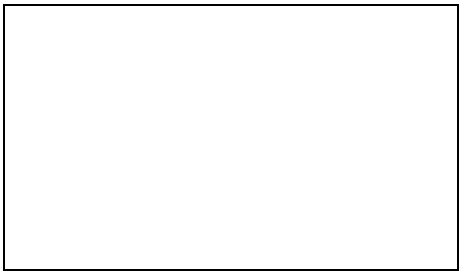
Valid for the following model:
EMS-VVX 2EM Art.No.95-13021
EMS-VVX 4EM Art.No.95-13041
EMS-VVX 6EM Art.No.01-1545-01



EMS-VVX™ MASTER(EM) DRIVE SYSTEM

INSTRUCTION MANUAL

Document number: 01-0071-01
Document version: r3b
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SAFETY INSTRUCTIONS

During installation

- Read the operating instructions thoroughly before installing and running the unit.
- Installation must be carried out by qualified personnel.
- The appropriate rules and regulations governing the installation and operation of electrical equipment should be closely followed (e.g., VDE 0100).
- Measures to protect against personal injury and machine damage should be carried out according to local rules and regulations.
- EMS-VVX is designed for fixed installation.
- Cables should not be connected or disconnected while the mains voltage is being supplied to the unit.
- Check that the equipment is correctly installed before operating it. Refer to the instructions given under section 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 running or mains voltage is being supplied.
- Measurements may be taken in the control unit while the equipment is running but only at the connection terminals. Note: take great care while doing this.
- The unit must not be opened or dismounted while in operation.

During dismantling and disposal

- The housing to VVX-2EM and -4EM is made of plastic, and to VVX-6EM is made of aluminium, steel and plastic. This material should be handled and recycled according to appropriate local rules and regulations.
- The circuit boards contain small amounts of tin and lead which should be handled and recycled according to appropriate local rules and regulations.
- The motor is made of copper, plastic, aluminium and steel. This material should also be handled and recycled according to appropriate local rules and regulations.

CONTENT

1. PRODUCT DESCRIPTION

1.1 General description

EMS-VVX Master is a speed-controlled drive system specially designed for driving rotary heat-exchangers. The system comprises an enclosed control unit and a motor unit with worm reduction gear, which are linked by two cables. The control unit is driven by a single-phase power supply, 230 VAC, 50/60 Hz.

EMS-VVX Master has numerous built-in features that make it ideal for this particular application:

- No initial trimming is required.
- A Tachometer that guarantees that the motor always keeps to the correct rotation speed determined by the control signal.
- Constant torque over the complete speed range
- Functioning of rotation monitor even during automatic purging
- Soft starting/soft stop
- Electronic motor protection
- The drive system is designed to suit most types of control signal.
- All control inputs are galvanically-isolated.
- The operational status of the system can be displayed.
- High efficiency

1.2 Built-in functions

Automatic purging

If the control signal falls below a certain value, the heat-exchanger will turn through about 15° every 5 minutes. This low speed (average rotation speed) allows no heat transfer but ensures that the rotor is kept clean by purging.

Rotation monitor (DIP-switch 4)

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. Even other types of sensors can be used, for example, induction sensors of NPN-type that make connection to (-), from CARLO GAVAZZI ELECTROMATIC, designation EI 1808 NPOS.

If the drive belt fails, the heat-exchanger rotor will stop, the pulses will also stop and an alarm will be triggered. The motor rotates continuously irrespective of whether an alarm indicates it has stopped. If you want the motor to stop at any type of alarm tripped, including the rotation check alarm, the mains voltage can be interlocked externally when the alarm is given by EMS-VVX. The time to alarm is 20 minutes at minimal rotation speed and 24 seconds at maximum rotation speed.

The magnet and impulse sensor are ordered separately. The rotation monitor functions even when the system is undergoing purging.

Display of exact rotation

The exact rotation speed is displayed as rpm when a rotation sensor is connected.

Test button

The control unit is equipped with a test button located under the terminal-block lid. When the test button is kept depressed, the motor soft starts and accelerates up to max. rpm. The test button controls the motor independent of any other signals. See the chapter **Troubleshooting**.

Status indicators

Table 1: Status indication on the control unit.

8.8	Rotor speed as rpm. "Default" gear reduction motor / rotor = 1:300, the correct reduction is shown after two sensor signals are processed. Display range 0.2-99 rpm.
0.1	Purging. Low control signal
.	Blinks when the magnet on the VVX-rotor passes its sensor. It remains lit while the contact is closed, at least 1 s.
5	Summer mode / Heat recovery on cooling, is displayed when the exhaust air temperature is lower than that for incoming air. (The voltage between terminals 51-53 is higher than between terminals 51-52.)
on	Displayed when the rotation monitor DIP-switch is set in position not connected.

Alarm relay

A built-in relay with switch contacts triggers an alarm at:

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

Priority switch

On termination of the external potential-free input, the motor is rotated at the preset rpm with the help of the built-in potentiometer (located under the terminal-block cover). The priority switch has a higher priority than both the summer/winter switches and control signals.

Analog output
0-10 V or 0-20 mA in proportion to the motor speed of between 0-3000 rpm. 0-10 V becomes operational on connection of a 500 Ω (499 Ω) resistor to the terminal used for analog output.

