SIEMENS

SIMOTICS GP, SD, DP

Low-voltage motors

1LA, 1LE, 1LF, 1LG, 1LP, 1FP, 1PC, 1PF, 1PK, 1PP, 1PQ

Compact operating instructions

Edition 02/2015

56100000002001

Answers for industry.

SIEMENS

SIMOTICS GP, SD, DP
Low-voltage motors
Standard machines

Compact Operating Instructions

1 Introduction

1.1 Machine types

Machine types

1LA, 1LE, 1LF, 1LG, 1LP, 1FP, 1PC, 1PF, 1PK, 1PP, 1PQ

1.2 Information for the reader

Explanation of the icons

Note for 1LE1, 1FP1, 1MB1, 1PC1, 1PC3 machines

1.3 Note regarding the terminal box

Explanation of the icons

Note for 1LE1, 1PC1 and 1PC3 machines, frame sizes 80 and 90 with central terminal box locking

56100000002001, 02/2015

2 Safety notes

2.1 Information for those responsible for the plant or system

This electric machine has been designed and built in accordance with the specifications contained in Directive 2006/95/EC ("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 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 personal safety and to prevent material damage when carrying out any work, always observe the safety instructions and the following five safety rules, according to EN 50110-1 "Dead working". Apply the five safety rules in the sequence stated before starting work.

Five safety rules

1. Disconnect completely.
   Disconnect the auxiliary circuits, for example anti-condensation heating.

2. Secure against reconnection.
3. Verify absence of operating voltage.
4. Carry out earthing and short-short-circuiting.
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 The safe use of electrical machines

⚠ WARNING

High voltages

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 in compliance with the applicable 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 in compliance with the applicable regulations.
- Operate the machines properly.
- Perform regular maintenance on the machine.
- Secure free-standing shaft extensions.

WARNING

Risk of burning

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 down before starting any work on it.
- Only remove covers in compliance with the applicable regulations.
- Operate the machines properly.

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.

3 Description

3.1 Languages of operating instructions available in the Internet

Additional languages in the Internet

You can find the operating instructions in other languages on the Internet page: http://www.siemens.com/motors

If you require additional language versions, please contact the Siemens Service Center.

Intended use of the machines

These machines are intended for industrial installations. They comply with the harmonized standards of the series EN / IEC 60034 (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 so that they cannot be touched by children) are made in special cases – i.e. use in non-industrial installations – these conditions must have been complied with in the plant or system itself when the motors are installed.

Note

Machine directive

Low-voltage motors are components designed for installation in machines in accordance with the current Machinery Directive. They must not be commissioned until it has been verified that the end product complies with this directive (refer to EN 60204-1).

3.2 Operating UL-certified machines with a converter

Note

Operating a machine with a converter

Implement all machines of the overall machine-converter system according to UL-File E227215 assuming that the machines are only to be operated with a converter and are supplied with UL certificate.
The company operating the equipment is responsible for implementing this in the actual application.

3.3 CE marking

Note

Use of machines without CE identification

Machines without CE marking are intended for operation outside the European Economic Area (EEA). Do not use any machines without CE mark within of the EEA!

3.4 IE2 marking

Note

IE2 marking

According to REGULATION (EC) No. 640/2009, low-voltage motors with power ratings between 7.5 kW and 375 kW – and with IE2 efficiency – have this label from January 1, 2015 onwards.
This is only mandatory within the European Economic Area (EEA). Customers are solely responsible in ensuring the correct use.
When connecting the machine to a converter, carefully observe the rules and notes in Chapter "Connecting a converter."

3.5 Regulations for standard motors

Standard motors

The regulations and standards used as basis to design and test this machine are stamped on the rating plate. The machine design basically complies with the following standards:

Table 3-1 Applicable general regulations

Feature	Standard
Dimensioning and operating behavior	EN / IEC 60034-1
Procedure for determining the losses and the efficiency of rotating electrical machines and inspections	EN / IEC 60034-2-1 EN / IEC 60034-2-2 EN / IEC 60034-2-3
Degree of protection	EN / IEC 60034-5
Cooling	EN / IEC 60034-6
Type of construction	EN / IEC 60034-7
Terminal designations and direction of rotation	EN / IEC 60034-8
Noise emission	EN / IEC 60034-9
Starting characteristics of rotating electrical machines	EN / IEC 60034-12
Vibration severity grades	EN / IEC 60034-14

Feature	Standard
Efficiency classification of three-phase squirrel-cage induction motors	EN / IEC 60034-30
IEC standard voltages	IEC 60038

Forced ventilation (optional): Type of cooling IC 416 in accordance with EN / IEC 60034-6

⚠ WARNING

Risk of burning

Operating the machine without external fan results in overheating. This may result in personal injury and material damage.

