1PV5/1FV5 synchronous/induction motors

Operating instructions · 01/2012

SIEMENS

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Operating Instructions

01/2012

610.45002.40

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 relevant 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, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING

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

Trademarks

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

Disclaimer of Liability

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

Siemens AG
Industry Sector
Postfach 48 48
90026 NÜRNBERG
GERMANY

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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 the delivery to the disposal stage.

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

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 rear of the inside front.

Note

All data that are generally applicable for the motor also always apply to the generator.

Text format features

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

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

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

Note

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

Safety notes

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2.1 General safety information

Safety and commissioning information for converter-fed low-voltage three-phase motors (in accordance with the Low Voltage Directive 2006/95/EC)

⚠ DANGER

All work associated with transporting, connecting, commissioning, and maintaining the motors must be carried out by **qualified, responsible personnel** (DIN EN 50110-1; note IEC 60364).

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

The valid **national, local and plant/system-specific regulations and requirements** must be carefully observed.

Special versions and **construction variants** 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.

Vehicles with converter-fed low-voltage three-phase motors must fulfill the protective requirements of the EMC Directive 2004/108/EC.

The user is responsible for ensuring that installation is carried out properly. The signal and power cables must be shielded.

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

2.2 Safety and operating instructions

The safe use of electrical machines

⚠ WARNING

Rotating or live parts

Rotating or live parts are dangerous.

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.

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 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.

Note

Siemens Service Center

We recommend engaging the support and services of your local Siemens Service Center for all planning, installation, commissioning, and maintenance work.

2.3 Observing the five safety rules

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

Five safety rules

1. Disconnect the system.

   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.
4. Ground and short-circuit.
5. Cover or enclose adjacent components that are still live.

When work has been completed, remove these measures in reverse order.

2.4 Thermal hazard

⚠ CAUTION

The surface temperature of the motors can exceed 65 °C.

Do not touch any hot surfaces!

Temperature-sensitive components (electric cables, electronic components) must not be placed on hot surfaces. If the motors overheat, this can destroy the windings/bearings and the permanent magnet may become demagnetized

Only operate the motors in conjunction with effective temperature control.

2.5 Information about electromagnetic fields

NOTICE

Permanent magnets

The rotors of 1FV5 synchronous motors contain permanent magnets with high magnetic flux densities and strong forces of attraction to ferromagnetic bodies.

Persons with cardiac pacemakers are endangered in the vicinity of a disassembled rotor.

Data stored on electronic data carriers can be destroyed.

⚠ WARNING

Electromagnetic fields

Electromagnetic fields are generated when electrical power engineering installations (e.g. transformers, converters, or motors) are operated.

Electromagnetic fields can interfere with electronic devices, which could cause them to malfunction. Heart pacemakers can be affected, for example, which could potentially damage a person's health or even result in death. Steps must be taken, therefore, to ensure that persons with heart pacemakers cannot 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. shields) to reduce electromagnetic fields at their source.

2.6 Electrostatic sensitive devices (ESD)

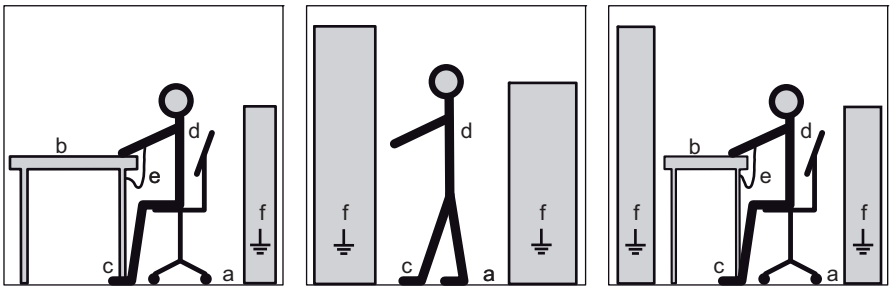
ESD guidelines

CAUTION
Electrostatic discharge
Electronic modules contain components that can be destroyed by electrostatic discharge.
These modules can be easily destroyed by improper handling.
To protect your equipment against damage, follow the instructions given 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 immediately beforehand and be grounded.
- Electronic modules should not come into contact with electrically insulating materials (e.g. plastic foil, plastic parts, insulating table supports, or clothing made of synthetic fibers).
- Always place the modules on conductive bases.
- Always store and transport electronic modules or components in conductive packaging (e.g. metallized plastic or metal containers).

CAUTION
Use conductive packaging material
Electronic modules must be stored, transported, and dispatched in conductive packaging.
Electronic modules that are not correctly stored, transported, or dispatched can be damaged.
Pack electronic modules in appropriate conductive packaging (e.g. foam rubber or aluminum foil).

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



(1) (2) (3)

(1) Sitting
(2) Standing
(3) Standing/sitting

ESD protective measures

a = conductive floor
b = ESD table
c = ESD footwear
d = ESD coat
s = ESD wrist strap
f = cubicle ground connection

Figure 2-1 ESD protective measures

Description

3

3.1 Application

Proper usage

The motors are designed for installation in electrically driven vehicles. and are characterized by their high power density, ruggedness, long lifetime, and overall reliability. The variable-speed three-phase motors are operated from a frequency converter. The direct connection to the three-phase line supply is not permissible. It is forbidden to install them in hazardous areas unless they are explicitly designed for this.

Mode of operation and design

The 1PV5 motors are liquid-cooled squirrel-cage induction motors.

The 1FV5 generators are liquid-cooled synchronous motors with permanent magnet rotors.

Both active parts are equipped with two temperature sensors integrated in the stator winding, where the second can be used as a reserve.

An encoder system for sensing the speed and direction of rotation is optionally installed in the NDE bearing shield of the motors.

3.2 Rating plate (type plate)

The rating plate (type plate) shows the technical specifications for the supplied motor.

