

SPSP

DIFFERENTIAL
PRESSURE
CONTROLLER

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 SPSP differential pressure controller controls directly EC fans or drives. It is equipped with Modbus RTU communication and has an analog / digital output. The controller features integrated PI control, setpoint and K-factor setting.

ARTICLE CODES

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

INTENDED AREA OF USE

Direct fan / pressure control for EC drives and frequency inverters, VAV (Variable Air Volume) and CAV* (Constant Air Volume) mode

- Pressure / airflow monitoring in clean rooms
- Clean air and non-aggressive, non-combustible gases
- For indoor use only

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

TECHNICAL DATA

- Analog output: 0–10 VDC / 0–20 mA
- Digital output: PWM (open collector)
- Maximum power consumption:
 - ▶ SPSPF-2K0, SPSPF-6K0: 0,96 W
 - ▶ SPSPG-2K0, SPSPG-6K0: 1,2 W
- Nominal or average power consumption in normal operation:
 - ▶ SPSPF-2K0, SPSPF-6K0: 0,72 W
 - ▶ SPSPG-2K0, SPSPG-6K0: 0,9 W
- I_{max}:
 - ▶ SPSPF-2K0, SPSPF-6K0: 40 mA
 - ▶ SPSPG-2K0, SPSPG-6K0: 50 mA
- Power consumption, no load:
 - ▶ 18–34 VDC supply: 10–20 mA
 - ▶ 13–26 VAC supply: 10–15 mA
- Automatic operating ranges, depending on the selected setpoint:
 - ▶ SPSPX-2K0: 0–100 Pa, 0–250 Pa, 0–500 Pa, 0–750 Pa, 0–1.000 Pa, 0–2.000 Pa
 - ▶ SPSPX-6K0: 0–1.000 Pa, 0–2.000 Pa, 0–3.000 Pa, 0–4.000 Pa, 0–5.000 Pa, 0–6.000 Pa
- Operating modes: Differential pressure / Air volume**
- Accuracy of the analog output voltage: ±3 %
- Long-term stability: ±1 % per year
- Enclosure: reinforced plastic ABS, grey (RAL 7035)
- 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

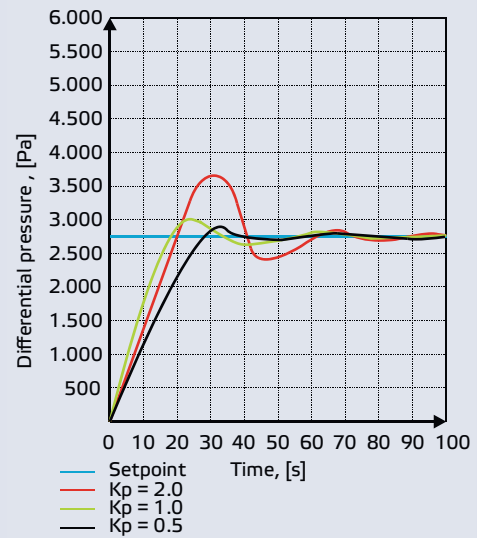
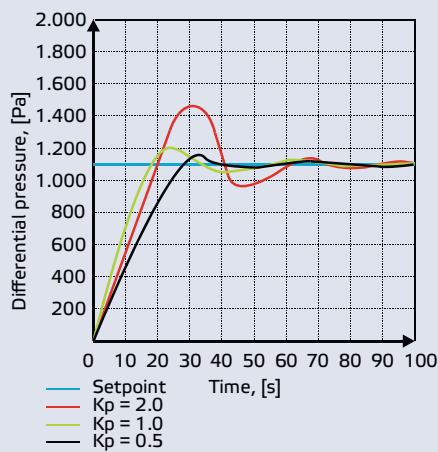
**Only when K-factor of fan is known (refer to the datasheets)

