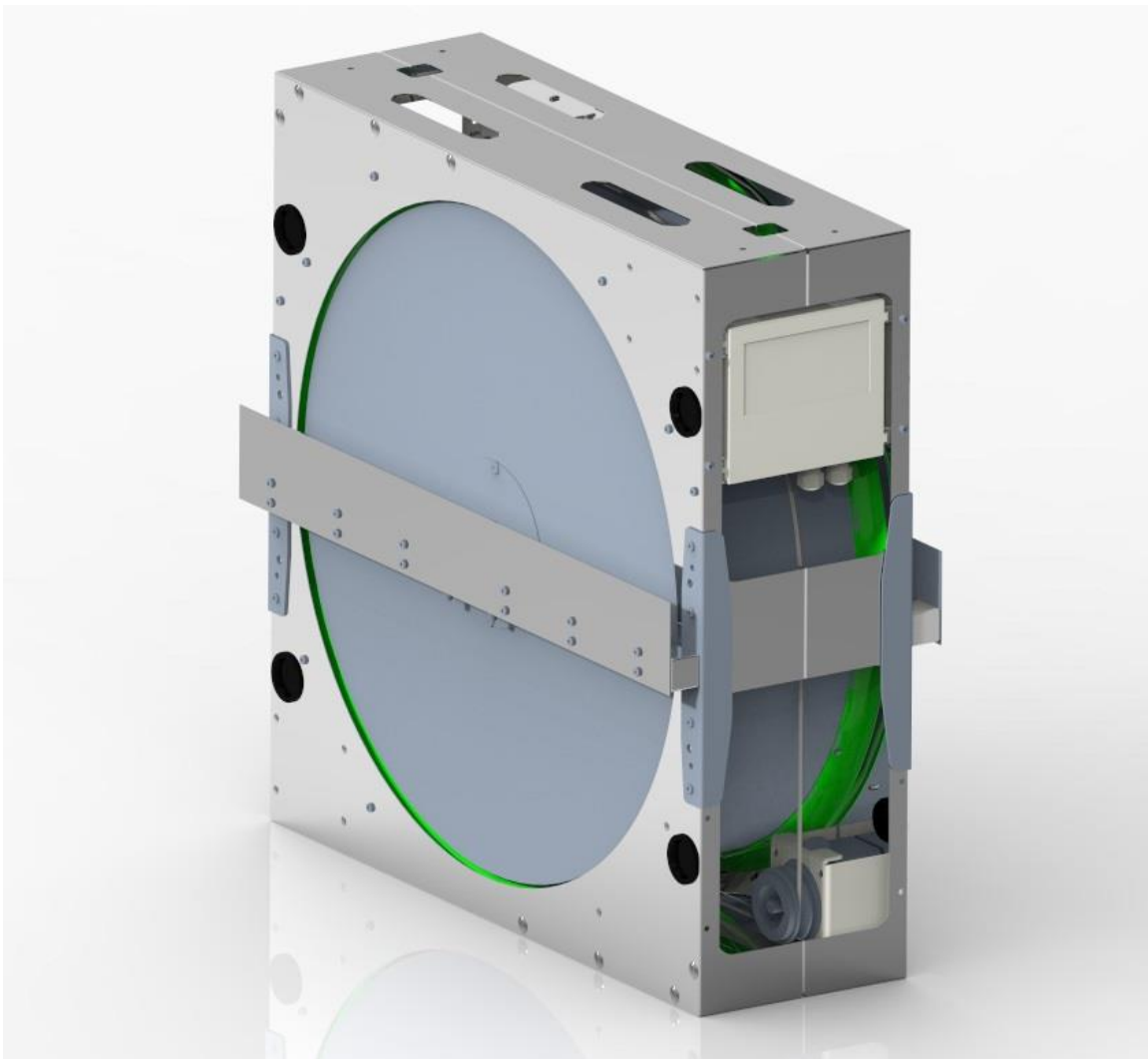




ENERGY RECOVERY WHEEL MOTOR MANUAL

OPERATION AND MAINTANANCE





Please read the following documentation carefully before performing installation, maintenance and operating of rotary heat exchangers motors. In case of doubts contact VTS official support. This manual must only be used by a qualified installer/service technician.

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1. GENERAL SAFETY



CAUTION! Electric Voltage: All motors described in the following manual can be operated, connected, installed, repaired and modified by qualified personnel only. Failure in performing in any of this operations may result in risk of fatal injury, electric shock, incorrect mounting or product damage. Installation should be carried out with usage of power lines, without short circuits and with proper grounding. Follow the connection diagrams dedicated to given motors.

WARNING: Do not open or disassemble the motor while power supply is connected to the device. It may result in fatal injury caused by electric shock. If it is necessary to open the motor, wait at least 5 minutes after disconnecting from the power supply.

NOTE: It is the user and the installer responsibility to provide the system with the proper grounding and protection in accordance with national and local standards. VTS is not responsible for any damages or injuries caused by incorrect installation, bad circuits or other failures.



Before installation and operating the motor please read entire instruction carefully! Follow the connection diagrams to perform successful installation.

2. PRODUCT DESCRIPTION & TECHNICAL SPECIFICATION

Rotary Heat Exchangers may be equipped with three different stepper motors configurations tailored to the needs and electrical requirements of our customers. Table 1 Stepper motors used in the series of Rotary Heat Exchangers represents the general characteristics of stepper motors occurring in the series of Rotary Heat Exchangers.

| Torque - Power | 2.0 Nm – 55W | 4.0 Nm – 110W | 8.0 Nm – 260 W |
|----------------|--------------|---------------|----------------|
| Weight | ≈ 2.4 kg | ≈ 3.5 kg | ≈ 5.0 kg |
| Dimensions | 85 x 85 x 67 | 85 x 85 x 97 | 85 x 85 x 156 |
| Shaft diameter | 12 mm | 12 mm | 12 mm |

Table 1 Stepper motors used in the series of Rotary Heat Exchangers

Table 2 Available motor configurations represents configuration of motors in reference to the AHU size.

| Motor | AHU Size |
|--------------|---------------|
| 2 Nm – 55 W | VVS021-VVS055 |
| 4 Nm – 110 W | VVS075-VVS300 |
| 8 Nm – 260 W | VVS150-VVS300 |

Table 2 Available motor configurations

Note: Given setups are explanatory. VTS reserves the right to change those configurations without informing. Any modification or configuration changes other than proposed should be reported and consulted in details with VTS technical department first.

Tables below represent the technical specifications of the given motors with the correct identification numbers. The index number is a unique code identifying the suitable motor for the product.

| Torque | 2.0 Nm | 4.0 Nm | 8.0 Nm |
|---------------------------|------------------------|------------------------|------------------------|
| INDEX NUMBER | 7-1-0005-0082 | 7-1-0002-0083 | 7-1-0005-0084 |
| PH | 1 | 1 | 1 |
| Voltage [V] | 208-240 | 208-240 | 208-240 |
| Stepper motor voltage [V] | 3 x 0-200 V | 3 x 0-200 V | 3 x 0-200 V |
| RPM | 0-400 | 0-400 | 0-400 |
| Frequency [Hz] | 50 | 50 | 50 |
| HP | 0,08 | 0,15 | 0,36 |
| Power size (250 rpm) | 55 W | 110 W | 260 W |
| Weight | ≈ 2.4 kg | ≈ 3.5 kg | ≈ 5.0 kg |
| Sealing grade [IP] | 54 | 54 | 54 |
| Operating temperature | -40°C to +40°C | -40°C to +40°C | -40°C to +40°C |
| Storage temperature | -40°C to +70°C | -40°C to +70°C | -40°C to +70°C |
| Dimensions | 85 x 85 x 67 | 85 x 85 x 97 | 85 x 85 x 156 |
| Shaft diameter | 12 mm | 12 mm | 12 mm |
| Electrical connection | 4-pole Tyco MATE-N-LOK | 4-pole Tyco MATE-N-LOK | 4-pole Tyco MATE-N-LOK |