Summer / winter switch, temperature
Two NTC-resistors, 2000 Ω, e.g., EGL 511, one in the incoming air duct and one in the exhaust air duct, can be connected directly. When the exhaust air is colder than the incoming air, the motor rotates at maximum rpm to effect heat recovery on cooling. When the exhaust air is warmer than the incoming air, the normal situation, the motor speed is regulated by the control signal for heat-recovery.

Summer / winter switch, enthalpy
The sensors are connected to an external controller, which in turn is linked to the same terminal as the temperature sensor - the exhaust air for summer/winter-switching temperature.

Temperature
The sensor is connected to an external controller, e.g., RS 20-40, which is supplied with +12 V and -12 V from EMS-VVX. The temperature regulator controls the motor speed by means of control signal input. Maximum load is ± 50 mA.

Absolute humidity
The humidity sensor is connected to an external transducer and controls the motor speed by means of control signal input.

Protection of the control unit
The control unit is equipped with monitoring for both mains supply over- and undervoltage. When the power supply increases or decreases below preset 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 incorporates electronic motor protection against overloading and therefore no external motor protection is required. At overload the power supply to the motor is cut. To restart the drive system the power supply to the control unit is interrupted for 2 seconds.

Alarm indicators: (Blinking)
An alarm is indicated on the display immediately after a fault has been detected, whereas the alarm relay first changes after a while. See the following table.

Table 2: Alarmindication on the control unit.

Indication	Protective function	Alarm relay is tripped after	Restart	Resetting the alarm
F 1	Mains fault, overvoltage	2 min.	Automatic	Manual, switch off and then switch on mains voltage
F2	Mains fault, undervoltage	2 min.	Automatic[1)]	
F3	Rotation alarm	24 sec. - 9 h, max rpm - purging	Motor does not stop	
F5	Overload, high motor current[2)]	2 min.	Manual, switch off and then switch on mains voltage	
F7	Short circuit[3)]	10 sec.	Manual, switch off and then switch on mains voltage	

[1)] If an F2 alarm (undervoltage) is detected repeatedly, the alarm is held and the system can only be restarted by switching off mains voltage and then switching it on again.

[2)] The drive system attempts a restart an overload alarm is indicated.

[3)] Only EMS-VVX 6

1.3 Choice of drive system size

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

Rotor diameter	Drive system
< 1900 mm	EMS-VVX 2
< 3500 mm	EMS-VVX 4
< 5500 mm	EMS-VVX 6

WARNING! A higher rotor speed than 10 rpm increases the load and a more powerful drive system may then be required. Rotor seals in firm contact with the rotor can also mean that a larger drive system is required.

2. INSTALLATION

2.1 Basic installation

The drive unit (motor plus reduction gear) is mounted on the bracket located in the heat-exchanger, and the control unit is mounted in a suitable position either in the heat-exchanger housing or, e.g., a control room. Vibration damping material such as rubber anti-vibration mountings should be inserted between the motor and the motor bracket. The rotation direction must not be changed. If this happens the drive unit must be turned 180º or exchanged for another model. A installation kit for the motor can be ordered separately.

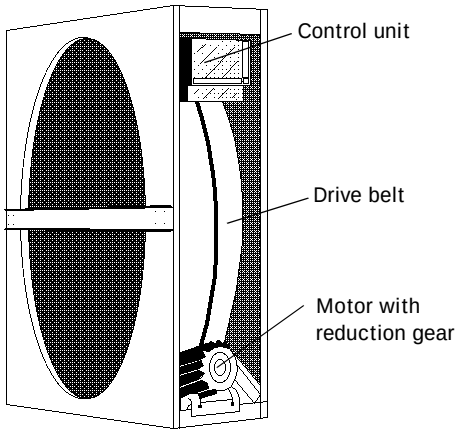


Fig. 1 The heat-exchanger assembly

Mounting the rotation monitor

The magnet for the impulse sensor/rotation monitor is screwed tight on the periphery of the heat-exchanger. If the housing around the rotor is magnetic itself then the sensor magnet must be isolated from the housing. The impulse sensor is mounted to ensure that the magnet passes over it at a distance of 5-8 mm, see figure 2. If an induction sensor type EI 1808 NPOS is used, the magnet is replaced with an appropriate metal stud.

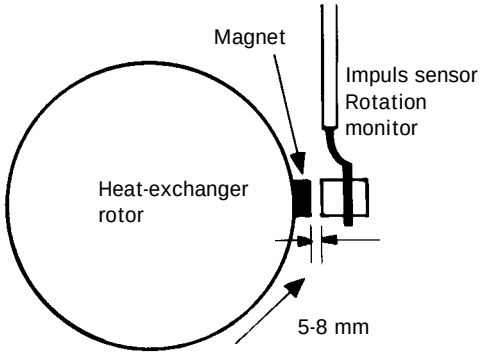


Fig. 2 Impulse sensor

2.2 Accessories

The following items can be ordered separately:

- Plastic cable nipples for EMS-VVX 2EM and 4EM, plastic and metal cable nipples for EMS-VVX 6EM
- Rotation monitor plus magnet, unscreened cable for EMS-VVX 2EM and 4EM, screened cable for EMS-VVX 6EM
- Installation fittings, for the motor including fixed bolts, nuts, washers and rubber vibration dampers.
- Screened cabling between the motor and control unit

2.3 Choice of pulley diameter

Table 4: Choice of pulley diameter for different diameters of heat-exchanger and different gear ratios.

