BD SENSORS®
pressure measurement

Operating Manual

Plug-On Display for IS-areas

AX14-PA 430

0637

READ THOROUGHLY BEFORE USING THE DEVICE
KEEP FOR FUTURE REFERENCE

ID: BA_PA430-EX_E_SRO | Version: 09.2020.0

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.

The following documents are an important part of the operating manual:

- *data sheet*
- *type-examination certificate*

For specific data on the individual device, please refer to the respective data sheet.

Download these by accessing *www.bdsensors.cz* or request them: info@bdsensors.cz | phone.: +420 572 411 011

The IS versions of our products are variants of the standard products.

Example: Standard: PA 430 → IS version: AX14-PA 430

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

For the installation, maintenance and cleaning of the device, the relevant regulations and provisions on explosion protection (VDE 0160, VDE 0165 and/or EN 60079-14) as well as the accident prevention regulations must absolutely be observed.

The device was designed by applying the following standards:

- EN IEC 60079-0:2018
- EN 60079-11:2012

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 **PA 430 plug-on display** is used for measured value display and optionally for limit point monitoring (with PNP open collector output) for a large variety of transmitters (pressure, temperature, etc.) with 4 ... 20 mA / 2-wire analogue output. The PA 430 may be used with all transmitters if the following requirements are met:

• output signal of the transmitter: 4 … 20 mA / 2-wire

• suitable electrical connection (according to data sheet)

The digital plug-on display PA 430 has to be mounted between the connector and transmitter and is ready for immediate operation. No additional supply is required, the display is supplied by the 4 … 20 mA circuit. A preferred application is on-site process monitoring, for example.

Programming is performed via two buttons on the front side. The following parameters can be set: scaling, decimal point, damping, switch point, and delay. Moreover, a min./max. value memory is available. The settings will be retained even in case of a power failure. Incidences of range exceedance in both directions can be displayed as messages. The integrated diagnostic system constantly monitors all functions of the display. The housing can be turned by 300° in an infinitely variable manner, the display by 330°.

This operating manual applies to devices with explosion protection approval and is intended for the use in IS-areas. A device has an explosion-protection approval if this was specified in the purchase order and confirmed in our order acknowledgement. In addition, the manufacturing label includes a Ⓔx sign.

The user must check whether the device is suited for the selected use. In case of doubt, please contact our sales department: info@bdsensors.cz | phone: +420 572 411 011

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

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 or download it from our homepage: http://www.bdsensors.cz

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

1.4 Foreseeable misuse

The digital plug-on display AX14-PA 430 must not be used particularly in the following cases:
In areas for which the device has no approval. When the AX14-PA 430 is used in combination with other devices, the approval of the device with the lowest approved area applies.

1.5 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.

1.6 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.

1.7 Safety-related maximum values

Permissible temperatures for environment: -25 ... 70 °C
U_i = 28 V, I_i = 93 mA, P_i = 660 mW, $C_i \approx 0$ nF, $L_i \approx 0$ µH
plus cable inductivities 1 µH/m and
cable capacities 100 pF/m (for cable by factory)

1.8 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:

- plug-on display PA 430
- only with ISO 4400 connector:
  fastening screw, profiled gasket
- sheet of unit labels
- operating manual

1.9 UL approval (for devices with UL marking)

The UL approval was effected by applying the US standards, which also conform to the applicable Canadian standards on safety.

Observe the following points so that the device meets the requirements of the UL approval:

- only indoor usage
- maximum operating voltage: according to data sheet
- The device must be operated via a supply with energy limitation (acc. to UL 61010) or an NEC Class 2 energy supply.

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. The version of the firmware, (e. g. P07) will appear for about 1 second in the display after starting up the device. Please hold it ready for inquiry calls.

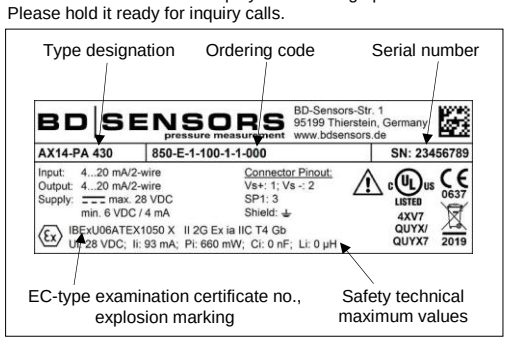


Fig. 1: Example of manufacturing label

NOTE - The manufacturing label must not be removed!

