www.hydropa.de

hydropa®
HYDRAULISCHE ERZEUGNISSE GMBH & CIE. KG

Operating instructions

Safety pressure switch series DS6

Table of contents

1 Notes on the operating instructions

1.1 Use of the operating instructions

These operating instructions contain all the information required by the manufacturer of controls and / or machines to be able to integrate the safety pressure switches type DS6 into a control as intended.

1.2 Presentation and significance of the safety information

Marking	Significance
⚠WARNING	Alerts you to a hazardous situation that, if not avoided, could result in **death** or **serious** injury.
⚠CAUTION	Indicates a hazardous situation which, if not avoided, may result in **minor** to **moderate** injury.
Security-related activity	SECURITY-RELATED ACTIVITIES Draws your attention to the fact that all steps in the procedure described are relevant to safety.

Please observe the following notes:

- Safety instructions in *chapter 1* apply to the entire operating manual.
- Warnings at the beginning of a section apply to the entire section.
- A warning in one action step applies only to this action step.

1.3 Presentation and significance of other information

Marking	Significance
NOTE	Draws your attention to possible damage to property.
	Helps you learn about useful tips and recommendations, as well as information for efficient and trouble-free operation.

- Operating elements in these operating instructions are shown in CAPITAL LETTERS.
- Displays and cross-references are shown in italics in these operating instructions.
- Position numbers in images are shown in brackets in the corresponding text.
- Information on the position of elements (left, right, top, bottom, front, back) refer to the view in the image

1.4 Terms and abbreviations

Term / abbreviation	Significance
S	▪ Monitoring of rising pressures (maximum pressure monitoring)
F	▪ Monitoring of decreasing pressures (minimum pressure monitoring)
1K / 2K	▪ Single-channel / dual-channel version

2 Safety

2.1 Operating instructions

These operating instructions contain all the information required to avoid personal injury and damage to property, to ensure trouble-free operation and not to harm the environment.

When integrating the pressure switches, comply with all requirements specified in these operating instructions. Any other use may result in personal injury and/or property damage.

As a control or machine manufacturer, you are responsible for reading these operating instructions carefully and completely, for understanding it and for integrating the pressure switches into the control in accordance with the regulations. In the process, the following aspects have to be observed, in particular:

- Carefully observe all the information in these instructions.
- Copy the operation relevant information into the operating manual of the control unit and / or machine.
- Ensure that your staff always has unrestricted access to the complete operating instructions.

2.2 Permissible use, limitations of use

The pressure switches of the DS6 series are safety components in accordance with Directive 2006/42/EC and are used to monitor fluid pressures. The pressure switches may only be operated in accordance with the technical data defined in these operating instructions; *see chapter 5 Technical data*.

The pressure switch type with the suffix "S" (rising) is used to monitor a maximum permissible pressure. This type of pressure switch interrupts the power supply of a monitoring circuit if the pressure exceeds a dangerous level.

The pressure switch type with the suffix “F" (decreasing) is used to monitor the minimum pressure required to ensure safety. This type of pressure switch interrupts the power supply of a monitoring circuit if the pressure drops below a pressure level required for safety.

Any other use or use extending beyond this is considered to be not intended, and is therefore expressly prohibited. The integrator is responsible for all damage caused by improper use.

In addition, the following restrictions apply to the use of pressure switches:

- The pressure switches must not be operated in hazardous areas.

- The pressure switches may only be operated in accordance with the technical data defined in these operating instructions; *see chapter 5 Technical data*.
- The pressure switches must not be modified or changed in any other way.

2.3 Interface to controls or machine manufacturer

2.3.1 Requirement of the electrical equipment

The pressure switches may only be operated with safety extra-low voltage (SELF or PELV). For this purpose, the electrical power supply must be obtained from an energy source that meets the requirements for safety isolating transformers according to EN 61558-1 or EN 61558-2-6.

2.3.2 Requirement of the fluidic equipment

Before dismantling the pressure switch, the fluid power supply must be reliably disconnected and stored energy must be dissipated by means of a mains disconnection device in accordance with EN ISO 4413 or EN ISO 4414. An appropriate mains disconnection device must be provided by the control or machine manufacturer.

2.4 Who is allowed to do what?

2.4.1 Staff description and authorizations

⚠WARNING

Job descriptions, which do not contain a specific reference to staff authorized to carry out the work, may be carried out by instructed staff.

Job descriptions, which must not be carried out by instructed persons, contain a specific reference to the staff authorized to carry out the work.

Activities other than those described in these operating instructions may only be carried out by authorized Hydropa staff.

Persons whose reactivity is impaired, e.g. by drugs, alcohol or medication, must not carry out any work on the pressure switches.

2.4.2 Definition and demands placed on staff

Instructed persons	An instructed person is someone who has been comprehensively instructed in his tasks in connection with the safe operation of the pressure switches. Required age: 16 years. The instruction is carried out by specialists.
Specialist	A specialist is someone who is able to assess and carry out the work assigned to him on the basis of his technical training, knowledge and experience as well as knowledge of the relevant regulations and who is able to recognise possible hazards independently.

