 100mm.
- Make sure that the pipe is not soiled by accumulated dirt. If necessary, clean the pipe at regular intervals.
- The pipe must be provided with a sufficient venting hole (A) (\varnothing 5...10mm) at the upper edge.

3.1.3 Flow measurement

Example: Triangular weir



- Install the device at the inflow side, as close above the maximum water level H_{max} as possible (take into account the blocking distance BD).
- Position the device in the middle of the channel or weir.
- Align the sensor membrane parallel to the water surface.
- Keep to the installation distance of the channel or weir.

3.2 Installation notes

- Drive the system pressure free prior installation resp. deinstallation of the sensor.
- The screw-in of the thread process connection by using the terminal enclosure, the connection plug resp. the connection cable is not permitted.
- The tightening of the thread process connection may only be done at the hexagon by a suitable spanner and with the maximum permitted torque strength (see chapter „Technical data“).
- The housing can be rotated every time, also at operation, mechanically by 300°.
- The display can be rotated every time electrically by 180°.

3.2.1 Pressure / vacuum

Gauge pressure in the vessel does not influence the measuring result. Low pressure or vacuum does, however, damp the ultrasonic pulses. This influences the measuring result, particularly if the level is very low ($\leq -0,2\text{bar}$ resp. -20kPa).

3.2.2 Vapor pressure

The vapor pressure at 20°C (68°F) gives a hint on the accuracy of the ultrasonic level measurement. If the vapor pressure at 20°C (68°F) is below 50mbar, ultrasonic level measurement is possible with a very high accuracy.

This is valid for water, aqueous solutions, water-solid-solutions, dilute acids (e.g. hydrochloric acid, sulfuric acid), dilute bases (e.g. caustic soda), oils, greases, slurries, pastes, etc.

High vapor pressures or outgassing media (e.g. ethanol, acetone, ammoniac) can influence the accuracy.

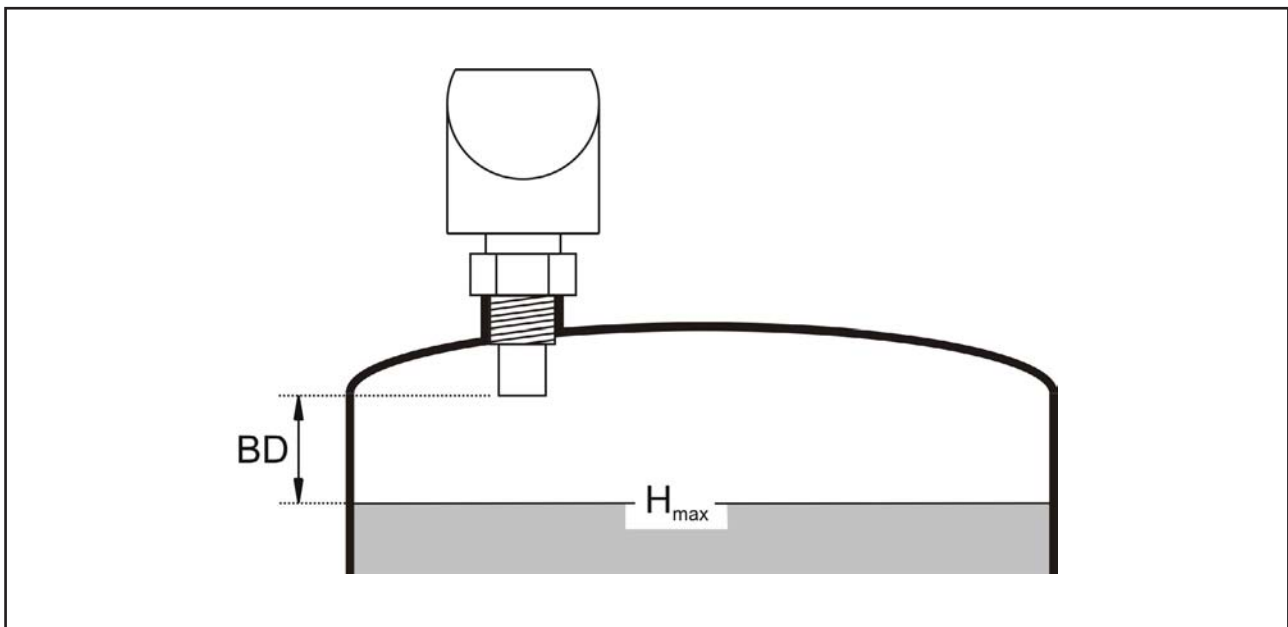
3.2.3 Range

The sensor range is dependent on the measuring conditions.

The maximum range can be found in the chapter “Technical Data - Input”.

3.2.4 Blocking distance

If the blocking distance is undershot, it may cause device malfunction.

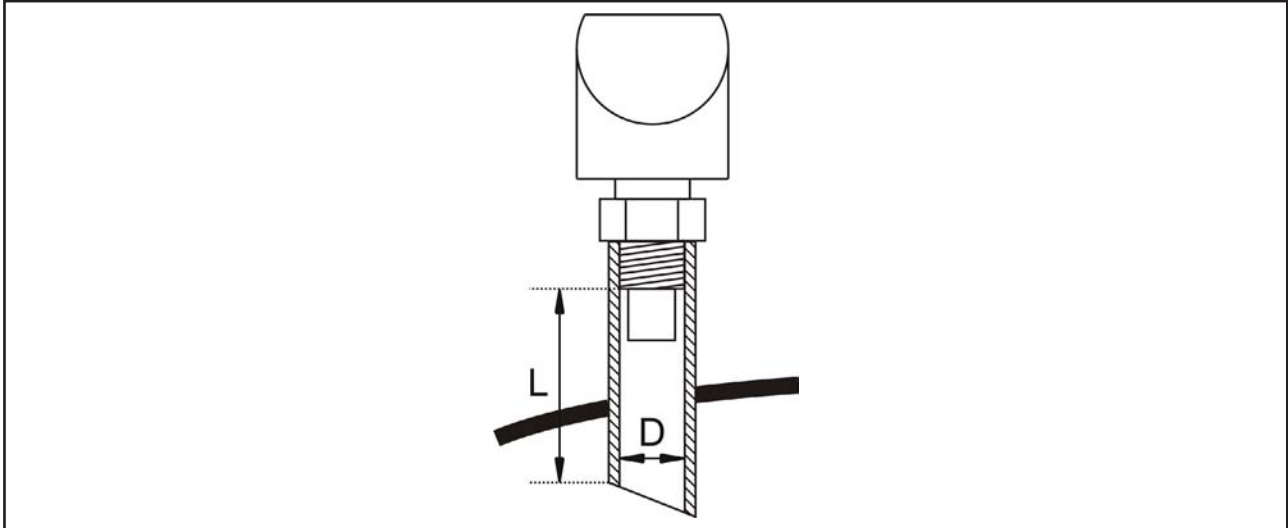


- Install the device at a height so that the blocking distance BD (see chapter “Technical Data - Input”) is not undershot, even at maximum fill level H_{max}.
- If the medium reaches the transducer, buildup can form on it and cause faulty measurements later on.

3.2.5 Nozzle installation

Use a pipe nozzle if you cannot maintain the blocking distance in any other way.

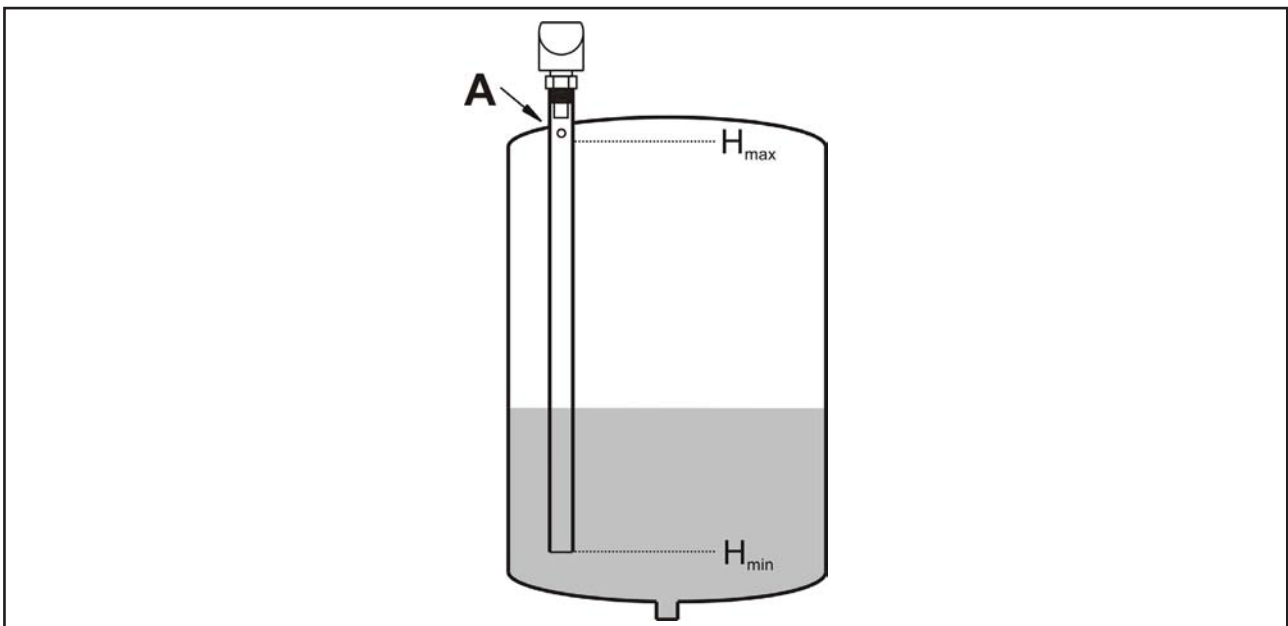
- The interior of the nozzle must be smooth and may not contain any edges or welded joints. In particular, there should be no burr on the inside of the tank side nozzle end.
- To minimize disturbing factors, we recommend an angled socket edge (ideally 45°).
- Note the specified limits for nozzle diameter and length.



Nozzle diameter D	Maximum nozzle length L
DN50 / 2"	80mm
DN80 / 3"	240mm
DN100 / 4"	300mm
≥ DN150 / 6"	400mm

3.2.6 Standpipe measurement

By using a standpipe (surge or bypass tube), the influence of vessel installations, foam generation and turbulence is excluded.



- Standpipes must extend all the way down to the requested min. level, as measurement is only possible within the tube.
- The pipe must be provided with a sufficient venting hole (A) (Ø 5...10mm) at the upper edge.
- Avoid large gaps and thick welding joints when connecting the tubes.
- Measurement in a standpipe is not recommended for very adhesive products.

4 Electrical connection

The electrical connection of the device must be carried out according to the respective country specific standards.

Incorrect installation or adjustment could cause applicationally conditioned risks.

Warning!

The instrument may only be installed if the supply voltage is switched off.

4.1 Potential equalization - earthing

The device must be grounded.

The earthing can be carried out by the metallic process connection.

The metallic parts of the device are electrically connected with the socket of the plug M12.

4.2 Connection cable

Use only shielded signal and measurement wires and install these wires separated from power leading wires.

Connect the cable shield of a connected cable only at one side to earth, ideally at the installation place of the device.

4.3 Supply voltage

The voltage applied to the terminal contacts may not exceed the maximum permitted supply voltage to avoid damage of the electronic.

The maximum permitted supply voltage range is:

Signal 0/4...20mA	9...30V _{DC}
Signal 0...10V	14...30V _{DC}

All connections are reverse polarity protected.

4.4 Switch output

Warning!

Inductive loads at the PNP switch outputs, e.g. relays, contactors or magnetic vents may only be used with a free-wheeling diode or a RC protection circuit to avoid high voltage peaks.

Note!

For inauguration it is suggested, to deactivate all connected control devices, to avoid unwanted control reactions.

The load at the PNP switch output will be connected to the terminal +L of the supply voltage by a semiconductor switch contactless and by this bounce-free.

At an activated switch state a positive signal near supply voltage is feed to the output.

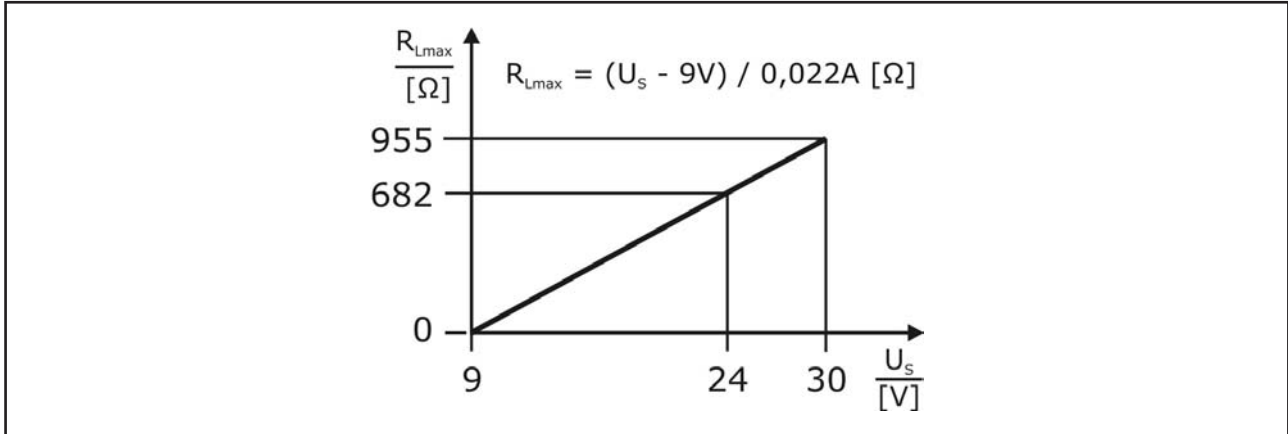
At deactivated switch state and at failure of supply voltage the semiconductor switch is shut off.

The PNP switch output is current limited, overload and short circuit protected.

4.5 Analogue output

4.5.1 Current output – Load resistor

A load resistor, e.g. the measuring shunt of an evaluation device, requires a minimum supply voltage. Dependent on the connected supply voltage and the maximum output current, it results in a maximum value for this resistor, where a correct function is still possible.



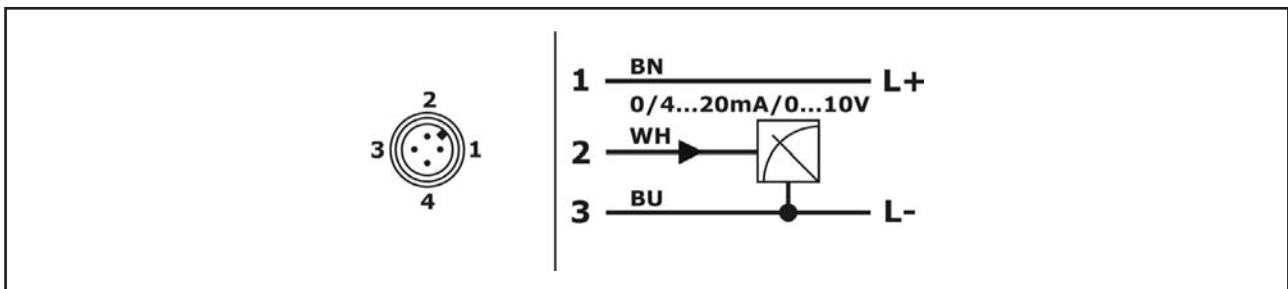
4.6 Connection scheme

Conductor color standard connection cable M12 – A-coded:

- BN = brown
- WH = white
- BU = blue
- BK = black
- GY = grey
- YE = yellow
- GN = green
- PK = pink