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.

3.6 Degree of protection

The motor degree of protection is stamped on the rating plate. They can be installed in dusty or humid environments.

⚠ WARNING

Dangerous voltage

The winding can be damaged if objects are introduced into the condensation holes (optional). This can lead to death, serious injury or material damage.

Note the following to maintain the degree of protection:

- Switch off the machine so that it is in a no-voltage condition, before you open the condensation drain holes.
- Close the condensation drain holes, e.g. using T-plugs, before commissioning the machine.

Environmental requirements

The machine is suitable for tropical climates.

Guide value for the standard version, maximum 55 % relative humidity at an ambient temperature of (T_{amb}) 40 °C.

Ambient temperature: -20 °C to +40 °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.

4 Preparing for use

⚠ WARNING

Risk of dropping and swinging when transported suspended

If you transport the motor suspended from cables or ropes, the cables or ropes can break, e.g. as a result of damage. Further, if not adequately attached, the motor can swing. This can result in death, serious injury, or material damage.

- Use additional, suitable lifting equipment for transport and during installation.
- Two cables alone must be able to carry the complete load.
- Prevent the lifting equipment from sliding by appropriately securing it.

⚠ WARNING

Toppling over or slipping of the motor

The motor can slide or topple over if it is not correctly lifted or transported. This can result in death, serious injury, or material damage.

- Use all the lifting eyes on the machine.
- When using the lifting eyes on the machine, do not attach any additional loads or weight. The lifting eyes are only designed for the weight of the machine itself.
- Any eyes that are screwed in must be tightly fastened.
- Eyebolts must be screwed in right up to their supporting surface.
- Comply with the permissible eyebolt loads.
- If necessary, use suitable, sufficiently-sized transport equipment such as lifting straps (EN1492-1) and lashing straps (EN12195-2).

Storage temperature

Permissible temperature range: -20 °C to +50 °C

The relative humidity of the air should be less than 60 %.

For machines that have a special design regarding the coolant temperature in the operating state or the installation altitude, other conditions could apply regarding the storage temperature. In this case, refer to the machine rating plate for data on the coolant temperature and installation altitude.

Storage time

Turn the shafts 1x every year to avoid bearing brinelling. Prolonged storage periods reduce the useful life of the bearing grease (aging).

Open bearings

- For open bearings e.g. 1Z, check the state of the bearing grease over 12 months.
- Replace the grease if it is identified that the grease has lost its lubricating properties or is polluted. The consistency of the grease will change if condensation is allowed to enter.

Closed bearings

- For sealed bearings, replace the DE and NDE bearings after a storage time of 48 months.

NOTICE
Storage The motor can be damaged if you use it or store it unprotected outdoors. • Protect the motor against intensive solar radiation, rain, snow, ice and dust. Use a superstructure or additional cover, for example. • If required, contact the Siemens Service Center, or technically coordinate outdoors use.

5 Mounting, installation

5.1 Safety instructions

⚠ WARNING

Risk of burning

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 down before starting any work on it.
- Only remove covers in compliance with the applicable regulations.
- Operate the machines properly.
- Prevent parts (cables, etc.) from coming into contact with the machine enclosure.

NOTICE

Damage to the motor

In order to avoid material damage, check the following points before commissioning the motor.

- Using appropriate measures, check whether the correct direction of rotation of the motor has been set by the customer, e.g. by decoupling from the driven load.
- Ensure that temperature-sensitive parts (cables, etc.) are not in contact with the machine enclosure.
- Ensure that the condensation drain holes are always located at the lowest part of the motor.

Note

Observe the technical data on the rating plates attached to the motor enclosure.

5.2 Conformity

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.

5.3 Ventilation

⚠ CAUTION

Overheating and failure of the motor

Material damage or slight injury can occur if you do not observe the following points:

- Do not obstruct ventilation.
- Prevent the air expelled by neighboring equipment from being immediately sucked in again.
- On the vertical type of machine construction with air intake from above, protect the air inlets from the ingress of foreign bodies and water.
- If the shaft extension is facing upwards, liquid must be prevented from entering by moving along the shaft.

Table 5-1 Minimum dimension "X" for the distance between neighboring modules and the air intake of the machine

Frame size	X [mm]
63 ... 71	15
80 ... 100	20
112	25
132	30
160	40
180 ... 200	90
225 ... 250	100
280 ... 315	110

5.4 Electromagnetic compatibility

Note

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.

