

SIEMENS



Operating Instructions

SIMOTICS

SIMOTICS L-1FN3 Linear Motors

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SIMOTICS

Drive Technology 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.

Introduction

About these operating instructions

These operating instructions describe the motor and explain how to handle the motor from the delivery to the disposal stage.

- Before you start using the motor, you must read these operating instructions to ensure safe, problem-free operation and to maximize the service life.

These operating instructions complement the relevant SIEMENS Configuration Manual.

Siemens strives continually to improve the quality of information provided in these operating instructions.

- If you find any mistakes or would like to offer suggestions about how this document could be improved, contact the Siemens Service Center.
- Always follow the safety instructions and notices in these operating instructions.

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

Text features

In addition to the notes that you must observe for your own personal safety as well as to avoid material damage, in these operating instructions you will find the following text features:

Operating instructions

Operating instructions with the specified sequence are designated using the following symbols:



The arrow indicates the start of the operating instructions.

The individual handling steps are numbered.

1. Execute the operating instructions in the specified sequence.



The square indicates the end of the operating instruction.

Operating instructions without a specified sequence are identified using a bullet point:

- Execute the operating instructions.

Enumerations

- Enumerations are identified by a bullet point without any additional symbols.
 - Enumerations at the second level are hyphenated.

Notes

Notes are shown as follows:

Note

A Note is an important item of information about the product, handling of the product or the relevant section of the document. Notes provide you with help or further suggestions/ideas.

Target group

These operating instructions are intended for electricians, fitters, service technicians and warehouse personnel.

Training

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

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

Technical Support

Country-specific telephone numbers for technical support are provided on the Internet under Contact:

Technical Support (<https://support.industry.siemens.com>)

Recommended additional documents

System components	Manufacturer's manuals
Motor	• Configuration Manual • Safety instructions for direct drives
Encoder system	• User Manual • Operating Instructions
Brake	• Operating Instructions
Sensor module	• Manual
Drive system	• Commissioning Manual • List Manual • Function Manual

More information

Information on the following topics is available under the link:

- Ordering documentation/overview of documentation
- Additional links to download documents
- Using documentation online (find and search in manuals/information)

More information (<https://support.industry.siemens.com/cs/de/en/view/108998034>)

Please send any questions about the technical documentation (e.g. suggestions for improvement, corrections) to the following e-mail address:

docu.motioncontrol@siemens.com

Any manuals or operating instructions that you may have in printed or electronic file form could be of an older product version.

You can also request all descriptions and safety instructions from your local Siemens office.

My support

The following link provides information on how to create your own individual documentation based on Siemens content, and adapt it for your own machine documentation:

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

Note

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

Later, you can log on with your login data.

Websites of third parties

This publication contains hyperlinks to websites of third parties. Siemens does not take any responsibility for the contents of these websites or adopt any of these websites or their contents as their own, because Siemens does not control the information on these websites and is also not responsible for the contents and information provided there. Use of these websites is at the risk of the person doing so.

Internet address for products

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

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Fundamental safety instructions

1.1 General safety instructions



DANGER

Danger to life due to live parts and other energy sources

Death or serious injury can result when live parts are touched.

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

Generally, six steps apply when establishing safety:

1. Prepare for shutdown and notify all those who will be affected by the procedure.
2. Disconnect the machine from the supply.
 - Switch off the machine.
 - Wait until the discharge time specified on the warning labels has elapsed.
 - Check that it really is in a no-voltage condition, from phase conductor to phase conductor and phase conductor to protective conductor.
 - Check whether the existing auxiliary supply circuits are de-energized.
 - Ensure that the motors cannot move.
3. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems, or water.
4. Isolate or neutralize all hazardous energy sources by closing switches, grounding or short-circuiting or closing valves, for example.
5. Secure the energy sources against switching on again.
6. Ensure that the correct machine is completely interlocked.

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



WARNING

Danger to life through a hazardous voltage when connecting an unsuitable power supply

Touching live components can result in death or severe injury.

- 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

Danger to life when live parts are touched on damaged motors/devices

Improper handling of motors/devices can damage them.

For damaged motors/devices, hazardous voltages can be present at the enclosure or at exposed components.

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



! WARNING

Danger to life through electric shock due to unconnected cable shields

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

Danger to life due to electric shock when not grounded

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

Danger to life due to electric shock when opening plug connections in operation

When opening plug connections in operation, arcs can result in severe injury or death.

- Only open plug connections when the equipment is in a no-voltage state, unless it has been explicitly stated that they can be opened in operation.

NOTICE**Material damage due to loose power connections**

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

- Tighten all power connections with the specified tightening torques, e.g. line supply connection, motor connection, DC link connections.
- Check all power connections at regular intervals. This applies in particular after transport.

**WARNING****Danger to life through unexpected movement of machines when using mobile wireless devices or mobile phones**

Using mobile wireless devices or mobile phones with a transmit power > 1 W closer than approx. 2 m to the components may cause the devices to malfunction, influence the functional safety of machines therefore putting people at risk or causing material damage.

- Switch the wireless devices or mobile phones off in the immediate vicinity of the components.

**WARNING****Danger of an accident occurring due to missing or illegible warning labels**

Missing or illegible warning labels can result in accidents involving death or serious injury.

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

 WARNING

Danger to life when safety functions are inactive

Safety functions that are inactive or that have not been adjusted accordingly can cause operational faults on machines that could lead to serious injury or death.

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

Note

Important safety notices for Safety Integrated functions

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

 WARNING

Danger to life from electromagnetic fields

Electromagnetic fields (EMF) are generated by the operation of electrical power equipment, such as transformers, converters, or motors.

People with pacemakers or implants are at particular risk in the immediate vicinity of this equipment.

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


! WARNING
Danger to life from permanent-magnet fields

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

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

! WARNING
Risk of injury caused by moving parts or parts that are flung out

Touching moving motor parts or drive output elements and loose motor parts that are flung out (e.g. feather keys) in operation 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
Danger to life due to fire if overheating occurs because of insufficient cooling

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

- Comply with the specified coolant requirements for the motor.

! WARNING
Danger to life due to fire as a result of overheating caused by incorrect operation

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

Risk of injury due to touching hot surfaces

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

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

Measures when maintenance is required:

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

1.2 Handling electrostatic sensitive devices (ESD)

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



NOTICE

Damage through 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).

1.3 Industrial security

Note

Industrial security

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 only represent one component of such a concept.

The customer is responsible for preventing unauthorized access to its plants, systems, machines and networks. Systems, machines and components should only be connected to the enterprise network or the internet if and to the extent necessary and with appropriate security measures (e.g. use of firewalls and network segmentation) in place.

Additionally, Siemens' guidance on appropriate security measures should be taken into account. For more information about industrial security, please visit:

Industrial security (<http://www.siemens.com/industrialsecurity>).

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

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

Industrial security (<http://www.siemens.com/industrialsecurity>).



WARNING

Danger to life as a result of unsafe operating states resulting from software manipulation

Software manipulations (e.g. viruses, trojans, malware 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.

1.4 Residual risks of power drive systems

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

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

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

Description

2.1 Use for the intended purpose

 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. • If, in an exceptional case, the motors are not used in industrial or commercial plants and systems, then ensure that increased requirements (e.g. regarding touch protection) are complied with. • 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 aggressive 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 Siemens office if you have any questions relating to correct 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 Siemens office.

 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

Personal injury and material damage by noncompliance with directive 2006/42/EC

There is a risk of death, serious injury and/or material damage if 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 Directive 2006/42/EC.
- Please take into account all safety instructions and provide these to end users.

Please take note of national and international license terms when operating direct motors so that no patent rights are violated.

Applications for peak load motors

Combined with a drive system with closed-loop control, peak load motors are well suited as direct drives for linear motion, e.g. for:

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

Applications for continuous load motors

Combined with a drive system with closed-loop control, continuous load motors are well suited as direct drives for linear motion, e.g. for:

- Oscillating motion (e.g. out-of-center machining)
- Applications with high process forces (e.g. grinding, turning, etc.)
- Vertical axes without weight compensation, quills
- Handling, Cartesian robots

2.2 Technical features and ambient conditions

2.2.1 Directives and standards

Standards that are complied with

SIMOTICS S, SIMOTICS M, SIMOTICS L, SIMOTICS T, SIMOTICS A motors - subsequently called the "SIMOTICS motor series" - comply with the following 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 IEC / EN 60034:

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

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

Relevant directives

The following directives are relevant for SIMOTICS motors.

European Low-Voltage Directive

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

European Machinery Directive

SIMOTICS motors do not fall within the area of validity 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 area of validity covered by the EMC Directive. The products are not considered as devices in the sense of the directive.





Eurasian conformity

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



China Compulsory Certification

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

CCC product certification

(<https://support.industry.siemens.com/cs/products?search=CCC&ctp=Certificate&mf=ps&o=DefaultRankingDesc&pnid=13347&lc=de-VW>)



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 important that you carefully observe the contents of the quotation and that there is a cUL mark on the rating plate!

Quality systems

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

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

Certificates for SIMOTICS motors

(<https://support.industry.siemens.com/cs/products?ctp=Certificate&mf=ps&pnid=13347&lc=de-VW>)

2.2.2 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.

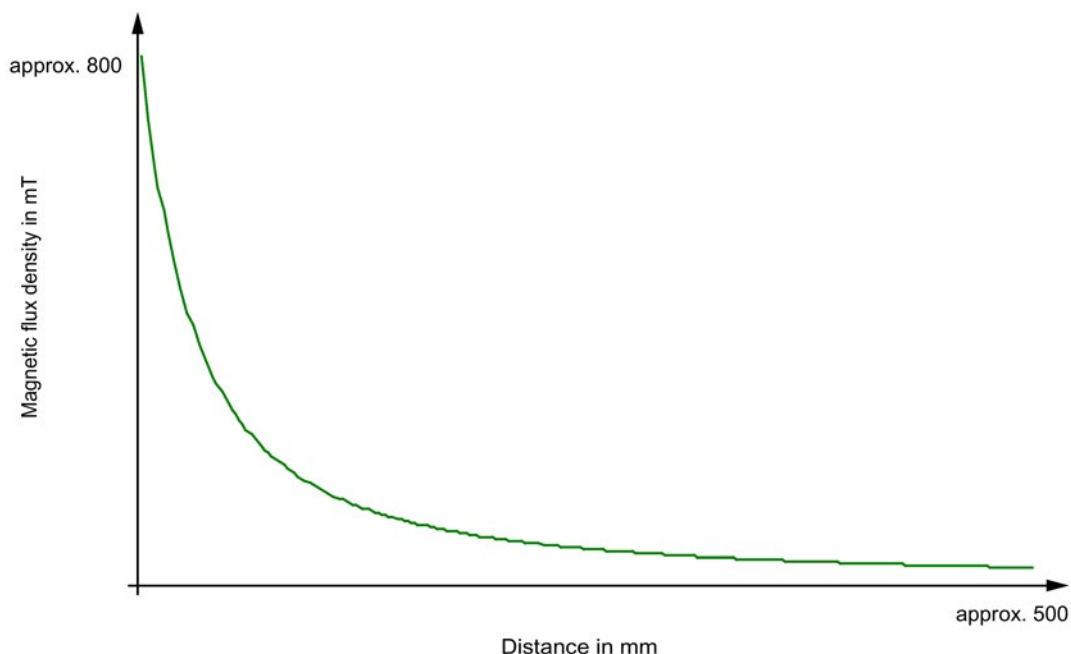


Figure 2-1 Schematic representation of the static magnetic field of a secondary section, depending on distance

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.

- 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 assembly.
- 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.
- 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.
- Press the emergency stop switch and, where necessary, switch off the main switch if the machine is live.
- Administer FIRST AID. Call for further help if required.
- To free jammed body parts (e.g., hands, fingers, feet), pull apart components that are clamped together.
 - To do this, use a hammer to drive a wedge into the separating rift
 - Release the jammed body parts.
- If necessary, call for an EMERGENCY DOCTOR.

Material damage caused by strong magnetic fields

NOTICE
Data loss caused by strong magnetic fields 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. • Do not carry any magnetic/electronic data media and no electronic devices when you are close to a secondary section!

2.2.3 Technical features

Table 2- 1 Standard version of the 1FN3 range of motors: Technical features

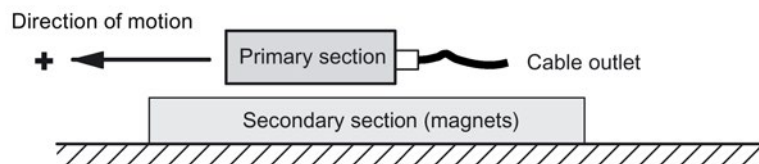
Technical feature	Design
Motor type	Permanently excited synchronous linear motor
Type of construction	Individual components
Degree of protection according to EN 60034-5	- Primary section: IP65 - Mounted motor: The degree of protection depends on the machine design and must therefore be realized by the machine manufacturer; minimum requirement: IP23
Cooling method	Water cooling - Maximum pressure in the cooling circuit: 10 bar = 1 MPa - Wiring: with G1/8 pipe thread (in compliance with DIN EN ISO 228-1); special connectors are required to connect hoses/pipes
Thermal motor protection	In the primary section: 1x PTC for thermistor triplet with response threshold +120 °C (according to DIN 44081/44082)
Temperature monitoring	In the primary section: 1FN3xxx-xxxxx-xxx1 with 1 x KTY 84 (according to EN 60034-11) 1FN3xxx-xxxxx-xxx3 with 1 x Pt1000 (according to EN 60751)
2nd rating plate	Enclosed separately
Insulation of motor winding according to EN 60034-1	Temperature class 155 (F)
Magnet material	Rare earth material
Connection, electrical	1FN3050: Signal and power cables with connectors or open ends permanently connected to the motor 1FN3100 ... 1FN3900: Terminal panel with cover integrated in the motor, with metric cable glands for signal and power cables. Additional cover with heavy-gauge threaded joint for combined lines with 1FN3100-xW ... 1FN3900-xW
Encoder system	- Not included in the scope of supply - Selection based on application-specific and converter-specific supplementary conditions

2.2.4 Direction of motion of the motor

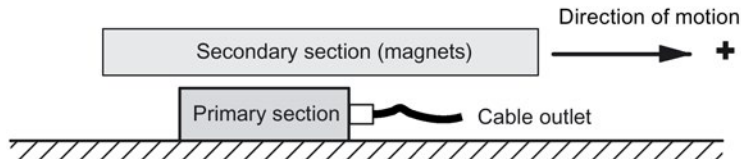
Defining the traversing direction

If the primary section is connected to the terminals of the terminal box with the phase sequence U-V-W and is supplied with current by a three-phase system with a clockwise rotating field, the direction of motion of the primary or secondary section is positive.

1. primary section moveable, secondary section permanently fixed



2. primary section permanently fixed, secondary section movable



2.2.5 Environmental conditions for stationary use

Based on DIN EN 60721-3-3 (for fixed installation locations that are weather protected)

Table 2- 2 Climatic ambient conditions

Lower air temperature limit:	- 5 °C (deviates from 3K3)
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
Fixed location:	Class 3K3

Devices can only be operated in locations that are fully protected against the weather (in halls or rooms).

Table 2- 3 Biological ambient conditions

Fixed location:	Class 3B1
-----------------	-----------

Table 2- 4 Chemical ambient conditions

Fixed location:	Class 3C2 Different to class 3C2: Operating site in the immediate vicinity of industrial plants with chemical emissions
-----------------	--

Table 2- 5 Mechanically active ambient conditions

Fixed location:	Class 3S1
-----------------	-----------

Table 2- 6 Mechanical ambient conditions

Fixed location:	Class 3M3
-----------------	-----------

2.2.6 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 IP65 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. Provide suitable covers for this. As of a distance of 150 mm from the surface of the secondary section, ferromagnetic particles are generally no longer attracted.

Avoid using abrasive or aggressive 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.

2.2.7 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 60034-14 (IEC 60034-14) is not reached.

Excessive vibration caused by resonance effects can frequently be avoided by making suitable settings. Contact Mechatronic Support if you require help in applying remedial measures. You can find contact data in the Introduction under "Technical Support".

2.2.8 Noise emission

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

- Machine design
- Encoder system
- Storage
- 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. Contact Mechatronic Support if you require help in applying remedial measures. You can find contact data in the Introduction under "Technical Support".

2.3 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 2- 7 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.

2.4 Rating plate data (type plate)

The rating plate (type plate) lists the valid technical data for a primary section. A second rating plate is provided separately for a primary section.

Data on the rating plate

The following data is on the rating plate:

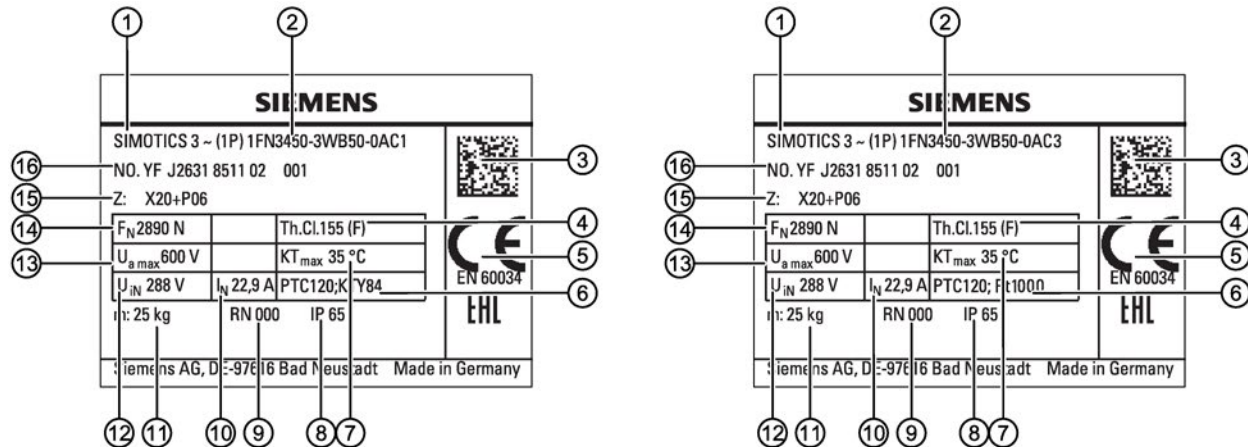


Figure 2-2 Examples of rating plates for primary sections

Table 2- 8 Elements on the rating plate for primary sections

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

2.5 Design

2.5.1 Motor components

Basic characteristics of the motor

1FN3 motors are permanent-magnet synchronous linear motors with a modular cooling concept. Depending on the accuracy requirements, the motor can be optionally operated with a primary section precision cooler and/or a secondary section cooling. To a large extent, the motors are then thermally neutral with respect to the machine itself.

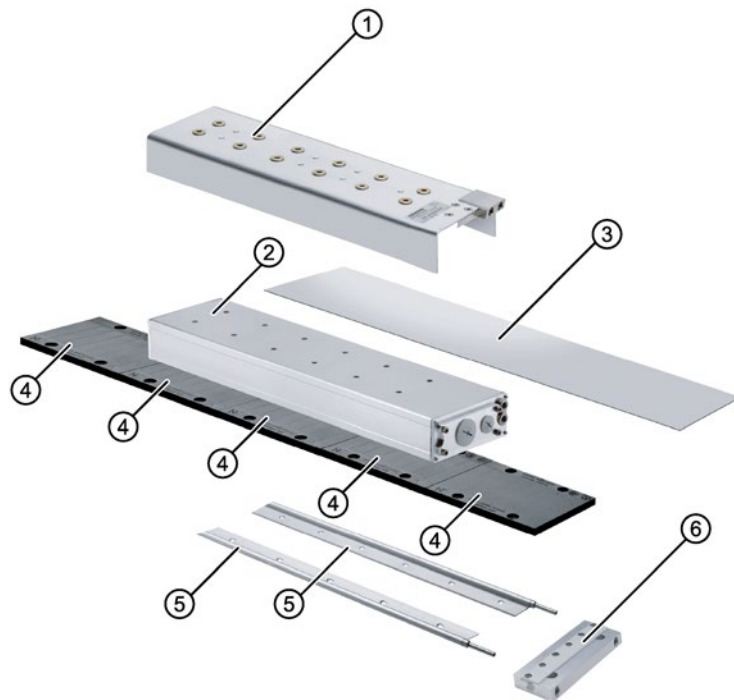
The motor is delivered in components (at least primary section and secondary sections) and installed directly in the machine. Due to the series connection of primary and secondary sections, user-defined motor forces and straight traversing paths of various lengths can be achieved.