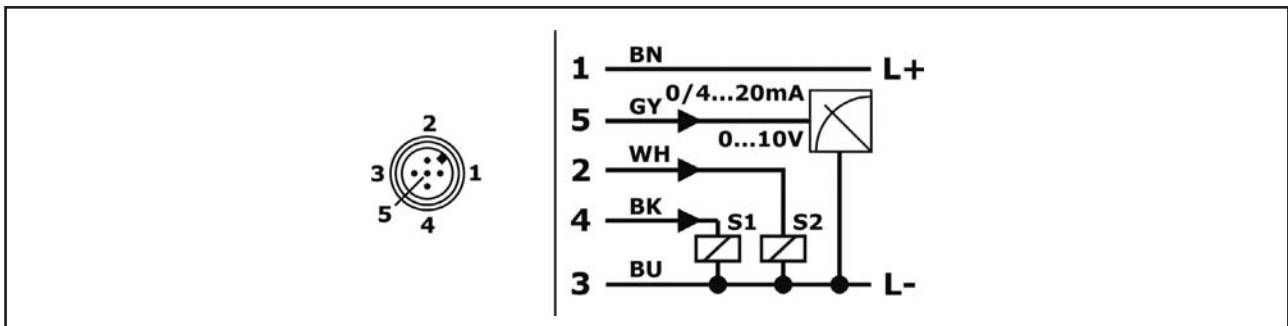
4.6.1 Electronic output type M

1x signal 0/4...20mA-0...10V, supply 24VDC



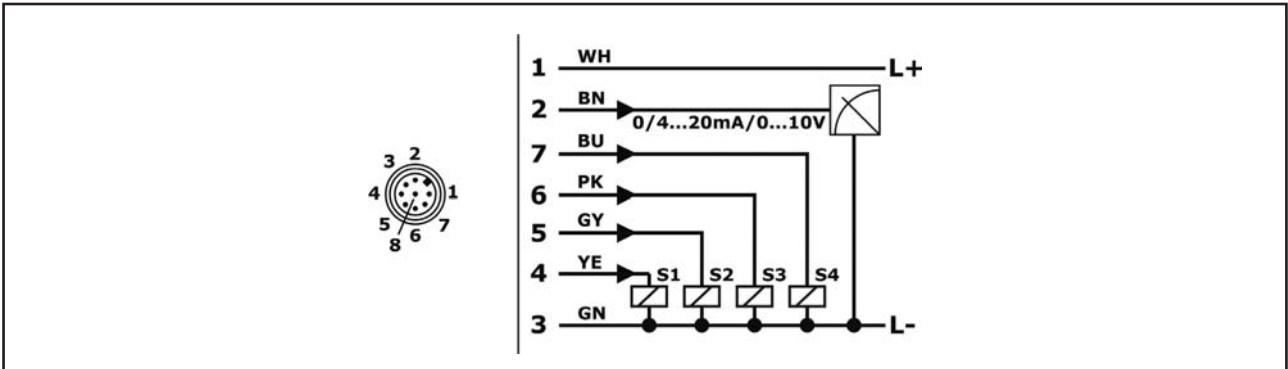
4.6.2 Electronic output type K

1x signal 0/4...20mA-0...10V, 2x switch PNP, supply 24VDC



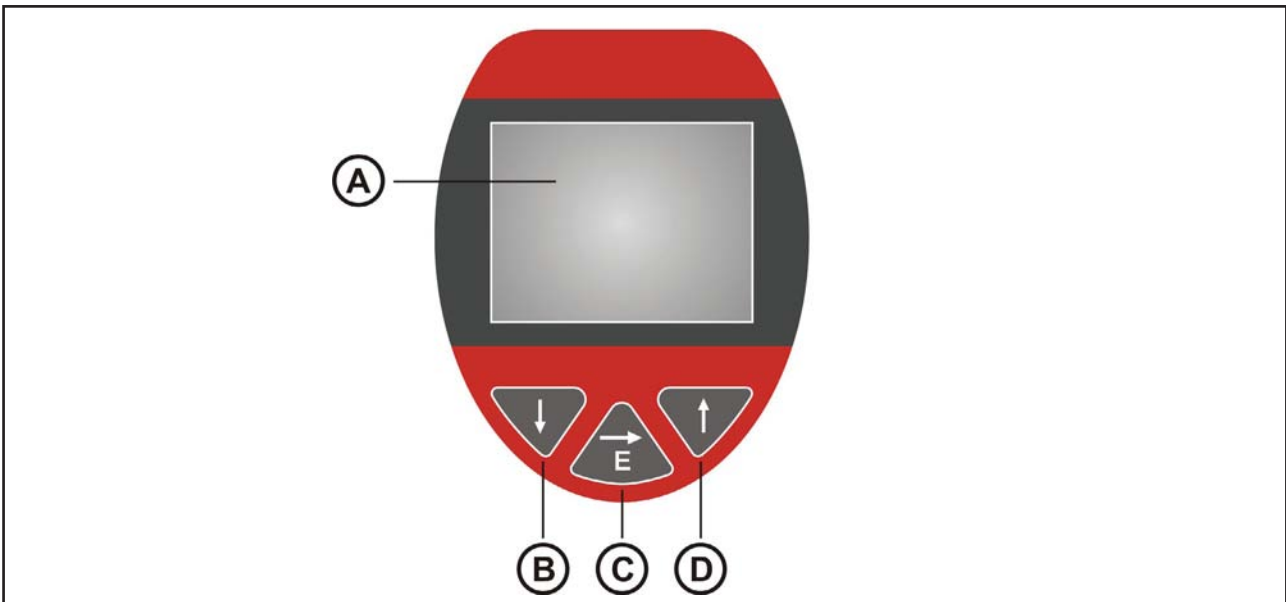
4.6.3 Electronic output type R

1x signal 0/4...20mA-0...10V, 4x switch PNP, supply 24VDC



5 Operation

5.1 Operation and display parts



A – LCD display

- Display of measuring value, device state and operation menu

B - Key Down

- In the selection menu navigation downwards
- In the set menu decreasing of value
- Used, in combination with the key up, for leaving selection and set menu without applying changings
- Used, in combination with the key up, for a step backwards one menu item

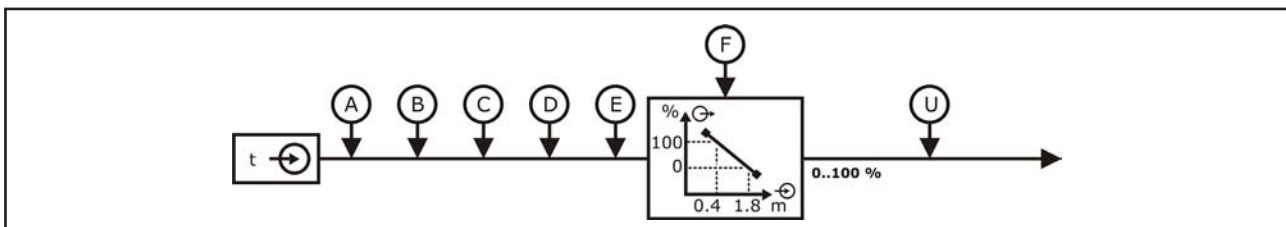
C - Key Enter/Shift right

- Access to operation menu
- In the selection menu entering the selected sub menu
- In the set menu applying the new value and digit shift right

D - Key Up

- In the selection menu navigation upwards
- In the set menu increasing of value
- Used, in combination with the key down, for leaving selection and set menu without applying changings
- Used, in combination with the key down, for a step backwards one menu item

5.2 Function scheme



A – Commissioning

B – Operating mode (4..20mA/0..20mA/0..10V)

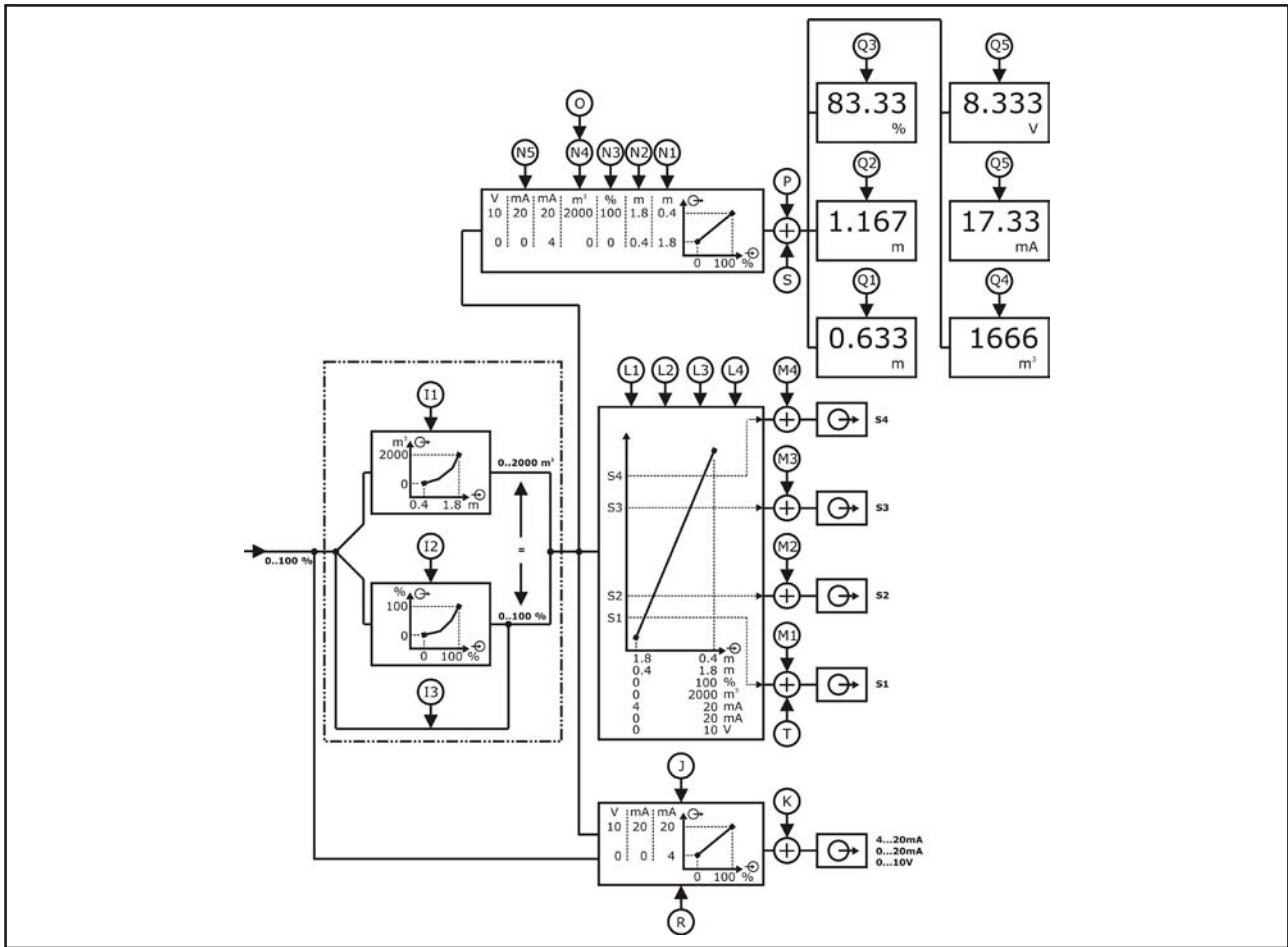
C – Pulse rate

D – Echo loss

E – Damping

F – Min/Max adjustment > e.g. 1,8..0,4m = 0..100%

U – Limit min/max



I1 - Linearization > Level - display scaling e.g. $0,4..1,8 \text{ m} = 0..2000 \text{ m}^3$

I2 - Linearization > Percent $0..100 \%$ - Lin. Percent $0..100 \%$

I3 - No linearization

J - Signal output > e.g. $0..100 \%$ = $4..20 \text{ mA}$ resp. $0..20 \text{ mA}$ resp. $0..10\text{V}$

R - Signal output > Percent $0..100 \%$ - Lin. Percent $0..100 \%$

K - Error signal evaluation

L1 - Switch / reset switch point S1

L2 - Switch / reset switch point S2

L3 - Switch / reset switch point S3

L4 - Switch / reset switch point S4

M1 - Error indication function S1

M2 - Error indication function S2

M3 - Error indication function S3

M4 - Error indication function S4

T - Impulse output S1 for quantity counter

N1 - Display scaling > Distance e.g. $0..100 \%$ = $1,8..0,4 \text{ m}$

N2 - Display scaling > Fill level e.g. $0..100 \%$ = $0,4..1,8 \text{ m}$

N3 - Display scaling > Percent $0..100 \%$ = $0..100 \%$

N4 - Display scaling > scaled e.g. $0..100 \%$ = $0..2000$

N5 - Display scaling > Signal Output $0..100 \%$ = $4..20 \text{ mA}$ resp. $0..20 \text{ mA}$ resp. $0..10 \text{ V}$

O - Display unit > at display scaling scaled e.g. m^3

P - Error indication display

S - Quantity counter > e.g. m^3/h , l/min

Q1 - Display - Distance e.g. $1,8..0,4 \text{ m}$

Q2 - Display - Fill level e.g. $0,4..1,8 \text{ m}$

Q3 - Display - Percent $0..100 \%$

Q4 - Display - scaled e.g. $0..2000 \text{ m}^3$

Q5 - Display - Signal Output $4..20 \text{ mA}$ resp. $0..20 \text{ mA}$ resp. $0..10 \text{ V}$

5.3 Menu structure

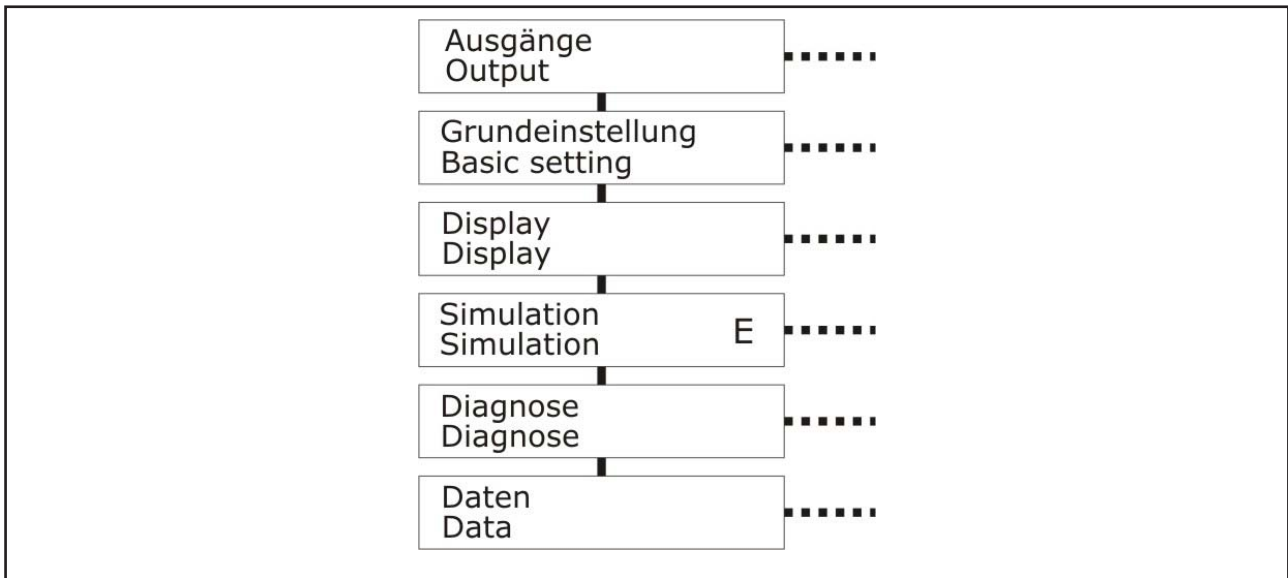
The entrance to the different function areas of the selection and set menu layer is done by the main menu (push the key Enter/Shift right for 3 seconds).

If failures are registered (see chapter diagnose/failure), these are indicated prior the jump into the main menu.

By the key Enter/Shift right the failure indication will be canceled.

The symbol E at a menu item indicates its position in the extended menu structure.

This extended menu structure can be shown in the submenu display by the menu item menu structure.



- **Submenu output**
Settings for the function of the switch outputs and the signal output.
- **Submenu basic setting**
Settings for the basic adaption of the device to the measuring task, e.g. adjustment, damping and linearization.
- **Submenu display**
Settings for the adaption of the measuring value indication to the measuring task, e.g. measuring value scaling, display type, menu language and also password protection.
- **Submenu simulation**
Settings for the simulation of the switch outputs and the signal output, e.g. for inauguration or also for failure analysis.
- **Submenu diagnose**
Multiple information to the historical measuring activity and the device, that can be useful for system surveillance or also for failure analysis.
- **Submenu data**
Settings for the measuring value recording and the data transmission by Bluetooth.

5.4 Navigation

The navigation in a submenu and in a selection window is done by the keys Up and Down.

The selection of a submenu and the selection of a setting in a selection menu is done by the key Enter/Shift right.

The jump backward from a submenu to the higher-level menu is done by the menu item back or by the simultaneous pushing the keys Up and Down.

The leaving of a selection menu without applying the changings is done by the simultaneous pushing the keys Up and Down.

The input of a value or text in a set menu is done digit by digit.

For the changing of the selected digit the keys Up and Down are used.

For the changing of the digit the key Enter/Shift right is used.

The applying of a set value resp. text is done by pushing the key Enter/Shift right for 3 seconds.

