SIEMENS

Operating Instructions
Installation Instructions

Main motors

SIMOTICS M-1PH8

Type 1PH818., 1PH822., 1PH828.

Edition 10/2017

www.siemens.com/drives

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Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION
indicates that minor personal injury can result if proper precautions are not taken.

NOTICE
indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Introduction

1

These operating instructions are valid for 1PH8 induction motors in shaft heights 180 ... 280 in a force-ventilated or water-cooled version.

- 1PH818.1 and 1PH818.3
- 1PH822.1 and 1PH822.3
- 1PH828.1

The serial number of the motor can be found on the rating plate.

These instructions describe the machine and explain how to handle it, from initial delivery to final disposal of the equipment. Keep these instructions for later use.

Read these operating instructions before you handle the machine and follow the instructions to become familiar with its design and operating principles and thus ensure safe, problem-free machine operation and long service life.

Please contact the Service Center (Page 161) if you have any suggestions on how to improve this document.

Text format features

The warning notice system is explained on the rear of the inside front. Always follow the safety instructions and notices in these instructions.

In addition to the safety-related warning notices which you must read, you will find the text in these instructions is formatted in the following way:

1. Handling instructions are always formatted as a numbered list. Always perform the steps in the order given.

- Lists are formatted as bulleted lists.
  - Lists on the second level are hyphenated.

Note

A Note is an important item of information about the product, handling of the product or the relevant section of the document. Notes provide you with help or further suggestions/ideas.

Safety information 2

2.1 Information for the nominated person in control of the electrical installation

This electric machine has been designed and built in accordance with the specifications contained in Directive 2014/35/EU ("Low-Voltage Directive") and is intended for use in industrial plants. Please observe the country-specific regulations when using the electric machine outside the European Community. Follow the local and industry-specific safety and setup regulations.

The persons responsible for the plant must ensure the following:

- Planning and configuration work and all work carried out on and with the machine is only to be done by qualified personnel.
- The operating instructions must always be available for all work.
- The technical data as well as the specifications relating to the permissible installation, connection, ambient and operating conditions are taken into account at all times.
- The specific setup and safety regulations as well as regulations on the use of personal protective equipment are observed.

Note

Use the services and support provided by the appropriate Service Center (Page 161) for planning, installation, commissioning, and servicing work.

You will find safety instructions in the individual sections of this document. Follow the safety instructions for your own safety, to protect other people and to avoid damage to property.

Observe the following safety instructions for all activities on and with the machine.

2.2 The five safety rules

For your own personal safety and to prevent material damage when carrying out any work, always observe the safety-relevant instructions and the following five safety rules according to EN 50110-1 "Working in a voltage-free state". Apply the five safety rules in the sequence stated before starting work.

Five safety rules

1. Disconnect the system.
   Also disconnect the auxiliary circuits, for example, anti-condensation heating.
2. Secure against reconnection.
3. Verify absence of operating voltage.

4. Ground and short-circuit.
5. Provide protection against adjacent live parts.

To energize the system, apply the measures in reverse order.

2.3 Qualified personnel

All work at the machine must be carried out by qualified personnel only. For the purpose of this documentation, qualified personnel is taken to mean people who fulfill the following requirements:

- Through appropriate training and experience, they are able to recognize and avoid risks and potential dangers in their particular field of activity.
- They have been instructed to carry out work on the machine by the appropriate person responsible.

2.4 Safe handling

Workplace safety depends on the attentiveness, care, and common sense of the personnel who install, operate, and maintain the machine. In addition to the safety measures cited, as a matter of principle, the use of caution is necessary when you are near the machine. Always pay attention to your safety.

Also observe the following to prevent accidents:

- General safety regulations applicable in the country where the machine is deployed.
- Manufacturer-specific and application-specific regulations
- Special agreements made with the operator
- Separate safety instructions supplied with the machine
- Safety symbols and instructions on the machine and its packaging

⚠ WARNING

Live parts

Electric machines contain live parts.

Fatal or severe injuries and substantial material damage can occur if the covers are removed or if the machine is not handled, operated, or maintained properly.

- Always observe the “five safety rules" (Page 15) when carrying out any work on the machine.
- Only remove the covers using the methods described by these operating instructions.
- Operate the machine properly.
- Regularly and correctly maintain the machine.

⚠ WARNING

Rotating parts

Electric machines contain dangerous rotating parts.

Fatal or severe injuries and substantial material damage can occur if the covers are removed or if the machine is not handled, operated, or maintained properly.

- Only remove the covers using the methods described by these operating instructions.
- Operate the machine properly.
- Regularly and correctly maintain the machine.
- Secure free-standing shaft ends and other rotating parts such as couplings, belt pulleys etc. against touch.

⚠ WARNING

Hot surfaces

Electric machines have hot surfaces. Do not touch these surfaces. They could cause burns.

- Allow the machine to cool before starting work on the machine.
- Only remove the covers using the methods described by these operating instructions.
- Operate the machine properly.

⚠ CAUTION

Hazardous substances

Chemical substances required for the setup, operation and maintenance of machines can present a health risk.

Poisoning, skin damage, cauterization of the respiratory tract, and other health damage may result.

- Read the information in these operating instructions and the product information supplied by the manufacturer.
- Observe the relevant safety regulations and wear the personal protective equipment specified.

⚠ CAUTION

Flammable substances

Chemical substances required for the setup, operation and maintenance of machines may be flammable.

Burns and other damage to health and material may result.

- Read the information in these operating instructions and the product information supplied by the manufacturer.
- Observe the relevant safety regulations and wear the personal protective equipment specified.

⚠ WARNING

Noise emissions

During operation, the machine's noise emission levels can exceed those permitted at the workplace, which can cause hearing damage.

Take steps to reduce noise, such as introducing covers and protective insulation or adopting hearing protection measures, so that the machine can be operated safely within your system.

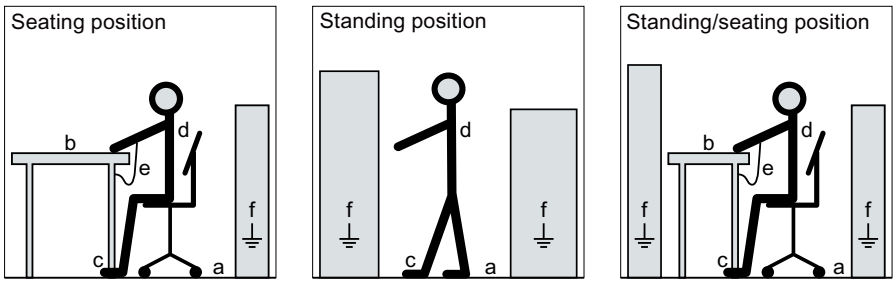
2.5 Electrostatic sensitive devices

Material damage due to electrostatic discharge

Electronic modules contain components that can be destroyed by electrostatic discharge. These components can be damaged or destroyed if they are not handled correctly. To protect equipment against damage, follow the instructions given below.

- Only touch electronic modules if you absolutely have to work on them.
- The body of the person concerned must have been electrostatically discharged and grounded immediately before any electronic modules are touched.
- Electronic modules should not be brought into contact with electrically insulating materials, such as:
  - Plastic film
  - Plastic parts
  - Insulating table supports
  - Clothing made of synthetic fibers
- Always place electrostatic sensitive devices on conductive bases.
- Always pack, store and transport electronic modules or components in conductive packaging, such as:
  - Metallized plastic or metal containers
  - Conductive foam material
  - Domestic aluminum foil

The necessary ESD protective measures for electrostatic sensitive devices are illustrated once again in the following drawings:



a = conductive floor surface b = ESD table c = ESD shoes
d = ESD overall e = ESD wristband f = cabinet ground connection

See also

Replacing the DRIVE-CLiQ interface (encoder module) (Page 130)

2.6 Interference immunity

By selecting suitable signal cables and evaluation units, companies operating complete plants and systems must ensure that the interference immunity of the machine is not diminished.

2.7 Interference voltages when operating the converter

⚠ WARNING

Interference voltages when operating the converter

When a converter is in operation, the emitted interference varies in strength depending on the converter (manufacturer, type, interference suppression measures undertaken). On machines with integrated sensors (e.g. PTC thermistors), interference voltages caused by the converter may occur on the sensor lead. This can cause faults which can result in eventual or immediate death, serious injury or material damage.

Observe the EMC instructions of the converter manufacturer in order to avoid exceeding the limit values according to IEC/EN 61000-6-3 for drive systems comprising machine and converter. You must put appropriate EMC measures in place.

2.8 Electromagnetic fields when operating electrical power engineering installations

⚠ WARNING

Interference to electronic devices caused by electrical power equipment

Electrical power equipment generate electric fields during operation. Potentially lethal malfunctions can occur in medical implants, e.g. pacemakers, in the vicinity of electrical power equipment. Data may be lost on magnetic or electronic data carriers.

- It is forbidden for people with pacemakers to enter the vicinity of the machine.
- Protect the personnel working in the plant by taking appropriate measures, such as erecting identifying markings, safety barriers and warning signs and giving safety talks.
- Observe the nationally applicable health and safety regulations.
- Do not carry any magnetic or electronic data media.

Description

3

Application range

The motors of the 1PH818., 1PH822., 1PH828. series are used as industrial drives. They have been designed to address a wide range of drive applications exclusively fed from converters.

They are characterized by their high power density, ruggedness, long lifetime, and overall reliability.

⚠ WARNING

Risk of explosion

This machine is not designed for use in hazardous areas. An explosion can occur if the machine is operated in these areas. This can result in death, serious injury or material damage.

Never operate this machine in hazardous areas.

Rating plate

The rating plate shows the identification data and the most important technical data. The data on the rating plate and the contractual agreements define the limits of proper usage.

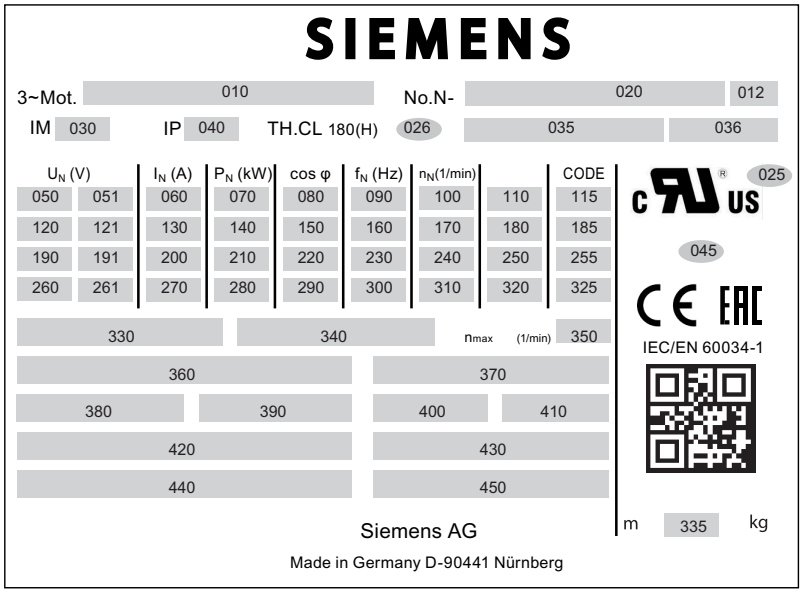


Figure 3-1 Schematic layout of rating plate

Table 3-1 Elements on the rating plate

No.	Description	No.	Description
010	MLFB	200	Rated current I_N (3)
012	Consecutive number, part of serial number	210	Rated power P_N (3)
020	Serial number *	220	cos φ (3)
025	UL approval	230	Rated frequency f_N (3)
026	(empty)	240	Rated speed n_N (3)
030	Type of construction	250	Operating mode (3)
035	(empty)	255	Code for operating point 3
036	(empty)	260	Rated voltage V_N (4)
040	Degree of protection	261	Switching mode 4
045	Type of balancing	270	Rated current I_N (4)
050	Rated voltage U_N (1)	280	Rated power P_N (4)
051	Connection type 1	290	cos φ (4)
060	Rated current I_N (1)	300	Rated frequency f_N (4)
070	Rated power P_N (1)	310	Rated speed n_N (4)
080	cos φ (1)	320	Operating mode (4)
090	Rated frequency f_N (1)	325	Code for operating point 4
100	Rated speed n_N (1)	330	Maximum current I_{MAX}
110	Operating mode (1)	335	Weight
115	Code for operating point 1	340	Maximum torque M_{MAX}
120	Rated voltage U_N (2)	350	Maximum speed n_{MAX}
121	Connection type 2	360	Temperature sensor
130	Rated current I_N (2)	370	Tachometer/resolver
140	Rated power P_N (2)	380	Cooling method
150	cos φ (2)	390	Throughput l/min (m^3/s)
160	Rated frequency f_N (2)	400	System pressure
170	Rated speed n_N (2)	410	Maximum coolant temperature
180	Operating mode (2)	420	Options (I)
185	Code for operating point 2	430	Options (II)
190	Rated voltage U_N (3)	440	Optional customer information
191	Connection type 3	450	Anti-condensation heater / place holder

* Based on the serial number, you can identify where the machine was manufactured and where you can have your questions answered:

No:N... = Nuremberg
No.UC... = Frenstat

Rotor

This machine is an induction motor for low voltage with squirrel-cage induction motor and integrated cooling circuit.

Machine design

The regulations and standards used as basis for designing and testing this machine are stamped on the rating plate. The machine design basically complies with the subsequent standards: Please refer to the EU Declaration of Conformity for the versions of the harmonized standards referenced.

Table 3-2 Machine design

Feature	Standard
Dimensions and operation characteristics	IEC / EN 60034-1
Degree of protection	IEC / EN 60034-5
Cooling	IEC / EN 60034-6
Type of construction	IEC / EN 60034-7
Terminal markings and direction of rotation	IEC/EN 60034-8
Noise emission	IEC / EN 60034-9
Mechanical vibrations	IEC / EN 60034-14
IEC-standard voltages	IEC/DIN IEC 60038
Vibration limit values	DIN ISO 10816-3

Relevant directives

The following directives are relevant for the SIMOTICS motor series.

European low-voltage directive

The SIMOTICS motor series complies with the requirements of the low-voltage directive 2014/35/EU.

European machinery directive

The SIMOTICS motor series does not fall within the area of validity of the machinery directive. However, the use of the products in a typical machine application has been fully assessed for compliance with the main regulations in this directive concerning health and safety.

European EMC Directive

The SIMOTICS motor series does not fall within the area of validity of the EMC directive. The products are not considered as devices in the sense of the directive.

Eurasian conformity

The SIMOTICS motor series complies with the requirements of the Russia/Belarus/ Kazakhstan customs union (EAC).

China Compulsory Certification

The SIMOTICS motor series does not fall in the area of validity of the China Compulsory Certification (CCC).

Underwriters Laboratories

The SIMOTICS motor series generally complies with UL and cUL requirements as component of motor applications - and is correspondingly listed. Specifically developed motors and functions are the exceptions in this case. Here, it is important that you carefully observe the contents of the quotation and that there is a cUL mark on the rating plate (nameplate)!

Quality management system

Siemens AG employs a quality management system that meets the requirements of ISO 9001 and ISO 14001.

Certificates that can be downloaded

You can download certificates for the SIMOTICS motor series at the following link:

Certificates (https://support.industry.siemens.com/cs/ww/en/ps/13358/cert)

Drive

The motor speed is controlled using a converter.

NOTICE
Destruction of the machine when operated directly from the line supply The machine will be destroyed if it is directly connected to the line supply. Only operate the machine using a converter.

Types of construction

The motor is supplied with two attached lifting eyes. The type construction can be found on the rating plate.

Vertical type of construction

For IM V5 and IM V15 types of construction with "shaft extension pointing downward", the motor is equipped with two additional Vario eye bolts. The Vario eyebolts are in the terminal box.

NOTICE
Protection against falling parts For vertical types of construction, protect the air intake or discharge against falling parts, e.g. by attaching a canopy. Otherwise the machine could be damaged.

Cooling water-cooled motors

Cooling circuit

The cooling circuit consists of an enclosed, internal air circulation, which is driven by the shaft-mounted fans and stainless steel tubes that are directly integrated into the laminated stator core; cooling type IC 71W according to IEC / EN 60034-6.

Cooling capacity

To ensure adequate cooling of the motor, it is essential to adhere to the specified cooling water rate, temperature and cooling water quality (Page 29).

Cooling with external fan

The machine has cooling method IC 416 in accordance with IEC / EN 60034-6. The separately driven fan unit and the terminal box can be mounted in a different position depending on the order.

⚠ WARNING

Improper use of the external fan

Improper use of the external fan can result in death, serious injury, and material damage.

- Observe and follow the operating instructions of the external fan.

See also

Additional documents (Page 167)

External fan

Different external fans are used depending on the shaft height and particular motor version:

Type	Version	External fan
1PH818. 1PH822.	Standard version	EC external fan with single-phase EC motor
	Version with option L75	External fan with three-phase motor
	Version with option L76	EC external fan with three-phase EC motor
1PH828.	Standard version	External fan with three-phase motor

EC external fans with a fixed operating speed have been specifically designed for this motor series.

Degree of protection

Depending on the version, the machine has degree of protection IP23 or IP55.

Supplementary devices

A temperature sensor is integrated in the stator winding to monitor the winding temperature. The type of temperature sensor is specified on the rating plate.

Depending on the order options, various supplementary devices such as encoder systems can be either installed or mounted.

Holding brake

Depending on the order, a special version of a holding brake from the Stromag company is mounted. Various types of holding brake are mounted depending on the shaft height.

NOTICE
Technical data for the special version of the holding brake The following technical data applies to the special version of the mounted holding brake. The corresponding data in the manufacturers operating instructions do not apply.

Table 3-3 Technical data of the holding brake

Technical data			NFF-A 63 AH180	NFF-A 100 AH225
Braking torque	M_{Brake}	[Nm]	1000	1600
Max. speed	n_{Brake}	[rpm]	3500	3100
Weight incl. hollow shaft	m_{brake}	[kg]	63	88
Moment of inertia	J_{brake}	[kgm^2]	0,022	0,051
Total moment of inertia (emergency stop)	J_{total}	[kgm^2]	1,3	3,9
Rated voltage	U	[V]	230 V (AC)	230 V (AC)
Permitted single switched energy	P	[W]	98	210
Coil current	I	[A]	2,21	2,70
Number of emergency stops	Z	-	2100	1200
Opening time		[ms]	300	300
Closing time		[ms]	80	100

Note

More information

- Commissioning (Page 87)

See also

Operating instructions, holding brake (Page 169)

Ambient conditions

The standard machines are not suitable for use in corrosive atmospheres, atmospheres with a high salt content, or outdoor applications.

Roller bearings

The machines are equipped with different types of roller bearings depending on the version and the operating conditions described in the order. If the machine is equipped with a regreasing system, you will find the relevant data on the machine's lubricant plate.

The following standard roller bearing versions are available:

Table 3-4 Roller bearing versions

Design	Bearings
Standard design and "Performance"	Drive end deep-groove ball bearing as spring-loaded floating bearing Non-drive end deep-groove ball bearing as fixed bearing
Version for increased radial forces	Drive end cylindrical-roller bearing as floating bearing Non-drive end deep-groove ball bearing as fixed bearing

Paint finish

The machine is painted according to the instructions in your order.

Preparations for use

4

Good planning and preparation of machine applications are essential in terms of keeping installation simple and avoiding errors, ensuring safe operation, and allowing access to the machine for servicing and corrective maintenance.

This chapter outlines what you need to consider when configuring your plant in relation to this machine and the preparations you need to make before the machine is delivered.

4.1 Safety-related aspects to consider when configuring the plant

A number of residual risks are associated with the machine. These are described in the chapter titled "Safety information" (Page 15) and in related sections.

Take appropriate safety precautions (covers, barriers, markings, etc.) to ensure the machine is operated safely within your plant.

4.2 Observing the operating mode

Observe the machine's operating mode. Use a suitable control system to prevent overspeeds, thus protecting the machine from damage.

4.3 Cooling water quality for water-cooled motors

The values specified for the cooling water correspond to the requirements for a closed cooling circuit. Not all of the specified concentrations will occur in the cooling water at the same time. A filter can be used to ensure smooth operation; the grade of filtration should not exceed 100 µm.

Cooling water specification

Table 4-1 Cooling water specification

Constituent	Value
pH value	6.0 … 9.0
Total hardness	< 170 ppm
Conductivity	< 500 µS/cm
Chloride ions	< 40 ppm
Sulfate ions	< 50 ppm
Nitrate ions	< 50 ppm
Dissolved solids	< 340 ppm
Max. grain size	< 100 µm

Constituent	Value
Operating pressure	6 bar max.
Inlet temperature	< 30°C
Minimum cooling water inlet temperature	$T_{cooling\ water} > T_{ambient} - 5\ K$
Anti-freeze protection / corrosion protection	20 … 30 %
Inhibitor NALCO 00GE056	0.2 … 0,25 %

Cooling water intake temperature

The maximum cooling water intake temperature is 30 °C.

NOTICE

Condensation for an excessively low cooling water intake temperature

If the temperature difference between cooling water and ambient temperature is greater than 5 K, this may result in condensation forming in the machine. This results in material damage.

- Make sure that the condensation can drain away freely.
- Adopt appropriate measures to achieve the required intake temperature of the cooling water.
- Alternatively, dry the ambient air.

4.4 Ensuring cooling

Note

Note also the technical data on the rating plates on the motor enclosure.

Preconditions for adequate cooling

- For motors that are cooled by the ambient air, the cooling air must be able to flow unimpeded to and from the motors. Hot discharged air should not be drawn in again.

NOTICE
Overheating If the required cooling air flow cannot be maintained, the machine can overheat. This can result in material damage. • Maintain the required minimum clearance for customer-supplied mounted accessories at the air intake opening and at the air discharge openings to ensure the required cooling air flow.

- Comply with the conditions of the IP degree of protection.
  More stringent requirements regarding the IP degree of protection may necessitate the installation of suitable filters and special arrangement of the intake and outlet openings.
- Equipment and cables must be connected without strain.

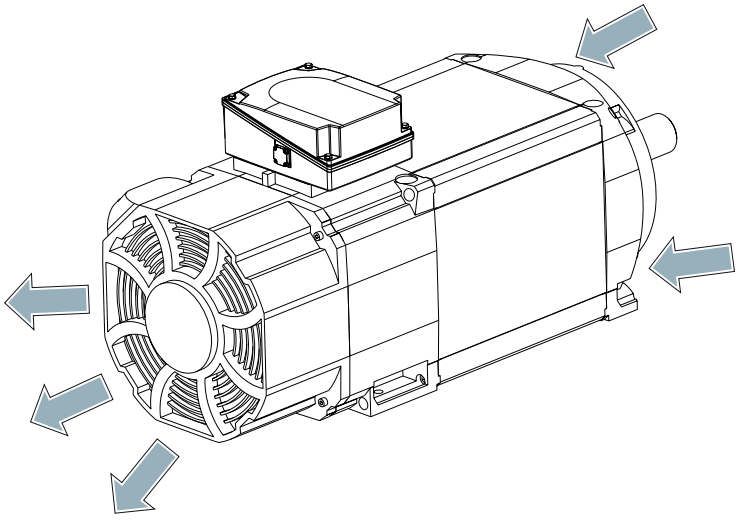


Figure 4-1 Air guidance from the DE to the NDE (schematic representation, types 1PH818. and 1PH822.)

A bypass is available for 1PH822. with IP23 degree of protection and air guidance from the DE to the NDE.

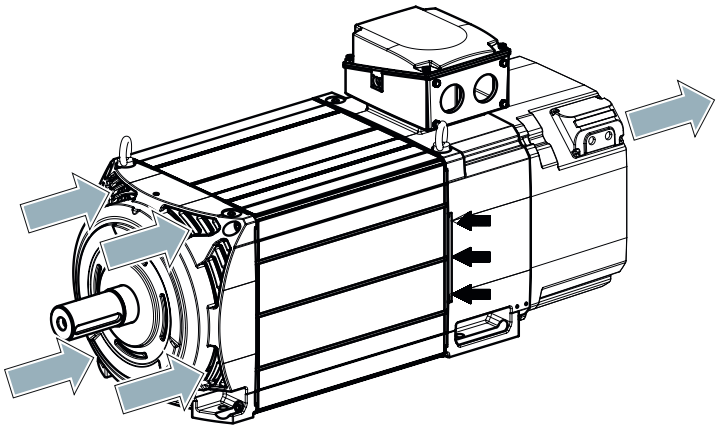


Figure 4-2 Bypass for 1PH822. for IP23

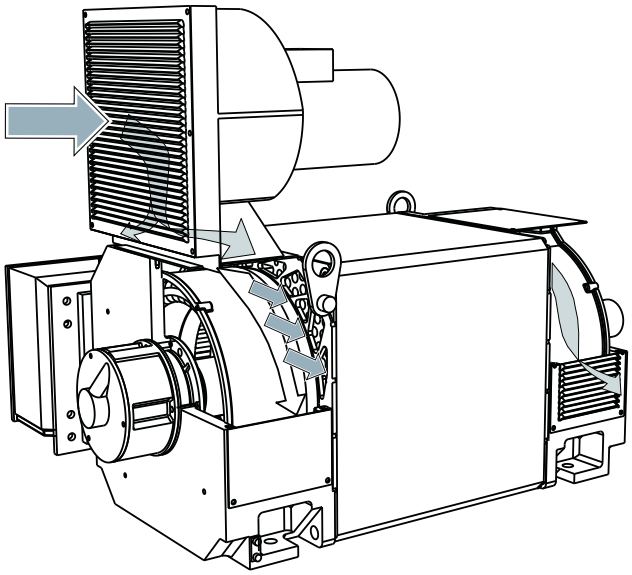


Figure 4-3 Air guidance from the NDE to the DE (schematic representation, type 1PH828.) for IP55

External fan

The code for the external fan is at the eleventh position of the order number. The order number – and therefore the installed external fan type – is specified on the rating plate.

Machines with pipe connection

You must mount and connect pipes and a fan of suitable type and dimensioning to machines that are intended for the connection of pipes and/or for operation with an external fan.

Please observe the following when connecting pipes:

- Additional pressure drop in the system.
- Shipping covers on the ventilation openings must have been removed.

For machines with a pipe connection, the potential pressure drop inside the machine is given in the following table:

Table 4-2 Pressure drop in motors with pipe connection

Type	Degree of protection	Volume flow	Pressure drop	Flow resistance
1PH818.	IP23	0.21 m^3/s	450 Pa	10204 Ns^2/m^8
	IP55	0.17 m^3/s	550 Pa	19030 Ns^2/m^8
1PH822.	IP23	0.33 m^3/s	600 Pa	5510 Ns^2/m^8
	IP55	0.31 m^3/s	650 Pa	6760 Ns^2/m^8
1PH828.	IP23	0.52 m^3/s	600 Pa	2220 Ns^2/m^8
	IP55	0.42 m^3/s	600 Pa	3400 Ns^2/m^8

4.5 Interlock circuit for the external fan

Interlock circuit for the external fan motor

For machines with external fans, install an interlock circuit that prevents the main machine being switched on if the external fan is not operational.

Force-ventilated 1PH818. and 1PH822. motors are equipped with electronically commutated motors (EC motor).

NOTICE
Voltage fluctuations The electronics of the external fan equipped with EC motor can be damaged as a result of voltage fluctuations. Supply the external fan with power from the line supply and not via a frequency converter.

4.6 Interlock circuit for anti-condensation heating (option)

If the anti-condensation heating is operated while the machine is running, this can increase the temperatures inside the machine.

- Install an interlock circuit that switches off the anti-condensation heating once the main machine is switched on.
- Only switch on the anti-condensation heating after the machine has been switched off.

See also

Switching on the machine (Page 97)

4.7 Thermal motor protection

The machine is equipped as standard with a temperature sensor, optionally with PTC thermistors to directly monitor the motor temperature in order to protect the machine against overload in operation. Plan a corresponding circuit for monitoring.

See also

Connecting the temperature sensor (Page 83)

4.8 Overheating during periodic duty

NOTICE
Non-periodic duty In all of the operating modes, always operate the external fan according to DIN EN 60034-1. For non-periodic operation, it is possible that the machine is thermally overloaded. This can result in damage to the machine. • In the case of extended non-operational periods, the fan should be in operation until the machine has approximately reached the temperature of the coolant, see S2 duty type in DIN EN 60034-1. • Use a suitable circuit to ensure that the external fan is appropriately operated.

NOTICE
EC fan control via an input signal The fan motor can overheat if the external EC fan is operated at low fan speeds as a result of the setpoint signal it receives. • Monitor the motor using the integrated temperature sensors. • Integrate the temperature monitoring into the interlocking circuit.

4.9 Noise emissions

⚠ WARNING
Noise emissions During operation, the machine's noise emission levels can exceed those permitted at the workplace, which can cause hearing damage. Take steps to reduce noise, such as introducing covers and protective insulation or adopting hearing protection measures, so that the machine can be operated safely within your system.

4.10 Rotational speed limit values

⚠ WARNING

Excessively high speeds

Excessive rotational speed can lead to serious damage to the machine. This can result in death, serious injury, or material damage.

- Avoid operation above the permissible speed by using the appropriate control function.
- Observe the speeds stamped on the rating plate.

4.11 System-inherent frequencies

NOTICE

System resonances

Excessive vibrations and system resonances can damage the machine set.

- Configure and match the system consisting of the foundation and machine set in such a way that no system resonances can arise and result in the permissible vibration levels being exceeded.
- The vibration limit values according to DIN ISO 10816-3 must not be exceeded.

4.12 Torsional loading of the drive train due to faults in the electrical supply

In the event of faults in the electrical connection during operation, excessive air gap torques can lead to additional mechanical torsional load on the line shaft.

Note

The system planner is responsible for the entire drive train.

⚠ WARNING

Torsional loadings of the shaft assembly

If the configuration does not correctly recognize the mechanical torsional loadings of the shaft assembly, this can lead to serious damage to the machine. This can result in death, serious injury or material damage.

When planning the system, consider the configuration data.

4.13 Transport and storage

When carrying out any work on the machine, observe the general safety instructions (Page 15) and the specifications contained in EN 50110-1 regarding safe operation of electrical equipment.

4.13.1 Checking the delivery

Checking the delivery for completeness

The drive systems are put together on an individual basis. When you take receipt of the delivery, please check immediately whether the items delivered are in accordance with the accompanying documents. Siemens will not accept any claims relating to items missing from the delivery and which are submitted at a later date.

- Report any apparent transport damage to the delivery agent immediately. Never commission a damaged motor.
- Report any apparent defects/missing components to the appropriate Siemens office immediately.

These safety instructions are part of the scope of supply; keep them in a location where they can be easily accessed.

4.13.2 Lifting and transportation

To safely lift and transport the machine, the following requirements must be met:

- Personnel operating cranes and fork-lift trucks must be appropriately qualified.
- If the motor is packed, depending on the weight, size and on-site conditions, lift crates and transport frames using a fork-lift truck or a crane with slings. Use a crane or fork-lift truck suitable for the load.
- When lifting the machine, use only approved and undamaged sling guides and spreaders of sufficient rated capacity. Check the lifting equipment prior to its use. The weight of the machine is shown on the rating plate.
- When lifting the machine, refer to the information on the lifting plate.
  - Comply with the specified spreading angles.
  - Do not exceed the maximum lifting acceleration and lifting speed specified on the lifting plate. Lift the machine without jerking it.
    Acceleration a ≤ 0.4 g (≈ 4 m/s^2)
    Velocity v ≤ 20 m/min
- Use only the load carrying device on the stator frame for lifting.

⚠ WARNING

Transport for a different type of construction

If you do not transport or lift the machine in a position appropriate for its construction, the machine can tip, slip into the lifting equipment or fall down. This can result in death, serious injury or material damage.

- Use only the load carrying device on the stator frame for lifting.
- Use the load carrying device appropriate for the machine position.
- Use suitable rope guiding or spreading devices. The weight of the machine is shown on the rating plate.

⚠ WARNING

Transport if the center of gravity is not at the center.

If the center of gravity of a load is not located centrally between the attachment points, the motor can tip over or slip out of the lifting equipment and fall when it is being transported or lifted. This can result in death, serious injury or material damage.

- Comply with the handling instructions on the machine when transporting it.
- Be aware of the possibility of different loads on the sling ropes or lifting straps and the carrying capacity of the lifting equipment.
- Always take account of the center of gravity when transporting or lifting the motor. If the center of gravity is not located centrally between the attachment points, then position the hoisting hook above the center of gravity.

There are two lifting eyebolts for horizontal transport of the motor. Always transport and lift the motor by the lifting eyebolts.

- Only lift the motor at the lifting eyebolts on the bearing end shields. To hoist the motor, in particular if there are built-on assemblies, use suitable cable-guidance or spreading equipment.

NOTICE
Damage to the terminal box The terminal box can be damaged when lifting without using suitable spreading equipment,. Only lift the machine using suitable spreading equipment.

- Pay attention to the lifting capacity of the hoisting gear. The weight of the motor is specified on the rating plate.

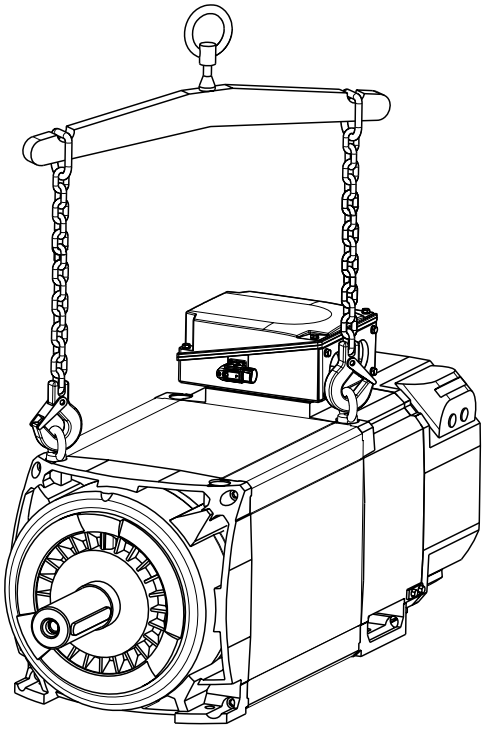


Figure 4-4 Lifting the machine (schematic representation)

Rotor shipping brace

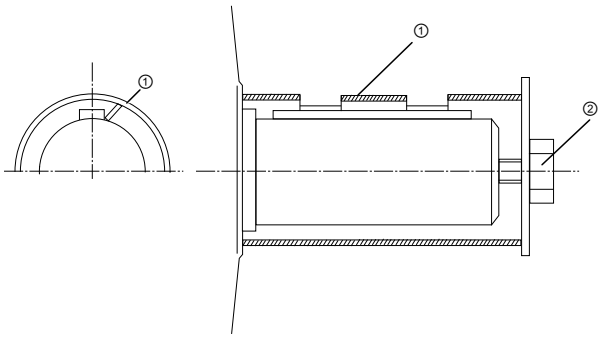
Machines ordered with the "Increased radial force" option are equipped with cylindrical-roller bearings and a rotor shipping brace.

NOTICE

Transport damage if the rotor shipping brace device is not used.

The motor can be damaged if it is jolted during transport. This can result in material damage.

- Always transport the motor with the rotor shipping brace supplied. The rotor shipping brace must be attached during transportation.
- Only remove it before pushing on the drive element.
- If you transport the machine after the output transmission element has been pulled on, then you must axially fix the rotor in another way.



① Sleeve
② Shaft screw

Figure 4-5 Rotor shipping brace

Table 4-3 Tightening torque and preloading force for axially fixing the rotor

Type	Thread in the shaft end	Tightening torque	Preload
1PH818.	M20	50 Nm	12 kN
1PH822.	M20	50 Nm	12 kN
1PH828.	M24	100 Nm	20 kN

⚠ WARNING

Lifting using the cooling water pipes

The cooling water pipe system has not been designed so that it can be used to lift the motor. The machine can fall when lifted. Death, serious injury, or material damage will result.

- Only use the eyebolts on the bearing shields to transport and lift the motor.

Lifting force-ventilated motors in type of construction IM V5 with side-mounted terminal boxes

Proceed as follows if you wish to lift a machine with type of construction IM V5 and with side-mounted terminal box:

1. Screw off the external fan.
2. Screw in the eyebolts supplied and use these to lift the machine.
3. Screw on the external fan again after the work has been completed.

4.13.3 Transporting a force-ventilated motor that has already been in operation

If you have already operated the motor and now want to transport it, proceed as follows:

1. Allow the motor to cool down.
2. Remove the connections provided by the customer.
3. Fit the rotor shipping brace.
4. Only use the eyebolts on the bearing shields to transport and lift the motor.

4.13.4 Transporting a water-cooled motor that has already been in operation

If you have already operated the motor and now want to transport it, proceed as follows:

1. Allow the motor to cool down.
2. Remove the connections provided by the customer.
3. Drain the cooling-water system and purge it carefully with air.
4. Fit the rotor shipping brace, if present.
5. Only use the eyebolts on the bearing shields - for example - to transport and lift the motor.

Note

Store the rotor locking device

Be sure to store the rotor locking device. It must be remounted for possible disassembly and transport.

4.13.5 Transporting the machine set

⚠ WARNING

Falling down of the machine

The lifting lugs on the machine are designed only for the weight of the machine. If a machine set is lifted and transported on a single machine, this can lead to mechanical failure of the lifting lug. The machine or machine set may fall. This can result in death, serious injury or material damage.

- Do not lift machine sets by attaching lifting tackle to the individual machines.
- Use only the equipment provided, e.g. the openings or lugs on the base plates, for transporting machine sets. Note the maximum capacity of the lifting lug.

Note

Place the machine in a secure and raised position

In order to obtain easy and safe access to the underside of the machine, place it in a secure and raised position.

⚠ DANGER

Standing under suspended loads

If the lifting gear or load handling attachments were to fail, the machine could fall. This can result in death, serious injury or material damage.

Never remain under or in the immediate vicinity of the machine when it is raised.

4.13.6 Storage

You can store the machine for up to two years in dry, dust-free and vibration-free rooms without reducing the specified storage time.

NOTICE

Seizure damage to bearings

If the motor is stored incorrectly, bearing damage can occur at standstill, e.g. brinelling, as a result of vibration or shock.

Read the following storage instructions.

Preparation

- Fit the rotor shipping brace.
- Apply a preserving agent, for example to external components such as shaft ends, if this has not already been applied in the factory.

Storing indoors

NOTICE
Damage caused as a result of outdoor storage
Storing the machine outdoors can result in it being damaged. • Ensure that the machine is only stored in areas that comply with the following conditions.

- Store the motor in an area that meets the following criteria:
  - The room must be dry, dust-free, frost-free and vibration-free. The relative humidity of the air should be less than 60%. The temperature should not drop below -15 °C in accordance with EN 60034-1.
  - The room must be well ventilated.
  - The room must provide protection against extreme weather conditions.
  - The air in the room must not contain any harmful gases.
- Protect the motor from shocks and humidity.
- Cover the motor properly.
- Avoid contact corrosion:
  - Every three months, remove the shipping brace. Rotate the shaft extension by hand.
  - Then reattach the rotor shipping brace.

Protection against humidity

- If a dry storage area is not available, then take the following precautions:
  - Wrap the machine in a material that absorbs moisture. Then pack the machine in an airtight film.
  - Include several bags of desiccant in the seal-tight packaging. Check the desiccant and replace as required.
  - Place a humidity meter in the airtight packaging that indicates the level of humidity inside it.
  - Inspect the motor regularly.

See also

Protect the cooling water system of water-cooled motors (Page 44)

4.13.7 Attaching the rotor shipping brace prior to storage

NOTICE
Bearing damage caused by vibration If storage conditions are inappropriate there is a risk of bearing seizure damage. This can result in material damage, such as damage to bearings caused by vibration. • On machines that have been supplied with a rotor shipping brace, secure the rotor as per the notes on transportation. • Protect the machine against strong radial vibrations, since the rotor shipping brace might not absorb these completely.

NOTICE
Bearing damage when being transported If the customer has already mounted parts, for example coupling, belt pulley, etc., the bearing can be damaged during transport. • In this case, make sure that the customer uses a rotor shipping brace.

Long-term storage

If you are storing a machine for more than six months, you must check its condition every six months.

- Check the machine for damage.
- Carry out any necessary maintenance work.
- Document all preservation measures taken so that they can be reversed before the machines are put back into service.
- Provide air-conditioning for the storage room.

Condensation

The following factors result in condensation in the machine:

- Significant fluctuations of the ambient temperature
- Direct sunshine
- Direct exposure to the weather
- High air humidity during storage
- Intermittent operation or load fluctuations in operation

Water drain holes (option L12)

Depending on the specific order, water drainage holes are provided in the bearing shields at the DE and NDE in the foot area and opposite the regreasing system. Make sure that the condensation can always drain away freely.

- Shaft heights 180 and 225: The plug that has been inserted into the water drainage holes allows the condensation to drain away. Do not remove the plug, otherwise the machine's degree of protection will be affected.
- Shaft height 280: There are no plugs in the water drain holes. The water must be able to drain away freely.

The water drain holes only function when the motor is mounted horizontally for types of construction IM B3, IM B35 and IM B5.

NOTICE
Damage due to condensation If the stator winding is damp, its insulation resistance is reduced. This can result in voltage flashovers, which can destroy the winding. Condensation can cause rusting inside the machine. • Make sure that the condensation can always drain away freely.

4.13.8 Protect the cooling water system of water-cooled motors

When the units are delivered, the high-grade steel cooling-water pipe system is not filled with cooling water.

- When you put the motor into storage after use, drain the cooling water ducts and purge with air to ensure that they are completely empty.
- For operation, add a maximum of 20 % to 30 % of an anti-freeze agent to the cooling water; use Antrifrogen N or Tyfocor, for example, as the anti-freeze.

NOTICE
Frost damage to the cooling circuit Damage may be caused to the cooling circuit if the cooling water freezes. If the ambient temperature falls below 0 °C during operation add anti-freeze to the cooling water.

4.13.9 Protection against corrosion

If the machine is stored in dry conditions, then apply the subsequently listed anti-corrosion measures:

- Storage up to six months:
  Apply a coat of corrosion protective compound to all accessible bare metal parts such as the exposed shaft extension, flange or machine feet.
- Storage for longer than six months:
  Apply a coat of long-term anti-corrosion agent to all accessible bare parts.
- Inspect the machine regularly and if necessary, apply an additional coating of corrosion protection.

Document all preservation measures taken so that they can be reversed before the machines are put back into service.

4.14 Converter operation

4.14.1 Connecting to a converter

Selecting and connecting the cable

- Use Motion Connect cables or symmetrically constructed, shielded cables to connect the motor to a converter. The cable shielding, made up of as many strands as possible, must have good electrical conductivity. Braided shields made of copper or aluminum are well suited.
- The shield is connected at both ends, at the motor and converter. Keep unshielded cable ends as short as possible.
- In order to ensure that high-frequency currents are efficiently discharged, provide a 360° contact through a large surface area at the converter and at the motor. Use for instance, EMC glands at the cable entries.

Measures to reduce bearing currents

To specifically reduce and prevent damage caused by bearing currents, consider the system as a whole, which comprises the motor, converter, and driven machine. The following precautions help to prevent bearing currents:

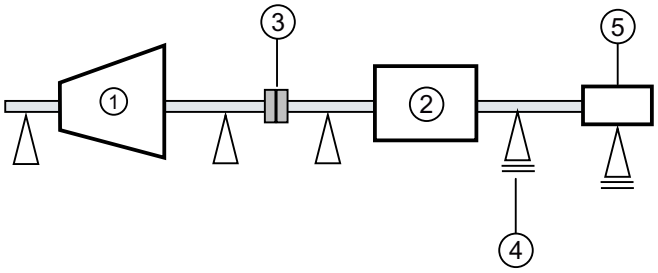
- Setting up a properly meshed grounding system in the system as a whole, with low impedance for high-frequency currents
- No potential difference between the motor, converter, and working machine.
  - Use symmetrical, shielded connecting cables.
  - Connect the cable shield at both ends over the greatest possible surface area (360° contact).
  - Use equipotential bonding conductors between the motor and the driven machine as well as between the motor and the converter
- Limit the voltage rate of rise by using an output filter to dampen harmonic components in the output voltage

4.14.2 Insulated bearings for converter operation

If the machine is operated with a low-voltage converter such as SINAMICS G150 / S150 / S120, then an insulated bearing and a speed encoder with insulated bearings (option) is mounted at the non-drive end.

For 1PH818, the insulated bearings are optional; for 1PH822 and 1PH828, insulated bearings are standard.

Comply with the plates on the machine relating to bearing insulation and possible bridges.



① Driven machine
② Motor
③ Coupling
④ Insulated bearings
⑤ Insulated tachometer fitting

Figure 4-6 Schematic representation of a single drive

NOTICE
Bearing damage The bearing insulation must not be bridged. Bearing currents can damage bearings. • Also when performing subsequent installation work, e.g. installing an automatic lubrication system or a non-insulated vibration sensor, ensure the bearing insulation is not bridged. • Contact your Service Center, if necessary.

See also

Service and Support (Page 161)

Mounting

5

When carrying out any work on the machine, observe the general safety instructions (Page 15) and the specifications contained in EN 50110-1 regarding safe operation of electrical equipment.

Note

Loss of conformity with European directives

In the delivery state, the machine corresponds to the requirements of the European directives. Unauthorized changes or modifications to the machine lead to the loss of conformity with European directives and the loss of warranty.

5.1 Preparing for installation

5.1.1 Requirements for installation

The following requirements must be satisfied prior to starting installation work:

- Staff have access to the operating and installation instructions.
- The machine is unpacked and ready for mounting at the installation location.

Note

Measure the insulation resistance of the winding before starting installation work

Wherever possible, measure the insulation resistance of the winding before starting installation work. If the insulation resistance lies below the specified value, take appropriate remedial measures. These remedial measures may necessitate the machine being removed again and transported.

NOTICE

High temperatures

The motor components get very hot during operation. High temperatures can damage mounting parts such as the cable insulation.

- Temperature-sensitive parts such as normal cables or electronic components must not rest against or be attached to mounted machine parts.
- Only use heat-resistant mounting parts. The connecting cables and cable entries must be suitable for the ambient temperature.

5.1.2 Insulation resistance and polarization index

Measuring the insulation resistance and polarization index (PI) provides information on the condition of the machine. It is therefore important to check the insulation resistance and the polarization index at the following times:

- Before starting up a machine for the first time
- After an extended period in storage or downtime
- Within the scope of maintenance work

The following information is provided regarding the state of the winding insulation:

- Is the winding head insulation conductively contaminated?
- Has the winding insulation absorbed moisture?

As such, you can determine whether the machine needs commissioning or any necessary measures such as cleaning and/or drying the winding:

- Can the machine be put into operation?
- Must the windings be cleaned or dried?

Detailed information on testing and the limit values can be found here:

"Testing the insulation resistance and polarization index" (Page 50)

5.1.3 Testing the insulation resistance and polarization index

⚠ WARNING

Hazardous voltage at the terminals

During and immediately after measuring the insulation resistance or the polarization index (PI) of the stator winding, hazardous voltages may be present at some of the terminals. Contact with these can result in death, serious injury or material damage.

- If any power cables are connected, check to make sure line supply voltage cannot be delivered.
- Discharge the winding after measurement until the risk is eliminated, e.g. using the following measures:
  - Connect the terminals with the ground potential until the recharge voltage drops to a non-hazardous level
  - Attach the connection cable.

Measure the insulation resistance

1. Before you begin measuring the insulation resistance, please read the operating manual for the insulation resistance meter you are going to use.
2. Make sure that no power cables are connected.

3. Measure the winding temperature and the insulation resistance of the winding in relation to the machine enclosure. The winding temperature should not exceed 40° C during the measurement. Convert the measured insulation resistances in accordance with the formula to the reference temperature of 40° C. This thereby ensures that the minimum values specified can be compared.
4. Read out the insulation resistance one minute after applying the measuring voltage.

Limit values for the stator winding insulation resistance

The following table specifies the measuring voltage and limit values for the insulation resistance. These values correspond to IEEE 43-2000 recommendations.

Table 5-1 Stator winding insulation resistance at 40° C

U_N [V]	U_{Meas} [V]	R_C [MΩ]
U ≤ 1000	500	≥ 5
1000 ≤ U ≤ 2500	500 (max. 1000)	100
2500 < U ≤ 5000	1000 (max. 2500)	
5000 < U ≤ 12000	2500 (max. 5000)	
U > 12000	5000 (max. 10000)	

U_{rated} = rated voltage, see the rating plate

U_{meas} = DC measuring voltage

R_C = minimum insulation resistance at reference temperature of 40° C

Conversion to the reference temperature

When measuring with winding temperatures other than 40° C, convert the measuring value to the reference temperature of 40° C according to the following equations from IEEE 43-2000.

(1) $R_C = K_T \cdot R_T$	R_C	Insulation resistance converted to 40° C reference temperature
	k_T	Temperature coefficient according to equation (2)
	R_T	Measured insulation resistance for measuring/winding temperature T in °C
(2) $K_T = (0.5)^{(40-T)/10}$	40	Reference temperature in °C
	10	Halving/doubling of the insulation resistance with 10 K
	T	Measuring/winding temperature in °C

In this case, doubling or halving the insulation resistance at a temperature change of 10 K is used as the basis.

- The insulation resistance halves every time the temperature rises by 10 K.
- The resistance doubles every time the temperature falls by 10 K.

For a winding temperature of approx. 25° C, the minimum insulation resistances are 20 MΩ (U ≤ 1000 V) or 300 MΩ (U > 1000 V). The values apply for the complete winding to ground. Twice the minimum values apply to the measurement of individual assemblies.

- Dry, new windings have an insulation resistance of between 100 and 2000 MΩ, or possibly even higher values. An insulation resistance value close to the minimum value could be due to moisture and/or dirt accumulation. The size of the winding, the rated voltage and other characteristics affect the insulation resistance and may need to be taken into account when determining measures.
- Over its operating lifetime, the motor winding insulation resistance can drop due to ambient and operational influences. Calculate the critical insulation resistance value depending on the rated voltage by multiplying the rated voltage (kV) by the specific critical resistance value. Convert the value for the current winding temperature at the time of measurement, see above table.

Measuring the polarization index

1. To determine the polarization index, measure the insulation resistances after one minute and ten minutes.
2. Express the measured values as a ratio:
   $PI = R_{insul\ 10\ min} / R_{insul\ 1\ min}$
   Many measuring devices display these values automatically following the measurement.

For insulation resistances > 5000 MΩ, the measurement of the PI is no longer meaningful and consequently not included in the assessment.

$R_{(10\ min)} / R_{(1\ min)}$	Assessment
≥ 2	Insulation in good condition
< 2	Dependent on the complete diagnosis of the insulation

NOTICE

Damage to insulation

If the critical insulation resistance is reached or undershot, this can damage the insulation and cause voltage flashovers.

- Contact the Service Center (Page 161).
- If the measured value is close to the critical value, you must subsequently check the insulation resistance at shorter intervals.

Limit values of the anti-condensation heating insulation resistance

The insulation resistance of the anti-condensation heating with respect to the machine housing should not be lower than 1 MΩ when measured at 500 V DC.

5.1.4 Prepare the mounting surfaces (IM B3)

- Ensure that the foundation faces are flat and clean.
- Check the dimensions of the mounting-foot holes.

5.1.5 Prepare the mounting surfaces (flange mounting)

- Clean the flange before installation, and make sure that the flange face is flat and free of contaminations.
- Check the geometry of the flange.

5.2 Lift the machine to where it will be mounted and position it

5.2.1 Preconditions for correct alignment and secure attachment

Detailed specialist knowledge of the following measures is required in order to correctly align and securely fit the equipment.

- Preparing the foundation
- Selecting and mounting the coupling
- Measuring the concentricity and axial eccentricity tolerances
- Positioning the machine

If you are not familiar with the prescribed measures and procedures, then you can make use of the services offered by the local Service Center (Page 161).

5.2.2 Checking the load handling attachments

Inspect the load handling attachments such as the load stands, lifting eyes and ring bolts and also the lifting gear, before lifting the machine:

- Inspect the load handling attachments on the machine for possible damage. Replace any load handling attachments that are found to be damaged.
- Check before use that the load handling attachments are correctly secured.
- When lifting the machine, use only approved and undamaged lifting gear of sufficient rated capacity. Check these before using them.

⚠ WARNING

The machine can be dropped

If the load handling attachments and lifting gear are damaged or not correctly secured, the machine may be dropped during lifting. This can result in death, serious injury or material damage. Inspect the load handling attachments and lifting gear before use.

5.2.3 Removing anti-corrosion protection

Machined, bare metallic surfaces of the motor, such as the shaft end, fitted key, foot and flange surfaces, are treated with an anti-corrosion agent.

1. Remove this layer of anti-corrosion agent from the mounting surfaces of the motor by wiping it away with an absorbent cloth or paper sheet.

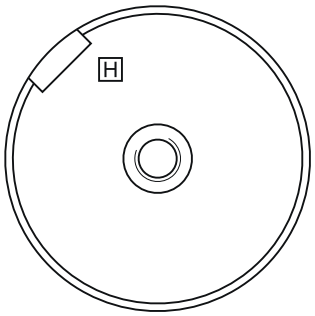
NOTICE
Damage to the machine surface Using metal objects such as scrapers, spatulas, or plates to remove the anti-corrosion protection could result in damage to the surfaces of the machine parts.

2. Then lightly oil the bare surfaces again.

5.2.4 Mounting the output elements

Balance quality

The rotor is dynamically balanced. For shaft extensions with featherkeys, the balancing type is specified using the following coding on the face of the drive end of the shaft:



H Balancing with half a feather key

F Balancing with a full feather key

N Balancing with a plain shaft - no keyway

Figure 5-1 Balancing type on the drive-end side

Pushing on the power output elements

- Prerequisites:
  - The coupling and/or the output element must be appropriately dimensioned for the operating case at hand.
  - Comply with the coupling manufacturer's instructions.
  - Make sure that the balancing type of the transmission element correctly matches the type of balance of the rotor.
  - Use only ready drilled and balanced transmission elements. Check the hole diameters and the balancing status before pulling them on. Thoroughly clean the shaft extension.
- Pulling on:
  - Warm up the transmission elements to expand them before pulling them on. Select the temperature difference for the heating process to suit the coupling diameter, fit and material. See the coupling manufacturer's instructions.
  - Power output elements may only be pushed on or pulled off with the correct equipment. The output element must be pulled on in one continuous operation via the front thread holes in the shaft or pulled on by hand.
  - Do not strike it with a hammer, as this would damage the bearings.

Shaft extensions with feather key

To maintain the balancing quality, you have the following options:

- If the output element is shorter than the feather key for balancing type "H": Machine off the section of feather key protruding from the shaft contour and output element in order to maintain the balance quality.
- If the output element is mounted up to the shaft shoulder for motors with full-key balancing "F", or if the output element is longer than the motor shaft extension: When balancing the coupling or the belt pulley, take into account that the feather key does not take up all of the hub groove.

⚠ WARNING

The feather key can fall out

The feather keys are only locked against falling out during shipping. If a machine with two shaft extensions does not have an output element on one shaft extension, the feather key can fall out during operation.

Death or serious injury can result.

- Do not operate the machine unless the transmission elements have been pulled on.
- On shaft extensions without output element, take suitable measures to ensure that the feather key cannot be flung out. For balancing type "H", shorten the feather key by about half.

Note

Type of balancing

In the case of shaft extensions with feather keys, the type of balancing is also included on the rating plate next to the CE mark.

5.2.5 Lifting and transporting the machine

To safely lift and transport the machine, the following requirements must be met:

- Personnel operating cranes and fork-lift trucks must be appropriately qualified.
- If the motor is packed, depending on the weight, size and on-site conditions, lift crates and transport frames using a fork-lift truck or a crane with slings. Use a crane or fork-lift truck suitable for the load.
- When lifting the machine, use only approved and undamaged sling guides and spreaders of sufficient rated capacity. Check the lifting equipment prior to its use. The weight of the machine is shown on the rating plate.
- When lifting the machine, refer to the information on the lifting plate.
  - Comply with the specified spreading angles.
  - Do not exceed the maximum lifting acceleration and lifting speed specified on the lifting plate. Lift the machine without jerking it.
    Acceleration a ≤ 0.4 g (≈ 4 m/s^2)
    Velocity v ≤ 20 m/min
- Use only the load carrying device on the stator frame for lifting.

⚠ WARNING

Transport for a different type of construction

If you do not transport or lift the machine in a position appropriate for its construction, the machine can tip, slip into the lifting equipment or fall down. This can result in death, serious injury or material damage.

- Use only the load carrying device on the stator frame for lifting.
- Use the load carrying device appropriate for the machine position.
- Use suitable rope guiding or spreading devices. The weight of the machine is shown on the rating plate.

⚠ WARNING

Transport if the center of gravity is not at the center.

If the center of gravity of a load is not located centrally between the attachment points, the motor can tip over or slip out of the lifting equipment and fall when it is being transported or lifted. This can result in death, serious injury or material damage.

- Comply with the handling instructions on the machine when transporting it.
- Be aware of the possibility of different loads on the sling ropes or lifting straps and the carrying capacity of the lifting equipment.
- Always take account of the center of gravity when transporting or lifting the motor. If the center of gravity is not located centrally between the attachment points, then position the hoisting hook above the center of gravity.

Note

Place the machine in a secure and raised position

In order to obtain easy and safe access to the underside of the machine, place it in a secure and raised position.

⚠ DANGER

Standing under suspended loads

If the lifting gear or load handling attachments were to fail, the machine could fall. This can result in death, serious injury or material damage.

Never remain under or in the immediate vicinity of the machine when it is raised.

NOTICE

Damage due to condensation

If the stator winding is damp, its insulation resistance is reduced. This can result in voltage flashovers, which can destroy the winding. Condensation can cause rusting inside the machine.

- Make sure that the condensation can always drain away freely.

5.2.6 Open the condensation water drain holes (water-cooled motor)

In the bearing shields at the DE and NDE, a water drain hole ① is situated in the foot area and another opposite the regreasing device.

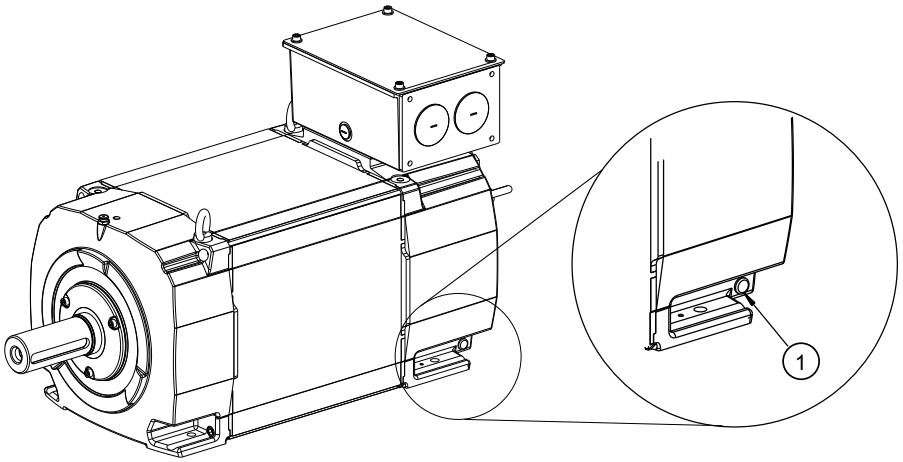


Figure 5-2 Water drain holes

- Make sure that the condensation can always drain away freely.
- The plug that has been inserted into the water drain holes allows the condensation to drain away. Do not remove the plug, otherwise the machine's degree of protection will be affected.
- If you have any questions, contact the Siemens Service Center (Page 161).

5.2.7 Open condensation drain holes (air-cooled motor, L12)

If the machine is ordered with option L12, then for types 1PH818. and 1PH822., a water drain hole with plugs is provided in the DE and NDE bearing shields. For type 1PH828., there are water drain holes without plugs at the DE and NDE.

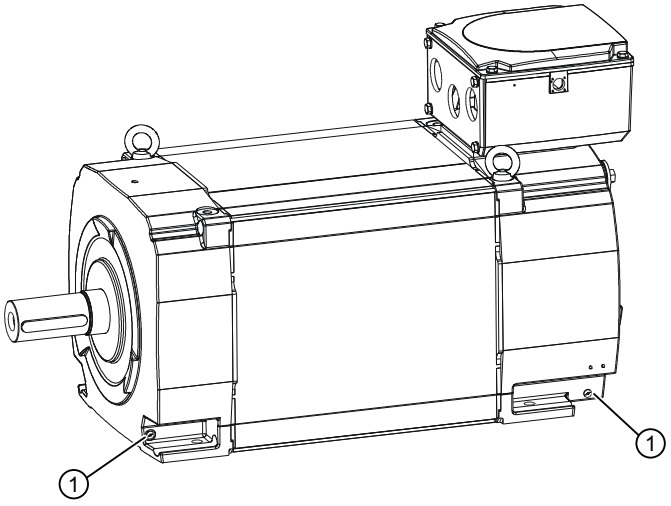


Figure 5-3 Water drain holes, for types 1PH818., 1PH822.

- Make sure that the condensation can always drain away freely.
- The plug that has been inserted into the water drainage holes allows the condensation to drain away. Do not remove the plug, otherwise the machine's degree of protection will be affected.
- If you have any questions, contact the Siemens Service Center (Page 161).

5.2.8 Putting the machine down

Requirements

The following preconditions must be satisfied before setting down the machine at the installation location:

- The mating faces must be clean.
- The anti-corrosion protection paint has been removed from the mating faces, such as the machine mounting feet, flange, ...
- There is no condensation present within the machine.

Setting down the machine

- Set down the machine slowly and carefully at the installation location to avoid any impact.

5.2.9 Roughly aligning the machine

Requirement

The transmission element such as a coupling half has already been pulled on.

Roughly aligning the machine

- For horizontal positioning, push the motor sideways across the foundation. When doing so, ensure that the axial position is maintained.

5.3 Installing the machine

⚠ WARNING

Inappropriate fastening material

If screws of an incorrect property class have been selected or if they have been fastened to an incorrect tightening torque, they may break or become loose. This will cause the machine to move, which could damage the bearings. The rotor could smash into the machine enclosure and machine parts could be flung out of place. This can result in death, serious injury or material damage.

- Comply with the required property classes for screwed connections.
- Tighten the screwed connections to the specified tightening torques.

⚠ WARNING

Incorrect alignment

If the machine has not been properly aligned, this will mean the fastening parts are subjected to stress/distortion. Screws may become loose or break, the machine will move, machine parts could be flung out of place. This can result in death, serious injury or material damage.

- Carefully align the machine to the driven machine.

NOTICE

Improper handling

Mounting parts such as temperature sensors or speed sensors are attached to the machine and could be ripped off or destroyed as a result of improper handling. This could lead to machine malfunctions, extending even to total loss of the machine.

- Where necessary, use suitable steps when performing installation work on the machine.
- Do not stand on cables or attachments during installation. Do not use attachments as steps.

5.3.1 Selecting fixing screws

- Unless specified otherwise, use mounting bolts with at least strength class 8.8 to ISO 898-1. In this way you guarantee that the machine is securely mounted and the forces can be transferred through the torque.
- Take into account the maximum forces occurring in the case of a fault such as short circuit or system transfers in phase opposition.
  - When selecting the bolts
  - When designing the foundation

See also

Tightening torques for screw and bolt connections (Page 163)

5.3.2 Preconditions for smooth, vibration-free operation

Preconditions for smooth, vibration-free operation:

- Stable foundation design
- Precise alignment of the machine
- Correct balancing of parts to be fitted to the shaft end.
- Maintaining the vibration velocity according to ISO 10816-3

5.3.3 Vibration severity

Due to the influencing variables listed below, the vibration response of the system at the site of operation can lead to increased vibration severity at the motor:

- Transmission elements
- Assembly conditions
- Alignment and installation
- Effects of external vibrations

Under certain circumstances, the rotor may have to be balanced completely with the output element.

Please take care to ensure that the vibration severity specified in accordance with ISO 10816 is not exceeded at the defined measuring points on the motor. By doing this, you can ensure problem-free operation and a long service life.

Maximum permitted vibration severity

The values for the maximum permitted radial and axial vibration severity must both be maintained.

Table 5-2 Maximum permitted radial vibration severity

Vibration frequency	Vibration values[1)]
< 6.3 Hz	Vibration displacement s ≤ 0.25 mm
6.3 to 63 Hz	Vibration velocity v_{rms} ≤ 7.1 mm/s
> 63 Hz	Vibration acceleration a ≤ 4.0 m/s^2

Table 5-3 Maximum permitted axial vibration severity

Vibration velocity	Vibration acceleration
v_{rms} = 7.1 mm/s	a_{peak} = 3.55 m/s^2

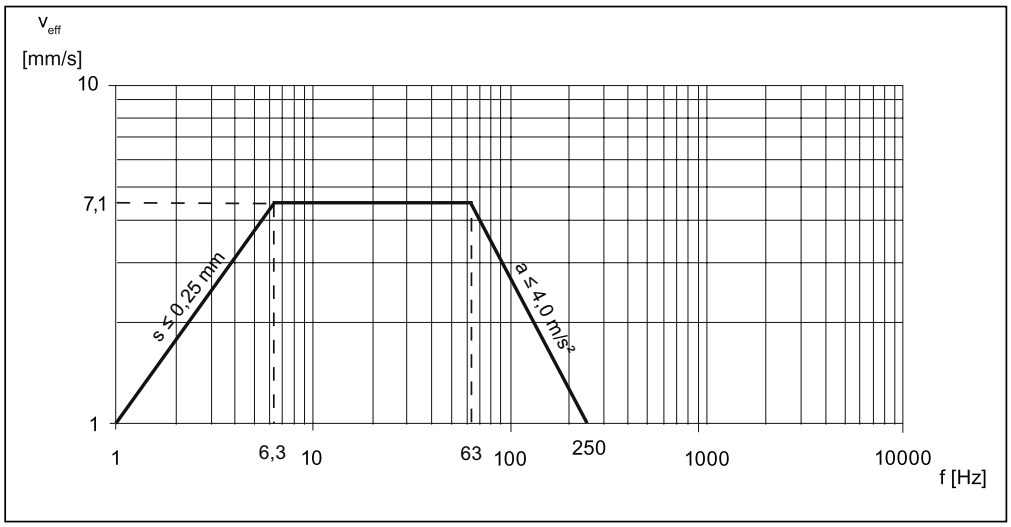


Figure 5-4 Max. permissible vibration velocity, taking into account the vibration displacement and vibration acceleration

To measure the vibration velocity, the measuring equipment must fulfill the requirements of ISO 2954.

The vibration acceleration must be measured as a peak value in the time domain in a frequency band of 10 to 2000 Hz.

If excitation in excess of 2000 Hz (e.g. gear tooth meshing frequencies) is to be expected, then you must adapt the measuring range accordingly. This does not alter the maximum permissible values.

5.3.4 Aligning to the driven machine

Vertical and horizontal alignment

The following measures are required in order to compensate any radial offset at the coupling and to horizontally adjust the motor with respect to the driven machine:

- The contact surfaces of the motor feet must lie on one plane. Place shims under the motor feet to position it vertically and to prevent any stress/distortion. The number of shims should be kept as low as possible, so use as few thicker shims as possible, instead of several thinner shims.
- Shift the motor to the side on the foundation for horizontal positioning. Pay attention to maintaining the axial position.
- When positioning the motor, ensure that a uniform axial gap is maintained around the coupling.

Alignment accuracy

Note

Alignment accuracy

Remember to take account of data concerning the alignment accuracy of the driven load and the coupling.

1. Align the motors with coupling output in such a manner that the center lines of the shafts are parallel with no offset. This ensures that no additional forces affect their bearings during operation.
2. Perform the fine adjustments with plates under the entire motor foot.

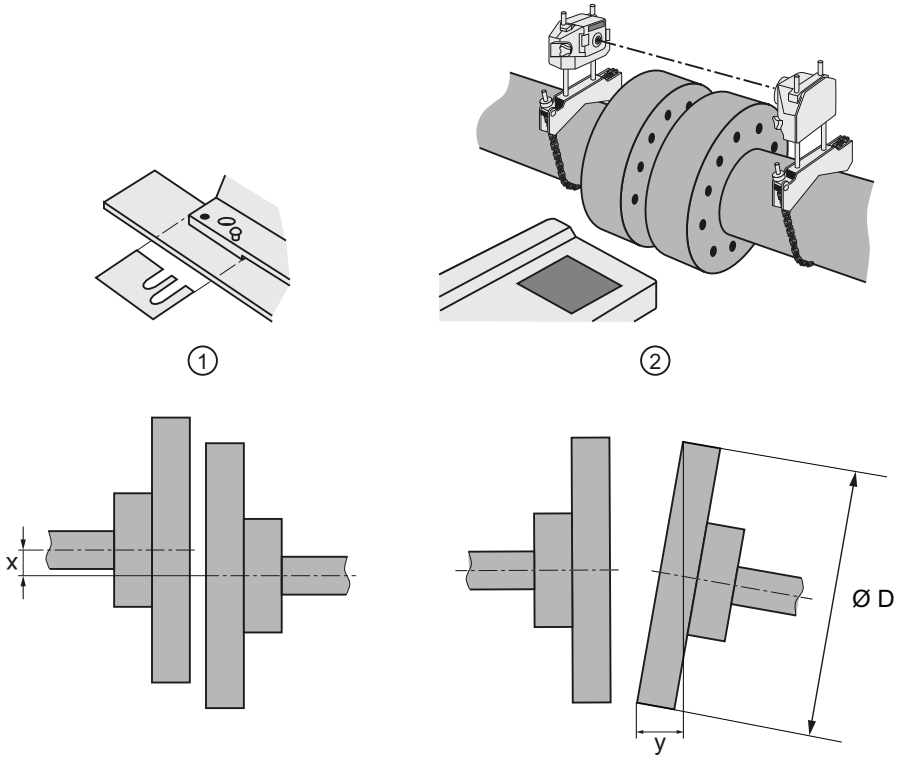


Figure 5-5 Aligning the motor

Table 5-4 Permissible deviations when aligning the motor

Permissible deviations	Radial shaft offset [x]	Axial shaft offset [y]
Flexible coupling	0.05 mm	0.05 mm

5.3.5 Mounting the motor

Fixing by means of motor feet

- Select foot screws as per ISO 898-1 in compliance with the loading conditions and machine type:
- Use foot screws with a minimum property class of 8.8.
- Pin the mounting feet to the customer foundation for motors with types of construction B6, B7, B8, V5 and V6.

