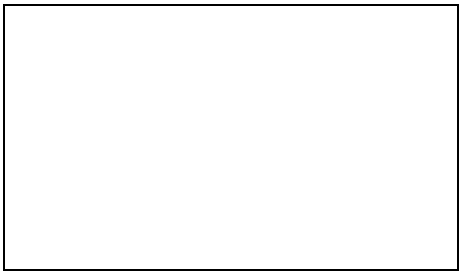
This manual applies to the following models:
EMS-VVX 2N
EMS-VVX 4N
EMS-VVX 2N/ET
EMS-VVX 4N/ET



EMS-VVX™ N, N/ET DRIVE SYSTEM

INSTRUCTION MANUAL

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SAFETY MEASURES

During installation

- Read the operating instructions carefully before installing and running the unit.
- The installation must be carried out by qualified personnel.
- The appropriate rules and regulations governing the installation and operation of electrical equipment should be observed.
- Measures for protection against personal injury and damage to machinery should be taken in accordance with local rules and regulations.
- EMS-VVX is designed for fixed installation.
- Cables should not be connected or disconnected while mains voltage is being supplied to the unit.
- Check that the equipment is correctly connected before operating it. See the instructions in the chapter on Installation.
- Faults caused by incorrect installation or operation are not covered by the guarantee.

During operation

- Measurements must not be taken inside the motor unit while the equipment is in operation, i.e. when mains voltage is being supplied.
- Measurements may be taken in the control unit during operation, but only at the connection terminals. N.B.: Great care must be taken while doing this.
- The units must not be opened or dismantled while in operation.

During dismantling and disposal

- The control unit's housing is made from plastic. The material should be handled and recycled in accordance with the relevant regulations.
- The circuit board contains small quantities of tin and lead, which should be handled and recycled in accordance with the relevant regulations.
- The motor is made from copper, plastic, aluminium, and iron. The materials should be handled and recycled in accordance with the relevant regulations.

CONTENTS

1. PRODUCT DESCRIPTION

1.1 General description

EMS-VVX 2N, 4N, 2N/ET and 4N/ET are speed-controlled drive systems specially designed for driving rotary heat exchangers. The drive systems consist of an enclosed control unit and a motor unit with worm reduction gear, linked by two cables.

The control unit is supplied by single-phase alternating voltage, 220/230/240 VAC, 50/60 Hz. EMS-VVX drive systems are manufactured in four sizes, and a number of versions. In addition to the drive system described in these instructions, there is also the EMS-VVX 1, which is intended for smaller rotors, and the Master serie EMS-VVX 2EM, 4EM and 6EM. The 6EM is for rotors up to 5500 mm.

EMS-VVX has been equipped with a number of features which make the system perfectly suited to its task:

- A built-in tachometer ensures that the motor always keeps to the correct rotation speed determined by the control signal.
- Constant torque over the entire speed range.
- Rotation monitor which functions even during cleaning operation (purging).
- Soft starting.
- Electronic motor protection.
- A drive system adapted to suit most control signals on the market.
- Control inputs which are galvanically isolated from the mains supply.
- A drive system which requires no tuning.
- High efficiency.

1.2 Integral functions

Automatic purging operation
When the control signal falls below a certain value, the heat exchanger's rotor turns through about 15º every five minutes. This low average rotation speed provides no heat transfer, but simply ensures that the rotor is kept clean (purging). For the exact values of the control signal during cleaning operation see the chapter on wiring.

Rotation monitor
The rotation monitor checks that the heat exchanger rotor is actually rotating. A magnet mounted on the periphery of the rotor triggers a pulse sensor once every revolution. If, for example, the drive belt fails, and the heat exchanger rotor stops, the pulses will stop, and an alarm will be issued. The motor does not stop, but rotates continuously, irrespective of whether an alarm has been issued for the stoppage of the rotor rotation. If you want the motor to stop in the event of all types of alarm, including rotation monitor alarm, the mains voltage can be interlocked externally when the alarm is issued by EMS-VVX. The time period to the alarm is approximately 20 minutes. The magnet and pulse generator are ordered separately. The rotation monitor also functions when the system is in purging operation, although then the time to alarm is longer.

Test button

The control unit is equipped with a test button on its housing. If the test button is kept depressed, the motor soft starts and is brought up to maximum revolutions (the ramp time is about 1-2 minutes). The test button controls the motor irrespective of the control signal. The engaged test button is equivalent to a maximum control signal.

