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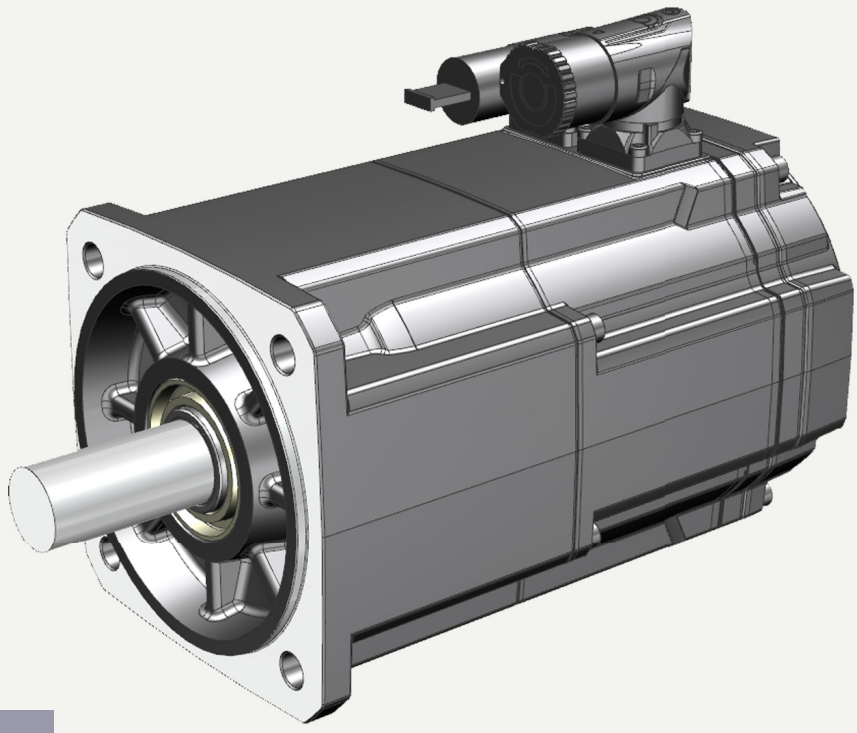

Edition 02/2022

OPERATING INSTRUCTIONS

SIMOTICS

S-1FK2 synchronous motors

For SINAMICS S120

www.siemens.com/drives

SIEMENS

SIMOTICS

Drive technology SIMOTICS S-1FK2 synchronous motors for SINAMICS S120

Operating Instructions

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Legal information

Warning notice system

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

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

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

⚠ **CAUTION**
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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Ⓟ 04/2022 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 use

Target group

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

Utilization phase

Planning and engineering phase, implementation phase, installation and commissioning phase, application phase, maintenance and service phase.

About these operating instructions

These operating instructions apply to the SIMOTICS S-1FK2 servo motor, referred to as "1FK2" in this document.

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.

The operating instructions inform you about how to handle the 1FK2 from delivery to final disposal.

You will find additional information in the configuration manual for the 1FK2.

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/cs/de/en/my)

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".

SIOS (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.

See also

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

Training

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

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

Technical Support

If you have any technical questions, 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".

SIOS (https://support.industry.siemens.com/cs/de/en/)

Procedure

1. Click on "Your direct way to the Support Request" or follow the 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.

General Data Protection Regulation

Compliance with the General Data Protection Regulation

Siemens respects the principles of data protection, in particular the data minimization rules (privacy by design).

For this product, this means:
The product does not process neither store any person-related data, only technical function data (e.g. time stamps). If the user links these data with other data (e.g. shift plans) or if he stores person-related data on the same data medium (e.g. hard disk), thus personalizing these data, he has to ensure compliance with the applicable data protection stipulations.

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Fundamental safety instructions for the SIMOTICS documentation

1

1.1 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.

- Only use screw inserts that exactly match the screw head.
- 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.
- Adjust the tools used regularly.

⚠ WARNING

Unexpected machine movement caused by radio devices or mobile phones

Using radio devices, cellphones, or mobile WLAN devices 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, cellphones or WLAN devices.
- 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 instructions for Safety Integrated

If you want to use Safety Integrated functions, you must observe the Safety instructions in the Safety Integrated documentation.

⚠ WARNING

Active implant malfunctions due to electromagnetic fields

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

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

⚠ WARNING

Active implant malfunctions due to permanent-magnet fields

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

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

⚠ WARNING

Injury caused by moving or ejected parts

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

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

⚠ WARNING

Fire due to inadequate cooling

Inadequate cooling can cause the motor to overheat, resulting in smoke and fire. Possible consequences can be serious injury or death. 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.

1.1.2 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).

1.1.3 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/cert (https://www.siemens.com/cert).

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.

1.1.4 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 Use for the intended purpose

⚠ WARNING

Use not as intended

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.
- Do not use the motors in hazardous areas (where there is a risk of explosion), if the motors have not been expressly released and authorized for these types of applications. Carefully observe any special supplementary notes that may be attached.
- 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 30 cm away from the motors (tripping threshold for static magnetic fields of 0.5 mT according to Directive 2013/35/EU).

Please contact your local Siemens office in the following cases:

- If you wish to use special versions and design variants whose specifications vary from the motors described in this document.
- You have questions about the intended use.

The 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.

For more detailed information, refer to Chapter "Ambient conditions (Page 24)".

The motor is only approved for operation through a converter.

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

Compliance with all specifications in the operating instructions is part of correct usage.

Observe the details on the rating plate.

2.2 Technical characteristics and ambient conditions

2.2.1 Directives and standards

Standards that are complied with

Note

The standards listed in this manual are not dated.

You can take the currently relevant and valid dates from the Declaration of Conformity.

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.

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)

China RoHS

The SIMOTICS motor series meets the requirements of China RoHS.

You can find more information at:

China RoHS (https://support.industry.siemens.com/cs/de/de/view/109772626)

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 Energy Label

Name of the standard	Minimum allowable values for energy efficiency and energy efficiency class of permanent-magnet synchronous motors (GB30253).
Date of entry into force	July 1, 2020
Affected motors	Permanent-magnet synchronous motors (without incorporated brake) with a rated power of 0.55 kW to 90 kW and a rated speed of 500 r/min to 3000 r/min driven by frequency converter with variable frequency on a power supply below 1000 V.
Motor requirements	As of the implementation date of the standard, all affected motors must be provided with the "China Energy Label".
Affected Siemens products	The Siemens motors involved are subject to the requirements of Guideline GB30253: SIMOTICS S-1FK2, SIMOTICS S-1FT2

Examples of the "China Energy Label" and the motor rating plate:

China Energy Label

Figure 2-1 ① Article number (example illustration for 1FK2)

Motor rating plate

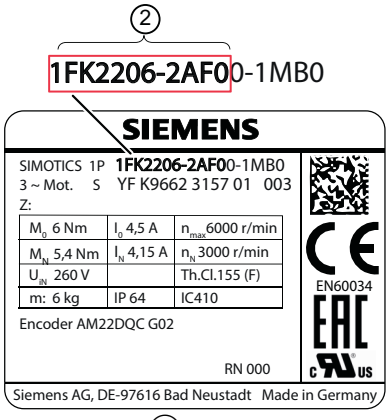


Figure 2-2 ② Article number of the basic motor type (example illustration for 1FK2)

Note

The article number ① stated on the China Energy Label corresponds to the article number of the basic motor type ② (boldface type) in the motor article number.

2.2.2 General technical features

Property	Version
Type of motor	Permanent-magnet synchronous motor
Degree of protection according to EN 60034-5 (IEC 60034-5)	IP64, optionally IP65
Cooling acc. to EN 60034-6	Natural cooling (IC410)
Type of construction according to EN 60034-7 (IEC 60034-7)	IM B5 (IM V1, IM V3)
Shaft extension according to DIN 748-3 (IEC 60072-1)	Plain shaft or with fitted key (half key balancing)
Shaft and flange accuracy acc. to DIN 42955 (IEC 60072–1)	Tolerance N (normal), for radial eccentricity of the shaft extension, concentricity of centering edge, and axial eccentricity of the mounting flange to the axis of the shaft extension
Vibration severity grade according to EN 60034-14 (IEC 60034-14)	Grade A is maintained up to rated speed
Insulation of the stator winding according to EN 60034-1 (IEC 60034-1)	1FK2☐03: Temperature class 130 (B) for a winding temperature of ΔT = 80 K at an ambient temperature of +40 °C 1FK2☐04 ... 1FK2☐10: Temperature class 155 (F) for a winding temperature of ΔT = 100 K at an ambient temperature of +40 °C

Property	Version
Sound pressure level L_{pA} (1 m) according to DIN EN ISO 1680, max. tolerance + 3 dB(A)	1FK2□03, 1FK2□04: 55 dB (A); 1FK2□05, 1FK206: 65 dB (A); 1FK2□08, 1FK2□10: 70 dB (A)
Encoder systems, built-in with DRIVE-CLiQ interface	• AS22DQC absolute encoder 22-bit singleturn • AM22DQC absolute encoder 22-bit + 12-bit multiturn
Holding brake	optionally installed, 24 V DC
Connection	Connectors for power and signals, rotatable
Paint finish	Anthracite, similar to RAL7016

2.2.3 Ambient conditions

You can classify the ambient conditions according to the standard DIN EN 60721-3-3: 1995-09 for stationary, weather-protected use.

With the exception of environmental influences "Low air temperature", "Low air pressure", and "Condensation", the motor complies with climate class 3K4.

Table 2-1 **Permissible ambient conditions for the motor based on climate class 3K4**

Environmental parameter		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

The motor is not suitable for operation

- In salt-laden or aggressive atmospheres
- Outdoors
- In a vacuum
- In hazardous areas with a danger of explosion

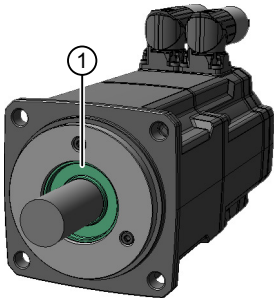
You will find additional data on the ambient conditions, such as for transport and storage of the motor, in Chapter "Transportation and storage (Page 52)".

2.2.4 Degree of protection

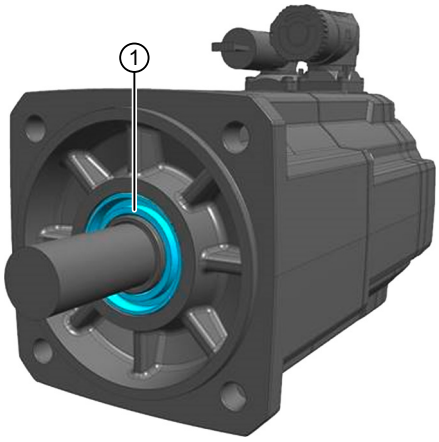
1FK2 motors can be designed with degree of protection IP64 or IP65.

The degree of protection if stated on the rating plate.

The motors with IP65 degree of protection have a radial shaft seal ring.



1FK2☐03 ... 1FK2☐04



1FK2☐05 ... 1FK2☐10

① Radial shaft seal ring

The radial shaft seal ring shortens the useful shaft extension on the 1FK2☐03 and 1FK2☐04.

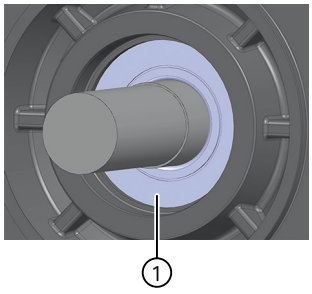
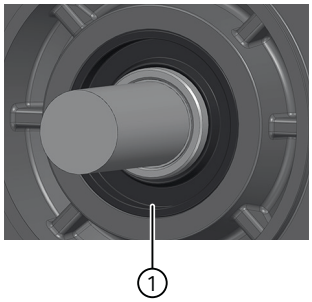
Note

It is permissible that the radial shaft seal ring runs dry.

With degree of protection IP65, it is not permissible for liquid to collect in the flange.

The service life of the radial shaft seal ring is approximately 25000 operating hours.

Motor shaft sealing

IP64	IP65
	
① Ball bearing with sealing washers Moisture in the area around the shaft and the flange is not permissible. Note: For IP64, it is not permissible that liquid collects in the flange.	① Radial shaft sealing ring without annular spring Sealing of the shaft outlet against splashwater and/or cooling-lubricating medium. Dry running of the radial shaft sealing ring is permissible. Service life approx. 25000 h (guide value). With degree of protection IP65, it is not permissible for liquid to collect in the flange.

More information is provided in Chapter "Shaft extension (Page 34)".

2.2.5 Noise emission

When operated in the speed range 0 to rated speed, 1FK2 motors can reach the following measuring surface sound pressure level L_p:

Table 2-2 Sound pressure level

Cooling method	Frame size	Enveloping surface sound pressure level L_p
Naturally cooled	1FK2☐03 1FK2☐04	55 dB(A) + 3 dB tolerance
	1FK2☐05 1FK2☐06	65 dB(A) + 3 dB tolerance
	1FK2☐08 1FK2☐10	70 dB(A) + 3 dB tolerance

The motors are approved for numerous installation and operating conditions. These conditions such as rigid or vibration-isolated foundation design influence noise emission, sometimes significantly.

2.2.6 Derating factors

Due to the decreasing air pressure in higher installation altitudes, the cooling of the motor deteriorates. Therefore, reduce the power of the motor as the installation altitude increases.

Multiply the permissible torques or powers by the factors from the following table.

Reduce the torques and powers according to the values determined.

