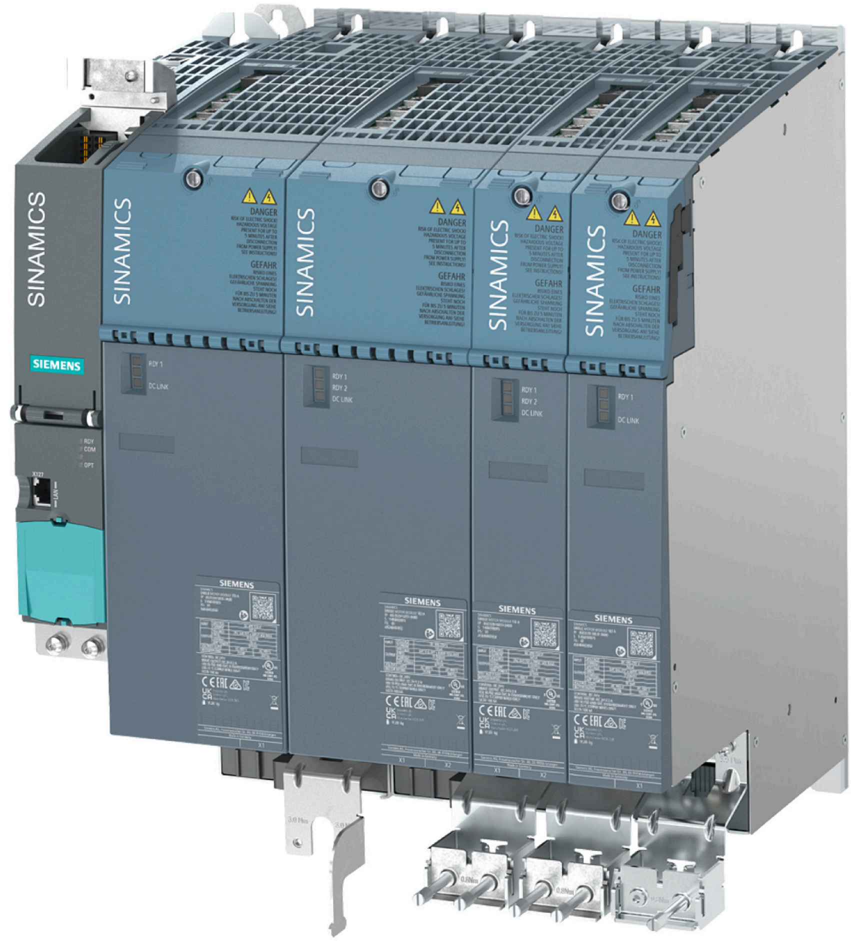

Edition 08/2024

EQUIPMENT MANUAL

SINAMICS

S220

Booksize power units
www.siemens.com

SIEMENS

SIEMENS

SINAMICS

S220
Booksize power units

Equipment Manual

08/2024
A5E53307519A AB

Legal information

Warning notice system

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

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

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

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

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

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

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

Trademarks

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

Disclaimer of Liability

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

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A5E53307519A AB
Ⓟ 08/2024 Subject to change

Table of contents

Introduction 1

1.1 About SINAMICS

Description

With the SINAMICS converter series you can solve drive tasks in the low, medium and DC voltage range. All Siemens drive components, such as converters, motors, and controls, are matched to each other and can be integrated into your existing automation systems.

You can find more information via the SINAMICS YouTube playlist (https://www.youtube.com/playlist?list=PLw7lLwXw4H53rtHeTeifKtVMr2aXTYt0X).

1.2 About this manual

1.2.1 Content

Overview

The Equipment Manual describes hardware components, and provides the information, procedures and operator actions required for the particular usage phase.

The Equipment Manual provides information so that the target group is capable of installing, setting up, testing, operating and troubleshooting the devices safely and correctly.

1.2.2 Sales law

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

1.2.3 Target group

Overview

The Equipment Manual addresses the following target groups:

- Planning engineers
- Installation personnel
- Project engineers

1.2.4 Standard scope

The functions of the system as delivered can only be found in the order documents.

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

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

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

1.2.5 Use of third-party products in this documentation

This documentation 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 use of third-party products.

1.2.6 Websites of third-party companies

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

1.3 SINAMICS documentation

Description

Comprehensive documentation on the SINAMICS converter series can be found at Siemens Industry Online Support (https://support.industry.siemens.com/cs/ww/en/view/109807358).

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

The SINAMICS documentation is divided into the following categories:

Table 1-1 SINAMICS documentation

Information	Documentation class	Content
General information	Function Manual	Description, commissioning, and optionally the application (programming or configuring) of functions that can be used in the system or on a machine
	List Manual	Meaning, setting options and dependencies of the parameters and messages of the converter
	Commissioning Manual	Complete and detailed description for commissioning a product, system, or plant
	Configuration Manual	Rules, guidelines, and tools for configuring products, systems, and plants. Also contains information on the operating and ambient conditions for hardware and software, the use of functions, as well as on circuit diagrams and terminal diagrams and the installation of software insofar as this is necessary for commissioning.
Device information	Equipment Manual	Compact description of module-specific information, such as properties, connection diagrams, characteristics, technical specifications
Basic information	System Manual	Configuring, installation, wiring and commissioning
	Product Information	Information that only becomes known shortly before or even after start of delivery and is therefore not included in the associated user documentation

1.4 Service and Support

1.4.1 ID link and Siemens Online Support

You can find additional information about the product:

- via ID link
- using the Siemens Industry Online Support
  - Website: SIOS (https://support.industry.siemens.com/cs/ww/en/)
  - App Industry Online Support (for Apple iOS and Android)

Product-specific information via ID link

The QR code on your product and on the product packaging contains the ID link.

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

You can use the ID link to access product data, manuals, Declarations of Conformity, certificates and other information about your product.

Figure 1-1 QR code with ID link included

The ID link is characterized by a frame with a black corner at the bottom right.

Content of Siemens Online Support

- Product support
- Global forum for information and best practice sharing between users and specialists
- Local contact persons via the contact person database (→ Contact)
- Product information
- FAQs (frequently asked questions)
- Application examples
- Manuals
- Downloads
- Compatibility tool
- Newsletter with product selection

- Catalogs/brochures
- Certificates

1.4.2 Spare parts services

The online spare part service "Spares on Web (https://www.sow.siemens.com)" offers spare parts for the product.

1.5 Important product information

1.5.1 Proper and intended use

Requirement

WARNING

Death or serious injury if not used as intended

Not using as intended can result in hazardous states.

- Carefully observe the description of proper and intended use

Note

It cannot be guaranteed that EMC emission limits are complied with if the products are connected to an isolated line supply grounded through a high ohmic connection or a line supply with grounded line conductor.

- Draw-up an EMC plan to comply with the EMC requirements of the intended application.

Description

The products described in this document, together with software, accessories and options, form an electric drive to supply low-voltage three-phase motors.

The products are professional devices for stationary indoor use in industrial, light-industrial and commercial applications and are intended for supply from a non-public (industrial) low-voltage network. The products are not intended for use in residential areas and are not intended for supply from a public low-voltage network.

The products must be correctly transported and stored and must be installed, commissioned and maintained by professionals who have adequate knowledge to implement the safety, cybersecurity and EMC measures in accordance with the specifications described in this manual and recognized state-of-the-art engineering practice.

You may only use the products when the following requirements are complied with:

- All regulations and directives that are applicable at the place of final use, especially with regard to electrical safety, functional safety and electromagnetic compatibility (EMC).
- All instructions, notes, technical specifications, safety information, and cybersecurity information contained in this document and other supporting documentation.

The products are part of a machine or system. They must guarantee the safety of persons and material assets as well as electromagnetic compatibility by applying suitable measures when designing the system.

A risk assessment of the complete application, including third-party products and implementation of adequate safety and cybersecurity measures must be performed before you use the product.

Products without protective enclosure (IP00 or IP20) are intended for installation in control panels or control cabinets that provide the required level of protection.

Any other use that is not expressly permitted can result in malfunctions and unpredictable hazards.

2 Fundamental safety instructions

2.1 General safety instructions

⚠ WARNING

Electric shock and danger to life due to other energy sources

Touching live components can result in death or severe injury.

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

Generally, the following steps apply when establishing safety:

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

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

⚠ WARNING

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

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

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

Damage to equipment due to unsuitable tightening tools.

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

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

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

Electromagnetic interference due to inadequate shield support

A lack of adequate shield support for the power cables can cause malfunctions and impermissibly high levels of interference.

- Use the shield connection plates supplied or recommended.
- Use the shield connection clips recommended.

⚠ WARNING

Active implant malfunctions due to electromagnetic fields

Converters 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 converter 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.

⚠ CAUTION

Symptomatic respiratory and skin reaction to chemicals

A newly purchased product might contain traces of substances that are identified as sensitizers.

Sensitizers are substances which can cause sensitization in the lungs and skin after exposure to them.

Once sensitized, individuals can have severe reactions to further exposure, even in small amounts. In the most extreme cases, individuals might develop asthma or dermatitis respectively.

- If the product has a strong smell, keep it in a well-ventilated area for 14 days.

⚠ WARNING
Unexpected machine movement caused by radio devices or cellphones
Using radio devices, cellphones, or mobile WLAN devices in the immediate vicinity of the components can result in equipment malfunction or faults and damage to the devices. Malfunctions may impair the functional safety of machines and can therefore put people in danger or lead to property damage. • Avoid operating radio devices, cellphones and mobile WLAN devices in the direct vicinity of converters and operating units. • Scan the machine readable code, e.g. a QR code, from a greater distance or switch off the converter power supply before scanning. • Only operate built-in devices with the control cabinet doors closed. • When control cabinet doors are open, only qualified electrical personnel are allowed to carry out service and maintenance work.

⚠ CAUTION
Radio frequency interference in residential areas
When you operate EMC category C2 devices in residential areas, the devices can cause radio frequency interference. When you operate EMC category C3 or C4 devices in residential areas, it is to be expected that the devices will cause radio frequency interference. • Do not operate EMC category C2 devices in residential areas. • Do not operate EMC category C3 or C4 devices in public low-voltage networks supplying residential buildings.

NOTICE
Damage to motor insulation due to excessive voltages
When operated on systems with grounded line conductors or in the event of a ground fault in the IT system, the motor insulation can be damaged by the higher voltage against 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

Electric shock due to unsuitable motor temperature evaluation system

Voltage flashovers to the electronics of the converter can occur in motors without safe electrical separation of the temperature sensors in accordance with IEC 61800-5-1 when the motor develops a fault.

- Install a temperature monitoring relay 3RS1… or 3RS2…
- Evaluate the temperature monitoring relay output using a digital input of the converter, e.g. using the "External fault" function.

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 insulation resistance tests
High test voltages can damage the device. • Measure the insulation resistance of low voltage circuits of machines or systems only with ≤ 500 V DC. • Measure the insulation resistance of SELV circuits of machines or systems only with ≤ 250 V DC.

NOTICE
Device damage caused by incorrect voltage tests
High test voltages can damage the device. Capacitive leakage currents can distort the test results. • Disconnect the components before carrying out a voltage test on the machine. 1)

1) The components are voltage tested in accordance with the IEC 61800-5-1 product standard and must be disconnected during testing in accordance with IEC 60204-1:2021 Section 18.4.

⚠ WARNING
Unexpected movement of machines caused by inactive safety functions
Inactive or non-adapted safety functions can trigger unexpected machine movements that may result in serious injury or death. • Observe the information in the appropriate product documentation before commissioning. • Carry out a safety inspection for functions relevant to safety on the entire system, including all safety-related components. • Ensure that the safety functions used in your drives and automation tasks are adjusted and activated through appropriate parameterizing. • Perform a function test. • Only put your plant into live operation once you have guaranteed that the functions relevant to safety are running correctly.

Note

Important Safety instructions for Safety Integrated

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

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 customer-specific solutions, but merely serve to provide assistance with 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 Cybersecurity information

Siemens provides products and solutions with industrial cybersecurity 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 cybersecurity concept. Siemens’ products and solutions constitute one element of such a concept.

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

For additional information on industrial cybersecurity measures that may be implemented, please visit
https://www.siemens.com/cybersecurity-industry.

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

To stay informed about product updates, subscribe to the Siemens Industrial Cybersecurity RSS Feed under
https://new.siemens.com/cert.

Further information is provided on the Internet:

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

⚠ WARNING

Unsafe operating states resulting from software manipulation

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

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

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 integrator must take into account the following residual risks emanating from the control and drive components of a drive system:

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

6. Influence of network-connected and wireless communications systems, e.g. ripple-control transmitters or data communication via the network or mobile radio, WLAN or Bluetooth.
7. Motors for use in potentially explosive areas:
When moving components such as bearings become worn, this can cause enclosure components to exhibit unexpectedly high temperatures during operation, creating a hazard in areas with a potentially explosive atmosphere.

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

3 System overview

3.1 Overview of the SINAMICS booksize drive system

3.1.1 SINAMICS booksize drive system

Overview

SINAMICS S220 booksize components are harmonized with one another and implemented as modular system.

Description

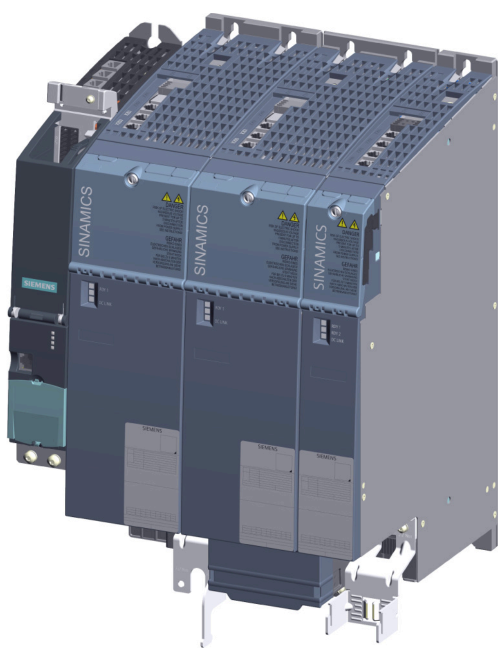


Figure 3-1 Example of a SINAMICS S220 booksize of drive line-up

The components are arranged in the following groups:

Designation	Function, use	Components (examples)
Line-side power components	Switching the energy supply and to comply with EMC regulations	• Fuses • Contactors • Reactors • Filters
Line Modules	Central energy supply into the DC link	• Smart Line Modules

Designation	Function, use	Components (examples)
DC link components	Additional components for the DC link	• Braking Modules • Capacitor Module • Control Supply Modules
Motor Modules	Inverters, which draw energy from the DC link and supply the connected motors	• Motor Modules
Motor-side power components	Additional components on the output side	• Motor reactors
Control Units	Processing cross-axis drive and technological functions	• Control Unit
Additional system components	Extend the functionality, provide various interfaces to encoders and process signals	• Option Board • Communication Board • Terminal Modules

3.1.2 Mixed operation of SINAMICS S120 and S220 components

Overview

Mixed operation of SINAMICS S120 booksize and S220 booksize components is possible.

Requirement

WARNING

Danger to life due to unsuitable firmware version

Operating SINAMICS S220 booksize components with an unsuitable firmware version can result in unsafe operating states. For example, it can lead to converter components overheating, a motor unexpectedly accelerating or safety functions not functioning.

- When using a SINAMICS S220 Smart Line Module, use a Control Unit with firmware V5.2 SP3 HF10 or later.
- When using a SINAMICS S220 Motor Module, use a Control Unit with firmware V5.2 SP3 HF9 or later.

Description

The article numbers of SINAMICS S220 booksize components start with 6SL5.

In mixed operation, the article numbers of SINAMICS S220 booksize components are displayed with the compatible article numbers of SINAMICS S120 booksize components in the engineering tools (e.g. Startdrive). If there is no compatible SINAMICS S120 booksize component for a component, then the article number of the SINAMICS S220 booksize component is displayed.

Table 3-1 Examples for displaying article numbers in mixed operation for the engineering tools (e.g. Startdrive)

Compatible SINAMICS S120 booksize component	Displays the article number	Article number on the component nameplate	Article No. in the Control Unit
Available	Article No. of the SINAMICS S120 booksize component	6SL5130-6UE21-6AC0	6SL3130-6TE21-6AA8
Not available	Article No. of the SINAMICS S220 booksize component	6SL5130-6UE21-6AD0	6SL5130-6UE21-6AD0

More information

Additional information on compatibility with SINAMICS S120 booksize components as well as mixed operation with SINAMICS S120 chassis components is provided in the Internet:

- SINAMICS S220/S120 booksize modules, compatibility list (https://support.industry.siemens.com/cs/ww/en/view/109806050)
- Mixed operation of booksize and chassis modules (https://support.industry.siemens.com/cs/ww/en/view/109757730)

3.2 Guideline, standards, certificates

3.2.1 Applicable standards

EC Declaration of Conformity

European Machinery Directive

The converters fulfill the requirements stipulated in the Machinery Directive 2006/42/EC, if they are covered by the application area of this directive.

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

European Low-Voltage Directive

The converter fulfills the requirements stipulated in the Low-Voltage Directive 2014/35/EU, insofar as they are covered by the application area of this directive.

Directive 2011/65/EU

The converters fulfill the requirements stipulated in Directive 2011/65/EU relating to the restriction of the use of certain hazardous substances in electrical and electronic devices (RoHS).

European EMC Directive

The compliance of the converter with the regulations of the Directive 2014/30/EU has been demonstrated by full compliance with the IEC/EN 61800-3.

Ecodesign Directive 2009/125/EC

The converter meets the requirements of Ecodesign Directive 2009/125/EC.

UKCA Declaration of Conformity

The converter complies with the requirements for the British market (England, Wales and Scotland).

Underwriters Laboratories (North American market)

Converters provided with the test symbols displayed fulfil the requirements stipulated for the North American market as a component of drive applications.

Australia and New Zealand (RCM formerly C-Tick)

Converters with the symbols shown comply with EMC requirements for Australia and New Zealand.

ISO 9001 and ISO 14001 quality systems

Siemens AG employs a quality management system that complies with ISO 9001 and ISO 14001.

Taking back and recycling waste electrical and electronic equipment (WEEE)

The converters fulfill the requirements stipulated in Directive 2012/19/EU with regard to the return and recycling of waste electrical and electronic equipment.

EMC requirements for South Korea

Converters with the KC marking on the nameplate fulfill the EMC requirements for 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.

3.2.2 Non-relevant certification

China Compulsory Certification

The converters do not fall in the area of validity of the China Compulsory Certification (CCC).

3.2.3 Certificates

Certificates

A list of currently certified components is available on request from your sales partner. If you have any questions relating to certifications that have not yet been completed, please ask your sales partner.

The certificates can be downloaded from the internet: Certificates (https://support.industry.siemens.com/cs/ww/en/ps/29047/cert)

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, manufacturer 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/29047/cert).

North American market

You can find the relevant certificates on the internet pages of the certifying body (https://iq.ulprospector.com).

3.3 System data

3.3.1 General technical data

Technical specifications

Table 3-2 Technical specifications of the drive system

Feature	Value
Line connection voltage	3 AC 380 ... 480 V ±10% (-15% < 1 min)
Line frequency	50/60 Hz (47 ... 63 Hz)
Electronic power supply	24 V DC -15 / +20%[1], safety/protective extra-low voltage (SELV/PELV)[2]
Maximum rated short-circuit current (SCCR) according to UL 61800-5-1 or I_{cc} according to IEC 61800-5-1	100 kA at 480 V The SCCR or I_{cc} value depends on the overcurrent protective device used. The SCCR or I_{cc} value is included in the following product information: "Protective Devices for SINAMICS S220 Line Modules Booksize (https://support.industry.siemens.com/cs/ww/en/view/109804134)"
Electromagnetic compatibility	According to IEC 61800-3: Used in the second environment (industrial line supplies). Without additional components, Category C3. With additional components, Category C2.
Overvoltage category	III[3] according to IEC 61800-5-1, UL 61800-5-1 and CSA C22.2 No 274
Pollution degree	2 according to IEC 61800-5-1, UL 61800-5-1 and CSA C22.2 No 274
Sound pressure level with internal air cooling	< 75 dB(A) < 85 dB(A) for Motor Modules 85 A ... 200 A

1) In the event of a fault, the power supply voltage must not exceed 60 V DC (DVC A).

2) Power supplies with safety extra-low voltage (SELV) can be used. The electric circuit must be implemented as a PELV circuit due to the internal grounding of the 24 V electronic power supply in the components.

3) The components are designed for connection to circuits of overvoltage Category III. Ensure this through the installation itself or install an upstream overvoltage protection device. Limit any overvoltages to 6 kV with respect to ground and 4 kV between phases. Use overvoltage protection devices that are suitable for the line voltage and the prospective short-circuit current of the line.

3.3.2 Degree of protection / protection class

Technical data

Table 3-3 Degree of protection and protection class of the drive system

Feature	*Value*
Degree of protection	IPXXB according to IEC 60529, open type according to UL/CSA
Protection class	I (with protective conductor connection) according to IEC 61800-5-1

3.3.3 Environmental conditions

Technical data

Table 3-4 Protection against chemically active substances

Usage phase	Description
Long-term storage	Class 1C2 according to IEC 60721-3-1:1997, in product packaging[1)]
Transport	Class 2C2 according to IEC 60721-3-2:1997, in transport packaging[2)]
Operation	Class 3C2 according to IEC 60721-3-3:2002 Class 3C2 according to IEC 60068-2-42 degree of severity G3 according to ANSI/ISA-S71.04.2013 Class 3C3 according to IEC 60721-3-3:2002 for H2S and SO2

Table 3-5 Biological environmental conditions

Usage phase	Description
Long-term storage	Class 1B1 according to IEC 60721-3-1:1997, in product packaging[1)]
Transport	Class 2B1 according to IEC 60721-3-2:1997, in transport packaging[2)]
Operation	Class 3B1 according to IEC 60721-3-3:2002

Table 3-6 Climatic environmental conditions

Usage phase	Description
Long-term storage	Class 1K4 according to IEC 60721-3-1:1997, in product packaging[1)] Temperature: -25 ... +55 °C
Transport	Class 2K4 according to IEC 60721-3-2:1997, in transport packaging[2)] Temperature: -40 ... +70 °C
Operation	Class 3K3 according to IEC 60721-3-3:2002 with increased ruggedness with respect to relative humidity Temperature: -10 ... +40 °C without reduction of the output current > 40 ... +55 °C with reduction of the output current by 2.67 % per °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

Table 3-7 Mechanical environmental conditions

Usage phase	Description
Long-term storage	Class 1M2 according to IEC 60721-3-1:1997, in product packaging[1)]
Transport	Class 2M3 according to IEC 60721-3-2:1997, in transport packaging[2)]
Operation	Class 3M1 according to IEC 60721-3-3:2002
Vibration test in operation	According to IEC 60068-2-6 test Fc (sinusoidal) • 9 ... 29 Hz: 0.3 mm amplitude of deflection • 29 ... 200 Hz: 1 g acceleration amplitude • 10 frequency cycles per axis
Shock test in operation	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

1) Product packaging (storage packaging) is single unit 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.

3.3.4 Installation altitude

Technical data

Table 3-8 Installation altitude for the drive system

Usage phase	Description
Operation	0 ... 1000 m above sea level without reducing the output current and the ambient temperature > 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 with line supplies with grounded neutral point, or • Operation with an isolating transformer with secondary grounded neutral point

Application planning 4

4.1 Service life

Requirement

⚠ WARNING
Unexpected motor response when the service life is exceeded If the service life is exceeded, the probability of failure of the Safety Integrated Functions increases. This can result in unexpected motor movement and as a consequence can cause accidents involving death or severe injury. • Take the converter out of service once the service life has been exceeded.

Description

You may not operate converters with active Safety Integrated Functions for longer than 20 years. The 20 years starts when the device is delivered. The service life cannot be extended. This is the case even if a service department checks the converter – or in the meantime, the converter was decommissioned.

A defective converter with active Safety Integrated Functions cannot be repaired and must be replaced by a brand new converter.

4.2 Protecting persons from electromagnetic fields

Requirement

⚠ WARNING
Negative impact on health from electromagnetic fields During operation, converters generate electromagnetic fields (EMF). Electromagnetic fields can have a negative impact on your health and can even cause death. • As operating company, carefully design workplaces so that workers are protected from impermissibly strong electromagnetic fields. • When working close to the converter, carefully comply with the data on electromagnetic compatibility (EMC) provided in the product documentation. • Maintain the minimum clearances to the converter.

The converter components are installed according to the EMC guidelines in the technical documentation:

- The components are operated inside a metal control cabinet.
- The motor connection cables are shielded.

Protection against electromagnetic fields (EMF) is defined in the following guidelines and regulations, for example:

- European EMF-Guideline 2013/35/EU
- 26th BImSchV (German Federal Emission Protection Regulations)

Limit values according to ICNIRP 2020 for a workplace are the basis for assessing electromagnetic fields.

Description

To determine the minimum clearance, the electromagnetic field of the converter was evaluated as follows:

- At the pulse frequency, e.g. 4 kHz
- At a multiple of the pulse frequency up to a maximum of 100 kHz

The following tables contain the evaluation of the electromagnetic fields and the minimum clearances to the converter components.

The minimum clearance is applicable for the head and the entire torso of the human body. Smaller clearances are possible for extremities.

Measurements for SINAMICS S220 booksize components

Table 4-1 Data for frequency range 0 Hz to 300 GHz

Frequency range	**Frequency range**	
	0 Hz ... 100 kHz	**100 kHz ... 300 GHz**
Electric field strength	Limit values not exceeded	Limit values not exceeded
Magnetic flux density	Evaluation in the following table	Limit values not exceeded

Table 4-2 Minimum clearance based on magnetic flux density (0 Hz ... 100 kHz)

<table>
<tr><th rowspan="2">Rated power of component</th><th rowspan="2">Unit</th><th colspan="2">General</th><th colspan="2">Individuals with active implants</th></tr>
<tr><th>Closed control cabinet</th><th>Open control cabinet</th><th>Closed control cabinet</th><th>Open control cabinet</th></tr>
<tr><td>≤ 55 kW</td><td>cm (inch)</td><td>0 (0)</td><td>25 (10)</td><td rowspan="2">The limit value of 100 µT (RMS) at 50 Hz is not exceeded. Must be assessed depending on the active implant.</td><td rowspan="2">Must be assessed depending on the active implant.</td></tr>
<tr><td>55 kW ≤ 120 kW</td><td>cm (inch)</td><td>0 (0)</td><td>50 (20)</td></tr>
</table>

A 24 V component, e.g. Control Unit, Terminal Module, Sensor Module, DRIVE-CLiQ Switch Module or Voltage Sensing Module, does not emit any significant electromagnetic fields.

No minimum clearance has to be maintained with respect to a 24 V component.

4.3 Protecting against the spread of fire

Description

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

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

4.4 Protection against condensation and electrically conductive pollution

Description

Carefully observe the following for protection against mechanical and climatic conditions as well as to guarantee functional safety and the Safety Integrated safety functions: The components must always be operated in housings, cabinets or enclosed electrical operating areas/rooms, which as a minimum have degree of protection IP54 according to IEC 60529 or are in compliance with US, Canadian and Mexican regulations as type 12 enclosure, according to NEMA 250.

A lower degree of protection is permissible, if condensation, conductive pollution and all other types of pollution can be excluded at the installation site.

It is not intended that the device is cleaned.

4.5 Low-voltage switchgear and controlgear assemblies

Description

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.

4.6 Operation on a TN system

Overview

The drive line-up is suitable for connection to a TN system.

Requirement

The following applies when connecting line filters and Line Modules to a TN system:

- Operation on TN systems with grounded neutral point is permissible
- Operation on TN systems with grounded line conductor not permissible

Description

The TN system transfers the PE protective conductor to the installed electrical installation using a conductor.

Generally, in a TN system the neutral point is grounded. There are variants of a TN system with grounded line conductor, e.g. with grounded L1.

The TN system can transfer the neutral conductor N and the PE protective conductor either separately or combined.

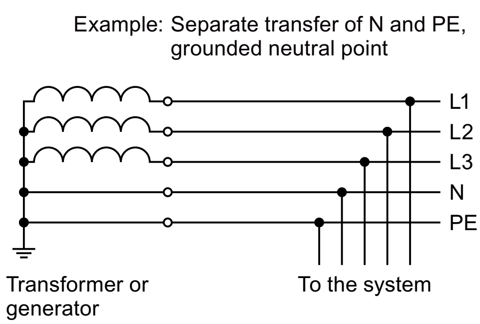


Figure 4-1 TN system

4.7 Operation on a TT system

Overview

The drive line-up is suitable for connection to a TT system.

Requirement

The following applies when connecting line filters and Line Modules to a TT system:

- Operation in IEC or UL systems
  - For installations according to IEC, operation on TT systems is permissible.
  - For installations according to UL, operation on TT systems is not permissible.
- Line filters and Line Modules
  - Operation on TT systems with grounded neutral point is permissible
  - Operation on TT systems without grounded neutral point is not permissible

Description

In a TT system, the PE protective conductor of the transformer and the installed system are independent of one another.

There are TT systems with and without transfer of the neutral conductor N.

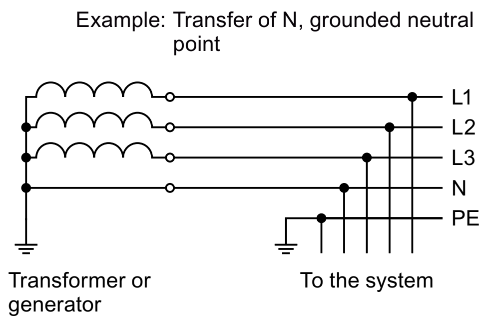


Figure 4-2 Example: Transfer of the neutral conductor, grounded neutral point

4.8 Operation on an IT system

Overview

The drive line-up is suitable for connection to an IT system.

Requirement

When connected to an IT system, only Line Modules without line filter are permissible.

Description

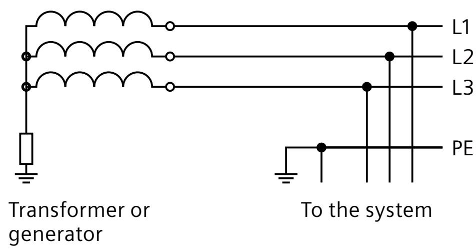
In an IT system, all active conductors are isolated from ground or are connected to ground through a high-resistance impedance.

Either a transformer or an independent current source such as a generator is used for infeed.

No active conductor is connected to ground through a low resistance.

Under defined conditions, it is also possible to include the neutral conductor in an IT system.

Example: IT network without neutral conductor



Example: IT network with neutral conductor

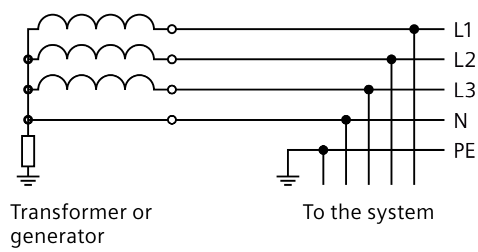


Figure 4-3 IT system

4.9 Conditions for the line connection

Description

Table 4-3 Conditions for connecting Smart Line Modules to the line supply

Component	Description[1)]
Smart Line Module	Operation on line supplies from $S_{K\ line}/P_{rated} \geq 30$

1) $S_{K\ line}$ = short-circuit power of the line supply; P_{rated} = rated power of the Line Module

4.10 Power failure-buffering concept

Description

Dimension the system comprising Line Modules and Motor Modules so that at the rated power there is no functional restriction (3 ms of the line supply dip or interruption according to IEC 61800-3 (2017)).

General statements cannot be made regarding the buffer times. These can be extended a multiple number of times depending on the particular drive system and the operating conditions. Significantly longer buffer times can be obtained when components operate in either the motoring or generating mode. The existing installation must be assessed on a case-for-case basis.

4.11 24 V DC supply voltage

4.11.1 Selecting power supply

Overview

The following components require a 24 V DC voltage:

- Electronics of the components via the integrated 24 V busbar
- Electronics of the Control Units, Option Boards, Sensor Modules and Terminal Modules
- Digital outputs
- Holding brakes

Requirement

NOTICE
Damage to other loads as a result of overvoltage
Overvoltage of switched inductances (contactors, relays) can damage connected loads. • Install suitable overvoltage protection circuits.

Description

Use power supplies with safety extra-low voltage (SELV) or protective extra-low voltage (PELV) to supply the components. In SINAMICS S220 booksize components, the electronics ground M is permanently connected to the protective conductor potential. This is the reason that you must implement the circuit as PELV circuit.

Component	Input voltage
Drive line-up	24 V DC -15 / +20 %, safety/protective extra-low voltage (SELV/PELV)[1)]

1) In the event of a fault, the power supply voltage must not exceed 60 V DC (DVC A).

The following also applies:

- When connected to a "DC power supply" as specified in EN 60204-1:1997, Chapter 4.3.3, malfunctions may occur due to the voltage interruptions permitted for them.
- The 24 V supply voltage ripple must not exceed 2.5 %.

- When using a holding brake, take into consideration the restricted voltage tolerances (24 V ± 10%) that may apply.
- A malfunction can occur if the 24 V supply voltage falls below the specified minimum value at a component in the drive line-up.
  - Select an input voltage that is high enough for there to be sufficient voltage at the last component.
  - Do not exceed the maximum supply voltage value.
  - If required, supply the voltage to the assembly at various locations in the drive line-up.

Supplying other loads

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

4.11.2 Selecting the input voltage of a holding brake

Requirement

NOTICE
Premature wear of the holding brake when incorrectly operated
Operating the holding brake outside its permissible voltage range at the motor connection will damage the brake. • Ensure that the holding brake is only operated within its permissible voltage range.

NOTICE
Faulty holding brake function due to inadmissible wear
Inadmissible wear means that the holding brake function can no longer be guaranteed. • Comply with the specified EMERGENCY STOP characteristics. • Avoid repeated brief acceleration of the motor against a holding brake that is still closed. Consider the operating times of the holding brakes and relay switching times in the drive control and when enabling the drive.

Note

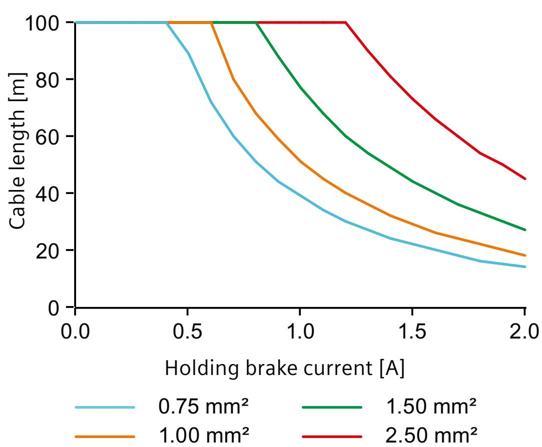
Protection circuit against overvoltages

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

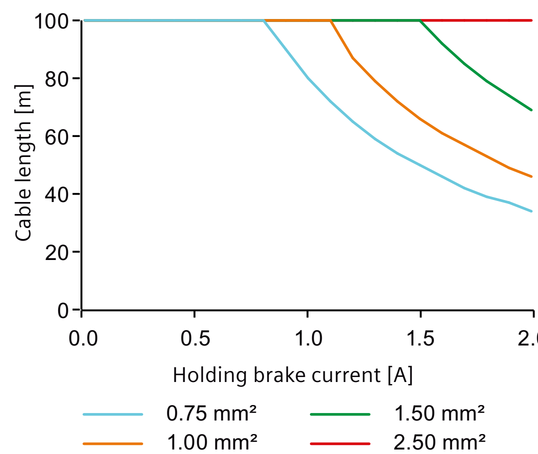
Procedure

The holding brake requires a typical voltage of 24 V ±10%. Proceed as follows to determine the input voltage of the Motor Module that matches the holding brake:

1. Take the holding brake voltage and its tolerance from the motor technical data.
   - Take into account possible voltage drops in the Motor Module and along the supply cable. Use a Control Supply Module or a controlled DC power supply whose setpoint is set to at least 26 V.
   - Note that there are holding brakes that close again when the maximum voltage is exceeded.
2. Check the permissible cable length using the following diagrams.



24 V input voltage



26 V input voltage

4.11.3 Selecting power supply units

The following devices meet the applicable requirements of EN 60204-1 and they are recommended:

Recommended power supplies: SITOP Power modular				
Rated output current [A]	**Phases**	**Rated input voltage [V] Operating voltage range [V]**	**Short-circuit current [A]**	**Article number**
5	1 / 2	AC 120 ... 230/230 ... 500 85 ... 264/176 ... 550	approx. 5.5 (running up) typ. 15 for 25 ms (in operation)	6EP1333-3BA00-8AC0
10	1 / 2	AC 120 ... 230/230 ... 500 85 ... 264/176 ... 550	approx. 12 (running up) typ. 30 for 25 ms (in operation)	6EP1334-3BA00-8AB0
20	1 / 2	AC 120 / 230 85 ... 132/176 ... 264	approx. 23 (running up) typ. 60 for 25 ms (in operation)	6EP1336-3BA00-8AA0
	3	3 AC 230/400 ... 288/500 320 ... 550		6EP1436-3BA00-8AA0

Recommended power supplies: SITOP Power modular				
Rated output current [A]	**Phases**	**Rated input voltage [V] Operating voltage range [V]**	**Short-circuit current [A]**	**Article number**
40	1 / 2	AC 120/230 85 ... 132/176 ... 264	approx. 46 (running up) typ. 120 for 25 ms (in operation)	6EP1337-3BA00-8AA0
	3	3 AC 230/400 ... 288/500 320 ... 550		6EP1437-3BA00-8AA0

Recommended power supply: SITOP PSU400M				
Rated output current [A]	**Phases**	**Rated input voltage [V] Operating voltage range [V]**	**Short-circuit current [A]**	**Article number**
20	-	300 ... 824 DC	approx. 40 (running up) typ. 60 for 25 ms (in operation)	6EP1536-3AA00

Recommended power supply: Control Supply Module				
Rated output current [A]	**Phases**	**Rated input voltage [V] Operating voltage range [V]**	**Short-circuit current [A]**	**Article number**
20	3	3 AC 380 ... 480 300 ... 800 DC	< 24	6SL3100-1DE22-0AA1

4.11.4 Overcurrent protection

Overview

The cables on the primary and secondary sides of the 24 V power supply must be protected against impermissible overcurrents.

Description

Primary side protection must be implemented according to the manufacturer's instructions.

Secondary side protection depends on the prevailing situation:

- Load levels as a result of connected loads, including the simultaneity factor depending on the operation of the machine
- Establishing the 24 V connection between the components in the drive line-up via the 24 V busbars integrated in the components; continuous current-carrying capacity of these 24 V busbars: 20 A
- Continuous current-carrying capacity of the conductors and cables used in normal and short-circuit conditions
- Ambient temperature

- Cable bundling (laying cables in a common duct)
- Type of cable routing

Determine the overcurrent protection devices based on EN 60204-1, Section 14.

The following are recommended as overcurrent protection devices:

- Primary side: Circuit breakers
- Secondary side: Miniature circuit breakers or SITOP select (article number 6EP1961-2BA00)

Consider the following when selecting the miniature circuit breaker.

- Local installation guidelines
- Tripping characteristic of the miniature circuit breaker

Select the miniature circuit breaker to match the loads to be protected. Also take into account the maximum current provided by the power supply unit in the case of a short-circuit.

Table 4-4 Miniature circuit breaker according to core cross-section and temperature

Core cross-section of the cable	Maximum rated current of the miniature circuit breaker	
	Max. current up to 40 °C	Max. current up to 55 °C
1.5 mm^2	10 A	6 A
2.5 mm^2	16 A	10 A
4 mm^2	25 A	16 A
6 mm^2	32 A	20 A
24 V busbar	20 A	20 A

More information

You can find more information about possible overcurrent protection devices on the Internet:

Siemens Industry Mall (https://mall.industry.siemens.com/goos/WelcomePage.aspx?regionUrl=/de&language=en)

4.11.5 Overvoltage protection

4.11.5.1 Using overvoltage protection elements

Overview

To protect the 24 V supply of the components against overvoltage, from a certain cable length, overvoltage protection elements must be installed.

Description

Overvoltage protection elements are required for a cable length of 30 m and longer.

The following overvoltage protection element is recommended:

Overvoltage protection element			
Component / cables	**Manufacturer**	**Article**	**Article number**
24 V power supply	Dehn	BVT AVD 24	918422

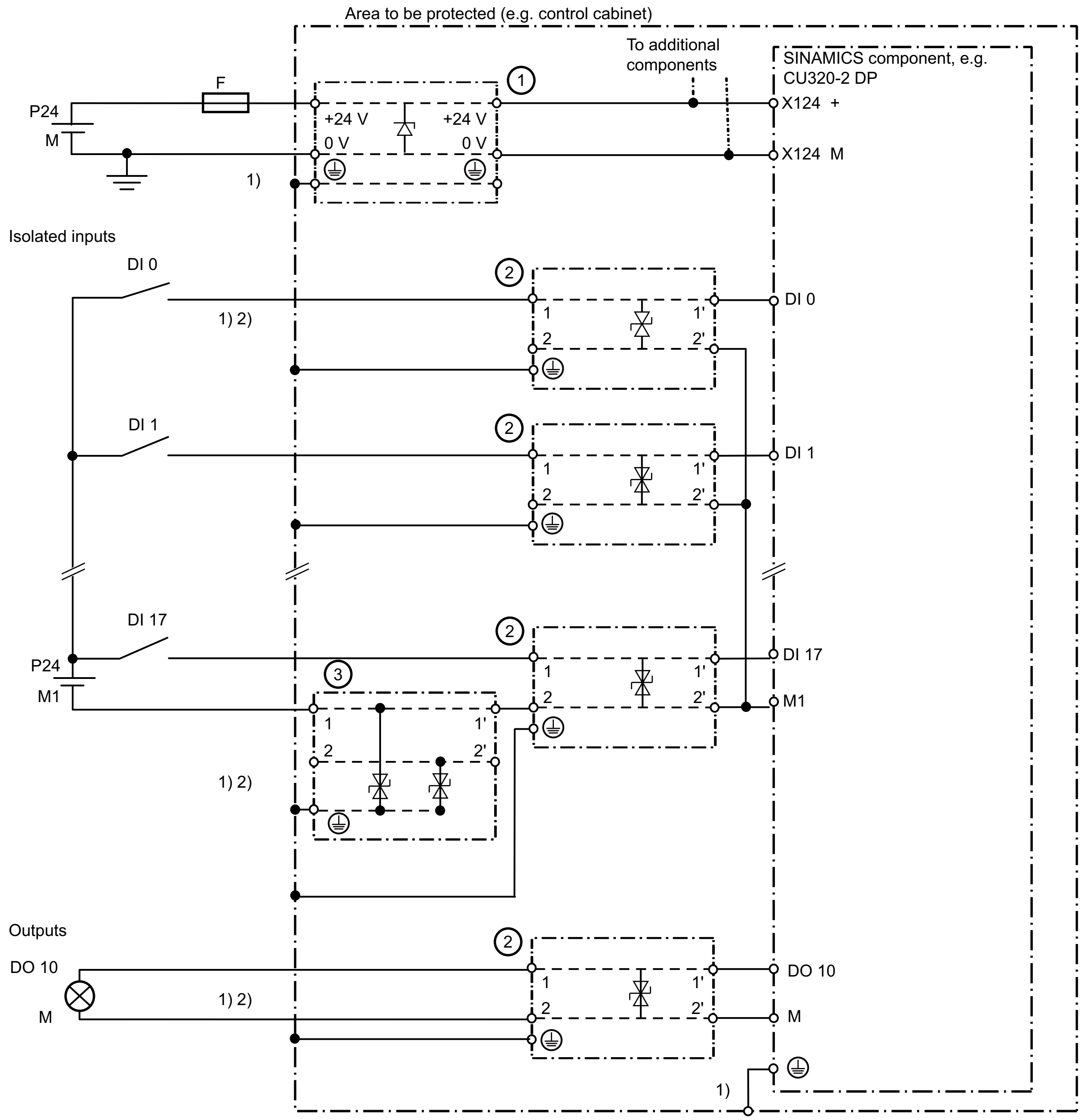
4.11.5.2 Connection example for overvoltage protection elements

Connection example

The position of the connection for the overvoltage protection element is shown in the following connection example.

Observe the following notes when installing overvoltage protection elements:

- Always place overvoltage protection elements at the boundary of the area to be protected, e.g. at the entry point to the control cabinet.
- Install an overvoltage protection element for all 24 V cables that exit the protected area.



1. 24 V overvoltage protection supply
2. 24 V overvoltage protection signal cable differential
3. 24 V overvoltage protection signal cable protective conductor

1) For equipotential bonding, the metal enclosure of the component and the protective conductor connection of the overvoltage protection element must be conductively connected. You can achieve this, for example, by mounting the component on a metal mounting plate to establish a good electrically conductive connection. Then connect the protective conductor connections of the overvoltage protection elements to the mounting plate through the shortest distance.

2) The overvoltage protection element is snapped-on to a metal DIN rail for equipotential bonding of overvoltage protection elements for signal cables. It is then sufficient to conductively connect the DIN rail to the metallic enclosure of the component. To establish this connection, mount the DIN rail and the component on a common metal mounting plate.

Figure 4-4 Connecting the overvoltage protection elements to a CU320-2 DP

4.12 Cable selection and cable routing

Description

Comply with the following notes when installing power and signal cables to guarantee, safe, reliable, permanent and disturbance-free operation:

- Only use DRIVE-CLiQ signal cables from Siemens.
- Siemens cables are also recommended for all other power and signal cables.
- Always follow the correct procedures for the shielding and the specified cable lengths.

4.13 Cable lengths

4.13.1 Maximum permissible cable lengths

Technical specifications

An overview of the maximum permissible lengths of all signal, supply and power cables is provided in the following table.

Also comply with the following notes:

- Keep all cables as short as possible to minimize the antenna effect.
- Carefully observe the permissible cable lengths and the maximum total cable lengths for the various EMC categories.

Table 4-5 Maximum permissible cable lengths

Cables	Unit	Max. permissible cable lengths
24 V DC power supply cables	m	30[1)]
24 V signal cable for digital input X21/X22	m	1000
Temperature sensor signal cable for X21/X22 KTY input		
Unshielded	m	30
Shielded	m	600
DRIVE-CLiQ signal cables MC500	m	100
DRIVE-CLiQ signal cables MC800PLUS	m	75
DC link cable, shielded	m	10[2)]
Connecting cable between line filter and line reactor, shielded	m	10[2)]

Cables	Unit	Max. permissible cable lengths
Connecting cable between line reactor and Line Module, shielded	m	10[2)]
Power cable between motor and Motor Module with I_N = 3 A ... 9 A, shielded	m	50[3)]
Power cable between motor and Motor Module with I_N = 18 A ... 24 A, shielded	m	70[3)]
Power cable between Motor and Motor Module with I_{rated} = 30 A ... 200 A, shielded	m	100[3)]

1) Connect suitable overvoltage protection elements for cable lengths exceeding 30 m.

2) Shielding is not required if the cables are not longer than 1 m or they are routed close to the rear panel of the metal control cabinet.

3) Longer motor cables are possible if the output current reduction is taken into consideration or motor reactors are used.

4.13.2 Configuring the Motor Modules depending on the cable length

Description

If you require a longer motor connection cable than your Motor Module permits, then you must select a larger Motor Module or reduce the permissible continuous output current $I_{continuous}$ in relation to the rated output current I_{rated}.

Table 4-6 Configuration rules for the Motor Modules depending on the cable length

Rated output current I_{rated}	**Length of the motor connection cable (shielded)**		
	> 50 ... 100 m	**> 100 ... 150 m**	**> 150 ... 200 m**
3 A ... 5 A D type	Use Motor Module 9 A D type	Use Motor Module 9 A D type	Not permissible
9 A D type	Use Motor Module 18 A C type or $I_{max} \leq 2.2$ x I_{rated} $I_{continuous} \leq 0.95$ I_{rated}	Use Motor Module 18 A C type	Not permissible
18 A ... 24 A C type	≤ 70 m: Always permissible > 70 m: Use Motor Module 18/24 A D type or $I_{max} \leq 1.6 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	$I_{max} \leq 1.5 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	$I_{max} \leq 1.2 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$
18 A ... 24 A D type	≤ 70 m: Always permissible > 70 m: I_{max}: No restriction $I_{continuous} \leq 0.95 \times I_{rated}$	$I_{max} \leq 2.7 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	$I_{max} \leq 2.4 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$
30 A C type	Always permitted	$I_{max} \leq 1.4 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	$I_{max} \leq 1.3 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$

Rated output current I_{rated}	Length of the motor connection cable (shielded)		
	> 50 ... 100 m	**> 100 ... 150 m**	**> 150 ... 200 m**
30 A D type	Always permitted	$I_{max} \leq 2.7 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	$I_{max} \leq 2.4 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$
45 A ... 60 A C type	Always permitted	$I_{max} \leq 1.8 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	$I_{max} \leq 1.6 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$
85 A C type	Always permitted	$I_{max} \leq 1.5 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	$I_{max} \leq 1.3 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$
132 A C type	Always permitted	$I_{max} \leq 1.4 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	$I_{max} \leq 1.2 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$
200 A C type	Always permitted	$I_{max} \leq 1.25 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	$I_{max} \leq 1.1 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$
85 A ... 200 A D type	Always permitted	I_{max}: always permitted $I_{continuous} \leq 0.95 \times I_{rated}$	$I_{max} \leq 1.8 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$

Also observe the following notes:

- Motor connection cables longer than 200 m are not permissible.
- When using a holding brake, the maximum motor cable length is 100 m. Voltage drops may occur as a function of the motor cable length, holding brake current and cross-section of the holding brake cables.

4.13.3 Maximum permissible total cable length

Overview

The maximum total cable length is the sum of all cable lengths of all power cables used in the drive line-up. Specifically, this means the sum of all motor cables, the line supply cable from the line reactor or when using a line filter, from the line filter to the Line Module as well as the DC link length.

The maximum total cable length in a drive line-up depends on the following preconditions:

- EMC category
- Use with or without a line filter

Description

Table 4-7 Maximum permissible total cable length according to the system design and EMC category in m[1)]

Smart Line Module Rated power	Line filter	Line reactor	Category C2	Category C3	Limit values not complied with
16 kW ... 36 kW	-	x	-	-	1000
16 kW ... 36 kW	x	x	750	1000	-
55 kW	-	x	-	-	1200
55 kW	x	x	750	1200	-

1) Cables must be shielded in order to comply with EMC limit values according to IEC 61800-3.

