SIEMENS

Edition 10/2021

INSTALLATION MANUAL

SIMOTICS

M-1FE2 built-in motors

For SINAMICS S120

www.siemens.com

SIEMENS

SIMOTICS

SIMOTICS M-1FE2 built-in motors

Hardware Installation Manual

10/2021

A5E50074509B AB

Legal information

Warning notice system

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

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

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

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

NOTICE
indicates that property damage can result if proper precautions are not taken.

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

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

Trademarks

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

Disclaimer of Liability

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

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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

This Hardware Installation Manual addresses installation technicians, commissioning engineers, service and maintenance personnel.

About this Hardware Installation Manual

This Hardware Installation Manual applies to the SIMOTICS M-1FE2 built-in motor, called "1FE2" in the following text.

The Hardware Installation Manual explains how to handle the 1FE2 from delivery to disposal.

The Hardware Installation Manual provides 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.

- Before you start using the motor, you must read this Hardware Installation Manual. This will ensure safe, problem-free operation and maximize the service life of the motor.
- Always follow the safety instructions and notices in this Hardware Installation Manual.

This Hardware Installation Manual complements the relevant Siemens Configuration Manual.

Siemens strives continually to improve the quality of information provided in this Hardware Installation Manual.

- If you find any mistakes or would like to offer suggestions about how this document could be improved, contact the Siemens Service Center.

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).

Internet address for products

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

mySupport

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

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

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

To do so, click "My Documentation".

Note

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

Later, you can log on with your login data.

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

Precondition

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

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.

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.

❒

Websites of third parties

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

Table of contents

Fundamental safety instructions

1

1.1 General safety instructions

⚠ WARNING

Electric shock and danger to life due to other energy sources

Touching live components can result in death or severe injury.

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

Generally, the following steps apply when establishing safety:

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

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

⚠ WARNING

Electric shock due to connection to an unsuitable power supply

When equipment is connected to an unsuitable power supply, exposed components may carry a hazardous voltage. Contact with hazardous voltage can result in severe injury or death.

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

⚠WARNING

Electric shock due to damaged motors or devices

Improper handling of motors or devices can damage them.

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

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

⚠WARNING

Electric shock due to unconnected cable shield

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

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

⚠WARNING

Electric shock if there is no ground connection

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

- Ground the device in compliance with the applicable regulations.

⚠WARNING

Arcing when a plug connection is opened during operation

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

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

NOTICE

Property damage due to loose power connections

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

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

NOTICE

Damage to equipment due to unsuitable tightening tools.

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

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

⚠WARNING

Unexpected movement of machines caused by radio devices or mobile phones

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

- Therefore, if you move closer than 20 cm to the components, be sure to switch off radio devices or mobile telephones.
- Use the "SIEMENS Industry Online Support app" only on equipment that has already been switched off.

⚠WARNING

Unrecognized dangers due to missing or illegible warning labels

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

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

⚠WARNING

Unexpected movement of machines caused by inactive safety functions

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

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

Note

Important safety notices for Safety Integrated functions

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

⚠WARNING

Active implant malfunctions due to electromagnetic fields

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

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

⚠WARNING

Active implant malfunctions due to permanent-magnet fields

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

- If this affects you, maintain the minimum distance to such equipment that is specified in the "Intended use" chapter.
- When transporting or storing permanent-magnet motors always use the original packing materials with the warning labels attached.
- Clearly mark the storage locations with the appropriate warning labels.
- IATA regulations must be observed when transported by air.

⚠WARNING

Injury caused by moving or ejected parts

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

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

⚠WARNING

Fire due to inadequate cooling

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

- Comply with the specified cooling requirements for the motor.

⚠WARNING

Fire due to incorrect operation of the motor

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

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

⚠CAUTION

Burn injuries caused by hot surfaces

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

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

Measures when maintenance is required:

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

1.2 Equipment damage due to electric fields or electrostatic discharge

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

NOTICE

Equipment damage due to electric fields or electrostatic discharge

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

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

1.3 Security information

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

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

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

For additional information on industrial security measures that may be implemented, please visit
https://www.siemens.com/industrialsecurity (https://www.siemens.com/industrialsecurity).

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

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under
https://www.siemens.com/industrialsecurity
(https://new.siemens.com/global/en/products/services/cert.html#Subscriptions).

Further information is provided on the Internet:

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

⚠ WARNING

Unsafe operating states resulting from software manipulation

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

- Keep the software up to date.
- Incorporate the automation and drive components into a holistic, state-of-the-art industrial security concept for the installation or machine.
- Make sure that you include all installed products into the holistic industrial security concept.
- Protect files stored on exchangeable storage media from malicious software by with suitable protection measures, e.g. virus scanners.
- On completion of commissioning, check all security-related settings.

1.4 Residual risks of power drive systems

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

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

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

Special safety notices for handling built-in motors 2

Components with permanent magnets

The synchronous version of the 1FE2 built-in motor contains permanent magnets in the rotor.

⚠WARNING

Danger to life and material damage when incorrectly used

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

- Only use the motors for their intended purpose.
- Make sure that the conditions at the location of use comply with all the rating plate data.
- Make sure that the conditions at the location of use comply with the conditions specified in this documentation. When necessary, take into account deviations regarding approvals or country-specific regulations.

⚠WARNING

Danger to life caused by magnetic and electrical fields to persons with active implants

Electric motors represent a danger for people with active implants who come close to the motors.

- If you are an affected person, maintain a minimum separation of 500 mm to motors.

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

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

⚠WARNING

Electrical shock hazard

Every movement of the rotor compared with the stator and vice versa induces a voltage at the stator power connections.

When the motor is switched on, the stator power connections are also at a specific voltage.

If you use defective cable ports, you could suffer an electric shock.

- Only mount and remove the electrical components if you are qualified to do so.
- Any work carried out at the motor must always be done with the system in a no-voltage condition.
- Do not touch the cable ports. Correctly connect the stator power connections, or insulate them properly.
- Do not disconnect the power connections when the stator is under voltage (live).
- Only use the specific power cables intended for the purpose.
- First connect the protective conductor (PE).
- Connect the cable shield through a wide area.
- First connect the power cable to the stator before you connect the power cable to the inverter.
- First disconnect the connection to the inverter before you disconnect the power connection to the stator.
- Disconnect the protective conductor PE last.

Material damage caused by strong magnetic fields

NOTICE

Data loss caused by strong magnetic fields

If you are close to the rotor (< 100 mm) any magnetic or electronic data medium as well as electronic devices that you are carrying can be destroyed. For example, credit cards, USB sticks, floppy disks and watches are at risk.

- Do not carry any magnetic/electronic data media and no electronic devices when you are close to a rotor!

Description

3

3.1 Correct and intended use

⚠WARNING

Danger to life and material damage when incorrectly used

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

- Only use the motors for their intended purpose.
- Make sure that the conditions at the location of use comply with all the rating plate data.
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If you have any questions regarding the intended usage, please contact your local Siemens office.

Built-in motors are components for installation in machines and for deployment in industrial or commercial plants.

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

The observance of the specifications contained in the installation instructions and the configuration manual is part of the intended purpose.

- Observe the data on the rating plate (type plate).

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

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

The motor is not permitted to be operated in explosion-endangered areas.

1FE2 motors are only certified for frequency converter operation.

Motor applications

The 1FE2 built-in motors have been developed for directly-driven motor spindles.

The installation of the rotor and the stator by the spindle manufacturer results in a motor spindle unit.

WARNING
Danger to life through the use of an incomplete machine If you use a machine that does not conform to the 2006/42/EU decree, there is the danger of death, severe injury and/or material damage. • Commission the machine only when it conforms to the regulations of the EU 2006/42/EU machine decree and the conformity has been declared.

3.2 Overview of the motors

Features of the built-in motors

The 1FE2 built-in motor is a compact drive solution where the mechanical motor power is transferred directly to the spindle without any mechanical transmission elements.

As the motor is mounted between the spindle bearings, the motor spindle has a high degree of stiffness. This means, for example, that C axis mode for turning machines can be implemented using just one drive.

- Water-cooled built-in motor in permanent-magnet synchronous version or asynchronous version

Synchronous version	Asynchronous version
Finish-machined rotor	Unmachined inside diameter of the rotor
Depending on the particular manufacturer version, rotors with sleeve are either prebalanced or not balanced. Rotors with sleeve can be removed.	Rotors without sleeve are not balanced. It cannot be guaranteed that they can be removed without causing damage.

- High speeds and torque dependent on the motor version and frame size

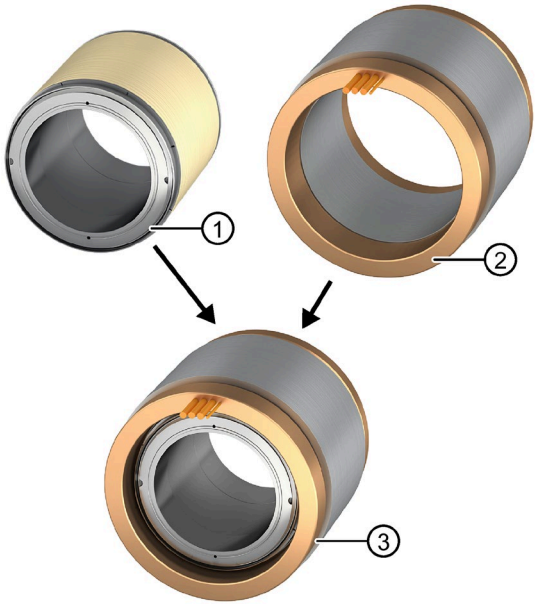
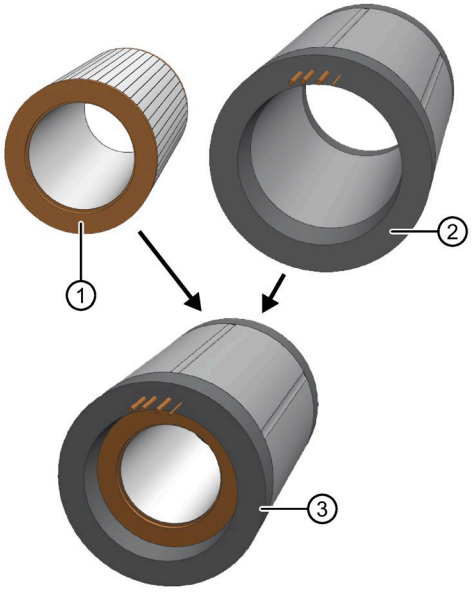
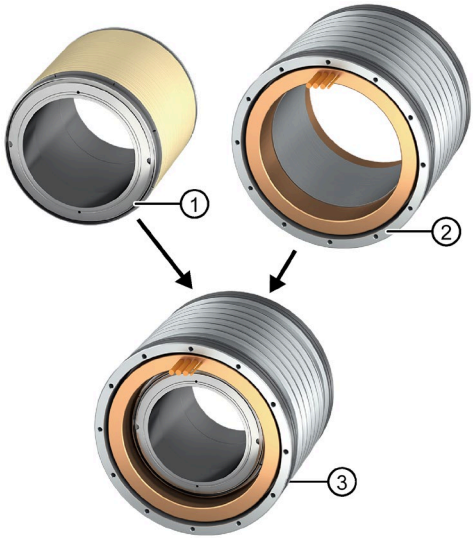
	Synchronous version	Asynchronous version
Maximum speed	Up to 4200 rpm[1)]	Up to 19000 rpm[1)]
Maximum torque	up to 1530 Nm[1)]	up to 1100 Nm[1)]

1) Depending on the frame size

- Torque is transferred without any play through a friction-locked press fit

Overview of the variants of the 1FE2

The 1FE2 built-in motors are supplied as components.
You can select the following versions of the 1FE2 components.

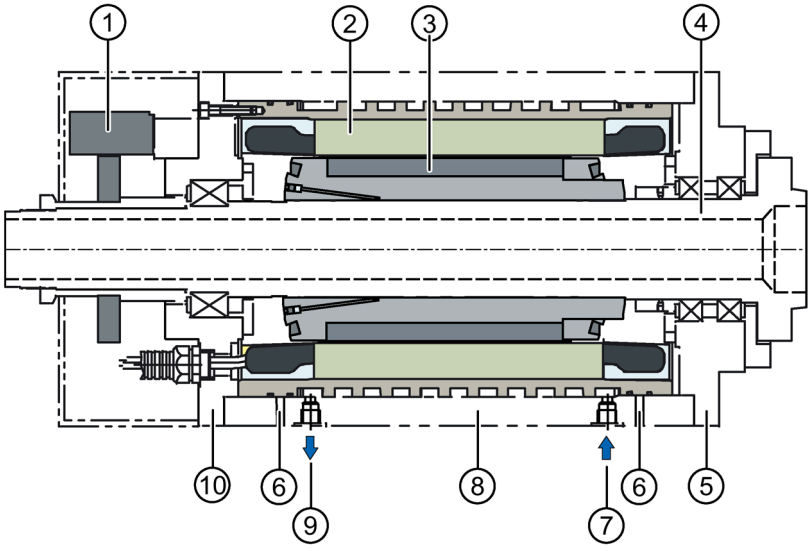
<table>
<tr><th></th><th colspan="2">Synchronous motor</th><th colspan="2">Asynchronous motor</th></tr>
<tr><td>Design without cooling jacket</td><td colspan="2"> 
</td><td colspan="2"> 
</td></tr>
<tr><td></td><td colspan="2">1 Rotor with externally mounted permanent magnets (APM)
2 Stator without cooling jacket (optional)
3 Installed 1FE2 built-in motor (shown without shaft)</td><td colspan="2">1 Rotor with short-circuit cage
2 Stator without cooling jacket (Standard)
3 Installed 1FE2 built-in motor (shown without shaft)</td></tr>
<tr><td>Design with cooling jacket</td><td colspan="2"> 
</td><td colspan="2" rowspan="2"></td></tr>
<tr><td></td><td colspan="2">1 Rotor with externally mounted permanent magnets (APM)
2 Stator with cooling jacket
3 Installed 1FE2 built-in motor (shown without shaft)</td></tr>
<tr><td>Frame sizes (shaft heights)</td><td>16-pole</td><td>1FE218.-8L..</td><td>8-pole</td><td>1FE209☐.-8A..
1FE209☐.-8C..
1FE214☐.-8C..</td></tr>
</table>

A complete motor is created after the rotor has been mounted into the stator.
As a rule, the built-in motor is installed in a motor spindle.

Motor spindle design

A motor spindle comprises the following modules (see the following diagram):

- Spindle housing
- Spindle shaft with bearings
- Built-in motor
- Cooling system
- Encoder system



1	Encoder	6	Drain hole
2	Stator with cooling jacket	7	Inlet cooling water connection
3	Rotor with sleeve	8	Spindle housing
4	Spindle shaft with bearings	9	Outlet cooling water connection
5	End shield DE (Drive End)	10	End shield NDE (Non Drive End)

Figure 3-1 Motor spindle design

Note

The spindle manufacturer is responsible for designing the bearings, lubrication and cooling.

A ferritic spindle shaft is a prerequisite in order to achieve the electrical parameters.

3.3 Technical features and system requirements for built-in motors

3.3.1 Directives and standards

Standards that are complied with

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

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

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

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

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

Relevant directives

The following directives are relevant for SIMOTICS motors.

CE

European Low-Voltage Directive

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

European Machinery Directive

SIMOTICS motors do not fall within the scope covered by the Machinery Directive.

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

European EMC Directive

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

European RoHS Directive

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

European Directive on Waste Electrical and Electronic Equipment (WEEE)

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

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

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

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

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

Eurasian conformity

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

China Compulsory Certification

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

CCC negative certification:

CCC product certification
(https://support.industry.siemens.com/cs/products?search=CCC&dtp=Certificate&mfn=ps&o=DefaultRankingDesc&pnid=13347&lc)

Underwriters Laboratories

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

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

Quality systems

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

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

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

See also

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

3.3.2 Technical features and ambient conditions

Table 3- 1 Technical characteristics of built-in motors

Type of motor	1FE2...-.A.. Built-in motor in asynchronous version with Al squirrel-cage rotor 1FE2...-.C.. Built-in motor in asynchronous version with Cu squirrel-cage rotor 1FE2...-.L.. Built-in motor in synchronous version with permanent magnet rotor
Type of construction	Individual components (IM 5110 acc. to IEC 60034-7): Stator, rotor
Degree of protection	IP00 (acc. to DIN IEC 60034, Part 5): Stator, rotor
Cooling	Water cooling with T_{H2O} = 20 °C acc. to EN 60034-1 (see section "Cooling (Page 62)")
Standard protection - temperature monitoring	2 Pt1000 PTC thermistors in the stator winding (of which 1 is spare)
Full protection (optional)	In addition to the standard protection 1 x PTC thermistor triplet (3 sensors in series) Can be evaluated, e.g. using a thermal motor protection unit: Order No.: 3RN2013-1GW130
Universal protection (optional)	Full protection + NTC PT3-51-F + NTC K227
Winding insulation	Temperature class 155 (F) acc. to EN 60034. At a coolant temperature of 20 °C an average winding overtemperature of 125 K is permitted. The performance data applies for a cooling water temperature of 5 ... 20 °C.
Balance quality of the rotor (acc. to ISO 1940-1)	• Rotor without sleeve, not prebalanced (standard) • Rotor with sleeve, not prebalanced (standard) • Rotor with sleeve, prebalanced (optional): Balancing quality G 2.5 Reference speed 3600 rpm
Motor voltage (terminal voltage)	Regulated: maximum 3 AC 510 V_{rms} Non-regulated: maximum 3 AC 460 V_{rms} Non-regulated: minimum 3 AC 360 V_{rms}
Supply voltage of the SINAMICS S120 drive system	ALM 400 V SLM 400 V ALM 480 V SLM 480 V
Type of connection	Free single cables, length 0.5 m or 1.5 m
Torque ripple	≦ 1 + 0.5 % at 20 rpm and $M_N/2$ based on the rated torque
UL marking	The motors are UL-1004 certified.

Note

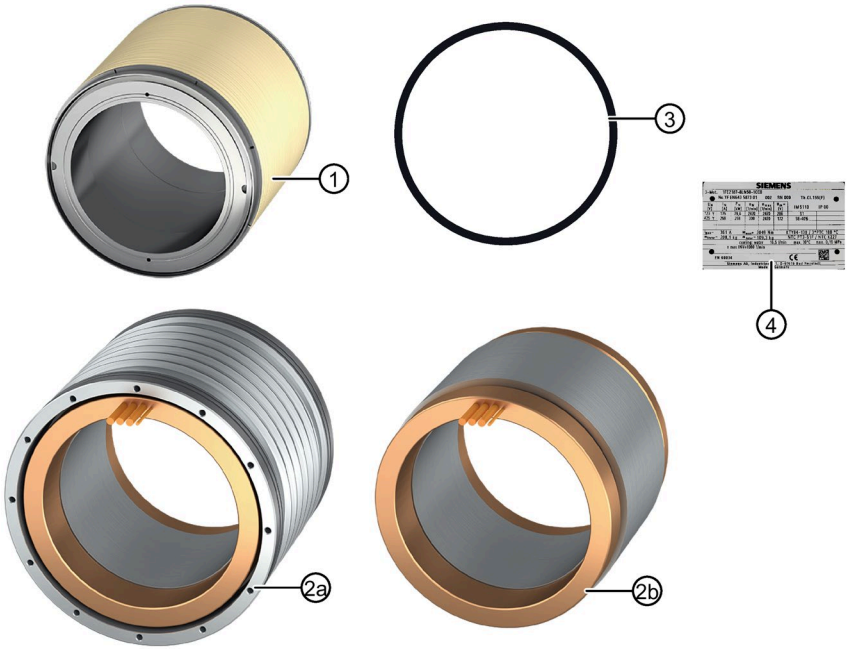
Technical specifications are system data and applicable only in conjunction with the specified system components (1FE2 built-in motor, SINAMICS S120 drive system, VPM, etc.).

3.3.2.1 Structure and characteristics of the synchronous version

Motor parts

Note

Special versions and construction variants may differ in the scope of delivery with respect to certain technical aspects.



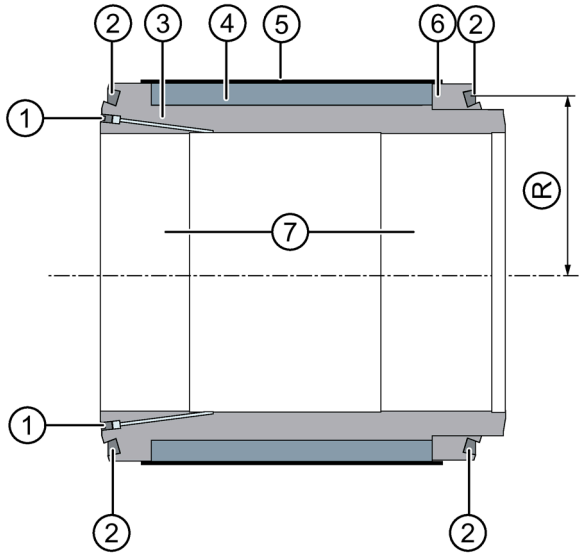
1 APM rotors
2a Stator version with cooling jacket (on request)
2b Stator version without cooling jacket (basic type)
3 Round sealing rings (4x) (for version with standard cooling jacket)
4 Motor rating plate (type plate)

Figure 3-2 Parts of the 1FE2 built-in motor in the synchronous version

Design of the rotor core (APM)

NOTICE
Damage to the rotor bandage due to premature removal of the protection foil A rotor bandage with a foil is provided for transport protection. • Remove the protective foil only immediately before assembly. • Check the bandage for damage.

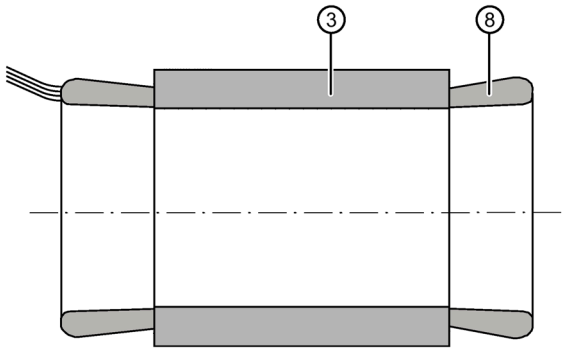
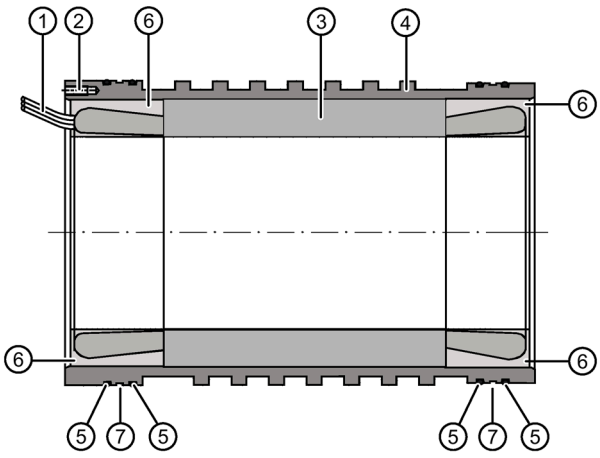
APM rotor core



① Pressure oil connection with grub screw
② Encircling groove for deployable balancing elements
③ Sleeve
④ Rotor core
⑤ Bandage (composite fiber)
⑥ Balancing disk
⑦ Step press fit
R Balancing radius

Figure 3-3 APM rotor core design

Stator design

Stator without cooling jacket (standard version)	Stator with cooling jacket (on request)
	

Stator core in cross-section

1	Cables for power connection and temperature sensors	5	O-ring seal
2	Thread for axial fixation	6	Winding overhang
3	Stator core	7	Leakage channel
4	Cooling jacket with cooling duct	8	Impregnated winding

Rotor weights and moments of inertia_1FE2_synchronous

Rotor weights and moments of inertia for the motor in synchronous version

Table 3- 2

Motor article number	Rotor		Stator	
	J with sleeve in kg•m²	Mass with sleeve in kg	Mass without cooling jacket in kg	Mass with cooling jacket in kg
1FE2182-8LN□□-□CC1	0.75	60	65	110
1FE2182-8LH□□-□CC1	0.75	60	65	110
1FE2183-8LN□□-□CC1	0.9	70	80	130
1FE2183-8LH□□-□CC1	0.9	70	80	130
1FE2184-8LN□□-□CC1	1.05	80	95	150
1FE2184-8LK□□-□CC1	1.05	80	95	150
1FE2184-8LH□□-□CC1	1.05	80	95	150
1FE2185-8LN□□-□CC1	1.2	90	110	170
1FE2185-8LL□□-□CC1	1.2	90	110	170
1FE2185-8LH□□-□CC1	1.2	90	110	170
1FE2186-8LN□□-□CC1	1.35	105	125	190
1FE2186-8LM□□-□CC1	1.35	105	125	190
1FE2186-8LH□□-□CC1	1.35	105	125	190
1FE2187-8LN□□-□CC1	1.49	115	135	210
1FE2187-8LH□□-□CC1	1.49	115	135	210

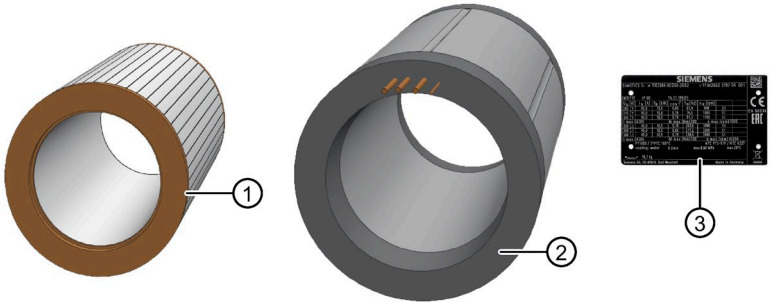
The mass values are rounded.

3.3.2.2 Design and characteristics of the asynchronous versions 1FE2....-.A... and 1FE2...-.C...

Motor parts

Note

Special versions and construction variants may differ in the scope of delivery with respect to certain technical aspects.

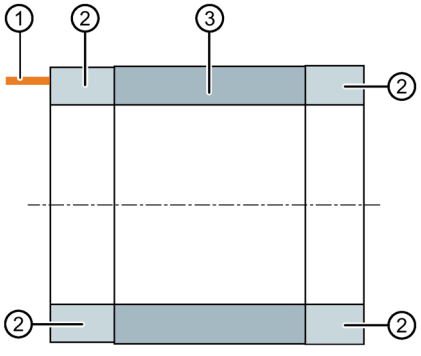


1 Rotor in Cu or Al version
2 Stator without cooling jacket
3 Motor rating plate (type plate)

Figure 3-4 Parts of the 1FE2 built-in motor in the asynchronous version

Design of the stators for the asynchronous version

Stator without cooling jacket



1 Cables for power connection and temperature sensors
2 Winding overhang, cast
3 Stator core

Figure 3-5 Stator without cooling jacket, cast, cross-section

Rotor weights and moments of inertia for the motor in asynchronous version

Motor article number	Rotor		Stator
	J without sleeve in kgm²	Mass without sleeve in kg	Mass without cooling jacket in kg
1FE2093-8A□□□-□□□□	0.0203	6.4	16
1FE2094-8A□□□-□□□□	0.0266	8.5	20
1FE2094-8C□□□-□□□□	0.0377	12.2	20
1FE2095-8C□□□-□□□□	0.0443	14.3	24
1FE2145-8C□□□-□□□□	0.2667	36.1	63
1FE2147-8C□□□-□□□□	0.3589	48.6	81

The mass values are rounded.

3.3.3 Features, properties, and system preconditions

Features

- 1FE2 in 8-pole version as asynchronous motor
- 1FE2 in 16-pole version as synchronous motor
- Maximum speed up to 19000 rpm (depending on frame size)
- Maximum rated torque up to 1530 Nm (depending on the frame size)
- Torque is transferred to the spindle without any play through a friction-locked press fit
- Rotor without sleeve, optionally machined ready for installation
- Optional rotor with sleeve for removal in pressurized oil procedure, optionally prebalanced
- Stator with cast winding without cooling jacket, finish machined
- Optional stator with cooling jacket machined ready for installation

Properties

Magnetic attraction

Forces of attraction occur between the rotor and stator in electric motors to the magnetic principle.

The surrounding mechanical assembly must be able to withstand these forces.

To prevent vibration excitations, the enclosing construction (spindle shaft, bearings, spindle housing) should be as rigid as possible.

Accuracy

The achievable machining accuracy of the motor spindle is influenced by:

- The rigidity of the system (housing, bearings, spindle)
- The smooth running of the motor spindle
- The closed-loop control technology and the encoder resolution

The spindle manufacturer is responsible for the achieved accuracy.

Degree of protection

Note

Degree of protection selection

The spindle manufacturer is responsible for the selection of the degree of protection, its variant and the proof of suitability.

The motor components must be protected from moisture, foreign bodies and contact.

As delivered, the stator and the rotor have degree of protection IP00 in accordance with EN 60034-5.

The final degree of protection is defined by the spindle manufacturer as a result of the mechanical design of the spindle housing.

Recommended degree of protection: IP54 (minimum degree of protection)

Static charging

⚠WARNING

Danger to life caused by static charging of the rotor

The rotor can be statically charged at higher speeds depending on the mechanical spindle design as well as the properties of the spindle bearings (e.g. grease and minimum oil lubrication). This can cause an electric shock if touched.

- If ceramic bearings are used, avoid voltage discharges from the shaft to the sensor housing caused by grounding the motor shaft.

Closed-loop control

The determining factors of closed-loop control include:

- The number of encoder signals per spindle revolution
- The precision achieved when mounting and adjusting the encoder system
- Multiplication of the encoder signals
- The sampling time of the current and speed controller

EMF = Electro Motive Force (applies only to synchronous motors)

Note

EMF > 820 V

Depending on the amplitude of the induced chained voltage at maximum speed (field EMF > 820 V), a Voltage Protection Module (VPM) may be required; see "Voltage limitation" section.

System requirements for the closed-control

Ensure the following requirements:

- Open-loop and closed-loop control modules

	Synchronous motors	Asynchronous motors
	From software release	From software release
SINAMICS S120	V4.8	5.2 SP3
SINUMERIK 828D sl	V4.8	4.94
SINUMERIK ONE		6.13
SINUMERIK 840D sl		4.94

Note

Operation with older software versions

If you operate the motors with older software versions, you must commission the motors as if they were made by other manufacturers. This may involve limitations of the technical performance.

Contact your Siemens Technical Support for more information.

- Hollow-shaft measuring system

Parameterizing the converter

The rated data of the motors applies for a converter pulse frequency of 4 kHz.

Motors whose maximum speeds exceed the following speeds must be operated with a converter frequency of 8 kHz and a current controller cycle of 62.5 µs.

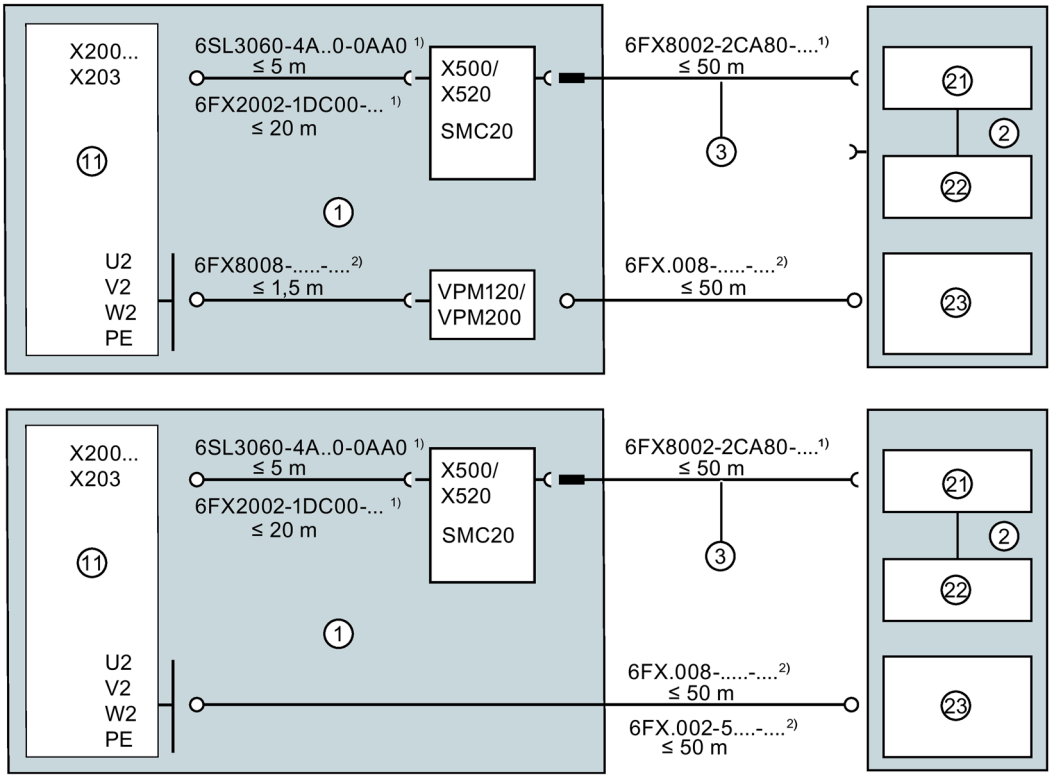
- 1FE2...-8A...-.... : 12,000 rpm
- 1FE2...-8C...-.... : 12,000 rpm

Observe an appropriate Motor Module derating and the configuration specifications of the S120. The rated motor current is the basis when selecting the Motor Module.

Versions of the system integration for synchronous motors

The following diagrams show the possible system integration configurations of the 1FE2 in synchronous version.