Factors for power derating depending on the installation altitude and the ambient temperature

Installation altitude above sea level in m	Ambient temperature in °C				
	30	40	45	50	55
1000	1.05	1	0.95	0.89	0.84
2000	1	0.95	0.86	0.8	0.73
3000	0.95	0.89	0.76	0.69	0.62
4000	0.89	0.84	0.65	0.57	0.47

Calculate the derating value for ambient temperatures that are not shown here and installation altitudes below the maximum values by interpolating. For example: 40 °C at 1500 m above sea level = derating factor 0.965

Calculating the reduced characteristic curve

$$M_{S1\ red}(n) = x_d \bullet M_{S1}(n / xd)$$

$M_{S1\ red}$ Reduced motor torque for S1 operation at the required installation altitude and ambient temperature

M_{S1} Motor torque for S1 operation at ambient temperature of 40 °C and 1000 m above sea level (see Chapter "Data sheets and characteristic curves" in the Configuration Manual)

n Motor speed

x_d Derating factor from the table "Factors for reducing the power..." above

Graphic display of the derating factors

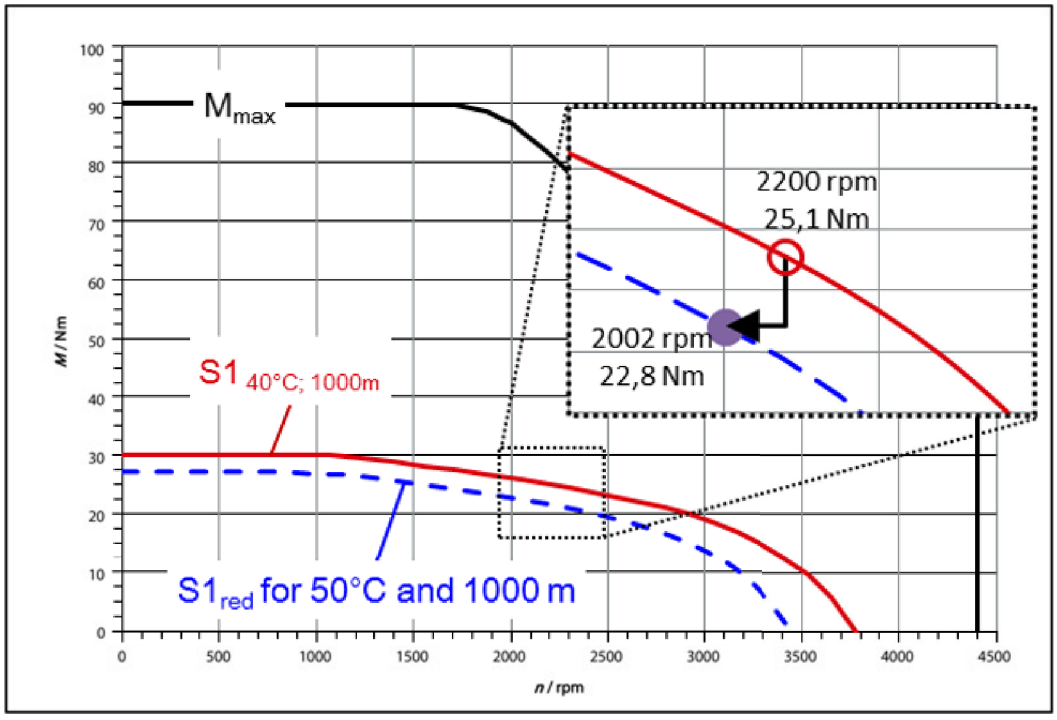


Figure 2-3 Example of a derating factor

Factors for reducing the DC link voltage depending on the installation altitude

For installation altitudes above 2000 m above sea level, you must also reduce the voltage stress on the motors.

The permissible DC link voltage decreases with increasing installation altitude due to the decreasing air pressure.

Table 2-3 Limit values for the DC link voltage for motors of the 1FK2/1FS2/1FT2 series at installation altitudes below 2000 m mean sea level

Motors with the following rated speed in the article number (part number) 1F□2□□-□□X□□..., X =	Max. permissible converter DC link voltage in V
G	375
B, C, F, H, K	720

Reduce the DC link voltage according to the reduction factors in the table below.

Table 2-4 Factors for reducing the DC link voltage depending on the air pressure

Installation altitude above sea level in m	Air pressure in hPa	Reduction factor
2000	784	1
3000	689	0.887

Installation altitude above sea level in m	Air pressure in hPa	Reduction factor
4000	606	0.775
5000	533	0.656
6000	469	0.588

Table 2-5 Typical DC link voltage of the SINAMICS converters

Network	Infeed	DC link voltage in V
230 V 1 AC	unregulated/SLM/BLM	248
240 V 3 AC	unregulated/SLM/BLM	307
400 V 3 AC	unregulated/SLM/BLM	528
480 V 3 AC	unregulated/SLM/BLM	634
400 V 3 AC	ALM	600
480 V 3 AC	ALM	720

Calculation example:

- given:
  - Motor 1F□2□□-□□**F**□□...
  - Installation altitude: 3000 m above sea level: 0.877
  - Max. permissible DC link voltage according to the table "Limit values for DC link voltages...": 720 V
- Calculate the permissible DC link voltage as follows: 0.877 • 720 V = 631 V
- Determine the intended line voltage + converter for 400 V 3 AC with non-stabilized infeed or SLM according to the table "Typical DC link voltages...": DC link voltage 528 V

Note

Observe the specifications for the installation altitude of the converter

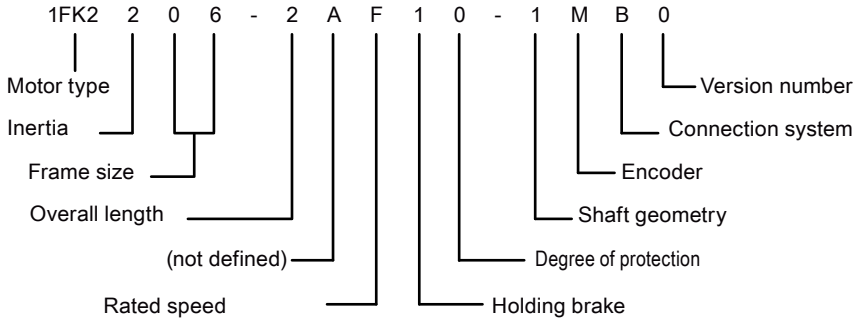
Observe the specifications for the installation altitude of the converter used. The information can be found in the manuals of the respective product.

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.

2.3 Structure of the article number

The article number describes the motor with the following structure.



Article number structure for 1FK2

You can find possible combinations in the relevant catalog.
Please note that not every theoretical combination is possible.

Description		Position in the article number																
		1	2	3	4	5	6	7	-	8	9	10	11	12	-	13	14	15	16
SIMOTICS S-1FK2 synchronous servomotors		**1**	**F**	**K**	2														
Version/inertia	High Dynamic					1													
	Compact					2													
	High Inertia					3													
Frame size / shaft height	SH 30						0	3											
	SH 40						0	4											
	SH 48 CT SH 52 HD						0	5											
	SH 63						0	6											
	SH 80						0	8											
	SH 100						1	0											
Overall length	0 ... 8								-	☐									
(Not defined)											A								
Rated speed	1500 r/min @ 400 V											B							
	2000 r/min @ 400 V											C							
	3000 r/min @ 400 V											F							
	4500 r/min @ 400 V											H							
	6000 r/min @ 400 V											K							
Holding brake	None												0						
	with												1						
Degree of protection	IP64													0					
	IP65 with radial shaft seal ring without spring													1					
Shaft geometry	Plain shaft (without keyway)															0			
	Shaft with feather key															1			
	Plain shaft, alternative shaft extension (11 mm x 23 mm), for 1FK2☐03 only						0	3						0		2			
	Plain shaft, alternative shaft extension (14 mm x 30 mm), only for 1FK2☐04						0	4						0		2			
Encoder	Absolute encoder, singleturn, 22-bit (encoder AS22DQC)																S		
	Absolute encoder 22-bit + 12-bit multiturn (encoder AM22DQC)																M		
Connection system	2CC (two cable system) for S120																	B	
Version number	Start																		0

2.4 Rating plate data

Rating plate

The rating plate contains the article number and the technical data of the motor.

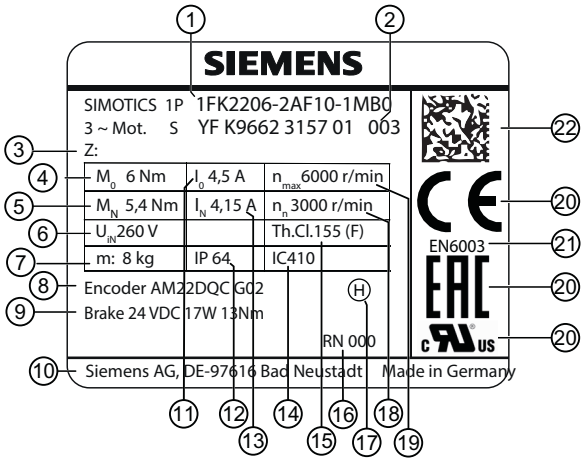


Figure 2-4 Rating plate 1FK2 for S210 (example illustration)

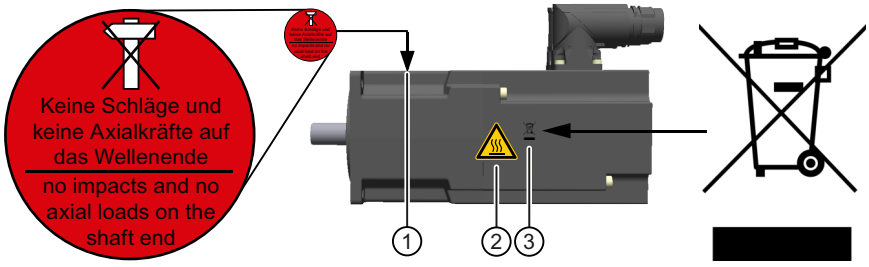
Position	Description / technical specifications	Position	Description / technical specifications
1	Article number	12	Degree of protection
2	ID No., serial number	13	Rated current I_N
3	Order codes as a supplement to the article number.	14	Cooling method according to EN 60034-6
4	Static torque M_0	15	Temperature class of the insulation system
5	Rated torque M_N	16	Revision
6	Induced voltage at rated speed U_{IN}	17	Type of balancing (only for motors with feather key)
7	Motor weight m	18	Rated speed n_N
8	Marking of encoder type	19	Maximum permissible speed of the motor n_{max}
9	Data of the holding brake	20	Certifications
10	Manufacturer's address	21	Standard for all rotating electrical machines
11	Stall current I_0	22	Data matrix code

Mounting and options

3

3.1 Safety symbols on the motor

The following warnings and notices are attached to the motor.



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

2 Warning symbol "Warning against hot surface"

3 WEEE mark
Dispose of the motor in accordance with WEEE Directive 2012/19/EU.

Note

Glue on the warning and information labels

If product warning and information labels are provided, attach them to the product so that they are clearly visible.

3.2 Shaft extension

The motors are supplied with cylindrical shaft extensions. The shaft extension usually has a centering thread according to DIN 332, form DR.

Optionally, a shaft extension with a keyway and feather key can be supplied.

For the 1FK2□03 and 1FK2□04 with degree of protection IP65, the radial shaft seal ring shortens the useful shaft extension.

Frame size	Shaft dimensions with IP64 Diameter × length in mm	Shaft dimensions with IP65 Diameter × length in mm	Fitted key Width × height × length in mm	Centering thread DIN 332-DR
1FK2□03	14 (h6) × 30	14 × 21.5	5 × 5 × 16	M5
	11 (k6) × 23 [1]	-	-	M4
1FK2□04	19 (k6)× 40	19 × 32	6 × 6 × 22	M6
	14 (k6) × 30 [1]	-	-	M5
1FK2□05	19 (k6) × 40		6 × 6 × 32	M6
1FK2□06	24 (k6) × 50		8 × 7 × 40	M8
1FK2□08	32 (k6) × 58		10 × 8 × 45	M12
1FK2□10	38 (k6) × 80		10 × 8 × 70	M12

[1] Shaft extensions 11 (k6) mm × 23 mm and 14 (k6) × 30 are only available without keyway and without shaft sealing ring (IP65).

3.3 Bearing version

The 1F□2 motors have deep-groove ball bearings with lifetime grease lubrication.

3.4 Permissible radial and axial forces

Permissible axial forces

Type	Axial force, static [1] $F_{A\,stat}$ / N
1F□2□03	75
1F□2□04	100
1F□2105	120
1F□2106	200
1F□2205	120
1F□2206	200
1F□2208	300
1F□2210	450

[1] The specified axial forces are determined by the spring loading and therefore also apply for motors with holding brake.

Note

Applications with an angular toothed pinion directly on the motor shaft are not permitted if the permissible axial forces are exceeded.

Permissible radial forces

As a result of the bearing arrangement, the 1F□2 is designed for aligned forces. Forces such as these occur for belt drives, for example.

All radial forces always refer to aligned forces.

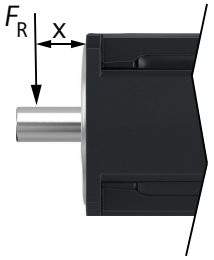
NOTICE

Motor damage caused by circulating forces

Circulating forces can cause bearing motion, and therefore damage the motor.

- Circulating forces are not permissible.

Point of application of radial forces F_R at the shaft extension



F_R Point of application of the radial force

x Distance between where the radial force is applied and the shaft shoulder in mm

Figure 3-1 Force application point at the shaft extension

The following diagrams indicate the maximum permissible radial force for the corresponding motor frame size. It depends on the force application point and the average speed for a nominal bearing service life (L10h) of 25000 h.

