

**SIEMENS**

Operating instructions

**SIMOTICS**

Synchronous-/Induction motors  
**SIMOTICS A-1FV5/1PV5**

For SINAMICS S120

Edition

06/2018

[www.siemens.com](http://www.siemens.com)



# SIEMENS

## SIMOTICS

### Drive technology SIMOTICS A-1PV5/1FV5 synchronous/induction motors

#### Operating Instructions

#### Introduction

---

Fundamental safety  
instructions

1

Description

---

2

Preparing for use

---

3

Mounting

---

4

Connecting

---

5

Commissioning

---

6

Operation

---

7

Faults and their rectification

---

8

Service and maintenance

---

9

Decommissioning and  
disposal

---

10

Appendix

---

A

## 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.

<b>⚠ DANGER</b>
indicates that death or severe personal injury <b>will</b> result if proper precautions are not taken.
<b>⚠ WARNING</b>
indicates that death or severe personal injury <b>may</b> result if proper precautions are not taken.
<b>⚠ CAUTION</b>
indicates that minor personal injury can result if proper precautions are not taken.
<b>NOTICE</b>
indicates that property damage can result if proper precautions are not taken.

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

### Qualified Personnel

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

### Proper use of Siemens products

Note the following:

<b>⚠ WARNING</b>
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.

# Introduction

## Keeping the documentation safe

This documentation should be kept in a location where it can be easily accessed and made available to the personnel responsible.

## Target group and use

### Target group

These Operating Instructions are intended for installation engineers, commissioners, machine operators, and service and maintenance personnel.

### Utilization phase

Planning and configuration phase, implementation phase, setup and commissioning phase, application phase, maintenance and service phase

These operating instructions describe the 1FV5 and 1PV5 motors and explain how to handle them, from initial delivery to final disposal of the equipment.

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 features

In addition to the notes that you must observe for your own personal safety as well as to avoid material damage, in this document you will find the following text features:

### Operating instructions

Handling instructions with a specified sequence start with the word "Procedure":

The individual handling steps are numbered.

1. Execute the operating instructions in the specified sequence.



The square indicates the end of the operating instruction.

Operating instructions without a specified sequence are identified using a bullet point:

- Execute the operating instructions.

#### Enumerations

- Enumerations are identified by a bullet point without any additional symbols.
  - Enumerations at the second level are hyphenated.

#### Notes

Notes are shown as follows:

---

#### 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.

---

### More information

Information on the following topics is available at:

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

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

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

### My support

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

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

---

#### Note

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

Later, you can log on with your login data.

---

## Training

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

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

## Technical Support

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

Technical Support (<https://support.industry.siemens.com/sc/ww/en/sc/2090>)

## Internet address for products

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

## Websites of third parties

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





# Table of contents

	<b>Introduction</b> .....	<b>3</b>
<b>1</b>	<b>Fundamental safety instructions</b> .....	<b>9</b>
1.1	General safety instructions .....	9
1.2	Equipment damage due to electric fields or electrostatic discharge .....	14
1.3	Industrial security .....	15
1.4	Residual risks of power drive systems.....	17
<b>2</b>	<b>Description</b> .....	<b>19</b>
2.1	Correct usage .....	19
2.2	Technical features and ambient conditions .....	20
2.2.1	Directives and standards .....	20
2.2.2	Technical features.....	22
2.2.3	Environmental conditions.....	23
2.2.4	IP rating.....	24
2.2.5	Noise emission.....	24
2.3	Rating plate data:.....	24
2.4	Design .....	26
2.4.1	Types of construction.....	26
2.4.2	Cooling.....	26
<b>3</b>	<b>Preparing for use</b> .....	<b>31</b>
3.1	Shipping and packaging .....	31
3.2	Transporting and storing .....	32
3.2.1	Transporting .....	32
3.2.2	Storage .....	34
<b>4</b>	<b>Mounting</b> .....	<b>37</b>
4.1	Safety instructions.....	37
4.2	Checklists prior to mounting .....	38
4.3	Mounting instructions .....	39
4.4	Pushing on the power output elements .....	41
4.5	Vibration behavior .....	43
<b>5</b>	<b>Connecting</b> .....	<b>45</b>
5.1	Connecting the water cooling .....	45
5.2	Electrical connection .....	46
5.2.1	Safety instructions.....	46
5.2.2	Circuit diagram.....	47
5.2.3	System integration .....	48

5.2.3.1	Connecting-up notes .....	48
5.2.3.2	Connecting to a converter .....	49
5.2.3.3	Data for electrical connection .....	49
5.2.3.4	Power connection .....	50
5.2.3.5	Signal connection .....	52
<b>6</b>	<b>Commissioning .....</b>	<b>53</b>
6.1	Safety instructions .....	53
6.2	Checklists for commissioning .....	55
6.3	Commissioning procedure .....	57
6.4	Switching on and switching off .....	59
<b>7</b>	<b>Operation .....</b>	<b>61</b>
7.1	Safety instructions .....	61
7.2	Switching on and switching off .....	62
7.3	During operation .....	62
7.4	Stoppages .....	63
<b>8</b>	<b>Faults and their rectification .....</b>	<b>65</b>
<b>9</b>	<b>Service and maintenance .....</b>	<b>67</b>
9.1	Safety instructions .....	67
9.2	Inspection and maintenance .....	70
9.3	Repairing .....	70
<b>10</b>	<b>Decommissioning and disposal .....</b>	<b>71</b>
10.1	Safety instructions .....	71
10.2	Decommissioning .....	73
10.2.1	Removing the motor .....	73
10.2.2	Dismantling the motor .....	74
10.3	Disposal .....	74
<b>A</b>	<b>Appendix .....</b>	<b>75</b>
A.1	List of abbreviations .....	75
	<b>Index .....</b>	<b>77</b>

# Fundamental safety instructions

## 1.1 General safety instructions



### **! WARNING**

#### **Electric shock and danger to life due to other energy sources**

Touching live components can result in death or severe injury.

- Only work on electrical devices when you are qualified for this job.
- Always observe the country-specific safety rules.

Generally, the following six steps apply when establishing safety:

1. Prepare for disconnection. Notify all those who will be affected by the procedure.
2. Isolate the drive system from the power supply and take measures to prevent it being switched back on again.
3. Wait until the discharge time specified on the warning labels has elapsed.
4. Check that there is no voltage between any of the power connections, and between any of the power connections and the protective conductor connection.
5. Check whether the existing auxiliary supply circuits are de-energized.
6. Ensure that the motors cannot move.
7. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems, or water. Switch the energy sources to a safe state.
8. Check that the correct drive system is completely locked.

After you have completed the work, restore the operational readiness in the inverse sequence.



### **! WARNING**

#### **Electric shock due to connection to an unsuitable power supply**

When equipment is connected to an unsuitable power supply, exposed components may carry a hazardous voltage that might result in serious injury or death.

- Only use power supplies that provide SELV (Safety Extra Low Voltage) or PELV- (Protective Extra Low Voltage) output voltages for all connections and terminals of the electronics modules.



**! WARNING**

**Electric shock due to damaged motors or devices**

Improper handling of motors or devices can damage them.

Hazardous voltages can be present at the enclosure or at exposed components on damaged motors or devices.

- Ensure compliance with the limit values specified in the technical data during transport, storage and operation.
- Do not use any damaged motors or devices.



**! WARNING**

**Electric shock due to unconnected cable shield**

Hazardous touch voltages can occur through capacitive cross-coupling due to unconnected cable shields.

- As a minimum, connect cable shields and the conductors of power cables that are not used (e.g. brake cores) at one end at the grounded housing potential.



**! WARNING**

**Electric shock if there is no ground connection**

For missing or incorrectly implemented protective conductor connection for devices with protection class I, high voltages can be present at open, exposed parts, which when touched, can result in death or severe injury.

- Ground the device in compliance with the applicable regulations.



**! WARNING**

**Arcing when a plug connection is opened during operation**

Opening a plug connection when a system is operation can result in arcing that may cause serious injury or death.

- Only open plug connections when the equipment is in a voltage-free state, unless it has been explicitly stated that they can be opened in operation.

**NOTICE****Property damage due to loose power connections**

Insufficient tightening torques or vibration can result in loose power connections. This can result in damage due to fire, device defects or malfunctions.

- Tighten all power connections to the prescribed torque.
- Check all power connections at regular intervals, particularly after equipment has been transported.

 **WARNING****Unexpected movement of machines caused by radio devices or mobile phones**

When radio devices or mobile phones with a transmission power  $> 1$  W are used in the immediate vicinity of components, they may cause the equipment to malfunction.

Malfunctions may impair the functional safety of machines and can therefore put people in danger or lead to property damage.

- If you come closer than around 2 m to such components, switch off any radios or mobile phones.
- Use the "SIEMENS Industry Online Support app" only on equipment that has already been switched off.

 **WARNING****Unrecognized dangers due to missing or illegible warning labels**

Dangers might not be recognized if warning labels are missing or illegible. Unrecognized dangers may cause accidents resulting in serious injury or death.

- Check that the warning labels are complete based on the documentation.
- Attach any missing warning labels to the components, where necessary in the national language.
- Replace illegible warning labels.

 **WARNING**

**Unexpected movement of machines caused by inactive safety functions**

Inactive or non-adapted safety functions can trigger unexpected machine movements that may result in serious injury or death.

- Observe the information in the appropriate product documentation before commissioning.
- Carry out a safety inspection for functions relevant to safety on the entire system, including all safety-related components.
- Ensure that the safety functions used in your drives and automation tasks are adjusted and activated through appropriate parameterizing.
- Perform a function test.
- Only put your plant into live operation once you have guaranteed that the functions relevant to safety are running correctly.

**Note**

**Important safety notices for Safety Integrated functions**

If you want to use Safety Integrated functions, you must observe the safety notices in the Safety Integrated manuals.

 **WARNING**

**Active implant malfunctions due to electromagnetic fields**

Electromagnetic fields (EMF) are generated by the operation of electrical power equipment, such as transformers, converters, or motors. People with pacemakers or implants are at particular risk in the immediate vicinity of this equipment.

- If you have a heart pacemaker or implant, maintain the minimum distance specified in chapter "Correct usage" from such motors.

 **WARNING**

**Active implant malfunctions due to permanent-magnet fields**

Even when switched off, electric motors with permanent magnets represent a potential risk for persons with heart pacemakers or implants if they are close to converters/motors.

- If you have a heart pacemaker or implant, maintain the minimum distance specified in chapter "Correct usage".
- When transporting or storing permanent-magnet motors always use the original packing materials with the warning labels attached.
- Clearly mark the storage locations with the appropriate warning labels.
- IATA regulations must be observed when transported by air.

**⚠ WARNING****Injury caused by moving or ejected parts**

Contact with moving motor parts or drive output elements and the ejection of loose motor parts (e.g. feather keys) out of the motor enclosure can result in severe injury or death.

