

OPERATING MANUAL - BA09.22

Thermocont TK4SS

Ultra-compact temperature sensor
with resistance sensor Pt-platinum



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1 Safety instructions

1.1 Authorized personnel

Installation, electrical connection, commissioning, operation, dismantling and disposal of the device must be made by a qualified and authorized expert according to the information's in the Operating manual and the relevant standards and rules. This expert must have read and understood the Operating manual and especially the safety notes. During work on and with the device, the required personal protective equipment must always be worn.

The Operating manual is part of the device and must be kept always accessible nearest its installation location. All statements within this document correspond to the information available at the time of printing. Subject to change without prior notice.

1.2 Terms

- **NOTE:** Notes to prevent failures, malfunctions, damage to devices or plants.
- **WARNING:** Non-observance of the information may result in serious or fatal personal injury.

1.3 Appropriate use

The device is an electronic temperature transmitter / temperature switch for monitoring, control and continuous measurement of temperatures in gases, vapors, liquids and dusts.

The operational reliability of the device is ensured only at the intended use. Inappropriate or incorrect use of this product can give rise to application specific hazards, e.g. vessel overheating through incorrect mounting or adjustment. Damage to property and persons or environmental contamination can result. Also, the characteristics of the instrument can be impaired. An inappropriately use, disregarding the Operating manual and the technical rules, using under-qualified personnel, making unauthorized alterations as well as damage of the device releases the manufacturer from liability for any resulting damage. This renders the manufacturer's warranty null and void.

1.4 Operational safety

The device is safely built and tested according to state-of-the-art technology. The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for the trouble-free operation of the instrument. The device may only be used within the permitted operation limits. 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 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.

For safety and warranty reasons, any invasive work on the device beyond that described in the Operating manual may be carried out only by personnel authorized by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden.

For safety reasons, only the accessory specified by the manufacturer must be used.

The device meets the legal requirements of all relevant EU directives. This is confirmed by attaching the CE mark. The associated EU-Declaration of Conformity can be ordered or downloaded from the homepage.

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 Product description

2.1 Product code

TK4 [01][02][03][04][05][06][07][08][09][10][11][12][13][14][80][81][94][95][96][97][98]

01	Version	S	Standard
02	Sensor / material diaphragm	S	Resistance sensor Pt-platinum – IEC 60751
03	Approval	S	Standard
04	Process connection	0	without process connection
04		6	Thread ISO 228-1 – G¼"A
04		1	Thread ISO 228-1 – G½"A
04		E	Thread ANSI – NPT ¼"
04		C	Thread ANSI – NPT ½"
04		9	Thread ISO 228-1 – G ½"A, O-Ring front-flush
04		4	Thread ISO 228-1 – G ½"A, metallic sealing
04		R	Milk pipe coupling DIN 11851 – DN25, PN40
04		S	Clamp DIN 32676 – DN25...40/1" ...1½", ISO 2852 – DN25...38, PN25
04		F	Varivent F – DN25...32 (1...1¼"), Ø 50mm, PN40
05	Material process seal	0	without
05		1	FKM/FPM – FDA
05		3	EPDM – FDA
06	Material process connection	V	CrNi-steel
07	Material terminal enclosure	C	CrNi-steel
08	Measuring range temperature	00	Pt class A – IEC 60751
08		01	0°C...+50°C (+32°F...+122°F)
08		02	0°C...+100°C (+32°F...+212°F)
08		03	0°C...+150°C (+32°F...+302°F)
08		04	0°C...+200°C (+32°F...+392°F)
08		11	-50°C...+50°C (-58°F...+122°F)
08		12	-50°C...+100°C (-58°F...+212°F)
08		13	-50°C...+150°C (-58°F...+302°F)
08		14	-50°C...+200°C (-58°F...+392°F)
09	Electronic – Output	C	Pt100 class A – IEC 60751, 4-wire
09		D	Pt1000 class A – IEC 60751, 4-wire
09		A	Current 4...20mA, FSK interface, 2-wire
09		V	RS485 Modbus-RTU, 4-wire
09		L	IO-Link, current 0/4...20mA / 2x Sout PP, 4-wire
10	Electronic – Function	S	Standard
11	Neck tube	0	without
11		1	35mm
11		H	Length L2
12	Probe tube diameter	K	Ø6mm
13	Measuring accuracy	A	Pt class A – IEC 60751
13		S	≤ ±0,25K + 0,002 * T
13		X	Xcellence ≤ ±0,15K, linearization protocol
14	Electrical connection	S	Plug M12x1 A
80	Length L1 – Probe tube	-030	30mm
80		-050	50mm
80		-100	100mm
80		-150	150mm
80		-200	200mm
80		-###	mm (≤ 300mm)
81	Length L2 – Neck tube	-###	mm (050...200mm)
94	Additional option	-SF	LABS-free, silicone-free / paint compatible version
95	Additional option	-ML	Measurement point designation / TAG – Laser marking
96	Additional option	-MZ	Material test certificate – EN10204 3.1
97	Additional option	-WT	Factory certification – drink water suitability
98	Additional option	-KF	Configuration / Preset

2.2 Function

The device is used for measurement of temperatures from -50°C (-58°F) to $+200^{\circ}\text{C}$ ($+392^{\circ}$) and is suitable for applications in virtually all industries. The device is especially provided for time critical applications with higher temperatures and constricted installation situations. Measured products are gases, vapours, liquids and dusts.

The measuring system is completely welded and thus sealed against the process.

The process fitting is sealed against the process by a suitable seal.

The process connection with metallic sealing allows a hygienic, dead-space and elastomer-free process adaption.

An optional neck tube allows higher process temperatures.

The process temperature acts by the probe tube onto a directly contacted thin film platinum sensor element class A.

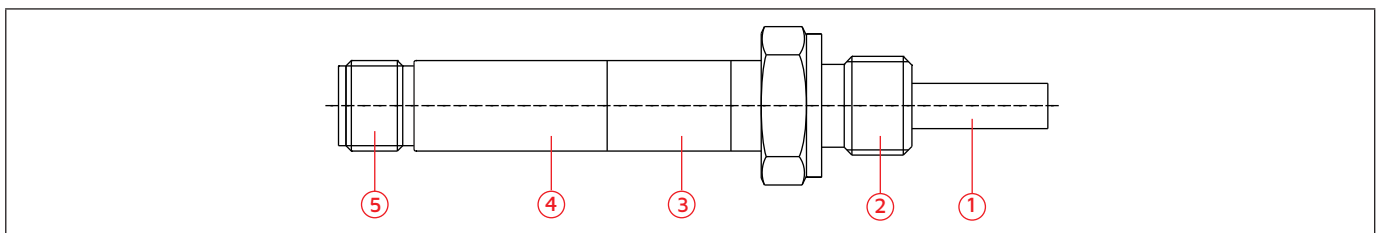
The direct contact ensures an ideal heat transfer from the process to the sensor element and thus allows extremely fast response times and high levels of measurement accuracies even with short insertion lengths.

The process temperature causes a resistance change at the sensor element, that can be taken directly at the plug connector or that will be converted by an optional integrated evaluation electronic into a corresponding output signal.

The parameterization and operation can be made to the integrated evaluation electronic by the integrated wired interface.

2.3 Configuration

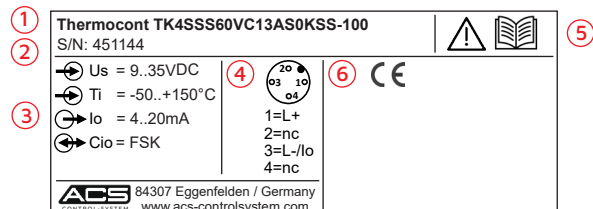
The device consists on the components:



- ① Probe tube
- ② Process connector
- ③ Neck tube – optional
- ④ Terminal enclosure / Electronic enclosure
- ⑤ Plug connector

2.4 Product label

The type label contains the most important data for identification and use of the instrument.



- ① Type code
- ② Serial number
- ③ Technical data
- ④ Assignment
- ⑤ Safety notes
- ⑥ Approvals

2.5 Packaging, transport, storage

The device is protected by packaging. It can handle normal loads during transport. Transport must be carried out in due consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device. The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

Dispose of the packaging material via specialized recycling companies.

