fill level | water level | pressure | temperature | flow | visualization | signal converter | sensoric

Thermocont TS4L

Temperature switch for hygienic applications

Monitoring of temperatures
in gases, vapors, liquids and dust

Technical manual
04.19

Applications

Hygienic and aseptic applications in
- Food and beverage industry
- Pharmaceutical industry
- Biotechnology
- Sterile process engineering

Main features

Wide range of applications
- Wide process temperature range –99,9°C to +500°C
- High process pressure tightness up to 50 bar
- Wide variety of hygienic and aseptic process connections
- High protection class IP65 / IP67
- Wide environmental temperature range –40°C to +85°C

Long term stable temperature sensor platinum Pt100 class A – DIN EN 60751

Increased process safety and cost saving by self-supervising measuring system for drift monitoring and redundancy function

High accuracy – characteristic deviation ≤ 0,5% of measuring range

Short response time

Integrated evaluation electronic
- Digital display, function LED's, keyboard
- 2x PNP switch output
- 1x current output 4…20mA
- Connector plug M12

High operating comfort
- Enclosure and display rotatable for optimal operability in each installation position
- Robust high brightness LED display for best readability
- 3-key operation without additional assistance with tactile feedback

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 temperature switch for monitoring, control as well as continuous measurement of temperatures in gases, vapors, liquids and dusts.

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

1.2 Field of application

Due to the device construction with

- Process temperature from up to –99,9°C to +500°C
- Process pressures up to 50 bar
- Process contacting material stainless steel V4A

as well as the availability of a variety of process connections like

- Elastomer-free and free of dead space metallic sealing connection, EHEDG-/3A-/FDA-conformal
- Varivent®
- Dairy coupling DIN 11851
- Clamp ISO 2852 / BS 4825 / DIN 32676
- Aseptic tube coupling DIN 11864-1-A

the device is especially suitable for the use for

- food and beverage industry
- pharmaceutical industry
- biotechnology
- sterile process engineering

The temperature switch 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.

Compared with temperature sensors, which are calibrated cyclic, the process safety increases when using the **temperature switch with self-supervision**. At cyclic calibration an occurring drift will be also detected, but an undefined time it has been produced with a drift affected sensor. Because the device generates a signal immediately at exceedance of the set drift limit, it must not be waited until to the end of the calibration interval. Thus the process safety and with this the product quality will be improved significantly.
Besides the increased process safety, the use of the **temperature switch with self-supervision** allows substantial cost savings. Due to the use of two redundantly working sensors, which are mutually monitored, the calibration intervals can be increased und thus calibrations can be saved. Although the device is a little bit more expensive at the acquisition costs than a standard temperature sensor, when saving only one calibration the acquisition price will pay off shortly.

The process connection with metallic sealing has been specifically designed for the hygienic, dead-space and elastomer-free process adaption.

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 the lowest temperatures when used outdoors, extreme 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
  - flange acc. to EN 1092-1/DIN 2527, ASME or JIS
  - hygienic and aseptic connections, e.g. DIN 11853, DRD, SMS, APV-Inline, BioControl®, Aseptoflex, etc.
- other process materials, e.g. Hastelloy, Titan, etc.
- surface coating, e.g. PTFE
- special adjustment

1.3 System components

The device consists on the components:

- Sensor tube, as junction point in direct contact with the applied medium.
- Process connection, for installation into the wall of the container or of the pipeline.
- Neck tube, 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 detection of the process temperature is made by the measurement of the temperature dependent change of resistance of a precise and long term stable resistive temperature sensor Pt100 class A, which is installed in the sensor tube.

1.4.2 Self-supervision function

At the self-supervising measuring system with drift monitoring and redundancy function the recording of the Temperature is made additionally by a semiconductor temperature sensor.

Because of the parallel measurement with two physically different thermal coupled sensor elements, the device detects impermissible drifts of a sensor and errors at the temperature measurement automatically.

At the failure of one of the two sensor elements the temperature measurement can be also continued with the second element, what realizes a redundancy function.

1.4.3 Signal processing

The temperature signal is converted by the temperature sensor into an electrical signal and processed by the integrated evaluation electronic according to the respective preferences:

- The measuring value is monitored by two PNP switch outputs for exceedance of limit values.
- The measuring value is converted into a continuous current signal 4...20mA.
- The measuring value is displayed at the robust high brightness LED display.
- Several function LED’s signal the device state.
- 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:

- Adjustable measuring range down to 25% of nominal measuring span
- Integrated unit conversion °C – °K – °F
- Peak value memory minimum – maximum
- Error memory for fast failure analysis
- Hysteresis or window function, time delay and working principle of the switch outputs
- Error indication function to switch output, current output and display
- Simulation of the switch outputs and the current output

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 choice of the place of installation of the sensor and the length of the sensor tube are of considerable importance for the quality and the reliability of the measuring results.

If the sensor isn’t installed deeply enough, an error in the measured temperature can occur because of the different process flow temperature at the pipeline wall and the heat transfer along the sensor tube.

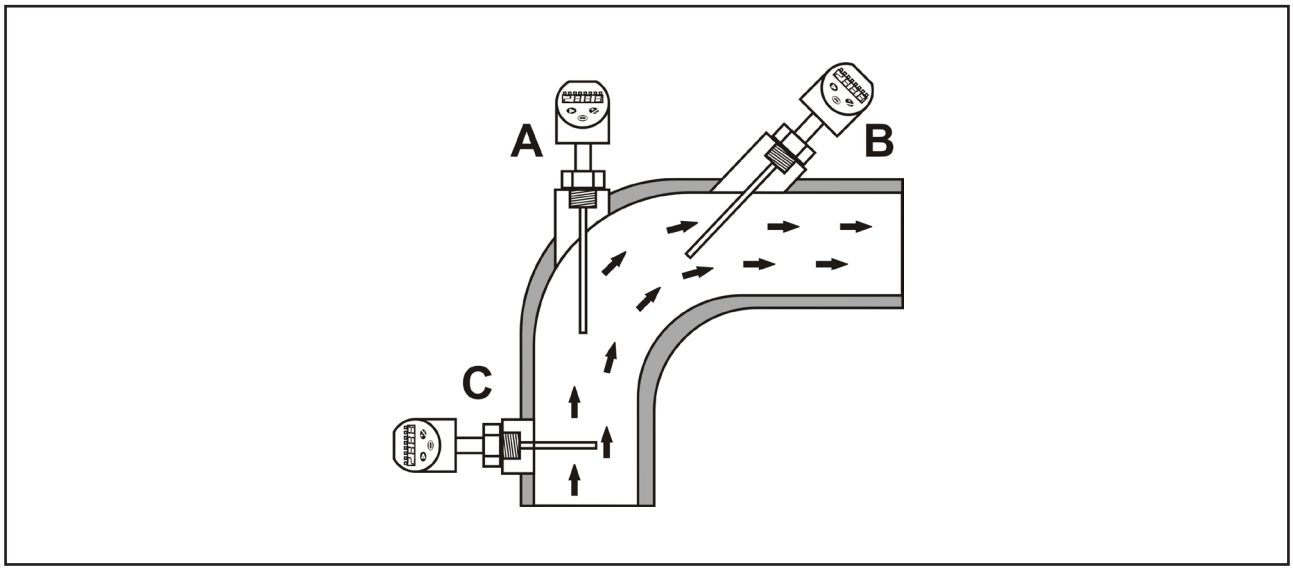
The appearance of the error should not be ignored if a considerable difference between process temperature and environmental temperature exists.
Thus it is suggested to use an installation length of at least 80...100 mm.
The shorter the installation length, the greater is the deviation against the real medium temperature caused by the heat transfer.

The following general recommendations can be applied as approximately guideline:

- In liquids, the sensor tube length should be 5...6 times greater than the diameter of the sensor tube plus the sensitive length of 50 mm.
- In steam, air and gases, the sensor tube length should be 10...15 times greater than the diameter of the sensor tube plus the sensitive length of 50 mm.

In pipelines with small diameter the tip of the sensor tube should reach the axis line, that means the middle of the pipeline, and if possible additionally a little more.

By isolating the external parts of the sensor, the effect caused by too low installation depth, can be reduced.
An additional solution for optimizing the measurement quality of small formatted pipelines could be the installation of the sensor tube diagonal to the pipeline longitudinal axis or the installation of the sensor tube in the pipeline arc.



A) In the pipe arc against the flow direction
B) In small pipes diagonal against the flow direction
C) Vertical to the flow direction

At a horizontal installation, especially in hygienic applications, the probe should be installed with a decline against the horizontal of minimum 3°, to ensure a self-emptying.