- Remove any loose parts or secure them so that they cannot be flung out.
- Do not touch any moving parts.
- Safeguard all moving parts using the appropriate safety guards.

**⚠ WARNING****Fire due to inadequate cooling**

Inadequate cooling can cause the motor to overheat, resulting in death or severe injury as a result of smoke and fire. This can also result in increased failures and reduced service lives of motors.

- Comply with the specified cooling requirements for the motor.

**⚠ WARNING****Fire due to incorrect operation of the motor**

When incorrectly operated and in the case of a fault, the motor can overheat resulting in fire and smoke. This can result in severe injury or death. Further, excessively high temperatures destroy motor components and result in increased failures as well as shorter service lives of motors.

- Operate the motor according to the relevant specifications.
- Only operate the motors in conjunction with effective temperature monitoring.
- Immediately switch off the motor if excessively high temperatures occur.

**⚠ CAUTION****Burn injuries caused by hot surfaces**

In operation, the motor can reach high temperatures, which can cause burns if touched.

- Mount the motor so that it is not accessible in operation.

Measures when maintenance is required:

- Allow the motor to cool down before starting any work.
- Use the appropriate personnel protection equipment, e.g. gloves.

## 1.2 Equipment damage due to electric fields or electrostatic discharge

Electrostatic sensitive devices (ESD) are individual components, integrated circuits, modules or devices that may be damaged by either electric fields or electrostatic discharge.



### NOTICE

#### Equipment damage due to electric fields or electrostatic discharge

Electric fields or electrostatic discharge can cause malfunctions through damaged individual components, integrated circuits, modules or devices.

- Only pack, store, transport and send electronic components, modules or devices in their original packaging or in other suitable materials, e.g. conductive foam rubber or aluminum foil.
- Only touch components, modules and devices when you are grounded by one of the following methods:
  - Wearing an ESD wrist strap
  - Wearing ESD shoes or ESD grounding straps in ESD areas with conductive flooring
- Only place electronic components, modules or devices on conductive surfaces (table with ESD surface, conductive ESD foam, ESD packaging, ESD transport container).



## 1.3 Industrial security

---

### Note

#### Industrial security

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the Internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit:

Industrial security (<http://www.siemens.com/industrialsecurity>)

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed at:

Industrial security (<http://www.siemens.com/industrialsecurity>)

---

Further information is provided on the Internet:

Industrial Security Configuration Manual  
(<https://support.industry.siemens.com/cs/ww/en/view/108862708>)

 **WARNING**

**Unsafe operating states resulting from software manipulation**

Software manipulations (e.g. viruses, trojans, malware or worms) can cause unsafe operating states in your system that may lead to death, serious injury, and property damage.

- Keep the software up to date.
- Incorporate the automation and drive components into a holistic, state-of-the-art industrial security concept for the installation or machine.
- Make sure that you include all installed products into the holistic industrial security concept.
- Protect files stored on exchangeable storage media from malicious software by with suitable protection measures, e.g. virus scanners.
- Protect the drive against unauthorized changes by activating the "know-how protection" drive function.

## 1.4 Residual risks of power drive systems

When assessing the machine- or system-related risk in accordance with the respective local regulations (e.g., EC Machinery Directive), the machine manufacturer or system installer must take into account the following residual risks emanating from the control and drive components of a drive system:

1. Unintentional movements of driven machine or system components during commissioning, operation, maintenance, and repairs caused by, for example,
  - Hardware and/or software errors in the sensors, control system, actuators, and cables and connections
  - Response times of the control system and of the drive
  - Operation and/or environmental conditions outside the specification
  - Condensation/conductive contamination
  - Parameterization, programming, cabling, and installation errors
  - Use of wireless devices/mobile phones in the immediate vicinity of electronic components
  - External influences/damage
  - X-ray, ionizing radiation and cosmic radiation
2. Unusually high temperatures, including open flames, as well as emissions of light, noise, particles, gases, etc., can occur inside and outside the components under fault conditions caused by, for example:
  - Component failure
  - Software errors
  - Operation and/or environmental conditions outside the specification
  - External influences/damage
3. Hazardous shock voltages caused by, for example:
  - Component failure
  - Influence during electrostatic charging
  - Induction of voltages in moving motors
  - Operation and/or environmental conditions outside the specification
  - Condensation/conductive contamination
  - External influences/damage
4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc., if they are too close
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly
6. Influence of network-connected communication systems, e.g. ripple-control transmitters or data communication via the network

For more information about the residual risks of the drive system components, see the relevant sections in the technical user documentation.



## Description

### 2.1 Correct usage

<p><b>⚠ WARNING</b></p> <p><b>Motors not used for the intended purpose</b></p> <p>If you do not use the motors correctly, there is a risk of death, severe injury and/or material damage.</p> <ul style="list-style-type: none"> <li>• Only use the motors for their intended purpose.</li> <li>• Make sure that the conditions at the location of use comply with all the rating plate data.</li> <li>• Make sure that the conditions at the location of use comply with the conditions specified in this documentation. When necessary, take into account deviations regarding approvals or country-specific regulations.</li> </ul>
--

<p><b>⚠ WARNING</b></p> <p><b>Malfunctions of active implants due to magnetic and electrical fields</b></p> <p>Electric motors endanger people with active implants, for example heart pacemakers, who come close to the motors.</p> <ul style="list-style-type: none"> <li>• If you are affected, stay a minimum distance of 300 mm from the motors (tripping threshold for static magnetic fields of 0.5 mT according to Directive 2013/35/EU).</li> </ul>
--

If you wish to use special versions and design variants whose specifications vary from the motors described in this document, then contact your local Siemens office.

If you have any questions regarding the intended usage, please contact your local Siemens office.

The motors are designed for installation in electrically driven vehicles.

It is not permissible that 1FV5/1PV5 motors are operated in hazardous zones.

Any other application of the 1FV5/1PV5 is considered to represent incorrect usage.

Compliance with all of the specifications in the Operating Instructions is part of correct usage.

---

#### Note

The performance data assumes an ambient temperature of -15 °C to +40 °C and an installation altitude of up to 1 000 m above sea level.

In the case of other ambient temperatures and installation altitudes, please contact Technical Support.

---

2.2 Technical features and ambient conditions

Conditions at the location of use must comply with the specifications on the rating plate.

**Note**

Operate the 1FV5/1PV5 within the specified power range.

Deviating operating conditions must be contractually agreed.

The 1FV5/1PV5 is only approved for converter operation.

Direct connection to the three-phase line supply is not permissible.

**Note**

Any change to a 1FV5/1PV5 motor and its operating conditions requires that the local Siemens office must be contacted and they must give their express authorization in writing prior to any change being made.

## 2.2 Technical features and ambient conditions

### 2.2.1 Directives and standards

#### Standards that are complied with

The motors of the series SIMOTICS S, SIMOTICS M, SIMOTICS L, SIMOTICS T, SIMOTICS A, called "SIMOTICS motor series" below, fulfill the requirements of the following directives and standards:

- EN 60034-1 - Rotating electrical machines – Dimensioning and operating behavior
- EN 60204-1 - Safety of machinery – Electrical equipment of machines; general requirements

Where applicable, the SIMOTICS motor series are in conformance with the following parts of IEC / EN 60034:

Feature	Standard
Degree of protection	IEC / EN 60034-5
Cooling <sup>1)</sup>	IEC / EN 60034-6
Type of construction	IEC / EN 60034-7
Connection designations	IEC / EN 60034-8
Noise levels <sup>1)</sup>	IEC / EN 60034-9

Feature	Standard
Temperature monitoring	IEC / EN 60034-11
Vibration severity levels <sup>1)</sup>	IEC / EN 60034-14

<sup>1)</sup> Standard component, e.g. cannot be applied to built-in motors

## Relevant directives

The following directives are relevant for SIMOTICS motors.

### European Low-Voltage Directive



SIMOTICS motors comply with the Low-Voltage Directive 2014/35/EU.

### European Machinery Directive

SIMOTICS motors do not fall within the area of validity covered by the Machinery Directive.

However, the use of the products in a typical machine application has been fully assessed for compliance with the main regulations in this directive concerning health and safety.

### European EMC Directive

SIMOTICS motors do not fall within the area of validity covered by the EMC Directive. The products are not considered as devices in the sense of the directive. Installed and operated with a converter, the motor - together with the Power Drive System - must comply with the requirements laid down in the applicable EMC Directive.

### Eurasian conformity



SIMOTICS motors comply with the requirements of the customs union Russia/Belarus/Kazakhstan (EAC).

### China Compulsory Certification



SIMOTICS motors do not fall within the area of validity covered by the China Compulsory Certification (CCC).

CCC negative certification:

CCC product certification

<https://support.industry.siemens.com/cs/products?search=CCC&ctp=Certificate&mf=ps&o=DefaultRankingDesc&pnid=13347&lc>

### Underwriters Laboratories



SIMOTICS motors are generally in compliance with UL and cUL as components of motor applications, and are appropriately listed.

Specifically developed motors and functions are the exceptions in this case. Here, it is important that you carefully observe the contents of the quotation and that there is a cUL mark on the rating plate!

### Quality systems

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

2.2 Technical features and ambient conditions

Certificates for SIMOTICS motors can be downloaded from the Internet at the following link:

Certificates for SIMOTICS motors  
<https://support.industry.siemens.com/cs/ww/de/ps/13347/cert>

**European RoHS Directive**

The SIMOTICS motor series complies with the Directive 2011/65/EU regarding limiting the use of certain hazardous substances.

**2.2.2 Technical features**

Table 2- 1 Technical features

	<b>1FV5</b>	<b>1PV5</b>
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)
	Resolver; Safety ASIL Level C: SH130: 6-pole SH160: 8-pole	
Insulation of stator winding according to EN 60034-1	Thermal class 180 (H)	
Impulse withstand voltage insulation class according to EN 60034-18-41 (IEC 60034-18-41)	IVIC: C	
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 (IM V1, IM V3)	
Degree of protection to EN60034-5	IP65/IP69K (without DE shaft output)	
Temperature monitoring in accordance with EN 60034-11	2 temperature sensors in the stator winding	
DE shaft extension 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	



### 2.2.3 Environmental conditions

You can classify the ambient conditions for stationary use at weather protected locations according to the standard DIN EN 60721-3-3. The environmental effects and their limit values are defined in various classes in this standard.

With the exception of "Condensation", "Low air temperature" and "Low air pressure" ambient parameters, you can assign SIMOTICS A motors to climatic class 3K4.

