



Edition

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CONFIGURATION MANUAL

SIMOTICS

Built-in motors M-1FE2

For SINAMICS S120

www.siemens.com

SIMOTICS

Drive technology SIMOTICS M-1FE2 built-in motors

Configuration Manual

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Legal information

Warning notice system

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

DANGER

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

WARNING
--

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

CAUTION
--

indicates that minor personal injury can result if proper precautions are not taken.
--

NOTICE

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

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

WARNING
--

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

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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

1.1 About SIMOTICS

Description

SIMOTICS is the Siemens family of electric motors addressing the complete motor spectrum in Digital Industry.

1.2 About this manual

1.2.1 Content

Description

This Configuration Manual supports you when selecting motors for your application. The Configuration Manual refers to rules and guidelines for configuring motors.

To illustrate possible application areas for our products, typical use cases are listed in this product documentation and in the online help. These are purely exemplary and do not constitute a statement on the suitability of the respective product for applications in specific individual cases. Unless explicitly contractually agreed, Siemens assumes no liability for such suitability. Suitability for a particular application in specific individual cases must be assessed by the user, taking into account all technical, legal, and other requirements on a case-by-case basis. Always observe the descriptions of the technical properties and the relevant constraints of the respective product contained in the product documentation.

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

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.

1.2.2 Target group

Description

This Configuration Manual addresses:

- Planning engineers
- Design engineers
- Mechanical design engineers

1.2.3 Standard scope

Description

This documentation describes the functionality of the standard scope. This scope may differ from the scope of the functionality of the system that is actually supplied. Please refer to the ordering documentation only for the functionality of the supplied drive system.

Further functions may be executable in the system, which are not explained in this documentation. However, there is no entitlement to these functions in the case of a new delivery or service.

This documentation does not contain all detailed information on all types of the product. Furthermore, this documentation cannot take into consideration every conceivable type of installation, operation and service/maintenance.

The machine manufacturer must document any additions or modifications they make to the product themselves.

1.2.4 Websites of third-party companies

Description

This document may contain hyperlinks to third-party websites. Siemens is not responsible for and shall not be liable for these websites and their content. Siemens has no control over the information which appears on these websites and is not responsible for the content and information provided there. The user bears the risk for their use.

1.3 Service and Support

1.3.1 Siemens Industry Online Support on the Web

Description

The following is available via Siemens Industry Online Support (<https://support.industry.siemens.com/cs/ww/en/>), among others:

- Product support
- Global forum for information and best practice sharing between users and specialists
- Local contact persons via the contact person database (→ Contact)
- Search for product info
- Important topics at a glance
- FAQs (frequently asked questions)
- Application examples
- Manuals
- Downloads
- Compatibility tool
- Newsletters with information about your products
- Catalogs/brochures

1.3.2 Siemens Industry Online Support on the road

Description



Figure 1-1 "Siemens Industry Online Support" app



The "Industry Online Support" app supports you in the following areas, for example:

- Resolving problems when executing a project
- Troubleshooting when faults develop
- Expanding a system or planning a new system

Furthermore, you have access to the Technical Forum and other articles that our experts have drawn up:

- FAQs
- Application examples
- Manuals
- Certificates
- Product announcements and much more

There is a data matrix code or QR code on the nameplate of your product. Scan the code using the "Industry Online Support" app to obtain technical information about the device.

The app is available for Apple iOS and Android.

See also

App (<https://support.industry.siemens.com/cs/ww/en/sc/2067>)

1.3.3 Getting information about the product

Overview

You can use the ID link to get information about your product.

The ID link is a globally unique identifier according to IEC 61406-1.

Requirement

There is a QR code on the product and on the product packaging.



Figure 1-2 QR code with ID link included

You can recognize the ID link by the frame with a black frame corner at the bottom right.

Procedure

Scan the QR code using either a standard code scanner or the "Industry Online Support" app. When using a standard code scanner, you open the scanned ID link in an Internet browser that is provided on your device.

Result

You can use the ID link to get product data, manuals, declarations of conformity, certificates and other information about your product.

1.3.4 Feedback on the technical documentation

Description

We welcome your questions, suggestions, and corrections for this technical documentation. Please use the "Provide feedback" link at the end of the entries in Siemens Industry Online Support.

Requests and feedback

What do you want to do?

- You have a technical question / problem: Ask the Technical Support
 > [Create support request](#)
- You want to discuss in our forum and exchange experiences with other users
 > [Go to the Forum](#)
- You want to create CAX data for one or more products
 > [Go to the CAX download manager](#)
- You would like to send us feedback on this Entry
 > [Provide feedback](#)

Note: The feedback always relates to the current entry / product. Your message will be forwarded to our technical editors working in the Online Support. In a few days, you will receive a response if your feedback requires one. If we have no further questions, you will not

Figure 1-3 Requests and feedback

1.3.5 mySupport documentation

Description

With the "mySupport documentation" web-based system, you can compile your own individual documentation based on Siemens content and adapt this for your own machine documentation.

To start the application, click the "My Documentation" tile on the mySupport homepage (<https://support.industry.siemens.com/cs/ww/en/my>):

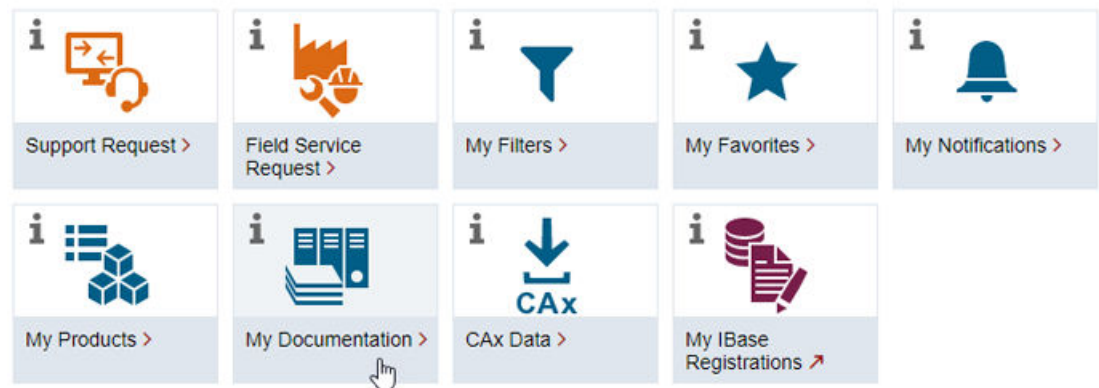
mySupport Links and Tools

Figure 1-4 mySupport

The configured manual can be exported in the PDF or XML format.

Siemens content that supports the mySupport documentation can be identified by the "Configure" link.

1.3.6 Technical support

Description

Your routes to technical support (<https://support.industry.siemens.com/cs/ww/en/sc/4868>):

- Support Request (<https://www.siemens.com/SupportRequest>)
- Contact person database (https://www.automation.siemens.com/aspa_app)
- "Industry Online Support" mobile app

The Support Request is the most important input channel for questions relating to products from Siemens Industry. This will assign your request a unique ticket number for tracking purposes. The Support Request offers you:

- Direct access to technical experts
- Recommended solutions for various questions (e.g. FAQs)
- Status tracking of your requests

Technical support also assists you in some cases via remote support (<https://support.industry.siemens.com/cs/de/en/view/106665159>) to resolve your requests. A Support representative will assist you in diagnosing or resolving the problem through screen transfer.

More information on the Support service packages is available on the Internet via the following address (<https://support.industry.siemens.com/cs/ww/en/sc/4869>).

1.3.7 Training

Description

SITRAIN – Digital Industry Academy offers a comprehensive range of training courses on Siemens industrial products – directly from the manufacturer, for all industries and use cases, for all knowledge levels from beginner to expert.

More information can be found on the Internet via the following address (<https://www.siemens.com/sitrain>).

1.3.8 Spare parts services

Description

By using the online spare parts service "Spares on Web", you ensure the smooth operation of your product. The spare parts service is aimed at the following:

- Improved spare parts inventories by balancing stock and spare parts on call
- Minimized downtimes during a plant standstill
- Reduced costs

More information can be found on the Internet via the following address (<https://www.sow.siemens.com>).

1.4 Important information

1.4.1 Proper and intended use / foreseeable incorrect use

1.4.1.1 Safety note for correct usage_separation 500 mm

 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.

Contact your local sales partner if you have any questions regarding the intended use.

Proper and intended use

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.

Predictable incorrect use



WARNING

Injuries due to incorrect use

If you use the motor other than how SIEMENS intended, then death or severe injury can occur. You destroy or damage the motor.

Misuse includes, for example

- Not complying with the operating instructions or the Configuration Manual
- Not observing the data on the rating plate
- Using the motor in hazardous zones
- Directly connecting the motor to the line supply
- Using the motor outside the permissible ambient conditions
- Using the motor as a generator
- Using the motor holding brake as an operating brake to reduce the motor speed
- Using the motor as a result of its size, its weight, its shape, or its material for applications other than those described in this manual

Fundamental safety instructions

2.1 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 in operation can result in arcing that may cause serious injury or death.

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

NOTICE

Property damage due to loose power connections

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

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

NOTICE**Damage to equipment due to unsuitable tightening tools.**

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

- Only use screw inserts that exactly match the screw head.
- Tighten the screws with the torque specified in the technical documentation.
- Use a torque wrench or a mechanical precision nut runner with a dynamic torque sensor and speed limitation system.
- Adjust the tools used regularly.

**WARNING****Unexpected machine movement caused by radio devices or mobile phones**

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

- Therefore, if you move closer than 20 cm to the components, be sure to switch off radio devices, cellphones or WLAN devices.
- Use the "SIEMENS Industry Online Support App" or a QR code scanner only on equipment that has already been switched off.

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

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

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



WARNING

Unexpected movement of machines caused by inactive safety functions

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

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

Note

Important Safety instructions for Safety Integrated

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



WARNING

Active implant malfunctions due to electromagnetic fields

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

- If this affects you, maintain the minimum distance to such equipment that is specified in the "Important product information" 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 "Important product information" 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 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****Burns and thermal damage caused by hot surfaces**

Temperatures above 100 °C may occur on the surfaces of motors, converters, and other drive components.

Touching hot surfaces may result in burns. Hot surfaces may damage or destroy temperature sensitive parts.

- Ensure that temperature-sensitive parts do not come into contact with hot surfaces.
- Mount drive components so that they are not accessible during operation.

Measures when maintenance is required:

- Allow drive components to cool off before starting any work.
- Use appropriate personnel protection equipment, e.g. gloves.

2.2 Equipment damage due to electric fields or electrostatic discharge

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



NOTICE

Equipment damage due to electric fields or electrostatic discharge

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

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

2.3 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>.

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

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

<https://www.siemens.com/cert>.

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.

2.4 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 integrator 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 faults and/or software errors in the sensors, control system, actuators, 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 inside and outside the components, including open flames, as well as emissions of light, noise, particles, gases, etc. due to fault conditions, e.g.:
 - Component failure
 - Software errors
 - Operation and/or environmental conditions outside the specification
 - External influences/damage
 - Short circuits or ground faults in the intermediate DC circuit of the converter
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 and wireless communications systems, e.g. ripple-control transmitters or data communication via the network or mobile radio, WLAN or Bluetooth.
7. Motors for use in potentially explosive areas:
When moving components such as bearings become worn, this can cause enclosure components to exhibit unexpectedly high temperatures during operation, creating a hazard in areas with a potentially explosive atmosphere.

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

Description

3.1 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 r/min ¹⁾	up to 19000 r/min ¹⁾
Maximum torque	up to 1530 Nm ¹⁾	up to 1100 Nm ¹⁾

1) Depending on the frame size

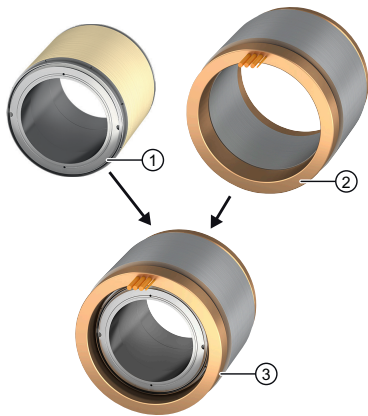
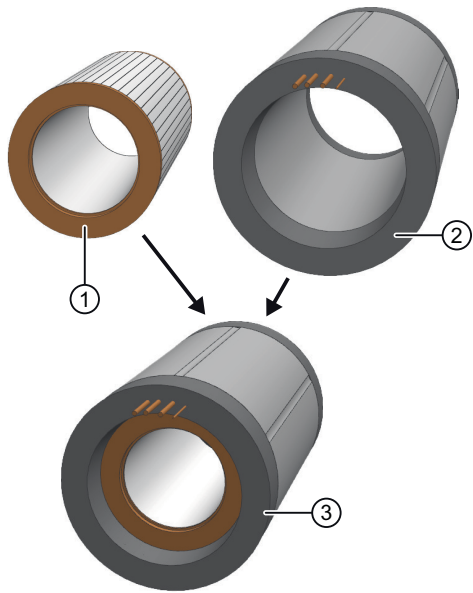
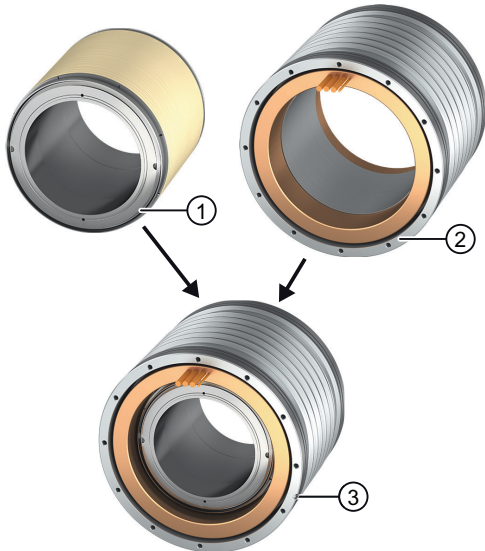
- Torque is transferred without any play through a friction-locked press fit

Overview of the variants of the 1FE2

The 1FE2 built-in motors are supplied as components.

3.1 Overview of the motors

You can select the following versions of the 1FE2 components.

	Synchronous motor		Asynchronous motor	
Design with- out cooling jacket				
	1 Rotor with externally mounted permanent magnets (APM) 2 Stator without cooling jacket (optional) 3 Installed 1FE2 built-in motor (shown without shaft)		1 Rotor with short-circuit cage 2 Stator without cooling jacket (Standard) 3 Installed 1FE2 built-in motor (shown without shaft)	
Design with cooling jack- et				
	1 Rotor with externally mounted permanent magnets (APM) 2 Stator with cooling jacket 3 Installed 1FE2 built-in motor (shown without shaft)			
Frame sizes (shaft heights)	16-pole	1FE218.-8L..	8-pole	1FE209□.-8A.. 1FE209□.-8C.. 1FE214□.-8C..

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:

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

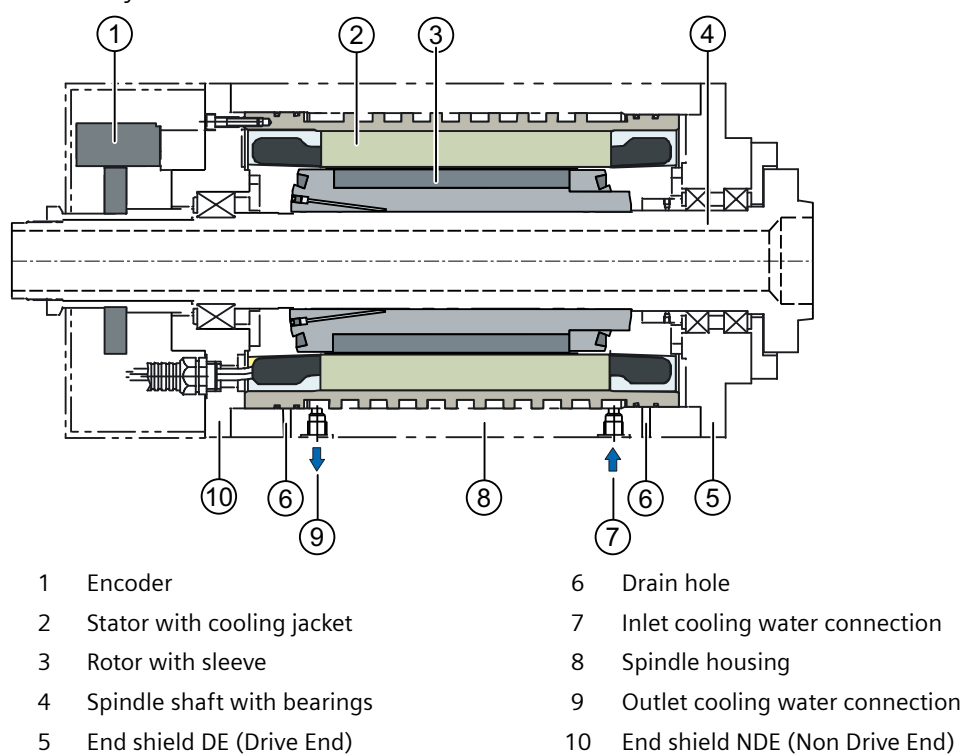


Figure 3-1 Motor spindle design

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.

3.2 Technical features and system requirements

3.2.1 Directives and standards

The chapter lists the standards and directives that are applicable for the motor and which the motor complies with.

Standards that are complied with

Note

The standards listed in this manual are not dated.

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

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

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

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

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

¹⁾ Standard part, e.g. cannot be used for built-in motors.

Relevant directives

The following directives are relevant for SIMOTICS motors.

European Low-Voltage Directive

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

European Machinery Directive

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

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



European EMC Directive

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

European RoHS Directive

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

European Directive on Waste Electrical and Electronic Equipment (WEEE)

SIMOTICS motors comply 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 (EU) Regulation 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 (<https://support.industry.siemens.com/cs/de/de/view/109769143>)

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 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>)



3.2 Technical features and system requirements

China RoHS

SIMOTICS motors comply with the China RoHS.

You can find more information at:

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

3.2.2 Technical features

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 $T_{H2O} = 20\text{ °C}$ acc. to EN 60034-1 (see section "Cooling (Page 66)")
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): Balance quality G 2.5 Reference speed 3600 r/min
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	$\leq 1 + 0.5\%$ at 20 r/min and $M_N/2$ referred to 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.).

3.2.3 Rotor weights and moments of inertia

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•m ²	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.

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

Motor article number	Rotor		Stator
	J without sleeve in kgm ²	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

3.2 Technical features and system requirements

Motor article number	Rotor		Stator
	J without sleeve in kgm ²	Mass without sleeve in kg	Mass without cooling jacket in kg
1FE2145-8C□□□-□□□□	0.2667	36.1	63
1FE2147-8C□□□-□□□□	0.3589	48.6	81

The mass values are rounded.

3.2.4 System requirements

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.

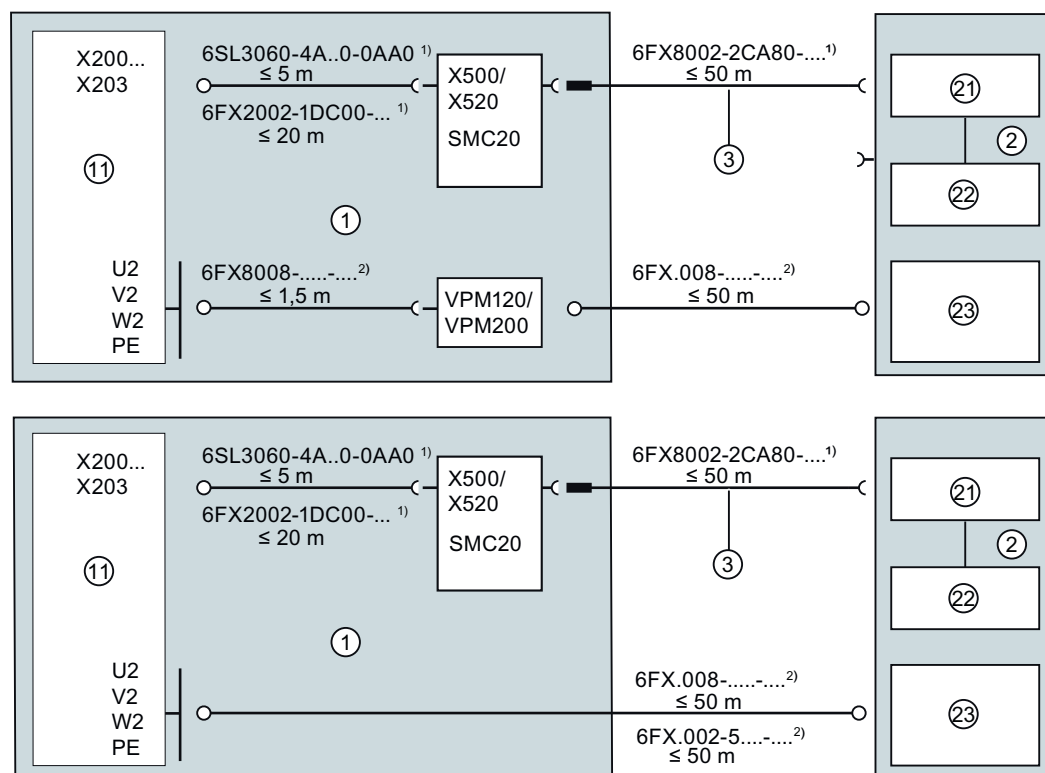
- 1FE2...-8A...-.... : 12,000 r/min
- 1FE2...-8C...-.... : 12,000 r/min

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.