Up to the time of installation, the packages must be left closed and, unless otherwise indicated, must be stored only under the following conditions:

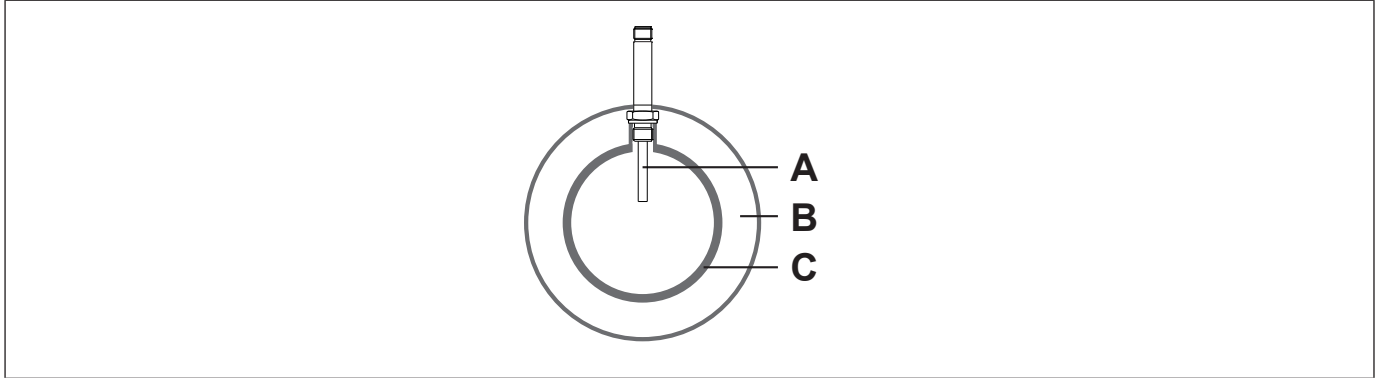
- Not in the open
- Dry and dust free
- Not exposed to corrosive media
- Protected against solar radiation
- Avoiding mechanical shock and vibration
- Storage and transport temperature $-20\dots+85^{\circ}\text{C}$
- Relative humidity $20\dots85\%$

3 Installation

3.1 Ambient and process conditions

The correct function of the device within the specific technical data can only be guaranteed, if the permitted ambient and process conditions at the installation place (see chapter Technical Data) will not be exceeded. Hence make sure before mounting that all parts of the instrument exposed to the process (e.g. probe tube, process fitting, process seal) are suitable for the existing process conditions (e.g. process pressure, process temperature, chemical properties of the medium, abrasion, mechanical influences).

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



- A) Probe tube
- B) Insulation
- C) Tube

3.2 Installation place

The choice of the place of installation of the sensor and the length of the probe 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 probe 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.

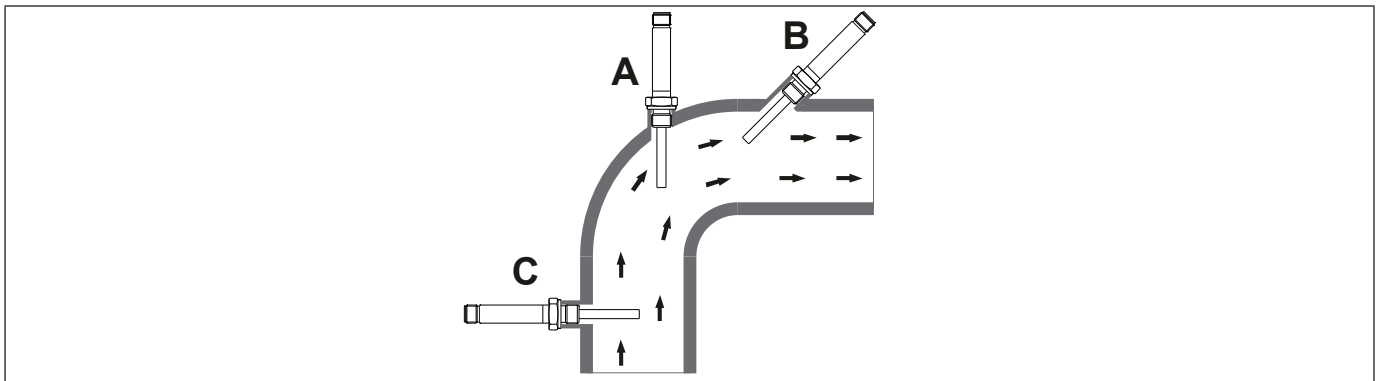
The shorter the installation length, the greater is the deviation against the real medium temperature caused by the heat transfer.

The following general recommendations can be applied as approximately guideline:

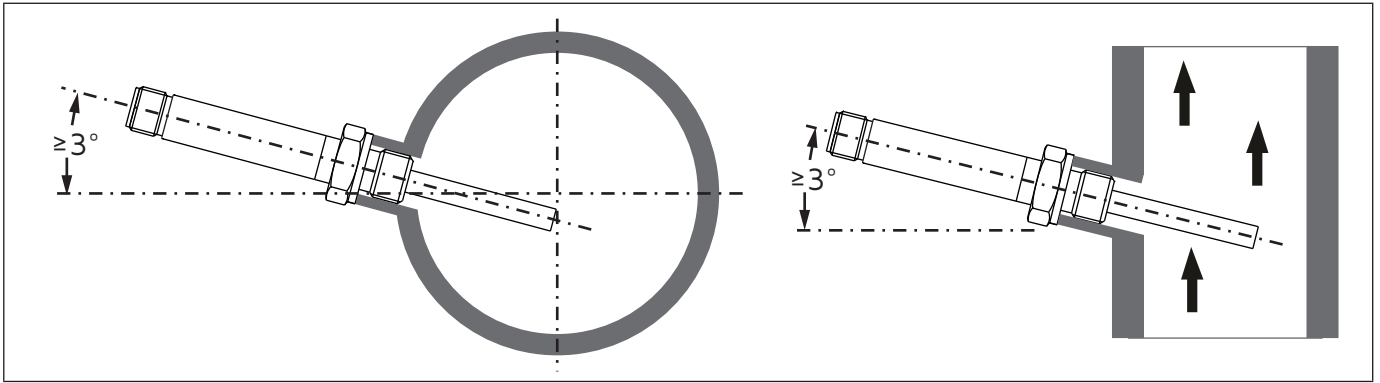
- In liquids, the probe tube length should be 5...6 times greater than the diameter of the probe tube plus the sensitive length of 10 mm.
- In steam, air and gases, the probe tube length should be 10...15 times greater than the diameter of the probe tube plus the sensitive length of 10 mm.

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

Another possibility is the diagonal installation to the pipeline longitudinal axis.



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

3.3 Installation notes

Do not remove packaging until just before mounting and check the device for any damage.

WARNING: Install the device only when the system is pressureless. There is a risk of fast escaping media resp. pressure blow.

WARNING: Let the system cool down sufficiently before installing the device. There is a risk of dangerous and hot media escaping.

Sealing faces on the device and at the mounting point must be clean and without damage.

Parallel threads must be sealed by a suitable O-ring, flat or profile gasket. An additional sealing material such as yarn, hemp or PTFE tape should not be used. Tapered threads should be wound with additional sealing material, e.g. PTFE tape for sealing.

NOTE: The tightening of the thread process connection may only be done at the hexagon by a suitable spanner at most with the maximum permitted torque strength (see chapter Dimensions).

4 Electrical connection

WARNING: Install the device only in de-energized state.

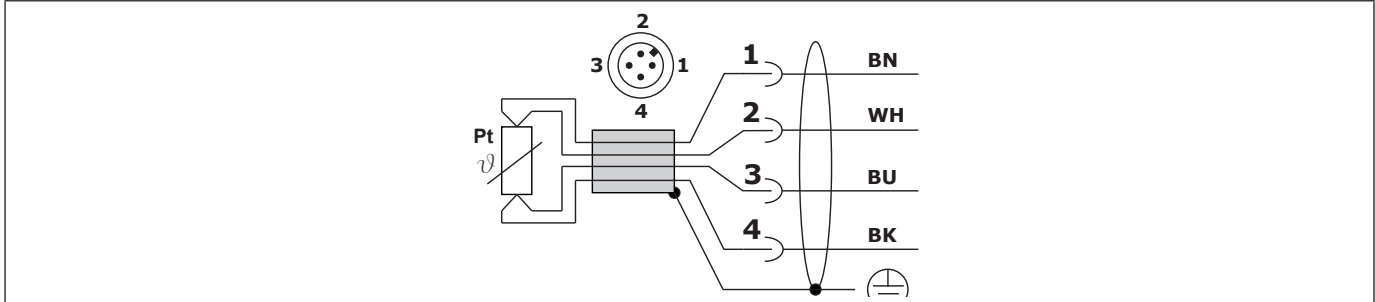
NOTE: For start-up deactivate all connected control devices, to avoid unwanted control reactions.

The device must be grounded, preferred by the metallic process connection, alternatively by the cable shield. Install cable separated from power leading cables, if existing connect shield to earth.

