SIEMENS

Equipment Manual

SINAMICS

S120

Booksize C/D-type Power Units

Edition 06/2019

www.siemens.com/drives

SIEMENS

SINAMICS

S120
Power Units in Booksize C/D-Type Format

Manual

06/2019

6SL3097-5AC20-0BP1

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

Disclaimer of Liability

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

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Introduction 1

Preface to the SINAMICS S120 Manual "Booksize C/D-Type Power Units"

Based on the booksize design, SINAMICS S120 booksize C/D-type power units have been developed for full compatibility with the booksize series

- The C type power unit includes Single Motor Modules from 18 A to 60 A and the Double Motor Module 2 x 18 A. They can be operated with an overload factor of up to 2 (continuous motion).
- The D type encompasses Single Motor Modules from 3 A to 30 A and Double Motor Modules from 2 x 3 A to 2 x 18 A. They can be operated with an overload factor of up to 3 (discontinuous motion).
- The C/D-type Motor Modules can be seamlessly integrated into a SINAMICS S120 booksize drive line-up irrespective of the installed firmware.

Only components from the booksize C/D-type series plus the relevant connection components are described in this manual.

The documentation relating to conventional power units and accessories, as well as detailed information about connection systems, protective measures, etc. can be found in the SINAMICS S120 Manual "Booksize Power Units".

1.1 The SINAMICS converter family

With the SINAMICS converter family, you can solve any individual drive task in the low-voltage, medium-voltage and DC voltage range. From converters to motors and controllers, all Siemens drive components are perfectly matched to each other and can be easily integrated into your existing automation system. With SINAMICS you are prepared for digitization. You benefit from highly efficient engineering with a variety of tools for the entire product development and production process. And you also save space in the control cabinet – thanks to the integrated safety technology.

You can find additional information about SINAMICS at the following address (http://www.siemens.com/sinamics).

1.2 General information about SINAMICS documentation

SINAMICS documentation

The SINAMICS documentation is organized in the following categories:

- General documentation/catalogs
- User documentation
- Manufacturer/service documentation

Standard scope

The scope of the functionality described in this document can differ from that of the drive system that is actually supplied.

- Other functions not described in this documentation might be able to be executed in the drive system. However, no claim can be made regarding the availability of these functions when the equipment is first supplied or in the event of service.
- The documentation can also contain descriptions of functions that are not available in a particular product version of the drive system. Please refer to the ordering documentation only for the functionality of the supplied drive system.
- Extensions or changes made by the machine manufacturer must be documented by the machine manufacturer.

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

Target group

This documentation is intended for machine manufacturers, commissioning engineers, and service personnel who use the SINAMICS drive system.

Benefits

This manual provides all of the information, procedures and operator actions required for the particular usage phase.

Siemens MySupport/Documentation

You can find information on how to create your own individual documentation based on Siemens content and adapt it for your own machine documentation at the following address (https://support.industry.siemens.com/My/ww/en/documentation).

Additional information

You can find information on the topics below at the following address (https://support.industry.siemens.com/cs/de/en/view/108993276):

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

Questions relating to the technical documentation

Please send any questions about the technical documentation (e.g. suggestions for improvement, corrections) to the following email address (mailto:docu.motioncontrol@siemens.com).

FAQs

You can find Frequently Asked Questions under Product Support (https://support.industry.siemens.com/cs/de/en/ps/faq).

1.3 Usage phases and their documents/tools (as an example)

Usage phase	Document/tool
Orientation	SINAMICS S Sales Documentation
Planning/configuration	• SIZER Engineering Tool • Configuration Manuals, Motors
Deciding/ordering	SINAMICS S120 catalogs • SINAMICS S120 and SIMOTICS (Catalog D 21.4) • SINAMICS Converters for Single-Axis Drives and SIMOTICS Motors (Catalog D 31) • SINAMICS Converters for Single-Axis Drives – Built-In Units (D 31.1) • SINAMICS Converters for Single-Axis Drives – Distributed Converters (D 31.2) • SINAMICS S210 Servo Drive System (D 32) • SINUMERIK 840 Equipment for Machine Tools (Catalog NC 62)
Installation/assembly	• SINAMICS S120 Equipment Manual for Control Units and Supplementary System Components • SINAMICS S120 Equipment Manual for Booksize Power Units • SINAMICS S120 Equipment Manual for Booksize Power Units C/D Type • SINAMICS S120 Equipment Manual for Chassis Power Units • SINAMICS S120 Equipment Manual for Chassis Power Units, Liquid-cooled • SINAMICS S120 Equipment Manual water-cooled chassis power units for common cooling circuits • SINAMICS S120 Equipment Manual for Chassis Power Units, Air-cooled • SINAMICS S120 Equipment Manual for AC Drives • SINAMICS S120 Equipment Manual Combi • SINAMICS S120M Equipment Manual Distributed Drive Technology • SINAMICS HLA System Manual Hydraulic Drives
Commissioning	• Startdrive Commissioning Tool • SINAMICS S120 Getting Started • SINAMICS S120 Commissioning Manual • SINAMICS S120 Function Manual Drive Functions • SINAMICS S120 Safety Integrated Function Manual • SINAMICS S120 Function Manual Communication • SINAMICS S120/S150 List Manual • SINAMICS HLA System Manual Hydraulic Drives
Usage/operation	• SINAMICS S120 Commissioning Manual • SINAMICS S120/S150 List Manual • SINAMICS HLA System Manual Hydraulic Drives
Maintenance/servicing	• SINAMICS S120 Commissioning Manual • SINAMICS S120/S150 List Manual
References	• SINAMICS S120/S150 List Manual

1.4 Where can the various topics be found?

Software		Manual
Alarms	Described in order of ascending numbers	SINAMICS S120/S150 List Manual
Parameters	Described in order of ascending numbers	SINAMICS S120/S150 List Manual
Function block diagrams	Sorted according to topic	SINAMICS S120/S150 List Manual
	Described in order of ascending numbers	
Drive functions		SINAMICS S120 Function Manual Drive Functions
Communication topics		SINAMICS S120 Function Manual Communication[2)]
Safety Integrated	Basic and Extended Functions	SINAMICS S120 Safety Integrated Function Manual
	Basic Functions	SINAMICS S120 Function Manual Drive Functions
Commissioning	Of a simple SINAMICS S120 drive with STARTER	Getting Started[1)]
Commissioning	With STARTER	SINAMICS S120 Commissioning Manual[1)]
Commissioning	Of a simple SINAMICS S120 drive with Startdrive	Getting Started[2)]
Commissioning	With Startdrive	SINAMICS S120 Commissioning Manual[2)]
Web server		SINAMICS S120 Function Manual Drive Functions

Hardware			Manual
Control Units and expansion components	• Control Units • Option Boards • Terminal Modules	• HUB Modules • VSM10 • Encoder system connection	SINAMICS S120 Equipment Manual for Control Units and Supplementary System Components
Booksize power units	• Line connection • Line Modules • Motor Modules	• DC link compo-nents • Braking resistors • Control cabinet design	SINAMICS S120 Equipment Manual for Booksize Power Units
Power units, booksize C/D type format			SINAMICS S120 Equipment Manual for Booksize Power Units C/D Type
Chassis power units			SINAMICS S120 Equipment Manual for Chassis Power Units, air, liquid or water cooled
AC drive components			SINAMICS S120 Equipment Manual for AC Drives
S120 Combi components			SINAMICS S120 Equipment Manual Combi
Diagnostics via LEDs	STARTER		SINAMICS S120 Commissioning Manual[1)]
	Startdrive		SINAMICS S120 Commissioning Manual[2)]
Meaning of the LEDs			Equipment Manuals
High Frequency Drive components			SINAMICS S120 System Manual High Frequency Drives

1) Up to firmware version 5.1 SP1

2) From firmware version 5.2

1.5 Training and support

Training

At the following address (http://www.siemens.com/sitrain), you can find information about SITRAIN (Siemens training on products, systems and solutions for automation and drives).

Technical Support

Country-specific telephone numbers for technical support are provided in the Internet at the following address (https://support.industry.siemens.com/cs/ww/en/sc) in the "Contact" area.

1.6 Directives, standards, certificates

Relevant directives and standards

You can obtain an up-to-date list of currently certified components on request from your local Siemens office. If you have any questions relating to certifications that have not yet been completed, please ask your Siemens contact person.

Certificates for download

The certificates can be downloaded from the Internet:

Certificates (https://support.industry.siemens.com/cs/ww/de/ps/13206/cert)

CE

EC Declaration of Conformity

You can find the EC Declaration of Conformity for the relevant directives as well as the relevant certificates, prototype test certificates, manufacturers declarations and test certificates for functions relating to functional safety ("Safety Integrated") on the Internet at the following address (https://support.industry.siemens.com/cs/ww/en/ps/13231/cert).

The following directives and standards are relevant for SINAMICS S devices:

- **European Low Voltage Directive**

  SINAMICS S devices fulfil the requirements stipulated in the Low-Voltage Directive 2014/35/EU, insofar as they are covered by the application area of this directive.

- **European Machinery Directive**

  SINAMICS S devices fulfil the requirements stipulated in the Low-Voltage Directive 2006/42/EU, insofar as they are covered by the application area of this directive.

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

- **Directive 2011/65/EU**

  SINAMICS S devices comply with the requirements of Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic devices (RoHS II).

- **European EMC Directive**

  SINAMICS S devices comply with the EMC Directive 2014/30/EU.

- **EMC requirements for South Korea**

  SINAMICS S devices with the KC marking on the type plate satisfy the EMC requirements for South Korea.

- **Eurasian conformity**

  SINAMICS S comply with the requirements of the Russia/Belarus/Kazakhstan customs union (EAC).

- **North American market**

  SINAMICS S devices provided with one of the test symbols displayed fulfill the requirements stipulated for the North American market as a component of drive applications.

  You can find the relevant certificates on the Internet pages of the certifier (http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.html).

- **Specification for semiconductor process equipment voltage drop immunity**

  SINAMICS S devices meet the requirements of standard SEMI F47-0706.

- **Australia and New Zealand (RCM formerly C-Tick)**

  SINAMICS S devices showing the test symbols fulfill the EMC requirements for Australia and New Zealand.

- **Quality systems**

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

Not relevant standards

China Compulsory Certification

SINAMICS S devices do not fall in the area of validity of the China Compulsory Certification (CCC).

EMC limit values in South Korea

이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.
For sellers or other users, please bear in mind that this device is an A-grade electromagnetic wave device.
This device is intended to be used in areas other than at home.

The EMC limit values to be observed for Korea correspond to the limit values of the EMC product standard for variable-speed electric drives EN 61800-3 of category C2 or the limit value class A, Group 1 to KN11. By implementing appropriate additional measures, the limit values according to category C2 or limit value class A, Group 1, are observed. Further, additional measures may be required, such as using an additional radio interference suppression filter (EMC filter).
The measures for EMC-compliant design of the system are described in detail in this manual respectively in the EMC Installation Guideline Configuration Manual.
The final statement regarding compliance with the standard is given by the respective label attached to the individual unit.

1.7 Additional information

Ensuring reliable operation

The manual describes a desired state which, if maintained, ensures the required level of operational reliability and compliance with EMC limit values.

Should there be any deviation from the requirements in the manual, appropriate actions (e.g. measurements) must be taken to check/prove that the required level of operational reliability and compliance with EMC limit values are ensured.

Spare parts

Spare parts are available on the Internet at the following address (https://www.automation.siemens.com/sow?sap-language=EN).

Product maintenance

The components are subject to continuous further development within the scope of product maintenance (improvements to robustness, discontinuations of components, etc).

These further developments are "spare parts-compatible" and do not change the article number.

In the scope of such spare parts-compatible further developments, connector/connection positions are sometimes changed slightly. This does not cause any problems with proper use of the components. Please take this fact into consideration in special installation situations (e.g. allow sufficient clearance for the cable length).

Use of 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.

Ground symbols

Table 1- 1 Symbols

Icon	Meaning
	Connection for protective conductor
	Ground (e.g. M 24 V)
	Connection for function potential bonding

1.8 General Data Protection Regulation

Compliance with the General Data Protection Regulation

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

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

Fundamental safety instructions

2

2.1 General safety instructions

⚠WARNING

Electric shock and danger to life due to other energy sources

Touching live components can result in death or severe injury.

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

Generally, the following six steps apply when establishing safety:

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

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

⚠WARNING

Risk of electric shock and fire from supply networks with an excessively high impedance

Excessively low short-circuit currents can lead to the protective devices not tripping or tripping too late, and thus causing electric shock or a fire.

- In the case of a conductor-conductor or conductor-ground short-circuit, ensure that the short-circuit current at the point where the inverter is connected to the line supply at least meets the minimum requirements for the response of the protective device used.
- You must use an additional residual-current device (RCD) if a conductor-ground short circuit does not reach the short-circuit current required for the protective device to respond. The required short-circuit current can be too low, especially for TT supply systems.

⚠WARNING

Risk of electric shock and fire from supply networks with an excessively low impedance

Excessively high short-circuit currents can lead to the protective devices not being able to interrupt these short-circuit currents and being destroyed, and thus causing electric shock or a fire.

- Ensure that the prospective short-circuit current at the line terminal of the inverter does not exceed the breaking capacity (SCCR or Icc) of the protective device used.

⚠WARNING

Electric shock if there is no ground connection

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

- Ground the device in compliance with the applicable regulations.

⚠WARNING

Electric shock due to connection to an unsuitable power supply

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

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

⚠WARNING

Electric shock due to equipment damage

Improper handling may cause damage to equipment. For damaged devices, hazardous voltages can be present at the enclosure or at exposed components; if touched, this can result in death or severe injury.

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

⚠WARNING

Electric shock due to unconnected cable shield

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

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

⚠WARNING

Arcing when a plug connection is opened during operation

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

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

⚠WARNING

Electric shock due to residual charges in power components

Because of the capacitors, a hazardous voltage is present for up to 5 minutes after the power supply has been switched off. Contact with live parts can result in death or serious injury.

- Wait for 5 minutes before you check that the unit really is in a no-voltage condition and start work.

NOTICE

Property damage due to loose power connections

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

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

⚠WARNING

Spread of fire from built-in devices

In the event of fire outbreak, the enclosures of built-in devices cannot prevent the escape of fire and smoke. This can result in serious personal injury or property damage.

- Install built-in units in a suitable metal cabinet in such a way that personnel are protected against fire and smoke, or take other appropriate measures to protect personnel.
- Ensure that smoke can only escape via controlled and monitored paths.

⚠WARNING

Active implant malfunctions due to electromagnetic fields

Inverters generate electromagnetic fields (EMF) in operation. Electromagnetic fields may interfere with active implants, e.g. pacemakers. People with active implants in the immediate vicinity of an inverter are at risk.

- As the operator of an EMF-emitting installation, assess the individual risks of persons with active implants.
- Observe the data on EMF emission provided in the product documentation.

⚠WARNING

Unexpected movement of machines caused by radio devices or mobile phones

When radio devices or mobile phones with a transmission power > 1 W are used in the immediate vicinity of components, they may cause the equipment to malfunction. Malfunctions may impair the functional safety of machines and can therefore put people in danger or lead to property damage.

- If you come closer than around 2 m to such components, switch off any radios or mobile phones.
- Use the "SIEMENS Industry Online Support app" only on equipment that has already been switched off.

NOTICE

Damage to motor insulation due to excessive voltages

When operated on systems with grounded line conductor or in the event of a ground fault in the IT system, the motor insulation can be damaged by the higher voltage to ground. If you use motors that have insulation that is not designed for operation with grounded line conductors, you must perform the following measures:

- IT system: Use a ground fault monitor and eliminate the fault as quickly as possible.
- TN or TT systems with grounded line conductor: Use an isolating transformer on the line side.

⚠WARNING

Fire due to inadequate ventilation clearances

Inadequate ventilation clearances can cause overheating of components with subsequent fire and smoke. This can cause severe injury or even death. This can also result in increased downtime and reduced service lives for devices/systems.

- Ensure compliance with the specified minimum clearance as ventilation clearance for the respective component.

NOTICE

Overheating due to inadmissible mounting position

The device may overheat and therefore be damaged if mounted in an inadmissible position.

- Only operate the device in admissible mounting positions.

⚠WARNING

Unrecognized dangers due to missing or illegible warning labels

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

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

NOTICE

Device damage caused by incorrect voltage/insulation tests

Incorrect voltage/insulation tests can damage the device.

- Before carrying out a voltage/insulation check of the system/machine, disconnect the devices as all converters and motors have been subject to a high voltage test by the manufacturer, and therefore it is not necessary to perform an additional test within the system/machine.

⚠WARNING

Unexpected movement of machines caused by inactive safety functions

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

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

Note

Important safety notices for Safety Integrated functions

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

2.2 Equipment damage due to electric fields or electrostatic discharge

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

NOTICE

Equipment damage due to electric fields or electrostatic discharge

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

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

2.3 Warranty and liability for application examples

Application examples are not binding and do not claim to be complete regarding configuration, equipment or any eventuality which may arise. Application examples do not represent specific customer solutions, but are only intended to provide support for typical tasks.

As the user you yourself are responsible for ensuring that the products described are operated correctly. Application examples do not relieve you of your responsibility for safe handling when using, installing, operating and maintaining the equipment.

2.4 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. Products and solutions from Siemens constitute one element of such a concept.

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

For additional information on industrial security measures that can be implemented, please visit:

Industrial security (https://www.siemens.com/industrialsecurity)

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

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

Industrial security (https://www.siemens.com/industrialsecurity)

Further information is provided on the Internet:

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

⚠WARNING

Unsafe operating states resulting from software manipulation

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

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

2.5 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.

System overview

3

3.1 Field of application

SINAMICS is the family of drives from Siemens designed for machine and plant engineering applications. SINAMICS offers solutions for all drive tasks:

- Simple pump and fan applications in the process industry
- Complex single drives in centrifuges, presses, extruders, elevators, as well as conveyor and transport systems
- Drive line-ups in textile, plastic film, and paper machines as well as in rolling mill plants
- High-precision servo drives in the manufacture of wind turbines
- Highly dynamic servo drives for machine tools, as well as packaging and printing machines

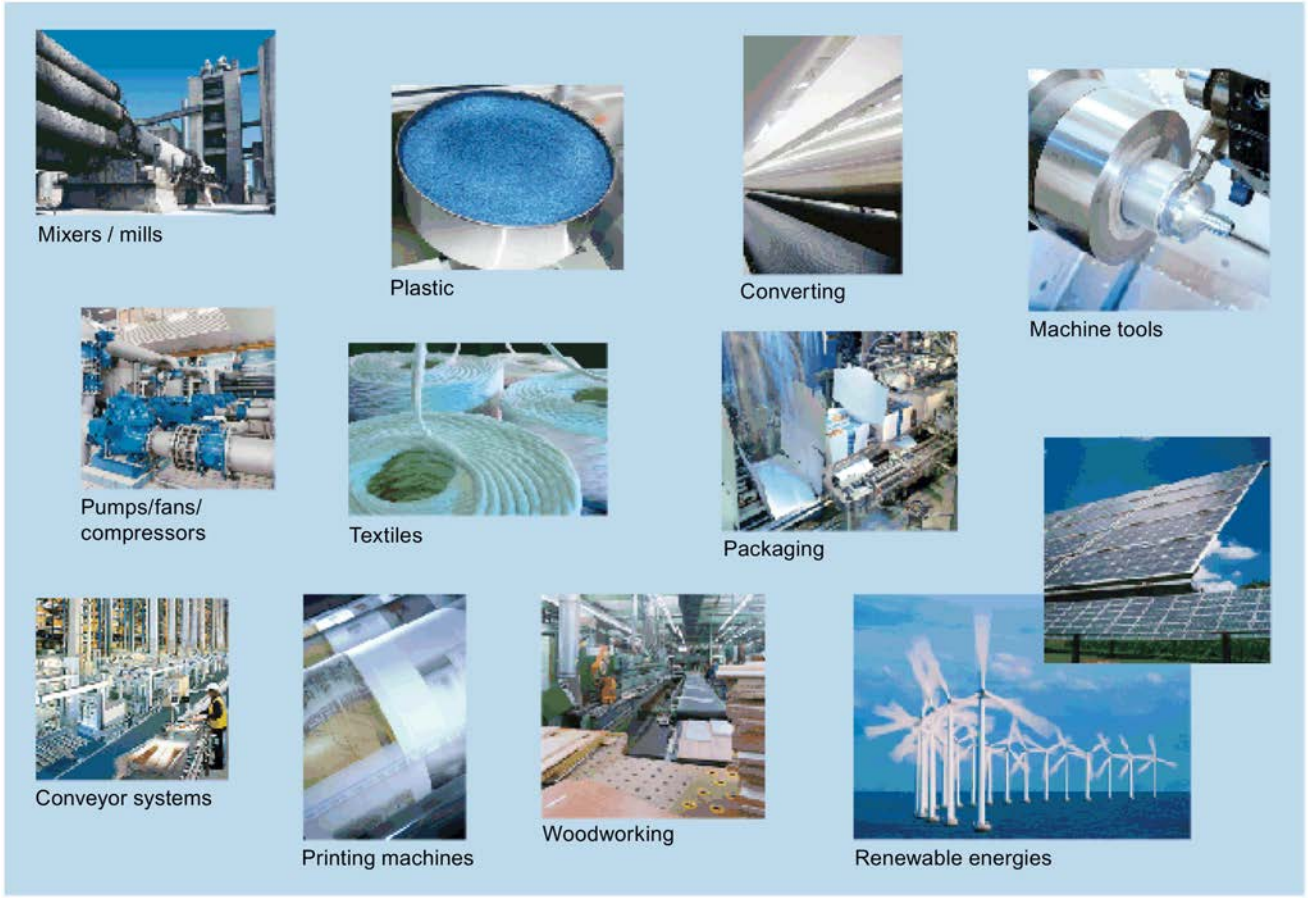


Figure 3-1 SINAMICS applications

Depending on the application, the SINAMICS range offers the ideal variant for any drive task.

- SINAMICS S handles complex drive tasks with synchronous motors and induction motors and fulfills stringent requirements regarding:
  - the dynamic performance and accuracy
  - the integration of extensive technological functions in the drive control system
- SINAMICS G is designed for standard applications with induction motors. These applications have less stringent requirements regarding the dynamic performance of the motor speed.
- SINAMICS V is designed to address applications where basic drive functions are available quickly and at a favorable cost - and which are easy to handle.

3.2 Platform Concept and Totally Integrated Automation

All SINAMICS versions are based on a platform concept. Joint hardware and software components, as well as standardized tools for design, configuration, and commissioning tasks ensure high-level integration across all components. SINAMICS handles a wide variety of drive tasks with no system gaps. The different SINAMICS versions can be easily combined with each other.

Totally Integrated Automation (TIA) with SINAMICS S120

Apart from SIMATIC, SIMOTION and SINUMERIK, SINAMICS is one of the core components of TIA. It is thus possible to assign parameters, program and commission all components in the automation solution with the Startdrive or STARTER commissioning tool using a standardized engineering platform and without any system transitions (seamless engineering). The system-wide data management functions ensure consistent data and simplify archiving of the entire plant project.

From V14, the Startdrive commissioning tool is an integral element of the TIA platform.

SINAMICS S120 supports communication via PROFINET and PROFIBUS DP.

Communication via PROFINET

This Ethernet-based bus enables control data to be exchanged at high speed via PROFINET IO with IRT or RT and makes SINAMICS S120 a suitable choice for integration in high-performance multi-axis applications. At the same time, PROFINET also uses standard IT mechanisms (TCP/IP) to transport information, e.g. operating and diagnostic data, to higher-level systems. This makes it easy to integrate into an IT corporate network.

Communication via PROFIBUS DP

This bus provides a high-performance, system-wide and integrated communication network which links all automation components of the automation solution:

- HMI (operator control and monitoring)
- Control
- Drives and I/O

Figure 3-2 SINAMICS as part of the Siemens modular automation system

3.3 Introduction

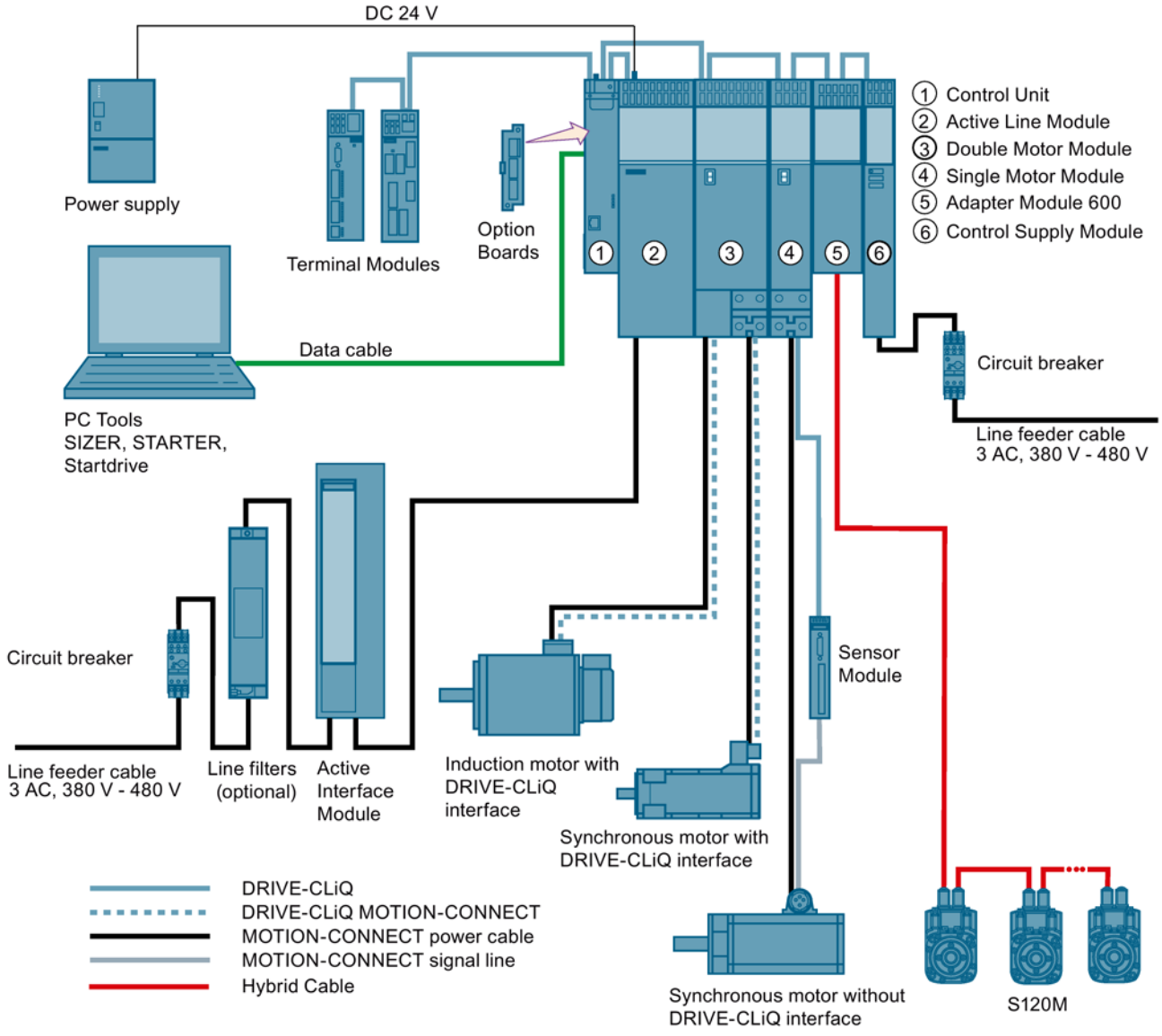


Figure 3-3 System overview, SINAMICS S120 with S120M distributed servo drive technology

Modular system for sophisticated drive tasks

SINAMICS S120 solves complex drive tasks for a wide range of industrial applications and is, therefore, designed as a modular system. Select from many different harmonized components and functions to create the combination that best meets your requirements. SIZER, a high-performance engineering tool, makes it easier to select and determine the optimum drive configuration.

SINAMICS S120 is supplemented by a wide range of motors. SINAMICS S120 optimally supports:

- SINAMICS S120M
- Synchronous and induction motors
- Linear and torque motors

System architecture with a central Control Unit

On the SINAMICS S120, the drive intelligence is combined with closed-loop control functions into Control Units. These units are capable of controlling drives in the vector, servo and V/f control modes. They also perform the speed and torque control functions plus other intelligent drive functions for all axes on the drive. Inter-axis connections can be established within a component and easily configured by mouse click in the Startdrive or STARTER commissioning tool.

Functions for higher efficiency

- Basic functions: Speed control, torque control, positioning functions
- Intelligent starting functions for independent restart after power supply interruption
- BICO technology with interconnection of drive-related I/Os for easy adaptation of the drive system to its operating environment
- Integrated safety functions for rational implementation of safety concepts
- Regulated infeed/regenerative feedback functions for preventing undesirable reactions on the supply, allowing recovery of braking energy and ensuring greater stability against line fluctuations.

DRIVE-CLiQ – the digital interface between SINAMICS components

Most of the SINAMICS S120 components, including the motors and encoders, are connected to each other via the common DRIVE-CLiQ serial interface. The standardized cables and connectors reduce the variety of different parts and cut storage costs. Encoder evaluations for converting standard encoder signals to DRIVE-CLiQ are available for third-party motors or retrofit applications.

Electronic rating plates in all components

An important digital linkage element of the SINAMICS S120 drive system are the electronic type plates integrated in every component. They allow all drive components to be detected automatically via a DRIVE-CLiQ link. As a result, data does not have to be entered manually during commissioning or component replacement – helping to ensure that drives are commissioned more reliably.

The rating plate contains all the relevant technical data about that particular component. For motors, these are the parameters of the electrical equivalent circuit diagram and key values of the integrated motor encoder, for example.

In addition to the technical data, the type plate includes logistical data (manufacturer ID, article number and ID). Since this data can be called up electronically on site or remotely, all the components used in a machine can always be individually identified, which helps simplify servicing.

3.4 SINAMICS S120 components

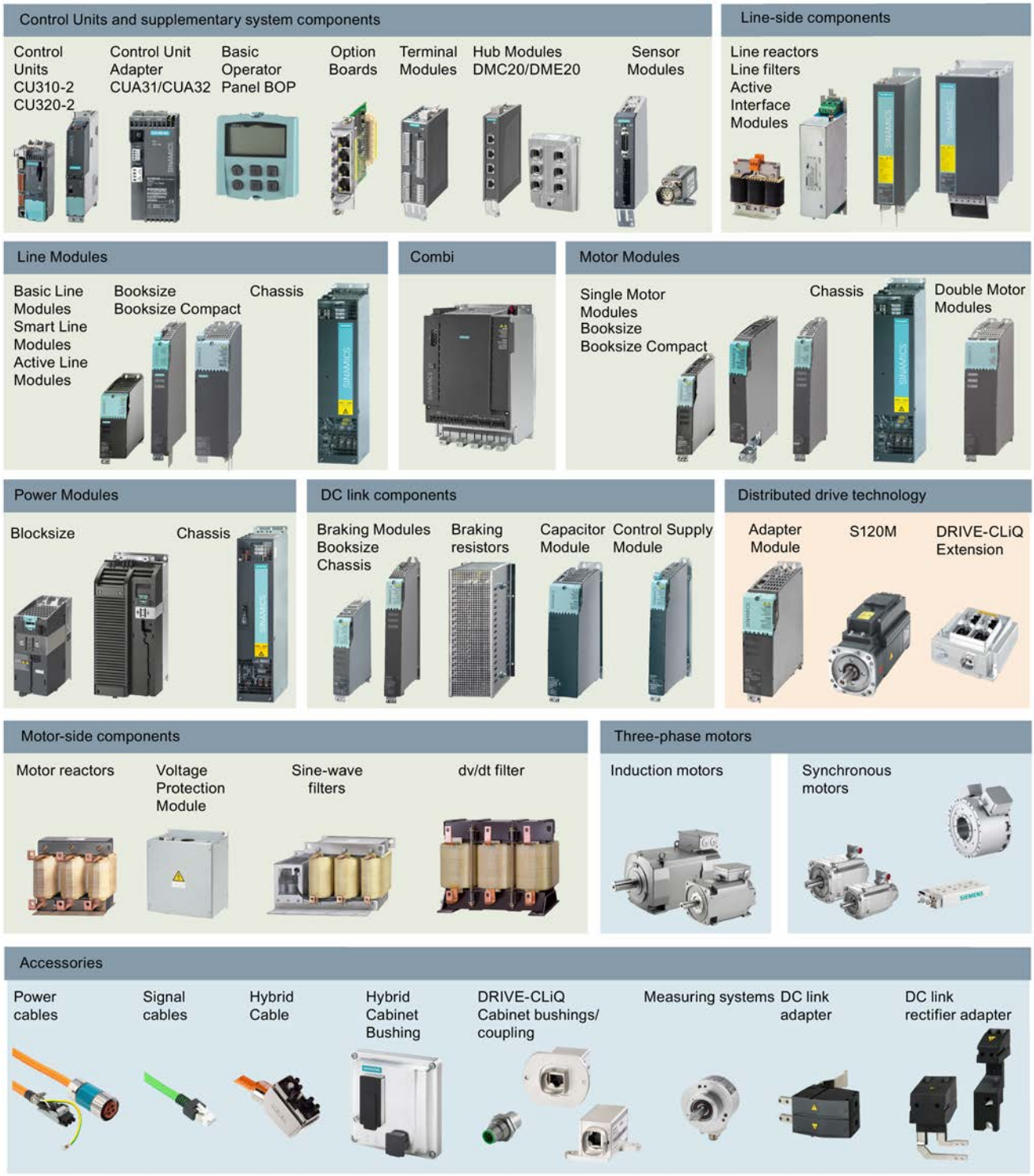


Figure 3-4 SINAMICS S120 components

System components

- Line-side power components, such as fuses, contactors, reactors, and filters for switching the power supply and meeting EMC requirements.
- Line Modules, which supply power centrally to the DC link
- DC link components (optional), which stabilize the DC link voltage.
- Motor Modules, which act as inverters, receive power from the DC link, and supply the connected motors

To carry out the required functions, SINAMICS S120 is equipped with:

- Control Units that process the drive and technological functions across all axes
- Additional system components to expand the functionality and to implement various interfaces for encoders and process signals.

SINAMICS S120 components are intended for installation in cabinets. They have the following features and characteristics:

- Easy to handle, simple installation and wiring
- Practical connection system, cable routing in accordance with EMC requirements
- Standardized design, side-by-side mounting

Note

Installation location in the cabinet

As a general rule, SINAMICS S120 components must be mounted vertically in the control cabinet. If other mounting positions are permissible, these are specified in the descriptions for the individual components.

NOTICE

Overheating of components due to incorrect mounting position

Incorrectly installed components can overheat during operation. Overheating can lead to malfunctions and component damage.

- Only install the components in a permissible mounting position in the control cabinet.

Booksize C/D-type format

- C-type: Optimized for continuous load with an overload factor of up to 2 (continuous motion)
- D-type: Optimized for highly dynamic intermittent duty cycles with an overload factor of up to 3 (discontinuous motion)

Devices in booksize C/D-type format are optimized for multi-axis applications and are mounted adjacent to one another. The connection for the shared voltage-source DC link is an integral feature.

Booksize C/D-type modules are cooled by internal air cooling.

Documentation of required system components

Only components from the booksize C/D-type series plus the relevant connection components are described in this manual. Additional documentation containing system information and system component descriptions can be found in the SINAMICS S120 Manual "Booksize Power Units".

This manual also contains all further information that is required to operate Motor Modules in booksize C/D-type format:

- Line connection variants, Line Module protection, operation with RCDs
- AIM, line reactors and line filters required for conformance with EMC regulations
- Line Modules for energy infeed into the DC link
- Motor Modules >60 A
- DC link components
- Cables
- Further information about design of control cabinets

3.4.1 Advantages of Motor Modules in booksize C/D-type format

Based on the booksize design, SINAMICS S120 booksize C/D-type Motor Modules have been developed for full compatibility with the booksize series. The advantages of this new product include:

- There is no need to remove the module in order to replace the fan.

50 mm modules and 100 mm modules 30 A and 2 x 18 A

- The amount of space required beneath the Motor Modules has been reduced by using a new motor plug connector.
- The motor connections on the Double Motor Module are located side by side, making them much more accessible.
- With the new design of motor connector, the brake cables and the PE connection are integrated directly in the connector.

100 mm modules 45 A and 60 A

- The previous width has been reduced from 150 mm down to 100 mm.
- The overload factor is 2.
- The motor connection block is now integrated in the module. The amount of space required is therefore reduced.
- The protective conductor connection for the motor is integrated in the motor connection block.

3.4.2 Overview of C/D-type Motor Modules

The Motor Modules of the SINAMICS S system in booksize C-type and D-type format operate as inverters. They make the energy from the connected motors' DC link available at an adjusted voltage and with variable frequency. The control information is generated in the Control Unit and distributed to the individual Motor Modules via DRIVE-CLiQ.

Depending on the number of motors to be supplied, each Motor Module has one or two DRIVE-CLiQ interfaces for connecting the Sensor Modules that evaluate the motor encoders.

Table 3- 1 Overview of Motor Modules in booksize C-type format (with up to 2x overload)

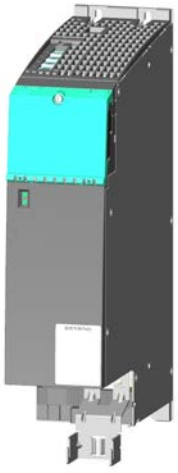
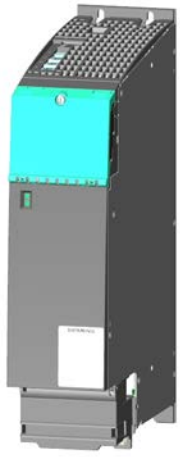
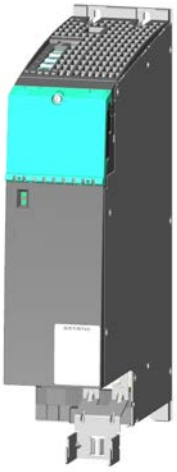
50 mm modules	100 mm modules	100 mm modules
		
• 6SL3120-1TE21-8AC. (18 A) • 6SL3120-1TE22-4AC. (24 A)	• 6SL3120-1TE23-0AC. (30 A) • 6SL3120-2TE21-8AC. (2x18 A)	• 6SL3120-1TE24-5AC. (45 A) • 6SL3120-1TE26-0AC. (60 A)

Table 3- 2 Overview of Motor Modules in booksize D-type format (with up to 3x overload)

50 mm modules	100 mm modules
	
• 6SL3120-1TE13-0AD. (3 A) • 6SL3120-1TE15-0AD. (5 A) • 6SL3120-1TE21-0AD. (9 A) • 6SL3120-1TE21-8AD. (18 A) • 6SL3120-1TE22-4AD. (24 A) • 6SL3120-2TE13-0AD. (2 x 3 A) • 6SL3120-2TE15-0AD. (2 x 5 A) • 6SL3120-2TE21-0AD. (2 x 9 A)	• 6SL3120-1TE23-0AD. (30 A) • 6SL3120-2TE21-8AD. (2 x 18 A)

Characteristics of the Motor Modules:

- Version as Single Motor Module from 3 A to 60 A
- Version as Double Motor Module from 2 x 3 A to 2 x 18 A
- Internal air cooling
- Short-circuit/ground-fault-proof
- Integrated DC link and electronics current busbar connection
- Integrated "safety motor braking control"
- Electronic rating plate
- Operating status and error status via LEDs
- DRIVE-CLiQ interfaces for communication with the Control Unit and/or other components in the drive line-up
- Integration in system diagnostics

3.5 System data

Unless explicitly specified otherwise, the following technical data is valid for components of the SINAMICS S120 booksize drive system described in this document.

Table 3- 3 Electrical data

Line connection voltage	380 … 480 V 3 AC ±10 % (-15 % < 1 min)
Line frequency	47 … 63 Hz
Electronics power supply	24 V DC -15/+20 %[1], safety extra-low voltage (PELV or SELV)
Maximum rated short-circuit current SCCR according to UL	100 kA Maximum SCCR at 480 V AC in conjunction with Booksize Line Modules and the protective devices described in product information "Protective Devices for SINAMICS S120 Line Modules Booksize (https://support.industry.siemens.com/cs/document/109749282/sinamics-s120-line-modules-booksize-protective-devices-for-line-modules-booksize?dti=0&lc=de-WW)".
Electromagnetic compatibility	According to IEC / EN 61800-3: Used in the second environment (industrial line supplies). As standard, Category C3. With additional components, Category C2 (see GH2).
Overvoltage category	III[2] According to IEC 61800-5-1, EN 61800-5-1, UL 61800-5-1 and CSA C22.2 No 274
Degree of pollution	2[3] According to IEC 61800-5-1, EN 61800-5-1, UL 61800-5-1 and CSA C22.2 No 274

1) When using a motor holding brake, restricted voltage tolerances (24 V ±10 %) might need to be taken into account.

2) The components are designed for connection to electric circuits of overvoltage category III. If this has not already been ensured by the installation, an upstream overvoltage protection device may have to be installed. Overvoltages must be limited to 6 kV against ground and 4 kV between phases. Overvoltage protection devices must be suitable for the line voltage and the prospective short-circuit current of the line.

3) The components must be protected against conductive pollution, e.g. by installing them in a control cabinet with degree of protection IP54 according to IEC 60529 or a Type 12 enclosure according to NEMA 250. If conductive pollution can be excluded at the installation site, a lower degree of cabinet protection may be permitted.

Table 3- 4 Modules

Motor Modules in booksize C/D-type format	
DC link supply voltage	510 … 720 V DC
Rated pulse frequency	4 kHz At higher pulse frequencies, the associated characteristic for current derating (Page 75) must be taken into consideration.

Table 3- 5 Degree of protection / protection class

Degree of protection	IPXXB according to EN 60529, open type according to UL/CSA
Protection class Power circuits Electronic circuits	 I (with protective conductor connection) safety extra-low voltage PELV/SELV

Table 3- 6 Environmental conditions

Chemically active substances	
Long-term storage	Class 1C2 according to EN 60721-3-1, in product packaging[1)]
Transport	Class 2C2 according to EN 60721-3-2, in transport packaging[2)]
Operation	Class 3C2 according to EN 60721-3-3
Biological environmental conditions	
Long-term storage	Class 1B1 according to EN 60721-3-1, in product packaging[1)]
Transport	Class 2B1 according to EN 60721-3-2, in transport packaging[2)]
Operation	Class 3B1 according to EN 60721-3-3
Climatic environmental conditions	
Long-term storage	Class 1K4 according to EN 60721-3-1, in product packaging[1)] Temperature: -25 … +55 °C
Transport	Class 2K4 according to EN 60721-3-2, in transport packaging[2)] Temperature: -40 … +70 °C
Operation	Class 3K3 according to EN 60721-3-3 with increased ruggedness with respect to relative humidity Temperature: 0 ... +40 °C without derating > 40 ... +55 °C with reduction of the output current by 2.67 % pro °C Relative humidity: 5 … 95 % no condensation (better than Class 3K3) Oil mist, salt mist, ice formation, condensation, dripping water, spraying water, splashing water and water jets are not permitted
Mechanical environmental conditions	
Long-term storage	Class 1M2 according to EN 60721-3-1, in product packaging[1)]
Transport	Class 2M3 according to EN 60721-3-2, in transport packaging[2)]
Operation Vibration test in operation Shock test in operation	Class 3M1 according to EN 60721-3-3 According to IEC 60068-2-6 test Fc (sinusoidal) • 10 … 57 Hz: 0.075 mm deflection amplitude • 57 ... 150 Hz: 1 g acceleration amplitude • 10 frequency cycles per axis According to IEC 60068-2-27 test Ea (half-sine) • 5 g peak acceleration • 30 ms duration • 3 shocks in all three axes in both directions

Installation altitude	
Operation	0 ... 1000 m above sea level without derating > 1000 ... 4000 m • Reduction of the output current by 10 % per 1000 meters, or • Reduction in the ambient temperature by 5 °C per 1000 meters > 2000 ... 4000 m • Operation on line supply systems with grounded neutral point, or • Operation on an isolation transformer with secondary grounded neutral

1) Product packaging (storage packaging) is individual packaging for storage - and does not satisfy the requirements for transport. As a consequence, product packaging is therefore not suitable for shipping.

2) Transport packaging is either packaging that is directly suitable for transport, or secondary packaging which, together with the product packaging, satisfies the requirements for transport.

Table 3- 7 Certificates

Declarations of Conformity	CE
Approvals 1)	cULus2) cURus RMC (C-Tick) KC EAC

1) Possible deviations are specified for the corresponding component.

2) cULus approval for the Motor Modules is only valid in conjunction with the Line Modules in the Booksize format.

Motor Modules in booksize C/D-type format

4

4.1 Description

A Motor Module is an inverter that supplies AC voltage to the connected motor(s). The Motor Module is supplied with DC voltage from a Line Module via the DC link.

Connect Motor Modules via DRIVE-CLiQ to a Control Unit in which the open-loop and closed-loop control functions for the Motor Module are implemented.

1 motor can be connected to Single Motor Modules and 2 motors can be connected to Double Motor Modules.

4.2 Safety instructions for Motor Modules of C/D-type

⚠WARNING

Electric shock caused by a high DC link voltage

As long as the Line Module is connected to the line supply, the DC link is charged with a high voltage, and as a consequence, also the Motor Module. A hazardous voltage can be present independent of the status of the LED "DC LINK" Contact with live parts and components can result in death or severe injury.

- Isolate the Line Module from the line supply during installation or maintenance work, e.g. via the line contactor with isolation function or main switch.
- Observe the warning information on the component.

⚠WARNING

Electric shock when the protective cover of the DC link is open

Live parts of the DC link are freely exposed when operating Motor Modules with open protective flap. Contact with live parts can result in death or serious injury.

- Only operate the components with closed protective cover.

⚠WARNING

Electric shock or fire caused by the DC link being incorrectly connected

Incorrect connections can result in overheating and therefore fire. There is also a risk of an electric shock. This can result in serious injury or death.

- Only use adapters (DC link adapters and DC link rectifier adapters) approved by Siemens for the connection to the DC link.

⚠WARNING

Electric shock due to incorrectly installed DC link bridges

Incorrectly installed DC link bridges **at the left-hand end of the drive line-up** can cause an electric shock.

- For all 50 mm wide modules[1)], remove the DC link bridge including the screws. Do not tighten the screws without the DC link bridges.
- For all components that are 75 mm wide or wider, the DC link bridges may neither be swung over to the left nor removed[2)].

[1)] For 50 mm wide modules, the DC link bridge cannot be swung inwards.
[2)] The DC link bridge guarantees the mechanical stability of the DC link busbars.

⚠WARNING

Electric shock due to missing DC link side covers

There is a danger of an electric shock through contact when the side covers of the DC link are missing.

- Mount the side covers on the first and last component in the drive line-up.

You can order missing side covers (article number: 6SL3162-5AA00-0AA0).

⚠WARNING

Electric shock due to unsuitable brake cable insulation

When routing brake cables, whose insulation properties are not suitable for safe electrical separation, the insulation can fail resulting in electric shock.

- Connect the holding brake with the specified MOTION-CONNECT cable.
- Only use third-party cables that have brake conductors with insulation properties that comply with safe electrical separation or separately route the brake conductors to absolutely ensure safe electrical separation.

⚠WARNING

Overheating of the motor cables when the permissible conductor cross-sections are fallen below

Excessively thin motor cables can result in overheating. This can result in severe injury or death due to fire and smoke.

- Use cables that correspond to the Motor Module currents. Take into account the routing type, ambient temperature and cable length.
- If the rated motor current is less than the rated Motor Module output current, then you can select appropriately smaller cross-sections.

Note

Fault protection when insulation fails in the motor circuit at the output side

In case of insulation failure in the motor circuit, the overcurrent trip meets the requirements of IEC 60364-4-41:2005/AMD1:2017 - Section 411, Annex D for protection against electric shock.

- Observe the installation specifications provided in this manual.
- Ensure the continuity of the protective conductor.
- Observe the applicable installation standards.

⚠WARNING

Overheating when the total length of the power cables is exceeded

When the total permissible length of the power cables is exceeded, this can result in components overheating. Further, the motor insulation can be damaged as a result of the system vibration. This can cause fire and smoke, which can lead to death or severe injury.

- Ensure that the total length of all power cables (motor supply cable, DC link cable) does not exceed the specified permissible length.

NOTICE

Temperature signal disturbances and failure of components as a result of unshielded or incorrectly routed cables

With unshielded or incorrectly routed cables, it can be expected that interference will be coupled into the signal processing electronics from the power side. This can significantly disturb the motor sensor temperature signal and can result in the failure of individual components (destruction of the devices).

- Only use shielded cables as temperature sensor cables.
- For temperature sensor cables that are routed together with the motor cable, use only cables that are twisted in pairs and shielded separately.
- Connect the cable shield to the chassis potential at both ends over a large surface area.

NOTICE

Damage to the motor or brake when using an incorrect power supply

With an incorrect power supply, the brake can malfunction, i.e. the brake does not open reliably. If the motor constantly operates against the closed brake, the brake and/or the motor will be damaged.

- Always use a stabilized DC power supply to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars.
- Take note of the motor holding brake voltage tolerances (24 V ± 10%) and the connecting cable voltage losses. If the voltage is too high, the brake can close.
- Set the DC power supply to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:
  - Siemens three-phase motors are used
  - Siemens MOTION-CONNECT power cables are used
  - Note that there are motor holding brakes that close again when the maximum voltage is exceeded.

NOTICE

Use of incorrect DRIVE-CLiQ cables

Damage or malfunctions can occur on the devices or system when DRIVE-CLiQ cables are used that are either incorrect or have not been approved for this purpose.

- Only use suitable DRIVE-CLiQ cables that have been approved by Siemens for the particular application.

NOTICE

Motor damage due to the use of an unsuitable third-party motor

The motor insulation is subject to higher stresses when operated with a converter. Damage to the motor winding may occur as a result.

- Observe the notes in the System Manual "Requirements placed on third-party motors (https://support.industry.siemens.com/cs/document/79690594)".

Note

Malfunctions due to soiled DRIVE-CLiQ interfaces

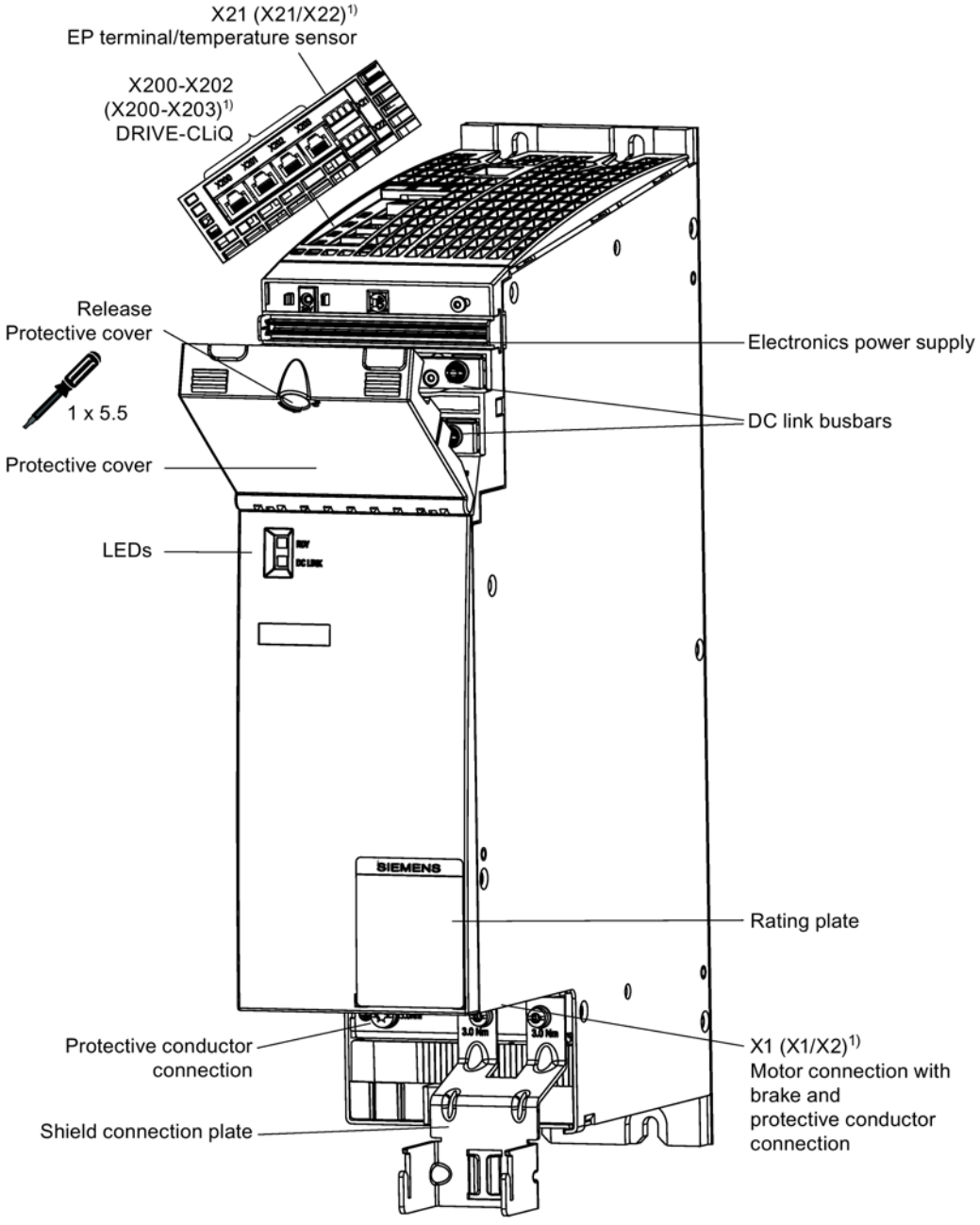
Malfunctions can occur in the system through the use of soiled DRIVE-CLiQ interfaces.

- Cover unused DRIVE-CLiQ interfaces with the supplied blanking covers.
- Order any additional blanking covers with the article number 6SL3066-4CA00-0AA0 (50 covers).

4.3 Interface description

4.3.1 Overview

Interfaces of the 50 mm modules and 100 mm modules (30 A and 2 x 18 A)



1) The interface designations for Double Motor Modules are shown in parentheses.

Figure 4-1 Overview of interfaces of Motor Modules in booksize C/D-type format (here: 100 mm)

Note

Shield connection

The shield connection plate is fitted to the Motor Module in the delivery state. The associated shield connection clamp can be found in the terminal kit.

Note

Protective conductor connection

On the 100 mm module illustrated above, the protective conductor connection is located on the left next to the shield connection plate. On a 50 mm module, the protective conductor connection is behind the shield connection plate. For more details, see Chapter "Protective conductor connection" (Page 54).

Interfaces of the 100 mm modules (45 A / 60 A)

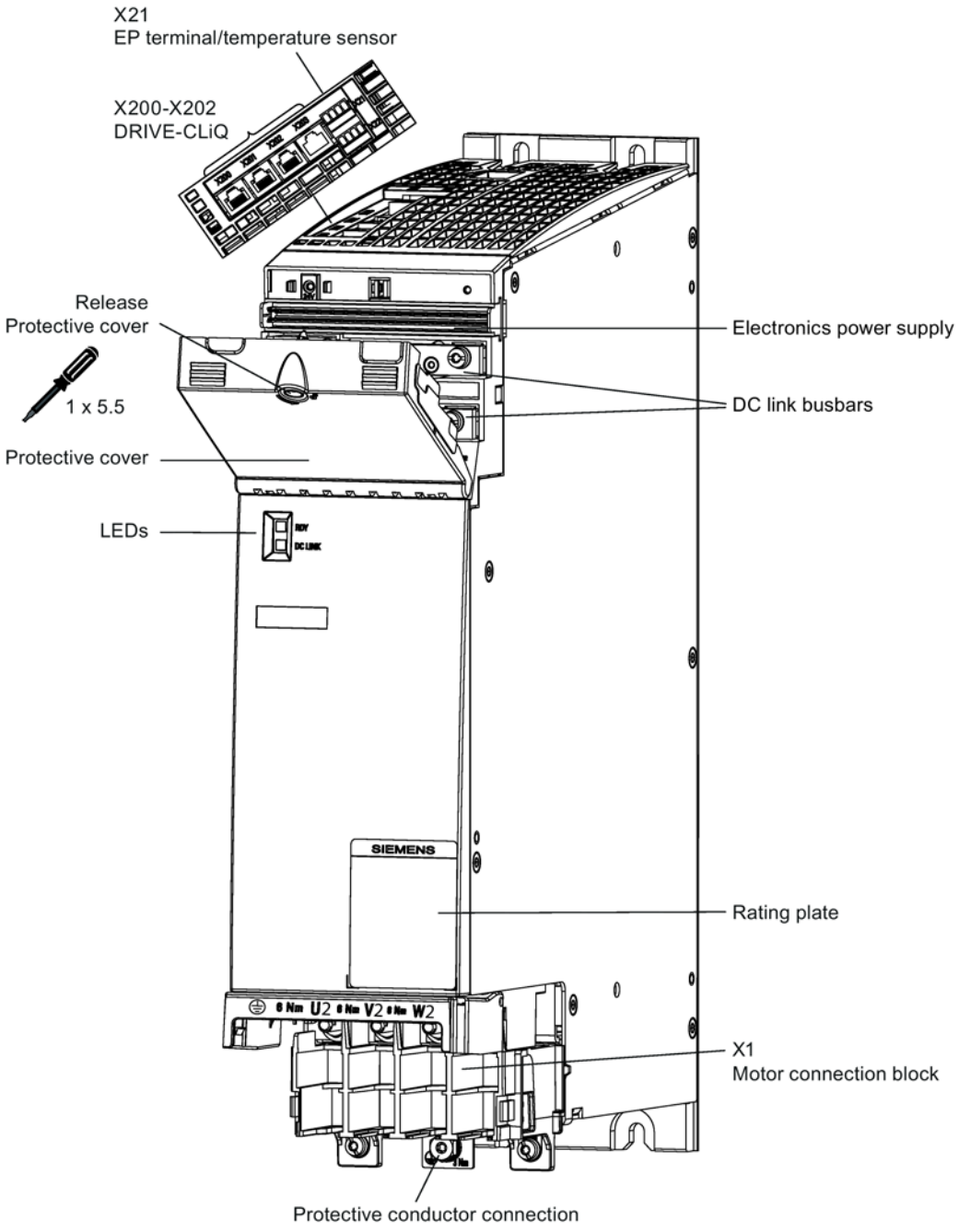
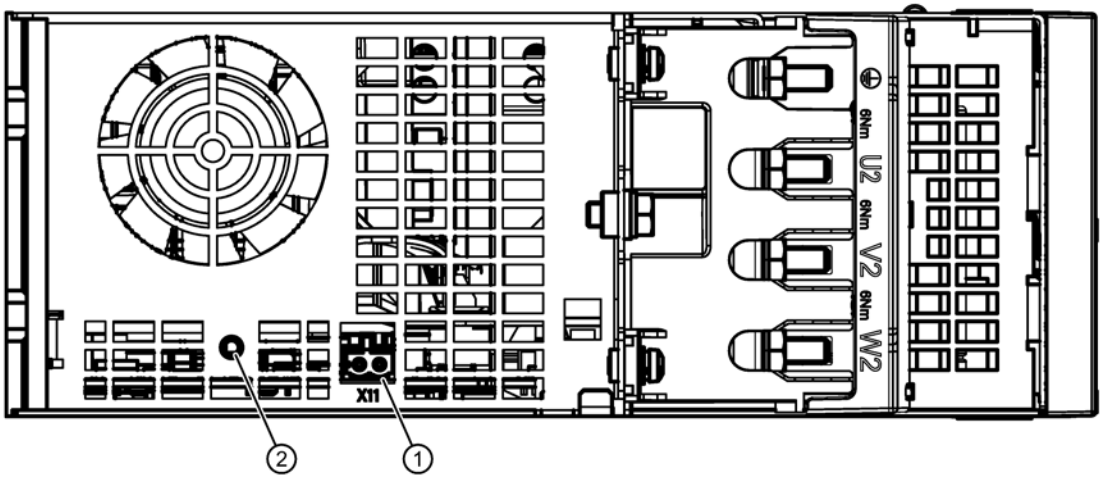


Figure 4-2 Overview of interfaces of Motor Modules in booksize C-type format 45 A / 60 A



① Interface X11 to connect the motor holding brake

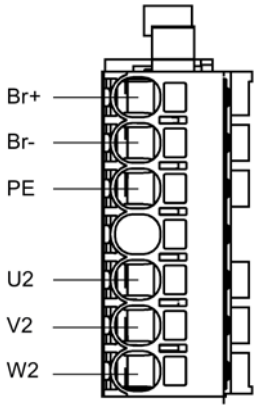
② Threaded socket M4 for attachment of the shield connection clamp (Page 120)

Figure 4-3 Motor Module 45 A / 60 A (view from below)

Additional data regarding connecting motor holding brakes is provided in Chapter "Control cabinet installation/electrical connection (Page 120)".

4.3.2 Motor and brake connection

Table 4- 1 X1: Motor and brake connection for Single Motor Modules 3 A to 30 A
X1/X2: Motor and brake connection for Double Motor Modules 2 x 3 A to 2 x 18 A

	Terminal	Technical data
	BR+	Brake connection:
	BR-	Module output voltage: 24 V DC Maximum load current: 2 A Minimum load current: 0.1 A
	PE	Motor connection
	U2	
	V2	
	W2	

Note

Motor connector

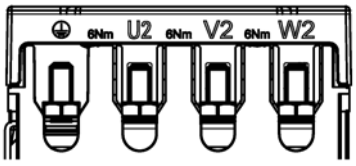
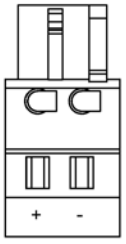
For information about the motor connector, please refer to Chapter "Motor connector" (Page 77).

Note

Shielding

Attach the motor cable shield to the shield connection plate on the Motor Module using the shield connection clamp supplied in the terminal kit. You can find more detailed information in Chapters "Motor connector" (Page 77) and "Shielding and routing cables" (Page 129).

Table 4- 2 X1 motor connection and X11 brake connection for Single Motor Modules 45 A and 60 A

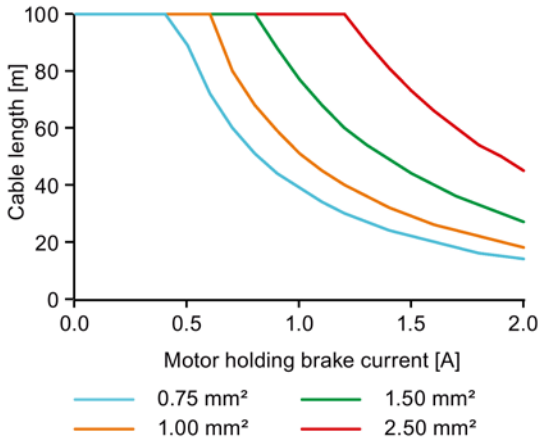
	Terminal	Technical data
	⏚	Threaded bolts: M6 / 6 Nm[1)]
	U2	
	V2	
	W2	
	+ (BR+)	**X11 brake connection connector**:
	- (BR-)	Module output voltage: 24 V DC Max. load current: 2 A Minimum load current: 0.1 A Type: Spring-loaded terminal (Page 123) The brake connector is part of the prefabricated cable.
[1)] For ring cable lugs without insulation (Page 124)		

Motor holding brake connection

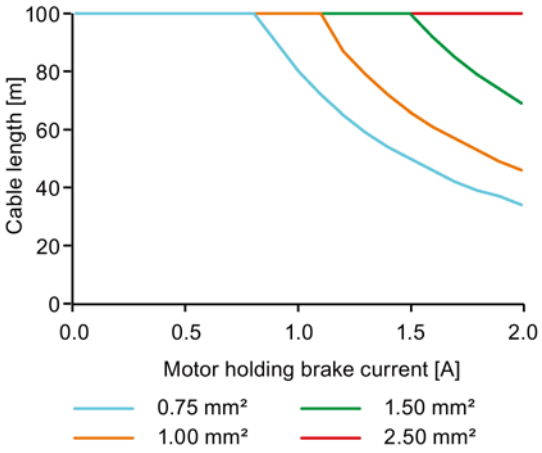
To ensure reliable opening of the motor holding brake, it requires a typical voltage of 24 V ± 10% at the motor connection. Refer to the data sheet of the motor for the motor holding brake voltage and tolerance.

- Also take into account that voltage drops occur in the motor module and on the supply cable.
- Use a Control Supply Module or a regulated DC power supply whose setpoint is set to at least 26 V.
- Note that there are motor holding brakes that close again when the maximum voltage is exceeded.

The following diagrams show the dependencies of motor cable length, motor holding brake current and cross-section of the motor holding brake cables:



Module input voltage 24 V



Module input voltage 26 V

Note

Protective circuit against overvoltages

The Motor Modules have an integrated overvoltage protection circuit for the motor holding brake. External protective circuits are not required.

⚠WARNING

Electric shock caused by high touch voltages for braking cables

For motor cables with integrated brake cable, when the motor is operated, the motor can charge the brake cable up to hazardous voltage levels. Coming into contact with the conductors or the shield of the brake cable can result in death or serious injury.

- Use motor cables with separate, shielded brake cables.
- Connect the shield of the brake cable at both ends.

NOTICE

Premature wear of the motor holding brake when incorrectly operated

Operating the motor holding brake outside its permissible voltage range at the motor connection will damage the brake.

- Ensure that the motor holding brake is only operated within its permissible voltage range.

NOTICE

Faulty brake function due to inadmissible wear

Inadmissible wear means that the braking function can no longer be guaranteed.

- Comply with the defined Emergency Stop characteristics.
- Avoid repeated brief acceleration of the motor against a holding brake that is still closed. Consider the operating times of the brakes and the relays in the drive control and/or enable circuit.

Note

Motor holding brake connection

The motor holding brake must be connected via outputs BR+ and BR- of the Motor Module. The BR- cable must not be connected directly to electronics ground (M).

4.3.3 Protective conductor connection

	50 mm modules	100 mm modules (30 A, 2 x 18 A)	100 mm modules (45 A / 60 A)
Screw	M5	M5	M6
Ring/pipe-type cable lug	M5[1)]	M5	M6
Tightening torque	3 Nm (26.6 lbf in)	3 Nm (26.6 lbf in)	6 Nm (53.1 lbf in)
Screwdriver	Torx 20	Torx 20	Hexagon Torx

1) With a maximum width of 12 mm (0.47 in)

		
50 mm modules: Protective conductor connection behind the shield connection plate	100 mm modules (30 A, 2 x 18 A): Protective conductor connection to the left, adjacent to the shield connection plate	100 mm modules (45 A / 60 A): Protective conductor connection at the motor connection block

Note

Protective conductor connection for 45 A and 60 A modules

The connection block cover partially covers the protective conductor connecting screw.

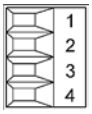
- Open the flap to connect the protective conductor.

Note

For further information about protective connections, please refer to Chapter "Protective connection and equipotential bonding" (Page 131).

4.3.4 X21/X22 EP terminals / temperature sensor

Table 4- 3 X21/X22: EP terminals / temperature sensor

	Terminal	Function	Technical data
 	1	+ Temp	Temperature sensors: KTY84-130 / Pt1000 / PTC / bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (digital input for Enable Pulses)	Supply voltage: 24 V DC (20.4 ... 28.8 V) Current consumption, typical: 4 mA at 24 V Isolated input
	4	EP M1 (enable pulses)	
Type: Screw terminal (Page 123) or spring-loaded terminal, type 2 (Page 123)			

Explanation of the EP terminals

Parameters p9651 and p9851 are used to set the filter times for debouncing terminals X21.3 and X21.4, as well as X22.3 and X22.4. You can find additional information in the SINAMICS S120/S150 List Manual.

Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For detailed information, refer to the SINAMICS S120 Safety Integrated Function Manual, Chapter "Controlling the safety functions".

Note

Function of the EP terminals

The function of the EP terminals for pulse inhibit is only available if the "Safety Integrated Basic Functions via onboard terminals" is enabled in the software.

Temperature sensor connection

WARNING

Electric shock when the motor temperature sensor insulation fails

When connecting temperature sensors, which have no safe protective separation with respect to the motor power circuit, then arcing to the signal electronics can occur.

- Use motors whose temperature sensors have safe protective separation.
- If protective separation cannot be guaranteed (with linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or the TM120 Terminal Module.

NOTICE

Damage to motor due to incorrectly connected KTY temperature sensor

If a KTY temperature sensor is connected with incorrect polarity, it is not possible to detect when the motor overheats. Overheating can cause damage to the motor.

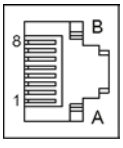
- Connect the KTY temperature sensor with the correct polarity.

Note

The temperature sensor input is not needed if the motors feature an integrated DRIVE-CLiQ interface or if temperature values are detected by means of a different module (SMC, SME, TM).

4.3.5 X200-X203 DRIVE-CLiQ interface

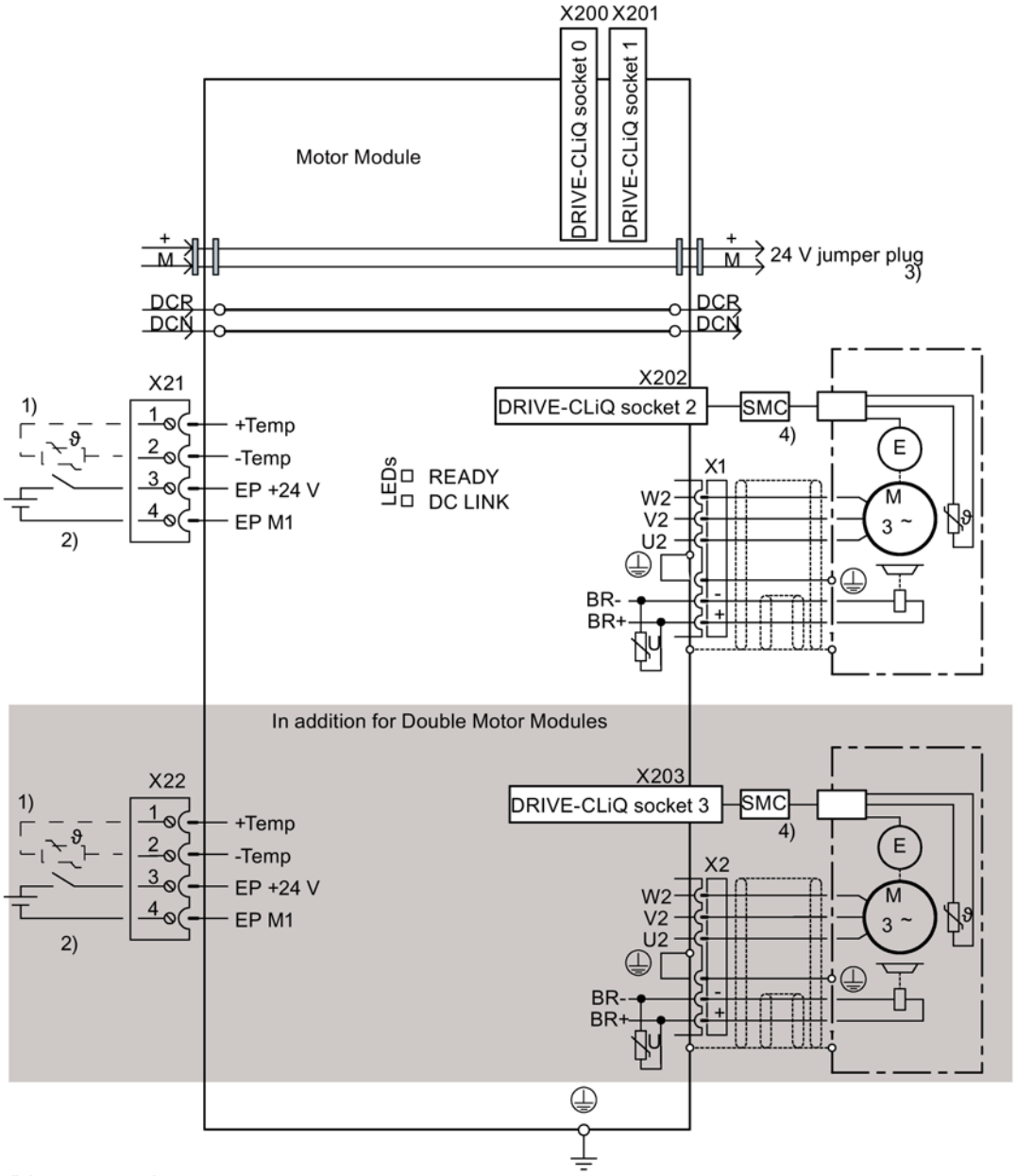
Table 4- 4 X200-X202: DRIVE-CLiQ interfaces of Single Motor Modules
X200-X203: DRIVE-CLiQ interfaces of Double Motor Modules

	Pin	Name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	–
	5	Reserved, do not use	–
	6	RXN	Receive data -
	7	Reserved, do not use	–
	8	Reserved, do not use	–
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

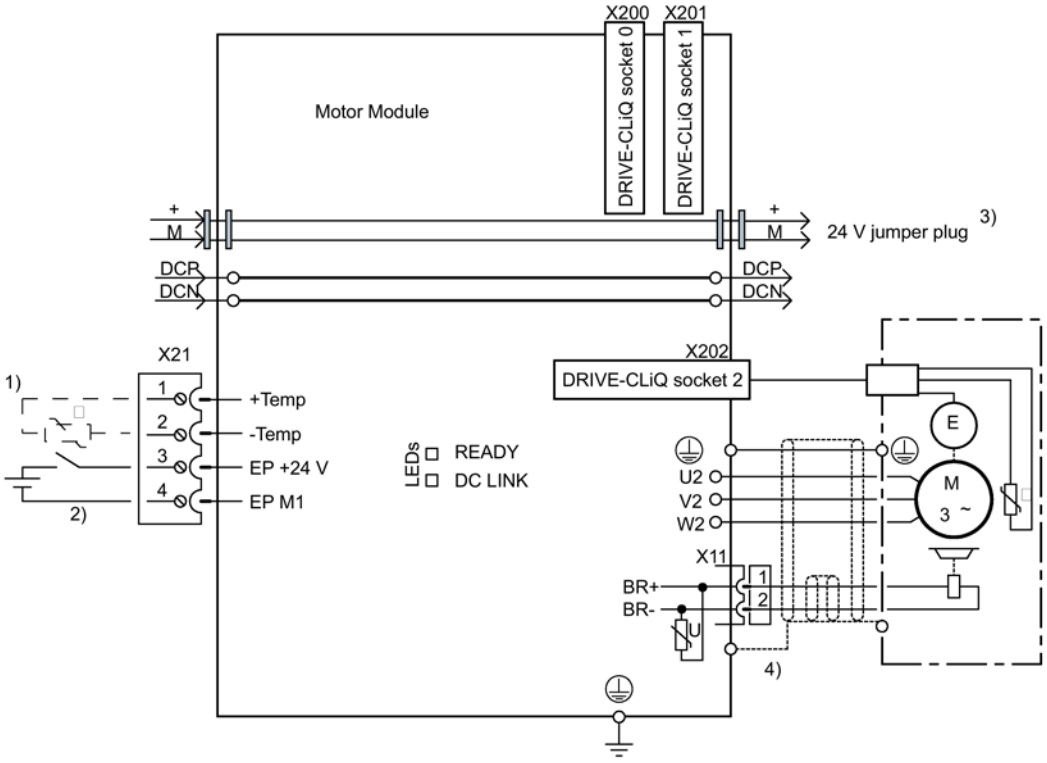
Additional blanking covers (50 units): Article number 6SL3066-4CA00-0AA0

4.4 Connection examples



[1] Optional, e.g. for a motor without encoder
[2] Required for safety
[3] 24 V to the next module
[4] SMC required for motors without DRIVE-CLiQ interface

Figure 4-4 Connection example for Motor Modules Book a room size format C/D type, 3 A ... 30 A, 2x3 A ... 2x18 A



1) Optional, e.g. for a motor without encoder
2) Required for safety
3) 24 V to the next module
4) Contact established through a shield connection plate

Figure 4-5 Connection examples for Motor Modules Booksize format C type, 45 A / 60 A

4.5 Meaning of the LEDs

Table 4- 5 Meaning of the LEDs on the Motor Module

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
Green	–[1)]	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The DC-link voltage is present.	–
	Red	The DC link voltage is outside the permissible tolerance range.	Check the line supply voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–[1)]	This component has at least one fault. **Note:** The LED is controlled irrespective of the corresponding messages being reconfigured.	Resolve and acknowledge the fault.
Green/red (0.5 Hz)	–[1)]	Firmware is being downloaded.	–
Green/red (2 Hz)	–[1)]	Firmware download is complete. The system is waiting for POWER ON.	Carry out a POWER ON.
Green/orange or red/orange (2 Hz)	–[1)]	Component recognition via LED is activated by the commissioning tool (parameter p0124). **Note:** Both options depend on the LED status when component recognition is activated.	–

[1)] Irrespective of the status of the LED "DC LINK"

4.6 Dimension drawings

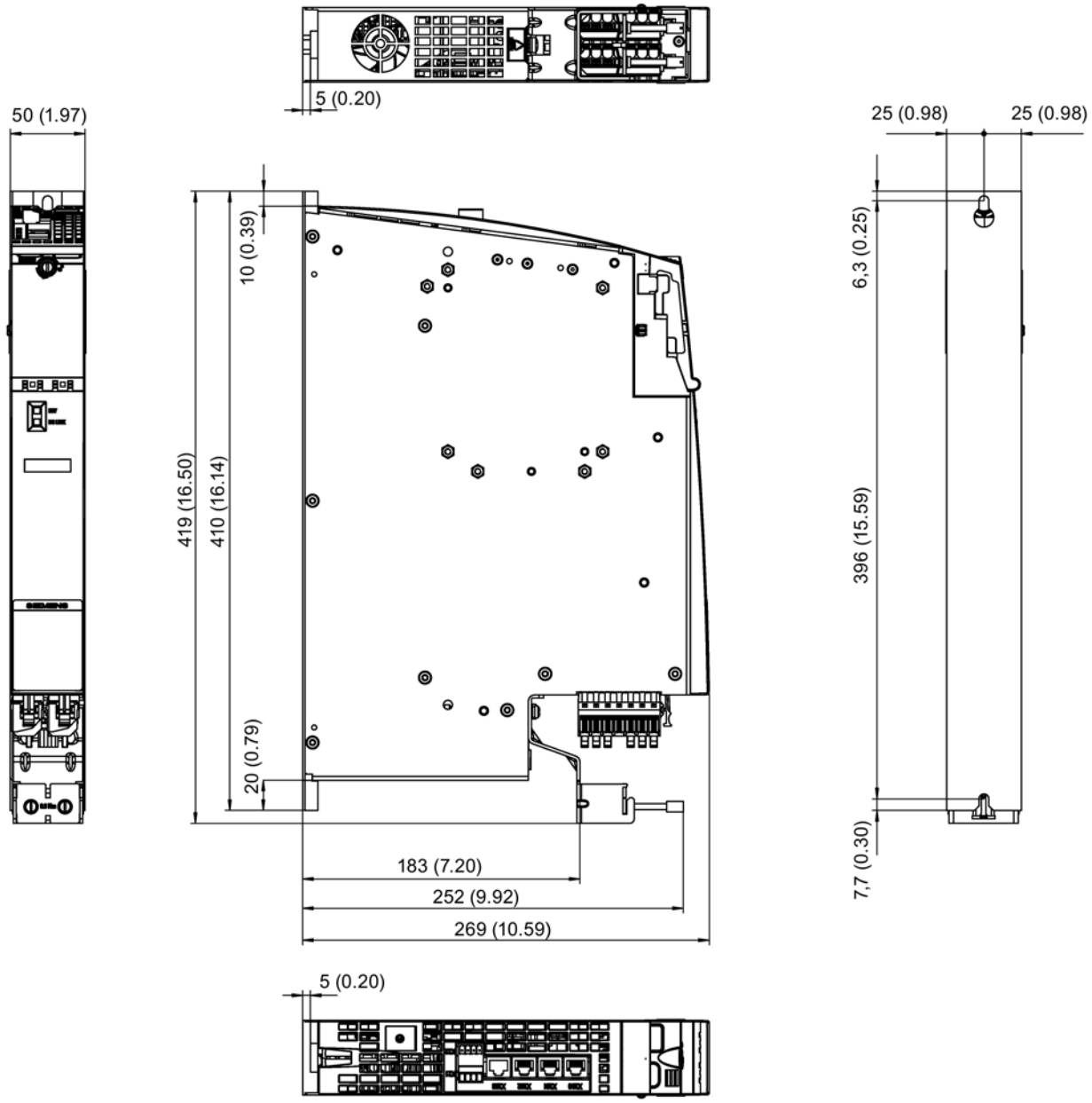


Figure 4-6 Dimension drawing of 50 mm Motor Modules in booksize C/D-type format with internal air cooling, all dimensions in mm and (inches)

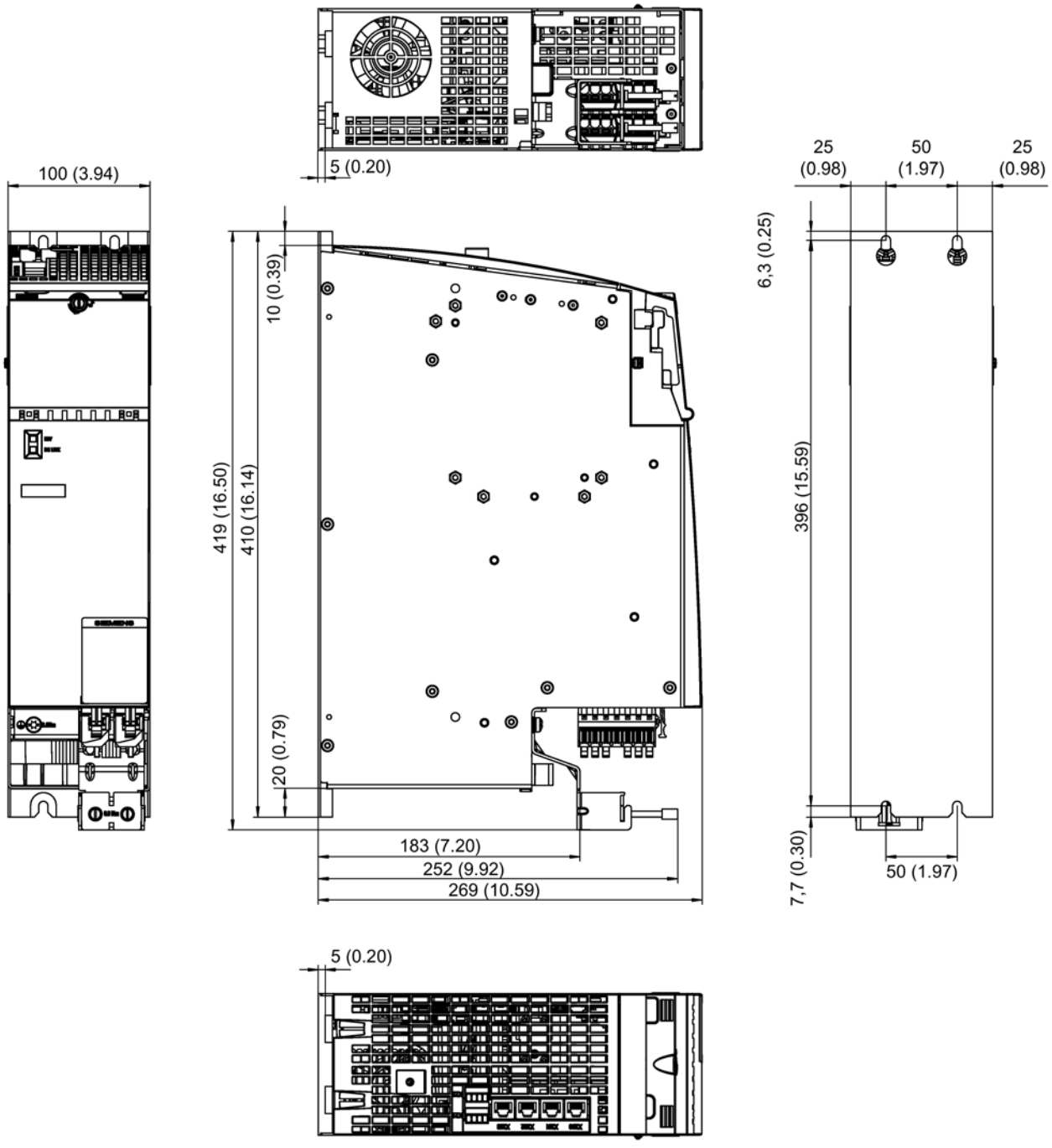


Figure 4-7 Dimension drawing of 100 mm Motor Modules 30 A / 2 x 18 A in Booksize format C/D type with internal air cooling, all dimensions in mm and (inches)

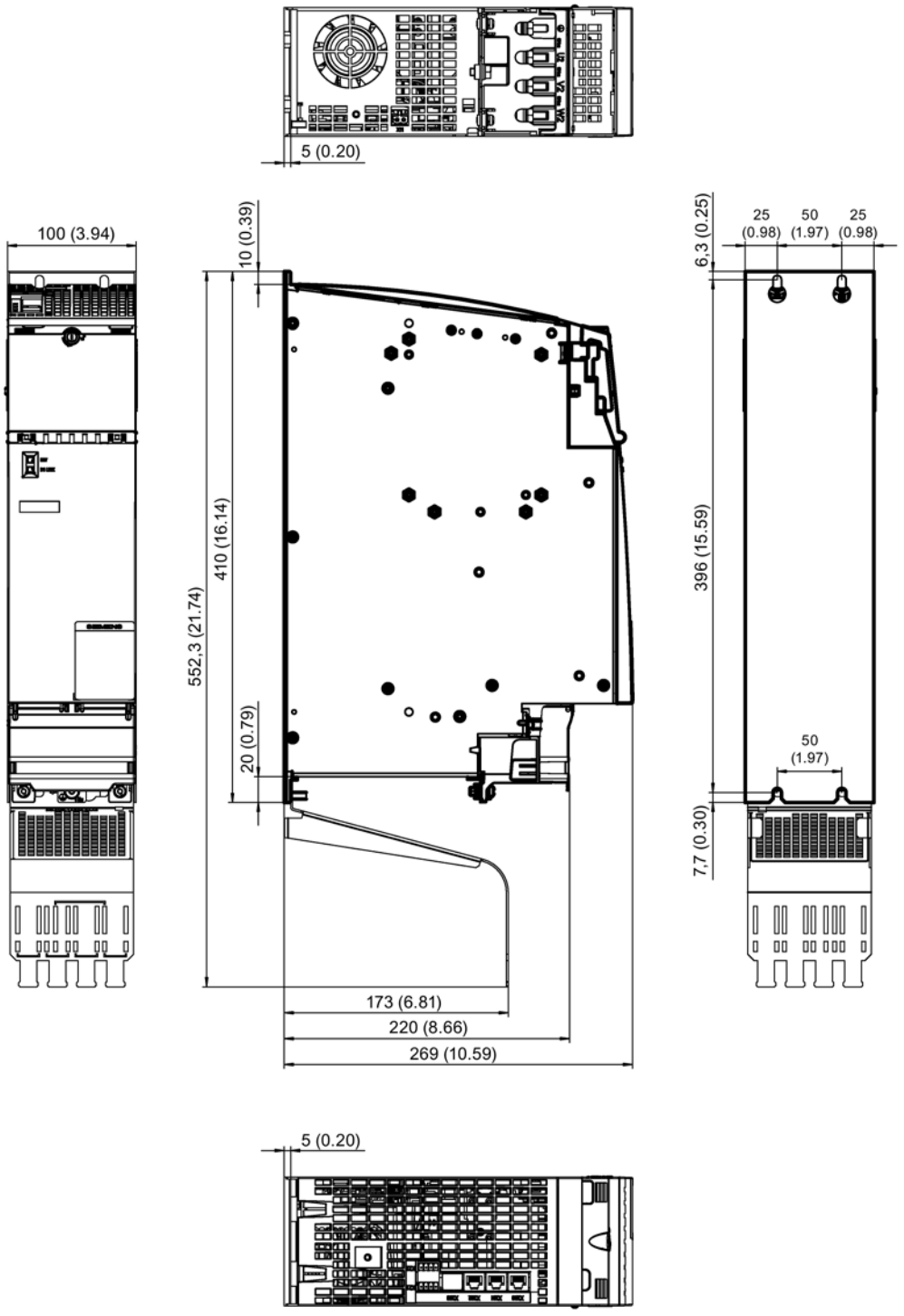


Figure 4-8 Dimension drawing of 100 mm Motor Modules 45 A / 60 A in Booksize format C type with internal air cooling, all dimensions in mm and (inches)

4.7 Installation

Motor Modules are designed for installation in the control cabinet. They are fixed to the control cabinet wall or a mounting panel using M6 screws.

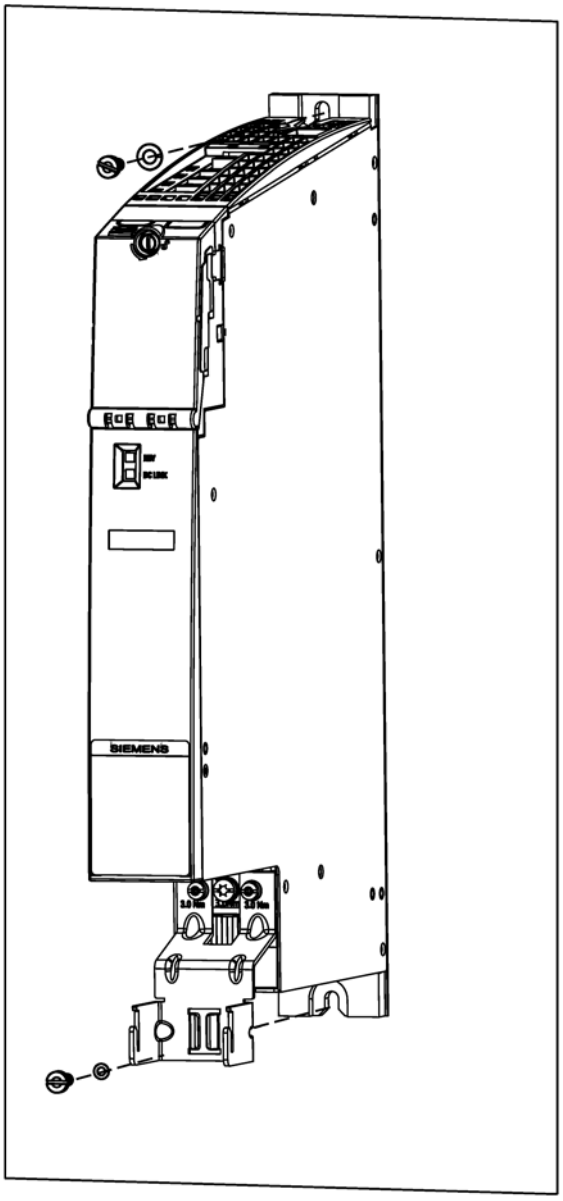
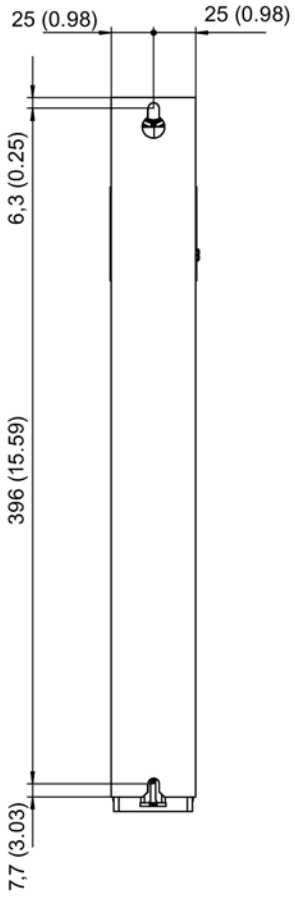
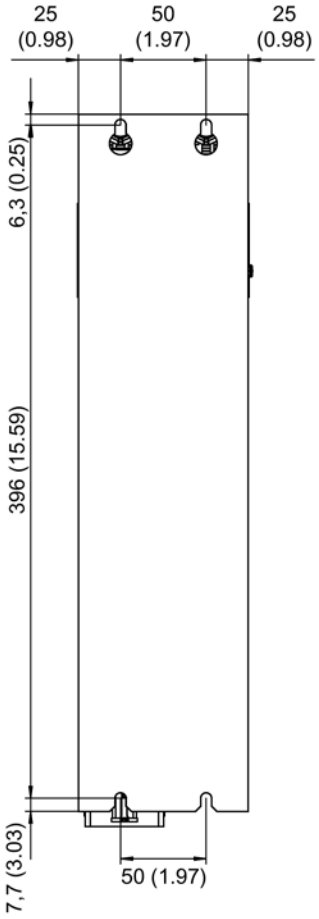


Figure 4-9 Installing a Motor Module

Drilling patterns



Drilling pattern for 50 mm Motor Modules



Drilling pattern for 100 mm Motor Modules

Requirements placed on the electrical cabinet

- Housing: Sheet steel
- Panel thickness: 3 mm (0.12 in)
- Tensile strength: ≥270 N/mm^2 according to DX51 EN10346

Tightening torques

1. Initially tighten the screws finger-tight only with a tightening torque of 0.5 Nm (4.43 lbf in).
2. Then tighten the screws with a tightening torque of 6 Nm (53.1 lbf in).

4.8 Technical data

4.8.1 Single Motor Modules

Table 4- 6 Technical data of Single Motor Modules in Booksize format C type (18 A to 60 A)

C-type	**6SL3120-**	**1TE21-8AC.**	**1TE22-4AC.**	**1TE23-0AC.**	**1TE24-5AC.**	**1TE26-0AC.**
Output current						
Rated current (I_n)	A_{AC}	18	24	30	45	60
Base load current (I_H)	A_{AC}	15.3	20.4	25.5	38	51
Intermittent duty current (I_{s6}) 40 %	A_{AC}	24	32	40	60	80
Peak current (I_{max})	A_{AC}	36	48	56	90	120
Output voltage 3 AC	V_{AC}	0 … 0.717 x DC link voltage (0 ... 480 V at 670 V DC)				
Output frequency	Hz	0 ... 550[1]				
DC link current	A_{DC}	22	29	36	54	72
DC link voltage	V_{DC}	510 … 720				
DC link capacitance	µF	220	390	705	1230	1410
Overvoltage trip	V_{DC}	820 ± 2 %				
Undervoltage trip[2]	V_{DC}	380 ± 2 %				
Electronics power supply	V_{DC}	24 (20.4 … 28.8)				
Electronics current drawn at 24 V DC	A_{DC}	0.75	1.00	0.80	0.90	0.90
Current carrying capacity						
DC link busbars	A_{DC}	100[3]		200		
24 V DC busbars	A_{DC}	20		20		
Unit rating[4]						
Based on I_n (600 V DC; 4 kHz)	kW	9.7	12.9	16	24	32
Based on I_H	kW	8.2	10.9	13.7	21	28
Typical power loss see also Power losses of the components (Page 140)	W	140	189	263	342	460
Max. pulse frequency						
Without derating	kHz	4				
With derating	kHz	16				
Sound pressure level	dB(A)	< 60	< 68	< 60	< 71	< 71
Cooling method		Internal fan				
Cooling air requirement	m^3/h	33.3	53	56	84	84
Max. permissible heat sink temperature	°C	95	95	98	93	93

C-type	6SL3120-	1TE21-8AC.	1TE22-4AC.	1TE23-0AC.	1TE24-5AC.	1TE26-0AC.
Ventilation clearances above/below	mm	≥ 80				
Weight	kg	4.6	4.7	7.9	8.5	8.6

1) Higher output frequencies up to a maximum of 3200 Hz are possible with an additional license.

2) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

3) When using 6 mm thick DC link (article number 6SL3162-2BB00-0AA0): 200 A

4) Rated power of a typical standard induction motor at 400 V 3 AC

Table 4- 7 Technical data of Single Motor Modules in Booksize format D type (3 A to 30 A)

D-type	6SL3120-	1TE13-0AD.	1TE15-0AD.	1TE21-0AD.	1TE21-8AD.	1TE22-4AD.	1TE23-0AD.
Output current							
Rated current (I_n)	A_{AC}	3	5	9	18	24	30
Base load current (I_H)	A_{AC}	2.6	4.3	7.7	15.3	20.4	25.5
Intermittent duty current (I_{s6}) 40 %	A_{AC}	4	6.7	12	24	32	40
Peak current (I_{max})	A_{AC}	9	15	27	54	72	90
Output voltage 3 AC	V_{AC}	0 … 0.717 x DC link voltage (0 ... 480 V at 670 V DC)					
Output frequency	Hz	0 ... 550[1)]					
DC link current	A_{DC}	3.6	6	11	22	29	36
DC link voltage	V_{DC}	510 … 720					
DC link capacitance	µF	110	110	110	220	390	705
Overvoltage trip	V_{DC}	820 ± 2 %					
Undervoltage trip[2)]	V_{DC}	380 ± 2 %					
Electronics power supply	V_{DC}	24 (20.4 … 28.8)					
Electronics current drawn at 24 V DC	A_{DC}	0.75	0.75	0.75	0.75	1.00	0.80
Current carrying capacity							
DC link busbars	A_{DC}	100[3)]					200
24 V DC busbars	A_{DC}	20					20
Unit rating[4)]							
Based on I_n (600 V DC; 4 kHz)	kW	1.6	2.7	4.8	9.7	12.9	16
Based on I_H	kW	1.4	2.3	4.1	8.2	10.9	13.7
Typical power loss see also Power losses of the components (Page 140)	W	26	36	60	140	190	263
Max. pulse frequency							
Without derating	kHz	4					
With derating	kHz	16					
Sound pressure level	dB(A)	< 60	< 60	< 60	< 60	< 68	< 60
Cooling method		Internal fan					
Cooling air requirement	m^3/h	33.3	33.3	33.3	33.3	53	56
Max. permissible heat sink temperature	°C	72	83	84	95	95	98

D-type	6SL3120-	1TE13-0AD.	1TE15-0AD.	1TE21-0AD.	1TE21-8AD.	1TE22-4AD.	1TE23-0AD.
Ventilation clearances above/below	mm	≥ 80					
Weight	kg	4.6	4.6	4.6	4.6	4.7	7.9

1) Higher output frequencies up to a maximum of 3200 Hz are possible with an additional license.

2) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

3) When using 6 mm thick DC link (article number 6SL3162-2BB00-0AA0): 200 A

4) Rated power of a typical standard induction motor at 400 V 3 AC

Note

Operation of 18 A to 30 A Single Motor Modules with 300 % overload connected to a 16 kW Line Module

The maximum power of a 16 kW Line Module is not sufficient for operating 18 A up to 30 A Single Motor Modules at their peak current.

- Take into consideration the motor power if you wish to operate an 18 A, 24 A or 30 A Single Motor Module on a 16 kW Line Module. Depending on the operating state, the power consumption of these Single Motor Modules can be > 35 kW, and it may be necessary to install a Line Module with a higher power rating for applications such as these.

4.8.2 Double Motor Modules

Table 4- 8 Technical data of Double Motor Modules in booksize C-type format (2 x 18 A)

C-type	6SL3120-	2TE21-8AC.
Output current		
Rated current (I_n)	A_{AC}	2 x 18
Base load current (I_H)	A_{AC}	2 x 15.3
Intermittent duty current (I_{s6}) 40 %	A_{AC}	2 x 24
Peak current (I_{max})	A_{AC}	2 x 36
Output voltage 3 AC	V_{AC}	0 … 0.717 x DC link voltage (0 ... 480 V at 670 V DC)
Output frequency	Hz	0 ... 550[1]
DC link current	A_{DC}	43
DC link voltage	V_{DC}	510 … 720
DC link capacitance	µF	705
Overvoltage trip Undervoltage trip[2]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %
Electronics power supply	V_{DC}	24 (20.4 … 28.8)
Electronics current drawn at 24 V DC	A_{DC}	1.1
Current carrying capacity DC link busbars 24 V DC busbars	A_{DC} A_{DC}	200 20
Unit rating[3] Based on I_n (600 V DC; 4 kHz) Based on I_H	kW kW	2 x 9.7 2 x 8.2
Typical power loss See also Power losses of the components (Page 140)	W	281
Max. pulse frequency Without derating With derating	kHz kHz	4 16
Sound pressure level	dB(A)	< 60
Cooling method		Internal fan
Cooling air requirement	m^3/h	56
Max. permissible heat sink temperature	°C	91
Ventilation clearances above/below	mm	≥ 80
Weight	kg	7.7

1) Higher output frequencies up to a maximum of 3200 Hz are possible with an additional license.

2) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

3) Rated power of a typical standard induction motor at 400 V 3 AC

Table 4- 9 Technical data of Double Motor Modules in booksize D-type format (2 x 3 A to 2 x 18 A)

D-type	**6SL3120-**	**2TE13-0AD.**	**2TE15-0AD.**	**2TE21-0AD.**	**2TE21-8AD.**
Output current					
Rated current (I_n)	A_{AC}	2 x 3	2 x 5	2 x 9	2 x 18
Base load current (I_H)	A_{AC}	2 x 2.6	2 x 4.3	2 x 7.7	2 x 15.3
Intermittent duty current (I_{s6}) 40 %	A_{AC}	2 x 4	2 x 6.7	2 x 12	2 x 24
Peak current (I_{max})	A_{AC}	2 x 9	2 x 15	2 x 27	2 x 54
Output voltage 3 AC	V_{AC}	0 … 0.717 x DC link voltage (0 ... 480 V at 670 V DC)			
Output frequency	Hz	0 ... 550[1]			
DC link current	A_{DC}	7.2	12	22	43
DC link voltage	V_{DC}	510 … 720			
DC link capacitance	µF	220	220	220	705
Overvoltage trip	V_{DC}	820 ± 2 %			
Undervoltage trip[2]	V_{DC}	380 ± 2 %			
Electronics power supply	V_{DC}	24 (20.4 … 28.8)			
Electronics current drawn at 24 V DC	A_{DC}	0.9	0.9	0.9	1.1
Current carrying capacity					
DC link busbars	A_{DC}	100[3]			200
24 V DC busbars	A_{DC}	20			20
Unit rating[4]					
Based on I_n (600 V DC, 4 kHz)	kW	2 x 1.6	2 x 2.7	2 x 4.8	2 x 9.7
Based on I_H	kW	2 x 1.4	2 x 2.3	2 x 4.1	2 x 8.2
Typical power loss See also Power losses of the components (Page 140)	W	54	81	152	281
Max. pulse frequency					
Without derating	kHz	4			
With derating	kHz	16			
Sound pressure level	dB(A)	< 60			
Cooling method		Internal fan			
Cooling air requirement	m^3/h	33.3	33.3	33.3	56
Max. permissible heat sink temperature	°C	82	82	93	91
Ventilation clearances above/below	mm	≥ 80			
Weight	kg	4.7	4.7	4.7	7.7

1) Higher output frequencies up to a maximum of 3200 Hz are possible with an additional license.

2) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

3) When using 6 mm thick DC link (article number 6SL3162-2BB00-0AA0): 200 A

4) Rated power of a typical standard induction motor at 400 V 3 AC

Note

Operation of 2 x 9 A / 2 x 18 A Double Motor Modules with 300 % overload connected to a 16 kW Line Module

The maximum power of a 16 kW Line Module is not sufficient for operating 2 x 9 A / 2 x 18 A Double Motor Modules with their peak current.

- Take the motor power into account if you wish to operate a 2 x 9 A or 2 x 18 A Double Motor Module on a 16 kW Line Module. Depending on the operating state, the power consumption of these Double Motor Modules can be > 35 kW, and it may be necessary to install a Line Module with a higher power rating for applications such as these.

4.8.3 Motor overload protection according to IEC/UL 61800-5-1

The Motor Module has integrated motor overload protection according to IEC/UL 61800-5-1. Ensure that the motor is protected from overload by observing and following the instructions below.

- The protection threshold is 115% of the rated motor current.
- Monitoring for motor overload protection is automatically activated during commissioning.
- Enter the motor data and protection function values when commissioning a Motor Module.
- Operation **without** motor temperature sensor
  - Synchronous motors

    To ensure motor overload protection, the minimum value of 40 °C for the ambient motor temperature must be entered in parameter p0613.
  - Induction motors

    To ensure motor overload protection, the minimum value of 40 °C for the ambient motor temperature must be entered in parameter p0625.
- **Additional information**

  Additional information on parameter assignment for thermal motor models can be found in Chapter "Thermal motor protection" in the SINAMICS S120 Function Manual Drive Functions.

4.9 Characteristics

4.9.1 Duty cycles

Rated duty cycles of Motor Modules in booksize C-type format

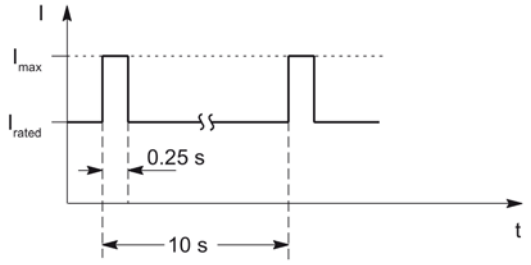


Figure 4-10 Duty cycle with initial load

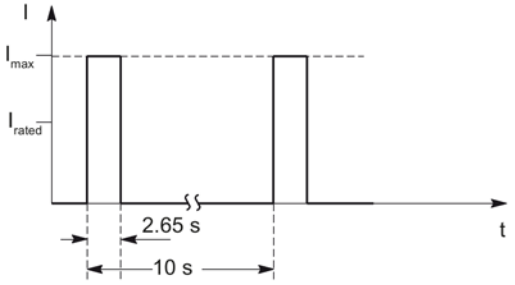


Figure 4-11 Duty cycle without initial load

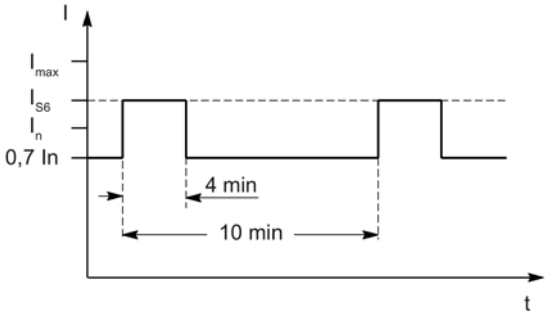


Figure 4-12 S6 duty cycle with initial load for a duty cycle duration of 600 s

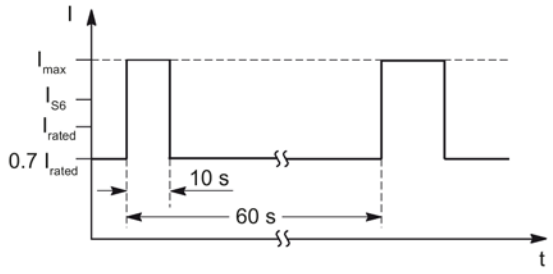


Figure 4-13 S6 duty cycle with initial load for a duty cycle duration of 60 s

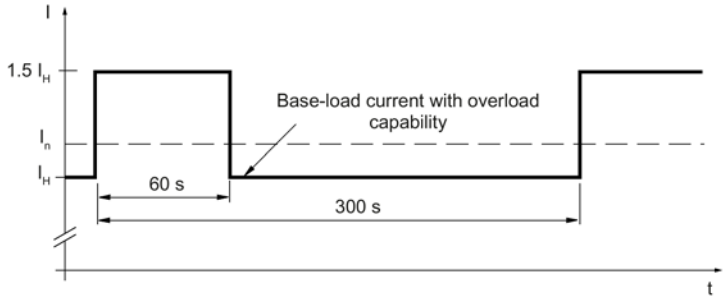


Figure 4-14 Duty cycle with 60 s overload for a duty cycle duration of 300 s

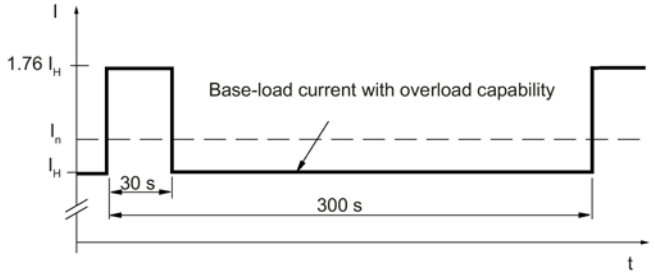


Figure 4-15 Duty cycle with 30 s overload for a duty cycle duration of 300 s

Rated duty cycles of Motor Modules in booksize D-type format

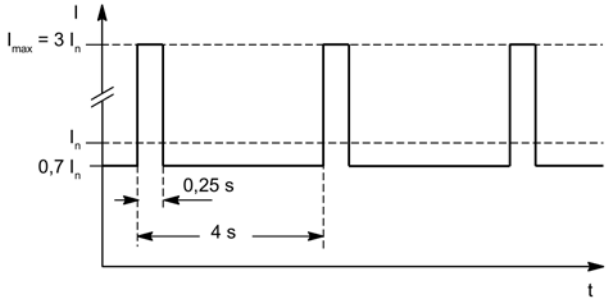


Figure 4-16 Peak current duty cycle with initial load (300 % overload)

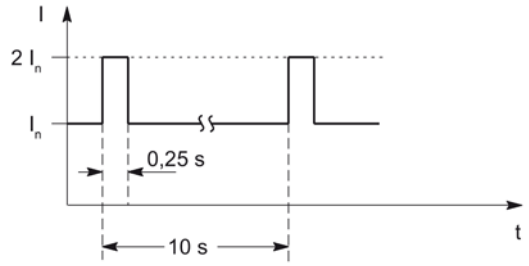


Figure 4-17 Duty cycle with initial load

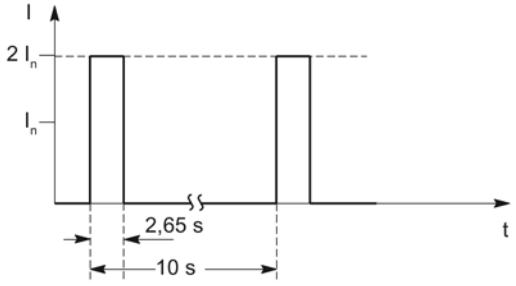


Figure 4-18 Duty cycle without initial load for a duty cycle duration of 10 s

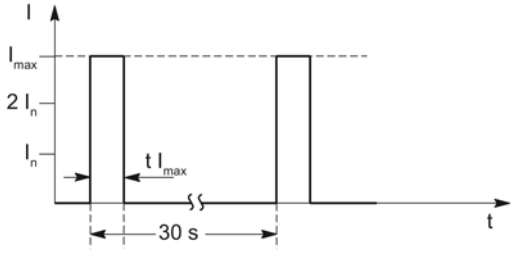


Figure 4-19 Duty cycle without initial load for a duty cycle duration of 30 s

Table 4- 10 Times I_{max} for the duty cycle

Motor Modules	t I_{max}	Duty cycle duration
3 A, 2 x 3 A	0.5 s	30 s
5 A, 2 x 5 A	0.5 s	30 s
9 A, 2 x 9 A	0.5 s	30 s
18 A, 2 x 18 A	1.25 s	30 s
24 A	1.25 s	30 s
30 A	3 s	30 s

Note

Supplementary condition

The duty cycle "without initial load for a duty cycle duration of 30 s" is not permissible with a pulse frequency of 16 kHz. The current must be derated for a pulse frequency of 8 kHz.

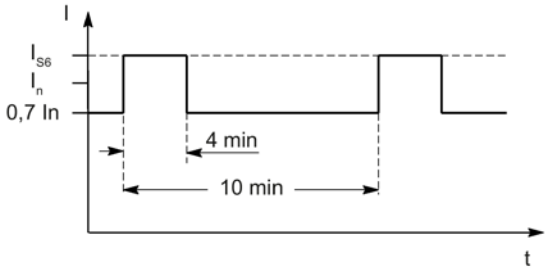


Figure 4-20 S6 duty cycle with initial load for a duty cycle duration of 600 s

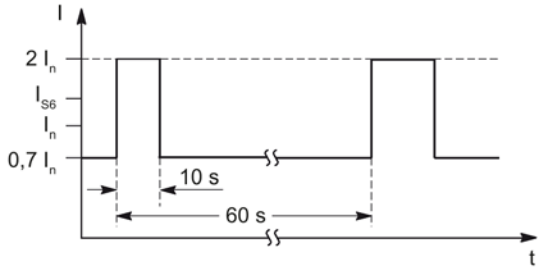


Figure 4-21 S6 duty cycle with initial load for a duty cycle duration of 60 s

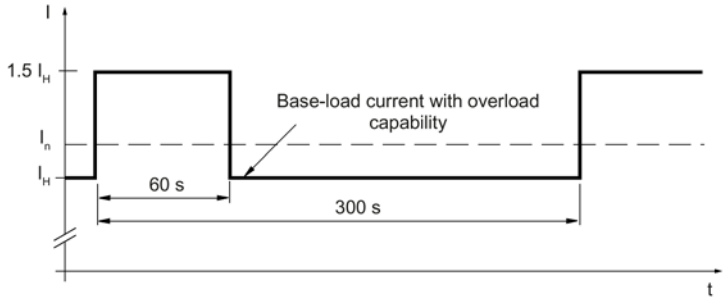


Figure 4-22 Duty cycle with 60 s overload for a duty cycle duration of 300 s

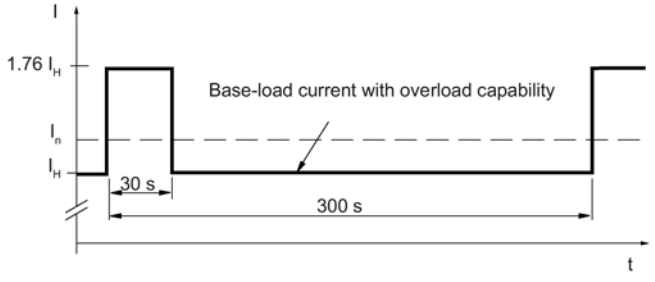


Figure 4-23 Duty cycle with 30 s overload for a duty cycle duration of 300 s

4.9.2 Derating characteristics

Derating characteristics for Motor Modules in booksize C/D-type format

Note

For information about derating depending on ambient temperature and installation altitude, please refer to Chapter "System data" (Page 39).

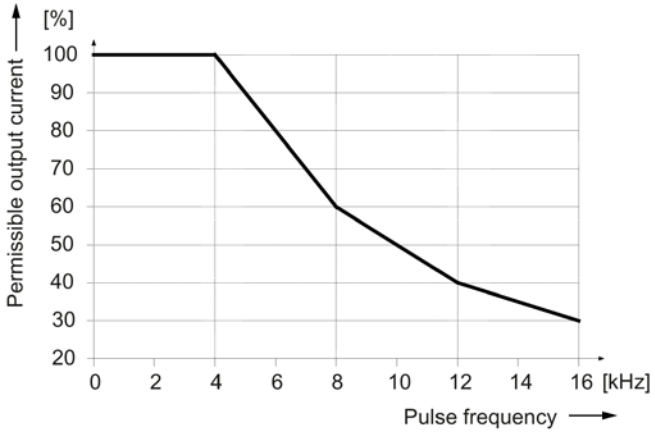


Figure 4-24 Output current as a function of the pulse frequency

Note

Operation at a pulse frequency of 16 kHz

At a pulse frequency of 16 kHz, the maximum permissible ambient temperature is 40 °C and the maximum DC link voltage is 600 V DC.

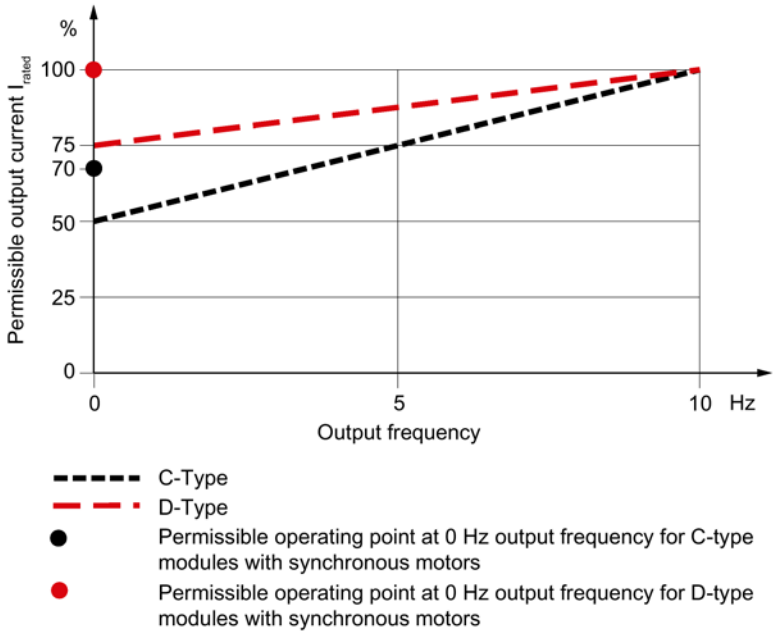


Figure 4-25 Output current during operation at low frequencies

Supplementary conditions applicable to operation at low frequencies

- Derating does not apply to acceleration from zero speed if an output frequency of >10 Hz is reached within 100 ms. Current derating should be taken into account if the total amount of time of this operation at frequencies < 10 Hz is more than 2% of the daily operating time.
- The D-type characteristic applies only to a 4 kHz pulse frequency. With a pulse frequency of 8/16 kHz, the C-type characteristic must be used taking the relevant current derating requirement into account.
- For drive systems with induction motors (with slip frequency), the permissible continuous load at zero speed corresponds to 75 % of I_{rated} for D-type modules, or 50 % of I_{rated} for C-type modules (e.g. suspended axis without counterweight or travel to fixed stop).

Motor connection, shield support and fabrication 5

5.1 Motor plug connector for Motor Modules 3 A ... 30 A

5.1.1 Description

Motor Modules up to 30 A are connected to motors using a motor plug connector (power connector). The motor plug connector is not included in the scope of supply.

The motor connector must be ordered separately for power cables that do not have preassembled connectors.

The following cores of the motor connecting cable can be wired up to the motor connector:

- Protective conductor to the motor
- BR+ and BR- to the motor holding brake
- U2, V2 and W2

The following connector versions are available:

	
Type C/D connectors, push-in with actuators that can be snapped into place	Connector with screw terminals

Article No.	Designation	Connection type
6SL3162-2MB00-0AC0	Type C/D connectors, push-in with actuators that can be snapped into place	Spring-loaded terminals
6SL3162-2MA00-0AC0	Connector with screw terminals	Screw terminals

Note

Using identical plug connector variants for Double Motor Modules

Two connectors of identical type must be used on Double Motor Modules (both push-in connectors or both connectors with screw terminals). It will not otherwise be possible to plug them into the module.

The motor plug connectors 6SL3162-2M□00-0AC0 as well as the motor plug connectors used in the MOTION-CONNECT cable assemblies have been type-tested in combination with the Motor Modules. Compliance with the stipulations made in the EC Declaration of Conformity is only ensured in combination with these motor connection plugs.

The cULus approval has been granted for the motor plug connector system 6SL3162-2M□00-0AC0 as well as the motor plug connectors used in the MOTION-CONNECT cable assemblies. Warranty for the technical function can only be ensured in combination with the stated motor connection plugs.

⚠WARNING

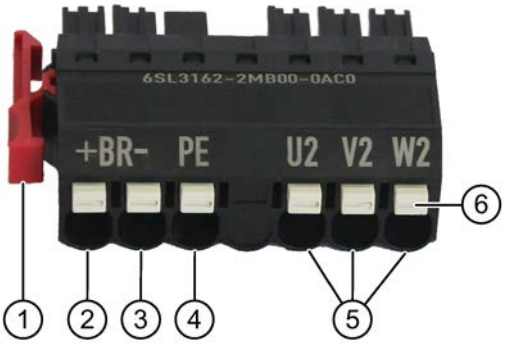
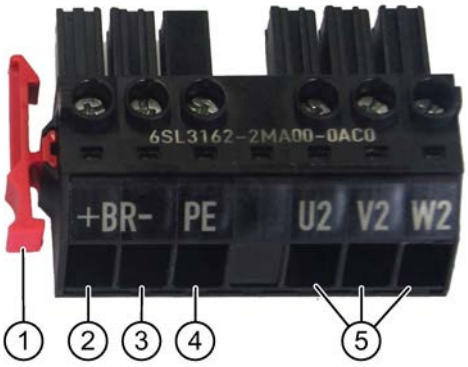
Electric shock or fire caused by non-certified plug connectors in the power circuit

If non-certified plug connectors are used in the power circuit, this can result in overheating, fire and/or electric shock.

- Only use approved plug connectors in the power circuit.

5.1.2 Electrical connection

The terminal assignments for individual cores at the motor connector are shown in the following diagrams.

	
Connections for connector with push-in terminals	Connections for connector with screw terminals

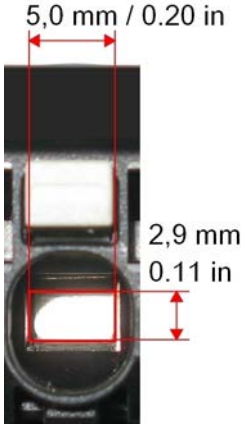
① Catch
② BR+ (black)
③ BR- (white)
④ Motor protective conductor connection (PE)
⑤ U2, V2, W2
⑥ Locking lever (for push-in connector only)

		Spring-loaded terminal (push-in)	**Screw terminal**
U2, V2, W2, protective conductor, BR+, BR-	Conductor cross-section for cables with conductor end sleeves	1.5 … 6 mm^2 AWG 16 ... AWG 10	1.5 … 6 mm^2 AWG 16 ... AWG 10
	Screwdriver	-	Slotted 0.8 x 4.0 mm
	Tightening torque	-	0.5 ... 0.6 Nm 4.4 lbf in

5.1.2.1 Cable cross-sections and end sleeves

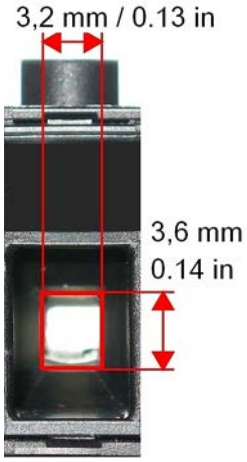
To assemble the motor cable, refer to the tables below for the connectable cable cross-sections, the possible end sleeves and the terminal openings for the individual motor connector variants.

Table 5- 1 Connector with push-in terminal

	1.5 mm² AWG 16	2.5 mm² AWG 14	4 mm² AWG 12	6 mm² AWG 10	Dimensions of the terminal openings
	✓	✓	✓	✓[1)]	
	✓	✓	✓	✓[1)]	

[1)] When crimped, conductor end sleeves must not exceed the maximum dimensions of 2.9 x 5.0 mm (0.11 x 0.20 in), as otherwise individual conductors will not be able to be inserted or removed.

Table 5- 2 Connector with screw terminals

	1.5 mm² AWG 16	2.5 mm² AWG 14	4 mm² AWG 12	6 mm² AWG 10	Dimensions of the terminal openings
	✓	✓	✓	✓[1)]	
	✓	✓	✓	✓[1)]	
	✓ 2x	✓ 2x	✓ 2x	Not possible	

[1)] When crimped, conductor end sleeves must not exceed the maximum dimensions of 3.6 x 3.2 mm (0.14 x 0.13 in).

Note

Motor cables with 10 mm²

Self-assembly of motor cables with 10 mm² cores is not possible. Only use prefabricated MOTION-CONNECT power cables.

5.1.2.2 Crimping conductor end sleeves

The following crimping tool is available from Weidmüller to crimp conductor end sleeves (www.weidmueller.com).

- Type PZ 6/5, Article No. 9011460000

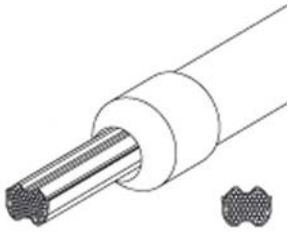


Figure 5-1 Crimp shape PZ 6/5

Note

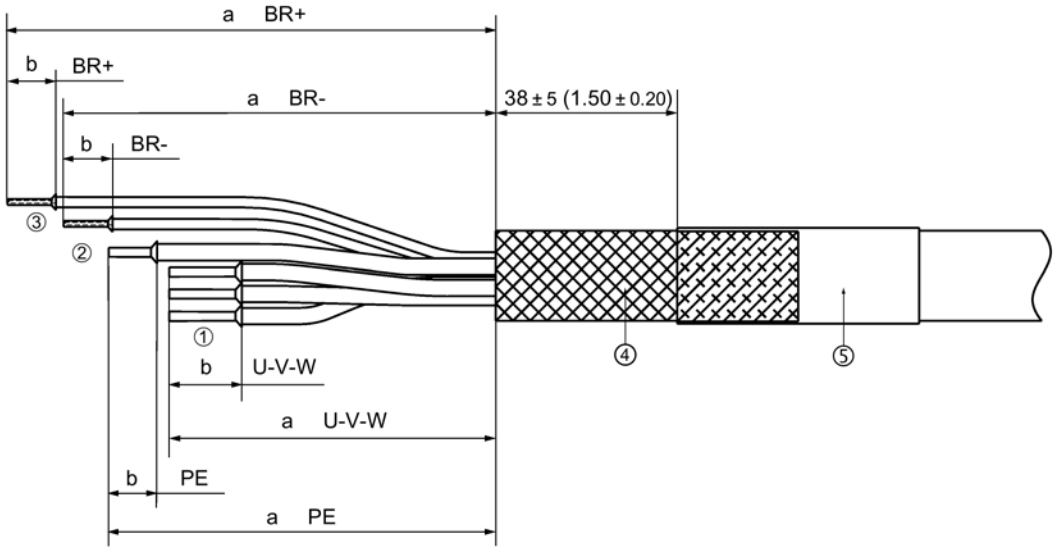
Crimping 6 mm² conductor end sleeves (AWG 10)

When the 6 mm² conductor end sleeves (AWG 10) are crimped, it must be ensured that the outer dimension of the crimped end sleeve specified above is not exceeded, as otherwise the individual conductors will not fit into the terminals.

5.1.3 Preparing the power cables

The power cables must be prepared before they can be attached to a motor connector:

1. Remove the cable sheath to 85 mm (3.35 in) length with a tolerance of ±5 mm (±0.02 in).
2. Fold back the braided shield. If you are using a motor cable with brake conductors, then the braided shield of the brake conductors must be unbraided. This is then folded back against the outer shield.
3. Fix the braided shield. Preferably use shrink tubing with hot melt adhesive.
4. Shorten the individual conductors as indicated in the drawing and table below.
5. Remove the insulation of the individual conductors to a length of "b" corresponding to the table below.
6. Use conductor end sleeves according to DIN 46228 with the appropriate cross-section.



① Conductors U-V-W
② Protective conductor core
③ Holding brake conductors
④ Protective braided shield
⑤ Shrink tubing

Figure 5-2 Conductor and stripped insulation lengths

Table 5- 3 Conductor and stripped insulation lengths as a function of the cable cross-section, data in mm and (inch)

	1.5 mm² (AWG 16)		2.5 / 4 / 6 mm² (AWG 14 / AWG 12 / AWG 10)	
	a	b	a	b
U	55 +2/-3 (2.17 +0.08/-0.12)	12 ±0.5 (0.47 ±0.02)	55 +2/-3 (2.17 +0.08/-0.12)	12 ±0.5 (0.47 ±0.02)
V				
W				
Protective conductor	64 +2/-3 (2.52 +0.08/-0.12)	12 ±0.5 (0.47 ±0.02)	62 +2/-3 (2.44 +0.08/-0.12)	12 ±0.5 (0.47 ±0.02)
BR-	73 ±5 (2.87 ±0.20)	12 ±0.5 (0.47 ±0.02)	73 ±5 (2.87 ±0.20)	12 ±0.5 (0.47 ±0.02)
BR+	79 ±5 (3.11 ±0.20)	12 ±0.5 (0.47 ±0.02)	79 ±5 (3.11 ±0.20)	12 ±0.5 (0.47 ±0.02)

Note

Adherence to conductor and stripped insulation lengths

If the specified conductor and insulation stripping lengths are not complied with, individual conductors can be damaged or shield contact prevented.

Note

Cables for UL applications

For UL applications, only 60/75 °C copper cables may be used.

5.1.4 Connecting the motor cable

Connecting conductors to the push-in connector

	
The state of the push-in plug connector when it is delivered: The 6 locking levers are locked in the engaged state, the terminals open.	Insert the conductors into the open terminals. For cross-sections from 4 mm² and higher it is helpful if U2, V2, W2 are simultaneously inserted.
	
Lock the terminals by pressing a 0.8 x 4 mm slot-head screwdriver down vertically on the locking lever. Make sure that the conductor has been inserted as far as it will go. Start with W2, V2, U2, and by gently pulling on the conductors ensure that they are securely engaged in the terminals before you continue with the protective conductor and the brake conductors in the same way.	Assembled push-in connector

Opening the terminals/releasing the motor cables

To release the terminals, press the individual locking levers up using a slot-head screwdriver (0.8 x 4 mm) until the lever snaps back into the motor connector casing.

If it is difficult to withdraw the conductors from the open terminal, it may help to press the locking lever up as far as it will go while withdrawing the conductor. This action opens the spring-loaded terminal to its maximum.

Note

We do not recommend manual release of the terminal due to the high forces that need to be applied.

Connecting conductors to connectors with screw terminals

Starting with W2, V2, U2, insert the conductors into the open terminals.

Ensure that the conductors are inserted as far as they will go.

For larger cross-sections, it is helpful if U2, V2, W2 are simultaneously inserted and secured by screws.

Tighten the screws with a torque of 0.5-0.6 Nm (4.4 lbf in). Screwdriver: Slot-head 0.8 x 4 mm.

5.1.5 Installation

5.1.5.1 Installation

Plug the motor connector into socket X1 for Single Motor Modules and into sockets X1 and X2 for Double Motor Modules.

The motor connector has a catch, which snaps into the opening provided on the Motor Module.

Note

The catch mechanism does not provide strain relief for the cables connected to the Motor Module.

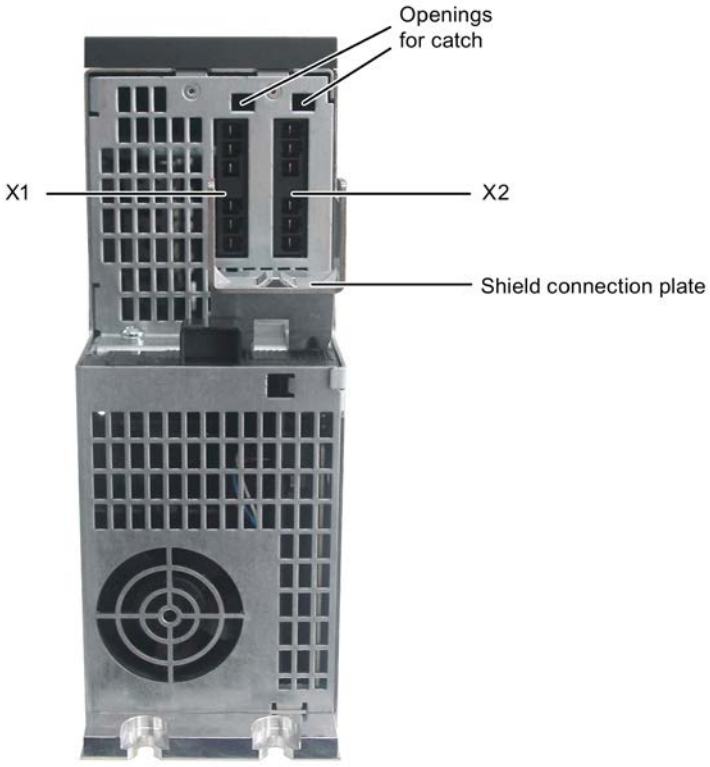


Figure 5-3 Latching the motor connector into position

Figure 5-4 Connecting the power cables to the Motor Module

5.1.5.2 Shielding

Shield for 50 mm modules and 100 mm modules (30 A, 2 x 18 A)

Shield connection

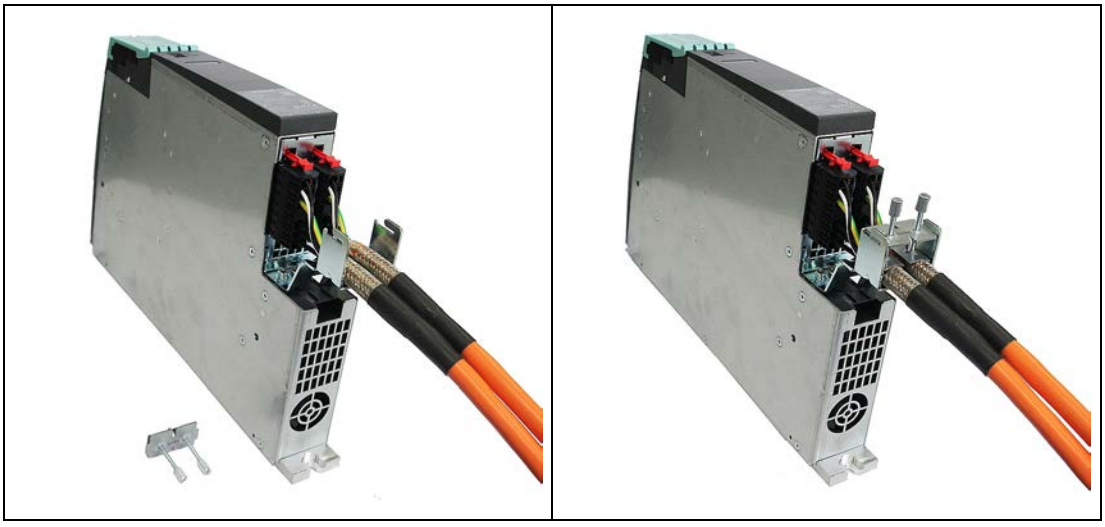
The shield is connected through the shield connecting plate, which is screwed to the Motor Module, and a shield connecting terminal. The shield connection clamp with two pressure plates for a Double Motor Module is illustrated in the diagrams below.

		
Shield connection plate	Shield connection clamp with pressure plates ① and knurled screws ②	Shield connection

Shield support

The power cable shield is attached to the shield connection plate of the Motor Module by means of the supplied shield connection clamp.

1. Insert the motor connector into the connection sockets X1/X2 on the Motor Module and route the power cables through the shield connection plate.
2. Hook the shield connection clamp into the shield connection plate.
3. Clamp the power cables securely in position by tightening the pressure plates of the shield connecting clamps using the knurled screws to a torque of 0.8 Nm (7.08 lbf in). For a Double Motor Module, tighten the first motor cable again to the specified torque after you have securely fixed the second motor cable.



Note

Pressure plate twist prevention

The pressure plates of the shield connection clamp are prevented from twisting only when the knurled screws are unscrewed as far as they will go (delivery state). For this reason, the screws must be unscrewed to the limit when the clamp is dismantled.

After the shield connection clamp has been fitted in the shield connection plate, the connection plate prevents the pressure plates from twisting.

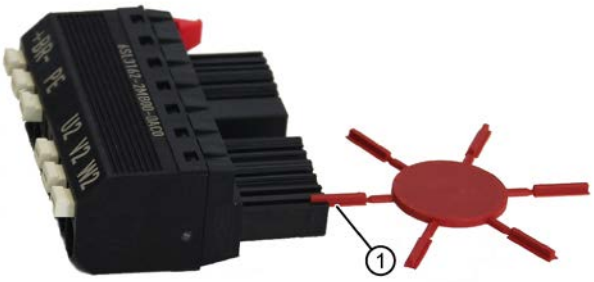
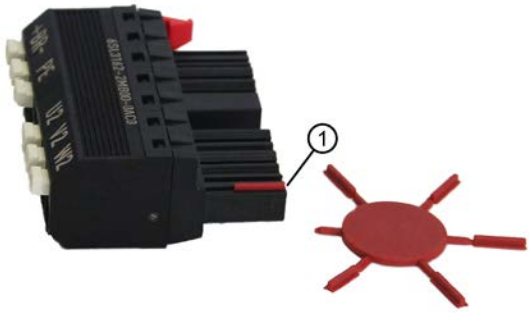
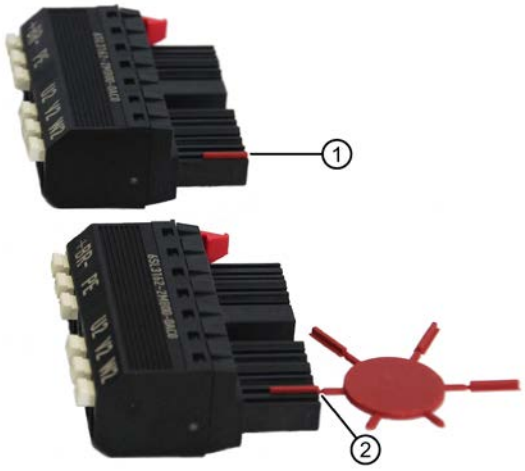
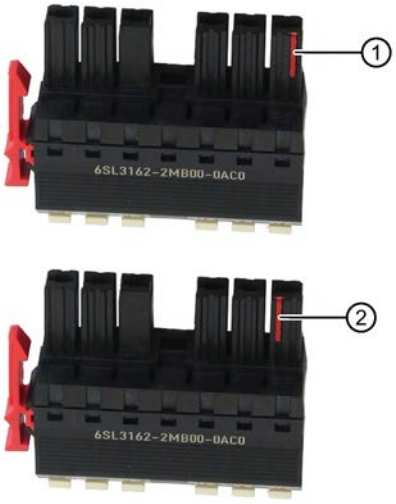
Note

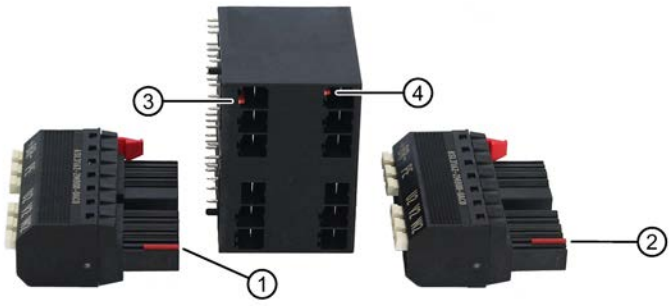
Further information about shielding can be found in the Chapter "Shielding and routing cables" (Page 129).

5.1.5.3 Coding

Coding keys can be used to distinguish between different motor connectors, especially those for Double Motor Modules. The terminal kit contains 2 coding stars, each of which has 6 coding keys.

The example below illustrates how to code 2 push-in connectors and the motor connector terminal in such a way that the connectors cannot be interchanged.

	
Motor connector with a coding star from the terminal kit Insert the coding key ① into the slot at the end of terminal W2 of the motor connector.	Push the coding key as far as it will go into the slot and then twist the star until the key snaps off.
	
At the 2nd motor connector, insert a different coding key into the inner slot of terminal W2 ② and then twist the star until the key snaps off.	The two motor connectors now have different codes.



Now insert coding keys into the matching slots on the motor connector terminal. In order to prevent the connector with coding key ② from being inserted into the left-hand connector terminal, a coding key must be inserted into the matching slot ③ of this terminal. Insert a coding key into the uppermost slot ④ of the right-hand connector terminal.

The connector with coding key ① is now only compatible with the terminal with coding key ③. The same applies to the connector and terminal with coding keys ② and ④.

5.1.5.4 Pre-assembled power cables

Description

The pin assignments of the pre-assembled power cables are as follows:

Cable	Color	Labeling
U2	Black	U/L1
V2	Black	V/L2
W2	Black	W/L3
Protective conductor connection (PE)	Green/yellow	-
Holding brake BR+	Black	-
Holding brake BR-	White	-

Detaching the preassembled power cable from the motor connector

If the power cable needs to be routed through a confined space, the motor connector must be detached from the preassembled cable.

	
Preassembled power cable with push-in connector	To remove, insert a 0.6 x 3.5 slot-head screwdriver into the opening provided above the terminal location and withdraw the conductor.

Note

Screwdrivers with an insulated shaft are not suitable because it will not be possible to insert them deep enough into the terminal.

5.2 Motor connection block for 45 A / 60 A Motor Modules

5.2.1 Description

The motor connection block is used for the 45 and 60 A modules to connect phase conductors U2, V2, W2 and the protective conductor connection (PE) of the motor.

5.2.2 Installation

5.2.2.1 Mounting the motor connection block

Connection X1 for the motor is implemented as connection block, and is in the module. In addition, the protective conductor connection for the motor is integrated in the block. The connections are established through M6x18 mm threaded bolts.

① Protective conductor connection, motor
② U2
③ V2
④ W2
⑤ BR+ (black)
⑥ BR- (white)
⑦ Protective conductor connection, Motor Module

Motor connection block with connection cables

Table 5- 4 Connectable cross-sections

Module	Bolt	Torque	Single conductor connection	Two-wire connection
45 A / 60 A	Threaded bolts M6	6 Nm (53.1 lbf in)	6 ... 50 mm² (AWG 8 ... 1/0)	4 ... 25 mm² (AWG 10 ... 4)

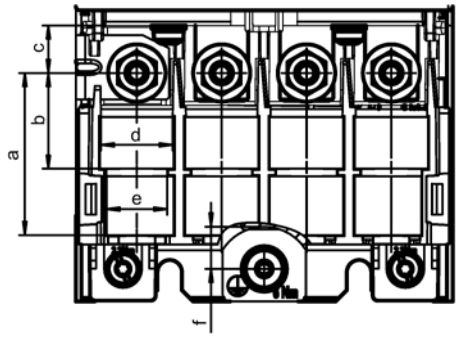


Figure 5-5 Dimension drawing of the motor connection block

Table 5- 5 Dimensions of the motor connection block in mm (inch)

	a	b	c	d	e	f
Maximum dimensions	42 (1.65)	24.5 (0.96)	12 (0.47)	18.5 (0.73)	15.6 (0.61)	10.5 (0.41)

① Fillets at the motor connection block that can be removed to connect cables from a diameter of 9.5 mm (0.37 in) and higher. The fillets have already been removed on the right-hand side.

Figure 5-6 Fan unit for 45 A / 60 A Motor Modules

Note

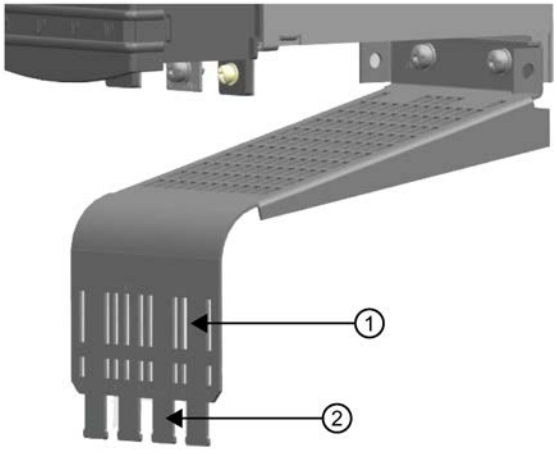
Cable lugs for 50 mm² cables

For cables with a cross-section of 50 mm², use tubular cable lugs from Klauke, article 6SG6, with additional shrink-on sleeve to maintain touch protection. Other tubular cable lugs cannot be used because the maximum possible cable lug width is 18.5 mm.

5.2.2.2 Shield connection plate for 45 A / 60 A Motor Modules 100 mm

Attach the shield connecting plate to the lower mounting points of the module. The shield connecting plate has several slots, which provide various options for connecting a shield:

- Phoenix SK14 shield connection terminal for individual conductors up to 16 mm^2
- Phoenix SK35 shield connection terminal for cables up to 35 mm²
- Hose clamp



① Attachment for the shield connecting terminal
② Attachment for the hose clamp

Figure 5-7 Shield connection plate block for 45 A / 60 A Motor Modules

Figure 5-8 SK35 and SK14 shield connection terminals

Connection using a shield connection clamp at the shield connecting plate

Connection using a hose clamp at the shield connecting plate

The shield connecting plate, shield connecting terminals and hose clamps are not included in the scope of supply of the Motor Module.

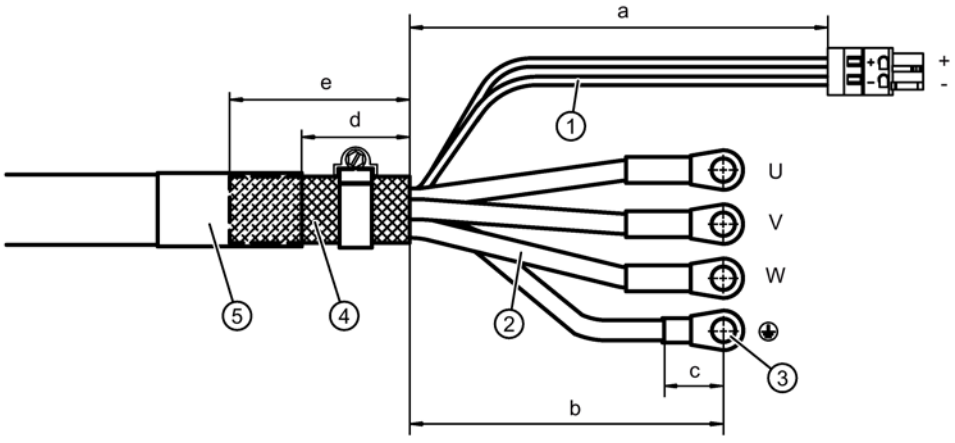
Table 5- 6 Accessories for the shield support

Designation	Torque	Article No.
Shield connection plate	6 Nm (53.1 lbf in)	6SL3162-1AD00-0AA0
Phoenix SK14 shield connection terminal	0.8 Nm (7.08 lbf in)	8WH9130-0MA00
Phoenix SK35 shield connection terminal	0.8 Nm (7.08 lbf in)	8WH9130-0PA00
Hose clamp	0.8 ... 1 Nm (7.08 ... 8.85 lbf in)	-

5.2.3 Prefabricating a motor connecting cable

The stripped lengths of the motor cables are the same for all cross-sections. The lengths for the individual conductors are specified below.

1. Remove the cable sheath to 205 mm (8.07 in) length with a tolerance of ±10 mm (±0.04 in).
2. Shorten the braided shield to 80 mm (3.15 in) and fold it back.
3. If you are using a motor cable with brake conductors, then the braided shield of the brake conductors must be unbraided. This is then folded back against the outer shield.
4. Fix the braided shield using heat-shrink tubing. Preferably use shrink-on sleeving, which has hot-melt adhesive on the inside.
5. Shorten the individual conductors as indicated in the drawing and table below.
6. Use suitable ring or tubular cable lugs (see Chapter "Control cabinet installation/Connection systems").



① Holding brake conductors
② Conductors U, V, W and protective conductor
③ Ring or pipe-type cable lug
④ Protective braided shield
⑤ Shrink tubing

Figure 5-9 Motor connection cables

Table 5- 7 Required insulation stripping lengths in mm (inches)

		Connection using a shield connection clamp		Connection using a hose clamp	
		Length	Tolerance	Length	Tolerance
BR+, BR-	a	180 (7.09)	±10 (±0.4)	205 (8.07)	±10 (±0.4)
U, V, W, protective conductor	b	145 (5.71)	±5 (±0.2)	170 (6.69)	±5 (±0.2)
Ring or pipe-type cable lug	c	depending on the cable lug used			
Shield	d	45 (1.77)	±5 (±0.2)	40 (1.57)	±5 (±0.2)
folded back braided shield	e	80 (3.15)	±10 (±0.4)	80 (3.15)	±10 (±0.4)

Note

Cables for UL applications

For UL applications, only 60/75 °C copper cables may be used.

Motor-side power components

6

6.1 Motor reactors

6.1.1 Description

Motor reactors reduce discharge currents which means that longer motor cables may be used.

At the same time, the reduced rates of voltage rise (dv/dt) also reduce the stress on the motor windings.

Table 6- 1 Requirements for using a motor reactor

Maximum ambient temperature	40 °C
Pulse frequency	4 kHz
Maximum output frequency	120 Hz
Maximum current limit	2 x rated current
Control types	Vector control and U/f control

Further information such as safety instructions and dimension drawings can be found in the SINAMICS S120 Manual "Booksize Power Units".

6.1.2 Safety instructions for motor reactors

⚠WARNING

Electric shock in the event of missing touch protection

Touching live components can result in death or severe injury.

- For the motor reactors, use touch protection according to IPXXA or corresponding to the local installation regulations.

⚠CAUTION

Burns due to high surface temperatures

The motor reactors can become very hot. You can get seriously burnt when touching the surface.

- Mount the motor reactors so that contact is not possible. If this is not possible, attach clearly visible and understandable warning notices at hazardous positions.
- To prevent adjacent components from suffering damage due to these high temperatures, maintain a clearance of 100 mm on all sides of the motor reactors.

NOTICE

Damaged device due to use of incorrect motor reactors

When using motor reactors that have not been approved by Siemens for SINAMICS, the motor reactors can be damaged.

- Only use motor reactors that Siemens has approved for operation with SINAMICS.

Note

Maximum cable length of the connection cables

The connection cables to the Motor Module must be kept as short as possible (max. 5 m).

6.1.3 Technical data

Table 6- 2 Technical data, motor reactors, part 1

Article No.		**6SE7021-0ES87-1FE0**	**6SL3000-2BE21-0AA0**	**6SE7022-6ES87-1FE0**
Suitable for Motor Modules booksize C/D type		6SL3120- 1TE13-0AD. 2TE13-0AD. 1TE15-0AD. 2TE15-0AD.	6SL3120- 1TE21-0AD. 2TE21-0AD.	6SL3120- 1TE21-8AC. 1TE21-8AD. 2TE21-8AC. 2TE21-8AD.
Rated current	A	5	9	18
Maximum current	A	10	18	36
Inductance	µH	1243	1000	332
Power loss	W	80	90	110
Motor cable connection		Screw-type terminals 4 mm^2	Screw-type terminals 16 mm^2	Screw-type terminals 16 mm^2
Protective conductor connection		Threaded bolts M6		
Maximum motor cable lengths • shielded: 1 / 2 reactors • unshielded: 1 / 2 reactors	 m m	 100 / - 150 / -	 135 / - 200 / -	 160 / 320 240 / 480
Degree of protection according to EN 60529		IP00		
Ventilation clearances above/below	mm	≥ 100		
Weight	kg	5.5	4.8	7.8

Table 6- 3 Technical data, motor reactors, part 2

Article No.		**6SE7024-7ES87-1FE0**		**6SE7027-2ES87-1FE0**	**6SL3000-2BE26-0AA0**
Suitable for Motor Modules booksize C/D type		6SL3120- 1TE22-4AC. 1TE22-4AD.	6SL3120- 1TE23-0AC. 1TE23-0AD.	6SL3120- 1TE24-5AC.	6SL3120- 1TE26-0AC.
Rated current	A	30		45	60
Maximum current	A	60		90	120
Inductance	µH	180		59	62
Power loss	W	165	190	200	105
Motor cable connection		Flat connector for M8 screw			
Protective conductor connection		Threaded bolts M6			
Maximum motor cable lengths • shielded: 1 / 2 / 3 reactors • unshielded: 1 / 2 / 3 reactors	 m m	 190 / 375 / - 280 / 560 / -		 200 / 400 / 600 300 / 600 / 900	 200 / 400 / 600 300 / 600 / 900
Degree of protection according to EN 60529		IP00			
Ventilation clearances above/below	mm	≥ 100			
Weight	kg	13		11	10.5

Cabinet design

7

7.1 General information

SINAMICS S components are available as chassis units with degree of protection IP20 or IPXXB according to IEC 60529 and as open type devices to UL 50. This therefore ensures that fingers cannot come into contact with any active components.

To ensure also protection against mechanical stress and climatic conditions, the components must always be operated in housings, cabinets or enclosed electrical operating areas/rooms that fulfill at least degree of protection IP54 according to European enclosure specifications, or in compliance with US, Canadian and Mexican regulations as enclosure type 12, according to NEMA 250.

Note

Protection against the spread of fire

The converter may be operated only in closed housings or in higher-level control cabinets with protective covers that are closed, and when all of the protective devices are used.

Converters of the open type / IPXXB degree of protection must be installed in a metal control cabinet or protected by another equivalent measure such that fire cannot spread and emissions outside of the control cabinet are prevented.

Note

Protection against condensation and electrically conductive contamination

To ensure the functional safety and safety functions of Safety Integrated, protect the converter, e.g. by installing it in a control cabinet with degree of protection IP54 according to IEC 60529 or Type 12 according to NEMA 250. Further measures may be necessary for particularly critical operating conditions.

If condensation and conductive pollution can be excluded at the installation site, a lower degree of cabinet protection is permissible.

Low-voltage switchgear and controlgear assemblies

If the SINAMICS S drive line-up is used for the electrical equipment of machines, the applicable requirements of EN 60204-1 must also be adhered to.

Safety of machinery - electrical equipment of machines

All information relating to device selection in this section applies to

- Operation on TN and TT line supply systems with grounded neutral point and grounded protective conductor as well as to IT line supply systems
- Operating voltage range from 3-phase 380 … 480 V AC ±10 %

7.2 Safety instructions with respect to control cabinet design

⚠WARNING

Danger of injury caused by foreign objects in the device

Parts (e.g. drilling chips, end sleeves) falling into the device can cause short circuits and damage the insulation. As a consequence, arcing, a loud bang or parts and components flying out of the device can cause severe injury.

- Only perform installation and other work when the devices are safely isolated from the power supply.
- Cover the ventilation slits during the installation of components in the cabinet and remove the cover before switching on.

7.3 Electromagnetic compatibility

7.3.1 General information

Electromagnetic compatibility (EMC) describes – according to the definition of the EMC Directive – the "ability of equipment to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to other equipment in that environment". To guarantee that the appropriate EMC standards are observed, the devices must demonstrate a sufficiently high noise immunity, and also the emitted interference must be limited to acceptable values.

Product standard IEC 61800-3 describes the EMC requirements for "Adjustable-speed electrical power drive systems". A variable-speed drive system (or Power Drive System - PDS) consists of a Control Unit, Line Module and Motor Module - as well as the associated electric motors, encoders and connecting cables. The driven machine is not part of the drive system.

Compliance with the EMC Directive of the EC is ensured by taking the measures described in the Configuration Manual "EMC Installation Guideline" (article number 6FC5297-0AD30-0.P.).
For installation of components in cabinets, the following conditions must additionally be fulfilled for compliance with the EMC Directive:

- Operation on TN and TT line supply systems with grounded neutral point
- Observance of information about cable shielding and equipotential bonding
- Use of the recommended power and signal cables from Siemens.
- Only use Siemens cables for the DRIVE-CLiQ connections.

Note

EMC requirements for Safety Integrated

In order to meet the requirements for interference immunity of IEC 61800-5-2 (2nd Ed., 2016), Annex E, the drive systems are permitted to be operated only after installation in a control cabinet.

7.3.2 Classification of EMC behavior

The EMC environments and EMC categories are defined in the EMC product standard IEC 61800-3 as follows:

Environments

First environment (public systems)

An environment that includes domestic premises and establishments that are connected directly to a public low-voltage line supply without the use of an intermediate transformer.

Examples: houses, apartments, commercial premises or offices in residential buildings.

Second environment (industrial systems)

An environment that includes all other establishments that are not connected directly to a public low-voltage line supply.

Examples: industrial and technical areas of buildings fed from a dedicated transformer.

Categories

Category C1

Drive systems with a rated voltage < 1000 V that are intended for unrestricted use in the first environment.

Category C2

Stationary drive systems with a rated voltage < 1000 V for operation in the second environment.

Drive systems of Category C2 may only be used in the first environment if they are installed and commissioned by an expert and the limit values for harmonic currents are complied with.

Note

In a residential environment, this product may cause radio interference, in which case supplementary mitigation measures may be required.

- Have the installation and commissioning performed with appropriate radio interference suppression measures by experts.

Category C3

Drive systems with a rated voltage < 1000 V that are solely intended for use in the second environment.

Note

In a residential environment, this product may cause radio interference.

- Do not use this device in the first environment (residential area).

Category C4

Drive systems for IT line supplies for operation in complex systems in the second environment. An EMC plan must be drawn up.

7.3.3 Drive system applications

SINAMICS S120 units are designed for use in the second environment. They are to be used on a professional basis in trade, business and industry and are not sold to the general public.

In order to satisfy the EMC requirements, the drive system must be installed by appropriately qualified personnel in compliance with EMC regulations and the installation notes provided in the manual.

Note

Qualified personnel

An appropriately trained and qualified person has the necessary experience for installing and/or commissioning drive systems (Power Drive Systems - PDS), including the associated EMC aspects.

More detailed requirements regarding areas of application can be found in the SINAMICS S120 Manual "Booksize Power Units".

7.3.4 Emitted interference/interference immunity

Limiting interference emission

Radio interference suppression filters are required in order to limit interference emissions. These filters can either be integrated in the device or externally mounted.

- It is not permissible to use Basic Line Filters in IT line systems.
- For Active Interface Modules and Basic Line Modules in IT line systems, the connection screw or the connection bracket to the radio interference suppression capacitor with respect to ground must be removed.
- In conjunction with Smart Line Modules, to reduce symmetrical interference emission, special filters can be used (without capacitors to ground).

Interference immunity

Note

Integrating SINAMICS S120 in other plants/machines

When variable-speed drive systems are integrated in other plants/machines, additional measures may be required in order to comply with their product standards.

With respect to the compliance with limits for harmonic currents, the EMC product standard IEC 61800-3 for drive systems (PDS) refers to compliance with standards IEC 61000-3-2 and IEC 61000-3-12.

Converters are classified as equipment used on a professional basis, deployed in certain areas of business and industry - and are not operated in the general public domain.

The following constraints must be observed when used in the first environment:

- The drive system must be installed in compliance with EMC regulations by appropriately trained professionals.
- The converters must be equipped with a Category C2 line filter.
- The device-specific information and instructions for maintaining harmonic current limits must be complied with.

Note

Malfunctions when not using original Siemens accessories

Malfunctions can occur if accessories are used that are not original.

- For DRIVE-CLiQ connections, only use the genuine Siemens DRIVE-CLiQ wiring and DRIVE-CLiQ cabinet bushings.

Note

Faulty operation of the machine due to incorrect shielding or cables that are too long

The machine can malfunction if the shielding is incorrect or the cables are too long.

- Always follow the correct procedures for the shielding and the specified cable lengths.

7.4 Electromagnetic fields in the workplace

7.4.1 Preliminary remarks

Protection of workers from electromagnetic fields is specified in the European EMF Directive 2013/35/EU. This directive is implemented in national law in the European Economic Area (EEA). Employers are obligated to design workplaces in such a way that workers are protected from impermissibly strong electromagnetic fields. To this end, assessments and/or measurements must be performed for workplaces.

General conditions for correct assessment or measurement

1. The laws for protection from electromagnetic fields in force in individual EU member states can go beyond the minimum requirements of the EMF Directive 2013/35/EU and always take precedence.
2. The ICNIRP 2010 limits for the workplace are the basis for the assessment.
3. The 100 µT (RMS) mentioned below for assessment of active implants comes from the 26th BIMSchV (German Federal Emission Protection Regulation).
   According to Directive 2013/35/EU, 500 µT (RMS) at 50 Hz is applicable here.
4. Compliance with the limit values was checked for the following frequencies:
   - Line frequency 47 ... 63 Hz (see system data)
   - Pulse frequency, for example 4/8/16 kHz and multiples thereof, assessed up to a maximum of 100 kHz (see system data or relevant technical specifications)
5. The routing of power cables has a significant impact on the electromagnetic fields that occur. You can find more detailed information in the "EMC installation guideline (https://support.industry.siemens.com/cs/ww/de/view/60612658)".

7.4.2 Measurements/assessments for SINAMICS S120 Booksize Power Units

Note

Validity

The following information regarding electromagnetic fields relates solely to products and components supplied by Siemens. A precondition is the installation and operation of components inside metallic cabinets in compliance with the documentation and the "EMC installation guideline (https://support.industry.siemens.com/cs/ww/de/view/60612658)" and the use of shielded motor cables.

The components of the SINAMICS S120 product family are normally used in machines. The assessment and testing is based on DIN EN 12198.

Table 7- 1 Information for frequency range 0 Hz to 300 GHz

Frequency range	0 Hz ... 100 kHz	100 kHz ... 300 GHz
Electric field strength	Limits not exceeded	Limits not exceeded
Magnetic flux density	For assessment, see the following table	Limits not exceeded

Table 7- 2 Minimum distances from SINAMICS S120 power units at 0 Hz ... 100 kHz in cm (inch)

Line Module with power rating	Generally		Individuals with active implants	
	Control cabinet closed	Control cabinet open	Control cabinet closed	Control cabinet open
P ≤ 36 kW	0 (0)	10 (4)	The limit of 100 µT (RMS) at 50 Hz is not exceeded. Must be separately assessed depending on the active implant.	Must be separately assessed depending on the active implant.
36 kW ≤ 55 kW	0 (0)	25 (10)		
55 kW ≤ 120 kW	0 (0)	50 (20)		

Note

The minimum distances indicated above apply to the head and complete torso of the human body. Shorter distances are possible for extremities.

7.5 Arrangement of components and equipment

The arrangement of the components and equipment depends on the following conditions:

- Space requirements
- Cable routing
- Bending radii of connecting cables
- Heat dissipation
- EMC

Note

Further information about the arrangement of components and equipment

For detailed information about the arrangement of components and equipment, please refer to the SINAMICS S120 Manual "Booksize Power Units".

7.6 Electrical connection

7.6.1 Releasing the DC link protective cover

The protective covers for the DC link on the SINAMICS S120 components have an interlocking mechanism, which must be opened using a flat bladed screwdriver (1 x 5.5 mm). This interlocking mechanism is identical for the power units of all series.

Table 7- 3 Opening the protective cover for the DC link using a screwdriver

		
1. Protective cover with interlocking mechanism	2. To open the protective cover, use a screwdriver to slightly turn the interlocking screw in the direction of the arrow (counter-clockwise)	3. Opened protective cover

To lock, press the protective cover back on until you hear the interlock engage.

7.6.2 Connecting the DC link busbars and 24 V busbars to components in the Booksize C/D type format

7.6.2.1 Description

The DC link busbars and 24 V busbars of the components must be connected in a drive line-up before commissioning.

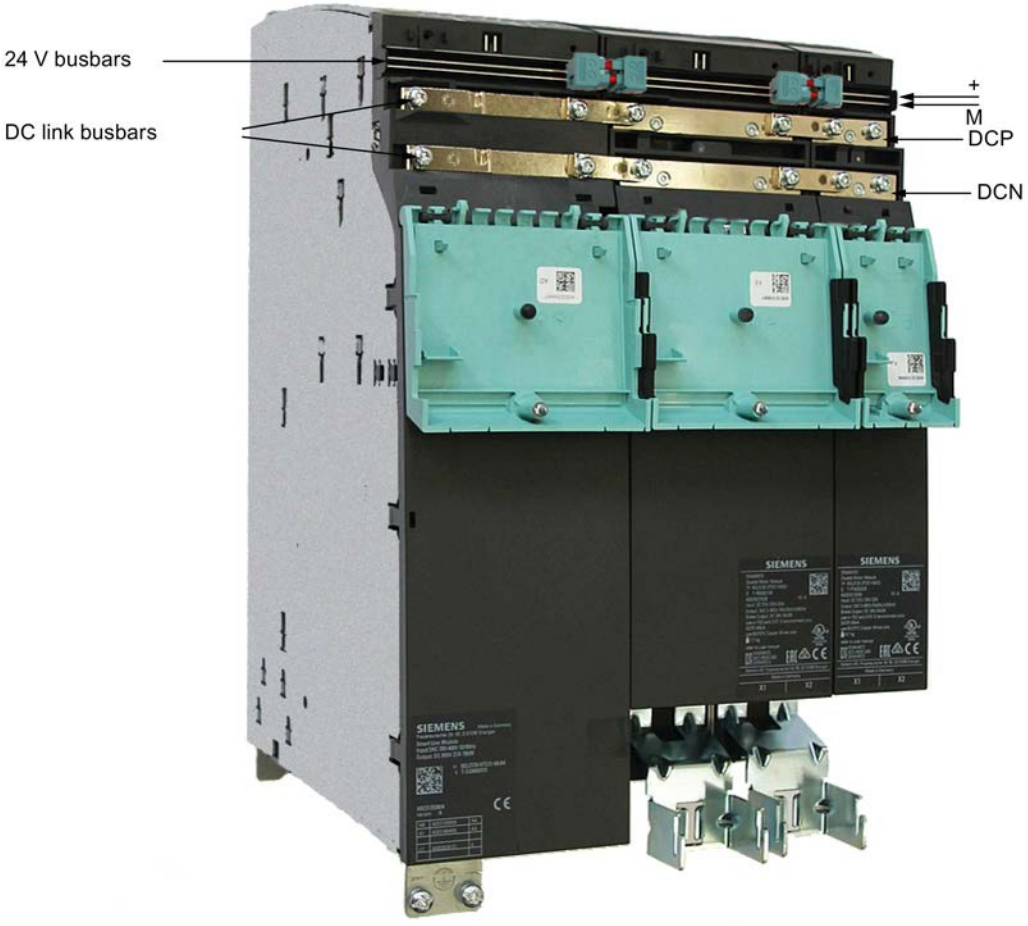


Figure 7-1 Position of the DC link and 24 V busbars

Current carrying capacity of the DC link busbars

To calculate the load of the DC link busbar, add the DC link currents $I_{d\ rated}$ of the connected Motor Modules. It is not permissible that the maximum current carrying capacity of the DC link busbar is exceeded. For detailed information on this topic, see SINAMICS S120 Manual "Booksize Power Units ", Chapter "Current carrying capacity of DC links".

Table 7- 4 Current carrying capacity of the DC link busbars

DC link busbar or bridge	Current carrying capacity [A]
DC link busbars of 50 mm modules	100
DC link busbars of 100 mm modules 30 A / 2 x 18 A (FS A)[1)]	100
DC link busbars of 100 mm modules 30 A / 2 x 18 A (from FS B)[1)]	200
DC link busbars of 100 mm modules 45 A / 60 A	200

1) FS = Function State; is stamped on the rating plate (see below)

Figure 7-2 Motor Module rating plate ("FS" in the red circle)

For Motor Modules Booksize C/D type, the current load capability can be increased across the board from 100 A to 200 A by replacing the existing 4 mm DC link jumpers with 6 mm thick DC link jumpers. The existing M4 connecting screws can be reused when making the replacement.

4 mm DC link bridge

6 mm DC link bridge

Article number for 6 mm DC link bridge (10 bridges in a package). 6SL3162-2BB00-0AA0

NOTICE
Component damage caused by excessively low current load capability of the DC link busbars The DC link busbars of the individual components have different current carrying capacities (current ratings). If the current flowing through a DC link busbar is higher than the current specified for the busbar, the component will heat up and may sustain damage as a result of overheating. • When configuring the drive lineup, carefully observe the current load capabilities of the individual components. If required, replace the DC link bridge or reduce the load.

7.6.2.2 Installation

Always connect the lower DC link busbars first, then the upper DC link busbars and finally the 24 V busbars.

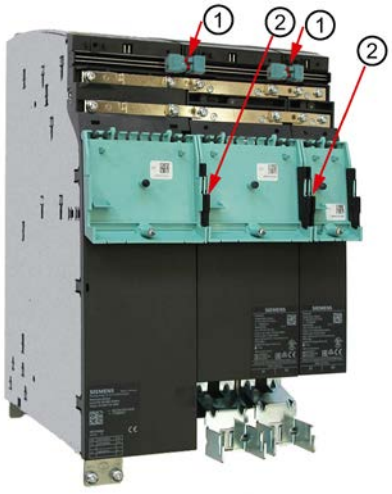
Required tools:

- Slotted screwdriver (1 x 5.5 mm) for releasing the protective cover
- Screwdriver Torx T20 for the DC link screws
- Pliers for removing the side covers of the DC link protective covers

Installation steps

Note

To install the DC link busbars on modules in booksize C/D-type format, M4x20 mm screws are used at the right and left-hand ends of the busbars.

	
Loosen the DC link screws at the right-hand end of the left module, and at the left-hand end of the adjacent module.	Always connect the lower DC link busbars first and then the upper DC link busbars. To do this, turn over the DC link bridge.
	
Screw the DC link busbar screws tight: Starting from the left at the lower DC link busbar, and then from the left at the upper DC link busbar. Tightening torque: 1.8 Nm (16 lbf in)	Fit the 24 V jumper plugs ① from the terminal kit onto the 24 V busbars. Press the 24 V jumper plugs until they latch into position. Remove the side covers from the DC link protective cover ②.

	
Close the DC link protective covers until you hear them snap into place.	

WARNING

Electric shock due to incorrectly installed DC link bridges

Incorrectly installed DC link bridges **at the left-hand end of the drive line-up** can cause an electric shock.

- For all 50 mm wide modules[1], remove the DC link bridge including the screws. Do not tighten the screws without the DC link bridges.
- For all components that are 75 mm wide or wider, the DC link bridges may neither be swung over to the left nor removed[2].

[1] For 50 mm wide modules, the DC link bridge cannot be swung inwards.
[2] The DC link bridge guarantees the mechanical stability of the DC link busbars.

WARNING

Electric shock due to missing DC link side covers

There is a danger of an electric shock through contact when the side covers of the DC link are missing.

- Mount the side covers on the first and last component in the drive line-up.

You can order missing side covers (article number: 6SL3162-5AA00-0AA0).

NOTICE

Material damage due to loose power connections

Insufficient tightening torques or vibration can result in faulty electrical connections. This can cause fire damage or malfunctions.

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

7.6.3 24 V connection

7.6.3.1 Description

The electronic circuitry of the components is supplied with 24 V via the 24 V busbar system.

The 24 V connections between modules are established using jumper plugs from the terminal kit.

The 24 V jumper plugs must be inserted before the drive line-up is commissioned.

⚠WARNING

Electric shock when inserting and removing 24 V jumper plugs in operation

If you attempt to connect or disconnect the 24 V jumper plugs when the system is in operation, you might touch the DC link busbars. Contact with these busbars when they are live can lead to death or serious injury.

- Only connect or disconnect the 24 V jumper plugs when the system is deenergized.

⚠WARNING

Fire caused by 24 V jumper plugs when DC link busbars are not connected

The 24 V jumper plugs may only be used when the DC link busbars of the components are also connected. The 24 V jumper plugs can otherwise burn and cause severe injury or death as result of fire or smoke.

- If the DC link busbars of the components are not connected, each component must be supplied with 24 V separately via a 24 V terminal adapter.

Note

Malfunction because 24 V supply voltage is too low

Malfunctions can occur if the 24 V supply voltage to a component in the drive line-up drops below the minimum value.

- Select an input voltage that is high enough to ensure a sufficient voltage supply to all devices in the drive line-up. Do not exceed the maximum value for the supply voltage. For information about the minimum and maximum values of the 24 V supply voltage, please refer to the Chapter "System data" (Page 39).

  If required, connect the 24 V voltage supply via Control Supply Modules or 24 V terminal adapters at various points in the line-up.

Ordering spare parts

	Article No.
24 V jumper plug	6SL3162-2AA01-0AA0

7.6.4 Connection of booksize components to booksize C/D-type components

7.6.4.1 Description

It is possible to combine components in booksize format with components in booksize C/D-type format with one another in the SINAMICS S120 drive line-up. They are mutually compatible in terms of both hardware design and software support.

The following components in booksize format can also be used for components in booksize C/D-type format:

- DC link busbars
- DC link adapter
- DC link rectifier adapter
- 24 V jumper plugs
- 24 V terminal adapter

7.6.5 Connecting the DC link rectifier adapter and the DC link adapter

DC link rectifier adapter

The DC link voltage can be supplied directly to an individual component by means of the DC link rectifier adapter. In this case, the component is connected separately to the DC link and does not utilize the internal DC link busbars.

Further information can be found in the SINAMICS S120 Manual "Booksize Power Units".

NOTICE
DC link rectifier adapters for 45 A and 60 A modules burning
No appropriate DC link rectifier adapters are available for 45 A and 60 A Motor Modules, Booksize C type. The adapter (6SL3162-2BD00-0AA0) used for the 100 mm wide Booksize modules are not adequately dimensioned for the current. • For 45 A and 60 A Motor Modules, Booksize C type, do not feed in the DC link voltage via a DC link rectifier adapter.

DC link adapter

Using the DC link adapter, it is possible to distribute a drive line-up over several tiers in the control cabinet.

Further information about the DC link adapter and multi-tier configurations can be found in chapters "Accessories / DC link adapter" and "Control cabinet design / Arrangement of components and equipment" in the SINAMICS S120 Manual "Booksize Power Units".

7.6.6 Connecting the 24 V terminal adapter

The 24 V voltage can be supplied to or tapped from a component by means of the 24 V terminal adapter.

The 24 V terminal adapter can be installed in every Line Module, Motor Module, and Control Supply Module.

- Connectable cable cross-sections: 0.5 to 6 mm^2 (AWG 20 ... 8)
- Tightening torque: 1.2 ... 1.5 Nm (16 lbf in)

	Article No.
24 V terminal adapter	6SL3162-2AA00-0AA0

Further information can be found in the SINAMICS S120 Manual "Booksize Power Units".

7.6.7 Shield connection

7.6.7.1 Shield connection for X21/X22 on the Motor Module

The diagram below illustrates the shield connection for cables routed to terminal X21.

The following make of shield connection clamp must be used: Weidmüller, type KLBÜ 3-8 SC

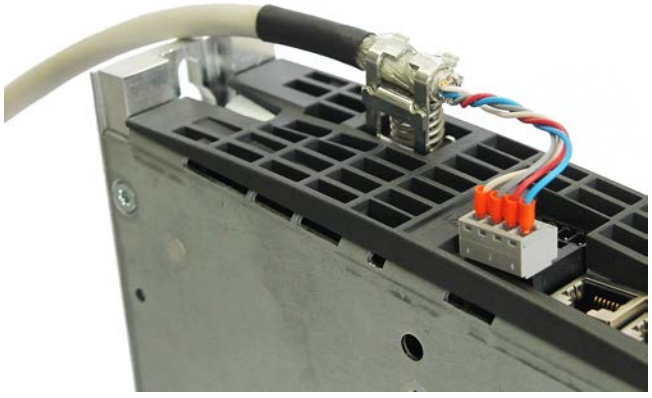


Figure 7-3 Shield connection for X21

Note

Correct shield connection for Single Motor Modules

A Single Motor Module can also have both terminals X21 and X22. The shield connection must be made at X21. Terminal X22 has no function.

7.6.7.2 Shield connection for the motor holding brake

For the 45 A / 60 A Motor Modules, there is an M4 threaded bushing in the housing next to the X11 interface. A shield support, type KLBÜ 3-8 SC (Weidmüller) can be screwed into the sleeve connect the motor holding brake shield (see Fig. "45 A / 60 A Motor Module (view from above) (Page 50)").

7.7 Connection system

Note

Information about the connection system and cables

For detailed information about the connection system and cables, please refer to the SINAMICS S120 Manual "Booksize Power Units"

7.7.1 Configuring the cable length

To implement a longer motor cable, you can

- select a higher rating Motor Module or
- reduce the permissible continuous output current $I_{continuous}$ in relation to the rated output current I_{rated}.

The configuring data for booksize format Motor Modules are given in the following table:

Table 7- 5 Permissible cable lengths for shielded motor cables

Motor Module	Length of motor cable (shielded)		
Rated output current I_N	> 50 … 100 m	> 100 … 150 m	> 150 … 200 m
3 A / 5 A	Use 9 A Motor Module	Use 9 A Motor Module	Not permissible
9 A	Use 18 A Motor Module	Use 18 A Motor Module	Not permissible
18 A	Use 30 A Motor Module or $I_{max} \leq 1.5 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	Use 30 A Motor Module	Not permissible
24 A	Use 30 A Motor Module or $I_{max} \leq 1.5 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	Use 30 A Motor Module	Not permissible
30 A	Always permitted	$I_{max} \leq 1.35 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$	$I_{max} \leq 1.1 \times I_{rated}$ $I_{continuous} \leq 0.85 \times I_{rated}$
45 A / 60 A	Always permitted	$I_{max} \leq 1.75 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$	$I_{max} \leq 1.5 \times I_{rated}$ $I_{continuous} \leq 0.85 \times I_{rated}$

It is not permissible to use shielded motor cables that are longer than 200 m.

When using a motor holding brake, the maximum motor cable length is 100 m. Voltage drops may occur as a function of the motor cable length, motor holding brake current and cross-section of the motor holding brake cables. Additional information on connection of the motor holding brake can be found in Chapter "Options for the 24 V supply (Page 126)".

The permissible cable length for an unshielded motor cable is 150 % of the length for a shielded motor cable.

Motor reactors can also be installed in order to permit the use of longer motor cables in the VECTOR and U/f control types.

7.7.2 Current-carrying capacity and derating factors for power cables and signal cables

The current carrying capacity of PVC/PUR-insulated copper cables is specified for routing types B1, B2 and C under continuous operating conditions in the table below with reference to an ambient air temperature of 40° C. For other ambient temperatures, the values must be corrected by the factors listed in the "Derating factors for deviating ambient temperatures" table.

Table 7- 6 **Routing types**

B1	Cables in conduits or cable ducts
B2	Multi-conductor cables in conduits or cable ducts
C	Cables along walls, without conduits or cable ducts

Table 7- 7 Current carrying capacity according to EN 60204-1 for 40° C ambient temperature

Cross-section	**Current carrying capacity, effective; AC 50/60 Hz or DC For routing type**		
mm²	**B1 A**	**B2 A**	**C A**
Signal cables			
0.20	–	4.3	4.4
0.50	–	7.5	7.5
0.75	–	9	9.5
Power cables			
0.75	8.6	8.5	9.8
1.00	10.3	10.1	11.7
1.50	13.5	13.1	15.2
2.50	18.3	17.4	21
4	24	23	28
6	31	30	36
10	44	40	50
16	59	54	66
25	77	70	84
35	96	86	104
50	117	103	125

Table 7- 8 Derating factors for deviating ambient temperatures

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

⚠WARNING

Overheating of the motor cables when the permissible conductor cross-sections are fallen below

Excessively thin motor cables can result in overheating. This can result in severe injury or death due to fire and smoke.

- Use cables that correspond to the Motor Module currents. Take into account the routing type, ambient temperature and cable length.
- If the rated motor current is less than the rated Motor Module output current, then you can select appropriately smaller cross-sections.

7.7.3 Connecting terminals

Table 7- 9 Connectable conductor cross-sections and tightening torques for screw terminals

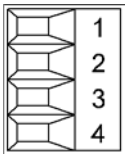
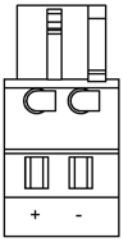
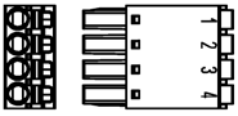
Screw terminal type			
	Conductor cross sections that can be connected	Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve	0.08 … 1.5 mm² (AWG 28 ... AWG 16) 0.25 … 1.5 mm² (AWG 24 ... AWG 16) 0.25 … 0.5 mm² (AWG 24 ... AWG 20)
	Stripped length	7 mm (0.28 in)	
	Tool	Screwdriver 0.4 x 2.0 mm	
	Tightening torque	0.22 Nm (2 ... 4 lbf in)	

Table 7- 10 Connectable conductor cross-sections for spring-loaded terminals

Spring-loaded terminal type			
Type 1 	Conductor cross sections that can be connected	Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve	0.08 … 2.5 mm² (AWG 28 ... AWG 12) 0.25 … 2.5 mm² 0.25 … 1.5 mm²
	Stripped length	8 ... 9 mm (0.31 ... 0.35 in)	
	Tool	Screwdriver 0.5 x 3.5 mm	
Type 2 	Conductor cross sections that can be connected	Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve	0.20 … 1.5 mm² (AWG 24 ... AWG 16) 0.25 … 1.5 mm² 0.25 … 1.0 mm²
	Stripped length	10 mm (0.39 in)	
	Tool	Screwdriver 0.4 x 2.5 mm	

7.7.4 Cable lugs

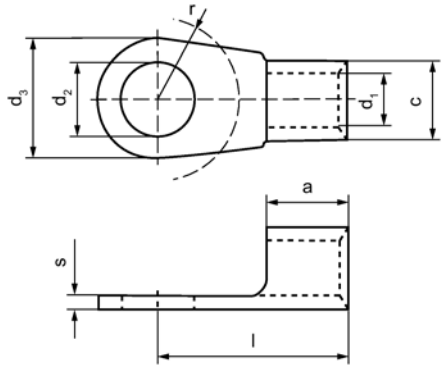


Figure 7-4 Dimension drawing of cable lugs

Table 7- 11 Dimensions of cable lugs

Cable lug	Bolt	Cable cross-section [mm²]	a [mm]	c [mm]	d_1 [mm]	d_2 [mm]	d_3 [mm]	l [mm]	r [mm]	s [mm]
Ring	M5	1 - 2.5	5	4.5	2.3	5.3	10	14	6.5	0.8
Ring	M5	2.5 - 6	6	6	3.6	5.3	10	15	6.5	1
Ring	M5	6 - 10	8	8	4.5	5.3	10	16	6.5	1.1
Ring	M5	10 - 16	10	10.5	5.8	5.3	11	20	7.5	1.2
Ring	M6	6 - 10	8	8	4.5	6.5	11	17	7.5	1.1
Ring	M6	10 - 16	10	10.5	5.8	6.5	11	20	7.5	1.2
Ring	M6	16 - 25	11	12	7.5	6.5	12	25	7.5	1.2
Ring	M6	25 - 35	12	15	9	6.5	15	26	9.5	1.6
Ring	M6	35 - 50	16	17	11	6.5	15	26	9.5	2
Pipe	M6	10	10	7	4.5	6.5	12	22	-	1.5
Pipe	M6	16	13	8.5	5.5	6.5	12	27	-	2.5
Pipe	M6	25	15	10	7	6.5	14	30	-	3
Pipe	M6	35	17	12	8.5	6.5	17	32	-	2.5

7.8 Possible functions of the 24 V supply

The 24 V DC voltage is required for:

- To supply the electronics of the SINAMICS components via the integrated 24 V busbar
- To supply the electronics of the Control Units, Active Interface Modules, Option Boards, Sensor Modules, and Terminal Modules, as well as the process voltage of their digital inputs
- To supply the load voltage of the digital outputs
- To supply the motor holding brakes

Other loads can be connected to these power supply units if they are separately protected from overcurrent.

The 24 V busbars have a current-carrying capacity of 20 A. They must be protected against overcurrent.

Note

The electronics power supply should be implemented by the user, as described in Chapter "System data" (Page 39).

When connecting a DC power supply as specified in EN 60204-1:1997, Sect. 4.3.3, malfunctions may occur due to the voltage interruptions permitted for them.

Note

Grounding the 24 V electronics power supply

In SINAMICS S120 components, the electronics ground is permanently connected to the protective conductor potential. The connection cannot be disconnected.

⚠WARNING

Electric shock due to unsuitable insulation of brake cables

When routing brake cables, whose insulation properties are not suitable for safe electrical separation, the insulation can fail resulting in electric shock.

- Connect the holding brake with the specified MOTION-CONNECT cable.
- Only use third-party cables that have brake conductors with insulation properties that comply with safe electrical separation or separately route the brake conductors to absolutely ensure safe electrical separation.

NOTICE

Damage to other loads as a result of overvoltage

Overvoltages of switched inductances (contactors, relays) can damage connected loads.

- Install suitable overvoltage protection circuits and devices.

Note

Malfunction because 24 V supply voltage is too low

If the 24 V supply voltage falls below the specified minimum value on a device in the assembly, a malfunction can occur.

- Select an input voltage that is high enough for there to be sufficient voltage at the last device. Do not exceed the maximum value for the supply voltage. If required, supply the voltage to the assembly at various locations in the lineup.

Note

Operating motors with a built-in holding brake

A regulated DC power supply is required to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars. The voltage tolerances of the motor holding brakes (24 V ±10%) and the voltage drops of the connecting cables must be observed.

Set the DC power supply to at least 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:

- Siemens three-phase motors are used
- Siemens MOTION-CONNECT power cables are used
- Note that there are motor holding brakes that close again when the maximum voltage is exceeded.

Note

Protective circuit against overvoltages

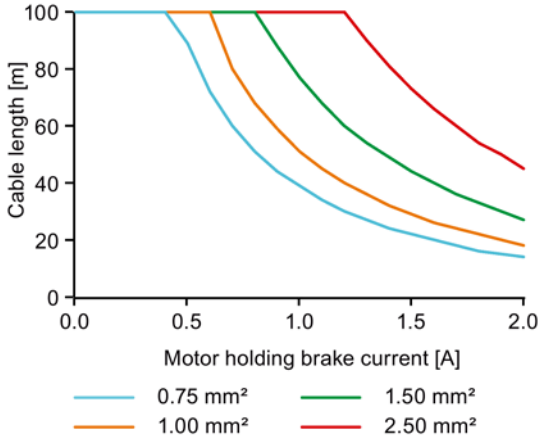
The Motor Modules have an integrated overvoltage protection circuit for the motor holding brake. External protective circuits are not required.

Motor holding brake connection

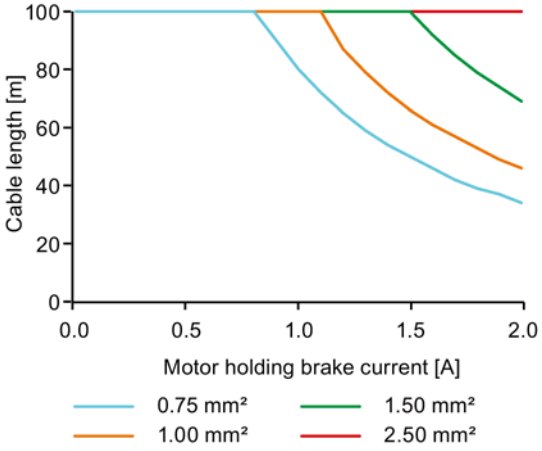
To ensure reliable opening of the motor holding brake, it requires a typical voltage of 24 V ± 10% at the motor connection. Refer to the data sheet of the motor for the motor holding brake voltage and tolerance.

- Also take into account that voltage drops occur in the motor module and on the supply cable.
- Use a Control Supply Module or a regulated DC power supply whose setpoint is set to at least 26 V.
- Note that there are motor holding brakes that close again when the maximum voltage is exceeded.

The following diagrams show the dependencies of motor cable length, motor holding brake current and cross-section of the motor holding brake cables:



Module input voltage 24 V



Module input voltage 26 V

Protective circuit against overvoltages

The Motor Modules have an integrated overvoltage protection circuit for the motor holding brake. External protective circuits are not required.

Note

More information

Further information about conductor protection and the possible functions of the 24 V supply can be found in the SINAMICS S120 Manual "Booksize Power Units".

7.9 Cable shielding and routing

In order to comply with the EMC requirements, certain cables must be routed apart from other cables and from certain components. To satisfy EMC requirements, the following cables must be used with shields:

- Line supply conductors from the line filter via the line reactor to the Line Module
- All motor cables (if necessary, including cables for motor holding brake)
- Cables for "fast inputs" of the Control Unit
- Cables for analog direct voltage/current signals
- Signal cables for sensors
- Cables for temperature sensors

Supplementary conditions

- Alternative measures (e.g. routing behind mounting plates, suitable clearances) can also be used provided they have similar results. This excludes measures that relate to the design, installation, and routing of motor power cables and signal cables.
- If unshielded cables are used between the line supply connection point and the line filter, make sure that no interference-emitting cables are routed in parallel.
- Power and signal cables must always be routed separately. For this purpose, it is practical to arrange the various cables according to cable groups. Cables belonging to a group can be combined in a bundle. The various cable groups must be routed with the necessary clearance between them. A minimum clearance of 20 cm has proven itself in practice. As an alternative, shielding plates with the appropriate contacts at several locations can be used between the cable bundles.
- All cables inside the cabinet must be routed as closely as possible to parts connected with cabinet ground, such as a mounting plate or cabinet wall. Ducts made of sheet steel or cables routed between steel sheets (e.g. between the mounting plate and back wall) should provide adequate shielding.
- All cables must be kept as short as possible, to minimize the antenna effect.
- Signal and power cables may cross each other (if absolutely necessary), but must never be routed closely to one another in parallel over longer distances.
- Signal cables must be routed with a minimum clearance of 20 cm from strong magnetic fields (motors, transformers). Alternatively, shield plates with the appropriate contacts at several locations along their length can be used to provide the appropriate clearance.
- Cables for the 24 V supply should be treated just like signal cables.
- Avoid, where possible, routing unshielded cables, connected to the drive line-up, in the immediate vicinity of noise sources, e.g. transformers. Signal cables (shielded and unshielded) connected to the drive line-up must be laid at a great distance from strong external magnetic sources (e.g. transformers, line reactors). In both cases, a distance of ≥ 300 mm is usually sufficient.

Shield support

The cable shields must be connected as close to the conductor terminal connections as possible to ensure a low-impedance connection with cabinet ground. For power cables from Siemens in which the shield is connected to the connector shell (see relevant catalog), this is a sufficiently good shield support.

For components that do not have any special shield connection or where the shield connection is not sufficient, the cable shields can be connected to the metal mounting plate using hose clamps and toothed rails. The cable length between the shield contact point and the terminals for cable conductors must be kept as short as possible.

Shield connection plates with preprepared clip contacts are available for contacting the shields for power cables of Line Modules and Motor Modules. Up to a module width of 100 mm (inclusive), these plates are part of the scope of delivery of the components, or they are integrated in the connector.

Routing 24 V cables

When routing 24 V cables, the following must also be observed:

- A maximum of one conductor pair may be bundled together.
- 24 V conductors must be routed separately from other cables and conductors that could conduct the operating current.
- 24 V cables must never be routed parallel to power cables.
- 24 V cables as well as power cables should be routed to the components so that they never cover ventilation slots.

Conditions of use for 24 V cables

- Ambient temperature: 55 °C
- Conductor limit temperature: ≤ 70° C for operation with the rated load current
- Max. cable length: 30 m for 24 V power supply cables and for signal lines without additional connections

7.10 Protective connection and equipotential bonding

Protective connections

The SINAMICS S Booksize drive system is designed for use in cabinets with a PE conductor connection.

The protective conductor connection of the SINAMICS components must be connected to the protective conductor connection of the control cabinet as follows:

Table 7- 12 Conductor cross-section for copper protective connections

Line supply cable in mm^2	Copper protective connection in mm^2
Up to 16 mm^2	The same as the line supply cable
From 16 mm^2 to 35 mm^2	16 mm^2
From 35 mm^2	0.5 x line supply cable

The values listed in this table are applicable if the protective conductor is manufactured out of the same metal as the line conductors. If this is not the case, then the protective conductor cross-section must be determined so that a level of conductivity is obtained that is as a minimum, the same as the data listed in this table.

All system components and machine parts must be incorporated in the protection concept.

The protective connection for the motors used must be established through the motor cable.

Copper cables with the appropriate cross-section (> 2.5 mm^2) must be used for the ground connection of PROFIBUS participants.

Further information about ground connection for PROFIBUS can be found at:
http://www.profibus.com/fileadmin/media/wbt/WBT_Assembly_V10_Dec06/index.html

⚠WARNING

Electric shock caused by high leakage currents when the protective conductor in the line feeder cable is interrupted

The drive components conduct a high leakage current via the protective conductor. Touching conductive parts when the protective conductor is interrupted can result in death or serious injury.

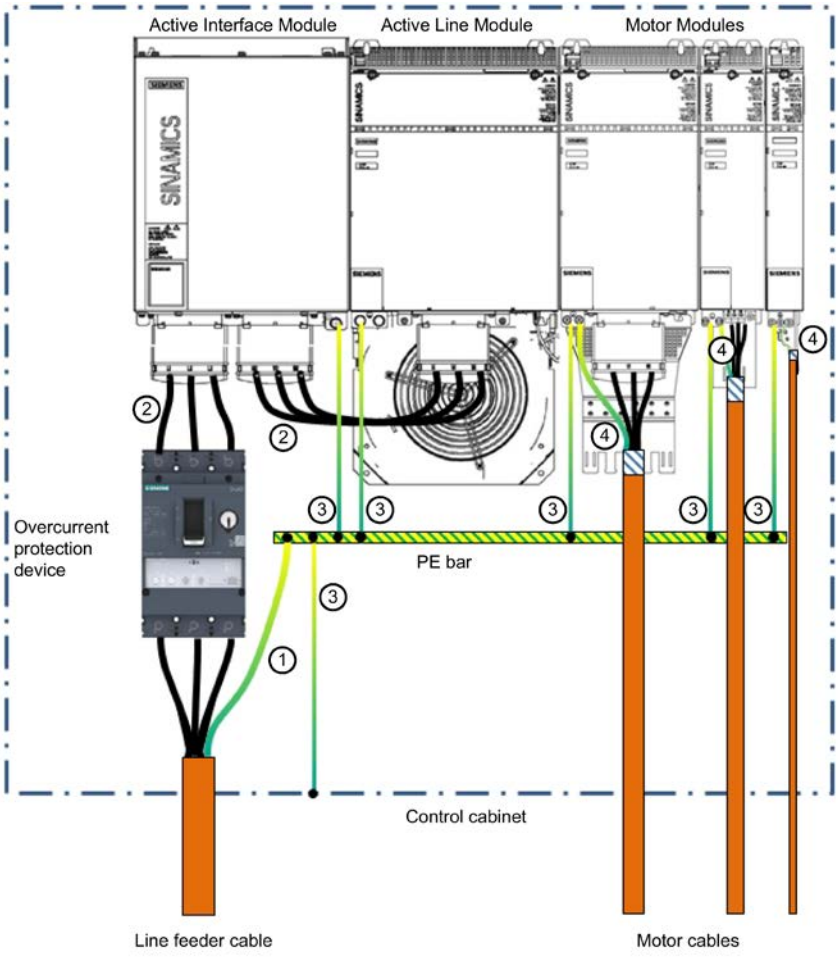
- Carefully comply with the applicable regulations for dimensioning the protective conductor (see below).

Protective connection concept, SINAMICS S120 booksize power units

Booksize power units should always be connected with a protective conductor to the central PE busbar or the conductive mounting plate in the control cabinet (see the following diagram).

Note

Ensure that for increased leakage currents, the local regulations for protective conductors at the installation site are complied with.



① The protective conductor (PE) must be dimensioned in accordance with the local installation rules for equipment with increased leakage currents. As a minimum, one of the following conditions must be satisfied:

- The protective conductor is routed so that along its complete length it is protected against mechanical damage.
- The protective conductor has a cross-section ≥ 10 mm² Cu.
- A second protective conductor with the same cross-section is provided.
- When establishing the connection using an industrial plug connector according to EN 60309, the protective conductor of a multi-conductor cable must have a cross-section ≥ 2.5 mm² Cu.
- As a conductor of a multi-conductor cable, the protective conductor has a cross-section ≥ 2.5 mm² Cu.

② The cable cross-section must be dimensioned in compliance with local installation rules.

③ The cable cross-sections must be dimensioned in compliance with local installation rules.

Additional details are provided in the following document "Dimensioning the protective conductor for SINAMICS S120 Booksize (https://support.industry.siemens.com/cs/ww/en/view/109738572)".

④ Same cross-section as the line conductor of the motor cable.

Figure 7-5 Protective connection concept, SINAMICS S120 booksize

Protective connection via the mounting plate

Alternative to the described methods with protective conductors, it is also possible to establish the protective conductor connection of the electrical cabinet through the mounting plate, assuming that all of the following conditions are satisfied. As a consequence, the requirements placed on a protective conductor for an increased discharge current are satisfied. The marked protective conductor connections of the devices are then not assigned.

Conditions

- Only permissible for modules with internal air cooling
- Use a bare metal mounting plate that is resistant to corrosion, e.g. galvanized with a minimum thickness of 2 mm.
- Electrically conductive connection between the mounting plate and the electrical cabinet corresponding to the specifications of the electrical cabinet manufacturer.
- All module fixing screws must be screwed-in with spring washer and washer - and then tightened with the specified tightening torque. Equivalent screw fittings are permissible.
- At least one fixing screw of the module is designated as protective conductor connection with the symbol ⏚ (IEC 60417–5019).
- The continuity of the protective conductor connection must be checked, e.g. according to IEC 60204-1 Chapter 18.2.2 or IEC 60364-6 Chapter 6.4.3.2.
- Just like all power connections, the fixing screws of the modules are regularly re-tightened with the specified tightening torques.

Note

- Observe the local installation regulations.
- In the case of equipment whose final destination is the USA or Canada, connection using a protective conductor is mandatory.

Functional equipotential bonding

For EMC reasons, the shield of the motor cable should be connected through a large surface area both at the Motor Module as well as at the motor.

The drive line-up must be arranged on a single, bare metal mounting plate in order to comply with the EMC limit values. The mounting plate must be connected to the protective conductor connection of the control cabinet through a low impedance.

It simultaneously serves as a functional equipotential bonding surface. This means that no additional functional equipotential bonding is required within the drive line-up.

If a single, bare metal mounting plate is not available, then equally good functional equipotential bonding must be established using cable cross-sections as listed in the table above or, as a minimum, with the same conductivity.

When mounting components on standard mounting rails, the data listed in the table apply. If only smaller conductor cross-sections are permissible on components, the largest cross-section must be used (e.g. 6 mm^2 for TM31 and SMC). These requirements also apply to distributed components located outside the control cabinet.

No functional equipotential bonding conductors are required for PROFIBUS inside a control cabinet. For PROFIBUS connections between different buildings or parts of buildings, a functional equipotential bonding must be routed in parallel to the PROFIBUS cable. The following cross-sections must be observed in accordance with IEC 60364-5-54:

- Copper 6 mm^2
- Aluminum 16 mm^2
- Steel 50 mm^2

Further information about equipotential bonding for PROFIBUS can be found at:
http://www.profibus.com/fileadmin/media/wbt/WBT_Assembly_V10_Dec06/index.html

Note

PROFINET

For installation guidelines and information of protective grounding and equipotential bonding for all PROFINET types and topologies, refer to DOWNLOADS at:
http://www.profibus.com

7.11 Notes on control cabinet cooling

7.11.1 Control cabinet cooling options

The following options are available for cooling the control cabinet:

- Filter fan
- Heat exchanger
- Cooling unit
- Liquid cooling
- External air cooling
- External liquid cooling

The prevailing environmental conditions and the cooling power required define the method used to cool the control cabinet.

The air routing within the control cabinet and the ventilation clearances specified must be observed. No components may be mounted and no cables routed in the ventilation clearance spaces.

You must take into account the following specifications when installing a SINAMICS drive line-up:

- Ventilation clearance
- Cable routing
- Air guidance, air-conditioners

NOTICE
Shorter component service life as a result of incorrect installation Failure to observe the guidelines for mounting SINAMICS components in the cabinet can reduce the service life of the equipment and result in premature component failure. • Observe the guidelines for installing SINAMICS components.

7.11.2 General information on ventilation

SINAMICS components are force-ventilated using integrated fans, and in some cases through natural convection. The fans are not equipped with temperature-dependent speed control; only the states "on" or "off" exist.

Fan operation up to firmware version 2.5

The fans are switched on and off as a function of the heat sink temperature.

The fans start up at a specific heat sink temperature for the particular device. They switch themselves off with a small hysteresis as soon as the heat sink temperature falls below this threshold. The run-on time of the fan depends on various factors such as ambient temperature, output current, duty cycle and, therefore, cannot be determined directly.

Fan operation as of firmware version 2.6

The fans can be controlled as a function of the heat sink temperature.

The fans start up at a specific heat sink temperature for the particular device – or when a pulse enable is set. They switch themselves off with a small hysteresis as soon as the heat sink temperature drops below the stored temperature value and there is no pulse enable. The fan run-on time can be parameterized (see SINAMICS S120/S150 List Manual).

Air guidance

The cooling air must flow through the components vertically from bottom (cooler region) to top (region heated by operation).

If filter fans, heat exchangers, or air conditioners are used, you must ensure that the air is flowing in the right direction. You must also ensure that the warm air can escape at the top. A ventilation clearance of at least 80 mm at the top and bottom must be provided.

NOTICE

Damage caused by overheating resulting from covered ventilation slots

Covered ventilation slots can cause the system to overheat. This can damage components.

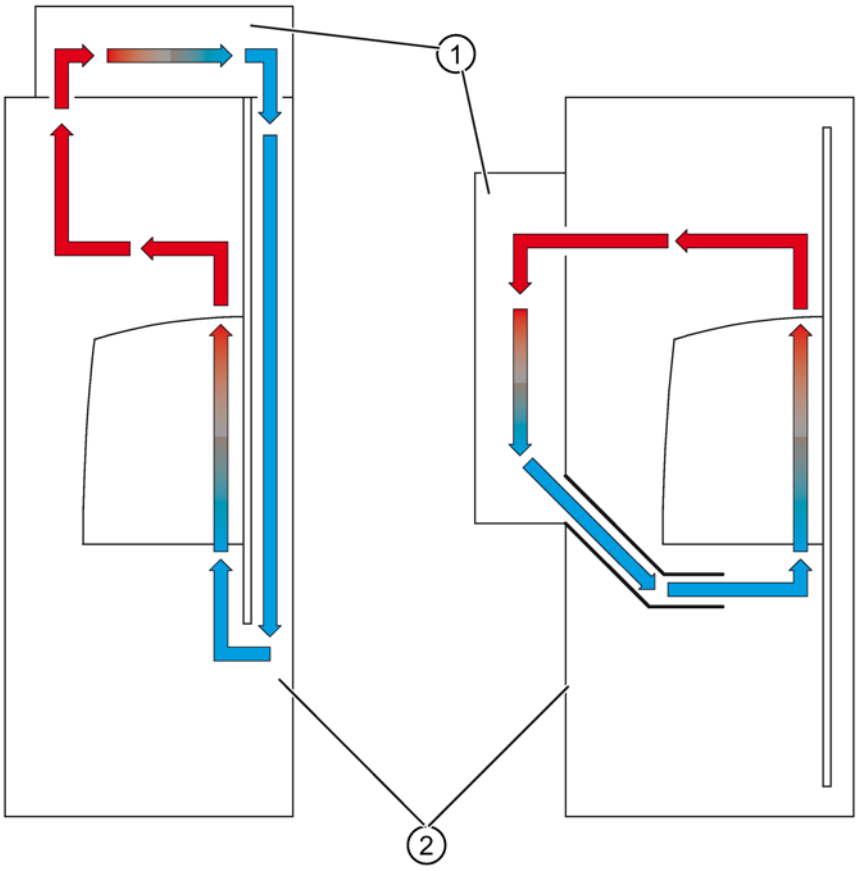
- Route the connected signal and power cables to the components in such a way that they do not cover the ventilation slots.

Note

The distance between the discharge opening of the air conditioner and the electronic equipment must be at least 200 mm.

Note

If the components are mounted in a sealed cabinet, an internal air cooling system must be installed to circulate the air and prevent hot spots. It is best to mount the fan above the components so that air is sucked up from the bottom of the cabinet to provide an optimized air flow.



① Cooling unit
② Control cabinet

Figure 7-6 Examples of cabinet ventilation

NOTICE
Component damage caused by condensation Condensation on the components can result in their failure. • Select the air circuit and arrangement of the cooling equipment in such a way that no condensation can form on the components. • If required, an anti-condensation heater must be installed in the cabinet.

If air conditioners are used, the relative air humidity of the expelled air increases as the air in the air conditioner cools and may exceed the dew point. To avoid condensation, climate control equipment should be arranged so that cold discharged air is not directly blown onto SINAMICS components. Using air guidance baffles, ensure that the air is adequately mixed with the air inside the cabinet. Mixing this cold air with warm cabinet air reduces the relative air humidity to non-critical values.

7.11.3 Ventilation clearances

Table 7- 13 Ventilation clearances required above and below SINAMICS components

Component	Ventilation clearances in mm and (inches)
Motor Modules in booksize C/D-type format	80 (3.15)

Note

Ventilation clearances of the SINAMICS booksize drive line-up

The ventilation clearances of other components in the booksize drive line-up can be found in the SINAMICS S120 Manual "Booksize Power Units".

Drive line-up with internal air cooling

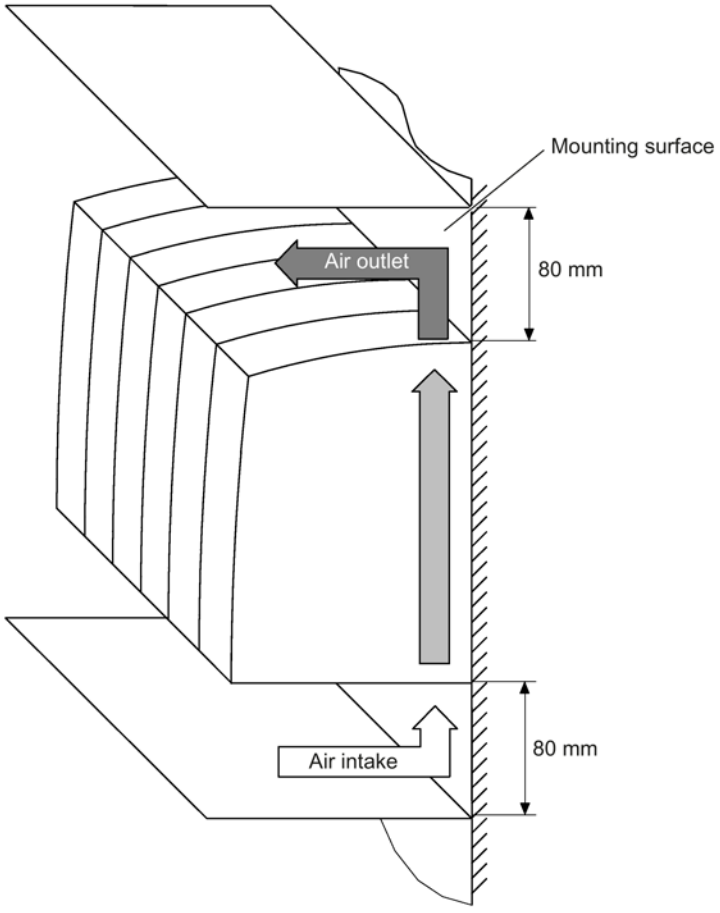


Figure 7-7 Ventilation clearances for a drive line-up with internal air cooling

7.11.4 Dimensioning cooling equipment

Manufacturers provide calculation programs for selecting cooling equipment. It is always necessary to know the power loss of the components and equipment installed in the cabinet.

The physical relationship is shown in the following example.

Formula to calculate the power loss: $q = Q - k \cdot A \cdot \Delta T$

q = thermal power that has to be dissipated by a cooling unit [W]

Q = power loss [W]

k = thermal resistance coefficient [W / (m^2 K)] (example: Painted sheet steel k = 5.5 W / (m^2 K))

A = free-standing cabinet surface area [m^2]

ΔT = difference between temperatures inside and outside the cabinet [K]

Table 7- 14 Example of power loss calculation for a drive configuration

Component	Quanti-ty	Total power loss [W] (including electronic losses)	Total power loss [W]
CU320-2	1	24	24
Basic Line Filter for AIM / ALM 36 kW	1	26	26
Active Interface Module	1	340	340
Active Line Module 36 kW	1	666	666
Motor Module 18 A	2	150	300
Motor Module 30 A	3	270	810
SMC	5	10+	50
SITOP 20	1	53	53
Line contactor	1	12	12
Total:			**2281**

Assumption:
Free-standing cabinet surface area A = 5 m^2
Difference between temperature inside and outside the cabinet ΔT = 10 K
$q = 2281\ W - 5.5\ W / (m^2\ K) \cdot 5\ m^2 \cdot 10\ K = 2006\ W$

7.12 Power losses of the components

7.12.1 Typical power losses for Motor Modules

The information on the power losses in the previous chapters are maximum values, which occur in the most unfavorable case. For typical applications, the losses are lower.

The following applies as typical application:

- Motor cable length 30 m
- 4 kHz pulse frequency
- DC link voltage 540 V - 600 V

The power loss for typical applications can be calculated using the following formula:

$P_V [W] = a + S_1 \cdot (I_1 + I_2) + S_2 \cdot (I_1^2 + I_2^2)$

a	Electronics losses of the Motor Module
S_1, S_2	Coefficients to calculate power loss
I_1	Current (arithmetic mean value) of the 1st axis
I_2	Current (arithmetic mean value) of the 2nd axis

Overview of required coefficients

Table 7- 15 Coefficients to calculate the power loss in the control cabinet for internally cooled Motor Modules for typical applications

Motor Module	a [W]	S_1 [W/A]	S_2 [W/A²]
Single Motor Module 3 A	14	3.29	0.205
Single Motor Module 5 A	14	3.29	0.205
Single Motor Module 9 A	14	3.29	0.205
Single Motor Module 18 A	14	3.29	0.205
Single Motor Module 24 A	24	3.50	0.140
Single Motor Module 30 A	20	4.71	0.113
Single Motor Module 45 A	22	4.40	0.060
Single Motor Module 60 A	22	4.00	0.055
Double Motor Module 2 x 3 A	19	5.20	0.200
Double Motor Module 2 x 5 A	19	5.20	0.200
Double Motor Module 2 x 9 A	19	5.18	0.247
Double Motor Module 2 x 18 A	22	5.57	0.091

Overview of typical power losses at the rated operating point

Table 7- 16 Typical power losses in the control cabinet for operation at the rated operating point for internally cooled Motor Modules

Motor Module	P_{Vn} [W] internal air cooling
Single Motor Module 3 A	26
Single Motor Module 5 A	36
Single Motor Module 9 A	60
Single Motor Module 18 A	140
Single Motor Module 24 A	189
Single Motor Module 30 A	263
Single Motor Module 45 A	342
Single Motor Module 60 A	460
Double Motor Module 2 x 3 A	54
Double Motor Module 2 x 5 A	81
Double Motor Module 2 x 9 A	152
Double Motor Module 2 x 18 A	281

7.12.2 Maximum power losses in the rated load range

Table 7- 17 Overview of power loss at rated operation for power units with internal air cooling (including electronics losses)

	Power loss [W]
Single Motor Modules booksize C/D-type	
3 A	30
5 A	52
9 A	82
18 A	150
24 A	190
30 A	270
45 A	348
60 A	471
Double Motor Modules booksize C/D-type	
2 x 3 A	56
2 x 5 A	90
2 x 9 A	155
2 x 18 A	286

Note

Additional power loss values

The power loss data for other components in the booksize drive line-up can be found in the SINAMICS S120 Manual "Booksize Power Units".

7.12.3 Maximum power losses in the partial load range

Losses in the partial load range for Motor Modules

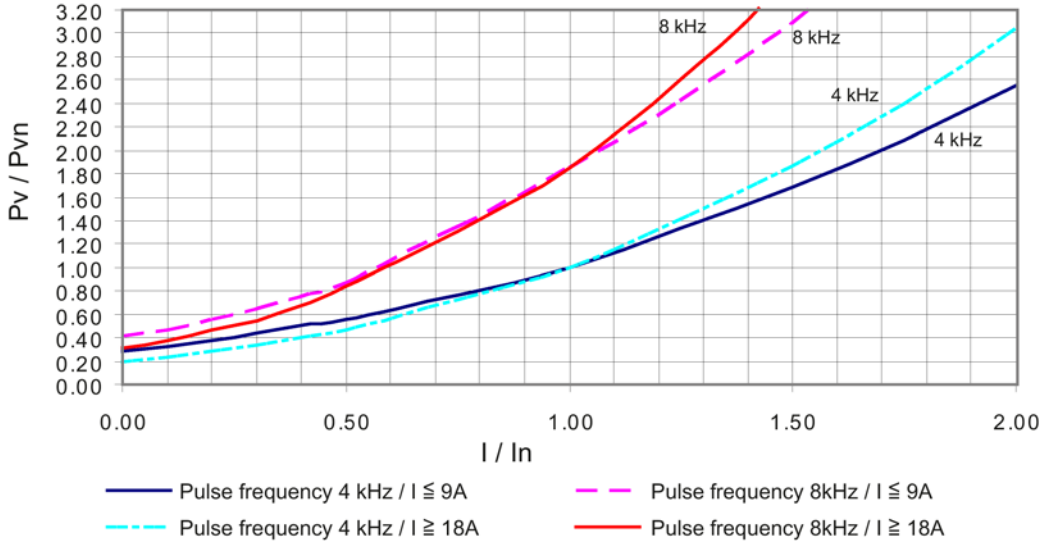


Figure 7-8 Losses in the partial load range for Motor Modules

Service and support for booksize C/D-type

8

8.1 Spare parts

You can find spare parts in the Internet here (https://www.sow.siemens.com).

8.2 Replacing the fan

8.2.1 Safety instructions when replacing a fan

⚠WARNING

Electric shock when live parts are touched

Before replacing the fan, you must switch off the power supplies (400 V AC and 24 V DC). A hazardous voltage is still present for up to five minutes after the power supply has been switched off.

Contact with live parts can result in death or serious injury.

- Check for zero voltage before removing the component.

Note

When replacing the fan, you must observe the ESD regulations (Page 23).

Only qualified personnel are permitted to replace components.

8.2.2 Replacing the fan

Note

Service life and replacement intervals of the fan module

The modules have an operating hours counter (p0251). When the maximum operating duration is reached, a corresponding message is output (A30042).

The fan modules of the Motor Modules can be ordered as replacement parts.

Table 8- 1 Fan modules as replacement part when replacing a fan

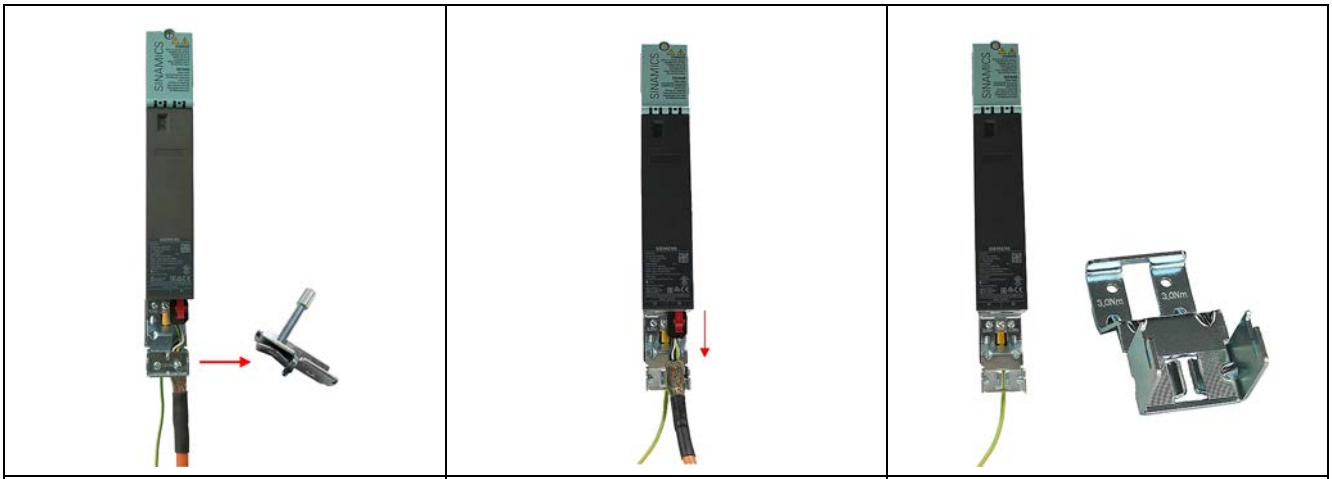
Module width	Type	Article No.	Rated fan voltage
50 mm	3 A ... 18 A 2 x 3 A ... 2 x 9 A	6SL3162-0AN00-0AA0	24 V
50 mm	24 A	6SL3162-0AS00-0AA0	12 V
100 mm	30 A / 2 x 18 A	6SL3162-0AP00-0AA0	24 V
100 mm	45 A / 60 A	6SL3162-0AT00-0AA0	12 V

Required tools:

- Torx screwdriver T20
- Slotted screwdriver 0.8 x 5.5 mm

Replacing the fan for 50 mm modules (3 A ... 24 A, 2 x 3 A ... 2 x 9 A)

Removing the existing fan module

		
Remove the shield connection clamp. Screwdriver: slotted, 0.8 x 5.5 mm	Release the catch of the motor connector and pull the connector out of the Motor Module (possibly applies to 2 motor connectors).	Remove the shield connection plate from the Motor Module. Screwdriver: Torx 20

		
Detach the protective conductor from the Motor Module. Screwdriver: Torx 20	Pull the fan module out forwards out of the Motor Module.	Motor Module with removed fan module (12 V or 24 V)

Installing a new fan module

1. Insert a new fan assembly into the Motor Module. The power supply for the fan is automatically established.
2. Connect the protective conductor to the Motor Module.
   Tightening torque: 3 Nm (26.6 lbf in)
3. Reattach the shield connection plate and tighten the fastening screws.
   Tightening torque: 3 Nm (26.6 lbf in)
4. Reconnect the motor connector (or connectors).
5. Reattach the shield connection clamp and tighten the fastening screws.
   Tightening torque: 0.8 Nm (7.08 lbf in)

NOTICE

Defective fan when using a wrong fan module

24 V and 12 V fans are available for 50 mm Motor Modules (see the table above). If, when replacing the fan at a Motor Module 3 A ... 18 A or 2 x 3 A ... 2 x 9 A, a 12 V fan is used, then this can be damaged when operated. If a 24 V fan is used as replacement part for a 24 A Motor Module, then this module will not start.

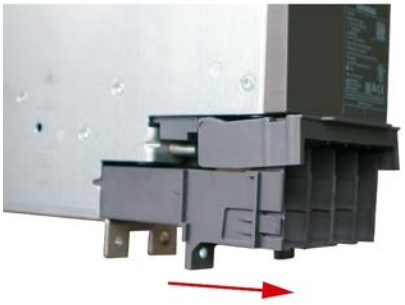
- When replacing the fan for a 50 mm Motor Module, always use the associated fan as specified in the table.

Replacing the fan for 100 mm Modules (30 A, 2 x 18 A)

The procedure for replacing the fan of 100 mm modules (30 A and 2 x 18 A) is the similar to the procedure for 50 mm modules. Since the protective conductor is located not behind the connection plate but next to it, you can loosen it first and, after installation of the new fan module, screw it down as the last step.

Replacing the fan for 100 mm modules (45 A / 60 A)

The fan assembly is integrated in the motor connection block.

		
Use a slotted screwdriver to release the terminal block cover on the left and right.	Open the cover.	Remove the conductors of the motor connecting cable (von left: protective conductor, U2, V2, W2): SW 10
		
Remove the two fixing screws of the fan module. Screwdriver: Torx 20	All connections are removed.	Pull the fan module out forwards out of the Motor Module.

		
Motor Module without fan	Removed fan module	

Installing a new fan module

1. Insert a new fan assembly into the Motor Module. The power supply for the fan is automatically established.
2. Retighten the fan module screws.
   Tightening torque: 2.2 Nm (19.5 lbf in)
3. Attach the conductors of the motor connecting cable (protective conductor, U2, V2, W2).
   Tightening torque: 6 Nm (53.1 lbf in)
4. Close the terminal block cover.

8.3 Recycling and disposal

For environmentally friendly recycling and disposal of your old device, please contact a company certified for the disposal of electrical and electronic waste and dispose of the device in accordance with the regulations in your country.

Appendix

A

A.1 List of abbreviations

Note

The following list of abbreviations includes all abbreviations and their meanings used in the entire SINAMICS family of drives.

A

Abbreviation	Derivation of abbreviation	Meaning
A…	Alarm	Warning
AC	Alternating Current	Alternating current
ADC	Analog Digital Converter	Analog digital converter
AI	Analog Input	Analog input
AIM	Active Interface Module	Active Interface Module
ALM	Active Line Module	Active Line Module
AO	Analog Output	Analog output
AOP	Advanced Operator Panel	Advanced Operator Panel
APC	Advanced Positioning Control	Advanced Positioning Control
AR	Automatic Restart	Automatic restart
ASC	Armature Short-Circuit	Armature short-circuit
ASCII	American Standard Code for Information Interchange	American coding standard for the exchange of information
AS-i	AS-Interface (Actuator Sensor Interface)	AS-Interface (open bus system in automation technology)
ASM	Asynchronmotor	Induction motor
AVS	Active Vibration Suppression	Active load vibration damping
AWG	American Wire Gauge	American Wire Gauge (Standard for cross-sections of cables)

B

Abbreviation	Derivation of abbreviation	Meaning
BB	Betriebsbedingung	Operation condition
BERO	-	Contactless proximity switch
BI	Binector Input	Binector input
BIA	Berufsgenossenschaftliches Institut für Arbeitssicherheit	BG Institute for Occupational Safety and Health

Abbreviation	Derivation of abbreviation	Meaning
BICO	Binector Connector Technology	Binector connector technology
BLM	Basic Line Module	Basic Line Module
BO	Binector Output	Binector output
BOP	Basic Operator Panel	Basic operator panel

C

Abbreviation	Derivation of abbreviation	Meaning
C	Capacitance	Capacitance
C…	-	Safety message
CAN	Controller Area Network	Serial bus system
CBC	Communication Board CAN	Communication Board CAN
CBE	Communication Board Ethernet	PROFINET communication module (Ethernet)
CD	Compact Disc	Compact disc
CDS	Command Data Set	Command data set
CF Card	CompactFlash Card	CompactFlash card
CI	Connector Input	Connector input
CLC	Clearance Control	Clearance control
CNC	Computerized Numerical Control	Computer-supported numerical control
CO	Connector Output	Connector output
CO/BO	Connector Output/Binector Output	Connector/binector output
COB-ID	CAN Object-Identification	CAN Object Identification
CoL	Certificate of License	Certificate of License
COM	Common contact of a change-over relay	Center contact of a change-over contact
COMM	Commissioning	Commissioning
CP	Communication Processor	Communications processor
CPU	Central Processing Unit	Central processing unit
CRC	Cyclic Redundancy Check	Cyclic redundancy check
CSM	Control Supply Module	Control Supply Module
CU	Control Unit	Control Unit
CUA	Control Unit Adapter	Control Unit Adapter
CUD	Control Unit DC	Control Unit DC

D

Abbreviation	Derivation of abbreviation	Meaning
DAC	Digital Analog Converter	Digital analog converter
DC	Direct Current	Direct current
DCB	Drive Control Block	Drive Control Block
DCBRK	DC Brake	DC braking
DCC	Drive Control Chart	Drive Control Chart

Abbreviation	Derivation of abbreviation	Meaning
DCN	Direct Current Negative	Direct current negative
DCP	Direct Current Positive	Direct current positive
DDC	Dynamic Drive Control	Dynamic Drive Control
DDS	Drive Data Set	Drive Data Set
DHCP	Dynamic Host Configuration Protocol	Dynamic Host Configuration Protocol (Communication protocol)
DI	Digital Input	Digital input
DI/DO	Digital Input/Digital Output	Digital input/output, bidirectional
DIN	Deutsches Institut für Normung	Deutsches Institut für Normung (German Institute for Standardization)
DMC	DRIVE-CLiQ Hub Module Cabinet	DRIVE-CLiQ Hub Module Cabinet
DME	DRIVE-CLiQ Hub Module External	DRIVE-CLiQ Hub Module External
DMM	Double Motor Module	Double Motor Module
DO	Digital Output	Digital output
DO	Drive Object	Drive object
DP	Decentralized Peripherals	Distributed I/O
DPRAM	Dual Ported Random Access Memory	Dual-Port Random Access Memory
DQ	DRIVE-CLiQ	DRIVE-CLiQ
DRAM	Dynamic Random Access Memory	Dynamic Random Access Memory
DRIVE-CLiQ	Drive Component Link with IQ	Drive Component Link with IQ
DSC	Dynamic Servo Control	Dynamic Servo Control
DSM	Doppelsubmodul	Double submodule
DTC	Digital Time Clock	Timer

E

Abbreviation	Derivation of abbreviation	Meaning
EASC	External Armature Short-Circuit	External armature short-circuit
EDS	Encoder Data Set	Encoder data set
EEPROM	Electrically Erasable Programmable Read-Only Memory	Electrically Erasable Programmable Read-Only Memory
EGB	Elektrostatisch gefährdete Baugruppen	Electrostatic sensitive devices
EIP	EtherNet/IP	EtherNet Industrial Protocol (real-time Ethernet)
ELCB	Earth Leakage Circuit Breaker	Residual current operated circuit breaker
ELP	Earth Leakage Protection	Ground-fault monitoring
EMC	Electromagnetic Compatibility	Electromagnetic compatibility
EMF	Electromotive Force	Electromotive force
EMK	Elektromotorische Kraft	Electromotive force
EMV	Elektromagnetische Verträglichkeit	Electromagnetic compatibility
EN	Europäische Norm	European standard
EnDat	Encoder-Data-Interface	Encoder interface
EP	Enable Pulses	Pulse enable

Abbreviation	Derivation of abbreviation	Meaning
EPOS	Einfachpositionierer	Basic positioner
ES	Engineering System	Engineering system
ESB	Ersatzschaltbild	Equivalent circuit diagram
ESD	Electrostatic Sensitive Devices	Electrostatic sensitive devices
ESM	Essential Service Mode	Essential service mode
ESR	Extended Stop and Retract	Extended stop and retract

F

Abbreviation	Derivation of abbreviation	Meaning
F…	Fault	Fault
FAQ	Frequently Asked Questions	Frequently Asked Questions
FBLOCKS	Free Blocks	Free function blocks
FCC	Function Control Chart	Function control chart
FCC	Flux Current Control	Flux current control
FD	Function Diagram	Function diagram
F-DI	Failsafe Digital Input	Fail-safe digital input
F-DO	Failsafe Digital Output	Fail-safe digital output
FEPROM	Flash-EPROM	Non-volatile write and read memory
FG	Function Generator	Function generator
FI	-	Fault current
FOC	Fiber-Optic Cable	Fiber-optic cable
FP	Funktionsplan	Function diagram
FPGA	Field Programmable Gate Array	Field Programmable Gate Array
F-PLC	Fail-safe PLC	Fail-safe PLC
FW	Firmware	Firmware

G

Abbreviation	Derivation of abbreviation	Meaning
GB	Gigabyte	Gigabyte
GC	Global Control	Global control telegram (broadcast telegram)
GND	Ground	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as M)
GSD	Gerätestammdatei	Generic Station Description: Describes the features of a PROFIBUS slave
GSV	Gate Supply Voltage	Gate supply voltage
GUID	Globally Unique Identifier	Globally Unique Identifier

H

Abbreviation	Derivation of abbreviation	Meaning
HF	High frequency	High frequency
HFD	Hochfrequenzdrossel	Radio frequency reactor
HLA	Hydraulic Linear Actuator	Hydraulic linear actuator
HLG	Hochlaufgeber	Ramp-function generator
HM	Hydraulic Module	Hydraulic Module
HMI	Human Machine Interface	Human Machine Interface
HTL	High-Threshold Logic	Logic with high interference threshold
HTTP	Hypertext Transfer Protocol	Hypertext Transfer Protocol (communication protocol)
HTTP	Hypertext Transfer Protocol Secure	Hypertext Transfer Protocol Secure (communication protocol)
HW	Hardware	Hardware

I

Abbreviation	Derivation of abbreviation	Meaning
i. V.	In Vorbereitung	Under development: This property is currently not available
I/O	Input/Output	Input/output
I2C	Inter-Integrated Circuit	Internal serial data bus
IASC	Internal Armature Short-Circuit	Internal armature short-circuit
IBN	Inbetriebnahme	Commissioning
ID	Identifier	Identification
IE	Industrial Ethernet	Industrial Ethernet
IEC	International Electrotechnical Commission	International Electrotechnical Commission
IF	Interface	Interface
IGBT	Insulated Gate Bipolar Transistor	Insulated gate bipolar transistor
IGCT	Integrated Gate-Controlled Thyristor	Semiconductor power switch with integrated control electrode
IL	Impulslöschung	Pulse suppression
IP	Internet Protocol	Internet Protocol
IPO	Interpolator	Interpolator
ISO	Internationale Organisation für Normung	International Standards Organization
IT	Isolé Terre	Non-grounded three-phase line supply
IVP	Internal Voltage Protection	Internal voltage protection

J

Abbreviation	Derivation of abbreviation	Meaning
JOG	Jogging	Jogging

K

Abbreviation	Derivation of abbreviation	Meaning
KDV	Kreuzweiser Datenvergleich	Data cross-check
KHP	Know-how protection	Know-how protection
KIP	Kinetische Pufferung	Kinetic buffering
Kp	-	Proportional gain
KTY84-130	-	Temperature sensor

L

Abbreviation	Derivation of abbreviation	Meaning
L		
L	-	Symbol for inductance
LED	Light Emitting Diode	Light emitting diode
LIN	Linearmotor	Linear motor
LR	Lageregler	Position controller
LSB	Least Significant Bit	Least significant bit
LSC	Line-Side Converter	Line-side converter
LSS	Line-Side Switch	Line-side switch
LU	Length Unit	Length unit
LWL	Lichtwellenleiter	Fiber-optic cable

M

Abbreviation	Derivation of abbreviation	Meaning
M	-	Symbol for torque
M	Masse	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as GND)
MB	Megabyte	Megabyte
MCC	Motion Control Chart	Motion Control Chart
MDI	Manual Data Input	Manual data input
MDS	Motor Data Set	Motor data set
MLFB	Maschinenlesbare Fabrikatebezeichnung	Machine-readable product code
MM	Motor Module	Motor Module
MMC	Man-Machine Communication	Man-machine communication
MMC	Micro Memory Card	Micro memory card
MRCD	Modular Residual Current protection Device	Modular Residual Current protection Device
MSB	Most Significant Bit	Most significant bit
MSC	Motor-Side Converter	Motor-side converter
MSCY_C1	Master Slave Cycle Class 1	Cyclic communication between master (class 1) and slave

Abbreviation	Derivation of abbreviation	Meaning
MSR	Motorstromrichter	Motor-side converter
MT	Messtaster	Probe

N

Abbreviation	Derivation of abbreviation	Meaning
N. C.	Not Connected	Not connected
N…	No Report	No report or internal message
NAMUR	Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie	Standardization association for measurement and control in chemical industries
NC	Normally Closed (contact)	NC contact
NC	Numerical Control	Numerical control
NEMA	National Electrical Manufacturers Association	Standardization association in USA (United States of America)
NM	Nullmarke	Zero mark
NO	Normally Open (contact)	NO contact
NSR	Netzstromrichter	Line-side converter
NTP	Network Time Protocol	Standard for synchronization of the time of day
NVRAM	Non-Volatile Random Access Memory	Non-volatile read/write memory

O

Abbreviation	Derivation of abbreviation	Meaning
OA	Open Architecture	Software component which provides additional functions for the SINAMICS drive system
OAIF	Open Architecture Interface	Version of the SINAMICS firmware as of which the OA application can be used
OASP	Open Architecture Support Package	Expands the commissioning tool by the corresponding OA application
OC	Operating Condition	Operation condition
OCC	One Cable Connection	One-cable technology
OEM	Original Equipment Manufacturer	Original equipment manufacturer
OLP	Optical Link Plug	Bus connector for fiber-optic cable
OMI	Option Module Interface	Option Module Interface

P

Abbreviation	Derivation of abbreviation	Meaning
p…	-	Adjustable parameters
P1	Processor 1	CPU 1
P2	Processor 2	CPU 2
PB	PROFIBUS	PROFIBUS

Abbreviation	Derivation of abbreviation	Meaning
PcCtrl	PC Control	Master control
PD	PROFIdrive	PROFIdrive
PDC	Precision Drive Control	Precision Drive Control
PDS	Power unit Data Set	Power unit data set
PDS	Power Drive System	Drive system
PE	Protective Earth	Protective ground
PELV	Protective Extra Low Voltage	Safety extra-low voltage
PFH	Probability of dangerous failure per hour	Probability of dangerous failure per hour
PG	Programmiergerät	Programming device
PI	Proportional Integral	Proportional integral
PID	Proportional Integral Differential	Proportional integral differential
PLC	Programmable Logical Controller	Programmable logic controller
PLL	Phase-Locked Loop	Phase-locked loop
PM	Power Module	Power Module
PMI	Power Module Interface	Power Module Interface
PMSM	Permanent-magnet synchronous motor	Permanent-magnet synchronous motor
PN	PROFINET	PROFINET
PNO	PROFIBUS Nutzerorganisation	PROFIBUS user organization
PPI	Point to Point Interface	Point-to-point interface
PRBS	Pseudo Random Binary Signal	White noise
PROFIBUS	Process Field Bus	Serial data bus
PS	Power Supply	Power supply
PSA	Power Stack Adapter	Power Stack Adapter
PT1000	-	Temperature sensor
PTC	Positive Temperature Coefficient	Positive temperature coefficient
PTP	Point To Point	Point-to-point
PWM	Pulse Width Modulation	Pulse width modulation
PZD	Prozessdaten	Process data

Q

Abbreviation	Derivation of abbreviation	Meaning
No entries		

R

Abbreviation	Derivation of abbreviation	Meaning
r…	-	Display parameters (read-only)
RAM	Random Access Memory	Memory for reading and writing
RCCB	Residual Current Circuit Breaker	Residual current operated circuit breaker
RCD	Residual Current Device	Residual current device

Abbreviation	Derivation of abbreviation	Meaning
RCM	Residual Current Monitor	Residual current monitor
REL	Reluctance motor textile	Reluctance motor textile
RESM	Reluctance synchronous motor	Synchronous reluctance motor
RFG	Ramp-Function Generator	Ramp-function generator
RJ45	Registered Jack 45	Term for an 8-pin socket system for data transmission with shielded or non-shielded multi-wire copper cables
RKA	Rückkühlanlage	Cooling unit
RLM	Renewable Line Module	Renewable Line Module
RO	Read Only	Read only
ROM	Read-Only Memory	Read-only memory
RPDO	Receive Process Data Object	Receive Process Data Object
RS232	Recommended Standard 232	Interface standard for cable-connected serial data transmission between a sender and receiver (also known as EIA232)
RS485	Recommended Standard 485	Interface standard for a cable-connected differential, parallel, and/or serial bus system (data transmission between a number of senders and receivers, also known as EIA485)
RTC	Real Time Clock	Real-time clock
RZA	Raumzeigerapproximation	Space-vector approximation

S

Abbreviation	Derivation of abbreviation	Meaning
S1	-	Continuous operation
S3	-	Intermittent duty
SAM	Safe Acceleration Monitor	Safe acceleration monitoring
SBC	Safe Brake Control	Safe brake control
SBH	Sicherer Betriebshalt	Safe operating stop
SBR	Safe Brake Ramp	Safe brake ramp monitoring
SBT	Safe Brake Test	Safe brake test
SCA	Safe Cam	Safe cam
SCC	Safety Control Channel	Safety Control Channel
SCSE	Single Channel Safety Encoder	Single-channel safety encoder
SD Card	SecureDigital Card	Secure digital memory card
SDC	Standard Drive Control	Standard Drive Control
SDI	Safe Direction	Safe motion direction
SE	Sicherer Software-Endschalter	Safe software limit switch
SESM	Separately-excited synchronous motor	Separately excited synchronous motor
SG	Sicher reduzierte Geschwindigkeit	Safely limited speed
SGA	Sicherheitsgerichteter Ausgang	Safety-related output
SGE	Sicherheitsgerichteter Eingang	Safety-related input

Abbreviation	Derivation of abbreviation	Meaning
SH	Sicherer Halt	Safe stop
SI	Safety Integrated	Safety Integrated
SIC	Safety Info Channel	Safety Info Channel
SIL	Safety Integrity Level	Safety Integrity Level
SITOP	-	Siemens power supply system
SLA	Safely-Limited Acceleration	Safely limited acceleration
SLM	Smart Line Module	Smart Line Module
SLP	Safely-Limited Position	Safely Limited Position
SLS	Safely-Limited Speed	Safely limited speed
SLVC	Sensorless Vector Control	Sensorless vector control
SM	Sensor Module	Sensor Module
SMC	Sensor Module Cabinet	Sensor Module Cabinet
SME	Sensor Module External	Sensor Module External
SMI	SINAMICS Sensor Module Integrated	SINAMICS Sensor Module Integrated
SMM	Single Motor Module	Single Motor Module
SN	Sicherer Software-Nocken	Safe software cam
SOS	Safe Operating Stop	Safe operating stop
SP	Service Pack	Service pack
SP	Safe Position	Safe position
SPC	Setpoint Channel	Setpoint channel
SPI	Serial Peripheral Interface	Serial peripheral interface
SPS	Speicherprogrammierbare Steuerung	Programmable logic controller
SS1	Safe Stop 1	Safe Stop 1 (time-monitored, ramp-monitored)
SS1E	Safe Stop 1 External	Safe Stop 1 with external stop
SS2	Safe Stop 2	Safe Stop 2
SS2E	Safe Stop 2 External	Safe Stop 2 with external stop
SSI	Synchronous Serial Interface	Synchronous serial interface
SSL	Secure Sockets Layer	Encryption protocol for secure data transfer (new TLS)
SSM	Safe Speed Monitor	Safe feedback from speed monitor
SSP	SINAMICS Support Package	SINAMICS support package
STO	Safe Torque Off	Safe torque off
STW	Steuerwort	Control word

T

Abbreviation	Derivation of abbreviation	Meaning
TB	Terminal Board	Terminal Board
TEC	Technology Extension	Software component which is installed as an additional technology package and which expands the functionality of SINAMICS (previously OA application)
TIA	Totally Integrated Automation	Totally Integrated Automation

Abbreviation	Derivation of abbreviation	Meaning
TLS	Transport Layer Security	Encryption protocol for secure data transfer (previously SSL)
TM	Terminal Module	Terminal Module
TN	Terre Neutre	Grounded three-phase line supply
Tn	-	Integral time
TPDO	Transmit Process Data Object	Transmit Process Data Object
TSN	Time-Sensitive Networking	Time-Sensitive Networking
TT	Terre Terre	Grounded three-phase line supply
TTL	Transistor-Transistor-Logic	Transistor-transistor logic
Tv	-	Rate time

U

Abbreviation	Derivation of abbreviation	Meaning
UL	Underwriters Laboratories Inc.	Underwriters Laboratories Inc.
UPS	Uninterruptible Power Supply	Uninterruptible power supply
USV	Unterbrechungsfreie Stromversorgung	Uninterruptible power supply
UTC	Universal Time Coordinated	Universal time coordinated

V

Abbreviation	Derivation of abbreviation	Meaning
VC	Vector Control	Vector control
Vdc	-	DC link voltage
VdcN	-	Partial DC link voltage negative
VdcP	-	Partial DC link voltage positive
VDE	Verband Deutscher Elektrotechniker	Verband Deutscher Elektrotechniker [Association of German Electrical Engineers]
VDI	Verein Deutscher Ingenieure	Verein Deutscher Ingenieure [Association of German Engineers]
VPM	Voltage Protection Module	Voltage Protection Module
Vpp	Volt peak to peak	Volt peak to peak
VSM	Voltage Sensing Module	Voltage Sensing Module

W

Abbreviation	Derivation of abbreviation	Meaning
WEA	Wiedereinschaltautomatik	Automatic restart
WZM	Werkzeugmaschine	Machine tool

X

Abbreviation	Derivation of abbreviation	Meaning
XML	Extensible Markup Language	Extensible markup language (standard language for Web publishing and document management)

Y

Abbreviation	Derivation of abbreviation	Meaning
No entries		

Z

Abbreviation	Derivation of abbreviation	Meaning
ZK	Zwischenkreis	DC link
ZM	Zero Mark	Zero mark
ZSW	Zustandswort	Status word

A.2 Documentation overview

General documentation/catalogs			
SINAMICS	G110	D 11	- Converter Chassis Units 0.12 kW up to 3 kW
	G120	D 31	- SINAMICS Converters for Single-Axis Drives and SIMOTICS Motors
	G130, G150	D 11	- Converter Chassis Units - Converter Cabinet Units
	S120, S150	D 21	- SINAMICS S120 Chassis Units and Cabinet Modules - SINAMICS S150 Converter Cabinet Units
	S120	D 21.4	- SINAMICS S120 and SIMOTICS
Manufacturer/service documentation			
SINAMICS	G110		- Getting Started - Operating Instructions - List Manuals
	G120		- Getting Started - Operating Instructions - Installation Manuals - Function Manual Safety Integrated - List Manuals
	G130		- Operating Instructions - List Manual
	G150		- Operating Instructions - List Manual
	GM150, SM120/SM150, GL150, SL150		- Operating Instructions - List Manuals
	S110		- Equipment Manual - Getting Started - Function Manual - List Manual
	S120		- Getting Started - Commissioning Manual - Function Manual Drive Functions - Function Manual Communication (from Firmware V5.2) - Function Manual Safety Integrated - Function Manual DCC - List Manual - Equipment Manual for Control Units and Additional System Components - Equipment Manual for Booksize Power Units - Equipment Manual for Booksize Power Units C/D Type - Equipment Manual for Air-Cooled Chassis Power Units - Equipment Manual for Liquid-Cooled Chassis Power Units - Equipment Manual for Water-Cooled Chassis Power Units for Common Cooling Circuits - Equipment Manual Combi - Equipment Manual for Cabinet Modules - Equipment Manual for AC Drives - SINAMICS S120M Equipment Manual Distributed Drive Technology - SINAMICS HLA System Manual Hydraulic Drive
	S150		- Operating Instructions - List Manual
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General			- Configuration Manual, EMC Installation Guideline

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Additional information

Siemens:
www.siemens.com

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

IndustryMall:
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