Alarm relay

A built-in relay with switch contacts triggers an alarm in the event of:

- Mains supply overvoltage
- Mains supply undervoltage
- Loss of power supply
- Motor overload
- Loss of signal from the magnet to the rotation monitor, e.g. in the event of a snapped drive belt.

Heat recovery on cooling

Heat recovery on cooling refers to the mode of operation when the exterior air temperature exceeds the exhaust air temperature. By driving the rotating heat exchanger at maximum revolutions, a cooling effect is achieved on the incoming air. The heat recovery on cooling function is most simply obtained by using an external regulator which has this function built-in. EMS-VVX is then controlled by a control signal, e.g. 0-10V. If, for example, an external regulator is already installed, you can obtain the heat recovery on cooling function by directly connecting a separate differential thermostat to EMS-VVX.

Defrosting

The defrosting function is obtained by connecting a differential pressure sensor directly to the EMS-VVX. When there is an excessive drop in pressure on the heat exchanger rotor, the defrosting function is activated, and EMS-VVX slows the rotor's speed to 5% of the maximum speed.

Protection of the control unit

The control unit is equipped with monitoring for both mains supply over- and undervoltage. When the power supply exceeds or falls below pre-set thresholds, the control unit is disconnected and the motor stops. When the mains supply returns to normal, the motor is restarted automatically. The control unit has built-in motor protection against overloading, so no external motor protection is required. In the event of an overload, the supply to the motor is cut. To restart the drive system, the power supply to the control unit must be interrupted for five seconds.

Table 1: Protective and alarm functions

Protective function	External alarm after	Restart	Resetting of alarm
Mains fault, overvoltage	20 min	Automatically	Automatically
Mains fault, undervoltage	Immediately	Automatically	Automatically
Rotation alarm	20 min. (9 hours during purging operation)	The motor does not stop	Automatically
Overload, high motor current	20 min	Manually, interrupt and switch on mains voltage	Manually, interrupt and switch on mains voltage

1.3 EMS-VVX 2N/ET and 4N/ET

Operating indicators

The ET version of EMS-VVX differs from the standard version in that it features an indicator panel which provides information on the rotor's operational status. The indicator panel consists of five LEDs which indicate the following:

Table 2: Operating indicators with LEDs.

Green	Normal operation, the rotor rotates continuously
Yellow	Purging. Low control signal.
Red 1	Over-/undervoltage
Red 2	Overload
Red 3	Rotation alarm

1.4 Choice of drive system size

Table 3: Choice of drive system at the highest rotor speed of 10 rpm.

Rotor diameter [mm]	Drive system
< 1900	EMS-VVX 2
< 3500	EMS-VVX 4

N.B.: A rotor speed higher than 10 rpm increases the load and a larger model may be required. Rotor seals in firm contact with the rotor can also mean that a larger drive system is required.

2. INSTALLATION

2.1 Mounting

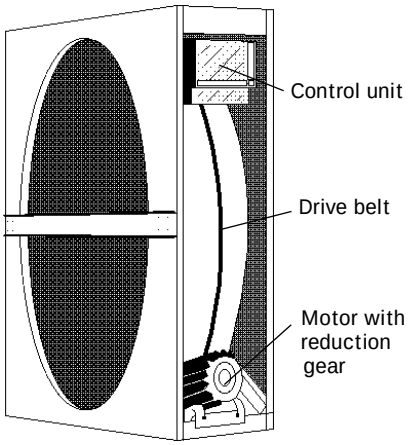

Figure 1 Rotor with drive system

The drive unit (motor with gear) is mounted on a sprung motor bridge in the heat exchanger's housing. Because of the risk of interference, the control unit should ideally be installed in a suitable position inside the heat exchanger's housing. It can, however, also be mounted in the control room. The motor is insulated against vibration from the motor bridge with a rubber damper, for example. The direction of rotation cannot be changed. If it should rotate in the wrong direction, the drive unit can be turned 180° or be replaced by another model. The mounting kit for the motor can be ordered separately.

Mounting the rotation monitor

The magnet for the pulse generator – the rotation monitor – is screwed tightly to the periphery of the heat exchanger. If the housing around the rotor is itself magnetic, then the magnet must be isolated from the housing. The pulse generator is mounted so that the magnet passes over it at a distance of 5-8 mm, see below. The rotation monitor can be ordered separately.

