EN

BD SENSORS® pressure measurement

Operating Manual

Pressure Transmitter for Shipbuilding and Offshore Applications for IS-Areas

DX4A DMK 456, DX14A DMK 458,
DX9 DMK 457, DX19 DMP 457

DMP 457

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1. General information

1.1 Information on the operating manual

This operating manual contains important information on proper usage of the device. Read this operating manual carefully before installing and starting up the pressure measuring device.

Adhere to the safety notes and operating instructions which are given in the operating manual. Additionally applicable regulations regarding occupational safety, accident prevention as well as national installation standards and engineering rules must be complied with!

For the installation, maintenance and cleaning of the device, you must absolutely observe the relevant regulations and stipulations on explosion protection (VDE 0160, VDE 0165 or EN 60079-14) as well as the occupational safety provisions. The device was constructed acc. to standards

DX4A: EN IEC60079-0:2018, EN60079-11:2012, EN60079-26:2015

DX9: EN IEC60079-0:2018, EN60079-11:2012, EN60079-26:2015

This operating manual is part of the device, must be kept nearest its location, always accessible to all employees.

– Technical modifications reserved –

1.2 Symbols used

⚠ DANGER! – dangerous situation, which may result in death or serious injuries

⚠ WARNING! – potentially dangerous situation, which may result in death or serious injuries

⚠ CAUTION! – potentially dangerous situation, which may result in minor injuries

! CAUTION! – potentially dangerous situation, which may result in physical damage

☞ NOTE – tips and information to ensure a failure-free operation

1.3 Target group

⚠ WARNING! To avoid operator hazards and damages of the device, the following instructions have to be worked out by qualified technical personnel.

1.4 Limitation of liability

By non-observance of the operating manual, inappropriate use, modification or damage, no liability is assumed and warranty claims will be excluded.

1.5 Intended use

- Pressure transmitters DMK 456, DMK 457, DMK 458 and DMP 457 have been designed for typical applications in shipbuilding and offshore constructions. They are suitable for measuring tasks with fluids and gases. Typical applications of DMK 456 and DMK 458 are pressure monitoring for loading and discharge processes as well as level measurement for ballast and product storage tanks. Preferred areas of usage for DMK 457 are gears, compressors, boilers, pneumatic controls, elevators, oxygen applications and e.g. level measurement into ballast tanks, etc.. With mechanical versions G1/2" open port or G1/2" flush DIN 3852 the DMK 457 is especially suited for viscous, pasty or contaminated media due to the easily reachable ceramic diaphragm. Preferred areas of usage for DMP 457 are diesel engines, gears, compressors, pumps, boilers, hydraulic and pneumatic controls as well as elevators. The pressure transmitters DMK 456, DMK 457, DMK 458 and DMP 457 fulfil the requirements of Det Norske Veritas (DNV) as standard. The certificates are available for download on our homepage: http://www.bdsensors.com/prouct s/download/certificates
- 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 has been specified in the purchase order and confirmed in our order confirmation. In addition, the manufacturing label contains the Ⓔx-symbol.
- It is the operator's responsibility to check and verify the suitability of the device for the intended application. If any doubts remain, please contact our sales department in order to ensure proper usage. BD SENSORS is not liable for any incorrect selections and their effects!
- Permissible media are gases or liquids, which are compatible with the media wetted parts described in the data sheet. In addition it has to be ensured, that this medium is compatible with the media wetted parts.
- The technical data listed in the current data sheet are engaging. If the data sheet is not available, please order or download it from our homepage. (http://www.bdsensors.com/products/download/datasheets)

⚠ WARNING! – Danger through improper usage!