Type	Foot screw size
1PH818.	M12
1PH822.	M16
1PH828.	M20

Flange mounting

The flange is only used to transfer the torque. Due to the empty weight or as a result of vibrations that arise if the flange is too soft, the motor can be damaged if it is only fastened via the flange.

1. Fasten the flange-mounted motors via a stable motor suspension and support them via the end shield feet (foot flange type of construction).
2. During commissioning, ensure that the permitted vibration values are maintained in accordance with ISO 10816-3.
   If the motor is to be only flange mounted, then the maximum speed n_{max} is reduced for rigid foundations according to the following table:

Type	Maximum speed n_{max}
1PH818.	3000 $^{1}/_{min}$
1PH822.	2500 $^{1}/_{min}$
1PH828.	2000 $^{1}/_{min}$

Maximum speed for a rigid foundation and flange mounting

5.4 Connecting the cooling water supply

The inlet and outlet sockets for the cooling water supply are situated on the non-drive end in the bearing shield area. On the bearing shield, there are two hexagonal couplers with a female thread, which are each screwed onto a washer: At shaft heights of 180 and 225, hexagonal couplers with $^{3}/_{8}$" female threads are used, at a shaft height of 280 $^{1}/_{2}$" female threads are used.

1. Only use valves, fittings and cooling water pipes made of rust-proof, stainless steel in the cooling system.
2. Make sure that the cooling water meets the required cooling water specification, see section headed "Cooling Water Quality" (Page 29).

3. Make sure that the appropriate volume of cooling water is available, see Rating Plate (Page 21).
4. Hold the hexagon head with an open-ended wrench while you screw in the water pipes.
5. Screw the cooling water pipes into the female thread. You can connect the inlet and outlet as required.

NOTICE
Securing the hexagonal couplers The hexagonal couplers are connected directly to the water pipes inside the machine. Applying excessive torque when screwing in can damage the pipe system. Hold the couplers steady with an open-ended wrench when you screw in the water pipes.

6. Ensure that the maximum permissible operating pressure does not exceed 6 bar. The pressure drop is determined by the machine type and the shaft height:

Table 5-5 Rate of flow and pressure drop

Type	Flow rate	Pressure drop
1PH8 184	15 l/min	0.6 bar
1PH8 186	15 l/min	0.7 bar
1PH8 224	20 l/min	0.6 bar
1PH8 226	20 l/min	0.6 bar
1PH8 228	20 l/min	0.6 bar
1PH8 284	35 l/min	0.6 bar
1PH8 286	35 l/min	0.6 bar
1PH8 288	35 l/min	0.6 bar

5.5 Refitting the external fan

Subsequently changing the air flow direction from NDE to DE or vice versa must only be carried out by qualified personnel or a Siemens Service Center (Page 161).

Electrical connection 6

When carrying out any work on the machine, observe the general safety instructions (Page 15) and the specifications contained in EN 50110-1 regarding safe operation of electrical equipment.

Note

Service Center

If you require support when electrically connecting up the machine, please contact the Service Center (Page 161).

Material damage as a result of connection parts coming loose

If you use fixing elements made from the wrong material or apply the wrong tightening torque, this could impair current transfer or cause connecting parts to become loose. This could result in material damage to the machine or even in total failure, which could in turn lead indirectly to material damage to the system.

- Tighten the screwed connections to the specified tightening torques.
- Observe any specifications regarding the materials from which fixing elements must be made.
- When performing servicing, check the fastenings.

See also

Tightening torques for screw and bolt connections (Page 163)

NOTICE

Electrostatically sensitive devices

The DRIVE-CLiQ interface contains components that are susceptible to electrostatic charging. Touching connections with electrostatically charged hands or tools can cause malfunctions.

Maintain the ESD protective measures (Page 18) as well as the five safety rules (Page 15).

6.1 Preparation

6.1.1 Selecting cables

Take the following criteria into account when selecting the connecting cables:

- Rated current
- Rated voltage
- If required, service factor
- System-dependent conditions, such as ambient temperature, routing type, cable cross-section as defined by required length of cable, etc.
- Configuration notes
- Requirements according to IEC/EN 60204-1

6.1.2 Connect up the ground conductor

The grounding conductor of the motor must be in full conformance with the installation regulations, e.g. in accordance with IEC/EN 60204-1.

- Connect the ground conductor to the end shield of the motor. There is a fixing lug ① for the ground conductor at the designated connection point.
  - The fixing lug ① is suitable for grounding high-frequency currents using HF ribbon cable with appropriately formed conductor ends.
- When making connections, ensure the following:
  - the connecting surface is bare and protected against corrosion using a suitable substance, e.g. acid-free Vaseline
  - the flat and spring washers are located under the bolt head.

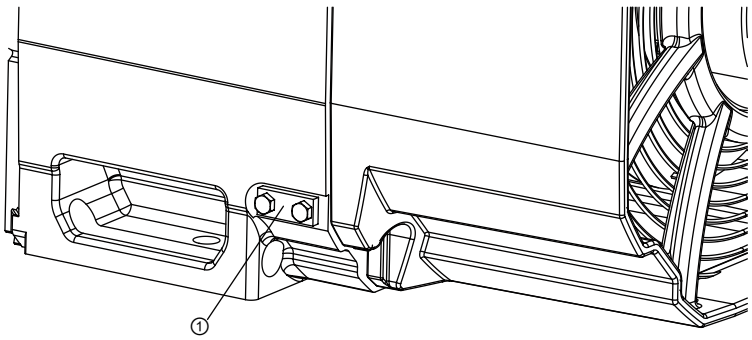


Figure 6-1 Terminal lug ① for the grounding conductor for a force-ventilated motor

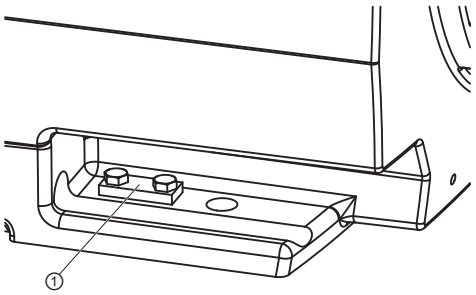


Figure 6-2 Terminal lug ① for the grounding conductor for a water-cooled motor

6.2 Connecting

Depending on the version, different terminal boxes may be installed on the machine. Dependent on the terminal box, different cable entries and options for the cable connection are possible. You can identify the terminal box installed on the machine via the illustrations in the following chapters.

6.2.1 Circuit diagram

Data on the connection and connecting the motor winding can be found in the circuit diagram in the cover of the terminal box.

6.2.2 Terminal designation

According to IEC / EN 60034-8, the following basic definitions apply to the terminal designations for 3-phase machines:

Table 6-1 Terminal designations using the 1U1-1 as an example

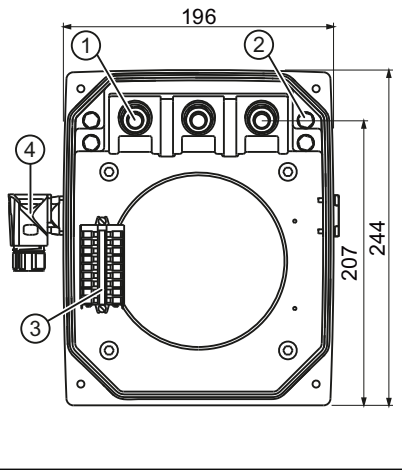
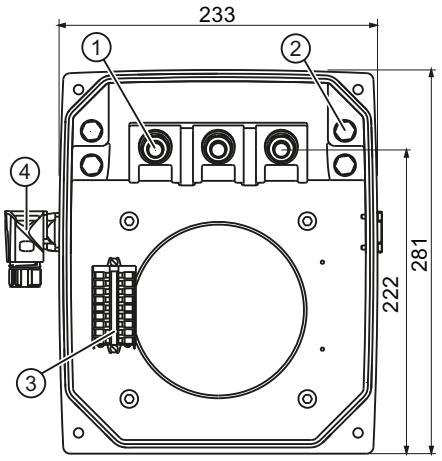
1	U	1	-	1	Designation
x					Index for pole assignment for pole-changing machines where applicable. A lower index signifies a lower speed. Special case for split winding.
	x				Phase designation U, V, W
		x			Index for winding start (1) or end (2) or if there is more than one connection per winding
				x	Additional indices for cases in which it is obligatory to connect parallel power feed cables to several terminals with otherwise identical designations

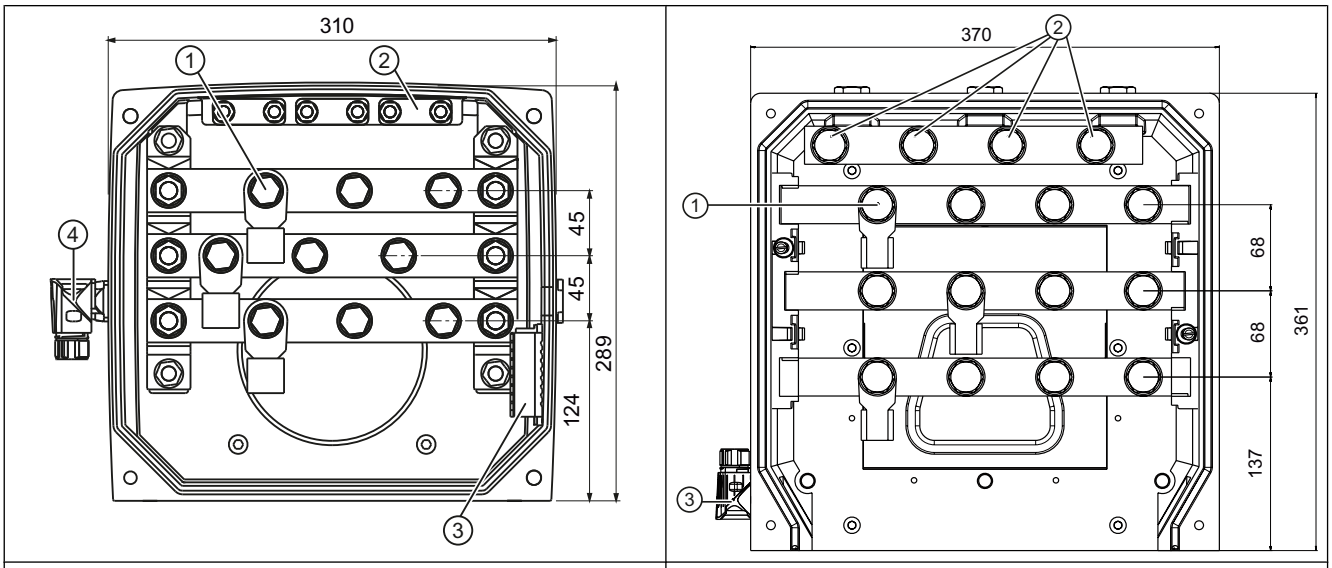
6.2.3 Laying cables

- Lay the cables in accordance with IEC/EN 60364-5-52.
- Use EMC cable glands for fixed cables. Screw the EMC cable glands into the threaded holes in the entry plate, which can be unscrewed.
- Use shielded cables whose shields are conductively connected to a large area of the terminal box of the motor via EMC cable glands.
- In the case of aluminum connecting bars, insert a steel washer between the cable lug and the connecting bar. This prevents contact corrosion.
- Arrange the exposed connecting cables in the terminal box so that the PE conductor has excess length and the insulation of the cable strands cannot be damaged.
- Close off unused bushings with a metal threaded plug. This is the way to achieve a high frequency-proof shielding.

6.2.4 Electrical connection data

Cable entry and technical connection data depend on the mounted terminal box. You can find more information on the terminal box that is mounted in the ordering documentation or in the catalog.

	
1XB7 322	1XB7 422



1XB7 700	1XB7 712 (*)
① main terminal	③ signal connection terminal
② ground terminal	④ signal connection

Table 6-2 Data for electrical connection

Terminal box type	1XB7 322	1XB7 422	1XB7 700	1XB7 712 (*)
Cable entry	2 x M50 x 1.5	2 x M63 x 1.5	3 x M75 x 1.5	4 x M75 x 1.5
Max. poss. cable outer diameter	38 mm	53 mm	68 mm	68 mm
Number of main terminals	3 x M12	3 x M12	3 x 3 x M12	3 x 4 x M16
Max. cross-section per terminal	2 x 50 mm^2	2 x 70 mm^2	3 x 150 mm^2	4 x 185 mm^2
Max. current per terminal ①	210 A	270 A	700 A	1150 A
Number of ground terminals	4 x M6	4 x M8	Terminal strip	4 x M16

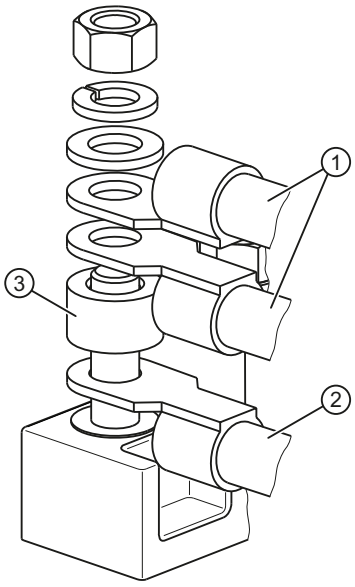
① Current carrying capacity based on IEC / EN 60204-1 or IEC / EN 60364-5-32

6.2.5 Connection with cable lugs

1. To connect the cables to the main terminals, select cable lugs that match the necessary cable cross-section and appropriate screw size.
   The connectable cable cross section is determined by the cable lug size for example.
   - Cable lug in accordance with DIN 46234 from 35 mm^2 to 185 mm^2,
   - Cable lug in accordance with DIN 46235 from 35 mm^2 to 185 mm^2.
     Observe the possible outer diameter of the connecting cable in the chapter entitled "Electrical connection data".
     Connect only one conductor per cable lug.
2. Remove the insulation from the conductor ends so that the remaining insulation is almost long enough to reach the cable lug.

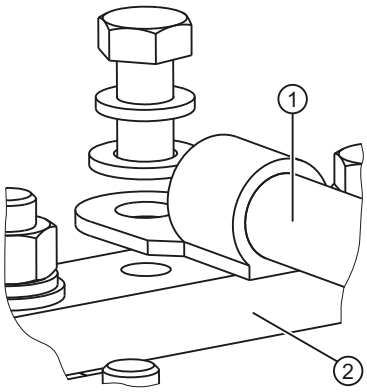
3. Fasten the cable lug to the end of the conductor correctly, e.g. by crimping.
4. If necessary, insulate the cable lugs in order to maintain the minimum clearances of 10 mm and the 20 mm creepage distance, which are normally available.
   The tightening torque for contact nuts and fixing screws depends on the size of the screw, see Case A in the table in Chapter Tightening torques for screw and bolt connections (Page 163).

Connection using a cable lug at terminal boxes 1XB7 322 / 1XB7 422



① Customer connecting cable
② Internal motor connecting cable
③ Copper spacer ring

Connection using a cable lug at terminal boxes 1XB7 700 / 1XB7 712



① Customer connecting cable
② Connection bar

See also

Electrical connection data (Page 70)

6.2.6 Connecting aluminum conductors

If you are using aluminum conductors, comply in addition with the following:

- Use only cable lugs that are suitable for connecting aluminum conductors.
- Immediately before inserting the aluminum conductor, remove the oxide layer from the contact areas on the conductor and/or the mating piece, by brushing or filing.
- Then grease the contact areas immediately using neutral vaseline in order to avoid re-oxidation.

NOTICE
Aluminum flow due to contact pressure Aluminum flows following installation due to the contact pressure. The connection with the clamping nuts can loosen as a result. The contact resistance would increase and the current-carrying impeded; as a consequence the terminal box and the surrounding components could burn. This could result in material damage to the machine or even in total failure, which could in turn lead to indirect material damage to the system. Retighten the clamping nuts after approximately 24 hours and then again after approximately four weeks. Make sure that the terminals are de-energized before you tighten the nuts.

6.2.7 Stepless mating face for the seal in the terminal box cover

The sealing face of the terminal box cover is formed by the terminal box enclosure and the cable entry element. Therefore make sure these parts are correctly aligned, so as to ensure the seal and hence the degree of protection.

Align the cable entry support and the cable entry plate to the terminal box enclosure so that the sealing surface between the terminal box and the terminal box cover form a flat face. There must be no steps in the sealing area.

6.2.8 Performing connection operations

1. Before closing the terminal box, please check that:
   - The electrical connections in the terminal box are tight and are in full compliance with the specifications above.
   - The required clearances in air of 10 mm are maintained.
   - Wire ends do not protrude.
   - The inside of the terminal box is clean and free of any cable debris.
   - All seals and sealing surfaces are undamaged.
   - The connecting cables are arranged so that they do not come into contact with the machine, and the cable insulation cannot be damaged.
   - unused entry points are sealed. The sealing elements are firmly screwed in, i.e. they can only be removed with a tool.
   - The cable/conductor glands are fitted compliant with the specifications regarding degree of protection, cable routing type, permissible cable diameter etc.
2. Then close the terminal box with the terminal box cover fixing screws.

See also

Tightening torques for screw and bolt connections (Page 163)

6.2.9 Internal equipotential bonding

The internal equipotential bonding between the grounding terminal in the box enclosure and the motor frame is established through the terminal box retaining bolts. The contact locations underneath the bolt heads are bare metal and protected against corrosion.

The standard cover fixing screws are sufficient for equipotential bonding between the terminal box cover and terminal box housing.

Note

Connecting points are available at the frame or bearing end shield to connect an external protective conductor or potential bonding connector.

See also

Connect up the ground conductor (Page 68)

6.3 Auxiliary circuits

6.3.1 Selecting cables

Take the following criteria into account when selecting the connecting cables for the auxiliary circuits:

- Rated current
- Rated voltage
- System-dependent conditions, such as ambient temperature, routing type, cable cross-section as defined by required length of cable, etc.
- Requirements according to IEC/EN 60204-1

6.3.2 Connecting an external fan

Preconditions

- Only use cables that comply with the relevant installation regulations regarding voltage, current, insulation material, and load-carrying capacity.
- Before connecting the device, make sure that the line voltage matches the device voltage.
- Check whether the data on the fan rating plate matches the connection data.
- Cable glands are not included in the scope of supply. Close unused cable entries, otherwise, the degree of protection is not maintained.
- The line voltage corresponds to the quality attributes laid down in DIN EN 50160 and the defined standard voltages laid down in DIN IEC 60038.

Procedure

1. Open the terminal box of the external fan and route the cables into it. The cables are not included in the scope of supply.
2. Connect the protective conductor (PE).
3. Connect the other cables to the relevant terminals, refer to the connection diagram in the terminal box.
   Connection cables must not be subject to excessive tensile stress.

Note

For fans equipped with EC motor, the fan motor starts with a delay after the line voltage is connected.

Protection against humidity

Protect the external fan against moisture. Water must not be allowed to run along the cables and into the terminal box of the external fan.

- Use suitable cables at the connection cable gland on the terminal box.
- Attach the terminal box cover of the external fan orrectly and completely.

⚠ WARNING

Voltages at the internal motor connections

The motor may continue running, e.g. due to airflow, or may run on after being shut down. This means that dangerous voltages of over 50 V can occur at the internal motor connections. This can result in death, serious injury or material damage.

- For safety reasons, it is not permissible to make any unauthorized modifications or changes to the fan.
- Wait until the external fan has come to a standstill before approaching it.
- Provide a protective circuit that prevents the main motor from being switched on when the external fan is not in operation.
  - After a power failure or when the power has been disconnected, the external fan starts up automatically again when the voltage is restored.
  - The external fan can automatically switch on and switch off as a result of its inherent function.

See also

Interlock circuit for the external fan (Page 33)

NOTICE

Overheating when the factory-installed jumper is removed

If the company operating the plant or system removes the jumper in the EC fan terminal box (which was inserted in the factory), then that company becomes responsible for the functional safety of the drive. The motor can overheat. This can result in material damage.

- Carefully follow the safety instructions.

Supply values

Type	Option	Fan	Supply voltage	Current drawn
1PH818.	Standard	Single-phase EC	1~ AC 200 … 277 V (±10 %) 50/60 Hz ±10 %	1.1 A ... 1.3 A *
1PH818.	L76	Three-phase EC	3~ AC 380 … 480 V (-5 %/+10 %) 50/60 Hz ±10 %	0.44 A ... 0.5 A *
1PH822.	Standard	Single-phase EC	1~ AC 200 … 277 V (±10 %) 50/60 Hz ±10 %	2.0 A ... 2.3 A *

1PH822.	L76	Three-phase EC	3~ AC 380 … 480 V (-5 %/+10 %) 50/60 Hz ±10 %	0.75 A ... 0.9 A *
1PH828.	Standard	Three phase	3~ 400 V / 50 Hz 3~ 460 V / 60 Hz 3~ 460 V / 60 Hz	2.4 A 2.35 A 2.10 A

Connection values for external fans

* For EC fans for 1PH818. and 1PH822., as a result of the electronic input circuitry, the current drawn can briefly reach four times the specified current.

See also

Operating instructions for the three-phase EC external fan, suction, SK180 (Page 249)

6.3.2.1 Connecting an EC external fan

The external fan is connected in the external fan terminal box. If necessary, you can rotate the external fan through 90°.

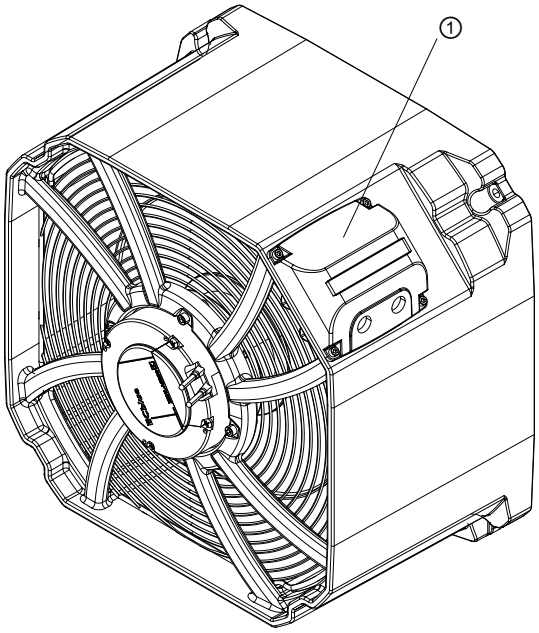


Figure 6-3 External fan terminal box ① (schematic representation)

NOTICE
Short circuit due to standing water
Water that accumulates at the cable glands can result in a short circuit. • It is not permissible that the cable outlet points upward. • Rotate the terminal box cover of the external fan through 180°.

See also

Interlock circuit for the external fan (Page 33)

6.3.2.2 Connecting an external fan with three-phase motor (option L75)

The external fan is connected in the external fan terminal box.

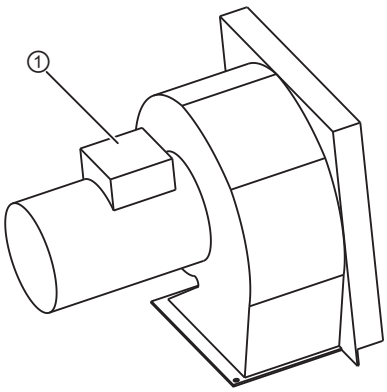


Figure 6-4 External fan terminal box ① (schematic representation)

NOTICE
An external fan is only suitable for one direction of rotation The external fan is only designed for one direction of rotation corresponding to the direction of rotation arrow. Operation with the wrong direction of rotation can cause overheating or destruction of the motor. • Ensure that the external fan is operated in the proper direction of rotation. The direction-of-rotation arrow and the direction of movement of the fan impeller are indicated on the rear side of the blower. • If necessary, change the direction of rotation by interchanging two phase conductors in the external fan terminal box.

See also

Interlock circuit for the external fan (Page 33)

6.3.2.3 Supply values for external fans with three-phase motor (option L75)

Supply values

The external fan with three-phase motor has a terminal box that is mounted on the external fan motor.

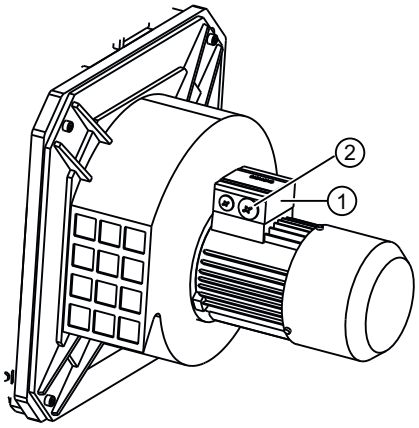
	Air-flow direction	3 AC 400 V / 50 Hz (±10 %)	3 AC 400 V / 60 Hz (1) (±10 %)	3 AC 480 V / 60 Hz (1) (+5 %, -10 %)	Sound pressure level LpA (1 m) Motor + external fan unit 50 Hz operation Tolerance +3 dB Rated pulse frequency 2 kHz	Air flow rate at 50 Hz, approx.
		[A]	[A]	[A]	[dB]	[m³/s]
1PH8 forced ventilation degree of protection IP55, option L75						
1PH818.-...0.-...1-Z 1PH818.-...1.-...1-Z	DE → NDE NDE → DE	2.25	2.25	1.98	76 (2)	0.17
1PH822.-...0.-...1-Z 1PH822.-...1.-...1-Z	DE → NDE NDE → DE	2.25	2.25	1.98	76 (2)	0.31
1PH8 open-circuit ventilated, degree of protection IP23, option L75						
1PH818.-...3.-...1-Z 1PH818.-...4.-...1-Z	DE → NDE NDE → DE	2.25	2.25	1.98	76 (3)	0.21
1PH822.-...3.-...1-Z 1PH822.-...4.-...1-Z	DE → NDE NDE → DE	2.25	2.25	1.98	76 (3)	0.33

(1) 60 Hz operation only permissible with throttle plate

(2) Speed ranges: 1PH818. up to 5000 rpm, 1PH822. up to 3500 rpm

(3) Speed ranges: 1PH818. up to 3000 rpm, 1PH822. up to 2000 rpm

1. Connect the power supply in the terminal box. The terminal diagram is in the terminal box cover.



① Terminal box of the external fan

② Cable entry

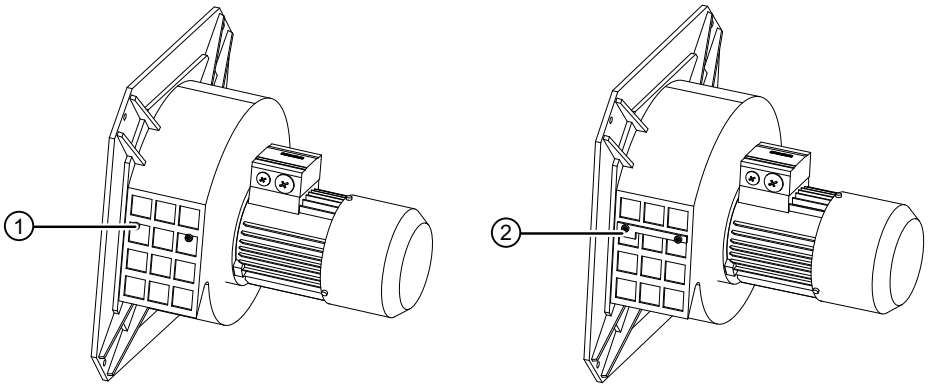
NOTICE
Incorrect direction of rotation The external fan is only suitable for one direction of rotation. Operation with the wrong direction of rotation can destroy the motor. • If necessary, change the direction of rotation by interchanging two phase conductors in the terminal box. The direction of rotation arrow and the direction of rotation of the fan impeller can be seen at the rear of the fan.

6.3.2.4 Attached air discharge throttle plate (option L75)

When operated from a 60 Hz line supply, you require the air discharge throttle plate provided in the terminal box.

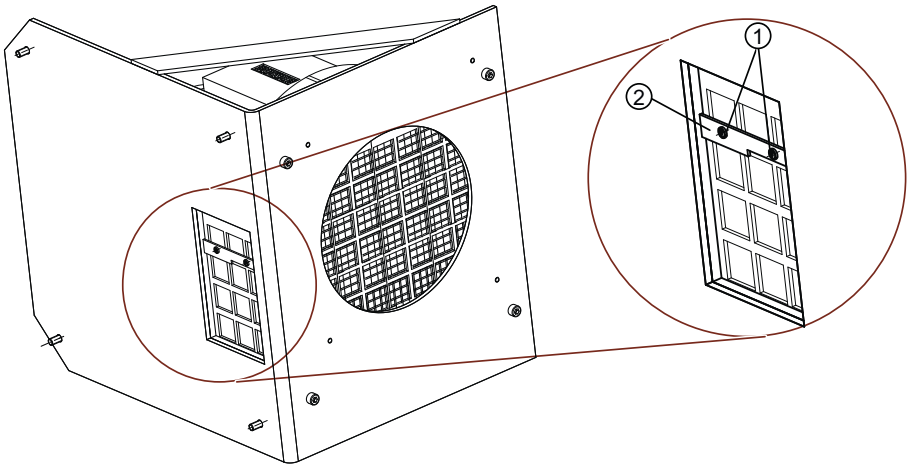
NOTICE
Operation without air discharge throttle plate The external fan motor can be damaged if it is operated on a 60 Hz line supply without air discharge throttle plate.

- Screw the air discharge throttle plate ② to the air discharge mesh.



① Fixing screws for air discharge throttle metal plate
② Air discharge throttle metal plate

Figure 6-5 Throttle plate for suction-type ventilation (DE to NDE)



① Fixing screws for air discharge throttle metal plate
② Air discharge throttle metal plate

Figure 6-6 Throttle plate for forced-draft ventilation (NDE to DE)

6.3.3 Connecting the speed encoder

The speed encoder is connected at the terminal box using a plug connection ①. This is located on the terminal box enclosure.

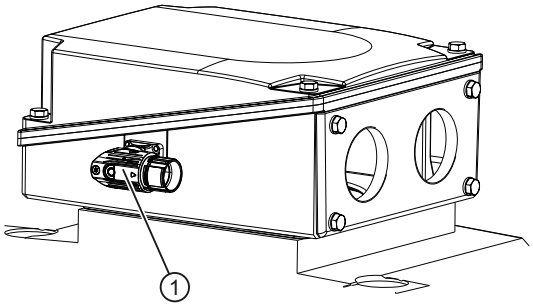


Figure 6-7 Detailed view: Plug-in connection

Note

The plug-in connection may differ from the standard layout in the case of special orders. For versions without speed encoder, connection thread M16x1.5 is located here.

Connecting a speed encoder via DRIVE-CLiQ

The signal connection between the motor and the converter is established via the DRIVE-CLiQ cable MOTION-CONNECT.

- Always use prefabricated cables from Siemens. These cables reduce the mounting/ installation time and costs and increase operational reliability.
- Push the connector of the DRIVE-CLiQ cable into the socket until the catch spring latches into place. Pay attention to the coding of the connector.

Cable outlet directions

The sensor module is mounted on the motor terminal box. The sensor module can be rotated through approximately 235°. You can change the cable outlet directions by rotating the sensor module, as shown in the diagram below.

NOTICE
Damage to the sensor module
You can damage the sensor module if you turn it with a pipe wrench, a hammer, or similar tools.
Turn the sensor module by hand. The typical torque is approx. 4 ... 8 Nm.

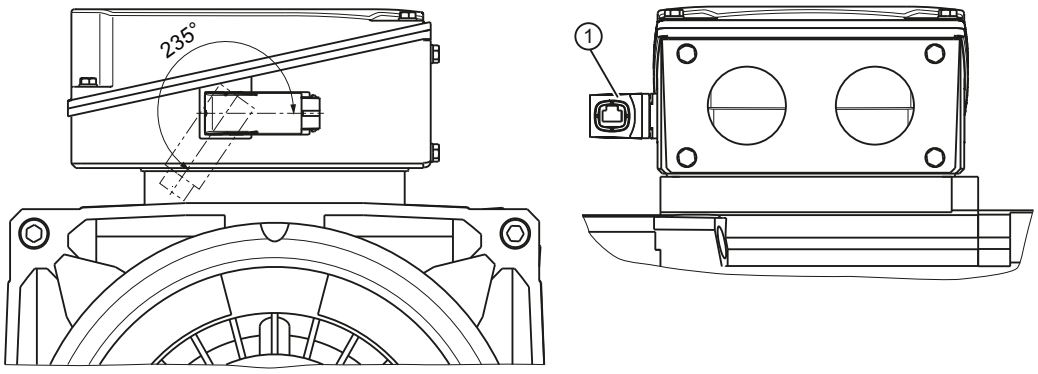


Figure 6-8 Sensor Module ① mounted on the terminal box

NOTICE
Modifying the cable outlet direction Changing the cable outlet direction by any improper means will damage the connecting cables. The permissible rotation range must not be exceeded. A maximum of ten changes to the rotation angle of the Sensor Module are permissible within the rotation range.

6.3.4 Connect the holding brake

Information for electrically connecting the holding brake can be found in the operating instructions supplied by the manufacturer in the (Page 169) appendix.

6.3.5 Connecting the temperature sensor

- The temperature sensor is connected to the signal connector together with the speed encoder signal.
- For the version without speed encoder, the temperature sensor is connected at the terminal strip.
- The motor has a reserve temperature sensor, which is also connected at the auxiliary terminal strip. Reconnect the temperature sensor as needed, e.g. if the previous temperature sensor fails.

⚠ WARNING

Risk of electric shock

The insulation of the temperature sensors for the winding monitoring with respect to the winding is implemented according to the requirements for basic insulation. The temperature sensor connections are located in terminal boxes, safe to touch - and have no protective separation. This is the reason that in the case of a fault, a hazardous voltage can be present at the measuring sensor cable. When touched, this can result in death, severe bodily injury and material damage.

- When connecting the temperature sensor to external temperature monitoring devices, when required, apply additional measures to fully comply with the requirements set out in IEC 60664-1 or IEC 61800-5-1 "Hazard due to electric shock".

6.3.6 Connecting to a converter

Selecting and connecting the cable

- Use Motion Connect cables or symmetrically constructed, shielded cables to connect the motor to a converter. The cable shielding, made up of as many strands as possible, must have good electrical conductivity. Braided shields made of copper or aluminum are well suited.
- The shield is connected at both ends, at the motor and converter. Keep unshielded cable ends as short as possible.
- In order to ensure that high-frequency currents are efficiently discharged, provide a 360° contact through a large surface area at the converter and at the motor. Use for instance, EMC glands at the cable entries.

Measures to reduce bearing currents

To specifically reduce and prevent damage caused by bearing currents, consider the system as a whole, which comprises the motor, converter, and driven machine. The following precautions help to prevent bearing currents:

- Setting up a properly meshed grounding system in the system as a whole, with low impedance for high-frequency currents
- No potential difference between the motor, converter, and working machine.
  - Use symmetrical, shielded connecting cables.
  - Connect the cable shield at both ends over the greatest possible surface area (360° contact).
  - Use equipotential bonding conductors between the motor and the driven machine as well as between the motor and the converter
- Limit the voltage rate of rise by using an output filter to dampen harmonic components in the output voltage

6.3.7 Converter operation on a grounded network

NOTICE
Damage resulting from protective conductor currents When the machine is operated on a converter with current limiter, but without ground-fault monitoring, protective conductor currents of up to 1.7 times the external conductor current can arise if there is a ground fault on the output side. Neither the PE conductors of normally rated multi-core connecting cables nor the PE connecting points of normal terminal boxes are suitable for this purpose. Material damage can result. • Use an appropriately sized PE conductor. • Connect the PE conductor to the grounding terminal on the motor enclosure.

Commissioning

7

Observe the following when carrying out any work on the machine:

- Comply with the general safety instructions
- Comply with the applicable national and sector-specific regulations.
- When using the machine within the European Union, comply with the specifications laid down in EN 50110-1 regarding safe operation of electrical equipment.

See also

Safety information (Page 15)

⚠ WARNING

Magnetic field when the holding brake is open

If the motor is equipped with a holding brake, then the shaft extension is magnetized when the holding brake is open, i.e. if a voltage is connected to it.

Magnetic objects will then be suddenly attracted as a result of this magnetic field. This can result in death, severe injury or material damage.

- Working close to the shaft extension is only permissible in exceptional, justified cases. Clear access rules must be applied and complied with corresponding to magnetic fields at the workplace. Clearly mark the boundaries of the areas where standing is permitted.
- People who need to use electronic or magnetic medical aids such as pacemakers, hearing aids, implants or similar devices, are at particularly high risk. Such persons must undergo an occupational health assessment.
- Observe the following measures.

Personal protective measures

- Ensure that you never wear or carry any of the following objects and that they are kept a safe distance from the machine:
  - All kinds of magnetic metal parts such as, keys, glasses, tools, knives, scissors, tape measures, etc.
  - Magnetic jewelry such as rings, chains, needles, watches, etc.
  - Electronic devices and data carriers such as service cards, check cards, credit cards, calculators, cell phones, etc.
  - Wallets or other iron-containing objects
  - Electrically conductive foreign bodies
- Do not use any magnetic tools or lifting devices.
- Wear only occupational safety items without magnetic metal parts, e.g. occupational safety shoes with non-magnetic protective caps and soles.

- Keep your shoes and clothing free from chips and waste containing iron.
- Exercise caution when installing accessories. Ensure that no parts fall into the inside of the machine.
- Do not perform any cutting at the machine, e.g. drilling threaded holes. Any exceptions require written approval from the manufacturer.

See also

The five safety rules (Page 15)

7.1 Insulation resistance and polarization index

Measuring the insulation resistance and polarization index (PI) provides information on the condition of the machine. It is therefore important to check the insulation resistance and the polarization index at the following times:

- Before starting up a machine for the first time
- After an extended period in storage or downtime
- Within the scope of maintenance work

The following information is provided regarding the state of the winding insulation:

- Is the winding head insulation conductively contaminated?
- Has the winding insulation absorbed moisture?

As such, you can determine whether the machine needs commissioning or any necessary measures such as cleaning and/or drying the winding:

- Can the machine be put into operation?
- Must the windings be cleaned or dried?

Detailed information on testing and the limit values can be found here:

"Testing the insulation resistance and polarization index" (Page 50)

NOTICE
Damage to the converter The electronics of the integrated converter can be destroyed when measuring the insulation resistance at the EC external fan. • Do not measure the insulation resistance of the EC external fan. • More information can be found in the instructions of the EC external fan.

7.2 Checks to be carried out prior to commissioning

Once the system has been correctly installed, you should check the following prior to commissioning:

Note

Checks to be carried out prior to commissioning

The following list of checks to be performed prior to commissioning does not claim to be complete. It may be necessary to perform further checks and tests in accordance with the specific situation on-site.

- The machine is undamaged.
- The machine has been correctly installed and aligned, the transmission elements are correctly balanced and adjusted.
- All fixing screws, connection elements, and electrical connections have been tightened to the specified tightening torques.
- The operating conditions match the data provided in accordance with the technical documentation, such as degree of protection, ambient temperature, etc..
- Moving parts such as the coupling move freely.
- All touch protection measures for moving and live parts have been taken.
- If the second shaft extension is not in use, its feather key is secured to prevent it from being thrown out, and cut back to roughly half its length if the rotor has balancing type "H" (standard type). The unused shaft extension is covered and protected against accidental contact.
- The rotor can spin without coming into contact with the stator.
- The bearing insulation is not bridged.

Electrical connection

- The grounding and equipotential bonding connections have been made correctly.
- The machine is connected so that it rotates in the direction specified.
- Appropriately configured control and speed monitoring functions ensure that the motor cannot exceed the permissible speeds specified in the technical data. For this purpose, compare the data on the rating plate or, if necessary, the system-specific documentation.
- The minimum insulation resistance values are within tolerance.
- Minimum air clearances have been maintained.
- Any supplementary motor monitoring devices and equipment have been correctly connected and are functioning correctly.
- All brakes and backstops are operating correctly.
- At the monitoring devices, the values for "Warning" and "Shutdown" are set.

- Appropriately configured control and speed monitoring functions ensure that the the permissible speeds specified on the rating plate cannot be exceeded.
- Any supplementary motor monitoring devices and equipment have been correctly connected and are fully functional.

Converter operation

- If the design of the motor requires connection to a particular converter type, the rating plate will contain corresponding additional information.
- The converter is correctly parameterized. The parameterization data is specified on the rating plate of the machine. Information about the parameters is available in the operating instructions for the converter.
- Any supplementary motor monitoring devices and equipment have been correctly connected and are functioning correctly.

Roller bearing

- If the motor has been stored for more than two years in a dry, dust-free and vibration-free room, prepare for commissioning as follows:
  - Replace the rolling-contact bearings on motors with lifetime lubrication.
  - Replace the grease in motors with re-greasing system.
  - If stored under less favorable conditions, the bearings or the grease must be replaced after a storage period of approx. 18 months.

Table 7-1 Minimum radial forces

Type	Minimum radial force
1PH818.	4 kN
1PH822.	5 kN
1PH828.	9 kN

External fan

- All external fans fitted are ready for operation and have been connected so that they rotate in the direction specified.
- The flow of cooling air is not impeded.

Cooling water supply

- The cooling water supply is connected and ready for operation.
- The cooling water supply is switched on. The data can be found on the rating plate.
- Cooling water is available in the configured quality and quantity.

7.3 Perform a test run with the water-cooled motor

If you want to start the machine for a trial run, ensure that it is connected to the cooling water supply.

⚠ WARNING

Risk of burning from hot steam

If the cooling water supply fails, the motor will overheat. If cooling water runs into the hot machine, hot steam suddenly forms, which escapes under high pressure. The cooling water system can burst. This can result in death, serious injury or material damage.

Do not connect the cooling water supply until the machine has cooled down.

7.4 Switching on

- See the operating instructions of the frequency converter for switching on.
- Before you switch on the motor, ensure that the parameters of the frequency converter have been assigned correctly.
- Use appropriate commissioning tools, such as "Drive ES" or "STARTER".

NOTICE

Operation noise or abnormal noises

The motor can be damaged by improper handling during transport, storage or set up. If a damaged motor is operated damage to the winding, bearings or, complete destruction of the motor can be the result.

If the motor is not running smoothly or is emitting abnormal noises, de-energize it, and determine the cause of the fault as the motor runs down.

Maximum speed

The maximum rotational speed n_{max} is the highest permissible operating speed. The maximum rotational speed is specified on the rating plate.

See also

Description (Page 21)

7.5 Test run

After installation or inspection, carry out a test run:

1. Switch on the cooling systems.
2. Start up the machine without a load. To do this, close the circuit breaker and do not switch off prematurely. Check whether it is running smoothly.
   Switching the machine off again while it is starting up and still running at slow speed should be kept to a bare minimum, for example for checking the direction of rotation or for checking in general.
   Allow the machine to run down before switching it on again.
3. If it runs perfectly, connect a load.
4. During the test run, check and document the following:
   - Check whether it is running smoothly.
   - Document the voltage, current and power values. As far as possible, document the corresponding values of the driven machine.
   - If this is possible using the available measuring equipment, check the bearing and stator winding temperatures until they have reached steady-state values.
   - Check the machine for noise or vibrations on the bearings or bearing shields as it runs.
5. In case of uneven running or abnormal noise, switch off the machine. As the machine runs down, identify the cause.
   - If the mechanical operation improves immediately after the machine is switched off, then the cause is magnetic or electrical.
   - If the mechanical running does not improve immediately after switching the machine off, then the cause is mechanical.
     - Imbalance of the electrical machine or the driven machine
     - The machine set has not been adequately aligned
     - The machine is being operated at the system resonance point. System = motor, base frame, foundation, ...

NOTICE
Serious damage to the machine If the vibration values in operation are not maintained in accordance with DIN ISO 10816-3, then the machine can be mechanically destroyed. • During operation, observe the vibration values in accordance with DIN ISO 10816-3.

7.6 Set values for monitoring the bearing temperature (optional)

Prior to commissioning

If the machine is equipped with bearing thermometers, set the temperature value for disconnection on the monitoring equipment before the first machine run.

Table 7-2 Set values for monitoring the bearing temperatures before commissioning

Set value	Temperature
Alarm	115 °C
Shutting down	120 °C

Normal operation

Measure the normal operating temperature of the bearings T_{op} at the installation location in °C. Set the values for shutdown and warning corresponding to the operating temperature T_{op}.

Table 7-3 Set values for monitoring the bearing temperatures

Set value	Temperature
Alarm	$T_{operation}$ + 5 K ≤ 115 °C
Shutting down	$T_{operation}$ + 10 K ≤ 120 °C

Operation

8

When carrying out any work on the machine, observe the general safety instructions (Page 15) and the specifications contained in EN 50110-1 regarding safe operation of electrical equipment.

8.1 Safety guidelines in operation

⚠ WARNING

Live parts

Terminal boxes accommodate live parts and components. If you open the terminal box cover, this can result in death, serious injury or material damage.

- When the machine is in operation, the terminal boxes must remain closed at all times. Terminal boxes may be opened only when the machine is stopped and de-energized.

⚠ WARNING

Rotating and live parts

Rotating or live parts are dangerous. If you remove the required covers, this can result in death, serious injury or material damage.

- Any covers that prevent live electrical or rotating parts from being touched, ensure compliance with a particular degree of protection or are required for ensuring proper air flows, and hence effective cooling, must not be opened during operation.

⚠ WARNING

Fire hazard resulting from hot surfaces

Certain parts of the machine become hot during operation. Severe burns can result from contact with these parts.

- Check the temperature of parts before touching them. If required, apply suitable protective measures.
- Allow the machine to cool before starting work on the machine.

⚠ WARNING

Faults in operation

Deviations from normal operation such as increased power consumption, temperatures or vibrations, unusual noises or odors, tripping of monitoring devices, etc., indicate that the machine is not functioning properly. This can cause faults which can result in eventual or immediate death, serious injury or material damage.

- Immediately inform the maintenance personnel.
- If you are in doubt, immediately switch off the motor, being sure to observe the system-specific safety conditions.

NOTICE

Risk of corrosion due to condensate

Humid air can condense inside the machine during operation as a result of intermittent duty or load fluctuations. Condensate can collect inside the motor. Damage such as rust can result.

- Make sure that any condensation can drain away freely.

NOTICE

Non-periodic duty

In all of the operating modes, always operate the external fan according to DIN EN 60034-1. For non-periodic operation, it is possible that the machine is thermally overloaded. This can result in damage to the machine.

- In the case of extended non-operational periods, the fan should be in operation until the machine has approximately reached the temperature of the coolant, see S2 duty type in DIN EN 60034-1.
- Use a suitable circuit to ensure that the external fan is appropriately operated.

NOTICE

EC fan control via an input signal

The fan motor can overheat if the external EC fan is operated at low fan speeds as a result of the setpoint signal it receives.

- Monitor the motor using the integrated temperature sensors.
- Integrate the temperature monitoring into the interlocking circuit.

8.2 Do not operate water-cooled motors without cooling water

The motor must always be connected to the cooling water supply during operation.

NOTICE
Cooling water supply If the cooling water supply fails or if the motor is operated for a short time without water cooling, the motor will overheat. This can result in material damage or even a write-off. Never operate the motor without the cooling water supply switched on. Monitor the permissible water inlet temperatures.

⚠ WARNING
Risk of burning from hot steam If the cooling water supply fails, the motor will overheat. If cooling water runs into the hot motor, hot steam suddenly forms, which escapes under high pressure. The cooling water system can burst. This can result in death, serious injury or material damage. Do not connect the cooling water supply until the motor has cooled down.

8.3 Switching on the machine

- After starting the motor, observe it for a while to see if it is running smoothly and check the monitoring devices.
- Monitor operation and the monitoring devices regularly and record the values you read off.

NOTICE
Speed monitoring The motor is designed for a certain speed range. If a motor is operated at impermissible speeds damage to the winding, bearings, or complete destruction of the motor can be the result. Ensure that the speeds specified on the rating plate are not exceeded by appropriately configuring controller and speed monitoring components.

See also

Description (Page 21)

NOTICE
Excessive machine temperature If the anti-condensation heating is operated while the machine is running, this can increase the temperatures inside the machine. This can result in material damage. • Make sure that the anti-condensation heating is switched off before the machine is switched on. • Only operate anti-condensation heating when the machine is switched off.

8.4 Switching off water-cooled motors

- Switch off the cooling water supply for longer non-operational periods.
- When switching-off, also observe the converter operating instructions.
- If anti-condensation heating is available, switch it on.

8.5 Switching off force-ventilated motors

- Switch off the external fan during longer standstill periods.
  Leave the fan on for approximately 30 minutes after switching off the motor to avoid overheating of the motor.
- Follow the operating instructions of the converter.

8.6 Switching on again after an emergency switching-off

- Check the machine before recommissioning the driven machine after an Emergency Off.
- Eliminate all the causes that have led to the emergency off

8.7 Stoppages

The stoppage is a shutdown for a period of time, during which the machine is stopped but remains at the location of use.

Under normal ambient conditions, e. g. the stopped machine is not exposed to any vibration, no increased level of corrosion, etc. in general, the following measures are necessary during stoppages.

Measures for machines ready to operate during longer non-operational periods

- For longer periods when the machine is not being used, either energize it at regular intervals (roughly once a month), or at least spin the rotor.
- Please refer to the section"Switching on" (Page 91) before switching on to recommission the motor.

NOTICE
Damage due to improper storage The machine can be damaged if it is not stored properly. If the motor is out of service for extended periods of time, implement suitable anti-corrosion, preservation, and drying measures. When recommissioning the motor after a long period out of service, carry out the measures recommended in the chapter entitled "Commissioning (Page 87)".

8.7.1 Avoidance of damage to roller bearings during stoppages

Extended stoppages at the identical or almost identical resting position of the roller bearings can lead to damage such as brinelling or corrosion, for example.

- During stoppages, regularly start the machine up for a brief period once a month. As a minimum, rotate the rotor several times.
  If you have uncoupled the machine from the driven machine and secured the rotor with a rotor shipping brace, then remove this before turning the rotor over or starting the machine up.
  Make sure that the resting position of the roller bearings after the rotor has been turned over is different from what it previously had been. Use the fitted key or the coupling halves as reference markers.
- During re-commissioning, refer to the information in the "Commissioning" section.

See also

Commissioning (Page 87)

8.8 Decommissioning the machine

NOTICE
Damage as a result of an extended period out of service If the machine is going to be out of service for longer than six months, then take the necessary measures for preservation and storing. Otherwise damage to the machine will result.

Record the decommissioning steps. This log will be useful upon recommissioning.

8.9 Re-commissioning the machine

When you re-commission the machine, proceed as follows:

- Study the record made when the machine was decommissioned, and reverse the measures that were taken for conservation and storage.
- Perform the measures listed in the "Commissioning" section.

See also

Commissioning (Page 87)

Insulation resistance and polarization index (Page 50)

8.10 Faults

8.10.1 Inspections in the event of faults

Natural disasters or unusual operating conditions, such as overloading or short circuit, are faults that overload the machine electrically or mechanically.

Immediately perform an inspection after such faults.

Correct the cause of the fault as described in the respective remedial measures section. Repair any damage to the machine.

8.10.2 Electrical faults at force-ventilated motors

Note

When operating the machine with a converter, also refer to the operating instructions of the frequency converter if electrical faults occur.

Table 8-1 Electrical faults

↓ Motor fails to start								
	↓ Motor accelerates sluggishly							
		↓ Humming noise when starting						
			↓ Humming noise in operation					
				↓ High temperature rise during no-load operation				
					↓ High temperature rise under load			
						↓ High temperature rise of individual winding sections		
							Possible causes of faults	Remedial measures
X	X		X		X		Overload	Reduce the load.
X							Interruption of a phase in the supply cable	Check frequency converters and supply cables.
	X	X	X		X		Interruption of a phase in the supply after switching on	Check frequency converters and supply cables.
	X	X	X			X	Winding short circuit or phase short circuit in stator winding	Determine the winding and insulation resistances. Contact the Service Center.
				X			Converter output voltage too high, frequency too low	Check the settings at the frequency converter and perform the automatic motor identification.
					X		External fan is not running	Check the external fan and its connections.
					X		Wrong direction of rotation of the external fan	Check the electrical connections to the external fan.
					X		Reduced air intake	Check the air ducts; clean the machine.

8.10.3 Electrical faults at water-cooled motors

Note

When operating the machine with a converter, also refer to the operating instructions of the frequency converter if electrical faults occur.

Table 8-2 Electrical faults

↓ Motor fails to start								
	↓ Motor accelerates sluggishly							
		↓ Humming noise when starting						
			↓ Humming noise in operation					
				↓ High temperature rise during no-load operation				
					↓ High temperature rise under load			
						↓ High temperature rise of individual winding sections		
							Possible causes of faults	Remedial measures
X	X		X		X		Overload	Reduce the load.
X							Interruption of a phase in the feeder cable	Check the frequency converters and feeder cables.

↓ Motor fails to start								
	↓ Motor accelerates sluggishly							
		↓ Humming noise when starting						
			↓ Humming noise in operation					
				↓ High temperature rise during no-load operation				
					↓ High temperature rise under load			
						↓ High temperature rise of individual winding sections		
							Possible causes of faults	Remedial measures
	X	X	X		X		Interruption of a phase in the feeder cable after switching on	Check the frequency converters and feeder cables.
	X	X	X			X	Winding short circuit or interphase short circuit in stator winding	Determine the winding and insulation resistances. Contact the Service Center.
				X			Converter output voltage too high, frequency too low	Check the settings at the frequency converter and perform the automatic motor identification.
				X	X		Cooling water not connected Cooling water supply switched off Water connection / pipes defective	Check the cooling water connection. Switch on the cooling water supply. Find the leak and seal it. Contact the Service Center.
				X	X		Cooling water flow rate too low Intake temperature too high	Increase the cooling water flow rate. Set the correct intake temperature.

8.10.4 Mechanical faults

The following table shows the possible causes of and remedial measures for mechanical faults.

Table 8-3 Mechanical faults

↓ Grinding noise					
	↓ Overheating				
		↓ Radial vibrations			
			↓ Axial vibrations		
				Possible causes of faults	Remedial measures
X				Rotating parts are grinding	Establish the cause and realign the parts.
		X		Rotor not balanced	Decouple the rotor and then rebalance it.
		X		Rotor out of true, shaft bent	Contact the Service Center.
		X	X	Poor alignment	Align the machine set and check the coupling. [1]
		X		Coupled machine not balanced	Rebalance the coupled machine.
			X	Shocks from coupled machine	Examine the coupled machine.
		X	X	Resonance of the overall system comprising motor and foundation	Reinforce the foundation after prior consultation with the Service Center.
		X	X	Changes in foundation	Determine the cause of the changes and, if necessary, rectify. Realign the machine.
	X			Reduced air supply, direction of rotation of fan possibly incorrect	Check the air ducts; clean the machine.
		X	X	Uneven gearbox operation	Resolve any gearbox faults.

[1] Take into account possible changes which may occur during overheating.

8.10.5 Roller bearing faults

Damage to roller bearings can be difficult to detect in some cases. If in doubt, replace the bearing. Use other bearing designs only **after consulting the manufacturer**.

Table 8-4 Roller bearing faults

↓ Bearing overheats				
	↓ Bearing "whistles"			
		↓ Bearing "knocks"		
			Possible causes of faults	**Remedial measures**
X			High coupling pressure	Align the machine more accurately.
X			Belt tension too high	Reduce the drive belt tension.
X			Bearing contaminated	Clean or replace the bearing. Check the seals.
X			High ambient temperature	Use a suitable high-temperature grease.
X	X		Insufficient lubrication	Grease the bearings as instructed.
X	X		Bearing canted	Properly install the bearing.
X	X		Insufficient bearing play	Contact the Service Center.
		X	Excessive bearing play	Contact the Service Center.
X	X		Bearing corroded	Replace the bearing. Check the seals.
X			Too much grease in bearing	Remove surplus grease.
X			Wrong grease in the bearing	Use the correct grease.
		X	Friction marks on raceway	Replace the bearing.
		X	Brinelling or scoring	Replace the bearing. Avoid any vibration at standstill

8.10.6 Holding brake faults

Information on holding brake faults can be found in the manufacturer's operating instructions in the (Page 169) appendix.

Maintenance 9

Through careful and regular maintenance, inspections, and overhauls you can detect faults at an early stage and resolve them. This means that you can avoid consequential damage.

Operating conditions and characteristics can vary widely. For this reason, only general maintenance intervals can be specified here. Maintenance intervals should therefore be scheduled to suit the local conditions (dirt, starting frequency, load, etc.).

Observe the following when carrying out any work on the machine:

- Comply with the general safety instructions (Page 15)
- Comply with the applicable national and sector-specific regulations at the place of installation
- When using the machine within the European Union, comply with the specifications laid down in EN 50110-1 regarding safe operation of electrical equipment.

Note

Service Center

Please contact the Service Center (Page 161), if you require support with servicing, maintenance or repair.

9.1 Observe the operating instructions of the components

When carrying out any maintenance and repair work, always carefully observe the manufacturer's operating instructions for additional components.

See also

Operating instructions, holding brake (Page 169)

Operating instructions for the three-phase EC external fan, suction, SK180 (Page 249)

Operating instructions for the three-phase EC external fan, suction, SK225 (Page 263)

9.2 Inspection and maintenance

⚠ WARNING

Rotating and live parts

Electric machines contain live and rotating parts. Fatal or serious injuries and substantial material damage can occur if maintenance work is performed on the machine when it is not stopped or not de-energized.

- Perform maintenance work on the machine only when it is stopped. The only operation permissible while the machine is rotating is regreasing the roller bearings.
- When performing maintenance work, comply with the five safety rules (Page 15).

⚠ WARNING

Machine damage

If the machine is not maintained it can suffer damage. This can cause faults which can result in eventual or immediate death, serious injury or material damage.

Perform regular maintenance on the machine.

⚠ CAUTION

Dust disturbances when working with compressed air

When cleaning with compressed air, dust, metal chips, or cleaning agents can be whirled up. Injuries can result.

When cleaning using compressed air, make sure you use suitable extraction equipment and wear protective equipment (safety goggles, protective suit, etc.).

NOTICE

Damage to insulation

If metal swarf enters the winding head when cleaning with compressed air, this can damage the insulation. Clearance and creepage distances can be undershot. This may cause damage to the machine extending to total failure.

When cleaning with compressed air, ensure there is adequate extraction.

NOTICE
Machine damage caused by foreign bodies Foreign bodies such as dirt, tools or loose components, such as screws etc., can be left by accident inside the machine after maintenance is performed. These can cause short circuits, reduce the performance of the cooling system or increase noise in operation. They can also damage the machine. • When carrying out maintenance work, make sure that no foreign bodies are left in or on the machine. • Securely attach all loose parts again once you have completed the maintenance procedures. • Carefully remove any dirt.

Note

Operating conditions and characteristics can vary widely. For this reason, only general intervals for inspection and maintenance measures can be specified here.

9.2.1 Inspections in the event of faults

Natural disasters or unusual operating conditions, such as overloading or short circuit, are faults that overload the machine electrically or mechanically.

Immediately perform an inspection after such faults.

9.2.2 Initial inspection

Perform the following checks after approximately 500 operating hours or at the latest after six months:

Table 9-1 Checks after installation or repair

Check	When the motor is running	At stand-still
The electrical parameters are maintained.	X	
The smooth running characteristics and machine running noise have not deteriorated.	X	
The motor foundation has no cracks and indentations. (*)	X	X

(*) You can perform these checks while the motor is running or at a standstill.

Additional checks may also be required according to the system-specific conditions.

NOTICE
If you detect any deviations during the inspection, you must rectify them immediately. They may otherwise damage the motor.

9.2.3 Main inspection

Table 9-2 Checks that must be performed during the main inspection

Checking	When the motor is running	At stand-still
The stated electrical characteristics are being observed	X	
The smooth running characteristics and machine running noise have not deteriorated	X	
The foundation has no cracks or indentations. (*)	X	X
The motor is aligned within the permissible tolerance range.		
All the fixing bolts/screws for the mechanical and electrical connections have been securely tightened		X
The winding insulation resistances are sufficiently high.		X
Any bearing insulation has been fitted as shown on plates and labeling.		X
Cables and insulating parts and components are in good condition and there is no evidence of discoloring		X
Condensation can freely flow away.		X

(*) You can perform these checks while the motor is running or at a standstill.

NOTICE
Deviations from the normal state If you detect any defects or malfunctions during the inspection, you must rectify them immediately. They may otherwise cause damage to the machine.

See also

Testing the insulation resistance and polarization index (Page 50)

9.2.4 Regreasing intervals

NOTICE
Damage to roller bearings The regreasing intervals for roller bearings are different from the servicing intervals for the machine. Failure to regrease the rolling-contact bearings at the specified intervals can result in them sustaining damage. • Comply with the regreasing intervals for roller bearings. The regreasing intervals are specified on the lubricant plate.

9.2.5 Changing bearings when using permanently lubricated rolling-contact bearings

The replacement of the permanently lubricated roller bearing is determined by the number of operating hours and is required around every three years.

9.2.6 Maintenance

When carrying out any work on the machine, observe the general safety instructions (Page 15) and the specifications contained in EN 50110-1 regarding safe operation of electrical equipment.

9.2.6.1 Measuring the insulation resistance during the course of maintenance work

Measuring the insulation resistance and polarization index (PI) provides information on the condition of the machine. It is therefore important to check the insulation resistance and the polarization index at the following times:

- Before starting up a machine for the first time
- After an extended period in storage or downtime
- Within the scope of maintenance work

The following information is provided regarding the state of the winding insulation:

- Is the winding head insulation conductively contaminated?
- Has the winding insulation absorbed moisture?

As such, you can determine whether the machine needs commissioning or any necessary measures such as cleaning and/or drying the winding:

- Can the machine be put into operation?
- Must the windings be cleaned or dried?

Detailed information on testing and the limit values can be found here:

"Testing the insulation resistance and polarization index" (Page 50)

9.2.6.2 Maintenance intervals

Perform the following maintenance measures after the operating time or the intervals specified in the following table elapse.

Table 9-3 Maintenance measures

Maintenance measures	Maintenance intervals
Initial inspection	After 500 operating hours, at the latest after six months
Regreasing	See the lubricant plate
Permanent lubrication (with coupling output)	Replace bearings after approximately 20,000 operating hours, at the latest after three years
Cleaning	Depending on the degree of pollution
Main inspection	After approximately 16,000 operating hours, at the latest after two years

9.2.6.3 Rolling-contact bearings

The motors have rolling-contact bearing bushes for grease lubrication. Depending on the version, the motors are permanently lubricated or are equipped with a regreasing device.

Depending on the type of load, a deep-groove ball bearing or a cylindrical-roller bearing is fitted as a floating bearing on the drive end.

The DE bearing contains built-in compression springs that help to rebalance the axial play of the external bearing rings.

See also

Checks to be carried out prior to commissioning (Page 89)

9.2.6.4 Lubrication

The specified grease data apply for the data specified on the rating plate data and for high-quality grease in accordance with the specifications in these operating instructions. These greases significantly exceed the requirements according to DIN 51825 and ISO 6743-9, therefore permitting the specified relubrication intervals.

Initial lubrication

The following greases are used for initial lubrication of the bearings in the factory.

- Standard version: ESSO / Unirex N3
- "Performance" version: Lubcon / Sintono GPE702

Grease selection criteria

The following greases are permissible for standard applications without any special requirements:

- High quality ISO-L-X BDEA3 greases according to ISO 6743-9
- K3N-20 greases according to DIN 51825 with lithium soap as thickener and an upper service temperature of at least +140 °C / +284 °F.

When selecting the lubricating grease, ensure that the technical data of the grease is suitable for the application.

The lubricating grease must satisfy the criteria listed in the table below and must match the operating conditions. If different special lubricating greases are stated on the lubricant plate, then different criteria apply.

Table 9-4 Criteria for selecting roller bearing greases

Criteria	Standard	Property, characteristic value	Unit
Type of base oil	-	Mineral oil	-
Thickener	-	Lithium	-
Consistency according to NLGI class	DIN 51818	• 3 for vertical and horizontal types of construction • 2 alternatively for horizontal type of construction with reduced lubrication interval	-
Worked penetration	DIN ISO 2137	220–295	0.1 mm
Operating temperature range	-	At least -20 °C ... +140 °C	°C
Dropping point	DIN ISO 2176	At least +200 °C	°C
Basic oil viscosity	DIN 51562-1	• Approx. 100 mm²/s at 40° C • Approx. 10 mm²/s at 100 °C	mm²/s
Additive	-	• Antioxidation (AO), Anti-Wear (AW) • No solid lubricants • Alternatively: Extreme-Pressure (EP) only after consultation with grease and bearing manufacturers	-
FE9 test: A/1500/6000	DIN 51821-1/-2	F10 ≥ 50 h at +140 °C F50 ≥ 100 h at +140 °C	h
Behavior with respect to water	DIN 51807	0 or 1 at a test temperature of +90 °C	-
Corrosive effect on copper	DIN 51811	0 or 1 at a test temperature of +140 °C	Corr.°
Resistance to corrosion (EMCOR)	DIN 51802 / ISO 11007	0 - 0 (0 - 1, permissible for special greases)	Corr.°
Solid matter content, particle sizes > 25 µm	DIN 51813	< 10 mg/kg	mg/kg
Suitability of bearings Speed characteristic value nxdm	-	Suitable for the built-in motor bearings, seals and these speeds	- mm/min

NOTICE
Other ambient temperatures and operating conditions For other ambient temperatures and operating conditions, an alternative grease to the one stated on the lubricant plate may only be used after prior consultation with the manufacturer. Otherwise the roller bearing could be damaged.

NOTICE
Use of other greases If other greases are used, compatibility with the overall system cannot be guaranteed. Otherwise the roller bearing could be damaged. If you use greases that satisfy only the minimum requirements of DIN 51825 or ISO 6743-9, then reduce the lubrication intervals by half or appropriately adapt them. If in doubt, consult the manufacturer.

Recommended greases for roller bearings

For standard applications, the following high-quality greases are recommended for roller bearings for vertical and horizontal motor types of construction due to their technical attributes:

Table 9-5 Roller bearing greases for vertical and horizontal types of construction

Manufacturer	Grease type
ExxonMobil	Unirex N3
Esso	
Fuchs	Renolit H443 HD88
Lubcon	Turmoplex 3
FAG	Arcanol Multi 3

For motors with a horizontal type of construction, you can alternatively use greases with NLGI Class 2. However, the lubrication interval is reduced by 20 %.

Table 9-6 Alternative greases with NLGI Class 2 for motors with a horizontal type of construction

Manufacturer	Grease type
ExxonMobil	Unirex N2
Esso	
Castrol	Longtime PD2
Lubcon	Turmogrease L 802 EP plus
Shell	Retinax LX2
FAG	Arcanol Multi 2

For the "Performance" version, only use these special greases. The Performance version is not available for explosion-protected motors.

Table 9-7 Grease for the "Performance" version

Manufacturer	Grease type
Lubcon	Sintono GPE702

NOTICE

Damage caused by mixing lubrication types

Mixing different greases adversely affects the lubricating properties. Only the manufacturer provides a guarantee as to whether certain greases can be mixed.

- Never mix different greases.

Regreasing

Regreasing data are stamped on the lubricant plate of the machine:

- Relubrication intervals in operating hours
- Regreasing amount in grams
- Grease type

Regrease the bearing at the latest every 12 months irrespective of the actual number of operating hours.

NOTICE

Relubrication intervals

The relubrication intervals for roller bearings are different from the servicing intervals for the machine. The roller bearings may be damaged if the relubrication intervals are not complied with.

- Pay attention to the instructions on the lubricant plate.

Grease replacement intervals

The grease replacement intervals in these operating instructions or the relubrication intervals indicated on the plate apply for the following conditions:

- Normal load
- Operation at speeds in accordance with the rating plate
- Low-vibration operation
- Neutral ambient air
- High-quality roller bearing greases

In the case of unfavorable conditions, reduce the relubrication intervals after prior consultation with the manufacturer.

Regreasing

While regreasing, the shaft must rotate so that the new grease is evenly distributed throughout the bearing. For motors that are be operated with a converter, regreasing should be carried out at low-to-medium speeds (n_{min} = 250 rpm, n_{max} = 3600 rpm) to ensure an even distribution of grease. This ensures adequate even lubrication.

⚠ WARNING

Rotating parts

When regreasing, pay attention to all rotating components. This can result in death, serious injury or material damage.

1. Clean the grease nipple before regreasing. Gradually press in an appropriate type and amount of grease, as stamped on the lubricant plate and specified in these operating instructions.
   The roller bearing temperature initially increases noticeably. After the excess grease has been displaced out of the bearing, the temperature will return to the normal value.

The used grease collects outside each bearing in a spent grease chamber.

Lubricating using the regreasing system

A flat grease nipple in accordance with DIN 3404, size M10x1, is provided at both the DE ① and the NDE ② for regreasing.

1. Clean the grease nipples at the DE and NDE.
2. Press in the type and quantity of grease specified (see lubrication instruction plate). The shaft rotates so that the new grease is evenly distributed throughout the bearing.
   The bearing temperature initially increases noticeably. After the excess grease has been displaced out of the bearing, the temperature will return to the normal value.

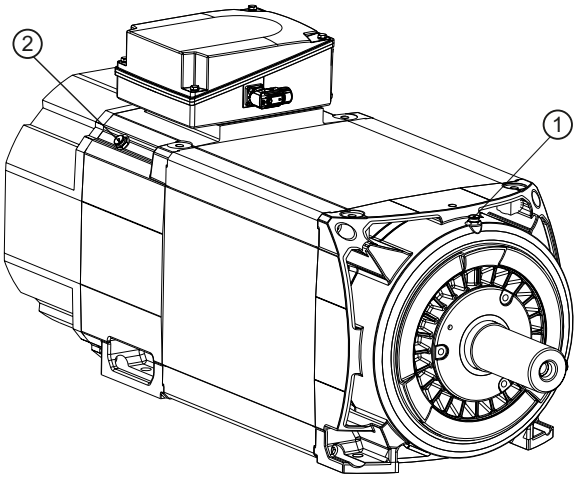


Figure 9-1 Flat grease nipples ① and ②, schematic representation for types 1PH818. and 1PH822.