2.4.3 Authorization according to activities

Activity	**Authorization**
Installation and initial operation	Specialist for hydraulics and electrics or mechatronics
Maintenance and troubleshooting / rectification	Specialist for hydraulics and electrics or mechatronics
Disassembly, disposal	Instructed persons

2.5 Residual hazards and protective measures

2.5.1 Hazard caused by stored energy

Before removing the pressure switches, the stored energy must be safely dissipated.

2.5.2 Hazard caused by extreme temperatures

Due to the permissible maximum temperature of 80 deg. C, the housing of the pressure switch may be excessively hot. The pressure switches must therefore be integrated by the control or machine manufacturer in such a way that access is prevented during normal operation. In case of maintenance a suitable PPE has to be worn by the staff or a sufficient cooling time has to be considered.

2.6 Personal protective equipment

The personal protective equipment you must wear is described in these operating instructions in the description of the respective activity.

Wear the prescribed personal protective equipment during all work:

- Eye protection: Protective goggles

- Skin protection: Gloves

3 Configuration and function

The pressure switch series DS6 is available for monitoring both decreasing and rising pressures. Thus, the monitoring of a minimum as well as a maximum pressure is possible.

The pressure switches operate according to the piston-spring principle. The hydraulic force resulting from the pressure of the medium acts on one side of the piston. On the other side, the spring force acts resulting from the spring preload. The switching pressure can be adjusted individually by changing the spring preload.

Version „S“
As long as the pressure force resulting from the medium pressure is less than the set spring force, the microswitches are not actuated and the safety-related contacts remain closed. The safety-related contacts open only when the pressure to be monitored is exceeded.

Version „F“
As long as the pressure force resulting from the medium pressure is higher than the set spring force, the microswitches are not actuated and the safety-related contacts remain closed. The safety-related contacts open only when the pressure to be monitored is gone below.

4 Safety characteristics

The DS6 pressure switch series is available in a single-channel as well as a dual-channel version.

In addition, the safety-related microswitches have positively actuated contacts in accordance with EN 60947, which enable positive opening of the contacts at a type-dependent pressure level. This enables an inherently safe separation of the safety-related contacts.

4.1 Single channel version (1K)

The pressure switch version with the type designation "1K" has a safety-related channel consisting of the safety-related microswitch S1. Its safety-related contact pair 1/2 generates a safety-related electrical output signal from the existing pressure signal.

4.1.1 Safety related block plugging diagram

This pressure switch version has a single-channel architecture which corresponds to category 1 according to EN ISO 13849-1. In this case, the block diagram corresponds to a structure as shown in Fig.(1).

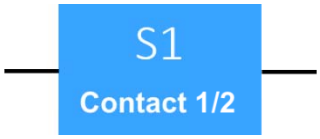


Fig. (1): Block plugging diagram of the „Sensor system“ subsystem – single-channel version

4.1.2 Performance Level (PL) of the subsystems

Due to their architecture, subsystems consisting of only one pressure switch of this version can achieve a maximum performance level of "c" according to DIN EN ISO 13849-1.

The achievable performance level results from the calculated $MTTF_d$ value for the safety-related contact pair 1/2 of the microswitch S1.

For the calculation of the performance level we recommend the use of the SISTEMA software tool, which is provided free of charge by the German Institute for Occupational Safety IFA.

4.1.3 $MTTF_D$ value of the subsystems

The $MTTF_d$ value of the subsystem depends on the average annual actuation frequency n_{op} of the safety-related contact pair 1/2 of the microswitch S1

and must be determined by the control unit and/or machine manufacturer within the framework of PL verification. For this purpose, the principles of EN ISO 13849-1 must be observed.

4.1.4 Calculation example

The calculation was based on the following values:

Reliability parameter $B10_D$ (for the individual microswitch)	1,5 m switching cycles
Actuation frequency n_{op}	2.880 cycles / year

Calculation result for the subsystem:

$MTTF_D$ value (subsystem)	100 years
PFH_D (subsystem)	$1{,}1 \cdot 10^{-6}$ 1/h
PL (subsystem)	c

4.2 Dual-channel Version (2K)

The pressure switch version with type designation "2K" has two (redundant) safety-related channels which are each capable of generating a safety-related electrical output signal from the existing pressure signal. For this purpose this pressure switch variant has two microswitches S1 and S2. Its safety-related contact pair 1/2 generates an independent safety-related electrical output signal each from the existing pressure signal.

4.2.1 Safety related block plugging diagram

This pressure switch version has a dual-channel (redundant) architecture which corresponds to category 3 or 4 according to EN ISO 13849-1. Thus, the prerequisite for *single error safety* is given. In this case, the block diagram corresponds to a structure as shown in Fig. (2).