1.6 Safety technical maximum values

supply and signal circuit:

DX14A-DMK 456; DX14A-DMK 458 with field housing:
U_i = 28 V; I_i = 93 mA; P_i = 660 mW; C_i = 52,3 nF;
L_i = 5 µH; 90,2 nF opposite GND; plus cable inductivities 1 µH/m and cable capacities 160 pF/m (for cable by factory)

DX14A-DMK 458 with ISO 4400, M12x1, cable outlet:
U_i = 28 V; I_i = 93 mA; P_i = 660 mW; C_i = 105 nF;
L_i = 5 µH; 140 nF opposite GND; plus cable inductivities 1 µH/m and cable capacities 160 pF/m (for cable by factory)

DX19-DMK 457, DX19-DMP 457:
U_i = 28 V, I_i = 93 mA, P_i = 660 mW, L_i ≤ 5 µH, with field housing C_i = 105 nF, with cable outlet C_i = 84.7 nF, with ISO 4400 C_i = 62.2 nF effective internal capacitance to ground ≤ 90 nF (140 nF with fieldhousing); plus cable inductivities 1 µH/m and cable capacities 160 pF/m (for cable by factory)

permissible temperatures for environment:

DX4A-DMK 456: -20 ... 60 °C

DX4A-DMK 458:
in zone 0 (p_{atm} 0.8 up to 1.1 bar): -20 ... 60 °C
in zone 1: -25 ... 70 °C

DX9-DMK 457, DX19-DMP 457:
in zone 0 (p_{atm} 0.8 up to 1.1 bar): -20 ... 60 °C
in zone 1: -20 ... 70 °C

1.7 Package contents

Please verify that all listed parts are undamaged included in the delivery and check for consistency specified in your order:

- pressure transmitter
- this operating manual

2. Product identification

The device can be identified by its manufacturing label. It provides the most important data. By the ordering code the product can be clearly identified.

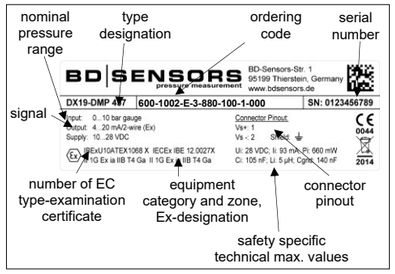


Abb. 1 manufacturing label- example

! The manufacturing label must not be removed from the device!

3. Mechanical installation

3.1 Mounting and safety instructions

⚠ WARNING! Install the device only when depressurized and currentless!

⚠ WARNING! This device may only be installed by qualified technical personnel who has read and understood the operating manual!

⚠ DANGER! Caused by the explosion hazard following instructions have to be complied with:

- The technical data listed in the EC type-examination certificate are engaging and must absolutely be complied with. If the certificate is not available, please order or download it from our homepage: http://www.bdsensors.com/products/ download/certificates
- Working on supplied (active) parts, except for intrinsically safe circuits, is principally prohibited during an explosion hazard.
- Make sure that an equipotential bonding is in place for the entire course of the line, both inside and outside the intrinsic area.
- In case of increased danger of lightning strike or damage by overvoltage, a stronger lightning protection should be planned.
- Observe the limiting values specified in the EC type-examination certificate. (Capacitance and inductance of the connection cable are not included in the values.)
- Make sure that the entire interconnection of intrinsically safe components remains intrinsically safe. The operator is responsible for the intrinsic safety of the overall system (installation of intrinsic parts).
- Do not mount the device in a pneumatic flow rate!
- Excessive dust deposits (over 5 mm) and a complete dust covering must be avoided!
- It is prohibited to open a device with field housings in the presence of explosion hazards.

⚠ DANGER! Explosion hazard, with devices for oxygen applications, when used improperly. To ensure a usage without danger, the following points must be adhered to:

- Make sure, your device has been ordered and delivered as a special version for oxygen applications. You can check the manufacturing label (see figure 1). If the ordering code ends with "007", then the device is suitable for oxygen applications.
- At time of delivery the device is packed into a plastic bag in order to prevent it from impurity. Please observe the indication label "Device for oxygen, unpack only directly before assembling". Also, avoid any skin contacts during unpacking and assembly, in order to prevent greasy residues on the device.
- During installation, the respective explosion protection regulations have to be met.
- Note the entire design requirements meet the standard demand of BAM (DIN 19247).
- Transmitters with o-rings of FKM Vi 567: permissible maximum values: 15 bar/ 60° C.