STANDARDS

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



OPERATIONAL DIAGRAM



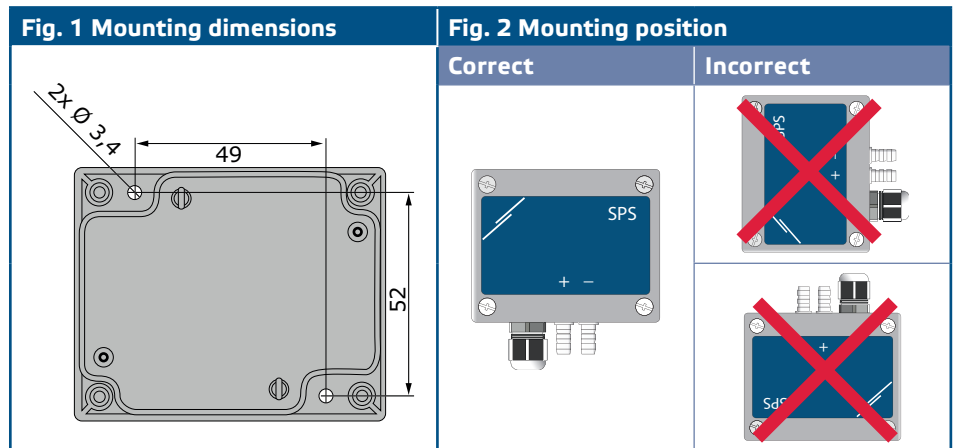
WIRING AND CONNECTIONS

Vin	Positive DC voltage / AC ~
GND	Ground / AC ~
A	Modbus RTU (RS485) signal A
/B	Modbus RTU (RS485) signal /B
Ao1	Analog / PWM (open collector) output
GND	Ground reference for analog output
Connections	Cable cross section: max. 0,75 mm ² Cable gland clamping range: 3–6 mm

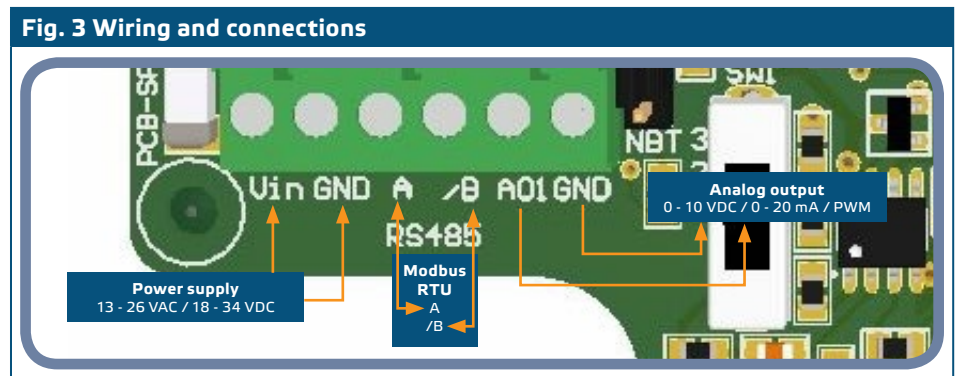
MOUNTING INSTRUCTIONS IN STEPS

Before you start mounting the SPSP controller, read carefully **“Safety and Precautions”**. Choose a smooth surface for an installation location (a wall, a panel, etc.) and follow these steps:

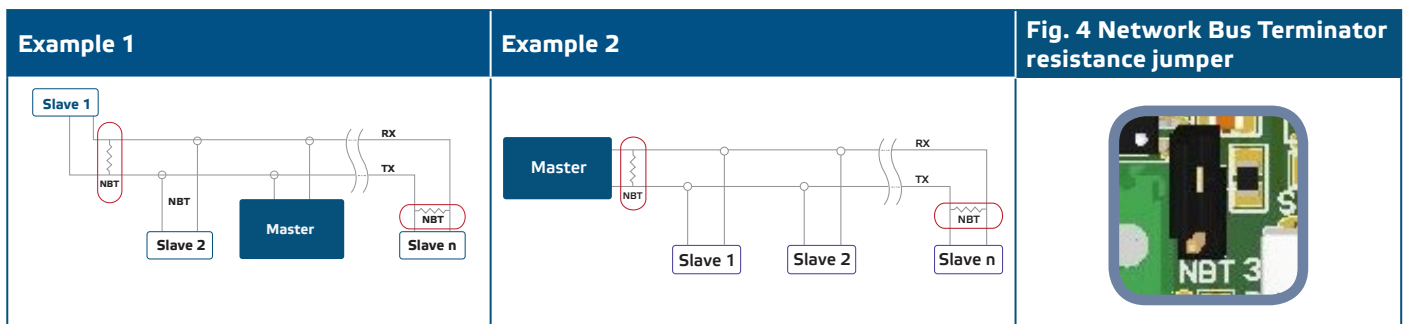
1. Unscrew the four screws on the front cover of the enclosure to remove it.
2. Fix the enclosure onto the surface by means of suitable fasteners adhering to the fixing dimensions and the correct mounting position shown in **Fig. 1 Mounting dimensions** and **Fig. 2 Mounting position**.