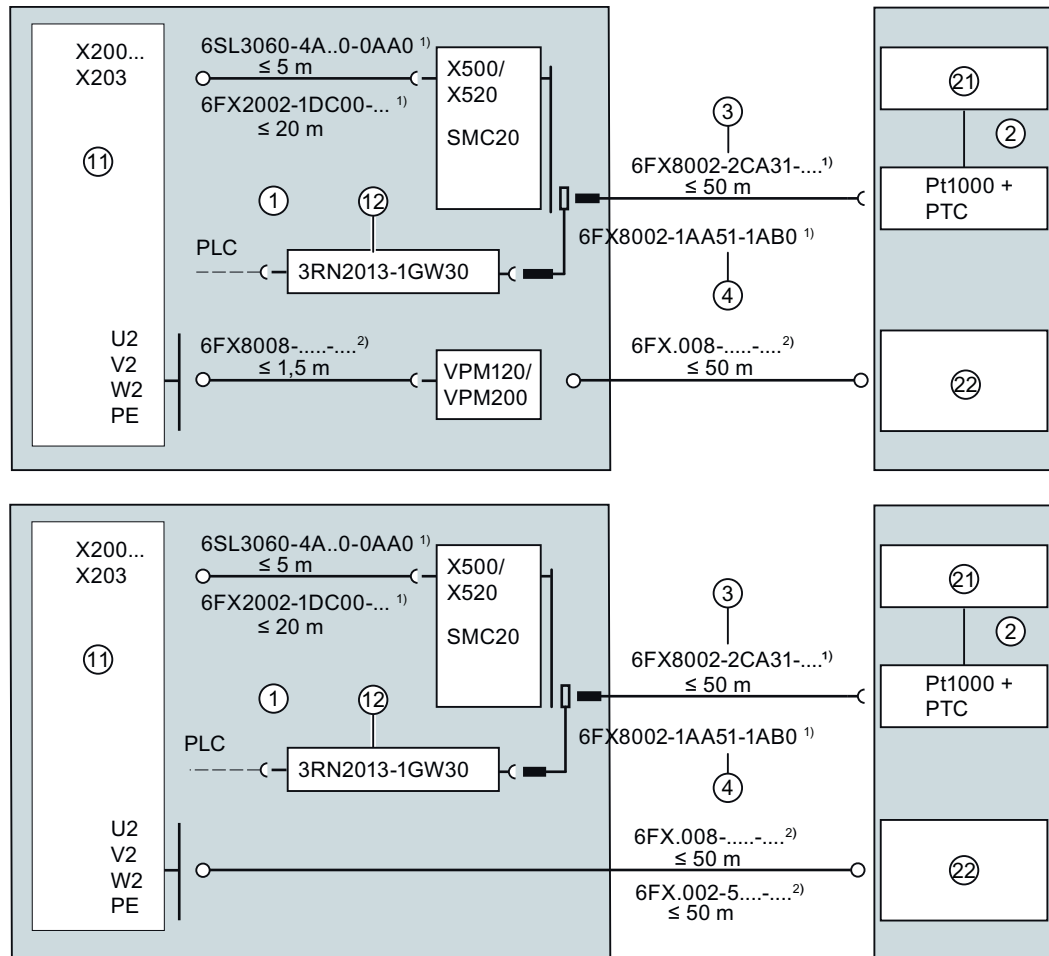
General rule: Motor with standard protection, integrated into the system via SMC20, with or without VPM



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

²⁾ Article numbers for prefabricated MOTION-CONNECT power cables

- | | | | |
|----|--|----|--|
| 1 | Control cabinet | 22 | Pt1000 temperature sensor |
| 11 | SINAMICS S120 Motor Modules, Booksize format, DRIVE CLiQ communication via SMC20 | 23 | 1FE2 winding, connection via terminal box |
| 2 | 1FE2 built-in motor | 3 | Signal cable for encoder and temperature sensor,
17-pin M23 round connector |
| 21 | Incremental encoder sin/cos 1 Vpp or EnDat 2.1 absolute encoder | | |

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

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

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

22 1FE2 winding, connection via terminal box

12 Tripping unit

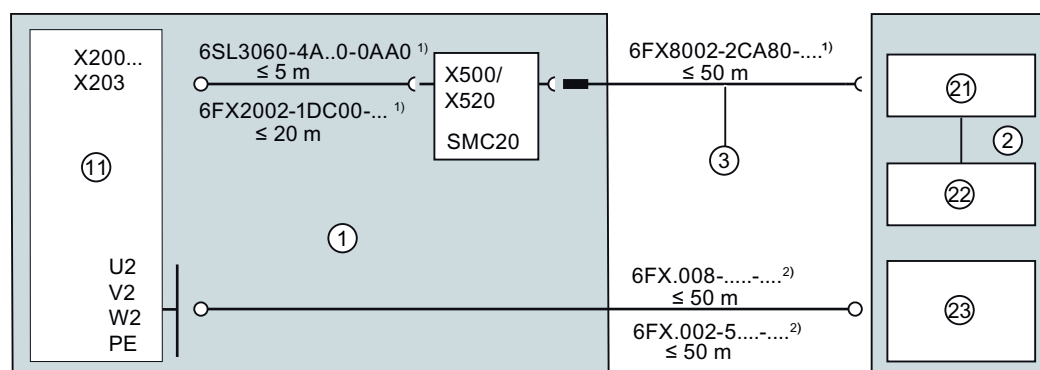
3 Signal cable for encoder and temperature sensor, 17-pin M23 round connector

2 1FE2 built-in motor

4 Signal cable for PTC via tripping unit

Versions of the system integration for asynchronous motors

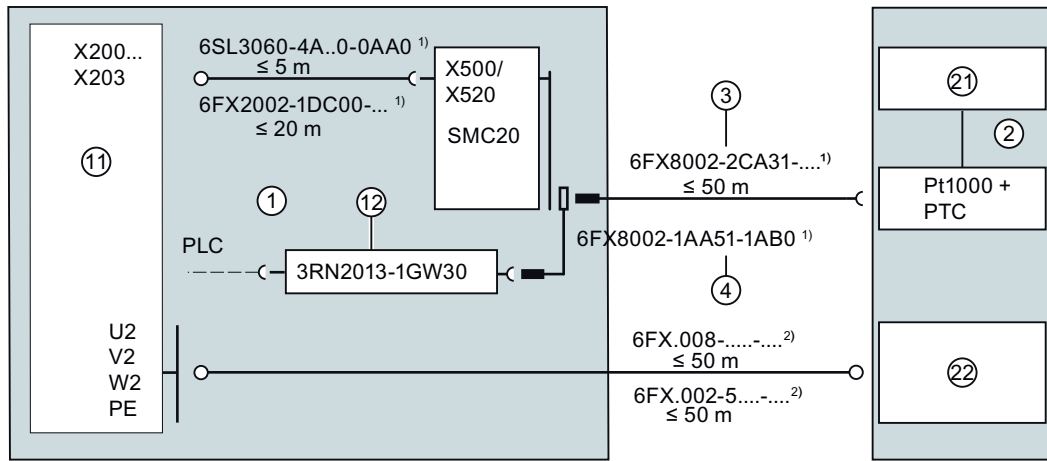
The following diagrams show the possible system integration configurations of the 1FE2 in asynchronous version.

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 | 22 | Pt1000 temperature sensor |
| 11 | SINAMICS S120 Motor Modules, Booksize format, DRIVE CLiQ communication via SMC20 | 23 | 1FE2 winding, connection via terminal box |
| 2 | 1FE2 built-in motor | 3 | Signal cable for encoder and temperature sensor,
17-pin M23 round connector |
| 21 | Incremental encoder sin/cos 1 Vpp or EnDat 2.1 absolute encoder | | |

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 Design of the motor in the synchronous version

Motor parts

Note

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

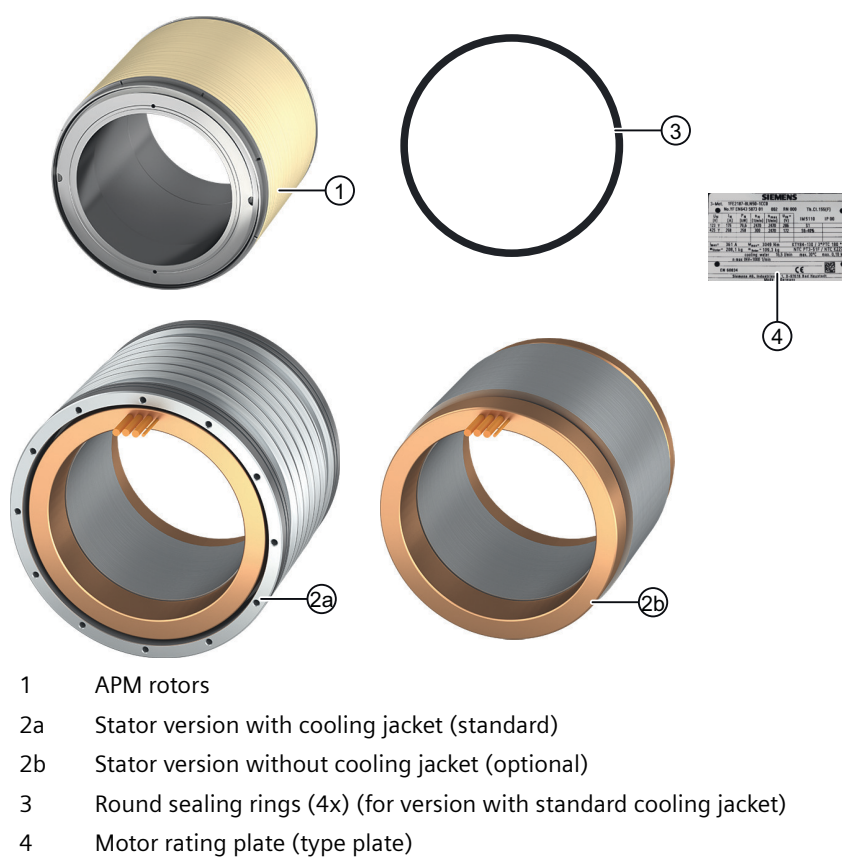


Figure 3-2 Parts of the 1FE2 built-in motor in the synchronous version

Design of the rotor core (APM)

APM rotors are rotors with externally located permanent magnets.

The rotors of built-in motors are finish machined and mounted directly onto the motor spindle shaft without requiring any subsequent machining.

3.3 Design of the motor in the synchronous version

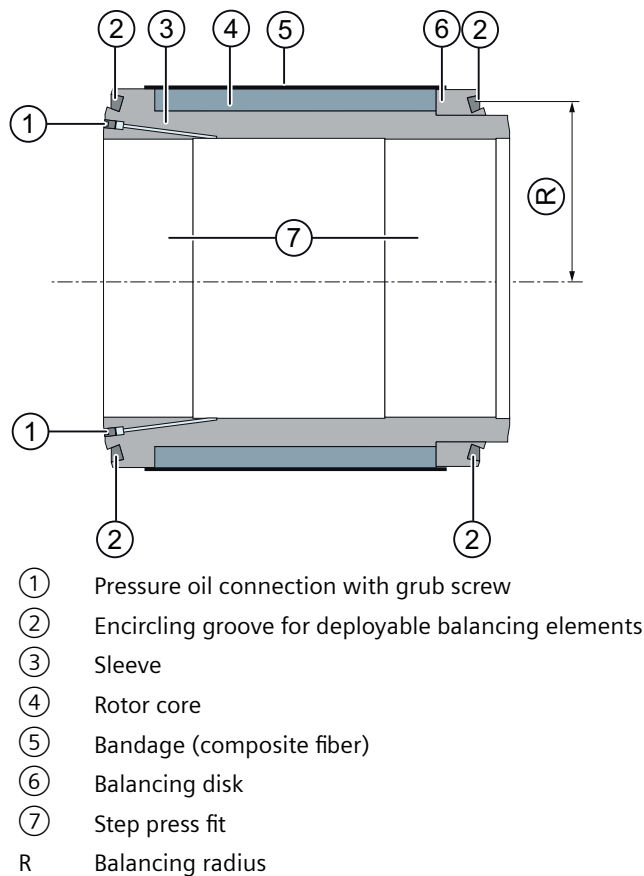


Figure 3-3 APM rotor core design

By default, the rotors are not balanced.

Optionally, the rotor can be supplied in balancing quality G2.5 (reference speed 3600 rpm) in accordance with DIN ISO 1940 (order with "Z" option T00).

Note

With pre-balanced rotors ("Z" option T00), a balancing track is visible in each of the two step interference fits. It has no influence on the function of the step interference fit

The rotor is located on an inner sleeve with step interference fit.

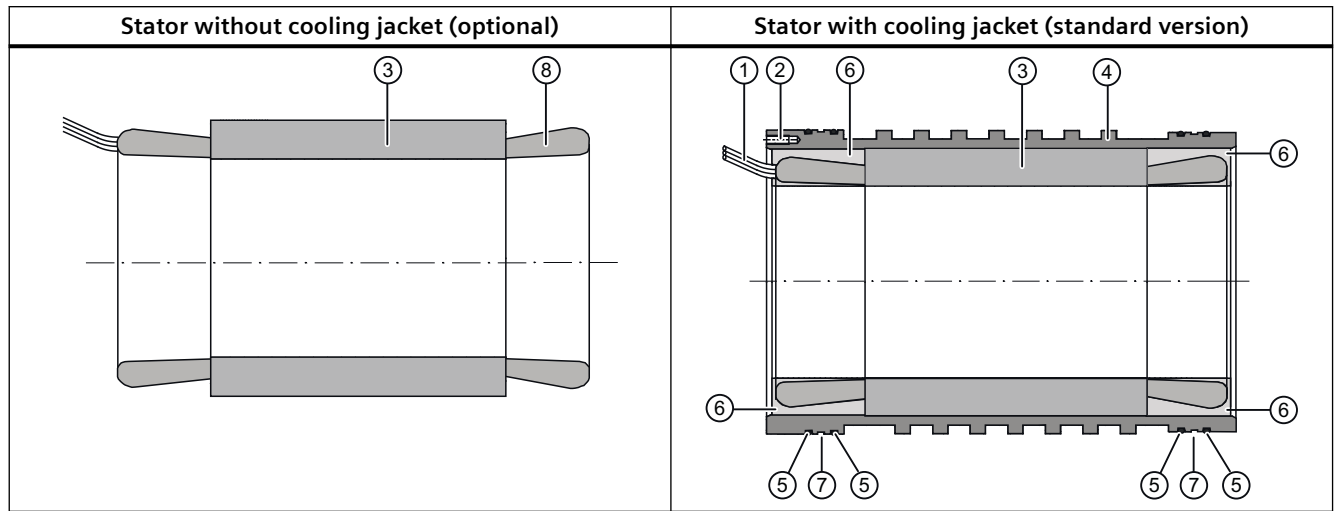
The spindle manufacturer thermally mounts the rotor onto the spindle (thermal shrinking).

The bond can be released by pressure-oil injection without affecting the joint surfaces.

To ensure torque transmission without any play, in the area of the interference fit, the spindle must be machined with the specified dimensions and tolerances.

After the rotor is mounted on the spindle, the rotor-spindle system can be finely balanced with the available balancing levels on the rotor. Two all-round grooves are used for accommodating the balancing weights. (See the figure Design of APM rotors, position ②)

Stator design



Stator core in cross-section

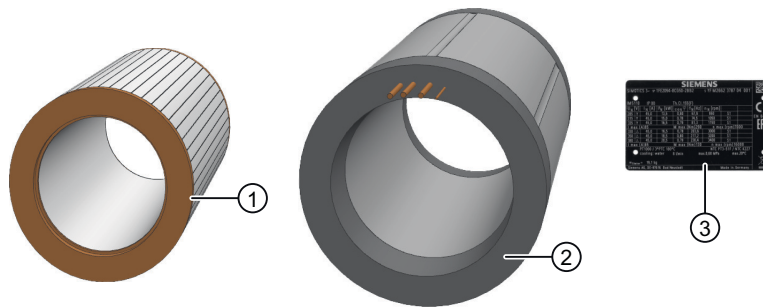
- | | | | |
|---|---|---|---------------------|
| 1 | Cables for power connection and temperature sensors | 5 | O-ring seal |
| 2 | Thread for axial fixation | 6 | Winding overhang |
| 3 | Stator core | 7 | Leakage channel |
| 4 | Cooling jacket with cooling duct | 8 | Impregnated winding |

3.4 Design of the motor in the asynchronous version

Motor parts

Note

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

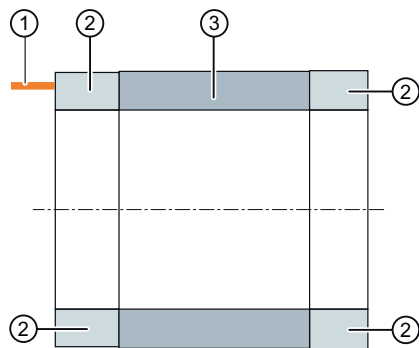


- 1 Rotor in Cu or Al version
- 2 Stator without cooling jacket
- 3 Motor rating plate (type plate)

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

3.5 Nameplate data

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

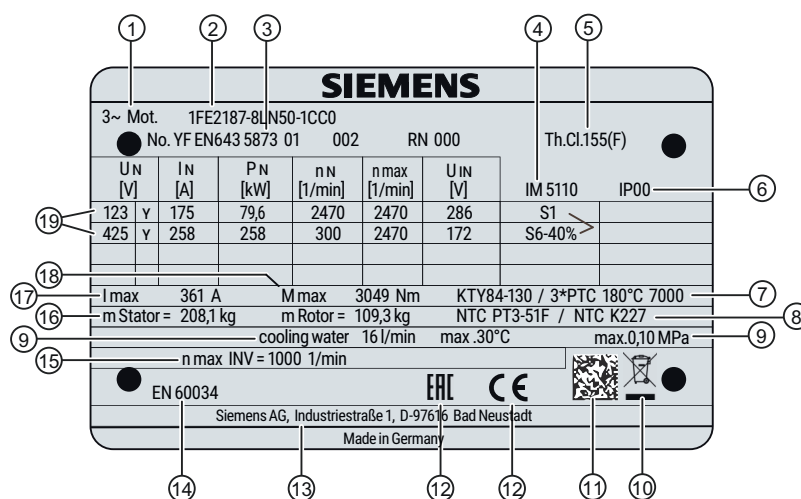


Figure 3-6 1FE2 synchronous version

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 when using a converter in r/min
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

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

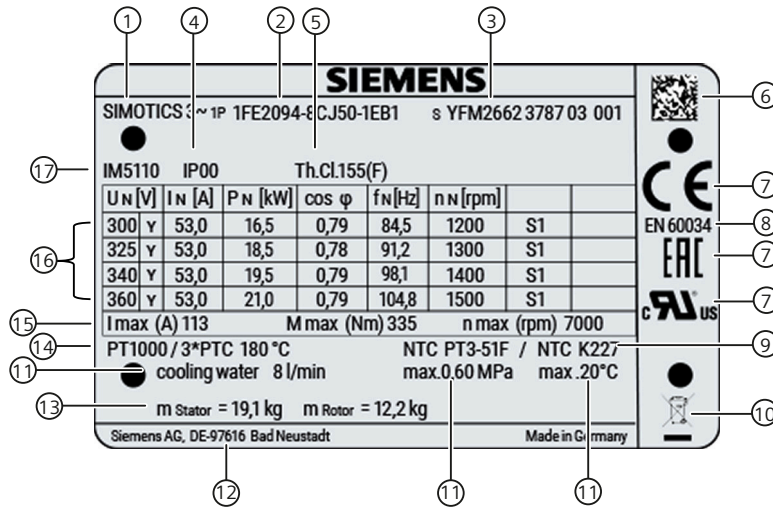


Figure 3-7 1FE2 synchronous version, star connection

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

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

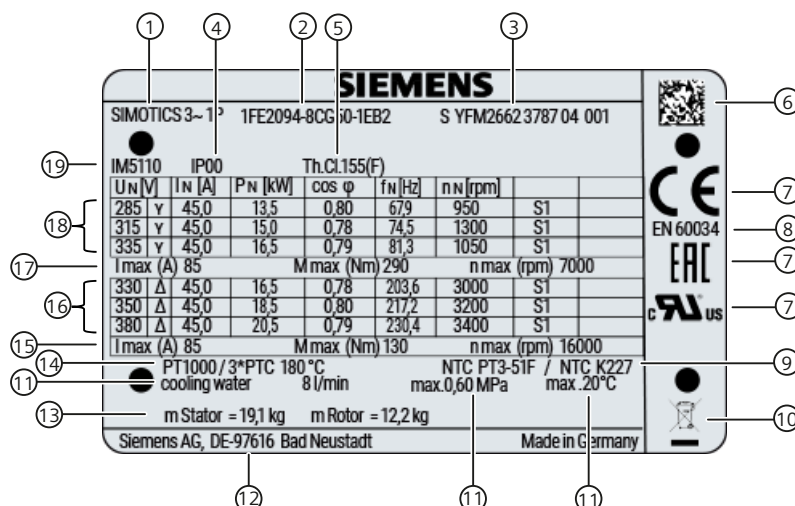


Figure 3-8 1FE2 synchronous version, star-delta connection

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

3.6 Selection and ordering data

The required Motor Modules are selected according to the peak and continuous currents that occur in the load cycle.

If more than one motor is operated in parallel on one drive system, the total (summed) values of the peak and continuous currents must be taken into account.

Use the SIZER (<https://support.industry.siemens.com/cs/document/54992004/sizer-for-siemens-drives?dti=0&pnid=13434&lc=en-WW>) engineering tool to select the appropriate Motor Module.

NOTICE**Damage to the insulation on synchronous built-in motors on regulated infeed units**

Where synchronous built-in motors are used together with regulated (closed-loop controlled) infeed units (e.g. Active Line Modules), electrical oscillations can occur with respect to ground potential. These oscillations result in increased voltage loads (stress).

Factors that influence these system oscillations include, for example:

- cable lengths
 - size of the Motor Module
 - number of axes
 - motor size
 - winding design
-
- Avoid increased voltage loads or damage to the main insulation of the motor by using an Active Interface Module in Active Line Mode of the motor.

Using smaller Motor Modules

Note

For several motor types, smaller Motor Modules with $I_n < I_{n, \text{motor}}$ can restrict the speed range that can be used, even in partial load operation.

Therefore, please contact your local Siemens office.