General rule: Motor with standard protection, integrated into the system via SMC20, with or without VPM



1) Article numbers for prefabricated MOTION-CONNECT signal cables, M23 connector size

2) Article numbers for prefabricated MOTION-CONNECT power cables

1 Control cabinet

11 SINAMICS S120 Motor Modules, Booksize format, DRIVE CLiQ communication via SMC20

2 1FE2 built-in motor

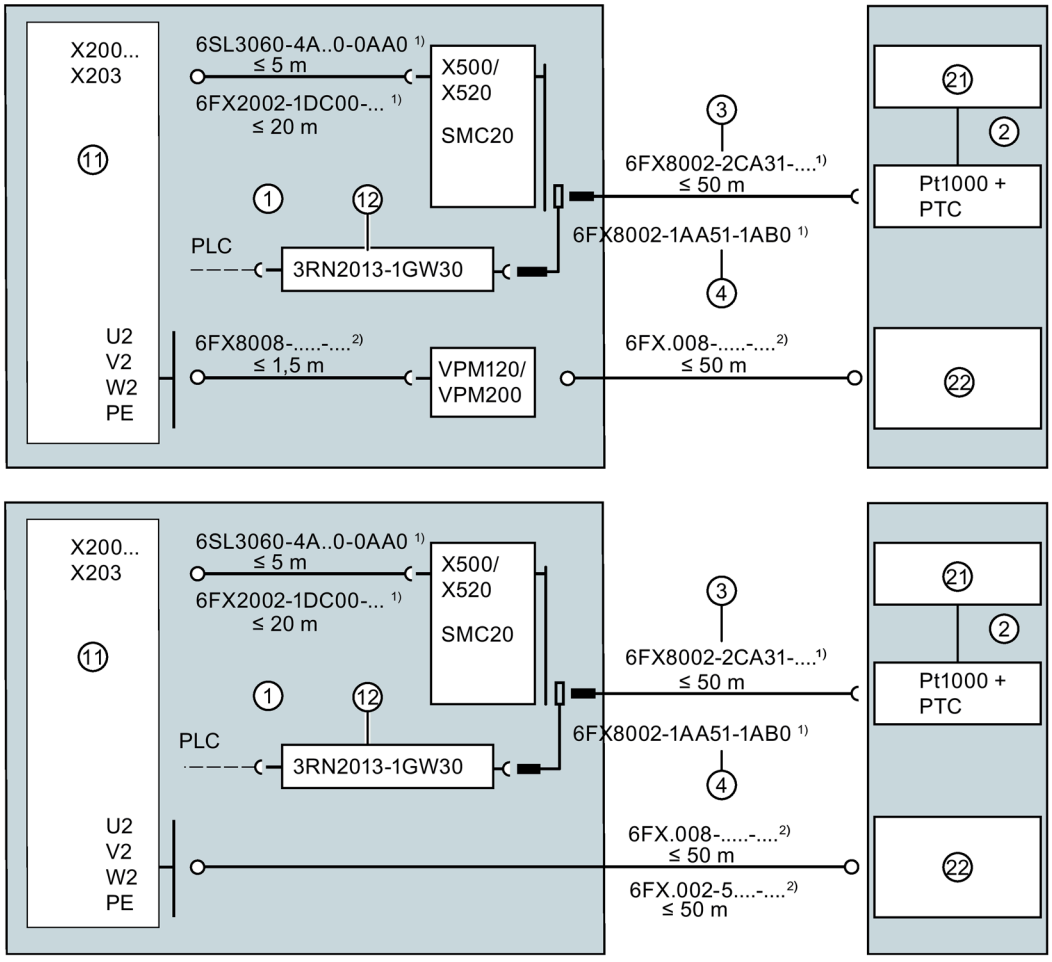
21 Incremental encoder sin/cos 1 Vpp or EnDat 2.1 absolute encoder

22 Pt1000 temperature sensor

23 1FE2 winding, connection via terminal box

3 Signal cable for encoder and temperature sensor,
17-pin M23 round connector

Motor with full protection, integrated into the system via SMC20, with or without VPM



1) Article numbers for prefabricated MOTION-CONNECT signal cables, M23 connector size

2) Article numbers for prefabricated MOTION-CONNECT power cables

1 Control cabinet

11 SINAMICS S120 Motor Modules, Booksize format, DRIVE CLiQ communication via SMC20

12 Tripping unit

2 1FE2 built-in motor

21 Incremental encoder sin/cos 1 Vpp or EnDat 2.1 absolute encoder

22 1FE2 winding, connection via terminal box

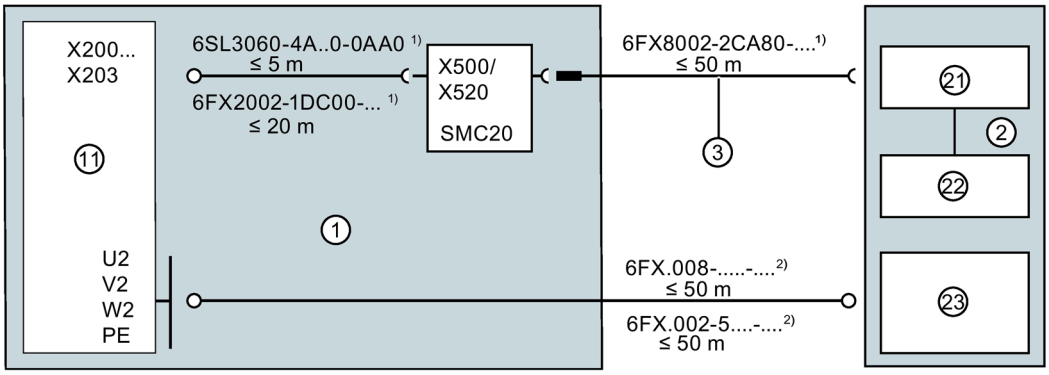
3 Signal cable for encoder and temperature sensor,
17-pin M23 round connector

4 Signal cable for PTC via tripping unit

Versions of the system integration for asynchronous motors

The following diagrams show the possible system integration configurations of the 1FE2 in asynchronous version.

General rule: Motor with standard protection, integrated into the system via SMC20



1) Article numbers for prefabricated MOTION-CONNECT signal cables, M23 connector size

2) Article numbers for prefabricated MOTION-CONNECT power cables
≤ 25 m in the case of star-delta changeover in the control cabinet

1 Control cabinet

11 SINAMICS S120 Motor Modules, Booksize format, DRIVE CLiQ communication via SMC20

2 1FE2 built-in motor

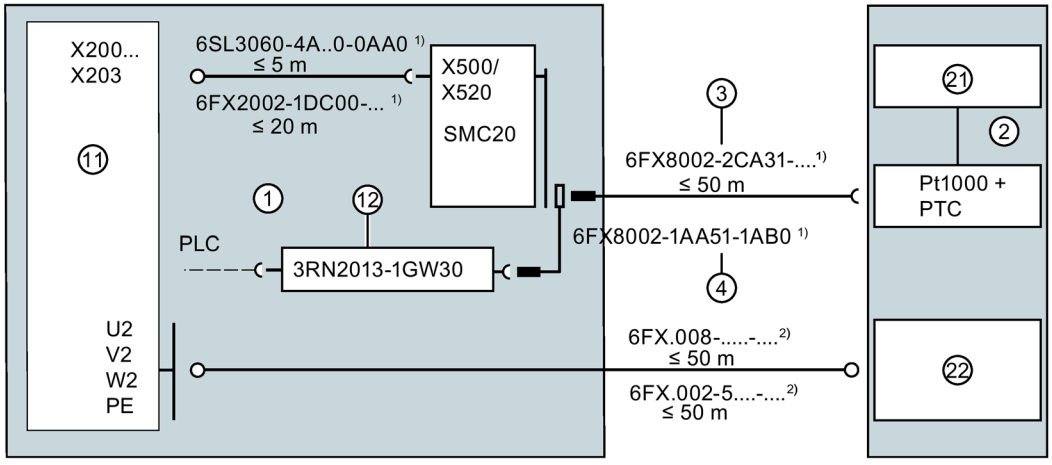
21 Incremental encoder sin/cos 1 Vpp or EnDat 2.1 absolute encoder

22 Pt1000 temperature sensor

23 1FE2 winding, connection via terminal box

3 Signal cable for encoder and temperature sensor,
17-pin M23 round connector

Motor with full protection, integrated into the system via SMC20



1) Article numbers for prefabricated MOTION-CONNECT signal cables, M23 connector size

2) Article numbers for prefabricated MOTION-CONNECT power cables
≤ 25 m in the case of star-delta changeover in the control cabinet

1 Control cabinet

11 SINAMICS S120 Motor Modules, Booksize format, DRIVE CLiQ communication via SMC20

12 Tripping unit

2 1FE2 built-in motor

21 Incremental encoder sin/cos 1 Vpp or EnDat 2.1 absolute encoder

22 1FE2 winding, connection via terminal box

3 Signal cable for encoder and temperature sensor,
17-pin M23 round connector

4 Signal cable for PTC via tripping unit

3.3.4 Version and operating modes of the motor in the synchronous version

1FE2 motors of shaft height 180 (1FE218☐) consist of two winding systems, i.e. each motor has six connecting cables (three connecting cables for each winding system).

Both partial windings are galvanically separated and only weakly coupled magnetically.

This means the motors can be operated in two different ways.

Option 1: Connection of the two windings to one (large) power section and the "classic" operation of the motor on a CU/NCU.

Option 2: Connection of each partial winding to its own (small) power section and operation of the (complete) motor using

- a master-slave closed-loop control or
- the SINAMICS OA Support Package with the Technology Extension SERVCOUP

to a CU/NCU (e. g. operation of 1FE218□ motors with rated current I_N > 200 A on booksize power sections) (see following table).

1FE2184-8LH□□-□CC1	
1FE2185-8LH□□-□CC1	
1FE2186-8LH□□-□CC1	
1FE2187-8LH□□-□CC1	
Operating modes for	
$n \leq n_{max\_inv}$	$n > n_{max\_inv}$
1. Operation on a chassis power section without VPM module 2. Parallel circuit on two booksize power sections without VPM modules	Operation on two booksize power sections with two VPM modules

Motors with rated current > 200 A

Note

Option 2 allows individual power sections to be deployed whose current/power data lies below the current/power data of the complete motor.

Note

The motor cannot be operated on a pure parallel circuit for SINAMICS booksize power sections or with only one partial winding system.

Possible variants of the master-slave closed-loop control:

Option 1	Option 2
Deployment of "SERVCOUP" OA software	Application created by the user
Encoder evaluation on the master, encoder information is forwarded internally to the slave via DRIVE-CLiQ	The encoder information must be made available to the master and slave (encoder switch necessary)
The OA software ensures the correct current/torque distribution in the motor	The user application must ensure the uniform current/torque distribution in the motor
The OA software ensures the mutual error monitoring for the master and slave	The user application must ensure the correct fault response within the master-slave unit

Both procedures are described in the following chapters.

Note

For a master-slave layout (each partial winding connected to its own power section), operation with only one winding system or an asymmetric current distribution between master and slave is not envisaged or excluded by the customer. This is true not only for the commissioning phase but also for any emergency operation with only one winding.

Operation with booksize power section

Practical advantages:

- You can arrange the converter components variably in the work machine.
- Less installation space is required compared with a chassis module.

Operation with chassis power section

No suitable VPM is currently available for operation of the motor on a chassis power section.

- Reduce the permitted maximum speed of the motor to the converter maximum speed n_{max_Inv} specified in the datasheets.

Note

Always operate the power sections with a pulse frequency of f_p = 4 kHz.

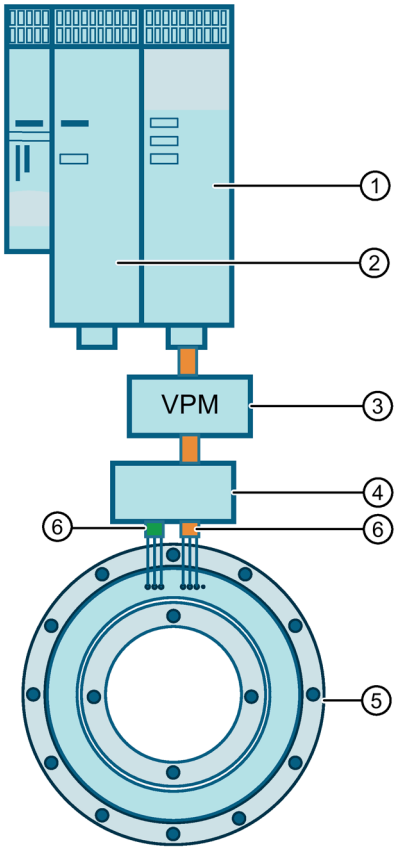
Note

The 1FE218□ motors do not require a series reactor.

3.3.4.1 Operation on a power section

For operation of the 1FE218☐ on a power section, the two partial winding systems of the stator are connected together in the motor terminal box using the following assignment. 1U1 and 2U1 → U, 2V1 and 2V1 → V, 1W1 and 2W1 → W

For this operational case, the values are specified on the datasheets or in the converter software.



1 Motor Module power unit
2 Line Module infeed
3 Voltage limiting module (VPM), if necessary
4 Terminal box
5 1FE218☐ built-in motor
6 Motor cables of the partial windings (partial winding 1: 1U1, 1V1, 1W1; partial winding 2: 2U1, 2V1, 2W1)

Figure 3-6 General design 1FE218☐ on SINAMICS S120 booksize (one power section)

3.3.4.2 Operation on two power sections

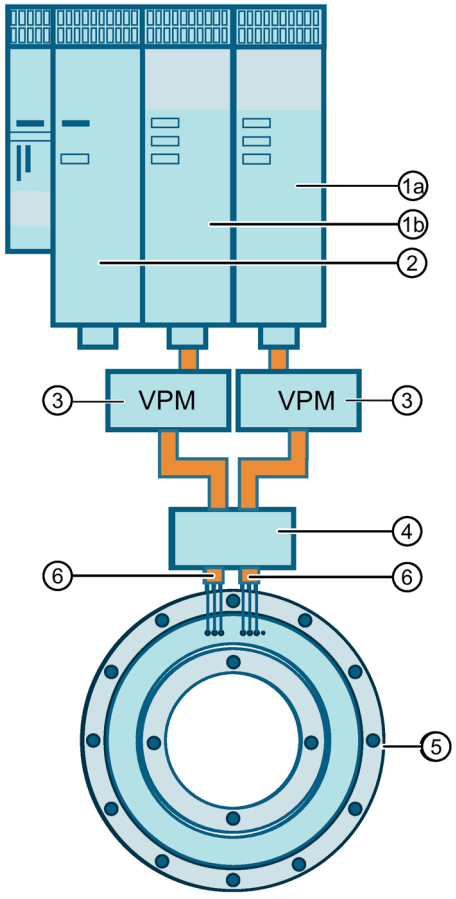
Precondition

Two identical power sections (Motor Modules) with the same software release.
Both power sections are connected to the same DC link.

Note

The power of a 120 kW infeed (Active Line Modules) can be doubled by using an appropriate parallel circuit Both power sections then operate on a shared DC link.

Otherwise deploy an infeed unit from the chassis area.



1a Master power unit (Motor Module)
1b Slave power unit (Motor Module)
2 Line Module infeed
3 Voltage limiting modules (VPM), if necessary
4 Terminal box
5 1FE218☐ built-in motor
6 Motor cables of the partial windings (partial winding 1: 1U1, 1V1, 1W1; partial winding 2: 2U1, 2V1, 2W1)

Figure 3-7 General design 1FE2 booksize parallel circuit (two power sections)

Note

- Use a shared DC link.
- Deactivate the displaced cycles.

If both notes are not observed, the motor can be damaged.

Recommendation:
Use the "SERVCOUP" OA software. This permits a simple design, a simple commissioning and a better quality operation.

We recommend the use of an encoder switch / signal splitter from the following manufacturers:

- DR. JOHANNES HEIDENHAIN GmbH
  www.heidenhain.de

or

- BaumerHübner
  www.baumer.com

3.3.4.3 Conversion of the converter setting data

As standard, the 1FE218☐ motor data always relates to the complete motor (both partial windings) and is stored in the converter software. The values in the datasheets also refer to the complete motor.

The values cannot be parameterized 1:1 for the master-slave operation. They must convert the values to the individual subconverters.

The following example shows the conversion procedure.

Motor type: 1FE2184-8LH☐☐-☐CC1

V_{motor}: 425 V

Parameter Sinamics	Parameter Simodrive	Designation	Variable	Values	Units
	P1102	SIMODRIVE code number	Code no.		
P0300		SINAMICS motor type		232	-
P0301		SINAMIC code number	Code no.		
	P1000	current controller cycle time	f_i	4	x * 31.25 µs
	P1015	Activate PE-HSA (1=on; 0=off)	PE-HSA	1	-
	P1075	pole position identification mode		1	
P1980		Pole position identification mode		1	
	P1019	Current pole position identification [% of P1104] current pole position identification	$I_{Rotor\ position}$	30	%
P0329		SINAMICS current pole position identification current pole position identification	$I_{Rotor\ position}$	141	A_{rms}
	P1020	Allowed angle pole position identification allowed angle pole position identification	α_{PLI}	10	°
P1981		Allowed angle pole position identification allowed angle pole position identification	α_{PLI}	10	°
	P1100	Frequency pulse-width-modulation	f_p	4000	Hz
P0305	P1103	Nominal motor current	I_n	226	A_{rms}
P0323	P1104	Maximum motor current	I_{max}	469	A_{rms}
P0314	P1112	Number of motor pole pairs	p	8	–
P0316	P1113	Torque constant	k_t	4.48	Nm/A
P0317	P1114	Voltage constant	k_e	294	$V_{eff\ verk}/1000min^{-1}$
P0350	P1115	Phase resistance	R_a	0.0281	Ω
		Inductance of d-axis	L_d	0.829	mH
P0356	P1116	Inductance of q-axis	L_q	0.72	mH
P0341	P1117	Rotor inertia w.o. sleeve [1)]	J_m [1)]	0.54	kg/m^2
	P1118	Motor standstill current	I_0	228	A_{rms}
	P1122	Motor current limit	I_{max}	469	A_{rms}
P0338		Motor current limit	I_{max}	469	A_{rms}
P0327	P1128	Optimum load angle	α_{opt}	90	°
P0328	P1149	Reluctance torque constant	$k_{Trelu??}$	0	mH
P0320	P1136	Motor short circuit current:	I_k	244	A_{rms}
P0348	P1142	Starting speed for field weakening	n_{FS}	1440	$min.^{-1}$
P0326	P1145	Pull-out torque derating factor	k_{Red}	53	%
P0322	P1146	Maximum motor mechanical speed	n_{max}	4200	$min.^{-1}$
P0311	P1400	Motor rated speed	n_n	1000	$min.^{-1}$
	P1180	Current controller adaptation lower limit [% of P1104] adaptation current controller lower limit		0	%
P0391		Current controller adaptation lower limit adaptation current controller lower limit		0	A_{rms}
	P1181	Current controller adaptation upper limit [% of P1104] adaptation current controller upper limit		100	%
P0392		Current controller adaptation upper limit adaptation current controller upper limit		469	A_{rms}
P0393	P1182	Derating factor current controller		70	%
P1402.2	P1183	Current controller adaptation on (0=off; 1=on) Current controller adaptation on/off		1	
P0604	P1602	Motor temperature warning threshold	T_{Alarm}	150	°C
P0605	P1607	Motor temperature shutdown threshold motor temperature breaking threshold	T_{trip}	160	°C
P0318		Hold-up current 100K	I_0	228	A_{rms}
P0319		Hold-up torque 100K	M_0	1020	Nm
P0312		Rated torque	M_n	1007	Nm
P0304		Rated voltage	U_n	425	$V_{eff\ verk??}$
P0307		Rated motor power	P_n	105.5	kW
P0321		Maximum motor voltage DC	$U_{max\ DC}$	600	V_{DC}
P0335		Motor cooling (0=self; 1=external; 2=water)	-	2	-

1) Values with rotor sleeve, see 1FE2 Configuration Instructions or customer-specific documentation

Figure 3-8 Converter setting data

The winding of the 1FE218x for the connection of the free cable ends of the same phases is a parallel circuit from two partial windings.

This produces the following conversion:

Voltage	$U_1 = U_2 = U_{EMF} \rightarrow k_{E1} = k_{E2} = k_E \rightarrow k_{T1} = k_{T2} = k_T$
Speed	$n_1 = n_2 = n$
Thermal time constant	$T_{th1} = T_{th2} = T_{th}$
Rating	$P_1 = P_2 = P/2$
Torque	$M_1 = M_2 = M/2$
Current	$I_1 = I_2 = I/2$
Moment of inertia	$J_1 = J_2 = J/2$
Motor weight	$m_1 = m_2 = m/2$
Resistance	$R_1 = R_2 = 2R$
Inductance	$L_1 = L_2 = 2L$

The indexes refer to the winding halves 1 or 2. The value without index designates the value for the complete motor.

The connection cables and the water quantity are halved on the hardware.

Example for the conversion of the converter setting data of a 1FE2184-8.H in master-slave operation (specification per winding):

Parameter	Designation	Total	Master	Slave	Index
Parameters(145, 0)	'Enable/disable encoder interface	1	1	2	1)
Parameters(300, 0)	'Motor type selection	2	2	2	
Parameters(305, 0)	'Rated motor current	226	113	113	6)
Parameters(307, 0)	'Rated motor power	105.5	52.8	52.8	6)
Parameters(311, 0)	'Rated motor speed	1000	1000	1000	6)
Parameters(312, 0)	'Rated motor torque	1007	503.5	503.5	6)
Parameters(314, 0)	'Motor pole pair number	8	8	8	6)
Parameters(316, 0)	'Motor torque constant	4.48	4.48	4.48	6)
Parameters(317, 0)	'Motor voltage constant	294	294	294	6)
Parameters(318, 0)	'Motor stall current	228	114	114	6)
Parameters(319, 0)	'Motor static torque	1020	510	510	6)
Parameters(320, 0)	'Motor rated magnetizing current / short-circuit current	244	122	122	6)
Parameters(322, 0)	'Maximum motor speed	2000	4200	4200	6)
Parameters(323, 0)	'Maximum motor current	469	234.5	234.5	6)
Parameters(325, 0)	'Motor pole position identification current 1st phase	14.1	7.05	7.05	6)
Parameters(326, 0)	'Motor stall torque correction factor	53	53	53	6)
Parameters(329, 0)	'Motor pole position identification current	141	70.5	70.5	6)
Parameters(338, 0)	'Motor limit current	469	234.5	234.5	6)
Parameters(341, 0)	'Motor moment of inertia	1.05	0.525	0.525	6)
Parameters(344, 0)	'Motor weight (for thermal motor type)	230	115	115	6)
Parameters(348, 0)	'Speed at the start of field weakening Vdc = 600 V	1440	1440	1440	6)

Parameter	Designation	Total	Master	Slave	Index
Parameters(350, 0)	'Motor stator resistance, cold	0.0281	0.0562	0.0562	6)
Parameters(356, 0)	'Motor stator leakage inductance	0.723	1.446	1.446	6)
Parameters(392, 0)	'Current controller adaptation, starting point KP adapted	469	234.5	234.5	6)
Parameters(393, 0)	'Current controller adaptation, P gain adaptation	70	70	70	6)
Parameters(400, 0)	'Encoder type selection	9999	9999	9999	4)
Parameters(404, 0)	'Encoder configuration effective	&H109010	&H109010	&H109010	4)
Parameters(408, 0)	'Rotary encoder pulse number	256	256	256	4)
Parameters(425, 0)	'Encoder, rotary zero mark distance	256	256	256	4)
Parameters(431, 0)	'Commutation angle offset	83	83	0	1)
Parameters(604, 0)	'Mot_temp_mod 2 / KTY alarm threshold	150	150	150	6)
Parameters(605, 0)	'Mot_temp_mod 41671 threshold	160	160	160	6)
Parameters(611, 0)	'I2t motor model thermal time constant	240	240	240	6)
Parameters(612, 0)	'Mot_temp_mod activation	&H1	&H1	&H1	
Parameters(640, 0)	'Current limit	469	234.5	234.5	5)
Parameters(643, 0)	'Overvoltage protection for synchronous motors	0	1	1	
Parameters(845, 0)	'BI: No coast down / coast down (OFF2) signal source 2	1	722:10:01	722:10:01	VPM
Parameters(1082, 0)	'Maximum speed	2000	4200	4200	6)
Parameters(1441, 0)	'Speed actual value smoothing time	0.2	0.2	0.2	4)
Parameters(1460, 0)	'Speed controller P gain adaptation speed lower	700	350	0	1) & 5)
Parameters(1520, 0)	'CO: Torque limit, upper/motoring	2006	1021	1021	5)
Parameters(1521, 0)	'CO: Torque limit, lower/regenerative	-2006	-1021	-1021	5)
Parameters(1530, 0)	'Power limit, motoring	210	107	107	5)
Parameters(1531, 0)	'Power limit, regenerative	-210	-107	-107	5)
Parameters(1612, 0)	'Current setpoint, open-loop control, encoderless	112.5	56.5	56.5	
Parameters(1715, 0)	'Current controller P gain	2.0	6.0	6.0	
Parameters(1752, 0)	'Motor model, changeover speed operation with encoder	238	153	153	
Parameters(1755, 0)	'Motor model changeover speed encoderless operation	169	160	160	
Parameters(1800, 0)	'Pulse frequency setpoint	4	4	4	
Parameters(1815, 0)	Phase for PWM generation, subunit	&H1	&H1	&H1	3)
Parameters(1816, 0)	Phase for PWM generation, set manually	0	0	0	3)
Parameters(1819, 0)	Phase for PWM generation	0	0	0	3)
Parameters(1980, 0)	'PolID procedure	1	1	1	
Parameters(1981, 0)	'PolID maximum distance	30	30	30	2)
Parameters(1982, 0)	'PolID selection	1	1	1	
Parameters(1993, 0)	'PolID motion-based current	30	30	30	2)
Parameters(1994, 0)	'PolID motion-based rise time	30	30	30	2)
Parameters(1995, 0)	'PolID motion-based gain	80	80	80	2)

Parameter	Designation	Total	Master	Slave	Index
Parameters(1996, 0)	'PolID motion-based integral time	30	30	30	2)
Parameters(1997, 0)	'PolID motion-based smoothing time	1	1	1	2)
Parameters(2000, 0)	'Reference speed reference frequency	2000	4200	4200	5)
Parameters(2002, 0)	'Reference current	469	234.5	234.5	5)
Parameters(2003, 0)	'Reference torque	2006	1021	1021	5)
Parameters(2007, 0)	'Reference acceleration	16.67	16.67	16.67	5)
Parameters(4955, 0...8)	'OA DO-specific identifier		"SERVCOUP"	"SERVCOUP"	7)
Parameters(4956, 0)	'OA DO-specific activation		1	1	
Parameters(31740, 0)	'SERVCOUP operation mode		1	2	1)
Parameters(31741, 0)	'SERVCOUP master encoder count		1	0	1)
Parameters(31746, 0)	'CI: SERVCOUP slave coupling input		0	31745:0:3	1)

1) Differentiation between master-slave essential
2) Differentiation between master-slave without meaning
3) Parameter equality for master and slave
4) Depending on the deployed encoder
5) Depending on the application
6) Motor data
7) See note for r4955 below

Note

Note for r4955

The number of OA applications is displayed in r4950.

r4955[0...8] contains the designation for OA application 1
r4955[9...17] contains the designation for OA application 2, etc.

r4950 = 1 means:

- Only one OA application present
- In this case, p4956[0] is used to activate an OA application

r4950 > 1 means:

- More than one OA application present
- The associated index for activating the OA application SERVCOUP depends on the designation
  - If r4955[0...8] contains "SERVCOUP", then p4956[0] applies
  - If r4955[9...17] contains "SERVCOUP", then p4956[1] applies, etc.

The parameter list shown here illustrates the conversion of the motor data for master-slave operation.

In accordance with this parameter list, some reference values must be changed.

Note that some converter-specific parameters depend on the encoder or application.

If you have questions, please contact the Technical Support.

3.3.5 Version and operating modes of the motor in the asynchronous version

You can connect the windings of the asynchronous version in different variants.

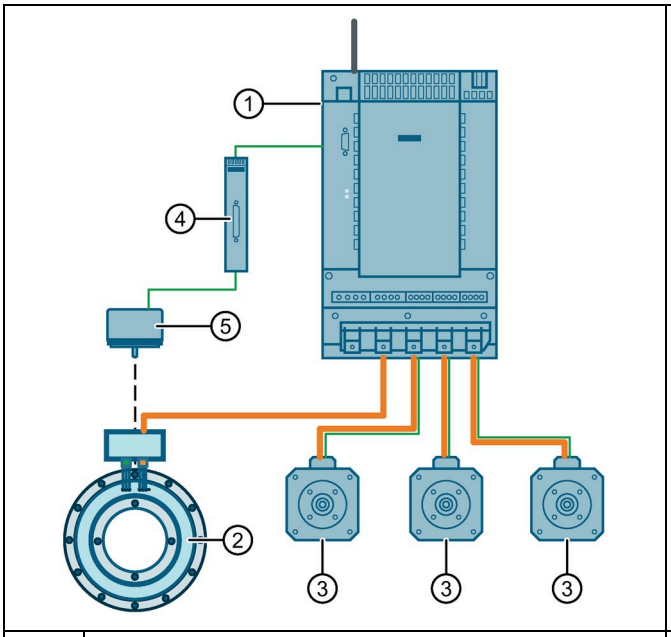
Note

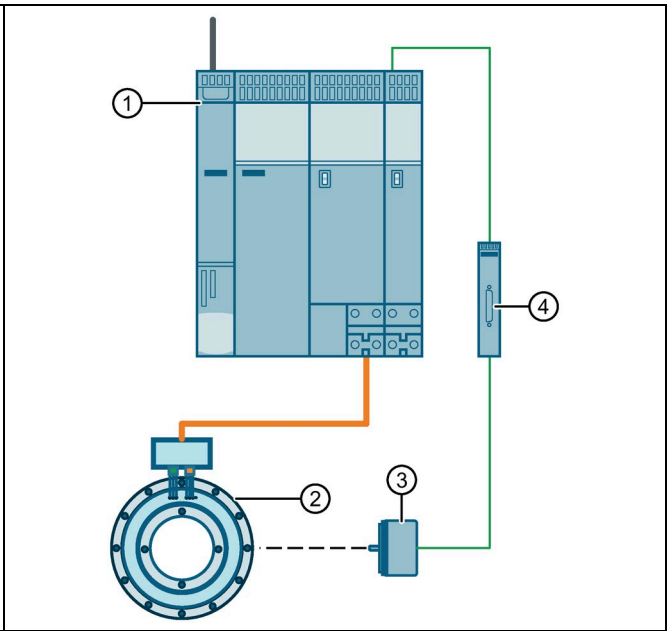
The 1FE2 motors do not require a series reactor.

Winding in a star connection

The 1FE2□□□-□□□□□-□□□1 motors are designed internally in a permanent star connection. The electrical connection is made via 3 power cables: U1, V1, W1.

Table 3- 3 1FE2 in asynchronous version in star connection to SINAMICS S120 Combi or Booksize





①	SINAMICS S120 Combi Power Module	①	SINAMICS S120 Booksize Power Module
②	1FE2 in asynchronous version	②	1FE2 in asynchronous version
③	Servo motor	③	Encoder
④	SMC20	④	SMC20
⑤	Encoder		

Winding with star-delta changeover

The 1FE2□□□-□□□□□-□□□2 motors have two cables per phase (U1-U2, V1-V2, W1-W2). A star/delta changeover takes place by means of an external contactor circuit or as a fixed configuration in the terminal box.

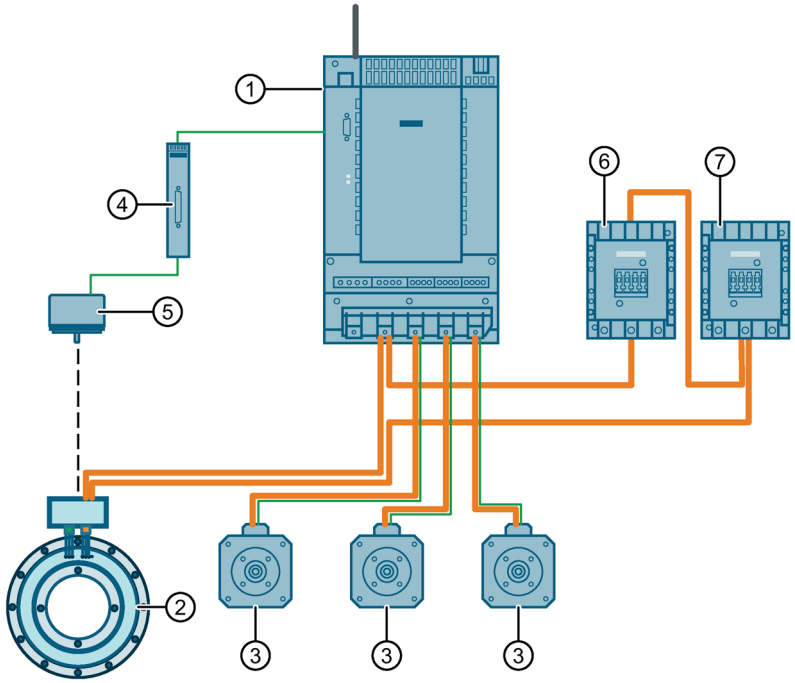
Note

Star-delta changeover

We recommend SIRIUS 3RT power contactors. Notes on the selection and dimensioning can be found in Catalog IC 10.

Note that you must make the star-delta changeover without current, i.e. when the converter is pulse inhibited.

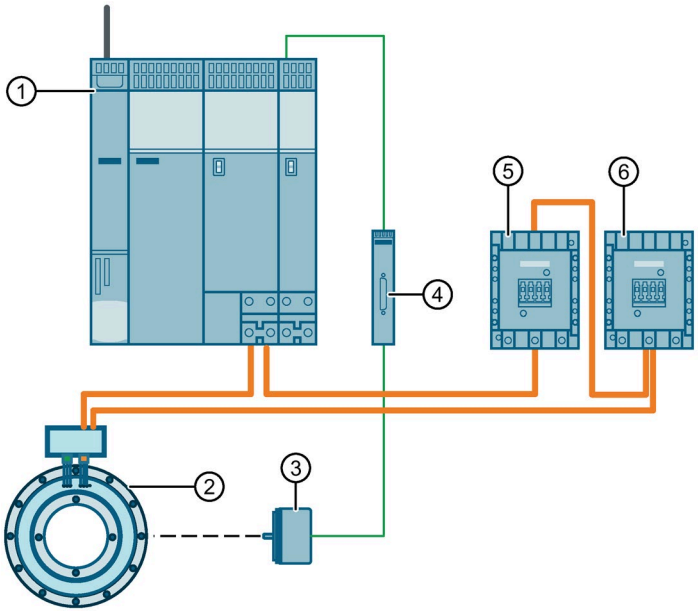
1FE2 in asynchronous version with star-delta changeover to SINAMICS S120 Combi



① SINAMICS S120 Combi Power Module
② 1FE2 in asynchronous version
③ Servo motor
④ SMC20
⑤ Encoder
⑥ Delta contactor
⑦ Star contactor

Figure 3-9 1FE2 with star-delta connection to SINAMICS S120 Combi

1FE2 in asynchronous version with star-delta connection to SINAMICS S120 Booksize



① SINAMICS S120 Power Module Booksize
② 1FE2 in asynchronous version
③ Encoder
④ SMC20
⑤ Delta contactor
⑥ Star contactor

Figure 3-10 1FE2 with star-delta changeover to SINAMICS S120 Booksize

You will find additional information in Chapter "Electrical connection (Page 139)".

