

Hydrocont HN4

Hydrostatic level transmitter / level switch with data memory for general applications

Monitoring of levels in liquids

Technical manual
05.25

Applications

General applications in

- Water and waste water sector
- Machinery and plant engineering
- Air-conditioning and refrigeration plant engineering
- Hydraulic and pneumatic systems
- Process industry
- Environmental technology

Main features

Wide range of applications

- Finely graded measuring ranges from 50 mbar up to 20 bar
- Wide process temperature range -40°C to $+125^{\circ}\text{C}$
- Construction types extension cable and extension tube
- Wide variety of process connections
- High protection class IP65 / IP67
- Wide environmental temperature range -20°C to $+70^{\circ}\text{C}$

Ceramic front-flush diaphragm

Highest accuracy – characteristic deviation to $\leq 0,05\%$ 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
- 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



You have purchased a high-grade and modern measuring device of ACS-CONTROL-SYSTEM GmbH.

We want to give thanks for your purchase and for your confidence to us.

The actual technical manual includes instructions for installation, electrical connection and inauguration, as well as the technical data of the device.

Modifications, that answer the purpose of the technical progress, are reserved by ACS-CONTROL-SYSTEM GmbH without prior notice.

If a question occurs, that can't be answered by the listed informations, please call on our technicians team in Eggenfelden Tel: +49 8721/ 9668-0 or info@acs-controlsystem.de

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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 levels in liquids.

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 from -1 bar to 20 bar
- Measuring spans from 50 mbar to 20 bar
- Process temperatures from -40°C to +125°C
- Process materials Al₂O₃-ceramic / CrNi-steel

as well as the availability of the two construction types

- Extension cable e.g.
 - at limited installation situations
 - long sensor length
- Extension tube e.g.
 - at strong turbulences
 - aggressive media
 - high temperatures

and the availability of industrial standard process connections like

- thread connection ISO 228-1

the device is especially suitable for the use for

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

for general applications in

- Water and waste water sector
- Machinery and plant engineering
- Air-conditioning and refrigeration plant engineering
- Hydraulic and pneumatic systems
- Process industry
- Environmental technology

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 or factory certifications for drink water resp. food suitability.

Customer specific special versions can be realized short-term 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
 - thread connection acc. to ANSI NPT, DIN 13 or JIS
 - flange acc. to EN 1092-1/DIN 2527, ASME or JIS
 - hygienic and aseptic connections, e.g. DIN 11851, Varivent®, Clamp ISO 2852 / BS 4825 / DIN 32676, DRD, DIN 11864, DIN11853, SMS, APV-Inline, BioControl®, Aseptoflex, etc.
- other process materials, e.g. Hastelloy, Titan, PEEK, etc.
- special adjustment

1.3 System components

The device consists on the components:

- Process connection, for installation into the wall of the container.
- Probe extension, for positioning the pressure measuring sensor in the required depth.
- Pressure measuring sensor with ceramic diaphragm, as junction point in direct contact with the applied medium.
- Temperature decoupler, for decoupling of the terminal enclosure from high process temperatures.
- 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 height of the liquid column over the measuring membrane causes on the measuring membrane the so-called hydrostatic pressure, which is defined besides the height of the liquid column also by the density of the liquid and the gravitational constant.

$$h = p / (\rho * g)$$

h >> height (level)
p >> pressure
 ρ >> density of the liquid
g >> gravitational constant

The system pressure is applied to the ceramic diaphragm of the pressure measuring sensor. A dry pressure measuring sensor is used, without using a fill fluid.

The pressure dependent deflection of the diaphragm is transferred to a high-precision capacitive sensor and causes there a change of the output voltage.

1.4.2 Signal processing

The pressure signal is converted by the pressure measuring sensor into an electrical signal and 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:

- 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.

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

The installation of the device at locations where high pressure blows can occur should be avoided.

At a pressure measurement in gases, the device should be installed above the tapping point, so that the condensate can flow into the process.

At a pressure measurement in steams, the device should be installed after a siphon and a shut-off device below the tapping point.

The siphon reduces the temperature to almost ambient temperature.

Fill the siphon with fluid before commissioning.

At a pressure measurement in liquids, the device should be installed after a shut-off device below or at the same level as the tapping point.

At a filling level measurement in liquids, the device should be installed below the lowest measuring point. Do not mount the device in the fill flow, in the suction area of a pump, in the tank outlet or at a point in the container which could be affected by pressure pulses from an agitator. Calibration and functional test can be carried out more easily if you mount the device after a shut-off device.

The installation position can have an influence on the measuring result of the kind of a zero value shift because of the deadweight of the measuring diaphragm. The correction of this deviation at the device is possible.

3.2 Process and environmental temperature

The installation of the device should be made if possible at temperature calmed places to get a reliable measuring result.

Strong temperature steps, e.g. at filling of a hot liquid into a cold system, can produce a short-time higher measuring signal deviation.

At high process temperatures a heat transfer to the terminal enclosure can be reduced by isolation of the medium carrying part of the plant.

3.3 Installation notes

Drive the system pressure free prior installation resp. deinstallation of the sensor.

The protective cap, which is attached at the diaphragm, must only be removed immediately before the installation.

The diaphragm must not be point loaded, because this can lead to diaphragm damage.

The installation of the device into a closed off completely with process liquid filled connection can lead to destruction of the measuring diaphragm. The reduction of the volume of the liquid at screw-in leads to a very high pressure boosting, which can exceed the permitted maximum value by a multiple. Thus, before installation, the connection must be sufficiently emptied.

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“).

3.4 Air pressure compensation

Avoid the damaging or pollution of the pressure compensation system.

The hindrance of the pressure compensation can lead to faulty measuring results.

The filter element of the pressure compensation system is positioned at the side of the enclosure.

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.

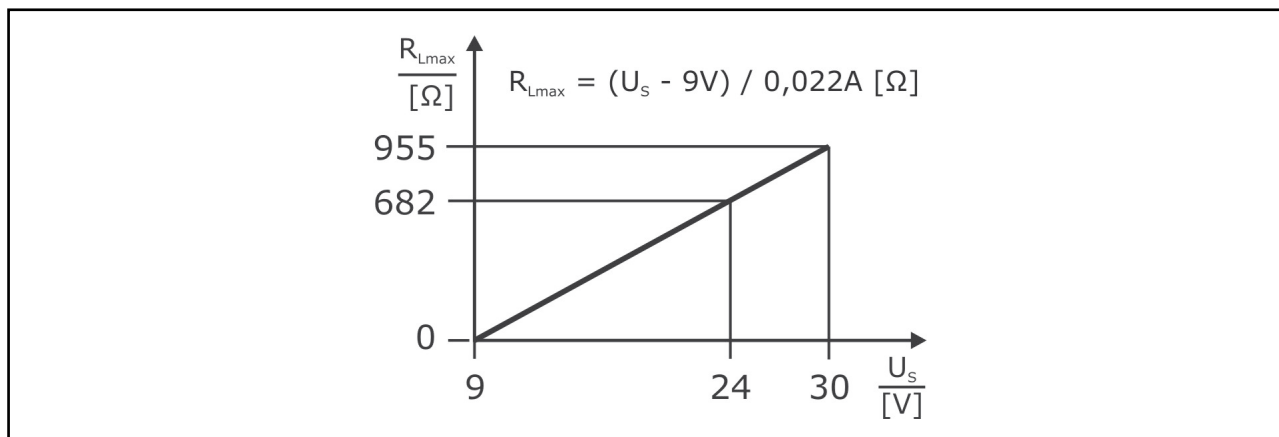
At deactivated switch state and at failure of supply voltage the semiconductor switch is shut off.

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.



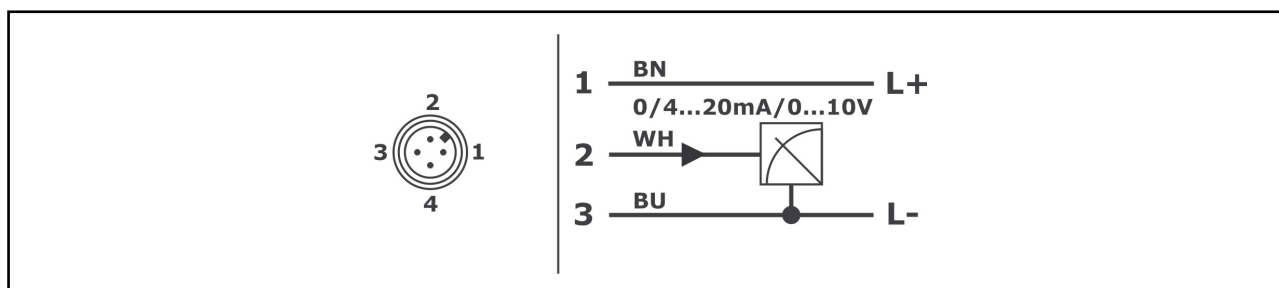
4.6 Connection scheme

Conductor color standard connection cable M12 – A-coded:

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

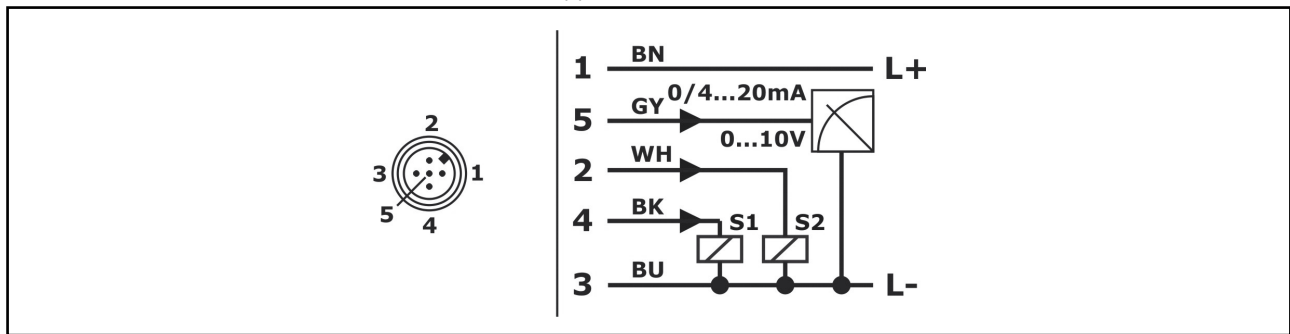
4.6.1 Electronic output type M

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



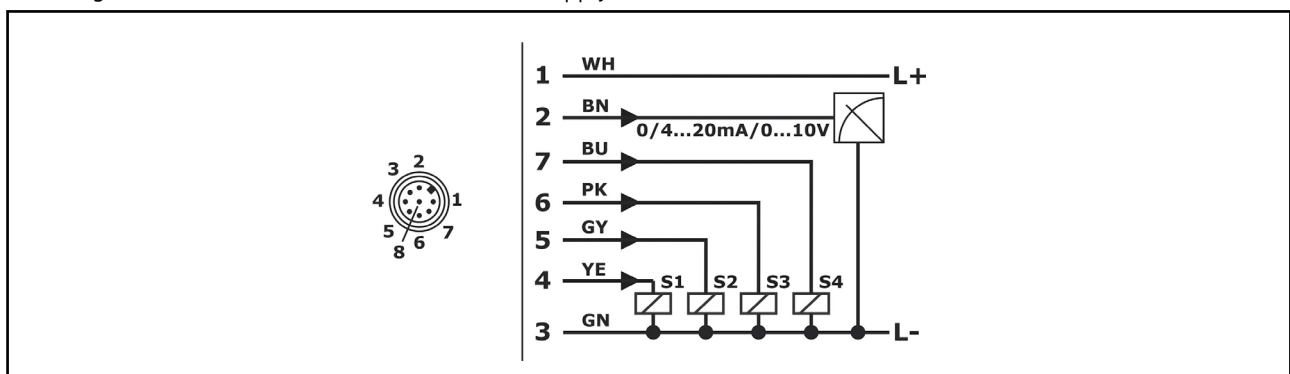
4.6.2 Electronic output type K

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



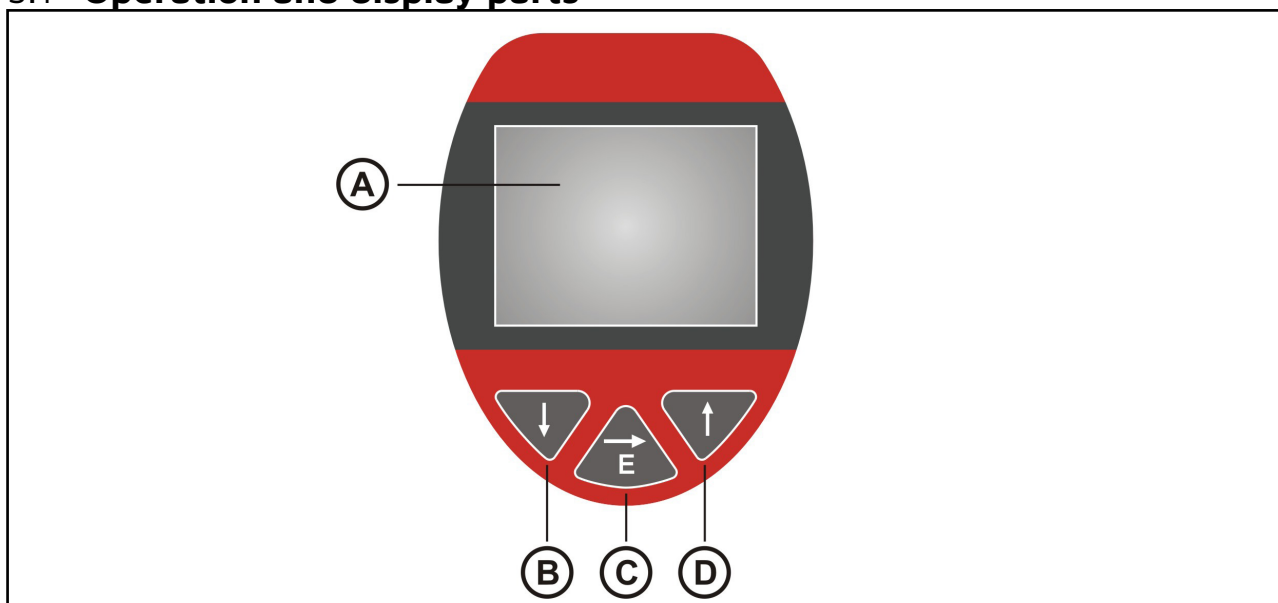
4.6.3 Electronic output type R

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



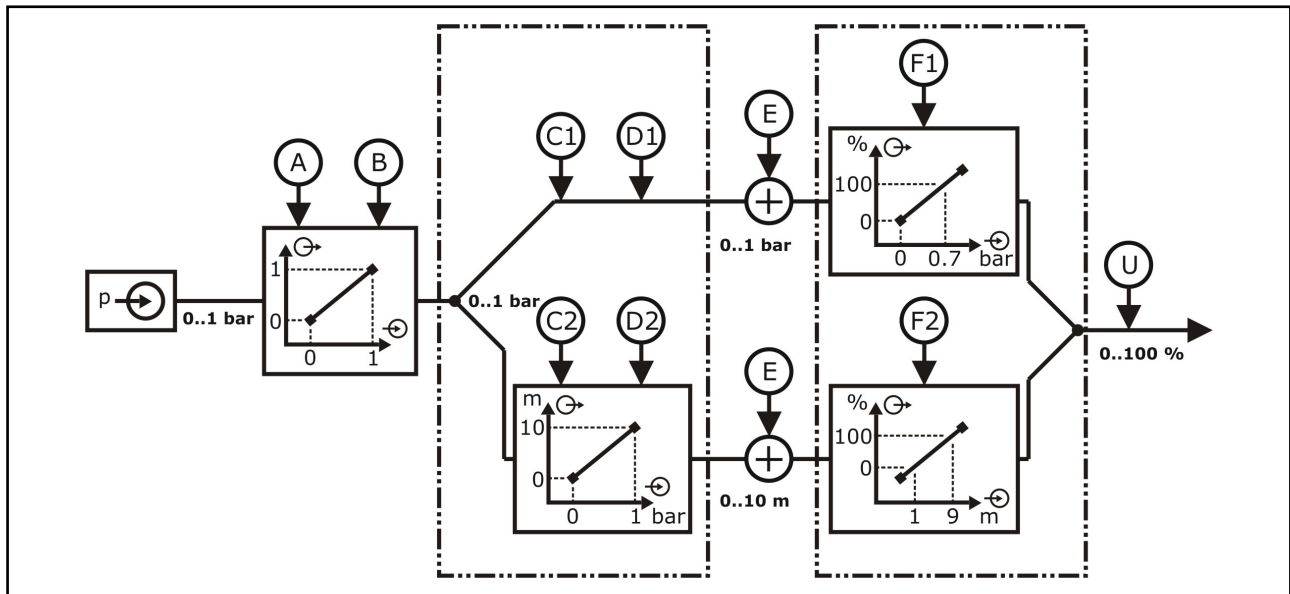
5 Operation

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 - Damping
- B - Position adjustment
- C1 - Primary unit > e.g. bar
- C2 - Primary unit > m
- D1 - Density > not available (at primary unit bar/mbar)
- D2 - Density > e.g. 1,0194 kg/dm³
- E - Offset adjustment > e.g. no offset
- F1 - Min/Max adjustment > e.g. 0..0,7 bar = 0..100 %
- F2 - Min/Max adjustment > e.g. 1..9 m = 0..100 %
- U - Limit min/max

Q5 - Display - Signal Output 4..20 mA resp. 0..20 mA resp. 0..10 V

5.3 Menu structure

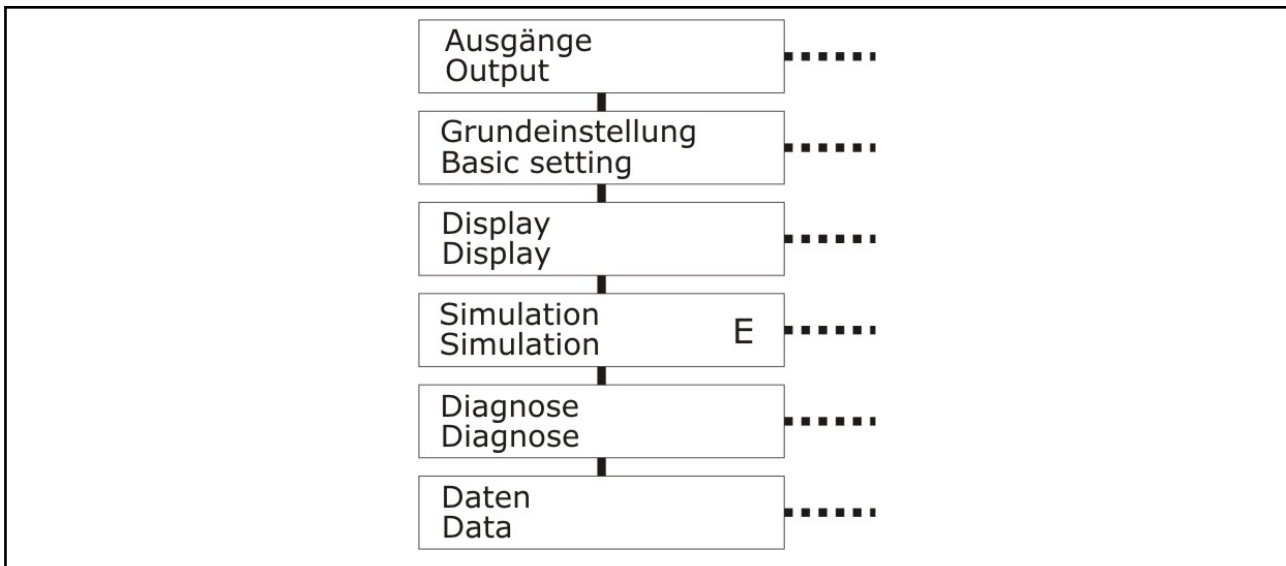
The entrance to the different function areas of the selection and set menu layer is done by the main menu (push the key Enter/Shift right for 3 seconds).

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.

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.

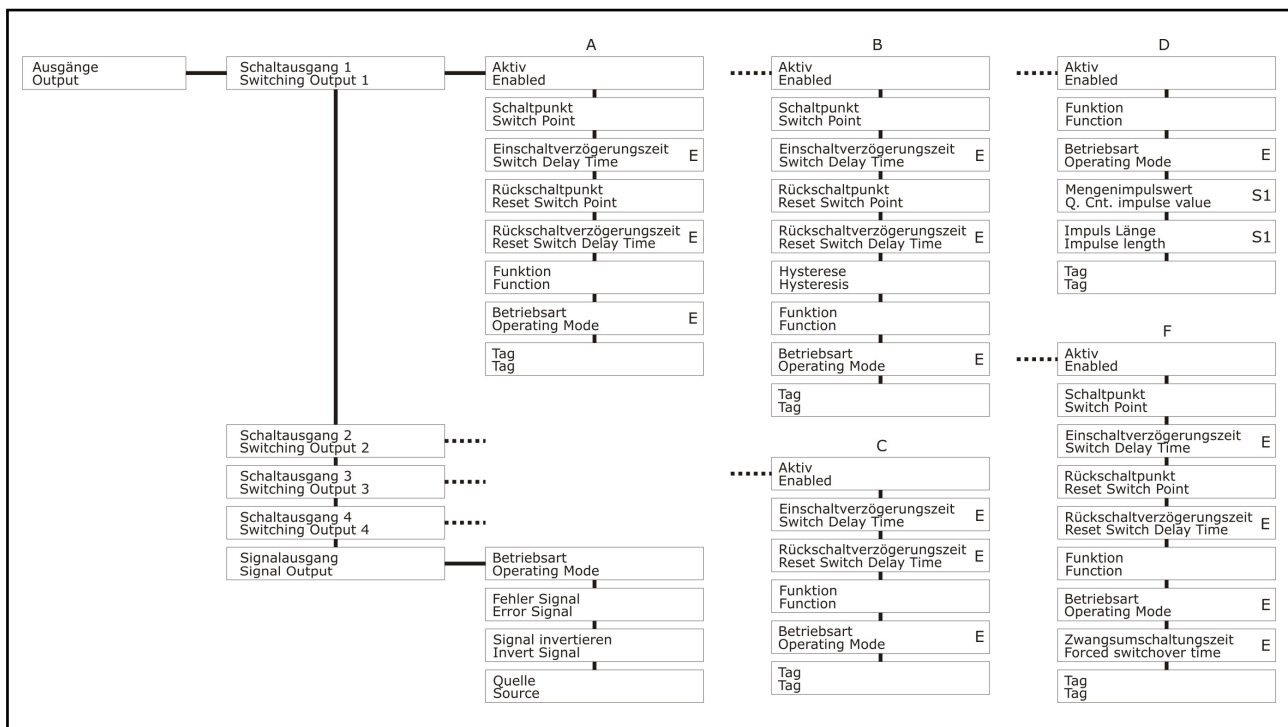
After 5 minutes of inactivity the active submenu resp. selection menu will automatically be left and a change to the measuring value indication is executed.

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.



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, in the set primary unit or acc. to display scaling.

The reset switch point must be lower 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

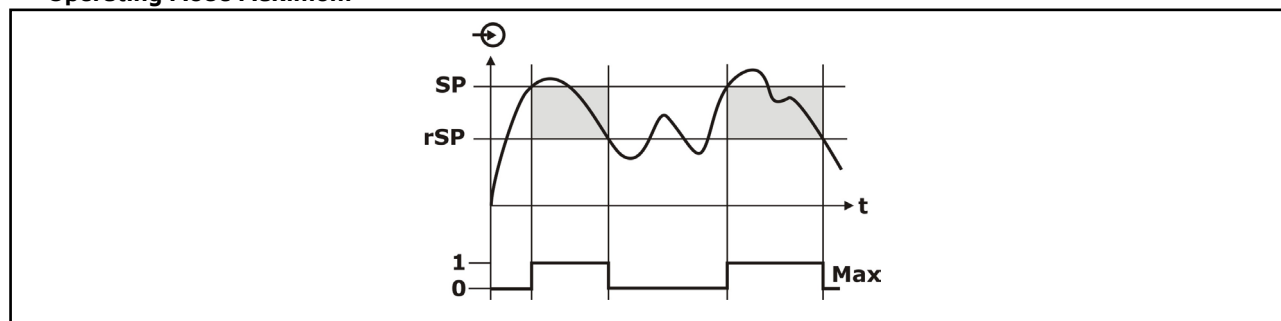
The hysteresis function realizes a stable switch state, independent from system conditioned signal fluctuations around the adjusted set point.

