EN

BD|SENSORS pressure measurement

Original User Manual

DS 3XX Electronic Pressure Switch

DS 300, DS 300 P, DS 301

DS 300

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Table of contents

1. General Information

1.1 Information concerning the user manual

Follow the safety and handling instructions that are set out in this user manual. Compliance with the applicable accident prevention regulations and safety regulations as well as with national installation standards and recognized codes of practice must also be ensured.

This user manual is part of the device and should be kept accessible to personnel at all times in the immediate vicinity of the installation location of the device.

– Subject to technical alteration –

1.2 Symbols used

Warning term	- Nature and source of danger - Measures to prevent danger

Warning term	Meaning
DANGER	Immediate danger! Failure to observe **will result** in death or serious injury.
WARNING	Possible danger! Failure to observe **may result** in death or serious injury.
CAUTION	Dangerous situation! Failure to observe **may result** in slight or moderate injury.

☞ NOTE – Tips and information for the user in order to ensure trouble-free operation.

1.3 Qualification of personnel

Installation, commissioning, operation, maintenance, decommissioning and disposal may be carried out only by appropriately qualified specialist personnel.

Work on electrical components must be performed only by a qualified electrician and in accordance with the applicable regulations and guidelines.

1.4 Limitation of liability and warranty

Failure to follow the instructions or observe technical regulations, improper use or use of the device in a manner other than that intended, or alteration or damage to the device will void the warranty and invalidate claims for liability.

1.5 Intended use

- The **DS 3XX Pressure Switches** have been developed for pressure monitoring applications depending on the particular model. They are equipped with a 4-digit LED display which indicates the adjacent system pressure. Depending on the particular device and mechanical connection, they are suitable for a wide range of applications. The pressure sensor is intended for installation in a machine or system. It is the responsibility of the user to check whether the device is suitable for the chosen application. If in doubt, please contact our sales office. BD SENSORS cannot, however, assume any liability for an incorrect choice or any consequences arising from this!
- Media that can be measured are gases or liquids that are compatible with the materials that contact the medium. These are described in the data sheet. Furthermore, it must be ensured in each individual case that the medium is compatible with the parts the come in contact with it.
- The technical data as set out in the current data sheet are authoritative. If you do not have the data sheet, please request it from us or download it from our website.

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

1.6 Package contents

Check that all of the listed parts are included in the delivered package and have been supplied in accordance with your order:

- Electronic pressure switch from the DS 3XX series
- For DIN 3852 mech. connectors: O-ring (pre-fitted)
- User manual

1.7 UL – Approval (for devices with UL-identification)

The UL – Approval was done with respect to U.S. standards norms which also correspond with the applicable Canadian standards norms for safety.

Note the following points, so that devices fulfils the demands of UL approval:

- The transmitter shall be supplied by Limited Energy Source (per UL 61010) or NEC Class 2 Power Source.
- maximum operating voltage: see technical data

2. Product Identification

The type plate serves to identify the device. The most important data can be taken from this. The order code is used for unique identification of your product.

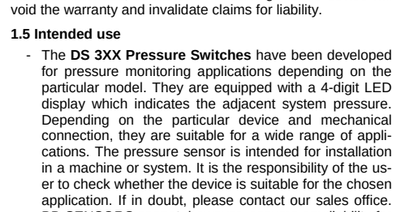


Fig. 1 Type plate

☞ The type plate must not be removed from the device!

3. Installation

3.1 General installation and safety instructions

DANGER	**Danger of death from electric shock** - Install the device only when the machine is depressurized and the power supply has been switched off!
WARNING	**Danger of death from improper installation** - Installation must be performed only by appropriately qualified specialist personnel who have read and understood the user manual.

☞ Please treat this highly sensitive electronic measuring instrument carefully, both when packed and when unpacked!

☞ No modifications or alterations may be made to the device.

☞ Do not throw or drop the device!

☞ Only remove the packaging and, if applicable, the protective cap from the device shortly before its installation, so as to avoid damaging the diaphragm. Be sure to retain the supplied protective cap!