4.14 Continuous current-carrying capacity and factors to reduce the current for power and signal cables

4.14.1 Requirements for cable cross-sections

Requirement

⚠ WARNING

Overheating of power cables when permissible cross-sections are fallen below

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

- Only use power cables with sufficiently large cross-sections. Take into account the routing type, ambient temperature and cable length.
- If smaller cross-sections are selected, you must ensure the appropriate level of conductor protection in another way, e.g. by suitably setting closed-loop control parameters.

Description

Dimension cable cross-sections in compliance with local installation regulations.

4.14.2 Cable requirements for UL applications

Description

Additional requirements apply to cables for UL applications:

- For UL applications, only use copper cables with a specific thermal stability:
  - Smart Line Modules: 75 °C
  - Motor Modules 3 - 60 A: 60/75 °C
  - Motor Modules 85 - 200 A: 75 °C
- Copper cables with a higher thermal stability can also be used.
- 60/75 °C or 75 °C copper cables serve as the basis for calculating cable cross-sections.
- The current carrying capacity of the cable must be at least 125 % of the rated current of the component.

4.14.3 Continuous current-carrying capacity for power and signal cables

Technical data

The continuous current-carrying capacity of PVC/PUR-insulated copper cables is specified for routing types B1, B2 and C under conditions for continuous operating according to IEC 60364-5-52 in the following tables. The values are applicable for an ambient air temperature of 40 °C.

Table 4-8 Continuous current-carrying capacity for signal cables according to EN 60204-1 for 40 °C ambient temperature

Type of routing	Description
B1	Cables in conduits or cable ducts
B2	Multi-conductor cables in conduits or cable ducts
C	Cables routed along walls, without protective tubes and cable ducts

Table 4-9 Continuous current-carrying capacity for signal cables according to EN 60204-1 for 40 °C ambient temperature

Cable cross-section for signal cables [mm²]	Continuous current-carrying capacity rms [A], AC 50/60 Hz or DC, for routing type		
	B1	**B2**	**C**
0.20	–	4.3	4.4
0.50	–	7.5	7.5
0.75	–	9.0	9.5

Table 4-10 Continuous current-carrying capacity for power cables according to EN 60204-1 for 40 °C ambient temperature

Cable cross-section for power cables [mm²]	Continuous current-carrying capacity rms [A], AC 50/60 Hz or DC, for routing type		
	B1	**B2**	**C**
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

Cable cross-section for power cables [mm²]	Continuous current-carrying capacity rms [A], AC 50/60 Hz or DC, for routing type		
	B1	B2	C
70	149	130	160
95	180	165	194
120	208	179	225

Table 4-11 Continuous current-carrying capacity for power cables according to IEC 60364-5-52 for 40 °C ambient temperature

Cable cross-section for power cables [mm²]	Continuous current-carrying capacity rms [A], AC 50/60 Hz or DC, for routing type		
	B1	B2	C
150	–	–	260
185	–	–	297
> 185	Values must be taken from the standard		

4.14.4 Continuous current-carrying capacity as a function of the ambient temperature

Technical data

As a function of the ambient temperature, you can calculate the continuous current-carrying capacity for power and signal cables based on the correction factors from the subsequent table.

Table 4-12 Correction factors for the continuous current-carrying capacity according to the ambient temperature

Ambient air temperature [°C]	Correction factor according to IEC 60204-1
30	1.15
35	1.08
40	1.00
45	0.91
50	0.82
55	0.71
60	0.58

4.15 Power losses

4.15.1 Power losses in rated operation

Technical specifications

The tables below provide an overview of the power loss of all components in rated operation. The total losses of the relevant power unit (Line Module, Motor Module) are calculated from the power loss and the corresponding electronics loss of the power unit.

The specified values are valid for the following conditions:

- Line voltage for Line Modules 400 V
- Pulse frequency of the Motor Modules 4 kHz
- Operating components at their rated power (Line Modules) or rated current (Motor Modules)

Table 4-13 Power losses for Smart Line Modules during rated operation (including losses of the electronics)

Smart Line Modules	Unit	Power loss
16 kW	W	150
24 kW	W	250
36 kW	W	400
55 kW	W	650

Table 4-14 Power losses for Single Motor Modules during rated operation (including losses of the electronics)

Single Motor Modules	Unit	Power loss
3 A	W	29
5 A	W	40
9 A	W	65
18 A	W	150
24 A	W	189
30 A	W	261
30 A (slim)	W	272
45 A	W	344
60 A	W	486
85 A	W	760
132 A	W	1215
200 A	W	2010

Table 4-15 Power losses for Double Motor Modules during rated operation (including losses of the electronics)

Double Motor Modules	Unit	Power loss
2 x 3 A	W	59
2 x 5 A	W	88
2 x 9 A	W	159
2 x 18 A	W	282
2 x 18 A (slim)	W	291

Table 4-16 Power loss of line filters and line reactors for rated operation

Component	Article number	Unit	Power loss
Line filters for Smart Line Modules	6SL5100-0HE21-6DD0	W	12
	6SL5100-0HE22-4DD0	W	22
	6SL5100-0HE23-6DD0	W	28
	6SL5100-0HE25-5DD0	W	38
Line reactors for Smart Line Modules	6SL3100-0EE21-6AA0	W	90
	6SL5100-0EE21-6AD0	W	90
	6SL5100-0EE22-4AC0	W	92
	6SL5100-0EE22-4AD0	W	92
	6SL5100-0EE23-6AC0	W	99
	6SL5100-0EE23-6AD0	W	99
	6SL5100-0EE23-6AD0	W	190
	6SL5100-0EE25-5AD0	W	190

4.15.2 Calculating the power loss for Motor Modules in typical applications

Overview

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:

- Maximum motor cable length, 30 m
- 4 kHz pulse frequency
- DC link voltage 540 V - 600 V

Description

Power losses for typical applications can be calculated based on the following formula:

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

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 4-17 Coefficients to calculate the power loss in the control cabinet for Motor Modules for typical applications

Motor Module	a [W]	S_1 [W/A]	S_2 [W/A²]
Single Motor Module 3 A	17	3.29	0.205
Single Motor Module 5 A	18	3.29	0.205
Single Motor Module 9 A	19	3.29	0.205
Single Motor Module 18 A	24	3.29	0.205
Single Motor Module 24 A	24	3.50	0.140
Single Motor Module 30 A	18	4.71	0.113
Single Motor Module 30 A (slim)	29	4.71	0.113
Single Motor Module 45 A	24	4.40	0.060
Single Motor Module 60 A	24	4.40	0.055
Single Motor Module 85 A	125	6.01	0.017
Single Motor Module 132 A	125	6.01	0.017
Single Motor Module 200 A	125	6.01	0.017
Double Motor Module 2 x 3 A	24	5.20	0.200
Double Motor Module 2 x 5 A	26	5.20	0.200
Double Motor Module 2 x 9 A	26	5.18	0.247
Double Motor Module 2 x 18 A	23	5.57	0.091
Double Motor Module 2 x 18 A (slim)	31	5.57	0.091

Overview of typical power losses at the rated operating point

Table 4-18 Typical power losses in the control cabinet for operation at the rated operating point for Motor Modules

Motor Module	P_{Vn} [W]
Single Motor Module 3 A	29
Single Motor Module 5 A	40
Single Motor Module 9 A	65
Single Motor Module 18 A	150
Single Motor Module 24 A	189
Single Motor Module 30 A	261
Single Motor Module 30 A (slim)	272
Single Motor Module 45 A	344
Single Motor Module 60 A	462

Motor Module	P_{Vn} [W]
Single Motor Module 85 A	760
Single Motor Module 132 A	1215
Single Motor Module 200 A	2010
Double Motor Module 2 x 3 A	59
Double Motor Module 2 x 5 A	88
Double Motor Module 2 x 9 A	159
Double Motor Module 2 x 18 A	282
Double Motor Module 2 x 18 A (slim)	291

4.15.3 Losses in the partial load range for power units

Technical data

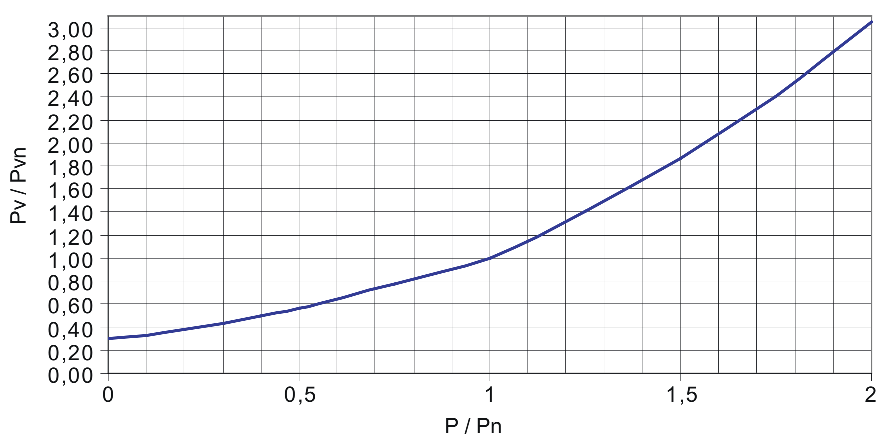


Figure 4-5 Losses in the partial load range for Smart Line Modules

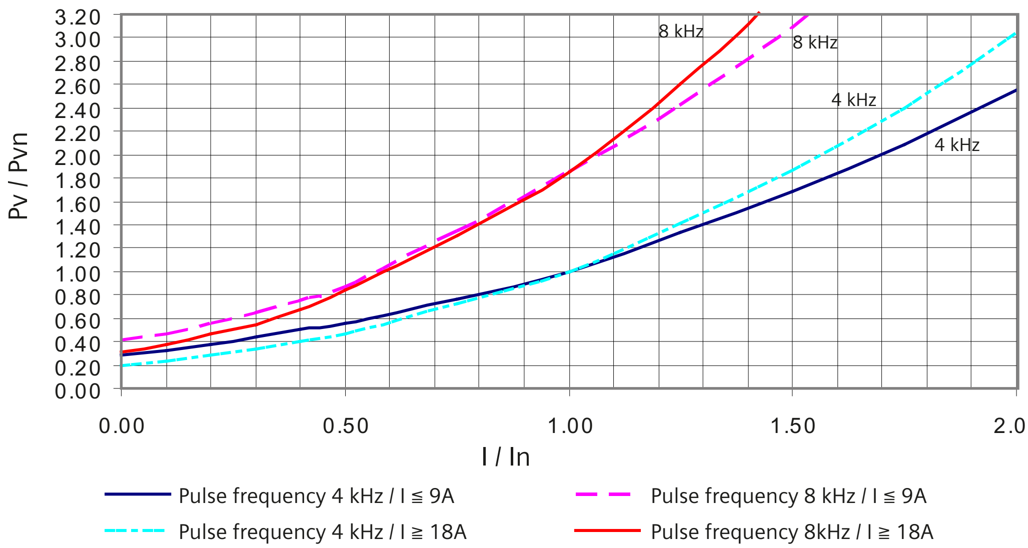


Figure 4-6 Losses in the partial load range for Motor Modules

4.15.4 Losses in the partial load range for line reactors

Technical data

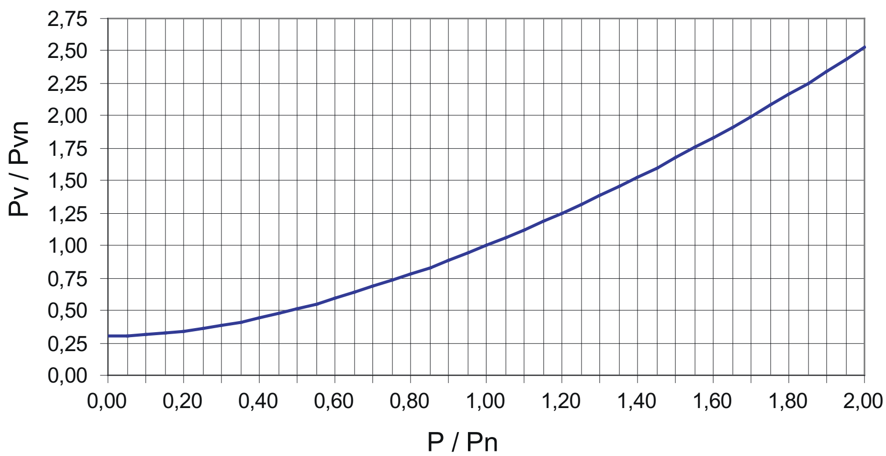


Figure 4-7 Losses in the partial load range for line reactors for Smart Line Modules

4.16 Overvoltage protection for voltage limitation

Description

Suitable overvoltage protection must be used for motors with an electromagnetic force (EMF) of between 800 V and 2000 V. This ensures that the DC link voltage will be limited in the case of a fault.

The overvoltage protection is installed within the motor cable between the Motor Module and motor. If the line voltage fails at the maximum motor speed or the pulses at the Motor Module are canceled as a result, then the motor regenerates a high voltage back into the DC link. The overvoltage protection detects an excessively high motor voltage (> 800 V) and short-circuits the 3 motor supply cables.

4.17 Electromagnetic compatibility (EMC)

4.17.1 Interference caused by electromagnetic fields

Description

Fluctuating currents and voltages generate electromagnetic fields. Electromagnetic fields can interfere with the operation of electrical devices.

Equipment that generate electromagnetic fields are called sources of interference. Sources of interference are converters that have not been correctly installed, for example. On the other hand, interference sinks are devices that are disturbed by electromagnetic fields, e.g. mobile telephones.

The type of transmission is another distinguishing feature of interference. A source of interference either transmits the interference to the sink through conduction or through radiation.

4.17.2 Electromagnetic compatibility (EMC)

Description

Interference suppression measures increase the electromagnetic compatibility (EMC).

EMC interference suppression measures allow the device to function correctly. As a consequence, the device is neither a source of interference for other devices nor an interference sink that can be disturbed by other devices.

More information

Fundamental information for EMC-compliant planning and EMC-compliant installation is provided in the Internet:

Configuration Manual EMC Installation Guideline (https://support.industry.siemens.com/cs/ww/en/view/60612658).

4.17.3 EMC environments in residential and industrial areas

Description

IEC 61800-3 defines EMC requirements for using variable-speed drives in the following 2 environments:

- 1st environment: Residential environment
  The residential environment includes residential buildings or locations where the drive is directly connected to the public low-voltage grid without using an intermediate transformer. Equipment and systems that are operated on the public low-voltage grid must comply with defined limit values for interference immunity and interference emission. The limit values are specified in the applicable standards. Especially for interference emissions, increased requirements apply regarding the 2nd environment.
- 2nd environment: Industrial Environment
  An industrial environment includes all other installations that are not directly connected to the low-voltage supply for residential buildings. The 2nd environment essentially encompasses industrial areas that are supplied from the medium voltage grid via their own transformers.

4.17.4 EMC category

Description

Together with the associated motors and encoders, including the connecting cables, the converter forms a variable-speed drive. Product standard IEC 61800-3 defines the EMC requirements for a variable-speed drive. Product standard IEC 61800-3 calls a variable-speed drive a "Power Drive System" (PDS).

IEC 61800-3 defines the categories for electromagnetic compatibility.

Table 4-19 Application environments and categories according to IEC 61800-3

Low-voltage network	Public supply network		Non-public and industrial supply networks	
Application environment	Residential	Commercial/ light industry	Industry / Large-scale plants	Heavy industry

Lowest category for high-frequency interference	C1	C2	C3	C3	C4 [1)]
Line system configuration	TN, TT				TN, TT, IT
Installation, commissioning	No requirement	By specialist personnel			

[1)] Precondition: Plant manufacturers and operating companies agree on plant-specific measures in an appropriate EMC plan. If specified in the product documentation, the drive can also be operated on ungrounded IT line systems in accordance with product standard IEC 61800-3.

More information

To comply with product standards of plants and/or machines, when integrating the drive in plants or machines, additional measures may be required. The additional measures are the responsibility of the plant builder or machine OEM.

Disturbance-free operation of the drive is only guaranteed when specialist personnel carry out the installation work in strict compliance with EMC regulations.

See also

Configuration Manual EMC Installation Guideline (https://support.industry.siemens.com/cs/ww/en/view/60612658)

4.17.5 EMC in the 2nd environment (industrial areas)

4.17.5.1 The converter in the 2nd environment

⚠ WARNING

High-frequency interference

Drives designed for the 2nd environment can cause high-frequency interference in a residential environment. In cases such as these, supplementary interference suppression measures are required.

4.17.5.2 Complying with Category C2 interference emission

Description

The drive complies with limit values of IEC 61800-3 Category C2 with regard to conducted and field-bound interference emissions under the following conditions:

- Operation on a TN or TT line system with a grounded neutral point
- Use of shielded motor cables
- Compliance with the maximum permissible total cable length
- Operation with the default pulse frequency or with reduced pulse frequency
- Using line filters:
  A separate line filter must be used for each converter.

When supplying converter components via a DC link adapter, it is not guaranteed that limit values relating to field-bound interference according to IEC 61800-3 are complied with.

For operation with a 200 A Motor Module with 8 kHz and 16 kHz pulse frequencies, it cannot be guaranteed that limit values for field-bound interference are complied with.

4.17.5.3 Complying with Category C3 interference emission

Description

The drive complies with limit values of IEC 61800-3 Category C3 with regard to conducted and field-bound interference emissions under the following conditions:

- Operation on a converter permitted for the specific line system configuration
- Use of shielded motor cables
- Compliance with the maximum permissible total cable length
- Operation with the default pulse frequency or with reduced pulse frequency
- Using line filters:
  A separate line filter must be used for each converter.

When supplying converter components via a DC link adapter, it is not guaranteed that limit values relating to field-bound interference according to IEC 61800-3 are complied with.

For operation with a 200 A Motor Module and a Line Module < 80 kW, it cannot be guaranteed that limit values for conducted interference are complied with. In this case, use a higher rating Line Module, which is suitable for the current drawn by the 200 A Motor Module.

4.17.5.4 Reduction of conducted interference above 1 MHz

Requirement

NOTICE
Damage to the line feeder cable as a result of the toroidal cores overheating
As a result of saturation effects of the toroidal cores, these can overheat and damage the line feeder cable. • Carefully ensure that the temperature of the toroidal cores lies in the permissible range. • If required, install temperature monitoring.

Description

When using devices outside their factory settings, additional measures may be required to reduce conducted interference above 1 MHz. In this case, to achieve EU conformity, it must be checked as to whether additional measures are required in the drive line-up. For a Motor Module, the factory setting for the pulse frequency setpoint (p1800) is 4 kHz.

A possible measure is to route the three line conductors of the line feeder cable and the protective conductor through toroidal cores. Series T60006 toroidal cores from VAC Vacuumschmelze with VITROPERM core material – for example T60006-L2080-W531 or equivalent – are recommended.

Install the toroidal cores directly on the line feeder cable at the entry to the electrical cabinet. Ensure that a suitable and correct mounting of the toroidal core is selected.

The user is responsible for the selection and mounting of the toroidal core.

More information

You can find more information about setting the pulse frequency setpoint on the Internet:

SINAMICS S120/S150 List Manual (https://support.industry.siemens.com/cs/ww/en/view/109827046)

4.17.5.5 Limit values for current harmonics in the industrial supply

Description

IEC 61800-3 does not define any current harmonic limits when converters are operated on industrial line supplies. A system evaluation according to IEC 61000-3-14 or IEC 61800-3 Annex B.4 is recommended.

More information

We recommend using the "TIA Selection Tool" configuring software to calculate the current harmonics of the converter.

More information about the "TIA Selection Tool" is available on the Internet:

TIA_Selection_Tool (www.siemens.com/tst)

4.17.6 EMC requirements for South Korea

Description

The EMC limit values to be observed for South Korea correspond to the limit values of the EMC product standard for adjustable speed electrical power drive systems IEC 61800-3 Category C2 or to the limit value Class A, Group 1 to KSC 9811. By implementing appropriate additional measures, the limit values according to category C2 or Class A, Group 1, are adhered to. Further, additional measures may be required, for instance, using an additional radio interference suppression filter (EMC filter).

More information

Measures to ensure EMC-compliant installation are provided in the product documentation and on the Internet:

Configuration Manual EMC Installation Guideline (https://support.industry.siemens.com/cs/ww/en/view/60612658)

4.18 Protective connection and equipotential bonding suitable for high frequencies

4.18.1 Rules to dimension the protective connection

Description

> ⚠ **WARNING**
>
> **Electric shock caused by high leakage currents when the protective conductor in the line supply 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 when dimensioning the protective conductor.

Observe the following requirements for the protective conductor connection of the control cabinet:

- Incorporate all system components and machine parts in the protection concept.
- For increased leakage currents, carefully ensure that the local regulations for protective conductors at the installation site are complied with.
- The protective connection for the motors used must be established through the motor cable.
- Use copper cables with a cross-section (> 2.5 mm²) for the ground connection of PROFIBUS participants.

More information

You can find more information about the grounding connection for PROFIBUS on the Internet:

PROFIBUS Installation Guideline (http://www.profibus.com/fileadmin/media/wbt/WBT_Assembly_V10_Dec06/index.html)

4.18.2 Conductor cross-section for protective connections

Technical data

Select the conductor cross-section of the protective conductor corresponding to the table below.

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

Table 4-20 Conductor cross-section for copper protective connections

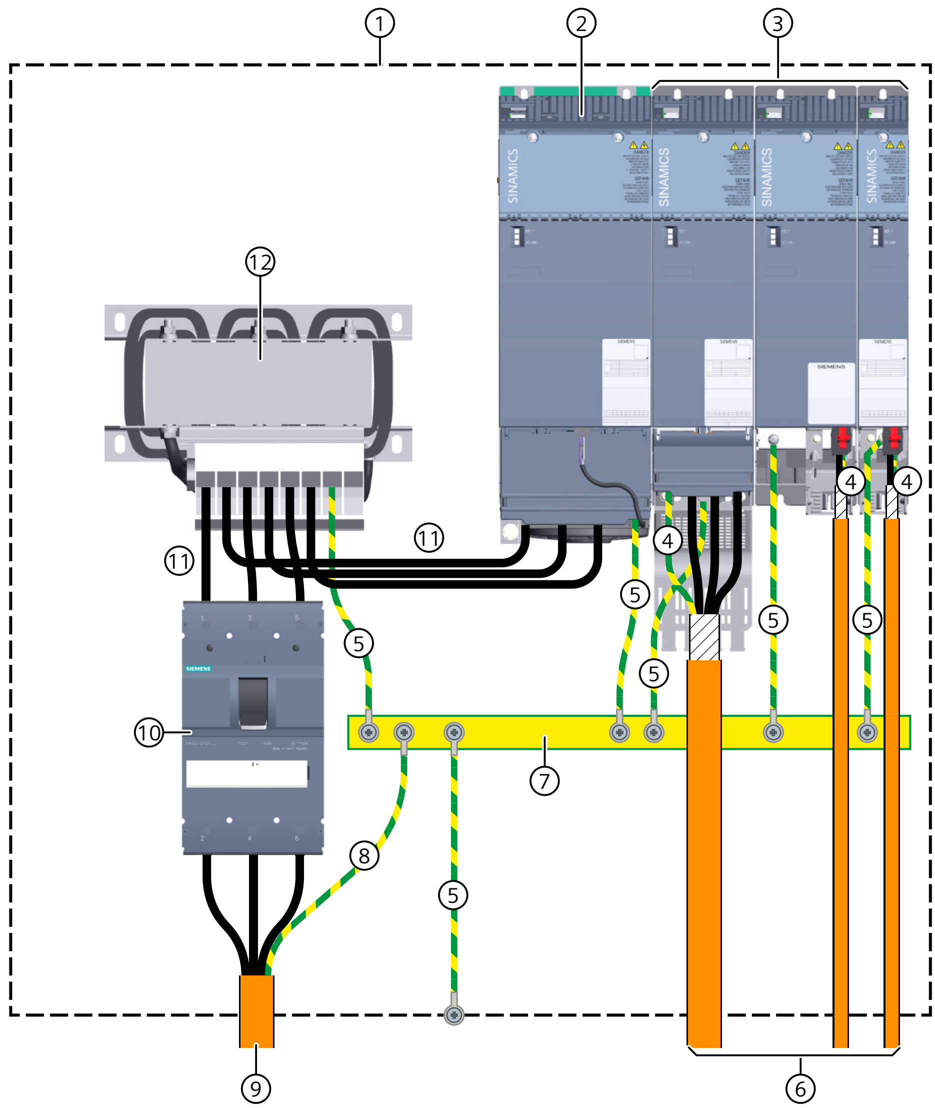
Cross-section of the line supply cable [mm²]	Cable cross-section of the copper protective connection [mm²]
Up to 16 mm²	The same as the line supply cable
From 16 mm² to 35 mm²	16 mm²
From 35 mm²	0.5 x line supply cable

4.18.3 Protective connection via the PE busbar

Overview

Install a protective connection via the PE busbar by connecting the power units with the central PE busbar in the control cabinet using a protective conductor. The following diagram shows the protective connection concept for the drive line-up as example.

Overview diagram



① Control cabinet	⑦ PE rail
② Smart Line Module	⑧ Protective conductor of the line supply cable[3)]
③ Motor Modules	⑨ Power supply cord
④ Motor protective conductor[1)]	⑩ Overcurrent protection device
⑤ Protective conductor of the component/ control cabinet[2)]	⑪ Connecting cables[2)]
⑥ Motor cables	⑫ Line reactor

Figure 4-8 Protective connection concept for the drive line-up

[1)] The protective conductor must have the same cross-section as the line conductor of the motor connection cable.

[2)] Dimension cable cross-sections in compliance with local installation regulations.

3) Dimension the protective conductor (PE) in compliance with local installation rules for equipment with increased leakage currents. As a minimum, it must satisfy one of the following conditions:

- 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, as core of a multi-core cable it has a cross-section ≥ 2.5 mm² Cu.
- As a core of a multi-core cable, the protective conductor has a cross-section ≥ 2.5 mm² Cu.

More information

You can find more information about cable cross-sections on the Internet:

SINAMICS S220 Booksize dimensioning the protective conductor (https://support.industry.siemens.com/cs/ww/en/view/109804135)

4.18.4 Protective connection via the mounting plate

Overview

As an alternative to the protective connection via the protective conductor busbar, you can also connect power units to the protective conductor connection of the control cabinet through the conductive mounting plate in the control cabinet.

Description

When establishing a protective connection via the mounting plate, carefully comply with all of the subsequent conditions:

- Use a bare metal mounting plate that is resistant to corrosion, e.g. sendzimir coated with a minimum thickness of 2 mm.
- Carefully ensure that the electrically conductive connection between the mounting plate and the control cabinet corresponding to the specifications of the control cabinet manufacturer.
- For all component fixing screws, use spring lock washer and plain washer and tighten the connection to the specified tightening torque. Equivalent screw connections are permissible.
- Mark at least one fixing screw of the component as protective conductor connection using the following symbol according to IEC 60417–5019: ⏚
- To ensure that the protective connection has been correctly established, 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 components are regularly re-tightened with the specified tightening torques.

The marked protective conductor connections of the devices are then not assigned.

4.18.5 Equipotential bonding suitable for high frequencies

Overview

Equipotential bonding suitable for high frequencies is required for all drive components to ensure the electromagnetic compatibility of the drive. This section provides information on installing equipotential bonding suitable for high frequencies for a drive line-up.

Description

Connecting the motor connection cable shield at the Motor Module and at the motor

- Connect the motor connection cable shield at the Motor Module and at the motor through a large surface area.

Using a mounting plate

- To maintain EMC limit values of the drive line-up, ensure that all components are on a common bare metal mounting plate.
- Connect the mounting plate to the protective conductor connection of the control cabinet through a low impedance.

The mounting plate simultaneously serves as surface for equipotential bonding suitable for high frequencies. As a consequence, no additional equipotential bonding is required within the drive line-up.

If a common, bare metal mounting plate is not available, then equipotential bonding must be used that is suitable for high frequencies and equally effective. Implement these using conductor cross-sections used for protective connections, or as a minimum, with the same conductivity value. More information on the cable cross-sections can be found in Chapter "Conductor cross-section for protective connections (Page 69)".

Mounting components on DIN rails

When mounting components on DIN rails, the conductor cross-sections specified in the technical data for the particular component apply. If smaller conductor cross-sections are permissible for components, the largest cross-section must be used, e.g. 6 mm^2 for TM31 and / or SMC. These requirements also apply to distributed components located outside the control cabinet.

PROFIBUS

Equipotential bonding conductors suitable for high frequencies are not required for PROFIBUS inside a control cabinet. For PROFIBUS connections between different buildings or parts of buildings, equipotential bonding suitable for high frequencies must be routed in parallel to the PROFIBUS cable. The following minimum conductor cross-sections must be observed in accordance with IEC 60364-5-54:

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

More information

You can find more information about the potential equalization for PROFIBUS on the Internet:

PROFIBUS Installation Guideline (http://www.profibus.com/fileadmin/media/wbt/WBT_Assembly_V10_Dec06/index.html)

Installation guidelines and information on protective grounding and equipotential bonding for all PROFINET types and topologies are available under "DOWNLOADS" on the Internet:

PROFIBUS & PROFINET International (https://www.profibus.com/)

Mounting 5

5.1 Installation in the control cabinet

⚠ WARNING
Spread of fire
Devices with an open construction (built-in devices) can cause a fire or a pressure wave in the event of a fault, which can result in severe personal injury and damage to property. The higher the power rating of a converter, the more dangerous the effects of an arc or pressure wave. • Install the devices in a robust metal control cabinet that is designed to prevent fire from escaping. • Only operate the devices with the control cabinet doors closed. • When control cabinet doors are open, only qualified electrical personnel are allowed to carry out service and maintenance work. • Comply with the minimum control cabinet volume.

Information on the minimum control cabinet volume is available on the Internet:

Protective Devices for SINAMICS S220 Line Modules Booksize (https://support.industry.siemens.com/cs/ww/en/view/109804134)

5.1.1 Installation regulations for SINAMICS components

Requirement

NOTICE
Reduction of component service lives through incorrect mounting
Failure to observe the guidelines for installing components in the control cabinet can reduce the service life of the parts and result in premature component failure. • Comply with the installation regulations for SINAMICS components.

Description

Power units and their accessories may only be operated in an environment as described in this documentation (pollution, ambient temperature, installation altitude, air humidity, degree of protection). More detailed information on this is provided in Chapter "System data (Page 34)".

5.1.2 Contact persons

Description

Contact the following address for support when mechanically constructing the control cabinet:

Siemens AG
Digital Industries, DI MC MF - WKC
TCCCC (Technical Competence Center Cabinets Chemnitz)
email: cc.cabinetcooling.aud@siemens.com

5.1.3 Requirements for installation

Description

For installation, for the control cabinet panel and/or mounting panel, the following preconditions apply:

- Housing: Sheet steel
- Panel thickness: min. 3 mm (0.12 in)
- Tensile strength: ≥ 270 N/mm^2 acc. to DX51 EN 10346

5.1.4 Mounting position

Requirement

NOTICE
Overheating due to inadmissible mounting position
Components can overheat and therefore be damaged if mounted in an impermissible position. • Only mount the components in a permissible mounting position in the control cabinet.

Description

The permissible mounting position for components in the control cabinet is vertical with the DRIVE-CLiQ connection at the top. Generally, all components are located directly next to one another at a central position in the control cabinet.

If another mounting position is permissible for a component, then this is separately described in the corresponding chapter (e.g. line filters, line reactors).

5.1.5 Closed-loop control of the device fan

Description

The Line Modules and Motor Modules are force-ventilated using integrated fans and cooled by natural convection. Variable speed fans are used, whose speed is aligned to the heat sink temperature. When the pulse enable is issued, the fans operate for approx. 10 - 30 s at their maximum speed. The speed is then reduced as a function of the heat sink temperature.

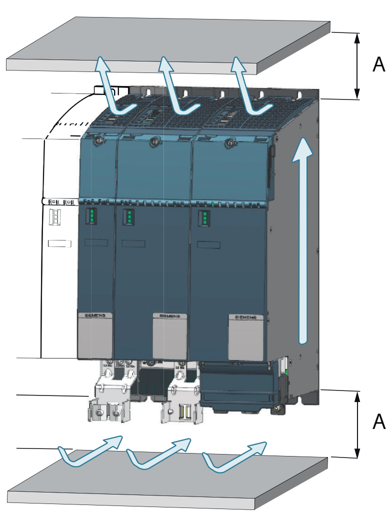
5.1.6 Ventilation clearances

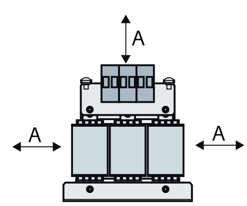
Overview

Ventilation clearances in the control cabinet protect components from overheating in operation. Inadequate ventilation clearances can result in malfunctions and can damage components.

Description

The ventilation clearances are defined by the minimum clearances of the components in the control cabinet that must be maintained. To ensure adequate ventilation in the control cabinet, the ventilation clearances as well as the ventilation slots of the components must be kept free and unobstructed. The air supply must not be significantly obstructed by the arrangement of neighboring components and the cable routing.





Minimum ventilation clearances

The following table lists the minimum clearances of the components in the control cabinet.

Table 5-1 Ventilation clearances

Component	Unit	Minimum clearances A
Smart Line Modules	mm	80[1)]
Motor Modules	mm	80[1)]
Line reactors	mm	100[2)]
Motor reactors	mm	100[2)]

1) Minimum clearance A refers to a component without shield connection plate. For the Smart Line Modules 36 kW and 55 kW and for the Motor Modules 85 A ... 200 A the lower ventilation clearance A starts from the bottom edge of the fan.

2) Ventilation clearances around the outside of line reactors or motor reactors with respect to the mounting surface

5.1.7 Components for control cabinet cooling

Description

The following options are available for cooling the control cabinet:

- Filter fans
- Heat exchanger
- Air-conditioning unit

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

5.1.8 Air humidity

Requirement

NOTICE
Component damage caused by condensation
Condensation on the components can cause them to fail. • Select the air circuit and arrangement of the cooling equipment in such a way that no condensation can form on the components. • You can install a heater in the control cabinet if required.

Description

When using air-conditioning units, the relative air humidity of the air that is discharged can increase as a result of the air being cooled in the air-conditioning unit. Under certain circumstances, the air humidity can exceed the dew point.

Comply with the following instructions:

- To avoid condensation, arrange the air-conditioning units so that cold discharged air is not directly blown onto the components.
- If required, use air guidance baffles to ensure that the air is adequately mixed with the air inside the control cabinet. Mixing with warm air reduces the relative air humidity down to uncritical values.

5.1.9 Air guidance

Overview

When installing in the control cabinet, take into account the support for the intended air guidance.

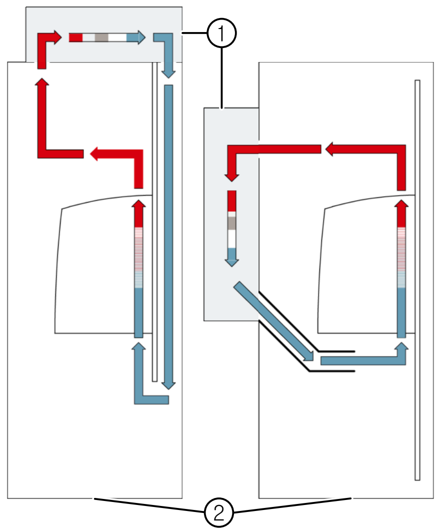
Description

Install the components so that the cooling air flows through them vertically from the bottom (cool region) to the top (warm region due to thermal component loss).

Also take into account the following notes:

- Ensure that the air flows in the right direction if you are using filter fans, heat exchangers or air-conditioning units.
- Ensure that warm air can escape at the top.
- Maintain the ventilation clearances when installing components.
- The clearance between the discharge opening of the air-conditioning unit and the electronic equipment must be at least 200 mm.
- If the components are installed in a sealed control cabinet, you must use internal air cooling that ensures an unobstructed airflow to prevent local hotspots. It is advantageous to mount the fan above the components to optimize the air flow (air is drawn in).

Example



① Air-conditioning unit
② Control cabinet

Figure 5-1 Control cabinet ventilation

5.1.10 Cable Installation

Description

Comply with the following notes when routing cables in the control cabinet:

- Route all cables as close as possible to parts connected with the control cabinet ground, such as mounting plates or cabinet side panels. Ducts made of sheet steel or cables routed between steel sheets (e.g. between the mounting plate and rear panel) should provide adequate shielding.
- Route the cables to the components so that they do not cover the ventilation slots.

5.1.11 Shield support

Description

For the shield support, Line Modules and Motor Modules have shield connection plates. The shield support for these components is described in the corresponding chapters.

For components that do not have any special shield connection or where the shield connection is not adequate, e.g. line reactors and line filters, the shield support is connected to the metal mounting plate (power cables are fastened using pipe clamps and toothed rails).

5.2 Layout of the components

5.2.1 Combination of components

Description

The modular concept of SINAMICS chassis units allows a wide range of device combinations. It is not possible to describe each individual combination. This documentation provides fundamentals and generally valid rules and regulations.

5.2.2 Selecting the Line Module to the Motor Module

Description

The DC link input current of the Motor Module was calculated for a synchronous motor with cos φ = 1. You can approximately calculate the real current based on the current and the cos φ of the motor using the following formula:

$I_{DC\ link\ real} = I_{DC\ link} * I_{Motor}/I_{Motor\ Module} * \cos\varphi$

Table 5-2 Overview of abbreviations

Abbreviation	Meaning
$I_{d\ real}$	Real DC link current of the Motor Module
I_d	DC link current of the Motor Module at rated current (I_n)
I_{Motor}	Rated motor current
$I_{Motor\ Module}$	Rated current of the Motor Module
cos φ	Motor power factor

The values for the motor are provided in the technical data of the motor. The Motor Module values are listed in the technical data of the Motor Modules.

5.2.3 Calculating the continuous current-carrying capacity of the DC link busbars

Overview

The configuration of the drive line-up is directly associated with the current requirement of the components. When engineering the system, calculate the continuous current-carrying capacity of the DC link busbars in order that they are not overloaded.

Procedure

Proceed as follows to calculate the current load of the DC link busbars:

1. Add the DC link currents $I_{DC\ link}$ of the connected Motor Modules. The DC link current values are listed in the technical data of the Motor Modules.
2. Check whether the continuous current-carrying capacity of the DC link busbars is exceeded.
   – The maximum continuous current-carrying capacity of the DC link required depends on the specific component. You can take the values from the following table:

DC link busbar or bridge	Continuous current-carrying capacity[1)]
Smart Line Modules 100 mm	200 A
Smart Line Modules 150 mm	250 A
Motor Modules 50 mm with 4 mm DC link bridges	100 A
Motor Modules 50 mm with 6 mm DC link bridges (Article No. 6SL3162-2BB00-0AA0)	200 A
Motor Modules 100 mm	200 A
Motor Modules 150 mm - 200 mm	250 A
DC link components	100 A

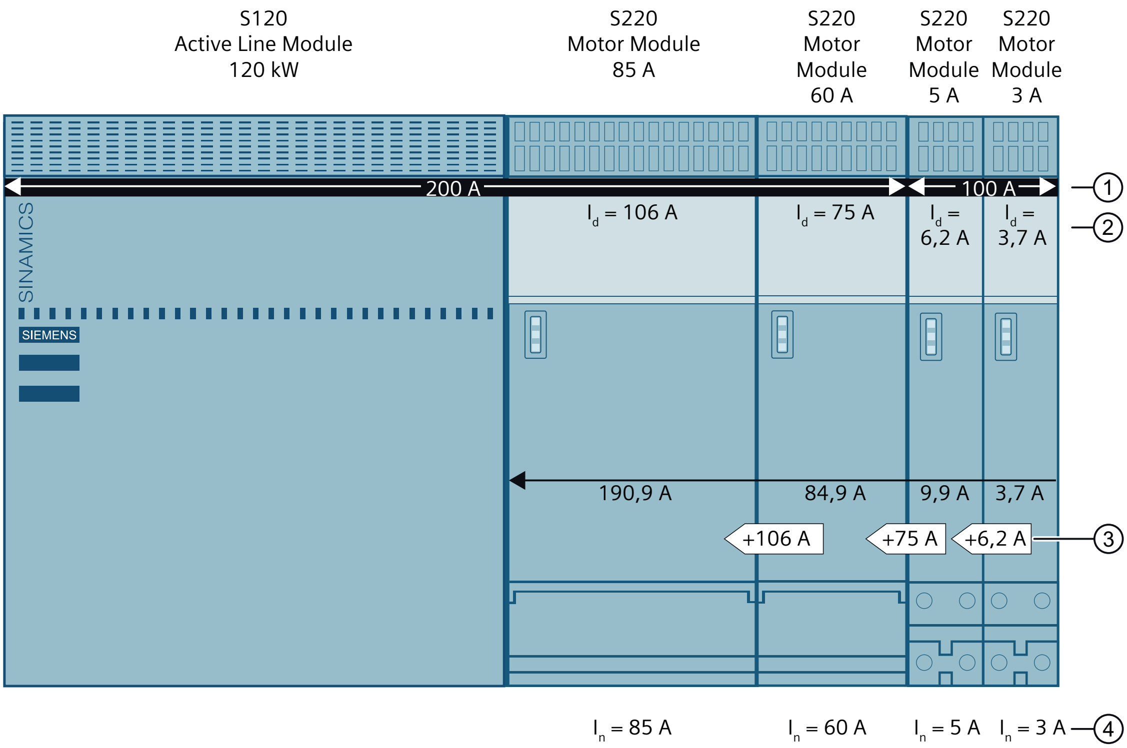
[1)] The continuous current-carrying capacity specified here applies to an ambient temperature of up to 40 °C. From 40 °C up to 55 °C, the continuous current-carrying capacity is reduced by 2.67 % per °C.

For the planned configuration, if the current load to be assumed exceeds the continuous current-carrying capacity of the DC link busbars, then the following solution is available to configure the drive line-up:

- Center infeed: Configuration with infeed at the center and the Motor Modules and DC link components mounted to the left and right

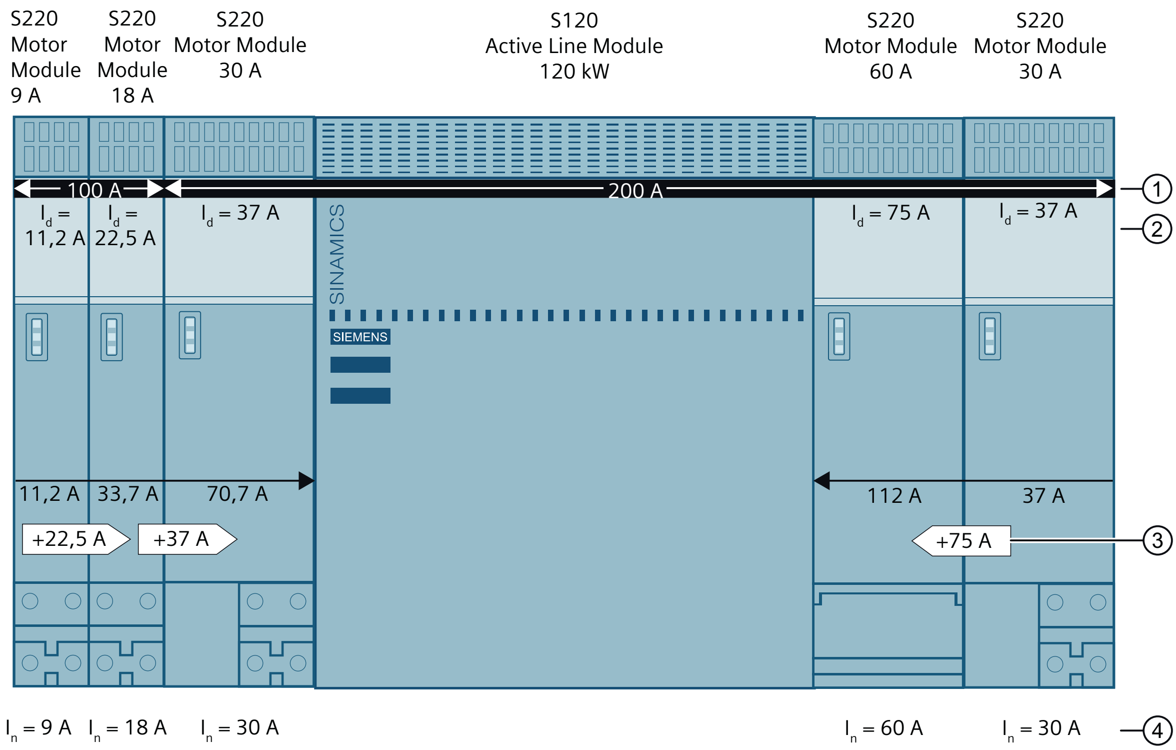
Examples

The following examples are based on the simultaneous use and loading of the Motor Modules with the rated current I_{rated}.



1. DC link busbar current-carrying capacity
2. DC link busbar load: DC link current $I_{DC\ link}$ at rated current I_{rated} of the Motor Module
3. Increased load of the DC link busbar
4. Motor current = rated current I_{rated} of the Motor Module

Figure 5-2 Load of the DC link busbar for a typical configuration with the infeed to the right in the DC link



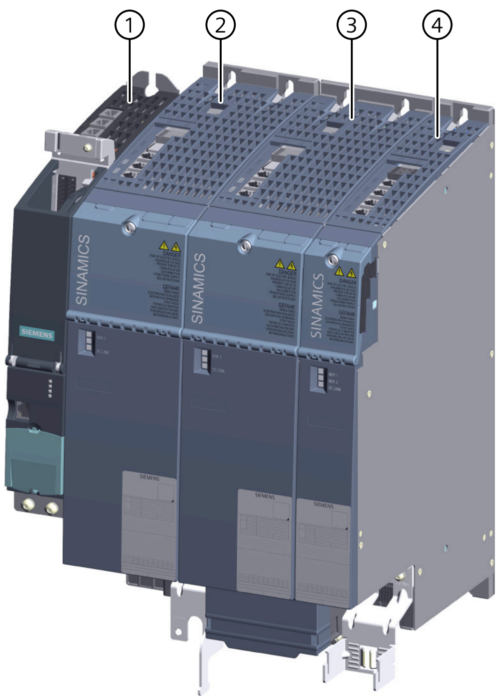
① DC link busbar current-carrying capacity
② DC link busbar load: DC link current $I_{DC\ link}$ at rated current I_{rated} of the Motor Module
③ Increased load of the DC link busbar
④ Motor current = rated current I_{rated} of the Motor Module

Figure 5-3 Load of the DC link busbar for an infeed to the left and to the right in the DC link (center infeed)

5.2.4 Configuration examples

5.2.4.1 Single-tier configuration with infeed to the right

Overview diagram



① SINAMICS S120 Control Unit 320-2
② SINAMICS S220 Smart Line Module 16 kW
③ SINAMICS S220 Motor Module 60 A
④ SINAMICS S220 Motor Module 2x9 A

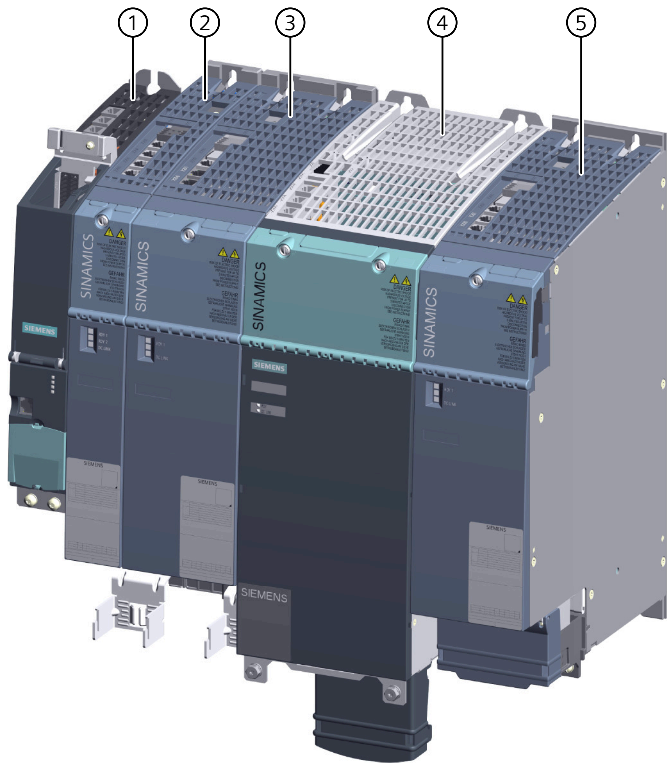
Figure 5-4 Example of a single-tier drive line-up with the infeed to the right

The following arrangement rule applies from left to right within a drive line-up:

- Line Module
- Motor Modules in order of power from the highest power to the lowest power
- DC link components, e.g. Braking Module, Control Supply Module, Capacitor Module

5.2.4.2 Single-tier configuration with center infeed

Overview diagram



① SINAMICS S120 Control Unit 320-2
② SINAMICS S220 Motor Module 2x9 A
③ SINAMICS S220 Motor Module 30 A
④ SINAMICS S120 Active Line Module 36 kW
⑤ SINAMICS S220 Motor Module 60 A

Figure 5-5 Example of a single-tier drive line-up with center infeed

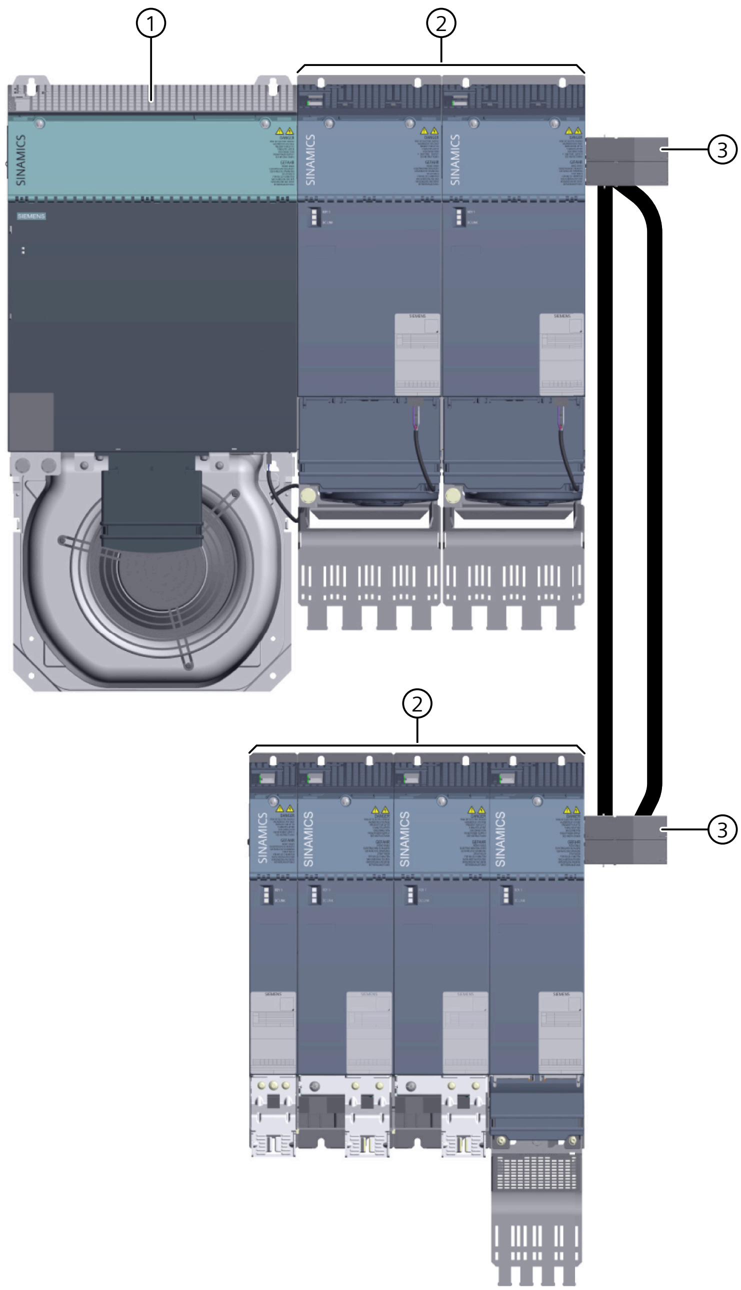
The center infeed represents the ideal solution if the continuous current-carrying capacity of the DC link busbars is exceeded for a typical configuration to the right.