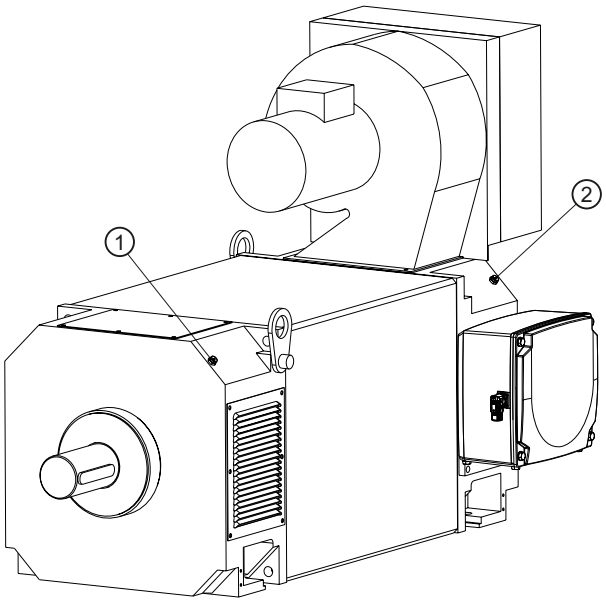


Figure 9-2 Flat grease nipple ① and ② (schematic representation for type 1PH828.)

9.2.6.5 Cleaning the spent grease chamber

The rolling-contact bearing's spent grease chamber only has room for a limited amount of spent grease. When the spent grease chamber is full, the spent grease must be removed, otherwise it will penetrate into the interior of the machine. The information on the amount of grease to be used when regreasing can be found on the lubricant plate. When changing the bearings remove the spent grease that has collected in the spent grease chamber and in the outer bearing cover.

To remove the spent grease, proceed as follows:

1. Remove the transmission element.
2. Remove the spent grease:
   - At the DE, unscrew the outer bearing cover and empty the spent grease from the outer bearing cover.
   - At the NDE, remove the cover of the speed sensor and the cover of the spent grease chamber. Empty the spent grease chamber.

   Note

   For types 1PH818. and 1PH822., you must remove the fan before removing the speed encoder cover. At the NDE, remove the fan and then the speed encoder cover.

9.2.6.6 Maintaining the cooling water system

The cooling water pipe system, made of high-grade steel, is maintenance-free if the required coooling water quality (Page 29) is maintained.

9.2.6.7 Servicing the external fan

- Check the external fan every 12 months for mechanical vibration as specified in DIN ISO 10816. The maximum permissible vibrational severity is 2.8 mm/s measured at the fan housing.
- Regularly clean and inspect the fan. Impeller and frame are subject to natural wear depending on the area of application and displacement medium.

⚠ WARNING

Impeller can crack

Due to deposits and the resulting imbalance there is a hazard of fatigue fracture of the impeller. The impeller can crack in operation. Death, serious injury, or material damage can result.

- Regularly clean and inspect the fan.

⚠ WARNING

Voltages at the internal motor connections

The motor may continue running, e.g. due to airflow, or may run on after being shut down. This means that dangerous voltages of over 50 V can occur at the internal motor connections. Death, serious injury, or material damage can result.

- For safety reasons, it is not permissible to make any unauthorized modifications or changes to the fan.
- The external fan can automatically switch on and switch off as a result of its inherent function.
- After a power failure or when the power has been disconnected, the external fan starts up automatically again when the voltage is restored.
- Wait until the external fan has come to a standstill before approaching it.
- Provide a protective circuit that prevents the main motor from being switched on when the external fan is not in operation.

Clean the external fan

⚠ WARNING

Danger of shearing

Death, severe injury and material damage can occur if you come into contact with the rotating fan impeller.

- The fan impeller must be stationary when carrying out any work on the external cooling system.
- Interrupt/disconnect the external cooling unit circuit.
- Lock out the circuit so that it cannot be switched on again.

NOTICE
Applying force If excessive forces are present, this can damage the fan impeller.

- Use a suitable cloth or brush to clean the external fan, ensuring that moisture does not enter the motor.
- Once the voltage has been disconnected on all poles, wait for five minutes before touching the device.
- Never open the external cooling unit during operation.
- Never loosen any fixing screws for the external cooling unit during operation.

Changing the filter mat of the external fan (option)

Check the state of the filter mat regularly depending on the prevailing conditions. Change it if it is dirty.

⚠ CAUTION
Changing the filter only when the fan is stationary When the mesh is removed, the degree of protection is no longer guaranteed. There is a risk of injury. Only change the filter when the fan is stationary.

1. Unscrew the fan guard and remove the old filter mat.
2. Insert the new filter mats and screw the fan guard back into position.

You can order the filter mat as a spare part.

- Spare parts, external fan (Page 145)
- Spare parts kits (Page 133)
- Ordering spare parts via the Internet (Page 134)

9.2.6.8 Maintaining terminal boxes

Requirement

The machine is de-energized.

Checking the terminal box

- Terminal boxes must be regularly checked for tightness, undamaged insulation, and tight terminal connections.
- If dust or humidity have infiltrated the terminal box, this should be cleaned and dried (particularly the insulators).
  Check all the seals and sealing surfaces and address the cause of the leakiness.

- Check the insulators, connectors and cable connections in the terminal box.
- Replace the damaged components if necessary.

⚠ WARNING

Short-circuit hazard

Damaged components can cause short circuits, possibly resulting in death, serious injuries and property damage.

Replace damaged components.

9.3 Repair

When carrying out any work on the machine, observe the general safety instructions (Page 15) and the specifications contained in EN 50110-1 regarding safe operation of electrical equipment.

Note

If the motor has to be transported, please observe the information and instructions in the "Transport" (Page 36) section.

9.3.1 Prepare servicing work

- The drawings and parts lists do not contain any detailed information about the type and dimensions of fixing elements and components. For this reason, you should establish this information when dismantling them and make a note of it for the purpose of reassembly.
- Document the type, dimensions and arrangement of the parts so that you will be able to reassemble the machine to its original state.
- Use suitable tools to disassemble the machine.
- Take measures to prevent parts from dropping down before you dismantle them, e.g. by replacing fastening elements with extra-long screws, threaded bolts or similar. This ensures that the part is supported after it is pulled off.
- The centerings in the shaft extensions have reset threads. Use lifting gear which is suitable for the rotor weight and direction of loading.

⚠ WARNING

Rotor can fall down

Eyebolts in accordance with DIN 580 are unsuitable for suspending the rotor. The rotor can fall off. This can result in death, serious injury or material damage.

Use lifting gear which is suitable for the rotor weight and direction of loading.

⚠ WARNING

Machine damage caused by improper repair work

Improper servicing work can damage the machine. This can cause damages and/or faults which can result in eventual or immediate death, serious injury, or property damage.

- Properly assemble or disassemble the machine.
- Use only suitable tools and equipment.
- Immediately replace damaged components.
- Contact the Service Center (Page 161), if necessary.

9.3.2 Screws with preCOTE coating

The motor can partly be fitted with screws with preCOTE coating. To ensure screw locking, use new screws with preCOTE coating during assembly/repair. As an alternative, use normal screws with a threadlocker such as Loctite.

9.3.3 Disassembling a water-cooled motor

The drawings and parts lists do not contain any detailed information about the type and dimensions of fixing elements, etc.

NOTICE

Removing centered parts

Centered parts can be damaged if removed improperly with unsuitable tools.

Use pullers or suitable devices to remove parts and components attached to the motor shaft.

Disassembly

1. Unscrew the water pipes.
2. Ensure you do not damage insulation when dismantling the device. Check the insulation for possible damage prior to re-installing.
3. To disassemble the motor, disconnect the connecting cables from the terminals and the entry plate from the terminal box housing.
   In this way, the respective positioning of the cables in relation to one another and the sealing of the cables in the cable entries are maintained to a large extent.
4. Remove the cable at the outer grounding terminal
5. Pull out the connector of the speed sensor.

Links

The circuit diagram (Page 69) shows the relationships required when connecting to the line supply.

Component assignment

When dismantling or assembling the bearing pay attention to the proper arrangement of the components particularly if the bearing is the same size on the DE side and NDE side, for example:

- Bearing shield
- Bearings
- Corrugated springs
- Covers with different centering length, etc.

See also

Service and Support (Page 161)

9.3.4 Dissembling a force-ventilated motor

The drawings and parts lists do not contain any detailed information about the type and dimensions of fixing elements, etc.

NOTICE
Removing centered parts
Centered parts can be damaged if removed improperly with unsuitable tools.
Use pullers or suitable devices to remove parts and components attached to the motor shaft.

Disassembly

1. Ensure you do not damage insulation when dismantling the device. Check the insulation for possible damage prior to re-installing.
2. To disassemble the motor, disconnect the connecting cables from the terminals and the entry plate from the terminal box housing.
   In this way, the respective positioning of the cables in relation to one another and the sealing of the cables in the cable entries are maintained to a large extent.
3. Remove the connecting cables in the terminal box of the fan motor, and if necessary the cable on the ground terminal and the cables laid out on the motor.
4. Pull out the connector of the speed sensor.

Links

The circuit diagram (Page 69) shows the relationships required when connecting to the line supply.

Component assignment

When dismantling or assembling the bearing pay attention to the proper arrangement of the components particularly if the bearing is the same size on the DE side and NDE side, for example:

- Bearing shield
- Bearings
- Compression springs
- Spacer washers,
- Covers with different centering length, etc.

See also

Service and Support (Page 161)

If roller-contact bearings with an insulated design are installed, use roller bearings of the same type as spare parts. This will prevent any bearing damage being caused by bearing currents.

9.3.5 Removing and installing the protecting ring

The protecting ring acts as an outer bearing seal. It sits on the shaft outside the bearing end shield.

Disassembly

- Once the coupling is detached, you can remove the protective ring from the shaft. After it has been removed, the protective ring will be deformed and must be replaced.

Assembly

- Push the protecting ring over the end of the shaft.
- For 1PH818. or 1PH822. motors, ensure that the outer collar is placed with a space of 1 mm from the bearing end shield (detail Z).

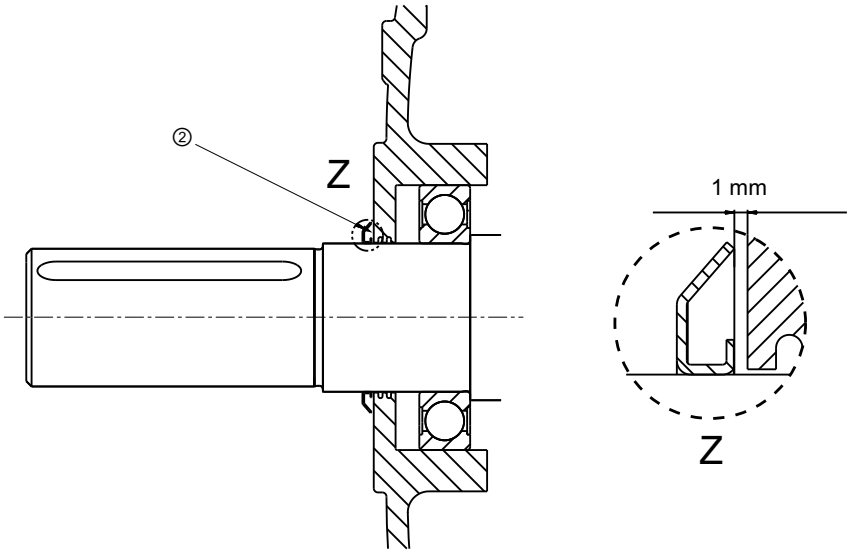


Figure 9-3 Fitting the protecting ring

9.3.6 Removing and mounting the bearing shields

1. Unscrew the belt pulleys. The belt pulleys may be jammed or distorted, in which case you should lever them off carefully.
2. Remove the bearing shield.
   - When removing the bearing shields, take care that the windings are not damaged.
   - For water-cooled motors, also ensure that the cooling water pipes are not damaged.

For assembly, proceed in reverse order.

⚠ WARNING

Lifting using the cooling water pipes

The cooling water pipe system has not been designed so that it can be used to lift the motor. The machine can fall when lifted. Death, serious injury, or material damage will result.

- Only use the eyebolts on the bearing shields to transport and lift the motor.

9.3.7 Installing and sealing the motor

Strictly ensure the greatest possible care and cleanliness when repairing the machine.

Mount the machine on an alignment plate. This ensures that the contact surfaces of the motor feet are all on the same level.

NOTICE
Do not damage windings Windings protrude from the stator housing and can be damaged when attaching the end shield. This can damage the motor. When mounting the end shield, ensure that the windings that project from the stator housing are not damaged.

Sealing the machine (types 1PH818. and 1PH8225.)

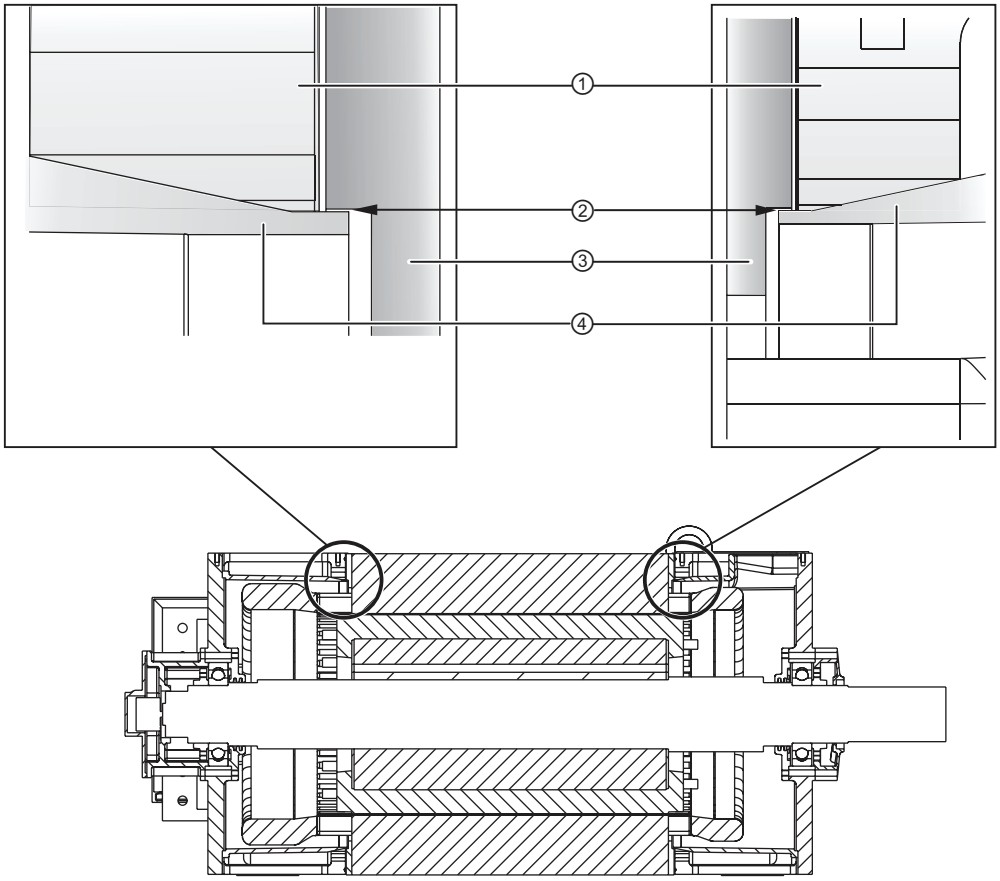
- Clean bare joints between parts before re-assembling (e.g. between enclosures, end shields and the active parts of bearings).
- Brush the bare joints with the non-hardening sealing agent "Hylomar M".
- Note that these joints between parts (e.g. the sealing gap on the active part of the bearing) must also be resealed with a suitable, silicone-free sealant during assembly.
- Check the sealing elements fitted (e.g. at the terminal boxes) and replace them if they do not provide an adequate seal.
- Follow the manufacturer's application and safety instructions when using the sealant.
- Replace parts that are subject to wear such as the adjusting springs.

Installing the bearing inserts

1. First position the parts that must be arranged on the shaft within the bearing.
2. To fit the bearings on the shaft, heat them up to about 80 °C in oil or air.
3. Then push the bearings onto the shaft up to its shoulder. Avoid any heavy blows that might damage the bearings.
4. Fill the bearing to the top with the specified lubricating grease (Page 110).

9.3.8 Sealing the motor (type 1PH828.)

1. When assembling, seal the joints between parts, such as the sealing gap between the enclosure and bearing shield, using suitable, silicon-free sealing compound.
2. Use joint sealant due to the higher requirements for degree of protection IP55.
   Seal the joint ② using a non-hardening sealant, which remains permanently plastic, before screwing on the bearing shields, for example "Hylomar M".
3. Check all the sealing elements, for example on the terminal box, for elasticity, aging or damage. Replace any sealing elements if they are no longer fully effective.



① End shields
② Sealing gap
③ Housing
④ Protective tube

Figure 9-4 Sealing gap between the enclosure and bearing shields (schematic representation)

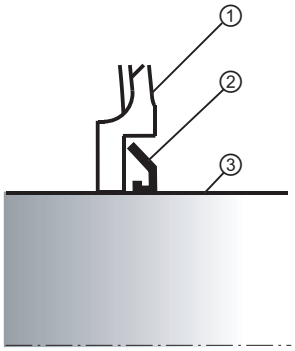
Installing the active parts of the bearings

- When installing/replacing the bearing, ensure that an insulated bearing is again installed at the NDE.
- If radial shaft seals without helical springs are installed, also install the replacement part without a spring.

Sealing the bearings

The outer bearing seal comprises a rotary shaft seal.

- When installing the bearings, make sure that the seat of the shaft is not greased.
- The correct axial position of the rotary shaft seal is achieved when the outer edges of the bearing cap end face ① and rotary shaft seal ② are flush.



① Bearing cap end face
② Rotary shaft seal
③ Seat of shaft

Figure 9-5 Installing the rotary shaft seal

See also

Installing and sealing the motor (Page 123)

9.3.9 Relocating the external fan (type 1PH828.)

Subsequently moving the external fan from NDE to DE or vice versa must only be carried out by qualified personnel or a Siemens Service Center (Page 161).

9.3.10 Removing and mounting the external fan

⚠ WARNING

Live parts

Contact with live parts can cause death, serious injury or material damage.

1. Before carrying out any maintenance work on the device, disconnect it from the line supply, particularly before opening the terminal box.
2. Make sure that the device cannot be switched back on.

Removing and mounting the external fan

1. Before carrying out any maintenance work on the device, disconnect it from the line supply.
2. Unscrew the screws ① and remove the external fan.
3. For mounting, proceed in reverse order.

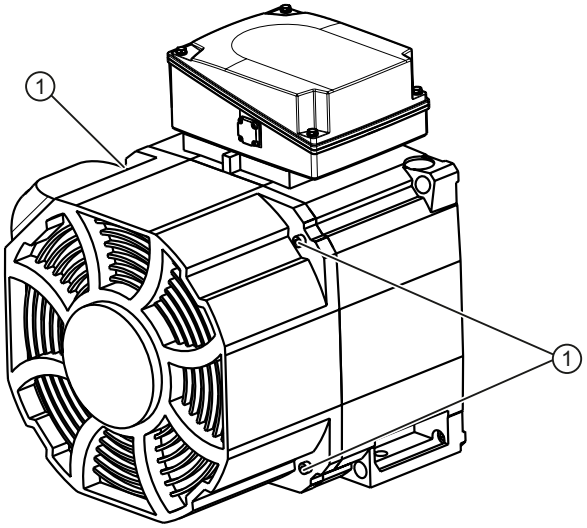


Figure 9-6 Unscrewing the external fan (1PH818., 1PH822.)

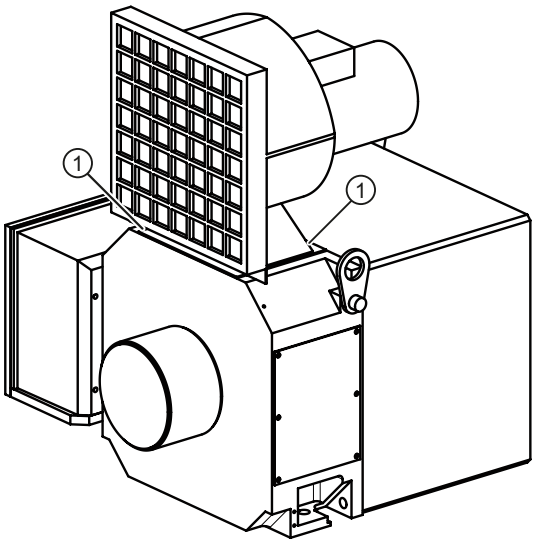


Figure 9-7 Unscrewing the external fan (1PH828.)

See also

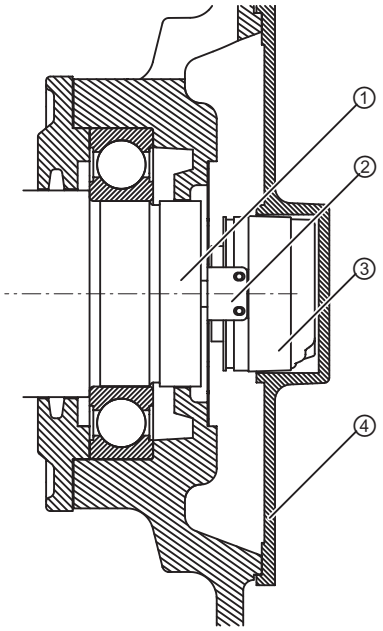
Operating instructions for the three-phase EC external fan, suction, SK180 (Page 249)

9.3.11 Removing and mounting the speed sensor

NOTICE
Electrostatic discharge
Electronic modules contain components that can be seriously damaged by electrostatic discharge. These modules can easily be destroyed unless they are handled properly.
To protect your equipment against damage, follow the instructions given in the section headed "Electrostatic Sensitive Devices" (Page 18).

Preparation

For 1PH818. and 1PH822. motors, the speed encoder can only be removed and replaced if the external fan (Page 126) has been removed.



①	Shaft	③	Speed encoder
②	Torque arm	④	Encoder cover

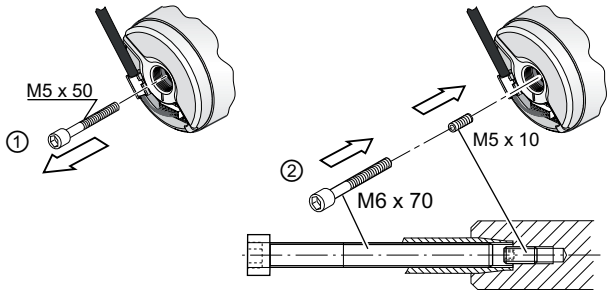
Figure 9-8 Detailed view of the speed encoder

1. Unscrew the cover of the speed encoder.
2. Detach the electrical connection.
   - Pull the cable carefully out of its holder.
   - Pull out the connector.
3. Remove the screwed union connections for the speed encoder from the bearing shield.

Separating the speed encoder

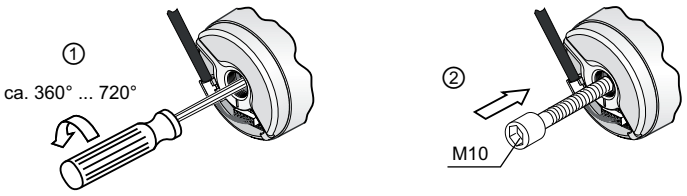
The following options are available for the purpose of separating the speed encoder from the shaft by means of a clamping screw:

Disassembling the speed encoder - Version A



1. Remove screw M5x50 (①).
2. Screw in screw M5x10 and screw M6x70 one after the other. This releases the encoder cone in the motor shaft (②).
3. Remove the speed encoder.

Removing the speed encoder - version B



1. Loosen the retaining screw (①).
2. Press screw M10 onto the original screw. This will then drop out (②).
3. Remove the speed encoder.

Mounting the speed encoder

1. Screw the torque arm to the speed encoder, tightening the two screws by hand.
2. Use the M5x50 screw to secure the speed encoder over the internal cone, ensuring a tightening torque of 5 Nm at the shaft extension.
3. Attach the torque arm to the bearing cover with a tightening torque of 3 Nm.
4. Loosen the screws of the torque arm so as to relieve the stress and tighten them crosswise, with a tightening torque of 0.6 Nm.
5. Establish the electrical connection.
6. Screw on the cover of the speed encoder.

9.3.12 Connecting the speed encoder

NOTICE

Electrostatic discharge

Electronic modules contain components that can be seriously damaged by electrostatic discharge. These modules can easily be destroyed unless they are handled properly.

To protect your equipment against damage, follow the instructions given in the section headed "Electrostatic Sensitive Devices" (Page 18).

1. Insert the connector into the socket.
2. Press the cable into the holder provided for it.
3. Screw on the sensor cover. Take care that you do not catch the cable as you screw it in.

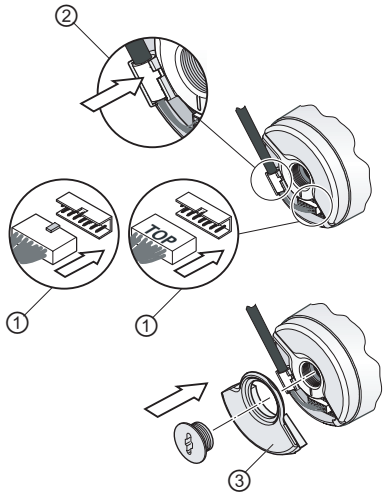


Figure 9-9 Electrical connection of the speed sensor

9.3.13 Replacing the DRIVE-CLiQ interface (encoder module)

Only trained Siemens service engineers (Page 161) are authorized to replace the DRIVE-CLiQ interface (sensor module).

NOTICE

Electrostatic discharge

Electronic modules contain components that can be destroyed by electrostatic discharge. These modules can be easily destroyed by improper handling.

To protect your equipment against damage, follow the instructions given in the chapter ESD Guidelines (Page 18).

⚠ WARNING

Motor-specific sensor module

The Sensor Module contains motor-specific and sensor-specific data and an electronic nameplate.

If you operate a different Sensor Module on the motor, this can result in serious injury or death, or cause considerable material damage.

Only operate the sensor module on the original motor. Do not install the sensor module on other motors. Do not replace the sensor module with a sensor module from a different motor.

9.3.14 Touch up any damaged paintwork

If the paint is damaged, it must be repaired in order to protect the unit against corrosion.

Note

Paint system

Contact the Service Center (Page 161) before you repair any paint damage. They will provide you with more information about the correct paint system and methods of repairing paint damage.

Spare parts 10

10.1 Ordering data

When ordering spare parts, in addition to the precise designation of the spare part, specify the motor type and the serial number of the motor. Ensure that the spare part designation matches the designation in the spare part lists and add the associated part number.

Example:

Spare part	Spare parts kit, drive-end bearing (Part 3.00)
Machine type	1PH81841JD202FA1
Serial number	N-W91246206010001

The machine type and the serial number are indicated on the rating plate and in the technical data, and are also embossed on the drive end of the shaft.

Note

Bar code on rating plate

You can also read the machine type and serial number from the bar code on the rating plate.

Note

The graphics in this chapter are **schematic representations** of the basic versions. They are used for spare parts definitions. The supplied version may differ in details from these representations.

10.2 Spare parts kits

The spare parts are bundled with the necessary wearing parts in a logical way so as to create spare parts kits.

The following spare parts kits are available for you to order:

3.00	Spare parts kit, non-drive-end bearing (complete)
4.00	Spare parts kit, drive-end bearing (complete)
32.00	Spare parts kit, external fan (only force-ventilated motors)
55.00	Spare parts kit, relevant version of speed encoder

Additional spare parts are available on request.

See also

Service and Support (Page 161)

Note

DRIVE-CLiQ interface

If you order a DRIVE-CLiQ interface, please specify when ordering from Spares on Web that the DRIVE-CLiQ interface must be described along with the motor data.

If roller-contact bearings with an insulated design are installed, use roller bearings of the same type as spare parts. This will prevent any bearing damage being caused by bearing currents.

10.3 Holding brake

Contact your Service Center for spare parts for the holding brake.

See also

Operating instructions, holding brake (Page 169)

10.4 Ordering spare parts via the Internet

You can use "Spares on Web" to determine the order numbers for motor spare parts quickly and easily.

Spares on Web (https://www.automation.siemens.com/sow).

A short description of how to use "Spares on Web" is available on the Internet.

Guide for Spares on Web (http://support.automation.siemens.com/WW/news/en/25248626).

10.5 Anti-condensation heating

The anti-condensation heater is mounted directly on the winding. The anti-condensation heater cannot be removed without causing damage to the winding. A new anti-condensation heater may only be installed by Siemens Service Center (Page 161) specialists.

10.6 Water-cooled motor

10.6.1 Water-cooled motor, complete

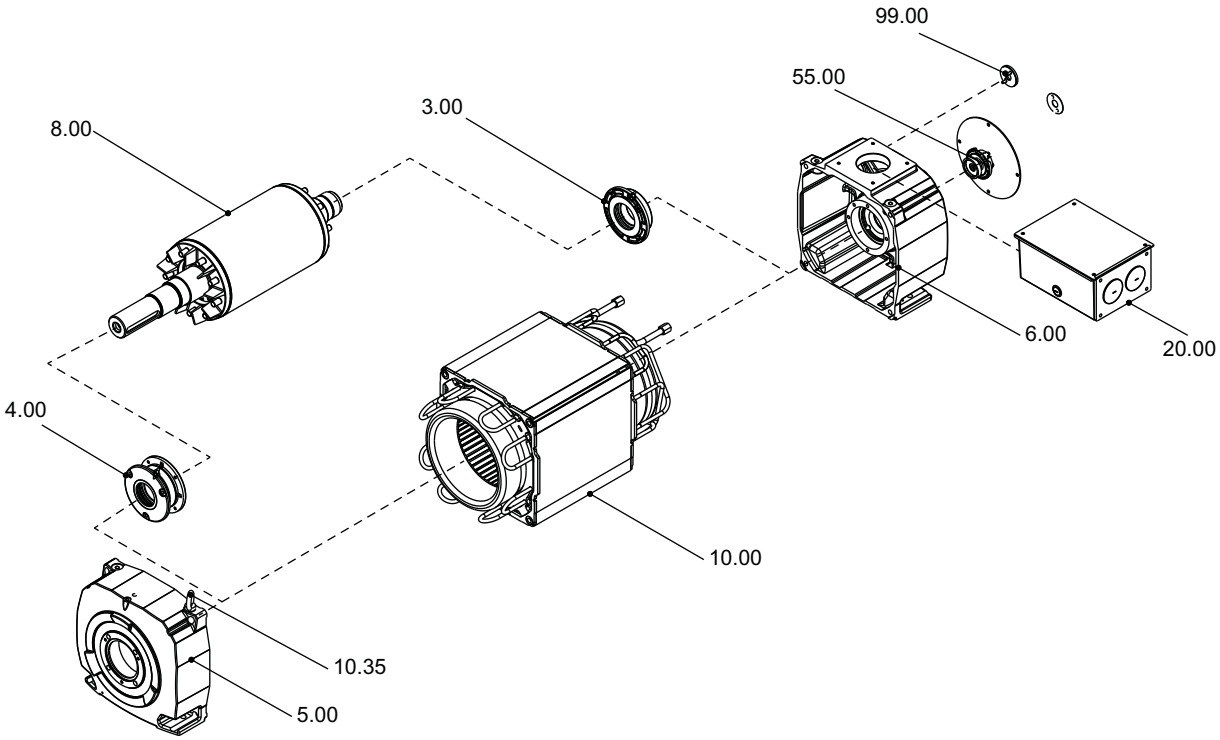


Figure 10-1 Schematic diagram of motor (complete)

Table 10-1 Motor, complete

Number	Designation	Number	Designation
3.00	Spare parts kit, non-drive-end bearing	8.00*	Rotor, complete
4.00	Spare parts kit, drive-end bearing	10.00*	Stator housing (with laminated core, winding and cooling water pipe system)
55.00	Spare parts kit, speed encoder	10.35*	Hoisting lug
5.00*	Bearing shield, drive end	20.00*	Terminal box
6.00*	Bearing shield, non-drive end	99.00*	Special built-on parts

* On request

10.6.2 Roller bearing cartridge DE with radial shaft sealing ring with regreasing

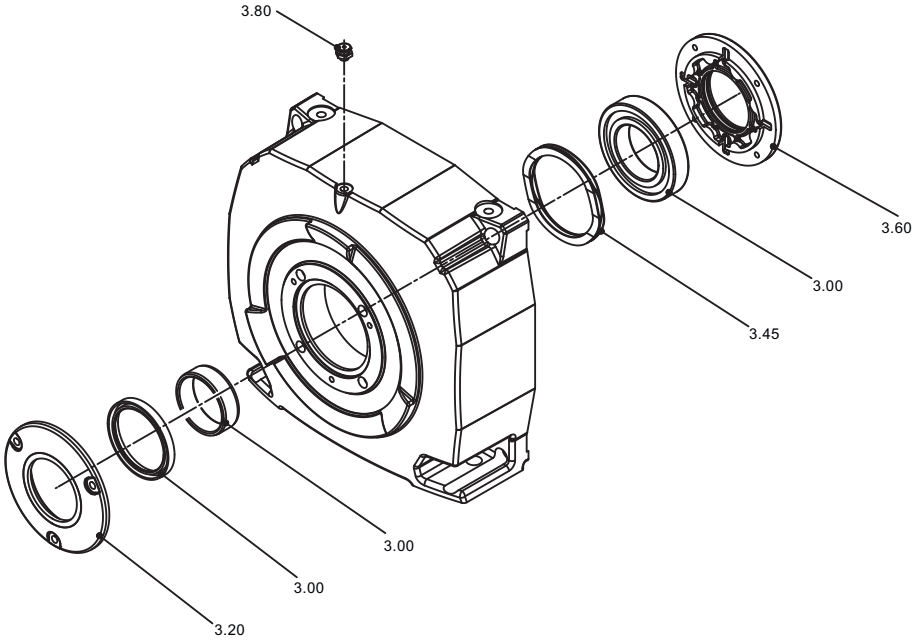


Figure 10-2 Rolling-contact bearing bush drive end with mounted gearing, with regreasing

Table 10-2 Spare parts for rolling-contact bearing bush drive end with mounted gearing, with regreasing

Number	Designation	Number	Designation
3.00	Spare parts kit, drive-end bearing • Deep-groove ball bearing (floating bearing) • Radial shaft sealing ring • Inner ring	3.60*	Inner bearing cover
3.20*	Outer bearing cover	3.80*	Grease nipple
3.45*	Corrugated spring/compression springs		

* On request

10.6.3 Rolling-contact bearing bush drive end, belt coupling

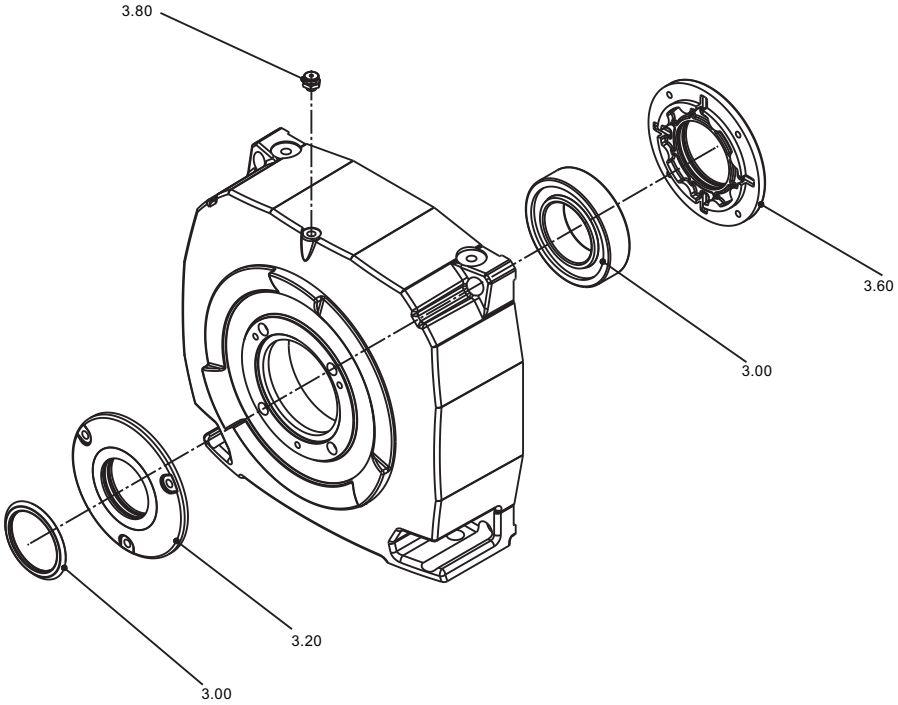


Figure 10-3 Rolling-contact bearing bush drive end with belt coupling, with regreasing

Table 10-3 Spare parts for rolling-contact bearing bush drive end with belt coupling, with regreasing

Number	Designation	Number	Designation
3.00	Spare parts kit, drive-end bearing • Cylindrical-roller bearing (floating bearing) • Protecting ring (rotating)	3.60*	Inner bearing cover
3.20*	Outer bearing cover	3.80*	Grease nipple

* On request

10.6.4 Rolling-contact bearing bush drive end, coupling output, with regreasing

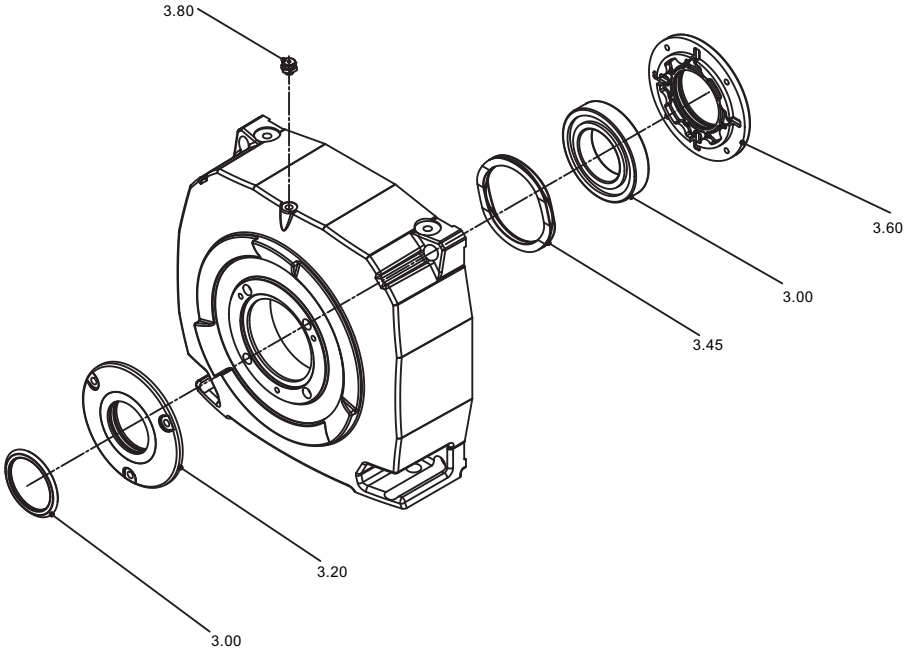


Figure 10-4 Rolling-contact bearing bush drive end, with coupling output, with regreasing

Table 10-4 Spare parts for rolling-contact bearing bush drive end, with coupling output, with regreasing

Number	Designation	Number	Designation
3.00	Spare parts kit, drive-end bearing • Deep-groove ball bearing (floating bearing) • Protecting ring (rotating)	3.60*	Inner bearing cover
3.20*	Outer bearing cover	3.80*	Grease nipple
3.45*	Corrugated spring		

* On request

10.6.5 Rolling-contact bearing bush drive end, coupling output, with permanent lubrication

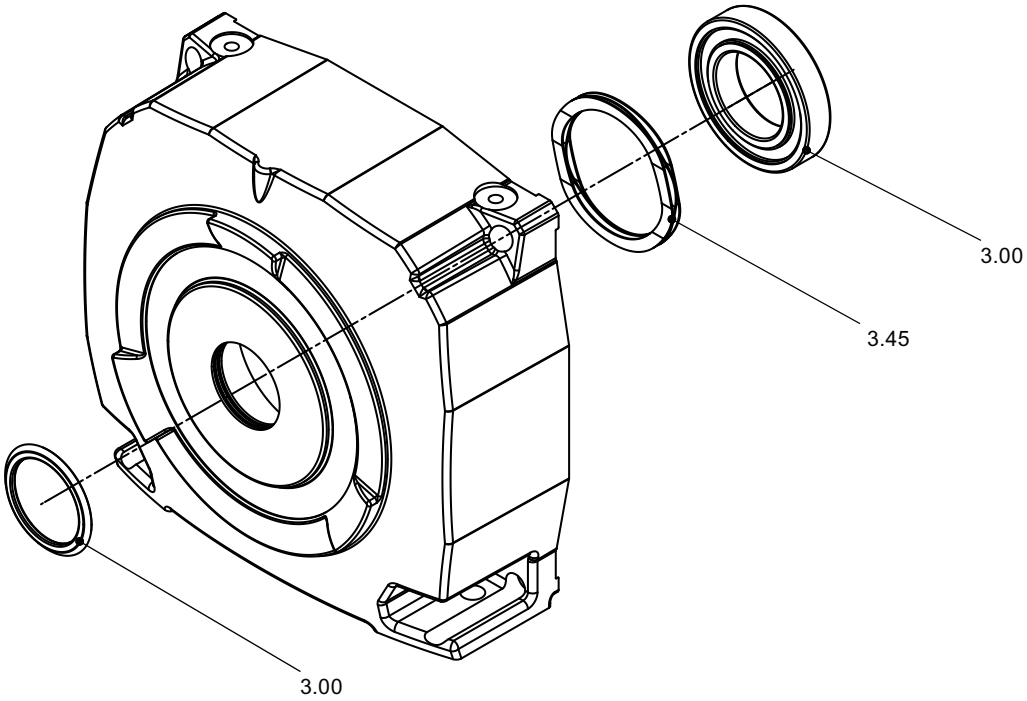


Figure 10-5 Rolling-contact bearing bush drive end, with coupling output, with permanent lubrication

Table 10-5 Spare parts for rolling-contact bearing bush drive end, with coupling output, with permanent lubrication

Number	Designation
3.00	Spare parts kit, drive-end bearing • Deep-groove ball bearing (floating bearing) • Protecting ring (rotating)
3.45*	Corrugated spring/compression springs

* On request

10.6.6 Rolling-contact bearing bush non-drive end, with permanent lubrication

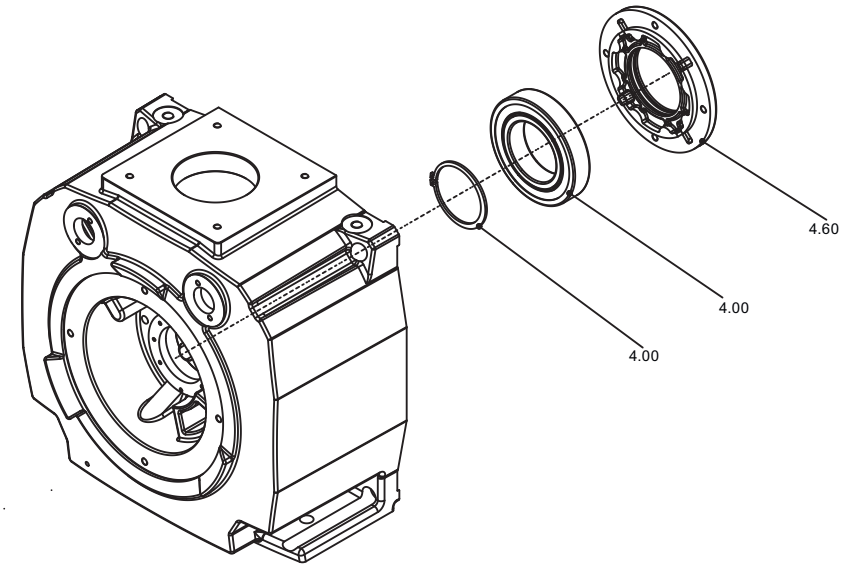


Figure 10-6 Rolling-contact bearing bush non-drive end, permanent lubrication

Table 10-6 Spare parts for rolling-contact bearing bush non-drive end, permanent lubrication

Number	Designation
4.00	Spare parts kit, non-drive-end bearing • Deep-groove ball bearing (locating bearing) • Retaining ring
4.60*	Inner bearing cover

* On request

10.6.7 Roller bearing cartridge NDE, with regreasing (type 1PH818., 1PH822.)

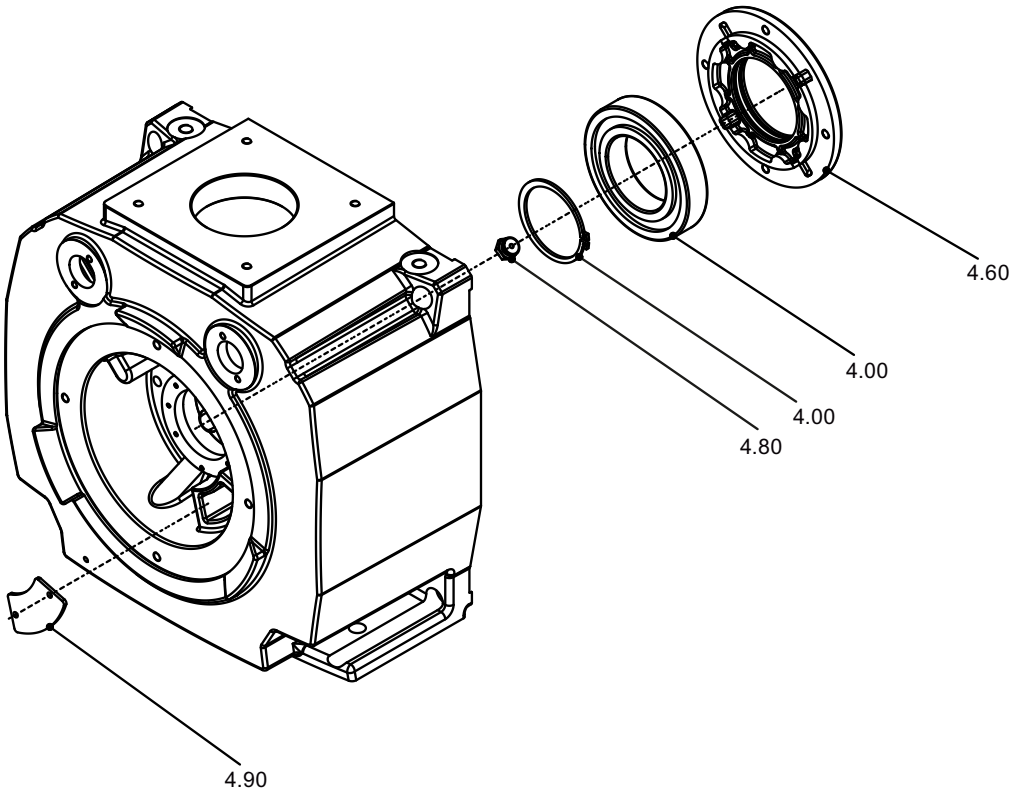


Figure 10-7 Roller bearing cartridge NDE, with regreasing (type 1PH818., 1PH822.)

Table 10-7 Spare part, roller bearing cartridge NDE, with regreasing (type 1PH818., 1PH822.)

Number	Designation	Number	Designation
4.00	Spare parts kit, NDE bearing • Deep-groove ball bearing (locating bearing) • Retaining ring	4.80*	Grease nipple
4.60*	Inner bearing cover	4.90*	Cover of spent grease chamber

* On request

10.6.8 Roller bearing cartridge NDE, with regreasing (type 1PH828.)

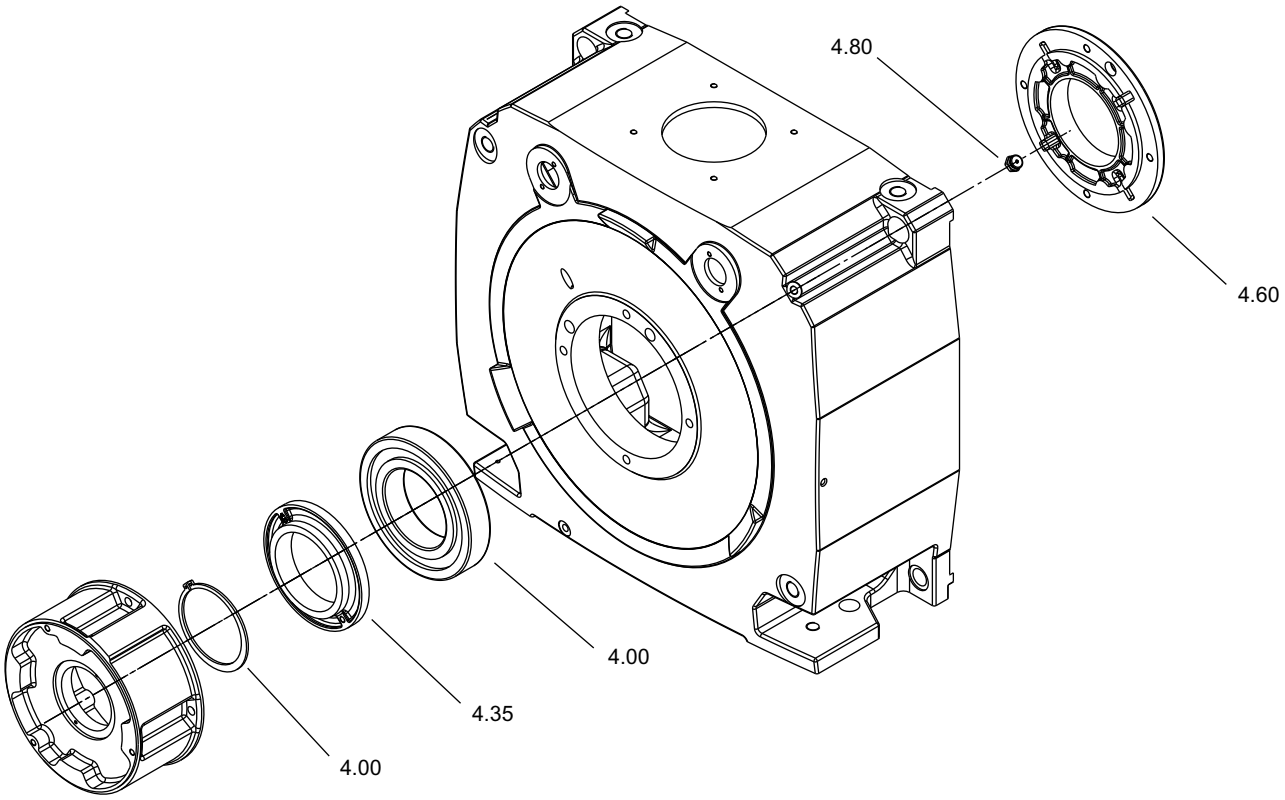


Figure 10-8 Roller bearing cartridge NDE, with regreasing (type 1PH828.)

Table 10-8 Spare part, roller bearing cartridge NDE, with regreasing (type 1PH828.)

Number	Designation	Number	Designation
4.00	Spare parts kit, NDE bearing • Deep-groove ball bearing (locating bearing) • Retaining ring	4.80* 4.60*	Grease nipple Inner bearing cover

* On request

10.6.9 Rolling-contact bearing bush non-drive end "Performance"

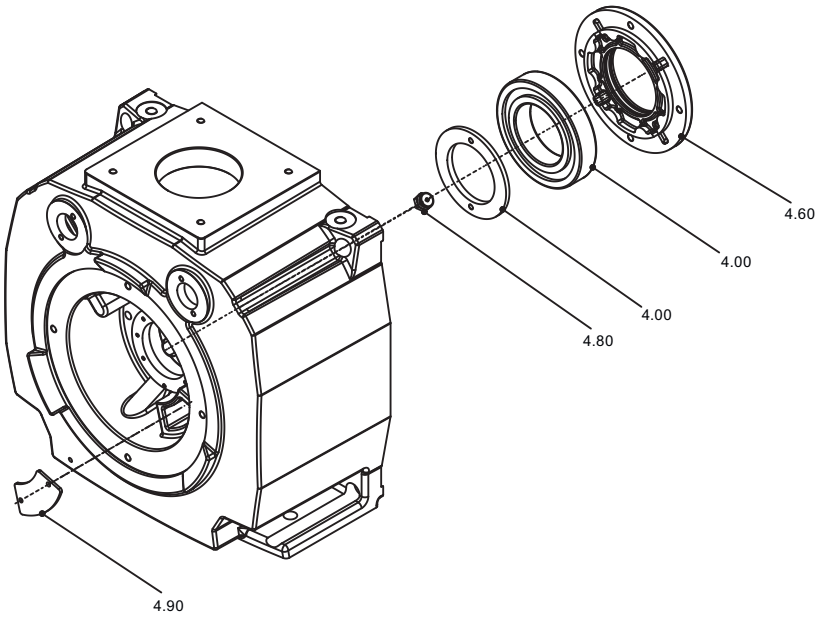


Figure 10-9 Rolling-contact bearing bush non-drive end with regreasing

Table 10-9 Spare parts for rolling-contact bearing bush non-drive end with regreasing

Number	Designation	Number	Designation
4.00	Spare parts kit, non-drive-end bearing • Deep-groove ball bearing (locating bearing) • Shrink ring	4.80*	Grease nipple
4.60*	Inner bearing cover	4.90*	Cover of spent grease chamber

* On request

10.7 Force-ventilated motor

10.7.1 Force-ventilated motor, complete

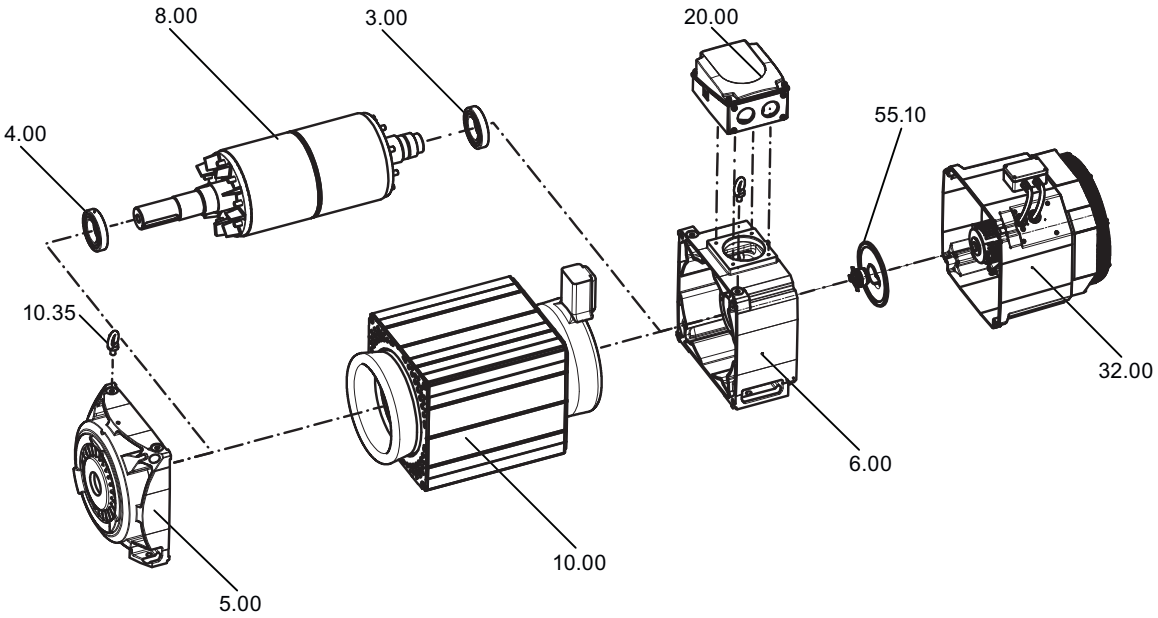


Figure 10-10 Schematic representation of the motor, complete

Table 10-10 Motor, complete

Number	Designation	Number	Designation
3.00	Spare parts kit, NDE bearing	10.00*	Stator housing (with laminated core and winding)
4.00	Spare parts kit, DE bearing	10.35*	Eyebolt
5.00*	Bearing shield, DE	20.00*	Terminal box
6.00*	Bearing shield, NDE	32.00	External fan
8.00*	Rotor, complete	55.10	Spare parts kit, speed encoder

* On request

10.7.2 External fan

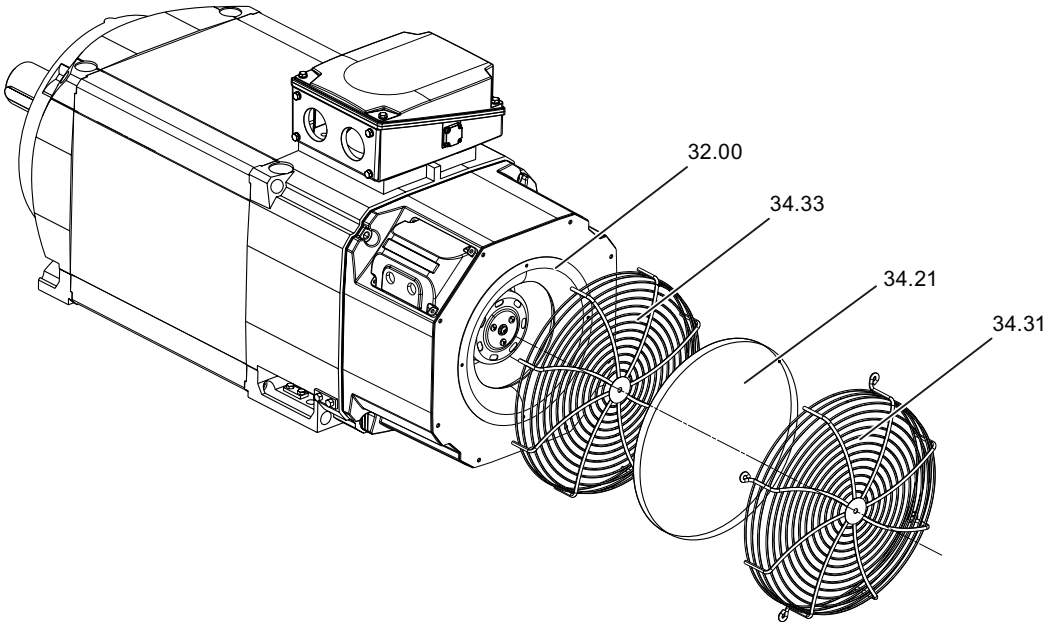


Figure 10-11 Spare parts for external fan (type 1PH818., 1PH822.)

Table 10-11 Spare parts for external fan

Part	Description	Part	Description
32.00	Fan	34.31	External grill cover
34.21	Filter element *	34.33	Inside basket

* Option for type 1PH828.

10.7.3 External fan (option L75)

The external fan for option L75 can only be ordered as a part. Contact the Service Center, if necessary.

10.7.4 Roller bearing cartridge DE with radial shaft sealing ring with regreasing

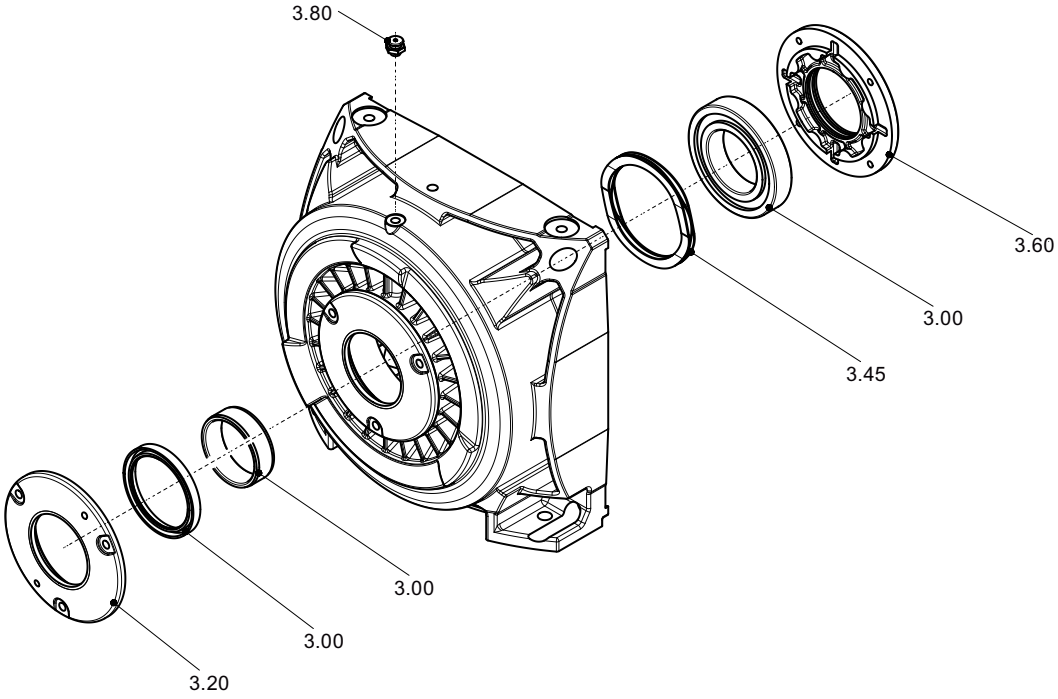


Figure 10-12 Rolling-contact bearing bush drive end with mounted gearing, with regreasing

Table 10-12 Spare parts for rolling-contact bearing bush drive end with mounted gearing, with regreasing

Number	Designation	Number	Designation
3.00	Spare parts kit, drive-end bearing • Deep-groove ball bearing (floating bearing) • Radial shaft sealing ring • Inner ring	3.60*	Inner bearing cover
3.20*	Outer bearing cover	3.80*	Grease nipple
3.45*	Corrugated spring/compression springs		

* On request

10.7.5 Roller bearing cartridge DE, belt coupling

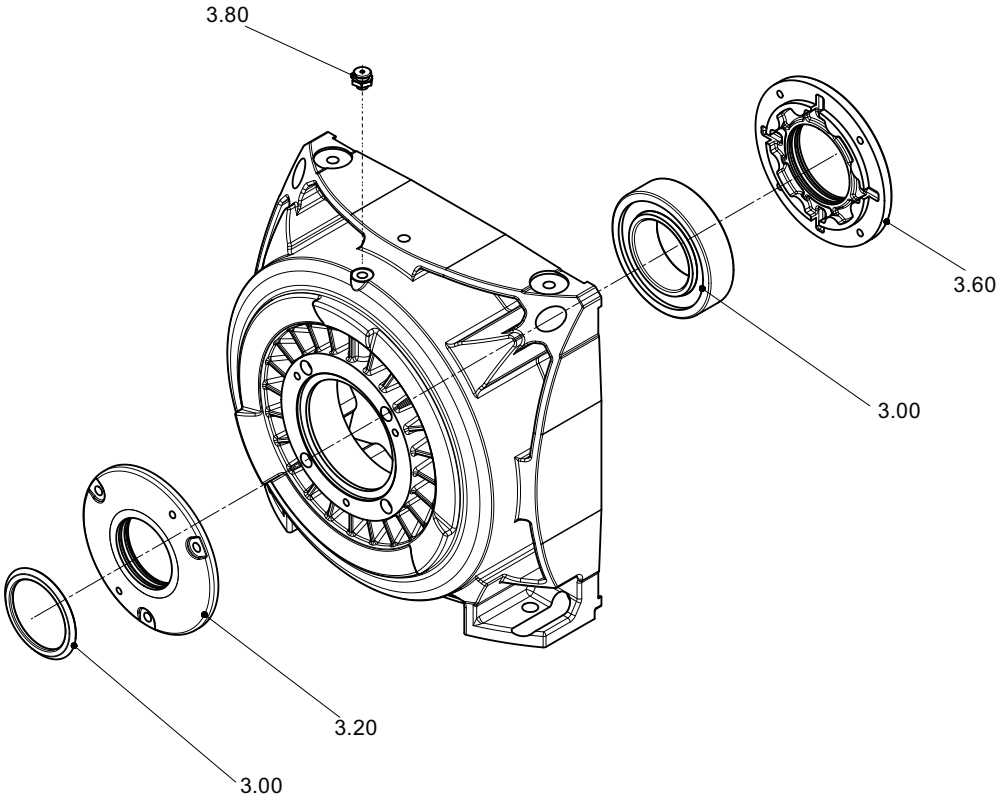


Figure 10-13 Rolling-contact bearing bush drive end with belt coupling, with regreasing

Table 10-13 Spare parts for rolling-contact bearing bush drive end with belt coupling, with regreasing

Number	Designation	Number	Designation
3.00	Spare parts kit, drive-end bearing • Cylindrical-roller bearing (floating bearing) • Protecting ring (rotating)	3.60*	Inner bearing cover
3.20*	Outer bearing cover	3.80*	Grease nipple

* On request

10.7.6 Roller bearing cartridge DE, coupling output, with regreasing

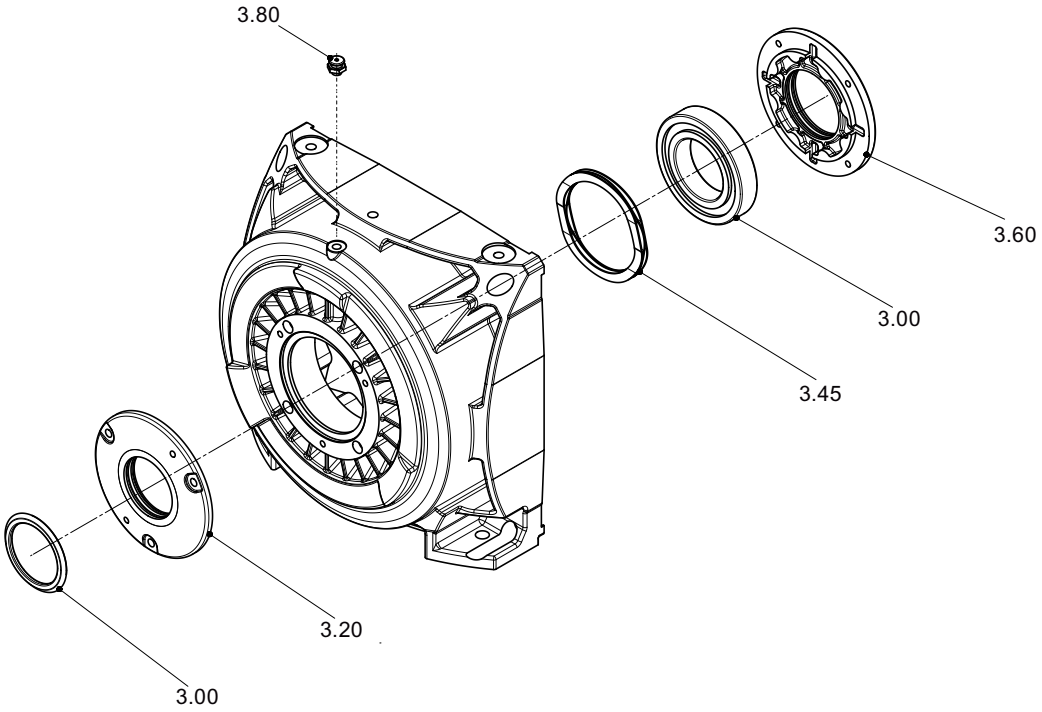


Figure 10-14 Rolling-contact bearing bush drive end, with coupling output, with regreasing

Table 10-14 Spare parts for rolling-contact bearing bush drive end, with coupling output, with regreasing

Number	Designation	Number	Designation
3.00	Spare parts kit, drive-end bearing • Deep-groove ball bearing (floating bearing) • Protecting ring (rotating)	3.60*	Inner bearing cover
3.20*	Outer bearing cover	3.80*	Grease nipple
3.45*	Corrugated spring		

* On request

10.7.7 Roller bearing cartridge DE, coupling output, with permanent lubrication

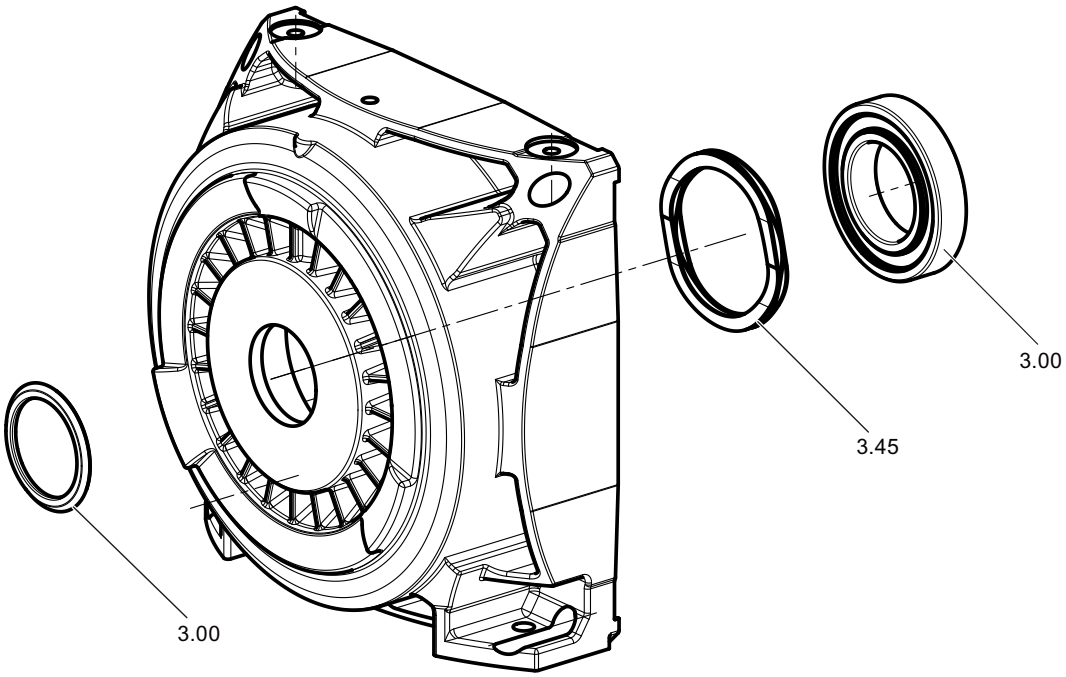


Figure 10-15 Rolling-contact bearing bush drive end, with coupling output, with permanent lubrication

Table 10-15 Spare parts for rolling-contact bearing bush drive end, with coupling output, with permanent lubrication

Number	Designation
3.00	Spare parts kit, drive-end bearing • Deep-groove ball bearing (floating bearing) • Protecting ring (rotating)
3.45*	Corrugated spring/compression springs

* On request

10.7.8 Roller bearing cartridge NDE, with permanent lubrication

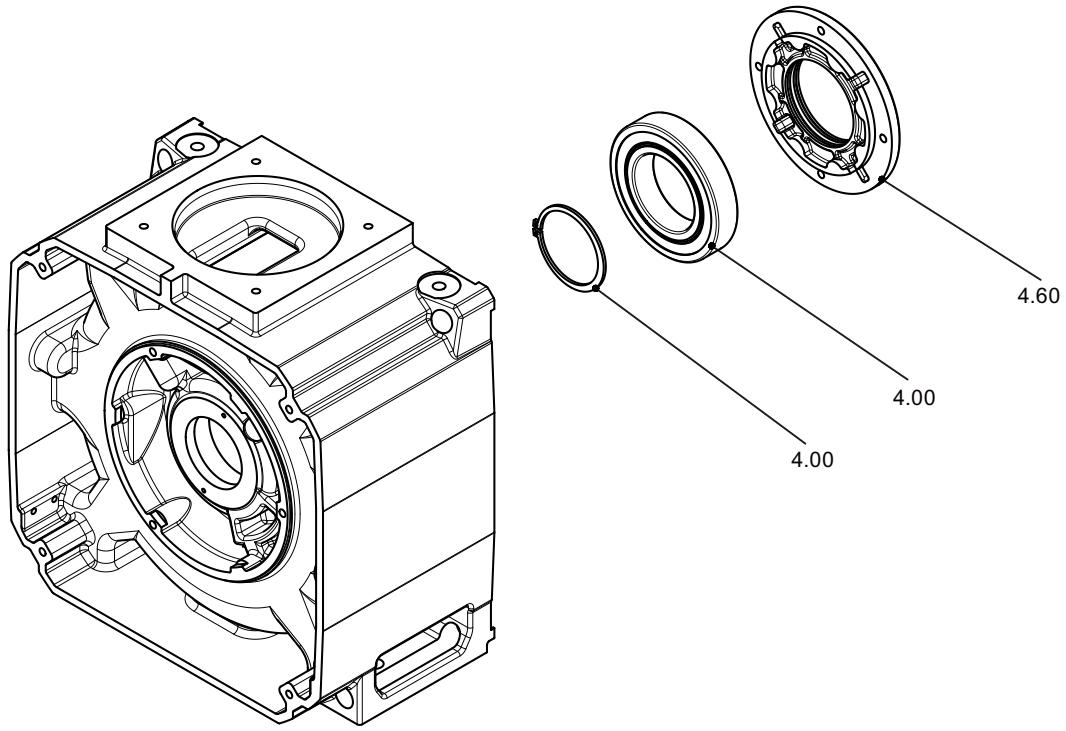


Figure 10-16 Roller bearing cartridge, non-drive end, permanent lubrication

Table 10-16 Spare parts for roller bearing cartridge, non-drive end, permanent lubrication

Number	Designation
4.00	Spare parts kit, NDE bearing • Deep-groove ball bearing (locating bearing) • Retaining ring
4.60*	Inner bearing cover

* On request

10.7.9 Roller bearing cartridge NDE, with regreasing (type 1PH818., 1PH822.)

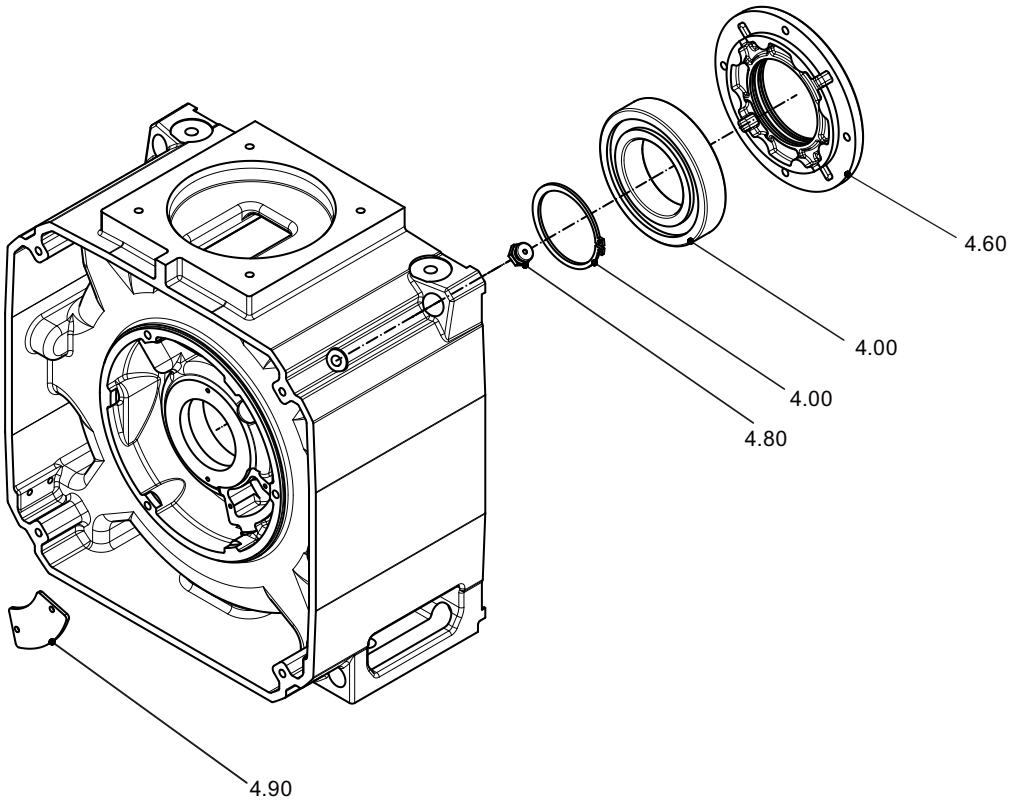


Figure 10-17 Roller bearing cartridge NDE, with regreasing (type 1PH818., 1PH822.)