! Handle this high-sensitive electronic precision measuring device with care, both in packed and unpacked condition!

! There are no modifications/changes to be made on the device.

! Do not throw the package/device!

! To avoid damaging the diaphragm, remove packaging and protective cap directly before starting assembly. The delivered protective cap has to be stored!

! Place the protective cap on the pressure port again immediately after disassembling.

! Handle the unprotected diaphragm very carefully - it is very sensitive and may be easily damaged.

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

! For installations outdoor and in damp areas following these instructions:

- To prevent moisture admission in the plug the device should be installed electrically after mounting, at once. Otherwise a moisture admission has to be blocked e.g. by using a suitable protection cap. (The ingress protection in the data sheet is valid for the connected device.)
- Choose an assembly position, which allows the flow-off of splashed water and condensation. Avoid permanent fluid at sealing surfaces!
- When using a cable gland device, turn the outgoing cable downwards. If the cable has to be turned upwards, then point it downward so the moisture can drain.
- Install the device in such a way that it is protected from direct solar irradiation. Direct solar irradiation can lead to the permissible operating temperature being overstepped in the worst case. This is prohibited for applications in IS-areas!

! For devices with gauge reference in the housing (small hole next to the electrical connection), install the device in such a way, that the gauge reference is protected from dirt and moisture. Should the device be exposed to fluid admission, the functionality will be blocked by the gauge reference. An exact measurement in this condition is not possible. Furthermore this can lead to damages on the device.

☞ Take care that no inadmissibly high mechanical stresses occur at the pressure port as a result of the installation, since this may cause a shifting of the characteristic curve or to the demage. This is especially important for very small pressure ranges as well as for devices with a pressure port made of plastic.

☞ In hydraulic systems, position the device in such a way that the pressure port points upward (venting).

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

3.2 General installation steps

- Carefully remove the pressure measuring device from the package and dispose of the package properly.
- Go ahead as detailed in the specific instructions below.

3.3 Installation steps for DIN 3852

⚠ **DO NOT USE ANY ADDITIONAL SEALING MATERIALS, LIKE YARN, HEMP OR TEFLON TAPE!**

- Check to ensure the proper groove fitting of the o-ring and additionally to ensure no damage to the o-ring.
- Ensure that the sealing surface of the taking part is perfectly smooth and clean. (R_z 3,2)
- Screw the device into the corresponding thread by hand.
- Tighten it with a wrench (G1/4": approx. 5 Nm; G1/2": approx. 10 Nm; G3/4": approx. 15 Nm; G1": approx. 20 Nm; G1 1/2": approx. 25 Nm). **The indicated tightening torques must not be exceeded!**

3.4 Installation steps for EN 837

- Use a suitable seal, corresponding to the medium and the pressure input (e. g. a cooper gasket).
- Ensure that the sealing surface of the taking part is perfectly smooth and clean. (R_z 6.3)
- Screw the device into the corresponding thread by hand.
- Tighten it with a wrench (for G1/4": approx. 20 Nm; for G1/2": approx. 50 Nm). **The indicated tightening torques must not be exceeded!**

3.5 Installation steps for NPT

- Use a suitable seal (e. g. a PTFE-strip).
- Screw the device into the corresponding thread by hand.
- Tighten it with a wrench (for 1/4" NPT: approx. 30 Nm; for 1/2" NPT: approx. 70 Nm). **The indicated tightening torques must not be exceeded!**

3.6 Installation steps for connecting flanges

- Use a suitable seal corresponding to the medium and the pressure input. (e. g. a fiber gasket).
- Put the seal between connecting flange and counter flange.
- Install the device with 4 resp. 8 screws (depending on flange version) on the counter flange.