The inverse sequence applies when the infeed is located to the right of the drive line-up. The following components are arranged from right to left at the Line Module:

- Motor Modules depending on their power, starting with the highest power
- DC link components, such as Braking Modules, at the end of the tier

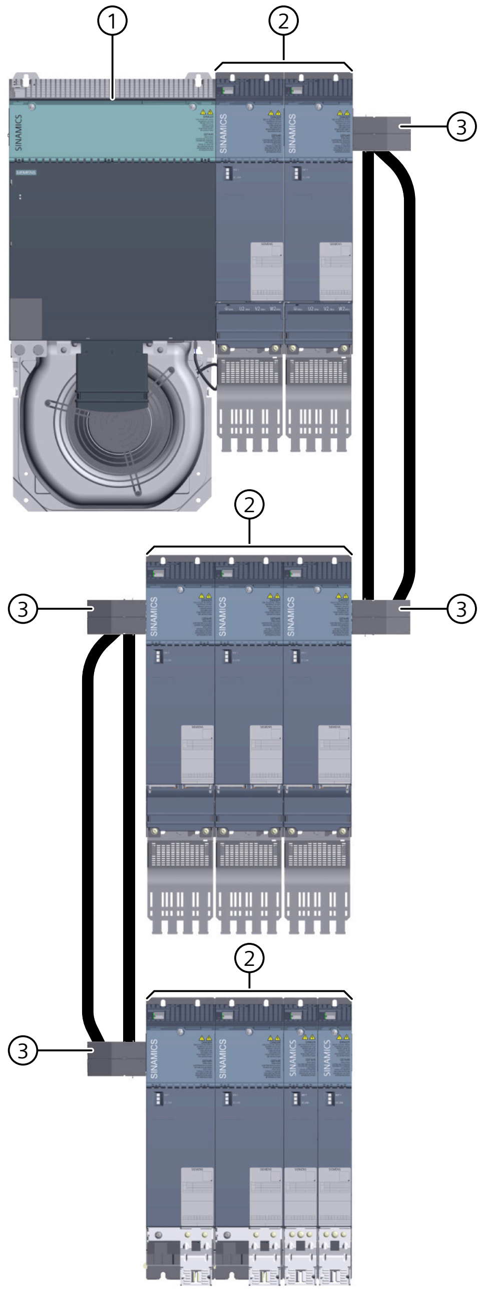
5.2.4.3 Configuration examples for a multi-tier configuration

Overview diagrams



① Active Line Module
② Motor Modules
③ DC link adapter

Figure 5-6 Assembly example for a two-tier design



① Active Line Module
② Motor Modules
③ DC link adapter

Figure 5-7 Assembly example for a three-tier design

5.3 DC link busbars

5.3.1 Connecting the DC link busbars

Overview

Within a drive line-up, all components must be connected with one another by the DC link busbars. Alternatively, you can use DC link adapters to individually supply a component. The connection is explained in the following using a Smart Line Module and a Motor Module as example.

Requirement

> **⚠ WARNING**
>
> **Electric shock when the protective flap 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.
>
> - Before opening the protective flap, bring the drive system into a no-voltage condition and lock it out so that it cannot be switched on again.
> - Check that the DC link is in a no voltage condition.

> **⚠ 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, remove the DC link bridge.
> - For all components that are wider, you must neither move the DC link bridge to the left nor remove it, as the DC link bridge ensures the mechanical stability of the DC link busbars.

In a drive line-up, the components are mounted next to one another.

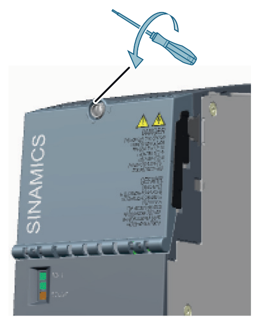
Required tools:

- Slotted screwdriver 1.0 x 5.5 mm to release the protective flap
- Torx screwdriver TX 20 for the DC link screws

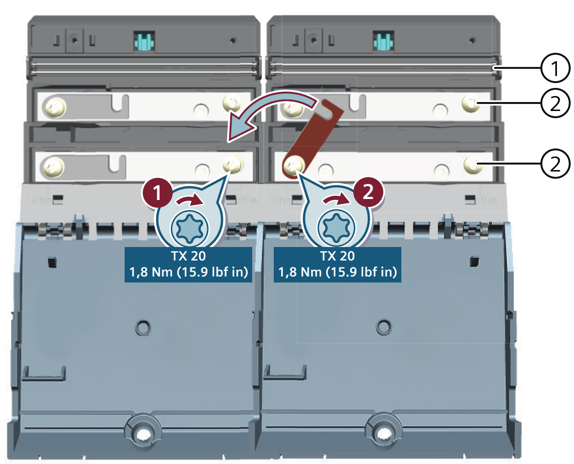
Procedure

Proceed as follows to connect the DC link busbars:

1. Open the protective flap of all components of the drive line-up.
   - Protective flaps have a locking mechanism.
   - Using a slotted screwdriver 1.0 x 5.5 mm, slightly turn the locking screw in the counter-clockwise direction.



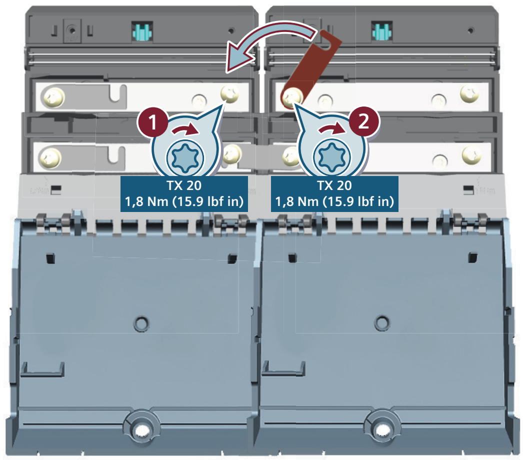
2. Loosen the DC link screws and swing over the DC link bridge.
3. Connect the lower DC link busbars.
4. Tighten the DC link screws (M4 x 20) in the sequence shown in the diagram. Torx screwdriver TX 20. Tightening torque: 1.8 Nm (15.9 lbf in)



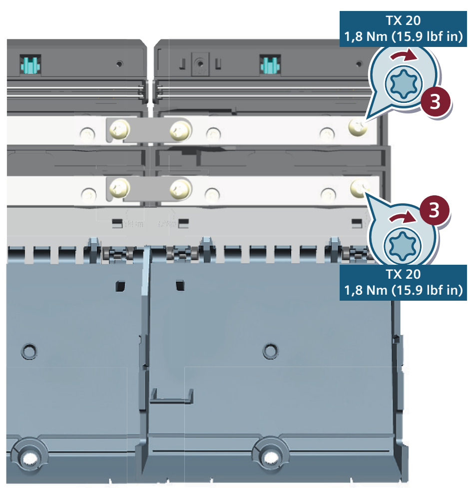
① 24 V DC
② Top: DCP, bottom: DCN

5. Connect the upper DC link busbars.

6. Tighten the DC link screws (M4 x 20) in the sequence shown in the diagram. Torx screwdriver TX 20. Tightening torque: 1.8 Nm (15.9 lbf in)



7. For the components arranged to the far right, tighten the DC link screws (M4x20). Torx screwdriver TX 20. Tightening torque: 1.8 Nm (15.9 lbf in)



8. Remove the black touch protection of the side covers at the connection positions.
9. Close the protective flaps until you hear them snap into place.

5.3.2 Order data DC link bridge

Accessories	**Article number**	**Description**
	included in the scope of delivery	4 mm bridge
	6SL3162-2BB00-0AA0 Included in the scope of delivery for components wider than 100 mm	6 mm bridge to achieve a continuous current-carrying capacity of 200 A

5.4 24 V terminal adapter

5.4.1 Mounting the 24 V terminal adapter

Overview

The 24 V terminal adapter is included in the Terminal Kit of the Smart Line Module.

Requirement

WARNING

Electric shock if the cutout in the protective flap has been broken out

Live parts are exposed if the 24 V terminal adapter is again removed at a later point in time. Touching live components can result in death or severe injury.

- Replace the protective flap with the broken out cutouts with a new protective flap.

NOTICE

Damage to the 24 V terminal adapter as a result of incorrect mounting/removal

Incorrect insertion/withdrawal of the 24 V terminal adapter can damage it.

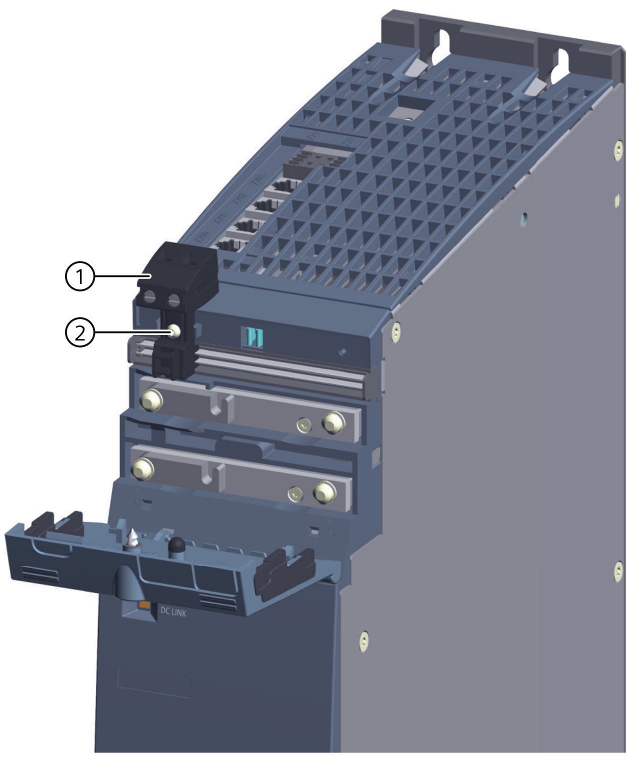
- Only remove the 24 V terminal adapter vertically in relation to the front plate.
- Inserting and withdrawing the 24 V terminal adapter a maximum of 5 times.

Mount the 24 V terminal adapter on the left side of the component that is located to the far left to avoid space problems with the 24 V connectors.

Required tools:

- Slotted screwdriver 1.0 x 5.5 mm to release the protective flap
- Torx screwdriver TX 10 to fasten the 24 V terminal adapter
- Slotted screwdriver 1.0 x 4.0 mm
- Pliers for breaking out the cutout

Procedure



① 24 V terminal adapter
② Screw for fixing

Figure 5-8 Mounting the 24 V terminal adapter

Proceed as follows to mount the 24 V terminal adapter:

1. Release and open the protective flap of the component. Slotted screwdriver 1.0 x 5.5 mm
2. Clip the 24 V terminal adapter on to the 24 V busbars.
3. Firmly attached the 24 V terminal adapter using the screw provided. Torx screwdriver TX 10. Tightening torque: 0.8 Nm (7 lbf in)
4. Using pliers, break out the cutout in the protective flap.
5. Close the protective flap until you hear it snap into place.
6. Fasten the 24 V DC supply cables to the 24 V terminal adapter. Slotted screwdriver 1.0 x 4.0 mm. Tightening torque: 1.2 ... 1.5 Nm (10.6 ... 13.3 lbf in)

5.4.2 Order data for the 24 V terminal adapter

The 24 V terminal adapter can be ordered as replacement part.

X24: 24 V terminal adapter	
Article number	**Description**
6SL3162-2AA00-0AA0	24 V terminal adapter for all Line Modules and Motor Modules in the booksize format

5.5 Connecting the 24 V busbars

5.5.1 Connecting the 24 V busbars

Overview

Within a drive line-up, the 24 V busbars of components installed next to one another must be connected using 24 V connectors. The 24 V connectors are included in the Terminal Kit of the Motor Modules.

Requirement

⚠ WARNING

Fire hazard for 24 V connectors and unconnected DC link busbars

For drive lineups in series, whose DC link busbars are not connected with one another, it is not permissible to insert 24 V connectors between these drive lineups. The 24 V connectors could otherwise burn and cause severe injury or death as a result of fire or smoke.

- If the DC link busbars of the components are not connected with one another, then you must ensure that there is a separate 24 V supply for each component using a 24 V terminal adapter.

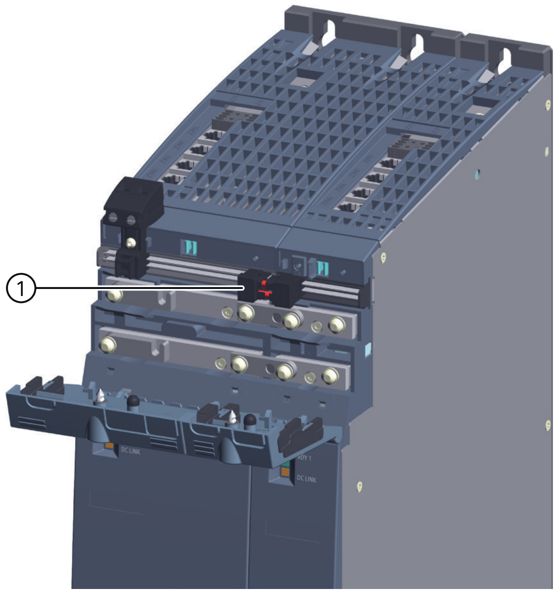
NOTICE

Damage to 24 V connector caused by incorrect insertion/withdrawal

Incorrect insertion/withdrawal of a 24 V connector can damage it.

- Only remove a 24 V connector vertically in relation to the front plate.
- Insert and withdraw a 24 V connector a maximum of 5 times.

Procedure



① Mounted 24 V connector

Figure 5-9 Connecting the 24 V busbars

Proceed as follows to connect the 24 V busbars using 24 V connectors:

1. Place the 24 V connectors on to the 24 V busbars.
2. Press the 24 V connectors down until they click into place.

5.5.2 Order data for the 24 V connector

24 V connectors can be ordered as replacement parts.

X24: 24 V jumpers	
Article number	**Description**
6SL3162-2AA01-0AA0	24 V connectors for all Line Modules and Motor Modules in the booksize format

5.6 Information on routing cables 24 V conductors

Overview

Handle the cables for the 24 V supply the same as you would signal cables.

Description

Conditions of use for 24 V cables:

- Ambient temperature: 55 °C
- Conductor limit temperature: ≤ 70 °C for operation with the rated load current

The following applies when routing 24 V cables:

- A maximum of 1 conductor pair may be bundled together.
- Route the 24 V cables separately away from other cables and conductors that could conduct the operating current.
- 24 V cables must never be routed parallel to power cables.
- Route the 24 V cables just like power cables to the components so that they do not cover the ventilation slots.

5.7 24 V power supply

5.7.1 Using a Control Supply Module

Overview

You can use a Control Supply Module (CSM) for the 24 V infeed in the drive line-up.

Description

When a Control Supply Module is used, the 24 V supply is directly established via the integrated 24 V busbars. When a fault occurs, the electronic current limitation integrated in the Control Supply Module protects the busbar system. Additional loads can be connected via the 24 V terminal adapter.

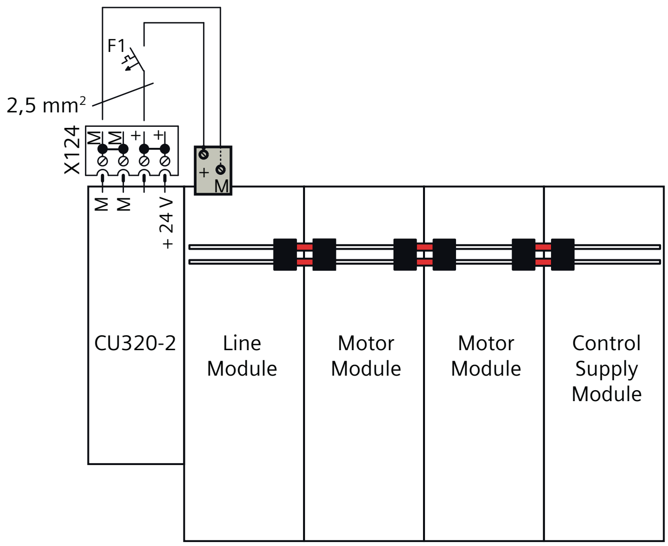


Figure 5-10 Example of a 24 V supply via a Control Supply Module

If you use cables with a cross-section of 2.5 mm², no additional protection is required on the 24 V side for the following cable types:

- XLPE type cables
- EPR type cables
- Cables with similar properties and which are thermally stable up to 90 °C

More information

You can find information on the Control Supply Module on the Internet:

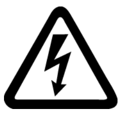
SINAMICS S120 Booksize Power Units Equipment Manual (https://support.industry.siemens.com/cs/ww/en/view/109781351)

5.7.2 Using an external power supply

Overview

As an alternative to the Control Supply Module (CSM), you can also use an external 24 V power supply, e.g. SITOP, for the 24 V infeed in the drive line-up.

Requirement



⚠ WARNING

Hazardous voltage when connecting an external power supply

As a result of the connection, parts and components of the device can be live (under voltage). Touching live components can result in death or severe injury.

- Connect the ground potential at the output of the power supply to the protective conductor connection (PELV).
- Mount the power supply close to the drive line-up.
  Ideally, they should be mounted on a common mounting plate. If different mounting plates are used, they must be electrically connected in compliance with the requirements in Configuration Manual EMC Installation Guideline (https://support.industry.siemens.com/cs/ww/en/view/60612658).

Description

SELV or PELV power supplies can be used when using external 24 V power supplies. The following points must be taken into account when using an external 24 V power supply:

- The cross-section of the connection between ground and the protective conductor connection must be at least as large as the cross-section of the 24 V conductors.
- The 24 V terminal adapter must be used for the infeed in the drive line-up.
- The external power supply must be installed close to the drive line-up.

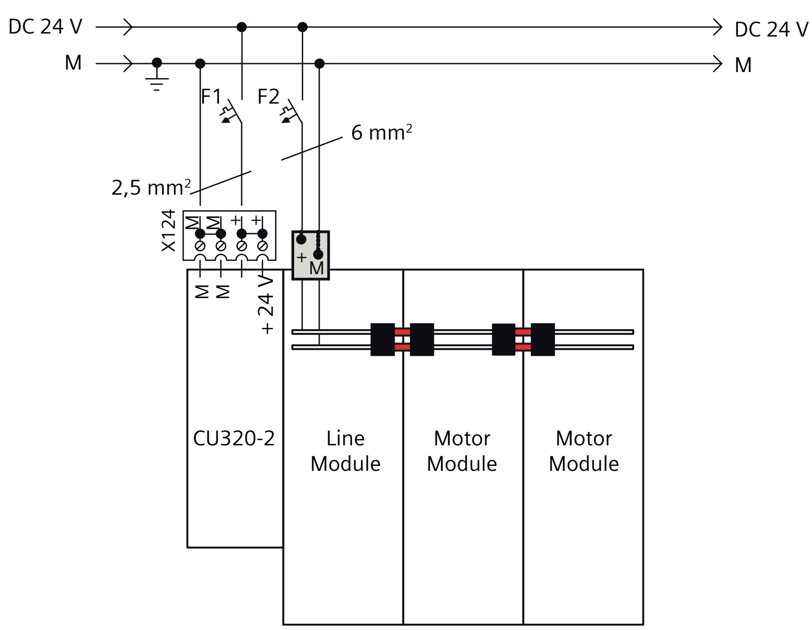


Figure 5-11 Example of a 24 V supply via an external power supply

6 Line-side power components

6.1 Components for connection to the line supply

Overview

The following components are used to connect the drive line-up to the line supply:

- Disconnector unit
- Overcurrent protective device
- Line contactor (optional)
- Line filter (optional)
- Line reactor

Overview image

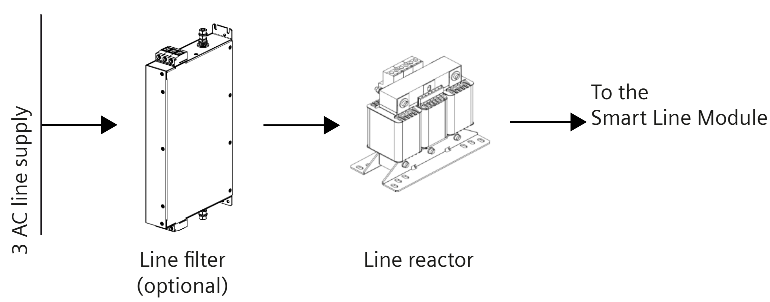


Figure 6-1 Line connection with line filters and line reactors (example for Smart Line Modules)

6.2 Disconnector units

Overview

A disconnector unit is required for disconnecting the drive line-up from the supply system.

Requirement

NOTICE
Damage to the drive electronics when switching the disconnector unit under load
Switching the disconnector unit under load will cause the contacts to wear prematurely. This can cause the disconnector unit to malfunction, with subsequent damage to the drive electronics. • Use a leading switch-off auxiliary contact or use a Voltage Sensing Module (VSM10). • If this is not possible, then avoid switching the disconnector unit under load.

Description

Carefully comply with local regulations when selecting a disconnector unit.

The accessories required for the disconnector unit can be found in the manufacturer catalogs.

6.3 Overcurrent protection and fault current protection

6.3.1 Overcurrent protective devices

Requirement

WARNING
Electric shock or fire due to overcurrent protective devices that trip too late or not at all
Overcurrent protective devices that trip too late or not all can cause electric shock or fire. • In the case of a conductor-conductor or conductor-ground short-circuit, ensure that the short-circuit current at the point where the converter is connected to the line supply corresponds as a minimum to the requirements of the protective device used. • You must additionally use a residual current device (RCD) if, for a conductor-ground short circuit, the required short-circuit current is not reached. The required short-circuit current can be too low, especially for TT line supply systems. • The short-circuit current must not exceed the SCCR of the converter and the breaking capacity of the protective device.

Description

Line-side overcurrent protection devices must be used to ensure that components and their line supply cables are protected. Either line fuses or circuit breakers must be used for this purpose. Take into consideration that the protection equipment used may result in reduced power.

More information

More information on overcurrent protection equipment and their associated short-circuit rating values are available on the Internet:

Protective Devices for SINAMICS S220 Line Modules Booksize (https://support.industry.siemens.com/cs/ww/en/view/109804134)

6.3.2 Residual current protective devices (RCD)

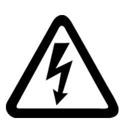
6.3.2.1 Description

Overview

Residual current devices are required in addition to overcurrent protection devices for certain line characteristics.

Residual current devices also provide preventative fire protection in the case of insulation faults, e.g. for use in working environments with a high fire risk.

Requirement



> **WARNING**
>
> **Electric shock or fire when using unsuitable residual current devices**
>
> In the case of a fault, converters can generate smooth residual currents, rendering type A or type AC residual current devices unusable.
>
> - Use the recommended type B residual current devices to protect converters.
> - If higher-level residual current devices are used, these must also be type B devices.

Description

If the ground-fault loop impedance of the line supply at the infeed point is too high to ensure that the overcurrent protective device trips within the stipulated time in the case of insulation failure (ground fault, fault to frame), then you must use additional residual current devices.

In case of unfavorable line supply conditions, as a result of the system that they are being used in, converters can generate capacitive leakage currents that can cause residual current devices to nuisance trip. To prevent that a residual current device trips due to operational leakage currents, the following requirements must be met:

- The residual current device must have a rated residual current of 300 mA.
- Every Line Module must be provided with its own designated residual current device.
- Ensure that the loop impedance complies with local installation regulations.

- The total length of the shielded power cables (motor cables including line supply cable from the line filter to the connecting terminals of the Line Module) in the drive line-up must be shorter than 350 m.
- The system may be operated only with the recommended line filters.
- Switching elements (disconnector unit, line contactors) for connecting and disconnecting the drive system have a maximum 35 ms delay time between closing or opening of the individual main contacts.

6.3.2.2 Overview

Description

Only type B super-resistant (short-time-delayed) universal current-sensitive residual current devices are permitted for Line Modules.

Table 6-1 Residual current devices that can be used with Line Modules

Abbreviation	Residual current circuit breakers (RCCB)[1]	RCD with 3VA1 molded case circuit breaker[2]
Smart Line Module	16 ... 36 kW	55 kW
Rated current	≤ 80 A	80 ... 160 A
Rated residual current	300 mA	300 mA
Recommendation	Siemens SIQUENCE RCCB (residual current operated circuit breaker), type B, short-time-delayed [K], 300 mA rated residual current, series 5SV364.-4	Siemens RCD520B (3VA9113-0RL21) residual current device, mounted on a Siemens 3VA1 molded case circuit breaker

1) = Residual current circuit breaker or residual current operated circuit breaker

2) = Residual current device or ground-fault circuit interrupter (= higher-level term)

6.3.2.3 RCD520B with 3VA1 molded case circuit breaker

Description

RCD520B is a module that is directly mounted onto a Siemens 3VA1 molded case circuit breaker. Additional external components, such as current transformer or power supply, are not required. The combination is certified as ground-fault circuit interrupter, and also offers short-circuit and overload protection of a circuit breaker.

The RCD520B with 3VA1 molded case circuit breaker is connected just like a residual current circuit breaker (RCCB).

Recommended settings:

- Tripping characteristic: B type
- Differential response current: 300 mA
- Response delay: ≥ 0.06 s

Figure 6-2 RCD520B, mounted on a 3VA1 molded case circuit breaker

6.3.2.4 Connection example (RCCB and RCD)

Connection example

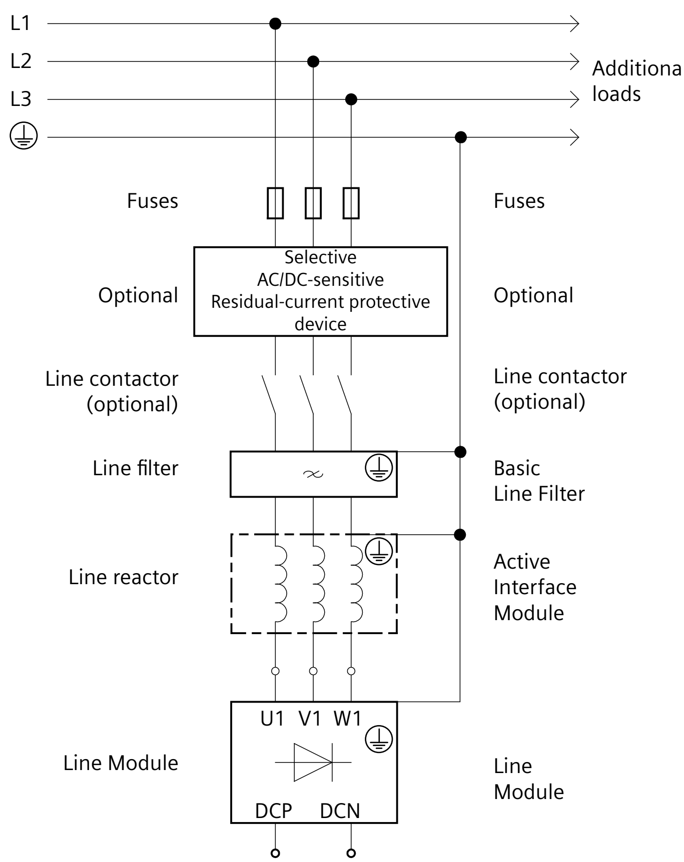


Figure 6-3 Connecting a residual current circuit breaker

6.4 Line contactors

Overview

The optional line contactor isolates the converter from the line supply, reducing the standby losses of the drive line-up.

Requirement

NOTICE
Damage to the drive electronics when switching the line contactor under load
Switching the line contactor (type according to the recommended selection) under load will cause the contacts to wear prematurely. This can cause the contactor to malfunction, with subsequent damage to the drive electronics. • Use a leading switch-off auxiliary contact or use a Voltage Sensing Module (VSM10). • If this is not possible, then avoid switching the line contactor under load.

Description

The following requirements apply when using a line contactor:

- The characteristic values in the technical specifications apply when the line contactor is selected.
- Dimension the cables and conductors to be connected in strict compliance with local installation regulations.
- When using the digital output to control the line contactor, take account of its switching capacity.
- To limit the switching overvoltage, the contactor coil must be connected to a surge suppression device (e.g. freewheeling diode or varistor).

6.5 Line filter

6.5.1 Overview

Requirement

NOTICE
Damage to the system caused by a line filter that is not permissible
A line filter that is not permissible can cause system damage. • Use line filters only with the possible combinations of Line Modules and line reactors specified in this product documentation. More detailed information on this is provided in Chapter "Maximum permissible total cable length (Page 54)".

Description

Line filters can optionally be used for Smart Line Modules in conjunction with the associated line reactors. In conjunction with line reactors and a consequential EMC-compliant system design, line filters limit the conducted electromagnetic emissions generated by the Line Modules to the limit values according to IEC 61800-3. They are mainly effective in the frequency range from 9 kHz to 30 MHz; this is the range relevant to ensure compliance with the appropriate standard.

Table 6-2 Line filters for Smart Line Modules

Line filter	Article number
16 kW	6SL5100-0HE21-6DD0
24 kW	6SL5100-0HE22-4DD0
36 kW	6SL5100-0HE23-6DD0
55 kW	6SL5100-0HE25-5DD0

6.5.2 Safety information

⚠ WARNING
Electric shock due to residual charges in power components
As a result 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.

⚠ WARNING
High leakage currents when the protective conductor in the line supply 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. • Adhere to the requirements for the dimensioning of the protective conductor set out in this Equipment Manual.

⚠ CAUTION
Burns due to high surface temperatures
The surface of the components can reach high temperatures during operation. You can get seriously burnt when touching the surface. • Do not touch the component.

NOTICE
Line filter damage by connecting to impermissible line supply
The line filters are only suitable for direct connection to line supplies with grounded neutral point. Connecting the line filter to another line supply will damage the line filter. • Only connect the line filter to a line supply with grounded neutral point.

NOTICE
Line filter damage due to interchanged connections
The line filter will be damaged if the input and output connections are interchanged. • Connect the incoming line supply cable to LINE L1, L2, L3. • Connect the outgoing cable to the line reactor at LOAD U, V, W (L1´, L2´, L3´).

NOTICE
Damage caused by using third party filters
According to product standard IEC 61800-3, radio interference suppression corresponding to the application conditions is required, and is legally stipulated in the EU (EMC Directive). Line filters and line reactors are required in order to comply with this standard. The use of filters of other makes can lead to limit value violations, resonances, overvoltage, and irreparable damage to motors or other equipment. • The machine manufacturer must provide verification that the machine equipped with the drive products and the installed suppression elements, e.g. line filters, is EMC-compliant before the machines are placed in the market.

NOTICE
Destruction or damage of components by incorrectly connecting the line filter
When incorrectly connecting the line filter, components can be destroyed or damaged. • Connect the line filter in accordance with the instructions in the technical documentation. • Do not connect any additional loads downstream of the line filter.

NOTICE
Damage caused by connecting several loads to the same line infeed point
Damage can be caused if several loads are connected to the same line infeed point. • Provide interference suppression for the other loads using appropriate line filters. To prevent mutual interference, it is not permissible that this line filter is equipped with capacitors on the line side with respect to ground. A filter from the B84144A*R120 (EPCOS) series is recommended.

Note

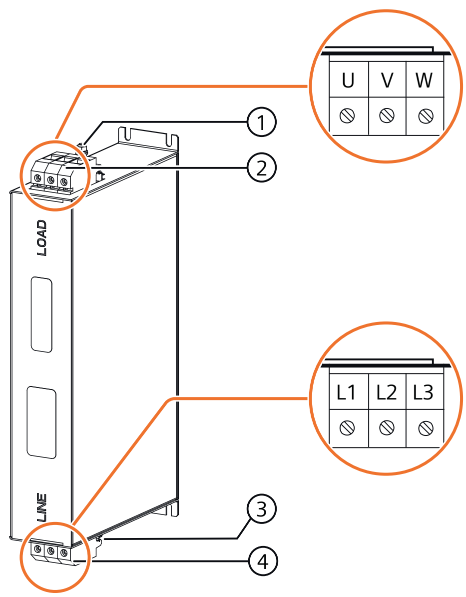
Disconnect the line filter for a high-voltage test

If a high-voltage test is conducted in the system with an alternating voltage, you must disconnect the line filters in order to obtain a correct measurement result.

6.5.3 Interfaces and connections

6.5.3.1 Overview

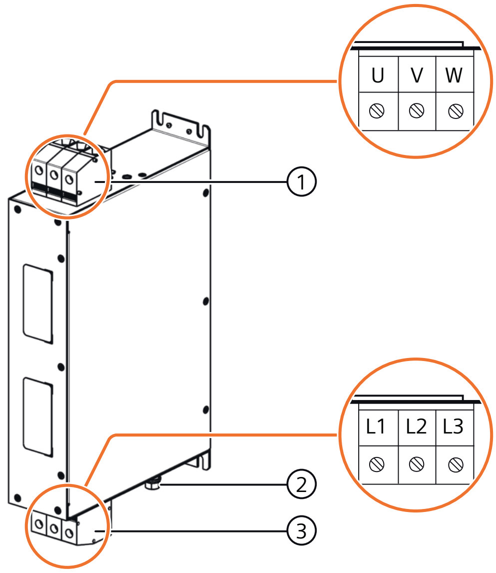
Overview diagram



① Protective conductor[1)]
② Load connection
③ Protective conductor[1)]
④ Line connection

Figure 6-4 Interface overview, line filter for Smart Line Modules 16 kW and 24 kW

[1)] You can use either the upper or lower screw to connect the protective conductor. One of the screws remains unused. "Looping-through" the protective connection to the line reactor is not permissible.



① Load connection
② Protective conductor
③ Line connection

Figure 6-5 Interface overview, line filter for Smart Line Modules 36 kW and 55 kW

6.5.3.2 Line and load connections

Description

Table 6-3 Line and load connection line filter Smart Line Modules 16 kW ... 55 kW

6SL5100-	0HE21-6DD0	0HE22-4DD0	0HE23-6DD0	0HE25-5DD0
Rated power	16 kW	24 kW	36 kW	55 kW
Line connection	L1, L2, L3	L1, L2, L3	L1, L2, L3	L1, L2, L3
Load connection	U, V, W	U, V, W	U, V, W	U, V, W
Terminals	Screw terminals	Screw terminals	Screw terminals	Screw terminals
Connectable cable cross-sections	6 ... 16 mm^2 (AWG 10 ... AWG 6) 3-pole 2 ... 2.2 Nm (18 ... 19.8 lbf in)	6 ... 16 mm^2 (AWG 10 ... AWG 6) 3-pole 2 ... 2.2 Nm (18 ... 19.8 lbf in)	16 ... 50 mm^2 (AWG 6 ... AWG 1) 3-pole 4 ... 5.5 Nm (53.1 lbf in)	16 ... 50 mm^2 (AWG 6 ... AWG 1) 3-pole 4 ... 5.5 Nm (53.1 lbf in)
Protective conductor connection[1)]	Terminal studs M8 5.7 ... 6.3 Nm (55.7 lbf in)	Terminal studs M8 5.7 ... 6.3 Nm (55.7 lbf in)	Terminal studs M8 5.7 ... 6.3 Nm (55.7 lbf in)	Terminal studs M8 5.7 ... 6.3 Nm (55.7 lbf in)

[1)] For ring cable lugs without insulation.

6.5.4 Dimension drawings

Overview diagram

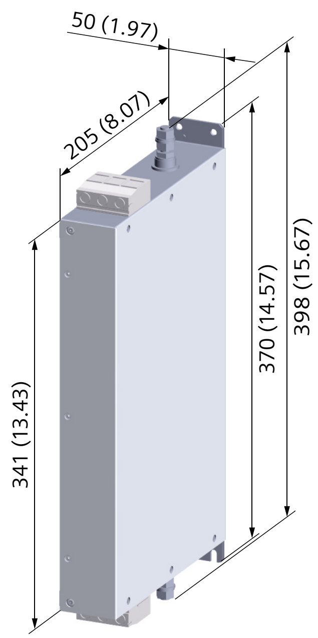


Figure 6-6 Dimension drawing of line filters for Smart Line Modules 16 kW and 24 kW, all dimensions in mm and (inch)

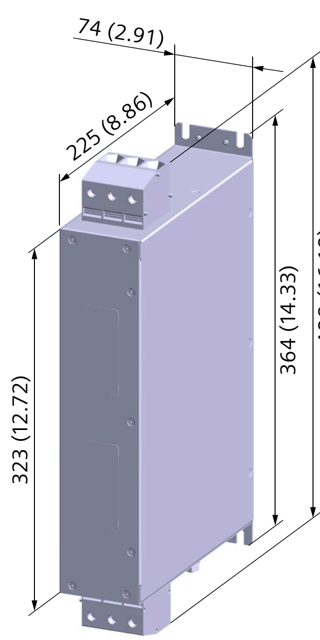


Figure 6-7 Dimension drawing of line filters for Smart Line Modules 36 kW and 55 kW, all dimensions in mm and (inch)

6.5.5 Installation

Overview

Line filters are designed for installation in the control cabinet. They are fixed to the control cabinet panel or a mounting panel.

Line filters may be installed vertically or horizontally.

Requirement

⚠ WARNING

Risk of injury as a result of foreign bodies in the device

Parts (e.g.: drilling chips, end sleeves) falling into the device can cause short-circuits and damage the insulation. This can result in severe injury (arcing, loud bang, parts that are flung out).

- Only perform installation and other work when the devices are current-free.
- Cover the ventilation slots when mounting and installing the control cabinet and remove the cover before switching on.

NOTICE

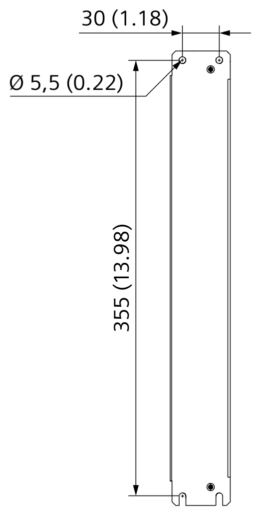
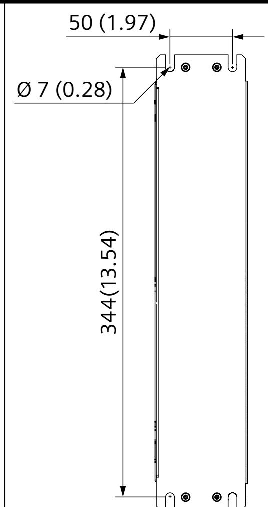
Overheating of components due to incorrect mounting position

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.

Procedure

Table 6-4 Rear view of line filters for Smart Line Modules 16 kW ... 55 kW in mm and (inch)

Rated power	16 kW and 24 kW	36 kW and 55 kW
Rear view		
Mounting parts	4 x M5 screws 4 x M5 washers	4 x M6 screws 4 x M6 washers
Tightening torque	3 Nm (26.6 lbf in)	6 Nm (53.1 lbf in)

Fit a line filter on the mounting panel as follows:

1. Prepare the mounting panel.
2. First, screw the 4 screws in far enough so that you can attach the component.
3. Attach the component.
4. Tighten the screws finger-tight. Tightening torque: 0.5 Nm (4.4 lbf in)
5. Then tighten the screws fully.

6.5.6 Technical data

Technical specifications

Table 6-5 Line filters for Smart Line Modules[1)]

Feature	6SL5100-	0HE21-6DD0	0HE22-4DD0	0HE23-6DD0	0HE25-5DD0
Rated power	kW	16	24	36	55
Power loss	W	12	22	28	38
Weight	kg	5.0	5.0	7.2	7.8

1) Further, the same electrical rated values for the line filters apply as for the assigned Smart Line Modules.

6.6 Line reactors

6.6.1 Overview

Requirement

NOTICE
Damage to the system caused by line reactors that are not permissible
Line reactors that are not permissible can damage the Line Modules. Line harmonics that damage/disturb other loads connected to the same line supply can also occur. • Only use line reactors that are listed in this Equipment Manual.

Description

Line reactors are interfaces on the line side for the Smart Line Modules. They limit line harmonics to permissible values. This is the reason that line reactors are always required when operating Line Modules.

Table 6-6 Line reactors for Smart Line Modules

Line reactors	C type	D type
16 kW	6SL3100-0EE21-6AA0	6SL5100-0EE21-6AD0
24 kW	6SL5100-0EE22-4AC0	6SL5100-0EE22-4AD0
36 kW	6SL5100-0EE23-6AC0	6SL5100-0EE23-6AD0
55 kW	6SL5100-0EE25-5AC0	6SL5100-0EE25-5AD0

6.6.2 Safety information

CAUTION
Burns resulting from high surface temperature of the line reactor
The line reactors can become very hot. You can get seriously burnt when touching the surface. • Mount the line 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 ventilation clearance of 100 mm on all sides of the line reactors.

Note

Malfunctions through magnetic fields

Line reactors produce magnetic fields that can disturb or damage components and cables.

- Arrange the components and cables at a suitable distance (at least 200 mm) or shield the magnetic fields appropriately.

Note

Length of connecting cables

The connecting cables between line reactor and Line Module, as well as between line reactor and line filter, must be kept as short as possible (max. 10 m).

Use shielded connecting cables and connect the cable shields at both ends.

Shielding is not required if the following preconditions are satisfied:

- The cables do not exceed 1 m in length.
- The cables are laid flush with the rear metal panel of the control cabinet.
- The cables are laid in a way that keeps them physically separate from signal cables.

All signal cables must be laid separately from the line reactor and from unshielded connecting cables of the reactor with a minimum clearance of 200 mm.

6.6.3 Interfaces and connections

6.6.3.1 Overview

Overview diagram

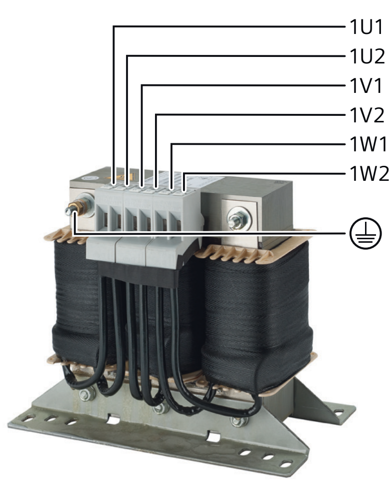


Figure 6-8 Interface overview, line reactor for Smart Line Modules 16 kW C type

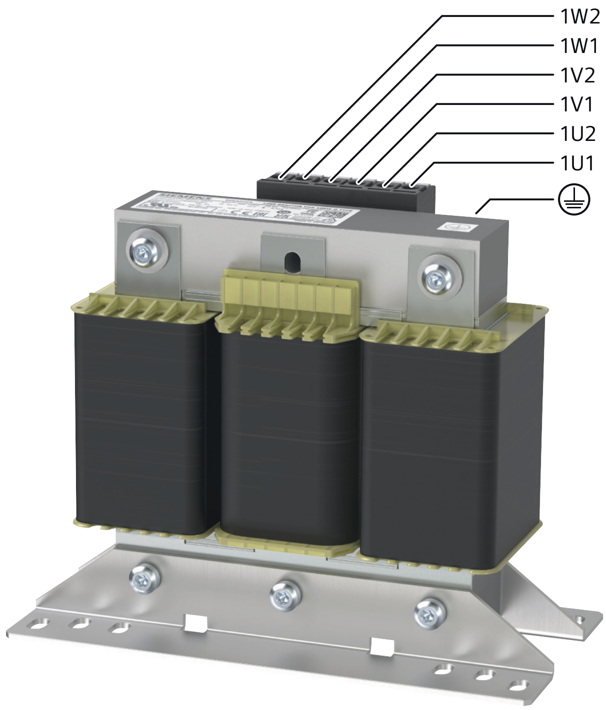


Figure 6-9 Interface overview, line reactor for Smart Line Modules 16 kW D type and 24 kW

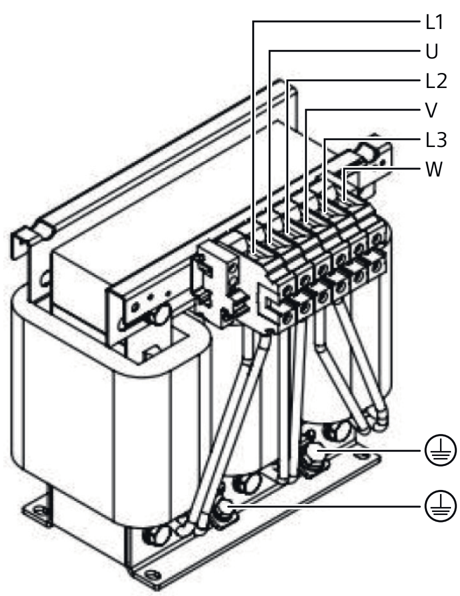


Figure 6-10 Interface overview, line reactor for Smart Line Modules 36 kW

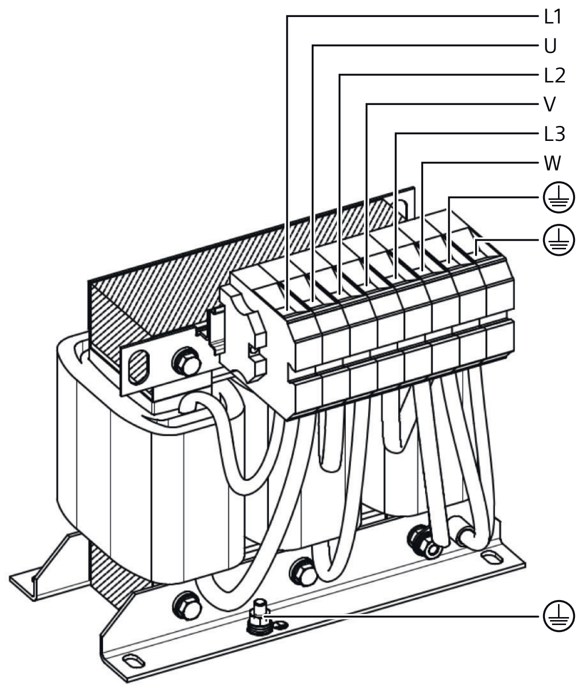


Figure 6-11 Interface overview, line reactor for Smart Line Modules 55 kW

6.6.3.2 Line and load connections

Overview diagram

Table 6-7 Line reactors for Smart Line Modules[1)]

Article number	**6SL3100-0EE21-6AA0**	**6SL5100-0EE21-6AD0** **6SL5100-0EE22-4AC0** **6SL5100-0EE22-4AD0**	**6SL5100-0EE23-6AC0** **6SL5100-0EE23-6AD0**	**6SL5100-0EE25-5AC0** **6SL5100-0EE25-5AD0**
Rated power	16 kW	16 kW, 24 kW	36 kW	55 kW
Line connection	1U1, 1V1, 1W1	1U1, 1V1, 1W1	L1, L2, L3	L1, L2, L3
Load connection	1U2, 1V2, 1W2	1U2, 1V2, 1W2	U, V, W	U, V, W
Terminals	Screw terminals	Screw terminals	Screw terminals	Screw terminals

Article number	6SL3100-0EE21-6AA0	6SL5100-0EE21-6AD0 6SL5100-0EE22-4AC0 6SL5100-0EE22-4AD0	6SL5100-0EE23-6AC0 6SL5100-0EE23-6AD0	6SL5100-0EE25-5AC0 6SL5100-0EE25-5AD0
Connectable cable cross-sections	2.5 ... 10 mm^2 (AWG 20 ... AWG 8) 1.5 ... 1.8 Nm (15.9 lbf in)	2.5 ... 16 mm^2 (AWG 20 ... AWG 6) 2.5 Nm (22.1 lbf in)	10 ... 50 mm^2 (AWG 8 ... AWG 1)[1)] 3.2 ... 3.7 Nm (30 ... 50 lbf in)	25 ... 70 mm^2 (AWG 4 ... AWG2/0)[2)] 8 ... 12 Nm (106.2 lbf in)
Protective conductor connection[3)]	M6 screw 6 Nm (53.1 lbf in)	M6 screw 6 Nm (53.1 lbf in)	M8 screw: 13 Nm (115 lbf in) / M6 screw: 6 Nm (53.1 lbf in)	Screw terminals 25 ... 70 mm^2 (AWG 4 ... AWG2/0) 8 ... 12 Nm (106.2 lbf in) / M8 screw 13 Nm (115 lbf in)

1) Degree of protection IPXXB according to IEC 60529 is only obtained if conductor cross-sections ≥ 16 mm^2 (AWG 6) and insulated end sleeves are used. The end sleeves must have the shortest length that can be used for a cable cross-section according to DIN 46228-4.