Radial force diagram 1F□2□03

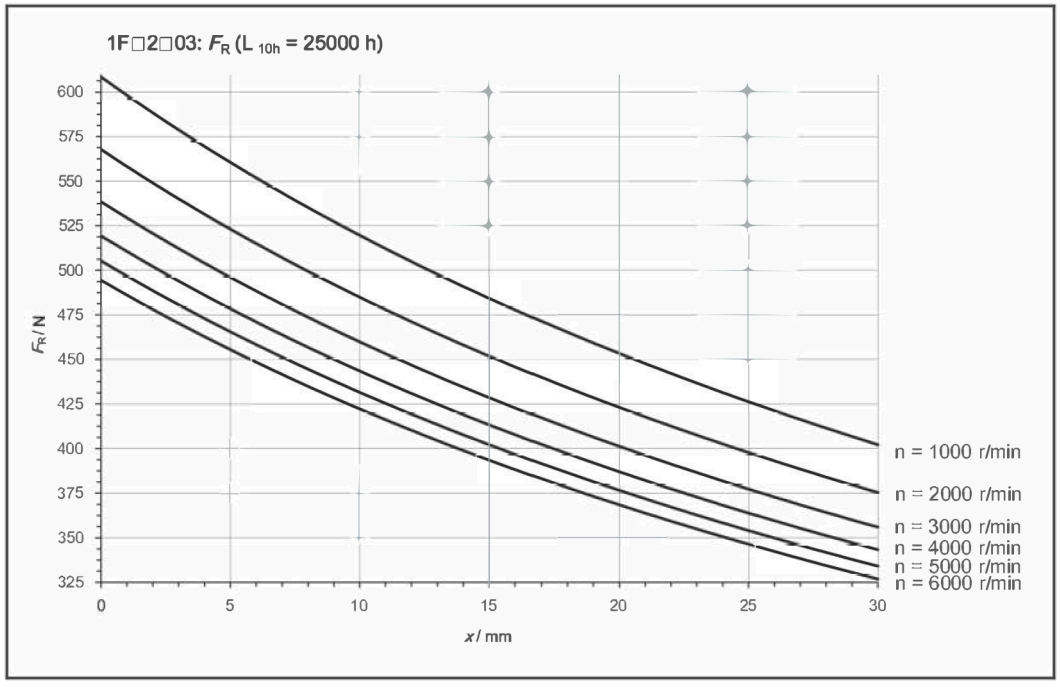


Figure 3-2 Maximum permissible radial force F_R at a distance x from the shaft shoulder for a nominal bearing lifetime of 25000 h.

Radial force diagram 1F□2□04

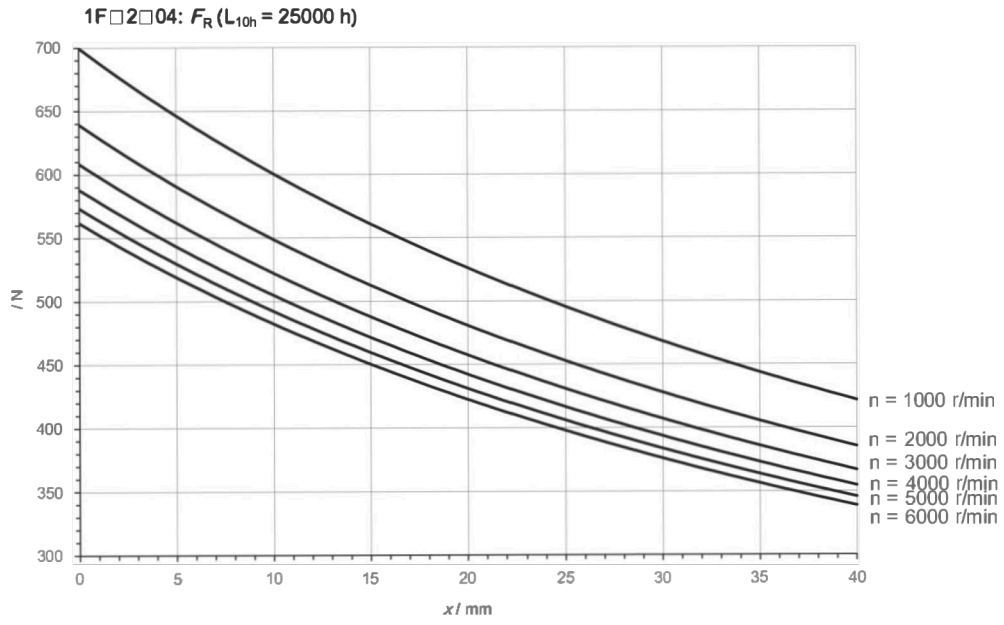


Figure 3-3 Maximum permissible radial force F_R at a distance x from the shaft shoulder for a nominal bearing lifetime of 25000 h.

Radial force diagram 1F□2105

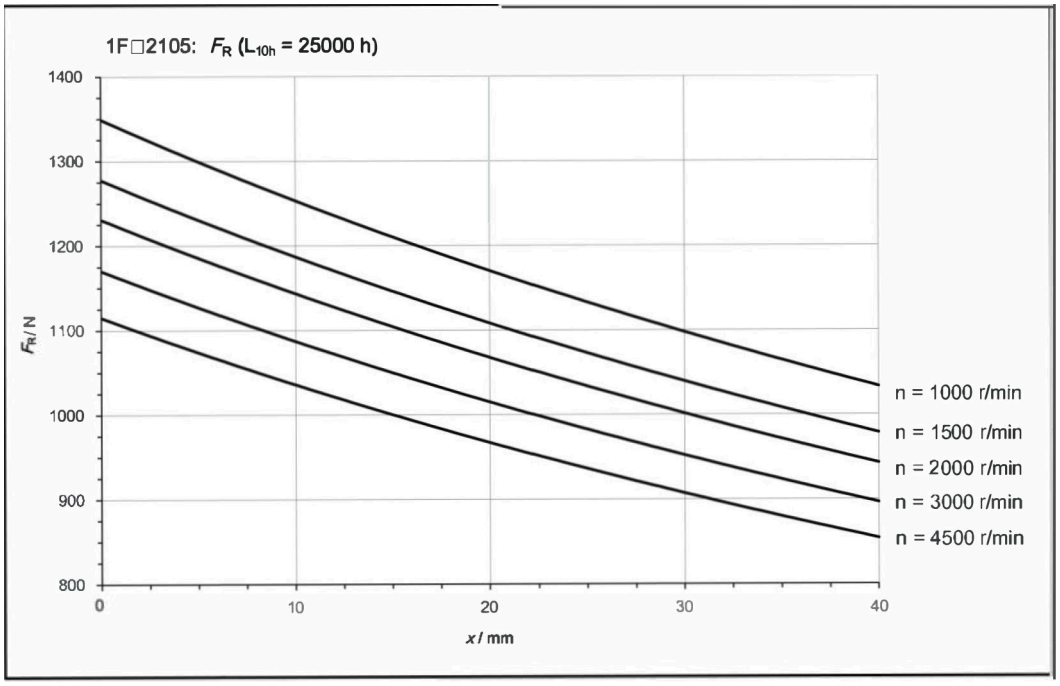


Figure 3-4 Maximum permissible radial force F_R at a distance x from the shaft shoulder for a nominal bearing lifetime of 25000 h.

Radial force diagram 1F□2205

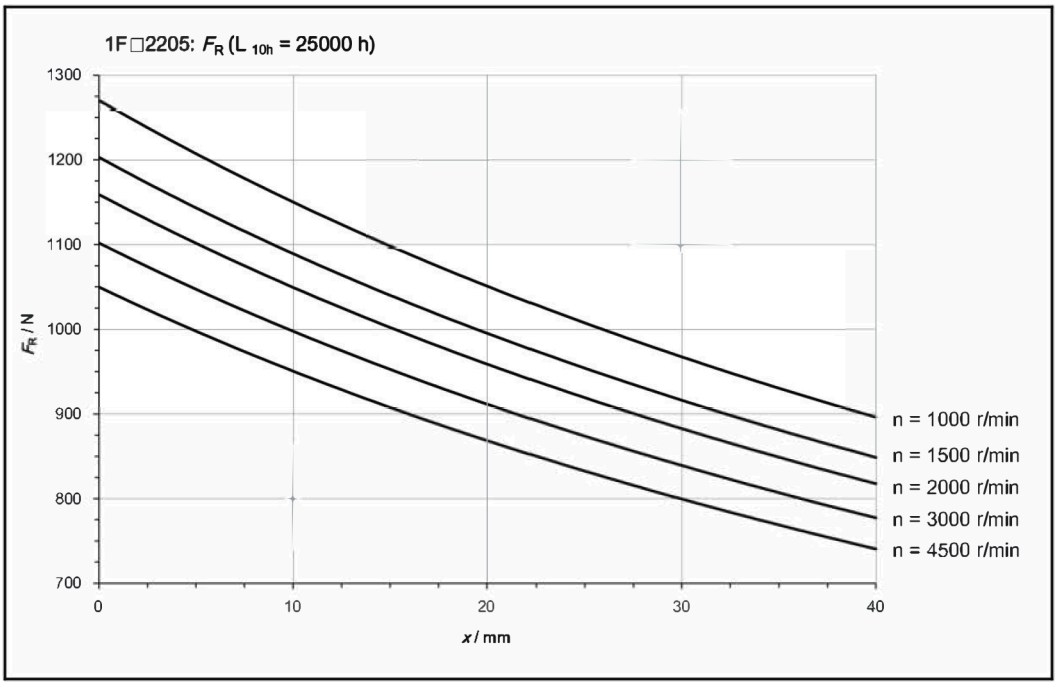


Figure 3-5 Maximum permissible radial force F_R at a distance x from the shaft shoulder for a nominal bearing lifetime of 25000 h.

Radial force diagram 1F□2□06

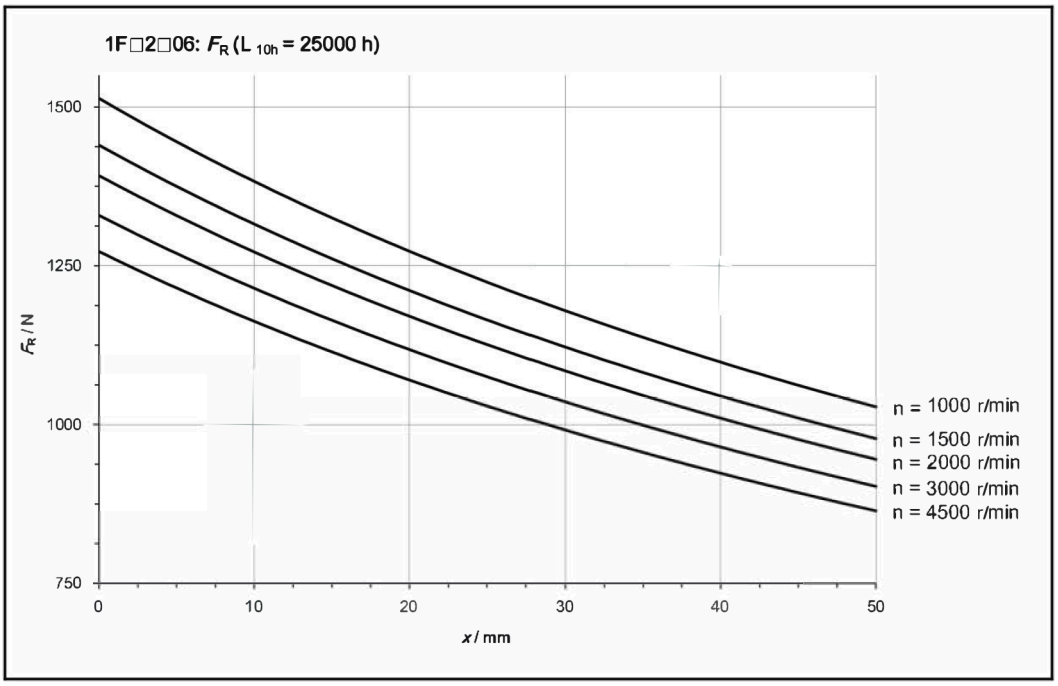


Figure 3-6 Maximum permissible radial force F_R at a distance x from the shaft shoulder for a nominal bearing lifetime of 25000 h.

Radial force diagram 1F□2208

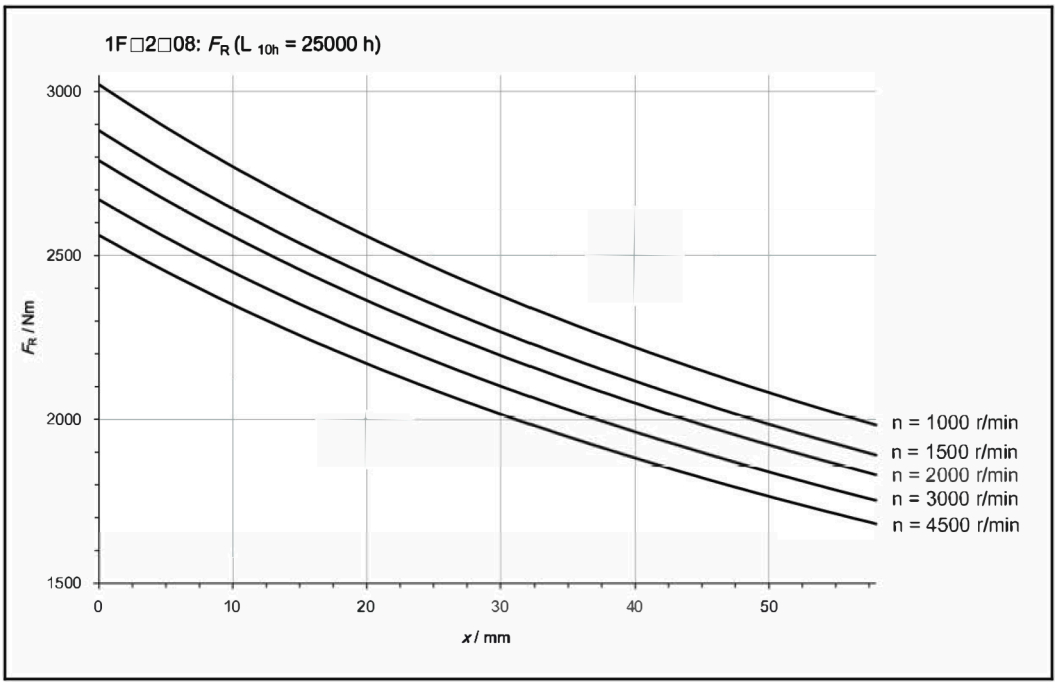


Figure 3-7 Maximum permissible radial force F_R at a distance x from the shaft shoulder for a nominal bearing lifetime of 25000 h.