Rotor diameter [mm]	EMS-VVX 2				EMS-VVX 4		EMS-VVX 6	
	Gear ratio 13:1		Gear ratio 26:1		Gear ratio 14:1		Gear ratio 15,5:1	
	Pulley, diameter [mm]	Rotor speed [rpm]	Pulley, diameter [mm]	Rotor speed [rpm]	Pulley, diameter [mm]	Rotor speed [rpm]	Pulley, 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	118	10.0
2600	-	-	-	-	118	9.7	140	10.4
2900	-	-	-	-	140	10.3	140	9.4
3200	-	-	-	-	140	9.4	150	9.1
3500	-	-	-	-	150	9.2	180	10.2
3800	-	-	-	-	-	-	180	9.2
4200	-	-	-	-	-	-	200	9.2
4600	-	-	-	-	-	-	224	9.4
5000	-	-	-	-	-	-	250	9.7
5500	-	-	-	-	-	-	250	8.8

2.4 Wiring

WARNING! Residual voltage remains in the system for 4 minutes after disconnection of mains voltage.

The following two cables must be connected between the motor unit and the control system according to the wiring diagram. The cables for linking the motor and control unit can be ordered separately.

- Motor cable: 5-core, 1.5 mm^2 screened.
- Tachometer cable: 3-core screened, min. 0.1 mm^2 cross sectional area.

If cables are lengthened, ensure that the shielding is spliced carefully.

NOTE! No initial adjustment of the control unit is required.

An external fuse must always be provided. 10 AT for both VVX-2EM, VVX-4EM and VVX-6EM. VVX-2 is protected internally with 2 AT, VVX-4 with 6.3 AT and VVX-6 with 10 AT (Glass/wire fuse 5x20 mm).

WARNING! The control units EMS-VVX 2 and 4 are not protected against a short circuit between leads in themotor cable or to earth. A short circuit will immediately cause a complete 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 should be installed between the power supply and the control unit. Note that when the power supply is isolated, an alarm will be triggered indicating a loss of power.

WARNING! Do not instal a switch between the motor and the control unit.

EMC recommendations

To fulfill the requirements regarding Electromagnetic Compatibility (EMC) stipulated in the European directive 89/336/EEC, it is essential to follow the instructions adhered to. All EMX-VVX models feature an integral EMC filter.

The following should be observed for EMS-VVX 2EM and 4EM:

- The screened motor cable must be placed against a metal support, such as the rotor housing. The shielding must be connected to the earth screw in the motor, and to the motor's earth terminal in the control unit.

The following should be observed for EMS-VVX 6EM:

- Screened cable must be used for the motor cable, the tachometer cable, the control cable and the cable to the rotation monitor. The shields shall be connected to the chassi/earth with metall cable nipples.
- The mains cable and the alarm cable do not need to be screened.
- The screened motor cable must be placed against a metal support, such as the rotor housing. The shielding must be connected to the chassi of both the motor and the control unit. Metal cable nipples should be used.
- The shielding of the tachometer cable must be connected to the chassi of both the control unit and the motor. Metal cable nipples should be used. The shield should not be connected to terminal "S" in the control unit as in EMS-VVX 2EM and 4EM.
- The control cables connected to terminals 31-37 and 51-57 must be screened. The shieldings must be connected to the chassi/earth using metal cable nipples. The cable to the rotation monitor must also be screened.