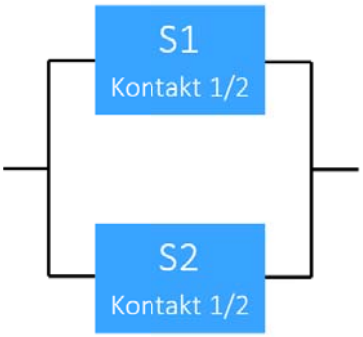


Fig. (2): Block plugging diagram of the “Sensor system” subsystem - dual-channel version

4.2.2 Performance Level (PL) of the subsystems

Due to their architecture, subsystems consisting of only one pressure switch of this version can achieve, as rule, a maximum performance level of “d" according to DIN EN ISO 13849-1.

The achievable performance level results from the symmetrized $MTTF_d$ value and the average diagnostic coverage DC_{avg} of the subsystem.

For the calculation of the performance level we recommend the use of the SISTEMA software tool, which is provided free of charge by the German Institute for Occupational Safety IFA.

4.2.3 Symmetrized $MTTF_D$ value of the subsystem

The symmetrised $MTTF_d$ value of the subsystem depends on the average annual actuation frequency n_{op} of the safety-related contact pair 1/2 of the microswitches S1 and S2 and must be determined by the control unit and/or machine manufacturer within the framework of PL verification. For this purpose, the principles of EN ISO 13849-1 must be observed.

4.2.4 Average diagnostic coverage DC_{avg} of the subsystems

The average diagnostic coverage DC_{avg} depends on the measures applied to detect faults that can lead to a safety-critical failure of the safety-related contact 1/2 of the microswitches S1 or S2. The measures for fault detection must be defined by the control and/or machine manufacturer. For this purpose, the principles of EN ISO 13849-1 must be observed.

As a component manufacturer, we recommend cross comparison of redundant output signals to detect errors. The signal status of the output signals must be compared in the logic of the control. The pressure switches always show no error, if the signal status of both output signals is identical, or if the output signals change (from HIGH to LOW and vice versa), the output signals show the same status again within a predefined period of time (e.g. 500 ms).

4.2.5 Calculation example

The calculation was based on the following values:

Reliability parameter $B10_D$ (for the individual microswitch)	1,5 m switching cycles
Diagnostic coverage DC (for the individual microswitch)	99 % (cross comparison of the output signals in logics)
Actuation frequency n_{op}	2.880 cycles / year

Calculation result for the subsystem:

Symmetrized $MTTF_D$ value	100 years

Average diagnostic coverage DC_{avg}	99 %
PFH_D (subsystem)	$2,5 \cdot 10^{-8}$ 1/h
PL (subsystem)	e

4.3 Forced disconnection Version „S“

In version "S", the pressure switches are designed in such a way that the safety-related contact pair of the microswitches is positively opened when the set pressure is exceeded by a corresponding positive opening differential pressure (see Table (1)). This results in an inherently safe separation of the output signals. The minimum pressure required for this is known as positive opening pressure and must be calculated by the control and/or machine manufacturer for each application.

Table (1): Positive opening differential pressures of the pressure switches

Type	p positive opening difference
5	1,6 [bar]
10	3,5 [bar]
100	20 [bar]
200	45 [bar]
300	60 [bar]

If the application allows the positive opening pressure to be used as the safety-related cut-off pressure, the inherently safe forced disconnection of the safety-related contacts allows the exclusion of the "contact will not open" fault in accordance with EN ISO 13849-2; Table D.8. Due to this error exclusion, an error exclusion can be declared for the pressure switch during PL verification. As a result, the reliability parameter ($B10_D$ value) is no longer relevant for the calculation of the failure probability of the safety function.

Calculation example “Positive opening pressure; Version S“:

The calculation was based on the following values:

Type of pressure switch	Type 100
Pressure setting (intended pressure at which the safety-related contact is to be opened	$p_{setting}$ = 60 bar
Positive opening differential pressure (according to Table (1); depending on type)	$p_{positive\ opening\ difference}$ = 20 bar

The positive opening pressure is calculated using the following formula:

Positiv opening difference $= p_{setting} + p_{positive\ opening\ difference}$
$= 60\ bar + 20\ bar$
$= 80\ bar$

4.4 Forced disconnection: Version „F“

In version “F", the pressure switches are designed in such a way that the safety-related contact pair of the microswitches is positively opened when the set pressure is going below by a corresponding positive opening differential pressure (see Table (1)). This results in an inherently safe separation of the output signals. The minimum pressure required for this is known as positive opening pressure and must be calculated by the control and/or machine manufacturer for each application.

If the application allows the positive opening pressure to be used as the safety-related cut-off pressure, the inherently safe forced disconnection of the safety-related contacts allows the exclusion of the "non-opening of contacts" fault in accordance with EN ISO 13849-2; Table D.8. Due to this error exclusion, an error exclusion can be declared for the pressure switch during PL verification. As a result, the reliability parameter ($B10_D$ value) is no longer relevant for the calculation of the failure probability of the safety function.