Cable: M12 – A-coded, 1-BN = brown / 2-WH = white / 3-BU = blue / 4-BK = black

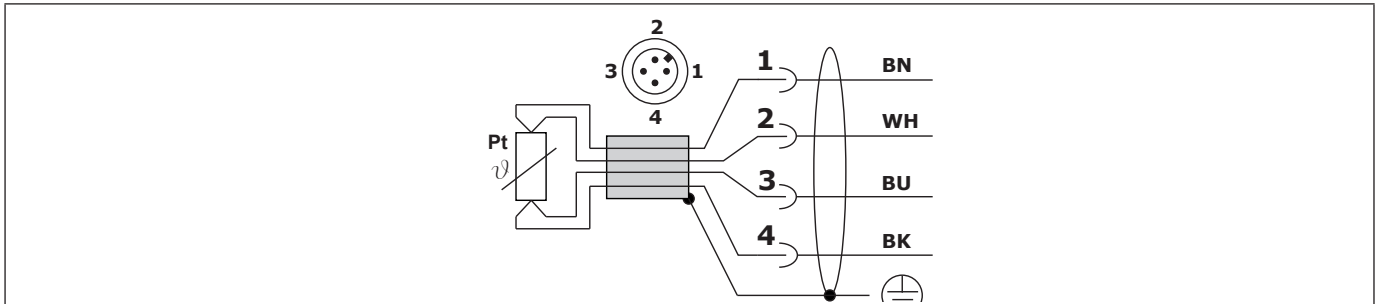
4.1 Electronic output [09-C] – Pt100, 4-wire

Version without transmitter



4.2 Electronic output [09-D] – Pt1000, 4-wire

Version without transmitter



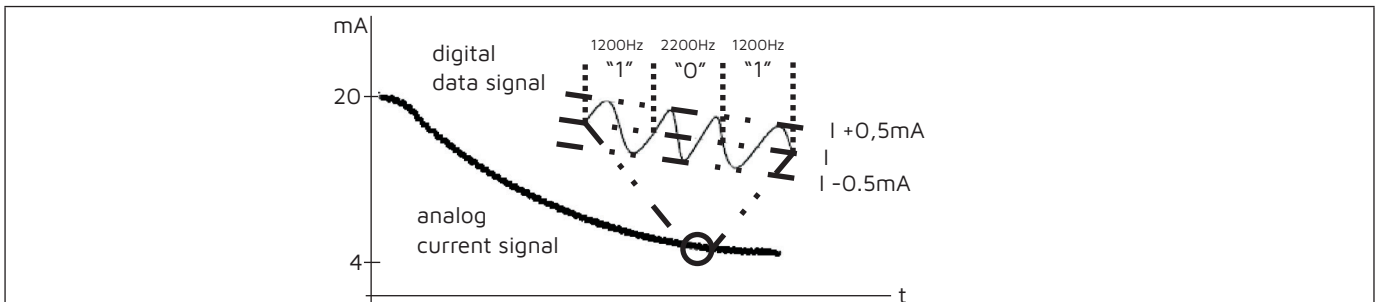
4.3 Electronic output [09-A] – Current 4...20mA, FSK interface

The digital communication protocol uses Frequency Shift Keying (FSK) technology and is superimposing onto the analogue sensor signal 4...20mA. This allows a two-way-communication with the field and thus allows the transmission of additional information's, that going above the normal process variables, from or to an intelligent field device.

The communication protocol communicates with 1.200 Bit/s without interrupting the 4...20mA signal and thus allows the host application (master), to receive two or more digital actualizations per seconds from an intelligent field device. The digital signal does not disturb the 4...20mA.

The communication protocol offers two simultaneous communication channels: the analogue 4...20mA signal and a digital signal. The 4...20mA signal transmits the primary measuring value by the 4...20mA current loop, the fastest and most reliable industry standard. The digital signal transmits additional information's from the device like device state, diagnosis date, additional measuring values or calculated values, etc.

The combination of both principles in one installation allows a cost effective and especially robust comprehensive field communication solution, which can be simply uses and configured.



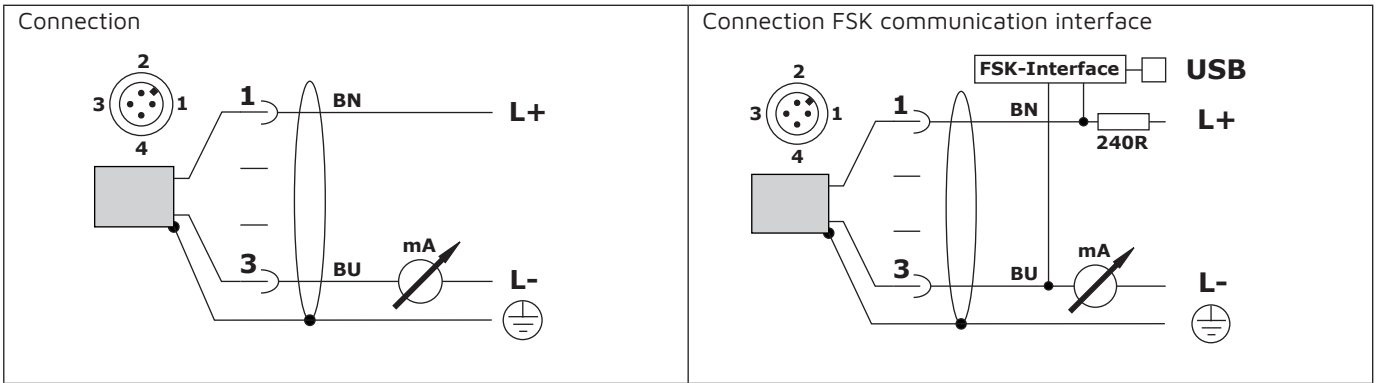
Use a cable 2-core, twisted, shielded.

Observe maximum permitted supply voltage U_s at the terminals L+/L-:

- $U_s = 9...35VDC$

Observe maximum permitted load resistor R_L of the analogue output:

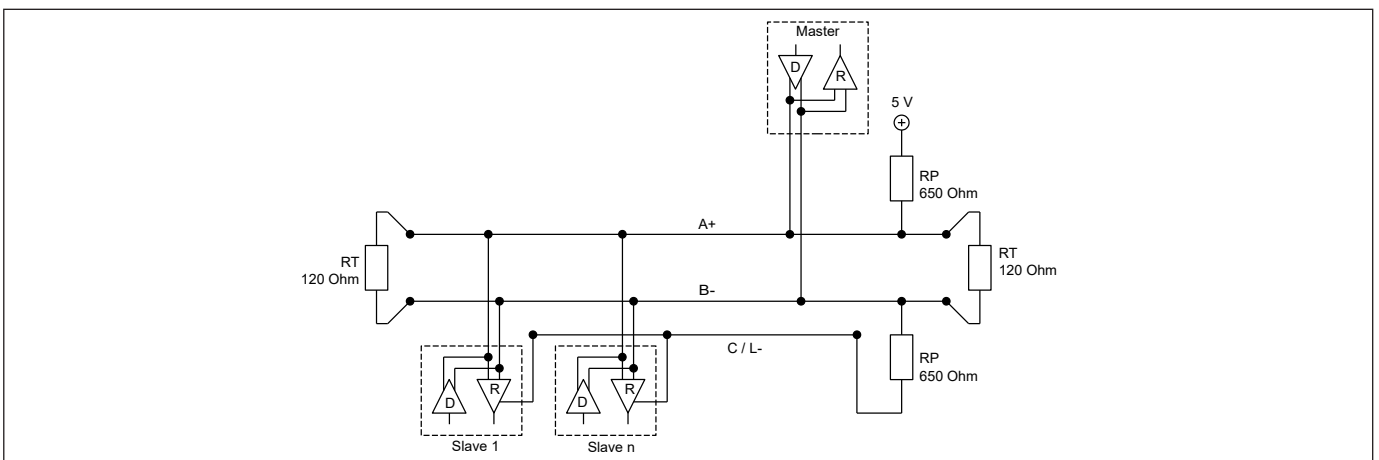
- $R_L \leq (U_s - 9V) / 22mA$



Consider resistor 240Ω within wire +L for connection of the FSK-communication device.

4.4 Electronic output [09-V] – Interface RS485 Modbus-RTU

The Modbus protocol is a communication protocol, that base on a master/slave architecture. All devices are connected by two data wires (A+ / B-) and by one COMMON-wire (C/L-).