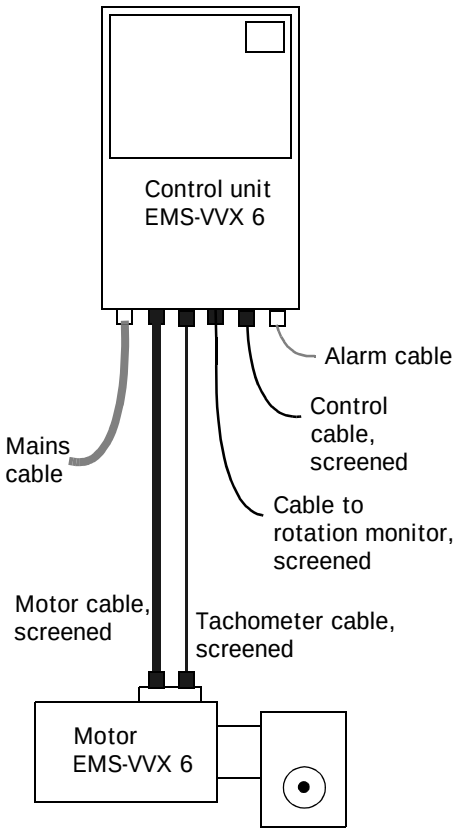


Fig. 3 EMC-adapted installation of EMS-VVX 6EM

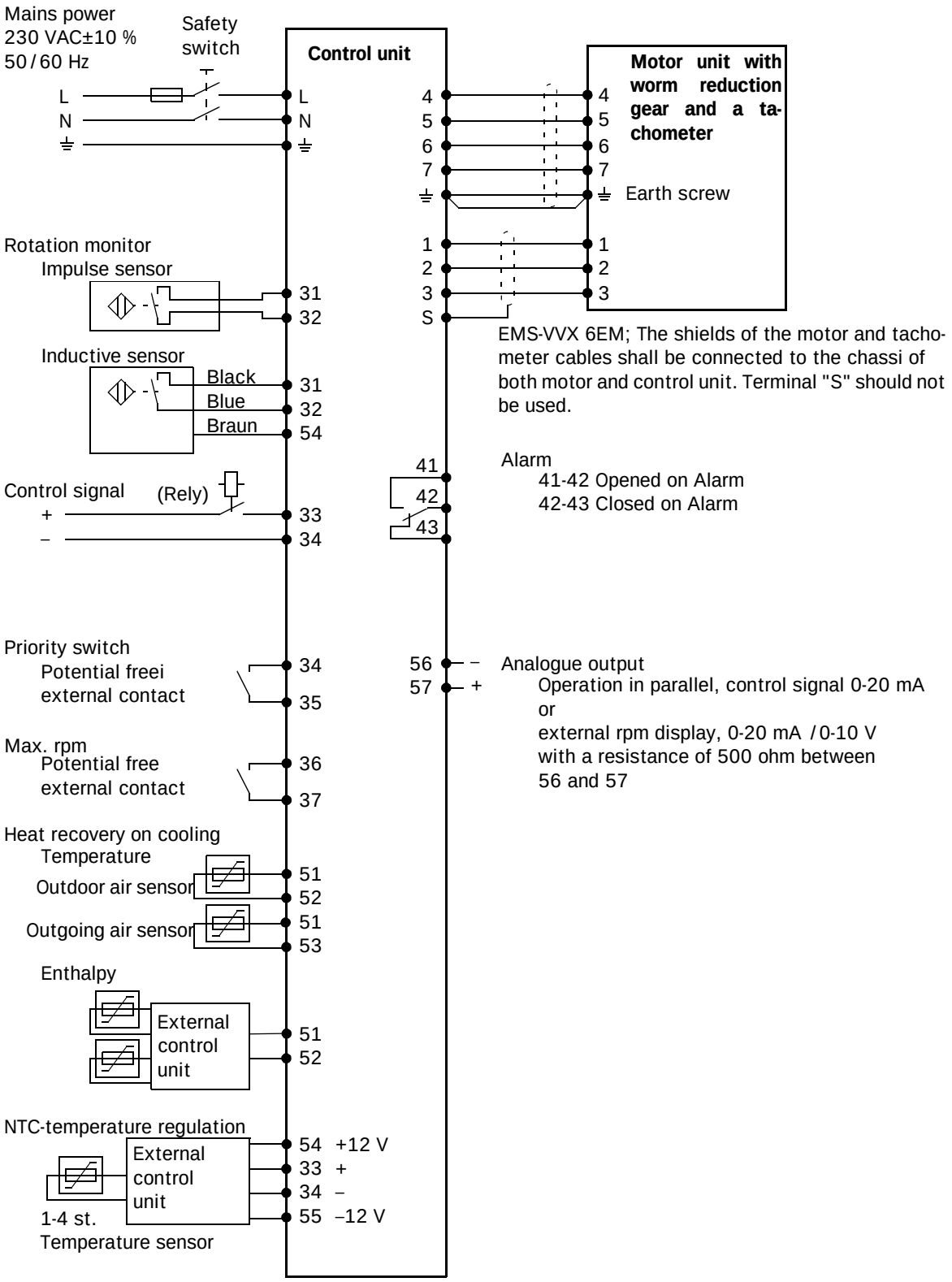
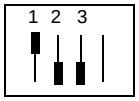


Fig. 4 Wiring diagram

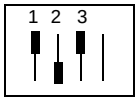
DIP switch settings

Control signal

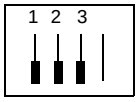
0-10 V
10 kΩ



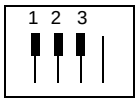
2-10 V



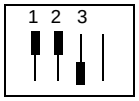
0-20 V



4-20 mA

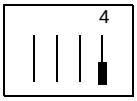


0-20 mA



Rotation sensor

YES



NO

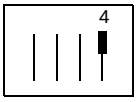


Table 5: Operation of the drive system at different control signal levels.

Control signal	Purging	From min. to max. rpm	Max. rpm
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

Manual control using 10 kΩ potentiometer

The drive system can easily be controlled manually with the help of a 10 kΩ potentiometer which is connected in the following manner:

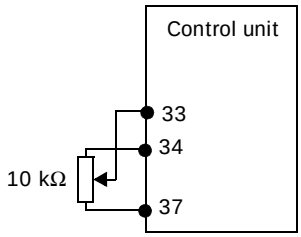


Fig. 5 10 kΩ potentiometer

Switching off

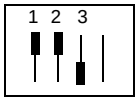
When the heat-exchanger rotor needs to be switched off, for example, during the night, this can be achived by disconnecting the control signal by means of a relay, see Fig. 4. The same result is achieved by setting the control signal to it´s minimum value.