2) Degree of protection IPXXB according to IEC 60529 is only guaranteed if conductor cross-sections ≥ 50 mm^2 (AWG 1) and insulated end sleeves are used. The end sleeves must have the shortest length that can be used for a conductor cross-section according to DIN 46228-4.

3) For ring cable lugs without insulation

6.6.4 Dimension drawing

Overview diagram

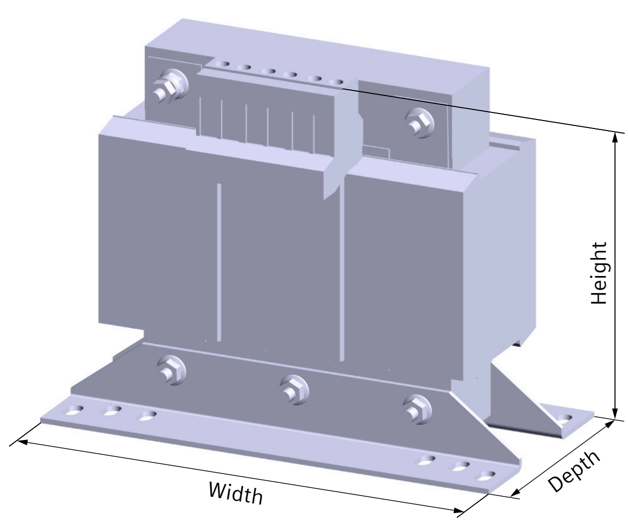


Figure 6-12 Dimension drawing of line reactors for Smart Line Module 16 kW ... 55 kW

Table 6-8 Dimensions of line reactors for Smart Line Modules 16 kW ... 55 kW, all dimensions in mm and (inch)

Article number	**6SL3100-0EE21-6AA0**	**6SL5100-0EE21-6AD0** **6SL5100-0EE22-4AC0** **6SL5100-0EE22-4AD0**	**6SL5100-0EE23-6AC0** **6SL5100-0EE23-6AD0**	**6SL5100-0EE25-5AC0** **6SL5100-0EE25-5AD0**
Rated power	**16 kW**	**16 kW, 24 kW**	**36 kW**	**55 kW**
Height	176 (6.93)	195 (7.68)	235 (9.25)	280 (11.02)
Width	219 (8.62)	219 (8.62)	225 (8.86)	300 (11.81)
Depth	110.5 (4.35)	126 (4.96)	114 (4.49)	153 (6.02)

6.6.5 Installation

Overview

Line reactors are designed for installation in the control cabinet. They are fixed to the control cabinet panel or a mounting panel.

Line reactors may be installed vertically or horizontally.

Requirement

⚠ **WARNING**

Risk of injury as a result of foreign bodies in the device

Parts (e.g.: drilling chips, end sleeves) falling into the device can cause short-circuits and damage the insulation. This can result in severe injury (arcing, loud bang, parts that are flung out).

- Only perform installation and other work when the devices are current-free.
- Cover the ventilation slots when mounting and installing the control cabinet and remove the cover before switching on.

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.

Procedure

Table 6-9 Rear views of line reactors for Smart Line Modules 16 and 24 kW in mm and (inch)

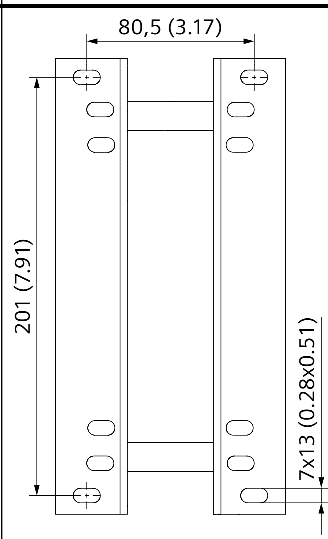
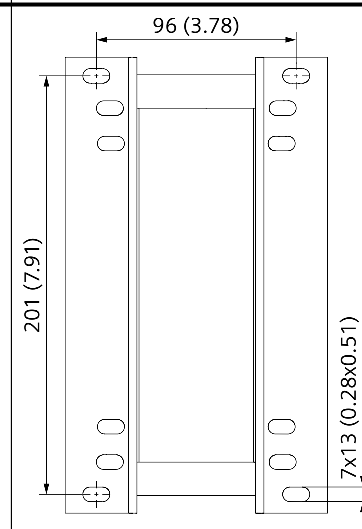
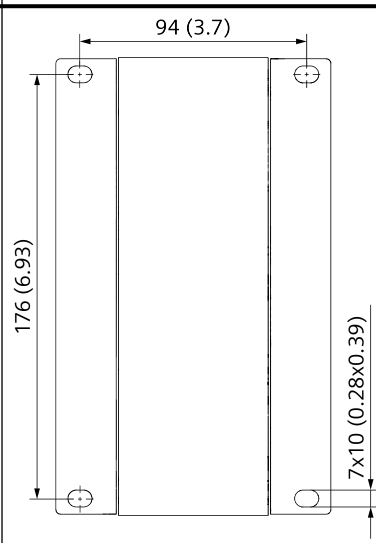
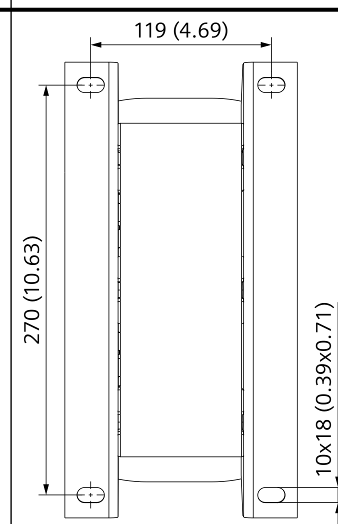
Rated power	16 kW C type	16 kW D type, 24 kW
Rear view		
Mounting parts	4 x M6 screws 4 x M6 washers	4 x M6 screws 4 x M6 washers
Tightening torque	6 Nm (53.1 lbf in)	6 Nm (53.1 lbf in)

Table 6-10 Rear views of line reactors for Smart Line Modules 36 and 55 kW in mm and (inch)

Rated power	36 kW	55 kW
Rear view		
Mounting parts	4 x M6 screws 4 x M6 washers	4 x M8 screws 4 x M8 washers
Tightening torque	6 Nm (53.1 lbf in)	13 Nm (115 lbf in)

Fit a line reactor on the mounting panel as follows:

1. Prepare the mounting panel.
2. Screw the line reactor securely onto the mounting panel with the four screws.

6.6.6 Technical data

Technical specifications

Table 6-11 Line reactors for Smart Line Modules[1)]

Article number		**6SL3100-**	**6SL5100-**						
Feature	**Unit**	**0EE21-6AA0**	**0EE21-6AD0**	**0EE22-4AC02**	**0EE22-4AD0**	**0EE23-6AC0**	**0EE23-6AD0**	**0EE25-5AC0**	**0EE25-5AD0**
Rated power	kW	16	16	24	24	36	36	55	55
Power loss	W	90	90	92	92	99	99	190	190
Weight	kg	9.0	9.0	15.5	15.5	18	18	35.5	35.5

1) Further, the same electrical rated values for the line reactors apply as for the assigned Smart Line Modules.

Smart Line Modules 7

7.1 Description

Overview

Smart Line Modules are rectifiers that generate a DC voltage in the DC link from the 3-phase line voltage.

Requirement

Note

Operation on line supplies where energy recovery is not possible

For line supply systems without energy recovery capability (e.g. a diesel generator), device faults can occur as the braking energy cannot be dissipated.

- Deactivate the energy recovery function of the Smart Line Modules using parameter p3533.
- The braking energy must then be dissipated via an additional Braking Module with braking resistor in the drive line-up.

Description

The Smart Line Module supplies power to the connected Motor Modules. It does this by providing a non-regulated DC voltage at the DC link busbars. A Smart Line Module exhibits the typical current and voltage waveforms of a 6-pulse diode rectifier bridge in infeed mode.

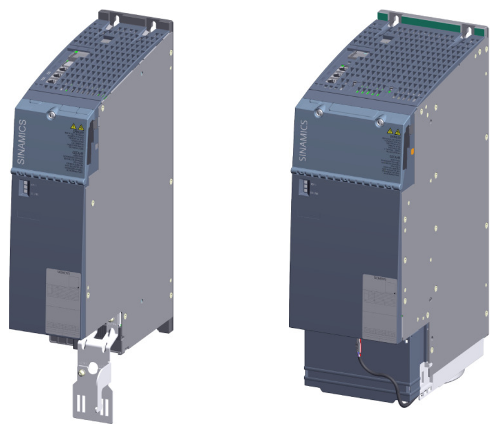
Smart Line Modules also have an unregulated energy recovery capability. In the energy recovery mode, the current waveform is square waved. The energy recovery functionality can be disabled if necessary using parameter p3533.

The DC link starts precharging as soon as the line voltage is applied and is independent of the phase sequence direction of the line supply.

A main contactor can be installed on the line side if the system has to be electrically isolated from the line supply.

7.2 Overview

Overview diagram



100 mm
16 kW, 24 kW

150 mm
36 kW, 55 kW

Figure 7-1 16 kW ... 55 kW Smart Line Modules

Table 7-1 Smart Line Modules

Rated power	Width	C type	D type
16 kW	100 mm	6SL5130-6UE21-6AC0	6SL5130-6UE21-6AD0
24 kW	100 mm	6SL5130-6UE22-4AC0	6SL5130-6UE22-4AD0
36 kW	150 mm	6SL5130-6UE23-6AC0	6SL5130-6UE23-6AD0
55 kW	150 mm	6SL5130-6UE25-5AC0	6SL5130-6UE25-5AD0

7.3 Safety instructions

7.3.1 Safety information

WARNING

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

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

- Only operate the components with closed protective flap.

WARNING

High leakage currents when the protective conductor in the line supply 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 when dimensioning the protective conductor. More detailed information on this is provided in Chapter "Protective connection and equipotential bonding suitable for high frequencies (Page 68)".

WARNING

Electric shock due to improper DC link connection

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

- When connecting to the DC link, only use the DC link adapter that has been approved by Siemens.

WARNING

Electric shock due to missing DC link side covers

Live parts are exposed if the DC link side covers are not fitted. Contact with these live parts could cause an electric shock.

- Mount the side covers on the first and last component in the drive line-up.
- Order any missing side covers (article number: 6SL3162-5AA00-0AA0).

WARNING

Fire due to overheating resulting from power cables with inadequate cable cross-sections

Power cables with excessively low cross-sections can cause them to overheat. This can result in severe injury or death due to fire and smoke.

- Only use power cables with sufficiently large cross-sections. Take into account the routing type, ambient temperature and cable length.

WARNING

Fire due to overheating when the total length of the power cables is exceeded

Overheating can result when the total length of the power cables is exceeded. This can result in severe injury or death due to fire and smoke.

- Ensure that the total length of all power cables (motor supply cable, DC link cable) does not exceed the maximum permissible total cable length described in this documentation.

NOTICE

Damage through 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.

Note

Malfunctions due to polluted DRIVE-CLiQ interfaces

Dirty/polluted DRIVE-CLiQ interfaces can result in system malfunctions.

- Close and seal unused DRIVE-CLiQ interfaces using the blanking covers included in the scope of delivery. You can order missing blanking covers (article number: 6SL3066-4CA00-0AA0, 50 units).

7.3.2 Notes for UL applications

Description

Note

Overload protection for Smart Line Modules

The Smart Line Module has integrated overload protection according to UL 61800-5-1.

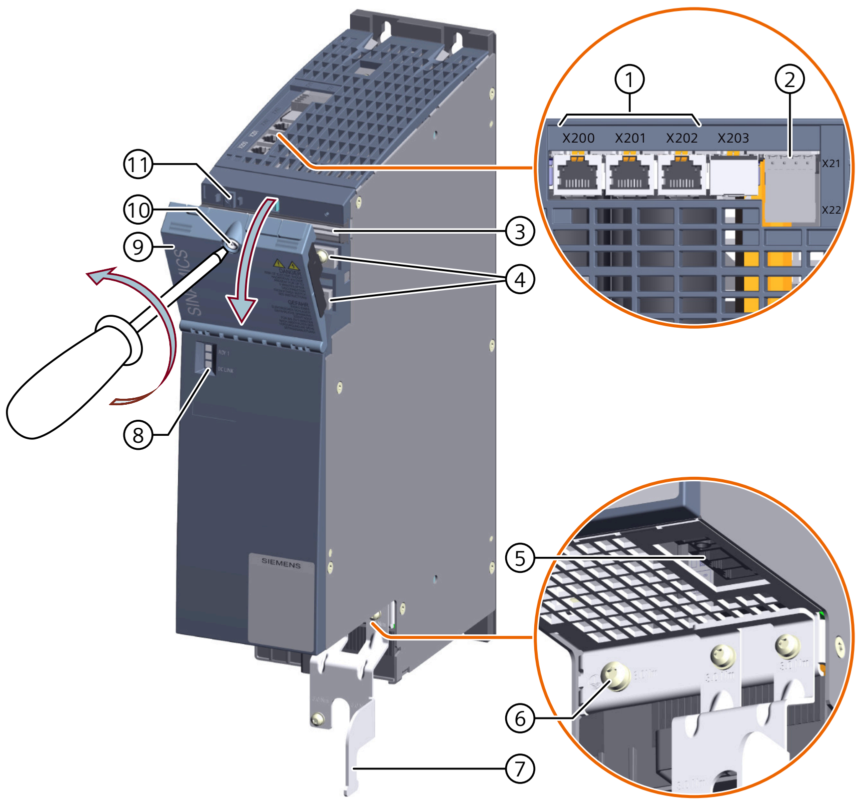
Ensure that overload protection is active by following the instructions below:

- The protection threshold is 115 % of the rated output current of the Smart Line Module.
- Using the appropriate configuration, ensure that if the Smart Line Module develops a fault condition, a pulse inhibit is set for the Motor Modules connected to the DC link.

7.4 Interfaces and connections

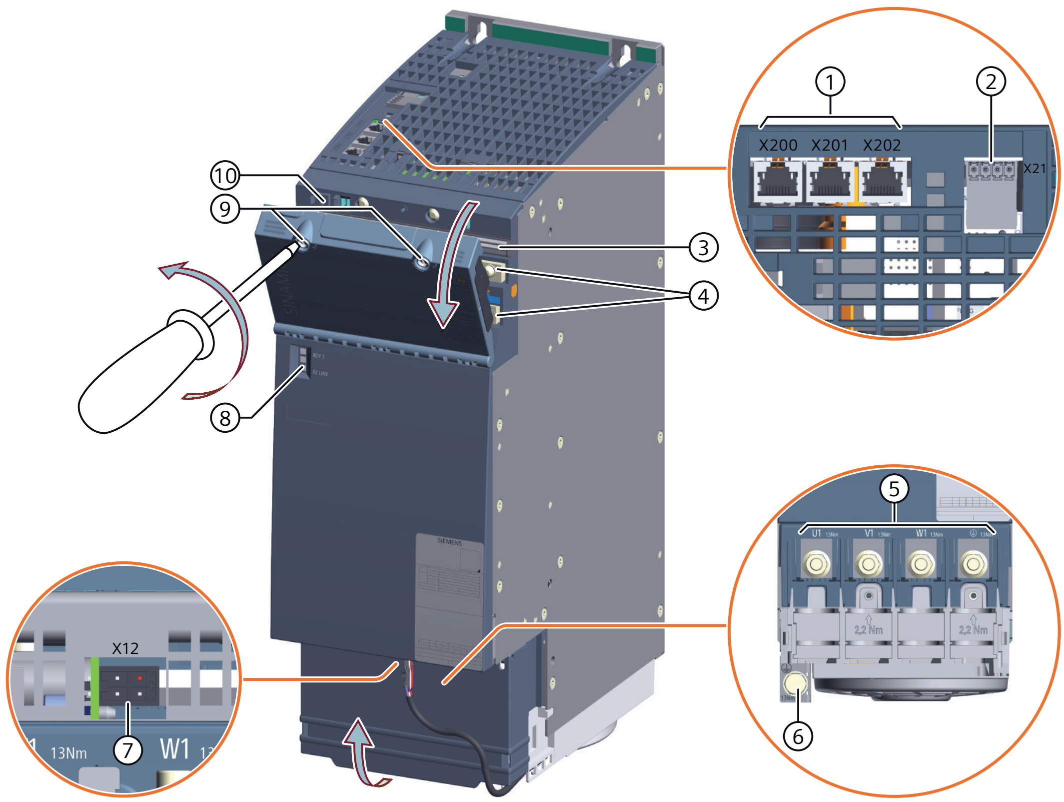
7.4.1 Overview

Overview diagram



① X200 - X202: DRIVE-CLiQ interfaces
② X21: EP terminals / temperature sensor
③ 24 V busbar
④ DC link busbars
⑤ X1: Line connection
⑥ Protective conductor connection
⑦ Shield connection plate
⑧ LEDs (RDY, DC Link)
⑨ Protective flap
⑩ Releasing the protective flap
⑪ X24: Connection for 24 V terminal adapter

Figure 7-2 Interface overview, Smart Line Modules 16 kW and 24 kW



① X200 - X202: DRIVE-CLiQ interfaces
② X21: EP terminals / temperature sensor
③ 24 V busbar
④ DC link busbars
⑤ X1: Line connection
⑥ Protective conductor connection
⑦ X12: Fan connection
⑧ LEDs (RDY, DC Link)
⑨ Releasing the protective flap
⑩ X24: Connection for 24 V terminal adapter

Figure 7-3 Interface overview, Smart Line Modules 36 kW and 55 kW

7.4.2 X200 - X202 DRIVE-CLiQ

Requirement

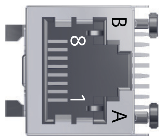
Note

MOTION-CONNECT DRIVE-CLiQ cables are required

Only MOTION-CONNECT DRIVE-CLiQ cables may be used for connections.

Description

Table 7-2 X200 - X202: DRIVE-CLiQ interface

Socket	Pin	Designation	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

7.4.3 X21 EP terminals and temperature sensor

Overview

A temperature sensor and the signal cable for the Enable Pulses (EP) function are connected at the X21 interface.

The connector is included in the Terminal Kit of the Smart Line Module.

Requirement

Note

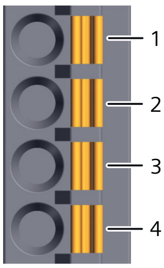
Terminals X21.3 and X21.4

Operation of the Line Module can only be enabled if the "1" signal is applied at the EP terminals.

If the "0" signal is applied at the EP terminals, pulse inhibit is enabled. As a consequence, energy recovery is disabled and the bypass relays drop out. The DC link remains charged if the Line Module is not isolated from the line supply in this process, for example because there is no main contactor present.

Description

Table 7-3 X21: EP terminal/temperature sensor

Connector	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors[1]: Pt1000/PTC/KTY84-130/ bimetallic switch with NC contact
	2	- Temp	
	3	EP + (Enable Pulses +)	Voltage: -3 ... +30 V DC Electrical isolation: Yes Input characteristic acc. to IEC 61131-2, type 1 and type 3 Input voltage (including ripple) "1" signal: 11 ... 30 V signal "0": -3 ... +5 V Input current at 24 V DC: 2.5 ... 4 mA at < 1.5 mA: "0" signal reliably detected Input delay for "0" → "1": typ. 25 µs / max. 50 µs for "1" → "0": typ. 110 µs + 2 µs/m / max. 150 µs + 4 µs/m
	4	EP M (Enable Pulses M)	
Connectable cable cross-sections	Rigid, flexible		0.25 ... 1.5 mm²
	Flexible, with end sleeve without protective collar		0.25 ... 1.5 mm²
	Flexible, with end sleeve with protective collar		0.25 ... 0.75 mm²
	AWG / kcmil		24 ... 16
Stripped length	8 mm (0.31 inch)		
Screwdriver to release the terminals	Slotted screwdriver 0.4 x 2.5 mm		

1) Accuracy of temperature measurement (temperature sensor, including evaluation):
- Pt1000: ±5 °C (Pt1000 tolerance Class B acc. to EN 60751)
- PTC: ±5 °C
- KTY: ±7 °C

Temperatures are detected but not evaluated in the Smart Line Module.

7.4.4 X24 24 V terminal adapter

Overview

The 24 V terminal adapter is connected at the X24 interface.

Description

Table 7-4 X24: 24 V terminal adapter

Connector	Pin/terminal	Pin assignment/designation	Technical data
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Connectable cable cross-sections	Flexible		0.5 ... 6 mm²
	Flexible, with end sleeve without protective collar		0.5 ... 6 mm²
	Flexible, with end sleeve with protective collar		0.5 ... 6 mm²
	AWG / kcmil		20 ... 8
Stripped length	12 mm (0.47 inch)		
Screwdriver	Slotted screwdriver 1.0 x 4.0 mm		
Tightening torque	1.2 ... 1.5 Nm (10.6 ... 13.3 lbf in)		

7.4.5 X1 line connection

Overview

The line supply cable is connected at the Smart Line Module at line connection X1.

Description

Table 7-5 X1: Line connection for Smart Line Modules 16 kW and 24 kW

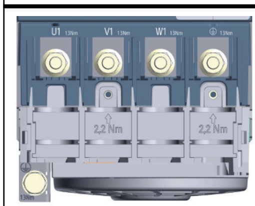
Connector[1)]	Terminal	Function	Technical data
 	U1	Line connection	Supply voltage: 3 AC 380 ... 480 V, 50/60 (47 ... 63) Hz
	V1		
	W1		
	⏚	Protective conductor connection	

Connector[1]	Terminal	Function	Technical data
Connectable cable cross-sections	Flexible		6 ... 16 mm^2
	Flexible, with end sleeve without protective collar		6 ... 16 mm^2
	Flexible, with end sleeve with protective collar		6 ... 16 mm^2
	AWG / kcmil		10 ... 6
Stripped length	12 mm (0.47 inch)		
Screwdriver	Slotted screwdriver 1.0 x 5.5 mm		
Tightening torque[2]	1.2 ... 1.5 Nm (18 lbf in)		

[1] Power connector with screw terminal (top) or push-in connection (bottom)

[2] for power connector with screw terminal

Table 7-6 X1: Line connection for Smart Line Modules 36 kW and 55 kW

Line connection block	Terminal	Function	Technical data
	U1	Line connection	Supply voltage: 3 AC 380 ... 480 V, 50/60 (47 ... 63) Hz M8 threaded bolts, nut: Hexagon size 13
	V1		
	W1		
	⏚	Protective conductor connection	
Connectable cable cross-sections	Smart Line Module 36 kW		10 ... 50 mm^2 (AWG 8 ... 1)[1]
	Smart Line Module 55 kW		25 ... 70 mm^2 (AWG 4 ... 2/0)[1]
Tightening torque	13 Nm (115 lbf in)		

[1] To ensure IPXXB touch protection according to IEC 60529, reduction collars must be used for all cable cross-sections.

7.4.6 X12 fan connection

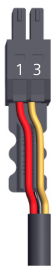
Overview

The fan is connected at interface X12. Interface X12 is available for 36 kW and 55 kW Smart Line Modules.

The fan connection plug is pre-assembled and premounted on the fan module.

Description

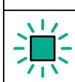
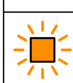
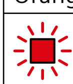
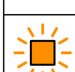
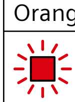
Table 7-7 X12: Fan connection at Smart Line Modules 36 kW and 55 kW

Connector	Terminal	Designation	Technical data
	1	Fan connection + (red)	Voltage: 12 V DC
	2	Fan connection - (black)	
	3	PWM input (brown)	
	4	Tacho signal (white)	

7.5 LEDs

Response of the LEDs in operation

Table 7-8 Meaning of the LEDs on the Smart Line Module

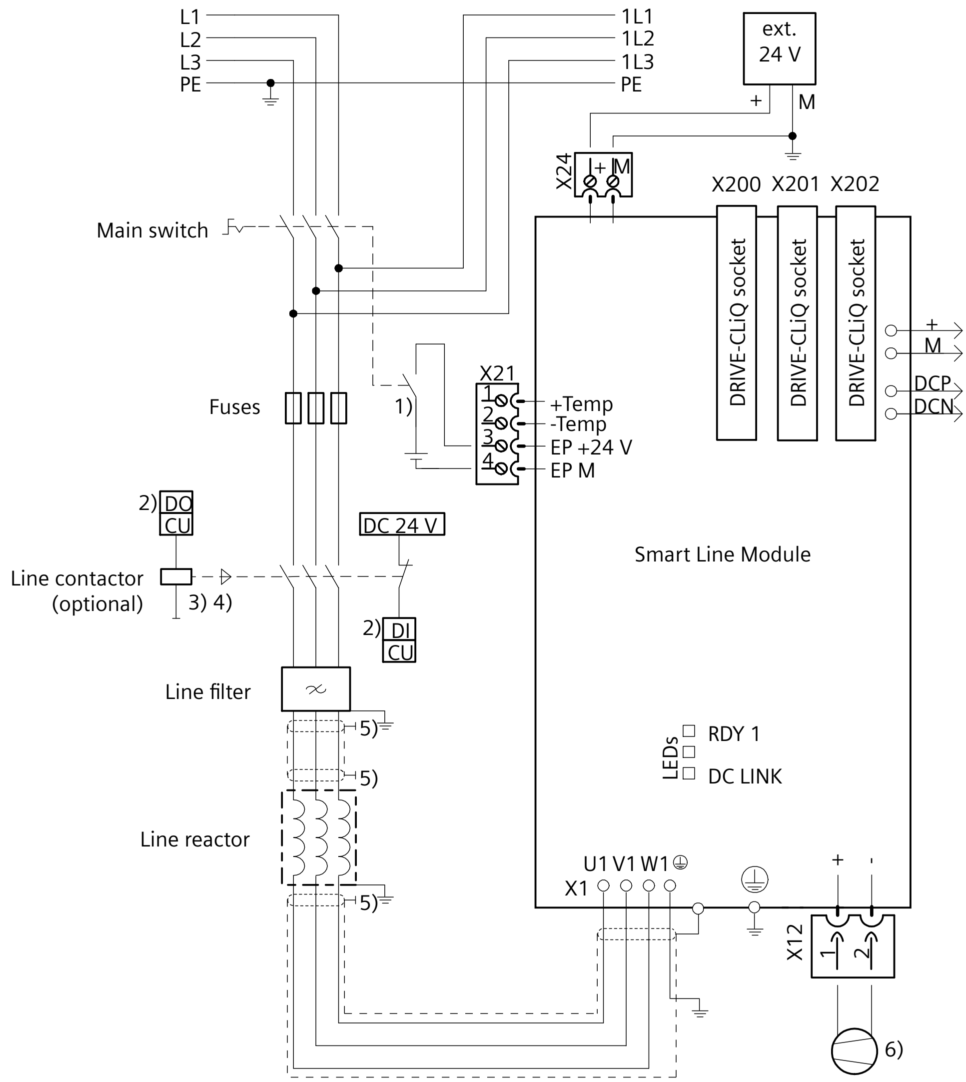
LEDs		Description, cause	Remedy
RDY 1	**DC LINK**		
□	□	The electronics power supply is missing or outside the permissible tolerance range.	Check the 24 V supply.
 Green	–1)	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	□	The DC link voltage is < 50 V.	–
	 Orange	The DC link voltage is present.	–
	 Red	The DC link voltage lies above the permissible tolerance range.	Check the line voltage.
 Orange	 Orange	DRIVE-CLiQ communication is being established.	–
 Red	–1)	This component has at least one fault. **Remark:** The LED is controlled irrespective of the corresponding messages being reconfigured.	Resolve and acknowledge the fault.

LEDs		Description, cause	Remedy
RDY 1	**DC LINK**		
Red/Green (0.5 Hz)	–[1)]	Firmware is being downloaded.	–
Red/Green (2 Hz)	–[1)]	Firmware download is complete. The system waits for POWER ON.	Carry out a POWER ON.
Orange/ Green or Orange/Red (2 Hz)	–[1)]	Component recognition via LED is activated by the commissioning tool (parameter p0124). **Remark:** The colors of the flashing LED depend on what status the LED had on activation (setting of parameter p0124 to "1").	–

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

7.6 Connection example

Connection example



1) Leading opening contact t > 10 ms
When using a Voltage Sensing Module VSM10, the leading opening contact can be omitted.
2) DI/DO (= digital input/digital output), controlled by the Control Unit
3) No additional load permitted downstream of the line contactor
4) The current-carrying capacity of the DO must be observed; an output coupling device may have to be used.
5) Contact is established through the rear panel or shield rails in accordance with the EMC installation guideline
6) Fan connection for Smart Line Modules 36 kW and 55 kW

Figure 7-4 Connection example for Smart Line Modules 16 kW ... 55 kW

7.7 Dimension drawings

Dimension drawing

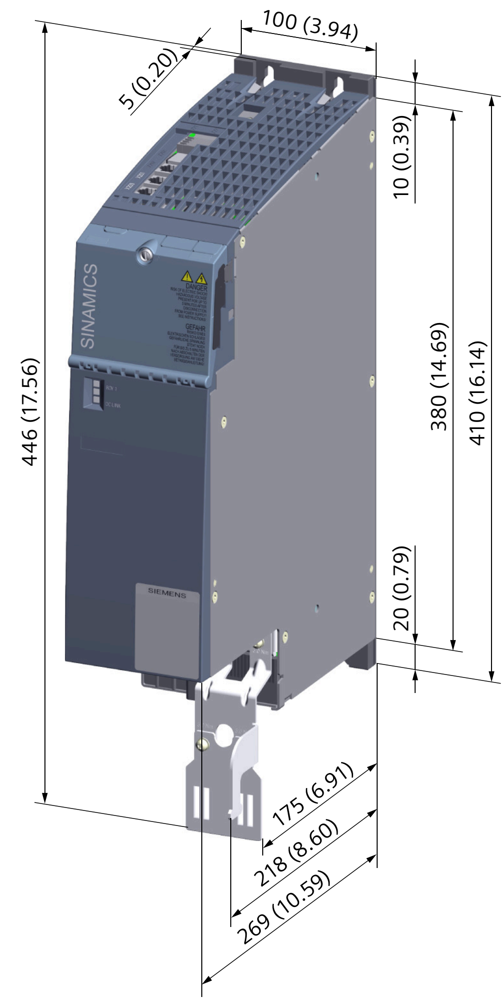


Figure 7-5 Dimension drawing of Smart Line Modules 16 kW and 24 kW, all dimensions in mm and (inch)

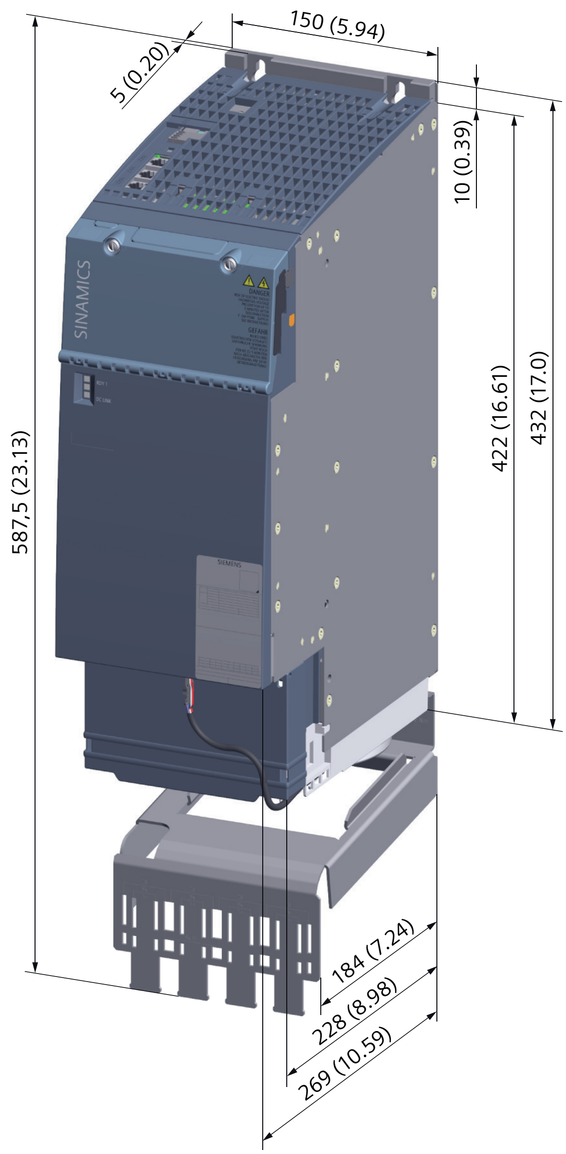


Figure 7-6 Dimension drawing of Smart Line Modules 36 kW and 55 kW, all dimensions in mm and (inch)

7.8 Frequency with which the DC link is precharged

Description

The permissible precharging frequency of the DC link capacitance by the Line Module is obtained using the following formula:

$$\text{Permissible number of pre-charging operations within 8 min} = \frac{\text{Max. permissible DC link capacitance Line Module in μF}}{\sum \text{DC link capacitance of the configured drive line-up in μF}}$$

Figure 7-7 Frequency with which the DC link is precharged

The DC link capacitances of the individual components are indicated in the relevant technical specifications.

7.9 Duty cycles

7.9.1 16 kW ... 55 kW Smart Line Modules

Duty cycle overview

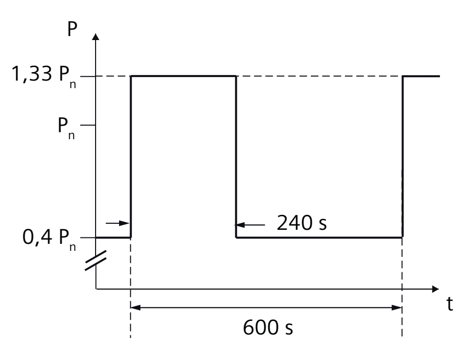


Figure 7-8 S6 duty cycle with initial load for a duty cycle duration of 600 s

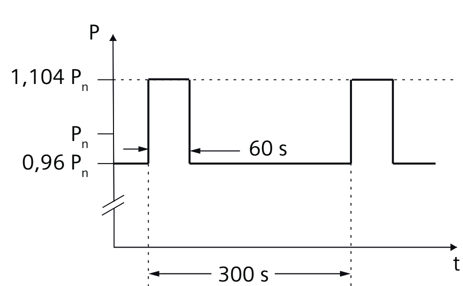


Figure 7-9 Duty cycle with low overload for a duty cycle duration of 300 s

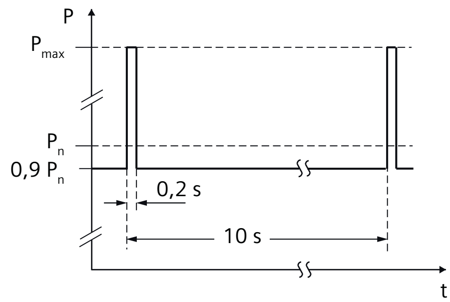


Figure 7-10 Peak power duty cycle with 0.2 s overload for a duty cycle duration of 10 s

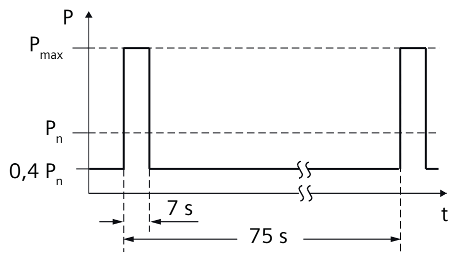


Figure 7-11 Peak power duty cycle with 7 s overload for a duty cycle duration of 75 s

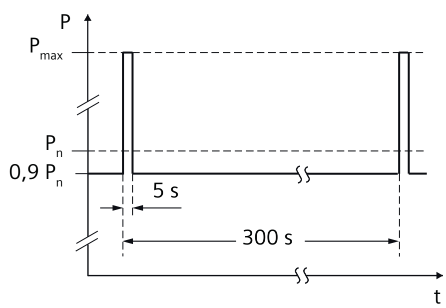


Figure 7-12 Peak power duty cycle with 5 s overload for a duty cycle duration of 300 s

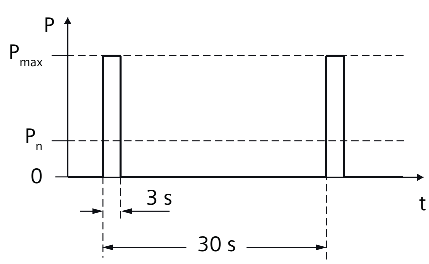


Figure 7-13 Spindle duty cycle with 3 s overload for a duty cycle duration of 30 s

7.10 Installation

7.10.1 Install the Smart Line Module

Overview

Smart Line Modules are designed for installation in the control cabinet. They are fixed to the control cabinet panel or a mounting panel.

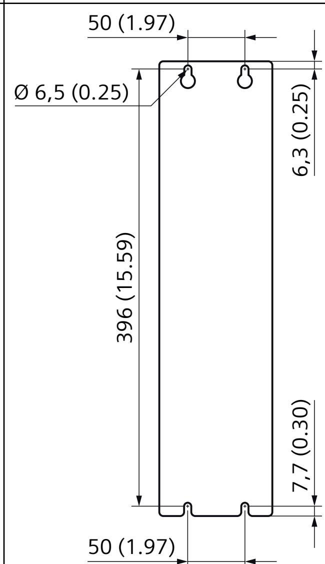
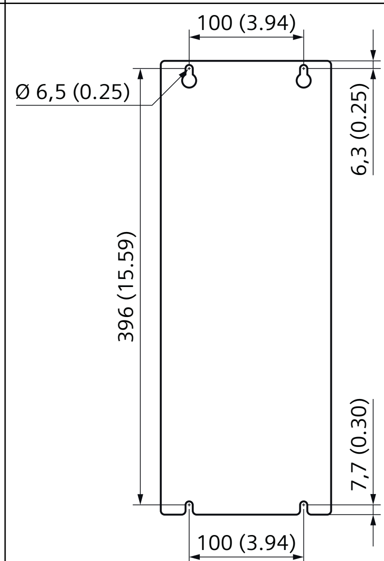
Requirement

⚠ WARNING
Risk of injury as a result of foreign bodies in the device
Parts (e.g.: drilling chips, end sleeves) falling into the device can cause short-circuits and damage the insulation. This can result in severe injury (arcing, loud bang, parts that are flung out). • Only perform installation and other work when the devices are current-free. • Cover the ventilation slots when mounting and installing the control cabinet and remove the cover before switching on.

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.

Procedure

Table 7-9 Rear view of Smart Line Modules 16 kW ... 55 kW in mm und (inch)

Rated power	16 kW and 24 kW	36 kW and 55 kW
Width	100 mm	150 mm
Rear view		
Mounting parts	4 x M6 screws 4 x M6 washers	4 x M6 screws 4 x M6 washers
Tightening torque	6 Nm (53.1 lbf in)	6 Nm (53.1 lbf in)

Fit a Smart Line Module on the mounting panel as follows:

1. Prepare the mounting panel.
2. First, screw the 4 screws in far enough so that you can attach the component.
3. Attach the component.
4. Tighten the screws finger-tight. Tightening torque: 0.5 Nm (4.4 lbf in)
5. Then tighten the screws fully.

7.10.2 Mounting the shield connection plate

Overview

When using a shielded line supply cable or when attaching strain relief for the line supply cable, you can optionally mount a shield connection plate onto 36 kW and 55 kW Smart Line Modules.

The shield connection plate is not included in the scope of delivery.

Requirement

Mount the shield connection plate before mounting the fan module to be able to reach the lower mounting points on the mounting panel.

- The fan module has still not been installed in the component or was removed.

Components required:

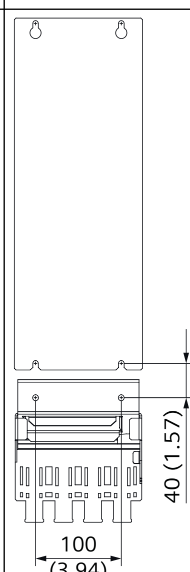
- Shield connection plate (to be ordered separately)

Table 7-10 Shield connection plate

Width	Article number	Smart Line Module
150 mm	6SL5166-1AF00-0AA0	36 kW and 55 kW

Procedure

Table 7-11 Rear view of Smart Line Modules 36 kW and 55 kW with shield connection plate in mm and (inch)

Rated power	36 kW and 55 kW
Width	150 mm
Rear view	
Mounting parts	2 x M6 screws, with a max. head height of 7.7 mm 2 x M6 washers
Tightening torque	6 Nm (53.1 lbf in)

The shield connection plate is mounted separately from the Smart Line Module with a defined clearance on the control cabinet panel or on a mounting panel. Proceed as follows to mount the shield connection plate:

1. Prepare the mounting panel.
2. Fasten the shield connection plate to the mounting panel using screws at the prepared distance.
3. Tighten the screws.

See also

Replacing the fan, 36 kW and 55 kW Smart Line Modules (Page 310)

7.10.3 Mounting the fan

Overview

A fan must also be mounted when mounting Smart Line Modules 36 kW and 55 kW.

Install the fan module provided with the Smart Line Module.

Requirement

Note the following before installing the fan module in the Smart Line Module:

- The shield connection plate is mounted (if a shielded line supply cable and the shield connection plate are used).

Required tool:

- T20 torx screwdriver

Procedure

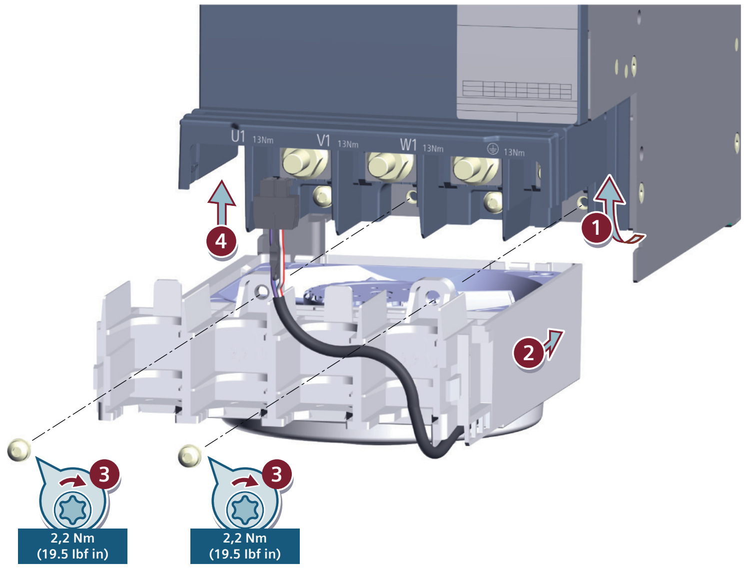


Figure 7-14 Mounting the fan

Proceed as follows to install the fan module in the Smart Line Module:

1. Open the line connection block cover upward.
2. Slide the fan module from the front into the Smart Line Module.
3. Tighten the fixing screws of the fan module. T20 torx screwdriver. Tightening torque: 2.2 Nm (19.5 lbf in)
4. As soon as the line supply cable and the protective conductor have been connected, insert the fan connection plug into socket X12.

7.11 Connecting

7.11.1 Line connection Smart Line Modules 16 kW and 24 kW

7.11.1.1 Connectable cable cross-sections

Description

Table 7-12 Conductor cross-sections and tightening torques

Rated power	Line connection	Cable cross-sections	Tightening torque
16 kW and 24 kW	Plug with screw connection (6SL5166-2NA00-0AA0)	Finely stranded connection with: 6 ... 16 mm^2 (AWG 10 ... 6)	1.2 - 1.5 Nm (18 lbf in)
	Plug with push-in connection (6SL5166-2NB00-0AA0)		-

7.11.1.2 Prepare the line supply cable

Overview

Smart Line Modules 16 kW and 24 kW are connected to the line supply using a power connector and a line supply cable. To be able to connect the line supply cable to the power connector, you must first prefabricate it.

Requirement

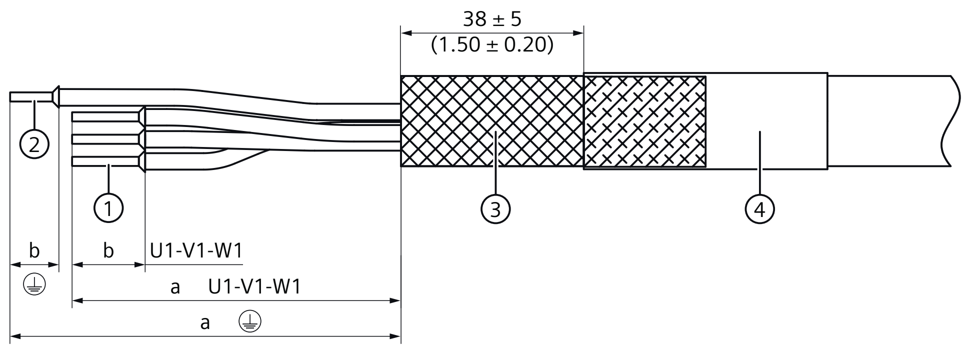
NOTICE

Adherence to core and stripped lengths

If the specified core and stripped lengths are not complied with, single cores can be damaged or shield contact prevented.

- Comply with the specified core and stripped lengths.

Procedure



① Cores U1-V1-W1
② Protective conductor core
③ Protective braided shield (when using a shielded line supply cable)
④ Shrink-on sleeve (when using a shielded line supply cable)

Figure 7-15 Design of the line supply cable for Smart Line Modules 16 kW and 24 kW

Table 7-13 Core and stripped lengths as a function of the cable cross-section, data in mm and (inch)

Power connector	Connection	6 mm² AWG 10		10 mm² / 16 mm² AWG 8 / AWG 6	
		a	b	a	b
Plug with screw connection	U1, V1, W1	90 +2/-3 (3.54+0.08/-0.12)	12 ±0.5 (0.47 ±0.02)	90 +2/-3 (3.54+0.08/-0.12)	15 ±0.5 (0.59 ±0.02)
	Protective conductor	95 +2/-3 (3.74 +0.08/-0.12)	12 ±0.5 (0.47 ±0.02)	95 +2/-3 (3.74 +0.08/-0.12)	15 ±0.5 (0.59 ±0.02)
Plug with push-in connection	U1, V1, W1	95 +2/-3 (3.74+0.08/-0.12)	12 ±0.5 (0.71 ±0.02)	95 +2/-3 (3.74+0.08/-0.12)	18 ±0.5 (0.71 ±0.02)
	Protective conductor	100 +2/-3 (3.94 +0.08/-0.12)	12 ±0.5 (0.71 ±0.02)	100 +2/-3 (3.94 +0.08/-0.12)	18 ±0.5 (0.71 ±0.02)

To connect the line supply cable at the power connector, prepare these as follows:

1. Remove 110 mm (4.33 in) of cable sheath with a tolerance of ±5 mm (±0.20 in).
2. When using a shielded line supply cable, shorten the protective braided shield and fold it back by the same length.
3. Fix the protective braided shield. Preferably use a shrink-on sleeve with hot melt adhesive.
4. Shorten the single cores to length "a" according to the table above. The stripped lengths of the line supply cables are the same for all cross-sections.
5. Remove the insulation of the single cores to length "b" according to the table above.

7.11.1.3 Prepare end sleeves

Requirement

The following requirements apply when crimping end sleeves:

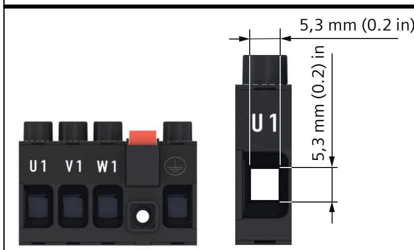
- You will need a crimping tool. We recommend the following crimping tool from Weidmüller (www.weidmueller.com):
  - Type PZ 6/5, article number 9011460000
- Use end sleeves compliant with DIN 46228.

Procedure

Fit end sleeves on the line supply cable as follows:

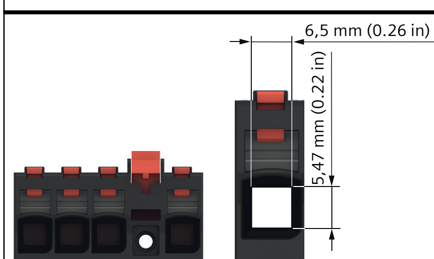
1. Match the cross-sections of the end sleeves and the line supply cable according to the following table.
2. Crimp the end sleeves.

Table 7-14 Power connector with screw terminal (6SL5166-2NA00-0AA0)

Dimensions of the terminal openings	Permissible conductor cross-sections	End sleeve	
			
	6 mm² (AWG 10)	✓	✓
	10 mm² (AWG 8)	✓	✓
	16 mm² (AWG 6)	✓ 1)	✓ 1)

1) When crimped, end sleeves must not exceed the maximum dimensions of 5.3 x 5.3 mm (0.21 x 0.21 in).

Table 7-15 Power connector with push-in connection (6SL5166-2NB00-0AA0)

Dimensions of the terminal openings	Permissible conductor cross-sections	End sleeve	
			
	6 mm² (AWG 10)	✓	✓
	10 mm² (AWG 8)	✓	✓
	16 mm² (AWG 6)	✓ 1)	✓ 1)

1) When crimped, end sleeves must not exceed the maximum dimensions of 6.5 x 5.47 mm (0.26 x 0.22 in).

7.11.1.4 Wiring the line supply cable

Requirement

⚠ WARNING
Electric shock or fire caused by non-certified power connector in the power circuit
Using a non-certified power connector can result in overheating with fire or electric shock. • Only use certified power connectors.

Components required:

- Power connector with screw terminal or push-in connection (Article No.: 6SL5166-2NA00-0AA0, 6SL5166-2NB00-0AA0, to be ordered separately)

Required tools:

- Slotted screwdriver 1.0 x 5.5 mm

Procedure

As standard, the protective conductor is connected at the power connector. If this is not possible, for example due to space reasons, then you can connect the protective conductor at the protective conductor connection of the Smart Line Module, see Chapter "Connect the protective conductor (Page 159)". In this case, in the following, it is not necessary to connect a core for the protective conductor connection at the power connector.

To connect the line supply cable at the power connector, proceed as follows:

1. When using the power connector with push-in connection, carefully check that the 4 actuators are locked in the pressed state and that the terminals are open (condition when delivered).
2. Starting with U1, V1, W1 and the protective conductor, insert the cores into the open terminals.
   – The cores must be inserted as far as they will go.
   – For larger cross-sections, it is helpful if U1, V1, W1 and the protective conductor are simultaneously inserted and suitably screwed or interlocked.
3. Fixing the cores.
   – For a screw terminal, tighten the screws. Slotted screwdriver 1.0 x 5.5 mm. Tightening torque: 1.2 - 1.5 Nm (18 lbf in)
   – For a push-in connection, you lock the terminals by sliding the slotted screwdriver horizontally under the actuator and then pressing the actuator upward. Then check that the terminals are locked by gently pulling on the insulated conductors.