3.2 Process and environmental temperature

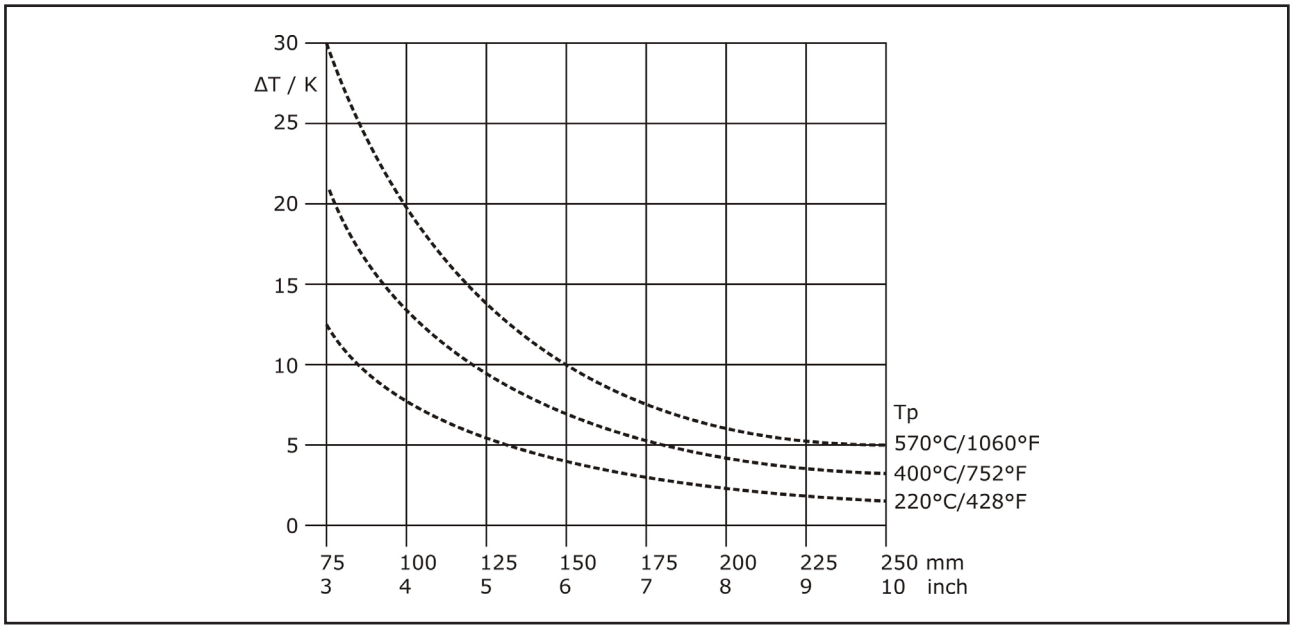
At high process temperatures a heat transfer to the terminal enclosure can be reduced by isolation of the medium carrying part of the plant or by the use of a neck tube.

3.2.1 Neck tube

The neck tube is used to decouple the temperatures between medium and the terminal enclosure in order to reduce the temperature at the terminal enclosure.

By using a neck tube at extreme process temperatures it can be achieved, that the permitted environmental temperature range in the area of the terminal enclosure will not be exceeded.

The length of the needed neck tube depends on the height of the process temperature and the respective installation situation.



Like shown in the graphic, the length of the neck tube can considerably influence the temperature at the terminal enclosure.
The graphic is only an approximately guide, because the real heating of the terminal enclosure can be influenced by additional factors, e.g. a system isolation or also the position of the terminal enclosure.

3.3 Installation notes

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

Be sure that no medium is flowing in the system. At extreme system or medium temperatures there could exist serious dangers.

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").

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:

All versions	10,5…35V_{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.

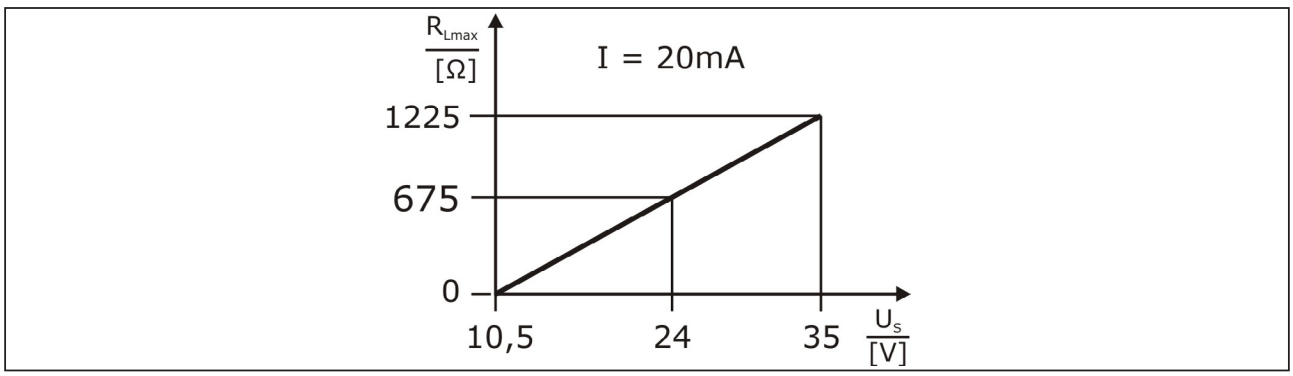
Note!
For inauguration it is suggested, to deactivate all connected control devices, to avoid unwanted control reactions.

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.



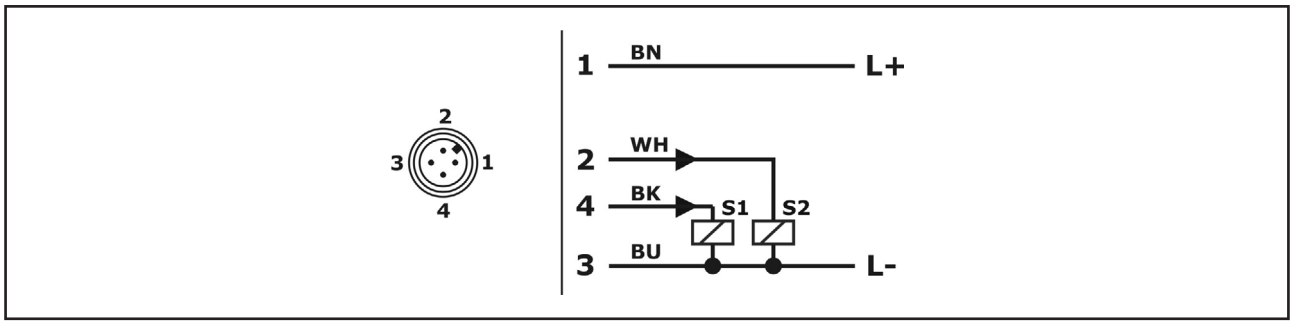
4.6 Connection scheme

Conductor color standard connection cable M12 – A-coded:

- BN = brown
- WH = white
- BU = blue
- BK = black
- GY = grey

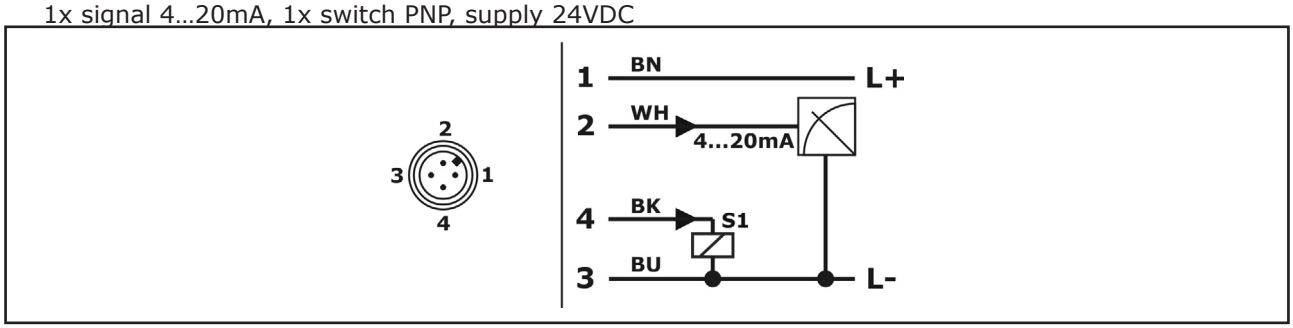
1.1.1 Electronic output type A

2x switch PNP, supply 24VDC



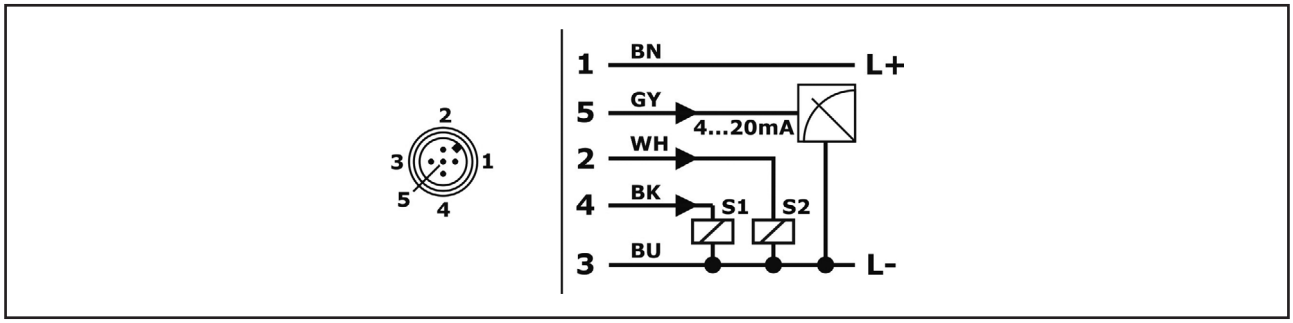
1.1.2 Electronic output type B

1x signal 4…20mA, 1x switch PNP, supply 24VDC



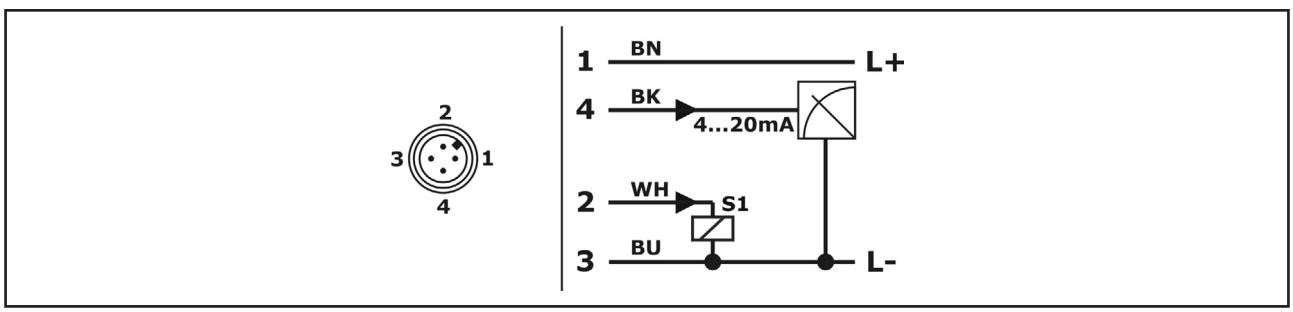
1.1.3 Electronic output type C

1x signal 4…20mA, 2x switch PNP, supply 24VDC



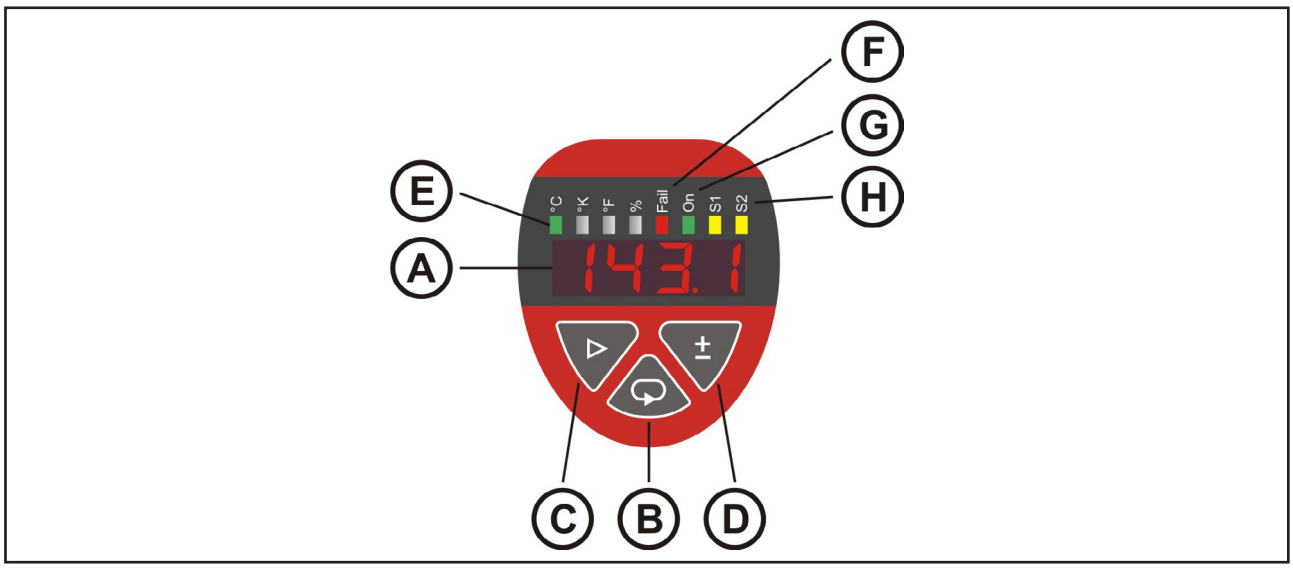
1.1.4 Electronic output type D

1x signal 4…20mA, 1x switch PNP, supply 24VDC / Desina conformal



5 Operation

5.1 Operation and display parts



A – LED display
- Display of measuring value and operation menu

B - Key Set
- Access to operation menu
- In the selection menu entering the selected sub menu
- In the set menu applying the new value

C - Key Change
- Change between sub menu
- Cancel value input without applying
- Changeover the counter advance sense of the key +/- from + resp. increasing to - resp. decreasing.

D - Key +/-
- Value changing by + resp. increasing or - resp. decreasing. The counter advance sense is at first always + resp. increasing. Change counter advance sense by the key Change.
- Change setting in a selection menu

E - Unit LED
- Indication unit by green LED

F - Error indication LED
- Indication abnormal behavior by red LED

G - Operation LED
- Indication ready status by green LED

H - Switch condition LED
- Indication of an active switch output by the respective yellow LED

5.2 Function modes

5.2.1 Run mode

The device records the applied physical measurand and proceeds the chosen functions according to the set parameter.

The active operation is confirmed by the green operation LED.

The measuring value is displayed in the display window.

The chosen unit is marked through the come on of the respective green unit LED.

The current output and the switch outputs and are driven.

A turned on switch output is signaled by the come on of the respective yellow switch condition LED.

The exceedance of the frame specifications, abnormal operation conditions and also device malfunctions are displayed by the red error indication LED.

5.2.2 Programming mode

Access to the function menus by the key Set.

- In the switch function menu – password 1903 – all the adjustable parameter and functions are chosen especially for the use of the device as switch.
- In the transmitter function menu – password 3009 – all the adjustable parameter and functions are chosen especially for the use of the device as transmitter by using the current output.
- In the switch point menu – password 1111 – only switch resp. switch back point of the PNP switch output resp. outputs are accessible for fast adjustment. The function of the switch outputs can be displayed.

5.3 Switch output S1 / S2

5.3.1 Switch point / Reset switch point

The input values refer to the current measuring value or acc. to display scaling.
The reset switch point must be lower or equal to the switch point.
For both switch functions, there is no default minimum difference (hysteresis) between switch resp. switch back point resp. between upper and lower switch point.
If the switch back point is set higher or equal to the switch point resp. the lower switch point is set higher or equal to the upper switch point the switch back point is set automatically to the switch point resp. the lower switch point is set automatically to the upper switch point.
The red error indication LED is flashing.
In the error memory service (SEr) / error memory (ErrM) there will be the indication of the concerning switch output (S1oG or S2oG).

5.3.2 Switch delay time / Reset switch delay time

The activation resp. deactivation of the switch output can be biased with a delay time (resolution 0,1s), to realize simple sequence control system.

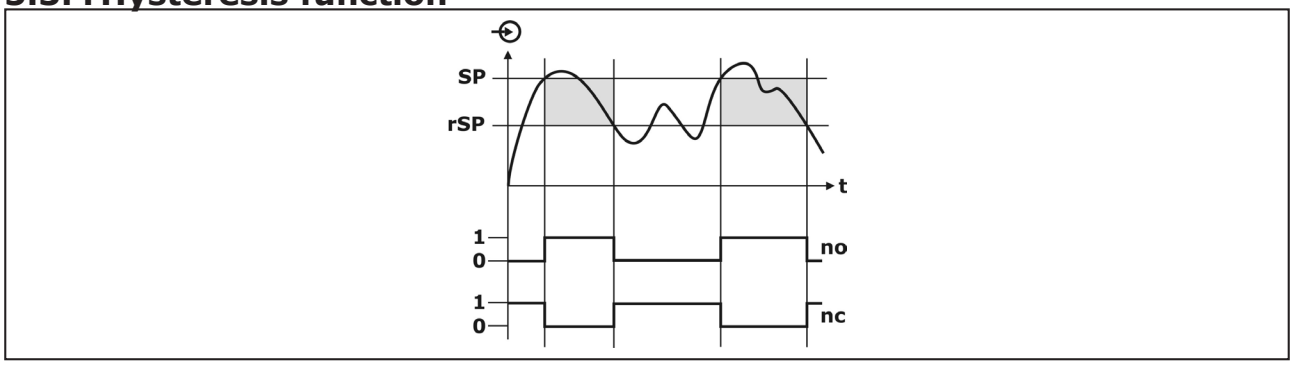
5.3.3 Operating mode

The operating mode defines the function direction of the switch output.

Normal Open / NO
- At the output there is no signal, if the switch condition is not fulfilled.
- At the output there is a signal, if the switch condition is fulfilled.

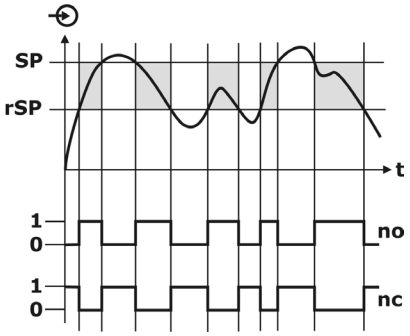
Normal Close / NC
- At the output there is a signal, if the switch condition is not fulfilled.
- At the output there is no signal, if the switch condition is fulfilled.

5.3.4 Hysteresis function



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 input the switch point and switch back point.
The switch output is activated, if the current measuring value exceeds the switch point and if the set switch point delay time has been expired.
The switch output is deactivated, if the current measuring value exceeds the reset switch point and if the set reset switch point delay time has been expired.
The actual applied measuring signal can be applied or an arbitrary value can be set as switch resp. switch back point.

5.3.5 Window function



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 input the switch point and switch back point.
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 actual applied measuring signal can be applied or an arbitrary value can be set as switch resp. switch back point.

5.3.6 Error indication function

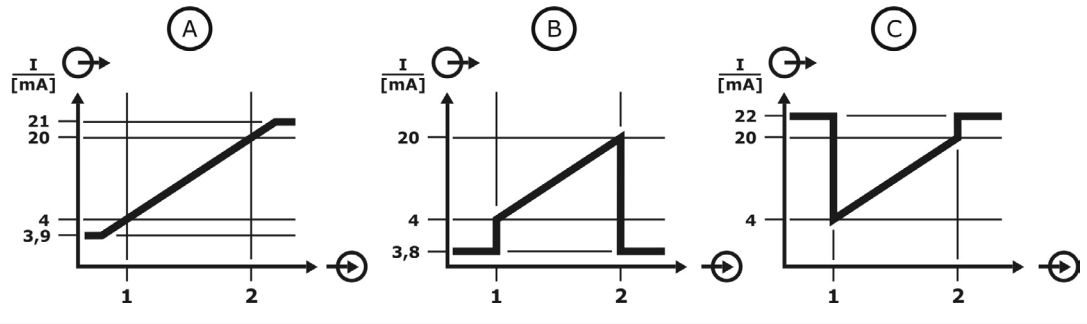
The switch output S1 can be alternatively used for error indication function. Doing this a switch action happens, if the output current becomes higher than 20mA resp. lower than 4mA.

5.4 Current output

The nominal values of the current output (4mA/20 mA) refers to the set signal zero and signal end value.

