

SPS | DIFFERENTIAL PRESSURE TRANSMITTER

Mounting and operating instructions



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SAFETY AND PRECAUTIONS



Read all the information, the datasheet, mounting and operating instructions and study the wiring and connection diagram before working with the product. For personal and equipment safety, and for optimum product performance, make sure you entirely understand the contents before installing, using, or maintaining this product.



For safety and licensing (CE) reasons, unauthorised conversion and /or modifications of the product are inadmissible.



The product should not be exposed to abnormal conditions, such as: extreme temperatures, direct sunlight or vibrations. Long-term exposure to chemical vapours in high concentration can affect the product performance. Make sure the work environment is as dry as possible; avoid condensation.



All installations shall comply with local health and safety regulations and local electrical standards and approved codes. This product can only be installed by an engineer or a technician who has expert knowledge of the product and safety precautions.



Avoid contacts with energised electrical parts; always treat the product as if it is live. Always disconnect the power supply before connecting, servicing or repairing the product.



Always verify that you apply appropriate power supply to the product and use appropriate wire size and characteristics. Make sure that all the screws and nuts are well tightened and fuses (if any) are fitted well.



Recycling of equipment and packaging should be taken into consideration and these should be disposed of in accordance with local and national legislation / regulations.



In case there are any questions that are not answered, please contact your technical support or consult a professional.

PRODUCT DESCRIPTION

The SPS-2K0/6K0 is a compact multi-range differential pressure transmitter. It provides an analog / digital output and eight selectable measuring windows alongside with easy manual sensor calibration and Modbus register reset.

ARTICLE CODES

Code	Supply	Connection
SPS-G-2K0 SPS-G-6K0	13–26 VAC 18–34 VDC	3-wire
SPS-F-2K0 SPS-F-6K0	18–34 VDC	4-wire

INTENDED AREA OF USE

- Fan / pressure control and VAV (Variable Air Volume) mode
- CAV* (Constant Air Volume) mode
- Valve and damper control (actuators)
- Pressure / airflow monitoring in clean rooms
- Clean air and non-aggressive, non-combustible gases
- For indoor use only

TECHNICAL DATA

- Analog output: 0–10 VDC / 0–20 mA
- Digital output: PWM (open collector)
- Maximum power consumption:
 - ▶ SPS-F-2K0, SPS-F-6K0: 0,96 W
 - ▶ SPS-G-2K0, SPS-G-6K0: 1,2 W
- Nominal or average power consumption in normal operation:
 - ▶ SPS-F-2K0, SPS-F-6K0: 0,72 W
 - ▶ SPS-G-2K0, SPS-G-6K0: 0,9 W
- I_{max}:
 - ▶ SPS-F-2K0, SPS-F-6K0: 40 mA
 - ▶ SPS-G-2K0, SPS-G-6K0: 50 mA
- Power consumption, no load:
 - ▶ 18–34 VDC supply: 10–20 mA
 - ▶ 13–26 VAC supply: 10–15 mA
- Operating modes, selectable via Modbus:
 - ▶ Differential pressure
 - ▶ Air volume*
- Operating pressure ranges:
 - ▶ SPS-X-2K0: 0–100 Pa / 0–250 Pa / 0–500 Pa / 0–750 Pa / 0–1.000 Pa / 0–2.000 Pa / -50 - 50 Pa / -100–100 Pa
 - ▶ SPS-X-6K0: 0–1.000 Pa / 0–1.500 Pa / 0–2.000 Pa / 0–2.500 Pa / 0–3.000 Pa / 0–4.000 Pa / 0–5.000 Pa / 0–6.000 Pa
- Response time: 0,5 / 1 / 2 / 5 s
- Accuracy of the analog voltage output: ±3 %
- Long-term stability: ±1 % per year
- Enclosure: reinforced plastic ABS, grey (RAL7035)
- Aluminium pressure connection nozzles: hose diameter = 6 / 7 mm
- Protection standard: IP65 (according to EN 60529)
- Operating ambient conditions:
 - ▶ temperature: 10–60 °C
 - ▶ rel. humidity: < 95 % rH (non-condensing)
- Storage temperature: -40–60 °C