Table 3 Technical specification of available motor setups

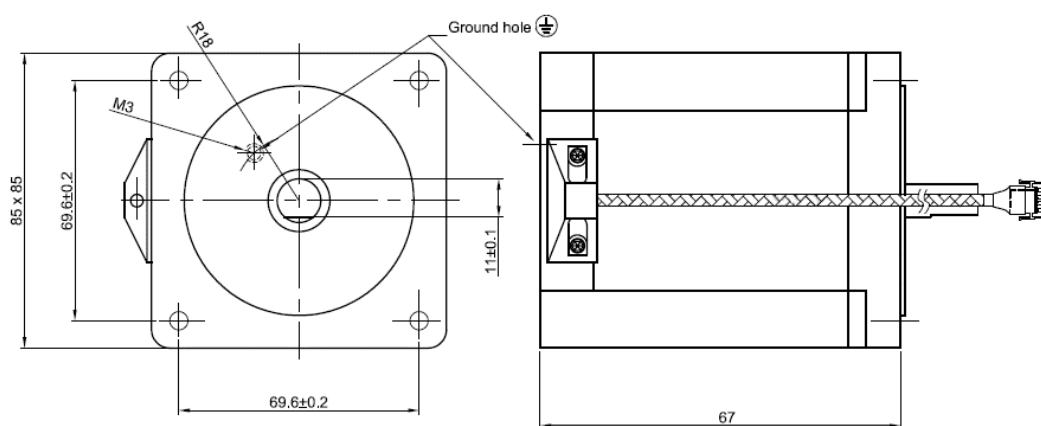


Figure 1 Stepper Motor 2.0 Nm (all dimensions are given in mm units)

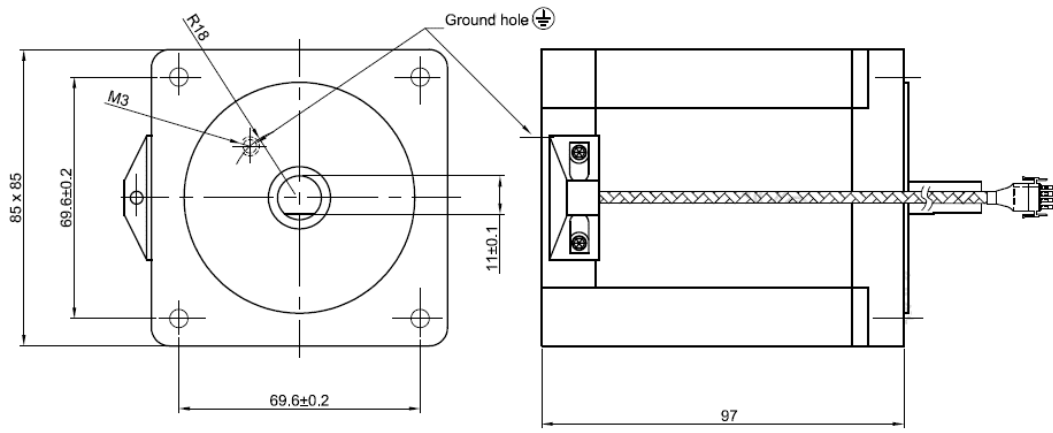


Figure 2 Stepper Motor 4.0 Nm (all dimensions are given in mm units)

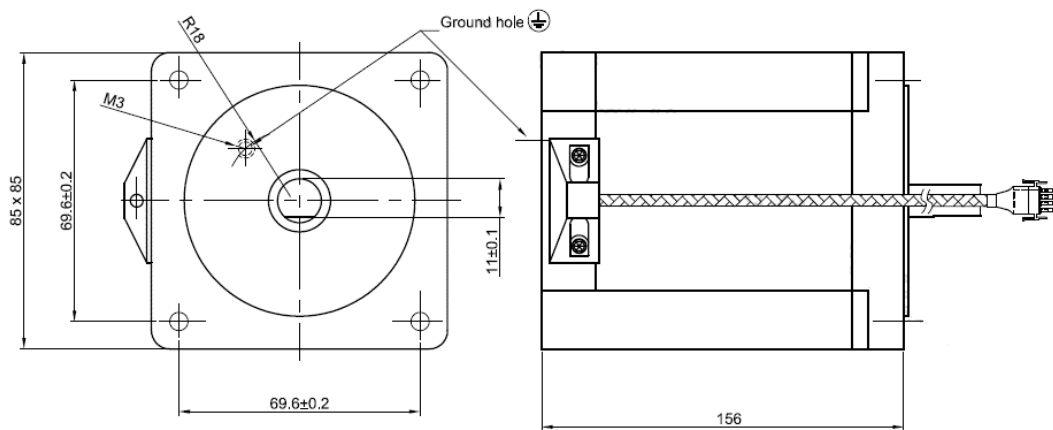


Figure 3 Stepper Motor 8.0 Nm (all dimensions are given in mm units)

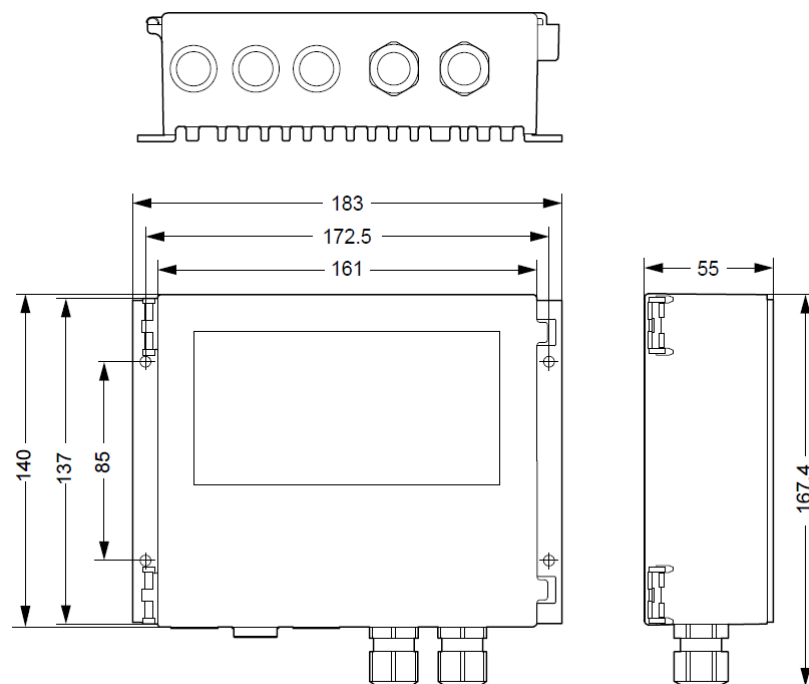


Figure 4 Dedicated controller (all dimensions are given in mm units)

3. INSTALLATION

3.1 Assembly and installation

Following illustrations and instructions presents the correct assembling of the motors and controller with the casing of the rotary heat exchanger. Motors are designated to be firmly attached to casing of the exchanger. Pulleys are selected to match the expected speed, efficiencies and performance of the motors. Please refer to the *Chapter 2 - Product Description and Technical Specification* to determine the correct set of components for the product. Pulley wheels must be firmly attached to the shaft of the motor.