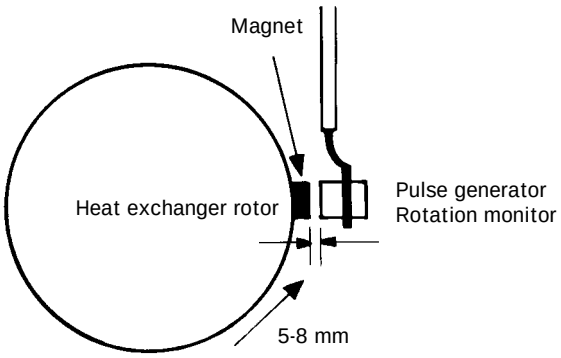

Figure 2 The pulse generator

2.2 Accessories

The following items can be ordered separately:

- Cable fittings
- Rotation monitor with magnet
- Installation fittings for the motor, including fixing screws, washers, nuts, and rubber vibration dampers
- Cables between the motor and the control unit
- Additional board VVX-100.

2.3 Choice of drive belt diameter

Table 4: Choice of drive belt diameter for different diameters of heat exchanger and different gear ratios.

Rotor diameter [mm]	EMS-VVX 2				EMS-VVX 4	
	Gear ratio 13:1		Gear ratio 26:1		Gear ratio 14:1	
	Drive belt, diameter [mm]	Rotor speed [rpm]	Drive belt, diameter [mm]	Rotor speed [rpm]	Drive belt, diameter [mm]	Rotor speed [rpm]
500	-	-	50	11.5	-	-
700	50	16.5	63	10.4	-	-
900	50	12.8	71	9.1	-	-
1100	50	10.5	100	10.5	-	-
1300	63	11.2	118	10.4	63	10.4
1500	63	9.7	118	9.0	71	10.1
1700	71	9.6	140	9.5	80	10.1
1900	80	9.7	150	9.1	80	9.0
2100					100	10.2
2300					100	9.3
2600					118	9.7
2900					140	10.3
3200					140	9.4
3500					150	9.2

2.4 Connection

WARNING! Residual voltage remains four minutes after mains voltage has been switched off.

The following two cables must be connected between the motor unit and the control unit (see the wiring diagram). The cabling between the motor and control unit can be ordered separately.

- The motor cable (5-wire, 1.5mm²): the earth conductor is connected to the earth screw in the motor.
- Tacho-cable (3-wire, min. 0.1mm², shielded). The shielding is insulated from the motor. If the cable is extended, make sure the shielding is jointed carefully.

External fuses must always be installed. These should be 10AT for both size 2 and size 4. Internally, power electronics are protected by 2AT in EMS-VVX 2 and 6.3AT in EMS-VVX 4. Furthermore, the control electronics in both models are protected with 32mAT. All internal fuses are 5x20m glass tube fuses.

N.B.: No adjustment of the control unit is required.

WARNING! The control unit is not protected against short circuiting between the leads in the motor cable, or against earth faults between the motor cables and earth. A short circuit will cause an immediate breakdown of the control unit. To prevent this, always use an ohmmeter to check for a short circuit before switching on the power supply.

A safety isolation switch is installed between the mains supply and the control unit. When the mains voltage is disconnected, an alarm will be issued for loss of power.

WARNING! Switches must not be installed between the motor and control unit.

EMC recommendations

To satisfy the requirements regarding the Electromagnetic Compatibility (EMC) directive 89/336/EEC the following must be considered:

- For EMS-VVX 4N and 4N/ET, the mains cable is wound twice round the enclosed ferrites at the control unit. See the figure.

All EMS-VVX models feature an integral EMC filter. Shielded motor cables are not required.