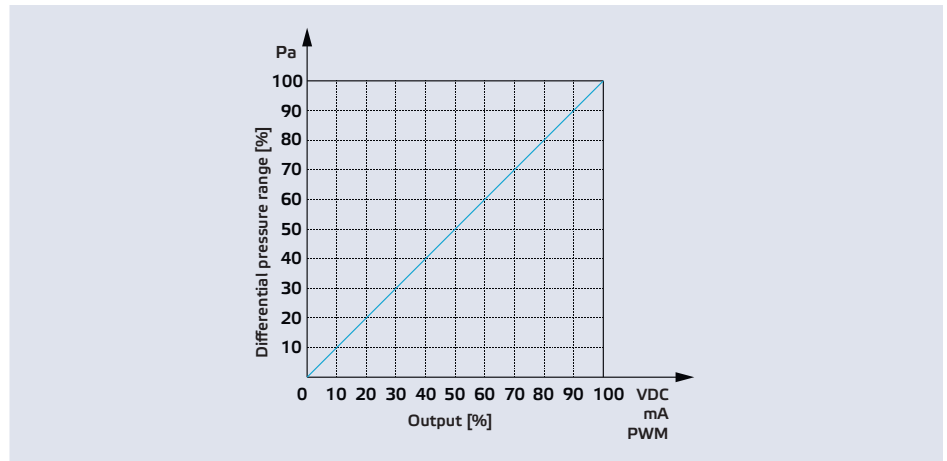
* Only when K-factor of the fan is known (consult the datasheets)

STANDARDS

- Low Voltage Directive 2014/35/EC
- EMC Directive 2014/30/EC
- WEEE Directive 2012/19/EU
- RoHS Directive 2011/65/EU

CE

OPERATIONAL DIAGRAM



WIRING AND CONNECTIONS

Vin	Positive DC voltage / AC ~
GND	Ground / AC ~
A	Modbus RTU (RS485) signal A
/B	Modbus RTU (RS485) signal /B
Ao1	Analog (0–10 VDC / 0–20 mA) or PWM (open collector) output
GND	Ground
Connections	Cable cross section: max. 1,5 mm ² Cable gland clamping range: 3–6 mm

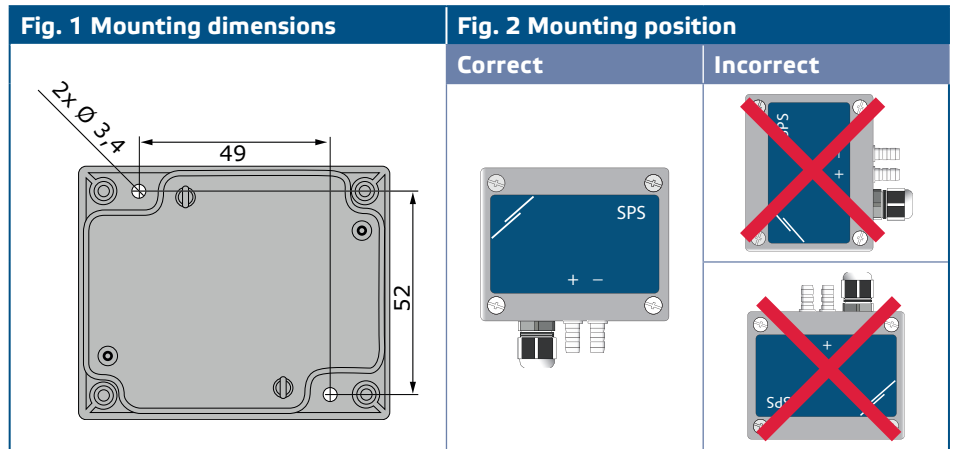
MOUNTING INSTRUCTIONS IN STEPS

Before you start mounting the SPS differential pressure transmitter, read carefully "**Safety and Precautions**". Choose a smooth surface for an installation location (a wall, panel and etc.).