3.7 Structure of the Article No.

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

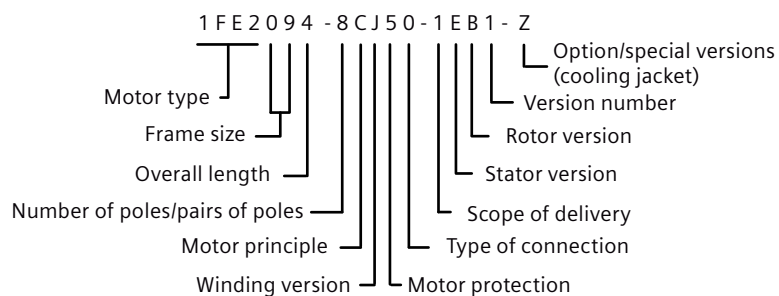


Figure 3-9 Structure of the article number 1FE2

3.7 Structure of the Article No.

Possible combinations are provided in Catalog NC 62, NC82 and D21.4, as well as in the SIEMENS Product Configurator (www.siemens.com/SPC).
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																
		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																
Number of poles/pairs of poles		8-pole								8														
		16-pole (1FE218□ only)								8														
		Special version								9														
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										

Description

3.7 Structure of the Article No.

Description		Position of the article number																			
		1	2	3	4	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-	Z
	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 ¹⁾				
	Impregnated winding with standard cooling jacket																C				
	Cast winding with standard cooling jacket (on request)																D				
	Cast winding without cooling jacket																E				
	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

¹⁾ Can no longer be ordered

Mechanical properties

4.1 Types of construction

Motor 1FE2 is available as a synchronous and asynchronous version.

The rotors of the synchronous version are APM rotors, rotors with **externally located** permanent magnets.

The rotors of the asynchronous version are available in Cu or Al

Assignment of the types of construction to the built-in motors

Article number	Synchronous version		Asynchronous version			
	with sleeve	without sleeve	Cu		Al	
			with sleeve	without sleeve	with sleeve	without sleeve
16-pole						
1FE2182-8LN	X	-	-	-	-	-
1FE2182-8LH	X	-	-	-	-	-
1FE2183-8LN	X	-	-	-	-	-
1FE2183-8LH	X	-	-	-	-	-
1FE2184-8LN	X	-	-	-	-	-
1FE2184-8LK	X	-	-	-	-	-
1FE2184-8LH	X	-	-	-	-	-
1FE2185-8LN	X	-	-	-	-	-
1FE2185-8LL	X	-	-	-	-	-
1FE2185-8LH	X	-	-	-	-	-
1FE2186-8LN	X	-	-	-	-	-
1FE2186-8LM	X	-	-	-	-	-
1FE2186-8LH	X	-	-	-	-	-
1FE2187-8LN	X	-	-	-	-	-
1FE2187-8LH	X	-	-	-	-	-
8-pole						
1FE2093-8A	-	-	-	-	-	X
1FE2094-8A	-	-	-	-	-	X
1FE2094-8C	-			X	-	-
1FE2095-8C	-	-	-	X	-	-
1FE2145-8C	-	-	-	X	-	-
1FE2147-8C	-	-	-	X	-	-

Rotor sleeves

Note

Built-in motors without rotor sleeve:

The force is transmitted without any play through a friction-locked connection. Larger shaft diameter diameters are achieved due to the fact that there is no rotor sleeve. Generally, it is not possible to release the group (rotor and stator) using the version without sleeve.

Built-in motors with rotor sleeve:

The rotor is located on an inner sleeve with a step interference fit. The press fit can be released using pressurized oil without this influencing the joint surfaces.

The spindle manufacturer mounts the rotor on the spindle using a thermal shrinking procedure.

NOTICE
Damage to the rotor permanent magnets due to excessively high temperatures
If the temperature exceeds 140 °C on APM motors, the permanent magnets in the rotor will be irreversibly demagnetized.
• Prevent this temperature from being exceeded on APM rotors by checking the rotor temperature using a temperature-reactive dye or a temperature measuring device. • Inductive heating of the rotor is not permissible.

To ensure torque transmission without any play, in the area of the interference fit, the spindle must be machined with the specified dimensions and tolerances. Additional information is provided in the dimension drawing in Chapter "Dimension drawings (Page 159)".

4.2 Degree of protection

Note

Selecting the degree of protection

The spindle manufacturer is responsible for selecting the degree of protection, its implementation and its verification regarding suitability.

- Protect the motor components against moisture, foreign bodies and contact.
-

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

The spindle manufacturer defines the final degree of protection as a result of the mechanical design of the spindle housing.

Recommended degree of protection: at least IP54

4.3 Permissible motor vibration levels

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 4-1 Maximum permitted radial vibration values

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

Maximum permitted axial vibration values

Vibration velocity	Vibration acceleration
$v_{\text{rms}} = 4.5 \text{ mm/s}$	$a_{\text{peak}} = 2.25 \text{ m/s}^2$

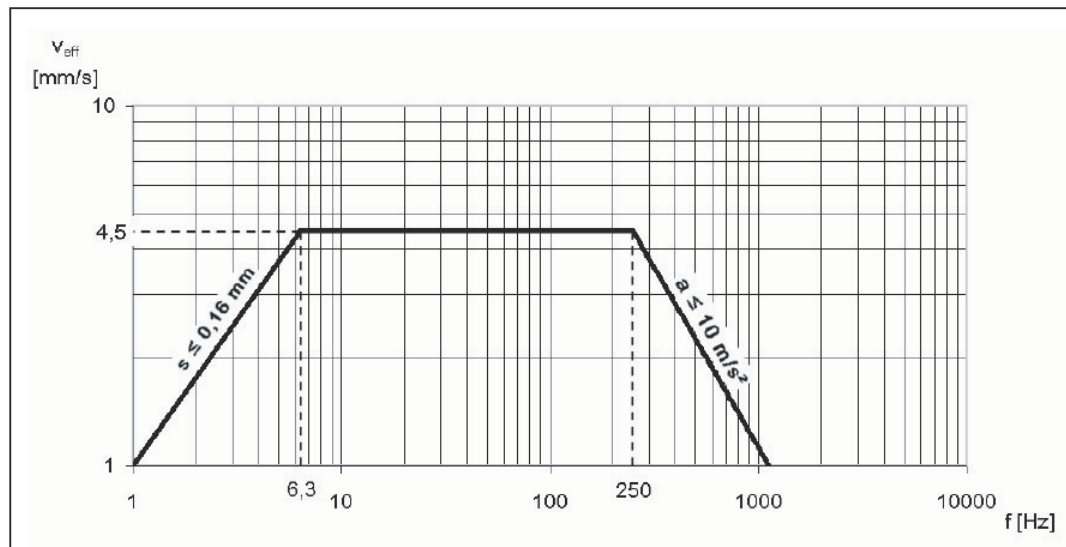


Figure 4-1 Maximum permissible vibration velocity taking into account the vibration displacement and vibration acceleration

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.

Motor components and options

5.1 Motor components

5.1.1 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)
Full protection (option):	Temperature sensors + PTC thermistor triplet (3 sensors in series) (2 x Pt1000 + 1 x PTC180 C) see Chapter "Temperature evaluation using the PTC thermistor triplet (full motor protection, option) (Page 59)"
Universal protection (option):	Temperature sensors + PTC thermistor triplet + NTC thermistor (2 x Pt1000+ 1 x PTC180 C + NTC PT3-51F + NTC K227/33k/A1) see Chapter "Temperature evaluation using NTC thermistors (universal protection, option) (Page 60)"

Note

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

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

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.

5.1.1.1 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&ntp=Manual&mfn=ps&o=DefaultRankingDesc&pnid=13204&lc=d e-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 5-1 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.

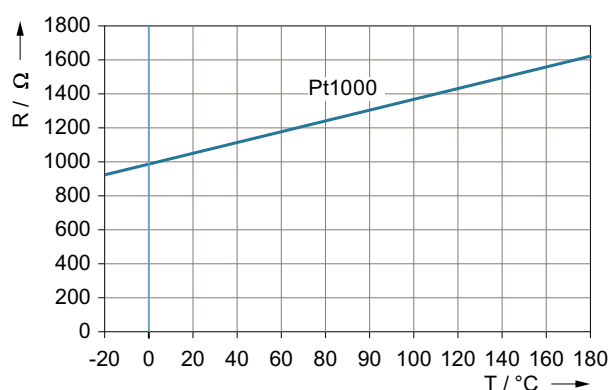


Figure 5-1 Pt1000 characteristic

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.

5.1.1.2 Temperature evaluation using the PTC thermistor triplet (full motor protection, option)

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.

The PTC thermistor triplet must be evaluated using an external tripping/evaluation 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 5-2 Technical data for the PTC thermistor triplet

Designation	Technical data
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 Possible connections (Page 61)
Cable cross-section/outer diameter	0.14 mm ² / 0.9 mm

5.1 Motor components

Designation	Technical data
Response temperature	180° C
Note: PTC thermistors do not have a linear characteristic and are, therefore, not suitable to determine the instantaneous temperature.	

5.1.1.3 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.

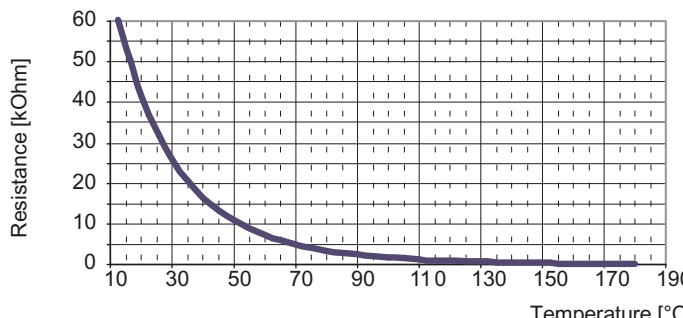
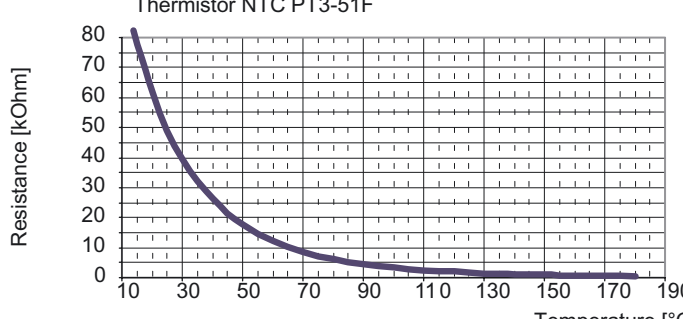
They are intended for operating the motor on third-party systems.

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 5-3 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 Possible connections (Page 61)	

Designation	Technical specifications	
	NTC K227	NTC PT3-51F
cable cross-section	0.14 mm ²	0.14 mm ²
Outer diameter	0.8 mm	0.8 mm
Temperature characteristic NTC thermistor K227/33k/A1  Thermistor NTC PT3-51F 		

5.1.1.4 Possible connections



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.

Note

Connect the Pt1000 temperature sensor independent of the polarity via two-conductor yellow cables.

Before you commission the motor, carefully check that the shutdown circuit via the PLC (programmable logic controller) functions correctly.

- 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

3R2013-1GW30 thermistor motor protection

1FE2 built-in motor

NTC K227

Red 1TN2

Gray 1TN1

W1

Yellow 2TN2

Red 2TN1

NTC PT3-51F

V1

2TP1 White

PTC

2TP2 Red

U1

1R1 Yellow

1R2 Yellow

Pt1000

230 V AC

Input

T1

A1

A2

T2

+24 V

PLC

Output

Pulse inhibit or no torque (M = 0 Nm)

Encoder

X520, 25, 13 (1-8, 16-18, 24)

SMC20/SME20

X500

DRIVE-CLiQ

X200-X203

Drive system, SINAMICS Motor Modules

Notes:

- Pt1000: independent of the polarity; yellow = 1R1, yellow = 1R2
- PTC: independent of the polarity; red = 2TP2, white = 2TP1
- NTC K227: independent of the polarity; red = 1TN2, gray = 1TN1
- NTC PT3-51F: independent of the polarity; red = 2TN1, yellow = 2TN2
- PLC: Before you commission the motor, carefully check that the shutdown circuit via the programmable logic controller (PLC) functions correctly.

Figure 5-2 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

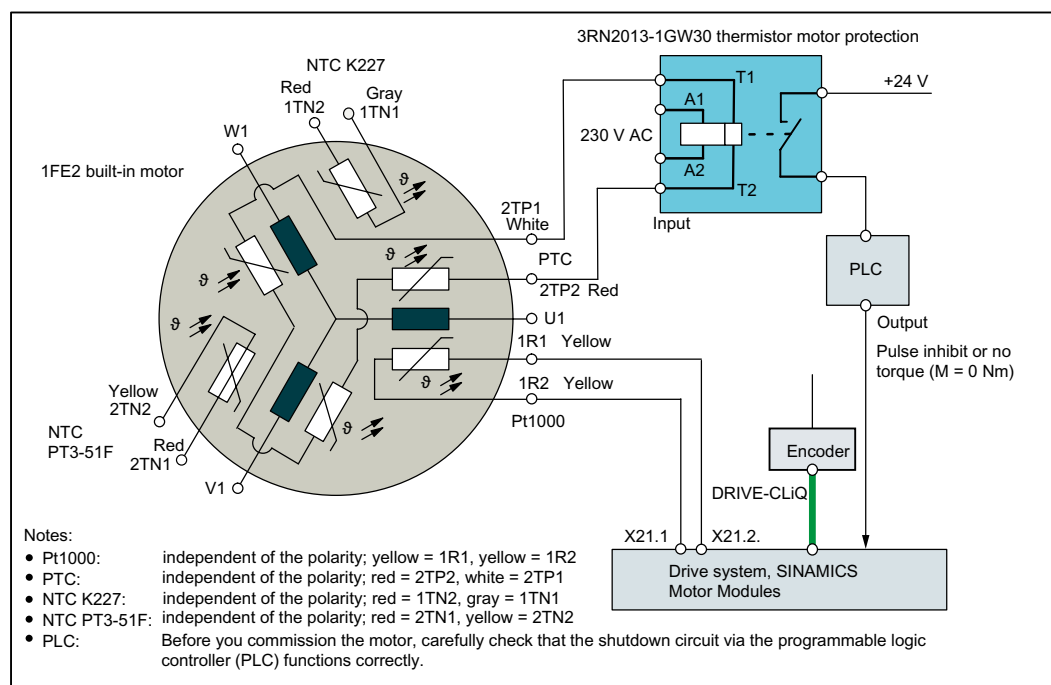


Figure 5-3 Connecting the PTC via thermistor motor protection 3RN2013-1GW30, Pt1000 directly to the drive system

Connecting the PTC and Pt1000 to SME120

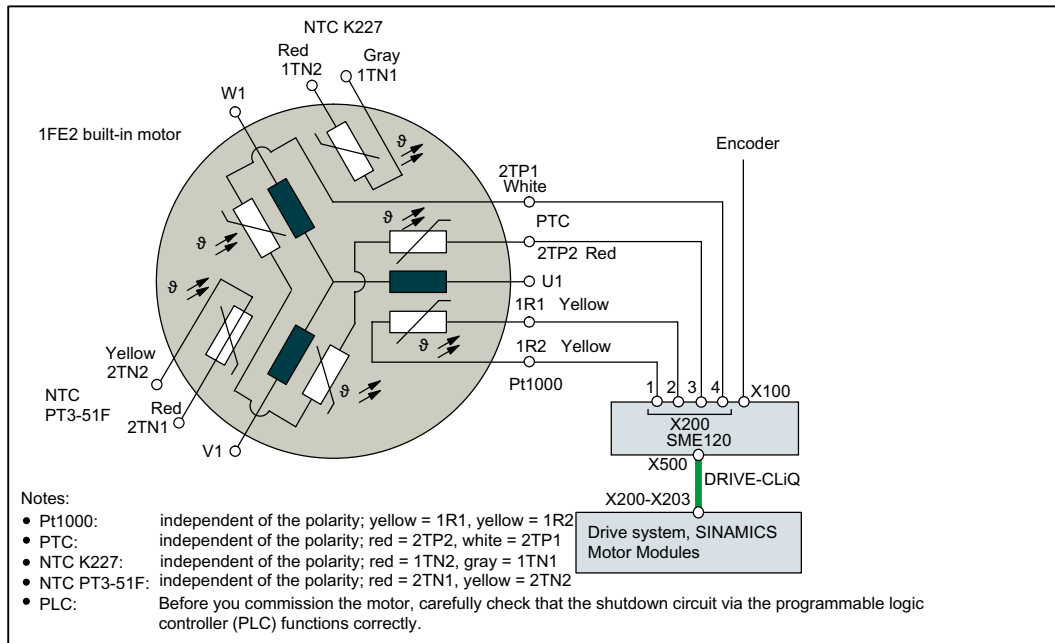


Figure 5-4 Connecting the PTC and Pt1000 to SME120

Note

SME120

Additional information about connecting-up and operating the SME120 is provided in the SINAMICS Control Unit Manual and supplementary system component documentation.

5.1.2 Encoder

Function

The encoder system has the following functions:

- Actual speed value encoder for the speed control
- Position encoder for closed-loop position control

The rotor position is determined when switching on using the "pole position identification" software function, see Chapter Commutation angle and pole position identification (Page 77).

Encoder systems that can be used

- Gearwheel encoder or a
- Comparable hollow shaft encoder system with sinusoidal voltage signals 1 Vpp.

Note

The encoder system is not included in the scope of supply.

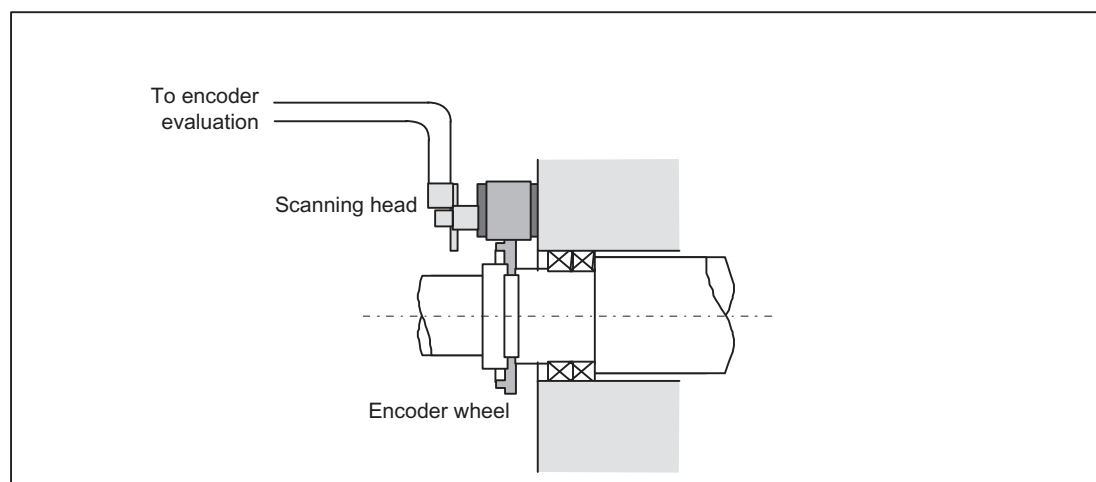


Figure 5-5 Encoder mounting schematic

Measuring systems from different manufacturers can be used.

Recommended encoder systems

Note

The recommended encoder systems are third-party products with fundamental suitability.

The user must check and ensure the necessary compatibility of the encoder systems for the associated applications.

Siemens cannot guarantee the properties/features of third-party products.

Contact the specified manufacturer directly for technical information or questions regarding orders.

We recommend encoder systems from

- Lenord and Bauer, type GEL 244□; www.lenord.de
- Johannes Heidenhain, type ERM 2□□; www.heidenhain.de

Encoderless operation

Together with the appropriate experts, carefully check whether your application is suitable for operation without an encoder.

To do this, contact your local Siemens office.

5.1.3 Cooling

5.1.3.1 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 5-4 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.

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.

Materials used in the motor cooling circuit

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

Table 5-5 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 5-6 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 (AcrylnitrileButadieneStyrene)	Pipes, valves and fittings	Suitable according to the definition in Chapter "Coolant definition". Suitable for mixing with inhibitor and/or biocide as well as Antifrogen N.
Installation comprising different materials (mixed installation)	Pipes, valves and fittings	Use is not permitted.
PVC	Pipes, valves, fittings and hoses	Use is not permitted.
Hoses		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).

5.1 Motor components

Material	Used as	Description
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
Pfannenberger GmbH	www.pfannenberger.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.

5.1.3.2 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.

5.1.3.3 Pressure loss**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 5-7 Approximate pressure drop at the nominal coolant flow rate

Motor type	Values for the synchronous version	
	Flow rate Q in l/min	Pressure drop d_p 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 5-8 Rated coolant volume flow

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

Pressure equalization

If various components are connected up in the cooling circuit, it may be necessary to provide pressure equalization.

Reactor elements are installed at the coolant outlet of the motor or the relevant components.

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 across the 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; see diagram (Influence of the coolant inlet temperature on M_N as a percent"

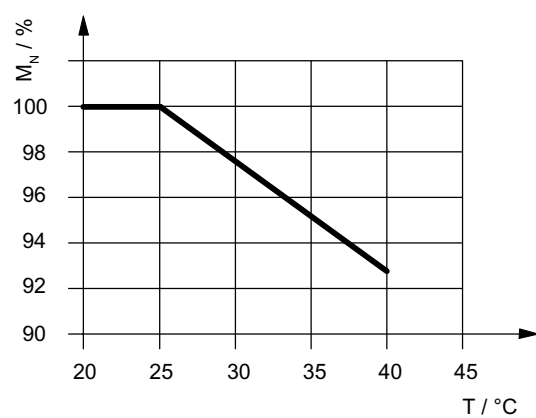
Coolant inlet temperature**NOTICE****Motor damage caused by condensation formation**

Water condensation can cause motor damage.

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

The motors are designed for full-load operation at maximum +25 °C coolant inlet temperature.