Do not change the motor configurations. Follow the correctly selected setup given in the first chapter of this manual (see Table 2). Changing the settings is associated with poor performance of the rotary wheel and risk of incorrect attachment to the housing of the exchanger, and most importantly, the risk of motor damage, as well as electric shock due to incorrect connection.

Warning: Incorrect mechanical installation of the motor can be a cause of error alerts.

Following illustrations represents stepper motor assembly and installation methods. Each of the stepper motor model has its own way of assembly and may differ in according to Table 2 *Available motor configurations*.

Important notes:

- Stepper motor must be fixed firmly to a casing via dedicated motor holder.
- Stepper motor must be grounded.
- Do not use cables or connectors other than that included in the set with motor and controller.
- Do not change the size of the pulley wheel. Optimal pulley sizes were calculated and chosen to match the desired performance of the Rotary Heat Exchanger.
- Position the controller correctly to avoid overheating. Avoid exposure to direct sunlight.
- Check the specification plate on the motor and controller to confirm electrical configuration.

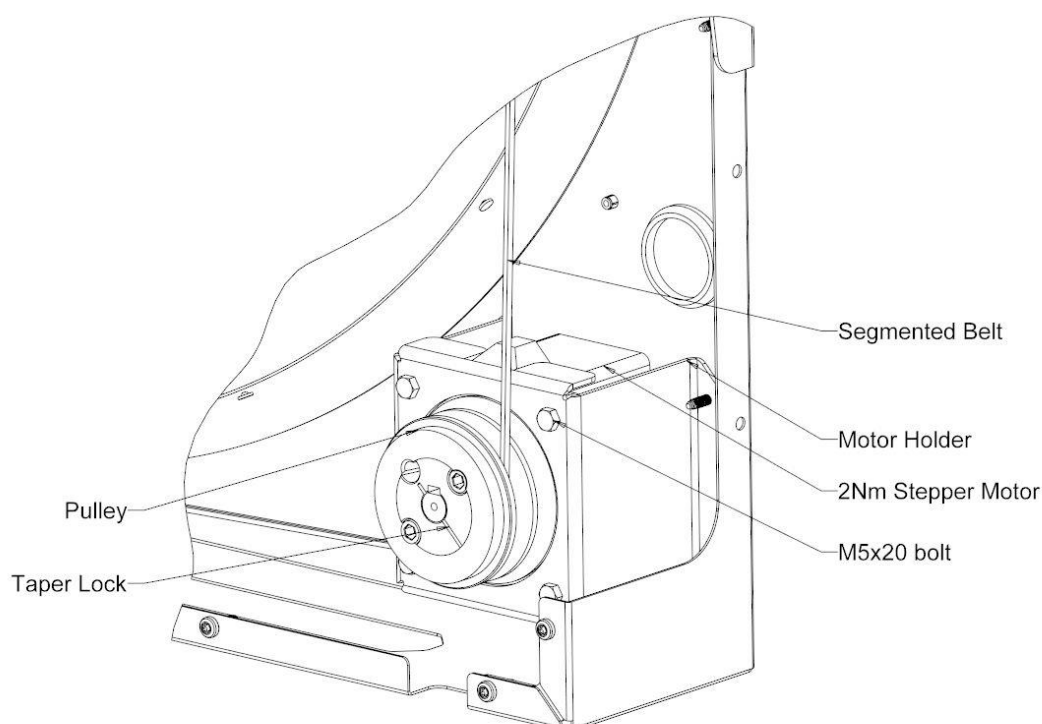


Figure 5 Stepper Motor 2Nm assembly schematic

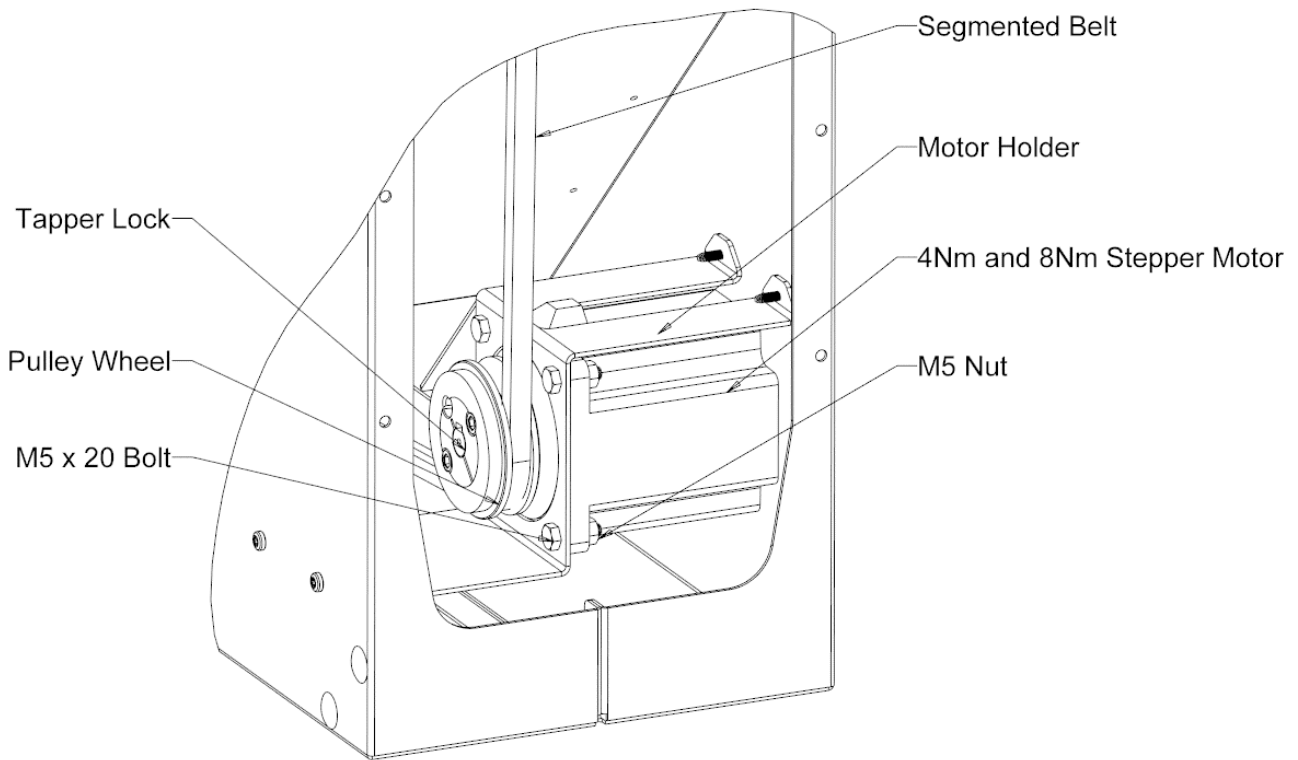


Figure 6 Stepper Motor 4Nm and 8Nm assembly schematic

3.2 Connection and wiring



To perform the correct setup, please refer to the following diagrams representing possible ways of motor connection. Installation and connection can be done by qualified personnel only. Failure in performing in any of this operations may result in risk of fatal injury, electric shock, incorrect mounting or product damage.

WARNING: Do not open or disassemble the motor nor controller while power supply is connected to the device. It may result in fatal injury caused by electric shock. If it is necessary to open the motor, wait at least 5 minutes after disconnecting from the power supply.

Notes on proper installation:

- Use fuses at power line.
- Check the wires condition before operating. Make sure that there are no short circuits.
- Use cables fulfilling the voltage, current, load and insulation installation requirements.
- Use only high quality hard wire or fiber copper wire with ferrule.
- Use shield cable.
- Make sure that motor label plate specification matches the operating supply voltage. Use cables that are adapted to work with the desired current.