☞ Fit the protective cap back over the diaphragm immediately after dismounting the device.

☞ Treat the unprotected diaphragm with extreme care; it can be damaged very easily.

☞ Do not apply any force to install the device so as to avoid damaging the device and the system!

☞ 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.

☞ When installing outdoors or in humid environments, the following points should be noted:

- The device should be electrically connected immediately after installation to ensure that no moisture is able to penetrate into the plug connector, If this is not possible, the ingress of moisture must be prevented by using a suitable protective cap. (The protection class specified in the data sheet applies to the connected device.)
- Select an installation position that allows splashed water and condensation to drain away. Ensure that sealing surfaces are not exposed to standing liquid!
- Install the device such that it is protected from direct sunlight. In the worst case, direct sunlight may result in the maximum permissible operating temperature being exceeded, which can then damage the device or affect its ability to function correctly. If the internal pressure in the device rises, this could also cause temporary measurement errors.

☞ Take care that the pressure connector is not subjected to any mechanical stresses higher than that permitted, since this could cause the characteristic to shift or result in damage. This applies especially to very small pressure ranges, as well as to devices with a pressure connector made of plastic.

☞ In the case of hydraulic systems, orient the device such that the pressure connector faces upwards (for venting).

☞ Provide a cooling section when using the device in steam lines.

☞ If there is a risk that a device installed outdoors might be damaged by lightning strike or overvoltage, we recommend the provision of overvoltage protection between the power supply unit or control cabinet and the device.

☞ If the device is installed with the pressure connector facing upwards, make sure that no liquid runs down the housing. This could result in moisture and dirt blocking the gauge reference in the housing and cause malfunctions. If necessary, remove any dust and dirt from the edge of the screw joint of the electrical connector.

3.2 Installation and safety instructions oxygen

DANGER	**Danger of death from explosion through improper use of devices intended for use with oxygen** - The following points must be observed in order to ensure safe handling:

- Make sure that a special version of your device has been ordered for use with oxygen and that the expected device has been delivered. The easiest way for you to verify this is by checking the type plate (see Fig. 1 regarding this). If your order code ends with the digits "007", then your device is suitable for oxygen applications.
- When it is delivered, the device is packaged in a plastic bag to protect it from contamination. Take note of the advice sticker with the text "Device for oxygen; unpack immediately before installation"! Also note that contact with skin should be avoided when unpacking and installing the device so as to avoid leaving grease residues on the device.
- The relevant provisions concerning explosion protection must be met during installation. Also check whether approval as intrinsically safe equipment is required in addition to suitability for oxygen. (This is not the case for the device as supplied!)
- Please note that the entire system must comply with the requirements of the BAM (German Federal Institute for Materials Research and Testing, DIN 19247).
- Pressure transmitters designed for use without seals are recommended for oxygen applications > 25 bar.
- Pressure transmitters with FKM (Vi 567) sealing rings: Maximum permitted values: 25 bar / 150° C (BAM approval).

3.3 General installation instructions

- Carefully remove the device from its packaging and dispose of the packaging properly.
- Then proceed as described in the following installation instructions.

3.4 Installation instructions for DIN 3852 connectors

⚠ **DO NOT USE ANY ADDITIONAL SEALING MATERIALS SUCH AS TOW, HEMP OR TEFLON TAPE!**

- Check that the O-ring is undamaged and is seated in the groove provided for it.
- Make sure that the sealing surface of the receiving part is perfectly clean and smooth. (R_Z 3.2)
- Screw the device into the mounting thread by hand.
- If you have a device with a knurled ring, the device need only be screwed in by hand.
- Devices with wrench flats must be tightened with an open-end wrench (with steel wrench flats: G1/4": approx. 5 Nm; G1/2": approx. 10 Nm; G3/4": approx. 15 Nm; G1": approx. 20 Nm; with plastic wrench flats: max. 3 Nm).
- **The specified tightening torques must not be exceeded!**

