1PH4 induction motors

Operating instructions · 05/2010

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1PH4 Induction Motors

Operating Instructions

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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

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE

indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

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 for the specific task, 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 adhered to. The information in the relevant documentation must be observed.

Trademarks

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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

1.1 About these operating instructions

These operating instructions describe the motor and explain how to handle the motor from delivery up to disposal.

Before you start using the motor, you must read these operating instructions. to ensure safe, problem-free operation and to maximize the service life.

These operating instructions are applicable in conjunction with the relevant SIEMENS Configuration Manual.

Siemens strives continually to improve the quality of information provided in these operating instructions. If you find any mistakes or would like to offer suggestions about how this document could be improved, please contact the Siemens Service Center.

Always follow the safety instructions and notices in these operating instructions. The warning notice system is explained on the back of the inside title page.

Text format features

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

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

- Lists are in the form of bullet points.
  - A dash indicates a second level list entry.

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.

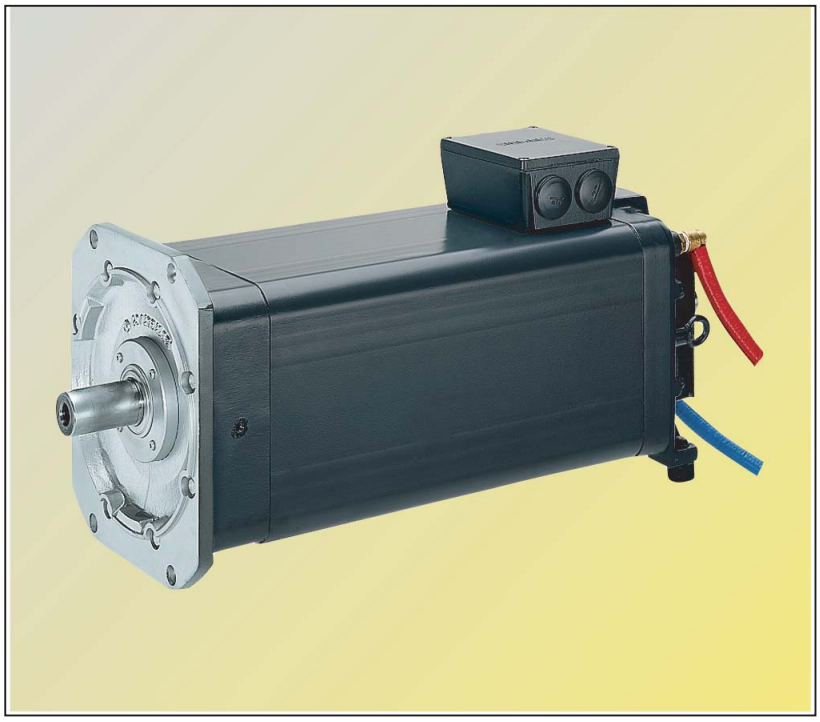


Figure 1-1 1PH4 three-phase motor

Safety instructions 2

2.1 General safety notes

Safety and commissioning information for converter-fed low-voltage three-phase motors

⚠ DANGER

All activities associated with transporting, connecting, commissioning, and maintaining the motors must be carried out by properly trained, responsible personnel (DIN EN 50110-1; observe IEC 60364).

Failure to follow proper procedures may result in injury or material damage.

Special versions and construction versions may differ with respect to certain technical aspects! If in doubt, you are strongly advised to contact the manufacturer, specifying the type designation and serial number (see rating plate), or arrange for any maintenance work to be carried out by the SIEMENS Service Center.

Systems and machines with converter-fed low-voltage three-phase motors must fulfill the protective requirements of the EMC Directive.

The machine manufacturer is responsible for ensuring that installation is carried out properly. The signal and power cables to the motor must be shielded.

The information provided by the converter manufacturer regarding EMC-compliant installation must be observed!

Intended use

These motors are designed for use in industrial or commercial systems. They comply with the EN 60034-1 standards and the relevant associated sections.

⚠ WARNING

It is forbidden to install them in hazardous areas unless they are explicitly designed for this.

If more stringent requirements are necessary in special non-commercial cases (e.g. touch protection for children's fingers), the customer must implement the relevant measures to ensure that these requirements are fulfilled.

Any alternative data specified on the rating plate (nameplate) must be taken into account. The on-site conditions must comply with the rating plate data.

The motors are designed for use in covered areas and rooms under normal climatic conditions, such as those found in production halls.

2.2 Safety and application instructions

The safe use of electrical motors

⚠ WARNING

Rotating or live parts

Rotating or live parts represent a danger.

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

Covers must only be removed and the motor operated in accordance with the relevant regulations. The motor must be maintained on a regular basis.

Qualified personnel

These operating instructions only contain the information necessary for ensuring that the motor is operated by properly trained personnel in accordance with its 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 suitably qualified personnel and checked by responsible, suitably skilled personnel.
- The operating instructions and the motor documentation are available at all times.
- 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.
- Unqualified persons must not work on or in the vicinity of these motors at any time.
- If the motors are used outside industrial areas, the installation site must be protected against unauthorized access by means of suitable protection facilities (e.g. safety fences and warning signs).

Note

Siemens Service Center

You are advised to contact your nearest Siemens Service Center to request their services and support for planning, installation, commissioning, and maintenance activities.

2.3 Observing the five safety rules

For your personal safety and to prevent material damage when working on the motor, always observe the safety instructions and the following five safety rules. Apply the five safety rules in the order stated before starting any work at/on the motor.

Five safety rules

1. Disconnect and isolate

   You must also make sure that the auxiliary circuits are also disconnected.
2. Protect against reconnection.
3. Make sure that the equipment is de-energized and is in a no-voltage condition.
4. Ground and short-circuit.
5. Cover or enclose adjacent components that are still live.

After the work has been completed, undo the measures taken in the inverse sequence.

2.4 Thermal hazard

⚠ CAUTION

The surface temperature of the motors can reach 80 °C.

Do not touch hot surfaces!

Temperature-sensitive components (electric cables and/or electronic components) must not be placed on hot surfaces. The windings and bearings can be destroyed if the motor overheats.

Only operate the motors in conjunction with effective temperature control!

2.5 Notes about electromagnetic fields

⚠ WARNING

Electromagnetic fields

Electromagnetic fields are generated by the operation of electrical power equipment such as transformers, converters or motors.

Electromagnetic fields can interfere with electronic devices, which could cause them to malfunction. For example, the operation of pacemakers can be impaired, potentially leading to damage to a person's health or even death. It is therefore forbidden for persons with pacemakers to enter these areas.

The plant operator is responsible for taking appropriate measures (labels and hazard warnings) to adequately protect operating personnel and others against any possible risk.

- Observe the relevant nationally applicable health and safety regulations. In Germany, "electromagnetic fields" are subject to regulations BGV B11 and BGR B11 stipulated by the German statutory industrial accident insurance institution.
- Display adequate hazard warning notices.
- Place barriers around hazardous areas.
- Take appropriate measures (e.g. by using shields) to reduce electromagnetic fields at their source.

2.6 ESD-sensitive components

ESD guidelines

CAUTION

Electrostatic discharge

Electronic modules contain components that can be destroyed by electrostatic discharge.

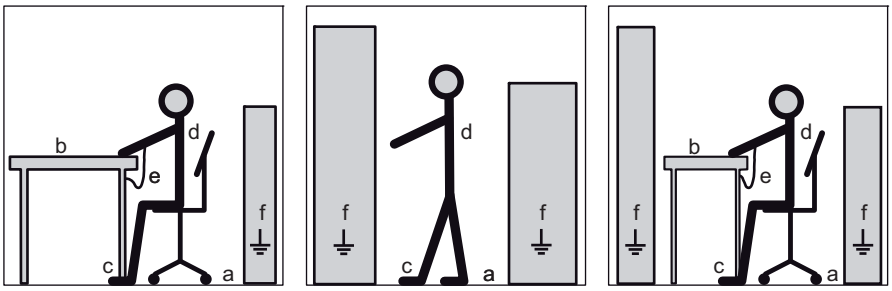
These modules can be easily destroyed if they are not handled properly.

To protect your equipment against damage, follow the instructions given below.

- Never touch electronic modules unless absolutely necessary in the course of maintenance and repair procedures.
- If the modules have to be touched, the body of the person concerned must be electrostatically discharged and grounded immediately beforehand.
- Electronic modules should not be brought into contact with electrically insulating materials such as plastic foil, plastic parts, insulating table supports or clothing made of synthetic fibers.
- Always place electrostatic sensitive devices down on conductive surfaces.
- Always store and transport electronic modules or components in conductive packaging (e.g. metallized plastic or metal containers).

CAUTION
Use conductive packaging material Electronic components must be stored, transported, and shipped in conductive packaging. Electronic modules that are not properly stored, transported, and shipped may be damaged. Pack electronic modules in appropriate conductive packaging (e.g. foam rubber or household aluminum foil).

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



(1) (2) (3)

(1) Seated

(2) Standing

(3) Seated/standing

ESD protective measures

a = conductive floor

b = ESD table

c = ESD footwear

d = ESD coat

e = ESD wrist strap

f = cabinet ground connection

Figure 2-1 ESD protective measures

Description 3

3.1 Area of application

Given the compact design of modern machines, the heat loss from electrical drives can have an adverse effect on the machining precision. The consequential requirement for cold motors at high power densities led to the development of 1PH4 water-cooled motors.

Furthermore, a combination of high torque and low envelope dimensions (low moments of inertia) results in short acceleration and braking times. and thus in a reduction in non-productive times.

1PH4 motors are robust, 4-pole squirrel-cage induction motors. Power loss and noise emission are reduced to a minimum. Thanks to the compact design of the motors, high maximum speeds can be achieved.

The motors are equipped with an encoder system for sensing the motor speed and indirect position. In machine tools, the encoder system is capable of C-axis operation as standard – i.e. an additional encoder is not required for C-axis operation.

NOTICE
The standard motors are neither suitable for use in corrosive atmospheres, atmospheres with a high salt content, nor in outdoor applications.

3.2 Rating plate (nameplate)

The rating plate (nameplate) contains the technical data of the motor.

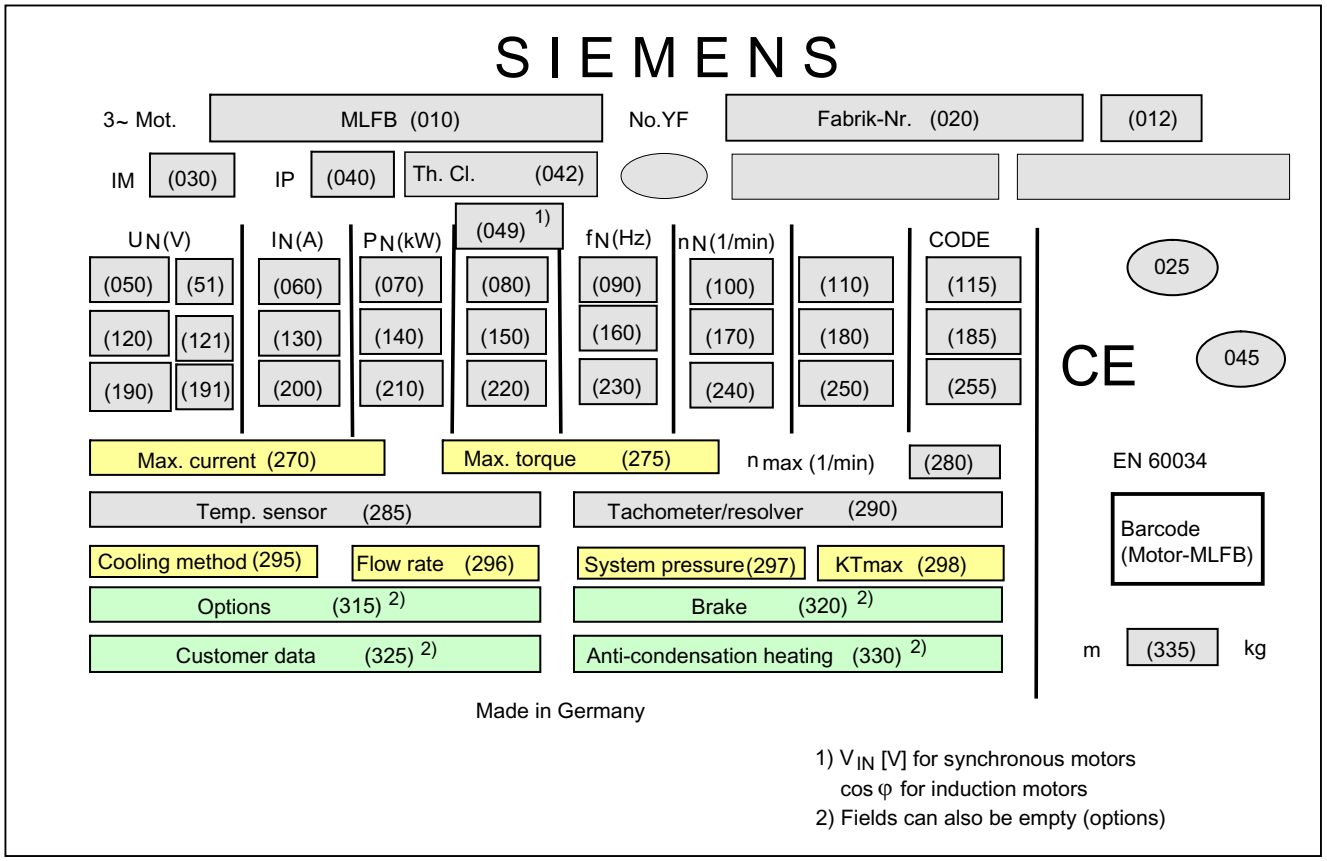


Figure 3-1 Basic layout of a 1PH4 rating plate

Table 3- 1 Elements on the rating plate

No.	Description	No.	Description
010	MLFB	180	Operating mode (2)
012	Consecutive number	185	Code No. 2
020	Factory serial number	190	Rated voltage V_N (3)
025	UL marking	191	Winding connection 3
030	Type of construction	200	Rated current I_N (3)
040	Degree of protection	210	Rated power P_N (3)
042	Thermal class	220	cos φ (3)
045	Balancing code	230	Rated frequency f_N (3)
049	for induction motors: cos φ	240	Rated speed n_N (3)
050	Rated voltage V_N (1)	250	Operating mode (3)
051	Winding connection 1	255	Code No. 3
060	Rated current I_N (1)	270	Maximum current I_{max}
070	Rated power P_N (1)	275	Maximum torque M_{max}
080	cos φ (1)	280	Maximum speed n_{max}
090	Rated frequency f_N (1)	285	Temperature sensor
100	Rated speed n_N (1)	290	Tachometer or resolver
110	Operating mode (1)	295	Cooling method
115	Code No. 1	296	Flow rate l/min (m^3/s)
120	Rated voltage V_N (2)	297	System pressure
121	Winding connection 2	298	Maximum coolant temperature
130	Rated current I_N (2)	315	Options (I)
140	Rated power P_N (2)	320	Options (II)
150	cos φ (2)	325	Optional customer information
160	Rated frequency f_N (2)	330	Anti-condensation heating
170	Rated speed n_N (2)	335	Weight

3.3 Design

3.3.1 Standards and regulations

The motors comply with the following regulations to IEC/EN 60034:

Table 3- 2 Regulations that have been applied

Designation	Standard
Rating and performance	IEC/EN 60034-1
Degree of protection [1)]	IEC/EN 60034-5
Cooling	IEC/EN 60034-6
Type of construction [1)]	IEC/EN 60034-7
Terminal markings	IEC/EN 60034-8
Noise emission	IEC/EN 60034-9
Temperature monitoring	IEC/EN 60034-11
Vibration severity grades	IEC/EN 60034-14

[1)] The degree of protection and type of construction of the motor are stamped on its rating plate.