Table 10-17 Spare part, roller bearing cartridge NDE, with regreasing (type 1PH818., 1PH822.)

Number	Designation	Number	Designation
4.00	Spare parts kit, NDE bearing • Deep-groove ball bearing (locating bearing) • Retaining ring	4.80*	Grease nipple
4.60*	Inner bearing cover	4.90*	Cover of spent grease chamber

* On request

10.7.10 Roller bearing cartridge NDE, with regreasing (type 1PH828.)

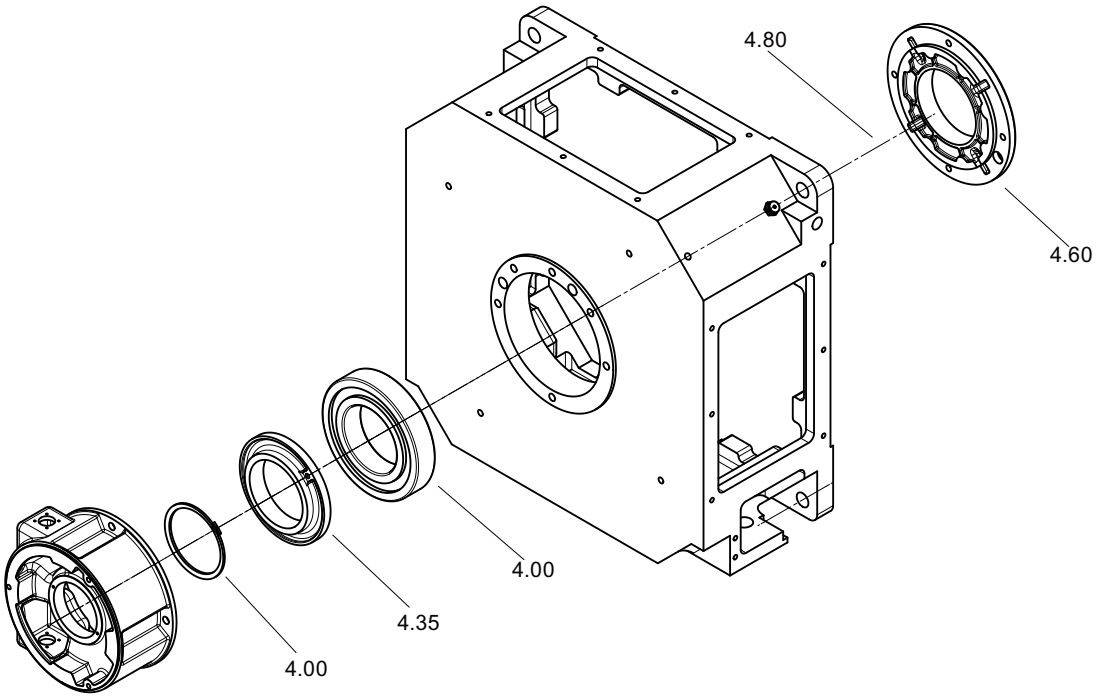


Figure 10-18 Roller bearing cartridge NDE, with regreasing (type 1PH828.)

Table 10-18 Spare part, roller bearing cartridge NDE, with regreasing (type 1PH828.)

Number	Designation	Number	Designation
4.00	Spare parts kit, NDE bearing • Deep-groove ball bearing (locating bearing) • Retaining ring	4.80* 4.60*	Grease nipple Inner bearing cover

* On request

10.7.11 Roller bearing cartridge NDE, "Performance"

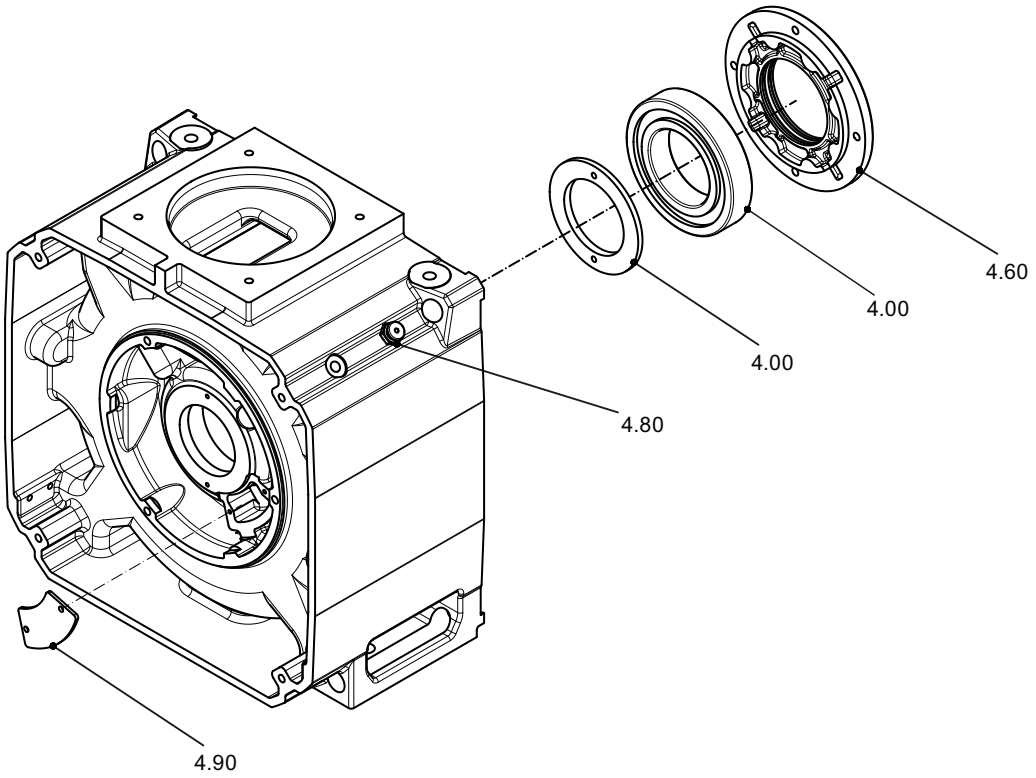


Figure 10-19 Rolling-contact bearing bush non-drive end with regreasing

Table 10-19 Spare parts for rolling-contact bearing bush non-drive end with regreasing

Number	Designation	Number	Designation
4.00	Spare parts kit, non-drive-end bearing • Deep-groove ball bearing (locating bearing) • Shrink ring	4.80*	Grease nipple
4.60*	Inner bearing cover	4.90*	Cover of spent grease chamber

* On request

10.8 Terminal box

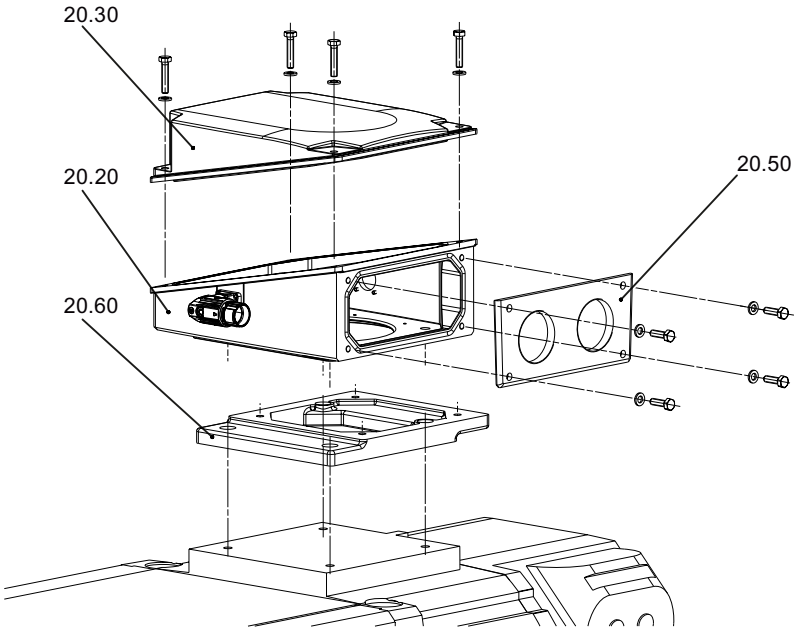


Figure 10-20 Terminal box

Table 10-20 Spare parts for terminal box

Number	Designation	Number	Designation
20.20*	Enclosure	20.50*	Entry plate
20.30*	Cover	20.60*	Adapter plate (optional)

* On request

10.9 Speed encoder (type 1PH818., 1PH822.)

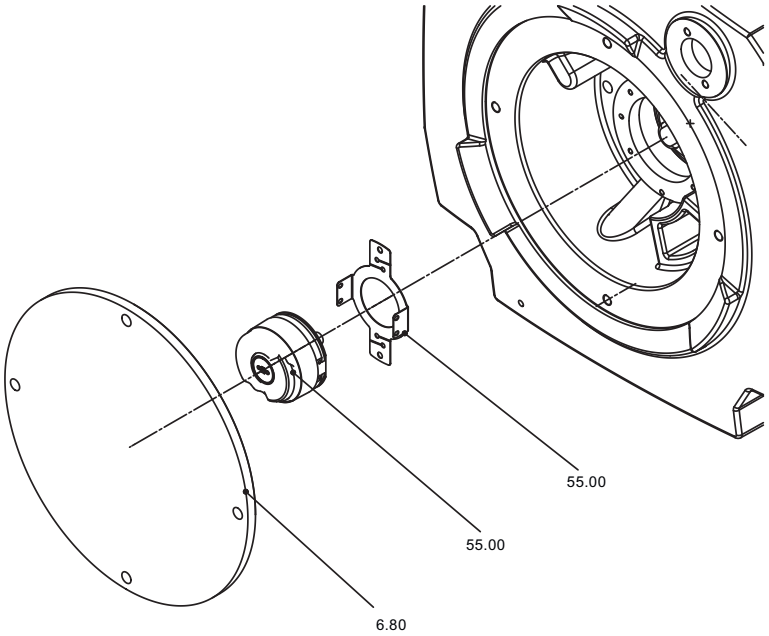


Figure 10-21 Speed encoder

Table 10-21 Spare part, speed encoder (type 1PH818., 1PH822.)

Part	Description
55.00	Spare parts kit, speed encoder • Speed encoder • Torque arm
55.71	Cable with plug connector
6.80*	Cover

* On request

10.10 Speed encoder (type 1PH828.)

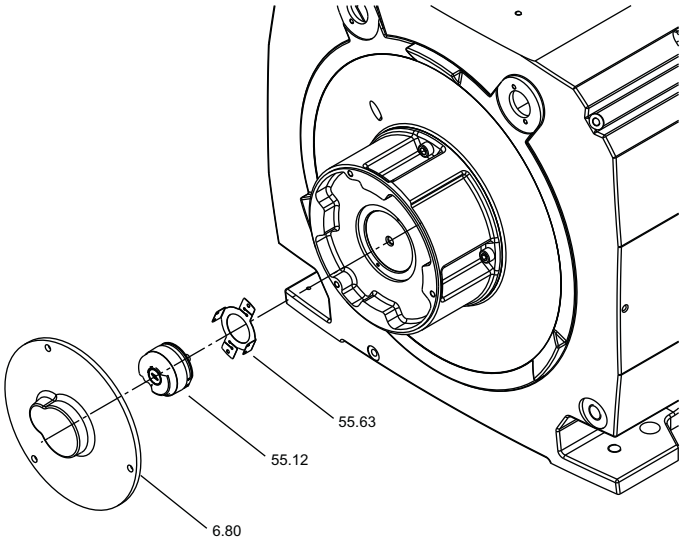


Figure 10-22 Speed encoder (type 1PH828.)

Table 10-22 Spare part, speed encoder (type 1PH828.)

Part	Description	Part	Description
6.80	Cover	55.63	Torque arm
55.12	Speed encoder	55.71	Cable with plug connector

Disposal

11

Protecting the environment and preserving its resources are corporate goals of the highest priority for us. Our worldwide environmental management system to ISO 14001 ensures compliance with legislation and sets high standards in this regard. Environmentally friendly design, technical safety and health protection are always firm goals even at the product development stage.

Recommendations for the environmentally friendly disposal of the machine and its components are given in the following section. Be sure to comply with local disposal regulations.

11.1 RoHS - restricting the use of certain hazardous substances

In compliance with RoHS ("Restriction of certain Hazardous Substances") we replace substances that are damaging to the environment by those that are not based on state-of-the-art technology. In doing so, safety in operation and handling will take priority at all times.

11.2 Preparing for disassembly

Disassembly of the machine must be carried out and/or supervised by qualified personnel with appropriate expert knowledge.

1. Contact a certified waste disposal organization in your vicinity. Clarify what is expected in terms of the quality of dismantling the machine and provision of the components.
2. Follow the five safety rules (Page 15).
3. Disconnect all electrical connections and remove all cables.
4. Remove all liquids such as oil and cooling liquids. Collect the liquids separately and dispose of them in a professional manner.
5. Detach the machine fixings.
6. Transport the machine to a suitable location for disassembly.

See also

Maintenance (Page 105)

11.3 Dismantling the machine

Dismantle the machine using the general procedures commonly used in mechanical engineering.

⚠ WARNING

Machine parts can fall

The machine is made up of heavy parts. These parts are liable to fall during dismantling. This can result in death, serious injury or material damage.

- Before you release any machine parts, secure them so that they cannot fall.

11.4 Disposal of components

Components

The machines consist mainly of steel and various proportions of copper and aluminum. Metals are generally considered to be unlimitedly recyclable.

Sort the components for recycling according to whether they are:

- Iron and steel
- Aluminum
- Non-ferrous metal, e.g. windings
  The winding insulation is incinerated during copper recycling.
- Insulating materials
- Cables and wires
- Electronic waste

Process materials and chemicals

Sort the process materials and chemicals for recycling according to whether they are for example:

- Oil
- Grease
- Cleaning substances and solvents
- Paint residues
- Anti-corrosion agent
- Coolant additives such as inhibitors, antifreeze or biocides

Dispose of the separated components according to local regulations or via a specialist disposal company. The same applies for cloths and cleaning substances which have been used while working on the machine.

Packaging material

- If necessary, contact a suitable specialist disposal company.
- Wooden packaging for sea transport consists of impregnated wood. Observe the local regulations.
- The foil used for water-proof packaging is an aluminum composite foil. It can be recycled thermally. Dirty foil must be disposed of via waste incineration.

Service and Support

A

* Based on the serial number stamped on the rating plate, you can identify where the machine was manufactured and where you can have your questions answered:

- No:N... = Nuremberg
- No.UC... = Frenstat

See also

Description (Page 21)

More information

Information on the following topics is available at:

- Ordering documentation / overview of documentation
- Additional links to download documents
- Using documentation online (find and search in manuals / information)

More information (https://support.industry.siemens.com/cs/de/en/view/108998034)

If you have any questions regarding the technical documentation (e.g. suggestions, corrections), please send an e-mail to the following address E-mail (mailto:docu.motioncontrol@siemens.com).

My support

The following link provides information on how to create your own individual documentation based on Siemens content, and adapt it for your own machine documentation:

My support (https://support.industry.siemens.com/My/de/en/documentation)

Note

If you want to use this function, you must first register.

Later, you can log on with your login data.

Training

The following link provides information on SITRAIN - training from Siemens for products, systems and automation engineering solutions:

SITRAIN (http://siemens.com/sitrain)

Technical Support

Country-specific telephone numbers for technical support are provided on the Internet under Contact:

Technical Support (https://support.industry.siemens.com)

Websites of third parties

This publication contains hyperlinks to websites of third parties. Siemens does not take any responsibility for the contents of these websites or adopt any of these websites or their contents as their own, because Siemens does not control the information on these websites and is also not responsible for the contents and information provided there. Use of these websites is at the risk of the person doing so.

Internet address for products

Products (http://www.siemens.com/motioncontrol)

Siemens Support for on the move

You can obtain optimum support anywhere you go using the "Siemens Industry Online Support" app. The app is available for Apple iOS, Android and Windows Phone.

Technical specifications

B

B.1 Tightening torques for screw and bolt connections

Bolt locking devices

- Refit nuts or bolts that are mounted together with locking, resilient, and/or force-distributing elements with identical, fully-functional elements when re-assembling. Always renew keyed elements.
- When screwing together threads secured with a liquid adhesive, use a suitable medium such as Loctite 243.
- Always use suitable securing devices or removable adhesives (e.g., Loctite 243) when installing fixing bolts with a clamping length of less than 25 mm. The clamping length is taken as the distance between the head of the bolt and the point at which the bolt is screwed in.

Tightening torques

The bolted connections with metal contact surfaces, such as end shields, bearing cartridge parts, terminal box parts bolted onto the stator frame, should be tightened to the following torques, depending on the thread size:

Table B-1 Tightening torques for screw/bolt connections with a tolerance of ±10%

Case	M4	M5	M6	M8	M10	M12	M16	M20	M24	M30	M36	M42	M48	M56	
A	1.2	2.5	4	8	13	20	40	52	80	150	-	-	-	-	Nm
B	1.3	2.6	4.5	11	22	38	92	180	310	620	1080	1700	2600	4200	Nm
C	3	5	8	20	40	70	170	340	600	1200	2000	3100	4700	7500	Nm

Applications

The above-mentioned tightening torques apply for the following applications:

- Case A
  Applies to electrical connections in which the permissible torque is normally limited by the bolt materials and/or the current carrying capacity of the insulators, with the exception of the busbar connections in case B.
- Case B
  Applies to bolts screwed into components made from materials with lower property class (e. g. aluminum) and to bolts with property class 8.8 according to ISO 898-1.
- Case C
  Applies to bolts with property class 8.8 or A4-70 according to ISO 898-1, however only to bolts screwed into components made from materials with higher property class, e.g. cast iron, steel or cast steel.

Note

Non-standard tightening torques

Different tightening torques for electrical connections and bolted connections for parts with flat seals or insulating parts are specified in the relevant sections and drawings.

Quality documents

C

You can find the quality documents here:

https://support.industry.siemens.com/cs/ww/de/ps/13358/cert (https://support.industry.siemens.com/cs/ww/en/ps/13358/cert)

Additional documents

D

D.1 Reader notes on the operating instructions of the holding brake

Holding brake

Depending on the order, a special version of a holding brake from the Stromag company is mounted. Various types of holding brake are mounted depending on the shaft height.

NOTICE
Technical data for the special version of the holding brake The following technical data applies to the special version of the mounted holding brake. The corresponding data in the manufacturers operating instructions do not apply.

Table D-1 Technical data of the holding brake

Technical data			NFF-A 63 1PH818. (SH180)	NFF-A 100 1PH822. (SH225)
Braking torque	M_{Brake}	[Nm]	1000	1600
Max. speed	n_{Brake}	[rpm]	3500	3100
Weight incl. hollow shaft	m_{brake}	[kg]	63	88
Moment of inertia	J_{brake}	[kgm^2]	0.022	0.051
Total moment of inertia (emergency stop)	J_{total}	[kgm^2]	1.3	3.9
Rated voltage	U	[V]	230 V (AC)	230 V (AC)
Permitted single switched energy	P	[W]	98	210
Coil current	I	[A]	2.21	2.70
Number of emergency stops	Z	-	2000	1200
Opening time		[ms]	300	300
Closing time		[ms]	80	100

Note

More information

- Commissioning (Page 87)

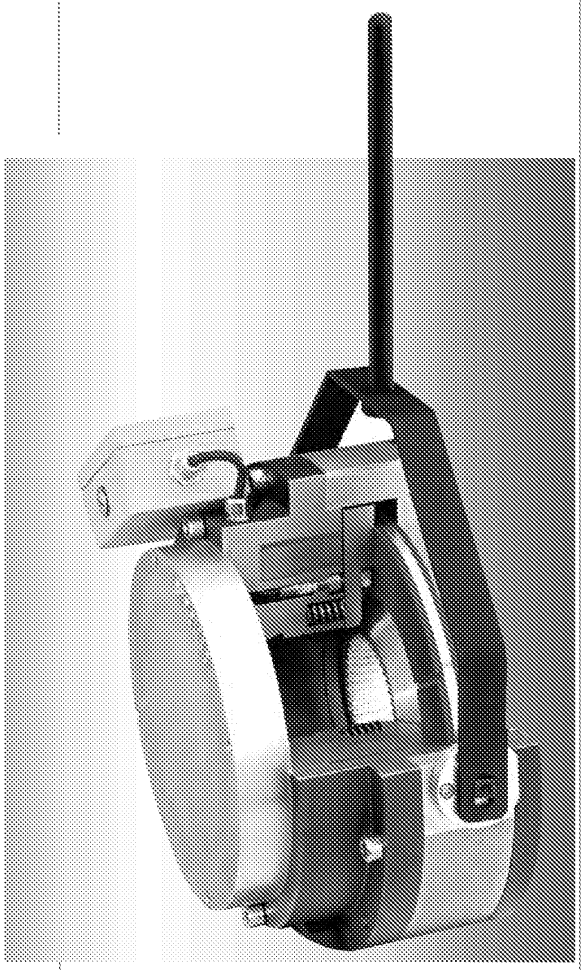
See also

Operating instructions, holding brake (Page 169)

D.2 Operating instructions, holding brake

Stromag Dessau
safety in motion

Service Instructions



NFF

Electromagnetic - Double - Face Spring - Applied Brake

These operating instructions are intended to enable the user to operate the Stromag Dessau product safely and effectively, to use it sensibly and to maintain it properly so as to exclude the possibility of any damage or incorrect operation.

Stromag Dessau GmbH
Dessauer Str. 10
D-06844 Dessau-Roßlau
Telefon: 0340-2190-0
Telefax: 0340-2190-201
E-mail: vertrieb.dessau@stromag.com
Internet: http://www.stromag-dessau.de

Service Instructions NFF IP 66

Stromag Dessau
safety in motion

Electromagnetic Double Face Spring – Applied Brake

01.06.2009

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1 Technical data

1.1 Nameplate data

The following data is stated on the nameplate (73). It is provided on the front side of the brake.

Series / Size	
Order – Ref. – No.	
Delivery date month /year	
Nominal voltage	V DC
Nominal wattage	W
Nominal current	A
Brake torque	Nm
Connexion on	V AC
Airgap "off" norm.	mm
max.	mm

This data must comply with the identifications of the order acknowledgement.

1.2 Torque, speed, and other technical data

Table 1

size NFF	M_{dyn} Nm	M_{stat} Nm	n_0 min^{-1}	n_{zn} min^{-1}	U_n * V-DC	P_k W	Airgap min/max	W KJ	P_{VN} kW	J kgm^2	m kg
2	20	22	5300	3000	103	89,9	0,6/1,0	25	0,080	0,00040	6,3
4	40	44	4900	3000	103	90,7	0,6/1,0	30	0,067	0,00043	10,4
6,3	63	70	4500	3000	103	113,9	0,6/1,2	65	0,103	0,00080	13
10	100	110	4100	2500	103	110,4	0,6/1,2	75	0,110	0,00125	14
16	160	175	3800	2400	103	115,8	0,6/1,2	120	0,124	0,00340	21
25	250	275	3500	2100	103	136,6	0,6/1,2	150	0,149	0,00430	30
40	400	440	3200	1800	103	212,9	0,6/1,3	250	0,170	0,01212	40
63	630	700	3000	1600	103	227,3	0,6/1,5	320	0,249	0,01463	68
100	1000	1100	2800	1300	103	277,6	0,6/1,6	450	0,270	0,04171	85,5
160	1600	1750	2200	1000	103	353,5	0,6/1,6	450	0,325	0,14821	133
250	2500	2750	1900	900	207	367,0	0,6/1,8	700	0,400	0,23515	176
400	4000	4400	1600	**	207	400,9	0,6/1,8	**	0,482	0,43412	278
630	6300	7000	1400	**	207	489,6	0,6/1,6	**	0,601	1,01607	367
1000	10000	11000	1200	**	207	535,5	0,6/1,6	**	0,587	1,56099	491

* other voltages on request
** on request

M_{dyn}	dynamic torque (friction torque, nominal value for working brake) applies to dry operation with an oil- and grease-free friction lining after running-in
M_{stat}	static torque (torque of adhesion)
n_o	maximum idling speed
n_{zn}	nominal switching speed
P_k	excitation output at 20°C
P_{vn}	nominal breaking capacity (S4-40% I.O.)
W	switch work per switching operation for z = 1-5 h^{-1}
J	mass moment of inertia of rotating parts
m	weight
Protection class	IP 66 in accordance with DIN 40050
Mode of operation	S1, S4 - 40% I.O.
thermical class	155 'F' in accordance with DIN VDE 0580
The main parameters are also given on the nameplate	
AC control	via rectifier

The max. admissible speed as well as the other technical data are stated on the dimensional drawing which is binding for the pertinent order and can be inquired at our after-sales service; address is given in chap. 10.3.

1.3 Bore and keyway dimensions, connections

The binding dimensions for the bore, keyway and connections are stated on the dimensional drawing as mentioned in chap. 1.2.

1.4 Application range and utilization as per specification

in docks:
in harbour cranes, container loading facilities for crane, hoisting and trolley travel gears.

Operating conditions:

Protection class IP 66 in accordance with DIN 40050 (VDE 0470). Electrical design of brakes in accordance with DIN VDE 0580 in thermical class 155 (F). The brake corresponds to Directive 93/68/EEC (Low Voltage Directive).
The Directive 89/336/EEC (EMC) must be ensured by the user, taking into account the instructions given by the manufacturer.
The products are marked accordingly.
Mode of operation S1, S4.
Horizontal installation. Vertical operation after consultation with manufacturer.
With the friction combination steel/ organic friction lining the brake may only be used for dry running under the conditions described in chapters 7.1 and 7.3
In addition, compliance with the assembly, dismantling, commissioning and maintenance conditions specified by the manufacturer must be ensured.
Non-compliance with these conditions or any use beyond this shall be deemed use not in accordance with the specification.
The manufacturer shall not be liable for any such use, the risk shall be exclusively borne by the user.

If the brake is to be used outside this contractual scope of operation, contact Stromag Dessau for further details (Address see Chapter 10.3).

2 Safety guidelines

2.1 Symbol for safety at work

This symbol denotes all the safety instructions in this manual which deal with danger to life and limb of personnel. These instructions must be adhered to and particular caution exercised in these cases. All users must be familiarised with the safety instructions.

2.2 Instructions Caution!

The term "Caution!" denotes those sections in this manual which require special attention, in order that the guidelines, recommendations and correct procedures are complied with to prevent damaging or destroying the brake.

2.3 Safety instructions for working

The following recommendations are of particular importance:
The brake has been manufactured to the highest up to date standard and is operationally safe. However, the brake can become a risk to safety when used improperly by untrained personnel or for an application it is not designed for.
Every person involved in assembling, disassembling, commissioning, operating and maintaining (inspecting, servicing and repairing) the brake must be authorised, adequately trained and instructed. Each such person must have read and understood this instruction manual, especially in respect to the safety instructions.
We do not accept liability for damage or malfunctioning, resulting from non - adherence to this manual.

Repair and maintenance works must be carried - out by skilled and trained workmen only meeting the minimum requirements for aptitude and qualification according to DIN VDE 1000-10.
Any work process involving the brake which impairs safety is to be avoided.
The user is obliged to inform the supplier immediately of any change occurring to the brake which adversely affects safety; address see chap. 10.3.
The user is obliged to only operate the brake when it is functioning correctly.
Unauthorised changes and modifications which impair safety, as well as the use of non - authentic components is not permitted.
To exclude any danger to people, domestic animals and goods by parts in motion, the user has to take protective measures according to DIN 31000 / VDE 1000.
As protection against hazardous shock currents, the user has to take protective measures according to DIN VDE 0100 - 410 and DIN EN 50274.
To avoid dangerous influences due to heating of the units and in case of a failure, the user has to take suitable protective measures according to DIN 31000 / VDE 1000 and DIN VDE 0100 - 420.
To exclude any danger to people, domestic animals and goods by direct or indirect effect of electromagnetic fields, the user has to take suitable measures according to DIN V VDE V 0848-4/A3.

Caution! In every case the local safety and accident prevention regulations are also applicable, the user must ensure that these are complied with.

We reserve the right to make modifications of a technical nature to this manual if required for brake development.
We recommend that these instructions are incorporated into the service manual of the user (machine manufacturer).

2.4 Electromagnetic Compatibility

The Electromagnetic Compatibility of Equipment Act (EMVG) demands to meet defined protective requirements when using electrical equipment so that this equipment can operate in its electromagnetic environment without mutual impairment of function.
Machine manufacturers, system and plant constructors must assure that the product is installed as required and that the installation of the pertinent current supply is made correctly in order to adhere to the protective requirements of the EMVG.
Please inquire our leaflet "EMC - notes", No. 900 - 00001 at Stromag Dessau GmbH; address as per chap. 10.3.

3 Transportation

3.1 Packing

The type of packing complies with the agreements with the orderer as stated in the order acknowledgement. If no type of packing has been agreed, it depends on the transportation route. The symbols marked on the packing must be adhered to.

3.2 Pre-mounting conditions

The brakes will be supplied completely mounted and with all settings made. The pinion (15) is supplied as a loose part. If a hand lever is required (4) it is loosely attached and has to be mounted.

3.3 Sensitivity

Caution!

Make sure to avoid damage as a result of shocks or impacts during transportation. Special care should be exercised with regard to the radial connecting cable (version without terminal box). For **direct transportation** or assembly of the brake, from size 16 there are threaded bores provided in the coil body (1) for screwing of supporting eyes, see figure 1.

Caution!

The support eye shall **not** be used for transport and for mounting of the unit motor with mounted brake.
Make sure to avoid the generation of condensation water as a result of strong temperature fluctuations.

3.4 In - process stocking

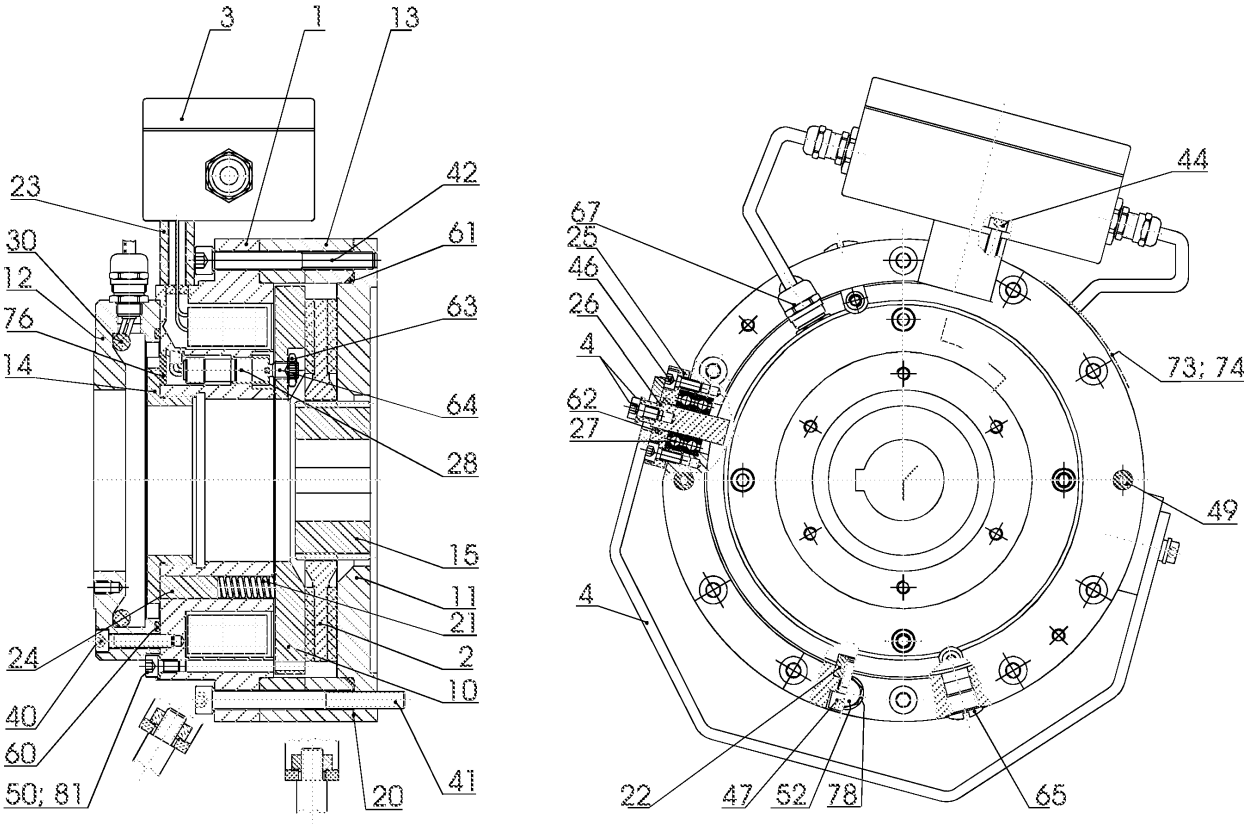
All parts are made of stainless material or are provided with a surface protection by gas nitrocarburizing. In addition they are prined with a zinc phosphate painting.
Bore and keyway of the driving hub (15) are supplied greased.
Should it be intended to stock the brake in - process, another protection against corrosion has to be provided. Please consult our after - sales service (address given in chapter 10.3).

3.5 Delivery extent

On receipt check the consignment for completeness (see packing list).
Possible damage during transportation and/or missing parts must be advised immediately and in writing.

4 Construction, functioning, construction characteristics

Fig. 1



4.1 Designation of individual components (shown size NFF 16 with option speedometer installation)

1 Coil body with coil
2 friction lining assy.
3 terminal box assy.
4 hand lever assy.
10 armature disc
11 brake flange
12 tacho flange
13 outer body
14 adjusting ring
15 hub
20 shim
21 compression spring
22 locating doc
23 terminal box spacer
24 brass pin
25 hand release end cap
26 hand release pivot pin
27 grooved ball bearing
28 micro switch
30 condensation heater
40 screw for tacho flange
41 brake mounting screw
42 cylindric screw
46 mounting screw for hand release end cap
47 screw for locating dog
49 emergency release screw
50 cap screw for emergency release
52 screw for lockable hand release
60 seal ring for tacho
61 seal ring for brake flange
63 counter nut for micro switch
64 set screw (micro switch)
65 cap screw for airgap measurement
67 gland
73 nameplate
74 metal tack (to mount identification plate)
76 adhesive
78 washer for pos. 52
81 seal ring for pos. 50

4.2 Functioning and design characteristics of the standard version

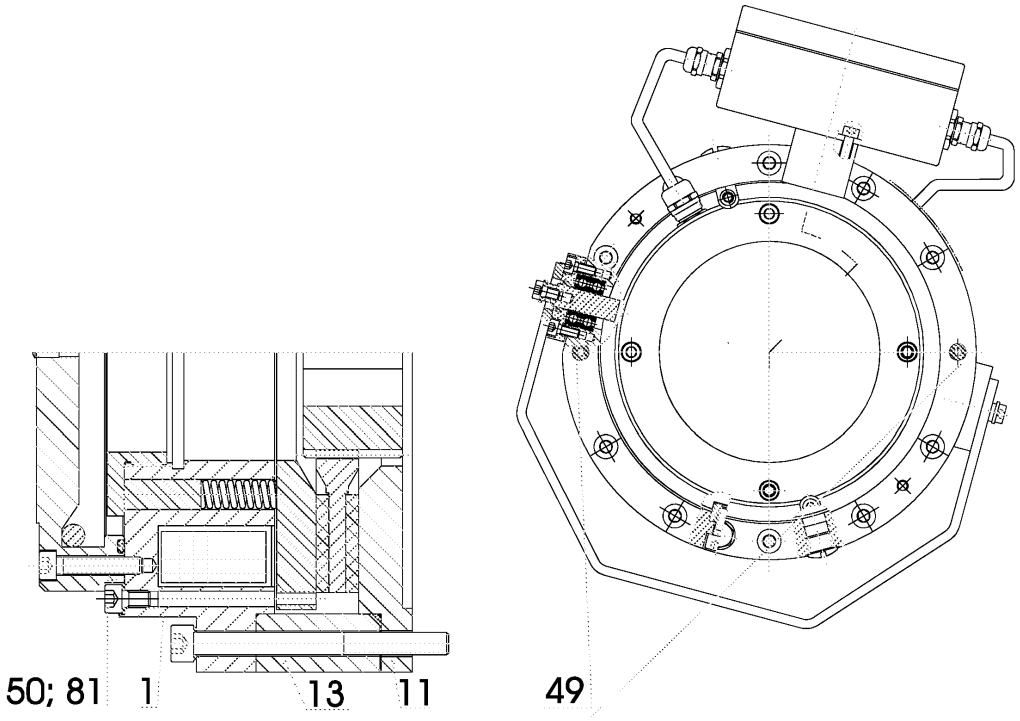
The brake **NFF** is a spring-loaded electromagnetic double-face brake which brakes without current and is released electromagnetically.
The brake type **NFF** meets highest requirements with regard to fatigue strength and robustness and is seawater-proof. The brakes are manufactured and tested in accordance with DIN VDE 0580.
The brake is screwed to a motor or any other machine part by means of cyl. screws (mounting screws pos. 41).

The coil body contains a coil which is potted with a synthetic resin compound in accordance with thermical class 155 (F), (max. limit of temperature 155°C).

If the coil is not excited, the springs (21) press the armature disc (10) against the friction disc (2), which is firmly clamped between the torsion-protected armature disc (10) and the brake disc (11) and thus prevented from rotating. The braking effect is transmitted from the geared friction disc (2) via the hub (15) and a fitting key to the shaft. If the coil is connected to a direct voltage as specified on the identification plate (73), the magnetic force will draw the armature disc (10) to the coil body (1) overcoming the spring pressure. The friction disc (2) is released, the braking effect is cancelled and the brake is released.

4.3 Mechanical release by means of emergency release screws

Fig. 2



1 coil body with coil
11 brake flange
13 outer body
49 emergency release screw
50 cap screw for axial emergency release
81 seal ring

For the mechanical release in case of emergency of the system use red marked screws (49) which have to be removed of its position (coil body (1) – outer body (13) – brake flange (11)) (up to size NFF 10 loosely attached) – up to size NFF 63-2 screws, up size NFF 100 –3 screws).
For release, unscrew the cap screws (50) from the coil body (1). In the now free holes, screw in the release screws (49). The release is made by alternating clockwise turning of the screws until the braking effect is cancelled.

Caution!

The emergency release is self-locking; for normal operation it must be re-turned into the initial position, i.e. the screws (49) are re-turned counter-clockwise. Then re-screw the release screws (49) into the original threaded hole (coil body (1) – outer body (13) – brake flange (11)). Then screw the cap crews (50) into the coil body (1). We recommend to seal the threaded holes with hylomar.

Take care that the seal rings (81) are also re-fitted. This is necessary to assure the full electrical operation and **sealing effect (IP 66).**


Manual emergency release shall **not** be used to maintain temporary operation!

4.4 Mechanical release by means of hand lever (optional)

By pulling the hand lever (4) at approx. 30° towards the back of the brake the armature disc (10) is moved axially until it is lying against the coil body (1) thus the friction disc lining (2) may rotate freely.


Manual emergency release shall **not** be used to maintain temporary operation!

4.5 Current supplies and electrical connections

Make sure that the electrical connection is performed by expert personnel taking into account the installation regulations (such as DIN IEC 92).

The coil has been designed for 100% duty factor and connection to D.C. supply only, given on the identification plate (residual ripple< 0.5).
According to DIN VDE 0580 the permanently admissible voltage change is +5% to –10% of the nominal voltage.
To protect the coil or the power supply unit it is recommended to connect a varistor of the corresponding operating A.C. voltage range and with the required power to the rectifier output.

5 Assembly and dismantling

(individual parts with Item-No. see chap. 4.1)

Caution! The brake must only be operated, maintained and repaired by accordingly authorized, trained and instructed people. Each such person must have read and understood the complete instruction manual and must have been informed in particular about possible risks and danger.

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5.1 Assembly

The assembly to the motor is simple, no dismantling of the brake is required.

- Check the connecting dimensions for compatibility with the brake.
- Remove any existing transportation or bearing protections devices, as well as any burr or impact damage.
- Check face run out of the flange mounting surface relative to the shaft to be braked (tolerance class N in accordance with DIN 42955 should not be exceeded).
- Slightly grease shaft and fitting key with assembly paste. Mount pinion (15) and secure it axially.
- Use suitable slings (shackles or equivalent) to move the brake cautiously across the pinion (15) and turn the shaft or swivel the brake to engage pinion teeth with the mating teeth of the friction disc (2). (The friction disc is pre-centered during the final acceptance of the brake).

Caution!

Do not use force! Do not tilt! Pay attention of the cable!

- offer brake onto the motor in the position specified
- tighten the mounting screws (41) to correct bolt tightening torque (as specified on the drawing)
- To prevent mechanical blocking of the stainless steel screws (41) we recommend to grease these screws with Klüber paste HEL 46-54
- Make sure that the electrical connection is performed by expert personnel taking into account the installation regulations (such as DIN IEC 92).

Caution!

When mounting always assure that all seal rings and sealings are properly lying in the accordingly provided positions (IP 66).

5.2 Mounting accuracy

The concentric run of the shaft piece on which the driving hub (15) is fixed as well as the coaxiality and the run - out of the fixing flange must comply with tolerance class "N" of DIN 42955.

5.3 Dimensions, space requirement and mass

The binding dimensions, the mass (weight) and the other technical data are stated on the dimensional drawing which is binding for the pertinent order. This drawing can be inquired at our after - sales service; address is given in chap. 10.3.

5.4 Dismantling

Dismantling is subject to the same instructions and regulations as installation. Carry out the operations in inversed order of succession!

Important note!

Check up: The brake must be torque-free on the output side.
Before removing the brake, disconnect it from the mains and secure with slings.

6 Initial setting into service

(Single parts with item designation as per chap. 4.1)

Before the initial setting into service, the following test measures are necessary:

- As the new friction lining does not yet dispose of optimum friction characteristics, some electric releases have to be carried - out to smooth the friction face pinpoints.
- The electric connection values on the nameplate (73), see chap. 1.1, must comply with the values at site
- The brake must be undamaged, i.e. it must not have any damage generated during transportation, stocking, etc.
- The prescribed service conditions (chap. 7.1) must comply with those ones at site
- Not only the emergency manual release as per chap. 4.3 but also the hand lever emergency release as per chap. 4.4 or 9.3 must not be active.

7 Operation

Notwithstanding any instructions given below, operation of the brake must always comply with local mandatory safety and accident prevention rules. Compliance with these rules shall be ensured by the user.

7.1 Operating conditions

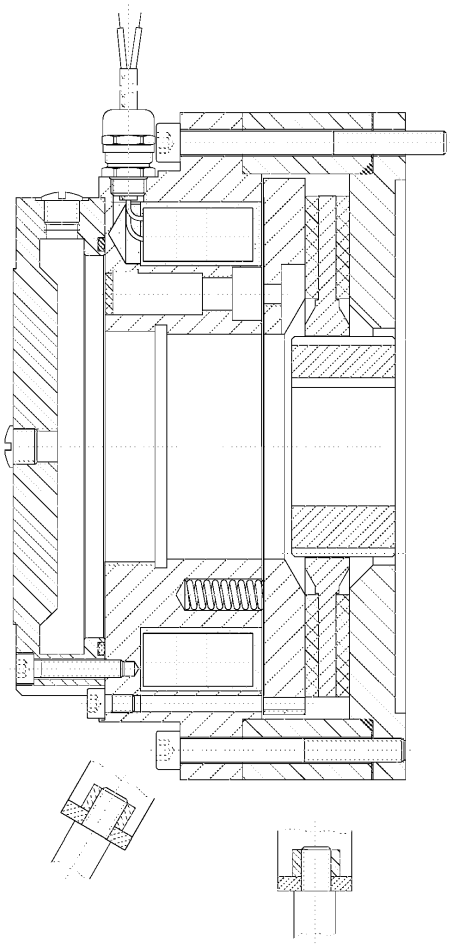
The operating conditions to be maintained for a faultless operation of the brake are given below:

- The operating temperature should not be below **–30°C** and not above **+50°C**.
- In the case of higher and/or lower ambient temperatures, please contact our after-sales service (for address see Chapter 10.3).
- Air humidity may be 100%.

7.2 Protection classes

In completely mounted condition and under consideration of the following hints assembled, the brake as standard execution (as shown in fig 3) complies with protection class IP 66, in accordance with DIN 40050 and DIN VDE 0530.
When using original Stromag accessory, such as terminal box, cable glands (see Fig. 1) the type of protection is maintained. The same applies when the speed encoder is rigidly connected to the cover by means of a flange gland which is sealed by round ring.
Sealings of through-shafts (by means of shaft seal ring), reduce the type of protection in relation to the execution. Please consult the manufacturer.

Fig. 3



Important note!

The contact surfaces of the brake to the motor, as well as the surfaces of the "speedometer connection" option shall be sealed with suitable means (e.g. Hylomar or sealing ring) to guarantee the protection class.

The user has to provide a sealing element on the shaft in direction to the motor side in order to prevent the penetration of grease from the motor bearing.

7.3 Duty cycle, switching frequency

The design as well as admissible loads on brakes as per braking torque, speed, switching capacity are given under „Technical Data“ (see Chapter 1) and the dimensional drawing (appendix). If any of these data are exceeded consult the manufacturer.

7.4 Trouble shooting (individual parts with Item-No. see chapter 4)

Störungen	Mögliche Ursachen	Erforderliche Maßnahmen
Insufficient braking effect	Friction surfaces are not free from grease	replace friction disc (2)
	Max. Air gap “off” exceeded due to wear of friction lining	re-adjust brake (chapter 8.3.), if necessary replace friction disc (2)
	Brake not completely run-in	Let brake run in
	Brake has been overloaded	Replace brake
	Spring rupture	Dismantling of brake contact manufacturer
No braking effect	Manual release (4) has been actuated and not re-set	See Chapter 4.3
Brake does not release	Max. Air gap „off“ too large due to wear of friction lining	Re-adjust brake (chapter 8.3.) if necessary replace friction disc (2)
	Friction disc (2) is stuck on pinion (15)	Replace friction disc (2) and pinion (15) (chapter 8.4.)
	Armature disc (10) distorted	Replace brake (chapter 5)
	Coil connecting voltage too low	Check DC voltage supply
	Coil defective	Replace brake (chapter 5)
	Feed line defective	Renew feed line
	Contact points loose	Re-tighten contact points
	foreign particles in the air gap (e.g. spring rupture)	Dismantling of brake, contact manufacturer
when micro switch is used:	Armature plate is not being attracted against the coil body because of:	Re-adjust brake (chapter 8.3.) if necessary replace friction disc (2)
No operational switch indication	- max. air gap has been exceeded	Check position of micro switch under consideration of adjustment procedure of micro switch
	- foreign particles in the air gap	Dismantle and clean the brake

8 Maintenance

8.1 Maintenance and inspection work

 Make sure to comply with Chapter 2 "Safety guidelines" during all maintenance and inspection work.

As the brakes work under varying operating conditions, it is not possible to pre-define wear check, inspection, maintenance and repair intervals.
Higher loads on the brake (e.g. as a result of torque, speed, switching frequency, ambient temperature etc.) require shorter maintenance intervals.
Therefore it is first of all necessary to observe the brake with regard to safety and wear, and then adapt the maintenance intervals in accordance with the observations made.
Wear of the friction lining will result in a greater air gap „off".
Depending on the load on the brake, the air gap must be checked from time to time. This will be done by measuring the air gap according to chapter 8.2.
If the max. air gap as determined in chap. 1.1. is reached please readjust the air gap described in chap.8.3.

Caution!

If wear re-adjustment is not carried out early enough, both the transmission of the rated load torque and the lifting of the brake will not be ensured.

8.2 Measurement of the air gap

The measurement of the air gap between coil body (1) and armature disc (10) can only be done when the coil is currentless.
The measurement of the air gap must be taken on two places be opposited 180°. Therefore remove the two cap screws (65) in the outer body and control with a finger gauge. The air gap between the armature disc (10) and coil body (1) must be between „off min." and „off max." described in chap.1.1.
After the measurement the thread hole must be closed with cap screw (65) and sealing ring for protection of IP 66.

8.3 Wear re-adjustment

When the maximum 'air gap off' has been reached in brakes (chap.1.1) a onetime wear re-adjustment is possible.

 **Important! Check up: the brake must be torque-free on the output side.**

Disconnect the brake from current.

Proceed as follows (fig. 1)

- Remove the mounting screws (41) and (42)
- dismantle the complete coil body assembly with outer body (13) from the brake flange (11) taking care not to damage armature disc (10)
- remove shim (20) and re-assemble in inversed order coil body assembly and outer body.
- offer brake onto the motor in the position specified
- tighten the mounting screws (41) to correct bolt tightening torque (as specified on the drawing)

To simplify maintenance works the armature disc (10) may be retained in position by using the emergency release screws (49). Ensure these are removed before setting into operation.

Note: If the shim (29) has previously been removed, a new friction disc (2), see chap. 8.4., together with shim (20) has to be fitted.

Attention: On assembling the brake or replacing the friction disc, care should be taken that the linings do not come in contact with grease etc. Greasy substances if any, can be removed by suitable degreasing agents. Never use petrol or paraffin.

8.4 Replacement of the friction disc

Proceed as follows:


Important ! Check up: The brake must be **torque-free on the output side.**

- Remove the mounting screws (41) and (42)
- dismantle the complete coil body assembly with outer body (13) from the brake flange (11) taking care not to damage armature disc (10)
- take the friction disc (2) from the pinion (15)
- clean the brake
- push the friction disc (2) onto the toothing of the pinion (15)
- fit the shim (20)
- mount in inversed order coil body assembly (1) and outer body (13)
- offer brake onto the motor in the position specified
- tighten the mounting screws (41) to correct bolt tightening torque (as specified on the drawing)

To simplify maintenance works the armature disc (10) may be retained in position by using the emergency release screws (49). Ensure these are removed before setting into operation.


The new friction linings on the friction disc will transmit the full braking torque only after a certain run-in period.

9 Variants (optional)

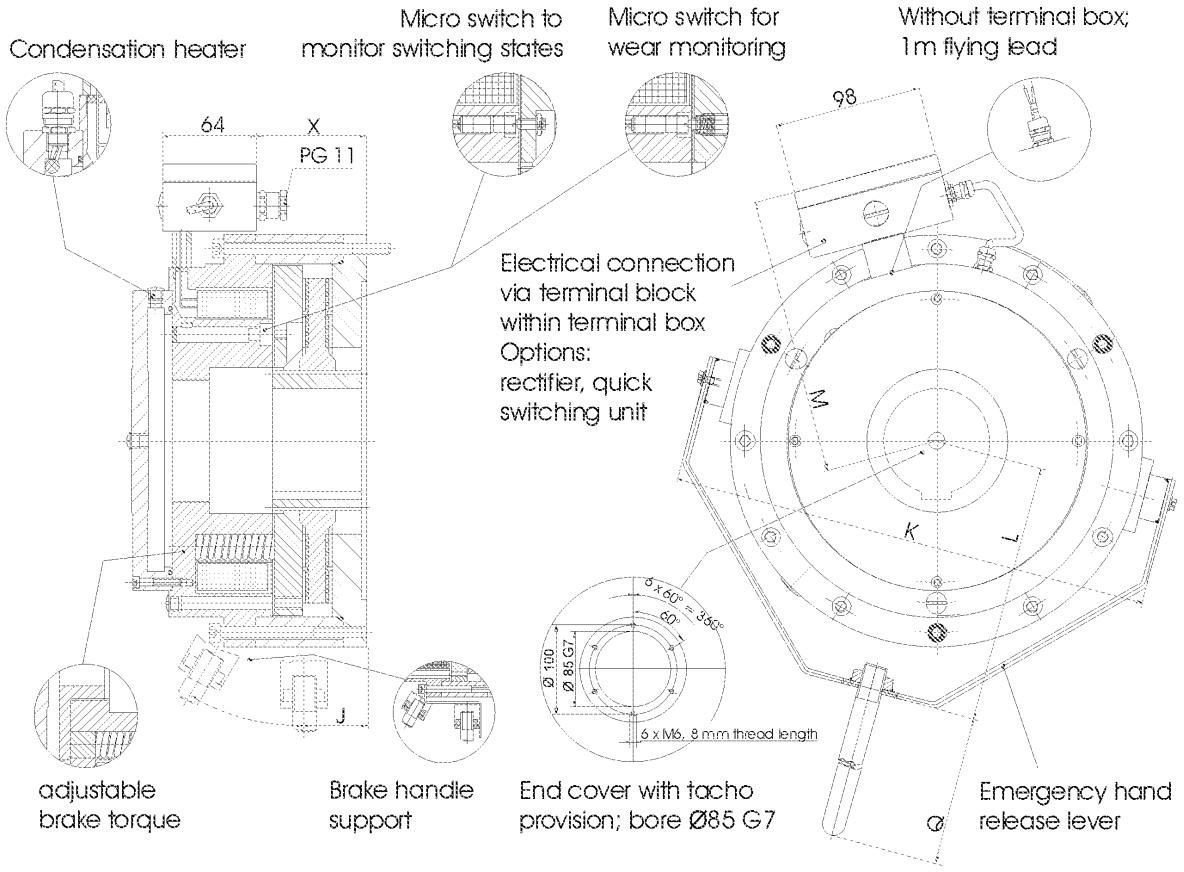


Fig. 4

Brake Size	2	4	6.3	10	16	25	40	63	100	160	250	400	630	1000
M	115.5	128.5	128	125	151	165	179	196	238	260	290	327	364	420
K	179.5	198	201	216	251	276	300	343	408	Refer to Stromag Dessau				
J	20.9	28	29	29	32	39	40	45	54					
L	95	110	110	123	140	150	170	200	220					
X	19	33.75	33.75	38	48	62	83	86	113	125.5	133.5	168	172	182
Q	110	110	110	110	110	150	150	250	500					

9.1 Execution with micro switch

If the switching condition of the brake should be controlled, a micro switch (28) could be used. When the armature disc (10) is moved against the coil body (1) as a result of the electromagnetic force of the coil or the actuation of the mechanical emergency release device, (chap. 4.3), it will operate a micro switch (28) via set screw (64). The micro switch (28) may be included in the control circuit of the motor contactor as a normally open or normally closed contact.

The micro switch is preset in our works and should not require adjustment. If replacement of the micro switch is required this must be done by our agreed procedure (096-701:181)

9.2 Execution with adjusting ring to reduce the brake torque

The torques given in the technical data (chap. 1.1.) were obtained only by fully tightening the adjusting ring (14). By turning the adjusting ring (14) this changes the pre-load of the cylindrical pressure springs (21) and the brake torque is altered accordingly.

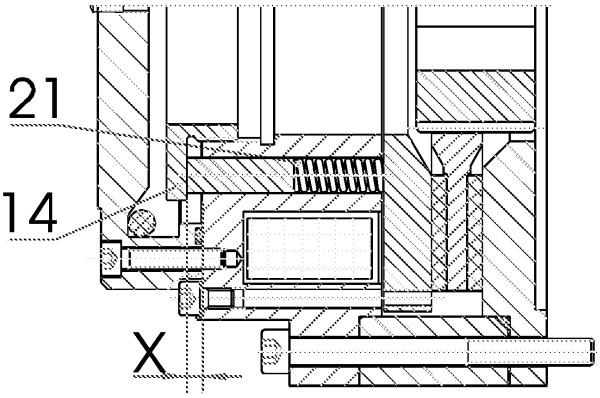


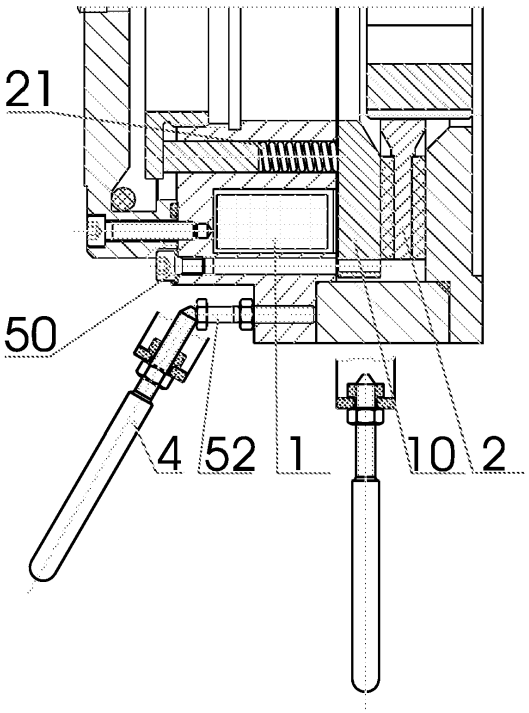
Fig. 5

The table shown here below indicates the dimension X and the respective torque rating.

These are approx. figures only

Brake size	100% X(mm)	90% X(mm)	80% X(mm)	70% X(mm)	60% X(mm)	50% X(mm)	40% X(mm)	30% X(mm)	20% X(mm)	10% X(mm)
2	0	0.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3
4	0	1.1	2.2	3.3	4.4	5.5	6.6	7.7	8.8	9.9
6.3	0	0.95	1.9	2.85	3.8	4.75	5.7	6.65	7.6	8.55
10	0	1.3	2.6	3.9	5.2	6.5	7.8	9.1	10.4	11.7
16	0	1.3	2.6	3.9	5.2	6.5	7.8	9.1	10.4	11.7
25	0	0.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3
40	0	0.55	1.1	1.65	2.2	2.75	3.3	3.85	4.4	4.95
63	0	2.2	4.4	6.6	8.8	11.0	13.2	15.4	17.6	19.8
100	0	1.03	2.06	3.09	4.12	5.15	6.18	7.21	8.24	9.27
160	0	1.05	2.10	3.15	4.20	5.25	6.3	7.35	8.4	9.45

9.3 Hand lever emergency with self locking



Optionally the brake can be equipped with a self - locking hand lever release allowing the manual release in case of emergency, e.g. current failure. By pulling the hand lever (4) at approx. 30° towards the back of the brake the armature disc (10) is moved axially until it is lying against the coil body (1) thus the friction disc lining may rotate freely. The handle (4) must be screwed in at this position to operate the locking mechanism. Please ensure brake is fully released. Then screwed out to release.

Please note: the cap screws (50) can be removed and the emergency release screws can be fitted (see chapt. 4.3) to release brake (this is recommended method of brake release).

Fig. 6

Manual emergency release shall <u>not</u> be used to maintain temporary operation!
Please note: this is a Fail Safe Brake and "fails to safety" when there is a power failure. When locking handles are used this disables the Fail Safe system and we do not recommend using them.

9.4 Execution with condensation heater

If strong temperature fluctuations are expected, a condensation heater (30) may be used to prevent the generation of condensation water. A special feed line will be provided accordingly. In case of questions please contact the manufacturer.

9.5 Speedometer installation

If a speedometer connection is required for the brake, the brake is provided with a tacho flange (12) with connecting bores in accordance with „Euro dimensions" (Diameter 85/100).

It is recommended to connect the tachometer or the encoder to the shaft through a plug-type coupling.

Caution!

The type of protection only maintains when the speed encoder is rigidly connected to the cover by means of a flange gland which is sealed by round ring.

10 Spare parts stocking, after-sales service

10.1 Spare parts stocking

Stocking of spare and parts subject to wear is an important precondition for permanent and reliable functioning of the brake.
Friction disc (2), armature disc (10), brake flange (11) and pinion (15) (for item see Chapter 4.1) are parts subject to wear.

Warranty will be provided only for the original spare parts supplied by us. We expressly state that the installation or use of spare parts other than the original ones supplied by us will negatively affect the design characteristics of the brake and thus have an impact on active and/or passive safety.
Stromag Dessau GmbH shall have no warranty obligations for any damage caused by the use of spare parts or accessories other than the original ones supplied by us.
Please bear in mind that often particular manufacturing and delivery specifications exist for parts manufactured by us or bought from others, and that we offer spare parts to the up-dated technical conditions and the up-dated legal prescriptions.

10.2 Data for spare parts orders

Please specify the following details when ordering spare parts:
- Series and size of brake
- article code
- Location and designation of spare part (see chapt. 4.1. and fig. 1)
- Number of pieces

10.3 Address of after-sales service

This is our address for after-sales service and spare parts distribution:

Stromag Dessau GmbH
Dessauer Str. 10
D-06844 Dessau-Roßlau

Telefon : +49 (340) 2190-203
Telefax : +49 (340) 2190-201
E-Mail : vertrieb.dessau@stromag.com
Internet : http://www.stromag-dessau.de

If you require a service engineer, please contact our "Technical after-sales service" under the above address.

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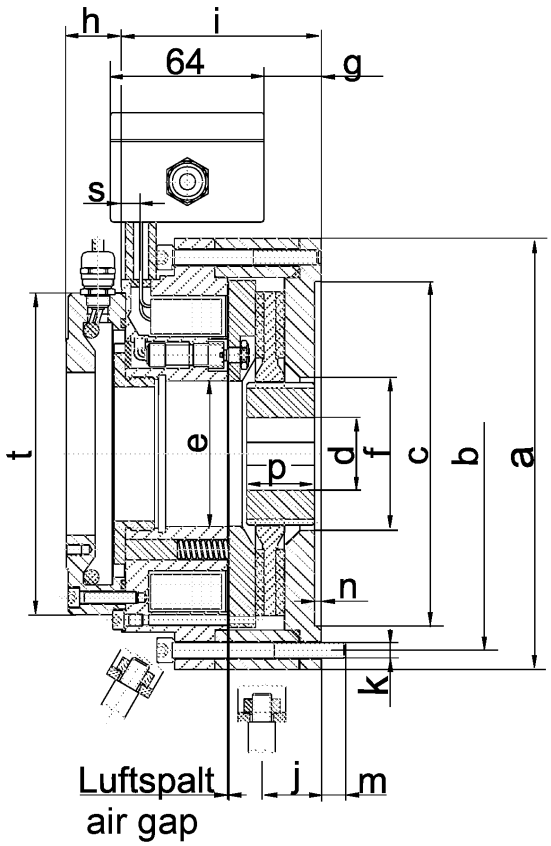
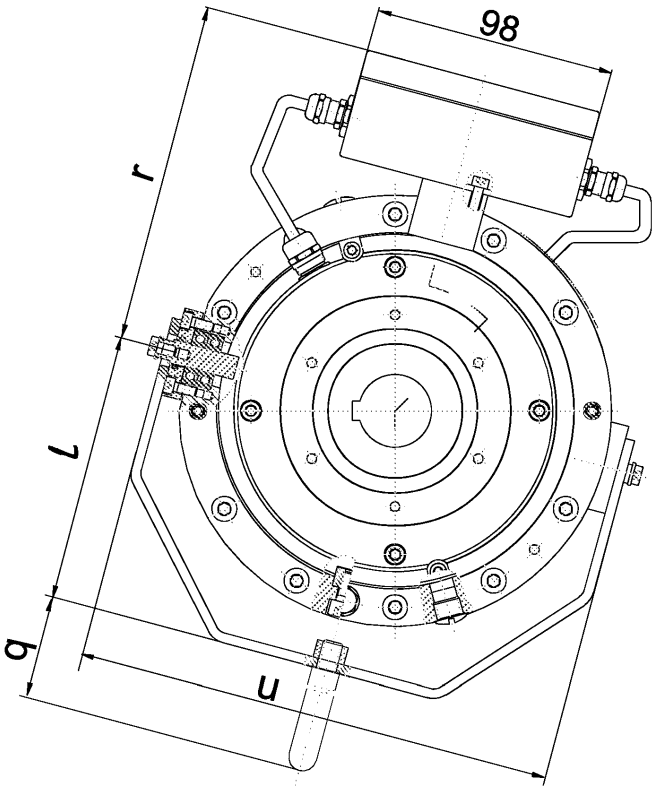
11 Listed standards and regulations

DIN 6885	Sheet 1 Fitting keys
DIN 40050	(VDE 0470) Protection classes
DIN 42948	Fastening flanges for electrical machines
DIN 42955	Concentricity of shaft ends, co-axial and true running of fastening flanges of rotating electrical machines
DIN IEC 92	Electrical equipment on ships
DIN VDE 0530	Rotating electrical machines
DIN VDE 0580	Regulations for electrical devices
VDE 0660 T 200/09.82,	Section 4.2.4, Table 1 - Inductive load
89/336/EEC (EMC)	Electromagnetic compatibility
93/68/EEC	Low Voltage Directive





Brake size		2	4	6.3	10	16	25	40	63	100	160	250	400	630	1000
Brake torque	Nm	20	40	63	100	160	250	400	630	1000	1600	2500	4000	6300	10000
Nom. speed	min^{-1}	5300	4900	4500	4100	3800	3500	3200	3000	2800	2200	1900	1600	1400	1200
Moment of Inertia B side	kgm^2	0.0004	0.00043	0.00080	0.00125	0.00340	0.00430	0.01212	0.01463	0.04171	0.14821	0.23515	0.43412	1.0161	1.5610
Weight	kg	6.3	10.4	13	14	21	30	40	68	85,5	133	167	278	367	491
Nom. voltage	V DC	103	103	103	103	103	103	103	103	103	103	207	207	207	207
Nom. power	W	89,9	90,7	113,9	110,4	115,8	136,6	212,9	227,3	277,6	353,5	367	400,9	489,6	535,5
Nom. current	A	0,87	0,88	1,11	1,07	1,12	1,37	2,07	2,21	2,70	3,43	357	3,89	4,75	5,2
Air gap norm.	mm	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Air gap max.	mm	1	1	1.2	1.2	1.2	1.2	1.3	1.5	1.6	1.6	1.8	1.8	1.6	1.6
a	mm	150	165	175	190	225	250	270	314	350	440	500	560	650	750
b	mm	135	152	162	175	205	225	250	292	325	418	472	530	620	710
c H8	mm	120	140	140	160	180	200	220	240	270	340	390	460	530	600
d max H7	mm	25	30	40	40	45	50	60	60	80	110	120	130	140	160
e	mm	53	55	55	65	76	78.5	90	96	100	200	215	240	270	300
f	mm	47	80	80	65	80	90	105	120	158	220	255	280	320	330
g	mm	19	33,7	33,75	38	48	62	83	86	113	125,5	133,5	168	172	182
h	mm	30	33	31	26	29	30	32	32	32	33	33	33	33	33
i	mm	73.5	89.6	92.8	95.3	104	121	141	145	168	182.6	191	226	225	265
j	mm	20,9	28	29	29	32	39	40	45	54	On request				
6 screws k	mm	M5	M6	M6	M6	M8	M8	M8	M10	M10	M12	M16	M16	M16	M20
l	mm	95	110	110	123	140	150	170	200	220	On request				
m	mm	10.5	7.8	13	14	14	13	14.2	19.5	19	24.4	21.4	26.3	30	30
n	mm	2.5	2.5	2.5	3.5	3.5	3.5	4	4	5	5.5	5	5	6	6
p	mm	24	28	30	30	35	45	45	55	75	125	130	150	185	210
q	mm	110	110	110	110	110	150	150	250	500	On request				
r	mm	115,5	128,5	128	125	151	165	179	196	238	260	290	327	364	420
s	mm	8.5	10.5	10	10	10	10	10	12	10	10	10	10	10	10
t	mm	123	140	150	146	168	172	184	230	255	270	280	320	340	380
u	mm	179,5	198	201	216	251	276	300	343	408	On request				

D.3 Operating instructions for the single-phase EC external fan, suction, SH180

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www.ebmpapst.com

CONTENTS

1. SAFETY REGULATIONS AND INFORMATION

Read these operating instructions carefully before starting work on the device. Observe the following warnings to prevent malfunctions or danger to persons.
These operating instructions are to be regarded as part of the device. The device is only to be sold or passed on together with the operating instructions.
These operating instructions may be duplicated and distributed to inform about potential dangers and their prevention.