3.5 Installation instructions for EN 837 connectors

- Use a suitable seal that is compatible with the process medium and the pressure to be measured (e.g. a copper seal).
- Make sure that the sealing surface of the receiving part is perfectly clean and smooth. (R_Z 6.3)
- Screw the device into the mounting thread by hand.
- Then tighten it with the open-end wrench (for G1/4": approx. 20 Nm; for G1/2": approx. 50 Nm).
- **The specified tightening torques must not be exceeded!**

3.6 Installation instructions for NPT connectors

- Additional seal materials, e.g. PTFE tape, may be used to provide sealing.
- Screw the device into the mounting thread by hand.
- Then tighten it with the open-end wrench (for 1/4" NPT: approx. 30 Nm; for 1/2" NPT: approx. 70 Nm).
- **The specified tightening torques must not be exceeded!**

3.7 Installation instructions for dairy pipe connectors

- Check that the O-ring is undamaged and is seated in the groove provided for it in the receiving fitting.
- Center the dairy pipe connector in the corresponding receiving fitting.
- Screw the union nut on to the receiving fitting.
- Then pull it tight with a hook wrench.

3.8 Installation instructions for clamp and Varivent® connectors

- Use a suitable seal that is compatible with the process medium and the pressure to be measured.
- Place the seal on the corresponding receiving fitting.
- Center the clamp or Varivent® connector above the corresponding receiving fitting with its seal.
- Then attach the device using a suitable fastening element (e.g. semi-ring or retractable ring clamp) in accordance with the manufacturer's instructions.

☞ The sensor must not be exposed to high temperatures or rapid pressure increases that exceed the specified limits (see data sheet for limit values). The sensitive diaphragm of the flush-mounted sensor must not be touched since it may deform or tear.

3.9 Orientation 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.)

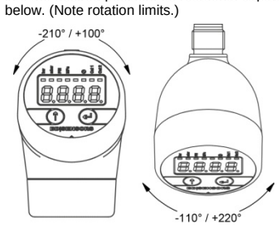


Fig. 2 Display module

4. Electrical Installation

WARNING	**Danger of death from electric shock** - Switch off the power supply before installing the device.

⚠ The supply must correspond to the safety class II (protective insulation)!

⚠ The transmitter shall be supplied by Limited Energy Source (per UL 61010) or NEC Class 2 Power Source!

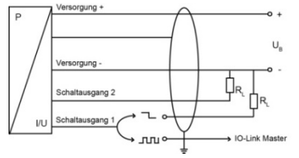
Electrically connect the device in accordance with the specifications given on the type plate, the following pin assignment table and the connection diagram.

Pin assignment table:

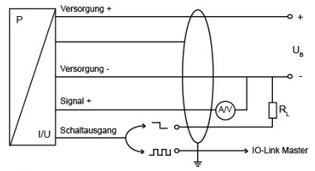
Electrical connections	M12x1 (4-pin) metal (without analog output)	M12x1 (4-pin) metal (with analog output)
Supply +	1	1
Supply –	3	3
Signal +	-	2
Communication/ Switching Output 1	4	4
Switching Output 2	2	-
Shielding	Pressure connector	Pressure connector

Connection diagrams:

3-wire system (IO-Link / SIO with switching output)



3-wire system (IO-Link / SIO with analog output)



☞ If possible, use a shielded and twisted multicore cable for the electrical connection.

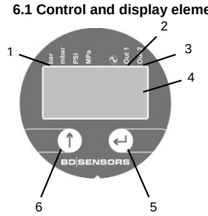
5. Commissioning

☞ Before using the device for the first time, check that it has been properly installed, and make sure that it does not show any visible defects.

☞ The device may by commissioned only by appropriately qualified specialist personnel who have read and understood the user manual.