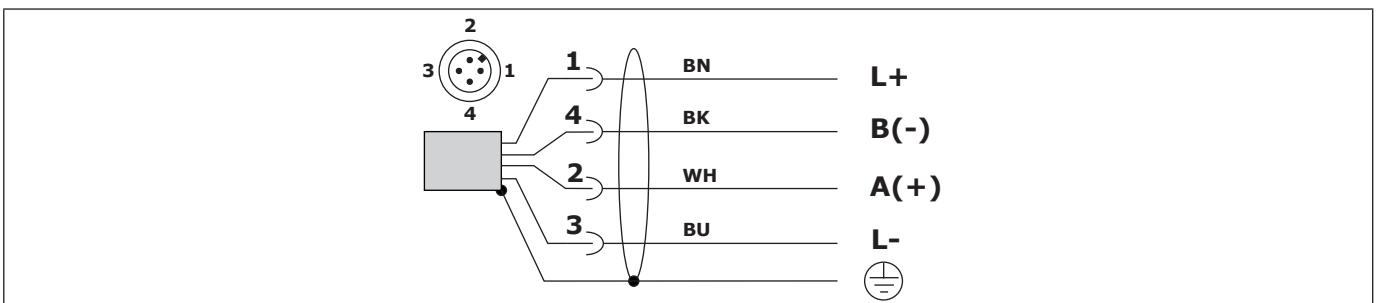


An original RS485 allows the connection of 32 slaves within one segment. The device has a load of only 1/8 of the standard load ($R_{in} \geq 96 \text{ k}\Omega$), thus up to 256 of the devices can be theoretically operated within one network segment. However the number is limited to 247 due to the Modbus address space.

The both termination resistors RT prevent reflections on the data wires. The optimum resistor value depends on the wave impedance of the used cable, but a value of 120 Ohm is a popular choice.

The polarisation network is necessary, to ensure suitable potentials, if none of the devices transmits and thus the wires A+ and B- are undefined (high impedance). The value for RP depends e.g. on bus load or the termination resistors. Recommended values are between 450 Ohm and 650 Ohm.

The use of a polarisation network is recommended, to ensure a stable network. Usually the polarisation resistors are implemented within the master device or they are connectible.



Connect the device at bus topology (line). A stub line must be avoided.

Use a cable 4-core acc. to the EIA485 recommendations:

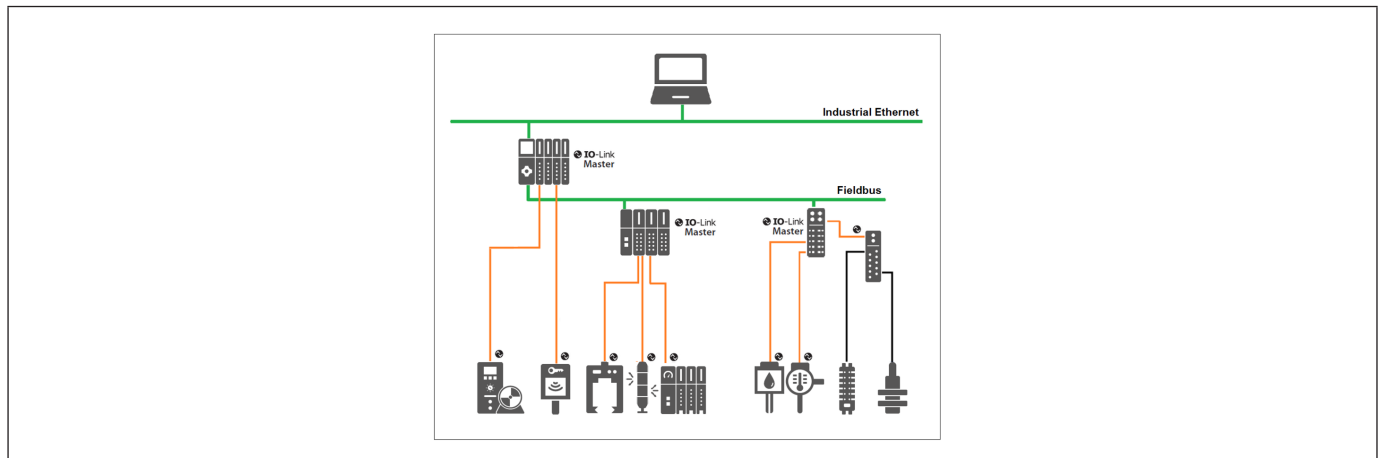
Impedance	135...165Ω @ 3...20Mhz
Cable capacity	< 30pF/m
Cable diameter	> 0,64mm
Cable cross section	0,34 mm ² / AWG 22
Loop resistance	< 110Ω/km
Shielding	Braided shield /shield foil
Cable length	38400 Baud ≤ 1200m

Observe maximum permitted supply voltage U_s at the terminals L+/L-:

- $U_s = 6...35VDC$

4.5 Electronic output [09-L] - Interface IO-Link

IO-Link is a worldwide standardized I/O technology to communicate with sensors. It is a serial bidirectional point-to-point connection.



The IO-Link communication requires an IO-Link-Master.

Use a cable max. 20m, 3- resp. 4-core, unshielded.

Analogue output: A shielded cable must be used.

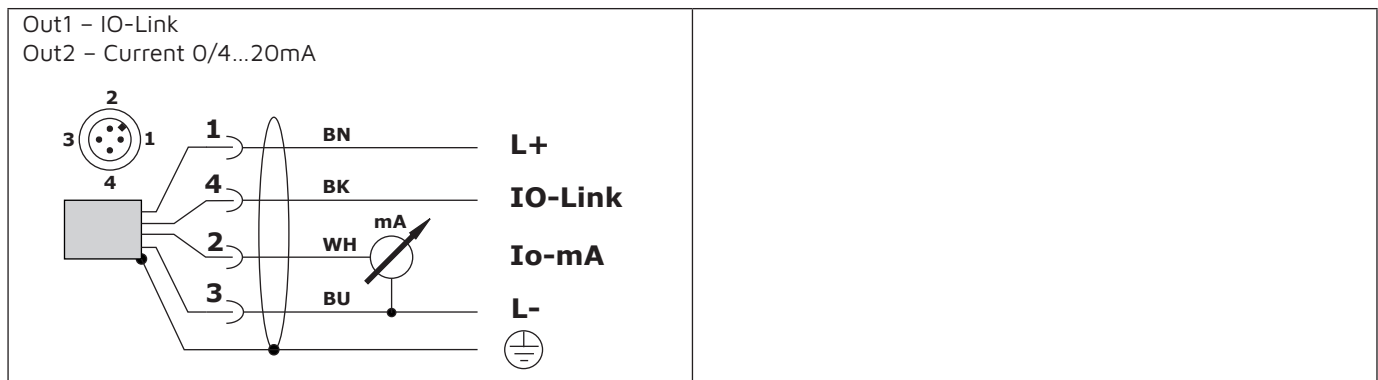
Observe maximum permitted supply voltage U_s at the terminals L+/L-:

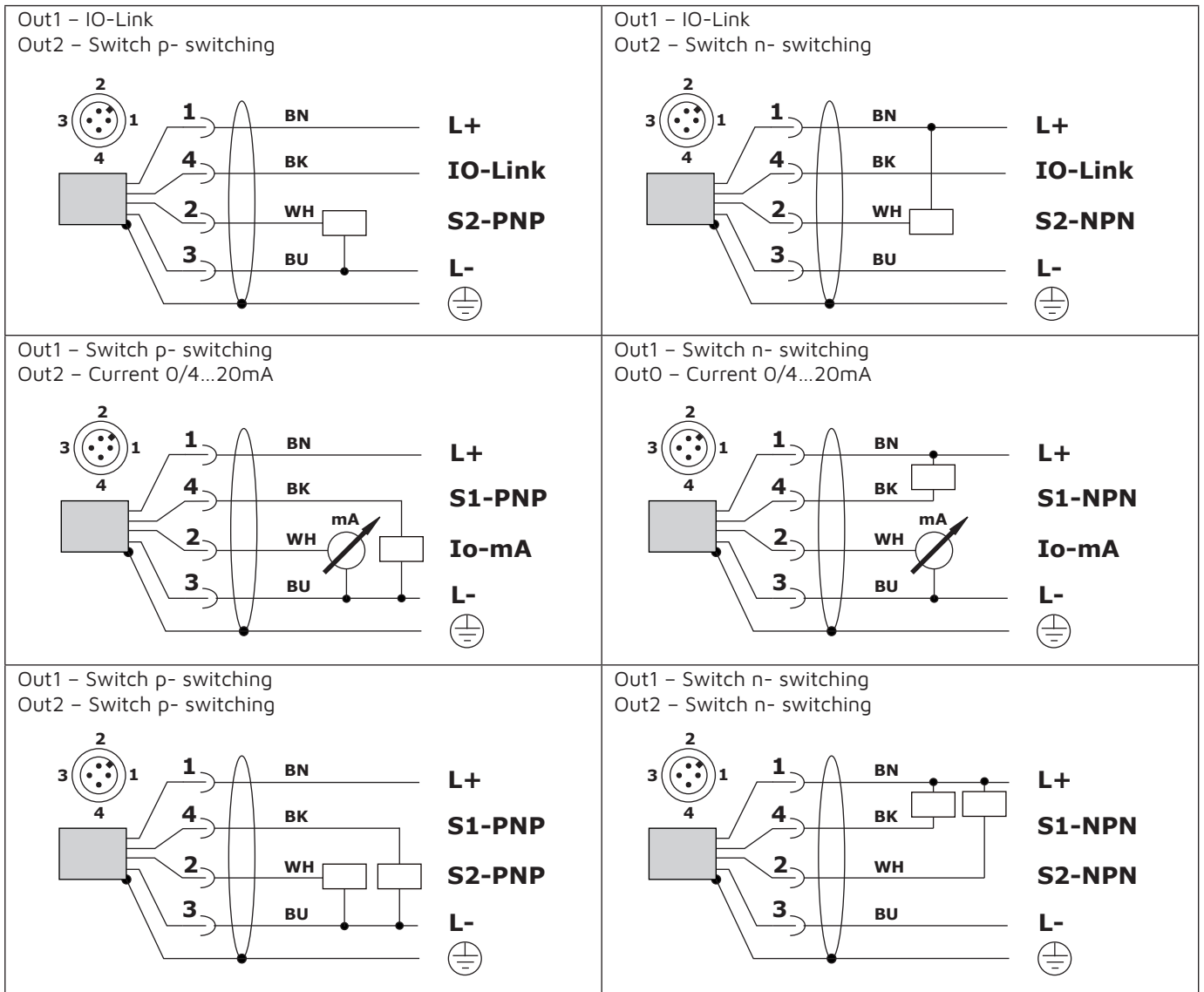
- $U_s = 9...35VDC$
- $U_s = 18...30VDC$, IO-Link