1.1 Hazard levels for warnings

These operating instructions use the following hazard levels to indicate potentially hazardous situations and important safety regulations:

DANGER
Indicates an imminently hazardous situation which will result in death or serious injury if the specified actions are not taken. Compliance with the instructions is imperative.

WARNING
Indicates a potentially hazardous situation which can result in death or serious injury if the specified actions are not taken. Exercise extreme caution while working.

CAUTION
Indicates a potentially hazardous situation which can result in minor or moderate injury or damage to property if the specified actions are not taken.

NOTE
A potentially harmful situation can occur and, if not avoided, can lead to property damage.

1.2 Staff qualifications

The device may only be transported, unpacked, installed, operated, maintained and otherwise used by suitably qualified, trained and authorized technical staff.
Only authorized specialists are permitted to install the device, to carry out a test run and to perform work on the electrical installation.

1.3 Basic safety rules

The safety hazards associated with the device must be assessed again following installation in the final product.
The locally applicable industrial safety regulations are always to be observed when working on the device.
Keep the workplace clean and tidy. Untidiness in the work area increases the risk of accidents.
Note the following when working on the device:

⇒ Do not perform any modifications, additions or conversions on the device without the approval of ebm-papst.

1.4 Voltage

⇒ Check the device's electrical equipment at regular intervals; see Chapter 6.3 Safety inspection.

⇒ Replace loose connections and defective cables immediately.

DANGER
Electrically charged device
Risk of electric shock

→ When working on an electrically charged device, stand on a rubber mat.

WARNING
Live terminals and connections even with device switched off
Electric shock
→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

CAUTION
In the event of a fault, the rotor and the impeller will be energized
The rotor and the impeller have basic insulation.
→ Do not touch the rotor and impeller once installed.

CAUTION
If control voltage or a stored speed set value is applied, the motor will restart automatically, e.g. after a power failure.
Risk of injury
→ Keep out of the device's danger zone.# When working on the device, switch off the line voltage and ensure that it cannot be switched back on.
→ Wait until the device comes to a stop.
→ After working on the device, remove any tools or other objects from the device.

1.5 Safety and protective features

DANGER
Protective device missing and protective device not functioning
Without a protective device there is a risk of serious injury, for instance when reaching into the device during operation.
→ Operate the device only with a fixed protective device and guard grille.
→ The fixed protective device must be able to withstand the kinetic energy of a fan blade that becomes detached at maximum speed. There must not be any gaps which it is possible to reach into with the fingers, for example.
→ The device is a built-in component. As the operator, you are responsible for ensuring that the device is secured adequately.
→ Stop the device immediately if you notice a missing or ineffective protective device.

1.6 Electromagnetic radiation

Interference from electromagnetic radiation is possible, e.g. in conjunction with open- and closed-loop control devices.
If impermissible radiation levels occur following installation, appropriate shielding measures have to be taken by the user.

NOTE
Electrical or electromagnetic interference after installing the device in customer equipment.
→ Verify that the entire setup is EMC-compliant.

1.7 Mechanical movement

DANGER
Rotating device
Risk of injury to body parts coming into contact with the rotor or the impeller.
→ Secure the device against accidental contact.
→ Before working on the system/machine, wait until all parts have come to a standstill.

WARNING
Rotating device
Long hair and dangling items of clothing, jewelry and the like can become entangled and be pulled into the device. Injuries can result.
→ Do not wear any loose-fitting or dangling clothing or jewelry while working on rotating parts.
→ Protect long hair with a cap.

1.8 Emissions

WARNING
Depending on the installation and operating conditions, the sound pressure level may exceed 70 dB(A).
Risk of noise-induced hearing loss
→ Take appropriate technical safety measures.
→ Protect operating personnel with appropriate safety equipment such as hearing protection.
→ Also observe the requirements of local agencies.

1.9 Hot surface

CAUTION
High temperature on electronics housing
Risk of burns
→ Ensure sufficient protection against accidental contact.

1.10 Transport

NOTE
Transporting the device
→ Transport the device in its original packaging only.
→ Secure the device so it cannot slip, e.g. by using a lashing strip.

1.11 Storage

⇒ Store the device, partially or fully assembled, in a dry place, protected against the weather and free from vibration, in the original packaging in a clean environment.
⇒ Protect the device against environmental effects and dirt until final installation.
⇒ We recommend storing the device for no longer than one year in order to guarantee trouble-free operation and the longest possible service life.
⇒ Even devices explicitly intended for outdoor use are to be stored as described prior to commissioning.
⇒ Maintain the storage temperature, see Chapter 3.6 Transport and storage conditions.
⇒ Make sure that all cable glands are fitted with dummy plugs.

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2. INTENDED USE

The device is exclusively designed as a built-in device for conveying air according to its technical data.
Any other usage above and beyond this does not conform with the intended purpose and constitutes misuse of the device.
Customer equipment must be capable of withstanding the mechanical and thermal stresses that can arise from this product. This applies for the entire service life of the equipment in which this product is installed.

Intended use also includes

- The device is only to be used in IT networks with a permissible maximum voltage of 277 V between the phase conductors.
- Use of the device in stationary systems only.
- Conveying air at an ambient air pressure between 800 mbar and 1050 mbar.
- Using the device within the permitted ambient temperature range; see Chapter 3.6 Transport and storage conditions and Chapter 3.2 Nominal data.
- Operating the device with all protective devices.
- Following the operating instructions.

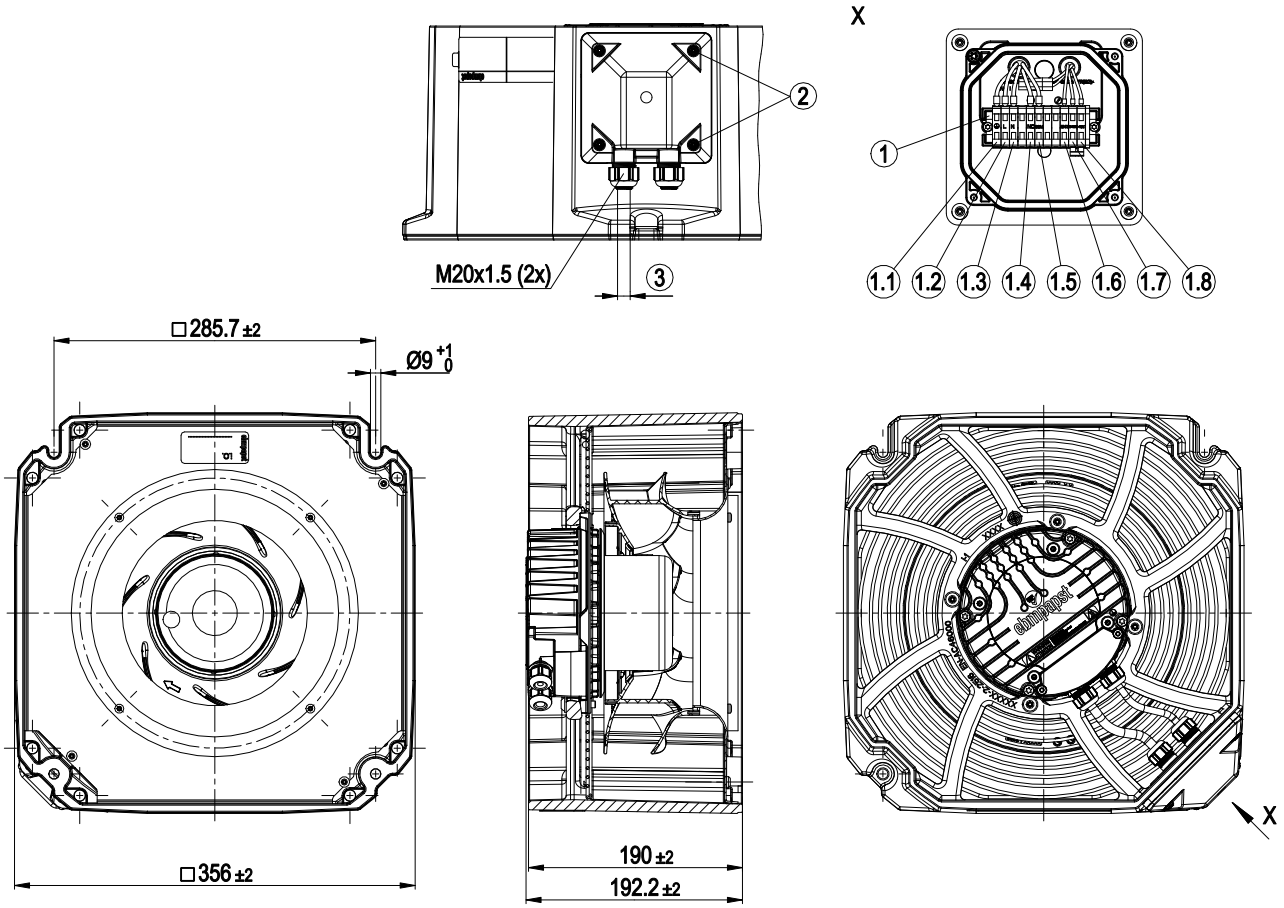
Improper use

In particular, operating the device in the following ways is prohibited and could be hazardous:

- Operating the device in an unbalanced state, e.g. due to dirt deposits or ice formation.
- Resonant operation, operation with severe vibration. This also includes vibration transmitted to the fan from the customer installation.
- Opening the terminal box during operation.
- Conveying air that contains abrasive particles.
- Conveying highly corrosive air, e.g. salt spray. Exception: devices designed for salt spray and correspondingly protected.
- Conveying air with high dust content, e.g. suctioning off sawdust.
- Operating the device close to flammable materials or components.
- Operating the device in an explosive atmosphere.
- Using the device as a safety component or to perform safety-related functions.
- Operation with completely or partially disassembled or manipulated protective devices.
- In addition, all applications not listed among the intended uses.

3. TECHNICAL DATA

3.1 Product drawing



All dimensions in mm.

1	Terminal strip
1.1	PE
1.2	L
1.3	N
1.4	NC
1.5	COM
1.6	GND
1.7	0-10 V
1.8	+10 V
2	Tightening torque 1.2±0.2 Nm
3	Cable diameter min. 6 mm, max. 10 mm, tightening torque 2.5 ± 0.4 Nm

3.2 Nominal data

Motor	M3G084-DF

Phase	1~
Nominal voltage / VAC	230
Nominal voltage range / VAC	200 .. 277
Frequency / Hz	50/60

Method of obtaining data	ml
Speed (rpm) / min^{-1}	2900
Power consumption / W	245
Current draw / A	1.1
Min. ambient temperature / °C	-25
Max. ambient temperature / °C	60

ml = Max. load · me = Max. efficiency · fa = Free air
cs = Customer specification · ce = Customer equipment

Subject to change

Control input 0-10 V / PWM Control range for modulation level 50-100%
Alarm relay activates on warning "Module temperature 101°C"

3.3 Data according to Commission Regulation (EU) 327/ 2011

	Actual	Req. 2015
01 Overall efficiency η_{es} / %	46.8	43.8
02 Measurement category	A	
03 Efficiency category	Static	
04 Efficiency grade N	64	61
05 Variable speed drive	Yes	
06 Year of manufacture	The year of manufacture is specified on the product's rating label.	
07 Manufacturer	ebm-papst Mulfingen GmbH & Co. KG Amtsgericht (court of registration) Stuttgart · HRA 590344 D-74673 Mulfingen	
08 Type	K3G250-RR03-H4	
09 Power consumption P_{ed} / kW	0.23	
09 Air flow q_v / m³/h	705	
09 Pressure increase total p_{sf} / Pa	486	
10 Speed (rpm) n / min^{-1}	2905	
11 Specific ratio*	1.01	
12 Recycling/disposal	Information on recycling and disposal is provided in the operating instructions.	
13 Maintenance	Information on installation, operation and maintenance is provided in the operating instructions.	
14 Additional components	Components used to calculate the energy efficiency that are not apparent from the measurement category are detailed in the CE declaration.	

* Specific ratio = 1 + p_{fs} / 100 000 Pa

Data obtained at optimum efficiency level. The ErP data is determined using a motor-impeller combination in a standardized measurement setup.

3.4 Technical description

Weight	11.8 kg
Fan size	250 mm
Rotor surface	Painted black
Electronics housing material	Die-cast aluminum, painted black
Impeller material	PA plastic, galvanized sheet-metal plate
Housing material	Die-cast aluminum
Support plate material	Sheet steel, galvanized
Inlet nozzle material	Sheet steel, galvanized
Guard grille material	Steel, phosphated and coated with black plastic (RAL 9005)
Number of blades	7
Direction of rotation	Clockwise, viewed toward rotor
Degree of protection	IP55
Insulation class	"F"
Moisture (F) / Environmental (H) protection class	H1
Installation position	Any
Condensation drainage holes	None
Mode	S1
Motor bearing	Ball bearing
Technical features	- Output 10 VDC, max. 10 mA - Operation and alarm display - Alarm relay - Integrated PID controller - Power limiter - Motor current limitation - PFC, active - RS-485 MODBUS-RTU - Soft start - Control input 0-10 VDC / PWM - Control interface with SELV potential safely disconnected from the mains - Thermal overload protection for electronics/motor - Line undervoltage / phase failure detection
Touch current according to IEC 60990 (measuring circuit Fig. 4, TN system)	<= 3.5 mA
Electrical hookup	Via terminal box
Motor protection	Thermal overload protector (TOP) internally connected
Protection class	I (if protective earth is connected by customer to the housing's connection point)
Conformity with standards	EN 61800-5-1; CE
Approval	C22.2 No.77 + CAN/CSA-E60730-1; EAC; UL 1004-7 + 60730

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With regard to cyclic speed loads, note that the rotating parts of the device are designed for a maximum of one million load cycles. If you have special questions, consult ebm-papst for support.

⇒ Use the device in accordance with its degree of protection.

Information on surface quality

The surfaces of the products conform to the generally applicable industrial standard. The surface quality may change during the production period. This has no effect on strength, dimensional stability and dimensional accuracy.
The color pigments in the paints used perceptibly react to UV light over the course of time. This does not however in any way affect the technical properties of the products. The product is to be protected against UV radiation to prevent the formation of patches and fading. Changes in color are not a reason for complaint and are not covered by the warranty.

3.5 Mounting data

Strength class of screws	8.8

⇒ Secure the screws against unintentional loosening (e.g. use self-locking screws).

Any further mounting data required can be taken from the product drawing or Section Chapter 4.1 Mechanical connection.

3.6 Transport and storage conditions

Max. permitted ambient temp. for motor (transport/ storage)	+80 °C
Min. permitted ambient temp. for motor (transport/ storage)	-40 °C

3.7 Electromagnetic compatibility

EMC immunity to interference	According to EN 61000-6-2 (industrial environment)
EMC circuit feedback	According to EN 61000-3-2/3
EMC interference emission	According to EN 61000-6-3 (household environment)

4. CONNECTION AND STARTUP

4.1 Mechanical connection

CAUTION
Risk of cutting and crushing when removing device from packaging

→ Carefully remove the device from the packaging by grasping hold of the frame. Never subject to any impact.

→ Wear safety shoes and cut-resistant safety gloves.

CAUTION
Heavy load when unpacking device
Risk of physical injury, such as back injuries.

→ Two people should work together to remove the device from its packaging.

NOTE
Damage to the device from vibration
Bearing damage, shorter service life

→ The fan must not be subjected to force or excessive vibration from sections of the installation. #If the fan is connected to air ducts, the connection should be isolated from vibration, e.g. using compensators or similar elements. #Ensure stress-free attachment of the fan to the substructure.

⇒ The fan may not be handled in the area around the inlet nozzle during transport and installation.
There is a risk of damage to the impeller.

⇒ Check the device for transport damage. Damaged devices are not to be installed.

⇒ Install the undamaged device in accordance with your application.

CAUTION
Possible damage to the device
If the device slips during installation, serious damage can result.

→ Ensure that the device is securely positioned at its place of installation until all fastening screws have been tightened.

- The fan must not be strained on fastening.

4.2 Electrical connection

DANGER
Voltage on the device
Electric shock

→ Always connect a protective earth first.

→ Check the protective earth.

DANGER
Faulty insulation
Risk of fatal injury from electric shock

→ Use only cables that meet the specified installation regulations for voltage, current, insulation material, capacity, etc.

→ Route cables so that they cannot be touched by any rotating parts.

DANGER
Electrical charge (>50 µC) between phase conductor and protective earth connection after switching off supply with multiple devices connected in parallel.
Electric shock, risk of injury

→ Ensure sufficient protection against accidental contact. Before working on the electrical hookup, short the supply and PE connections.

CAUTION
Voltage
The fan is a built-in component and has no disconnecting switch.

→ Only connect the fan to circuits that can be switched off with an all-pole disconnection switch.

→ When working on the fan, secure the system/machine in which the fan is installed so as to prevent it from being switched back on.

NOTE
Water ingress into wires or cables
Water ingress at the customer end of the cable can damage the device.

→ Make sure the end of the cable is connected in a dry environment.

Only connect the device to circuits that can be switched off with an all-pole disconnection switch.

4.2.1 Requirements

⇒ Check whether the information on the nameplate matches the connection data.

⇒ Before connecting the device, make sure the power supply matches the device voltage.

⇒ Only use cables designed for the current level indicated on the nameplate.
For determining the cross-section, note the sizing criteria according to EN 61800-5-1. The protective earth must have a cross-section equal to or greater than that of the phase conductor.
We recommend the use of 105 °C cables. Ensure that the minimum cable cross-section is at least
AWG 26 / 0.13 mm².

⇒ Note the following when routing the cables:
For permanently installed lines, the bending radius must be at least four times the outside diameter of the cable.
For movable lines, the bending radius must be at least 15 times the outside diameter of the cable.

Protective earth contact resistance according to EN 61800-5-1

Compliance with the resistance specifications according to EN 61800-5-1 for the protective earth connection circuit must be verified in the end application. Depending on the installation situation, it may be necessary to connect an additional protective earth conductor by way of the extra protective earth terminal provided on the device. The protective earth terminal is located on the housing and provided with a protective earth symbol and a hole.

4.2.2 Reactive currents

Because of the EMC filter integrated for compliance with EMC limits (interference emission and immunity to interference), reactive currents can be measured in the supply line even when the motor is at a standstill and the line voltage is switched on.

- The values are typically in the range < 250 mA
- At the same time, the effective power in this operating state (operational readiness) is typically < 4 W.

4.2.3 Residual current circuit breaker (RCCB)

If the use of a residual current device (RCD) is required in your installation, only AC/DC-sensitive residual current devices (type B or B+) are permissible. As with variable frequency drives, residual current devices cannot provide personal safety while operating the device. When the device power supply is switched on, pulsed charging currents from the capacitors in the integrated EMC filter can lead to the instant tripping of residual current devices. We recommend the use of residual current circuit breakers (RCCB) with a trip threshold of 300 mA and delayed tripping (super-resistant, characteristic K).

4.2.4 Locked-rotor protection

Due to the locked-rotor protection, the starting current (LRA) is equal to or less than the nominal current (FLA).

4.3 Connection in terminal box

4.3.1 Preparing cables for connection

Only strip the cable as far as necessary, ensuring that the cable gland is sealed and there is no strain on the connections. For tightening torques, see Chapter 3.1 Product drawing.

NOTE
Tightness and strain relief are dependent on the cable used.

→ This must be checked by the user.

4.3.2 Connecting wires to terminals

WARNING
Live terminals and connections even with device switched off
Electric shock

→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

⇒ Remove the cap from the cable gland.

Only remove caps where cables are fed in.

⇒ Route the wire(s) (not included in scope of delivery) into the terminal box.

⇒ First connect the "PE" (protective earth).

⇒ Connect the wires to the corresponding terminals.

Use a screwdriver to do so.
When connecting, ensure that no wire ends fan out.

⇒ Seal the terminal box.

4.3.3 Cable routing

Water must be prevented from reaching the cable gland along the cable.

NOTE
Damage caused by moisture penetration.
Moisture can penetrate into the terminal box if water is constantly present at the cable glands.

→ To prevent the constant accumulation of water at the cable glands, the cable should be routed in a U-shaped loop wherever possible.# If this is not possible, a drip edge can be produced by fitting a cable tie directly in front of the cable gland for example.

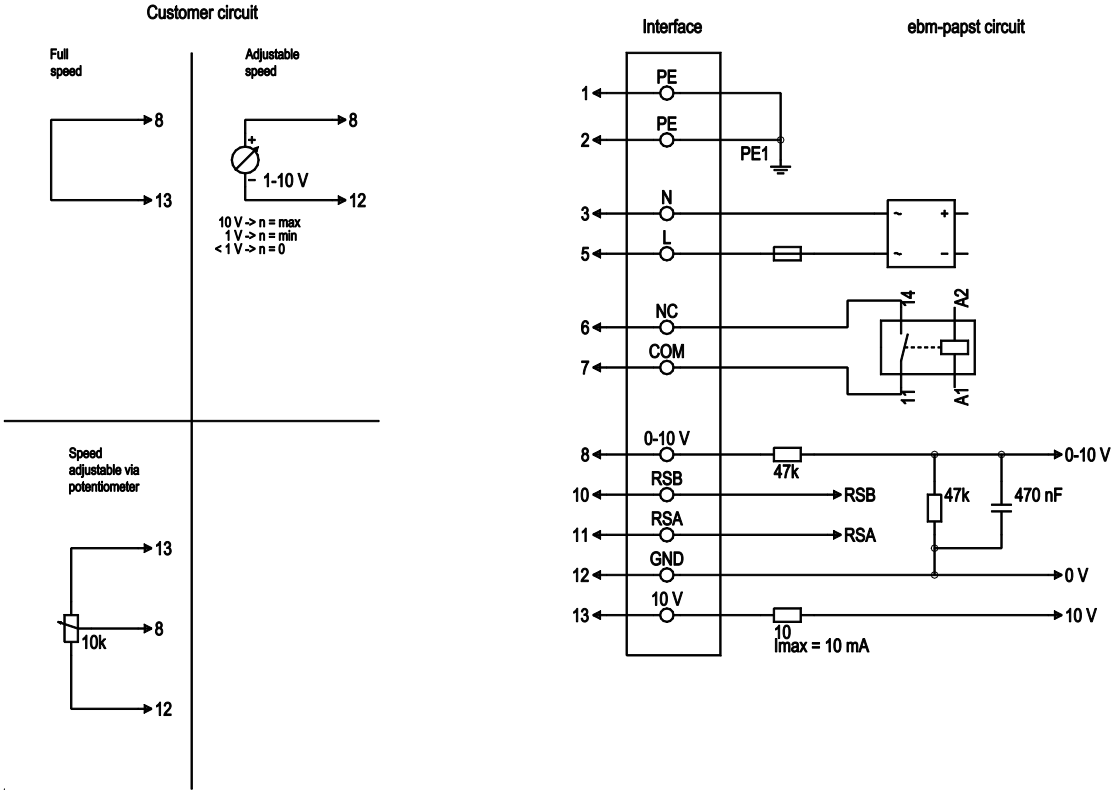
When routing the cable, make sure that the cable glands are located at the bottom. The cables must always be routed downward.

4.4 Factory settings

Factory settings made for the device by ebm-papst.

Mode parameter set 1	PWM control
Mode parameter set 2	PWM control
Fan/device address	01
Max. PWM / %	100
Min. PWM / %	10
Save set value to EEPROM	No
Set value requirement	Analog (linear)
Direction of action parameter set 1	Positive (heating)
Direction of action parameter set 2	Positive (heating)

4.5 Connection diagram



Drawing preliminary!

No.	Conn.	Designation	Color	Function/assignment
1	1, 2	PE	green/ yellow	Protective earth
1	3	N	blue	Power supply, neutral conductor, 50/60 Hz
1	5	L	black	Power supply, phase, 50/60 Hz
1	6	NC	white 1	Status relay, floating status contact; break for failure, contact rating 250 VAC / 2A (AC1) / min. 10 mA, basic insulation on supply side and reinforced insulation on control interface side
1	7	COM	white 2	Status relay, floating status contact; common connection, contact rating 250 VAC / 2A (AC1) / min. 10 mA, basic insulation on supply side and reinforced insulation on control interface side
2	8	0-10V	yellow	Analog input (set value); 0-10 V; Ri = 100 kΩ; adjustable curve
2	10	RSB	brown	RS485 interface for MODBUS, RSB
2	11	RSA	white	RS485 interface for MODBUS, RSA
2	12	GND	blue	Reference ground for control interface, SELV
2	13	+10V	red	Fixed voltage output 10 VDC, +10 V ±3%; max. 10 mA; short-circuit-proof; power supply for external devices (e.g. pot)

4.6 Checking connections

⇒ Ensure isolation from supply (all phases).
⇒ Make sure a restart is impossible
⇒ Check the cables for proper fit.
⇒ Screw the terminal box cover back on again. Terminal box tightening torque, see Chapter 3.1 Product drawing.
⇒ Route the cables in the terminal box so that the terminal box cover closes without resistance.
⇒ Use all screw plugs. Insert the screws by hand to avoid damage to the threads.
⇒ Make sure the terminal box is completely closed and sealed and that all screws and cable glands have been properly tightened.

4.7 Switching on the device

The device may only be switched on if it has been installed properly and in accordance with its intended use, including the required safety mechanisms and professional electrical hookup. This also applies for devices which have already been equipped with plugs and terminals or similar connectors by the customer.

WARNING
Hot motor housing
Risk of fire
→ Ensure that no combustible or flammable materials are located close to the fan.

⇒ Before switching on, check the device for visible external damage and make sure the protective devices are functional.
⇒ Check the fan's air flow paths for foreign matter and remove any foreign matter found.
⇒ Apply the nominal supply voltage.
⇒ Start the device by changing the input signal.

NOTE
Damage to the device from vibration
Bearing damage, shorter service life
→ Low-vibration operation of the fan must be ensured over the entire speed control range. #Severe vibration can arise for instance from inexpert handling, transportation damage and resultant imbalance or be caused by component or structural resonance. #Speed ranges with excessively high vibration levels and possibly resonant frequencies must be determined in the course of fan commissioning. #Either run through the resonant range as quickly as possible with speed control or find another remedy.# Operation with excessively high vibration levels can lead to premature failure.

4.8 Switching off the device

Switching off the device during operation:
⇒ Switch off the device via the control input.
⇒ Do not switch the motor (e.g. in cyclic operation) on and off via power supply.

Switching off the device for maintenance:
⇒ Switch off the device via the control input.
⇒ Do not switch the motor (e.g. in cyclic operation) on and off via power supply.
⇒ Disconnect the device from the power supply.
⇒ When disconnecting, be sure to disconnect the ground connection last.

5. INTEGRATED PROTECTIVE FEATURES

The integrated protective functions cause the motor to switch off automatically in the event of the faults described in the table.

Fault	Safety feature description/ function
Rotor position detection error	An automatic restart follows.
Blocked rotor	⇒ After the blockage is removed, the motor restarts automatically.
Line undervoltage (line voltage outside of permitted nominal voltage range)	⇒ If the line voltage returns to permitted values, the motor restarts automatically.

6. MAINTENANCE, MALFUNCTIONS, POSSIBLE CAUSES AND REMEDIES

Do not perform any repairs on your device. Send the device to ebm-papst for repair or replacement.

WARNING
Live terminals and connections even with device switched off
Electric shock
→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

CAUTION
If control voltage or a stored speed set value is applied, the motor will restart automatically, e.g. after a power failure.
Risk of injury
→ Keep out of the device's danger zone.# When working on the device, switch off the line voltage and ensure that it cannot be switched back on.
→ Wait until the device comes to a stop.
→ After working on the device, remove any tools or other objects from the device.

If the device is out of use for some time, e.g. when in storage, we recommend switching it on for at least two hours to allow any condensation to evaporate and to move the bearings.

Malfunction/fault	Possible cause	Possible remedy
Impeller not running smoothly	Imbalance in rotating parts	Clean the device; replace it if imbalance persists after cleaning. Make sure no weight clips are removed during cleaning.
Motor not turning	Mechanical blockage	Switch off, isolate from supply and remove mechanical blockage.
	Line voltage faulty	Check line voltage, restore power supply, apply control signal.

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	Faulty connection	Isolate from supply, correct connection; see connection diagram.
	Thermal overload protector activated	Allow motor to cool off, locate and rectify cause of error, release restart lockout if necessary
Motor/electronics overtemperature	Deficient cooling	Improve cooling. Let the device cool down. To reset the error message, switch off the line voltage for at least 25 s and then switch it on again.
	Ambient temperature too high	Reduce the ambient temperature. Reset by reducing control input to 0.
	Impermissible point of operation	Correct the operating point. Let the device cool down.

In the event of further malfunctions, contact ebm-papst.

6.1 Vibration testing

Checking of fan for mechanical vibration based on ISO 14694.
Recommendation: Every 6 months. Max. vibration severity is 3.5 mm/s, measured at the motor fastening diameter on the motor support plate in the direction of the motor axis of rotation and perpendicular to this.

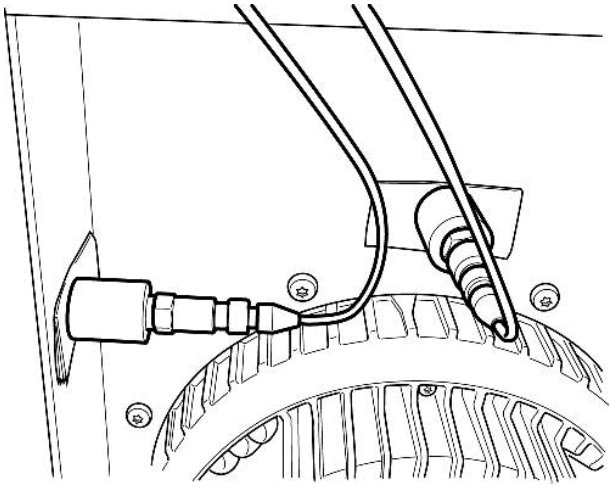

Fig. 1: Example illustrating vibration measurement. The arrangement of the sensors depends on the device concerned and the installation situation.

6.2 Cleaning

NOTE
Damage to the device during cleaning
Malfunction possible

→ Do not clean the device using a high-pressure cleaner.

→ Do not use acid, alkali or solvent-based cleaning agents.

→ Do not use any pointed or sharp-edged objects for cleaning

6.3 Safety inspection

NOTE
High-voltage test
The integrated EMC filter has Y capacitors. The tripping current is exceeded when AC testing voltage is applied.

→ Test the device with DC voltage when you perform the legally required high-voltage test. The voltage to be used corresponds to the peak value of the AC voltage required by the standard.

What to check	How to check	How often	What action?
Contact protection cover for intactness or damage	Visual inspection	At least every 6 months	Repair or replacement of device
Device for damage to blades and housing	Visual inspection	At least every 6 months	Replacement of device
Fastening the cables	Visual inspection	At least every 6 months	Fasten
Fastening the protective earth terminal	Visual inspection	At least every 6 months	Fasten
Insulation of cables for damage	Visual inspection	At least every 6 months	Replace cables
Impeller for wear/deposits/ corrosion and damage	Visual inspection	At least every 6 months	Clean impeller or replace device
Tightness of cable gland	Visual inspection	At least every 6 months	Retighten, replace if damaged
Abnormal bearing noise	acoustic	At least every 6 months	Replace device

6.4 Disposal

For ebm-papst, environmental protection and resource preservation are top priority corporate goals.
ebm-papst operates an environmental management system which is certified in accordance with ISO 14001 and rigorously implemented around the world on the basis of German standards.
Right from the development stage, ecological design, technical safety and health protection are fixed criteria.
The following section contains recommendations for ecological disposal of the product and its components.

6.4.1 Country-specific legal requirements

NOTE
Country-specific legal requirements
Always observe the applicable country-specific legal regulations with regard to the disposal of products or waste occurring in the various phases of the life cycle. The corresponding disposal standards are also to be heeded.

6.4.2 Disassembly

Disassembly of the product must be performed or supervised by qualified personnel with the appropriate technical knowledge.
The product is to be disassembled into suitable components for disposal employing standard procedures for motors.

WARNING
Heavy parts of the product may drop off. Some of the product components are heavy. These components could drop off during disassembly.
This can result in fatal or serious injury and material damage.
→ Secure components before unfastening to stop them falling.

6.4.3 Component disposal

The products are mostly made of steel, copper, aluminum and plastic. Metallic materials are generally considered to be fully recyclable.
Separate the components for recycling into the following categories:

- Steel and iron
- Aluminum
- Non-ferrous metal, e.g. motor windings
- Plastics, particularly with brominated flame retardants, in accordance with marking
- Insulating materials
- Cables and wires
- Electronic scrap, e.g. circuit boards

Only ferrite magnets and not rare earth magnets are used in external rotor motors from ebm-papst Mulfingen GmbH & Co. KG.

⇒ Ferrite magnets can be disposed of in the same way as normal iron and steel.

Electrical insulating materials on the product, in cables and wires are made of similar materials and are therefore to be treated in the same manner.
The materials concerned are as follows:

- Miscellaneous insulators used in the terminal box
- Power cables
- Cables for internal wiring
- Electrolytic capacitors

Dispose of electronic components employing the proper procedures for electronic scrap.

→ Please contact ebm-papst for any other questions on disposal.

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D.4 Operating instructions for the single-phase EC external fan, suction, SH225

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CONTENTS

1. SAFETY REGULATIONS AND INFORMATION

Read these operating instructions carefully before starting work on the device. Observe the following warnings to prevent malfunctions or danger to persons.
These operating instructions are to be regarded as part of the device. The device is only to be sold or passed on together with the operating instructions.
These operating instructions may be duplicated and distributed to inform about potential dangers and their prevention.

1.1 Hazard levels for warnings

These operating instructions use the following hazard levels to indicate potentially hazardous situations and important safety regulations:

DANGER
Indicates an imminently hazardous situation which will result in death or serious injury if the specified actions are not taken. Compliance with the instructions is imperative.

WARNING
Indicates a potentially hazardous situation which can result in death or serious injury if the specified actions are not taken. Exercise extreme caution while working.

CAUTION
Indicates a potentially hazardous situation which can result in minor or moderate injury or damage to property if the specified actions are not taken.

NOTE
A potentially harmful situation can occur and, if not avoided, can lead to property damage.

1.2 Staff qualifications

The device may only be transported, unpacked, installed, operated, maintained and otherwise used by suitably qualified, trained and authorized technical staff.
Only authorized specialists are permitted to install the device, to carry out a test run and to perform work on the electrical installation.

1.3 Basic safety rules

The safety hazards associated with the device must be assessed again following installation in the final product.
The locally applicable industrial safety regulations are always to be observed when working on the device.
Keep the workplace clean and tidy. Untidiness in the work area increases the risk of accidents.
Note the following when working on the device:

⇒ Do not perform any modifications, additions or conversions on the device without the approval of ebm-papst.

1.4 Voltage

⇒ Check the device's electrical equipment at regular intervals; see Chapter 6.3 Safety inspection.

⇒ Replace loose connections and defective cables immediately.

DANGER
Electrically charged device
Risk of electric shock

→ When working on an electrically charged device, stand on a rubber mat.

WARNING
Live terminals and connections even with device switched off
Electric shock

→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

CAUTION
In the event of a fault, the rotor and the impeller will be energized
The rotor and the impeller have basic insulation.

→ Do not touch the rotor and impeller once installed.

CAUTION
If control voltage or a stored speed set value is applied, the motor will restart automatically, e.g. after a power failure.
Risk of injury

→ Keep out of the device's danger zone.# When working on the device, switch off the line voltage and ensure that it cannot be switched back on.

→ Wait until the device comes to a stop.

→ After working on the device, remove any tools or other objects from the device.

1.5 Safety and protective features

DANGER
Protective device missing and protective device not functioning
Without a protective device there is a risk of serious injury, for instance when reaching into the device during operation.

→ Operate the device only with a fixed protective device and guard grille.

→ The fixed protective device must be able to withstand the kinetic energy of a fan blade that becomes detached at maximum speed. There must not be any gaps which it is possible to reach into with the fingers, for example.

→ The device is a built-in component. As the operator, you are responsible for ensuring that the device is secured adequately.

→ Stop the device immediately if you notice a missing or ineffective protective device.

1.6 Electromagnetic radiation

Interference from electromagnetic radiation is possible, e.g. in conjunction with open- and closed-loop control devices.
If impermissible radiation levels occur following installation, appropriate shielding measures have to be taken by the user.

NOTE
Electrical or electromagnetic interference after installing the device in customer equipment.

→ Verify that the entire setup is EMC-compliant.

1.7 Mechanical movement

DANGER
Rotating device
Risk of injury to body parts coming into contact with the rotor or the impeller.

→ Secure the device against accidental contact.

→ Before working on the system/machine, wait until all parts have come to a standstill.

WARNING
Rotating device
Long hair and dangling items of clothing, jewelry and the like can become entangled and be pulled into the device. Injuries can result.

→ Do not wear any loose-fitting or dangling clothing or jewelry while working on rotating parts.

→ Protect long hair with a cap.

1.8 Emissions

WARNING
Depending on the installation and operating conditions, the sound pressure level may exceed 70 dB(A).
Risk of noise-induced hearing loss

→ Take appropriate technical safety measures.

→ Protect operating personnel with appropriate safety equipment such as hearing protection.

→ Also observe the requirements of local agencies.

1.9 Hot surface

CAUTION
High temperature on electronics housing
Risk of burns

→ Ensure sufficient protection against accidental contact.

1.10 Transport

WARNING
Transporting the fan
Injuries from tipping or slipping

→ The fan is always to be transported with care and in its original packaging. #If set down too hard or at an angle for example, the impact can lead to bearing damage or deformation of the frame or impeller. #It must be ensured that the fans cannot tip over during transportation and handling.

→ Secure the fan(s) with appropriate equipment such as a lashing strip so that nothing can slip or tip, especially when stacking multiple fans. #Also make allowance for possible wind forces.

1.11 Storage

⇒ Store the device, partially or fully assembled, in a dry place, protected against the weather and free from vibration, in the original packaging in a clean environment.

⇒ Protect the device against environmental effects and dirt until final installation.

⇒ We recommend storing the device for no longer than one year in order to guarantee trouble-free operation and the longest possible service life.

⇒ Even devices explicitly intended for outdoor use are to be stored as described prior to commissioning.

⇒ Maintain the storage temperature, see Chapter 3.6 Transport and storage conditions.

⇒ Make sure that all cable glands are fitted with dummy plugs.

2. INTENDED USE

The device is exclusively designed as a built-in device for conveying air according to its technical data.
Any other usage above and beyond this does not conform with the intended purpose and constitutes misuse of the device.
Customer equipment must be capable of withstanding the mechanical and thermal stresses that can arise from this product. This applies for the entire service life of the equipment in which this product is installed.

Intended use also includes

- The device is only to be used in IT networks with a permissible maximum voltage of 277 V between the phase conductors.
- Use of the device in stationary systems only.
- Conveying air at an ambient air pressure between 800 mbar and 1050 mbar.
- Using the device within the permitted ambient temperature range; see Chapter 3.6 Transport and storage conditions and Chapter 3.2 Nominal data.
- Operating the device with all protective devices.
- Following the operating instructions.

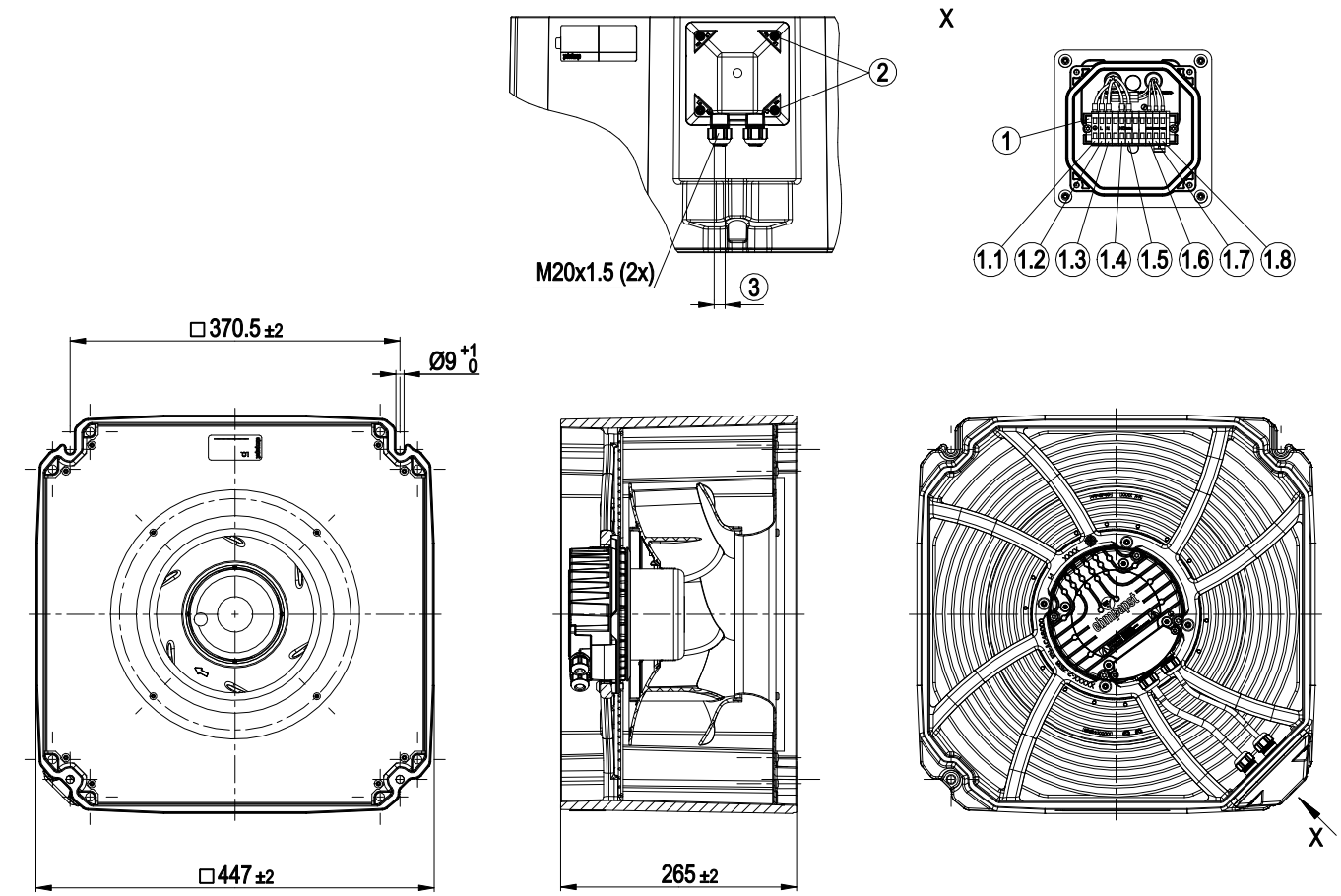
Improper use

In particular, operating the device in the following ways is prohibited and could be hazardous:

- Operating the device in an unbalanced state, e.g. due to dirt deposits or ice formation.
- Resonant operation, operation with severe vibration. This also includes vibration transmitted to the fan from the customer installation.
- Opening the terminal box during operation.
- Conveying air that contains abrasive particles.
- Conveying highly corrosive air, e.g. salt spray. Exception: devices designed for salt spray and correspondingly protected.
- Conveying air with high dust content, e.g. suctioning off sawdust.
- Operating the device close to flammable materials or components.
- Operating the device in an explosive atmosphere.
- Using the device as a safety component or to perform safety-related functions.
- Operation with completely or partially disassembled or manipulated protective devices.
- In addition, all applications not listed among the intended uses.

3. TECHNICAL DATA

3.1 Product drawing



All dimensions in mm.

1	Terminal strip
1.1	PE
1.2	L
1.3	N
1.4	NC
1.5	COM
1.6	GND
1.7	0-10 V
1.8	+10 V
2	Tightening torque 1.2±0.2 Nm
3	Cable diameter min. 6 mm, max. 10 mm, tightening torque 2.5 ± 0.4 Nm

3.2 Nominal data

Motor	M3G084-DF

Phase	1~
Nominal voltage / VAC	230
Nominal voltage range / VAC	200 .. 277
Frequency / Hz	50/60

Method of obtaining data	ml
Speed (rpm) / min-1	2550
Power consumption / W	460
Current draw / A	2.0
Min. ambient temperature / °C	-25
Max. ambient temperature / °C	60

ml = Max. load · me = Max. efficiency · fa = Free air
cs = Customer specification · ce = Customer equipment

Subject to change

3.3 Data according to Commission Regulation (EU) 327/2011

	Actual	Req. 2015
01 Overall efficiency η_{es} / %	56.2	46.8
02 Measurement category	A	
03 Efficiency category	Static	
04 Efficiency grade N	70.4	61
05 Variable speed drive	Yes	
06 Year of manufacture	The year of manufacture is specified on the product's rating label.	
07 Manufacturer	ebm-papst Mulfingen GmbH & Co. KG Amtsgericht (court of registration) Stuttgart · HRA 590344 D-74673 Mulfingen	
08 Type	K3G280-RR03-H4	
09 Power consumption P_{ed} / kW	0.44	
09 Air flow q_v / m³/h	1605	
09 Pressure increase total p_{sf} / Pa	512	
10 Speed (rpm) n / min-1	2560	
11 Specific ratio*	1.01	
12 Recycling/disposal	Information on recycling and disposal is provided in the operating instructions.	
13 Maintenance	Information on installation, operation and maintenance is provided in the operating instructions.	
14 Additional components	Components used to calculate the energy efficiency that are not apparent from the measurement category are detailed in the CE declaration.	

* Specific ratio = 1 + p_{fs} / 100 000 Pa

Data obtained at optimum efficiency level. The ErP data is determined using a motor-impeller combination in a standardized measurement setup.

3.4 Technical description

Weight	17.5 kg
Fan size	280 mm
Rotor surface	Painted black
Electronics housing material	Die-cast aluminum, painted black
Impeller material	PP plastic, galvanized sheet-metal plate
Housing material	Die-cast aluminum
Support plate material	Sheet steel, galvanized
Inlet nozzle material	Sheet steel, galvanized
Guard grille material	Steel, phosphated and coated with black plastic (RAL 9005)
Number of blades	6
Direction of rotation	Clockwise, viewed toward rotor
Degree of protection	IP55
Insulation class	"F"
Moisture (F) / Environmental (H) protection class	H1
Installation position	Any
Condensation drainage holes	None
Mode	S1
Motor bearing	Ball bearing
Technical features	- Output 10 VDC, max. 10 mA - Operation and alarm display - Alarm relay - Integrated PID controller - Power limiter - Motor current limitation - PFC, active - RS-485 MODBUS-RTU - Soft start - Control input 0-10 VDC / PWM - Control interface with SELV potential safely disconnected from the mains - Thermal overload protection for electronics/motor - Line undervoltage / phase failure detection
Touch current according to IEC 60990 (measuring circuit Fig. 4, TN system)	<= 3.5 mA
Electrical hookup	Via terminal box
Motor protection	Thermal overload protector (TOP) internally connected
Protection class	I (if protective earth is connected by customer to the housing's connection point)
Conformity with standards	EN 61800-5-1; CE
Approval	C22.2 No.77 + CAN/CSA-E60730-1; EAC; UL 1004-7 + 60730

With regard to cyclic speed loads, note that the rotating parts of the device are designed for a maximum of one million load cycles. If you have special questions, consult ebm-papst for support.

⇒ Use the device in accordance with its degree of protection.

Information on surface quality

The surfaces of the products conform to the generally applicable industrial standard. The surface quality may change during the production period. This has no effect on strength, dimensional stability and dimensional accuracy.
The color pigments in the paints used perceptibly react to UV light over the course of time. This does not however in any way affect the technical properties of the products. The product is to be protected against UV radiation to prevent the formation of patches and fading. Changes in color are not a reason for complaint and are not covered by the warranty.

3.5 Mounting data

Strength class of screws	8.8

⇒ Secure the screws against unintentional loosening (e.g. use self-locking screws).

Any further mounting data required can be taken from the product drawing or Section Chapter 4.1 Mechanical connection.

3.6 Transport and storage conditions

Max. permitted ambient temp. for motor (transport/ storage)	+80 °C
Min. permitted ambient temp. for motor (transport/ storage)	-40 °C

3.7 Electromagnetic compatibility

EMC immunity to interference	According to EN 61000-6-2 (industrial environment)
EMC circuit feedback	According to EN 61000-3-2/3
EMC interference emission	According to EN 61000-6-3 (household environment)

4. CONNECTION AND STARTUP

4.1 Mechanical connection

CAUTION
Risk of cutting and crushing when removing device from packaging

→ Carefully remove the device from the packaging by grasping hold of the frame. Never subject to any impact.

→ Wear safety shoes and cut-resistant safety gloves.

CAUTION
Heavy load when unpacking device
Risk of physical injury, such as back injuries.

→ Two people should work together to remove the device from its packaging.

NOTE
Damage to the device from vibration
Bearing damage, shorter service life

→ The fan must not be subjected to force or excessive vibration from sections of the installation. #If the fan is connected to air ducts, the connection should be isolated from vibration, e.g. using compensators or similar elements. #Ensure stress-free attachment of the fan to the substructure.

⇒ The fan may not be handled in the area around the inlet nozzle during transport and installation.
There is a risk of damage to the impeller.

⇒ Check the device for transport damage. Damaged devices are not to be installed.

⇒ Install the undamaged device in accordance with your application.

CAUTION
Possible damage to the device
If the device slips during installation, serious damage can result.

→ Ensure that the device is securely positioned at its place of installation until all fastening screws have been tightened.

- The fan must not be strained on fastening.

4.2 Electrical connection

DANGER
Voltage on the device
Electric shock

→ Always connect a protective earth first.

→ Check the protective earth.

DANGER
Faulty insulation
Risk of fatal injury from electric shock

→ Use only cables that meet the specified installation regulations for voltage, current, insulation material, capacity, etc.

→ Route cables so that they cannot be touched by any rotating parts.

DANGER
Electrical charge (>50 µC) between phase conductor and protective earth connection after switching off supply with multiple devices connected in parallel.
Electric shock, risk of injury

→ Ensure sufficient protection against accidental contact. Before working on the electrical hookup, short the supply and PE connections.

CAUTION
Voltage
The fan is a built-in component and has no disconnecting switch.

→ Only connect the fan to circuits that can be switched off with an all-pole disconnection switch.

→ When working on the fan, secure the system/machine in which the fan is installed so as to prevent it from being switched back on.

NOTE
Water ingress into wires or cables
Water ingress at the customer end of the cable can damage the device.

→ Make sure the end of the cable is connected in a dry environment.

Only connect the device to circuits that can be switched off with an all-pole disconnection switch.

4.2.1 Requirements

⇒ Check whether the information on the nameplate matches the connection data.

⇒ Before connecting the device, make sure the power supply matches the device voltage.

⇒ Only use cables designed for the current level indicated on the nameplate.
For determining the cross-section, note the sizing criteria according to EN 61800-5-1. The protective earth must have a cross-section equal to or greater than that of the phase conductor.
We recommend the use of 105 °C cables. Ensure that the minimum cable cross-section is at least
AWG 26 / 0.13 mm².

⇒ Note the following when routing the cables:
For permanently installed lines, the bending radius must be at least four times the outside diameter of the cable.
For movable lines, the bending radius must be at least 15 times the outside diameter of the cable.

Protective earth contact resistance according to EN 61800-5-1

Compliance with the resistance specifications according to EN 61800-5-1 for the protective earth connection circuit must be verified in the end application. Depending on the installation situation, it may be necessary to connect an additional protective earth conductor by way of the extra protective earth terminal provided on the device. The protective earth terminal is located on the housing and provided with a protective earth symbol and a hole.

4.2.2 Reactive currents

Because of the EMC filter integrated for compliance with EMC limits (interference emission and immunity to interference), reactive currents can be measured in the supply line even when the motor is at a standstill and the line voltage is switched on.

- The values are typically in the range < 250 mA
- At the same time, the effective power in this operating state (operational readiness) is typically < 4 W.

4.2.3 Residual current circuit breaker (RCCB)

If the use of a residual current device (RCD) is required in your installation, only AC/DC-sensitive residual current devices (type B or B+) are permissible. As with variable frequency drives, residual current devices cannot provide personal safety while operating the device. When the device power supply is switched on, pulsed charging currents from the capacitors in the integrated EMC filter can lead to the instant tripping of residual current devices. We recommend the use of residual current circuit breakers (RCCB) with a trip threshold of 300 mA and delayed tripping (super-resistant, characteristic K).

4.2.4 Locked-rotor protection

Due to the locked-rotor protection, the starting current (LRA) is equal to or less than the nominal current (FLA).

4.3 Connection in terminal box

4.3.1 Preparing cables for connection

Only strip the cable as far as necessary, ensuring that the cable gland is sealed and there is no strain on the connections. For tightening torques, see Chapter 3.1 Product drawing.

NOTE
Tightness and strain relief are dependent on the cable used.

→ This must be checked by the user.

4.3.2 Connecting wires to terminals

WARNING
Live terminals and connections even with device switched off
Electric shock

→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

⇒ Remove the cap from the cable gland.

Only remove caps where cables are fed in.

⇒ Route the wire(s) (not included in scope of delivery) into the terminal box.

⇒ First connect the "PE" (protective earth).

⇒ Connect the wires to the corresponding terminals.

Use a screwdriver to do so.
When connecting, ensure that no wire ends fan out.

⇒ Seal the terminal box.

4.3.3 Cable routing

Water must be prevented from reaching the cable gland along the cable.

NOTE
Damage caused by moisture penetration.
Moisture can penetrate into the terminal box if water is constantly present at the cable glands.

→ To prevent the constant accumulation of water at the cable glands, the cable should be routed in a U-shaped loop wherever possible.# If this is not possible, a drip edge can be produced by fitting a cable tie directly in front of the cable gland for example.

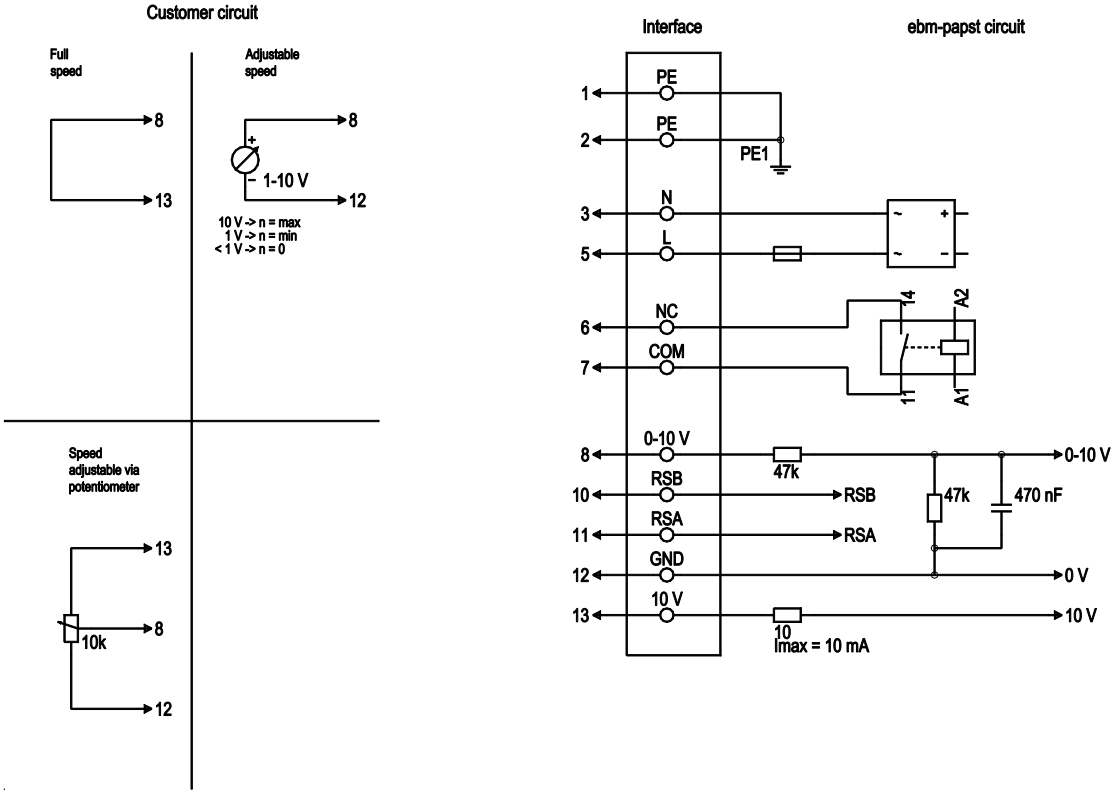
When routing the cable, make sure that the cable glands are located at the bottom. The cables must always be routed downward.

4.4 Factory settings

Factory settings made for the device by ebm-papst.

Mode parameter set 1	PWM control
Mode parameter set 2	PWM control
Fan/device address	01
Max. PWM / %	100
Min. PWM / %	10
Save set value to EEPROM	No
Set value requirement	Analog (linear)
Direction of action parameter set 1	Positive (heating)
Direction of action parameter set 2	Positive (heating)

4.5 Connection diagram



Drawing preliminary!

No.	Conn.	Designation	Color	Function/assignment
1	1, 2	PE	green/ yellow	Protective earth
1	3	N	blue	Power supply, neutral conductor, 50/60 Hz
1	5	L	black	Power supply, phase, 50/60 Hz
1	6	NC	white 1	Status relay, floating status contact; break for failure, contact rating 250 VAC / 2A (AC1) / min. 10 mA, basic insulation on supply side and reinforced insulation on control interface side
1	7	COM	white 2	Status relay, floating status contact; common connection, contact rating 250 VAC / 2A (AC1) / min. 10 mA, basic insulation on supply side and reinforced insulation on control interface side
2	8	0-10V	yellow	Analog input (set value); 0-10 V; Ri = 100 kΩ; adjustable curve
2	10	RSB	brown	RS485 interface for MODBUS, RSB
2	11	RSA	white	RS485 interface for MODBUS, RSA
2	12	GND	blue	Reference ground for control interface, SELV
2	13	+10V	red	Fixed voltage output 10 VDC, +10 V ±3%; max. 10 mA; short-circuit-proof; power supply for external devices (e.g. pot)

4.6 Checking connections

⇒ Ensure isolation from supply (all phases).
⇒ Make sure a restart is impossible
⇒ Check the cables for proper fit.
⇒ Screw the terminal box cover back on again. Terminal box tightening torque, see Chapter 3.1 Product drawing.
⇒ Route the cables in the terminal box so that the terminal box cover closes without resistance.
⇒ Use all screw plugs. Insert the screws by hand to avoid damage to the threads.
⇒ Make sure the terminal box is completely closed and sealed and that all screws and cable glands have been properly tightened.

4.7 Switching on the device

The device may only be switched on if it has been installed properly and in accordance with its intended use, including the required safety mechanisms and professional electrical hookup. This also applies for devices which have already been equipped with plugs and terminals or similar connectors by the customer.

WARNING
Hot motor housing
Risk of fire
→ Ensure that no combustible or flammable materials are located close to the fan.

⇒ Before switching on, check the device for visible external damage and make sure the protective devices are functional.
⇒ Check the fan's air flow paths for foreign matter and remove any foreign matter found.
⇒ Apply the nominal supply voltage.
⇒ Start the device by changing the input signal.

NOTE
Damage to the device from vibration
Bearing damage, shorter service life
→ Low-vibration operation of the fan must be ensured over the entire speed control range. #Severe vibration can arise for instance from inexpert handling, transportation damage and resultant imbalance or be caused by component or structural resonance. #Speed ranges with excessively high vibration levels and possibly resonant frequencies must be determined in the course of fan commissioning. #Either run through the resonant range as quickly as possible with speed control or find another remedy.# Operation with excessively high vibration levels can lead to premature failure.

→ The maximum permissible vibration severity must not exceed 3.5 mm/s and should be checked at intervals of 6 months. #It is to be measured at the motor mount at the motor support plate in all three 3 dimensions, see Chapter 6. Maintenance, malfunctions, possible causes and remedies.

4.8 Switching off the device

Switching off the device during operation:
⇒ Switch off the device via the control input.
⇒ Do not switch the motor (e.g. in cyclic operation) on and off via power supply.

Switching off the device for maintenance:
⇒ Switch off the device via the control input.
⇒ Do not switch the motor (e.g. in cyclic operation) on and off via power supply.
⇒ Disconnect the device from the power supply.
⇒ When disconnecting, be sure to disconnect the ground connection last.

5. INTEGRATED PROTECTIVE FEATURES

The integrated protective functions cause the motor to switch off automatically in the event of the faults described in the table.

Fault	Safety feature description/ function
Rotor position detection error	An automatic restart follows.
Blocked rotor	⇒ After the blockage is removed, the motor restarts automatically.
Line undervoltage (line voltage outside of permitted nominal voltage range)	⇒ If the line voltage returns to permitted values, the motor restarts automatically.

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6. MAINTENANCE, MALFUNCTIONS, POSSIBLE CAUSES AND REMEDIES

Do not perform any repairs on your device. Send the device to ebm-papst for repair or replacement.

WARNING
Live terminals and connections even with device switched off
Electric shock

→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

CAUTION
If control voltage or a stored speed set value is applied, the motor will restart automatically, e.g. after a power failure.
Risk of injury

→ Keep out of the device's danger zone.# When working on the device, switch off the line voltage and ensure that it cannot be switched back on.

→ Wait until the device comes to a stop.

→ After working on the device, remove any tools or other objects from the device.

If the device is out of use for some time, e.g. when in storage, we recommend switching it on for at least two hours to allow any condensation to evaporate and to move the bearings.

Malfunction/fault	Possible cause	Possible remedy
Impeller not running smoothly	Imbalance in rotating parts	Clean the device; replace it if imbalance persists after cleaning. Make sure no weight clips are removed during cleaning.
Motor not turning	Mechanical blockage	Switch off, isolate from supply and remove mechanical blockage.
	Line voltage faulty	Check line voltage, restore power supply, apply control signal.
	Faulty connection	Isolate from supply, correct connection; see connection diagram.
	Thermal overload protector activated	Allow motor to cool off, locate and rectify cause of error, release restart lockout if necessary
Motor/electronics overtemperature	Deficient cooling	Improve cooling. Let the device cool down. To reset the error message, switch off the line voltage for at least 25 s and then switch it on again.
	Ambient temperature too high	Reduce the ambient temperature. Reset by reducing control input to 0.
	Impermissible point of operation	Correct the operating point. Let the device cool down.

In the event of further malfunctions, contact ebm-papst.

6.1 Vibration testing

Checking of fan for mechanical vibration based on ISO 14694. Recommendation: Every 6 months. Max. vibration severity is 3.5 mm/s, measured at the motor fastening diameter on the motor support plate in the direction of the motor axis of rotation and perpendicular to this.

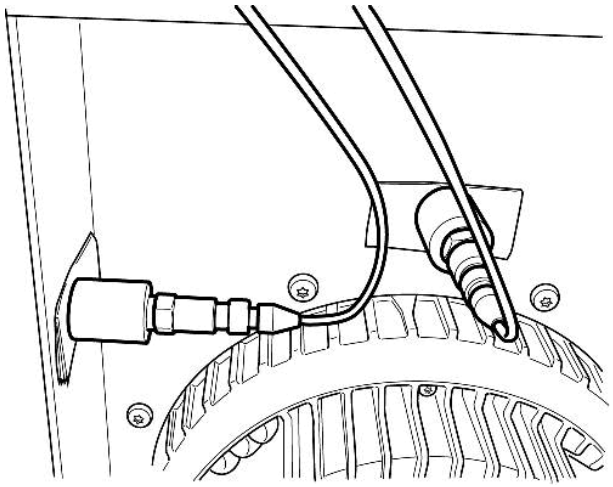

Fig. 1: Example illustrating vibration measurement. The arrangement of the sensors depends on the device concerned and the installation situation.

6.2 Cleaning

NOTE
Damage to the device during cleaning
Malfunction possible

→ Do not clean the device using a high-pressure cleaner.

→ Do not use acid, alkali or solvent-based cleaning agents.

→ Do not use any pointed or sharp-edged objects for cleaning

6.3 Safety inspection

NOTE
High-voltage test
The integrated EMC filter has Y capacitors. The tripping current is exceeded when AC testing voltage is applied.

→ Test the device with DC voltage when you perform the legally required high-voltage test. The voltage to be used corresponds to the peak value of the AC voltage required by the standard.

What to check	How to check	How often	What action?
Contact protection cover for intactness or damage	Visual inspection	At least every 6 months	Repair or replacement of device

Device for damage to blades and housing	Visual inspection	At least every 6 months	Replacement of device
Fastening the cables	Visual inspection	At least every 6 months	Fasten
Fastening the protective earth terminal	Visual inspection	At least every 6 months	Fasten
Insulation of cables for damage	Visual inspection	At least every 6 months	Replace cables
Impeller for wear/deposits/ corrosion and damage	Visual inspection	At least every 6 months	Clean impeller or replace device
Tightness of cable gland	Visual inspection	At least every 6 months	Retighten, replace if damaged
Abnormal bearing noise	acoustic	At least every 6 months	Replace device
Vibration test	Vibration tester, start-up or deceleration measurement	Recommended every 6 months	Clean impeller or replace device

6.4 Disposal

For ebm-papst, environmental protection and resource preservation are top priority corporate goals.
ebm-papst operates an environmental management system which is certified in accordance with ISO 14001 and rigorously implemented around the world on the basis of German standards.
Right from the development stage, ecological design, technical safety and health protection are fixed criteria.
The following section contains recommendations for ecological disposal of the product and its components.

6.4.1 Country-specific legal requirements

NOTE
Country-specific legal requirements
Always observe the applicable country-specific legal regulations with regard to the disposal of products or waste occurring in the various phases of the life cycle. The corresponding disposal standards are also to be heeded.

6.4.2 Disassembly

Disassembly of the product must be performed or supervised by qualified personnel with the appropriate technical knowledge.
The product is to be disassembled into suitable components for disposal employing standard procedures for motors.

WARNING
Heavy parts of the product may drop off. Some of the product components are heavy. These components could drop off during disassembly.
This can result in fatal or serious injury and material damage.
→ Secure components before unfastening to stop them falling.

6.4.3 Component disposal

The products are mostly made of steel, copper, aluminum and plastic. Metallic materials are generally considered to be fully recyclable.
Separate the components for recycling into the following categories:

- Steel and iron
- Aluminum
- Non-ferrous metal, e.g. motor windings
- Plastics, particularly with brominated flame retardants, in accordance with marking
- Insulating materials
- Cables and wires
- Electronic scrap, e.g. circuit boards

Only ferrite magnets and not rare earth magnets are used in external rotor motors from ebm-papst Mulfingen GmbH & Co. KG.

⇒ Ferrite magnets can be disposed of in the same way as normal iron and steel.