Radial force diagram 1F□2210

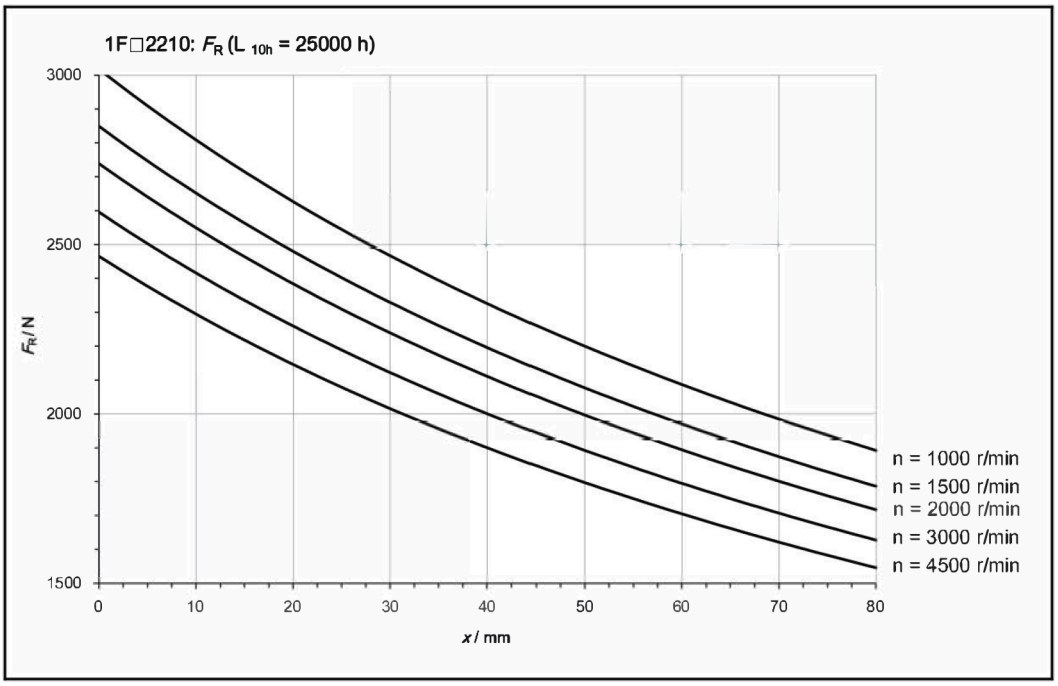


Figure 3-8 Maximum permissible radial force F_R at a distance x from the shaft shoulder for a nominal bearing lifetime of 25000 h.

3.5 Thermal motor protection

To protect the motor from overheating, a thermal motor type is implemented in the SINAMICS S120 converter.

If the motor is operated within the permissible ambient temperature range and the ambient temperature is correctly set in the converter, the converter protects the motor from overheating.

Before the motor reaches the maximum temperature, the converter outputs the warning "Motor overtemperature".

If the motor exceeds the maximum temperature, the converter switches off the motor with the error message "Motor overtemperature".

If the ambient temperature exceeds 40 °C, you must adjust the ambient temperature in the thermal motor model. In this case, the thermal protection routine requires that the ambient temperature is specified in parameter p0613. For more details about parameter p0613, see "SINAMICS S120 List Manual".

3.6 Encoder

Motors with DRIVE-CLiQ interface are designed to operate with the SINAMICS converter system.

Signal transmission to the converter is performed digitally.

The motors 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.

You will find further information in the relevant SINAMICS manual.

NOTICE
Damage to electrostatic sensitive devices The contacts of the DRIVE-CLiQ interface have direct contact with components that can be destroyed by electrostatic discharge (ESDS). • Avoid touching the terminals directly with hands or tools. They may be electrostatically charged and damage components.

The encoders are suitable for the extended safety functions.

Table 3-1 The 1FK2 can be supplied with the following encoders:

Encoder designation	**AS22DQC**	**AM22DQC**
Description	Absolute encoder 22-bit single-turn	Absolute encoder 22-bit + 12-bit multiturn
Identifier at the 14th digit of the article number	S	M
Operating voltage	24 V	24 V
Maximum current consumption	70 mA	70 mA
Resolution	4,194,304 = 22 bit	4,194,304 = 22 bit
Absolute position	Yes, one revolution	Yes, 4096 revolutions (12 bits)
Maximum angular error	± 100 "	± 100 "

3.7 Cooling

The motor is naturally cooled. The power loss is dissipated through thermal conduction, thermal radiation and natural convection.

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

You will find information on this in the relevant configuration manual.

3.8 Holding brake

3.8.1 Types and modes of operation of the holding brakes

The chapter describes types and modes of operation of the holding brakes.

The type of holding brake installed depends on the size of the motor.

Type of holding brake	Spring-loaded brake	Permanent-magnet brake
Installed in the motors	1FK2☐03 ... 1FK2☐04	1FK2☐05 ... 1FK2☐10
Method of operation	The spring causes a compressive 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 24 V DC rated voltage is applied to the brake, the current-carrying coil produces an opposing field. This neutralizes the force of the spring and the brake opens without any residual torque. The spring-loaded brake has a torsional backlash less than 1°.	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 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 a torsionally stiff connection to the motor rotor.

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 holding brake.

- Avoid impermissible forces on the shaft extension. You can find the permitted axial forces in the section "Permissible radial and axial forces (Page 36)".

- 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.

3.8.2 Technical specifications

The following table contains technical specifications of the holding brakes:

Note

The following specifications apply to control with 24 V DC.

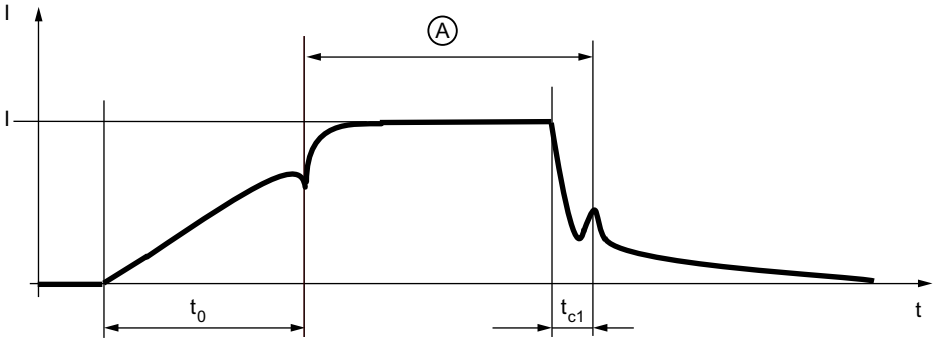
Motor type	Holding torque at 120 °C	Dyn. braking torque	Rated current	Opening time [1]	Closing time [1]	Maximum permissible single operating energy [2]	Total operating energy (service life)
	M_4 / Nm	M_{1m} / Nm	I_{supp} / A	t / ms	t / ms	W_{max} / J	W_{total} / kJ
For spring-loaded brake							
1F□2□03	1.3	1.3	0.4	90	30	62	5
1F□2□04	3.3	3.3	0.5	110	40	270	35
For permanent-magnet brake							
1F□2□05	8	5	0.6	90	25	568	284
1F□2106	16	9	0.7	100	50	1065	774
1F□2206	13	6.5	0.7	100	50	1548	774
1F□2□08-3	19	12	0.8	100	40	2000	1800
1F□2□08-4 1F□2□08-5	32	17	0.9	200	60	4800	2400
1F□2□10-3	32	17	0.9	200	60	6658	2400
1F□2□10-4 1F□2□10-5	55	26	1.0	220	80	8700	3800

[1] Measured with varistor for a rated holding brake voltage of 24 V DC.

[2] Maximum three EMERGENCY STOP operations in sequence with a maximum of 25% total operating energy

Note

If the brake is switched in two stages (two clicks), the first switching point is decisive for opening and the second for closing.



I Current

t Time

t_0 Opening time

t_{c1} Closing time

A Brake opened

Figure 3-9 Terminology (time) for holding operation

Holding torque M_4

The holding torque M_4 is the highest permissible torque for the closed brake in steady-state operation without slip (holding function when motor is at standstill). The data applies for the state at operating temperature (120 °C).

Dynamic braking torque M_{1m}

The dynamic braking torque M_{1m} is the smallest mean dynamic braking torque that can occur for an EMERGENCY STOP.

Opening time and closing time

The delay times that occur when switching the brake.

Maximum permissible single switching energy

The maximum permissible single switching energy of an individual EMERGENCY STOP operation.

After an EMERGENCY STOP with the maximum single operating energy, allow a cooling time of at least 3 minutes before you operate the motor again.

Total operating energy (service life)

The total switching energy is the sum of the single switching energy (switching energy for each EMERGENCY STOP procedure). If the total operating energy is exceeded, brakes can no longer be guaranteed to function correctly.

- Refurbish the motor.

Formula for calculating the operating energy per braking operation

$W_{BR} = (J_{Mot\ Br} + J_{load}) \bullet n_{mot}^2 / 182.4$

W_{Br} / J	Operating energy per braking operation
n_{Mot} / min^{-1}	Speed at which the brake is engaged
$J_{Mot\ Br}$ / kgm^2	Rotor moment of inertia of the motor with brake
J_{load} / kgm^2	Load moment of inertia of the mounting part on the motor with brake (kgm^2)
182.4	Constant for calculating the circular frequency and SI units

The corresponding data is provided in the Configuration Manual

Preparing for use

4

4.1 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 4-1 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.

4.2 Transportation and storage

4.2.1 Transport

Note

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

Precondition

- Use suitable load suspension devices when transporting and installing the motor.
- Do not lift the motor by the connector.
- Transport the motor carefully.

Procedure for lifting and transporting using slings

You can lift and transport the motor using lifting 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 with lifting slings".

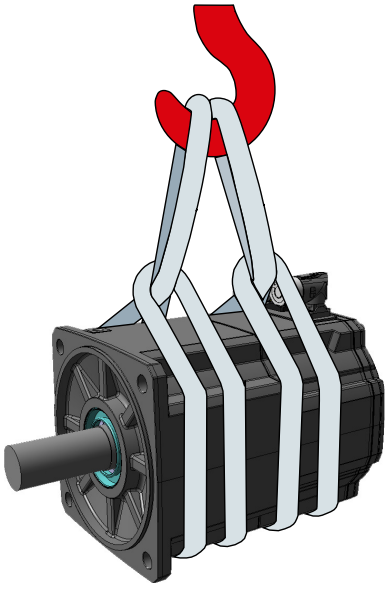


Figure 4-1 Lifting and transporting with lifting slings (example diagram)

Procedure for lifting and transporting using eyebolts

For the 1F□2□10 motors, you can use eyebolts and a crossbar for lifting and transporting.

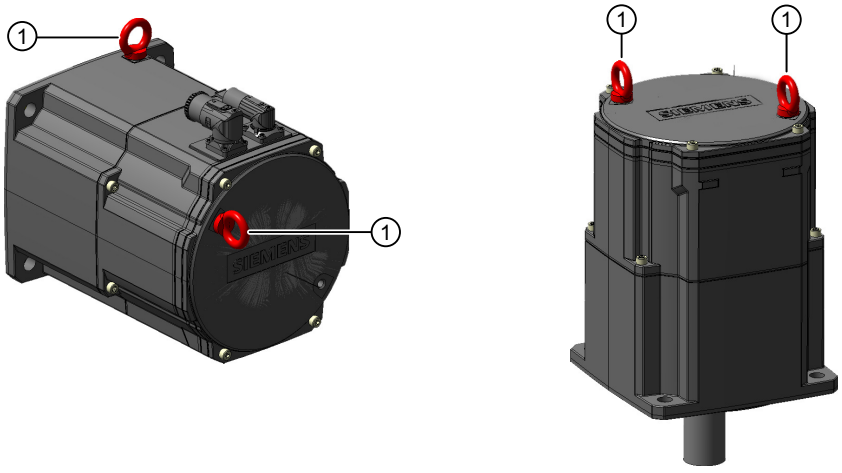
⚠ WARNING

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.

1. Screw in the lifting eyes (eyebolts) depending on the position of the motor during transport.



① Position of the eyebolts

2. Hook the crossbar into the eyebolts (lifting eyes).

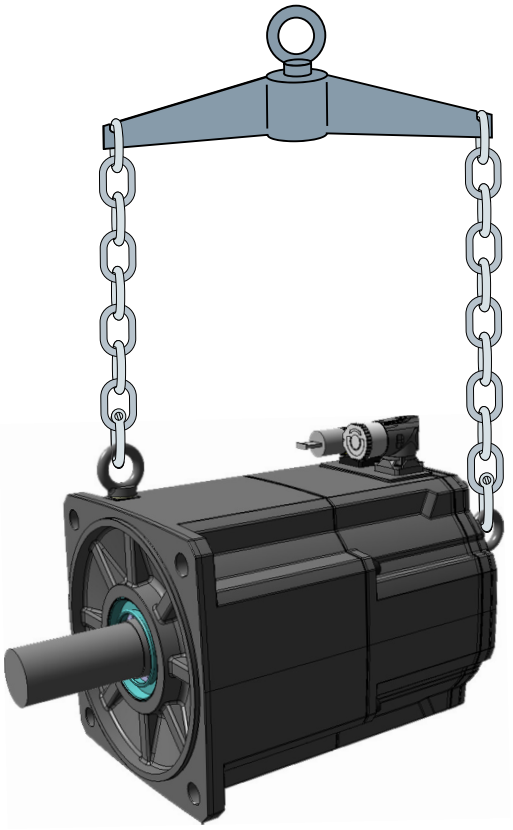


Figure 4-2 Transporting the motor with a beam (example)

3. Set the motor down on a hard, level surface.

⚠ 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.