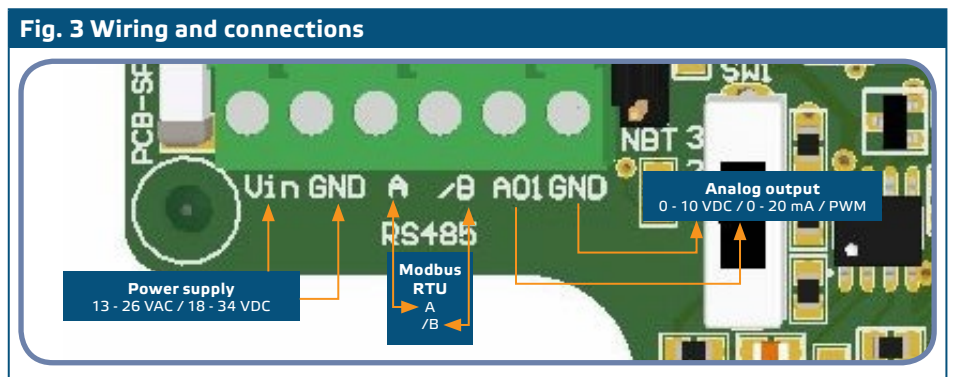
Follow these steps:

1. Unscrew the four screws on the front cover and open it.

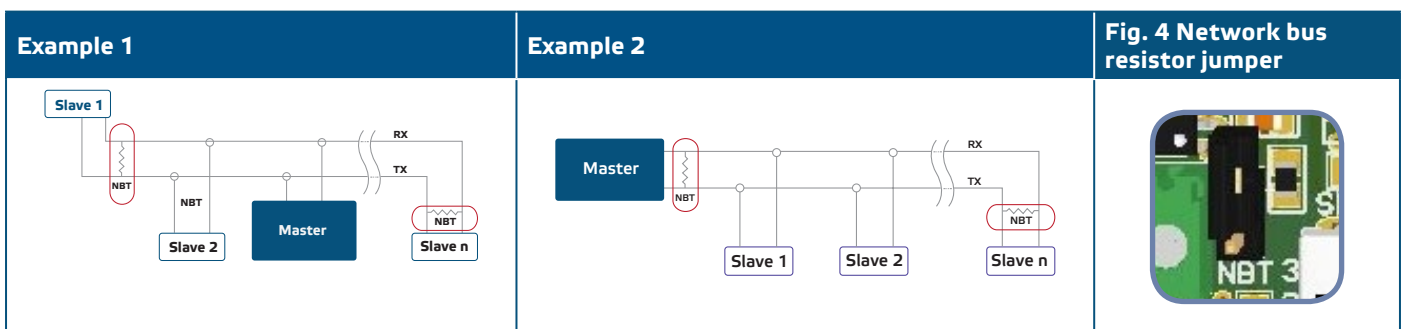
- Fix the rear lid of the enclosure on the wall / panel by suitable fastening elements. Mind the correct mounting position and unit mounting dimensions. (See **Fig. 1 Mounting dimensions** and **Fig. 2 Mounting position**.)



- Do the wiring according to the wiring diagram (see **Fig. 3**) using the legend information from section **“Wiring and connections”**.



- Check if your unit starts or terminates the network (see **Example 1** and **Example 2**). If it does, set the NBT jumper onto the pins. Otherwise leave it open. See **Fig. 4 Network bus resistor jumper**.



ATTENTION

If an AC power supply is used with any of the units in a Modbus network, the GND terminal should NOT BE CONNECTED to other units on the network or via the CNVT-USB-RS485 converter. This may cause permanent damage to the communication semiconductors and / or the computer!

5. Customise the factory settings to the desired ones:

5.1 To select the analog output mode, use SW1 switch. (See **Fig. 5 Analog output selection switch**.)

- ▶ Select switch position 1 for 0–10 VDC mode of the analog output.
- ▶ Select switch position 2 for 0–20 mA mode of the analog output.
- ▶ Select switch position 3 for PWM (open collector).

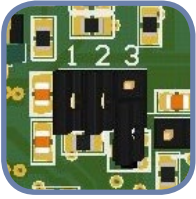
Fig. 5 Analog output selection switch



5.2 To select the sensor range, use the jumpers indicated with 1, 2 and 3. (See **Fig. 6 Sensor range selection jumpers** and the enclosed information.)