4. Special regulations for IS-areas

4.1 Protection against electrostatic charge hazards

Different types of submersible pressure transmitters partially consist of chargeable plastic components. These are, in particular, the carrying and connection cables. A potential electrostatic charge presents the danger of spark generation and ignition. An electrostatic charge must therefore be absolutely prevented.

☞ Generally, a shielded cable must be used.

☞ Avoid friction on the plastic surfaces!

☞ Do not clean the device dry! Use, for example, a damp cloth.

4.2 Overvoltage protection

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

4.3 Schematic circuit

The operation of an intrinsically safe transmitter in intrinsic safe areas requires special care when selecting the necessary Zener barrier or transmitter repeater devices to allow the utilization of the device's properties to the full extent. The following diagram shows a typical arrangement of power supply, Zener barrier and transmitter.

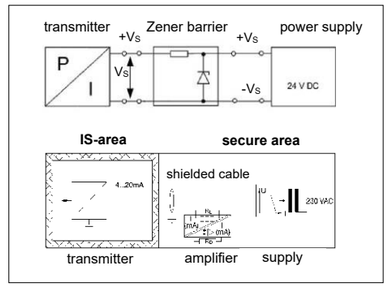


Fig. 2 Circuit diagrams

! Please pay attention to item (17) of the type examination certificate, which stipulates special conditions for intrinsically safe operation.

4.4 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 breakdown diodes as protective components. Subsequently, the operating voltage is applied to the transmitter and, depending on the pressure, a particular signal current flows.

⚠ When installing the intrinsically safe device as zone-0-equipment, the supplying must be carried out by a power supply which must be galvanically insulated and which must not be grounded.

4.5 Functional selection criteria for Zener barriers and galvanic power supply

The minimum supply voltage $V_{S\,min}$ of the transmitter must not fall short since a correct function of the device can otherwise not be guaranteed. The minimum supply voltage has been defined in the respective product-specific data sheet under "Output signal / supply".

For supplying the device a galvanically insulated amplifier or a Zener barrier (depending on the zone) with linear bonding has to be used. Note that therefore the terminal voltage of the transmitter will decrease. Furthermore, you have to note that the supply will additionally decrease with an optionally used signal amplifier.

4.6 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 transmitter. The full level control, i.e. a maximum or nominal output signal (20 mA), can be reached by applying the maximum physical input signal (pressure).

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 maximum signal current of 0.02 A is assumed, then – according to Ohm's law – a particular voltage drop will result from the series resistance of the Zener barrier. This voltage drop is subtracted by the voltage of the power supply and as a result, the terminal voltage is obtained which is applied on the transmitter at full level control. If this voltage is smaller than the minimum supply voltage, another barrier or a higher supply voltage should be chosen.

☞ When selecting the supplied devices / Zener barrier, the maximum operating conditions according to the EC type-examination certificate must be observed. When assessing these, refer to their current data sheets to ensure that the entire interconnection of intrinsically safe components remains intrinsically safe.

4.7 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} ± 5 %. This results in:

- greatest supply voltage:
  $V_{Sup\,max}$ = 24 V * 1.05 = 25.2 V
- smallest supply voltage:
  $V_{Sup\,min}$ = 24 V * 0.95 = 22.8 V

The series resistance of the Zener barrier is listed with 295 ohm. The following values must still be calculated:

- Voltage drop at the barrier:
  $V_{ab\,barrier}$ = 295 Ω * 0.02 A = 5.9 V
  (with full conduction)
- Terminal voltage at the transmitter with Zener barrier:
  $V_{KI} = V_{Sup\,min} – V_{ab\,barrier}$ = 22.8 V – 5.9 V = 16.9 V
- Minimum supply voltage of the transmitter
  (according to data sheet):
  $V_{KI\,min}$ = 12 V_{DC} (corresponding to $V_{B\,min}$)

Condition:

$V_{KI} \geq V_{KI\,min}$

Result:

The terminal voltage of the transmitter with Zener barrier lies at 16.9 V and is therefore higher than the minimum supply voltage of the transmitter which lies at 12 V_{DC}. This means, the Zener barrier has been selected correctly regarding the supply voltage.

