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Operating Manual

Electronic Temperature Switch

TS 300

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READ THOROUGHLY BEFORE USING THE DEVICE
KEEP FOR FUTURE REFERENCE

ID: BA_TS300_E | Version: 02.2020.0

1. General and safety-related information on this operating manual

This operating manual enables safe and proper handling of the product, and forms part of the device. It should be kept in close proximity to the place of use, accessible for staff members at any time.

All persons entrusted with the mounting, installation, putting into service, operation, maintenance, removal from service, and disposal of the device must have read and understood the operating manual and in particular the safety-related information.

Complementary to this operating manual the current data sheet has to be adhered to.

If the data sheet is not available, please request it:
info@bdsensors.de | Phone: +49 (0) 92 35 / 98 11 0

In addition, the applicable accident prevention regulations, safety requirements, and country-specific installation standards as well as the accepted engineering standards must be observed.

1.1 Symbols used

Warning word	- Type and source of danger - Measures to avoid the danger

Warning word	Meaning
DANGER	- Imminent danger! - Non-compliance **will result in** death or serious injury.
WARNING	- Possible danger! - Non-compliance **may result in** death or serious injury.
CAUTION	- Hazardous situation! - Non-compliance **may result in** minor or moderate injury.

NOTE - draws attention to a possibly hazardous situation that may result in property damage in case of non-compliance.

✓ Precondition of an action

1.2 Staff qualification

Qualified persons are persons that are familiar with the mounting, installation, putting into service, operation, maintenance, removal from service, and disposal of the product and have the appropriate qualification for their activity.

This includes persons that meet at least one of the following three requirements:

- They know the safety concepts of metrology and automation technology and are familiar therewith as project staff.
- They are operating staff of the measuring and automation systems and have been instructed in the handling of the systems. They are familiar with the operation of the devices and technologies described in this documentation.
- They are commissioning specialists or are employed in the service department and have completed training that qualifies them for the repair of the system. In addition, they are authorized to put into operation, to ground, and to mark circuits and devices according to the safety engineering standards.

All work with this product must be carried out by qualified persons!

1.3 Intended use

The TS 300 has been designed for plant and machine engineering, to control the temperature in industrial processes and operate efficiently. It is equipped with an IO-Link interface as standard in order to exchange process data, diagnostic reports and status messages with a superordinate control level. The parameters are set either also via the control level or via the VDMA-compliant menu system, which can be carried out at a local level using two keys.

The user must check whether the device is suited for the selected use. In case of doubt, please contact our sales department: info@bdsensors.de | phone: +49 (0) 92 35 98 11 0

BD|SENSORS assumes no liability for any wrong selection and the consequences thereof!

Permissible media are gases or liquids, which are compatible with the media wetted parts described in the data sheet.

The technical data listed in the current data sheet are engaging and must absolutely be complied with. If the data sheet is not available, please order it.

WARNING	**Danger through incorrect use** - In order to avoid accidents, use the device only in accordance with its intended use.

1.4 Limitation of liability and warranty

Failure to observe the instructions or technical regulations, improper use and use not as intended, and alteration of or damage to the device will result in the forfeiture of warranty and liability claims.

1.5 Safe handling

NOTE - Do not use any force when installing the device to prevent damage of the device and the plant!

NOTE - Treat the device with care both in the packed and unpacked condition!

NOTE - The device must not be altered or modified in any way.

NOTE - Do not throw or drop the device!

NOTE - Excessive dust accumulation (over 5 mm) and complete coverage with dust must be prevented!

NOTE - The device is state-of-the-art and is operationally reliable. Residual hazards may originate from the device if it is used or operated improperly.

1.6 Scope of delivery

Check that all parts listed in the scope of delivery are included free of damage, and have been delivered according to your purchase order:

- electronic temperature switch
- for DIN 3852, external thread: O-Ring (pre-mounted)
- this operating manual

2. Product identification

The device can be identified by means of the manufacturing label with order code. The most important data can be gathered therefrom.