5.3 Select the desired response time using the relevant jumpers (see **Fig. 7 Response time selection jumpers**). Use the enclosed information.

Fig. 6 Sensor range selection jumpers




SPS-X-2K0	0–100 Pa	0–250 Pa	0–500 Pa	0–750 Pa
SPS-X-6K0	0–1.000 Pa	0–1.500 Pa	0–2.000 Pa	0–2.500 Pa

1 2 3	1 2 3	1 2 3	1 2 3
on on on	off on on	on off on	off off off

SPS-X-2K0	0–1.000 Pa	0–2.000 Pa	-50–50 Pa	-100–100 Pa
SPS-X-6K0	0–3.000 Pa	0–4.000 Pa	0–5.000 Pa	0–6.000 Pa

1 2 3	1 2 3	1 2 3	1 2 3
on on off	off on off	on off off	off off off

Fig. 7 Response time selection jumpers



0,5 sec	1 sec (default)	2 sec	5 sec
4 5	4 5	4 5	4 5
on on	on off	off on	off off

6. Close the enclosure and fix the cover.
7. Connect the nozzles with the tubing.
8. Switch on the power supply.

ATTENTION

If a G-type article is using the same AC power supply source (transformer) as F-type article, a SHORT CIRCUIT may result when the power supply and analog signal terminals are connected to the same common ground! In this case always connect different article types to separate AC transformers or use the same article version.

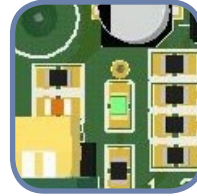
NOTE

For sensor calibration and Modbus register reset procedures refer to section "Operating instructions".

VERIFICATION OF INSTALLATION INSTRUCTIONS

When you switch on the unit the green LED (**Fig 8 Power indication**) should give out continuous green light. If it does, your unit is powered on. If this is not the case, check the connections again.

Fig. 8 Power indication

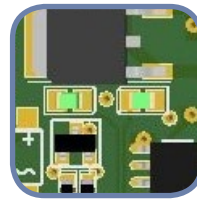


NOTE

*Rapid, continuous blinking of the blue LED (**Fig. 10 Sensor calibration / Modbus register reset / normal operation indication**) indicates that the unit operates properly.*

Check if the LEDs shown in **Fig. 9 Modbus communication indication** blink. If they do, your unit has detected a Modbus network. If they do not blink, check the connections again.

Fig. 9 Modbus communication indication



ATTENTION

The status of the LEDs can be checked only when the unit is energised. Take the relevant safety measures!

OPERATING INSTRUCTIONS

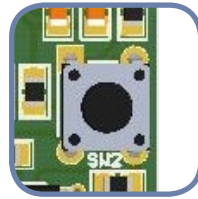
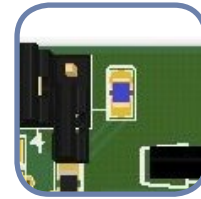
1. Calibration procedure:



ATTENTION

Make sure that the nozzles are free and not connected.

- 1.1 Disconnect the nozzles.
- 1.2 Press button SW2 (**Fig. 10**) for 4 seconds until the blue LED on the printed circuit board blinks twice. (See **Fig. 11 Sensor calibration and Modbus register reset indication**.) Then release this button.
- 1.3 In 2 seconds the blue LED blinks twice to show that the calibration procedure has finished.

Fig. 10 Sensor calibration and Modbus register reset tact switch**Fig. 11 Sensor calibration / Modbus register reset / normal operation indication****2. Reset of Modbus Registers procedure:**

Press button SW2 for 4 seconds until the blue LED on the printed circuit board (**Fig. 11**) blinks twice and keep pressing the button until it blinks three times. The Modbus registers are restored to their default values (factory preset).

**NOTE**

*Do not release SW2 button after the LED (**Fig. 11**) blinks twice until it blinks again three times. Otherwise the SPS pressure transmitter will carry out a calibration procedure instead of Modbus registers reset procedure.*

**NOTE**

*Continuous rapid blinking of the blue SMD LED (**Fig. 11**) indicates normal operation of the microprocessor.*

**ATTENTION**

The status of the LEDs can be checked only when the unit is energised. Take the relevant safety measures!