The three-phase motors comply with the relevant sections of EN 60034 and EN 60204-1. The three-phase motors comply with low-voltage directive 2006/95/EC. Standard motors comply with the UL regulations. "UR" is stamped on the rating plate of these motors.

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

Note

Make sure that your end product is in compliance with all of the applicable regulations and legislation! The applicable national, local, and system-specific regulations and requirements must be taken into account.

3.3.2 Types of construction

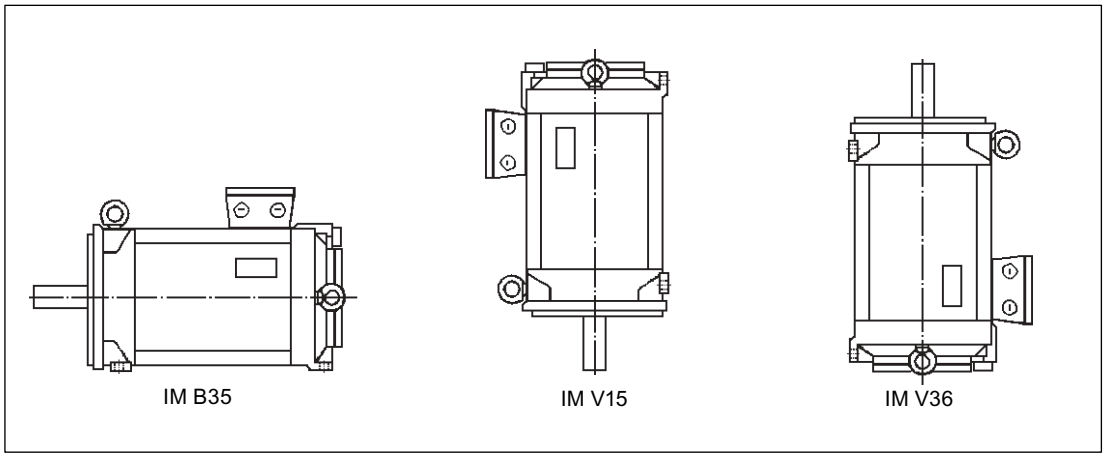


Figure 3-2 Types of construction

Lifting eyebolts, which can be screwed onto the motor in accordance with its type of construction, are supplied with the motor for transportation purposes.

NOTICE
Liquid must not be allowed to build up on the flange on vertically or horizontally mounted motors. Failure to protect the flange against liquid build-up may damage the bearing and/or the bearing grease.

3.3.3 Degree of protection

Water-cooled 1PH4 motors have degree of protection IP65, and at the shaft output, degree of protection IP54.

3.3.4 Cooling

Water cooling

The motor can only be operated in a closed cooling-water circuit with a heat-exchanger unit. The motor is connected to the cooling circuit by means of two female threads at the rear of the motor. The water inlet and outlet can be freely selected.

Table 3- 3 Technical data relating to water cooling

Cooling water connection	G1/4" for 1PH410 G3/8" for 1PH413 G1/2" for 1PH416
Cooling water flow	6 l/min for 1PH410 8 l/min for 1PH413 10 l/min for 1PH416
Cooling power to be dissipated	1900 W for the 1PH4103 2600 W for the 1PH4105 3000 W for the 1PH4107 2750 W for the 1PH4133 3500 W for the 1PH4135 4100 W for the 1PH4137 4500 W for the 1PH4138 4600 W for the 1PH4163 5400 W for the 1PH4167 6200 W for the 1PH4168
Max. pressure at the inlet	6 bar max.
Pressure loss between inlet and outlet	< 0.9 bar for minimum cooling water flow
Min. cooling water inlet temperature	$T_{cool} > T_{ambient} - 5$ K
Maximum cooling water inlet temperature, without derating	≤ 30 ° higher values mean that the power has to be reduced (derating)

Only water with the appropriate quantities of additives to protect against corrosion and minimize the growth of algae can be used as a coolant. Other coolants (e.g. cooling-lubricating medium, water-oil mixtures with 10% oil and higher) may result in derating.

If there is a risk of frost, preventive measures must be taken during operation, storage, and transportation (anti-freeze, emptying the cooling system and blowing out with air, etc.). Use and concentration of the anti-freeze according to the manufacturer's data (max. 25%). Different anti-freeze agents should not be mixed.

A filter (100 µm) must be installed in the inlet pipe to protect the motor against contamination. Additional protection for the motor must be provided by means of a pressure relief valve installed downstream of the filter in the inlet pipe.

Cables and fittings can be made out of e.g. stainless steel, or plastic. If different materials are used in close proximity to each other, however, the electrochemical series must be taken into account, which is why zinc must not be used in cooling water circuits.

If a throttle is needed to restrict the flow, it is best to install it downstream of the motor. It must not be installed directly in front of the inlet because the effects of cavitation may damage the motor.

The values specified for the cooling water (refer to the following table) correspond to the requirements of closed cooling circuits. Not all of the specified concentrations will occur in the cooling water at the same time.

Table 3- 4 Water specifications for coolant

	Quality of the water used as coolant for motors with aluminum, stainless steel tubes and cast iron or steel jacket
Chloride ions	< 40 ppm, can be achieved by adding deionized water
Sulfate ions	< 50 ppm
Nitrate ions	< 50 ppm
pH value	6 ... 8
Electrical conductivity	< 500 µS/cm
Total hardness	< 170 ppm

Note

It is recommended to use deionized water with reduced conductivity (5 ... 10 µS/cm) (if required, ask the water utility for the values). According to 98/83/EC, drinking water may contain up to 2500 ppm of chloride!

Manufacturers of chemical additives can provide support when analyzing the water that is available on the plant side.

Table 3- 5 Coolant quality

	Coolant quality
Cooling water	According to the table "Water specifications for cooling water"
Corrosion protection	0.2 to 0.25 % inhibitor, Nalco TRAC100 (previously 0GE056)
Anti-freeze protection	When required, 20 - 30 % Antifrogen N (from the Clariant Company)
Dissolved solids	< 340 ppm
Size of particles in the water	< 100 µm

Note

Corrosion protection is not required if it ensured that the concentration of Antifrogen N is > 20%.

Derating is not required for an anti-freeze protection concentration of < 30%.

NOTICE

Storing or transporting the motor

The cooling circuit must be emptied when storing the motor, when the motor is out of service for a long period, and when the motor is being transported.

3.3.5 Noise emission

When operated in the range from 0 up to the rated speed, motors can reach the following measuring-surface sound pressure level Lp(A):

Table 3- 6 Measuring-surface sound-pressure level

Shaft height	Measuring-surface sound pressure level Lp(A)
1PH410	69 dB(A) + 3 dB(A) tolerance
1PH413	69 dB(A) + 3 dB(A) tolerance
1PH416	71 dB(A) + 3 dB(A) tolerance

The motors are certified for a wide range of installation and operating conditions. These conditions such as rigid or vibration-isolated foundation design influence noise emission, sometimes significantly.

Preparing for use 4

4.1 Shipping and packaging

Checking the delivery for completeness

The drive systems are assembled on an individual basis. Upon receipt of the delivery, 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.
- 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.

The rating plate, which is supplied separately, should be located in the vicinity of the motor as an additional means of making the motor data available.

The rating plate (type plate) is inside the terminal box.

4.2 Transport and storage

4.2.1 Transporting

Use suitable load suspension devices when transporting and installing the motor. Make sure that all of the eyebolts provided are used during transportation. Country-specific regulations must be observed.

If the motor is not to be commissioned immediately following delivery, it must be stored in a dry, dust-free room that is not susceptible to vibration (see "Storage").

⚠ WARNING

Hazards when lifting and transporting!

Devices and tools that are badly designed, unsuitable, or damaged can result in personal injury and/or material damage.

Lifting devices, fork lift trucks, and load suspension devices must comply with the appropriate regulations. Pay attention to the lifting capacity of the hoisting gear. Do not attach any additional loads. To hoist the motor, use suitable cable-guidance or spreading equipment (particularly if the motor is equipped with built-on assemblies). The weight of the motor is specified on the rating plate (type plate).

⚠ WARNING

Transporting and lifting the motor by means of the lifting eyebolts

Only lift the motor using the lifting eyebolts on the bearing end shields.

Lifting eyebolts must not be attached to the shaft extension.

Never lift the motor by the Sensor Module or the cooling water piping system. The motor can fall down. This can result in death or serious injury as well as damage or total loss of the motor.

CAUTION

When lifting and transporting the motors using the eyebolts supplied (acc. to DIN 580), you must use a cross-arm!

The following should be noted:

- The ring bolt must be screwed in completely and secured by hand (approx. 8 Nm). Do not overtighten.
- Do not remove the plain pressboard washer and do not use deformed or damaged ring bolts.
- Loads that run transverse to the ring plane are not permitted.
- If the motor is installed with the shaft extension pointing downwards or upwards, the lifting eyebolts must be positioned as shown in the table "Arrangement of the lifting eyebolts".

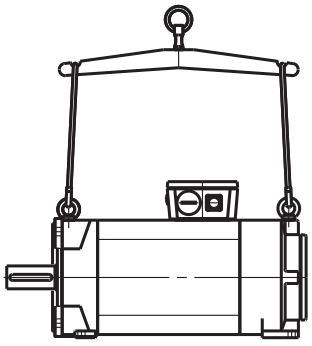


Figure 4-1 Lifting and transporting the motor with a cross beam (example)

Transporting a motor that has already been in operation

If you want to transport a motor that has already been in operation, proceed as follows:

1. Allow the motor to cool down.

2. Remove the connections on the customer side.
3. Empty any cooling water in the motor and purge it carefully with air.
4. Always transport and lift the motor by the lifting eyebolts on the bearing end shields.

4.2.2 Storage

The motors can be stored for up to two years in a dry, dust-free room that is free of vibration (v_{rms} < 0.2 mm/s) without the specified storage time being reduced.

CAUTION
Bearing damage caused by long non-operational periods If the motors are stored incorrectly there is a risk of bearing damage such as brinelling, for example as a result of vibration.

Storing indoors

- Apply a preservation agent (e.g. Tectyl) to bare, external components (e.g. shaft extensions) if this has not already been carried out in the factory.
- Store the motor in an area that fulfills the following requirements:
  - Dry, dust-free, frost-free and vibration-free. The relative air humidity should be less than 60% and the temperature should not drop below -15 °C in accordance with EN 60034-1.
  - Well ventilated.
  - Offers protection against extreme weather conditions.
  - The air in the storage area must not contain any aggressive gases.
- Protect the motor against shock and humidity.
- Make sure that motor is covered properly.
- Avoid contact corrosion. You are advised to rotate the shaft extension manually every three months.

Protection against humidity

If a dry storage area is not available, the following measures must be taken:

- Wrap the motor in moisture-absorbing material and then wrap it in film so that it is air tight.
- Include several bags of desiccant in the sealed packaging. Check the desiccant and replace as required.
- Place a humidity meter in the sealed packaging to indicate the level of air humidity inside it in four levels.
- Inspect the motor on a regular basis.

Long-term storage

If you intend to place the motor in storage for longer than six months, then you must check its condition every six months.

- Check the motor for any damage.
- Carry out any necessary maintenance work.
- Document all preservation measures taken so that they can be reversed before the motors are commissioned at a later date.
- Air condition the storage room.

Condensation

Condensation can collect in the motor as a result of significant fluctuations in ambient temperature, exposure to direct sunlight, high levels of humidity in the storage location or intermittent operation/variations in load during operation.

CAUTION
Damage caused by condensation water If the stator winding is damp, its insulation resistance decreases. This results in voltage flashovers, which can destroy the winding. Condensation can also cause rusting inside the motor.

Protecting the cooling-water system

When the units are delivered, the cooling-water system is not filled with cooling water.

- When you place the motor in storage after use, drain the cooling water ducts and purge them with air so that they are completely empty.
- To operate the motor, add an anti-freeze agent (e.g Antifrogen or Tyfocor) to the cooling water (max. 20% to 30%).

CAUTION
Frost damage to the cooling circuit The cooling circuit can be damaged if the cooling water freezes. If the ambient temperature falls below 0 °C during operation, add anti-freeze to the cooling water.

Installation 5

5.1 Installation

CAUTION
Temperature-sensitive parts Some parts of the 1PH4 motor enclosure can reach temperatures of up to 80 °C. Temperature-sensitive components, e.g. cables etc., can be damaged if they come into direct contact with the motor enclosure. When locating temperature-sensitive components, ensure that they do not come into contact with the motor enclosure.

CAUTION
Shaft extension When installing and mounting the motor, ensure that the shaft extension is protected against impact and pressure.