Calculation example “Positive opening pressure; Version F“:

The calculation was based on the following values:

Type of pressure switch	Type 100
Pressure setting (intended pressure at which the safety-related contact is to be opened	$p_{setting}$ = 60 bar
Positive opening differential pressure (according to Table (1); depending on type)	$p_{positive\ opening\ difference}$ = 20 bar

The positive opening pressure is calculated using the following formula:

Positive opening pressure = $p_{setting}$ - $p_{positive\ opening\ differenc}$
= 60 bar - 20 bar
= 40 bar

4.5 Physical restrictions

Due to manufacturing tolerances that cannot be avoided due to technical conditions, the redundantly installed microswitches in a pressure switch housing have different switching times. The switching time difference is the greater, the lower the pressure build-up or pressure reduction speed is.

Under certain circumstances this can lead to error messages with the pressure switch version "2K", although the safety-related contacts of the pressure switch are not faulty. This is then due to a discrepancy time that is too short, which was programmed in the logics for error detection purposes. To avoid frequent error messages, this circumstance must be taken into account when programming the plausibility routines.

In this context, the minimum actuating speed and/or the minimum pressure change speed $\Delta v_{p,min.}$ of the pressure switch must also be observed; see *chapter 5 Technical data*.

Furthermore, this phenomenon can usually be expected only in the case of a very slow change in pressure. For example, when the pressure supply is switched off and the pressure in the fluid system drops very slowly due to minor leaks.

NOTE: Due to technical reasons and stress independent smallest amount of drag oil arise, which can be accumulated in the device during use. When using an electrically conductive pressure medium in conjunction with a sufficient amount of drag oil there is a risk that a forced separation can no longer be guaranteed. To avoid an unsafe condition electrically conductive media must not be used.

4.6 Marking and type plate

Fig. (3): Type plate | Version 1K and 2 K

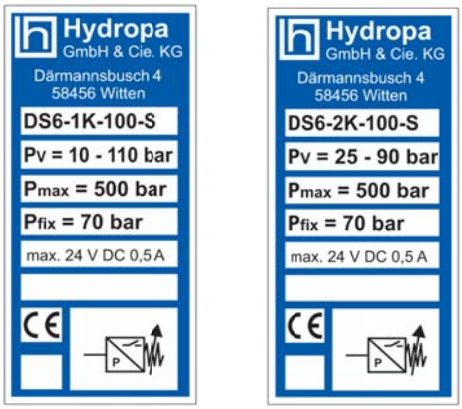
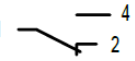
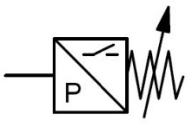


Table (2): Designation on the type plate

Field-No.:	Field label	Customer specific data
1	Type code	z. B.: DS6-2K-100-S
2	Switching pressure range	z. B.: P_E = 25 - 90 bar
3	Max. permissible operating pressure	z. B.: Pmax = 500
4	Pressure preselection of the manufacturer (optional)	bar z. B.: Pfix = 70 bar
5	Electrical parameters	z. B.: max. 24 VDC; 0,5 A
6	Free-field	
7	CE-marking	in conformity with Guidelines 2006/42/EG (safety component)
8	Circuit symbol	

5 Technical data

General characteristics	
Contact system, electrical symbol	1 change-over contact, form C 
Fluidic symbol	

Fluidic data				
Pressure range and max. permissible operating pressure	Type	Pressure setting range $p_{Setting}$ [bar]		p_{max} [bar]
		Version: 1K	Version: 2K	
	5	0,8 - 9,5	1* /2 - 8	40
	10	1 - 15	4 - 12	40
	100	10 - 110	25 - 90	500
	200	20 - 220	60 - 200	500
	300	30 - 330	70 - 300	500
Approved pressure media	Type	Medium		
	5 - 10	Compressed air		
	10 - 300	Mineral oil (HL, HLP) according to DIN 51524; viscosity range: 10 - 800 mm²/s		
	Other pressure media upon request. Electrically conductive media must not be used.			
Purity class	Medium	Class		
	Compressed air	7/4/4 according to ISO 8573		
	Mineral oil	18/16/13 according to ISO 4406		
Temperature range of the media	Medium	Unit	Temperature range	
	Compressed air	°C	+3 bis +60	
	Mineral oil	°C	-40 bis +70	

Electrical data		
Voltage	VDC	24
Voltage tolerance	%	-10 / +10
Rated normal current I_e	A	0,5
Contact resistance	mΩ	100
Protection against short circuit	2 A gG	