Electrical insulating materials on the product, in cables and wires are made of similar materials and are therefore to be treated in the same manner.
The materials concerned are as follows:

- Miscellaneous insulators used in the terminal box
- Power cables
- Cables for internal wiring
- Electrolytic capacitors

Dispose of electronic components employing the proper procedures for electronic scrap.

→ Please contact ebm-papst for any other questions on disposal.

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D.5 Operating instructions for the single-phase EC external fan, pressing, SH180

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CONTENTS

1. SAFETY REGULATIONS AND INFORMATION

Read these operating instructions carefully before starting work on the device. Observe the following warnings to prevent malfunctions or danger to persons.
These operating instructions are to be regarded as part of the device. The device is only to be sold or passed on together with the operating instructions.
These operating instructions may be duplicated and distributed to inform about potential dangers and their prevention.

1.1 Hazard levels for warnings

These operating instructions use the following hazard levels to indicate potentially hazardous situations and important safety regulations:

DANGER
Indicates an imminently hazardous situation which will result in death or serious injury if the specified actions are not taken. Compliance with the instructions is imperative.

WARNING
Indicates a potentially hazardous situation which can result in death or serious injury if the specified actions are not taken. Exercise extreme caution while working.

CAUTION
Indicates a potentially hazardous situation which can result in minor or moderate injury or damage to property if the specified actions are not taken.

NOTE
A potentially harmful situation can occur and, if not avoided, can lead to property damage.

1.2 Staff qualifications

The device may only be transported, unpacked, installed, operated, maintained and otherwise used by suitably qualified, trained and authorized technical staff.
Only authorized specialists are permitted to install the device, to carry out a test run and to perform work on the electrical installation.

1.3 Basic safety rules

The safety hazards associated with the device must be assessed again following installation in the final product.
Note the following when working on the device:

⇒ Do not perform any modifications, additions or conversions on the device without the approval of ebm-papst.

1.4 Voltage

⇒ Check the device's electrical equipment at regular intervals; see Chapter 6.3 Safety inspection.

⇒ Replace loose connections and defective cables immediately.

DANGER
Electrically charged device
Risk of electric shock

→ When working on an electrically charged device, stand on a rubber mat.

WARNING
Live terminals and connections even with device switched off
Electric shock

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→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

CAUTION
In the event of a fault, the rotor and the impeller will be energized
The rotor and the impeller have basic insulation.

→ Do not touch the rotor and impeller once installed.

CAUTION
If control voltage or a stored speed set value is applied, the motor will restart automatically, e.g. after a power failure.
Risk of injury

→ Keep out of the device's danger zone.# When working on the device, switch off the line voltage and ensure that it cannot be switched back on.

→ Wait until the device comes to a stop.

→ After working on the device, remove any tools or other objects from the device.

1.5 Safety and protective features

DANGER
Protective device missing and protective device not functioning
Without a protective device there is a risk of serious injury, for instance when reaching into the device during operation.

→ Operate the device only with a fixed protective device and guard grille.

→ The fixed protective device must be able to withstand the kinetic energy of a fan blade that becomes detached at maximum speed. There must not be any gaps which it is possible to reach into with the fingers, for example.

→ The device is a built-in component. As the operator, you are responsible for ensuring that the device is secured adequately.

→ Stop the device immediately if you notice a missing or ineffective protective device.

1.6 Electromagnetic radiation

Interference from electromagnetic radiation is possible, e.g. in conjunction with open- and closed-loop control devices.
If impermissible radiation levels occur following installation, appropriate shielding measures have to be taken by the user.

NOTE
Electrical or electromagnetic interference after installing the device in customer equipment.

→ Verify that the entire setup is EMC-compliant.

1.7 Mechanical movement

DANGER
Rotating device
Risk of injury to body parts coming into contact with the rotor or the impeller.

→ Secure the device against accidental contact.

→ Before working on the system/machine, wait until all parts have come to a standstill.

WARNING
Rotating device
Long hair and dangling items of clothing, jewelry and the like can become entangled and be pulled into the device. Injuries can result.

→ Do not wear any loose-fitting or dangling clothing or jewelry while working on rotating parts.

→ Protect long hair with a cap.

1.8 Emissions

WARNING
Depending on the installation and operating conditions, the sound pressure level may exceed 70 dB(A).
Risk of noise-induced hearing loss

→ Take appropriate technical safety measures.

→ Protect operating personnel with appropriate safety equipment such as hearing protection.

→ Also observe the requirements of local agencies.

1.9 Hot surface

CAUTION
High temperature on electronics housing
Risk of burns

→ Ensure sufficient protection against accidental contact.

1.10 Transport

NOTE
Transporting the device

→ Transport the device in its original packaging only.

→ Secure the device so it cannot slip, e.g. by using a lashing strip.

1.11 Storage

⇒ Store the device, partially or fully assembled, in a dry place, protected against the weather and free from vibration, in the original packaging in a clean environment.

⇒ Protect the device against environmental effects and dirt until final installation.

⇒ We recommend storing the device for no longer than one year in order to guarantee trouble-free operation and the longest possible service life.

⇒ Even devices explicitly intended for outdoor use are to be stored as described prior to commissioning.

⇒ Maintain the storage temperature, see Chapter 3.6 Transport and storage conditions.

⇒ Make sure that all cable glands are fitted with dummy plugs.

2. INTENDED USE

The device is exclusively designed as a built-in device for conveying air according to its technical data.
Any other usage above and beyond this does not conform with the intended purpose and constitutes misuse of the device.
Customer equipment must be capable of withstanding the mechanical and thermal stresses that can arise from this product. This applies for the entire service life of the equipment in which this product is installed.

Intended use also includes

- The device is only to be used in IT networks with a permissible maximum voltage of 277 V between the phase conductors.
- Use of the device in stationary systems only.
- Conveying air at an ambient air pressure between 800 mbar and 1050 mbar.
- Using the device within the permitted ambient temperature range; see Chapter 3.6 Transport and storage conditions and Chapter 3.2 Nominal data.
- Operating the device with all protective devices.
- Following the operating instructions.

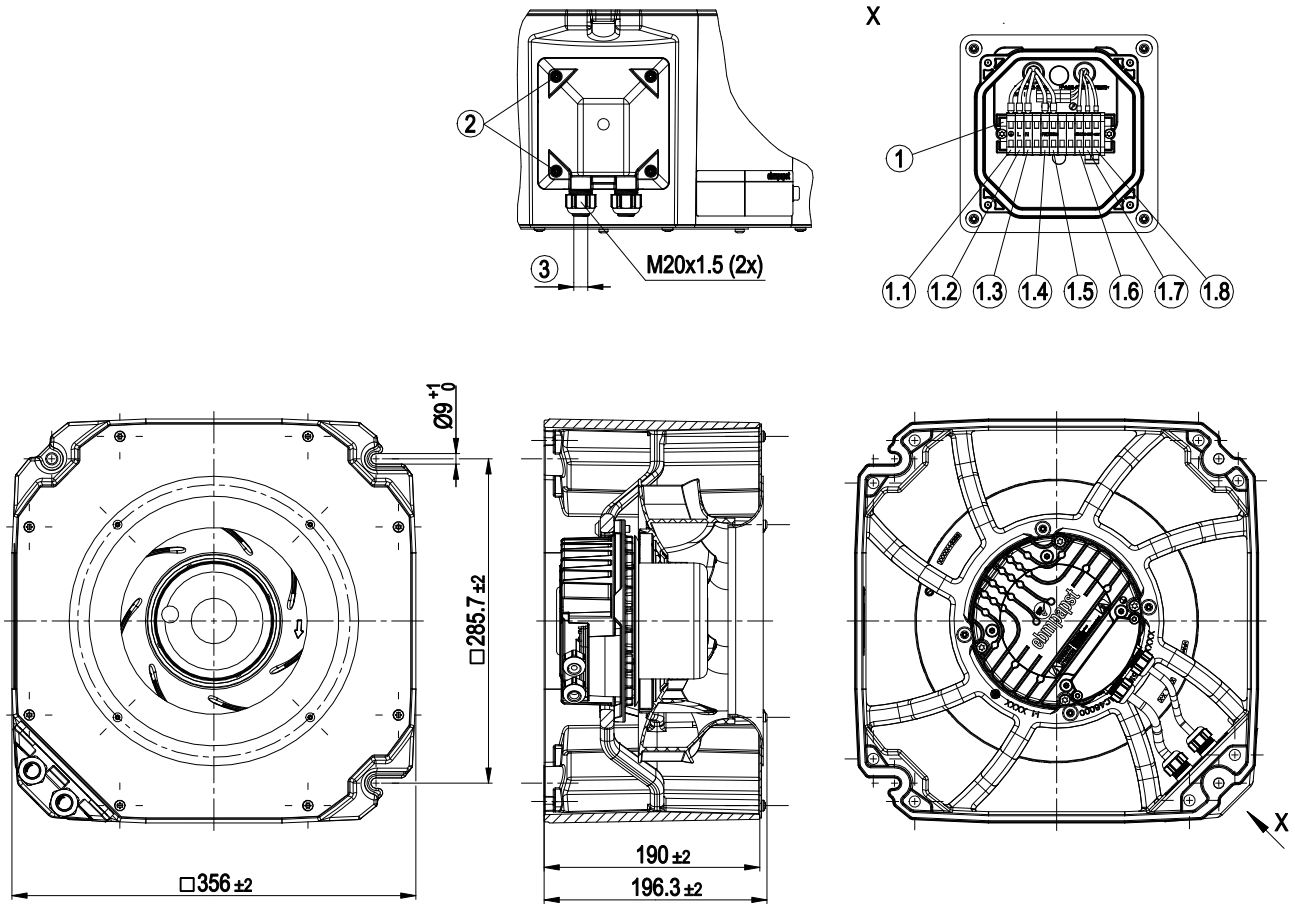
Improper use

In particular, operating the device in the following ways is prohibited and could be hazardous:

- Operating the device in an unbalanced state, e.g. due to dirt deposits or ice formation.
- Resonant operation, operation with severe vibration. This also includes vibration transmitted to the fan from the customer installation.
- Opening the terminal box during operation.
- Conveying air that contains abrasive particles.
- Conveying highly corrosive air, e.g. salt spray. Exception: devices designed for salt spray and correspondingly protected.
- Conveying air with high dust content, e.g. suctioning off sawdust.
- Operating the device close to flammable materials or components.
- Operating the device in an explosive atmosphere.
- Using the device as a safety component or to perform safety-related functions.
- Operation with completely or partially disassembled or manipulated protective devices.
- In addition, all applications not listed among the intended uses.

3. TECHNICAL DATA

3.1 Product drawing



All dimensions in mm.

1	Terminal strip
1.1	PE
1.2	L
1.3	N
1.4	NC
1.5	COM
1.6	GND
1.7	0-10 V
1.8	+10 V
2	Tightening torque 1.2±0.2 Nm
3	Cable diameter min. 6 mm, max. 10 mm, tightening torque 2.5 ± 0.4 Nm
	Accessory part: Guard grill 20180-2-4039, filter 99950-2-5170 and filter mount 25180-2-4041 not included in scope of delivery.

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3.2 Nominal data

Motor	M3G084-DF

Phase	1~
Nominal voltage / VAC	230
Nominal voltage range / VAC	200 .. 277
Frequency / Hz	50/60

Method of obtaining data	ml/ce
Speed (rpm) / min-1	3100
Power consumption / W	300
Current draw / A	1.3
Min. ambient temperature / °C	-25
Max. ambient temperature / °C	60

ml = Max. load · me = Max. efficiency · fa = Free air
cs = Customer specification · ce = Customer equipment

Subject to change

3.3 Data according to Commission Regulation (EU) 327/2011

	Actual	Req. 2015
01 Overall efficiency η_{es} / %	49.7	44.8
02 Measurement category	A	
03 Efficiency category	Static	
04 Efficiency grade N	66	61
05 Variable speed drive	Yes	
06 Year of manufacture	The year of manufacture is specified on the product's rating label.	
07 Manufacturer	ebm-papst Mulfingen GmbH & Co. KG Amtsgericht (court of registration) Stuttgart · HRA 590344 D-74673 Mulfingen	
08 Type	K3G250-RR17-H9	
09 Power consumption P_{ed} / kW	0.28	
09 Air flow q_v / m³/h	805	
09 Pressure increase total p_{sf} / Pa	574	
10 Speed (rpm) n / min-1	3105	
11 Specific ratio*	1.01	
12 Recycling/disposal	Information on recycling and disposal is provided in the operating instructions.	
13 Maintenance	Information on installation, operation and maintenance is provided in the operating instructions.	
14 Additional components	Components used to calculate the energy efficiency that are not apparent from the measurement category are detailed in the CE declaration.	

* Specific ratio = 1 + p_{fs} / 100 000 Pa

Data obtained at optimum efficiency level. The ErP data is determined using a motor-impeller combination in a standardized measurement setup.

3.4 Technical description

Weight	11.8 kg
Fan size	250 mm
Rotor surface	Painted black
Electronics housing material	Die-cast aluminum, painted black
Impeller material	PA plastic, galvanized sheet-metal plate
Housing material	Die-cast aluminum
Support plate material	Sheet steel, galvanized
Inlet nozzle material	Sheet steel, galvanized
Guard grille material	Steel, phosphated and coated with black plastic (RAL 9005)
Number of blades	7
Direction of rotation	Clockwise, viewed toward rotor
Degree of protection	IP55
Insulation class	"F"
Moisture (F) / Environmental (H) protection class	H1
Installation position	Any
Condensation drainage holes	None
Mode	S1
Motor bearing	Ball bearing
Technical features	- Output 10 VDC, max. 10 mA - Operation and alarm display - Alarm relay - Integrated PID controller - Power limiter - Motor current limitation - PFC, active - RS-485 MODBUS-RTU - Soft start - Control input 0-10 VDC / PWM - Control interface with SELV potential safely disconnected from the mains - Thermal overload protection for electronics/motor - Line undervoltage / phase failure detection
Touch current according to IEC 60990 (measuring circuit Fig. 4, TN system)	<= 3.5 mA
Electrical hookup	Via terminal box
Motor protection	Thermal overload protector (TOP) internally connected
Protection class	I (if protective earth is connected by customer to the housing's connection point)
Conformity with standards	EN 61800-5-1; CE
Approval	UL 1004-7 + 60730; C22.2 No.77 + CAN/CSA-E60730-1; EAC
Comment	Operational is only permitted with the optional guard grill available from ebm-papst.

With regard to cyclic speed loads, note that the rotating parts of the device are designed for a maximum of one million load cycles. If you have special questions, consult ebm-papst for support.

⇒ Use the device in accordance with its degree of protection.

Information on surface quality

The surfaces of the products conform to the generally applicable industrial standard. The surface quality may change during the production period. This has no effect on strength, dimensional stability and dimensional accuracy.
The color pigments in the paints used perceptibly react to UV light over the course of time. This does not however in any way affect the technical properties of the products. The product is to be protected against UV radiation to prevent the formation of patches and fading. Changes in color are not a reason for complaint and are not covered by the warranty.

3.5 Mounting data

⇒ Secure the screws against unintentional loosening (e.g. use self-locking screws).

Strength class of screws	8.8

Any further mounting data required can be taken from the product drawing or Section Chapter 4.1 Mechanical connection.

3.6 Transport and storage conditions

Max. permitted ambient temp. for motor (transport/ storage)	+80 °C
Min. permitted ambient temp. for motor (transport/ storage)	-40 °C

3.7 Electromagnetic compatibility

EMC immunity to interference	According to EN 61000-6-2 (industrial environment)
EMC circuit feedback	According to EN 61000-3-2/3
EMC interference emission	According to EN 61000-6-3 (household environment)

4. CONNECTION AND STARTUP

4.1 Mechanical connection

CAUTION
Risk of cutting and crushing when removing device from packaging

→ Carefully remove the device from the packaging by grasping hold of the frame. Never subject to any impact.

→ Wear safety shoes and cut-resistant safety gloves.

CAUTION
Heavy load when unpacking device
Risk of physical injury, such as back injuries.

→ Two people should work together to remove the device from its packaging.

NOTE
Damage to the device from vibration
Bearing damage, shorter service life

→ The fan must not be subjected to force or excessive vibration from sections of the installation. #If the fan is connected to air ducts, the connection should be isolated from vibration, e.g. using compensators or similar elements. #Ensure stress-free attachment of the fan to the substructure.

⇒ The fan may not be handled in the area around the inlet nozzle during transport and installation.
There is a risk of damage to the impeller.

⇒ Check the device for transport damage. Damaged devices are not to be installed.

⇒ Install the undamaged device in accordance with your application.

CAUTION
Possible damage to the device
If the device slips during installation, serious damage can result.

→ Ensure that the device is securely positioned at its place of installation until all fastening screws have been tightened.

- The fan must not be strained on fastening.

4.2 Electrical connection

DANGER
Voltage on the device
Electric shock

→ Always connect a protective earth first.

→ Check the protective earth.

DANGER
Faulty insulation
Risk of fatal injury from electric shock

→ Use only cables that meet the specified installation regulations for voltage, current, insulation material, capacity, etc.

→ Route cables so that they cannot be touched by any rotating parts.

DANGER
Electrical charge (>50 µC) between phase conductor and protective earth connection after switching off supply with multiple devices connected in parallel.
Electric shock, risk of injury

→ Ensure sufficient protection against accidental contact. Before working on the electrical hookup, short the supply and PE connections.

CAUTION
Voltage
The fan is a built-in component and has no disconnecting switch.

→ Only connect the fan to circuits that can be switched off with an all-pole disconnection switch.

→ When working on the fan, secure the system/machine in which the fan is installed so as to prevent it from being switched back on.

NOTE
Water ingress into wires or cables
Water ingress at the customer end of the cable can damage the device.

→ Make sure the end of the cable is connected in a dry environment.

Only connect the device to circuits that can be switched off with an all-pole disconnection switch.

4.2.1 Requirements

⇒ Check whether the information on the nameplate matches the connection data.

⇒ Before connecting the device, make sure the power supply matches the device voltage.

⇒ Only use cables designed for the current level indicated on the nameplate.
For determining the cross-section, note the sizing criteria according to EN 61800-5-1. The protective earth must have a cross-section equal to or greater than that of the phase conductor.
We recommend the use of 105 °C cables. Ensure that the minimum cable cross-section is at least
AWG 26 / 0.13 mm².

⇒ Note the following when routing the cables:
For permanently installed lines, the bending radius must be at least four times the outside diameter of the cable.
For movable lines, the bending radius must be at least 15 times the outside diameter of the cable.

Protective earth contact resistance according to EN 61800-5-1

Compliance with the resistance specifications according to EN 61800-5-1 for the protective earth connection circuit must be verified in the end application. Depending on the installation situation, it may be necessary to connect an additional protective earth conductor by way of the extra protective earth terminal provided on the device. The protective earth terminal is located on the housing and provided with a protective earth symbol and a hole.

4.2.2 Reactive currents

Because of the EMC filter integrated for compliance with EMC limits (interference emission and immunity to interference), reactive currents can be measured in the supply line even when the motor is at a standstill and the line voltage is switched on.

- The values are typically in the range < 250 mA
- At the same time, the effective power in this operating state (operational readiness) is typically < 4 W.

4.2.3 Residual current circuit breaker (RCCB)

If the use of a residual current device (RCD) is required in your installation, only AC/DC-sensitive residual current devices (type B or B+) are permissible. As with variable frequency drives, residual current devices cannot provide personal safety while operating the device. When the device power supply is switched on, pulsed charging currents from the capacitors in the integrated EMC filter can lead to the instant tripping of residual current devices. We recommend the use of residual current circuit breakers (RCCB) with a trip threshold of 300 mA and delayed tripping (super-resistant, characteristic K).

4.2.4 Locked-rotor protection

Due to the locked-rotor protection, the starting current (LRA) is equal to or less than the nominal current (FLA).

4.3 Connection in terminal box

4.3.1 Preparing cables for connection

Only strip the cable as far as necessary, ensuring that the cable gland is sealed and there is no strain on the connections. For tightening torques, see Chapter 3.1 Product drawing.

NOTE
Tightness and strain relief are dependent on the cable used.

→ This must be checked by the user.

4.3.2 Connecting wires to terminals

WARNING
Live terminals and connections even with device switched off
Electric shock

→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

⇒ Remove the cap from the cable gland.

Only remove caps where cables are fed in.

⇒ Route the wire(s) (not included in scope of delivery) into the terminal box.

⇒ First connect the "PE" (protective earth).

⇒ Connect the wires to the corresponding terminals.

Use a screwdriver to do so.
When connecting, ensure that no wire ends fan out.

⇒ Seal the terminal box.

4.3.3 Cable routing

Water must be prevented from reaching the cable gland along the cable.

NOTE
Damage caused by moisture penetration.
Moisture can penetrate into the terminal box if water is constantly present at the cable glands.

→ To prevent the constant accumulation of water at the cable glands, the cable should be routed in a U-shaped loop wherever possible.# If this is not possible, a drip edge can be produced by fitting a cable tie directly in front of the cable gland for example.

When routing the cable, make sure that the cable glands are located at the bottom. The cables must always be routed downward.

4.4 Factory settings

Factory settings made for the device by ebm-papst.

Mode parameter set 1	PWM control
Mode parameter set 2	PWM control
Fan/device address	01
Max. PWM / %	100
Min. PWM / %	10
Save set value to EEPROM	No
Set value requirement	Analog (linear)
Direction of action parameter set 1	Positive (heating)
Direction of action parameter set 2	Positive (heating)

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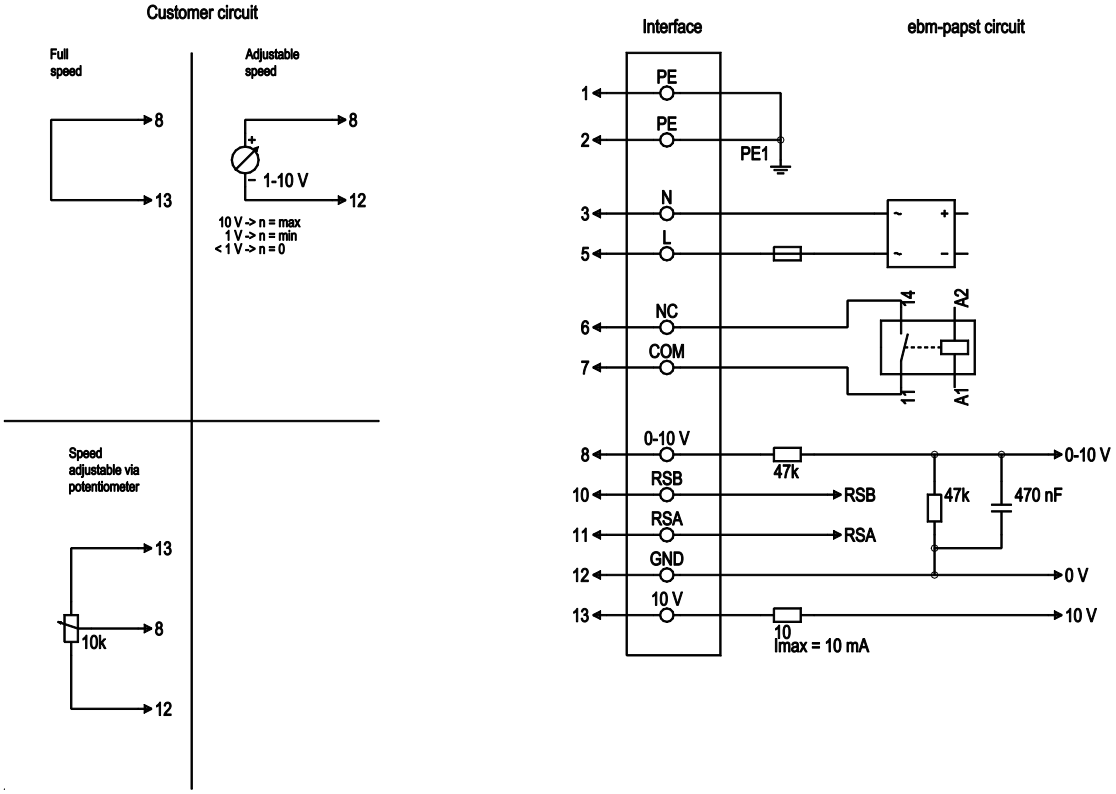
4.5 Connection diagram



Drawing preliminary!

No.	Conn.	Designation	Color	Function/assignment
1	1, 2	PE	green/ yellow	Protective earth
1	3	N	blue	Power supply, neutral conductor, 50/60 Hz
1	5	L	black	Power supply, phase, 50/60 Hz
1	6	NC	white 1	Status relay, floating status contact; break for failure, contact rating 250 VAC / 2A (AC1) / min. 10 mA, basic insulation on supply side and reinforced insulation on control interface side
1	7	COM	white 2	Status relay, floating status contact; common connection, contact rating 250 VAC / 2A (AC1) / min. 10 mA, basic insulation on supply side and reinforced insulation on control interface side
2	8	0-10V	yellow	Analog input (set value); 0-10 V; Ri = 100 kΩ; adjustable curve
2	10	RSB	brown	RS485 interface for MODBUS, RSB
2	11	RSA	white	RS485 interface for MODBUS, RSA
2	12	GND	blue	Reference ground for control interface, SELV
2	13	+10V	red	Fixed voltage output 10 VDC, +10 V ±3%; max. 10 mA; short-circuit-proof; power supply for external devices (e.g. pot)

4.6 Checking connections

⇒ Ensure isolation from supply (all phases).
⇒ Make sure a restart is impossible
⇒ Check the cables for proper fit.
⇒ Screw the terminal box cover back on again. Terminal box tightening torque, see Chapter 3.1 Product drawing.
⇒ Route the cables in the terminal box so that the terminal box cover closes without resistance.
⇒ Use all screw plugs. Insert the screws by hand to avoid damage to the threads.
⇒ Make sure the terminal box is completely closed and sealed and that all screws and cable glands have been properly tightened.

4.7 Switching on the device

The device may only be switched on if it has been installed properly and in accordance with its intended use, including the required safety mechanisms and professional electrical hookup. This also applies for devices which have already been equipped with plugs and terminals or similar connectors by the customer.

WARNING
Hot motor housing
Risk of fire
→ Ensure that no combustible or flammable materials are located close to the fan.

⇒ Before switching on, check the device for visible external damage and make sure the protective devices are functional.
⇒ Check the fan's air flow paths for foreign matter and remove any foreign matter found.
⇒ Apply the nominal supply voltage.
⇒ Start the device by changing the input signal.

NOTE
Damage to the device from vibration
Bearing damage, shorter service life
→ Low-vibration operation of the fan must be ensured over the entire speed control range. #Severe vibration can arise for instance from inexpert handling, transportation damage and resultant imbalance or be caused by component or structural resonance. #Speed ranges with excessively high vibration levels and possibly resonant frequencies must be determined in the course of fan commissioning. #Either run through the resonant range as quickly as possible with speed control or find another remedy.# Operation with excessively high vibration levels can lead to premature failure.

4.8 Switching off the device

Switching off the device during operation:
⇒ Switch off the device via the control input.
⇒ Do not switch the motor (e.g. in cyclic operation) on and off via power supply.

Switching off the device for maintenance:
⇒ Switch off the device via the control input.
⇒ Do not switch the motor (e.g. in cyclic operation) on and off via power supply.
⇒ Disconnect the device from the power supply.
⇒ When disconnecting, be sure to disconnect the ground connection last.

5. INTEGRATED PROTECTIVE FEATURES

The integrated protective functions cause the motor to switch off automatically in the event of the faults described in the table.

Fault	Safety feature description/ function
Rotor position detection error	An automatic restart follows.
Blocked rotor	⇒ After the blockage is removed, the motor restarts automatically.
Line undervoltage (line voltage outside of permitted nominal voltage range)	⇒ If the line voltage returns to permitted values, the motor restarts automatically.

6. MAINTENANCE, MALFUNCTIONS, POSSIBLE CAUSES AND REMEDIES

Do not perform any repairs on your device. Send the device to ebm-papst for repair or replacement.

WARNING
Live terminals and connections even with device switched off
Electric shock
→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

CAUTION
If control voltage or a stored speed set value is applied, the motor will restart automatically, e.g. after a power failure.
Risk of injury
→ Keep out of the device's danger zone.# When working on the device, switch off the line voltage and ensure that it cannot be switched back on.
→ Wait until the device comes to a stop.
→ After working on the device, remove any tools or other objects from the device.

If the device is out of use for some time, e.g. when in storage, we recommend switching it on for at least two hours to allow any condensation to evaporate and to move the bearings.

Malfunction/fault	Possible cause	Possible remedy
Impeller not running smoothly	Imbalance in rotating parts	Clean the device; replace it if imbalance persists after cleaning. Make sure no weight clips are removed during cleaning.
Motor not turning	Mechanical blockage	Switch off, isolate from supply and remove mechanical blockage.
	Line voltage faulty	Check line voltage, restore power supply, apply control signal.

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	Faulty connection	Isolate from supply, correct connection; see connection diagram.
	Thermal overload protector activated	Allow motor to cool off, locate and rectify cause of error, release restart lockout if necessary
Motor/electronics overtemperature	Deficient cooling	Improve cooling. Let the device cool down. To reset the error message, switch off the line voltage for at least 25 s and then switch it on again.
	Ambient temperature too high	Reduce the ambient temperature. Reset by reducing control input to 0.
	Impermissible point of operation	Correct the operating point. Let the device cool down.

In the event of further malfunctions, contact ebm-papst.

6.1 Vibration testing

Checking of fan for mechanical vibration based on ISO 14694.
Recommendation: Every 6 months. Max. vibration severity is 3.5 mm/s, measured at the motor fastening diameter on the motor support plate in the direction of the motor axis of rotation and perpendicular to this.

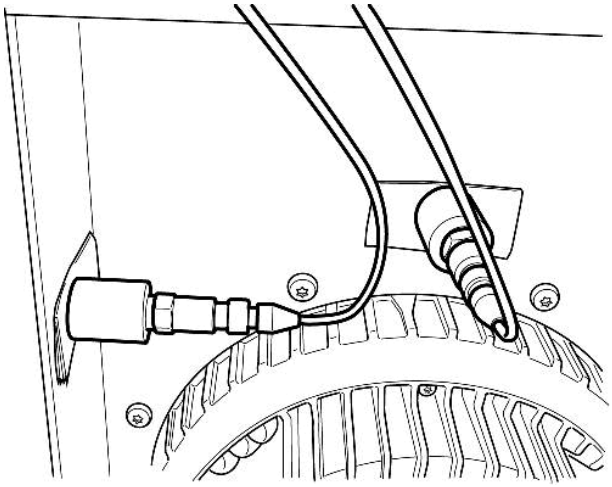

Fig. 1: Example illustrating vibration measurement. The arrangement of the sensors depends on the device concerned and the installation situation.

6.2 Cleaning

NOTE
Damage to the device during cleaning
Malfunction possible

→ Do not clean the device using a high-pressure cleaner.

→ Do not use acid, alkali or solvent-based cleaning agents.

→ Do not use any pointed or sharp-edged objects for cleaning

6.3 Safety inspection

NOTE
High-voltage test
The integrated EMC filter has Y capacitors. The tripping current is exceeded when AC testing voltage is applied.

→ Test the device with DC voltage when you perform the legally required high-voltage test. The voltage to be used corresponds to the peak value of the AC voltage required by the standard.

What to check	How to check	How often	What action?
Contact protection cover for intactness or damage	Visual inspection	At least every 6 months	Repair or replacement of device
Device for damage to blades and housing	Visual inspection	At least every 6 months	Replacement of device
Fastening the cables	Visual inspection	At least every 6 months	Fasten
Fastening the protective earth terminal	Visual inspection	At least every 6 months	Fasten
Insulation of cables for damage	Visual inspection	At least every 6 months	Replace cables
Impeller for wear/deposits/ corrosion and damage	Visual inspection	At least every 6 months	Clean or replace impeller
Tightness of cable gland	Visual inspection	At least every 6 months	Retighten, replace if damaged
Abnormal bearing noise	acoustic	At least every 6 months	Replace device

6.4 Disposal

For ebm-papst, environmental protection and resource preservation are top priority corporate goals.
ebm-papst operates an environmental management system which is certified in accordance with ISO 14001 and rigorously implemented around the world on the basis of German standards.
Right from the development stage, ecological design, technical safety and health protection are fixed criteria.
The following section contains recommendations for ecological disposal of the product and its components.

6.4.1 Country-specific legal requirements

NOTE
Country-specific legal requirements
Always observe the applicable country-specific legal regulations with regard to the disposal of products or waste occurring in the various phases of the life cycle. The corresponding disposal standards are also to be heeded.

6.4.2 Disassembly

Disassembly of the product must be performed or supervised by qualified personnel with the appropriate technical knowledge.
The product is to be disassembled into suitable components for disposal employing standard procedures for motors.

WARNING
Heavy parts of the product may drop off. Some of the product components are heavy. These components could drop off during disassembly.
This can result in fatal or serious injury and material damage.
→ Secure components before unfastening to stop them falling.

6.4.3 Component disposal

The products are mostly made of steel, copper, aluminum and plastic. Metallic materials are generally considered to be fully recyclable.
Separate the components for recycling into the following categories:

- Steel and iron
- Aluminum
- Non-ferrous metal, e.g. motor windings
- Plastics, particularly with brominated flame retardants, in accordance with marking
- Insulating materials
- Cables and wires
- Electronic scrap, e.g. circuit boards

Only ferrite magnets and not rare earth magnets are used in external rotor motors from ebm-papst Mulfingen GmbH & Co. KG.

⇒ Ferrite magnets can be disposed of in the same way as normal iron and steel.

Electrical insulating materials on the product, in cables and wires are made of similar materials and are therefore to be treated in the same manner.
The materials concerned are as follows:

- Miscellaneous insulators used in the terminal box
- Power cables
- Cables for internal wiring
- Electrolytic capacitors

Dispose of electronic components employing the proper procedures for electronic scrap.

→ Please contact ebm-papst for any other questions on disposal.

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D.6 Operating instructions for the single-phase EC external fan, pressing, SH225

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CONTENTS

1. SAFETY REGULATIONS AND INFORMATION

Read these operating instructions carefully before starting work on the device. Observe the following warnings to prevent malfunctions or danger to persons.
These operating instructions are to be regarded as part of the device. The device is only to be sold or passed on together with the operating instructions.
These operating instructions may be duplicated and distributed to inform about potential dangers and their prevention.

1.1 Hazard levels for warnings

These operating instructions use the following hazard levels to indicate potentially hazardous situations and important safety regulations:

DANGER
Indicates an imminently hazardous situation which will result in death or serious injury if the specified actions are not taken. Compliance with the instructions is imperative.

WARNING
Indicates a potentially hazardous situation which can result in death or serious injury if the specified actions are not taken. Exercise extreme caution while working.

CAUTION
Indicates a potentially hazardous situation which can result in minor or moderate injury or damage to property if the specified actions are not taken.

NOTE
A potentially harmful situation can occur and, if not avoided, can lead to property damage.

1.2 Staff qualifications

The device may only be transported, unpacked, installed, operated, maintained and otherwise used by suitably qualified, trained and authorized technical staff.
Only authorized specialists are permitted to install the device, to carry out a test run and to perform work on the electrical installation.

1.3 Basic safety rules

The safety hazards associated with the device must be assessed again following installation in the final product.
The locally applicable industrial safety regulations are always to be observed when working on the device.
Keep the workplace clean and tidy. Untidiness in the work area increases the risk of accidents.
Note the following when working on the device:

⇒ Do not perform any modifications, additions or conversions on the device without the approval of ebm-papst.

1.4 Voltage

⇒ Check the device's electrical equipment at regular intervals; see Chapter 6.3 Safety inspection.

⇒ Replace loose connections and defective cables immediately.

DANGER
Electrically charged device
Risk of electric shock

→ When working on an electrically charged device, stand on a rubber mat.

WARNING
Live terminals and connections even with device switched off
Electric shock

→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

CAUTION
In the event of a fault, the rotor and the impeller will be energized
The rotor and the impeller have basic insulation.

→ Do not touch the rotor and impeller once installed.

CAUTION
If control voltage or a stored speed set value is applied, the motor will restart automatically, e.g. after a power failure.
Risk of injury

→ Keep out of the device's danger zone.# When working on the device, switch off the line voltage and ensure that it cannot be switched back on.

→ Wait until the device comes to a stop.

→ After working on the device, remove any tools or other objects from the device.

1.5 Safety and protective features

DANGER
Protective device missing and protective device not functioning
Without a protective device there is a risk of serious injury, for instance when reaching into the device during operation.

→ Operate the device only with a fixed protective device and guard grille.

→ The fixed protective device must be able to withstand the kinetic energy of a fan blade that becomes detached at maximum speed. There must not be any gaps which it is possible to reach into with the fingers, for example.

→ The device is a built-in component. As the operator, you are responsible for ensuring that the device is secured adequately.

→ Stop the device immediately if you notice a missing or ineffective protective device.

1.6 Electromagnetic radiation

Interference from electromagnetic radiation is possible, e.g. in conjunction with open- and closed-loop control devices.
If impermissible radiation levels occur following installation, appropriate shielding measures have to be taken by the user.

NOTE
Electrical or electromagnetic interference after installing the device in customer equipment.

→ Verify that the entire setup is EMC-compliant.

1.7 Mechanical movement

DANGER
Rotating device
Risk of injury to body parts coming into contact with the rotor or the impeller.

→ Secure the device against accidental contact.

→ Before working on the system/machine, wait until all parts have come to a standstill.

WARNING
Rotating device
Long hair and dangling items of clothing, jewelry and the like can become entangled and be pulled into the device. Injuries can result.

→ Do not wear any loose-fitting or dangling clothing or jewelry while working on rotating parts.

→ Protect long hair with a cap.

1.8 Emissions

WARNING
Depending on the installation and operating conditions, the sound pressure level may exceed 70 dB(A).
Risk of noise-induced hearing loss

→ Take appropriate technical safety measures.

→ Protect operating personnel with appropriate safety equipment such as hearing protection.

→ Also observe the requirements of local agencies.

1.9 Hot surface

CAUTION
High temperature on electronics housing
Risk of burns

→ Ensure sufficient protection against accidental contact.

1.10 Transport

WARNING
Transporting the fan
Injuries from tipping or slipping

→ The fan is always to be transported with care and in its original packaging. #If set down too hard or at an angle for example, the impact can lead to bearing damage or deformation of the frame or impeller. #It must be ensured that the fans cannot tip over during transportation and handling.

→ Secure the fan(s) with appropriate equipment such as a lashing strip so that nothing can slip or tip, especially when stacking multiple fans. #Also make allowance for possible wind forces.

1.11 Storage

⇒ Store the device, partially or fully assembled, in a dry place, protected against the weather and free from vibration, in the original packaging in a clean environment.

⇒ Protect the device against environmental effects and dirt until final installation.

⇒ We recommend storing the device for no longer than one year in order to guarantee trouble-free operation and the longest possible service life.

⇒ Even devices explicitly intended for outdoor use are to be stored as described prior to commissioning.

⇒ Maintain the storage temperature, see Chapter 3.6 Transport and storage conditions.

⇒ Make sure that all cable glands are fitted with dummy plugs.

2. INTENDED USE

The device is exclusively designed as a built-in device for conveying air according to its technical data.
Any other usage above and beyond this does not conform with the intended purpose and constitutes misuse of the device.
Customer equipment must be capable of withstanding the mechanical and thermal stresses that can arise from this product. This applies for the entire service life of the equipment in which this product is installed.

Intended use also includes

- The device is only to be used in IT networks with a permissible maximum voltage of 277 V between the phase conductors.
- Use of the device in stationary systems only.
- Conveying air at an ambient air pressure between 800 mbar and 1050 mbar.
- Using the device within the permitted ambient temperature range; see Chapter 3.6 Transport and storage conditions and Chapter 3.2 Nominal data.
- Operating the device with all protective devices.
- Following the operating instructions.

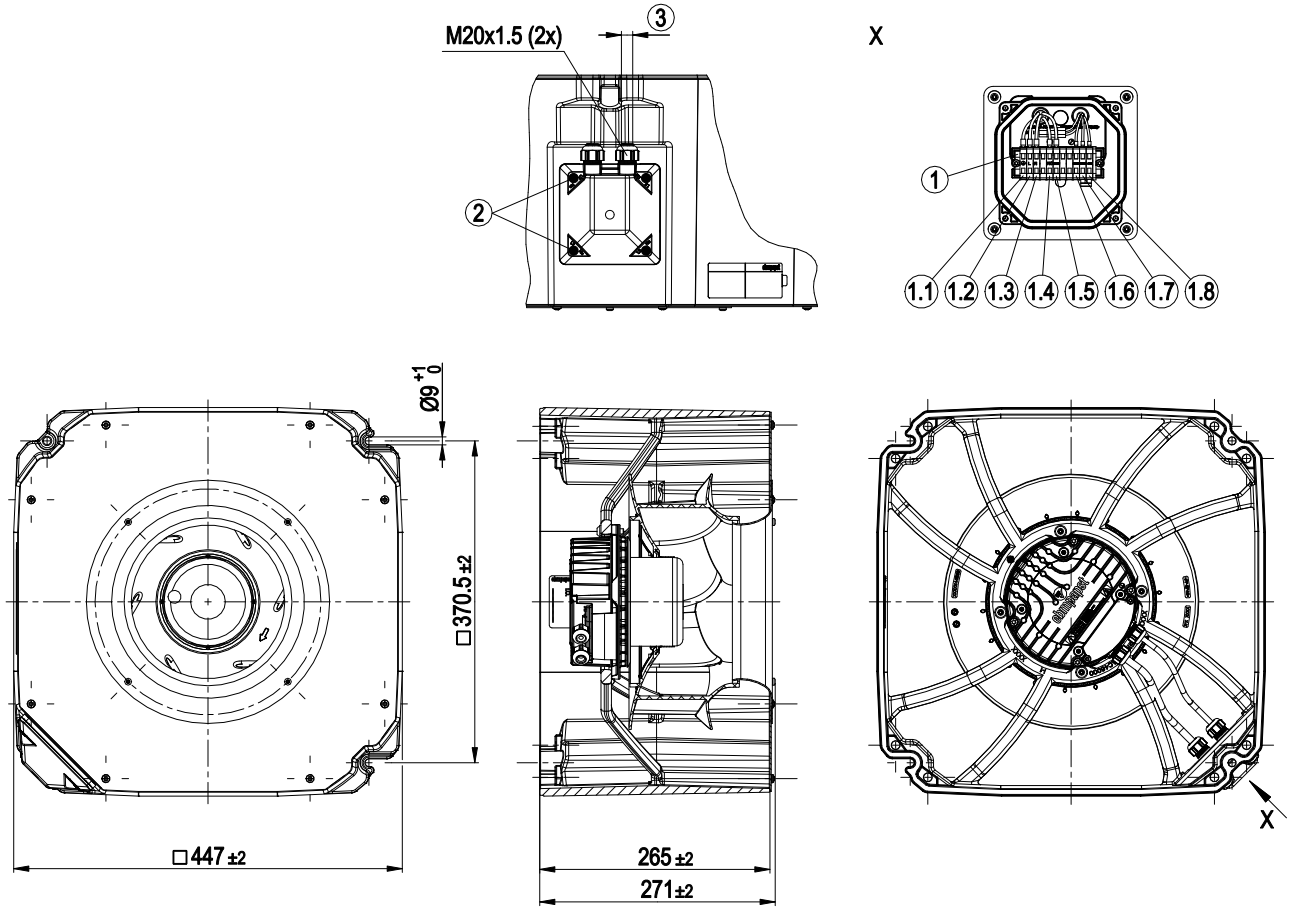
Improper use

In particular, operating the device in the following ways is prohibited and could be hazardous:

- Operating the device in an unbalanced state, e.g. due to dirt deposits or ice formation.
- Resonant operation, operation with severe vibration. This also includes vibration transmitted to the fan from the customer installation.
- Opening the terminal box during operation.
- Conveying air that contains abrasive particles.
- Conveying highly corrosive air, e.g. salt spray. Exception: devices designed for salt spray and correspondingly protected.
- Conveying air with high dust content, e.g. suctioning off sawdust.
- Operating the device close to flammable materials or components.
- Operating the device in an explosive atmosphere.
- Using the device as a safety component or to perform safety-related functions.
- Operation with completely or partially disassembled or manipulated protective devices.
- In addition, all applications not listed among the intended uses.

3. TECHNICAL DATA

3.1 Product drawing



All dimensions in mm.

1	Terminal strip
1.1	PE
1.2	L
1.3	N
1.4	NC
1.5	COM
1.6	GND
1.7	0-10 V
1.8	+10 V
2	Tightening torque 1.2±0.2 Nm
3	Cable diameter min. 6 mm, max. 10 mm, tightening torque 2.5 ± 0.4 Nm
	Accessory part: Guard grill 20225-2-4039, filter 99951-2-5170 and filter mount 25225-2-4041 not included in scope of delivery.

3.2 Nominal data

Motor	M3G084-DF

Phase	1~
Nominal voltage / VAC	230
Nominal voltage range / VAC	200 .. 277
Frequency / Hz	50/60

Method of obtaining data	ml
Speed (rpm) / min-1	2700
Power consumption / W	520
Current draw / A	2.3
Min. ambient temperature / °C	-25
Max. ambient temperature / °C	60

ml = Max. load · me = Max. efficiency · fa = Free air
cs = Customer specification · ce = Customer equipment

Subject to change

3.3 Data according to Commission Regulation (EU) 327/2011

	Actual	Req. 2015
01 Overall efficiency η_{es} / %	58.6	47.4
02 Measurement category	A	
03 Efficiency category	Static	
04 Efficiency grade N	72.2	61
05 Variable speed drive	Yes	
06 Year of manufacture	The year of manufacture is specified on the product's rating label.	
07 Manufacturer	ebm-papst Mulfingen GmbH & Co. KG Amtsgericht (court of registration) Stuttgart · HRA 590344 D-74673 Mulfingen	
08 Type	K3G280-RR04-H9	
09 Power consumption P_{ed} / kW	0.51	
09 Air flow q_v / m³/h	1815	
09 Pressure increase total p_{sf} / Pa	540	
10 Speed (rpm) n / min-1	2655	
11 Specific ratio*	1.01	
12 Recycling/disposal	Information on recycling and disposal is provided in the operating instructions.	
13 Maintenance	Information on installation, operation and maintenance is provided in the operating instructions.	
14 Additional components	Components used to calculate the energy efficiency that are not apparent from the measurement category are detailed in the CE declaration.	

* Specific ratio = 1 + p_{fs} / 100 000 Pa

Data obtained at optimum efficiency level. The ErP data is determined using a motor-impeller combination in a standardized measurement setup.

3.4 Technical description

Weight	16.8 kg
Fan size	280 mm
Rotor surface	Painted black
Electronics housing material	Die-cast aluminum, painted black
Impeller material	PP plastic, galvanized sheet-metal plate
Housing material	Die-cast aluminum
Support plate material	Sheet steel, galvanized
Inlet nozzle material	Sheet steel, galvanized
Guard grille material	Steel, phosphated and coated with black plastic (RAL 9005)
Number of blades	6
Direction of rotation	Clockwise, viewed toward rotor
Degree of protection	IP55
Insulation class	"F"
Moisture (F) / Environmental (H) protection class	H1
Installation position	Any
Condensation drainage holes	None
Mode	S1
Motor bearing	Ball bearing
Technical features	- Output 10 VDC, max. 10 mA - Operation and alarm display - Alarm relay - Integrated PID controller - Power limiter - Motor current limitation - PFC, active - RS-485 MODBUS-RTU - Soft start - Control input 0-10 VDC / PWM - Control interface with SELV potential safely disconnected from the mains - Thermal overload protection for electronics/motor - Line undervoltage / phase failure detection
Touch current according to IEC 60990 (measuring circuit Fig. 4, TN system)	<= 3.5 mA
Electrical hookup	Via terminal box
Motor protection	Thermal overload protector (TOP) internally connected
Protection class	I (if protective earth is connected by customer to the housing's connection point)
Conformity with standards	EN 61800-5-1; CE
Approval	UL 1004-7 + 60730; C22.2 No.77 + CAN/CSA-E60730-1; EAC
Comment	Operational is only permitted with the optional guard grill available from ebm-papst.

With regard to cyclic speed loads, note that the rotating parts of the device are designed for a maximum of one million load cycles. If you have special questions, consult ebm-papst for support.

⇒ Use the device in accordance with its degree of protection.

Information on surface quality

The surfaces of the products conform to the generally applicable industrial standard. The surface quality may change during the production period. This has no effect on strength, dimensional stability and dimensional accuracy.
The color pigments in the paints used perceptibly react to UV light over the course of time. This does not however in any way affect the technical properties of the products. The product is to be protected against UV radiation to prevent the formation of patches and fading. Changes in color are not a reason for complaint and are not covered by the warranty.

3.5 Mounting data

Strength class of screws	8.8

⇒ Secure the screws against unintentional loosening (e.g. use self-locking screws).

Any further mounting data required can be taken from the product drawing or Section Chapter 4.1 Mechanical connection.

3.6 Transport and storage conditions

Max. permitted ambient temp. for motor (transport/ storage)	+80 °C
Min. permitted ambient temp. for motor (transport/ storage)	-40 °C

3.7 Electromagnetic compatibility

EMC immunity to interference	According to EN 61000-6-2 (industrial environment)
EMC circuit feedback	According to EN 61000-3-2/3
EMC interference emission	According to EN 61000-6-3 (household environment)

4. CONNECTION AND STARTUP

4.1 Mechanical connection

CAUTION
Risk of cutting and crushing when removing device from packaging

→ Carefully remove the device from the packaging by grasping hold of the frame. Never subject to any impact.

→ Wear safety shoes and cut-resistant safety gloves.

CAUTION
Heavy load when unpacking device
Risk of physical injury, such as back injuries.

→ Two people should work together to remove the device from its packaging.

NOTE
Damage to the device from vibration
Bearing damage, shorter service life

→ The fan must not be subjected to force or excessive vibration from sections of the installation. #If the fan is connected to air ducts, the connection should be isolated from vibration, e.g. using compensators or similar elements. #Ensure stress-free attachment of the fan to the substructure.

⇒ The fan may not be handled in the area around the inlet nozzle during transport and installation.
There is a risk of damage to the impeller.

⇒ Check the device for transport damage. Damaged devices are not to be installed.

⇒ Install the undamaged device in accordance with your application.

CAUTION
Possible damage to the device
If the device slips during installation, serious damage can result.

→ Ensure that the device is securely positioned at its place of installation until all fastening screws have been tightened.

- The fan must not be strained on fastening.

4.2 Electrical connection

DANGER
Voltage on the device
Electric shock

→ Always connect a protective earth first.

→ Check the protective earth.

DANGER
Faulty insulation
Risk of fatal injury from electric shock

→ Use only cables that meet the specified installation regulations for voltage, current, insulation material, capacity, etc.

→ Route cables so that they cannot be touched by any rotating parts.

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DANGER
Electrical charge (>50 µC) between phase conductor and protective earth connection after switching off supply with multiple devices connected in parallel.
Electric shock, risk of injury

→ Ensure sufficient protection against accidental contact. Before working on the electrical hookup, short the supply and PE connections.

CAUTION
Voltage
The fan is a built-in component and has no disconnecting switch.

→ Only connect the fan to circuits that can be switched off with an all-pole disconnection switch.

→ When working on the fan, secure the system/machine in which the fan is installed so as to prevent it from being switched back on.

NOTE
Water ingress into wires or cables
Water ingress at the customer end of the cable can damage the device.

→ Make sure the end of the cable is connected in a dry environment.

Only connect the device to circuits that can be switched off with an all-pole disconnection switch.

4.2.1 Requirements

⇒ Check whether the information on the nameplate matches the connection data.

⇒ Before connecting the device, make sure the power supply matches the device voltage.

⇒ Only use cables designed for the current level indicated on the nameplate.
For determining the cross-section, note the sizing criteria according to EN 61800-5-1. The protective earth must have a cross-section equal to or greater than that of the phase conductor.
We recommend the use of 105 °C cables. Ensure that the minimum cable cross-section is at least
AWG 26 / 0.13 mm².

⇒ Note the following when routing the cables:
For permanently installed lines, the bending radius must be at least four times the outside diameter of the cable.
For movable lines, the bending radius must be at least 15 times the outside diameter of the cable.

Protective earth contact resistance according to EN 61800-5-1

Compliance with the resistance specifications according to EN 61800-5-1 for the protective earth connection circuit must be verified in the end application. Depending on the installation situation, it may be necessary to connect an additional protective earth conductor by way of the extra protective earth terminal provided on the device. The protective earth terminal is located on the housing and provided with a protective earth symbol and a hole.

4.2.2 Reactive currents

Because of the EMC filter integrated for compliance with EMC limits (interference emission and immunity to interference), reactive currents can be measured in the supply line even when the motor is at a standstill and the line voltage is switched on.

- The values are typically in the range < 250 mA
- At the same time, the effective power in this operating state (operational readiness) is typically < 4 W.

4.2.3 Residual current circuit breaker (RCCB)

If the use of a residual current device (RCD) is required in your installation, only AC/DC-sensitive residual current devices (type B or B+) are permissible. As with variable frequency drives, residual current devices cannot provide personal safety while operating the device. When the device power supply is switched on, pulsed charging currents from the capacitors in the integrated EMC filter can lead to the instant tripping of residual current devices. We recommend the use of residual current circuit breakers (RCCB) with a trip threshold of 300 mA and delayed tripping (super-resistant, characteristic K).

4.2.4 Locked-rotor protection

Due to the locked-rotor protection, the starting current (LRA) is equal to or less than the nominal current (FLA).

4.3 Connection in terminal box

4.3.1 Preparing cables for connection

Only strip the cable as far as necessary, ensuring that the cable gland is sealed and there is no strain on the connections. For tightening torques, see Chapter 3.1 Product drawing.

NOTE
Tightness and strain relief are dependent on the cable used.

→ This must be checked by the user.

4.3.2 Connecting wires to terminals

WARNING
Live terminals and connections even with device switched off
Electric shock

→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

⇒ Remove the cap from the cable gland.

Only remove caps where cables are fed in.

⇒ Route the wire(s) (not included in scope of delivery) into the terminal box.

⇒ First connect the "PE" (protective earth).

⇒ Connect the wires to the corresponding terminals.

Use a screwdriver to do so.
When connecting, ensure that no wire ends fan out.

⇒ Seal the terminal box.

4.3.3 Cable routing

Water must be prevented from reaching the cable gland along the cable.

NOTE
Damage caused by moisture penetration.
Moisture can penetrate into the terminal box if water is constantly present at the cable glands.

→ To prevent the constant accumulation of water at the cable glands, the cable should be routed in a U-shaped loop wherever possible.# If this is not possible, a drip edge can be produced by fitting a cable tie directly in front of the cable gland for example.

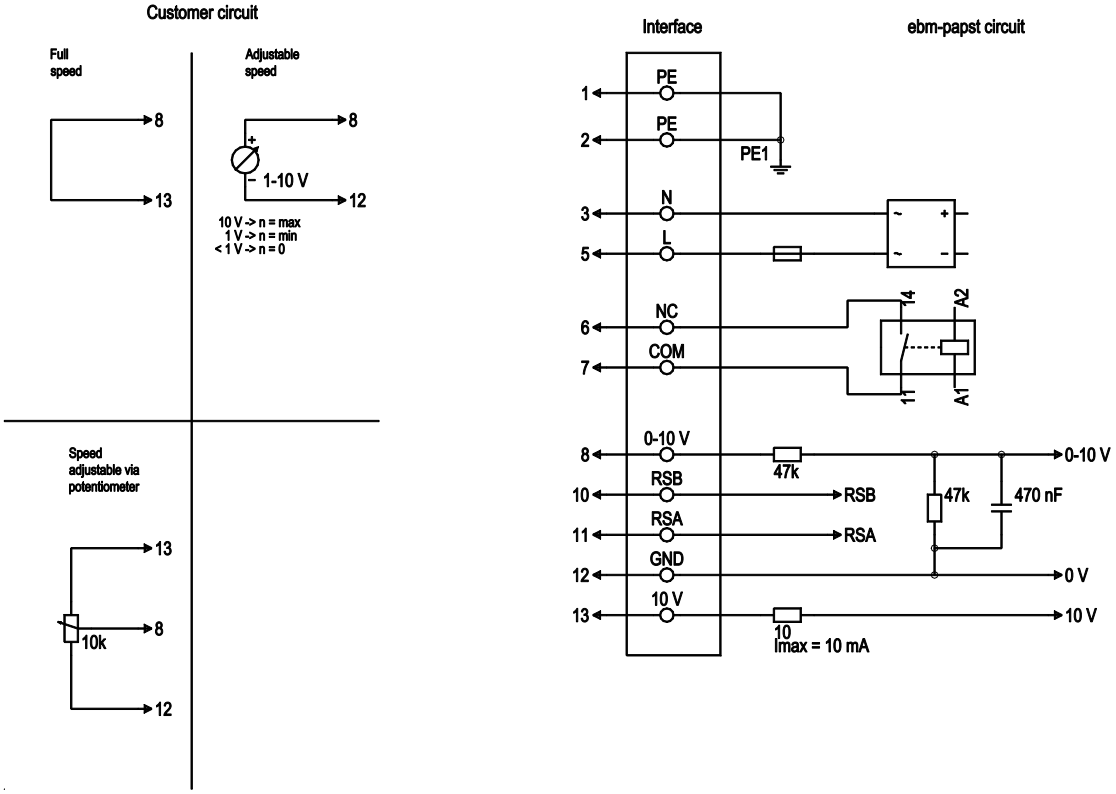
When routing the cable, make sure that the cable glands are located at the bottom. The cables must always be routed downward.

4.4 Factory settings

Factory settings made for the device by ebm-papst.

Mode parameter set 1	PWM control
Mode parameter set 2	PWM control
Fan/device address	01
Max. PWM / %	100
Min. PWM / %	10
Save set value to EEPROM	No
Set value requirement	Analog (linear)
Direction of action parameter set 1	Positive (heating)
Direction of action parameter set 2	Positive (heating)

4.5 Connection diagram



Drawing preliminary!

No.	Conn.	Designation	Color	Function/assignment
1	1, 2	PE	green/ yellow	Protective earth
1	3	N	blue	Power supply, neutral conductor, 50/60 Hz
1	5	L	black	Power supply, phase, 50/60 Hz
1	6	NC	white 1	Status relay, floating status contact; break for failure, contact rating 250 VAC / 2A (AC1) / min. 10 mA, basic insulation on supply side and reinforced insulation on control interface side
1	7	COM	white 2	Status relay, floating status contact; common connection, contact rating 250 VAC / 2A (AC1) / min. 10 mA, basic insulation on supply side and reinforced insulation on control interface side
2	8	0-10V	yellow	Analog input (set value); 0-10 V; Ri = 100 kΩ; adjustable curve
2	10	RSB	brown	RS485 interface for MODBUS, RSB
2	11	RSA	white	RS485 interface for MODBUS, RSA
2	12	GND	blue	Reference ground for control interface, SELV
2	13	+10V	red	Fixed voltage output 10 VDC, +10 V ±3%; max. 10 mA; short-circuit-proof; power supply for external devices (e.g. pot)

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4.6 Checking connections

⇒ Ensure isolation from supply (all phases).
⇒ Make sure a restart is impossible
⇒ Check the cables for proper fit.
⇒ Screw the terminal box cover back on again. Terminal box tightening torque, see Chapter 3.1 Product drawing.
⇒ Route the cables in the terminal box so that the terminal box cover closes without resistance.
⇒ Use all screw plugs. Insert the screws by hand to avoid damage to the threads.
⇒ Make sure the terminal box is completely closed and sealed and that all screws and cable glands have been properly tightened.

4.7 Switching on the device

The device may only be switched on if it has been installed properly and in accordance with its intended use, including the required safety mechanisms and professional electrical hookup. This also applies for devices which have already been equipped with plugs and terminals or similar connectors by the customer.

WARNING
Hot motor housing
Risk of fire
→ Ensure that no combustible or flammable materials are located close to the fan.

⇒ Before switching on, check the device for visible external damage and make sure the protective devices are functional.
⇒ Check the fan's air flow paths for foreign matter and remove any foreign matter found.
⇒ Apply the nominal supply voltage.
⇒ Start the device by changing the input signal.

NOTE
Damage to the device from vibration
Bearing damage, shorter service life
→ Low-vibration operation of the fan must be ensured over the entire speed control range. #Severe vibration can arise for instance from inexpert handling, transportation damage and resultant imbalance or be caused by component or structural resonance. #Speed ranges with excessively high vibration levels and possibly resonant frequencies must be determined in the course of fan commissioning. #Either run through the resonant range as quickly as possible with speed control or find another remedy.# Operation with excessively high vibration levels can lead to premature failure.

→ The maximum permissible vibration severity must not exceed 3.5 mm/s and should be checked at intervals of 6 months. #It is to be measured at the motor mount at the motor support plate in all three 3 dimensions, see Chapter 6. Maintenance, malfunctions, possible causes and remedies.

4.8 Switching off the device

Switching off the device during operation:
⇒ Switch off the device via the control input.
⇒ Do not switch the motor (e.g. in cyclic operation) on and off via power supply.

Switching off the device for maintenance:
⇒ Switch off the device via the control input.
⇒ Do not switch the motor (e.g. in cyclic operation) on and off via power supply.
⇒ Disconnect the device from the power supply.
⇒ When disconnecting, be sure to disconnect the ground connection last.

5. INTEGRATED PROTECTIVE FEATURES

The integrated protective functions cause the motor to switch off automatically in the event of the faults described in the table.

Fault	Safety feature description/ function
Rotor position detection error	An automatic restart follows.
Blocked rotor	⇒ After the blockage is removed, the motor restarts automatically.
Line undervoltage (line voltage outside of permitted nominal voltage range)	⇒ If the line voltage returns to permitted values, the motor restarts automatically.

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6. MAINTENANCE, MALFUNCTIONS, POSSIBLE CAUSES AND REMEDIES

Do not perform any repairs on your device. Send the device to ebm-papst for repair or replacement.

WARNING
Live terminals and connections even with device switched off
Electric shock

→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

CAUTION
If control voltage or a stored speed set value is applied, the motor will restart automatically, e.g. after a power failure.
Risk of injury

→ Keep out of the device's danger zone.# When working on the device, switch off the line voltage and ensure that it cannot be switched back on.

→ Wait until the device comes to a stop.

→ After working on the device, remove any tools or other objects from the device.

If the device is out of use for some time, e.g. when in storage, we recommend switching it on for at least two hours to allow any condensation to evaporate and to move the bearings.

Malfunction/fault	Possible cause	Possible remedy
Impeller not running smoothly	Imbalance in rotating parts	Clean the device; replace it if imbalance persists after cleaning. Make sure no weight clips are removed during cleaning.
Motor not turning	Mechanical blockage	Switch off, isolate from supply and remove mechanical blockage.
	Line voltage faulty	Check line voltage, restore power supply, apply control signal.
	Faulty connection	Isolate from supply, correct connection; see connection diagram.
	Thermal overload protector activated	Allow motor to cool off, locate and rectify cause of error, release restart lockout if necessary
Motor/electronics overtemperature	Deficient cooling	Improve cooling. Let the device cool down. To reset the error message, switch off the line voltage for at least 25 s and then switch it on again.
	Ambient temperature too high	Reduce the ambient temperature. Reset by reducing control input to 0.
	Impermissible point of operation	Correct the operating point. Let the device cool down.

In the event of further malfunctions, contact ebm-papst.

6.1 Vibration testing

Checking of fan for mechanical vibration based on ISO 14694. Recommendation: Every 6 months. Max. vibration severity is 3.5 mm/s, measured at the motor fastening diameter on the motor support plate in the direction of the motor axis of rotation and perpendicular to this.

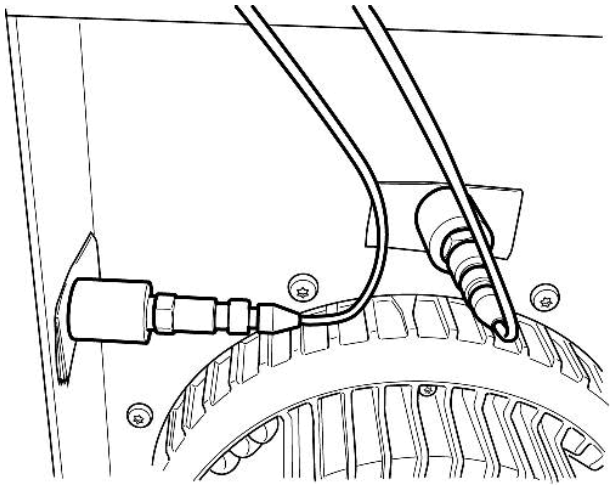

Fig. 1: Example illustrating vibration measurement. The arrangement of the sensors depends on the device concerned and the installation situation.

6.2 Cleaning

NOTE
Damage to the device during cleaning
Malfunction possible

→ Do not clean the device using a high-pressure cleaner.

→ Do not use acid, alkali or solvent-based cleaning agents.

→ Do not use any pointed or sharp-edged objects for cleaning

6.3 Safety inspection

NOTE
High-voltage test
The integrated EMC filter has Y capacitors. The tripping current is exceeded when AC testing voltage is applied.

→ Test the device with DC voltage when you perform the legally required high-voltage test. The voltage to be used corresponds to the peak value of the AC voltage required by the standard.

What to check	How to check	How often	What action?
Contact protection cover for intactness or damage	Visual inspection	At least every 6 months	Repair or replacement of device

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Device for damage to blades and housing	Visual inspection	At least every 6 months	Replacement of device
Fastening the cables	Visual inspection	At least every 6 months	Fasten
Fastening the protective earth terminal	Visual inspection	At least every 6 months	Fasten
Insulation of cables for damage	Visual inspection	At least every 6 months	Replace cables
Impeller for wear/deposits/ corrosion and damage	Visual inspection	At least every 6 months	Clean impeller or replace device
Tightness of cable gland	Visual inspection	At least every 6 months	Retighten, replace if damaged
Abnormal bearing noise	acoustic	At least every 6 months	Replace device
Vibration test	Vibration tester, start-up or deceleration measurement	Recommended every 6 months	Clean impeller or replace device

6.4 Disposal

For ebm-papst, environmental protection and resource preservation are top priority corporate goals.
ebm-papst operates an environmental management system which is certified in accordance with ISO 14001 and rigorously implemented around the world on the basis of German standards.
Right from the development stage, ecological design, technical safety and health protection are fixed criteria.
The following section contains recommendations for ecological disposal of the product and its components.

6.4.1 Country-specific legal requirements

NOTE
Country-specific legal requirements
Always observe the applicable country-specific legal regulations with regard to the disposal of products or waste occurring in the various phases of the life cycle. The corresponding disposal standards are also to be heeded.

6.4.2 Disassembly

Disassembly of the product must be performed or supervised by qualified personnel with the appropriate technical knowledge.
The product is to be disassembled into suitable components for disposal employing standard procedures for motors.

WARNING
Heavy parts of the product may drop off. Some of the product components are heavy. These components could drop off during disassembly.
This can result in fatal or serious injury and material damage.
→ Secure components before unfastening to stop them falling.

6.4.3 Component disposal

The products are mostly made of steel, copper, aluminum and plastic. Metallic materials are generally considered to be fully recyclable.
Separate the components for recycling into the following categories:

- Steel and iron
- Aluminum
- Non-ferrous metal, e.g. motor windings
- Plastics, particularly with brominated flame retardants, in accordance with marking
- Insulating materials
- Cables and wires
- Electronic scrap, e.g. circuit boards

Only ferrite magnets and not rare earth magnets are used in external rotor motors from ebm-papst Mulfingen GmbH & Co. KG.

⇒ Ferrite magnets can be disposed of in the same way as normal iron and steel.

Electrical insulating materials on the product, in cables and wires are made of similar materials and are therefore to be treated in the same manner.
The materials concerned are as follows:

- Miscellaneous insulators used in the terminal box
- Power cables
- Cables for internal wiring
- Electrolytic capacitors

Dispose of electronic components employing the proper procedures for electronic scrap.

→ Please contact ebm-papst for any other questions on disposal.

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D.7 Operating instructions for the three-phase EC external fan, suction, SK180

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CONTENTS

1. SAFETY REGULATIONS AND INFORMATION

Read these operating instructions carefully before starting work on the device. Observe the following warnings to prevent malfunctions or danger to persons.
These operating instructions are to be regarded as part of the device. The device is only to be sold or passed on together with the operating instructions.
These operating instructions may be duplicated and distributed to inform about potential dangers and their prevention.

1.1 Hazard levels for warnings

These operating instructions use the following hazard levels to indicate potentially hazardous situations and important safety regulations:

DANGER
Indicates an imminently hazardous situation which will result in death or serious injury if the specified actions are not taken. Compliance with the instructions is imperative.

WARNING
Indicates a potentially hazardous situation which can result in death or serious injury if the specified actions are not taken. Exercise extreme caution while working.

CAUTION
Indicates a potentially hazardous situation which can result in minor or moderate injury or damage to property if the specified actions are not taken.

NOTE
A potentially harmful situation can occur and, if not avoided, can lead to property damage.

1.2 Staff qualifications

The device may only be transported, unpacked, installed, operated, maintained and otherwise used by suitably qualified, trained and authorized technical staff.
Only authorized specialists are permitted to install the device, to carry out a test run and to perform work on the electrical installation.

1.3 Basic safety rules

The safety hazards associated with the device must be assessed again following installation in the final product.
Note the following when working on the device:

⇒ Do not perform any modifications, additions or conversions on the device without the approval of ebm-papst.

1.4 Voltage

⇒ Check the device's electrical equipment at regular intervals; see Chapter 6.3 Safety inspection.

⇒ Replace loose connections and defective cables immediately.

DANGER
Electrically charged device
Risk of electric shock

→ When working on an electrically charged device, stand on a rubber mat.

WARNING
Live terminals and connections even with device switched off
Electric shock

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→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

CAUTION
In the event of a fault, the rotor and the impeller will be energized
The rotor and the impeller have basic insulation.

→ Do not touch the rotor and impeller once installed.

CAUTION
If control voltage or a stored speed set value is applied, the motor will restart automatically, e.g. after a power failure.
Risk of injury

→ Keep out of the device's danger zone.# When working on the device, switch off the line voltage and ensure that it cannot be switched back on.

→ Wait until the device comes to a stop.