Note

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

Motor installation

- Observe the type of construction and degree of protection stamped on the rating plate and check that they comply with the conditions at the installation location.
- Refer to the configuration manual for the permissible radial and axial forces.
- Check that they match the conditions (temperature, installation altitude) at the installation location.
- Ensure that the end of the shaft is completely free of any anti-corrosion protection (use a commercially available solvent).
- Ensure that the flange or mounting foot has even contact with the mounting surface. No stress or strain is permissible.
- If the motor is installed vertically with the shaft extension facing up, ensure that no liquid can enter the upper bearing.

- Rotate the drive output elements by hand. If you hear any grinding noise, rectify the cause or contact the manufacturer.
- Lifting eyebolts that have been screwed in must either be tightened or removed after installation.

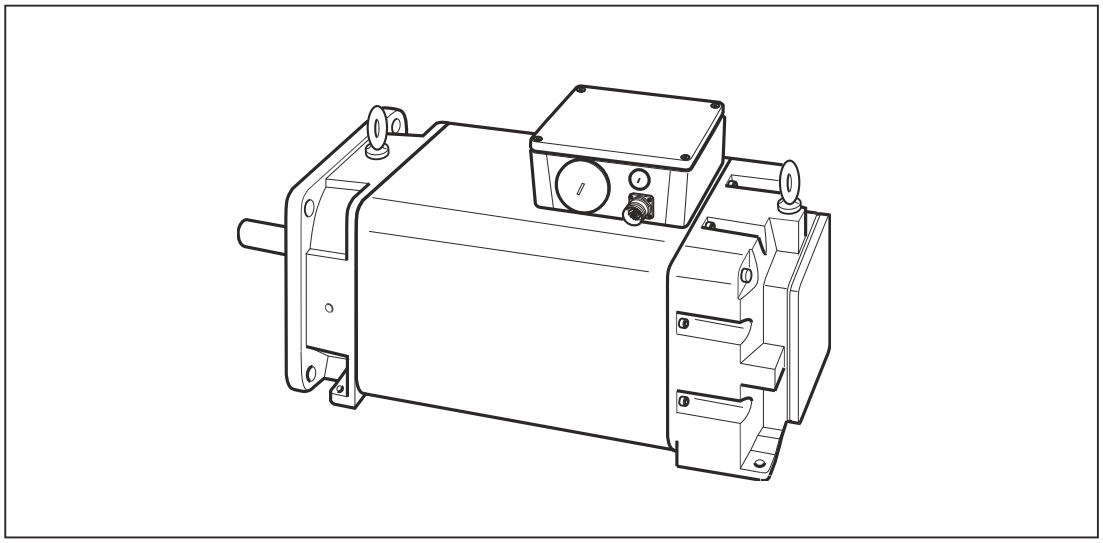


Figure 5-1 1PH4 motor

5.2 Mounting

To ensure smooth, vibration-free operation, the foundation must be designed in accordance with DIN 4024, the motor must be precisely aligned, and the components to be mounted on the shaft extension must be correctly balanced.

Mounting the motor using its motor feet (foot mounting)

The contact surfaces of the motor feet must lie on one plane. If the motor needs to be aligned, locate metal shims below the motor feet in order to prevent the motor from being subject to any strain. The number of shims should be kept as low as possible i.e. stack as few as possible.

Mounting using the motor flange (flange mounting)

NOTICE
When the motor is flange-mounted, this creates a system that is capable of oscillation with specific natural mounting frequencies. In operation, this can result in excessive vibration. Countermeasures: Provide additional support at the NDE. Ensure that the motor is not subject to excessive strain.

Tightening torques for foot/flange mounting

Table 5- 1 Tightening torques

Mounting type	Screw	Washer ISO 7092	Tightening torque ± 10% [Nm]
Foot mounting	M10	10 (d2 = 18)	42
Foot mounting	M12	12 (d2 = 20)	70
Flange mounting	M16	16 (d2 = 28)	165
The appropriate bolts must be used depending on the mounting space. Use bolts with property class 8.8 or higher.			

Alignment accuracy for coupling output

The maximum concentricity of the shafts of the motor and the driven machine is 0.05 mm in the diameter.

5.3 Attaching the output elements

Balancing

The rotors are balanced dynamically. For shaft extensions with feather keys, the balancing method at the DE of the shaft is marked as follows:

- "H" means **H**alf key = balancing with a half feather key
- "F" means **F**ull key = balancing with a whole feather key

Attaching the output elements

- Make sure that the balancing method of the output element is correct. The output elements must be balanced to balance quality grade G2.5 acc. to ISO 1940. Rotary forces that exceed this value are not permissible. Please note that rotary forces can also occur when using a coupling output.
- If the output element is shorter than the feather key with balancing method "H", the section of the feather key that protrudes from the shaft contour and output element must be removed. to maintain the balance quality.
- Only use suitable equipment to mount and remove the output elements:
  - Use the threaded hole in the shaft extension (face).
  - If necessary, heat up the output element.
  - When removing output elements, use a washer to protect the centering in the shaft extension.

⚠ WARNING

Touch protection for output elements

The general touch protection measures for output elements must be observed.

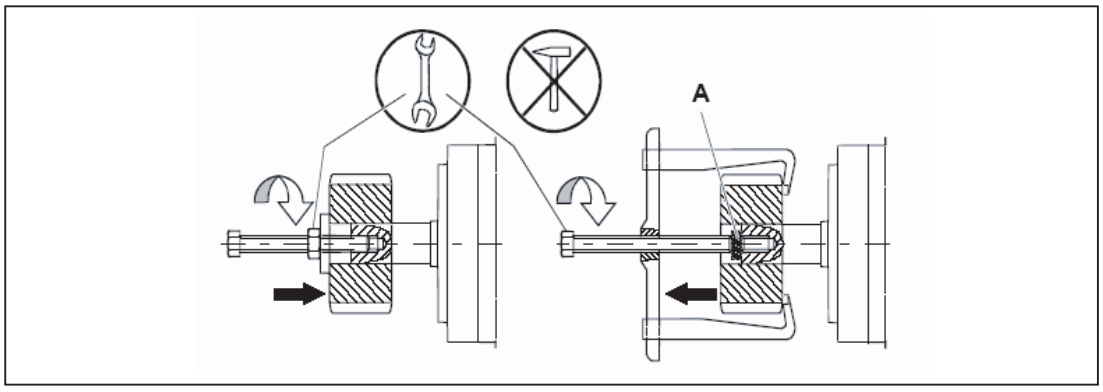


Figure 5-2 Fitting/removing output elements; A = intermediate washer (to protect the centering in the shaft extension)

Motor without output element

⚠ WARNING

The feather key can be flung out

The featherkeys are only secured during transport to prevent them from falling out. If a motor is not equipped with an output element, the feather key may be flung out in operation.

Death or serious injury can result.

At the shaft extension, secure the feather key without output element so that it cannot be flung out and for balance type "H" shorten it by approximately half.

5.4 Vibration resistance

The on-site system vibration behavior depends on factors such as the output elements, mounting situation, alignment, installation, and external vibration and can increase the level of vibration on the motor.

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

To ensure problem-free operation and a long service life, the vibration values specified to ISO 10816 must not be exceeded at the specified measuring points on the motor.
The threaded holes of the lifting eyebolts are defined as a measuring point. The necessary pickups can be screwed in here if required. Care must be taken to ensure that the pickup is securely connected to the motor.

Table 5- 2 Max. permissible radial vibration values [1)]

Vibration frequency	Vibration values
< 6.3 Hz	Vibration amplitude s ≤ 0.16 mm
6.3 - 250 Hz	Vibration velocity v_{rms} ≤ 4.5 mm/s
> 250 Hz	Vibration acceleration a ≤ 10 m/s^2

1) Both values must be maintained simultaneously

Table 5- 3 Max. permissible axial vibration values [1)]

Vibration velocity	Vibration acceleration
v_{rms} = 4.5 mm/s	a_{peak} = 2.25 m/s^2

1) Both values must be maintained simultaneously

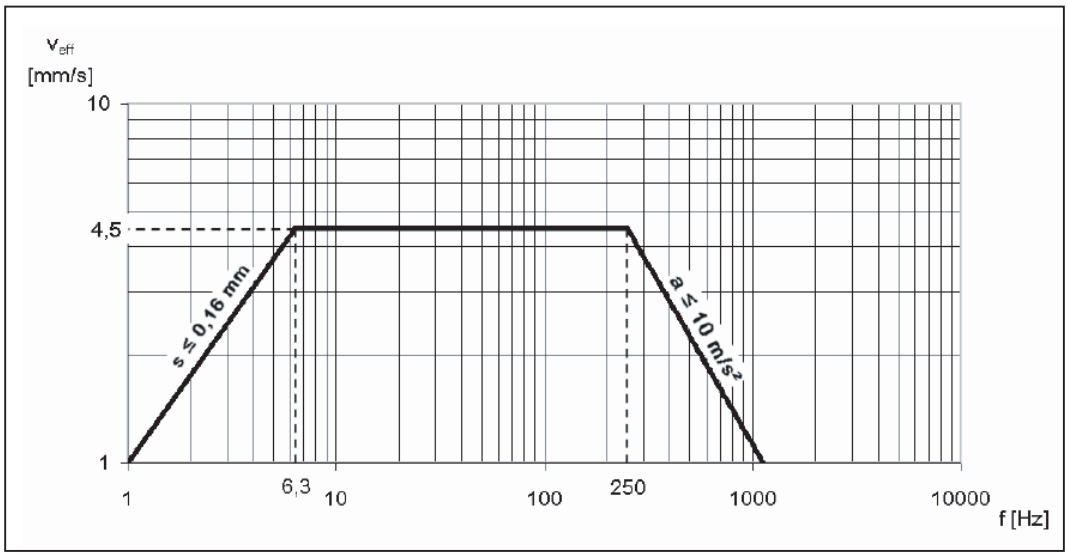


Figure 5-3 Max. permissible vibration velocity, taking into account the vibration amplitude and vibration acceleration

To measure the vibration velocity, the measuring equipment must fulfill the requirements of ISO 2954. The vibration acceleration must be evaluated as a peak value in the time range and in a frequency band of 10 to 2000 Hz.

If vibration is excited in excess of 2000 Hz (e.g. gear tooth meshing frequencies) can be expected, the measurement range must be adapted accordingly. This does not alter the maximum permissible values.

Connection 6

6.1 Mechanically connecting the water cooling system

The inlet and outlet holes for the cooling water supply are located on the NDE in the bearing shield.

1. Make sure that the cooling water fulfills the required cooling water specification, see the chapter titled "Cooling".
2. Make sure that the appropriate volume of cooling water is available, see the rating plate (type plate).
3. Screw the cooling water pipes into the female thread. You can connect the inlet and outlet as required.
4. Ensure that the maximum permissible operating pressure does not exceed 6 bar.

6.2 Electrical connection

6.2.1 Safety instructions

⚠ DANGER

Risk of electric shock

All electrical work must be carried out when the motor is at a standstill! This also applies to auxiliary circuits (e.g. external fan unit).

Converters and connectors must only be installed by properly trained personnel! Regulations regarding work carried out in electrical installations must be observed!

Safety regulations for work performed in electrical installations to EN 50110-1 (DIN VDE 0105-100):

- Disconnect and isolate.
- Take measures to prevent reconnection to the supply (lock out the supply).
- Make sure that the equipment is de-energized and is in a no voltage condition.
- Ground and short-circuit.
- Erect barriers around or cover adjacent live parts.

CAUTION

Electrostatically sensitive devices

The DRIVE-CLiQ interface contains electrostatically sensitive devices. Touching connections with electrostatically charged hands or tools can cause malfunctions.

Note the ESD protection measures.

⚠ DANGER

Warning regarding motor damage!

- The motor will be destroyed if it is connected directly to the three-phase line supply.
- Only operate the motors with the appropriately configured converters!
- Ensure that the correct phase sequence is used!
- Encoder systems and temperature sensors are electrostatic sensitive devices (ESD).
- Do not touch the connections with either hands or tools that could be electrostatically charged!

6.2.2 Terminal box connection

The following must be observed when connecting the terminal box:

- Just enough insulation must be removed from the cable ends so that the insulation almost extends up to the cable lug or terminal.
- The size of the cable lugs are adapted in line with the dimensions of the terminal board connections and the cross-section of the line supply cable (use parallel connecting cables, if necessary).
- The protective conductor is connected.
- The inside of the terminal box is clean and free of any cable remains.
- All screwed connections of the electrical connection – terminal board connections (with the exception of the terminal strips) – are tightened to the specified tightening torques (refer to the following table listing the tightening torques).
- When connecting or relocating internal connecting cables, the minimum air distances must be observed (see the following table listing the minimum air distances).
- The minimum air distances are maintained for live, non-insulated parts. There should be no protruding wire ends.
- Unused cable entries are closed and their plugs are tightly screwed in place and are completely sealed.
- To maintain the degree of protection, all sealing surfaces of the terminal box must have the appropriate surface quality!

Table 6- 1 Tightening torques for screwed electrical connections – terminal board connections (with the exception of terminal strips)

Thread diameter		M4	M5	M6	M8	M10	M12	M16
Tightening torque [Nm]	min	0.8	1.8	2.7	5.5	9	14	27
	max	1.2	2.5	4	8	13	20	40

Power connection

The power connection is established in the terminal box.

⚠ CAUTION

Motors must not be directly connected to the three-phase line supply as this will destroy them.

Ensure the correct phase sequence!

The motor may only be operated with a frequency converter with the matching power rating.

Note

For the terminal boxes of the 1PH4 10. the cable lugs of the power connections must be precisely located on the cable lugs of the motor winding connections and no further.

