VFSC9 | ELECTRONIC SPEED CONTROLLER

Mounting and operating instructions

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SAFETY AND PRECAUTIONS

Read all information, the datasheet, mounting instructions and wiring scheme 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 to the product are not permitted.

The product must not be exposed to abnormal conditions, such as: extreme temperatures, direct sunlight or vibrations. Chemical vapours with high concentration in combination with long exposure times can affect the product performance. Make sure the work environment is as dry as possible; check for condensation spots.

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

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

Always verify that you apply appropriate power supply to the product and use wires with appropriate 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 disposed 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

VFSC9 are electronic fan speed controllers for single phase induction motors (110—240 VAC / 50—60 Hz). They have a selectable analogue input (0—10 VDC / 0—20 mA / PWM) and Modbus RTU communication. Compared to phase angle control (Triac fan speed controllers), the VFSC9 series generates an output signal with almost perfect sinusoidal shape, while the EMC pollution remains limited, the power factor exceeds 95 %.

ARTICLE CODES

Code	Max. output current, Imax	Max. load	Potentiometer
VFSC9-25-FP	2,5 A	600 W	yes
VFSC9-25-FC			no

INTENDED AREA OF USE

- Fan speed control in ventilation systems
- For indoor use only

TECHNICAL DATA

- Selectable analogue input 0—10 VDC / 0—20 mA / PWM
- Modbus RTU (RS485) communication
- Software configurable network bus terminator (NBT)
- Stand-by power consumption: < 1 W
- Two LED indications
- Potentiometer knob*
- Adjustable minimum and maximum speed
- Selectable input control: Modbus, Analogue Input / Potentiometer*
- Adjustable OFF level: 1—4 VDC / 2—8 mA / 10—40 % PWM
- Passive heatsink
- Adjustable acceleration / deceleration rate
- Digital input for run / stop command
- Reinforced enclosure ABS UL94-V0 (IP, grey (RAL 7035)
- Supply voltage: 110—240 VAC / 50—60 Hz (single phase)
- Power factor: > 95 %
- Maximum output current (Imax): 2,5 A
- Maximum load: 600 W
- Adjustable settings via Modbus registers:
  - Minimum speed: 20—65 %
  - Maximum speed: 70—90 %
  - Input control: Modbus, Analogue Input / Potentiometer*
  - OFF level: 1—4 VDC / 2—8 mA / 10—40 % PWM
  - Acceleration / deceleration: 1—10 %/s
- Protections: fuse, thermal contact (TK) input
- Protection standard: IP54 (according to EN 60529)
- Operating ambient conditions:
  - temperature: -10—40 ºC
  - rel. humidity: 5—85 % rH (non-condensing)
- Storage temperature: -20—50 ºC

*Potentiometer knob is available only in the FP version

STANDARDS

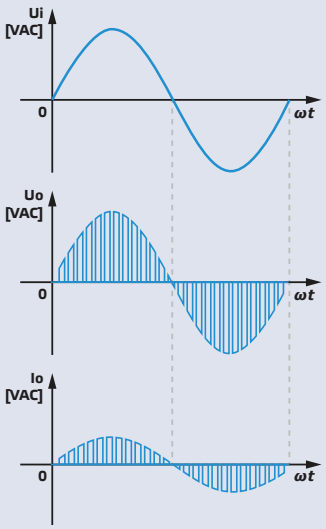
- Low Voltage Directive 2014/35/EU CE
- EMC Directive 2014/30/EU: EN 61000-6-2: 2005 / AC: 2005; EN 61000-6-3: 2007 / A1: 2011 / AC: 2012; EN 61000-6-3: 2014

WIRING AND CONNECTIONS

L	Supply voltage 110—240 VAC / 50—60 Hz	
N	Neutral	
PE	Earth terminal	
U1, U2	Regulated output to the motor	
TK, GND	Thermal contact input	
Di, GND	Digital input	
Ai, GND	Analogue input	
A	Modbus RTU (RS485), signal A	
/B	Modbus RTU (RS485), signal /B	
+V	Supply output 15 VDC for external potentiometer 10 kΩ	
RJ45 connector on PCB	Modbus RTU (RS485) connection	
Connections	L, N, PE	0,75—1,5 mm², 3-wire insulated
	U1, U2	0,75—1,5 mm², 2-wire, screened and insulated
	TK, GND	
	Di, GND	0,5—1,25 mm²
	Ai, GND	0,5—1,25 mm², screened / shielded
	+ V	
	A, /B, GND	Cat 5 network cable , screened, foil-shielded, twisted pair (S/FTP)