5.4.1 Error signal

Defines the current output regarding operating range and if errors are registered.



A - Off >> 3.9-21mA
B - 3.8mA
C - 22mA

5.4.2 Invert signal

Inverts the current output.

- 4-20mA >> 20-4mA

5.5 Self-supervising function

5.5.1 Drift monitoring function

The drift monitoring function is only adjustable at devices with option self-supervising.

Each sensor element that is used for the recording of temperatures has the unavoidable characteristic a specific behavior concerning long term drift and ageing.
This behavior is very similar if not identically at physically equal-type sensor elements like e.g. multiple resistive sensors Pt100.
At physically different sensor elements like resistive sensors Pt100 and semiconductor sensors or also NTC however these characteristics are serious different.

In the tip of the sensor tube are two physically different sensor elements mounted thermal coupled. For the realizing of a reliable drift supervising a different drift behavior of the two sensor elements is necessary.
Therefore e.g. not two resistive sensors Pt100 are uses, but only one resistive sensor element Pt100 and a semiconductor sensor element.

Under nominal conditions the temperature measuring values, which are recorded by the sensor elements and transmitted to the processor are identically. Because of the not exactly identical position of both sensor elements within the sensor tube, the installation position of the sensor tube and the present process conditions temperature differences of up to ±0,1K can occur, already at a new device. This does not affect the function of the drift supervision concerning ageing.

Because of the use of two physically different sensor elements it is guaranteed, that the ageing conditioned characteristic drift of both sensor elements is different. At the occurring of an ageing conditioned characteristic drift in one or also in both sensor elements the difference between the temperature measuring values of both sensor elements increases.

The detected difference between the temperature measuring values is compared with the set drift response value (drAL) by the processor.
If the temperature difference between the temperature measuring values transgresses the set drift response value (drAL), the drift alarm will be registered in the error memory (ErrM), the red error indication LED starts flashing and the switch output 1, if configured for error function, will be activated corresponding to the settings in normally open or normally closed function.
The display and the current output generate furthermore a temperature proportional signal, referring to the temperature measuring value of the primary sensor element, the resistive sensor Pt100. The switch outputs, which are configured for normal function, refers also to this temperature measuring values.

Because of the different response time of the two sensor elements, at fast and strong temperature fluctuations in the measured medium, e.g. at filling a hot medium in a cold container, it can come to short time differences between the two temperature measuring values that are higher than the set drift response value (drAL).
A wrong drift alarm would be detected.
For the compensation of such wrong behaviors a drift delay time (drd) can be set.
Due to this a drift alarm will only be detected, if after the transgression of the drift response value (drAL) and after the set drift delay time (drd) the set drift response value (drAL) is already transgressed.

5.5.2 Redundancy function

The redundancy function is only adjustable at devices with option self-supervising.

The display, the switching output resp. outputs and the current output refers principally to the temperature measuring value of the primary sensor element, the resistive sensor Pt100.

In the case of a short circuit or a wire break of the primary sensor element, the resistive sensor Pt100 there is the possibility to continue the measurement automatically with the secondary sensor element, the semiconductor sensor.

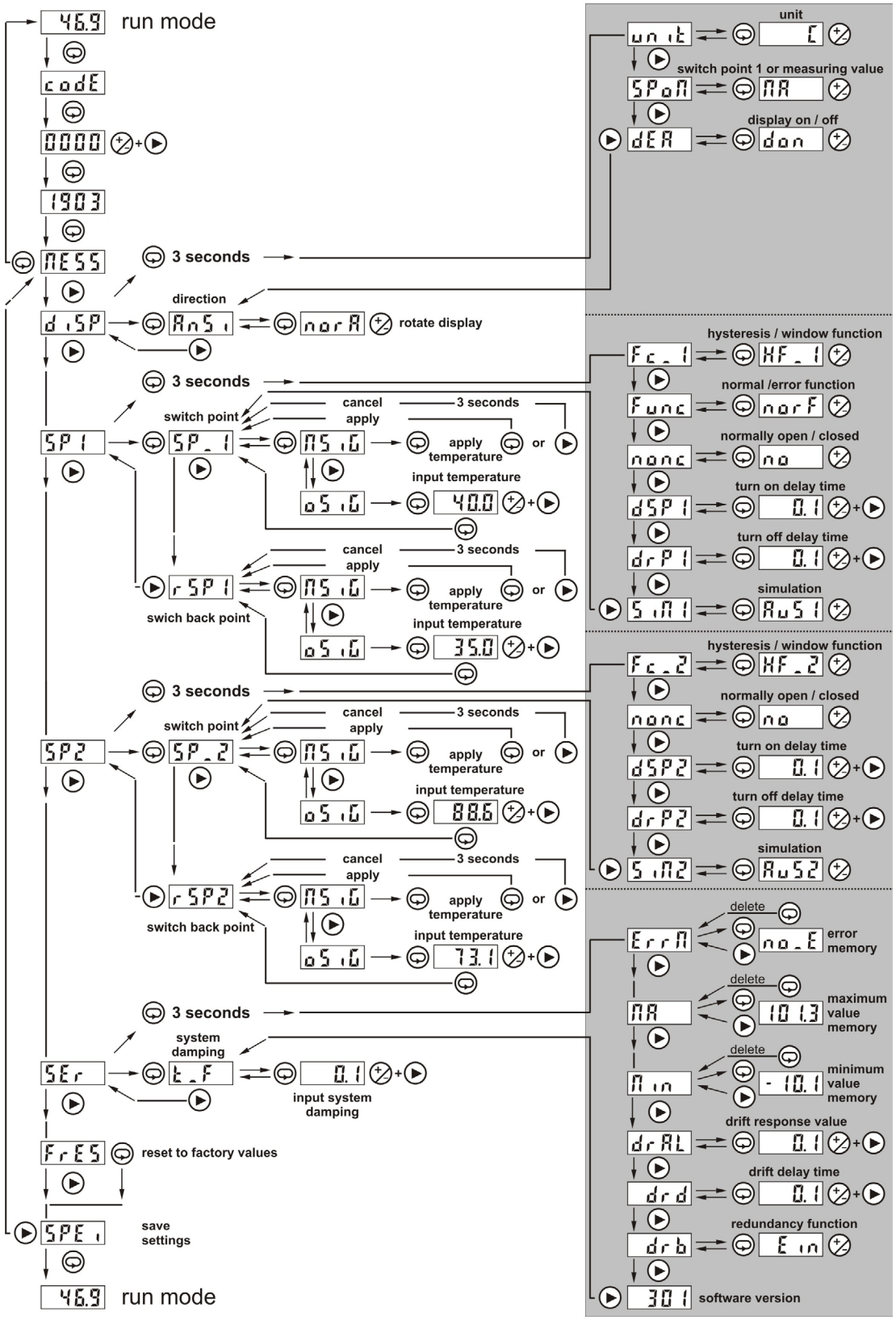
The display, the switching output resp. outputs and the current output refers now to the temperature measuring value of the secondary sensor element, the semiconductor sensor.

A drift monitoring is not possible in the case of the failure of one of the two sensor elements.

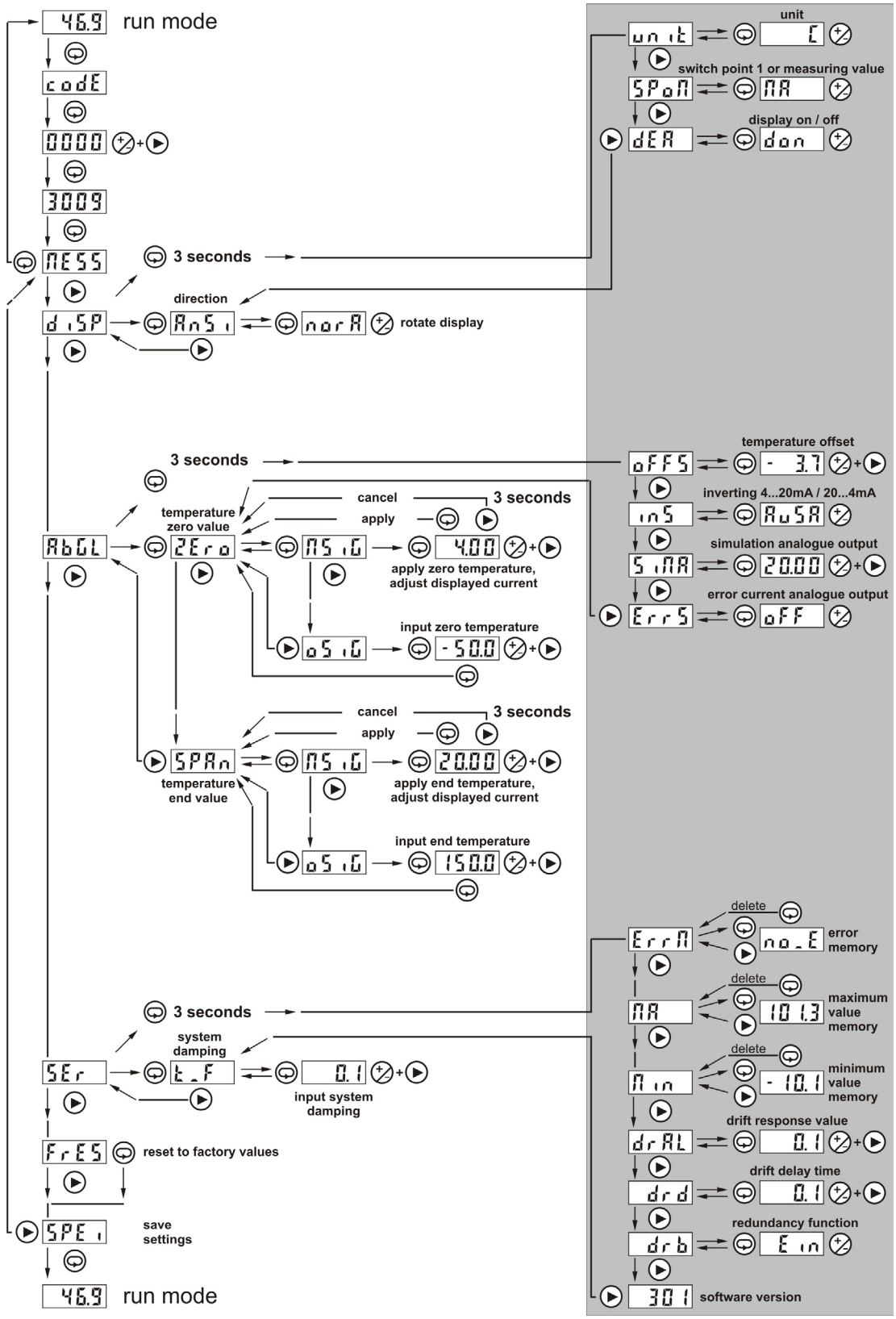
The behavior of the temperature switch in the case of the failure of the primary sensor Pt100 resp. the activation of the redundancy function is made by the parameter (drb).