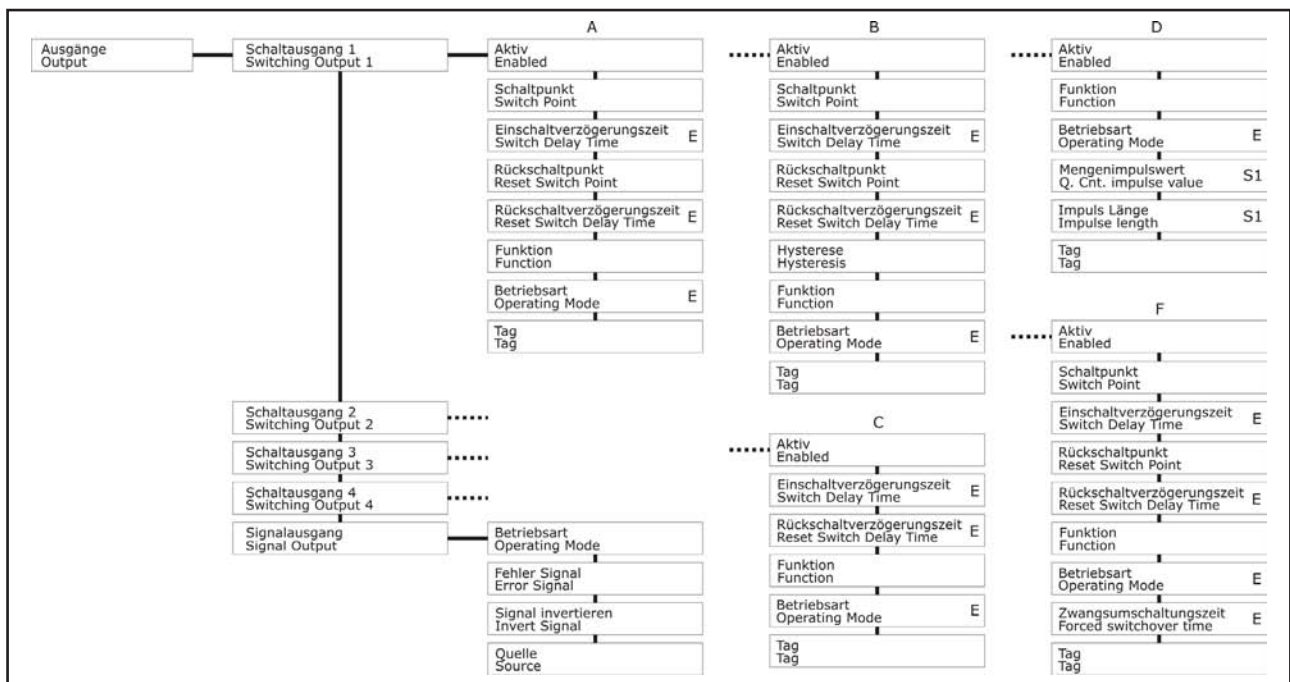
The leaving of an set menu without applying a value resp. text is done by the simultaneous pushing the keys Up and Down.

After 5 minutes of inactivity the active submenu resp. selection menu will automatically be left and a change to the measuring value indication is executed.

A jump backward is not executed from an active set menu.

5.5 Output

The symbol E at a menu item indicates its position in the extended menu structure. This extended menu structure can be shown in the submenu display by the menu item menu structure.



- A – Hysteresis function
- B – Window function
- C – Error indication function
- D – Impulse function
- F – Pump function

5.5.1 Switch output S1 / S2 / S3 / S4

5.5.1.1 Enabled

Each switch output can be activated resp. deactivated separately.

Yes

No

Default > Yes

5.5.1.2 Switch Point / Reset Switch Point

The input values refers to the set display value or acc. to display scaling.

The reset switch point must be lower or equal to the switch point.

At inverse measuring principle, e.g. distance measurement, the reset switch point must be greater or equal to the switch point.

The input range is limited to the measuring range.

Default > S1 = 20% / S2 = 40% / S3 = 60% / S4 = 80%

5.5.1.3 Switch Delay Time / Reset Switch Delay Time – E

The activation resp. deactivation of the switch output can be biased with a delay time (resolution 0,01s), to realize simple sequence control system.

The input range is indefinite.

Default > 0s

5.5.1.4 Function - E

5.5.1.4.1 Hysteresis function S1/S2/S3/S4

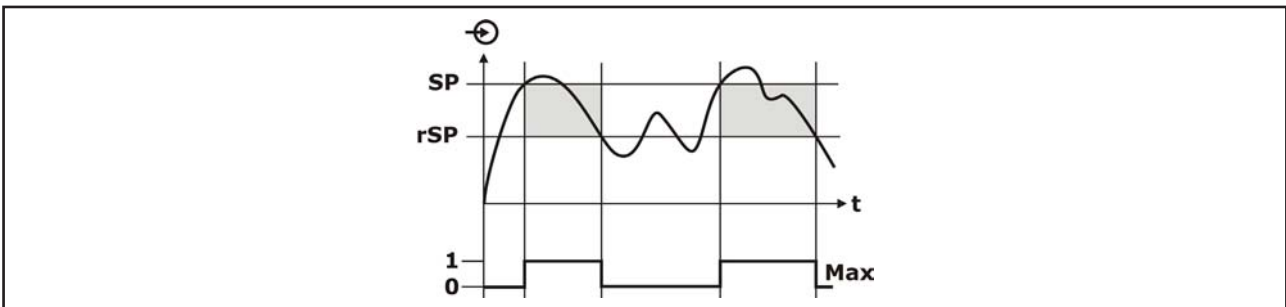
The hysteresis function realizes a stable switch state, independent from system conditioned signal fluctuations around the adjusted set point.

It can be used for realizing a signal controlled two-position control.

The switch range is determined by definition of switch point and reset switch point.

In the menu Operating Mode, the working principle of the switch output can be inverted.

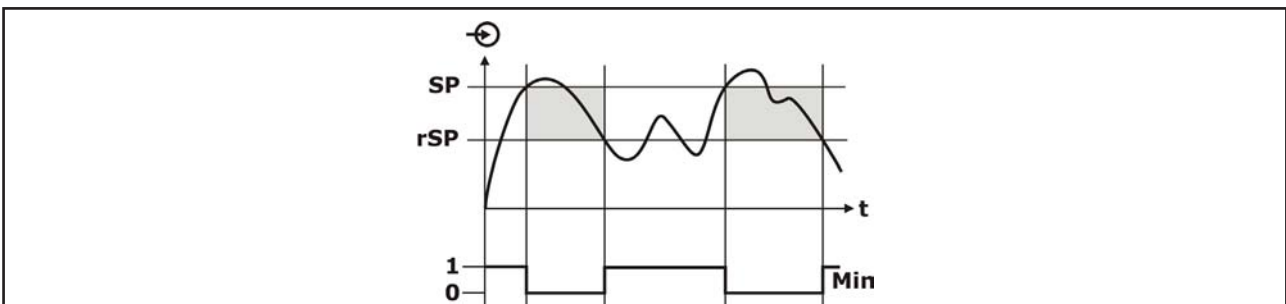
- Operating Mode Maximum



The switch output is activated, if the current measuring value overshoots the switch point and if the set switch point delay time has been expired.

The switch output is deactivated, if the current measuring value undershoots the reset switch point and if the set reset switch point delay time has been expired.

- Operating Mode Minimum



The switch output is activated, if the current measuring value undershoots the reset switch point and if the set reset switch point delay time has been expired.

The switch output is deactivated, if the current measuring value overshoots the switch point and if the set switch point delay time has been expired.

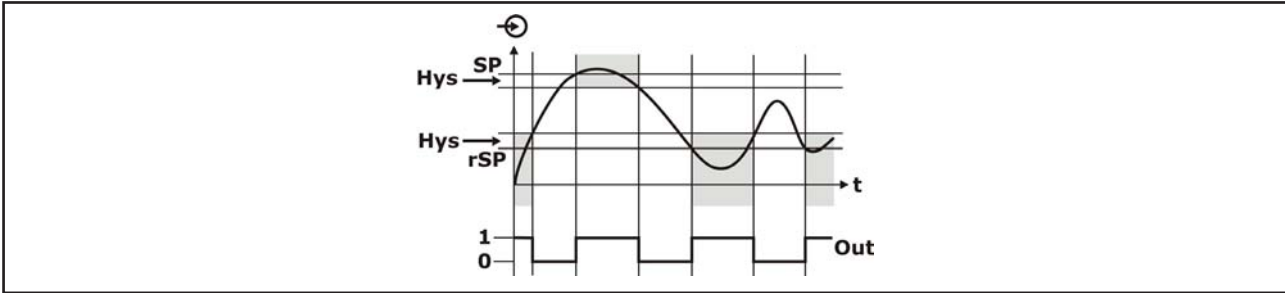
5.5.1.4.2 Window function S1/S2/S3/S4

The window function realizes a signal range – acceptance region –, where the switch output is set to a definitive switch state.

The switch range is determined by definition of switch point, reset switch point and hysteresis.

In the menu Operating Mode, the working principle of the switch output can be inverted.

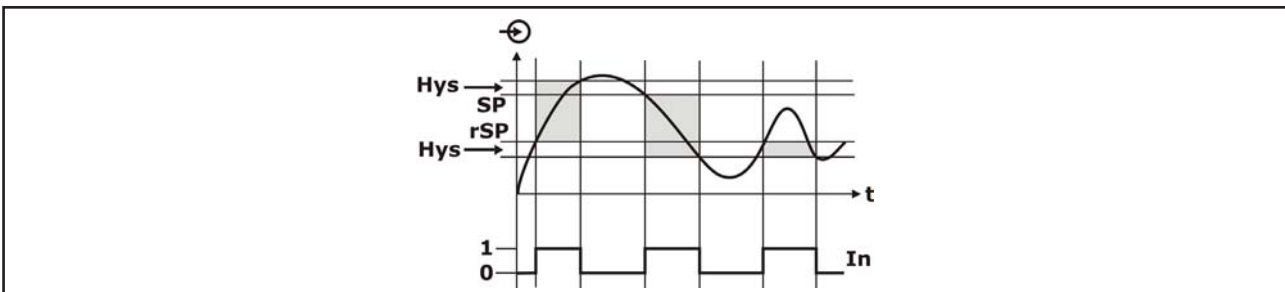
- **Operating Mode outside**



The switch output is activated, if the current measuring value is outside the area that is defined by the switch point and the reset switch point and if the set switch point delay time has been expired. The switch output is deactivated, if the current measuring value is inside the area that is defined by the switch point and the reset switch point and if the set reset switch point delay time has been expired.

The hysteresis is positioned inside the area that is defined by the switch point and the reset switch point.

- **Operating Mode inside**



The switch output is activated, if the current measuring value is inside the area that is defined by the switch point and the reset switch point and if the set switch point delay time has been expired. The switch output is deactivated, if the current measuring value is outside the area that is defined by the switch point and the reset switch point and if the set reset switch point delay time has been expired.

The hysteresis is positioned outside the area that is defined by the switch point and the reset switch point.

5.5.1.4.3 Error Indication Function S1/S2/S3/S4

The switch output is activated, if the device has detected a failure behavior (see chapter diagnose/ failures).

In the menu Operating Mode, the working principle of the switch output can be inverted.

5.5.1.4.4 Impulse Function S1

The switch output generates one switch impulse per calculated quantity value of the quantity counter (see data/quantity counter).

A warning message is generated, if the quantity counter impulse value is set too low or the impulse length is set too high. The calculation base for this warning message is the display scaling at 100%.

- **Quantity counter impulse value**

Amount of the quantity counter value, for which one switch impulse is generated.

The input range is indefinite.

Default > 1

- **Impulse length**

Duration of a pulse resp. additionally the duration of a pulse pause.

The input range is limited to values from 0,1 to 99999.

Default > 0,5 s

In the menu Operating Mode, the working principle of the switch output can be inverted.

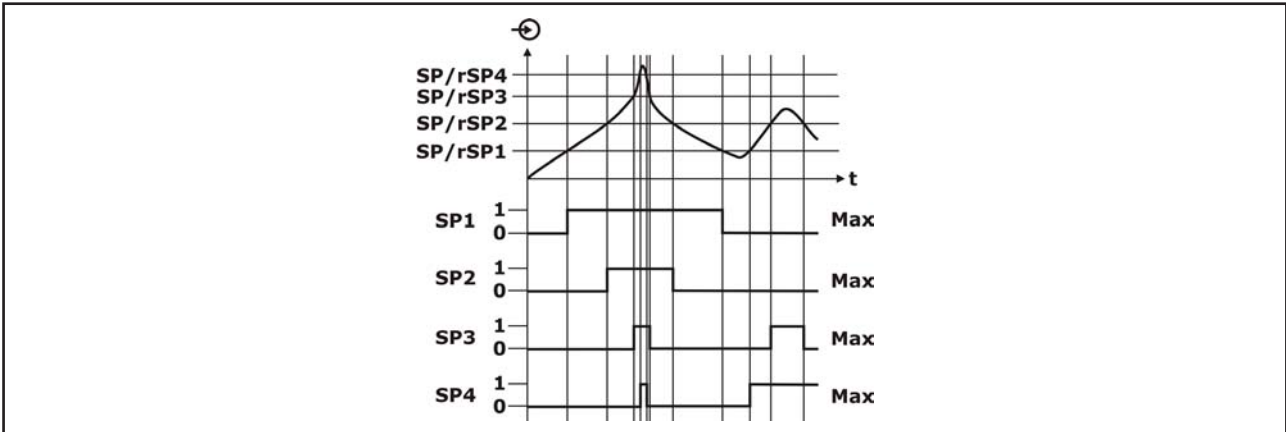
5.5.1.4.5 Pump function runtime S1/S2/S3/S4

Pump function runtime is used to control several pumps with the same function dependent on the previous running time.

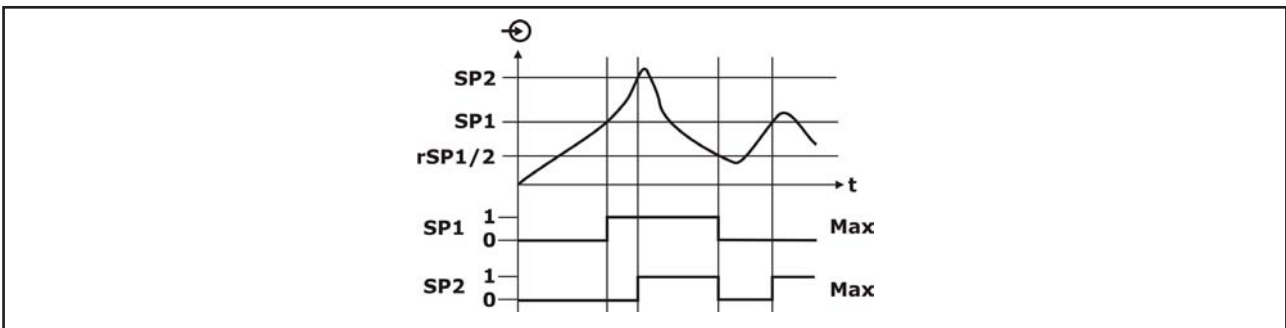
Always the pump with the shortest running time is switched on and the pump with the longest running time switched off.

With increased requirement, all pumps can also run at the same time dependent on the entered switching points. With this measure, a steady utilization of the pumps is achieved and the reliability increased.

All switch outputs with activated pump control are not assigned to a certain switching point but are switched on or off depending on the accumulated operating time. The signal conditioning instrument selects the switch output with the shortest operating time when the switch point is reached and the relay with the longest operating time when the reset switch point is reached.



Switch point and reset switch point can be set to different values, to achieve a complex switch mechanism.



The runtime of each switch output can be reset in the menu „Diagnosis – Switching output“.

In the menu Operating Mode, the working principle of the switch output can be inverted.

In the menu Operating Mode, the working principle of the switch output can be inverted.

5.5.1.4.6 Pump function sequential S1/S2/S3/S4

Purpose of the pump function sequential is the alternating use of multiple pumps for the same task (Overflow protection or dry running protection).

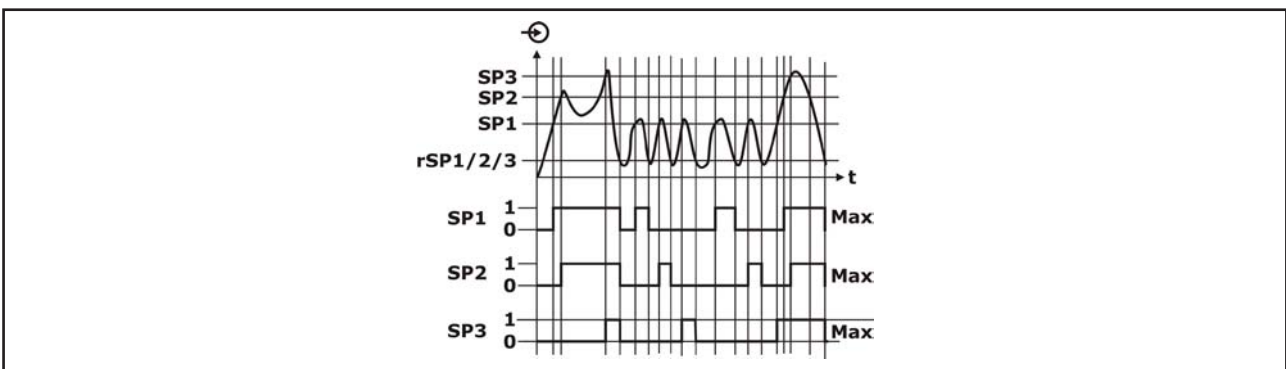
Due using the pumps for the same task, it can be detected by the pump switch-on time, if one of the pumps doesn't operate with the necessary performance (Runtime of the pump increases).