Table 2- 2 Environmental conditions are based on climate class 3K4

Environmental variables that have an influence		Unit	Value
a)	Low air temperature	°C	- 15
b)	High air temperature	°C	+ 40
c)	Low relative humidity	%	5
d)	High relative humidity	%	95
e)	Low absolute humidity	g/m <sup>3</sup>	1
f)	High absolute humidity	g/m <sup>3</sup>	29
g)	Rate of temperature change <sup>1)</sup>	°C/min	0.5
h)	Low air pressure <sup>4)</sup>	kPa	89
i)	High air pressure <sup>2)</sup>	kPa	106
j)	Solar radiation	W/m <sup>2</sup>	700
k)	Thermal radiation	-	-
l)	Air movement <sup>3)</sup>	m/s	1.0
m)	Condensation	-	Not permitted
n)	Wind-driven precipitation (rain, snow, hail, etc.)	-	-
o)	Water (other than rain)	-	See protection class
p)	Formation of ice	-	-

<sup>1)</sup> Averaged over a period of 5 min

<sup>2)</sup> Conditions in mines are not considered.

<sup>3)</sup> A cooling system based on natural convection can be disturbed by unforeseen air movements.

<sup>4)</sup> The limit value of 89 kPa covers applications at altitudes up to 1000 m.

You can find additional data on the environmental conditions, such as ambient temperatures or conditions for transport and storage of the motors, in the relevant chapters of this documentation.

2.3 Rating plate data:

2.2.4 IP rating

The motors have degree of protection IP65/IP69K.

- Implement the A-side flange mounting so that the appropriate degree of protection is ensured.

2.2.5 Noise emission

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

2.3 Rating plate data:

The rating plate (type plate) shows the technical data of the motor. A second rating plate is supplied loose with the motor.

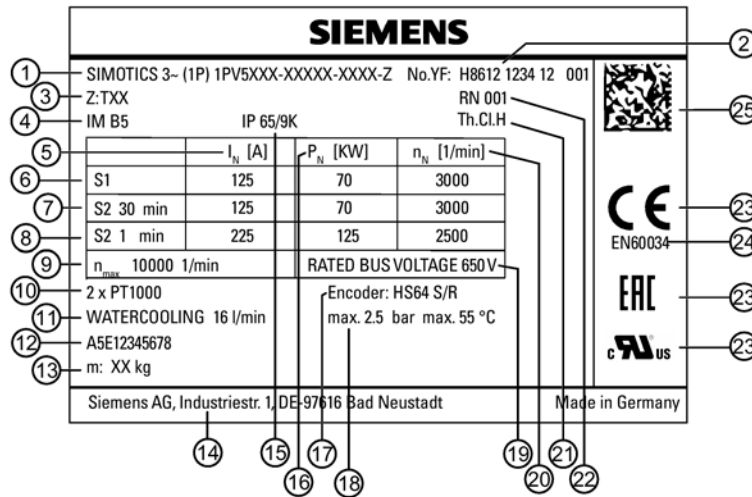


Figure 2-1 1FV5 1PV5 rating plate

Table 2- 3 Description of the rating plate data

Item	Description/technical data
1	Motor type: Synchronous/induction motors; motor type / order number
2	Ident. no., serial number
3	Specification of Z option
4	Type of construction
5	Rated current $I_{\text{Rated}}$ in A
6	Operating mode, rated time, unit of rated time (1)
7	Operating mode, rated time, unit of rated time (2)
8	Operating mode, rated time, unit of rated time (3)
9	Maximum speed $n_{\text{max}}$ in rpm
10	Number and type of temperature sensors
11	Cooling method, throughput of coolant
12	A5E number
13	Motor weight $m$ in kg
14	Production address
15	Degree of protection
16	Rated power $P_{\text{Rated}}$ in kW
17	Encoder type designation
18	Max. pressure in cooling system, max. coolant temperature
19	Rated voltage $U$ in V
20	Rated speed $n_{\text{Rated}}$ in rpm
21	Thermal class
22	Revision number
23	Certifications
24	Standard for all rotating electrical machines
25	2D code

## 2.4 Design

### Design of principle of operation

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

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

Both active sections have two temperature sensors in the stator winding, one of which is a reserve.

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

### 2.4.1 Types of construction

The motor is designed as IM B5 (IM V1 and IM V3) types of construction.

### 2.4.2 Cooling

#### Water cooling

It is only permissible that the motor is operated in a closed cooling circuit with cooling unit.

Table 2- 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	$T_{cool} > T_{ambient} - 5 \text{ K}$ at $T_{ambient} < 60 \text{ °C}$ ; $T_{coolmin} > -40 \text{ °C}$
Maximum cooling water inlet temperature, without derating	$\leq 55 \text{ °C}$ , higher values will result in derating

As coolant, only a water/anti-freeze mixture in a ratio of 50 %: 50 % is permissible.

Glycol is the preferred antifreeze. When you use a different anti-freeze, a minimum steady-state temperature of  $-40 \text{ °C}$  is a precondition. Avoid mixing different antifreeze agents.

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 2- 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 $\mu\text{S}/\text{cm}$
Size of any particles in the coolant	< 100 $\mu\text{m}$

#### Notes for setting up the cooling circuit

The motor is connected to the cooling circuit using two hose connections at the NDE bearing shield. The hose connections have an outer diameter of 18 mm. After releasing the locknuts, you can adjust the angled hose connections in both directions (preferred direction clockwise; max. 1 revolution). After setting, the coolant connections must be re-tightened with the locknut.

You can connect the intake and discharge as required.

- The materials used in the cooling circuit must be coordinated with the materials in the motor (aluminum alloy) and hose connections (nickel plated brass).
- Use pipes and fittings made of brass, stainless steel, or plastic. Galvanized pipes and fittings are not permissible.

---

#### Note

If you use different materials in the cooling circuit, pay attention to the electrochemical series. Which is why zinc must not be used in cooling water circuits.

---

- Install a filter (100  $\mu\text{m}$ ) in the intake line of the cooling circuit to filter out dirt and contaminants.
- If necessary, limit the flow rate using a throttle. Install the flow restrictor (throttle) downstream of the motor. It is not permissible to install a throttle immediately before the intake as a result of potential cavitation effects.

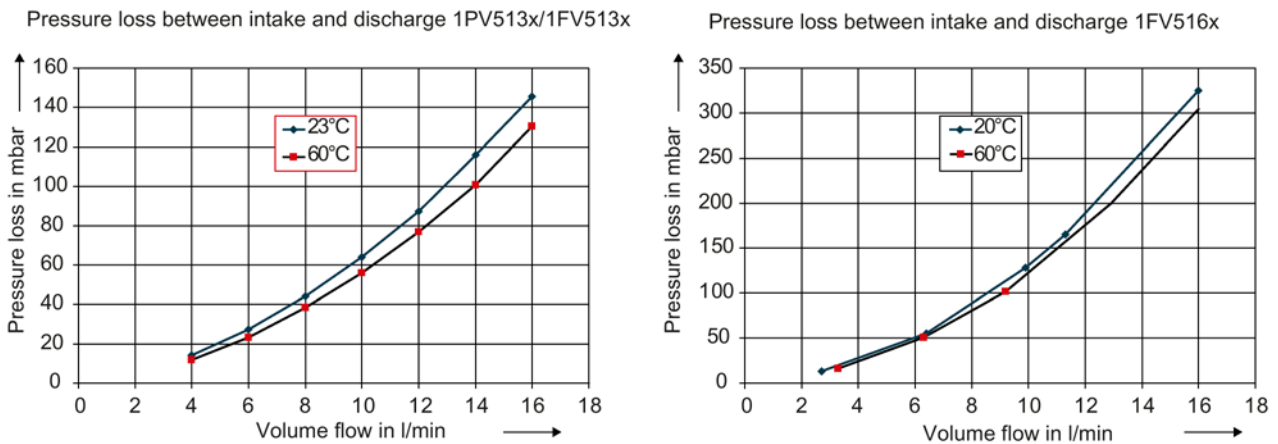


Figure 2-2 Pressure losses as a result of volumetric flow

**Note**

**Avoid condensation**

Cooling water temperatures that are lower than the ambient temperature tend to result in increased levels of condensation. The difference between the cooling water inlet temperature and the ambient temperature must therefore not exceed a maximum of 5 K (Kelvin).

- Select the cooling water intake temperature such that condensation does not form on the surface of the motor:  $T_{Cool} > T_{Ambient} - 5\text{ K}$
- Further, shut off the coolant supply if the motor is to remain at a standstill for a longer period of time.

Lowering the inlet temperature of the cooling water by 5 K relative to the ambient temperature permits a relative humidity up to approx. 75% for the temperatures in the "Derating factors" table below. Condensation does not then occur. Refer to the Mollier diagram for deviations from these.

- If the relative humidity is higher than 75 %, you will have to further increase the intake temperature of the cooling water.
- If the actual relative humidity is less than 75 %, you can further lower the intake temperature of the cooling water.

## 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 2- 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 (AcrylnitrileButadieneStyrene)	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 <sup>9</sup> 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 Pipe - hose	Secure with clips conforming to EN14420, 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.





## Preparing for use

### 3.1 Shipping and packaging

#### Checking the delivery for completeness

The drive systems are assembled on an individual basis.

- Immediately check whether the scope of the delivery matches up 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.

The safety instructions are included in the scope of delivery.

- Store the safety instructions so they are available.

You can attach the additional rating plate supplied separately in the vicinity of the motor.

The additional rating plate is located in the terminal box.

## 3.2 Transporting and storing

### 3.2.1 Transporting

 **WARNING**

**Motor falls due to incorrect transport and/or lifting**

Due to incorrect transport and/or lifting, the motor can fall and cause death, severe injury and/or damage to property.

- Lifting devices, industrial trucks, and load bearing equipment must comply with requirements.
- The load carrying capacity of the lifting equipment and the load suspension device must correspond to the weight of the motor (see the rating plate).
- Do not attach any additional loads to the lifting equipment.
- To hoist the motor, use suitable cable-guidance or spreading equipment (particularly if the motor is equipped with built-on assemblies).
- It is not permissible that the motor is lifted or transported using the terminal box or signal connector.
- Do not stand in the slewing range of hoisting gear or under suspended loads.

- When transporting, always comply with the country-specific regulations.
- Use suitable load suspension devices when transporting and installing the motor.

---

**Note**

**Transporting and lifting the motor using its eyebolts**

- Only lift the motor using the eyebolts on the bearing end shields.
- It is not permissible to attach eyebolts to the shaft extension.

- When transporting the motor, use all of the eyebolts.
- If you do not immediately commission a motor after it has been delivered, it must be stored in a dry, dust-free room that is not subject to any vibration, see Chapter "Storage (Page 34)".

**Transporting and lifting the motor using a cross beam**

Lifting and transporting the motors using eyebolts (according to DIN 580) and a cross beam.

When doing so, note the following:

- Completely screw in the eyebolts and tighten by hand (approx. 8 Nm)
- Use the laminated fiber washers provided
- Do not use bent or damaged eyebolts.

Loads applied transversely to the plane of the eyebolts are not permitted.

