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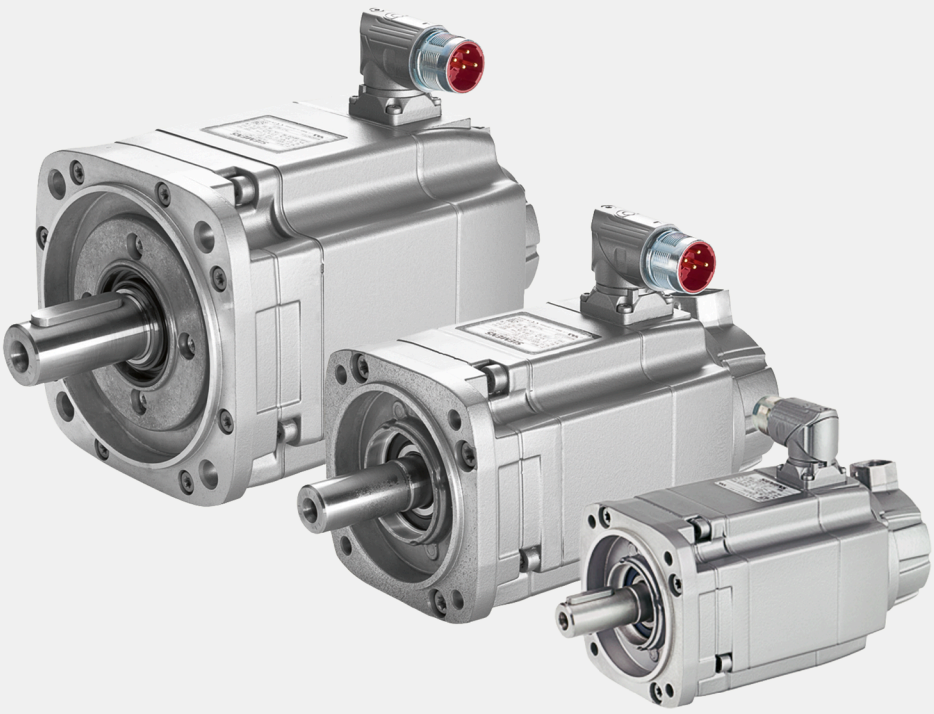

Edition 10/2021

OPERATING INSTRUCTIONS

SIMOTICS

S-1FK7 2nd generation synchronous motors

For SINAMICS S120

www.siemens.com

SIEMENS

SIMOTICS

Drive technology
1FK7 G2 synchronous motors

Operating Instructions

10/2021
A5E50907562B AB

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠**DANGER**
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠**WARNING**
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠**CAUTION**
indicates that minor personal injury can result if proper precautions are not taken.

NOTICE
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:

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

Trademarks

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

Disclaimer of Liability

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

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Ⓟ 10/2021 Subject to change

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 benefits

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

About these Operating Instructions

These Operating Instructions apply to the SIMOTICS S-1FK7 servomotor, 2nd generation, called "1FK7" later.

The Operating Instructions provide information about the components that enable the target group to install, set up, test, commission, operate, and troubleshoot the products and systems correctly and safely.

These Operating Instructions explain how to handle the 1FK7 from delivery to disposal.

You find additional information in the Configuration Manual for the 1FK7.

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, contact the Siemens Service Center.
- Always follow the safety instructions and notices in this Product Information.

The warning notice system is explained on the rear of the inside front.

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:

- 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).

mySupport

Extensive assistance and more information can be found under the following link:

My Support Links and Tools (https://support.industry.siemens.com/My/de/en/documentation)

You can individually compile your personal library, e.g. for your documentation based on Siemens content, and adapt it for your own machine documentation.

To do so, click "My Documentation".

Note

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

Later, you can log on with your login data.

You can create your own personal library under "mySupport" using the following procedure.

Precondition

You have registered for and logged on to "Siemens Industry Online Support", hereinafter referred to as "SIOS".

Siemens Industry Online Support (https://support.industry.siemens.com/cs/de/en/)

Procedure for creating a personal library

1. Open SIOS and log on.
2. Enter the product you are looking for under "Search for product info" and press "Enter".
3. Select the doc. class you want, e.g. "Manual", under "Entry type".
4. Click on your desired manual under the entries.
5. Click on "Add to mySupport documentation".
6. Enter a title.
7. Press "OK".

❒

The selected manual can be found under "mySupport". To find further functions, click on the icon located to the right of the document.

In this way, you can create your own library and quickly access your documentation.

Training

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

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

If you have any technical questions, please contact Technical Support (https://support.industry.siemens.com/cs/ww/en/ps).

To make a support request, proceed as follows:

Precondition

You have registered for and logged on to "Siemens Industry Online Support", abbreviated "SIOS".

Siemens Industry Online Support (https://support.industry.siemens.com/cs/de/en/)

Procedure

1. Click on "Your direct way to the Support Request" or follow this link Support Request (https://support.industry.siemens.com/cs/de/en/my)
2. Follow the instructions in the online form.

❒

Internet address for products

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

Websites of third parties

This document includes hyperlinks to websites of third-party companies. Siemens is not responsible for and shall not be liable for these websites and is not responsible for the content or information they provide. Siemens does not control the information on these websites and is not responsible for the content and information provided there. The user bears the risk for their use.

Table of contents

Fundamental safety instructions

1

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 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. Contact with hazardous voltage can result in severe 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.

NOTICE

Damage to equipment due to unsuitable tightening tools.

Unsuitable tightening tools or fastening methods can damage the screws of the equipment.

- Be sure to only use screwdrivers which exactly match the heads of the screws.
- Tighten the screws with the torque specified in the technical documentation.
- Use a torque wrench or a mechanical precision nut runner with a dynamic torque sensor and speed limitation system.

⚠WARNING

Unexpected movement of machines caused by radio devices or mobile phones

Using radio devices or mobile telephones in the immediate vicinity of the components can result in equipment malfunction. Malfunctions may impair the functional safety of machines and can therefore put people in danger or lead to property damage.

- Therefore, if you move closer than 20 cm to the components, be sure to switch off radio devices or mobile telephones.
- 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 this affects you, maintain the minimum distance to such equipment that is specified in the "Intended use" chapter.

⚠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 this affects you, maintain the minimum distance to such equipment that is specified in the "Intended use" chapter.
- 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 of 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 Security information

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
https://www.siemens.com/industrialsecurity (https://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 under
https://www.siemens.com/industrialsecurity
(https://new.siemens.com/global/en/products/services/cert.html#Subscriptions).

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, 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.
- On completion of commissioning, check all security-related settings.

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 of the motors

2

2.1 Intended use

⚠WARNING

Motors not used for the intended purpose

If you do not use the motors correctly, there is a risk of death, severe injury and/or material damage.

- Only use the motors for their intended purpose.
- Make sure that the conditions at the location of use comply with all the rating plate data.
- 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.

⚠WARNING

Malfunctions of active active implants due to magnetic and electrical fields

Electric motors endanger people with active implants, for example heart pacemakers, who come close to the motors.

- 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).

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 1FK7 motor is intended for industrial or commercial plants.

The motor is designed for operation in sheltered areas under normal climatic conditions, such as those found on shop floors.

More detailed information is provided in Chapter "Environmental conditions (Page 25)".

The 1FK7 motor is certified only for operation through a converter.

NOTICE
Motor damage Motors with an EnDat2.2 encoder must only be operated with suitable non-Siemens converters. Operation with SINAMICS converters (via SMC40) is not permitted.

Any other use of the motor is considered to be incorrect usage.

Use as intended includes compliance with all of the specifications in the operating instructions and the Configuration Manual.

Observe the details on the rating plate.

Typical applications

The 1FK7 synchronous motors have the following typical application areas:

- Machine tools (e.g. auxiliary axes, feed drives)
- Robots and handling systems
- Packaging, plastics and textile machines
- Wood, glass, ceramics and stone working machines

2.2 Technical features and environmental conditions

2.2.1 Directives and standards

Standards that are complied with

The motors of the type 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 EN 60034:

Feature	Standard
Degree of protection	EN 60034-5
Cooling [1)]	EN 60034-6
Type of construction	EN 60034-7
Connection designations	EN 60034-8
Noise levels [1)]	EN 60034-9
Temperature monitoring	EN 60034-11
Vibration severity grades [1)]	EN 60034-14

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

Relevant directives

The following directives are relevant for SIMOTICS motors.

CE

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 scope 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 scope 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.

European RoHS Directive

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

European Directive on Waste Electrical and Electronic Equipment (WEEE)

The SIMOTICS motor series complies with the 2012/19/EU directive on taking back and recycling waste electrical and electronic equipment.

European Directive 2005/32/EC defining requirements for environmentally friendly design of electric motors

The SIMOTICS motor series is not subject to Regulation (EC) No. 640/2009 for implementation of this directive.

European Directive 2009/125/EC defining ecodesign requirements of electric motors and speed controls

The SIMOTICS motor series is not subject to Regulation (EU) 2019/1781 for implementation of this directive.

Eurasian conformity

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

China Compulsory Certification

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

CCC negative certification:

CCC product certification (https://support.industry.siemens.com/cs/products?search=CCC&dtp=Certificate&mfn=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 crucial that you carefully observe the content of the quotation and that there is a UL or 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.

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)

China RoHS

SIMOTICS motors comply with the China RoHS.

You can find more information at:

China RoHS (https://support.industry.siemens.com/cs/ww/de/view/109738656/en)

2.2.2 Technical features

Table 2- 1 Technical features

Type of motor	Permanent-magnet synchronous motor
Magnet material	Rare-earth magnetic material
Cooling	Natural cooling, forced ventilation
Insulation of the stator winding according to EN 60034-1 (IEC 60034-1)	Temperature class 155°C (F) for a winding temperature of ΔT = 100 K at an ambient temperature of +40°C
Impulse voltage insulation class according to EN 60034-18-41 (IEC 60034-18-41)	IVIC: C
Operating range	-15° to +40°C, derating at higher temperatures
Installation altitude (according to EN 60034–1 and IEC 60034–1)	≤ 1000 m above sea level, otherwise power derating
Type of construction according to EN 60034-7 (IEC 60034-7)	IM B5 (IM V1, IM V3)
Degree of protection according to EN 60034-5 (IEC 60034-5)	IP64; optional IP65 or IP65 + IP67 at the shaft gland Motors with forced ventilation IP54
Temperature monitoring	Temperature sensor in the stator winding
Paint finish	Anthracite (RAL 7016)
Shaft extension according to DIN 748-3 (IEC 60072-1)	Plain shaft, optional shaft with fitted key and keyway (half-key balancing)
Radial eccentricity, concentricity, and axial eccentricity according to DIN 42955 (IEC 60072–1) [1)]	Tolerance N (normal)
Vibration severity grade according to EN 60034-14 (IEC 60034-14)	Grade A is maintained up to rated speed
Sound pressure level L_{pA} (1 m) according to DIN EN ISO 1680, max. tolerance + 3 dB(A)	Natural cooling: • 1FK703☐ to 1FK704☐: 55 dB(A) • 1FK706☐: 65 dB(A) • 1FK708☐ to 1FK710☐: 70 dB(A) Forced ventilation: • 1FK708☐: 73 dB(A)
Built-in encoder systems for motors without DRIVE-CLiQ interface	• IC2048S/R incremental encoder, sin/cos 1 Vpp, 2048 S/R [2)] with C and D tracks for SH 36 to SH 100 • AM2048S/R absolute encoder 2048 S/R [2)], 4096 revolutions multiturn, with EnDat 2.1 interface for SH 36 to SH 100 • AM25EN22 absolute encoder multiturn 25-bit, 4096 revolutions multiturn, with EnDat 2.2 interface (without incremental signal) for SH 48 to SH 100 • Resolver, multipole (number of pole pairs corresponds to number of pole pairs of the motor) • 2-pole resolver

Integrated encoder systems for motors with DRIVE-CLiQ interface	• AS24DQI absolute encoder singleturn 24-bit, for SH 36 to SH 100 • AM24DQI absolute encoder 24-bit + 12-bit multiturn, for SH 36 to SH 100 • AS20DQI absolute encoder singleturn 20-bit, for SH 36 to SH 100 • AM20DQI absolute encoder 20-bit + 12-bit multiturn, for SH 36 to SH 100 • IC22DQ incremental encoder 22-bit for SH 36 to SH 100 • AM16DQ absolute encoder 16-bit + 12-bit multiturn, for SH 48 to SH 100 • AM20DQ absolute encoder 20-bit + 12-bit multiturn, for SH 63 to SH 100 • AM22DQI absolute encoder 22-bit + 12-bit multiturn, for SH 36 to SH 100 • R15DQ resolver 15-bit • R14DQ resolver 14-bit
Connection	Connectors for signals and power, can be rotated Plug connector for an external fan, rotatable
Holding brake	Optional integrated holding brake (free of backlash, 24 V)

1) Radial eccentricity of the shaft extension, concentricity of centering edge, and axial eccentricity of the mounting flange to the axis of the shaft extension.

2) S/R = Signals/Revolution

2.2.3 Environmental conditions

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

With the exception of environmental influences "Condensation", "Low air temperature" and "Low air pressure", you can assign SIMOTICS S servomotors to climate class 3K4.

The following temperature ranges apply for natural-cooled and forced-ventilation motors.

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

Influencing environmental variables		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/m³	1
f)	High absolute humidity	g/m³	29
g)	Rate of temperature change[1)]	°C/min	0.5
h)	Low air pressure[4)]	kPa	89
i)	High air pressure[2)]	kPa	106
j)	Solar radiation	W/m²	700
k)	Thermal radiation	-	-
l)	Air movement[3)]	m/s	1.0
m)	Condensation	-	Not permissible
n)	Wind-driven precipitation (rain, snow, hail, etc.)	-	-
o)	Water (other than rain)	-	See protection class
p)	Formation of ice	-	-

1) *Averaged over a period of 5 min*

2) *Conditions in mines are not considered.*

3) *A cooling system based on natural convection can be disturbed by unforeseen air movements.*

4) *The limit value of 89 kPa covers applications at altitudes up to 1000 m.*

Note

Installation instructions

SIMOTICS S motors are not suitable for operation

- In salt-laden or aggressive atmospheres
- Outdoors

You 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.

2.2.4 Degree of protection

1FK7 motors are available with IP64 or IP65 degree of protection. The degree of protection of the motor is specified on the rating plate.

2.2.5 Noise emission

When operated in the speed range 0 to rated speed, 1FK7 motors can reach the following measuring-surface sound pressure level Lp(A):

Table 2- 3 Sound pressure level

Cooling method	Shaft height	Measuring-surface sound pressure level Lp(A)
Naturally cooled	1FK703 to 1FK704	55 dB(A) + 3 dB tolerance
	1FK706	65 dB(A) + 3 dB tolerance
	1FK708 to 1FK710	70 dB(A) + 3 dB tolerance
Forced-ventilated	1FK708	73 dB(A) + 3 dB tolerance

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

2.3 Derating factors

Under conditions other than those specified above (ambient temperature > 40° C or installation altitude > 1000 m above sea level), the permissible torques/powers are shown in the following table.

Ambient temperatures and installation altitudes are rounded off to 5° C or 500 m respectively.

Table 2- 4 Power de-rating depending on the installation altitude and the ambient temperature

Installation altitude above sea level in m	**Ambient temperature in °C**					
	30	35	40	45	50	55
1000	1.05	1.02	1.00	0.97	0.95	0.92
1500	1.02	1.00	0.97	0.95	0.92	0.89
2000	1.00	0.97	0.95	0.92	0.89	0.87
2500	0.97	0.95	0.92	0.89	0.87	0.84
3000	0.95	0.92	0.89	0.87	0.84	0.81
3500	0.92	0.89	0.87	0.84	0.81	0.77
4000	0.89	0.87	0.84	0.81	0.77	0.74

Factors x_D refer to static torque M_0.

Determine the reduced torque using the following formula:

$M_{red} = M_N - (M_0 - (M_0 \bullet x_D))$

M_{red} / Nm = reduced torque at rated speed
M_N / Nm = rated torque S1 (100K)
M_0 / Nm = static torque (100K)
x_D = derating factor

You shift the S1 characteristic curve in parallel.

At installation altitudes of 2000 m above sea level or higher, the voltage stress on the motors must be reduced accordingly based on the "Factors for reducing the maximum DC-link voltage" table (reciprocal values from EN 60664-1 Table A. 2).

Table 2- 5 Factors for reducing the maximum DC-link voltage

Installation altitude up to [m] above mean sea level	**F**actor
2000	1
3000	0.877
4000	0.775
5000	0.656
6000	0.588
7000	0.513
8000	0.444

As the DC-link voltage is reduced, the converter output voltage also decreases. This reduces the operating range in the M-n diagram.

The M-n diagrams are contained in the associated Configuration Manual.

Operation in a vacuum is not permissible because of the low dielectric strength and poor heat dissipation.

2.4 Structure of the article number

The article number comprises a combination of digits and letters. It is divided into three hyphenated blocks.

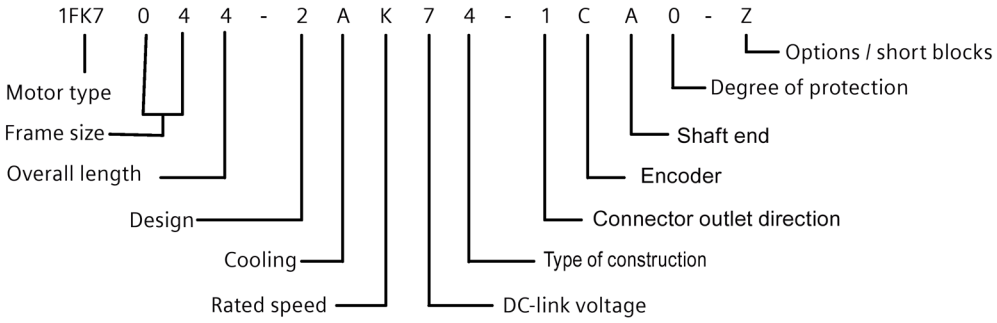


Figure 2-1 Structure of the 1FK7G2 article number

Possible combinations can be found in Catalog D 21.4 (https://support.industry.siemens.com/cs/ww/de/view/109747019/en). Please note that not every theoretical combination is available.