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



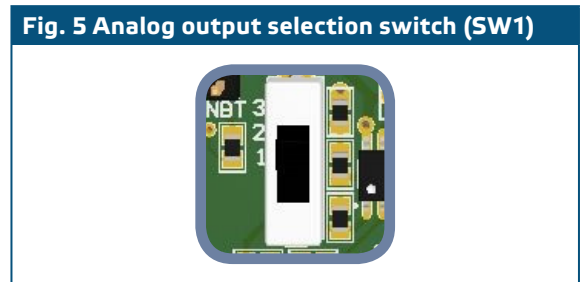
4. If your unit starts or terminates the network, make sure the NBT jumper is placed onto the pins as indicated in **Examples 1 & 2** below. In all other cases, the jumper must not be connected. By default, the NBT jumper is disconnected - see **Fig. 4 Network Bus Terminator resistance jumper**.



ATTENTION

If an AC power supply is used with any of the units in a Modbus network, the GND terminal must 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. Select the desired analog output mode from 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).



6. Put back the front cover and fix it.
7. Connect the nozzles with the tubing.
8. Switch on the power supply.

ATTENTION

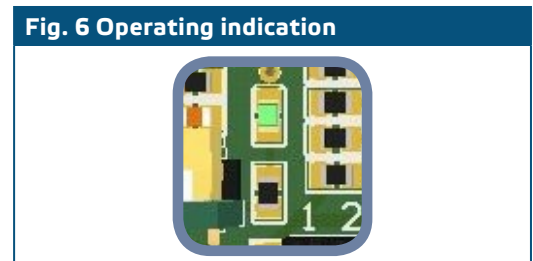
If a G-type article is using the same AC power supply source (transformer) as an F-type article, a SHORT CIRCUIT may result when the power supply and analog signal terminals are connected to the same common ground! In this case, always connect different article types to separate AC transformers or use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

NOTE

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

VERIFICATION OF INSTALLATION INSTRUCTIONS

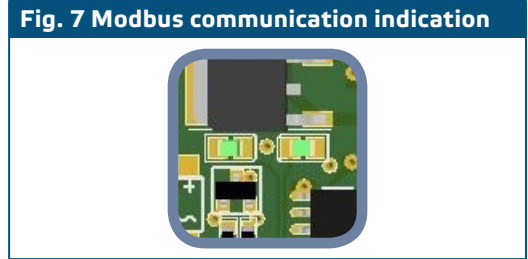
Check if the green LED shown in Fig 6 *Operating indication* is on. Continuous green light means the unit is supplied. If the light is not on, check the connections again.



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. 7 Modbus communication indication** blink. If they do, your unit has detected a Modbus network. If they do not blink, check the connections again.