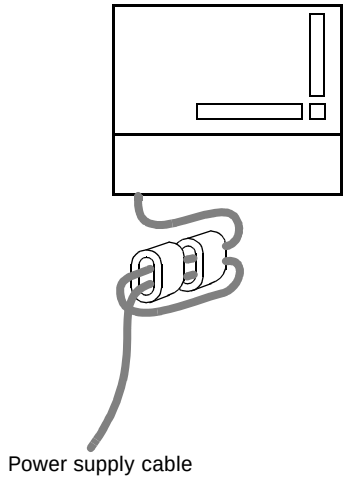

Figure 3 EMC installation of EMS-VVX 4N and 4N/ET

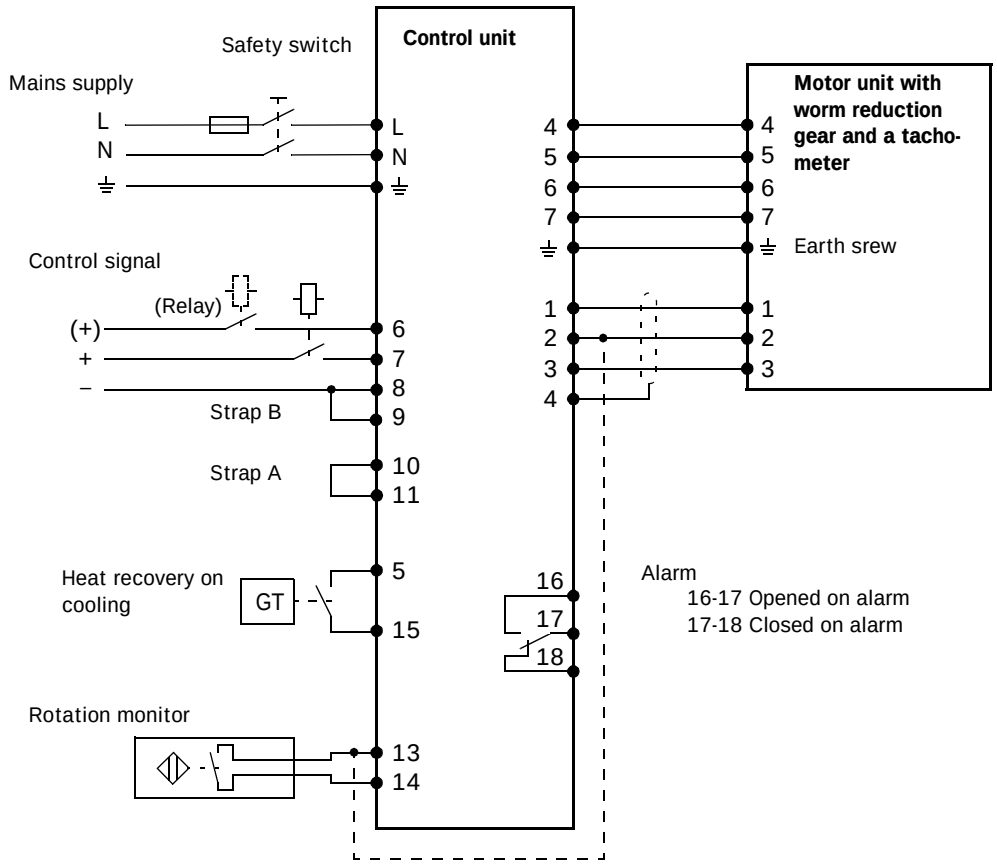

Figure 4 Wiring diagram

Table 5: Control signal connection and straps (where necessary)

Control signal	Control terminal	Strap
0-10 V	7 - 8	-
2-10 V	7 - 8	A
0-20 V	6 - 8	-
4-20 mA	7 - 8	A + B
0-20 mA	7 - 8	B

Table 6: The drive system's operation with various control signals

Control signal	Purging	From min- to max revolutions	Max. revolutions
0-10 V	0-1.5 V	1,5-9.7 V	>9.7 V
2-10 V	0-3 V	3-9.7 V	>9.7 V
0-20 V	0-3 V	3-19.4 V	>19.4 V
4-20 mA	0-6 mA	6-19.4 mA	>19.4 mA
0-20 mA	0-3 mA	3-19.4 mA	>19.4 mA

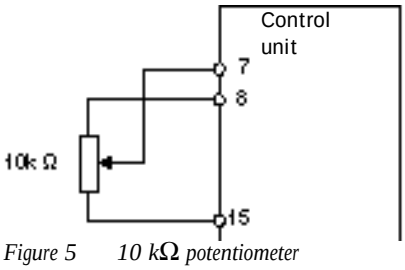

Figure 5 10 kΩ potentiometer

Manual control with a 10 kΩ potentiometer

The drive system can be easily controlled manually with a 10 kΩ potentiometerconnected as shown in figure 5.

Rotation monitor

If a rotation monitor is not used, the strap between terminals 2 - 13 must be connected to the control terminal block. See figure 4.