Parallel connection

When several heat-exchangers are operated in parallel from one control signal/ sensor, each heat-exchanger must be equipped with its own control and motor unit.

The control signal/sensor is connected to the first drive system as described in the connection instructions, and drive system number two is connected by connecting terminals 33 and 34 to terminals 57 and 56 on the first drive system. The third drive system is connected by connecting terminals 33 and 34 to terminals 57 and 56 on the second drive system, and so on.

The dip switches on the first drive unit are set in the normal way, and the others as shown below.

0-20 mA 

The control units issue alarms individually. The alarm outputs can be connected in parallel, or in series to obtain a group alarm.

3. TROUBLESHOOTING

WARNING! Residual voltage remains in the system for 4 minutes after disconnection of mains voltage.

A fault is indicated by a blinking "F" followed by a number presented on the display. After about 5 minutes, depending on the fault, the alarm relay is tripped for a further alert. In order for the unit to restart after an alarm has tripped, it must remain off for at least 2 seconds.

Check that installation has been correctly carried out, that the terminal block screws are tight, that there are no loose connections, etc., and that the DIP switches are correctly set.

If an alarm situation is not indicated, a test run of the drive system should always be performed by means of the TEST-button located beneath the terminal block lid. Keep this button depressed to increase the rotation speed. If this does not work then check the motor leads (terminals 4-7), otherwise change the control unit.

Checking of input and output signals is done in test mode. To enter test mode, simultaneously switch on the drive system and keep the TEST-button depressed for 2 seconds.

Test mode:

- The alarm relay trips in and out at 2 second intervals.
- Analog output (0-20 mA) remains at a fixed value 15 mA - irrespective of the rotation speed.

.

Table 6: Indication on the control unit

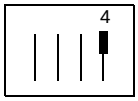
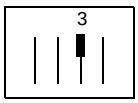
8.	The level of the control signal is shown on the display to the right; 0-9. If the DIP-switch is set for 0-20 mA, 9 is shown when the input signal is 20 mA. If the priority signal is connected, the input is shown on the potentiometer
-..	Priority input 34-35 closed
-..	Summer mode / heat recovery on cooling (the voltage between terminals 51-53 is higher than between terminals 51-52).
-..	DIP-switch 4 in position 
I..	DIP-switch 3 in position 
..	A signal from the rotation sensor (terminal 31-32) is indicated by the decimal point to the right.

Table 7: Trouble shooting

Indication / fault symptom		Reason / remedy
0.1	The system does not respond to a control signal	Check that the DIP-switches are correctly set. Put the system in test mode as described above and check the control signal. Are terminals 33, 34 exchanged?
F1	Overvoltage / Motor does not start	Supply voltage is over 270 VAC. In some industrial environments a distorted electrical supply may occur
F2	Undervoltage / Motor does not start	Supply voltage is below 205 VAC. Check the fuse. The electrical supply may be weak and require stabilization, e.g., using a voltage stabilizer.
F3	Rotations alarm	The heat-exchanger rotor remains still, check the drive belt. The rotor is turning, check that the decimal point to the right blinks on the display when the magnet passes the sensor. The distance between these should be 5-8 mm. The sensor closes when affected by the magnet, the control unit must be disconnected before checking this. Put a jumper between terminals 31-32, the decimal point should now be lit, if not change the control unit.
F5	Overload	Remove the drive belt and try again. If the motor does not start then check the motor leads (terminals 4-7 and 1-3, S). If the fault remains then change the control unit and / or motor. If the rotor rotate longer periods before F5 occur, then the rotor and / or polly may be too great. Check the rotor.
F7	Short circuit, only EMS-VVX 6	Short circuit or disconnection in the motor windings, the motor cable (terminal 4-7) or the control unit. Check the motor including the motor cable, see below. Change parts that are out of order. Change the control unit if the motor and the motor cable are not out of order.

Checking the motor

Remove the motor leads from the control unit. Measure motor resistance between terminal 4-5 and 6-7. This should be:

VVX-2: 20-60 Ω
VVX-4: 5-15 Ω
VVX-6 1-3 Ω

Even check the insulation between 4-6, earth-4 and earth-6.

The motor´s direction of rotation can´t be changed.

4. TECHNICAL DATA FOR EMS-VVX 2EM

Output

Purging mode	built-in function
Motor protection	built-in function
Soft start	built-in function
Alarm output	switch contacts for a max. load of 5 A 250 VAC
Motor capacity	90 W
Max. motor speed	3000 rpm

Input

Mains supply	230 VAC ±10%, 50/60 Hz
Current	Max. 1.2 A
Control signal	0-10 V, 2-10 V, 0-20 V (phase cut), 0-20 mA, 4-20 mA, 10 kΩ potentiometer
Rotation monitor	impulse sensor must be connected

General

Protection class	IP 54
Weight	motor unit, 5.4 kg; control unit, 1.2 kg
Ambient temperature	from -30° to +40°C
Tachometer	built-in function
Motor size	IEC 71
Insulation class	B
Gear type	DV33