All switch outputs, which are activated for pump function, are not assigned to a certain switch point, but should be switched-on resp. switched-off alternating. When reaching the switch delay value, the evaluation device chooses the switch output, which is next in the alternating row.

When reaching the reset switch point, the switch outputs are switched-off in the same order like they have been switched-on.

The order is predefined. It starts with the switch output with the lowest index. The next switch output is the switch output with the next higher index. After the switch output with the highest index it will be changed to the switch output with the lowest index, e.g. S1...S2...S3...S4...S1...S2....

The order is valid for all switch outputs, which corresponds to the pump function.



The index of the last switched-on switch output will not be saved, that means that after power-on it will be started always with the switch output with the lowest index.

In the case, that multiple pumps are operated alternating in the same range, the switch points resp. reset switch points must be set to the same value.

Due to this, all switch outputs will switch always together. To achieve still the required switch behaviour, one switch output must be set to the needed switch point resp. reset switch point. All other switch outputs must be set to switch points resp. reset switch points, which will never be achieved in standard operation.

In the menu Operating Mode, the working principle of the switch output can be inverted.

5.5.1.5 Operating Mode – E

The operating mode defines the function direction of the switch output, dependent on the function. The effects of this parameter are described in the respective sub-chapter of the chapter „Function“.

5.5.1.6 Forced switchover – E

This menu item is only available at function principle pump function runtime resp. pump function sequential.

The purpose of the forced switchover is the change of a pump after a predefined time.

This gets relevant, if the measuring value does not change for a longer time and thus always the same pump is switched-on.

The parameter forced switchover time defines the time, after that a forced switchover of the pump is processed.

The menu „Forced switchover time“ is only available at activated forced switchover.

The pump, which is switched-on, depends on the chosen pump function. If already all pumps of the pump function are switched-on, the pump stays switched-on.

If the pump is already switched-on, when the forced switchover is activated, the timer will not be started. The timer starts after the next switch-off and a new switch-on.

At the forced pump switchover, a set reset switch delay time will not be considered, that means the forced switchover is processed exactly after the set forced switchover time.

At the forced pump switchover, a set switch delay time will be considered, that means the forced switchover to another pump is processed exactly after the time.

The set switch delay time for this pump must be expired, before the new selected pump will be switched-on.

- Yes
- No

Default > No

5.5.1.7 Forced switchover time

This menu is only available at activated forced switchover.

The effects of this parameter are described in the chapter “Forced switchover”.

The input range is indefinite.

Default > 1h

5.5.1.8 Switch output TAG

Due to the Switch output TAG each switch output can be separately marked with a label. At the indicator type digital the Sensor TAG is indicated in the display.

Up to 10 characters can be input.

The input range is indefinite.

Default > no Switch output TAG allocated

5.5.2 Signal output

The nominal values of the analogue signal (4/20 mA resp. 0/10mA resp. 0/10 V) refers to the set display nominal values 0% and 100%

5.5.2.1 Operating Mode

Defines the type of the analogue output signal

- 4-20 mA
- 0-20 mA
- 0-10V

Default > 4-20 mA

5.5.2.2 Error Signal

Defines, dependent on the operating mode, the analogue output signal regarding operating range and if errors (see chapter diagnose/failures) are registered.

Operating mode 4-20mA

The linear output range is 3,8...20,5mA.

- Off >> At exceedance the limit values will be kept.
- 3.6mA >> At exceedance the error signal 3,6mA is generated.
- 22mA >> At exceedance the error signal 22mA is generated.

Operating mode 0-20mA

The linear output range is 0...20,5mA.

- Off >> At exceedance the limit values will be kept.
- 0mA >> At exceedance the error signal 0mA is generated.
- 22mA >> At exceedance the error signal 22mA is generated.

Operating mode 0-10V

The linear output range is 0...10,5V.

- Off >> At exceedance the limit values will be kept.
- 0V >> At exceedance the error signal 0V is generated.
- 11V >> At exceedance the error signal 11V is generated.

Default > Off

5.5.2.3 Invert Signal

Inverts, dependent on the operating mode, the analogue output signal.

- 4-20 mA >> 20-4 mA
- 0-20 mA >> 20-0 mA
- 0-10 V >> 10-0 V

Default > No

5.5.2.4 Source

Defines the source for the generation of the signal output. For the source, it can be chosen between the measuring value before (%) or after (Lin %) an optionally set linearization.

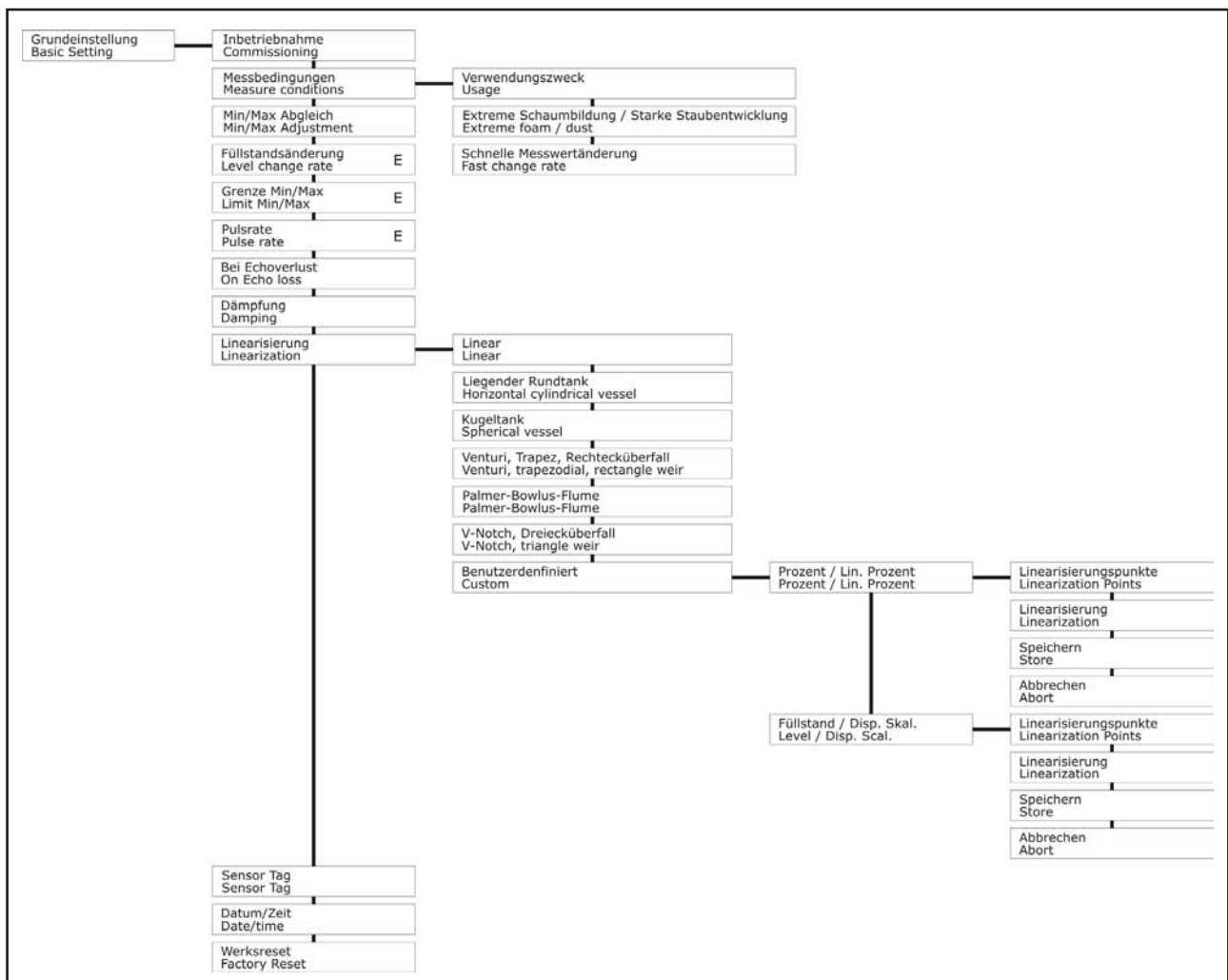
This allows e.g. the output of a linear filling level at the signal output, whereas a linearized volume is shown at the display.

- Lin %
- %

Default > Lin %

5.6 Basic setting

The symbol E at a menu item indicates its position in the extended menu structure. This extended menu structure can be shown in the submenu display by the menu item menu structure.



5.6.1 Measure conditions

Preselection for optimized adaption at increased requirements.

- Usage

- **Object detection**

Each measuring value at the set pulse rate will be displayed resp. output.

- **Fluid**

The measured signal will be checked for plausibility and fast signal changes > 1m/min, e.g. due to an agitator, will be suppressed.

If faster signal changes occurs, e.g. at filling or emptying, this can be allowed separately (menu "Fast change rate")

- **Bulk Solid**

The measured signal will be checked for plausibility and fast signal changes > 1m/min, e.g. due to an agitator, will be suppressed.

If faster signal changes occurs, e.g. at filling or emptying, this can be allowed separately (menu "Fast change rate")

Default > Fluid

- **Extreme foam / Extreme dust**

At extreme foam resp. extreme dust the measuring signal will be damped very much. The activation of this function allows at such applications a significant improvement of the signal evaluation.

Default > no

- **Fast change rate**

The measured signal can be checked for plausibility and only very fast jumpy signal changes will be suppressed.

Default > no

5.6.2 Commissioning

The commissioning function can be used to adapt the device to the constructive conditions. Therefore the device must be operated in its finally installed position at the maximum possible distance resp. at the lowest possible known filling level.

After setting the vessel type the detected measuring value must be confirmed or possibly corrected.

Afterwards the detection of the envelope curve for the error echo suppression is processed.

Error echoes causing installations, positioned below the filling level when processing the commissioning function, cannot be detected.

5.6.3 Min/Max-Adjustment

The min/max-adjustment set the measuring range limits.

2 points are defined, that set the ratio of the measured distance signal and the operating range of the device.

The current measuring value is indicated in the display.

The input of the measuring range limits 0% and 100% are not mandatory. Values within the measuring range e.g. 11% and 87% can be also input. In this case there is an automatic calculation to 0% resp. 100%. The higher the difference between these points, the more precise is the following calculation.

The min/max-adjustment is relevant for linearization, signal output and display scaling.

- Lower adjustment value
- Upper adjustment value

The input range is indefinite.

Default > Lower calibrated measuring value = 0% / Upper calibrated measuring value = 100%

5.6.4 Pulse rate – E

The pulse rate defines the measurement velocity resp. the repetition rate of the ultrasonic measurement pulses.

The use of a slower pulse rate (t_p) can be used for energy saving and also for conservation of the sensor (reduction of component stress due to high energetic ultrasonic signals).

The use of a slower pulse rate extends the actualization time of display and outputs by the respective factor.

- very fast – maximum pulse rate (see chapter „Technical Data“) x factor 1
- fast – maximum pulse rate (see chapter „Technical Data“) x factor 0,5
- slow – maximum pulse rate (see chapter „Technical Data“) x factor 0,25

Default > very fast

5.6.5 Limit min/max – E

If the measuring value exceeds the limits of the Min/Max-Adjustment, these limits are kept at activated function. An exceedance is not possible.

At deactive function measurement values besides the limit values are output.

This function is especially useful at a flow measurement to avoid negative flow measuring values.

- deactive
- active

Default > deactive

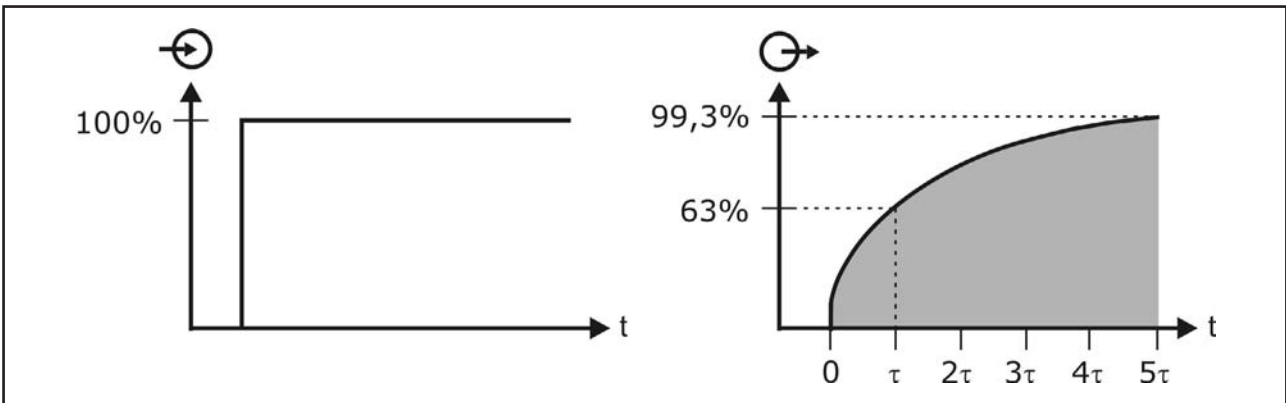
5.6.6 On echo loss

If no measuring signal can be detected, e.g. due to a too high distance or a strong deviation of the ultrasonic signal, up to the next valid measuring signal alternatively the last detected measuring value can be hold or the minimum resp. maximum adjusted limit value can be output.

- hold
- maximum measuring range
- minimum measuring range

Default > hold

5.6.7 Damping



The damping influences the reaction speed of display, output signal and switch output at a change of the measuring signal.

The behavior of display and output signal follows an exponential characteristic with the damping time constant t .

Within the time period t the output signal increases respectively by 63% of the existing deviation.

With 99,3%, the end value is nearly achieved after $5 t$.

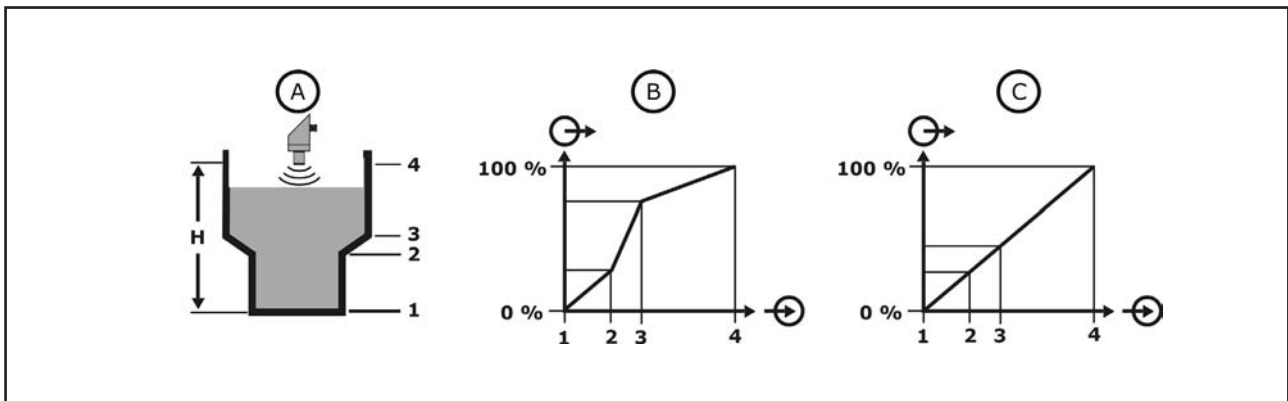
The set time equals $5 t$.

The input range is indefinite.

Default > 1 sec

5.6.8 Linearization

Due to the integrated linearization function it is possible, to linearize a measuring signal e.g. for volume calculation of conical or horizontal cylindrical vessels or also for flow calculation.



- A - Tank with linearization points 1 / 2 / 3 / 4
- B - Characteristic distance - level not linearized
- C - Characteristic distance - level linearized

5.6.8.1 Predefined linearization curves

- Linear - no linearization

Volume linearization

- Horizontal cylindrical vessel
- Spherical vessel

Flow linearization

- Venturi, trapezoidal weir, rectangle weir
- Palmer-Bowlus-Flume
- V-Notch, triangle weir

Free linearization characteristic with up to 40 points

- Custom

Default > Linear

5.6.8.2 Input mode custom defined linearization

- Percent / Linearized Percent
- Filling level / Display Scaling
- CSV-file via Bluetooth-interface

The percentual input (referring to the measuring range) is only possible without applying measuring value, whereby the input in filling level and display scaling e.g. liter can be done without applying measuring signal as well as with applying measuring signal.

At the linearization without applying measuring signal, for each linearization point a needed signal value (in percent or filling level) is input and referred to the needed output value (in percent or primary unit) that must be also input.

At the linearization with applying measuring signal, for each linearization point the current measuring value is captured and referred to the output value (acc. to display scaling) that must be input.

- **Linearization Points**

The number of linearization points for the complete measuring characteristic must be defined.

The input range is limited to values from 2 to 40.

Default > 2

- **Linearization**

At the input mode percent / linearized percent the input signal refers percentual to the measuring range, that is defined at the min./max. adjustment for 0% and 100%. The output signal must also be considered percentual.