3.4 Rating plate data

3.4.1 Rating plate details (type plate) of 1FE2 in synchronous version

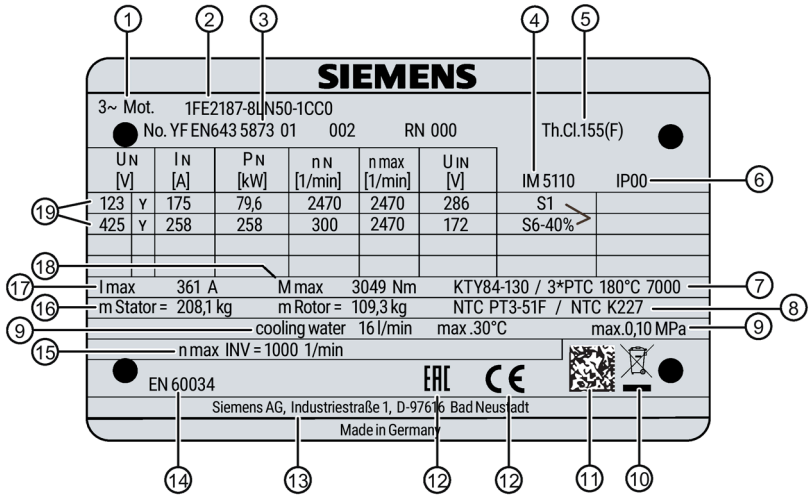


Figure 3-11 1FE2 synchronous version

Position	Description / technical specifications
1	Type of motor
2	Motor type / designation / article number
3	Motor serial number
4	Type of construction
5	Temperature class
6	Degree of protection
7	Technical specifications for S1 and S6 40% 2 min
7	Identification temperature sensor
8	Identification temperature monitoring
9	Information on water cooling, flow rate, maximum permissible coolant temperature in °C, pressure of the cooling system in MPa
10	WEEE symbol
11	Data matrix code
12	Certifications
13	Manufacturer's address
14	Standard for all rotating electrical machines
15	Maximum speed via frequency converters in rpm
16	Mass of stator and rotor in kg
17	Maximum amperage in A
18	Maximum torque in Nm
19	Technical specifications for S1 and S6 40% 2 min

3.4.2 Rating plate details (type plate) of 1FE2 in asynchronous version, star connection

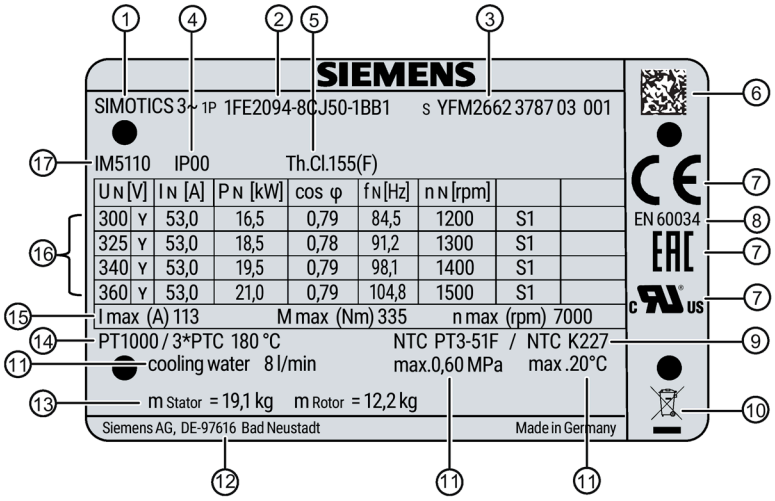


Figure 3-12 1FE2 synchronous version, star connection

Position	Description / technical specifications
1	Type of motor
2	Motor type / designation / article number
3	Motor serial number
4	Degree of protection
5	Temperature class
6	Data matrix code
7	Certifications
8	Standard for all rotating electrical machines
9	Identification temperature monitoring
10	WEEE symbol
11	Information on water cooling, flow rate, maximum permissible coolant temperature in °C, pressure of the cooling system in MPa
12	Manufacturer's address
13	Mass of stator and rotor in kg
14	Identification temperature sensor
15	Maximum values of the motor
16	Technical specifications for S1
17	Type of construction

3.4.3 Rating plate details (type plate) of 1FE2 in asynchronous version, star-delta connection

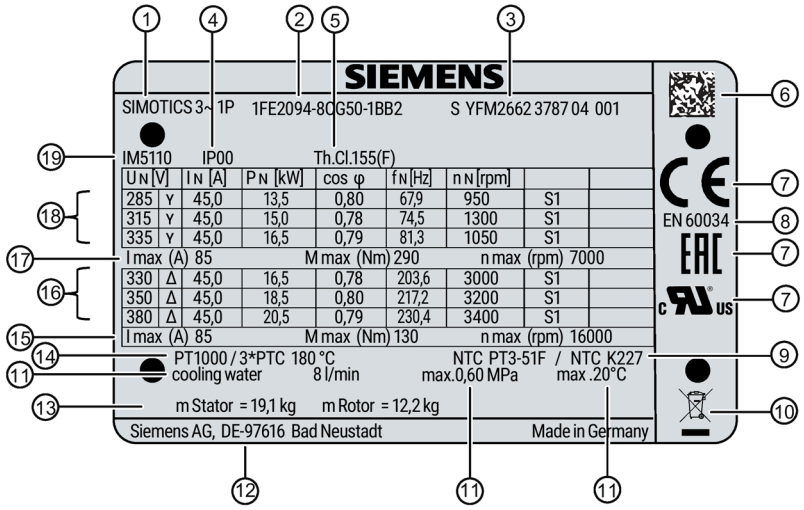


Figure 3-13 1FE2 synchronous version, star-delta connection

Position	Description / technical specifications
1	Type of motor
2	Motor type / designation / article number
3	Motor serial number
4	Degree of protection
5	Temperature class
6	Data matrix code
7	Certifications
8	Standard for all rotating electrical machines
9	Identification temperature monitoring
10	WEEE symbol
11	Information on water cooling, flow rate, maximum permissible coolant temperature in °C, pressure of the cooling system in MPa
12	Manufacturer's address
13	Mass of stator and rotor in kg
14	Identification temperature sensor
15	Maximum values of the motor for delta connection
16	Technical specifications for S1 operation with delta connection
17	Maximum values of the motor for star connection
18	Technical specifications for S1 operation with star connection
19	Type of construction

3.5 Structure of the Article No.

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

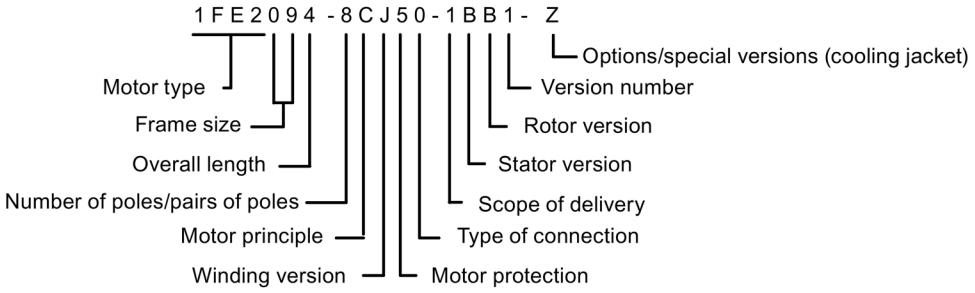


Figure 3-14 Structure of the article number 1FE2

Possible combinations are provided in Catalog NC 62, NC82 and D21.4, as well as in the DT configurator.
Please note that not every theoretical combination is available.

Description	Position of the article number																			
	1	2	3	4	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-	Z
SIMOTICS M-1FE2 synchronous built-in motors Standard type with water cooling, machine tools main spindle drive	**1**	**F**	**E**	2																
Frame size without cooling jacket	90 mm				**0**	**9**														
	140 mm				**1**	**4**														
	180 mm				**1**	**8**														
Active length	100 mm (all except 1FE218☐)						**2**													
	150 mm (all except 1FE218☐)						**3**													
	200 mm (all except 1FE218☐)						**4**													
	250 mm (all except 1FE218☐)						**5**													
	300 mm (all except 1FE218☐)						**6**													
	350 mm (all except 1FE218☐)						**7**													
	Special length						**9**													**G1☐**
	200 mm (1FE218☐ only)						**2**													
	250 mm (1FE218☐ only)						**3**													
	300 mm (1FE218☐ only)						**4**													
	350 mm (1FE218☐ only)						**5**													
	400 mm (1FE218☐ only)						**6**													
	450 mm (1FE218☐ only)						**7**													

Description		Position of the article number																	
		1	2	3	4	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-	Z
Number of poles/pairs of poles	8-pole									**8**											
	16-pole (1FE218☐ only)									**8**											
	Special version									**9**											**H1☐**
Motor principle	Asynchronous Al rotor										**A**										
	Asynchronous Cu rotor										**C**										
	Synchronous APM										**L**										
Winding version	Rated speed differs according to frame size											☐									
Motor protection	Standard protection 2 x temperature sensor (2 x Pt1000)												**1**								
	Complete motor protection: Standard protection + PTC thermistor triplet (3 x PTC180 in series)												**3**								
	Universal protection: Full motor protection + 2 x NTC thermistors (NTC PT3-51-F + NTC K227)												**5**								
Connection variant	Free cable ends, length 0.5 m; cable outlet of large external diameter or stator without cooling jacket													**0**							
	Free cable ends, length 0.5 m; cable outlet of small external diameter													**1**							
	Free cable ends, length 1.5 m; cable outlet of large external diameter or stator without cooling jacket													**2**							
	Free cable ends, length 1.5 m; cable outlet of small external diameter													**3**							
	Special version													**9**							**L1☐**
Components (scope of supply)	Stator and rotor															**1**					
	Stator only (individual parts)															**2**					
	Rotor only (individual parts)															**3**					
Stator version	Impregnated winding without cooling jacket																**A**				
	Cast winding without cooling jacket																**B**				
	Impregnated winding with standard cooling jacket																**C**				
	Cast winding with standard cooling jacket (on request)																**D**				
	Special version																				**P1☐**
Rotor design	Rotor core without sleeve, inside diameter unmachined, unbalanced																	**A**			
	Rotor core without sleeve, inside diameter machined ready for installation, unbalanced, (on request)																	**B**			
	Rotor core with standard sleeve																	**C**			
	Special version																				**Q1☐**
Version	With Pt1000 temperature sensor - star connection																		**1**		
	With Pt1000 temperature sensor - star-delta connection																		**2**		
Options	Rotor prebalanced (only available for 1FE218☐-8L)																				**T00**

Motor components, characteristics and options 4

4.1 Thermal motor protection

The stator winding can be supplied with the following motor protection to sense (measure) and monitor the motor temperature:

Standard protection:	Temperature sensors (2 x Pt1000); 2x2 conductors in a protective sleeve; protective sleeve diameter 3 mm; conductor cross-section 0.22/0.14 mm²
Full protection (option):	Temperature sensors + PTC thermistor triplet (3 sensors in series) (2 x Pt1000 + 1 x PTC180 C) in addition to standard protection: 1x2 conductors in a protective sleeve; protective sleeve diameter 3 mm; conductor cross-section 0.22/0.14 mm²
Universal protection (option):	Temperature sensors + PTC thermistor triplet + NTC thermistor (2 x Pt1000 + 1 x PTC180 C + NTC PT3-51F + NTC K227/33k/A1; in addition to full protection: 2x2 conductors in a protective sleeve; protective sleeve diameter 3 mm; conductor cross-section 0.22/0.14 mm²

Note

If water-cooled built-in motors are operated for longer than one minute at a standstill with the standstill torque, one phase can be disproportionately loaded thermally.

- Reduce the permanent standstill torque by up to 20 %.
- Protect the winding thermally with a thermistor triplet (PTC) with an external trip unit or with an I^2t monitoring of the drive system.

NOTICE

Thermal damage to temperature-sensitive parts

Some parts of the electric motor enclosure can reach temperatures > 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.

4.1.1 Thermal motor protection with temperature sensors (standard protection)

The stator laminated core has 2 Pt1000 temperature sensors to monitor the winding temperature; one of these is a reserve.

Note

When the motor is operated at its rated power, the winding temperature can reach approx. 150 °C.

The winding has thermal class 155 (F) and is dimensioned for this operating state.

The type of temperature sensor installed is stamped on the rating plate.

The temperature sensor protects the motor from overload when operational.

The temperature sensor detects the motor temperature. The drive system evaluates the motor temperature. An external tripping unit is not required. The PTC thermistor function is monitored.

1. Pre-alarm temperature (default setting for the 1FE2)

   If the pre-alarm temperature of 150 °C is exceeded, the drive system issues an appropriate alarm signal. This alarm signal must be evaluated externally.
   The alarm signal is cleared when the motor temperature decreases to below the pre-alarm temperature.

   If the pre-alarm temperature is exceeded for longer than 240 seconds (standard setting) or longer than the parameterized time, then an alarm signal is issued and the drive is shut down.
   A detailed description is provided in the SINAMICS S120/S150 List Manual.

   SINAMICS S120_150 List Manual
   (https://support.industry.siemens.com/cs/products?search=Listenhandbuch&dtp=Manual&mfn=ps&o=DefaultRankingDesc&pnid=13204&lc=de-WW)

2. Motor limit temperature (standard setting for the 1FE2)

   If the motor temperature limit of 160 °C ±5 °C is exceeded, the drive system is shut down and it issues an appropriate fault signal.

Table 4- 1 Features and technical specifications

Type	Pt1000
Resistance when cold (20 °C)	Approx. 1090 Ω
Resistance when hot (100 °C)	Approx. 1390 Ω
Connection	Via signal cable
Response temperature (standard setting for SINAMICS S120)	Pre-alarm at 150 °C Trip/shutdown at 160 °C ± 5 °C

The resistance change is proportional to the change in the winding temperature. The temperature characteristic is taken into account in the closed-loop control.

The following diagram shows the resistance characteristic as a function of the temperature for Pt1000 temperature sensors.

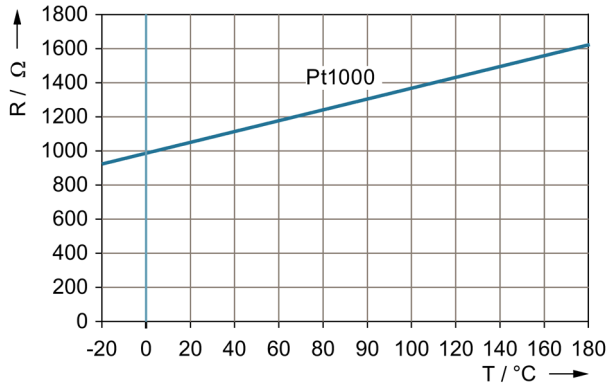


Figure 4-1 Pt1000 characteristic

High short-term overload conditions require additional protective measures as a result of the thermal coupling time of the temperature sensor.

Note

Temperature evaluation using only a Pt1000 does not guarantee full motor protection.

NOTICE
Destruction of the motor for a thermal critical load A thermally critical load, e.g. high overload when the motor is stationary, can destroy the motor. • Employ additional protective measures, e.g. an overcurrent relay.

4.1.2 Temperature evaluation using the PTC thermistor triplet (full motor protection)

For special applications (e.g. when a load is applied with the motor stationary or for extremely low speeds), the temperature of all of the three motor phases must be additionally monitored using a PTC thermistor triplet.

Note

If water-cooled built-in motors are operated for longer than one minute at a standstill with the standstill torque, one phase can be disproportionately loaded thermally.

- Reduce the permanent standstill torque by up to 20 %.
- Protect the winding thermally with a thermistor triplet (PTC) with an external tripping unit.

The PTC thermistor triplet can be evaluated using an external tripping unit (this is not included in the scope of delivery). This means that the sensor cable is monitored for wire breakage and short-circuit by this unit.

The motor must be de-energized within 1 second when the response temperature is exceeded.

Table 4- 2 Technical specifications for the PTC thermistor triplet

Designation	Technical specifications
Type (acc. to DIN 44082–M180)	PTC thermistor triplet
Thermistor resistance (20° C)	≤ 750 Ω
Resistance when hot (180° C)	≥ 1710 Ω
Connection	Via an external trip unit
Cable cross-section/outer diameter	0.14 mm^2/0.9 mm
Response temperature	180 °C
Note: PTC thermistors do not have a linear characteristic curve and are, therefore, not suitable for determining the instantaneous temperature.	

Note

PTC thermistors are ESD components

Carefully observe the ESD instructions.

4.1.3 Temperature evaluation using NTC thermistors (universal protection, option)

Note

Temperature evaluation using the NTC K227 and NTC PT3-51F thermistors does not guarantee full motor protection.

NTC K227 and NTC PT3-51F thermistors are used if the drive system cannot evaluate Pt1000 thermistors.

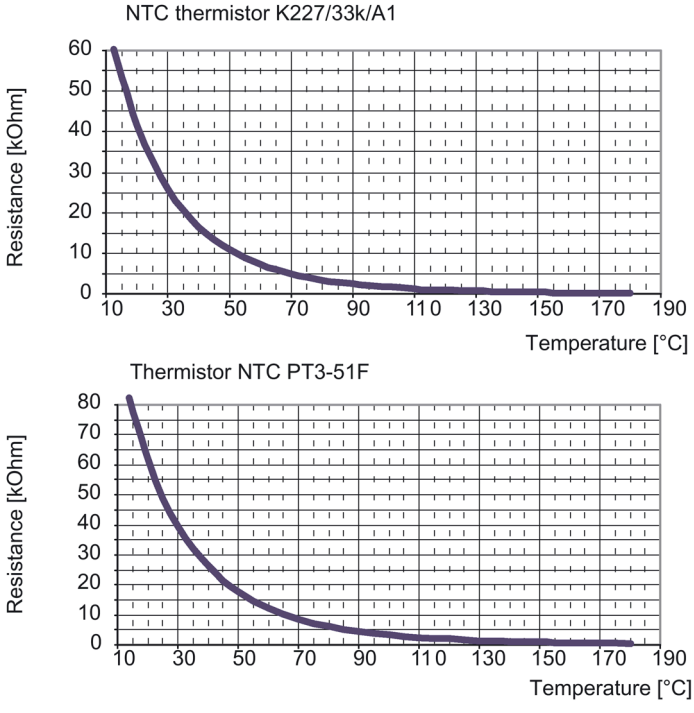
They are intended for operating the motor on third-party systems.

The NTC thermistor should be connected in accordance with the configuration and operating instructions of the third-party system.

The drive system senses and evaluates the motor temperature using the sensor signal (refer to the drive system documentation).

Table 4- 3 Technical specifications, NTC K227 and NTC PT3-51

Designation	Technical specifications	
	NTC K227	NTC PT3-51F
PTC thermistor resistance (25 °C)	Approx. 32.8 kΩ	Approx. 49.1 kΩ
Resistance when hot (100 °C)	Approx. 1800 Ω	Approx. 3300 Ω
Connection	Via the encoder cable Signal connection and motor protection (Page 161)	
cable cross-section	0.14 mm^2	0.14 mm^2
Outer diameter	0.8 mm	0.8 mm
Temperature characteristic		



4.2 Cooling

4.2.1 Safety instructions

⚠WARNING

Danger to life caused by short-circuit to a frame in a fault situation

The spindle housing must be electrically connected to the cooling jacket.

In a fault situation, lethal voltage can be present at the spindle housing that causes death or severe injuries because of an electric shock.

- Ground the complete motor spindle in accordance with the regulations.

⚠WARNING

Danger to life caused by rotation of the assembled spindle shaft on synchronous motors

The rotating of an assembled built-in motor produces induction that causes lethal voltages at the cable ends of the motor.

The voltages can cause death or severe injuries because of an electric shock.

- Do not touch any bare cable ends.
- Prevent assembled built-in motors from turning.
- Insulate the terminals and cores of bare cable ends.

⚠WARNING

Danger to life caused by high leakage currents

High leakage currents can cause death or injuries as result of an electric shock.

- Satisfy the requirements placed on protective conductors in accordance with EN 61800-5-1.

⚠WARNING

Danger to life caused by high residual voltages

When the power supply voltage is switched-off, active components of the motor can have an electrical charge of more than 60 µC.

The residual voltages that occur at the connections of the built-in motor several seconds after power-down can cause death or severe injuries as result of an electric shock.

- Do not touch any bare connections.
- Protect bare connections and active components against inadvertent contact.
- Ground the motor properly.

⚠WARNING

Danger to life when the cooling system bursts

The motor will overheat if it is operated without cooling. When cooling water enters the hot motor, this immediately and suddenly generates hot steam that escapes under high pressure. This can cause the cooling water system to burst, resulting in death, severe injury and material damage.

- Never operate the motor without cooling.
- Only commission the cooling water circuit when the motor is in a cool condition.

⚠CAUTION

Danger of burns a result of touching hot surfaces

In operation, the motor housing 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.

NOTICE

Material damage due to the effect of electrochemical series

When using different conductive materials, material damage can occur as a result of the electrochemical series.

- Do not use any zinc in the cooling circuit.
- Use brass, stainless steel or plastic for pipes and fittings.

NOTICE

Motor damage due to lack of cooling

If you operate the motor without water cooling, the motor will be damaged or destroyed.

- Only operate the motor with a closed cooling water loop with heat exchange equipment.
- If air cooling is used (special version) only operate the motor with fan switched on in accordance with project specifications

4.2.2 Cooling circuit

Note

The electrochemical processes that take place in a cooling system must be minimized by choosing the right materials.

- Avoid mixed installations (i.e. a combination of different materials, such as copper, brass, iron, or halogenated plastic (PVC hoses and seals)).

Cool the built-in motor using a semi-open or closed cooling circuit.

Table 4- 4 Description of the cooling circuits

Definition	Description
Closed cooling circuit	The pressure equalization tank is closed and possesses an overpressure valve. Oxygen cannot enter the cooling circuit. The coolant is only routed through the motors and converters as well as through the components required to dissipate heat.
Semi-open cooling circuit	Contrary to closed cooling circuits, oxygen can enter the coolant through the pressure equalization tank.

Note

Laying the cooling water pipes

Electrically conductive cooling water pipes must not come into contact with live components.

- Lay only insulated cooling water pipes or insulate the cooling water pipes subsequently.
- Fasten the cooling water pipes mechanically.

All components in the cooling system (motor, heat exchanger, piping system, pump, pressure equalization tank) must be connected to an equipotential bonding system.

- Install the equipotential bonding properly with a copper busbar or copper strand with the appropriate cross-section.

Materials used in the motor cooling circuit

- Match the materials in the cooling circuit to the materials in the motor.

Table 4- 5 Materials used in the motor cooling circuit

Cooling jacket design	Material
Cooling jacket	Steel or aluminum (see the dimension drawing)
O rings	FKM (ISO 1629)

Materials and components in the cooling circuit

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

Table 4- 6 Materials and components of a cooling circuit

Material	Used as	Description
Zinc	Pipes, valves and fittings	Use is not permitted.
Brass	Pipes, valves and fittings	Can be used in closed circuits with inhibitor.
Copper	Pipes, valves and fittings	Can be used only in closed circuits with inhibitors in which the heat sink and copper component are separated (e.g. connection hose on units).
Standard steel (e.g. P235 TR1, P235 TR2)	Pipes	Permissible in closed circuits and semi-open circuits with inhibitors or Antifrogen N, check for oxide formation, inspection window recommended.
Cast steel, cast iron	Pipes, motors	Closed circuit and use of strainers and flushback filters. Fe separator for stainless heat sink.
High-alloy steel, Group 1 (V2A)	Pipes, valves and fittings	Can be used for drinking or municipal water with a chloride content up to < 250 ppm, suitable according to definition in Chapter "Coolant definition".
High-alloy steel, Group 2 (V4A)	Pipes, valves and fittings	Can be used for drinking or municipal water with a chloride content up to < 500 ppm, suitable according to definition in Chapter "Coolant definition".
ABS (**A**crylnitrile**B**utadiene**S**tyrene)	Pipes, valves and fittings	Suitable according to the definition in Chapter "Coolant definition". Suitable for mixing with inhibitor and/or biocide as well as Antifrogen N.
Installation comprising different materials (mixed installation)	Pipes, valves and fittings	Use is not permitted.
PVC	Pipes, valves, fittings and hoses	Use is not permitted.
Hoses		The use of hoses should be reduced to a minimum (connecting equipment) and must not be used as the main supply line for the complete system. Recommendation: EPDM hoses with an electrical resistance > 10^9 Ω (e.g. Semperflex FKD supplied from Semperit or DEMITTEL; from PE/EPD, supplied from Telle).
Gaskets	Pipes, valves and fittings	The use of FKM, AFM34, EPDM is recommended.
Hose connections	Transition Pipe - hose	Secure with clips conforming to DIN 2817, available e.g. from the Telle company.

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

- Construct a closed cooling circuit with the cooling unit using stainless steel technology. The cooling circuit dissipates the heat via a water-water heat exchanger.
- For all other components, such as cooling circuit pipes and fittings manufactured of ABS, use stainless steel or general construction steel.

Cooling system manufacturers

ait-deutschland GmbH	www.kkt-chillers.com
BKW Kälte-Wärme-Versorgungstechnik GmbH	www.bkw-kuema.de
DELTATHERM Hirmer GmbH	www.deltatherm.de
Glen Dimplex Deutschland GmbH	www.riedel-cooling.com
Helmut Schimpke und Team Industriekühlanlagen GmbH + Co. KG	www.schimpke.org
Hydac System GmbH	www.hydac.com
Hyfra Industriekühlanlagen GmbH	www.hyfra.de
Pfannenberg GmbH	www.pfannenberg.com

Note

Other manufacturers

You can also use equivalent products from other manufacturers.

Responsibility for the properties of third-party products resides with the plant manufacturer.

4.2.3 Configuring the cooling circuit

Note

Observing the maximum permitted pressure

The maximum permitted pressure in the cooling circuit is 0.7 MPa (7 bar).

If a pump is deployed that produces a higher pressure, the produced pressure must be limited by the plant with suitable measures (safety valve $p \leq 0.7$ MPa, pressure control) to the maximum permitted pressure.

- Specify the working pressure depending on the flow conditions in the supply and return of the cooling circuit.

  Select the smallest possible pressure difference between the supply and return so that pumps with a flat characteristic curve can be used.
- Set the required coolant flow rate per time unit according to the technical data of the equipment and motors.

Note

Install a backflush filter in the cooling circuit to prevent blockage and corrosion so that any deposited material is flushed out.

4.2.4 Volume flow and pressure drop

Volume flow and pressure drop in cooling circuit

Observe the nominal coolant flows specified in the following table to ensure that the motor is cooled adequately.

Table 4- 7 Approximate pressure drop at the nominal coolant flow rate

Motor type	Values for the synchronous version	
	Flow rate Q in l/min	Pressure drop dp in MPa
1FE2182-8LN□□-□CC1	9	0.3
1FE2182-8LH□□-□CC1	9	0.3
1FE2183-8LN□□-□CC1	10.5	0.4
1FE2183-8LH□□-□CC1	10.5	0.4
1FE2184-8LN□□-□CC1	12	0.5
1FE2184-8LK□□-□CC1	12	0.5
1FE2184-8LH□□-□CC1	12	0.5
1FE2185-8LN□□-□CC1	13.5	0.6
1FE2185-8LL□□-□CC1	13.5	0.6
1FE2185-8LH□□-□CC1	13.5	0.6
1FE2186-8LN□□-□CC1	15	0.8
1FE2186-8LM□□-□CC1	15	0.8
1FE2186-8LH□□-□CC1	15	0.8
1FE2187-8LN□□-□CC1	16.5	1
1FE2187-8LH□□-□CC1	16.5	1

Table 4- 8 Rated coolant volume flow

Motor type	Values for the asynchronous version
	Volume flow Q in l/min
1FE209□-8□□□□-□□□□	8
1FE214□-8□□□□-□□□□	12

Preventing cavitation

NOTICE

Motor damage caused by cavitation and abrasion

An excessive pressure drop at the motor can cause motor damage as the result of cavitation and/or abrasion.

- Operate the motor so that the pressure drop at a converter or motor in continuous operation does not exceed 0.2 MPa.

Connecting motors in series

For the following reasons, connecting motors in series can be recommended only conditionally:

- The required flow rates of the motors must be approximately the same (< a factor of 2)
- An increase in the coolant temperature can result in derating the second or third motor if the maximum coolant inlet temperature is exceeded

Coolant inlet temperature

NOTICE

Motor damage caused by condensation formation

Water condensation can cause motor damage.

- Select the coolant inlet temperature so that condensation does not form on the surface of the motor. $T_{cooling} > T_{ambient}$ - 5 K.
- Interrupt the supply of coolant for a longer motor standstill.

The motors are designed for full-load operation at maximum +20 °C coolant inlet temperature.

Operation up to +40 °C coolant inlet temperature is possible with derating (reduced power).

Note

Derating

The spindle manufacturer is responsible for the derating.

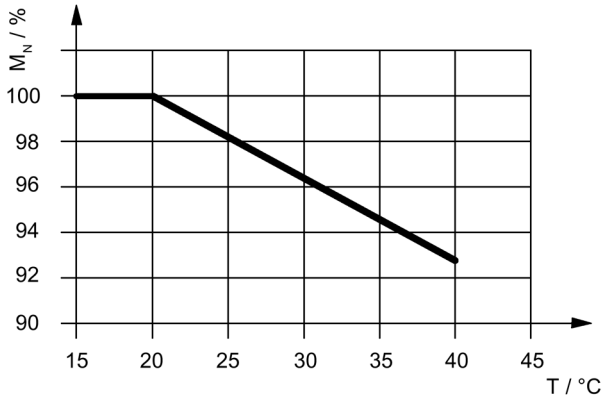
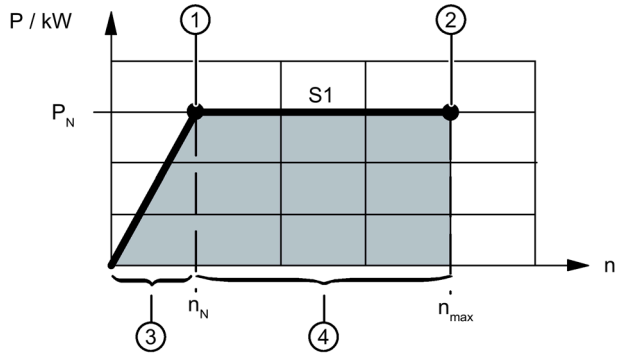


Figure 4-2 Effect of the cooling-medium intake temperature

4.2.5 Cooling powers to be dissipated (power loss)

You can determine the cooling power to be dissipated based on:

- Reading off the power loss at rated power for n_{max} or n_N in the table "Cooling powers to be dissipated".
- Using the calculation tool.
  The power loss can be calculated within the shaded area of the subsequent diagram for any load state and speed. P and n must lie within the shaded area. The general conditions ③ and ④ must be complied with.



① Cooling power to be dissipated at rated speed
② Cooling power to be dissipated at maximum speed
③ For $n < n_N$, the following applies: $P \leq P_N \times n / n_V$
④ For $n_N < n < n_{max}$, the following applies: $P \leq P_N$

Figure 4-3 Calculating the power loss

The intermediate values of the cooling power can be interpolated linearly in the ratio to the speed.

The cooling power to be dissipated depends on the rated power P_N of the motor. If the motor is operated with reduced power, then the cooling power to be dissipated decreases in an approximately linear relationship.

4.2.6 Calculation of the cooling power to be dissipated (power loss)

Table for calculating the cooling powers to be dissipated (power loss) for synchronous motors

The values specified in the following table refer to a cooling-medium temperature of 20 °C and S1 duty.

The cooling capacities to be dissipated at maximum speed and at rated speed are listed in the following table. Intermediate values can be linearly estimated proportional to the speed.

	P_N / kW	n_{max} / rpm	n_N / rpm	P_V / kW at n_N	P_V / kW at n_{max}
1FE2182-8LN□□-□CC1	34.2	2400	500	4.5	4.4
1FE2182-8LH□□-□CC1	67.9	4200	1000	5	5.7
1FE2183-8LN□□-□CC1	44.3	2400	500	5.6	5.3
1FE2183-8LH□□-□CC1	88.1	4200	1000	6.1	7
1FE2184-8LN□□-□CC1	53.1	2400	500	6.5	6.2
1FE2184-8LK□□-□CC1	84.9	4010	800	6.9	8.3
1FE2184-8LH□□-□CC1	105.5	4200	1000	7.1	8.2
1FE2185-8LN□□-□CC1	62.0	2420	500	7	7.2
1FE2185-8LL□□-□CC1	86.6	3440	700	7.4	8.7
1FE2185-8LH□□-□CC1	122.5	4200	1000	8	9.7
1FE2186-8LN□□-□CC1	71.8	2400	500	8.2	8
1FE2186-8LM□□-□CC1	86.2	3000	600	8.3	9.1
1FE2186-8LH□□-□CC1	142.4	4200	1000	9.1	10.9
1FE2187-8LN□□-□CC1	80.1	2670	500	8.8	9.4
1FE2187-8LH□□-□CC1	158.9	4200	1000	9.8	12.2

Table for calculating the cooling powers to be dissipated (power loss) for asynchronous motors

The values specified in the following table refer to a cooling-medium temperature of 20 °C and S1 duty.

The cooling capacities to be dissipated at maximum speed and at rated speed are listed in the following table. Intermediate values can be linearly estimated proportional to the speed.

	Circuit	P_N / kW	n_N / rpm	$P_{V,stator}$ / kW at n_N	$P_{V,rotor}$ / kW at n_N	$P_{V,total}$ / kW at n_N
1FE2093-8AG□□-□□□1	Y	7.5	950	1.66	1.07	2.73
1FE2093-8AM□□-□□□2	Y	11	1600	1.55	0.85	2.4
1FE2093-8AM□□-□□□2	D	11.5	4750	1.03	0.45	1.48
1FE2094-8AJ□□-□□□1	Y	11	1100	1.8	0.97	2.77
1FE2094-8AM□□-□□□2	Y	15	1600	2.0	1.1	3.1
1FE2094-8AM□□-□□□2	D	17.5	4750	1.4	0.7	2.1
1FE2094-8CJ□□-□□□1	Y	18.5	1300	3.1	0.95	4.05
1FE2094-8CG□□-□□□2	Y	15	1050	3	0.9	3.9
1FE2094-8CG□□-□□□2	D	18.5	3200	1.7	0.3	2
1FE2095-8CJ□□-□□□1	Y	22.5	1250	3.75	1.15	4.9
1FE2095-8CG□□-□□□2	Y	18.5	1000	3.8	1.2	5
1FE2095-8CG□□-□□□2	D	22	3000	1.8	0.4	2.2
1FE2145-8CE□□-□□□1	Y	33	750	3.7	1.8	5.5
1FE2145-8CC□□-□□□2	Y	22	500	3.3	1.6	4.9
1FE2145-8CC□□-□□□2	D	25	1500	1.7	0.35	2.05
1FE2147-8CE□□-□□□1	Y	48	750	4.5	2.6	7.1
1FE2147-8CC□□-□□□2	Y	32	500	4.5	2.6	7.1
1FE2147-8CC□□-□□□2	D	35	1300	2.35	0.45	2.8

4.2.7 Coolant

Coolant specification

As coolant, use only water that complies with the "water specification for coolant".

Note

If possible, use deionized water with reduced conductivity (5 ... 10 µS/cm) as the coolant.

Table 4- 9 Coolant water specifications

	Quality of the coolant water for motors with a cooling jacket manufactured out of steel or aluminum
Chloride ions	< 40 ppm, can be achieved by adding deionized water.
Sulfate ions	< 50 ppm
Nitrate ions	< 50 ppm
pH value	For steel: 6 ... 9; for aluminum: 6 ... 8
Electrical conductivity	< 500 µS/cm
Total hardness	< 170 ppm
Dissolved solids	< 340 ppm
Size of entrained particles	< 100 µm
Corrosion protection	0.2 to 0.25% inhibitor, Nalco TRAC100 (previously 0GE056)
Anti-freeze protection	When required, 20 - 30% Tyfocor

The values specified for the water as a coolant are the requirements for a closed cooling circuit. Not all of the specified concentrations will occur in the water at the same time. When necessary, contact your water utility for the values.

Note

Inhibitor is not required if a Tyfocor concentration > 20% is ensured.

Derating is not required for antifreeze protection components < 30%.

Measures for frost danger

If there is danger of frost, adopt frost protective measures for complete or preassembled motor spindle units.