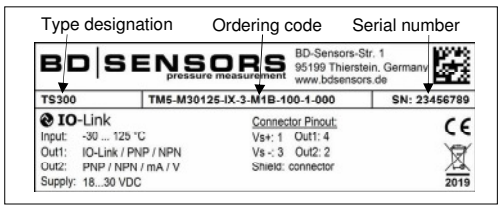


Fig. 1 Example of manufacturing label

NOTE - The manufacturing label must not be removed!

3. Mounting

3.1 Mounting and safety instructions

DANGER	**Danger of death from airborne parts, leaking fluid, electric shock** - Always mount the device in a depressurized and de-energized condition!
DANGER	**Danger of death from improper installation** - Installation must be performed only by appropriately qualified persons who have read and understood the operating manual.

NOTE - If there is increased risk of damage to the device by lightning strike or overvoltage, increased lightning protection must additionally be provided!

NOTE - Do not remove the packaging or protective caps of the device until shortly before the mounting procedure, in order to exclude any damage! Protective caps must be kept! Dispose of the packaging properly!

NOTE - The display and the plastic housing are equipped with a rotation limiter. Please do not attempt to overtighten the display or the housing by applying increased force.

NOTE - When installing the device, avoid high mechanical stresses on the process connection! This will result to damage, in particular with plastic process connections.

NOTE - The specified tightening torques must not be exceeded!

NOTE - Please check the conditions of use and operation of the device at regular intervals. If the properties are changed, initiate appropriate measures.

NOTES - for mounting outdoors / in a humid environment and for cleaning:

- Please note that your application does not show a dew point, which causes condensation and can damage the device.
- Connect the device electrically straightaway after mounting or prevent moisture penetration, e.g. by a suitable protective cap. (The ingress protection specified in the data sheet applies to the connected device.)
- Select the mounting position such that splashed and condensed water can drain off. Stationary liquid on sealing surfaces must be excluded!
- Mount the device such that it is protected from direct solar radiation. In the most unfavourable case, direct solar radiation leads to the exceeding of the permissible operating temperature, which can then damage the device or affect its ability to function correctly

3.2 Mounting steps for connections according to DIN 3852

NOTE - Do not use any additional sealing material such as yarn, hemp or Teflon tape!

✓ The O-ring is undamaged and seated in the designated groove.

✓ The sealing face of the mating component has a flawless surface. (R_Z 3.2)

1 Screw the device into the corresponding thread by hand.

2 Tighten it by using a suitable open-end wrench

process connection G1/2":
in stainless steel: approx. 10 Nm
in PVDF: max. 3 Nm

3.3 Positioning of the display module

In order to ensure easy readability even when the device is installed in an awkward location, the display can be rotated into the desired position. Its rotational capability is illustrated below. Note rotation limits.

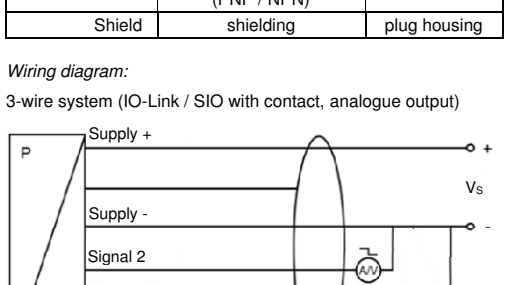


Fig. 2 Display module

4. Electrical connection

4.1 Connection and safety instructions

DANGER	**Danger of death from electric shock** - Always mount the device in a depressurized and de-energized condition!

✓ The supply corresponds to protection class III (protective insulation).

NOTE - Use a shielded and twisted multicore cable for the electrical connection.

4.2 Electrical installation

Establish the electrical connection of the device according to the technical data shown on the manufacturing label, the following table and the wiring diagram.