Stepper motors used in series of VTS Heat Exchangers (Figure 7 Stepper motor with male type terminal) are connected and powered via controller responsible for basic operational parameters. Motor itself is equipped with male type terminal which characteristic are described below in the Figure 8 Connection cable with dedicated terminal.

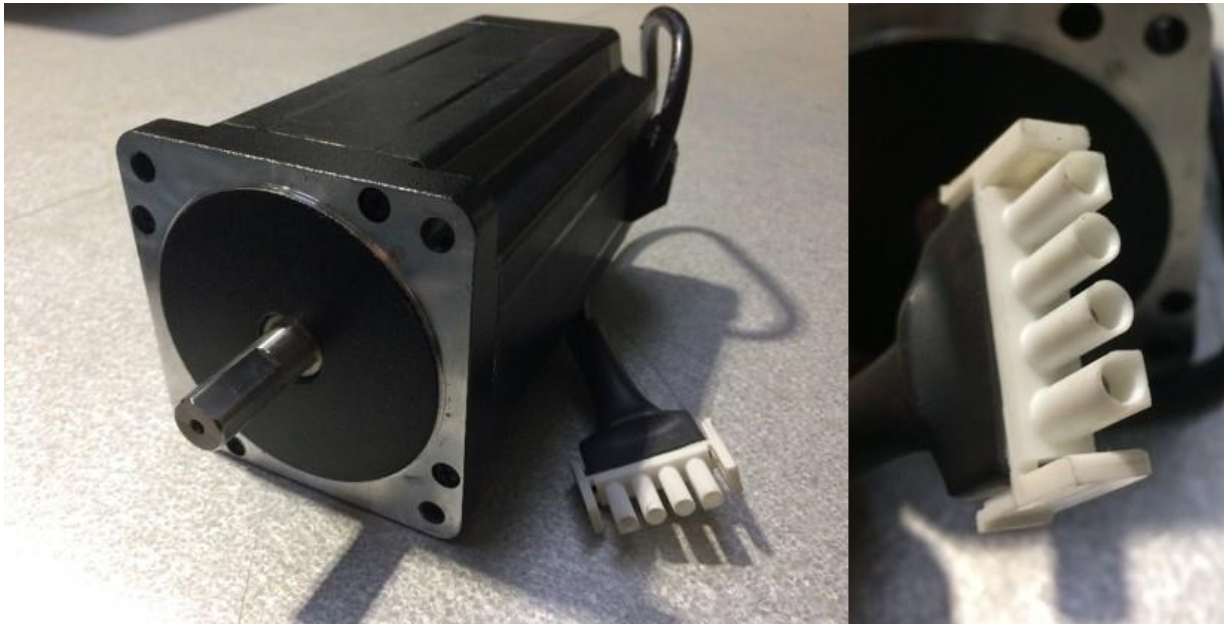


Figure 7 Stepper motor with male type terminal

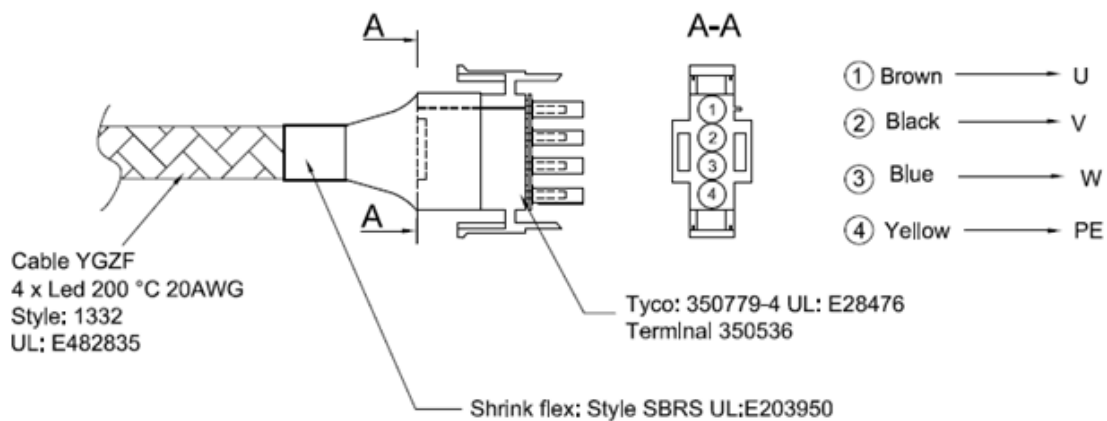


Figure 8 Connection cable with dedicated terminal

Due to length of the motor cables, extension cables connecting motor with the controller are supplied additionally. Extension cable is equipped with 4 pole connectors sleeves fitting terminal of the motors (Figure 9 Extension cable).

Lengths of the cables differs depending on the size of the Rotary Heat Exchanger. Figure below represents the cable connection with proper wiring description.

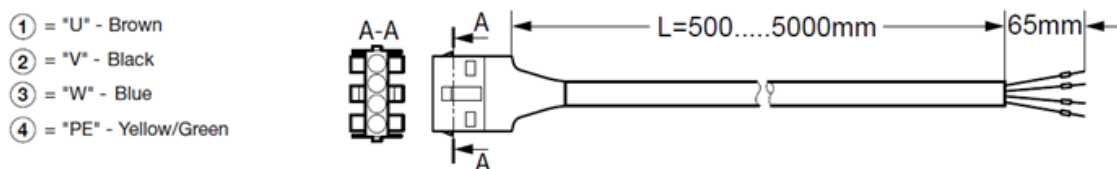


Figure 9 Extension cable

Stepper motors are operated via designated controller connected with the motor by the up mentioned cables. Figure 14 Stepper motor controller - wiring slots represents the slot description of the controller. Wires of the motor must be connected according to the following figures - start with opening the cover of the controller by unscrewing it.



WARNING! Wait at least 3 minutes after disconnecting the main voltage before opening the cover of controller. Be sure that supply voltage is disconnected before opening.

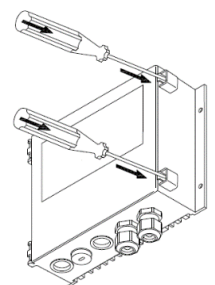


Figure 10 Opening controller by removing screws

To make the wiring process easier it is possible to remove the cover completely by detaching it from the controller. It will provide an easy access to the wiring slots. Hinged brackets allow to detach the doors by light pull (Figure 11 Controller cover). Despite that, cover doors can be opened at approximately 135°.

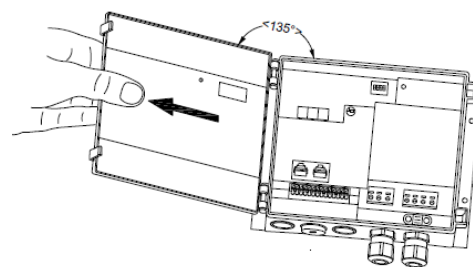


Figure 11 Controller cover

Electronic circuits of the controller (PCB) is protected by additional plastic cover (Figure 12 PCB cover) - it is forbidden to remove by unqualified personnel. This cover can be opened only to perform specialized service repairs. Do not attempt to perform any repairs by your own. Manufacturer warranty will not be void until the cover has traces of opening.

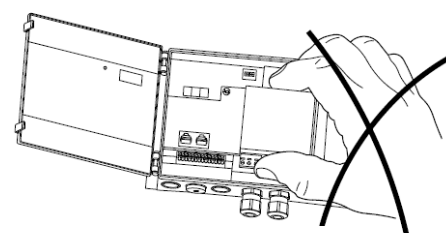


Figure 12 PCB cover

Controller is equipped with spring terminals to make the installation faster. Spring-loaded terminal allows to easily insert the wire into the desired slot by pushing it inside – no tools required. It is compatible with an multi-core cables/leads with additional core sleeves/end sleeves. Maximum and minimum dimensions of the wires are given in the Table 5. Wire ends or end sleeves must be between 8 – 10 mm. To detach the wire – press the terminal carefully with the screwdriver.