Table 6- 2 Electrical connection

Type		1PH410□	1PH413□	1PH416□
Motor terminal box		gk233	gk433	gk433
Main terminal box	Number x size	3 x M5	4 x M10	4 x M10
	for max. cable cross-section with cable lug	16 mm^2	35/50 mm^2	2 x 35 mm^2
	Max. current carrying capacity [1]	53 A	83/98 A	2 x 83 A
Terminal strip for temperature sensor	Number of terminals	3	3	3
Protective conductor connection	Size	M4	M6	M6
	Max. cable lug width	9 mm	15 mm	15 mm

[1] Max current carrying capacity of PVC-insulated cables with copper cores, adjacent cable cross-section without metal sheath; guide values for the "Current carrying capacity of cables for machines for large series production in a cable duct" for an ambient temperature of 40 °C according to EN 60 204-1

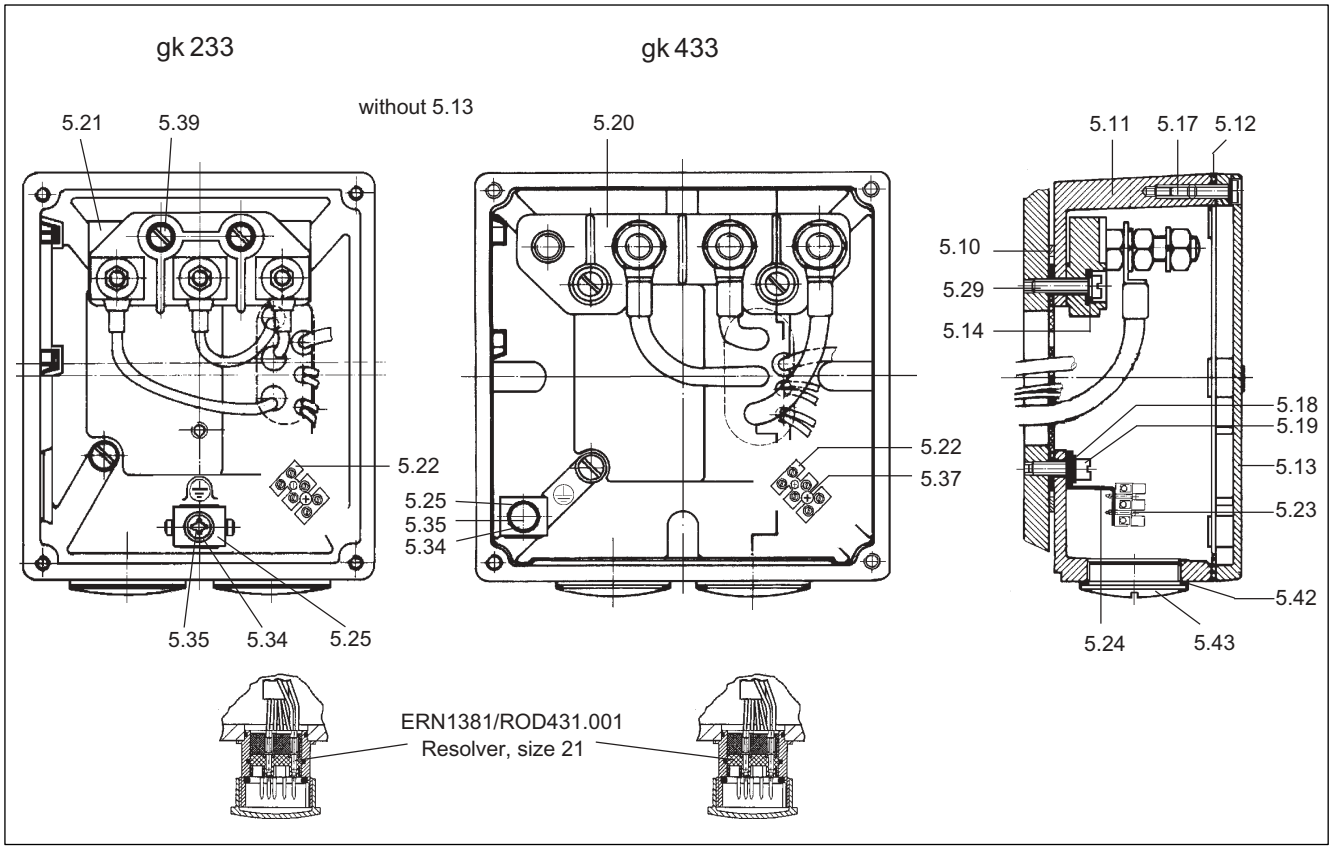


Figure 6-1 Motor terminal box

Pulse encoder and temperature sensor

The connection is established via the flange socket with pins integrated in the terminal box.

6.2.3 Cable entry and routing

- When selecting the required connecting cables, make sure that you take into account the rated current and plant-specific conditions, such as ambient temperature, routing type, etc. according to IEC / EN 60364-5-52 and IEC / EN 60204-1.
- Use EMC cable glands for permanently installed cable entries.
- Use shielded cables whose shields are conductively connected to a large area of the terminal box of the motor via EMC cable glands.
- Arrange the exposed connecting cables in the terminal box so that the PE conductor has an excess length and the insulation of the cable strands cannot be damaged.
- Only remove insulation from the cable ends so that the insulation reaches up to the cable lug, terminal, or end sleeve.
- Adapt the size of the cable lugs or end sleeves in line with the dimensions of the terminal board connections and the cross-section of the power cable (use parallel connection cables, if necessary).
- Make sure that the inside of the terminal box or connector is clean and free of cable remains and moisture.
- Tighten all of the screws for the electrical connections (terminal board connections, with the exception of the terminal strips) to the specified torque:

Table 6- 3 Tightening torques

Thread diameter	M4	M5	M6	M8	M10
Tightening torque [Nm]	0.8 ... 1.2	1.8 ... 2.5	2.7 ... 4	5.5 ... 8	9 ... 13

- When connecting or relocating internal connecting cables, the minimum air distances must be observed:

  Max. terminal voltage ≤ 500 V → minimum air distance 4.5 mm
- Avoid protruding cable ends.
- Seal unused cable entries and screw in sealing elements so that they are secure and airtight.
- Check seals and sealing surfaces of the terminal box or connector to ensure that the degree of protection is maintained.
- Take measures to ensure that connecting cables cannot rotate, are not subject to strain and pushing force and also provide anti-kink protection. It is not permissible to subject the connector to continuous force.
- The coding slot for the plug-in connections must be aligned when inserted into the socket connector. The union nut must be tightened by hand up to the endstop.
- Make sure that the cable shields are properly connected.

Current-carrying capacity for power and signal cables

The current-carrying capacity of PVC/PUR-insulated copper cables is specified for routing types B1, B2 and C under continuous operating conditions in the table with reference to an ambient air temperature of 40 °C. For other ambient temperatures, the values must be corrected by the factors from the "Derating factors" table.

Table 6- 4 Cable cross section and current-carrying capacity

Cross-section	Current-carrying capacity rms; AC 50/60 Hz or DC for routing type		
[mm²]	B1 [A]	B2 [A]	C [A]
Electronics (according to EN 60204-1)			
0.20	-	4.3	4.4
0.50	-	7.5	7.5
0.75	-	9	9.5
Power (according to EN 60204-1)			
1.50	13.5	13.1	15.2
2.50	18.3	17.4	21
4	24	23	28
6	31	30	36
10	44	40	50
16	59	54	66
25	77	70	84
35	96	86	104
50	117	103	125
70	149	130	160

Table 6- 5 Derating factors for power and signal cables

Ambient air temperature [°C]	Derating factor according to EN 60204-1 Table D1
30	1.15
35	1.08
40	1.00
45	0.91
50	0.82
55	0.71
60	0.58

6.2.4 Circuit diagram

Information about wiring and connecting the motor winding is provided in the circuit diagram. The circuit diagram is attached to the cover of the terminal box.

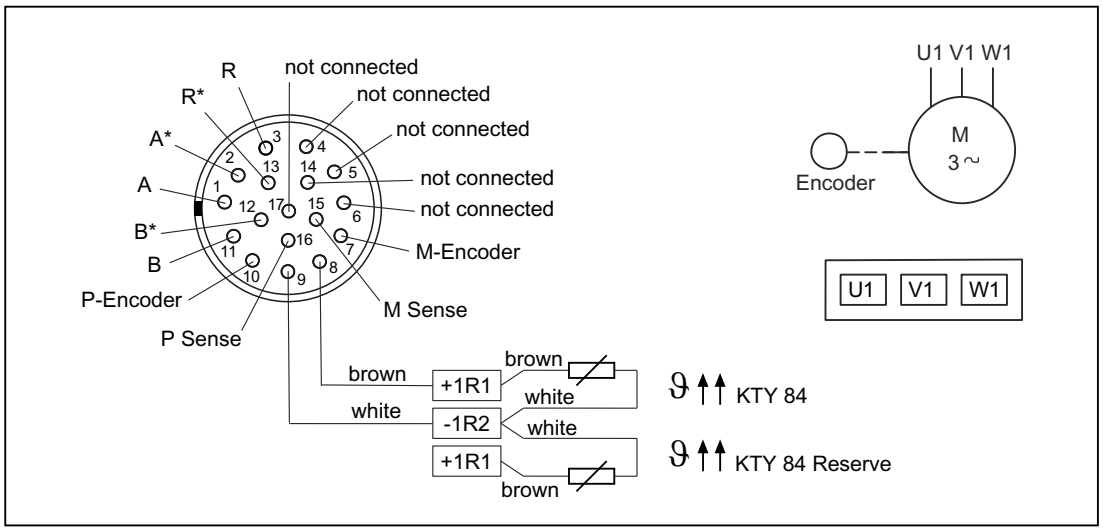


Figure 6-2 Circuit diagram

NOTICE
Cable outlet direction If the direction of the cable outlet is not changed correctly, this can damage the connecting cables. The direction of the cable outlet must not be changed since this renders all warranty claims null and void.

6.2.5 Motors with DRIVE-CLiQ interface

Motors designed for SINAMICS drive systems are equipped with an internal Sensor Module, which contains an encoder and temperature evaluation system as well as an electronic rating plate. The Sensor Module is mounted instead of the signal connector and is equipped with a 10-pin RJ45plus socket. This is known as a DRIVE-CLiQ interface. The pin assignment is independent of the motor-internal encoder.

The Sensor Module can be rotated through approx. 180°. The typical torsional torque is between 4 and 8 Nm. The Sensor Module must only be rotated by hand. The use of pipe wrenches, hammers etc. is not permitted.

NOTICE
The Sensor Module is in direct contact with electrostatically-sensitive devices. It is not permissible to touch the connections with either hands or tools that could be electrostatically charged.

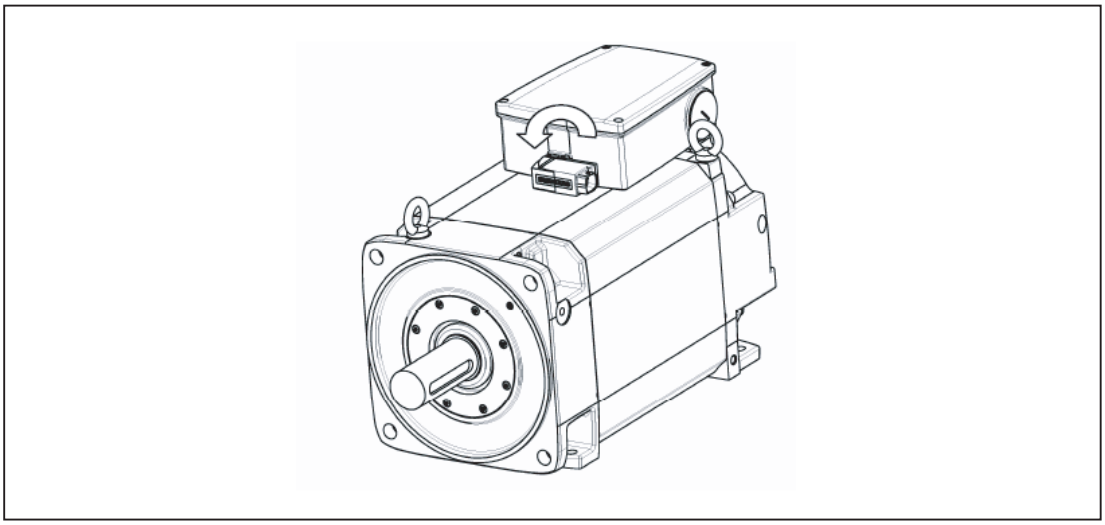


Figure 6-3 Motor with DRIVE-CLiQ interface (example)

The signal connection between the motor and Motor Module is established by means of a MOTION-CONNECT DRIVE-CLiQ cable. The MOTION-CONNECT DRIVE-CLiQ cable connector must be inserted far enough so that the catch springs engage.

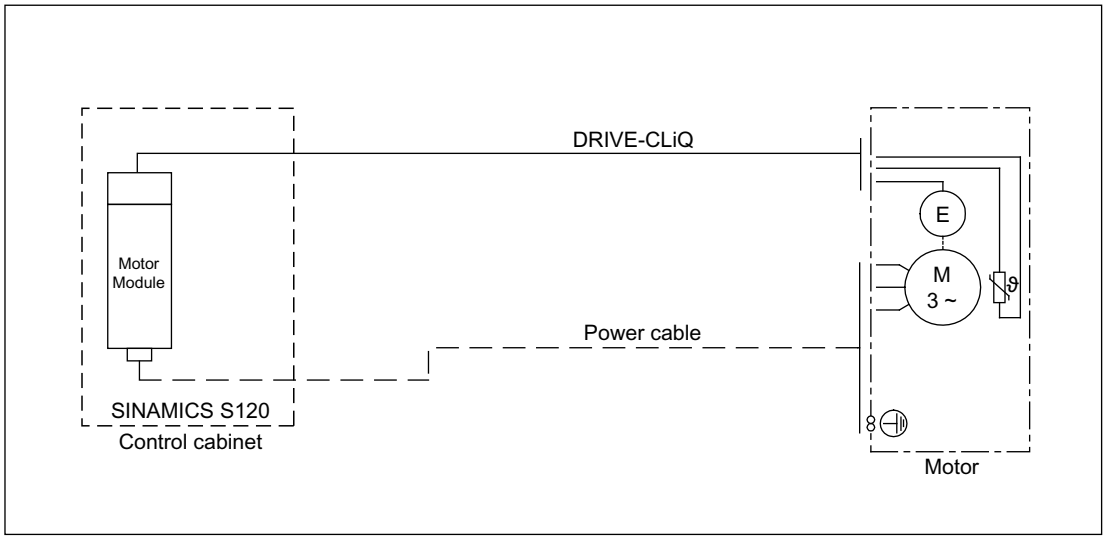


Figure 6-4 Encoder interface with DRIVE-CLiQ

6.2.6 Motors without DRIVE-CLiQ interface

If a motor is not equipped with a DRIVE-CLiQ interface, the speed encoder and temperature sensor are connected via a signal connector.