- Replenish antifreeze for operation (see Table "Coolant water specifications").

Note

- Avoid mixing different antifreeze products.
- Use and dose the antifreeze according to the manufacturer’s specifications.

Manufacturers of chemical additives

Tyforop Chemie GmbH	http://www.tyfo.de
Clariant Produkte Deutschland GmbH (Antifrogen)	https://www.clariant.com
Cimcool Industrial Products Inc	http://www.cimcool.net
FUCHS PETROLUB SE	http://www.fuchs.com
Hebro Chemie GmbH	http://www.hebro-chemie.de
HOUGHTON Deutschland GmbH	http://www.houghton.com
Nalco Water in Germany (Ecolab)	http://www.nalco.com
Schweitzer-Chemie GmbH	http://www.schweitzer-chemie.de

Information regarding third-party products

Note

Recommendation relating to third-party products

This document contains recommendations relating to third-party products. Siemens accepts the fundamental suitability of these third-party products.

You can use equivalent products from other manufacturers.

Siemens does not accept any warranty for the properties of third-party products.

Other coolants (not water-based)

The deployment of other coolants (e.g. oil, cooling lubricating medium) may require derating in order that the thermal motor limit is not exceeded.

Note

Oil-water mixtures with more than 10% oil require derating.

Contact your local Siemens office for the power reduction (derating) resulting from the values.

Biocide

Closed cooling circuits with soft water are susceptible to microbes.

- If possible, use chlorinated potable water.

Note

Compatibility of coolant additives

Biocides and Antifrogen N must not be mixed.

- If no chlorinated potable water is available, add, for example Antifrogen N or a biocide, to the potable water.

Antifrogen N acts like a biocide for a minimum concentration > 20%.

- Conduct a water analysis at least annually to determine the type and concentration of microbes.

  The following microbes can occur in practice:

  – Bacteria that cause the formation of slime
  – Corrosive bacteria
  – Bacteria that cause deposits of iron

- Add a biocide that counters the determined microbes to the cooling water.

  The manufacturer's recommendations must be followed in regard to the dosage and compatibility with any inhibitor used.

4.2.8 Commissioning the cooling circuit

Commission the cooling circuit before performing the electrical commissioning.

Precondition

- You have flushed the cooling water pipes before connecting the motor and the converter to the cooling circuit.
- The cooling water pipes are properly connected.

Procedure

- Open the cooling water feed.
- Check all of the connections of the cooling water circuit for leaks.
- Check whether the prescribed volume of coolant is guaranteed. Further information on this can be found in Chapter "Connecting the cooling (Page 135)".

Maintenance and service for assembled motor spindles

Check at least once annually

- the filling level,
- for any discoloring and
- the cooling-water specification Information on this is provided in Chapter "Coolant (Page 72)".

Note

Use cooling water only with the permitted specification.

In case of cooling water loss, refill with a previously prepared mixture of deionized water and inhibitor or Antifrogen N.

4.3 Encoder system

The encoder is not included in the scope of delivery.

The spindle manufacturer is responsible for the selection and assembly.

Note

Additional information about the encoder is contained in the associated Configuration Manual

Preparing for use

5

5.1 Safety instructions for electromagnetic and permanent-magnetic fields

The following safety instructions on permanent magnets and permanent magnetic fields apply only to synchronous motors.

⚠WARNING

Risk of death and crushing as a result of permanent magnet fields

Severe injury and material damage can result if you do not take into consideration the safety instructions relating to permanent magnet fields.

- Refer to Chapter "Special safety notices for handling built-in motors (Page 19)".

Safety measures for electromagnetic and permanent-magnetic fields

- Observe the relevant nationally applicable health and safety regulations.
- Take measures, e.g. using shields, to reduce electromagnetic fields at their source.
- Keep the motor components in their individual packaging until installation.
- Mark the storage location with the warning and prohibition signs from the following tables.
- Avoid being crushed when handling the rotor core.
- Place the unpacked rotor core on a safe non-magnetic surface. Secure the rotor core with non-magnetic devices.
- Avoid contact of the rotor core with ferromagnetic objects.
- Use tools made of non-magnetic materials. Ferromagnetic assembly tools must have low mass.

Attaching warning signs

Any danger areas must be identified by well visible warning and prohibition signs (pictograms) in the immediate vicinity of the danger.

Note

The text for the warning signs should be written in the language of the country of use.

Identification of dangers using warning and prohibition signs:

Table 5- 1 Warning signs according to ISO 7010 and their meaning

Sign	Meaning	Sign	Significance
	Warning - magnetic field (W006)		Warning - hand injuries (W024)
	Warning for electrical voltage (W012)		Warning - hot surface (W017)

Table 5- 2 Prohibition signs according to ISO 7010 and their meaning

Sign	Significance	Sign	Significance
	No access for persons with pacemakers or defibrillator implants (P007)		No access for persons with metal implants (P014)
	No metal objects or watches (P008)		

Note

UN number for permanent magnets

UN number 2807 is allocated to permit magnets as hazardous item.

⚠WARNING

Components falling as a result of incorrect packing, storage and/or transport

Risk of death, injury and/or material damage can occur if the devices are packed, stored, or transported incorrectly.

- Always follow the safety instructions for storage and transport.
- Before transporting or lifting machines or parts machines, lock the rotary axes so the they cannot accidentally rotate.
- Always correctly and carefully carry out storage, transport and lifting operations.
- Only use suitable devices and equipment that are in perfect condition.
- Only use lifting devices, transport equipment and suspension equipment that comply with the appropriate regulations.
- IATA regulations must be observed when components are transported by air.
- Mark locations where rotors are stored with warning and prohibit signs according to the tables in Chapter "Supplied pictograms".
- Observe the warning instructions on the packaging.
- Always wear safety shoes and safety gloves.
- When working with synchronous versions of motors, keep the following tools and aids available to free any trapped body parts:
  - A hammer made of non-magnetizable material
  - Two pointed wedges (wedge angle approx. 10° - 15°, minimum height 50 mm) made of non-magnetizable material (e.g. hard wood)
- Take into account the maximum loads that personnel can lift and carry.
- Transport and store built-in motors only in their packed state.
  - Use only undamaged original packaging.
  - Replace any defective packaging. Correct packaging offers protection against sudden forces of attraction of the rotor in the synchronous version that can occur in their immediate vicinity. Further, when correctly packaged you are protected against hazardous motion when storing and moving rotors.

5.2 Shipping and packaging

Shipping

Note

The packaging of 1FE2 motors is suitable for transport by road, rail, sea and air.

Packaging

The 1FE2 built-in motors are supplied as motor components in individual or bulk packaging as specified in the delivery contract.

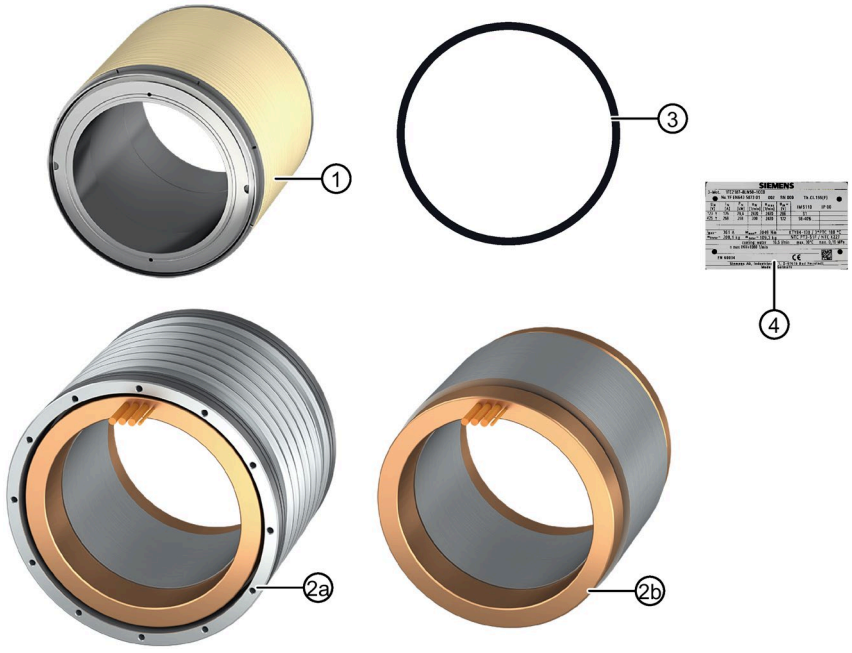
- Please pay attention to the handling notes on the packaging when the motor is delivered.

Table 5- 3 Handling notes and their significance

Symbol	Significance	Symbol	Significance
	Fragile (ISO 7000, No. 0621)		Keep dry (ISO 7000, No. 0626)
	This way up (ISO 7000, No. 0623)		Do not stack (ISO 7000, No. 2402)

The following chapter describes the scope of delivery of the built-in motors.

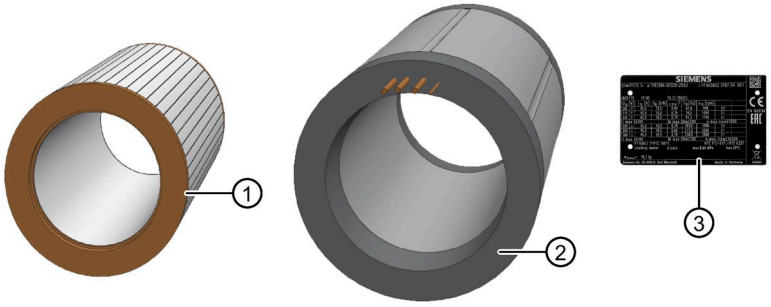
Scope of delivery of the synchronous version of the 1FE2



1	APM rotor core
2a	Stator with cooling jacket or
2b	optional stator without cooling jacket
3	Four O-ring seals (for version with standard cooling jacket)
4	Rating plate (type plate)
not illustrated	Balancing weights
not illustrated	Safety information and instruction leaflet. The URL to download the installation instructions is provided on the instruction leaflet
not illustrated	SINAMICS converter settings and circuit diagram as adhesive label

Figure 5-1 Scope of delivery of the synchronous version of the 1FE2

Scope of delivery of the asynchronous version of the 1FE2



1	Rotor in Cu or Al version, optionally with sleeve
2	Stator without cooling jacket
3	Rating plate (type plate)
not illustrated	Safety information and instruction leaflet. The URL to download the installation instructions is provided on the instruction leaflet
not illustrated	SINAMICS converter settings and circuit diagram as adhesive label

Figure 5-2 Scope of delivery of the asynchronous version of the 1FE2

Procedure

- Check the shipment immediately for completeness and for damage.

  Note

  Siemens will not accept any claims relating to items missing from the delivery and which are submitted at a later date.

- Register a complaint about
  - any apparent transport damage with the delivery agent immediately.
  - any apparent defects or missing components with the appropriate SIEMENS office immediately.

The safety instructions are included in the scope of delivery.

Note

Store the safety instructions so they are always available.

Note

Special versions and construction variants may differ in the technical details and scope of delivery.

5.3 Transportation and storage

⚠WARNING

Danger to life when lifting and transporting

Improper lifting and transport procedures, unsuitable or damaged lifting gear and load handling equipment can cause death, severe injury and/or material damage.

- Only use suitable and intact lifting gear and load handling equipment which comply with the specific national regulations.
- Only use lifting gear and load handling equipment which are suitable for the weight of the motor. The weight of the motor appears on the rating plate.
- Do not attach any additional loads to lifting gear and load handling equipment.
- Only use suitable strap-guiding systems rope guides and spreading devices for lifting and transporting the motor.

Transport and store the built-in motors in the original packaging.

Transporting

Note

Observe the country-specific regulations.

- Fasten the load suspension device to the provided locations of the packaging or the motor.
- Transport the motor carefully.
- Avoid any jerky and oscillating movements during transport.

If a motor is not installed immediately after the delivery, it must be stored appropriately.

Observe the following storage conditions.

Storage

Storage conditions

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 ... 70 °C
- Relative humidity: 5% ... 85%

Identification of the storage location

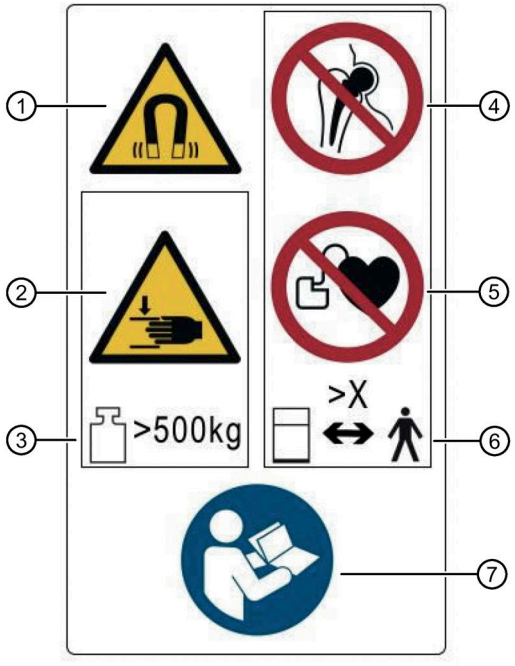
Mark the storage location clearly with warning notices as per the packaging of the built-in motors.

Note

This identification must also be visible after removal of the external packaging.

Label on the packaging of the rotor in the synchronous version

Use this label for identifying the bearing location of motors in the synchronous version.



① Warning against magnetic field (W006)
② Warning against hand injuries (W024)
③ Danger of crushing by more than 500 kg
④ No access for persons with metallic implants (P014)
⑤ No access for persons with pacemakers or implanted defibrillators (P007)
⑥ For synchronous motors, maintain a minimum clearance of 500 mm
⑦ Observe the instructions for use (M002)

The warning and information signs comply with ISO 7010; the information in brackets defines the sign according to ISO 7010

Please observe the warning instructions on the packaging and labels.

Long-term storage

Check the correct state of the machine 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 fluctuations of the ambient temperature
- Direct sunshine
- High air humidity during storage

Avoid these ambient conditions.

Use a desiccant and a hygroscope in the packaging.

NOTICE
Risk of motor damage by voltage discharges resulting from condensation If the stator winding is damp, its insulation resistance decreases. This can cause voltage discharges that damage the windings. • Keep the drain holes free so that condensation can escape freely.

NOTICE
Risk of motor damage by corrosion resulting from condensation Condensation that does not escape can cause corrosion and motor damage. • Keep the drain holes free so that condensation can escape freely.

Mechanical mounting

6

6.1 Safety instructions

The following safety instructions on permanent magnets and permanent magnetic fields apply only to synchronous motors.

Safety measures for electromagnetic and permanent-magnetic fields

Note

Only qualified, suitably trained personnel who clearly understand the special hazards involved may work with and on permanent-magnet rotor cores.

Note

Apply safety marking in accordance with the country-specific regulations at the assembly stations for rotor cores.

- Observe the relevant nationally applicable health and safety regulations.
- Take measures, e.g. using shields, to reduce electromagnetic fields at their source.
- Keep the motor components in their original packaging until installation.
- Mark the storage location with the symbol for magnetic danger.
- Place the unpacked rotor core in a safe place. Secure the rotor core with non-magnetic devices.
- Avoid contact of the rotor core with ferromagnetic bodies.
- Preferably use tools made of non-magnetic materials. Ferromagnetic assembly tools must have low mass. Work carefully!

Attaching warning signs

Any danger areas encountered during normal operation, maintenance, and servicing must be identified by well visible warning and prohibition signs (pictograms) in the immediate vicinity of the danger.

The associated texts must be provided in the language of the country in which the product is used.

Identification of dangers using warning and prohibition signs:

Table 6- 1 Warning signs according to ISO 7010 and their meaning

Sign	Significance	Sign	Significance
	Warning - magnetic field (W006)		Warning - hand injuries (W024)
	Warning for electrical voltage (W012)		Warning - hot surface (W017)

Table 6- 2 Prohibition signs according to ISO 7010 and their meaning

Sign	Significance	Sign	Significance
	No access for persons with pacemakers or defibrillator implants (P007)		No access for persons with metal implants (P014)
	No metal objects or watches (P008)		

⚠ WARNING

Active implant malfunctions due to electromagnetic fields

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

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

⚠WARNING

Danger to life from 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 a minimum distance of 50 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 transported by air.

⚠WARNING

Danger of crushing caused by the strong attractive forces of permanent magnets

The strong attractive forces on magnetizable materials and tools when working near motors with permanent magnets (distance less than 100 mm) can cause severe injuries that result from crushing.

- Do not underestimate the strength of the attractive forces.
- Wear protective gloves.
- Always work at least as a pair.
- Remove the packaging of the motor components only immediately before assembly.
- Do not carry any objects made of magnetizable materials (e.g. watches, steel or iron tools) and/or permanent magnets close to the motor with permanent magnets.
- Never place components with permanent magnets directly next to each other.
- To free any trapped body parts (hand, finger, foot, etc.), keep available:
  - A hammer (about 3 kg) made of solid, non-magnetizable material
  - Two pointed wedges (wedge angle approx. 10° to 15°) made of solid, non-magnetizable material (e.g. hard wood)

⚠WARNING

Danger to life when lifting and transporting

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

- Lifting devices, industrial trucks, and load suspension devices must comply with the regulations.
- The maximum capacity of the lifting equipment and the load suspension device must correspond to the weight of the motor parts (see the rating plate) or of the (partially) mounted motor spindle.
- 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).
- Fasten the lifting equipment only in the provided threaded holes and never at the balancing disk.
- Do not lift and transport the motor with the motor cables.
- Do not stand in the slewing range of hoisting gear or under suspended loads.
- Observe the country-specific regulations.

NOTICE

Data loss or damage caused by magnetic fields

Magnetic fields can lead to a loss of data on magnetic or electronic data media and damage watches.

- Keep magnetic or electronic data media (e.g. credit cards, memory cards) and watches outside magnetic fields (> 100 mm).

6.2 Installation requirements

The mounting instructions in the following chapters are recommendations.

The spindle manufacturer can specify different actions, and tools and resources needed for mounting.

Tools and resources needed for mounting are not included in the scope of delivery. The spindle manufacturer is responsible for their provision.

To mount/dismantle the motor parts, ensure the following ambient conditions:

- A draught-free room
- Technically dust-free and dry environment. The permissible relative air humidity lies within the range 5% to 85%.
- The personal protection equipment required is specified in the appropriate work stages.

NOTICE

Danger of damage to the rotor banding of a synchronous motor

APM rotors have a banding (composite fiber) around the external diameter of the rotor that must not be damaged.

- Keep the protective film until mounting the rotor.
- Remove the protective film only for balancing or immediately before mounting.
- Check the banding for damage before mounting.
- Mount the APM rotor centered in the spindle box using a mounting device.
- Use an assembly film.

Mechanical machining of the motor in the asynchronous version

Note

Mechanical machining of the rotor in the synchronous version by the customer is not permissible.

Before shrink-fitting, the inner diameter must be machined to the shrinkage dimension according to the specifications in the respective dimension sheet.

Shrink-fitting the rotor core generally causes stresses in the spindle shaft. These stresses cause deformations. For this reason, we recommend re-machining the shaft sections that are important for the function, e.g. bearing seats, together with the external diameter of the rotor core.

The shrink-fit rotor core must be machined to the external diameter specified in the respective dimension sheet.

We recommend machining by grinding.

6.3 Installing/removing the rotor

6.3.1 Overview of installation methods for the rotors

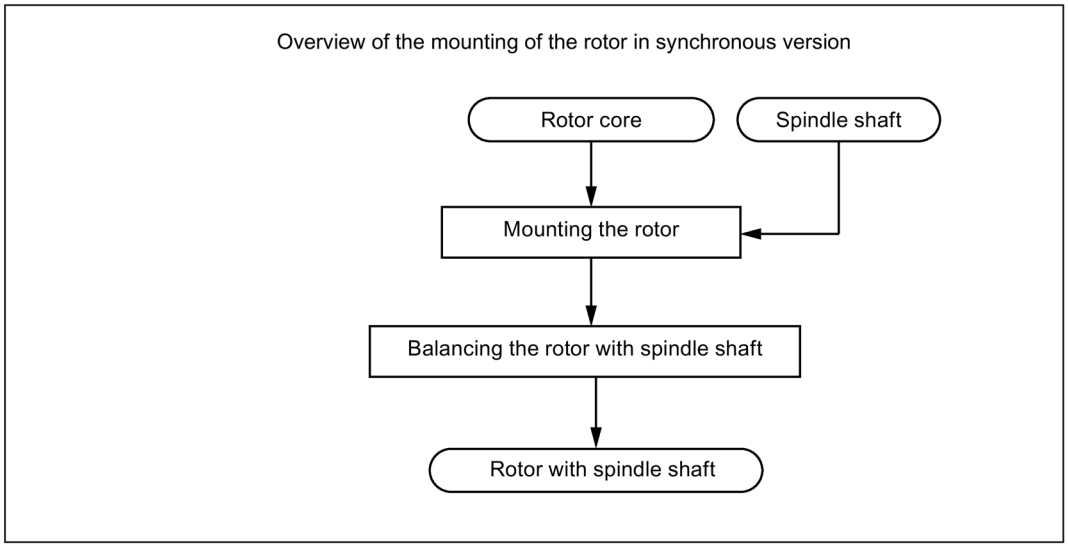


Figure 6-1 Sequence for mounting the rotor in synchronous version

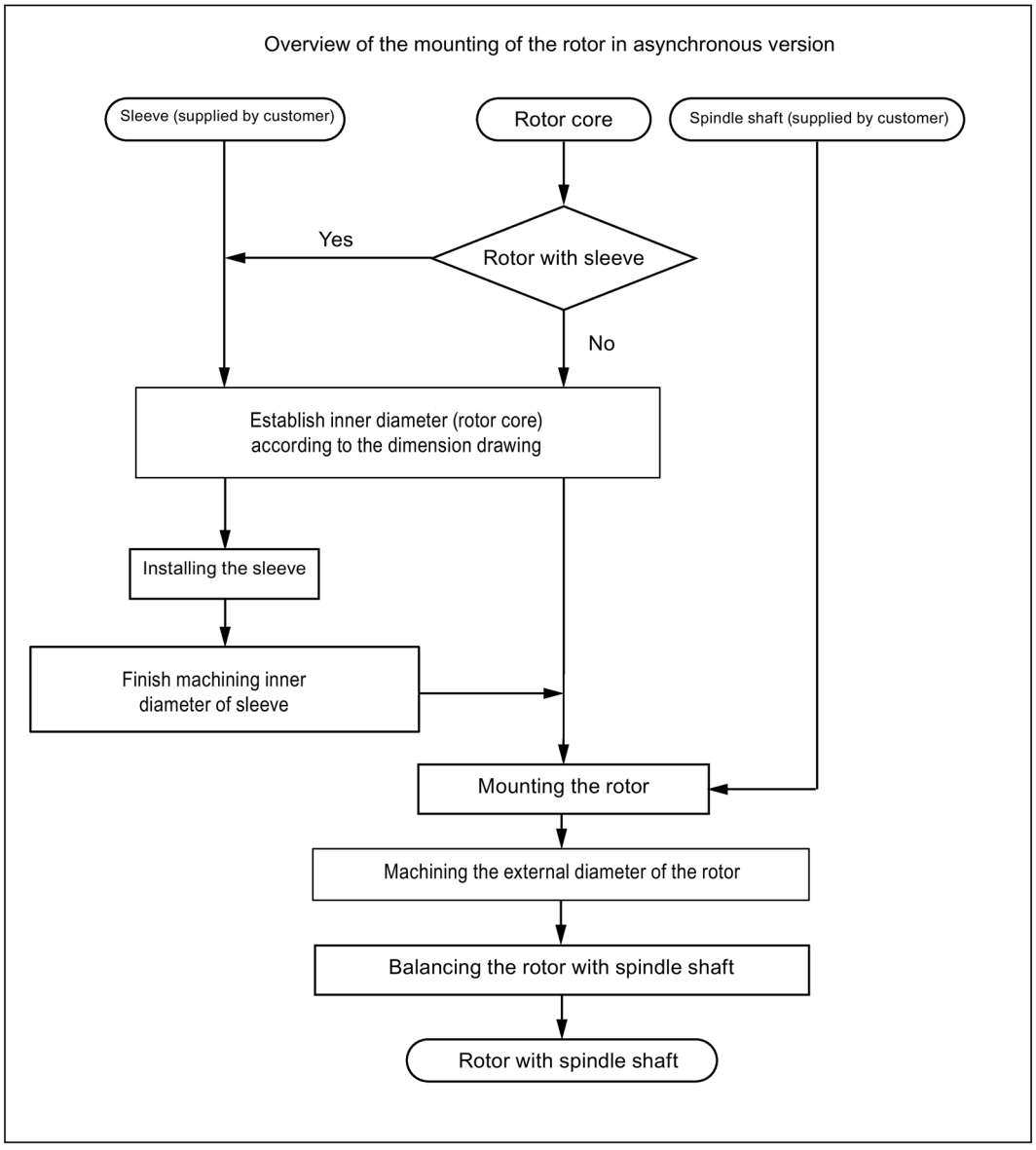


Figure 6-2 Sequence for mounting the rotor in asynchronous version

6.3.2 Tools and resources

To install the motor components you require the following installation equipment and resources.

- A draught-free room

Personal protection equipment

- Face protection shield
- Gloves for protection against cold or heat depending on the joining process
- Sealed protective clothing for protection against any oil leaks and high or low surface temperatures

Devices for joining the rotor

The following devices may be required depending on the joining process.

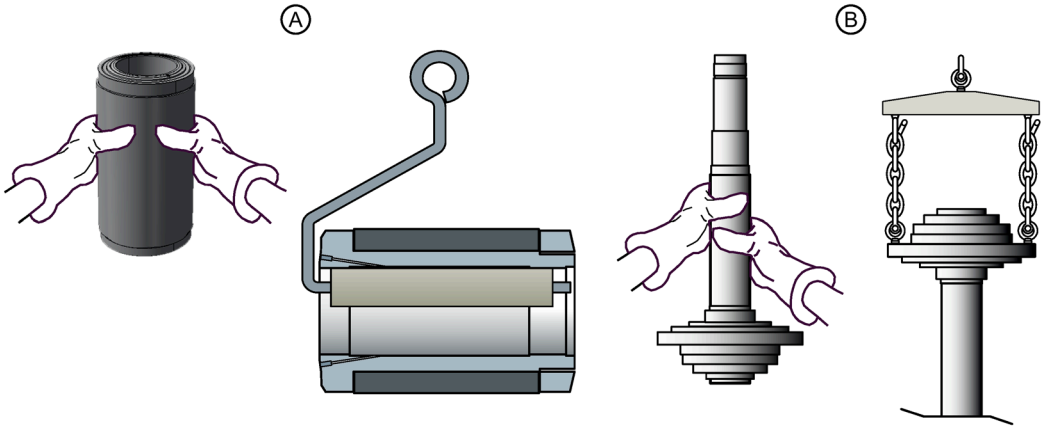
Joining with the heat process (shrink fit)	Joining with the cold process (stretch fit)
• Hot-air oven with temperature monitoring - suitable for installation temperatures [1)] • Oven volume appropriate for the rotor type, placement of the oven in the immediate vicinity of the workplace • Air-conditioned room or cold chamber for tempering the spindle shaft and rotor core	• Dewar vessel with liquid nitrogen N2 (-195.8 °C) • For a small workspace: good ventilation

1) The temperatures for the installation can be found in the "Installation temperatures" Cable in chapter "Mounting the rotor (Page 99)".

Hoisting gear for transporting the components

Hoisting gear, gripper, load suspension device, see figure "Examples for transporting components"

- Carrying capacity dependent upon the rotor core weight (please refer to the rating plate for the weights)
- Preferably with a device for quick lowering



Transport of the heated rotor core depending on size and weight

Transport of the cooled or tempered spindle shaft depending on size and weight

Figure 6-3 Examples for transporting components

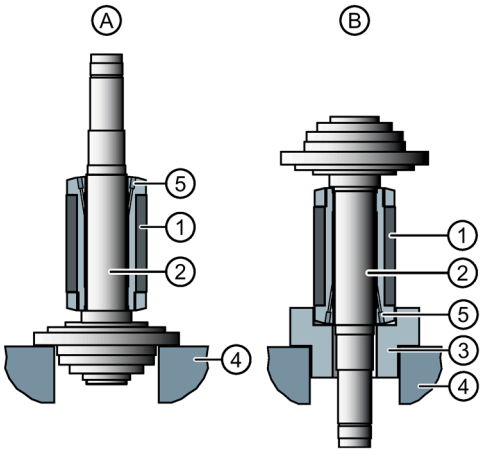
Instructions for installing the rotor

Note

Different shape

The spindle shaft is supplied by the spindle manufacturer. The shape of the spindle shaft may differ from the illustration.

You can install the rotor in two ways:



A Joining the rotor core
B Joining the spindle shaft
① Rotor core
② Spindle shaft
③ Stable support with opening
④ Assembly fixture (non-magnetic, resistant to heat and cold, thermally insulating)
⑤ Connecting thread for oil pressure pump for rotor cores with sleeve

Figure 6-4 Arrangement for assembling the rotor

Devices and materials for relieving stress on the rotor with sleeve after installation

- Oil-pressure hand pump with manometer for relieving the stress on, or removing the rotor with sleeve for "oil press fit" device version

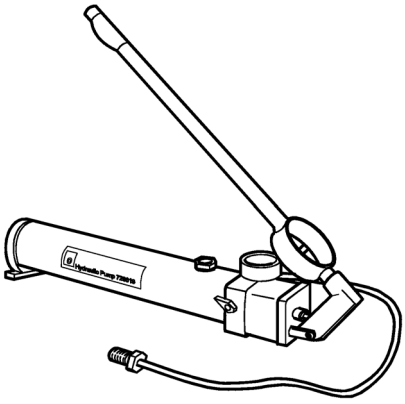
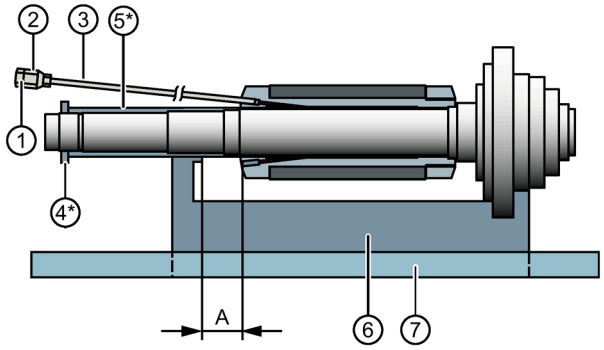


Figure 6-5 Oil pressure hand pump e.g. type SKF 1077454

- Equipment for relieving stress on the rotor or removing it



Comprising

① Connection hydraulic hand pump
② Connector nipple
③ Extension tube, e.g. type SKF1077453
④ Slotted nut (only for relieving stress)
⑤ Spacer sleeve (only for relieving stress)
⑥ Equipment (prism)[1)]
⑦ Tray for catching oil made from aluminum, for example [1)]
A Dimension for the axial relative movement for removal of the synchronous version, 90 mm
* Not required for removal
[1)] In the synchronous version these parts must be non-magnetic.

Figure 6-6 Equipment for relieving stress on the rotor with sleeve and for removing it

- Pressure oil for relieving stress, e.g. SKF LHMF 300 (viscosity 300 mm²/s at 20° C)
- Pressure oil for removal, e.g. SKF LHDF 900 (viscosity 900 mm²/s at 20° C)

Further devices and tools

- A fixture for checking the radial runout of the spindle shaft
- A balancing machine for balancing the rotor (fine or complete balancing)
- Detergent, e.g. Loctite 7061 or Loctite 7063; screw locking compound, e.g. Loctite 243

6.3.3 Mounting preparations

Prior to mounting, perform the following operations:

Preconditions for preparing for installation

Check that the components to be joined are correct and complete.

Check whether all mounting requirements (Page 91) have been observed.

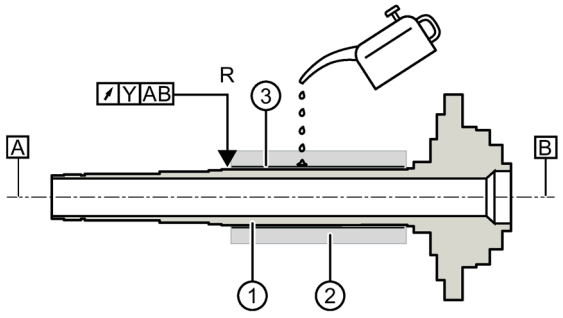
Procedure when preparing for mounting

1. Clean the surfaces to be joined as a prerequisite for the separation and reuse of the components later. The surfaces to be joined must be free from contamination, rust, sharp edges, damage and machining marks.
2. Clean the oil connection holes in accordance with the following description.
   - Remove the grub screws from the connection holes.
   - Remove oil, grease or other contaminants from the grub screws and holes (e.g. with Loctite 7061 or 7063).

   Note

   Observe the manufacturer's instructions for the cleaning products used.

   Ensure adequate ventilation for solvent-based products.
3. Measure and record the radial runout of the spindle to the reference plane (see measurement plane "R")



① Spindle shaft
② Position of the rotor core
③ Oiled surface (assembly without stress relief)
R Reference plane for radial runout check
Y Measured value (before and after assembly)
A-B Spindle shaft axis (reference axis)

Figure 6-7 Checking the radial runout

4. If the stress of the rotor core is not relieved after assembly, rub mounting fluid, such as SKF LHMF300, onto the joined surfaces ③.

❑

6.3.4 Mounting the rotor

The rotor core and spindle shaft are connected to the rotor using thermal joining.
Three processes are deployed.

Hot process (shrinkage)	Cold process (stretching)	Combined cold-hot process
The tempered spindle shaft is inserted into the rotor core that has been heated up.	The rotor core is inserted over the spindle shaft that has been cooled down.	The heat rotor core is inserted over the spindle shaft that has been cooled down.

Observe the following safety instructions when mounting the rotor.

⚠ WARNING

Risk of explosion when using other coolants

Liquid oxygen or liquid air can cause explosions and death or severe injuries.

- Only use liquid nitrogen.

NOTICE

Danger of bearing damage

Low temperatures can damage the bearing of the spindle shaft.

- Use the cold process only when the bearing lubricant is certified for low temperatures.

NOTICE

Demagnetize the permanent magnets of the rotor core (applies only to synchronous motors)

If the rotor temperature exceeds 150 °C, the permanent magnets in the rotor will be demagnetized irreversibly.

- Prevent the rotor being heated above 150 °C by checking the rotor temperature with a temperature-reactive dye or a temperature measuring device.
- Inductive heating of the rotor core is not permissible.

NOTICE

Damage to the rotor banding caused by impermissible temperatures

APM rotors have a banding (composite fiber) around the external diameter of the rotor which must not be damaged.

- Comply with the permissible temperatures during assembly (see Table "Assembly temperatures")

NOTICE

Damage to the aluminum version of the asynchronous rotor when heating up

Inductively heating up the aluminum version of the asynchronous rotor is only permitted via the inside diameter.

- Only inductively heat up the aluminum version of the asynchronous rotor via the inside diameter.