Observe maximum permitted load resistor R_L of the analogue output:

- $R_L \leq (U_s - 8V) / 22mA$

Note – Inductive loads at the switch outputs, e.g. contactors or magnetic vents may only be used with a free-wheeling diode or a RC protection circuit.





5 Operation

The parameterization and operation can be made by the integrated wired interface, dependent on the electronic variant. Knowledge concerning the communication technology is provided.

5.1 Electronic output [09-C] – Pt100, 4-wire

An operation is not intended at this version.

5.2 Electronic output [09-D] – Pt1000, 4-wire

An operation is not intended at this version.

5.3 Electronic output [09-A] – Current 4...20mA, FSK interface

Configuration and data transmission can be made per standard FSK interface (e.g. isHRT USB resp. isHRT USBex) and operating software (e.g. PACTware).

The use of the DTM isHRT CommDTM resp. ICS Generic HART DTM is recommended.

Information's for installation resp. using the FSK interface resp. the operating software are not content of this manual.

Note: Damping:

- At a set damping from 0s...<1s the communication is only active for 20s after power-up the supply voltage. After establishing the connection it will be stay active. While this, the damping is set to 1s. After 4 minutes of inactivity the connection will be terminated and the damping is reset to the set value.
- At a set damping of ≥ 1 s the establishing of a communication connection is always possible.

Default settings [Adjustment range]:

	Default settings	Description
Address	0 [0...15]	
Damping	1s [0s...60s]	Time till a change at the input has been processed at the output by 100%.
Start value LRV	Nominal lower adjust value = 4mA	LRV < URV Span \geq 25%
End value URV	Nominal upper adjust value = 20mA	LRV < URV Span \geq 25%

5.4 Electronic output [09-V] – Interface RS485 Modbus-RTU

Configuration and data transmission can be made per RS485 interface (e.g. Waveshare 15817) and operating software (e.g. QModMaster). Information's for installation resp. using the RS485 interface resp. the operating software are not content of this manual.

Function code	Function
03	Read Holding Register
04	Read Input Register
06	Write Single Register
16	Write Multiple Register

Holding Register – Device settings			2 Byte – Uint16 – R/W
Address	Description	Default	Comment
2000	Modbus ID	1	Modbus ID / 1 ... 247
2001	Baud-Rate	3	0 = 1200 / 1 = 2400 / 2 = 4800 / 3 = 9600 4 = 19200 / 5 = 38400 / 6 = 57600 / 7 = 115200
2002	Parity	2	0 = None / 1 = Odd / 2 = Even
2003	Number Stopbits	0	0 = 1 Stop Bit / 1 = 2 Stop Bit
2004	Word Order	0	0 = ABCD / 1 = CDAB

Input Register – Values		2 Byte – Read only
Address	Data Type	Description
1000	UInt16	Device Type
1001	UInt32	Serial Number
1003	UInt16	Calibration Date
1004	UInt16	Hardware Version

Input Register – Values		4 Byte – Float – Read only
Address	Data Type	Description
1010	Upper Range	PV = Temperature
1012	Lower Range	PV = Temperature
1014	Maximum	PV = Temperature
1016	Minimum	PV = Temperature

Input Register – Values			Read only
Address	Byte / Type	Description	Comment
1100	2 / UInt16	Status	Bit 0: 1 = Invalid Measure Value PV
1101	2 / UInt16	Unit	PV = Temperature
1102	4 / Float	Measure Value	PV = Temperature

Holding Register – Values			2 Byte – UInt16 – R/W
Address	Description	Default	Comment
2020	Damping Tau	1000	ms / PV = Temperature

Unit Code Table	
Code	Unit
32	C
33	F
34	R
35	Kelvin

5.5 Electronic output [09-L] – Interface IO-Link

Configuration and data transmission can be made per IO-Link-Master (e.g. IFM AL1330 / AL1940) and operating software (e.g. IFM LR Device resp. moneo configure). Information's for installation resp. using the IO-Link-Master resp. the operating software are not content of this manual.

The IODD file as well as the IODD description can be downloaded from the homepage.

6 Service

6.1 Maintenance

At appropriate use, the device is free of maintenance.

Solid coatings on the probe tube can lead to faulty measurement results. In this case the probe tube must be regularly cleaned. Don't use sharp resp. hard tools, pressured air or aggressive chemicals. For dismantling the device see chapter "Dismounting".

6.2 Dismounting

Use suitable protective clothing, e.g. goggles, gloves.

WARNING: Dismount the device only when power supply is off.

WARNING: Let the device and the system cool down sufficiently fore dismantling it. There is a risk of hot surfaces as well as dangerous and hot media escaping.

WARNING: Dismount the device only when the system is pressureless. There is a risk of fast escaping media resp. pressure blow.

6.3 Troubleshooting / Repair

The operator of the system is responsible for taking suitable measures to rectify faults.

In case of malfunction check:

Component / area	Check	Rectification
Enclosure	Damage	Replace device or send in for repair
Probe tube	Pollution	Clean device or send in for repair
	Damage	Replace device or send in for repair
Process seal	Damage	Replace process seal Use other seal material if necessary
Supply voltage	Operating voltage available	Switch-on resp. repair operating voltage
		Check terminals resp. repair
	Operating voltage too low / too high	Adapt resp. repair
	Load resistance too high	Reduce resistance Increase operating voltage
Connection cable damaged	Change resp. repair cable	

For dismantling the device see chapter "Dismounting".

If the malfunction cannot be eliminated, please contact the manufacturer.

A repair may only be carried out by the manufacturer.

6.4 Return

Enclose necessary information's for return:

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

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

- Adhesive product residues e.g. caustic, toxic, radioactive etc. must be removed.
- A returning must be refrained, if it is not possible by 100% to remove the unhealthy product completely.
- The device must be packed damage-proof.

6.5 Disposal

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.