The marking for devices with explosion-protection approval has to include following information:

AX 14: EC-type examination certificate **IBExU06ATEX1050 X**

Ex-designation: **II 2G Ex ia IIC T4 Gb**

3. Mounting

3.1 Mounting and safety instructions

DANGER	**Danger of death from explosion, airborne parts, leaking fluid, electric shock** - Always mount the device in a depressurized and de-energized condition! - Do not install the device while there is a risk of explosion.
DANGER	**Danger of death from improper installation** - Installation must be performed only by appropriately qualified persons who have read and understood the user manual.

NOTE - The technical data listed in the EC type-examination certificate are binding. Download these by accessing www.bdsensors.cz or request them by e-mail or phone: info@bdsensors.cz | Tel.: +420 572 411 011

NOTE - Make sure that the entire interconnection of intrinsically safe components remains intrinsically safe. The owner-operator is responsible for the intrinsic safety of the overall system (entire circuitry).

NOTE - Make sure that an equipotential bonding is in place for the entire course of the line, both inside and outside the intrinsic area.

NOTE - The external circuit must prevent an external power-inflow to the contacts. Suitable signal separating devices which fulfil this demand have to be used.

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 of the device until shortly before the mounting procedure in order to exclude any damage! Dispose of the packaging properly!

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

3.2 Mounting steps for Binder and M12x1 connectors

1. Plug the plug-on display onto the transmitter.
2. Plug the cable socket or mating plug onto the PA 430 and fasten it properly.

3.3 Mounting steps for ISO-4400 connectors

1. Loosen and carefully pull off the cable socket from the transmitter.
2. Plug the PA 430 onto the transmitter. When doing so, ensure that the profiled gasket premounted on the bottom side is seated correctly.
3. Remove the fastening screw from the cable socket.
4. Replace the pre-assembled profile seal of the cable socket by the delivered seal to ensure an ingress protection of IP 65.
5. Plug the cable socket onto the PA 430.
6. Insert the supplied stainless steel screw through cable socket and plug-on display and tighten the screw handtight on the transmitter using a screwdriver.

3.4 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.

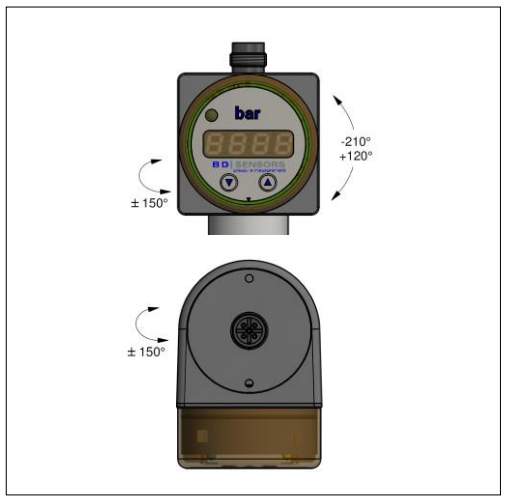


Fig. 2 Display module (example with M12x1)

4. Electrical connection

4.1 Connection and safety instructions

DANGER	**Danger of death from electric shock or explosion** - Explosion hazard if the operating voltage is too high (max. 28 V_{DC}). - Always mount the device in a depressurized and de-energized condition! - Do not install the device while there is a risk of explosion. - Operate the device only within the specification! (according data sheet and EC-type examination certificate)

✓ The limit values listed in the EC type-examination certificate are observed. (Capacity and inductance of the connection cable are not included in the values.)

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

NOTE - If the device is equipped with a **cable socket** it must be ensured that the external diameter of the used cable is within the permissible clamping range. Moreover you have to ensure that it lies in the cable gland firmly and cleftlessly!