ATTENTION

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

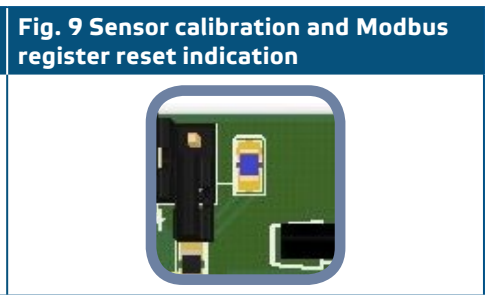
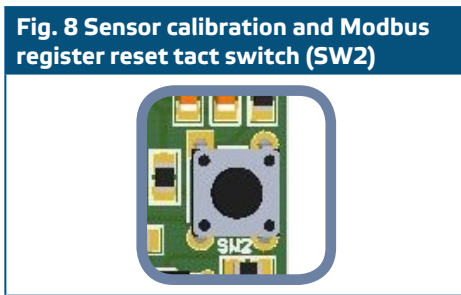
OPERATING INSTRUCTIONS

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. 8**) for 4 seconds until the blue LED on the printed circuit board blinks twice. (See **Fig. 9 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.



2. Reset of Modbus Registers procedure:

Press button SW2 for 4 seconds until the blue LED on the printed circuit board (**Fig. 9**) blinks twice and hold the button until it blinks three times. The Modbus registers are reset to their default values (factory presets).

NOTE

*Do not release SW2 button after the LED (**Fig. 9**) has blinked twice until it blinks three times once again, otherwise the SPSP pressure transmitter will carry out a calibration procedure instead of Modbus registers reset procedure.*

3. Factory preset values of the parameters:

All the data is arranged in two sectors: input registers and holding registers. The input registers contain the measured 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. Input registers which are not used with this unit return '0', when they are addressed.

All the data can be read using the command "Read Input Registers". **Table 1 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** contains information about the current air volume / flow rate. For instance, value '1.000' in this register means that the current air volume flow rate is 1.000 m³/h. The value in this register is equal to the K-factor of the motor (holding register 13) multiplied by square root of the current differential pressure. For correct calculation of the air volume flow rate, you have to enter the correct K-factor of the motor in holding register 13. Consult the datasheets.
- **Input registers 7** gives information about the current range selection. To get better measurement resolution the ranges switch automatically according to the selected setpoint. The maximum setpoint for a given range is 80 % of the range span.
- **Input registers 4, 5, 6, 8, 9 and 10** are not used. When addressed, they return '0'.

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** 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 and 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 and 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.



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

Part 2:

- **Holding register 11 (40011)** contains the setpoint for the differential pressure. The default value is '100' (100 Pa). If you write a value out of the range in this register, the controller will automatically write the default value '100' back in this holding register. If you write '0' in register 11, the controller stops working.
- **Holding register 12 (40012)** contains the setpoint for the air volume / flow rate. The default value is '10.000' and you are allowed to write values in the range of 0–44.000. If a different value is written, the controller automatically writes the default value '10.000' back in holding register 12. If you write '0' in register 12, the controller stops working.
- **Holding register 13 (40013)** is the "K-factor register". You should enter the correct K-factor of the used motor in it. Please consult the motor datasheets.

- **Holding register 14** (40014) contains the active setpoint value. When it contains '0' the setpoint is according to the values set in holding register 11 (Differential Pressure), when it contains '1' the setpoint is according to the value in the holding register 12 (Air Flow Volume Rate). The default value is '0'. If you write a value higher than '1' the controller assigns the default value '0' back in this register 14.
- **Holding register 15** (40015) is not used. It returns '0'.
- **Holding register 16** (40016) contains the proportional gain (Kp). The default value is '10' and the user is allowed to write values in the range of 1–100. Writing a different value, assigns the default value '10' in this holding register.
- **Holding register 17** (40017) contains the integration time (Ti). The default value is '30' and the user is allowed to write values in the range of 1–1.000. When a different value is written, the default value '30' is written back in this register.
- **Holding register 18** (40018) is for initiation of Autotune function. Autotune function computes the parameters Kp and Ti according to the system response. Writing '1' into the holding register 18 starts Autotune function. When the procedure finishes the controller automatically writes '0' in the holding register 18 and overwrites holding registers 16 and 17 with the new calculated values for Kp and Ti. Once started the function cannot stop. If the controller restarts during progress, the Autotune function is aborted and it doesn't start automatically after a controller restart.
- **Holding register 19** (40019) contains the setting for the minimum fan / drive speed (output). This speed is the required minimum at which the fan / drive can run and below this value the fan stalls. The default value is 20 %. The minimum speed can be selected between 10 % and 50 %.
- **The holding register 20** (40020) contains the setting for the maximum fan / drive speed (output). The default value is 100 %. The maximum speed can be selected between 50 % and 100 %.