Switching off

When you wish to switch off the heat exchanger rotor, at night for example, this can be done by disconnecting the control signal by means of a relay (see figure 4). Alarms caused by a cutting-off of mains supply are thereby avoided. The control signal can also be set to its minimum value in order to achieve the same effect.

Heat recovery on cooling

The differential thermostat for heat recovery on cooling (maximum rotor speed) can be connected between terminals 5 and 15. See figure 4.

Defrosting

The differential pressure switch for defrosting (5% of maximum rotor speed) can be connected as shown in the figure below..

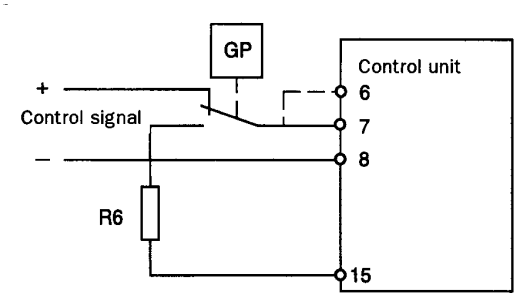

Figure 6 Defrosting

Table 7: R6 Values

Control signal	R6
0-10 V	560 kΩ
2-10 V	249 kΩ
0-20 V	470 kΩ
4-20 mA	1.2 kΩ
0-20 mA	2.7 kΩ

2.5 VVX-100 potentiometer board

For control from a potentiometer with a value lower than 10 kOhm, the VVX-100 potentiometer board must be used. A 100 to 5 kOhm potentiometer is connected to the potentiometer board. The signal is converted on the board and is transferred to the control unit. The points on the board are screwed tightly to the connection terminals 7, 8 and 15. See the figure below.

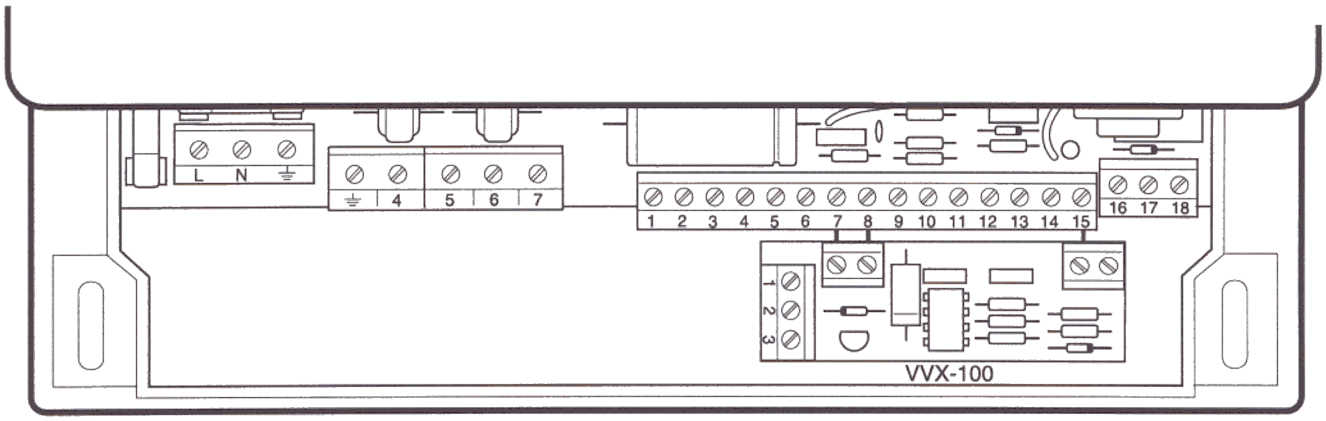

Figure 7 Mounting of the VVX-100 potentiometer board

The potentiometer is connected to the potentiometer board in accordance with the figure below. The rotation monitor, alarm, and heat recovery on cooling function are connected in accordance with the previous description.

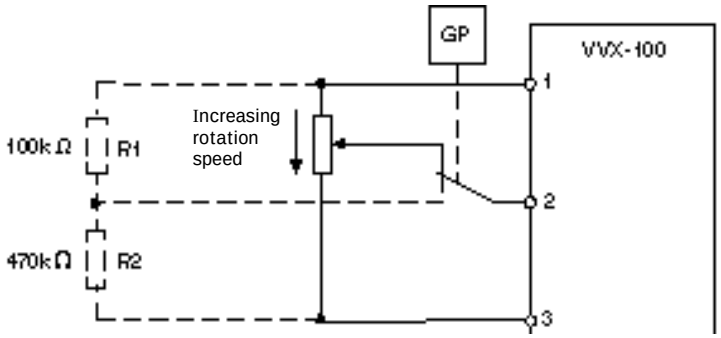

Figure 8 Connection of a potentiometer to VVX-100 potentiometer board.