At the input mode filling level / display scaling the input signal refers to the filling level (inverted distance). The output signal refers to the display range, that is defined in the display scaling.

The complete characteristic, eventually also the measuring range end values 0% and 100% must be defined, cause the measuring range end values from the min./max. adjustment are not copied into the linearization table.

The input range is indefinite.

Default > Linearization point 1 > 0.000% = 0.000% resp. 0.000bar / Linearization point 2 > 100.000% = 100.000% resp. 1.000bar

- **Store**

Input linearization points are not automatically stored loss-protected.

To store one or also more linearization points loss-protected, the function store must be executed.

5.6.9 Sensor TAG

Due to the Sensor TAG different devices can be differentiated. At the indicator type digital the Sensor TAG is indicated in the display.

The Sensor TAG is added automatically to the Bluetooth-name, to allow the device identification when using multiple devices in reception range.

Up to 19 characters can be input.

The input range is indefinite.

Default > no Sensor TAG allocated

5.6.10 Date/Time

Input of date and time. For the measurement value recording, the measurement values are supplied with a time stamp of the integrated real time clock, which includes date and time. The set values are buffered at a short time (see chapter „Technical data“) supply voltage fail, whereas a longer failure resets the values. The values must then be set again.

At the battery powered system the values are buffered also at a long term failure of the supply voltage.

The input range is limited to conclusive values for date and time.

Default > 01.01.2001 / 00:00:00 resp. current date / current time

5.6.11 Factory Reset

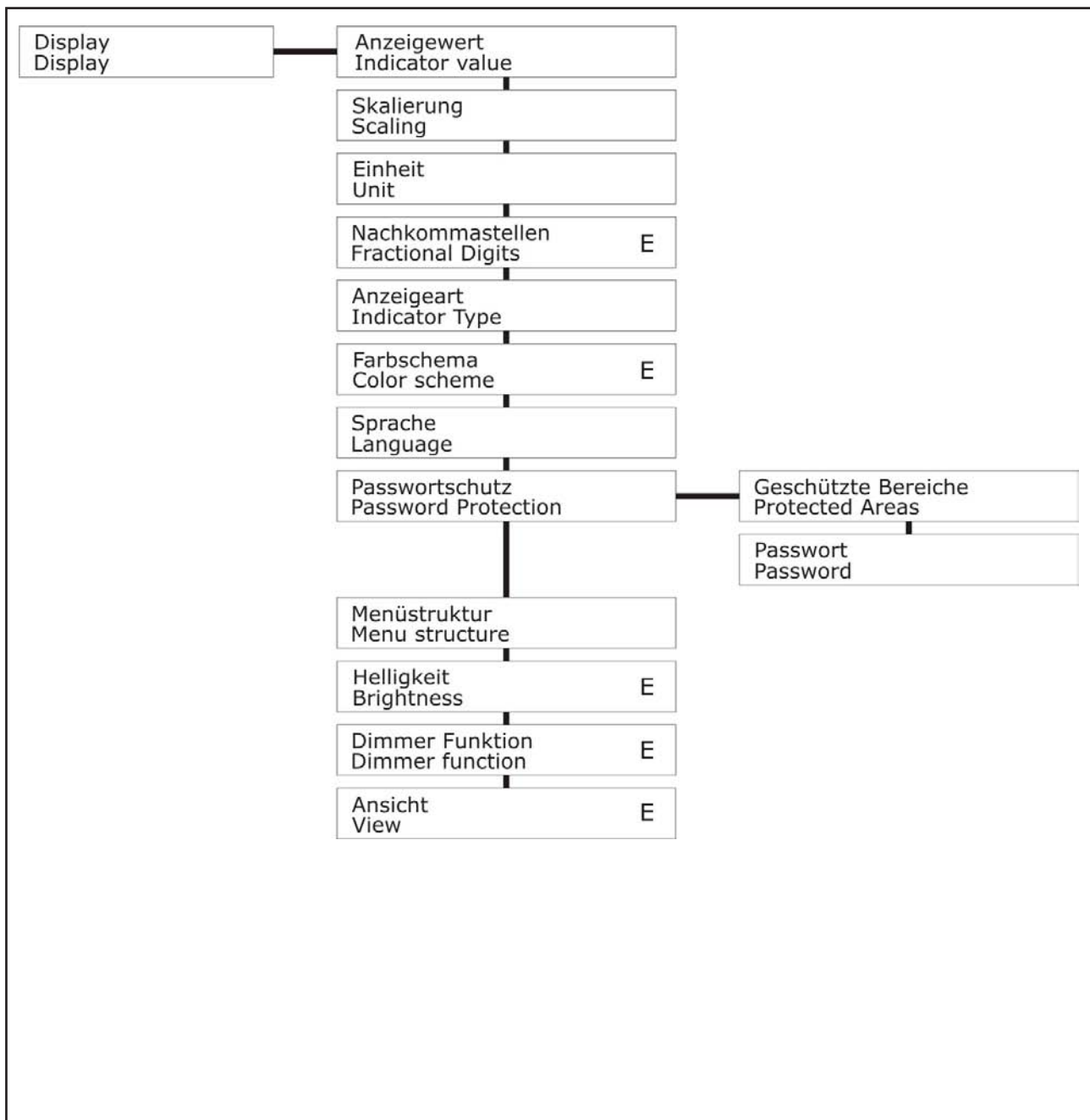
The factory reset changes all settings to default values.

The factory reset does not concern:

- Diagnose data
- Historical measuring data
- Storage interval
- Custom defined linearization

5.7 Display

The symbol E at a menu item indicates its position in the extended menu structure. This extended menu structure can be shown in the submenu display by the menu item menu structure.



5.7.1 Indicator value

The measuring value can be alternatively displayed as distance, as filling level, percentual, with any desired scaling referring percentual to the measuring range or by displaying the analogue output value.

- Distance
- Filling level
- Percent
- Scaled
- Signal output

Default > Distance

5.7.2 Scaling

This menu item is only available at indicator value scaled.

By defining a scaling the measuring range can be rescaled into any desired numerical range. This allows e.g. the indication of the volume in liter.

The current measuring value is indicated in the display.

The input of the measuring range limits 0% and 100% are not mandatory. Values within the measuring range e.g. 11% and 87% can be also input. In this case there is an automatic calculation to 0% resp. 100%.

- Lower display value
- Upper display value

The input range is indefinite.

Default > Measuring value 0.000% = Display 0.000 / Measuring value 100.000% = Display 1.000

5.7.3 Unit

This menu item is only available at indicator value scaled

If a scaled indicator value is used, additionally an unit can be selected, that is indicated in the display (not at indicator type vertical bargraph).

The unit is only indicated as text and is not included into calculations.

There are multiple predefined units in different categories available.

Mass

- kg / t / lb

Volume

- l / hl / m³ / in³ / gal / ft³

Height

- mm / cm / m / in / ft

Pressure

- mbar / bar / Pa / kPa / MPa / Psi / Torr / mmH₂O

Flow

- l/s / l/min / l/h / m³/s / m³/min / m³/h / lb/s / gal/s

Custom defined

Up to 10 characters can be input.

The input range is indefinite.

Default > no text allocated

5.7.4 Fractional Digits – E

The measuring value can be formatted by the use of fractional digits.

Is the indication of the measuring value with the current fractional digits number not possible, a change to the correct fractional digits number is executed automatically.

The input range is limited to values from 0 to 3.

Default > 3

5.7.5 Indicator Type

Dependent on the requirements the measuring values can be indicated in different types.

Digital



- Switch points, active or inactive
- Sensor TAG
- Digital measuring value
- Unit
- Quantity counter value (only at activated function quantity counter)
- Horizontal scaled bargraph
- Mark of switch points at the bargraph

Manometer



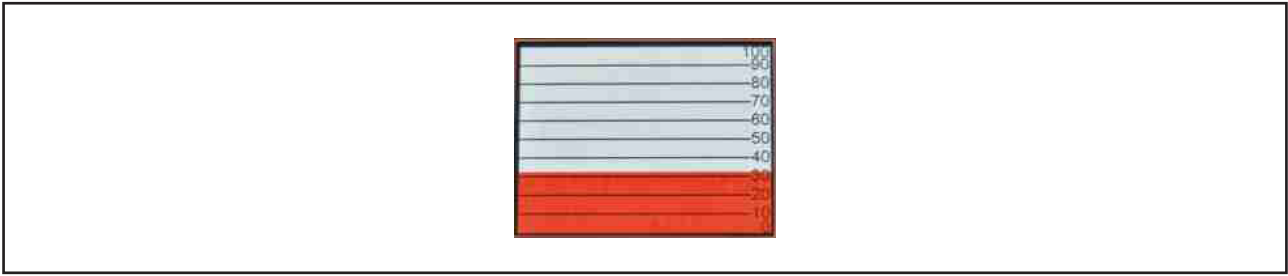
- Round pointer scale
- Mark of the switch points at the pointer scale
- Unit
- Digital measuring value

Bargraph



- Digital measuring value
- Unit
- Horizontal scaled bargraph

Vertical Bargraph



- Vertical percentual scaled bargraph

Chart



- Scaled graphical measuring value-to-time-window
- Selected historical digital measuring value with unit and with date / time
- Digital measuring value with unit.
- The entrance to the chart menu is done by pushing the key Enter/Shift right for 3 seconds.
- The measuring value cursor can be set to the oldest resp. youngest measuring value or to an arbitrary point of time in days/hours/minutes/seconds.
- Navigation of the measuring value cursor with cursor keys within the graphic window.
- After 5 minutes of inactivity the measuring value cursor is automatically set to 0s.

Default > Digital

5.7.6 Color Scheme – E

For the adaption of the display to the requirements 6 color schemes are available.

- Standard / Black / Blue / Red / Green / Yellow

Color scheme black



Default > Standard

5.7.7 Language

The menu navigation can be done in the following different languages.

- Deutsch
- English

Default > Deutsch

5.7.8 Password Protection

For the protection of the settings against unauthorized persons individual or all main menu items can be protected by a password.

At each activation of the main menu the password protection is active.

An unknown or forgotten password can be erased by use of a service code and an activation code.

These codes can be requested at the manufacturer.

- **Protected Areas**

- Output
- Basic Setting
- Display
- Simulation
- Diagnose
- Data

Default > all No

- **Password**

Up to 10 characters can be input.

The input range is indefinite.

Default > no Password allocated

5.7.9 Menu Structure

For a breakdown illustration of the menu navigation different menu items (**mark E in the menu structures overview**) are arranged in a removable extended structure.

To achieve access to all functions of the device, the extended menu structure must be activated.

- Normal
- Extended

Default > Normal

5.7.10 Brightness – E

For the adaption of the display to the requirements the brightness of the backlight can be varied in a wide range.

For the protection of the backlight at higher environmental temperatures, a reduction of the brightness can be necessary.

At an input value of 0 a minimum residual brightness is already present.

The input range is limited to values from 0 to 100.

Default > 75

5.7.11 Dimmer function – E

To reduce the supply current and also to minimize the system typical aging influences on the brightness of the backlight an automatic dim after 5 minutes of inactivity (no key touch) can be activated.

- 0% / 10% / 20% / 30% / 40% / 50% / Off

Default > Off

5.7.12 View – E

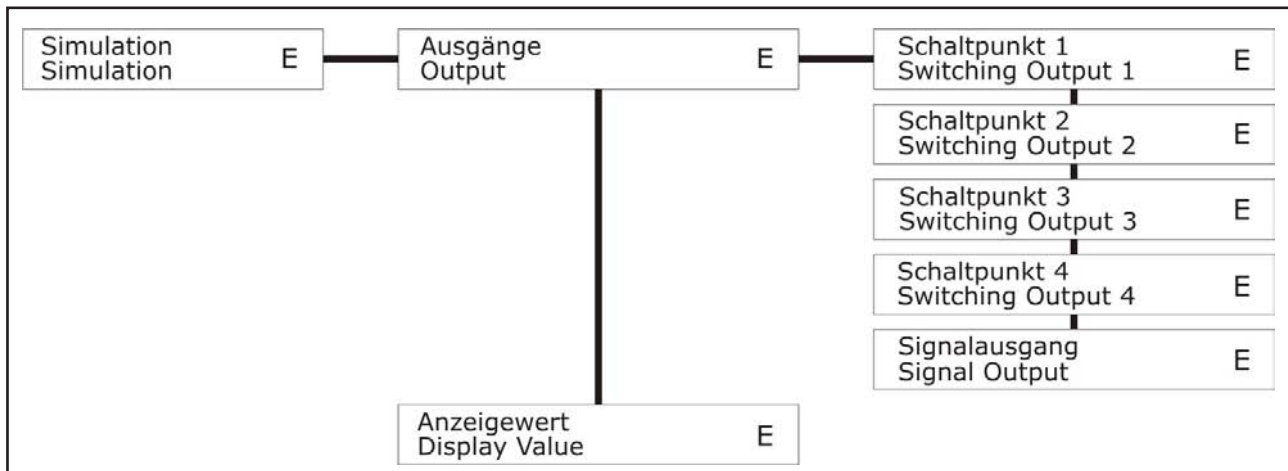
For the adaption of the display to the requirements of the installation situation the view of the display can be rotated by 180°. In combination with the mechanical rotatability of app. 330° a readability from all directions in all installation positions is possible.

- Normal
- 180°

Default > Normal

5.8 Simulation – E

The symbol E at a menu item indicates its position in the extended menu structure. This extended menu structure can be shown in the submenu display by the menu item menu structure.



5.8.1 Output

5.8.1.1 Switch Output S1/S2/S3/S4

The switch output is activated resp. deactivated regardless of an already existing activation and also regardless of delay times.

5.8.1.2 Signal Output

At the signal output an analogue signal is output regardless of the current measuring value. The input range is limited, dependent on the set Operating Mode.

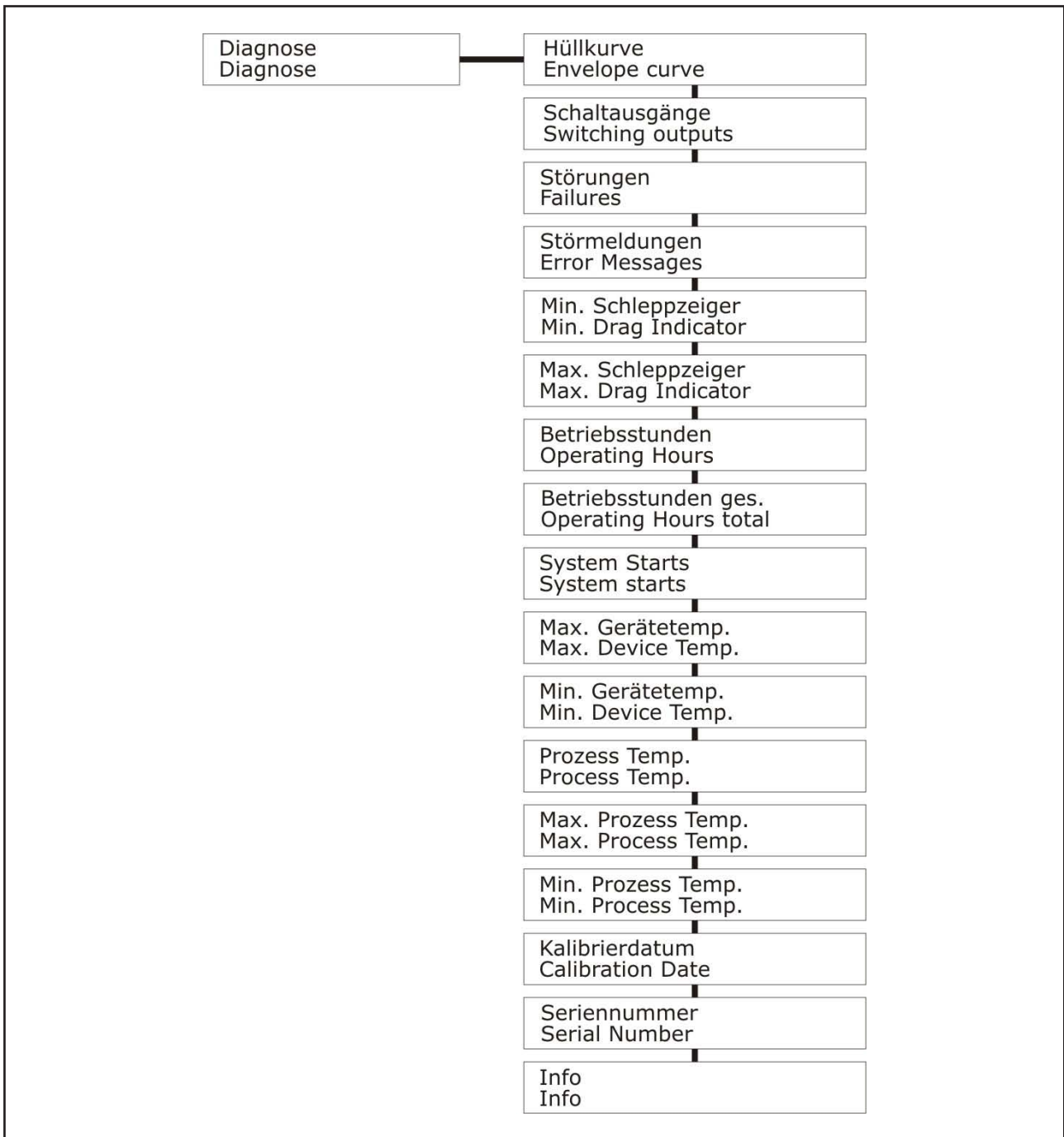
- 3.600 – 22.00 mA (4-20 mA)
- – 22.00 mA (0-20 mA)
- – 11.00 V (0-10 V)

5.8.2 Display Value

The display value can be simulated, whereby all following functional steps (signal output, switch output) are also simulated acc. to the settings.