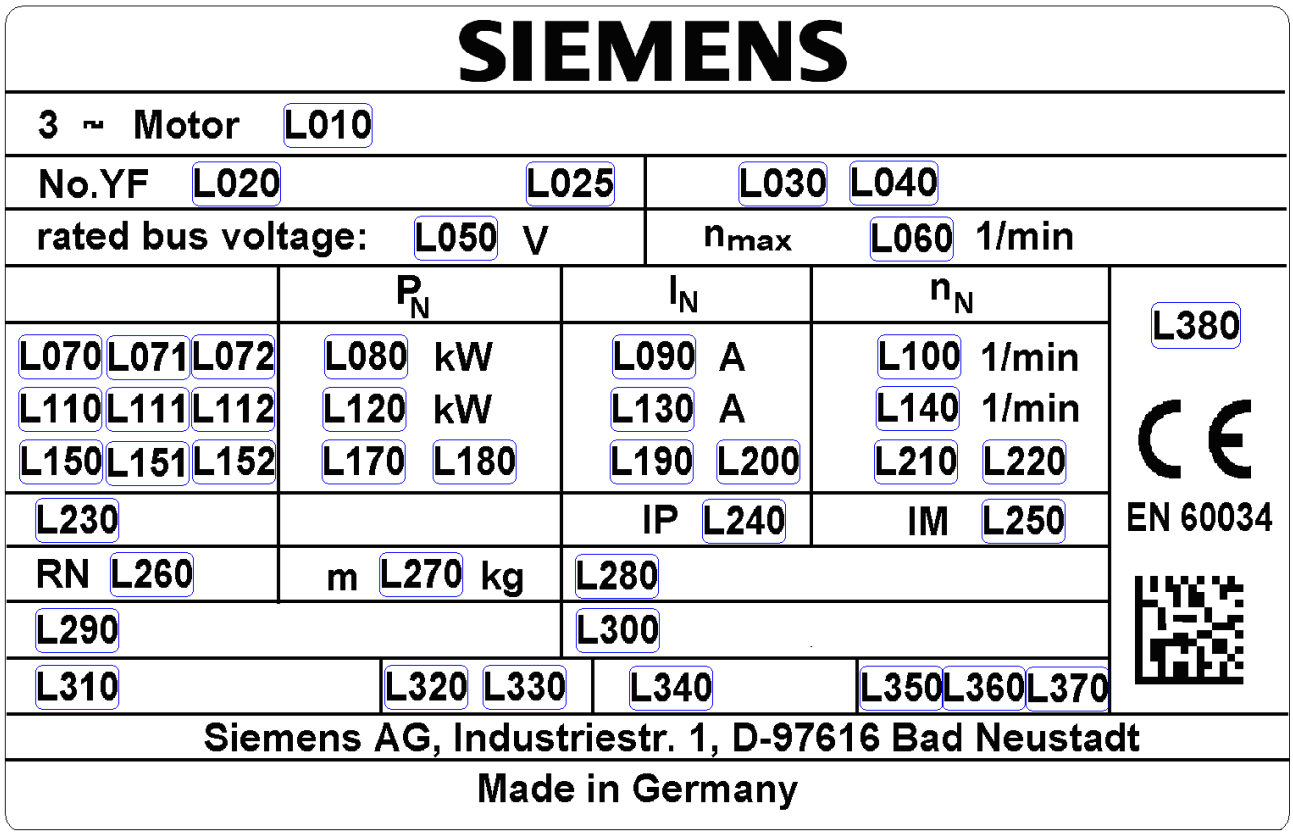


Figure 3-1 Schematic layout of rating plate

Table 3- 1 Elements on the rating plate

No.	Description	No.	Description
L010	MLFB	L170	Rated power P_N (3)
L020	Factory serial number	L180	Unit rated power (3)
L025	Consecutive number	L190	Rated current I_N (3)
L030	Z: (For options)	L200	Unit rated current I_N (3)
L040	Options	L210	Rated speed n_N (3)
L050	Rated voltage	L220	Rated speed n_N (3)
L060	Maximum speed n_{max}	L230	Temperature class
L070	Operating mode (1)	L240	Degree of protection
L071	Rated time (1)	L250	Type of construction
L072	Unit rated time (1)	L260	Revision number
L080	Rated power P_N (1)	L270	Weight
L090	Rated current I_N (1)	L280	Temperature sensor

No.	Description	No.	Description
L100	Rated speed n_N (1)	L290	Encoder (encoder)
L110	Operating mode (2)	L300	Optional customer information
L111	Rated time (2)	L310	Cooling method
L112	Unit rated time (2)	L320	Coolant flow
L120	Rated power P_N (2)	L330	Unit coolant flow
L130	Rated current I_N (2)	L340	Cooling pressure
L140	Rated speed n_N(2)	L350	Maximum value
L150	Operating mode (3)	L360	Maximum coolant temperature
L151	Rated time (3)	L370	Unit maximum coolant temperature
L152	Unit rated time (3)	L380	UL mark

3.3 Technical features

Table 3- 2 Technical features

	1FV5	1PV5
Type of motor	Permanent-magnet synchronous motor	Induction motor
Magnet material	Rare-earth magnetic material	---
Speed encoder (optional)	Rotor position encoder (RPE)	Toothed-wheel encoder (64 pin)
Insulation of stator winding according to EN 60034–1	Thermal class 180 (H)	
Cooling	Liquid cooling	
Installation altitude according to EN 60034-1	≤ 2500 m above sea level, otherwise power derating	
Type of construction acc. to EN 60034–7	IM B5	
Degree of protection to EN60034-5	IP65/IP69K (without DE shaft output)	
Temperature monitoring in accordance with EN 60034-11	2 x KTY 84-130 temperature sensor in the stator winding	
Drive shaft end in accordance with DIN 748-3	Plain or geared shaft, optional shaft with fitted key and keyway (half-key balancing)	
Radial eccentricity, concentricity and axial eccentricity in accordance with DIN 42955	Tolerance N (normal)	
Vibration severity grade according to EN 60034-14	Grade A is maintained up to rated speed	
Sound pressure level according to DIN EN ISO 1680	75 dB (A) + 3 dB (A) tolerance	
Connection	Terminal board in the terminal box for power 12-pin signal connector	

3.4 Design

3.4.1 Regulations

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

Table 3- 3 Regulations that have been applied

Feature	Standard
Rated and operation characteristics	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. 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.

Note

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

3.4.2 Types of construction

The motor has type construction IM B5.

3.4.3 Degree of protection

The motors have degree of protection IP65/IP69K. In order to guarantee the degree of protection, the drive end flange must be suitably implemented.

3.4.4 Ambient conditions

The motors are designed for ambient temperatures from -40 °C to +70 °C and installation altitudes up to 2500 m above sea level. In the case of different ambient conditions, contact the manufacturer.

3.4.5 Cooling

Water cooling

The motor can only be operated in a closed coolant circuit with a cooling unit. The motor is connected to the cooling circuit using two hose connections with an outer diameter of 18 mm at the non-drive bearing shield of the motor. On motors with angled hose connections, after loosening the locknuts they can be adjusted in both directions (preferred direction clockwise; max. 1 revolution). After adjusting the position, the coolant connections must be fixed by tightening the locknuts.

The inlet and outlet connections can be selected as required.

Table 3- 4 Technical data of the water cooling

Coolant	Water/anti-freeze mixture, 50/50 %
Cooling water connection	Hose connection with an outer diameter of 18 Female thread in the bearing shield Pg 13.5 /8 deep
Cooling water flow	16 l/min Lower values will result in a derating
Max. pressure at inlet	max. 2.5 bar
Pressure loss between inlet and outlet	< 0.2 bar for minimum cooling water flow with 1PV513/1FV513 < 0.4 bar for minimum cooling water flow with 1FV516
Min. cooling water inlet temperature	$T_{cool} > T_{ambient} - 5$ K at $T_{ambient}$ <60 °C; $T_{coolmin}$ > -40 °C
Maximum cooling water inlet temperature, without derating	≤ 55 °C, higher values will result in derating

As coolant, only a water/anti-freeze mixture in a ratio of 50 % / 50% is permissible. Glycol is recommended as antifreeze. When you select a different anti-freeze, a minimum steady-state temperature of -40 °C must be observed. Different anti-freeze agents should not be mixed.

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

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

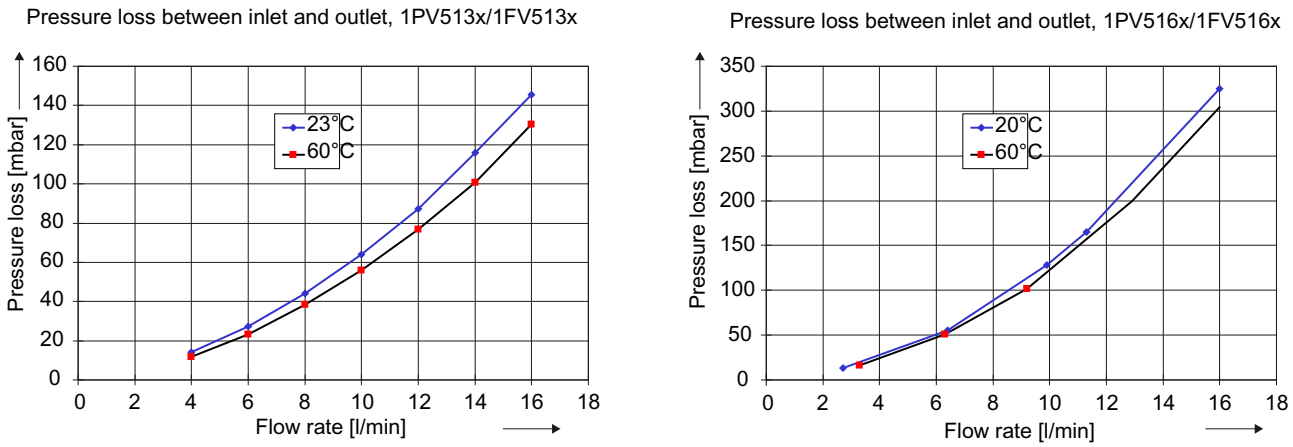


Figure 3-2 Pressure losses as a result of volumetric flow

Coolant temperatures below the ambient temperature lead to increased condensation of water. The difference between the coolant inlet temperature and ambient temperature should therefore not exceed maximum 5 Kelvin. If the motor is out of operation for a prolonged period of time, coolant inflow must additionally be interrupted.

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- 5 Water specifications for the coolant

Contents and chemical composition	Value
pH value	6 … 8
Chloride ions	< 40 ppm
Sulfate ions	< 50 ppm
Nitrate ions	< 50 ppm
Dissolved solids	< 340 ppm
Total hardness	< 170 ppm
Electrical conductivity	< 500 µS/cm
Size of any particles in the coolant	< 100 µm

NOTICE
Storing or transporting the motor The cooling circuit must be emptied when storing the motor, for longer periods when the motor is out of service and when the motor is being transported.

Materials used in the cooling circuit

The materials used in the cooling circuit must the coordinated with the materials in the motor (aluminum alloy) and hose connection (nickel plated brass).

Materials and components in the cooling circuit

The following table lists a wide variety of materials and components which may or may not be used in a cooling circuit.