5.6 Menu structure

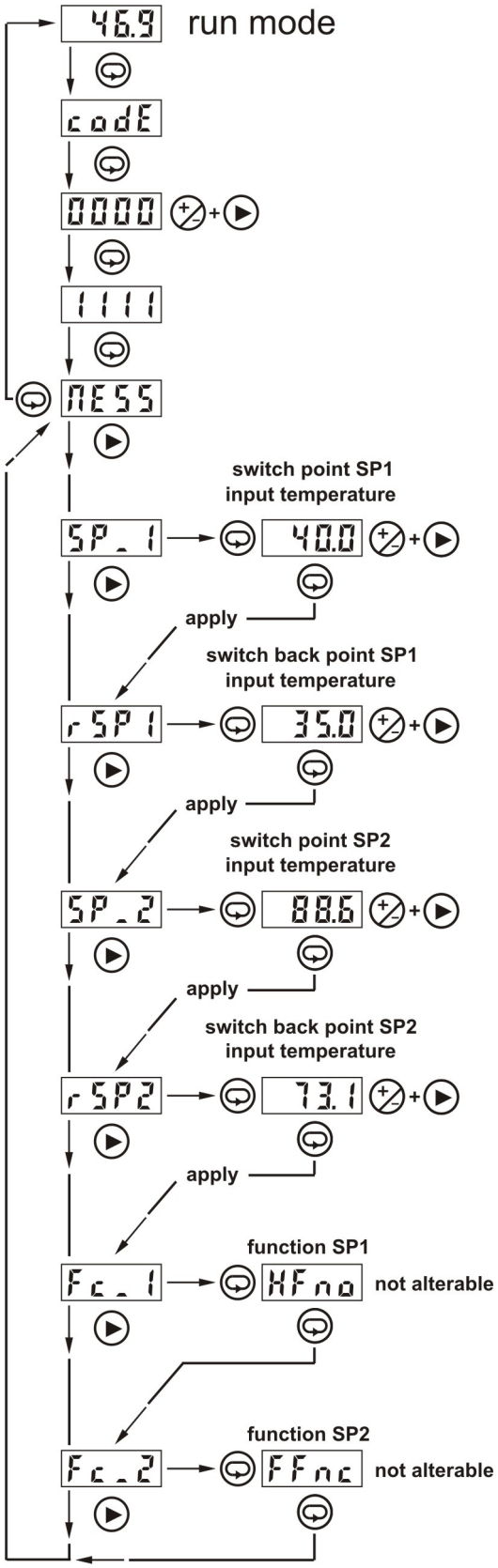
5.6.1 Menu structure switch function - password 1903



5.6.2 Menu structure transmitter function - password 3009



5.6.3 Menu structure switch point - password 1111



5.7 Parameter overview

Menu group	Function	Input	Description
code		3009	Password input for the access to the transmitter function menu
		1903	Password input for the access to the switch function menu
		1111	Password input for the access to the switch point menu

Menu group	Function	Input	Description
diSP			DISPLAY – includes all parameters concerning the display
	AnSi	norA	View normal
		GEdA	View rotated by 180°
	Unit	C	Unit °C
		K	Unit °K
		F	Unit °F
	SPon	MA	Display measuring value - the actual measuring value is shown in the display
		SPA	Display switch value - the upper limit value of the switch point 1 is shown in the display
	dEA	don	Display indication on – measurement value and status LED are indicated
		doFF	Display indication off – measurement value and unit LED are deactivated in the run mode. The operation, error and switch condition indicator LED are still in process. When accessing the password input by simultaneous pushing the two operation keys +/- and > for three seconds, the complete display is switched on again.

Menu group	Function	Input	Description
SP1			Switch output 1 – includes all parameters concerning the switch output 1
	SP_1	MSiG	Adjustment with applied signal – The actual applied temperature value is captured as switch point resp. upper switch point
		oSiG	Adjustment without applied signal – The actual switch point / upper switch point is shown in the display and can now be adjusted by the operation keys +/- and >.
	rSP1	MSiG	Adjustment with applied signal – The actual applied temperature value is captured as switch back point resp. lower switch point
		oSiG	Adjustment without applied signal – The actual switch back point / lower switch point is shown in the display and can now be adjusted by the operation keys +/- and >.
	Fc_1	HF_1	The switch output 1 operates in hysteresis function with switch point and switch back point
		FF_1	The switch output 1 operates in window function with lower and upper switch point
	Func	norF	Normal function – The switch output 1 operates in hysteresis or in window function
		ErrF	Error indication function – The switch output 1 operates in error indication function for the current output. At underrun of 4mA resp. at exceedance of 20mA, the switch output 1 is activated depending on the settings as closed-circuit or as open-circuit.
	nonc	no	The switch output 1 operates in open-circuit principle resp. – no normally open
		nc	The switch output 1 operates in closed-circuit principle resp. – nc normally closed
	dSP1		Switch delay time for switch point / upper switch point of switching output 1. The switching output 1 is only activated, if after the entrance of the switch condition and after the set switch delay time the temperature signal already fulfills the switch conditions. By this e.g. temperature fluctuations can be eliminated. The adjustment range is 0...99 seconds, in steps of 0,1 seconds
	drP1		Switch delay time for switch back point / lower switch point of switching output 1. The switch output 1 is only activated, if after the entrance of the switch back condition and after the set switch delay time the temperature signal already fulfills the switch back conditions. By this e.g. temperature fluctuations can be eliminated. The adjustment range is 0...99 seconds, in steps of 0,1 seconds
	SiM1	AuS1	Simulation – the switch output 1 is deactivated
		Ein1	Simulation – the switch output 1 is activated

Menu group	Function	Input	Description
SP2			Switch output 2 – includes all parameters concerning the switch output 2
	SP_2	MSIG	Adjustment with applied signal – The actual applied temperature value is captured as switch point resp. upper switch point
		oSIG	Adjustment without applied signal – The actual switch point / upper switch point is shown in the display and can now be adjusted by the operation keys +/- and >.
	rSP2	MSIG	Adjustment with applied signal – The actual applied temperature value is captured as switch back point resp. lower switch point
		oSIG	Adjustment without applied signal – The actual switch back point / lower switch point is shown in the display and can now be adjusted by the operation keys +/- and >.
	Fc_2	HF_2	The switch output 2 operates in hysteresis function with switch point and switch back point
		FF_2	The switch output 2 operates in window function with lower and upper switch point
	nonc	no	The switch output 2 operates in open-circuit principle resp. – no normally open
		nc	The switch output 2 operates in closed-circuit principle resp. – nc normally closed
	dSP2		Switch delay time for switch point / upper switch point of switching output 2. The switch output 2 is only activated, if after the entrance of the switch condition and after the set switch delay time the temperature signal already fulfills the switch conditions. By this e.g. temperature fluctuations can be eliminated. The adjustment range is 0...99 seconds, in steps of 0,1 seconds
	drP2		Switch delay time for switch back point / lower switch point of switching output 2. The switch output 2 is only activated, if after the entrance of the switch back condition and after the set switch delay time the temperature signal already fulfills the switch back conditions. By this e.g. temperature fluctuations can be eliminated. The adjustment range is 0...99 seconds, in steps of 0,1 seconds
	SIM2	AuS2	Simulation – the switch output 2 is deactivated
		EIN2	Simulation – the switch output 2 is activated

Menu group	Function	Input	Description
AbGL			Adjustment – includes all parameters concerning the temperature adjustment
	2Ero	MSIG	Adjustment lower temperature reference value with applied signal - The actual applied temperature value is captured as lower temperature reference value. - The output current of 4mA, that can be adjusted by the control keys +/- and > arbitrarily, is assigned to this temperature reference value. Adjustment range 3,9mA to 21mA. - If the adjusted measuring range is lower than 25% of the nominal measuring range, the change will be refused and the display shows EEEE. - An already set offset will be regarded at the adjustment.
		oSIG	Adjustment lower temperature reference value without applied signal - The freely adjustable pressure value, in the set unit - Unit-, is captured as lower temperature reference value. - The lower output current end value, 4mA, refers to this pressure reference value. - The measuring span cannot be adjusted lower than 25% of the nominal measuring range. - An already set offset will be regarded at the adjustment.
	SPAn	MSIG	Adjustment upper temperature reference value with applied signal - The actual applied temperature value is captured as upper temperature reference value. - The output current of 20mA, that can be adjusted by the control keys +/- and > arbitrarily, is assigned to this temperature reference value. Adjustment range 3,9mA to 21mA. - If the adjusted measuring range is lower than 25% of the nominal measuring range, the change will be refused and the display shows EEEE. - An already set offset will be regarded at the adjustment.
		oSIG	Adjustment upper pressure reference value without applied signal - The freely adjustable pressure value, in the set unit - Unit-, is captured as upper pressure reference value. - The upper output current end value, 20mA, refers to this pressure reference value. - The measuring span cannot be adjusted lower than 25% of the nominal measuring range. - An already set offset will be regarded at the adjustment.
	oFFS		The temperature measuring value can be shift by an offset of up to □ 25°C. This can be necessary in unfavorable installation situations or at considerable temperature differences between medium and measurement position.
	inS	AUSA	The output current corresponds to the assignment of the adjustment >> 4...20mA
		EINA	The output current behaves inverted to the assignment of the adjustment >> 20...4mA
	SIMA		The current output can be arbitrarily simulated in the whole utilizable range from 3,8mA to 22mA by using the operation keys +/- and >.
	ErrS	oFF	The current output operates linear in the range from 3,9mA to 21,0mA. A current output besides this limits is not possible, the end values are kept at exceedance. An error current output at underrun resp. exceedance does not occur.
		FS38	The current output operates linear in the range from 4,0mA to 20,0mA. At underrun of 4mA resp. at exceedance of 20mA a constant current of 3,8mA is generated.
		FS22	The current output operates linear in the range from 4,0mA to 20,0mA. At underrun of 4mA resp. at exceedance of 20mA a constant current of 22mA is generated.