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



M_N Torque reduction referred to M_N as a %

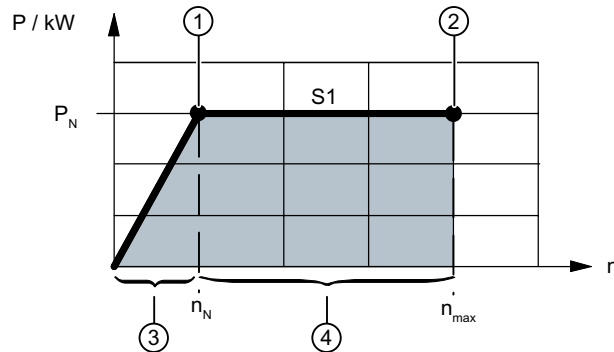
T Coolant inlet temperature in °C

Figure 5-6 Influence of the coolant inlet temperature on M_N as a percentage

5.1.3.4 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: $P \leq P_N \times n / n_N$
- ④ For $n_N < n < n_{\max}$, the following applies: $P \leq P_N$

Figure 5-7 Calculating the power loss

You can calculate the power loss using the following program: Calculation of the cooling power to be dissipated (power loss) (Page 72)

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.

5.1.3.5 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	$P_{V, \text{stator}}$ / kW at n_N	$P_{V, \text{rotor}}$ / kW at n_N	$P_{V, \text{total}}$ / 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

5.1 Motor components

	Circuit	P_N / kW	n_N / rpm	$P_{V, \text{stator}}$ / kW at n_N	$P_{V, \text{rotor}}$ / kW at n_N	$P_{V, \text{total}}$ / kW at n_N
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

5.1.3.6 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 $\mu\text{S/cm}$) as the coolant.

Table 5-9 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 $\mu\text{S/cm}$
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 OGE056)
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.

5.1.3.7 Other coolant

Other coolants (not water-based)

If you use other cooling media (e.g. oil, lubricating coolant), then it may be necessary to reduce the motor power (derating) so that the thermal motor limit is complied with. (Derating)

Note

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

Determine the values of the coolant from the following table:

	Formula symbol	Unit
Density	ρ	kg/m ³
Specific thermal capacitance	c_p	J/(kg•K)
Thermal conductivity	λ	W/(K•m)
Kinematic viscosity	η	m ² /s
Flow rate	V	l/min
Third-party cooling jacket		Cooling jacket geometry is required

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

See also

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

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.

5.1.4 Commutation angle and pole position identification

5.1.4.1 Versions of pole position identification

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 $\geq 50\%$ 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.

5.1.4.2 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.

Configuration

6.1 Configuration workflow

6.1.1 Configuration sequence SINAMICS_1FE2_S120

Overview

The motors are optimized for rotary motion within a defined travel cycle.

The motors are used as main spindle drives.

The following table "Configuring procedure" is valid for synchronous and induction motors.

General configuring procedure

The function description of the machine provides the basis for configuration. The components are selected according to physical interdependencies and in the following steps:

Table 6-1 Configuration sequence

step	Description of the configuring activity	
1.	Clarify the drive type	See the next chapter
2.	Define the constraints and incorporate them into the automation system	
3.	Define the load case, calculate the maximum load torque and determine the motor	
4.	Define the converter required	See catalog
6.	Determine line-side power options (main switch, fuses, line filters, etc.)	
7.	Define additional system components	
9.	Determine the connection system components	
10.	Configure the drive line-up components	
11.	Calculate the required cable cross sections for power supply and motor connections	
12.	Inclusion of mandatory installation clearances	

Observe also the recommended combinations of converters and motors with the associated connecting cables in the Chapters "Connecting (Page 119)".

6.1.2 1. Clarification of the drive type_1FE2

Select the motor based on the required torque (load torque), which is defined by the main spindle drive application.

You must know the following mechanical data in order to determine the required motor torque:

- The load torque specified for the application
- Masses to be moved
- Frictional resistance data
- Mechanical efficiency
- Maximum speed
- Maximum acceleration and maximum deceleration
- Cycle time

See also

Technical specifications and characteristics (<https://support.industry.siemens.com/cs/ww/de/view/109783767/en>)

SIZER (<https://support.industry.siemens.com/cs/document/54992004/sizer-for-siemens-drives?dti=0&pnid=13434&lc=en-WW>)

6.1.3 2. Define the constraints and integration into the automation_1FE2

When configuring, take into account the following:

- The line system configuration when using specific motor types and/or line filter
- The rated values of the motor, e.g. winding overtemperature of 100 K
- The ambient temperatures and the installation altitude of the motors and drive components
- Heat dissipation from the motors

Other conditions apply when integrating the drives into an automation environment such as SINUMERIK.

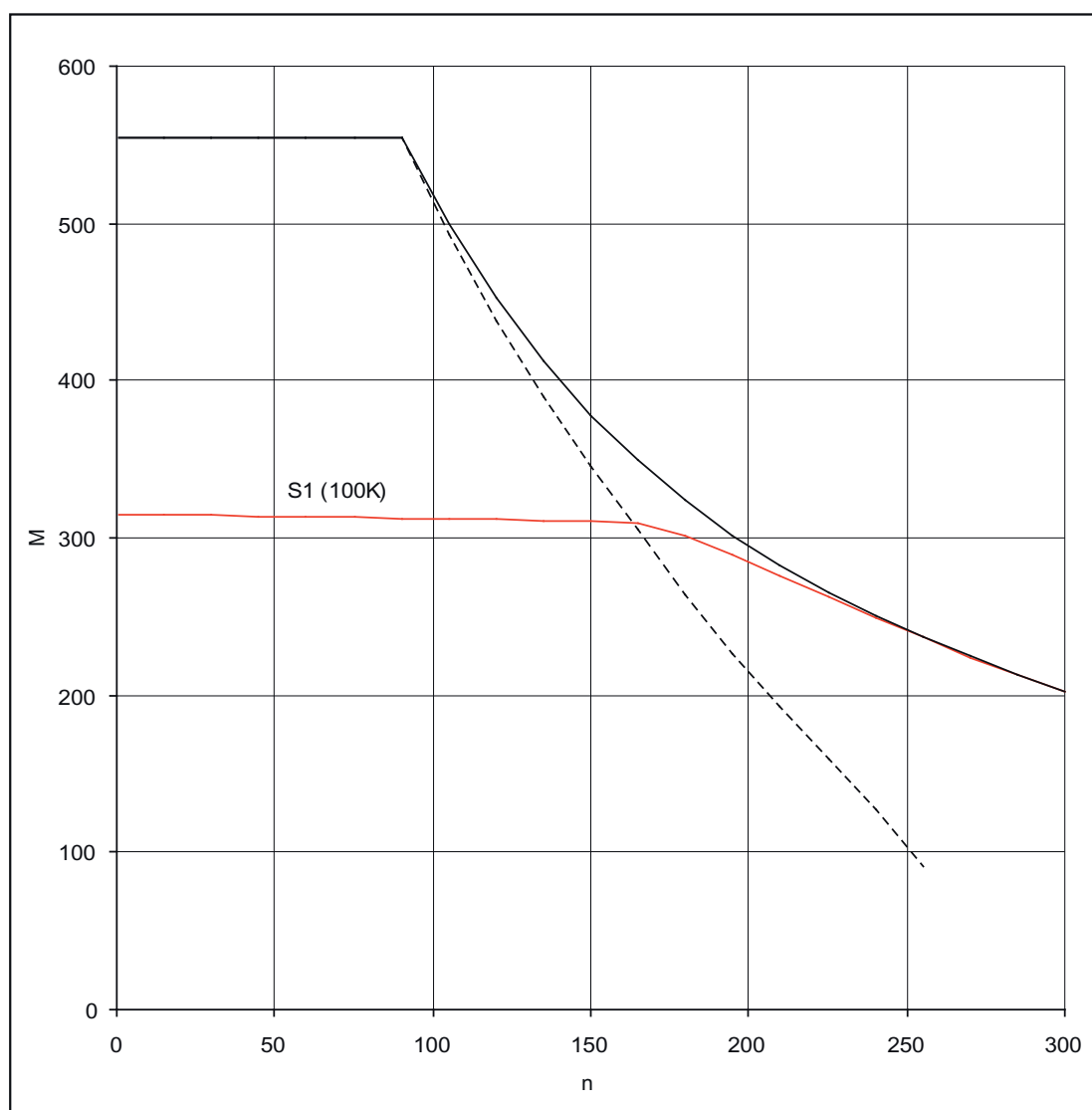
The drives are connected to the higher-level automation system via PROFIBUS.

6.1.4 3. Definition of load cycle, calculation of max. load torque, definition of motor_1FE2

3. Definition of the load case, calculation of the max. load torque, definition of the motor

The motor-specific characteristics provide the basis for defining the motor.

The characteristics define the torque characteristic with respect to speed and take into account the motor limit values based on the line supply voltage and the infeed function.



M in Nm; n in r/min

Figure 6-1 Characteristics for a synchronous motor

Procedure

1. Determine the load case that is specified by the application.
Use different characteristics for the different loads.
The following operating scenarios have been defined:
 - Duty cycle with constant switch-on duration
 - Duty cycle with varying switch-on duration
 - Free duty cycle
2. Determine the characteristic torque and speed operating points of the motor for the defined load.

3. Calculate the acceleration torque of the motor.
Add the load torque and the acceleration torque to obtain the maximum required torque.
4. Verify the maximum motor torque with the limiting characteristic curves of the motors.
The following criteria must be taken into account when selecting the motor:
 - Compliance with the dynamic limits.
All speed-torque points of the load must be below the relevant limiting characteristic curve.
 - Compliance with the thermal limits.
At an average motor speed, the effective motor torque must be below the S1 characteristic (continuous operation) during the load case.

Specifying the motor on the basis of the duty cycle

1. Using the characteristics, identify characteristic operating points of torque and speed with which you can specify the motor according to duty cycle.
2. Specify the duty cycle and the load case
3. Calculate the maximum motor torque
The maximum motor torque occurs during the acceleration phase. In the acceleration phase, the load torque and the torque required to accelerate the motor are added
4. Verify the maximum motor torque using the motor characteristic
5. Specify the motor
When specifying the motor, take into account the following criteria:
 - The dynamic limits must be observed. All torque-speed points of the load must be below the relevant limiting characteristic curves.
 - The thermal limits must be observed. On synchronous motors, the effective motor torque must be below the S1 characteristic (continuous duty). The effective motor torque is around the average motor speed resulting from the duty cycle.

Note

In the case of synchronous motors, note that the maximum permissible motor torque is reduced at higher speeds as a result of the voltage limiting characteristic.

To safeguard against voltage fluctuations, maintain a 10% distance from the voltage limiting characteristic.



Duty cycles with constant switch-on duration

For duty cycles with constant switch-on duration, specific requirements are placed on the torque characteristic as a function of the speed
e.g. $M = \text{constant}$, $M \sim n^2$, $M \sim n$ or P constant.

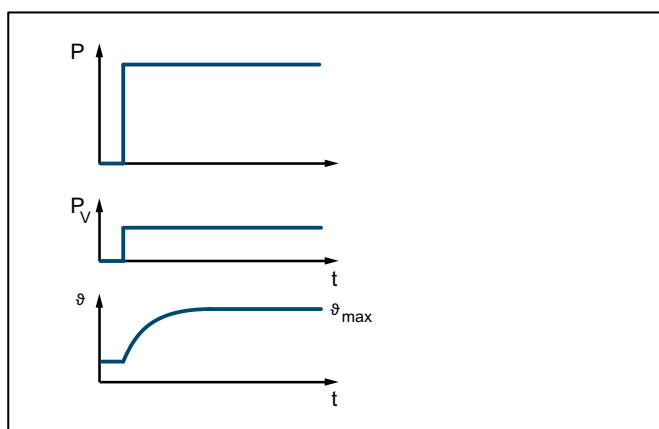


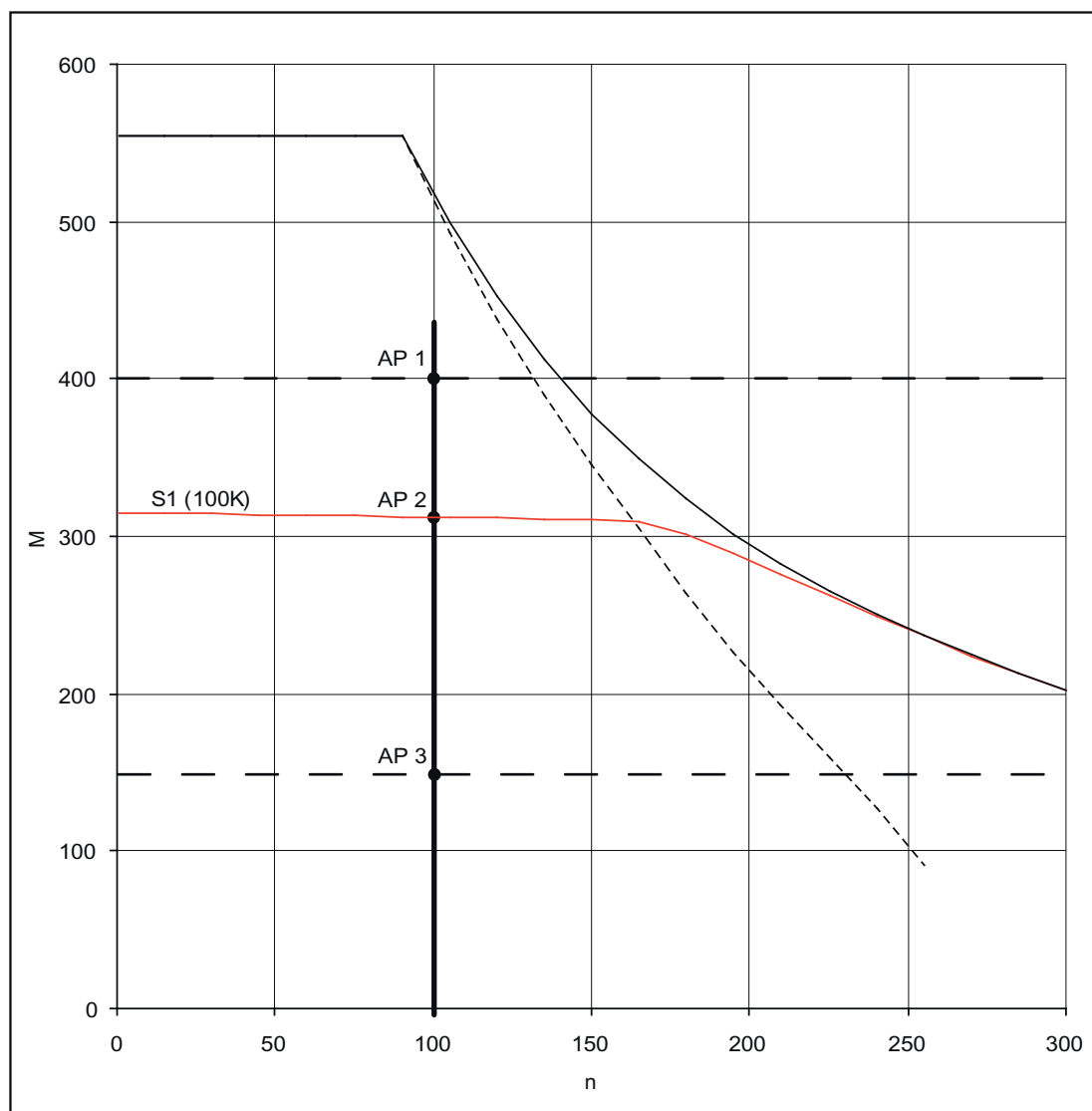
Figure 6-2 Duty type S1 MCC

These drives typically operate at a specific operating point. This stationary operating point is dimensioned for a base load.

The base load torque must lie on or below the S1 characteristic.

In the event of transient overloads (e.g. when accelerating) an overload has to be taken into consideration.

For synchronous motors, the peak torque must lie below the voltage limiting characteristic.



M in Nm; n in r/min

AP 1 Operate for e.g. 1 min

AP 2 Continuous operation (S1) for x h (with water cooling)

AP 3 Continuous operation (S1) for x h (without water cooling)

Figure 6-3 Selecting motors for load duty cycles with a constant switch-on duration

Note

Free convection must be possible for operation without water cooling.

Duty cycles with varying switch-on duration

As well as continuous duty (S1), standard intermittent duty types (S3) are also defined for duty cycles with varying switch-on duration. This involves operation that comprises a sequence of similar load cycles. Each of these load cycles encompasses a time with constant load and an off period.

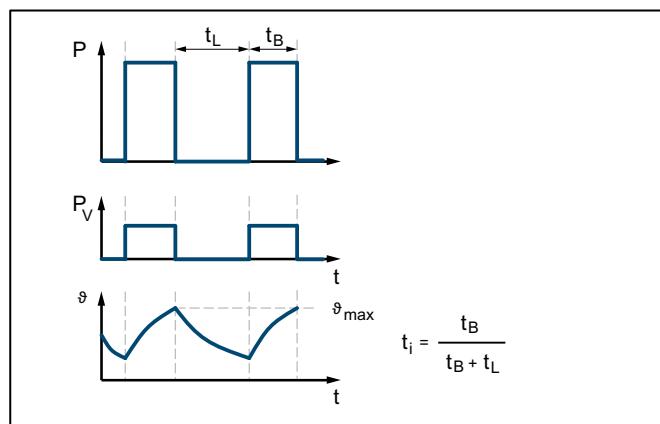


Figure 6-4 S3 duty (intermittent operation without influencing starting)

Fixed variables are generally used for the relative switch-on duration:

- S3 – 60 %
- S3 – 40 %
- S3 – 25 %

The corresponding motor characteristics are provided for these specifications.

The motor torque must lie below the corresponding thermal limiting characteristic of the motor.

Take into account an overload for duty cycles with varying switch-on duration.

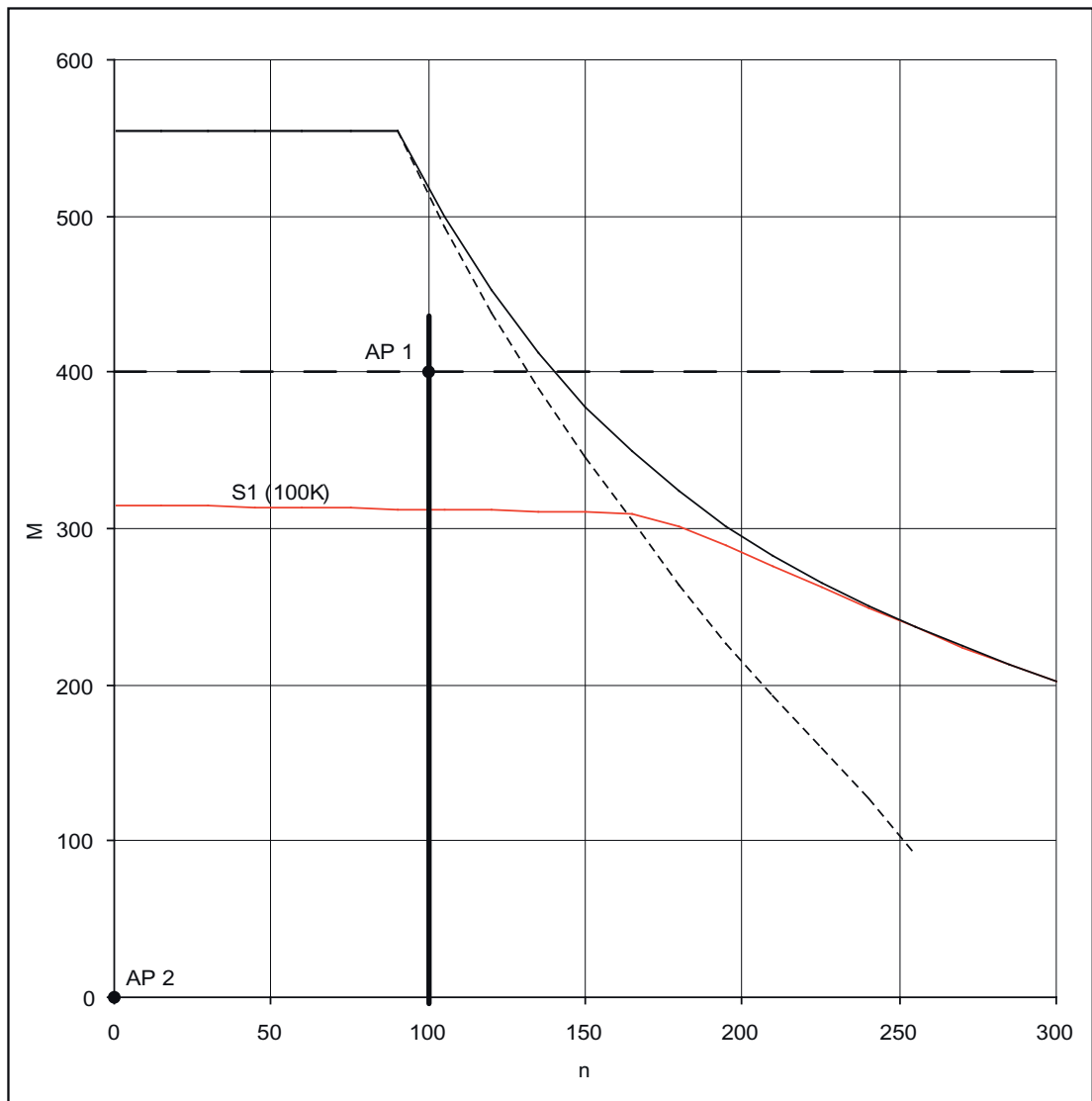
Note

For duty cycles in the field-weakening range, configure the motor using the SIZER for SIEMENS Drives engineering tool.