Description			Position of the article number																		
			1	2	3	4	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-	Z
SIMOTICS S-1FK7 synchronous servomotors			**1**	**F**	**K**	**7**																
Frame size / shaft height			SH 36				0	3														
			SH 48				0	4														
			SH 63				0	6														
			SH 80				0	8														
			SH 100				1	0														
Overall length									0													
									1													
									2													
									3													
									4													
									5													
									6													
Design	Compact										2											
	High Inertia										3											
	High Dynamic										4											
Cooling	Natural cooling											A										
												B										
												C										
	Forced ventilation											S										
Rated speeds	(3 AC 380 V ... 480 V)	2,000 rpm											C									
		3,000 rpm											F									
		4,500 rpm											H									
		6,000 rpm											K									

Description			Position of the article number							-									-	
			1	2	3	4	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-	Z
DC-link voltage		270 V ... 330 V												2								
		510 V ... 720 V												7								
Type of construction		IM B5 with a KTY84-130 or Pt1000 temperature sensor (see Chapter "Thermal motor protection" (Page 34))													1							
		IM B5 with Pt1000 temperature sensor													4							
Connector outlet direction		Connector size M23 and M40; rotatable connector															1					
Encoder	With DRIVE-CLiQ	AS24DQI																B				
		AM24DQI																C				
		IC22DQ																D				
		AM22DQ																F				
		AM16DQ																K				
		AM20DQ																L				
		R14DQ resolver																P				
		AS20DQI																Q				
		AM20DQI																R				
		R15DQ resolver																U				
	without DRIVE-CLiQ	IC2048S/R																A				
		AM2048S/R, with EnDat 2.1																E				
		AM25EN22, with EnDat 2.2, for frame size 1FK704...1FK710																N				
		Resolver, multi-pole																S				
		Resolver, 2-pin																T				
Shaft end	Fitted key and keyway	**Shaft and flange accuracy**	Tolerance N	**Holding brake**	None	A																
					With	B																
	Plain shaft				None	G																
					With	H																
Vibration severity grade	Grade A	**Degree of protection**	IP64																	0		
			IP65																	1		
			IP65 with IP67 DE-flange																	2		

Options [1]	**Mounting of SP+ planetary gearbox**	J□□
	Mounting of planetary gearbox LP+	V□□
	Version for potentially explosive atmospheres Zone 2	M03
	Version for potentially explosive atmospheres Zone 22	M39
	Alternative shaft geometry	N05
	Version for increased chemical resistance	N16
	Reinforced brake	N24
	Metal rating plate instead of adhesive label	Q31
	Factory certificate	B02
	Reference mark on the motor shaft	R06
	Customer data on the rating plate	Y84
	Connection to equalize pressure	Q20
	Special paint finish for environmental conditions according to climate Group 3K4	K23
	Special paint finish for environmental conditions according to climate Group 3K4, primer and additional paint finish	K23+ X..
	Primed (unpainted)	K24

Description	Position of the article number																		
	1	2	3	4	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-	Z
	Paint finish [2]								Jet black matt						RAL 9005					X01
									Cream						RAL 9001					X02
									Reseda green						RAL 6011					X03
									Pebble gray						RAL 7032					X04
									Sky blue						RAL 5015					X05
									Light ivory						RAL 1015					X06
									White aluminum						RAL 9006					X08

1) Refer to the Catalog D 21.4 (https://support.industry.siemens.com/cs/ww/de/view/109747019/en) for more information.

2) You can order the motors with additional special colors. More information about this can be found in the "Configuration Manual (https://support.industry.siemens.com/cs/document/55379345?lc=de-WW&pnid=13349&dl=en)" and in the Catalog D 21.4 (https://support.industry.siemens.com/cs/ww/de/view/109747019/en).

2.5 Rating plate data

The rating plate contains the technical data applicable to the delivered motor. A second rating plate is provided with the motor, and this should be used for documentation purposes.

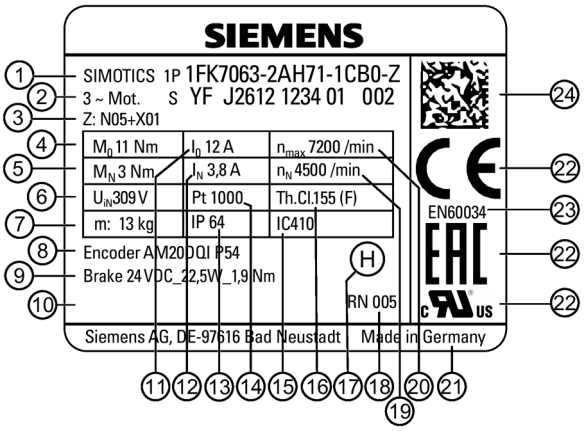


Figure 2-2 1FK7 G2 rating plate content

Table 2- 6 Description of the rating plate data

Position	Description / technical data
1	Motor type: Synchronous motors; motor type / order number
2	ID No., serial number
3	Display of Z option
4	Static torque M_0 / Nm
5	Rated torque M_N / Nm
6	Induced voltage at rated speed U_{IN} / V
7	Motor weight *m* / kg
8	Code, encoder type
9	Holding brake data: Typical, voltage, power consumption, holding torque
10	Space for customer information
11	Stall current I_0 / A
12	Rated current I_N / A
13	Degree of protection
14	Temperature sensor
15	Cooling method
16	Cooling method according to EN 60034-6:1993
17	Balancing type (only for motors with fitted key)
18	Revision status
19	Rated speed n_N / rpm
20	Maximum speed n_{max} / rpm
21	Production address
22	Certifications
23	Product standard
24	2D code

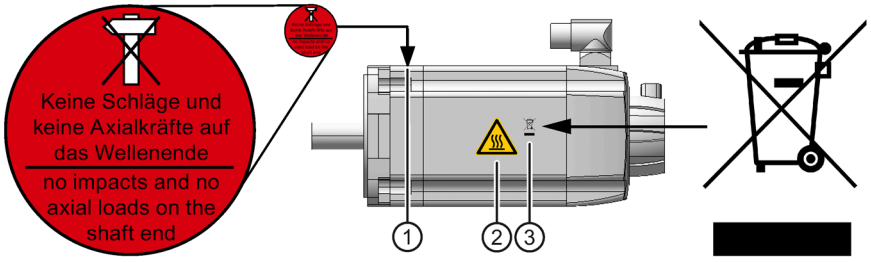
2.6 Mounting and options

2.6.1 Safety symbols on the motor

The following warning and information labels are attached to the motor.

- Observe these instructions when handling the motor.

Warning and information labels on the motor



1 Notice: "No impacts and no axial loads on the shaft end"

2 "Warning, hot surface" warning sign

3 WEEE mark
Dispose of the motor in compliance with WEEE directive 2012/19/EU.

China Energy Label (CEL)

The CEL is located on the plastic sheeting wrapped around the motor.

It shows the energy classification of the motor.

Figure 2-3 Example of the "China Energy Label"

The following motor specifications are listed on the CEL:

- Motor type
- Efficiency in %
- Rated power in kW
- Rated speed in rpm

Further labels

Note

Further labels are enclosed in the packaging. If the motor is visible and touchable following installation, attach the enclosed labels to further sides of the motor where applicable.

2.6.2 Bearing version

The 1FK7 motors are equipped with permanently lubricated deep-groove ball bearings. The location bearing is at the DE.

2.6.3 Thermal motor protection

A temperature-dependent resistor is integrated as temperature sensor to monitor the motor temperature.

- Starting in 2017, 1FK7 motors with integrated DRIVE-CLiQ interface are generally changed to the Pt1000. The marking is made with the revision number of the motors. The order number does not need to be changed.
- Motors without integrated DRIVE-CLiQ interface are converted with changed order number to the new Pt1000 temperature sensor. In connection with the following encoders without DRIVE-CLiQ, the 12th digit of the order number must be changed accordingly.

1FK7 2nd generation motors without DRIVE-CLiQ interface:	Old order number with KTY 84	New order number with Pt1000
IC2048 S/R incremental encoder	1FK7□□□-□□□□1-□A□□	1FK7□□□-□□□□4-□A□□
AM2048 S/R absolute encoder	1FK7□□□-□□□□1-□E□□	1FK7□□□-□□□□4-□E□□
AM32 S/R absolute encoder	1FK7□□□-□□□□1-□G□□	1FK7□□□-□□□□4-□G□□
Multi-pole resolver	1FK7□□□-□□□□1-□S□□	1FK7□□□-□□□□4-□S□□
2-pole resolver	1FK7□□□-□□□□1-□T□□	1FK7□□□-□□□□4-□T□□

Table 2- 7 Features and technical data

Type	KTY 84-130	Pt1000
Resistance when cold (20°C)	Approx. 580 Ω	Approx. 1090 Ω
Resistance when hot (100°C)	Approx. 1000 Ω	Approx. 1390 Ω
Connection	Via signal cable	Via signal cable
Response temperature	Prewarning > 130°C Alarm/disconnection at max. 145°C ±5°C	Prewarning > 130°C*) Alarm/disconnection at max. 145°C ±5°C *)

*) For AM25EN22 encoders with EnDat 2.2, the temperature output value does not directly correspond to the winding temperature. Observe the table below.

Winding temperature of the motor	Output value of the AM25EN2.2 encoder
130°C	Prewarning > 4452
145°C	Alarm/disconnection > 4525

The following figure shows the resistance characteristic as a function of the temperature for KTY 84-130 and Pt1000 temperature sensors.

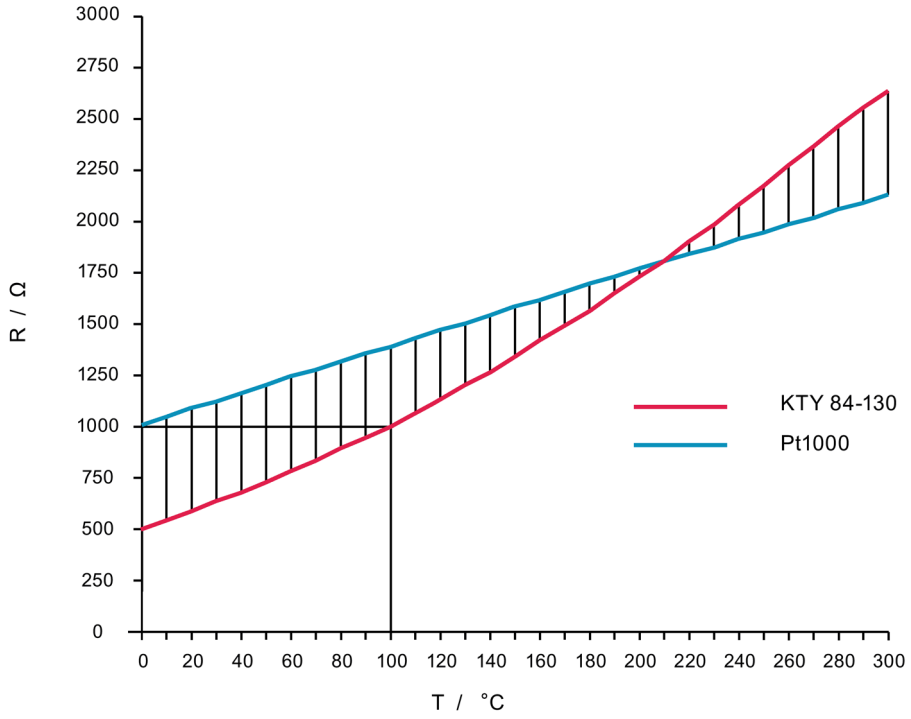


Figure 2-4 Comparison of KTY 84-130 and Pt1000 temperature sensors

The winding temperature is evaluated in the converter. When a fault occurs, an appropriate message is output at the converter. When the motor temperature increases, a message "Alarm motor overtemperature" is output. The message can be evaluated externally.

If this message is ignored, the converter shuts down with the appropriate fault message after a preset time period or when the motor limiting temperature or the shutdown temperature is exceeded.

The integrated temperature sensor protects the synchronous motors only to a certain extent against overloads:

1FK703 to 1FK704: up to 2 · $I_{0\,(60\,K)}$ and speed ≠ 0
1FK706 to 1FK710: up to 4 · $I_{0\,(60\,K)}$ and speed ≠ 0

NOTICE
Destruction of the motor for a thermal critical load For load applications that are critical from a thermal perspective, e.g. overload when the motor is stationary or an overload of M_{max} longer than 4 s, adequate protection is no longer available. • Activate the "Thermal motor model i^2t monitoring" function in the converter.

The temperature sensor is part of a SELV circuit, which can be destroyed if high voltage is applied. The temperature sensor is designed so that the DIN/EN requirement for "protective separation" is fulfilled.

2.6.4 Encoder

Encoder systems with DRIVE-CLiQ interface

Motors with a DRIVE-CLiQ encoder interface should be used with the SINAMICS S110/S120 converter system. Signal transmission to the converter is performed digitally. They have an electronic rating plate that simplifies commissioning and diagnostics. The motor and encoder system are automatically identified and all motor parameters are automatically set, see SINAMICS Equipment Manual.

NOTICE

Destruction of the encoder when incorrectly handling ESD parts and components

Encoders are ESD components.

- Comply with the regulations for handling electrostatic sensitive devices. See Chapter: Equipment damage due to electric fields or electrostatic discharge (Page 16).

Encoder systems without a DRIVE-CLiQ interface

For motors without an integrated DRIVE-CLiQ interface, the analog encoder signal is first converted to a digital signal in the drive system. For these motors, the encoder signals for SINAMICS S110 / S120 must be transferred via Sensor Modules.

NOTICE

Damage to components that are sensitive to electrostatic discharge

The contacts of the connector plug have direct contact to components that can be damaged/destroyed by electrostatic discharge (ESDs).

- Do not touch the connections directly even with tools that could be electrostatically charged.

2.6.4.1 Overview of the encoders that can be deployed

NOTICE

Destruction of the encoder when incorrectly handling ESD parts and components

Encoders are ESD components.

- Carefully comply with the regulations for handling parts and components that can be destroyed by electrostatic discharge. See Equipment damage due to electric fields or electrostatic discharge (Page 16)

The following encoders can be used with the 1FK7.

	Encoders with DRIVE-CLiQ interface: For SINAMICS drive systems		
	Single-turn absolute encoders	**Multiturn absolute encoders**	
High resolution, suitable for Safety Integrated Extended Functions			
Encoder designation	**AS24DQI**	**AM24DQI**	
Identification in the article number	B	C	
Resolution	16,777,216 = 24 bits	16,777,216 = 24 bits	
Absolute position	Yes, one revolution	Yes, 4096 revolutions (12 bits)	
Max. angular error	± 40"	± 40"	
Average resolution, suitable for Safety Integrated Extended Functions			
Encoder designation	**AS20DQI**	**AM20DQI**	
Identification in the article number	Q	R	
Resolution	1,048,576 = 20 bits	1,048,576 = 20 bits	
Absolute position	Yes, one revolution	Yes, 4096 revolutions (12 bits)	
Max. angular error	± 120"	± 120"	
	Incremental encoder	**Multiturn absolute encoders**	
Encoder designation	**IC22DQ**	**AM20DQ**	**AM22DQ**
Identification in the article number	D	L	F
Resolution	4,194,304 =22 bits	1,048,576 = 20 bits	4,194,304 =22 bits
Absolute position	No	Yes, 4096 revolutions (12 bits)	Yes, 4096 revolutions (12 bits)
Max. angular error	± 40"	± 120"	± 40"
Simple resolution, not suitable for Safety Integrated Extended Functions			
Encoder designation	**R15DQ resolver R14DQ resolver**		**AM16DQ**
Identification in the article number	U, P		K
Resolution	32,768 = 15 bits or 16,384 = 14 bits		65,536 = 16 bits
Absolute position	only for R14DQ: 1 revolution		Yes, 4096 revolutions (12 bits)
Max. angular error	±240" to ±840" depending on the type and motor		± 280"

	Encoder without DRIVE-CLiQ interface: EnDat 2.1 or EnDat 2.2 or Sin/Cos 1Vpp or resolver		
	Incremental encoder	**Multiturn absolute encoders**	
Suitable for Safety Integrated Extended Functions			
Encoder designation	**IC2048S/R**	**AM2048S/R**	**AM25EN22**
Identification in the article number	A	E	N
Resolution	2048 Sin/Cos 1Vpp	2048 Sin/Cos 1Vpp	25-bit
Absolute position	No	Yes, 4096 revolutions	
Max. angular error	± 40"	± 40"	
Simple resolution, not suitable for Safety Integrated Extended Functions			
Encoder designation	**R2P resolver RMP resolver**		
Identification in the article number	T, S		
Resolution	32,768 = 15 bits or 16,384 = 14 bits		
Absolute position	only for R2P: 1 revolution		
Max. angular error	240" to 840" depending on the type and motor		

2.6.4.2 Technical data of the incremental encoders for 1FK7 motors

Description

This encoder senses relative movements and does not supply absolute position information. In combination with an evaluation logic, a zero point can be determined using the integrated reference mark, which can be used to calculate the absolute position.

The encoder outputs sine and cosine signals. These signals can be interpolated using evaluation logic (usually 2048x) and the direction of rotation can be determined. In the version with a DRIVE-CLiQ interface, this evaluation logic is already integrated in the encoder.

Function and technical data

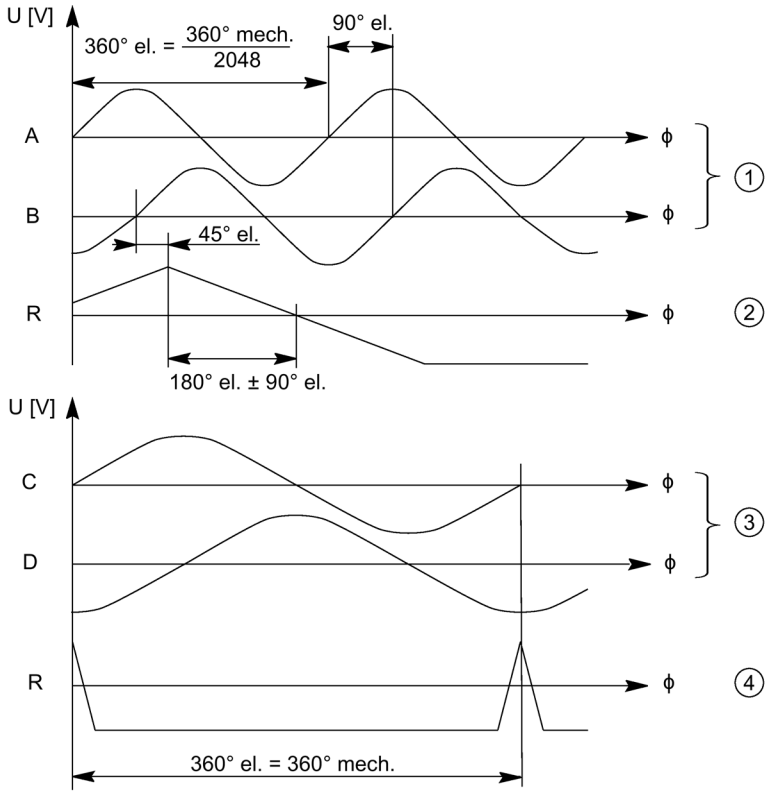
- Angular measuring system for commutation
- Speed actual value sensing
- Indirect incremental measuring system for the position control loop
- One zero pulse (reference mark) per revolution

Table 2- 8 Technical data for incremental encoders

Encoders	Code	Operating voltage	Max. current drain	A-B track: Resolution incremental (sin/cos periods per revolution)	C-D track: Rotor/commutation position (sin/cos periods per revolution)	Angular error
without DRIVE-CLiQ interface						
1FK703 to 1FK710: Incremental encoder sin/cos 1 Vpp, 2048 S/R with C and D tracks	IC2048S/R	5 V ±5%	140 mA	2048 S/R (1 Vpp)	1 S/R (1 Vpp)	±40"
with DRIVE-CLiQ interface [1)]						
1FK703 to 1FK710: Incremental encoder 22-bit (4,194,304 resolution, 2048 S/R encoder-internal) + 11-bit commutation position	IC22DQ	24 V	180 mA	4,194,304 (=22 bits)	2048 (=11 bits)	±40"

Mech. speed limit for all incremental encoders: 12000 rpm

1) The "singleturn absolute encoders" can also be used as incremental encoders on the SINAMICS drive system. Use the new encoder generation for new applications. The replacement type for the IC22DQ is the single-turn AS24DQI absolute encoder.



1 Incremental signals A/B track
2 Zero pulse/reference signal
3 Incremental signals C/D track
4 Zero pulse/reference signal

Figure 2-5 Signal sequence and assignment for encoder IC2048S/R without DRIVE-CLiQ interface for a positive direction of rotation

Information on the encoder connection, pin assignment and cables is provided in Chapter "Signal connection (Page 91).