Assembly temperatures

	Hot process (shrinkage)		Cold process (stretching) [1]		Combined cold-hot process [1]	
	For synchronous version	**For asynchronous version**	**For synchronous version**	**For asynchronous version**	**For synchronous version**	**For asynchronous version**
Temperature of the rotor core	135 ... 140 °C	245 ... 250 °C	20 ... 40 °C	Not recommended	135 ... 140 °C	245 ... 250 °C
Temperature of the spindle shaft	10 ... 20 °C	10 ... 20 °C	-160 ... -196 °C		-40 ... -30 °C	-30 ... 0 °C

[1] After joining, dry the rotor core and spindle shaft (2...3 hours at approx. 60 °C)

Requirements for mounting

Note

Depending on the weight of the rotor core, use lifting gear and load suspension devices capable of carrying the components.

- Check that the resources function properly.
- Check the dimensions of the joining surfaces on the rotor and on the spindle shaft. The dimensions required for your motor can be found on the dimension sheets in Chapter "Dimensional drawings (Page 191)".

Note

Avoid positioning errors

- Carry out the joining procedure without delay.
- Observe the position of the holes for the rotor core.

Note

Installing balancing disks

Depending on the type of rotor (without or with sleeve) and the balancing method, you may have to mount balancing disks together with the rotor on the spindle shaft.

Procedure during mounting

⚠ WARNING

Danger caused by hot/cold surfaces

During mounting, the components are very hot or very cold and can cause burns or frost bite.

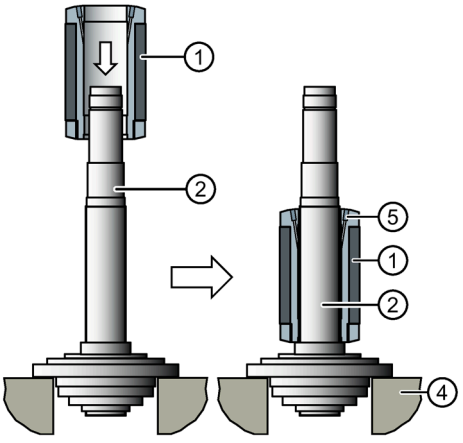
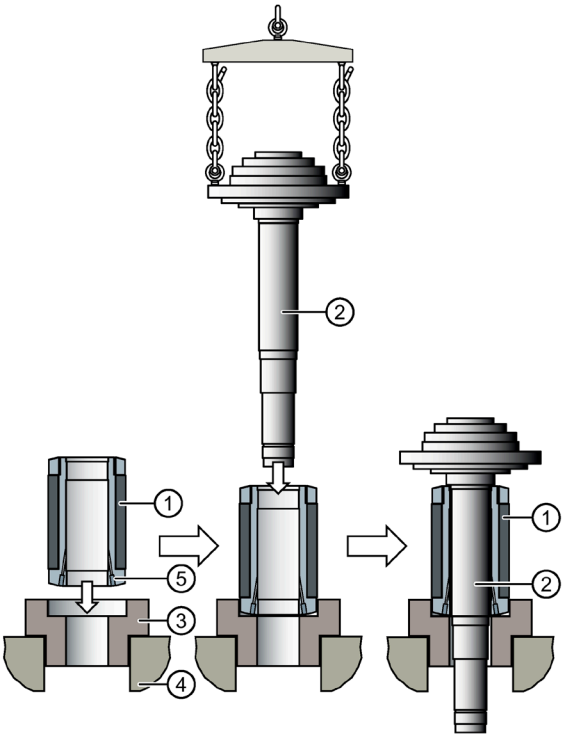
- Do not touch any components with unprotected hands.
- Wear heat-resistant gloves, safety goggles and closed work clothes.

1. Select joining process A or B

Note

Different shape

The spindle shaft is supplied by the spindle manufacturer. The shape of the spindle shaft may differ from the illustration.

A Joining the rotor core	B Joining the spindle shaft
	

1 Rotor core
2 Spindle shaft
3 Mounting device [1)]
4 Rigid support
5 Oil connection hole
[1)] For rotors with permanent magnets made of non-magnetic material

2. Temper the components according to the joining method used

3. Position the components according to the joining method used.
4. Join the components quickly to their final position.
5. Allow the components to cool down to room temperature.
6. Measure the radial runout at the reference level and mark the position of largest deviation, see the "Checking the radial runout" figure.

❒

6.3.5 Compensating mechanical stresses and deformations of the spindle shaft

Note

The stress compensation is possible only for mounted rotors with sleeve.

The thermal joint causes stresses (pressing) by the fit interference of the spindle shaft. These stresses can deform the spindle shaft.

After joining, a destressing of the spindle shaft with oil pressure for stress compensation or for reducing the spindle deformation is recommended.

The following chapter describes the compensation for the mechanical stresses.

Stress compensation principle

Forcing oil between the spindle shaft and the rotor core releases the step press fit.

Note

Undesired displacement between spindle shaft and rotor package

If the pressure is sufficient, the spindle shaft will slide off the rotor core.

- Prevent the relative axial movement when relieving stress (see figure "Design of the equipment for stress compensation and realignment (example)")

Requirements for the compensation for the mechanical stresses

Make sure that the following safety measures are observed for the stress compensation.

- Check the pump and accessories for functional safety.
- Operate the pump only with manometer.
- Do not make any changes to the device and its safety equipment.
- Observe the notes contained in the oil press pump operating instructions.
- Wear a face protective mask and closed work clothes.
- Vent the hydraulic system.

  The oil pressure is built up manually.
- Do not exceed the maximum permissible oil pressure (see "Maximum permissible oil pressure" table)

Table 6- 3 Maximum permissible oil pressure

Motor type	**Maximum oil pressure P_{max} / MPa**
1FE218□-8□	80

Table 6- 4 Oil that can be used for stress compensation

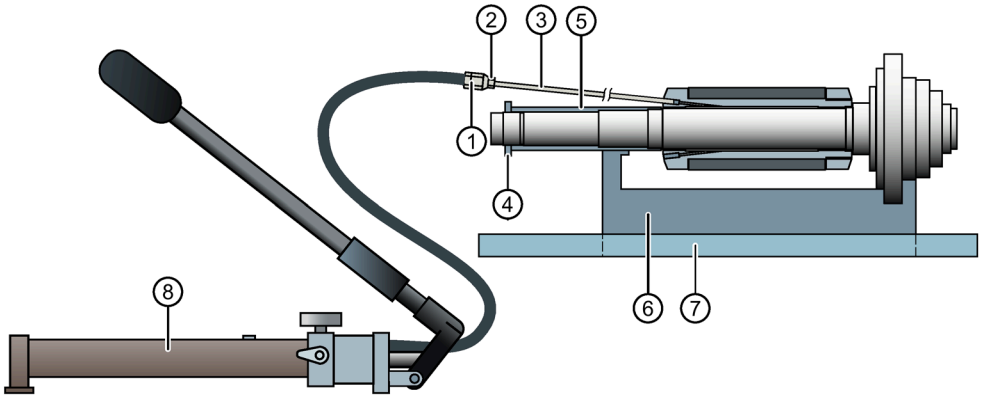
Viscosity	300 mm^2/s at 20° C	e.g. type SKF LHMF 300

Note

For special designs with a rotor sleeve, please contact the relevant Siemens office.

Procedure when compensating for the mechanical stresses

NOTICE
Environmental harm due to leaking oil The forcing of oil can cause oil to escape and result in environmental damage. • Catch any escaping oil. • Bind the escaping oil with a suitable oil binding agent. • Dispose of the oil and oil binding agent in accordance with the legal regulations.



① Connection hydraulic hand pump
② Connector nipple
③ Extension tube
④ Slotted nut
⑤ Spacing sleeve
⑥ Supporting fixture (prism) [1)]
⑦ Collecting tray [1)]
⑧ Manual oil pump
[1)] For synchronous version made of non-magnetic material

Figure 6-8 Design of the equipment for stress compensation and realignment (example)

1. Unscrew both grub screws from the rotor core sleeve.
2. Wrap the threaded shoulder on the extension tube and the second grub screw with Teflon sealing tape.
3. Screw the extension tube firmly into the sleeve of the rotor core.
4. Place the rotor core with spindle shaft, slotted nut and the spacing sleeve on the prism.
5. Attach the oil hand pump.
6. Vent the hydraulic system.
7. Screw the second grub screw with Teflon sealing tape tightly into the sleeve thread.

8. Force the oil with the hand pump slowly until the pressure of approx. 50 MPa (500 bar) is reached.

⚠WARNING

Danger to life caused by oil under high pressure

The spurting of oil and/or mechanical damage from the hydraulic system can cause severe injury or death.

- Use only intact devices and tools.
- Observe the prescribed pressures.

9. Allow the oil to act for approximately 15 minutes.
   → The oil penetrates the fitting gaps and distributes itself.
10. Increase the pressure to approx. 60 to 70 MPa (600 to 700 bar).
    → The unit floats.
    The rotor is prevented from sliding off by the slotted nut and the spacing sleeve.

Note

A few oil drops can spurt out in the axial direction.

11. Reduce the oil pressure at the pump.
12. Check the radial runout at the reference mark. See the "Checking the radial runout" figure.
13. If the required accuracy is not attained, repeat the pressure operation.
    → This rotates the rotor core and the shaft against one another.
14. Remove the extension pipe.
15. Place the "rotor - spindle shaft" system vertical.
    → Allow the oil to drip from the sleeve.
16. Store the unit for 24 hours.
    → Collect the escaping residual oil in the sump.

    The "rotor - spindle shaft" system is fully loadable again after 24 hours.
17. Degrease the threaded holes and grub screws with e.g. Loctite 7061.
18. To secure the grub screw, apply Loctite 243 or similar to the threaded hole.
19. Screw the grub screws into the threaded hole.
20. Mark on the face the position of the rotor to the spindle.

❒

Compensation for deformations caused by thermal joining

Thermal joining can cause deformation of the bearing seat. For this reason, we recommend re-machining the bearing seat.

6.3.6 Balancing of rotors in synchronous version

In accordance with the requirements for smooth running, the rotor core with the spindle shaft must be implemented with the appropriate vibration severity level.

The following chapter describes the balancing of the synchronous rotor with sleeve.

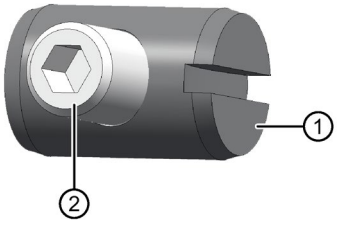
The rotor can be supplied in one of two balance conditions.

Rotor unbalanced	**Rotor prebalanced**
Standard	Optional (Z option: T00)
Not prebalanced	Balancing quality level G2.5 to DIN ISO 1940 Reference speed 3600 rpm
There are no balancing weights in the balancing planes.	Any balancing weights previously placed by the manufacturer can be replaced or augmented with additional balancing weights.
Balance the rotor with the balancing planes present on the rotor in a single work step.	Fine balancing of the rotor with the balancing planes present on the rotor.

Description of the balancing weights

To balance the rotor core you require balancing weights.

The balancing weights are supplied with the rotor.



1 Balancing weight

2 Allen screw SW 2.5 mm

Mass of the balancing weight: approx. 4.1 g

Length of the balancing weight: approx. 12 mm

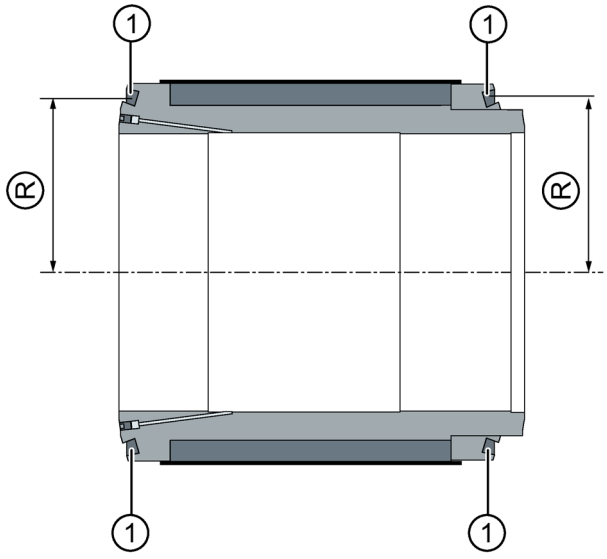
Figure 6-9 Balancing weight

Depending on the motor type, the provided accompanying balancing weights normally permit the additional compensation:

Motor type	Additional minimum possible compensation of imbalance during fine balancing [1] (gmm)	Number of balancing weights (units) provided
1FE2182-8	2200	16
1FE2183-8		
1FE2184-8		
1FE2185-8	3200	22
1FE2186-8		
1FE2187-8		
[1]) without rotor		

Design of the rotor core

For balancing, the rotor has circumferential grooves ① (balancing planes) in which you insert and position the balancing weights.



1 Encircling groove for accepting the balancing weights

R Balancing radius = 128.2 mm

Figure 6-10 Structural preparation of the rotor core for balancing

Preconditions for balancing

The rotor core is mounted on the spindle shaft.

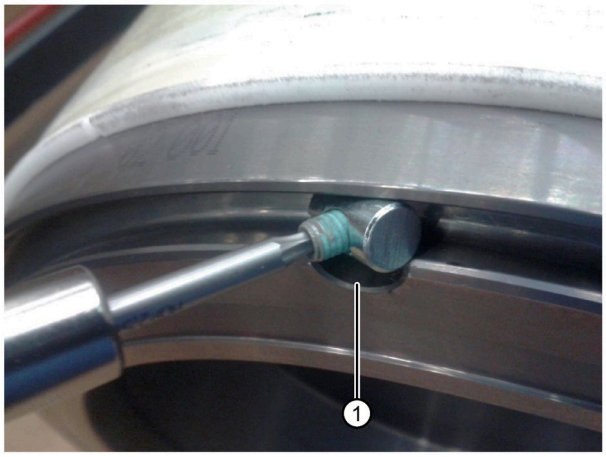
The rotor is located in the balancing device.

Note

The spindle manufacturer is responsible for verifying the balancing system.

Procedure for balancing the synchronous rotor with sleeve

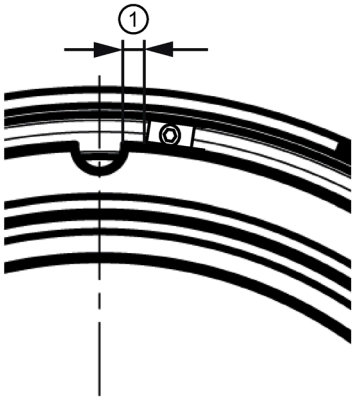
1. Remove the protective film before balancing the rotor core.
2. Insert the balancing weight in the groove of the rotor core through the groove openings.



1 Groove opening

Figure 6-11 Placing balancing weights

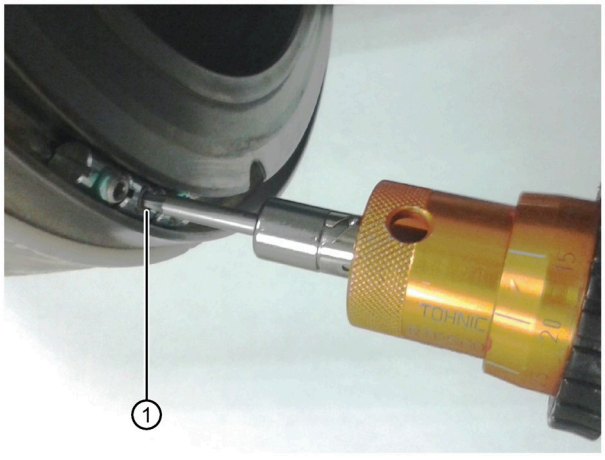
3. Move the balancing weight in the groove at the position specified by the balancing machine.
   Maintain a minimum clearance of 5 mm to the groove openings displaced by 180°.



1 Minimum clearance 5 mm

Figure 6-12 Balancing weight - groove opening minimum clearance

4. Center the balancing weight between the edges of the groove.



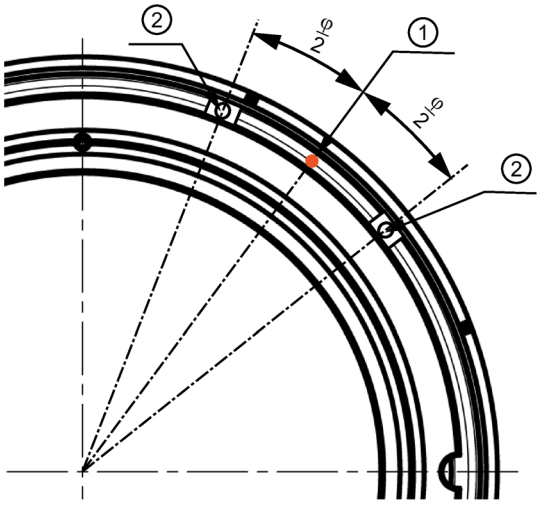
1 Align the balancing weights centered, and fasten (tightening torque 2.5 Nm)

5. Tighten the grub screw of the balancing weight with a torque of 2.5 Nm.
6. Repeat steps 1 to 4 until you have positioned all required balancing weights.

NOTICE
Danger caused by loosening of the balancing weights as result of ineffective screw securing If you loosen the balancing weights already screwed in place by the manufacturer (e.g. for the prebalanced rotor) you destroy the lock against inadvertent loosening. Retightening is not permitted because of the ineffective screw lock. • Replace the loosened balancing weights with new balancing weights. • If required, newly placed balancing weights can be loosened, moved and retightened within two hours. The screw lock becomes effective after 2 hours. If loosened after two hours, the balancing weights must be replaced with new balancing weights.

Procedure for fine-balancing

Fine-balancing can be achieved by spreading two balancing weights.



$$\frac{\varphi}{2} = \arccos\left(\frac{u}{m_W}\right)$$

1 Imbalance
2 Balancing weights
φ Spreading angle in degrees (°)
u Unbalance mass in gram (g)
mw Mass of the balancing weight in gram (g)

Figure 6-13 Spreading the balancing weight

If you require additional balancing weights, they can be ordered with order number 340.40002.01 from the Service Center.

6.3.7 Balancing of rotors in asynchronous version

Balancing the asynchronous rotor

In accordance with the requirements for smooth running, the rotor core with the spindle shaft must be implemented with the appropriate vibration severity level. Asynchronous rotors are unbalanced as standard and offer no balancing planes integrated in the rotor core. Verification of balancing is the responsibility of the spindle manufacturer.

We recommend that you balance the system "spindle shaft - rotor core without sleeve".

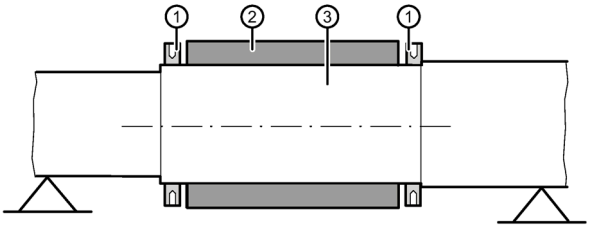
Precondition

You have mounted the appropriate balancing disks on the spindle shaft.

Procedure

NOTICE
Damage to the rotor core by drilled balancing holes
Drilling into the rotor core ② is not permitted.
When drilling the balancing disks, make sure that no chips of metal can foul the rotor core.

Use balancing disks to balance the system on balancing planes of the spindle axis that are to be provided.



① Balancing disks on the balancing planes (not included in scope of supply)
② Rotor core
③ Spindle shaft

Figure 6-14 Balancing a spindle shaft and rotor core without sleeve

Recommendations for the mechanical dimensions of the balancing disks can be found in the Configuration Manual.

6.3.8 Removing the rotor core with sleeve

The following chapter describes the removal of the rotor core with sleeve from the spindle shaft.

Note

You cannot remove the rotor without sleeve without damage.

The rotor core is removed from the spindle shaft using the oil pressing procedure.

The supporting fixture must allow the rotor core to move.

Principle of the oil pressing procedure

Forcing oil between the spindle shaft and the rotor core releases the step press fit.

The oil pressing procedure causes a high level of mechanical stress in the components.

If the pressure is sufficient, the spindle shaft will slide off the rotor core.

The necessary section for the relative movement is specified by the construction of the stepped press fit. The section is specified by dimension A in the "Rotor core removal" figure.

Precondition for removal using the oil pressing procedure

Observe the following safety measures during removal.

- Check the pump and accessories for functional safety.
- Operate the pump only with manometer.
- Do not make any changes to the device and its safety equipment.
- Observe the notes contained in the oil press pump operating instructions.
- Wear a face protective mask and closed work clothes.
- Vent the hydraulic system.

  The oil pressure is built up manually.
- Do not exceed the maximum permissible oil pressure (see "Maximum permissible oil pressure" table)

Table 6- 5 Maximum permissible oil pressure

Motor type	Maximum oil pressure P_{max} / MPa
1FE218□-8□	80

Table 6- 6 Oil that can be used for removal

Viscosity	900 mm^2/s at 20 °C	e.g. type SKF LHDF 900

Procedure for removal using the oil pressing procedure

NOTICE

Environmental harm due to leaking oil

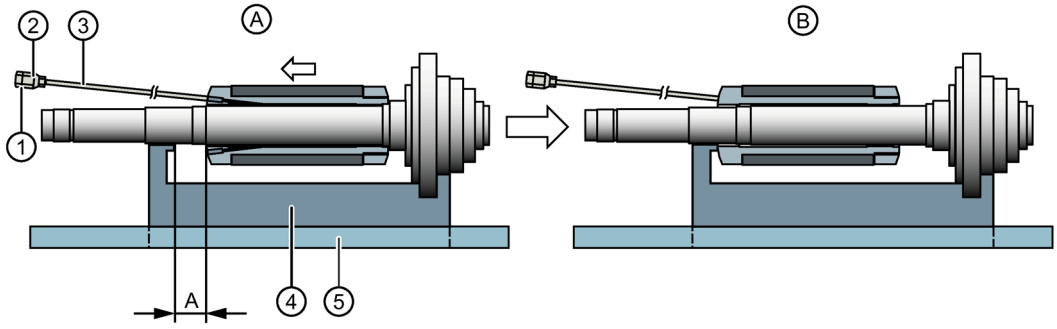
The forcing of oil can cause oil to escape and result in environmental damage.

- Catch any escaping oil.
- Bind the escaping oil with a suitable oil binding agent.
- Dispose of the oil and oil binding agent in accordance with the legal regulations.

Note

Different shape

The spindle shaft is supplied by the spindle manufacturer. The shape of the spindle shaft may differ from the illustration



A Position of rotor before release
B Position of rotor after release
① Connection hydraulic hand pump
② Connector nipple
③ Extension tube
④ Supporting fixture (prism) [1] (example)
⑤ Collecting tray [1] (example)
A Dimension for the relative movement = 90 mm for the synchronous version
[1] For synchronous motors made of non-magnetic material

Figure 6-15 Design of equipment for removing the rotor

1. Unscrew both grub screws from the rotor core sleeve.
2. Wrap the threaded shoulder on the extension tube ③ and the second grub screw with Teflon sealing tape.
3. Screw the extension tube firmly into the sleeve of the rotor core.
4. Place the rotor on the prism ④.
5. Attach the oil hand pump securely to the connection ①.
6. Vent the hydraulic system.

7. Screw the second grub screw with Teflon sealing tape tightly into the sleeve thread.
8. Force the oil with the hand pump slowly until the pressure of approx. 50 MPa (500 bar) is reached.

⚠WARNING

Danger to life caused by oil under high pressure

The spurting of oil and/or mechanical damage from the hydraulic system can cause severe injury or death.

- Use only intact devices and tools for the removal process.
- Observe the prescribed pressures.

9. Allow the oil to act for approximately 15 minutes.
   → The oil penetrates the fitting gaps and distributes itself.
10. Increase the pressure to approx. 65 to 70 MPa (650 to 700 bar) until the oil escapes at both sides of the press fit.
    → The rotor core automatically slides off the spindle shaft.

Note

A few oil drops can spurt out in the axial direction.

The rotor core movement is limited by the prism ④.

If necessary, support the loosening of the rotor core by tapping lightly, for example, with a soft-faced hammer.

11. Check the joint surfaces for scratches or marks in the longitudinal direction.

Note

Scratches or marks in the longitudinal direction inhibit the pressure build-up in subsequent dismantling operations and consequently the release of the joined components.

❒

6.4 Installing the stator in the spindle housing

6.4.1 Flow chart for the stator installation

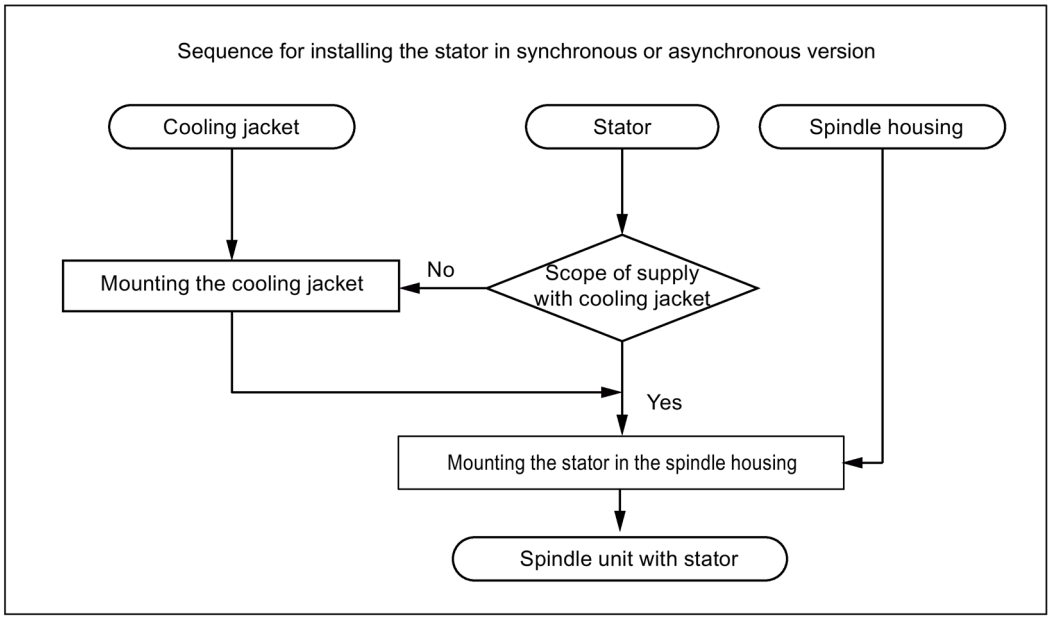


Figure 6-16 Flow chart for installing the stator in synchronous and asynchronous versions

The following chapters describe the installation of the stator in the spindle housing.

The stator is available in the following versions.

Stator without cooling jacket (standard version)	Stator with cooling jacket (on request)

Note

Example diagrams

The illustrations and descriptions are examples and may vary.

- From the following, select the installation chapter relevant for your stator.

6.4.2 Mounting the stator without cooling jacket

Note

The procedure described in the following chapter can be applied analogously to the installation of a cooling jacket provided additionally by the customer.

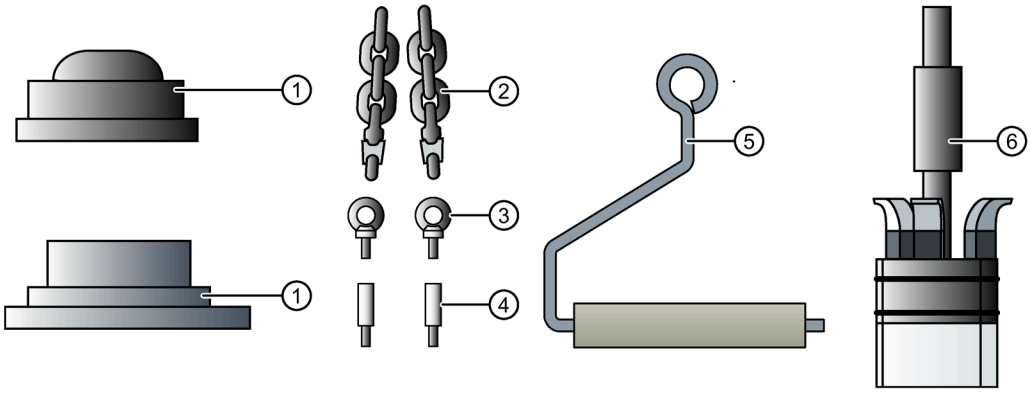
6.4.2.1 Production equipment, assembly tools and other resources

To install the stator, you require the following production equipment, mounting tools and other equipment.

Personal protection equipment

- Face protection shield
- Protective gloves
- Closed protective clothing for protection against high surface temperatures

Mounting, production and auxiliary equipment for installation



1	Appropriate axial stops (examples)
2	Load suspension equipment (example)
3	Eyebolts
4	Spacing sleeves
5	Plastic-covered support arm for horizontal mounting (example)
6	Internal tensioning spindle (example)
Not shown	Anti-corrosion agent for steel surfaces

Additional installation, production and auxiliary equipment

- Hot-air oven with temperature monitoring
  - Oven volume appropriate for the stator type
  - Placement of the oven in the immediate vicinity of the workplace

6.4.2.2 Mounting the stator without cooling jacket

The chapter describes the installation of the stator core without cooling jacket in the spindle housing.

Note

The procedure can be applied analogously to the installation of a cooling jacket provided additionally by the customer.

The stator is connected with the spindle housing by warm shrinking.

There are several variants for joining the stator with the spindle housing.

Note

Perform the joining procedure without delay.

NOTICE
Damage to the winding and insulation due to improper installation Incorrect installation of cast and impregnated rotors can cause damage to the winding and insulation. • Use only such equipment and tools that guarantee installation without any damage.

Precondition

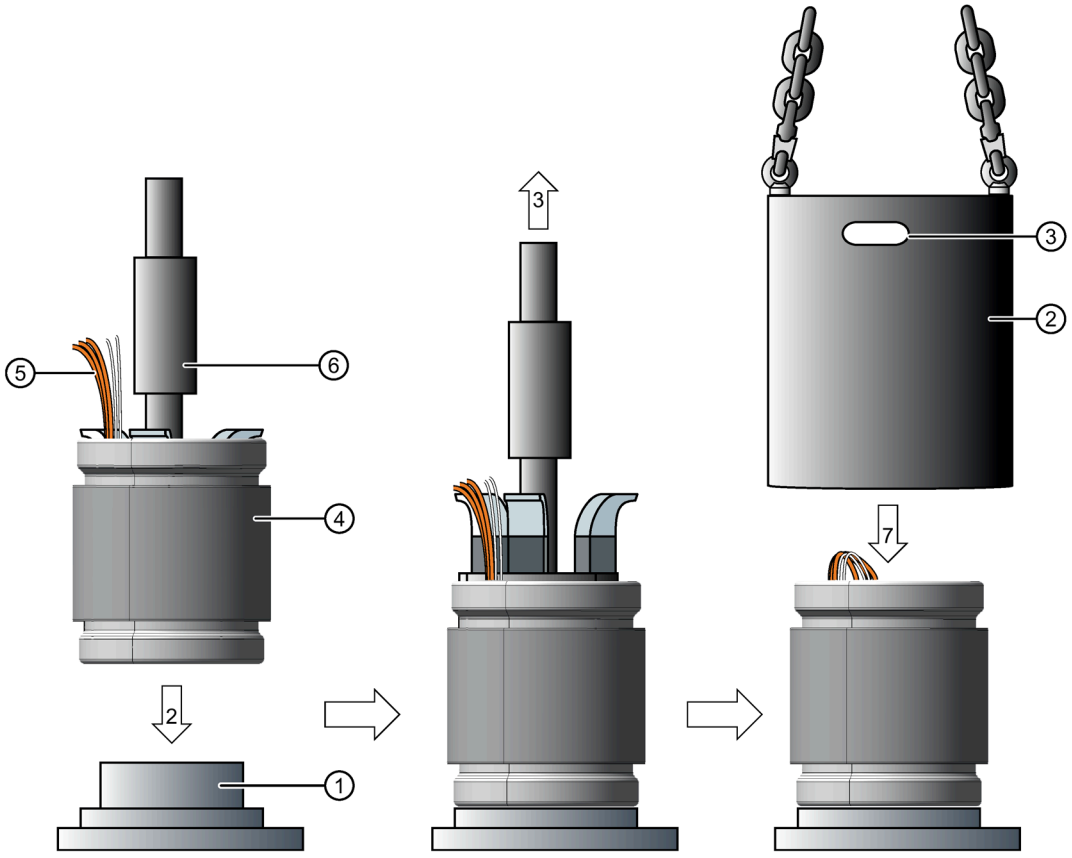
- All personal protection equipment is available and is worn.
- All production equipment, mounting tools and other equipment for installation are available and ready for operation.
- All preparatory work for the installation is completed.

Procedure when mounting the spindle housing over the stator

Note

Different shape

The spindle housing ② can also represent a cooling jacket provided additionally by the customer. The shape of the component may differ from the illustration. The shapes of the axial end-stop ① and of the internal mandrel ⑥ depend on the shape of the components and may differ from those in the illustration.



1	Axial stop for stator	4	Stator without cooling jacket
2	Spindle housing/cooling jacket	5	Connection cables
3	Cable entry	6	Internal tensioning spindle

Figure 6-17 Mounting the spindle housing over the stator without cooling jacket, steps 2, 3 and 7

The numbered arrows visualize the following steps with the same numbering.

1. Clean contaminants and chips from the subassemblies ② and ④.
2. Place the stator on the mounting support.
3. Remove the internal tensioning spindle from the stator.

4. Warm up the spindle housing.

NOTICE
Damage to the winding and insulation due to excessive temperatures Excessive temperatures can damage the winding and insulation. • Ensure that the temperature of the spindle housings during joining does not exceed 160 °C.

5. Mount without delay the lifting lug and the eyebolts.
6. Take the heated spindle housing at the lifting lug.
7. Immediately push the spindle housing over the stator as far as the lower end stop. Ensure the correct position of the connection cables at the cable gland in the spindle housing or end shield.

NOTICE
Damage to the power and signal cables caused by a hot spindle housing The insulation can be damaged if the power and signal cables come into contact with the hot spindle housing. • Avoid the cables making contact with the hot spindle housing.

Note

- If necessary, push the spindle housing by hand to the final position.

8. Let the hot spindle housing cool down.
9. Push the connection cables through the cable gland of the spindle housing or the end shield in accordance with the project specifications.
10. Attach the end shield.
11. Bolt the end shield onto the spindle housing. You will find further information in the Chapter "Mounting the motor spindle (Page 127)".
    - First tighten all bolts with half the maximum tightening torque.
    - Then tighten the bolts with a torque wrench diagonally to the maximum tightening torque. See table "Tightening torques"

❒

6.4.3 Mounting the stator with cooling jacket

6.4.3.1 Production equipment, assembly tools and other resources

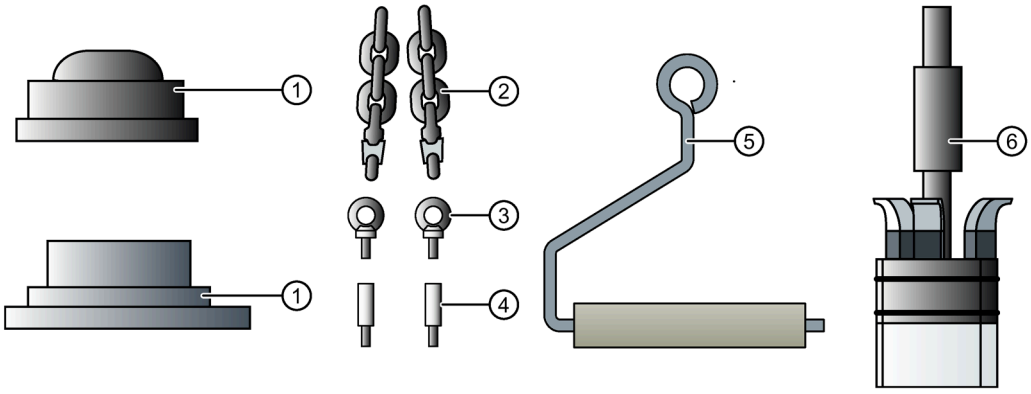
To install the cooling jacket, you require the following production equipment, mounting tools and other equipment.