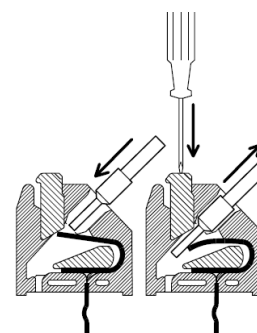


Figure 13 Spring terminals

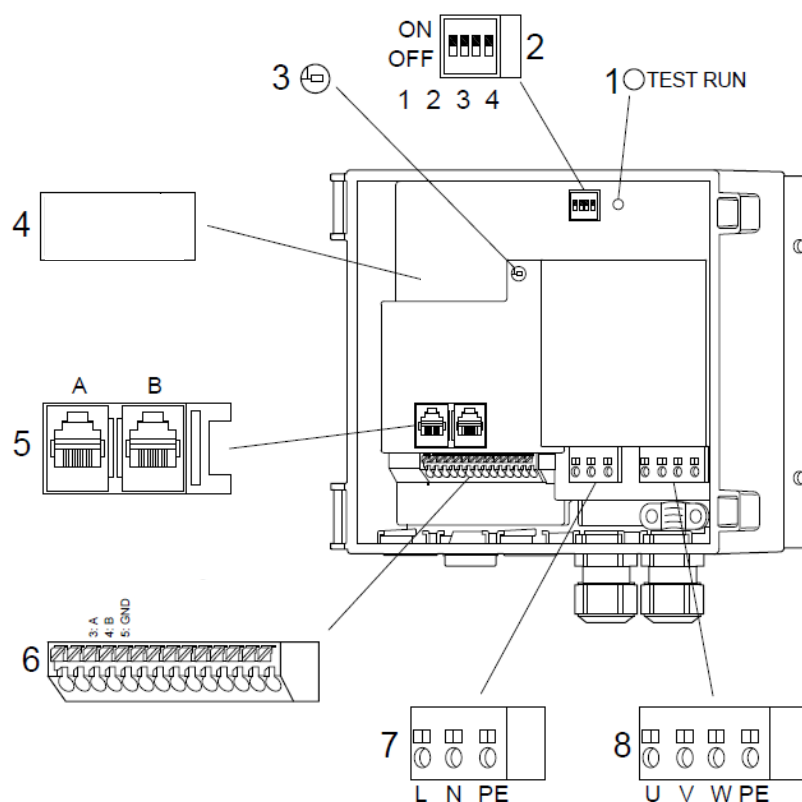


Figure 14 Stepper motor controller - wiring slots

| No. | Description |
|-----|--|
| 1 | Test button |
| 2 | 4-pole DIP switch |
| 3 | LED |
| 4 | Display – not used in base VTS automation |
| 5 | RJ12 Modbus connector (2 x RJ12) |
| 6 | A/D control and signal terminals, depending on version |
| 7 | Supply terminals (L, N, PE) |
| 8 | Connection terminals for stepper motor (U, V, W, PE) |

Table 4 Controller slots description

3.2.1 Main voltage and stepper motor wiring

The power supply of the controller is 230V AC; +/- 10%. Cable of the power supply should be connected on the terminals marked with letters “L”, “N” and “PE” (see Figure 15 Power supply connection). Cables should be inserted via dedicated cable entries/glands. After the wiring is performed, remember to re-tighten the cable glands and avoid pulling out or twisting.

Stepper motor is assembled with the integrated cable and connected to the controller via dedicated extension cable. Both of them are ended with the 4-pole connectors allowing for quick connection. Locking pawl of terminals will ensure the firm installation of both cables. Do not shorten the cables.