4. Secure the motor against unintentional movements.
❒

4.2.2 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 rolling bearing grease.

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

If you store the motor for longer than six months, carefully ensure that the storage facility complies with the following conditions:

Table 4-2 **Ambient 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 to +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 above-mentioned conditions. • Special preservation measures are required for storage periods of 6 months up to a 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:

- Significant ambient temperature fluctuations,
- Direct sunshine,
- High humidity during storage.

Avoid these ambient conditions.

Use a dehydrating agent in the packaging.

Mounting

5

5.1 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

Active implant malfunctions due to 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 converters/motors.

- If you have a heart pacemaker or implant, keep a distance of at least 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

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 touch protection.

⚠ 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 safety-relevant functions on the entire system, including all safety-related components.
- Ensure that the safety functions used in your drives and automation tasks are adapted and activated using the appropriate parameter assignment.
- Perform a function test.
- Only put your plant into live operation once you have ensured that the safety-relevant functions are running correctly.

⚠ WARNING

Injuries 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.

5.2 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.

- Install 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 5-1 Checklist before installing

Check	OK
General checks	
Are all necessary components of the configured drive available?	
Are the ambient conditions in the permissible range? • Section "Ambient conditions (Page 24)"	

Table 5-2 Checklist for checking the mechanical system

Check	OK
Check of the mechanical system	
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?	

5.3 Mounting instructions

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
Damage to the motor due to radial eccentricity at the shaft extension Radial eccentricity and axial forces at the shaft extension can damage the motor. • Mount the motor in such as way that no radial eccentricity and axial forces at the shaft extension occur.

- Adhere to the specifications on the rating plate.
- Observe the warning and information plates on the motor.
- Check the permissible ambient conditions (e.g. temperature, installation altitude) ant the installation site.
- Thoroughly remove any anti-corrosion agents from the shaft extension. Use commercially available solvents.
- Ensure sufficient dissipation of the heat loss. See Chapter "Cooling (Page 46)" (page 36)".
- If the motor is installed vertically with the shaft extension facing up, ensure that no liquid can enter the upper bearing.
- 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 for the fixing screws (see table below).

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.

Table 5-3 **The data apply to 1FK2 and 1FT2 motors.**

Motor	Bolt DIN 7984	Washer ISO 7092 in mm	Tightening torque for bolts (not for electrical connections)
1F□2□03	M5	5 (d2 = 9)	4 Nm
1F□2□04 1F□2205	M6	6 (d2 = 11)	8 Nm

Motor	Bolt DIN 7984	Washer ISO 7092 in mm	Tightening torque for bolts (not for electrical connections)
1F□2105 1F□2□06	M8	8 (d2 = 15)	20 Nm
1F□2□08	M10	10 (d2 = 18)	35 Nm
1F□2□10	M12	12 (d2 = 20)	60 Nm

5.4 Mounting the feather key

⚠ WARNING

Injuries due to ejected feather key

When the motor with feather key is running, the key on the shaft can be ejected by centrifugal force. This can result in personal injury or property damage.

- Before operating the motor, the feather key must be secured on the shaft to prevent it from being ejected by centrifugal force.

NOTICE

Damage to motor bearings due to improper operation

Never install the feather key by hammering it into the slot, as this may damage the bearing.

- Mount the feather key without hammering on the keyway or the shaft extension.

Precondition

To avoid damage to the shaft extension or feather key, use water pump pliers or siphon pliers with soft tips made of plastic or measurement to mount the feather key.

Procedure

1. Place the feather key straight on the keyway.
2. Press the feather key lightly into the keyway with the siphon pliers.

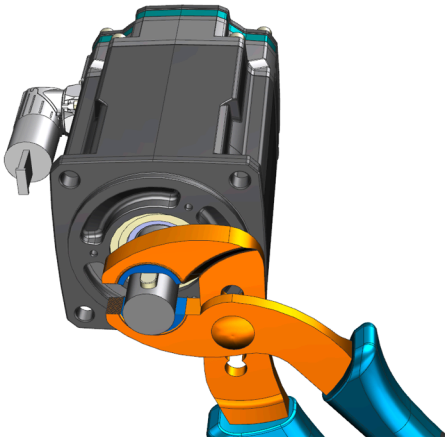


Figure 5-1 Mounting the feather key

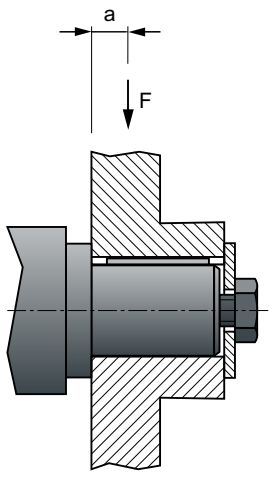
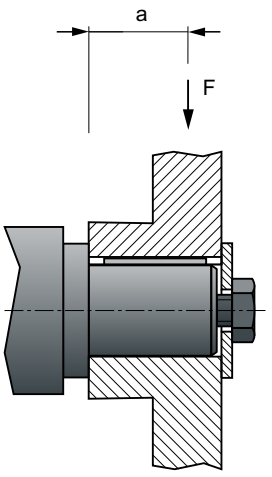
3. Before operating the motor, you must mount drive elements, e.g. a belt pulley or a coupling, on the shaft extension with feather key.

❒
You have mounted the feather key.

5.5 Mounting the drive elements

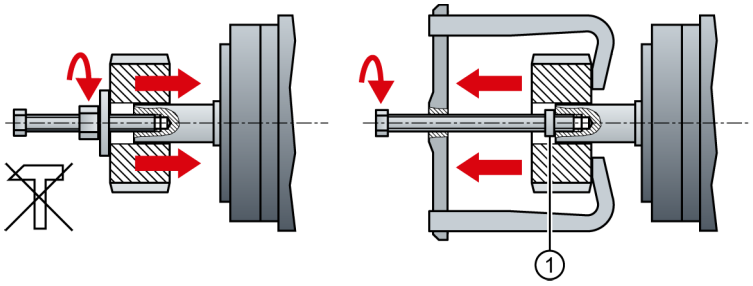
Reduce the bending torque load applied to the shaft and the bearing by appropriately arranging the output elements.

Mount the output elements as close as possible to the motor bearing.

optimum	unfavorable
	
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.



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

Figure 5-2 Mounting and removing output elements

- 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.

The motor dimensions can be found in section "Dimension drawings (Page 107)".

5.6 Vibration response

Vibration severity grade

Motors with keyway are balanced by the manufacturer using a half-key.

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)

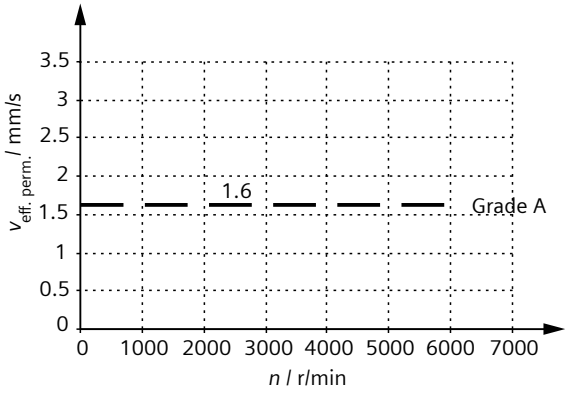


Figure 5-3 Vibration severity levels

Vibration response

Comply with the vibration values in the following table to ensure perfect functioning of the motor and a long service life.

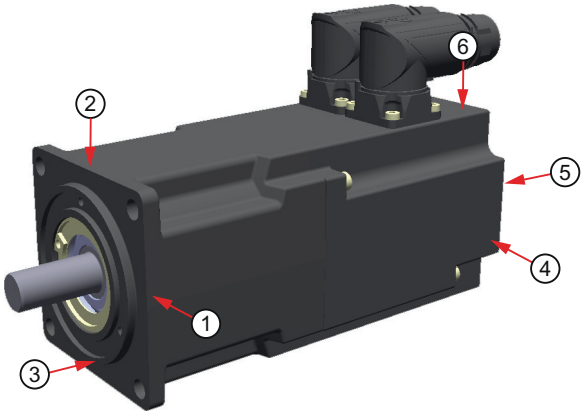
Motor	Vibration velocity V_{rms} to ISO 10816	Vibration acceleration a_{peak} axial	Vibration acceleration a_{peak} radial
1F□2□□□	max. 4.5 mm/s	50 m/s²	50 m/s²

The measuring equipment must fulfill the requirements of ISO 2954 to evaluate the vibration velocity

Select the measuring locations according to ISO 10816-1, Section 3.2.

The vibration acceleration is evaluated in the frequency range from 10 Hz ... 2000 Hz. The maximum peak in the measurement time range is taken into consideration.

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 5-4 Measuring points for vibration values

Connecting

6

6.1 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.

6.2 Permissible line system types

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.

6.3 System integration

6.3.1 Connection notes

6.3.1.1 Motor connection

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.

Table 6-1 Cable cross-section and current-carrying capacity

Cross-section in mm²	Current-carrying capacity rms; AC 50/60 Hz or DC for routing type		
	B1 in A	B2 in A	C in 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

Table 6-2 Derating factors for power and signal cables

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

6.3.1.2 Rotating the connector on the motor

You can rotate power connectors and signal connectors within a limited range of angles.

Use a suitable socket connector to rotate the angle plug.

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

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.

Rotatability of the power connector and signal connector

Table 6-3 Rotation range of the power connector ①

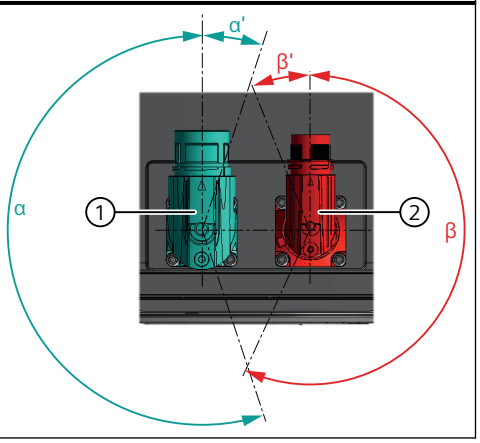
Motor	Connector size of the power connector ①	Angle α	Angle α'	Drawing
1F□2□03	M17	205	29	
1F□2□04		205	25	
1F□2□05		228	35	
1F□2□06	M23	222	40	
1F□2□08		222	46	
1F□2□10		222	55	
	M40	228	48	

Table 6-4 Rotation range of the signal connector ②

Motor	Connector size of the signal connector ②	Angle β	Angle β'	Drawing
1F□2□03	M17	209	25	See table "Rotation range of the power connector"
1F□2□04		205	25	
1F□2□05		215	48	
1F□2□06		215	41	
1F□2□08		215	46	
1F□2□10		215	57	
		210	48	

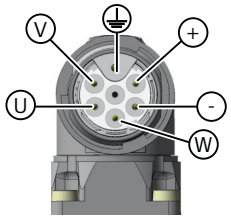
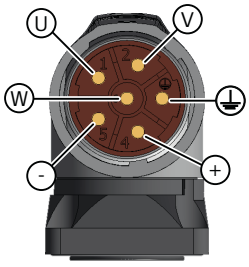
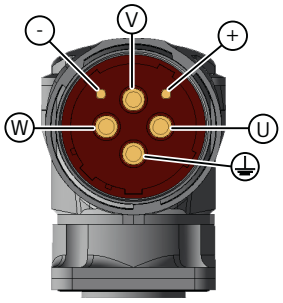
Table 6-5 Maximum rotating torque for the connectors

Connectors	Max. torque when rotating
Connector M17	8 Nm
Connector M23	12 Nm
Connector M40	20 Nm

6.3.2 Line connection

Designs of the power connectors

The 1F□2 is equipped with the following power connectors depending on the frame size and performance level.

Round connector M17	Round connector M23	Round connector M40
		
Brake connection 24 V: "+" = BD1+; "-" = BD2-		

The power connectors can be rotated within a certain range.

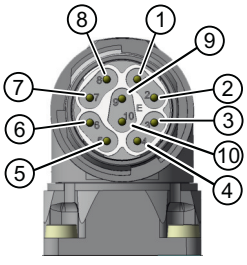
More precise information about the equipping of the motors and the angles of rotation is provided in Chapter "Rotating the connector on the motor (Page 70)".

6.3.3 Signal connection

Signal connector designs

The signal connection of the 1F□2 is established using a round connector M17.

The connector pin assignment is as follows.

M17 signal connector, with DRIVE-CLiQ		
	1	TX-P
	2	TX-N
	3	-
	4	-
	5	RX-P
	6	RX-N
	7	-
	8	-
	9	24 V
	10	0 V

The signal connector can be twisted in a certain range.