Note

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).
- Avoid that the specified limit values stipulated for the drive system (consisting of the motor and converter) are 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.

5.5 Balancing

⚠ CAUTION

Incorrect mounting or removal

To avoid injury and material damage, carefully observe general touch protection measures for output transmission elements.

- The general touch protection measures for drive output elements must be observed.
- Output elements may only be attached or withdrawn using the correct equipment.
- The feather keys are only secured against falling out during shipping. If you commission a machine without an output element, the feather keys must be secured to prevent them from being thrown out.

The rotor is dynamically balanced. 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 featherkey 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 featherkey (code "H") in accordance with ISO 8821.
- "F" means balancing with a whole featherkey (optional version).

- "N" means balancing without a featherkey (optional version).

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.

5.6 Alignment and fastening

When aligning and mounting, please observe the following:

- Uniform mounting surface
- Mounting feet and flanges are securely fixed.
- Precise alignment for a direct coupling
- Mounting surfaces must be clean
- Remove any anti-corrosion protection using white spirit.
- Avoid installation-related resonances with the rotating frequency and twice the line frequency.
- Listen for unusual noises when turning the rotor manually.
- Check the direction of rotation with the machine decoupled.
- Avoid rigid couplings.
- Repair any damage to the paint, this must be done immediately and correctly.

Flatness of the supporting surfaces for conventional motors

Frame size	Flatness [mm]
≤ 132	0,10
160	0,15
≥ 180	0,20

6 Electrical connection

⚠ DANGER

Hazardous voltages

Death, injury or material damage can occur. Note the following safety information before connecting-up the machine:

- Only qualified and trained personnel should carry out work on the machine while it is stationary.
- Disconnect the machine from the power supply and take measures to prevent it being reconnected. This also applies to auxiliary circuits.
- Check that the machine really is in a no-voltage condition.
- Establish a safe protective conductor connection before starting any work.
- If the incoming power supply system displays any deviations from the rated values in terms of voltage, frequency, curve form or symmetry, such deviations will increase the temperature and influence electromagnetic compatibility.

⚠ DANGER

Hazardous voltages

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

6.1 Terminal box

6.1.1 Instructions for terminal boxes

⚠ DANGER

Hazardous voltage

Electric motors have high voltages. When incorrectly handled, this can result in death or severe injury.

Switch off the machine so that it is in a no-voltage condition before you open the terminal box.

NOTICE

Damage to the terminal box

If you incorrectly carry out work on or in the terminal box, this can result in material damage. You must observe the following to avoid damaging the terminal box:

- Ensure that the components inside the terminal box are not damaged.
- It must be ensured that there are no foreign bodies, dirt or moisture in the terminal box.
- Close the terminal box using the original seal so that it is dust tight and water tight.
- Use O-rings or suitable flat gaskets to seal entries in the terminal box (DIN 42925) and other open entries.
- Please observe the tightening torques for cable glands and other screws.
- When performing a test run, secure the feather keys without output elements.

⚠ WARNING

Hazardous voltage

Loosening the safety torx screw can result in death, serious injury or material damage.

Do not loosen the safety torx screw with respect to the center terminal, as this ensures a conductive connection between the grounding conductor and frame!

NOTICE

Serious damage to the machine

Failure to observe these measures will destroy the motor.

- Only rotate the terminal box if the connection cables have still not been laid.
- If you release the safety torx screw at both sides of the outer connecting terminals, this can destroy the machine.
- Remove the three large snap hooks on the terminal board before rotating the the terminal box. Keep the snap hooks pressed while rotating the terminal box and use a screwdriver to re-engage when finished.

6.1.2 Optional terminal board (star or delta circuit)

NOTICE

Arcing at the optional terminal board can destroy the machine

In order to prevent destroying the machine, it is absolutely essential that you comply with the following note:

To change the operating mode, always press the jumper fully into the base of the slot and use the red locking lever to ensure that it is engaged.

6.1.3 Protruding connection cables

⚠ WARNING

Risk of short-circuit and voltage hazard

A short-circuit can occur if the connecting cables are clamped between the enclosure parts and cover plate. This can result in death, severe injury and material damage.
During disassembly and particularly when installing the cover plate, make sure that the connecting cables are not clamped between enclosure parts and the cover plate.