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
 - Integrated main cooler to dissipate the heat loss
- Precision cooler (optional):
 - Additional cooler to minimize the heat transfer to the machine in accordance with the Thermo-Sandwich® principle
 - Recommended for applications with high precision requirements
- 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
- Secondary section cover (optional):
 - Mechanical protection for secondary sections
 - Stainless steel plate that can be magnetized (thickness $d = 0.4 \text{ mm}$)
 - Adheres to secondary sections
 - Can be removed without tools if worn
 - Available as a continuous band or as a segmented cover with fixed lengths

- Cooling sections with plug-in connector/nipple (optional):
 - Secondary cooling component
 - Aluminum rail sections with integrated cooling channels
 - Are placed under the secondary sections when high machine precision is required
- Secondary section end pieces (optional):
 - Secondary cooling component
 - Used to hold down the integrated secondary section cover
 - Available in different versions



- | | | |
|---------------------------------------|---|---|
| ① Precision cooler
(option) | ③ Secondary section cover
(option),
here as continuous band;
alternatively as segmented
cover | ⑤ Cooling section
with plug-in connector
(option) |
| ② Primary section with main
cooler | ④ Secondary section | ⑥ Secondary section end
piece
(option) |

Figure 2-3 Components of a 1FN3 linear motor

Overview of the connection variants



Peak and continuous load motor
with two pre-assembled cables
with/without connector



Peak and continuous load motor
with connection cover for two cables



Peak load motor
with connector cover for one cable
or
with a fixed cable without a connector

2.5.2 Scope of delivery

2.5.2.1 Linear motors

Primary section

- Primary section
- One rating plate (attached); additional loose rating plate
- Accessory pack note (safety accessory pack)
- Safety warning instructions (pictograms)
- For the terminal box design: Terminal box accessories (fixing accessories) with connection cover

Secondary section

- Secondary section
- Accessory pack note (safety accessory pack)
- Safety warning instructions (pictograms)

2.5.2.2 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 2- 9 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 2- 10 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 2- 11 Warning signs according to BGV A8 and EN ISO 7010 included with secondary sections and their meaning

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

Table 2- 12 Prohibiting signs according to BGV A8 and EN ISO 7010 included with secondary sections and their meaning

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)		

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.

2.5.3 Cooling

2.5.3.1 Design of the cooling

Components

The cooling system of the motors from the 1FN3 product family can be made up of various components:

- Primary section main cooler
- Primary section precision cooler (optional)
- Secondary section cooling (optional)

These components are structurally separated in motors of the 1FN3 product family. They allow the cooling system to be laid out according to the Thermo-Sandwich® principle.

Structure of a cooling system according to the Thermo-Sandwich® principle.

In the Thermo-Sandwich® principle, components of the cooling system are layered on top of each other. All components are separated by an insulating layer (see the image below). The thermal flow from the primary section into the machine assembly is restricted by this multi-layer cooling design: Heat is dissipated in each component of the cooling system. Therefore, the residual amount of heat that ultimately reaches the machine is very low.

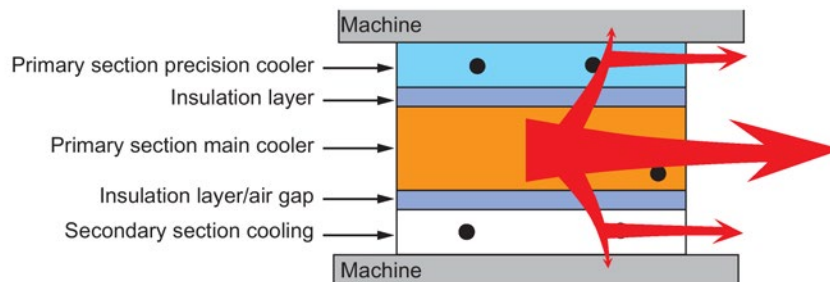


Figure 2-4 Schematic representation of the Thermo-Sandwich® principle

2.5.3.2 Cooling circuits

Cooling circuit requirements

Avoid algae growth by using suitable chemical agents and opaque water lines.

We recommend that the cooling circuits be designed as closed systems. The maximum permissible pressure is 10 bar.

NOTICE
Blocked and clogged cooling circuits Cooling circuits can become blocked and clogged as a result of pollution and longer-term deposits. • We recommend that you use a separate cooling circuit to cool the motors.

- If you use the machine cooling circuits to also cool the motors, you must ensure that the cooling medium fully complies with the requirements listed in this chapter.

- Also note the maximum non-operational times of cooling circuits corresponding to the coolant manufacturer's data.

Interconnecting cooling circuits

NOTICE
Leaks associated with rigid connections Rigid connections between the cooling circuits can lead to problems with leaks! • Use flexible connections (hoses) when interconnecting cooling circuits.

You can connect primary section cooling circuits in parallel to simplify connection systems and piping. In this case, you must carefully take into consideration the temperature and pressure differences between the intake and return.

Note
Connect the cooling ducts of the primary sections in parallel. This ensures that each primary section is supplied with coolant with the same intake temperature.

Example of the interconnection of cooling circuits

The following figure shows two examples for the series connection of different cooling circuits: On the left, all cooling circuits of the motor are connected in series. On the right, the cooling circuits of the primary section precision cooler and the primary section main cooler of a motor form a series connection. The resulting cooling circuits are connected in parallel. The secondary section cooling systems of both motors are also connected in series.

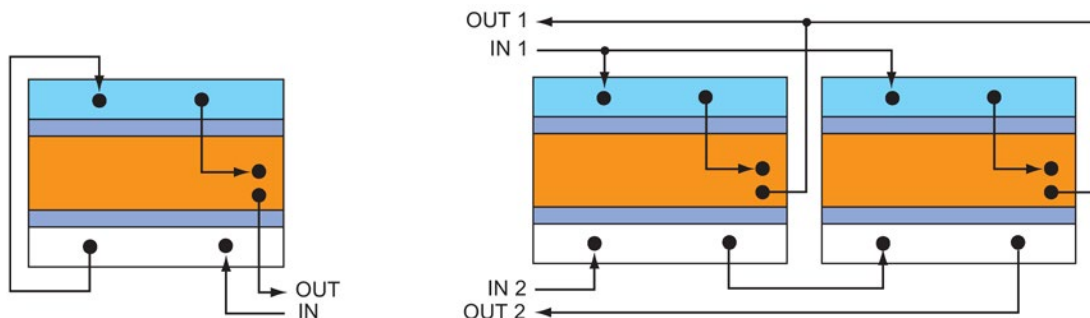


Figure 2-5 Examples for the interconnection of various different circuits (schematic diagram)

Materials used

The following table lists the materials that are used for the cooling system in the motors.

Table 2- 13 Materials used for the cooling system

Precision cooler	Main cooler	Secondary section cooling
1.4301/1.4305; 1.4541; Viton	SF-Cu; 1.4301/1.4305; Viton;	AlMgSi0.5 (anodized) ; 1.4305; Viton; Delo 5327

NOTICE

Corrosion as a result of unsuitable materials used to connect the cooler

Corrosion damage can occur if you use unsuitable materials to connect to the cooler.

- We recommend that you use brass or stainless steel fittings when connecting the cooler.

Coolant intake temperature

NOTICE

Corrosion in the machine

Condensation can lead to corrosion in the machine.

- Select the intake temperatures so that no condensation forms on the surface of the motor. Condensation does not form if the intake temperature T_{VORL} is higher than the ambient temperature or corresponds to the ambient temperature.

The rated motor data refer to operation at a coolant intake temperature of 35 °C. If the intake temperature is different, the continuous motor current changes as shown below.

Note

For a cooler intake temperature of < 35 °C, the possible continuous motor current is greater than the rated current I_N .

Larger cable cross-sections may be required. This means that you must take into account the rated current of the cables.

The following diagram shows the dependency of the relative continuous primary section current $(I_{\text{Primärteil}} / I_N) \cdot 100$ on the water intake temperature in the cooling system. Losses due to friction and eddy currents are ignored here.

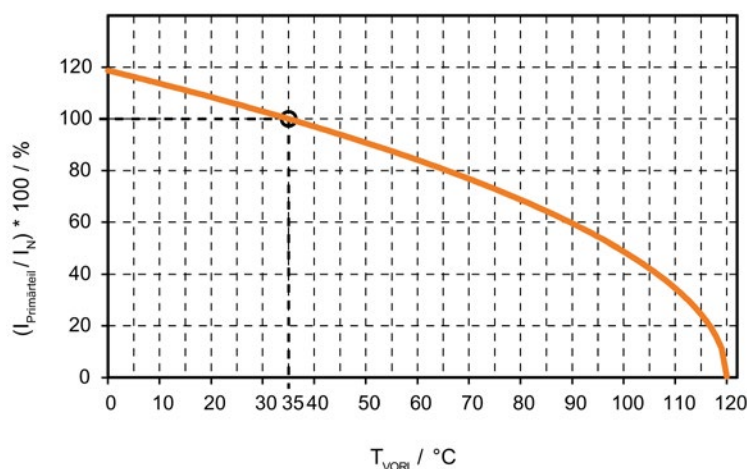


Figure 2-6 Influence of the coolant intake temperature

2.5.3.3 Coolants

Provision of the coolant

The customer must provide the coolant. The motors are designed for use with an anti-corrosion protection agent added to the water.

NOTICE
Disintegration of O-rings and hoses
The use of oil as a coolant can lead to material incompatibilities. O-rings and hoses can disintegrate.
• Use water with anti-corrosion protection as coolant.

Reason for the use of water with an anti-corrosion agent

The use of untreated water may lead to considerable damage and malfunctions due to water hardness deposits, the formation of algae and slime, as well as corrosion, for example:

- Worsening of the heat transfer
- Higher pressure losses due to reductions in cross-sectional area
- Blockage of nozzles, valves, heat exchangers and cooling ducts

General requirements placed on the cooling medium

The cooling medium must be pre-cleaned or filtered in order to prevent the cooling circuit from becoming blocked. The formation of ice is not permitted!

Note

The maximum permissible size for particles in the cooling medium is 100 µm.

Requirements placed on the water

Water which is used as basis for the coolant must comply as a minimum with the following requirements:

- Chloride concentration: $c < 100 \text{ mg/l}$
- Sulfate concentration: $c < 100 \text{ mg/l}$
- $6.5 \leq \text{pH value} \leq 9.5$

Contact the anti-corrosion agent manufacturer relating to additional requirements!

Requirements placed on the anti-corrosion agent

The anti-corrosion agent must fulfill the following requirements:

- The basis is ethylene glycol (also called ethanediol)
- The water and anti-corrosion agent do not segregate
- The freezing point of the water used is reduced to at least -5° C
- The anti-corrosion agent used must be compatible with the fittings and cooling system hoses used as well as the materials of the motor cooler

Check these requirements, especially in regard to material compatibility, with the cooling unit manufacturer and the manufacturer of the anti-corrosion agent!

Suitable mixture

- 25 % - 30 % ethylene glycol (= ethanediol)
- The water used contains a maximum of 2 g/l dissolved mineral salt and is largely free from nitrates and phosphates

Manufacturer recommendations: see appendix

2.5.4 Temperature monitoring and thermal motor protection

2.5.4.1 Temperature monitoring circuits Temp-S and Temp-F

The primary sections are equipped with two subsequently described temperature monitoring circuits - Temp-S and Temp-F.

- 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.
- Temp-F is used for temperature monitoring and diagnostics during commissioning and in operation.

Both temperature monitoring circuits are independent of one another.

For example, 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.

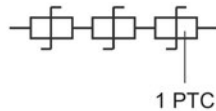


Figure 2-7 PTC triplet

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.

Temp-F

The Temp-F temperature monitoring circuit comprises an individual temperature sensor. Contrary to Temp-S, this temperature sensor only monitors one phase winding. As a consequence, Temp-F is only used for monitoring the temperature and diagnosing the motor winding temperature.

NOTICE
Motor destroyed as a result of overtemperature If you use Temp-F for thermal motor protection, then the motor is not adequately protected against destruction as a result of overtemperature. • Evaluate the Temp-S temperature monitoring circuit to implement thermal motor protection.

Temp-F as KTY 84 or Pt1000

The 16th digit of the order designation on the rating plate of the primary section indicates whether a KTY 84 or a Pt1000 is installed, see Rating plate data (type plate) (Page 36):

1FN3xxx-xxxxx-xxx1: with KTY 84

1FN3xxx-xxxxx-xxx3: with Pt1000

No direct connection of the temperature monitoring circuits



! WARNING

Risk of electric shock when incorrectly connecting the temperature monitoring circuit

In the case of a fault, circuits Temp-S and Temp-F do not provide safe electrical separation with respect to the power components.

- Use, for example, the TM120 or the SME12x to connect the Temp-S and Temp-F temperature monitoring circuits. 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).

Correctly connecting temperature sensors

NOTICE

Motor destroyed as a result of overtemperature

The motor can be destroyed as a result of overtemperature if you do not correctly connect the temperature sensors.

- When connecting temperature sensor cables with open conductor ends, pay attention to the correct assignment of conductor colors.

2.5.4.2 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.

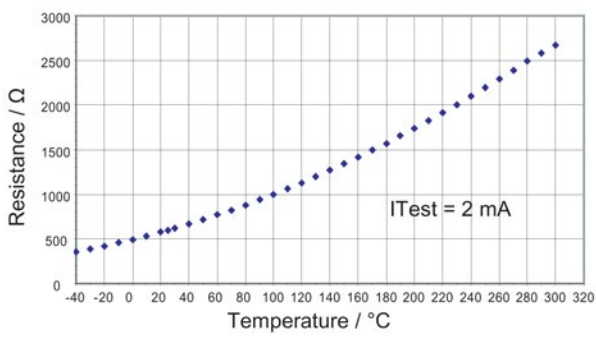
Table 2- 14 Technical data of the PTC temperature sensors

Name	Description
Type	PTC triplet acc. to DIN 44082 Individual PTC temperature sensor according to DIN 44081
Response threshold (nominal response temperature ϑ_{NAT})	$120\text{ }^{\circ}\text{C} \pm 5\text{ K}$
PTC resistance R ($20\text{ }^{\circ}\text{C}$) at the PTC triplet	See the characteristic if $-20\text{ }^{\circ}\text{C} < T < \vartheta_{\text{NAT}} - 20\text{ K}$ $R \leq 3 \times 250\text{ }\Omega$ $R \leq 750\text{ }\Omega$
Minimum resistance when hot R in the PTC triplet and in the individual PTC temperature sensor	See the characteristic if $T \leq \vartheta_{\text{NAT}} - 5\text{ K}$ $R \leq 3 \times 550\text{ }\Omega$ $R \leq 1650\text{ }\Omega$ if $T > \vartheta_{\text{NAT}} + 5\text{ K}$ $R \geq 3 \times 1330\text{ }\Omega$ $R \geq 3990\text{ }\Omega$ if $T > \vartheta_{\text{NAT}} + 15\text{ K}$ $R \geq 3 \times 4000\text{ }\Omega$ $R \geq 12000\text{ }\Omega$
Typical characteristic R(ϑ) of a PTC temperature sensor according to DIN 44081	

Technical features of the KTY 84 temperature sensor

The KTY 84 has a progressive temperature resistance characteristic that is approximately linear. In addition, the KTY 84 has a low thermal capacity and provides good thermal contact with the motor winding. The KTY 84 has a continuous characteristic.

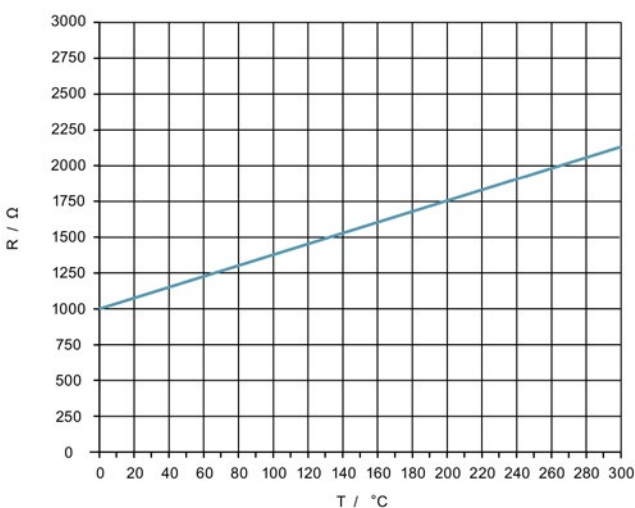
Table 2- 15 Technical data of the KTY 84 PTC thermistor

Name	Description
Type	KTY 84 according to EN 60034-11
Transfer range	-40 °C ... +300 °C
Resistance when cold (20 °C)	ca. 580 Ω
Resistance when warm (100 °C)	ca. 1000 Ω
Characteristic of a KTY 84	 The graph illustrates the resistance characteristic of a KTY 84 PTC thermistor. The vertical axis represents Resistance in Ohms (Ω), ranging from 0 to 3000 with major grid lines every 500 units. The horizontal axis represents Temperature in degrees Celsius ($^{\circ}\text{C}$), ranging from -40 to 320 with major grid lines every 20 units. The data points form a curve that starts at approximately 580 Ω at 20 $^{\circ}\text{C}$ and increases progressively, reaching approximately 2700 Ω at 300 $^{\circ}\text{C}$. A label 'I Test = 2 mA' is positioned within the graph area.

Technical features of the Pt1000 temperature sensor

The Pt1000 has a linear temperature resistance characteristic. In addition, the Pt1000 has a low thermal capacity and provides good thermal contact with the motor winding.

Table 2- 16 Technical data of the Pt1000 PTC thermistor

Name	Description																																		
Type	Pt1000 according to EN 60751																																		
Transfer range	0 °C ... +300 °C																																		
Resistance when cold (20 °C)	ca. 1080 Ω																																		
Resistance when warm (100 °C)	ca. 1380 Ω																																		
Characteristic of a Pt1000	 The graph illustrates the linear relationship between the resistance of the Pt1000 sensor and temperature. The y-axis represents resistance (R) in Ohms, ranging from 0 to 3000 with major grid lines every 250 units. The x-axis represents temperature (T) in degrees Celsius, ranging from 0 to 300 with major grid lines every 20 units. A single blue line starts at approximately 1080 Ω at 0 °C and extends linearly to approximately 2150 Ω at 300 °C. <table border="1"> <caption>Key data points from the Pt1000 characteristic graph</caption> <thead> <tr> <th>Temperature (T / °C)</th> <th>Resistance (R / Ω)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>~1080</td> </tr> <tr> <td>20</td> <td>~1100</td> </tr> <tr> <td>40</td> <td>~1120</td> </tr> <tr> <td>60</td> <td>~1140</td> </tr> <tr> <td>80</td> <td>~1160</td> </tr> <tr> <td>100</td> <td>~1180</td> </tr> <tr> <td>120</td> <td>~1200</td> </tr> <tr> <td>140</td> <td>~1220</td> </tr> <tr> <td>160</td> <td>~1240</td> </tr> <tr> <td>180</td> <td>~1260</td> </tr> <tr> <td>200</td> <td>~1280</td> </tr> <tr> <td>220</td> <td>~1300</td> </tr> <tr> <td>240</td> <td>~1320</td> </tr> <tr> <td>260</td> <td>~1340</td> </tr> <tr> <td>280</td> <td>~1360</td> </tr> <tr> <td>300</td> <td>~1380</td> </tr> </tbody> </table>	Temperature (T / °C)	Resistance (R / Ω)	0	~1080	20	~1100	40	~1120	60	~1140	80	~1160	100	~1180	120	~1200	140	~1220	160	~1240	180	~1260	200	~1280	220	~1300	240	~1320	260	~1340	280	~1360	300	~1380
Temperature (T / °C)	Resistance (R / Ω)																																		
0	~1080																																		
20	~1100																																		
40	~1120																																		
60	~1140																																		
80	~1160																																		
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200	~1280																																		
220	~1300																																		
240	~1320																																		
260	~1340																																		
280	~1360																																		
300	~1380																																		

System requirements for the Pt1000 temperature sensor

To use the Pt1000 together with the following systems, you will need at least the specified versions:

SINAMICS S120 Firmware V4.8 and V4.7 HF17

SINUMERIK V4.8 as well as V4.7 SP2 HF1 and V4.5 SP6

SIMOTION V4.5 (SINAMICS Integrated Firmware V4.8)

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 26)".

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 prohibit signs according to the tables in 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.

Checking the delivery for completeness

When you take receipt of the delivery, please check immediately whether the items delivered are in accordance with the accompanying documents.

- Report any apparent transport damage to the delivery agent immediately.
- Report any apparent defects / missing components to the appropriate Siemens office immediately.

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

3.1 Shipment 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 3- 1 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 3- 2 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)		

3.1 Shipment and packaging

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

Table 3- 3 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.

Original packaging can also be requested from your local Siemens office.

3.2 Transport and storage

Note

UN number for permanent magnets

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

NOTICE

Damage to the primary section when incorrectly lifted

Improper use of lifting equipment and slings can lead to permanent deformation and damage to the primary section.

- Always ensure the primary section is horizontal when lifting and transporting it.
- To fasten the suspension ropes for lifting the primary section, use
 - the threaded holes on the top of the primary section
 - Eye bolts acc. to DIN 580
- To lift and transport in a horizontal position, screw in the eye bolts in diagonally opposing threaded holes of the primary section. Choose the threaded holes with the greatest possible distance from one another.
- If the unit must be lifted and transported in a vertical position, you must screw in the eye bolts in adjacent threaded holes directly on a front end of the primary section.
- The locating surfaces of the eye bolts must be positioned flat and over the whole surface on the top of the primary section.
- Observe the specifications for thread depths and screw-in depths in the primary section (Specifications for mounting linear motors (Page 69)).
The values cited in this chapter also apply to the eye bolts.
If the threaded pins of the eye bolts are too long, you must ensure that the maximum screw-in depth is adhered to, using washers if necessary.
- All of the suspension ropes must be the same length.
When lifting and transporting in a horizontal position, the taut suspension ropes must form an angle of at least 50° between the rope and the primary section. The center of gravity of the primary section must be centered between the threaded holes that are used and lie vertically under the hook of the crane.
- Two suspension ropes and two eyebolts are sufficient to lift and transport the primary section. The primary section may incline to one side during this, however.
- If you use four suspension ropes and four eye bolts, the load is optimally distributed, which means that a sideward inclination is ruled out.
- The positioning of the primary section with suspension ropes on the provided installation position is not permitted.

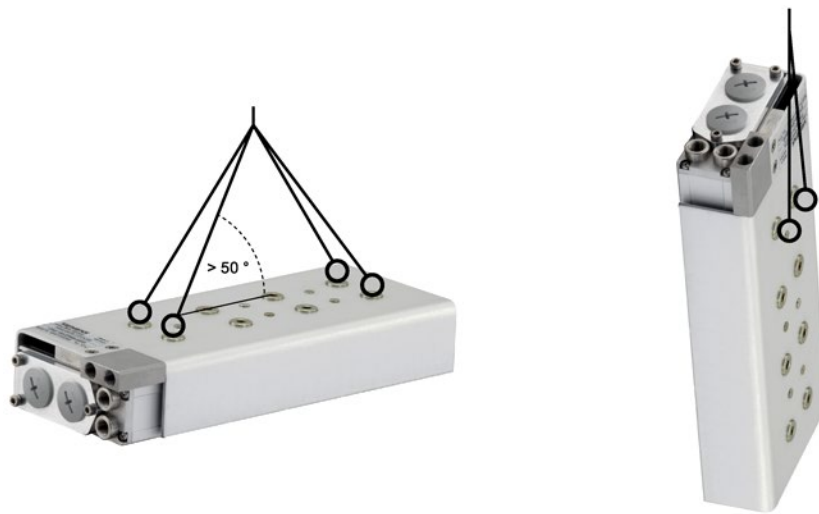


Figure 3-1 Correct lifting of primary sections

3.2.1 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 the IATA packaging instruction 953. If the values change, then 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.

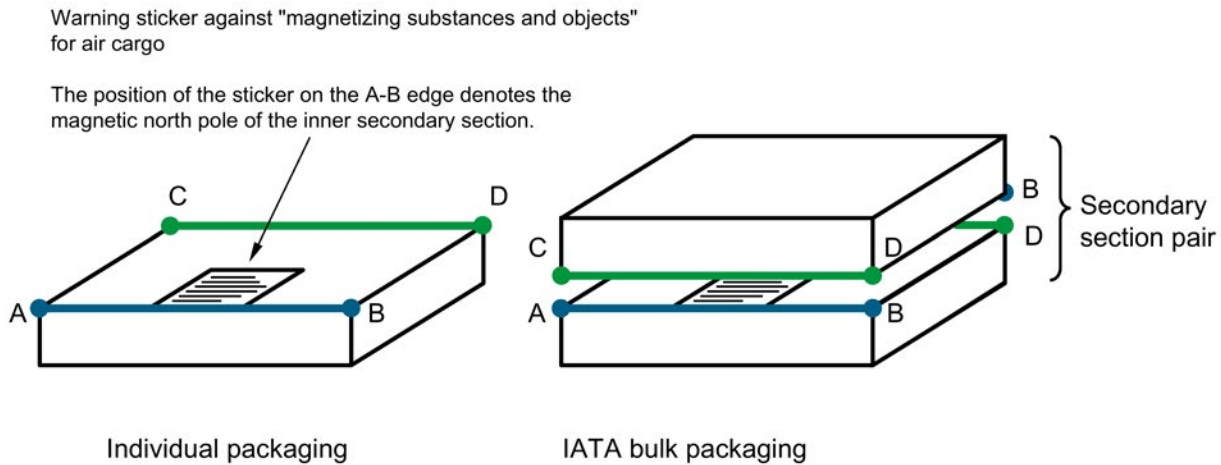


Figure 3-2 Packing for secondary sections and correct stacking

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 3- 4 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 cable arbitrarily arranged			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.

3.2.2 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 3- 5 Climatic ambient conditions

Lower air temperature limit:	- 5 °C (deviates from 3K3)
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 3- 6 Biological ambient conditions

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

Table 3- 7 Chemical ambient conditions

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

Table 3- 8 Mechanically active ambient conditions

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

Table 3- 9 Mechanical ambient conditions

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

3.2.3 Storage

The motors can be stored for up to two years under the following conditions:

Storing indoors

- Apply a preservation agent (e.g. Tectyl) to bare external 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.

Protecting the cooling system for motors with integrated cooling

Before you store the motor after use, perform the following actions:

- Empty the cooling channels.
- Blow out the cooling ducts with dry, compressed air so that the cooling ducts are completely empty.
- Seal the connections of the cooling system.

Mechanical installation

4.1 Safety instructions for mechanical 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.

- Observe the information in Chapter "Danger from strong magnetic fields (Page 26)".



! 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 assembly.
- 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.
- 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.
- Note the permissible bending radii according to the data in the catalog.
- 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).
- Attach the shield through a large surface area.
- 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).

4.1 Safety instructions for mechanical installation



CAUTION

Sharp edges and falling objects

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

- Always wear safety shoes and safety gloves!

4.2 Specifications for mounting linear motors

General rules

When you fasten primary sections and secondary sections on the machine construction, you must observe the following:

- Use screws of property class 10.9.
- Use only new, unused screws.
- Ensure that the mounting surfaces are free of oil and grease and are clean and unpainted.
- Maintain the optimal surface roughness depth Rz of the screw connection surface. Rz lies between 10 and 40 µm.
- Minimize the number of joints. This keeps the settling effect for the material and the screws low.
- Note the presets for the thread depths and screw-in depths in the primary section.
- 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. Note the tightening torques specified in the table below.
- Tighten the screws gradually, with no jerky movements.
- Select a long terminal length $l_k/d > 5$ for securing the screws. Alternatively, secure the screws with Loctite 243, for example.

Tightening torques for screws of property class 10.9

Applicable for screws of property class 10.9		
Friction value $\mu_{tot} = 0.1$		
M5	M6	M8
7.6 Nm	13.2 Nm	31.8 Nm

Thread depth and screw-in depths in the primary section

The following drawings schematically illustrate the minimum permissible and maximum screw-in depth of the fixing screws in the screwed-in state, with and without the use of a precision cooler. For selecting the screw length, a **good range** is thus made available to the machine manufacturer.

The selection of the length of the fixing 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.

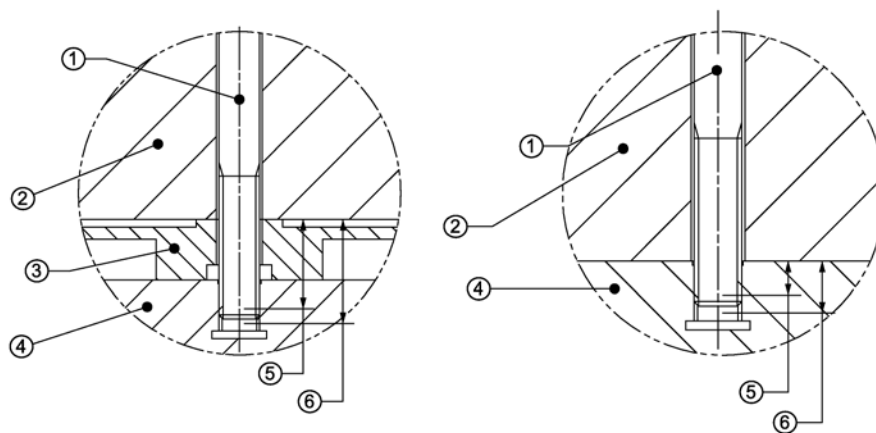


Figure on the left: Primary section with precision cooler, figure on the right: Primary section without precision cooler

- ① Fixing screw
- ② Slide
- ③ Precision cooler
- ④ Primary section
- ⑤ The minimum screw-in depth as per the installation drawing of the primary section in the configuration manual under ① "Screw-in depth MP"
- ⑥ Maximum screw-in depth

Figure 4-1 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 4- 1 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.

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

4.3 Procedure when installing the motor

Installing a linear motor is subdivided into the following steps:

- ➔ 1. Check the installation dimension before installing motors
2. Clean the mounting surfaces for motor parts and the machine.
3. Installing primary sections, secondary sections and components
4. Checking the motor installation



4.3.1 Comply with the installation dimensions

Installation dimensions for the motor installation

The following figure shows the installation dimensions for the motor installation. The associated values are specified in the following table.

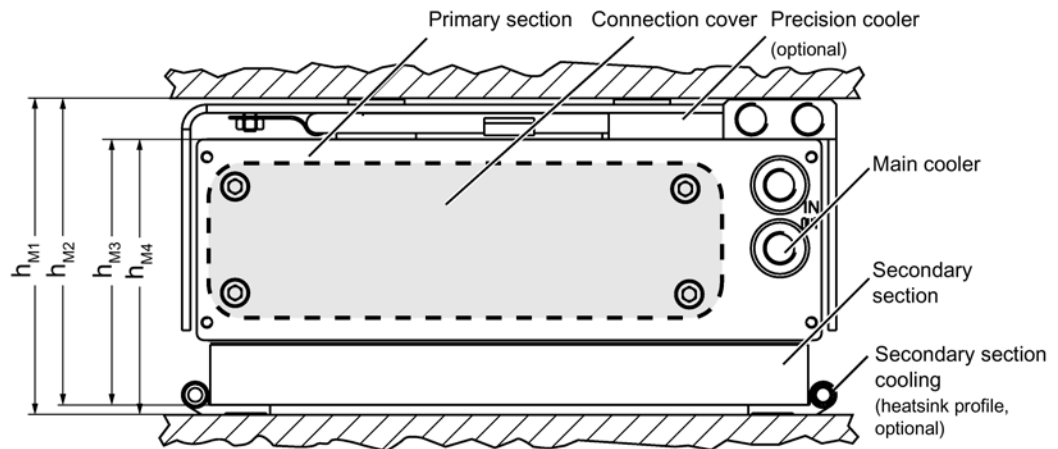


Figure 4-2 Installation dimensions for the motor installation

4.3 Procedure when installing the motor

Peak load motor: Installation dimensions

Table 4- 2 Dimensions for the air gap and installation dimensions for installing the motor, according to figure above

	Installation dimension with precision cooler and with secondary section cooler	Installation dimension with precision cooler and without secondary section cooler	Installation dimension without precision cooler and without secondary section cooler	Installation dimension without precision cooler but with secondary section cooler	Tolerance of the installation dimensions
1FN3..-xW	h_{M1} in mm	h_{M2} in mm	h_{M3} in mm	h_{M4} in mm	in mm
1FN3050 1FN3100	63.4	60.4	48.5	51.1	+0.3
1FN3150	65.4	62.4	50.5	53.5	+0.3
1FN3300	79.0	76.0	64.1	67.1	+0.3
1FN3450	81.0	78.0	66.1	69.1	+0.3
1FN3600	86.0	--	--	74.1	+0.3
1FN3900	88.0	--	--	76.1	+0.3

Continuous load motor: Installation dimensions

Table 4- 3 Dimensions for the air gap and installation dimensions for installing the motor, according to figure above

	Installation dimension with precision cooler and with secondary section cooler	Installation dimension with precision cooler and without secondary section cooler	Installation dimension without precision cooler and without secondary section cooler	Installation dimension without precision cooler but with secondary section cooler	Tolerance of the installation dimensions
1FN3..-xN	h_{M1} in mm	h_{M2} in mm	h_{M3} in mm	h_{M4} in mm	in mm
1FN3050 1FN3100	74.3	71.3	59.4	62.4	+0.3
1FN3150	76.3	73.3	61.4	64.4	+0.3
1FN3300	92.9	89.9	78	81	+0.3
1FN3450	94.9	91.9	80	83	+0.3
1FN3600	99.9	--	--	88	+0.3
1FN3900	101.9	--	--	90	+0.3

4.3.2 Motor installation procedures

There are three different procedures for installing a linear motor in a machine:

- Assembly with divided secondary section track
- Assembly by introducing the slide
- Assembly through the mounting of the motor components

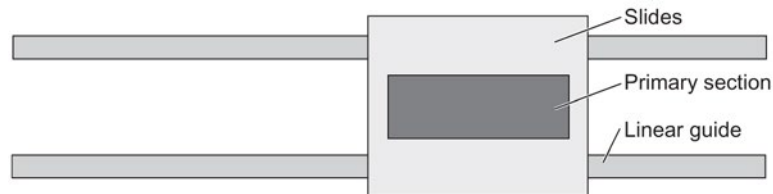
Motor assembly with divided secondary section track

One prerequisite for this type of assembly is that the entire secondary section track can be divided into two sections. In this case, the two sections must at least be as long as the slide.

Procedure



1. Mount the slide together with the linear guide and the primary section.
- 2.



2. Push the slide to one side. Mount the secondary section on the other side. Align the secondary section track. Tighten the fixing screws according to the specifications.



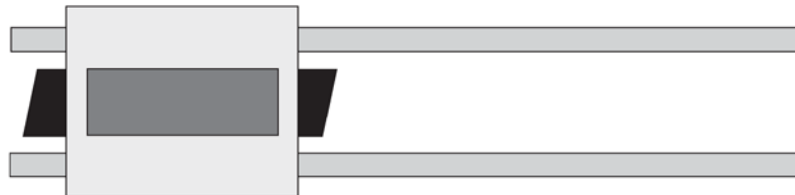
WARNING

Risk of crushing when moving the primary section onto the secondary section track (step 3)

When moving the primary section onto the secondary section track (Step 3), drawing forces towards the secondary section will occur for a short time. Danger of crushing!

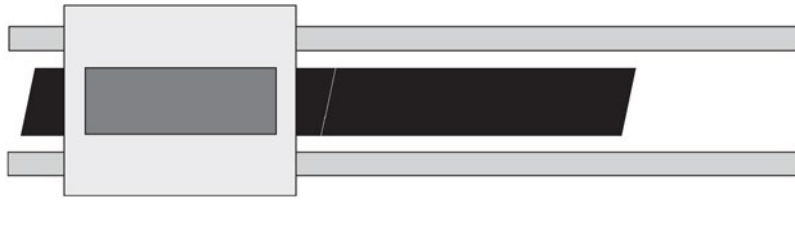
- Make sure that your fingers do not reach into the danger zone!

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



4.3 Procedure when installing the motor

4. Mount the remaining secondary section track. Align the track as well. Tighten the fixing screws according to the specifications.



Motor assembly through the insertion of the slide

This type of assembly is only intended for setting up motors in a double-sided arrangement.



! 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.

Slide the movable part of the motor into the stationary housing with the already assembled motor parts, see the following figure. Normally, for this you will need a threading unit to be provided by the customer.

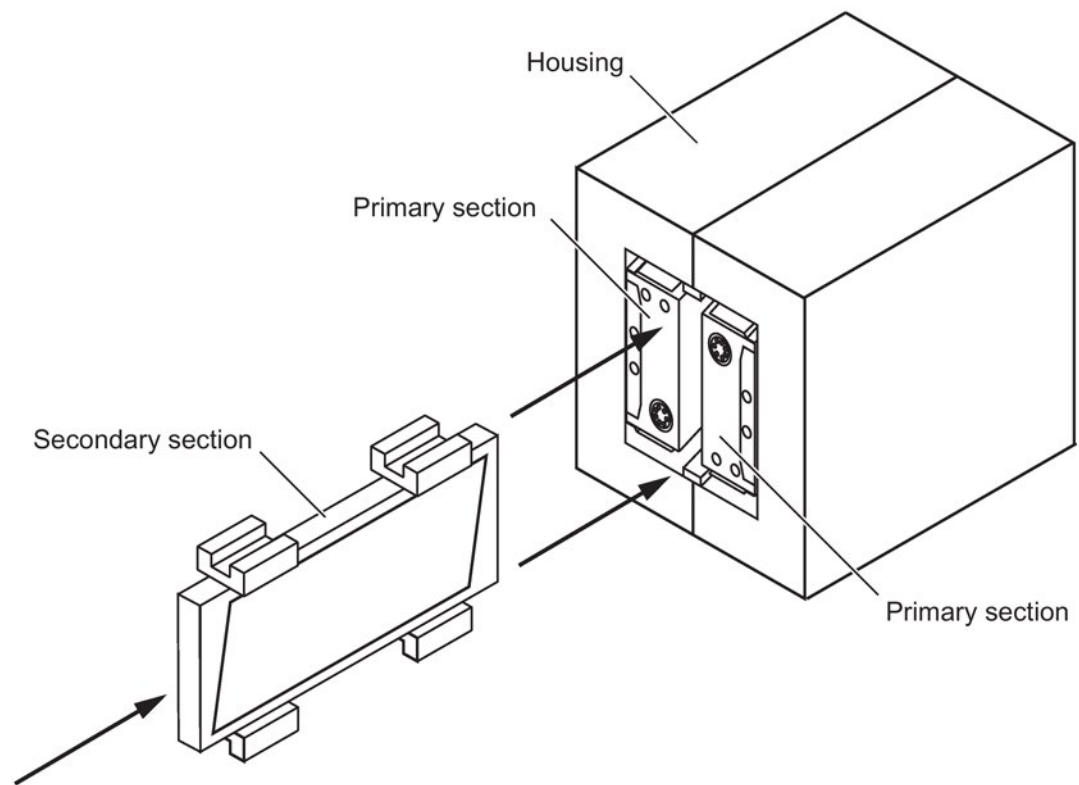


Figure 4-3 Insertion of the secondary section with a double-sided motor

Motor assembly through the mounting of the motor components

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

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.

For this installation technique, you must place a non-magnetic foil between the primary section and secondary section track. This foil prevents the primary section from lying directly on the secondary section track and causing physical damage.



! WARNING

High forces of attraction when the placing the primary section onto the secondary section

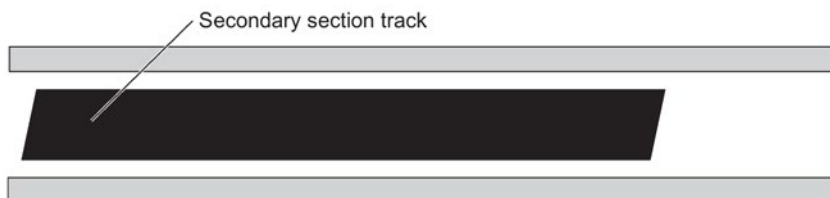
When the primary section is being mounted, high attraction forces (up to 40 kN) act in the direction of the secondary section track. There is a risk of crushing!

- For this type of installation, a forcing assembly is required that allows the primary section to be lowered in a controlled fashion.
- The stiffness of the forcing plate and the length of the jack screws must be selected 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



1. Mount the secondary section track according to Chapter "Assembling individual motor components (Page 79)".
- 2.



2. Place the primary section with a forcing assembly on the secondary section track as follows.

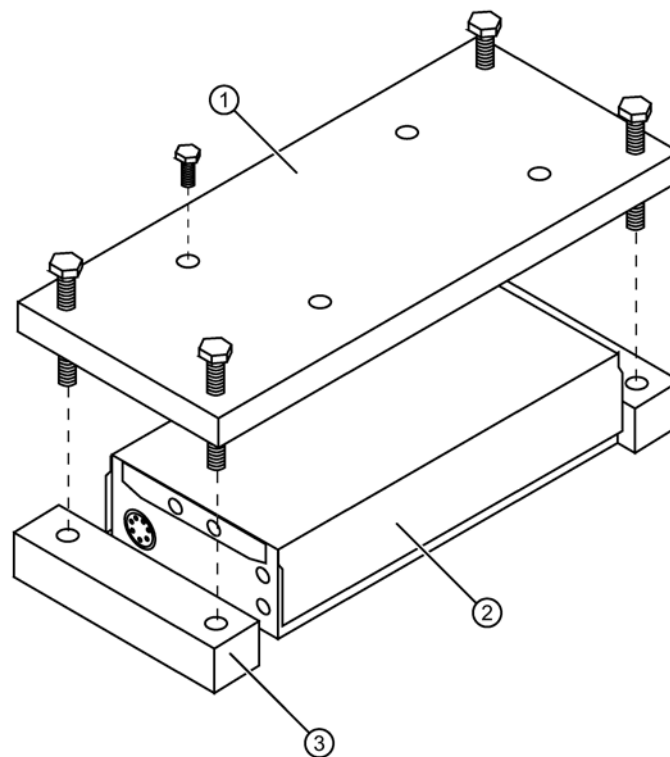


! WARNING

Danger of crushing when mounting the primary section on the secondary section!

When you are placing the primary section on the secondary section, there is a risk of crushing due to the high forces of attraction.

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



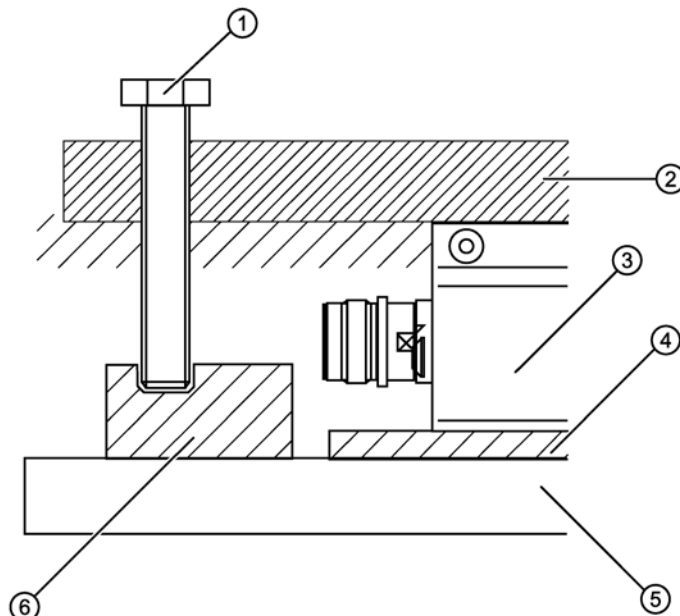
- ① Forcing plate
- ② Primary section
- ③ End support block

Figure 4-4 Forcing assembly

- Mount the primary section on the forcing plate of a forcing assembly. You can use the factory-made fastening drill-holes for this purpose.
- 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. This 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 assembly without any effort. The forcing assembly 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.

4.3 Procedure when installing the motor

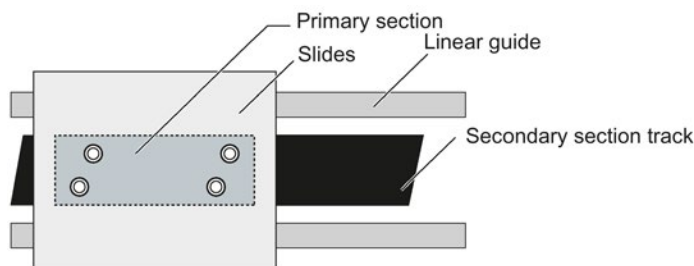
- Screw back the jack screws in steps to lower the primary section onto the secondary section track, in parallel and centered with it.
- Then completely remove the forcing assembly from the primary part.



- ① Jack bolt
- ② Forcing plate
- ③ Primary section
- ④ Spacer foil
- ⑤ Secondary section
- ⑥ End support block (aluminum/brass)

3. Mount 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 fixing 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.



4.3.3 Assembling individual motor components

Assembly of the secondary sections

Use the fixing screws to force-fit the secondary sections to the machine bed. You screw in the optional installable cooling profiles together with secondary sections between the secondary sections and the machine bed. The mounting dimensions without secondary section cooling are reduced by the height of the cooling sections.

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.

There is a letter N 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.

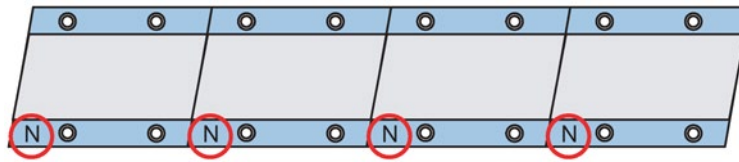


Figure 4-5 Position of the "N" mark on 1FN3 secondary sections

Screw on the secondary sections in the prescribed order as per the following figure.

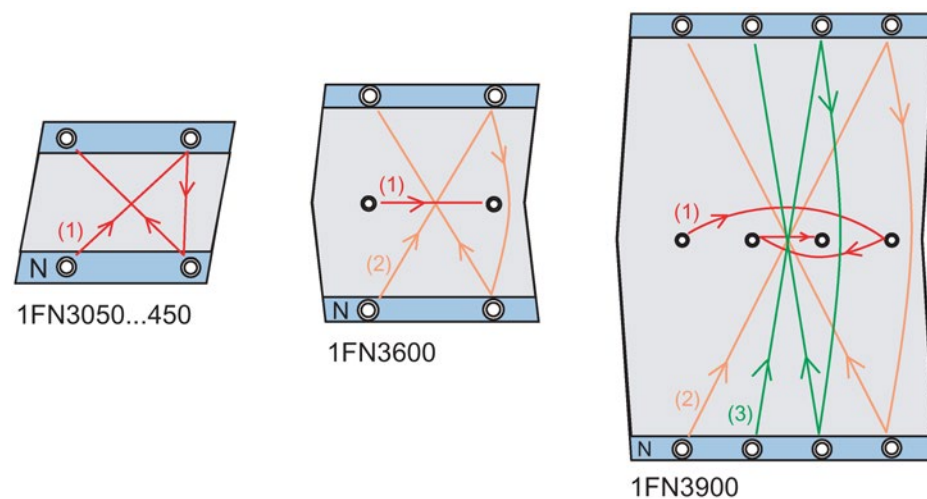


Figure 4-6 Screwed joint sequence of 1FN3 secondary sections

**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 instructions for mechanical installation (Page 65)".

Assembly of the secondary section cooling system

If you use secondary section cooling, you must install the cooling profiles and the secondary section end pieces prior to assembly of the secondary sections.

To attach the secondary section end pieces, you must remove the wedges. The mounting screws for the wedges are standard steel socket head cap screws (hex socket, DIN 7984 M3x6). You can also use stainless steel fillister-head screws (Phillips head H1, DIN 7985 M3x8). The respective number of screws for each option is specified in the following table.

To mount the secondary section end pieces, use the same screws as for mounting the secondary sections.

Table 4- 4 Number of mounting screws for the wedge of the secondary section end pieces

	1FN3...						
	050	100	150	300	450	600	900
Combi adapter	4	6	6	6	8	--	--
Combi end piece	4	6	6	6	8	--	--
Combi distributor	4	6	6	6	8	10	14
Cover end piece	2	5	5	6	7	--	--

If you use the cooling profiles with plug-in connector, you must proceed as follows:



1.
2.

1. At first, only fix the cooling sections with a few screws so that all threads in the machine bed are visible. Do not tighten the screws, because you will have to remove them again later.
2. Slide the secondary section end piece No. 1 without wedge axially onto the plug-in connectors of the cooling sections.
3. Screw in the fixing screws of the secondary section end piece No. 1. Do not tighten the fixing screws.
4. Slide the secondary section end piece No. 2 without wedge axially onto the plug-in connectors of the cooling sections.
5. Screw in the fixing screws of the secondary section end piece No. 2. Do not tighten the fixing screws.
6. Tighten the fixing screws of the secondary section end pieces.

7. Check the cooling circuit for leaks, if applicable (pressure check at a maximum of 10 bar).
8. Check again whether all threads in the machine bed are visible.
9. Remove the screws that were used for fastening.

NOTICE

Damage to the plug-in connectors

If you remove the fastening screws too early, the plug-in connectors may become deformed and thus overstressed, especially if the secondary section track is set up vertically. The reason for this is the dead weight of the cooling profiles.

- At a vertically arranged secondary section track, remove the screws used to position the heatsink profiles only step by step.

10. Screw the secondary sections together with the heatsink profiles.
11. If the cover band is not used as a secondary section cover, mount the wedges of the secondary section end pieces.

The following figure shows the correct position for fixing cooling sections and combi-distributors.

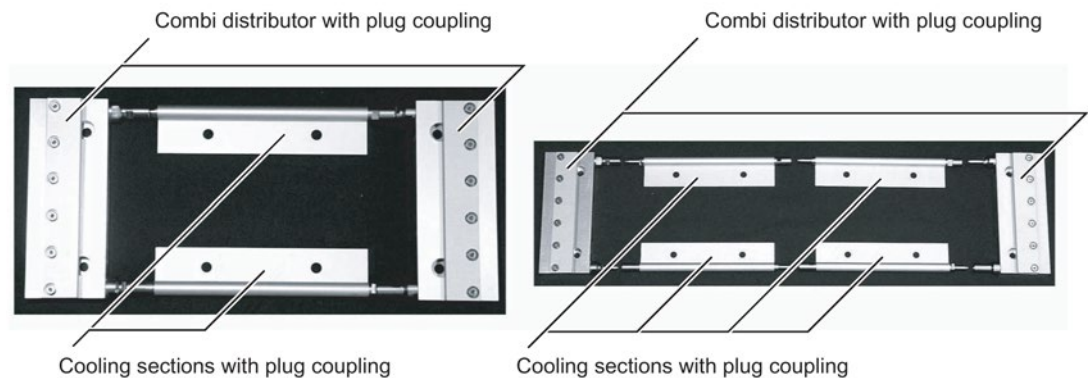


Figure 4-7 Position of the heatsink profiles and combi distributors (illustration without fastening screws)

Assembly of the secondary section cover

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

- Continuous cover band
- Segmented cover

Cover band

If fine dust or the like can accumulate in the spaces of the segmented cover, the use of a cover band is advantageous.

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.

If the traversing distance of the axis is greater than twice the slide length, proceed as follows:



1. Mount the primary section under the slide.
2. Push the slide to one side of the traversing path.
3. Mount the secondary sections on the other side up to the center of the traversing path.
4. Mark the length of the mounted secondary sections plus the required clamping length on the cover band.
5. From the mark, slide the cover band under the primary section to the side without secondary sections.
6. Starting from the mark, place the other half of the cover band onto the secondary sections.
7. Push the slide over the covered secondary sections. The magnetic forces are taken up by the guides.
8. Carefully lift the cover band from the machine frame.
9. Mount the remaining secondary sections located under the cover band.
10. Place the second half of the secondary section cover onto the secondary section track.
11. Lock both ends on the secondary section end pieces using the wedges.

The following work steps are required for the following conditions:

- The traversing path of the axis is less than twice the slide length.
- Accessibility for installing the secondary section cover is limited.

Segmented cover

The following work steps are required before you can install the segmented cover:



1. Mount the secondary sections with the slide plate removed.
2. Starting from one end, place the magnetic secondary section cover on the secondary sections.
3. Secure both ends of the secondary section cover on the secondary section end pieces with a wedge.
4. Place the primary section with spacer and forcing assembly on the secondary section track.
5. Mount the slide onto the guide.
6. Align the slide over the mounting holes of the primary section.
7. Remove the primary section from the secondary section track using the forcing assembly.
8. Mount the primary section securely on the slide.



To install the segmented cover, carry out the following work steps:



1. 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.
2. Check for correct position:
If the first segment of the cover reaches to the middle of a secondary section, the position is correct.
3. Mount all other segments the same way as the first segment.



The following figures show Steps 1 and 3.

4.3 Procedure when installing the motor

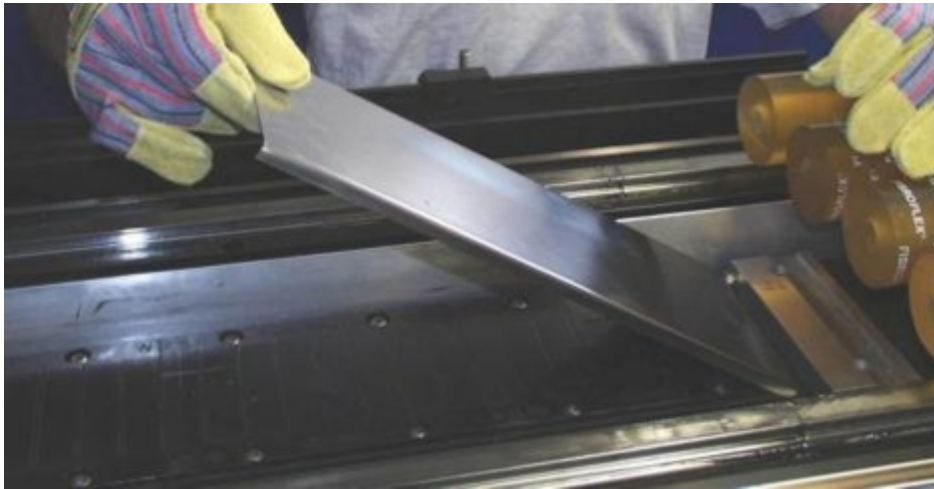


Figure 4-8 Mounting of the first segment of the segmented secondary section cover



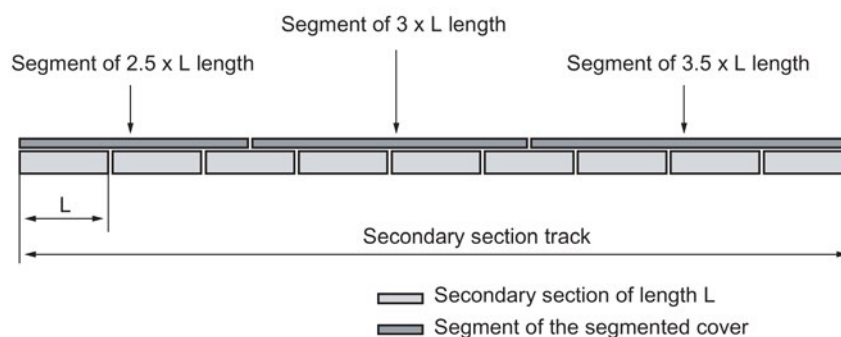
Figure 4-9 Mounting of a further segment of the segmented secondary section cover

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 following figure.



Example: Segment position of the segmented secondary section cover

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



Figure 4-10 Dismounting a segment of the segmented secondary section cover

Assembling the primary section

Force fit the primary section and screw it on to the back of the primary section via the threaded holes. Make sure that the terminal end of the primary section usually points in the same direction as the north pole mark "N" on the secondary sections.

NOTICE

Damage to motor components due to incorrect screw-in depths

Incorrect screw-in depths of the fixing screws can damage components of the motor. In addition, incorrect screw-in depths of the fixing screws can lead to an insufficiently rigid connection of the motor components on the machine construction. This gives rise to very disadvantageous characteristics.

- Observe the minimum permissible screw-in depth and the maximum screw-in depth of the fixing screws.

Assembling of the Hall sensor box

NOTICE

Uncontrolled traversing movements due to incorrect installation of the Hall sensor box

Incorrect installation of the Hall sensor box can lead to uncontrolled traversing movements of the motor. The machine can also become damaged.

- Starting at a certain minimum distance, the distance between the primary section and the Hall sensor box can only be increased by the integer multiple of the pole pair width $2T_M$. The count factor N_P is specified in the drawings.
The exact installation dimensions of the Hall sensor box can be found in the annex in Chapter "Mounting the Hall sensor box (Page 139)".

The cable outlet direction and position of the Hall sensor within the Hall sensor box are permanently assigned to one another. Therefore, be sure to follow the respective installation diagrams when installing the Hall sensor box with regard to position and alignment with the primary section.

Note

If several primary sections are operated on one drive system, the master is always to be used as reference for the Hall sensor box.

Place the holding fixture for the Hall sensor box so that a distance of $x = 35 \text{ mm}$ between the top edge of the Hall sensor box and the bottom edge of the primary section is maintained, see following figure.

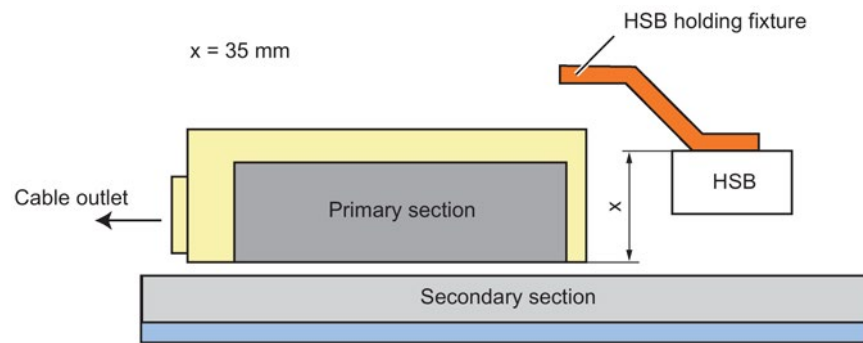


Figure 4-11 Specified dimension for mounting the Hall sensor box (HSB)

The Hall sensor box cable is trailable and may therefore be integrated into tow chains.

4.4 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.

4.4.1 Smooth running of the slide

Checking the smooth running of the slide

The motor assembly 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 residual force of the linear motor.

- If excessive sluggishness results locally, check the air gap and the alignment of the guidance 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.

4.4.2 Check of the air gap height

Note

Installation dimension and air gap

The installation dimension must lie within the specified tolerances along the entire traversing path.

If the installation dimension matches, the correct air gap height will automatically result.

If, however, the installation dimension matches, but the correct air gap height does not result, there is generally an installation error.

A correct air gap height is critical for keeping the electrical characteristics of the motor in accordance with the data sheet.

After the installation, use tear-resistant spacer foil with a constant thickness as an aid in checking to ensure that a minimum air gap height has been complied with.

- For secondary section with cover sheet: Foil thickness 0.5 mm
- For secondary section without cover sheet: Foil thickness 1.0 mm

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



1.
2.

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 determines that an air gap height is too small, then the prescribed installation dimensions were not complied with or there is an installation error. The machine must not be put into operation.
• Ensure that the installation dimensions of the machine are within tolerance.

Connection

5.1 Connection of the cooling system

Connection system

Please note the following for the connection of the cooling system:

- All connections should be flexible (hoses)
- All material used must be resistant to the local environmental conditions
- All materials must be compatible
- Manufacturer's information regarding mounting are to be observed.

5.1.1 Primary section cooling connection

Preconditions for the connection

All cooling connections of the primary section main cooler and primary section precision cooler have a G1/8 cylindrical pipe thread according to DIN ISO 228-1. Suitable connectors are required for connecting the hoses.

NOTICE
Never use any used connection parts and components Faulty and used connection parts and components can result in pressure losses and leaks. • Use only new, unused connection parts and components • Check the compatibility of the materials of the connection parts and components and seals with respect to one another and the coolant used.

Properties and attributes of the sealants used:

- Viton: resistant to temperature and glycol
- Perbunan: up to water temperatures of 80 °C
- Ethylene-propylene: resistant to temperature and glycol

Note

Recommended manufacturers

Manufacturers of connection parts and components for cooling 1FN3 motors are recommended in the Appendix.

Installing

The connection parts and components can generally be installed using standard tools.

Recess at the machine slides

If the connection assembly of the primary section in the traversing direction protrudes over the primary section, a recess must be machined at the machine slides above the cooling connections so that the connection components can be used. See figure below.

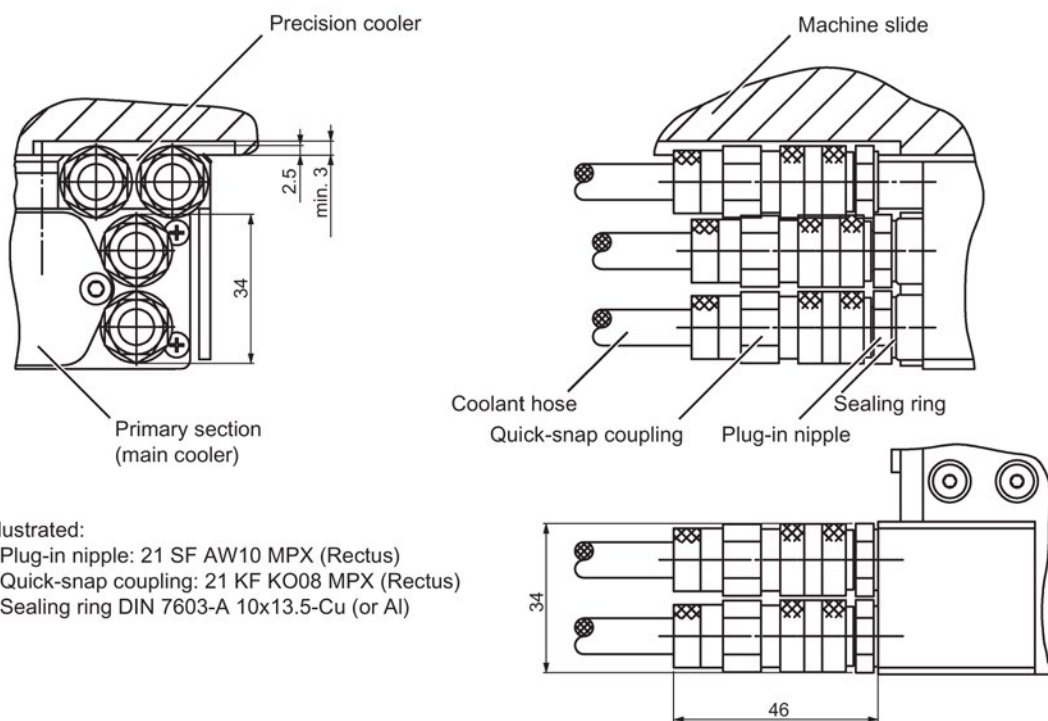


Figure 5-1 Example of a cooling connection with recess at the machine slides

5.1.2 Secondary section cooling connection

Connection options

For 1FN3 motors, secondary section end pieces can be used for the intake and return lines of the secondary section cooling system. As an alternative, if the continuous secondary section cover band is not used, the plastic hoses can be connected directly to the cooling sections using hose connector nipples.

Properties of the plastic hose

The plastic hoses must be resistant to the cooling medium, flexible and abrasion resistant.

Note

Recommended manufacturers

Recommended manufacturers of plastic hoses are listed in the appendix

Connection via secondary section end pieces

To connect plastic hoses to secondary section end pieces, screwed connectors with screwed nipples and reinforcing sleeves can be used. However, the plastic hoses can also be attached with hose clamps over the hose connector nipples.

For this connection, be sure to note the maximum outer diameter (12 mm) and the maximum square span (width across flats 10) of the screwed joint or the screwed nipple: If larger screw joints or screwed nipples are used, the connection point of the secondary section must be fitted with corresponding cutouts.

Screwed nipples can be sealed to the end piece by using an axial-acting O-ring, a sealing ring or a thread sealer. It is recommended to use conical nipples.

Note

Recommended manufacturers

Recommended manufacturers of screwed connections with nipples and reinforcing sleeves are listed in the appendix.

Position of the connections for secondary section end pieces

G 1/8 threaded connectors are used to connect the secondary section cooling system. These are located on the front faces of the secondary section end pieces.

For models with combi distributors, the intake is located on one side of the secondary section track and the runback on the opposite side, see also the following figure.

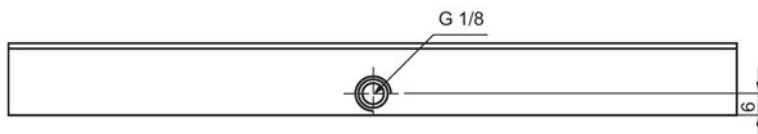


Figure 5-2 Position of the connection elements of the secondary section cooling system with combi distributor (face view)

For models with combi adapter / combi end piece, the cooling medium intake and runback are located on the combi adapter, see following figure.

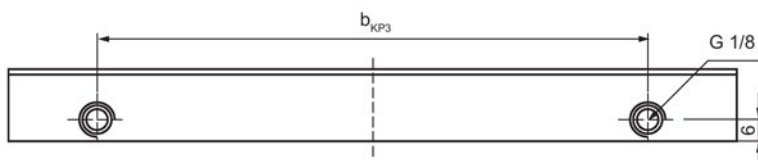


Figure 5-3 Position of the connection elements of the secondary section cooling system with combi adapter (face view)

Table 5- 1 Connector dimensions of the secondary section cooling system with combi adapter (available only for 1FN3050...450)

Motor type	b _{KP3} [mm]
1FN3050	40
1FN3100	40
1FN3150	100
1FN3300	50
1FN3450	100

Direct connection

To connect plastic hoses directly, cooling sections with hose connector nipples can be ordered from Siemens. The inside diameter of the hose should be 5 mm. Hose and hose connector nipple are connected with a hose clamp.

5.2 Electrical connection

5.2.1 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.

- Only operate the motors with the appropriately configured converters.



! WARNING

Risk of electric shock

If you connect the voltage to the primary section as individual component, then there is a risk of electric shock as there is no touch protection.

- Only connect a voltage if the motor component is installed in the assembled machine.



! 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.

- 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.

- 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).
- Attach the shield through a large surface area.
- 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
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 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.

No direct connection of the temperature monitoring circuits



 WARNING
Risk of electric shock when incorrectly connecting the temperature monitoring circuit In the case of a fault, circuits Temp-S and Temp-F do not provide safe electrical separation with respect to the power components. • Use, for example, the TM120 or the SME12x to connect the Temp-S and Temp-F temperature monitoring circuits. 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).

Correctly connecting temperature sensors

NOTICE

Motor destroyed as a result of overtemperature

The motor can be destroyed as a result of overtemperature if you do not correctly connect the temperature sensors.

- When connecting temperature sensor cables with open conductor ends, pay attention to the correct assignment of conductor colors.

5.2.2 Important information about the electrical connection

The 1FN3050 motors either have a permanently connected combination cable or two separate permanently connected cables for the power connection and the signal connection. There is a choice of 0.5 m length and preassembled connectors (size 1 or M17) or 2 m length and open conductor ends for these cables.

The 1FN3100 to 1FN3900 motors are provided with separate cables for the power connection and signal connection. To connect these motors, use the connection cover with metric cable glands directly on the integrated terminal panel.

Peak load motors from this series are also available with a combination cable. Connect the combination cable via a connection cover with PG cable gland on the terminal panel.

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 shielding and grounding.

General notes for routing electric cables

Drives with linear motors are subject to a high dynamic load. It must be ensured that vibration is not transferred to the connectors by suitably routing the cables or by providing strain relief close to the connector (distance < 10 $D_{\max}$). $D_{\max}$ is the maximum cable diameter (see Catalog).

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, cables in the carrier made from different materials must be installed in the cable carrier with spacers.

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 conductors and cable cross-sections

Cables that are connected to the motor must have four conductors for the power cable / four conductors for the signal cable. The cross-section for each of the signal cable conductors is 0.5 mm². 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 (laying system C). The table below specifies the maximum permissible rated current of the motor for different cross-sections of the power cable conductors.

Table 5- 2 Maximum permissible rated current with different cross-sections of the power cable conductors

Power cable conductor cross-section	2.5 mm ²	4 mm ²	6 mm ²	10 mm ²	16 mm ²	25 mm ²
Maximum permissible rated current	21 A	28 A	36 A	50 A	66 A	84 A

Note

Connection of large cable cross-sections

Connecting cables with conductor cross-sections of more than 16 mm² is not possible at the motor terminal panel. If the rated current of a motor requires power conductors with a cross-section of 25 mm², please contact your local Siemens office.

5.2.3 PIN assignments for the connectors

PIN assignments of the plug-in connectors for combination cables

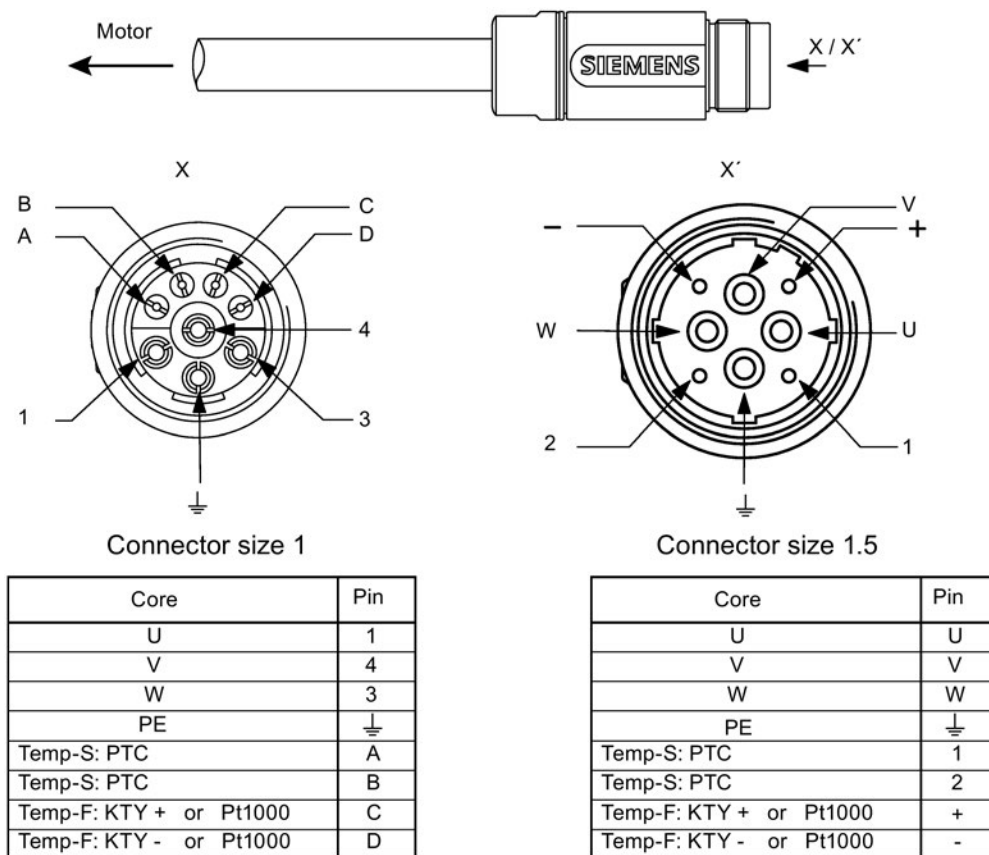


Figure 5-4 PIN assignments of the plug-in connectors for combination cables

Connect the cables at the motor end with EMC-compliant metallic PG cable glands. This allows cable connections with low bending radii in all directions.

Pin assignment of the plug-in connectors for separate cables

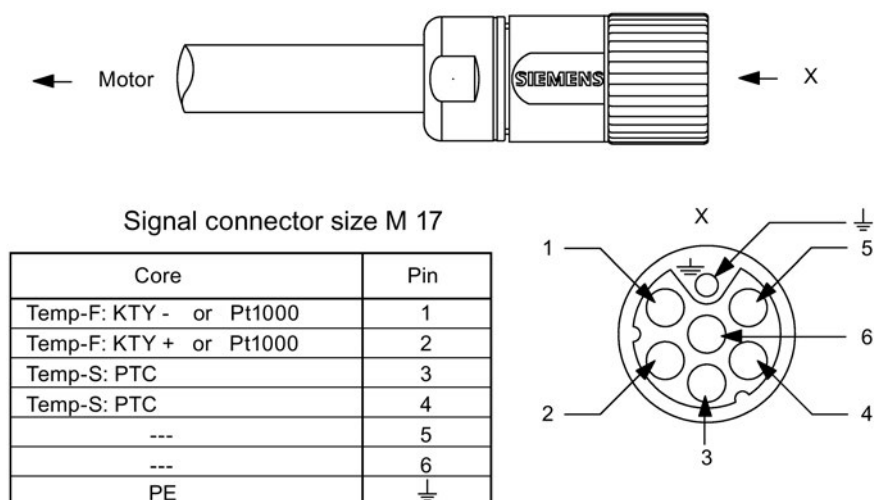


Figure 5-5 PIN assignments of the plug-in connectors for signal cables

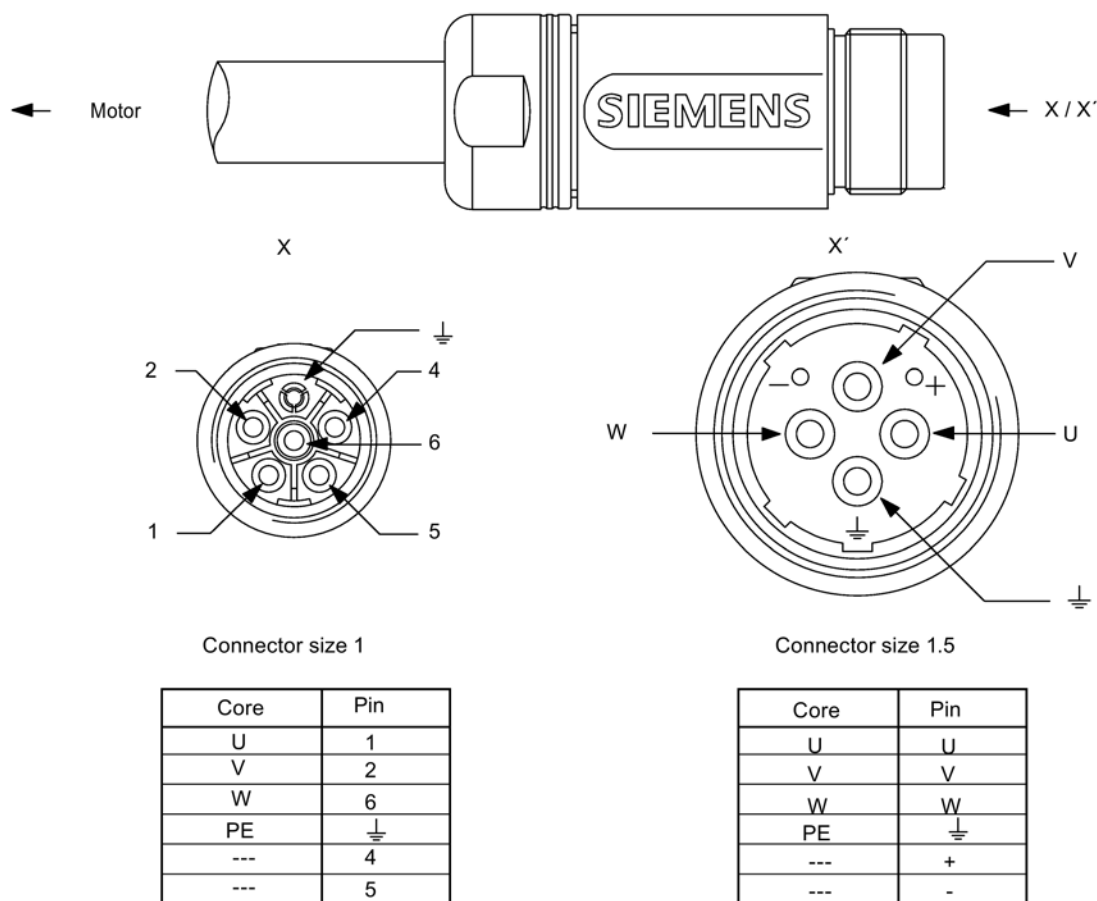


Figure 5-6 PIN assignments of the plug-in connectors for power cables

5.2.4 Terminal panel

Terminal panel

Note

Preassemble the cables before installing

If the primary section is already installed, the terminal panel may be difficult to access.

- Install the cables in the connection frame before installing the primary section in the machine.

The following figures show the terminal assignment of the terminal panel for various peak load motor types. The terminal panel of peak load and continuous load motors is identical. The only difference is that the dimensions of the casing are larger on the continuous load motor. However, this is of no significance for the electrical connection.

With the EN 60034-8:2002 standard the terminal markings have changed. For the old terminal markings, see Appendix.

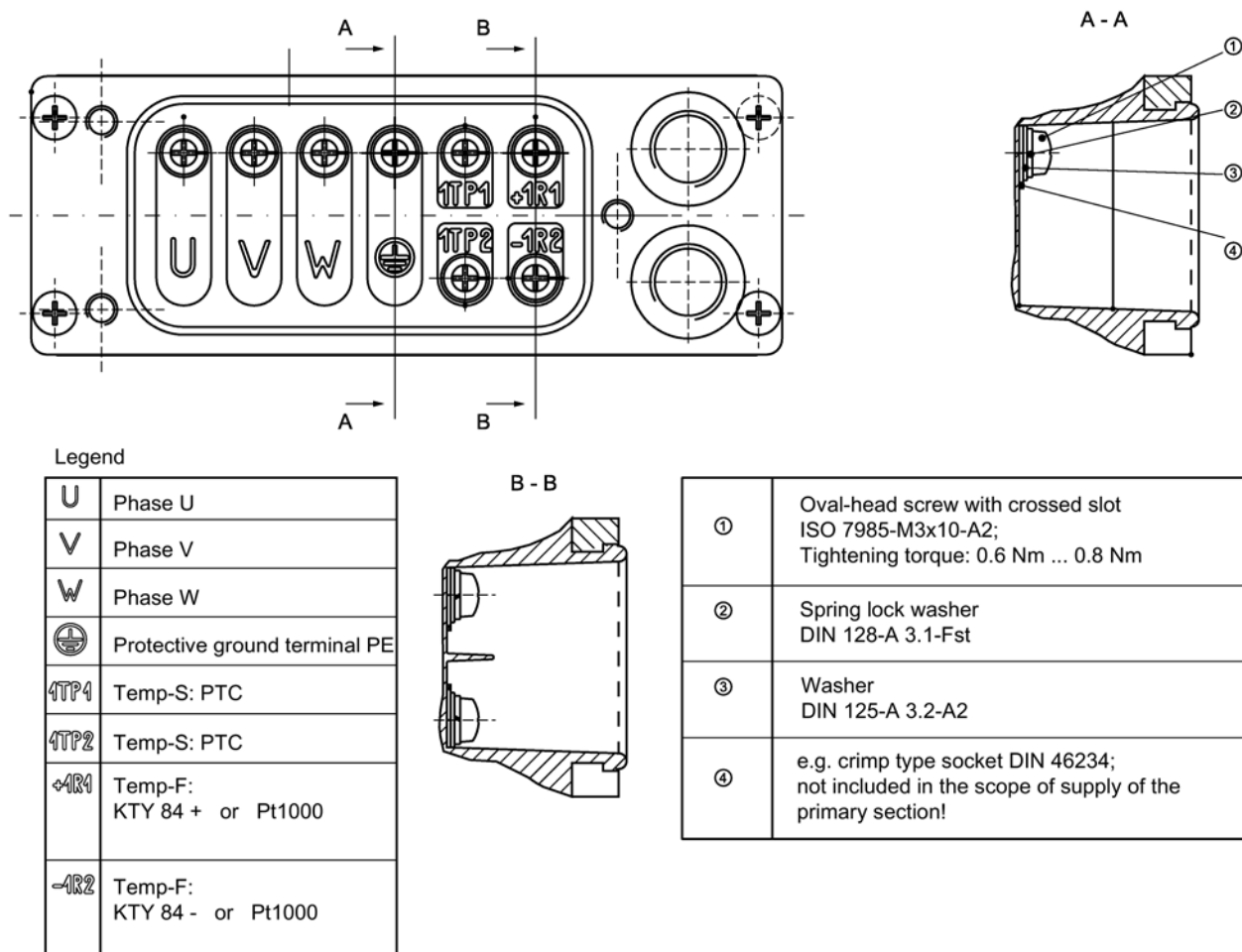


Figure 5-7 Terminal panel for the motors 1FN3100 to 1FN3150

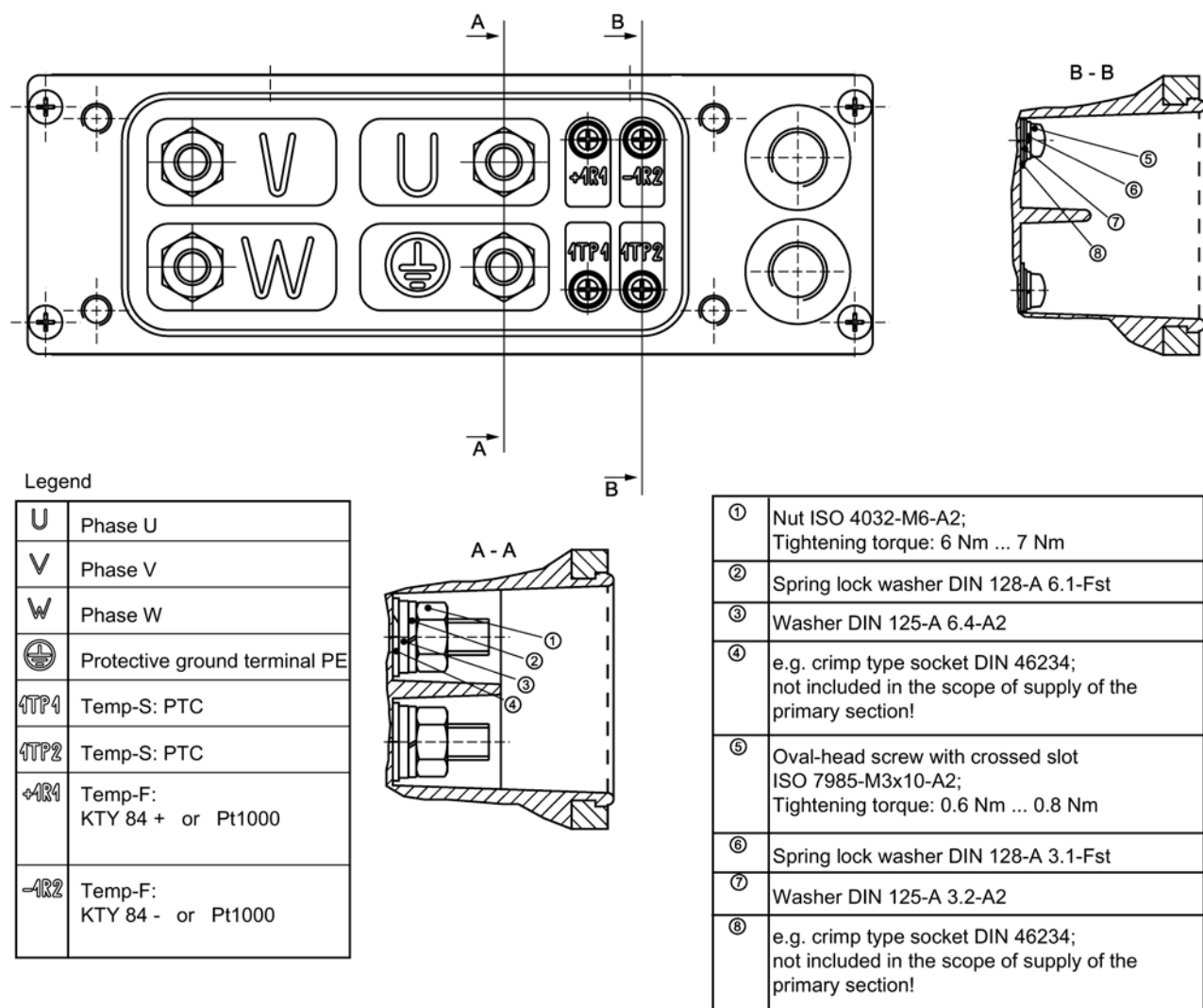


Figure 5-8 Terminal panel for the motors 1FN3300 to 1FN3900

The supplied screws and the tightening torques are listed in following table.

Table 5- 3 Connection cover screws supplied and tightening torques

Motor type 1FN3...	Screw compliant with DIN EN ISO 4762	Tightening torque
100, 150	M4x20-A2	2.2 Nm
300, 450, 600, 900	M5x20-A4	3.4 Nm

Disassembly of the connection cover

NOTICE

Damage to the seal

The seal can be damaged during disassembly of the connection cover.

- When unscrewing the connection cover, take care that the seal stays completely in the groove in the connection cover.
- Carefully remove the seal from the motor if necessary. Then press the seal back into the groove of the connection cover.

5.2.5 Power connection

Table 5- 4 Conductor assignment for power cables with open conductor ends

Color/identification	Connection
green/yellow	PE
black / U / L1 / C / L+	U
black / V / L2	V
black / W / L3 / D / L-	W

5.2.6 Temperature sensor connection

Note

Observe the polarity

Carefully note the polarity when connecting the KTY.

The following shows various connection variants for the temperature sensors. These illustrations apply to the operation of 1FN3 linear motors with the SINAMICS S120 drive system. The IDs A, B or C are used to identify the conductor assignments of the temperature sensor cables in the following tables.

5.2 Electrical connection

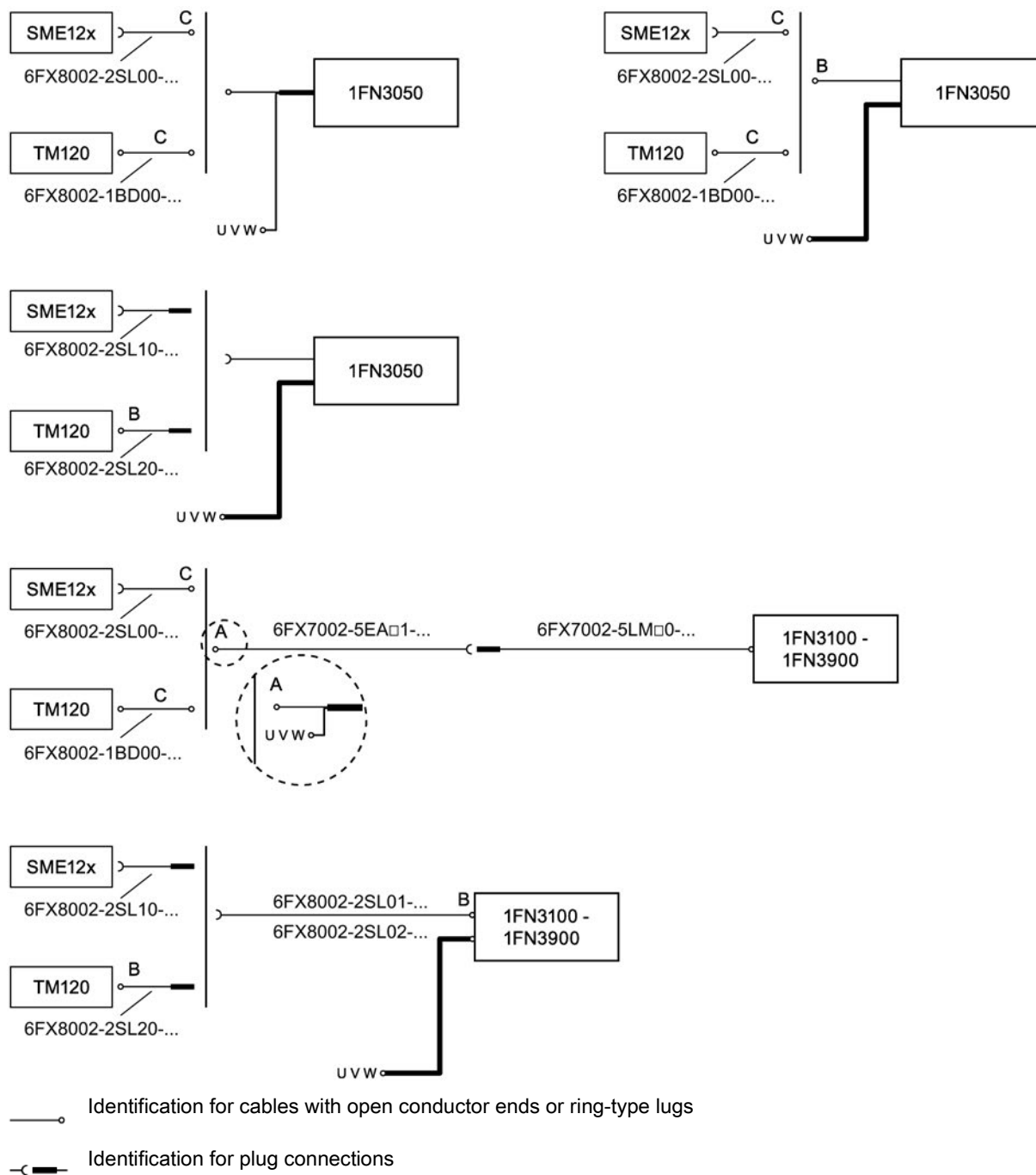


Figure 5-9 Connection variants for temperature sensors for the SINAMICS S120 drive system

Table 5- 5 Conductor assignments of the temperature sensor cables – Table A

Conductor color	Interface
White	-1R2: -KTY or Pt1000
black	+1R1: +KTY or Pt1000
red	1TP1: PTC
Yellow	1TP2: PTC

Applies to permanently connected combination cable with open conductor ends for 1FN3050

Table 5- 6 Conductor assignments of the temperature sensor cables – Table B

Conductor color	Interface
White	-1R2: -KTY or Pt1000
Brown	+1R1: +KTY or Pt1000
Green	1TP1: PTC
Yellow	1TP2: PTC

Applies to cable 6FX8002-2SL01-..., 6FX8002-2SL02-..., 6FX8002-2SL20-... and permanently connected sensor cable with open conductor ends for 1FN3050

Table 5- 7 Conductor assignments of the temperature sensor cables – Table C

Conductor color	Pin
White	1
Brown	2
Green	3
Yellow	4
Gray	5
Pink	6
Green/yellow	

Applies to cable 6FX8002-2SL00-...; the conductor colors also apply for cable 6FX8002-1BD00-... (sold by the meter)

5.2.7 Motor circuit diagram

The circuit diagram of the primary section looks like this:

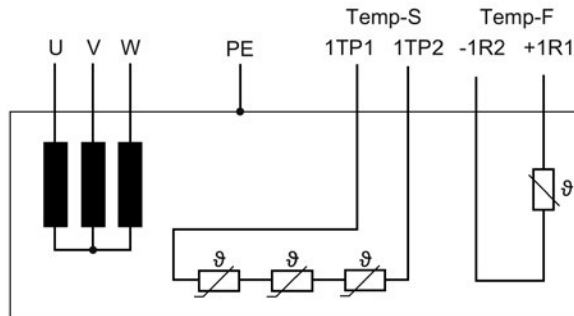


Figure 5-10 Circuit diagram for primary section

5.2.8 Shielding, grounding, and equipotential bonding

Important notes regarding shielding, grounding and equipotential bonding

Correct installation, correctly connecting cable shields and protective conductors is very important, not only for the safety of personnel but also for the effect on interference emission and interference immunity.



! 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 conductors of shielded or unshielded cables and their associated shields to the grounded enclosure potential at one end as minimum.

Alternatively:

Insulate unused conductors of shielded or unshielded cables and their associated shields. 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.

- | |
|---|
| <ul style="list-style-type: none"> • 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.

- | |
|--|
| <ul style="list-style-type: none"> • 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 subsequent 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.

6.1 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.

- Observe the information in Chapter "Danger from strong magnetic fields (Page 26)".



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.

- 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. Use shielded signal and power cables. 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.

- 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 the free axis travel path.
- Check before switching on the commutation! Also observe the instructions of the drive system being used.
- Limit the motor currents.
- 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.

- 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).
- Attach the shield through a large surface area.
- 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**

Touching the surfaces of the motors may result in burns. The surface temperature of the motors can be more than 100 °C (212 °F).

- Ensure that the cooling system is functioning perfectly.
- 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. For specific details, refer to the documentation of the drive system being used or contact your local Siemens office.

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.

6.2 Checklists

Checklists for commissioning linear motors

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

Table 6- 1 Checklist (1) - general checks

Check	OK
Are all of the necessary components of the configured drive line-up available, correctly dimensioned, installed and connected?	
Are the manufacturer documentation for the system components (e.g. drive system, encoder, cooling system, brake) and the Configuration Manual "SIMOTICS L-1FN3 linear motors" available?	
If the 1FN3 linear motor is to be fed from a SINAMICS S120 drive system: Is the following, current SINAMICS documentation available? • SINAMICS S120 Commissioning Manual • Getting Started S120 • S120 Function Manual • S120/150 List Manual	
If the 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.) • 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?	

Table 6- 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?	
Has the cooling system required according to the manufacturer's data been connected and is it functioning correctly?	
Does the coolant meet the requirements stated in chapter "Coolant"?	
Were the cooling circuits purged before being filled with coolant?	
Is it ensured that the permissible cooling circuit pressure stated in chapter "Technical features" in the operating instructions will not be exceeded?	
Have measures been taken to relieve strain on the cables?	

Table 6- 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 motors connected with shielded power cables?	
Are the power cable shields connected as closely as possible to the terminal box across a wide area?	
Are all cable shields connected to the respective housings through the largest possible surface area?	
Have the control cables been connected in accordance with the required interface configuration and the shield applied?	
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 circuits to ensure that they correctly trip?	
Has the encoder been correctly connected?	
Have the digital and analog signals been routed using cables that are separate from the power cables?	
Has the distance from power cables been observed?	
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?	

6.3 Checking the insulation resistance

Notes for checking the insulation resistance



! WARNING

Risk of electric shock

If you check the insulation resistance using high voltage on a plant/machine equipped with direct drives or directly at the motors, this can damage the motor insulation! Examples necessitating that the insulation resistance is checked include the installation test, preventive maintenance and troubleshooting.

- 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.
- The test may only be carried out with a maximum direct voltage of 1000 V for a maximum time of 60 s!
- Measure the test voltage with respect to ground or the motor housing.
- If a higher DC or AC voltage is necessary to test the machine/plant, you must coordinate the test with your local Siemens office!
- Carefully observe the operating instructions of the test equipment!

Always proceed as follows when testing the insulation resistance of individual motors:



1.
2.

1. Connect all winding and temperature sensor connections with each other; the test voltage must not exceed 1000 VDC, 60 s with respect to PE connection.
2. Connect all temperature sensor connections to the PE connection and all winding connections with each other; the test voltage must not exceed 1000 VDC, 60 s, winding with respect to PE connection.



Each insulation resistance must be at least 10 MΩ, otherwise the motor insulation is defective.



! 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.

6.4 Cooling

**! 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****Danger to life when the cooling system bursts**

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

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

! CAUTION**Risk of burns when hot cooling water escapes**

There is a risk of burns caused by escaping hot cooling water and steam if you open the cooling circuit of a motor that was previously in operation.

- Do not open the motor cooling circuit until the motor has cooled down.

Operation

7.1 Safety instructions for operation

WARNING

Danger to persons in areas with rotary and crushing motion

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.

- Keep persons away from the axis traversing parts and areas where there is a danger of crushing.

NOTICE

Material damage caused by incorrect operation

Improper operation can lead to serious material damage.

- 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.
- Ensure that the motor cooling system functions perfectly.
- Only operate the motor in conjunction with effective temperature protection.



WARNING

Faults while the motor is operational

Examples of possible faults that can cause malfunctions:

- Higher power consumption
- Changed temperatures
- Vibration
- Unusual noise
- Unusual smells
- Response of the monitoring devices

Faults while the motor is operational can result in death, severe injury or material damage.

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

7.2 Switching off and operating phases

During downtimes, deposits must not be produced that can block the cooling system. Check with the manufacturer of the coolant as to how long it can remain in the cooling system.

7.3 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

Risk to life as a result of non-functioning protective devices

Protective devices that are not functioning can result in death, serious injury or material damage.

- Do not deactivate protective devices. This also applies to test operation.
- Only work with protective devices that are fully functional.

NOTICE

Damage to the machine caused by faults

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

Table 7- 1 Possible faults

Fault	Cause of the fault (see following table)												
	A	B	C	D									
Motor blocked				D	E					K			
Noise during operation				D		F	G						
High temperature rise during no-load operation				D		F	G						
High temperature rise when under load	A			D		F	G						
Uneven running								H	J				
Axis is sluggish					E					K	L		
Water is leaking													N

Table 7- 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
F	Cooling water not connected / switched off	Check cooling water connection / switch on cooling water / check cooler
	Water connection / pipes defective	Locate leaks and seal as necessary, or consult the manufacturer
G	Cooling water flow rate too low	Check cooling water flow rate according to data sheet specification
	Intake temperature too high	Set correct intake temperature
H	Insufficient shielding for motor and/or encoder cable	Check the shielding and grounding
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
N	Cooling water pipes/water connection defective	Locate leaks and seal as necessary, or consult the manufacturer

If the fault still cannot be resolved after applying the measures specified above, please contact the manufacturer or your local Siemens office.

Maintenance

8.1 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 26)".

**! 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 assembly.
- 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.
- 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
Danger to life when the cooling system bursts

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

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

! CAUTION
Risk of burns when hot cooling water escapes

There is a risk of burns caused by escaping hot cooling water and steam if you open the cooling circuit of a motor that was previously in operation.

- Do not open the motor cooling circuit 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).
- Attach the shield through a large surface area.
- 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.

- 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.

- 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.

Siemens service centers are available to answer any questions you may have. Siemens Service Center addresses can be found at
<http://www.siemens.com/automation/service&support>



CAUTION

Sharp edges and falling objects

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

- Always wear safety shoes and safety gloves!

8.2 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

Test and replacement intervals of the cooling medium

The test and replacement intervals for the cooling medium should be agreed with the manufacturers of the anti-corrosion agent and the cooling system.

Decommissioning and disposal

9.1 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.



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. Switch off the cooling. Reduce the pressure to 0 bar.
4. Disconnect the power and signal cables.
5. If necessary, properly isolate the power connections. Any movement of primary sections respective to secondary sections can lead to induced voltages.
6. Disconnect the coolant lines.
7. Drain the coolant from the motor and dispose of it correctly.
8. Remove chips, dirt, foreign particles, etc. from the motor.
9. Remove the primary sections. Observe the respective installation procedures.
When installing with a divided secondary section track, you must first slide the primary section on one end of the secondary section track, for example. Then you can dismantle the secondary sections that are not covered.
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.
10. Pack the motor components in the original packaging.
11. Correctly store the motor components.



9.2 Disposal

The product must be disposed of in the normal recycling process in compliance with national and local regulations.



WARNING

Injury or material damage if not correctly disposed of

If you do not correctly dispose of direct drives or their components (especially components with permanent magnets), then this can result in death, severe injury and/or material damage.

- Ensure that direct drives and their associated components are correctly disposed of.

Main constituents of a proper disposal procedure

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

9.2.1 Disposing of secondary sections



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 26)".

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.

9.2.2 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 Mounting the Hall sensor box

Mounting the Hall sensor box onto the peak load motors 1FN3050 - 1FN3150

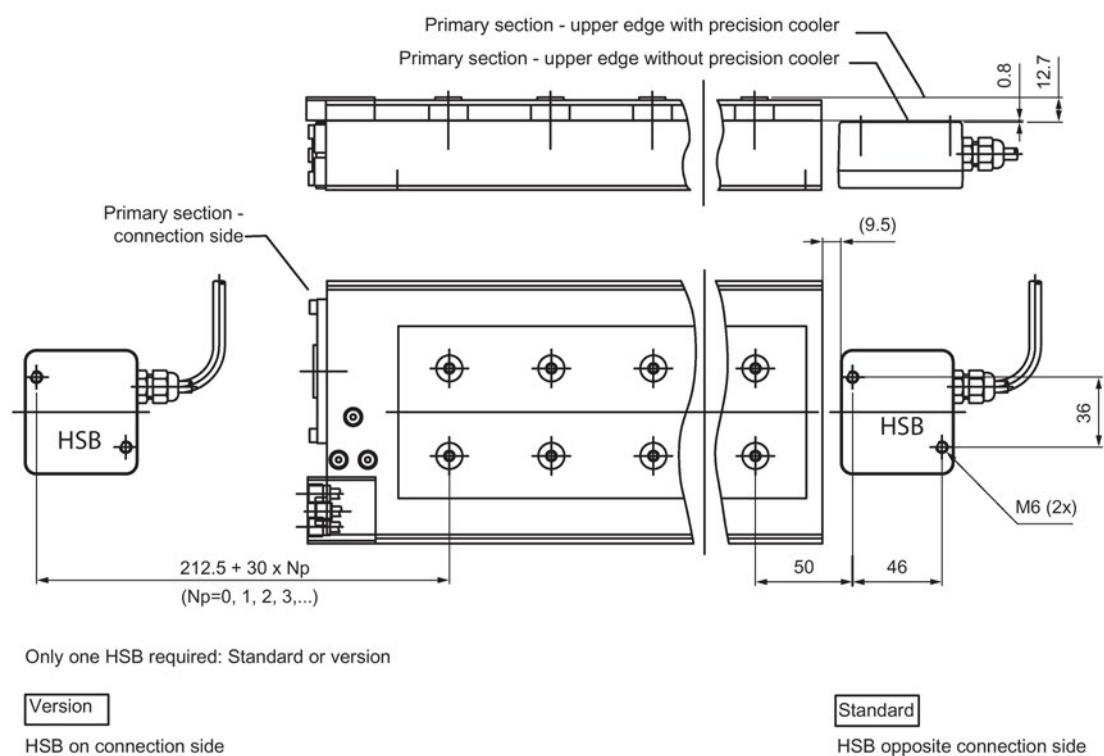
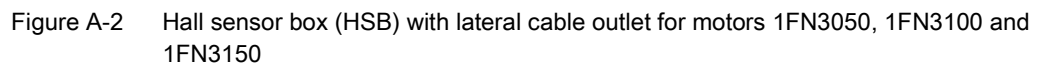
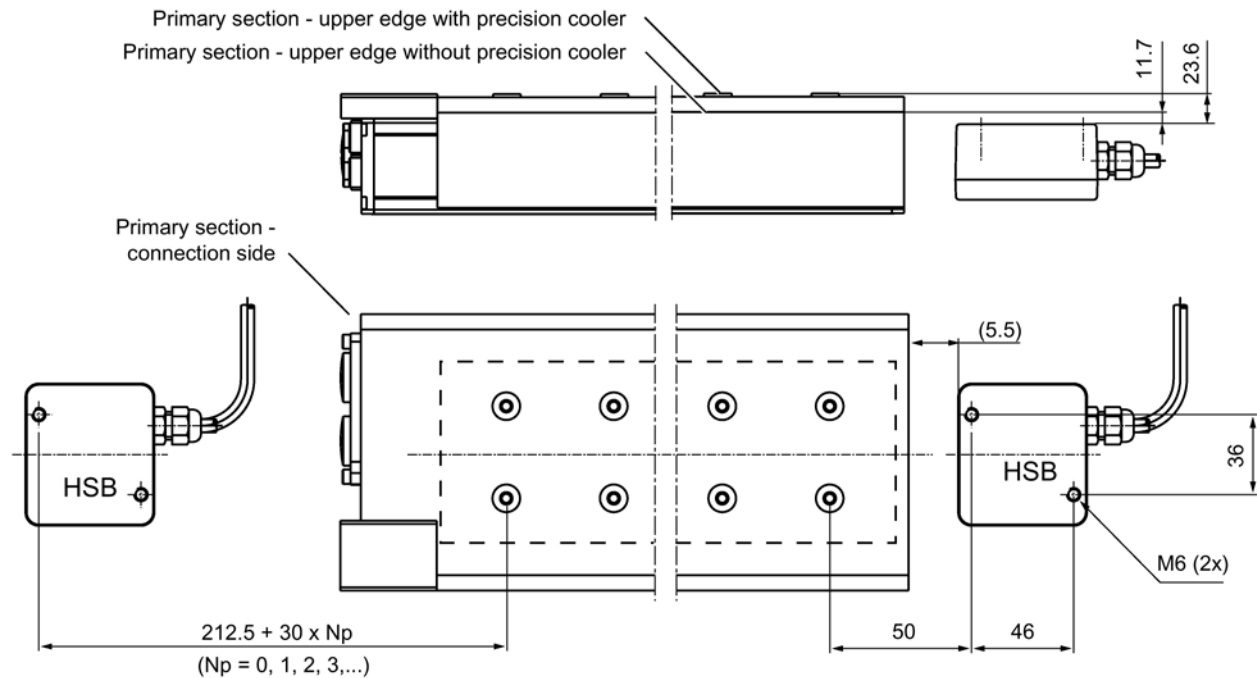


Figure A-1 Hall sensor box (HSB) with straight cable outlet for motors 1FN3050, 1FN3100 and 1FN3150



Mounting the Hall sensor box onto the continuous load motors 1FN3050 - 1FN3150



Only one HSB required: Standard or version

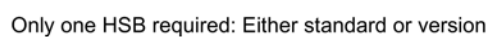
Version

HSB on connection side

Standard

HSB opposite the connection side

Figure A-3 Mounting the Hall sensor box (HSB) with straight cable outlet for motors 1FN3050-xN ... 150-xN



HSB on connection side

HSB opposite connection side

Figure A-4 Mounting the Hall sensor box (HSB) with lateral cable outlet for motors 1FN3050-xN ... 150-xN

Mounting the Hall sensor box onto the peak load motors 1FN3300 - 1FN3450

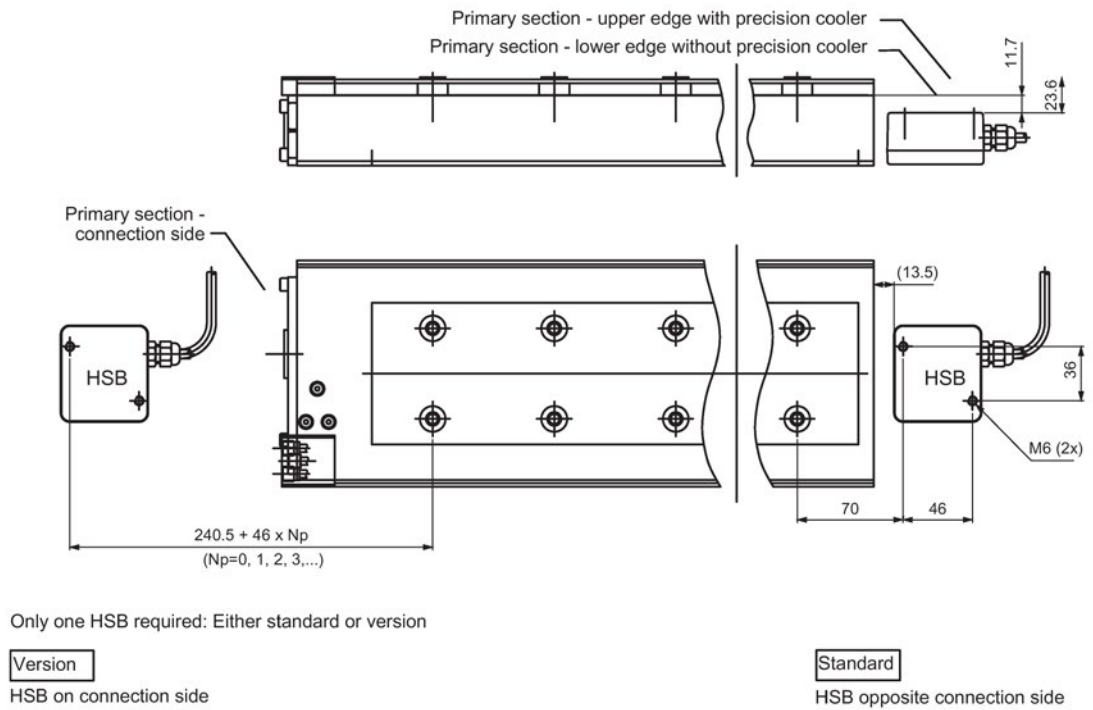


Figure A-5 Hall sensor box (HSB) with straight cable outlet for motors 1FN3300 and 1FN3450

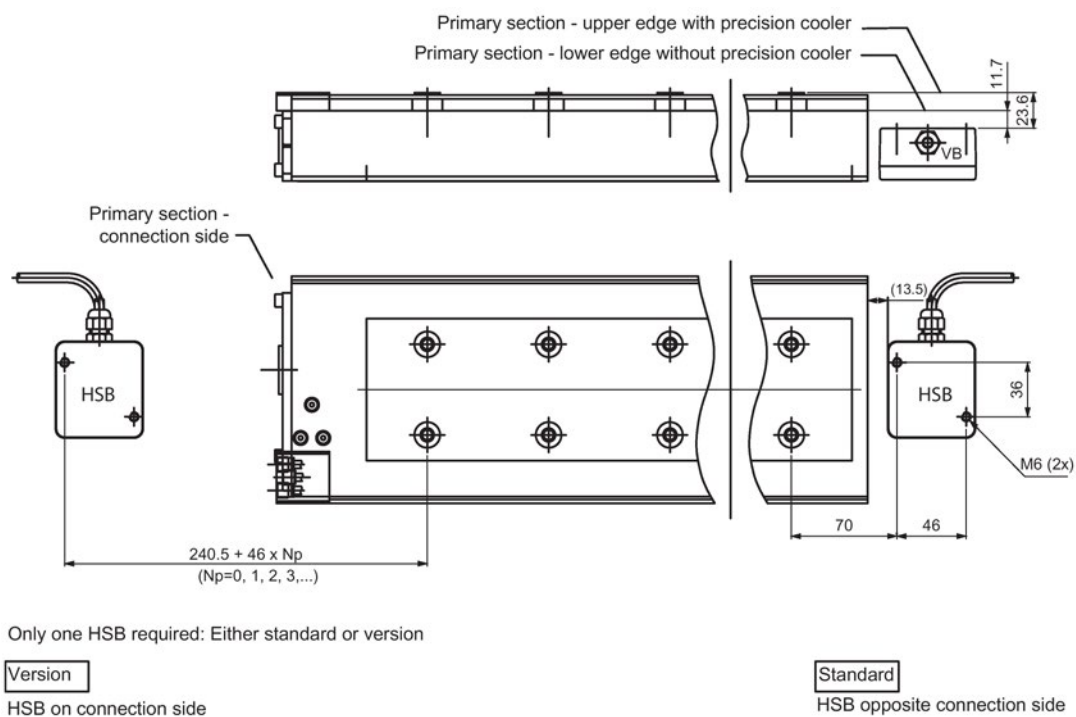
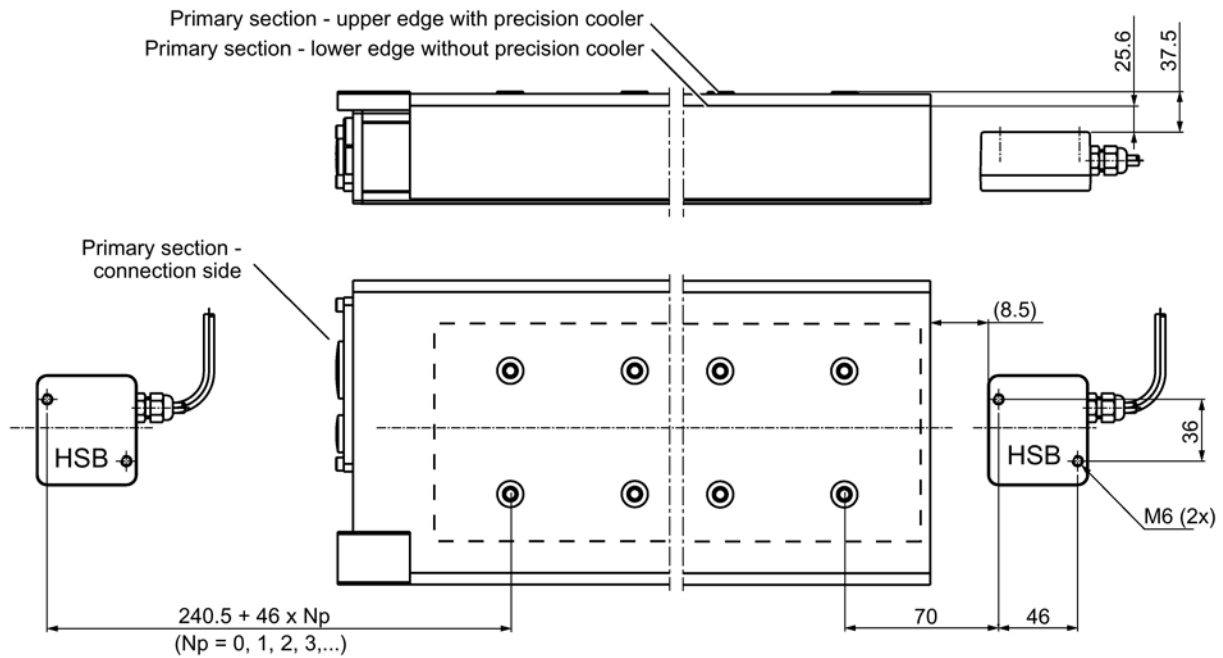


Figure A-6 Hall sensor box (HSB) with lateral cable outlet for motors 1FN3300 and 1FN3450

Mounting the Hall sensor box onto continuous load motors 1FN3300 - 1FN3450



Only one HSB required: Either standard or version

Version

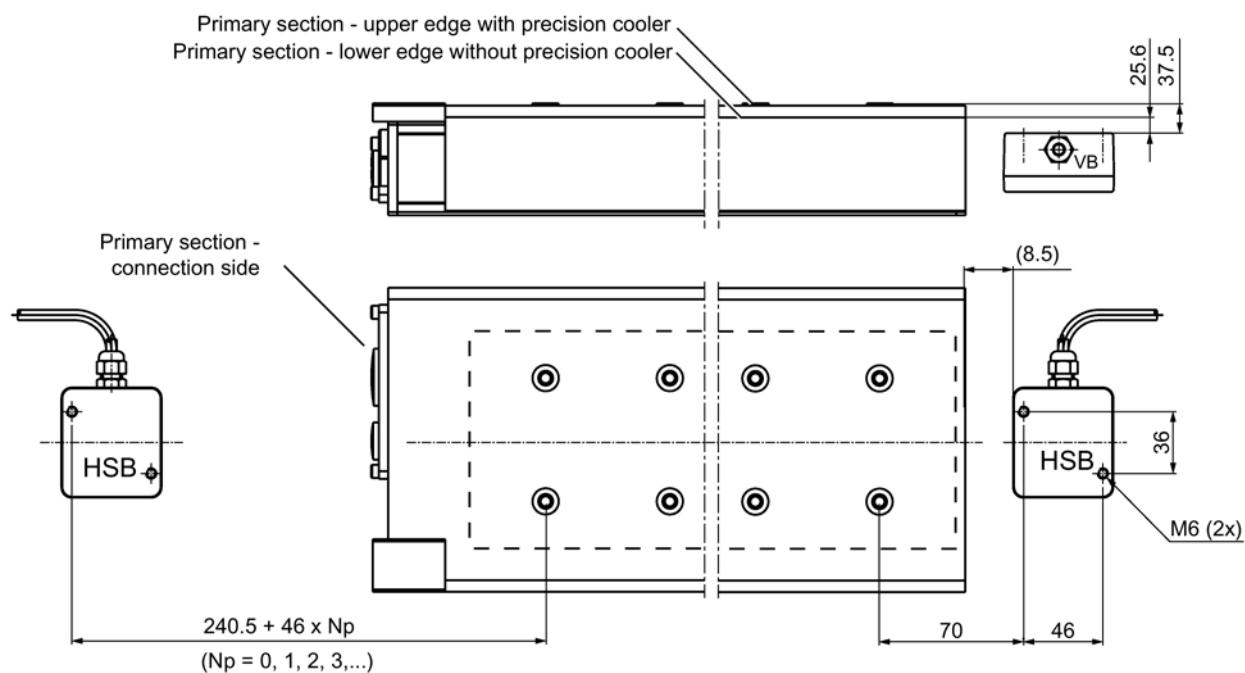
HSB on connection side

Standard

HSB opposite connection side

Figure A-7 Mounting the Hall sensor box (HSB) with straight cable outlet for motors 1FN3300-xN ... 450-xN

A.1 Mounting the Hall sensor box



Only one HSB required: Either standard or version

Version

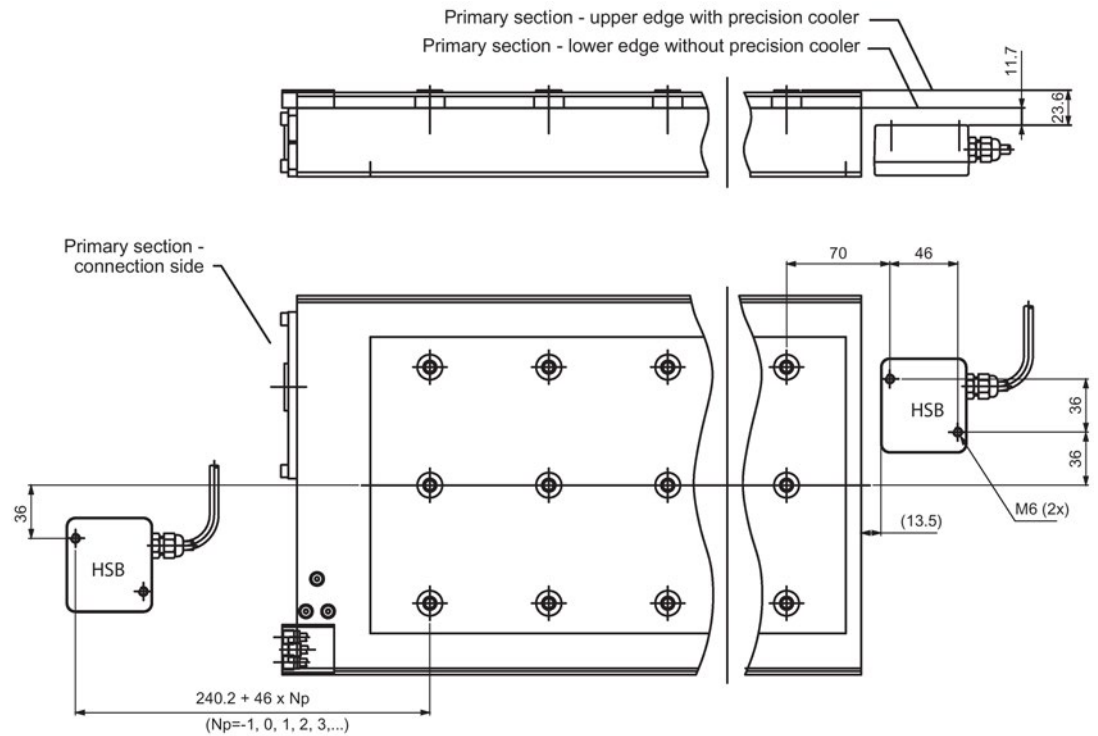
HSB on connection side

Standard

HSB opposite connection side

Figure A-8 Mounting the Hall sensor box (HSB) with lateral cable outlet for motors 1FN3300-xN ... 450-xN

Mounting the Hall sensor onto the peak load motor 1FN3600



Only one HSB required: Either standard or version

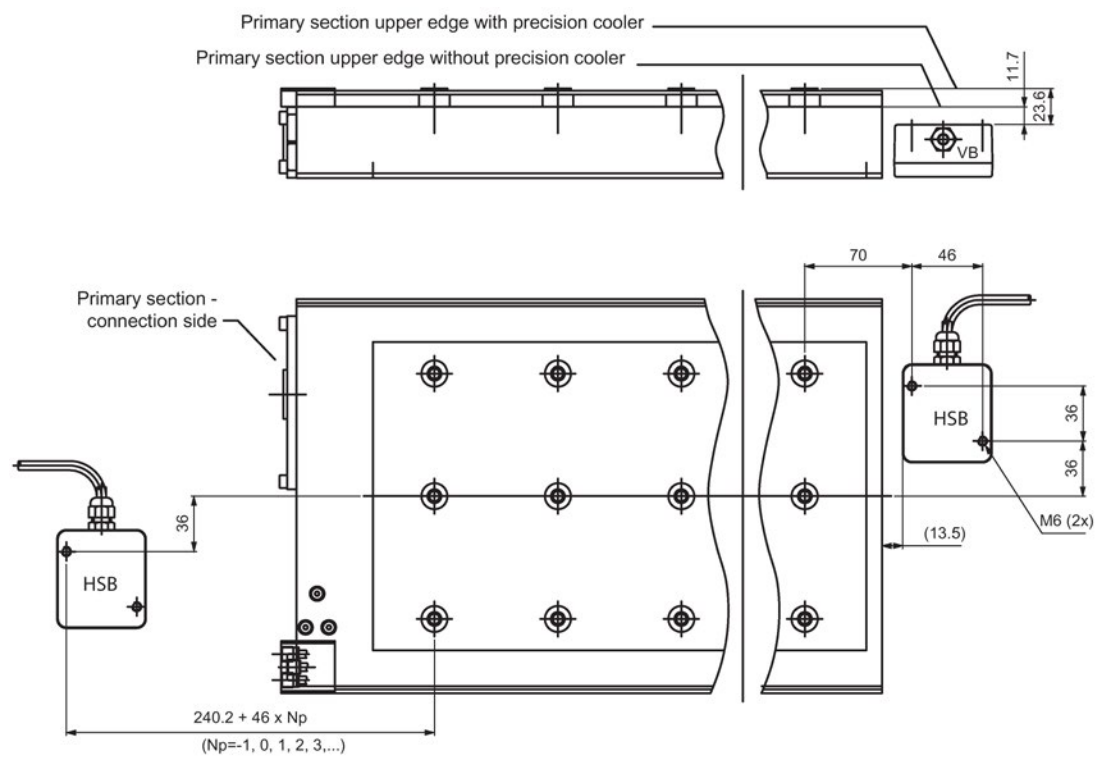
Version

HSB on connection side

Standard

HSB opposite connection side

Figure A-9 Hall sensor box (HSB) with straight cable outlet for 1FN3600 motors



Only one HSB required: Either standard or version

Version

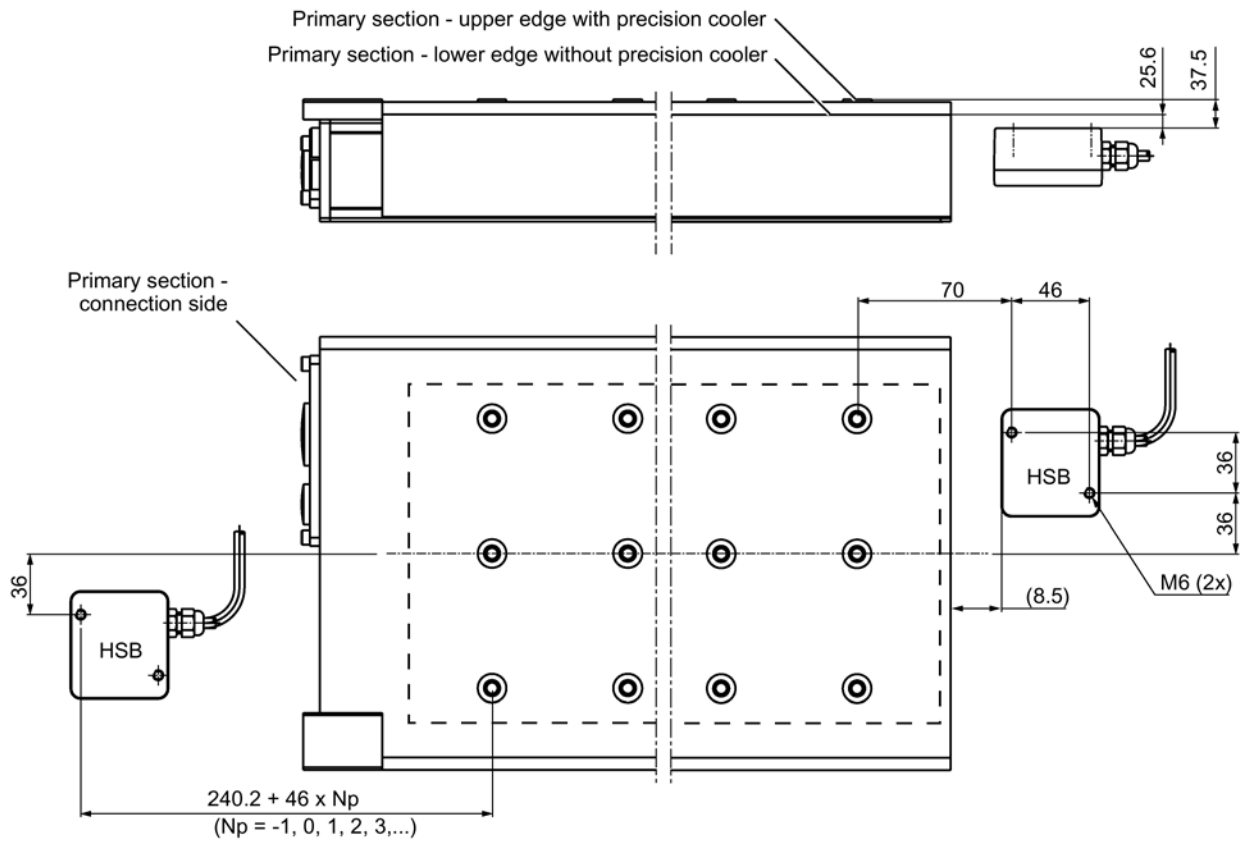
HSB on connection side

Standard

HSB opposite connection side

Figure A-10 Hall sensor box (HSB) with lateral cable outlet for 1FN3600 motors

Mounting the Hall sensor box onto the continuous load motor 1FN3600



Only one HSB required: Either standard or version

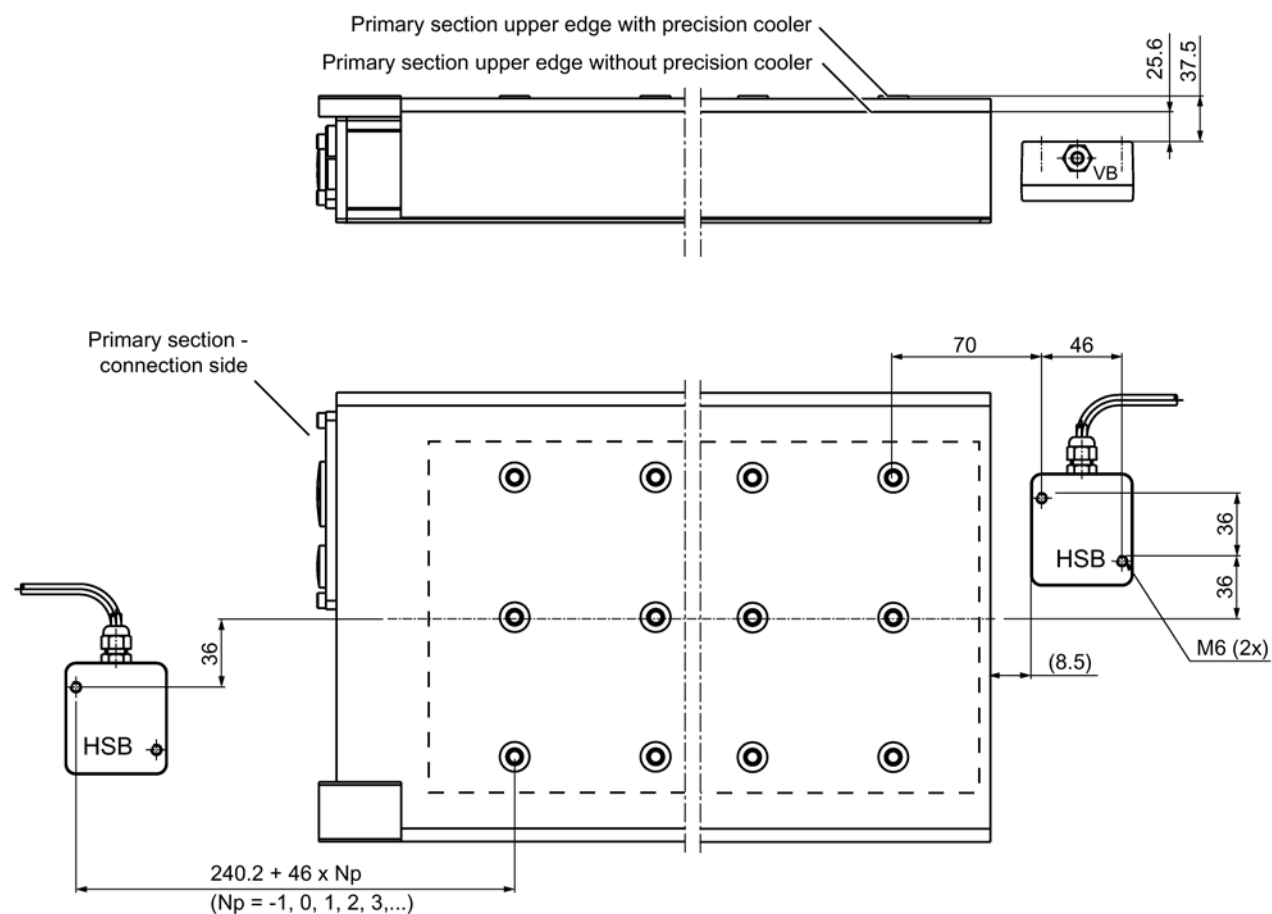
Version

HSB on connection side

Standard

HSB opposite connection side

Figure A-11 Mounting the Hall sensor box (HSB) with straight cable outlet for 1FN3600-xN motors



Only one HSB required: Either standard or version

Version

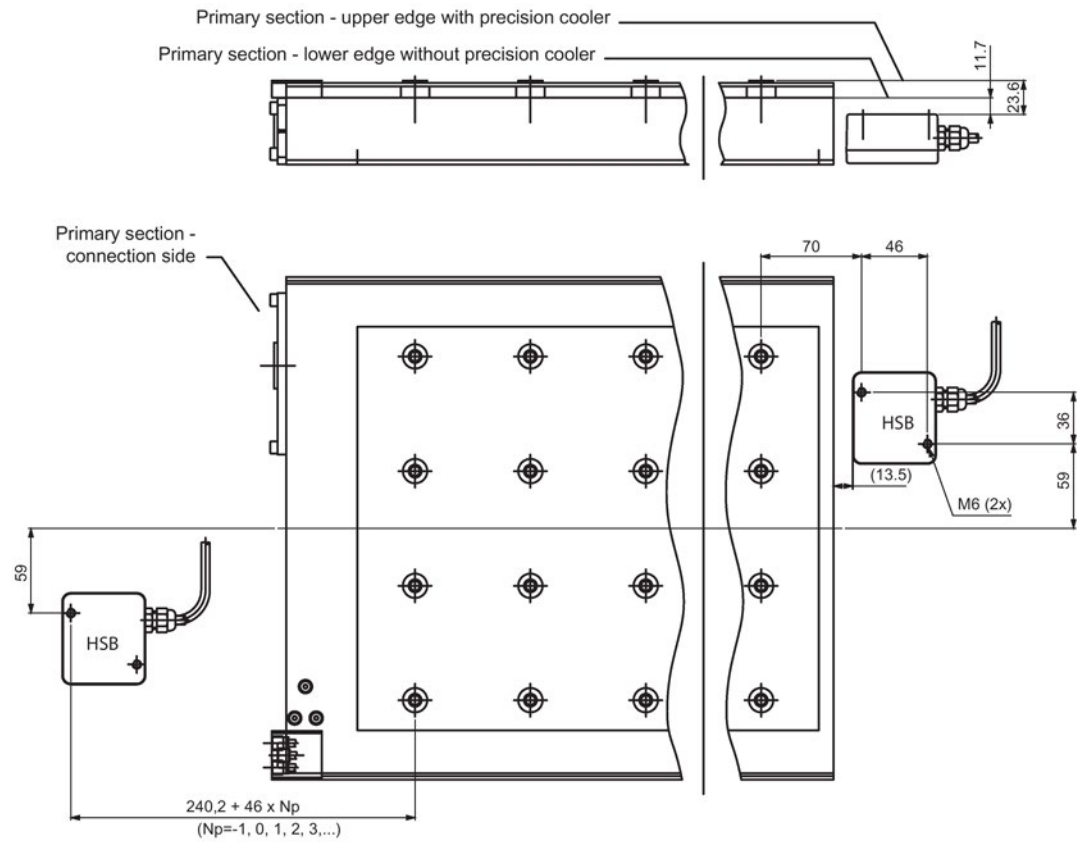
HSB on connection side

Standard

HSB opposite connection side

Figure A-12 Mounting the Hall sensor box (HSB) with lateral cable outlet for 1FN3600-xN motors

Mounting the Hall sensor box onto the peak load motor 1FN3900



Only one HSB required: Either standard or version

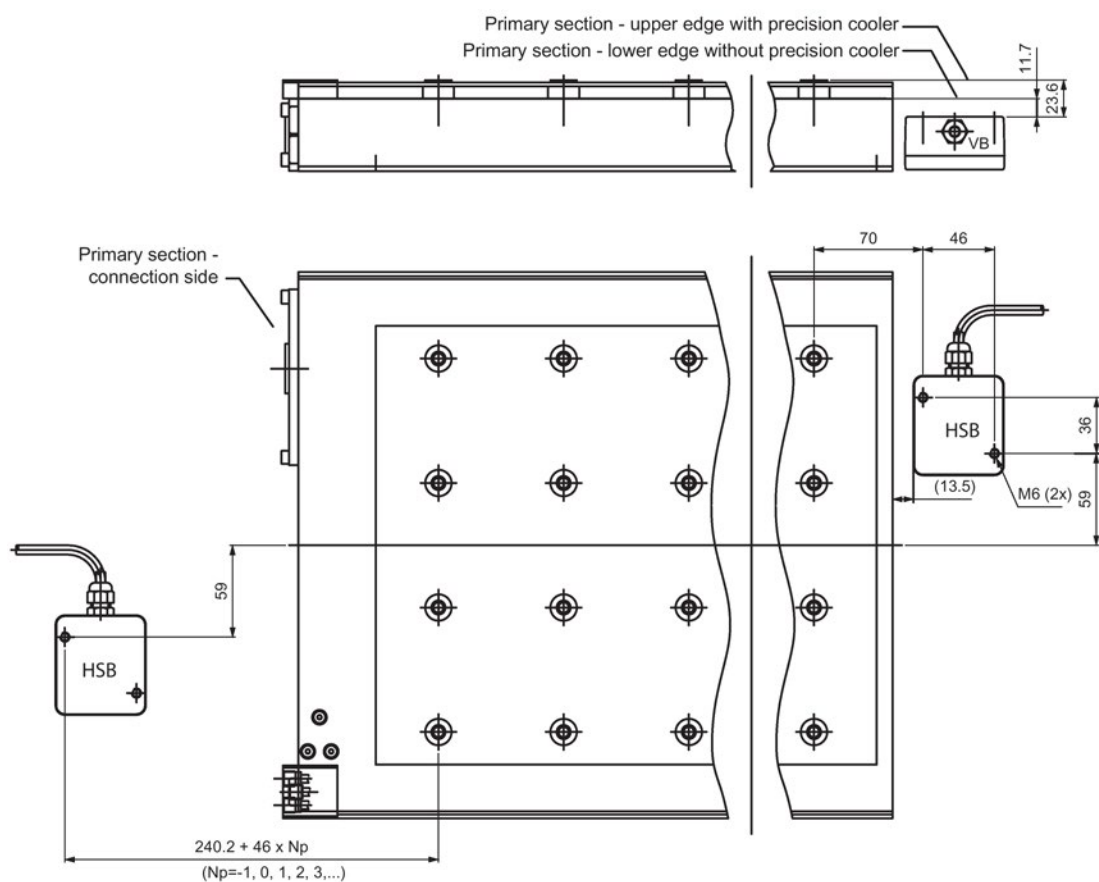
Version

HSB on connection side

Standard

HSB opposite connection side

Figure A-13 Hall sensor box (HSB) with straight cable outlet for 1FN3900 motors



Only one HSB required: Either standard or version

Version

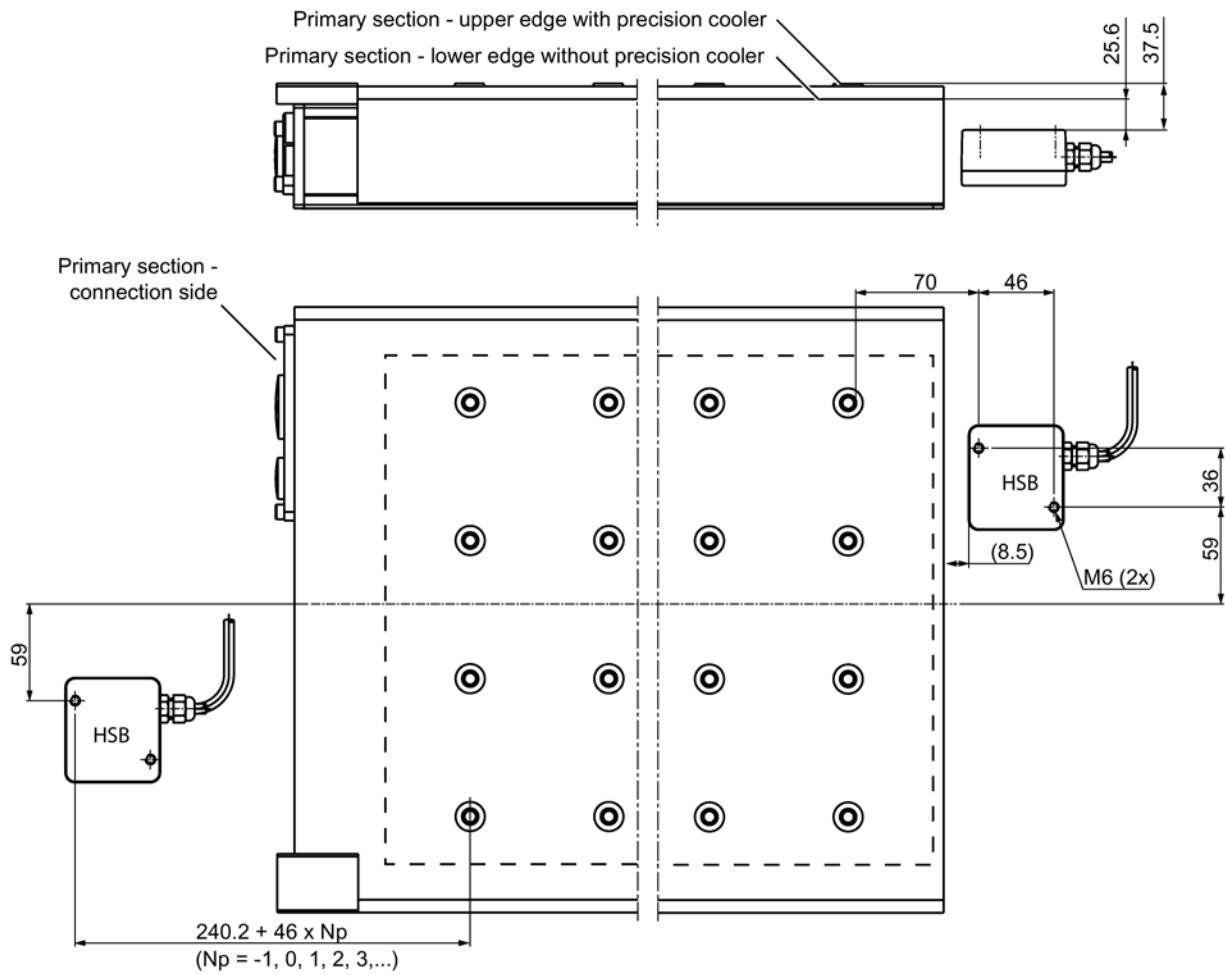
HSB on connection side

Standard

HSB opposite connection side

Figure A-14 Hall sensor box (HSB) with lateral cable outlet for 1FN3900 motors

Mounting the Hall sensor box to the continuous load motor 1FN3900



Only one HSB required: Either standard or version

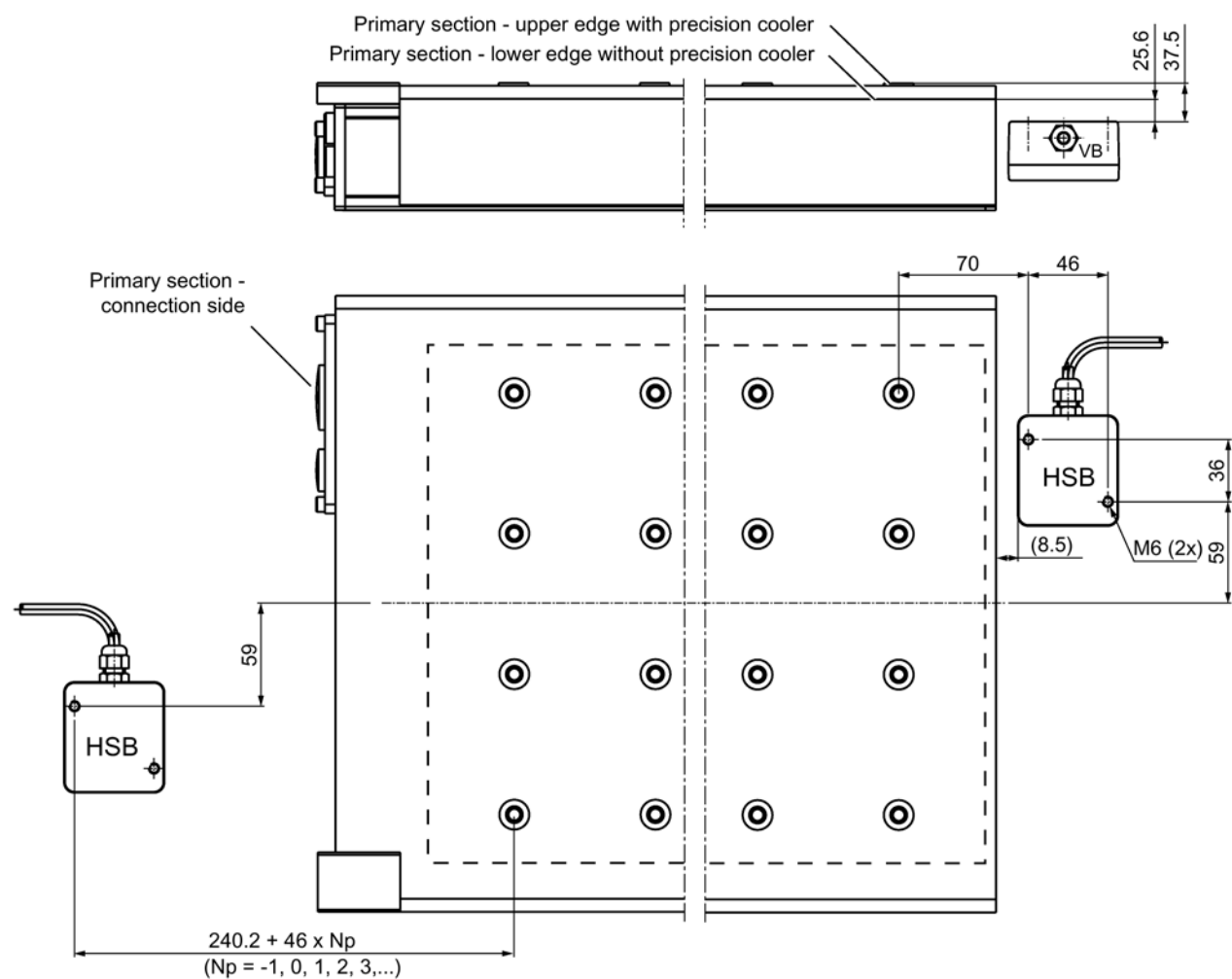
Version

HSB on connection side

Standard

HSB opposite connection side

Figure A-15 Mounting the Hall sensor box (HSB) with straight cable outlet for 1FN3900-xN motors



Only one HSB required: Either standard or version

Version

HSB on connection side

Standard

HSB opposite connection side

Figure A-16 Mounting the Hall sensor box (HSB) with lateral cable outlet for 1FN3900-xN motors

A.2 Manufacturer 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.2.1 Manufacturers of anti-corrosion agents

TYFOROP CHEMIE GmbH	
Anti-corrosion protection: Tyfocor	www.tyfo.de
Clariant Produkte (Deutschland) GmbH	
Anti-corrosion protection: Antifrogen N	www.clariant.de

A.2.2 Manufacturers of connectors for cooling

Rectus GmbH	
	www.rectus.de

A.2.3 Manufacturers of plastic hose manufacturers

Festo AG & Co. KG	
	www.festo.com

Rectus GmbH	
	www.rectus.de

A.2.4 Manufacturers of spacer foils

SAHLBERG GmbH & Co. KG	
	www.sahlberg.de

A.3 List of abbreviations

AAA - abbreviations

CE	Communaute Europeene
DIN	Deutsches Institut für Normung (German standards organization)
EC	European Community
EMC	Electromagnetic compatibility
EN	European standard
HFD	High-frequency damping
HSB	Hall sensor box
HW	Hardware
IATA	International Air Transport Association
IEC	International Electrotechnical Commission
IP	International Protection or Ingress Protection; type of protection für electric devices according to DIN EN 60529
ISO	International Standardization Organization
KTY	Temperature sensor with progressive, almost linear characteristic
PDS	Power drive system
PE	Protective earth
PELV	Protective extra low voltage
PLC	Programmable logic controller
Pt	Platinum resistance thermometer
PTC	Temperature sensor with positive temperature coefficient
SMC	Sensor Module Cabinet
SME	Sensor Module External
SSI	Synchronous serial interface
SW	Software
Temp-F	Circuit for monitoring the temperature of the motor winding
Temp-S	Temperature monitoring circuit for switching off the drive at overtemperature
TM	Terminal Module

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