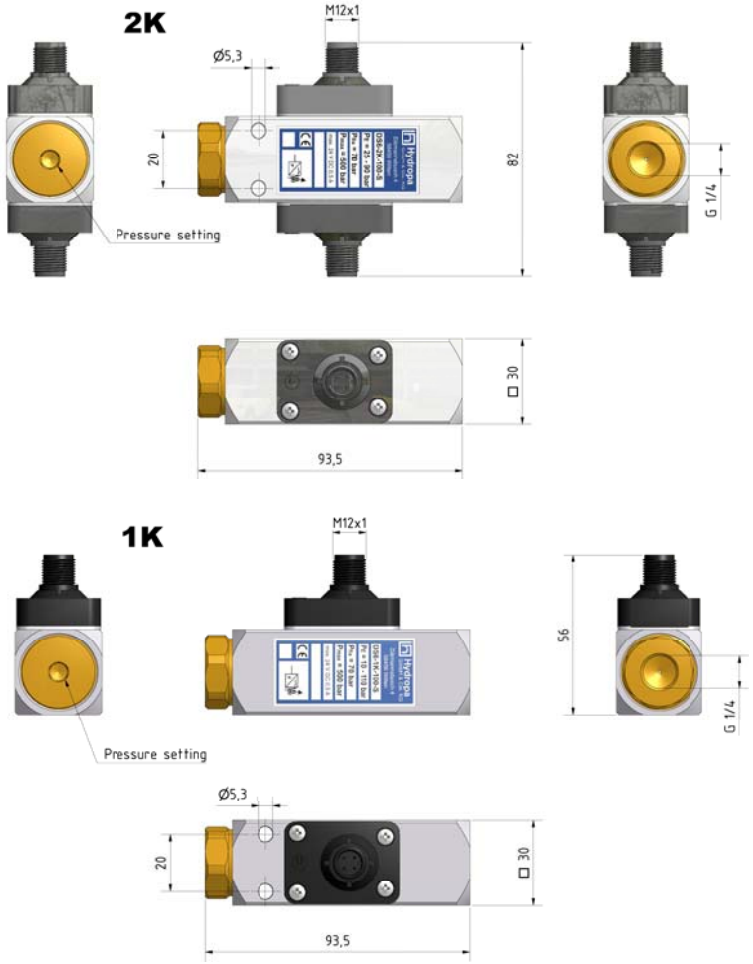
* 1 bar only by factory adjustment

Environmental data				
Utilization category	DC-13			
Clearance and creepage distance				
Overvoltage category	II			
Degree of contamination	2			
Ambient temperature range	°C	- 25 … + 80		
Condensation in operation	Impermissible			
Mechanical loads				
Type of mechanical load	Severity level	Peak acceleration	Shock duration	
Single shock (EN 60068-2-27)	2	30 g	11 ms	
Continuous shock (EN 60068-2-29)	2	15 g	6 ms	
Type of mechanical load	Severity level	Frequency	Amplitude	
Oscillation (EN 60068-2-6)	2	10 bis 60 Hz	0,35 mm	
	2	60 bis 150 Hz	5 g	
Protection class	IP 65 (higher protection class upon request			

Mechanical data		
Installation position	Random	
Mechanical service life of the micro-switch	At least 1.5 m switching cycles	
Max. switching frequency	60 switching cycles / minute	
Minimum activation speed	0,5 mm/s	
Minimum pressure change speed $\Delta v_{p, min.}$	Type	$\Delta v_{p, min.}$ [bar/s]
	5	0,6
	10	1,5
	100	8,5
	200	20
	300	25

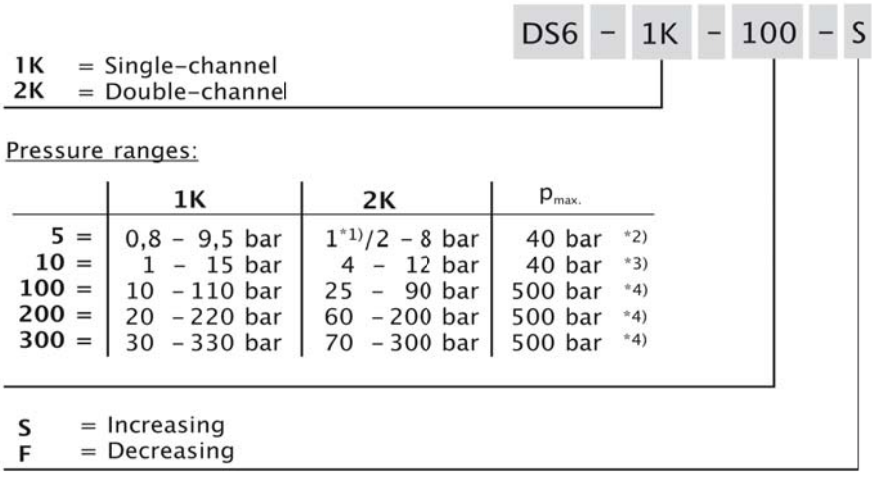
Safety		
Reliability parameter $B10_D$ (for the individual microswitch)	1,5 m switching cycles	
Category and PL (according to EN ISO 13849-1)	Version: 1K	Version: 2K
	Category 1 ⇒ bis PL c	Category 3 oder 4 ⇒ bis PL e