⚠ CAUTION

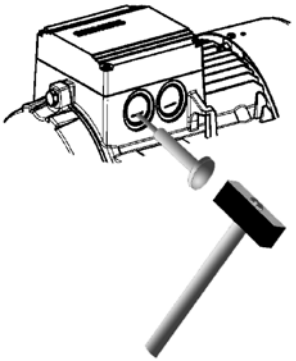
Damage to connecting cables that are freely led out

You must observe the following note to avoid damaging connecting cables that are freely led out:

- 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.

6.1.4 Knockout openings

NOTICE
Damage to the terminal box You must observe the following notes to avoid damaging the terminal box: • Knockout openings in the terminal box must be knocked out using appropriate methods. • Take care not to damage the terminal box or its interior components (the terminal board, cable connections, and so on).



6.1.5 Installation and routing

NOTICE
Damage to terminal board The terminal board can be damaged for incorrect installation and routing. You must apply the following measures to avoid damaging the terminal board: • Remove the screw-type connections (EN 50262) only when the terminal box is closed. • Tighten the screw-type connections to rated torque value only when the terminal box is closed. • Tighten the screw-type connections only finger tight when the terminal box is open. • Make sure that the three large snap hooks are engaged when tightening the screw connections.

6.2 Tightening torques

6.2.1 Electrical connections - Termincal board connections

Table 6-1 Tightening torques for electrical connections on the terminal board

	Thread ∅		M 3,5	M 4	M 5	M 6	M 8	M 10	M 12	M 16
	Nm	min	0,8	0,8	1,8	2,7	5,5	9	14	27
		Max.	1,2	1,2	2,5	4	8	13	20	40

6.2.2 Cable glands

Note

Avoid damaging the cable jacket.

Adapt the tightening torques to the cable jacket materials.

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 6-2 Tightening torques for cable glands

	Metal ± 10% [Nm]	Plastic ± 10% [Nm]	Clamping range [mm]		O ring Cord dia. [mm]
			Standard -30 °C ... 100 °C Ex -30 °C ... 90 °C	Ex -60 °C ... 105 °C	
M 12 x 1.5	8	1,5	3,0 ... 7,0	-	2
M 16 x 1.5	10	2	4,5 ... 10,0	6,0 ... 10,0	
M 20 x 1.5	12	4	7,0 ... 13,0	6,0 ... 12,0	
M 25 x 1.5			9,0 ... 17,0	10,0 ... 16,0	
M 32 x 1.5	18	6	11,0 ... 21,0	13,0 ... 20,0	
M 40 x 1.5			19,0 ... 28,0	20,0 ... 26,0	
M 50 x 1.5	20		26,0 ... 35,0	25,0 ... 31,0	
M 63 x 1.5			34,0 ... 45,0	-	

6.2.3 Terminal boxes, end shields, grounding conductors, sheet metal fan covers

If no other tightening torques are specified, then the values in the following table apply.

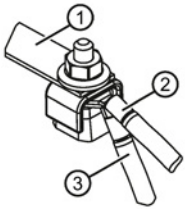
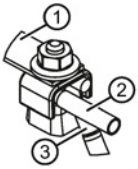
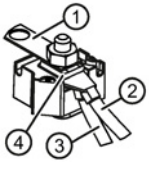
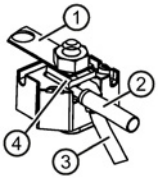
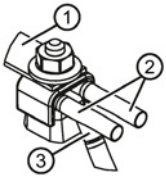
Table 6-3 Tightening torques for screws on the terminal box, end shields, screw-type grounding conductor connections

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 6-4 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

6.3 Type of conductor connection

Terminal board		Conductor cross-section [mm²]
Connection with cable lug DIN 46 234 Bend down the cable lug for the connection.		... 25
Connection of an individual conductor with terminal clamp	  	... 10
Connection of two conductors of approximately the same thickness with terminal clamp		... 25

① Link rail
② Power supply cable
③ Motor connecting cable
④ Cover washer

6.4 Short-circuit hazard conductor connection

⚠ WARNING

Short-circuit hazard

Connection and installation errors at connecting cables and cover washers can result in a short-circuit. Death or serious physical injury can result.

Note the following precautionary measures:

- Do not lay connection cables over the central dome of the terminal board.
- Observe the opening direction and the mounting position of the cover washers on the terminal board.

6.5 General information on connecting the grounding conductor

Note

The machine's grounding conductor cross-section must comply with EN / IEC 60034-1.

Please also observe installation regulations such as those specified in EN / IEC 60204-1.

6.6 Connecting converters

NOTICE

Excessively high supply voltage

Material damage can occur if the supply voltage is too high for the insulation system.