2.6.4.3 Technical data of the absolute encoders for 1FK7 motors

Description, multiturn absolute encoder

This encoder outputs an absolute angular position between 0° and 360° in the specified resolution. An internal measuring gearbox enables it to differentiate between 4096 rotations. For a ballscrew spindle, over a longer distance, the encoder can determine the absolute position of the slide, for example.

Description, absolute value singleturn

This encoder outputs an absolute angular position between 0° and 360° in the specified resolution. Contrary to a multiturn absolute encoder, the singleturn absolute encoder has no measuring gear, which means that it can only supply position values within just one revolution. The singleturn absolute encoder has no traversing range.

Function and technical data

- Angular measuring system for commutation
- Speed actual value sensing
- Indirect measuring system for absolute position determination within a revolution
- Indirect measuring system for determining the absolute position within a traversing range of 4096 revolutions
- For multiturn encoders: Indirect measuring system for absolute position determination within a traversing range
- Indirect incremental measuring system for position control loop

Table 2- 9 Technical data, absolute value encoder without DRIVE-CLiQ interface

Designation	Code	Operating voltage	Max. current drain	Absolute resolution (singleturn)	Traversing-range (multiturn)	A-B track: Resolution incremental (sin/cos periods per revolution)	Angular error
Serial absolute position interface: EnDat 2.1							
Absolute value encoder 2048 S/R, (4096 revolutions, multiturn, with EnDat interface)	AM2048S/R	5 V ±5%	200 mA	8192 (=13 bits)	4096 (=12 bits)	2048 S/R (1 Vpp)	±40"
Serial absolute position interface: EnDat 2.2 1)							
Absolute encoder, 25-bit, 4096 revolutions multiturn, with EnDat interface 2.2 (without incremental signals) for 1FK704 ... 1FK710	AM25EN22	3.6 ... 14 V	at 5 V: 105 mA	33,554,432 (= 25 bits)	4096 (= 12 bits)	Without	± 40"

1) Adjusting the encoder for motor voltage When turning the motor clockwise (view to motor shaft), the ST position zero value of the encoder coincides with the zero crossing of the motor voltage $v_{\text{neutral point}}$ with positive gradient.

Table 2- 10 Technical data, absolute value encoder with DRIVE-CLiQ interface

Designation	Code	Operating voltage	Max. current drain	Absolute resolution (singleturn)	Traversing-range (multiturn)	Angle error
Serial absolute position interface: DRIVE-CLiQ						
Absolute encoder, singleturn 24 bit	AS24DQI	24 V	110 mA	16,777,216 (= 24 bits)	-	±40"
Absolute encoder 24 bit + 12 bit multiturn	AM24DQI	24 V	110 mA	16,777,216 (= 24 bits)	4096 (=12 bits)	±40"
Absolute encoder, singleturn 20 bit	AS20DQI	24 V	110 mA	1,048,576 (=20 bits)	-	±120"
Absolute encoder 20 bit + 12 bit multiturn	AM20DQI	24 V	110 mA	1,048,576 (=20 bits)	4096 (=12 bits)	±120"
Absolute encoder 22 bit + 12 bit multiturn	AM22DQ	24 V	210 mA	4,194,304 (=22 bits)	4096 (=12 bits)	±40"
Absolute encoder 20 bit + 12 bit multiturn	AM20DQ	24 V	210 mA	1,048,576 (=20 bits)	4096 (=12 bits)	±120"
Absolute encoder 16 bit + 12 bit multiturn	AM16DQ	24 V	210 mA	65,536 (=16 bits)	4096 (=12 bits)	±280"

Mech. speed limit for all absolute value encoders: 12000 rpm

The signal sequence and assignment A/B track is provided in Chapter Technical data of the incremental encoders for 1FK7 motors (Page 39), Fig "Signal sequence and assignment for encoders IC2048S/R without DRIVE-CLiQ interface for a positive direction of rotation".

Information on the encoder connection, pin assignment and cables is provided in Chapter "Signal connection (Page 91).

2.6.4.4 Resolvers

Description

The number of sine and cosine periods per revolution corresponds to the number of pole pairs of the resolver. In the case of a 2-pole resolver, the evaluation electronics may output an additional zero pulse per encoder revolution. This zero pulse ensures a unique assignment of the position information in relation to an encoder revolution. A 2-pole resolver can therefore be used as a singleturn encoder. 2-pole resolvers can be used for motors with any number of pole pairs. With multi-pole resolvers, the pole pair numbers of the motor and the resolver are always identical. The resolution is correspondingly higher than for 2-pole resolvers.

Function and technical data

- Angular measuring system for commutation
- Speed actual value sensing
- Indirect incremental measuring system for the position control loop

Table 2- 11 Technical data, resolver without DRIVE-CLiQ interface

Designation	Short designation	Excitation voltage rms, excitation frequency	Angle error
2-pole resolver	Resolver p=1	2 ... 8 V, 5 ... 10 kHz	840"
6-pole resolver	Resolver p=3	2 ... 8 V, 5 ... 10 kHz	420"
8-pole resolver	Resolver p=4	2 ... 8 V, 5 ... 10 kHz	240"
Calculation of the output signals	Transformation ratio $\ddot{U} = 0.5 \pm 5\ \%$ $U_{\text{Sinusoidal track}} = \ddot{U} \bullet U_{\text{Excitation}} \bullet \sin \alpha$ $U_{\text{Cosinusoidal track}} = \ddot{U} \bullet U_{\text{Excitation}} \bullet \cos \alpha$ $\alpha = \arctan (U_{\text{Sinusoidal track}} / U_{\text{Cosinusoidal track}})$		

Table 2- 12 Technical data, resolver with DRIVE-CLiQ interface

Designation	Short designation	Supply voltage	Resolution	Angle error
Resolver 15-bit resolution 32768, internal, multi-pole	R15DQ	24 V	32,768 (= 15 bit)	for 6-pole and 8-pole 240"
Resolver 14-bit resolution 16384, internal, 2-pole	R14DQ	24 V	16,384 (= 14 bit)	840"

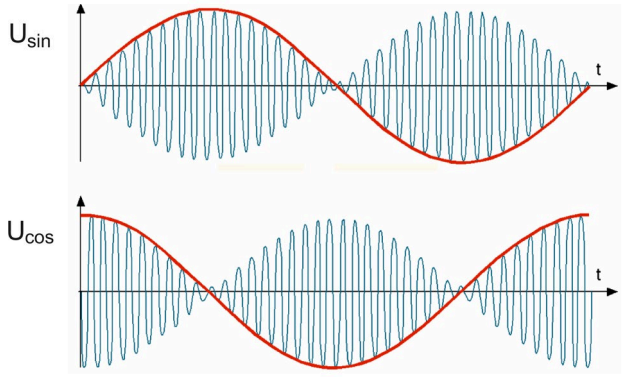


Figure 2-6 Output signals, resolver

2.6.5 Cooling

2.6.5.1 Natural cooling

On naturally cooled motors, the heat loss is dissipated through thermal conduction, radiation and natural convection.

Some of the heat loss is dissipated through the mounting surface of the motor. From large motors, heat is dissipated via the base frame (steel plate).

The motor ratings apply in an ambient temperature of 40° C (104° F). If the ambient temperature exceeds 40° C (104° F), you must adjust the torque and power of the motor accordingly, see Chapter "Derating factors (Page 27)".

2.6.5.2 Forced ventilation

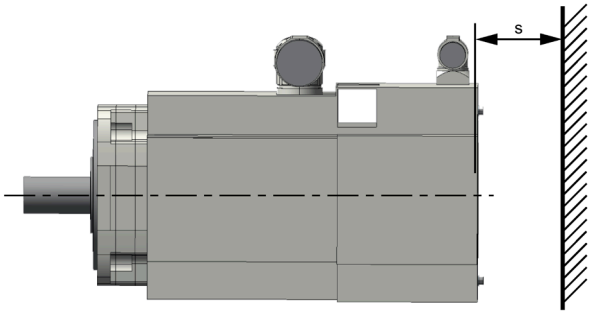
This cooling method is achieved using a separate ventilation unit with a fan that is driven independently of the motor.

Operate the fan only with normal ambient air.

The direction of air flow is from the non-drive end (NDE) to the drive end (DE).

Deposits of contaminated air can impair the heat dissipation of the motor or block the cooling duct and overheat the motor.

Maintain the minimum clearance between the air intake and discharge openings and adjacent components (see the "Minimum clearance" diagram).



s A minimum clearance of 30 mm applies for SH 80

Figure 2-7 Minimum clearance s

2.6.6 Holding brake

2.6.6.1 Type of holding brake

The holding brake is implemented as a permanent-magnet brake.

The magnetic field of the permanent magnets exerts a pulling force on the brake armature disk. This means that in the no-current condition, the brake is closed and the motor shaft is held.

When a 24 V DC rated voltage is applied to the brake, the current-carrying coil produces an opposing field. This neutralizes the force of the permanent magnets and the brake opens without any residual torque.

The permanent magnet brake has zero backlash.

NOTICE

Damage to the motor due to axial forces on the shaft extension

Axial forces on the shaft extension can damage motors with an integrated permanent-magnet holding brake.

- Avoid axial forces on the shaft extension.

2.6.6.2 Properties

- The holding brake is used to clamp the motor shaft when the motor is at a standstill. The holding brake is **not** a working brake for braking the rotating motor. When the motor is at a standstill, the holding brake is designed for at least 5 million switching cycles.
- A limited number of Emergency Stop operations is permissible.

⚠ WARNING

Unpredictable movements of the machine or system because of inadequate braking performance

If you use the holding brake incorrectly, e.g. as an operating brake or you ignore the permissible operating energy of the brake, then the brake will be subject to excessive and impermissible wear. As a consequence, there may be no braking effect at all. Unintentional movements of the machine or system can result in death or serious injury.

- Observe the permissible operating energy and EMERGENCY STOP properties.
- Operate the motor only in conjunction with an intact brake.
- Avoid repeated brief acceleration of the motor against a holding brake that is still closed.

- Do not exceed the maximum operating energy per emergency braking.

NOTICE
Premature wear of the motor holding brake when operated outside its permissible voltage range Operating the motor holding brake outside its permissible voltage range at the motor connection will damage the brake. • Ensure that the motor holding brake is only operated within its permissible voltage range.

- The rated voltage of the holding brake is 24 V DC +/- 10 %. Voltages outside this tolerance range can cause disturbances.

Note

Subsequent conversion of motors with or without a holding brake is not possible.

The technical data for the holding brake is contained in the Configuration Manual of the motor.

2.6.6.3 Technical data of the holding brake_1FK7

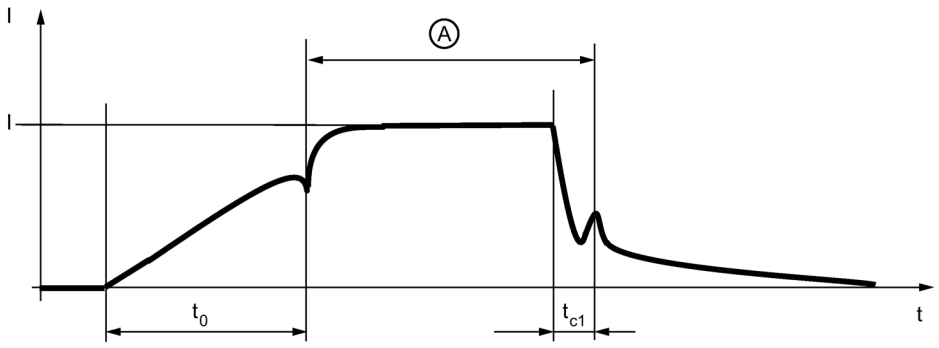
Table 2- 13 Technical data of the holding brakes used for 1FK7 motors

Motor type	Holding torque at 120 °C M_4 / Nm	Dyn. braking torque $M_{1(m)}$ [1] / Nm	DC current at 20 °C I / A	Opening time with varistor T_0 / ms	Closing time with varistor t_{c1} / ms	Highest braking energy W / J
1FK703□	1.9	1	0.3	50	30	40
1FK704□	4	3	0.5	70	30	150
1FK706□	13	8.5	0.8	100	50	380
1FK708□	22	11	0.9	200	60	1400
1FK7100	23	11	1.0	300	70	3380
1FK7101 1FK7103 1FK7105	43	25	1.0	300	70	3380

*) (m) = averaged value

Note

If the brake is switched in two stages ("click" twice), then when opening, the first switching point is decisive, and when closing, the second switching point.



I Current magnitude
t Time
t_0 Opening time
t_{c1} Closing time
A Brake open

Figure 2-8 Time-related terminology for holding operation

Holding torque M_4

The holding torque M_4 is the highest possible torque that can be applied to the closed brake in steady-state operation without slip (holding function in a no-current state).

Dynamic braking torque $M_{1\,m}$

The dynamic braking torque M_1 is the lowest average dynamic braking torque that can occur for EMERGENCY STOP operation.

2.6.7 Options

The descriptions of the options are contained in the associated Configuration Manual (https://support.industry.siemens.com/cs/document/55379345?lc=de-WW&pnid=13349&dl=en) of the motor

Preparing for use

3

3.1 Shipping and packaging

The drive systems are put together on an individual basis.

Please pay attention to the handling notes on the packaging in which the motor is delivered.

Table 3- 1 Handling notes and their meaning

Symbol	Meaning	Symbol	Meaning
	Fragile (ISO 7000, No. 0621)		Keep dry (ISO 7000, No. 0626)
	Top (ISO 7000, No. 0623)		Do not stack (ISO 7000, No. 2402)

Checking the delivery for completeness

- Upon receipt of the delivery, check immediately whether the items delivered match the accompanying documents.

  Note

  Siemens will not accept any claims for missing or incorrect items submitted at a later date.

- Report any visible transportation damage to the delivery company immediately.
- Report any visible defects or missing items to the competent Siemens office immediately.

The items supplied include a second rating plate. The second rating plate can be used to post the motor data additionally in the vicinity of the motor.

The additional rating plate is located in the product packaging.

The inserts with the safety instructions are part of the scope of delivery.

Note

Keep the sheets with the safety instructions in an accessible location at all times.

3.2 Transportation and storage

3.2.1 Transport

Note

Comply with the local national regulations for the transportation of motors.

- Use suitable load suspension devices when transporting and installing the motor.
- Transport the motor carefully.

Lifting and transporting the motor using slings up to SH 80

Up a shaft height of 80 mm, you can lift and transport the motor with slings.

⚠WARNING

Incorrectly dimensioned or incorrectly used lifting slings

If lifting slings are incorrectly dimensioned or incorrectly used, the motor can fall and cause death, severe injury and/or damage to property.

- Only use lifting slings that are suitable for the weight of the motor.
- Attach the lifting slings as shown in the figure "Lifting and transporting the motor using slings".

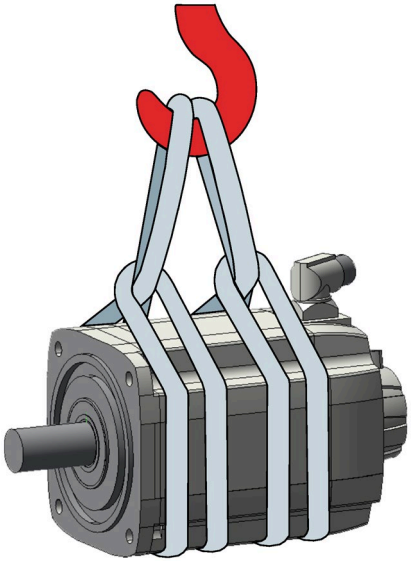


Figure 3-1 Transporting with slings

Lifting and transporting with lifting eyes as of SH 80

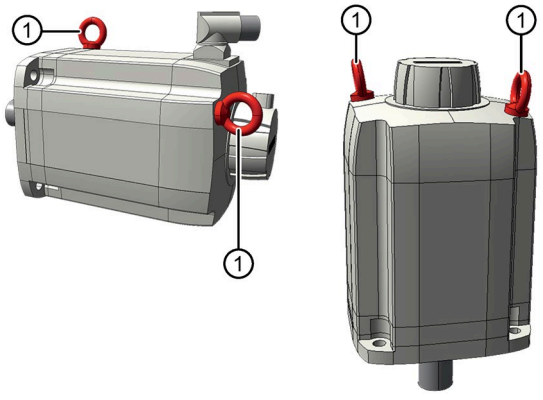
For motors as of a shaft height of 80 mm, use lifting eyes and a beam to lift and transport the motor.

⚠WARNING

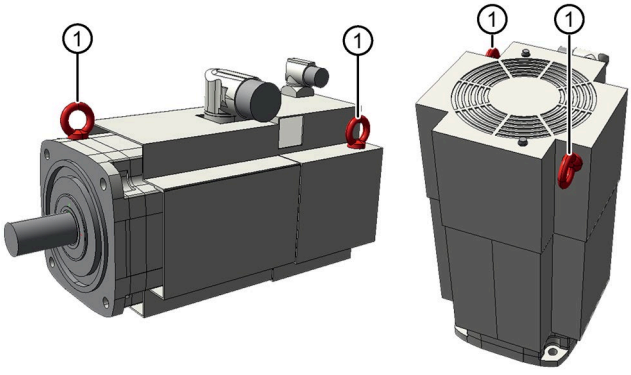
Incorrect or unused lifting points

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

- Only lift and transport larger motors using the eyebolts screwed on to the end shields.
- Completely screw in the eyebolts and tighten by hand (approx. 8 Nm).
- Do not use bent or damaged eyebolts.
- Only use eyebolts with laminated fiber washers.
- Loads applied transversely to the plane of the eyebolts are not permitted.



1FK7 with natural cooling (shaft height 80 - 100)



1FK7 with forced ventilation

1 lifting eye	

Procedure

1. Screw the lifting eyes (eyebolts) in at appropriate locations for the orientation of the motor during transportation.
2. Hook the beam into the lifting eyes (eyebolts).

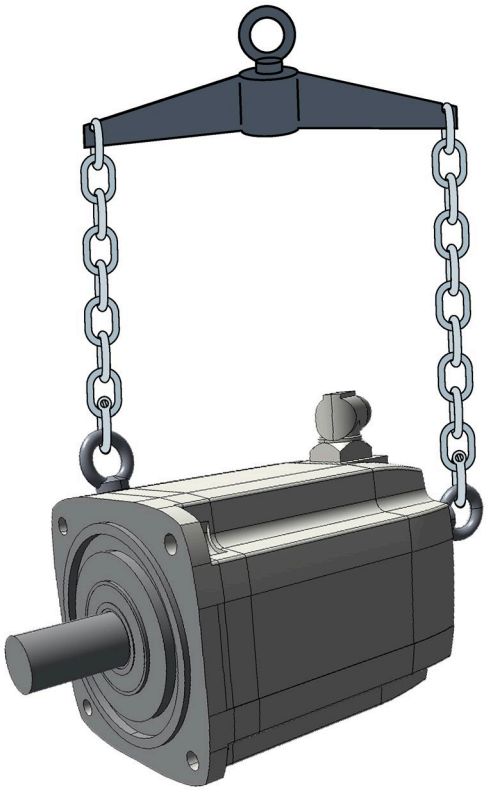


Figure 3-2 Transportation with beam

❒

Setting down the motor

⚠WARNING

Danger of severe injury due to unintentional movements of the motor

If the motor is not secured after being set down, unintentional movements of the motor can cause serious injury.

- After the motor has been set down, secure it in position.
- Do not release the lifting devices until the motor has been secured in position.