If a differential pressure switch is installed, the cabling shown with a dotted line should be installed, and R1 and R2 mounted.

2.6 Parallel connection

For parallel operation of several heat exchangers from a control signal, each heat exchanger must be equipped with its own control and motor unit.

Control signal

The control signal is connected to the first drive system in accordance with the wiring instructions. Other control units are connected by connecting terminals 7 and 8 on the control terminal block to terminals 7 and 8 on the control terminal block of the first control unit.

Terminals 8 - 9 on the control signal block must be strapped to the first control unit if the control signal is 0-20 mA or 4-20 mA, but must never be strapped to the other control units.

Terminals 10 - 11 on the control signal block must be strapped to all control units if the control signal is 2-10 V or 4-20 mA.

Potentiometer control with the VVX-100 additional board

If the VVX-100 additional board is used (see the section "VVX-100 potentiometer board"), one of these should be mounted on each control unit.

The potentiometer is connected in the normal way on the first VVX-100 board. Other control units are connected in parallel, by connecting terminals 1 and 2 on the VVX-100 board to terminals 1 and 2 on the first VVX-100 board. Terminal 3 is left unconnected. Terminals 7 and 8 should not be connected to other control units when the VVX-100 board is used.

Heat recovery on cooling with a differential thermostat

First connect the control signal in accordance with figure 4. The differential thermostat is then connected to the first control unit in the normal way. Again, see figure 4. Other control units are linked in parallel by connecting terminal 5 on the control terminal block to terminal 5 on the first control unit.

N.B.: Terminal 15 on the control signal terminal block must not be connected to terminal 15 on any other control unit.

Defrosting with a differential pressure switch

First connect the control signal in accordance with figure 4. The differential pressure switch is then connected to the first control unit in the usual way (see figure 6), except that the resistance R6 should be decreased by the number of control units connected in parallel, so that:

R6 = R6 normal value the number of control units

Other control units need not be connected to the differential pressure switch. In parallel operation with the differential pressure switch and the VVX-100 board, R6 is not involved and the resistance values specified in the wiring instructions should be used.

Alarm relay

The control systems are individually wired for alarm signals. The alarm output terminals can be connected in parallel, or in series, to receive a group alarm.

3. MAINTENANCE AND TROUBLE-SHOOTING

Maintenance

The motor and control unit usually require no maintenance. Check the cabling as well as the tightness of the connection screws. Check also that the units are securely mounted.

Troubleshooting

Check that the equipment has been correctly installed, e.g. terminals screws are correctly tightened, that cables are properly stripped, that any straps are connected, etc..

Table 8: Troubleshooting

Observation	Indication (ET version only)	Cause of fault / Action
The drive system does not respond to the control signal. The motor is stationary.	No LED lights	Check that 220 / 230 / 240 VAC +-10% is on the mains terminal block, and that the two fuses in the control unit are intact.
	Yellow LED Purging / low control signal	Check EMS-VVX by holding down the test button. The motor should then reach maximum revolutions. Vary the control signal between min. and max. Can 0-10 V (or 2-10 V) be measured between 7 (+) and 8 (-) on the control terminal block? Are + and - interchanged?
	Red LED 1 Overvoltage / undervoltage	Mains voltage is below 198 or above 264 VAC. The mains supply could be weak and should be stabilised with a voltage stabiliser. In some industrial environments, mains voltage can also be distorted and have a high peak value, which causes overvoltage.
	Red LED 2 Overload	The motor protection device has tripped due to an excessively high load. Check that the motor and tachometer cables (motor terminals 4-7, and control terminals 1-4) are correctly connected, and that there are no bad contacts. Also check that the correct size motor and control unit are being used. Disconnect the mains supply for 5 seconds to reset the control unit, and then reconnect the supply. If the fault remains, check the motor with a meter (see below). Change either the control unit alone (if the motor is OK), or both the motor and control unit. If the drive system runs for longer periods, the load may be too great – check the rotor and that the pulley is not too large.
The motor rotates, but an alarm signal is issued;	Red LED 3 Rotation alarm	The heat exchanger rotor is stationary – check the drive belt. The rotor rotates – check that terminals 2 - 13 are strapped if a rotation monitor is not connected. If a rotation monitor is connected, check it by measuring the voltage between terminals 13 and 14 on the control terminal block. When the magnet affects the sensor, the distance between the magnet and sensor should be 5-8 mm, and the voltage should be <1 V (the sensor switches on when it is affected by the magnet). When the magnet does not affect the sensor, the voltage should be >11 V. If not, replace the rotation monitor. If the rotation monitor is OK, check that the alarm relay has de-energised by measuring between terminals 17 and 18 on the control terminal block. Is the alarm output closed? If not, look for the fault outside EMS-VVX, otherwise change the control unit.
The heat exchanger rotates in the wrong direction;	-	The motor's direction of rotation cannot be changed. In the event of a fault, the entire drive unit can be turned 180° or exchanged for another model.