Motors that are not equipped with DRIVE-CLiQ require a Sensor Module Cabinet-Mounted (SMC) or a Sensor Module External (SME) when operated with SINAMICS S120. The motor is connected to the SMC or the SME via the signal cable. The SMC or SME is connected to the Motor Module via a MOTION-CONNECT DRIVE-CLiQ cable.

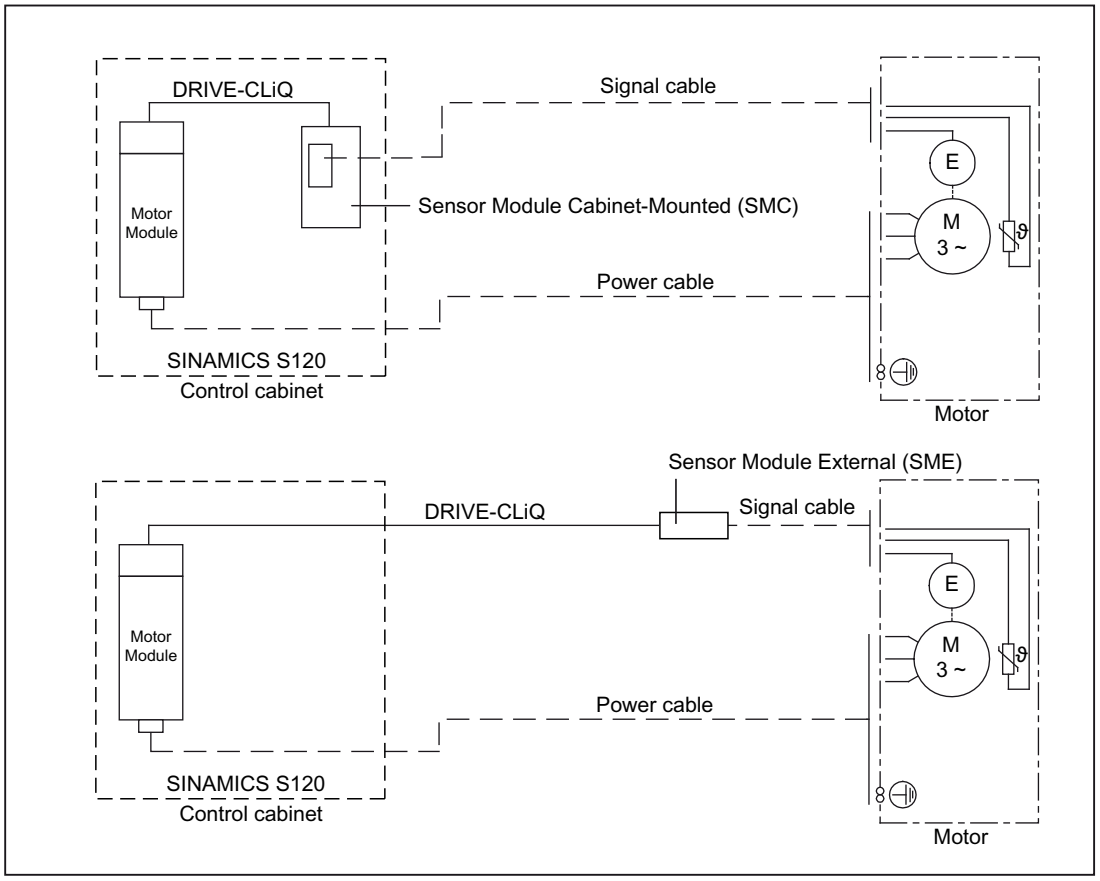


Figure 6-5 Encoder interface without DRIVE-CLiQ

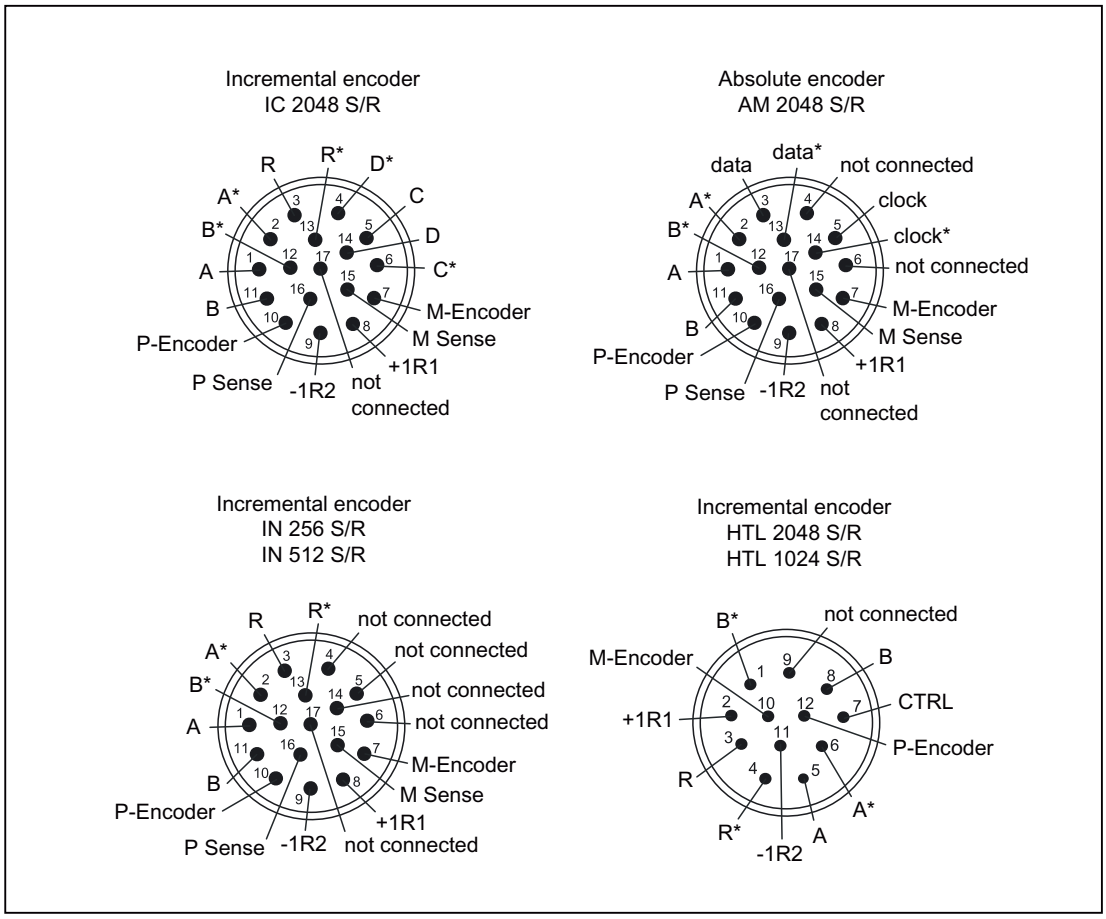


Figure 6-6 Signal connection (view of connector pins)

A suitable socket connector can be used to rotate the angle plug. Make sure that the socket connector is completely screwed into place to avoid damaging the pin contacts.

6.2.7 Connecting the temperature sensor

The temperature sensor is connected to the signal connector together with the speed encoder signal.

6.2.8 Connecting the grounding conductor

The motor grounding conductor cross-section must be in full compliance with the installation regulation, e.g. according to IEC / EN 60204-1. The grounding conductor is connected in the terminal box.

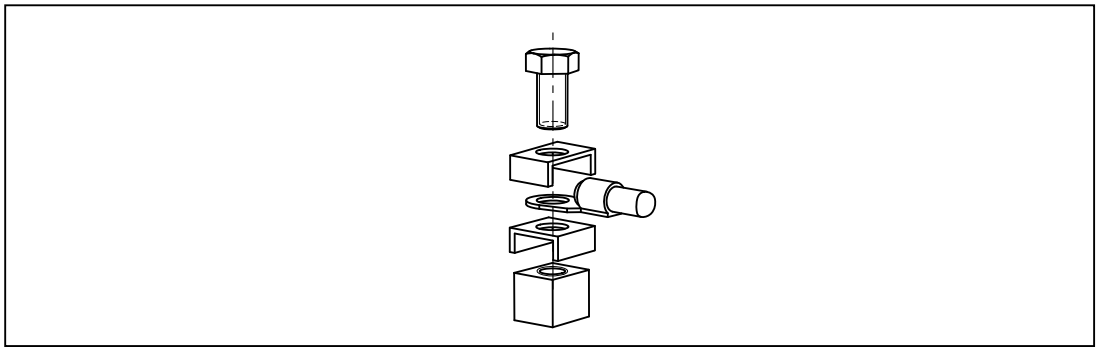


Figure 6-7 Connecting the grounding conductor

Equipotential bonding

The internal equipotential bonding between the grounding terminal in the terminal box enclosure and the motor enclosure is directly established through a metal contact.

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

6.2.9 Connecting to a converter

Selecting and connecting the cable

To connect the motor to a converter, use Motion-Connect cables or shielded connection cables. The protective braided shield must be made up of as many individual wires as possible and must have good electrical conductivity. Braided shields made of copper or aluminum are very suitable.

The shield must be connected at both ends to the motor and the converter; unshielded cable ends must be kept as short as possible.

To ensure that there is a good connection for high-frequency currents to be effectively discharged, establish the shield connection through the largest possible area, as 360 ° contact at the converter and at the motor, e.g. using EMC glands at the cable entry points.

Commissioning 7

7.1 Measures prior to commissioning

Before commissioning the system, check that it is properly installed and connected.
The drive system must be commissioned as described in the operating instructions for the converter/inverter.

Note

This list below does not claim to be complete. It may be necessary to perform additional checks and tests in accordance with the specific, on-site situation.

⚠ CAUTION

Thermal hazards a result of hot surfaces

The surface temperature of the motors can reach 80 °C.

Do not touch hot surfaces!

If necessary, implement touch protection measures!

Temperature-sensitive parts (electric cables, electronic components) must not be placed on hot surfaces.

Mechanical connection

- All touch protection measures have been taken for moving and live parts.
- The motor has been assembled and aligned properly.
- The rotor can freely rotate.
- The operating conditions correspond to the data specified on the rating plate.
- All fixing screws, connecting elements, and electrical connections must be tightened and properly implemented.
- The output elements have the proper setting conditions according to type, e.g.:
  - Couplings are aligned and balanced.
  - The belt tension is properly adjusted if a belt drive is used.
  - Gear tooth flank play and gear tooth tip play as well as radial play are properly adjusted if a gearwheel drive output is used.

Electrical connection

- The motor is connected so that it rotates in the direction specified.
- The minimum insulation resistance values are maintained.
- The grounding and equipotential bonding connections have been established correctly.
- All brakes that are being used are operating correctly.
- The specified speed limit n_{max} is not exceeded when operated from a converter.

⚠ CAUTION

If the speed n_{max} is exceeded, then this can result in damage to the bearings, short-circuit end rings, press fits etc. It should be ensured that higher speeds are not possible by appropriately designing the control or by activating the speed monitoring in the drive system.

Monitoring equipment

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

Water cooling

If water cooling is used, the cooling water supply must be connected and be ready for operation. The cooling water circulation (flow rate, temperature) complies with the requirements.

Brake (optional)

- If a brake is fitted, this is released when the operating voltage is applied.
- The brake functions (releases/engages) correctly.

Roller bearings

If the motor has been stored under favorable conditions (i.e. in a dry, dust-free room that is free of any vibration) for more than 2 years, the bearings must be replaced.

NOTICE

Unfavorable conditions

If the motor was stored under unfavorable conditions, the bearings need to be replaced after approx. 18 months.

7.2 Performing the test run

⚠ WARNING

With water cooling, risk of burns 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. Death, serious injury, or material damage can result.

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

⚠ WARNING

Danger from a rotating rotor!

Provide touch protection for output elements! Take suitable measures to ensure that feather keys (if used) cannot be flung out!

NOTICE

Holding brake

The brake can only be used for an emergency stop in certain cases (power failure, Emergency Off). The brake must not be used as an operating brake. When the motor is shut down, the brake operates as a holding brake.

7.3 Testing the insulation resistance

After long storage or shutdown periods, the insulation resistance of the windings must be measured with respect to ground using a DC voltage.

⚠ WARNING

Work on power installations must only be carried out by appropriately trained personnel. Before measuring the insulation resistance, read the operating instructions for the insulation resistance meter you are going to use.

⚠ WARNING

Hazardous voltage

The terminals are at hazardous voltage levels during the measurement as well as immediately after the measurement. Touching live components can result in death or serious injury.

Never touch the terminals when making measurements or immediately after the measurement.

Check the connected supply feeder cables to ensure that the line supply voltage cannot be connected.

- Always measure the insulation resistance of the winding with respect to the motor enclosure when the winding temperature is between 20 ... 30 °C.
- When making a measurement, wait until the final resistance value is reached. This will take approximately one minute.

Limit values

The table below specifies the measuring voltage as well as the limit values for the minimum insulation resistance and the critical insulation resistance for a rated motor voltage of V_N < 2 kV.

Table 7- 1 Stator winding insulation resistance at 25 °C

	Rated voltage V_N < 2 kV
Measurement voltage	500 V (at least 100 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

Note the following:

- Dry, new windings have an insulation resistance of between 100 ... 2000 MΩ (sometimes higher).

  If the insulation resistance is close to the minimum value, this could be due to moisture and/or an accumulation of dirt.

- The insulation resistance of the motor winding can drop during the course of its service life due to environmental and operational effects. The critical insulation resistance at 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 a rated voltage (V_N) of 0.6 kV:

  0.6 kV x 0.5 MΩ/kV = 0.3 MΩ

NOTICE
Cleaning and/or drying the windings when a critical insulation resistance is reached
If the critical insulation resistance is reached or fallen below, then the windings must be dried or, if the fan is removed, cleaned thoroughly and dried.
Note that after cleaned windings have been dried, the insulation resistance is lower for a warm winding. The insulation resistance can only be correctly evaluated by measuring a winding that has first cooled down to room temperature (approx. 20 ... 30 °C).