7 Technical Data

Reference conditions	15..25°C (59°F... 77°F) / 860..1060kPa / 45..75%r.F. / ton240s / 24VDC±0,1V / vertical, sensor downside
Measurement deviation	EN/IEC 60770-1: Characteristic deviation (Nonlinearity + Hysteresis + Reproducibility)- Limit value adjustment
Response time	IEC 60751: water / 0,4 m/s / temperature step =10K

7.1 Electronic Output [09-C] – Pt100, 4-wire

Sensor type	Resistor Pt100 / class A / 4-wire – IEC 60751
Measuring range – FSI	-50...+200°C (-58...+392°C)
Response time	t50 ≤ 1s / t90 ≤ 2s
Measurement deviation	≤ ±0,15K + 0,002 * [Tp]
Sensor current	0,1...5mA

7.2 Electronic Output [09-D] – Pt1000, 4-wire

Sensor type	Resistor Pt1000 / class A / 4-wire – IEC 60751
Measuring range – FSI	-50...+200°C (-58...+392°C)
Response time	t50 ≤ 1s / t90 ≤ 2s
Measurement deviation	≤ ±0,15K + 0,002 * [Tp]
Sensor current	0,1...2mA

7.3 Electronic Output [09-A] – Current 4...20mA, FSK interface

Auxiliary power	
Supply voltage Us	9...35VDC reverse polarity protected / Ripple voltage ≤ 2Vpp
Input current Is	≤ 20,5mA
Ready delay time	ton ≤ 0,1s (damping td = 0s)
Input – Ti	
Sensor type	Resistor Pt – IEC 60751
Measuring range – FSI	-50...+200°C (-58...+392°F)
Response time	t50 ≤ 1s / t90 ≤ 2s
Resolution	FSI ≥ 16 Bit
Characteristic deviation	[13-S]: ≤ ±0,25K + 0,002 * [Tp] >> Tp = +50°C >> dT = ±0,35K / Tp = +200°C >> dT = ±0,65K [13-X]: ≤ ±0,15K
Long term drift zero value	≤ ±0,1K/year
Digital output / Interface – Cio	
Interface type	FSK / 1200 Bit/s
Communication resistor	≥ 240Ω, externally
Signal range	-50...+200°C (-58...+392°F)
Analogue output – Io	
Signal range	4...20mA ± Measuring range [08], limit/error = 3,9...20,5mA, dI ≤ 1μA
Permitted load	RL ≤ (Us - 9V) / 20,5mA
Influence of auxiliary power	≤ ±0,5μA/V
Influence of temperature Ta	≤ ±0,5μA/K

7.4 Electronic Output [09-V] – Interface RS485 Modbus-RTU

Auxiliary power	
Supply voltage Us	6...35VDC reverse polarity protected / Ripple voltage ≤ 2Vpp
Input current Is	≤10mA (without load)
Ready delay time	ton ≤ 0,1s (damping td = 0s)
Input – Ti	
Sensor type	Resistor Pt – IEC 60751
Measuring range – FSI	-50...+200°C (-58...+392°F)
Response time	t50 ≤ 1s / t90 ≤ 2s
Resolution	FSI ≥ 16 Bit
Characteristic deviation	[13-S]: ≤ ±0,25K + 0,002 * [Tp] >> Tp = +50°C >> dT = ±0,35K / Tp = +200°C >> dT = ±0,65K [13-X]: ≤ ±0,15K
Long term drift zero value	≤ ±0,1K/year
Digital output / Interface – Cio	
Interface type	RS485, bidirectional / Modbus-RTU / 9600 Baud (4800...38400 Baud)
Input resistor	112kΩ
Signal range	-50...+200°C (-58...+392°F)

7.5 Electronic Output [09-L] – Interface IO-Link

Auxiliary power	
Supply voltage Us	9...35VDC reverse polarity protected / Ripple voltage ≤ 2Vpp: IO-Link inactive 18...30VDC reverse polarity protected / Ripple voltage ≤ 2Vpp: IO-Link active
Input current Is	≤20mA (without load)
Ready delay time	ton ≤ 0,1s (damping td = 0s)

Input – Ti	
Sensor type	Resistor Pt – IEC 60751
Measuring range – FSI	-50...+200°C (-58...+392°C)
Response time	t50 ≤ 1s / t90 ≤ 2s
Resolution	FSI ≥ 16 Bit
Characteristic deviation	[13-S]: ≤ ±0,25K + 0,002 * [Tp] >> Tp = +50°C >> dT = ±0,35K / Tp = +200°C >> dT = ±0,65K [13-X]: ≤ ±0,15K
Long term drift zero value	≤ ±0,1K/year
Digital output / Interface – Cio	
Interface type	IO-Link V1.1 / Com2 (38400 Baud)
Cycle time	≥ 2,3ms
Signal range	-50...+200°C (-58...+392°C)
Switch output – So	
Switch output type	2x PP (Push-Pull), switch to +L/-L
Output signal	Uo ≤ 0,2V, ≥ Us – 2V / Io = 0...200mA (current limited ≤ 450mA, short circuit protected)
Switch delay time	trise < 30µs (RL < 3kR / Io > 4,5mA)
Switch cycles	≥ 100.000.000
Analogue output – Io	
Signal range	4...20mA ± -50...+200°C (-58...+392°C), limit 3,8...20,5mA, error ≥ 3,6mA / ≤ 22mA, dl ≤ 1µA 0...20mA ± -50...+200°C (-58...+392°C), limit 0...20,5mA, error ≤ 0,05mA / ≤ 22mA, dl ≤ 1µA
Permitted load	RL ≤ (Us - 8V) / 22mA
Influence of auxiliary power	≤ ±0,5µA/V
Influence of temperature Ta	≤ ±0,5µA/K

7.6 Process conditions

Process temperature Tp	[09-C/-D]: -50...+200°C (-58°F...+392°F)
	[09-A/-V/-L]+[11-0]: -50...+150°C (-58...+302°F)
	[09-A/-V/-L]+[11-1/-H]: -50...+200°C (-58°F...+392°F)
	[04-9]+[05-1]: (FKM/FPM) -15°C...+200°C (+5°F...+392°F)
	[04-9]+[05-3]: (EPDM) -50°C...+140°C (-58°F...+284°F)
Process pressure	[04-0/-6/-1/-C/-E]: ≤ 100bar [L1 ≤ 200mm]
	[04-9/-4/-R]: ≤ 40bar
	[04-F/-S]: ≤ 25bar

7.7 Environmental conditions

Ambient temperature Ta	[09-C/-D]+[11-0]: -40...+85°C (-40°F...+185°F) / Tp -50°C...+200°C (-58°F...+392°F)
	[09-C/-D]+[11-0]: -40...+100°C (-40°F...+212°F) / Tp -50°C...+150°C (-58°F...+302°F)
	[09-C/-D]+[11-0]: -40...+125°C (-40°F...+257°F) / Tp -50°C...+125°C (-58°F...+257°F)
	[09-C/-D]+[11-1/-H]: -40...+125°C (-40°F...+257°F) / Tp -50°C...+200°C (-58°F...+392°F)
	[09-A/-V/-L]+[11-0]: -40...+85°C (-40°F...+185°F) / Tp -50°C...+150°C (-58°F...+302°F)
	[09-A/-V/-L]+[11-0]: -40...+100°C (-40°F...+212°F) / Tp -50°C...+125°C (-58°F...+257°F)
	[09-A/-V/-L]+[11-1/-H]: -40...+85°C (-40°F...+185°F) / Tp -50°C...+200°C (-58°F...+392°F)
	[09-A/-V/-L]+[11-1/-H]: -40...+100°C (-40°F...+212°F) / Tp -50°C...+150°C (-58°F...+302°F)
Protection level	IP69K/IP67 (EN/IEC 60529)
Climatic classification	4K4H (EN/IEC 60721-3-4)
Shock classification	500g [1ms] (EN/IEC 60068-2-27)
Vibration classification	20g [10...2000 Hz] (EN/IEC 60068-2-6)
EM compatibility	Operation device class B / Industrial range (EN/IEC 61326)
Insulation voltage	500Vac
Protection class	III
Pollution degree	4
Altitude above sea level	2000m above sea level
MTTF	[09-A]: 745 years
	[09-V]: 561 years
	[09-L]: 601 years
	[09-C]: 13091 years
	[09-D]: 13091 years
Weight	0,1...1,0kg

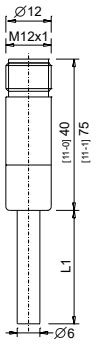
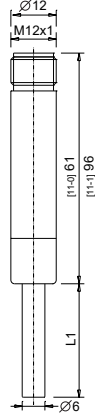
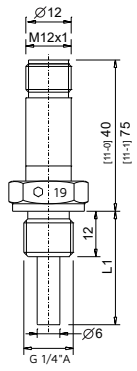
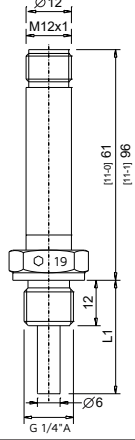
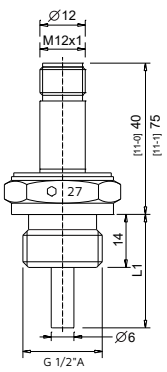
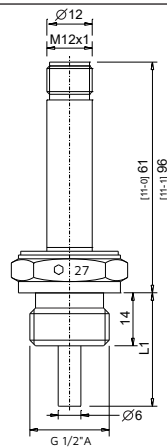
7.8 Materials