Personal protection equipment

Personal protection equipment:

- Face protection shield
- Protective gloves
- Closed protective clothing for protection against high surface temperatures

Mounting, production and auxiliary equipment for installation



1	Appropriate axial stops (examples)
2	Load suspension equipment (example)
3	Eyebolts
4	Spacing sleeves
5	Plastic-covered support arm for horizontal mounting (example)
6	Internal tensioning spindle (example)
Not shown	Anti-corrosion agent for steel surfaces
	Grease or talcum as lubricants for Viton O-ring seals

Medium for the leak test with liquid

Water connection, maximum test pressure 0.7 MPa (7 bar).

6.4.3.2 Preparation for installation

The chapter describes the preparatory measures for installing the stator with cooling jacket in the spindle housing.

Note

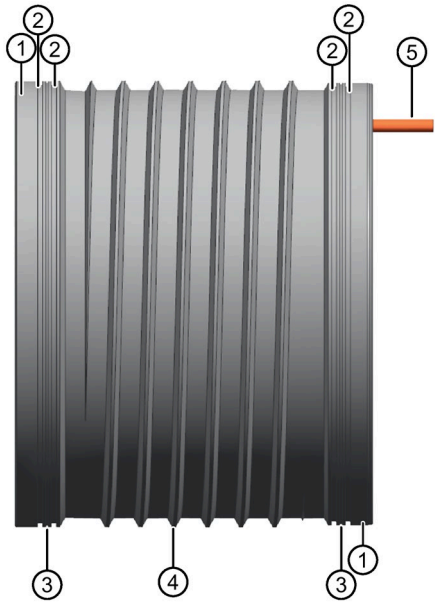
The illustrations and descriptions are examples and may vary.

Precondition

- Check that the components are correct and complete.
- All installation, production and other equipment is available.

Procedure

1. Check the insulation resistance before mounting stators that have been stored for a longer period. You will find further information in the Chapter "Test the insulation resistance (Page 172)".
2. Clean the surfaces to be joined①.



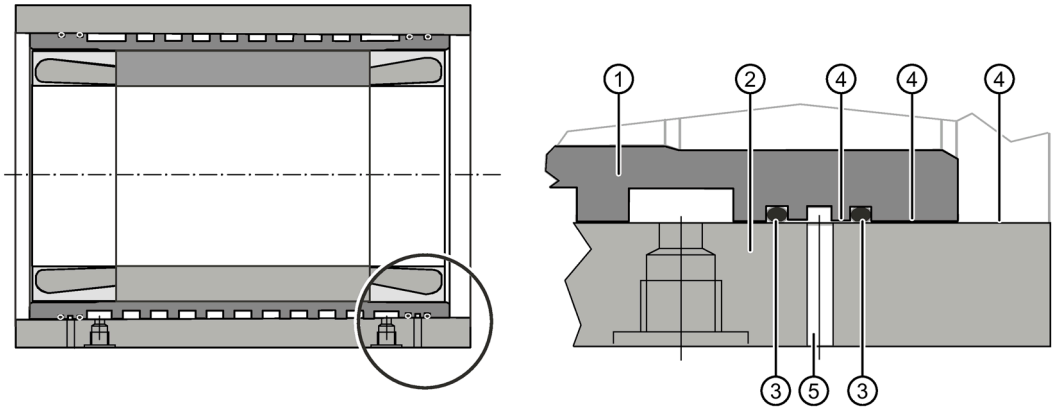
1 Joining surfaces for the stator to be coated with anti-corrosion agent.
2 Four slots for the O-ring seals for sealing the stator
3 Center slots for discharge in the drain holes
4 Cooling thread
5 Motor cable from the stator

Figure 6-18 Surfaces and slots for the stator with water cooling (example)

All surfaces must be free from contamination, rust, sharp edges, shrink holes, damage and machining marks, in particular:

– The ring slots for the O-ring seals
– The cooling thread on the cooling jacket (for the stator with cooling jacket variant)
– The spindle housing
– The cable duct in the spindle housing
– The drain holes

3. Apply a suitable anti-corrosion agent for steel to the stator and spindle housing surfaces that do not come into contact with the cooling fluid.

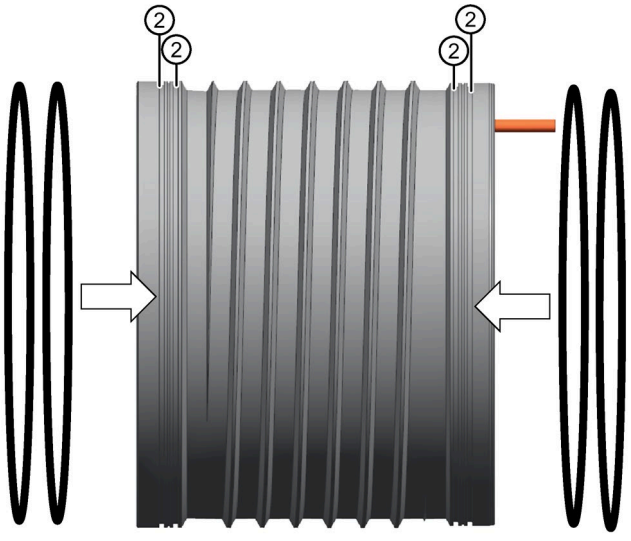


The diagram shows an example of a fully installed stator.

① Stator core with cooling jacket
② Spindle housing
③ O-ring seal
④ Surface coated with anti-corrosion agent
⑤ Drain hole

Figure 6-19 Applying the anti-corrosion agent

4. To improve sliding, rub the O-ring seals with an appropriate grease or talcum.



2 The slots for the O-ring seals

Figure 6-20 Mounting the O-ring seals in the stator with cooling jacket

5. Insert the O-ring seals in the slots.
6. If necessary, screw the eyebolts with spacer sleeves into the front face of the cooling jacket for the attachment of the hoisting gear.
   Alternatively, you can use an internal mandrel.

❒

6.4.3.3 Mounting the stator with cooling jacket in the stator housing

This chapter describes the installation of the stator core with cooling jacket in the spindle housing.

There are several variants for mounting the stator in the spindle housing.

Vertical mounting of the spindle housing	Horizontal mounting of the spindle housing

Note

The spindle manufacturer is responsible for selecting and executing the joining process.

NOTICE

Risk of damage to the winding and insulation from incorrect assembly

Incorrect installation of cast and impregnated rotors can cause damage to the winding and insulation.

- Use only such equipment and tools that guarantee installation without any damage.

NOTICE

Damage to power and sensor cables

The power and sensor cables can be damaged during mounting.

- Position the cables so they are not damaged during mounting.
- Avoid tensions on the cables.
- Do not crush the cables.

Note

The spindle housing seals the cooling thread of the cooling jacket from the exterior.

Tightening torques

For installation, use bolts with at least property class 8.8, $\mu_{tot} = 0.14$.

Diameter in mm	Tightening torque in Nm
M10	45

Preconditions

- All personal protection equipment is available and is worn.
- All production equipment, mounting tools and other equipment for installation are available and ready for operation.
- All preparatory work for the installation is completed.

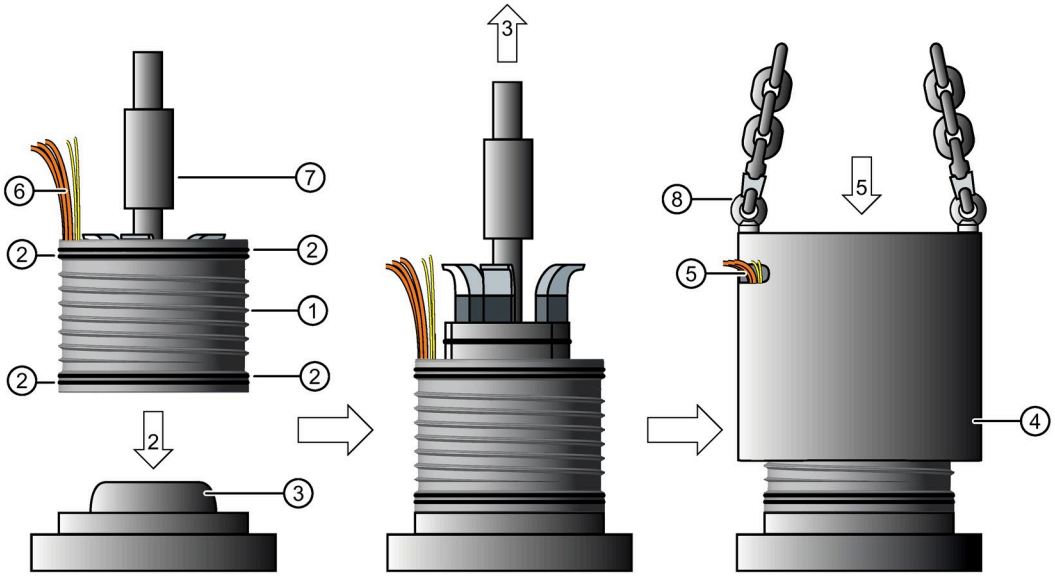
Procedure for the vertical installation in the spindle housing

Note

Different shape

The shapes of the cooling jacket ① and the spindle housing ⑤ may differ from those in the illustration. The shapes of the axial end-stop ③ and of the internal mandrel ⑦ depend on the shape of the components and may differ from those in the illustration.

The numbered arrows visualize the following steps with the same numbering.



1	Stator with cooling jacket (example)	5	Cable entry
2	O-ring seals (four)	6	Connection cables
3	Axial stop (example)	7	Internal tensioning spindle
4	Spindle housing	8	Lifting lug / eyebolts

Figure 6-21 Vertical installation of the spindle housing over the stator without cooling jacket, steps 2, 3 and 5

The numbered arrows visualize the following steps with the same numbering.

1. Check that the four O-ring seals are fitted correctly.
2. Position the stator on the axial stop
3. Remove the internal tensioning spindle from the stator.
4. Position the spindle housing so that you can route the electrical cables through the cable gland of the spindle housing or the end shield later.

5. Place the spindle housing over stator from above.

Note

- If necessary, push the spindle housing by hand to the final position.
- When joining, ensure that the O-ring seals remain in the stator slots.

6. Remove the lifting lug and the eyebolts from the spindle housing.
7. Push the connection cables through the cable gland of the spindle housing or the end shield in accordance with the project specifications.
8. Attach the end shield.
9. Bolt the end shield or mounting shield onto the cooling jacket. You will find further information in the Chapter "Mounting the motor spindle (Page 127)".
   – First tighten all bolts with half the maximum tightening torque.
   – Then tighten the bolts with a torque wrench diagonally to the maximum tightening torque. See table "Tightening torques"
10. Use a liquid medium to check whether the spindle housing is sealed properly. Test pressure 0.7 MPa (7 bar).
    – Turn the spindle housing so that the drain holes are facing downwards.
11. If the spindle housing leaks, dismantle the spindle housing.
    – Replace the O-ring seals on the stator.
    – Deburr any sharp edges.
12. Remount the stator in the spindle housing.

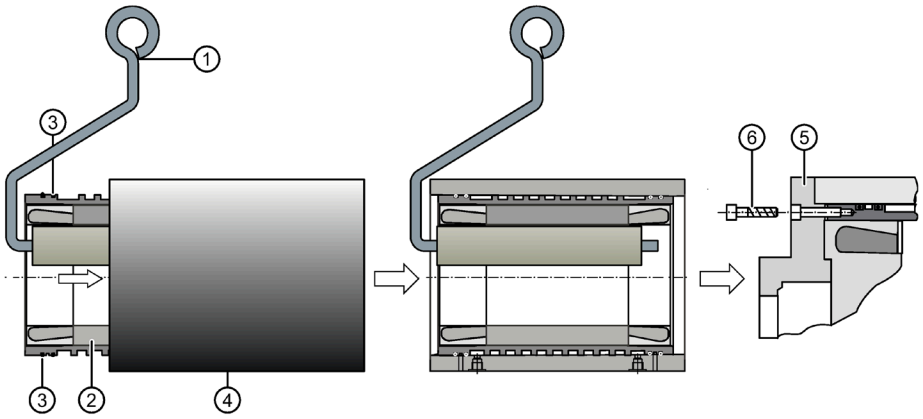
❒

Procedure for horizontal installation of the stator in the spindle housing

Note

Different shape

The shapes of the cooling jacket ① and the spindle housing ⑤ may differ from those in the illustration. The shapes of the axial end-stop ③ and of the internal mandrel ⑦ depend on the shape of the components and may differ from those in the illustration.



1	Plastic-covered support arm	4	Spindle housing
2	Stator with cooling jacket	5	End shield
3	O-ring seals (four)	6	Bolt

Figure 6-22 Horizontal mounting of the stator in the spindle housing, steps 3, 4 and 7

1. Check that the four O-ring seals are fitted correctly.
2. Take the stator at the support arm.
3. Position the spindle housing so that you can route the electrical cables through the cable gland of the spindle housing or the end shield.
4. Insert the stator horizontally in the spindle housing. When inserting, ensure that the O-ring seals remain in the stator slots.
5. Thread the connection cables through the cable gland.
6. Attach the end shield.
7. Bolt the end shield or mounting shield onto the cooling jacket. You will find further information in the Chapter "Mounting the motor spindle (Page 127)".
   - First tighten all bolts with half the maximum tightening torque.
   - Then tighten the bolts with a torque wrench diagonally to the maximum tightening torque. See table "Tightening torques"

   Use a liquid medium to check whether the spindle housing is sealed properly. Test pressure 0.7 MPa (7 bar).
   - Turn the spindle housing so that the drain holes are facing downwards.
8. If the spindle housing leaks, dismantle the spindle housing.
   - Replace the O-ring seals on the stator.
   - Deburr any sharp edges.
9. Remount the stator in the spindle housing.

❒

6.5 Mounting the motor spindle

6.5.1 Preparation

To install the stator in the spindle housing you require the following installation equipment and resources.

Assembly tools and resources required

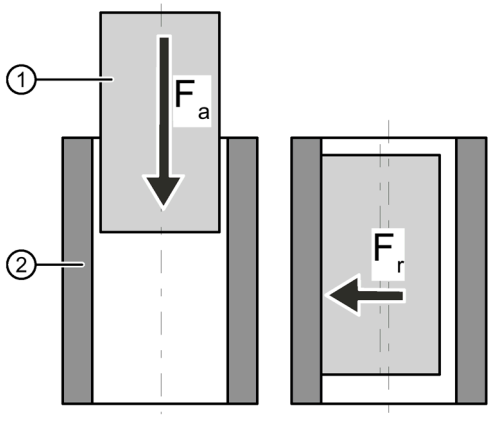
- Hoisting gear with suitable load suspension device
- Eyebolts
- Centering assembly fixture
- Assembly film
- Personnel protective equipment

6.5.2 Acting magnetic forces

Note

This chapter applies only to rotors with permanent magnets (synchronous version).

The higher magnetic forces present as a result of the permanent magnets in the rotor draw the spindle into the stator bore.



① Spindle shaft with rotor core
② Stator core with spindle housing
F_a Axial attractive force
F_r Radial attractive force

Figure 6-23 Attractive_forces_motor_spindle

Magnetic forces that occur in stators with permanent magnets (synchronous version)

The magnitude of the present magnetic forces is motor-specific.

Table 6- 7 Magnetic forces that occur in synchronous motors

Motor type	F_a / N	F_r / N
16-pole synchronous built-in motors		
1FE2182-8L□□□-□□□□	500	6000
1FE2183-8L□□□-□□□□	500	7500
1FE2184-8L□□□-□□□□	500	9000
1FE2185-8L□□□-□□□□	500	10500
1FE2186-8L□□□-□□□□	500	12000
1FE2187-8L□□□-□□□□	500	13500

Note

The specified radial forces are the maximum values that occur if the rotor comes into contact with the stator at one side. For an ideally centric rotor (no eccentricity), the resulting radial force is zero.

The radial force between a centric rotor and the rotor in contact with the stator can be linearly converted (calculated air gap = 0.5 mm).

Depending upon the relative position and the weight of the rotor core, an additional axial mounting force of about 300 N is required.

6.5.3 Mounting the motor spindle

The following chapter describes the mounting of the spindle housing with spindle shaft onto the motor spindle.

NOTICE

Danger of damage to the banding of APM rotors (synchronous version).

The banding (composite fibers) must not be damaged and must not come into contact with the stator bore.

- Remove the protective film only immediately before mounting.
- Use an assembly film.
- Always use a centering assembly fixture for mounting.

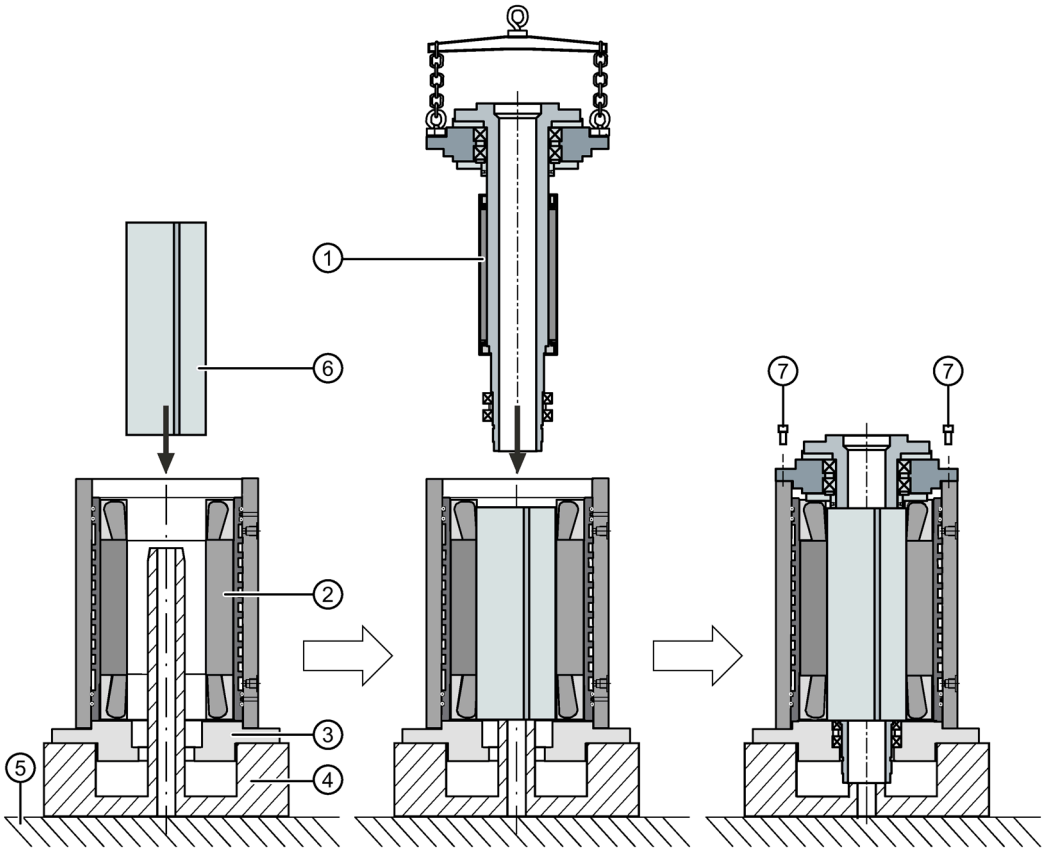
Precondition

- All personal protection equipment is available and must be worn.
- All installation equipment and resources are available.

Procedure

Carry out the mounting according to the following sequence:

1. Clean contaminants and chips from the subassemblies ①②.
2. Remove carefully the protective film from the rotor (in the scope of delivery for some variants).



1 Spindle shaft with rotor core and end shield
2 Spindle housing with stator core
3 Centering assembly fixture for stator core
4 Centering assembly fixture for rotor core
5 Stable support
6 Mounting film (for the synchronous version)
7 Bolts for attaching the end shield

Figure 6-24 Mounting the motor spindle

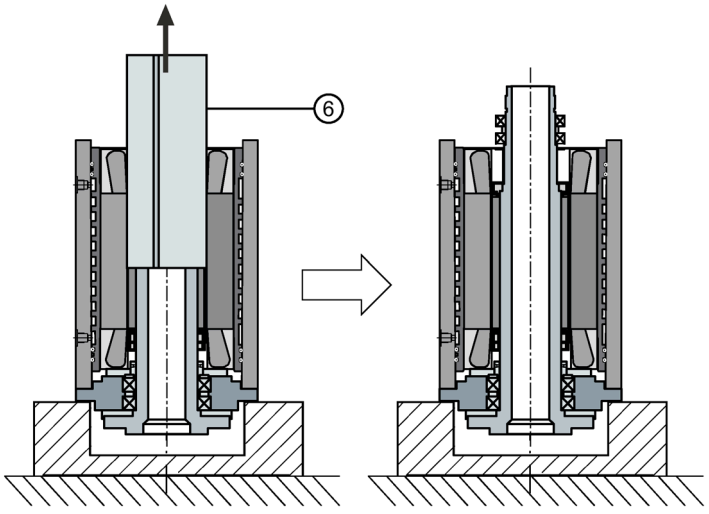
3. Place the required assembly film in the stator bore (applies only to the synchronous version).

4. Using the hoisting gear, ease the spindle shaft with rotor core ① slowly and carefully into the spindle housing with the stator core ②.

Note

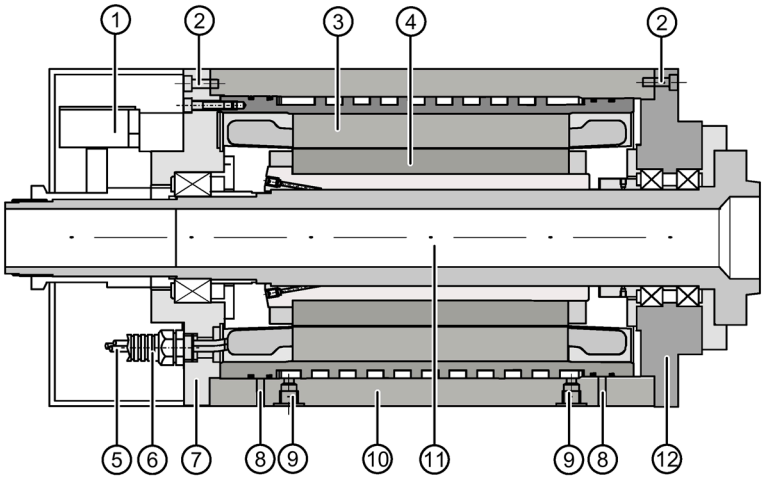
Depending upon the relative position and the weight of the spindle shaft, an additional axial mounting force of about 300 N may be required.

5. Screw down the end shield of the spindle shaft using the screws ⑦.
6. Rotate the preassembled motor spindle through 180°.



6 Assembly film

7. If you have used an assembly film ⑥, remove it now.



①	Encoder (separate mounting instructions)	⑦	End shield NDE
②	Housing bolts	⑧	Drain hole
③	Stator core with cooling jacket	⑨	Coolant connection
④	Rotor core	⑩	Spindle housing
⑤	Free cable ends	⑪	Spindle shaft with bearings
⑥	Flexible tube	⑫	End shield DE

Figure 6-25 Complete motor spindle

8. Complete the motor spindle in accordance with the project.
9. Fasten the rating plate, supplied as a loose item, securely to the spindle box in a clearly visible position.

❒

6.6 Setting up the motor spindle

This chapter provides instructions on mounting the motor spindle.

NOTICE
Danger of component destruction caused by contact with hot surfaces If temperature-sensitive components and cables come into contact with hot motor surfaces, they can be damaged or destroyed. • Install temperature-sensitive components and cables so they cannot come into contact with the hot motor surface.

Instructions on mounting the motor spindle

- Observe the project specifications of the spindle manufacturer.
- Observe the technical specifications on the motor housing rating plate or the details contained in the machine documentation of the spindle manufacturer.
- Check whether the rating plate details match the conditions pertaining at the installation location.
- Observe the permitted maximum radial and axial vibration values.
- Ensure that the motor spindle mounting (e.g. foot-flange or mounting foot) has even contact with the mounting surface. Stresses on the motor spindle are not permitted.
- Turn the output elements by hand.
  If a grinding noise occurs, rectify the cause or contact the manufacturer.

Emissions

The motors are certified for a wide range of mounting and operating conditions.

The installation and operating conditions can affect the motor noise.

6.7 Permissible motor vibrations

The following effects can increase motor vibration values:

- The on-site system vibration characteristics depend on factors such as the output elements, mounting conditions, alignment and installation
- Effects of external vibrations

Ensure that the vibration values conform to project specifications and the following tables are not exceeded at the specified measuring points on the motor.

Observe the notes for measuring points, measurement and evaluation according to ISO 10816.

If necessary, balance the rotor with the drive system completely.

Maximum permitted radial vibration values

Table 6- 8 Maximum permitted radial vibration values

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

Maximum permitted axial vibration values

Vibration velocity	Vibration acceleration
v_{rms} = 4.5 mm/s	a_{peak} = 2.25 m/s²

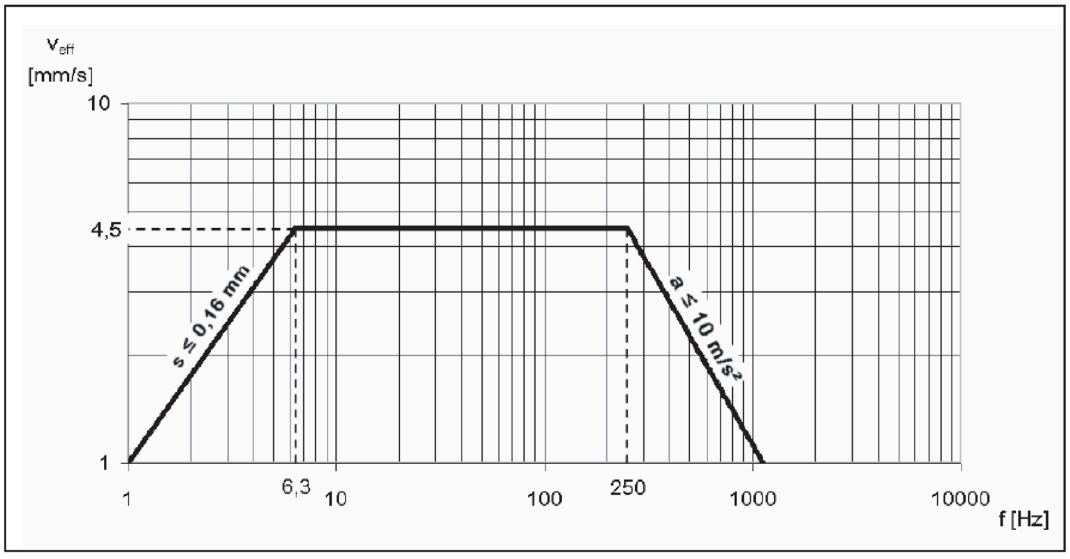


Figure 6-26 Maximum permissible vibration velocity taking into account the vibration displacement and vibration acceleration

Measure the vibration velocity using appropriate measuring equipment.

The vibration acceleration must be evaluated in a frequency band of 10 ... 2000 Hz.

Note

If vibration excitation levels > 2000 Hz (e.g. gear teeth meshing frequencies) can be expected, you must adapt the measurement range accordingly.

The permitted maximum values remain unchanged.

Connection 7

7.1 Connecting the cooling

7.1.1 Warning of the consequences of unqualified work

⚠WARNING

Defective work on the cooling circuit

Defective work on the cooling circuit can cause injury and/or damage to property.

- Only qualified personnel may assemble, install, and commission the cooling circuit.
- Perform installation or service work on the cooling circuit only when the system is de-energized.

7.1.2 Safety instructions

⚠WARNING

Danger to life caused by short-circuit to a frame in a fault situation

The spindle housing must be electrically connected to the cooling jacket.

In a fault situation, lethal voltage can be present at the spindle housing that causes death or severe injuries because of an electric shock.

- Ground the complete motor spindle in accordance with the regulations.

⚠WARNING

Danger to life caused by rotation of the assembled spindle shaft on synchronous motors

The rotating of an assembled built-in motor produces induction that causes lethal voltages at the cable ends of the motor.

The voltages can cause death or severe injuries because of an electric shock.

- Do not touch any bare cable ends.
- Prevent assembled built-in motors from turning.
- Insulate the terminals and cores of bare cable ends.

⚠ WARNING

Danger to life caused by high leakage currents

High leakage currents can cause death or injuries as result of an electric shock.

- Satisfy the requirements placed on protective conductors in accordance with EN 61800-5-1.

⚠ WARNING

Danger to life caused by high residual voltages

When the power supply voltage is switched-off, active components of the motor can have an electrical charge of more than 60 µC.

The residual voltages that occur at the connections of the built-in motor several seconds after power-down can cause death or severe injuries as result of an electric shock.

- Do not touch any bare connections.
- Protect bare connections and active components against inadvertent contact.
- Ground the motor properly.

⚠ WARNING

Danger to life when the cooling system bursts

The motor will overheat if it is operated without cooling. When cooling water enters the hot motor, this immediately and suddenly generates hot steam that escapes under high pressure. This can cause the cooling water system to burst, resulting in death, severe injury and material damage.

- Never operate the motor without cooling.
- Only commission the cooling water circuit when the motor is in a cool condition.

⚠ CAUTION

Danger of burns a result of touching hot surfaces

In operation, the motor housing 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.

NOTICE

Material damage due to the effect of electrochemical series

When using different conductive materials, material damage can occur as a result of the electrochemical series.

- Do not use any zinc in the cooling circuit.
- Use brass, stainless steel or plastic for pipes and fittings.

NOTICE

Motor damage due to lack of cooling

If you operate the motor without water cooling, the motor will be damaged or destroyed.

- Only operate the motor with a closed cooling water loop with heat exchange equipment.
- If air cooling is used (special version) only operate the motor with fan switched on in accordance with project specifications

7.1.3 Connecting the water cooling system

Note

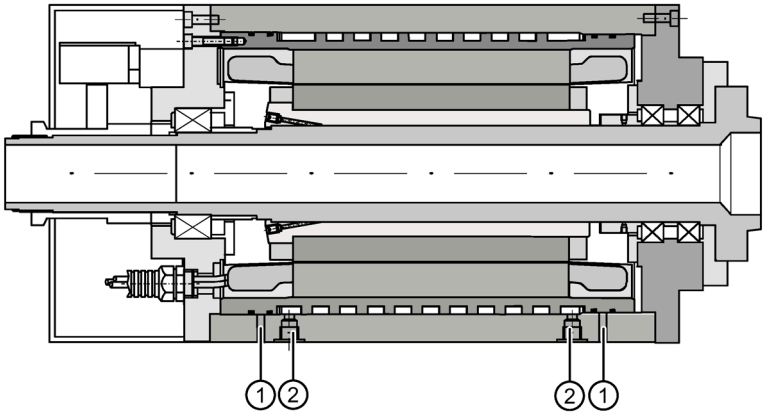
Lay the cooling water supply intake and drain outlet connections according to project requirements.

Preconditions

- Ensure that the cooling water complies with the required cooling water specification. See Chapter "Cooling (Page 62) "
- Ensure that cooling water with the required flow volume is available. See rating plate (type plate).

Procedure

1. Connect the cooling water pipes for intake and drainage according to project requirements



1 Drain holes

2 Connections for the cooling water pipes

2. Set for the inlet a maximum permitted operating pressure of 0.7 MPa

NOTICE
Risk of motor damage by voltage discharges resulting from condensation If the stator winding is damp, its insulation resistance decreases. This can cause voltage discharges that damage the windings. • Keep the drain holes free so that condensation can escape freely.

NOTICE
Risk of motor damage by corrosion resulting from condensation Condensation that does not escape can cause corrosion and motor damage. • Keep the drain holes free so that condensation can escape freely.

3. Check that the drain holes are free so that condensation can escape freely
4. Check the water cooling for leaks

❒

7.2 Electrical connection

7.2.1 Safety information

NOTICE

Motor destruction caused by incorrect connection

The direct connection to the three-phase line supply damages the motor.

- Connect the motor only at the configured converter.
- Observe the correct phase sequence.

7.2.2 High-voltage test

⚠DANGER

Lethal voltage hazards

A dangerous voltage is present at the motor during a high-voltage test. Death or serious injury can result when live parts are touched.

- Do not touch any live parts.
- Adhere to the fundamental safety instructions.

NOTICE

Destruction of electronic components and damage to the insulation

A high-voltage test on the motor can damage the insulation of the motor and destroy electronic components, e.g. temperature sensors.

- Use maximum 80% of the test voltage in accordance with EN 60034-1.
- Prior to the test, short-circuit the cable ends of the temperature sensors.

Before being shipped, the stators of the built-in motors are subject to a high-voltage test in compliance with EN 60034-1.

However, the Standards Commission recommends that when electrical components (such as built-in motors) are installed, a new high-voltage test according to EN 60034-1 should be performed after the final assembly has been completed.

7.2.3 Electrical equipment

The following equipment is provided by the spindle manufacturer:

- Terminal box box or connector, version with at least IP54 according to EN 60034
- Protective tubing for the free cable ends from the spindle
- Ground cable with cable lug

7.2.4 Notes on electrical connection

The following chapter provides instructions for the electrical connection of the motor.

Responsibility of the spindle manufacturer

The spindle manufacturer installs the following cable connections:

- Power connection
- Internal protective ground cable (protection from dangerous shock currents)
- Connection of Pt1000 temperature sensors
- Encoder connection

Notes on connecting up the motor

In the standard version, the stator core has the following connection cables:

- Power connection with identification
- 2 cables for the temperature sensor (of which 1 is a spare), two-conductor, each cable cross-section is 0.22 mm^2, with color coding, diameter 3 ... 4 mm

Note

Electrical connection via terminal box or power connector

The power cables of the motor are not suitable as direct electrical interface of the spindle. The spindle must be electrically connected via a terminal box or power connector.

- Route out the free cable ends from the spindle box in a suitable protective tubing with cable gland to a terminal box provided by the customer.
- Ensure effective strain relief. Comply with the specified bending radii (minimum, 3 to 4x the outer cable diameter).

- To connect the motor to a converter, use MOTION-CONNECT cables or shielded connecting cables from the terminal box or power connector interface.

  Note

  The maximum total length of the connecting cable is 50 m with or without VPM.

  With a star/delta changeover in the control cabinet, the maximum total length of the connecting cable from the supply line to the cabinet and the return line to the motor adds up. The maximum length of the supply line to the control cabinet and the return line to the motor is 25 m in each case.

- Due to the high voltages, use cables for higher mechanical requirements in combination with a connection socket and VPM.