Pin configuration M12x1 (4-pin):

Electrical connections	Description	M12x1 (4-pin)
Supply +	supply	1
Supply –	supply	3
Output signal 1	IO-Link / SIO (PNP / NPN)	4
Output signal 2	4 … 20 mA – 3-wire / 0 …10 V – 3-wire (PNP / NPN)	2
Shield	shielding	plug housing

Wiring diagram:

3-wire system (IO-Link / SIO with contact, analogue output)

5. Commissioning

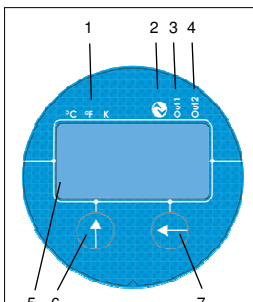
DANGER	**Danger of death from airborne parts, leaking fluid, electric shock** - Operate the device only within the specification! (according to data sheet)

✓ The device has been installed properly.

✓ The device does not have any visible defect.

6. Operation

6.1 Control and display elements



1. three LEDs for the indication of unit (°C, °F, K)
2. LED IO-Link status display IO-Link
3. LED Out 1: status display switching output 1
4. LED Out 2: status display switching output 2
5. seven segment display for measured value and parameters
6. button to move within the menu (ascending)
7. button for menu selection and for confirming / entering

Fig. 3 Touch pad

LED status in normal mode		
LED IO-Link	on	IO-Link active (while master-slave operation)
	off	IO-Link inactive (without master-slave operation)
LED Out 1	on	switching point 1 reached, switching output active
	off	switching point 1 not reached
LED Out 2	on	switching point 2 reached, switching output active
	off	switching point 2 not reached

Button functions		
↑	short press	scroll from menu 1 to menu 5, and then back to the display
	long press	rapidly increment parameter value
←	short press	select the menu item within a menu
	long press	apply the set parameter and return to the current menu item
↑ + ←	press both buttons simultaneously	return to the display

The device is configured according to VDMA 24574-1.

6.2 Switching / resetting behaviour

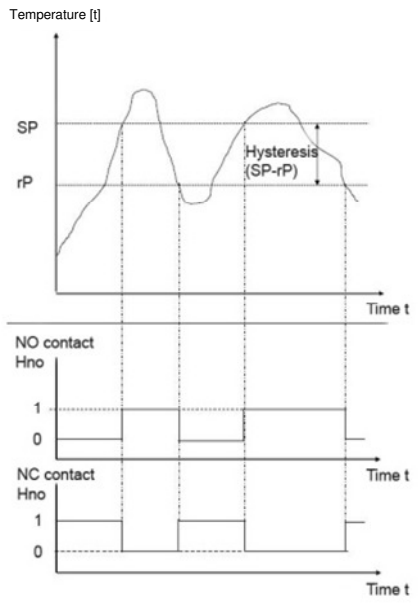


Fig. 4 Switching and resetting behaviour for hysteresis function in temperature-time graph

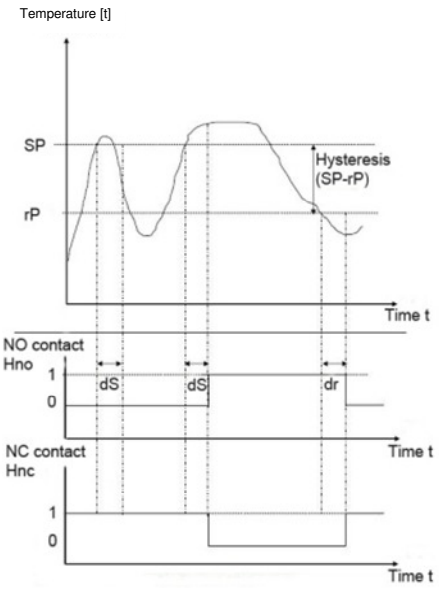


Fig. 5 Switching and resetting delay for hysteresis function in temperature-time graph