3. Factory preset values of the parameters:

The sensor data is arranged in two sectors: input registers and holding registers. The input registers contain the measured sensor data and the current analog / digital output. The holding registers contain all the settings.

INPUT REGISTERS (see **Table Modbus register maps**)

Input registers are read-only. They contain the measured data. It is stored from address 1 (30001) to address 8 (30008). The other input registers are not used with this unit; when these registers are addressed, they return 0.

All the data can be read using the command "Read Inputs Registers". **Table Modbus register maps** shows the returned data type and the way it should be interpreted. For example the reading 1.000 in register 1 means that the measured differential pressure is 1.000 Pa, reading 100 in register 2 means that the analog / digital output is 10,0 % of the full scale.

- **Input registers 3 and 4** are "Max. Pressure Limit Flag" and "Min. Pressure Limit Flag".
 - ▶ "Max. Pressure Limit Flag" is set to '1' when the pressure is above the maximum limit defined by holding register 14, and it is set to '0' when the pressure is below this limit.
 - ▶ "Min. Pressure Limit Flag" is set to '0' when the pressure is above the minimum limit defined by holding register 15, and it is set to '1' when the pressure is below this limit. An update of these registers occurs after the Power-up time (defined by holding register 16) expires.
- **Input registers 5** (and input register 6 with SPS-X-6K0) give(s) information about the current air volume flow rate (if the K-factor of the used fan / drive is known). For instance 1.000 in this register means that current air volume flow rate is 1.000 m³/h (for SPS-X-2-K0). The value in this register is equal to the K-factor of the motor (holding register 17) multiplied by square root of the measured differential pressure.

**NOTE**

To get correct calculation of the volume flow rate, the correct K-factor of the fan / drive has to be written in holding register 17!

- **Input register 7** gives information about the current working range. In Standalone mode it contains the working range which is set by jumpers 1, 2 and 3. In Modbus mode it contains the working range set via Modbus RTU (RS485) (mirror of holding register 12).
- **Input register 8** gives information about the current response time. In Standalone mode it contains the current response time set by jumpers 4 and 5. In Modbus mode it contains the current response time set via Modbus RTU (RS485) (mirror of holding register 13).

HOLDING REGISTERS (see **Table Modbus register maps**)

These registers are read / write registers and they can be managed with "Read Holding Registers" command, "Write single register" and "Write Multiple Registers" commands. They are separated in parts containing different kind of information.

Part 1:

This part contains information about the unit and Modbus communication settings.

- **Register 1** (40001) contains the address at which the unit replies to the master unit in a Modbus network. The default address is '1'. It can be changed in two ways:
 1. Send command "Write Single Register" with address '1' and write the new address value.
 2. Connect only your unit to a master controller or use the 3SModbus PC application and send the command "Write Single Register" to address '0' (Modbus broadcast address), and write a new address value.
- **The next two registers (2 & 3)** contain also Modbus settings. Changes in these registers change the communication settings. The default Modbus settings are 19200-E-1 as it is stated in the *Modbus Protocol Specification*.
- **The next three registers (4, 5 & 6)** are read only. They keep information about the hardware and firmware versions.
- **The next four registers (7, 8, 9 and 10)** are not used. They are read only.

**NOTE**

Writing on these registers does not return Modbus error exception, however it does not change anything either!

Part 2:

- **Holding register 11** (40011) sets the mode of the SPS differential pressure transmitter. By sending the command "Write Single Register" with address 11 and data '2', the unit is set in Modbus mode. In this mode the range and response time settings are controlled via Modbus only; in Standalone mode these settings are controlled by the board jumpers. To change to Standalone mode it is necessary to send the command "Write Single Register" to address 11 with data '1'. Once the user has set the SPS unit in Modbus mode, it automatically sets the default range 0–1.000 Pa (value 4 in holding register 12) and the response time to 1 s (value 1 in holding register 13).
- **Holding register 12** (40012) sets the current range in Modbus mode. The default value is 4 (0–1.000 Pa range).
- **Holding register 13** (40013) sets the current response time in Modbus mode. The default value is 1 s.
- **Holding register 14** (40014) defines the maximum pressure limit. The default value is the maximum of the set range. When the measured pressure is higher or equal to this value, input register 3 ("Max Pressure Limit Flag") sets to '1', otherwise it is '0'. This register accepts values between -100 and 2.000. When a value out of this range is written, the register returns to its default value. The maximum limit also depends on the current range. If the maximum limit in holding register 14 is higher than the maximum of the current range, it automatically becomes equal to the maximum of the range.