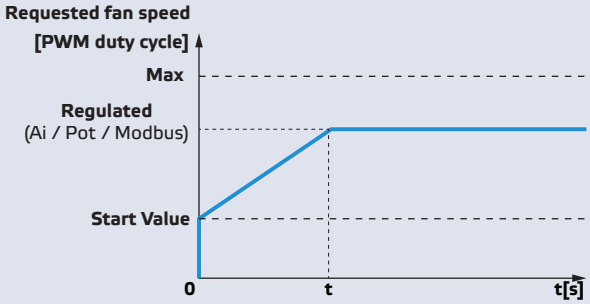
OPERATIONAL DIAGRAMS

Input / Output



When the motor starts, it runs at proportional step (acceleration / deceleration) from the start value to the regulated value. The start value can be equal to 45 % of PWM duty cycle or equal to the minimum value of PWM duty cycle, depending on the minimum value of PWM duty cycle.

Startup diagram



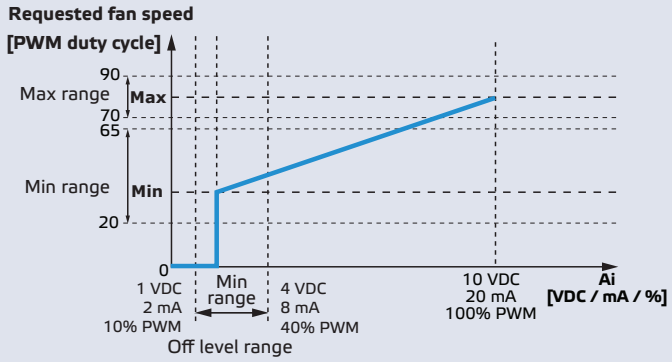
If min. > 45 % , Start value = min.
If min. < 45 %, Start value = 45 %

If Regulated > Start Value, $t = \frac{(Regulated - StartValue)}{acceleration}$

If Regulated < Start Value, $t = \frac{(Regulated - StartValue)}{deceleration}$

Max	Maximum value of PWM duty cycle (%)
Min	Minimum value of PWM duty cycle (%)
Regulated	Regulated value of PWM duty cycle (%)
Start Value	The value of PWM duty cycle to start the motor (%)
t	Time duration to reach the regulated value according to proportional step (acceleration / deceleration)

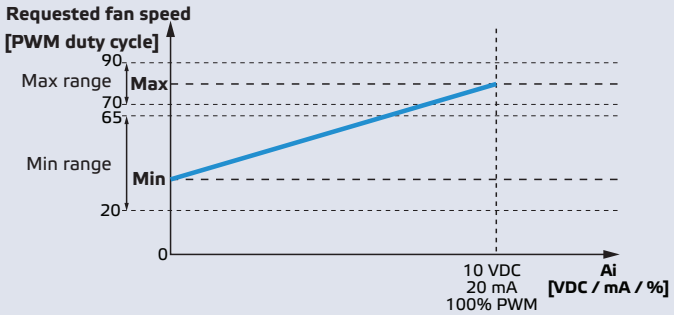
Analogue input (Ai) with OFF level



PWM duty cycle = $Min + \frac{A_i - OFF\ Level}{A_{i_{max}} - OFF\ Level}(Max - Min)$

OFF level	OFF level value of analogue input (VDC / mA / %)
OFF level range	(1—4 VDC / 2—8 mA / 10—40 % PWM)

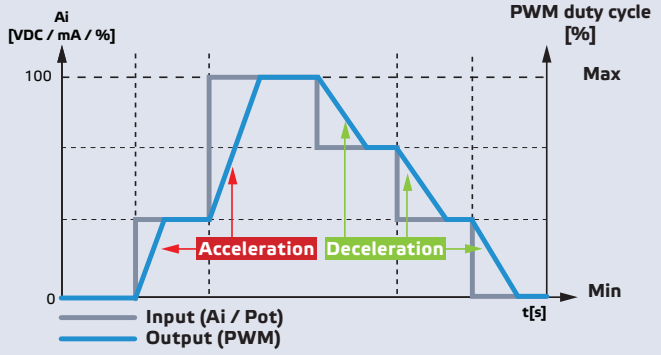
Analogue input (Ai)



PWM duty cycle = $Min + \frac{A_i}{A_{i_{max}}}(Max - Min)$

Max	Maximum value of PWM duty cycle (%)
Min	Minimum value of PWM duty cycle (%)
Max. range	Range of maximum value of PWM duty cycle (70—90 %)
Min. range	Range of minimum value of PWM duty cycle (20—65 %)
Ai	Analogue input (settable)
Ai max	Maximum value of analogue input (10 VDC / 20 mA / 100 % PWM)

Analogue input (Ai) - output related to acceleration / deceleration



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MOUNTING INSTRUCTIONS IN STEPS

Before you start mounting the VFSC9-25 controller, read carefully **"Safety and Precautions"**. Choose a smooth surface for an installation location (a wall, panel, etc.)