Safty principles well-tried components	The pressure switches fulfil the following component-related safety principles according to EN ISO 13849-2: • well-tried safety principles according to tables A.1,B,1,C.1 and D.1 • well-tried safety principles according to tables A.2,B,2,C.2 and D.2 Furthermore the pressure switches are well-tried components according to EN ISO 13849-1	
Max. switching frequency	60 switching cycles / minute	
Min. switching frequency	see chapter. 9.4	
Max. permissible operating time T_M	Type	Max. operating time T_M
	5 - 10	10 years
	100 - 300	10 years

Weight, Dimensions	
Weight	0,3 kg
Dimensions (L x T x H)	
Fluidic connection	G ¼“ (internal thread in inch)

6 Order information

Please use the following type code to determine the desired pressure switch type.



*1) 1 bar only by factory adjustment
*2) for pneumatic media exclusively
*3) also for pneumatic media
*4) for hydraulic media exclusively

7 Scope of supply and storage

7.1 Scope of supply

Complain about any defects immediately.

Claims for damages can only be asserted within the applicable complaint periods.

Check the delivery for completeness and transport damage immediately upon receipt. If external transport damage are recognizable:

- Do not accept the delivery or accept it only under reservation
- Make a note of the transport damage on the transport documents or on the carrier's delivery note
- Initiate a complaint by contacting the supplier

Complain about any defects as soon as they are detected. Claims for damages can only be asserted within the applicable complaint periods.

If the scope of delivery is incomplete, complain about the incomplete scope of delivery.

7.2 Storage

NOTE

Observe all storage requirements in this chapter.

In addition, note any requirements for storage on the packaging of individual pieces of packaging.

Maximum permissible ambient temperature	5 to 50 °C (no freezing)
Other requirements for storage	▪ Do not store in the open ▪ Store dry and dust-free ▪ Do not expose to aggressive media ▪ Protect from solar radiation ▪ Avoid mechanical shocks

8 Installation and initial operation

NOTE

During assembly, the greatest possible cleanliness must be ensured. Contamination introduced during installation can lead to malfunctions and impair the safe functioning of the pressure switches.

Do not mount pressure switches that are damaged.

Compare the permissible technical data of your pressure switch with the technical data of your application. Only install pressure switches, the technical data of which correspond to the technical data of the application.

⚠WARNING

Always depressurize all relevant plant components before assembling / disassembling the pressure switch.

The pressure switch may only be used in systems, in which the max. permissible operating pressure P_{max} is not exceeded; see *chapter 5 Technical data or nameplate*.

Exceeding the max. permissible operating pressure P_{max} due to pressure peaks and pressure surges has to be excluded as well.

The use of the pressure switches outside the specified operating and operating conditions can lead to personal injury or damage to property.

8.1 Installation of the pressure switch

NOTE

To increase the service life, the pressure switch should be mounted with low vibration. In this context, the permissible mechanical loads must be observed; see *chapter 5 Technical data*.

8.1.1 Mechanical attachment

The mechanical fastening of the pressure switch must be carried out using two M5 screws provided by the customer. For this purpose, the pressure switch has two through bores with a diameter of 5.3 mm.

8.1.2 Fluidic connection

The following steps are required to establish the fluidic connection:

1. Check the media connection for impurities and damage to the thread and sealing surfaces.
2. Screw a standard fitting with a G1/4" male thread into the media connection of the pressure switch. The screw connection is not part of the scope of delivery.

3. Connection of the screw connection with the pipe system of the fluid system.

8.1.3 Electrical connection

NOTE

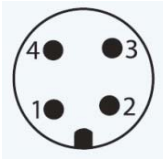
The electrical connection must be carried out by a qualified electrician in accordance with the applicable safety and accident prevention regulations. Relevant installation and operating regulations (e.g. for cable cross-sections, fuse protection, &c.) must be taken into account.

⚠WARNING

The pressure switches may only be operated with safety extra-low voltage (SELF or PELV). For this purpose, the electrical power supply must be obtained from an energy source that meets the requirements for safety isolating transformers according to EN 61558-1 or EN 61558-2-6.

To establish the electrical connection, the pressure switches are equipped with 4-pole M12-A type cable connectors. The cable plug on the machine must be assembled according to the pin assignment.

Pin assignment

Contact	Function	
1 → 2	Safety-related break contact	
1 → 4	Signal contact	

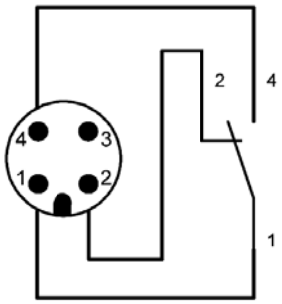


Fig. (4): Pin assignment of the M12 cable plug

8.2 Setting the cut off pressure

⚠WARNING

Before initial commissioning, check that the pressure switch has been correctly installed.