Procedure

1. Set the motor down on a hard, level surface.
2. Secure the motor against unintentional movements.

❒

3.2.2 Storage

Note

If possible, store the motor in its original packaging.

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

NOTICE
Seizure damage to bearings 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 up to two years

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

- Store the motor for up to two years at -15° C to 55° C.

If you intend to place the motor in storage for longer than six months, you must ensure that the storage area satisfies the following conditions.

Table 3- 2 **Environmental conditions for long-term storage in the product packaging according to Class 1K3 to EN 60721-3-1 - with the exception of influencing environmental variables "Air temperature", "Highest relative humidity" and "Condensation"**

Climatic ambient conditions	- 15 °C ... + 55 °C
Highest relative humidity	< 60 %, condensation not permissible
Mechanical ambient conditions	vibration-free storage room v_{rms} < 0.2 mm/s
Protection against chemical substances	Protected in acc. with Class 1C2
Biological ambient conditions	Suitable in acc. with Class 1B2
Duration	• Six months for the conditions listed above. • Special preservation measures are required for storage times of 6 months up to maximum of two years.

Check the correct state of the motor every six 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 encourage the formation of condensation:

- Large fluctuations of the ambient temperature
- Direct sunshine
- High air humidity during storage.

Avoid these ambient conditions.

Use a dehydrating agent in the packaging.

Mounting

4

4.1 Safety instructions

⚠WARNING

Danger of the motor down 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, 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.

⚠WARNING

Danger to life from permanent magnet fields

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.

- If you have a heart pacemaker or implant, keep a minimum distance of 30 cm.
- 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 transporting by air.

⚠WARNING

Danger to life due to freely rotating parts

Contact with rotating parts can cause death or severe injury.

- Do not touch any rotating parts.
- Mount a cover cap or protective shroud over freely rotating parts.

⚠WARNING

Danger to life due to unpredictable movements of the system

The system can perform unpredictable movements under load that can cause death or severe injury.

- De-energize the system before starting work.
- Disconnect all loads from the system.
- Secure the system against accidental reclosure.

NOTICE

Damage to shaft sealing rings caused by solvent

If shaft sealing rings come into contact with solvents when preservation coating is removed, the shaft sealing rings can be damaged.

- Avoid contact between solvents and shaft sealing rings.

NOTICE

Thermal damage to temperature-sensitive parts

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.

- Ensure that no temperature-sensitive parts come into contact with hot surfaces.

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

NOTICE
Damage to the motor due to runout on the shaft extension
Runout and thrust on the shaft extension of the motor can damage the motor. • Mount the motor without runout and thrust on the shaft extension.

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.
- Ensure sufficient dissipation of heat. See Chapter "Mounting conditions (Page 60)"
- If the motor is installed vertically with the end of the shaft facing up, ensure that no liquid can enter the upper bearing.
- If fluid media come into contact with the DE flange, a special flange seal is required.

  The motor is sealed via the machined flat contact surface of the centering edge on the DE flange, e.g. with an O ring. The sealing is on the circumference. Sealing at the flange contact surface of the motor is not envisaged.

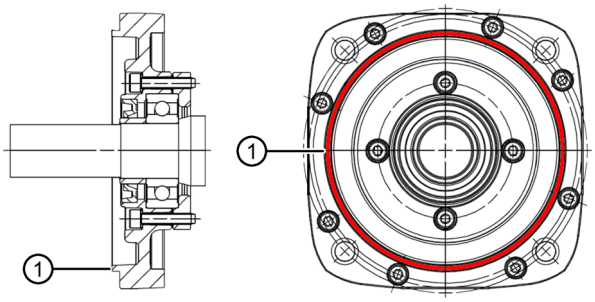


Figure 4-1 Position of the sealing surface on the face of the centering edge

- Ensure that the flange is in even contact with the mounting surface.
- Use hexagon socket head cap screws with a property class of at least 8.8.
- When tightening the fastening bolts avoid any uneven stressing.
- 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.

Tightening torques for fastening bolts

The general tolerance for the tightening torque is 10%. The tightening torque is based on a friction coefficient of μ = 0.14.

Motor	Screw DIN 7984	Washer ISO 7092 [mm]	Tightening torque for screws (not for electrical connections)
1FK703☐	M6	6 (d2 = 11)	8 Nm
1FK704☐	M6	6 (d2 = 11)	8 Nm
1FK706☐	M8	8 (d2 = 15)	20 Nm
1FK708☐	M10	10 (d2 = 18)	35 Nm
1FK710☐	M12	12 (d2 = 20)	60 Nm

Tightening torques for fastening bolts

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

4.4 Mounting conditions

4.4.1 Natural cooling

Note the specifications on thermally non-insulated mounting and on thermally insulated mounting.

Note

To ensure enough heat is dissipated, a minimum clearance to adjacent components of 100 mm must be kept free on three side surfaces.

- Mount the motor in such a way that sufficient clearance is provided for heat dissipation.

The motor ratings apply in an ambient temperature of 40° C (104° F). If the ambient temperature exceeds 40° C (104° F), you must adjust the torque and power of the motor accordingly.

- Adjust the torque or the power of the motor at the converter based on the table in Chapter "Derating factors (Page 27)."
  Follow the Operating Instructions of the converter.

Non-thermally insulated mounting

Observe the following mounting conditions for the specified motor data:

Table 4- 3 Non-thermally insulated mounting conditions

Shaft height	Steel plate, width x height x thickness in mm	Mounting surface in m^2
1FK703□ to 1FK704□	120 x 100 x 40	0.012
1FK706□ to 1FK710□	450 x 370 x 30	0.17

For larger mounting surfaces, the heat dissipation conditions improve.

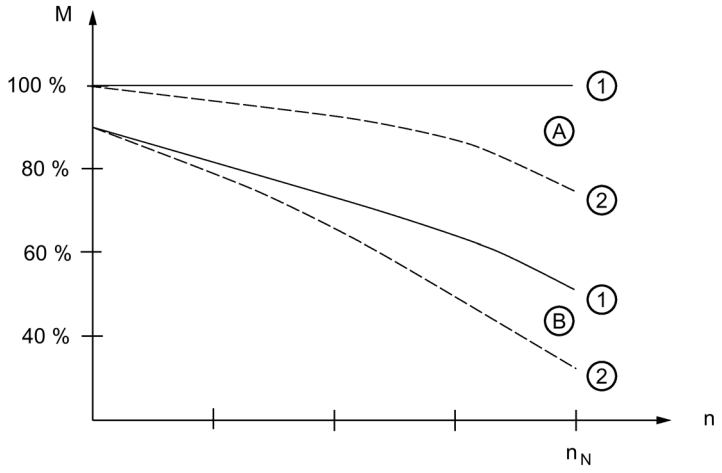
Thermally insulated mounting without additional mounted components

For non-ventilated motors, the motor torque must be reduced by between 5% and 10%. Configure the motor using the $M_{0\,(60\,K)}$ values. As the speed increases, the reduction factor rises, see figure "Effect of the mounting conditions on the S1 characteristic curve".

Thermally insulated mounting with additional mounted components

- Holding brake (integrated in the motor):
  No additional torque reduction required
- Gearboxes:
  The torque must be reduced. See figure "Effect of the mounting conditions on the S1 characteristic curve"

Effect of thermally insulated/non-insulated mounting without and with gearbox



A Characteristics for non-thermally insulated mounting
1 Characteristic without mounted gearbox
2 Characteristic with mounted gearbox
B Characteristics for thermally insulated mounting
1 Characteristic without mounted gearbox
2 Characteristic with mounted gearbox

Figure 4-2 Effect of the mounting conditions on the S1 characteristic curve

4.4.2 Forced ventilation

This cooling method is achieved using a separate ventilation unit with a fan that is driven independently of the motor.

The fan has degree of protection IP54.

⚠WARNING

Risk of explosion when operated in hazardous environments

Operating the fan in an environment with inflammable, chemically corrosive, electrically conductive, or explosive dust or gases can cause explosions and result in death or serious injury.

- Operate the motor with forced ventilation only in an environment that is free of inflammable, chemically corrosive, electrically conductive, or explosive dust or gases.

⚠WARNING

Hair, clothing and other objects can be drawn in

For example, hair, neckties, loose objects can be sucked into the air intake and cause death or serious injury.

- Take measures to prevent objects from being sucked in, e.g.
  - Wear a head covering or hair net,
  - Remove any neckties or similar,
  - Keep the air intake area free.

Note

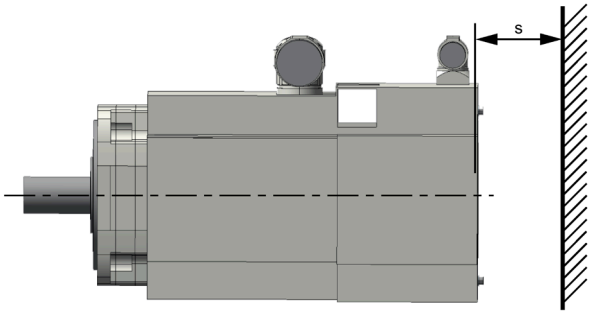
Ensure that the motor is only operated when the external fan is running.

Operate the fan only with normal ambient air.

The direction of air flow is from the non-drive end (NDE) to the drive end (DE).

Deposits of contaminated air can impair the heat dissipation of the motor or block the cooling duct and overheat the motor.

- Position the motor so that the cooling air can freely flow in and out.
- Make sure that no heated discharged air is drawn in.
- Maintain the minimum clearance between the air intake and discharge openings and adjacent components (see the "Minimum clearance" figure).
- To remove the fan cover and connect the signal connector when the motor is installed, maintain a minimum clearance of 125 mm.



s A minimum clearance of 30 mm applies for SH 80

Figure 4-3 Minimum clearance s

4.5 Mounting the drive elements

Overview

NOTICE

Damage to the motor due to runout on the shaft extension

Runout and thrust on the shaft extension of the motor can damage the motor.

- Mount the motor without runout and thrust on the shaft extension.

NOTICE

Damage to shaft sealing rings caused by heating

When mounting input and output elements with the heat treatment, shaft sealing rings can be damaged by overheating.

- Use thermal shields to protect shaft sealing rings against overheating above 100°C due to radiant heat.

Note

Twisting or warping during assembly can damage the gearbox

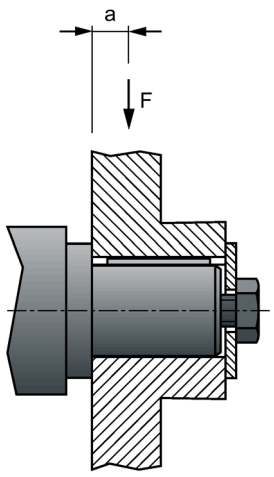
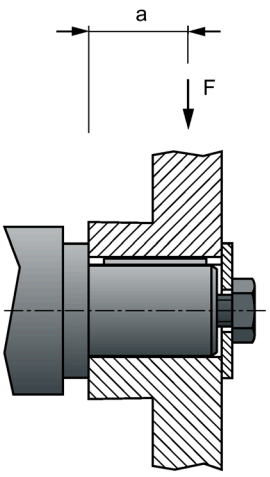
- Use suitable tools or fixtures for assembly
- When mounting or shrinking an attachment onto the output shaft, ensure that the maximum allowable static axial forces of the output bearing are not exceeded.
- Observe the values from the following table.

Size NP	015	025	035
$F_{a\,max}$ / N	4300	5100	11300

Maximum permissible static axial forces with static load rating C_0 = 1.8 and radial force F_r = 0

Functional description

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

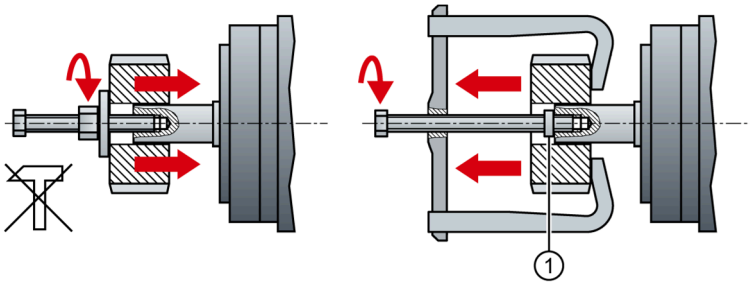
Optimal	Permissible
	
low stress on shafts and bearings	high stress on shafts and bearings

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 4-4 Mounting and removing output elements

The motor dimensions can be found in DT CONFIGURATOR (http://siemens.de/dt-konfigurator).

4.6 Vibration response

Vibration severity grade

Motors with a keyway are balanced with a half fitted key by the manufacturer. The vibration response of the system at the location of use is influenced by output elements, any built-on parts, the alignment, the installation, and external vibrations. This can change the vibration values of the motor.

The motors conform to vibration severity grade A according to EN 60034-14 (IEC 60034-14).

The specified values refer only to the motor. The installation-dependent system vibration behavior can increase these values at the motor.

The vibration severity grade is maintained up to the rated speed (n_N).

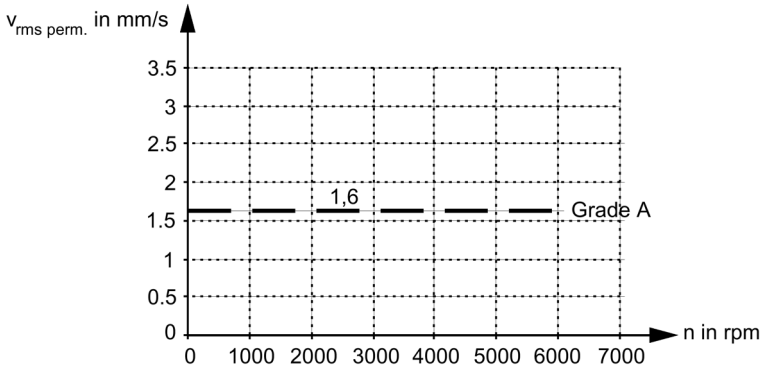


Figure 4-5 Vibration severity grades

Vibration response

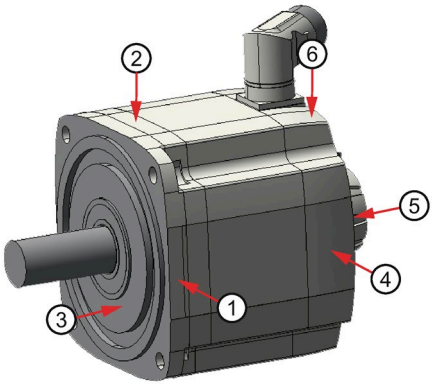
For perfect function and to comply with the motor specification (in particular, the bearing service life) the vibration values specified in the following table must be observed.

Table 4- 4 Vibration values

Vibration speed v_{rms} according to ISO 10816	max. 4.5 mm/s
Vibration acceleration a_{peak} axial [1)]	25 m/s²
Vibration acceleration a_{peak} radial [1)]	50 m/s²

1) For motors with separately driven fans, the limit value for axial and radial vibration acceleration is limited to 10 m/s² .

Select the measuring locations according to ISO 10816-1, Section 3.2. The vibration values must not exceed the specified limits at any measuring location.



1	End shield DE radial	4	End shield NDE radial
2	End shield DE radial	5	End shield NDE axial
3	End shield DE axial	6	End shield NDE radial

Figure 4-6 Measuring points for vibration values

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

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

Connecting 5

5.1 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 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.

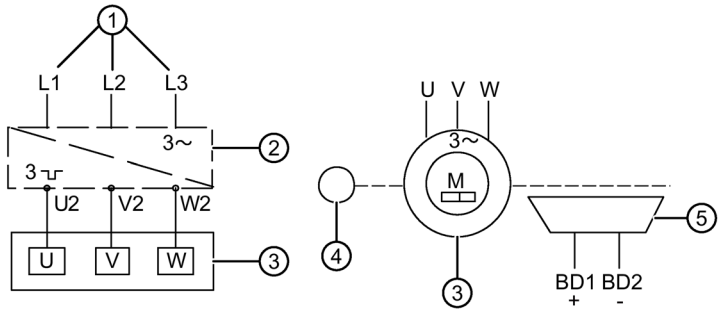
5.2 Permissible line systems

In combination with the drive system, the motors are generally approved for operation on TN and TT systems with **grounded neutral** and on IT systems.

In operation on IT systems, the occurrence of a first fault between an active part and ground must be signaled by a monitoring device. According to IEC 60364-4-41, it is recommended that the first fault is removed as quickly as is practically possible.

In systems with a **grounded external conductor**, an isolating transformer with grounded neutral (secondary side) must be connected between the line supply and the drive system to protect the motor insulation from excessive stress. The majority of TT systems have a grounded external conductor, so in this case an isolating transformer must be used.

5.3 Motor circuit diagram



1	Feeder cable	4	Encoder
2	Power Module	5	Brake
3	Motor		

Figure 5-1 Circuit diagram

5.4 System integration

5.4.1 Connection notes

5.4.1.1 Motor connection

Overview

NOTICE
Destruction of the motor if it is directly connected to the three-phase line supply
The motor will be destroyed if it is directly connected to the three-phase line supply. • Only operate the motors with the appropriately configured converters.

NOTICE
Damage to electronic components as a result of electrostatic discharge
Electrostatically sensitive devices (ESD) can be damaged or destroyed by electrostatic discharge. • Observe the ESD protection measures. • Only grounded personnel with grounded tools may touch the component connections. • Heed the EMC information provided by the manufacturer of the converter.

- The manufacturer of the plant/machine is responsible for the ensuring that the installation is performed correctly.
- Observe the data on the rating plate and the circuit diagrams.
- Adapt the connecting cables to the type of use and the voltages and currents that occur.
- Use prefabricated cables from SIEMENS (not in the scope of delivery). These cables reduce installation costs and increase operational reliability (see the Product Information).
- Make sure that the inside of the connector is clean and free of cable cuttings and moisture.
- Check that the degree of protection is complied with at the seals and sealing surfaces of the connectors.
- Secure connecting cables against torsion, tensile and compressive strain, and protect them against kinking. It is not permissible to subject the connector to continuous force.

Current-carrying capacity for power and signal cables

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

Cable cross-section and current-carrying capacity

Cross-section	Current-carrying capacity rms; AC 50/60 Hz or DC for routing type		
mm²	*B1* / A	*B2* / A	*C* / A
Electronics (according to EN 60204-1)			
0.20	-	4.3	4.4
0.50	-	7.5	7.5
0.75	-	9	9.5
Power (according to EN 60204-1)			
0.75	8.6	8.5	9.8
1.00	10.3	10.1	11.7
1.50	13.5	13.1	15.2
2.50	18.3	17.4	21
4	24	23	28
6	31	30	36
10	44	40	50
16	59	54	66
25	77	70	84
35	96	86	104
50	117	103	125

Cable cross-section and current-carrying capacity

Derating factors for power and signal cables

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

Derating factors for power and signal cables

5.4.1.2 Rotating the connector at the motor

Power connectors and signal connectors can be rotated to a different angle to a limited extent.

Use a suitable socket connector to rotate the angle plug.

Unscrew and open the socket connector completely to avoid damaging the pin contacts.

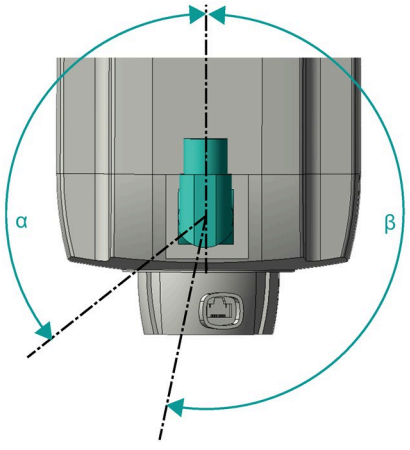
On encoders with an integrated Sensor Module (DQI), the cable outlet toward the top is fixed and cannot be changed. The M17 encoder connector for option N16 can be rotated.