→ After working on the device, remove any tools or other objects from the device.

1.5 Safety and protective features

DANGER
Protective device missing and protective device not functioning
Without a protective device there is a risk of serious injury, for instance when reaching into the device during operation.

→ Operate the device only with a fixed protective device and guard grille.

→ The fixed protective device must be able to withstand the kinetic energy of a fan blade that becomes detached at maximum speed. There must not be any gaps which it is possible to reach into with the fingers, for example.

→ The device is a built-in component. As the operator, you are responsible for ensuring that the device is secured adequately.

→ Stop the device immediately if you notice a missing or ineffective protective device.

1.6 Electromagnetic radiation

Interference from electromagnetic radiation is possible, e.g. in conjunction with open- and closed-loop control devices.
If impermissible radiation levels occur following installation, appropriate shielding measures have to be taken by the user.

NOTE
Electrical or electromagnetic interference after installing the device in customer equipment.

→ Verify that the entire setup is EMC-compliant.

1.7 Mechanical movement

DANGER
Rotating device
Risk of injury to body parts coming into contact with the rotor or the impeller.

→ Secure the device against accidental contact.

→ Before working on the system/machine, wait until all parts have come to a standstill.

WARNING
Rotating device
Long hair and dangling items of clothing, jewelry and the like can become entangled and be pulled into the device. Injuries can result.

→ Do not wear any loose-fitting or dangling clothing or jewelry while working on rotating parts.

→ Protect long hair with a cap.

1.8 Emissions

WARNING
Depending on the installation and operating conditions, the sound pressure level may exceed 70 dB(A).
Risk of noise-induced hearing loss

→ Take appropriate technical safety measures.

→ Protect operating personnel with appropriate safety equipment such as hearing protection.

→ Also observe the requirements of local agencies.

1.9 Hot surface

CAUTION
High temperature on electronics housing
Risk of burns

→ Ensure sufficient protection against accidental contact.

1.10 Transport

NOTE
Transporting the device

→ Transport the device in its original packaging only.

→ Secure the device so it cannot slip, e.g. by using a lashing strip.

1.11 Storage

⇒ Store the device, partially or fully assembled, in a dry place, protected against the weather and free from vibration, in the original packaging in a clean environment.

⇒ Protect the device against environmental effects and dirt until final installation.

⇒ We recommend storing the device for no longer than one year in order to guarantee trouble-free operation and the longest possible service life.

⇒ Even devices explicitly intended for outdoor use are to be stored as described prior to commissioning.

⇒ Maintain the storage temperature, see Chapter 3.6 Transport and storage conditions.

⇒ Make sure that all cable glands are fitted with dummy plugs.

2. INTENDED USE

The device is exclusively designed as a built-in device for conveying air according to its technical data.
Any other usage above and beyond this does not conform with the intended purpose and constitutes misuse of the device.
Customer equipment must be capable of withstanding the mechanical and thermal stresses that can arise from this product. This applies for the entire service life of the equipment in which this product is installed.

Intended use also includes

- Using the device only in power systems with grounded neutral (TN/ TT power systems) and in ungrounded IT power systems.
- The device is to be used in networks with network quality characteristics as per EN 50160.
- Use of the device in stationary systems only.
- Conveying air at an ambient air pressure between 800 mbar and 1050 mbar.
- Using the device within the permitted ambient temperature range; see Chapter 3.6 Transport and storage conditions and Chapter 3.2 Nominal data.
- Operating the device with all protective devices.
- Following the operating instructions.

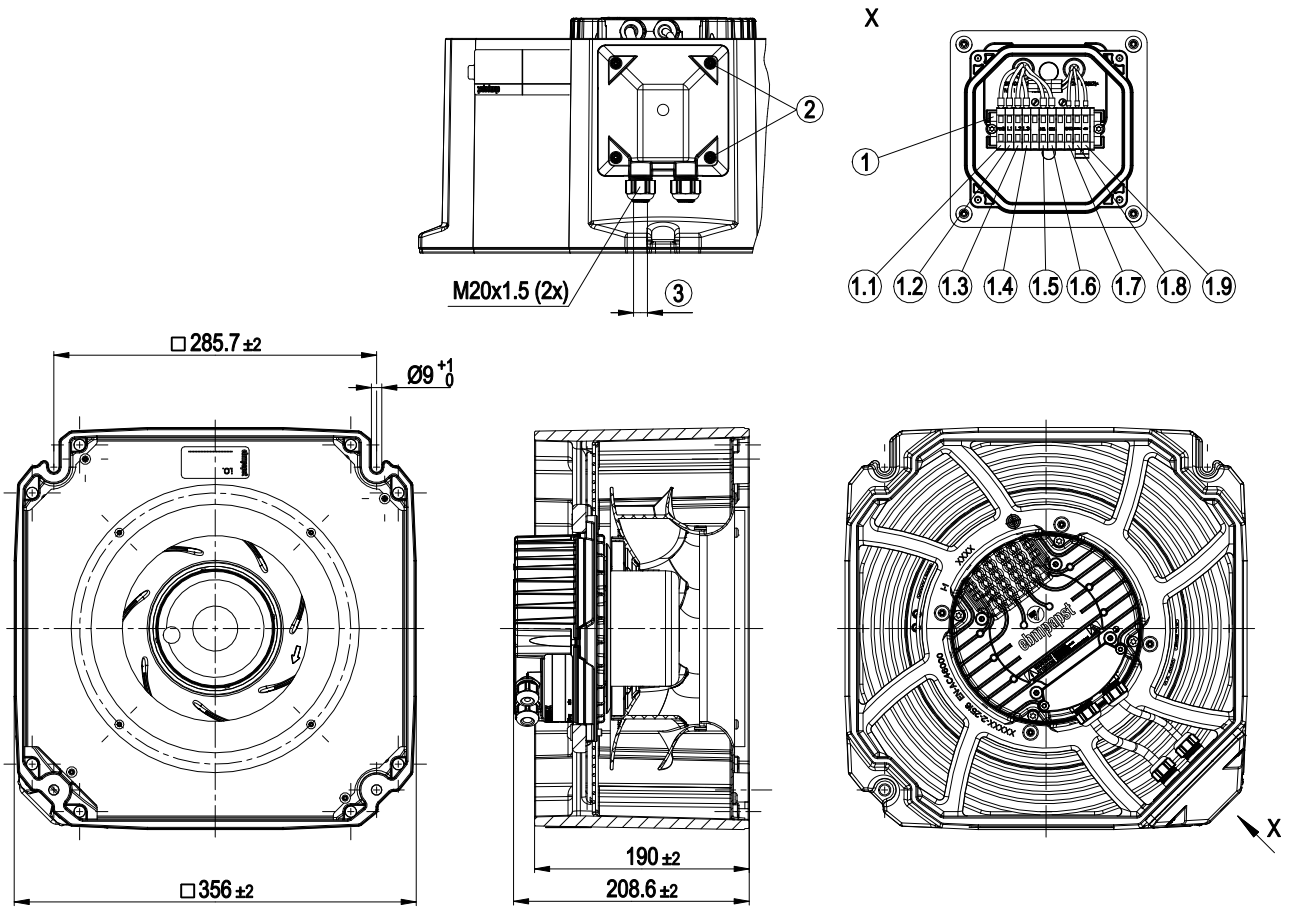
Improper use

In particular, operating the device in the following ways is prohibited and could be hazardous:

- Operating the device in an unbalanced state, e.g. due to dirt deposits or ice formation.
- Resonant operation, operation with severe vibration. This also includes vibration transmitted to the fan from the customer installation.
- Opening the terminal box during operation.
- Conveying air that contains abrasive particles.
- Conveying highly corrosive air, e.g. salt spray. Exception: devices designed for salt spray and correspondingly protected.
- Conveying air with high dust content, e.g. suctioning off sawdust.
- Operating the device close to flammable materials or components.
- Operating the device in an explosive atmosphere.
- Using the device as a safety component or to perform safety-related functions.
- Operation with completely or partially disassembled or manipulated protective devices.
- In addition, all applications not listed among the intended uses.

3. TECHNICAL DATA

3.1 Product drawing



All dimensions in mm.

1	Terminal strip
1.1	PE
1.2	L1
1.3	L2
1.4	L3
1.5	NC
1.6	COM
1.7	GND
1.8	0-10 V
1.9	+10 V
2	Tightening torque 1.2±0.2 Nm
3	Cable diameter min. 6 mm, max. 10 mm, tightening torque 2.5 ± 0.4 Nm

3.2 Nominal data

Motor	M3G084-DF

Phase	3~
Nominal voltage / VAC	400
Nominal voltage range / VAC	380 .. 480
Frequency / Hz	50/60

Method of obtaining data	ml
Speed (rpm) / min-1	2900
Power consumption / W	240
Current draw / A	0.44
Min. ambient temperature / °C	-25
Max. ambient temperature / °C	60

ml = Max. load · me = Max. efficiency · fa = Free air
cs = Customer specification · ce = Customer equipment

Subject to change

3.3 Data according to Commission Regulation (EU) 327/2011

	Actual	Req. 2015
01 Overall efficiency η_{es} / %	46.9	43.9
02 Measurement category	A	
03 Efficiency category	Static	
04 Efficiency grade N	64.1	61
05 Variable speed drive	Yes	
06 Year of manufacture	The year of manufacture is specified on the product's rating label.	
07 Manufacturer	ebm-papst Mulfingen GmbH & Co. KG Amtsgericht (court of registration) Stuttgart · HRA 590344 D-74673 Mulfingen	
08 Type	K3G250-RR03-M4	
09 Power consumption P_{ed} / kW	0.23	
09 Air flow q_v / m³/h	700	
09 Pressure increase total p_{sf} / Pa	500	
10 Speed (rpm) n / min-1	2920	
11 Specific ratio*	1.01	
12 Recycling/disposal	Information on recycling and disposal is provided in the operating instructions.	
13 Maintenance	Information on installation, operation and maintenance is provided in the operating instructions.	
14 Additional components	Components used to calculate the energy efficiency that are not apparent from the measurement category are detailed in the CE declaration.	

* Specific ratio = 1 + p_{fs} / 100 000 Pa

Data obtained at optimum efficiency level. The ErP data is determined using a motor-impeller combination in a standardized measurement setup.

3.4 Technical description

Weight	11.8 kg
Fan size	250 mm
Rotor surface	Painted black
Electronics housing material	Die-cast aluminum, painted black
Impeller material	PA plastic, galvanized sheet-metal plate
Housing material	Die-cast aluminum
Support plate material	Sheet steel, galvanized
Inlet nozzle material	Sheet steel, galvanized
Guard grille material	Steel, phosphated and coated with black plastic (RAL 9005)
Number of blades	7
Direction of rotation	Clockwise, viewed toward rotor
Degree of protection	IP55
Insulation class	"F"
Moisture (F) / Environmental (H) protection class	H1
Installation position	Any
Condensation drainage holes	None
Mode	S1
Motor bearing	Ball bearing
Technical features	- Output 10 VDC, max. 10 mA - Operation and alarm display - External 24 V input (parameter setting) - Alarm relay - Integrated PID controller - Motor current limitation - PFC, passive - RS-485 MODBUS-RTU - Soft start - EEPROM write cycles: 100,000 maximum - Control input 0-10 VDC / PWM - Control interface with SELV potential safely disconnected from the mains - Thermal overload protection for electronics/motor - Line undervoltage / phase failure detection
Touch current according to IEC 60990 (measuring circuit Fig. 4, TN system)	<= 3.5 mA
Electrical hookup	Via terminal box
Motor protection	Thermal overload protector (TOP) internally connected
Protection class	I (if protective earth is connected by customer to the housing's connection point)
Conformity with standards	EN 61800-5-1; CE
Approval	C22.2 No.77 + CAN/CSA-E60730-1; EAC; UL 1004-7 + 60730

With regard to cyclic speed loads, note that the rotating parts of the device are designed for a maximum of one million load cycles. If you have special questions, consult ebm-papst for support.

⇒ Use the device in accordance with its degree of protection.

Information on surface quality

The surfaces of the products conform to the generally applicable industrial standard. The surface quality may change during the production period. This has no effect on strength, dimensional stability and dimensional accuracy.
The color pigments in the paints used perceptibly react to UV light over the course of time. This does not however in any way affect the technical properties of the products. The product is to be protected against UV radiation to prevent the formation of patches and fading. Changes in color are not a reason for complaint and are not covered by the warranty.

3.5 Mounting data

⇒ Secure the screws against unintentional loosening (e.g. use self-locking screws).

Strength class of screws	8.8

Any further mounting data required can be taken from the product drawing or Section Chapter 4.1 Mechanical connection.

3.6 Transport and storage conditions

Max. permitted ambient temp. for motor (transport/ storage)	+80 °C
Min. permitted ambient temp. for motor (transport/ storage)	-40 °C

3.7 Electromagnetic compatibility

EMC immunity to interference	According to EN 61000-6-2 (industrial environment)
EMC circuit feedback	According to EN 61000-3-2/3
EMC interference emission	According to EN 61000-6-3 (household environment)

If several devices are switched in parallel on the supply side so that the line current of the arrangement is in the range of 16-75 A, then this arrangement conforms to IEC 61000-3-12 provided that the short-circuit power S_{sc} at the connection point of the customer system to the public power system is greater than or equal to 120 times the rated output of the arrangement. It is the responsibility of the installation engineer or operator/ owner of the device to ensure, if necessary after consultation with the network operator, that this device is only connected to a connection point with a S_{sc} value that is greater than or equal to 120 times the rated output of the arrangement.

4. CONNECTION AND STARTUP

4.1 Mechanical connection

CAUTION
Risk of cutting and crushing when removing device from packaging

→ Carefully remove the device from the packaging by grasping hold of the frame. Never subject to any impact.

→ Wear safety shoes and cut-resistant safety gloves.

CAUTION
Heavy load when unpacking device
Risk of physical injury, such as back injuries.

→ Two people should work together to remove the device from its packaging.

NOTE
Damage to the device from vibration
Bearing damage, shorter service life

→ The fan must not be subjected to force or excessive vibration from sections of the installation. #If the fan is connected to air ducts, the connection should be isolated from vibration, e.g. using compensators or similar elements. #Ensure stress-free attachment of the fan to the substructure.

⇒ The fan may not be handled in the area around the inlet nozzle during transport and installation.
There is a risk of damage to the impeller.

⇒ Check the device for transport damage. Damaged devices are not to be installed.

⇒ Install the undamaged device in accordance with your application.

CAUTION
Possible damage to the device
If the device slips during installation, serious damage can result.

→ Ensure that the device is securely positioned at its place of installation until all fastening screws have been tightened.

- The fan must not be strained on fastening.

4.2 Electrical connection

DANGER
Voltage on the device
Electric shock

→ Always connect a protective earth first.

→ Check the protective earth.

DANGER
Faulty insulation
Risk of fatal injury from electric shock

→ Use only cables that meet the specified installation regulations for voltage, current, insulation material, capacity, etc.

→ Route cables so that they cannot be touched by any rotating parts.

DANGER
Electrical charge (>50 µC) between phase conductor and protective earth connection after switching off supply with multiple devices connected in parallel.
Electric shock, risk of injury

→ Ensure sufficient protection against accidental contact. Before working on the electrical hookup, short the supply and PE connections.

CAUTION
Voltage
The fan is a built-in component and has no disconnecting switch.

→ Only connect the fan to circuits that can be switched off with an all-pole disconnection switch.

→ When working on the fan, secure the system/machine in which the fan is installed so as to prevent it from being switched back on.

NOTE
Device malfunctions possible
Route the device's control lines separately from the supply line.

→ Maintain the greatest possible clearance. Recommendation: clearance > 10 cm (separate cable routing)

NOTE
Water ingress into wires or cables
Water ingress at the customer end of the cable can damage the device.

→ Make sure the end of the cable is connected in a dry environment.

Only connect the device to circuits that can be switched off with an all-pole disconnection switch.

4.2.1 Requirements

⇒ Check whether the information on the nameplate matches the connection data.

⇒ Before connecting the device, make sure the power supply matches the device voltage.

⇒ Only use cables designed for the current level indicated on the nameplate.
For determining the cross-section, note the sizing criteria according to EN 61800-5-1. The protective earth must have a cross-section equal to or greater than that of the phase conductor.
We recommend the use of 105 °C cables. Ensure that the minimum cable cross-section is at least
AWG 26 / 0.13 mm².

Protective earth contact resistance according to EN 61800-5-1

Compliance with the resistance specifications according to EN 61800-5-1 for the protective earth connection circuit must be verified in the end application. Depending on the installation situation, it may be necessary to connect an additional protective earth conductor by way of the extra protective earth terminal provided on the device. The protective earth terminal is located on the housing and provided with a protective earth symbol and a hole.

4.2.2 Supply connection and fuses

Assignment of supply cable cross-sections and their required fuses (line protection only, no equipment protection).

Nominal voltage	Fuse		Automatic circuit breaker	Cable cross-section	Cable cross-section
	VDE	UL	VDE	mm²	*AWG
3/PE AC 380-480 VAC	16 A	15 A	C16A	1.5	16

* AWG = American Wire Gauge

4.2.3 Reactive currents

Because of the EMC filter integrated for compliance with EMC limits (interference emission and immunity to interference), reactive currents can be measured in the supply line even when the motor is at a standstill and the line voltage is switched on.

- The values are typically in the range < 250 mA
- At the same time, the effective power in this operating state (operational readiness) is typically < 5 W.

4.2.4 Residual current circuit breaker (RCCB)

If the use of a residual current device (RCD) is required in your installation, only AC/DC-sensitive residual current devices (type B or B+) are permissible. As with variable frequency drives, residual current devices cannot provide personal safety while operating the device. When the device power supply is switched on, pulsed charging currents from the capacitors in the integrated EMC filter can lead to the instant tripping of residual current devices. We recommend the use of residual current circuit breakers (RCCB) with a trip threshold of 300 mA and delayed tripping (super-resistant, characteristic K).

4.2.5 Leakage current

For asymmetrical power systems or if a phase fails, the leakage current can increase to a multiple of the nominal value.

4.2.6 Locked-rotor protection

Due to the locked-rotor protection, the starting current (LRA) is equal to or less than the nominal current (FLA).

4.3 Connection in terminal box

4.3.1 Preparing cables for connection

Only strip the cable as far as necessary, ensuring that the cable gland is sealed and there is no strain on the connections. For tightening torques, see Chapter 3.1 Product drawing.

NOTE
Tightness and strain relief are dependent on the cable used.

→ This must be checked by the user.

4.3.2 Connecting wires to terminals

WARNING
Live terminals and connections even with device switched off
Electric shock
→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

⇒ Remove the cap from the cable gland.

Only remove caps where cables are fed in.

⇒ Route the wire(s) (not included in scope of delivery) into the terminal box.

⇒ First connect the "PE" (protective earth).

⇒ Connect the wires to the corresponding terminals.

Use a screwdriver to do so.
When connecting, ensure that no wire ends fan out.

⇒ Seal the terminal box.

4.3.3 Cable routing

Water must be prevented from reaching the cable gland along the cable.

NOTE
Damage caused by moisture penetration.
Moisture can penetrate into the terminal box if water is constantly present at the cable glands.
→ To prevent the constant accumulation of water at the cable glands, the cable should be routed in a U-shaped loop wherever possible.# If this is not possible, a drip edge can be produced by fitting a cable tie directly in front of the cable gland for example.

When routing the cable, make sure that the cable glands are located at the bottom. The cables must always be routed downward.

4.4 Factory settings

Factory settings made for the device by ebm-papst.

Mode parameter set 1	PWM control
Mode parameter set 2	PWM control
Fan/device address	01
Max. PWM / %	100
Min. PWM / %	5
Save set value to EEPROM	Yes
Set value requirement	Analog (linear)
Direction of action parameter set 1	Positive (heating)
Direction of action parameter set 2	Positive (heating)

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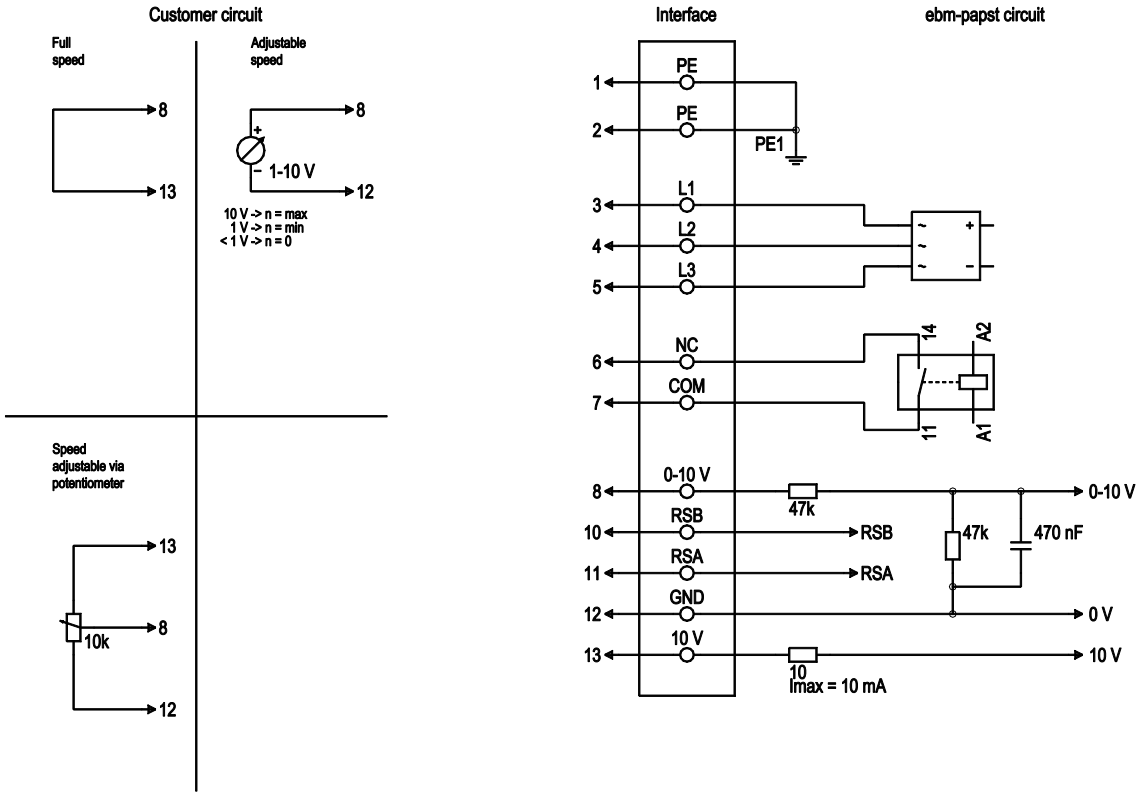
4.5 Connection diagram



Drawing preliminary!

No.	Conn.	Designation	Color	Function/assignment
1	1, 2	PE	green/ yellow	Protective earth
1	3	L1	black	Power supply
1	4	L2	black	Power supply
1	5	L3	black	Power supply
1	6	NC	white 1	Status relay, floating status contact, break for failure, contact rating 250 VAC / 2 A (AC1) / min. 10 mA; reinforced insulation on supply side and basic insulation on control interface side
1	7	COM	white 2	Status relay, floating status contact, break for failure, contact rating 250 VAC / 2 A (AC1) / min. 10 mA; reinforced insulation on supply side and basic insulation on control interface side
2	8	0-10V	yellow	Analog input (set value), 0-10 V, Ri = 100 kΩ, adjustable curve, SELV
2	10	RSB	brown	RS485 interface for MODBUS, RSB; SELV
2	11	RSA	white	RS485 interface for MODBUS, RSA; SELV
2	12	GND	blue	Reference ground for control interface, SELV
2	13	+10V	red	Fixed voltage output 10 VDC, +10 V ±3%, max. 10 mA, short-circuit-proof power supply for external devices (e.g. pot), SELV fixed voltage input 24 VDC for setting parameters via MODBUS without line voltage supply

4.6 Checking connections

⇒ Ensure isolation from supply (all phases).
⇒ Make sure a restart is impossible
⇒ Check the cables for proper fit.
⇒ Screw the terminal box cover back on again. Terminal box tightening torque, see Chapter 3.1 Product drawing.
⇒ Route the cables in the terminal box so that the terminal box cover closes without resistance.
⇒ Use all screw plugs. Insert the screws by hand to avoid damage to the threads.
⇒ Make sure the terminal box is completely closed and sealed and that all screws and cable glands have been properly tightened.

4.7 Switching on the device

The device may only be switched on if it has been installed properly and in accordance with its intended use, including the required safety mechanisms and professional electrical hookup. This also applies for devices which have already been equipped with plugs and terminals or similar connectors by the customer.

WARNING
Hot motor housing
Risk of fire
→ Ensure that no combustible or flammable materials are located close to the fan.

⇒ Before switching on, check the device for visible external damage and make sure the protective devices are functional.
⇒ Check the fan's air flow paths for foreign matter and remove any foreign matter found.
⇒ Apply the nominal supply voltage.
⇒ Start the device by changing the input signal.

NOTE
Damage to the device from vibration
Bearing damage, shorter service life
→ Low-vibration operation of the fan must be ensured over the entire speed control range. #Severe vibration can arise for instance from inexpert handling, transportation damage and resultant imbalance or be caused by component or structural resonance. #Speed ranges with excessively high vibration levels and possibly resonant frequencies must be determined in the course of fan commissioning. #Either run through the resonant range as quickly as possible with speed control or find another remedy.# Operation with excessively high vibration levels can lead to premature failure.

4.8 Switching off the device

Switching off the device during operation:
⇒ Switch off the device via the control input.
⇒ Do not switch the motor (e.g. in cyclic operation) on and off via power supply.

Switching off the device for maintenance:
⇒ Switch off the device via the control input.
⇒ Do not switch the motor (e.g. in cyclic operation) on and off via power supply.
⇒ Disconnect the device from the power supply.
⇒ When disconnecting, be sure to disconnect the ground connection last.

5. INTEGRATED PROTECTIVE FEATURES

The integrated protective functions cause the motor to switch off automatically in the event of the faults described in the table.

Fault	Safety feature description/ function
Rotor position detection error	An automatic restart follows.
Blocked rotor	⇒ After the blockage is removed, the motor restarts automatically.
Line undervoltage (line voltage outside of permitted nominal voltage range)	⇒ If the line voltage returns to permitted values, the motor restarts automatically.
Phase failure	A phase of the supply voltage fails for at least 5 s. ⇒ When all phases are correctly supplied again, the motor automatically restarts after 10-40 s.

6. MAINTENANCE, MALFUNCTIONS, POSSIBLE CAUSES AND REMEDIES

Do not perform any repairs on your device. Send the device to ebm-papst for repair or replacement.

WARNING
Live terminals and connections even with device switched off
Electric shock
→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

CAUTION
If control voltage or a stored speed set value is applied, the motor will restart automatically, e.g. after a power failure.
Risk of injury
→ Keep out of the device's danger zone.# When working on the device, switch off the line voltage and ensure that it cannot be switched back on.
→ Wait until the device comes to a stop.
→ After working on the device, remove any tools or other objects from the device.

If the device is out of use for some time, e.g. when in storage, we recommend switching it on for at least two hours to allow any condensation to evaporate and to move the bearings.

Malfunction/fault	Possible cause	Possible remedy
Impeller not running smoothly	Imbalance in rotating parts	Clean the device; replace it if imbalance persists after cleaning. Make sure no weight clips are removed during cleaning.
Motor not turning	Mechanical blockage	Switch off, isolate from supply and remove mechanical blockage.

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	Line voltage faulty	Check line voltage, restore power supply. Attention! The error message resets automatically. Device restarts automatically without warning.
	Faulty connection	Isolate from supply, correct connection; see connection diagram.
	Broken motor winding	Replace device
	Thermal overload protector activated	Allow motor to cool off, locate and rectify cause of error, release restart lockout if necessary
	Deficient cooling	Improve cooling. Let the device cool down. To reset the error message, switch off the line voltage for at least 25 s and then switch it on again. Alternatively, reset the error message by applying a control signal of < 0.5 V to Din1 or by shorting Din1 to GND.
	Ambient temperature too high	Reduce the ambient temperature. Let the device cool down. To reset the error message, switch off the line voltage for at least 25 s and then switch it on again. Alternatively, reset the error message by applying a control signal of < 0.5 V to Din1 or by shorting Din1 to GND.
	Impermissible point of operation (e.g. back pressure too high)	Correct the operating point. Let the device cool down. To reset the error message, switch off the line voltage for at least 25 s and then switch it on again. Alternatively, reset the error message by applying a control signal of < 0.5 V to Din1 or by shorting Din1 to GND.

In the event of further malfunctions, contact ebm-papst.

6.1 Vibration testing

Checking of fan for mechanical vibration based on ISO 14694. Recommendation: Every 6 months. Max. vibration severity is 3.5 mm/s, measured at the motor fastening diameter on the motor support plate in the direction of the motor axis of rotation and perpendicular to this.

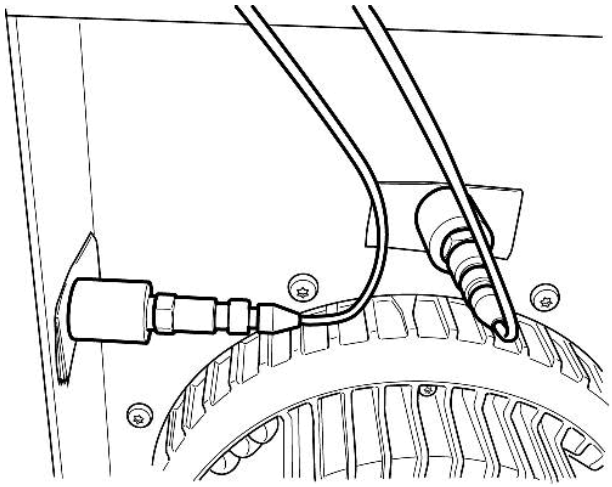

Fig. 1: Example illustrating vibration measurement. The arrangement of the sensors depends on the device concerned and the installation situation.

6.2 Cleaning

NOTE
Damage to the device during cleaning
Malfunction possible

→ Do not clean the device using a high-pressure cleaner.

→ Do not use acid, alkali or solvent-based cleaning agents.

→ Do not use any pointed or sharp-edged objects for cleaning

6.3 Safety inspection

NOTE
High-voltage test
The integrated EMC filter has Y capacitors. The tripping current is exceeded when AC testing voltage is applied.

→ Test the device with DC voltage when you perform the legally required high-voltage test. The voltage to be used corresponds to the peak value of the AC voltage required by the standard.

What to check	How to check	How often	What action?
Contact protection cover for intactness or damage	Visual inspection	At least every 6 months	Repair or replacement of device
Device for damage to blades and housing	Visual inspection	At least every 6 months	Replacement of device
Fastening the cables	Visual inspection	At least every 6 months	Fasten

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Fastening the protective earth terminal	Visual inspection	At least every 6 months	Fasten
Insulation of cables for damage	Visual inspection	At least every 6 months	Replace cables
Impeller for wear/deposits/ corrosion and damage	Visual inspection	At least every 6 months	Clean or replace impeller
Tightness of cable gland	Visual inspection	At least every 6 months	Retighten, replace if damaged
Abnormal bearing noise	acoustic	At least every 6 months	Replace device

6.4 Disposal

For ebm-papst, environmental protection and resource preservation are top priority corporate goals.
ebm-papst operates an environmental management system which is certified in accordance with ISO 14001 and rigorously implemented around the world on the basis of German standards.
Right from the development stage, ecological design, technical safety and health protection are fixed criteria.
The following section contains recommendations for ecological disposal of the product and its components.

6.4.1 Country-specific legal requirements

NOTE
Country-specific legal requirements
Always observe the applicable country-specific legal regulations with regard to the disposal of products or waste occurring in the various phases of the life cycle. The corresponding disposal standards are also to be heeded.

6.4.2 Disassembly

Disassembly of the product must be performed or supervised by qualified personnel with the appropriate technical knowledge.
The product is to be disassembled into suitable components for disposal employing standard procedures for motors.

WARNING
Heavy parts of the product may drop off. Some of the product components are heavy. These components could drop off during disassembly.
This can result in fatal or serious injury and material damage.
→ Secure components before unfastening to stop them falling.

6.4.3 Component disposal

The products are mostly made of steel, copper, aluminum and plastic.
Metallic materials are generally considered to be fully recyclable.
Separate the components for recycling into the following categories:

- Steel and iron
- Aluminum
- Non-ferrous metal, e.g. motor windings
- Plastics, particularly with brominated flame retardants, in accordance with marking
- Insulating materials
- Cables and wires
- Electronic scrap, e.g. circuit boards

Only ferrite magnets and not rare earth magnets are used in external rotor motors from ebm-papst Mulfingen GmbH & Co. KG.

⇒ Ferrite magnets can be disposed of in the same way as normal iron and steel.

Electrical insulating materials on the product, in cables and wires are made of similar materials and are therefore to be treated in the same manner.
The materials concerned are as follows:

- Miscellaneous insulators used in the terminal box
- Power cables
- Cables for internal wiring
- Electrolytic capacitors

Dispose of electronic components employing the proper procedures for electronic scrap.

→ Please contact ebm-papst for any other questions on disposal.

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D.8 Operating instructions for the three-phase EC external fan, suction, SK225

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CONTENTS

1. SAFETY REGULATIONS AND INFORMATION

Read these operating instructions carefully before starting work on the device. Observe the following warnings to prevent malfunctions or danger to persons.
These operating instructions are to be regarded as part of the device. The device is only to be sold or passed on together with the operating instructions.
These operating instructions may be duplicated and distributed to inform about potential dangers and their prevention.

1.1 Hazard levels for warnings

These operating instructions use the following hazard levels to indicate potentially hazardous situations and important safety regulations:

DANGER
Indicates an imminently hazardous situation which will result in death or serious injury if the specified actions are not taken. Compliance with the instructions is imperative.

WARNING
Indicates a potentially hazardous situation which can result in death or serious injury if the specified actions are not taken. Exercise extreme caution while working.

CAUTION
Indicates a potentially hazardous situation which can result in minor or moderate injury or damage to property if the specified actions are not taken.

NOTE
A potentially harmful situation can occur and, if not avoided, can lead to property damage.

1.2 Staff qualifications

The device may only be transported, unpacked, installed, operated, maintained and otherwise used by suitably qualified, trained and authorized technical staff.
Only authorized specialists are permitted to install the device, to carry out a test run and to perform work on the electrical installation.

1.3 Basic safety rules

The safety hazards associated with the device must be assessed again following installation in the final product.
The locally applicable industrial safety regulations are always to be observed when working on the device.
Keep the workplace clean and tidy. Untidiness in the work area increases the risk of accidents.
Note the following when working on the device:

⇒ Do not perform any modifications, additions or conversions on the device without the approval of ebm-papst.

1.4 Voltage

⇒ Check the device's electrical equipment at regular intervals; see Chapter 6.3 Safety inspection.

⇒ Replace loose connections and defective cables immediately.

DANGER
Electrically charged device
Risk of electric shock

→ When working on an electrically charged device, stand on a rubber mat.

WARNING
Live terminals and connections even with device switched off
Electric shock

→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

CAUTION
In the event of a fault, the rotor and the impeller will be energized
The rotor and the impeller have basic insulation.

→ Do not touch the rotor and impeller once installed.

CAUTION
If control voltage or a stored speed set value is applied, the motor will restart automatically, e.g. after a power failure.
Risk of injury

→ Keep out of the device's danger zone.# When working on the device, switch off the line voltage and ensure that it cannot be switched back on.

→ Wait until the device comes to a stop.

→ After working on the device, remove any tools or other objects from the device.

1.5 Safety and protective features

DANGER
Protective device missing and protective device not functioning
Without a protective device there is a risk of serious injury, for instance when reaching into the device during operation.

→ Operate the device only with a fixed protective device and guard grille.

→ The fixed protective device must be able to withstand the kinetic energy of a fan blade that becomes detached at maximum speed. There must not be any gaps which it is possible to reach into with the fingers, for example.

→ The device is a built-in component. As the operator, you are responsible for ensuring that the device is secured adequately.

→ Stop the device immediately if you notice a missing or ineffective protective device.

1.6 Electromagnetic radiation

Interference from electromagnetic radiation is possible, e.g. in conjunction with open- and closed-loop control devices.
If impermissible radiation levels occur following installation, appropriate shielding measures have to be taken by the user.

NOTE
Electrical or electromagnetic interference after installing the device in customer equipment.

→ Verify that the entire setup is EMC-compliant.

1.7 Mechanical movement

DANGER
Rotating device
Risk of injury to body parts coming into contact with the rotor or the impeller.

→ Secure the device against accidental contact.

→ Before working on the system/machine, wait until all parts have come to a standstill.

WARNING
Rotating device
Long hair and dangling items of clothing, jewelry and the like can become entangled and be pulled into the device. Injuries can result.

→ Do not wear any loose-fitting or dangling clothing or jewelry while working on rotating parts.

→ Protect long hair with a cap.

1.8 Emissions

WARNING
Depending on the installation and operating conditions, the sound pressure level may exceed 70 dB(A).
Risk of noise-induced hearing loss

→ Take appropriate technical safety measures.

→ Protect operating personnel with appropriate safety equipment such as hearing protection.

→ Also observe the requirements of local agencies.

1.9 Hot surface

CAUTION
High temperature on electronics housing
Risk of burns

→ Ensure sufficient protection against accidental contact.

1.10 Transport

WARNING
Transporting the fan
Injuries from tipping or slipping

→ The fan is always to be transported with care and in its original packaging. #If set down too hard or at an angle for example, the impact can lead to bearing damage or deformation of the frame or impeller. #It must be ensured that the fans cannot tip over during transportation and handling.

→ Secure the fan(s) with appropriate equipment such as a lashing strip so that nothing can slip or tip, especially when stacking multiple fans. #Also make allowance for possible wind forces.

1.11 Storage

⇒ Store the device, partially or fully assembled, in a dry place, protected against the weather and free from vibration, in the original packaging in a clean environment.

⇒ Protect the device against environmental effects and dirt until final installation.

⇒ We recommend storing the device for no longer than one year in order to guarantee trouble-free operation and the longest possible service life.

⇒ Even devices explicitly intended for outdoor use are to be stored as described prior to commissioning.

⇒ Maintain the storage temperature, see Chapter 3.6 Transport and storage conditions.

⇒ Make sure that all cable glands are fitted with dummy plugs.

2. INTENDED USE

The device is exclusively designed as a built-in device for conveying air according to its technical data.
Any other usage above and beyond this does not conform with the intended purpose and constitutes misuse of the device.
Customer equipment must be capable of withstanding the mechanical and thermal stresses that can arise from this product. This applies for the entire service life of the equipment in which this product is installed.

Intended use also includes

- Using the device only in power systems with grounded neutral (TN/TT power systems) and in ungrounded IT power systems.
- The device is to be used in networks with network quality characteristics as per EN 50160.
- Use of the device in stationary systems only.
- Conveying air at an ambient air pressure between 800 mbar and 1050 mbar.
- Using the device within the permitted ambient temperature range; see Chapter 3.6 Transport and storage conditions and Chapter 3.2 Nominal data.
- Operating the device with all protective devices.
- Following the operating instructions.

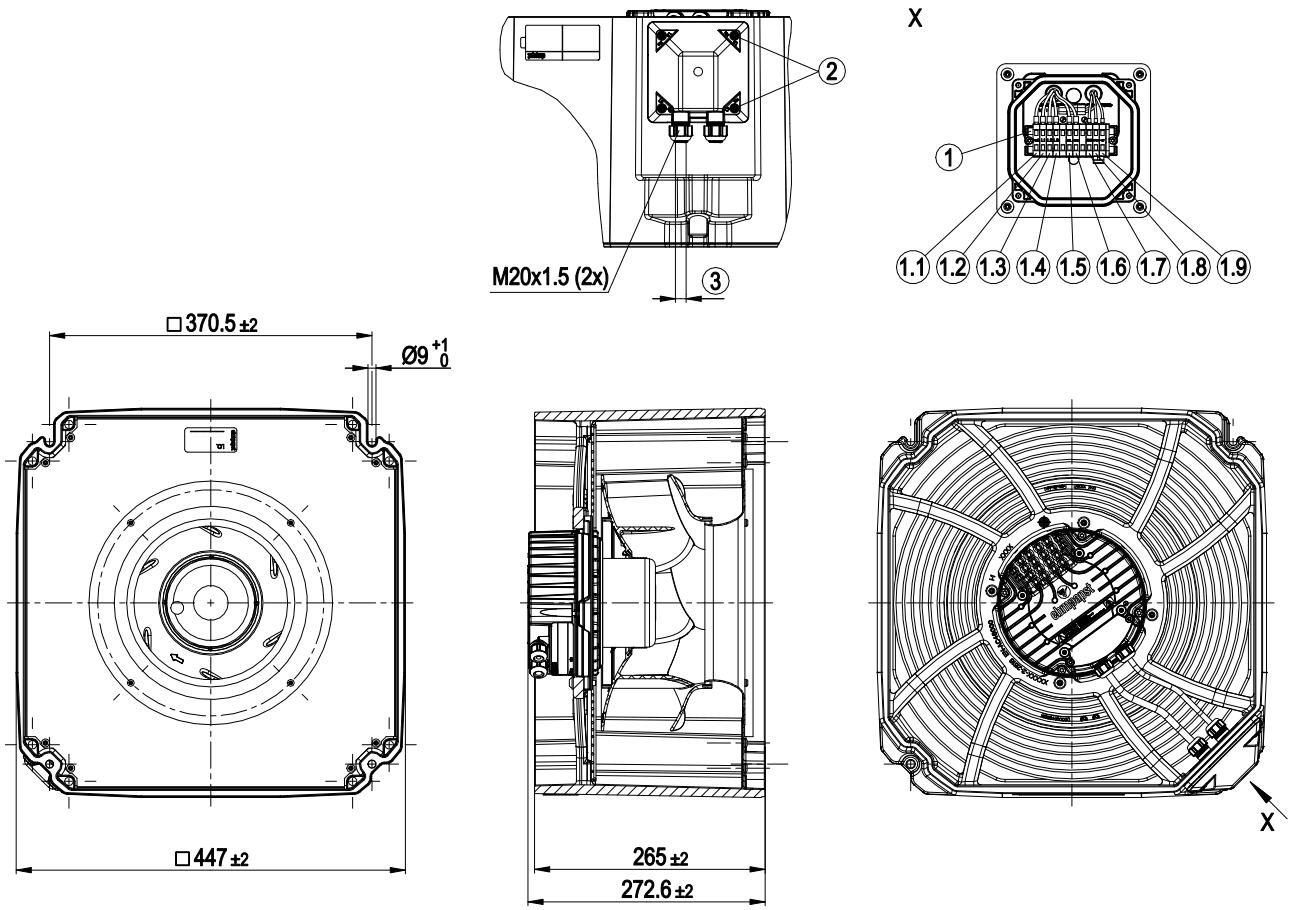
Improper use

In particular, operating the device in the following ways is prohibited and could be hazardous:

- Operating the device in an unbalanced state, e.g. due to dirt deposits or ice formation.
- Resonant operation, operation with severe vibration. This also includes vibration transmitted to the fan from the customer installation.
- Opening the terminal box during operation.
- Conveying air that contains abrasive particles.
- Conveying highly corrosive air, e.g. salt spray. Exception: devices designed for salt spray and correspondingly protected.
- Conveying air with high dust content, e.g. suctioning off sawdust.
- Operating the device close to flammable materials or components.
- Operating the device in an explosive atmosphere.
- Using the device as a safety component or to perform safety-related functions.
- Operation with completely or partially disassembled or manipulated protective devices.
- In addition, all applications not listed among the intended uses.

3. TECHNICAL DATA

3.1 Product drawing



All dimensions in mm.

1	Terminal strip
1.1	PE
1.2	L1
1.3	L2
1.4	L3
1.5	NC
1.6	COM
1.7	GND
1.8	0-10 V
1.9	+10 V
2	Tightening torque 1.2±0.2 Nm
3	Cable diameter min. 6 mm, max. 10 mm, tightening torque 2.5 ± 0.4 Nm

3.2 Nominal data

Motor	M3G084-DF

Phase	3~
Nominal voltage / VAC	400
Nominal voltage range / VAC	380 .. 480
Frequency / Hz	50/60

Method of obtaining data	ml
Speed (rpm) / min-1	2550
Power consumption / W	450
Current draw / A	0.75
Min. ambient temperature / °C	-25
Max. ambient temperature / °C	60

ml = Max. load · me = Max. efficiency · fa = Free air
cs = Customer specification · ce = Customer equipment

Subject to change

3.3 Data according to Commission Regulation (EU) 327/2011

	Actual	Req. 2015
01 Overall efficiency η_{es} / %	56.9	46.5
02 Measurement category	A	
03 Efficiency category	Static	
04 Efficiency grade N	71.4	61
05 Variable speed drive	Yes	
06 Year of manufacture	The year of manufacture is specified on the product's rating label.	
07 Manufacturer	ebm-papst Mulfingen GmbH & Co. KG Amtsgericht (court of registration) Stuttgart · HRA 590344 D-74673 Mulfingen	
08 Type	K3G280-RR03-M4	
09 Power consumption P_{ed} / kW	0.42	
09 Air flow q_v / m³/h	1400	
09 Pressure increase total p_{sf} / Pa	557	
10 Speed (rpm) n / min-1	2555	
11 Specific ratio*	1.01	
12 Recycling/disposal	Information on recycling and disposal is provided in the operating instructions.	
13 Maintenance	Information on installation, operation and maintenance is provided in the operating instructions.	
14 Additional components	Components used to calculate the energy efficiency that are not apparent from the measurement category are detailed in the CE declaration.	

* Specific ratio = 1 + p_{fs} / 100 000 Pa

Data obtained at optimum efficiency level. The ErP data is determined using a motor-impeller combination in a standardized measurement setup.

3.4 Technical description

Weight	18.0 kg
Fan size	280 mm
Rotor surface	Painted black
Electronics housing material	Die-cast aluminum, painted black
Impeller material	PP plastic, galvanized sheet-metal plate
Housing material	Die-cast aluminum
Support plate material	Sheet steel, galvanized
Inlet nozzle material	Sheet steel, galvanized
Guard grille material	Steel, phosphated and coated with black plastic (RAL 9005)
Number of blades	6
Direction of rotation	Clockwise, viewed toward rotor
Degree of protection	IP55
Insulation class	"F"
Moisture (F) / Environmental (H) protection class	H1
Installation position	Any
Condensation drainage holes	None
Mode	S1
Motor bearing	Ball bearing
Technical features	- Output 10 VDC, max. 10 mA - Operation and alarm display - External 24 V input (parameter setting) - Alarm relay - Integrated PID controller - Motor current limitation - PFC, passive - RS-485 MODBUS-RTU - Soft start - EEPROM write cycles: 100,000 maximum - Control input 0-10 VDC / PWM - Control interface with SELV potential safely disconnected from the mains - Thermal overload protection for electronics/motor - Line undervoltage / phase failure detection
Touch current according to IEC 60990 (measuring circuit Fig. 4, TN system)	<= 3.5 mA
Electrical hookup	Via terminal box
Motor protection	Thermal overload protector (TOP) internally connected
Protection class	I (if protective earth is connected by customer to the housing's connection point)
Conformity with standards	EN 61800-5-1; CE
Approval	C22.2 No.77 + CAN/CSA-E60730-1; EAC; UL 1004-7 + 60730

With regard to cyclic speed loads, note that the rotating parts of the device are designed for a maximum of one million load cycles. If you have special questions, consult ebm-papst for support.

⇒ Use the device in accordance with its degree of protection.

Information on surface quality

The surfaces of the products conform to the generally applicable industrial standard. The surface quality may change during the production period. This has no effect on strength, dimensional stability and dimensional accuracy.
The color pigments in the paints used perceptibly react to UV light over the course of time. This does not however in any way affect the technical properties of the products. The product is to be protected against UV radiation to prevent the formation of patches and fading. Changes in color are not a reason for complaint and are not covered by the warranty.

3.5 Mounting data

Strength class of screws	8.8

⇒ Secure the screws against unintentional loosening (e.g. use self-locking screws).

Any further mounting data required can be taken from the product drawing or Section Chapter 4.1 Mechanical connection.

3.6 Transport and storage conditions

Max. permitted ambient temp. for motor (transport/ storage)	+80 °C
Min. permitted ambient temp. for motor (transport/ storage)	-40 °C

3.7 Electromagnetic compatibility

EMC immunity to interference	According to EN 61000-6-2 (industrial environment)
EMC circuit feedback	According to EN 61000-3-2/3
EMC interference emission	According to EN 61000-6-3 (household environment)

If several devices are switched in parallel on the supply side so that the line current of the arrangement is in the range of 16-75 A, then this arrangement conforms to IEC 61000-3-12 provided that the short-circuit power S_{sc} at the connection point of the customer system to the public power system is greater than or equal to 120 times the rated output of the arrangement. It is the responsibility of the installation engineer or operator/ owner of the device to ensure, if necessary after consultation with the network operator, that this device is only connected to a connection point with a S_{sc} value that is greater than or equal to 120 times the rated output of the arrangement.

4. CONNECTION AND STARTUP

4.1 Mechanical connection

CAUTION
Risk of cutting and crushing when removing device from packaging

→ Carefully remove the device from the packaging by grasping hold of the frame. Never subject to any impact.

→ Wear safety shoes and cut-resistant safety gloves.

CAUTION
Heavy load when unpacking device
Risk of physical injury, such as back injuries.

→ Two people should work together to remove the device from its packaging.

NOTE
Damage to the device from vibration
Bearing damage, shorter service life

→ The fan must not be subjected to force or excessive vibration from sections of the installation. #If the fan is connected to air ducts, the connection should be isolated from vibration, e.g. using compensators or similar elements. #Ensure stress-free attachment of the fan to the substructure.

⇒ The fan may not be handled in the area around the inlet nozzle during transport and installation.
There is a risk of damage to the impeller.

⇒ Check the device for transport damage. Damaged devices are not to be installed.

⇒ Install the undamaged device in accordance with your application.

CAUTION
Possible damage to the device
If the device slips during installation, serious damage can result.

→ Ensure that the device is securely positioned at its place of installation until all fastening screws have been tightened.

- The fan must not be strained on fastening.

4.2 Electrical connection

DANGER
Voltage on the device
Electric shock

→ Always connect a protective earth first.

→ Check the protective earth.

DANGER
Faulty insulation
Risk of fatal injury from electric shock

→ Use only cables that meet the specified installation regulations for voltage, current, insulation material, capacity, etc.

→ Route cables so that they cannot be touched by any rotating parts.

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DANGER
Electrical charge (>50 µC) between phase conductor and protective earth connection after switching off supply with multiple devices connected in parallel.
Electric shock, risk of injury

→ Ensure sufficient protection against accidental contact. Before working on the electrical hookup, short the supply and PE connections.

CAUTION
Voltage
The fan is a built-in component and has no disconnecting switch.

→ Only connect the fan to circuits that can be switched off with an all-pole disconnection switch.

→ When working on the fan, secure the system/machine in which the fan is installed so as to prevent it from being switched back on.

NOTE
Device malfunctions possible
Route the device's control lines separately from the supply line.

→ Maintain the greatest possible clearance. Recommendation: clearance > 10 cm (separate cable routing)

NOTE
Water ingress into wires or cables
Water ingress at the customer end of the cable can damage the device.

→ Make sure the end of the cable is connected in a dry environment.

Only connect the device to circuits that can be switched off with an all-pole disconnection switch.

4.2.1 Requirements

⇒ Check whether the information on the nameplate matches the connection data.

⇒ Before connecting the device, make sure the power supply matches the device voltage.

⇒ Only use cables designed for the current level indicated on the nameplate.
For determining the cross-section, note the sizing criteria according to EN 61800-5-1. The protective earth must have a cross-section equal to or greater than that of the phase conductor.
We recommend the use of 105 °C cables. Ensure that the minimum cable cross-section is at least
AWG 26 / 0.13 mm².

Protective earth contact resistance according to EN 61800-5-1

Compliance with the resistance specifications according to EN 61800-5-1 for the protective earth connection circuit must be verified in the end application. Depending on the installation situation, it may be necessary to connect an additional protective earth conductor by way of the extra protective earth terminal provided on the device. The protective earth terminal is located on the housing and provided with a protective earth symbol and a hole.

4.2.2 Supply connection and fuses

Assignment of supply cable cross-sections and their required fuses (line protection only, no equipment protection).

Nominal voltage	Fuse		Automatic circuit breaker	Cable cross-section	Cable cross-section
	VDE	UL	VDE	mm²	*AWG
3/PE AC 380-480 VAC	16 A	15 A	C16A	1.5	16

* AWG = American Wire Gauge

4.2.3 Reactive currents

Because of the EMC filter integrated for compliance with EMC limits (interference emission and immunity to interference), reactive currents can be measured in the supply line even when the motor is at a standstill and the line voltage is switched on.

- The values are typically in the range < 250 mA
- At the same time, the effective power in this operating state (operational readiness) is typically < 5 W.

4.2.4 Residual current circuit breaker (RCCB)

If the use of a residual current device (RCD) is required in your installation, only AC/DC-sensitive residual current devices (type B or B+) are permissible. As with variable frequency drives, residual current devices cannot provide personal safety while operating the device. When the device power supply is switched on, pulsed charging currents from the capacitors in the integrated EMC filter can lead to the instant tripping of residual current devices. We recommend the use of residual current circuit breakers (RCCB) with a trip threshold of 300 mA and delayed tripping (super-resistant, characteristic K).

4.2.5 Leakage current

For asymmetrical power systems or if a phase fails, the leakage current can increase to a multiple of the nominal value.

4.2.6 Locked-rotor protection

Due to the locked-rotor protection, the starting current (LRA) is equal to or less than the nominal current (FLA).

4.3 Connection in terminal box

4.3.1 Preparing cables for connection

Only strip the cable as far as necessary, ensuring that the cable gland is sealed and there is no strain on the connections. For tightening torques, see Chapter 3.1 Product drawing.

NOTE
Tightness and strain relief are dependent on the cable used.

→ This must be checked by the user.

4.3.2 Connecting wires to terminals

WARNING
Live terminals and connections even with device switched off
Electric shock
→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

⇒ Remove the cap from the cable gland.

Only remove caps where cables are fed in.

⇒ Route the wire(s) (not included in scope of delivery) into the terminal box.

⇒ First connect the "PE" (protective earth).

⇒ Connect the wires to the corresponding terminals.

Use a screwdriver to do so.
When connecting, ensure that no wire ends fan out.

⇒ Seal the terminal box.

4.3.3 Cable routing

Water must be prevented from reaching the cable gland along the cable.

NOTE
Damage caused by moisture penetration.
Moisture can penetrate into the terminal box if water is constantly present at the cable glands.
→ To prevent the constant accumulation of water at the cable glands, the cable should be routed in a U-shaped loop wherever possible.# If this is not possible, a drip edge can be produced by fitting a cable tie directly in front of the cable gland for example.

When routing the cable, make sure that the cable glands are located at the bottom. The cables must always be routed downward.

4.4 Factory settings

Factory settings made for the device by ebm-papst.

Mode parameter set 1	PWM control
Mode parameter set 2	PWM control
Fan/device address	01
Max. PWM / %	100
Min. PWM / %	5
Save set value to EEPROM	Yes
Set value requirement	Analog (linear)
Direction of action parameter set 1	Positive (heating)
Direction of action parameter set 2	Positive (heating)

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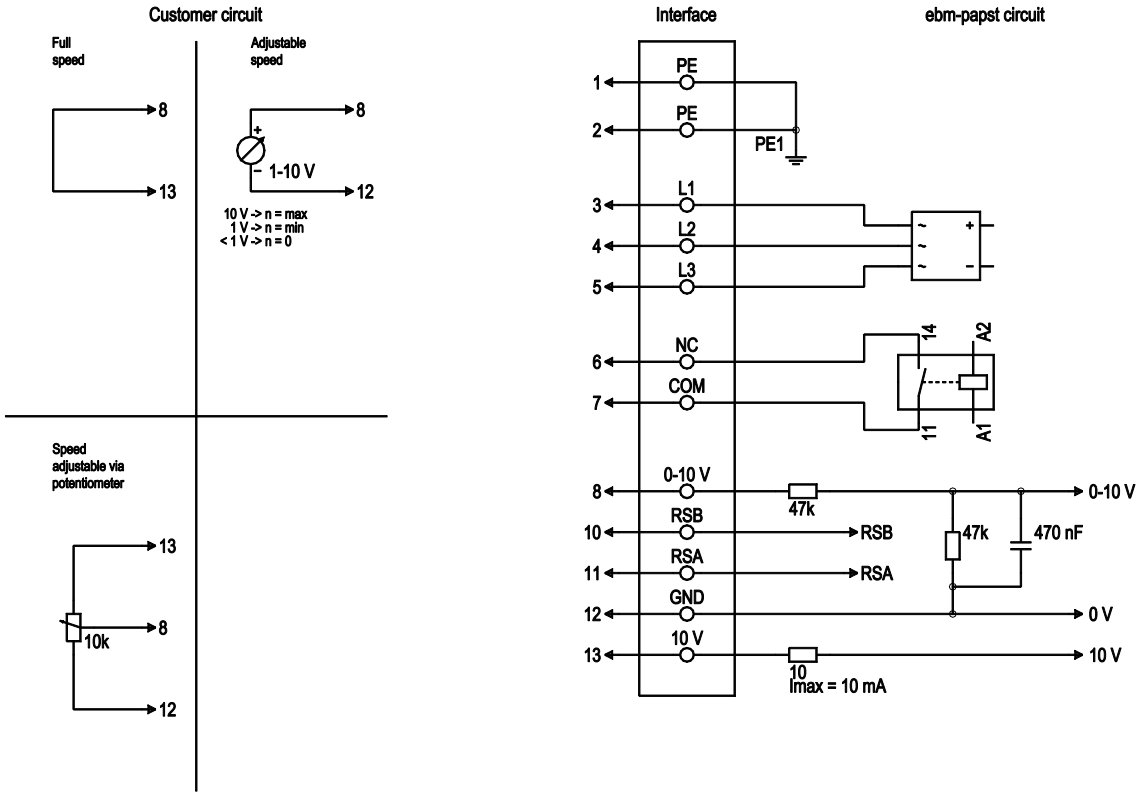
4.5 Connection diagram



Drawing preliminary!

No.	Conn.	Designation	Color	Function/assignment
1	1, 2	PE	green/ yellow	Protective earth
1	3	L1	black	Power supply
1	4	L2	black	Power supply
1	5	L3	black	Power supply
1	6	NC	white 1	Status relay, floating status contact, break for failure, contact rating 250 VAC / 2 A (AC1) / min. 10 mA; reinforced insulation on supply side and basic insulation on control interface side
1	7	COM	white 2	Status relay, floating status contact, break for failure, contact rating 250 VAC / 2 A (AC1) / min. 10 mA; reinforced insulation on supply side and basic insulation on control interface side
2	8	0-10V	yellow	Analog input (set value), 0-10 V, Ri = 100 kΩ, adjustable curve, SELV
2	10	RSB	brown	RS485 interface for MODBUS, RSB; SELV
2	11	RSA	white	RS485 interface for MODBUS, RSA; SELV
2	12	GND	blue	Reference ground for control interface, SELV
2	13	+10V	red	Fixed voltage output 10 VDC, +10 V ±3%, max. 10 mA, short-circuit-proof power supply for external devices (e.g. pot), SELV fixed voltage input 24 VDC for setting parameters via MODBUS without line voltage supply

4.6 Checking connections

⇒ Ensure isolation from supply (all phases).
⇒ Make sure a restart is impossible
⇒ Check the cables for proper fit.
⇒ Screw the terminal box cover back on again. Terminal box tightening torque, see Chapter 3.1 Product drawing.
⇒ Route the cables in the terminal box so that the terminal box cover closes without resistance.
⇒ Use all screw plugs. Insert the screws by hand to avoid damage to the threads.
⇒ Make sure the terminal box is completely closed and sealed and that all screws and cable glands have been properly tightened.

4.7 Switching on the device

The device may only be switched on if it has been installed properly and in accordance with its intended use, including the required safety mechanisms and professional electrical hookup. This also applies for devices which have already been equipped with plugs and terminals or similar connectors by the customer.

WARNING
Hot motor housing
Risk of fire
→ Ensure that no combustible or flammable materials are located close to the fan.

⇒ Before switching on, check the device for visible external damage and make sure the protective devices are functional.
⇒ Check the fan's air flow paths for foreign matter and remove any foreign matter found.
⇒ Apply the nominal supply voltage.
⇒ Start the device by changing the input signal.

NOTE
Damage to the device from vibration
Bearing damage, shorter service life
→ Low-vibration operation of the fan must be ensured over the entire speed control range. #Severe vibration can arise for instance from inexpert handling, transportation damage and resultant imbalance or be caused by component or structural resonance. #Speed ranges with excessively high vibration levels and possibly resonant frequencies must be determined in the course of fan commissioning. #Either run through the resonant range as quickly as possible with speed control or find another remedy.# Operation with excessively high vibration levels can lead to premature failure.

→ The maximum permissible vibration severity must not exceed 3.5 mm/s and should be checked at intervals of 6 months. #It is to be measured at the motor mount at the motor support plate in all three 3 dimensions, see Chapter 6. Maintenance, malfunctions, possible causes and remedies.

4.8 Switching off the device

Switching off the device during operation:
⇒ Switch off the device via the control input.
⇒ Do not switch the motor (e.g. in cyclic operation) on and off via power supply.

Switching off the device for maintenance:
⇒ Switch off the device via the control input.
⇒ Do not switch the motor (e.g. in cyclic operation) on and off via power supply.
⇒ Disconnect the device from the power supply.
⇒ When disconnecting, be sure to disconnect the ground connection last.

5. INTEGRATED PROTECTIVE FEATURES

The integrated protective functions cause the motor to switch off automatically in the event of the faults described in the table.

Fault	Safety feature description/ function
Rotor position detection error	An automatic restart follows.
Blocked rotor	⇒ After the blockage is removed, the motor restarts automatically.
Line undervoltage (line voltage outside of permitted nominal voltage range)	⇒ If the line voltage returns to permitted values, the motor restarts automatically.
Phase failure	A phase of the supply voltage fails for at least 5 s. ⇒ When all phases are correctly supplied again, the motor automatically restarts after 10-40 s.

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6. MAINTENANCE, MALFUNCTIONS, POSSIBLE CAUSES AND REMEDIES

Do not perform any repairs on your device. Send the device to ebm-papst for repair or replacement.

WARNING
Live terminals and connections even with device switched off
Electric shock

→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

CAUTION
If control voltage or a stored speed set value is applied, the motor will restart automatically, e.g. after a power failure.
Risk of injury

→ Keep out of the device's danger zone.# When working on the device, switch off the line voltage and ensure that it cannot be switched back on.

→ Wait until the device comes to a stop.

→ After working on the device, remove any tools or other objects from the device.

If the device is out of use for some time, e.g. when in storage, we recommend switching it on for at least two hours to allow any condensation to evaporate and to move the bearings.

Malfunction/fault	Possible cause	Possible remedy
Impeller not running smoothly	Imbalance in rotating parts	Clean the device; replace it if imbalance persists after cleaning. Make sure no weight clips are removed during cleaning.
Motor not turning	Mechanical blockage	Switch off, isolate from supply and remove mechanical blockage.
	Line voltage faulty	Check line voltage, restore power supply. Attention! The error message resets automatically. Device restarts automatically without warning.
	Faulty connection	Isolate from supply, correct connection; see connection diagram.
	Broken motor winding	Replace device
	Thermal overload protector activated	Allow motor to cool off, locate and rectify cause of error, release restart lockout if necessary
	Deficient cooling	Improve cooling. Let the device cool down. To reset the error message, switch off the line voltage for at least 25 s and then switch it on again. Alternatively, reset the error message by applying a control signal of < 0.5 V to Din1 or by shorting Din1 to GND.
	Ambient temperature too high	Reduce the ambient temperature. Let the device cool down. To reset the error message, switch off the line voltage for at least 25 s and then switch it on again. Alternatively, reset the error message by applying a control signal of < 0.5 V to Din1 or by shorting Din1 to GND.
	Impermissible point of operation (e.g. back pressure too high)	Correct the operating point. Let the device cool down. To reset the error message, switch off the line voltage for at least 25 s and then switch it on again. Alternatively, reset the error message by applying a control signal of < 0.5 V to Din1 or by shorting Din1 to GND.

In the event of further malfunctions, contact ebm-papst.

6.1 Vibration testing

Checking of fan for mechanical vibration based on ISO 14694. Recommendation: Every 6 months. Max. vibration severity is 3.5 mm/s, measured at the motor fastening diameter on the motor support plate in the direction of the motor axis of rotation and perpendicular to this.

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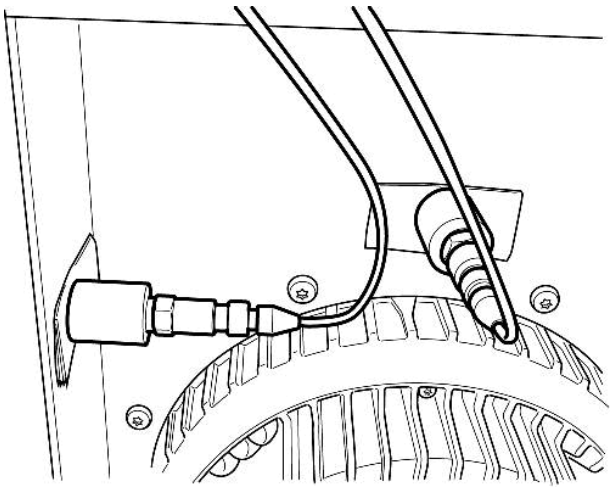

Fig. 1: Example illustrating vibration measurement. The arrangement of the sensors depends on the device concerned and the installation situation.

6.2 Cleaning

NOTE
Damage to the device during cleaning
Malfunction possible

→ Do not clean the device using a high-pressure cleaner.

→ Do not use acid, alkali or solvent-based cleaning agents.

→ Do not use any pointed or sharp-edged objects for cleaning

6.3 Safety inspection

NOTE
High-voltage test
The integrated EMC filter has Y capacitors. The tripping current is exceeded when AC testing voltage is applied.

→ Test the device with DC voltage when you perform the legally required high-voltage test. The voltage to be used corresponds to the peak value of the AC voltage required by the standard.

What to check	How to check	How often	What action?
Contact protection cover for intactness or damage	Visual inspection	At least every 6 months	Repair or replacement of device
Device for damage to blades and housing	Visual inspection	At least every 6 months	Replacement of device
Fastening the cables	Visual inspection	At least every 6 months	Fasten
Fastening the protective earth terminal	Visual inspection	At least every 6 months	Fasten
Insulation of cables for damage	Visual inspection	At least every 6 months	Replace cables
Impeller for wear/deposits/ corrosion and damage	Visual inspection	At least every 6 months	Clean impeller or replace device
Tightness of cable gland	Visual inspection	At least every 6 months	Retighten, replace if damaged
Abnormal bearing noise	acoustic	At least every 6 months	Replace device
Vibration test	Vibration tester, start-up or deceleration measurement	Recommended every 6 months	Clean impeller or replace device

6.4 Disposal

For ebm-papst, environmental protection and resource preservation are top priority corporate goals.
ebm-papst operates an environmental management system which is certified in accordance with ISO 14001 and rigorously implemented around the world on the basis of German standards.
Right from the development stage, ecological design, technical safety and health protection are fixed criteria.
The following section contains recommendations for ecological disposal of the product and its components.

6.4.1 Country-specific legal requirements

NOTE
Country-specific legal requirements
Always observe the applicable country-specific legal regulations with regard to the disposal of products or waste occurring in the various phases of the life cycle. The corresponding disposal standards are also to be heeded.

6.4.2 Disassembly

Disassembly of the product must be performed or supervised by qualified personnel with the appropriate technical knowledge.
The product is to be disassembled into suitable components for disposal employing standard procedures for motors.

WARNING
Heavy parts of the product may drop off. Some of the product components are heavy. These components could drop off during disassembly.
This can result in fatal or serious injury and material damage.

→ Secure components before unfastening to stop them falling.

6.4.3 Component disposal

The products are mostly made of steel, copper, aluminum and plastic. Metallic materials are generally considered to be fully recyclable.
Separate the components for recycling into the following categories:

- Steel and iron
- Aluminum
- Non-ferrous metal, e.g. motor windings
- Plastics, particularly with brominated flame retardants, in accordance with marking
- Insulating materials
- Cables and wires
- Electronic scrap, e.g. circuit boards

Only ferrite magnets and not rare earth magnets are used in external rotor motors from ebm-papst Mulfingen GmbH & Co. KG.

⇒ Ferrite magnets can be disposed of in the same way as normal iron and steel.

Electrical insulating materials on the product, in cables and wires are made of similar materials and are therefore to be treated in the same manner.
The materials concerned are as follows:

- Miscellaneous insulators used in the terminal box
- Power cables
- Cables for internal wiring
- Electrolytic capacitors

Dispose of electronic components employing the proper procedures for electronic scrap.

→ Please contact ebm-papst for any other questions on disposal.

D.9 Operating instructions for the three-phase EC external fan, pressing, SH180

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CONTENTS

1. SAFETY REGULATIONS AND INFORMATION

Read these operating instructions carefully before starting work on the device. Observe the following warnings to prevent malfunctions or danger to persons.
These operating instructions are to be regarded as part of the device. The device is only to be sold or passed on together with the operating instructions.
These operating instructions may be duplicated and distributed to inform about potential dangers and their prevention.

1.1 Hazard levels for warnings

These operating instructions use the following hazard levels to indicate potentially hazardous situations and important safety regulations:

DANGER
Indicates an imminently hazardous situation which will result in death or serious injury if the specified actions are not taken. Compliance with the instructions is imperative.

WARNING
Indicates a potentially hazardous situation which can result in death or serious injury if the specified actions are not taken. Exercise extreme caution while working.

CAUTION
Indicates a potentially hazardous situation which can result in minor or moderate injury or damage to property if the specified actions are not taken.

NOTE
A potentially harmful situation can occur and, if not avoided, can lead to property damage.

1.2 Staff qualifications

The device may only be transported, unpacked, installed, operated, maintained and otherwise used by suitably qualified, trained and authorized technical staff.
Only authorized specialists are permitted to install the device, to carry out a test run and to perform work on the electrical installation.