Table 3- 6 Materials and components of a cooling circuit

Material	Used as	Description
Zinc	Pipes, valves and fittings	Use is not permitted. Non-ferrous metals chips can lead to pitting corrosion in galvanized pipes. Zinc breaks down the glycol-based inhibitors.
Brass	Pipes, valves and fittings	Can be used in closed circuits.
Copper	Pipes, valves and fittings	Can be used only in closed circuits in which the heat sink and copper component are separated (e.g. connection hose of the units).
Common steel (e.g. St37)	Pipes	Permissible in closed circuits and semi-open circuits with inhibitors or Antifrogen N, check for oxide formation, inspection window recommended.
Cast steel, cast iron	Pipes, motors	Closed circuit and use of strainers and flushback filters. Fe separator for stainless heat sink.
High-alloy steel, Group 1 (V2A)	Pipes, valves and fittings	Can be used for drinking or municipal water with a chloride content up to <250 ppm, suitable according to definition in Chapter "Coolant definition".
High-alloy steel, Group 2 (V4A)	Pipes, valves and fittings	Can be used for drinking or municipal water with a chloride content up to <500 ppm, suitable according to definition in Chapter "Coolant definition".
ABS (**A**crylnitrile**B**utadiene**S**tyrene)	Pipes, valves and fittings	Suitable according to the definition in Chapter "Coolant definition". Suitable for mixing with inhibitor and/or biocide as well as Antifrogen N.
Installation comprising different materials (mixed installation)	Pipes, valves and fittings	Use is not permitted.
PVC	Pipes, valves, fittings and hoses	Use is not permitted.
Hoses		Reduce the use of hoses to a minimum (device connection). Must not be used as the main pipe for the whole system. Recommendation: EPDM hoses with an electrical resistance > 10^9 Ω (e.g. Semperflex FKD supplied from Semperit or DEMITTEL; from PE/EPD, supplied from Telle).
Gaskets	Pipes, valves and fittings	Use of Viton, AFM34, EPDM is recommended.
Hose connections	Transition Hose - pipe	Secure with clips conforming to DIN 2817, available e.g. from the Telle company.

The following recommendation applies in order to achieve an optimum motor heatsink (enclosure) lifetime:

- Engineer a closed cooling circuit with cooling unit manufactured out of stainless steel that dissipates the heat through a water-water heat exchanger.
- All other components such as cooling circuit cables and fittings manufactured out of ABS, stainless steel or general construction steel.

3.4.6 Noise emissions

In operation, in the speed range extending from 0 up to rated speed, 1PV5 and 1FV5 motors can reach the following measuring surface sound pressure level Lp(A) according to ISO 1680:

- 75 dB(A) + 3 dB tolerance

Preparing for use

4

4.1 Shipment 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 additional rating plate supplied separately with the consignment should be used for indication of the motor data in the vicinity of the motor.

The rating plate is located in the terminal box.

4.2 Transport and storage

4.2.1 Transport

Use suitable load bearing equipment when transporting and installing the motor. Make sure that all of the available eyebolts 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 during lifting and transportation!

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

Lifting devices, industrial trucks, and load bearing equipment must comply with requirements. 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.

⚠ 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 pipe 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 warped or damaged ring bolts.
- Loads that run transverse to the ring plane are not permitted.

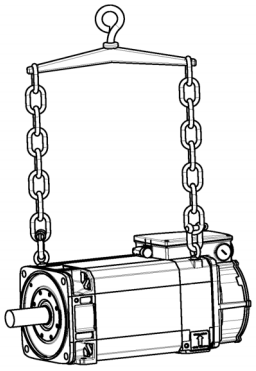


Figure 4-1 Lifting and transporting the motor with a cross beam (example)

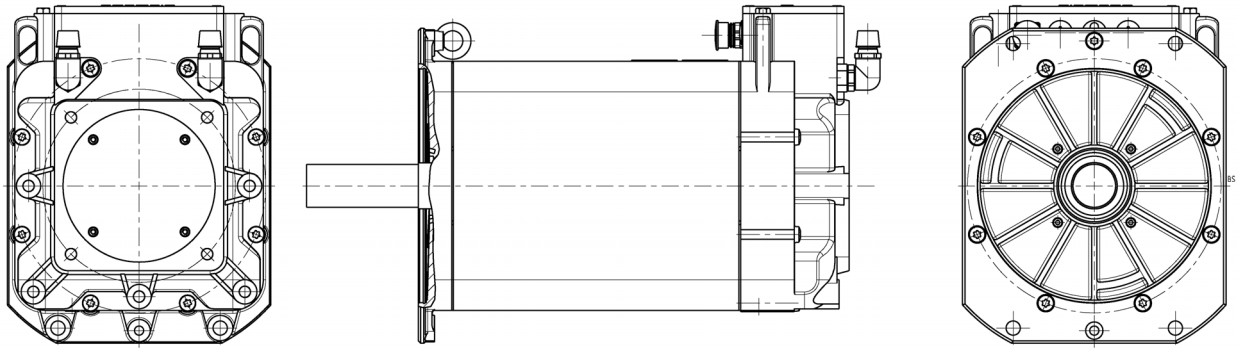


Figure 4-2 Arrangement of the lifting eyebolts for 1PV513x/1FV513x

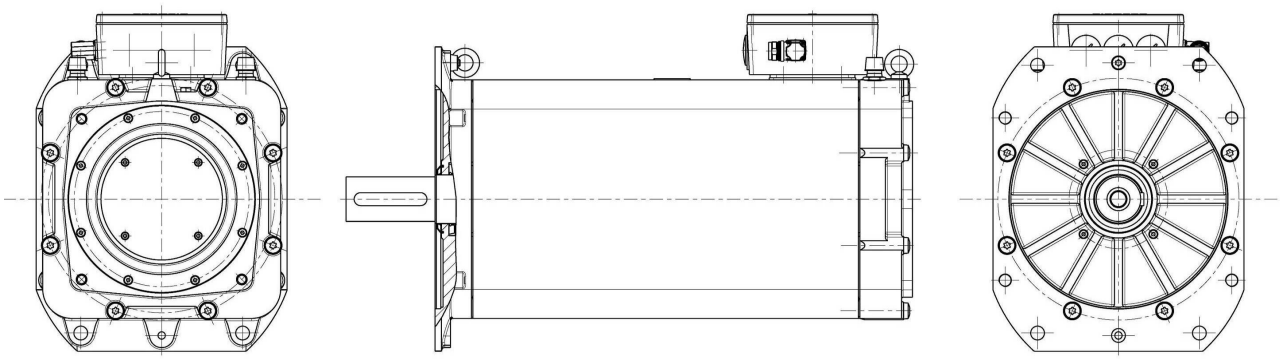


Figure 4-3 Arrangement of the lifting eyebolts for 1PV516x/1FV516x

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 provided by the customer.
3. Empty the motor of any cooling water and purge it carefully with air.
4. Close and seal all openings on the terminal box and housing.
5. 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 not susceptible to vibration (v_{eff} < 0.2 mm/s) without the specified storage time being reduced.

CAUTION
Seizure damage to bearings If the motors are stored incorrectly, bearing seizure damage can occur (e.g. brinelling) as a result of vibrations.

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 harmful gases.
- Protect the motor against shocks 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 humidity-absorbent material and then wrap it in film so that it is air tight.
- Include several bags of desiccant in the seal-tight packaging. Check the desiccant and replace as required.
- Place a humidity meter in the seal-tight packaging to indicate the level of air humidity inside it.
- Inspect the motor on a regular basis.

Long-term storage

If you intend to place the motor in storage for longer than six months, 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 machines are recommissioned.
- Make sure that storage area is air-conditioned.

Protecting the cooling-water system

When delivered, the cooling system is not filled with coolant.

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.

Mounting

5

5.1 Installation

CAUTION
Temperature-sensitive parts Some parts of the motor enclosure can reach temperatures that exceed 100°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 end When installing the motor, ensure that the end of the shaft is protected against blows and pressure.

Note

Observe the technical data on the motor enclosure rating plates.

The following must be taken into account when the motors are installed

- Observe the data on the rating plate, as well as the warning and information plates on the motor.
- The permissible cantilever and axial forces at the shaft end of the motors may not be exceeded.