The pressure switch may only be operated by qualified staff who have read and understood these operating instructions.

The pressure switch may only be operated in accordance with the specified operating and operating conditions.

8.2.1 Factory setting of the cut off pressure

If requested by the customer, a customer-specific shut-off pressure is set at the factory before the pressure switch is delivered. This value must be specified when ordering the pressure switch. The factory shut-off pressure is indicated as the p_{fix} value on the nameplate.

If necessary, this value can be changed again. In this case the descriptions in chapters 7.2.2 or 7.2.3 must be observed.

8.2.2 Setting of cut-off pressure; Version "S"

The following steps are required to set the cut-off pressure in version "S":

1. Loosen the lock washer using a hexagon socket wrench (6 mm).
2. Set the system pressure to a significantly lower value than the desired cut-off pressure, but at least up to the minimum permissible operating pressure of the pressure switch.
3. Connect a suitable voltage source to the safety-related break contact 1 → 2 an, with the help of which you can determine the interruption of the voltage supply by the break contact.
4. Now slowly increase the system pressure and check the switch-off signal of the microswitch. This should change from "HIGH" to "LOW" at the desired cut-off pressure.
5. If the cut-off pressure deviates, correct the spring preload force by means of adjusting element. Repeat steps 2 to 3 until the signal change of the microswitch occurs at the desired cut-off pressure.
6. Insert the lock washer and tighten at a torque of 5 - 6 Nm using an Allen key. Check the cut-off pressure again by repeating steps 2 and 3. If the cut-off pressure differs (this can shift by several bar when the lock washer is tightened), readjust the cut-off pressure by repeating steps 1 to 5. When readjusting the cut-off pressure, set the measured deviation (after tightening the lock washer) higher or lower so that the deviation does not occur after tightening the lock washer.

8.2.3 Setting of cut-off pressure; Version "F"

The following steps are required to set the cut-off pressure in version "F":

1. Loosen the lock washer using a hexagon socket wrench (6 mm).
2. Set the system pressure to a significantly higher value than the desired cut-off pressure, but maximum up to the maximum permissible operating pressure of the pressure switch.
3. Connect a suitable voltage source to the safety-related break contact 1 → 2 an, with the help of which you can determine the interruption of the voltage supply by the break contact.
4. Now slowly lower the system pressure and check the switch-off signal of the microswitch. This should change from "HIGH" to "LOW" at the desired cut-off pressure.
5. If the cut-off pressure deviates, correct the spring preload force by means of adjusting element. Repeat steps 2 to 3 until the signal change of the microswitch occurs at the desired cut-off pressure.
6. Insert the lock washer and tighten at a torque of 5 - 6 Nm using an Allen key. Check the cut-off pressure again by repeating steps 2 and 3. If the cut-off pressure differs (this can shift by several bar when the lock washer is tightened), readjust the cut-off pressure by repeating steps 1 to 5. During readjustment, increase or decrease the cut-off pressure by the measured deviation (after tightening the lock washer) so that the deviation does not occur after tightening the lock washer

9 Operation

⚠WARNING Observe the safety instructions as rendered in *chapter 2.5.2 Danger from extreme temperatures.*

No staff activities are required during operation.

10 Maintenance and repair

10.1 General notes

Scheduled maintenance of the pressure switches helps maintain their value and protects against unplanned service interruptions. Maintenance work must be carried out by instructed and trained staff.

Improperly carried out maintenance and repair work can lead to considerable personal injury and component damage.

The following activities must be carried out at regular intervals.

10.2 Safety

⚠WARNING

The following must be observed during maintenance and servicing:

- Only carry out activities that are described in this chapter.
- Activities not described in this chapter may only be carried out by Hydropa staff.
- Before each recommissioning the pressure switch, make sure that they are set properly (see *chapter 7.2*).
- Carry out all activities in due time and carefully.
- Observe the residual hazards and protective measures in *chapter 2.5*
- Re*sidual hazards and protective measures.*

10.3 Inspection and maintenance plan

The activities described below ensure that the reliable function of the pressure switches is permanently maintained.

nB = as required, FM = in case of error message, S = after each shift, w: weekly; m = monthly, ¼ j = quarterly, ½ j = semi-annually: j= yearly

Activities to be carried out	**nB**	**FM**	**S**	**w**	**m**	**¼ j**	**½ j**	**j**
Check pressure switch for leaks ▪ Visual inspection						X		
Test the switching point ▪ Functional test								X
Check the pressure switch function (for relevant types) ▪ Functional test							X	

10.4 Inspection and maintenance activities

10.4.1 Leak check

To avoid personal injury and component damage, a leakage test must be carried out every 3 months. If compressed air is used as pressure medium, leakage spray may have to be used to detect leaks. As part of this test, the following points on the pressure switch shall be checked for signs of leakage:

- Connection “pressure media supply”
- Sealing parts on electrical connections

If there are any signs of leakage, the pressure switch must no longer be used for safety-related functions and must be replaced by a new pressure switch.