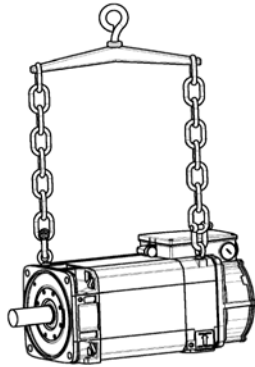


Figure 3-1 Lifting and transporting the motor with a cross beam (example)

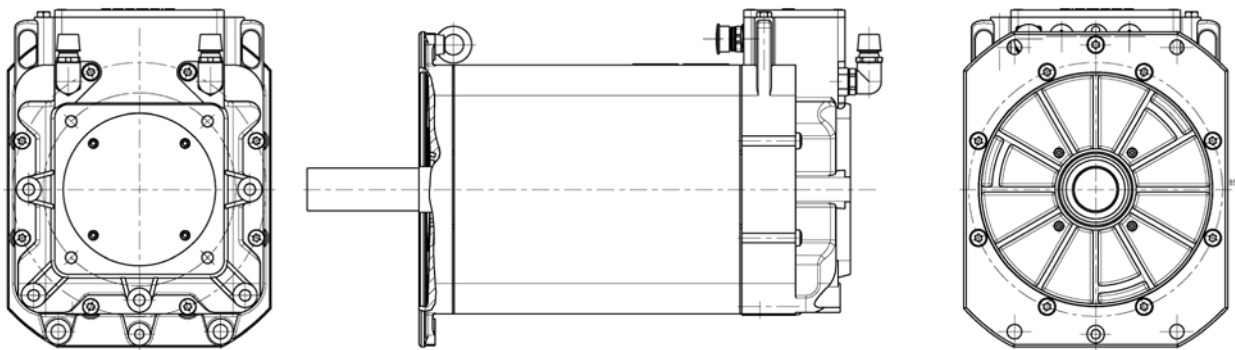


Figure 3-2 Arrangement of the eyebolts for 1PV513x/1FV513x

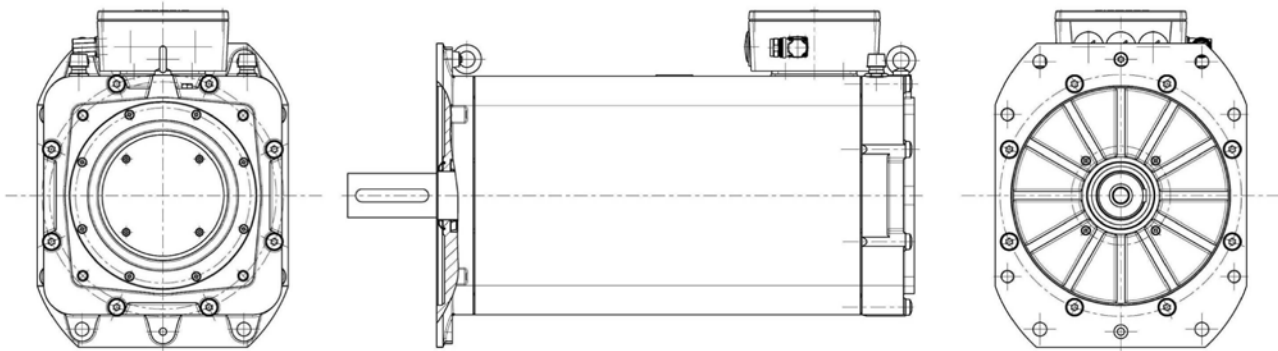


Figure 3-3 Arrangement of the eyebolts for 1FV516x

### Transporting a motor that has already been in operation

If you want to transport a motor that has already been in operation, then follow the subsequent procedure.

#### Procedure

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

### 3.2.2 Storage

---

#### Note

If possible, store the motor in its original packaging.

---

<b>NOTICE</b>
---------------

<b>Frost damage to water-cooled motors</b>
--

Water-cooled motors can be damaged by frost

- Remove the liquid coolant before storage.
- Blow out the cooling ducts with compressed air.

Preserve the free shaft ends, sealing elements, and flange surfaces with a protective coating.

<b>NOTICE</b>
---------------

<b>Seizure damage to bearings</b>
-----------------------------------

If the motors are stored incorrectly, bearing seizure damage can occur, e.g. brinelling, as a result of vibration.

- Comply with the storage conditions.

#### Storage conditions

Please observe the warning instructions on the packaging and labels.

Store the motor in a dry, dust-free, and vibration-free indoor storage facility.

Adhere to the following values:

- $v_{rms} < 0.2$  mm/s
- Max. temperatures: -15 °C to 55 °C
- Mean relative humidity < 75 %

## Long-term storage

### Note

#### Storage time of up to a maximum of 2 years

The storage time affects the properties of the roller bearing grease.

- Store the motor for a maximum of 2 years only.

If you store the motor for longer than 6 months, the storage area/room must meet the following environmental conditions:

Table 3- 1 **Environmental conditions for long-term storage in the transport packaging according to Class 1K3 to EN 60721-3-1 except for the "Air temperature", "Highest relative humidity" and "Condensation" environmental factors**

Climatic environmental conditions	- 15 °C ... + 55 °C
Highest relative humidity	< 60 %, condensation not permissible
Mechanical environmental conditions	Vibration-free storage space, $v_{rms} < 0.2$ mm/s
Protection against chemical substances	Protected according to Class 1C2
Biological environmental conditions	Suitable according to Class 1B2
Duration	<ul style="list-style-type: none"><li>• 6 months for the above-mentioned conditions.</li><li>• Special preservation measures are required for storage periods of 6 months up to a maximum of 2 years.</li></ul>

Check the correct state of the motor every 6 months.

- Check the motor for any damage.
- Perform any necessary maintenance work.
- Check the state of the dehydrating agent and replace when necessary.
- Record the preservation work so that all preservation coating can be removed prior to the commissioning.

### Condensation

The following ambient conditions favor the formation of condensation:

- Significant fluctuations of the ambient temperature
- Direct sunshine
- High humidity during storage


Avoid these environmental conditions.


Use a dehydrating agent in the packaging.



# Mounting

## 4.1 Safety instructions

 <b>WARNING</b>
<p><b>Danger of the motor down due to incorrect transport and/or lifting</b></p> <p>Due to incorrect transport and/or lifting, the motor can fall and cause death, severe injury and/or damage to property.</p> <ul style="list-style-type: none"> <li>• Lifting devices, ground conveyors, and load suspension equipment must comply with requirements.</li> <li>• The maximum capacity of the lifting equipment and the load suspension device must correspond to the weight of the motor (see the rating plate).</li> <li>• Do not attach any additional loads to the lifting equipment.</li> <li>• To hoist the motor, use suitable cable-guidance or spreading equipment, particularly if the motor is equipped with built-on assemblies.</li> <li>• It is not permissible that the motor is lifted or transported using the terminal box or signal connector.</li> <li>• Do not stand in the slewing range of hoisting gear or under suspended loads.</li> </ul>

 <b>WARNING</b>
<p><b>Danger to life from permanent magnet fields</b></p> <p>Even when switched off, electric motors with permanent magnets pose a potential risk for persons with heart pacemakers or implants if they are close to inverters/motors.</p> <ul style="list-style-type: none"> <li>• If you have a heart pacemaker or implant, keep a minimum distance of 20 cm.</li> <li>• When transporting or storing permanent magnet motors always use the original packing materials with the warning labels attached.</li> <li>• Clearly mark the storage locations with the appropriate warning labels.</li> <li>• IATA regulations must be observed when transporting by air.</li> </ul>

<b>NOTICE</b>
<p><b>Thermal damage to temperature-sensitive parts</b></p> <p>Some parts of the electrical motor enclosure can reach temperatures that exceed 100 °C. If temperature-sensitive parts, for instance electric cables or electronic components, come into contact with hot surfaces then these parts can be damaged.</p> <ul style="list-style-type: none"> <li>• Ensure that no temperature-sensitive parts come into contact with hot surfaces.</li> </ul>

## 4.2 Checklists prior to mounting

---

**Note**

**Required checks**

The checklists below do not purport to be complete. It may be necessary to perform additional checks and tests in accordance with the situation specific to the particular installation site.

---

Assemble the motor as described in the following chapters of the operating instructions.

Thoroughly familiarize yourself with the safety instructions and observe the checklists below before starting any work.

Table 4- 1 Checklist (1) - general checks

Check	OK
Are all of the necessary components of the configured drive line-up available, correctly dimensioned, installed and connected?	
Are the environmental conditions in the permissible range?	

Table 4- 2 Checklist (2) - checks regarding the mechanical system

Check	OK
Is the motor free of visible damage?	
Have the mounting surfaces (e.g. flange, shaft) on the customer machine and on the motor been cleaned?	
Are the mounting surfaces free of corrosion?	
Do the mounting dimensions (e.g. shaft diameter, shaft length, true run) on the customer machine meet the specification?	



## 4.3 Mounting instructions

<b>NOTICE</b>
<b>Damage to the motor due to runout on the shaft extension</b> Runout and thrust on the shaft extension of the motor can damage the motor. <ul style="list-style-type: none"><li>• Mount the motor without runout and thrust on the shaft extension.</li></ul>

---

**Note**

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

---

- Observe the data on the rating plate, as well as the warning and information plates on the motor.
- Check the permissible ambient conditions (e.g. temperature, installation altitude) at the installation location.  
Their use is prohibited in hazardous zones.
- Thoroughly clean the shaft extension of corrosion protection. Use commercially available solvents.
- Only remove the protective caps immediately before installation.
- Install the motor in such a way that the coolant can freely flow in and out unimpeded.
- If fluid media come into contact with the DE flange, a special flange seal is required.
- Ensure that the flange is in even contact with the mounting surface.
- Use washers and cylinder head screws with a property class of at least 8.8.

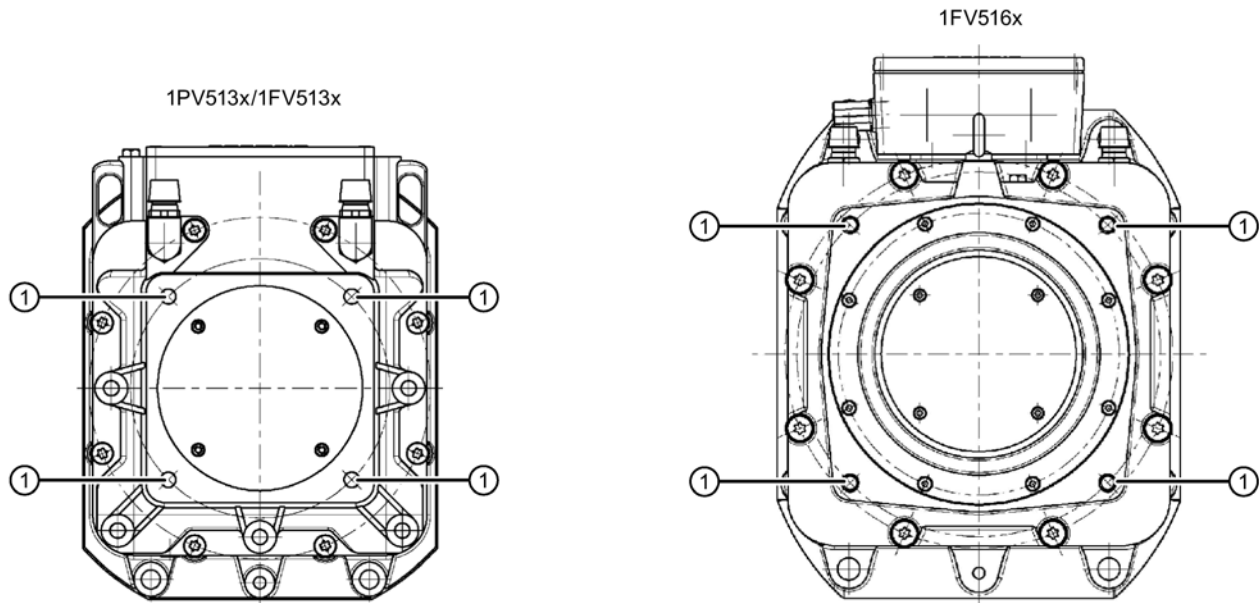
4.3 Mounting instructions

- When tightening the fastening bolts avoid any uneven stressing.