Table 5- 1 Permissible forces at the motor

	1PV513x/1FV513x	1PV516x/1FV516x
Radial force	1100 N	1800 N
Axial force (both directions)	700 N	1100 N

- 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. When tightening the fixing screws avoid any uneven stressing. Use hexagon socket head cap screws with a minimum property class of 8.8. Observe the tightening torques for the fixing screws of the motor flange,
- Rotate the drive elements by hand. If you hear any grinding noise, rectify the cause or contact the manufacturer.
- Eyebolts that have been screwed in must either be tightened or removed after installation.
- The motors are to be installed in such a way that the coolant can freely flow in and out unimpeded.
- Only remove all protective caps immediately before installing the respective parts.

5.2 Fixing

To ensure smooth, vibration-free operation, the motor must be precisely aligned and the components to be mounted on the shaft end correctly balanced.

Mounting using the motor flange (flange mounting)

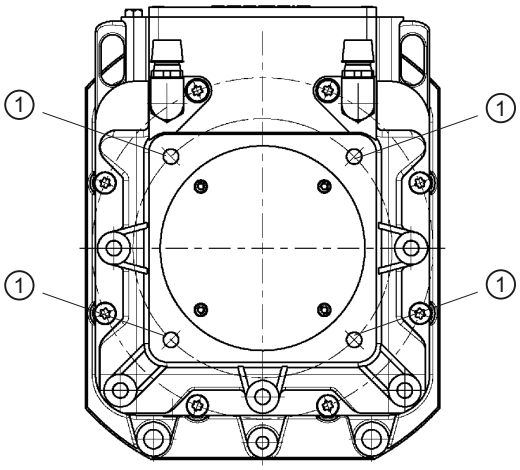
NOTICE
When the motor is flange-mounted, this creates a system that is capable of oscillation with specific natural mounting frequencies. In operation, this can result in excessive vibration. To counter this, additionally support the motor at the NDE. Ensure that the motor is not subject to excessive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

Note

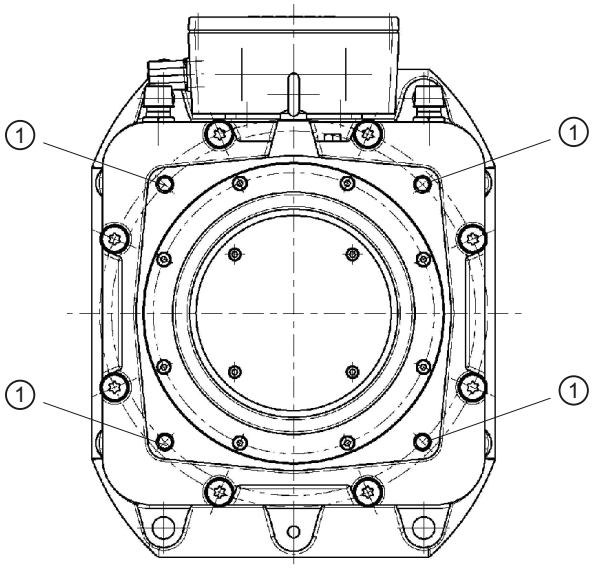
At the DE only use screws with washer.

When mounting on an unsprung mass, always support at the NDE.

1PV513x/1FV513x



1PV516x/1FV516x



① Thread for NDE support

Figure 5-1 Motor support at the NDE

Tightening torques

Table 5- 2 Tightening torques

Motor	Screw, DE	Screw NDE	Tightening torque DE ±10 % [Nm]	Tightening torque NDE ±10 % [Nm]	Property class of the screws
1PV513x/ 1FV513x	M12	4 x M12; screw-in depth 25...30 mm	100	100	8.8
1PV516x/ 1FV516x	M16	4 x M12; screw-in depth 18...20 mm	190	100	10.9

Alignment accuracy for coupling output

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

5.3 Attaching the output elements

NOTICE
Do not subject the motor's shaft and bearings to impact. Do not exceed permissible cantilever and radial forces.

Balancing

The motors are balanced so that when they are shipped, they correspond to vibration severity grade A in accordance with EN60034-14 over the complete speed range.

The motors are fitted with a key; this means that they are dynamically balanced with half a key. The balancing type is marked on the DE shaft end with "H" (half key).

Note

Note the designation of the balancing type on the shaft end face. Plain or toothed shaft ends are not marked.

Pushing on 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 to ISO 1940. Rotary forces that exceed this are not permissible. Please note that rotary forces can also occur with 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.
- Fit/remove the output elements only by means of suitable equipment:
  - Use the threaded hole in the shaft extension (front).
  - If necessary, heat up the output element.
  - When removing output elements, use a washer to maintain the centering in the shaft extension.

⚠ WARNING

Shock-hazard protection for output elements

The general shock-hazard protection measures for output elements must be observed.

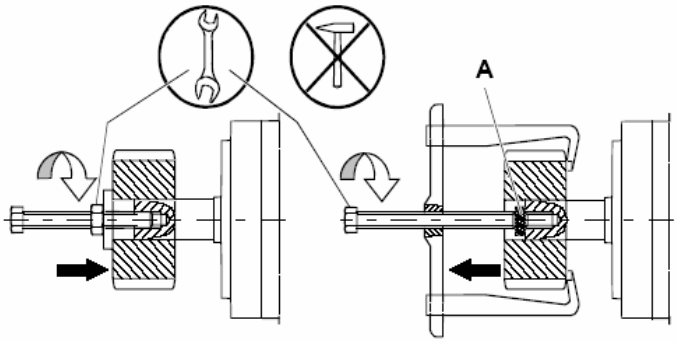


Figure 5-2 Fitting/removing output elements; A = intermediate washer (for maintaining the centering in the shaft extension)

Motor without output element

⚠ WARNING

The feather key can fall 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 fall out during operation.

Death or serious injury can result.

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

See also

Installation (Page 25)

5.4 Vibration load

The on-site system vibration characteristics depend on factors such as the output elements, assembly conditions, alignment, installation, and external vibrations 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 defined measuring points on the motor.

Table 5- 3 Vibration values

Description	Vibration values
Vibration velocity v_{rms} according to ISO 10816	Max. 4.5 mm/s
Vibration acceleration a_{peak} axial 1)	25 m/s²
Vibration acceleration a_{peak} radial 1)	50 m/s²

1) The measurement locations should be selected in accordance with ISO 10816-1 Paragraph 3.2.

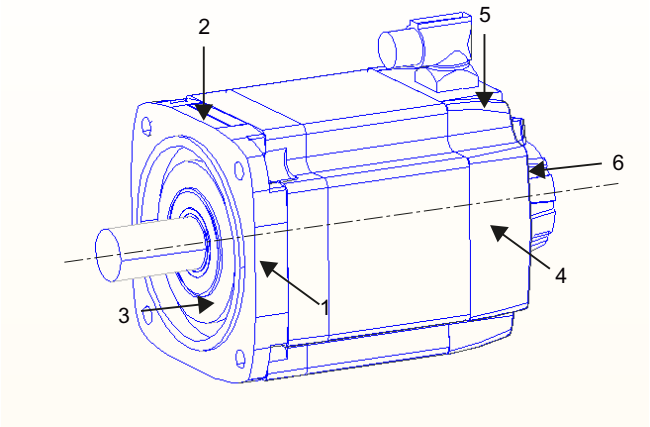


Figure 5-3 Vibration values at the measurement locations

The vibration acceleration must be evaluated in a frequency band of 10 to 2000 Hz. The maximum peak value in the time range is to be considered.

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

Connection

6

6.1 Mechanical connection of water cooling system

The inlet and outlet holes for the cooling water supply are located at 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. Attach the cooling water pipes to the cooling water connections. You can connect the inlet and outlet as required.
4. Ensure that the maximum permissible operating pressure does not exceed 2.5 bar.

See also

Cooling (Page 17)

6.2 Electrical connection

6.2.1 Safety information

⚠ DANGER

Risk of electric shock

For synchronous motors, hazardous voltages are present at the motor terminals when the rotors are rotating.

Only qualified personnel may perform work on the motor. The motor must be stationary, isolated from the line supply and locked out so that it can be accidentally switched on. This also applies to auxiliary circuits.

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

⚠ DANGER

Motor damage warning

The motor will be destroyed if it is directly connected to the three-phase line supply.

Only operate the motors with the appropriately engineered converters! Ensure the correct phase sequence is used!

CAUTION

Electrostatically sensitive devices

The motor contains electrostatic sensitive devices. Touching signal connections with electrostatically charged hands or tools can result in malfunctions.

Note the ESD protection measures.

Safety rules for working on electrical installations in accordance with EN 50110-1:

- Disconnect the system.
- Protect against reconnection.
- Make sure that the equipment is de-energized.
- Ground and short-circuit.
- Cover or enclose adjacent components that are still live.