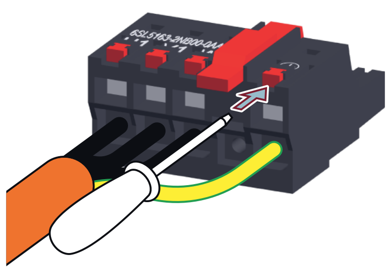


Figure 7-16 Example: Connecting the line supply cable at the power connector with push-in connection

7.11.1.5 Releasing the line supply cable from the push-in connector

Procedure

For a power connector with push-in connection, if the terminals have to be opened, then proceed as follows:

1. To release the terminals, using a slotted screwdriver 1.0 x 5.5 mm press the actuators horizontally into the housing one after the other until they engage.

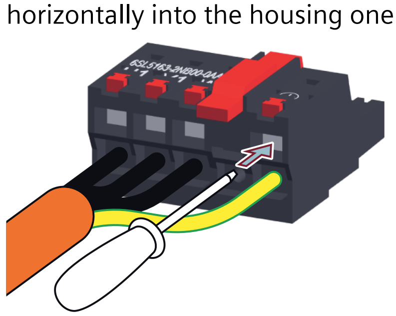


Figure 7-17 Releasing terminals

2. Withdraw the cores from the housing.

If cores are difficult to withdraw from the open terminal, pressing the actuator up as far as it will go at the same time will help. This action opens the spring-loaded terminal to its maximum.

7.11.1.6 Connecting the line supply cable

Procedure

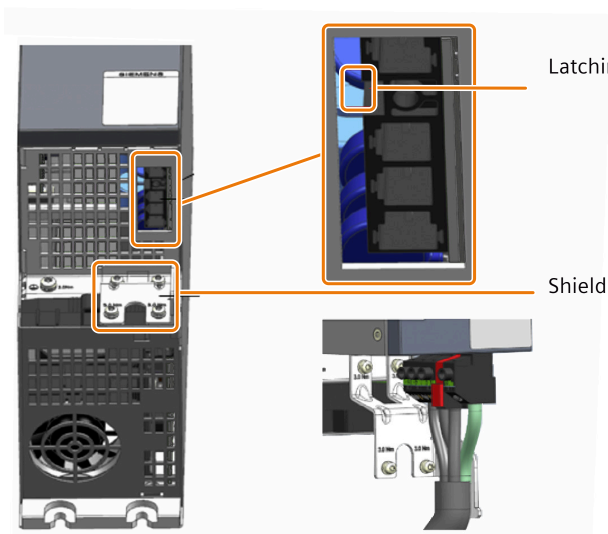


Figure 7-18 Attaching the power connector at the Smart Line Module

To connect the line supply cable with the power connector at the Smart Line Module, proceed as follows:

Insert the plug fully into connection socket X1 at the Smart Line Module until it audibly latches.

7.11.1.7 Attaching the strain relief of the line supply cable

Overview

If an unshielded line supply cable is used, this cable must also be fastened to the shield connection plate for strain relief on the Smart Line Module because the latching connection does not provide reliable strain relief.

Requirement

The following requirements apply:

- The line supply cable is connected at the Smart Line Module.
- Use a suitable cable tie.

Procedure

Secure the line supply cable to the Smart Line Module shield connection plate using a cable tie.

Result

You have secured the line supply cable to the Smart Line Module shield connection plate using a cable tie.

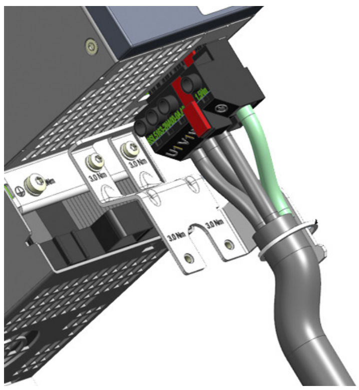


Figure 7-19 Line supply cable fixed to the Smart Line Module

7.11.1.8 Attach the cable shield using a hose clamp

Overview

If a shielded line supply cable is used, the line supply cable shield must be connected. The shield can be connected to the shield connection plate using a hose clamp.

Requirement

The following requirements apply:

- The line supply cable is connected at the Smart Line Module.
- Use a suitable hose clamp.

Procedure

Connect the line supply cable shield to the Smart Line Module shield connection plate as follows:

Fasten the line supply cable shield to the Smart Line Module shield connection plate using a hose clamp.

Result

You have secured the line supply cable shield to the Smart Line Module shield connection plate using a hose clamp.

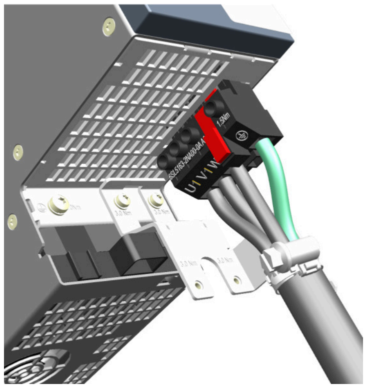


Figure 7-20 Shield support with hose clamp

7.11.1.9 Connect the cable shield using the shield connection clamp

Overview

If a shielded line supply cable is used, it is also possible to connect the line supply cable shield using an optional additional shield connection plate and a shield connection clamp.

This method has the advantage that it provides better contact and makes it easier to connect the shield. It is therefore recommended that the line supply cable shield always be connected using the optional additional shield connection plate.

The optional additional shield connection plate and the shield connection clamp are not included in the scope of delivery and will need to be ordered.

Requirement

The following requirements apply:

- The line supply cable is connected at the Smart Line Module.
- Use the following shield connection plate and a suitable shield connection clamp.

Table 7-16 Shield connection plate and shield connection clamps

Designation	Article number
Optional shield connection plate	6SL5166-1BD00-0AA0
Shield connection clamp for cable diameter 5 ... 28 mm (0.20 ... 1.10 inch)	8WH9130-0NA00
Shield connection clamp for cable diameter 20 ... 35 mm (0.79 ... 1.38 inch)	8WH9130-0PA00

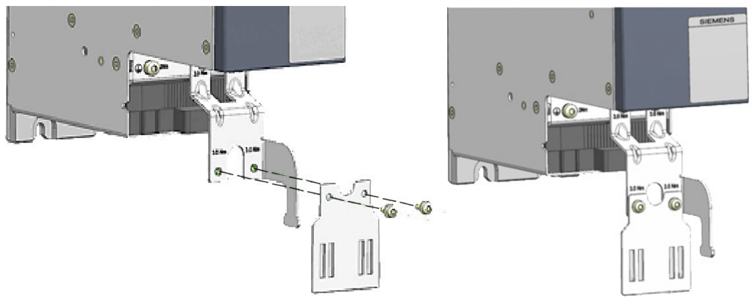
Required tools:

- Torx screwdriver TX 20

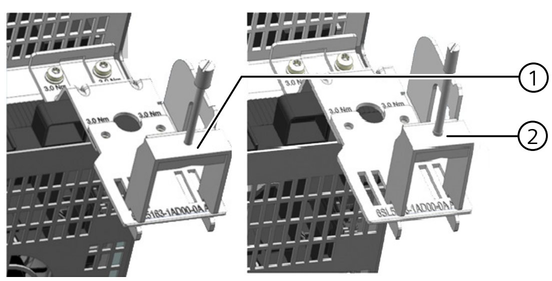
Procedure

Connect the line supply cable shield to the optional additional Smart Line Module shield connection plate as follows:

1. Fasten the additional shield connection plate to the lower mounting points of the existing shield connection plate.



2. Tighten the two screws. Torx screwdriver TX 20. Tightening torque: 3 Nm (26.6 lbf in)
3. Fully insert the power connector into connection socket X1 at the Smart Line Module until it audibly latches.
4. Insert the cable into the center of the shield connection clamp.
5. Hook the shield connection clamp into the slits of the shield connection plate.



① Shield connection clamp for cable diameter 20 ... 35 mm (0.79 ... 1.38 inch)

② Shield connection clamp for cable diameter 5 ... 28 mm (0.20 ... 1.10 inch)

6. Tighten the shield connection clamp pressure plates using the knurled screw according to the table below.
   – When fastening the shield connection clamp, carefully ensure that the conductor is positioned at the center of the clamp.

Shield connection clamp	Tightening torque
Cable diameter 5 ... 28 mm (0.20 ... 1.10 inch)	0.8 Nm (7.08 lbf in)
Cable diameter 20 ... 35 mm (0.79 ... 1.38 inch)	1.8 Nm (15.93 lbf in)

Result

The line supply cable shield is secured to the optional additional Smart Line Module shield connection plate using a shield connection clamp.

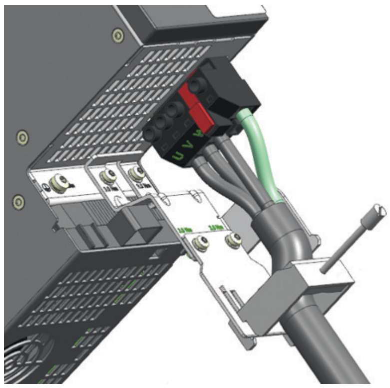


Figure 7-21 Shield support with shield connection plate

7.11.1.10 Withdrawing the power connector

Procedure

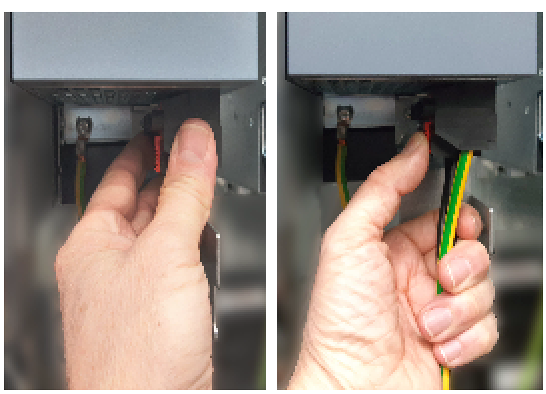


Figure 7-22 Releasing the power connector

You have two options, if the power connector has to be withdrawn to perform maintenance work:

Variant 1 (left image)

1. Using one hand, grasp the power connector at the front and back.
2. Release the plug using your other hand.

Variant 2 (right image)

Grasp the cable and release the power connector using your thumb.

7.11.2 Line connection Smart Line Modules 36 kW and 55 kW

7.11.2.1 Connectable cable cross-sections

Description

Table 7-17 Conductor cross-sections of the line supply cable for Smart Line Modules 36 kW and 55 kW

Rated power	Cable cross-sections[1)]
36 kW	10 ... 50 mm^2 (AWG 8 ... 1)
55 kW	25 ... 70 mm^2 (AWG 4 ... 2/0)

1) To ensure IPXXB touch protection according to IEC 60529, reduction collars must be used for all cable cross-sections.

7.11.2.2 Selecting cable lugs

Description

The dimensions of the line connection block to select a line supply cable and a ring or tubular cable lug are subsequently provided.

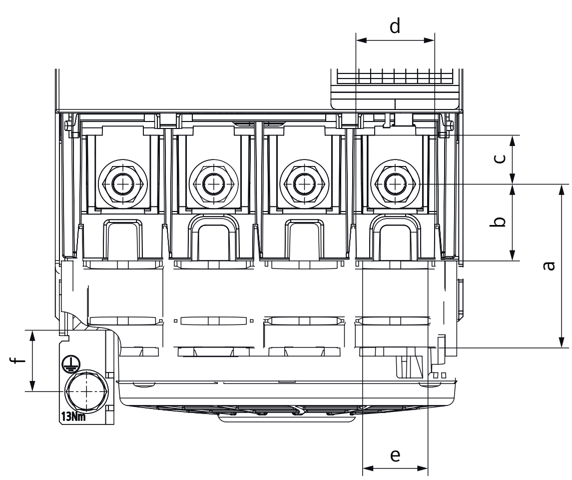


Figure 7-23 Dimensions of the line connection block of the Smart Line Modules 36 kW and 55 kW

Table 7-18 Dimensions of the line connection block in mm (inch)

	a	b	c	d	e	f
Maximum dimensions	59.8 (2.35)	28.1 (1.1)	21.2 (0.83)	29.4 (1.16)	25.4 (1.0)	22.5 (0.88)

Also note the following:

For UL applications, only use UL-approved ring or pipe-type cable lugs (ZMVV) certified for the particular voltage. The permissible current must be at least 125% of the input or output current. Use the higher value as basis.

7.11.2.3 Prepare the line supply cable

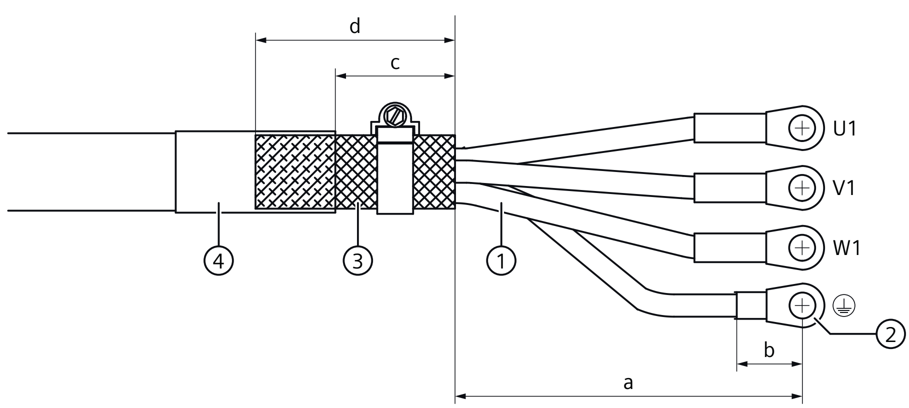
Overview

Smart Line Modules 36 kW and 55 kW are connected to the line supply using a line supply cable. This must first be prefabricated. If you use MOTION-CONNECT power cables, then first assemble them.

Requirement

NOTICE
Adherence to core and stripped lengths If the specified core and stripped lengths are not complied with, single cores can be damaged or shield contact prevented. • Comply with the specified core and stripped lengths.

Procedure



① Cores U1, V1, W1 and protective conductor
② Ring or pipe-type cable lug M8
③ Protective braided shield (when using a shielded line supply cable)
④ Shrink-on sleeve (when using a shielded line supply cable)

Figure 7-24 Design of the line supply cable for Smart Line Modules 36 kW and 55 kW

Table 7-19 Core and stripped lengths for the line supply cable, data in mm and (inch)

Connection	Length	Connection using a shield connection clamp	Connection using a hose clamp
U1, V1, W1, protective conductor	a	175 ±5 (6.9 ±0.2)	200 ±5 (7.9 ±0.2)
Pipe-type cable lug	b	depending on the cable lug used	depending on the cable lug used
Shield[1)]	c	50 ±5 (2.0 ±0.2)	50 ±5 (2.0 ±0.2)
folded back protective braided shield[1)]	d	100 ±10 (3.9 ±0.4)	100 ±10 (3.9 ±0.4)

[1)] When using a shielded line supply cable

To connect the line supply cable, prepare this as subsequently described:

1. Remove 210 mm (8.3 in) of cable sheath with a tolerance of ±10 mm (±0.4 in).
2. When using a shielded line supply cable, shorten the protective braided shield and fold it back by the same length.
3. Fix the protective braided shield. Preferably use a shrink-on sleeve with hot melt adhesive.
4. Shorten the single cores to length "a".
   - Length "a" is calculated based on length "b" and the cable lug being used.
   - The stripped lengths of the line supply cables are the same for all cross-sections.
5. Remove length "b" of the insulation from the single cores according to the table above.
6. Attach a ring or pipe-type cable lug to the stripped end area.

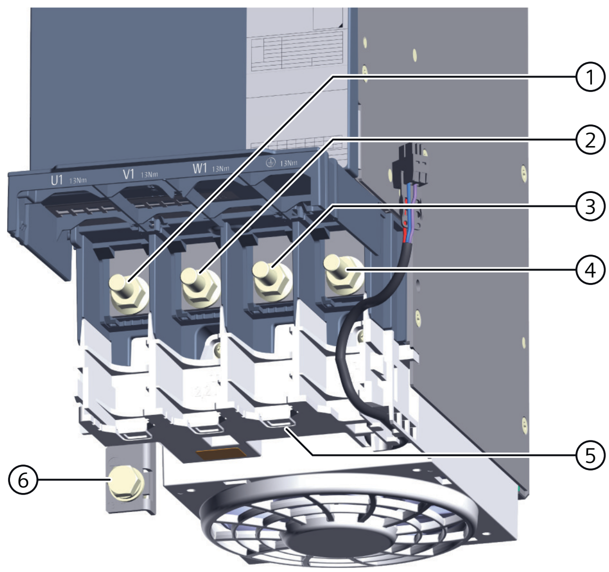
7.11.2.4 Connecting the line supply cable

Requirement

Required tools:

- Slotted screwdriver 0.8 x 5.5 mm
- Socket wrench size 13

Procedure



① U1
② V1
③ W1
④ Protective conductor connection
⑤ Touch protection
⑥ Protective conductor connection

Figure 7-25 Connections for the line supply cable at the Smart Line Modules 36 kW and 55 kW

Connection X1 for the line connection is implemented as line connection block. As standard, the protective conductor is also connected there. Alternatively, you can connect the protective conductor to the protective conductor connection at the component, see Chapter "Connect the protective conductor (Page 159)". In this case, in the following, it is not necessary to connect a core for the protective conductor connection at the line connection block.

To connect the line supply cable at the Smart Line Module, proceed as follows:

1. Open the locking of the cover of the line connection block left and right and swing it upwards. Slotted screwdriver 0.8 x 5.5 mm
2. Remove the nuts from the threaded studs. Socket wrench size 13
3. Place the cable lug onto the threaded studs.
4. Screw the nuts onto the threaded studs and tighten them. Socket wrench size 13. Tightening torque: 13 Nm (115 lbf in)
5. Push the reduction collar into the line connection block.
6. Close the line connection block cover.
7. Insert the fan connection plug into socket X12.

7.11.2.5 Using reduction collars

Overview

Reduction collars ensure touch protection according to IEC 60529. These are included in the Terminal Kit of the Smart Line Module.

To ensure IPXXB touch protection, you must use reduction collars for all cable cross-sections.

Procedure

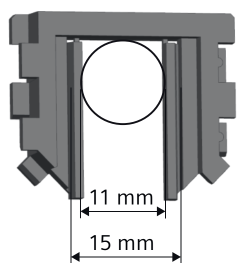


Figure 7-26 Dimensions of the reduction collar

The maximum diameter of the cable with a reduction collar is 11 mm and after cutting out the tabs, 15 mm.

Proceed as follows to install the reduction collars:

1. Take the reduction collars from the Terminal Kit.
2. Adapt the reduction collars to the diameter.
3. Mount this in the line connection block.

Example

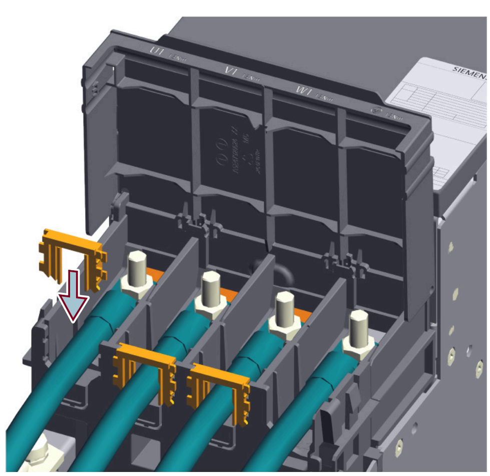


Figure 7-27 Example of installed reduction collars

7.11.2.6 Connecting the cable shield

Overview

If you are using a shielded line supply cable, you can attach the line supply cable shield to the Smart Line Module shield connection plate using a hose clamp or a shield connection clamp.

Requirement

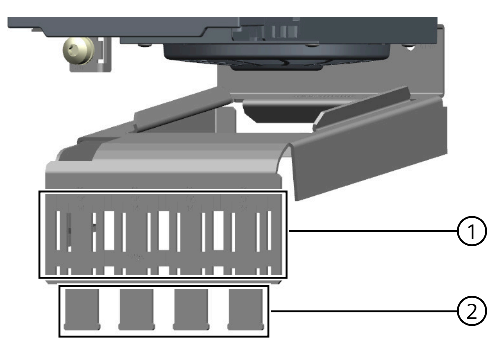
The following requirements apply:

- The line supply cable is connected at the line connection block.
- The shield connection plate is mounted.
- Use a suitable hose clamp or shield connection clamp.

Table 7-20 Shield connection clamps

Cable diameter	Article number
5 ... 28 mm (0.20 ... 1.10 inch)	8WH9130-0NA00
20 ... 35 mm (0.79 ... 1.38 inch)	8WH9130-0PA00

Procedure



① Mounting for shield connection clamp
② Mounting for the hose clamp

Connect the line supply cable shield to the Smart Line Module shield connection plate as follows:

1. Fasten the line supply cable shield to the shield connection plate using a hose clamp or a shield connection clamp according to the table below.
2. When fastening a shield connection clamp, ensure that the conductor is located at the center of the clamp.

Component	Cable diameter	Tightening torque
Hose clamp	-	0.8 ... 1 Nm (7.08 ... 8.85 lbf in)
Shield connection clamp	5 ... 28 mm (0.20 ... 1.10 inch)	1 Nm (8.85 lbf in)
Shield connection clamp	20 ... 35 mm (0.79 ... 1.38 inch)	1.8 Nm (15.93 lbf in)

Result

You have routed the line supply cable so that it is shielded.

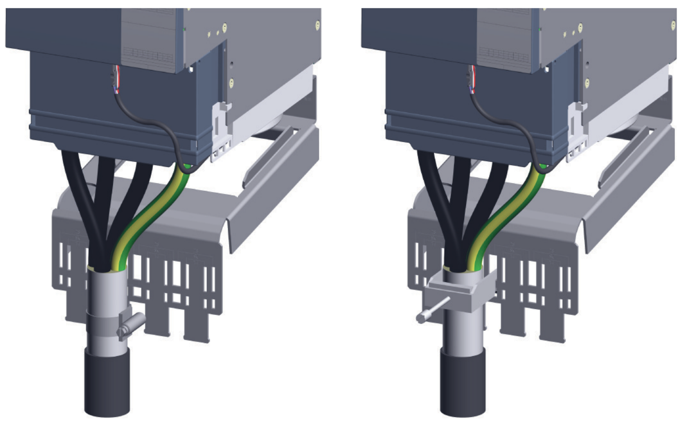


Figure 7-28 Shield support with a hose clamp (left) and a shield connection clamp (right)

7.11.3 Connect the protective conductor

Overview

There are two ways to connect the protective conductor to a Smart Line Module:

- Connection at the power connector (Smart Line Modules 16 kW and 24 kW) or line connection block (Smart Line Modules 36 kW and 55 kW)
- Protective conductor connection at the housing of the Smart Line Module

Instructions on how to connect the protective conductor to the housing of a Smart Line Module is provided below.

Requirement

⚠ WARNING
Electric shock if there is no ground connection
When the protective conductor connection of devices with protection class I is missing or incorrectly implemented, 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.

The following requirements apply:

Use a suitable ring or tubular cable lug.

Smart Line Module	Ring/pipe-type cable lug	Tool
16 kW and 24 kW	M5 (without insulation)	Torx screwdriver TX 25
36 kW and 55 kW	M8	Hexagon size 13

Description

Connect the protective conductor to the protective conductor connection of the Smart Line Module as follows:

1. Prepare the cable with a ring/tubular cable lug.
2. Connect the protective conductor to the component with the protective conductor connection screw.
3. Tighten the screw.

Screw	Tightening torque
M5	3 Nm (26.6 lbf in)
M8	13 Nm (115 lbf in)

More information

Information on how to connect the protective conductor to the power connector or to the line connection block is provided in the following Chapters:

"Wiring the line supply cable (Page 146)"

"Connecting the line supply cable (Page 155)"

7.12 Technical data

Technical specifications

Table 7-21 Smart Line Modules D type (16 kW ... 55 kW)

Feature	6SL5130-	6UE21-6AD0	6UE22-4AD0	6UE23-6AD0	6UE25-5AD0
Power data					
Rated power (P_{rated}) at 380 V / 400 V / 480 V	kW	16 / 16.8 / 20.2	24 / 25.3 / 30	36 / 38 / 45	55 / 58 / 69
Maximum power (P_{max}) at 380 V / 400 V / 480 V	kW	48 / 51 / 61	72 / 76 / 91	108 / 114 / 136	165 / 174 / 208
Input data					
Line voltage	V	3 AC 380 ... 480			
Line frequency	Hz	50/60			
Electronics power supply	V	24			
Rated current (I_{rated})	A	29	43	64	98
Peak current (I_{max})	A	86	129	192	294
Output data					
DC link voltage	V	495 ... 720 (typically 1.35 x line voltage)			
Overvoltage trip	V	820			
Undervoltage trip[1)]	V	360 ... 446			
DC link current ($I_{DC\ link}$)	A	33	49	72	111
DC link peak current ($I_{d\ max}$)	A	97	146	218	334
Current-carrying capacity					
DC link busbars	A	200	200	250	250
24 V DC busbars	A	20	20	20	20
Current consumption of the electronics at 24 V DC	A	0.70	0.70	2.3	2.3
Power loss	W	150	200	400	650
DC link capacitance					
Smart Line Module	μF	820	940	1410	2115
Drive line-up, max.	μF	20000	20000	20000	20000
Power factor	cos φ	0.98			
Cooling air requirement	m^3/h	77	77	155	155
Weight	kg	8.2	8.2	14.9	15.4
Cable lengths	m	See Chapter "Maximum permissible cable lengths (Page 52)"			

Table 7-22 Smart Line Modules C type (16 kW ... 55 kW)

Feature	6SL5130-	6UE21-6AC0	6UE22-4AC0	6UE23-6AC0	6UE25-5AC0
Power data					
Rated power					
at 380 V / 400 V / 480 V	kW	16 / 16.8 / 20.2	24 / 25.3 / 30	36 / 38 / 45	55 / 58 / 69
Maximum power					
at 380 V / 400 V / 480 V	kW	35 / 37 / 44	48 / 51 / 61	72 / 76 / 91	110 / 116 / 139
Input data					
Line voltage	V	3 AC 380 ... 480			
Line frequency	Hz	50/60			
Electronics power supply	V	24			
Rated current (I_{rated})	A	29	43	64	98
Peak current (I_{max})	A	62	86	128	196
Output data					
DC link voltage	V	495 ... 720 (typically 1.35 x line voltage)			
Overvoltage trip	V	820			
Undervoltage trip[1)]	V	360 ... 446			
DC link current ($I_{DC\ link}$)	A	33	49	72	111
DC link peak current ($I_{d\ max}$)	A	71	97	145	222
Current-carrying capacity					
DC link busbars	A	200	200	250	250
24 V DC busbars	A	20	20	20	20
Current consumption of the electronics					
at 24 V DC	A	0.70	0.70	2.3	2.3
Power loss	W	150	200	400	650
DC link capacitance					
Smart Line Module	μF	820	940	1410	2115
Drive line-up, max.	μF	20000	20000	20000	20000
Power factor	cos φ	0.98			
Cooling air requirement	m^3/h	77	77	155	155
Weight	kg	8.2	8.2	14.9	15.4
Cable lengths	m	See Chapter "Maximum permissible cable lengths (Page 52)"			

1) Depends on the parameterized line voltage

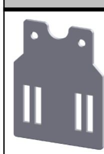
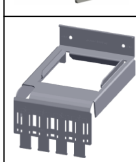
7.13 Accessories

7.13.1 Power connector order data

Smart Line Modules are connected to the line supply using a power connector and a line supply cable. A power connector must be ordered for this purpose. The following variants are available:

Power connector		
Connector variant	**Article number**	**Description**
	6SL5166-2NA00-0AA0	Power connector with screw terminal for Smart Line Modules 16 kW and 24 kW Connection type: Screw terminals
	6SL5166-2NB00-0AA0	Power connector with push-in connection for Smart Line Modules 16 kW and 24 kW Connection type: Spring-loaded terminals

7.13.2 Order data for shield connection plate and clamps

Shield connection plate and clamps		
Accessories	**Article number**	**Description**
	6SL5166-1BD00-0AA0	Optional shield connection plate for 16 kW and 24 kW Smart Line Modules
	8WH9130-0NA00	Shield connection clamp Cable diameter 5 ... 28 mm (0.20 ... 1.10 inch)
	8WH9130-0PA00	Shield connection clamp Cable diameter 20 ... 35 mm (0.79 ... 1.38 inch)
	6SL5166-1AF00-0AA0	Shield connection plate for 36 kW and 55 kW Smart Line Modules

Motor Modules 8

8.1 Description

8.1.1 Versions and types

Overview

A Motor Module is a power unit (inverter) that provides energy with an adapted voltage and variable frequency for the connected motor or motors.

Description

The SINAMICS S220 booksize system is available in 2 versions:

- Precisely 1 motor is connected and operated on a Single Motor Module.
- A Double Motor Module provides 2 independent power supplies for connecting 2 motors.

Motor Modules are available in 2 types depending on the power rating:

- C type: Optimized for continuous load with up to 200% overload (continuous motion)
- D type: Optimized for highly dynamic, intermittent duty cycles (discontinuous motion):
  - 300% overload for Motor Modules up to 30 A
  - 200% overload for the Motor Modules 85 A, 132 A und 200 A

The Motor Modules are supplied from the converter DC link.

The control information is generated in the Control Unit and distributed to the individual Motor Modules via DRIVE-CLiQ. For this reason, the Control Unit contains the open-loop and closed-loop control functions for the Motor Module.

Depending on the specific version, a Motor Module is equipped with one or two DRIVE-CLiQ interfaces for the encoder evaluation.

8.1.2 Single Motor Modules

Overview diagram

Figure 8-1 Single Motor Modules 3 A ... 200 A

Table 8-1 Single Motor Modules

Output current	Width	C type	D type
3 A	50 mm	-	6SL5120-1UE13-0AD0
5 A	50 mm	-	6SL5120-1UE15-0AD0
9 A	50 mm	-	6SL5120-1UE21-0AD0
18 A	50 mm	6SL5120-1UE21-8AC0	6SL5120-1UE21-8AD0
24 A	50 mm	6SL5120-1UE22-4AC0	6SL5120-1UE22-4AD0
30 A	50 mm	6SL5120-1UE23-0SC0	6SL5120-1UE23-0SD0
30 A	100 mm	6SL5120-1UE23-0AC0	6SL5120-1UE23-0AD0
45 A	100 mm	6SL5120-1UE24-5AC0	-
60 A	100 mm	6SL5120-1UE26-0AC0	-
85 A	150 mm	6SL5120-1UE28-5AC0	6SL5120-1UE28-5AD0
132 A	150 mm	6SL5120-1UE31-3AC0	6SL5120-1UE31-3AD0
200 A	200 mm	6SL5120-1UE32-0AC0	6SL5120-1UE32-0AD0

8.1.3 Double Motor Modules

Overview diagram

50 mm
2x3, 2x5
und 2x9 A,
2x18 A (slim)

100 mm
2x18A

Figure 8-2 Double Motor Modules 2x3 A ... 2x18 A

Table 8-2 Motor Modules

Output current	Width	C type	D type
2x3 A	50 mm	-	6SL5120-2UE13-0AD0
2x5 A	50 mm	-	6SL5120-2UE15-0AD0
2x9 A	50 mm	-	6SL5120-2UE21-0AD0
2x18 A	50 mm	6SL5120-2UE21-8SC0	6SL5120-2UE21-8SD0
2x18 A	100 mm	6SL5120-2UE21-8AC0	6SL5120-2UE21-8AD0

8.2 Safety instructions

8.2.1 Safety information

WARNING

Electric shock when the protective flap 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 flap.

WARNING

Electric shock due to improper DC link connection

Incorrectly established connections can result in overheating and therefore fire with associated smoke. 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) released 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, remove the DC link bridge.
- For all components that are wider, you must neither move the DC link bridge to the left nor remove it, as the DC link bridge ensures 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 if the DC link side covers are missing.

- Mount the side covers on the first and last component in the drive line-up.
- Order any 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 cores with insulation properties that comply with safe electrical separation or separately route the brake cores 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.

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

Failure of components as a result of unshielded or incorrectly routed cables to temperature sensors

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.
- Only use temperature sensor cables that are routed together with the motor cable and twisted in pairs and shielded separately.
- Connect the cable shield at both ends to ground potential through a large surface area.
- Only use third-party cables that have cores with insulation properties that comply with safe electrical separation or separately route the cores to fully comply with safe electrical separation.

NOTICE

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

With an incorrect power supply, the holding brake can malfunction, i.e. the holding brake does not reliably open. If the motor constantly operates against the closed holding brake, the holding 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 power supply is realized via the internal 24 V busbars.
- Observe the holding brake voltage tolerances (24 V ± 10%) and the connecting cable voltage losses. The holding brake can close if the voltage is too high.
- Set the DC power supply to 26 V. This ensures that the supply voltage for the holding brake remains within the permissible range when the following constraints are fulfilled:
  - Siemens three-phase motors are used
  - Using Siemens MOTION-CONNECT power cables
  - Note that there are holding brakes that close again when the maximum voltage is exceeded.

NOTICE

Using 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 SINAMICS S120 requirements placed on third-party motors (https://support.industry.siemens.com/cs/ww/en/view/109792187).

Note

Malfunctions due to polluted DRIVE-CLiQ interfaces

Dirty/polluted DRIVE-CLiQ interfaces can result in system malfunctions.

- Cover unused DRIVE-CLiQ interfaces with the supplied blanking covers. You can order missing blanking covers (article number: 6SL3066-4CA00-0AA0, 50 units).

8.2.2 Notes for UL applications

Description

Note

Motor overload protection

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.

More information

More information on parameterizing thermal motor models is provided in Chapter "Thermal motor protection" on the internet:

SINAMICS S120 Function Manual Drive Functions (https://support.industry.siemens.com/cs/ww/en/view/109781535)

8.2.3 Fault protection for the motor circuit

Description

The converter provides short-circuit protection at the motor output terminals.

The manufacturer's declaration describes the conditions regarding protection against electric shock in the event of an insulation failure in the motor circuit.

More information

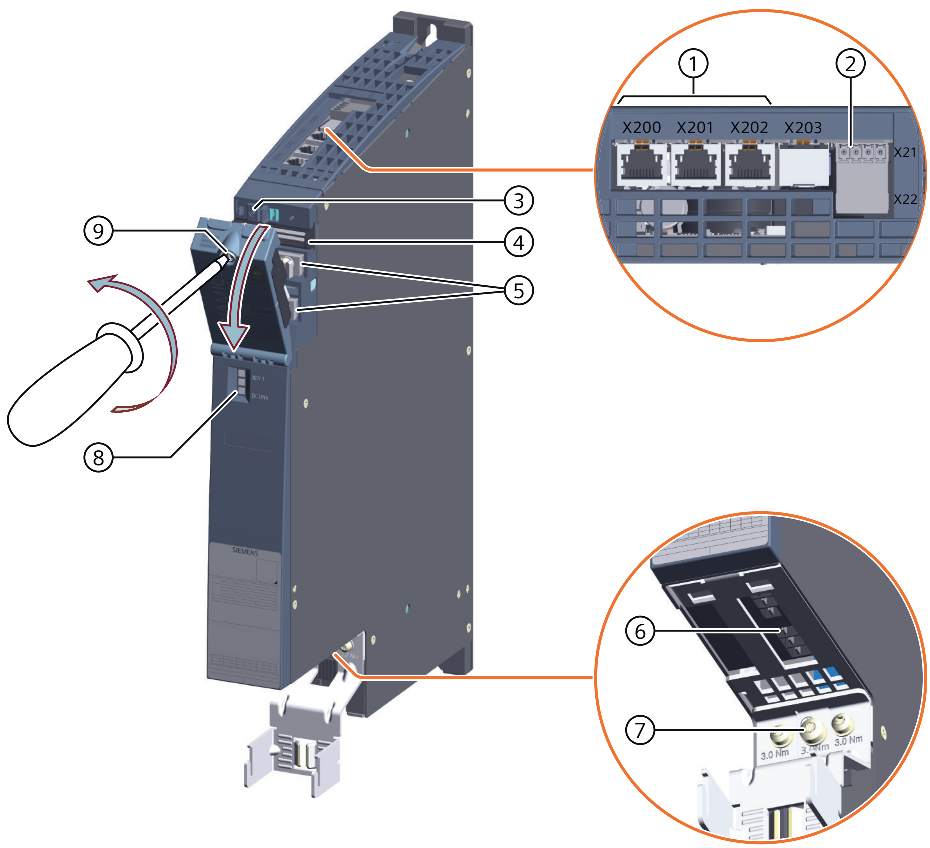
You can find more information on the Internet:

Manufacturer's declaration (https://support.industry.siemens.com/cs/ww/en/view/109476638)

8.3 Interfaces and connections

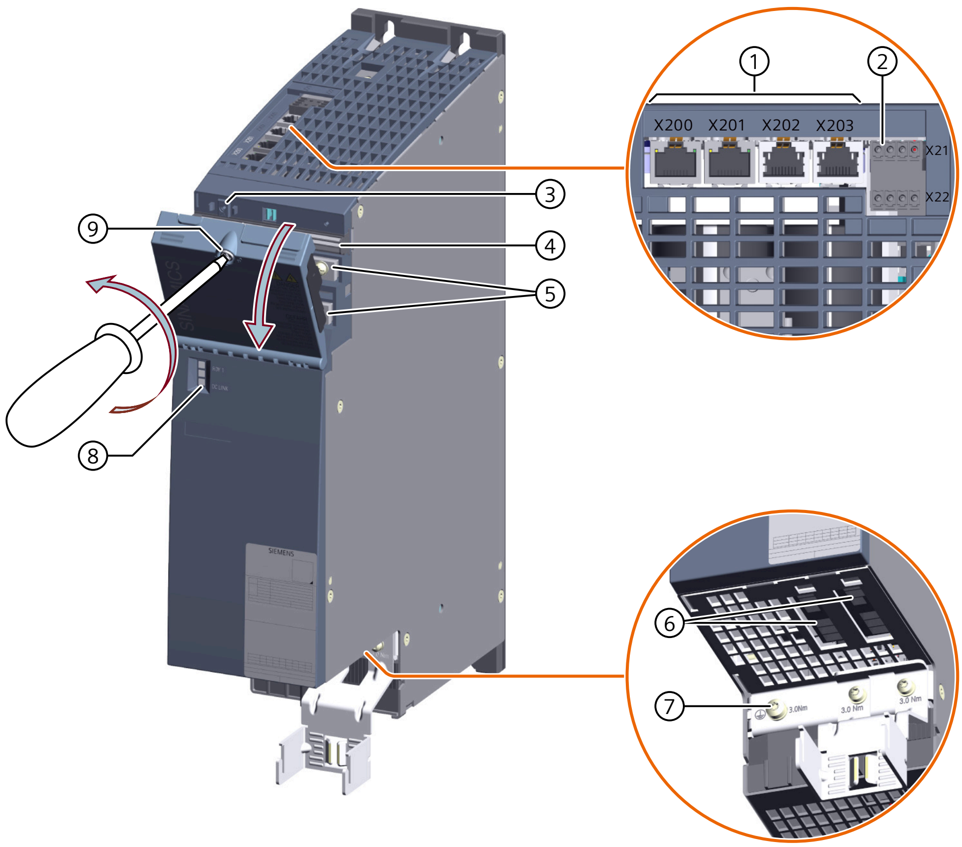
8.3.1 Overview

Overview diagram



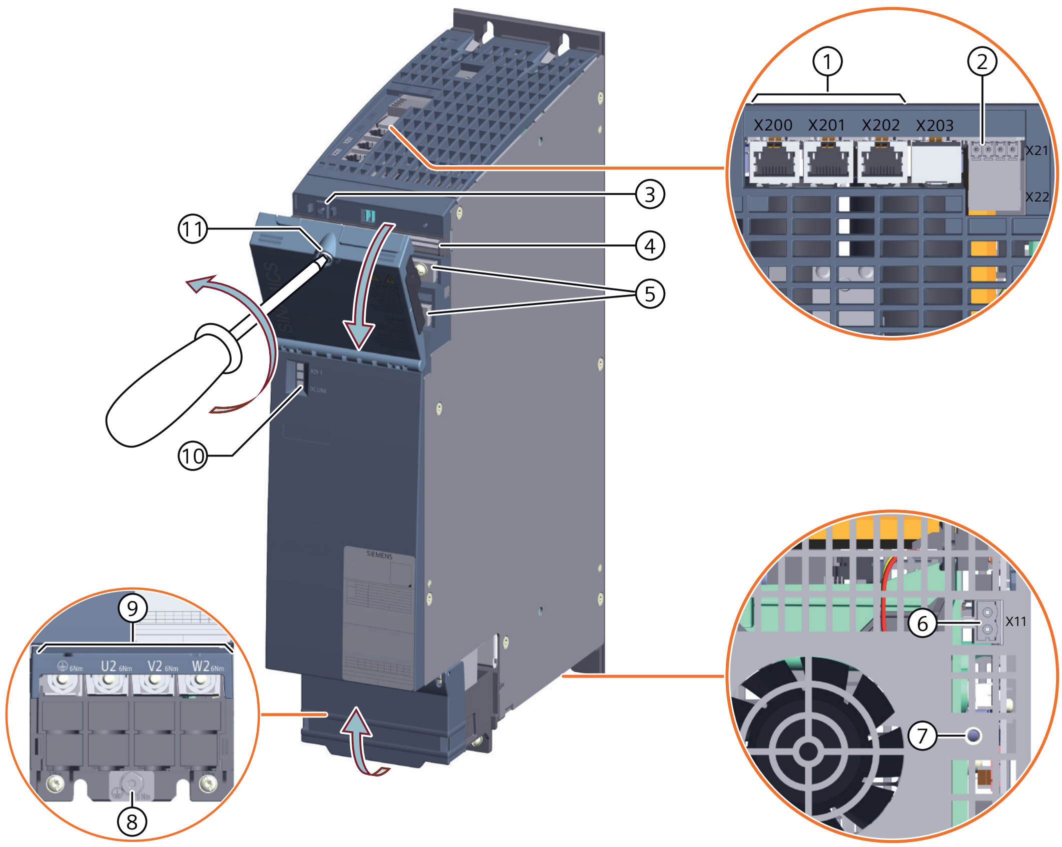
① X200 - X202: DRIVE-CLiQ interfaces
② X21: EP terminal, temperature sensor
③ X24: Connection for 24 V terminal adapter (optional)
④ 24 V busbar
⑤ DC link busbars
⑥ X1: Motor and holding brake connection
⑦ Protective conductor connection
⑧ LEDs (RDY, DC Link)
⑨ Releasing the protective flap

Figure 8-3 Interface overview Motor Modules 3 ... 30 A



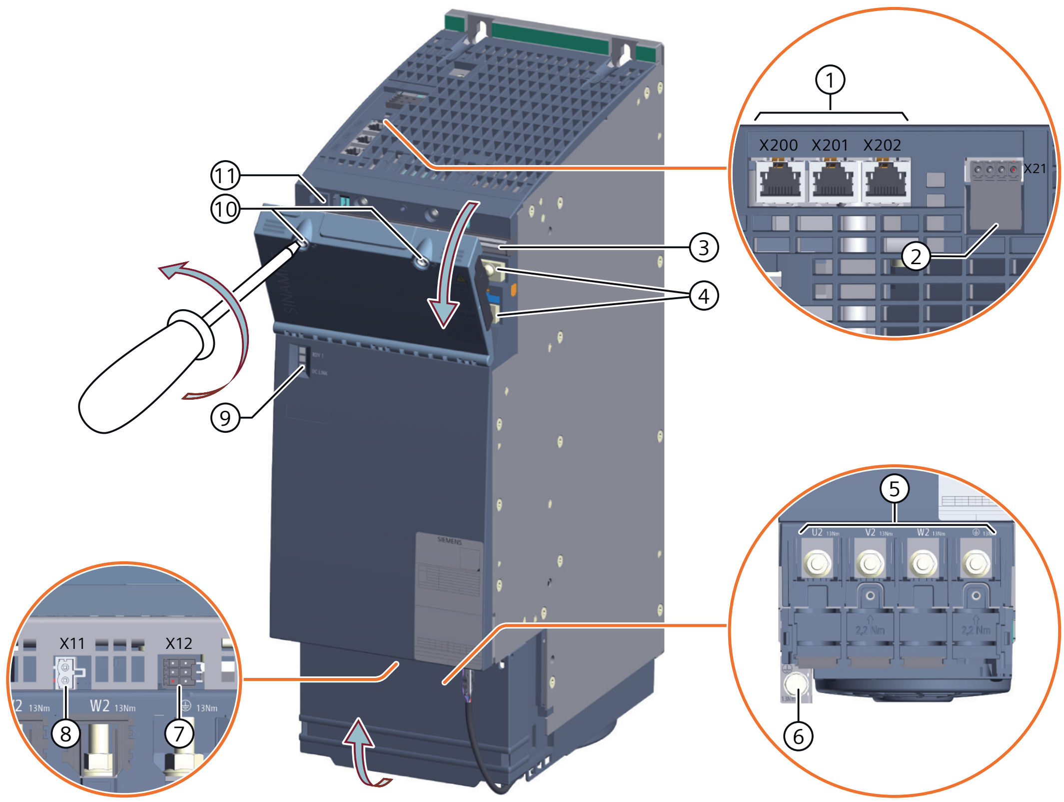
① X200 - X203: DRIVE-CLiQ interfaces
② X21, X22: EP terminals, temperature sensors
③ X24: Connection for 24 V terminal adapter (optional)
④ 24 V busbar
⑤ DC link busbars
⑥ X1, X2: Motor and holding brake connection
⑦ Protective conductor connection
⑧ LEDs (RDY 1, RDY 2, DC Link)
⑨ Releasing the protective flap

Figure 8-4 Interface overview Motor Modules 2x3 ... 2x18 A (Double Motor Modules)



①	X200 - X202: DRIVE-CLiQ interfaces	⑦	Threaded socket M4 for fixing the shield connection clamp
②	X21: EP terminal, temperature sensor	⑧	Protective conductor connection
③	X24: Connection for 24 V terminal adapter (optional)	⑨	X1: Motor connection
④	24 V busbar	⑩	LEDs (RDY, DC Link)
⑤	DC link busbars	⑪	Releasing the protective flap
⑥	X11: Holding brake connection		

Figure 8-5 Interface overview Motor Modules 45 A and 60 A



① X200 - X202: DRIVE-CLiQ interfaces
② X21: EP terminal, temperature sensor
③ 24 V busbar
④ DC link busbars
⑤ X1: Motor connection block
⑥ Protective conductor connection
⑦ X12: Fan connection
⑧ X11: Holding brake connection
⑨ LEDs (RDY, DC Link)
⑩ Releasing the protective flap
⑪ X24: Connection for 24 V terminal adapter (optional)

Figure 8-6 Interface overview Motor Modules 85 A, 132 A and 200 A

8.3.2 X200 - X203 DRIVE-CLiQ

Requirement

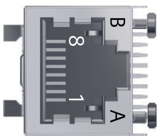
Note

MOTION-CONNECT DRIVE-CLiQ cables are required

Only MOTION-CONNECT DRIVE-CLiQ cables may be used for connections.

Description

Table 8-3 X200 - X202 (Single Motor Module) or X200 - X203 (Double Motor Module): DRIVE-CLiQ interface

Socket	Pin	Designation	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

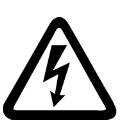
8.3.3 X21, X22 EP terminals and temperature sensor

Overview

At interface X21 (Motor Modules 3 A... 200 A) or X21 and X22 (Motor Modules 2x3 A ... 2x18 A), a temperature sensor and the signal cable for the enable pulses (EP) function are connected.

The connector is included in the Terminal Kit of the Motor Module.

Requirement



⚠ WARNING

Electric shock when the motor temperature sensor insulation fails

When connecting temperature sensors which are not isolated from the motor power circuit according to safe electrical separation, arcing to the signal electronics may occur.

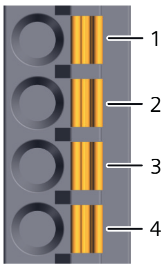
- Use motors whose temperature sensors have safe electrical separation.
- Use only connecting cables and connectors with safe electrical separation between the cores of the temperature sensor and the cores of the power circuit.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

Only use the temperature sensor input of the Motor Module if the following conditions are fulfilled:

- The connected motors are not equipped with an integrated DRIVE-CLiQ interface.
- The temperature values are not acquired via another component (Sensor Module Cabinet, Sensor Module External, Terminal Module).

Description

Table 8-4 X21, X22: EP terminal and temperature sensor

Connector	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors[1)]: Pt1000 / PTC / KTY84-130 / bimetallic switch with NC contact
	2	- Temp	
	3	EP + (Enable Pulses +)	Voltage: -3 ... +30 V DC Electrical isolation: Yes Input characteristic acc. to IEC 61131-2, type 1 and type 3 Input voltage (including ripple) "1" signal: 11 ... 30 V signal "0": -3 ... +5 V Input current at 24 V DC: 2.5 ... 4 mA at < 1.5 mA: "0" signal reliably detected Input delay for "0" → "1": typ. 25 μs / max. 50 μs for "1" → "0": typ. 110 μs + 2 μs/m / max. 150 μs + 4 μs/m
	4	EP M (Enable Pulses M)	
Connectable cable cross-sections	Rigid, flexible		0.25 ... 1.5 mm^2
	Flexible, with end sleeve without protective collar		0.25 ... 1.5 mm^2 [1)]
	Flexible, with end sleeve with protective collar		0.25 ... 0.75 mm^2
	AWG / kcmil		24 ... 16
Stripped length	8 mm (0.31 inch)		
Screwdriver to release the terminal	Slotted screwdriver 0.4 x 2.5 mm		

1) Accuracy of temperature measurement (temperature sensor, including evaluation):
- Pt1000: ±5 °C (Pt1000 tolerance Class B acc. to EN 60751)
- PTC: ±5 °C
- KTY: ±7 °C

8.3.4 X1 - X2 motor and holding brake connection

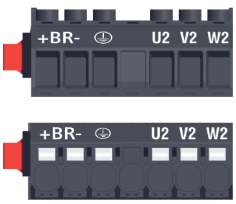
Overview

At interface X1 (Motor Modules 3 A ... 30 A) or X1 and X2 (Motor Modules 2x3 A ... 2x18 A), the motor and the holding brake are connected through a power connector.