**Note**

When the motor is flange-mounted, a system is created that is capable of oscillation with specific natural mounting frequencies. In operation, this can result in excessive vibration levels.

- If required, additionally support the motor at its NDE.



1 Thread for NDE support

Figure 4-1 Supporting the motor at the NDE

- Observe the tightening torques of the fastening bolts of the motor flange. See the "Tightening torques for fastening bolts" table.
- After installation, remove the lifting eyes or tighten them.

Table 4- 3 Permissible forces at the motor

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

**Alignment accuracy for the coupling output**

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

## Tightening torques for fastening bolts

Motor	Screw		Tightening torque ± 10 % in Nm	Property class of the screws
1PV513x/ 1FV513x	DE	M12	85	8.8
	NDE	M12 (screw-in depth, 25...30 mm)	85	8.8
1FV516x	DE	M16	190	10.9
	NDE	M12 (screw-in depth, 18...20 mm)	85	8.8

The mounting tools to be used are a torque wrench or pneumatic or impact power screwdriver with automatic switch-off.

## 4.4 Pushing on the power output elements

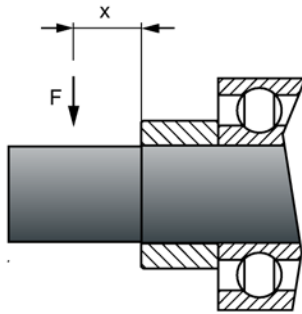
<p><b>⚠ WARNING</b></p> <p><b>The feather key can fall out</b></p> <p>The feather keys are only secured during transport to stop them falling out. If a motor is not equipped with an output element, the feather key may be flung out in operation.</p> <p>Death or serious injury can result.</p> <ul style="list-style-type: none"> <li>On shaft extensions without output element, make sure that the feather key cannot be flung out and shorten the feather key by approximately half for balance type "H".</li> </ul>
--

<p><b>NOTICE</b></p> <p><b>Damage to the motor due to runout on the shaft extension</b></p> <p>Runout and thrust on the shaft extension of the motor can damage the motor.</p> <ul style="list-style-type: none"> <li>Mount the motor without runout and thrust on the shaft extension.</li> </ul>
--

<p><b>NOTICE</b></p> <p><b>Damage to shaft sealing rings caused by heating</b></p> <p>When mounting input and output elements with the heat treatment, shaft sealing rings can be damaged by overheating.</p> <ul style="list-style-type: none"> <li>Use thermal shields to protect shaft sealing rings against overheating above 100 °C due to radiant heat.</li> </ul>
--

4.4 Pushing on the power output elements

Assemble the input and output elements in such a way as to minimize the stress on shafts and bearings from transverse forces.



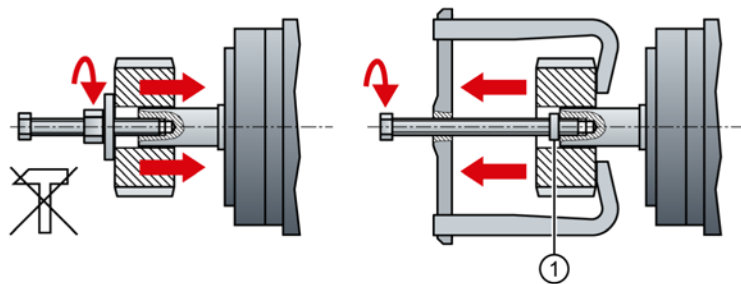
- F Radial force
- x Clearance between the point of application of the radial force up to the sleeve on the motor shaft

Mount or remove the power output elements (e.g. couplings, gear wheels, belt pulleys) using suitable devices only (see figure).

- Use the threaded hole in the shaft extension.
- If required, heat up the output elements before mounting or removing.
- When removing the output elements, use an intermediate disk to protect the centering in the shaft extension.
- If necessary, completely balance the motor together with the output elements according to ISO 1940.

**Note**

Motors with feather key are half-key balanced. The motors have been balanced with half a feather key.



- 1 Intermediate washer/disk (to protect the centering in the shaft extension)

Figure 4-2 Mounting and removing output elements

## 4.5 Vibration behavior

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.

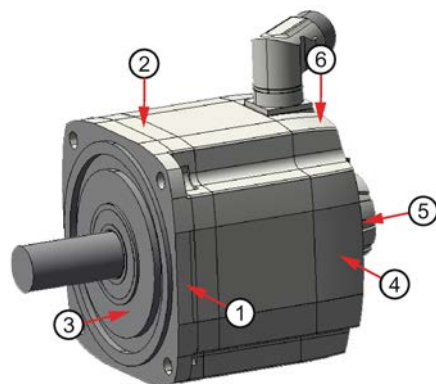
Under certain circumstances, the rotor may have to be balanced completely with the output element.

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 4- 4 Vibration values

Description	Vibration values
Vibration velocity $v_{rms}$ according to ISO 10816	Max. 4.5 mm/s
Vibration acceleration $a_{peak}$ axial <sup>1)</sup>	25 m/s <sup>2</sup>
Vibration acceleration $a_{peak}$ radial <sup>1)</sup>	50 m/s <sup>2</sup>

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



- |   |                          |   |                           |
|---|--------------------------|---|---------------------------|
| 1 | Bearing shield DE radial | 4 | Bearing shield NDE radial |
| 2 | Bearing shield DE radial | 5 | Bearing shield NDE axial  |
| 3 | Bearing shield DE axial  | 6 | Bearing shield NDE radial |

Figure 4-3 Measuring points for vibration values

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

To evaluate the vibration velocity, the measuring equipment must meet the requirements of ISO 2954.

### Note

#### Continuous operation within the natural frequency

Continuous operation within the natural frequencies of the mounted system should be avoided. Generally, this results in permissible vibration values being exceeded, resulting in damage to the system. To reduce vibration, flanged-mounted motors can be supported at the NDE.



## Connecting

### 5.1 Connecting the water cooling

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

#### Preconditions

1. Ensure that the cooling water fulfills the required cooling water specification, see Chapter "Cooling (Page 26)".
2. Make sure that the appropriate volume of cooling water is available, see the rating plate (type plate).
3. Ensure that the maximum permissible operating pressure does not exceed 2.5 bar.

#### Procedure

1. Attach the cooling water pipes to the cooling water connections. You can connect the inlet and outlet as required.
2. Ensure that the cooling water connections and the cooling water pipes are not subject to continuous forces.

You have connected cooling water supply.



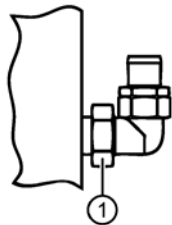
#### Adjusting the outlet direction of the cooling water connection:

#### Precondition

Tools required: Torque wrench, 32 Nm adjustable

#### Procedure

1. Remove the union nut from the adjusting bracket
2. Rotate the adjusting bracket to the required output direction
3. Manually fix the adjusting bracket
4. Tighten the union nut to 32 Nm using a torque wrench



1 Union nut

You have adjusted the outlet direction of the cooling water connection.



## 5.2 Electrical connection

### 5.2.1 Safety instructions



#### **! WARNING**

##### **Electric shock and danger to life due to other energy sources**

Touching live components can result in death or severe injury.

- Only work on electrical devices when you are qualified for this job.
- Always observe the country-specific safety rules.

Generally, the following six steps apply when establishing safety:

1. Prepare for disconnection. Notify all those who will be affected by the procedure.
2. Isolate the drive system from the power supply and take measures to prevent it being switched back on again.
3. Wait until the discharge time specified on the warning labels has elapsed.
4. Check that there is no voltage between any of the power connections, and between any of the power connections and the protective conductor connection.
5. Check whether the existing auxiliary supply circuits are de-energized.
6. Ensure that the motors cannot move.
7. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems, or water. Switch the energy sources to a safe state.
8. Check that the correct drive system is completely locked.

After you have completed the work, restore the operational readiness in the inverse sequence.

#### **! WARNING**

##### **Electric shock when connected to inadequately grounded line supplies**

Connecting a motor to an inadequately grounded line supply can result in death, severe injury and damage to the motor if a fault occurs.

- Connect motors, as part of the drive system, to TN and TT line supplies with a grounded neutral point or to IT line supplies.
- Ensure that the SINAMICS devices and motors are compatible with the residual current device according to EN 61800-5-1 before you connect the devices and motors to the line supply using residual current devices (RCDs).
- For line supplies with grounded line conductor, e.g. TT line supplies, use an isolating transformer with grounded neutral point (on the secondary side) between the line supply and the drive system, so that the motor insulation is not overstressed.
- When connected to IT line supplies, a monitoring device must signal the first fault between an active part and ground. Eliminate this fault immediately.