Menu group	Function	Input	Description
SEr			Service – includes all parameters concerning service purposes
	t_F		Input of the system damping for reassuring of cyclic fluctuating temperature signals. The adjustment range is 0...40 seconds, in steps of 0,1 seconds
	ErrM	noE	No error recorded in the error memory.
		brch	A wire break at the internal connections of the sensor element has been detected.
		Kur	A short circuit at the internal connections of the sensor element has been detected
		FLAS	An error in the internal nonvolatile data memory (flash) has been detected.
		Munt	The lower measuring range limit value (display zero) has been underrun.
		MuEb	The upper measuring range limit value (display span) has been exceeded.
		Aunt	The lower limit value of the current output (3,9mA) has been underrun.
		AuEb	The upper limit value of the current output (21mA) has been exceeded.
		S1oG	The switch back point rSP1 of the switch output 1 has been adjusted higher or equal to the switch point SP_1.
		S2oG	The switch back point rSP2 of the switch output 2 has been adjusted higher or equal to the switch point SP_2.
		S1oP	The switch output 1 is not activated, although it should be.
		S2oP	The switch output 2 is not activated, although it should be.
		rAM	An error in the internal working memory (RAM) has been detected.
		drFt	The exceedance of the set drift threshold value has been detected.
	MA		Maximum value memory – display of the highest measured temperature value.
	Min		Minimum value memory – display of the lowest measured temperature value.
	drAL		A drift alarm is only made, if the set drift threshold value, the difference between the temperature measuring values of the two sensor elements, has been exceeded. The adjustment range is 0,2...5 K, in steps of 0,1K.
	drd		A drift alarm is only made, if after the exceedance of the drift threshold value and after the set drift delay time the drift threshold value has been already exceeded. By this, e.g. the different response time of the two sensor elements at temperature deviations can be compensated. The adjustment range is 0...300 seconds, in steps of 1 second.
	drb	AUS	The redundancy function is deactivated
		Ein	The redundancy function is activated. At the failure of the sensor element Pt100 the measuring is continued with the semiconductor sensor element.
	301		Version number of the installed firmware
FrES			Factory Reset – reset of all parameters to factory values
SPEi			Storage – loss protected storage of all parameters

Menu group	Function	Input	Description
Switch point menu			
SP_1			The current switch point / upper switch point of switch output 1is shown in the display and can be adjusted by the control keys +/- and >.
rSP1			The current switch back point / lower switch point of switch output 1 is shown in the display and can be adjusted by the control keys +/- and >.
SP_2			The current switch point / upper switch point of switch output 2 is shown in the display and can be adjusted by the control keys +/- and >.
rSP2			The current switch back point / lower switch point of switch output 2 is shown in the display and can be adjusted by the control keys +/- and >.
Fc_1			The set switch function of the switch output 1 is displayed. This setting cannot be changed here.
		HFno	The switch output 1 operates in hysteresis function with working principle normal open
		HFnc	The switch output 1 operates in hysteresis function with working principle normal closed
		FFno	The switch output 1 operates in window function with working principle normal open
		FFnc	The switch output 1 operates in window function with working principle normal closed
Fc_2			The set switch function of the switch output 2 is displayed. This setting cannot be changed here.
		HFno	The switch output 2 operates in hysteresis function with working principle normal open
		HFnc	The switch output 2 operates in hysteresis function with working principle normal closed
		FFno	The switch output 2 operates in window function with working principle normal open
		FFnc	The switch output 2 operates in window function with working principle normal closed

5.8 Error indication at operation

The red error indication LED indicates the exceedance of operation limit values, faulty inputs or also device errors.
The information, what reason has led to an error indication can be found in each of the two function menus in the area extended functions of the menu point service.
Only the last detected error is displayed.
The error information in the service menu is not stored in the case of a voltage fail.
At every restart of the device the system is completely tested concerning the parameters and settings.

LED	error indication in service menu	description / remedy
red yellow – flashing	no	Short circuit at the switch output, whose yellow switch condition LED is flashing. Check the load at the respective switch output.
red	brch	The internal self-supervision has detected a wire break of the sensor element Pt100. If the error cannot be removed after repeated restart of the device by short voltage interrupts, there can be an irreversible device defect. By using the redundancy function it can be switched to the second sensor.
red	Kur	The internal self-supervision has detected a short circuit of the sensor element Pt100. If the error cannot be removed after repeated restart of the device by short voltage interrupts, there can be an irreversible device defect. By using the redundancy function it can be switched to the second sensor.
red	FLAS	An error in the internal nonvolatile data memory (flash) has been detected. If the error cannot be removed after repeated restart of the device by short voltage interrupts, there can be an irreversible device defect.
red – flashing	Munt	The lower measuring range limit value has been underrun. Check the system temperature of your plant. This temperature may be lower than the measuring range zero value.
red – flashing	MuEb	The upper measuring range limit value has been exceeded. Check the system temperature of your plant. This temperature may be higher than the measuring range end value.
red – flashing	Aunt	The lower limit value of the current output (3,9mA) has been underrun. Check the adjustment of the current output. The system temperature is lower than the temperature concerning to the current output at 3,9mA.
red – flashing	AuEb	The upper limit value of the current output (21mA) has been exceeded. Check the adjustment of the current output. The system temperature is higher than the temperature concerning to the current output at 21mA.
red – flashing	S1oG	The switch back point rSP1 of the switch output 1 has been adjusted higher or equal to the switch point SP_1. Check the adjustment of the switch output 1
red – flashing	S2oG	The switch back point rSP2 of the switch output 2 has been adjusted higher or equal to the switch point SP_2. Check the adjustment of the switch output 2
red – flashing	S1oP	An error has been detected at switch output 1. Detach the output load of the switch output 1. If the error cannot be removed after repeated restart of the device by short voltage interrupts, there can be an irreversible device defect.
red – flashing	S2oP	An error has been detected at switch output 2. Detach the output load of the switch output 2. If the error cannot be removed after repeated restart of the device by short voltage interrupts, there can be an irreversible device defect.
red – flashing	rAM	An error in the internal working memory (RAM) has been detected. If the error cannot be removed after repeated restart of the device by short voltage interrupts, there can be an irreversible device defect.
red – flashing	drFt	The transgression of the set drift threshold value has been detected. Increase the drift threshold value or the drift delay time. Replace, if necessary, the temperature switch.
EEEE	Display while operation	Wrong password entered – Acknowledgment by control key „Set“ Measuring range adjusted to ≤25% of the nominal range – Readjustment necessary Maximum display value of 9999 has been exceeded – Readjustment necessary
-EEE	Display while operation	Minimum display value of -999 has been underrun – Readjustment necessary

5.9 Software history

Version	Date	Modifications
3.01	03/2016	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	10,5…35V_{DC}, reverse polarity protected
Residual ripple U_{PP}	≤ 2V_{PP} / U_{Smin} ≤ U_S ≤ U_{Smax}
Supply current I_{In}	≤ 60mA Current output max. 22,5mA Switch output with no load

7.2 Output

7.2.1 Analogue output – current 4...20mA

Operating range I_{Out}	3,9…21mA, min. 3,8mA, max. 22mA
Permitted load R_L	≤ (U_S - 10,5V) / 20mA
Step response time T_{90}	≤ 3ms (t_d = 0s)
Start-up time t_{On}	≤ 1s

7.2.2 Switch output S1 / S2

Function	PNP switch to +L
Output voltage U_{Out}	U_{Out} ≥ U_S – 2V
Output current I_L	0… ≤ 200mA, current limited, short circuit protected
Step response time T_{90}	≤ 4ms (t_d = 0s)
Rise time T_{90}	< 30µs (R_L < 3kR / I_{Out} > 4,5mA)
Start-up time t_{On}	≤ 1s
Switch cycles	≥ 100.000.000

7.3 Measuring accuracy

Reference conditions	EN/IEC 60770-1	
	Environmental temperature	25°C
	Environmental air pressure	860..1060kPa
	Air humidity	45...75% r.h.
	Warm-up time t_{On}	240s
	Supply voltage U_S	24V_{DC} ±0,1V
	Calibration position	Vertical Process connection bottom