The standard insulation system is designed so that converter operation is possible for line voltages up to $U_N \leq 500$ V. Maintain the following limit values in all operating states (voltage values are peak values):

$\hat{U}_{conductor\text{-}conductor} \leq 1500$ V, $\hat{U}_{conductor\text{-}ground} \leq 1100$ V, voltage rise times of ts > 0.1 µs.

For VSD machines, the following data apply:
$\hat{U}_{conductor\text{-}conductor} \leq 1600$ V, $\hat{U}_{conductor\text{-}ground} \leq 1400$ V, voltage rise times of ts > 0.1 µs.

NOTICE
Shielding • When required, use shielded machine feeder cables when connecting machines to converters. • 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) through a large surface area. • Please observe the section containing instructions on ensuring electromagnetic compatibility (EMC).

See the list of additional operating instructions: Further documents (Page 39)

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.
- The specified limit speed n_{max} is not exceeded. Limit speed n_{min} is not fallen below.

Cooling

- Check that the machine cooling is available for commissioning.

6.7 Final checks

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

- Establish the electrical connections in the terminal box in accordance with the details in the sections above and tighten with the correct torque.
- The clearances between non-insulated parts have been maintained: ≥ 5.5 mm to 690 V, ≥ 8 mm to 1000 V.
- Avoid protruding wire ends!
- In order not to damage the cable insulation, freely arrange the connecting cables.
- Connect the machine corresponding to the specified direction of rotation.
- Keep the inside of the terminal box clean and free from trimmed-off ends of wire.
- Ensure that all seals and sealing surfaces are undamaged and clean.
- Correctly and professionally close unused openings in the terminal boxes.

7 Commissioning

7.1 Insulation resistance

⚠ WARNING

Hazardous voltage at the terminals

Only appropriately trained personnel may carry out this work.

Hazardous voltages are sometimes present at the terminals during and immediately after measurement of the winding insulation resistance. If you touch the terminals, this can result in death, serious injury or material damage.

If any power cables are connected, check to make sure line supply voltage cannot be connected. To discharge the winding, after measuring the insulation resistance, connect the winding to ground potential.

NOTICE

Short-circuit

Material damage can occur if you do not apply the following measures:

- Check the insulation resistance before commissioning and after any extended periods of storage or periods during which the equipment is not operational.
- Before measuring the insulation resistance, read the operating manual for the insulation resistance meter you are going to use.
- Disconnect any connected main-circuit cables from the terminals before measuring the insulation resistance.

Note

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.

Note

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

Measuring 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. Disconnect any connected main-circuit cables from the terminals before measuring the insulation resistance.
3. Where possible, measure the insulation resistance of the winding with respect to the motor enclosure when the winding temperature is between 20 ... 30 °C. Different insulation resistance values apply for other temperatures.
4. When measuring, wait until the final resistance value is reached. This is reached after approximately one minute. Then read off the insulation resistance.

Limit values of the stator winding insulation resistance

The following table indicates the measuring circuit voltage and the limit values for the minimum insulation resistance and the critical insulation resistance of the stator winding.

Table 7-1 Insulation resistance of the stator unwinding at 25 °C

Measuring circuit voltage	500 V DC
Minimum insulation resistance for new, cleaned or repaired windings	10 MΩ
Critical specific insulation resistance after a long operating time	0,5 MΩ / kV

Note the following:

- If the measurements are performed at winding temperatures ≠ 25 °C, convert the measured value to the reference temperature of 25 °C in order to be able to compare the values with the table above.
  - The insulation resistance halves every time the temperature rises by 10 K.
  - The resistance doubles every time the temperature falls by 10 K.
- Dry, new windings have a typical insulation resistance of more than 100 ... 2000 MΩ depending on the winding size, design and rated voltage. An insulation resistance value close to the minimum value could be due to moisture and/or dirt accumulation.
- During operation, the insulation resistance of the windings can fall to the critical insulation resistance due to ambient and operational influences. The critical insulation resistance value for a winding temperature of 25 °C can be calculated by multiplying the rated voltage (kV) by the specific critical resistance value (0,5 MΩ / kV).

  Example:

Critical resistance for U_N = 690 V rated voltage:
690 V x 0,5 MΩ / kV = 0,345 MΩ

NOTICE
Critical insulation resistance reached or fallen below If the critical insulation resistance is reached or fallen below, this can result in damage to the insulation or voltage flashovers. • Contact your Siemens Service Center. • If the measured value is close to the critical value, you must check the insulation resistance at suitably frequent intervals.

