



Edition

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OPERATING INSTRUCTIONS

SIMOTICS

Naturally ventilated SIMOTICS L-1FN3 linear motors

Drive technology for SINAMICS S120

SIEMENS

SIMOTICS

Drive technology for SINAMICS S120 Naturally-Cooled 1FN3 Linear Motors




Operating Instructions

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Legal information

Warning notice system

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

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


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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

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

Trademarks

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

Disclaimer of Liability

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

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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 Contents

Description

These Operating Instructions inform you about the motor and its components. You will learn how to handle the motor properly and safely from delivery to disposal:

- Transporting and storing
- Assembly and mounting
- Connecting
- Commissioning
- Checking
- Operation
- Troubleshooting
- Disassembling
- Disposal

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

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.

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

These operating instructions are intended for:

- Fitters
- Commissioning engineers
- Machine operators
- Service and maintenance personnel
- Warehouse personnel
- Personnel decommissioning the motor
- Personnel disposing of the motor

1.2.3 Avoiding dangers

Description

Avoid dangers. Ensure safe, problem-free operation and a maximum service life:

- Before you start using the motor, you must read these Operating Instructions.
- Always follow the safety instructions and notices in these operating instructions.

The warning notice system is explained at the beginning of this document.

1.2.4 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.

1.2.5 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 SIMOTICS documentation

Description

Comprehensive documentation on SIMOTICS, SIMOGEAR and on the SINAMICS converter family are provided in Internet (<https://support.industry.siemens.com/cs/ww/en/ps/13204/man>).

You can display documents or download them in PDF and HTML5 format.

The documentation is divided into the following categories:

Table 1-1 SIMOTICS / SIMOGEAR / SINAMICS documentation

Information	Documentation class ¹⁾	Content	Target group
General information	Configuration Manual	Rules, guidelines, and tools for configuring products, systems, and plants. Also contains information on the operating and ambient conditions for hardware and software, the use of functions, as well as on circuit diagrams and terminal diagrams and the installation of software insofar as this is necessary for commissioning.	Planners, configuration engineers
Device information	Installation Instructions	All relevant information on setting up, installing and cabling, as well as the required dimensional drawings and circuit diagrams	Installation personnel, commissioning engineers, service and maintenance personnel
Basic information	Operating instructions	Comprehensive collection of all information necessary for the safe operation of products, plant/system parts and complete plants (IEC 82079)	Machine operators, plant operators
	Compact instructions	Essential contents of the operating instructions in a reduced and condensed form	Machine operators, plant operators
	Product Information	Information that only becomes known shortly before or even after start of delivery and is therefore not included in the associated user documentation	Planners, configuration engineers, technologists, installation personnel, constructors; commissioning engineers, machine operators, programmers, service and maintenance personnel
	Online help	Instructions for configuring, programming, and commissioning	Configuration engineers, programmers, commissioning engineers

¹⁾ Not all documentation classes are available for every SIMOTICS / SIMOGEAR / SINAMICS product.

1.4 Service and Support

1.4.1 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

1.4.2 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>)

1.4.3 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

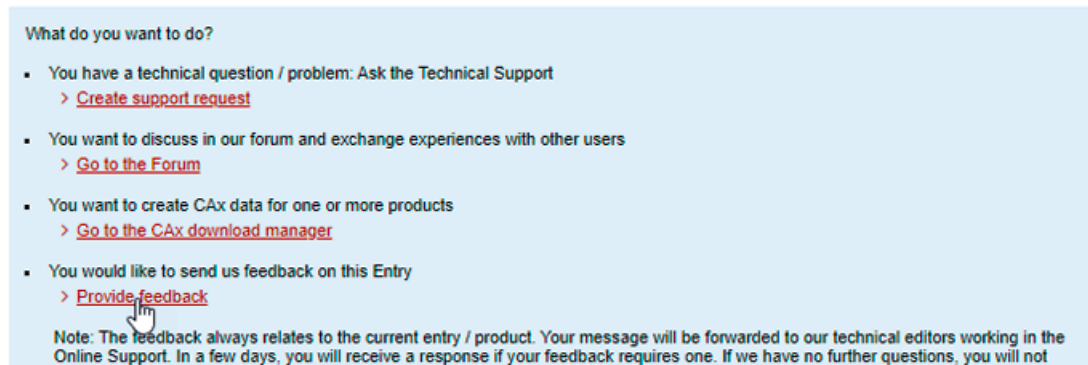


Figure 1-2 Requests and feedback

1.4.4 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 1-3 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.

1.4.5 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?lang=en)
- "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>).

You can obtain support on the topics of "Application" and "Mechatronics" at Application & Mechatronic Support Direct Motors ([mailto: motor.support.motioncontrol@siemens.com](mailto:motor.support.motioncontrol@siemens.com)).

1.4.6 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>).

1.5 Important product information

1.5.1 Intended use



WARNING

Risk of death and material damage as a result of incorrect use

There is a risk of death, serious injury and/or material damage when direct drives or their components are used for a purpose for which they were not intended.

- Only use the motors for industrial or commercial plants and systems.
- Do not install the motors in hazardous zones if the motors have not been expressly and explicitly designed and authorized for this purpose. Carefully observe any special additional notes provided.
- Only use direct drives and their components for applications that Siemens has explicitly specified.
- Protect the motors against dirt and contact with corrosive substances.
- Ensure that the installation conditions comply with the rating plate specifications and the condition specifications contained in this documentation. Where relevant, take into account deviations regarding approvals or country-specific regulations.
- Contact your local sales partner if you have any questions relating to proper and intended use.
- If you wish to use special versions and design versions whose technical details vary from the motors described in this document, then you must contact your local sales partner.

 **WARNING****Danger to life for wearers of active implants due to magnetic and electrical fields**

Electric motors pose a danger to people with active medical implants, e.g. cardiac stimulators, who come close to the motors.

- If you are affected, stay at a minimum distance of 500 mm from the motors (tripping threshold for static magnetic fields of 0.5 mT according to the Directive 2013/35/EU).

 **WARNING****Injury and material damage by not observing machinery directive 2006/42/EC**

There is a risk of death, serious injury and/or material damage if machinery directive 2006/42/EC is not carefully observed.

- The products included in the scope of delivery are exclusively designed for installation in a machine. Commissioning is prohibited until it has been fully established that the end product conforms with machinery directive 2006/42/EC.
- Please observe all safety instructions and provide these safety instructions to the end user.

Avoiding violation of protective rights

Carefully observe all national and international license terms when operating direct motors so that no patent rights are violated.

Area of application

In conjunction with a drive system with closed-loop control, naturally cooled linear motors are well suited as direct drives for linear motion, e.g. for:

- Highly dynamic and flexible machine tools
- Laser machining
- Handling

Protective mat with magnetic self-holding function

Use the protective mat with the magnetic self-holding function as mounting or removal aid for secondary sections. The protective mat with magnetic self-holding function protects you and the secondary sections against the consequences of the sudden forces of attraction of the secondary section in the immediate vicinity.

NOTICE

Damage to the protective mat with magnetic self-holding function

If you subject the protective mat with magnetic self-holding function to moisture and/or excessively high storage temperatures, the bonded connection between the foam rubber mat and the metal sheet will be damaged.

- Ensure that the conditions for storage and transport from Chapter "Preparations for use (Page 49)" are complied with for the protective mat with magnetic self-holding function.

NOTICE

No motor operation when the protective mat with magnetic self-holding function is placed down

The motor or the machines can be damaged if you operate the motor with the protective mat placed down on secondary sections.

- Remove the protective mat with magnetic self-holding function before commissioning the motor.

If the original packaging for the secondary sections is not available, then you can use the protection mat as follows:

- For securely placing down secondary sections
- For briefly storing secondary sections outside the machine, e.g. when carrying out repairs and maintenance work

Any other use is not as intended.

The original undamaged packaging is the preferred choice when transporting and storing secondary sections.

Correct packaging offers better protection than the protective mat with magnetic self-holding function against sudden forces of attraction of the secondary section that can occur in the immediate vicinity. Further, when correctly packaged, you are protected against hazardous motion when storing and moving the secondary section.

1.5.2 Reasonably foreseeable misuse

Description

Avoid the following incorrect uses:

- Disregarding safety information and instructions in this manual
- Directly connecting the motor power connection to the line supply
- Directly connecting temperature sensors to the converter
- Untrained or non-authorized personnel working at the motor
- Working on a motor that is not adequately secured
- Handling the motor carelessly or in a deliberately negligent way
- Underestimating the magnetic force of attraction of permanent magnets
- Disregarding safety clearances for persons with pacemakers, implanted defibrillators and/or metal implants
- Underestimating voltages at cable connections caused by induction
- Incorrect commutation setting when installing and replacing the encoder
- Contact with hot surfaces
- Handling the motor without personal protection equipment
- Disregarding any damage
- Using the motor
 - For non-industrial or commercial applications
 - In impermissible environmental conditions
 - In hazardous zones
 - In a dirty state
 - When in contact with aggressive substances
 - With inadequate cooling
- Disregarding data on the rating plate
- Incorrect packaging, storage and/or incorrect transport
- Opening the motor
- Incorrect disposal of the motor

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

2.4 Residual risks of power drive systems

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 Technical features and ambient conditions

3.1.1 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>)

China RoHS

SIMOTICS motors comply with the China RoHS.

You can find more information at:

China-RoHS (<https://support.industry.siemens.com/cs/de/de/view/109738670/en>)

UKCA - United Kingdom Conformity Assessed

The SIMOTICS motor series satisfies the conformity requirements for England, Wales and Scotland.



3.1.2 Danger from strong magnetic fields

Occurrence of magnetic fields

Motor components with permanent magnets generate very strong magnetic fields. In the no-current condition, the magnetic field strength of the motors comes exclusively from the magnetic fields of components equipped with permanent magnets. Additional electromagnetic fields occur in operation.

Components with permanent magnets

For the linear motors described in this manual, the permanent magnets are in the secondary sections.

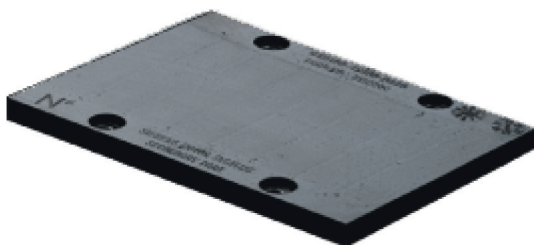


Figure 3-1 Secondary section with permanent magnets

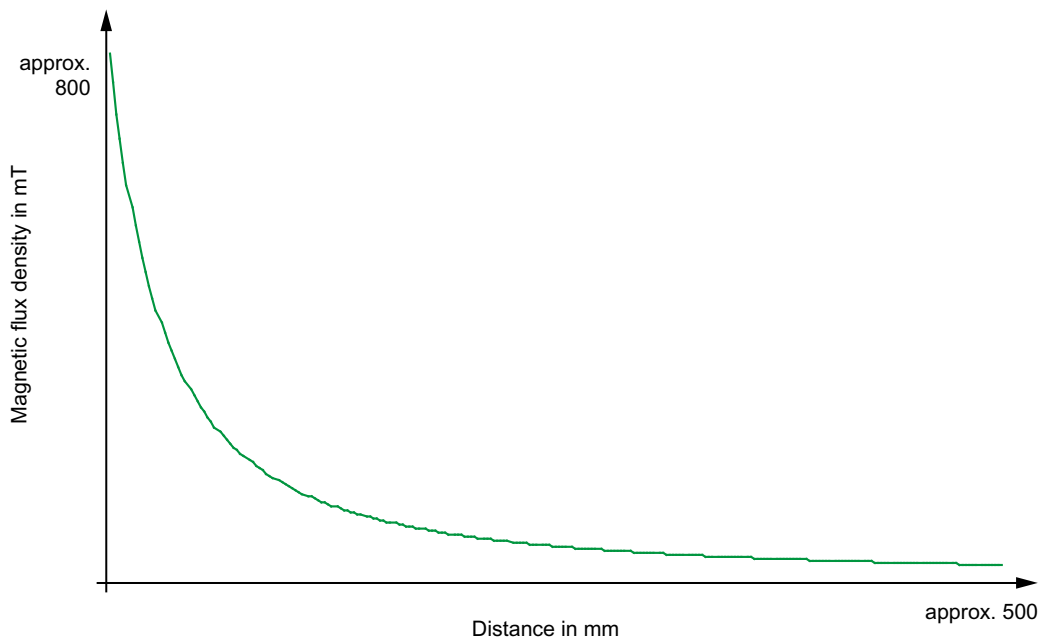



Figure 3-2 Schematic representation of the static magnetic field of a secondary section, depending on distance

Risk to persons as a result of strong magnetic fields



 WARNING
Risk of death as a result of permanent magnet fields
Even when the motor is switched off, the permanent magnets can put people with active medical implants at risk if they are close to the motor.
Examples of active medical implants include: Heart pacemakers, insulin pumps.
<ul style="list-style-type: none">• As the affected person, maintain a minimum distance of 500 mm from the permanent magnets (trigger threshold for static magnetic fields of 0.5 mT as per directive 2013/35/EU).

With regard to the effect of strong magnetic fields on people, the DGUV rule 103-013 "Electromagnetic Fields" of the German Social Accident Insurance applies in Germany. This rule specifies all the requirements that must be observed in the workplace. In other countries, the relevant applicable national and local regulations and requirements must be taken into account.

When dealing with magnetic fields, you must consider the requirements of DGUV rule 103-013 of the German Social Accident Insurance.

**⚠ CAUTION****Handling secondary sections**

The magnetic fields of the secondary sections are permanent. When you come into direct bodily contact with the secondary sections, a static magnetic flux density of 2 T is not exceeded.

- Observe DGUV rule 103-013, § 14 "Systems with high static magnetic fields".

**⚠ WARNING****Risk of electric shock**

Voltage is induced at the power connections of the primary section each time a primary section moves with respect to a secondary section - and vice versa. If you touch the power connections you may suffer an electric shock.

- Do not touch the power connections.
- Connect the motor cable ports correctly, or insulate them properly.



! WARNING

Danger of crushing by permanent magnets of the secondary section

The forces of attraction of magnetic secondary sections act on materials that can be magnetized. The forces of attraction increase significantly close to the secondary section. The trigger threshold of 3 mT for a risk of injury due to attraction and projectile effect is reached at a distance of 150 mm (directive 2013/35/EU). Secondary sections and materials that can be magnetized can suddenly slam together unintentionally. Two secondary sections can also unintentionally slam together.

There is a significant risk of crushing when you are close to a secondary section.

Close to the secondary section, the forces of attraction can be several kN - example: Magnetic attractive forces are equivalent to a force of 100 kg, which is sufficient to trap a body part.

- Do not underestimate the strength of the attractive forces, and work very carefully.
- Wear safety gloves.
- The work should be done by at least two people.
- Do not unpack the secondary section until immediately before installation.
- Never unpack several secondary sections at the same time.
- Never place secondary sections next to one another without taking the appropriate precautions.
- Never place any metals on magnetic surfaces and vice versa.
- Never carry any objects made of magnetizable materials (for example watches, steel or iron tools) and/or permanent magnets close to the secondary section! If tools that can be magnetized are nevertheless required, then hold the tool firmly using both hands. Slowly bring the tool to the secondary section.
- Immediately mount the secondary section that has just been unpacked.
- When mounting and removing secondary sections, we recommend that you use protective mats with magnetic self-holding function
- Never remove several secondary sections at the same time.
- Immediately after removal, pack the removed secondary section in the original packaging.
- Always comply with the specified procedure.
- Avoid inadvertently traversing direct drives.
- Keep the following tools at hand to release parts of the body (hand, fingers, foot etc.) trapped between two components:
 - A hammer (about 3 kg) made of solid, non-magnetizable material
 - Two pointed wedges (wedge angle approx. 10° to 15°, minimum height 50 mm) made of solid, non-magnetizable material (e.g. hard wood).

First aid in the case of accidents involving permanent magnets

- Stay calm.
- If the machine is energized, press the emergency stop switch and open the main switch if necessary.
- Administer FIRST AID. Call for further help if required.

- To free jammed parts of the body (e.g. hands, fingers, feet), pull apart components that are clamped together.
 - Do this using the non-magnetic hammer to drive the non-magnetic wedges into the separating rift.
 - Release the jammed body parts.
- If necessary, call the emergency medical service or an emergency physician.

Material damage caused by strong magnetic fields

NOTICE
<p>Data loss caused by strong magnetic fields</p> <p>If you are close to a secondary section (< 150 mm) any magnetic or electronic data medium as well as electronic devices that you are carrying can be destroyed. For example, credit cards, USB sticks, floppy disks and watches are at risk.</p> <ul style="list-style-type: none"> • Do not carry any magnetic/electronic data media and no electronic devices when you are close to a secondary section!

3.1.3 Technical features

Table 3-1 Standard version of the naturally cooled 1FN3 linear motor

Technical feature	Design
Motor type	Permanently excited synchronous linear motor
Type of construction	Individual components
Degree of protection according to DIN EN 60034-5	<ul style="list-style-type: none"> • Primary section: IP23 • Mounted motor: The degree of protection depends on the machine design and must therefore be realized by the machine manufacturer; minimum requirement: IP23
Cooling method	Natural cooling via cooling ribs and the contact surface between the primary section and machine
Thermal motor protection	<p>Temperature sensor in the primary section</p> <ul style="list-style-type: none"> • 1x PTC thermistor triplet with response threshold +120 °C (according to DIN 44081/44082) <p>Evaluation</p> <ul style="list-style-type: none"> • According to the SINAMICS S120 Equipment Manual via <ul style="list-style-type: none"> – Sensor Module SME120/SME125 or – TM120
2nd rating plate	Enclosed separately
Rating plate for secondary sections	Enclosed separately

Description

3.1 Technical features and ambient conditions

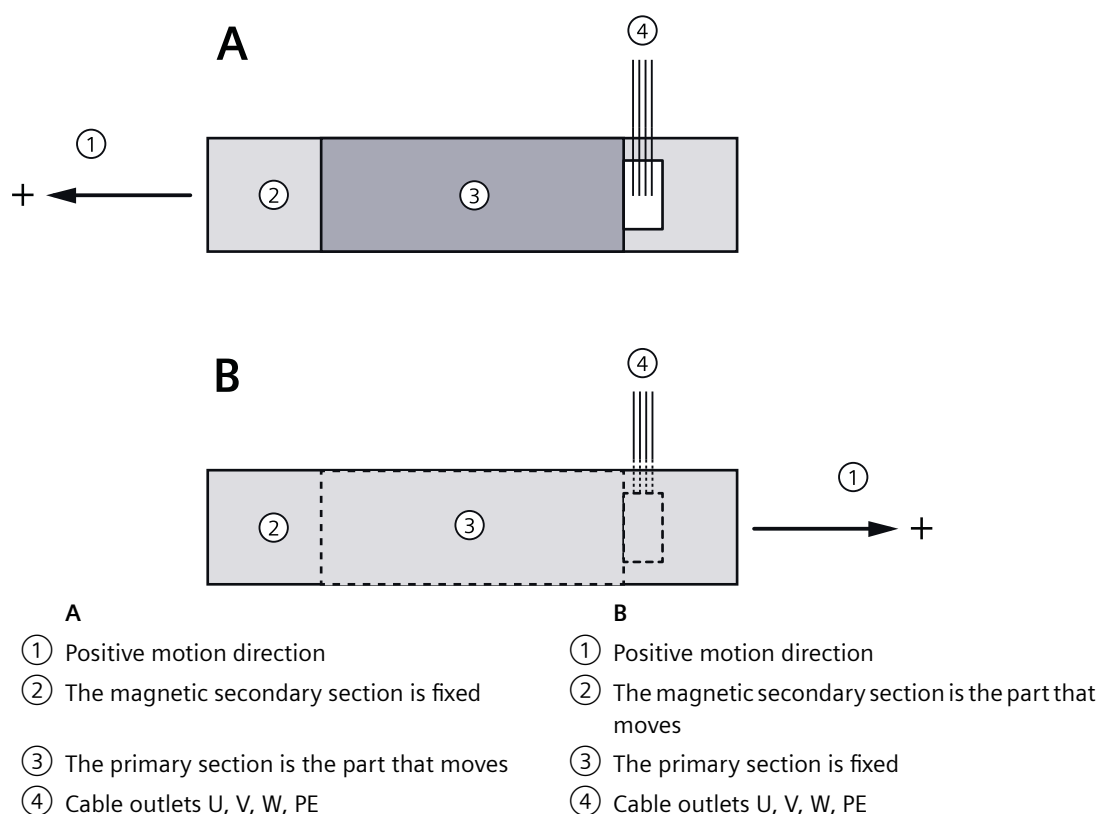
Technical feature	Design
Insulating material class of the motor winding according to EN 60034-1	Temperature class 155 (F)
Impulse withstand voltage insulation class according to EN 60034-18-41	IVIC: C
Magnet material	Rare earth material
Connection, electrical	1FN3050 ... 1FN3150 <ul style="list-style-type: none">• Permanently connected power cables as single core cables with open core ends• Permanently connected signal cable with open core ends
Encoder system	<ul style="list-style-type: none">• Not included in the scope of supply• Selection based on application-specific and converter-specific constraints

3.1.4 Direction of motion of the motor

Defining the traversing direction

The preconditions for primary section or secondary section motion in the positive direction are:

- The cable outlets for the power connection of the primary section are connected with phase sequence U V W
- A three-phase current system with clockwise phase sequence is connected to the primary section



3.1.5 Environmental conditions for stationary use

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

With the exception of environmental parameters "Low air temperature" and "Low air pressure", the motors satisfy climate class 3K3.

Table 3-2 Ambient conditions are based on climate class 3K3

Ambient parameter		Unit	Value
a)	Low air temperature	°C	- 5
b)	High air temperature	°C	+ 40
c)	Low relative humidity	%	5
d)	High relative humidity	%	85
e)	Low absolute humidity	g/m ³	1
f)	High absolute humidity	g/m ³	25
g)	Rate of temperature change ¹⁾	°C/min	0.5
h)	Low air pressure ⁴⁾	kPa	78.4
i)	High air pressure ²⁾	kPa	106
j)	Solar radiation (insolation)	W/m ²	700

3.1 Technical features and ambient conditions

Ambient parameter		Unit	Value
k)	Thermal radiation	-	-
l)	Air movement ³⁾	m/s	1.0
m)	Condensation	-	Not permissible
n)	Wind-driven precipitation (rain, snow, hail, etc.)	-	-
o)	Water (other than rain)	-	See degree of protection
p)	Formation of ice	-	-

¹⁾ Averaged over a period of 5 min

²⁾ Conditions in mines are not considered.

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

⁴⁾ The limit value of 78.4 KPa covers altitudes up to 2000 m.

Additional ambient conditions applicable for the motors for stationary use at weather-protected locations according to standard DIN IEC 60721-3-3 include.

Mechanically active ambient conditions	Class 3S1
Mechanical ambient conditions	Class 3M3

Note**Installation instructions**

The motors are not suitable for operation

- In salt-laden or corrosive atmospheres
- Outdoors

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

3.1.6 Degree of protection

NOTICE**Damage to the motor caused by pollution**

If the area where the motor is installed is polluted and dirty, then the motor can malfunction and clog up.

- Keep the area where the motor is installed free of all dirt and pollution.

Primary section

The primary sections satisfy the requirements for IP23 degree of protection in accordance with EN 60529 and EN 60034-5.

Secondary sections

The secondary sections are protected against corrosion to a large degree via structural measures. Ensure that the air gap remains free of chips and other foreign bodies. Provide suitable covers for this. From a distance of 150 mm from the surface of the secondary section, hardly any more ferromagnetic particles are attracted.

Avoid using abrasive or corrosive substances (e.g. acids).

Installed motor

The better the motor installation space is protected against the ingress of foreign particles (especially true for ferromagnetic particles), the longer the motor service life. The space around the motor must be kept free of chips and other foreign bodies.

The degree of protection of the installed motor according to EN 60529 and EN 60034-5 is primarily dictated by the machine construction, but must be at least IP23.


3.1.7 Vibration response

The vibration response of build-in motors in operation essentially depends on the machine design and the application itself.

As a result of an unfavorable machine design, configuration or system settings, resonance points can be excited, so that vibration severity level A according to EN 6003414 is not reached.

Excessive vibration caused by resonance effects can frequently be avoided by making suitable settings. You can obtain support on the topics of "Application" and "Mechatronics" at Application & Mechatronic Support Direct Motors ([mailto: motor.support.motioncontrol@siemens.com](mailto:motor.support.motioncontrol@siemens.com)).

3.1.8 Noise emissions

 WARNING
Hearing damage
Hearing damage may occur if the motor exceeds a sound pressure level of 70 dB (A) due to the type of mounting or pulse frequency.
<ul style="list-style-type: none"> Reduce the sound pressure level by implementing sound damping and/or soundproofing measures.

3.2 Derating factors

The following components and settings influence the noise levels reached when built-in motors are operational:

- Machine design
- Encoder system
- Bearing
- Controller settings
- Pulse frequency

As a result of unfavorable machine designs, configuration or system settings, measuring surface sound pressure levels of over 70dB (A) can occur. You can obtain support on the topics of "Application" and "Mechatronics" at Application & Mechatronic Support Direct Motors ([mailto: motor.support.motioncontrol@siemens.com](mailto:motor.support.motioncontrol@siemens.com)).

3.2 Derating factors

For installation altitudes above 2000 m above sea level, reduce the voltage stress of the motors according to table "Factors to reduce the maximum DC link voltage" (reciprocal values from EN 60664-1 Table A. 2).

Table 3-3 Factors to reduce the maximum DC link voltage

Installation altitude above sea level in m up to	Factor
2000	1
3000	0.877
4000	0.775
5000	0.656
6000	0.588
7000	0.513
8000	0.444

Reducing the DC link voltage reduces the converter output voltage. The operating range in the F-v diagram is thus also reduced.

You can find the F-v diagrams in the associated data sheet.

Operation in a vacuum is not permissible due to the low voltage strength and the poor cooling.

3.3 Rating plate data (type plate)

Data on the rating plate

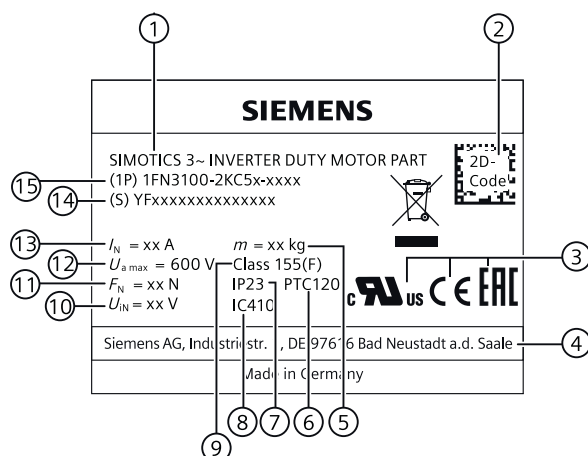


Figure 3-3 Example of a primary section rating plate (schematic)

Table 3-4 Elements on the primary section rating plate

Item	Description
1	Motor type
2	2D code, contains the motor data
3	Approvals/conformities
4	Manufacturer
5	Weight
6	Temperature sensors
7	Degree of protection
8	Cooling method
9	Temperature class
10	Induced voltage U_{iN} at rated speed v_N
11	Rated force F_N
12	Maximum permissible rms value of the motor terminal voltage $U_{a \text{ max}}$
13	Rated current I_N
14	Serial number
15	Article No.

3.4 Design

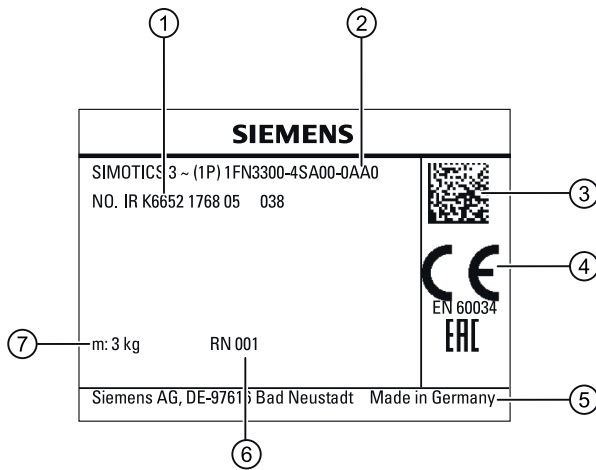


Figure 3-4 Example of a secondary section rating plate

Table 3-5 Elements on the secondary section rating plate

Item	Description
1	Serial number
2	Article No.
3	2D code, contains the data of the secondary section
4	Approvals/conformities
5	Manufacturer
6	Version of secondary section
7	Weight

3.4 Design

3.4.1 Motor components

Naturally cooled SIMOTICS L-1FN3 linear motors are built-in permanent magnet synchronous motors for linear motion.

The motor is delivered in components (at least one primary section and secondary sections) and installed directly in the machine.

An encoder is also required for a complete drive unit.

Primary sections connected in series multiply the motor force.

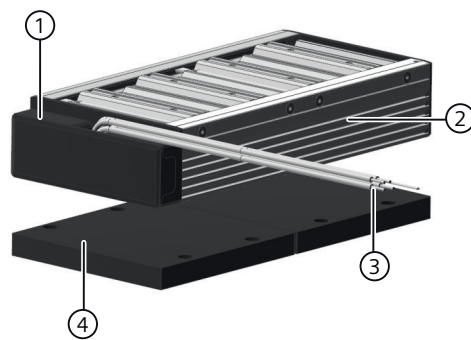
The length of the linear traversing distance is obtained from the number of secondary sections linked in series.

The type spectrum of these motors encompasses 3 different sizes (widths) in up to 3 different lengths.

Motor components

Motors of the 1FN3 product family consist of the following components:

- Primary section:
 - Basic component of the linear motor
 - With 3-phase winding
 - Cooling ribs to dissipate the power loss
- Secondary sections:
 - Mounted side-by-side these form the reactive part of the motor
 - Consist of a steel base with attached permanent magnets
 - The casing provides a large degree of protection against corrosion and external effects



① Primary section ② Cooling ribs ③ Electrical connection ④ Secondary section
Figure 3-5 Components of a naturally cooled 1FN3 linear motor

3.4.2 Scope of delivery

3.4.2.1 Linear motors

Primary section

- Primary section
- One rating plate (attached); additional loose rating plate
- Accessory pack note (safety accessory pack)
- Safety warning instructions (pictograms)

Secondary section

- Secondary section
- A nameplate included as a separate item
- Accessory pack note (safety accessory pack)
- Safety warning instructions (pictograms)

Note

Nameplates for secondary sections



The nameplates for secondary sections are not suitable for applying to a secondary section or to the secondary section cover. Apply the nameplates for secondary sections in a clearly visible position next to the secondary section track or in the vicinity of the motor.

3.4.2.2 Supplied pictograms

Primary sections



To identify hazards, warning signs in the form of permanent adhesive stickers are enclosed with all primary sections in the packaging:

Table 3-6 Warning signs included with primary sections according to BGV A8 and EN ISO 7010 and their meaning

Sign	Meaning	Sign	Meaning
	Warning against hot surface (W017)		Warning against electric voltage (W012)

The following safety instructions are attached at the signal port of the primary section:

Table 3-7 Safety instructions for temperature protection according to BGV A8 and EN ISO 7010 and their significance

Sign	Meaning	Sign	Meaning
	General warning sign (W001)		Observe instruction (M002)

Secondary sections

To identify hazards, warning and prohibition signs in the form of permanent adhesive stickers are enclosed with all secondary sections in the packaging:

Table 3-8 Warning signs according to BGV A8 and EN ISO 7010 included with secondary sections and their meaning

Sign	Meaning	Sign	Meaning
A yellow triangular warning sign with a black border, containing a black magnetic field symbol (two vertical lines with arrows pointing towards each other) and the code (W006) below it.	Warning: strong magnetic field (W006)	A yellow triangular warning sign with a black border, containing a black pictogram of a hand being struck by a falling object and the code (W024) below it.	Warning: hand injuries (W024)

Table 3-9 Prohibiting signs according to BGV A8 and EN ISO 7010 included with secondary sections and their meaning

Sign	Meaning	Sign	Meaning
A red circular prohibition sign with a white background, containing a black pictogram of a heart with a pacemaker symbol and a red diagonal slash over it, and the code (P007) below it.	No access for persons with pacemakers or implanted defibrillators (P007)	A red circular prohibition sign with a white background, containing a black pictogram of a metal implant in a joint and a red diagonal slash over it, and the code (P014) below it.	No access for persons with metal implants (P014)
A red circular prohibition sign with a white background, containing a black pictogram of a key and a watch and a red diagonal slash over it, and the code (P008) below it.	No metal objects or watches (P008)		

Note

Applying the stickers

The stickers are not suitable for applying to a secondary section or on the secondary section cover.

- Apply the stickers next to the secondary section track in the vicinity of the motor so that they are clearly visible.

Note

The quality of the label can diminish as result of extreme environmental conditions.

Any danger areas encountered during normal operation and when maintaining and servicing the motor must be identified using clearly visible warning and prohibit signs (pictograms) in the immediate vicinity of the danger (close to the motor). The associated texts must be available in the language of the country in which the product is used.

3.4.3 Cooling

Natural cooling

The power loss generated by the motor winding must be dissipated. To achieve this, the primary section is equipped with cooling ribs to increase the overall surface area. Most of the heat loss must be dissipated through convection via the mechanical machine interface.

For natural cooling, the rated force F_N depends on the thermal conductivity that the motor has to its environment. For instance, this is influenced by the following factors:

- Thermal contact to the machine
- Temperature difference to the environment

An enclosure or insulated motor mounting either prevents or obstructs motor heat from being dissipated.

3.4.4 Temperature monitoring and thermal motor protection

3.4.4.1 Temp-S temperature monitoring circuit

The primary sections are equipped with the subsequently described Temp-S temperature monitoring circuit.

Temp-S activates the thermal motor protection when the motor windings are thermally overloaded. In this case the precondition is that Temp-S is correctly connected and evaluated. For a thermal overload, the drive system must bring the motor into a no-current condition.

The SME12x Sensor Module or the TM120 Terminal Module evaluates the temperature sensor signals.

You can obtain commissioning information from Technical Support. Contact data is provided in the introduction.

Temp-S

To protect the motor winding against thermal overload, all primary sections are equipped with the following temperature monitoring circuit:

- 1 x PTC 120 °C temperature sensor per phase winding U, V, and W, switching threshold at 120 °C

The three PTC temperature sensors of this temperature monitoring circuit are connected in series to create a PTC triplet.

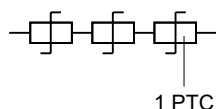


Figure 3-6 PTC triplet

Note**Shutdown time**

If Temp-S responds, and its response threshold is not undershot again in the meantime, then the drive system must shut down (de-energize) the motor within 2 seconds. This prevents the motor windings from becoming inadmissibly hot.

NOTICE**Motor destroyed as a result of overtemperature**

The motor can be destroyed if the motor winding overheats.

- Connect Temp-S.
- Evaluate Temp-S.
- Ensure that the shutdown time is not exceeded.

Note**No temperature monitoring with Temp-S**

As a result of their non-linear characteristic, PTC temperature sensors are not suitable for determining the instantaneous temperature.

No direct connection of the temperature monitoring circuit**⚠ WARNING****Risk of electric shock when incorrectly connecting the temperature monitoring circuit**

In the case of a fault, a Temp-S circuit does not provide safe electrical separation with respect to power circuits.

- Use, for example, the TM120 or the SME12x to connect the Temp-S temperature monitoring circuit. You therefore comply with the directives for safe electrical separation according to DIN EN 61800-5-1 (previously safe electrical separation according to DIN EN 50178).

3.4.4.2 Technical features of temperature sensors

Technical features of PTC temperature sensors

Every PTC temperature has a "quasi-switching" characteristic. The resistance suddenly increases in the vicinity of the response threshold (nominal response temperature ϑ_{NAT}).

PTC temperature sensors have a low thermal capacity - and have good thermal contact with the motor winding. As a consequence, the temperature sensors and the system quickly respond to inadmissibly high motor winding temperatures.


Table 3-10 Technical data of the PTC temperature sensors

Name	Description
Type	PTC triplet acc. to DIN 44082 Individual PTC temperature sensor according to DIN 44081
Response threshold (nominal response temperature ϑ_{NAT})	120 °C ± 5 K
PTC resistance R (20 °C) at the PTC triplet	See the characteristic if -20 °C < T < $\vartheta_{\text{NAT}} - 20$ K R ≤ 3 x 250 Ω R ≤ 750 Ω

Name	Description
Minimum resistance when hot R in the PTC triplet and in the individual PTC temperature sensor	See the characteristic if $T \leq \theta_{NAT} - 5\text{ K}$ $R \leq 3 \times 550\ \Omega$ $R \leq 1650\ \Omega$ if $T > \theta_{NAT} + 5\text{ K}$ $R \geq 3 \times 1330\ \Omega$ $R \geq 3990\ \Omega$ if $T > \theta_{NAT} + 15\text{ K}$ $R \geq 3 \times 4000\ \Omega$ $R \geq 12000\ \Omega$
Typical characteristic $R(\theta)$ of a PTC temperature sensor according to DIN 44081	

3.4 Design

Preparations for use

 **WARNING**

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

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

- Observe the information in Chapter "Danger from strong magnetic fields (Page 29)".

Keep these operating instructions so that they are accessible at all times. Please provide these operating instructions to the appropriate personnel.

 **WARNING**

Incorrect packaging, storage and/or incorrect transport

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

- Always follow the safety instructions for storage and transport.
- When transporting or lifting machines or machine parts with the motors installed, protect the components from moving unintentionally.
- Always correctly and carefully carry out storage, transport and lifting operations.
- Only use suitable devices and equipment that are in perfect condition.
- Only use lifting devices, transport equipment and suspension equipment that comply with the appropriate regulations.
- IATA regulations must be observed when components are transported by air.
- Mark locations where secondary sections are stored with warning and prohibition signs according to the tables in the Chapter "Supplied pictograms".
- Observe the warning instructions on the packaging.
- Always wear safety shoes and safety gloves.
- Take into account the maximum loads that personnel can lift and carry. The motors and their components can weigh more than 13 kg.
- Primary sections and secondary sections must always be transported and stored in the packaged condition.
 - Replace any defective packaging. Correct packaging offers protection against sudden forces of attraction that can occur in the immediate vicinity of a secondary section. Further, when correctly packaged, you are protected against hazardous motion when storing and moving the secondary section.
 - Only use undamaged original packaging.

4.1 Shipping and packaging






 WARNING
<p>Risk of cutting injuries when handling secondary section covers</p> <p>Secondary section covers have sharp edges. When delivered, the rolled up cover bands for secondary sections are secured using straps that are under spring tension.</p> <p>If you cut through these straps, then the rolled up cover bands can suddenly unroll. You can incur cutting injuries at your hands and eyes if you do not wear safety gloves and adequate eye protection.</p> <ul style="list-style-type: none"> • Always wear safety gloves when handling secondary section covers • Always wear suitable eye protection when unpacking cover bands • Work in pairs where necessary • Firmly hold the rolled up cover bands when cutting through the straps • Allow the cover bands to slowly unroll

Table 4-1 Safety pictograms on the packaging for secondary section covers as continuous cover bands

Pictogram	Meaning	Pictogram	Meaning
	Warning against the secondary section cover band suddenly unrolling (Non-standardized warning sign)		Warning against pointed/sharp object (ISO 7010-W022)
	Use eye protection (ISO 7010-M004)		Use protective gloves (ISO 7010-M009)

4.1 Shipping and packaging

When shipping products that contain permanent magnets by sea or road, no additional packaging measures are required for protection against magnetic fields.

Dangers are marked as follows on the original packaging of secondary sections:

Table 4-2 Warning signs according to BGV A8 and DIN EN ISO 7010 and their significance









Sign	Meaning	Sign	Meaning
	Warning: strong magnetic field (W006)		Warning: hand injuries (W024)

Table 4-3 Prohibit signs according to BGV A8 and DIN EN ISO 7010 and their significance

Sign	Meaning	Sign	Meaning
	No access for persons with pacemakers or implanted defibrillators (P007)		No access for persons with metal implants (P014)
	No metal objects or watches (P008)		

Furthermore, the following symbols are marked on the original packaging of primary sections and secondary sections:

Table 4-4 Handling notes and their significance

Symbols	Meaning	Symbols	Meaning
	fragile (ISO 7000, No. 0621)		protect against moisture (ISO 7000, No. 0626)
	top (ISO 7000, No. 0623)		

Note

Original packaging

Keep the packaging of components with permanent magnets where possible!

When reusing the original packaging do not cover safety instructions that are possibly attached. When required, use transparent adhesive tape for the packaging.

4.2 Transporting and storage

Note

UN number for permanent magnets

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

4.2.1 Packaging specifications for air transportation

When transporting products containing permanent magnets by air, the maximum permissible magnetic field strengths specified by the appropriate IATA Packing Instruction must not be exceeded. Special measures may be required so that these products can be shipped. Above a certain magnetic field strength, shipping requires that you notify the relevant authorities and appropriately label the products.

Note

The magnetic field strengths listed in the following always refer to values for the DC magnetic field specified in IATA packaging instruction 953. If the values change, we will take this into account in the next edition.

Products whose highest field strength exceeds 0.418 A/m, as determined at a distance of 4.6 m from the product, require shipping authorization. This product will only be shipped with previous authorization from the responsible national body of the country from where the product is being shipped (country of origin) and the country where the airfreight company is based. Special measures need to be taken to enable the product to be shipped.

When shipping products whose highest field strength is equal to or greater than 0.418 A/m, as determined at a distance of 2.1 m from the product, you have a duty to notify the relevant authorities and appropriately label the product.

When shipping products whose highest field strength is less than 0.418 A/m, as determined at a distance of 2.1 m from the product, you do not have to notify the relevant authorities and you do not have to label the product.

To achieve mutual optimal weakening of the magnetic fields (magnetic interference fields) the original and individual packaging of two secondary sections must always be stacked on one another in pairs, alternating according to the following diagram. In each case, edge A-B of the lower individual package must be placed on the edge C-D of the upper individual package.

Adhesive label warning of "Magnetizing substances and objects" on air cargo

The position of the adhesive label at edge A-B marks the magnetic north pole of the secondary section located inside.

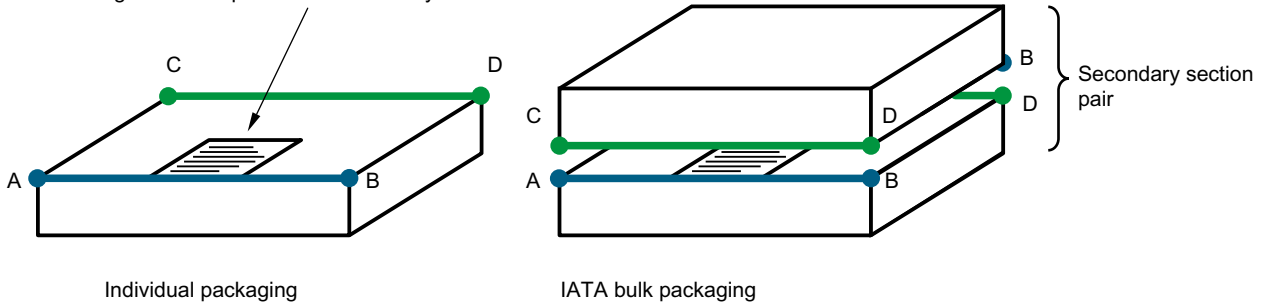


Figure 4-1 Packing for secondary sections and correct stacking

The precondition for correctly stacking two secondary sections is an offset within a secondary section pair of less than 1 cm, which must be guaranteed for the complete duration of the air transport. To achieve this, fix the original individual packaging, e.g. using adhesive packaging tape. When required, use transparent adhesive packaging tape in order not to cover any safety instructions.

If the individual packages with the secondary sections are not stacked pairwise alternating on top of one another, the magnetic fields strengthen one another. If the offset within a secondary section pair is larger than 1 cm during the complete duration of the air transport, then the magnetic fields also strengthen one another.

In bulk packaging, secondary section pairs (each pair stacked alternating, according to the diagram "Packaging for secondary sections and correct stacking") can be arranged as required.

Table 4-5 Packaging specifications for 1FN3xxx-xSxxx-xxxx secondary sections

	not subject to notification and labeling requirements	subject to notification and labeling requirements	subject to authorization
A single secondary section is packaged in its original individual packaging		X	
Two secondary sections each are packaged in the original individual packaging and correctly stacked in pairs	X ²⁾		
Secondary sections are packaged in the original individual packaging, and can be arranged as required			X ¹⁾

- ¹) If the secondary section is also packed in a ferromagnetic sheet metal case in addition to the original individual packaging, e.g. manufactured out of iron with a thickness of greater than 0.5 mm, then when shipping, you only have to notify the relevant authorities and attach appropriate labels.
- ²) If an offset within a secondary section pair of less than 1 cm cannot be guaranteed for the duration of the complete air transport, then for transportation you have to notify the relevant authorities and attach appropriate labels.

Example 1

Original individual packages with secondary section pairs with the Article number 1FN3xxx-xSxxx-xxxx are correctly stacked in new packaging (bulk packaging). The shipment is not subject to notification and labeling requirements.

Example 2

A maximum of one additional original individual packaging with one secondary section may be added to the new (bulk) packaging from example 1. This individual secondary section can be arbitrarily aligned, a sheet metal case to provide additional shielding is not required. The shipment of the complete new package is then subject to notification and labeling requirements.

4.2.2 Environmental conditions for long term storage and transport

Based on DIN EN 60721-3-1 (for long-term storage) and DIN EN 60721-3-2 (for transport)

Table 4-6 Climatic ambient conditions

Lower air temperature limit for long-term storage:	- 5 °C (deviates from 3K3)
Lower air temperature limit for transport:	- 15 °C

Upper air temperature limit:	+ 40° C
Lower relative humidity limit:	5 %
Upper relative humidity limit:	85 %
Rate of temperature fluctuations:	Max. 0.5 K/min
Condensation:	Not permissible
Formation of ice:	Not permissible
Long-term storage:	Class 1K3 and class 1Z1 have a different upper relative humidity
Transport:	Class 2K2

Storage and transport are only permissible only in locations that are fully protected against the weather (in halls or rooms).

Table 4-7 Biological ambient conditions

Long-term storage:	Class 1B1
Transport:	Class 2B1

Table 4-8 Chemical ambient conditions

Long-term storage:	Class 1C1
Transport:	Class 2C1

Table 4-9 Mechanically active ambient conditions

Long-term storage:	Class 1S2
Transport:	Class 2S2

Table 4-10 Mechanical ambient conditions

Long-term storage:	Class 1M2
Transport:	Class 2M2

4.2.3 Storage

Storing indoors

- Apply a preservation agent (e.g. Tectyl) to bare external motor components if this has not already been carried out in the factory.
- Store the motors as described in Section "Ambient conditions for long-term storage and transport". The storage room/area must meet the following conditions:
 - Dry
 - Dust-free
 - Free of vibration
 - Well ventilated
 - Protected against extreme weather conditions
 - The air inside the room or space must be free of any aggressive gases
- Protect the motor against shocks and humidity.
- Make sure that the motor is covered properly.


Protection against humidity

If a dry storage area is not available, then take the following precautions:

- Wrap the motor in humidity-absorbent material. Then wrap it in foil so that it is air tight.
- Include several bags of desiccant in the sealed packaging. Check the desiccant and replace it as required.
- Place a humidity meter in the sealed packaging to indicate the level of air humidity inside it.
- Inspect the motor on a regular basis.

Installation

5.1 Safety guidelines relating to installation

 WARNING
Risk of death and crushing as a result of permanent magnet fields Severe injury and material damage can result if you do not take into consideration the safety instructions relating to the permanent magnet fields of the secondary sections. <ul style="list-style-type: none">• Observe the information in Chapter "Danger from strong magnetic fields (Page 29)".



! WARNING

Danger of crushing by permanent magnets of the secondary section

The forces of attraction of magnetic secondary sections act on materials that can be magnetized. The forces of attraction increase significantly close to the secondary section. The trigger threshold of 3 mT for a risk of injury due to attraction and projectile effect is reached at a distance of 150 mm (directive 2013/35/EU). Secondary sections and materials that can be magnetized can suddenly slam together unintentionally. Two secondary sections can also unintentionally slam together.

There is a significant risk of crushing when you are close to a secondary section.

Close to the secondary section, the forces of attraction can be several kN - example: Magnetic attractive forces are equivalent to a force of 100 kg, which is sufficient to trap a body part.

- Do not underestimate the strength of the attractive forces, and work very carefully.
- Wear safety gloves.
- The work should be done by at least two people.
- Do not unpack the secondary section until immediately before installation.
- Never unpack several secondary sections at the same time.
- Never place secondary sections next to one another without taking the appropriate precautions.
- Never place any metals on magnetic surfaces and vice versa.
- Never carry any objects made of magnetizable materials (for example watches, steel or iron tools) and/or permanent magnets close to the secondary section! If tools that can be magnetized are nevertheless required, then hold the tool firmly using both hands. Slowly bring the tool to the secondary section.
- Immediately mount the secondary section that has just been unpacked.
- When mounting and removing secondary sections, we recommend that you use protective mats with magnetic self-holding function
- Never remove several secondary sections at the same time.
- Immediately after removal, pack the removed secondary section in the original packaging.
- Always comply with the specified procedure.
- Avoid inadvertently traversing direct drives.
- Keep the following tools at hand to release parts of the body (hand, fingers, foot etc.) trapped between two components:
 - A hammer (about 3 kg) made of solid, non-magnetizable material
 - Two pointed wedges (wedge angle approx. 10° to 15°, minimum height 50 mm) made of solid, non-magnetizable material (e.g. hard wood).



⚠ WARNING

Electric shock caused by defective cables

Defective connecting cables can cause an electric shock and/or material damage, e.g. by fire.

- When installing the motor, make sure that the connecting cables
 - are not damaged,
 - are not under tension,
 - do not come into contact with moving parts.
- Comply with the permissible bending radii.
- Do not hold a motor by its cables.
- Do not pull the motor cables.



⚠ WARNING

Risk of electric shock

Voltage is induced at the power connections of the primary section each time a primary section moves with respect to a secondary section - and vice versa.

When the motor is switched on, the power connections of the primary section are also live.

If you touch the power connections you may suffer an electric shock.

- Only mount and remove electrical components if you have been qualified to do so.
- Only work on the motor when the system is in a no-voltage condition.
- Do not touch the power connections. Correctly connect the power connections of the primary section or properly insulate the cable connections.
- Do not disconnect the power connection if the primary section is under voltage (live).
- When connecting up, only use power cables intended for the purpose.
- First connect the protective conductor (PE).
- First connect the power cable to the primary section before you connect the power cable to the converter.
- First disconnect the connection to the converter before you disconnect the power connection to the primary section.
- In the final step, disconnect the protective conductor (PE).

⚠ CAUTION

Sharp edges and falling objects

Sharp edges can cause cuts and falling objects can injure feet.

- Always wear safety shoes and safety gloves!

5.2 Specifications for mounting linear motors

Mounting system

The following specifications apply when mounting primary sections and secondary sections to the machine:

- Use M5 screws with property class 10.9. (friction value $\mu_{tot} = 0.1$).

Table 5-1 Number of screws per motor type

Number of screws		
4	8	12
1FN3050-1KD00	1FN3050-2KC40	-
1FN3100-1KC50	1FN3100-2KC50	1FN3100-3KC50
1FN3150-1KC70	1FN3150-2KC70	1FN3150-3KC70

- Only use new screws that have not been used before.
- Ensure that the correct types of mounting screws are used to fasten the secondary sections:
 - Cylinder head screws with standard head for 1FN3050 to 1FN3150 according to DIN EN ISO 4762 (hexagon socket-head screw) or DIN EN ISO 14579 (hexalobular screw)
- Ensure that the mounting surfaces are free of oil and grease and are clean and unpainted.
- Comply with the optimal surface roughness depth Rz of the screwing surface. Rz is between 10 and 40 μm .
- Minimize the number of joints. This keeps the settling effect for the material and the screws low.
- Carefully maintain the specifications for the thread depths and screw-in depths in the primary section.
- The tightening torque is 7.6 Nm.
Tighten the fixing screws using torque control. If you cannot tighten the fixing screws using torque control, at least use a calibrated torque wrench with a short wrench insert. You can increase the load capability of the screwed connection when using a tightening procedure with controlled angle of rotation or yield limits.
- Tighten the screws gradually, with no jerky movements.
- To secure the screws, select a long clamping length $l_k/d > 5$.
Alternatively, use a medium strength threadlocker to prevent screws becoming loose, e.g. Loctite 243.
- Minimize the amount that the screws settle. To do this, retighten all screws.

Thread depth and screw-in depths in the primary section

The following drawing schematically illustrates the minimum permissible and maximum screw-in depth of the fixing screws in the screwed-in state. For selecting the screw length, a **good range** is thus made available to the machine manufacturer.

The selection of the length of the mounting screws while taking all of the design tolerances into consideration is the responsibility of the machine manufacturer.

The machine manufacturer must ensure that the minimum screw-in depth is reached and the maximum screw-in depth is not exceeded.

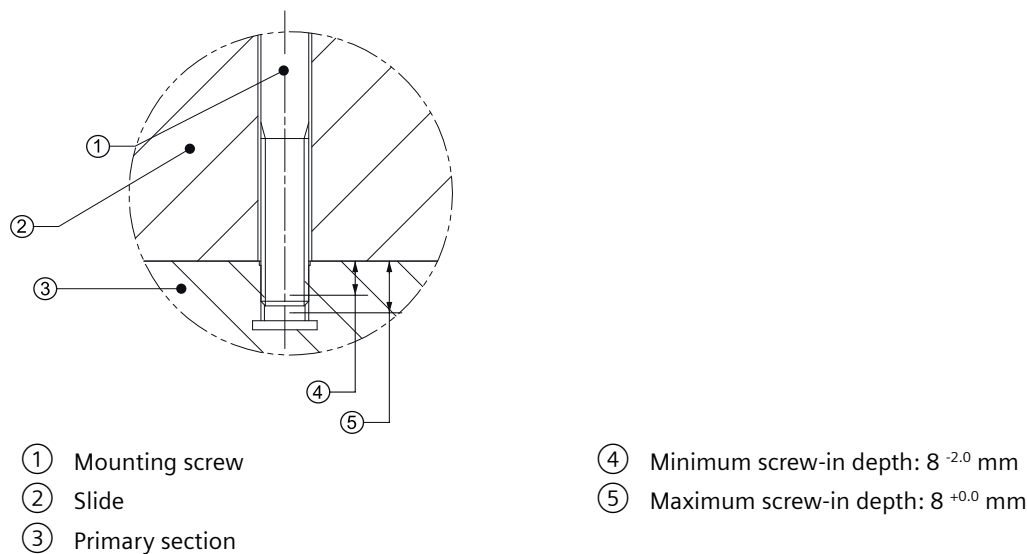


Figure 5-1 Schematic diagram for the screw-in depths in the primary section

Screw-in depths for the secondary section installation

Minimum permissible screw-in depth

The minimum permissible screw-in depths for the most commonly used materials for a machine bed are listed below. For different materials, you must determine the screw-in depth according to VDI Directive 2230.

Table 5-2 Minimum permissible screw-in depths

Material	Screw-in depth
EN GJL-250	$1.4 \cdot d$
EN GJL-300	$1.3 \cdot d$
EN GJS-600-3	$0.7 \cdot d$
G-ALZN10Si8Mg	$2.8 \cdot d$
St 37	$1.8 \cdot d$
St 50	$1.3 \cdot d$

Maximum screw-in depth

The maximum screw-in depth is at the discretion of the machine manufacturer.

5.3 Procedure when installing the motor

The maximum screw-in depth is specified by the threaded holes in the customers machine bed.

5.3 Procedure when installing the motor

Installing a linear motor is subdivided into the following steps:

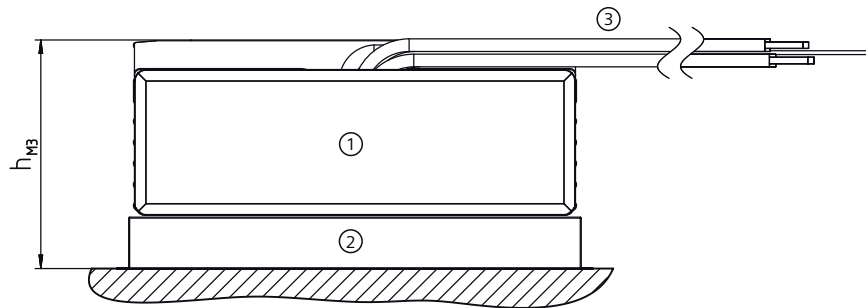
1. Check the installation height before you install the motor.
2. Clean the mounting surfaces of the motor parts and the machine.
3. Install the primary sections, secondary sections and components.
4. Check the motor installation.

□

5.3.1 Maintaining the installation height

Installation height for motor installation

The following diagram shows the installation height for motor installation. The associated values are specified in the following table.



- ① Primary section
- ② Secondary section
- ③ Electrical connections

Figure 5-2 Installation height for motor installation

Table 5-3 Installation height for motor installation corresponding to the previous diagram

	Installation height without secondary section	Installation height with secondary section cover	Tolerance of the installation height
Size	h_{M3} in mm	h_{M3} in mm	in mm
1FN3050 1FN3100	58	58.4	+0.2
1FN3150	60	60.4	+0.2

5.3.2 Overview of the installation technique

The following 3 different techniques are possible when installing a linear motor in a machine:

- Motor installation with divided secondary section track
- Motor installation by introducing the slide
- Motor installation by placing down motor components

5.3.3 Motor installation with divided secondary section track



! WARNING

Risk of crushing when moving the slide (step 3)

If you move the slides with the primary section on the installed secondary section, strong pulling forces briefly occur in the direction of the secondary section track. There is a risk of crushing!

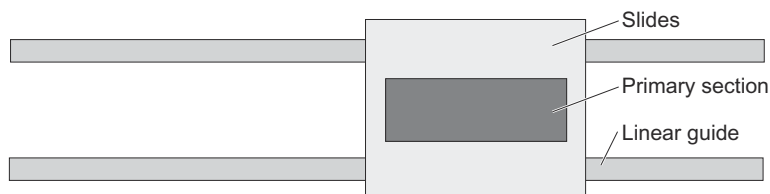
- Make sure that your fingers do not protrude into the danger zone!

Requirements

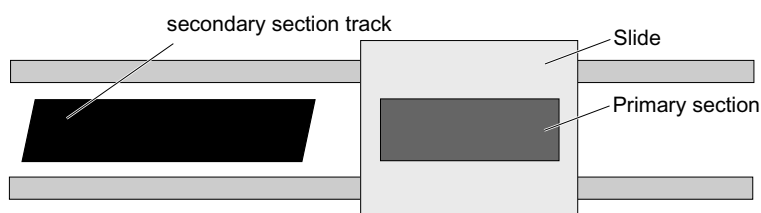
For this type of installation the entire secondary section track must be able to be divided into 2 sections. In this case, the two sections must at least be as long as the slide.

Procedure

1. Install the slide together with the linear guide and the primary section.

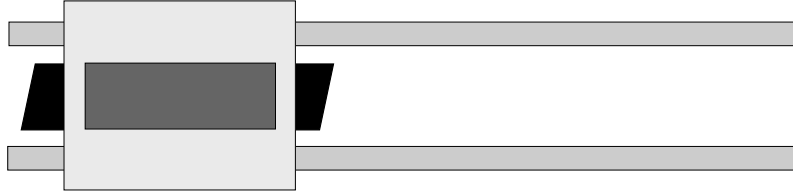


2. Push the slide to one side. Start the installation with the secondary section track on the other side. Proceed as explained in Chapter "Assembling individual motor components (Page 69)". Align the secondary section track. Tighten the mounting screws according to the specifications.

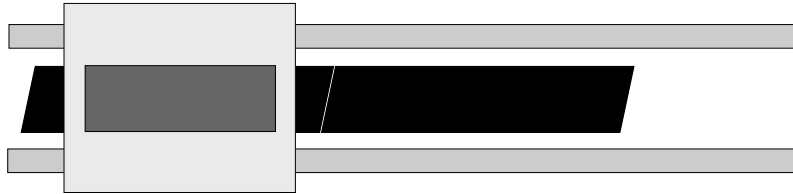


5.3 Procedure when installing the motor

3. Push the slide over the installed secondary section track. The attraction forces are taken up by the linear guides.



4. Install the remaining secondary section track as described in Chapter "Assembling individual motor components (Page 69)". Align the track as well. Tighten the mounting screws according to the specifications.



5.3.4 Motor installation through the insertion of the slide



! WARNING

Risk of crushing as result of attractive forces

In this procedure, pulling forces towards the stationary motor component occur. There is a risk of crushing!

- Ensure that the slide plate is guided through the threading unit before the magnetic forces of attraction take effect.
- Make sure that your fingers do not protrude into the danger zone!

Requirements

This type of installation is only intended for setting up motors in a double-sided arrangement. For this type of installation, normally you require a threading fixture provided by the customer.

Procedure

- Slide the movable part of the motor into the stationary housing with the already installed motor parts. See the following figure.

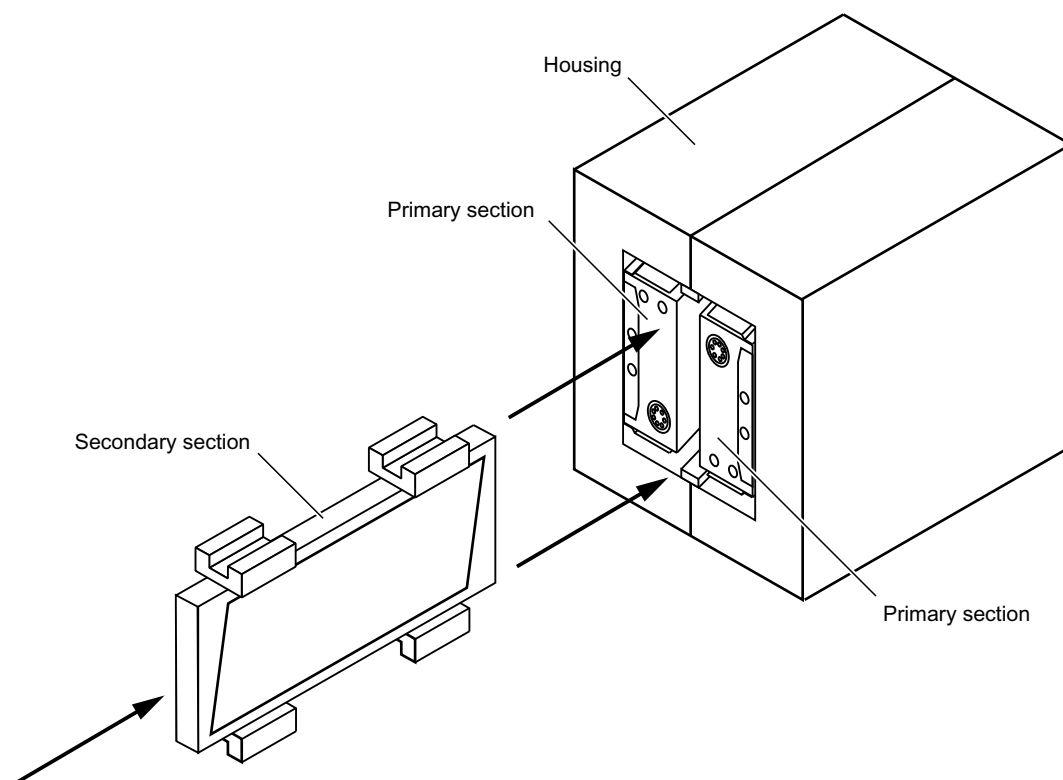


Figure 5-3 Inserting the secondary section for a double-sided motor (similar diagram)



5.3.5 Motor installation by placing down motor components



WARNING

Danger of crushing when placing down the primary section (step 2)

When you place the primary section on the secondary section track, high forces of attraction (up to 7.46 kN) act in the direction of the secondary section track. There is a risk of crushing!

- Use a forcing-off fixture that allows the primary section to be lowered in a controlled fashion.
- Make sure that your fingers do not protrude into the danger zone!

NOTICE

Damage to the primary section and secondary section track

If the primary section is located directly on the secondary section track, the two components can only be separated again with considerable effort. This can result in mechanical damage.

- Never place the primary section directly down onto the secondary section track.
- Always place a 0.5 mm thick distance foil manufactured out of non-magnetizable material between the primary section and secondary section.

Requirements

If other installation methods are not possible, this complex method is applied.

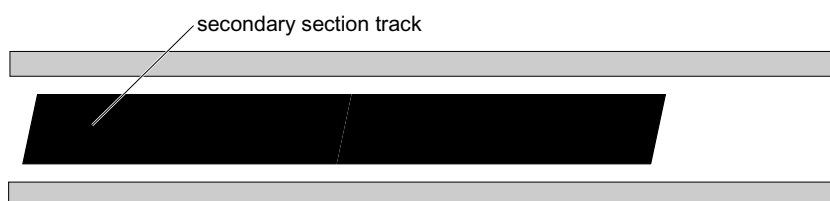
- For this installation technique, a non-magnetic spacer foil must be used between the primary section and secondary section track. This spacer foil prevents the primary section from coming into direct contact with the secondary section track.
The spacer foil must be thinner than the required air gap. This is necessary to ensure that the spacer foil can be removed at the end of the installation without any effort.
- A forcing-off fixture is required for this installation technique. The forcing-off fixture must ensure that the primary section can be lowered onto the secondary section track (covered with the spacer foil) in a controlled fashion. Further, it must be lowered in parallel with the secondary section track and centered.
The stiffness of the forcing plate and the length of the forcing-off screws must be dimensioned in such a way that the primary section is held at a height of at least 50 mm before touching down.
The high forces of attraction must be taken into account with sufficient reserve when dimensioning the screws.

Procedure

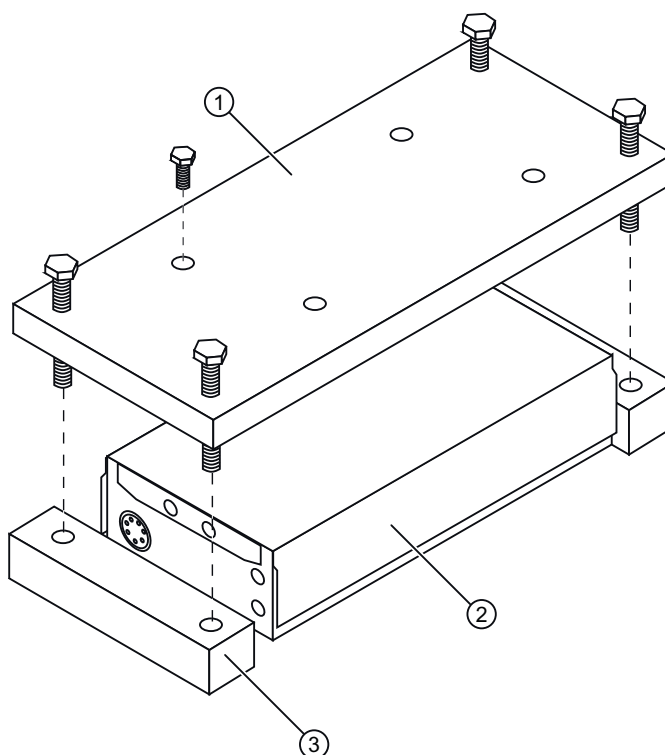
Application example

The secondary section track is shorter than twice the length of the primary section. The primary section together with the slide cannot be shifted to the side far enough so that all of the secondary sections can be easily screwed into place.

1. Install the secondary section track according to Chapter "Assembling individual motor components (Page 69)".



2. Using a forcing-off fixture, place the primary section down onto the secondary section track as follows:



- ① Forcing plate
- ② Primary section
- ③ End support block

Figure 5-4 Forcing-off fixture (similar diagram)

- Mount the primary section on the forcing plate of a forcing assembly. You can use the factory-made mounting holes for this purpose.

5.3 Procedure when installing the motor

- Screw the jack screws into the forcing plate. Ensure that the jack screws protrude evenly from the forcing plate. There must be a minimum distance of **50 mm** between the non-magnetic counter-bearing blocks and the forcing plate.
- Place a spacer foil between the primary section and the secondary section track.
- Screw back the jack screws in steps to lower the primary section onto the secondary section track, in parallel and centered with it.
- Then completely remove the forcing assembly from the primary section.

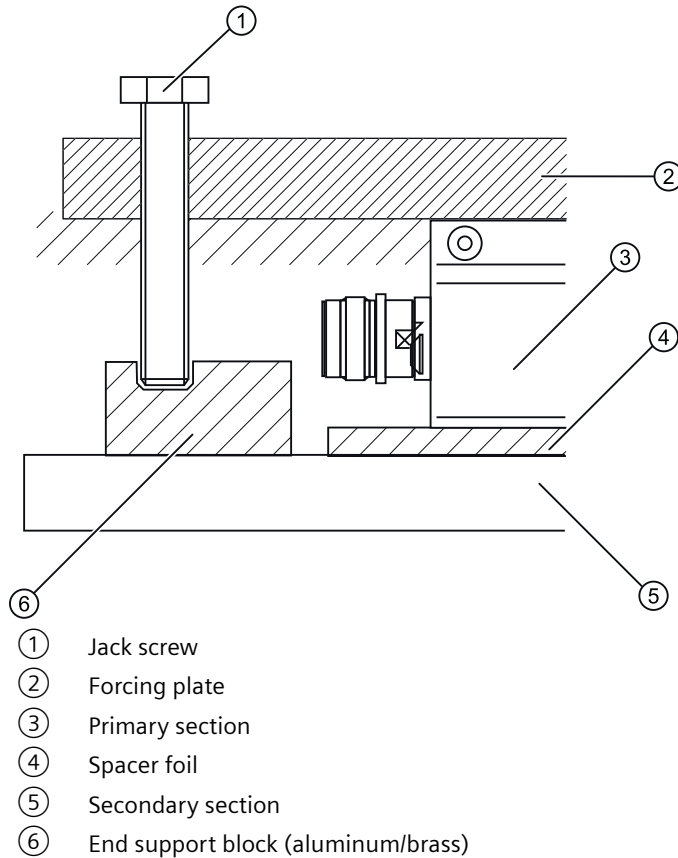
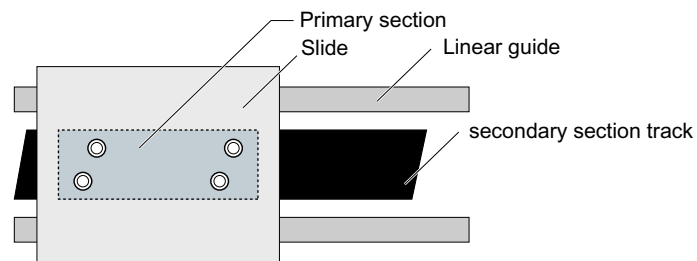


Figure 5-5 Remove the forcing off fixture from the primary section (similar diagram)

3. Installing the primary section on the slide.

- Secure the slide on the guides.
- Push the slide over the primary section. When doing this, the mounting holes of the primary section and slide must be fully aligned.
- The mounting screws are initially screwed through the slide into the primary section and tightened by hand. By uniform and alternating tightening of the mounting screws, the primary section is lifted from the secondary section track.

- Then remove the spacer foil from the air gap without applying any force.



5.3.6 Assembling individual motor components

5.3.6.1 Installing the secondary sections



WARNING

There is a high risk of crushing fingers etc. when handling unpacked secondary sections!

Secondary sections and materials that can be magnetized can suddenly slam together unintentionally. Two secondary sections can also unintentionally slam together.

- Heed the warning information "Risk of crushing caused by permanent magnets of the secondary section" in Chapter "Safety guidelines relating to installation (Page 57)".

Procedure

- Place an appropriately sized protective mat with magnetic self-holding function on the secondary section. If necessary, you can cover a secondary section using 2 protection mats placed down next to one another.



Figure 5-6 Protective mats with magnetic self-holding function for secondary sections

- Place the side of the protection mat with the black PU foam over the entire surface of the magnets of the secondary section. The protection mat has a metal sheet on its upper side so that it is attracted and held in position by the magnetic force of the secondary section. This weakens the force of attraction of the secondary section. As a consequence, it reduces the risk of crushing due to the secondary section permanent magnets.
- To replace a secondary section, place one protection mat in front of and one behind the secondary section to be replaced.
- Remove the protection mat before you commission the linear motor.

- Use the mounting screws to force-fit the secondary sections to the machine bed.

Note**Hole in the machine bed**

The shaft of the bolts, which are used to attach the secondary section to the machine base may not reach the thread.

- If necessary, you must lower the relevant hole in the machine bed.

The letter "N" is to be found on each secondary section. Ensure that the letter "N" on each of the secondary sections is pointing in the same direction, as shown in the following figure.

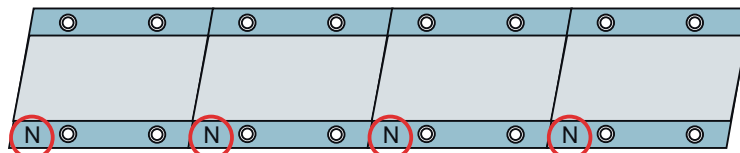
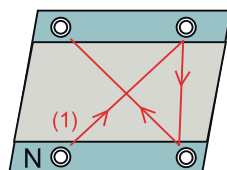


Figure 5-7 Position of the "N" mark on secondary sections of the 1FN3 product family

Screw on the secondary sections in the specified sequence as shown in the following figure.



1FN3050 ... 150

Figure 5-8 Screwed joint sequence of 1FN3 secondary sections



5.3.6.2 Installing the secondary section cover

⚠ WARNING

Risk of cutting injuries when handling secondary section covers





Secondary section covers have sharp edges. When delivered, the rolled up cover bands for secondary sections are secured using straps that are under spring tension.

If you cut through these straps, then the rolled up cover bands can suddenly unroll. You can incur cutting injuries at your hands and eyes if you do not wear safety gloves and adequate eye protection.

- Always wear safety gloves when handling secondary section covers
- Always wear suitable eye protection when unpacking cover bands
- Work in pairs where necessary
- Firmly hold the rolled up cover bands when cutting through the straps
- Allow the cover bands to slowly unroll

5.3 Procedure when installing the motor

Table 5-4 Safety pictograms on the packaging for secondary section covers as continuous cover bands

Pictogram	Meaning	Pictogram	Meaning
	Warning against the secondary section cover band suddenly unrolling (Non-standardized warning sign)		Warning against pointed/sharp object (ISO 7010-W022)
	Use eye protection (ISO 7010-M004)		Use protective gloves (ISO 7010-M009)

Note

Lower motor force for a larger air gap

If you use a secondary section cover, then the air gap between the primary section and secondary section must be increased by 0.4 mm. The motor force is then reduced by approx. 10 %.

The secondary section cover protects the secondary section track. The installation method depends on the type of cover. The following 2 variants are available:

- Continuous cover band
- Segmented cover

NOTICE

Loss of functionality and motor wear due to contamination in the motor compartment

Contamination in the motor compartment can cause the motor to stop functioning or cause wear and tear. The use of scrapers to keep the air gap free is not sufficient and therefore not recommended.

- Use suitable measures to protect the motor compartment from contamination independently of the use of a cover band.

Covering long secondary section tracks with cover bands is more complicated than with segments.

Requirements

On the machine side, always carefully ensure that the linear motor is protected against all types of dirt and pollution. The cover plates of the secondary sections and the stainless steel cover of the primary section towards the air gap serve as protection against dirt and pollution, which cannot be prevented using machine-side shielding.

The cover plates for the secondary sections primarily protect the secondary section surface against being mechanically damaged, for instance, resulting from deposits of dust, sand, metal chips, machine parts etc.

Unprotected secondary sections can be damaged if this dirt or pollution is caught by the primary section or by moving machine parts and is ground or is trapped in the air gap.

The dirt and pollution to be expected in the machine must be taken into consideration when deciding whether a secondary section cover is necessary. When 1FN3 linear motors are installed corresponding to the specifications, then a relatively large air gap is obtained so that small particles of dirt cannot result in any mechanical contact between moved and stationary parts. The length of any cleaning intervals required can be appropriately selected to reflect this. Further, smaller deformations of the machine, as a result of high acceleration levels for example, do not result in any mechanical contact.

The use of cover plates increases the magnetic air gap, and reduces the motor force.

5.3 Procedure when installing the motor

If it is advantageous to install secondary section covers, then you must select the most suitable cover variant (segmented cover or continuous cover band). This can be evaluated based on various criteria.

- Type of dirt/pollution
 - In the case of pointed and sharp-edged pollution, such as metal chips, the continuous cover band is the preferred choice, as it creates a smooth surface without any joints. Metal chips can become lodged in the joints between segmented covers and result in damage. The primary section can press dirt and pollution that can be compressed into the segmented cover joints therefore causing them to lift off. The cover can be shifted if a high degree of friction is created between the primary section and the cover as a result of the dirt and pollution.
 - For occasional exposure to liquids, the segmented cover offers less protection against liquid accumulating between the cover and the secondary sections. It can be advantageous not to use the cover in the case of substances that can attack or penetrate the encapsulation of the secondary sections and damage the magnet material. This allows any liquid to escape and the parts to dry.
- Length of the axis
 - The length of the continuous cover band is limited. Segmented covers can be used to cover any length of secondary section track.
 - When using the continuous cover band, the motor length is extended, even when secondary section cooling is not used, by the mounting areas at the ends of the secondary section track.
- Installation options and installation work involved
 - Installing the continuous cover band is more complex than installing the segmented cover, as it involves flexible and in most cases long sheets of metal. The length of the individual cover segments is limited and is stabilized using lateral edge profiles.
 - As a result of the magnetic force of attraction, the continuous cover band must already be aligned when coming into contact with the secondary sections for the first time. You have to lift it off almost completely if you want to subsequently adjust it. The segmented cover is placed down, and it automatically aligns itself as a result of the lateral edge profiles.
 - If the slides have already been mounted, then the continuous cover band must always be mounted together with the secondary sections, as it is not possible to introduce the cover band between the primary section and secondary section.
 - If the slide length is less than half the length of the secondary section track, then the secondary sections and the covers (both continuous and segmented) must be mounted before installing the slide.

Procedure

Mounting the continuous cover band

The procedure is valid for the following initial situation:

- The secondary section track is at least twice the length of the slide.
- The guides and the slides are mounted together with the primary section.

- The half secondary section track is mounted.
- The slide stands above the range that has no secondary section.



Figure 5-9 Initial situation when mounting the continuous cover band

1. Remove the clamping wedges of the secondary section end pieces and prepare an insertion aid for the cover band.
Material that cannot be magnetized must be used and the width should approximately correspond to that of the secondary sections (e.g. a wooden board as shown in the diagram above).
2. Position the insertion aid at the end of the secondary section track so that a ramp is created.
3. Unroll the cover band and place it down on the insertion aid.

5.3 Procedure when installing the motor

4. Position the insertion aid so that a clearance of at least 1 cm remains between the cover band and the secondary section track.

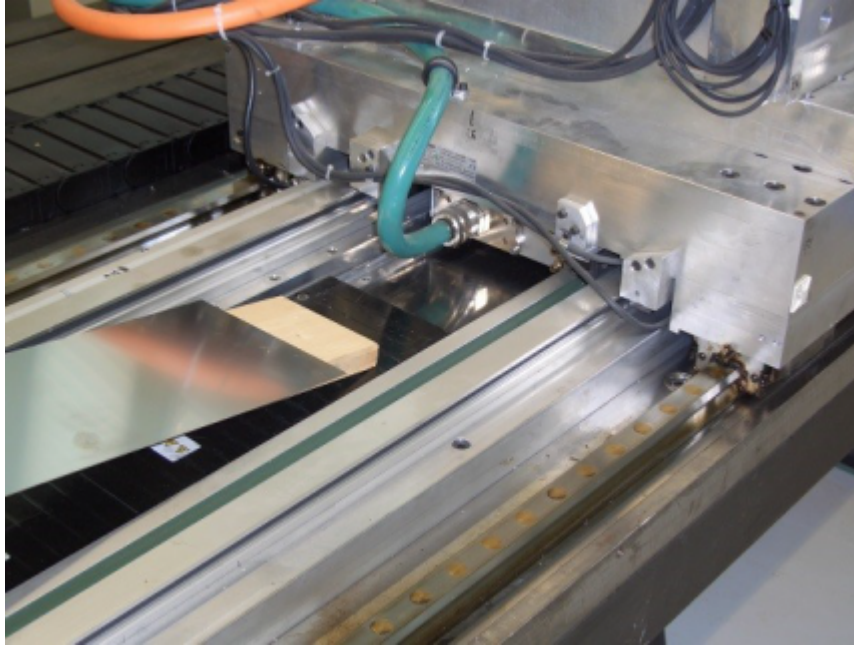


Figure 5-10 Positioning the insertion aid

5. Slide the cover band under the slides until the secondary section end piece is reached.



Figure 5-11 Sliding the cover band

6. Place the cover band in the wedge-shaped recess of the secondary section end piece and align it in the traversing direction and at right angles to this, centered with respect to the end piece.
Some clearance must be left between the end of the cover band and the threaded hole so that the fixing screws of the clamping wedge can be inserted.
7. Place the clamping wedge down and press it into position.

8. Insert the fixing screws and tighten them hand tight.

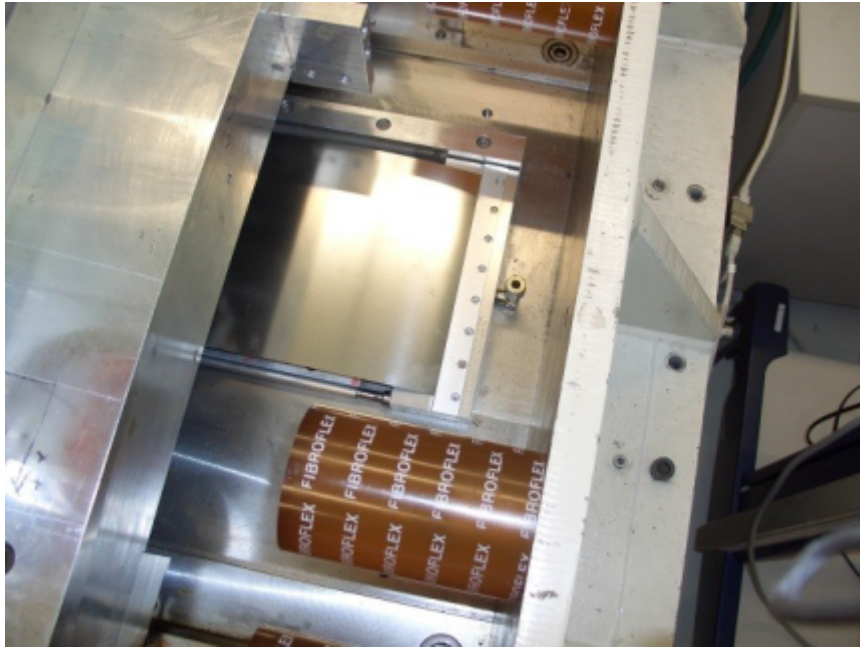


Figure 5-12 Inserting the fixing screws

9. Lift the cover band from the insertion aid and bend it upwards without kinking it.
10. Remove the insertion aid.
11. Slowly place the cover band on the already mounted secondary sections.

5.3 Procedure when installing the motor

12. When coming into contact with the secondary section edge for the first time, align the cover band centered with respect to the secondary section and check that the band is correctly positioned in the secondary section end piece. When placing down on the secondary sections, continuously check the alignment at right angles to the traversing direction. If the cover band significantly deviates from the secondary section track, then it must be lifted and realigned.

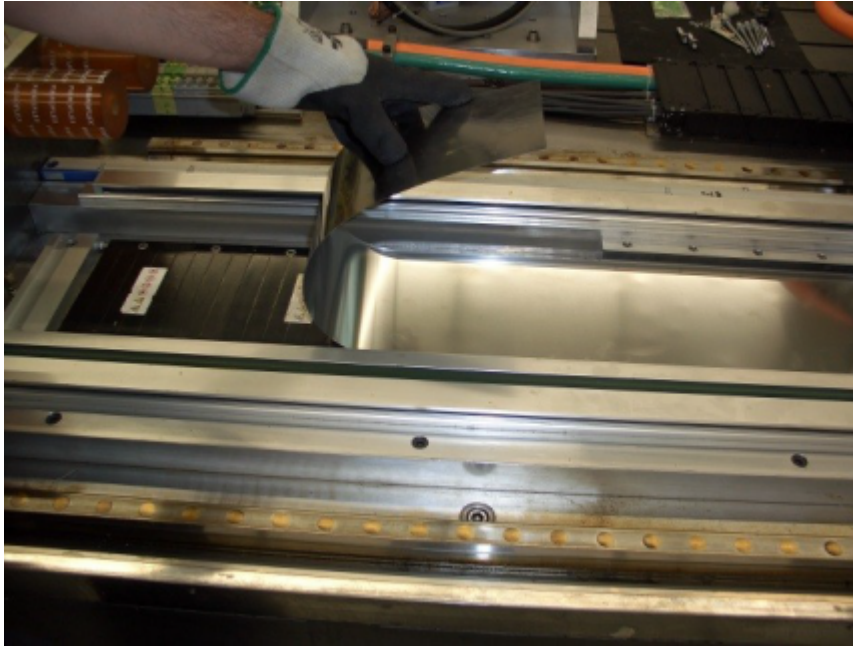


Figure 5-13 Aligning the cover band

13. Place the cover band on the second end piece and check the position in the traversing direction.

The cover band must be aligned in the traversing direction if the threaded holes for mounting the clamping wedge are covered. In this case, it must be completely lifted off, so that a marking on the cover band at the end of the already mounted parts of the secondary section track (slide side) can be helpful when repositioning.



Figure 5-14 Placing the cover band on the second end piece

14. Press in the clamping wedge once you have aligned the cover band.
15. Screw-in the fixing screws and tighten them.



Figure 5-15 Screwing-in the fixing screws

5.3 Procedure when installing the motor

16. Check again that the other end of the cover band is correctly aligned and the threaded holes in the secondary section end piece are not covered, even when the cover band is slightly pulled.
17. Push the slide over the mounted secondary section track to the other end position.
18. Release the cover band at the end without secondary section from the end piece and bend it upwards without kinking it.
19. Fix the cover band and insert a wedge between the secondary sections and cover band to compensate for the force of attraction.



Figure 5-16 Fixing the cover band

20. Mount the remaining secondary sections.

21. Unroll the cover band on the secondary sections, and ensure that it is correctly aligned. Minimum lateral deviations can be corrected.



Figure 5-17 Unroll the cover band on the secondary sections

22. Press on the clamping wedge again and screw it tight.



Figure 5-18 Moving up the clamping wedge

Mounting the segmented cover

1. Mount the secondary sections with the slide plate removed.
2. Mount the first segment of the cover as follows:
Place the end of the first segment starting from the top in a 45° angle, flush to the outer edge of the last secondary section.
Then lower the segment in alignment with the secondary section track.
When you sense the magnetic attraction, let loose of the segment.
The segment generally assumes the correct position on its own.

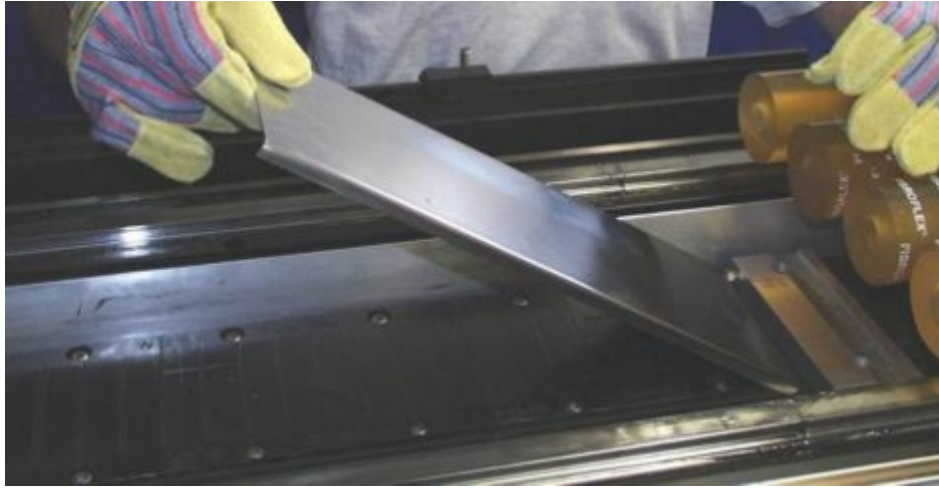


Figure 5-19 Mounting the first segment of the segmented cover

3. Check the correct position:
If the first segment of the cover extends to the middle of a secondary section, the position is correct.
4. Mount all other segments the same way as the first segment.



Figure 5-20 Mounting an additional segment of the segmented cover

5. Fasten the ends of the first and last segments to the secondary section end pieces.
6. Place the primary section with spacer and forcing assembly on the secondary section track.
7. Mount the slide onto the guide.
8. Align the slide over the mounting holes of the primary section.
9. Remove the primary section from the secondary section track using the forcing assembly.
10. Mount the primary section securely on the slide.



Note

Arranging segments of the cover

If you arrange the butt joints of the cover segments so that they are offset from the butt joints of the secondary sections, the secondary section track will be better protected against dust. The segments of the cover also align better.

This offset is achieved when the cover segments at the ends of the secondary section track have a $(n + 0.5)$ length instead of the integral length of the secondary sections, see the following diagram showing this.

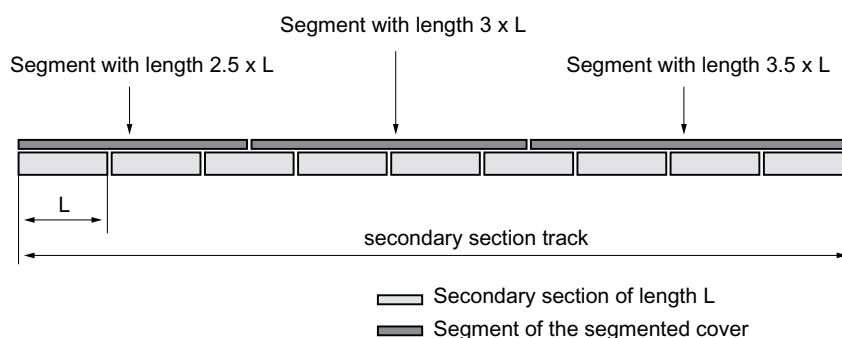


Figure 5-21 Example: Segment position of the segmented secondary section cover

Removing the segmented cover

If you want to remove the segmented secondary section cover, you must raise the segments on one side transversely to the traversing direction as per the following figure.



Figure 5-22 Demounting a segment of the segmented secondary section cover

5.3.6.3 Installing the primary section

NOTICE

Damage to motor components due to incorrect screw-in depths

The primary section can be damaged if the fixing screws are screwed in too deep and prevent an adequate force-locked connection to the machine.

Screwed connections can fail in operation if the fixing screws are not screwed in deep enough. Both scenarios damage or destroy motor parts.

- Strictly comply with the specifications regarding minimum and maximum permissible screw-in depth.

Procedure

- Screw the primary section to the back of the primary section using the threaded holes to establish a friction-locked connection.

5.4 Checking the work carried out

**⚠ WARNING****Risk of electric shock**

Voltage is induced at the power connections of the primary section each time a primary section moves with respect to a secondary section - and vice versa. If you touch the power connections you may suffer an electric shock.

- Do not touch the power connections.
- Connect the motor cable ports correctly, or insulate them properly.

5.4.1 Smooth running of the slide

Checking the smooth running of the slide

The motor installation must be specially checked for the smooth running of the slide.

- Remove all tools and objects from the traversing range.
- Clean the magnetic surface with a cloth before moving the slide.

If the guidance system is precisely aligned, it must be possible to move the moving part of the motor with a force that remains constant over the entire traversing range. A slight fluctuation in force is permissible. The force fluctuation results from the system-related cogging force of the linear motor.

- If excessive sluggishness results locally, check the installation height and the alignment of the guide system.

Note**Increased shifting force or force ripple**

When checking the smooth running of the slide, ensure that the power connections of the motor cable are not connected to the drive. In addition, the power connections must not be "short-circuited". In these cases, a greater shifting force or force ripple occurs.

5.4.2 Checking ease of movement in the air gap

Note

Installation height and air gap

The installation height must remain within the specified tolerances over the complete traversing distance.

The correct installation height automatically sets the correct air gap height.

Precisely measuring the air gap height is not possible as a result of the inherent design.

The correct installation height is a precondition to comply with the electrical properties of the motor according to the data sheet.

After installation, check ease of movement in the air gap over the complete length of the secondary section track using a piece of tear-resistant spacer foil that is 0.5 mm thick.

You can find the manufacturer's recommendation for spacer foil in the annex.

Procedure

1. Slide the spacer foil into the air gap between the primary and secondary sections.
The spacer foil must not jam. It must be easily moveable along the entire length of the air gap by hand with minimal use of force.
2. Slide the primary section over a section of the secondary section track that has not yet been checked. Repeat the check.
3. Repeat this procedure until the entire length of the secondary section track has been checked.



NOTICE
Air gap height is too small
If the check identifies that there is not the appropriate ease of movement in the air gap, then the specified installation height is not complied with or there is an installation error. It is not permissible that the machine is commissioned.
<ul style="list-style-type: none">• Ensure that the installation height of the machine is within tolerance and the motor has been correctly installed without any errors.

Electrical connection

6.1 Safety instructions for electrical connections

NOTICE
Destruction of the motor if it is directly connected to the three-phase line supply
The motor will be destroyed if it is directly connected to the three-phase line supply.
<ul style="list-style-type: none"> • Only operate the motors with the appropriately configured converters.



⚠ WARNING
Risk of electric shock due to incorrect connection
If you incorrectly connect the motor this can result in death, serious injury, or extensive material damage. The motors require an impressed sinusoidal current.
<ul style="list-style-type: none"> • Connect the motor in accordance with the circuit diagram provided in this documentation. • Refer also to the documentation for the drive system used.



⚠ WARNING
Risk of electric shock
Voltage is induced at the power connections of the primary section each time a primary section moves with respect to a secondary section - and vice versa.
When the motor is switched on, the power connections of the primary section are also live.
If you touch the power connections you may suffer an electric shock.
<ul style="list-style-type: none"> • Only mount and remove electrical components if you have been qualified to do so. • Only work on the motor when the system is in a no-voltage condition. • Do not touch the power connections. Correctly connect the power connections of the primary section or properly insulate the cable connections. • Do not disconnect the power connection if the primary section is under voltage (live). • When connecting up, only use power cables intended for the purpose. • First connect the protective conductor (PE). • First connect the power cable to the primary section before you connect the power cable to the converter. • First disconnect the connection to the converter before you disconnect the power connection to the primary section. • In the final step, disconnect the protective conductor (PE).

6.2 Important information about the electrical connection



! WARNING

Electric shock caused by high leakage currents

When touching conductive parts of the machine, high leakage currents can result in an electric shock.

- For high leakage currents, observe the increased requirements placed on the protective conductor. The requirements are laid down in standards DIN EN 61800-5-1 and DIN EN 60204-1.
- For high leakage currents, attach warning symbols to Power Drive System .



! WARNING

Risk of electric shock as a result of residual voltages

There is a risk of electric shock if hazardous residual voltages are present at the motor connections. Even after switching off the power supply, active motor parts can have a charge exceeding 60 μ C. In addition, even after withdrawing the connector 1 s after switching off the voltage, more than 60 V can be present at the free cable ends.

- Wait for the discharge time to elapse.

6.2 Important information about the electrical connection

Naturally cooled 1FN3 linear motors have 3 permanently connected single-core cables to connect the power and 1 protective conductor connection 0.5 m long.

The motor has 2 temperature signal conductors with a minimum length of 0.25 m to connect the temperature sensors to the drive. The two signal cables are combined and encased with a protective flexible tube and a shrink-on sleeve to form one signal cable.

All core ends are open.

Table 6-1 Data of the cables at the primary section

Cables at the primary section	Outer diameter in mm	No. of cores x crossection in mm ²	Minimum permissible bending radius in mm	
			Cables permanently routed	Cables freely routed
Power cable	3.2	4 x (1 x 1.5) single cores	14.0	28.0
Signal cable	3.5	2 x (1 x 0.14)	14.0	28.0

Connect the power cables at the points provided in the power module.

Connect the signal cables at the points provided in a sensor module.

When connecting cables with open conductor ends, ensure there is correct grounding.

Using the cables in the cable carrier

Note

When laying cables, carefully observe the instructions given by the cable carrier manufacturer!

To maximize the service life of the cable carrier and cables, it is not permissible to route cables manufactured from different materials without using spacers in the cable carrier.

The chambers must be filled evenly to ensure that the position of the cables does not change during operation. The cables should be distributed as symmetrically as possible according to their mass and dimensions.

If possible, use only cables with equal diameters in one chamber. Cables with very different outer diameters should be separated by spacers.

The cables must not be fixed in the carrier and must have room to move. It must be possible to move the cables without applying force, in particular in the bending radii of the carrier.

The specified bending radii must be adhered to. The cable fixings must be attached at both ends at an appropriate distance away from the end points of the moving parts in a dead zone.

A tension relief must be installed at least at the ends of the cable carrier. Be sure to mount the cables along the casing without crushing them.

The cables are to be taken off the drum free of twists, i.e. roll the cables off the drum instead of taking them off in loops from the drum flange.

Number of cores and cross-sections for extension cables

Power cables

The cross-section of the power cable conductors is based on the rated current of the motor. The rated current of the motor must be less than the current-carrying capacity of the cable according to DIN EN 60204-1 (routing type C).

The maximum permissible rated motor current is 15.2 A for a power conductor cross-section of 1.5 mm².

Signal cable

The signal cable extension must have 2 cores. The cross-section of the signal cores must be at least 0.14 mm².

6.3 System integration

The subsequent diagram shows an example of a motor integrated into a system with Temp-S connected via SME12x.

6.3 System integration

To connect an absolute value encoder EnDat with 1 V_{pp}, order designation EnDat01 or EnDat02, or SSI with 1 V_{pp}, you require the SME125.

To connect an incremental encoder (sin/cos 1 V_{pp}), you require the SME120.

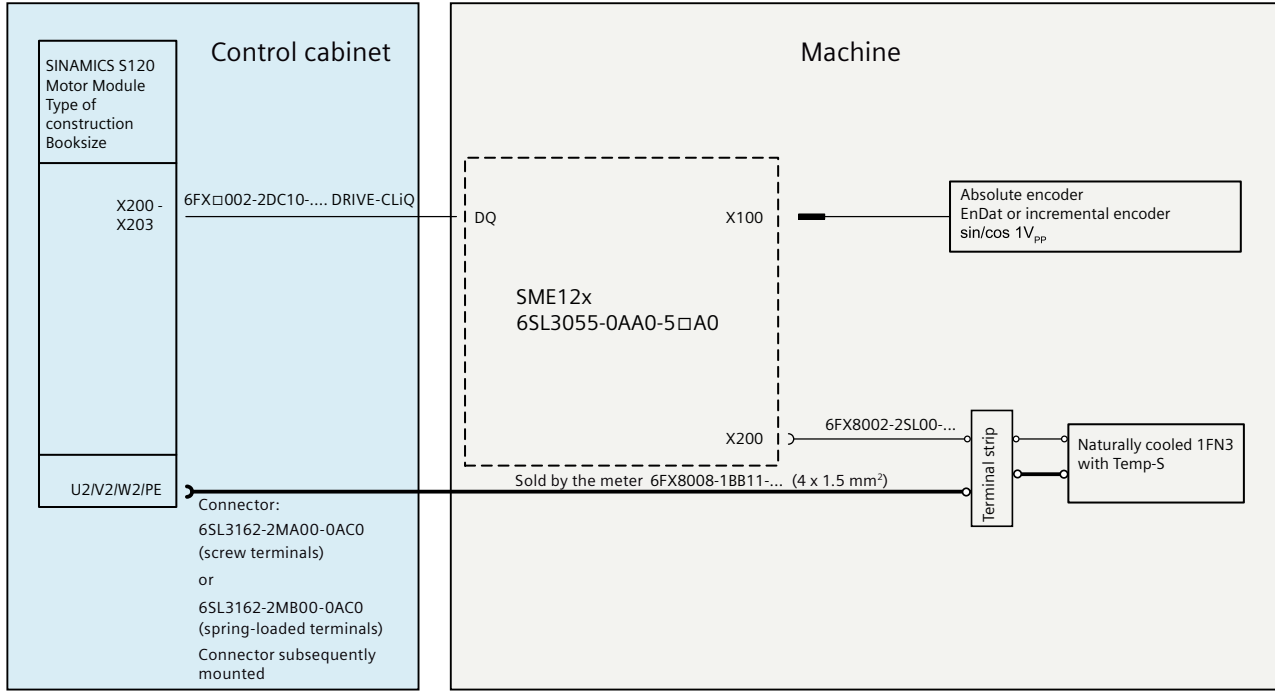


Figure 6-1 System integration with SME12x and separate cables for the signal and power connection (example)

The subsequent diagrams show 2 examples of motors integrated into systems where the Temp-S is connected via a TM120. A DRIVE-CLiQ encoder is connected directly to the TM120.

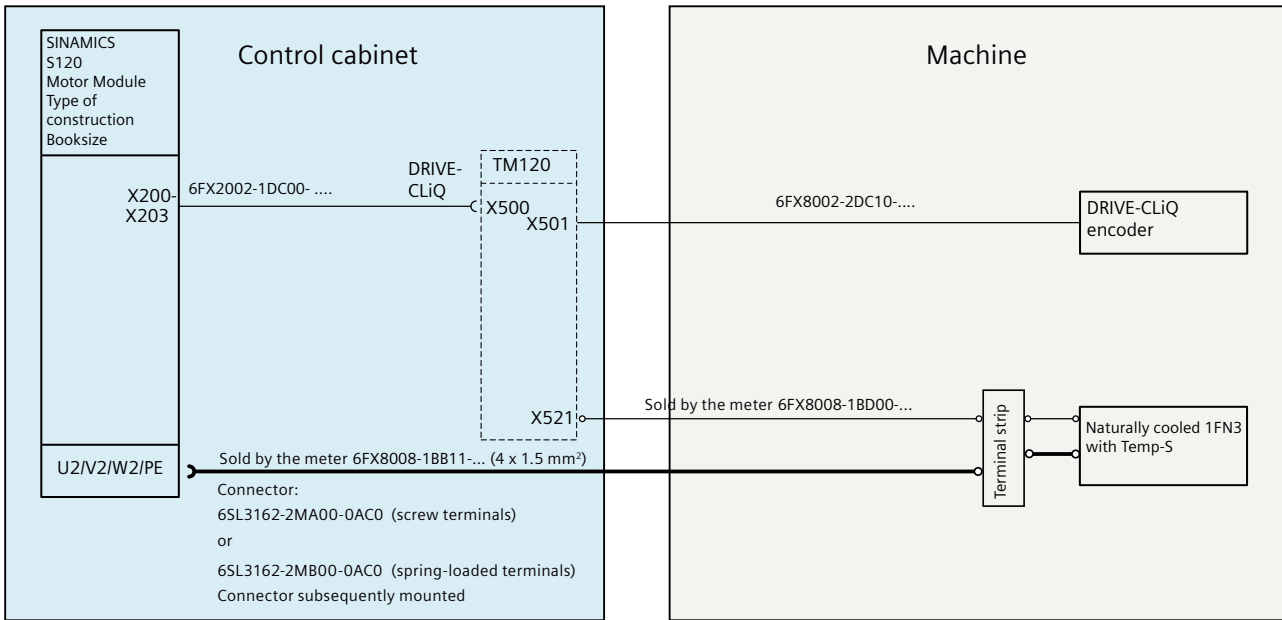


Figure 6-2 System integration with TM120 and separate cables for the signal and power connection (example)

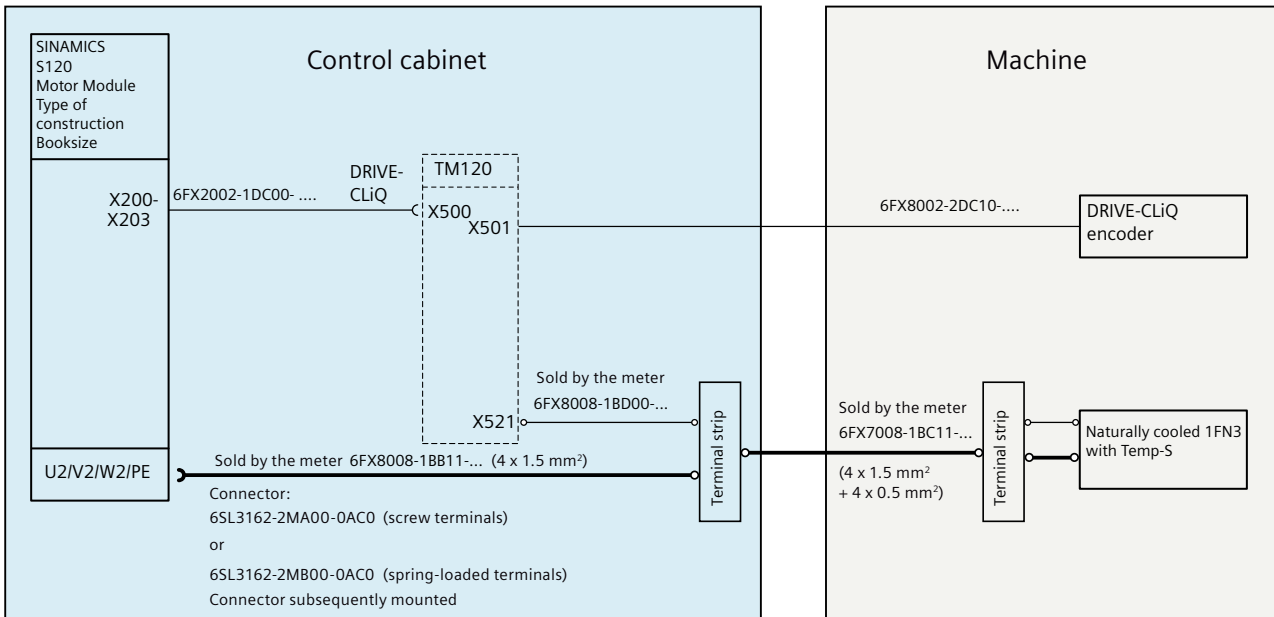


Figure 6-3 System integration with TM120 and combined cable for the signal and power connection (example)

6.4 Power connection

Table 6-2 Power connection - single cores

Color/identification	Connection
green/yellow	PE
black	U
blue	V
red	W

The terminal assignment from the following table is applicable for subsequently mounted connectors:

- Connector 6SL3162-2MA00-0ACO with screw terminals
- Connector 6SL3162-2MB00-0ACO with spring-loaded terminals

Table 6-3 Terminal assignment power connectors for motor modules, types C and D

Connection	Screw/ spring-loaded terminal	Terminal assignment power connector
U	U2	
V	V2	
W	W2	
PE	PE	
-	BR-	
-	BR+	

Cable protection when primary sections are connected in parallel

For the following configurations, you require a circuit breaker for each primary section:

- Several primary sections are connected in parallel to one Motor Module.
- The current-carrying capacity of the feeder cable cross-section is less than the rated current of the Motor Module.

Connect all of the primary sections to be connected in parallel to a Motor Module via a circuit breaker.

- Connect phases U, V, W of the primary section in question to the corresponding terminals of the associated circuit breaker:
U - L1
V - L2
W - L3
- Connect phases U, V, W of the Motor Module to the circuit breaker terminals:
U - T1
V - T2
W - T3
- Connect the auxiliary NO contacts of the circuit breaker in series.
- Connect the auxiliary NO contacts to an input on the CU/NCU.
- Connect the auxiliary NO contact to an external drive fault of the drive using BICO technology. This means that when a circuit breaker trips, the complete drive is shut down (OFF2).
- You can also evaluate the auxiliary NO contact of the circuit breaker using the PLC.
- Adjust the circuit breaker to the rated current of the motor feeder cables +10 %.

Avoiding false circuit breaker tripping

At the subsequent link you can find information in the Internet on the topic of "Influence of high-frequency currents on thermal overload releases of circuit breakers (3RV, 3VU) and overload relays (3RU, 3UA)" and "Additional effects that can result in nuisance tripping".

FAQ entry ID 24153083 (<http://support.automation.siemens.com/WW/llisapi.dll?func=cslib.csinfo&objid=24153083&nodeid0=20358027&caller=view&lang=de&extranet=standard&viewreg=WW&u=NDawMDAxNwAA&siteID=cseus>)

6.5 Signal connection



WARNING

Risk of electric shock when incorrectly connecting the temperature monitoring circuit

In the case of a fault, a Temp-S circuit does not provide safe electrical separation with respect to power circuits.

- Use the TM120 or the SME12x to connect the Temp-S temperature monitoring circuit. You therefore comply with the directives for electrical separation according to DIN EN 61800-5-1 (previously electrical separation according to DIN EN 50178).

NOTICE

Motor destroyed as a result of overtemperature

The motor can be destroyed if the motor winding overheats.

- Connect Temp-S.
- Evaluate Temp-S.
- Ensure that the shutdown time is not exceeded.

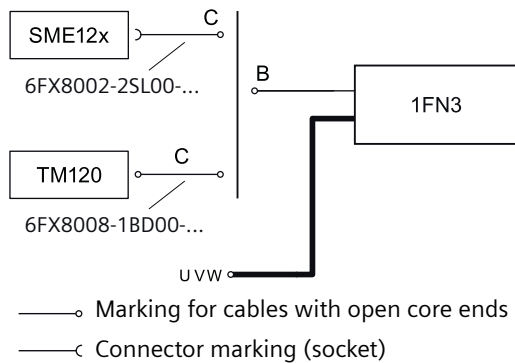


Figure 6-4 Connecting temperature sensors for the SINAMICS S120 drive system

The following table lists the interfaces of the signal cable permanently connected at the primary section with open core ends.

The interfaces and conductor colors are applicable for:

- Temperature sensor cable 6FX8008-1BD00-... (sold by the meter) to the TM120
- Temperature sensor cable 6FX8002-2SL00-... to the SME12x

Table 6-4 Interfaces and conductor colors

Interface	Core color B	Core color C
1TP1: PTC	Gray	Green
1TP2: PTC	Gray	Yellow

6.6 Motor circuit diagram

6.6.1 Circuit diagram, naturally cooled linear motor L-1FN3

The circuit diagram of the primary section looks like this:

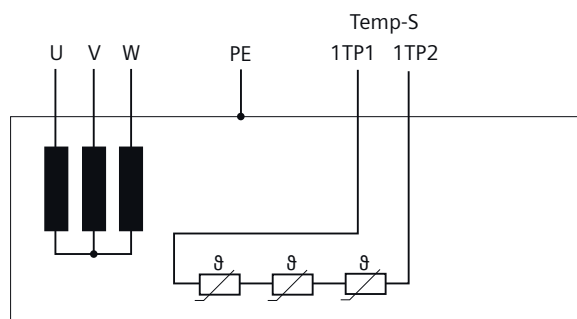


Figure 6-5 Circuit diagram for primary section

6.7 Shielding, grounding, and equipotential bonding

Note

Unshielded flexible leads as connecting cables

As a result of the inherent design, naturally cooled SIMOTICS L-1FN3 linear motors have unshielded flexible leads as connecting cables.

The EMC behavior of these motors depends on the customer-specific installation conditions.

Apply EMC measures against electromagnetic interference fields of the motor.

Important notes regarding shielding, grounding and equipotential bonding

The correct installation and connection of the cable shields and protective conductors is of crucial importance, not only for personal safety but also for interference and immunity to a disturbance.



⚠ WARNING

Risk of electric shock!

Hazardous touch voltages can be present at unused cores and shields if they have not been grounded or insulated.

- Connect the cable shields to the respective housings through the largest possible surface area. Use suitable clips, clamps or screw couplings to do this.
- Connect unused cores of shielded or unshielded cables and their associated shields to the grounded enclosure potential at one end as minimum.
Alternatively:
Insulate conductors and their associated shields that are not used. The insulation must be able to withstand the rated voltage.

Further, unshielded or incorrectly shielded cables can lead to faults in the drive – particularly the encoder – or in external devices, for example.

Electrical charges that are the result of capacitive cross coupling are discharged by connecting the cores and shields.

NOTICE

Device damage as a result of leakage currents for incorrectly connected protective conductor

High leakage currents may damage other devices if the motor protective conductor is not directly connected to the power module.

- Connect the motor protective conductor (PE) directly at the power unit.

NOTICE

Device damage as a result of leakage currents for incorrect shielding

High leakage currents may damage other devices if the motor power cable shield is not directly connected to the power module.

- Connect the power cable shield at the shield connection of the power module.

Note


Apply the EMC installation guideline of the converter manufacturer. For Siemens converters, this is available under document order No. 6FC5297-□AD30-0□P□.


Commissioning


The following information refers to commissioning the hardware components. Siemens provides commissioning support through its Technical Support organization.

The motor can only be commissioned when it has been installed and integrated in a functioning system. The commissioning documentation of all the system components must be taken into account for the commissioning.


7.1 Safety instructions for commissioning

 WARNING
Risk of death and crushing as a result of permanent magnet fields
Severe injury and material damage can result if you do not take into consideration the safety instructions relating to the permanent magnet fields of the secondary sections.
<ul style="list-style-type: none">• Observe the information in Chapter "Danger from strong magnetic fields (Page 29)".

 WARNING
injury and material damage if EMC safety requirements are not observed
Risk of death, serious personal injury, and/or material damage can occur if a machine that does not fulfill the recognized EMC safety requirements is commissioned.
<ul style="list-style-type: none">• Plants and machines with converter-fed low-voltage three-phase motors must fulfill the protection requirements of EMC Guideline 2014/30/EU.• The plant engineer is responsible for ensuring that installation is carried out in an EMC-compliant manner. Apply the EMC installation guideline of the converter manufacturer. For Siemens converters, this is available under document order No. 6FC5297-□AD30-0□P□.

 WARNING
Danger of severe injuries caused by unexpected movements of the motor
Unexpected movements of the motor may cause death, serious injury (crushing) and/or property damage.
<ul style="list-style-type: none">• Never stay in the traversing range while the machine is switched on.• Keep persons away from the traversing areas where there is a danger of crushing.• Ensure that the axis traversing path is free.• Check before switching on the commutation! Also observe the instructions of the drive system being used.• Set the motor current limiting to low values.• Set the speed limit to small values.• Monitor the end positions of the motor.



 WARNING
Risk of electric shock
Voltage is induced at the power connections of the primary section each time a primary section moves with respect to a secondary section - and vice versa.
When the motor is switched on, the power connections of the primary section are also live.
If you touch the power connections you may suffer an electric shock.
<ul style="list-style-type: none">• Only mount and remove electrical components if you have been qualified to do so.• Only work on the motor when the system is in a no-voltage condition.• Do not touch the power connections. Correctly connect the power connections of the primary section or properly insulate the cable connections.• Do not disconnect the power connection if the primary section is under voltage (live).• When connecting up, only use power cables intended for the purpose.• First connect the protective conductor (PE).• First connect the power cable to the primary section before you connect the power cable to the converter.• First disconnect the connection to the converter before you disconnect the power connection to the primary section.• In the final step, disconnect the protective conductor (PE).



! WARNING

Risk of electric shock as a result of residual voltages

There is a risk of electric shock if hazardous residual voltages are present at the motor connections. Even after switching off the power supply, active motor parts can have a charge exceeding 60 μC . In addition, even after withdrawing the connector 1 s after switching off the voltage, more than 60 V can be present at the free cable ends.

- Wait for the discharge time to elapse.

! WARNING

Incorrect commutation

Incorrect commutation can result in uncontrolled motor movements.

- When installing and replacing an encoder, ensure the correct commutation setting.
- Only carry out the associated work if you have been appropriately trained.



! WARNING

Fire hazard resulting from hot surfaces

You can suffer from burns if you touch the surfaces of the motors. The surface temperature of the motors may be more than 100° C (212° F).

- Never touch the motor during or immediately after use.
- Attach the "Hot Surface Do Not Touch" (W017) warning sign close to the source of danger where it can be easily seen.



NOTICE

Thermal damage to temperature-sensitive parts

Some parts of the electrical motor enclosure can reach temperatures that exceed 100 °C. If temperature-sensitive parts, for instance electric cables or electronic components, come into contact with hot surfaces then these parts can be damaged.

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

NOTICE

Motor destroyed as a result of overheating

The motor may overheat without temperature protection and be destroyed.

- Check whether the temperature protection is effective before switching on the DC link voltage for the first time!

NOTICE

Demagnetization of permanent magnets

If, during operation, the maximum permissible temperature of the secondary sections exceeds 70 °C, then there is a risk that the permanent magnets will be demagnetized.

- Ensure that the temperature of the secondary sections when operational does not exceed 70 °C!



NOTICE

Damaged main insulation

In systems where direct drives are used on controlled infeeds, electrical oscillations can occur with respect to ground potential. These oscillations are, among other things, influenced by:

- The lengths of the cables
- The rating of the infeed/regenerative feedback module
- The type of infeed/regenerative feedback module (particularly when an HFD commutating reactor is already present)
- The number of axes
- The size of the motor
- The winding design of the motor
- The type of line supply
- The place of installation

The oscillations lead to increased voltage loads and may damage the main insulation!

- To dampen the oscillations we recommend the use of the associated Active Interface Module or an HFD reactor with damping resistor. Review the documentation of the drive system being used for details. If you have any questions, please contact your local sales partner.

Note

Use an Active Interface Module or the matching HFD line reactor

Please note the following when connecting the motor to a SINAMICS S120 drive system:

The corresponding Active Interface Module or the appropriate HFD line reactor must be used to operate the Active Line Module controlled infeed unit.

7.2 Checklists

Checklists for commissioning linear motors

Before starting any work, get to know and understand the safety instructions and observe the following checklists.

Table 7-1 Checklist (1) - general checks

Check	OK
Are all of the necessary components of the configured drive line-up available, correctly dimensioned, installed and connected?	
Is the manufacturer's documentation for the system components (e.g. drive system, brake, encoder, brake) available?	
If the 1FN3 linear motor is to be fed from a SINAMICS S120 drive system: Is the following, current SINAMICS documentation available? <ul style="list-style-type: none"> • SINAMICS S120 Commissioning Manual • SINAMICS S120 Getting Started • SINAMICS S120 Function Manual • List Manual SINAMICS S120/150 	
If the 1FN3 linear motor is to be fed from a SINAMICS S120 drive system: Was the Chapter "Checklists for commissioning SINAMICS S" in the SINAMICS S120 Commissioning Manual carefully observed?	
If the 1FN3 linear motor is to be fed from a SINAMICS S120 drive system: Is the motor type to be commissioned known? (e.g. 1FN3__ - ____ - ____)	
If the 1FN3 linear motor is to be fed from a SINAMICS S120 drive system: If it involves a "third-party motor", are the following motor data known as a minimum? (A "third-party motor" is a motor that is not (yet) saved as standard in the Siemens commissioning software.) <ul style="list-style-type: none"> • Rated motor current • Motor rated velocity • Motor pole distance • Motor force constant • Maximum motor speed • Maximum motor current • Motor limit current • Motor weight • Phase resistor of the motor winding is cold • Phase inductance of winding 	
Are the environmental conditions in the permissible range?	

7.2 Checklists

Table 7-2 Checklist (2) - checks regarding the mechanical system

Check	OK
Is the motor correctly mounted according to the Siemens specifications and ready to be powered up?	
Is the axis free to move over the complete traversing range?	
Has the air gap height between the secondary section track and the primary section been checked?	
If a motor holding brake is being used, is this functioning correctly?	
Does the weight balance required for a suspended axis exist?	
Has the encoder been correctly mounted and adjusted according to the manufacturer's data?	
Are mechanical limit stops in place and tightly bolted to both ends of the traversing path?	
Are moving supply lines correctly routed in a tow chain assembly?	
Have measures been taken to relieve strain on the cables?	
Have all of the installation materials been removed, e.g. protection mats with yoke function?	

Table 7-3 Checklist (3) - checks regarding the electrical system

Check	OK
Has all wiring work been successfully completed?	
Is the protective conductor correctly connected?	
Is the ground of the motors directly connected to the ground of the power modules (short distance to avoid high discharge currents)?	
Are all connectors correctly plugged in and screwed in place?	
Are the motor power cables correctly connected?	
Have the control cables been connected according to the specified interface configuration?	
Have the motor power cables been correctly connected to the Motor Module(s) with the UVW phase sequence (clockwise rotating field)?	
Do the temperature monitoring circuits fulfill the specifications of protective separation?	
Before commissioning and switching on the DC link voltage for the first time, have you checked the temperature monitoring circuit to ensure that it correctly trips?	
Has the encoder been correctly connected?	
Have the digital and analog signals been routed using cables that are separate from the power cables?	
When designing and installing, have you carefully complied with the EMC installation guideline provided by the converter manufacturer?	
Have you ensured that temperature-sensitive components (electric cables, electronic components) are not placed on hot surfaces?	
Have the line-side and motor-side power cables been dimensioned and routed in accordance with the environmental and routing conditions?	
Have the maximum permissible cable lengths between the frequency converter and the motor (depending on the type of cables used) been observed?	

7.3 Checking the insulation resistance

Notes for checking the insulation resistance

Installation inspection, preventive maintenance and troubleshooting are examples of required checking of the insulation resistance on a machine/system with direct drives or directly on the motors.



WARNING

Risk of electric shock

If you check the insulation resistance using high voltage, this can damage the motor insulation. There is a risk of death or serious injury if energized parts are touched.

- Only use test equipment that is in compliance with DIN EN 61557-1, DIN EN 61557-2 and DIN EN 61010-1 or the corresponding IEC standards.
- Check the insulation resistance on the individual motors only according to the following procedure.
- If a DC voltage > 1000 V or an AC voltage is necessary to test the machine/system, then coordinate this test with your local sales partner.
- Carefully observe the operating instructions of the test device.

Procedure

1. Interconnect all winding and temperature sensor connections. Check against the PE connection or the motor enclosure with a maximum voltage of 1000 VDC for maximally 60 s.
2. Connect all temperature sensor connections to the PE connection and interconnect all winding connections. Check the winding against the PE connection or the motor enclosure with a maximum voltage of 1000 VDC for maximally 60 s.



Each insulation resistance must be at least 10 MΩ. A lower insulation resistance indicates that the motor insulation is damaged.



WARNING


Risk of death due to electric shock!

During and immediately after the measurement, in some instances, the terminals are at hazardous voltage levels, which can result in death if touched.


- Never touch the terminals during or immediately after measurement.

Operation

8.1 Safety instructions for operation


 WARNING
<p>Danger to persons in areas with rotary and crushing motion</p> <p>Machine parts driven by the linear motors can cause significant injury, e.g. through crushing. This is as a result of the very high speeds and acceleration rates – as well as low friction and self clamping.</p> <ul style="list-style-type: none"> • Keep persons away from the axis traversing parts and areas where there is a danger of crushing.

NOTICE
<p>Material damage caused by incorrect operation</p> <p>Improper operation can lead to serious material damage.</p> <ul style="list-style-type: none"> • Only operate the motor at locations equipped with full weather protection: The environment must be dry and protected against heat and cold. • Keep the area where the motor is installed free of all foreign bodies. Foreign bodies include metal chips, particles, liquids, oils, screws, tools, etc. • Only operate the motor in conjunction with effective temperature protection.

 WARNING
<p>Faults while the motor is operational</p> <p>Examples of faults that indicate functional impairments are:</p> <ul style="list-style-type: none"> • Higher power consumption • Changed temperatures • Vibration • Unusual noise • Unusual smells • Response of the monitoring devices <p>Faults while the motor is operational can result in death, severe injury or material damage.</p> <ul style="list-style-type: none"> • Immediately inform the maintenance personnel. • If in doubt, shut down the motor immediately, taking into account the plant-specific safety regulations.

8.2 Handling faults

If there are deviations from normal operation or if faults occur, initially proceed according to the following list. In this regard, observe the relevant chapters in the documentation associated with the components of the complete drive system.

 WARNING
<p>Risk to life as a result of non-functioning protective devices</p> <p>Protective devices that are not functioning can result in death, serious injury or material damage.</p> <ul style="list-style-type: none"> • Do not deactivate protective devices. This also applies to test operation. • Only work with protective devices that are fully functional.

<p>NOTICE</p> <p>Damage to the machine caused by faults</p> <ul style="list-style-type: none"> • Resolve the cause of the fault as specified in the remedial measures section. • Repair damage to the machine. • Replace the damaged motors.

Table 8-1 Possible faults

Fault	Origin of disturbance (according to the following table)											
	A	B	C	D								
Motor blocked				D								
Noise during operation				D	E					K		
High temperature rise during no-load operation				D								
High temperature rise when under load	A			D								
Uneven running								H	J			
Axis is sluggish					E					K	L	

Table 8-2 Key to causes of faults and remedial measures

No.	Cause of fault	How to remedy the problem
A	Overloading	Reduce load
B	Interrupted phase in the supply cable	Check frequency converter and supply cables
C	Interrupted phase in the supply cable after switching on	Check frequency converter and supply cables
D	Motor commutation is faulty	Check the commutation, if required re-adjust the commutation angle offset
E	Winding short-circuit or phase short-circuit in the primary section winding	Measure the winding resistances and insulation resistances, motor replacement after consultation with the manufacturer
H	Insufficient grounding of the motor and/or encoder cable	Check the grounding

No.	Cause of fault	How to remedy the problem
J	Drive controller gain too high	Adjust the controller
K	Motor components are rubbing	Determine cause and adjust components
	Foreign bodies in the air gap	Consult the manufacturer
	Guide rail is tight	Check that the guide rails are not distorted and are parallel to one another
L	Poor alignment	Align machine guides
M	Shocks from coupled machine	Check coupled machine

If the fault still cannot be resolved after applying the measures specified above, contact Technical Support or your local sales partner.

Maintenance

9.1 Safety instructions for maintenance

 **WARNING**

Risk of injury as a result of inadvertent traversing motions

If, with the motor switched on, you work in the traversing range of the motor, and the motor undesirably moves, this can result in death, injury and/or material damage.

- Always switch off the motor before working in the traversing range of the motor. Ensure that the motor is in a completely no-voltage condition.

 **WARNING**

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

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

- Observe the information in Chapter "Danger from strong magnetic fields (Page 29)".



 **WARNING**

Danger of crushing by permanent magnets of the secondary section


The forces of attraction of magnetic secondary sections act on materials that can be magnetized. The forces of attraction increase significantly close to the secondary section. The trigger threshold of 3 mT for a risk of injury due to attraction and projectile effect is reached at a distance of 150 mm (directive 2013/35/EU). Secondary sections and materials that can be magnetized can suddenly slam together unintentionally. Two secondary sections can also unintentionally slam together.

There is a significant risk of crushing when you are close to a secondary section.

Close to the secondary section, the forces of attraction can be several kN - example: Magnetic attractive forces are equivalent to a force of 100 kg, which is sufficient to trap a body part.

- Do not underestimate the strength of the attractive forces, and work very carefully.
- Wear safety gloves.
- The work should be done by at least two people.
- Do not unpack the secondary section until immediately before installation.
- Never unpack several secondary sections at the same time.
- Never place secondary sections next to one another without taking the appropriate precautions.
- Never place any metals on magnetic surfaces and vice versa.
- Never carry any objects made of magnetizable materials (for example watches, steel or iron tools) and/or permanent magnets close to the secondary section! If tools that can be magnetized are nevertheless required, then hold the tool firmly using both hands. Slowly bring the tool to the secondary section.
- Immediately mount the secondary section that has just been unpacked.
- When mounting and removing secondary sections, we recommend that you use protective mats with magnetic self-holding function
- Never remove several secondary sections at the same time.
- Immediately after removal, pack the removed secondary section in the original packaging.
- Always comply with the specified procedure.
- Avoid inadvertently traversing direct drives.
- Keep the following tools at hand to release parts of the body (hand, fingers, foot etc.) trapped between two components:
 - A hammer (about 3 kg) made of solid, non-magnetizable material
 - Two pointed wedges (wedge angle approx. 10° to 15°, minimum height 50 mm) made of solid, non-magnetizable material (e.g. hard wood).



 **WARNING**

Risk of burning when touching hot surfaces

There is a risk of burning when touching hot surfaces immediately after the motor has been operational.

- Wait until the motor has cooled down.



⚠ WARNING

Risk of electric shock due to incorrect connection

There is a risk of electric shock if direct drives are incorrectly connected. This can result in death, serious injury, or material damage.

- Motors must always be precisely connected up as described in these instructions.
- Direct connection of the motors to the three-phase supply is not permissible.
- Consult the documentation of the drive system being used.



⚠ WARNING

Risk of electric shock

Voltage is induced at the power connections of the primary section each time a primary section moves with respect to a secondary section - and vice versa.

When the motor is switched on, the power connections of the primary section are also live.

If you touch the power connections you may suffer an electric shock.

- Only mount and remove electrical components if you have been qualified to do so.
- Only work on the motor when the system is in a no-voltage condition.
- Do not touch the power connections. Correctly connect the power connections of the primary section or properly insulate the cable connections.
- Do not disconnect the power connection if the primary section is under voltage (live).
- When connecting up, only use power cables intended for the purpose.
- First connect the protective conductor (PE).
- First connect the power cable to the primary section before you connect the power cable to the converter.
- First disconnect the connection to the converter before you disconnect the power connection to the primary section.
- In the final step, disconnect the protective conductor (PE).




⚠ WARNING

Risk of electric shock as a result of residual voltages


There is a risk of electric shock if hazardous residual voltages are present at the motor connections. Even after switching off the power supply, active motor parts can have a charge exceeding 60 μC . In addition, even after withdrawing the connector 1 s after switching off the voltage, more than 60 V can be present at the free cable ends.

- Wait for the discharge time to elapse.

 WARNING
Risk of injury when carrying out disassembly work
Risk of death, serious personal injury and/or material damage when carrying out disassembly work.
<ul style="list-style-type: none">• When disassembling, observe the information in Chapter "Decommissioning".

The motors have been designed for a long service life. Carefully ensure that maintenance work is correctly performed, e.g. removing chips and particles from the air gap.


For safety reasons it is not permissible to repair the motors:

 WARNING
Risk of injury when changing safety-relevant motor properties
Changing safety-relevant motor properties may result in death, serious injury and/or material damage.
Examples of changed safety-relevant motor properties:
Damaged insulation does not protect against arcing. There is a risk of electric shock!
Damaged sealing no longer guarantees protection against shock, ingress of foreign bodies and water, which is specified as IP degree of protection on the rating plate.
Diminished heat dissipation can result in the motor being prematurely shut down and in machine downtime.
<ul style="list-style-type: none">• Do not open the motor.

Note

If incorrect changes or corrective maintenance are carried out by you or a third party on the contractual objects, then for these and the consequential damages, no claims can be made against Siemens regarding personal injury or material damage.

Technical Support is available for any questions you might have. Contact data is provided in the introduction.

 CAUTION
Sharp edges and falling objects
Sharp edges can cause cuts and falling objects can injure feet.
<ul style="list-style-type: none">• Always wear safety shoes and safety gloves!

9.2 Inspection and maintenance

Performing maintenance work on the motor

Note

It is essential that you observe the safety information provided in this documentation.

As a result of their inherent principle of operation, linear motors are always wear-free. To ensure that the motor functions properly and remains free of wear, the following maintenance work needs to be carried out:

- Regularly check that the traversing paths are free
- Regularly clean the motor space and remove foreign bodies (e.g. chips)
- Regularly check the condition of the motor components.
- Check the current consumption in the defined test cycle (compare with values of the reference travel)

Intervals between maintenance

Since operating conditions differ greatly, it is not possible to specify intervals between maintenance work.

Indications that maintenance work is required

- Dirt in the motor cabinet
- Distinctive changes in the behavior of the machine
- Unusual sounds emitted by the machine
- Problems with positioning accuracy
- Higher current consumption

Decommissioning and disposal

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

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

- Observe the information in Chapter "Danger from strong magnetic fields (Page 29)".

10.1 Decommissioning

Sequence when decommissioning and disassembling the motor

**WARNING****Risk of injury and material damage**

Injury can occur if you do not observe the specified sequence when decommissioning and disassembling the motor. Further, motor components could be damaged or destroyed.

- Comply with the specified sequence when carrying out decommissioning work.
- Dismantle the motors by carrying out the work steps of the respective procedure for installing the motor in the reverse order.

Procedure

1. Bring the motor into a no-voltage condition. Wait until the DC link of the power unit has been discharged.
2. Allow the motor to cool down for at least 30 min.
3. Disconnect the power and signal cables.
4. Insulate uncovered power connections.
5. Remove chips, dirt, foreign particles, etc. from the motor.

10.2 Disposal


6. Remove the primary sections. Apply the installation technique in the inverse sequence. When removing a linear motor with a divided secondary section track, you must first slide the primary section on one end of the secondary section track, for example. Then remove the first secondary section that is not covered. Pack the removed secondary section in the original packaging before you remove the next secondary section. Proceed with the other secondary sections in the same way. Then you have to move the primary section to the end without secondary section and remove the remaining secondary section track. Only then can you disassemble the slide together with the linear guide and the primary section.
 7. Pack the motor components in the original packaging.
 8. Correctly store the motor components.
-

10.2 Disposal

Recycling and disposal



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

 WARNING
Injury or material damage if not correctly disposed of
If you do not correctly dispose of direct drives or their components (especially components with permanent magnets), then this can result in death, severe injury and/or material damage.
<ul style="list-style-type: none">• Ensure that direct drives and their associated components are correctly disposed of.

Main constituents of a proper disposal procedure

- Complete demagnetization of the components that contain permanent magnets
- Components that are to be recycled should be separated into:
 - Electronics scrap (e.g. encoder electronics, Sensor Modules)
 - Electrical scrap (e.g. motor windings, cables)
 - Scrap iron (e.g. laminated cores)
 - Aluminum
 - Insulating materials
- No mixing with solvents, cold cleaning agents, or residue of paint, for example

10.2.1 Disposing of secondary sections

Demagnetization of the secondary sections

Disposal companies specialized in demagnetization use special disposal furnaces. The insides of the disposal furnace consist of non-magnetic material.

The secondary sections are put in the furnace in a solid, heat-resistant container (such as a skeleton container) made of non-magnetic material and left in the furnace during the entire demagnetization procedure. The temperature in the furnace must be at least 300° C during a holding time of at least 30 minutes.

Escaping exhaust must be collected and made risk-free without damaging the environment.

10.2.2 Disposal of packaging

Packaging materials and disposal

The packaging and packing aids we use contain no problematic materials. With the exception of wooden materials, they can all be recycled and should always be disposed of for reuse. Wooden materials should be burned.

Only recyclable plastics are used as packing aids:

- Code 02 PE-HD (polyethylene)
- Code 04 PE-LD (polyethylene)
- Code 05 PP (polypropylene)
- Code 04 PS (polystyrene)

Appendix

A.1 Manufacturer's recommendations

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.

A.1.1 Supply source for spacer foils

SAHLBERG GmbH & Co. KG	
	Internet address: (https://www.sahlberg.de)

A.1.2 Supply source for threadlocker

Henkel AG & Co. KGaA	
Threadlocker	Internet address: (https://www.henkel.com)

A.2 List of abbreviations

BGV	Binding national health and safety at work regulations in Germany, accident prevention regulations
CE	Conformité Européenne (European Conformity)
DIN	Deutsches Institut für Normung (German standards organization)
EU	European Community
EMF	Electromagnetic fields
EMC	Electromagnetic compatibility

EN	European standard
HFD	High-frequency damping
HW	Hardware
IATA	International Air Transport Association
IEC	International Electrotechnical Commission
ISO	International Standardization Organization
IP	International Protection or Ingress Protection; type of protection für electric devices according to DIN EN 60529
PDS	Power drive system
PE	Protective earth
PELV	Protective extra low voltage
PTC	Temperature sensor with positive temperature coefficient
RoHS	Restriction of (the use of certain) Hazardous Substances
SMC	Sensor Module Cabinet
SME	Sensor Module External
PLC	Programmable logic controller
SSI	Synchronous serial interface
SW	Software
Temp-S	Temperature monitoring circuit for switching off the drive at overtemperature
TM	Terminal Module
UL	Underwriters Laboratories

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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Motion Control
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91050 ERLANGEN
Germany

Scan the QR code
for more informa-
tion about
SIMOTICS.