Process wetted	Steel 1.4571/316Ti, [05-1]: FKM/FPM – FDA/, [05-3]: EPDM – FDA
Surface roughness	Ra ≤ 0,76µm (ASME BPE – SF3), process side
Not process wetted	CrNi-steel, PUR, FKM/FPM

8 Dimensions

Dimensions in mm

Without neck tube [11-0] / Neck tube 35mm [11-1]

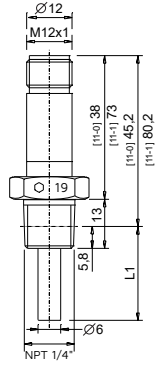
Process connection – without process connection – for compression fitting [04-0]	
Process pressure $P_{max} = 20$ bar, with compression fitting VA (SEM-52, SEM-58, SAM-62)	
Process pressure $P_{max} = 0$ bar, with compression fitting PTFE (SEMT-52, SEMT-58, SAMT-62)	
Without transmitter [09-C/-D]	With transmitter [09-A/-V/-L]
	
Process connection – Thread ISO 228-1 – G1/4" [04-6]	
Process pressure $P_{max} = 100$ bar [$L1 \leq 200$ mm]	
Torque $M_{max} = 50$ Nm	
Without transmitter [09-C/-D]	With transmitter [09-A/-V/-L]
	
Process connection – Thread ISO 228-1 – G1/2" [04-1]	
Process pressure $P_{max} = 100$ bar [$L1 \leq 200$ mm]	
Torque $M_{max} = 50$ Nm	
Without transmitter [09-C/-D]	With transmitter [09-A/-V/-L]
	

Process connection - Thread ANSI - NPT 1/4" [04-E]

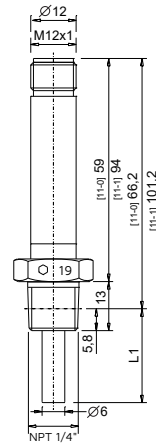
Process pressure Pmax = 100 bar [L1 ≤ 200mm]

Torque Mmax = 50Nm

Without transmitter [09-C/-D]



With transmitter [09-A/-V/-L]

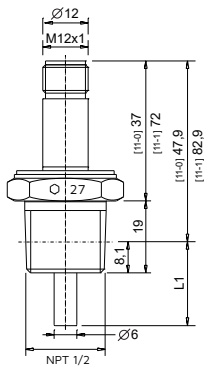


Process connection - Thread ANSI - NPT 1/2" [04-C]

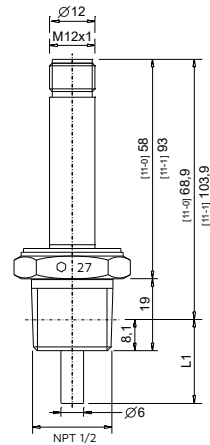
Process pressure Pmax = 100 bar [L1 ≤ 200mm]

Torque Mmax = 50Nm

Without transmitter [09-C/-D]



With transmitter [09-A/-V/-L]

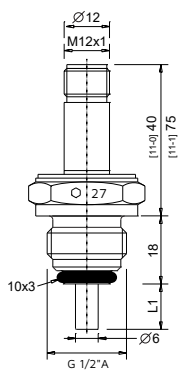


Process connection - Thread ISO 228-1 - G 1/2"A, O-Ring front-flush [04-9]

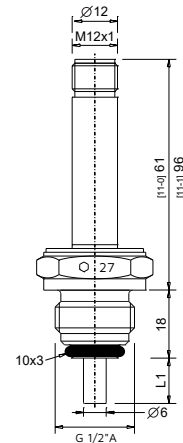
Process pressure Pmax = 40 bar

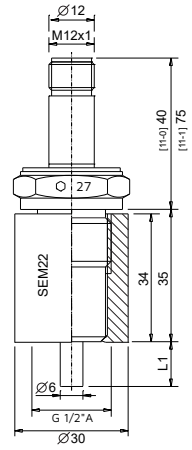
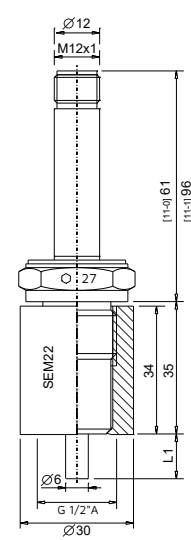
Torque Mmax = 50Nm

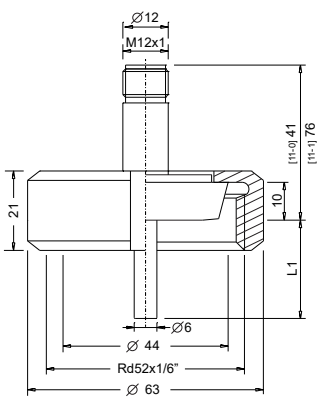
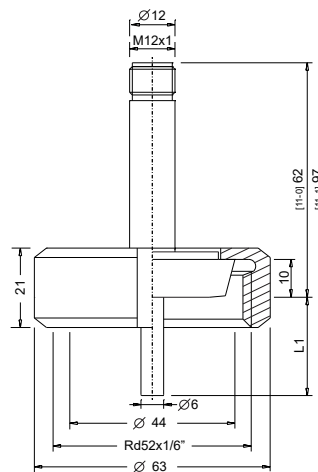
Without transmitter [09-C/-D]



With transmitter [09-A/-V/-L]



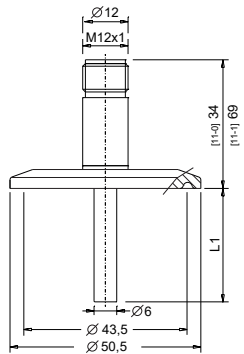
Process connection – Thread ISO 228-1 – G 1/2" A, metallic sealing [04-4]	
Process pressure P _{max} = 40 bar Torque M _{max} = 10Nm	
Without transmitter [09-C/-D]	With transmitter [09-A/-V/-L]
 <p>Technical drawing of a G 1/2" A process connection without transmitter. Dimensions include: top thread Ø12, M12x1; main body diameter Ø27; SEM22 label; body length 34 and 35; bottom thread Ø6, G 1/2" A; and overall diameter Ø30. Total height is [H=]40 and [H=]75.</p>	 <p>Technical drawing of a G 1/2" A process connection with transmitter. Dimensions include: top thread Ø12, M12x1; main body diameter Ø27; SEM22 label; body length 34 and 35; bottom thread Ø6, G 1/2" A; and overall diameter Ø30. Total height is [H=]61 and [H=]96.</p>

Process connection – Milk pipe coupling DIN 11851 – DN25 [04-R]	
Process pressure P _{max} = 40 bar	
Without transmitter [09-C/-D]	With transmitter [09-A/-V/-L]
 <p>Technical drawing of a milk pipe coupling without transmitter. Dimensions include: top thread Ø12, M12x1; main body diameter Ø44; SEM22 label; body length 10 and 10; bottom thread Ø6, Rd52x1/6"; and overall diameter Ø63. Total height is [H=]41 and [H=]76.</p>	 <p>Technical drawing of a milk pipe coupling with transmitter. Dimensions include: top thread Ø12, M12x1; main body diameter Ø44; SEM22 label; body length 10 and 10; bottom thread Ø6, Rd52x1/6"; and overall diameter Ø63. Total height is [H=]62 and [H=]97.</p>

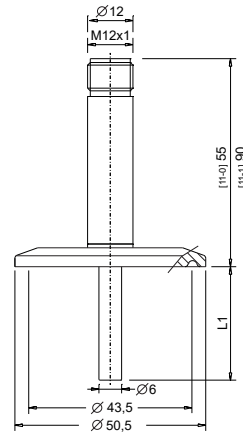
Process connection - Clamp DIN 32676 - DN25...40/1" ...1½", ISO 2852 - DN25...38 [04-S)

Process pressure Pmax = 25 bar

Without transmitter [09-C/-D]



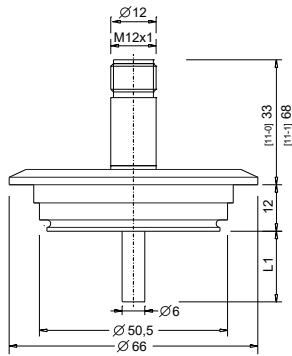
With transmitter [09-A/-V/-L]



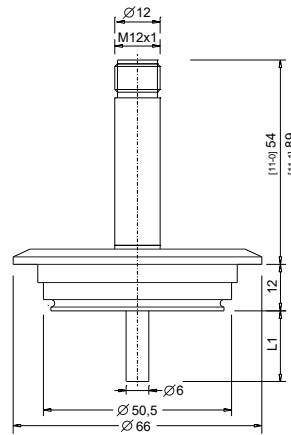
Process connection - Varivent F - DN25...32 (1...1¼"), Ø 50mm, [04-F)

Process pressure Pmax = 25 bar

Without transmitter [09-C/-D]



With transmitter [09-A/-V/-L]

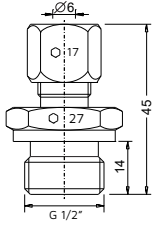
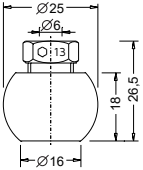
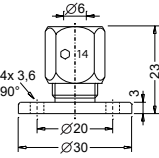
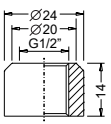


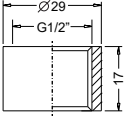
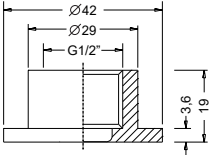
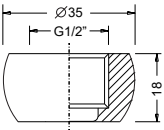
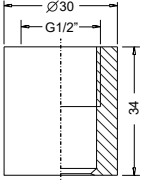
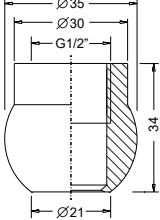
9 Accessories

Accessories, optimal matched to the device are directly available from the manufacturer.