The power connector is not included in the scope of delivery.

Description

Table 8-5 X1, X2: Motor and holding brake connection for Motor Modules 3 A... 30 A, 2x3 A... 2x18 A

Connector[1)]	Terminal	Designation	Technical data
	BR+	Holding brake connection[2)]	Output voltage: 24 V DC Maximum load current: 2 A Minimum load current: 0.1 A
	BR-		
	⏚	Motor PE/ground connection	
	U2	Motor connection	
	V2		
	W2		
Connectable cable cross-sections	Finely stranded connection		0.75 ... 6 mm2 (AWG 19 ... 10)
Tightening torque[3)]	0.5 - 0.6 Nm (4.4 lbf in)		

1) Power connector with screw terminal (top) or push-in connection (bottom)

2) The holding brake must be connected via outputs BR+ and BR- of connector X1 or X2. It is not permissible that the BR- conductor is directly connected to the electronics ground M.

3) For power connector with screw terminal

8.3.5 X1 Motor connection

Overview

The motor is connected at interface X1 (Motor Modules 45 A ... 200 A). Connection X1 is implemented as motor connection block. The cover of the connection block must be opened to access the connection threaded studs. The protective conductor connection for the motor is integrated in the connection block.

Description

Table 8-6 X1: Motor connection for Motor Modules 45 A and 60 A

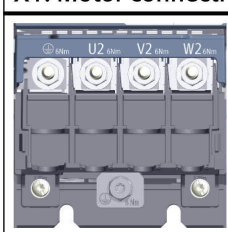
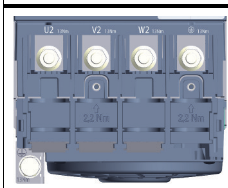
X1: Motor connection	Terminal	Designation	Technical data
	⏚	Motor PE/ground connection	Threaded bolts: M6 / 6 Nm (53.1 lbf in) Nut: Hexagon size 10
	U2	Motor connection	
	V2		
	W2		
Connectable cable cross-sections	Single conductor connection Two-wire connection		6 ... 50 mm² (AWG 10 ... 1) 4 ... 25 mm² (AWG 12 ... 4)
Tightening torque	6 Nm (53.1 lbf in)		

Table 8-7 X1: Motor connection for Motor Modules 85 A ... 200 A

X1: Motor connection	Terminal	Designation	Technical data
	U2	Motor connection	Threaded bolts: M8 / 13 Nm (115 lbf in) Nut: Hexagon size 13
	V2		
	W2		
	⏚	Motor PE/ground connection	
Connectable cable cross-sections	Single conductor connection Two-wire connection		16 ... 150 mm² (AWG 6 ... 300 kcmil)[1)] 16 ... 50 mm² (AWG 6 ... 1/0)[1)]
Tightening torque	13 Nm (115 lbf in)		

1) To ensure touch protection IPxxB according to IEC 60529, reduction collars must be used for cable cross-sections of 16 mm² - 95 mm² (AWG 6 - AWG 3/0).

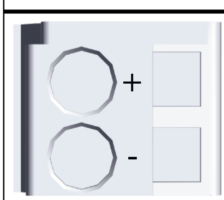
8.3.6 X11 holding brake connection

Overview

The holding brake connection plug is part of the pre-assembled cable. It is also included in the Terminal Kit of the Motor Module.

Description

Table 8-8 X11: Holding brake connection for Motor Modules 45 A ... 200 A

X11: Holding brake connection	Terminal	Designation	Technical data
	+ (BR+)	Connecting the holding brake	Module output voltage: 24 V DC Max. load current: 2 A Minimum load current: 0.1 A
	- (BR-)[1)]		
Connectable cable cross-sections	Rigid, flexible Flexible, with end sleeve without protective collar Flexible, with end sleeve with protective collar AWG / kcmil		0.08 ... 2.5 mm² 0.25 ... 2.5 mm² 0.25 ... 1.5 mm² 28 ... 12
Stripped length	8 ... 9 mm (0.31 ... 0.35 inch)		
Screwdriver	Slotted screwdriver 0.5 x 3.5 mm		

1) It is not permissible that you directly connect conductor BR- to electronics ground M.

8.3.7 X12 fan connection

Overview

For Motor Modules 85 A ... 200 A, the fan is connected to interface X12 using a connector.

The fan connection plug is pre-assembled and premounted on the fan module.

Description

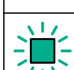
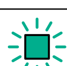
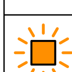
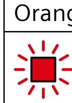
Table 8-9 X12: Fan connection for Motor Modules 85 A ... 200 A

X12: Fan connection	Terminal	Designation	Technical data
	1	Fan connection + (red)	Voltage: 48 V DC
	2	N/A	
	3	Fan connection - (black)	
	4	N/A	
	5	PWM input (brown)	
	6	Tacho signal (yellow)	

8.4 LEDs

Response of the LEDs in operation

Table 8-10 Meaning of the LEDs on the Motor Module

LEDs			Description, cause	Remedy
RDY 1 for axis 1	**RDY 2 for axis 2**[1)]	**DC LINK**		
□	□	□	The electronics power supply is missing or outside the permissible tolerance range.	Check the 24 V supply.
 Green	 Green	–[2)]	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
		□	The DC link voltage is < 50 V.	–
		 Orange	The DC link voltage is present.	–
		 Red	The DC link voltage lies above the permissible tolerance range.	Check the line voltage.

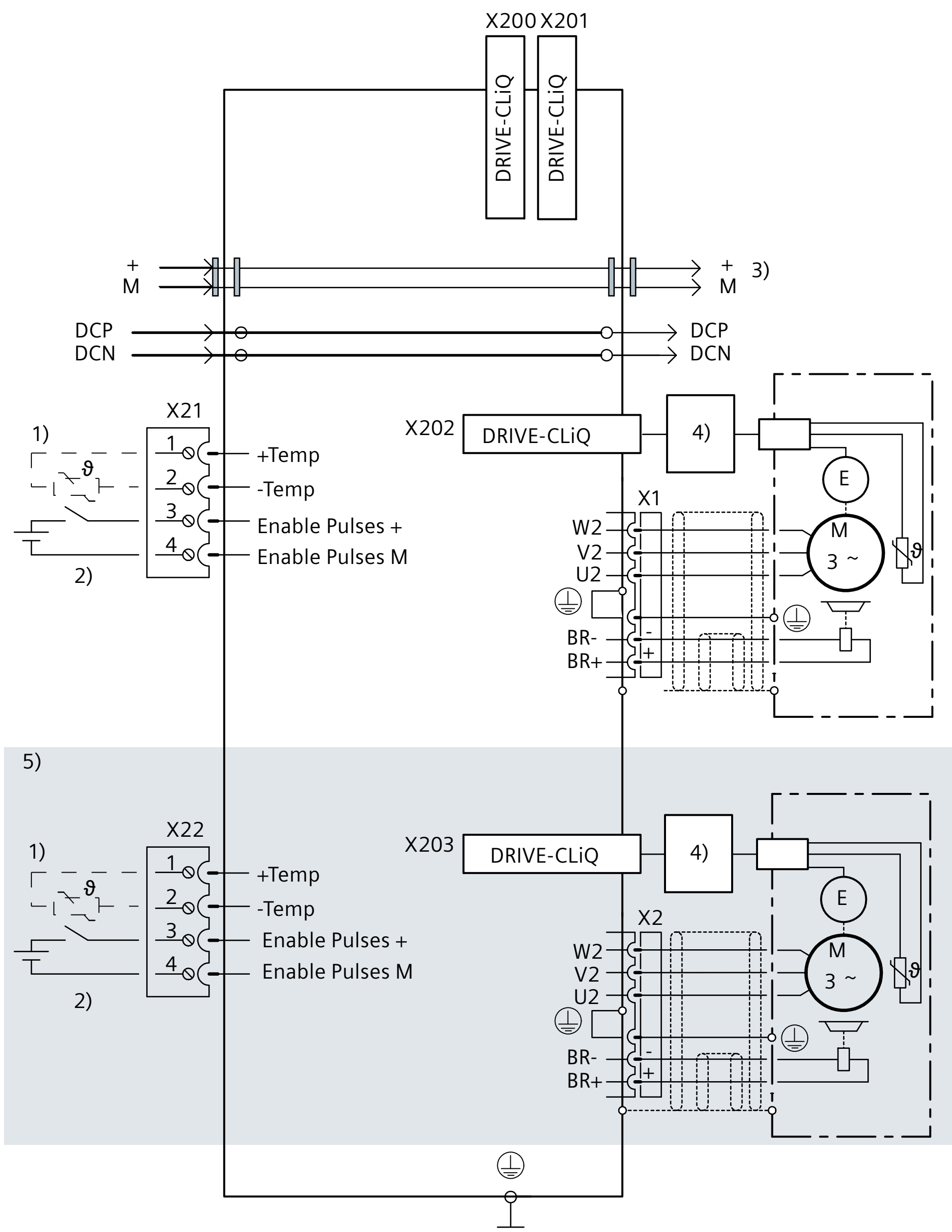
LEDs			Description, cause	Remedy
RDY 1 for axis 1	**RDY 2 for axis 2[1]**	**DC LINK**		
Orange	Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	Red	–[2]	This component has at least one fault. **Remark:** The LED is controlled irrespective of the corresponding messages being reconfigured.	Resolve and acknowledge the fault.
Red/Green (0.5 Hz)	Red/Green (0.5 Hz)	–[2]	Firmware is being downloaded.	–
Red/Green (2 Hz)	Red/Green (2 Hz)	–[2]	Firmware download is complete. The system waits for POWER ON.	Carry out a POWER ON.
Orange/ Green or Orange/Red (2 Hz)	Orange/ Green or Orange/Red (2 Hz)	–[2]	Component recognition via LED is activated by the commissioning tool (parameter p0124). **Remark:** The colors of the flashing LED depend on what status the LED had on activation (setting of parameter p0124 to "1").	–

1) Also applies to Double Motor Modules

2) Irrespective of the status of the LED "DC LINK"

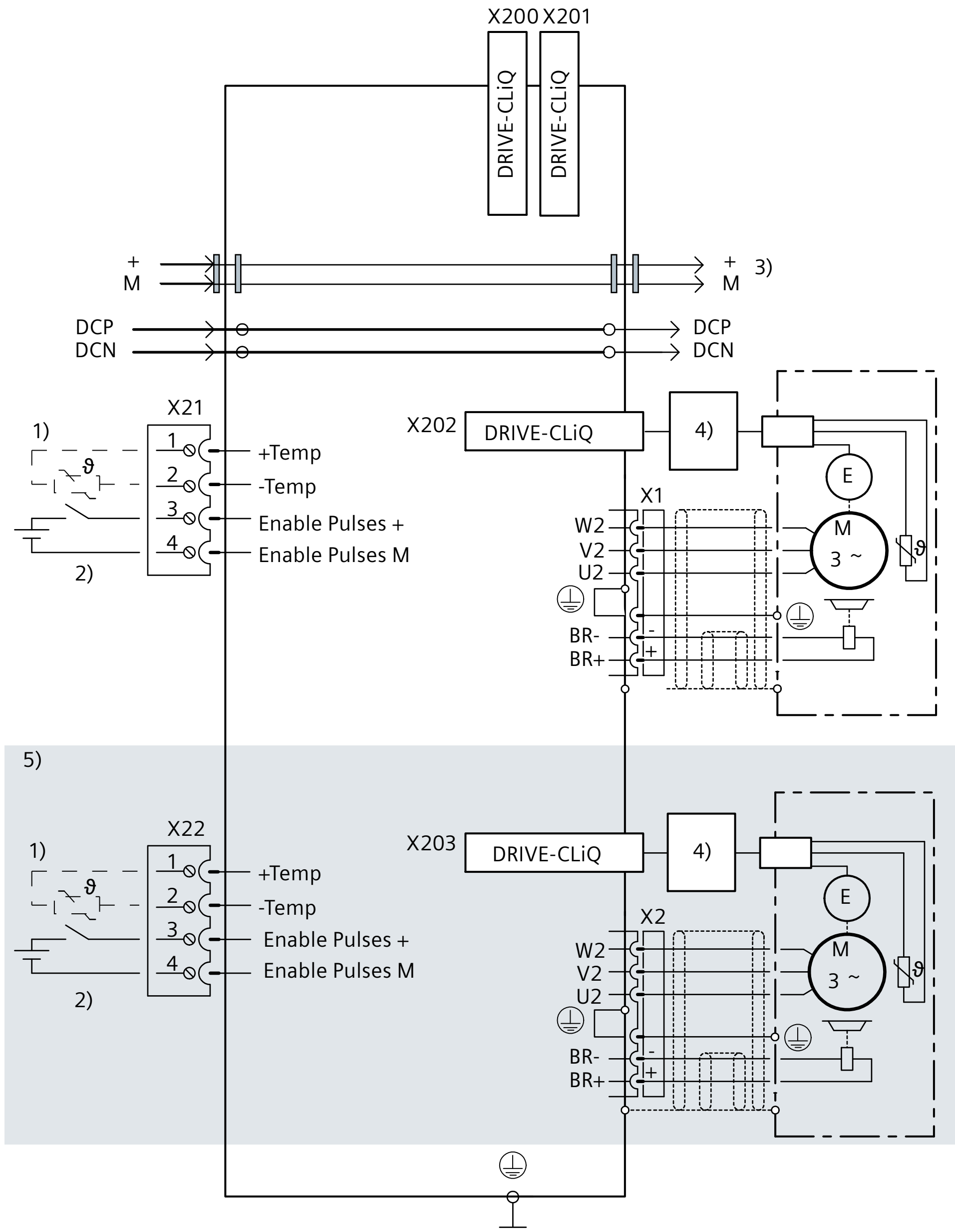
8.5 Connection examples

Connection example



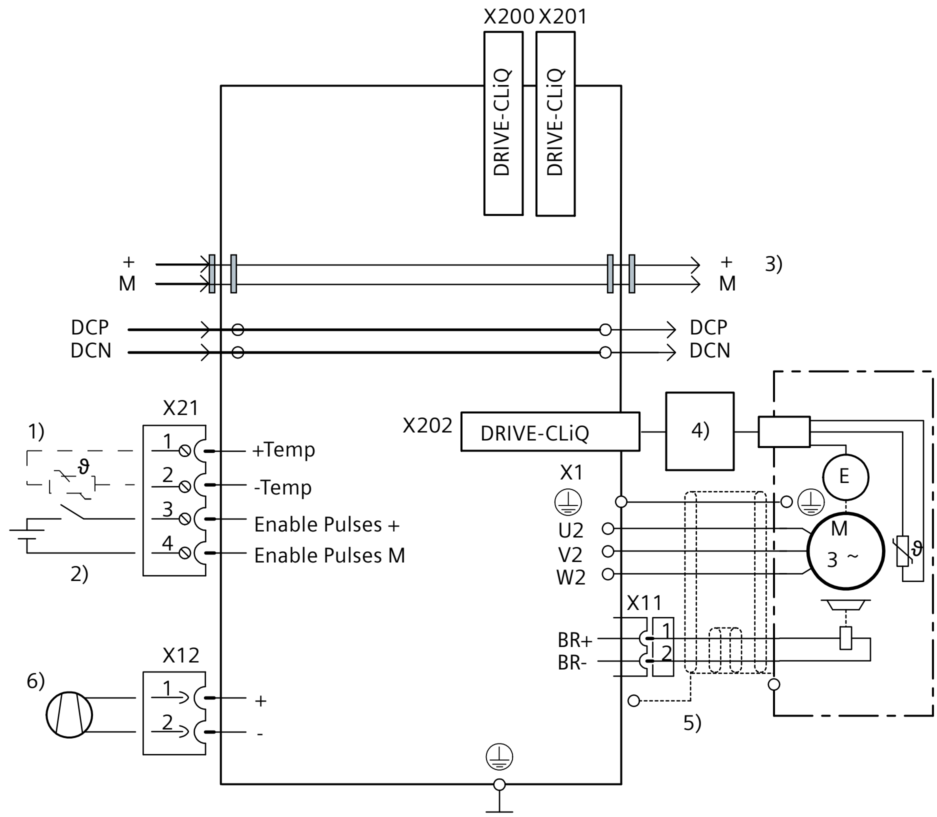
1) Optional, e.g. for motor without encoder
2) Required for Safety Integrated
3) 24 V to the next module
4) Sensor Module required for motors without DRIVE-CLiQ interface
5) In addition for the Double Motor Module

Figure 8-7 Connection example for Motor Modules 3 A ... 30 A, 2x3 A ... 2x18 A



1) Optional, e.g. for motor without encoder
2) Required for Safety Integrated
3) 24 V to the next module
4) Sensor Module Cabinet required for motors without DRIVE-CLiQ interface
5) Contact via a shield connection plate

Figure 8-8 Connection example for Motor Modules 45 A and 60 A

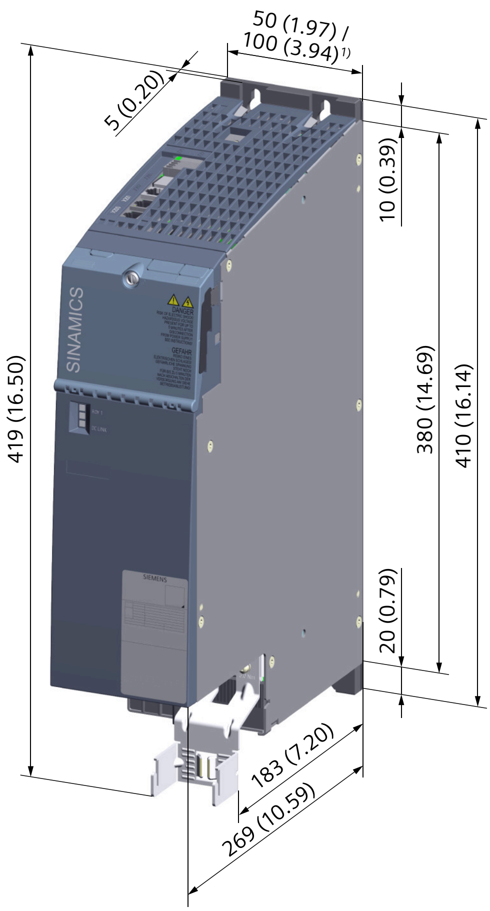


1) Optional, e.g. for motor without encoder
2) Required for Safety Integrated
3) 24 V to the next module
4) Sensor Module Cabinet required for motors without DRIVE-CLiQ interface
5) Contact via a shield connection plate
6) Fan connection

Figure 8-9 Connection example for Motor Modules 85 A ... 200 A

8.6 Dimension drawings

Dimension drawing



1) 50 mm: 3 ... 24 A, 2x3 ... 2x9 A, 2x18 A (slim), 30 A (slim) Motor Modules

100 mm: 30 A, 2x18 A Motor Modules

Figure 8-10 Dimension drawing, 3 ... 30 A, 2x3 ... 2x18 A Motor Modules, all data in mm and (inch)

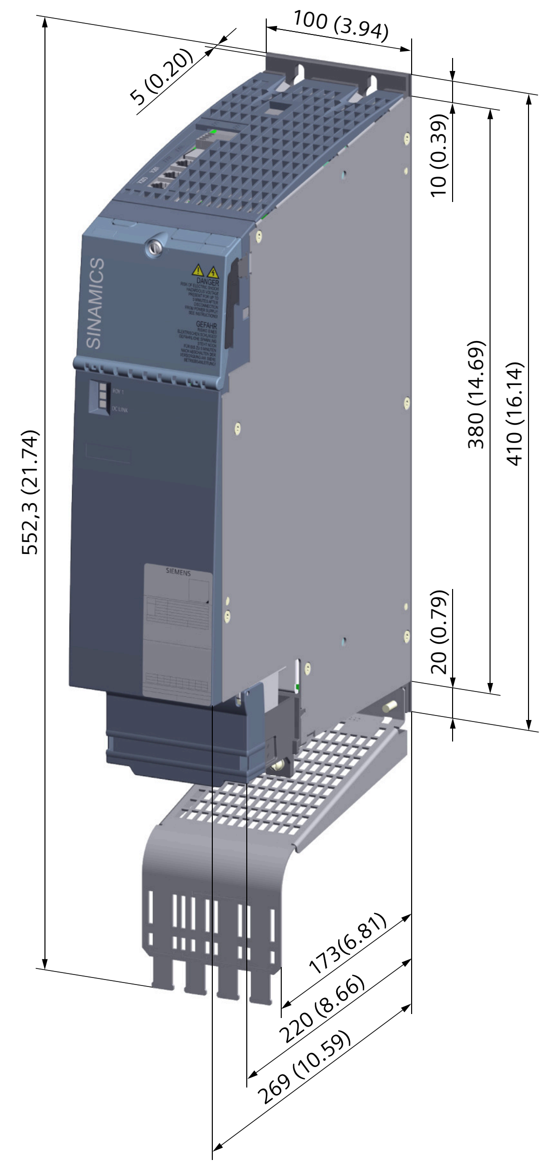
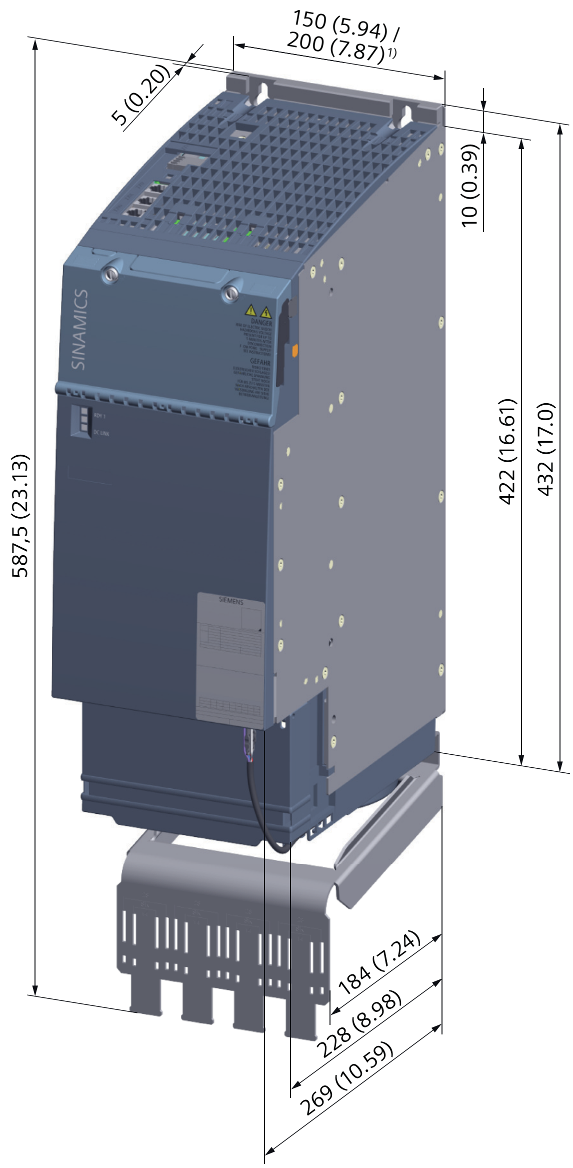


Figure 8-11 Dimension drawing Motor Modules 45 A and 60 A, all data in mm and (inch)



1) 150 mm: 85 A and 132 A Motor Modules
200 mm: 200 A Motor Modules

Figure 8-12 Dimension drawing, 85 A ... 200 A Motor Modules, all data in mm and (inch)

8.7 Duty cycles

8.7.1 Motor Modules 3 A ... 30 A, 2x3 A ... 2x18 A D type

Duty cycle overview

The following rated duty cycles are applicable for operation with up to a maximum of 300% overload.

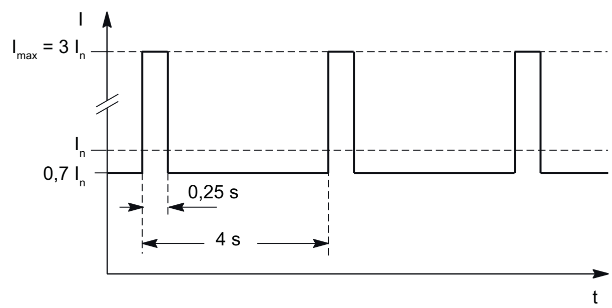


Figure 8-13 Peak current duty cycle with initial load (300% overload)

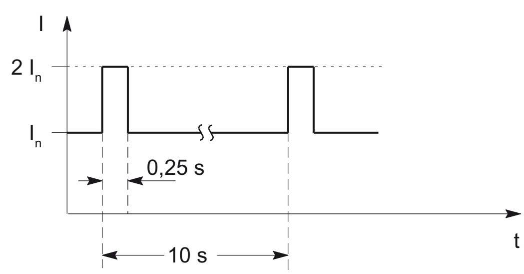


Figure 8-14 Duty cycle with initial load

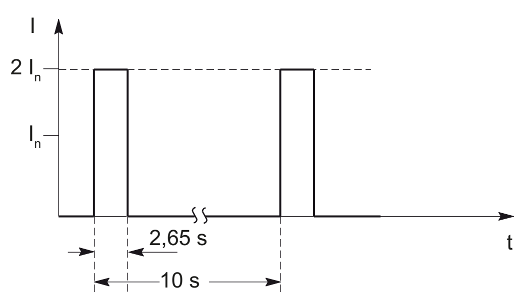


Figure 8-15 Duty cycle without initial load for a duty cycle duration of 10 s

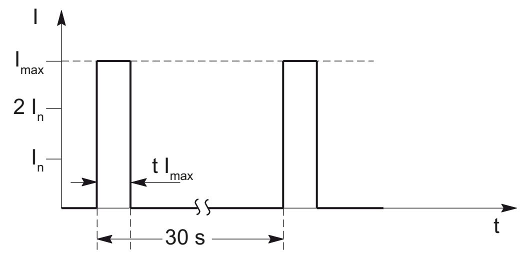


Figure 8-16 Duty cycle without initial load for a duty cycle duration of 30 s

Table 8-11 Times t I_{max} for the duty cycle

Motor Modules	t I_{max}	Duty cycle duration
3 A, 2x3 A	0.5 s	30 s
5 A, 2x5 A	0.5 s	30 s
9 A, 2x9 A	0.5 s	30 s
18 A, 2x18 A	1.25 s	30 s
24 A	1.25 s	30 s
30 A	3 s	30 s

Constraint

The duty cycle "without initial load for a duty cycle duration of 30 s" is not permissible with a pulse frequency of 16 kHz. Note the output current reduction for a pulse frequency of > 4 kHz.

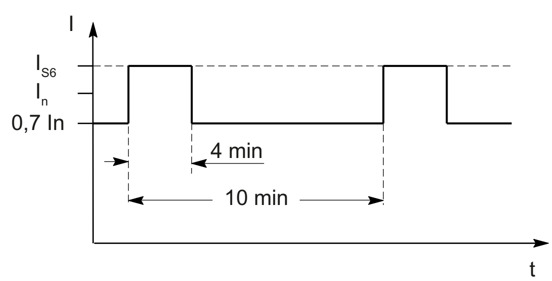


Figure 8-17 S6 duty cycle with initial load for a duty cycle duration of 600 s

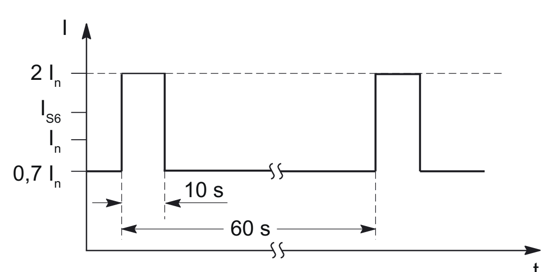


Figure 8-18 S6 duty cycle with initial load for a duty cycle duration of 60 s

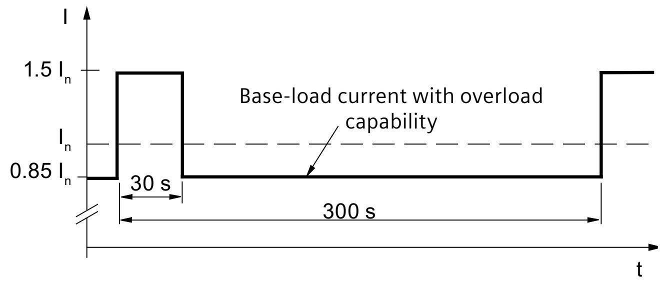


Figure 8-19 Duty cycle with 30 s overload for a duty cycle duration of 300 s

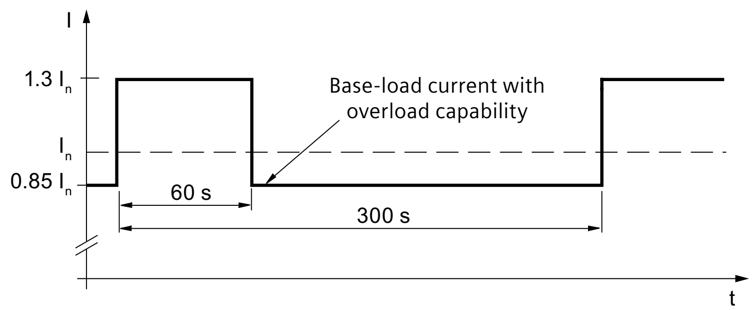


Figure 8-20 Duty cycle with 60 s overload for a duty cycle duration of 300 s

8.7.2 Motor Modules 3 A ... 60 A, 2x3 A ... 2x18 A C type

Duty cycle overview

The following rated duty cycles are applicable for operation with up to a maximum of 200% overload.

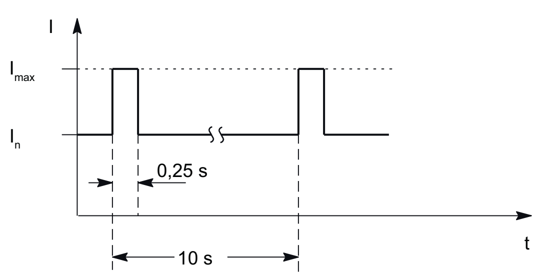


Figure 8-21 Duty cycle with initial load (for servo drives)

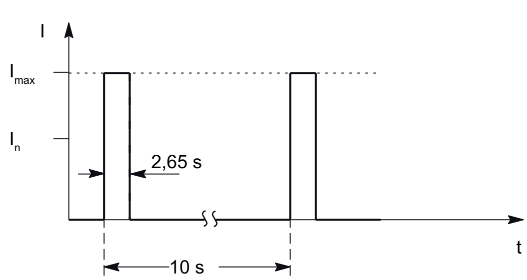


Figure 8-22 Duty cycle without initial load (for servo drives)

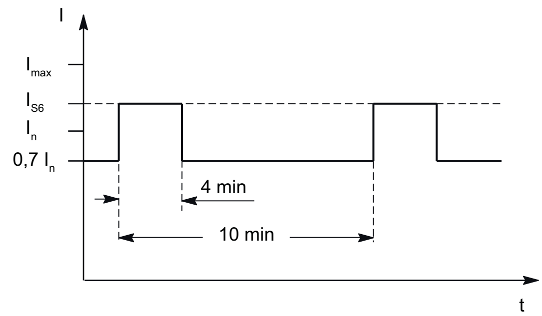


Figure 8-23 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

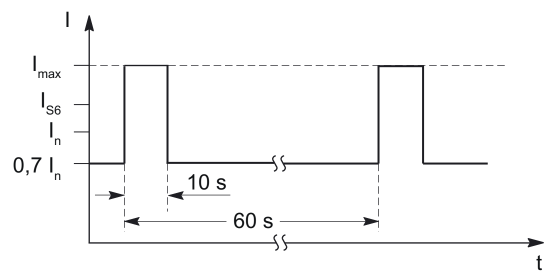


Figure 8-24 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

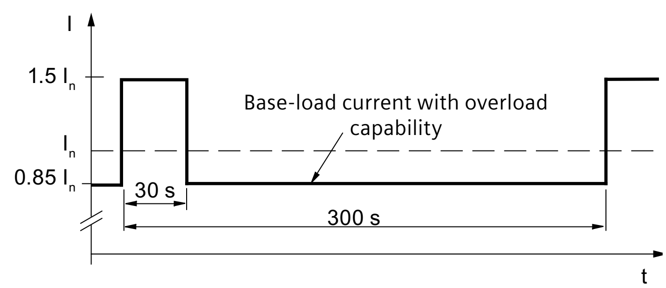


Figure 8-25 Duty cycle with 30 s overload for a duty cycle duration of 300 s

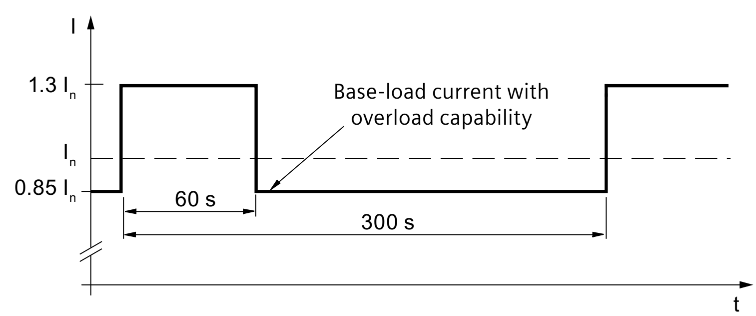


Figure 8-26 Duty cycle with 60 s overload for a duty cycle duration of 300 s

8.7.3 Motor Modules 85 A ... 200 A D type

Duty cycle overview

The following rated duty cycles are applicable for operation with up to a maximum of 200% overload.

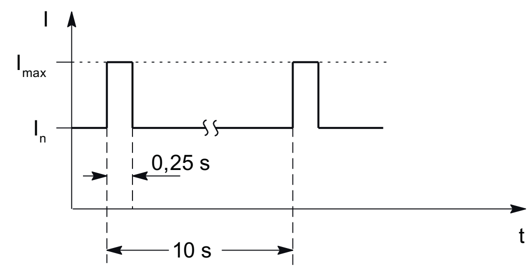


Figure 8-27 Duty cycle with initial load

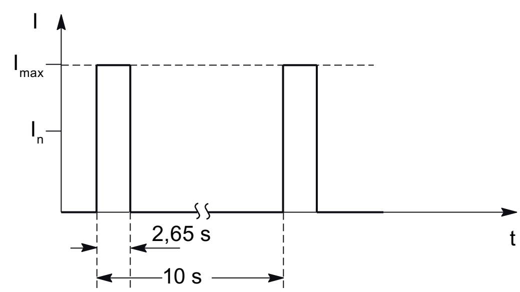


Figure 8-28 Duty cycle without initial load for a duty cycle duration of 10 s

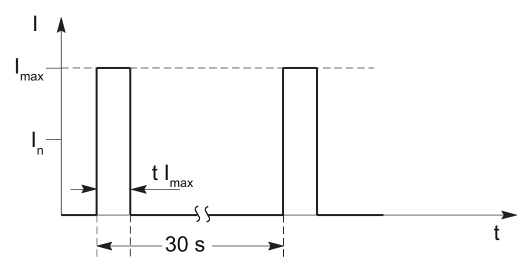


Figure 8-29 Duty cycle without initial load for a duty cycle duration of 30 s

Table 8-12 Times I_{max} for the duty cycle

Motor Module	t I_{max}	Duty cycle duration
85 A - 200 A	3 s	30 s

Constraint

The duty cycle "without initial load for a duty cycle duration of 30 s" is not permissible with a pulse frequency of 16 kHz. Note the output current reduction for a pulse frequency of > 4 kHz.

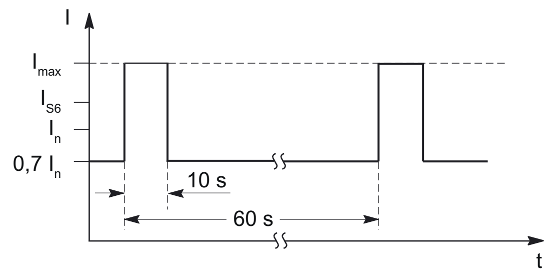


Figure 8-30 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

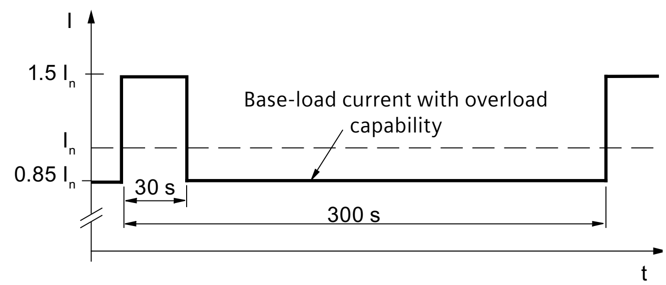


Figure 8-31 Duty cycle with 30 s overload for a duty cycle duration of 300 s (85 A and 132 A)

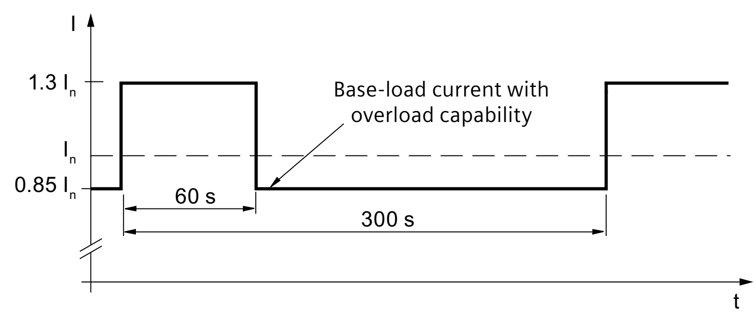


Figure 8-32 Duty cycle with 60 s overload for a duty cycle duration of 300 s (85 A and 132 A)

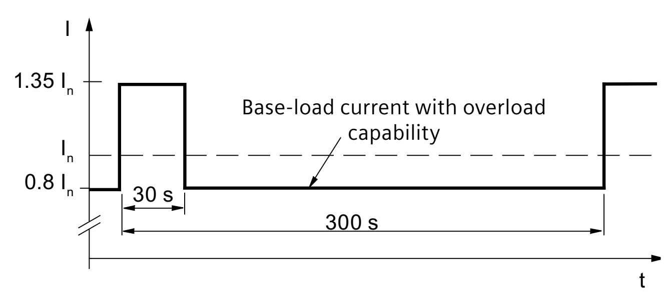


Figure 8-33 Duty cycle with 30 s overload for a duty cycle duration of 300 s (200 A)

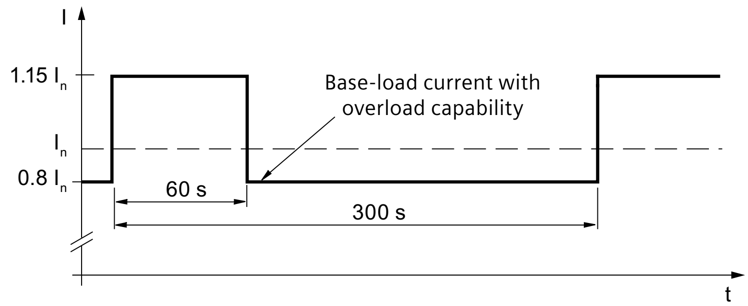


Figure 8-34 Duty cycle with 60 s overload for a duty cycle duration of 300 s (200 A)

8.7.4 Motor Modules 85 A ... 200 A C type

Duty cycle overview

The following rated duty cycles are applicable for operation with up to a maximum of 1.7 x overload.

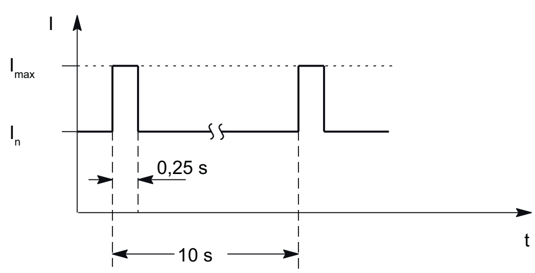


Figure 8-35 Duty cycle with initial load (for servo drives)

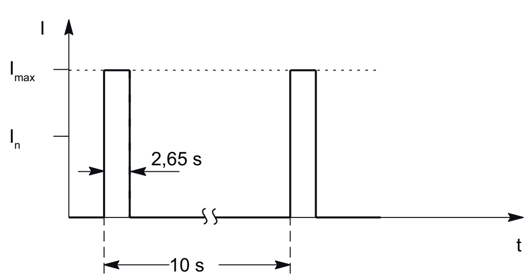


Figure 8-36 Duty cycle without initial load (for servo drives)

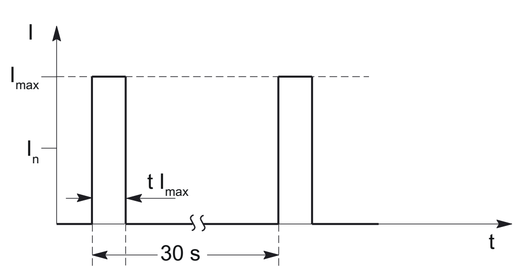


Figure 8-37 Duty cycle without initial load for a duty cycle duration of 30 s

Table 8-13 Times I_{max} for the duty cycle

Motor Module	t I_{max}	Duty cycle duration
85 A - 200 A	3 s	30 s

Constraint

The duty cycle "without initial load for a duty cycle duration of 30 s" is not permissible with a pulse frequency of 16 kHz. Note the output current reduction for a pulse frequency of > 4 kHz.

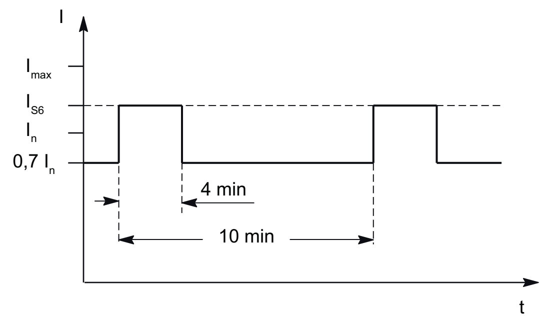


Figure 8-38 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

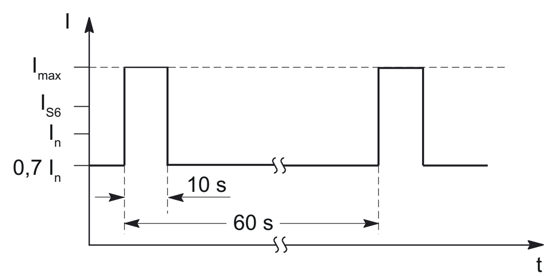


Figure 8-39 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

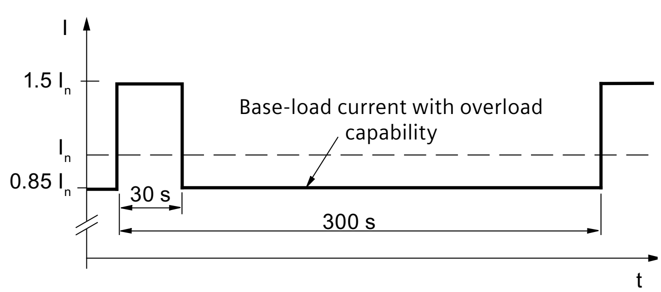


Figure 8-40 Duty cycle with 30 s overload for a duty cycle duration of 300 s (85 A and 132 A)

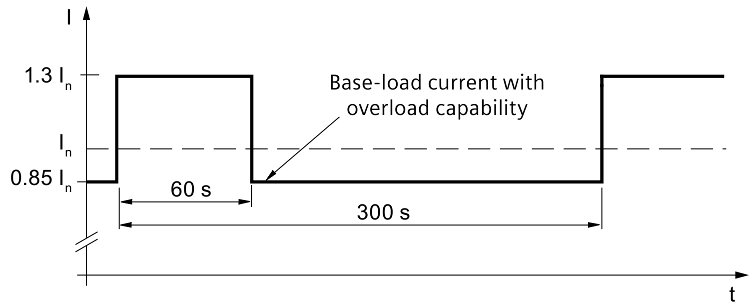


Figure 8-41 Duty cycle with 60 s overload for a duty cycle duration of 300 s (85 A and 132 A)

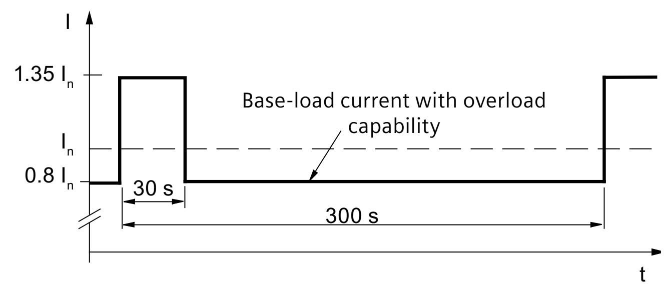


Figure 8-42 Duty cycle with 30 s overload for a duty cycle duration of 300 s (200 A)

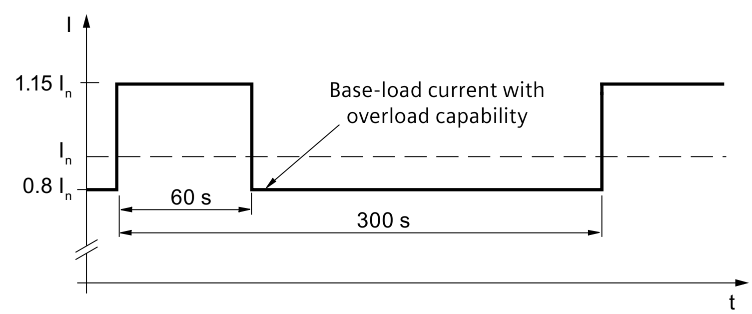


Figure 8-43 Duty cycle with 60 s overload for a duty cycle duration of 300 s (200 A)

8.8 Installation

8.8.1 Mounting the Motor Module

Overview

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

Requirement

⚠ WARNING
Risk of injury as a result of foreign bodies in the device
Parts (e.g.: drilling chips, end sleeves) falling into the device can cause short-circuits and damage the insulation. This can result in severe injury (arcing, loud bang, parts that are flung out). • Only perform installation and other work when the devices are current-free. • Cover the ventilation slots when mounting and installing the control cabinet and remove the cover before switching on.

NOTICE
Overheating due to inadmissible mounting position
Components can overheat and therefore be damaged if mounted in an inadmissible position. Overheating can cause malfunctions. • Only mount components in a vertical mounting position with the DRIVE-CLiQ connection at the top in the control cabinet. • Keep the ventilation clearances above and below components free and unobstructed.

Note

Use of protective gloves

It is recommended that you wear protective gloves when installing Motor Modules 85 A, 132 A and 200 A.

Procedure

Table 8-14 Rear views of Motor Modules 3 ... 60 A in mm and (inch)

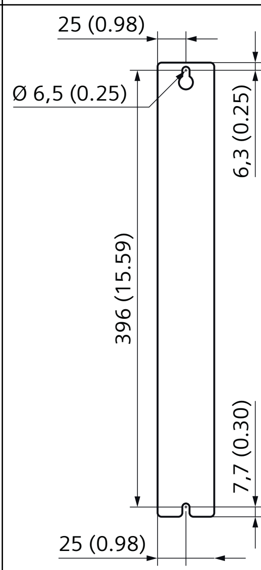
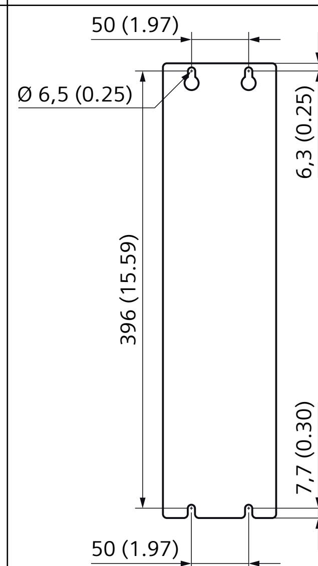
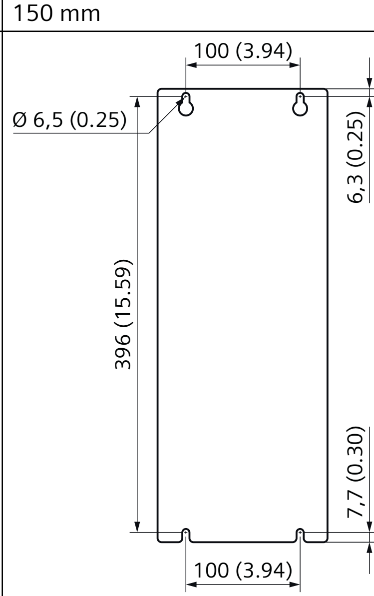
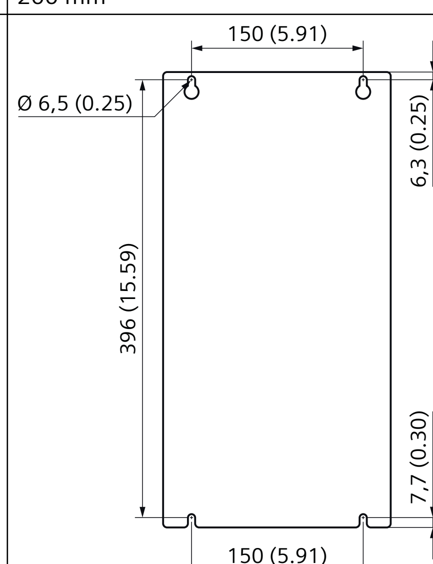
Rated current	**3 ... 30 A, 2x3 ... 2x18 A**	**30 A, 45A, 60 A, 2x18 A**
Width	50 mm	100 mm
Rear view		
Mounting parts	2 x M6 screws 2 x M6 washers	4 x M6 screws 4 x M6 washers
Tightening torque	6 Nm (53.1 lbf in)	6 Nm (53.1 lbf in)

Table 8-15 Rear views of Motor Modules 85 ... 200 A in mm and (inch)

Rated current	**85 A and 132 A**	**200 A**
Width	150 mm	200 mm
Rear view		

Rated current	85 A and 132 A	200 A
Mounting parts	4 x M6 screws 4 x M6 washers	4 x M6 screws 4 x M6 washers
Tightening torque	6 Nm (53.1 lbf in)	6 Nm (53.1 lbf in)

Fit a Motor Module on the mounting panel as follows:

1. Prepare the mounting panel.
2. First, screw the 4 screws in far enough so that you can attach the component.
3. Attach the component.
4. Tighten the screws finger-tight. Tightening torque: 0.5 Nm (4.4 lbf in)
5. Then tighten the screws fully.