## 5.2.2 Circuit diagram

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

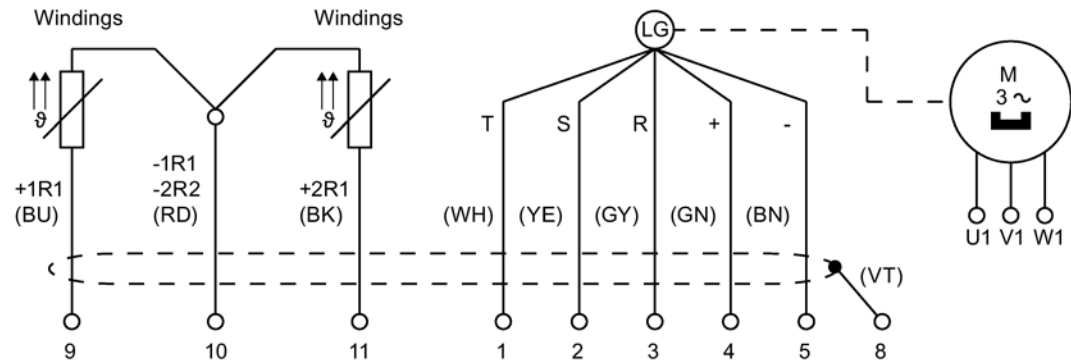


Figure 5-1 Circuit diagram\_1FV5 (without position encoder, contacts 1 ... 5 not assigned)

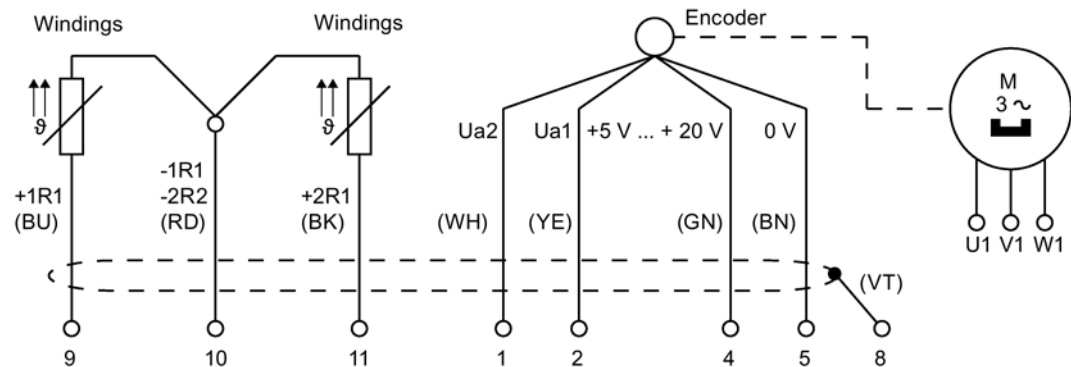


Figure 5-2 Circuit diagram\_1PV5 (without encoder, contacts 1 ... 5 not assigned)

### Note

#### Cable outlet direction

The connecting cables can be damaged if the cable outlet direction is not correctly and professionally changed. Changing the cable outlet direction is prohibited.

### 5.2.3 System integration

#### 5.2.3.1 Connecting-up notes

- When selecting the required connecting cables, make sure that you take into account the rated current and plant-specific conditions 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. Ensure that the cable shields are properly connected.
- Arrange the exposed connecting cables in the terminal box so that the PE conductor has 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 conductor end sleeve.
- Adapt the size of the cable lugs or conductor end sleeves in line with the dimensions of the terminal board connections and the cross-section of the line feeder cable. If necessary, install parallel connecting cables.
- Ensure 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 5- 1 Tightening torques

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

- When connecting and routing connecting cables, maintain minimum air clearances of 5.5 mm.
- Avoid protruding wire ends.
- Close and seal unused cable entries and screw in the sealing plugs and tighten them.
- Check seals and sealing surfaces of the terminal box or connector to ensure that the degree of protection is appropriately maintained.
- Secure connecting cables against torsion, tensile and compressive strain - and protect them against kinking. Avoid applying continuous force to the connector.
- Insert the coding groove of the plug-in connection so that it is aligned in the socket connector. Tighten the union nut by hand in the clockwise direction up to the endstop.
- Connect or disconnect the plug connections only when the system has been disconnected from the power supply.
- Ensure that the insulating foil is present in the terminal box.

### 5.2.3.2 Connecting to a converter

#### Selecting and connecting the cables

Use shielded connection cables to connect the motor to a converter.

We recommend fabricated MOTION CONNECT cables.

The shield is connected at both ends, at the motor and converter.

Keep unshielded cable ends short.

Connect the shield through a large surface area; use EMC glands at the converter and at the motor.

### 5.2.3.3 Data for electrical connection

Table 5- 2 1PV513x/1FV513x motors

Terminal box	Cable entry (power)	Cable entry (external signals)	Max. external cable diameter <sup>1)</sup>	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 <sup>2</sup>

1) Dependent on the cable gland design

Table 5- 3 1FV516x motors

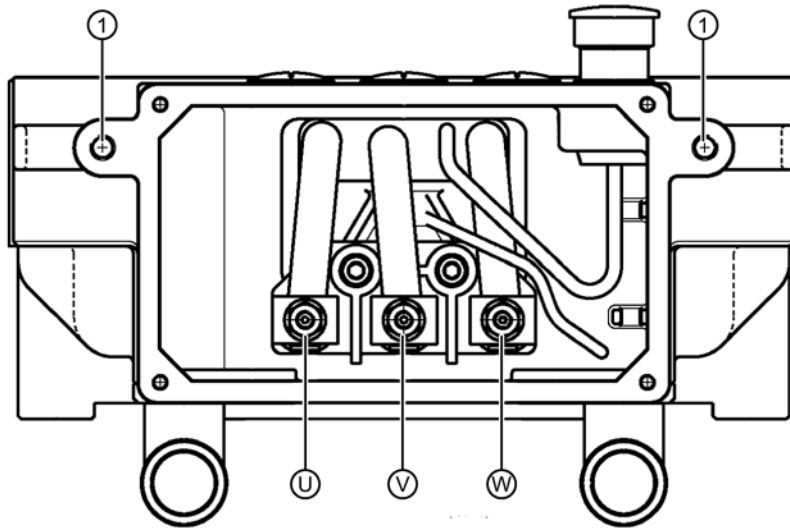
Terminal box	Cable entry (power)	Cable entry (external signals)	Max. external cable diameter <sup>1)</sup>	Number of main terminals	Cross-section per terminal, max.
Gk420	3 x M32 x 1.5	1 x M23	27 mm	Phases: 3 x M10 Grounding: 1 x M8	1 x 70 mm <sup>2</sup>

1) Dependent on the cable gland design

### 5.2.3.4 Power connection

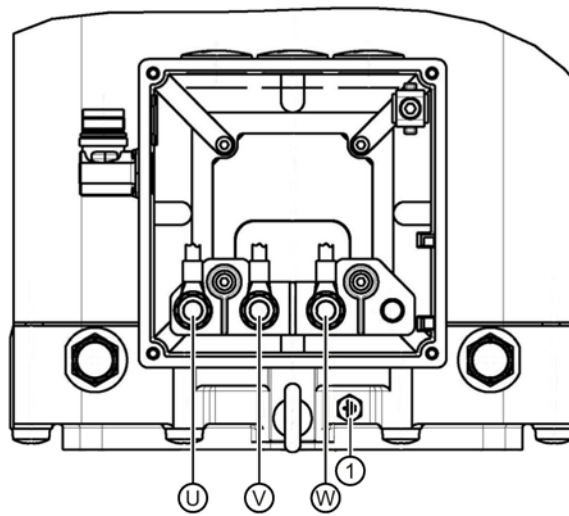
#### Terminal box

- Connect the motor for the required direction of rotation 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
- Terminals should be assigned in the terminal box as shown in the following diagrams.
- Use cable lugs according to DIN 46234.
- Screw the terminal box cover with a tightening torque of 5 Nm.



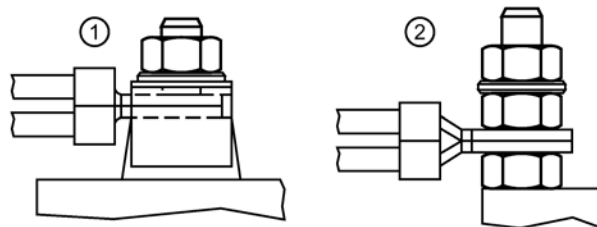
① Ground conductor connection, M8

Figure 5-3 Terminal box, 1PV513x/1FV513x



① Ground conductor connection, M8

Figure 5-4 1FV516x terminal box



① 1PV513x / 1FV513x    ② 1FV516

Figure 5-5 Attaching cable lugs

### Connecting the ground conductor

The grounding conductor connection is located on the enclosure (see Fig. 6-3 and Fig. 6-4).  
Connect the grounding conductor according to IEC / EN 60204-1.

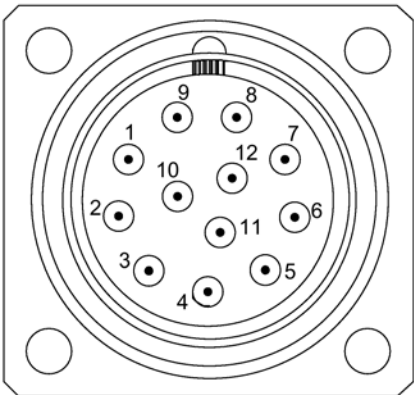
### See also

Terminal box (Page 50)

### 5.2.3.5 Signal connection

For the motors, the speed encoder and temperature sensor are connected using a 12-pin connector. The connector is located in the motor terminal box. The conductive contact is established through contact pins. If the motors are not equipped with an encoder, then only the temperature sensor signals are assigned in the connector, as shown in the following table.

Table 5- 4 Signal connection, view of connector pins


Pin	1PV5	1FV5	1PV5 without encoder	1FV5 without position encoder	1FV5 Resolver	Connector
1	Signal Ua2	Signal T	Not assigned		V <sub>S2</sub> (SIN P)	
2	Signal Ua1	Signal S	Not assigned		V <sub>S4</sub> (SIN N)	
3	Not assigned	Signal R	Not assigned		-	
4	Power supply		Not assigned		Pt1000 (1R1)	
5	Grounding		Not assigned		-	
6	-	-	-	-	-	
7	-	-	-	-	V <sub>R2</sub> (EXC N)	
8	-	-	-	-	Pt1000 (1R2/2R2)	
9	KTY84 or Pt1000 (+1R1)				Pt1000 (2R1)	
10	KTY84 or Pt1000 (-1R2/-2R2)				V <sub>R1</sub> (EXC P)	
11	KTY84 or Pt1000 (2R1)				V <sub>S1</sub> (COS P)	
12	-				V <sub>S3</sub> (COS N)	


**Note**


- Use a suitable socket connector to rotate the angle plug. Completely screw on the socket connector to avoid damaging the pin contacts.
- Remove, mount and adjust the encoders only according to the appropriate instructions.
- Only remove the protective cap from the angle connector immediately before inserting the mating connector.