1.3 Basic safety rules

The safety hazards associated with the device must be assessed again following installation in the final product.
Note the following when working on the device:

⇒ Do not perform any modifications, additions or conversions on the device without the approval of ebm-papst.

1.4 Voltage

⇒ Check the device's electrical equipment at regular intervals; see Chapter 6.3 Safety inspection.

⇒ Replace loose connections and defective cables immediately.

DANGER
Electrically charged device
Risk of electric shock

→ When working on an electrically charged device, stand on a rubber mat.

WARNING
Live terminals and connections even with device switched off
Electric shock

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→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

CAUTION
In the event of a fault, the rotor and the impeller will be energized
The rotor and the impeller have basic insulation.

→ Do not touch the rotor and impeller once installed.

CAUTION
If control voltage or a stored speed set value is applied, the motor will restart automatically, e.g. after a power failure.
Risk of injury

→ Keep out of the device's danger zone.# When working on the device, switch off the line voltage and ensure that it cannot be switched back on.

→ Wait until the device comes to a stop.

→ After working on the device, remove any tools or other objects from the device.

1.5 Safety and protective features

DANGER
Protective device missing and protective device not functioning
Without a protective device there is a risk of serious injury, for instance when reaching into the device during operation.

→ Operate the device only with a fixed protective device and guard grille.

→ The fixed protective device must be able to withstand the kinetic energy of a fan blade that becomes detached at maximum speed. There must not be any gaps which it is possible to reach into with the fingers, for example.

→ The device is a built-in component. As the operator, you are responsible for ensuring that the device is secured adequately.

→ Stop the device immediately if you notice a missing or ineffective protective device.

1.6 Electromagnetic radiation

Interference from electromagnetic radiation is possible, e.g. in conjunction with open- and closed-loop control devices.
If impermissible radiation levels occur following installation, appropriate shielding measures have to be taken by the user.

NOTE
Electrical or electromagnetic interference after installing the device in customer equipment.

→ Verify that the entire setup is EMC-compliant.

1.7 Mechanical movement

DANGER
Rotating device
Risk of injury to body parts coming into contact with the rotor or the impeller.

→ Secure the device against accidental contact.

→ Before working on the system/machine, wait until all parts have come to a standstill.

WARNING
Rotating device
Long hair and dangling items of clothing, jewelry and the like can become entangled and be pulled into the device. Injuries can result.

→ Do not wear any loose-fitting or dangling clothing or jewelry while working on rotating parts.

→ Protect long hair with a cap.

1.8 Emissions

WARNING
Depending on the installation and operating conditions, the sound pressure level may exceed 70 dB(A).
Risk of noise-induced hearing loss

→ Take appropriate technical safety measures.

→ Protect operating personnel with appropriate safety equipment such as hearing protection.

→ Also observe the requirements of local agencies.

1.9 Hot surface

CAUTION
High temperature on electronics housing
Risk of burns

→ Ensure sufficient protection against accidental contact.

1.10 Transport

NOTE
Transporting the device

→ Transport the device in its original packaging only.

→ Secure the device so it cannot slip, e.g. by using a lashing strip.

1.11 Storage

⇒ Store the device, partially or fully assembled, in a dry place, protected against the weather and free from vibration, in the original packaging in a clean environment.

⇒ Protect the device against environmental effects and dirt until final installation.

⇒ We recommend storing the device for no longer than one year in order to guarantee trouble-free operation and the longest possible service life.

⇒ Even devices explicitly intended for outdoor use are to be stored as described prior to commissioning.

⇒ Maintain the storage temperature, see Chapter 3.6 Transport and storage conditions.

⇒ Make sure that all cable glands are fitted with dummy plugs.

2. INTENDED USE

The device is exclusively designed as a built-in device for conveying air according to its technical data.
Any other usage above and beyond this does not conform with the intended purpose and constitutes misuse of the device.
Customer equipment must be capable of withstanding the mechanical and thermal stresses that can arise from this product. This applies for the entire service life of the equipment in which this product is installed.

Intended use also includes

- Using the device only in power systems with grounded neutral (TN/ TT power systems) and in ungrounded IT power systems.
- The device is to be used in networks with network quality characteristics as per EN 50160.
- Use of the device in stationary systems only.
- Conveying air at an ambient air pressure between 800 mbar and 1050 mbar.
- Using the device within the permitted ambient temperature range; see Chapter 3.6 Transport and storage conditions and Chapter 3.2 Nominal data.
- Operating the device with all protective devices.
- Following the operating instructions.

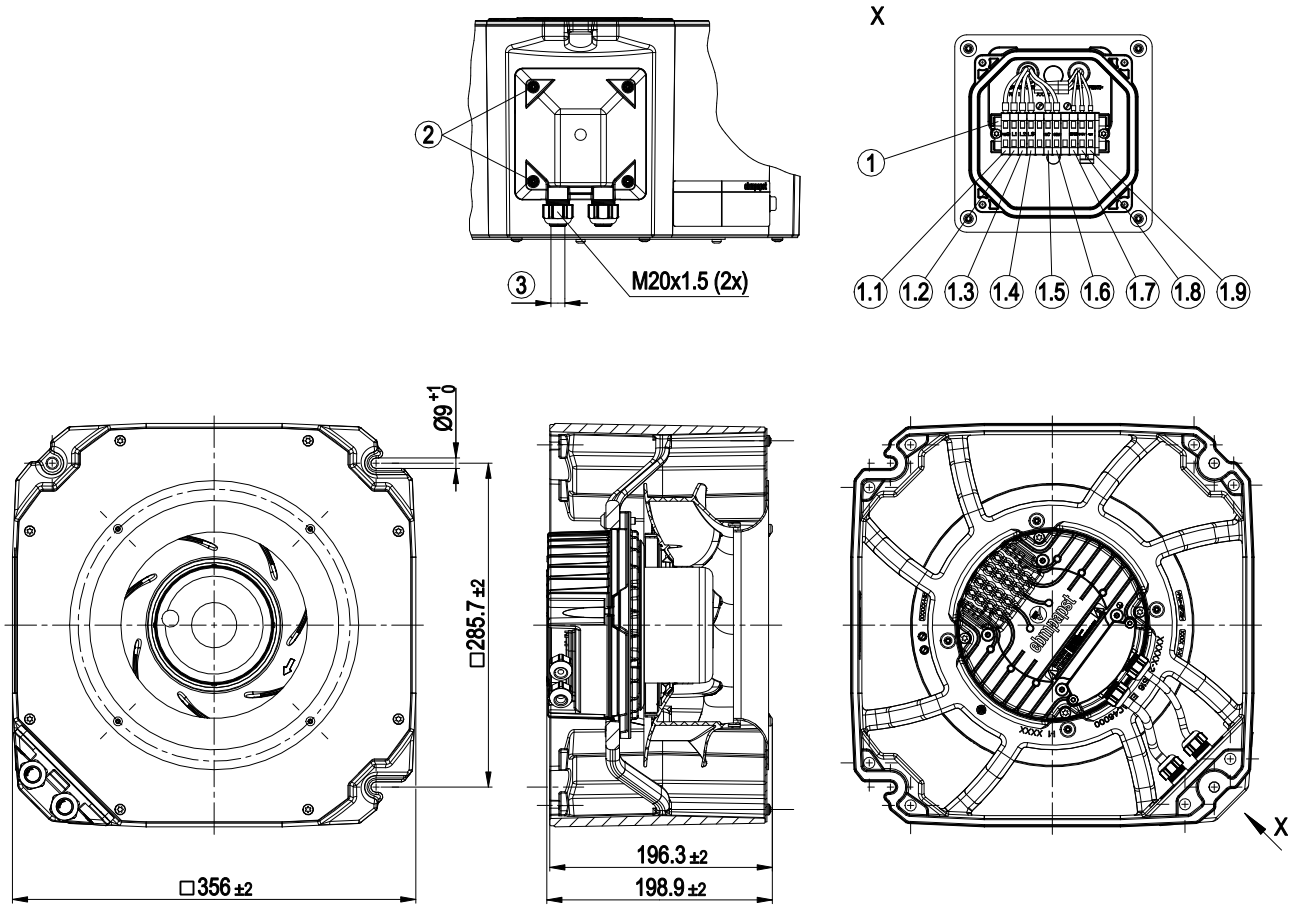
Improper use

In particular, operating the device in the following ways is prohibited and could be hazardous:

- Operating the device in an unbalanced state, e.g. due to dirt deposits or ice formation.
- Resonant operation, operation with severe vibration. This also includes vibration transmitted to the fan from the customer installation.
- Opening the terminal box during operation.
- Conveying air that contains abrasive particles.
- Conveying highly corrosive air, e.g. salt spray. Exception: devices designed for salt spray and correspondingly protected.
- Conveying air with high dust content, e.g. suctioning off sawdust.
- Operating the device close to flammable materials or components.
- Operating the device in an explosive atmosphere.
- Using the device as a safety component or to perform safety-related functions.
- Operation with completely or partially disassembled or manipulated protective devices.
- In addition, all applications not listed among the intended uses.

3. TECHNICAL DATA

3.1 Product drawing



All dimensions in mm.

1	Terminal strip
1.1	PE
1.2	L1
1.3	L2
1.4	L3
1.5	NC
1.6	COM
1.7	GND
1.8	0-10 V
1.9	+10 V
2	Tightening torque 1.2±0.2 Nm
3	Cable diameter min. 6 mm, max. 10 mm, tightening torque 2.5 ± 0.4 Nm
	Accessory part: Guard grill 20180-2-4039, filter 99950-2-5170 and filter mount 25180-2-4041 not included in scope of delivery.

3.2 Nominal data

Motor	M3G084-DF

Phase	3~
Nominal voltage / VAC	400
Nominal voltage range / VAC	380 .. 480
Frequency / Hz	50/60

Method of obtaining data	ml
Speed (rpm) / min-1	3100
Power consumption / W	300
Current draw / A	0.5
Min. ambient temperature / °C	-25
Max. ambient temperature / °C	60

ml = Max. load · me = Max. efficiency · fa = Free air
cs = Customer specification · ce = Customer equipment

Subject to change

3.3 Data according to Commission Regulation (EU) 327/2011

	Actual	Req. 2015
01 Overall efficiency η_{es} / %	48.9	44.9
02 Measurement category	A	
03 Efficiency category	Static	
04 Efficiency grade N	65	61
05 Variable speed drive	Yes	
06 Year of manufacture	The year of manufacture is specified on the product's rating label.	
07 Manufacturer	ebm-papst Mulfingen GmbH & Co. KG Amtsgericht (court of registration) Stuttgart · HRA 590344 D-74673 Mulfingen	
08 Type	K3G250-RR17-M9	
09 Power consumption P_{ed} / kW	0.29	
09 Air flow q_v / m³/h	905	
09 Pressure increase total p_{sf} / Pa	511	
10 Speed (rpm) n / min-1	3105	
11 Specific ratio*	1.01	
12 Recycling/disposal	Information on recycling and disposal is provided in the operating instructions.	
13 Maintenance	Information on installation, operation and maintenance is provided in the operating instructions.	
14 Additional components	Components used to calculate the energy efficiency that are not apparent from the measurement category are detailed in the CE declaration.	

* Specific ratio = 1 + p_{fs} / 100 000 Pa

Data obtained at optimum efficiency level. The ErP data is determined using a motor-impeller combination in a standardized measurement setup.

3.4 Technical description

Weight	11.8 kg
Fan size	250 mm
Rotor surface	Painted black
Electronics housing material	Die-cast aluminum, painted black
Impeller material	PA plastic, galvanized sheet-metal plate
Housing material	Die-cast aluminum
Support plate material	Sheet steel, galvanized
Inlet nozzle material	Sheet steel, galvanized
Guard grille material	Steel, phosphated and coated with black plastic (RAL 9005)
Number of blades	7
Direction of rotation	Clockwise, viewed toward rotor
Degree of protection	IP55
Insulation class	"F"
Moisture (F) / Environmental (H) protection class	H1
Installation position	Any
Condensation drainage holes	None
Mode	S1
Motor bearing	Ball bearing
Technical features	- Output 10 VDC, max. 10 mA - Operation and alarm display - External 24 V input (parameter setting) - Alarm relay - Integrated PID controller - Motor current limitation - PFC, passive - RS-485 MODBUS-RTU - Soft start - EEPROM write cycles: 100,000 maximum - Control input 0-10 VDC / PWM - Control interface with SELV potential safely disconnected from the mains - Thermal overload protection for electronics/motor - Line undervoltage / phase failure detection
Touch current according to IEC 60990 (measuring circuit Fig. 4, TN system)	<= 3.5 mA
Electrical hookup	Via terminal box
Motor protection	Thermal overload protector (TOP) internally connected
Protection class	I (if protective earth is connected by customer to the housing's connection point)
Conformity with standards	EN 61800-5-1; CE
Approval	UL 1004-7 + 60730; C22.2 No.77 + CAN/CSA-E60730-1; EAC
Comment	Operational is only permitted with the optional guard grill available from ebm-papst.

With regard to cyclic speed loads, note that the rotating parts of the device are designed for a maximum of one million load cycles. If you have special questions, consult ebm-papst for support.

⇒ Use the device in accordance with its degree of protection.

Information on surface quality

The surfaces of the products conform to the generally applicable industrial standard. The surface quality may change during the production period. This has no effect on strength, dimensional stability and dimensional accuracy.
The color pigments in the paints used perceptibly react to UV light over the course of time. This does not however in any way affect the technical properties of the products. The product is to be protected against UV radiation to prevent the formation of patches and fading. Changes in color are not a reason for complaint and are not covered by the warranty.

3.5 Mounting data

⇒ Secure the screws against unintentional loosening (e.g. use self-locking screws).

Strength class of screws	8.8

Any further mounting data required can be taken from the product drawing or Section Chapter 4.1 Mechanical connection.

3.6 Transport and storage conditions

Max. permitted ambient temp. for motor (transport/ storage)	+80 °C
Min. permitted ambient temp. for motor (transport/ storage)	-40 °C

3.7 Electromagnetic compatibility

EMC immunity to interference	According to EN 61000-6-2 (industrial environment)
EMC circuit feedback	According to EN 61000-3-2/3
EMC interference emission	According to EN 61000-6-3 (household environment)

If several devices are switched in parallel on the supply side so that the line current of the arrangement is in the range of 16-75 A, then this arrangement conforms to IEC 61000-3-12 provided that the short-circuit power S_{sc} at the connection point of the customer system to the public power system is greater than or equal to 120 times the rated output of the arrangement. It is the responsibility of the installation engineer or operator/ owner of the device to ensure, if necessary after consultation with the network operator, that this device is only connected to a connection point with a S_{sc} value that is greater than or equal to 120 times the rated output of the arrangement.

4. CONNECTION AND STARTUP

4.1 Mechanical connection

CAUTION
Risk of cutting and crushing when removing device from packaging

→ Carefully remove the device from the packaging by grasping hold of the frame. Never subject to any impact.

→ Wear safety shoes and cut-resistant safety gloves.

CAUTION
Heavy load when unpacking device
Risk of physical injury, such as back injuries.

→ Two people should work together to remove the device from its packaging.

NOTE
Damage to the device from vibration
Bearing damage, shorter service life

→ The fan must not be subjected to force or excessive vibration from sections of the installation. #If the fan is connected to air ducts, the connection should be isolated from vibration, e.g. using compensators or similar elements. #Ensure stress-free attachment of the fan to the substructure.

⇒ The fan may not be handled in the area around the inlet nozzle during transport and installation.
There is a risk of damage to the impeller.

⇒ Check the device for transport damage. Damaged devices are not to be installed.

⇒ Install the undamaged device in accordance with your application.

CAUTION
Possible damage to the device
If the device slips during installation, serious damage can result.

→ Ensure that the device is securely positioned at its place of installation until all fastening screws have been tightened.

- The fan must not be strained on fastening.

4.2 Electrical connection

DANGER
Voltage on the device
Electric shock

→ Always connect a protective earth first.

→ Check the protective earth.

DANGER
Faulty insulation
Risk of fatal injury from electric shock

→ Use only cables that meet the specified installation regulations for voltage, current, insulation material, capacity, etc.

→ Route cables so that they cannot be touched by any rotating parts.

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DANGER
Electrical charge (>50 µC) between phase conductor and protective earth connection after switching off supply with multiple devices connected in parallel.
Electric shock, risk of injury

→ Ensure sufficient protection against accidental contact. Before working on the electrical hookup, short the supply and PE connections.

CAUTION
Voltage
The fan is a built-in component and has no disconnecting switch.

→ Only connect the fan to circuits that can be switched off with an all-pole disconnection switch.

→ When working on the fan, secure the system/machine in which the fan is installed so as to prevent it from being switched back on.

NOTE
Device malfunctions possible
Route the device's control lines separately from the supply line.

→ Maintain the greatest possible clearance. Recommendation: clearance > 10 cm (separate cable routing)

NOTE
Water ingress into wires or cables
Water ingress at the customer end of the cable can damage the device.

→ Make sure the end of the cable is connected in a dry environment.

Only connect the device to circuits that can be switched off with an all-pole disconnection switch.

4.2.1 Requirements

⇒ Check whether the information on the nameplate matches the connection data.

⇒ Before connecting the device, make sure the power supply matches the device voltage.

⇒ Only use cables designed for the current level indicated on the nameplate.
For determining the cross-section, note the sizing criteria according to EN 61800-5-1. The protective earth must have a cross-section equal to or greater than that of the phase conductor.
We recommend the use of 105 °C cables. Ensure that the minimum cable cross-section is at least
AWG 26 / 0.13 mm².

Protective earth contact resistance according to EN 61800-5-1

Compliance with the resistance specifications according to EN 61800-5-1 for the protective earth connection circuit must be verified in the end application. Depending on the installation situation, it may be necessary to connect an additional protective earth conductor by way of the extra protective earth terminal provided on the device. The protective earth terminal is located on the housing and provided with a protective earth symbol and a hole.

4.2.2 Supply connection and fuses

Assignment of supply cable cross-sections and their required fuses (line protection only, no equipment protection).

Nominal voltage	Fuse		Automatic circuit breaker	Cable cross-section	Cable cross-section
	VDE	UL	VDE	mm²	*AWG
3/PE AC 380-480 VAC	16 A	15 A	C16A	1.5	16

* AWG = American Wire Gauge

4.2.3 Reactive currents

Because of the EMC filter integrated for compliance with EMC limits (interference emission and immunity to interference), reactive currents can be measured in the supply line even when the motor is at a standstill and the line voltage is switched on.

- The values are typically in the range < 250 mA
- At the same time, the effective power in this operating state (operational readiness) is typically < 5 W.

4.2.4 Residual current circuit breaker (RCCB)

If the use of a residual current device (RCD) is required in your installation, only AC/DC-sensitive residual current devices (type B or B+) are permissible. As with variable frequency drives, residual current devices cannot provide personal safety while operating the device. When the device power supply is switched on, pulsed charging currents from the capacitors in the integrated EMC filter can lead to the instant tripping of residual current devices. We recommend the use of residual current circuit breakers (RCCB) with a trip threshold of 300 mA and delayed tripping (super-resistant, characteristic K).

4.2.5 Leakage current

For asymmetrical power systems or if a phase fails, the leakage current can increase to a multiple of the nominal value.

4.2.6 Locked-rotor protection

Due to the locked-rotor protection, the starting current (LRA) is equal to or less than the nominal current (FLA).

4.3 Connection in terminal box

4.3.1 Preparing cables for connection

Only strip the cable as far as necessary, ensuring that the cable gland is sealed and there is no strain on the connections. For tightening torques, see Chapter 3.1 Product drawing.

NOTE
Tightness and strain relief are dependent on the cable used.

→ This must be checked by the user.

4.3.2 Connecting wires to terminals

WARNING
Live terminals and connections even with device switched off
Electric shock
→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

⇒ Remove the cap from the cable gland.

Only remove caps where cables are fed in.

⇒ Route the wire(s) (not included in scope of delivery) into the terminal box.

⇒ First connect the "PE" (protective earth).

⇒ Connect the wires to the corresponding terminals.

Use a screwdriver to do so.
When connecting, ensure that no wire ends fan out.

⇒ Seal the terminal box.

4.3.3 Cable routing

Water must be prevented from reaching the cable gland along the cable.

NOTE
Damage caused by moisture penetration.
Moisture can penetrate into the terminal box if water is constantly present at the cable glands.
→ To prevent the constant accumulation of water at the cable glands, the cable should be routed in a U-shaped loop wherever possible.# If this is not possible, a drip edge can be produced by fitting a cable tie directly in front of the cable gland for example.

When routing the cable, make sure that the cable glands are located at the bottom. The cables must always be routed downward.

4.4 Factory settings

Factory settings made for the device by ebm-papst.

Mode parameter set 1	PWM control
Mode parameter set 2	PWM control
Fan/device address	01
Max. PWM / %	100
Min. PWM / %	5
Save set value to EEPROM	Yes
Set value requirement	Analog (linear)
Direction of action parameter set 1	Positive (heating)
Direction of action parameter set 2	Positive (heating)

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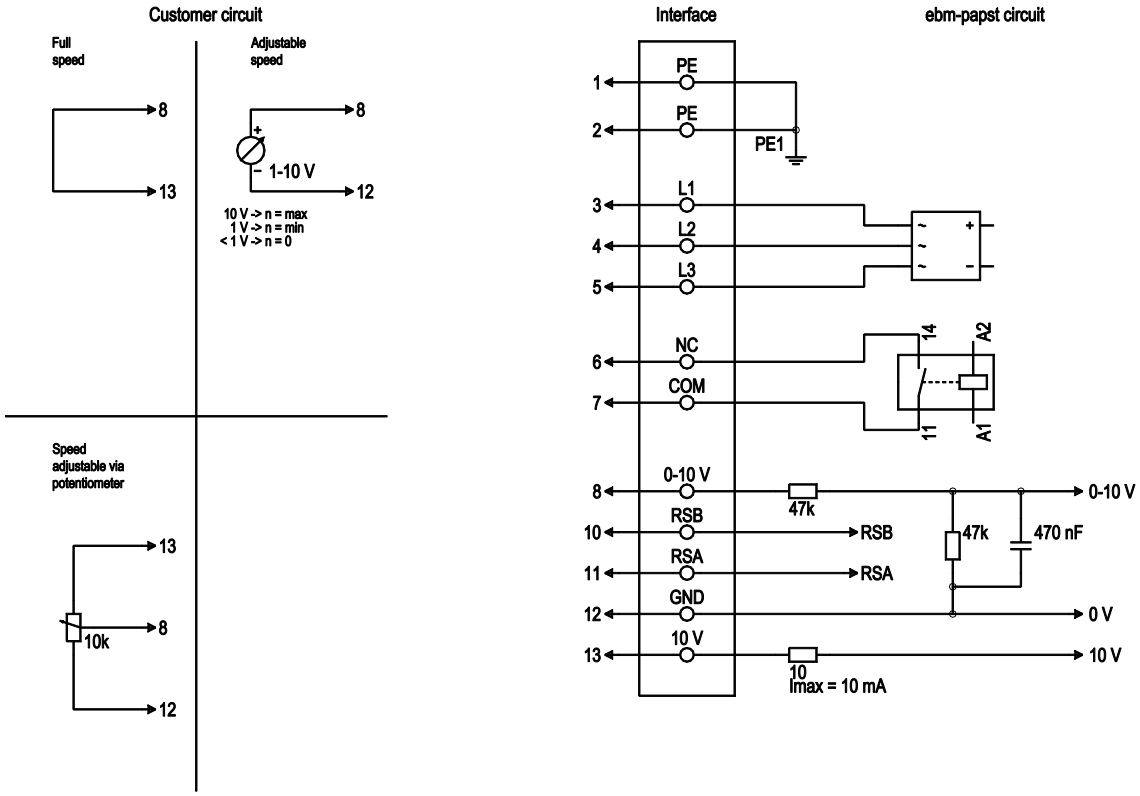
4.5 Connection diagram



Drawing preliminary!

No.	Conn.	Designation	Color	Function/assignment
1	1, 2	PE	green/ yellow	Protective earth
1	3	L1	black	Power supply
1	4	L2	black	Power supply
1	5	L3	black	Power supply
1	6	NC	white 1	Status relay, floating status contact, break for failure, contact rating 250 VAC / 2 A (AC1) / min. 10 mA; reinforced insulation on supply side and basic insulation on control interface side
1	7	COM	white 2	Status relay, floating status contact, break for failure, contact rating 250 VAC / 2 A (AC1) / min. 10 mA; reinforced insulation on supply side and basic insulation on control interface side
2	8	0-10V	yellow	Analog input (set value), 0-10 V, Ri = 100 kΩ, adjustable curve, SELV
2	10	RSB	brown	RS485 interface for MODBUS, RSB; SELV
2	11	RSA	white	RS485 interface for MODBUS, RSA; SELV
2	12	GND	blue	Reference ground for control interface, SELV
2	13	+10V	red	Fixed voltage output 10 VDC, +10 V ±3%, max. 10 mA, short-circuit-proof power supply for external devices (e.g. pot), SELV fixed voltage input 24 VDC for setting parameters via MODBUS without line voltage supply

4.6 Checking connections

⇒ Ensure isolation from supply (all phases).
⇒ Make sure a restart is impossible
⇒ Check the cables for proper fit.
⇒ Screw the terminal box cover back on again. Terminal box tightening torque, see Chapter 3.1 Product drawing.
⇒ Route the cables in the terminal box so that the terminal box cover closes without resistance.
⇒ Use all screw plugs. Insert the screws by hand to avoid damage to the threads.
⇒ Make sure the terminal box is completely closed and sealed and that all screws and cable glands have been properly tightened.

4.7 Switching on the device

The device may only be switched on if it has been installed properly and in accordance with its intended use, including the required safety mechanisms and professional electrical hookup. This also applies for devices which have already been equipped with plugs and terminals or similar connectors by the customer.

WARNING
Hot motor housing
Risk of fire
→ Ensure that no combustible or flammable materials are located close to the fan.

⇒ Before switching on, check the device for visible external damage and make sure the protective devices are functional.
⇒ Check the fan's air flow paths for foreign matter and remove any foreign matter found.
⇒ Apply the nominal supply voltage.
⇒ Start the device by changing the input signal.

NOTE
Damage to the device from vibration
Bearing damage, shorter service life
→ Low-vibration operation of the fan must be ensured over the entire speed control range. #Severe vibration can arise for instance from inexpert handling, transportation damage and resultant imbalance or be caused by component or structural resonance. #Speed ranges with excessively high vibration levels and possibly resonant frequencies must be determined in the course of fan commissioning. #Either run through the resonant range as quickly as possible with speed control or find another remedy.# Operation with excessively high vibration levels can lead to premature failure.

4.8 Switching off the device

Switching off the device during operation:
⇒ Switch off the device via the control input.
⇒ Do not switch the motor (e.g. in cyclic operation) on and off via power supply.

Switching off the device for maintenance:
⇒ Switch off the device via the control input.
⇒ Do not switch the motor (e.g. in cyclic operation) on and off via power supply.
⇒ Disconnect the device from the power supply.
⇒ When disconnecting, be sure to disconnect the ground connection last.

5. INTEGRATED PROTECTIVE FEATURES

The integrated protective functions cause the motor to switch off automatically in the event of the faults described in the table.

Fault	Safety feature description/ function
Rotor position detection error	An automatic restart follows.
Blocked rotor	⇒ After the blockage is removed, the motor restarts automatically.
Line undervoltage (line voltage outside of permitted nominal voltage range)	⇒ If the line voltage returns to permitted values, the motor restarts automatically.
Phase failure	A phase of the supply voltage fails for at least 5 s. ⇒ When all phases are correctly supplied again, the motor automatically restarts after 10-40 s.

6. MAINTENANCE, MALFUNCTIONS, POSSIBLE CAUSES AND REMEDIES

Do not perform any repairs on your device. Send the device to ebm-papst for repair or replacement.

WARNING
Live terminals and connections even with device switched off
Electric shock
→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

CAUTION
If control voltage or a stored speed set value is applied, the motor will restart automatically, e.g. after a power failure.
Risk of injury
→ Keep out of the device's danger zone.# When working on the device, switch off the line voltage and ensure that it cannot be switched back on.
→ Wait until the device comes to a stop.
→ After working on the device, remove any tools or other objects from the device.

If the device is out of use for some time, e.g. when in storage, we recommend switching it on for at least two hours to allow any condensation to evaporate and to move the bearings.

Malfunction/fault	Possible cause	Possible remedy
Impeller not running smoothly	Imbalance in rotating parts	Clean the device; replace it if imbalance persists after cleaning. Make sure no weight clips are removed during cleaning.
Motor not turning	Mechanical blockage	Switch off, isolate from supply and remove mechanical blockage.

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	Line voltage faulty	Check line voltage, restore power supply. Attention! The error message resets automatically. Device restarts automatically without warning.
	Faulty connection	Isolate from supply, correct connection; see connection diagram.
	Broken motor winding	Replace device
	Thermal overload protector activated	Allow motor to cool off, locate and rectify cause of error, release restart lockout if necessary
	Deficient cooling	Improve cooling. Let the device cool down. To reset the error message, switch off the line voltage for at least 25 s and then switch it on again. Alternatively, reset the error message by applying a control signal of < 0.5 V to Din1 or by shorting Din1 to GND.
	Ambient temperature too high	Reduce the ambient temperature. Let the device cool down. To reset the error message, switch off the line voltage for at least 25 s and then switch it on again. Alternatively, reset the error message by applying a control signal of < 0.5 V to Din1 or by shorting Din1 to GND.
	Impermissible point of operation (e.g. back pressure too high)	Correct the operating point. Let the device cool down. To reset the error message, switch off the line voltage for at least 25 s and then switch it on again. Alternatively, reset the error message by applying a control signal of < 0.5 V to Din1 or by shorting Din1 to GND.

In the event of further malfunctions, contact ebm-papst.

6.1 Vibration testing

Checking of fan for mechanical vibration based on ISO 14694. Recommendation: Every 6 months. Max. vibration severity is 3.5 mm/s, measured at the motor fastening diameter on the motor support plate in the direction of the motor axis of rotation and perpendicular to this.

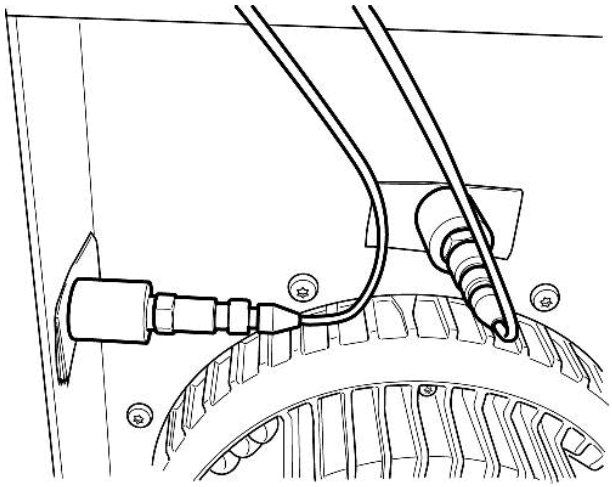

Fig. 1: Example illustrating vibration measurement. The arrangement of the sensors depends on the device concerned and the installation situation.

6.2 Cleaning

NOTE
Damage to the device during cleaning
Malfunction possible

→ Do not clean the device using a high-pressure cleaner.

→ Do not use acid, alkali or solvent-based cleaning agents.

→ Do not use any pointed or sharp-edged objects for cleaning

6.3 Safety inspection

NOTE
High-voltage test
The integrated EMC filter has Y capacitors. The tripping current is exceeded when AC testing voltage is applied.

→ Test the device with DC voltage when you perform the legally required high-voltage test. The voltage to be used corresponds to the peak value of the AC voltage required by the standard.

What to check	How to check	How often	What action?
Contact protection cover for intactness or damage	Visual inspection	At least every 6 months	Repair or replacement of device
Device for damage to blades and housing	Visual inspection	At least every 6 months	Replacement of device
Fastening the cables	Visual inspection	At least every 6 months	Fasten

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Fastening the protective earth terminal	Visual inspection	At least every 6 months	Fasten
Insulation of cables for damage	Visual inspection	At least every 6 months	Replace cables
Impeller for wear/deposits/ corrosion and damage	Visual inspection	At least every 6 months	Clean or replace impeller
Tightness of cable gland	Visual inspection	At least every 6 months	Retighten, replace if damaged
Abnormal bearing noise	acoustic	At least every 6 months	Replace device

6.4 Disposal

For ebm-papst, environmental protection and resource preservation are top priority corporate goals.
ebm-papst operates an environmental management system which is certified in accordance with ISO 14001 and rigorously implemented around the world on the basis of German standards.
Right from the development stage, ecological design, technical safety and health protection are fixed criteria.
The following section contains recommendations for ecological disposal of the product and its components.

6.4.1 Country-specific legal requirements

NOTE
Country-specific legal requirements
Always observe the applicable country-specific legal regulations with regard to the disposal of products or waste occurring in the various phases of the life cycle. The corresponding disposal standards are also to be heeded.

6.4.2 Disassembly

Disassembly of the product must be performed or supervised by qualified personnel with the appropriate technical knowledge.
The product is to be disassembled into suitable components for disposal employing standard procedures for motors.

WARNING
Heavy parts of the product may drop off. Some of the product components are heavy. These components could drop off during disassembly.
This can result in fatal or serious injury and material damage.
→ Secure components before unfastening to stop them falling.

6.4.3 Component disposal

The products are mostly made of steel, copper, aluminum and plastic.
Metallic materials are generally considered to be fully recyclable.
Separate the components for recycling into the following categories:

- Steel and iron
- Aluminum
- Non-ferrous metal, e.g. motor windings
- Plastics, particularly with brominated flame retardants, in accordance with marking
- Insulating materials
- Cables and wires
- Electronic scrap, e.g. circuit boards

Only ferrite magnets and not rare earth magnets are used in external rotor motors from ebm-papst Mulfingen GmbH & Co. KG.

⇒ Ferrite magnets can be disposed of in the same way as normal iron and steel.

Electrical insulating materials on the product, in cables and wires are made of similar materials and are therefore to be treated in the same manner.
The materials concerned are as follows:

- Miscellaneous insulators used in the terminal box
- Power cables
- Cables for internal wiring
- Electrolytic capacitors

Dispose of electronic components employing the proper procedures for electronic scrap.

→ Please contact ebm-papst for any other questions on disposal.

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D.10 Operating instructions for the three-phase EC external fan, pressing, SH225

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CONTENTS

1. SAFETY REGULATIONS AND INFORMATION

Read these operating instructions carefully before starting work on the device. Observe the following warnings to prevent malfunctions or danger to persons.
These operating instructions are to be regarded as part of the device. The device is only to be sold or passed on together with the operating instructions.
These operating instructions may be duplicated and distributed to inform about potential dangers and their prevention.

1.1 Hazard levels for warnings

These operating instructions use the following hazard levels to indicate potentially hazardous situations and important safety regulations:

DANGER
Indicates an imminently hazardous situation which will result in death or serious injury if the specified actions are not taken. Compliance with the instructions is imperative.

WARNING
Indicates a potentially hazardous situation which can result in death or serious injury if the specified actions are not taken. Exercise extreme caution while working.

CAUTION
Indicates a potentially hazardous situation which can result in minor or moderate injury or damage to property if the specified actions are not taken.

NOTE
A potentially harmful situation can occur and, if not avoided, can lead to property damage.

1.2 Staff qualifications

The device may only be transported, unpacked, installed, operated, maintained and otherwise used by suitably qualified, trained and authorized technical staff.
Only authorized specialists are permitted to install the device, to carry out a test run and to perform work on the electrical installation.

1.3 Basic safety rules

The safety hazards associated with the device must be assessed again following installation in the final product.
Note the following when working on the device:

⇒ Do not perform any modifications, additions or conversions on the device without the approval of ebm-papst.

1.4 Voltage

⇒ Check the device's electrical equipment at regular intervals; see Chapter 6.3 Safety inspection.

⇒ Replace loose connections and defective cables immediately.

DANGER
Electrically charged device
Risk of electric shock

→ When working on an electrically charged device, stand on a rubber mat.

WARNING
Live terminals and connections even with device switched off
Electric shock

→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

CAUTION
In the event of a fault, the rotor and the impeller will be energized
The rotor and the impeller have basic insulation.

→ Do not touch the rotor and impeller once installed.

CAUTION
If control voltage or a stored speed set value is applied, the motor will restart automatically, e.g. after a power failure.
Risk of injury

→ Keep out of the device's danger zone.# When working on the device, switch off the line voltage and ensure that it cannot be switched back on.

→ Wait until the device comes to a stop.

→ After working on the device, remove any tools or other objects from the device.

1.5 Safety and protective features

DANGER
Protective device missing and protective device not functioning
Without a protective device there is a risk of serious injury, for instance when reaching into the device during operation.

→ Operate the device only with a fixed protective device and guard grille.

→ The fixed protective device must be able to withstand the kinetic energy of a fan blade that becomes detached at maximum speed. There must not be any gaps which it is possible to reach into with the fingers, for example.

→ The device is a built-in component. As the operator, you are responsible for ensuring that the device is secured adequately.

→ Stop the device immediately if you notice a missing or ineffective protective device.

1.6 Electromagnetic radiation

Interference from electromagnetic radiation is possible, e.g. in conjunction with open- and closed-loop control devices.
If impermissible radiation levels occur following installation, appropriate shielding measures have to be taken by the user.

NOTE
Electrical or electromagnetic interference after installing the device in customer equipment.

→ Verify that the entire setup is EMC-compliant.

1.7 Mechanical movement

DANGER
Rotating device
Risk of injury to body parts coming into contact with the rotor or the impeller.

→ Secure the device against accidental contact.

→ Before working on the system/machine, wait until all parts have come to a standstill.

WARNING
Rotating device
Long hair and dangling items of clothing, jewelry and the like can become entangled and be pulled into the device. Injuries can result.

→ Do not wear any loose-fitting or dangling clothing or jewelry while working on rotating parts.

→ Protect long hair with a cap.

1.8 Emissions

WARNING
Depending on the installation and operating conditions, the sound pressure level may exceed 70 dB(A).
Risk of noise-induced hearing loss

→ Take appropriate technical safety measures.

→ Protect operating personnel with appropriate safety equipment such as hearing protection.

→ Also observe the requirements of local agencies.

1.9 Hot surface

CAUTION
High temperature on electronics housing
Risk of burns

→ Ensure sufficient protection against accidental contact.

1.10 Transport

WARNING
Transporting the fan
Injuries from tipping or slipping

→ The fan is always to be transported with care and in its original packaging. #If set down too hard or at an angle for example, the impact can lead to bearing damage or deformation of the frame or impeller. #It must be ensured that the fans cannot tip over during transportation and handling.

→ Secure the fan(s) with appropriate equipment such as a lashing strip so that nothing can slip or tip, especially when stacking multiple fans. #Also make allowance for possible wind forces.

1.11 Storage

⇒ Store the device, partially or fully assembled, in a dry place, protected against the weather and free from vibration, in the original packaging in a clean environment.

⇒ Protect the device against environmental effects and dirt until final installation.

⇒ We recommend storing the device for no longer than one year in order to guarantee trouble-free operation and the longest possible service life.

⇒ Even devices explicitly intended for outdoor use are to be stored as described prior to commissioning.

⇒ Maintain the storage temperature, see Chapter 3.6 Transport and storage conditions.

⇒ Make sure that all cable glands are fitted with dummy plugs.

2. INTENDED USE

The device is exclusively designed as a built-in device for conveying air according to its technical data.
Any other usage above and beyond this does not conform with the intended purpose and constitutes misuse of the device.
Customer equipment must be capable of withstanding the mechanical and thermal stresses that can arise from this product. This applies for the entire service life of the equipment in which this product is installed.

Intended use also includes

- Using the device only in power systems with grounded neutral (TN/ TT power systems) and in ungrounded IT power systems.
- The device is to be used in networks with network quality characteristics as per EN 50160.
- Use of the device in stationary systems only.
- Conveying air at an ambient air pressure between 800 mbar and 1050 mbar.
- Using the device within the permitted ambient temperature range; see Chapter 3.6 Transport and storage conditions and Chapter 3.2 Nominal data.
- Operating the device with all protective devices.
- Following the operating instructions.

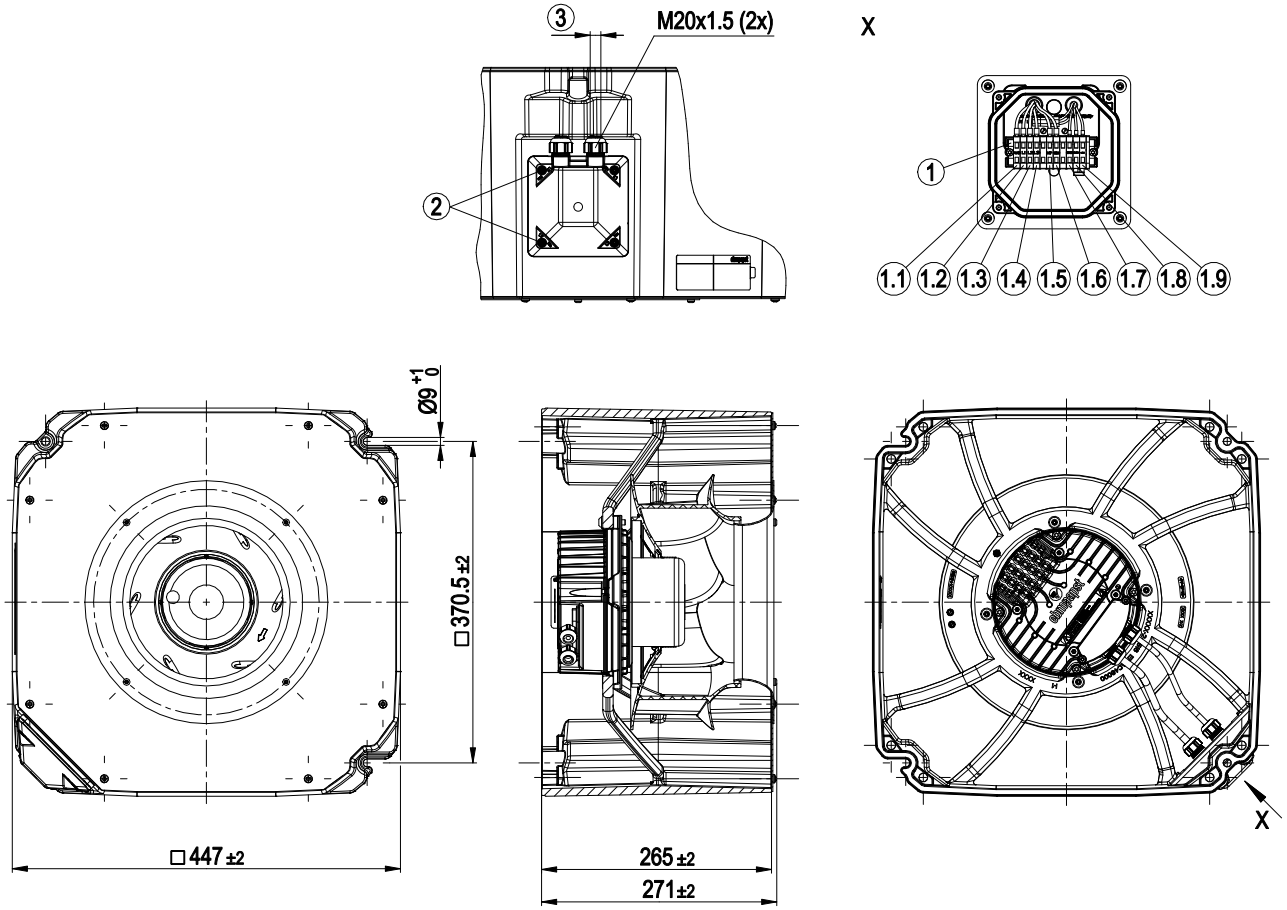
Improper use

In particular, operating the device in the following ways is prohibited and could be hazardous:

- Operating the device in an unbalanced state, e.g. due to dirt deposits or ice formation.
- Resonant operation, operation with severe vibration. This also includes vibration transmitted to the fan from the customer installation.
- Opening the terminal box during operation.
- Conveying air that contains abrasive particles.
- Conveying highly corrosive air, e.g. salt spray. Exception: devices designed for salt spray and correspondingly protected.
- Conveying air with high dust content, e.g. suctioning off sawdust.
- Operating the device close to flammable materials or components.
- Operating the device in an explosive atmosphere.
- Using the device as a safety component or to perform safety-related functions.
- Operation with completely or partially disassembled or manipulated protective devices.
- In addition, all applications not listed among the intended uses.

3. TECHNICAL DATA

3.1 Product drawing



All dimensions in mm.

1	Terminal strip
1.1	PE
1.2	L1
1.3	L2
1.4	L3
1.5	NC
1.6	COM
1.7	GND
1.8	0-10 V
1.9	+10 V
2	Tightening torque 1.2±0.2 Nm
3	Cable diameter min. 6 mm, max. 10 mm, tightening torque 2.5 ± 0.4 Nm
	Accessory part: Guard grill 20225-2-4039, filter 99951-2-5170 and filter mount 25225-2-4041 not included in scope of delivery.

3.2 Nominal data

Motor	M3G084-DF

Phase	3~
Nominal voltage / VAC	400
Nominal voltage range / VAC	380 .. 480
Frequency / Hz	50/60

Method of obtaining data	ml
Status	prelim.
Speed (rpm) / min^{-1}	2700
Power consumption / W	550
Current draw / A	0.9
Min. ambient temperature / °C	-25
Max. ambient temperature / °C	60

ml = Max. load · me = Max. efficiency · fa = Free air
cs = Customer specification · ce = Customer equipment

Subject to change

3.3 Data according to Commission Regulation (EU) 327/2011

	Actual	Req. 2015
01 Overall efficiency η_{es} / %	58.4	47.7
02 Measurement category	A	
03 Efficiency category	Static	
04 Efficiency grade N	71.7	61
05 Variable speed drive	Yes	
06 Year of manufacture	The year of manufacture is specified on the product's rating label.	
07 Manufacturer	ebm-papst Mulfingen GmbH & Co. KG Amtsgericht (court of registration) Stuttgart · HRA 590344 D-74673 Mulfingen	
08 Type	K3G280-RR04-M9	
09 Power consumption P_{ed} / kW	0.54	
09 Air flow q_v / m³/h	1820	
09 Pressure increase total p_{sf} / Pa	573	
10 Speed (rpm) n / min^{-1}	2720	
11 Specific ratio*	1.01	
12 Recycling/disposal	Information on recycling and disposal is provided in the operating instructions.	
13 Maintenance	Information on installation, operation and maintenance is provided in the operating instructions.	
14 Additional components	Components used to calculate the energy efficiency that are not apparent from the measurement category are detailed in the CE declaration.	

* Specific ratio = 1 + p_{fs} / 100 000 Pa

Data obtained at optimum efficiency level. The ErP data is determined using a motor-impeller combination in a standardized measurement setup.

3.4 Technical description

Weight	17.5 kg
Fan size	280 mm
Rotor surface	Painted black
Electronics housing material	Die-cast aluminum, painted black
Impeller material	PP plastic, galvanized sheet-metal plate
Housing material	Die-cast aluminum
Support plate material	Sheet steel, galvanized
Inlet nozzle material	Sheet steel, galvanized
Guard grille material	Steel, phosphated and coated with black plastic (RAL 9005)
Number of blades	6
Direction of rotation	Clockwise, viewed toward rotor
Degree of protection	IP55
Insulation class	"F"
Moisture (F) / Environmental (H) protection class	H1
Installation position	Any
Condensation drainage holes	None
Mode	S1
Motor bearing	Ball bearing
Technical features	- Output 10 VDC, max. 10 mA - Operation and alarm display - External 24 V input (parameter setting) - Alarm relay - Integrated PID controller - Motor current limitation - PFC, passive - RS-485 MODBUS-RTU - Soft start - EEPROM write cycles: 100,000 maximum - Control input 0-10 VDC / PWM - Control interface with SELV potential safely disconnected from the mains - Thermal overload protection for electronics/motor - Line undervoltage / phase failure detection
Touch current according to IEC 60990 (measuring circuit Fig. 4, TN system)	<= 3.5 mA
Electrical hookup	Via terminal box
Motor protection	Thermal overload protector (TOP) internally connected
Protection class	I (if protective earth is connected by customer to the housing's connection point)
Conformity with standards	EN 61800-5-1; CE
Approval	UL 1004-7 + 60730; C22.2 No.77 + CAN/CSA-E60730-1; EAC
Comment	Operational is only permitted with the optional guard grill available from ebm-papst.

With regard to cyclic speed loads, note that the rotating parts of the device are designed for a maximum of one million load cycles. If you have special questions, consult ebm-papst for support.

⇒ Use the device in accordance with its degree of protection.

Information on surface quality

The surfaces of the products conform to the generally applicable industrial standard. The surface quality may change during the production period. This has no effect on strength, dimensional stability and dimensional accuracy.
The color pigments in the paints used perceptibly react to UV light over the course of time. This does not however in any way affect the technical properties of the products. The product is to be protected against UV radiation to prevent the formation of patches and fading. Changes in color are not a reason for complaint and are not covered by the warranty.

3.5 Mounting data

⇒ Secure the screws against unintentional loosening (e.g. use self-locking screws).

Strength class of screws	8.8

Any further mounting data required can be taken from the product drawing or Section Chapter 4.1 Mechanical connection.

3.6 Transport and storage conditions

Max. permitted ambient temp. for motor (transport/ storage)	+80 °C
Min. permitted ambient temp. for motor (transport/ storage)	-40 °C

3.7 Electromagnetic compatibility

If several devices are switched in parallel on the supply side so that the line current of the arrangement is in the range of 16-75 A, then this arrangement conforms to IEC 61000-3-12 provided that the short-circuit power S_{sc} at the connection point of the customer system to the public power system is greater than or equal to 120 times the rated output of the arrangement. It is the responsibility of the installation engineer or operator/ owner of the device to ensure, if necessary after consultation with the network operator, that this device is only connected to a connection point with a S_{sc} value that is greater than or equal to 120 times the rated output of the arrangement.

4. CONNECTION AND STARTUP

4.1 Mechanical connection

CAUTION
Risk of cutting and crushing when removing device from packaging

→ Carefully remove the device from the packaging by grasping hold of the frame. Never subject to any impact.

→ Wear safety shoes and cut-resistant safety gloves.

CAUTION
Heavy load when unpacking device
Risk of physical injury, such as back injuries.

→ Two people should work together to remove the device from its packaging.

NOTE
Damage to the device from vibration
Bearing damage, shorter service life

→ The fan must not be subjected to force or excessive vibration from sections of the installation. #If the fan is connected to air ducts, the connection should be isolated from vibration, e.g. using compensators or similar elements. #Ensure stress-free attachment of the fan to the substructure.

⇒ The fan may not be handled in the area around the inlet nozzle during transport and installation.
There is a risk of damage to the impeller.

⇒ Check the device for transport damage. Damaged devices are not to be installed.

⇒ Install the undamaged device in accordance with your application.

CAUTION
Possible damage to the device
If the device slips during installation, serious damage can result.

→ Ensure that the device is securely positioned at its place of installation until all fastening screws have been tightened.

- The fan must not be strained on fastening.

4.2 Electrical connection

DANGER
Voltage on the device
Electric shock

→ Always connect a protective earth first.

→ Check the protective earth.

DANGER
Faulty insulation
Risk of fatal injury from electric shock

→ Use only cables that meet the specified installation regulations for voltage, current, insulation material, capacity, etc.

→ Route cables so that they cannot be touched by any rotating parts.

DANGER
Electrical charge (>50 µC) between phase conductor and protective earth connection after switching off supply with multiple devices connected in parallel.
Electric shock, risk of injury

→ Ensure sufficient protection against accidental contact. Before working on the electrical hookup, short the supply and PE connections.

CAUTION
Voltage
The fan is a built-in component and has no disconnecting switch.

→ Only connect the fan to circuits that can be switched off with an all-pole disconnection switch.

→ When working on the fan, secure the system/machine in which the fan is installed so as to prevent it from being switched back on.

NOTE
Device malfunctions possible
Route the device's control lines separately from the supply line.

→ Maintain the greatest possible clearance. Recommendation: clearance > 10 cm (separate cable routing)

NOTE
Water ingress into wires or cables
Water ingress at the customer end of the cable can damage the device.

→ Make sure the end of the cable is connected in a dry environment.

Only connect the device to circuits that can be switched off with an all-pole disconnection switch.

4.2.1 Requirements

⇒ Check whether the information on the nameplate matches the connection data.

⇒ Before connecting the device, make sure the power supply matches the device voltage.

⇒ Only use cables designed for the current level indicated on the nameplate.
For determining the cross-section, note the sizing criteria according to EN 61800-5-1. The protective earth must have a cross-section equal to or greater than that of the phase conductor.
We recommend the use of 105 °C cables. Ensure that the minimum cable cross-section is at least
AWG 26 / 0.13 mm².

Protective earth contact resistance according to EN 61800-5-1

Compliance with the resistance specifications according to EN 61800-5-1 for the protective earth connection circuit must be verified in the end application. Depending on the installation situation, it may be necessary to connect an additional protective earth conductor by way of the extra protective earth terminal provided on the device. The protective earth terminal is located on the housing and provided with a protective earth symbol and a hole.

4.2.2 Supply connection and fuses

Assignment of supply cable cross-sections and their required fuses (line protection only, no equipment protection).

Nominal voltage	Fuse		Automatic circuit breaker	Cable cross-section	Cable cross-section
	VDE	UL	VDE	mm²	*AWG
3/PE AC 380-480 VAC	16 A	15 A	C16A	1.5	16

* AWG = American Wire Gauge

4.2.3 Reactive currents

Because of the EMC filter integrated for compliance with EMC limits (interference emission and immunity to interference), reactive currents can be measured in the supply line even when the motor is at a standstill and the line voltage is switched on.

- The values are typically in the range < 250 mA
- At the same time, the effective power in this operating state (operational readiness) is typically < 5 W.

4.2.4 Residual current circuit breaker (RCCB)

If the use of a residual current device (RCD) is required in your installation, only AC/DC-sensitive residual current devices (type B or B+) are permissible. As with variable frequency drives, residual current devices cannot provide personal safety while operating the device. When the device power supply is switched on, pulsed charging currents from the capacitors in the integrated EMC filter can lead to the instant tripping of residual current devices. We recommend the use of residual current circuit breakers (RCCB) with a trip threshold of 300 mA and delayed tripping (super-resistant, characteristic K).

4.2.5 Leakage current

For asymmetrical power systems or if a phase fails, the leakage current can increase to a multiple of the nominal value.

4.2.6 Locked-rotor protection

Due to the locked-rotor protection, the starting current (LRA) is equal to or less than the nominal current (FLA).

4.3 Connection in terminal box

4.3.1 Preparing cables for connection

Only strip the cable as far as necessary, ensuring that the cable gland is sealed and there is no strain on the connections. For tightening torques, see Chapter 3.1 Product drawing.

NOTE
Tightness and strain relief are dependent on the cable used.

→ This must be checked by the user.

4.3.2 Connecting wires to terminals

WARNING
Live terminals and connections even with device switched off
Electric shock
→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

⇒ Remove the cap from the cable gland.

Only remove caps where cables are fed in.

⇒ Route the wire(s) (not included in scope of delivery) into the terminal box.

⇒ First connect the "PE" (protective earth).

⇒ Connect the wires to the corresponding terminals.

Use a screwdriver to do so.
When connecting, ensure that no wire ends fan out.

⇒ Seal the terminal box.

4.3.3 Cable routing

Water must be prevented from reaching the cable gland along the cable.

NOTE
Damage caused by moisture penetration.
Moisture can penetrate into the terminal box if water is constantly present at the cable glands.
→ To prevent the constant accumulation of water at the cable glands, the cable should be routed in a U-shaped loop wherever possible.# If this is not possible, a drip edge can be produced by fitting a cable tie directly in front of the cable gland for example.

When routing the cable, make sure that the cable glands are located at the bottom. The cables must always be routed downward.

4.4 Factory settings

Factory settings made for the device by ebm-papst.

Mode parameter set 1	PWM control
Mode parameter set 2	PWM control
Fan/device address	01
Max. PWM / %	100
Min. PWM / %	5
Save set value to EEPROM	Yes
Set value requirement	Analog (linear)
Direction of action parameter set 1	Positive (heating)
Direction of action parameter set 2	Positive (heating)

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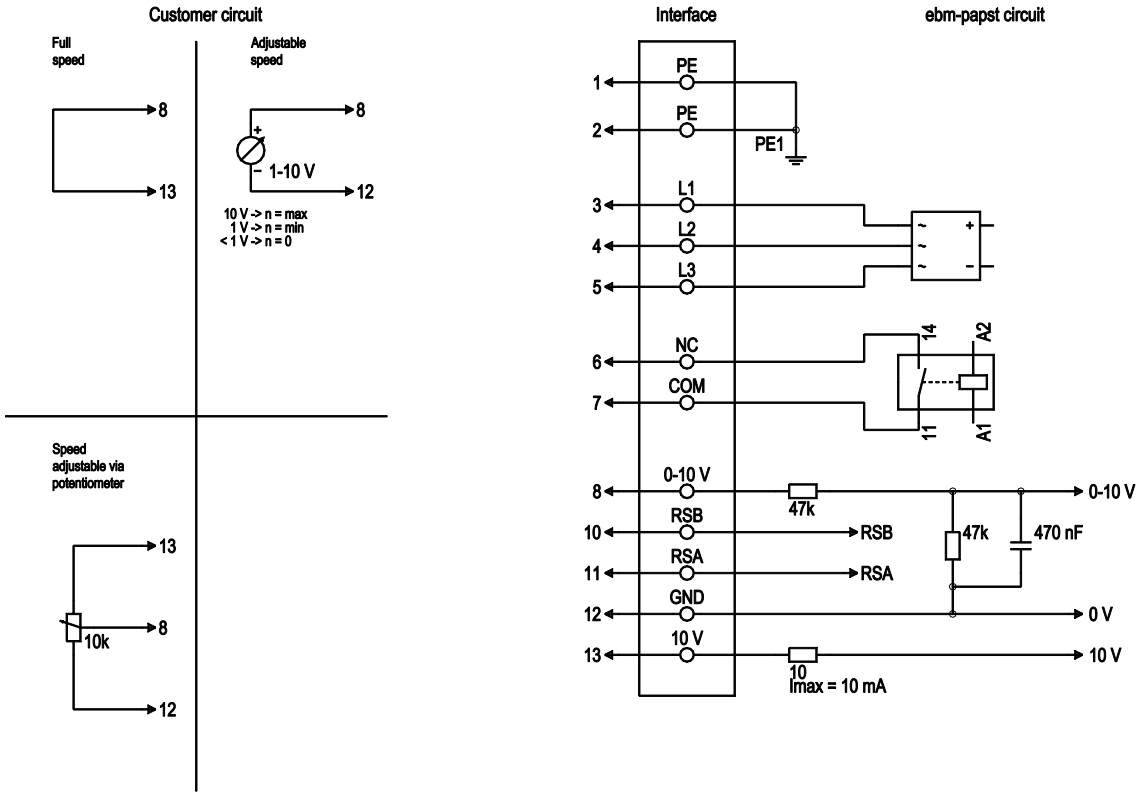
4.5 Connection diagram



Drawing preliminary!

No.	Conn.	Designation	Color	Function/assignment
1	1, 2	PE	green/ yellow	Protective earth
1	3	L1	black	Power supply
1	4	L2	black	Power supply
1	5	L3	black	Power supply
1	6	NC	white 1	Status relay, floating status contact, break for failure, contact rating 250 VAC / 2 A (AC1) / min. 10 mA; reinforced insulation on supply side and basic insulation on control interface side
1	7	COM	white 2	Status relay, floating status contact, break for failure, contact rating 250 VAC / 2 A (AC1) / min. 10 mA; reinforced insulation on supply side and basic insulation on control interface side
2	8	0-10V	yellow	Analog input (set value), 0-10 V, Ri = 100 kΩ, adjustable curve, SELV
2	10	RSB	brown	RS485 interface for MODBUS, RSB; SELV
2	11	RSA	white	RS485 interface for MODBUS, RSA; SELV
2	12	GND	blue	Reference ground for control interface, SELV
2	13	+10V	red	Fixed voltage output 10 VDC, +10 V ±3%, max. 10 mA, short-circuit-proof power supply for external devices (e.g. pot), SELV fixed voltage input 24 VDC for setting parameters via MODBUS without line voltage supply

4.6 Checking connections

⇒ Ensure isolation from supply (all phases).
⇒ Make sure a restart is impossible
⇒ Check the cables for proper fit.
⇒ Screw the terminal box cover back on again. Terminal box tightening torque, see Chapter 3.1 Product drawing.
⇒ Route the cables in the terminal box so that the terminal box cover closes without resistance.
⇒ Use all screw plugs. Insert the screws by hand to avoid damage to the threads.
⇒ Make sure the terminal box is completely closed and sealed and that all screws and cable glands have been properly tightened.

4.7 Switching on the device

The device may only be switched on if it has been installed properly and in accordance with its intended use, including the required safety mechanisms and professional electrical hookup. This also applies for devices which have already been equipped with plugs and terminals or similar connectors by the customer.

WARNING
Hot motor housing
Risk of fire
→ Ensure that no combustible or flammable materials are located close to the fan.

⇒ Before switching on, check the device for visible external damage and make sure the protective devices are functional.
⇒ Check the fan's air flow paths for foreign matter and remove any foreign matter found.
⇒ Apply the nominal supply voltage.
⇒ Start the device by changing the input signal.

NOTE
Damage to the device from vibration
Bearing damage, shorter service life
→ Low-vibration operation of the fan must be ensured over the entire speed control range. #Severe vibration can arise for instance from inexpert handling, transportation damage and resultant imbalance or be caused by component or structural resonance. #Speed ranges with excessively high vibration levels and possibly resonant frequencies must be determined in the course of fan commissioning. #Either run through the resonant range as quickly as possible with speed control or find another remedy.# Operation with excessively high vibration levels can lead to premature failure.

→ The maximum permissible vibration severity must not exceed 3.5 mm/s and should be checked at intervals of 6 months. #It is to be measured at the motor mount at the motor support plate in all three 3 dimensions, see Chapter 6. Maintenance, malfunctions, possible causes and remedies.

4.8 Switching off the device

Switching off the device during operation:
⇒ Switch off the device via the control input.
⇒ Do not switch the motor (e.g. in cyclic operation) on and off via power supply.

Switching off the device for maintenance:
⇒ Switch off the device via the control input.
⇒ Do not switch the motor (e.g. in cyclic operation) on and off via power supply.
⇒ Disconnect the device from the power supply.
⇒ When disconnecting, be sure to disconnect the ground connection last.

5. INTEGRATED PROTECTIVE FEATURES

The integrated protective functions cause the motor to switch off automatically in the event of the faults described in the table.

Fault	Safety feature description/ function
Rotor position detection error	An automatic restart follows.
Blocked rotor	⇒ After the blockage is removed, the motor restarts automatically.
Line undervoltage (line voltage outside of permitted nominal voltage range)	⇒ If the line voltage returns to permitted values, the motor restarts automatically.
Phase failure	A phase of the supply voltage fails for at least 5 s. ⇒ When all phases are correctly supplied again, the motor automatically restarts after 10-40 s.

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6. MAINTENANCE, MALFUNCTIONS, POSSIBLE CAUSES AND REMEDIES

Do not perform any repairs on your device. Send the device to ebm-papst for repair or replacement.

WARNING
Live terminals and connections even with device switched off
Electric shock

→ Wait five minutes after disconnecting the voltage at all poles before opening the device.

CAUTION
If control voltage or a stored speed set value is applied, the motor will restart automatically, e.g. after a power failure.
Risk of injury

→ Keep out of the device's danger zone.# When working on the device, switch off the line voltage and ensure that it cannot be switched back on.

→ Wait until the device comes to a stop.

→ After working on the device, remove any tools or other objects from the device.

If the device is out of use for some time, e.g. when in storage, we recommend switching it on for at least two hours to allow any condensation to evaporate and to move the bearings.

Malfunction/fault	Possible cause	Possible remedy
Impeller not running smoothly	Imbalance in rotating parts	Clean the device; replace it if imbalance persists after cleaning. Make sure no weight clips are removed during cleaning.
Motor not turning	Mechanical blockage	Switch off, isolate from supply and remove mechanical blockage.
	Line voltage faulty	Check line voltage, restore power supply. Attention! The error message resets automatically. Device restarts automatically without warning.
	Faulty connection	Isolate from supply, correct connection; see connection diagram.
	Broken motor winding	Replace device
	Thermal overload protector activated	Allow motor to cool off, locate and rectify cause of error, release restart lockout if necessary
	Deficient cooling	Improve cooling. Let the device cool down. To reset the error message, switch off the line voltage for at least 25 s and then switch it on again. Alternatively, reset the error message by applying a control signal of < 0.5 V to Din1 or by shorting Din1 to GND.
	Ambient temperature too high	Reduce the ambient temperature. Let the device cool down. To reset the error message, switch off the line voltage for at least 25 s and then switch it on again. Alternatively, reset the error message by applying a control signal of < 0.5 V to Din1 or by shorting Din1 to GND.
	Impermissible point of operation (e.g. back pressure too high)	Correct the operating point. Let the device cool down. To reset the error message, switch off the line voltage for at least 25 s and then switch it on again. Alternatively, reset the error message by applying a control signal of < 0.5 V to Din1 or by shorting Din1 to GND.

In the event of further malfunctions, contact ebm-papst.

6.1 Vibration testing

Checking of fan for mechanical vibration based on ISO 14694. Recommendation: Every 6 months. Max. vibration severity is 3.5 mm/s, measured at the motor fastening diameter on the motor support plate in the direction of the motor axis of rotation and perpendicular to this.

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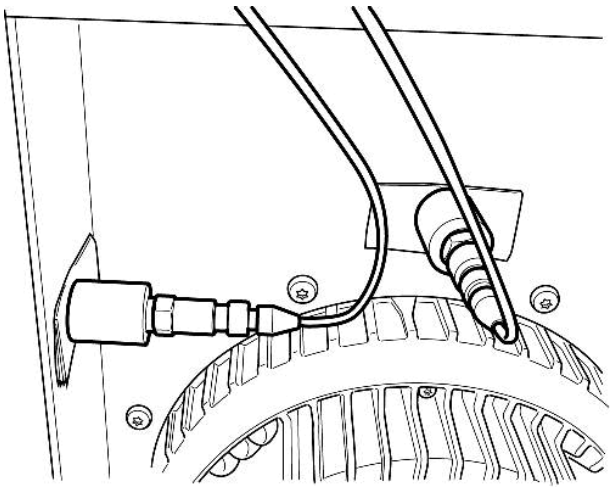

Fig. 1: Example illustrating vibration measurement. The arrangement of the sensors depends on the device concerned and the installation situation.

6.2 Cleaning

NOTE
Damage to the device during cleaning
Malfunction possible

→ Do not clean the device using a high-pressure cleaner.

→ Do not use acid, alkali or solvent-based cleaning agents.

→ Do not use any pointed or sharp-edged objects for cleaning

6.3 Safety inspection

NOTE
High-voltage test
The integrated EMC filter has Y capacitors. The tripping current is exceeded when AC testing voltage is applied.

→ Test the device with DC voltage when you perform the legally required high-voltage test. The voltage to be used corresponds to the peak value of the AC voltage required by the standard.

What to check	How to check	How often	What action?
Contact protection cover for intactness or damage	Visual inspection	At least every 6 months	Repair or replacement of device
Device for damage to blades and housing	Visual inspection	At least every 6 months	Replacement of device
Fastening the cables	Visual inspection	At least every 6 months	Fasten
Fastening the protective earth terminal	Visual inspection	At least every 6 months	Fasten
Insulation of cables for damage	Visual inspection	At least every 6 months	Replace cables
Impeller for wear/deposits/ corrosion and damage	Visual inspection	At least every 6 months	Clean or replace impeller
Tightness of cable gland	Visual inspection	At least every 6 months	Retighten, replace if damaged
Abnormal bearing noise	acoustic	At least every 6 months	Replace device
Vibration test	Vibration measuring device, start-up or run-down measurement	Recommended every 6 months	Clean, re-balance and if necessary replace impeller

6.4 Disposal

For ebm-papst, environmental protection and resource preservation are top priority corporate goals.
ebm-papst operates an environmental management system which is certified in accordance with ISO 14001 and rigorously implemented around the world on the basis of German standards.
Right from the development stage, ecological design, technical safety and health protection are fixed criteria.
The following section contains recommendations for ecological disposal of the product and its components.

6.4.1 Country-specific legal requirements

NOTE
Country-specific legal requirements
Always observe the applicable country-specific legal regulations with regard to the disposal of products or waste occurring in the various phases of the life cycle. The corresponding disposal standards are also to be heeded.

6.4.2 Disassembly

Disassembly of the product must be performed or supervised by qualified personnel with the appropriate technical knowledge.
The product is to be disassembled into suitable components for disposal employing standard procedures for motors.

WARNING
Heavy parts of the product may drop off. Some of the product components are heavy. These components could drop off during disassembly.
This can result in fatal or serious injury and material damage.

→ Secure components before unfastening to stop them falling.

6.4.3 Component disposal

The products are mostly made of steel, copper, aluminum and plastic. Metallic materials are generally considered to be fully recyclable.
Separate the components for recycling into the following categories:

- Steel and iron
- Aluminum
- Non-ferrous metal, e.g. motor windings
- Plastics, particularly with brominated flame retardants, in accordance with marking
- Insulating materials
- Cables and wires
- Electronic scrap, e.g. circuit boards

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Only ferrite magnets and not rare earth magnets are used in external rotor motors from ebm-papst Mulfingen GmbH & Co. KG.

⇒ Ferrite magnets can be disposed of in the same way as normal iron and steel.

Electrical insulating materials on the product, in cables and wires are made of similar materials and are therefore to be treated in the same manner.
The materials concerned are as follows:

- Miscellaneous insulators used in the terminal box
- Power cables
- Cables for internal wiring
- Electrolytic capacitors

Dispose of electronic components employing the proper procedures for electronic scrap.

→ Please contact ebm-papst for any other questions on disposal.

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Further Information

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