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.

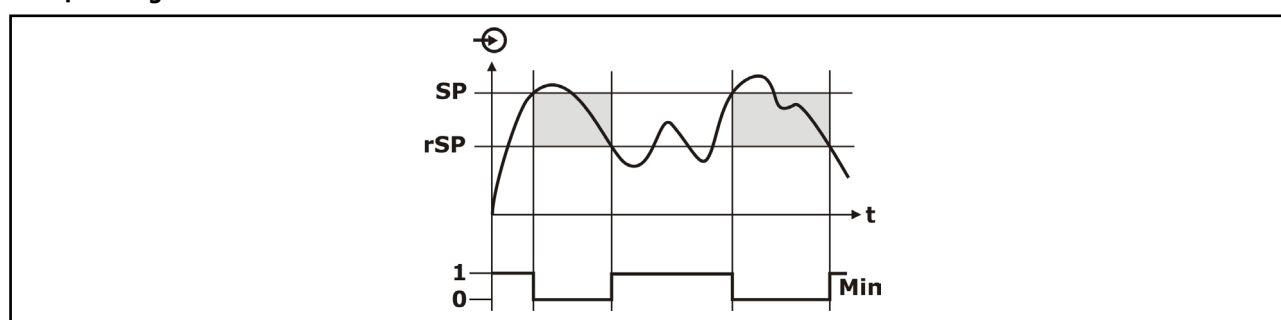
Operating Mode Maximum



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.

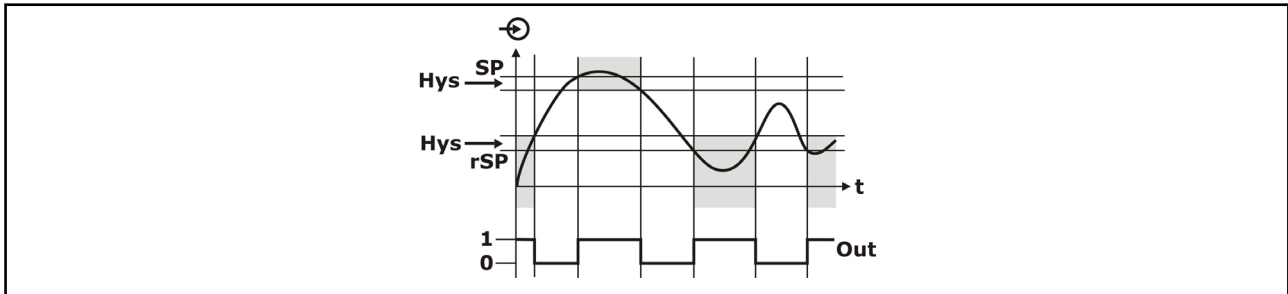
5.5.1.4.2 Window function S1/S2/S3/S4

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

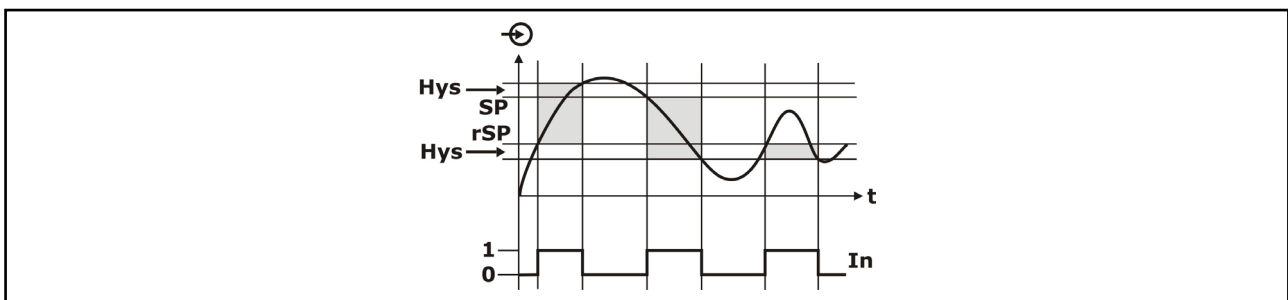


The switch output is activated, if the current measuring value is outside the area that is defined by the switch point and the reset switch point and if the set switch point delay time has been expired.

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.

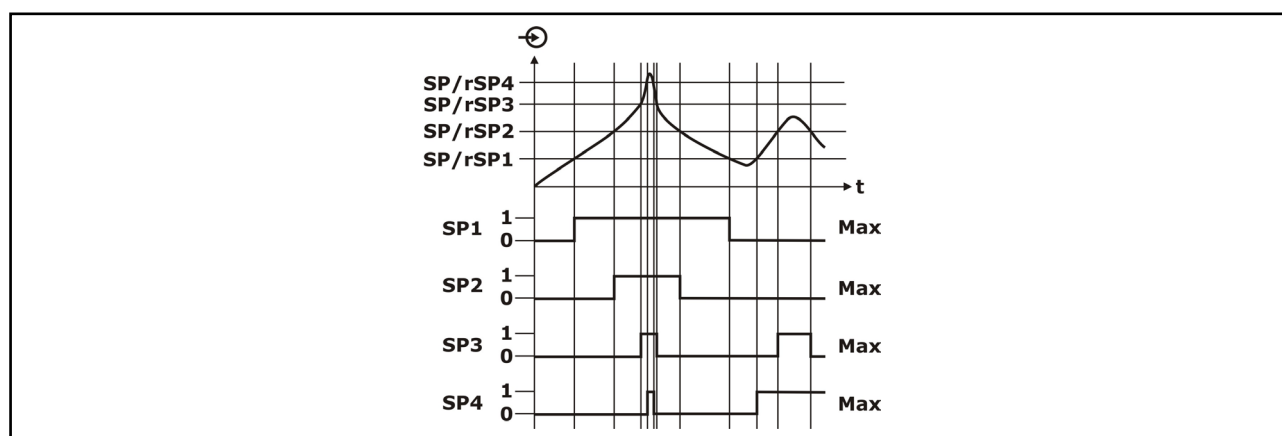
5.5.1.4.5 Pump function runtime S1/S2/S3/S4

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

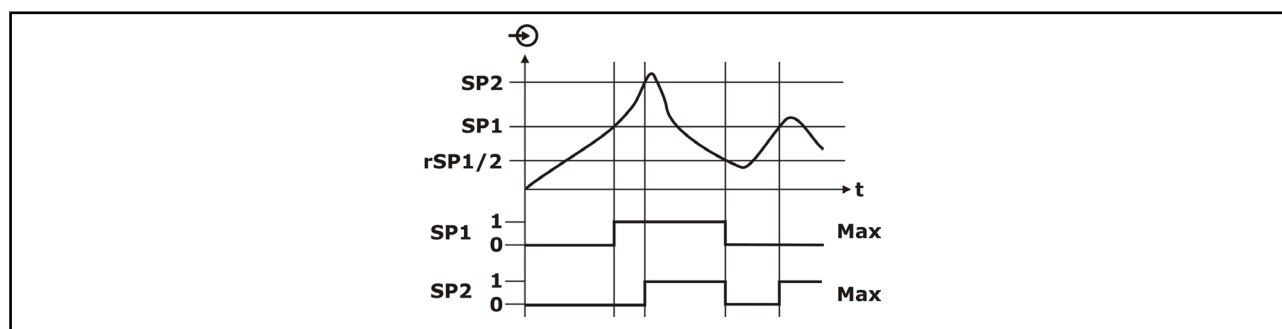
Always the pump with the shortest running time is switched on and the pump with the longest running time switched off.

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 of 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).

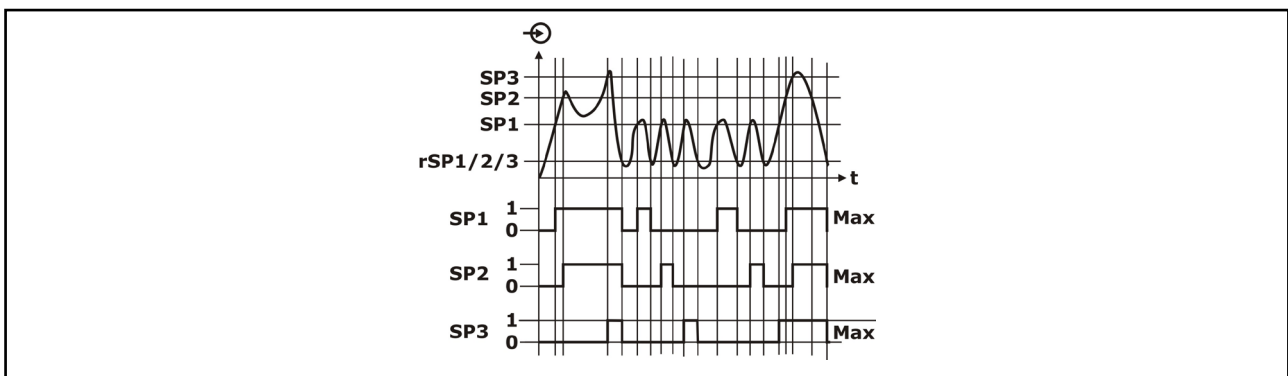
Due using the pumps for the same task, it can be detected by the pump switch-on time, if one of the pumps doesn't operate with the necessary performance (Runtime of the pump increases).

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.

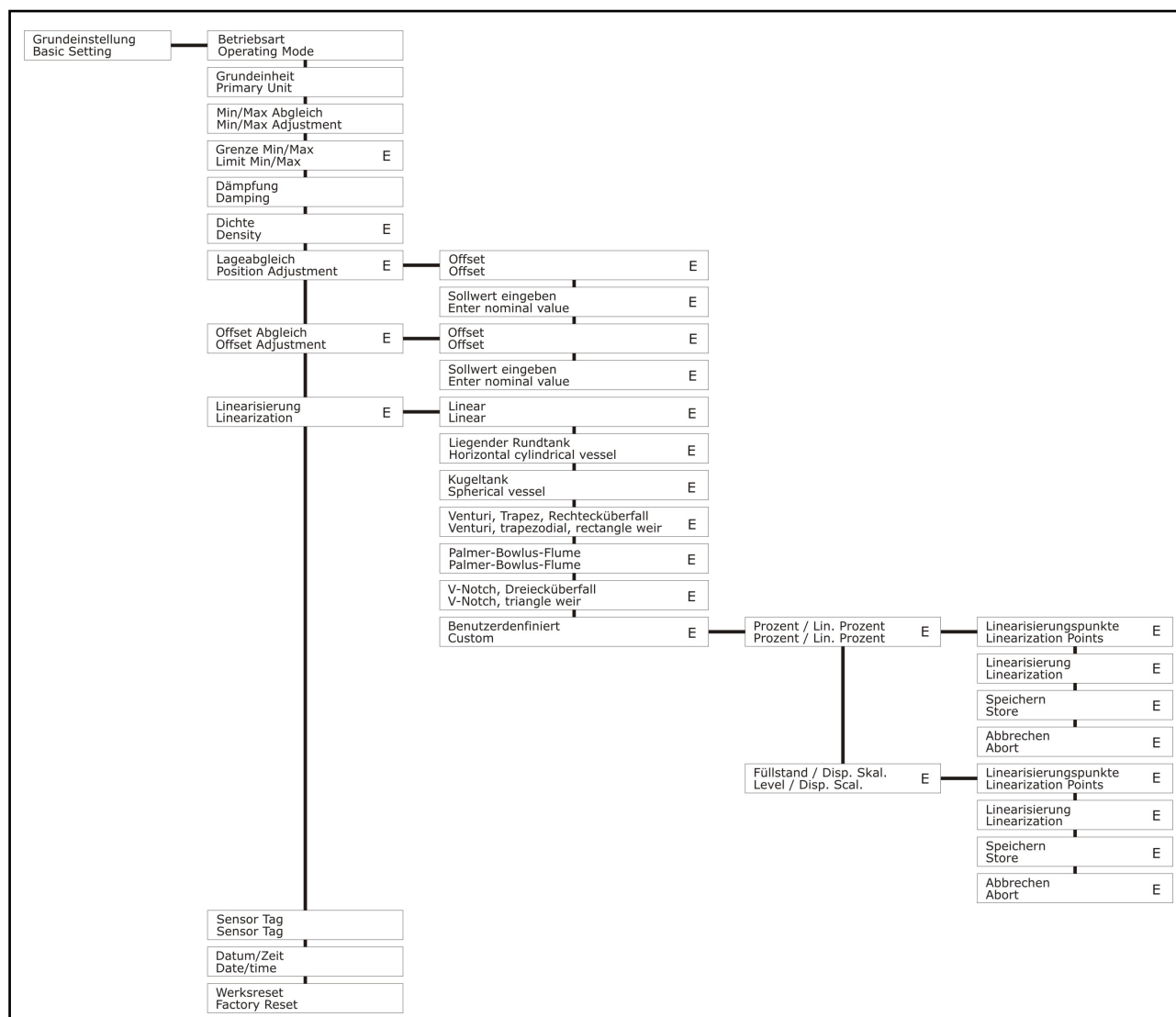
Lin %

%

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 Operating mode

Definition for the use of the device for pressure or level measurement.
The change of the setting erases an eventual min/max-adjustment.
The change from pressure to level set the primary unit to m.
The change from level to pressure set the primary unit to bar.
In the Operating Mode Level the input of a material density (menu "Density") is available.