The input range is limited to the set measuring range.

5.9 Diagnosis



5.9.1 Envelope curve

The current measuring signal is displayed as curve.

The envelope curve is displayed, below those the measuring signal is ignored.

The valid measuring signal is marked by a vertical mark.

Downright the characteristic curve the current distance value is displayed with unit m and the corresponding measured signal level in dB.

Cursor resp. Zoom mode

Below and left of the characteristic curve the position of a shiftable cursor is indicated.

A simple left-right-arrow-symbol allows a shift of the cursor by the keys Up resp. Down.

By simultaneous pushing of the keys Up and Down it is switched to the zoom mode for the x-axis. This is indicated by a doubled left-right-arrow-symbol.

The zoom is referring to the current cursor position.

The display of the envelope curve is canceled by pushing the key Enter/Shift right for 3 seconds.

5.9.2 Switching Outputs

5.9.2.1 Operation Cycles S1/S2/S3/S4

The number of operation cycles per switch output is indicated.

An operation cycle is a complete change of the switch state till back to the start state, thus deactive - active - deactive.

5.9.2.2 Runtime S1/S2/S3/S4

The runtime per switch output is indicated.

The runtime of each switch output can be reset here separately.

At the pump function runtime, this is especially necessary after a pump exchange, to include the new pump into the runtime dependent activation.

5.9.3 Failure

The device registers multiple of short time or also continuous existing functional failures in type and frequency of occurrence.

- **Echo lost**
No measurable echo signal available
- **Over Range**
exceeding the signal output range (dependent on Operating Mode)
 - 20.5 mA (4-20 mA)
 - 20.5 mA (0-20 mA)
 - 10.5 V (0-10 V)
- **Under Range**
exceeding the signal output range (dependent on Operating Mode)
 - 3.8 mA (4-20 mA)
 - -0.4 mA (0-20 mA) – theoretical value
 - -0.5 V (0-10 V) – theoretical value
- **Sig. out break**
wire break at signal output on signal output not connected at Operating Mode 4-20 mA resp. 0-20 mA

5.9.4 Error Messages

The type of failure, that leads to the device reactions

- Indication on display
- Error signal at analogue output, depending on selected operating mode
- Error function at switching output, depending on settings

can be selected.

The following failures can be selected:

- **Output overflow**
Overshoot of the analogue output range OutA1 depending on selected operating mode
 - Operating mode 4-20mA >> 21mA
 - Operating mode 0-20mA >> 21mA
 - Operating mode 0-10V >> 10,5VDefault > activated

-
- **Output underflow**
Undershoot of the analogue output range OutA1 depending on selected operating mode
 - Operating mode 4-20mA >> 3,8mA
 - Operating mode 0-20mA >> -0,4mA – theoretical value
 - Operating mode 0-10V >> -0,5V – theoretical valueDefault > activated
 - **Temperature sensor**
Error of the temperature sensor, which is integrated within the ultrasonic sensor, e.g. short circuit resp. wire break
Default > activated
 - **Echo loss**
No measuring signal can be detected, e.g. due to a too high distance or a strong deviation of the ultrasonic signal
Default > activated
 - **Power loss**
Default > deactivated

5.9.5 Min./Max. Drag Indicator

The drag indicator is used for detection and indication of the minimum and maximum registered measuring values.
The drag indicator can be separately reset by pushing the key Shift right/Enter.

5.9.6 Operating Hours

The operating hours of the device since the last device start-up are detected.
The indication is done in hours.

5.9.7 Operating Hours total

The operating hours of the device since the first device start-up are detected.
The indication is done in hours.

5.9.8 System Starts

The number of the occurred system starts resp. device restarts is registered.

5.9.9 Min./Max. Device Temperature

The minimum and maximum temperature of the electronic in the area of the terminal enclosure (not the process temperature) is registered.

5.9.10 Process Temperature

The current process temperature in the area of the transducer is registered.

5.9.11 Min./Max. Process Temperature

The minimum and maximum process temperature in the area of the transducer is registered.

5.9.12 Calibration Date

Indication of the date (format DDMMJJ), the calibration by factory is done.

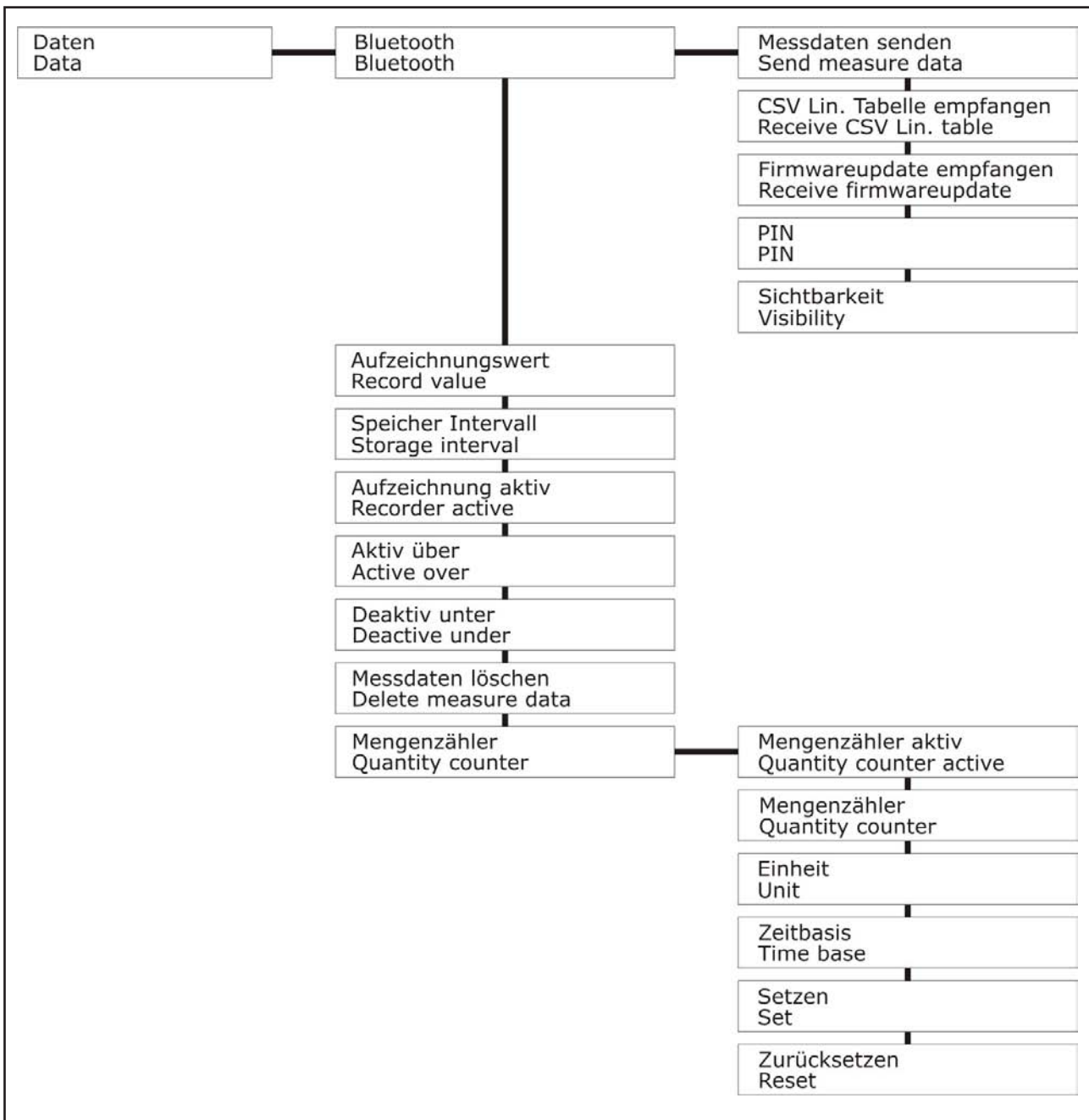
5.9.13 Serial Number

Indication of the serial number of the device.

5.9.14 Info

Indication of manufacturer data and firmware version

5.10 Data



The device is able to record app. a half million measuring values loss-protected.

The recording is made in ring memory method, whereas after an overflow the oldest measuring values are overwritten next.

The stored measuring values can be displayed graphically in the indicator type chart or exported as CSV-file per Bluetooth-interface.

By the Bluetooth-interface the download of linearization or firmware files is possible.

5.10.1 Bluetooth

For the Bluetooth-communication two authentication methods are available.

- **Unprotected transmission**

No PIN is used

Cause the device does only receive/send files only after selection in the menu, this is the most simple and recommended way of transmission.

If no PIN is used, each communication is uncoded, but the devices must not connect together.

- **Protected resp. encoded transmission**

A PIN is used.

If a PIN is used, the devices must be connected together for a transmission. The procedure differs depending on the end device.

A PIN must be input and the visibility must be switched to on.

Afterwards the connection can be made at the end device.

In the end device the same PIN must be used, that is input in the device.

After the file transmission the visibility should be switched to off.

Note: For a definite identification of the devices it is recommended to use a Sensor TAG.

5.10.1.1 Send measure data

The recorded measuring values can be transmitted as a CSV-file to a Bluetooth end device.

Alternatively all measuring values or only the measuring values from the measuring value cursor (setting in the chart menu) till to the current measuring value can be transmitted.

After the selection end devices with Bluetooth-ability are searched and after selection and approval the measuring values are transmitted.

5.10.1.2 Receive CSV Lin. Table

To simplify enormous linearization procedures directly at the device, it is possible to generate a linearization table as CSV-file and transmit it into the device.

There are different tank calculation programs available to calculate the linearization of a tank form comfortably.

The CSV-file must match a defined formatting.

- Comments can be marked with a leading *.
- Separator Tab
- Decimal separator dot or comma.
- First value percentual filling level, second value linearized percent.
- Table length maximum 40

Example file

* Container type: spherical tank

* d=1000,000

* 0% = 0,000

* 100% = 100,000

```
0,00 0,00
3,13 0,29
6,25 1,12
9,38 2,47
12,50 4,30
15,63 6,56
18,75 9,23
21,88 12,26
25,00 15,63
28,13 19,28
31,25 23,19
34,38 27,33
37,50 31,64
40,63 36,10
43,75 40,67
46,88 45,32
50,00 50,00
53,13 54,68
56,25 59,33
59,38 63,90
62,50 68,36
65,63 72,67
68,75 76,81
71,88 80,72
75,00 84,38
78,13 87,74
81,25 90,77
84,38 93,44
87,50 95,70
90,63 97,53
93,75 98,88
96,88 99,71
100,00 100,00
```

5.10.1.3 Receive firmware update

The internal software of the device (firmware) can be updated by a new firmware, which could include functional improvements, functional extensions, new functions or also customer specific modifications. At the file transmission the safety of the power supply must be ensured. A power fail can lead to a completely irreversible device failure.

5.10.1.4 PIN

For a protected resp. encoded data transmission a PIN must be input.

The input range is limited to values from 000000 to 999999.

Default > no PIN allocated

5.10.1.5 Visibility

To transmit a file to the device, it must be visible in the Bluetooth network. Other end devices can identify only visible devices.

Default > Off

5.10.2 Record value

The measuring value can be alternatively recorded as distance, as filling level, percentual, with any desired scaling referring percentual to the measuring range or by displaying the analogue output value.

- Distance
- Filling level
- Percent
- Scaled
- Signal output

Default > Distance

5.10.3 Storage interval

The storage interval defines the time interval between two measuring values, which should be stored in the measuring value memory.

The input range is limited to values from 1 to 99999.

Default > 60 s

5.10.4 Activation Recording

To start the recording of measuring values, this must be activated.

- **Always**
Each measuring value will be stored at the set storage interval.
- **Deactive**
The measuring value recording is switched off.
- **Threshold value**
The measuring value recording at the set storage interval will be switched on at overrun of the set threshold value (menu „Active over“) resp. switched off at underrun of the set threshold value (menu „Deactive under“)

The input range is limited to values from 1 to 99999.

Default > 0.000

Default > Deactive

5.10.5 Delete measure data

All existing stored measuring values in the measuring value memory are erased.

5.10.6 Quantity counter

The quantity counter integrates the calculated measuring values from the display scaling by the time. These values are stored every second.

If the eventually activated impulse output cant output all impulses time conformal due to a too high frequency, all impulses are output afterwards until all accumulated impulses could be output, also if the flow is already lower or has stopped. Thus the amount of output pulses fits always to the quantity counter. Nevertheless this should be avoided from the first by a correct setting.

Quantity counter active

- Yes
- No

Default > No

Quantity counter

The current quantity counter value, which is calculated at the moment of entering the menu, is displayed. This value can be actualized by the keys Up or Down.

Unit

- **Volume**
l / hl / m³ / in³ / gal / ft³
- **User defined**
Up to 10 characters can be input.
The input range is indefinite.
Default > no text allocated

Time base

- Hours
- Minutes
- Seconds

Default > Hours

Set

The value of the quantity counter can be preset to an arbitrary value.

The input range corresponds with the settings of the display scaling.

Default > 0

Reset

The quantity counter value is reset to 0.

5.11 Start-up procedure

5.11.1 Level measurement

The filling level is calculated by the device due to the distance of the filling material surface to the sensor.

Sub menu Basic Setting

- Commissioning
- Min/Max Adjustment

Sub menu Display

- Indicator value fill level

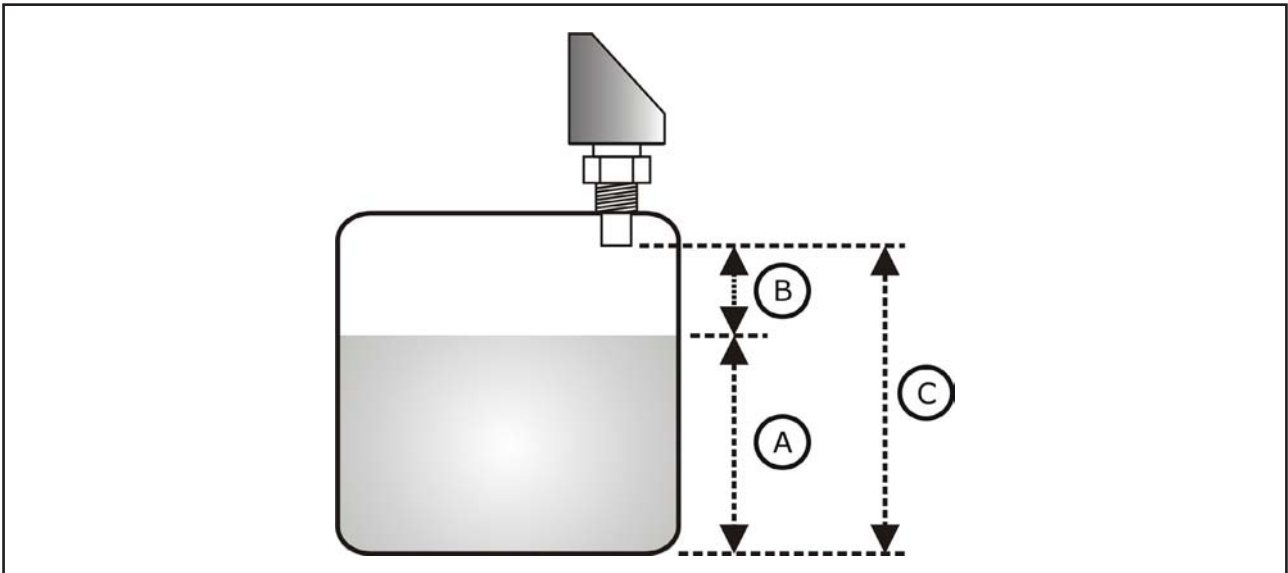
5.11.1.1 Example

Measurement task

- Distance Sensor - container bottom: 1,8m
- Minimum filling level: 0m >> distance 1,8m - 0m = 1,8m
- Maximum filling level: 1,4m >> distance 1,8m - 1,4m = 0,4m

Settings

- Process commissioning
- Min/Max Adjustment: 1,8m = 0% / 0,4m = 100%



- A - Filling level
- B - Distance sensor – filling material surface
- C - Distance sensor – container bottom

5.11.2 Volume measurement

For the indication of the tank volume a display scaling can be made.
If a nonlinear tank style is used, a linearization must be set.
Predefined linearization curves for some tank styles are available.