☞ Note that no line resistances have been listed in this calculation. However, these will lead to an additional voltage drop that must be taken into account.

5. Electrical Installation

⚠ WARNING! Install the device only when depressurized and currentless!

⚠ DANGER! Danger of explosion when surpassing the maximum supply of 28 V_{DC}!

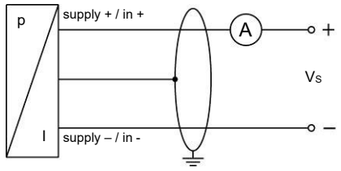
Establish the electrical connection of the device according to the technical data shown on the manufacturing label, the following table and the wiring diagram.

Pin configuration:

Electrical connection	ISO 4400	M12x1 (4-pin)
Supply +	1	1
Supply –	2	2
Shield	ground pin	4

Electrical connection	field housing	cable colours (DIN 47100)
Supply +	IN +	wh (white)
Supply –	IN -	bn (brown)
Shield	⏚	gn/ye (green / yellow)

Wiring diagram:



! For devices with cable gland as well as cable socket, you have to make sure that the external diameter of the used cable is within the allowed clamping range. Moreover you have to ensure that it lies in the cable gland firmly and cleftlessly!

! When routing the cable outlet following bending radiuses have to be complied with:

static installation : 10-fold cable diameter
dynamic application: 20-fold cable diameter

! Please note for devices with ISO 4400 plug and cable socket, that the socket has to be mounted properly to ensure the ingress protection mentioned in the data sheet. Please check if the delivered seal is placed between plug and cable socket. After connecting the cable fasten the cable socket on the device by using the screw.

! On devices with field housings, the terminal clamps are situated under the metal cap. To install the device electrically, the cap must be screwed off. Before the cover is screwed on again, the o-ring and the sealing surface on the housing have to be checked for damages and if necessary to be changed! Afterwards screw the metal cap on by hand and make sure that the field housing is firmly locked again.

! Prevent the damage or removal of the PTFE filter which is fixed over the end of the air tube on devices with cable outlet and integrated air tube.

! For a clear identification, the intrinsically safe cables are marked with light blue shrink tubing (over the cable insulation). If the cable has to be modified (e. g. shortened) and the marking at the cable end has been lost in the process, it must be restored (for example, by marking it again with light blue shrink tubing or an appropriate identification sign).

☞ For the electrical connection a shielded and twisted multicore cable has to be used.

6. Initial start-up

⚠ WARNING! Before start-up, the user has to check for proper installation and for any visible defects.

⚠ WARNING! The device can be started and operated by authorized personnel only, who have read and understood the operating manual!

⚠ WARNING! The device has to be used within the technical specifications, only! (compare the data in the data sheet and the EC type-examination certificate)

7. Placing out of service

⚠ WARNING! Disassemble the device only in current and pressure less condition! Check before disassembly, if it is necessary to drained off the media before dismantling!

⚠ WARNING! Depending on the medium, it may cause danger for the user. Comply therefore with adequate precautions for purification.

8. Maintenance

⚠ The operator is obligated to observe the information concerning operation and maintenance work on the warning signs possibly affixed to the device.

In principle, this device is maintenance-free. If desired, the housing of the device can be cleaned when switched of using a damp cloth and non-aggressive cleaning solutions.

With certain media, however, the diaphragm may be polluted or coated with deposit. It is recommended to define corresponding service intervals for control. After placing the device out of service correctly, the diaphragm can usually be cleaned carefully with a non-aggressive cleaning solution and a soft brush or sponge. If the diaphragm is calcified, it is recommended to send the device to BD SENSORS for decalcification. Please read therefore the chapter “Service/Repair” below.