7.1.1 Limit values of the anti-condensation heating insulation resistance

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.

7.2 Measures before start-up

⚠ 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. Before commissioning, attach the covers that prevent you coming into contact with active and rotating components.

NOTICE
Damage caused by insufficient cooling Effective cooling is no longer possible if air guidance of the machine is not provided as intended. This can damage the machine. Before commissioning, attach the covers in order to guarantee the required air guidance.

Measures

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.
  Relubricating machines with roller bearings that have been stored for longer than 24 months.
  Also observe the notes in Chapter Preparation for use.
- Any optional 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. See Chapter Setting values for monitoring the storage temperature.
- 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 resistances and minimum clearances are maintained.
- The grounding, equipotential bonding and protective conductor 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 optional 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 an optional 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.

8 Operation

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

⚠ CAUTION

Machine overheating

Slight injury or material damage can occur if you do not observe the following:

Switch off the (optional) anti-condensation heating before switching on.

Machine operation

⚠ DANGER

Hazardous voltages

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

⚠ WARNING

Rotating or live parts

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

- De-energize the machine and bring it into a no-voltage condition before removing any covers.
- Ensure that the following covers are closed in operation:
  - Covers that prevent coming into contact with active or rotating parts
  - Covers that are required for the correct air guidance, and therefore for effective cooling
  - Covers required to maintain the degree of protection of the machine.

WARNING

Danger of burns

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.

Do not touch the machine in operation and wait until the machine has completely cooled down.

NOTICE

Damage to the machine or premature bearing failure

The bearings can be damaged if the following is not observed.

- It is essential that you comply with the permissible vibration values in order to avoid damage to the machine or even its destruction.
- In operation, observe the vibration values in accordance with ISO 10816.
- Be sure to comply with the minimum radial load of 30% of the cylindrical roller bearings in accordance with catalog data.

WARNING

Faults in operation

Changes with respect to normal operation indicate that there is an impaired function. This can cause faults which can result in eventual or immediate death, severe injury or material damage.

For instance, observe the following signs that could indicate a malfunction:

- Higher power drawn than usual
- Higher temperatures than usual
- Unusual noises
- Unusual smells
- Response of monitoring equipment

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

NOTICE

Risk of corrosion due to condensation

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

- If available, remove the drain plugs or screws to drain the water depending on the ambient and operating conditions.
- If available, re-attach the drain plugs or screws.

If the motor is equipped with drain plugs, then the water can drain away by itself.

⚠ CAUTION

Risk of injury when touching the fan

There is a risk of injury at machines equipped with a fan cover (e.g. fan cover used in the textile industry), as the fan is not completely touch protected.

- Do not touch the rotating fan.
- Do not put your fingers into the larger air discharge openings.
- Manual intervention must be prevented on the customer's side by using suitable measures, e.g. appropriate housings or a protective grating.

8.1 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.

NOTICE

Restricted motor function

If not used for longer periods of time, material damage or complete motor failure can occur.

If the motor is out of service for a period of more than 12 months, then environmental effects can damage the motor.

Apply suitable corrosion protection, preservation, packing 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 Preparing for use (Page 8).

Lubricating before recommissioning

NOTICE
Dry running bearings
Bearings can be damaged if they do not have sufficient grease.
Re-grease the bearings if they have been out of service for more than one year. The shaft must rotate so that the grease can be distributed in the bearings. Observe the data on the lubricant plate.
See also Chapter, Maintenance - bearing service life.

9 Maintenance

9.1 Preparation and notes

⚠ WARNING
Hazards when carrying out maintenance work
You must observe the following safety instructions to prevent death, injury or material damage: • 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 circuits, make sure that supplementary and auxiliary circuits, particularly in heating devices, are also disconnected. • Certain parts of the motor 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 using compressed air for cleaning, make sure that appropriate methods of extraction systems are in place and that personal protective gear is worn (protective goggles, face mask and similar). • 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

For operating conditions, which deviate from the conditions specified on the rating plate, the general maintenance intervals specified up until now can change.

9.2 Maintenance

9.2.1 Regreasing (optional)

For machines with regreasing system, relubrication intervals, grease quantity and grease grade are provided on the lubricant plate. Additional data can be taken from the main machine rating plate.

Grade of grease for standard motors (IP55) UNIREX N3 - ESSO.

Note

It is not permissible to mix different types of grease.

Prolonged storage periods reduce the useful lifetime 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, the machine must be immediately relubricated before commissioning. For information on permanently-greased bearings, please refer to the section titled Bearings (Page 33).