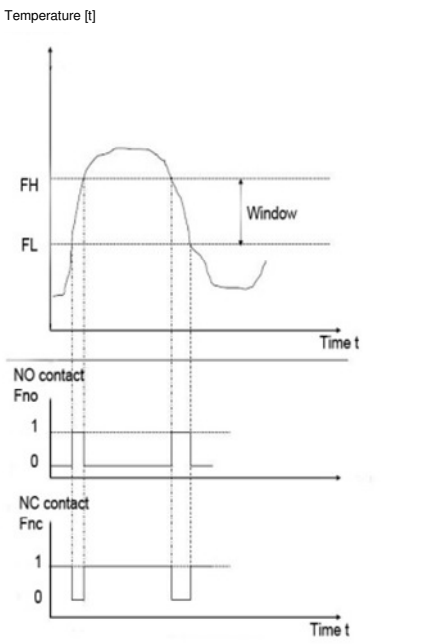


Fig. 6 Switching and resetting behaviour for window function in temperature-time graph

6.3 Pressure resistance depending on temperature

Process connection in PVDF							
Temperature measuring range: -30 … 125 °C							
°C	-30	-10	23	80	100	120	125
bar	40	50	70	40	35	20	16
temperature sensor Pt 1000 according to DIN EN 60751 class A							

Process connection in stainless steel (316L)
Temperature measuring range: -40 … 150 °C
max. 160 bar
within complete temperature range
temperature sensor Pt 1000 according to DIN EN 60751 class A

6.4 Menu list

✓ button functions are well known
(see "6.1 Control and display elements")

Display (the firmware version e. g. n011 will appear for about 1 second in the display after starting up the device)	
First menu level (display)	
SP1 / SP2 FH1 / FH2 **menu: 1** and 3	**Set switch-on points** Set the particular values, for the activation of switching point 1 and 2. If the window function is enabled in menu 5/6 and 5/7 the value of the switch-on point is the upper temperature limit of the window (**F**enster**H**igh).
rP1* / rP2* FL1 / FL2 **menu: 2** and 4	**Set switch-off points** Set the particular values, for the deactivation of switching point 1 and 2. If the window function is enabled in menu 5/6 and 5/7, the switch-off point of the contact is the lower temperature limit of the window (**F**enster**L**ow).
ASt2 / AEn2 *additional menu	only if output signal 2 is active (5/17) analogue output 2 (possibility to change ± 5% at start value and 90 % - 100 % at end value of measuring range); compare "8. Setting of offset and full scale"
EF **menu: 5**	**Extended functions** (pass to menu level two)
Second menu level	
rES **menu: 5/1**	**Reset** restores all settable parameters to their delivery state and deletes the minimum and maximum values
dS 1 / dS 2 **menu: 5/2** and 5/4	**Set switch-on delay** set the particular values, for the activation of switch-on point 1 and 2 (setting range: 0.0 ... 50.0 sec)
dr 1 / dr 2 **menu: 5/3** and 5/5	**Set switch-off delay** set the particular value of the delay after reaching the switch-off point 1 and 2 (setting range: 0.0 ... 50.0 sec)
ou1 / ou2 **menu: 5/6** and 5/7	**Set contacts 1 and 2** switching function of the contacts: Hno = hysteresis function, normally open Hnc = hysteresis function, normally closed Fno = window function, normally open Fnc = window function, normally closed
Uni **menu: 5/8**	**Change unit** selects the physical units for the set and displayed temperature values: C = °C F = °F K = K
FLIP **menu: 5/9**	**Rotation of display view to 180°**
Lo **menu: 5/10**	**Min. value** (only display) displays the minimum temperature, which was recorded during the measurement period (the value is lost if the voltage supply is interrupted)
Hi **menu: 5/11**	**Max. value** (only display) displays the maximum temperature, which was recorded during the measurement period (the value is lost if the voltage supply is interrupted)
---- **menu: 5/12**	**Delete min. and max. values** the execution of the value deletion process is confirmed on the display
SEt0 **menu: 5/13**	**Zero point adjustment** corrects the zero point of the display and the analogue output signal by up to ± 3 % of the measuring range
dAP **menu: 5/14**	**Measurement damping** sets the value for damping (0...1000 msec in 10 msec steps)
codE **menu: 5/15**	**Access protection** sets the password for protecting access to the menu 0000 = no password (deactivated) setting range 1111 ... 9999 (activated) To reset the password, contact BD|SENSORS.
o1 **menu: 5/16**	**Output signal 1** switching option between PNP and NPN function
o2 **menu: 5/17**	**Output signal 2** switching option between PNP or NPN function, 4 … 20 mA and 0 … 10 V
hcnt **menu: 5/18**	**Device operating hours counter in [h]**
Display	