Connecting Pt1000 temperature sensors

Circuit examples for evaluating temperatures are provided in Chapter "Signal connection and motor protection (Page 161)"

7.2.5 Notes on choosing the connecting leads

Note

As a result of the converter operation, high-frequency current and voltage oscillations in the motor feeder cables can cause electromagnetic interference.

Use only shielded power and signal cables.

- Select the connecting cables appropriate for the rated dynamic current and the plant-specific conditions, e.g. ambient temperature, routing type. Observe IEC / EN 60364-5-52 and IEC / EN 60204-1.

Note

The current-carrying capacity of PVC/PUR-insulated copper cables is specified in EN 60204-1.

- Use prefabricated cables from Siemens. These cables reduce the installation time and costs and increase operational reliability.
- Use EMC cable glands for permanently installed cable entries.

7.2.6 Cable cross-section, cable outer diameter and cable variant for synchronous versions

The values specified in the following table refer to the cable outlet of the motor.

Cable cross-sections (Cu) and outer diameter of the connecting cables

Motor type	Cable length l			
	l = 0.5 m [1]		l = 1.5 m [2]	
	Cable cross-section per phase[3] in mm²	Outer cable diameter in mm	Cable cross-section per phase[3] in mm²	Outer cable diameter in mm
16-pole built-in motors				
1FE2182-8LN□□-□CC1	2 x 6	2 x 5.0	2 x 10	2 x 6.8
1FE2182-8LH□□-□CC1	2 x 16	2 x 9.1	2 x 16	2 x 9.1
1FE2183-8LN□□-□CC1	2 x 6	2 x 5.0	2 x 10	2 x 6.8
1FE2183-8LH□□-□CC1	2 x 25	2 x 10.5	2 x 25	2 x 10.5
1FE2184-8LN□□-□CC1	2 x 10	2 x 6.8	2 x 16	2 x 9.1
1FE2184-8LK□□-□CC1	2 x 25	2 x 10.5	2 x 35	2 x 11.9
1FE2184-8LH□□-□CC1	2 x 25	2 x 10.5	2 x 35	2 x 11.9
1FE2185-8LN□□-□CC1	2 x 16	2 x 9.1	2 x 16	2 x 9.1
1FE2185-8LL□□-□CC1	2 x 25	2 x 10.5	2 x 35	2 x 11.9
1FE2185-8LH□□-□CC1	2 x 35	2 x 11.9	2 x 50	2 x 14.6
1FE2186-8LN□□-□CC1	2 x 16	2 x 9.1	2 x 25	2 x 10.5
1FE2186-8LM□□-□CC1	2 x 25	2 x 10.5	2 x 35	2 x 11.9
1FE2186-8LH□□-□CC1	2 x 50	2 x 14.6	2 x 50	2 x 14.6
1FE2187-8LN□□-□CC1	2 x 25	2 x 10.5	2 x 35	2 x 11.9
1FE2187-8LH□□-□CC1	2 x 50	2 x 14.6	--	--

[1] According to EN 46200 it can only be used in the motor spindle

[2] Notes on using cables are provided in VDE 0298, Part 3 and Part 4

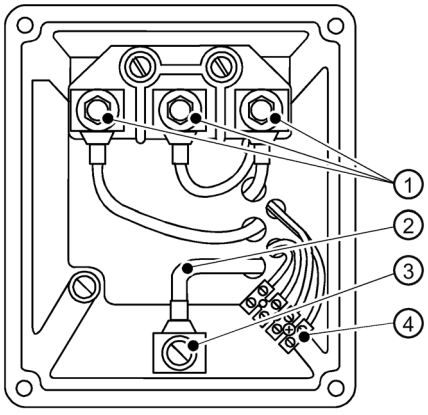
[3] For large cable cross-sections, provide an elongated hole as bushing, where necessary.

You configure further connection cables appropriate for the rated current in accordance with EN 60204-1 depending on the routing type and the ambient temperature.

Guidelines for power connection

Also observe the following notes for providing the power connection:

- Lead the cable ends through the flexible tube or cable duct.
- Keep the inside of the terminal box clean and free from trimmed-off ends of wire.
- See the following diagram for an example of terminal box design.



① Power connections (according to DIN 46200 can only be used in the motor spindle)
② Internal protective conductor
③ Ground connection for internal and external protective conductors
④ Connectors for temperature sensors

Figure 7-1 Terminal box (example)

Note

Connect the cables in accordance with project specifications of the spindle manufacturer.

7.2.7 Cable cross-section, cable outer diameter and cable variant for asynchronous versions

The values specified in the following table refer to the cable outlet of the motor.

Cable cross-sections (Cu) and outer diameter of the connecting cables

Motor type	Cable length l			
	l = 0.5 m [1]		l = 1.5 m [2]	
	Cable cross-section per phase in mm²	Outer cable diameter in mm	Cable cross-section per phase in mm²	Outer cable diameter in mm
8-pole built-in motors				
1FE2093-8AG□□-□□□1	3 x 4	3.9	3 x 4	3.9
1FE2093-8AM□□-□□□2	6 x 4	3.9	6 x 4	3.9
1FE2094-8AJ□□-□□□1	3 x 4	3.9	3 x 4	3.9
1FE2094-8AM□□-□□□2	6 x 4	3.9	6 x 4	3.9
1FE2094-8CJ□□-□□□1	3 x 6	5	3 x 6	5
1FE2094-8CG□□-□□□2	6 x 4	3.9	6 x 4	3.9
1FE2095-8CJ□□-□□□1	3 x 6	5	3 x 6	5
1FE2095-8CG□□-□□□2	6 x 6	5	6 x 6	5
1FE2145-8CE□□-□□□1	3 x 10	6.2	3 x 10	6.2
1FE2145-8CC□□-□□□2	6 x 6	5	6 x 6	5
1FE2147-8CE□□-□□□1	3 x 2 x 10	6.2	3 x 2 x 10	6.2
1FE2147-8CC□□-□□□2	6 x 10	6.2	6 x 10	6.2

[1] According to EN 46200 it can only be used in the motor spindle

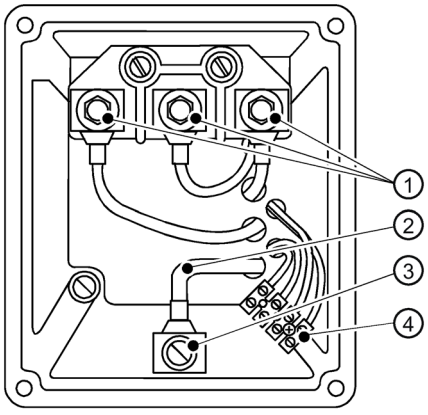
[2] Notes on using cables are provided in VDE 0298, Part 3 and Part 4

You configure further connection cables appropriate for the rated current in accordance with EN 60204-1 depending on the routing type and the ambient temperature.

Guidelines for power connection

Also observe the following notes for providing the power connection:

- Lead the cable ends through the flexible tube or cable duct.
- Keep the inside of the terminal box clean and free from trimmed-off ends of wire.
- See the following diagram for an example of terminal box design



① Power connections (according to DIN 46200 can only be used in the motor spindle)
② Internal protective conductor
③ Ground connection for internal and external protective conductors
④ Connectors for temperature sensors

Figure 7-2 Terminal boxes with permanent (internal) star connection (example)

Note

Connect the cables in accordance with project specifications of the spindle manufacturer.

7.2.8 Information on cable routing

- Lay loose connection cables so that the insulation is not damaged.
- Make sure that the minimum bending radii are not exceeded. Minimum radius for fixed installation: R = 4 x D
  (D = outer cable diameter).
- Only remove insulation from the cable ends so that the insulation reaches up to the cable lug, terminal, or wire end ferrule.
- Use cable lugs or wire end ferrules appropriate for the dimensions of the terminal board connections and the cable cross-section. If necessary, install parallel connection cables.
- Ensure that the inside of the terminal box or connector is clean and free of cable cuttings and moisture.
- Tighten all of the screws for the electrical connections (terminal board connections, with the exception of the terminal strips) to the torque specified by the spindle manufacturer.
- Observe the minimum air clearances for the connection and for the laying of internal connection cables.

Supply voltage in V	Minimum air distance in mm
< 500	4.5
500 - 600	6

- Avoid protruding cable ends.
- Close the terminal boxes and cable entries in accordance with the configured degree of protection.
- Ensure that connecting cables cannot rotate, are not subject to strain and pushing force, and also provide anti-kink protection.
- Plug in or remove the connector only when the system is de-energized.

7.2.9 Connecting the synchronous version

1FE2 motors of shaft height 180 (1FE218□) consist of two winding systems, i.e. each motor has six connecting cables (three connecting cables for each winding system).

Both partial windings are galvanically separated and only weakly coupled magnetically.

This means the motors can be operated in two different ways.

Option 1: Connection of the two windings to one (large) power section and the "classic" operation of the motor on a CU/NCU.

Option 2: Connection of each partial winding to its own (small) power section and operation of the (complete) motor using

- a master-slave closed-loop control or
- the SINAMICS OA Support Package with the Technology Extension SERVCOUP

to a CU/NCU (e.g. operation of 1FE218□ motors with rated current I_N > 200 A on booksize power sections) (see following table).

1FE2184-8LH□□-□CC1	
1FE2185-8LH□□-□CC1	
1FE2186-8LH□□-□CC1	
1FE2187-8LH□□-□CC1	
Operating modes for	
$n \leq n_{max\_inv}$	$n > n_{max\_inv}$
1. Operation on a chassis power section without VPM module 2. Parallel circuit on two booksize power sections without VPM modules	Operation on two booksize power sections with two VPM modules

Motors with rated current > 200 A

Note

Option 2 allows individual power sections to be deployed whose current/power data lies below the current/power data of the complete motor.

Note

The motor cannot be operated on a pure parallel circuit for SINAMICS booksize power sections or with only one partial winding system.

Possible variants of the master-slave closed-loop control:

Option 1	Option 2
Deployment of "SERVCOUP" OA software	Application created by the user
Encoder evaluation on the master, encoder information is forwarded internally to the slave via DRIVE-CLiQ	The encoder information must be made available to the master and slave (encoder switch necessary)
The OA software ensures the correct current/torque distribution in the motor	The user application must ensure the uniform current/torque distribution in the motor
The OA software ensures the mutual error monitoring for the master and slave	The user application must ensure the correct fault response within the master-slave unit

Both procedures are described in the following chapters.

Note

For a master-slave layout (each partial winding connected to its own power section), operation with only one winding system or an asymmetric current distribution between master and slave is not envisaged or excluded by the customer. This is true not only for the commissioning phase but also for any emergency operation with only one winding.

Operation with booksize power section

Practical advantages:

- You can arrange the converter components variably in the work machine.
- Less installation space is required compared with a chassis module.

Operation with chassis power section

No suitable VPM is currently available for operation of the motor on a chassis power section.

- Reduce the permitted maximum speed of the motor to the converter maximum speed n_{max_Inv} specified in the datasheets.

Note

Always operate the power sections with a pulse frequency of f_p = 4 kHz.

Note

The 1FE218☐ motors do not require a series reactor.

7.2.9.1 Overview of connections with one power unit

The following chapter presents the circuit diagrams for possible connections to the SINAMICS S120.

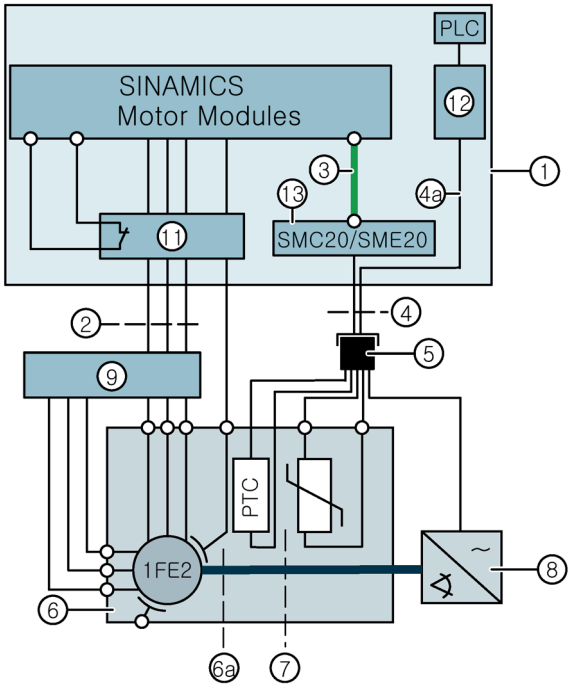
The circuit diagram contains information about wiring and connecting the motor winding. The circuit diagram is provided in the motor packaging.

If you connect the associated motor cables of the two partial windings (1U1 and 2U1 → U, 1V1 and 2V1 → V, 1W1 and 2W1 → W), operation with one power section is guaranteed.

Note

Connect a rotary encoder according to the project specifications.

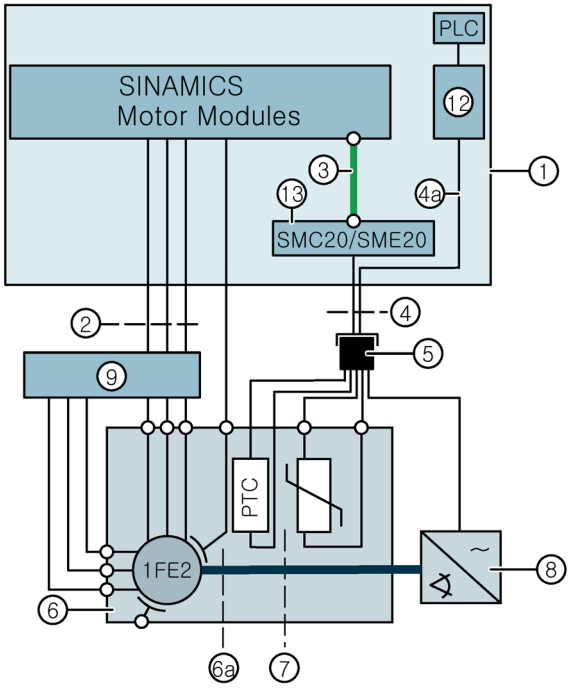
Circuit diagram for motor 1FE2 via SMC20/SME20 and VPM to SINAMICS



1 Control cabinet
11 Voltage limiting (VPM), only if the EMF > 820 V
12 Tripping unit for evaluating the PTC triplet
13 SMC20/SME20, encoder on the motor side, connector kits, 6FX2003-0SA12, 12-pin
2 Power cable
3 DRIVE-CLiQ cable, trailable or conditionally trailable
4 Signal cable, trailable or only conditionally trailable
4a Conductor in the signal cable from the PTC to the tripping unit
5 Signal connector, 17 pin, external thread, Article No.: 6FX2003-0SA17
Optional mounting flange for retrofitting, Article No.: 6FX2003-7DX00
6 1FE2 built-in motor
6a Ground connection
7 Temperature sensor (+1 Pt1000 spare)
8 Encoder
9 Terminal box

Figure 7-3 Circuit diagram for 1FE2 motor with VPM

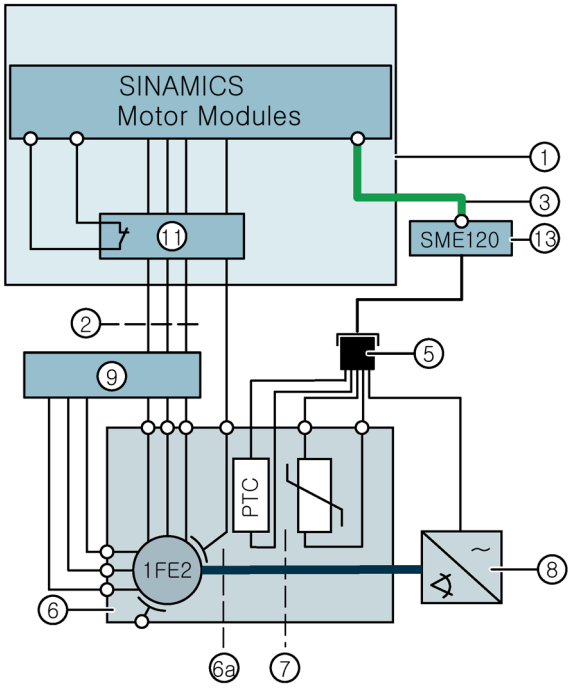
Circuit diagram for 1FE2 motor via SMC20/SME20 without VPM to SINAMICS



1 Control cabinet
11 Not available in this circuit
12 Tripping unit for evaluating the PTC triplet
13 SMC20/SME20, encoder on the motor side, connector kits, 6FX2003-0SA12, 12-pin
2 Power cable
3 DRIVE-CLiQ cable, trailable or conditionally trailable
4 Signal cable, trailable or only conditionally trailable, Article No.
4a Conductor in the signal cable from the PTC to the tripping unit
5 Signal connector, 17 pin, external thread, Article No.: 6FX2003-0SA17
Optional mounting flange for retrofitting, Article No.: 6FX2003-7DX00
6 1FE2 built-in motor
6a Ground connection
7 Temperature sensor (+1 Pt1000 spare)
8 Encoder
9 Terminal box

Figure 7-4 Circuit diagram for 1FE2 motor without VPM

Circuit diagram for 1FE2 motor via SME120 with VPM to SINAMICS



1 Control cabinet
11 Voltage limiting (VPM), only if the EMF > 820 V
12 Not available in this circuit
13 SME120, encoder, motor side, connector kits 6FX2003-0SA12, 12-pin
2 Power cable
3 DRIVE-CLiQ cable, trailable or conditionally trailable
4 Signal cable, trailable or only conditionally trailable, Article No.
5 Signal connector, 17 pin, external thread, Article No.: 6FX2003-0SA17
Optional mounting flange for retrofitting, Article No.: 6FX2003-7DX00
6 1FE2 built-in motor
6a Ground connection
7 Temperature sensor (+1 Pt1000 spare)
8 Encoder
9 Terminal box

Figure 7-5 Circuit diagram for 1FE2 motor with VPM via SME120

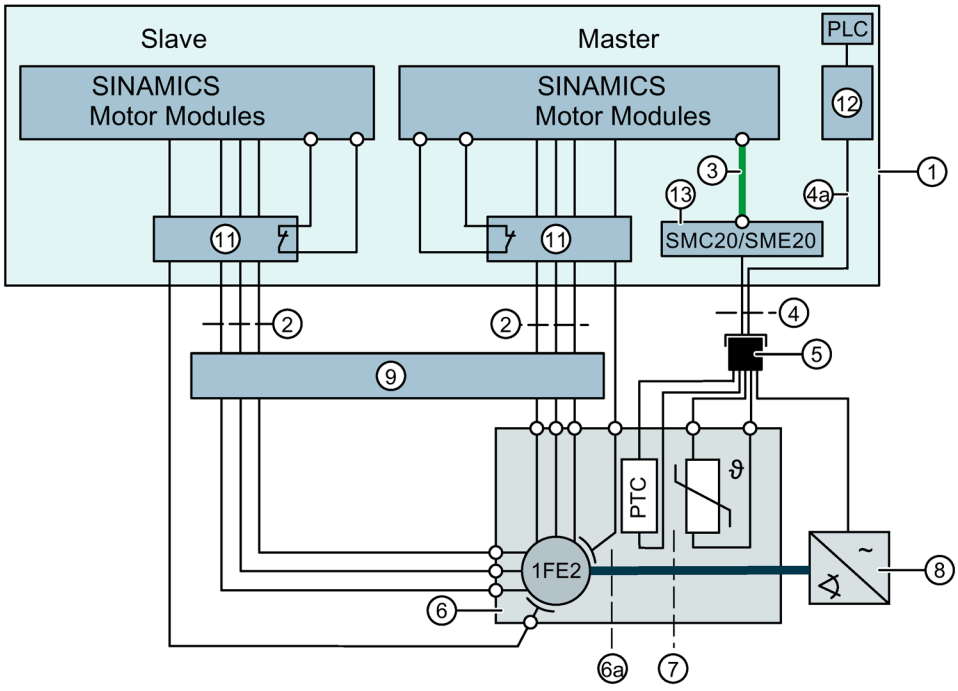
7.2.9.2 Overview of connections with two power units

You can operate the 1FE2 motor on two power units.

Connection overview for use of two power sections with the "SERVCOUP" OA software with VPM

Note

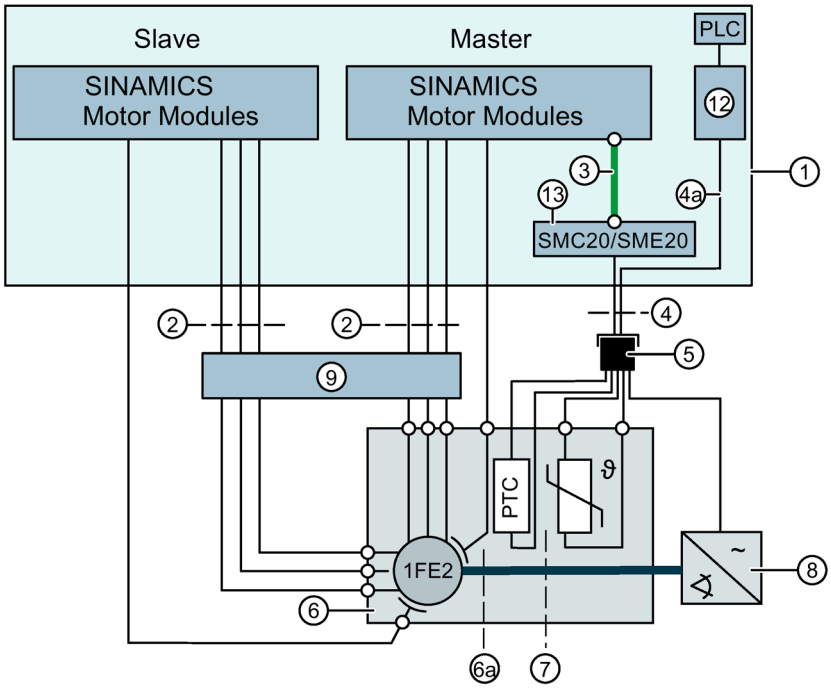
The following circuit applies only to 1FE2 with I_n > 200 A for a parallel circuit on two booksize Motor Modules.



1 Control cabinet
11 Voltage limiting (VPM), only if the EMF > 820 V
12 Tripping unit for evaluating the PTC triplet
13 SMC20/SME20, encoder on the motor side, connector kits 6FX2003-0SA12, 12-pin
2 Power cable
3 DRIVE-CLiQ cable, trailable or conditionally trailable
4 Signal line, trailable or only conditionally trailable
4a Conductor in the signal cable from the PTC to the tripping unit
5 Signal connector, 17 pin, external thread, Article No.: 6FX2003-0SA17
Optional mounting flange for retrofitting, Article No.: 6FX2003-7DX00
6 1FE2 built-in motor
6a Ground connection
7 Temperature sensor (+1 Pt1000 spare)
8 Encoder
9 Terminal box

Figure 7-6 Connection overview with OA software and VPM

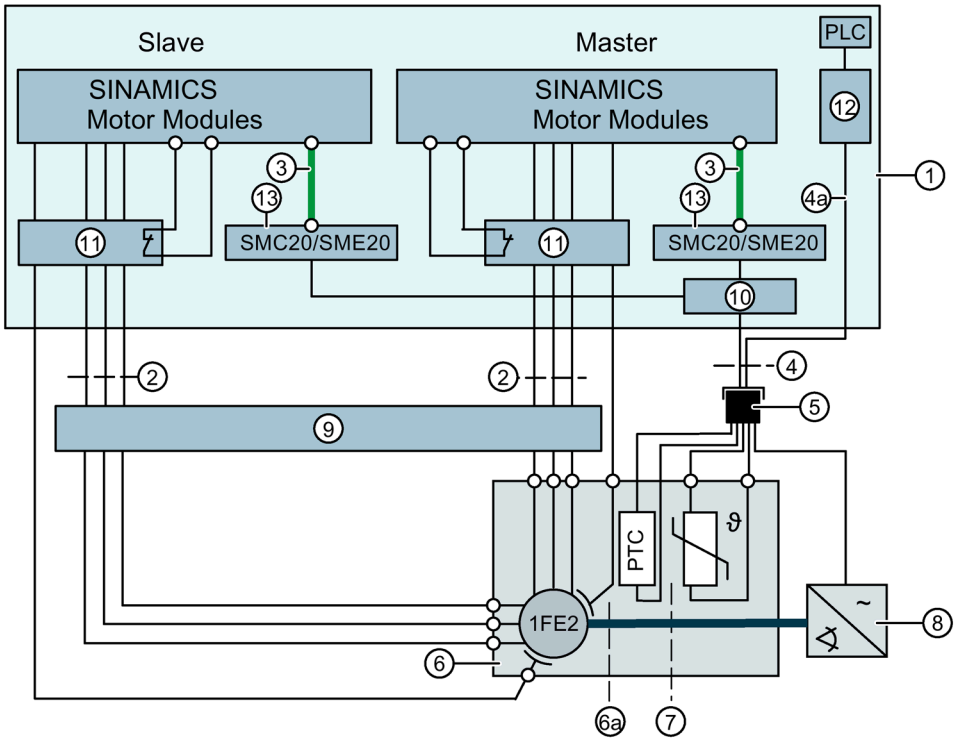
Connection overview for use of two power sections with the "SERVCOUP" OA software without VPM



1 Control cabinet
11 Not available in this circuit
12 Tripping unit for evaluating the PTC triplet
13 SMC20/SME20, encoder on the motor side, connector kits 6FX2003-0SA12, 12-pin
2 Power cable
3 DRIVE-CLiQ cable, trailable or conditionally trailable
4 Signal line, trailable or only conditionally trailable
4a Conductor in the signal cable from the PTC to the tripping unit
5 Signal connector, 17 pin, external thread, Article No.: 6FX2003-0SA17-....
Optional mounting flange for retrofitting, Article No.: 6FX2003-7DX00
6 1FE2 built-in motor
6a Ground connection
7 Temperature sensor (+1 Pt1000 spare)
8 Encoder
9 Terminal box

Figure 7-7 Connection overview with OA software without VPM

Connection overview for use of two power sections with VPM and encoder switch



1 Control cabinet
10 Encoder switch including adapter for signal cables at the input and output
11 Voltage limiting (VPM), only if the EMF > 820 V
12 Tripping unit for evaluating the PTC triplet
13 SMC20/SME20, encoder on the motor side, connector kits 6FX2003-0SA12, 12-pin
2 Power cable
3 DRIVE-CLiQ cable, trailable or conditionally trailable
4 Signal line, trailable or only conditionally trailable
4a Conductor in the signal cable from the PTC to the tripping unit
5 Signal connector, 17 pin, external thread, Article No.: 6FX2003-0SA17
Optional mounting flange for retrofitting, Article No.: 6FX2003-7DX00
6 1FE2 built-in motor
6a Ground connection
7 Temperature sensor (+1 Pt1000 spare)
8 Encoder
9 Terminal box

Figure 7-8 Connection overview with VPM and encoder switch

7.2.10 Connecting the asynchronous version

The motor changeover switches the winding in the motor in a star or delta connection.

The star-delta connection is implemented in the 1FE2 by means of:

- A fixed setting in the terminal box
- An external contactor circuit

The star-delta connection via a fixed setting in the terminal box

The standard setting is the star connection via jumpers.

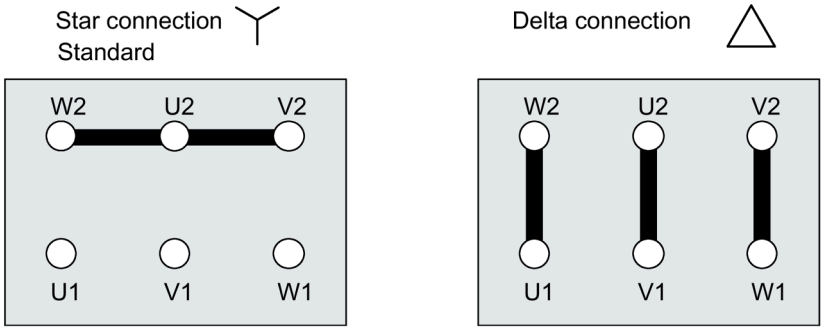


Figure 7-9 Fixed star/delta connection in the terminal box

Preconditions for the switching in the terminal box

⚠ WARNING

Electric shock

Touching live components can result in death or severe injury.

- Only work on electrical equipment if you are appropriately qualified.
- Always observe the country-specific safety rules for all work.
- Generally, the following six steps apply when establishing safety:

1. Prepare for shutdown. 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, or between them and the protective conductor connection.
5. Check whether the existing auxiliary supply circuits are de-energized.
6. Ensure that the motors cannot move.
7. Check that the correct drive system is completely locked.

After you have completed the work, perform the steps in the inverse sequence to restore readiness for operation.

Make sure that the system is isolated from the power supply and protected against being switched back on again.

Procedure

1. Open the terminal box.
2. Undo the screws for the jumpers.
3. Arrange the jumpers according to the required connection. (see diagram "Fixed star-delta connection in the terminal box")
4. Tighten the screws for the jumpers.
5. Close the terminal box. Ensure that the gasket is in the correct position.

❒

Star-delta changeover by means of speed threshold

You can implement the star-delta changeover by means of speed threshold with a contactor circuit.

Use the following contactors for the star-delta changeover.

Motor frame size	SIRIUS3RT contactor (star-delta winding)
1FE209□-8	Frame size S00 / S2
1FE214□-8....	Frame size S6

For circuit design and parameterization refer to the information in the SINAMICS S120 Drive Function Manual (Chapter 12.5) or

the SINUMERIK 840D sl PLC Function Manual.

Preconditions

The initial commissioning has been completed.

The following conditions must be true:

- 2 motor data sets (MDS), p0130 = 2
- 2 drive data sets (DDS), p0180 = 2
- 2 digital outputs to control the auxiliary contactors
- 2 digital inputs to monitor the auxiliary contactors
- 1 free speed setpoint monitor (p2155)
- 2 auxiliary contactors with auxiliary contacts (1 NO contact)

- 2 motor contactors with positively driven auxiliary contacts (1 NC contact, 1 NO contact)
- 1 motor, 1 Control Unit, 1 infeed, and 1 Motor Module

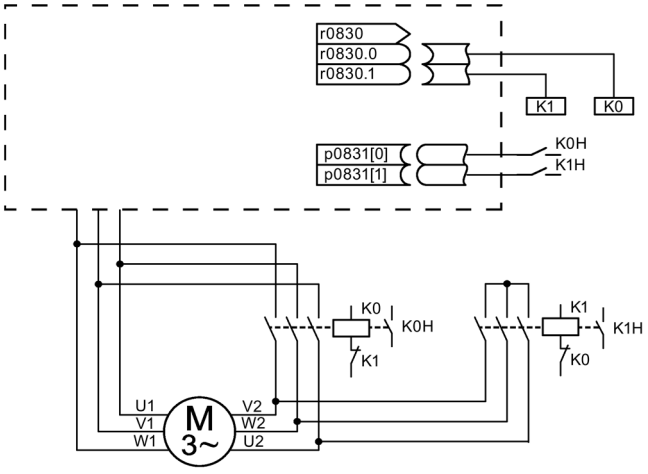


Figure 7-10 Example of star-delta changeover

Star-delta changeover sequence

1. Pulse inhibit:

   The pulses are inhibited on reaching the changeover speed (p2155).

2. Open the motor contactor:

   Motor contactor 1 is opened (r0830 = 0) and the status bit "Motor data set changeover active" (r0835.0) is set.

3. Change over the drive data set:

   The requested data set is activated (r0051 = requested data set).

4. Energize the motor contactor:

   After the feedback signal (motor contactor opened) from motor contactor 1, the appropriate bit of r0830 is set and motor contactor 2 is energized.

5. Enable the pulses:

   After the feedback signal (motor contactor closed) from motor contactor 2, the bit "motor changeover active" (r0835.0) is reset and the pulses are enabled.

The changeover is complete.

❒

Circuit diagrams for the 1FE2 in asynchronous version

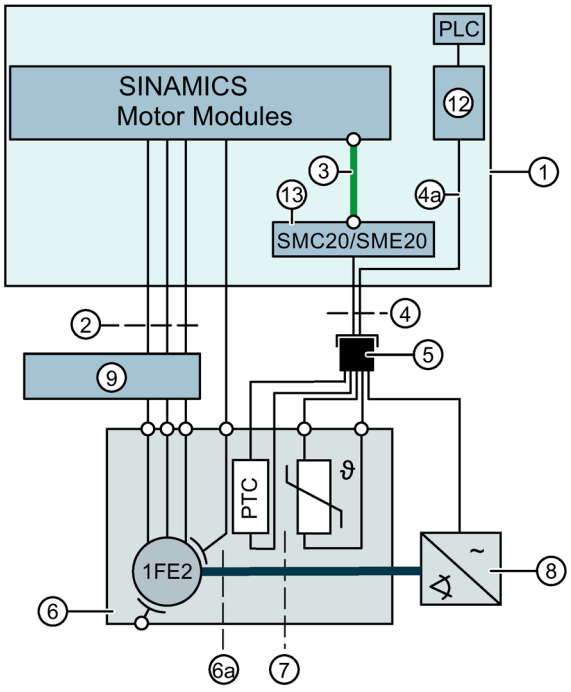
The following chapter presents the circuit diagrams for possible connections to the SINAMICS S120 for the asynchronous version.

The circuit diagram contains information about wiring and connecting the motor winding. The circuit diagram is provided in the motor packaging.

Note

Connect a rotary encoder according to the project specifications.

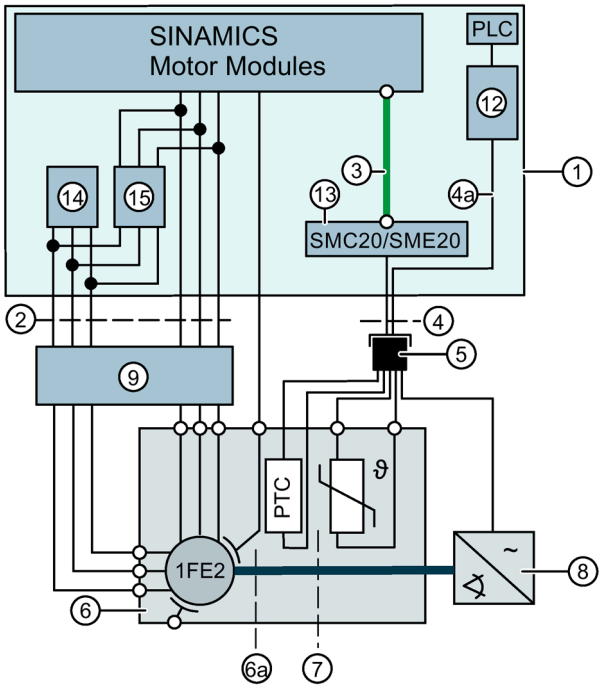
Circuit diagram for the 1FE2 in asynchronous version and fixed star connection to SINAMICS



1 Control cabinet
11 Not available in this circuit
12 3RN2013-1GW30 tripping unit
13 SMC20/SME20, encoder on the motor side, connector kits 6FX2003-0SA12, 12-pin
2 Power cable
3 DRIVE-CLiQ cable, trailable or conditionally trailable
4 Signal line, trailable or only conditionally trailable
4a Conductor in the signal cable from the PTC to the 3RN2013-1GW30 tripping unit
5 Signal connector, 17 pin, external thread, Article No.: 6FX2003-0SA17-....
Optional mounting flange for retrofitting, Article No.: 6FX2003-7DX00
6 1FE2 built-in motor
6a Ground connection
7 Temperature sensor (+1 spare)
8 Encoder
9 Terminal box

Figure 7-11 1FE2 asynchronous version connection overview for fixed star connection to SINAMICS

Circuit diagram for the 1FE2 in asynchronous version and star-delta connection via contactors to SINAMICS



1 Control cabinet
11 Not available in this circuit
12 3RN2013-1GW30 tripping unit
13 SMC20/SME20, encoder on the motor side, connector kits 6FX2003-0SA12, 12-pin
14 SIRIUS 3RT star contactor
15 SIRIUS 3RT delta contactor
2 Power cable
3 DRIVE-CLiQ cable, trailable or conditionally trailable
4 Signal line, trailable or only conditionally trailable
4a Conductor in the signal cable from the PTC to the 3RN2013-1GW30 tripping unit
5 Signal connector, 17 pin, external thread, Article No.: 6FX2003-0SA17-....
Optional mounting flange for retrofitting, Article No.: 6FX2003-7DX00
6 1FE2 built-in motor
6a Ground connection
7 Temperature sensor (+1 spare)
8 Encoder
9 Terminal box

Figure 7-12 1FE2 asynchronous version connection overview for star-delta connection via contactors to SINAMICS

7.2.11 Connection assignment of the encoder

Note

The encoders are not included in the scope of delivery.