NOTICE
Measured value of the insulation resistance close to the critical value
If the measured value is close to the critical value, the insulation resistance should be subsequently checked at suitably regular intervals.
The values apply for measurement at a winding temperature of 25 °C.

7.4 Switching on

Before you switch on the motor, ensure that the parameters of the frequency converter have been assigned correctly.

Use appropriate the commissioning tools (e.g. "Drive ES" or "STARTER").

CAUTION
Uneven running or abnormal noise The motor can be damaged by improper handling during transport, storage or installation. If a damaged motor is operated, this can damage the windings or bearings and could even completely destroy the motor. If the motor is not running smoothly or is making abnormal noises, switch it off and determine the cause of the fault as the motor coasts down.

⚠ CAUTION
Pay attention to the maximum speed The maximum speed n_{max} is the highest permissible operating speed. The maximum speed is specified on the rating plate. If the speed n_{max} is exceeded, this can damage the bearings, short-circuit rings, press fits, etc. To ensure that the motor does not run at excessive speeds, the control must be appropriately configured or speed monitoring must be activated in the drive system.

Water cooling

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

CAUTION
If the cooling water supply fails or the motor is operated for a short time without cooling water, this can cause it to overheat. This can result in material damage or destroy the motor completely. Never operate the motor without the cooling water supply. Monitor the permissible water inlet temperatures.

⚠ WARNING
Risk of burning from hot steam When cooling water enters the hot motor, this immediately generates hot steam that escapes under high pressure. The cooling water system can burst. Death, serious injury, or material damage can result. Do not connect the cooling water supply until the motor has cooled down.

7.5 Safety instructions in operation

⚠ WARNING

Do not remove covers when motor is running!

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

All covers that prevent personnel from coming into contact with active or rotating parts, ensure compliance with the required degree of protection, or ensure proper air guidance and, in turn, effective cooling must not be opened/removed during operation.

⚠ WARNING

Faults in operation

Deviations from normal operation (e.g. increased power consumption, temperature, or vibration levels, unusual noises or odors, tripping of monitoring equipment, etc.) indicate that the motor is not functioning properly. This can cause faults that can result in eventual or immediate death, severe personal injury, or material damage.

Immediately inform the maintenance personnel. If in doubt, shut down the motor immediately, taking into account the plant-specific safety regulations.

⚠ CAUTION

Danger of burns

The temperature of individual parts of the motor can be up to 80 °C. Physical contact with the motor could cause burns.

Check the temperature of the parts before touching them and take appropriate protective measures if necessary.

7.6 Non-operational periods

Measures when motors are at a standstill and ready for operation

- If the motor is non-operational for extended periods of time, run it at regular intervals (roughly once a month) or at least spin the rotor.
- Refer to the section titled "Switching on" before switching on the motor to re-commission it.

NOTICE
Damage due to improper storage The motor can be damaged if it is not stored properly. If the motor is non-operational for extended periods of time, implement suitable anti-corrosion and preservation measures and ensure that the motor is kept dry. When re-commissioning the motor after a long non-operational period, carry out the measures recommended in the chapter titled "Commissioning".

7.7 Switching off

Measures when switching off

- When switching off the motor, refer to the operating instructions of the frequency converter being used.
- Switch off the cooling water supply if the motor is not used for longer periods of time.

7.8 Faults

Note

Damage to the motor caused by faults

Correct the cause of the fault as specified in the remedial measures section. Repair any damage to the machine or motor.

Note

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

If there are deviations from normal operation or if faults occur, initially proceed according to the following list. In this regard, observe the relevant chapters in the documentation associated with the components of the complete drive system.

Even in test operation, never disable protective functions or devices.

Table 7- 2 Possible faults

Fault	Cause of fault (see code table)																	
Motor does not start up	A	B			E													
Motor starts up slowly	A		C		E	F												
Rumbling noise when starting			C		E	F												
Rumbling noise in operation	A		C		E	F												
High temperature rise in no-load operation				D			G	H	I									
High temperature rise under load	A		C				G	H	I									
High temperature rise of individual winding sections					E	F												
Uneven running										J	K							
Grinding sound, running noise												L						
Radial vibration													M	N	O	P	R	
Axial vibration															O	Q	R	
Water is escaping																		S

Table 7- 3 Codes for causes of faults and remedial measures

No.	Cause of fault	How to remedy the problem
A	Overload	Reduce load
B	Interruption of a phase in the supply cable	Check frequency converter and supply cables
C	Interruption of a phase in the supply after switching on	Check frequency converter and supply cables
D	Converter output voltage too high, frequency too low	Check the settings on the frequency converter, perform an automatic motor identification
E	Stator winding incorrectly connected	Check winding connections
F	Winding short circuit or inter-phase short circuit in stator winding	Measure the winding resistances and insulation resistances, repair after prior consultation with manufacturer
G	Cooling water not connected / switched off	Check cooling water connection / switch on cooling water
	Water connection / pipes defective	Locate leaks and seal as necessary, or consult the manufacturer
H	Cooling water flow rate too low	Increase cooling water flow rate
	Inlet temperature too high	Set correct inlet temperature
I	Cooling impeded by deposits	Clean the surface of the drives and ensure that the cooling air can flow in and out unimpeded
	Cooling air inlet/outlet is blocked by foreign bodies	Remove the block and ensure that the cooling air can flow in and out unimpeded
	Fan motor does not start	Check the function of the fan motor
J	Insufficient shielding of the motor and/or encoder cable	Check the shielding and grounding
K	Excessive drive controller gain	Adjust the controller
L	Rotating parts are grinding	Determine cause and align parts
	Foreign bodies in the motor	Send to manufacturer for repair
	Bearing damage	Send to manufacturer for repair
M	Rotor not balanced	Decouple rotor and rebalance
N	Rotor out of true, shaft bent	Consult the manufacturer
O	Poor alignment	Align motor unit, check coupling
P	Coupled machine not balanced	Re-balance coupled motor
Q	Shocks from coupled machine	Check the coupled machine
R	Imbalance originating from gear units	Adjust/repair gear unit
S	Cooling water pipe / water connection defective	Locate leaks and seal as necessary, or consult the manufacturer

If the fault still cannot be resolved after applying the measures specified above, please contact the manufacturer or the Siemens Service Center.

Maintenance 8

8.1 Inspection and maintenance

8.1.1 Safety instructions

If you are unclear about anything, consult the manufacturer, specifying the motor type and serial number, or arrange for the maintenance work to be carried out by one of the Siemens Service Centers.

⚠ DANGER

Risk of electric shock from touching live parts

Live electrical parts are dangerous. Touching these parts will result in an electric shock, which in turn causes death or serious injury.

Before starting work on the motors, 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.

Note all the information provided in "Safety information and application information" in these operating instructions and ensure that only persons who have the necessary know-how are entrusted to carry out work on power installations.

⚠ WARNING

Danger of burns

Some parts of electric motors can reach temperatures of 80 °C.

Touching components when the motor is in operation can cause severe burns.

Do not touch parts of the enclosure while the motor is in operation or immediately after the motor has been operated. Allow enclosure parts to cool down before starting any work.

Safety regulations

Before starting maintenance work, always observe the five safety rules:

1. Disconnect and isolate.
2. Take measures to prevent reconnection to the supply (lock out the supply).
3. Make sure that the equipment is de-energized and is in a no voltage condition.
4. Ground and short-circuit.
5. Erect barriers around or cover adjacent live parts.

Other safety-related measures

CAUTION
Personal protective equipment when using chemical cleaning agents
Chemical cleaning agents can be caustic or emit dangerous fumes.
If these come into contact with skin or if you inhale the fumes, this can cause injuries (e.g. chemical burns on the skin or respiratory passages, or skin irritation).
During cleaning, make sure that appropriate methods of extracting fumes are in place and that you wear the appropriate protective gear (e.g. gloves, goggles, face masks).
If using chemical cleaning agents, observe the instructions and any warnings provided in the relevant safety data sheet. Chemical cleaning agents must be suitable for use with the motor's components, particularly where plastic components are concerned.

CAUTION
Personal protective measures when working with compressed air
When cleaning using compressed air, this can stir up dust, metal chips, or cleaning agents, which can cause injury.
When cleaning using compressed air, make sure you use suitable extraction equipment and wear protective equipment (safety goggles, protective suit, etc.).

8.1.2 Maintenance intervals

General

Careful and regular maintenance, inspections, and overhauls are essential for detecting and eliminating faults in good time before they can cause any damage.

NOTICE
Inspection if there are faults or unusual conditions
Unusual conditions or faults that represent electrical or mechanical overstressing of the three-phase motor, such as overload, short circuit, etc. can consequentially damage the motor.
If there are faults or unusual conditions such as overload or short circuit etc. immediately perform an inspection.

Measures, inspection/maintenance intervals

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 (pollution/dirt, switching frequency, load, etc.).
- Perform the following measures after the operation time or the interval specified in the following table elapses.

Table 8- 1 Measures after operating times or intervals

Measures	Operating times and intervals
Initial inspection	After 500 operating hours, after 6 months at the latest
General inspection without radial shaft sealing rings with radial shaft sealing rings	 after approximately 8000 operating hours, at the latest after 2 years after approximately 5000 operating hours, at the latest after 2 years
Replace the bearings	Note the recommended bearing replacement intervals (see "Bearing replacement intervals")
Replace the radial shaft sealing rings	when changing the bearings
Cooling water system for water cooling	maintenance free (provided that the required cooling water quality is ensured)

8.1.3 General inspection guidelines

When inspecting a motor, you do not generally need to dismantle it. The motor only has to be dismantled if the bearings need to be replaced.

8.1.4 Initial inspection

An initial inspection is performed once the motor has been installed or following repairs.

While the motor is running, check that:

- The electrical characteristics are maintained.
- The smooth running characteristics and running noises of the three-phase motor have not deteriorated.

Correct any deviations that are determined in the inspection without delay.

NOTICE
Adapt the inspection in line with plant-specific conditions This list does not claim to be complete. Further tests should also be carried out in accordance with the additional instruction manuals (e.g. bearings, cooler, etc.) or in accordance with the particular system-specific conditions.

8.1.5 General inspection

While the motor is running, check that:

- The electrical characteristics are maintained.
- The smooth running characteristics and motor noise when operational have not deteriorated.

Once the motor has been shut down, check that:

- The motor foundation has no indentations or cracks.
- The motors are aligned within the permissible tolerance ranges.
- All the fixing bolts/screws for the mechanical and electrical connections have been securely tightened.
- The winding insulation resistances are sufficiently high.
- Cables and insulating parts are in good condition and do not exhibit any signs of discoloration.

⚠ CAUTION

If you identify any problems during the inspection, rectify them immediately, otherwise the motor could be subsequently damaged.

8.1.6 Bearing change interval

Bearing change interval (t_{LW}) and grease change interval

The values specified in the following table are valid for:

- Single and double bearings
- Cooling water temperature +30 °C
- Horizontal mounting position

Table 8- 2 Bearing change interval

SH	Double bearing (standard)		Single bearing (option K00)		Bearing for increased speed (option L37)	
100	$n_m < 2500$	$2500 < n_m < 6000$	$n_m < 4000$	$4000 < n_m < 7000$	$n_m \leq 8000$	$8000 < n_m < 12000$
132	$n_m < 2000$	$2000 < n_m < 5500$	$n_m < 3500$	$3500 < n_m < 6500$	$n_m \leq 6000$	$6000 < n_m < 10000$
160	$n_m < 1500$	$1500 < n_m < 4500$	$n_m < 3000$	$3000 < n_m < 5000$	$n_m \leq 5000$	$5000 < n_m < 8000$
t_{LW} [h]	16000	8000	20000	10000	16000	8000

n_m = average operating speed [rpm]

t_{LW} = bearing change interval; grease change interval= 0.8 • t_{LW}

Table 8- 3 Grease quantity per bearing

Shaft height	Deep-groove ball bearing [g]	Cylindrical-roller bearing [g]	Bearing for high speed (L37) [g]
100	7 - 9	7 - 9	7 - 9
132	8 - 10	8 - 10	8- 10
160	14 - 17	15 - 19	14 - 17

Maximum speed n_{max} and maximum continuous speed n_{s1}

The motor must not exceed the maximum speed n_{max}, nor may it operate at n_{max} continuously. The speed must be reduced in accordance with the following duty cycle:

Duty cycle for a 10-minute cycle

3 min n_{max}

6 min 2/3 n_{max}

1 min Standstill

⚠ CAUTION

If the speed n_{max} is exceeded, then this can result in damage to the bearings, short-circuit end rings, press fits etc. It should be ensured that higher speeds are not possible by appropriately designing the control or by activating the speed monitoring in the drive system.

The maximum permissible continuous speed n_{s1} is continually permitted without speed duty cycles. This speed depends on the bearings and shaft height.

Table 8- 4 Maximum permissible speed and maximum permissible continuous speed

SH	Double bearing [rpm]		Single bearing (option K00) [rpm]		Bearing for increased speeds (option L37) [rpm]	
	n_{max}	n_{s1}	n_{max}	n_{s1}	n_{max}	n_{s1}
100	7500	5600	9000	6500	12000	10000
132	6700	5200	8000	6000	10000	9250
160	5300	4000	6500	4500	8000	7000

Note

If the motor is operated at speeds between n_{s1} and n_{max}, a speed duty cycle with low speeds and standstill intervals is required in order to reliably guarantee that the grease is well distributed in the bearings.

8.2 Repair

8.2.1 Safety instructions

Qualified personnel

This motor must be commissioned and operated by qualified personnel only. For the purpose of the safety notices in these operating instructions, "qualified personnel" refers to those authorized to energize, ground, and tag equipment, systems, and circuits in accordance with established safety procedures.

Safety notes

⚠ WARNING

Rotating or live parts

Rotating or live parts represent a danger. Death, serious injury, or material damage can result if the required covers are removed or if the device is not operated properly.

Before starting work on the motor and, in particular, before opening the covers of live parts, make sure that the motor or system is properly isolated.

⚠ WARNING

Transport in accordance with proper procedures

Only transport the motor in accordance with the transport regulations. Death, serious injury, or material damage can result if the motor is not transported properly.