Sub menu Basic Setting

- Commissioning
- Min/Max Adjustment
- Linearization

Sub menu Display

- Indicator value Scaled
- Unit
- Scaling - ration percent / tank volume

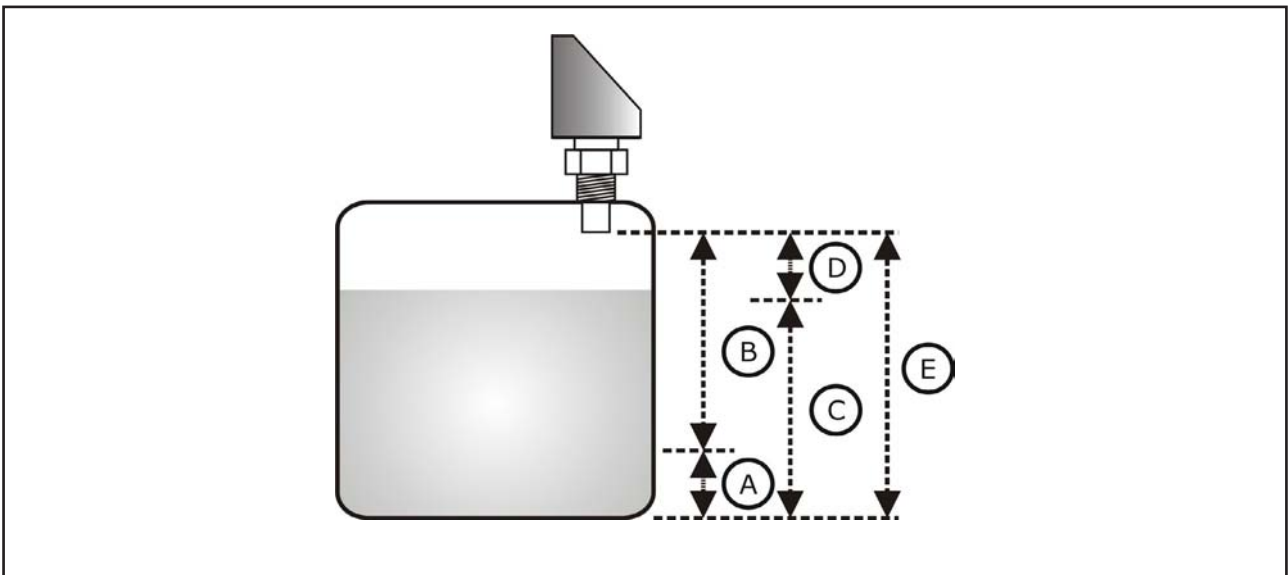
5.11.2.1 Example

Measurement task

- Distance Sensor - container bottom: 1,8m
- Container: Cylinder - linear volume
- Minimum filling level: 0,2m >> distance 1,8m - 0,2m = 1,6m
- Maximum filling level: 1,2m >> distance 1,8m - 1,2m = 0,6m
- Minimum volume: 0 liter
- Maximum volume: 2000 liter

Settings

- Process commissioning
- Min/Max Adjustment: 1,6m = 0% / 0,6m = 100%
- Display Indicator value: Scaled
- Display Unit: l
- Display Scaling: 0% = 0 l / 100% = 2000l
- Linearization: Linear



- A - Minimum volume
- B - Distance at minimum volume
- C - Maximum volume
- D - Distance at maximum volume
- E - Distance sensor - container bottom

5.11.3 Flow measurement

For the indication of the flow amount a display scaling can be made.
If a nonlinear flow opening style is used, a linearization must be set.
Predefined linearization curves for some flow opening styles are available.

Sub menu Basic Setting

- Commissioning
- Min/Max Adjustment
- Linearization

Sub menu Display

- Indicator value Scaled
- Unit
- Scaling - ration percent / flow amount

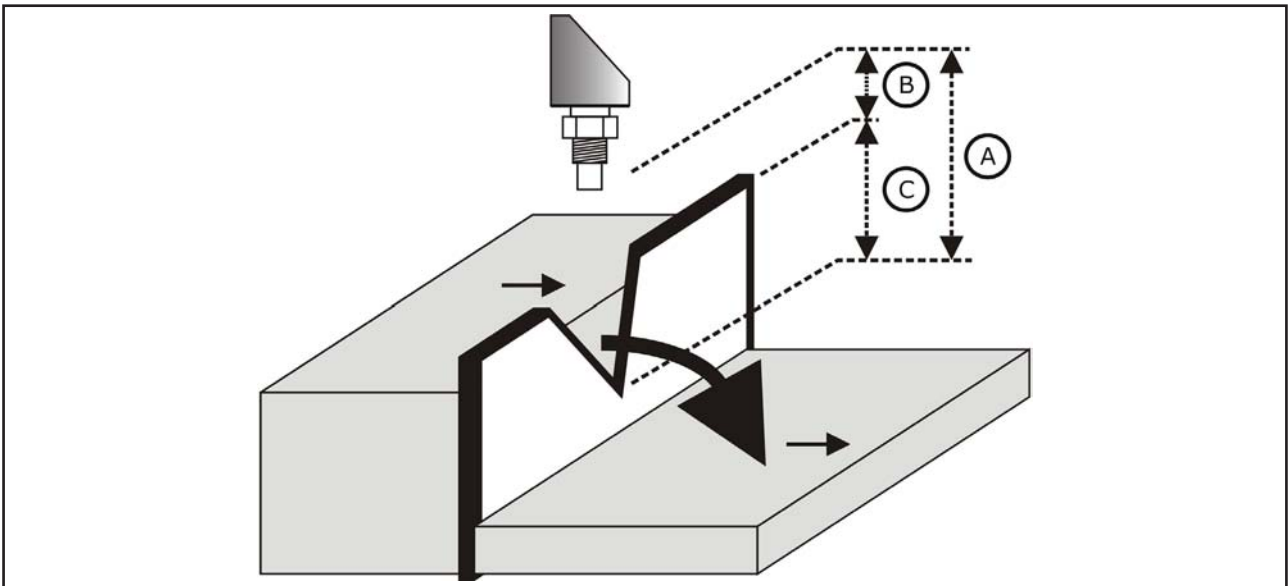
5.11.3.1 Example

Measuring task

- Style: Triangle weir
- Level minimum flow: 0,95m at 0 l/s
- Level maximum flow: 0,45m at 69 l/s

Settings

- Process commissioning
- Min/Max Adjustment: 0,95m = 0% / 0,45m = 100%
- Display Indicator value: Scaled
- Display Unit: l/s
- Display Scaling: 0% = 0 l/s / 100% = 69l/s
- Linearization: triangular weir



- A - Distance at minimum flow
- B - Distance at minimum flow
- C - Maximum water level H_{\max}

5.12 Software history

Version	Date	Modifications
4.1.0	07/2017	Original version

6 Service

6.1 Maintenance

The device is free of maintenance.

Special substances can lead to solid coatings on the sensor. Seized depositions can lead to faulty measurement results.

In the case of coat forming liquids the sensor must be regularly cleaned e.g. with clear water. Don't use sharp resp. hard tools or aggressive chemicals for cleaning.

6.2 Dismounting

Attention – Risk of burns!

Let the device cool down sufficiently fore dismounting it

During dismounting there is a risk of dangerously hot media escaping.

Attention – Risk of injury!

Dismount the device only when the system is pressureless.

During dismounting there is a risk of fast escaping media resp. pressure blow.

6.3 Repair

A repair may only be carried out by the manufacturer.

If the device is sent back for repair, the following information's must be enclosed:

- An exact description of the application.
- The chemical and physical characteristics of the product.
- A short description of the occurred error.

6.4 Return

Before returning the device, the following measures must be performed:

- All adhesive product residues must be removed. This is especially important, if the product is unhealthily, e.g. caustic, toxic, carcinogenic, radioactive etc.
- A returning must be refrained, if it is not possible by 100% to remove the unhealthily product completely, because e.g. it is penetrate into cracks or is diffused through plastic.

6.5 Disposal

Dispose of instrument components and packaging materials in an environmentally compatible way and in accordance with the country-specific waste disposal regulations.

This instrument is not subject to the WEEE directive and the respective national laws. Hence, pass the instrument directly on to a specialized recycling company and do not use the municipal collecting points. These may be used only for privately used products according to the WEEE directive.

7 Technical Data

7.1 Auxiliary power supply

Supply voltage U_s	<u>Setting output 0/4...20 mA</u> 9..30 V _{DC} , reverse polarity protected
	<u>Setting output 0...10 V</u> 14..30 V _{DC} , reverse polarity protected
Residual ripple U_{pp}	$\leq 2V_{pp} / U_{smin} \leq U_s \leq U_{smax}$
Supply current I_{in}	<u>Setting output 0/4...20 mA</u> ≤ 110 mA ($U_s = 9$ V / $I_o/S1/S2/S3/S4$ 0mA / Bluetooth Off) ≤ 130 mA ($U_s = 9$ V / $I_o/S1/S2/S3/S4$ 0mA / Bluetooth On) ≤ 70 mA ($U_s = 30$ V / $I_o/S1/S2/S3/S4$ 0mA / Bluetooth Off) ≤ 80 mA ($U_s = 30$ V / $I_o/S1/S2/S3/S4$ 0mA / Bluetooth On)
	<u>Setting output 0...10 V</u> ≤ 65 mA ($U_s = 14$ V / $U_o/S1/S2/S3/S4$ 0mA / Bluetooth Off) ≤ 80 mA ($U_s = 14$ V / $U_o/S1/S2/S3/S4$ 0mA / Bluetooth On) ≤ 50 mA ($U_s = 30$ V / $U_o/S1/S2/S3/S4$ 0mA / Bluetooth Off) ≤ 60 mA ($U_s = 30$ V / $U_o/S1/S2/S3/S4$ 0mA / Bluetooth On)

7.2 Input

7.2.1 Measuring range type 02 – 2m

Measuring range	$\leq 2m_*$
Blocking distance BD	$\leq 0,15m$ (typ. 0,06m)
Operating frequency	125kHz
Emitting angle α	$10^\circ \pm 2^\circ$ (-3dB)
Detection radius r_x	$r_x = 0,087m$ ($L_x = 1,0m / \alpha = 10^\circ$) $r_x = 0,175m$ ($L_x = 2,0m / \alpha = 10^\circ$)
Pulse rate t_p (meas. cycle time)	5Hz (200ms) 2,5Hz (400ms) 1,25Hz (800ms)

7.2.2 Measuring range type 05 – 5m

Measuring range	$\leq 5m_*$
Blocking distance BD	$\leq 0,20m$ (typ. 0,15m)
Operating frequency	75kHz
Emitting angle α	$14^\circ \pm 2^\circ$ (-3dB)
Detection radius r_x	$r_x = 0,307m$ ($L_x = 2,5m / \alpha = 14^\circ$) $r_x = 0,614m$ ($L_x = 5,0m / \alpha = 14^\circ$)
Pulse rate t_p (meas. cycle time)	2,5Hz (400ms) 1,25Hz (800ms) 0,625Hz (1600ms)

7.2.3 Measuring range type 08 – 8m

Measuring range	$\leq 8m_*$
Blocking distance BD	$\leq 0,30m$ (typ. 0,19m)
Operating frequency	50kHz
Emitting angle α	$10^\circ \pm 2^\circ$ (-3dB)
Detection radius r_x	$r_x = 0,491m$ ($L_x = 4,0m / \alpha = 10^\circ$) $r_x = 0,700m$ ($L_x = 8,0m / \alpha = 10^\circ$)
Pulse rate t_p (meas. cycle time)	1,667Hz (500ms) 0,833Hz (1000ms) 0,417Hz (2000ms)

7.3 Output

7.3.1 Analogue output – current 0...20mA

Operating range I_{Out}	0...20,5mA, max. 22mA
Permitted load R_L	$\leq (U_s - 9V) / 22mA$
Step response time T_{90}	\leq Pulse rate t_p ($t_d = 0s$)
Start-up time t_{On}	$\leq 1s$

7.3.2 Analogue output – current 4...20mA

Operating range I_{Out}	3,8...20,5mA, min. 3,6mA, max. 22mA
Permitted load R_L	$\leq (U_s - 9V) / 22mA$
Step response time T_{90}	\leq Pulse rate t_p ($t_d = 0s$)
Start-up time t_{On}	$\leq 1s$

7.3.3 Analogue output – voltage 0...10V

Operating range U_{Out}	0 ... 10,5 V, max. 11 V
Permitted load R_L	$\geq U_{Out} / 3mA$
Step response time T_{90}	\leq Pulse rate t_p ($t_d = 0s / R_L = 10kR$)
Start-up time t_{On}	$\leq 1s$

7.3.4 Switch output PNP S1 / S2 / S3 / S4

Function	PNP switch to +L
Output voltage U_{Out}	$U_{Out} \geq U_s - 2V$
Output current I_L	0... 200mA, current limited, short circuit protected
Step response time T_{90}	\leq Pulse rate t_p ($t_d = 0s$)
Rise time T_{90}	$< 30\mu s$ ($R_L < 3kR / I_{Out} > 4,5mA$)
Start-up time t_{On}	$\leq 1s$
Switch cycles	$\geq 100.000.000$

7.4 Measuring accuracy

Reference conditions	EN/IEC 60770-1	
	Environmental temperature	15...25°C
	Environmental air pressure	860..1060kPa
	Air humidity	45...75% r.F.
	Warm-up time t_{On}	240s
	Supply voltage U_s	24V _{DC} $\pm 0,1V$
	Calibration position	Vertical Process connection bottom Ideal reflective surface No interference reflections within signal beam

Characteristic deviation ³⁾	$\leq \pm 2mm$ or $\pm 0,2\%$ of set measuring range ¹⁴⁾
Influence of supply voltage	<i>Output 0/4...20 mA</i> $\leq \pm 0,001\% FS$ ²⁾ / V
	<i>Output 0...10 V</i> $\leq \pm 0,006\% FS$ ²⁾ / V
Load influence	<i>Output 0/4...20 mA</i> $\leq \pm 0,01\% FS$ ²⁾ / 100R
	<i>Output 0...10 V</i> $\leq \pm 0,05\% FS$ ²⁾ / 1mA
Temperature deviation	Mean T_k ⁴⁾ Zero $\leq \pm 0,006\% FS$ ²⁾ / K

²⁾ Referring to nominal measuring span resp. full scale (FS)

³⁾ Nonlinearity + Hysteresis + Reproducibility

⁴⁾ T_k = Temperature coefficient

¹⁴⁾ whichever is greater

7.5 Interface Bluetooth

Version	Bluetooth 2.1 + EDR
Specification	Class 2
Transmit power	≤ 2,5mW/4dBm
Range	≤ 10m

7.6 Data memory

Memory size	≥ 500.000 measuring values
Memory system	Ring memory
Memory rate	1...99999s

7.7 Clock

Cycle accuracy	≤ ±1 minute / month
Battery run time	≥ 10 years
Hold-up time battery-free system	≥ 1 minute

7.8 Process conditions

Process temperature	-40°C...+85°C
Process pressure	-0,3...2 bar

7.9 Environmental conditions

Environmental temperature	-20°C...+70°C <i>Limitation</i> Backlight LCD ≥ 60% >> -20°C...+60°C Backlight LCD ≥ 80% >> -20°C...+50°C
Protection	IP65/IP67 (EN/IEC 60529)
Climatic classification	4K4H (EN/IEC 60721-3-4)
Shock classification	15g [11ms] (EN/IEC 60068-2-27)
Vibration classification	4g [10...2000 Hz] (EN/IEC 60068-2-6)
EM compatibility	Operation device class B / Industrial range (EN/IEC 61326)
Tightening torque	≤ 50Nm
Weight	<i>Measuring range 02 - 2m</i> 0,6kg <i>Measuring range 05 - 5m</i> 1,0kg <i>Measuring range 08 - 8m</i> 1,2kg