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

4.2 Conditions for the explosion-hazardous area

Danger generated by electrostatic charging

DANGER	**Danger of death from explosion** - Explosion hazard due to spark formation from electrostatic charging of plastic components. - If devices are equipped with a cable outlet, the connection cable routing must be fixed. - Do not clean the device and, if applicable, the connection cable, in a dry state! Use a moist cloth, for example.

Overvoltage protection

If the device is used as electrical equipment of category 1 G, a suitable overvoltage protection device must be connected in series (attend the valid regulations for operating safety as well as EN60079-14).

Schematic circuit design

The operation of an intrinsically safe device in intrinsic safe areas requires special care when selecting the necessary Zener barrier or transmitter repeater devices to be able to use the device's characteristics to the full extent. The following diagram shows a typical arrangement of power supply, Zener barrier and plug-on display.

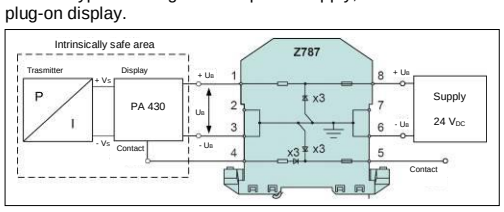


Fig. 3: circuit diagram

NOTE - Observe item (17) of the type-examination certificate which specifies special conditions for intrinsically safe operation.

Exemplary circuit description

The supply voltage of e. g. 24 V_{DC} provided by the power supply is led across the Zener barrier. The Zener barrier contains series resistances and Zener diodes as protective components. Subsequently, the operating voltage is applied to the device and, depending on the pressure, a particular signal current will flow.

Selection criteria for Zener barriers and galvanic power supply

The minimum supply voltage $V_{S\ min}$ of the device must not fall short.

When using a galvanically insulated amplifier with a linear bonding, please attend that the terminal voltage of the device will decrease like it does with a Zener barrier. Furthermore, account must be taken of the fact that a certain voltage drop will also occur on an optionally used signal isolation amplifier, whereby the operating voltage of the device will decrease additionally.

Test criteria for the selection of the Zener barrier

In order not to fall below $V_{S\ min}$, it is important to verify which minimum supply voltage is available at full level control of the device.

The technical data of the barrier will usually provide the information needed for the selection of the Zener barrier. However, the value can also be calculated. If a minimum supply voltage of e.g. 16 V is assumed, a certain voltage drop on the series resistor of the Zener barrier follows in accordance with Ohm's law. If the contact is additionally activated on a device with PNP switch output, the additional current flowing from the contact to the load resistor will also flow through the Zener barrier or from the output of a galvanic power supply. The higher the load current, the lower the available minimum operating voltage. In the circuit shown, the maximum current can be calculated from the maximum voltage difference ($V_{ab\ barrier\ max}$) between input and output of the Zener barrier divided by the series resistance of the Zener barrier. The maximum signal current must be subtracted from this value. If the available residual current is smaller than the current required at the contact, either a different barrier or a higher supply voltage before the barrier should be chosen.

NOTE - When selecting the power supply, the maximum operating conditions according to the EC type-examination certificate must be observed. When assessing the power supply, please refer to their current data sheets to ensure that the entire interconnection of intrinsically safe components will remain intrinsically safe.

Calculation example for the selection of the Zener barrier

The nominal voltage of the power supply in front of the Zener barrier is 24 V_{DC} ± 2%. This results in:

- greatest supply voltage: $V_{Sup\ max}$ = 24 V * 1.02 = 24.48 V
- smallest supply voltage: $V_{Sup\ min}$ = 24 V * 0.98 = 23.52 V

First, the minimum supply voltage of the combination of plug-on display and transmitter must be determined. This results from the minimum supply voltage of the transmitter plus the voltage drop of the plug-on display which is nominally 6 V. For example, $U_{B\ transmitter\ min}$ = 10 V results in a minimum supply voltage $V_{B\ min}$ = 16 V.