Whenever you have to transport the motor, follow the instructions provided in the section "Transport and storage".

8.2.2 Removing/installing the motor

Removal

- Remove the bearing shield screws at DE and withdraw the bearing shield with motor rotor from the stator.
- Remove the grease slinger from the shaft shoulder at the DE.
- Unscrew the bearing cap screws (see Chapter "Spare parts", item 1.48) can separate the bearing shield from the rotor.
- Use a suitable device to remove the roller bearings.
- Remove the shaft sealing ring from the bearing shield at the DE.
- Do not reuse roller bearings that have been removed.

Installation

- Heat up the new roller bearings evenly to 80 - 100 °C and install them. When doing so, make sure that the bearing inner ring lies on the shaft shoulder. Do not apply and hard blows (e.g. using a hammer etc.).
- Insert a new shaft sealing ring in the DE bearing shield.
- Clean the sealing surfaces at the bearing shield and enclosure (remove any grease) and re-seal.
- Introduce the motor rotor into the stator, in so doing observe the position of the spring in the NDE bearing shield.
- Slide on the DE bearing shield and attach the bearing cap. Then slide into the centering at the stator.

- Install the bearing shield screws at the DE; before tightening to the specified type in torque, the mounting feet surfaces should be aligned.
- Mount the grease slinger (gamma ring housing 9RB... without sealing lip) with a suitable sleeve on dimension X.
  - X = 4.5 ± 2 mm for 1PH410 and 1PH413
  - X = 5.5 ± 2 mm for 1PH416
  - Do not use any grease slingers that were damaged when removed.

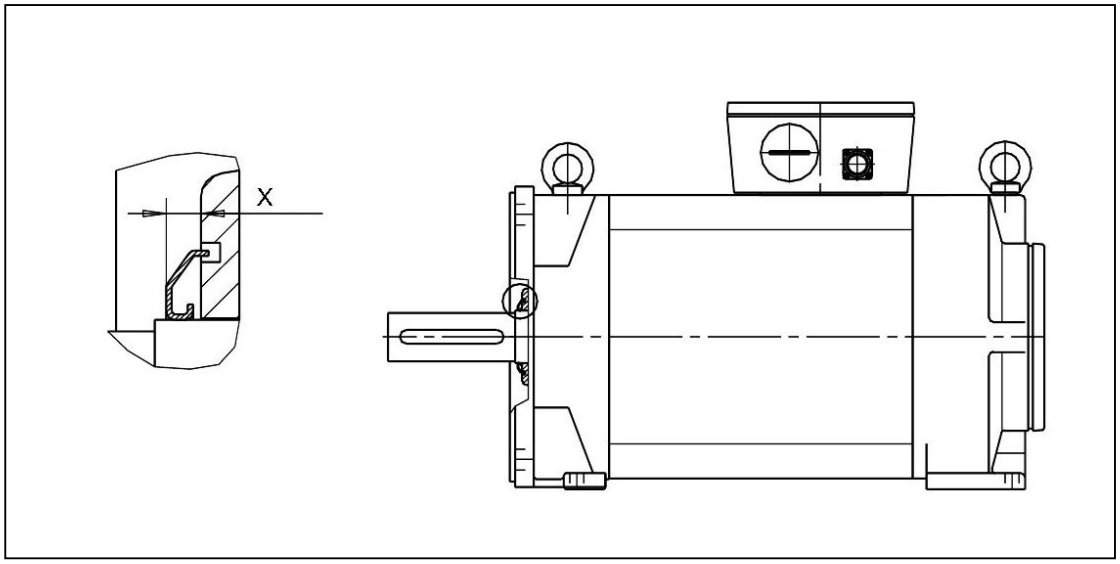


Figure 8-1 Installing the gamma ring

Running in the bearings

Once you have replaced the bearings, allow the roller bearings to run in to distribute the grease evenly. When doing so, the motors should be initially run continuously from 0 to approx. 75% of the maximum speed n_{max} over a period of 15 minutes.

8.2.3 Removing/installing the speed encoder

CAUTION

Electrostatically sensitive devices

Electronic modules contain components that can be destroyed by electrostatic discharge. These modules can be easily destroyed if they are not handled properly.

To protect your equipment against damage, follow the instructions given in the chapter "ESD Guidelines".

⚠ CAUTION

Qualified and trained personnel

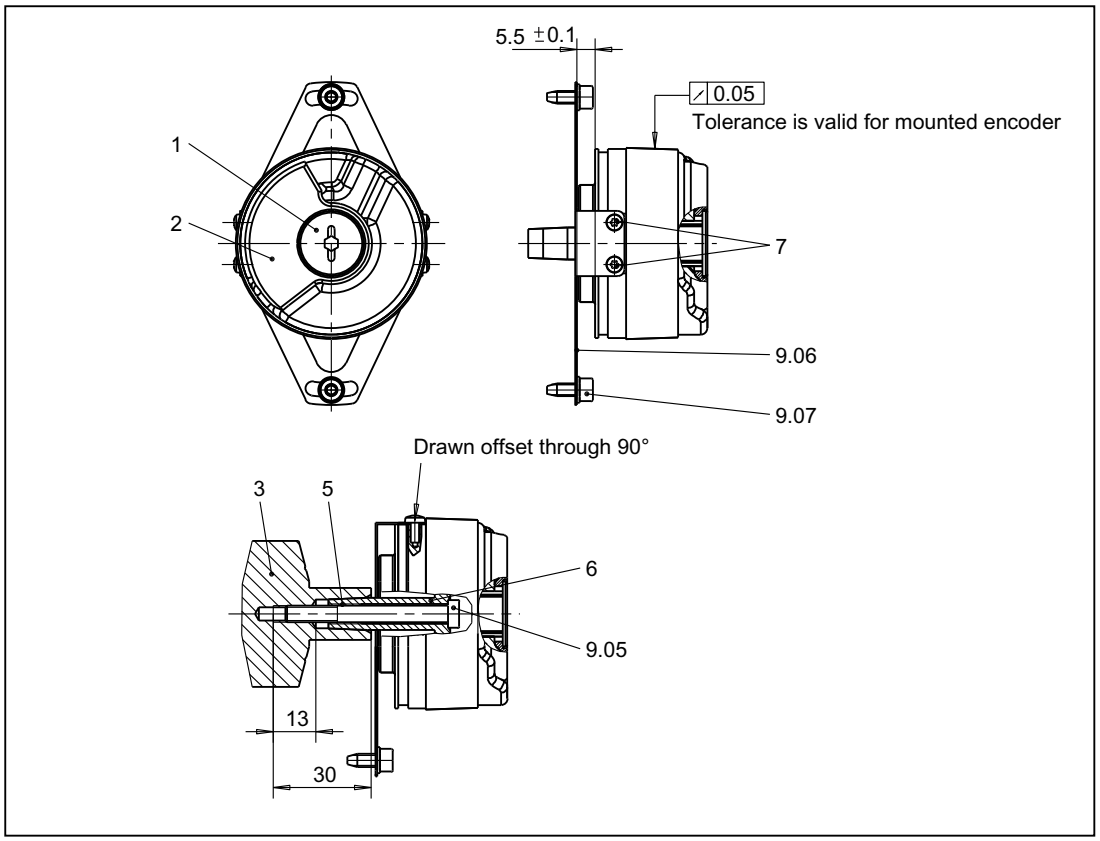
Only qualified, trained personnel may replace and adjust an encoder.

Note

Removing/installing the encoder

Unscrew the cover of the terminal box and disconnect the power and temperature sensor cables from the terminal strip.

Unscrew the separately-driven fan unit (if installed) and sensor cover.



1	Screw	7	Screws
2	Connector cover	9.05	Encoder screw
3	Motor shaft	9.06	Torque arm
5	Jacking thread	9.07	Screws
6	Encoder shaft		

Figure 8-2 Motor shaft - encoder shaft connection

Removal

1. Unscrew the screw (1).
2. Remove the connector cover (2).
3. Remove the connector with signal cable.
4. Unscrew the screws (9.07) for the torque arm.
5. Unscrew the encoder screw (9.05) (lock the motor rotor so that it can't rotate).
6. Remove the encoder from the motor shaft:
   - You can press off the encoder directly by inserting a special screw (see diagram).
   - If a special screw is not available, you can remove the encoder by inserting a threaded pin (e.g. DIN 913 M5 x 30) into the motor shaft extension to protect the centering hole thread and then insert a screw M6 x min. 40.

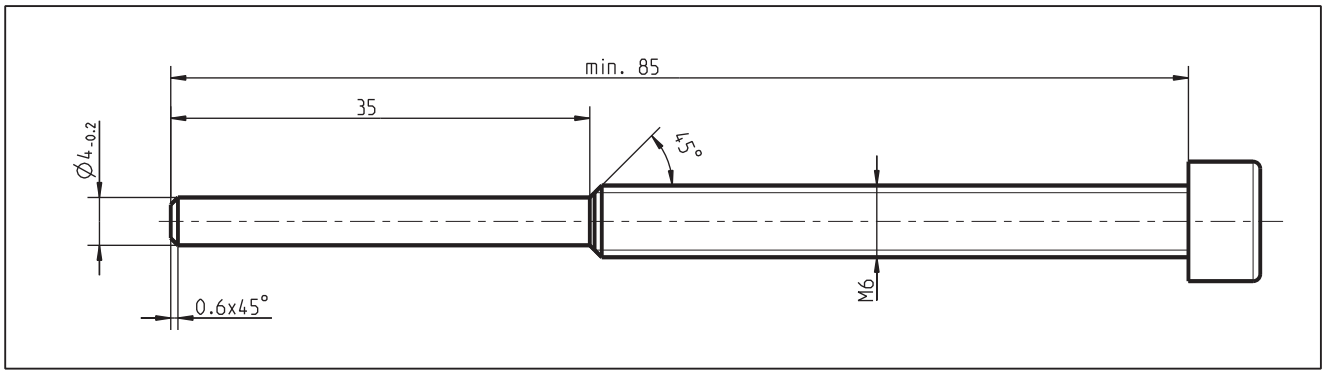


Figure 8-3 Special screw

Installation

1. Screw the torque arm (9.06) onto the encoder by means of screws (7) and secure (e.g. with Loctite 243). Note the distance between the torque arm and encoder! (This step does not need to be carried out if the encoder is already mounted as ordered.)
2. If necessary, remove the threaded pin (used earlier to remove the encoder).
3. Release the screw (1) for the replacement encoder.
4. Remove the connector cover (2) for the replacement encoder. Locate the encoder (with torque arm) (9.06) onto the taper of the motor rotor and screw in the encoder screw (9.05). Tightening torque 5^{-1} Nm. Lock the motor rotor so that it can't rotate!
5. Secure the torque arm (9.06) by means of screws (9.07) on the bearing shield (6.01) (note the radial deflection of the encoder).
6. Press on the metal sleeve for the connector cable.
7. Insert the connector with signal cable and place the cable into the guide.
8. Attach the connector cover (2) with the screw (1) and secure, e.g. with Loctite 243.

8.2.4 Replacing the DRIVE-CLiQ interface (encoder module)

Only trained Siemens service engineers are authorized to replace the DRIVE-CLiQ interface (Sensor Module).

CAUTION

Electrostatic discharge

Electronic modules contain components that can be destroyed by electrostatic discharge. These modules can be easily destroyed if they are not handled properly.

To protect your equipment against damage, follow the instructions given in the chapter "ESD Guidelines".

⚠ WARNING

Motor-specific Sensor Module

The Sensor Module contains motor/encoder-specific data and an electronic rating plate.

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 mount the Sensor Module onto other motors. Do not replace the Sensor Module with a Sensor Module from a different motor.

8.2.5 Tightening torques for screwed connections

The screwed connections with metal contact surfaces (end shields, parts of bearing inserts, terminal box parts bolted onto the stator enclosure) should be tightened, depending on the thread size, to the following torques with a tolerance of ± 10 % for property class 8.8 and 8 or higher according to DIN ISO 898.

Table 8- 5 Tightening torques for screwed connections

Thread diameter	M4	M5	M6	M8	M10	M12	M16
Tightening torque [Nm]	3	5	9	24	42	70	165

Bolt locking devices

Nuts or bolts that are mounted together with locking, resilient and/or force-distributing elements (e.g. safety plates, spring-lock washers, etc.) must be refitted together with identical, fully functional elements.

Always renew positively-driven locking elements.

Spare parts

9

Note

The diagram provided is merely intended as an example of the different motor versions and does not claim to provide detailed information for all versions.

The spare parts are available from our Service Centers in parts kits, which make sense from a technical perspective, and can be ordered by specifying the motor designation.