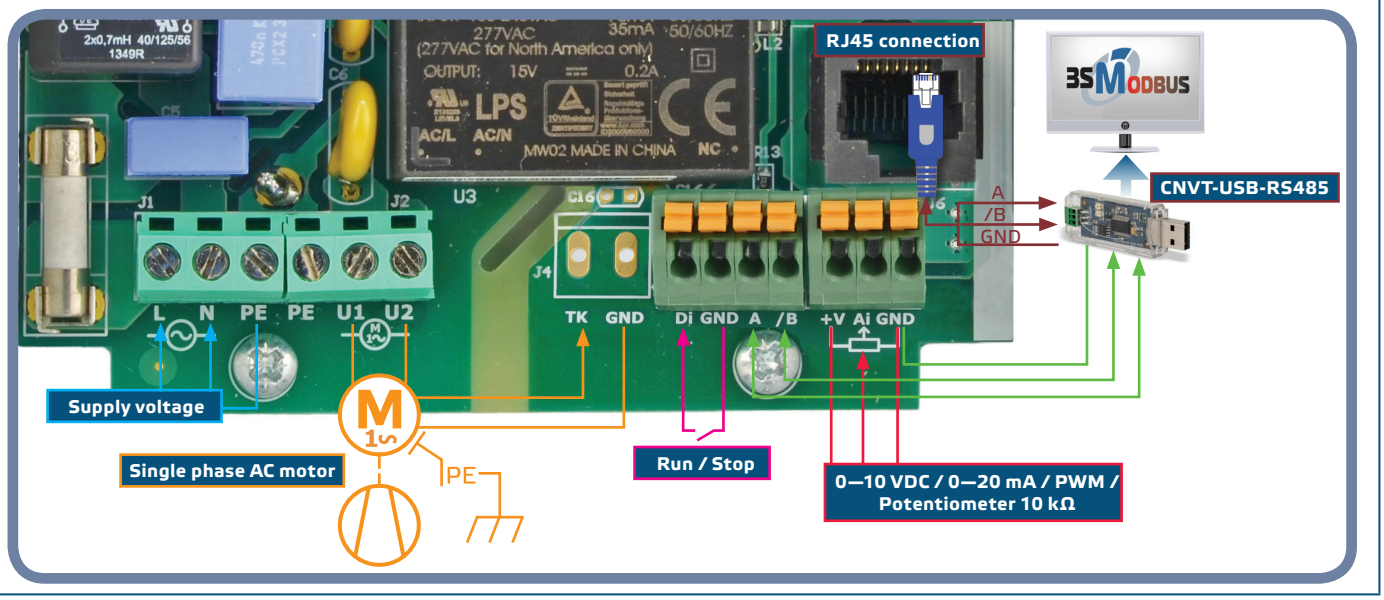
Follow these steps:

⚠ ATTENTION

Before mounting the controller, switch OFF the mains supply!

1. Unscrew the 4 screws on the front cover and open the enclosure. Mind the wires that connect the potentiometer with the printed circuit board.
2. Loosen the cable glands.
3. Insert the cables through the cable glands and connect adhering to the information from the "Wiring and connections" section, **Fig. 1** Wiring diagram and the following instructions:
   - 3.1 Connect the motor / fan.
   - 3.2 Connect the thermal cut-off contact cables, if any, or use a bridge on TK input. Do not leave it open!
   - 3.3 Connect the power supply cables.
   - 3.4 Connect the digital input (remote) cables, if any, or use a bridge on Di input.

Fig. 1 Wiring diagram



Legend	
L, N	Supply voltage: 110 – 240 VAC / 50 – 60 Hz (single phase)
PE	Power earth
U1, U2	Regulated output, Imax = 2,5 A (single phase)
TK, GND	Thermal contact input
Di, GND	Digital input
Ai, GND	Analogue input
+V	Supply voltage 15 VDC for external potentiometer 10 kΩ
A, /B	Modbus RTU (RS485) communication

4. Tighten the cable glands.

5. Fix the unit to the wall or panel using the provided screws and dowels. Mind the correct mounting position and unit mounting dimensions. (See **Fig. 2** *Mounting dimensions* and **Fig. 3** *Mounting position* above). Put back the front cover and fix it.