Procedure

To relubricate the roller bearings, proceed as follows:

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 motor is running (max. 3600 rpm).

The bearing temperature can rise significantly at first, and then drops to the normal value again when the excess grease is displaced out of the bearing.

9.2.2 Cleaning

Cleaning the grease ducts and spent grease chambers

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

Note

You have to dismantle the bearing cartridges to replace the grease that is in the grease duct.

Cleaning the cooling air ducts

Regularly clean the cooling air ducts through which the ambient air flows.

Note

The frequency of the cleaning intervals depends on the local degree of fouling.

⚠ WARNING

Damage to the machine

Material damage can occur if you direct compressed air towards the shaft outlet or openings in the machine.
Avoid pointing compressed air directly onto shaft sealing rings or labyrinth seals of the machine.

Cleaning machines with cover for the textile industry

In the case of machines with fan covers for the textile industry, 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.

9.3 Repair

9.3.1 Instructions for repair

Qualified personnel

Only appropriately qualified persons should be deployed to commission and operate equipment. Qualified persons, as far as the safety instructions specified in this manual are concerned, are those who have the necessary authorization to commission, ground and identify/tag equipment, systems and circuits in accordance with the relevant safety standards.

Instructions relevant to safety

⚠ WARNING
High voltages 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. Before starting to work on the motor, bring it into a no voltage condition, and only open the covers of active parts once this has been done.

Note

Observe the information in Chapter Preparing for use.

9.3.2 Bearings

For machines above frame size 100 – and for special machines, frame sizes 71 ... 90 (with larger rating plate) – always take the designations of the bearings used from the rating plate.

Standard machines, frame sizes 71 ... 90 have significantly smaller rating plates.

For these machines, refer to the catalog for the designations of the bearings used.

Bearing lifetime

Prolonged storage periods reduce the useful lifetime of the bearing grease. In the case of permanently lubricated bearings, this leads to a shorter bearing lifetime. Bearing or grease replacement is recommended after a storage time of 12 months, for longer than four years, replace the bearings or grease.

Replacing bearings

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

Table 9-1 Bearing replacement intervals

Ambient 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, high vibrational and impact loads, frequent reversing, higher ambient temperature, higher speeds, etc.

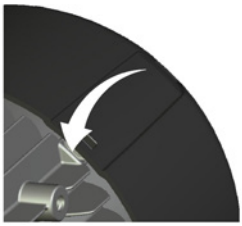
- Do not reuse bearings that have been removed.
- Remove any polluted old grease from the bearing shield.
- Replace old grease with new grease.
- Replace the shaft seals when the bearings are replaced.
- Lightly grease the contact surfaces of the sealing lips!

9.3.3 Removal fan cover, protective canopy, pulse encoder

Plastic fan cover

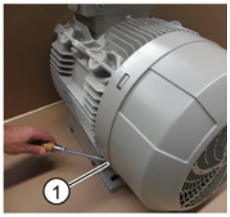
Frame sizes 80 – 160

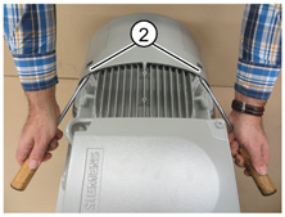
- Carefully release the snap openings of the cover one after the other from the lugs.
  Do not insert the lever directly under the lug, as otherwise it could break.
- Take care to not damage the catch mechanism. Order the appropriate new parts if damaged.



Frame sizes 180 – 200

- Carefully release the first snap opening using a lever.
  For machines with type of construction B3, select the first snap opening in the area around the machine mounting feet.
  Insert the lever at the edge of the cover close to the lug. ①
- Carefully release two other snap openings together and then withdraw the cover. ②
- Take care to not damage the catch mechanism. Order the appropriate new parts if damaged.





Canopy; incremental encoder under the canopy

Canopies with spacer bolts or with bolted holding brackets

Release the fixing screw on the outer surface of the canopy.

Under no circumstances remove the spacer bolts or the mounting bracket – or forcibly separate them from one another or the cover. Forcibly removing or separating can destroy the distance bolts, the connecting elements of the mounting bracket or the fan cover.

Canopies with welded support brackets

Release the fixing screws at the contact location (canopy foot - riveting nut) at the outer surface of the cover mesh.