# Commissioning

## 6.1 Safety instructions

 <b>WARNING</b>
<p><b>Electric shock when checking the insulation resistance</b></p> <p>During the measurement and immediately afterward, high voltages can be present at the terminals that can cause death or severe injury as result of an electric shock.</p> <p>Contact with live parts causes electric shocks.</p> <ul style="list-style-type: none"> <li>• Work on power installations must only be performed by qualified personnel.</li> <li>• Before you begin measuring the insulation resistance, read the operating manual for the insulation resistance meter you are going to use.</li> <li>• Never touch the terminals when making measurements or immediately after the measurement.</li> <li>• Check the connected supply feeder cables to ensure that the line supply voltage cannot be connected.</li> </ul>

 <b>WARNING</b>
<p><b>Danger to life due to unintentional starting of the drive unit</b></p> <p>Unintentional starting of the drive unit can cause death or severe injury.</p> <ul style="list-style-type: none"> <li>• Make sure that the drive unit cannot be started accidentally.</li> <li>• Post a warning notice to this effect at the point where the switch is located.</li> </ul>

 <b>WARNING</b>
<p><b>Risk of burns from hot steam</b></p> <p>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.</p> <p>Do not connect the cooling water supply until the motor has cooled down.</p>


 <b>CAUTION</b>
<p><b>Burns as a result of touching hot surfaces</b></p> <p>In operation, the motor enclosure can reach high temperatures, which can cause burns if touched.</p> <ul style="list-style-type: none"> <li>• Do not touch any hot surfaces.</li> <li>• Allow the motor to cool down before starting any work.</li> <li>• Use the appropriate personnel protective equipment, e.g. gloves.</li> </ul>

<b>NOTICE</b>
<b>Motor damage when the cooling system fails</b>
The motor will overheat if the cooling water supply fails or the motor is operated for a short time without cooling water. This can result in material damage or destroy the motor completely.
<ul style="list-style-type: none"><li>• Never operate the motor without the cooling water supply switched on. Monitor the permissible water intake temperatures.</li></ul>

<b>NOTICE</b>
<b>Thermal damage to temperature-sensitive parts</b>
Some parts of the frame of electric motors can reach temperatures that exceed 100° C. If temperature-sensitive parts, e.g. electric cables or electronic components, come into contact with hot surfaces, these parts could be damaged.
<ul style="list-style-type: none"><li>• Ensure that no temperature-sensitive parts are in contact with hot surfaces.</li></ul>

<b>NOTICE</b>
<b>Motor damage when the maximum speed is exceeded</b>
The maximum speed $n_{max}$ is the highest permissible operating speed. The maximum speed is specified on the rating plate.
Impermissible speeds can cause damage to the motor.
<ul style="list-style-type: none"><li>• Ensure that the maximum permissible speed is not exceeded. Realize this using a suitable control system or activate the speed monitoring function in the drive.</li></ul>

<b>NOTICE</b>
<b>Motor damage caused by uneven running or abnormal noise</b>
The motor can be damaged by improper handling during transport, storage or installation. If a damaged motor is operated, this can damage the winding or bearings and could even destroy the system.
<ul style="list-style-type: none"><li>• In case of uneven running or abnormal noise, switch off the motor.</li><li>• Identify the cause.</li></ul>

 <b>WARNING</b>
<b>Unsecured parts being flung out</b>
Feather keys and other parts that are not adequately secured can be flung out when the motor starts resulting in death or severe injury.
<ul style="list-style-type: none"><li>• Secure feather keys and other parts so that they cannot be flung out.</li><li>• Place the appropriate safety guards around output elements.</li></ul>



## 6.2 Checklists for commissioning

### Note

#### Required checks

The lists below do not claim to be complete. It may be necessary to perform additional checks and tests in accordance with the situation specific to the particular installation site.

- Before commissioning the system, check that it is properly installed and connected.
- Commission the drive system according to the operating instructions of the converter or inverter being used.
- Thoroughly familiarize yourself with the safety instructions and observe the checklists below before starting any work.

Table 6- 1 Checklist (1) - general checks

Check	OK
Are all of the necessary components of the configured drive line-up available, correctly dimensioned, installed and connected?	
Are the manufacturer's documentation for the system components (e.g. drive system, encoder, cooling system, brake) and the Operating Instructions for the SIMOTICS A-1PV5/1FV5 built-in motor available?	
Is the following, current SINAMICS documentation available? <ul style="list-style-type: none"> <li>• SINAMICS S120 Commissioning Manual</li> <li>• Getting Started S120</li> <li>• S120 Function Manual</li> <li>• S120/150 List Manual</li> </ul>	
Was the Chapter "Checklists for commissioning SINAMICS S" in the SINAMICS S120 Commissioning Manual carefully observed?	
Is the motor type to be commissioned known? (e.g. 1PV5 ___ - _____ - _____)	
Are the environmental conditions in the permissible range?	
Do the mode and the performance data for operation of the motors match the data on the rating plate (type plate)?	
Do the converter setting data match the data on the rating plate (type plate)?	

6.2 Checklists for commissioning

Table 6- 2 Checklist (2) - checks regarding the mechanical system

Check	OK
Have all touch protection measures for moving and live parts been implemented?	
Has the motor been correctly mounted and aligned?	
Can you rotate the rotor without it touching the stator?	
Do the operating conditions correspond to the data specified on the rating plate?	
Are all mounting screws, connecting elements, and electrical connections tight and properly attached?	
Do the output elements have the correct setting conditions according to type? Examples: <ul style="list-style-type: none"> <li>• Have the couplings been aligned and balanced?</li> <li>• Has the belt drive tension been correctly adjusted?</li> <li>• Have the gear tooth flank and gear tooth tip play as well as radial play been correctly adjusted for geared outputs?</li> </ul>	

Table 6- 3 Checklist (3) - checks regarding the electrical system

Check	OK
Has the motor been connected so that it rotates in the specified direction?	
Have the minimum insulation resistance values been maintained?	
Have the grounding and equipotential bonding connections been correctly established?	
Is the specified limit speed $n_{max}$ not exceeded when operated from a converter.	

Table 6- 4 Checklist (4) - Monitoring equipment checks

Check	OK
Has it been ensured that the maximum speed $n_{max}$ cannot be exceeded?	
Have all supplementary motor monitoring devices been correctly connected and are they working properly?	
Is the motor protected against excessively high loads?	
Is the installed temperature sensor connected properly to the converter temperature monitoring?	
Is the temperature sensor evaluated?	
Has the temperature sensor tripping temperature been correctly set?	
Has the I <sup>2</sup> t monitoring of the converter been switched on?	

Table 6- 5 Checklist (5) - Cooling system checks

Check	OK
<b>Water cooling</b> Has the cooling water supply been connected and is it ready for operation? Has the cooling water circuit been vented? Is the cooling water circulation (flow rate, temperature) in compliance with the specifications? Is the cooling water system leak-free?	

Table 6- 6 Checklist (6) - Roller-contact bearing checks

Check	OK
Are the roller-contact bearings OK?	
For motors that were stored, were the storage conditions according to the "Storage" section and the bearing replacement intervals according to the "Bearing replacement intervals" section complied with?	

## 6.3 Commissioning procedure

### Checking the insulation resistance

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

- 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  $U_N < 2 \text{ kV}$ :

Table 6- 7 Stator winding insulation resistance at 25 °C

	Rated voltage $U_N < 2 \text{ kV}$
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:

$$0.6 \text{ kV} \times 0.5 \text{ M}\Omega/\text{kV} = 0.3 \text{ M}\Omega$$

---

**Note**

**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).

---

---

**Note**

**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.

---

**Precondition**

You have successfully worked through the commissioning checklists.

**Procedure**

- Ensure that the frequency converter is correctly parameterized.
- Commission the motor with an appropriate commissioning tool, e.g. "Drive ES" or "STARTER".
- Follow the steps of the commissioning tool.

You have commissioned the motor.

**Switching off**

- Switch off the motor at the frequency converter.

## 6.4 Switching on and switching off

---

**Note****EMERGENCY OFF**

To avoid accidents, inform yourself about the EMERGENCY OFF function before you switch on the system.

---

The motor is switched on and off using the frequency converter.

- For more information on this topic, see the chapter in the Operating Instructions for the converter.

### Switching on

**Precondition**

- Ensure that the frequency converter is correctly parameterized.
- Check whether sufficient heat is dissipated from the motor.

**Procedure**

1. Switch on the motor at the frequency converter.
2. Observe any uneven running and abnormal noise of the motor.
3. Check the function of the safety equipment.
4. Check whether the motor reaches the required parameters

You have switched on the motor.





### Switching off


- Switch off the motor at the frequency converter.



## 7.1 Safety instructions

 <b>WARNING</b>
<b>Do not remove covers when motor is running</b> 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.

 <b>WARNING</b>
<b>Faults during operation</b> 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. <ul style="list-style-type: none"><li>• Inform maintenance personnel immediately.</li><li>• If in doubt, shut down the motor immediately, taking into account the plant-specific safety regulations.</li></ul>

 <b>CAUTION</b>
<b>Danger of burns</b> The temperature of certain parts of the motor can exceed 65 °C. Physical contact with the machine could cause serious burns. <ul style="list-style-type: none"><li>• Check the temperature of the parts before touching them and take appropriate protective measures if necessary.</li></ul>

## 7.2 Switching on and switching off

---

### Note

#### EMERGENCY OFF

To avoid accidents, inform yourself about the EMERGENCY OFF function before you switch on the system.

---

The motor is switched on and off using the frequency converter.

- For more information on this topic, see the chapter in the Operating Instructions for the converter.

### Switching on

#### Precondition

- Ensure that the frequency converter is correctly parameterized.
- Check whether sufficient heat is dissipated from the motor.

#### Procedure

1. Switch on the motor at the frequency converter.
2. Observe any uneven running and abnormal noise of the motor.
3. Check the function of the safety equipment.
4. Check whether the motor reaches the required parameters

You have switched on the motor.

### Switching off

- Switch off the motor at the frequency converter.
- For longer non-operational periods switch off the cooling water supply.

## 7.3 During operation

### Operation

While the motor is operating, ensure that the specified parameters are maintained.

Make sure that:

- The power consumption is in the specified range
- Cooling is ensured.  
Check the liquid level, coolant intake temperature and that the coolant is circulating.
- There is no abnormal motor noise
- The motor does not overheat

---

### Note

#### Observe the maintenance intervals

Service the motor at the prescribed maintenance intervals. (see Chapter "Service and maintenance (Page 67)")

---



## 7.4 Stoppages

### Measures for longer non-operational periods

<b>NOTICE</b>
<b>Damage due to improper storage</b> The motor can be damaged if it is not stored properly. <ul style="list-style-type: none"><li>• If the motor is out of service for extended periods of time, implement suitable anti-corrosion, preservation, and drying measures.</li><li>• When recommissioning the motor after longer stoppages, perform the measures recommended in Chapter "Commissioning".</li></ul>

---

#### Note

The motor remains installed.

---

#### Procedure

1. Disconnect the motor from the cooling water system.
2. Remove any cooling water from the motor.
3. Blow out the cooling ducts with compressed air to dry them.
4. Observe the instructions for storage contained in Chapter "Storage (Page 34)".

You have prepared the motor for a longer non-operational period.

- If the motor is not operational for extended periods of time, run it at regular intervals (roughly once a month) or spin the rotor by hand.
- Observe Chapter "Commissioning (Page 53)" before switching on to recommission the system.



## Faults and their rectification

---

### 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)															
	A	B			E											
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
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

### 9.1 Safety instructions

If you have any questions, please contact the manufacturer, quoting the machine type and serial number.

#### **WARNING**


##### **Electric shock when live parts are touched**


Death or serious injury can result when live parts are touched.


- Only work on electrical equipment if you are appropriately qualified.
- Always comply with the local national safety regulations when working on electrical equipment.