! An incorrect cleaning can cause irreparable damages on diaphragm. Never use spiky objects or pressured air for cleaning the diaphragm.

9. Service / Repair

9.1 Recalibration

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

9.2 Return

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 **www.bdsensors.com**. Should you dispatch a device without a declaration of decontamination and if there are any doubts in our service department regarding the used medium, repair will not be started until an acceptable declaration is sent.

⚠ **If the device came in contact with hazardous substances, certain precautions have to be complied with for purification!**

10. Disposal

The device must be disposed according to the 2012/19/EU and 16/2022 coll. (on waste electrical and electronic equipment) Waste of electrical and electronic equipment may not be disposed by domestic refuse!

⚠ WARNING! Depending on the measuring medium, deposit on the device may cause danger for the user and the environment. Comply with adequate precautions for purification and dispose of it properly.

11. Warranty conditions

The warranty conditions are subject to the legal warranty period of 24 months from the date of delivery. In case of improper use, modifications of or damages to the device, we do not accept warranty claims. Damaged diaphragms will also not be accepted. Furthermore, defects due to normal wear are not subject to warranty services.

12. 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.com.

Additionally, the operational safety is confirmed by the CE sign on the manufacturing label.

13. Explanation for the certificate

To item [12] of the EC type-examination "The marking of the equipment mentioned in [4] must include one of the following details:"

Ex					
Equipment group					
Explosion protection	II				
Equipment category					
Zone 0 – Gas, vapor, mist	1G				
Zone 1 – Gas, vapor, mist	2G				
Zone 20 - Dust	1D				
Zone 21 - Dust	2D				
Designation according to EN and ignition protection type					
Intrinsically safe design		Ex ia			
Explosion group [1]					
II B			IIB		
II C			IIC		
III C			IIIC		
Temperature class					
max. environmental temperature 85 °C (1G, 2G)				T4	
max. environmental temperature 135 °C (1G, 2G)				T6	
max. surface temperature 85 °C (1D, 2D)				T 85°C	
ignition protection standard					
Ga					Ga
Da					Da
Gb					Gb
Db					Db

[1] Exact specifications regarding limiting gap width and minimum ignition current ratio can be taken from the corresponding standard or the VDE publication.

14. Error handling

If you detect an error, please try to eliminate it by using this table or send the device to our service address for repair.

⚠ DANGER! Working on supplied (active) parts, except for intrinsically safe circuits, is principally prohibited during an explosion hazard. Additionally, the operator is obligated to observe the information concerning operation and maintenance work on the warning signs possibly affixed to the device.

Malfunction	Possible cause	Error detection / corrective
no output signal	wrong connected	inspect the connection
	line break	inspect all line connections necessary to supply the device (including the connector plugs)
	defective amperemeter (signal input)	inspect the amperemeter (fine-wire fuse) or the analogue input of the PLC
analogue output signal too low	load resistance too high	verify the value of the load resistance
	supply voltage too low	verify the output voltage of the power supply
	defective energy supply	inspect the power supply and the applied supply voltage at the device
small shift of output signal	diaphragm is highly contaminated	careful cleaning with non-aggressive cleaning solution and a soft brush or sponge; incorrect cleaning can cause irreparable damages on diaphragm or seals
	diaphragm is calcified or coated with deposit	if possible it is recommended to send the device to BD SENSORS for decalcification or cleaning
large shift of output signal	diaphragm is damaged (caused by overpressure or manually)	check the diaphragm; if it is damaged, please send the device to BD SENSORS for repair
wrong or no output signal	manually, thermical or chemically damaged cable	check the cable; a possible consequence of a damaged cable is pitting corrosion on the stainless steel housing; if you determine this please return the device to BD SENSORS for repair

! Improper action and opening can damage the device. Therefore repairs on the device may only be executed by the manu-