Table 8: Model designations

Article 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	anticlockwise	13:1	5-231 rpm	2 Nm
01-0817-11	EMS-VVX 2MO-26	anticlockwise	26:1	2-115 rpm	4 Nm
95-13021	EMS-VVX 2EM Control unit				

Dimensioner

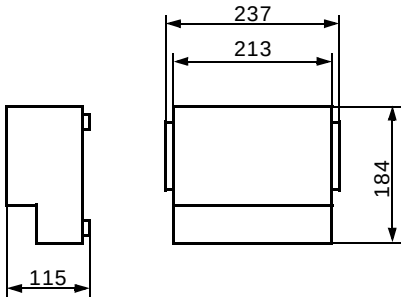


Fig. 6 Dimensions, control unit

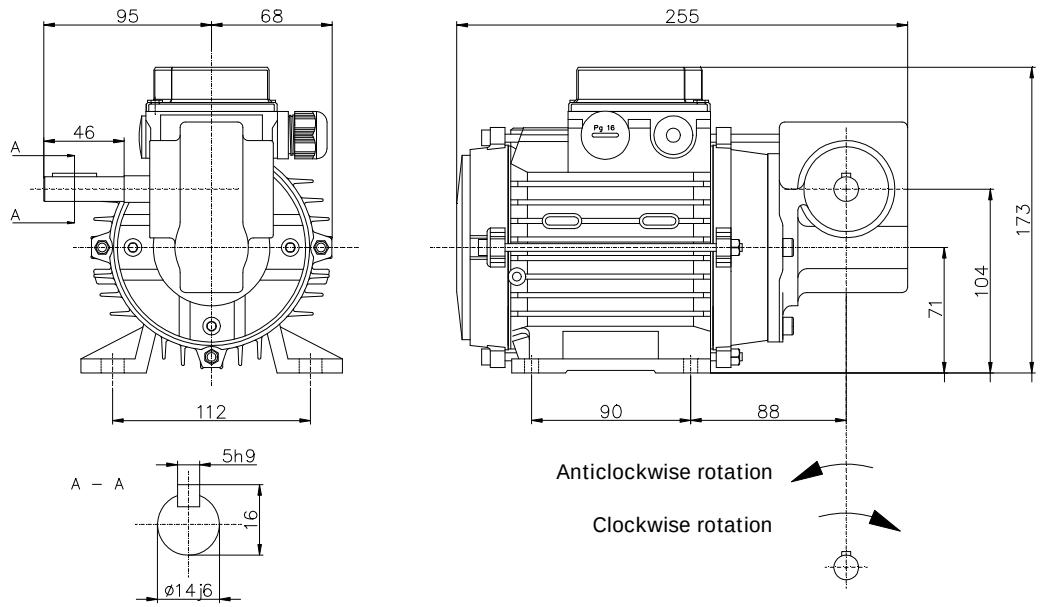


Fig. 7 Dimensions, drive unit

5. TECHNICAL DATA FOR EMS-VVX 4EM

Output

Purging mode	built-in function
Motor protection	built-in function
Soft start	built-in function
Alarm output	switch contacts for a max. load of 5 A 250 VAC
Motor capacity	250 W
Max. motor speed	3000 rpm

Input

Mains supply	230 VAC ±10%, 50/60 Hz
Current	Max. 3.5 A
Control signal	0-10 V, 2-10 V, 0-20 V (Phase cut), 0-20 mA, 4-20 mA, 10 kΩ potentiometer
Rotation monitor	Impulse sensor must be connected

General

Protection class	IP 54
Weight	motor unit, 6.1 kg; control unit, 1.2 kg
Ambient temperature	-30° to +40°C
Tachometer	built-in function
Motor size	IEC 71
Insulation class	B
Gear type	DA35

Table 9: Model designations

Article 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	anticlockwise	1	14:1	4-214 rpm	7 Nm
01-0819-11	EMS-VVX 4MO-14-D	anticlockwise	2	14:1	4-214 rpm	7 Nm
95-13041	EMS-VVX 4EM Control unit					