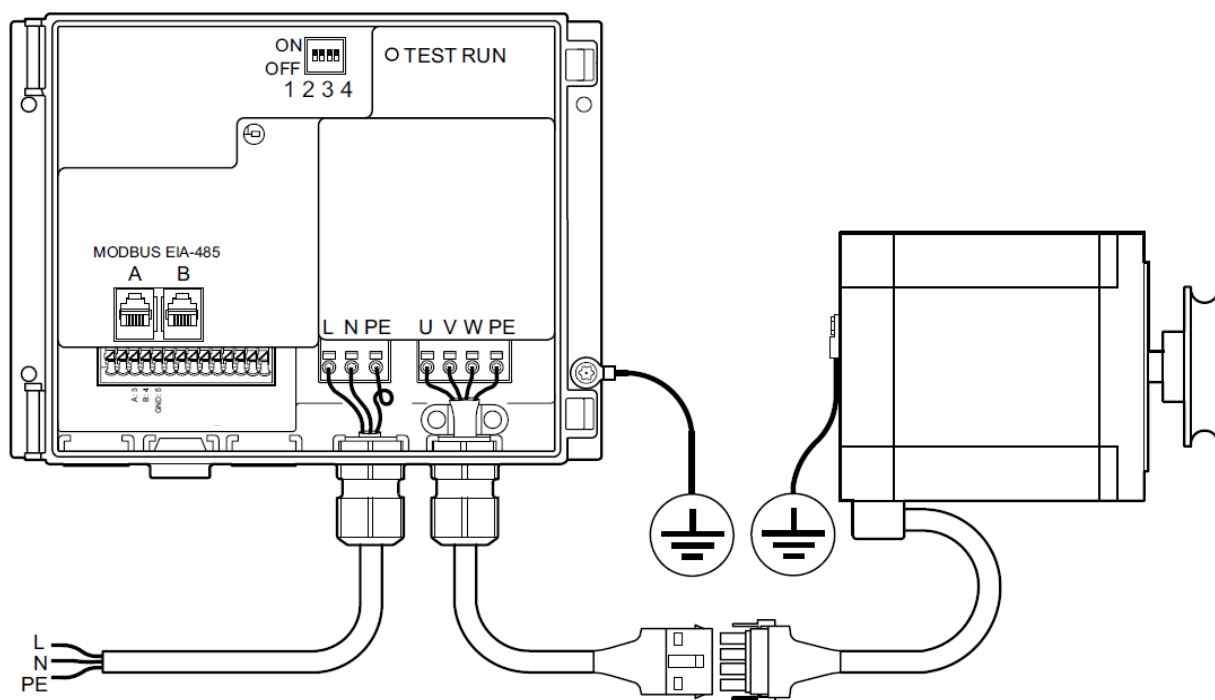


Figure 15 Power supply connection

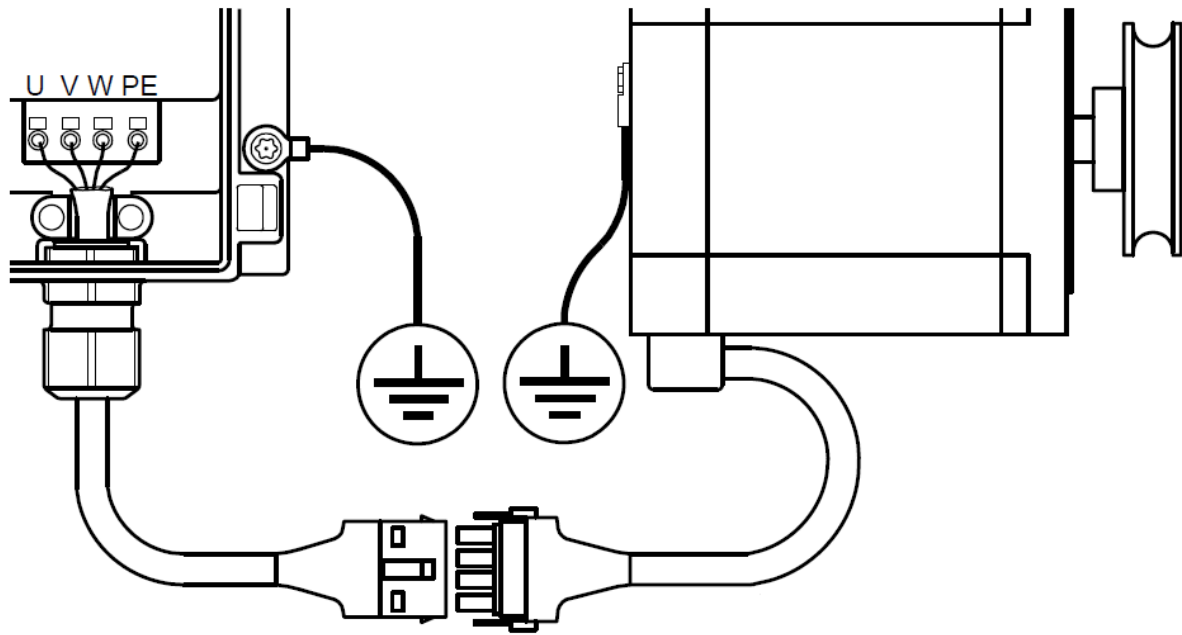


Figure 16 Stepper motor connection

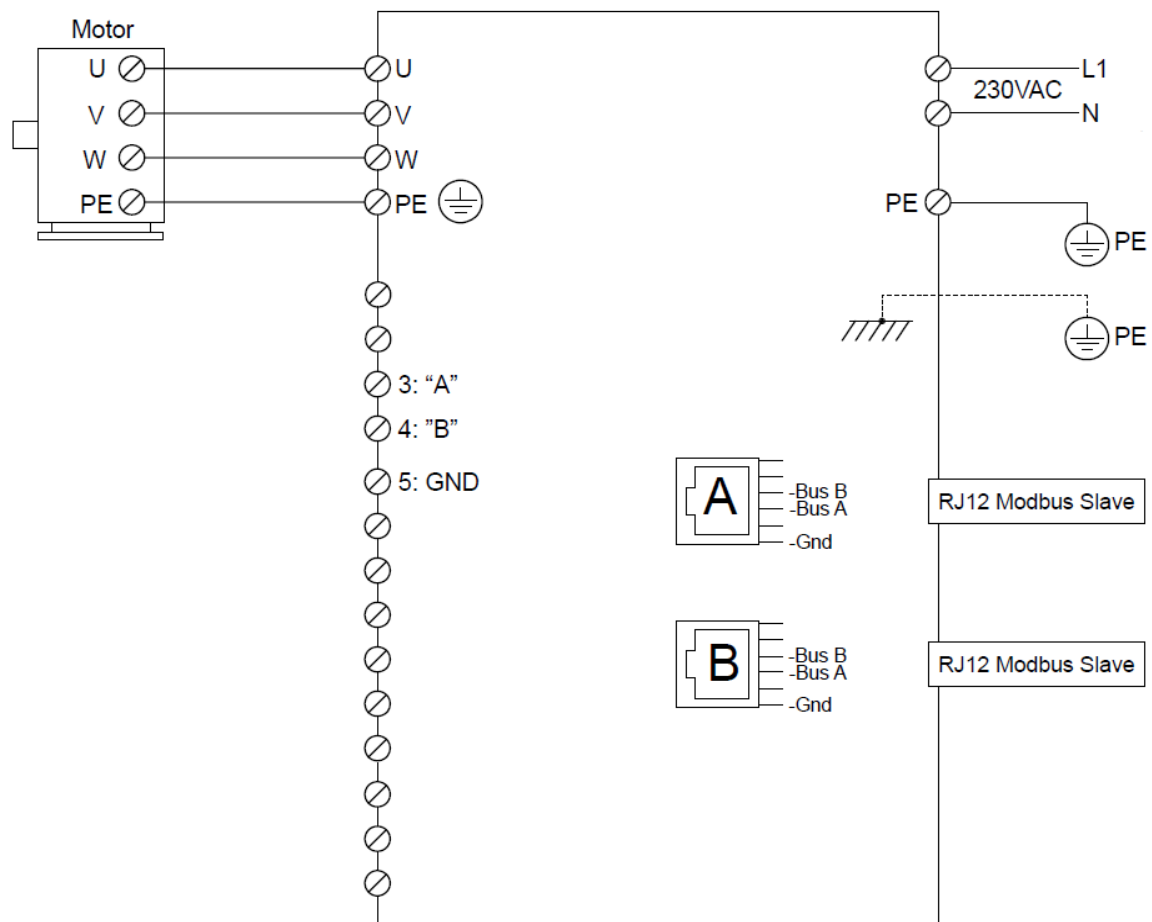


Figure 17 Controller schematic

3.2.2 Cable requirements

Before performing the installation, make sure that your setup fulfills the following list of requirements:

- All cables and leads must comply with the local and national regulations.
- Cable dimensions for PG9 connectors should be within the range of 3-8mm
- Cables meet the dimension requirements given in the Table 5.
- Copper wires are recommended.
- Modbus cable can be 6-wire unshielded, 30 AWG/0,066 m² or similar.

| Control wires and cables | Minimal Conductor Dimension | Maximum Conductor Dimension | Cable dimension |
|-------------------------------|-----------------------------|-----------------------------|-----------------|
| Solid wires | 0.08 mm ² | 1.5 mm ² | 3-8 mm |
| Multi-core wires | 0.14 mm ² | 1.0 mm ² | 3-8 mm |
| Power leads and cables | | | |
| Solid wires | 0.2 mm ² | 4.0 mm ² | 3-8 mm |
| Multi-core wires | 0.2 mm ² | 2.5 mm ² | 3-8 mm |

Table 5 Cable and wires dimension requirements

3.3 Elements of the controller panel

3.3.1 Test button

The driver is provided with a test function in the form of a built-in test push-button. The test button is located inside the drive in the upper right corner and must be operated with the drive open. The test button has different functions, depending on how long the button is pressed in:

1. Short press < 1sec.: The drive will enter test mode and stay in test mode until the button is pressed again. The rotor will start rotating in a sequence from 0–100 rpm according to the selected ramp-up time and remain at 100 rpm. Pressing the button a second time will cause the drive to leave test mode and stop the rotor according to the selected ramp-down time.
2. Pressing and holding the button will cause the drive to enter test mode where it will remain until the button is released. The signal to the rotor will override to 100 rpm according to the selected ramp-up time.

Please note, that when pressing the test button for more than 20 sec. the calibration function off the internal rotorguard may be triggered.

The test button also works when Modbus control is activated.

3.3.2 Dip switch

The driver is equipped with 4 DIP switches for setting the stepper motor size (see Table 6) and maximum motor speed (Table 7).

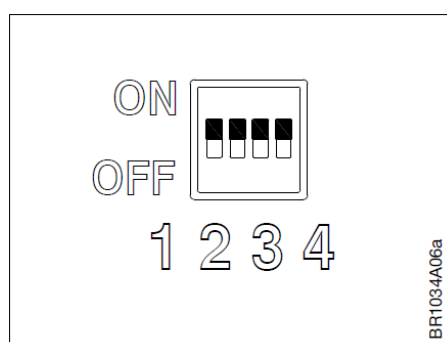


Figure 18 DIP switch

Note – motor size and speed settings of the device delivered with the VTS AHU are prepared by the manufacturer for optimal operation and should not be changed.

| | DIP1 | DIP2 |
|---------------------|------|------|
| Stepper motor = 2Nm | OFF | OFF |
| Stepper motor = 4Nm | ON | OFF |
| Stepper motor = 8Nm | OFF | ON |

Table 6 Stepper motor size setting

| | DIP3 | DIP4 |
|---------------|------|------|
| Max RPM = 250 | OFF | OFF |
| Max RPM = 200 | ON | OFF |
| Max RPM = 170 | OFF | ON |
| Max RPM = 150 | ON | ON |

Table 7 Max RPM settings

3.3.3 LED Indicator

The driver is fitted with a LED indicator - see Figure 19 LED indicator. The LED diode can be seen with both open and closed cover.