Use the following formulas for duty cycles outside the field-weakening range.

$$M_{\text{Mot, eff}} = \sqrt{\frac{\sum M_{\text{Mot, } i}^2 \cdot \Delta t_i}{T}}$$

$$n_{\text{Mot, medium}} = \frac{\sum n_{\text{Mot, k, A}} + n_{\text{Mot, k, E}} \cdot \Delta t_i}{\frac{2}{T}}$$



M in Nm; n in r/min

AP 1 = 400 Nm at 100 r/min

AP 2 = 0 Nm at 0 r/min

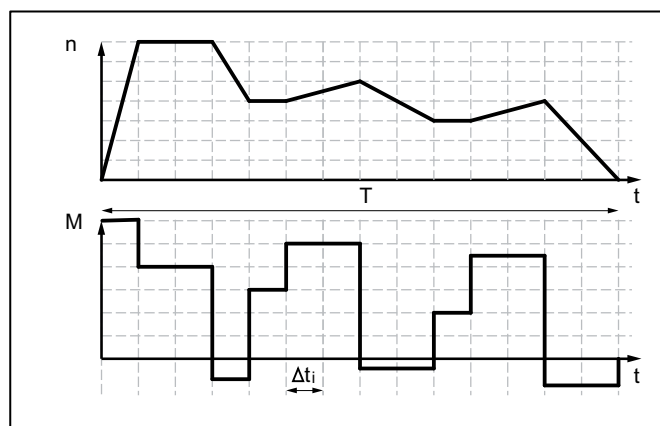
Figure 6-5 Selecting motors for duty cycles with varying switch-on duration

Note

A holding torque may be required when the motor is stationary. This holding torque must be taken into consideration for M_{rms} .
Self-locking gearboxes can be dispensed with by using the holding torque of the motor.

Free duty cycle

A duty cycle defines the characteristics of the motor speed and the torque with respect to time.



n	Speed	T	Cycle time, cycle duration
M	Torque	Δt_i	Time interval
t	Time		

Figure 6-6 free duty cycle

A load torque is specified for each time period. In addition to the load torque, the average load moment of inertia and motor moment of inertia must be taken into account for acceleration. A frictional torque that opposes the direction of motion can occur.

When calculating the load and/or accelerating torque to be provided by the motor, take account of the gear ratio and gear efficiency.

Note

For duty cycles in the field-weakening range, configure the motor using the SIZER for SIEMENS Drives engineering tool.

Use the following formulas for duty cycles outside the field-weakening range.

For the motor torque in a time slice Δt_i the following applies:

$$M_{\text{Mot, rms}} = (J_M + J_G) \cdot \frac{2\pi}{60} \cdot \frac{\Delta n_{\text{load, i}}}{\Delta t_i} \cdot i + (J_{\text{load}} \cdot \frac{2\pi}{60} \cdot \frac{\Delta n_{\text{load, i}}}{\Delta t_i} + (M_{\text{load, i}} + M_R) \cdot \frac{1}{i \cdot \eta_G}$$

Calculation of the motor speed

$$n_{\text{mot, i}} = n_{\text{load, i}} \cdot i$$

Calculating the rms torque

$$M_{\text{mot, rms}} = \sqrt{\frac{\sum M_{\text{mot, i}}^2 \cdot \Delta t_i}{T}}$$

Calculating the average motor speed

$$n_{\text{Mot, medium}} = \frac{\sum n_{\text{Mot, k, A}} + n_{\text{Mot, k, E}} \cdot \Delta t_i}{T}$$

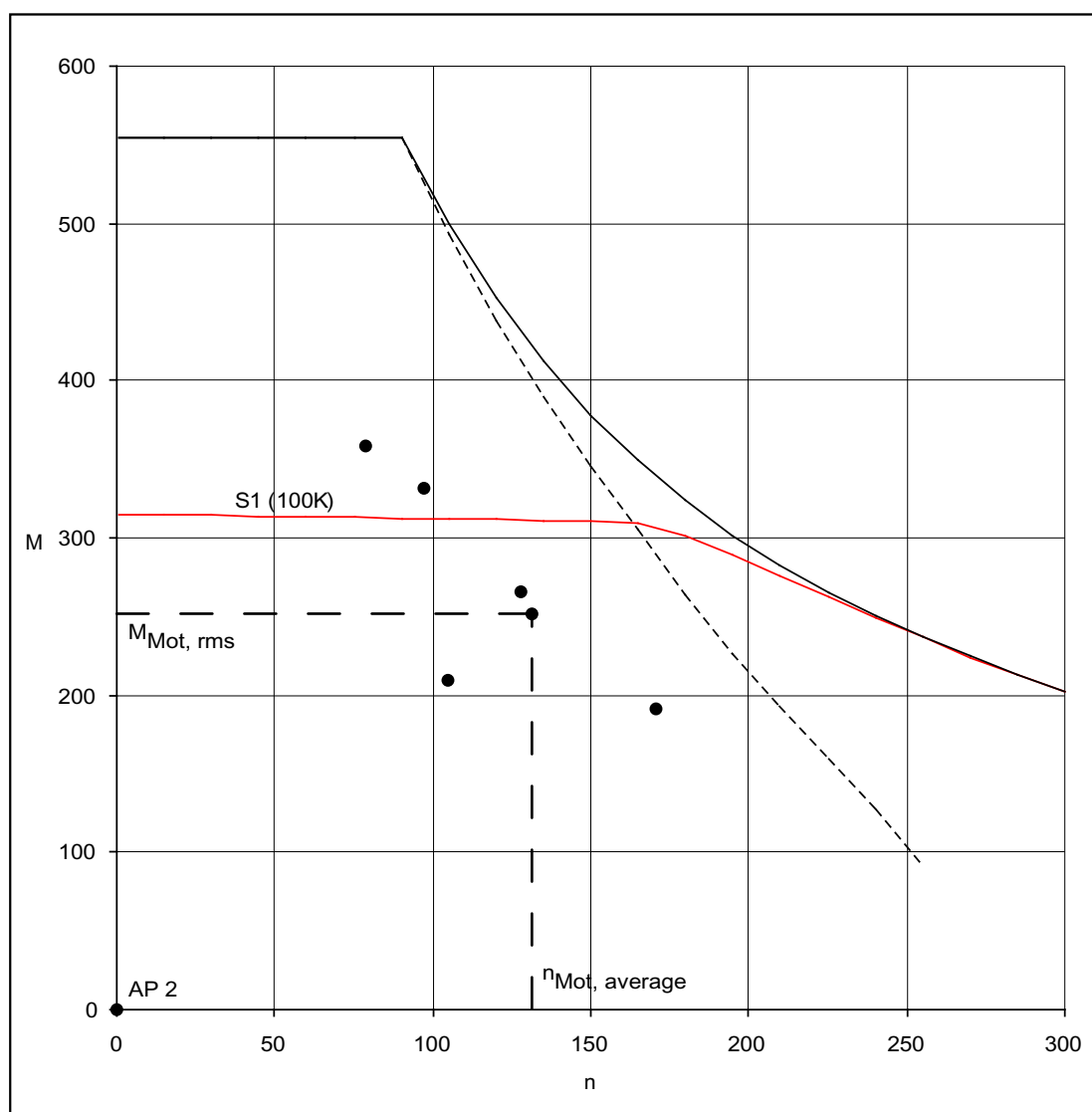
6.1 Configuration workflow

J_M	Motor moment of inertia
J_G	Gearbox moment of inertia
J_{load}	Load moment of inertia
n_{load}	Load speed
i	Gear ratio
η_G	Gearbox efficiency
M_{load}	Load torque
M_R	Frictional torque
T	Cycle time, clock cycle time
A; E	Initial value, final value in time slice Δt_i
t_e	Switch-on duration
Δt_i	Time interval

The rms torque $M_{mot, rms}$ must, for $n_{mot, average}$, lie below the S1 characteristic.

The maximum torque M_{max} is produced when the drive is accelerating and for both synchronous and induction motors must lie below the voltage limiting curve/ M_{max} characteristic.

As a result, the motor is dimensioned as follows:



M in Nm; n in r/min

Figure 6-7 Selecting a motor according to the duty cycle

Motor selection

When configuring according to the duty cycle with constant switch-on duration with overload, the overload current is calculated in relation to the required overload torque.

The calculation rules depend on,

- which motor type (synchronous motor or induction motor) and
- which operating case (duty cycles with constant or with different switch-on duration) applies.

Procedure

1. Select a motor that precisely fulfills the operating conditions
2. Determine the motor current at base load

6.1 Configuration workflow

3. Check that the thermal limits are maintained
4. Define the other properties of the motor. Configure the motor options.



6.2 Help when configuring

6.2.1 SIEMENS Product Configurator

The SIEMENS Product Configurator supports you when configuring your drive.

You will find the following quickly and easily in the SIEMENS Product Configurator

- Technical data
- Characteristics
- dimension drawings
- 2D/3D CAD data

The SIEMENS Product Configurator supports you when creating system documentation regarding project-specific information.

Note

The 3D model in the SIEMENS Product Configurator is a simplified representation that does not show every detail.

You can find further information on the Internet at SIEMENS Product Configurator (www.siemens.com/SPC):

6.2.2 DT CONFIGURATOR

The DT CONFIGURATOR supports you when configuring your drive.

In the DT CONFIGURATOR - you can simply and quickly find

- Technical data
- Characteristics
- dimension drawings
- 2D/3D CAD data

The DT CONFIGURATOR supports you when generating plant/system documentation regarding project-specific information.

Note

The 3D model in the DT CONFIGURATOR is a simplified representation that does not show all of the details.

You can find further information on the Internet at DT CONFIGURATOR (<http://siemens.de/dt-konfigurator>):

6.2.3 SIDIM configuration tool

The SIDIM configuration tool supports you in the calculation of the drive of SIMOTICS M-1FE2 built-in motors.

You can find additional information that you can download in the Internet at SIDIM (<https://support.industry.siemens.com/cs/ww/de/view/25297647>).

6.2.4 SIZER configuration tool

Overview

The SIZER calculation tool supports you in the technical dimensioning of the hardware and firmware components required for a drive task.

SIZER supports the following configuration steps:

- Configuring the power supply
- Designing the motor and gearbox, including calculation of mechanical transmission elements
- Configuring the drive components
- Compiling the required accessories
- Selection of the line-side and motor-side power options

The configuration process produces the following results:

- A parts list of components required (Export to Excel)
- Technical specifications of the system
- Characteristic curves
- Comments on system reactions
- Installation information of the drive and control components
- Energy considerations of the configured drive systems

You can find additional information that you can download in the Internet at SIZER (<https://support.industry.siemens.com/cs/document/54992004/sizer-for-siemens-drives?dti=0&pnid=13434&lc=en-WW>).

Preparing for use

7.1 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.

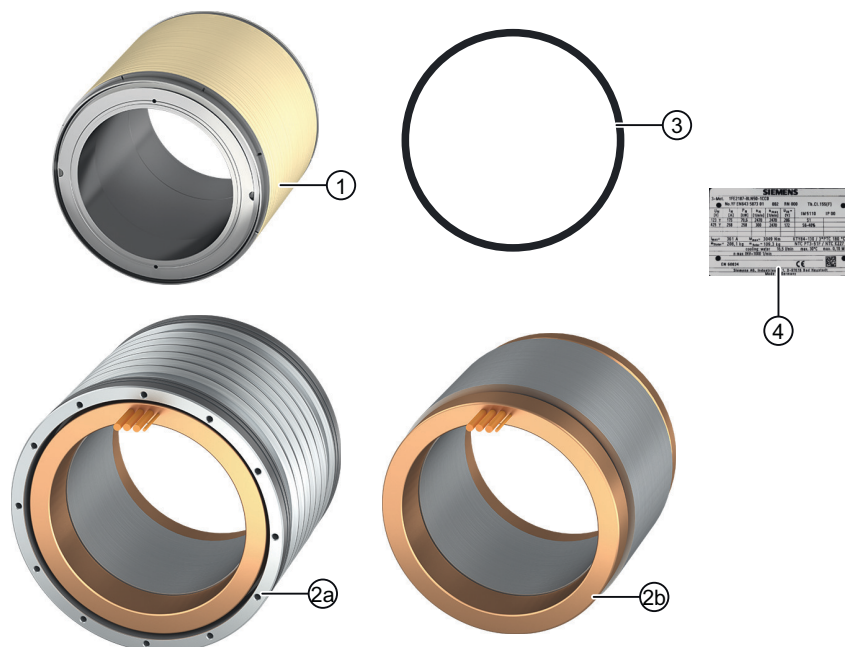
- Please pay attention to the handling notes on the packaging when the motor is delivered.

Table 7-1 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.

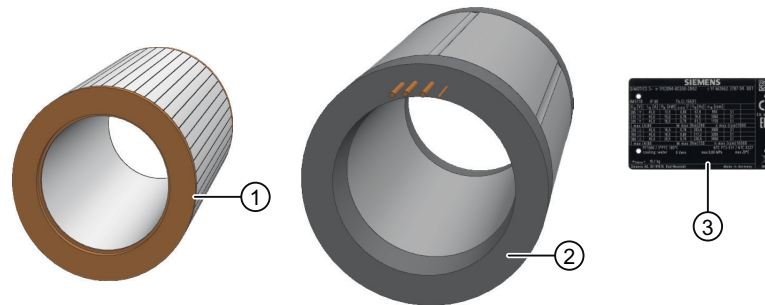
Scope of delivery of the synchronous version of the 1FE2



- | | |
|-----------------|--|
| 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 7-1 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 7-2 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.

7.2 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:

- $v_{rms} < 0.2 \text{ mm/s}$
- Max. temperatures: $-15 \text{ °C} \dots 70 \text{ °C}$
- Relative humidity: 5% ... 85%

Identification of the storage location

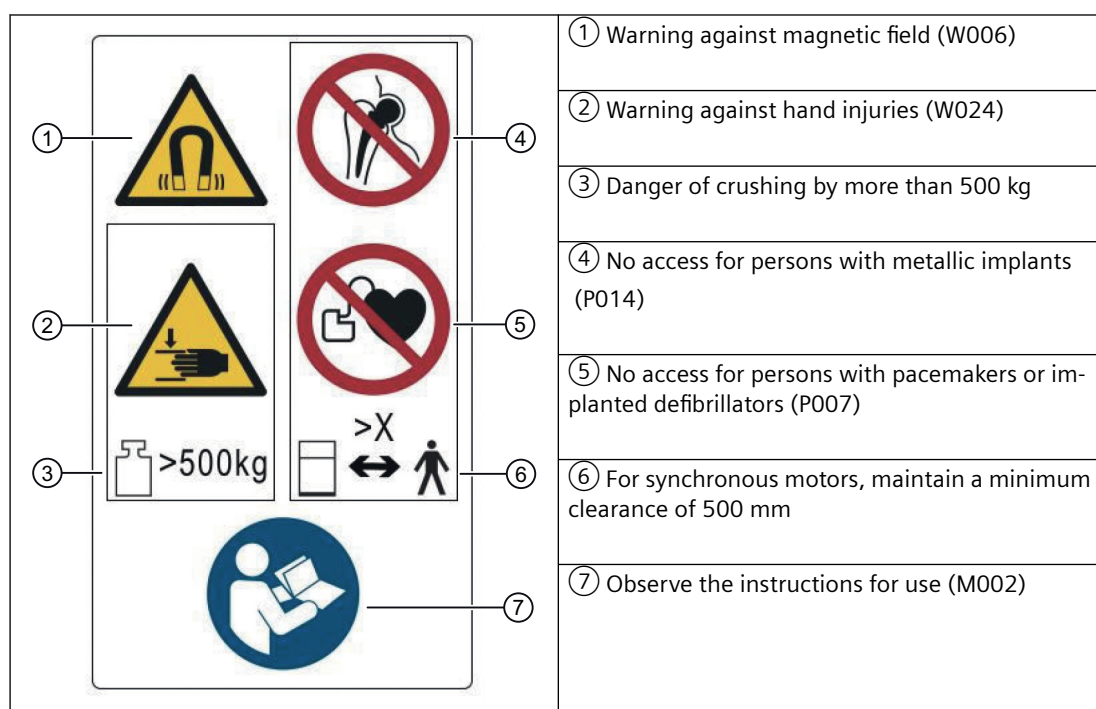
Mark the storage location clearly with warning notices as per the packaging of the built-in motors.

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.



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.

Installation

8.1 Safety notes

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 8-1 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 8-2 Prohibition signs according to ISO 7010 and their meaning

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



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 "Important product information" 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

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)

NOTICE

Data loss due to strong magnetic fields

If you are located close to the rotor, any magnetic or electronic data storage media as well as electronic devices that you might be carrying could be damaged.

- Do not wear or carry any magnetic or electronic data storage media (e.g. credit cards, USB sticks, floppy disks) and no electronic devices (e.g. watches) if you are close to a rotor!

8.2 Installation and removal of the rotor

8.2.1 Tools and resources

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

- A draft-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.

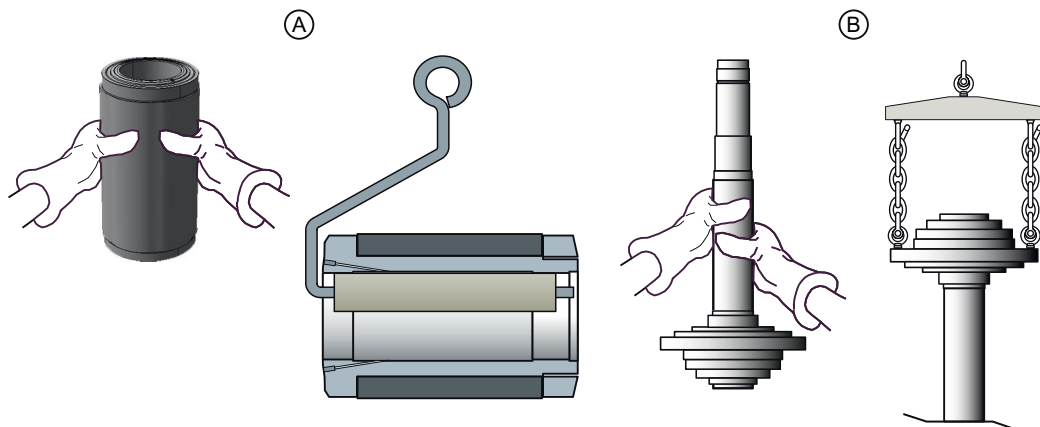
Joining with the heat process (shrink fit)	Joining with the cold process (stretch fit)
• Hot-air oven with temperature monitoring - suitable for installation temperatures ¹⁾ • Oven volume appropriate for the rotor type, placement of the oven in the immediate vicinity of the workplace • Air-conditioned 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 installation can be found in the Table "Installation temperatures" in the associated Hardware Installation Manual.

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 (the weights are specified on the rating plate)
- 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 8-1 Examples for transporting components

Instructions for installing the rotor

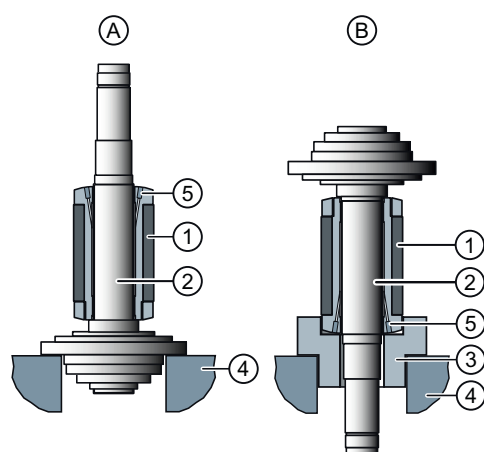
Note

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:

8.2 Installation and removal of the rotor



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 8-2 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

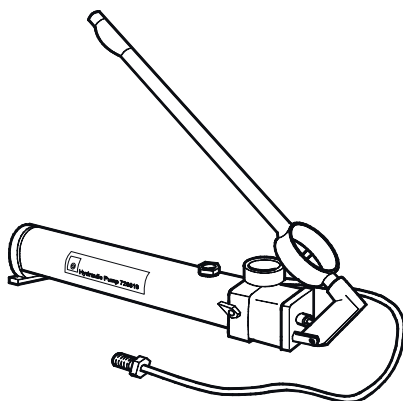
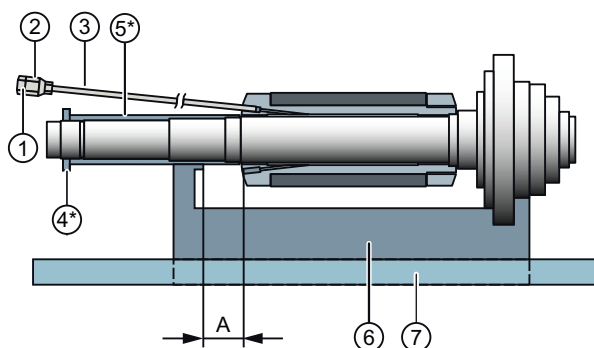


Figure 8-3 Oil pressure hand pump e.g. type SKF 1077454

- 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 8-4 Equipment for relieving stress on the rotor with sleeve and for removing it

- Pressure oil for relieving stress, e.g. SKF LHM 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 concentricity 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

The following section only applies to rotors for the asynchronous version.

Mechanical machining of the rotor

Note

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

Before mounting the rotor core by 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.