The series resistor of the Zener barrier is specified with 295 Ω. The maximum voltage drop at the Zener barrier may reach the following value:

$V_{ab\ barrier\ max}$ = 23.52 V – 16 V = 7.52 V

In order for this condition to be adhered to, the maximum current must not exceed the following value:

I_{max} = 7.52 V : 295 Ω = 25.49 mA

The maximum current of the combination of plug-on display and transmitter is made up of the sum of signal current and switching current. There are two approaches:

1. The measuring range is to be utilized in the range of 0 … 100 %. A maximum signal current of 20 mA is generated thereby. Based on the facts above, the available residual current through the switch output is calculated as follows:
   $I_{Resid\ 1}$ = 25.49 mA – 20 mA = 5.49 mA
2. With an analogue output of 4 ... 20 mA, the measuring range is to be utilized only in a specific range, e.g. 0 … 70 %. This results in a maximum signal current:
   $I_{Signal\ max} = \Delta i * 0.7 + i_{Offset}$ = 16 mA * 0.7 + 4 mA = 15.2 mA
   (with Δi = 20 mA – 4 mA and i_{Offset} = 4 mA)

Here, the available residual current through the switch output is:

$I_{Resid\ 2}$ = 25.49 mA – 15.2 mA = 10.29 mA

Condition: $I_{Resid} \geq I_{Switch\ output}$

The switching current (current through the switch output) must not exceed the determined residual current since this will impair the functionality of the device.

NOTE - The switching current must be determined separately by the user as it depends on the particular case of application. The switching current can be calculated or measured at the switch output.

NOTE - Please note that no line resistances have been listed in this calculation. These lead additionally to a voltage drop that must be taken into account.

4.3 Electrical installation

Connect the device electrically according to the information specified on the type plate, the following table, and the connection circuit diagram.

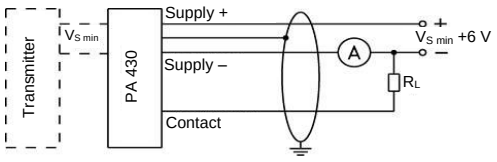
Pin configuration:

Electrical connections	ISO 4400	M12x1, metal (5-pin)
Supply +	1	1
Supply –	2	2
Contact 1	3	5
Shield	ground pin ⏚	4

Electrical connections	Binder 723 (5-pin)	Binder 723 (7-pin) [1]
Supply +	3	3
Supply –	4	1
Contact 1	2	-
Shield	ground pin	2

[1] designated for usage with DMP 331i, DMP 333i or LMP 331i with Binder 723 series (7-pin) electrical connector; Pins 4, 5, 6, 7 are 1:1 through-wired

Wiring *diagram:*



Voltage supply

The voltage drop generated by the device electronics is approx. 6 V_{DC}. Consider this when designing your system supply. The limit values of the voltage supply are calculated as follows:

minimum operating voltage: $V_{S\,min} = V_{transmitter\,min} + 6\ V$

maximum operating voltage: $V_{S\,max} = V_{transmitter\,max} + 6\ V$

$V_{transmitter\,min}$ = minimum operating voltage of the 2-wire transmitter used

$V_{transmitter\,max}$ = maximum operating voltage of the 2-wire transmitter used

5. Commissioning

DANGER	**Danger of death from explosion** - Explosion hazard if the operating voltage is too high (max. 28 V_{DC})! - Operate the device only within the specification! (according to data sheet and EC type-examination certificate)

✓ The device has been installed properly.

✓ The device does not have any visible defect.

6. Operation

6.1 Control and display elements

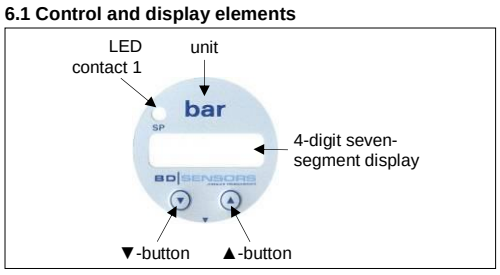


Fig. 5 touchpad

The device has, according to the order max. one LED which is allocated to the contact. The LED will light up when the set point has been reached and the contact is active. The display of the measured value as well as the configuration of the individual parameters occurs menu-driven via the seven-segment display.