- Holding register 15** (40015) defines the minimum pressure limit. The default value is the minimum of the set range. When the measured pressure is below this value, input register 4 (“Min Pressure Limit Flag”) sets to '0', otherwise it is '1'. This register accepts values between -100 and 2.000. When a written value is out of this range, the register returns to its default value. The minimum value cannot be higher than the maximum value. Therefore, when a value higher than the maximum value is written in this register, it automatically becomes equal to the maximum value of the range.
- Holding register 16** (40016) defines the “Power-Up Timer” value. The default value is 60 s. During this time the minimum pressure limit is not compared with the measured pressure values and “Min Pressure Limit Flag” register remains '0' for this period. You can change this register value only in the first 60 s after you switch on the unit.
- Holding register 17** (40017) is the “K-factor” register. You should enter the correct K-factor of the used motor in it. The default value is '0' and the measured unit is differential pressure, not air volume / flow rate
- The registers 18–20** are not used. They are read only.



Writing on these registers does not return Modbus error exception; however, it does not change anything either!

MODBUS REGISTER MAPS

INPUT REGISTERS		Data type	Description	Data	Values	
1	Differential pressure	signed int.	Actual differential pressure	SPS-X-2K0	-100–2.000	1.000 = 1.000 Pa
		unsigned int.		SPS-X-6K0	0–6.000	1.000 = 1.000 Pa
2	Output value	unsigned int.	Actual output value: 0–100 %		0–1.000 100 = 10.0 %	
3	Max. pressure limit flag	unsigned int.	Flag indicates that the pressure is over or below the max. limit	SPS-X-2K0	0 = below the limit	
				SPS-X-6K0	1 = over the limit	
				SPS-X-2K0	2 = the value written in holding register 14 is out of the range: -100–2.000 Pa	
4	Min. pressure limit flag	unsigned int.	Flag indicates that the pressure is over or below the min. limit	SPS-X-2K0	0 = below the limit	
				SPS-X-6K0	1 = over the limit	
				SPS-X-2K0	2 = the value written in holding register 14 is out of the range: -100–2.000 Pa	
5	Volume flow rate	unsigned int.	Actual air volume flow rate in m ³ /h	SPS-X-2K0	0–44.000	1.000 = 1.000 m ³ /h
	Volume flow rate high		Actual air volume flow rate in m ³ /h high word	SPS-X-6K0	0–77.000	
6	Volume flow rate low	unsigned int.	Reserved, returns 0	SPS-X-2K0		1.000 = 1.000 m ³ /h
			Actual air volume flow rate in m ³ /h low word	SPS-X-6K0	0–77.000	
7	Differential pressure range	unsigned int.	Flag indicates the current differential pressure range	SPS-X-2K0	SPS-X-6K0	2.000 = 2.000 Pa
				0 = 0–100 Pa	0 = 0–1.000 Pa	
				1 = 0–250 Pa	1 = 0–1.500 Pa	
				2 = 0–500 Pa	2 = 0–2.000 Pa	
				3 = 0–750 Pa	3 = 0–2.500 Pa	
				4 = 0–1.000 Pa	4 = 0–3.000 Pa	
				5 = 0–2.000 Pa	5 = 0–4.000 Pa	
				6 = -50–50 Pa	6 = 0–5.000 Pa	
7 = -100–100 Pa	7 = 0–6.000 Pa					
8	Diff. pressure response time	unsigned int.	Flag indicates the current response time	0 =	0,5 s	
				1 =	1 s	
				2 =	2 s	
				3 =	5 s	
9-10			Reserved, returns 0			