6.2.2 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 using EMC cable glands. Make sure that the cable shields are properly connected.
- Arrange the exposed connecting cables in the terminal box so that the PE conductor has an excess length and the insulation of the cable conductors cannot be damaged.
- Only remove insulation from the cable ends so that the insulation reaches up to the cable lug, terminal, or wire end ferrule.
- 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 connecting cables, if necessary).
- Make sure that the inside of the terminal box or connector is clean and free of cable cuttings 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- 1 Tightening torques at the terminal board

Thread ∅	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 changing internal connection cables, always observe the minimum air clearance of 5.5 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.
- Plug in or remove the connector only when the system is de-energized.
- The PE must be connected.
- The cable lugs of the power connections must extend directly to the cable lugs of the motor winding connections. (see the diagram, "Attaching the cable lugs").
- It is not permissible to mark the cable connections using paint.

6.2.3 Circuit diagram

The circuit diagram contains information about the connection, connecting the motor winding and signal lines.

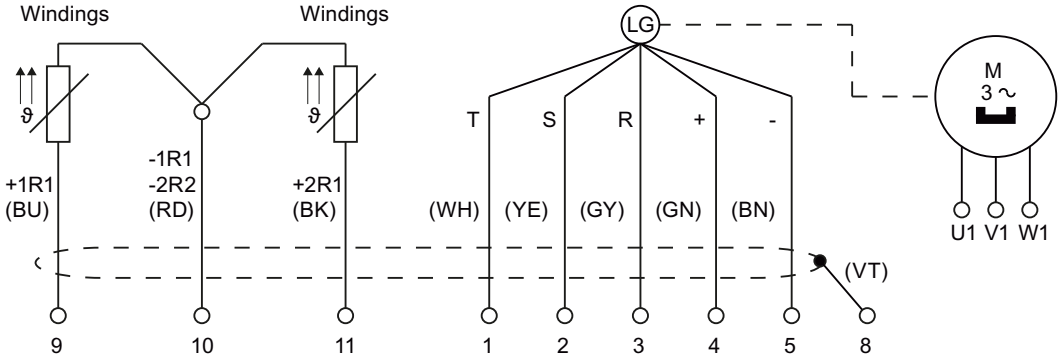


Figure 6-1 Circuit diagram_1FV5 (without position encoder, contacts 1 ... 5 not assigned)

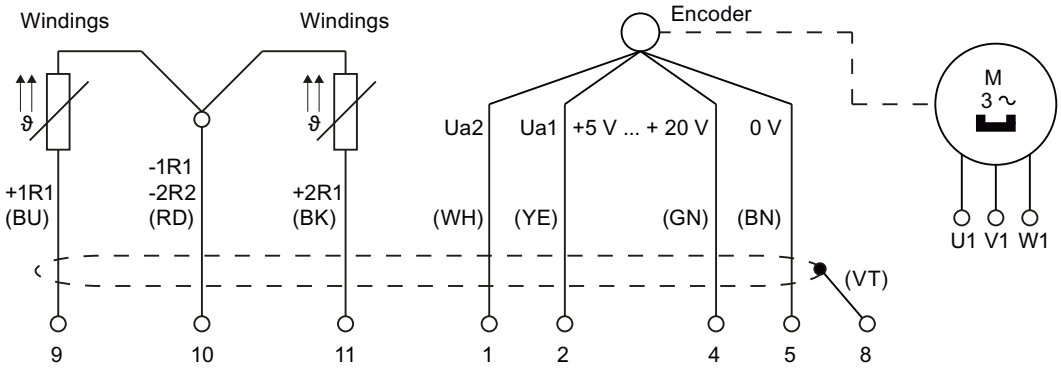


Figure 6-2 Circuit diagram_1PV5 (without encoder, contacts 1 ... 5 not assigned)

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 as this invalidates warranty claims.

6.2.4 Terminal box

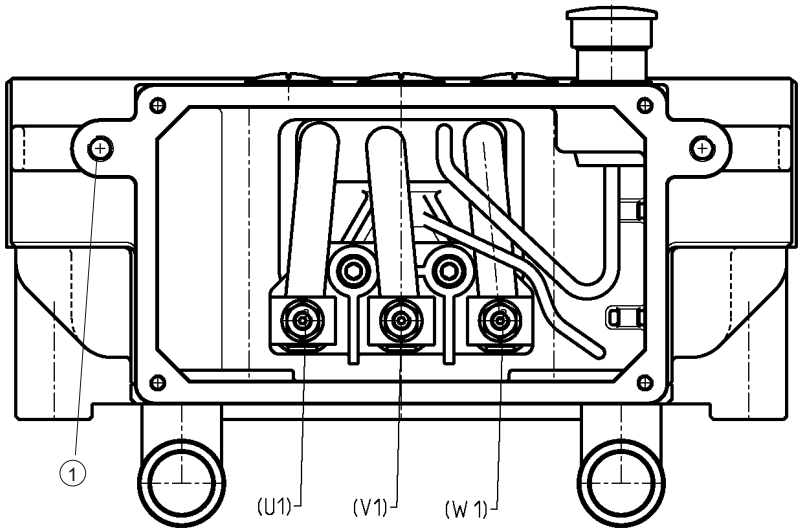
- The motor connection depends on the desired direction of rotation, and is carried out as follows: .
  - Clockwise direction of rotation when viewing the shaft extension:

    Phase U1 connected to L1, V1 to L2 and W1 to L3

    Signal Ua1 is received before Ua2.
  - Counter clockwise direction of rotation when viewing the shaft extension:

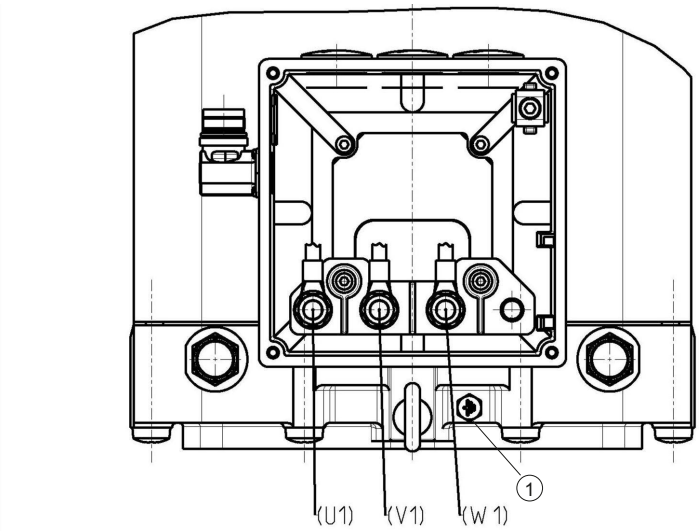
    Phase U1 connected to L3, V1 to L2 and W1 to L1

    Signal Ua2 is received before Ua1
- Terminal assignment in the terminal box should be implemented as shown in the following diagrams "Terminal box 1PV51xx/ 1FV51xx".
- Use cable lugs to DIN 46234.
- Screw the cover of the terminal box back on (tightening torque, 5 Nm).



① Ground conductor connection, M8

Figure 6-3 Terminal box, 1PV513x/1FV513x



① Ground conductor connection, M8

Figure 6-4 Terminal box, 1PV516x/1FV516x

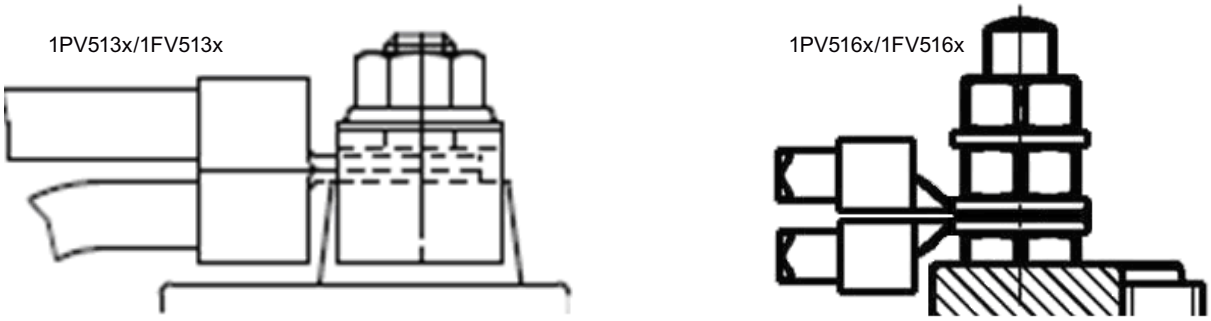


Figure 6-5 Attaching cable lugs

6.2.5 Data for electrical connection

Table 6- 2 1PV513x/1FV513x motors

Terminal box	Cable entry (power)	Cable entry (external signals)	Max. external cable diameter 1)	Number of main terminals	Cross-section per terminal, max.
Integrated in the motor	3 x PG16	1 x M23	15 mm	Phases: 3 x M6 Grounding: 1 x M8	1 x 35 mm^2