Note

Rotating the connectors

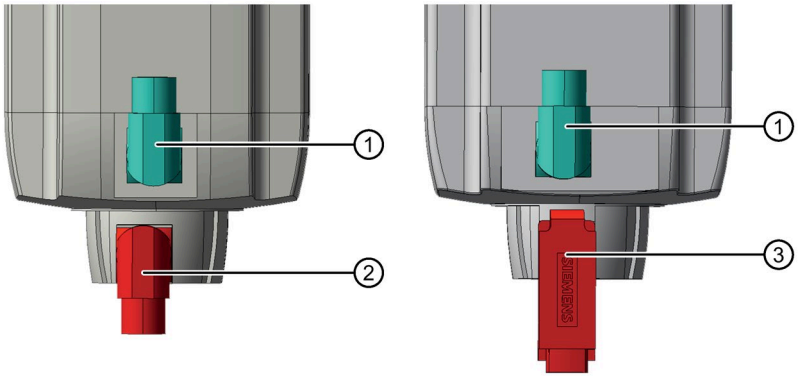
- Do not exceed the permissible range of rotation.
- To ensure the degree of protection, do not rotate more than 10 times.
- Rotate the connector using a mating connector that matches the connector thread. Only rotate Sensor Modules by hand. Use of tools is not permissible.

Twistability of the power connector for motors with DRIVE-CLiQ interface 1FK7□□□-□□□□□-□X□□; X = B, C, Q, R

Motor	Angle α	Angle β	Connector size	Drawing
1FK703	122°	208°	M23	
1FK704 1FK706 1FK708 1FK710	135°	195°	M23	
1FK708 1FK710	195°	140°	M40	

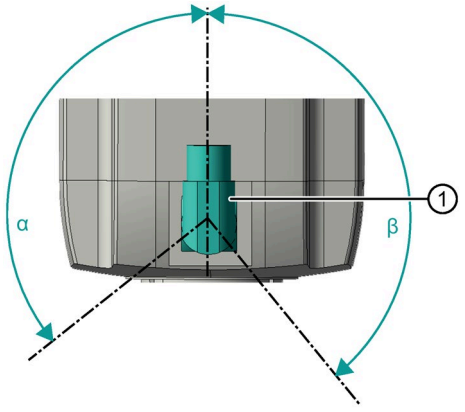
Rotation range of the power connector

Rotatability of the connectors for motors without DRIVE-CLiQ interface and for motors with DRIVE-CLiQ interface via Sensor Modules 1FK7□□□-□□□□□-□X□□; X = A, D, E, F, K, L, N



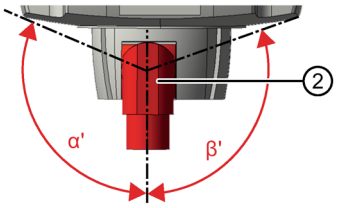
1 M23 or M40 power connector
2 Signal connector without DRIVE-CLiQ
3 Signal connector with DRIVE-CLiQ and Sensor Module (SMI)

Rotation range of the power connector ①

Motor	Connector size	Angle α	Angle β	Drawing
1FK703	M23	122°	158°	
1FK704 1FK706 1FK708	M23	135°	140°	
1FK710	M23	135°	195°	
1FK708 1FK710	M40	195°	140°	

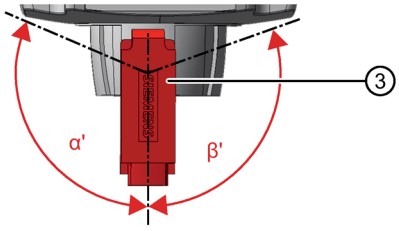
Rotation range of the power connector ①

Rotation range of the signal connector ②

Motor	Signal connector without DRIVE-CLiQ ②		Drawing
	Angle α´	Angle β´	
1FK703	160°	135°	
1FK704	145°	130°	
1FK706	150°	135°	
1FK708 1FK710	105°	105°	

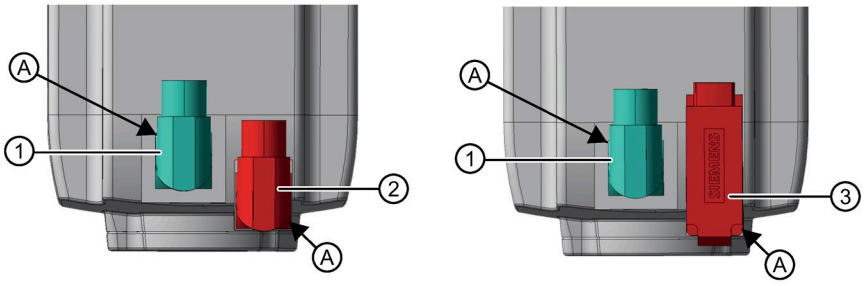
Rotation range of the signal connector ②

Rotation range of the signal connector ③

Motor	Signal connector with DRIVE-CLiQ via Sensor Modules (SMI) ③		Drawing
	Angle α´	Angle β´	
1FK703	160°	130°	
1FK704	145°	140°	
1FK706	140°	145°	
1FK708 1FK710	105°	100°	

Rotation range of the signal connector ③

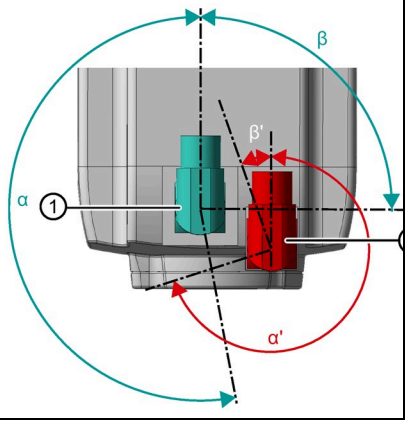
Twistability of the connectors for motors with Resolver 1FK7□□□-□□□□□-□X□□; X = S, T, U, P



1 Power connector, size M23 and M40
2 Signal connector M23
3 Signal connector with SMI
A Output cam on the connector foot to limit the twistability

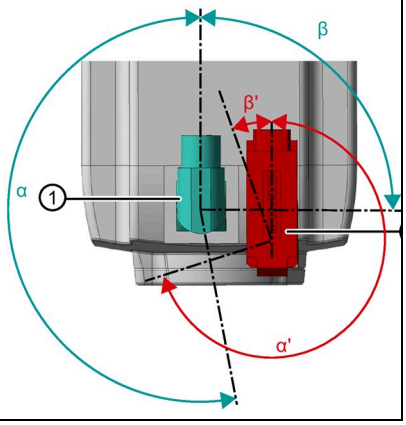
Figure 5-2 Twistability of the resolver variants

Rotation range of the power connector ① and M23 signal connector ②

Motor	Power connector, size M23 and M40 ①			M23 signal connector ②		Drawing
	Connector size	Angle α	Angle β	Angle α´	Angle β´	
1FK703	M23	170°	70°	250°	20°	
1FK704		190°	80°	255°	5°	
1FK706		185°	90°	255°	10°	
1FK708		205°	75°	260°	25°	
1FK708	M40	190°	70°	245°	15°	
1FK710	M23	205°	85°	265°	30°	
1FK710	M40	195°	80°	260°	25°	

Rotation range of the power connector ① and M23 signal connector ②

Rotation range of the power connector ① and signal connector with SMI ③

Motor	Power connector, size M23 and M40 ①			Signal connector with SMI ③		Drawing
	Connector size	Angle α	Angle β	Angle α´	Angle β´	
1FK703	M23	200°	70°	240°	5°	
1FK704		175°	80°	255°	5°	
1FK706		185°	85°	255°	5°	
1FK708		205°	75°	255°	5°	
1FK708	M40	190°	70°	235°	5°	
1FK710	M23	205°	85°	265°	5°	
1FK710	M40	195°	80°	255°	5°	

Rotation range of the power connector ① and signal connector with SMI ③

Maximum rotating torque for the connectors

Connectors	Max. torque when rotating
Power connector, size M23	12 Nm
Power connector, size M40	20 Nm
Signal connector (without DRIVE-CLiQ)	12 Nm
Signal connector (with DRIVE-CLiQ)	8 Nm

Maximum rotating torque for the connectors

5.4.1.3 Routing cables in a damp environment

Note

If the motor is mounted in a humid environment, the power and signal cables must be routed as shown in the following figure.

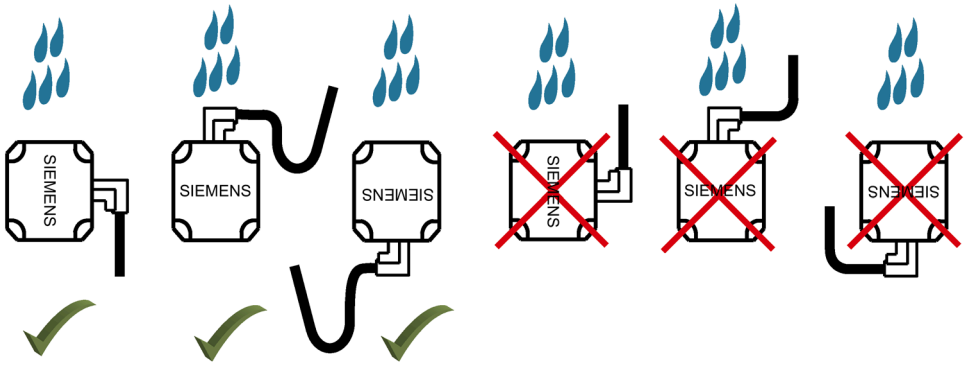


Figure 5-3 Routing cables in a damp environment

5.4.1.4 Connection notes for motors with M03 and M39

For deployment of the motor in the hazardous zones, you must secure the connection of the motor additionally.

Note

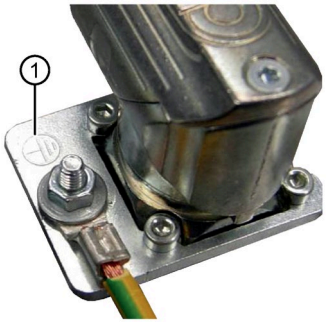
Limited twistability of the angle plug

The use of the grounding clip and/or the disassembly protection sleeves limits the twistability of the angle plug.

Additional grounding

Required parts

- Grounding clip (included in the scope of supply)



1 Grounding clip (included in the scope of supply)

Procedure

Note

Ensure a good conductive connection.

Connect the ground connection to the supplied grounding clip.
❒

Installing the disassembly protection sleeves for the M23 or M40 power connectors and signal connectors (round connectors)

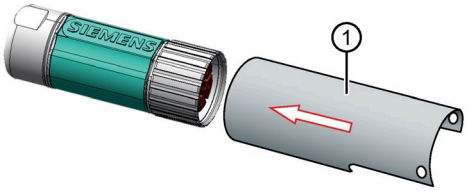
To prevent autonomous and inadvertent loosening of the cable connection, and to ensure an adequate grounding, install disassembly protection sleeves.

Required parts

- Disassembly protection sleeves according to connector size
- Cylinder head screw for M23 connector: M4 x 35, property class 8.8
- Cylinder head screw for M40 connector: M5 x 60, property class 8.8
- M4 or M5 nut

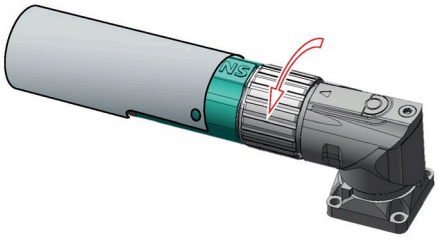
Procedure

1. Before connecting, push the disassembly protection sleeves over the connectors.

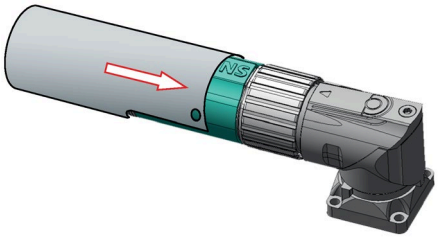


1 Disassembly protection sleeve

2. Establish the connector connection.



3. Push the disassembly protection sleeve over the connector connection.

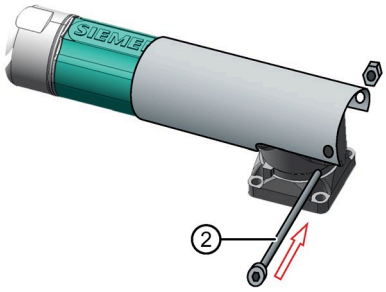


4. After you have pushed the disassembly protection sleeve completely over the connector connection, insert the supplied screw through the drill holes in the disassembly protection sleeve.

Note

Depending on the version, the disassembly protection sleeves can have two drill holes.

Select the drill hole nearest the connector.

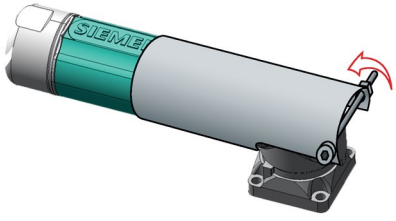


2 Cylinder head screw
for M23 connector: M4 x 35, property class 8.8
for M40 connector: M5 x 60, property class 8.8

5. Tighten the screwed connection until a friction-locking connection results.

Note

To achieve adequate grounding, a metallic contact must be made between the disassembly protection sleeve and the connector or mating connector.



You have installed the disassembly protection sleeve.
❒

Securing an RJ45 connection

Instead of the angle plug, the DRIVE-CLiQ connection of the encoder can also be an RJ45 connector.

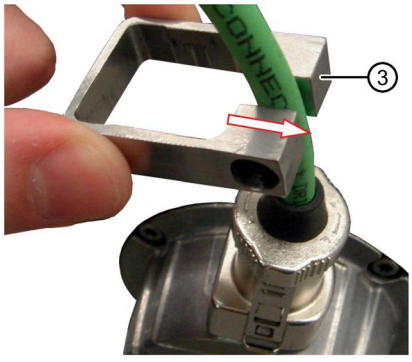
The following procedure describes the securing of an RJ45 connection.

Required parts

- Loosening protection for RJ45 connector

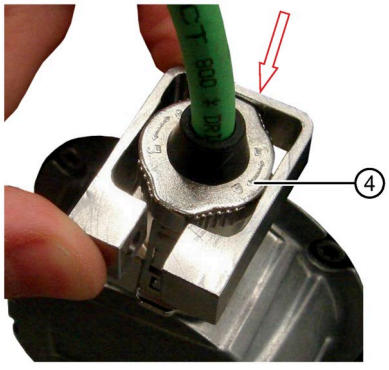
Procedure

1. Mount and lock the RJ45 connector.
2. Push the loosening protection over the signal connector.



3 Loosening protection

3. Turn the loosening protection over the connector. Push the loosening protection further over the connector locking as shown in the following figure.

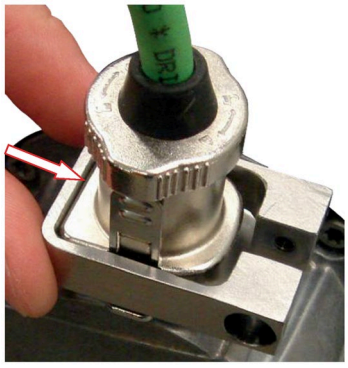


4 Latching the connector

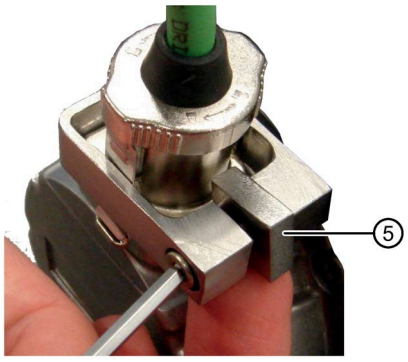
4. Push the loosening protection further down, while turning the loosening protection through 90°.

NOTICE
Unintentional unlatching of the RJ45 connector The RJ45 connector can be unlatched unintentionally by turning the loosening protection. • When turning the loosening protection, make sure that the RJ45 connector has not unlatched.

Position the connector as shown in the following figure.



5. Insert the supplied screw through the loosening protection and the supplied spacer. Tighten the screw slightly.



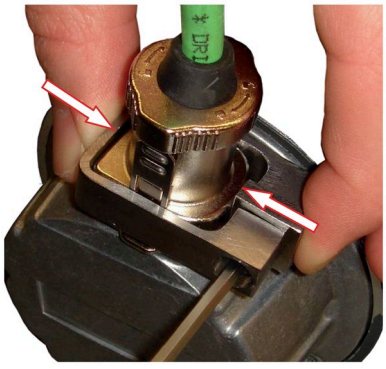
5 Supplied spacer

6. Position the spacer and the loosening protection correctly, and tighten the screw.

Note

The loosening protection and the spacer must be placed tightly on the connector.

The spacer must be securely clamped.



You have secured the RJ45 connector against being loosened unintentionally.
❒

5.4.2 Connecting to a converter

NOTICE
Motor damage Motors with an EnDat2.2 encoder must only be operated with suitable non-Siemens converters. Operation with SINAMICS converters (via SMC40) is not permitted.

Selecting and connecting the cables

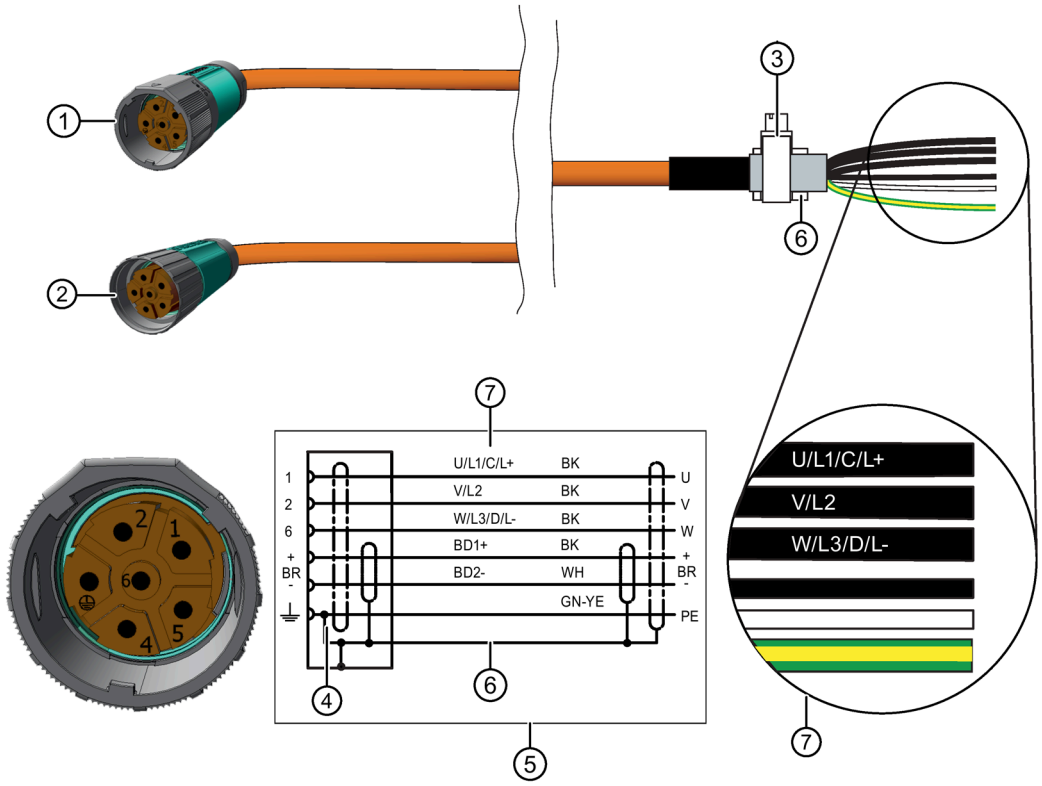
- To connect the motor to a converter, use MOTION-CONNECT cables or shielded connecting cables.