10.4.2 Check of the switching point

In order to avoid personal injury, the switching point must be checked once a year.

1. **Switching point inspection: Version "S"**

   - Connect a suitable voltage source to terminal "S1", which can be used to detect the interruption of the voltage supply by the break contact of the microswitch.
   - Now slowly increase the system pressure and check the switch-off signal of the microswitch. This should change from "HIGH" to "LOW" at the desired cut-off pressure.

If the switch-off signal does not occur at the desired pressure, the switching point of the pressure switch must be readjusted according to chapter 7.2.2.

2. **Switching oint inspection: Version "F"**

   - Connect a suitable voltage source to terminal "S1", which can be used to detect the interruption of the voltage supply by the break contact of the microswitch.
   - Set the system pressure to a significantly higher value than the desired cut-off pressure, but maximum up to the maximum permissible operating pressure of the pressure switch.
   - Now slowly lower the system pressure and check the switch-off signal of the microswitch. This should change from "HIGH" to "LOW" at the desired cut-off pressure.

If the switch-off signal does not occur at the desired pressure, the switching point of the pressure switch must be readjusted according to chapter 7.2.3.

10.4.3 Manual check of the pressure switch function

In order to avoid personal injury and to maintain the exclusion of faults for mechanical components of the pressure switch, a safety-related switching cycle must be carried out manually at intervals of 6 months for the pressure switch types listed below and the correct function of the pressure switch

must be checked.

Relevant types of pressure switch:

Type	Version
All	2K

1. **Manual pressure switch inspection: Version "S"**

   - Connect a suitable voltage source to terminal "S1", which can be used to detect the interruption of the voltage supply by the break contact of the microswitch.
   - Now slowly increase the system pressure and check the switch-off signal of the microswitch. This should change from "HIGH" to "LOW" at the desired cut-off pressure.

If the cut-off signal does not occur at the intended cut-off pressure, the pressure switch may no longer be used for safety-related functions and must be replaced by a new pressure switch.

2. **Manual pressure switch inspection: Version "F"**

   - Connect a suitable voltage source to terminal "S1", which can be used to detect the interruption of the voltage supply by the break contact of the microswitch.
   - Set the system pressure to a significantly higher value than the desired cut-off pressure, but maximum up to the maximum permissible operating pressure of the pressure switch.
   - Now slowly lower the system pressure and check the switch-off signal of the microswitch. This should change from "HIGH" to "LOW" at the desired cut-off pressure.

If the cut-off signal does not occur at the intended cut-off pressure, the pressure switch may no longer be used for safety-related functions and must be replaced by a new pressure switch.

10.5 Failures of function and troubleshooting

The malfunctions described below may be remedied by qualified staff using the appropriate remedial measures. If fault rectification is not possible, contact the manufacturer.

Failure	Potential cause	Fault detection / remedial action
Pressure switch delivers no signal	Faulty power supply	Check power supply (trained electrician)
Pressure switch delivers no signal or the signal at the port drops	Incorrect setting of cut-off pressure	Set the cut-off pressure correctly (specialist)
Shift of switching point	Adjust the compression spring	Readjust the cut-off pressure (see *chapte. 7.2*)

10.6 Safety relevant failures and troubleshooting

Failure	Potential cause	Fault detection / remedial action
Version 2K: The contact of one microswitch only is opened	The actuating speed of the pressure piston is too low	Increase the discrepancy time between the two microswitch signals
Version 2K: The contact of one microswitch only is opened	Microswitch is defective	Use a measuring instrument to check whether there is a signal change at both microswitches when the cut-off pressure is reached (qualified electrician). If this is not the case, the pressure switch must be replaced.
Pressure switch shows leaks	Internal leakage	The pressure switch must be replaced.
Pressure switch shows leaks	Mechanical damage	The pressure switch must be replaced.

11 Disassembly

⚠WARNING

Hazard caused by stored energy and extreme temperatures

See chapter *2.5 Residual hazards and protective measures*.

Security-related activity

1. Separating the fluid energy supply. Reduce stored energy in the fluid system and check that it is free of pressure.
2. Disconnect the electrical power supply by disconnecting the M12 cable plug.
3. Dispose of the pressure switch properly.
   (See chapter 12 Disposal)

---

12 Disposal

Position	
All components	Disposal in accordance with local regulations at approved collection points.
Packaging material	Dispose of in an environmentally friendly manner. In case of doubt, obtain information on environmentally friendly disposal from the local authority or special disposal companies.

Därmannsbusch 4, D-58456 Witten (Herbede)
Postfach 31 65, D-58422 Witten (Herbede)
Phone (0 23 02) 70 12-0
Fax (0 23 02) 70 12-47
Internet: www.hydropa.de
E-Mail: info@hydropa.de