Fig. 2 Mounting dimensions

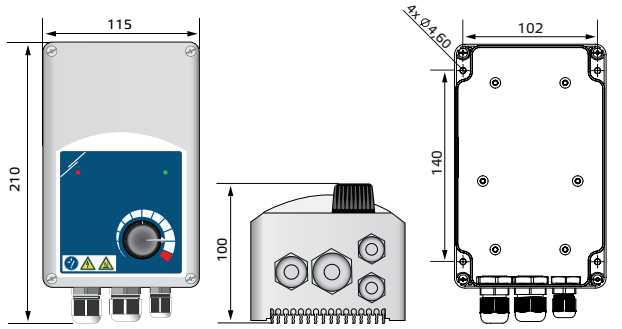
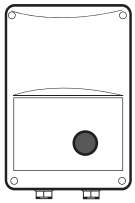
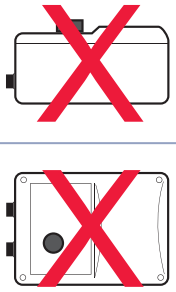


Fig. 3 Mounting position

Acceptable	Not acceptable
	

6. Switch on the power supply.
7. Set the Modbus registers, if necessary (refer to the *Modbus registers settings* below).

NOTE

The controller has 4 cable glands: an M16, an M20, and two M12 (metric size). Make sure you use appropriate cable sizes, so that they can fit into the provided cable glands.

3SMODBUS COMMUNICATION SETUP

VFSC9-25 is ready to use. If required, the advanced settings can be changed from a PC via Modbus communication using the *3SModbus* software.

IMPORTANT

- *The device ID for calling VFSC9-25 is 1 (default).*
- *The VFSC9-25 has baud rate 19200, Even parity (default).*

To connect the VFSC9-25 to the 3SModbus software on the PC, follow these steps:

1. Setup the Modbus (RS485) cable*.
   You needs a 3-wire cable to connect the converter to the VFSC9-25: a wire for A signal, a wire for /B signal, and a wire for ground.
2. Turn OFF the VFSC9-25 and connect the Modbus wires to the VFSC9-25. There are two options for connecting the wires to VFSC9-25:
   2.1 Connect directly to the Terminal Block slot A, /B (see **Fig. 4**);
   2.2 Plug an RJ45 connector into the socket (see **Fig. 5**).

* The Modbus (RS485) cables to connect the VFSC9-25 to the PC are not included in the set. It is highly recommended that you use shielded twisted-pair cable (S/FTP) for this connection.

Fig. 4 3SModbus terminal block connection

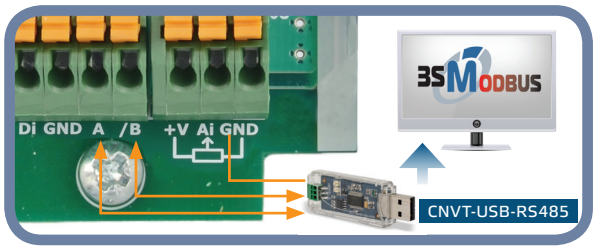
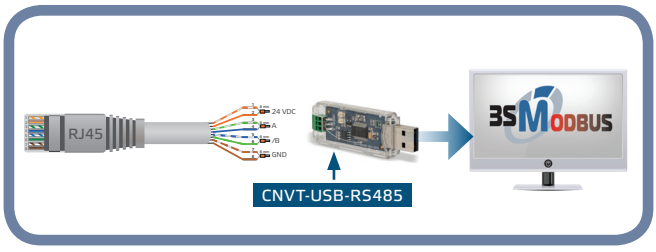


Fig. 5 3SModbus RJ45 connection



Connections	
Pins 1 & 2	Not connected (NC)
Pins 3 & 4	A signal
Pins 5 & 6	/B signal
Pins 7 & 8	Ground (GND)

NOTE

Make sure the Modbus cables fit into the cable glands. If the cables have an RJ45 connector, it is recommended that you plug the RJ45 connector into the RJ45 socket first and then insert the wires through the cable gland before connecting to the Modbus (RS485) converter.