8.8.2 Mounting the shield connection plate, 45 A and 60 A Motor Modules

Requirement

Components required:

- 2 x M6 screws
- 2 x M6 washers
- Shield connection plate (to be ordered separately)

Table 8-16 Shield connection plate

Width	Article number	Motor Module
100 mm	6SL3162-1AD00-0AA0	45 A and 60 A

Procedure

Proceed as follows to mount the shield connection plate:

1. Fasten the shield connection plate to the lower mounting points of the Motor Module using screws.
2. Tighten the screws. Tightening torque: 6 Nm (53.1 lbf in)

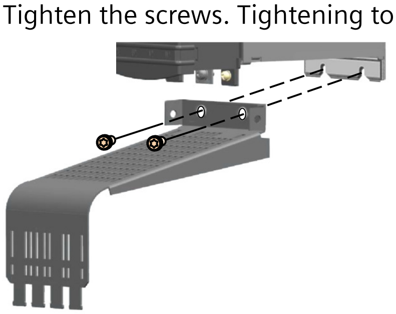


Figure 8-44 Motor Modules 45 A and 60 A - mounting the shield connection plate

8.8.3 Mounting the shield connection plate, 85 A ... 200 A Motor Modules

Overview

The shield connection plate is optional, and is mounted separately from the Motor Module with a defined clearance on the control cabinet panel or on a mounting panel.

The shield connection plate is not included in the scope of delivery.

Requirement

Mount the shield connection plate before mounting the fan module to be able to reach the lower mounting points on the mounting panel.

- The fan module has still not been installed in the component or was removed.

Components required:

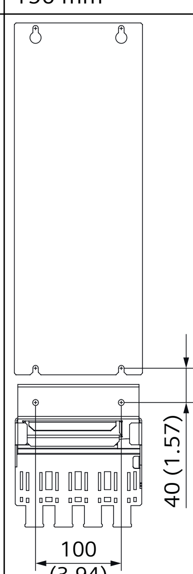
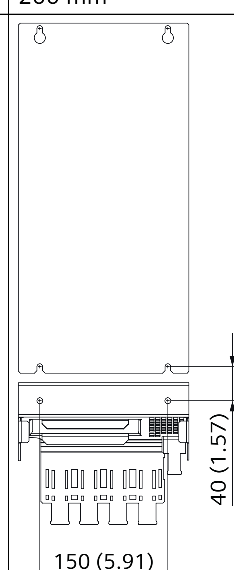
- Shield connection plate (to be ordered separately)

Table 8-17 Shield connection plates

Width	Article number	Motor Module
150 mm	6SL5166-1AF00-0AA0	85 A and 132 A
200 mm	6SL5166-1AH00-0AA0	200 A

Procedure

Table 8-18 Rear views of Motor Modules 85 A, 135 A and 200 A with shield connection plates in mm and (inch)

Rated current	85 A and 132 A	200 A
Width	150 mm	200 mm
Rear view		

Rated current	85 A and 132 A	200 A
Mounting parts	2 x M6 screws, with a max. head height of 7.7 mm 2 x M6 washers	2 x M6 screws, with a max. head height of 7.7 mm 2 x M6 washers
Tightening torque	6 Nm (53.1 lbf in)	6 Nm (53.1 lbf in)

Proceed as follows to mount the shield connection plate:

1. Prepare the mounting panel.
2. Fasten the shield connection plate to the mounting panel using screws at the prepared distance.
3. Tighten the screws.

8.8.4 Mounting the fan

Overview

The fan must also be mounted when mounting Motor Modules 85 A ... 200 A.

Install the fan module provided with the Motor Module.

Requirement

Note the following before installing the fan module in the Motor Module:

- The shield connection plate is mounted.

Required tool:

- T20 torx screwdriver

Procedure

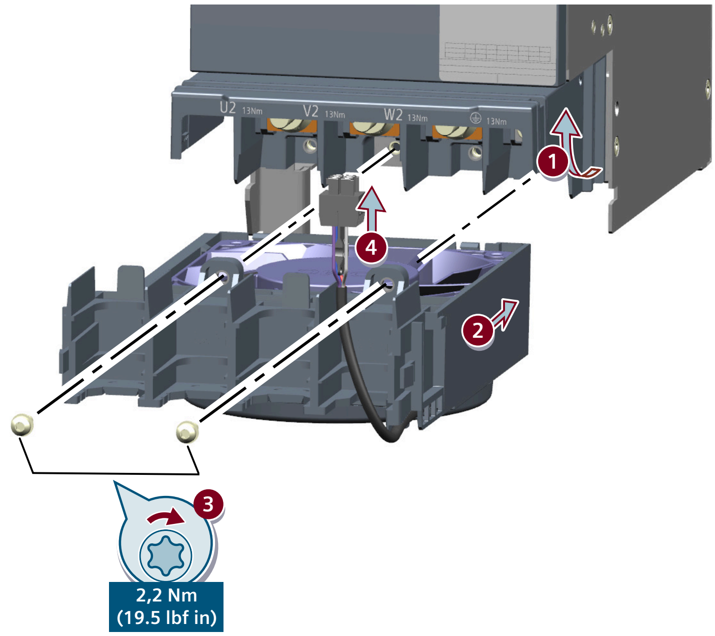


Figure 8-45 Mounting the fan

Proceed as follows to install the fan module into the Motor Module:

1. Open the motor connection block cover upwards.
2. Slide the fan module towards the front into the Motor Module.
3. Tighten the fixing screws of the fan module. T20 torx screwdriver. Tightening torque: 2.2 Nm (19.5 lbf in)
4. As soon as the motor cables and the protective conductor have been connected, insert the fan connection plug into socket X12.

8.9 Connecting

8.9.1 Motor connection, 3 A ... 30 A and 2x3 A ... 2x18 A Motor Modules

8.9.1.1 Connectable cable cross-sections

Description

Table 8-19 Conductor cross-sections and tightening torques

Output current	Motor connection	Cable cross-sections	Tightening torque
3 ... 30 A 2 x 3 A ... 2 x 18 A	Plug with screw terminal (6SL3162-2MA00-0AC0)	Finely stranded connection with: 0.75 ... 6 mm² (AWG 19 ... 10)	0.5 - 0.6 Nm (4.4 lbf in)
	Plug with push-in connection (6SL3162-2MB00-0AC0)		-

8.9.1.2 Preparing the motor connection cable

Overview

Motors are connected to a Motor Module using a motor connection cable with a power connector. We recommend that you use a completely pre-assembled MOTION-CONNECT power cable. If you are using a power cable or a MOTION-CONNECT power cable that has not yet been completely pre-assembled, then first assemble it.

Requirement

NOTICE

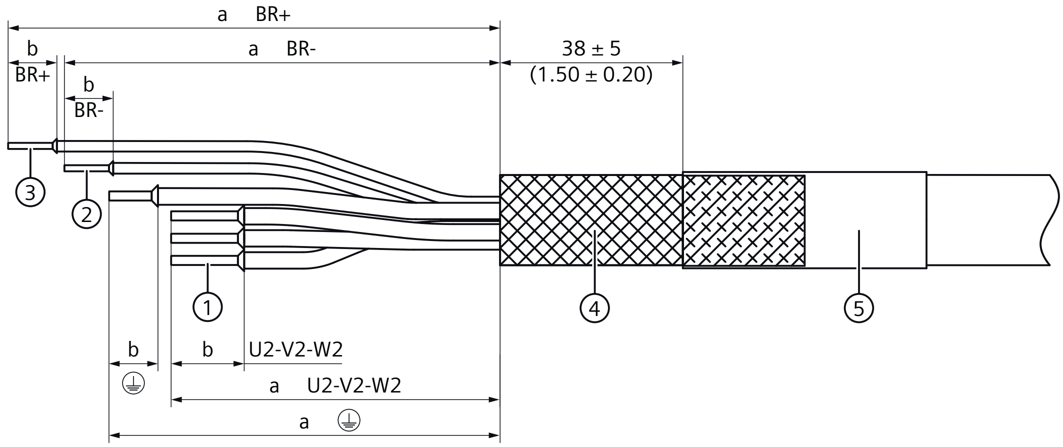
Adherence to core and stripped lengths

If the specified core and stripped lengths are not complied with, single cores can be damaged or shield contact prevented.

- Comply with the specified core and stripped lengths.

It is not possible to self-assemble motor connection cables having a core cross-section of 10 mm². In this case, use pre-assembled MOTION-CONNECT power cables.

Procedure



① Cores U2-V2-W2
② Protective conductor core
③ Holding brake cores
④ Protective braided shield
⑤ Shrink-on sleeve

Figure 8-46 Design of the motor connection cable for Motor Modules 3 ... 30 A and 2 x 3 A ... 2 x 18 A

Table 8-20 Core and stripped lengths for the motor connection cable, data in mm and (inch)

Connection	a	b
U2	55 +2/-3 (2.17 +0.08/-0.12)	12 ±0.5 (0.47 ±0.02)
V2		
W2		
Protective conductor to the motor	63 +2/-3 (2.48 +0.08/-0.12)	12 ±0.5 (0.47 ±0.02)
BR- to the holding brake	73 ±5 (2.87 ±0.20)	12 ±0.5 (0.47 ±0.02)
BR+ to the holding brake	79 ±5 (3.11 ±0.20)	12 ±0.5 (0.47 ±0.02)

To connect power cables at the power connector, prepare these as subsequently described:

1. Remove the cable sheath to a length of 85 mm (3.35 in) with a tolerance of ±5 mm (±0.2 in).
2. Shorten the protective braided shield and fold it back by the same length.
   – If you use a motor connection cable with brake cores, then you must unbraid the protective braided shield of the brake cores. This is then folded back against the outer shield.
3. Fix the protective braided shield. Preferably use a shrink-on sleeve with hot melt adhesive.
4. Shorten the single cores to length "a" according to the table above. The stripped lengths of the motor cables are the same for all cross-sections.
5. Remove length "b" of the insulation from the single cores according to the table above.

8.9.1.3 Prepare end sleeves

Requirement

The following requirements apply when crimping end sleeves:

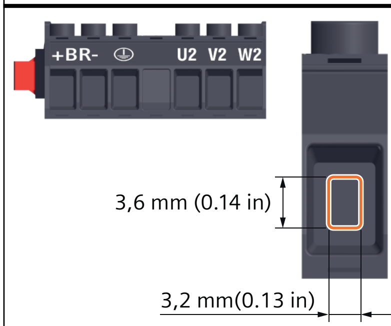
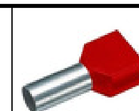
- You will need a crimping tool. We recommend the following crimping tool from Weidmüller (www.weidmueller.com):
  - Type PZ 6/5, article number 9011460000
- Use end sleeves compliant with DIN 46228.

Procedure

Proceed as follows to attach end sleeves to the cable of the motor and the holding brake:

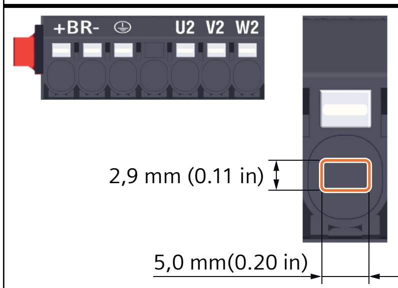
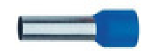
1. Match the cross-sections of the end sleeves and the motor connection cable according to the following table.
2. Crimp the end sleeves.

Table 8-21 Power connector with screw terminal (6SL3162-2MA00-0AC0)

Dimensions of the terminal openings	Permissible conductor cross-sections	End sleeve		
				
	0.75 mm² (AWG 19)	✓	✓	✓
	1.5 mm² (AWG 16)	✓	✓	✓
	2.5 mm² (AWG 14)	✓	✓	✓
	4 mm² (AWG 12)	✓[1]	✓[1]	✓[1]
	6 mm² (AWG 10)	✓[1]	✓[1]	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).

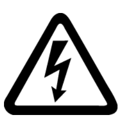
Table 8-22 Power connector with push-in connection (6SL3162-2MB00-0AC0)

Dimensions of the terminal openings	Permissible conductor cross-sections	End sleeve	
			
	0.75 mm² (AWG 19)	✓	✓
	1.5 mm² (AWG 16)	✓	✓
	2.5 mm² (AWG 14)	✓	✓
	4 mm² (AWG 12)	✓[1)]	✓[1)]
	6 mm² (AWG 10)	✓[1)]	✓[1)]

1) When crimped, end sleeves must not exceed the maximum dimensions of 2.9 x 5.0 mm (0.11 x 0.20 in).

8.9.1.4 Wiring a motor connection cable and holding brake

Requirement



⚠ WARNING

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

Using a non-certified power connector can result in overheating with fire or electric shock.

- Only use certified power connectors.

Components required:

- Power connector with screw terminal or push-in connection (Article No.: 6SL3162-2MA00-0AC0, 6SL3162-2MB00-0AC0, must be separately ordered)

Required tools:

- Slotted screwdriver 0.8 x 4.0 mm

Procedure

To connect the motor connection cable and the holding brake at the power connector, proceed as follows:

1. When using the power connector with push-in connection, carefully check that the 6 actuators are locked in the pressed state and that the terminals are open (condition when delivered).
2. Starting with W2, V2, U2, insert the cores into the open terminals.
   - The cores must be inserted as far as they will go.
   - For larger cross-sections, it is helpful if W2, V2, U2 etc. are simultaneously inserted and suitably screwed or interlocked.
3. Fixing the cores.
   - For a screw terminal, tighten the screws. Slotted screwdriver 0.8 x 4.0 mm. Tightening torque: 0.5 - 0.6 Nm (4.4 lbf in)
   - For a push-in connection, lock the terminals by vertically pressing on the actuators. Then check that the terminals are locked by gently pulling on the insulated conductors.

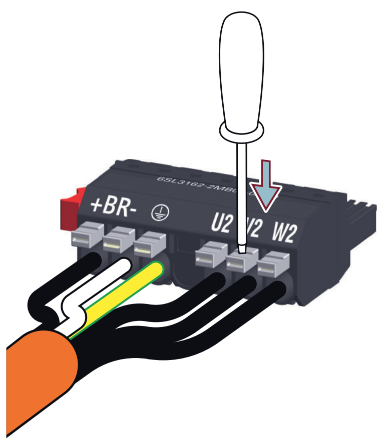


Figure 8-47 Example: Motor connection cable at the power connector with push-in connection

8.9.1.5 Releasing a motor connection cable from a push-in connector

Procedure

For a power connector with push-in connection, if the terminals have to be opened, then proceed as follows:

1. To release the terminals, using a slotted screwdriver 0.8 x 4.0 mm press the actuators horizontally into the housing one after the other until they engage.

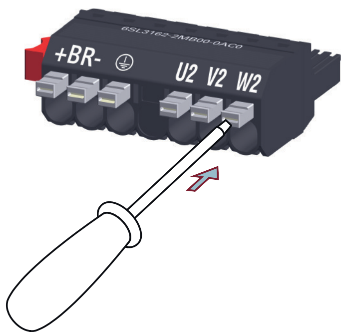


Figure 8-48 Releasing terminals

2. Withdraw the cores from the housing.

If cores are difficult to withdraw from the open terminal, pressing the actuator up as far as it will go at the same time will help. This action opens the spring-loaded terminal to its maximum.

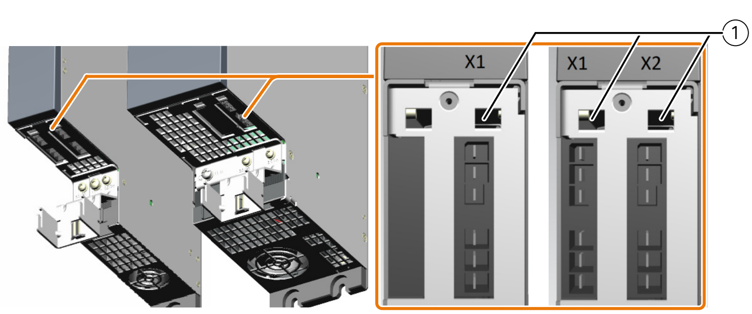
8.9.1.6 Connecting the motor connection cable and holding brake

Requirement

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

Procedure

The power connector has a catch. This snaps into the opening provided on the Motor Module.



① Openings for catches at socket X1 for Single Motor Modules or X1 and X2 for Double Motor Modules

Figure 8-49 Attaching power connectors to Motor Modules 3 ... 30 A and 2 x 3 A ... 2 x 18 A

To connect the motor connection cable and the holding brake with the power connector at the Motor Module, proceed as follows:

1. Route the power cables through the shield connection plate.
2. For Single Motor Modules insert the power connector into socket X1 and for Double Motor Modules, into sockets X1 and X2.

Result

The motor cable and the holding brake are connected at the Motor Module.

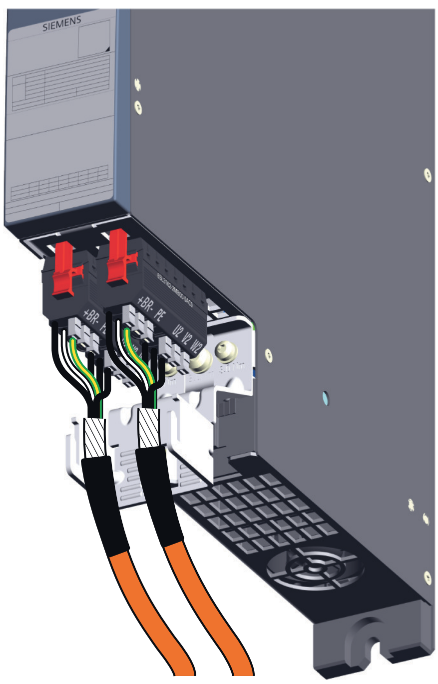


Figure 8-50 Example: Motor connection at a Double Motor Module

8.9.1.7 Connecting the cable shield

Overview

The motor connection cable shield is attached to the shield connection plate of the Motor Module using the shield connection clamp supplied.

Requirement

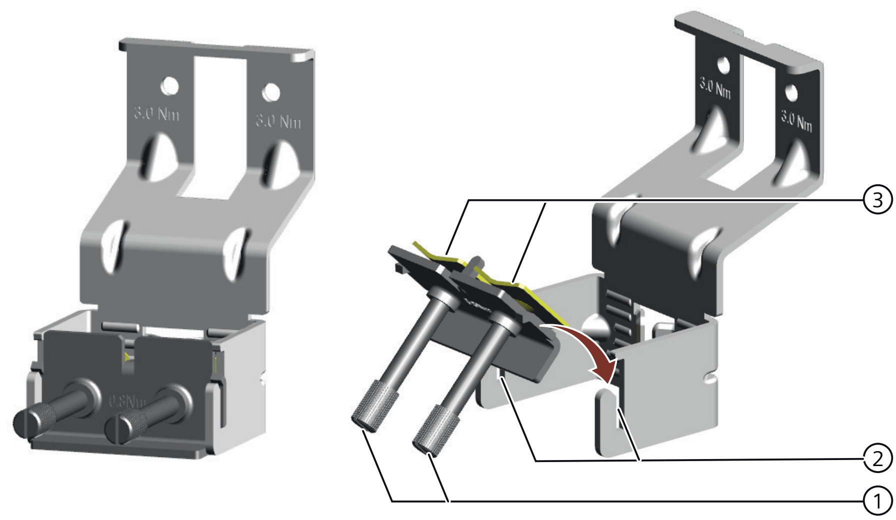
Note

Ensuring twist protection

For the shield connection clamp, twist protection of the pressure plate is only ensured when completely swung back (state when delivered). After the shield connection clamp has been fitted in the shield connection plate, the shield connection plate prevents twisting.

The power connector and/or the 2 power connectors for a Double Motor Module are inserted in connection sockets X1 and/or X2 at the Motor Module.

Procedure



① Knurled screws

② Slots to hook the shield connection clamp into the shield connection plate

③ Pressure plates

Figure 8-51 Shield connection - example for a Double Motor Module with two pressure plates

Proceed as follows to fix the motor connection cable or the motor connection cables:

1. Route the cable or both cables through the shield connection plate.
2. Hook the shield connection clamp into the shield connection plate.
3. Fix the cable using the pressure plate. To do this, tighten the knurled screws. Tightening torque: 0.8 Nm (7.08 lbf in)

8.9.2 Motor connection, 45 A and 60 A Motor Modules

8.9.2.1 Connectable cable cross-sections

Description

Table 8-23 Conductor cross-section of the motor cable for Motor Modules 45 A and 60 A

Output current [A]	Cable cross-sections
45 A and 60 A	Single core connection: 6 ... 50 mm² (AWG 10 ... 1) Two-wire connection: 4 ... 25 mm² (AWG 12 ... 4)

8.9.2.2 Selecting cable lugs

Description

The dimensions of the motor connection block for selecting the motor connection cable and the ring or tubular cable lug are subsequently listed.

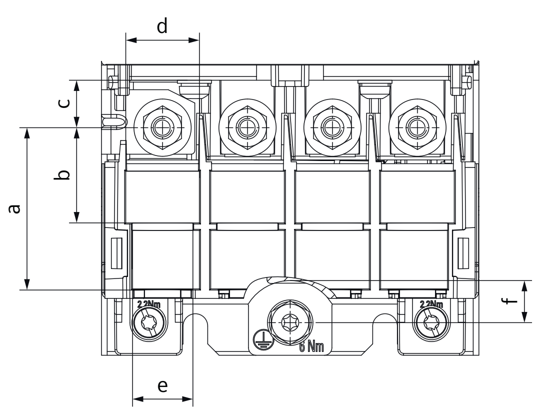


Figure 8-52 Dimensions of the motor connection block for Motor Modules 45 A and 60 A

Table 8-24 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)

For UL applications, only use UL-approved ring or pipe-type cable lugs (ZMVV) certified for the particular voltage. The permissible current must be at least 125% of the input or output current. Use the higher value as basis.

8.9.2.3 Preparing the motor connection cable

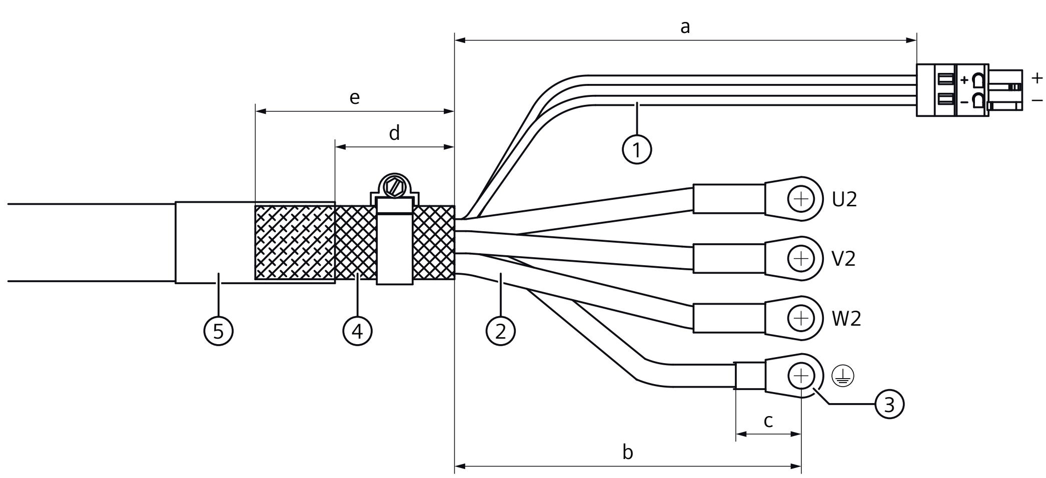
Overview

Motors are connected to a Motor Module using a motor connection cable. We recommend that you use a completely pre-assembled MOTION-CONNECT power cable. If you are using a power cable or a MOTION-CONNECT power cable that has not yet been completely pre-assembled, then first assemble it.

Requirement

NOTICE
Adherence to core and stripped lengths
If the specified core and stripped lengths are not complied with, single cores can be damaged or shield contact prevented.
• Comply with the specified core and stripped lengths.

Procedure



① Holding brake cores
② Cores U2, V2, W2 and protective conductor
③ Ring or pipe-type cable lug M6
④ Protective braided shield
⑤ Shrink-on sleeve

Figure 8-53 Design of the motor connection cable for Motor Modules 45 A and 60 A

Table 8-25 Core and stripped lengths for the motor connection cable, data in mm and (inch)

Connection	Length	Connection using a shield connection clamp	Connection using a hose clamp
BR+, BR-	a	180 ±10 (7.09 ±0.4)	205 ±10 (8.07 ±0.4)
U2, V2, W2, protective conductor	b	145 ±5 (5.71 ±0.2)	170 ±5 (6.69 ±0.2)
Ring or pipe-type cable lug	c	depending on the cable lug used	depending on the cable lug used
Shield	d	40 ±5 (1.57 ±0.2))	40 ±5 (1.57 ±0.2))
folded back protective braided shield	e	80 ±10 (3.15 ±0.4))	80 ±10 (3.15 ±0.4))

To connect the motor connection cable, prepare this as subsequently described:

1. Remove 215 mm (8.46 in) of cable sheath with a tolerance of ±10 mm (±0.39 in).
2. Shorten the protective braided shield and fold it back by the same length.
   – If you use a motor connection cable with brake cores, then you must unbraid the protective braided shield of the brake cores. This is then folded back against the outer shield.
3. Fix the protective braided shield. Preferably use a shrink-on sleeve with hot melt adhesive.
4. Shorten the single cores to length "a" according to the table above. The stripped lengths of the motor cables are the same for all cross-sections.
5. Remove length "b" of the insulation from the single cores according to the table above.
6. Use suitable ring or pipe-type cable lugs.

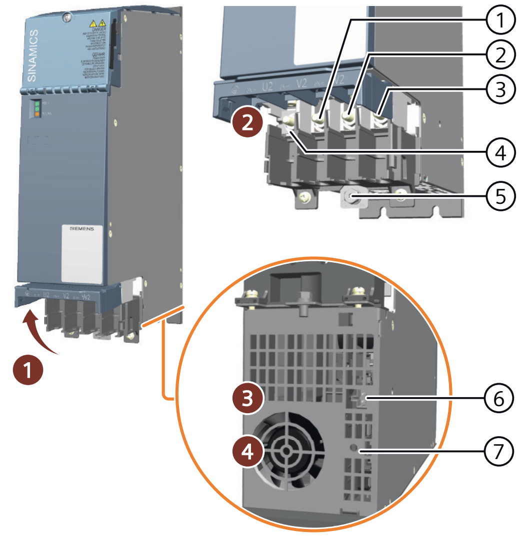
8.9.2.4 Connecting the motor connection cable and holding brake

Requirement

Required tools:

- Slotted screwdriver 0.8 x 5.5 mm
- Socket wrench size 10

Procedure



①	U2
②	V2
③	W2
④	Protective conductor connection for the motor
⑤	Protective conductor connection for the Motor Module
⑥	Interface X11 to connect the holding brake (BR+, BR-)
⑦	Threaded socket M4 for fixing the shield connection clamp

Figure 8-54 Connections for motor connection cable and holding brake at Motor Modules 45 A and 60 A

Connection X1 for the motor is implemented as motor connection block. The protective conductor connection for the motor is also integrated in this. Proceed as follows to connect the motor connection cable:

1. Open the locking of the cover of the motor connection block left and right and swing it upwards. Slotted screwdriver 0.8 x 5.5 mm
2. Remove the nuts from the threaded studs. Socket wrench size 10
3. Cut out the detachable tabs at the motor connection block if the cables have a diameter higher than 9.5 mm (0.37 inch).
4. Place the cable lug onto the threaded studs.
5. Screw the nuts onto the threaded studs and tighten them. Socket wrench size 10. Tightening torque: 6 Nm (53.1 lbf in)
6. Close the motor connection block cover.
7. Insert the connector for the holding brake into interface X11 provided on the lower side of the component.
8. When required, in the threaded socket M4 on the component, fasten a shield connection clamp, type KLBUE 3-8 SC (Weidmüller), and connect the shield of the holding brake there.

8.9.2.5 Connecting the cable shield

Overview

You can fasten the shield of the motor connection cable to the shield connection plate of the Motor Module using a hose clamp or a shield connection clamp.

Requirement

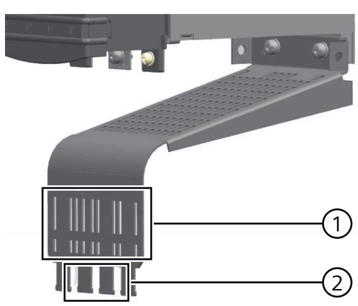
The following requirements apply:

- The motor connection cable is connected at the motor connection block.
- The shield connection plate is mounted.
- Use a suitable hose clamp or shield connection clamp.

Table 8-26 Shield connection clamps

Cable diameter	Article number
3 ... 14 mm (0.12 ... 0.55 inch)	8WH9130-0MA00
20 ... 35 mm (0.79 ... 1.38 inch)	8WH9130-0PA00

Procedure



① Mounting for shield connection clamp
② Mounting for the hose clamp

Figure 8-55 Shield support options for Motor Modules 45 A and 60 A

Proceed as follows to connect the shield of the motor connection cable to the shield connection plate of the Motor Module:

1. Fasten the shield of the motor connection cable to the shield connection plate using a hose clamp or a shield connection clamp according to the table below.
2. When fastening a shield connection clamp, ensure that the conductor is located at the center of the clamp.

Component	Cable diameter	Tightening torque
Hose clamp	-	0.8 ... 1 Nm (7.08 ... 8.85 lbf in)
Shield connection clamp	3 ... 14 mm (0.12 ... 0.55 inch)	0.8 Nm (7.08 lbf in)
Shield connection clamp	20 ... 35 mm (0.79 ... 1.38 inch)	1.8 Nm (15.93 lbf in)

Result

You have routed the motor connection cable so that it is screened.

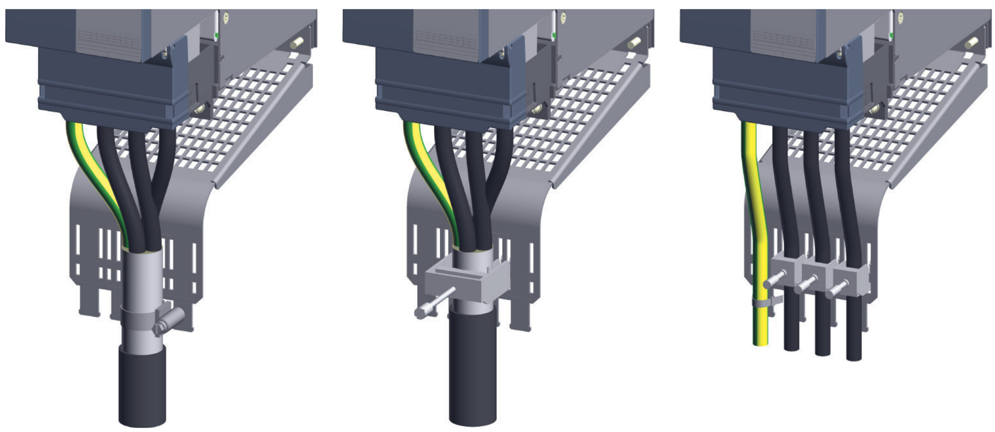


Figure 8-56 Shield support with hose clamp (left), shield connection clamp (center) and three shield connection clamps for single cores (right)

8.9.3 Motor connection, 85 A ... 200 A Motor Modules

8.9.3.1 Connectable cable cross-sections

Description

Table 8-27 Conductor cross-sections of the motor cable for Motor Modules 85 A, 132 A and 200 A

Output current [A]	Cable cross-sections[1)]
85 A ... 200 A	Single core connection: 16 ... 150 mm² (AWG 6 ... 300 kcmil) Two-wire connection: 16 ... 50 mm² (AWG 6 ... 1/0)

[1)] To ensure IPXXB touch protection according to IEC 60529, reduction collars must be used for cable cross-sections of 16 mm² - 95 mm² (AWG 6 - AWG 3/0).

8.9.3.2 Selecting cable lugs

Description

The dimensions of the motor connection block for selecting the motor connection cable and the ring or tubular cable lug are subsequently listed.

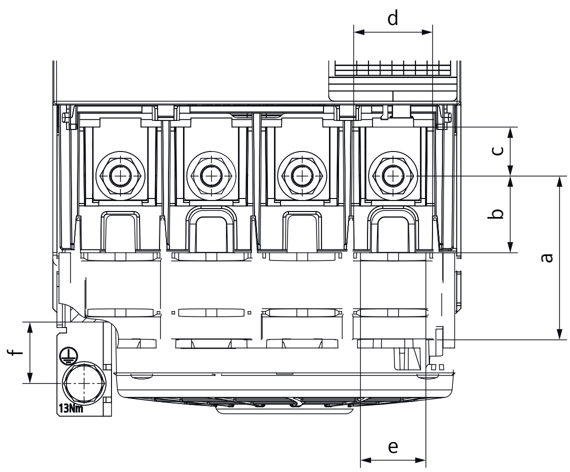


Figure 8-57 Dimensions of the motor connection block for Motor Modules 85 A, 132 A and 200 A

Table 8-28 Dimensions of the motor connection block in mm (inch)

	a	b	c	d	e	f
Maximum dimensions	59.8 (2.35)	28.1 (1.1)	21.2 (0.83)	29.4 (1.16)	25.4 (1.0)	22.5 (0.88)

Also note the following:

- For UL applications, only use UL-approved ring or pipe-type cable lugs (ZMVV) certified for the particular voltage. The permissible current must be at least 125% of the input or output current. Use the higher value as basis.
- For cables with a cross-section of 150 mm^2, use pipe-type cable lugs in a narrow design with a maximum cable lug width of 24 mm (e.g. from the Klauke company, article 10SG8), with additional shrink-on sleeve to ensure touch protection.

8.9.3.3 Preparing the motor connection cable

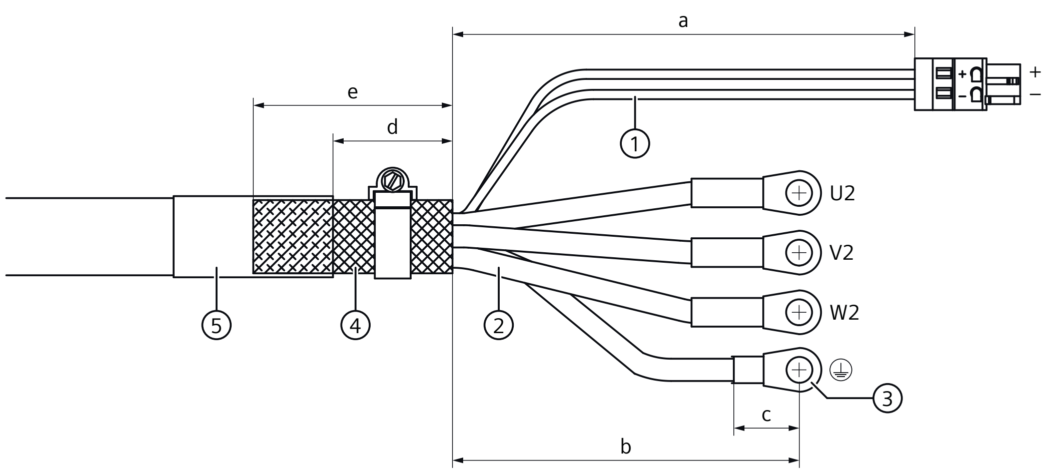
Overview

Motors are connected to a Motor Module using a motor connection cable. This must first be prefabricated. If you use MOTION-CONNECT power cables, then first assemble them.

Requirement

NOTICE
Adherence to core and stripped lengths
If the specified core and stripped lengths are not complied with, single cores can be damaged or shield contact prevented. • Comply with the specified core and stripped lengths.

Procedure



① Holding brake cores
② Cores U2, V2, W2 and protective conductor
③ Ring or pipe-type cable lug M8
④ Protective braided shield
⑤ Shrink-on sleeve

Figure 8-58 Design of the motor connection cable for Motor Modules 85 A, 132 A and 200 A

Table 8-29 Core and stripped lengths for the motor connection cable, data in mm and (inch)

Connection	Length	Connection using a shield connection clamp	Connection using a hose clamp
BR+, BR-	a	200 ± 10 (7.9 ± 0.4)	250 ± 10 (9.8 ± 0.4)
U2, V2, W2, protective conductor	b	175 ±5 (6.9 ±0.2)	200 ±5 (7.9 ±0.2)
Pipe-type cable lug	c	depending on the cable lug used	depending on the cable lug used
Shield	d	50 ±5 (2.0 ±0.2)	50 ±5 (2.0 ±0.2)
folded back protective braided shield	e	100 ±10 (3.9 ±0.4)	100 ±10 (3.9 ±0.4)

To connect the motor connection cable, prepare this as subsequently described:

1. Remove 260 mm (10.2 in) of cable sheath with a tolerance of ±10 mm (±0.4 in).
2. Shorten the protective braided shield and fold it back by the same length.
   – If you use a motor connection cable with brake cores, then you must unbraid the protective braided shield of the brake cores. This is then folded back against the outer shield.
3. Fix the protective braided shield. Preferably use a shrink-on sleeve with hot melt adhesive.
4. Shorten the single cores to length "a" according to the table above. The stripped lengths of the motor cables are the same for all cross-sections.
5. Remove length "b" of the insulation from the single cores according to the table above.
6. Attach a ring or pipe-type cable lug to the stripped end area.

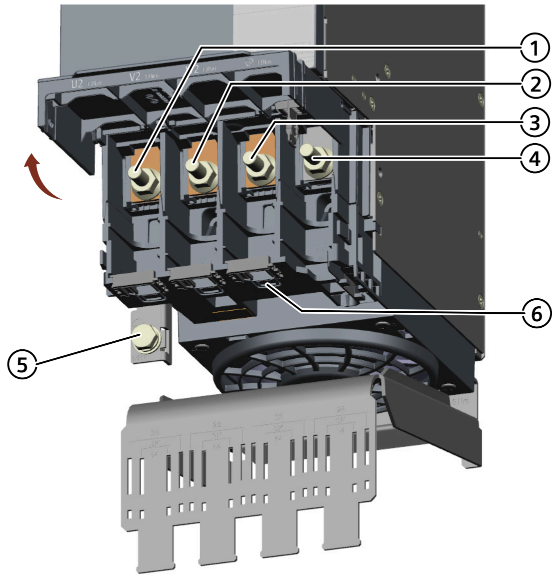
8.9.3.4 Connecting the motor connection cable and holding brake

Requirement

Required tools:

- Slotted screwdriver 0.8 x 5.5 mm
- Socket wrench size 13

Procedure



① U2
② V2
③ W2
④ Protective conductor connection for the motor
⑤ Protective conductor connection for the Motor Module
⑥ Touch protection

Figure 8-59 Connections for motor connection cable and holding brake at Motor Modules 85 A, 132 A and 200 A

Connection X1 for the motor is implemented as motor connection block. The protective conductor connection for the motor is also integrated in this. Proceed as follows to connect the motor connection cable:

1. Open the locking of the cover of the motor connection block left and right and swing it upwards. Slotted screwdriver 0.8 x 5.5 mm
2. Remove the nuts from the threaded studs. Socket wrench size 13
3. Place the cable lug onto the threaded studs. If you wish to connect two cables with cable lugs to one connection, then also remove the shock protection at the lower part of the fan module.
4. Screw the nuts onto the threaded studs and tighten them. Socket wrench size 13. Tightening torque: 13 Nm (115 lbf in)
5. Insert the reduction collars into the motor connection block if the cable cross-section of the motor cable is ≤95 mm².
6. Close the motor connection block cover.
7. Insert the connector for the holding brake into interface X11 provided on the lower side of the component.
8. Insert the fan connection plug into socket X12.

8.9.3.5 Using reduction collars

Overview

Reduction collars ensure touch protection according to IEC 60529. They are included in the Terminal Kit of the Motor Module.

To ensure IPXXB touch protection, you must use reduction collars for cable cross-sections of 16 mm² - 95 mm² (AWG 6 - AWG 3/0). For larger cable cross-sections, touching the threaded studs and cable ends can be ruled out when the cover is closed.

Procedure

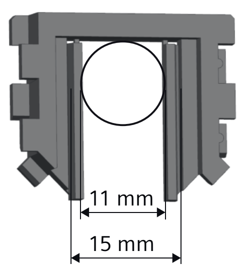


Figure 8-60 Dimensions of the reduction collar

The maximum diameter of the cable with a reduction collar is 11 mm and after cutting out the tabs, 15 mm.

Proceed as follows to install the reduction collars:

1. Take the reduction collars from the Terminal Kit.
2. Adapt the reduction collars to the diameter.
3. Install these in the motor connection block.

Example

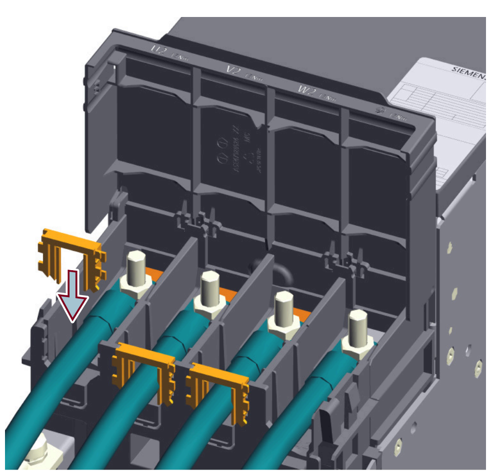


Figure 8-61 Example of installed reduction collars

8.9.3.6 Connecting the cable shield

Overview

You can fasten the shield of the motor connection cable to the shield connection plate of the Motor Module using a hose clamp or a shield connection clamp.

Requirement

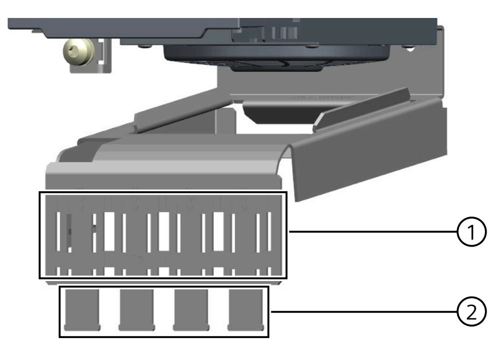
The following requirements apply:

- The motor connection cable is connected at the motor connection block.
- The shield connection plate is mounted.
- Use a suitable hose clamp or shield connection clamp.

Table 8-30 Shield connection clamps

Cable diameter	Article number
3 ... 14 mm (0.12 ... 0.55 inch)	8WH9130-0MA00
5 ... 28 mm (0.20 ... 1.10 inch)	8WH9130-0NA00
20 ... 35 mm (0.79 ... 1.38 inch)	8WH9130-0PA00

Procedure



① Mounting for shield connection clamp

② Mounting for the hose clamp

Figure 8-62 Shield support options for Motor Modules 85 A, 132 A and 200 A

Proceed as follows to connect the shield of the motor connection cable to the shield connection plate of the Motor Module:

1. Fasten the shield of the motor connection cable to the shield connection plate using a hose clamp or a shield connection clamp according to the table below.
2. When fastening a shield connection clamp, ensure that the conductor is located at the center of the clamp.

Component	Cable diameter	Tightening torque
Hose clamp	-	0.8 ... 1 Nm (7.08 ... 8.85 lbf in)
Shield connection clamp	3 ... 14 mm (0.12 ... 0.55 inch)	0.8 Nm (7.08 lbf in)
Shield connection clamp	5 ... 28 mm (0.20 ... 1.10 inch)	1 Nm (8.85 lbf in)
Shield connection clamp	20 ... 35 mm (0.79 ... 1.38 inch)	1.8 Nm (15.93 lbf in)

Result

You have routed the motor connection cable so that it is screened.

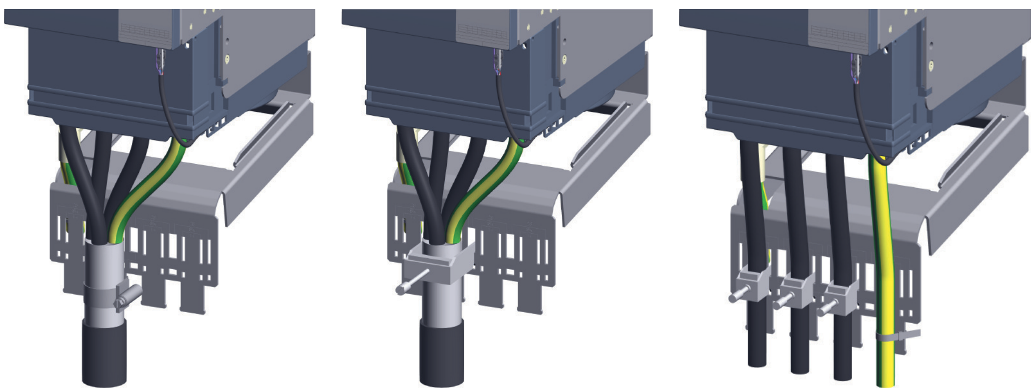
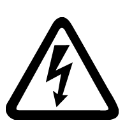


Figure 8-63 Shield support with hose clamp (left), shield connection clamp (center) and three shield connection clamps for single cores (right)

8.9.4 Connecting the shield for X21/X22 cables

Requirement



⚠ WARNING

Electric shock due to impermissible screw length

If you use a different shield connection clamp than recommended here, note the following: Excessively long screws can come into contact with live parts and can therefore result in death or serious injury.

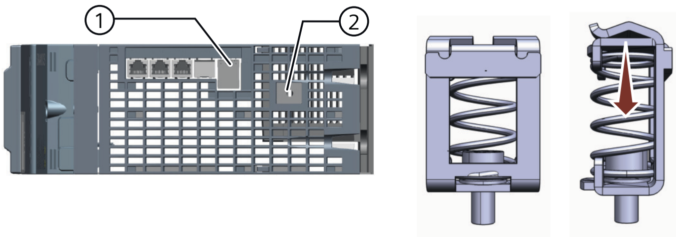
- Only use screws with a permissible insertion depth of 4 - 6 mm.

Permissible cable diameter: 3-8 mm

Required tool:

- Size 3 Allen key
- Shield connection clamp from Weidmüller, type KLBUE 3-8 SC

Procedure



① Terminal X21/X22

② Position for fixing the shield connection clamp (M4 threaded socket)

Figure 8-64 Shield connection for cables of terminal X21 or X21/X22

To connect the shield of connected cable(s) at terminal X21 (for a Single Motor Module) or X21/X22 (for a Double Motor Module), proceed as follows:

1. Screw the shield connection clamp into the M4 threaded socket next to the EP terminal. Tightening torque: 1.8 Nm (15.93 lbf in)
2. Remove the cable sheath and fix the cable in the shield connection clamp (stripped length of the shield: 22 mm).

More information

More detailed instructions are provided in the accessories pack sheet or in the online catalog of the Weidmüller company for shield connection clamp, type KLBUE 3-8 SC.

8.9.5 Connect the protective conductor

Overview

Motor Modules are designed for use in control cabinets with a protective conductor connection. The protective conductor is connected to the central PE busbar in the control cabinet.

Requirement

⚠ **WARNING**

Electric shock if there is no ground connection

When the protective conductor connection of devices with protection class I is missing or incorrectly implemented, 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.

The following requirement applies:

- Use a suitable ring or tubular cable lug.

Motor Module	Width	Ring/pipe-type cable lug	Tool
3 ... 24 A, 30 A (slim)	50 mm	M5[1]	Torx screwdriver TX 25
2x3 ... 2x9 A, 2x18 A (slim)	50 mm	M5[1]	Torx screwdriver TX 25
30 A, 2x18 A	100 mm	M5	Torx screwdriver TX 25
45 A, 60 A	100 mm	M6	Hexagon insert size 10 / Torx screwdriver TX 25
85 A, 132 A	150 mm	M8	Hexagon size 13
200 A	200 mm	M8	Hexagon size 13

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

Procedure

Proceed as follows to connect the protective conductor to the protective conductor connection of the Motor Module:

1. Prepare the cable with a ring/tubular cable lug.
2. Connect the protective conductor to the component with the protective conductor connection screw.
3. Tighten the screw. Torx screwdriver TX 25. Tightening torque: 3 Nm (26.6 lbf in)

Screw	Tightening torque
M5	3 Nm (26.6 lbf in)
M6	6 Nm (53.1 lbf in)
M8	13 Nm (115 lbf in)

8.10 Technical data

8.10.1 Motor Modules 3 A ... 30 A

Technical data

Table 8-31 Single Motor Modules D type (3 A to 30 A, 30 A (slim))

Feature	6SL5120-	1UE13-0AD0	1UE15-0AD0	1UE21-0AD0	1UE21-8AD0	1UE22-4AD0	1UE23-0AD0	1UE23-0SD0
Output data								
Rated current (I_{rated})	A	3	5	9	18	24	30	30
Intermittent duty current (I_{s6}) 40 %	A	4	6.7	12	24	32	40	40
Peak current (I_{max})	A	9	15	27	54	72	90	90
Output voltage 3 AC	V	0 ... 0.707 x DC link voltage[1] (0 ... 480 V at 680 V DC)						

Feature	6SL5120-	1UE13-0AD0	1UE15-0AD0	1UE21-0AD0	1UE21-8AD0	1UE22-4AD0	1UE23-0AD0	1UE23-0SD0
Output frequency	Hz	0 ... 550[2)]						
Apparent power for U_{DC} of 600 V	kVA	2.2	3.7	6.6	13.2	17.6	22	22
Rated power IEC[3)]	kW	1.1	2.2	4.0	7.5	11	15	15
Rated power NEC[4)]	hp	1.5	3.0	5.0	10	15	20	20
Input data								
DC link voltage (U_{DC})	V	495 ... 720						
Overvoltage trip	V	820						
Undervoltage trip[5)]	V	380 ... 432						
Electronics power supply	V	24						
DC link current ($I_{DC\ link}$)	A	3.7	6.2	11.2	22.5	30	37	37
DC link capacitance	µF	110	110	110	220	390	705	705
Current-carrying capacity								
DC link busbars	A	100[6)]					200	100[6)]
24 V DC busbars	A	20					20	20
Current consumption of the electronics at 24 V DC	A	0.7	0.75	0.8	1	1	0.75	1.2
Power loss	W	29	40	65	150	189	261	272
Cooling air requirement	m^3/h	18	20	22	33	33	58	33
Weight	kg	4.6	4.6	4.6	4.6	4.7	7.9	4.6
Cable lengths	m	See Chapter "Maximum permissible cable lengths (Page 52)"						

1) In the case of overmodulation, a motor output voltage up to 3% higher is possible.