8.2.2 Installation overview for asynchronous rotors (brief description)

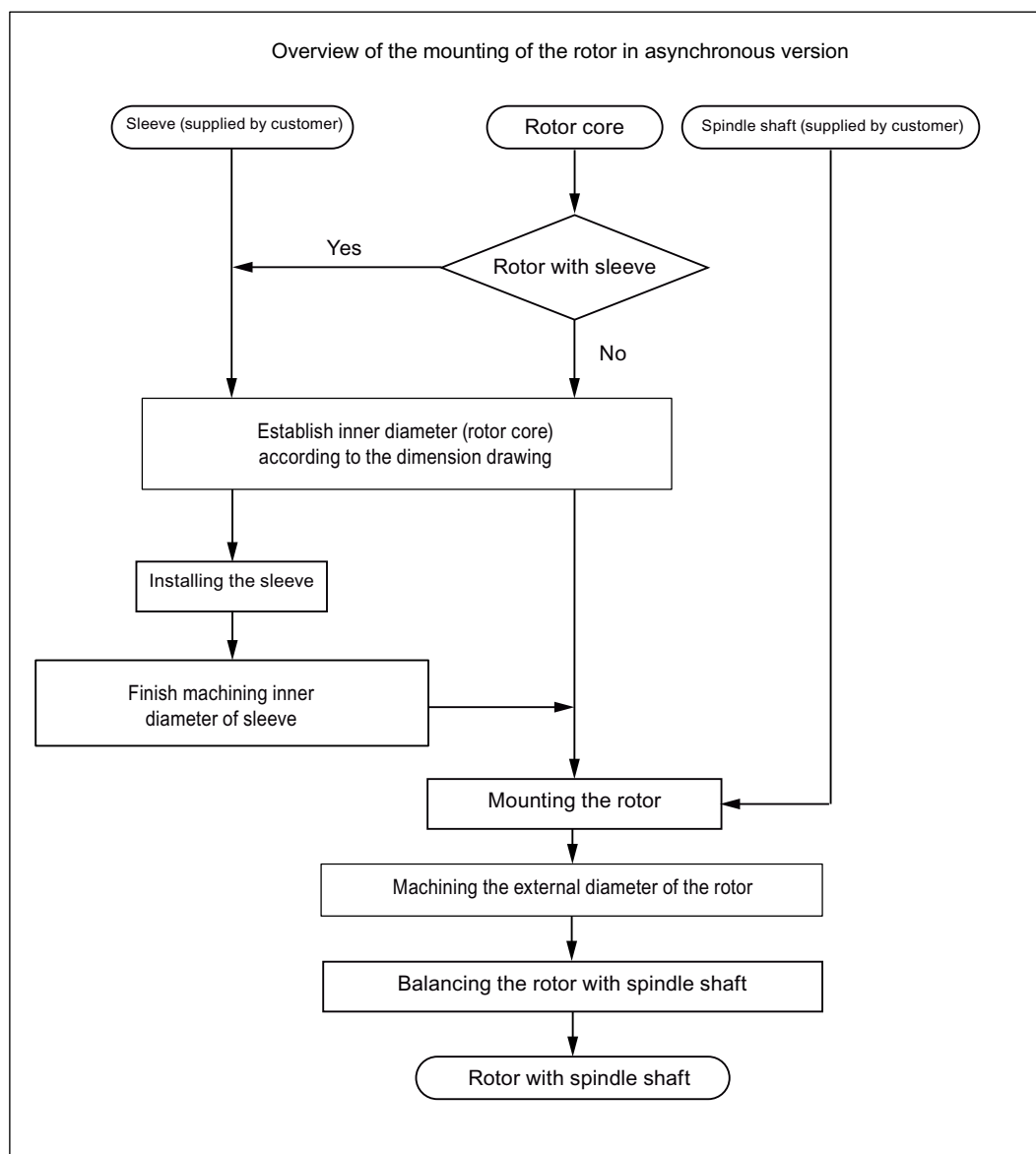


Figure 8-5 Sequence for mounting the rotor in asynchronous version

8.2.3 Balancing the asynchronous version

On the asynchronous version, you balance a rotor without its sleeve.

Rotor without sleeve

- The rotor is not pre-balanced.
- The "spindle shaft - rotor without sleeve" system must be balanced, e.g. with balancing disk. Use the balancing planes, which must be appropriately provided on the spindle axis.

Note

You must not remove material from the keeper ring

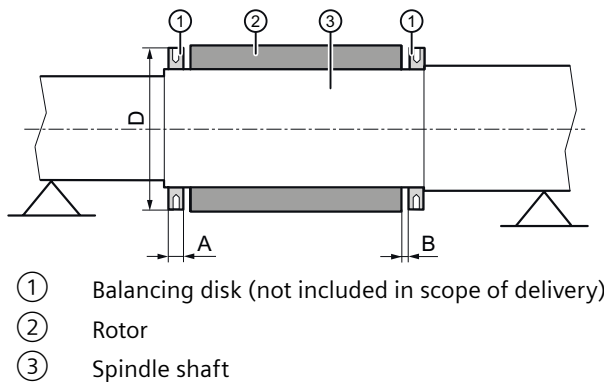


Figure 8-6 Recommended balancing disks for rotors without sleeve; dimensions A, B and D, refer to the following table

Table 8-3 Dimensions A, B and D for the recommended balancing disks

Motor type	A in mm	B in mm ¹⁾	D in mm
1FE109□-8□□□	12	3	125
1FE114□-8□□□	12	3	190

¹⁾ Minimum clearance B between the rotor and external balancing disk.

Mounting dimensions

The mounting dimensions can be taken from the dimension drawings, see Chapter Dimension drawings for the 1FE2 (<https://support.industry.siemens.com/cs/ww/en/view/109783766>).

A minimum shaft wall thickness is specified in the area of the interference fit. These can be taken from the dimension drawings.

8.2.4 Installation overview for synchronous rotors (brief description)

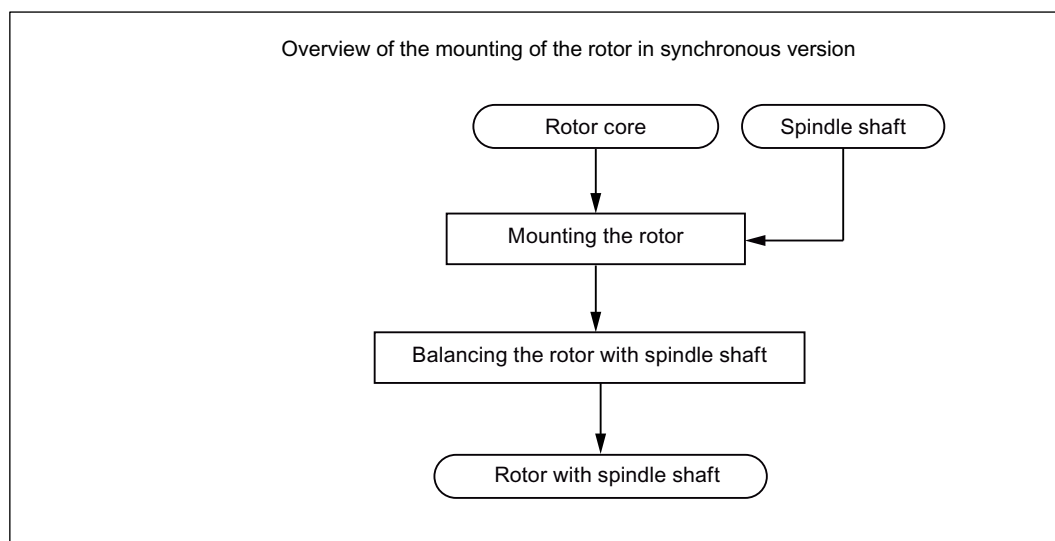


Figure 8-7 Sequence for mounting the rotor in synchronous version

8.2.5 Balancing the synchronous version

On the synchronous version, you balance a rotor with its sleeve.

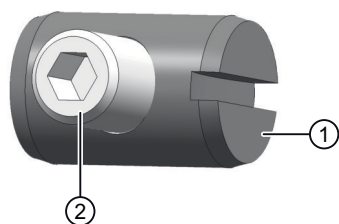
Rotor with sleeve

The rotor can be supplied in two balance states.

Rotor unbalanced	Rotor pre-balanced
Default	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 levels.	Balancing weights already mounted by the manufacturer can be replaced or supplemented with other balancing weights.
Balancing the "rotor-spindle shaft" system with the balancing levels available on the rotor in one operation.	Finely balancing the "rotor-spindle shaft" system with the balancing levels available on the rotor.

The balancing weights are included in the scope of supply of the rotor (positive balancing).

8.2 Installation and removal of the rotor



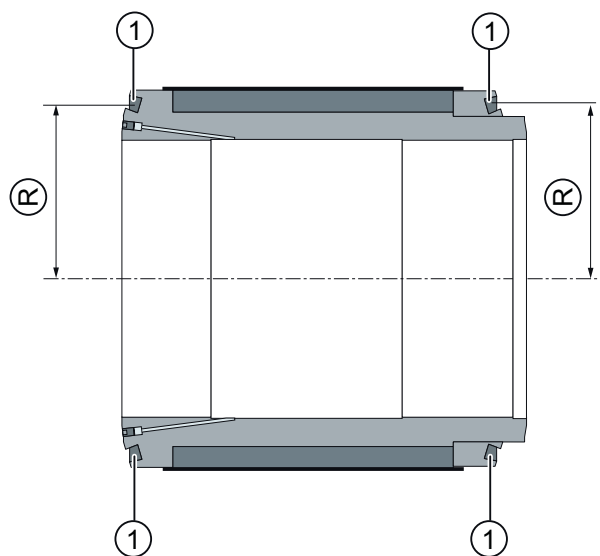
- 1 Balancing weight
- 2 Hexagon socket-head screw 2.5 mm

Figure 8-8 Balancing weight

Possible imbalance compensation

With the enclosed balancing weights, additional compensation of at least the following unbalances is possible depending on the motor type:

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



- ① Encircling groove for accepting the balancing weights
- R Balancing radius

Figure 8-9 Rotor data for balancing

Balancing radius: $W = 128.2 \text{ mm}$

Mass of the balancing weight: approximately 4.1 g

Length of the balancing weight: approximately 12 mm

Tightening torque: 2.5 Nm

NOTICE**Danger from loosening of the balancing weights due to ineffective screw retainer**

If the balancing weights already screwed in place by the manufacturer loosen (in the case of the pre-balanced rotor, for example), the safeguard against unintentional loosening is destroyed.

Retightening is impermissible due to the ineffective retainer.

- Replace the loosened balancing weights with new balancing weights.
- Newly installed balancing weights can be loosened, moved and re-tightened as desired within 2 hours. After 2 hours, the screw retainer becomes effective. If loosened after the period of 2 hours has expired, the balancing weights must again be replaced with new balancing weights.

If you require further balancing weights, you can order these with the article number 340.40002.01 from the Service Center.

Note

The spindle manufacturer is responsible for selecting and verifying the balancing system.

8.2.6 Removing the rotor (brief description)

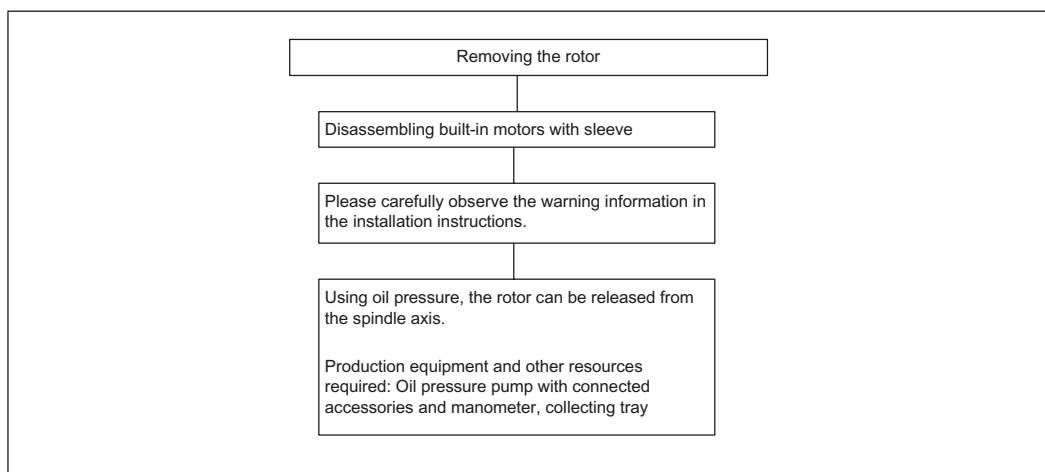


Figure 8-10 Procedure for removing the rotor

8.3 Installing the stator

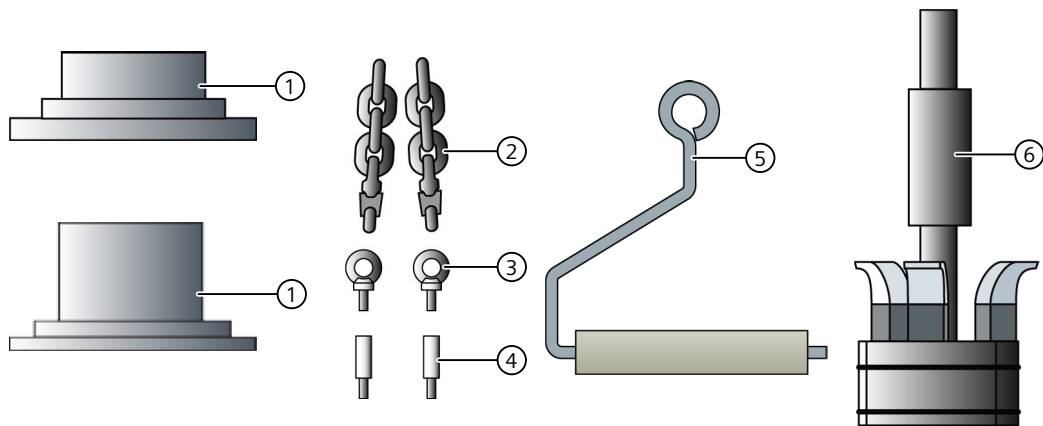
8.3.1 Production equipment, assembly tools and other resources

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
show
n

Anti-corrosion agent for steel surfaces

Additional installation, production and auxiliary equipment

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

8.3.2 Installing the stator (brief description)

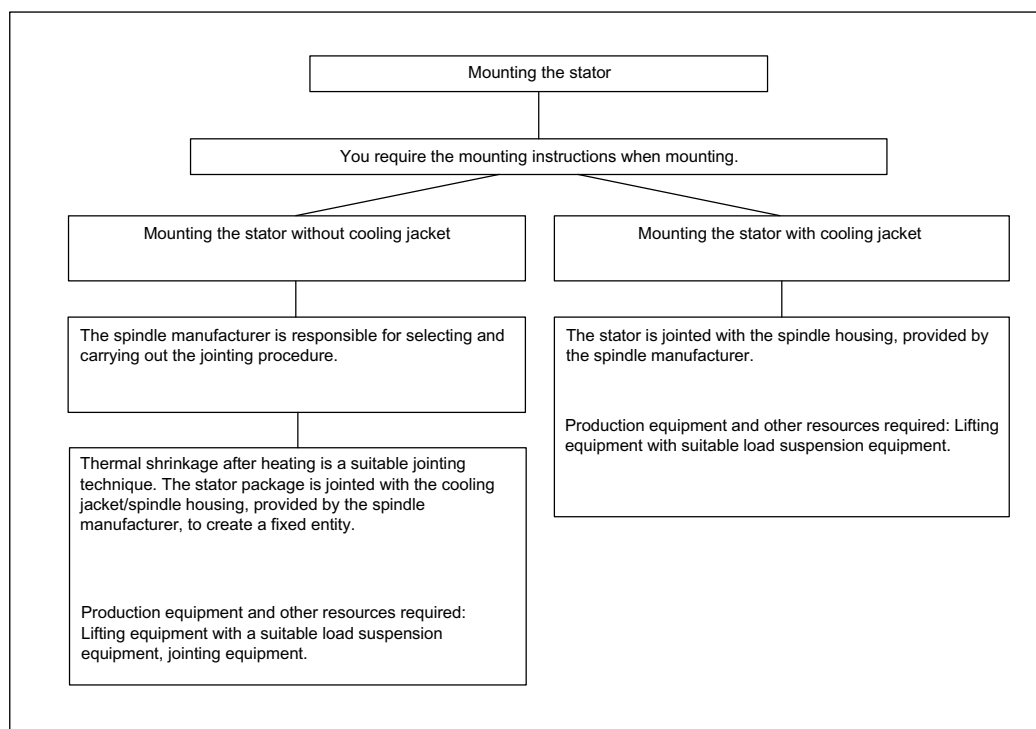


Figure 8-11 Procedure for mounting the stator

8.4 Installing the motor spindle

8.4.1 Installing the motor spindle (brief description)

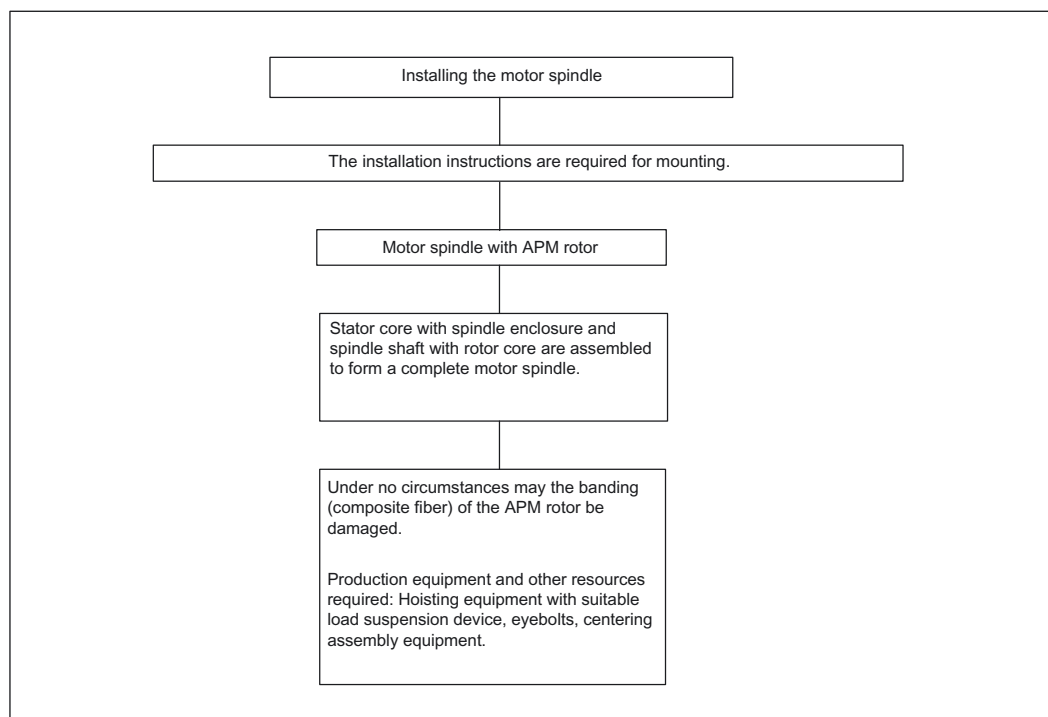


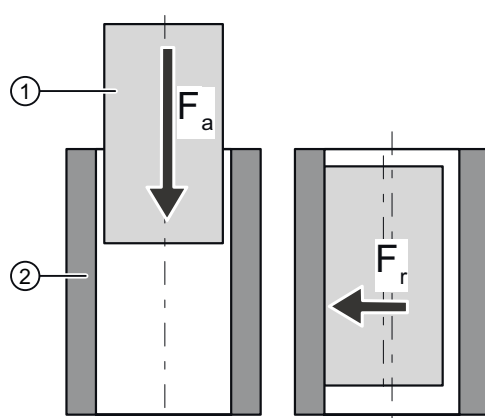
Figure 8-12 Procedure for installing the motor spindle

8.4.2 Magnetic forces that occur on synchronous motors

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 8-13 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 8-4 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.

8.4 Installing the motor spindle

Connecting

9.1 Connecting the water cooling

Note

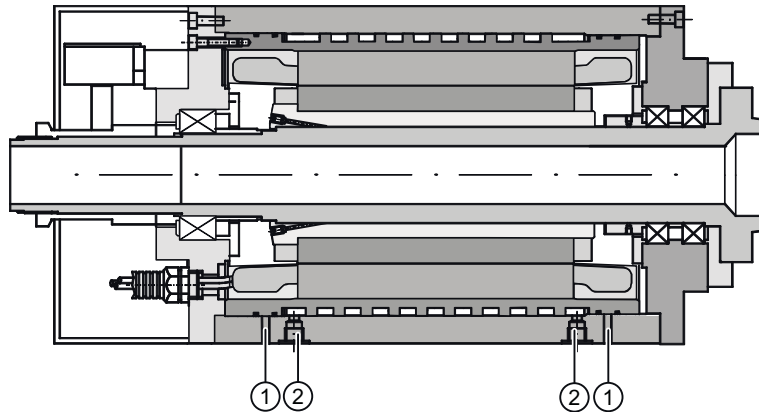
Lay the cooling water supply intake and drain outlet connections according to project requirements.

Preconditions

- Ensure that the cooling water complies with the required cooling water specification. See Chapter "Cooling (Page 66) "
- 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



9.2 Electrical connection

9.2.1 Connection technology

The following equipment is provided by the spindle manufacturer:

- Terminal 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

9.2.1.1 Connection cables

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

- Power connection with identification 1U1, 1V1, 1W1, 2U1, 2V1, 2W1
- 2 cables for temperature sensor (one of which is a reserve), two-wire cable

Note**Electrical connection via terminal box**

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.

The following electrical connections are made by the spindle manufacturer:

1. Power connection
2. Internal protective ground cable as protection from dangerous shock currents
3. Connecting the temperature sensor
4. Encoder connection

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

Note

The maximum length of the connecting cables is 50 m with and without VPM.

9.2.1.2 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 mm ²	Outer cable diameter in mm	Cable cross-section per phase in mm ²	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

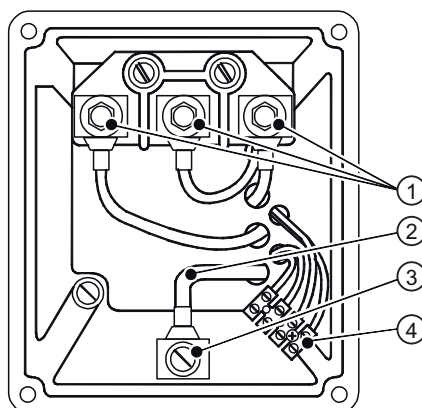
²⁾ Notes on using cables are provided in VDE 0298, Part 3 and Part 4

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 9-1 Terminal boxes with permanent (internal) star connection (example)

Note

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

9.2.1.3 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 mm ²	Outer cable diameter in mm	Cable cross-section per phase ³⁾ in mm ²	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

Motor type	Cable length l			
	l = 0.5 m ¹⁾		l = 1.5 m ²⁾	
	Cable cross-section per phase ³⁾ in mm ²	Outer cable diameter in mm	Cable cross-section per phase ³⁾ in mm ²	Outer cable diameter in mm
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

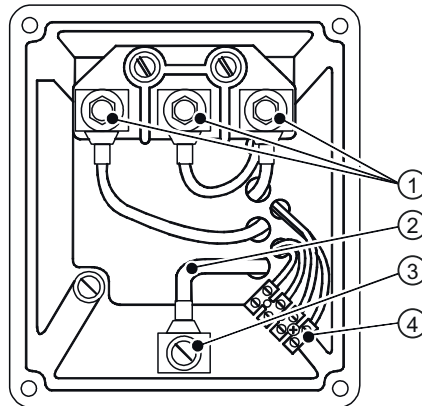
³⁾ For large cable cross-sections, provide an elongated hole as bushing, where necessary.