3. Insert a Modbus (RS485) converter (CNVT-USB-RS485) into the PC USB port.

SENSISTANT COMMUNICATION SETUP

VFSC9-25 is ready to use. If required, the advanced settings can be changed from a SENSISTANT configurator. The information below illustrates the way to connect the VFSC9-25 to a SENSISTANT.

IMPORTANT

- *The device ID for calling VFSC9-25 is 1 (default).*
- *The VFSC9-25 has baud rate 19200, Even parity (default).*

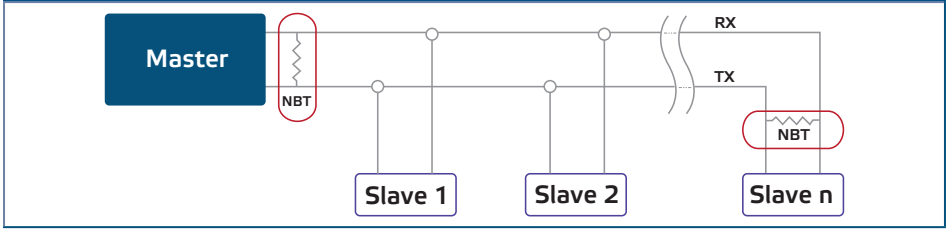
To connect the VFSC9-25 to the SENSISTANT Modbus configurator, follow these steps

1. Remove the power supply from the VFSC9-25 and the PDM unit. Connect the VFSC9-25 to the PDM unit using a standard network cable with an RJ45 connector at both ends.
2. Connect the SENSISTANT to the PDM using a standard network cable with an RJ45 connector at both ends.

Network bus terminator

The network bus termination resistor (NBT) should be connected only in case the unit is first or last on the line of device (See **Fig. 6** *NBT example*). The NBT is connected via holding register 40020.

Fig. 6 NBT Example



LED indications

1. When the green LED on the enclosure cover (see **Fig. 7** *Operating LED indications*) indicates the that the power is on and the modes, depending on if the light signal is blinking or permanent:
   - 1.1 Blinking green: Power ON, stand-by mode;
   - 1.2 Permanent green : Power ON, run mode (the motor runs).
2. The red LED on the enclosure cover indicates that there is thermal contact alarm.

3. The green LED on the main board and the controller board indicate that a 3,3 VDC supply voltage.
4. Blinking green LEDs on the RS485V board indicate that the controller transmits (Tx) and receives (Rx) packages via Modbus (**Fig. 8** *Communication LED indication*).

Fig. 7 Operating LED indications

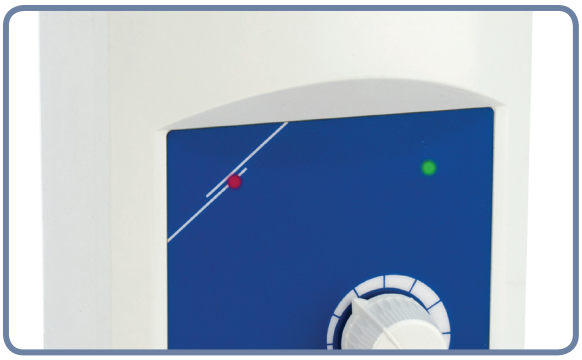
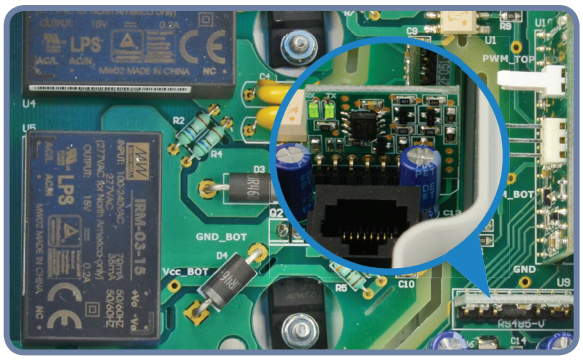


Fig. 8 Communication LED indication



VERIFICATION OF INSTALLATION

Switch OFF the remote control input (Di) and switch ON the power supply. The green LED must blink, the red LED must be off, and the motor must not run.
If the red LED is ON, the power supply should be restarted. Check the motor for a thermal problem or a thermal contact (TK) problem before restarting the power supply.

For FC version

1. Apply a "10 VDC" control signal to the analogue input. Switch ON the remote control input (Di). The green LED must be on and the motor must start running at maximum speed.
2. Apply a "0 VDC" control signal to the analogue input. The green LED must be on and the motor must start running at minimum speed.
3. Switch off the remote control input (Di). The motor must stop.