6.5 Default settings

Menu item	Description	Factory setting	Own setting
menu 1 SP1 / FH1	switch-on point 1 / window high 1	80 % of nominal pressure	
menu 2 rP1 / FL1	switch-off point 1 / window low 1	75 % of nominal pressure	
menu 3 SP2 / FH2	switch-on point 2 / window high 2	80 % of nominal pressure	
menu 4 rP2 / FL2	switch-off point 2 / window low 2	75 % of nominal pressure	
menu 5:2 dS1	switch-on delay 1	0.0 sec	
menu 5:3 dr1	switch-off delay 1	0.0 sec	
menu 5:4 dS2	switch-on delay 2	0.0 sec	
menu 5:5 dr2	switch-off delay 2	0.0 sec	
menu 5:6 ou1	switching function of contact 1	Hno	
menu 5:7 ou2	switching function of contact 2	Hno	
menu 5:8 Uni	unit	°C	
menu 5:14 dAP	measurement damping	0 msec	
menu 5:15 codE	password	0000	
menu 5:16 o1	output signal 1	PNP	
menu 5:17 o2	output signal 2	PNP	

7. IO-Link interface

7.1 General device information

Baud rate	COM 2 (38.4 kbit/sec)
Input process data length	2 bytes
Minimum cycle time	5 msec
IO-Link version	V 1.1 (backward compatible V1.0)
SIO mode	yes

7.2 SIO mode (standard IO mode)

In this mode the sensor operates like a normal temperature sensor with standard output signals. The digital output is always on pin 4 (Output 1) of the M12 connector plug. Depending on the design, pin 2 (Output 2) can be an analogue or an additional digital output.

7.3 IO-Link mode (communication mode)

The temperature sensor switches to the IO-Link communication mode, when it operates under an IO-Link master. IO-Link communication is only possible via pin 4 of the M12 connector plug.

7.4 Process data

The process data length of the sensor is 16 bits. The switching states (BCD1 and BCD2) as well as the current measured values are transmitted. The 14 bits of the measured value are scaled according to the measuring range.

15 bit	14…2	1	0
Signed bit	Measured value	BDC2 / Output 2	BDC1 / Output 1

NOTE - Please note the bit sequence, otherwise there will be a misinterpretation of the process value.

7.5 Error codes

Error code	Description
0x8011	Index not available
0x8012	Subindex not available
0x8023	Access denied
0x8030	Parameter value out of range
0x8033	Parameter length overrun
0x8034	Parameter length underrun

7.6 Event codes

	Event codes for IO-Link 1.1	Event codes for IO-Link 1.0	Device status	Type
No malfunction	0x0000	0x0000	0	Notification
General malfunction. Unknown error.	0x1000	0x1000	4	Error
Process variable range overrun. Process data uncertain.	0x8C10	0x8C10	2	Warning
Process variable range underrun. Process data uncertain.	0x8C30	0x8C10	2	Warning

7.7 Parameter data

The parameter data for the temperature sensor correspond to the Smart Sensor profile (V1.0).