More precise information on the angle of rotation is available in Chapter "Rotating the connector on the motor (Page 70)"

6.3.4 Connecting to a converter

6.3.4.1 Selecting and connecting cables

- Use prefabricated MOTION CONNECT cables from SIEMENS or shielded connecting cables. The appropriate cables for your motor are listed in the Configuration Manual.
- The prefabricated MOTION CONNECT cables reduce installation costs and increase the operational reliability

Note

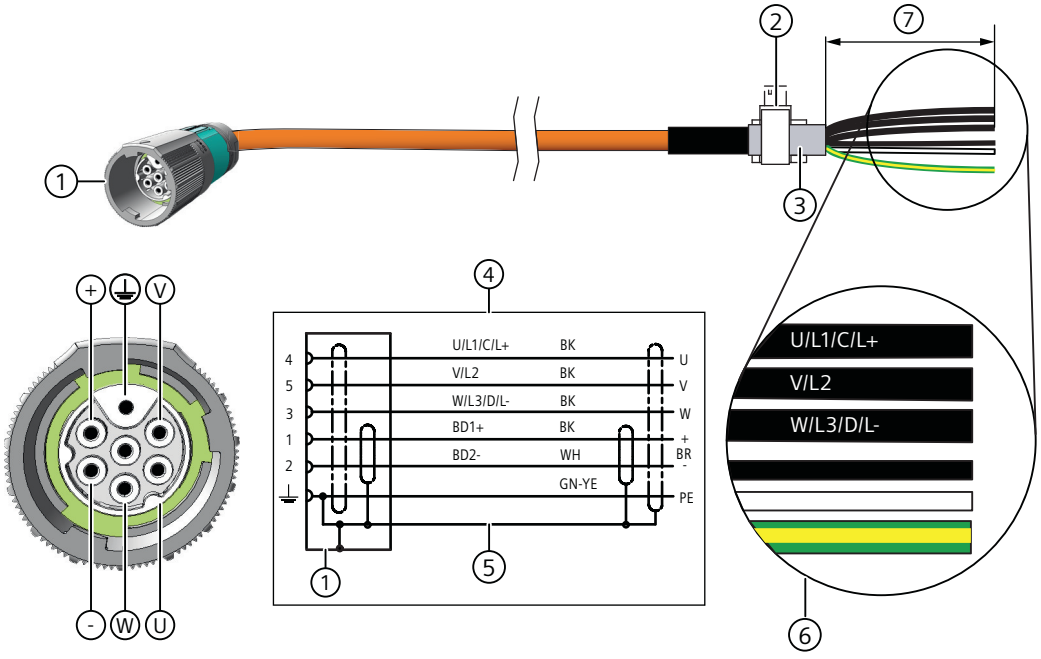
The cable shielding, made up of as many strands as possible, must have a high electrical conductivity. Braided shields made of copper or aluminum are well suited.

When connecting, comply with the following:

- Connect the shield to the converter.
- Keep the unshielded cable ends as short as possible.
- Apply the contact over a large area for a good dissipation of the high-frequency currents.

Connection diagram for the 1F□2 motor to S120 with a MOTION-CONNECT line

For connector size M17



1 MOTION-CONNECT cable with SPEED CONNECT plug, size M17

2 Terminal for the cable shield

3 Cable shield

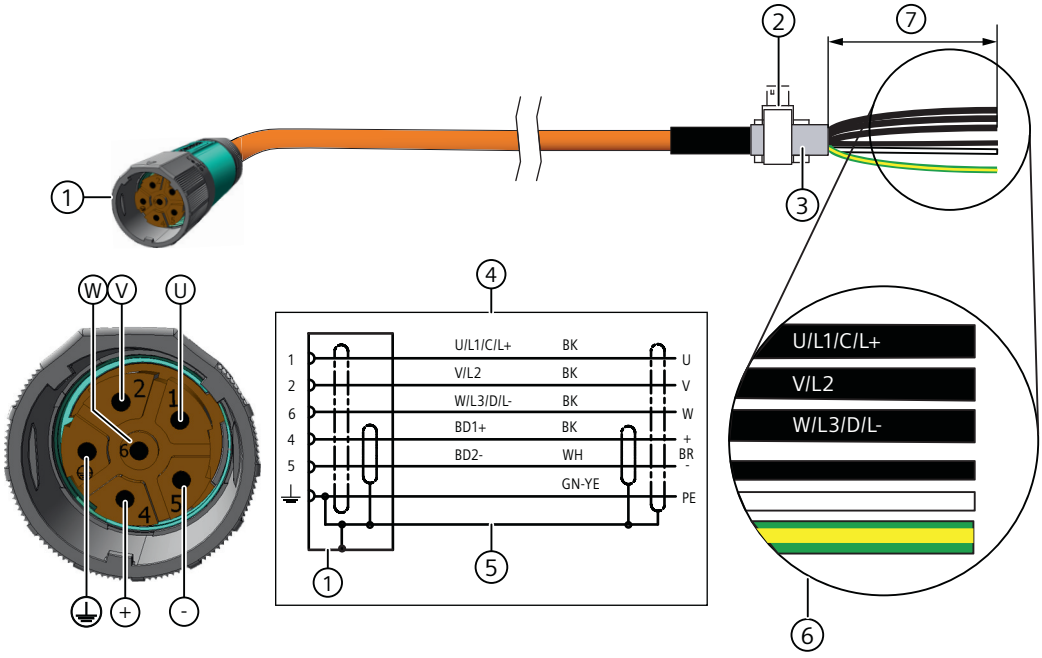
4 Connection diagram
U; V; W = power cables, 1.5 mm^2, each cable with separate shielding
BD1+ and BD2- = brake cable without lettering, 1.5 mm^2, shielded together
PE = protective conductor

5 Cable shield

6 Conductor designations

7 Recommended length of the cable ends: 105 mm

For connector size M23



1 MOTION-CONNECT cable with SPEED CONNECT plug, size M23

2 Terminal for the cable shield

3 Cable shield

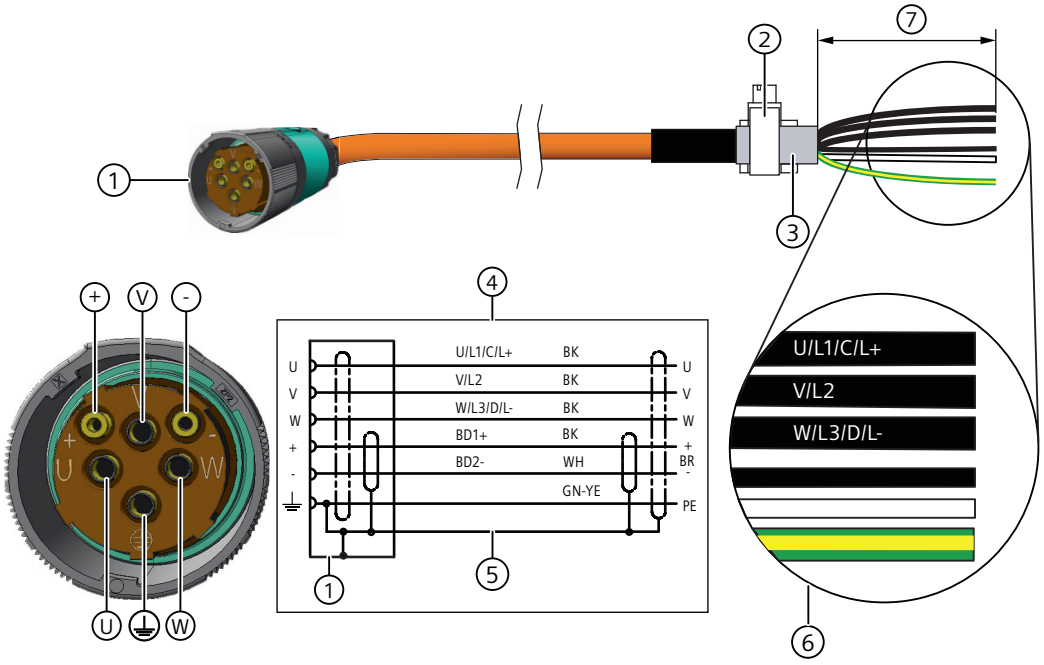
4 Connection diagram
U; V; W = power cables, 1.5 mm^2, each cable with separate shielding
BD1+ and BD2- = brake cable without lettering, 1.5 mm^2, shielded together
PE = protective conductor

5 Cable shield

6 Conductor designations

7 Recommended length of the cable ends: 105 mm

For connector size M40



1 MOTION-CONNECT cable with SPEED CONNECT plug, size M40
2 Terminal for the cable shield
3 Cable shield
4 Connection diagram
U; V; W = power cables, 1.5 mm^2, each cable with separate shielding
BD1+ and BD2- = brake cable without lettering, 1.5 mm^2, shielded together
PE = protective conductor
5 Cable shield
6 Conductor designations
7 Recommended length of the cable ends: 105 mm

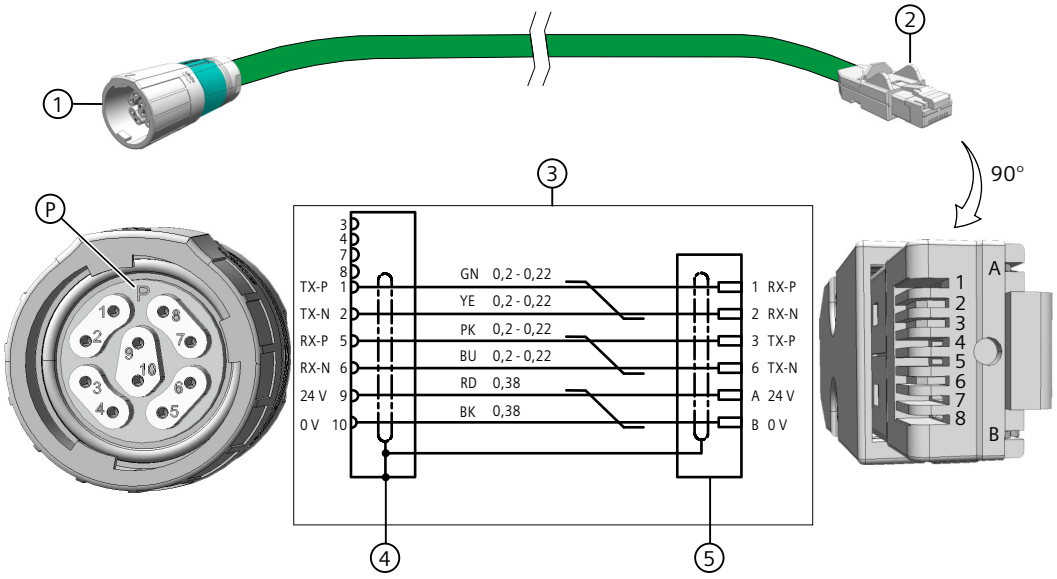
Locking the round connectors

Properly lock the connected round connector at the motor.

Information on locking is provided in Chapter "Handling the quick-action locking (Page 77)".

Connection diagram of the signal line for the 1F□2 motor on the S120

The connection is made on a signal line with connector M17, 10-pin and RJ45 connector



1	M17 round connector, 10-pin	4	Pin assignment of M17 round connector, 10-pin
2	RJ45/IP20 connector	5	Pin assignment of the RJ45 connector
3	Connection diagram	P	0° coded

Locking the round connector

Lock the round connector properly on the motor

Information on locking is provided in Chapter "Handling the quick-action locking (Page 77)".

6.3.4.2 Handling the quick-action locking

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

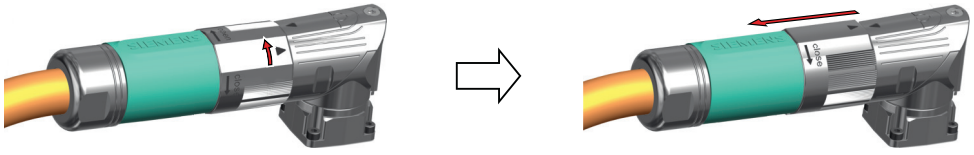
Note

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.

Routing cables in damp environments

If you are operating the motor in environments in which moisture can arise follow the installation instructions below.

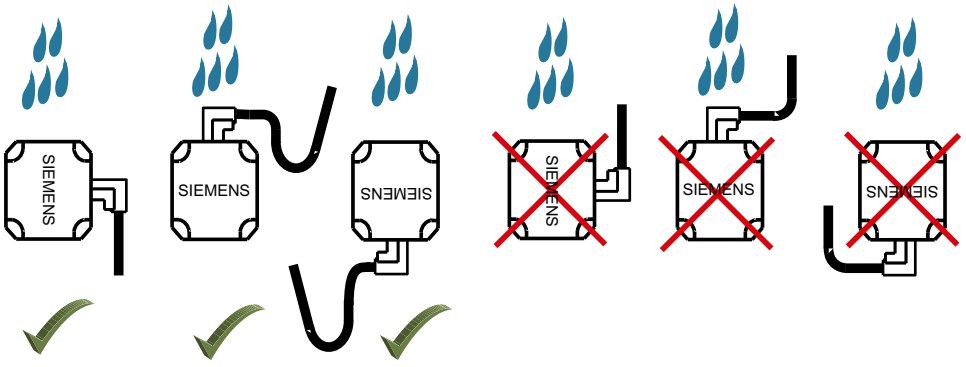


Figure 6-1 Permissible and impermissible cable routing when connecting in a damp environment

Commissioning 7

7.1 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.

7.2 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 in accordance with the situation specific to the particular installation site.

Before commissioning the system, check that it is properly installed and connected.

Commission the drive system according to the Operating Instructions of the converter or inverter being used.

Checklists for commissioning the motors 1FK2 and 1FT2

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

Table 7-1 Checklist (1) - general checks

Check	OK
Are all of the necessary components of the configured drive line-up available, correctly dimensioned, installed and connected?	
Is the manufacturer documentation for the system components (e.g. drive system, brake) available?	
Is the motor type to be commissioned known? (e.g. 1FK2 _ _ _ – _ _ _ _ _ – _ _ _ _)	
Are the ambient conditions in the permissible range?	

Table 7-2 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 fixing screws, connecting 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 7-3 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 7-4 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 7-5 Checklist (5) - Cooling system checks

Check	OK
Natural cooling Have you adapted the torque and power of the motor to the ambient conditions? You will find information on the derating in the configuration manual. Observe the information provided in the converter operating instructions.	

Table 7-6 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?	