Dimensioner

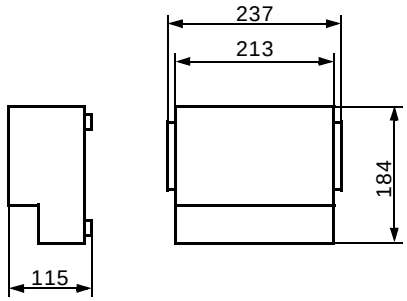


Fig. 8 Dimensions, control unit

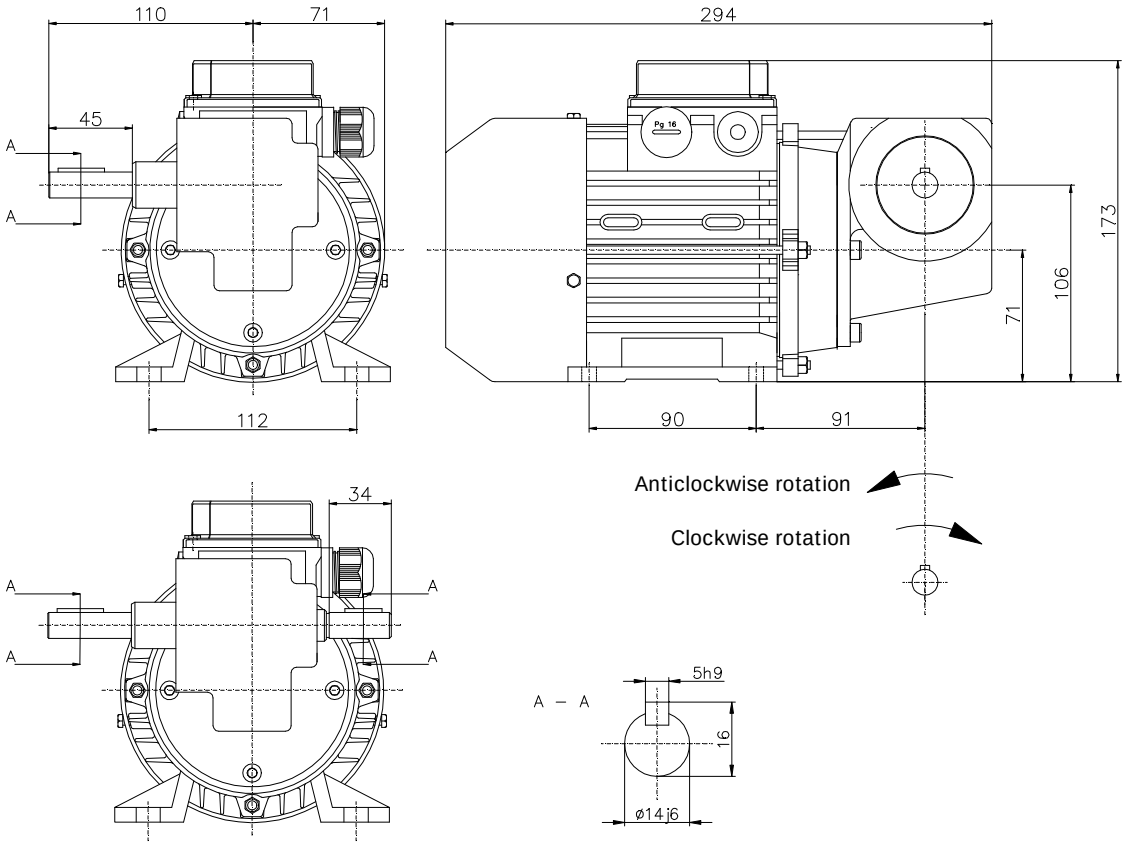


Fig. 9 Dimensions, drive unit with one or two shafts

6. TECHNICAL DATA EMS-VVX 6EM

Output

Purging mode	built-in function
Motor protection	built-in function
Soft start	built-in function
Alarm output	switch contacts for a max. load of 5 A 250 VAC
Motor capacity	750 W
Max. motor speed	3000 rpm
Intermitted operation	On receiving a low control signal, the drive system operates intermittently. This means that the motor stays still for a while (the time depends on the mean rotation speed) but then rotates about 1 revolution, etc. The motor gear´s mean rotation speed can vary between 4-13 rpm.

Input

Mains supply	230 VAC ±10%, 50/60 Hz
Current	Max. 7.2 A
Control signal	0-10 V, 2-10 V, 0-20 V (Phase cut), 0-20 mA, 4-20 mA, 10 kΩ potentiometer.
Rotation monitor	Impulse sensor must be connected

General

Protection class	IP 54
Weight	motor unit, 11.8 kg; control unit, 5.4 kg.
Ambient temperature	-30° to +40°C
Tachometer	built-in function
Motor size	IEC 71
Insulation class	B
Gear type	FM 50

Table 10: Model designations

Article number	Name	Direction of rotation	Reduction	Gear rpm	Torque gear
01-0820-10	EMS-VVX 6ME-15	clockwise	15.5:1	13-194 rpm	26 Nm
01-0821-10	EMS-VVX 6MO-15	anticlockwise	15.5:1	13-194 rpm	26 Nm
01-1545-01	EMS-VVX 6EM Control unit				