For FP version

1. Turn the potentiometer at the front of the enclosure to 'MAX' position. Switch ON the remote control input (Di). The green LED must be on and the motor must start running at maximum speed.
2. Turn the potentiometer at the front of the enclosure to 'MIN' position:
3. The GREEN LED should light and the motor running to minimum speed.
4. Switch OFF the remote control input (Di). The motor must stop.

NOTE

If the controller does not operate according to the instructions, the wiring connections and settings need to be checked.

ATTENTION

Hot surface! The surface of the unit may become hot and cause burns if touched. Avoid contact with the unit when in operation!

MODBUS REGISTER MAPS

INPUT REGISTERS

		Data type	Description	Data	Values	
30001	Output value	unsigned int.	Output value (PWM duty cycle) in %	0—90	80 =	80%
30002	Minimum value of PWM duty cycle	unsigned int.	Minimum value of PWM duty cycle in %	20—65	145 =	45 %
30003	Maximum value of PWM duty cycle	unsigned int.	Maximum value of PWM duty cycle in %	70—90	80 =	80%h
30004	Input mode	unsigned int.	Active input	1—2	1 = 2 =	Analogue input External potentiometer input
30005	Work mode	unsigned int.	Current work mode	0—2	0 = 1 = 2 =	STOP RUN ALARM / TK

HOLDING REGISTERS

		Data type	Description	Data	Default	Values	
40001	Device slave address	unsigned int.	Modbus device address	1—247	1		
40002	Modbus baud rate	unsigned int.	Modbus communication baud rate	0—5	2	0 = 1 = 2 = 3 = 4 = 5 =	4.800 bps 9.600 bps 19.200 bps 38.400 bps 57.600 bps 115.200 bps
40003	Modbus parity mode	unsigned int.	Parity check mode	0 = 8N1 1 = 8E1 2 = 8O1	1	0 = 1 = 2 =	None Even Odd
40004	Device type	unsigned int.	Device type (Read only)	3012		3012 =	VFSC9-XX
40005	HW version	unsigned int.	Hardware version of the device (Read only)	XXXX		0 x 0100 =	HW version 1.00
40006	FW version	unsigned int.	Firmware version of the device (Read only)	XXXX		0 x 0200 =	FW version 2.00
40007		unsigned int.	Reserved, returns 0				
40008	Overwrite mode	unsigned int.	Overwrite mode selection	0—1	0	0 = 1 =	Inactive Active
40009			Reserved, returns 0				
40010	Modbus registers reset	unsigned int.	Resets all Modbus registers to default values (except registers 1—3)	0—1	0	0 = 1 =	Idle Reset
40011	Minimum value of PWM duty cycle	unsigned int.	Sets minimum PWM duty cycle value in percentage	20—65	40	45 =	45% PWM
40012	Maximum value of PWM duty cycle	unsigned int.	Sets maximum PWM duty cycle value in percentage	70—90	90	80 =	80% PWM
40013	Input mode	unsigned int.	Selects active input	0—2	0	0 = 1 = 2 =	Auto Analogue input External potentiometer input
40014	Analogue input mode	unsigned int.	Selects analogue input mode	0—2	0	0 = 1 = 2 =	Voltage mode (0—10 VDC) Current mode (0—20 mA) PWM mode (100%)
40015	Off level	unsigned int.	Sets OFF level value	0; 10—40	0	0 = 10 =	Without Off level 10 % of input → ON
40016	Acceleration	unsigned int.	Sets acceleration speed	0—10	5	1 = 10 =	minimum acceleration maximum acceleration
40017	Deceleration	unsigned int.	Sets deceleration speed	1—10	5	1 = 10 =	minimum deceleration maximum deceleration
40018-40019			Reserved, return 0				
40020	Network bus terminator (NBT)	unsigned int.	Sets unit as first or last unit on the line by connecting the NBT resistor	1—1	0	0 = 1 =	Disconnected (NBT open) Connected (NBT connected)
40021	Overwrite value	unsigned int.	PWM duty cycle value (Overwrite mode) in percentage	0; 20—90	60	50 =	50 % PWM

For more information about Modbus over serial line, please visit: *http://www.modbus.org/docs/Modbus_over_serial_line_V1_02.pdf*

TRANSPORT AND STOCK KEEPING INFORMATION

Avoid shocks and extreme conditions. Stock in original packing at temperatures -20—50°C.

WARRANTY INFORMATION 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.
The warranty will be void in the event of damage caused by failure to observe the safety instructions! We do not assume liability for any resulting damage.

MAINTENANCE

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