HOLDING REGISTERS																																	
	Address	Data type	Description	Data	Default	Values																											
1	Address	unsigned int.	Device address	1–247	1																												
2	Baud rate	unsigned int.	Modbus communication baud rate	1 = 9.600 2 = 19.200 3 = 38.400	2																												
3	Parity mode	unsigned int.	Parity check mode	0 = 8N1 1 = 8E1 2 = 8O1	1	0 = 8N1 1 = 8E1 2 = 8O1																											
4	Device type	unsigned int.	Device type (Read only)	SPS-X-2K0 = 1015 SPS-X-6K0 = 1034																													
5	HW version	unsigned int.	Hardware version of the device (Read only)	XXXX		0 x 0210 = HW version 2.10																											
6	FW version	unsigned int.	Firmware version of the device (Read only)	XXXX		0 x 0110 = FW version 1.10																											
7-10		unsigned int.	Reserved, returns 0																														
11	Mode	unsigned int.	Operating mode	1 = Standalone mode 2 = Modbus mode	1																												
12	Range	unsigned int.	Differential pressure range	<table border="0"> <tr> <td></td> <td>SPS-X-2K0</td> <td>SPS-X-6K0</td> </tr> <tr> <td>0 =</td> <td>0–100 Pa</td> <td>0–1.000 Pa</td> </tr> <tr> <td>1 =</td> <td>0–250 Pa</td> <td>0–1.500 Pa</td> </tr> <tr> <td>2 =</td> <td>0–500 Pa</td> <td>0–2.000 Pa</td> </tr> <tr> <td>3 =</td> <td>0–750 Pa</td> <td>0–2.500 Pa</td> </tr> <tr> <td>4 =</td> <td>0–1.000 Pa</td> <td>0–3.000 Pa</td> </tr> <tr> <td>5 =</td> <td>0–2.000 Pa</td> <td>0–4.000 Pa</td> </tr> <tr> <td>6 =</td> <td>-50–50 Pa</td> <td>0–5.000 Pa</td> </tr> <tr> <td>7 =</td> <td>-100–100 Pa</td> <td>0–6.000 Pa</td> </tr> </table>		SPS-X-2K0	SPS-X-6K0	0 =	0–100 Pa	0–1.000 Pa	1 =	0–250 Pa	0–1.500 Pa	2 =	0–500 Pa	0–2.000 Pa	3 =	0–750 Pa	0–2.500 Pa	4 =	0–1.000 Pa	0–3.000 Pa	5 =	0–2.000 Pa	0–4.000 Pa	6 =	-50–50 Pa	0–5.000 Pa	7 =	-100–100 Pa	0–6.000 Pa	4	
	SPS-X-2K0	SPS-X-6K0																															
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5 =	0–2.000 Pa	0–4.000 Pa																															
6 =	-50–50 Pa	0–5.000 Pa																															
7 =	-100–100 Pa	0–6.000 Pa																															
13	Response time	unsigned int.	Response time selection	0 = 0,5 s 1 = 1 s 2 = 2 s 3 = 5 s	1																												
14	Max. pressure limit	unsigned int.	Maximum pressure limit	SPS-X-2K0 -100–2.000 SPS-X-6K0 0–6.000	1.000 3.000	1.000 = 1.000 Pa																											
15	Min. pressure limit.	unsigned int.	Minimum pressure limit	SPS-X-2K0 -100–2.000 SPS-X-6K0 0–6.000	0 3.000	1.000 = 1.000 Pa																											
16	Power-up timer	unsigned int.	Power-up time before measuring the lower limit	0–1.000 s	60 s	100 = 100 s																											
17	K-factor selection register	unsigned int.	K-factor according to the fan type	0–1.000	0																												
18-20			Reserved, returns 0																														

TRANSPORT AND STORAGE

Avoid shocks and extreme conditions; stock in original packing.

WARRANTY AND RESTRICTIONS

Two years from the delivery date against defects in manufacturing. Any modifications or alterations to the product after the date of publication relieve the manufacturer of any responsibilities. The manufacturer bears no responsibility for any misprints or mistakes in this data.

MAINTENANCE

In normal conditions this product is maintenance-free. If soiled, clean with a dry or damp cloth. In case of heavy pollution, clean with a non-aggressive product. In these circumstances the unit should be disconnected from the supply. Pay attention that no fluids enter the unit. Only reconnect it to the supply when it is completely dry.