7.3 Commissioning procedure

The chapter describes the commissioning of the motor

Precondition

- You have mounted and connected the motor correctly.
- All safety relays are functional and activated.
- Ensure that the frequency converter is correctly parameterized.
- You are connected to the converter, e.g. via the Profinet interface X127.
- You have an Internet connection.

Procedure

Note

Incorrect first commissioning due to power interruptions

Software updates are loaded when commissioning the motor at the converter for the first time. These updates can take some time. The system does not respond in this time.

The drive will not be correctly commissioned if you interrupt the system power supply in this phase.

- During the complete commissioning phase, ensure that the power supply is never interrupted.

1. Start the commissioning tool in the converter, e.g. STARTER, STARTDRIVE or the Web server
2. Follow the steps of the commissioning tool to commission the motor

❒
You have commissioned the motor.

Switching off

- Switch off the motor at the frequency converter.

7.4 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.
- All safety relays are functional and activated.
- 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.

During operation

8

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
- There is no abnormal motor noise
- The motor does not overheat

8.1 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. • Before taking the motor out of service for extended periods of time, take suitable anti-corrosion and preservation measures and ensure that the motor is kept dry.

- For lengthy non-operational periods carefully read the notes in Chapter "Storage (Page 55)".
- When recommissioning the system after longer non-operational periods, perform the checks and measures described in Chapter "Commissioning (Page 81)".
- Before switching on to recommission the system, carefully observe the notes in Chapter "Switching on and switching off (Page 87)".

Faults and their rectification

9

⚠ WARNING

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

Motor damage caused by faults

Faults can cause damage to the motor.

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

If there are deviations from normal operation or if faults occur, proceed as follows.

- Identify the fault using the "Possible faults" table.
  Also observe the converter messages.
- Try to correct the fault using the "Fault causes and remedial measures" key table.

Table 9-1 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									
Uneven running							J	K							
Grinding sound, running noise									L						
Radial vibrations										M	N	O	P		R
Axial vibrations												O		Q	R

Table 9-2 "Fault causes and remedial measures" key table

No.	Fault cause	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, supply cables and 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 the manufacturer, if required, replace the motor
I	Heat dissipation impeded by dirt	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 reason for the blocking and ensure that the cooling air can flow in and out unimpeded
J	Insufficient shielding for motor and/or encoder cable	Check the shielding and grounding
K	Excessive drive controller gain	Adjust the controller
L	Rotating parts are grinding	Determine cause and adjust parts
	Foreign bodies inside the motor	Replace the motor
	Bearing damage	Replace the motor
M	Rotor not balanced	Replace the motor
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 gearbox	Adjust/repair gearbox

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

Maintenance 10

10.1 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 the motors so that 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, for example by closing switches, grounding or short-circuiting, or closing valves.
6. Take measures to prevent reconnection of the energy sources.
7. Carefully ensure that the machine is completely locked and that you have the right machine.

After you have completed the work, restore readiness for operation by following 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.

⚠ 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.

⚠ CAUTION

Burns 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

Burns due to 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

Falling or toppling parts during lifting and transport operations

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

- The motor must not be lifted or transported by means of the power connector or signal connector.

10.2 Inspection and maintenance

10.2.1 Service and inspection intervals

To avoid motor faults, perform maintenance work, inspections and overhauls at regular intervals.

Note

Inspection if there are faults or unusual conditions

Unusual conditions or faults that represent overstressing of the motor, e.g. overload or short-circuit, can result in 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.
- Perform the following maintenance measures as specified in the table.

NOTICE
Improper maintenance Service and maintenance must only be performed by properly authorized qualified personnel. Use original Siemens parts only.

Table 10-1 Maintenance measures after operating times or intervals

Machine operation times and intervals	Measure
As required	Monitor and check the motor for unusual noises, vibrations and changes
If required or after 25000 operating hours	Check radial shaft seal ring and replace if worn.
If required or after 25000 operating hours	For 1F□2□03 ... 1F□2□05 motors: Replace motor if necessary. For 1F□2□06 ... 1F□2□10 motors: Check motor bearing and replace if necessary.

The maintenance and repair of the motor can be performed in authorized Siemens Service Centers all over the world.

Contact your personal Siemens representative if you would like to take advantage of this service.

10.2.2 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.

10.2.3 Motor replacement on reaching the bearing life

Motor bearings are wearing parts. They must be replaced after a defined number of operating hours.

At medium loads, the motor bearings last approx. 25000 h.

The procedure for replacing the motor bearing depends on the size of the motor.

For 1F□2□03 ... 1F□2□05 motors, it is not possible to replace the motor bearings. Replace these motors in their entirety.

Replacement of the motor bearings is only intended as from 1F□2□06.

Especially favorable ambient conditions, such as low average speed, low radial force (transverse force) and vibration load can prolong the interval until motor replacement.

Note

Premature bearing and motor replacement

Harsh operating conditions, e.g. continuous operation at n_{max}, high vibration/shock loads, frequent reversing duty reduce the bearing or motor replacement interval by up to 50 %.

The maintenance and repair of the motor can be performed in authorized Siemens Service Centers all over the world.

Contact your personal Siemens representative if you would like to take advantage of this service.

More information is provided in Chapter "Repair, replacing the motor (Page 98)".

10.3 Repair, replacing the motor

This chapter describes the exchange of a motor in short form

Precondition

The new motor has the same article number as the motor to be replaced.

Note

You can replace a motor with a singleturn encoder AS22DQC (1FK2□□□_□□□□□-□S□□) with an otherwise identical motor with a multiturn encoder AM22DQC (1FK2□□□_□□□□□-□M□□) without recommissioning.

Note

If you want to replace the motor with a motor with a different article number, you must perform converter commissioning after replacing the motor.

You will find more precise information in the manual for the converter in question

Procedure

1. Verify absence of operating voltage to the converter.

⚠ 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.

2. Replace the motor.

⚠ 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 protection equipment, e.g. gloves.

   – Release the motor connector. Detailed information is provided in Chapter "Notes for connecting the round connector at the motor".
   – Release the motor mounting screws.
   – Remove the motor.
   – Mount and install the new motor. Detailed information is provided in Chapter "Mounting instructions (Page 60)."
   – Connect the motor plug. Detailed information is provided in Chapter "Notes for connecting the round connector at the motor".

3. Switch the converter on.

❒
You have replaced the motor.

Decommissioning and disposal 11

11.1 Safety instructions

⚠ WARNING

Risk of injury through falling motors or machine components

Motors and machine components can fall when being dismantled from the machine. They can cause serious injury or property damage.

- Secure the machine components being dismantled to prevent them falling.

11.2 Decommissioning, removing the motor

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

Precondition

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

Removing the motor from the machine

Procedure

1. Check to make sure that the motor is voltage-free on all sides.
2. Let the motor cool down enough so that you are not burnt.
3. Disconnect all electrical connections. Information on this is provided in Chapter "Handling the quick-action locking (Page 77)".
4. Remove the fixing elements from the motor.
5. Transport the motor to a suitable location for disposal.

You have removed the motor.
❒

Dispose of the motor in accordance with the local legal requirements.

11.3 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 and characteristics

12

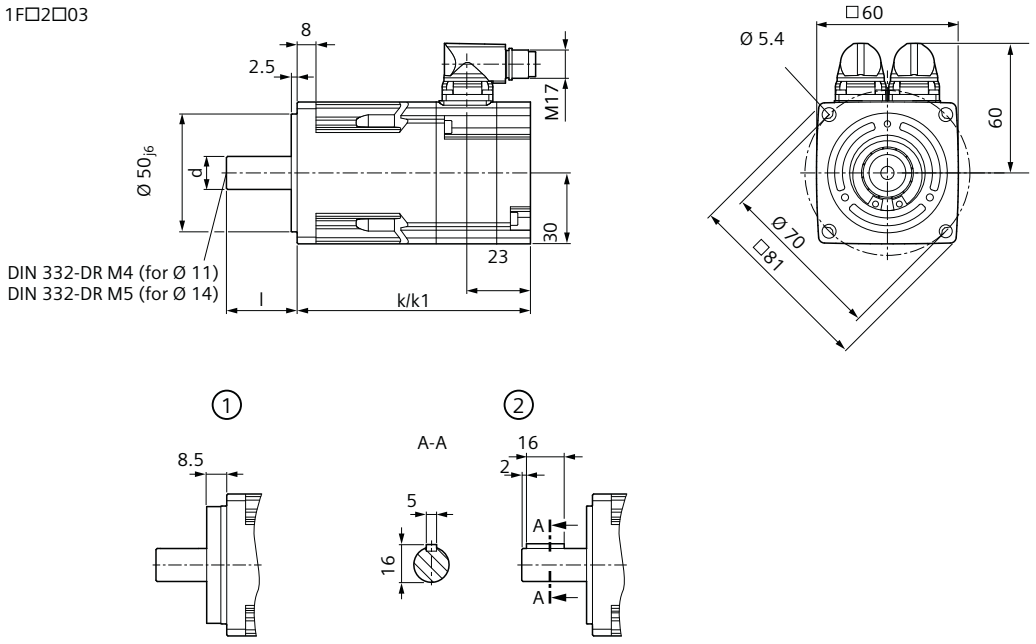
You will find the technical data for the various frame sizes of the motors in the configuration manual in Chapter "Technical data and characteristics".

Dimension drawings

13

13.1 Dimension drawing 1F□2□03

The motor has the following dimensions in the following frame sizes:



① Option with shaft sealing ring

② Option with feather key

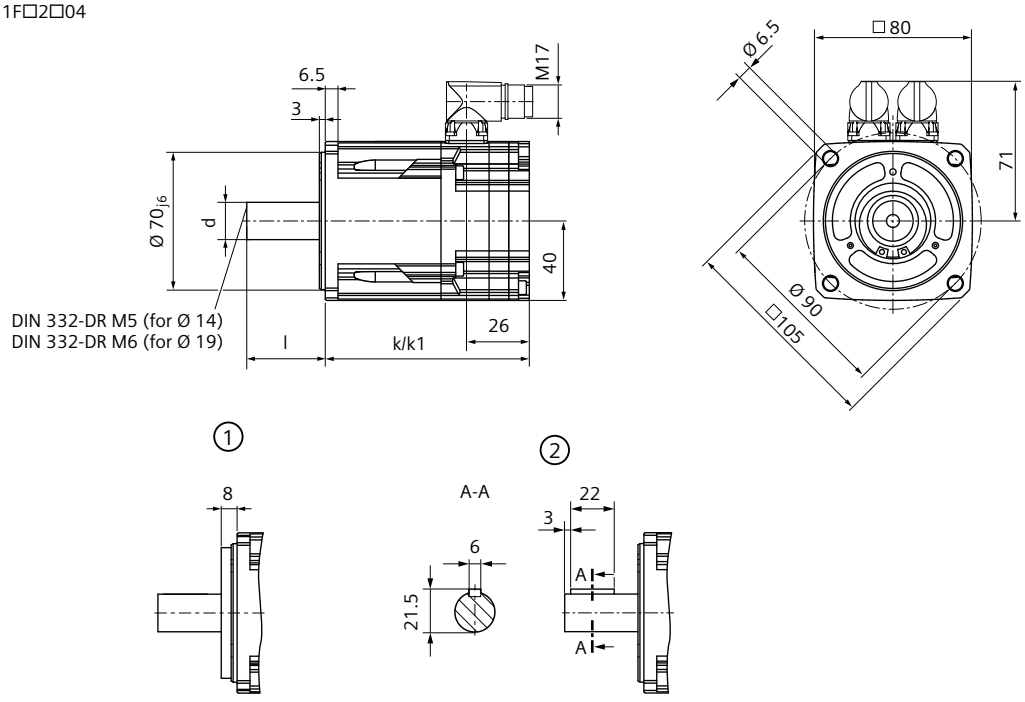
Motor frame size	Overall length of the motor		Shaft option "0" or "1"		Shaft option "2"	
	without brake	with brake				
	k / mm	k1 / mm	d / mm	l / mm	d / mm	l / mm
Motors max. 480 V						
1F□2103-2AH	99	131	14 (h6)	30	11 (k6)	23
1F□2203-2AK						
1F□2103-4AH	123	155				
1F□2203-4AK						

You will find further dimensions in the dimension drawings in the relevant catalog.

13.2 Dimension drawing 1F□2□04

The motor has the following dimensions in the following frame sizes:

1F□2□04



① Option with shaft sealing ring

② Option with feather key

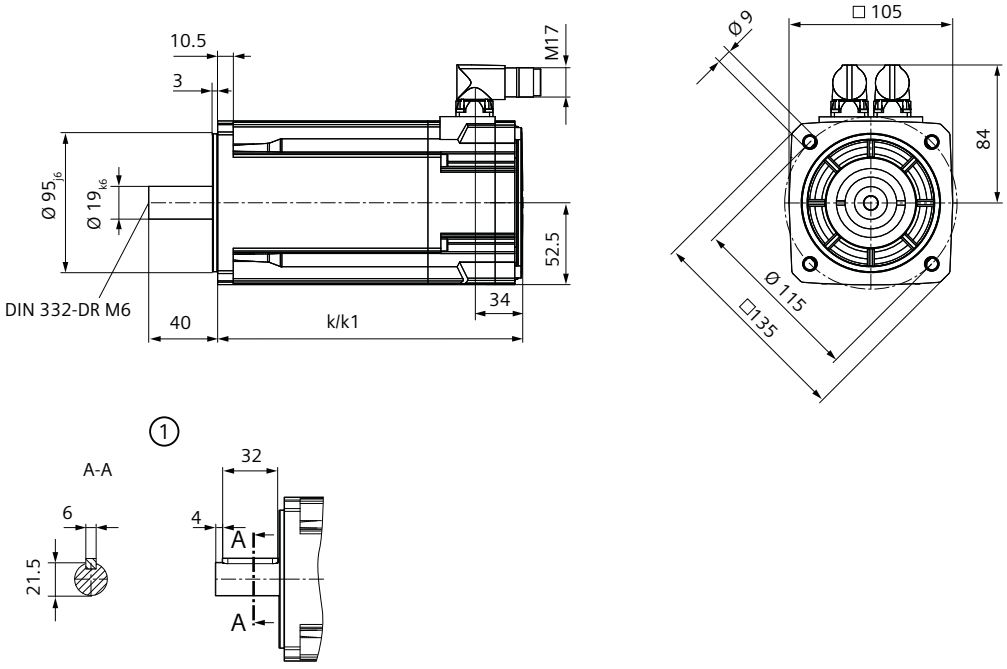
Motor frame size	Overall length of the motor		Shaft option "0" or "1"		Shaft option "2"	
	without brake	with brake				
	k / mm	k1 / mm	d / mm	l / mm	d / mm	l / mm
1F□2104-4	98	142	19 (k6)	40	14 (k6)	23
1F□2□04-5	126	170				
1F□2□04-6	144	188				

You will find further dimensions in the dimension drawings in the relevant catalog.