7.10 Materials - process wetted

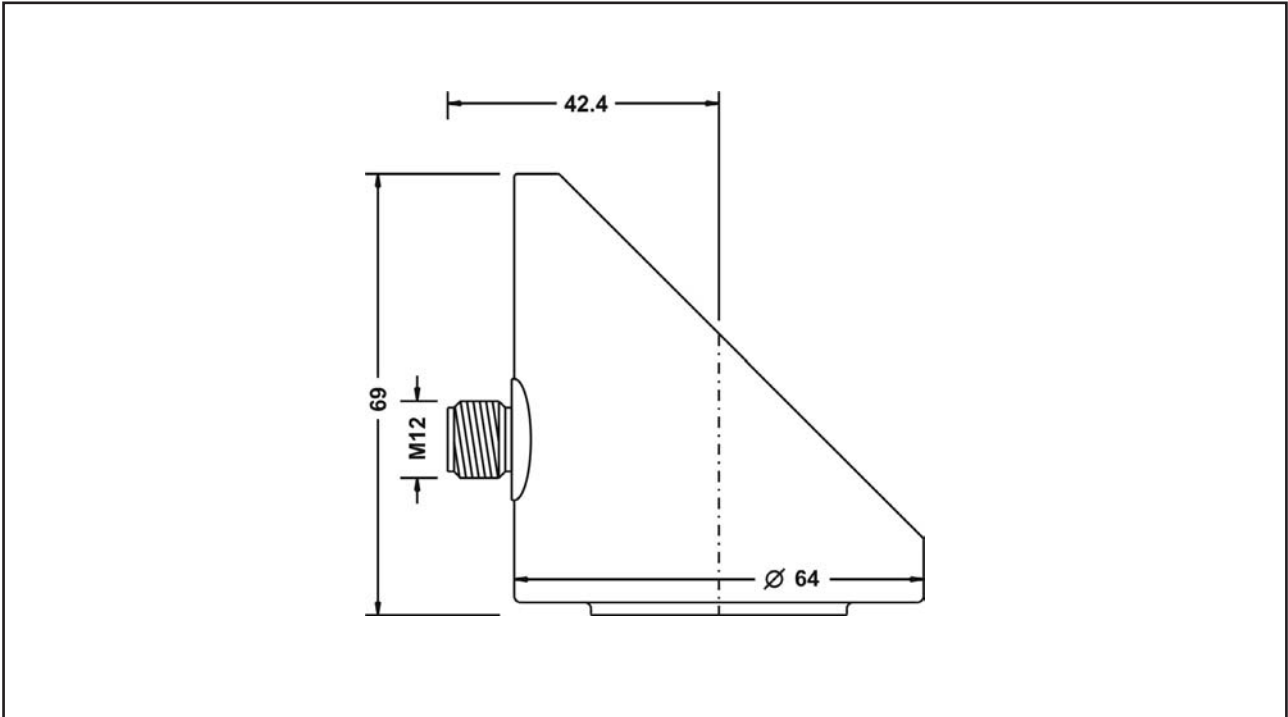
Sensor	PVDF
Process connection	Steel 1.4404/316L Steel 1.4571/316Ti
Gaskets	EPDM – ethylene-propylene-dienmonomere

7.11 Materials - not process wetted

Terminal enclosure	CrNi-steel
Control panel surface	PES
Electrical connection part	Device plug PUR
Pressure compensation element	Acrylic copolymer
Gaskets	FPM – fluorelastomere (e.g. Viton®)

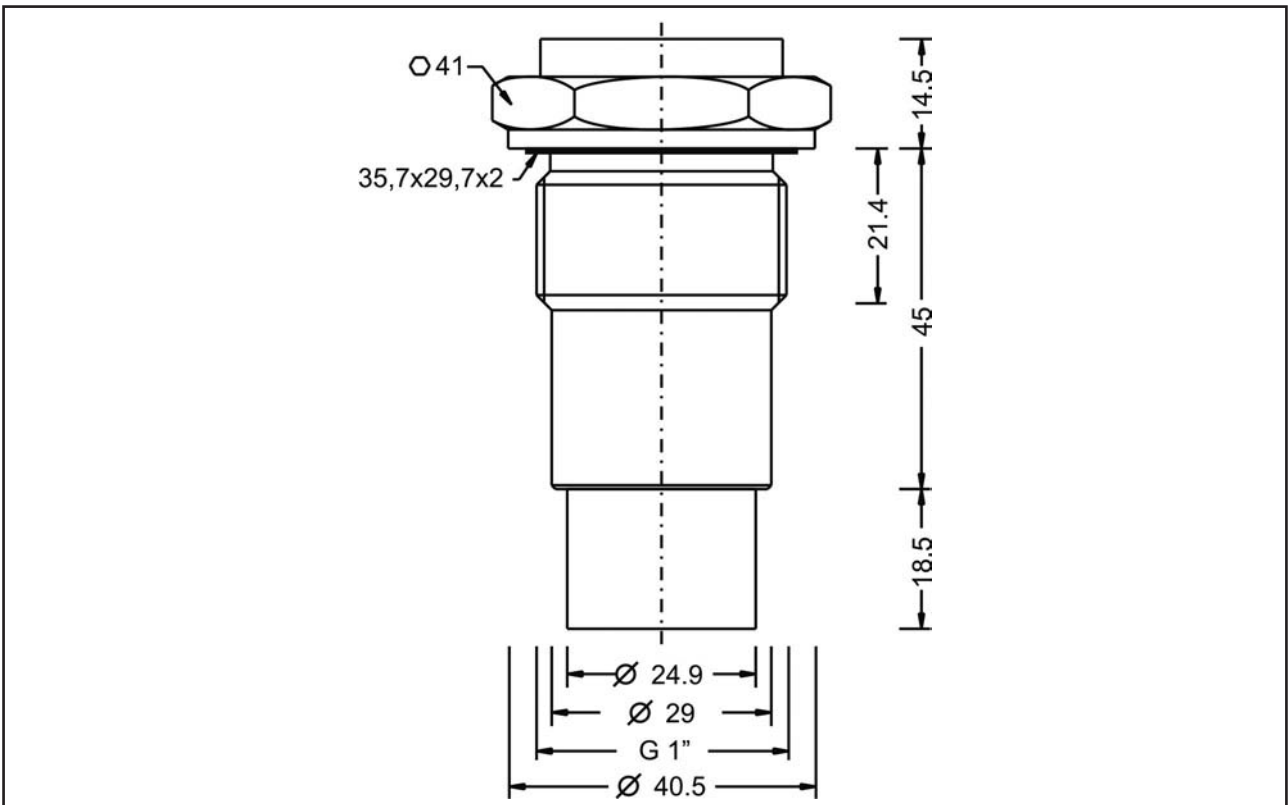
8 Dimension drawings

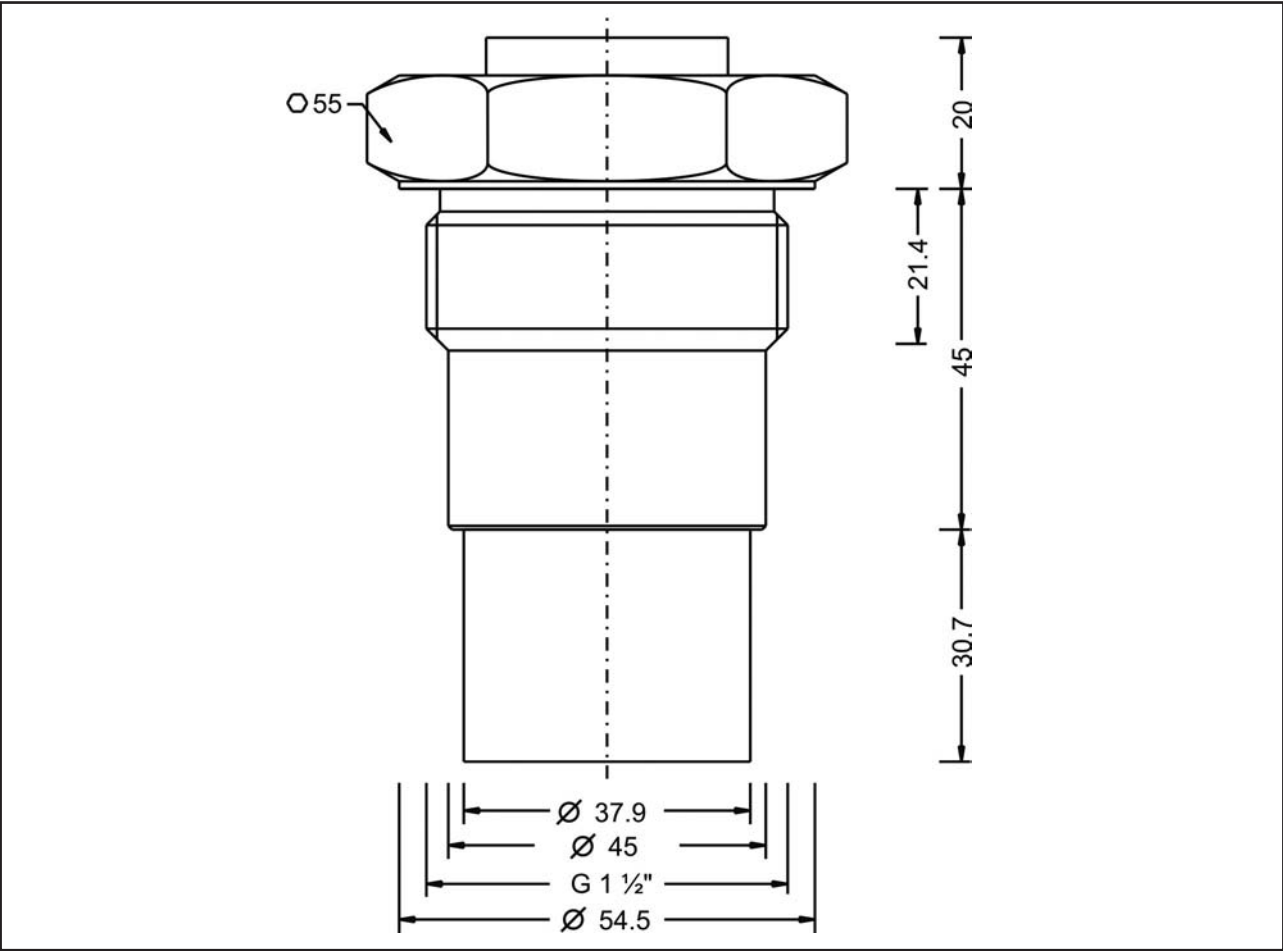
8.1 Terminal enclosure



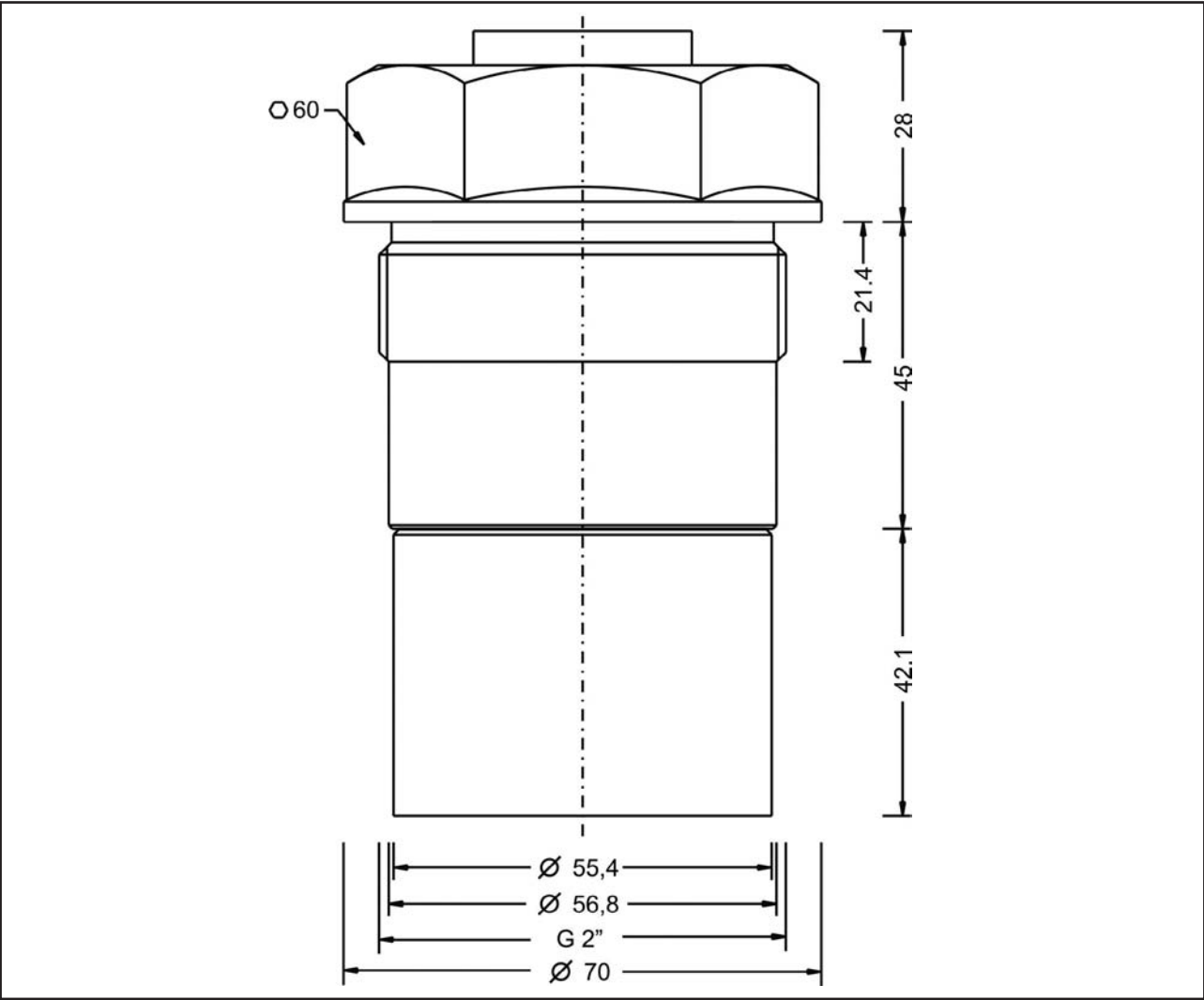
8.2 Process connection

Type 5 - Thread ISO 228-1 - G1" B / Measuring range type 02 - 2m





Type D – Thread ISO 228-1 – G2”B / Measuring range type 08 – 8m



9 Ordering information

9.1 Order code

Type
USN4S Standard

Measuring system – material diaphragm (process wetted) / sensor type
P PVDF / Piezo

Approval
S Standard

Process connection
5 Thread ISO 228-1 – G1”B
7 Thread ISO 228-1 – G1½”B
D Thread ISO 228-1 – G2”B
Y others

Material process gaskets (process wetted)
3 EPDM – ethylene-propylene-dienmonomere

Material process connection (process wetted)
V CrNi-steel

Material terminal enclosure
C CrNi-steel

Measuring range
02 2 m
05 5 m
08 8 m
YY Special measuring range

Electronic – output
M 1x signal 0/4...20mA-0...10V, supply 24VDC
K 1x signal 0/4...20mA-0...10V, 2x switch PNP, supply 24VDC
R 1x signal 0/4...20mA-0...10V, 4x switch PNP, supply 24VDC

Electronic – function
0 without
1 Bluetooth-Interface
2 Data logger with time stamp, battery powered
3 Bluetooth-Interface / Data logger with time stamp, battery powered
Y others

Process temperature
0 Standard –40°C...+85°C

Electrical connection
S Plug M12x1

Order code: USN4S P S 5 3 V C 02 M 0 0 0 S

Installation material and connection cable are not enclosed in contents of delivery.

9.2 Additional options

For the device additional options are available.
The respective abbreviation subsequently follows the order code.

- SF LABS-free, silicone-free / paint compatible version
- ML Measurement point designation / TAG – Laser marking
- KL Customer label on device – Laser marking
- TN Type label neutral
- MZ Material test certificate – EN10204 3.1
- KF Configuration / Preset
- WK Factory calibration – calibration certificate

9.3 Accessories

Accessories are not content of delivery of the device and must be ordered separately.

9.3.1 Installation material

A wide range of accessories for device installation is constantly available, e.g.

- Welding sockets
- Welding flanges
- Blind flanges
- Flanges with thread
- Reductions
- Tube nuts
- Siphons
- Marking plate measuring point, laser marked
- etc.

9.3.2 Connection cable / Cable box

Connection cable M12x1, material PUR, shielded

- LKZ04##PUR-AS 4-pole, straight, ## = length 2...30m
- LKW04##PUR-AS 4-pole, angled, ## = length 2...30m
- LKZ05##PUR-AS 5-pole, straight, ## = length 2...30m
- LKW05##PUR-AS 5-pole, angled, ## = length 2...30m
- LKZ08##PUR-AS 8-pole, straight, ## = length 2...30m
- LKW08##PUR-AS 8-pole, angled, ## = length 2...30m

Other connection cables, e.g. other material, unshielded or integrated LED are available.

Cable box M12x1

- BKZ0412-VA 4-pole
- BKZ0512-VA 5-pole
- BKZ0812-VA 8-pole

По вопросам продаж и поддержки обращайтесь:

Архангельск (8182)63-90-72	Казань (843)206-01-48	Новокузнецк (3843)20-46-81	Смоленск (4812)29-41-54
Астана +7(7172)727-132	Калининград (4012)72-03-81	Новосибирск (383)227-86-73	Сочи (862)225-72-31
Астрахань (8512)99-46-04	Калуга (4842)92-23-67	Омск (3812)21-46-40	Ставрополь (8652)20-65-13
Барнаул (3852)73-04-60	Кемерово (3842)65-04-62	Орел (4862)44-53-42	Сургут (3462)77-98-35
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Иваново (4932)77-34-06	Мурманск (8152)59-64-93	Саратов (845)249-38-78	Челябинск (351)202-03-61
Ижевск (3412)26-03-58	Набережные Челны (8552)20-53-41	Севастополь (8692)22-31-93	Череповец (8202)49-02-64
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