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 9-2 Terminal box (example)

Note

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

9.2.1.4 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.

9.2.1.5 Terminal box

The terminal box is not included in the scope of supply.

Note

The terminal box must have as a minimum, degree of protection IP54 according to DIN IEC 60034-5.

- Install the corresponding seals between the spindle box and terminal box, as well as at the terminal box cover.
-

9.2.1.6 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).
-

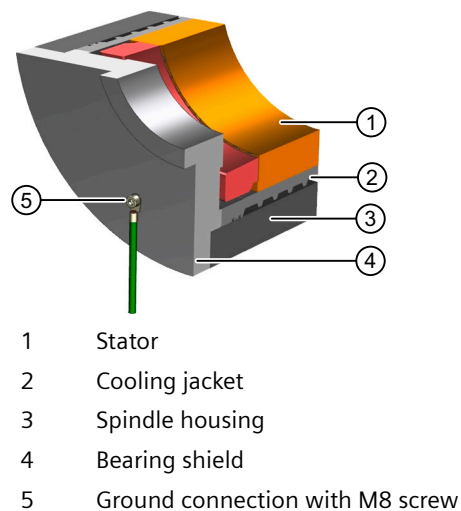


Figure 9-3 Recommended grounding

9.2.1.7 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.

9.2.2 Voltage limitation (applies to synchronous motors only)

Note

EMF (Electro Motive Force) > 820 V

In a fault situation, a voltage limitation of the DC-link voltage on the converter is required. The voltage limit depends on the maximum EMF (induced phase-to-phase voltage peak > 820 V).

Voltage limiting is required if you operate the motor with a speed $n > n_{\max \text{ inv}}$.

If the power fails (line voltage) at a speed $> n_{\max \text{ inv}}$ of the motor, or the converter pulses are canceled as a result of the power failure, then the synchronous motor feeds a high voltage back into the DC link. The voltage protection detects a DC link voltage that is too high (DC > 820 V) and short-circuits the 3 motor feeder cables. The energy remaining in the motor is converted into heat as a result of the short-circuit and causes the motor to quickly brake.

The VPM (Voltage Protection Module) is used as voltage limiter for SINAMICS S120.

Operation without voltage limiting

NOTICE

Danger of motor damage caused by exceeding the maximum speed

If you operate a motor with an EMF > 820 V without voltage limiting, then you must reduce the maximum permissible speed to $n_{\max \text{ inv}}$.

- Never operate the motor without voltage limitation.
- Do not exceed the maximum permissible speed.

Calculate the maximum permissible speed for operation without voltage limitation using the following equation:

$$n_{\max \text{ inv}} = 820 \text{ V} \cdot 1000 / k_E \cdot \sqrt{2}$$

$n_{\max \text{ inv}}$ / rpm - maximum permissible speed without voltage limiting

k_E / V for 1000 rpm = voltage constant,

Voltage limitation with the Voltage Protection Module (VPM)

The Voltage Protection Module (VPM) is not included with the 1FE2 built-in motors and must be ordered separately, see Catalog NC 62.



WARNING

Danger to life caused by the incorrect use of the VPM

The VPM can be used up to a maximum motor EMF of 2 kV. The use of motors with higher EMC can cause death or severe injury.

- Deploy the VPM only for motors with an EMF greater than 800 V to maximum 2 kV.
- The connection of motors with an EMF > 2 kV on the VPM is prohibited.

Integration and system prerequisites of the VPM

Integration

The VPM is located between the motor and the drive system. The maximum distance to the drive system is 1.5 m.

No switching elements may be added to the U, V, W connection cables between the drive system, VPM and motor.

Connect the VPM with shielded motor supply cables.

System requirements:

SINAMICS S120 booksize (6SL31xx-xxxxx-xxxx3)

Technical data

Table 9-1 Technical data VPM

Designation	VPM 120	VPM 200	VPM 200 DYNAMIC
Article number for metric gland	6SN1113-1AA00-1JA1	6SN1113-1AA00-1KA1	6SN1113-1AA00-1KC1
Dimensions H x W x D [mm]	300 · 150 · 180	300 · 250 · 190	300 · 250 · 260
Drive system connection (cable cross-section)	U3, V3, W3; M50 (max. 50 mm ²)	U3, V3, W3; 2 x M50 (max. 2 x 50 mm ²)	U3, V3, W3; 2 x M50 (max. 2 x 50 mm ²)
Motor side connection (cable cross-section)	U4, V4, W4; M50 (max. 50 mm ²)	U4, V4, W4; 2 x M50 (max. 2 x 50 mm ²)	U4, V4, W4; 2 x M50 (max. 2 x 50 mm ²)
Cable lug	Crimp-type cable lug M6	Crimp-type cable lug M8	Tubular cable lug M8, 90° angled
Signaling contact 1 x M16 Max. cable cross-section	1 x NC contact (floating) 24 VDC ≤ 1.5 mm ²	1 x NC contact (floating) 24 VDC ≤ 1.5 mm ²	1 x NC contact (floating) 24 VDC ≤ 1.5 mm ²
Rated current	≤ 3-phase 120 VAC _{rms}	≤ 3-phase 200 VAC _{rms}	≤ 3-phase 200 VAC _{rms}
Max. permissible short-circuit current	90 A	200 A	200 A
Short-time loading	2 x I _N for approx. 500 ms	3 x I _N for approx. 500 ms	3 x I _N for approx. 500 ms
Connection length, drive system	≤ 1.5 m	≤ 1.5 m	≤ 1.5 m
Connection length, motor side	≤ 50 m	≤ 50 m	≤ 50 m
Power loss · Normal operation · Short-circuit operation with I _N	approx. 0 W approx. 360 W (max. 2 min)	approx. 0 W approx. 1.1 kW (max. 2 min)	approx. 0 W approx. 1.1 kW (max. 2 min)
Tripping voltage	830 VDC +/- 1 %	830 VDC +/- 1 %	830 VDC +/- 1 %
Degree of protection	IP20	IP20	IP20
Ambient temperature	0 ... 50 °C	0 ... 50 °C	0 ... 50 °C
Installation altitude	1000 m above sea level (otherwise power reduction)	1000 m above sea level (otherwise power reduction)	1000 m above sea level (otherwise power reduction)
Vibratory load (in accordance with DIN EN 60721)	Up to 1 g	Up to 1 g	Up to 1 g
Shock load (in accordance with DIN EN 60721)	Up to 10 g	Up to 10 g	Up to 10 g
Max. permissible braking duration	≤ 2 min	≤ 2 min	≤ 2 min
Weight	approx. 6 kg	approx. 11 kg	approx. 13 kg

Capacity of the drive system with VPM

To ensure in a fault situation that a defined DC-link voltage is not exceeded and the voltage gain speed is limited, the DC link must have a minimum capacitance.

The DC-link minimum capacitance is calculated using the following equation:

$$C_{\text{Dlinkmin}} = I_{\text{rated motor}} \cdot 33.33$$

$$C_{\text{Dlinkmin}} / \mu\text{F}$$

$$I_{\text{rated motor}} / \text{A}$$

Consider the calculated DC-link capacitance when configuring the system.

Permitted braking duration with VPM

The braking duration for a terminal short-circuit (with VPM) can be approximately calculated as follows:

$$t_{Br} = K \cdot 10^{-6} \cdot J_{tot} \cdot n^2$$

t_{Br} = braking duration in s

K = brake constant $\times 10^6$ in $(s \cdot \min^2)/(kg \cdot m^2)$

J_{tot} = total moment of inertia ($J_{rot} + J_{ext}$) in kgm^2

J_{rot} = rotor moment of inertia

n = maximum speed in rpm

Note

Ensure that brake time t_{Br} 120 seconds is not exceeded.

Selecting the VPM and determining the brake constant K

Table 9-2 Selecting the VPM; brake constant K

Motor type ¹⁾	VPM		Brake constant (K)	
	1 power section	2 power sections	1 power section	2 power sections
1FE2182-8LNxx-xCC1	1 x VPM 120	2 x VPM 120	0.9	1.6
1FE2182-8LHxx-xCC1	1 x VPM 200 ²⁾	2 x VPM 120	0.7	1.1
1FE2183-8LNxx-xCC1	1 x VPM 200 ²⁾	2 x VPM 120	0.8	1.3
1FE2183-8LHxx-xCC1	1 x VPM 200 ²⁾	2 x VPM 200 ²⁾	0.8	0.9
1FE2184-8LNxx-xCC1	1 x VPM 200 ²⁾	2 x VPM 120	0.7	1.1
1FE2184-8LKxx-xCC1	1 x VPM 200 ²⁾	2 x VPM 200 ²⁾	0.8	0.8
1FE2184-8LHxx-xCC1	VPM cannot be deployed	2 x VPM 200 ²⁾	0.7	0.8
1FE2185-8LNxx-xCC1	1 x VPM 200 ²⁾	2 x VPM 120	0.6	1
1FE2185-8LLxx-xCC1	1 x VPM 200 ²⁾	2 x VPM 200 ²⁾	0.7	0.8
1FE2185-8LHxx-xCC1	VPM cannot be deployed	2 x VPM 200 ²⁾	0.7	0.7
1FE2186-8LNxx-xCC1	1 x VPM 200 ²⁾	2 x VPM 120	0.5	0.9
1FE2186-8LMxx-xCC1	1 x VPM 200 ²⁾	2 x VPM 200 ²⁾	0.6	0.8
1FE2186-8LHxx-xCC1	VPM cannot be deployed	2 x VPM 200 ²⁾	0.6	0.6

Motor type ¹⁾	VPM		Brake constant (K)	
1FE2187-8LNxx-xCC1	1 x VPM 200 ²⁾	2 x VPM 200 ²⁾	0.6	0.8
1FE2187-8LHxx-xCC1	VPM cannot be deployed	2 x VPM 200 ²⁾	0.5	0.6

¹⁾ Only those motors that must be operated with VPM are listed in the table.

²⁾ You can use VPM 200 or VPM 200 DYNAMIC.

Wiring diagram

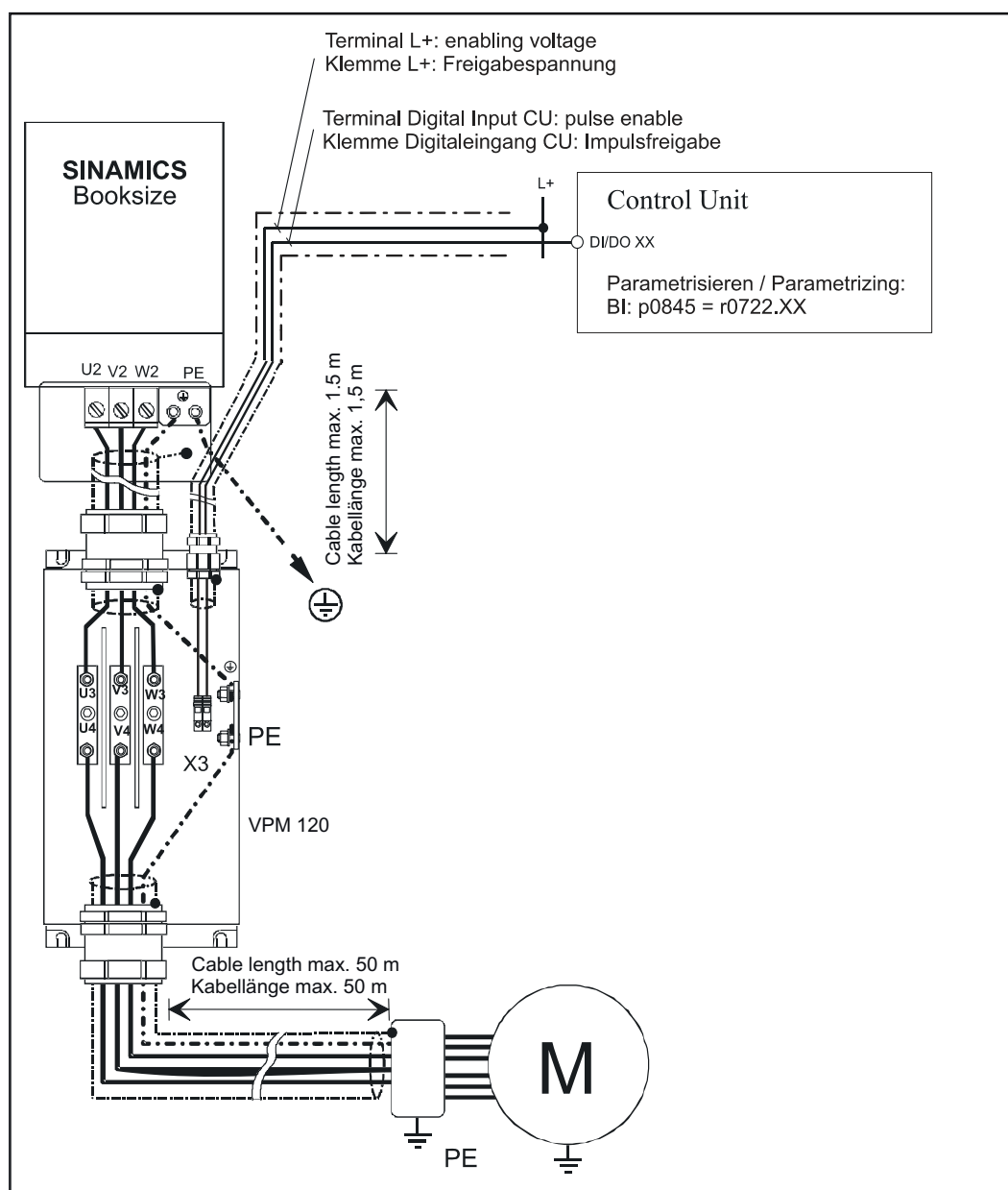


Figure 9-4 VPM120 connection diagram

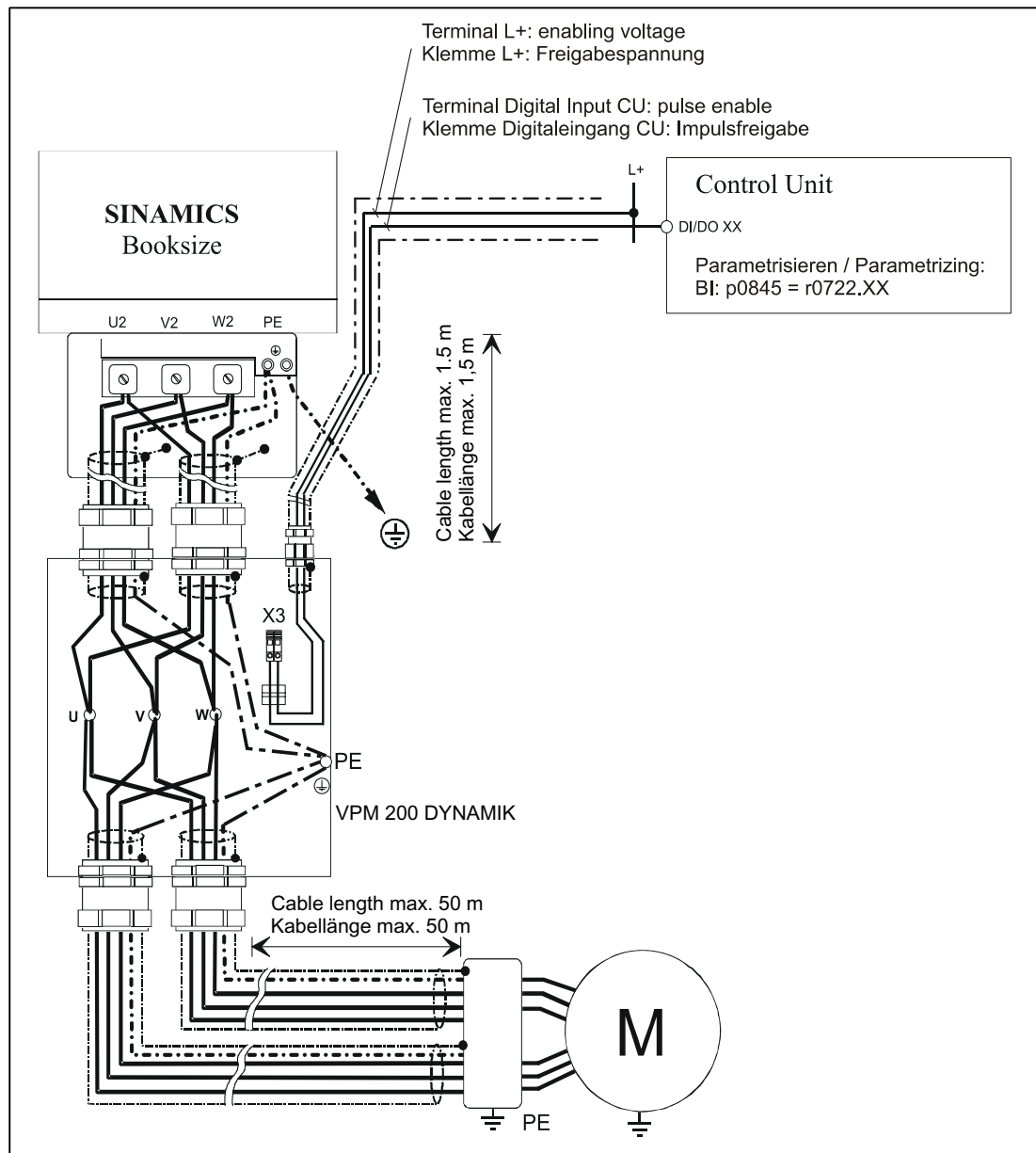


Figure 9-5 Wiring diagram VPM 200/VPM 200 DYNAMIC

9.2.3 Version and operating modes

9.2.3.1 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-device closed-loop control or
- the SINAMICS OA Support Package with the Technology Extension SERVCUP

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-device closed-loop control:

Option 1	Option 2
Deployment of "SERVCUP" OA software	Application created by the user
Encoder evaluation on the master, encoder information is transferred internally to the device via DRIVE-CLiQ	The encoder information must be made available to the master and device (encoder switch is required)
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 mutual error monitoring for the master and device	The user application must ensure the correct fault response within the master-device group

Both procedures are described in the following chapters.

Note

For a master-device arrangement (each partial winding connected to its own power unit), operation with only one winding system or an asymmetrical current distribution between master and device is not possible or can be ruled-out 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 $f_p = 4 \text{ kHz}$.

Note

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

Overview of connections with one power unit

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

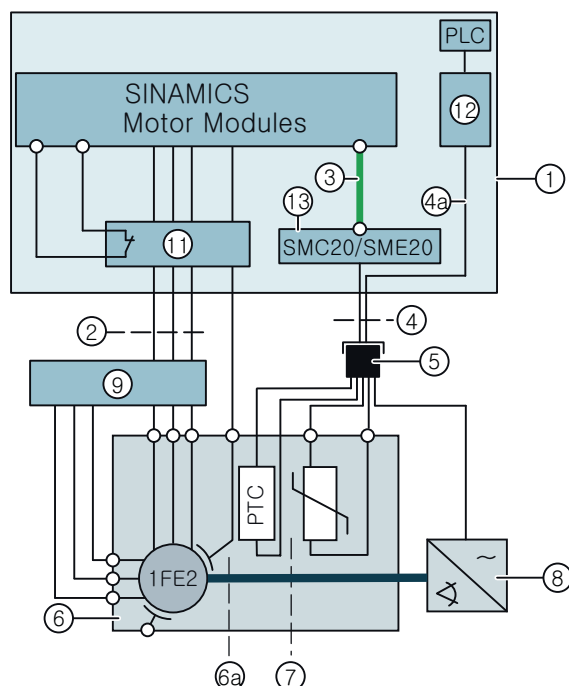
The circuit diagram contains information about wiring and connecting the motor winding. The circuit diagram is provided in the motor packaging.

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.