6. Operation

6.1 Control and display elements



1. Four LEDs to indicate units
2. LED Out 1 yellow: Status display for Switching Output 1
3. LED Out 2 green: Status display for Switching Output 2
4. Seven segment display for measured value and parameters
5. Button for movement within a menu
6. Button from menu to menu

Fig. 3 Control pad for device with 2 switching outputs

LED status in Normal Mode		
yellow LED	On	switching Point 1 reached, switching output enabled
	Off	switch point not reached
green LED	On	switching Point 2 reached, switching output enabled
	Off	switching point not reached

Button function		
↑	short press	page from Menu 1 to Menu 5, and then back to the display.
	long press	rapidly increment parameter value
↵		select the menu item within a menu
		apply the set parameter and return to the current menu item
↑ + ↵	press both buttons at the same time	return to the display

The device is configured according to VDMA 24574-1.

6.2 Switching / resetting behavior

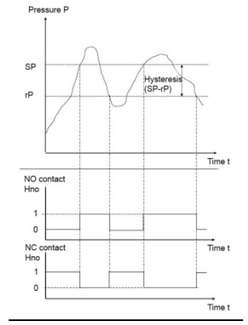


Fig. 4 Switching and resetting behavior for hysteresis function in pressure-time graph

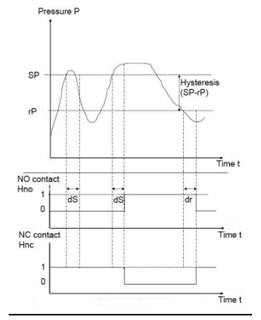


Fig. 5 Switching and resetting delay for hysteresis function in pressure-time graph

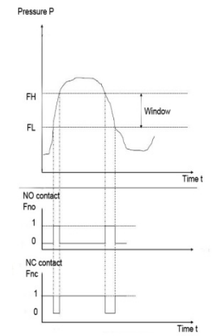


Fig. 6 Switching and resetting behavior for window function in pressure-time graph

6.3 Structure of the menu system

☞See DS3XX Menu System supplementary sheet

6.4 Menu list

First menu level	
SP 1 FH 1	**Menu 1 – Set Switching Point 1** Sets the particular value above which Switching Point 1 shall be enabled. If the window function is enabled in Menu 5:6, the value of Switching Point 1 is the upper pressure limit of the window (**F**enster**H**igh).
rP 1 FL 1	**Menu 2 – Set Return Point 1** Sets the particular value above which Return Point 1 shall be enabled. If the window function is enabled in Menu 5:6, the resetting value of Switching Point 1 is the lower pressure limit of the window (**F**enster**L**ow).
SP 2 FH 2	**Menu 3* – Set Switching Point 2** Sets the particular value above which Switching Point 2 shall be enabled. If the window function is enabled in Menu 5:7, the value of Switching Point 2 is the upper pressure limit of the window.
rP 2 FL 2	**Menu 4* – Set Return Point 2** Sets the particular value above which Return Point 2 shall be enabled. If the window function is enabled in Menu 5:7, the resetting value of Switching Point 2 is the lower pressure limit of the window.
EF	**Menu 5 – Extended Functions**
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	**Menu 5:2 – Switch Delay Time 1** Sets the value for Switch Delay Time 1 after reaching Switching Point 1 (setting range 0...50 s)
dr 1	**Menu 5:3 – Resetting Delay Time 1** Sets the value for Resetting Delay Time 1 after reaching Resetting Point 1 (setting range 0...50 s)
dS 2	**Menu 5:4* – Switch Delay Time 2** Sets the value for Switch Delay Time 2 after reaching Switching Point 2 (setting range 0...50 s)
dr 2	**Menu 5:5* – Resetting Delay Time 2** Sets the value for Resetting Delay Time 2 after reaching Resetting Point 2 (setting range 0...50 s)
ou 1	**Menu 5:6 – Output 1** Switching function of the switching output: Hno = Hysteresis function, normally open Hnc = Hysteresis function, normally closed Fno = Window function, normally open Fnc = Window function, normally closed
ou 2	**Menu 5:7* – Output 2** Switching function of the switching output: 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 Units** Selects the physical units for the displayed and set pressure values: bAr = bar, nnBa = mbar, PSi = PSI, mPA = MPa
lo	**Menu 5:9 – Min. Value** Displays the minimum pressure that was recorded during the measurement period (the value is lost if the voltage supply is interrupted)
Hi	**Menu 5:10 – Max. Value** Displays the maximum pressure that was recorded during the measurement period (the value is lost if the voltage supply is interrupted)
---	**Menu 5:11 – Delete Min. and Max. Values** The execution of the value deletion process is confirmed on the display
SET0	**Menu 5:12 – Zero Point Adjustment** Corrects the zero point of the display and the analog output signal by up to +/- 3% of the nominal pressure range
dAP	**Menu 5:13 – Measurement Damping** Sets the value for measurement damping (0...1000 ms in 10 ms steps)
codE	**Menu 5:14 – Access Protection** Sets the password for protecting access to the menu 0000 = No password Setting range 0000...9999
* Menus marked with an asterisk are not available for sensors with analog output	