Generally, the following six steps apply when establishing safety:


1. Prepare for shutdown and notify all those who will be affected by the procedure.
2. Disconnect the machine from the power supply.
  - Switch off the machine.
  - Wait until the discharge time specified on the warning labels has elapsed.
  - Check that it really de-energized, from phase to phase and phase to protective conductor.
  - Check that every auxiliary circuit is de-energized.
  - Ensure that the motors cannot move.
3. Secure SIMOTICS S motors against unintentional movements that generate a voltage at the terminals.
4. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems or water.
5. Isolate or neutralize all hazardous energy sources, for example by closing switches, grounding or short-circuiting, or closing valves.
6. Take measures to prevent reconnection of the energy sources.
7. Make sure that the machine is completely locked ... and that you have the right machine.

 <b>WARNING</b>
<b>Slipping on leaked oil</b> Leaked oil can result in slipping or falling and cause death or severe injury. <ul style="list-style-type: none"><li>• Prevent oil from leaking</li><li>• Absorb leaked oil immediately with a binding agent for oil or similar.</li><li>• Rough up the hazardous location.</li><li>• Mark the hazardous location.</li></ul>

 <b>WARNING</b>
<b>Danger to life due to unintentional starting of the drive unit</b> Unintentional starting of the drive unit can cause death or severe injury. <ul style="list-style-type: none"><li>• Make sure that the drive unit cannot be started accidentally.</li><li>• Post a warning notice to this effect at the point where the switch is located.</li></ul>

 <b>WARNING</b>
<b>Risk of burns from hot steam</b> 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.

 <b>CAUTION</b>
<b>Burning hazard caused by hot surfaces</b> Some parts of the frame of electrical machines can reach temperatures in excess of 100°C. Touching components when the machine is in operation can cause burns. <ul style="list-style-type: none"><li>• Do not touch frame parts while the machine is in operation or immediately after machine operation.</li><li>• Allow frame parts to cool off before starting any work.</li></ul>

 <b>CAUTION</b>
<b>Danger of scalding from the hot oil exiting the unit</b> Exiting hot oil can cause burns. <ul style="list-style-type: none"><li>• Before starting any work, wait until the oil has cooled down to below 30° C.</li></ul>

**⚠ CAUTION****Risk of burns from escaping cooling water**

Hot cooling water that escapes can cause burns.

- Before starting any work, wait until the cooling water has cooled down to below 30 °C.

**⚠ CAUTION****Chemical burns and irritations caused by 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****Injuries caused by stirred-up foreign bodies and dust when working with compressed air**

When you clean using compressed air, this can stir up dust, metal chips and cleaning agents, and so cause injuries.

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

**⚠ WARNING****Danger to life when lifting and transporting**

Incorrect lifting and transport operations, devices and equipment that are unsuitable or damaged can result in death, severe injury and/or damage to property.

- Lifting devices, ground conveyors, and load suspension equipment must comply with requirements.
- The maximum capacity of the lifting equipment and the load suspension device must correspond to the weight of the motor (see the rating plate).
- Do not attach any additional loads to the lifting equipment.
- To hoist the motor, use suitable cable-guidance or spreading equipment, particularly if the motor is equipped with built-on assemblies.
- The motor must not be lifted or transported by means of the power connector or signal connector.
- Do not stand in the slewing range of hoisting gear or under suspended loads.

## 9.2 Inspection and maintenance

### General

Carry out maintenance work, inspections and revisions at regular intervals in order to be able to identify faults at an early stage and remove them.

---

**Note****Inspection if there are faults or unusual conditions**

Unusual conditions or faults that place undue stress on a three-phase motor - e.g. overload, short-circuit - can cause consequential damage to the machine.

Immediately perform an inspection when faults or exceptional conditions occur.

---

### Maintenance measures, inspection/maintenance times intervals

The maintenance intervals depend on the operating conditions.

- Adapt the maintenance intervals to match the local conditions, such as pollution/dirt, switching frequency, load, etc.

<b>NOTICE</b>
<b>Improper maintenance</b>
Service and maintenance must only be performed by properly authorized qualified personnel.
Only use original SIEMENS parts.

Siemens Service Centers distributed around the globe can maintain and repair the motor. To do this, contact your local Siemens representative.

- Perform the following maintenance measures as listed in the table.

Table 9- 1 Maintenance measures after operating times or intervals

Operating times and intervals	Measure
<b>Operation</b>	
Daily; if possible, more frequently during operation.	Monitor and check the motor for unusual noise, vibrations, and changes.
As required, or after 20 000 operating hours, however, at the latest after 5 years.	Replace the motor bearings

## 9.3 Repairing

The Siemens Service Center Bad Neustadt and other regional service sites throughout the world can handle or organize the maintenance/repair of the motors.

Contact your regional Siemens contact if you require this service.



## Decommissioning and disposal

### 10.1 Safety instructions

#### Removing the motor from the machine

 **WARNING**

**Electric shock when live parts are touched**


Death or serious injury can result when live parts are touched.


- Only work on electrical equipment if you are appropriately qualified.
- Always comply with the local national safety regulations when working on electrical equipment.


Generally, six steps apply when establishing safety:


1. Prepare for shutdown and notify all those who will be affected by the procedure.
2. Disconnect the machine from the power supply.
  - Switch off the machine.
  - Wait until the discharge time specified on the warning labels has elapsed.
  - Check that it really de-energized, from phase to phase and phase to protective conductor.
  - Check that every auxiliary circuit is de-energized.
  - Ensure that the motors cannot move.
3. Secure SIMOTICS S motors against unintentional movements that generate a voltage at the terminals.
4. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems or water.
5. Isolate or neutralize all hazardous energy sources, for example by closing switches, grounding or short-circuiting, or closing valves.
6. Take measures to prevent reconnection of the energy sources.
7. Make sure that the machine is completely locked ... and that you have the right machine.


After you have completed the work, restore operational readiness by performing the above steps in the reverse order.


 <b>WARNING</b>
<b>Slipping on leaked oil</b> Leaked oil can result in slipping or falling and cause death or severe injury. <ul style="list-style-type: none"><li>• Prevent oil from leaking</li><li>• Absorb leaked oil immediately with a binding agent for oil or similar.</li><li>• Rough up the hazardous location.</li><li>• Mark the hazardous location.</li></ul>


 <b>CAUTION</b>
<b>Burning hazard caused by hot surfaces</b> Some parts of the frame of electrical machines can reach temperatures in excess of 100° C. Touching components when the machine is in operation can cause burns. <ul style="list-style-type: none"><li>• Do not touch frame parts while the machine is in operation or immediately after machine operation.</li><li>• Allow frame parts to cool off before starting any work.</li></ul>

 <b>CAUTION</b>
<b>Danger of scalding from the hot oil exiting the unit</b> Exiting hot oil can cause burns. <ul style="list-style-type: none"><li>• Before starting any work, wait until the oil has cooled down to below 30° C.</li></ul>

 <b>CAUTION</b>
<b>Chemical burns and irritations caused by chemical cleaning agents</b> 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. <ul style="list-style-type: none"><li>• 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).</li><li>• 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.</li></ul>

 <b>WARNING</b>
<b>Danger to life caused by falling machine parts</b> The machine partially comprises heavy individual components. When removing the machine, these components can fall. This can result in death, serious injury or material damage. <ul style="list-style-type: none"><li>• Secure the machine components that are being released so that they cannot fall.</li></ul>

 <b>WARNING</b>
<b>Injury as a result of suspended loads</b> When being dismantled and transported, the motor can cause injury as a result of its movement. <ul style="list-style-type: none"><li>• Only use perfectly functioning hoisting and load suspension equipment dimensioned to carry the motor load.</li><li>• Pay careful attention to possible movement when the motor is released.</li><li>• Do not stand under suspended loads or in their slewing range.</li><li>• When placing down the motor, ensure that it cannot roll.</li></ul>

 <b>CAUTION</b>
<b>Injuries caused by liquids when draining and environmental pollution</b> When draining, liquids can cause injuries, such as burns, chemical burns, irritation. Spilt oil can make floor surfaces slippery and pollute the environment. <ul style="list-style-type: none"><li>• Allow the liquid to cool down.</li><li>• Use a sufficiently large collection container.</li><li>• Avoid liquids coming into contact with the skin. Wear suitable personnel protection equipment, e.g. protective eyewear, gloves.</li><li>• Have materials on hand to soak up leaked liquids and prevent areas from being slippery.</li></ul>

## 10.2 Decommissioning

### 10.2.1 Removing the motor

Removing the motor must be performed and/or supervised by qualified personnel with appropriate expert knowledge.

- Contact a certified waste disposal organization in your vicinity.

#### Removing the motor from the machine

1. Disconnect all electrical connections.
  2. Remove all liquids such as oil, water.
  3. Remove all supply lines.
  4. Remove the fixing elements from the motor.
  5. Transport the motor to a suitable location for storage and disassembly.
-

## 10.2.2 Dismantling the motor

---

### Note

The rotor in a motor containing permanent magnets must only be removed by the manufacturer.

Contact the Siemens Service Center.

---

## 10.3 Disposal

### Recycling and disposal



For environmentally-friendly recycling and disposal of your old device, please contact a company certified for the disposal of waste electrical and electronic equipment, and dispose of the old device as prescribed in the respective country of use.

# Appendix

## A.1 List of abbreviations

Abbreviation	Meaning
ABS	Acrylonitrile-butadiene-styrene
SH	Motor shaft height
BGR	Rules of the German Trade Association
BGV	Regulations of the German Trade Association
DE	Drive end
DIN	Deutsche Industrie Norm (German Industry Standard)
EC	European Community
ESD	Electrostatically sensitive devices
EMC	Electromagnetic compatibility
EN	Euro-Norm
EPDM	Ethylene-propylene-diene-rubber
H	Halfkey balancing
IEC	International Electrotechnical Commission
IM	Type of construction
IP	International Protection
ISO	International Organization for Standardization
KTY / Pt1000	Temperature sensor
LG	Position encoder
MLFB	Machine-readable product code
NDE	Non-drive end
NN	Normal zero
PVC	Polyvinyl chloride
RPE	Rotor position encoder
UL	Underwriters Laboratories



# Index

## C

### Certificates

EAC, 21

EC Declaration of Conformity, 21

UL and cUL, 21

Circuit diagram, 47

Commissioning, 55

Correct usage, 19, **Fehler! Textmarke nicht definiert.**

## D

Degree of protection, 24

## F

faults, 65

## H

Hotline, 5

## I

Inspection and maintenance, 67

## M

Maintenance intervals, 70

## R

Rating plate data, 24

Recommissioning, 63

RoHS, 22

## S

Siemens Service Center, 5

## T

Target group, 3

Technical Support, 5

Terminal box, 50

Tightening torques, 40

Electrical connections, 48

Training, 5

Transport, 32

Types of construction, 26

## V

Vibration load, 43

Vibration values, 43

Siemens AG  
Digital Factory  
Motion Control  
Postfach 31 80  
91050 ERLANGEN  
Germany

Scan the QR code for  
additional informati-  
on about SIMOTICS.