Button functions	
▲	• move forward in the menu system (beginning with menu 1) • increase the displayed value note: increase the counting speed by keeping the button pushed for more than 5 second
▼	• move backwards in the menu system (beginning with the last menu) • decrease the displayed value note: increase the counting speed: keep the button pushed for more than 5 second
▼ + ▲	confirm the menu items and set values by pushing both buttons simultaneously

execution of configuration:

- set the desired menu item by pushing the ▲- or ▼-button
- activate the set menu item by pushing both buttons simultaneously
- set the desired value or select one of the offered settings by using the ▲- or ▼-button
- store / confirm the set value/selected setting and exit the menu by pushing both buttons simultaneously

6.2 Configuration

The menu system is a closed system allowing you to scroll both forward and backward through the individual set-up menus to navigate to the desired setting item. All settings are permanently stored in an EEPROM and therefore available again even after disconnecting from the supply voltage. The structure of the menu system is the same for all types of devices, regardless of the number of contacts. However, they only differ by the number of menus. Following figure and the menu list shows all possible menus.

Please follow the manual meticulously and remember that changes of the adjustable parameters (switch-on point, switch-off point, etc.) become only effective after pushing both buttons simultaneously and leaving the menu item.

6.3 Password system

The device can be locked in order to prevent configuration by unauthorized persons. Refer to menu 1 of the menu list for more information.

6.4 Unit

The unit of the measured value is already determined at the time of ordering by the desired measuring range. However, the device may also be labelled with another unit at a later time by attaching one of the supplied unit labels.

6.5 Explanation of hysteresis and compare mode

In order to invert the respective mode, the values for switch-on and switch-off points must be exchanged.

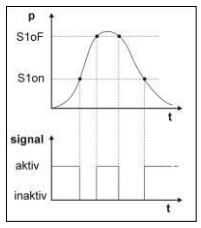


Fig. 5: Compare mode

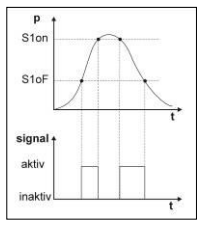


Fig. 6: Compare mode inverted

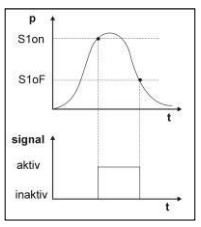


Fig. 7: Hysteresis mode

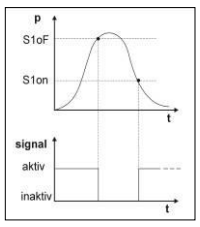
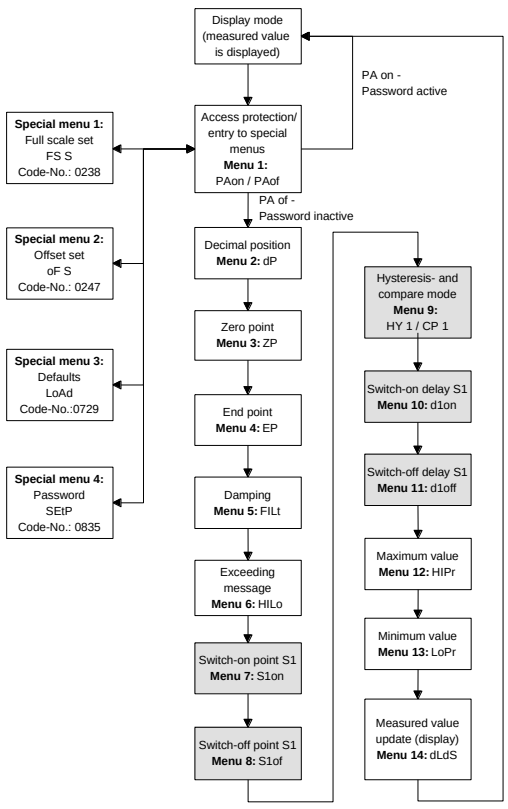


Fig. 8: Hysteresis mode inverted

6.6 Menu system structure



6.7 Menu list

✓ button functions are well known (see ″7.1 Control and display elements″)