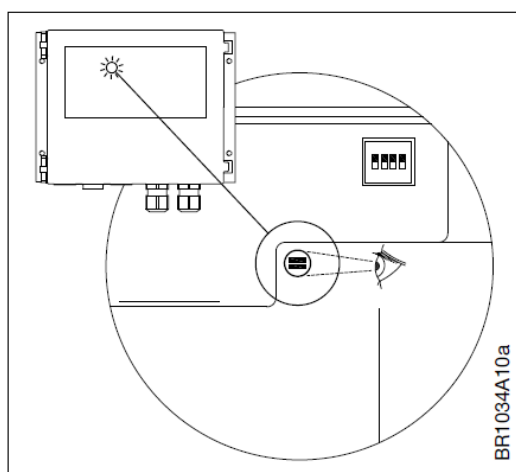


Figure 19 LED indicator

The statuses of the indicator are shown in Table 8 below. **Note:** Flashing means that the LED is off for 100 ms and on for min. 100 ms (ms=milliseconds).

| LED | State |
|-----------------|-------------------------------------|
| OFF | No voltage |
| Green ON | Voltage is present |
| Flashing green | Valid Modbus communication |
| Red ON | Rotor stopped due to critical alarm |
| Flashing red | Operating with reduced power |
| Orange ON | Test function activated |
| Flashing orange | Purging function activated |

Table 8 LED indicator statuses

3.4 Modbus control

Modbus can be connected to the controller via the two RJ12 connectors (connectors "A" and "B" are internally parallel connected and it is therefore optional which connector is used) or via spring terminals in the terminal strip. For RJ12 connectors, we recommend the use of telecom cable, 6-wire, unshielded, 30 AWG/0.066mm² (flat/telecom cable) and round communications cable (like twisted pair cables) for the spring terminal connectors.

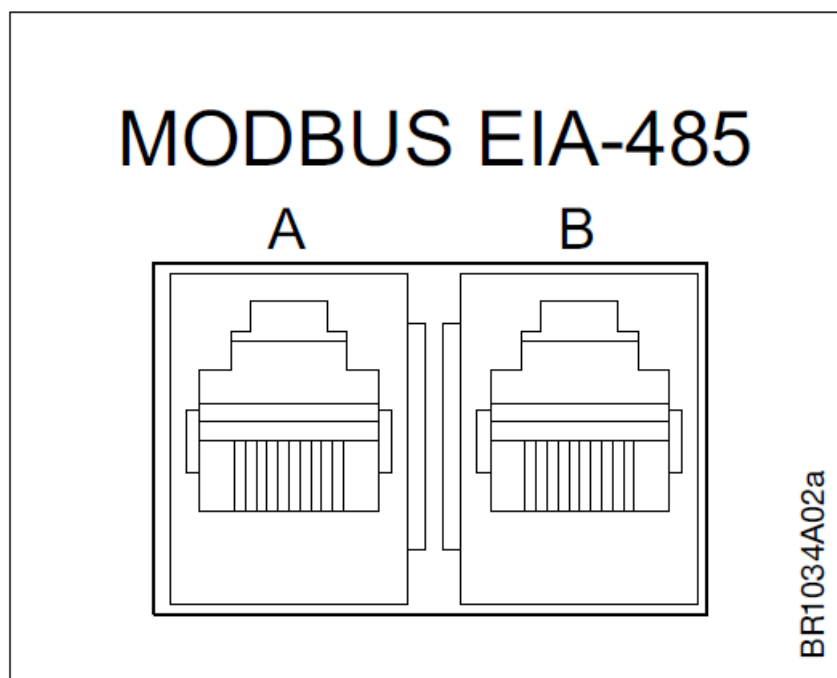


Figure 20 RJ12 Modbus connectors

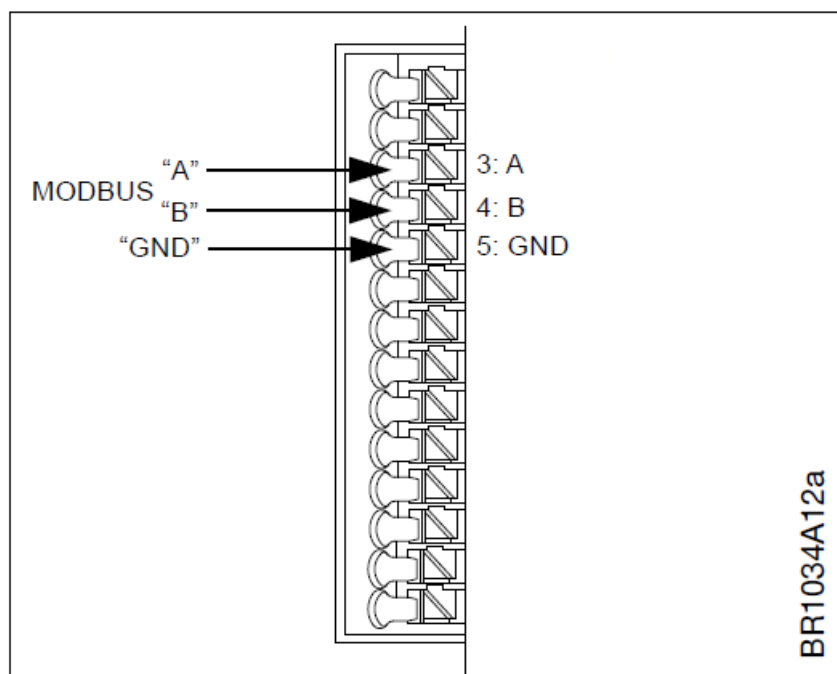


Figure 21 Spring terminal Modbus connector

After 10 seconds without receiving a valid Modbus request with the default parameters, the controller will try to detect a Modbus request with the alternative parameters (see Table 13 to see which registers are responsible for alternative communication parameters).

The default values of the parameters responsible for the communication between the controller and AHU are unchangeable - only the alternative parameters are to be changed.