Characteristic deviation [3) 5) 8)]	*Display / Switch output* ≤ ±(0,4K + 0,002 * [t]) [t] = process temperature in °C, no sign, unit K ≤ ±0,6% FS [2)]
	Current output ≤ ±(characteristic dev. display / switch output + 0,1% FS [2)]) ≤ ±0,9Kat ±100°C / meas. range –99,9..+200°C / TD [7)]=1
Characteristic deviation [3) 5) 8)] Type self-supervision	*Display / Switch output* ≤ ±0,2K
	Current output ≤ ±0,4K
	Drift monitoring ≤ ±0,2K
Repeatability [6) 8)]	≤ ±0,1% FS [2)]
Influence of supply voltage	≤ ±0,002% FS [2)] / V
Long term drift [6) 8)]	≤ ±0,1% FS [2)] / year
Temperature deviation [6) 8)]	*Display / Switch output* ≤ ±0,003% FS [2)] / K
	Current output ≤ ±0,008% FS [2)] / K
Response time [9)]	t90 ≤10s sensor tube tip diameter 6mm t90 ≤14s sensor tube tip diameter 8mm t90 ≤17s sensor tube tip diameter 10mm

[2)] Referring to nominal measuring span resp. full scale (FS)
[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 ≤ nominal measuring range) = specification at nominal measuring range x TD [7)]
[7)] Turn-Down TD = nominal measuring range (FS [2)]) / adjusted measuring range)
[8)]At reference conditions
[9)]Acc. to DIN EN 60751 / water / 0,4 m/s / temperature step 23 to 33°C

7.4 Process conditions

Process temperature The permitted range results from the narrowest limitation of standard range resp. extended range.	*Measuring range type 2* -99,9°C…+200°C, max. -103°C…230°C
	Measuring range type 3 -99,9°C…+500°C, max. -130°C…530°C
	Measuring range type 4 -50°C…+175°C, max. -55°C…+180°C
	Limitation Prozessanschluss Typ 6 – ≤ +250°C
Process pressure	*Process connection type 6* ≤ 50 bar
	Process connection type F / O / R / P ≤ 40 bar
	Process connection type G / N / M / T ≤ 25 bar

7.5 Environmental conditions

Environmental temperature	-40°C...+85°C
Protection	IP65/IP67 (EN/IEC 60529)
Climatic classification	4K4H (EN/IEC 60721-3-4)
Shock classification	50g [11ms] (EN/IEC 60068-2-27)
Vibration classification	10g (L1/L2 ≤ 100mm) [10…2000 Hz] (EN/IEC 60068-2-6) 2g (L1/L2 > 100mm) [10…2000 Hz] (EN/IEC 60068-2-6)
EM compatibility	Operation device class B / Industrial range (EN/IEC 61326)
Tightening torque	*Process connection type 6* ≥ 5Nm … ≤ 20Nm
Weight	0,35kg (L1=100mm/L2=0mm)

7.6 Materials - process wetted

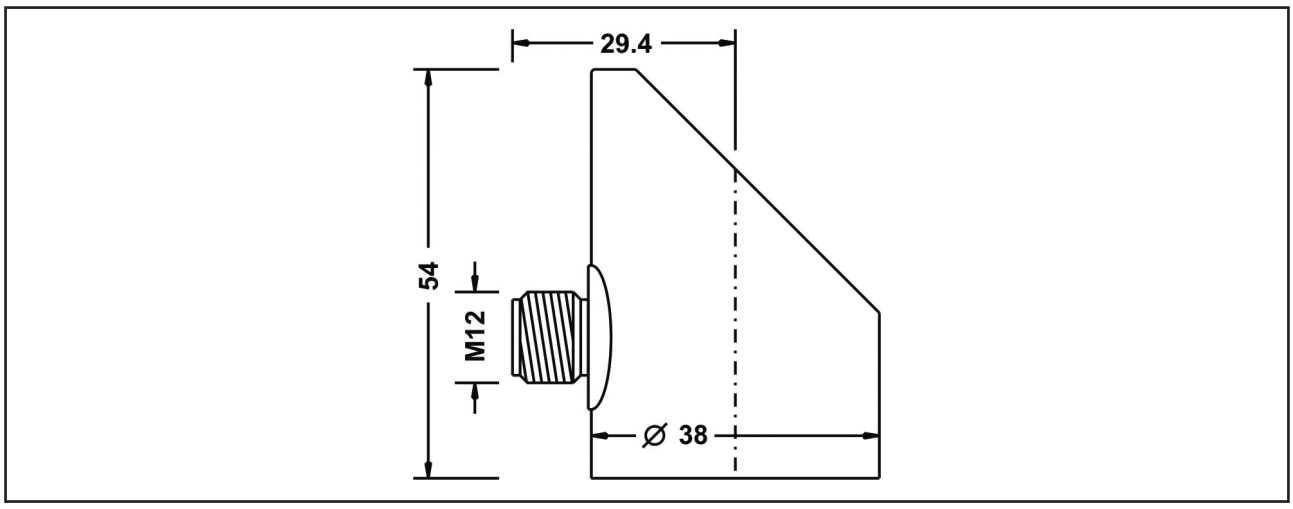
Sensor tube	Steel 1.4404/316L Steel 1.4571/316Ti
Process connection	Steel 1.4404/316L Steel 1.4571/316Ti
Surface quality	Ra < 0,8µm

7.7 Materials - not process wetted

Neck tube	CrNi-steel
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®)

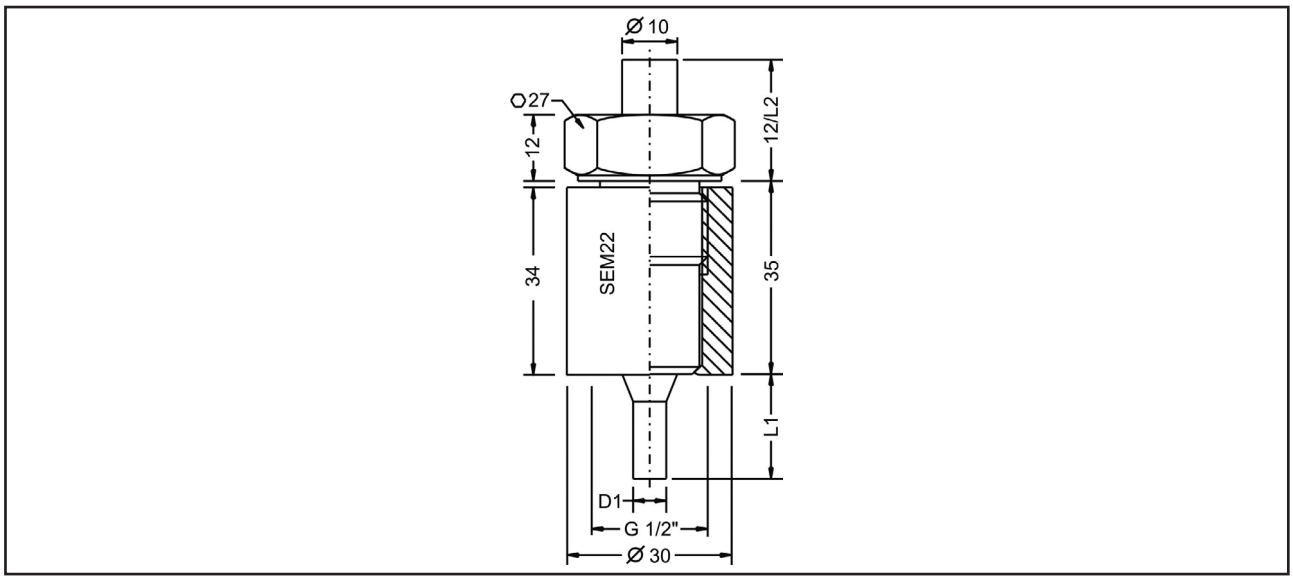
8 Dimension drawings

8.1 Terminal enclosure

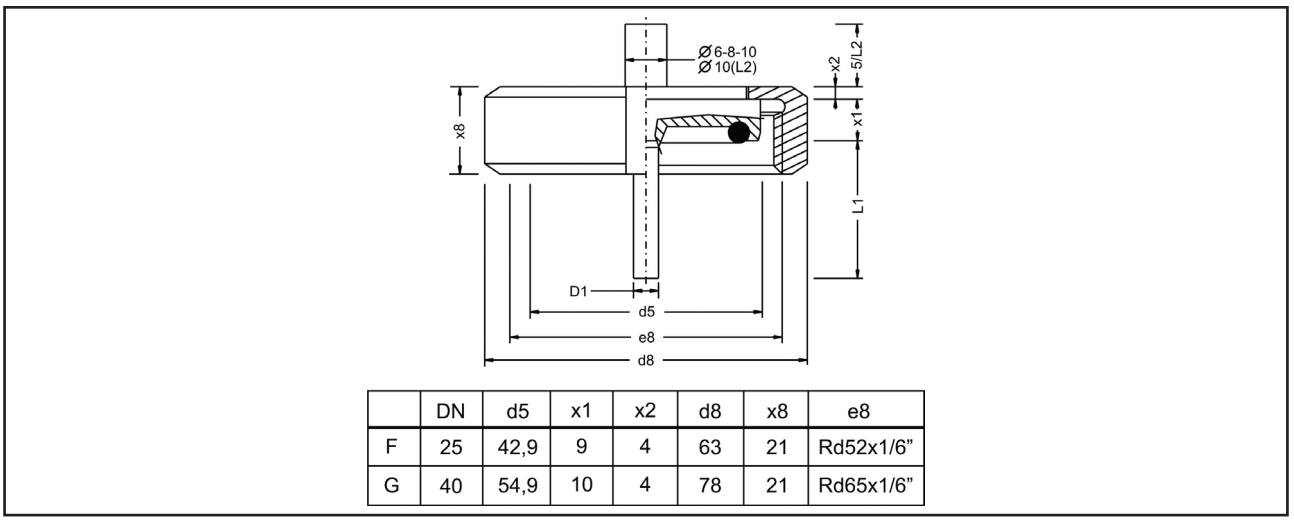


8.2 Process connection

Type 6 – Thread ISO 228-1 – G½"B, metallic elastomer-free sealing

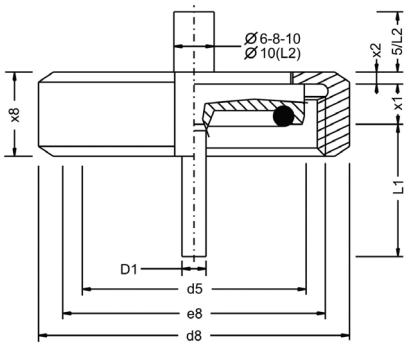


Type F – Aseptic tube coupling DIN 11864-1-A – DN25, PN40



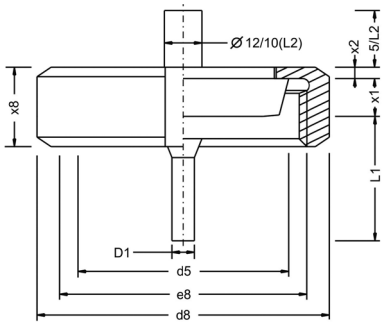
	DN	d5	x1	x2	d8	x8	e8
F	25	42,9	9	4	63	21	Rd52x1/6"
G	40	54,9	10	4	78	21	Rd65x1/6"