1) Dependent on the cable gland design

Table 6- 3 1PV516x/ 1FV516x motors

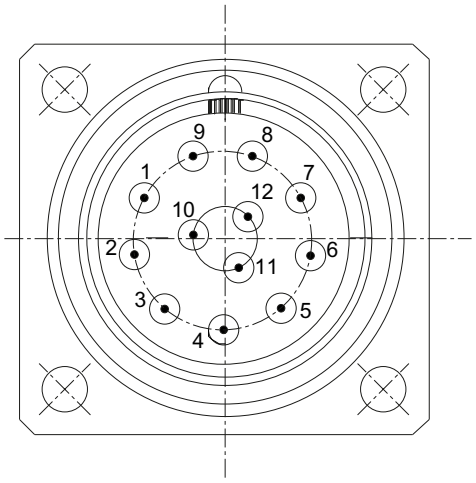
Terminal box	Cable entry (power)	Cable entry (external signals)	Max. external cable diameter 1)	Number of main terminals	Cross-section per terminal, max.
Gk420	3 x M32 x 1.5	1 x M23	27 mm	Phases: 3 x M10 Grounding: 1 x M8	1 x 70 mm^2

1) Dependent on the cable gland design

6.2.6 Signal connection

For the motors, the speed encoder and temperature sensor are connected using a 12-pin angle connector, which is installed in the terminal box. Contact is established through the contact pins. If the motors do not have an encoder, then only the temperature sensor signals are assigned in the connector, as shown in the following table.

Table 6- 4 Signal connection, view of connector pins

Pin	1PV5	1FV5	1PV5 without encoder	1FV5 without position encoder	Connector
1	Signal Ua2	Not assigned	Not assigned		
2	Signal Ua1	Not assigned	Not assigned		
3	Not assigned	Not assigned	Not assigned		
4	Power supply		Not assigned		
5	Grounding		Not assigned		
6	-	-	-	-	
7	-	-	-	-	
8	-	-	-	-	
9	KTY 84 + 1R1				
10	KTY 84 -1R2/ -2R2				
11	KTY 84 +2R1				
12	-				

Note

- A suitable socket connector can be used to rotate the angle plug. Make sure that the socket connector is completely screwed on to avoid damaging the pin contacts.
- Removal, installation and adjustment of sensors only according to the corresponding instructions.
- Only remove the protective cap from the angle connector immediately before inserting the mating connector.

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 ground 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.

See also

Terminal box (Page 35)

6.2.9 Connecting-up a converter

Selecting and connecting the cables

Use shielded connection cables to connect the motor to a converter. The cable shielding, made up of many strands, must have a high electrical conductivity. Braided shields made of copper or aluminum are well suited.

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 high-frequency currents are 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 hazard: hot surfaces

The surface temperature of the motors can exceed 65 °C.

Do not touch hot surfaces.

If necessary, implement shock-hazard protection measures.

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

Mechanical connection

The following conditions must be fulfilled and suitable for the operating conditions:

- All touch protection measures for moving and live parts must have been applied.
- The motor has been assembled and aligned properly.
- The rotor must be able to be manually rotated or using suitable equipment without coming into contact with the stator.
- 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, for example.
  - 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 is used.

Note

If changes occur with respect to normal operation (e.g. increased temperatures, noise or oscillation), if in doubt, switch off the motor. Determine the cause and if necessary consult the manufacturer. Even in test operation, never disable protective functions or devices.

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.
- The indicated speed limit n_{max} is not exceeded during operation on a converter.

⚠ CAUTION

If the speed n_{max} is exceeded, this can damage the bearings, short-circuiting rings, press fits, etc. To ensure that the motor does not run at excessive speeds, the controller must configured accordingly or speed monitoring must be activated 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.
- The temperature sensors for the motor monitoring devices have been correctly connected and are fully functional.

Liquid cooling

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

NOTICE
Venting The cooling circuit must be vented before commissioning.

Roller bearings

If the motor has been stored under favorable conditions (i.e. in a dry, dust-free room that is not susceptible to vibration) for more than three 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 a trial run

⚠ WARNING

Danger from rotating rotor

Implement shock-hazard protection measures for output elements. Take suitable measures to ensure that feather keys (if used) cannot fall out.

7.3 Checking the insulation resistance

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

⚠ WARNING

Work on power installations must only be carried out by specialists. Before measuring the insulation resistance, read the manual for the insulation resistance meter you are going to use.

⚠ WARNING

Danger! High voltage

During and immediately after the measurement, hazardous voltage levels may be present. Touching live components can be result in death or serious injury.

Never touch the terminals when measuring 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 to the motor enclosure when the winding temperature is between 20 and 30°C.
- When performing the measurement, wait until the final resistance value is reached (this takes approx. one minute).

Limits

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

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

	Rated voltage U_N < 2 kV
Measurement voltage	1000 V (minimum, 100 V)
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:

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

  An insulation resistance value close to the minimum value could be due to moisture and/or dirt accumulation.

- The insulation resistance of the motor winding can drop during the course of its service life can drop due to ambient and operational influences. The critical insulation resistance for a temperature of 25 °C on the winding 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 reaching critical insulation resistance

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.

Note that the insulation resistance of dried, clean windings is lower than that of warm windings. The insulation resistance can only be evaluated accurately when measured on a winding that has been cooled down to room temperature (approx. 20 to 30°C).

NOTICE

Measured value close to critical value

If the measured value is close to the critical value, the insulation resistance should be subsequently checked at suitably regular intervals.

Values apply for measurement at a winding temperature of 25 °C.

7.4 Switching on the motor

Before switching on the motor, make sure that the frequency converter parameters have been correctly assigned.

CAUTION

Operation noise or abnormal noises

The motor can be damaged by improper handling during transport, storage, or setup. If a damaged motor is operated, this can damage the winding or bearings and could even destroy the system.

If the motor is not running smoothly or is emitting abnormal noises, shut the motor down and try to determine the cause of the fault as it runs down.

⚠ CAUTION

Note the maximum rotational speed

The maximum rotational 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-circuiting rings, press fits, etc. To ensure that the motor does not run at excessive speeds, the controller must configured accordingly or speed monitoring must be activated in the drive system.

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

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

Operation 8

8.1 Safety instructions during operation

⚠ WARNING

Do not remove covers when motor is running

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

All covers that prevent operators 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 during operation

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

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

⚠ CAUTION

Danger of burns

The temperature of certain parts of the motor can exceed 65 °C. Physical contact with the machine could cause serious burns.

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

8.2 Stoppages

Measures for operational motors during stoppages

- If the motor is out of service for extended periods of time, run it at regular intervals (roughly once a month) or at least spin the rotor.
- Refer to the section "Energizing" before restarting the motor.

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

8.3 Shutdown

Measures during shutdown

- When switching off the motor, refer to the operating instructions for the converter.
- Switch off the cooling water supply if the standstill period is expected to be lengthy.

8.4 Faults

Note

Damage to the machine caused by faults

Correct the cause of the fault as specified in the remedial measures section. Repair any damage to the machine/motor that might have occurred.

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 8- 1 Possible faults

Fault	Cause of fault (see key table)																	
Motor does not start up	A	B			E													
Motor starts up slowly	A		C		E	F												
Rumbling noise during startup			C		E	F												
Rumbling noise during operation	A		C		E	F												
Overheating during no-load operation				D			G	H	I									
Overheating with load	A		C				G	H	I									
Overheating of individual winding sections					E	F												
Uneven running										J	K							
Grinding sound, running noise												L						
Radial vibrations													M	N	O	P		R
Axial vibrations															O		Q	R
Water is escaping																		S

Table 8- 2 Key to causes of faults and remedial measures

No.	Cause of fault	Remedial measures
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 automatic motor identification
E	Stator winding incorrectly connected	Check winding connections
F	Winding short circuit or phase short circuit in stator winding	Measure the winding resistances and insulation resistances, repair after 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	Heat dissipation 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 up	Make sure that the fan motor works properly
J	Insufficient shielding for 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 adjust parts
	Foreign bodies within 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 coupled motor
R	Imbalance originating from gearing	Adjust/repair gearing
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.