Pressure
Level

Default > Pressure

5.6.2 Primary Unit

The primary unit defines the internal reference unit of the measuring signal.
At the change of the primary unit an automatic conversion is calculated.
At the change of the primary unit from a pressure unit to a height unit the gravitational acceleration mean value 9,81 m/s² is used.
For special applications another value can be stored by factory.

bar / mbar / m / cm / mm / feet / inch

Default > bar

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 pressure/level and the measuring 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 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.

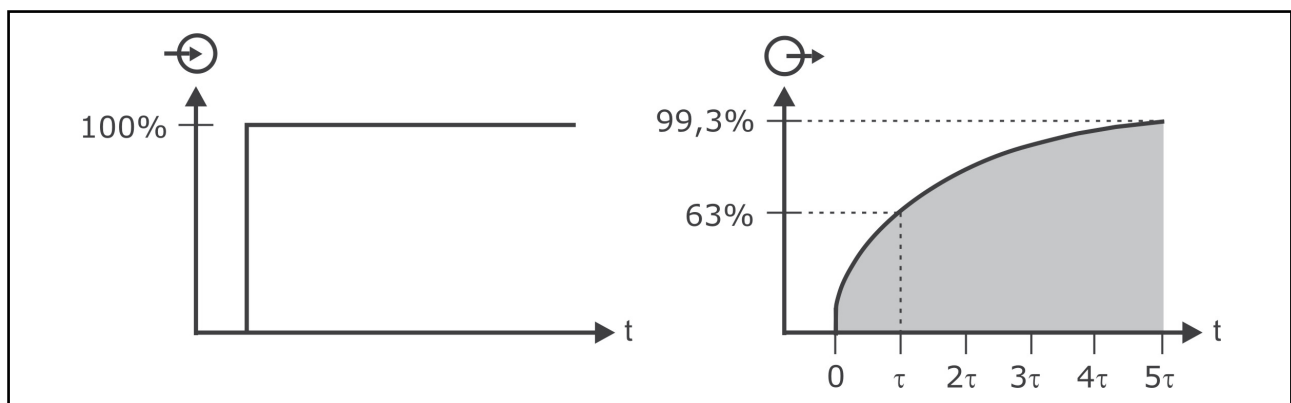
This function is especially useful at a flow measurement to avoid negative flow measuring values.

deactive

active

Default > deactive

5.6.5 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 measuring rate depends directly on the set damping.

Damping 0s >> Measuring rate 100x/s >> Resolution 12 bit

Damping 0,02s >> Measuring rate 50x/s >> Resolution 16 bit

Damping 0,05s >> Measuring rate 20x/s >> Resolution 18 bit

Damping 0,15s >> Measuring rate 7,5x/s >> Resolution 20 bit

At damping values $\geq 0,15$ s the resolution remains at 20 bit constantly.

The input range is indefinite.

Default > 1 sec

5.6.6 Density – E

This menu item is only available at operation mode level.

The density represents a material constant of the measured process material.

For the conversion of a pressure into a height besides the gravitational acceleration the density of the process material is also relevant for the calculation result.

$$h = p / (\rho \cdot g)$$

h >> Height (Level)

p >> Pressure

ρ >> Density

g >> Gravitational acceleration value (9,81 m/s²)

The input range is indefinite.

Default > 1 kg/dm³

5.6.7 Position Adjustment – E

By the use of the position adjustment measuring errors caused by the installation position can be corrected.

This errors can be caused e.g. by the dead weight of the measuring membrane or by a higher process temperature.

The position adjustment must be done in installed position at conditions, that are representative for the measuring task and should only be done in an absolutely pressure less condition, cause the set primary unit and a density value are not regarded in this function.

For the suppression of a measuring signal, which is caused by the process material, the function offset adjustment is available.

In the sub menu offset, a value can be input, that is added to the current measuring value or in the sub menu enter nominal value, a value can be input, which equals the current measuring signal.

Offset

Current measuring value -0.090 bar > Offset 0.090 bar > resulting measuring value 0.000 bar

The input range is indefinite.

Enter nominal value

Current measuring value -0.090 bar > Nominal Value 0.000 bar > resulting measuring value 0.000 bar

The input range is indefinite.

Default > Offset = 0

5.6.8 Offset Adjustment – E

By the use of the offset adjustment, a constant value can be added to the measuring value, e.g. to suppress overlayed measuring signals in a pressure biased system. For the suppressing of measuring deviations, caused by the installation position, the function position adjustment ist available.

Position adjustment and offset adjustment are identical, is primary unit and density are not altered compared to the default values.

In the sub menu offset, a value can be input, that is added to the current measuring value or in the sub menu enter nominal value, a value can be input, which equals the current measuring signal.

Offset

Current measuring value -0.090 bar > Offset 0.090 bar > resulting measuring value 0.000 bar

The input range is indefinite.

Enter nominal value

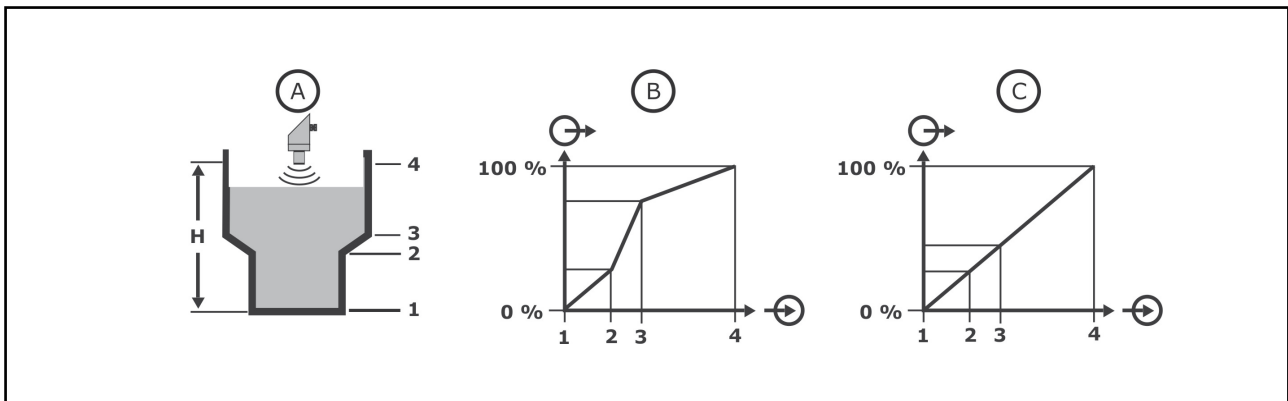
Current measuring value -0.090 bar > Nominal Value 0.000 bar > resulting measuring value 0.000 bar

The input range is indefinite.

Default > Offset = 0

5.6.9 Linearization - E

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 pressure - level not linearized
- C - Characteristic pressure - level linearized

5.6.9.1 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

5.6.9.2 Input mode custom defined linearization

Percent / Linearized Percent
Base Unit / Display Scaling
CSV-file via short-range-radio interface

The percentual input (referring to the measuring range) is only possible without applying measuring value, whereby the input in primary unit e.g. bar 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 primary unit) 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 primary unit / display scaling the input signal refers to the input signal in the primary unit. The output signal refers to the display range (primary unit or scaled), 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.

5.6.10 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.

Up to 19 characters can be input.

The input range is indefinite.

Default > no Sensor TAG allocated

5.6.11 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

5.6.12 Factory Reset

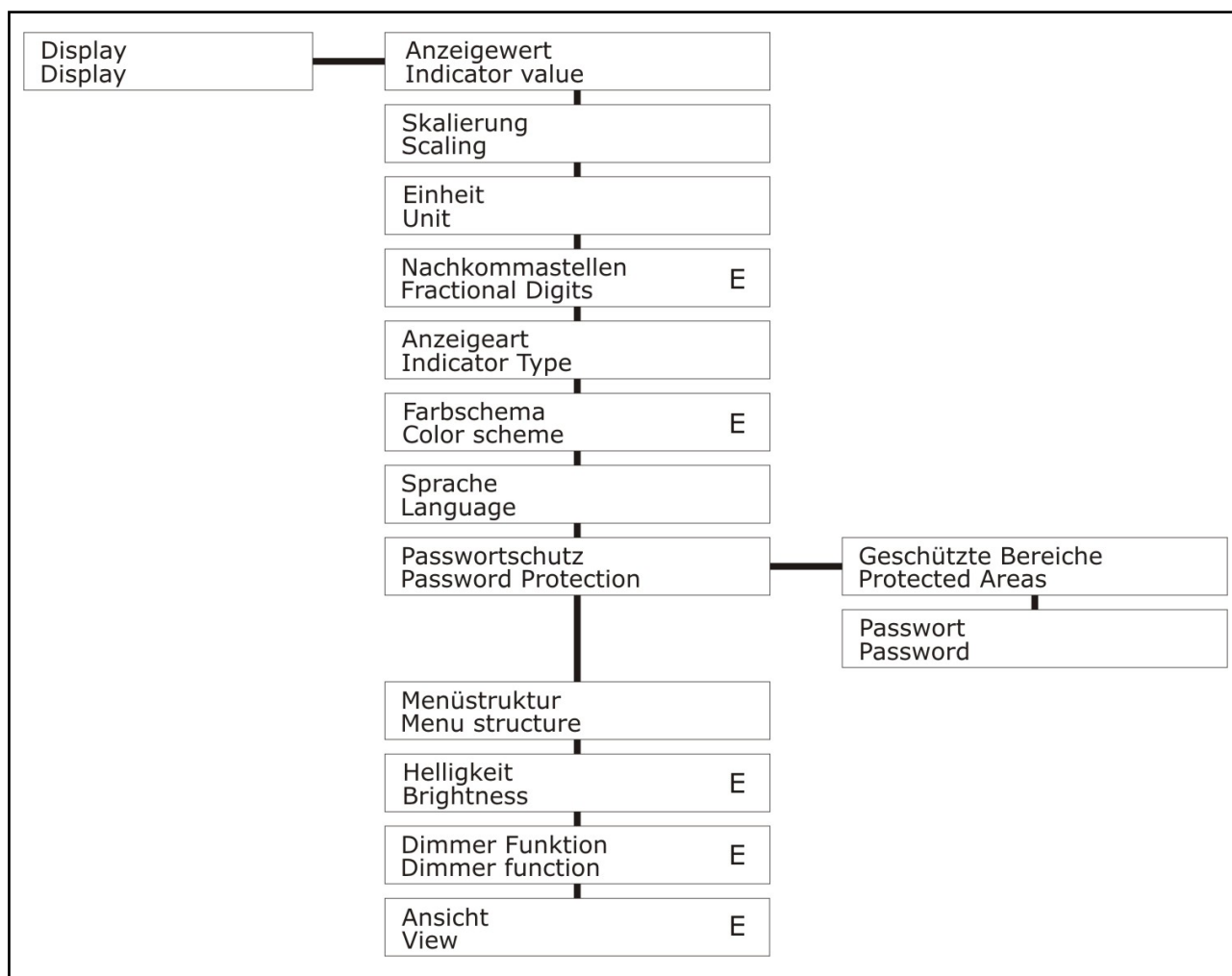
The factory reset changes all settings to default values.