PAon PAoF	**menu 1 – access protection** PAon ➔ password **active** ➔ to deactivate: set password PAof ➔ password **inactive** ➔ to activate: set password default setting for the password is "0005"; modification of the password is described in special menu 4
dP	**menu 2 – set decimal point position**
ZP EP	**menus 3 and 4 – set zero point / end point** the device has been configured correctly before delivery, so a later setting is only necessary, if a differing displayed value is desired (e. g. 0 ... 100 %)
F ILt	**menu 5 – set damping** this function allows getting a constant display value although the measuring values may vary considerably; the time constant for a simulated low-pass filter can be set (0.3 up to 30 sec permissible)
H ILo	**menu 6 – exceeding message** set "on" or "off"
S 1on	**menus 7 – set switch-on point** set the values, for the activation of contact 1
S 1oF	**menus 8 – set switch-off point** set the values, for the deactivation of contact 1
HY 1 CP 1	**menus 9 – select hysteresis or compare mode** select hysteresis mode (HY 1) or compare mode (CP 1) for contact 1
d 1on	**menus 10 – set switch-on delay** set the value of the switch-on delay after reaching contact 1 (0 up to 100 sec permissible)
d 1oF	**menus 11 – set switch-off delay** set the value of the delay after reaching switch-off point 1 (0 up to 100 sec permissible)
H IPr LoPr	**menus 12 and 13 – maximum / minimum pressure display** view high pressure (HIPr) or low pressure (LoPr) during the measurement process (the value will not remain stored if the power supply is interrupted) to delete: push both buttons again within one second
dLdS	**menu 14 – measured value update (display)** set the length of the update cycles for the display (0.0 up to 10 sec permissible)

special menus (to access a special menu, select the menu item "PAof" with the ▲- or ▼-button and confirm it; "1" appears in the display)	
FS S	**special menu 1 – full scale compensation** for full scale compensation, which is necessary if the indicated value for full scale differs from the real full scale value in the application: a compensation is only possible with a respective reference source, if the deviation of the measured value is within defined limits; set "0238"; confirm with both buttons; "FS S" will appear in the display; now it is necessary to place the device under pressure (the pressure must correspond to the end point of the pressure measuring range); push both buttons, to store the signal being emitted from the device as full scale; in the display the set end point will appear although the full scale sensor signal is displaced the analogue output signal (for devices with analogue output) is not affected by this change
oF S	**special menu 2 – offset compensation / position correction** set "0247";confirm menu item; if offset ≠ ambient pressure it is necessary to place the device under pressure (pressure reference has to correspond to the zero point of the pressure measuring range); push both buttons to store the signal being emitted from the device as offset; in the display the set zero point will appear although the sensor signal in the offset is displaced. A position correction is necessary, if the installation position differs from the calibration position (otherwise this can cause a little deviation of the signal, which gives a wrong value indication). The analogue output signal (for devices with analogue output) is not affected by this change; when displacing the offset, the full scale will also be displaced.
LoAd	**special menu 3 – load defaults** set "0729; to load the defaults, push both buttons simultaneously; any changes carried out will be reset (password will be set on "0005")
SEtP	**special menu 4 – set password** set "0835"; confirm with both buttons; "SEtP" appears in the display; set the password using the ▲- or ▼-button (0 ... 9999 are permissible, the code numbers 0238, 0247, 0729, 0835 are exempt); confirm the password by pushing both buttons simultaneously

7. Maintenance

DANGER	**Danger of death from explosion, airborne parts, leaking fluids, electric shock** - Working on supplied (active) parts, except for intrinsically safe circuits, is principally prohibited during an explosion hazard! - 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.

In principle, the device requires no maintenance.
If necessary, clean the housing of the device using a moist cloth and a non-aggressive cleaning solution.

8. 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.

9. Service / repair

Information on service / repair:

- www.bdsensors.cz
- info@bdsensors.cz
- service phone: +420 572 411 011

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, it has to be cleaned carefully and packed shatter-proofed. You have to enclose a notice of return with detailed defect description for defective devices. 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.cz or request them: info@bdsensors.cz | phone: +420 572 411 011

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

10. 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!

11. 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 diaphragm 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.

12. 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, which is available online at: http://www.bdsensors.cz.

Additionally, the operational