Dimensions

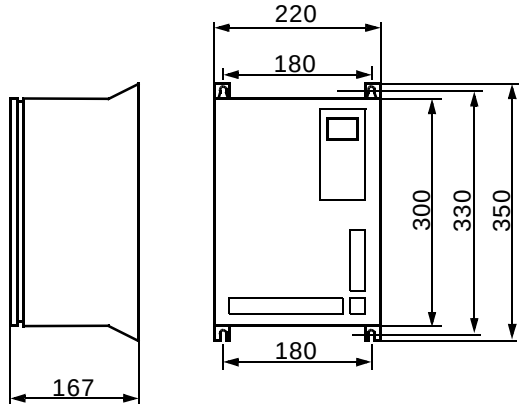


Fig. 10 Dimensions, control unit

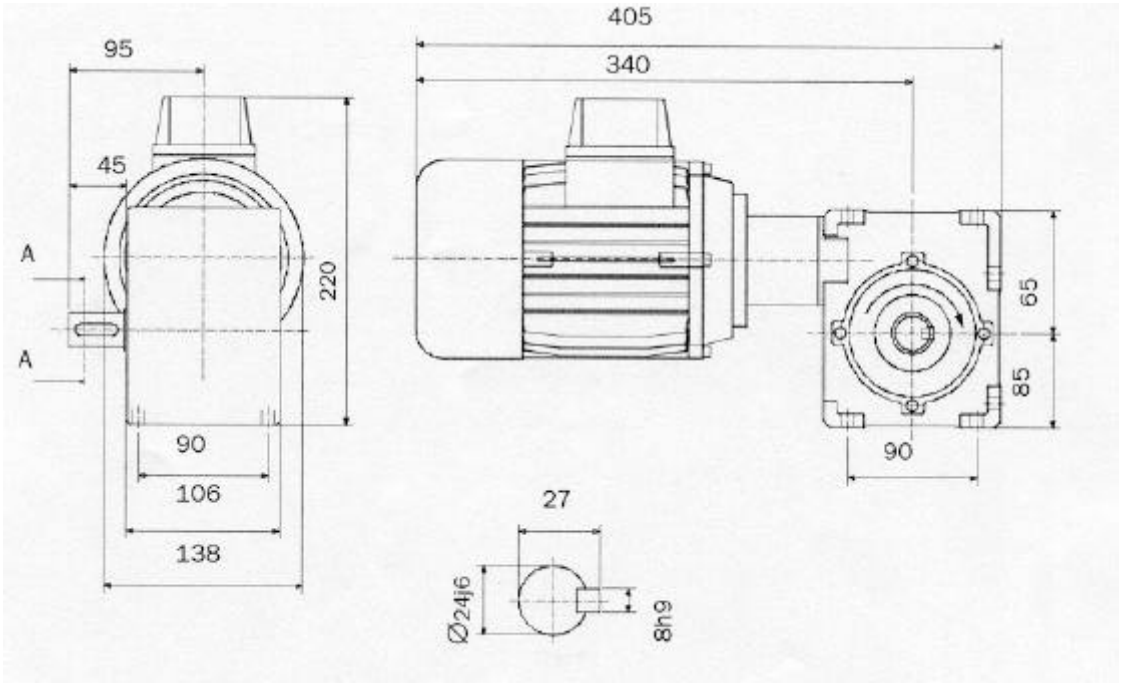


Fig. 11 Dimensions, drive unit with clockwise rotation

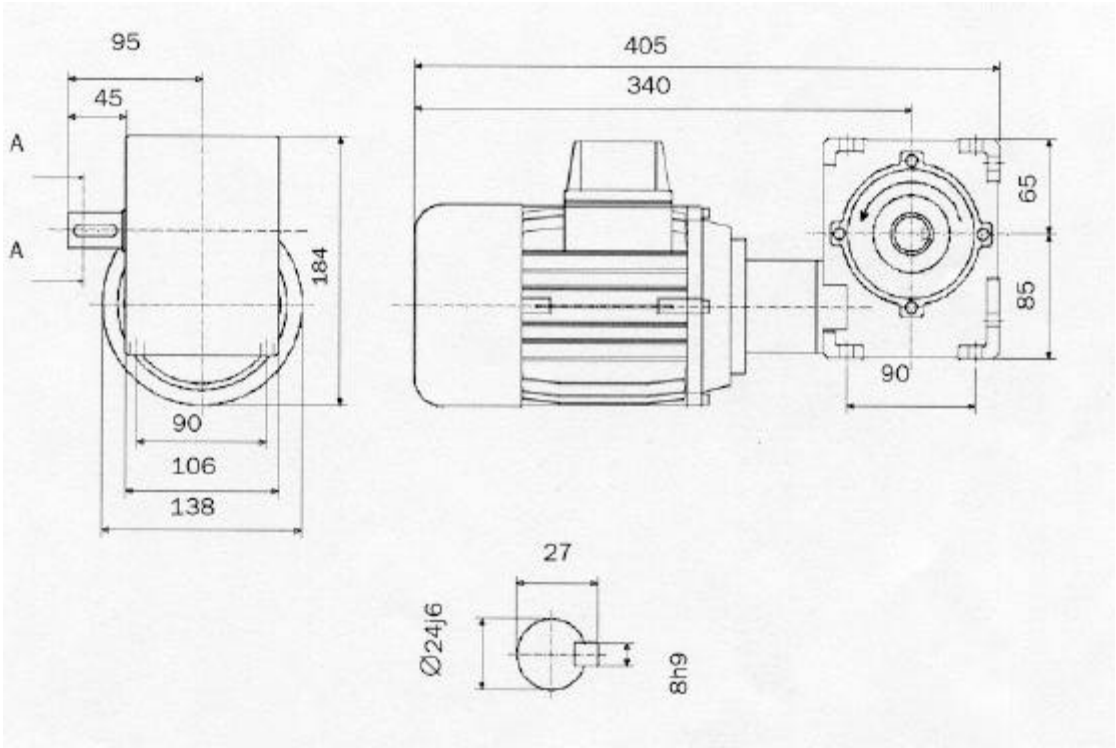


Fig. 12 Dimensions, drive unit with anticlockwise rotation