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 in the set primary unit e.g. bar or meter, or with any desired scaling referring percentual to the measuring range. The indication in primary unit is only possible with linearization linear.

Primary Unit
Scaled

The input range is indefinite.
Default > Primary Unit

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 deactive

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

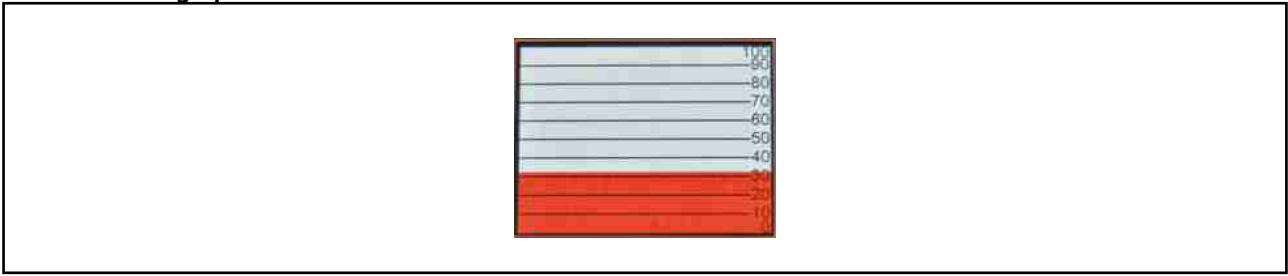


Digital measuring value

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.

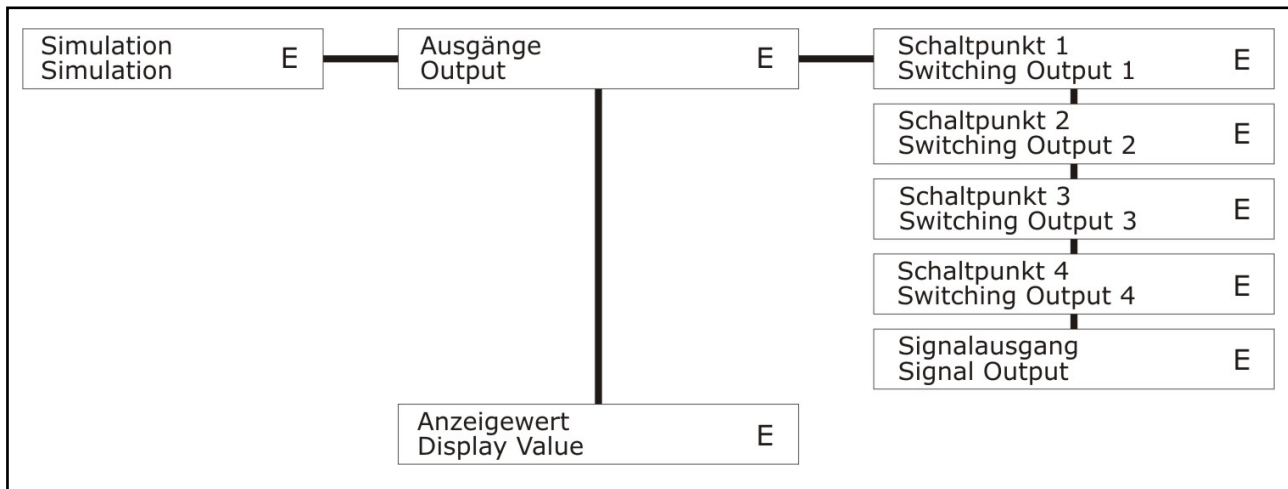
- Normal
- 180°

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)

0.000 – 22.00 mA (0-20 mA)

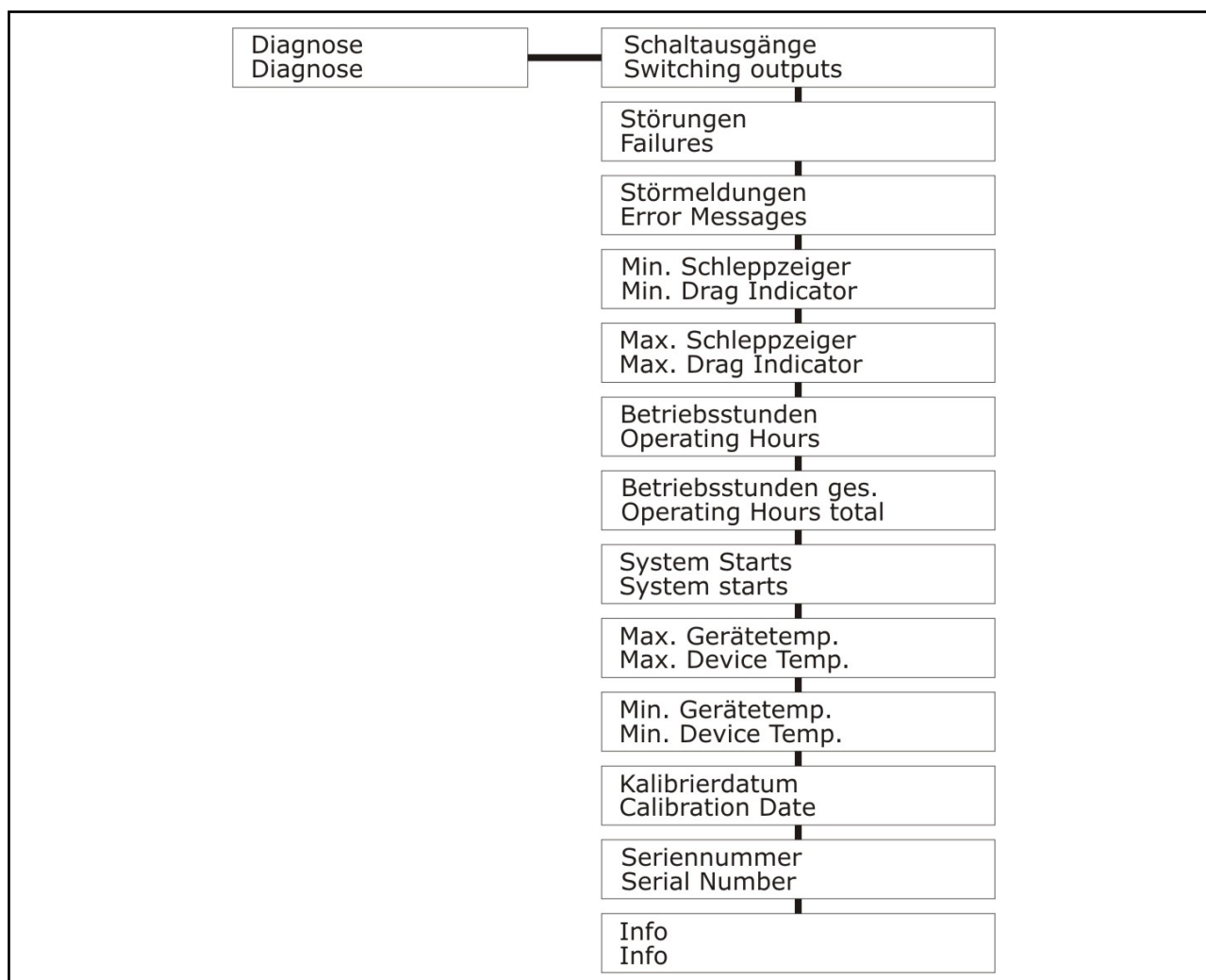
0.000 – 11.00 V (0-10 V)

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 Switching Outputs

5.9.1.1 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.

5.9.1.2 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.

5.9.2 Failure

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

Overpressure

exceeding the nominal measuring range by 3%

Underpressure

exceeding the nominal measuring range by 3%

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

5.9.3 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:

Overpressure

exceeding the nominal measuring range by 3%

Underpressure

exceeding the nominal measuring range by 3%

Output overflow

Overshoot of the analogue output range depending on selected operating mode

Operating mode 4-20mA >> 21mA

Operating mode 0-20mA >> 21mA

Operating mode 0-10V >> 10,5V

Default > activated

Output underflow

Undershoot of the analogue output range 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 value

Default > activated

Power loss

Default > deactivated

5.9.4 **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.

5.9.5 **Operating Hours**

The operating hours of the device since the last device start-up are detected.

The indication is done in hours.

5.9.6 **Operating Hours total**

The operating hours of the device since the first device start-up are detected.

The indication is done in hours.

5.9.7 **System Starts**

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

5.9.8 **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.

5.9.9 **Calibration Date**

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

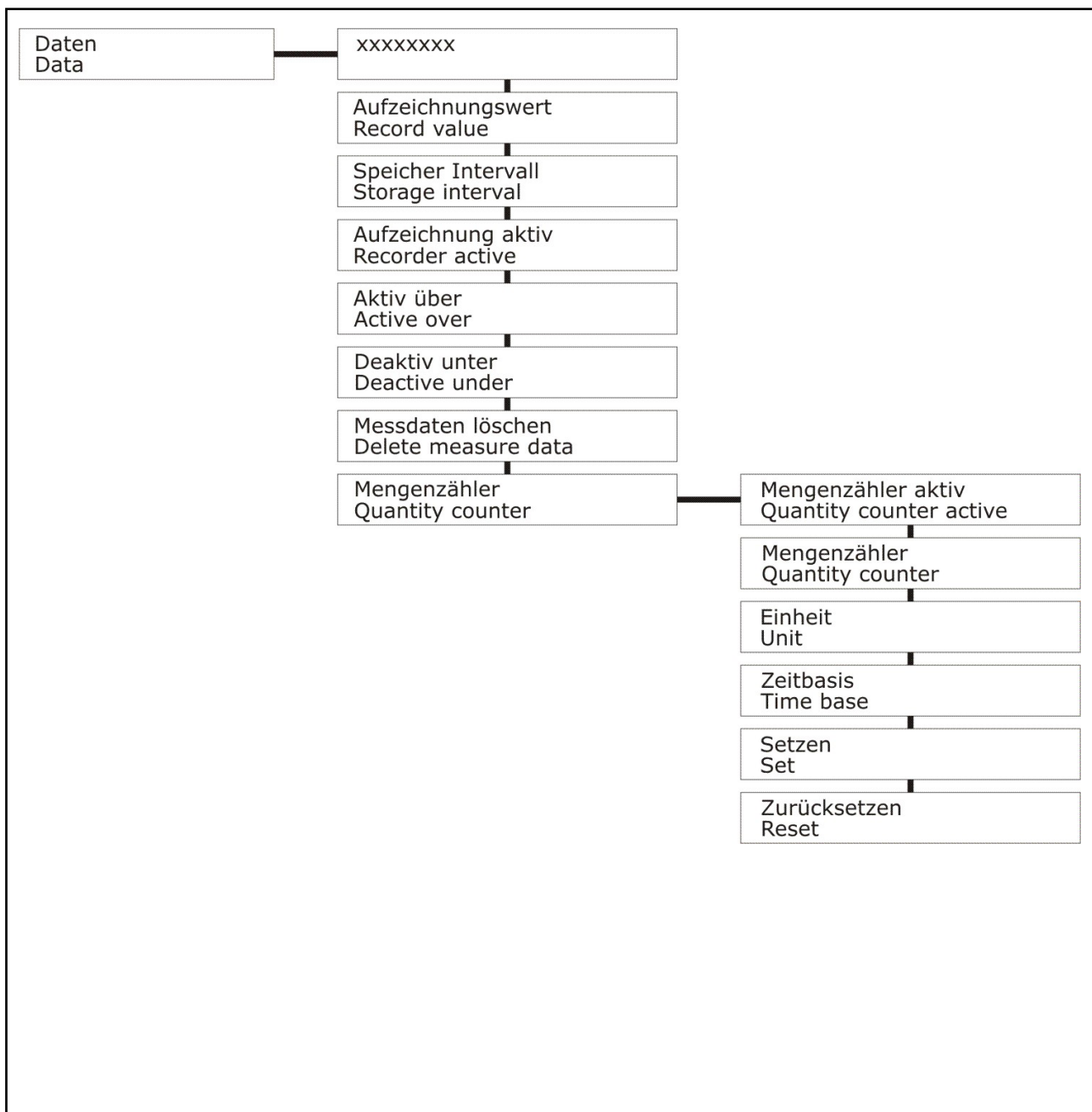
5.9.10 **Serial Number**

Indication of the serial number of the device.

5.9.11 **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.