9.1 Installation material

Dimensions in mm

	<p>Compression fitting SEM-52 Screw-in sliding sleeve Thread ISO 228-1 – G1/2"AG Probe diameter D6mm Process pressure ≤ 20bar Process connection steel 1.4571/316Ti Clamping ring steel 1.4571/316Ti Art.-No. 91980124</p> <p>For process connection: [04-0] without process connection</p>	<p>Compression fitting SEMT-52 Screw-in sliding sleeve Thread ISO 228-1 – G1/2"AG Probe diameter D6mm Process pressure Obar Process connection steel 1.4571/316Ti Clamping ring PTFE Art.-No. 91980127</p> <p>For process connection: [04-0] without process connection</p>
	<p>Compression fitting SEM-58 Ball welded sliding sleeve Diameter 25,5mm Probe diameter D6mm Process pressure ≤ 20bar Process connection steel 1.4571/316Ti Clamping ring steel 1.4571/316Ti Art.-No. 91980116</p> <p>For process connection: [04-0] without process connection</p>	<p>Compression fitting SEMT-58 Ball welded sliding sleeve Diameter 25,5mm Probe diameter D6mm Process pressure Obar Process connection steel 1.4571/316Ti Clamping ring PTFE Art.-No. 91980126</p> <p>For process connection: [04-0] without process connection</p>
	<p>Compression fitting SAM-62 Screw-on sliding sleeve Probe diameter D6mm Process pressure ≤ 20bar Process connection steel 1.4571/316Ti Clamping ring steel 1.4571/316Ti Art.-No. 91980180</p> <p>For process connection: [04-0] without process connection</p>	<p>Compression fitting SAMT-62 Screw-on sliding sleeve Probe diameter D6mm Process pressure Obar Process connection steel 1.4571/316Ti Clamping ring PTFE Art.-No. 91980842</p> <p>For process connection: [04-0] without process connection</p>
	<p>Welding socket BEF-14 Thread ISO 228-1 – G1/4"IG D24mm x L14mm Sealing surface Steel 1.4571/316Ti Art.-No. 611000586</p> <p>For process connection: [04-6] Thread ISO 228-1 – G1/4"</p>	

	<p>Welding socket TEM-11 Thread ISO 228-1 – G1/4"IG D26mm x L15mm Steel 1.4571/316Ti Art.-No. 91980042</p> <p>For process connection: [04-1] Thread ISO 228-1 – G1/2"</p>
	<p>Welding socket SEM-12 Thread ISO 228-1 – G1/2"IG Sealing surface front-flush – O-Ring 10x3 D42mm x L18mm Steel 1.4571/316Ti Art.-No. 611000130</p> <p>For process connection: [04-9] Thread ISO 228-1 – G1/2", O-Ring front-flush</p>
	<p>Ball welding socket SEM-32 Thread ISO 228-1 – G1/2"IG Sealing surface front-flush – O-Ring 10x3 D35mm x L18mm Steel 1.4571/316Ti Art.-No. 91980132</p> <p>For process connection: [04-9] Thread ISO 228-1 – G1/2", O-Ring front-flush</p>
	<p>Welding socket SEM-22 Thread ISO 228-1 – G1/2"IG Metallic sealing D30mm x L34mm Steel 1.4571/316Ti Art.-No. 611000133</p> <p>For process connection: [04-4] Thraed ISO 228-1 – G1/2", metallic sealing</p>
	<p>Ball welding socket SEM-42 Thread ISO 228-1 – G1/2"IG Metallic sealing D36mm x L34mm Steel 1.4571/316Ti Art.-No. 611000134</p> <p>For process connection: [04-4] Thraed ISO 228-1 – G1/2", metallic sealing</p>

9.2 Seals

O-ring seal, 10x3mm, FKM/FPM – FDA	Art.-No. 911002156
O-ring seal, 10x3mm, EPDM – FDA	Art.-No. 911002157

9.3 Connection cable

Cable shielded, PUR halogen free, black-grey, connection: Jack M12-A-4pole / Strands	
LKZ0405PUR-AS: 5m, jack straight	Art.-No. 611000000
LKZ0410PUR-AS: 10m, jack straight	Art.-No. 611000001
LKZ0420PUR-AS: 20m, jack straight	Art.-No. 30380292
LKZ0430PUR-AS: 30m, jack straight	Art.-No. 30380306
LKW0405PUR-AS: 5m, jack angled	Art.-No. 30380395
LKW0410PUR-AS: 10m, jack angled	Art.-No. 30380453
LKW0420PUR-AS: 20m, jack angled	Art.-No. 611000243
LKW0430PUR-AS: 30m, jack angled	Art.-No. 611000362

Cable shielded, PUR halogen free, black-grey, connection: Jack M12-A-4pole / Plug M12-A-4pole	
LKZV405PUR-AS: jack straight	Art.-No: 611000589
LKZV410PUR-AS: 10m, jack straight	Art.-No. 611000590
LKZV420PUR-AS: 20m, jack straight	Art.-No. 611000591

9.4 Confectionable connection jacks

BKZ0412-VA: Jack M12, A-coded, 4-pole, straight, shield connection	Art.-No. 611000015
BKW0412-VA: Jack M12, A-coded, 4-pole, angled, shield connection	Art.-No. 30380388
BKZM412-VA: Plug M12, A-coded, 4-pole, straight, shield connection	Art.-No. 611000593

9.5 Signal processing

TVA-100-U0	Isolation amplifier, active, 20..253Vuc transmitter supply, In-Out: 0/4...20mA/0...10V adjustable switch cabinet assembly at standard mounting rail, width 22,5mm	Art.-No. 171000012
TVA-120-U0	Isolation amplifier, active, 20..253Vuc transmitter supply, In-Out: 0/4...20mA/0...10V switch cabinet assembly at standard mounting rail, width 22,5mm	Art.-No. 171000004
WTAU-100-U0	Pt100 isolation amplifier, active, 20..253Vuc In: Pt100, Out: 0/4...20mA/0...10V adjustable switch cabinet assembly at standard mounting rail, width 22,5mm	Art.-No. 171000008
WTAU-120-U0	Pt100 isolation amplifier, active, 20..253Vuc In: Pt100, Out: 0/4...20mA/0...10V switch cabinet assembly at standard mounting rail, width 22,5mm	Art.-No. 171000002
GWA-250-U0	Limit value switch, 20..253Vuc transmitter supply, In: 0/4...20mA/0...10V, Out: 2x relay switch cabinet assembly at standard mounting rail, width 22,5mm	Art.-No. 171000015
GWAP-250-U0	Limit value switch, 20..253Vuc In: Pt100, Out: 2x relay switch cabinet assembly at standard mounting rail, width 22,5mm	Art.-No. 171000016
DPA	Process indicator/Data logger, TFT display, 18...36Vdc/186...253Vac In: 0/4...20mA/0...10V, Out: 4...20mA/0...10V/4x relay Field-/panel- or switch cabinet assembly at standard mounting rail	Art.-No. 161000178
isHRT USB	Interface converter FSK - USB	Art.-No. 611000595
Waveshare 15817	Interface converter RS485 - USB	Art.-No. 611000588
AL1330	IO-Link-Master, Ethernet IoT, EtherCAT, 4 IO-Link-Device-Ports, Field assembly, IP67	Art.-No. 611000592
AL1940	IO-Link-Master, Ethernet, Modbus TCP, 8 IO-Link-Device-Ports, switch cabinet assembly at standard mounting rail, width 45mm	Art.-No. 611000596



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