Note - the settings of the device delivered with the VTS AHU are prepared by the manufacturer for optimal operation and should be changed only in justified cases.

| Function code | Description |
|---------------|---|
| 1 | Read Coil Status |
| 2 | Read Input Status |
| 3 | Read Holding Registers |
| 4 | Read Input Registers |
| 5 | Force Single Coil |
| 6 | Preset Single Registers |
| 8 | Diagnostics. Sub-function 00 Only – Return Query Data (loop back) |
| 15 | Force Multiple Coils |
| 16 | Preset Multiple Registers |

Table 9 Available functions

| Adress | Function | Range | Active state |
|--------|------------------------------|-------|---|
| 0 | Motor ON/OFF | 0 - 1 | 1 = ON |
| 1 | Reset Alarms | 0 - 1 | 1 = Reset |
| 3 | Rotation direction | 0 - 1 | 1 = CounterClockWise |
| 8 | Use altern. comm. settings | 0 - 1 | 1 = Alternative |
| 12 | Disable internal rotor guard | 0 - 1 | 1 = Disabled |
| 13 | Enable external rotor guard | 0 - 1 | 1 = Enabled |
| 14 | High speed resolution | 0 - 1 | 0 = Resolution = 0.1 RPM 1 = Resolution = 0.01 RPM |
| 15 | K-factor for Modbus | 0 - 1 | 1 = K-factor not used for Modbus |
| 16 | Enable auto saving of UDF | 0 - 1 | 1 = UDF stored automatically |

Table 10 Available Coil Statuses

| Adress | Function | Range | Active state |
|--------|------------------------------|-------|------------------|
| 0 | Rotorguard Alarm | 0 - 1 | 1 = Alarm |
| 1 | V LO Alarm | 0 - 1 | 1 = Alarm |
| 2 | V HI Alarm | 0 - 1 | 1 = Alarm |
| 3 | I HI Alarm (Motor out short) | 0 - 1 | 1 = Alarm |
| 4 | Temperature High | 0 - 1 | 1 = Warning |
| 8 | Rotorguard Signal | 0 - 1 | 1 = Pulse |
| 9 | Overload / I_Limit | 0 - 1 | 1 = Warning |
| 10 | Internal Stop | 0 - 1 | 1 = Alarm (Stop) |
| 11 | Rotor Blocked | 0 - 1 | 1 = Alarm |
| 12 | EEPROM error | 0 - 1 | 1 = Warning |
| 13 | Communication error MOC | 0 - 1 | 1 = Alarm |
| 14 | Motor Phase Error | 0 - 1 | 1 = Alarm |
| 15 | Ripple | 0 - 1 | 1 = Warning |

| | | | |
|----|--------------------------|-------|--------------|
| 16 | Digital Input 1 | 0 - 1 | 1 = HI |
| 17 | Digital Input 2 | 0 - 1 | 1 = HI |
| 18 | Ext. 24V supply overload | 0 - 1 | 1 = Overload |
| 19 | MOC in bootloader | 0 - 1 | 1 = Alarm |
| 22 | Communication error IOM | 0 - 1 | 1 = Warning |
| 23 | Rotation OK | 0 - 1 | 1 = OK |
| 24 | Test function active | 0 - 1 | 1 = Active |
| 25 | Purging active | 0 - 1 | 1 = Active |
| 26 | IO Config mismatch | 0 - 1 | 1 = Warning |

Table 11 Available Input Statuses

| Adress | Function | Range | Resolution | Unit |
|--------|---------------------|---------------|--------------------|------|
| 0 | DHX Type | 0 - 14 | 1 | - |
| 1 | AOC SW version | 0 - ? | 0.01 | - |
| 2 | PrcOut | 0 - 10000 | 0.01 | % |
| 3 | Intern Temp | -5000 - 15000 | 0.01 | °C |
| 4 | Motor Speed Out | 0 - 40000 | 0.01 | RPM |
| 5 | V In | 0 - 300 | 1 | V |
| 6 | I Out (RMS) | 0 - 10000 | 1 | mA |
| 7 | Power In | 0 - 1000 | 1 | W |
| 8 | ExternSet | 0 - 10000 | 1 | mV |
| 9 | Operation Day | 0 - 9999 | 1 | Day |
| 10 | Operation Minutes | 0 - 1439 | 1 | Min. |
| 11 | I Ripple | 0 - 10000 | 1 | mA |
| 12 | V Ripple | 0 - 100 | 1 | V |
| 13 | Config file variant | AA - ZZ | 2 ASCII characters | |
| 14 | Config file version | 100 - 32000 | 0.01 | - |
| 15 | MOC SW version | 0 - ? | 0.01 | - |
| 16 | Rotor Speed Out | 0 - 40000 | 0.01 | RPM |
| 17 | Torque | 0 - 1500 | 0.01 | Nm |
| 17 | SW variant | - | - | - |
| 18 | AOC Boot SW | 0 - ? | 0.01 | - |
| 19 | MOC Boot SW | 0 - ? | 0.01 | - |
| 20 | Motor Cfg. Var. | 0 - 65535 | 1 | - |
| 21 | Motor Cfg. Ver. | 0 - 65535 | 0.01 | - |
| 22 | Rotor Cfg. Var. | 0 - 65535 | 1 | - |
| 23 | Rotor Cfg. Ver. | 0 - 65535 | 0.01 | - |
| 24 | User Data Var. | 0 - 65535 | 1 | - |
| 25 | User Data Ver. | 0 - 65535 | 0.01 | - |
| 26 | IOM SW version | 0 - ? | 0.01 | - |
| 27 | V DC Bus (Peak) | 0 - 400 | 1 | V |
| 28 | V Motor (Peak) | 0 - 400 | 1 | V |
| 29 | ExternSet2 (IOM) | 0 - 10000 | 1 | mV |

Table 12 Available Input Registers

| Adress | Function | Range | Resolution | Unit |
|--------|------------------------|--------------|------------|----------|
| 0 | Setpoint / PrcSet | 0 - 10000 | 0.01 | % |
| 1 | Min. Motor Speed | 100 - Max. | 0.01 | RPM |
| 2 | Max. Motor Speed | Min. - 40000 | 0.01 | RPM |
| 3 | Start I Out (Boost) | 0 - ? | 1 | mA (RMS) |
| 4 | Start Time (Boost) | 0 - ? | 1 | Sec. |
| 8 | Prc Holding Torque | 0 - 1000 | 0.1 | % of max |
| 9 | UpRampTime | 15 - 300 | 1 | Sec. |
| 10 | DownRampTime | 15 - 300 | 1 | Sec. |
| 11 | SwitchMode | 0 | (Auto) | |
| | | 1 | 8 | kHz |
| | | 2 | 10 | kHz |
| 12 | DHX Type | 0 - ? | 1 | - |
| 13 | Alternative Modbus ID | 1 - 247 | 1 | - |
| 14 | Alternative BaudRate | 0 | 9600 | bps |
| | | 1 | 19200 | bps |
| | | 2 | 38400 | bps |
| | | 3 | 57600 | bps |
| | | 4 | 115200 | bps |
| 15 | Alternative Parity | 0 | None | - |
| | | 1 | Odd | - |
| | | 2 | Even | - |
| 16 | Alternative Stop Bits | 0 | INVALID | - |
| | | 1 | 1 | - |
| | | 2 | 2 | - |
| 17 | Number of retries | -1 - 100 | 1 | - |
| 18 | Modbus Timeout | 0 - 240 | 1 | Sec. |
| 19 | Pulley size (diameter) | 0 - 1000 | 1 | mm. |
| 20 | Rotor size (diameter) | 0 - 10000 | 1 | mm. |
| 21 | Pulses per rotation | 0 - 10 | 1 | - |
| 22 | K factor | 0-10000 | - | - |

Table 13 Available Holding Registers

3.5 Adaptation of the new OI RRG controller (SPR) to work with VTS AHU

In order to adapt the brand new RRG controller (ordered as a spare part) to work with the automation of VTS AHUs, you should:

- connect to the RRG controller using a USB-RS485 converter and a PC with software that enables reading and writing of the Modbus slave devices registers (e.g. Modbus Poll) - the default communication parameters of the new controller are as follows: **address 79, baudrate 38400, no parity check, 2 stop bits**
- set the Holding Registers number 13-16 in accordance with the target communication parameters of the uPC3 controller: **address 4, baudrate 9600, no parity check, 1 stop bit** - see Table 13 (relevant registers are marked in blue in the table)

Access to the registers of the rotary exchanger controller settings is done without the use of a password. The password is also not required to save the settings after they have been changed.

To enable uPC3 - RRG OI cooperation, the RRG motor type selected on the I03 configuration screen of the uPC3 controller must be set to OI.