Testing the motor

Detach the motor cable from the control unit. Measure the motor resistance, including the motor cabling, between motor cables 4 - 5 and 6 - 7. The readings should be:

VVX-2: 20-60 Ω

VVX-4: 5-15 Ω

Check also the insulation between 4 - 6, earth -4, and earth -6.

When replacing

When replacing the control unit, the entire enclosed casing with circuit boards should be changed. When replacing a motor, the motor including reduction gear should be changed.

4. TECHNICAL DATA EMS-VVX 2 AND 4

Table 9: Data

Function		EMS-VVX 2	EMS-VVX 4
Output data	Motor output [W]	90	250
	Max. motor speed [rpm]	3000	
	Purging mode	Integral	
	Motor protection	Integral	
	Soft start	Integral	
	Alarm output	Alternating contact, max. 5A 30V	
Input data	Mains voltage	220/230/240 VAC ±10% 50/60 Hz	
	Current [A]	Max. 1.2	Max. 3.5
	Control signal	0-10V, 2-10V, 0-20V phase cut, 0-20mA, 4-20mA, 10 kOhm potentiometer	
General	Protection class	IP 54	
	Control unit weight [kg]	1.6	
	Motor weight [kg]	5.4	6.1
	Ambient temperature	-30 - +40°C	
	Tachometer	Integral	
	Motor size	IEC 71	
	Gear type	DV 33	DA 35

Table 10: Model designnations EMS-VVX 2

Item number	Name	Direction of rotation	Reduction	Gear rpm	Torque gear
01-0816-10	EMS-VVX 2ME-13	Clockwise	13:1	5-231 rpm	2 Nm
01-0817-10	EMS-VVX 2MO-13	Anti-clockwise	13:1	5-231 rpm	2 Nm
01-0817-11	EMS-VVX 2MO-26	Anti-clockwise	26:1	2-115 rpm	4 Nm
95-13011	EMS-VVX 2N Control Unit				
95-13012	EMS-VVX 2N/ET Control Unit				

Table 11: Model designnations EMS-VVX 4

Item number	Name	Direction of rotation	Number of shafts	Reduction	Gear rpm	Torque gear
01-0818-10	EMS-VVX 4ME-14	Clockwise	1	14:1	4-214 rpm	7 Nm
01-0819-10	EMS-VVX 4MO-14	Anti-clockwise	1	14:1	4-214 rpm	7 Nm
01-0819-11	EMS-VVX 4MO-14-D	Anti-clockwise	2	14:1	4-214 rpm	7 Nm
95-13013	EMS-VVX 4N Control unit					
95-13014	EMS-VVX 4N/ET Control unit					