9.3.4 Installation

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

Sealing measures

- Apply Fluid-D to the centering edge.
- Check the terminal box seals, and if required, replace these.
- Repair any damage to the paint, also to screws/bolts.
- Take the necessary measures to ensure compliance with the applicable degree of protection.
- Do not forget the foam rubber cover in the cable entry. Completely seal the holes, and ensure that cables do not come into contact with sharp edges.

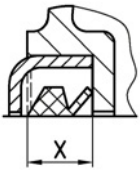
Sealing the bearings

Note the following details:

- Shaft sealing rings are used to seal machines at the rotor shaft. For V rings, comply with the assembly dimension.
- Use the specified bearings.
- Ensure that the bearing sealing disks are in the correct position.
- Insert the elements for bearing preloading at the correct end.
- Fixed bearings can have a locking ring or bearing cover.

Mounting dimension "x" of V rings

<table>
<tr><th>Frame size</th><th colspan="2">X
[mm]</th></tr>
<tr><td>71</td><td>4,5 ±0,6</td><td rowspan="5">Standard design
 

Special design
from frame size 180 and higher (e.g. for explosion-protected motors, with 2p=2 and for higher IP degree of protection)
 
</td></tr>
<tr><td>80 ... 112</td><td>6 ±0,8</td></tr>
<tr><td>132 ... 160
180 ... 200 (1LA, 1MA6)</td><td>7 ±1</td></tr>
<tr><td>180 ... 225
(1LG, 1MA622, 1LE, 1MB1)</td><td>11 ±1</td></tr>
<tr><td>250 ... 315
(1LG, 1MA6, 1LE, 1MB1)</td><td>13,5 ±1,2</td></tr>
</table>

Fans

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

⚠ CAUTION

Incorrectly mounting covers with snap mechanism

Carefully observe the required measure in order to avoid injury by coming into contact with the rotating fan or material damage if the cover becomes loose – either partially or completely – while the machine is operational.

Carefully ensure that all four snap openings of the cover completely engage in the associated snap-in lugs.

Fan cover, frame sizes 80 ... 200

- Align the cover with the line marked on the edge of the cover with the middle enclosure rib as extension to the terminal box base.
- Center the cover by axially moving on the snap-in lugs of the enclosure or the bearing shield cams.
- First engage two snap openings positioned next to one other, then carefully press the cover into position with the two openings situated opposite these using the snap-in lugs, and snap it into place.
- Attach the cover using all four of its snap-in lugs by applying axial pressure to the reinforced edge of the cover in the area of the cover mesh.
- If required, use a rubber hammer and apply it once or several times to the edge of the cover in the axial direction. When doing this, take care not to damage or destroyed the mesh of the cover.
- When fitting the cover, do not overextend it (you could break it).

Miscellaneous

- Number and position of rating plates and additional labels as in original condition
- If necessary, fix cables in place.
- Check tightening torques of all screws, as well as those of screws which have not been unscrewed.

10 Spare parts

General

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

A Appendix

A.1 SIEMENS Service Center

Details regarding the design of this electrical machine and the permissible operating conditions are described in these instructions.

On-site service calls and spare parts

If you wish to request on-site service calls or order spare parts, please contact your local Siemens sales office. This office will contact the responsible service center on your behalf. You can find your local contact partner here.

Technical queries or additional information

If you have any technical queries or you require additional information, please contact the Siemens Service Center.

Please have the following machine data ready:

- Machine type
- Serial number

You can find this data on the rating plate of the machine.

Service numbers

Table A-1 Siemens Service Center contact details

Time zone	Telephone	Fax	Internet
Europe / Africa	+49 911 895 7222	+49 911 895 7223	http://www.siemens.com/automation/support-request (http://www.siemens.de/automation/support-request)
Americas	+1 423 262 5710	+1 423 262 2231	mailto:techsupport.sea@siemens.com
Asia / Pacific	+86 10 6475 7575	+86 10 6474 7474	mailto:support.asia.automation@siemens.com

A.2 Further documents

These operating instructions can also be obtained at the following Internet site:

http://www.siemens.com/motors

General Documentation

1.517.30777.30.000	1XP8001 encoder
5 610 00000 02 000	Operating_Instructions_Simotics GP, SD, DP, XP
5 610 00000 02 001	Operating_Instructions_Compact_Simotics GP, SD, DP
5 610 00000 02 002	Operating_Instructions_Compact_Simotics XP
5 610 00002 09 000	Incremental encoder 1XP8012-1x
5 610 00002 09 001	Incremental encoder 1XP8012-2x
5 610 70000 02 015	External fan
5 610 70000 10 020	Spring-loaded brake

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Standard machines
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