13.3 Dimension drawing 1F□2105

The motor has the following dimensions in the following frame sizes:

1F□2105



① Option with feather key

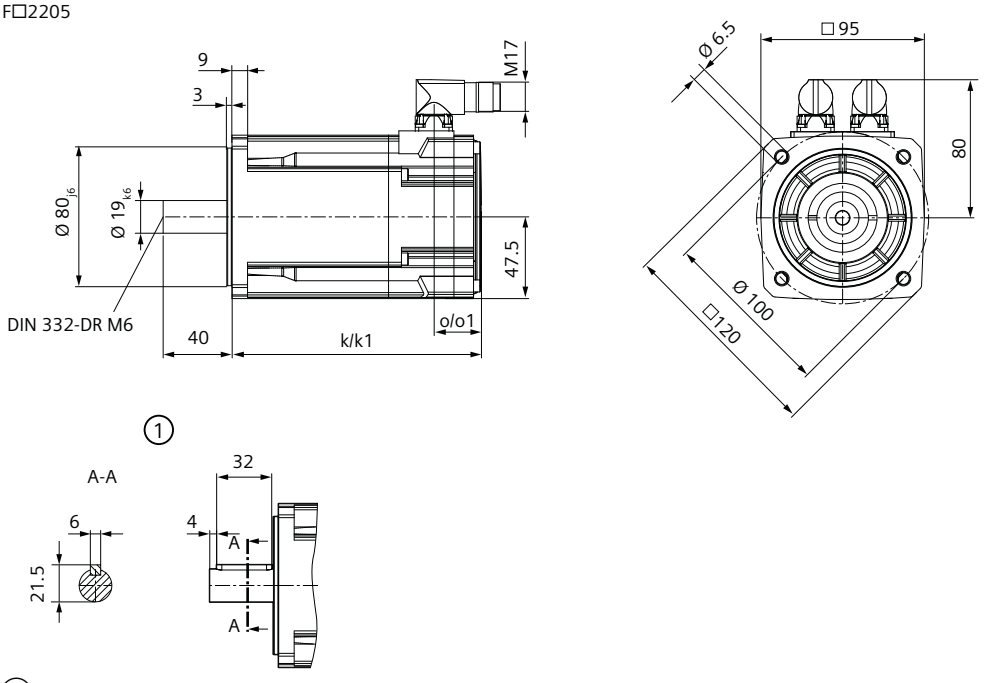
Motor frame size	Overall length of the motor	
	without brake	with brake
	k / mm	k1 / mm
1F□2105-4	173	200
1F□2105-6	215	242

You will find further dimensions in the dimension drawings in the relevant catalog.

13.4 Dimension drawing 1F□2205

The motor has the following dimensions in the following frame sizes:

1F□2205



① Option with feather key

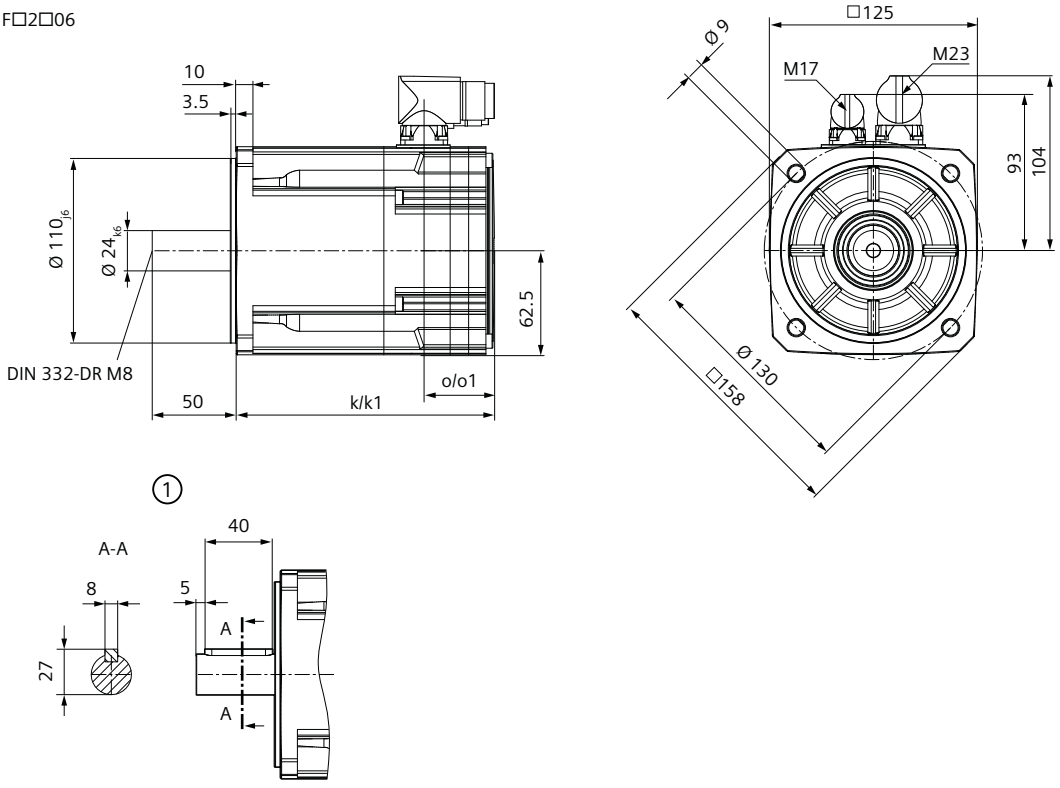
Motor frame size	Overall length of the motor			
	without brake		with brake	
	k / mm	o / mm	k1 / mm	o1 / mm
1F□2205-2	145	41	188	53
1F□2205-4	177		220	

You will find further dimensions in the dimension drawings in the relevant catalog.

13.5 Dimension drawing 1F□2□06

The motor has the following dimensions in the following frame sizes:

1F□2□06



① Option with feather key

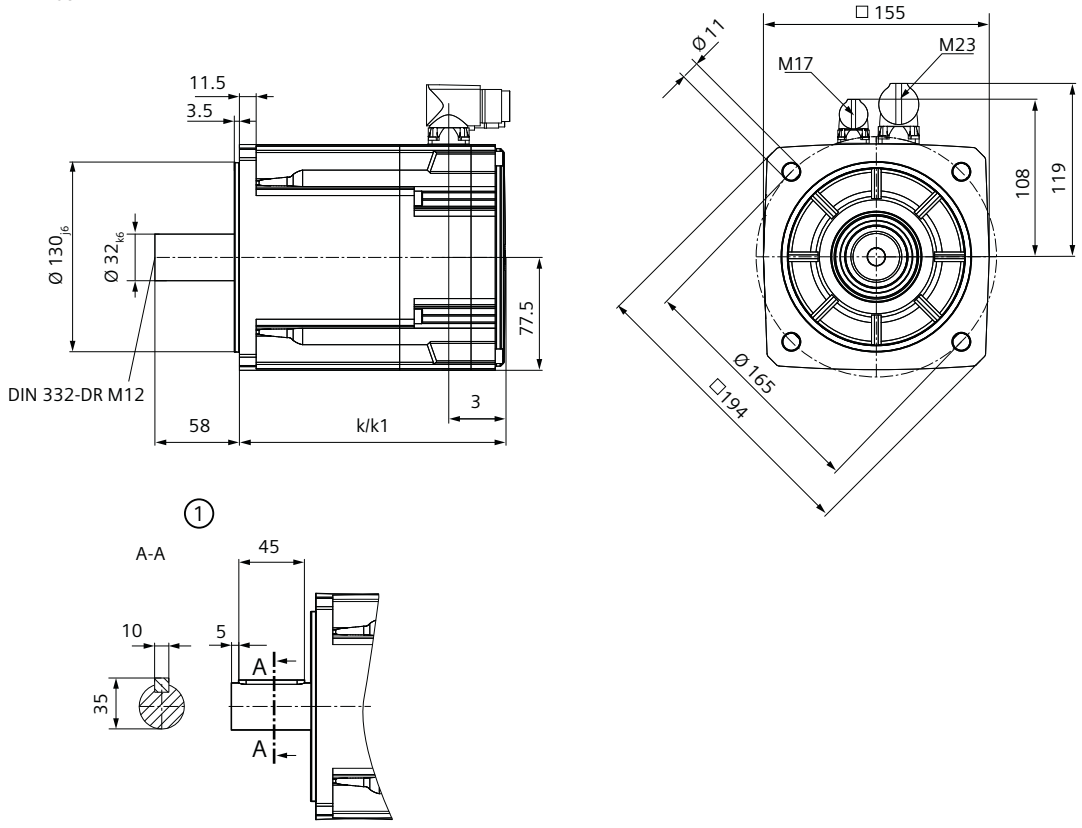
Motor frame size	Overall length of the motor	
	without brake	with brake
	k / mm	k1 / mm
1F□2106-3	174	225
1F□2106-4	193	244
1F□2106-6	232	283
1F□2206-2	154	205
1F□2206-4	193	244

You will find further dimensions in the dimension drawings in the relevant catalog.

13.6 Dimension drawing 1F□2208

The motor has the following dimensions in the following frame sizes:

1F□2208



① Option with feather key

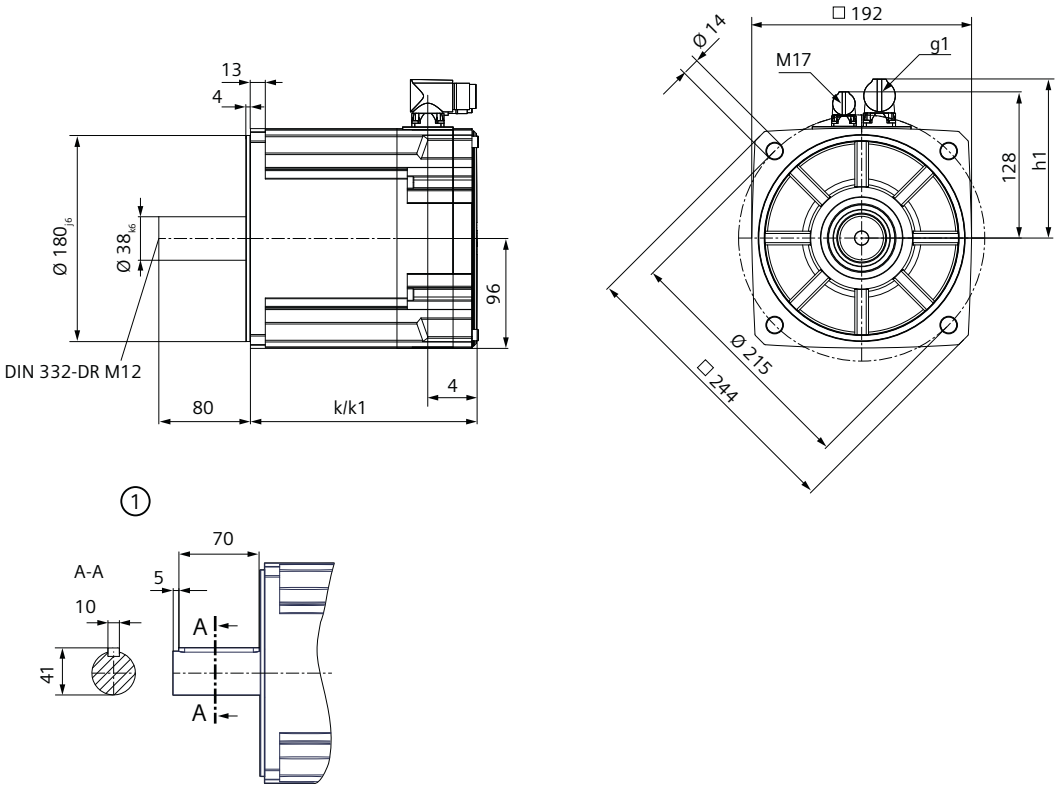
Motor frame size	Overall length of the motor	
	without brake	with brake
	k / mm	k1 / mm
1F□2208-3	183	236
1F□2208-4	203	256
1F□2208-5	223	276

You will find further dimensions in the dimension drawings in the relevant catalog.

13.7 Dimension drawing 1F□2210

The motor has the following dimensions in the following frame sizes:

1F□2210



① Option with feather key

Motor frame size	Connectors		Overall length of the motor	
			without brake	with brake
	g1	h1	k / mm	k1 / mm
1F□2210-3A□	M23	139	198	257
1F□2210-4AB			223	282
1F□2210-4AC				
1F□2210-4AF	M40	159	248	307
1F□2210-5A□				

You will find further dimensions in the dimension drawings in the relevant catalog.

More information

Siemens:
www.siemens.com/simotics

Industry Online Support (service and support):
www.siemens.com/online-support

Industry Mall:
www.siemens.com/industrymall

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