NOTE

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	unsigned int.	Measured differential pressure	SPSPX-2K0	-100–2.000 1.000 = 1.000 Pa
				SPSPX-6K0	0–6.000 1.000 = 1.000 Pa
2	Output	unsigned int.	Analog / digital output value 0–100 %		0–1.000 100 = 10.0 %
3	Volume flow rate	unsigned int.	Calculated air volume flow rate in m ³ /h	SPSPX-2K0	0–44.000 10.000 = 10.000 m ³ /h
				SPSPX-6K0	0–77.000
4	Volume flow rate (low word)	unsigned int.	Calculated air volume flow rate in m ³ /h	SPSPX-2K0	Reserved, returns 0
				SPSPX-6K0	0–77.000 10.000 = 10.000 m ³ /h
5-6			Reserved, returns 0		
7	Differential pressure range	unsigned int.	Flag indicates the current differential pressure range	SPSPX-2K0	SPSPX-6K0
				0 = 0–100 Pa	0 = 0–1.000 Pa
				1 = 0–250 Pa	1 = 0–2.000 Pa
				2 = 0–500 Pa	2 = 0–3.000 Pa
				3 = 0–750 Pa	3 = 0–4.000 Pa
				4 = 0–1.000 Pa	4 = 0–5.000 Pa
5 = 0–2.000 Pa	5 = 0–6.000 Pa				
8-10			Reserved, returns 0		
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	RS485 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)	SPSPX-2K0 = 1016 SPSPX-6K0 = 1035			
5	HW version	unsigned int.	Hardware version of the device (Read only)	XXX		100 =	HW version 1.00
6	FW version	unsigned int.	Firmware version of the device (Read only)	XXX		100 =	FW version 1.00
7-10		unsigned int.	Reserved, returns 0				
11	Setpoint Differential Pressure	unsigned int.	Setpoint - desired differential pressure	SPSPX-2K0 0–2.000 SPSPX-6K0 0–6.000	100	1.000 =	1.000 Pa
12	Setpoint Volume Flow Rate	unsigned int.	Setpoint - desired volume flow rate	SPSPX-2K0 0–44.000 SPSPX-6K0 0–77.000	10.000	10.000 =	10.000 m ³ /h
13 2K	K-factor selection register	unsigned int.	K-factor according to the motor type	SPSPX-2K0 0–1.000	0		
13 6K	Setpoint Volume Flow Rate (low word)	unsigned int.	Setpoint - desired volume flow rate	SPSPX-6K0 0–77.000	10.000	10.000 =	10.000 m ³ /h
14 2K	Active Setpoint Selection	unsigned int.	Register for active Setpoint selection	SPSPX-2K0 0 = Differential pressure 1 = Air volume flow rate	0		
14 6K	K-factor selection register	unsigned int.	K-factor according to the motor type	SPSPX-6K0 0–1.000	0		
15 2K			Reserved, returns 0	SPSPX-2K0			
15 6K	Active SetPoint Selection	unsigned int.	Register for active Setpoint selection	SPSPX-6K0 0 = Differential pressure 1 = Air volume flow rate	0		
16	Kp	unsigned int.	Proportional gain	0–100	10		
17	Ti	unsigned int.	Integration period	0–1.000	30	10 =	10*100 ms = 1 s
18	Auto-Tune Function Start	unsigned int.	Register for starting the Auto-tune function	0 = Function is not active 1 = Function is in progress	0		
19	Min Speed	unsigned int.	Minimum speed of the motor (between 10 % and 50 %)	100–500	200	100 =	10 %
18-20	Max Speed	unsigned int.	Maximum speed of the motor (between 50 % and 100 %)	500–1.000	1.000	500 =	50 %

If you want to find out more about Modbus over serial line, please visit: http://www.modbus.org/docs/Modbus_over_serial_line_V1_02.pdf

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.