Note

The cable shielding, made up of as many strands as possible, must have a high electrical conductivity. Braided shields made of copper or aluminum are well suited.

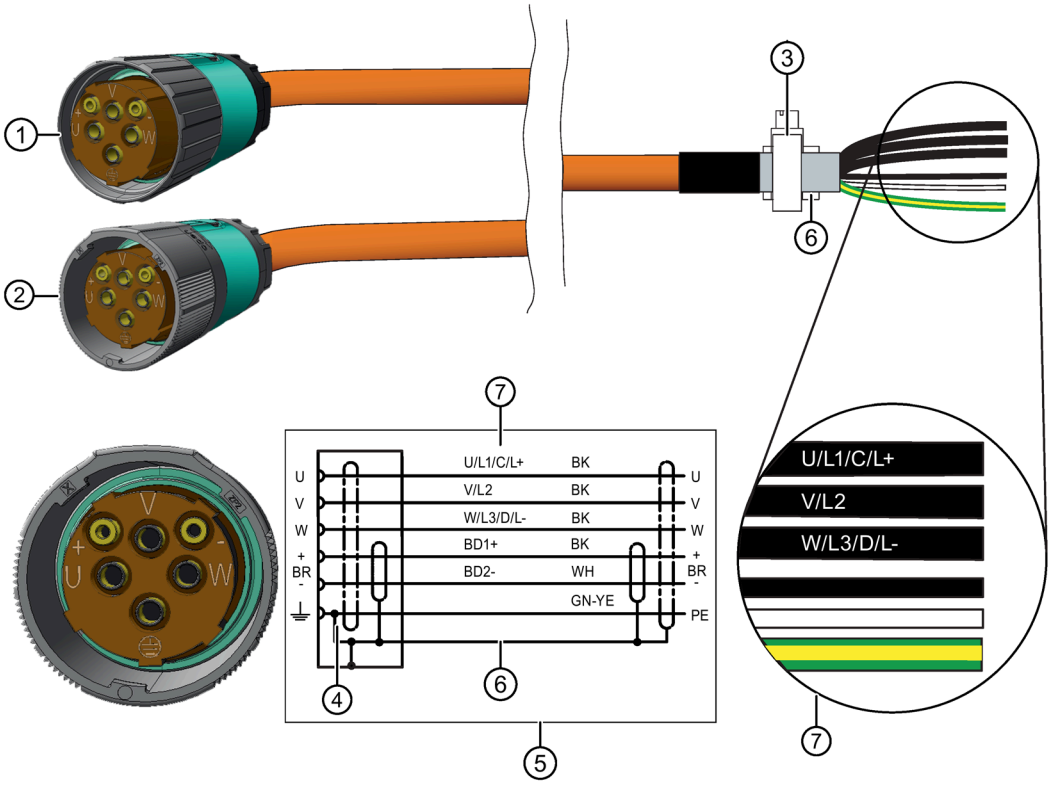
Connection scheme for the motor to the S120 Power Module and Motor Module Booksize and Compact with a MOTION CONNECT cable

For M23 connector



1 Connector, M23
2 SPEED CONNECT connector, M23
3 Terminal for the cable shield
4 Pin assignment
5 Circuit diagram
6 Cable shield
7 Conductor designation:
U, V, W = power cables, 1.5 mm^2, each cable separately shielded
BD1+ and BD2- = brake cable without lettering, 1.5 mm^2, shared shield
PE = protective conductor

For M40 connector



1 Connector, M40
2 SPEED CONNECT connector, M40
3 Terminal for the cable shield
4 Pin assignment
5 Circuit diagram
6 Cable shield
7 Conductor designation:
U; V; W = power cables, each cable separately shielded
BD1+ and BD2- = brake cable without lettering, 1.5 mm^2, shared shield
PE = protective conductor

- Connect the shield at both ends at the motor and at the converter.
- Keep unshielded cable ends as short as possible.
- Establish the connection through a larger surface area so that high-frequency currents are suitably discharged. Establish a 360° connection at the converter and at the motor, for instance using EMC cable glands at the cable entries.

5.4.3 Connecting the forced ventilation

The fan connection is a size M23 power connector.

Table 5- 1 Connection data for external fans for 1FK7

Shaft height	Max. current consumption at	
	230 V / 50 Hz (±10 %) in A	230 V / 60 Hz (±10 %) in A
80	0.40	0.40

Note the following information regarding connections:

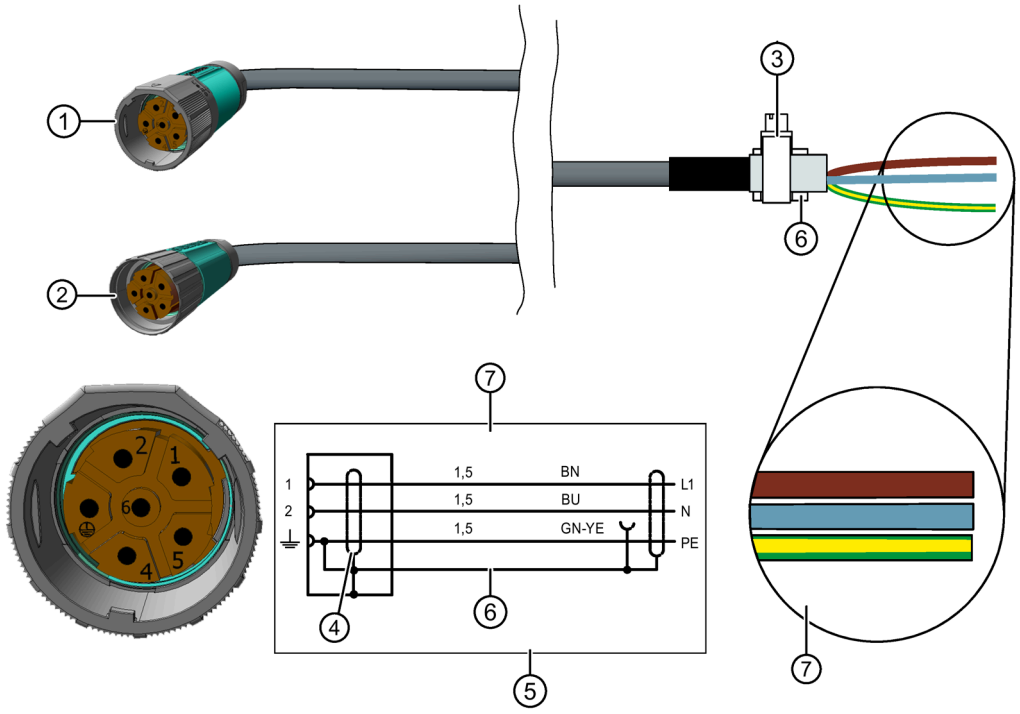
- Only use cables that comply with the relevant installation regulations regarding voltage, current, insulation material, and load-carrying capacity.
- Before connecting the device, make sure that the line voltage matches the device voltage.
- Check whether the data on the fan rating plate matches the connection data.
- Connection cables must not be subjected to excessive tensile stress.

NOTICE

Damage to the fan when inappropriately operated

The fan can be destroyed if inappropriately operated.

- Use blocking protection (stall protection) to protect the fan against inappropriate operation. To do this, use a suitable circuit-breaker where all poles can be opened. Operate the fan using this circuit-breaker.
- Provide an interlocking circuit that prevents the main motor from being switched on when the fan unit is not operational.



1 M23 connection plug (with full thread)
2 SPEED CONNECT M23 connection plug
3 Terminal for the cable shield
4 Pin assignment
5 Circuit diagram
6 Cable shield
7 Conductor designation:
L1, N = power cable, 1.5 mm^2
PE = protective conductor

Figure 5-4 1-phase connection of external fan

Table 5- 2 Order numbers

	Order number (article number)
M23 connector with full thread	6FX2003-0LU00
M23 connector with SPEED-CONNECT	6FX2003-0LU30
Prefabricated cable with full thread	6FX5001-5CG10-□□□□[1)]
Prefabricated cable with SPEED-CONNECT	6FX5002-5CG10-□□□□[1)] 6FX8002-5CG10-□□□□[1)]

[1)] The last 4 positions are the length code.

You can find additional information in Catalog D 21.4 (https://intranet.for.siemens.com/org/i-dt-mc/en/motion-control/support/marketing-materials/catalogs/d-21-4-sinamics-s120-simotics/Pages/d-21-4.aspx#), Chapter "MOTION-CONNECT connection system" in the print version or online.

5.4.4 Connecting the holding brake

Direct connection

The holding brake in the motor is directly connected to the SINAMICS converter using MOTION-CONNECT power cables with integrated brake connecting cable. See Chapter "Connecting to a converter (Page 82)"

Connection to external power supply

You can also control the holding brake via an external power supply.

The external power supply can be a PELV (PELV = Protective Extra Low Voltage) power supply, if:

- Protective separation from the motor winding is guaranteed for the brake cable in the motor
- The power cable has reinforced insulation

Note

The relay K1, located between coil and contact, must also have reinforced insulation to protect the internal logic voltage.

If you control the holding brake via an external power supply, you must protect the holding brake from voltage peaks with a protective circuit. See figure "Suggested circuit for the external power supply"

The protective circuit also guarantees the specified switching times, see Chapter "Technical data of the holding brake_1FK7 (Page 46)".

The motor holding brake requires 24 V ± 10 % at the motor connection in order to reliably open.

- Take into account the voltage drops along the supply cable.
- Use a Control Supply Module (CSM) or a regulated DC power supply, whose setpoint is set to 26 V.
- Use power supply cables with a minimum cross-section of 1.5 mm^2.
- Calculate the maximum permissible cable length using the following formula.

If the maximum voltage of 24 V DC +10 % is exceeded, then the brake can close again.

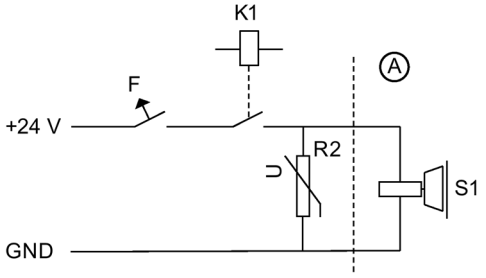
You can approximately calculate the voltage drop ΔU for copper cables as follows:

ΔU / V = 0.042 • x • I_{Brake}
$x = l / q$

l / m = cable length
q / mm^2 = brake conductor cross-section
I_{Brake} / A = brake DC current

Note

Integrate a protective circuit into the incoming cable. In this way, you avoid switching overvoltages and possible influence of the installation environment. See the figure below



A Motor
K1 Contactor
F Circuit-breaker
S1 Holding brake
R2 Varistors

Figure 5-5 Suggested circuit for the external power supply with protective circuit

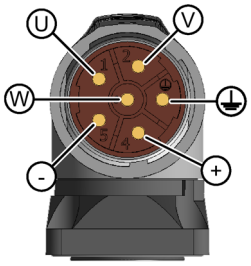
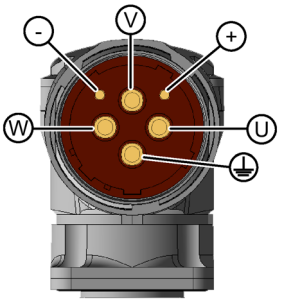
Table 5- 3 Example: Electrical components for the suggested circuit

Electrical component	Examples		
F	3RV10 circuit-breaker with current paths connected in series (if required with mounted auxiliary contact 3RV1901 to provide a feedback signal for the drive).	or	Miniature circuit-breaker 5SX21 (if required with mounted auxiliary contact to provide a feedback signal for the drive).
K1	Auxiliary contactor 3RH11	or	Contactor 3RT10
R2	Varistor SIOVS14K30 (EPCOS)		

5.4.5 Line connection

Connector types

Table 5- 4 Line connection

M23 connector	M40 connector
	
+ = BD1+; - = BD2-	

The motors are equipped with SPEED-CONNECT connectors.

You can connect quick-connection cables with SPEED-CONNECT as well as conventional cables with screw locks (fully threaded) to the motor connector.

Note

We recommend cables with SPEED-CONNECT because they are easier to use.

Establishing a SPEED-CONNECT connection

Procedure

Note

- Only tighten the connector by hand.
- Do not use any wrenches or similar tools.

1. Ensure that the union nut of the SPEED-CONNECT connector is rotated to the end stop in the direction of the "open" arrow.
2. Align the SPEED-CONNECT connector so that the triangles on the top of the connectors are opposite one another.

3. Push the power connector onto the motor connecting socket as far as it will go.
4. Turn the union nut by hand in the direction of "close" by at least 45° (position A) or up to the end stop (position B)

A Minimum locking
B Maximum locking up to the end stop

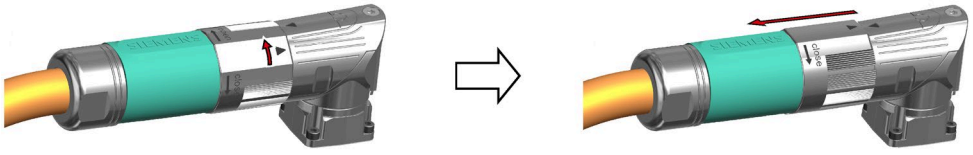
Note

A secure connection is only guaranteed from position A onward.

You have established a secure connection.

Releasing a SPEED-CONNECT connection

Procedure



1. Turn the union nut of the SPEED-CONNECT connector in the direction of "open" to the end stop. The triangles on the top of the connectors must be opposite one another.
2. Withdraw the connector.

Note

Pull out the connector at the connector itself, do not pull on the cable.

You have terminated the SPEED-CONNECT connection.

See also

Connection notes for motors with M03 and M39 (Page 77)

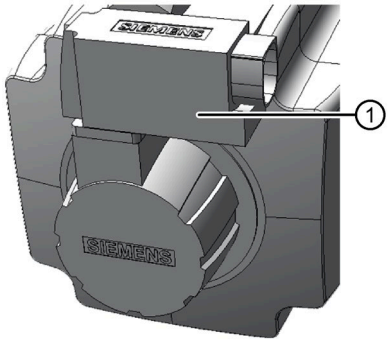
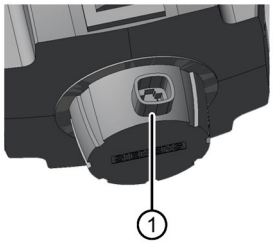
5.4.6 Signal connection

5.4.6.1 Motors with DRIVE-CLiQ interface

Motors designed for SINAMICS drive systems have an integrated encoder and temperature evaluation system as well as an electronic rating plate.

The motors are connected to the converter system via a DRIVE-CLiQ interface.

The following variants are possible for the DRIVE-CLiQ connection:

10-pin RJ45plus socket (SMI)	10-pin RJ45plus socket (DQI)
	
1 SMI with 10-pin RJ45plus socket	1 10-pin RJ45plus socket

The DRIVE-CLiQ interface supplies the motor encoder with power via the integrated 24 VDC power supply. The DRIVE-CLiQ interface transfers the motor encoder and temperature signals and the electronic rating plate data, e.g. a unique identification number, rating data (voltage, current, torque) to the Control Unit.

Motors with a DRIVE-CLiQ interface are connected to the associated Motor Module with a MOTION-CONNECT cable, see Chapter "Connecting the RJ45 DRIVE-CLiQ connector (Page 93)".

NOTICE

Damage to electronic components as a result of electrostatic discharge

The Sensor Module has direct contact with electrostatic sensitive devices that can be damaged or destroyed by electrostatic discharge (ESD).

- Ensure the ESD protection measures are taken (see Equipment damage due to electric fields or electrostatic discharge (Page 16)).
- Only grounded personnel with grounded tools may touch the component connections.
- Heed the EMC information provided by the manufacturer of the converter.

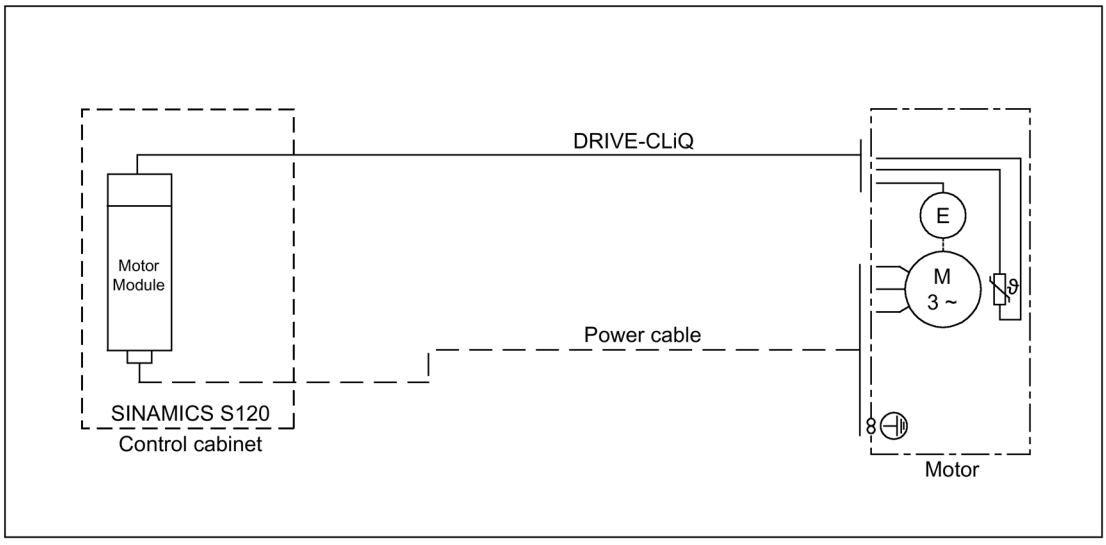
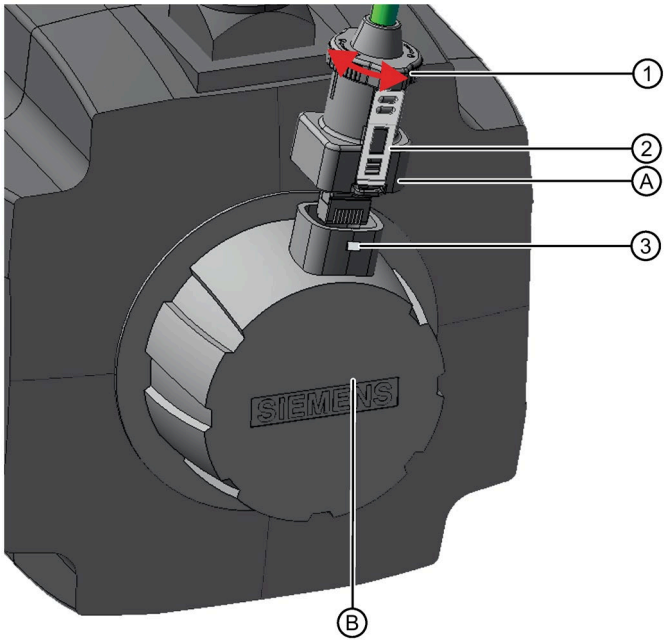


Figure 5-6 Encoder interface with DRIVE-CLiQ

5.4.6.2 Connecting the RJ45 DRIVE-CLiQ connector

Design of the DRIVE-CLiQ connection system with RJ45 connector

The DRIVE-CLiQ connection method with the RJ45 connector has the following components:



A DRIVE-CLiQ connector with RJ45Plus
B DRIVE-CLiQ socket with RJ45plus
1 Rotatable locking ring
2 Tabs (2, opposite each other)
3 Latches (2, opposite each other)

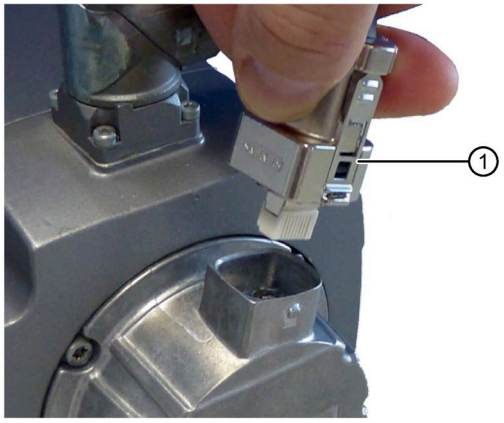
Insertion

Procedure

1. Check whether the locking ring of the connector is in the "locked" position.
   If not, turn the locking ring clockwise into the "locked" position.