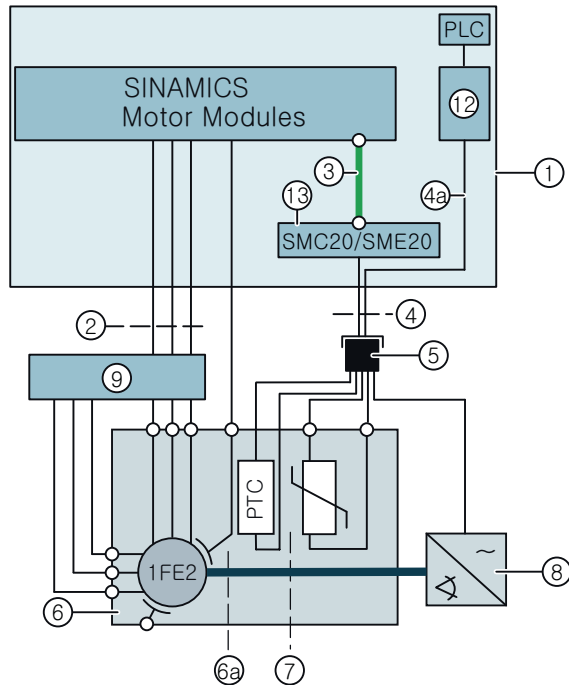
Circuit diagram for motor 1FE2 via SMC20/SME20 and VPM to SINAMICS



- 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 9-6 Circuit diagram for 1FE2 motor with VPM

Circuit diagram for 1FE2 motor via SMC20/SME20 without VPM to SINAMICS



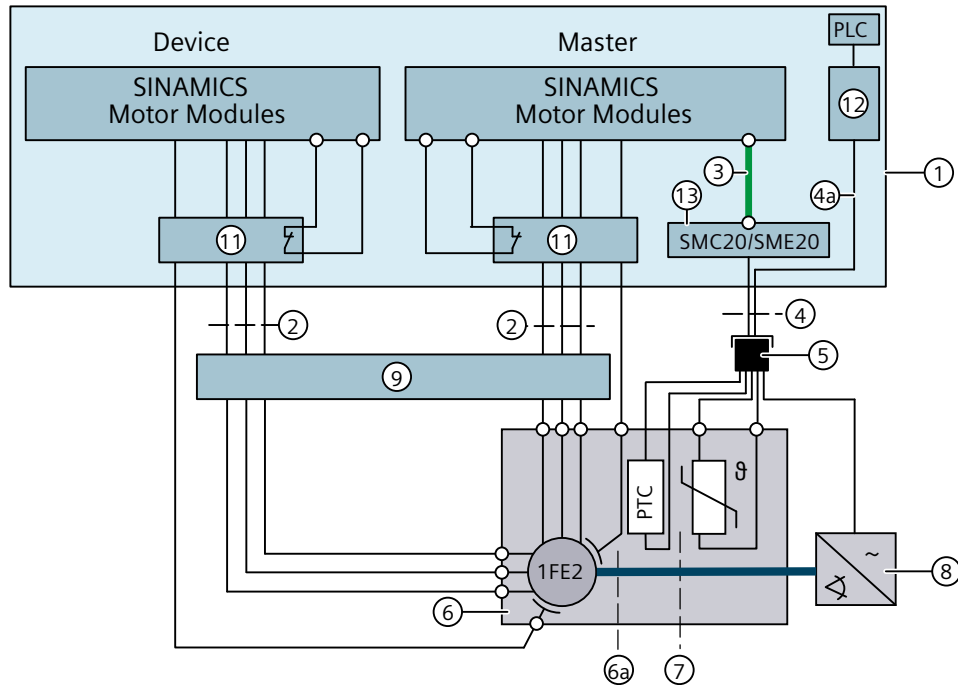
- 1 Control cabinet
- 11 Not available in this circuit
- 12 Tripping unit for evaluating the PTC triplet
- 13 SMC20/SME20, encoder on the motor side, connector kits, 6FX2003-0SA12, 12-pin
- 2 Power cable
- 3 DRIVE-CLiQ cable, trailable or conditionally trailable
- 4 Signal cable, trailable or only conditionally 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 9-7 Circuit diagram for 1FE2 motor without VPM

Connection overview for use of two power sections with the "SERVCOUP" OA software with VPM

Note

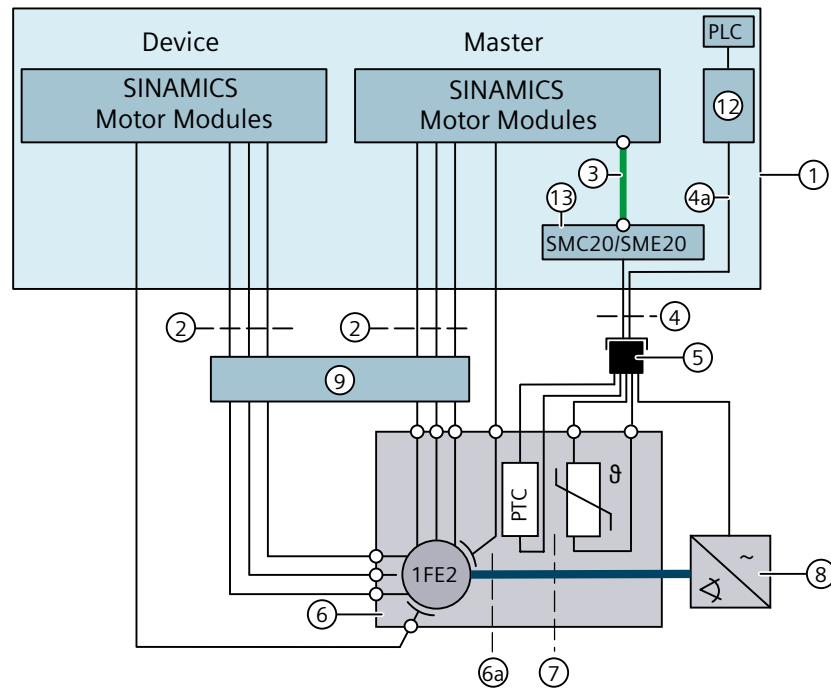
The following circuit applies only to 1FE2 with $I_n > 200$ A for a parallel circuit on two booksize Motor Modules.



- 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 9-9 Connection overview with OA software and VPM

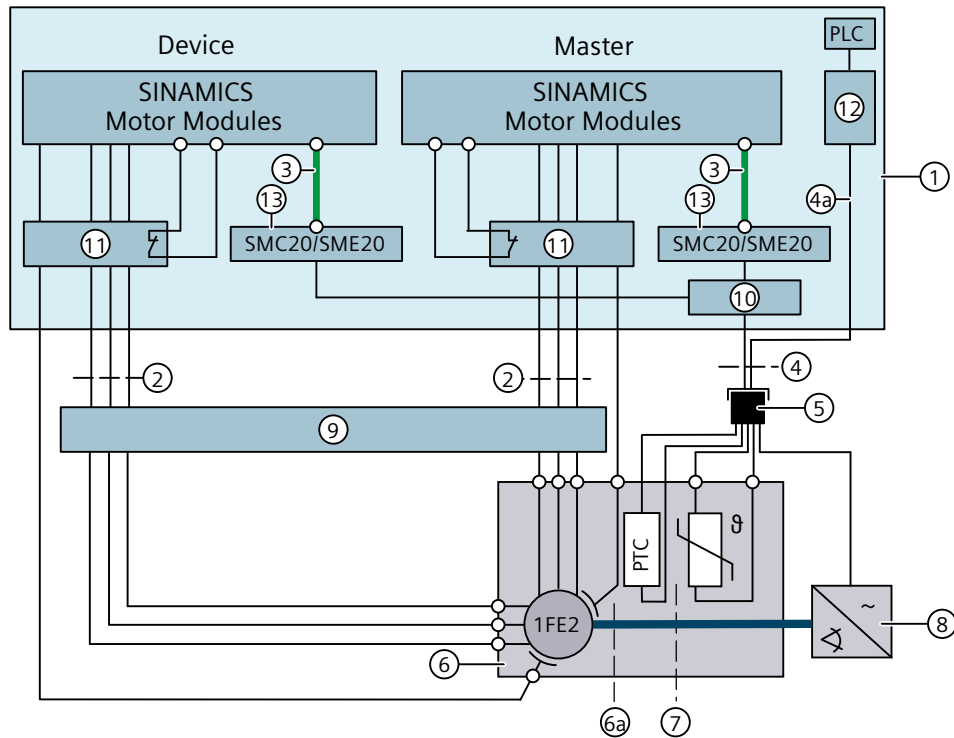
Connection overview for use of two power sections with the "SERVCOU" OA software without VPM



- | | |
|----|---|
| 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 9-10 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 9-11 Connection overview with VPM and encoder switch

9.2.3.2 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.

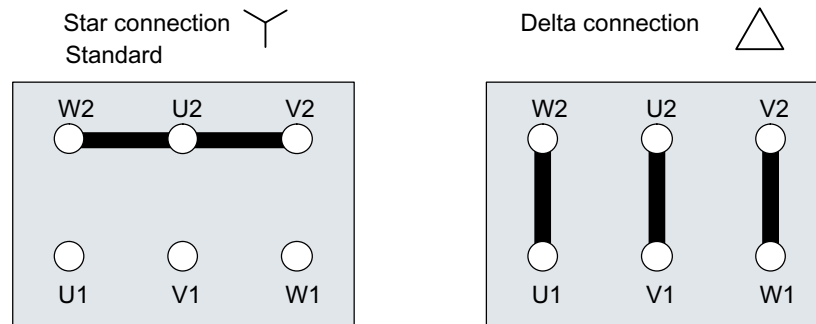


Figure 9-12 Fixed star/delta connection in the terminal box

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

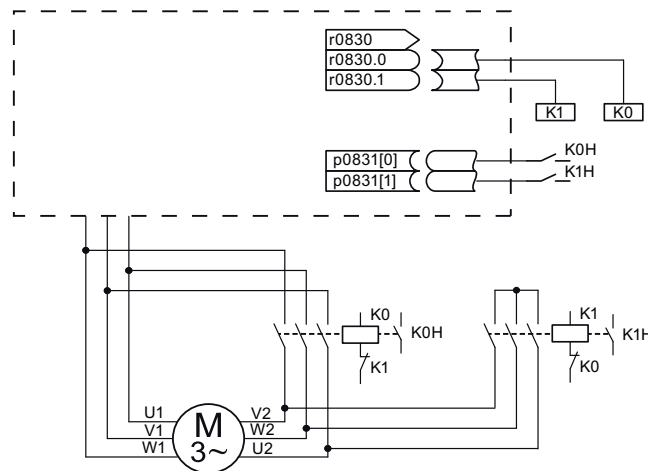


Figure 9-13 Example of star-delta changeover

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 ($r0051 = \text{requested data set}$).
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

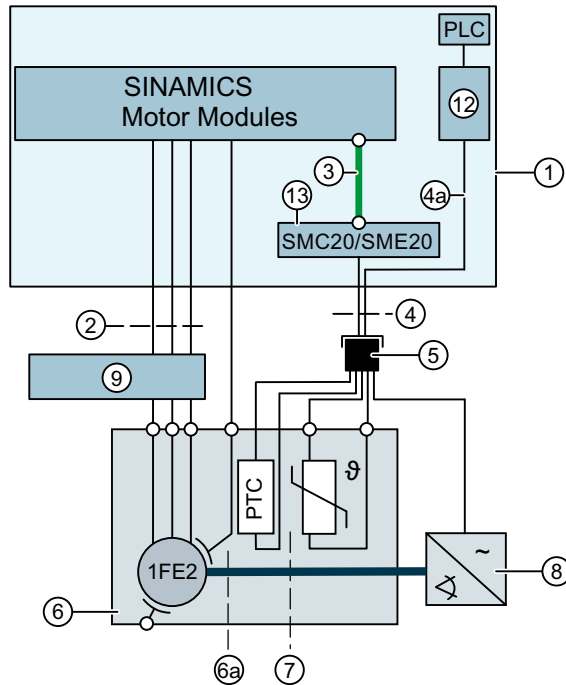
The following chapter presents the circuit diagrams for possible connections to the SINAMICS S120 for the asynchronous version.

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.

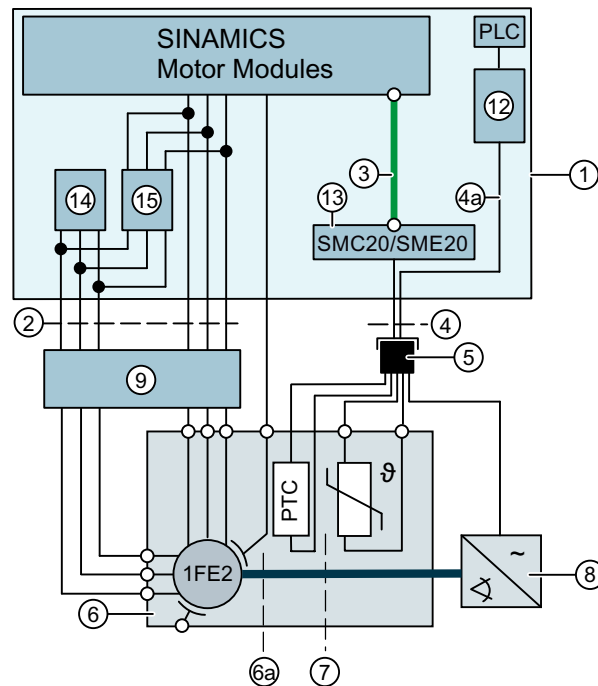
Circuit diagram for the 1FE2 in asynchronous version and fixed star connection to SINAMICS



- 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 9-14 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 9-15 1FE2 asynchronous version connection overview for star-delta connection via contactors to SINAMICS

9.2.3.3 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 master-device 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	Designation	Variable	Values	Units
Sinamics S120				
	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	$\times 31.25 \mu\text{s}$
	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	$I_{\text{Rotor position}}$	30	%
P0329	SINAMICS current pole position identification current pole position identification	$I_{\text{Rotor position}}$	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	$V_{\text{eff verk}}/1000\text{min}^{-1}$
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	$k_{\text{Trelu??}}$	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	$V_{\text{eff verk??}}$
P0307	Rated motor power	P_n	105.5	kW
P0321	Maximum motor voltage DC	$U_{\text{max DC}}$	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 9-16 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-device operation (data per winding):

Parameter	Designation	Total	Master	Device	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	Device	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)

Parameter	Designation	Total	Master	Device	Index
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)
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 device coupling input		0	31745:0:3	1)

- 1) Differentiation between master-device essential
2) Differentiation between master-device without meaning
3) Parameter equality for master and device
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-device 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.

Technical data and characteristics

10.1 Explanations

Built-in motors must be continually cooled independent of the operating mode.

Note

The characteristic curves and specified values are valid for water cooling and a cast winding design.

Note

Depending on the mechanical design of the motor spindle, various levels of frictional losses occur (e.g. bearing losses, eddy losses, losses at rotary glands).

The level of friction losses is not known to the manufacturer of the built-in motors.

The motor powers and torques specified in this documentation refer to the values that the rotor of the built-in motor transfers to the spindle.

To calculate the net power output at the shaft, subtract the total friction losses from the specified values.

10.2 Technical data

10.2.1 Technical data for the synchronous version

Note

The values specified in the following tables are valid for the synchronous version with water cooling.

Motor article number	Rated torque M_N / Nm			Rated current I_N / A			Maxi- mum current $I_{\max}^{1)}/A$	Rated speed n_N / rpm	Maxi- mum speed $n_{\max}/rpm$
	S1	S6-40%	S6-25%	S1	S6-40%	S6-25%			
16-pole built-in motors									
1FE2182-8LN□□-□CC1	650	925	1124	73	108	134	156	500	2400
1FE2182-8LH□□-□CC1	640	916	1111	145	214	265	315	1000	4200
1FE2183-8LN□□-□CC1	840	1197	1458	95	140	174	195	500	2400
1FE2183-8LH□□-□CC1	840	1190	1451	189	278	346	390	1000	4200
1FE2184-8LN□□-□CC1	1010	1437	1751	114	168	209	235	500	2400
1FE2184-8LK□□-□CC1	1010	1437	1749	190	280	348	390	800	4010
1FE2184-8LH□□-□CC1	1000	1425	1736	225	333	414	470	1000	4200
1FE2185-8LN□□-□CC1	1180	1646	2012	132	194	242	275	500	2420
1FE2185-8LL□□-□CC1	1180	1665	2031	189	278	346	390	700	3440
1FE2185-8LH□□-□CC1	1160	1653	2011	250	368	457	520	1000	4200
1FE2186-8LN□□-□CC1	1370	1941	2362	154	227	282	315	500	2400
1FE2186-8LM□□-□CC1	1380	1936	2352	192	283	351	390	600	3000
1FE2186-8LH□□-□CC1	1350	1932	2353	290	424	527	590	1000	4200

Motor article number	Rated torque M_N / Nm			Rated current I_N / A			Maximum current $I_{\max}^{1)}/A$	Rated speed n_N / rpm	Maximum speed $n_{\max}/rpm$
	S1	S6-40%	S6-25%	S1	S6-40%	S6-25%			
1FE2187-8LN□□-□□CC1	1530	2156	2626	190	280	348	390	500	2670
1FE2187-8LH□□-□□CC1	1510	2151	2618	325	479	595	670	1000	4200

1) The maximum current $I_{\max}$ must not be exceeded due to the risk of demagnetization

10.2.2 Technical data for the asynchronous version

Note

The values specified in the following tables are valid for the asynchronous version with water cooling.

Motor article number	Con- nec- tion type	Rated torque				Rated current				Maxi- mum cur- rent $I_{\max}^{1)}/$ A	Rated speed n_N / rpm	Maxi- mum speed $n_{\max}/$ rpm
		M_N / Nm				I_N / A						
		S1	S6-60 %	S6-40 %	S6-25 %	S1	S6-60 %	S6-40 %	S6-25 %			
8-pole built-in motors												
1FE2093-8AG□□ -□□□1	Y	75	90	106	125	24	29	34	40	60	950	10000
1FE2093-8AM□□ -□□□2	D	23	28	32	38	28.5	34	40	47	90	4750	19000
1FE2093-8AM□□ -□□□2	Y	65	79	93	109	30	36	42	50	90	1600	10000
1FE2094-8AJ□□- □□□1	Y	95	115	134	158	39	37	55	65	85	1100	10000
1FE2094-8AM□□ -□□□2	D	34	41	48	56	45	54	63	75	85	4750	19000
1FE2094-8AM□□ -□□□2	Y	90	108	126	148	45	54	65	75	85	1600	10000
1FE2094-8CJ□□- □□□1	Y	136	164	191	225	53	64	74	88	113	1300	10000
1FE2094-8CG□□- □□□2	D	55	67	78	91	45	54	63	74	85	3200	16000
1FE2094-8CG□□- □□□2	Y	136	164	192	226	45	54	63	74	85	1050	10000
1FE2095-8CJ□□- □□□1	Y	172	207	241	285	59	71	83	98	113	1250	10000

10.2 Technical data

Motor article number	Con- nec- tion type	Rated torque M_N / Nm				Rated current I_N / A				Maxi- mum cur- rent $I_{\max}^{1)}/$ A	Rated speed n_N / rpm	Maxi- mum speed $n_{\max}/$ rpm
		S1	S6-60 %	S6-40 %	S6-25 %	S1	S6-60 %	S6-40 %	S6-25 %			
1FE2095-8CG□□- □□□2	D	70	84	98	116	56	67	78	92	113	3000	16000
1FE2095-8CG□□- □□□2	Y	177	212	248	292	60	72	84	99	113	1000	10000
1FE2145-8CC□□- □□□2	Y	420	504	588	693	60	72	84	100	113	500	6000
1FE2145-8CC□□- □□□2	D	159	193	225	265	58	70	81	96	113	1500	10000
1FE2145-8CE□□- □□□1	Y	420	505	590	695	85	102	119	135	141	750	6000
1FE2147-8CC□□- □□□2	Y	611	733	856	1008	85	102	119	135	141	500	6000
1FE2147-8CC□□- □□□2	D	257	311	363	428	81	97	113	134	141	1300	10000
1FE2147-8CE□□- □□□1	Y	611	736	858	1012	130	154	180	205	210	750	6000

10.3 Characteristics

The data sheets and characteristics for the various motor frame sizes are available in SIOS under Technical data and characteristics (<https://support.industry.siemens.com/cs/ww/de/view/109783767/en>).

Dimension drawings

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:

DT CONFIGURATOR (<http://siemens.de/dt-konfigurator>),

SIEMENS Product Configurator (SPC) (www.siemens.com/SPC) 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.

Environmental compatibility

Recycling and disposal



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

Appendix A

A.1 Technical data and dimensions of the recommended series reactors

The drive system setting data, as well as the electrical power data, are only applicable in conjunction with these reactors.

Note

The specified data cannot be guaranteed when using other reactors.

Technical data and dimensions TEU2731-1UA00-0A



Datasheet: output choke
Type: TEU2731-1UA00-0A

**Description:**

English

phases:	3
mains voltage 1 Un [V]:	575
Cont. current Ithmax 1 [A] / -frequency 1 [Hz]	61 rated frequency [Hz]: 300
clock frequency (max.) [kHz]:	3
rated current I Ln [A]:	54,9
rated inductance [mH]:	0,317
referenced voltage drop at Ithmax and Un [%]:	12,6
rated ambient temperature / temp. Class:	40 / H
protection IP:	00
type of terminals:	flat-type terminal
standard :	EN 61558-2-20
Losses [W]:	291
Weight [kg]:	28

Connection:

Terminals 1: ---

Terminals 2: ---

Type	Voltage [V]	Terminals	Wiring
PRI1		1U1-1V1-1W1	
		1U2-1V2-1W2	

Dimension drawing / Mounting :

MTZEU001-03-13

(siehe Anlage)

(see enclosure)

Dimension values [mm]:

Figure A-1 DB_TEU2731-1UA00-0A_75



Technical data and dimensions TEU3031-0UA00-0A



Datasheet: output choke
Type: TEU3031-0UA00-0A

**Description:**

English

phases:	3
mains voltage 1 Un [V]:	575
Cont. current I _{thmax} 1 [A] / -frequency 1 [Hz]	82rated frequency [Hz]:300
clock frequency (max.) [kHz]:	3
rated current I _{Ln} [A]:	73,8
rated inductance [mH]:	0,232
referenced voltage drop at I _{thmax} and Un [%]:	12
rated ambient temperature / temp. Class:	40 /H
protection IP:	00
type of terminals:	flat-type terminal
standard :	EN 61558-2-20
Losses [W]:	373
Weight [kg]:	42

Connection:

Terminals 1: ---

Terminals 2: ---

Type	Voltage [V]	Terminals	Wiring
PRI1		1U1-1V1-1W1	
		1U2-1V2-1W2	

Dimension drawing / Mounting :

MTZEU001-04-13

(siehe Anlage)

(see enclosure)

Dimension values [mm]:

mdexx GmbH
<http://www.mdexx.com>
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TEU3031-0UA00-0A

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Dat.: 24.04.2019

Figure A-3 DB_TEU3031-0UA00-0A_75



More information

Siemens:
www.siemens.com/simotics

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

Industry Mall:
www.siemens.com/industrymall

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