Menu item	**Description**	**Factory setting**	**Own setting**
Menu 1 SP1/FH1	Switching Point 1 / Window High 1	80% of the nominal pressure	
Menu 2 rP1/FL1	Resetting Point 1 / Window Low 1	75% of the nominal pressure	
Menu 3 SP2/FH2	Switching Point 2 / Window High 2	80% of the nominal pressure	
Menu 4 rP2/FL2	Resetting Point 2 / Window Low 2	75% of the nominal pressure	
Menu 5:2 dS1	Switching Delay Time 1	0 sec	
Menu 5:3 dr1	Resetting Delay Time 1	0 sec	
Menu 5:4 dS2	Switching Delay Time 1	0 sec	
Menu 5:5 dr2	Resetting Delay Time 1	0 sec	
Menu 5:6 ou1	Switching Function for Output 1	Hno	
Menu 5:7 ou2	Switching Function for Output 2	Hno	
Menu 5:8 uni	Units	bar	
Menu 5:13 dAP	Measurement Damping	0 ms	
Menu 5:14 code	Password	0000	

7. IO-Link Interface

7.1 General device information

Baud rate	COM 2 (38.4 kbaud)
Input process data length	2 bytes
Minimum cycle time	5 ms
IO-Link version	V 1.1
SIO mode	Yes

7.2 SIO mode (standard IO mode)

In this mode the sensor operates like a normal pressure 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 analog or an additional digital output.

7.3 IO-Link mode (communication mode)

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

7.3 Process data

The process data length of the sensor is 16 bits. The switch 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

7.3 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

7.4 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

7.5 Parameter data

The parameter data for the pressure sensor correspond to the Smart Sensor profile.

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: IO-Link Lock 0x02: Data Storage Lock 0x04: Parameterization Lock 0x08: User Interface Lock 0x03: IO-Link Lock + Data Storage Lock 0x05: IO-Link Lock + Parameterization Lock 0x09: IO-Link Lock + User Interface Lock 0x06: Data Storage Lock + Parameterization Lock 0x0A: Data Storage Lock + User Interface Lock 0x07: Data Storage Lock + IO-Link Lock + Parameterization Lock 0x0B: Data Storage Lock + IO-Link Lock + User Interface Lock	0x00: Unlocked	
0x24	0x00	Device status	0x00 Device is operating properly 0x02 Out-of-Specification 0x04 Failure		
0x3D	0x02	SwitchPoint mode 1	0x80: Hysteresis NO 0x81: Hysteresis NC 0x82: Window NO 0x83: Window NC	0x80: HNo	
0x3F	0x02	SwitchPoint mode 2	0x80: Hysteresis NO 0x81: Hysteresis NC 0x82: Window NO 0x83: Window NC	0x80: HNo	
0xD4	0x00	Unit	0x00 bar 0x01 mbar 0x02 PSI 0x03 MPa	0x00: bar	Pressure units for the display are changed; the IO-Link process data are not changed