Index hex	Subindex hex	Object name	Single value	Default	Comment
0x02	0x00	System commands	0x81 = Delete min/max value 0x82 = res 0xA0 = Set0		The action is executed by writing in the subindex.
0x03	0x00	Data Storage Index	0x01: Upload Start 0x02: Upload End 0x03: Download Start 0x04: Download End 0x05: Data Storage Break		
0x0C	0x00	Device Access Lock	0x00: Unlocked 0x01: Parameter access - Lock 0x02: Data Storage - Lock 0x04: Local parameterization - Lock 0x08: Local user interface - Lock 0x03: Parameter access & Data Storage - Lock 0x05: Parameter access & Local parameterization - Lock 0x09: Parameter access & Local user interface - Lock 0x06: Data Storage & Local parameterization - Lock 0x0A: Data Storage & Local user interface - Lock 0x07: Data Storage & Parameter access & Local parameterization - Lock 0x0B: Data Storage & Parameter access & Local user interface - Lock	0x00: Unlocked	
0x24	0x00	Device status	0x00 Device is operating properly 0x02 Out-of-Specification 0x04 Failure		
0x3D	0x01	Switch point Logic 1	0x00: Value as specified		
0x3D	0x02	Switch point Mode 1	0x80: Hysteresis NO; 0x82: Window NO 0x81: Hysteresis NC; 0x83: Window NC	0x80: HNo	
0x3D	0x03	Switch point Hysteresis 1	0x0000: No Hysteresis		
0x3F	0x01	Switch point Logic 2	0x00: Value as specified		
0x3F	0x02	Switch point Mode 2	0x80: Hysteresis NO; 0x82: Window NO 0x81: Hysteresis NC; 0x83: Window NC	0x80: HNo	
0x3F	0x03	Switch point Hysteresis 2	0x0000: No Hysteresis		
0x93	0x00	Switch point Type 1	0x01 – NPN Output 0x00 – PNP Output		
0x97	0x00	Switch point Type 2	0x01 – NPN Output; 0x02 – 0 … 10 V Output 0x00 – PNP Output; 0x03 – 4 … 20 mA		
0xD4	0x00	Unit	0x00 °C 0x01 °F 0x02 K	0x00: °C	Temperature units for the display are changed; the IO-Link process data are not changed.

Index hex	Subindex hex	Object name	Access	Length	Value Range	Gradient	Unit	Default
0x3C	0x01	Switch point 1 = SP1	R/W	2 Byte	Process Data			80%
0x3C	0x02	Switch point 2 = rP1	R/W	2 Byte	Process Data			75%
0x3E	0x01	Switch point 1 = SP2	R/W	2 Byte	Process Data			80%
0x3E	0x02	Switch point 2 = rP2	R/W	2 Byte	Process Data			75%
0x57	0x00	Operating Hours	R	4 Byte	0 … 4294967295	1	h	0
0x60	0x00	Password	W	2 Byte	0000 … 9999			0
0xD0	0x00	Delay Switching Time 1	R/W	2 Byte	0 … 500	0.1	sec	0
0xD1	0x00	Delay Back Switching Time 1	R/W	2 Byte	0 ... 500	0.1	sec	0
0xD2	0x00	Delay Switching Time 2	R/W	2 Byte	0 ... 500	0.1	sec	0
0xD3	0x00	Delay Back Switching Time 2	R/W	2 Byte	0 ... 500	0.1	sec	0
0xD5	0x00	Min Temperature Value	R	2 Byte	Process Data			
0xD6	0x00	Max Temperature Value	R	2 Byte	Process Data			
0xD7	0x00	Measurement Damping	R/W	2 Byte	0 … 1000 in 10 msec steps	1	msec	0
0x0010	0	Get Vendor Name	R	64 Byte	Process Data			
0x0011	0	Get Vendor Text	R	64 Byte	Process Data			
0x0012	0	Get Product Name	R	64 Byte	Process Data			
0x0013	0	Get Product ID	R	64 Byte	Process Data			
0x0014	0	Get Product Text	R	64 Byte	Process Data			
0x0015	0	Get Serial Number	R	64 Byte	Process Data			
0x0016	0	Get Hardware Revision	R	64 Byte	Process Data			
0x0017	0	Get Software Revision	R	64 Byte	Process Data			