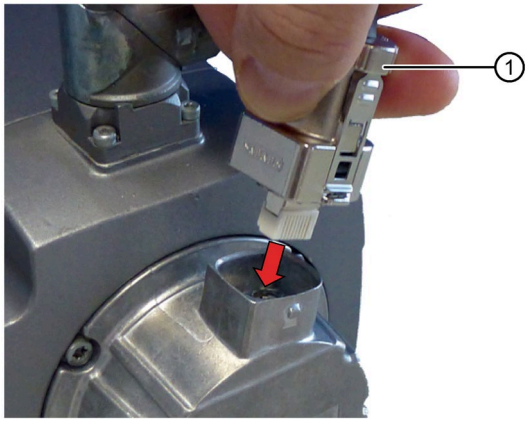
   Note

   In the "locked" position, the tabs are flush against the connector.



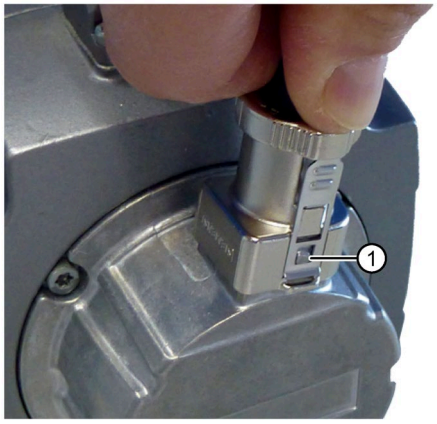
1 Locking ring in the "locked" position

2. Insert the connector into the RJ45 socket of the Sensor Module.

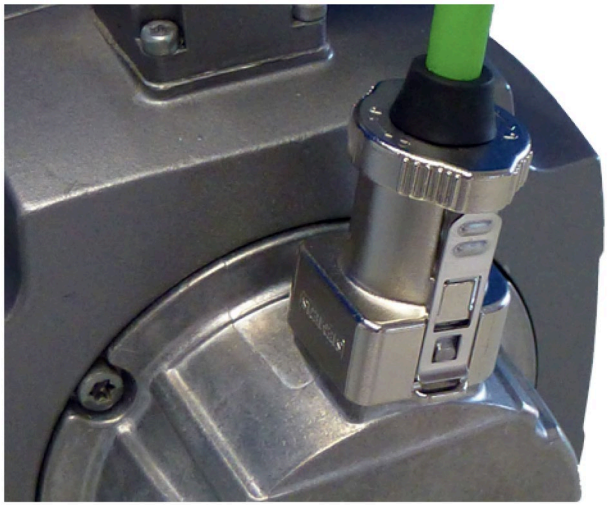


1 The locking ring remains in the "locked" position.

3. Check that the two tabs are engaged in both latches on the socket and that the connector cannot be pulled out.



1 Both tabs must engage in both latches.



The correct DRIVE-CLiQ connection is made when

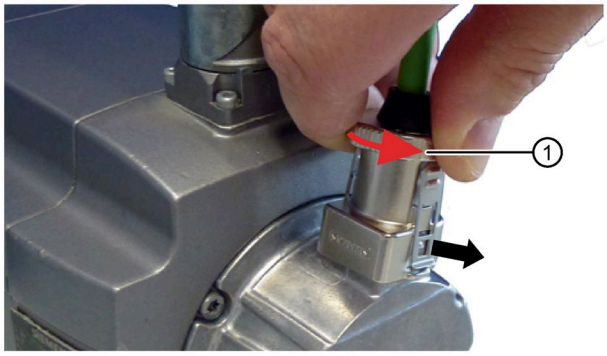
- the locking ring is in the "locked" position,
- both tabs are engaged in both latches.

You have established a DRIVE-CLiQ connection.
❒

Removal

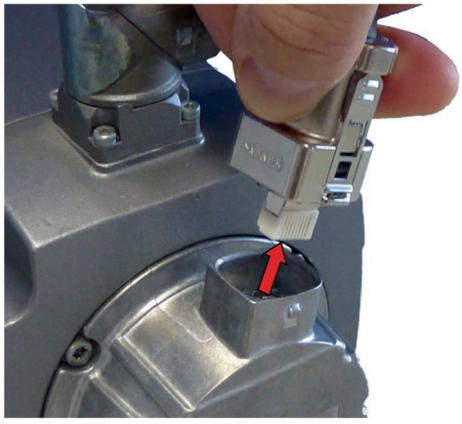
Procedure

1. Turn the locking ring of the connector counterclockwise into the "unlocked" position.



1 Turn the locking ring counterclockwise.
→ Both tabs are pressed away by the latches.

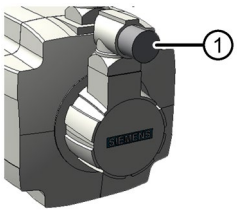
2. Check that the two tabs are disengaged from the latches.
3. Pull the connector out of the RJ45 socket of the Sensor Module.



You have released the DRIVE-CLiQ connection.
❒

5.4.6.3 Motors without a DRIVE-CLiQ interface

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



1 17-pin M23 signal connector

Figure 5-7 Motor with a signal connector

Motors without DRIVE-CLiQ require a Sensor Module Cabinet (SMC) for operation with a SINAMICS S120 drive system. The motor is connected with the SMC using a MOTION-CONNECT signal cable.

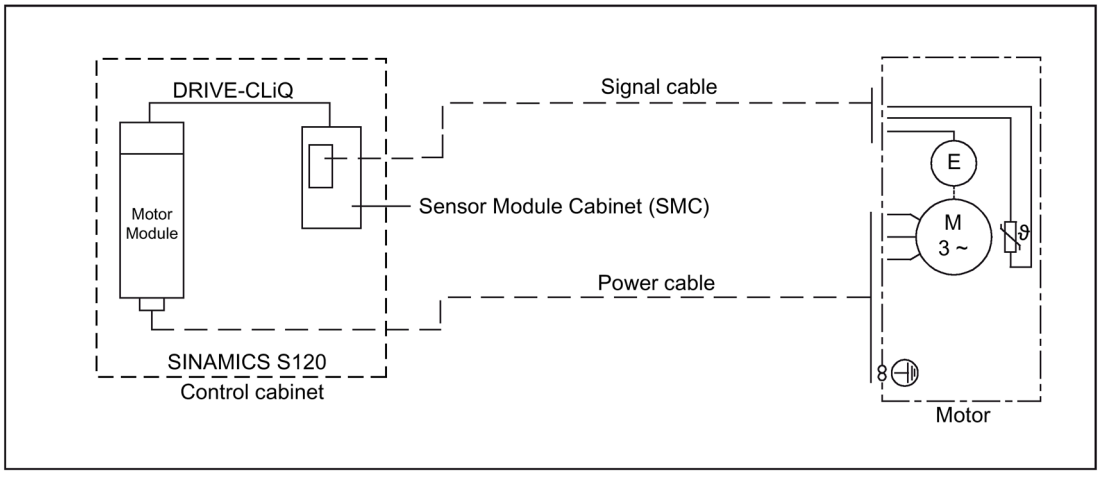
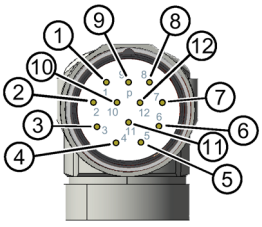
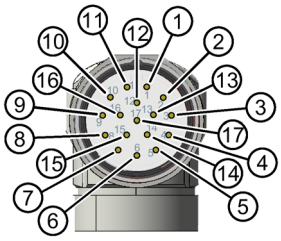
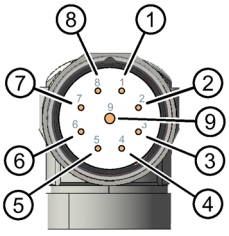


Figure 5-8 Encoder interface without DRIVE-CLiQ

Information on the connector pin assignment is provided in Chapter "Design of signal connectors (Page 98)".

5.4.6.4 Design of signal connectors

Pin assignment of the signal connector without DRIVE-CLiQ (encoder connection)

Pin assignment, M23 signal connector, 12-pole,	**Pin assignment, M23 signal connector, 17-pole,**		**Pin assignment, M23 signal connector, 9-pole**
			
Resolvers	Incremental encoder sin/cos 1 Vpp	Absolute encoder with EnDat 2.1	Absolute encoder with EnDat 2.2
1 = S2	1 = A	1 = A	1 = clock
2 = S4	2 = A*	2 = A*	2 = clock*
3 = not connected	3 = R	3 = data	3 = U_P
4 = not connected	4 = D*	4 = not connected	4 = 0 V
5 = not connected	5 = C	5 = clock	5 = data
6 = not connected*	6 = C*	6 = not connected	6 = data*
7 = R2	7 = M encoder	7 = M encoder	7 = U_P sensor
8 = +1R1	8 = +1R1	8 = +1R1	8 = 0 V sensor
9 = -1R2	9 = -1R2	9 = -1R2	9 = not connected
10 = R1	10 = P encoder	10 = P encoder	
11 = S1	11 = B	11 = B	
12 = S3	12 = B*	12 = B*	
	13 = R*	13 = data*	
	14 = D	14 = clock*	
	15 = M sense	15 = M sense	
	16 = P sense	16 = P sense	
	17 = not connected	17 = not connected	

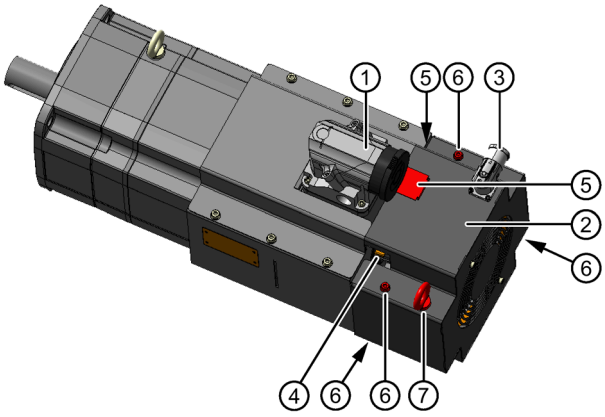
5.4.6.5 Connecting the signal line on a motor with forced ventilation

Connecting the signal line for a motor with forced ventilation up to frame size 100

Note the following information regarding connections:

- Use only cables that comply with the installation regulations.
- Signal lines must not be subjected to excessive tensile stress.

⚠ CAUTION
Danger of injury caused by the unintentional starting of the fan If the fan starts in the dismantled state, it can cause injuries. • Disconnect the fan from the power supply before you dismantle it.

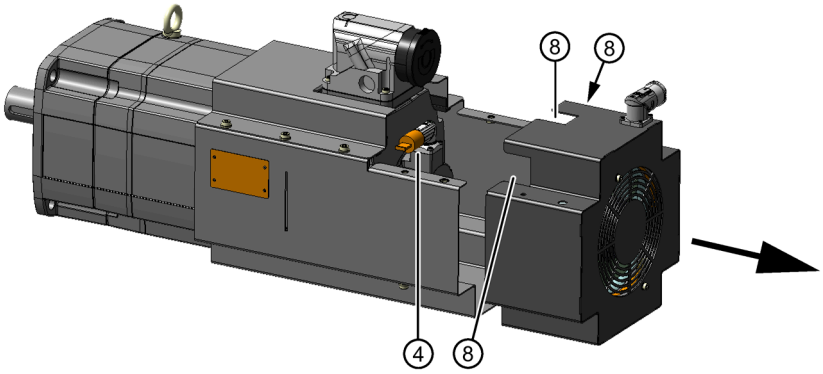


1 Motor power connector, e.g. size 3
2 Fan cover
3 Connection plug of the fan
4 Signal connector on the encoder
5 Sealing caps of the cable gland
6 4 hexagon socket-head screws with washer for fastening the fan cover
7 Lifting eyebolt

Figure 5-9 Forced ventilation parts

Connecting procedure

1. Remove the 4 screws (6) of the fan cover (2) and the lifting eyes (7).



4 Signal connector on the encoder
8 3 cable glands on the fan cover

2. Remove the fan cover (2).
3. Align the signal connector (4), at 90° to the motor axis left or right.
4. Connect the signal connector (4).
5. Close the superfluous cable glands (8) with the sealing caps (5).
6. Mount the fan cover (2) with the screws (6) (tightening torque 9 Nm). Secure all screw connections against unwanted loosening (e.g. with Loctite 243). Reattach any lifting eyes.

❒

Commissioning

6

6.1 Safety instructions

⚠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.

⚠WARNING

Electric shock caused by high touch voltages for brake cables

For motor cables with integrated brake cable, when the motor is operated, the motor can charge the brake cable up to hazardous voltage levels. Coming into contact with the conductors or the shield of the brake cable can result in death or serious injury.

- Use motor cables with separate, shielded brake cables and connect the shield of the brake cable at both ends.

⚠WARNING

Electric shock when checking the insulation resistance

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.

Contact with live parts causes electric shocks.

- Work on power installations must only be performed by qualified personnel.
- Before you begin measuring the insulation resistance, read the operating manual for the insulation resistance meter you are going to use.
- Never touch the terminals when making measurements or immediately after the measurement.
- Check the connected supply feeder cables to ensure that the line supply voltage cannot be connected.

⚠WARNING

Danger to life due to unintentional starting of the drive unit

Unintentional starting of the drive unit can cause death or severe injury.

- Make sure that the drive unit cannot be started accidentally.
- Post a warning notice to this effect at the point where the switch is located.

⚠WARNING

Danger to life caused by machine movement and loose objects

Machine movement and loose objects that can fall out or be ejected can cause death or severe injury.

- Ensure that the machine has been completely installed and all of the setting work completed.
- Ensure that nobody is at risk when the machine is switched on.
- Before switching on, check that there are no loose objects in or on the motor that can fall or be flung off.
- Before switching on, check that all safety guard covers are installed and all safety equipment functions correctly.

⚠CAUTION

Burns as a result of touching hot surfaces

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

- Do not touch any hot surfaces.
- Allow the motor to cool down before starting any work.
- Use the appropriate personnel protective equipment, e.g. gloves.

NOTICE

Thermal damage to temperature-sensitive parts

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.

- Ensure that no temperature-sensitive parts are in contact with hot surfaces.

NOTICE

Motor damage when the maximum speed is exceeded

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.

- 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.

NOTICE

Motor damage caused by uneven running or abnormal noise

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

- In case of uneven running or abnormal noise, switch off the motor.
- Identify the cause.

NOTICE

Premature wear of the motor holding brake when operated outside its permissible voltage range

Operating the motor holding brake outside its permissible voltage range at the motor connection will damage the brake.

- Ensure that the motor holding brake is only operated within its permissible voltage range.

6.2 Checklists for commissioning

Note

Required checks

The lists below do not purport to be complete. It may be necessary to perform additional checks and tests appropriate for 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.

Checklists for commissioning 1FK7 motors

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, brake, cooling system) and the "SIMOTICS S-1FK7 servo motors" Configuration Manual available?	
If the 1FK7 motor is operated on the SINAMICS S120 drive system: Is the following, current SINAMICS documentation available? • SINAMICS S120 Commissioning Manual • Getting Started S120 • S120 Function Manual • S120/150 List Manual	
If the 1FK7 motor is operated on the SINAMICS S120 drive system: 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. 1FK7 _ _ _ – _ _ _ _ _ – _ _ _ _)	
Are the environmental conditions in the permissible range?	

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

Check	OK
Have all touch protection measures for moving and live parts been fitted and are they functional?	
Has the motor been correctly mounted and aligned?	
Can you rotate the rotor without it touching the stator?	
Have all fastening screws, fastening elements, and electrical connections been tightened with the prescribed torques and properly attached?	
Do the operating conditions correspond to the data specified on the rating plate?	
Do the output elements have the correct setting conditions according to type? Examples: • Have the couplings been aligned and balanced? • Has the belt drive tension been correctly adjusted? • Have the gear tooth flank and gear tooth tip play as well as radial play been correctly adjusted for geared outputs?	

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} maintained during the operation on the converter?	

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

Check	OK
Has it been ensured that speeds higher than the maximum speed n_{max} cannot be reached?	
Have all supplementary motor monitoring devices been correctly connected and are they working properly?	

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

Check	OK
Natural cooling Have you adjusted the torque or the power of the motor at the converter based on the table in Chapter "Derating factors (Page 27)"? Follow the Operating Instructions of the converter.	
Forced ventilation Have you checked all safety-related and functionally relevant details? Examples: • Have you compared the data of the external cooling unit with the connection data? Connect the external cooling unit only if the supply data does not result in an overload condition. • Has the forced ventilation unit, including accessories, been correctly installed, e.g. fitting of the protective conductor? • Are the mechanical installation and electrical installation of the safety-related components correct? This includes the installation of the motor circuit-breaker and the fitting of protective grilles, for example. • Are the cable entry glands correctly fitted and tight? • Are the fan air intake and the area around the fan blades free of foreign bodies? • Is the fan rotation direction correct? An arrow is stamped on the fan rating plate. This arrow indicates the correct direction of rotation of the fan. An arrow is also marked on the fan blades. When the fan starts, you can check the direction of rotation using the arrows. The fan is functioning correctly if the direction of rotation of the blades matches the direction of the arrow on the fan rating plate.	
Can the motor only be switched on when the fan is running?	

Table 6- 6 Checklist (6) - Checks regarding the optional brake

Check	OK
Is the brake open when the operating voltage is applied?	
Does the brake open and close correctly?	

6.3 Commissioning procedure

Switch-on

Procedure

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

❒

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.

Operation 7

7.1 Safety instructions

⚠WARNING

Do not remove covers when the motor is running

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

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

⚠WARNING

Faults in operation

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

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

⚠CAUTION

Danger of burns

The temperature of certain parts of the motor can exceed 100 °C. Physical contact can cause serious burns.

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

7.2 Switching on and 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.

7.3 During 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
  - With forced ventilation: Check that the heat can dissipate freely
- There is no abnormal motor noise
- The motor does not overheat
- If available, the sealing air intake functions

Note

Observe the maintenance intervals

Service the motor at the prescribed maintenance intervals. (see Chapter "Maintenance and inspection intervals (Page 118)"

7.4 Stoppages

Measures for stationary motors that are ready for operation

- Operate the motor regularly, at least once a month, in the event of longer non-operational periods.

NOTICE
Damage due to improper storage The motor can be damaged if it is not stored properly. • If the motor is out of service for extended periods of time, apply suitable anti-corrosion, preservation, and drying measures.