Service and maintenance 9

9.1 Inspection and maintenance

9.1.1 Safety information

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

For synchronous motors, hazardous voltages are present at the motor terminals when the rotors are rotating.

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 machines, make sure that the plant or system has been disconnected in a manner that is compliant with the appropriate specifications and regulations. In addition to the main currents, make sure that supplementary and auxiliary circuits, particularly in heating devices, are also disconnected.

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 the enclosure of electrical machines can reach temperatures in excess of 65 °C.

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

Do not touch frame parts while the machine is in operation or immediately after machine operation. Allow frame parts to cool off before starting any work.

Safety regulations

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

1. Disconnect the system.
2. Protect against reconnection.
3. Make sure that the equipment is de-energized.
4. Ground and short-circuit.
5. Cover or enclose adjacent components that are still live.

These measures described above must not be reversed until the maintenance work has been completed and the motor fully assembly again.

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 machine's components, particularly where plastic components are concerned.

⚠ CAUTION

Personal protective measures when working with compressed air

When you clean using compressed air, this can stir up dust, metal chips, or cleaning agents, Personal injury will result.

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

9.1.2 Maintenance intervals

General

Within the scope of the bearing change intervals, the motors are maintenance-free within the specified usage time.

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 cause consequential damage to the machine. If there are faults or unusual conditions such as overload or short circuit etc. immediately inspect the motor.

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, such as pollution/dirt, switching frequency, load, etc.

9.1.3 General inspection guidelines

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

While the motor is running, check that:

- The smooth running characteristics and machine running noise have not deteriorated.
- The cooling water system is not leaking.

Once the machine has been shut down, check that:

- All the fixing bolts/screws for the mechanical and electrical connections have been securely tightened.

CAUTION
If you identify any problems during the inspection, rectify them immediately. Otherwise the machine may be damaged.

9.1.4 Bearing replacement intervals

The bearings are subject to wear and must be replaced after a defined number of operating hours. For average load levels, the bearings must be replaced after approx. 20,000 h, however, at the latest after 5 calendar years.

9.2 Corrective maintenance

9.2.1 Safety information

Qualified personnel

This machine must be commissioned and operated by qualified personnel only. For the purpose of the safety information in these Operating Instructions, a "qualified person" is someone who is 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 are dangerous. 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

Transportation in accordance with proper procedures

Only transport the motor in accordance with the transport guidelines. 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".

9.2.2 Removing/installing the motor

Note

The rotor of 1FV5 synchronous motors is fitted with permanent magnets and attracted to the stator assembly during assembly and disassembly.

In disassembled condition, the rotor should be protected against pollution through magnetic waste by - for example - a plastic bag.

Removal

- When removing the motor, mark the original position of the components with respect to each other (e.g. using a colored pen, scribing iron) to make subsequent installation easier.
- Drain any remaining cooling water from the motor. To do this, remove the drain plugs from the bearing shield at the NDE.
- When removing the encoder, see Chapter "Removing/installing the speed encoder"; however remove the additional toothed wheel using the M8 (2x) thread provided in the tooth wheel using a suitable tool (only required for a 1PV5 motor).
- Unscrew the bearing shield screws at the DE.
- Carefully remove the DE bearing shield together with the rotor from the motor stator.
- Remove the bearing shield screws and remove the DE bearing shield from the rotor.
- Remove roller bearings using a suitable tool.

Installation

- Do not reuse roller bearings that have been removed.
- Heat up the new roller bearings evenly to 100 - 110 °C and attach them. When doing so, make sure that the bearing inner ring lies on the shaft shoulder.
- The device must not be subject to hard knocks (e.g. do not use a hammer etc.).
- Installation in the reverse order, in this case replace the seals between DE bearing shield and the housing.
- Before inserting the rotor, check the position of the preloading in the NDE bearing shield.
- For attaching the toothed wheel to the shaft, heat it up to approx. 140 °C and ensure that the rotor is flush with the shaft shoulder.
- After assembly work has been completed, the cooling circuit at the motor must be checked for leaks. Maximum test pressure, 2.5 bar.

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.

9.2.3 Removing/installing the external fan

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 cables and plug-in connections.

To do this, special tools required.

Removal

1. Remove the NDE bearing shield and, if necessary, the axial sealing ring; remove the fastening screws for this purpose. Insert four M6 studs in the threads provided in the through holes and press off the cover by uniformly screwing in (min. required thread length 30 mm).
2. Remove the connector at the encoder.
3. Loosen the fixing screws at the encoder (4 x M4).
4. Mark the position before removing the rotor position encoder.

Installation

Installation in the reverse sequence; when doing this, check the sealing elements at the cover (O-ring, Usit washers), and, if necessary replace them.

Note

When replacing the encoder, toothed wheel/pole wheel must not be removed.

The encoder does not have to be adjusted if the position was previously marked.

When installing a new encoder adjustment is required.

For 1FV5 synchronous motors, re-adjust the encoder system each time it is removed.

9.2.4 Tightening torque for screwed connections

For screwed connections with metal contact surfaces (e.g. bearing end shields, active bearing components, or terminal box parts screwed onto the stator housing), the following tightening torques apply (depending on the thread size) with a tolerance of ±10 %, property class 8.8 and 8 or higher, to ISO 898.

Table 9- 1 Tightening torque 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 keyed elements.

Spare parts (title below) 10

Note

The diagram provided is merely intended as an example of the different motor versions and does not claim to detail every aspect of the different versions.

The spare parts are available from Service Centers in practical parts kits and can be ordered by specifying the motor designation.

1.0 DE bearings

- 1.1 Bearing shield DE
- 1.2 Corner seal
- 1.3 I-Torx screws M8 x 40
- 1.4 O-ring
- 1.5 Bearing cap, inner
- 1.6 DIN 6912 M5 screw
- 1.7 Roller bearings
- 1.8 Lifting eye
- 1.9 I-Torx screw M8 x 20

2.0 Rotor, complete

3.0 Stator, complete

4.0 Terminal box, complete

- 4.1 Terminal box cover
- 4.2 Seal
- 4.3 I-Torx screw M5 x 14
- 4.4 Terminal board, complete
- 4.5 DIN 6912 M5 x 16 screw
- 4.6 Signal connector
- 4.7 Nut with washer

5.0 NDE bearings

- 5.1 Bearing shield NDE
- 5.2 Corner seal
- 5.3 I-Torx screw
- 5.4 O-ring
- 5.5 Cover NDE
- 5.6 DIN 6912 M5 x 20 screw

	5.7	O-ring
	5.8	Roller bearings
	5.9	Spring washer
	5.10	Shim
	5.11	Hose connections 90°
	5.12	Screw plug G1/8"
	5.13	Grounding screw M8
	5.14	O-ring
	5.15	Axial sealing ring
6.0	Encoder, complete	
	6.1	Encoders
	6.2	DIN 6912 M4 x 16 screw
	6.3	Toothed wheel for encoders