Type G – Aseptic tube coupling DIN 11864-1-A – DN40, PN25



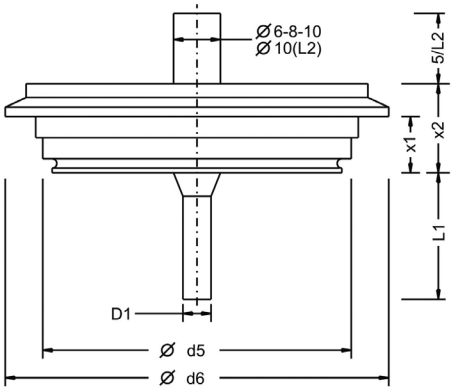
	DN	d5	x1	x2	d8	x8	e8
F	25	42,9	9	4	63	21	Rd52x1/6”
G	40	54,9	10	4	78	21	Rd65x1/6”

Type O – Dairy coupling DIN 11851 – DN25, PN40
Type N – Dairy coupling DIN 11851 – DN40, PN40
Type M – Dairy coupling DIN 11851 – DN50, PN25



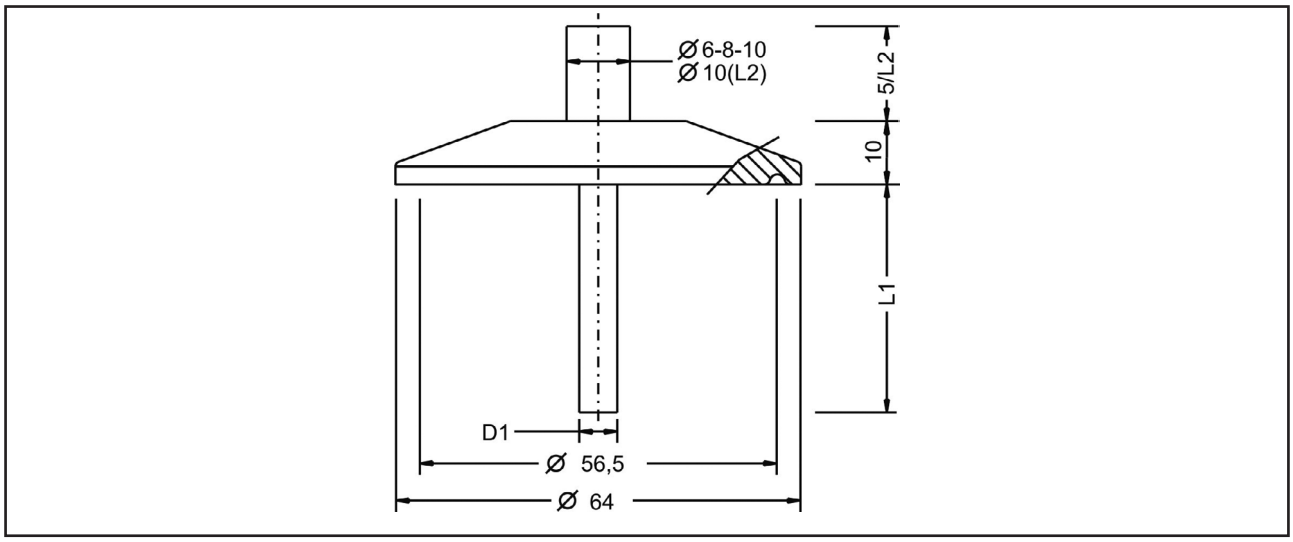
	DN	d5	x1	x2	d8	x8	e8
O	25	44	10	4	63	21	Rd52x1/6”
N	40	56	10	4	78	21	Rd65x1/6”
M	50	68	11	3	92	22	Rd78x1/6”

Type R – Varivent® – Type F / tube DN25-32 / 1”-1¼”, PN40
Type P – Varivent® – Type N / tube DN40-162 / 1½”-6”, PN40

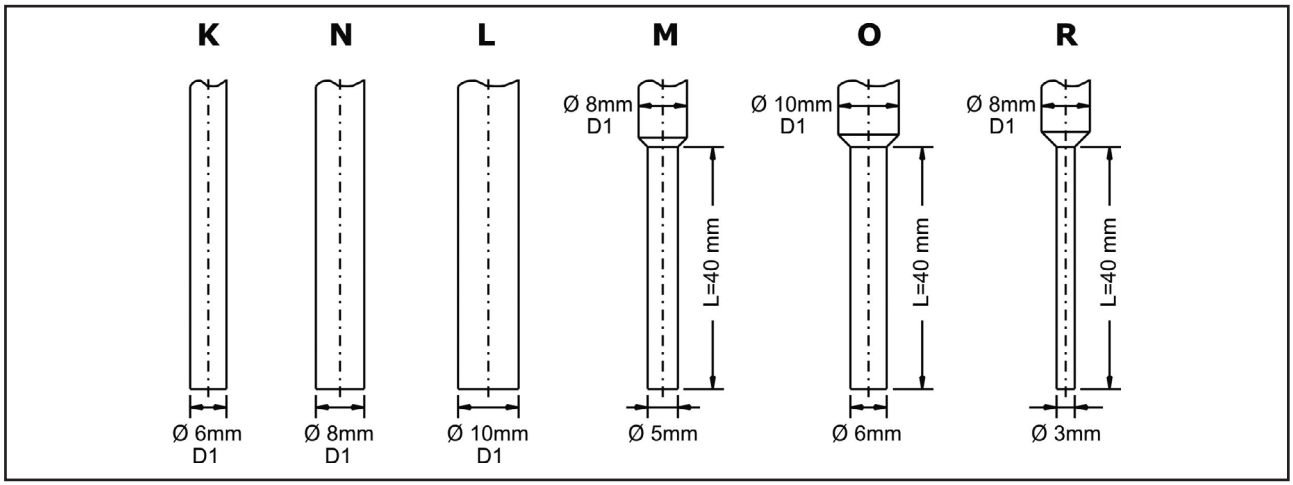


	Varivent	DN	d5	d6	x1	x2
R	F	25-32	50	66	12	19
P	N	40-162	68	84	12	19

Type T – Clamp ISO 2852 – DN40-51 / BS 4825 – 2" / DIN 32676 – DN50, PN25



8.3 Sensor tube



9 Ordering information

9.1 Order code

Type
TS4L Hygienic applications

Measuring system
S Resistance sensor Pt100-A
D Resistance sensor Pt100-A / semiconductor sensor, self-supervision function

Approval
S Standard

Process connection
6 Thread ISO228-1 – G½"B, metallic elastomer-free sealing (socket SEM-22/SEM-42)
F Aseptic tube coupling DIN 11864-1-A – DN25, PN40
G Aseptic tube coupling DIN 11864-1-A – DN40, PN25
O Dairy coupling DIN 11851 – DN25, PN40
N Dairy coupling DIN 11851 – DN40, PN40
M Dairy coupling DIN 11851 – DN50, PN25
R Varivent® – Type F / tube DN25-32 / 1"-1¼", PN40
P Varivent® – Type N / tube DN40-162 / 1½"-6", PN40
T Clamp ISO 2852 – DN40-51 / BS 4825 – 2" / DIN 32676 – DN50, PN25
Y others

Sensor tube material / diameter (process wetted)
K CrNi-steel, Ø6mm
N CrNi-steel, Ø8mm
L CrNi-steel, Ø10mm
M CrNi-steel, Ø8mm, tip Ø5mm / L 40 mm – only measuring system type S
O CrNi-steel, Ø10mm, tip Ø6mm / L 40 mm
R CrNi-steel, Ø8mm, tip Ø3mm / L 40 mm – only measuring system type S
Y others

Neck tube
0 without
1 Neck tube, standard L2 = 100mm
Y Neck tube, other length L2

Material terminal enclosure
C CrNi-steel

Measuring range
2 –99,9 … +200°C – measuring system type S
3 –99,9 … +500°C – measuring system type S
4 –50°C … +175°C – measuring system type D
Y Special measuring range

Electronic – output
A 2x switch PNP, supply 24VDC
B 1x switch PNP, 1x signal 4…20mA , supply 24VDC
C 2x switch PNP, 1x signal 4…20mA, supply 24VDC
D 1x switch PNP, 1x signal 4…20mA, supply 24VDC, Desina

Electronic – function
S Standard

Electrical connection
S Plug M12x1

Length L1 – Sensor tube / mm (L1 ≤ 2000mm)

Length L2 – Neck tube / mm (L2 ≤ 200mm)

Thermocont	TS4L		S				C			S	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
- 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.

- Compression fittings
- Screw-on sockets
- Welding sockets
- Welding flanges
- Blind flanges
- Flanges with thread
- Reductions
- Tube nuts
- 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

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

Cable box M12x1

- BKZ0412-VA 4-pole
- BKZ0512-VA 5-pole

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