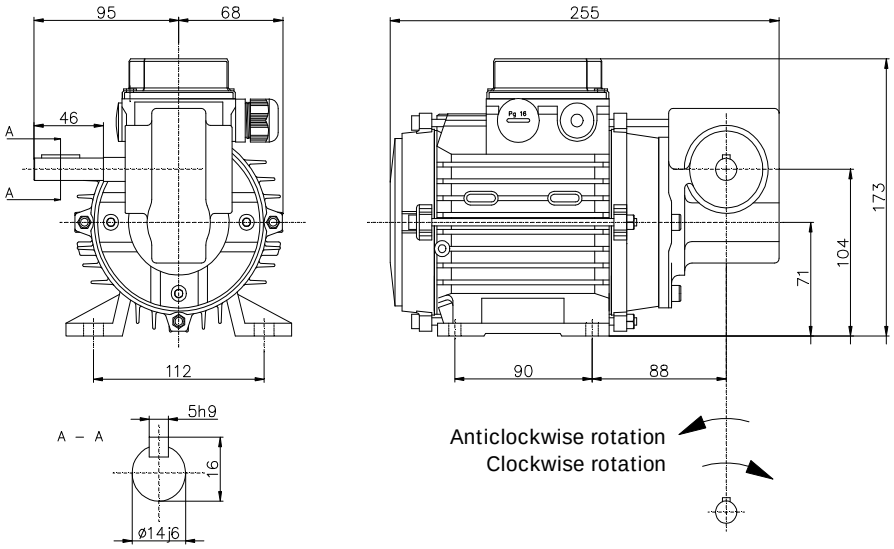

Figure 9 Dimensions of EMS-VVX 2 motor

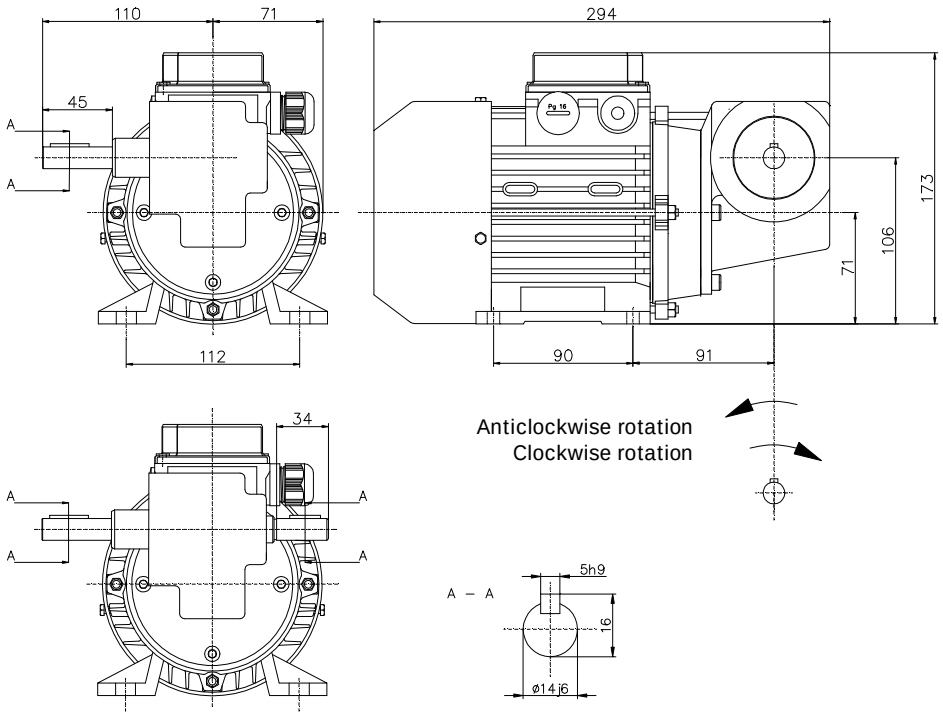

Figure 10 Dimensions of EMS-VVX 4 motor, with one and two shafts.

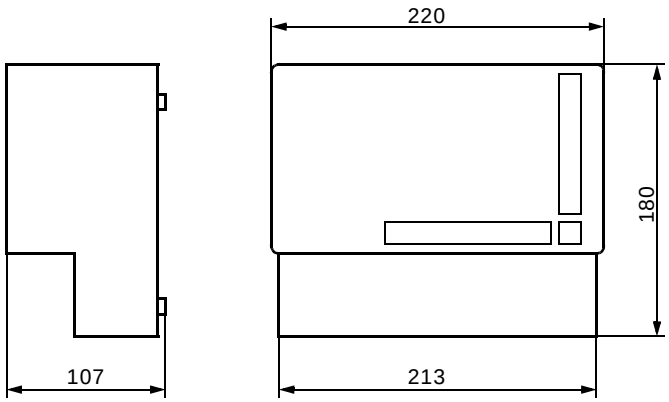

Figure 11 Dimensions of control unit 2N, 2N/ET, 4N and 4N/ET