5.10.1 Record value

The measuring value can be alternatively recorded with primary unit or with any desired scaling referring percentual to the measuring range.

Primary unit

Scaled

Default > Primary unit

5.10.2 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

5.10.3 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

5.10.4 Delete measure data

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

5.10.5 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 can't 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 Pressure measurement

The sensor is preconfigured to pressure measurement dependent on the pressure range alternatively in unit mbar or bar by factory.

Only a few changings must be optionally made.

Sub menu Basic Setting

Position Adjustment

Primary Unit

Min/Max Adjustment (when using the signal output)

5.11.2 Level measurement

The filling level is calculated by the device with entering the gravitational acceleration mean value $9,81\text{m/s}^2$ and the density of the process material into the equation.

Sub menu Basic Setting

- Position Adjustment
- Operating Mode Level
- Primary Unit
- Density process material
- Offset Adjustment
- Min/Max Adjustment (when using the signal output)

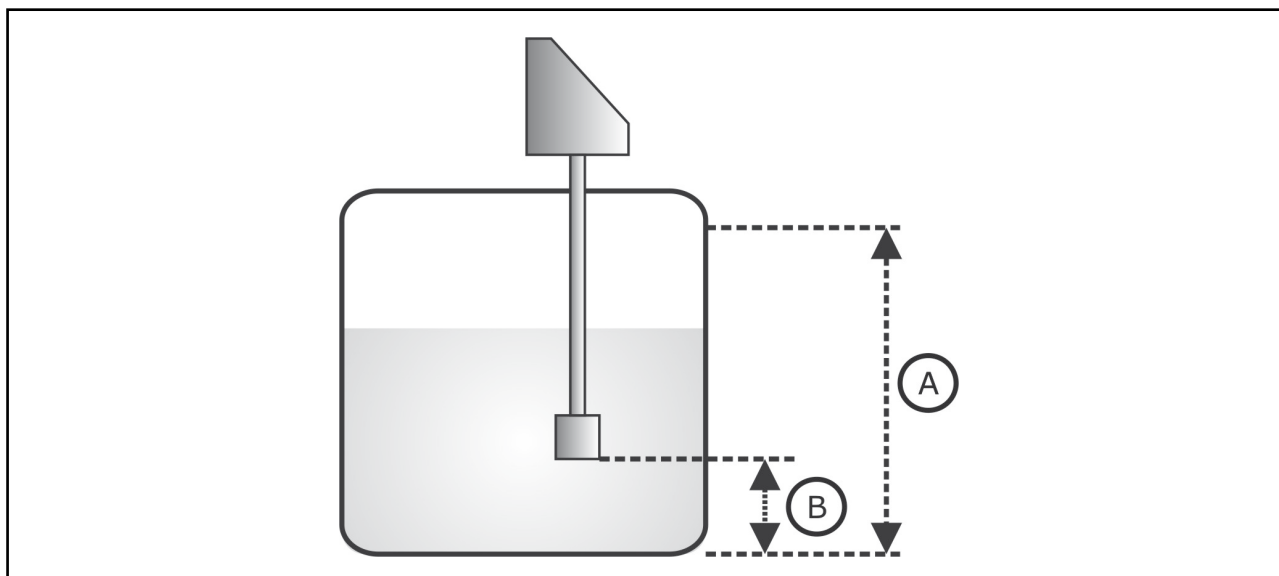
5.11.2.1 Example

Measurement task

- Process material: Water
- Not measurable level: 0,1m

Settings

- Operation Mode: Level
- Primary Unit: m
- Density: water 1.0 kg/dm^3
- Offset: 0.1m



- A - Maximum Level
- B - Offset / not measurable level range

5.11.3 Volume measurement

The operation mode level is used.

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

- Position Adjustment
- Operation Mode Level
- Primary Unit
- Density process material
- Offset Adjustment
- Min/Max Adjustment
- Linearization

Sub menu Display

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

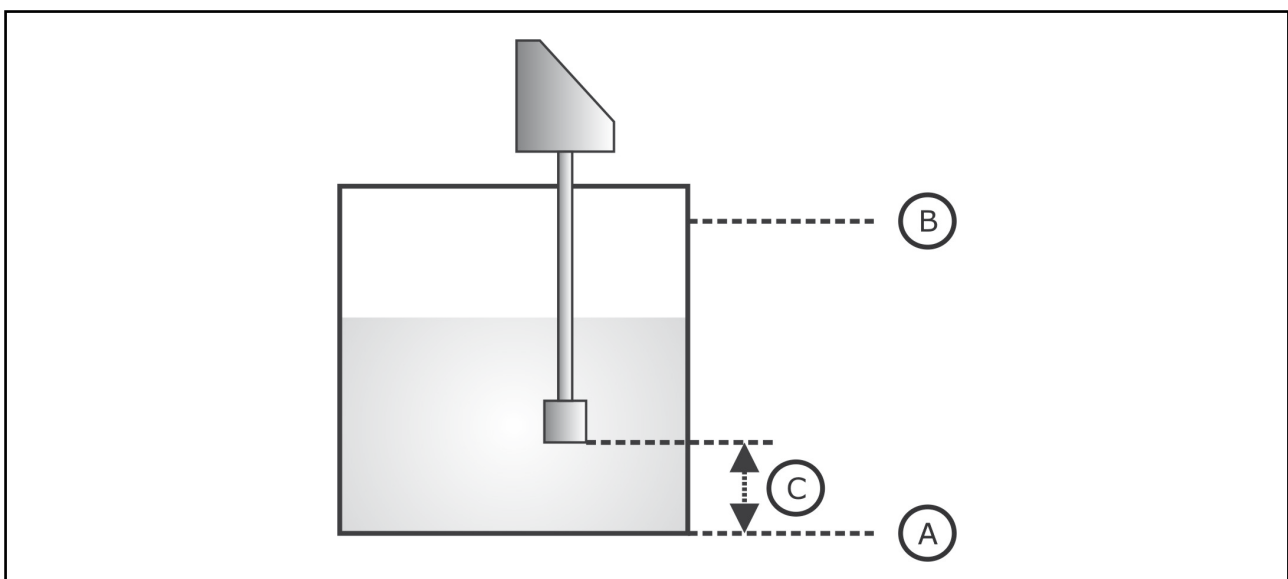
5.11.3.1 Example

Measurement task

- Container: Cylinder - linear volume
- Process material: Water
- Minimum measuring signal: 0,2m
- Maximum measuring signal: 3,2m
- Minimum level: 0 liter
- Maximum level: 2000 liter

Settings

- Operation Mode: Level
- Primary Unit: m
- Density: water 1.0 kg/dm³
- Offset: 0.2m
- Min/Max Adjustment: 0m = 0% / 3m = 100%
- Display Indicator value: Scaled
- Display Unit: l
- Display Scaling: 0% = 0 l / 100% = 2000l
- Linearization: Linear



- A - Minimum volume
- B - Maximum volume
- C - Offset / not measurable volume range

5.11.4 Flow measurement

The operation mode level is used.

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

- Position Adjustment
- Operation Mode Level
- Primary Unit
- Density process material
- Offset Adjustment
- Min/Max Adjustment
- Linearization

Sub menu Display

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

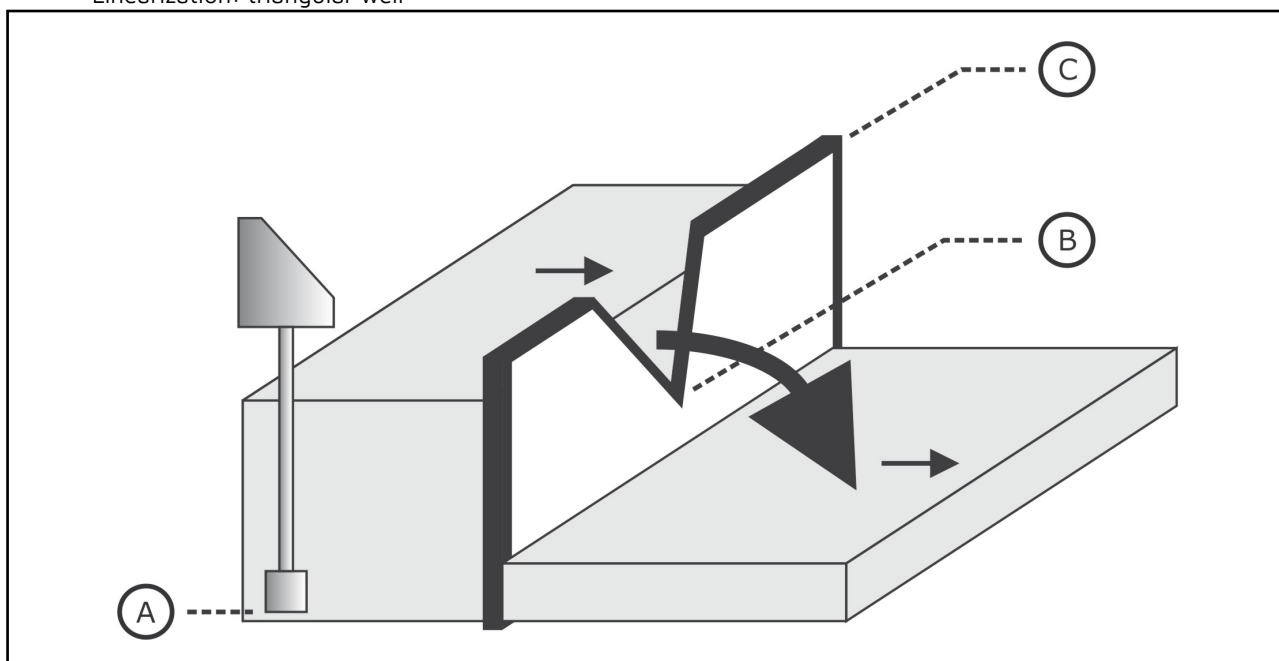
5.11.4.1 Example

Measuring task

- Style: Triangle weir
- Level minimum flow: 20 cm at 0 l/s
- Level maximum flow: 50 cm at 69 l/s
- Process material: Water

Settings

- Operation Mode: Level
- Primary Unit: cm
- Density: water 1.0 kg/dm³
- Min/Max Adjustment: 20cm = 0% / 50cm = 100%
- Display Indicator value: Scaled
- Display Unit: l/s
- Display Scaling: 0% = 0 l/s / 100% = 69l/s
- Linearization: triangular weir



- A - Minimum measuring signal
- B - Measuring signal at lower edge
- C - Measuring signal at top edge

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	Setting output 0/4...20 mA 9..30 V _{DC} , reverse polarity protected
	Setting output 0...10 V 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}	Setting output 0/4...20 mA ≤ 110 mA ($U_s = 9$ V / $I_o/S1/S2/S3/S4$ 0mA) ≤ 130 mA ($U_s = 9$ V / $I_o/S1/S2/S3/S4$ 0mA) ≤ 70 mA ($U_s = 30$ V / $I_o/S1/S2/S3/S4$ 0mA) ≤ 80 mA ($U_s = 30$ V / $I_o/S1/S2/S3/S4$ 0mA)
	Setting output 0...10 V ≤ 65 mA ($U_s = 14$ V / $U_o/S1/S2/S3/S4$ 0mA) ≤ 80 mA ($U_s = 14$ V / $U_o/S1/S2/S3/S4$ 0mA) ≤ 50 mA ($U_s = 30$ V / $U_o/S1/S2/S3/S4$ 0mA) ≤ 60 mA ($U_s = 30$ V / $U_o/S1/S2/S3/S4$ 0mA)

7.2 Output

7.2.1 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}	≤ 15 ms ($t_d = 0s$)
Start-up time t_{on}	$\leq 1s$

7.2.2 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}	≤ 15 ms ($t_d = 0s$)
Start-up time t_{on}	$\leq 1s$

7.2.3 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}	≤ 15 ms ($t_d = 0s$ / $R_L = 10k\Omega$)
Start-up time t_{on}	$\leq 1s$

7.2.4 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... $\leq 200mA$, current limited, short circuit protected
Step response time T_{90}	≤ 25 ms ($t_d = 0s$)

Rise time T_{90}	$< 30\mu s$ ($R_L < 3k\Omega$ / $I_{Out} > 4,5mA$)
Start-up time t_{on}	$\leq 1s$
Switch cycles	$\geq 100.000.000$

7.3 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

Characteristic deviation ^{3) 5) 6) 12)}	$\leq \pm 0,05\% / \pm 0,1\% / \pm 0,2\% FS$ ²⁾
Nonlinearity ^{6) 12)}	$\leq \pm 0,05\% / \pm 0,1\% / \pm 0,2\% FS$ ²⁾
Hysteresis ^{6) 12)}	negligible
Influence of supply voltage	Setting output 0/4...20 mA $\leq \pm 0,001\% FS$ ²⁾ / V
	Setting output 0...10 V $\leq \pm 0,006\% FS$ ²⁾ / V
Load influence	Setting output 0/4...20 mA $\leq \pm 0,01\% FS$ ²⁾ / 100R
	Setting output 0...10 V $\leq \pm 0,05\% FS$ ²⁾ / 1mA
Long term drift ^{6) 12)}	$\leq \pm 0,1\% FS$ ²⁾ / year - not cumulative
Temperature deviation ^{6) 12)}	T_k ⁴⁾ Zero $\leq \pm 0,015\% FS$ ²⁾ / K, max. $\pm 0,75\%$ (-20°C...+80°C)
	T_k ⁴⁾ Span $\leq \pm 0,015\% FS$ ²⁾ / K, max. $\pm 0,5\%$ (-20°C...+80°C / $> 0,4$ bar), max. $\pm 0,8\%$ (-20°C...+80°C / $\leq 0,4$ bar)
Mounting position deviation ¹⁰⁾	$\leq 0,18$ mbar

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

³⁾ Nonlinearity + Hysteresis + Reproducibility

⁴⁾ T_k = Temperature coefficient

⁵⁾ Limit value adjustment acc. to EN/IEC 60770-1

⁶⁾ Specification for TD ⁷⁾ = 1 (adjusted measuring range = nominal measuring range).

Specification for TD ⁷⁾ ≥ 1 (adjusted measuring range $\leq$ nominal measuring range) = specification at nominal measuring range x TD ⁷⁾

⁷⁾ Turn-Down TD = nominal measuring range (FS ²⁾) / adjusted measuring range

¹⁰⁾ Device rotated by 180°, process connection upside

¹²⁾ Higher values for special measuring range

7.4 Data memory

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

7.5 Clock

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

7.6 Process conditions

Process temperature	-40°C...+100°C
The permitted range results from the narrowest limitation of standard range resp. extended range.	<u>Extension</u> Temperature decoupler -40°C...+125°C <u>Limitation</u> Gasket – FKM/FPM -25°C...+200°C Gasket – EPDM -40°C...+140°C Gasket – FFKM / FFKM hd -15°C...+315°C Extension cable -20°C...+70°C

Process pressure	Pressure range	Over/Burst pressure	Vacuum
Process connection - Type 7 – G1½" [R] Gauge pressure [A] Absolute pressure	-100...0 mbar [R]	4 bar	700 mbar [A]
	-100...+100 mbar [R]	6 bar	500 mbar [A]
	-1...0 bar [R]	10 bar	0 bar [A]
	-1...+1 bar [R]	18 bar	0 bar [A]
	0...50 mbar [R]	4 bar	700 mbar [A]
	0...100 mbar [R]	4 bar	700 mbar [A]
	0...200 mbar [R]	6 bar	500 mbar [A]
	0...400 mbar [R]	6 bar	0 bar [A]
	0...600 mbar [R]	10 bar	0 bar [A]
	0...1 bar [R]	10 bar	0 bar [A]
	0...1,6 bar [R]	18 bar	0 bar [A]
	0...2,5 bar [R]	25 bar	0 bar [A]
	0...4 bar [R]	25 bar	0 bar [A]
	0...6 bar [R]	40 bar	0 bar [A]
	0...10 bar [R]	40 bar	0 bar [A]
	0...16 bar [R]	40 bar	0 bar [A]
	0...20 bar [R]	40 bar	0 bar [A]

Process pressure	Pressure range	Over/Burst pressure	Vacuum
Process connection - Type 8 – Thread G¾" [R] Gauge pressure [A] Absolute pressure	-100...0 mbar [R]	5 bar	0 bar [A]
	-100...+100 mbar [R]	5 bar	0 bar [A]
	-1...0 bar [R]	10 bar	0 bar [A]
	-1...+1 bar [R]	15 bar	0 bar [A]
	0...50 mbar [R]	5 bar	0 bar [A]
	0...100 mbar [R]	5 bar	0 bar [A]
	0...200 mbar [R]	5 bar	0 bar [A]
	0...400 mbar [R]	6 bar	0 bar [A]
	0...600 mbar [R]	10 bar	0 bar [A]
	0...1 bar [R]	10 bar	0 bar [A]
	0...1,6 bar [R]	15 bar	0 bar [A]
	0...2,5 bar [R]	15 bar	0 bar [A]
	0...4 bar [R]	25 bar	0 bar [A]
	0...6 bar [R]	40 bar	0 bar [A]
	0...10 bar [R]	40 bar	0 bar [A]
	0...16 bar [R]	40 bar	0 bar [A]
	0...20 bar [R]	40 bar	0 bar [A]

7.7 Environmental conditions

Environmental temperature	-20°C...+70°C
	<u>Limitation</u> Backlight LCD $\geq 60\%$ >> -20°C...+60°C Backlight LCD $\geq 80\%$ >> -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	$\leq 50\text{Nm}$
Weight	Depends on variant

7.8 Materials - process wetted

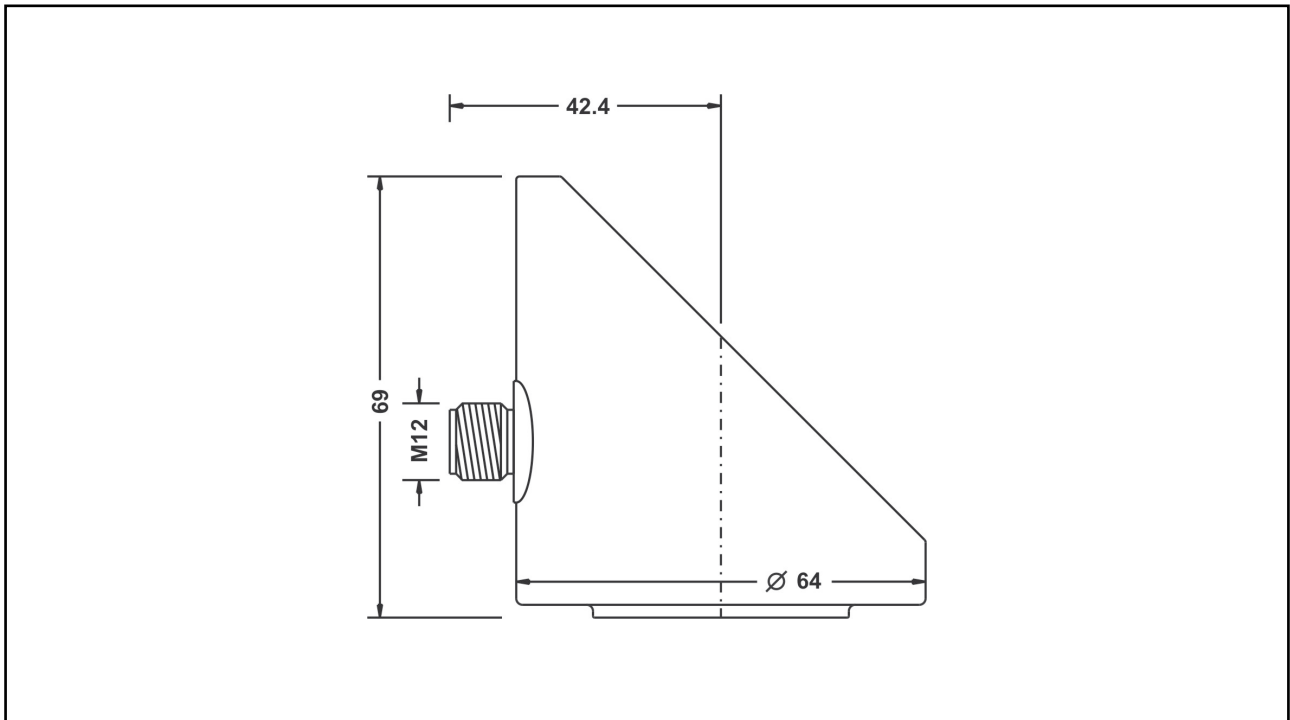
Membrane	Process connection Type 7 – Thread G1½" / Sensor Ø40mm Ceramic Al_2O_3 – 99,9%
	Process connection Type 8 – Thread G¾" / Sensor Ø22mm Measuring range $\leq 1\text{bar}$ Ceramic Al_2O_3 – 99,9%
	Process connection Type 8 – Thread G¾" / Sensor Ø22mm Measuring range $\geq 1,6\text{bar}$ Ceramic Al_2O_3 – 96%
Process connection	Steel 1.4404/316L Steel 1.4571/316Ti
Gaskets	FKM/FPM EPDM, FDA-listed FFKM FFKM hd
Extension cable	PE FEP
Extension tube	Steel 1.4404/316L Steel 1.4571/316Ti

7.9 Materials - not process wetted

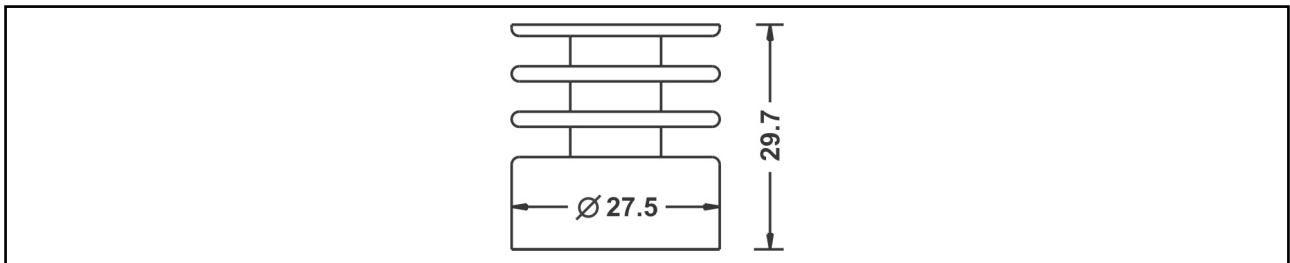
Terminal enclosure	CrNi-steel
Control panel surface	PES
Electrical connection part	Device plug PUR
Pressure compensation element	Acrylic copolymer
Gaskets	FKM/FPM

8 Dimension drawings

8.1 Terminal enclosure



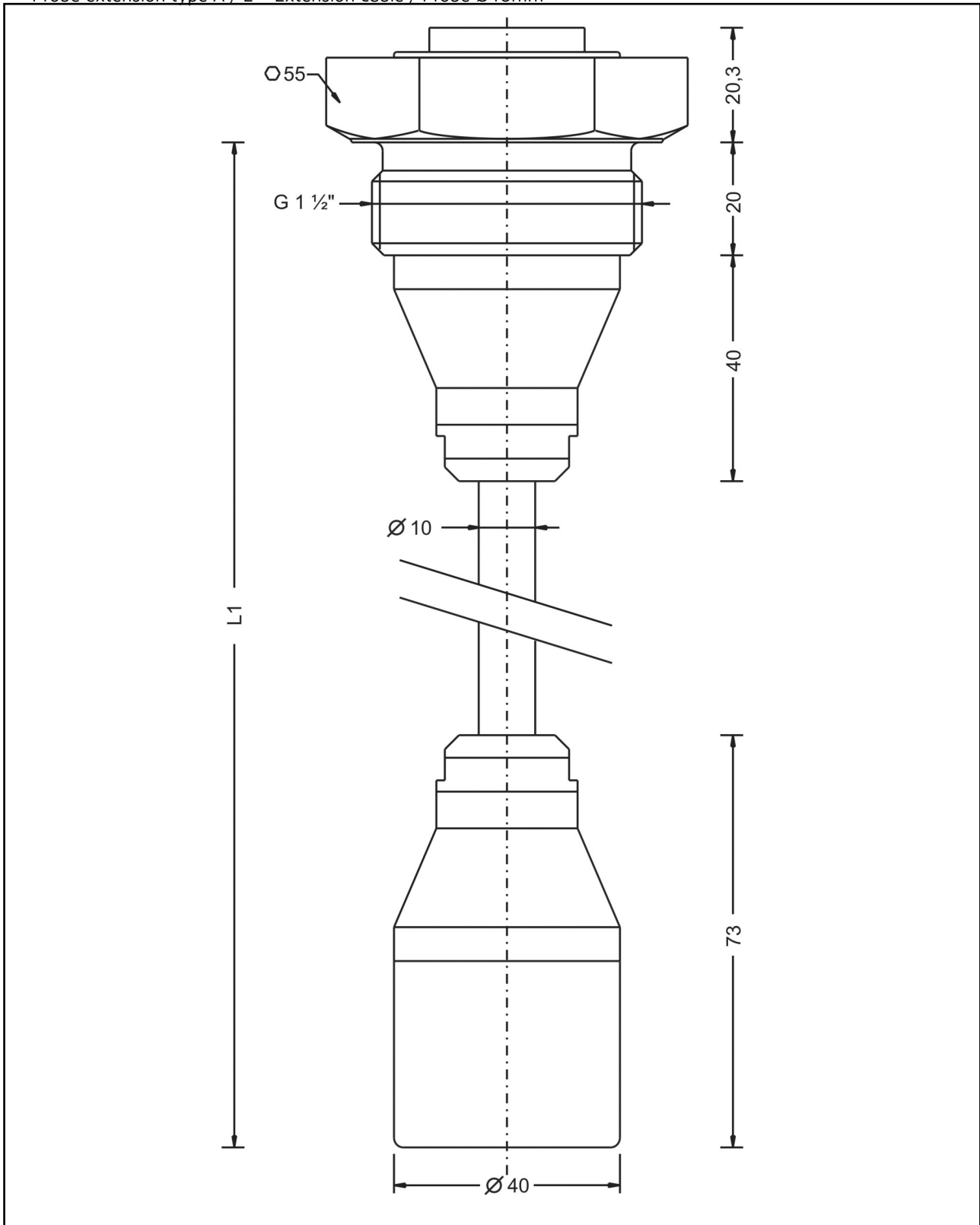
8.2 Temperature decoupler



8.3 Process connection

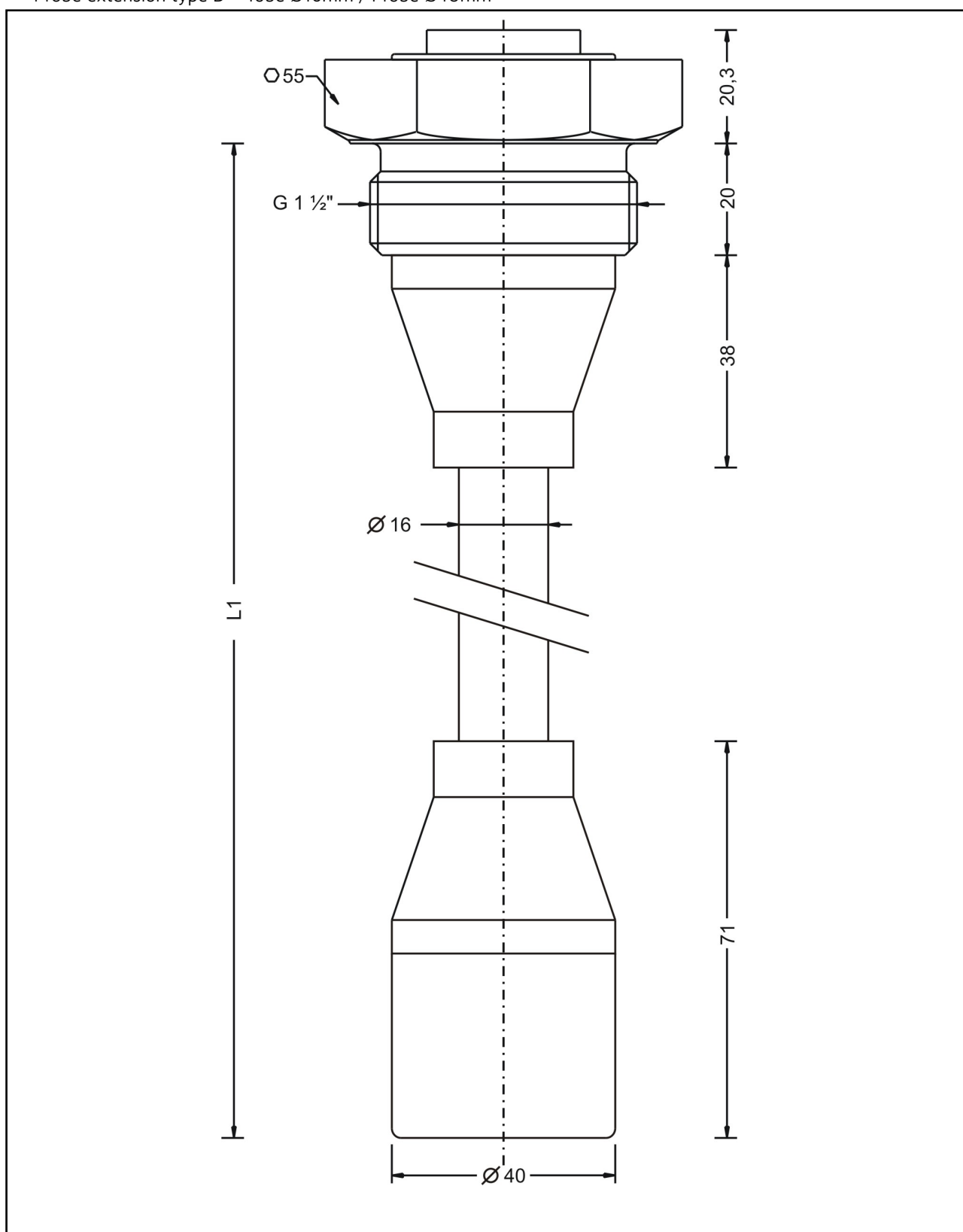
Type 7 – Thread ISO 228-1 – G1½"A

Probe extension type A / E – Extension cable / Probe Ø40mm



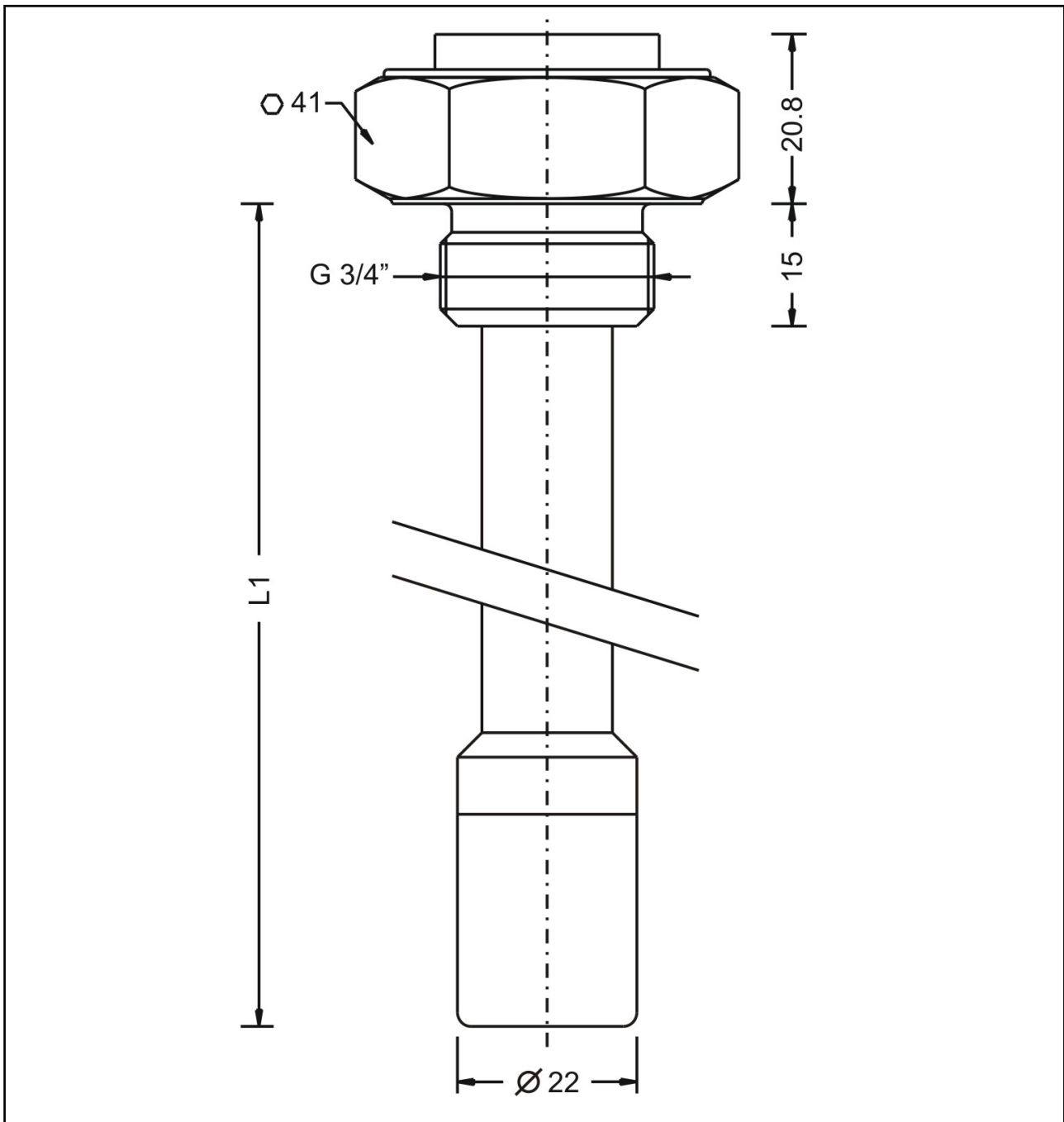
Length L1 ≤ 100 000 mm

Type 7 – Thread ISO 228-1 – G1½"A
 Probe extension type D – Tube Ø16mm / Probe Ø40mm



Length L1 ≤ 3000 mm

Type 8 – Thread ISO 228-1 – G $\frac{3}{4}$ "A
Probe extension type F – Tube $\varnothing 16$ mm / Probe $\varnothing 22$ mm



Length L1 $\leq$ 2000 mm

9 Ordering information

9.1 Order code

Type												
HN4R	Probe extension tube											
HN4T	Probe extension cable											
C	Measuring system – material diaphragm (process wetted) / sensor type Ceramic Al ₂ O ₃ 96%/99,7%/99,9% / capacitive											
S	Approval Standard											
7	Process connection Thread ISO 228-1 – G1½"A											
8	Thread ISO 228-1 – G¾"A											
Y	others											
1	Material process gaskets (process wetted) FKM/FPM											
3	EPDM, FDA-listed											
4	FFKM											
6	FFKM hd - gas applications											
Y	others											
V	Material process connection (process wetted) CrNi-steel											
C	Material terminal enclosure CrNi-steel											
	Measuring range											
26	0...50 mbar											
01	0...100 mbar											
02	0...200 mbar											
03	0...400 mbar											
04	0...600 mbar											
05	0...1 bar											
06	0...1,6 bar											
07	0...2,5 bar											
08	0...4 bar											
09	0...6 bar											
10	0...10 bar											
11	0...16 bar											
12	0...20 bar											
15	-100...0 mbar											
16	-1...0 bar											
17	-1...+1 bar											
18	-100...+100 mbar											
YY	Special measuring range											
M	Electronic – output 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											
2	Data logger, battery powered											
Y	others											
	Process temperature											
0	Standard -40°C...+100°C											
1	Extended -40°C...+125°C, temperature decoupler											
5	Reduced -20°C...+70°C, probe extension – extension cable											
	Pressure type Gauge pressure											
	Measuring system – accuracy											
1	0,2%											
3	0,1% (FS ≥ 100 mbar), linearization protocol											
6	Xcellence – 0,05% (FS ≥ 200mbar), linearization protocol											
	Electrical connection											
S	Plug M12x1											
	Probe extension											
A	Extension cable PE / Probe Ø40mm											
E	Extension cable FEP / Probe Ø40mm											
D	Tube Ø16mm / Probe Ø40mm											
F	Tube Ø16mm / Probe Ø22mm											
Y	others											
	Length L1 / mm											
HN4R/ HN4T	C	S		V	C				R	S		

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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
- WT Factory certification – drink water suitability
- WL Factory certification – food suitability
- 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



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