8. Setting of offset and full scale

Measuring range	Offset ± 5 %		Full scale 90 % - 100 %	
	min.	max.	min.	max.
-40 … 150 °C	-9.5 °C	+9.5 °C	135 °C	150 °C
-30 … 125 °C	-7.75 °C	+7.75°C	112.5 °C	125 °C

9. Maintenance

⚠ **DANGER**	**Danger of death from airborne parts, leaking fluids, electric shock** - Always service the device in a depressurized and de-energized condition!
⚠ **WARNING**	**Danger of injury from aggressive fluids or pollutants** - Depending on the measured medium, this may constitute a danger to the operator. - Wear suitable protective clothing e.g. gloves, safety goggles.

If necessary, clean the housing of the device using a moist cloth and a non-aggressive cleaning solution.

The cleaning medium for the media wetted may be gases or liquids which are compatible with the selected materials. Also observe the permissible temperature range according to the data sheet.

Deposits or contamination may occur on the process connection in case of certain media. Depending on the quality of the process, suitable maintenance intervals must be specified by the operator. As part of this, regular checks must be carried out regarding corrosion, damage to the diaphragm and signal shift.

If the diaphragm is calcified, it is recommended to send the device to BD SENSORS for decalcification.

NOTE - Wrong cleaning or improper touch may cause an irreparable damage on the temperature sensor.

10. Removal from service

⚠ **DANGER**	**Danger of death from airborne parts, leaking fluids, electric shock** - Disassemble the device in a depressurized and de-energized condition!
⚠ **WARNING**	**Danger of injury from aggressive media or pollutants** - Depending on the measured medium, this may constitute a danger to the operator. - Wear suitable protective clothing e.g. gloves, goggles.

NOTE - After dismounting, the process connection must be fitted with a protective cap.

11. Service/repair

Information on service / repair:

- www.bdsensors.de
- info@bdsensors.de
- Service phone: +49 (0) 92 35 98 11 0

11.1 Recalibration

During the life-time of the device, the value of offset and span may shift. As a consequence, a deviating signal value in reference to the nominal range starting point or end point may be transmitted. If one of these two phenomena occurs after prolonged use, a recalibration is recommended.

11.2 Return

⚠ **WARNING**	**Danger of injury from aggressive media or pollutants** - Depending on the measured medium, this may constitute a danger to the operator. - Wear suitable protective clothing e.g. gloves, goggles.

Before every return of your device, whether for recalibration, decalcification, modifications or repair, it has to be cleaned carefully and packed shatter-proofed. You have to enclose a notice of return with detailed defect description when sending the device. If your device came in contact with harmful substances, a declaration of decontamination is additionally required.

Appropriate forms can be downloaded from our homepage. Download these by accessing www.bdsensors.de or request them: info@bdsensors.de | phone: +49 (0) 92 35 / 98 11 0

In case of doubt regarding the fluid used, devices without a declaration of decontamination will only be examined after receipt of an appropriate declaration!

12. Disposal

⚠ **WARNING**	**Danger of injury from aggressive media or pollutants** - Depending on the measured medium, this may constitute a danger to the operator. - Wear suitable protective clothing e.g. gloves, goggles.

The device must be disposed of according to the European Directive 2012/19/EU (waste electrical and electronic equipment). Waste equipment must not be disposed of in household waste!

NOTE - Dispose of the device properly!

13. Warranty terms

The warranty terms are subject to the legal warranty period of 24 months, valid from the date of delivery. If the device is used improperly, modified or damaged, we will rule out any warranty claim. A damaged process connection will not be accepted as a warranty case. Likewise, there shall be no entitlement to services or parts provided under warranty if the defects have arisen due to normal wear and tear.

14. EU declaration of conformity / CE

The delivered device fulfils all legal requirements. The applied directives, harmonised standards and documents are listed in the EC declaration of conformity. Additionally, the operational safety is confirmed by the CE sign on the manufacturing label.

Notes: