rotor

Low-voltage Motors

5RN, 5RF, 5RB, 6RN, 7RN, HJN

Installation, Operation & Maintenance Instructions

Safety notes

The safe use of electrical machines

⚠WARNING

Live parts

Electrical machines contain live parts.

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

- Only remove covers using methods that comply with regulations.
- Operate the machines properly.
- Perform regular maintenance on the machine.

⚠WARNING

Rotating parts

Electrical machines contain dangerous rotating parts.

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

- Only remove covers using methods that comply with regulations.
- Operate the machines properly.
- Perform regular maintenance on the machine.
- Secure free-standing shaft extensions.

⚠WARNING

Hot surfaces

Electrical machines have hot surfaces.

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

- Allow the machine to cool before starting work on it.
- Only remove covers using methods that comply with regulations.
- Operate the machines properly.

This documentation only contains the instructions that will be required by qualified personnel who are using the machines in accordance with their intended purpose.

Those responsible for plant safety must ensure the following:

- The basic planning work for the system and all work relating to transportation, assembly, installation, commissioning, maintenance and repairs is carried out by qualified personnel and checked by responsible, suitably skilled personnel.
- The operating instructions and machine documentation are always available.
- The technical data and specifications relating to installation, connection, ambient and operating conditions are taken into account at all times.
- The system-specific installation and safety regulations are observed.
- Personal protective equipment is used.
- Work on or in the vicinity of these machines by unqualified persons is prohibited.
- If the machines are used outside industrial areas, the installation site must be safeguarded against unauthorized access by means of suitable protection facilities (e.g. safety gates) and appropriate warning signs.

Qualified personnel

All work on 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.

Note

Authorised Service Partners

Use the services and support provided by the Rotor Service Pertners for planning, installation, commissioning, and servicing work.

Description

Language variations

Aditional language variations of this document (shortform version only) are available upon request.

Intended use of the machines

These machines are intended for industrial installations. They comply with the harmonized standards of the series IEC/EN 60034-1 (VDE 0530). Their use in hazardous areas is forbidden unless the marking on the rating plate expressly permits this operation. If other/more wide-ranging demands (e.g. protection against touching by children) are made in special cases – i.e. use in non-industrial installations – these conditions must have been complied with in the installation when the motors are installed.

Note

Machine directive

Low-voltage machines are components for installation in machines which comply with machine directive 2006/42/EC. They must not be started up until the end product has been verified as complying with this directive (refer to EN 60204-1).

Forced ventilation (optional): Cooling method IC 416 in accordance with IEC/EN 60034-6

⚠ WARNING
Never commission the machine without an external fan.

Cooling that does not depend on the speed is achieved by means of a separately driven fan wheel (forced ventilation). Forced ventilation does not depend on the operating state of the machine.

The fan wheel for the external flow of cooling air is powered by an independent module and is enclosed by the fan cover.

Degree of protection

The degree of protection the machines feature is stated on the rating plate. They can be installed in dusty or humid environments.

CAUTION
Condensation holes To safeguard the degree of protection, any condensation holes need to be sealed.

NOTICE

Storage

If the machines are used or stored outdoors, we recommend keeping them under a shelter or an additional cover.

- Avoid exposing them to direct, intense solar radiation, rain, snow, ice, or dust for extended periods.
- If necessary, please consult us or seek advice regarding technical issues.

Environmental requirements

The machines are suitable for operation in tropical climates.

Guide value of 60 % relative humidity at ambient temperature (T_A) of 50 °C.

Ambient temperature: -20 °C to +50 °C

Installation altitude: ≤ 1000 m

Air with normal oxygen content, usually 21 % (V/V)

If the environmental requirements are different from the details listed here, then the values on the rating plate will apply.

Application planning

Transport

⚠WARNING

Use lifting eyes

The machine must only be transported and lifted using the lifting eyes, in a position that is appropriate for its type of construction. Otherwise, it could fall over or slip in the lifting tackle.

This can result in death, serious injury, or material damage.

- Use all the lifting eyes on the machine.
- Any eyes that are screwed in must be tightly fastened.
- Eyebolts must be screwed in right up to their supporting surface.
- If necessary, use suitable, sufficiently-sized transport materials such as lifting straps (EN 1492-1) and lashing straps (EN 12195-2).

⚠WARNING

Suspended transport

If several items of transport material are used for fastening, two straps must be able to carry the whole load.

- Use additional, suitable means of support for transport and during installation.
- Secure the support equipment to prevent it from slipping.

Bearing lifetime

Storage time

Prolonged storage periods reduce the useful life of the bearing grease. If stored for more than 12 months, the condition of the grease must be checked. If the grease is found to have lost some of its oil content or is contaminated (ingress of condensation leads to changes in the consistency of the grease), the grease must be replaced.

Rolling-contact bearings

The shafts must be turned once a year to prevent marks as a result of them resting in the same position for a long time. The rolling-contact bearings should be renewed if the time from delivery to start-up of the machine is longer than 4 years. The older the grease used, the shorter the expected bearing lifetime.

Mounting, installation

Safety instructions

⚠ CAUTION

The housing parts of electrical machines can become very hot!

⚠ CAUTION

Before commissioning can be carried out, the customer must check the machine's direction of rotation using appropriate methods (such as decoupling it from the driven machine).

CAUTION

It must be ensured that parts which are sensitive to temperature changes (cables etc.) do not rest against the housing of the machine.

NOTICE

Please note the technical data on the rating plates on the machine enclosure.

Electromagnetic compatibility

NOTICE

If the torque levels are very unequal (e.g. when a reciprocating compressor is being driven), a non-sinusoidal machine current will be induced whose harmonics can have an impermissible effect on the supply system and cause impermissible interference emissions as a result.

NOTICE

Converter

- If operated with a frequency converter, the emitted interference varies in strength, depending on the design of the converter (type, interference suppression measures, manufacturer).
- Prevent the limit values stipulated by EN 61000-6-3 for the drive system (consisting of the machine and converter) from being exceeded.
- You must observe the EMC information from the manufacturer of the converter.
- The most effective method of shielding is to conductively connect a shielded machine supply cable to the metal terminal box of the machine (with a metal screw connection) over a large surface area.
- On machines with integrated sensors (e.g. PTC thermistors), disturbance voltages caused by the converter may occur on the sensor cable.

Balancing

⚠ CAUTION

A suitable tool must always be used for fitting and pulling off output elements.
The feather keys are only secured to prevent them from falling out during transportation.
Please observe the general requirements regarding touch protection measures that need to be taken for the output elements.

NOTICE

If a machine without an output element is commissioned, the feather keys must be secured to prevent them from being thrown out.

The rotors are balanced dynamically. The balancing quality corresponds to vibration severity grade "A" for the complete machine as standard. The optional vibration severity grade "B" is indicated on the rating plate.

The declaration regarding the type of key for balancing is generally marked on the rating plate and optionally on the face of the shaft end.

Designation:

- As a standard measure, balancing is carried out dynamically with a half key (code "H") in accordance with ISO 8821.
- "F" means balancing with a whole key (optional version).
- "N" means balancing without a key (optional version).

Note

Measures conforming to ISO 10816 must be taken in order to compensate any offset between electrical machines and driven machines.
The foundation must be designed according to DIN 4024.

Alignment and fastening

When aligning and fastening the machine, please bear the following in mind:

- The machine must be level.
- Feet and flanges must be fastened securely.
- Alignment must be precise in the case of direct coupling.
- Fastening surfaces must be clean
- Look out for any damage to paint; this must be rectified immediately and correctly.
- Look out for traces of anti-corrosion protection agents; these must be removed using mineral turpentine.
- Look out for installation-related resonances with the rotating frequency and double line frequency; these must be prevented.
- Listen for unusual noises when turning the rotor manually.
- Check the direction of rotation with the machine decoupled.
- Avoid using rigid coupling measures.

Flatness of the supporting surfaces for conventional motors

Frame size (FS)	Flatness mm
≤ 132	0.10
160	0.15
≥ 180	0.20

Connecting

⚠WARNING

Any work on the stationary machine must be performed by qualified personnel, with the machine isolated from the supply and secured so that it cannot be switched back on again. This also applies to auxiliary circuits (e.g. anti-condensation heater). Check that the equipment is isolated from the supply.
If the incoming power supply system displays any deviations from the rated values for voltage, frequency, curve form, or symmetry, such deviations will exacerbate the increase in temperature and influence electromagnetic compatibility.
Before starting work, make sure that a protective conductor is securely connected.

⚠WARNING

Mains with non-earthed neutral point

Operating the machine on a mains with a non-earthed neutral point is only permitted during rarely occurring, short time intervals, e.g. until elimination of an error (earth fault of a cable, EN 60034-1).

Instructions for terminal boxes

CAUTION

Make sure that the interior components of the terminal box (such as the terminal board and cable connections) are not damaged.
Foreign bodies, dirt, and moisture must not be allowed to get into the terminal box.
For information on entries into the terminal box, please refer to DIN 42925.
Any other open entries must be sealed with O-rings or suitable flat gaskets to prevent dust and water from entering, while the terminal box itself must be sealed against dust and water using the original seal.

Please observe the tightening torques for cable glands and other screws.

When performing a test run, secure the feather keys without output elements.

NOTICE

The terminal box must be sealed so that dust and water cannot enter.

Protruding connection cables

⚠CAUTION

It must be ensured that there are no foreign bodies, dirt, or moisture in the terminal base of the machine enclosure.

- Use O-rings or suitable flat gaskets to seal entries in cover plates (DIN 42925) and other open entries.
- Seal the terminal base of the machine enclosure using the original seal of the cover plate to prevent dust and water from entering.
- Please observe the tightening torques for cable glands and other screws.
- When performing a test run, secure the feather keys without output elements.

⚠WARNING

During disassembly and particularly when installing the cover plate, make sure that the connection cables are not clamped between enclosure parts and the cover plate. Short-circuit hazard!

Final checks

Before closing the terminal box/terminal base of the machine enclosure, check the following:

- The electrical connections in the terminal box have been made in accordance with the specifications above and tightened to the required tightening torque.
- The clearances between non-insulated parts have been maintained: ≥ 5.5 mm to 690 V, ≥ 8 mm to 1000 V.
- There are no protruding wire ends.
- The connecting cables are laid so that they are not touching one another, to avoid damaging the cable insulation.
- The machine is connected so that it rotates in the direction specified.
- The inside of the terminal box is clean and free of any pieces of cable.
- All seals and sealing surfaces are clean and undamaged.
- Any openings in the terminal boxes that are not being used have been sealed correctly.
- The pressure relief device is undamaged (depending on the type of terminal box, this involves either cast-in slots or an overpressure diaphragm). Any damage is only repaired following discussion with the person responsible for the safety of the installation and using original parts.

Tightening torques

Cable glands

NOTICE
Take care not to damage the cable jacket. Tightening torques must be adapted to suit the type of cable jacket material in use.

You should refer to the table in order to find the correct tightening torque for any metal and plastic cable glands that are to be mounted directly on the machine, as well as for any other screw-type connections (such as adapters).

Table 1 Tightening torques for cable glands

	Metal ± 10% Nm	Plastic ± 10% Nm	O ring String ∅ mm
M 12 x 1,5	8	1,5	2
M 16 x 1,5	10	2	
M 20 x 1,5	12	4	
M 25 x 1,5			
M 32 x 1,5	18	6	
M 40 x 1,5			
M 50 x 1,5	20		
M 63 x 1,5			

Terminal boxes, end shields, earthing conductors, metal fan covers

Note

The specified tightening torques are applicable unless other values are indicated.

Table 2 Tightening torques for screws on the terminal box, end shields, screw-type grounding conductor connections

	Thread ∅		M 4	M 5	M 6	M 8	M 10	M 12	M 16	M20
	Nm	min	2	3.5	6	16	28	46	110	225
		max	3	5	9	24	42	70	165	340

Table 3 Tightening torques for self-tapping screws on the terminal box, end shields, screw-type grounding conductor connections, sheet metal fan covers

	**Thread ∅**		**M 4**	**M 5**	**M 6**
	Nm	min	4	7.5	12.5
		Max.	5	9.5	15.5

General information on conductor connection

Cross-sections that can be connected depending on the size of the terminal (possibly reduced due to size of cable entries)

General information on connecting the earthing conductor

Note

The machine's earthing conductor cross-section must comply with DIN EN 60034-1 (Section 11.1).

Please also observe installation regulations such as those laid down by DIN EN IEC 60204-1..

Connection to an inverter

⚠CAUTION

The standard insulating system is suitable for inverter voltages up to 460 V. For higher voltages, a special insulating system must be used or special measures must be taken, e.g. an output filter.

CAUTION

Machines must always be connected to frequency inverters using shielded machine supply cables. The most effective method of shielding is to conductively connect the cable to the metal terminal box of the machine (with a metal screw connections) over a large surface area.

Note

EMC

Please observe the section containing instructions on ensuring electromagnetic compatibility.

Commissioning

Insulation resistance

⚠WARNING

Only expert personnel should be entrusted with work on power installations.

Before starting commissioning, install all covers that are designed to prevent active or rotating parts from being touched, or which are necessary to ensure correct air guidance and thus effective cooling.

⚠WARNING

During measurement and immediately afterwards, some of the terminals are at hazardous voltage levels. Do not touch them.

With the power cables connected, check that no voltage can be applied.

Checking the insulation resistance

CAUTION

The insulation resistance needs to be checked prior to start-up and again after any extended periods of storage or periods during which the equipment is not in operation. Before you begin measuring the insulation resistance, please read the operating manual for the insulation resistance meter you are going to use. Disconnect any main-circuit cables that are connected to the terminals before measuring the insulation resistance.

NOTICE

If the critical insulation resistance is less than or equal to this value, the windings must be dried or, if the fan is removed, cleaned thoroughly and dried.

Please note that the insulation resistance of dried, clean windings is lower than that of warm windings. The insulation resistance can only be properly assessed after conversion to the reference temperature of 25 °C.

NOTICE

If the measured value is close to the critical value, you must check the insulation resistance at suitably frequent intervals.

Measure the minimum insulation resistance of the winding to the machine enclosure when the winding temperature is between 20 and 30 °C. Other values for the insulation resistance apply at different temperatures. When measuring, wait until the full-scale resistance value is reached (approx. 1 minute).

Measure the critical insulation resistance at the operating temperature of the winding.

Limit values

The following table indicates the measuring circuit voltage together with the minimum insulation resistance and the critical insulation resistance.

Table 4 Insulation resistance

	Rated voltage U_{rated}< 2 kV
Measuring circuit voltage	500 V
Minimum insulation resistance with new, cleaned or repaired windings	10 MΩ
Critical specific insulation resistance after a long operating time	0.5 MΩ/kV

(Values apply at a winding temperature of 25 °C.)

Measures to be taken before commissioning

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

- The machine has been assembled and aligned correctly.
- The machine has been connected so that it rotates in the direction specified.
- The operating conditions match the data specified on the rating plate.
- The bearings have been lubricated as appropriate for the version used. Rolling-contact bearing machines which have been in storage for more than 24 months have been relubricated.
- Any supplementary machine monitoring equipment has been connected correctly and is functioning as it should.
- For versions with bearing thermometers, the bearing temperatures must be checked during the machine's first period of operation. The warning and shutdown values are set on the monitoring device.
- Appropriately configured control and speed monitoring functions ensure that the machine cannot exceed the permissible speeds specified on the rating plate.
- The output elements have the correct settings for their type (e.g. alignment and balancing of couplings, belt forces in the case of a belt drive, tooth forces and tooth face clearance in the case of toothed-wheel power output, radial and axial clearance in the case of coupled shafts).
- The minimum insulation resistance and minimum clearance values have been adhered to.
- The grounding and equipotential bonding connections have been established correctly.
- All fixing screws, connection elements, and electrical connections have been tightened to the specified torques.
- Lifting eyes that were screwed in have been removed following installation or secured to prevent them becoming loose.
- The rotor can turn without coming into contact with the stator.

- All touch protection measures for both moving and live parts have been implemented.
- In cases where the shaft extension is not being used and is, therefore, exposed, it has been covered and the feather key has been secured to prevent it from being thrown out.
- If being used, the external fan is ready for operation and connected so that it rotates in the direction specified.
- The flow of cooling air is not obstructed.
- If a brake is being used, it is functioning correctly.
- The specified mechanical limit speed n_{max} is adhered to.

If the design of the machine requires the converter to be assigned in a particular way, the relevant information will be provided on the rating plate or an additional label.

Note

It may be necessary to perform additional checks and tests in accordance with the specific situation on site.

Operation

Switching on the machine with anti-condensation heating (optional)

⚠CAUTION

Before switching on, always make sure that the (optional) anti-condensation heating is switched off.

Machine operation

⚠WARNING

Supply system with non-grounded neutral point

Operating the machine on a supply system with a non-grounded neutral point is only permitted over short time intervals that occur rarely, e.g. the time leading to an error being eliminated (ground fault of a cable, EN 60034-1).

⚠WARNING

Do not remove covers when the motor is running

Rotating or live parts are dangerous. Death, serious injury, or material damage can result if the required covers are removed.

- De-energize the machine before removing any covers.
- Ensure that any covers which are designed to prevent active or rotating parts from being touched, which are necessary to ensure correct air guidance and thus effective cooling, or which guarantee the degree of protection of the machine remain closed during operation.

⚠CAUTION

The surfaces of the machines can reach high temperatures, which can lead to burns if touched.

⚠WARNING

Faults during operation

Deviations from conditions during normal operation, such as an increase in 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, severe injury or material damage.

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

CAUTION

Risk of corrosion due to condensation

When changing machines and/or ambient temperatures, air humidity can condense within the machines.

- If available, remove the screw plugs to drain the water depending on the ambient and operating conditions.
- Reinsert them afterwards.

If the machine is equipped with drainage plugs, the water can drain away automatically.

⚠WARNING

Machines with textile fan covers

The machine fan is not completely protected against contact.
The customer must put suitable measures in place, e.g. housings or protective grating, to prevent manual intervention.

Stoppages

Overview

If the machine remains out of service for an extended period of time (> 1 month), it should be commissioned regularly (around once a month) or, at the very least, the rotor should be turned. Please refer to the instructions in the section titled "Switching on" before recommissioning the machine. If a rotor locking device has been fitted to the machine, you must remove it before the rotor starts to turn.

CAUTION
If the machine is to be out of service for a period in excess of 12 months, you must take suitable anti-corrosion, mothballing, packaging, and drying measures.

Switching on the anti-condensation heater

If an anti-condensation heater is provided, switch it on during the machine stoppages.

Taking the machine out of service

For details of measures that need to be implemented, please refer to Section Application planning (Page 4).

Lubricating before recommissioning

CAUTION
The machine must be relubricated during commissioning if it has been out of service for more than 1 year, in order to ensure that the grease is distributed throughout the bearings. The shaft must rotate for the grease to be distributed. Please observe the information on the lubricant plate if carrying out relubrication using relubrication equipment. See also the section titled "Application planning - Bearing lifetime".

Servicing

⚠WARNING
Safety instructions • Before starting work on the machines, make sure that the plant or system has been disconnected in a manner that is compliant with the appropriate specifications and regulations. • In addition to the main currents, make sure that supplementary and auxiliary circuits, particularly in heating devices, are also disconnected. • Certain parts of the machine may reach temperatures above 50 °C. Physical contact with the machine could result in burn injuries! Check the temperature of parts before touching them. • When carrying out cleaning using compressed air, make sure that appropriate methods of extracting fumes are in place and that personal protective gear such as gloves, goggles, face masks, or similar are worn. • If you are using chemical cleaning agents, observe the instructions and any warnings provided in the relevant safety data sheet. Chemical agents must be compatible with the machine's components, especially if these contain plastics.

Note

Operation characteristics can vary widely. For this reason, only general maintenance intervals can be specified here.

Maintenance

Regreasing (optional)

General

As a standard feature, the machines have rolling-contact bearings which are permanently lubricated with grease (UNIREX N3, made by ESSO). A regreasing device is possible as an option. In this case, you can find information about relubrication intervals, quantities and types of grease, and, if required, additional data on the rating plate or lubricant plate.

Note

Do not mix different types of grease!

Prolonged storage periods reduce the useful life of the bearing grease. Check the condition of the grease if the equipment has been in storage for more than 12 months. If the grease is found to have lost oil content or to be contaminated, immediate relubrication must be carried out before commissioning. For information on permanently-greased bearings, please refer to the section titled Bearings (Page 18).

Note

Regreasing

1. Clean the grease nipples at the drive end and non-drive end.
2. Press in the type and quantity of grease specified (see rating/lubricant plate data).

- Please observe the information on the rating and lubricant plates.
- Regreasing should be carried out when the machine is running (max. 3600 rpm)!

The bearing temperature rises sharply at first, then drops to the normal value again after the excess grease has been displaced out of the bearing.

Cleaning

Cleaning the greasing channels and used grease chambers

The used grease collects outside each bearing in the used grease chamber of the outer bearing cap. When replacing bearings, remove the used grease.

NOTICE
You have to separate the active parts of the bearings to replace the grease that is in the greasing channel.

Cleaning the cooling air passages

Regularly clean the cooling air passages through which the ambient air flows, e.g. using dry compressed air.

NOTICE
Never direct compressed air in the direction of the shaft outlet or machine openings.

In the case of machines with textile fan covers, regularly remove fluff balls, fabric remnants, and similar types of contamination (particularly at the air passage opening between the fan cover and cooling fins of the machine enclosure) to ensure that the cooling air can flow without obstruction.

NOTICE
The frequency of the cleaning intervals depends on the local degree of contamination.

⚠WARNING
Particularly when carrying out cleaning using compressed air, make sure you use suitable extraction equipment and wear personal protective gear (safety goggles, respiratory filter, etc.).

Bearings

The bearings sizes may be indicated on the rating plate (at certain frame sizes only)

Bearing lifetime

Prolonged storage periods reduce the useful life of the bearing grease. In the case of permanently lubricated bearings, this leads to a reduction of the bearings' useful life. Replacement of the bearings is recommended after only 12 months of storage. If the bearings are stored for more than 4 years, they must be replaced.

Replacement of bearings

Recommended interval after which bearings are to be replaced under normal operating conditions:

Table 5 Bearing replacement intervals

Coolant temperature	Principle of operation	Bearing replacement intervals
40° C	Horizontal coupling operation	40 000 h
40° C	With axial and radial forces	20 000 h

Note

Special operating conditions

Examples of factors that can reduce operating hours are vertical machine installation, large vibrational and impact stress, frequent reversing, higher coolant temperature, higher speeds, etc.

NOTICE
Do not reuse bearings that have been removed.

Dismantling

NOTICE
Before commencing disassembly, you should mark how each of the fastening elements has been assigned, as well as how internal connections are arranged, for re-assembly purposes.

Fan

Take care not to damage the snapping mechanisms on fans that are equipped with these. To ensure this, the fans should be heated to a temperature of approximately 50 °C around the area of the hub. If any damage is caused, request new parts.

Fan cover

- Carefully lever the snap openings on the cover out of the snap-in lugs one after the other; do not apply the lever directly under the web (risk of breakage).
- Do not damage the snap mechanisms. If any damage is caused, request new parts.

Protective cover, incremental encoder under protective cover

Loosen fastening screws on the external surface of the protective cover.

Under no circumstances should the spacing bolts be disassembled or forcibly separated from each other or the cover. Forcibly removing or separating the spacing bolts or fan cover can result in damage to them.

Installation

NOTICE
Avoid damaging the windings protruding out of the stator enclosure when fitting the end shield.

Spare parts

General

In addition to the exact part designation, please specify the motor type and the factory serial number in all orders for spare parts.

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