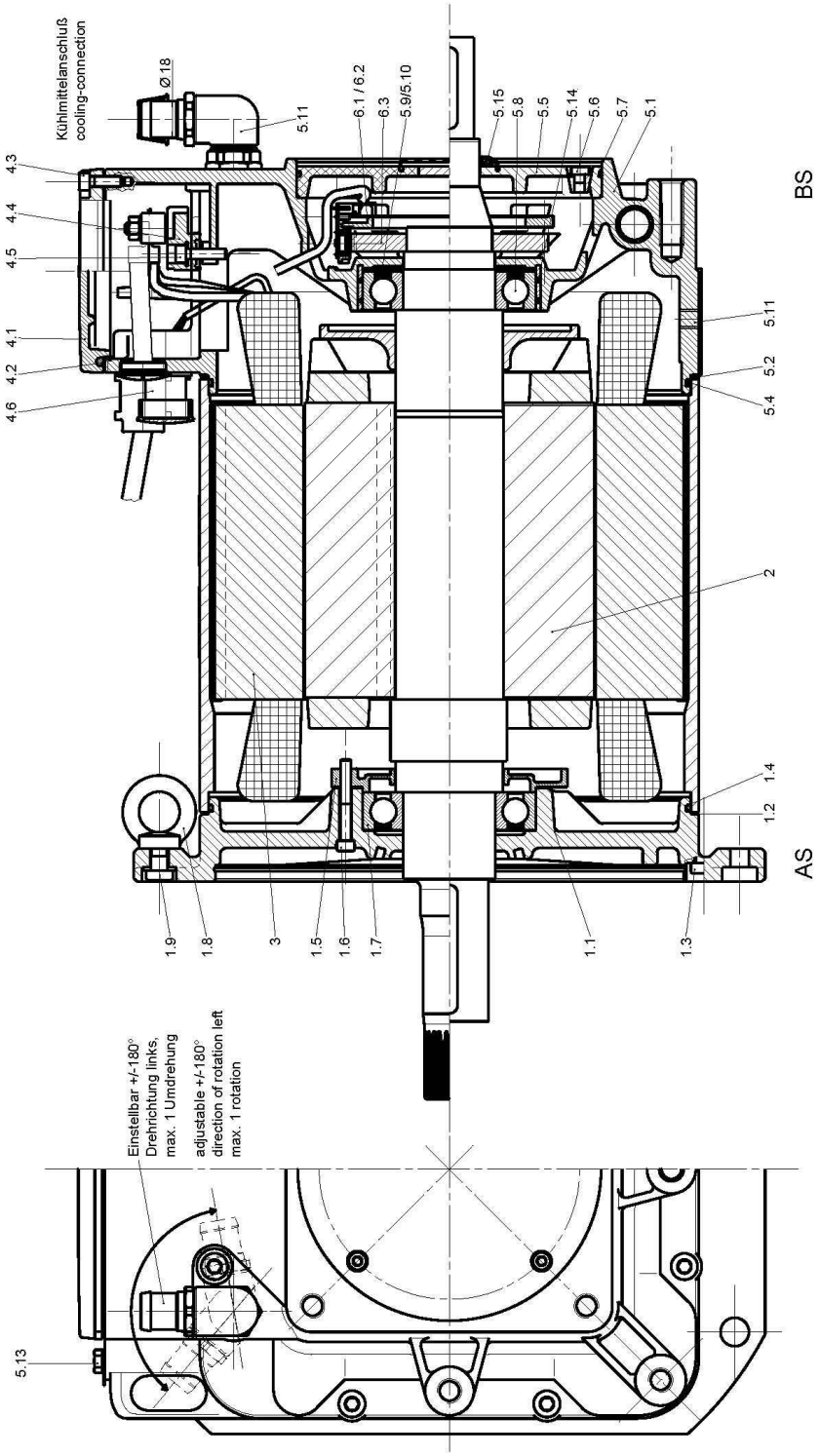


Figure 10-1 Spare parts (example)

Decommissioning and disposal 11

11.1 Decommissioning

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

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

Refer also to the information in the section headed "Maintenance".

Dismantle the machine using the general machine-typical procedures.

⚠ WARNING

Machine parts can fall

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

Secure the machine parts being dismantled to prevent them falling.

The motors must be disposed of in accordance with domestic 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.

11.2 Disposal

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

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

Components

Sort the components for recycling according to whether they are:

- Electronics waste, e.g., 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 insulating materials in question are used on the following items of equipment:

- Various insulators, which are used in terminals boxes
- Voltage and current transformers
- Electric cables
- Instrument wiring
- Surge arrester
- Capacitors

Disposing of permanent magnets

Permanent magnets must be demagnetized prior to disposal. This helps avoid potential hazards caused by permanent magnets during and after disposal. Permanent magnets are heated to demagnetize them.

Permanent magnets can be demagnetized in one of the following ways:

- Arrange for the entire machine to be subject to thermal treatment by a specialist disposal company.
- Return the machine to the manufacturer who can then remove and demagnetize the rotor and/or permanent magnets. Rotors that are still installed and have not been demagnetized must not be transported.

Appendix

A

A.1 Declaration of conformity

SIEMENS

EG-Konformitätserklärung
EC Declaration of Conformity

No. 664.20015.02

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 – Asynchronmotor, Typ 1PV51..** *Three-phase asynchronous motor, type 1PV51..*

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. .....
Michael Frank,
Head of the electric motor factory Bad Neustadt

i.V. .....
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* 664.20015.01 Stand / *Status*: 12/1996

Ausgabestand / *Status*: 06/2010
Erstausgabe / *first document*: 12/1996

Siemens Aktiengesellschaft: Chairman of the Supervisory Board: Gerhard Cromme; Managing Board: Peter Loescher, Chairman, President and Chief Executive Officer; Wolfgang Dehen, Heinrich Hiesinger, Joe Kaeser, Barbara Kux, Hermann Requardt, Siegfried Russwurm, Peter Y. Solmssen; Registered offices: Berlin and Munich, Germany; Commercial registries: Berlin Charlottenburg, HRB 12300, Munich, HRB 6684; WEEE-Reg.-No. DE 23691322

SIEMENS

EG-Konformitätserklärung
EC Declaration of Conformity

No. 664.20019.21

Hersteller: *Manufacturer:*	**Siemens Aktiengesellschaft** Industrie Sector DT MC EWN
Anschrift: *Address:*	Industriestraße 1 97615 Bad Neustadt a. d. Saale Germany
Produktbezeichnung: *Description of the product:*	**Drehstrom – Synchronmaschine Typ 1FV5...** *Three-phase synchronous machine, type 1FV5*

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 delivered 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 have to be considered in detail.

Erste CE - Kennzeichnung: 1999 */ first CE - marking: 1999*

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.
Diese Erklärung stellt keine Beschaffenheits- und Haltbarkeitsgarantie gemäß § 443 BGB dar.

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.
This declaration contains no condition and durability guarantee to § 443 BGB (German Civilian Code).

Bad Neustadt, den ....10.02.2010.....

Siemens Aktiengesellschaft

i.V. Frank ..... W. Schneider .....

Frank Michael,
Head of the Electric Motor Factory, Bad Neustadt

Schneider Wolfgang,
Head von Engineering Department (ST)

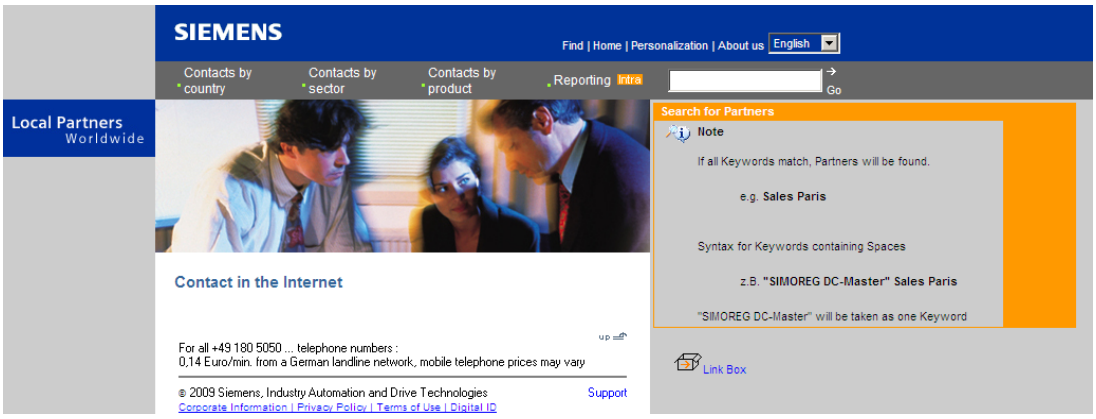
Diese Erklärung bescheinigt die Übereinstimmung mit der genannten Richtlinie, ist jedoch keine Zusicherung von Eigenschaften.
This declaration certifies the conformity to the specified Directive, but contains no assurance of properties.

Ersatz für / *Substitute for* 664.20019.01 Stand / *Status*: 02/1999

Ausgabestand / *Status*: 02/2010
Erstausgabe / *first document*: 02/1999

Siemens Aktiengesellschaft: Chairman of the Supervisory Board: Gerhard Cromme; Managing Board: Peter Loescher, Chairman, President and Chief Executive Officer; Wolfgang Dehen, Heinrich Hiesinger, Joe Kaeser, Barbara Kux, Hermann Requardt, Siegfried Russwurm, Peter Y. Solmssen; Registered offices: Berlin and Munich, Germany; Commercial registries: Berlin Charlottenburg, HRB 12300, Munich, HRB 6684; WEEE-Reg.-No. DE 23691322

A.2 Siemens Service Center



At

http://www.siemens.com/automation/partner

you can find Siemens contacts worldwide for information about specific technologies.

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,
- a product or
- a sector.

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

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Siemens AG
Industry Sector
Drive Technologies
Motion Control Systems
P.O. Box 3180
91050 ERLANGEN
GERMANY

www.siemens.com/motioncontrol

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