- For longer non-operational periods carefully read the notes in Chapter "Storage (Page 53) ".
- When recommissioning after long non-operational periods, perform the checks and measures listed in Chapter, " Commissioning (Page 101) ".
- Observe Chapter "Switching on and switching off (Page 108)" before switching on to recommission the system.

Faults and their rectification

8

⚠ WARNING

Danger to life for operation without functioning protective devices

Operation without functioning protective devices can cause death or severe injury.

- Operate the motor, even in test operation, only with functioning protective devices.

NOTICE

Damage to the motor caused by faults

Faults can cause damage to the motor.

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

Note

On occurrence of electrical faults, observe the notes in the frequency converter documentation.

- 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.

Table 8- 1 Possible faults

Fault	Fault cause (see "Fault causes and remedial measures" key table)															
Motor does not start	A	B														
Motor starts slowly	A		C		F											
Humming sound when starting			C		F											
Humming sound in operation	A		C		F											
High temperature rise under no-load operation				D				I								
High temperature rise under load	A		C					I								
High temperature rise of individual winding sections					F											
Uneven running									J	K						
Grinding sound, running noise											L					
Radial vibrations												M	N	O	P		R
Axial vibrations														O		Q	R

Table 8- 2 "Fault causes and remedial measures" key table

No.	Cause of fault	Remedial measures
A	Overload	Reduce load
B	Interruption of a phase in the supply cable / motor winding	Check the frequency converter and supply cables, measure the winding resistances and insulation resistances, repair after consultation with manufacturer
C	Interrupted phase in the feeder cable after switching on	Check the frequency converter and supply cables/check the winding resistances
D	Converter output voltage too high, frequency too low	Check the settings on the frequency converter, perform automatic motor identification
F	Winding short-circuit or phase short-circuit in stator winding	Measure the winding resistances and insulation resistances, repair after consultation with manufacturer
I	Heat dissipation impeded by deposits	Clean the surface of the drives and ensure that the cooling air can flow in and out unimpeded
	Cooling air inlet/outlet is blocked by foreign bodies	Remove the block and ensure that the cooling air can flow in and out unimpeded
	Fan motor does not start	Check the fan motor to ensure that it is functioning correctly
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 inside 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 set, check coupling
P	Coupled machine not balanced	Re-balance coupled machine
Q	Shocks from coupled machine	Check coupled machine
R	Fault originating from the gear unit	Adjust/repair gear unit

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

Maintenance 9

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, 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. Lock SIMOTICS S motors so they they cannot make any inadvertent motion, which would 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, e.g.

- By opening switches
- By grounding, short-circuiting or
- By closing valves

1. Take measures to prevent reconnection of the energy sources.
2. Carefully ensure that the machine is completely locked out and that you have the right machine!

⚠ WARNING

Slipping on leaked oil

Leaked oil can result in slipping or falling and cause death or severe injury.

- Prevent oil from leaking.
- Absorb leaked oil immediately with a binding agent for oil or similar.
- Rough up the hazardous location.
- Mark the hazardous location.

⚠ WARNING

Unintentional starting of the drive unit

Unintentional starting of the drive unit can cause death or severe injury.

- Make sure that the drive unit cannot be started accidentally.
- Post a warning notice to this effect at the point where the switch is located.

⚠ CAUTION

Burning hazard caused by hot surfaces

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.

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

⚠ CAUTION

Danger of scalding from escaping hot oil

Exiting hot oil can cause burns.

- Before starting any work wait until the oil 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

9.2.1 Maintenance and inspection intervals

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.

NOTICE
Improper maintenance 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
Operation	
Daily; if possible, more frequently during operation.	Monitor and check the motor for unusual noise, vibrations, and changes.
After approx. 10,000 operating hours, at the latest after two years	If oil-lubricated, replace the radial shaft seal rings
as required - or after 25 000 operating hours	Replace the motor bearings

9.2.2 Cleaning

⚠WARNING

Electric shock when cleaning due to failing to observe the protection class

When cleaning, especially with high-pressure cleaning equipment, water can enter energized parts and cause an electric shock.

- Clean the motor in a manner appropriate for its protection class.
- Avoid pressurized water on connectors, terminal boxes, and other live parts.

Clean the motor of dust and dirt as required. In this way, you ensure adequate heat dissipation.

9.2.3 Bearing replacement interval

The bearings are subject to wear and must be replaced after a defined number of operating hours.

For average load levels, the bearings must be replaced after approx. 25,000 hours.

Note

When replacing the motor bearings, always replace the encoder as well. For more information on encoder replacement, see Service manual replacing an encoder (https://support.industry.siemens.com/cs/document/99457853/encoder-replacement-in-1fk7-g2-and-1ft7?dti=0&dl=en&pnid=13308&lc=de-WW).

Bearing replacement intervals can be extended if the motor is operated under favorable conditions, e.g. low average speeds, low radial forces (cantilever forces), vibration load.

Note

Harsh operating conditions

If the motor is subject to harsh operating conditions (e.g. continuous operation at n_{max}, high vibration/shock loads, frequent reversing duty etc.), the bearing replacement intervals t_{LW} can decrease by up to 50%.

9.3 Repair

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.

Note regarding encoder replacement

You can replace a defective encoder.

The procedure for replacing an encoder is described in Service manual replacing an encoder (https://support.industry.siemens.com/cs/document/99457853/encoder-replacement-in-1fk7-g2-and-1ft7?dti=0&dl=en&pnid=13308&lc=de-WW).

Decommissioning and disposal 10

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.

⚠ WARNING

Slipping on leaked oil

Leaked oil can result in slipping or falling and cause death or severe injury.

- Prevent oil from leaking
- Absorb leaked oil immediately with a binding agent for oil or similar.
- Rough up the hazardous location.
- Mark the hazardous location.

⚠ CAUTION

Burning hazard caused by hot surfaces

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.

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

⚠ CAUTION

Danger of scalding from the hot oil exiting the unit

Exiting hot oil can cause burns.

- Before starting any work, wait until the oil 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.

⚠ WARNING

Danger to life caused by falling machine parts

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.

- Secure the machine components that are being released so that they cannot fall.

⚠WARNING

Injury as a result of suspended loads

When being dismantled and transported, the motor can cause injury as a result of its movement.

- Only use perfectly functioning hoisting and load suspension equipment dimensioned to carry the motor load.
- Pay careful attention to possible movement when the motor is released.
- Do not stand under suspended loads or in their slewing range.
- When placing down the motor, ensure that it cannot roll.

⚠CAUTION

Injuries caused by liquids when draining and environmental pollution

When draining, liquids can cause injuries, such as burns, chemical burns, irritation. Spilt oil can make floor surfaces slippery and pollute the environment.

- Allow the liquid to cool down.
- Use a sufficiently large collection container.
- Avoid liquids coming into contact with the skin. Wear suitable personnel protection equipment, e.g. protective eyewear, gloves.
- Have materials on hand to soak up leaked liquids and prevent areas from being slippery.

Dismantling the motor

Note

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

- Contact the Siemens Service Center (https://support.industry.siemens.com/cs/ww/en/ps).

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.

Removing the motor from the machine

Procedure

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 dismantling.

You have removed the motor.
❒

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.

Technical data

11

You will find the technical data for the various frame sizes of the motors in the Configuration Manual (https://support.industry.siemens.com/cs/de/en/view/55379345) in the Chapter "Technical data and characteristics".

Glossary

12

2D code

Data Matrix code for reading out the motor data. The code is defined in ISO/IEC 16022.

Rated torque M_N

Thermally permissible continuous torque in S1 duty at the rated motor speed.

Rated speed n_N

The characteristic speed range for the motor is defined in the speed-torque diagram by the rated speed.

Rated current I_N

RMS motor phase current for generating the particular rated torque. Specification of the RMS value of a sinusoidal current.

DE

Drive end = Drive end of the motor

Derating factor x_D

Factor for power derating with which static torque M_0 of a motor is reduced as a function of the installation altitude and the ambient temperature.

Torque constant k_T (value for a 100 K average winding temperature rise)

Quotient obtained from the static torque and stall current.

Calculation: $k_T = M_{0,\,100\,K} / I_{0,\,100\,K}$

The constant applies up to approx. $2 \cdot M_{0,\,60\,K}$ in the case of self-cooled motors

Note

This constant is not applicable when configuring the necessary rated and acceleration currents (motor losses!).

The steady-state load and the frictional torques must also be included in the calculation.

Mounting position

Spatial arrangement of a motor after it has been mounted

Maximum permissible speed (mechanical) n_{max}.

The maximum mechanically permissible speed is $n_{max\ mech}$. It is defined by the centrifugal forces and frictional forces in the bearing.

Maximum output torque of the gearbox M_{2Dyn}

Maximum permissible output torque of the geared motor that may be output for a short period of time

NDE

Non-drive end = Non-drive end of the motor

Number of poles 2p

Number of magnetic north and south poles on the rotor. p is the number of pole pairs.

Static torque M_0

Thermal limit torque at motor standstill corresponding to utilization according to 100 K or 60 K. M_0 is always higher than rated torque M_N.

Stall current I_0

Motor phase current to generate the particular stall torque ($M_0 = k_T \bullet I_0$). Specification of the RMS value of a sinusoidal current.

Transmission ratio i

Designates the value of a physical variable divided by another value of the same physical variable.

Winding resistance R_{Str} at 20° C winding temperature

The resistance of a phase at a winding temperature of 20° C is specified. The winding is in a star connection.

Appendix

A

A.1 Certificate for the "PS Premium" painting system from ECOLAB

ECOLAB®

Ecolab Deutschland GmbH
P.O. Box 13 04 06
D-40554 Düsseldorf

has executed on behalf of

SIEMENS Aktiengesellschaft

Industry Sector
DT MC MF-M

Industriestraße 1
97615 Bad Neustadt a. d. Saale
Germany

Material compatibility tests

with the following cleaning and disinfection products:
P3-topax 12, P3-topax 19, P3-topax 686, P3-topax 56, P3-topax 58, P3-topactive 200, P3-topactive 500, P3-topax 990, P3-oxonia active 150 and **deionised water.**

We herewith certify that
Coating PS Premium
is compatible with the above mentioned Ecolab products under given conditions - see next page.

Düsseldorf, 24th November 2011

Ecolab Deutschland GmbH

i.V.

Thomas Wershofen
Manager Corporate Service RD&E
Center of Excellence EMEA
Food & Beverage Division

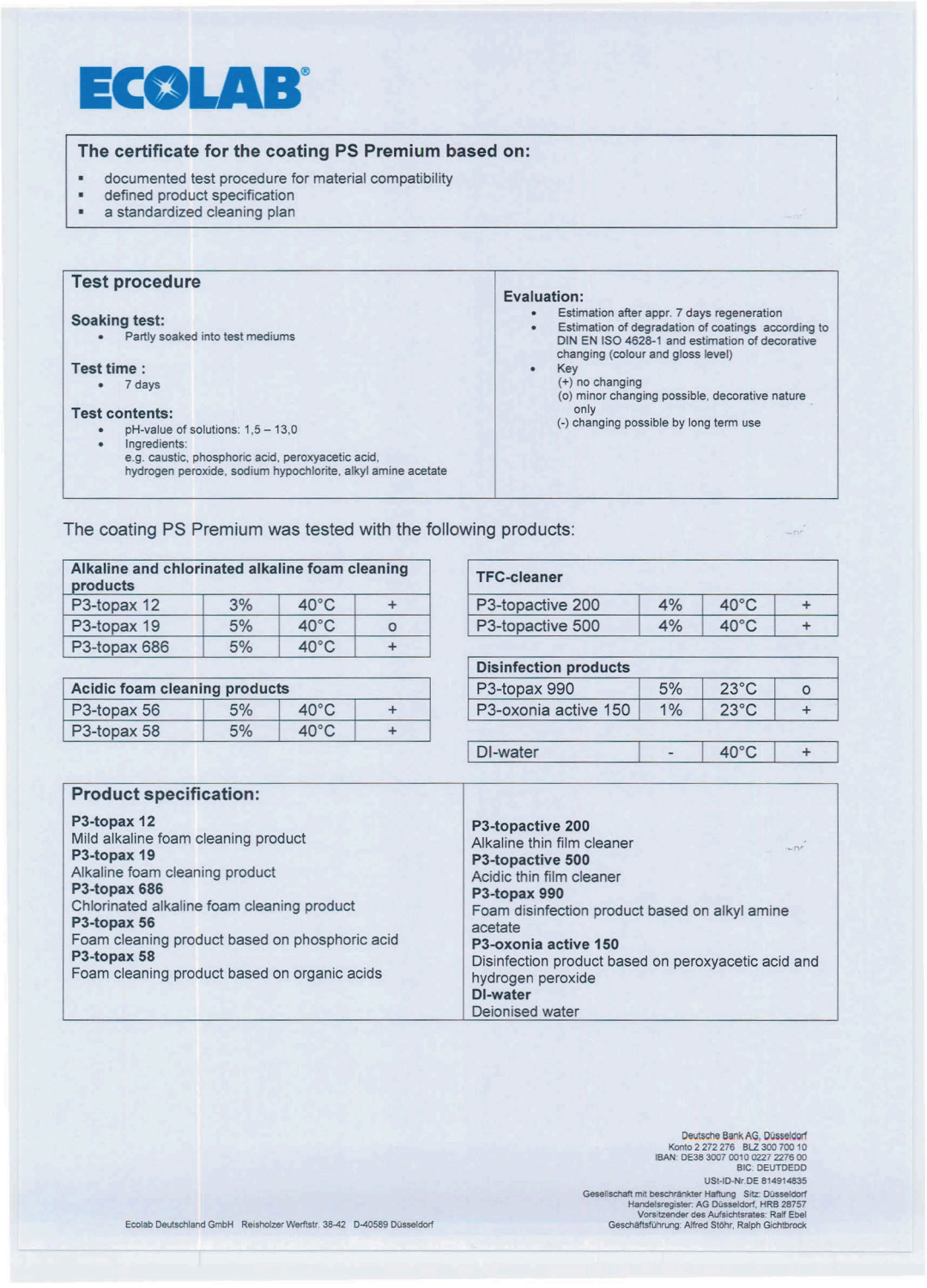
i. A.

Karin Uhlenbrock
Service Engineer RD&E
Center of Excellence EMEA
Food & Beverage Divsion

Deutsche Bank AG, Düsseldorf
Konto 2 272 276 BLZ 300 700 10
IBAN: DE38 3007 0010 0227 2276 00
BIC: DEUTDEDD
USt-ID-Nr DE 814914835
Gesellschaft mit beschränkter Haftung Sitz: Düsseldorf
Handelsregister: AG Düsseldorf, HRB 28757
Vorsitzender des Aufsichtsrates: Ralf Ebel
Geschäftsführung: Alfred Stöhr, Ralph Gichtbrock

Ecolab Deutschland GmbH Reisholzer Werftstr. 38-42 D-40589 Düsseldorf

Figure A-1 Certificate_option_N16_page 1



ECOLAB

The certificate for the coating PS Premium based on:

- documented test procedure for material compatibility
- defined product specification
- a standardized cleaning plan

Test procedure

Soaking test:
- Partly soaked into test mediums

Test time :
- 7 days

Test contents:
- pH-value of solutions: 1,5 – 13,0
- Ingredients:
  e.g. caustic, phosphoric acid, peroxyacetic acid,
  hydrogen peroxide, sodium hypochlorite, alkyl amine acetate

Evaluation:
- Estimation after appr. 7 days regeneration
- Estimation of degradation of coatings according to DIN EN ISO 4628-1 and estimation of decorative changing (colour and gloss level)
- Key
  (+) no changing
  (o) minor changing possible, decorative nature only
  (-) changing possible by long term use

The coating PS Premium was tested with the following products:

Alkaline and chlorinated alkaline foam cleaning products			
P3-topax 12	3%	40°C	+
P3-topax 19	5%	40°C	o
P3-topax 686	5%	40°C	+

Acidic foam cleaning products			
P3-topax 56	5%	40°C	+
P3-topax 58	5%	40°C	+

TFC-cleaner			
P3-topactive 200	4%	40°C	+
P3-topactive 500	4%	40°C	+

Disinfection products			
P3-topax 990	5%	23°C	o
P3-oxonia active 150	1%	23°C	+

DI-water	-	40°C	+

Product specification:

P3-topax 12
Mild alkaline foam cleaning product
P3-topax 19
Alkaline foam cleaning product
P3-topax 686
Chlorinated alkaline foam cleaning product
P3-topax 56
Foam cleaning product based on phosphoric acid
P3-topax 58
Foam cleaning product based on organic acids

P3-topactive 200
Alkaline thin film cleaner
P3-topactive 500
Acidic thin film cleaner
P3-topax 990
Foam disinfection product based on alkyl amine acetate
P3-oxonia active 150
Disinfection product based on peroxyacetic acid and hydrogen peroxide
DI-water
Deionised water

Deutsche Bank AG, Düsseldorf
Konto 2 272 276 BLZ 300 700 10
IBAN: DE38 3007 0010 0227 2276 00
BIC: DEUTDEDD
USt-ID-Nr DE 814914835
Gesellschaft mit beschränkter Haftung Sitz: Düsseldorf
Handelsregister: AG Düsseldorf, HRB 28757
Vorsitzender des Aufsichtsrates: Ralf Ebel
Geschäftsführung: Alfred Stöhr, Ralph Gichtbrock

Ecolab Deutschland GmbH Reisholzer Werftstr. 38-42 D-40589 Düsseldorf

Figure A-2 Certificate_option_N16_page 2

A.2 ECOLAB cleaning recommendation

ECOLAB

"Cleaning Recommendation"

SIEMENS AG, Industry Sector, DT MC MF-M

Coating PS Premium

Cleaning & Disinfection

EUROPE

Application:	Typical residues:
Foam / TFC Cleaning and disinfection	Organic and inorganic residues
Specific application area:	**General information:**
Removal of residues of the Food & Beverage Industry	Coating PS Premium for servomotors

Cleaning frequency: tbd

Cleaning Procedure & Chemicals	%	°C	min.	Notes
Pre-rinse Water	-	40-50	tbd	Low pressure pre-rinse with water to remove rough residues.
Foam Cleaning /Thin Film Cleaning P3-topax .... or P3-topactive	1-5	20-40	10 - 30	Concentration, application time and application temperature depends on foam cleaning product and TFC-product as well. For product application please see also the information from the product data sheet
Intermediate Rinse Water	-	40-50	tbd	Use water of drinking quality. Low pressure rinse thoroughly with fresh water of drinking quality until all product residues are removed.
Foam Disinfection /Thin Film Disinfection P3-topax .... or P3-topactive...	1-3	RT	10-30	Concentration, application time and application temperature depends on foam disinfection product and TFC-product as well. Use biocides safely. Always read the label and product information before use.
Final Rinse Water	-	40-50	tbd	Use water of drinking quality. Low pressure rinse thoroughly with fresh water of drinking quality until all product residues are removed.

For any assistance do not hesitate to contact your responsible Ecolab service.

Important additional remarks!

Due to the diversity of materials and applications the information given above represents only a non binding guideline and is not intended to supersede the manufacturers specifications, limitations and recommendations. It is compulsory to follow the manufacturers limitations, especially concerning pH and temperature stability of the materials. The cleaning process should be individually optimized.

Figure A-3 ECOLAB cleaning recommendation for option N16

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Digital Industry
Motion Control
P.O. Box 31 80
91050 ERLANGEN, Germany

Scan the QR code for additional information about SIMOTICS.