Index hex	**Sub-index hex**	**Object name**	**Access**	**Length**	**Value range**	**Gradient**	**Unit**	**Default**
0x3C	0x01	SetPoint 1 = SP1	R/W	2 bytes	Process Data			100%
0x3C	0x02	SetPoint 2 = rP1	R/W	2 bytes	Process Data			0%
0x3E	0x01	SetPoint 1 = SP2	R/W	2 bytes	Process Data			100%
0x3E	0x02	SetPoint 2 = rP2	R/W	2 bytes	Process Data			0%
0x60	0x00	Password	W	4 bytes	0000..9999			0
0xD0	0x00	Switching Delay Time 1	R/W	2 bytes	0..500	0.1	sec	0
0xD1	0x00	Resetting Delay Time 1	R/W	2 bytes	0..500	0.1	sec	0
0xD2	0x00	Switching Delay Time 2	R/W	2 bytes	0..500	0.1	sec	0
0xD3	0x00	Resetting Delay Time 2	R/W	2 bytes	0..500	0.1	sec	0
0xD5	0x00	Min Pressure Value	R	2 bytes	Process Data			
0xD6	0x00	Max Pressure Value	R	2 bytes	Process Data			
0xD7	0x00	Measurement Damping	R/W	2 bytes	0…1000 in 10 ms steps	1	ms	0

8. Decommissioning

WARNING	**Danger of injury from media escaping under pressure** - Dismount in an orderly fashion when the machine is depressurized and the power supply has been switched off. - Check whether the medium needs to be drained before dismounting!
WARNING	**Danger of injury from the measured medium** - Depending on the measured medium, suitable precautions should be taken, e.g. protective gloves, goggles.

9. Maintenance

The device is, in principle, maintenance free. If necessary, the housing of the device may be cleaned with a damp cloth and a non-aggressive cleaning solution while it is switched off.

With certain media may, however, deposits or contamination may accumulate on the diaphragm. The specification of appropriate maintenance intervals for inspection.is recommended in this case. Once the device has been properly decommissioned, the diaphragm can normally be cleaned with a non-aggressive cleaning solution and a soft brush or sponge. Care should be taken while doing so. If the diaphragm is covered in limescale, decalcification by BD SENSORS is recommended. See the Servicing/Repair section with regard to this.

☞Incorrect cleaning can result in irreparable damage to the measuring cell. For this reason, you should never use sharp objects or compressed air to clean the diaphragm.

10. Servicing/Repair

10.1 Recalibration

It is possible that the offset value or the scaling value may shift during the lifetime of the device. This is indicated by a deviation in the output signal value with reference to the set measurement range start or end values respectively. If either of these two phenomena should occur after a prolonged period of use, recalibration is recommended in order to ensure a continued high level of accuracy.

10.2 Return

Whenever the device is returned, no matter whether for recalibration, decalcification, modification or repair, it must be carefully cleaned and packed such that there is no risk of breakage. The device must be accompanied by a notice of return giving a detailed description of the fault. If your device has come into contact with pollutants, then a notice of decontamination will also be needed. You can find the relevant templates on our website at **www.bdsensors.de**. Should you send in your device without a notice of decontamination and doubts with regard to the medium used should arise in our service department, repair work will commence only once an appropriate notice has been received.

Caution	**Danger of injury from pollutants** - If the device has come into contact with pollutants, wear suitable protective clothing, e.g. gloves, goggles, when cleaning it.

11. Disposal

The device must be disposed of in accordance with European Directives 2002/96/EC and 2003/108/EC (Waste Electrical and Electronic Equipment). Waste electrical products may not be disposed of with household waste!

☞ Depending on the medium used, residues on the device may constitute a hazard to the environment. You should therefore take appropriate precautions if necessary and dispose of the device properly.

12. Guarantee Conditions

The guarantee conditions are subject to the statutory warranty period of 24 months, starting from the date of dispatch. No warranty claims will be accepted if the device has been used improperly, modified or damaged. The warranty does not cover damaged diaphragms. Warranty cover also excludes any claims for defects that have arisen as a result of normal wear.

13. Declaration of Conformity / CE

The supplied device fulfills the statutory requirements. The relevant directives, harmonized standards and documents are listed in the EU Declaration of Conformity applicable to the product. This can be found at http://www.bdsensors.de. In addition, the operational safety of the device is confirmed by the CE mark on the type plate.