Table 9- 1 Spare parts that can be supplied from the factory

1.00	**DE bearings**	
	1.41	Bearing shield IM B35
	1.42	Radial shaft sealing ring
	1.43	Sleeve
	1.44	Sealing ring
	1.45	Sleeve
	1.46	O-ring
	1.48	Screw
	1.49	Sealing washer
	1.60	Roller bearings
	1.70	Roller bearings
	1.95	Bearing cover, inner
3.00	**Rotor, complete**	
	3.10	Rotor
4.00	**Stator, complete**	
	4.10	Enclosure with core
	4.11	Rating plate
5.00	**Terminal box, complete**	
	5.10	Seal
	5.11	Upper terminal box section
	5.12	Seal
	5.13	Terminal box cover
	5.20	Terminal board, complete
	5.21	Adapter
	5.22	Terminal strip
	5.24	Bracket
	5.25	Terminal clamp
	5.35	Screw

6.00 NDE bearings

- 6.10 Roller bearings
- 6.20 Bearing shield, NDE
- 6.22 Spring washer
- 6.38 Gaskets and seals
- 6.83 Cover
- 6.84 Seal
- 6.85 Screw plug
- 6.90 O-ring

8.00 Installation

- 8.50 ERN 1381.001 / ROD431.001
- 8.51 Screw
- 8.52 Torque arm
- 8.53 Screw
- 8.54 Signal connector or DRIVE-CLiQ interface
- 8.57 Combination screw

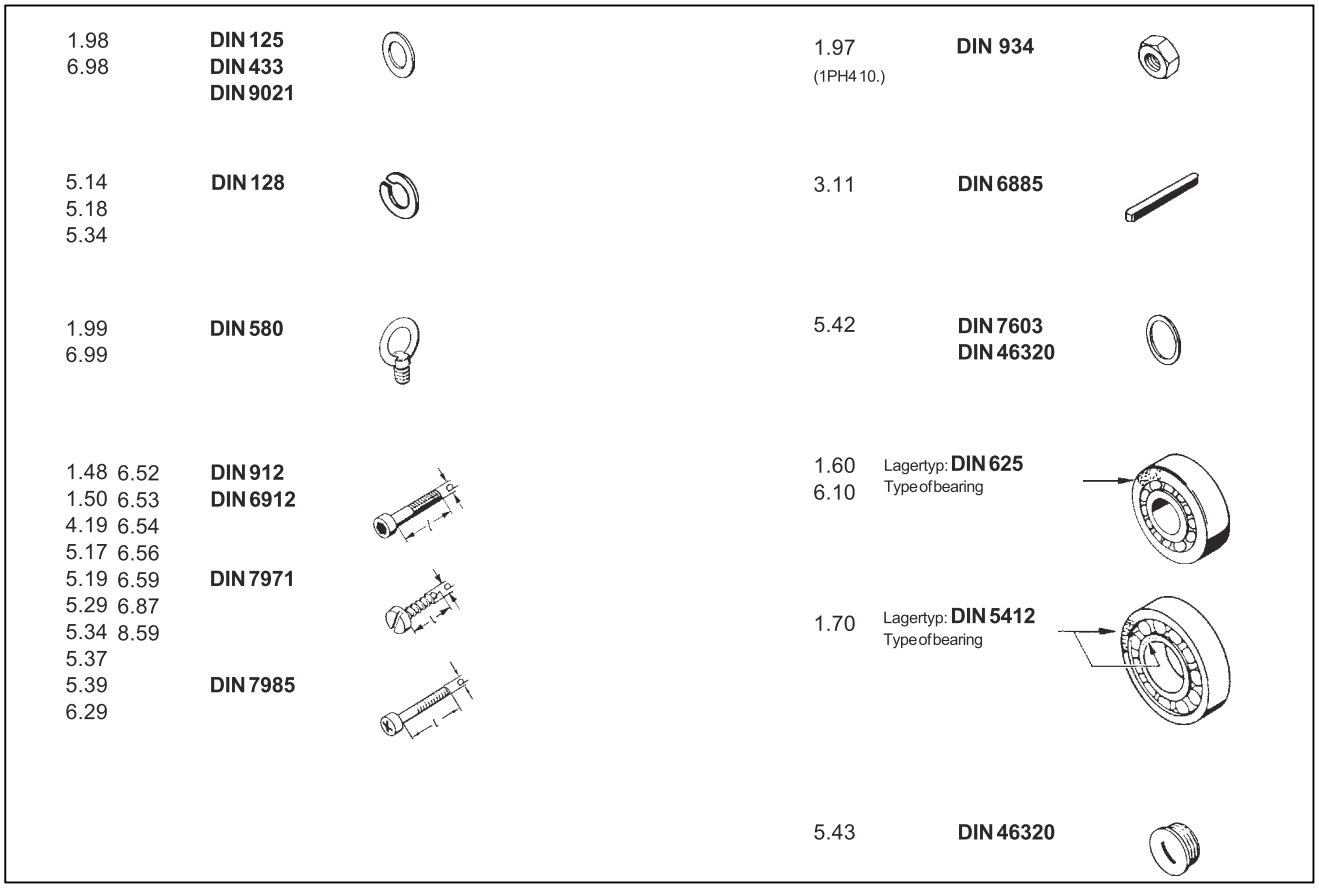


Figure 9-1 Standard parts should be commercially obtained in accordance with their dimensions, materials and surface finish

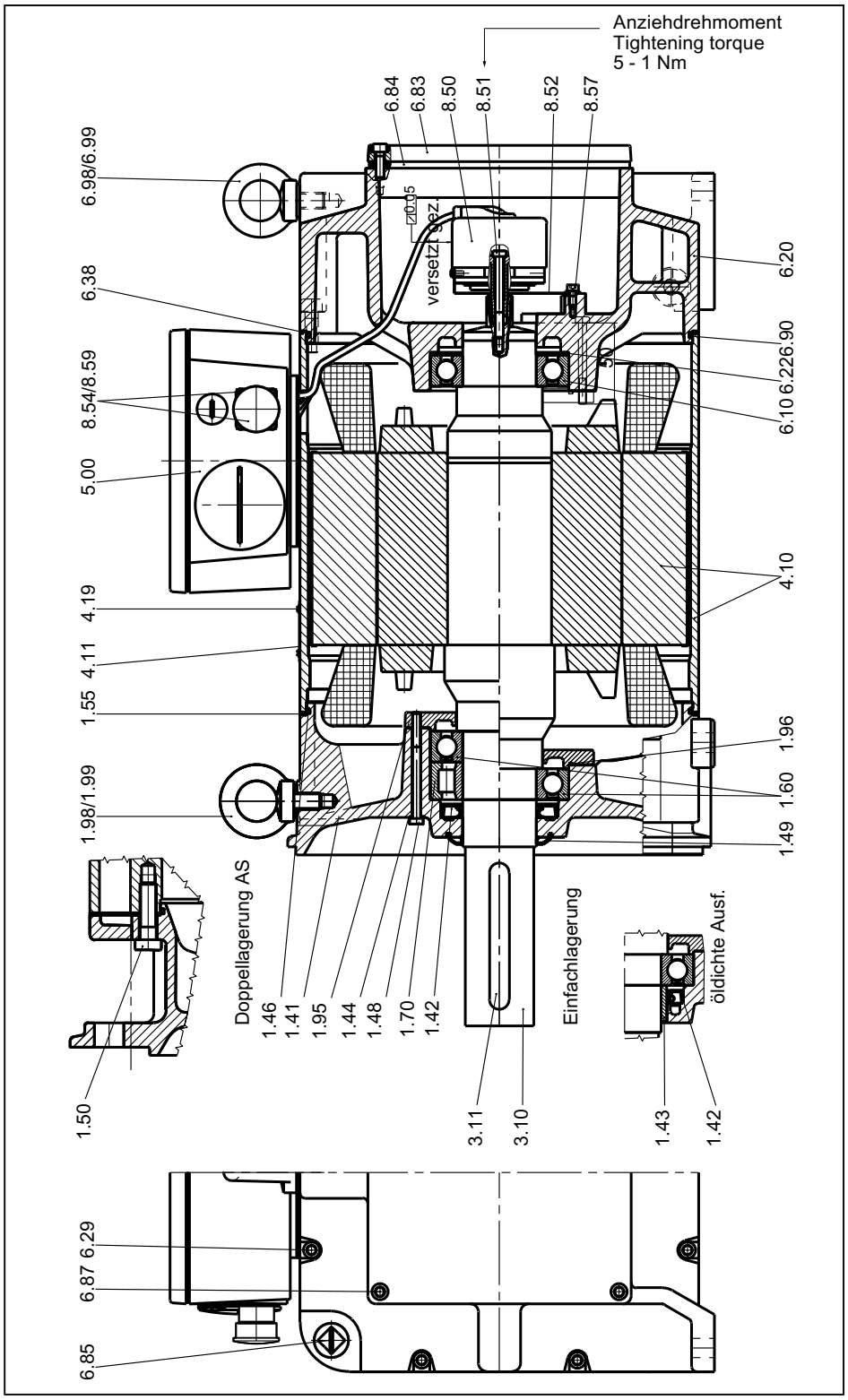


Figure 9-2 Spare parts

Decommissioning and disposal 10

10.1 Decommissioning

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

1. Contact a certified waste disposal organization in your vicinity. Clarify what is expected in terms of the quality when dismantling the motor and providing the components.
2. Follow the five safety rules.
3. Remove all electrical connections.
4. Remove all liquids such as oil, water, …
5. Remove all cables.
6. Release the motor from its mounting.
7. Transport the motor to a suitable location for disassembly.

Refer also to the notes in the Chapter, "Maintenance".

Dismantle the motor following the general procedures commonly used in mechanical engineering.

⚠ WARNING

Motor parts can fall down

The motor is made up of heavy parts. These parts can fall during dismantling. Death, serious injury, or material damage can result.

Secure the motor parts being dismantled to prevent them falling.

The motors must be disposed of in accordance with national and local regulations as part of the standard recycling process or they can be returned to the manufacturer.

The encoder electronics must be properly disposed of as electronic waste.

10.2 Disposal

Protecting the environment and preserving its resources are high priority corporate goals 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 motor and its components are given in the following section. Be sure to comply with local disposal regulations.

Components

Sort the components for recycling according to whether they are:

- Electronics waste, e.g. encoder/sensor electronics
- Iron to be recycled
- Aluminum
- Non-ferrous metal, e.g. motor windings
- Insulating materials

Process materials and chemicals

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

- Oil

  Dispose of the spent oil as special waste in accordance with the spent oil ordinance.
- Grease
- Solvents
- Cleaner solvent
- Paint residues

Do not mix solvents, cleaner solvents and paint residues.

Insulating materials

Electrical insulation materials are mainly used in the stator. Some supplementary components are made of similar materials and must therefore be handled in the same manner. The following materials are involved:

- Various insulators that are used in terminals boxes
- Voltage and current transformers
- Electric cables
- Instrument wiring
- Surge arresters
- Capacitors

Appendix A

A.1 Declaration of conformity

SIEMENS

EG-Konformitätserklärung
EC Declaration of Conformity
No. 664.20007.02

Hersteller: *Manufacturer:*	**Siemens Aktiengesellschaft** Industrie Sector I DT MC MF-M
Anschrift: *Address:*	Industriestraße 1 97615 Bad Neustadt a. d. Saale Germany
Produktbezeichnung: *Description of the product:*	**Drehstrom – Asynchronmotoren** *Three-phase asynchronous motors* Typen */ types:* 1PH41.., 1PH61.., 1PM41.., 1PM61..

Die bezeichneten Produkte stimmen in der von uns in Verkehr gebrachten Ausführung mit den Vorschriften folgender Europäischer Richtlinie überein:
The products described above in the form as placed on the market are in conformity with the provisions of the following European Directive:

2006/95/EG Richtlinie des Europäischen Parlaments und de Rates vom 12.Dezember 2006 zur Angleichung der Rechtsvorschriften der Mitgliedstaaten betreffend elektrische Betriebsmittel zur Verwendung innerhalb bestimmter Spannungsgrenzen.
Directive of the European Parliament and the Council of 12. December 2006 on the approximation of the laws of the Member States related to electrical equipment designed for use within certain voltage limits.

Die Konformität mit der Richtlinie wird nachgewiesen durch die Einhaltung folgender Normen:
Conformity to the Directive is assured through the application of the following standards:

EN 60034-1*): 2004 EN 60204-1 : 2006
) mit allen relevanten Teilen / *with all relevant parts

Die Sicherheitshinweise und Betriebsanleitungen sind zu beachten.
The safety and manual documentation shall be considered in detail.

Erste CE - Kennzeichnung: 1996 */ first CE - marking: 1996*

Die bezeichneten Produkte sind zum Einbau in andere Maschinen bestimmt. Die Inbetriebnahme ist solange untersagt, bis die Konformität des Endproduktes mit der Richtlinie 2006/42/EG festgestellt ist.
Alle Sicherheitshinweise der zugehörenden Produktdokumentation sind zu beachten sowie dem Endanwender zur Kenntnis zu geben.
The products supplied are intended exclusively for installation in a machine. Commissioning is prohibited until it has been established that the end product conforms with the Directive 2006/42/EU. All safety instructions in the associated product documentation must be observed and given to the end user for his/her information.

Bad Neustadt, den 28.6.2010
Siemens Aktiengesellschaft

i.V. Frank ..... i.V. Jainat .....

Michael Frank,
Head of the electric motor factory Bad Neustadt

Dr. Jan Dainat,
Head of product development department

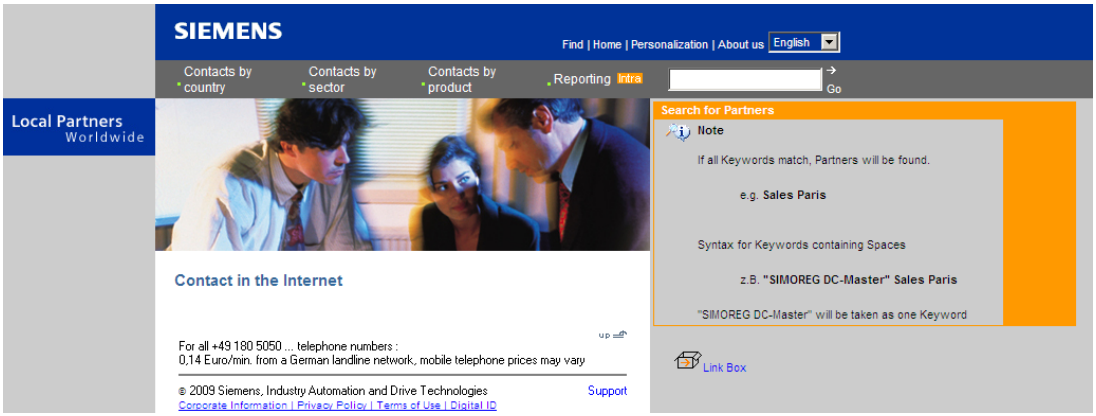
Diese Erklärung bescheinigt die Übereinstimmung mit der genannten Richtlinie, ist jedoch keine Beschaffenheits- oder Haltbarkeitsgarantie nach §443 BGB.
This declaration certifies the conformity to the specified directive but does not imply any warranty for properties.

Ersatz für / *Substitute for* 664.20007.01 Stand / *Status*: 10/2002

Ausgabestand / *Status*: 06/2010
Erstausgabe / *first document*: 08/1996

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A.2 Siemens Service Center



Visit http://www.siemens.com/automation/partner for information about Siemens contact partners for specific technologies worldwide.

Wherever possible, you will find a local contact partner for

- Technical support
- Spare parts/repairs
- Service
- Training
- Sales or
- Technical support/engineering

You start by selecting a

- Country
- Product or
- Sector

Once the remaining criteria have been defined, the required contact will be shown along with the associated area of expertise.

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