More detailed information is provided in the SINAMICS documentation.

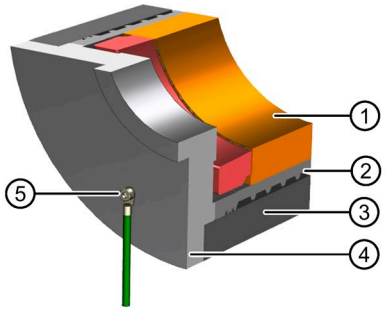
7.2.12 Recommended grounding

Note

A protective conductor / bearing shield must be connected at the spindle box through a good electrical connection.

The spindle housing / bearing shield must be electrically connected to the cooling jacket.

- Use a protective conductor with the required minimum cross-section.
- Ground so there is a good conductive transition between the protective conductor and spindle box protected against corrosion (e.g. bare contact surfaces with a coating of Vaseline).



1 Stator
2 Cooling jacket
3 Spindle housing
4 Bearing shield
5 Ground connection with M8 screw

Figure 7-13 Recommended grounding

7.2.13 Signal connection and motor protection

NOTICE

Risk of damage to temperature-sensitive components

Some parts of the electrical motor enclosure can reach temperatures that exceed 100 °C. If temperature-sensitive components, e.g. electric cables or electronic components, come into contact with hot surfaces, these components could be damaged.

- Carefully ensure that no temperature-sensitive components are in contact with hot surfaces.

Connecting the Pt1000 temperature sensors

Note

Pt1000 temperature sensors are not ESD components.

Connect the Pt1000 temperature sensor independent of the polarity via two-conductor yellow cables.

Note

Before you commission the motor, carefully check that the shutdown circuit via the PLC (programmable logic controller) functions correctly.

You can connect the Pt1000 and PTC as follows:

- PTC via thermistor motor protection 3RN2013-1GW30, Pt1000 to SMC20 or SME20
- PTC via thermistor motor protection 3RN2013-1GW30, Pt1000 directly connected to the drive system
- PTC and Pt1000 connected to SME120

Connecting the PTC via thermistor motor protection 3RN2013-1GW30, Pt1000 to SMC20 or SME20

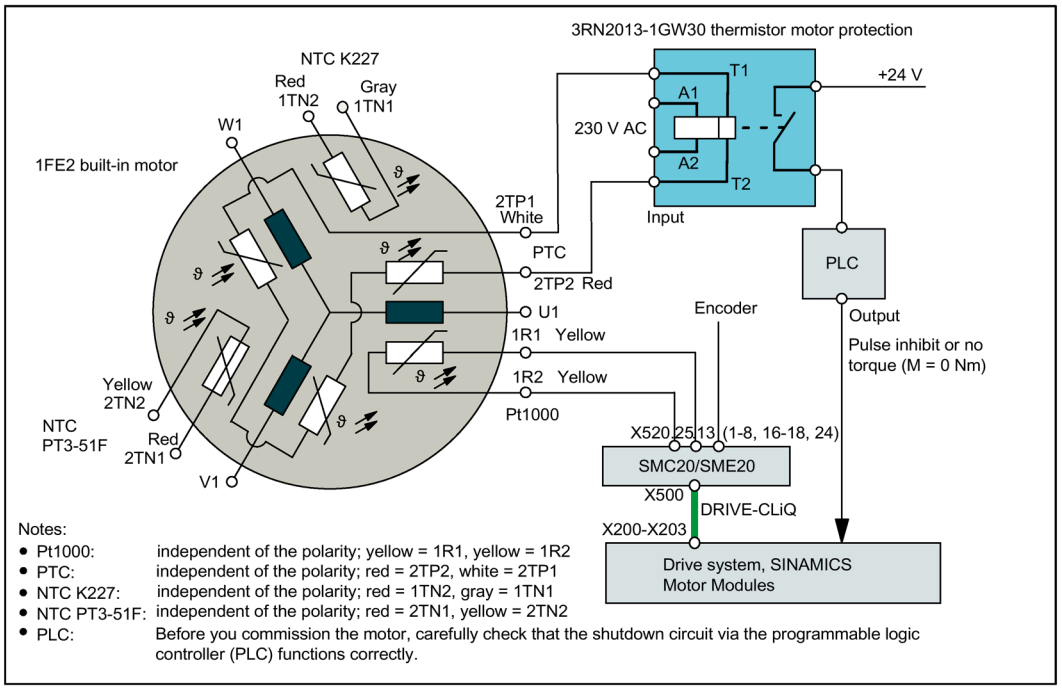


Figure 7-14 **Connecting the PTC via thermistor motor protection 3RN2013-1GW30, Pt1000 to SMC20 or SME20**

Note

SMC20

Additional information about connecting-up and operating the SMC20 is provided in the SINAMICS Control Unit Manual and supplementary system component documentation.

Note

SME20

Additional information about connecting-up and operating the SME20 is provided in the SINAMICS Control Unit Manual and supplementary system component documentation.

Connecting the PTC via thermistor motor protection 3RN2013-1GW30, Pt1000 without SMC/SME, directly to the drive system

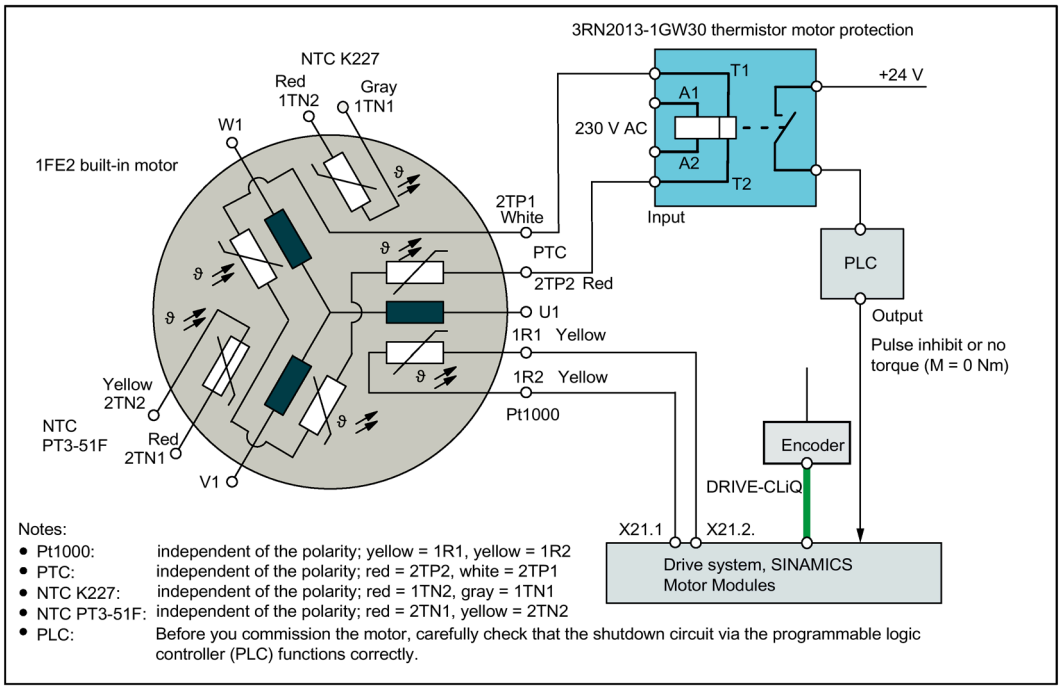


Figure 7-15 **Connecting the PTC via thermistor motor protection 3RN2013-1GW30, Pt1000 directly to the drive system**

Connecting the PTC and Pt1000 to SME120

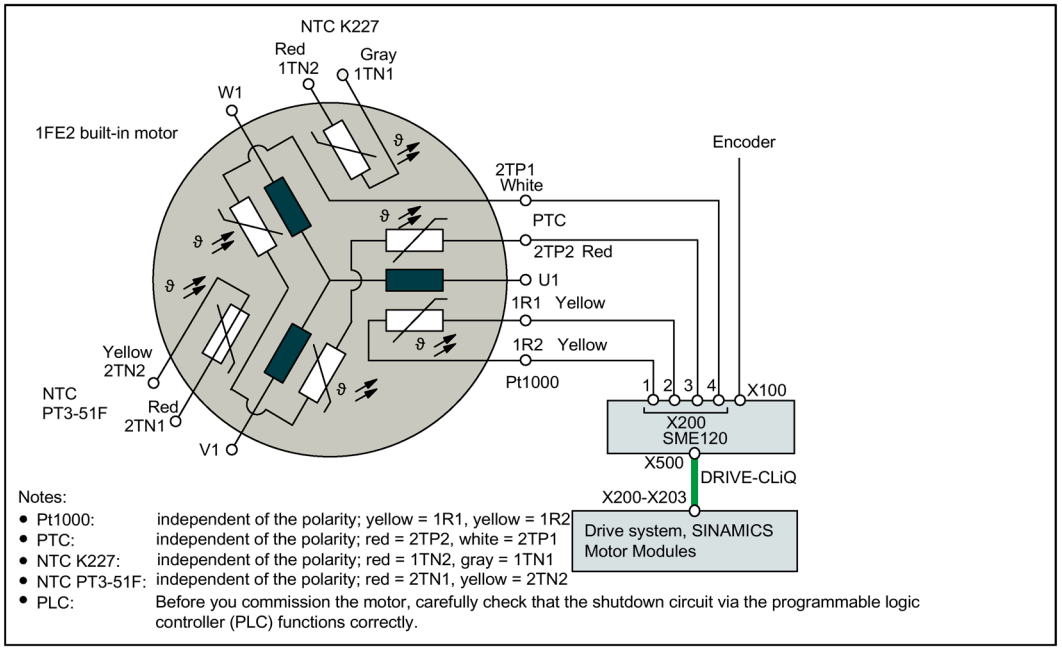


Figure 7-16 **Connecting the PTC and Pt1000 to SME120**

Note

SME120

Additional information about connecting-up and operating the SME120 is provided in the SINAMICS Control Unit Manual and supplementary system component documentation.

Commissioning

8

8.1 Manufacturer declaration

⚠WARNING

Danger to life through the use of an incomplete machine

If you use a machine that does not conform to the 2006/42/EU decree, there is the danger of death, severe injury and/or material damage.

- Commission the machine only when it conforms to the regulations of the EU 2006/42/EU machine decree and the conformity has been declared.

8.2 Safety instructions

⚠WARNING

Electric shock when connected to inadequately grounded line supplies

In the case of a fault, connecting a motor to an inadequately grounded line supply can result in death, severe injury and motor damage.

- 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. Remove this fault immediately.

⚠WARNING

Electric shock when checking the insulation resistance

During the measurement and immediately afterwards, high voltages can be present at the terminals that can cause death or severe injury as result of an electric shock.

Contact to live parts causes electric shocks.

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

Rotating rotors and the resulting ejected parts can cause death or injury.

- Secure rotating output elements using the appropriate safety guards.
- Secure loose parts, e.g. feather keys to prevent the ejection.

⚠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 at switch on.
- Before switching on, check that there are no loose objects in or on the motor that can fall or be flung off.

⚠WARNING

Danger to life when the cooling system bursts

The motor will overheat if it is operated without cooling. When cooling water enters the hot motor, this immediately and suddenly generates hot steam that escapes under high pressure. This can cause the cooling water system to burst, resulting in death, severe injury and material damage.

- Never operate the motor without cooling.
- Only commission the cooling water circuit when the motor is in a cool condition.

⚠CAUTION

Burns as a result of touching hot surfaces

In operation, the motor housing 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.

NOTICE

Motor damage caused by overheating due to lack of cooling

If the cooling fails or the motor is operated briefly without cooling, this can cause it to overheat. This can cause motor damage.

Never operate the motor without activated cooling.

Monitor the permitted water inlet temperatures and the cooling air supply.

Operate the motor only in conjunction with an effective temperature control.

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, 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.

The motor can be damaged if operated at inadmissible speeds.

- 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.

8.3 Checklist prior to commissioning

The following chapter describes the checks of the completely installed machine or system prior to 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.

Precondition

The machine or system is fully installed and connected.

All safety equipment is connected and functional.

Procedure

Check the machine or system according to the following checklists and record the results.

Checklist (1) - General checks

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

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, encoder, cooling system, brake) and the "SIMOTICS M-1FE2 built-in motors" Configuration Manual available?	
If you want to operate the 1FE2 motor on the SINAMICS S120 drive system, is the following, up-to-date SINAMICS documentation available? • SINAMICS S120 Commissioning Manual • Getting Started S120 • S120 Function Manual • S120/150 List Manual • SINAMICS S120 Equipment Manual	
If you want to operate the 1FE2 motor on the SINAMICS S120 drive system, make sure that the "Checklists for commissioning SINAMICS S" in the SINAMICS S120 Commissioning Manual have been observed.	
Is the motor type to be commissioned known? (e.g. 1FE2 _ _ _ – _ _ _ _ _ – _ _ _ _)	
Are the environmental conditions in the permissible range?	

The documentation on SINAMICS S120 can be found under the following link (https://support.industry.siemens.com/cs/products?dtp=Manual&mfn=ps&pnid=13231&lc=de-DE)

Checklist (2) - checks regarding the mechanical system

Check	OK
Do all touch protection measures for moving and live parts function properly?	
Has the motor been correctly mounted and aligned?	
Can you rotate the rotor without it touching the stator?	
Do the operating conditions correspond to the data specified on the rating plate?	
Are all mounting screws, connecting elements, and electrical connections tightened with the prescribed torques and properly attached?	
Do the output elements have the right setting conditions?	
Is the rating plate visible and fastened permanently on the spindle box?	
Have further specific spindle tests (e.g. balancing) been performed in accordance with spindle manufacturer's specifications?	

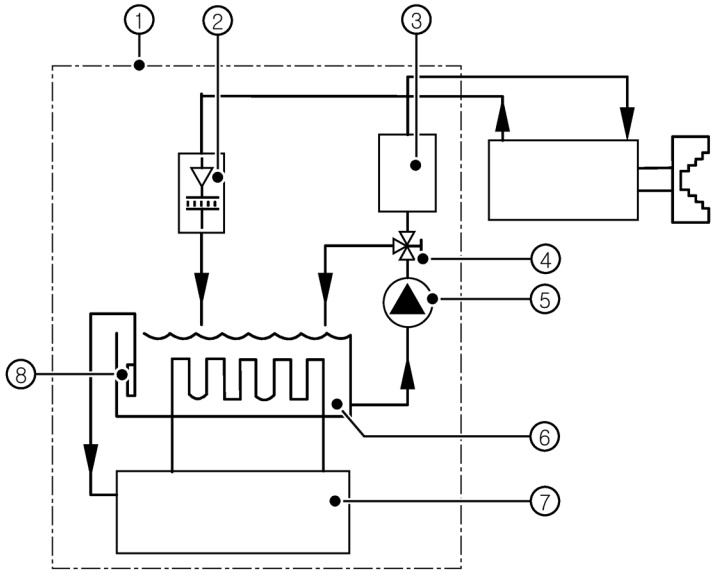
Checklist (3) - checks regarding the electrical system

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 established correctly?	
Is the specified limit speed n_{max} maintained during the operation on the converter?	
Applies only to the asynchronous version with external star-delta changeover: Are the contactors and auxiliary contacts correctly wired and parameterized?	

Checklist (4) - Monitoring equipment checks

Check	OK
Has it been ensured that no speeds higher than the maximum speed n_{max} can be reached?	
Have all supplementary motor monitoring devices been correctly connected and are they working properly?	

Checklist (5) - Cooling system checks

Check	OK
Water cooling Has the cooling water supply been connected and is it ready for operation?  Example for the coolant circuit 1 Cooling unit 2 Flow rate indicator (optional) 3 Filter (optional) 4 Set the flow rate (optional) 5 Pump 6 Coolant container 7 Compressor/recooling unit 8 Coolant temperature measurement Is the cooling water circulation (flow direction, flow rate, temperature) in compliance with the specifications? Is the seal between the spindle housing and the cooling jacket tight? No coolant may escape from the drain holes.	

❒

8.4 Test the insulation resistance

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

Limit values

The table below specifies the measuring circuit voltage as well as the limit values for the minimum insulation resistance and the critical insulation resistance with a rated motor voltage (U_n) of $U_n < 2$ kV.

Table 8- 1 Stator winding insulation resistance at 25 °C

	Rated voltage U_n < 2 kV
Measurement voltage	500 V (minimum, 100 V)
Minimum insulation resistance for new, cleaned or repaired windings	10 MΩ
Critical specific insulation resistance after a long operating time	0.5 MΩ/kV

Note the following:

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

  Note

  Measured value of the insulation resistance near the critical value

  If the measured value lies near the critical value, the insulation resistance must be checked in shorter intervals.

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

- The insulation resistance of the motor winding can reduce during the course of its service life due to ambient and operational influences (moisture, contamination).

Precondition

The motor has reached the prescribed winding temperature of 25 °C.

Procedure for determining the insulation resistance

Calculate the critical insulation resistance at a winding temperature of 25 °C

- Multiply the rated voltage U_n by the specific critical resistance value of 0.5 MΩ/kV.
  - Example: Critical resistance for a rated voltage U_n = 0.4 kV:

    0.4 kV x 0.5 MΩ/kV = 0.2 MΩ
- Measure the insulation resistance of the winding in relation to the machine enclosure. When measuring, wait about a minute until the final resistance value is reached.

❒

Measures on overshooting or undershooting the critical insulation resistance

If the critical insulation resistance is less than or equal to this value, then the windings must be dried or, if the fan is removed, cleaned thoroughly and dried.

Note

Lower resistance

Note that the insulation resistance of dried, clean windings is lower than that of warm windings. The correct insulation resistance must be achieved for a winding that has been cooled down to room temperature (approx. 20 ... 30 °C).

8.5 Commutation angle and pole position identification

8.5.1 Versions of the pole position identification (applies only to synchronous version)

Note

For the synchronous version, the commutation angle must be determined or entered when the spindle is first commissioned or when the spindle is replaced.

The stator magnetic field must be aligned to the rotor magnetic field for the optimum torque development (synchronized).

This reference is established using a pole position identification routine (PLI) and subsequently passing over the encoder zero mark. The commutation angle offset that is determined is saved to the drive system.

The pole position identification is available in two variants.

	Motion-based pole position identification	**Induction-based pole position identification**
Precondition	The rotor must be able to freely rotate.	• The rotor can rotate freely or be blocked • The pole position identification requires a minimum current. The rated current (S1 current) of the motor module must be ≥ 50% of the rated motor current.
Accuracy of determining the rotor position.	High, independent of the magnetic properties	Dependent on the magnetic motor characteristics
Effect of series reactors	Using series reactors has no effect on the result.	Using series reactors or motors with low saturation levels is not recommended, as determining the rotor position is not precise enough, or the pole position identification does not provide any result.

8.5.2 Determining the commutation angle (applies only to synchronous version)

The "installed" permanent magnetic field of the synchronous rotor must be synchronized with the electrically generated magnetic field of the stator. This enables the two magnetic fields of the stator and rotor to be optimally superimposed on one another.

This "synchronization angle" relative to the zero mark of the encoder system can be measured and saved in the drive system (commutation angle offset).

Precondition

You are using the "STARTER" wizard for the commissioning.

Procedure

1. Select the Motor Module and select the control type "Speed control with encoder".
2. Select the synchronous built-in motor in the motor selection list. Press the "Next" key.
3. Select the speed encoder (hollow shaft incremental encoder, 1 V_{pp}). Press the "Enter data" key.
4. The pole position identification routine provides coarse synchronization. A zero mark exists in the encoder.
   When the zero mark is traversed, the pole position can be matched automatically with the zero mark position (fine synchronization).
   The zero mark position must be electrically adjusted (p0431).
   We recommend a fine synchronization (p0404.15 = 1). This prevents measurement scattering and allows an additional test of the determined pole position.
5. In the encoder data mask, select the "Pole position identification" under "Coarse synchronization".
   Select "Zero marks" for the fine synchronization. The other fields are already pre-assigned.
   Via "Pole position ID parameter", select Procedure 1 - "Saturation based 1st harmonic" and confirm it.
6. The configuration is completed when the wizard is closed and the data has been loaded into the drive. The correct pole position identification technique (p1980) is preassigned with the motor-specific identification currents (p0325, p0329) and their selection (p1982).
7. Check the control direction of the drive before you determine the commutation angle offset. If the motor rotates clockwise, the encoder must deliver positive speed list values in r0061.
8. Select p1990 = 1 to determine the correct commutation angle offset (p0431). In the expert list, switch-on the drive using the "STARTER" commissioning tool on the control panel (PLI will be performed). p1990 = 1.
9. Enter a small speed setpoint. After the zero mark has been crossed for the first time, the determined commutation angle offset is automatically entered into p0431. Alarm A07971 is output during the determination routine. p1990 is automatically set to the value of 0 at the end of the measurement.
10. Check whether the automatically determined value in p0431 is plausible. Several techniques are recommended in the parameter description for p1990 (see SINAMICS S120/S150 List Manual LH1).

❒

If the angle is already known, e.g. from the final acceptance report, use this value to check the determined value.

Note

Deviations > 5°

In the case of deviations > 5°, contact the authorized technical personnel of the manufacturer.

8.6 Commissioning the cooling circuit

Commission the cooling circuit before performing the electrical commissioning.

Precondition

- You have flushed the cooling water pipes before connecting the motor and the converter to the cooling circuit.
- The cooling water pipes are properly connected.

Procedure

- Open the cooling water feed.
- Check all of the connections of the cooling water circuit for leaks.
- Check whether the prescribed volume of coolant is guaranteed. Further information on this can be found in Chapter "Cooling (Page 62)".

8.7 Switching on and switching off

This chapter describes the actions for switching the motor on and off for the first time.

Precondition

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

- Read about this topic in the converter operating instructions.

Note

EMERGENCY OFF

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

- Ensure that the frequency converter is correctly parameterized.
- Use appropriate commissioning tools, such as "Startdrive" or "Starter"
- Switch on the cooling system.

Procedure

Switching on

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 motor cooling system.
4. Check the function of the safety equipment.
5. Check as to whether the motor reaches the required parameters.

Switching off

- Switch off the motor at the frequency converter.

❒

Commissioning of motors with variable star-delta changeover

The contactors for star-delta switching can be controlled via the drive (SINAMICS S120) or the control system (PLC).

For circuit design and parameterization refer to the information in the SINAMICS S120 Drive Function Manual (Chapter 12.5) or SINUMERIK 840D sl PLC Function Manual.

Operation

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9.1 Safety instructions

⚠ 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 at switch 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.

⚠ WARNING

Danger to life caused by a rotating rotor or ejected parts

Rotating rotors and the resulting ejected parts can cause death or injury.

- Secure rotating output elements using the appropriate safety guards.
- Secure loose parts, e.g. feather keys to prevent the ejection.

⚠ WARNING

Danger to life when the cooling system bursts

The motor will overheat if it is operated without cooling. When cooling water enters the hot motor, this immediately and suddenly generates hot steam that escapes under high pressure. This can cause the cooling water system to burst, resulting in death, severe injury and material damage.

- Never operate the motor without cooling.
- Only commission the cooling water circuit when the motor is in a cool condition.

⚠ CAUTION

Burns as a result of touching hot surfaces

In operation, the motor housing 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.

NOTICE

Motor damage caused by overheating due to lack of cooling

If the cooling fails or the motor is operated briefly without cooling, this can cause it to overheat. This can cause motor damage.

- Never operate the motor without activated cooling.
- Monitor the permitted water inlet temperatures, the cooling water circulation and the cooling air supply.
- Operate the motor only in conjunction with an effective temperature control.
- Keep the air ducting free.
- Do not remove any air ducting.

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, 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.

The motor can be damaged if operated at inadmissible speeds.

- 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.

9.2 Operation

This chapter describes activities that ensure safe and trouble-free operation of the motor.

Precondition

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

- Read about this topic in the converter operating instructions.

Note

EMERGENCY OFF

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

Before switching on

- Ensure that the frequency converter is correctly parameterized.
- Switch on the cooling system.

Procedure

Switching on

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 motor cooling system.
4. Check the function of the safety equipment.
5. Check as to whether the motor reaches the required parameters.

❒

During operation

While the motor is operational ensure that the specified parameters are maintained.

Make sure that:

- The power consumption is in the specified range
- Cooling is ensured
  - Check the liquid level and coolant circulation
- There is no abnormal motor noise
- The motor does not overheat

Note

Observing the maintenance interval

Maintain the motor with the prescribed maintenance intervals in accordance with the project specifications of the spindle manufacturer.

Switching off

- Switch off the motor at the frequency converter.

❒

9.3 Faults and how to resolve them

This chapter describes possible faults and the measures to be taken to resolve them.

Precondition

Only eliminate faults and causes of faults if you are technically qualified to do so.

Possible faults and the measures to be taken to resolve them

⚠WARNING

Danger to life as a result of protective devices being taken out of service

If protective devices are taken out of service there is a risk of serious injury or death in the event of a fault.

- Never disable protective functions or devices, even in test operation.

- If there are deviations from normal operation or if faults occur, proceed initially according to the following list.

Fault	Cause of fault (see key table)															
Motor spindle does not start	A	B			E											
Motor spindle starts slowly	A		C		E	F										
Humming noise when starting			C		E	F										
Humming noise during operation	A		C		E	F										
High temperature rise during no-load operation				D			G	H	I							
High temperature rise under load	A		C				G	H	I							
High temperature rise of individual winding sections					E	F										
Uneven running										J	K					
Grinding sound, bearing noise												L				
Radial vibrations													M	N	O	
Axial vibrations															O	
Water escaping																P

- Correct the cause of the fault as specified in the remedial measures section.
- In this regard, observe the relevant chapters in the documentation associated with the components of the complete drive system.
- Repair any damage that occurred on the machine/motor spindle.

Note

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

Table 9- 1 Key to causes of faults and remedial measures

No.	Causes of fault	Remedial measures
A	Overload	Reduce load
B	Interruption of a phase in the supply cable	Check frequency converters, feeder cables and contactors, if necessary
C	Interruption of a phase in the supply after switching on	Check frequency converters, feeder cables and contactors, if necessary
D	Converter output voltage too high, frequency too low	Check the settings on the frequency converter, perform automatic motor identification
E	Stator winding incorrectly connected	Check the winding circuit and, if applicable, the wiring of the contactors
F	Winding short circuit or phase short circuit in stator winding	Measure the winding resistances and insulation resistances, repair after consultation with manufacturer
G	Cooling water not connected/switched off	Check cooling water connection/switch on cooling water
	Water connection / pipes defective	Locate leaks and seal as necessary, or consult the manufacturer
H	Cooling water flow rate too low	Increase cooling water flow rate
	Inlet temperature too high	Set correct inlet temperature
I	Heat dissipation impeded by deposits	Clean the surface of the drives and ensure that the cooling air can flow in and out unimpeded
	Cooling air inlet/outlet is blocked by foreign bodies	Remove the blockage 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 concerned
	Foreign bodies within the motor	Repair by manufacturer
	Bearing damage	Repair by manufacturer
M	Rotor not balanced	Decouple rotor and rebalance
N	Rotor out of round, shaft bent	Please consult the manufacturer
O	Poor alignment	Align machine set, check coupling
P	Cooling water pipes/water connection defective	Locate leaks and seal as necessary, or consult the manufacturer

9.4 Stoppages

This chapter describes activities to be carried out when the motor is not operated for prolonged periods.

NOTICE
Damage due to improper storage The motor can be damaged if it is not stored properly. • If the motor is out of service for extended periods of time, implement suitable anti-corrosion, preservation, and drying measures. • When recommissioning the motor after longer stoppages, perform the measures recommended in Chapter "Commissioning".

Precondition

Note

The motor remains installed.

Procedure for preparing the engine for a longer break in operation

1. Switch off the motor.
2. Disconnect the motor from the power supply.
3. Disconnect the motor from the cooling water system.
4. Remove any cooling water from the motor.
5. Blow out the cooling ducts with compressed air to dry them.
6. Observe the instructions for storage contained in Chapter "Transportation and storage (Page 83)".

❒

- If the motor is not operational for extended periods of time, run it at regular intervals (roughly once a month) or spin the rotor by hand.
- Observe Chapter "Commissioning (Page 165)" before switching on to recommission the system.

Service and maintenance

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10.1 Additional maintenance notice

Note

Carry out maintenance and servicing in accordance with the spindle manufacturer's project requirements.

Decommissioning and disposal 11

11.1 Safety instructions

Removing the motor from the machine

⚠WARNING

Danger to life caused by falling machine parts

The machine partially comprises heavy individual components. When removing the machine, these components can fall. This can result in death, serious injury or material damage.

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

⚠WARNING

Injury as a result of suspended loads

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

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

⚠CAUTION

Injuries caused by liquids when draining and environmental pollution

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

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

11.2 Decommissioning

11.2.1 Preparing for dismantling

This chapter describes the procedure for removing the motor from the machine or plant.

Precondition

Note

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

- Contact a certified waste disposal organization in your vicinity.
- Clarify what is expected in terms of the quality of disassembling the motor and delivery of the components.

Procedure for removal of the motor from the machine

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

Refer also to the information in the Chapter "Additional maintenance notice (Page 183)".

❒

11.2.2 Disassembling the motor

This chapter provides instructions on disassembling the motor.

Precondition

Disassemble the motor with appropriate expertise.

When disassembling synchronous motors, observe the safety instructions for handling permanent magnets.
Special safety notices for handling built-in motors (Page 19)

Procedure for disassembling a synchronous motor

⚠WARNING

Injury or material damage if not correctly disassembled

If you do not correctly disassembly direct drives or their components (especially components with permanent magnets), then this can result in death, severe injury and/or material damage.

- Ensure that direct drives and their associated components are correctly disassembled.

Note

Disassembling the synchronous motor

The motor must be disassembled by an authorized company or the manufacturer.

Procedure for disassembling an asynchronous motor

1. Disassemble the motor.
2. Dispose of the motor parts or return the motor parts to the manufacturer.

   Dispose of the motor parts according to the instructions in Chapter "Disposal (Page 188)".

❒

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.

⚠WARNING

Risk of death and crushing as a result of permanent magnet fields

Severe injury and material damage can result if you do not take into consideration the safety instructions relating to permanent magnet fields.

- Refer to Chapter "Special safety notices for handling built-in motors (Page 19)".

11.3.1 Guidelines for disposal

⚠WARNING

Injury or material damage if not correctly disposed of

If you do not correctly dispose of direct drives or their components (especially components with permanent magnets), then this can result in death, severe injury and/or material damage.

- Ensure that direct drives and their associated components are correctly disposed of.

Main constituents of a proper disposal procedure

- Complete demagnetization of the components that contain permanent magnets
- Components that are to be recycled should be separated into:
  - Electronics scrap (e.g. encoder electronics, Sensor Modules)
  - Electrical scrap (e.g. motor windings, cables)
  - Scrap iron (e.g. laminated cores)
  - Aluminum
  - Insulating materials
- No mixing with solvents, cold cleaning agents, or residue of paint, for example

11.3.2 Disposal of rotors in synchronous version

This chapter provides instructions on disposal of the synchronous rotor with permanent magnets.

Dispose of magnetized rotors by an appropriately specialized disposal company.

Precondition

For transport, pack the rotors individually in the original rotor packaging.

Procedure for disposal of rotors with permanent magnets

Make sure that rotors equipped with permanent magnets are demagnetized so that they do not pose any danger when disposed of.

11.3.3 Disposal of packaging

Packaging materials and disposal

The deployed packaging and packing aids contain no problematic materials. With the exception of wooden materials, they can all be recycled and should always be disposed of for reuse. Wooden materials should be thermally recovered.

Note

Original rotor packaging

Retain the original rotor packaging for transport to the disposal company.

Only recyclable plastics are used as packing aids:

- Code 02 PE-HD (polyethylene)
- Code 04 PE-LD (polyethylene)
- Code 05 PP (polypropylene)
- Code 04 PS (polystyrene)

Dimensional drawings

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You can find the dimension drawings for the 1FE2 built-in motors under Dimension drawings for the 1FE2 (https://support.industry.siemens.com/cs/ww/en/view/109783766) in SIOS.

Note

Siemens AG reserves the right to change the motor dimensions as part of design improvements without prior notification.

You can also find the dimension drawings for the required motors in:

CAD CREATOR (http://www.siemens.com/cadcreator),

DT CONFIGURATOR (http://siemens.de/dt-konfigurator) or

Catalog NC62 (https://intranet.for.siemens.com/org/i-dt-mc/intraDocs/catalogs/nc622019/NC%2062%20-%202019%20-%20Complete%20Catalog/motion-control-NC62-complete-English-2019.pdf)

Additional information about 1FE2 built-in motors is provided in the associated Hardware Installation Manual.

Spare parts

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Note

Spare parts can be ordered in our Service Center based on the motor designation.

Please also refer to the scope of delivery described in the Chapter Shipping and packaging (Page 80).

List of abbreviations

A

APM	Rotor with external permanent magnets and banding
BGR	Health and safety at work regulations
BGV	Health and safety at work regulations
CE	Conformité Européenne - compliance with EU directives
DIN	Deutsche Industrie Norm (German Industry Standard)
DRIVE-CLiQ	Drive Component Link with IQ - for installation with SINAMICS components
EGB	Electrostatic Sensitive Devices
EMF	Electromotive force
EMC	Electromagnetic compatibility
EN	European standard
IATA	International Air Transport Association
IPM	Rotor with internal permanent magnets
IEC	International Electrotechnical Commission
IP	International Protection
ISO	International Organization for Standardization
NTC	Negative Temperature Coefficient - temperature sensor with negative temperature coefficient
Pt1000	Platinum temperature sensor with rated value of 1000 Ω at 0° C
PTC	Positive Temperature Coefficient - temperature sensor with positive temperature coefficient
SMC	Sensor Module Cabinet
SME	Sensor Module External
VDE	Association of Electrical Engineering, Electronics and Information Technology (Germany)
VPM	Voltage Protection Module

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