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

3) Rated power of a typical standard induction motor at 3 AC 400 V according to IEC 60947-4-1:2018 Annex G Table G.1

4) Rated power of a standard induction motor at 3 AC 460 V according to NEC Table 430.250

5) Depends on the parameterized device supply voltage

6) 200 A when using 6 mm DC link bridges (Article No. 6SL3162-2BB00-0AA0)

Table 8-32 Single Motor Modules C type (18 A to 30 A, 30 A (slim))

Feature	6SL5120-	1UE21-8AC0	1UE22-4AC0	1UE23-0AC0	1UE23-0SC0
Output data					
Rated current (I_{rated})	A	18	24	30	30
Intermittent duty current (I_{s6}) 40 %	A	24	32	40	40
Peak current (I_{max})	A	36	48	56	56
Output voltage 3 AC	V	0 ... 0.707 x DC link voltage[1)] (0 ... 480 V at 680 V DC)			
Output frequency	Hz	0 ... 550[2)]			
Apparent power for U_{DC} of 600 V	kVA	13.2	17.6	22	22
Rated power IEC[3)]	kW	7.5	11	15	15
Rated power NEC[4)]	hp	10	15	20	20

Feature	6SL5120-	1UE21-8AC0	1UE22-4AC0	1UE23-0AC0	1UE23-0SC0
Input data					
DC link voltage (U_{DC})	V	495 ... 720			
Overvoltage trip	V	820			
Undervoltage trip[5)]	V	380 ... 432			
Electronics power supply	V	24			
DC link current ($I_{DC\ link}$)	A	22.5	30	37	37
DC link capacitance	μF	235	390	705	705
Current-carrying capacity					
DC link busbars	A	100[6)]		200	100[6)]
24 V DC busbars	A	20		20	20
Current consumption of the electronics at 24 V DC	A	1	1	0.75	1.2
Power loss	W	150	189	261	272
Cooling air requirement	m^3/h	33	33	58	33
Weight	kg	4.6	4.7	7.9	4.6
Cable lengths	m	See Chapter "Maximum permissible cable lengths (Page 52)"			

1) In the case of overmodulation, a motor output voltage up to 3% higher is possible.
2) Higher output frequencies up to a maximum of 3200 Hz are possible with an additional license.
3) Rated power of a typical standard induction motor at 3 AC 400 V according to IEC 60947-4-1:2018 Annex G Table G.1
4) Rated power of a standard induction motor at 3 AC 460 V according to NEC Table 430.250
5) Depends on the parameterized device supply voltage
6) 200 A when using 6 mm DC link bridges (Article No. 6SL3162-2BB00-0AA0)

8.10.2 Motor Modules 2x3 A ... 2x18 A

Technical specifications

Table 8-33 Double Motor Modules D type (2x3 A to 2x18 A, 2x18 A (slim))

Feature	6SL5120-	2UE13-0ADO	2UE15-0AD0	2UE21-0AD0	2UE21-8AD0	2UE21-8SD0
Output data						
Rated current (I_{rated})	A	2 x 3	2 x 5	2 x 9	2 x 18	2 x 18
Intermittent duty current (I_{s6}) 40%	A	2 x 4	2 x 6.7	2 x 12	2 x 24	2 x 24
Peak current (I_{max})	A	2 x 9	2 x 15	2 x 27	2 x 54	2 x 54
Output voltage 3 AC	V	0 ... 0.707 x DC link voltage[1)] (0 ... 480 V at 680 V DC)				
Output frequency	Hz	0 ... 550[2)]				
Apparent power for U_{DC} of 600 V	kVA	2 x 2.2	2 x 3.7	2 x 6.6	2 x 13.2	2 x 13.2
Rated power IEC[3)]	kW	2 x 1.1	2 x 2.2	2 x 4.0	2 x 7.5	2 x 7.5
Rated power NEC[4)]	hp	2 x 1.5	2 x 3.0	2 x 5.0	2 x 10	2 x 10

Feature	6SL5120-	2UE13-0ADO	2UE15-0AD0	2UE21-0AD0	2UE21-8AD0	2UE21-8SD0
Input data						
DC link voltage (U_{DC})	V	495 ... 720				
Overvoltage trip	V	820				
Undervoltage trip[5]	V	380 ... 432				
Electronics power supply	V	24				
DC link current ($I_{DC\ link}$)	A	7.5	12.5	22.5	45	45
DC link capacitance	μF	235	235	235	705	705
Current-carrying capacity						
DC link busbars	A	100[6]			200	100[6]
24 V DC busbars	A	20			20	20
Current consumption of the electronics						
at 24 V DC	A	1	1.1	1.1	0.95	1.3
Power loss	W	59	88	159	282	291
Cooling air requirement	m^3/h	22	25	27	62	33
Weight	kg	4.7	4.7	4.7	8.1	5.1
Cable lengths	m	See Chapter "Maximum permissible cable lengths (Page 52)"				

1) In the case of overmodulation, a motor output voltage up to 3% higher is possible.
2) Higher output frequencies up to a maximum of 3200 Hz are possible with an additional license.
3) Rated power of a typical standard induction motor at 3 AC 400 V according to IEC 60947-4-1:2018 Annex G Table G.1
4) Rated power of a standard induction motor at 3 AC 460 V according to NEC Table 430.250
5) Depends on the parameterized device supply voltage
6) 200 A when using 6 mm DC link bridges (Article No. 6SL3162-2BB00-0AA0)

Table 8-34 Double Motor Modules C type (2x18 A, 2x18 A (slim))

Feature	6SL5120-	2UE21-8AC0	2UE21-8SC0
Output data			
Rated current (I_{rated})	A	2 x 18	2 x 18
Intermittent duty current (I_{s6}) 40%	A	2 x 24	2 x 24
Peak current (I_{max})	A	2 x 36	2 x 36
Output voltage 3 AC	V	0 ... 0.707 x DC link voltage[1] (0 ... 480 V at 680 V DC)	
Output frequency	Hz	0 ... 550[2]	
Apparent power for U_{DC} of 600 V	kVA	2 x 13.2	2 x 13.2
Rated power IEC[3]	kW	2 x 7.5	2 x 7.5
Rated power NEC[4]	hp	2 x 10	2 x 10
Input data			
DC link voltage (U_{DC})	V	495 ... 720	
Overvoltage trip	V	820	
Undervoltage trip[5]	V	380 ... 432	
Electronics power supply	V	24	
DC link current	A	45	

Feature	6SL5120-	2UE21-8AC0	2UE21-8SC0
DC link capacitance	μF	705	
Current-carrying capacity			
DC link busbars	A	200	100 6)
24 V DC busbars	A	20	20
Current consumption of the electronics at 24 V DC	A	0.95	1.3
Power loss	W	282	291
Cooling air requirement	m^3/h	62	33
Weight	kg	8.1	5.1
Cable lengths	m	See Chapter "Maximum permissible cable lengths (Page 52)"	

1) In the case of overmodulation, a motor output voltage up to 3% higher is possible.

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

3) Rated power of a typical standard induction motor at 3 AC 400 V according to IEC 60947-4-1:2018 Annex G Table G.1

4) Rated power of a standard induction motor at 3 AC 460 V according to NEC Table 430.250

5) Depends on the parameterized device supply voltage

6) 200 A when using 6 mm DC link bridges (Article No. 6SL3162-2BB00-0AA0)

8.10.3 Motor Modules 45 A and 60 A

Technical data

Table 8-35 Single Motor Modules C type (45 A and 60 A)

Feature	6SL5120-	1UE24-5AC0	1UE26-0AC0
Output data			
Rated current (I_{rated})	A	45	60
Intermittent duty current (I_{s6}) 40 %	A	60	80
Peak current (I_{max})	A	90	120
Output voltage 3 AC	V	0 ... 0.707 x DC link voltage 1) (0 ... 480 V at 680 V DC)	
Output frequency	Hz	0 ... 550 2)	
Apparent power for U_{DC} of 600 V	kVA	33	44
Rated power IEC 3)	kW	22	30
Rated power NEC 4)	hp	30	40
Input data			
DC link voltage (U_{DC})	V	495 ... 720	
Overvoltage trip	V	820	
Undervoltage trip 5)	V	380 ... 432	
Electronics power supply	V	24	
DC link current ($I_{DC\ link}$)	A	56	75
DC link capacitance	μF	1230	1410

Feature	6SL5120-	1UE24-5AC0	1UE26-0AC0
Current-carrying capacity			
DC link busbars	A	200	
24 V DC busbars	A	20	
Current consumption of the electronics at 24 V DC	A	1	1
Power loss	W	344	462
Cooling air requirement	m^3/h	64	64
Weight	kg	8.5	8.6
Cable lengths	m	See Chapter "Maximum permissible cable lengths (Page 52)"	

1) In the case of overmodulation, a motor output voltage up to 3% higher is possible.
2) Higher output frequencies up to a maximum of 3200 Hz are possible with an additional license.
3) Rated power of a typical standard induction motor at 3 AC 400 V according to IEC 60947-4-1:2018 Annex G Table G.1
4) Rated power of a standard induction motor at 3 AC 460 V according to NEC Table 430.250
5) Depends on the parameterized device supply voltage

8.10.4 Motor Modules 85 A ... 200 A

Technical data

Table 8-36 Single Motor Modules D type (85 A to 200 A)

Feature	6SL5120-	1UE28-5AD0	1UE31-3AD0	1UE32-0AD0
Output data				
Rated current (I_{rated})	A	85	132	200
Intermittent duty current (I_{s6}) 40 %	A	113	176	230
Peak current (I_{max})	A	170	264	400
Output voltage 3 AC	V	0 ... 0.707 x DC link voltage[1)] (0 ... 480 V at 680 V DC)		
Output frequency	Hz	0 ... 550[2)]		
Apparent power for U_{DC} of 600 V	kVA	62	97	147
Rated power IEC[3)]	kW	45	75	110
Rated power NEC[4)]	hp	60	100	150
Input data				
DC link voltage (U_{DC})	V	495 ... 720		
Overvoltage trip	V	820		
Undervoltage trip[5)]	V	380 ... 432		
Electronics power supply	V	24		
DC link current ($I_{DC\ link}$)	A	106	165	250
DC link capacitance	µF	1880	2820	4080

Feature	6SL5120-	1UE28-5AD0	1UE31-3AD0	1UE32-0AD0
Current-carrying capacity				
DC link busbars	A	250		
24 V DC busbars	A	20		
Current consumption of the electronics at 24 V DC	A	0.75	0.75	0.8
Power loss	W	770	1270	2070
Cooling air requirement	m^3/h	290	290	340
Weight	kg	15	17.2	20
Cable lengths	m	See Chapter "Maximum permissible cable lengths (Page 52)"		

1) In the case of overmodulation, a motor output voltage up to 3% higher is possible.

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

3) Rated power of a typical standard induction motor at 3 AC 400 V according to IEC 60947-4-1:2018 Annex G Table G.1

4) Rated power of a standard induction motor at 3 AC 460 V according to NEC Table 430.250

5) Depends on the parameterized device supply voltage

Table 8-37 Single Motor Modules booksize C type (85 A to 200 A)

Feature	6SL5120-	1UE28-5AC0	1UE31-3AC0	1UE32-0AC0
Output data				
Rated current (I_{rated})	A	85	132	200
Intermittent duty current (I_{s6}) 40 %	A	113	176	230
Peak current (I_{max})	A	141	210	282
Output voltage 3 AC	V	0 ... 0.707 x DC link voltage[1)] (0 ... 480 V at 680 V DC)		
Output frequency	Hz	0 ... 550[2)]		
Apparent power for U_{DC} of 600 V	kVA	62	97	147
Rated power IEC[3)]	kW	45	75	110
Rated power NEC[4)]	hp	60	100	150
Input data				
DC link voltage (U_{DC})	V	495 ... 720		
Overvoltage trip	V	820		
Undervoltage trip[5)]	V	380 ... 432		
Electronics power supply	V	24		
DC link current ($I_{DC\ link}$)	A	106	165	250
DC link capacitance	μF	1880	2820	4080
Current-carrying capacity				
DC link busbars	A	250		
24 V DC busbars	A	20		
Current consumption of the electronics at 24 V DC	A	0.75	0.75	0.75
Power loss	W	770	1270	2070
Cooling air requirement	m^3/h	290	290	340

Feature	6SL5120-	1UE28-5AC0	1UE31-3AC0	1UE32-0AC0
Weight	kg	15	17.2	20
Cable lengths	m	See Chapter "Maximum permissible cable lengths (Page 52)"		

1) In the case of overmodulation, a motor output voltage up to 3% higher is possible.

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

3) Rated power of a typical standard induction motor at 3 AC 400 V according to IEC 60947-4-1:2018 Annex G Table G.1

4) Rated power of a standard induction motor at 3 AC 460 V according to NEC Table 430.250

5) Depends on the parameterized device supply voltage

8.10.5 Current derating depending on the pulse frequency

Technical data

The following diagram shows the permissible output current as a function of the pulse frequency.

Note

Ambient temperature for a pulse frequency of 16 kHz

For a pulse frequency of 16 kHz, for the Motor Module used, a maximum ambient air temperature of 30 °C is permissible.

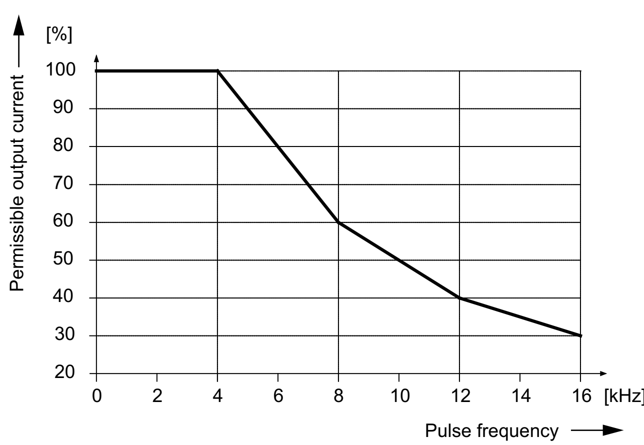


Figure 8-65 Output current as a function of the pulse frequency (Motor Modules 3 A ... 60 A, 2x3 A ... 2x18 A)

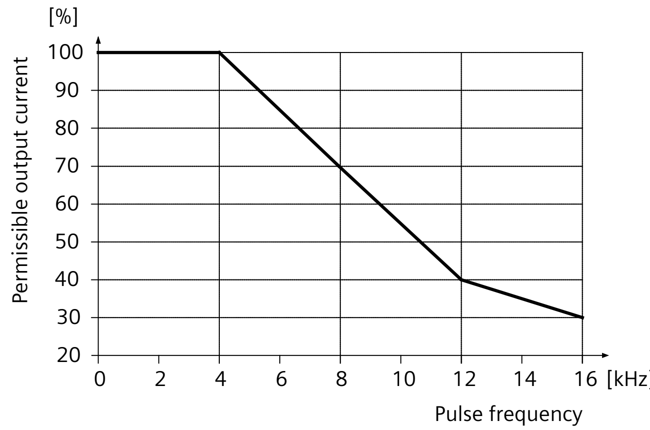


Figure 8-66 Output current as a function of the pulse frequency (Motor Modules 85 A ... 200 A)

8.10.6 Permissible output current at low frequencies

Technical specifications

The following diagram shows the permissible output current as a function of the output frequency when operating with low output frequencies.

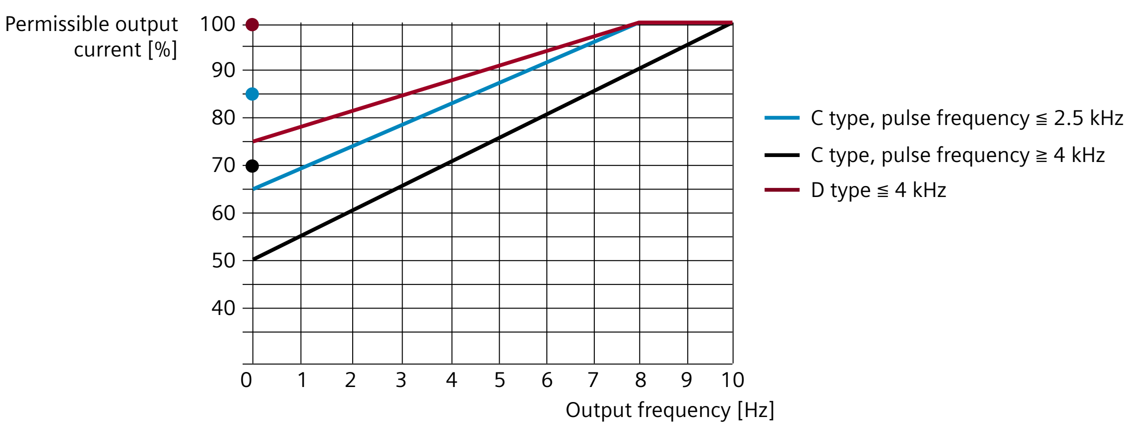


Figure 8-67 Output current at low frequencies

For applications with a constant load, e.g. in paper machines, rolling mills etc., the output current can be reduced as a function of the output frequency. To do this, the pulse frequency must be set to a frequency less than 4 kHz.

Additional conditions for operation at low output frequencies:

- The output current reduction does not apply to acceleration from zero speed if an output frequency of > 10 Hz is reached within 100 ms. A reduction of the output current must be taken into consideration if, at frequencies < 10 Hz, the operating time exceeds 2% of the daily operating time.
- The D type characteristic is only applicable for a pulse frequency ≤ 4 kHz. With pulse frequencies > 4 kHz, use the C type characteristic pulse frequency ≥ 4 kHz taking account of the corresponding output current reduction.
- For drive systems with induction motors (with slip frequency), the permissible continuous load at zero speed (e.g. suspended axis without counterweight or travel to fixed stop):
  - 75% of I_{rated} for D type
  - 50% of I_{rated} for C type Motor Modules with a pulse frequency ≥ 4 kHz
  - 65% of I_{rated} for C type Motor Modules with a pulse frequency ≤ 2.5 kHz
- For drive systems with synchronous motors, the permissible continuous load at zero speed is:
  - 100% of I_{rated} for D type ≤ 4 kHz
  - 85% of I_{rated} for C type ≤ 2.5 kHz
  - 70% of I_{rated} for C type ≥ 4 kHz

8.11 Accessories

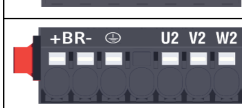
8.11.1 Power connector order data

Note

Using identical plug connector variants for Double Motor Modules

Two identical connectors must be used on Double Motor Modules (both push-in connectors or both screw connectors). Otherwise, they will not able to be inserted.

Motors are connected to Motor Modules using a power connector. The power connector must be separately ordered for power cables that are not prefabricated. The following variants are available:

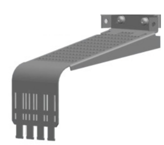
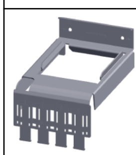
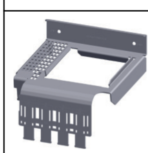
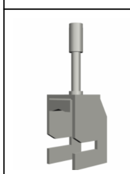
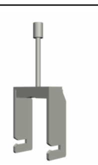
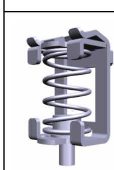
Connection plug		
Connector variant	**Article number**	**Description**
	6SL3162-2MA00-0AC0	Power connector with screw terminal for Motor Modules 3 A - 30 A Connection type: Screw terminals
	6SL3162-2MB00-0AC0	Power connector with push-in connection for Motor Modules 3 A - 30 A Connection type: Spring-loaded terminals

Power connector 6SL3162-2M☐00-0AC0 as well as the power connectors used to fabricate MOTION-CONNECT cables are type-tested together with the Motor Modules. Compliance with the regulations laid down in the EC Declaration of Conformity is only ensured in conjunction with these specific power connectors.

cULus approval has been issued for power connector 6SL3162-2M☐00-0AC0 as well for the power connectors used to fabricate MOTION-CONNECT cables.

The technical function can only be guaranteed in conjunction with the specified power connectors.

8.11.2 Order data for shield connection plates and clamps

Shield connection plates and clamps		
Accessories	**Article number**	**Description**
	6SL3162-1AD00-0AA0	Shield connection plate for Motor Modules 45 A and 60 A
	6SL5166-1AF00-0AA0	Shield connection plate for Motor Modules 85 A and 132 A
	6SL5166-1AH00-0AA0	Shield connection plate for Motor Module 200 A
	8WH9130-0MA00	Shield connection clamp Cable diameter 3 ... 14 mm (0.12 ... 0.55 inch)
	8WH9130-0NA00	Shield connection clamp Cable diameter 5 ... 28 mm (0.20 ... 1.10 inch)
	8WH9130-0PA00	Shield connection clamp Cable diameter 20 ... 35 mm (0.79 ... 1.38 inch)
	KLBUE 3-8 SC	KLBUE 3-8 SC shield connection clamp from the Weidmüller company

DC link components 9

9.1 Overview

Overview diagram

DC link components are installed in addition to the Line Modules and Motor Modules. They are connected to other components via the DC link.

Figure 9-1 DC link components

Table 9-1 DC link components

Component	Function
Braking Module Braking Module Compact	Specifically stops drives in the event of power failure and limits the DC link voltage
Capacitor Module	Increases the DC link capacitance to buffer brief line supply failures.
Control Supply Module	Generates a 24 V DC output voltage for the other components in the drive line-up. The Control Supply Module requires its own dedicated AC supply when starting.
SITOP PSU400M	Generates a 24 V DC output voltage for the other components in the drive line-up from the DC link.

More information

Information on Braking Modules, Capacitor Modules and Control Supply Modules is provided in Chapter "DC link components" on the internet:

SINAMICS S120 Booksize Power Units Equipment Manual (https://support.industry.siemens.com/cs/ww/en/view/109781351)

9.2 SITOP PSU400M

9.2.1 Description

Description

The SITOP PSU400M is a power supply for connection to DC link voltages. It provides an output voltage of 24 V to 28.8 V DC. The output voltage can be adjusted using an integrated potentiometer.

The SITOP PSU400M is used to maintain the 24 V supply for Line Modules. This makes it possible to execute retraction movements in the event of a power failure.

Table 9-2 Technical data, SITOP PSU400M (6EP1536-3AA00)

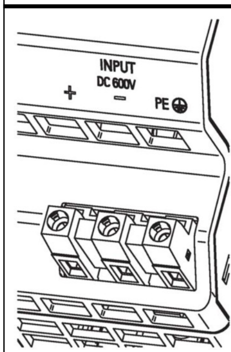
Feature	Unit	Article No. 6EP1536-3AA00
Input data		
Input voltage	V	300 ... 824
when the power supply starts	V	> 400
Input current	A	0.85
Inrush current (at 25 °C)	A	approx. 8
Output data		
Output voltage	V	24
Adjustment range	V	24 ... 28.8
Output current	A	20
Startup delay	s	10 s can be selected
Overload response (for $U_{DC\ Link}$ = 300 ... 820 V DC)	A	30 A for 5 s/min

9.2.2 Interfaces

Connection with the DC link busbars

The SITOP PSU400M is connected to the DC link via the "+" and "-" terminals using a DC link connection cable and a DC link adapter.

Table 9-3 INPUT DC: Input-side connection of the SITOP PSU400M at the DC link

INOUT DC	Terminal	Technical data
	+ positive	Screw terminals: DC inputs "+" and "-", PE:
	- negative	
	⏚	
Connectable cable cross-sections		0.05 mm² - 2.5 mm² (finely stranded) (AWG 24 ... 12)
Tool		Slotted screwdriver (0.6 x 3.5)/ cross-tip screwdriver PH1/ cross-tip screwdriver PZ1
Tightening torque		0.5 - 0.6 Nm

Note

Connecting the protective conductor

The SITOP PSU400M power supply has two protective conductor connections. Do not connect the protective conductor to the input (not even capacitively). The cross-sections of the protective conductor connections and the DC link connecting cable must be identical.

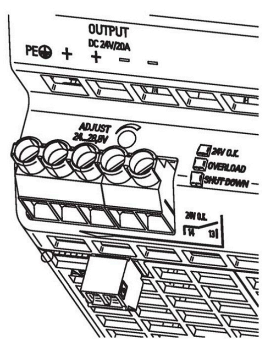
Table 9-4 DC link adapter that can be used

DC link adapter	6SL3162-2BD00-0AA0	
Rated current	43 A	
Terminal	DCP	Supply voltage: 495 ... 720 V
	DCN	

Connection to the 24 V busbars

The SITOP PSU400M provides an output voltage for the 24 V supply of the Smart Line Module via the "+" and "–" terminals.

Table 9-5 OUTPUT DC: Output-side connection (24 V) of the SITOP PSU400M

OUTPUT DC	Terminal	Technical data
	+ positive - negative ⏚	Screw terminals: Outputs "+" and "-", PE
Connectable cable cross-sections		0.2 mm² - 2.5 mm² (finely stranded) (AWG 24 ... 12)
Tool		Slotted screwdriver (0.6 x 3.5)/ cross-tip screwdriver PH1/ cross-tip screwdriver PZ1
Tightening torque		0.5 - 0.6 Nm

Note

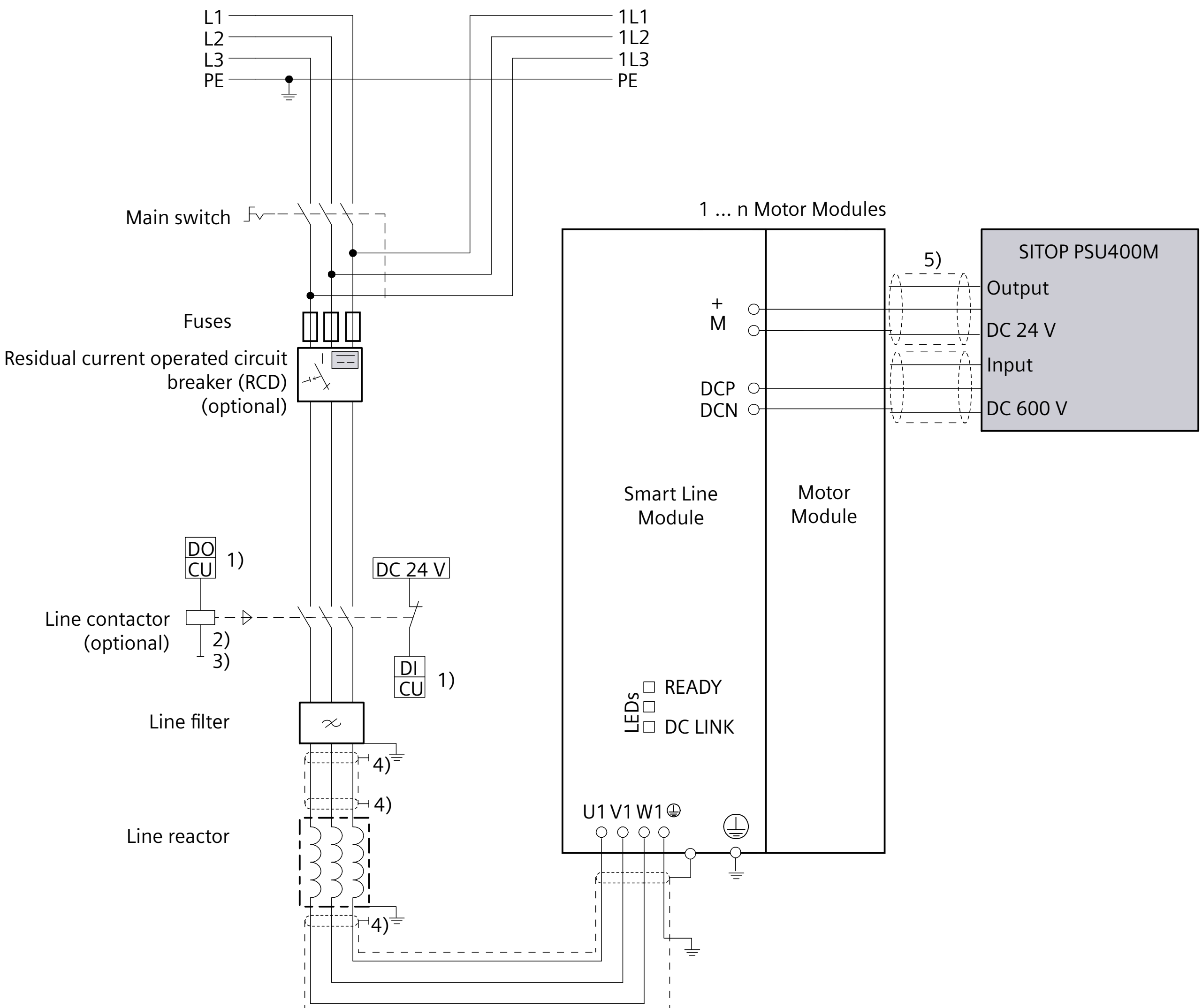
At the power supply output, you must connect the ground potential to the protective conductor system (PELV). The cross-section of this connection must be at least as large as the cross-section of the 24 V conductors.

More information

More information about connecting the device is provided on the internet:

SITOP PSU400M Manual (https://support.industry.siemens.com/cs/ww/en/view/59038719)

The SITOP PSU400M is connected to the drive lineup via the DC link adapter and via the 24 V terminal adapter.



1) DI/DO, controlled by the Control Unit
2) No additional load permitted downstream of the line contactor.
3) Observe the current-carrying capacity of the DO. It may be necessary to use an output coupling link.
4) Contact is established through the rear panel or shield rails in accordance with the EMC installation guideline.
5) A DC link adapter is required for connection to the DC link. The 24 V connection is made via a 24 V terminal adapter.

Figure 9-2 Connection example, SITOP PSU400M

9.2.3 Supported operation conditions

The following two operation conditions are supported when using the SITOP PSU400M. The precharging relay must be closed directly after the drive lineup has run up as the SITOP PSU400M represents a load for the DC link precharging resistors (equipped with PTCs). The DC link voltage collapses as a consequence.

First operation condition

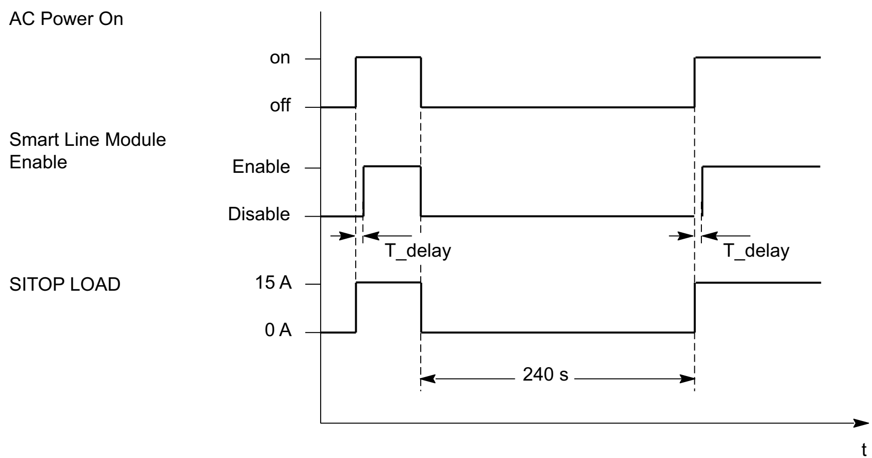


Figure 9-3 Time diagram

Condition:

- Environment: 40 °C line voltage: 400 V
- Drive system capacitance: 10 mF
- Module status: cold

Note

T_delay is the permitted system startup time, less than 45 s.

Second constraint

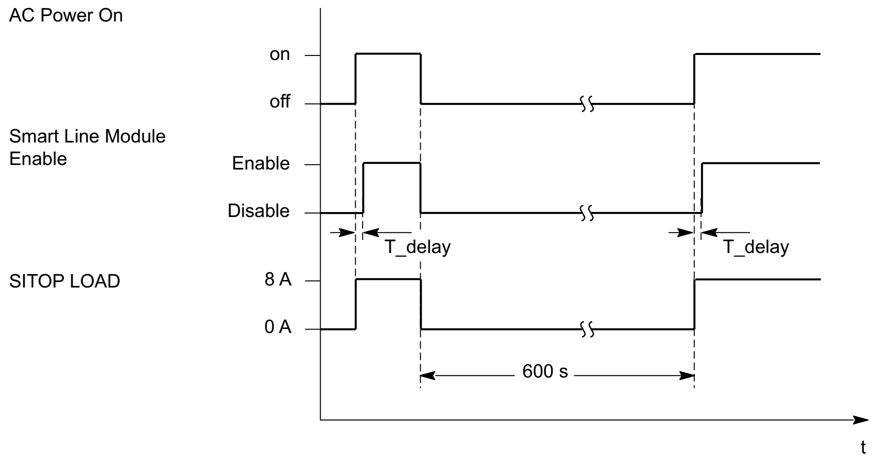


Figure 9-4 Time diagram

Condition:

- Environment: 55 °C line voltage: 480 V
- Drive system capacitance: 10 mF
- Module status: warm

Note

T_delay is the permitted system startup time, less than 45 s.

Motor-side power components 10

10.1 Overview

Overview diagram

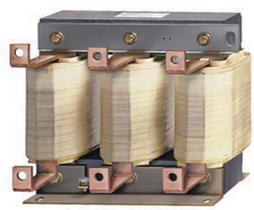


Figure 10-1 Motor-side power components

Table 10-1 Motor-side power components

Component	Function
Motor reactors	Motor reactors reduce the magnitude of capacitive discharge currents which means that longer motor cables can be used.

10.2 Motor reactors

10.2.1 Description

Overview

Figure 10-2 Motor reactors for Motor Modules 3 ... 60 A

NOTICE

Damage to components when using incorrect motor reactors

Using motor reactors that have not been approved by Siemens for SINAMICS can result in component damage.

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

Motor reactors **Article number**	6SE7021-0ES87-1FE0	6SL3000-2BE21-0AA0	6SE7022-6ES87-1FE0
Suitable for Motor Module Article number	6SL5120- . UE13-0A . . 6SL5120- . UE15-0A . .	6SL5120- . UE21-0A . .	6SL5120- . UE21-8A . . 6SL5120- . UE21-8S . .

Motor reactors **Article number**	6SE7024-7ES87-1FE0	6SE7027-2ES87-1FE0	6SL3000-2BE26-0AA0
Suitable for Motor Module Article number	6SL5120-1UE22-4A . . 6SL5120-1UE23-0A . . 6SL5120-1UE23-0S . .	6SL5120-1UE24-5A . .	6SL5120-1UE26-0A . .

Motor reactors **Article number**	6SE7031-5ES87-1FE0	6SE7031-8ES87-1FE0	6SE7032-6ES87-1FE0
Suitable for Motor Module Article number	6SL5120-1UE28-5A . .	6SL5120-1UE31-3A . .	6SL5120-1UE32-0A . .

10.2.2 Safety information

WARNING

Electric shock in the event of missing touch protection

Touching live components can result in death or severe injury.

- For motor reactors with degree of protection IP00, use touch protection according to IPXXA or corresponding to 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 being damaged as a result of the temperature, maintain the specified clearance around all sides of the motor reactors.

10.2.3 Using the motor reactor

Overview

Motor reactors reduce the magnitude of capacitive discharge currents which means that longer motor cables can be used. At the same time, the stress on the motor windings caused by rates of voltage rise (dv/dt) is also diminished.

Requirements

NOTICE
Overheating of the motor reactor when the maximum pulse frequency is exceeded
The motor reactor can overheat and therefore be damaged if the pulse frequency is exceeded. • When using a motor reactor, the pulse frequency of the converter must not exceed 4 k Hz.

Note the following requirements:

- Maximum ambient temperature: 40 °C without reduction of the output current, 55 °C with reduction of the output current
- Maximum pulse frequency: 4 kHz
- Maximum output frequency: 120 Hz
- Maximum current limit: 2 x rated current (I_{rated})
- Operating modes: Vector control, U/f control und servo control[1)]
- Maximum cable length of the connection cables between the Motor Module and a motor reactor: 5 m[2)]

[1)] The reactor for the servo control must be parameterized during commissioning.

[2)] Keep the connecting cables between the Motor Module and the motor reactor as short as possible.

10.2.4 Interfaces and connections

Overview

Motor reactors with a rated current up to 18 A are equipped with terminals. Motor reactors for Motor Modules with rated currents from 30 ... 200 A are connected using flat connectors.

Description

Article number	Rated current [A]	Connecting terminals with cable cross-sections	Tightening torque	Protective conductor
6SE7021-0ES87-1FE0	3 5	Screw terminals 0.5 - 4 mm^2 (AWG 18 ... 10)	0.5 Nm (4.5 lbf in)	M6
6SL3000-2BE21-0AA0	9	Screw terminals 2.5 - 10 mm^2 (AWG 14 ... 8)	2.5 Nm (22 lbf in)	
6SE7022-6ES87-1FE0	18	Screw terminals 1.5 - 16 mm^2 (AWG 12 ... 4)	1.2 Nm (11 lbf in)	

Article number	Rated current [A]	Flat connector	Tightening torque	Protective conductor
6SE7024-7ES87-1FE0	30	M8 screw	13 Nm (115 lbf in)	M6
6SE7027-2ES87-1FE0	45	M8 screw		
6SL3000-2BE26-0AA0	60	M8 screw		
6SE7031-5ES87-1FE0	85	M8 screw		
6SE7031-8ES87-1FE0	132	M10 screw	25 Nm (220 lbf in)	
6SE7032-6ES87-1FE0	200	M10 screw		

10.2.5 Dimension drawings

10.2.5.1 Dimension drawing, 3 ... 30 A motor reactors

Overview diagram

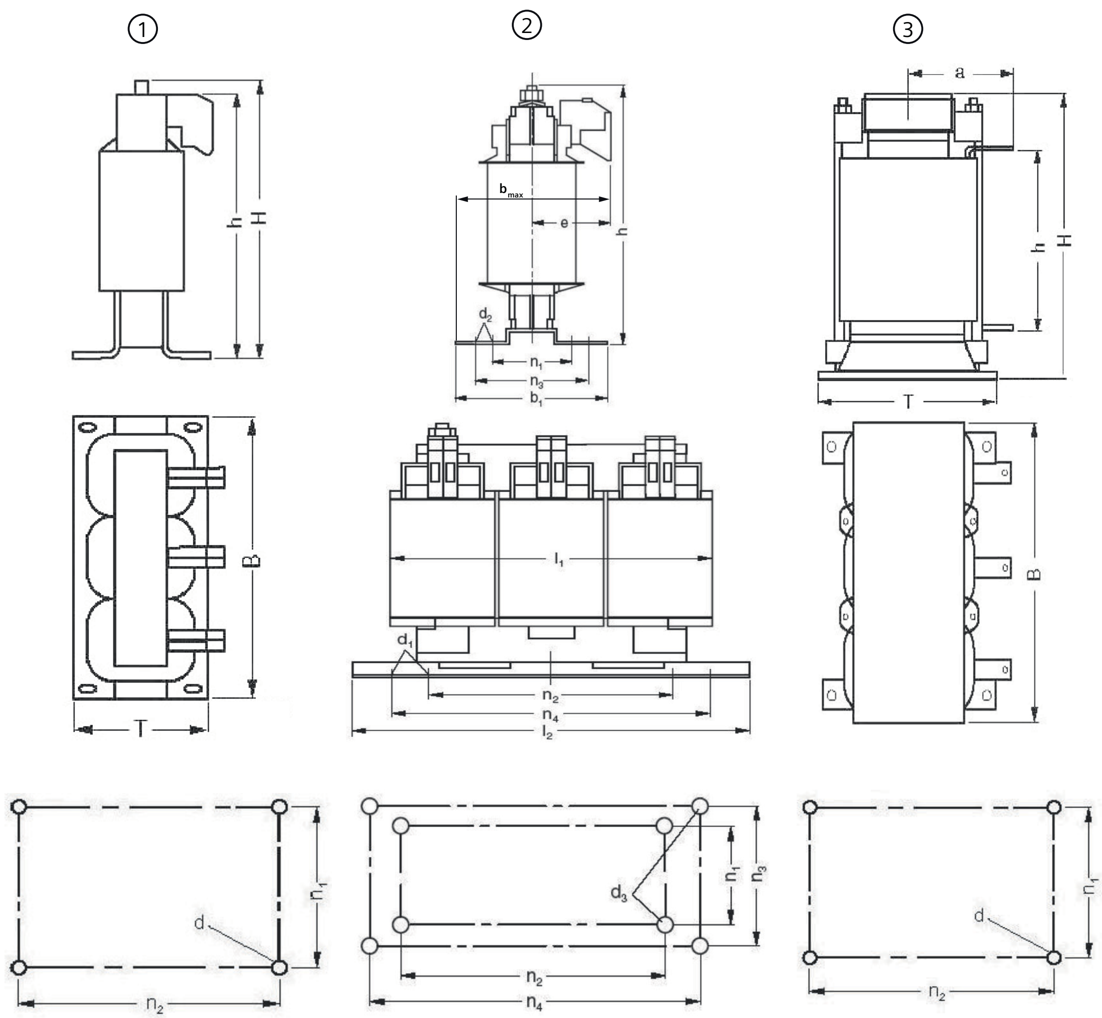


Figure 10-3 Dimension drawing, motor reactors 3 - 30 A

Table 10-2 Dimensions of motor reactors, all dimensions in mm and (inches)

Motor reactors Article No.	**6SE7021-0ES87-1FE0**	**6SE7022-6ES87-1FE0**	**6SE7024-7ES87-1FE0**
Rated current [A]	**3** **5**	**18**	**30**
Figure	①	①	③
B	178 (7.00)	219 (8.62)	197 (7.75)
H	153 (6.02)	180 (7.08)	220 (8.66)

Motor reactors Article No.	6SE7021-0ES87-1FE0	6SE7022-6ES87-1FE0	6SE7024-7ES87-1FE0
Rated current [A]	**3** **5**	**18**	**30**
Figure	①	①	③
T	88 (3.46)	119 (4.68)	104 (4.09)
a	-	-	69 (2.71)
h	146 (5.74)	181 (7.12)	103 (4.05)
n_1	68 (2.67)	89 (3.50)	70 (2.75)
n_2	166 (6.53)	201 (7.91)	176 (6.92)
d	M5	M6	M6
Lengths n_1 and n_2 correspond to the distances between holes.			

Table 10-3 Dimensions of motor reactors, all dimensions in mm and (inches)

Motor reactors Article No.	6SL3000-2BE21-0AA0
Rated current [A]	**9**
Figure	②
l_1	150 (5.90)
l_2	178 (7.00)
b_1	88 (3.46)
b_2	111 (4.37)
b_{max}	67 (2.64)
e	159 (6.26)
n_1	64 (2.52)
n_2	113 (4.45)
n_3	68 (2.68)
n_4	166 (6.54)
d_1	5.8 (0.23)
d_2	11 (0.43)
d_3	M5
Lengths n1, n2, n3 and n4 correspond to the distances between holes.	

10.2.5.2 Dimension drawing, motor reactors 45 A

Overview diagram

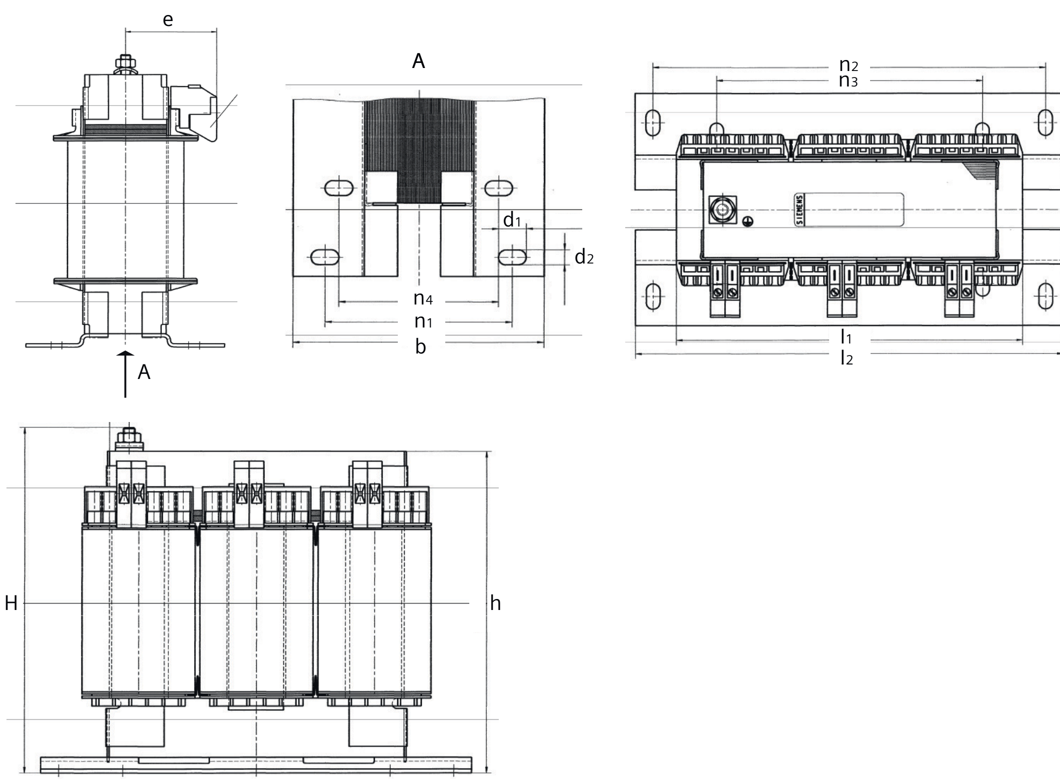


Figure 10-4 Dimension drawing, motor reactors 45 A

Table 10-4 Dimensions of motor reactors, all dimensions in mm and (inches)

Motor reactors Article No.	**6SE7027-2ES87-1FE0**
Rated current [A]	**45**
l_1	219 (8.62)
l_2	max. 182 (7.17)
b	119 (4.69)
H	max. 180 (7.09)
h	max. 165 (6.50)
e	58 (2.28) / terminal 4 mm^2 72 (2.83)/ terminal 10 mm^2
n_1	89 (3.50)
n_2	201(7.91)
n_3	136 (5.35)
n_4	76 (2.99)
d	M6
d_1	13 (0.51)

Motor reactors Article No.	6SE7027-2ES87-1FE0
Rated current [A]	**45**
d_2	7 (0.28)
Lengths n1, n2, n3 and n4 correspond to the distances between holes.	

10.2.5.3 Dimension drawing, motor reactors 60 A

Overview diagram

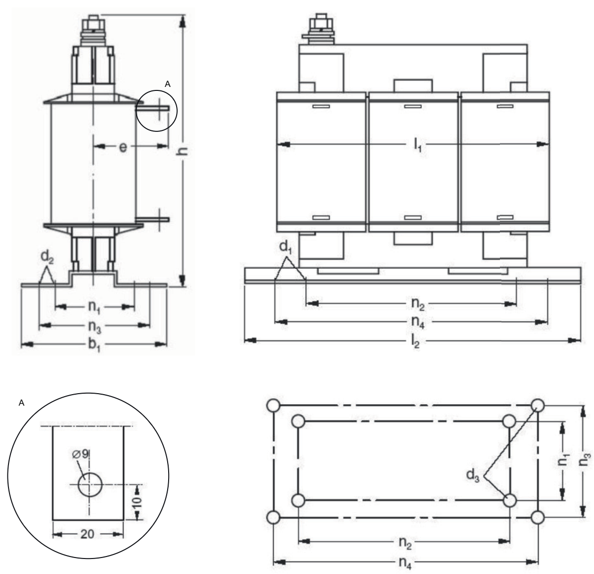


Figure 10-5 Dimension drawing, motor reactors 60 A

Table 10-5 Dimensions of motor reactors, all dimensions in mm and (inches)

Motor reactors Article No.	6SL3000-2BE26-0AA0
Rated current [A]	**60**
l_1	Max. 228 (8.97)
l_2	267 (10.51)
b_1	107 (4.21)
b_{max}	125.5 (4.94)
e	72 (2.83)
h	220 (8.66)
h_1	56 (2.20)
h_2	100 (3.93)
n_1	70 (2.75)
n_2	176 (6.92)
n_3	77 (3.03)
n_4	249 (9.80)

Motor reactors Article No.	6SL3000-2BE26-0AA0
Rated current [A]	**60**
d_1	36 (1.41)
Lengths n_1, n_2, n_3 and n_4 correspond to the distances between holes.	

10.2.5.4 Dimension drawing, 85 - 200 A motor reactors

Overview diagram

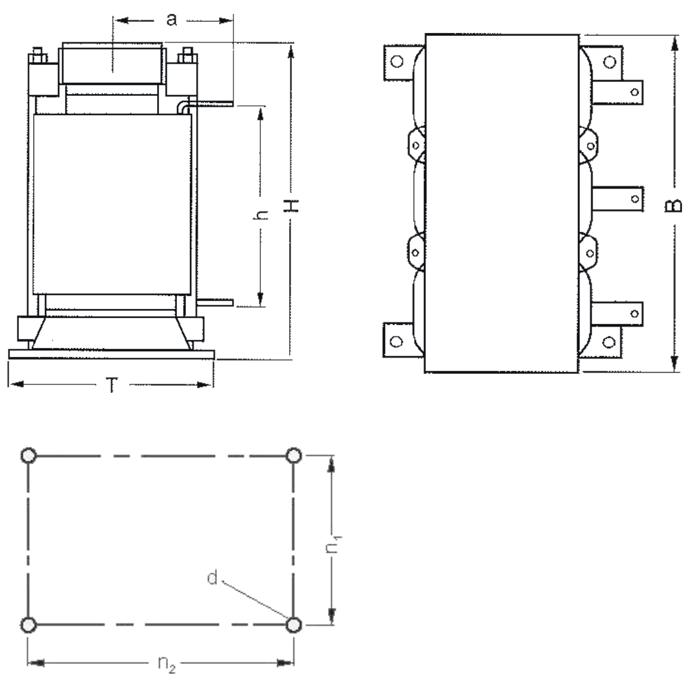


Figure 10-6 Dimension drawing, motor reactors 85 - 200 A

Table 10-6 Dimensions of motor reactors, all dimensions in mm and (inches)

Motor reactors Article No.	6SE7031-5ES87-1FE0	6SE7031-8ES87-1FE0	6SE7032-6ES87-1FE0
Rated current [A]	**85**	**132**	**200**
B	197 (7.75)	281 (11.06)	281 (11.06)
H	220 (8.66)	250 (9.84)	250 (9.84)
T	128 (5.03)	146 (5.74)	146 (5.74)
a	81 (3.18)	98 (3.85)	111 (4.37)
h	100 (3.93)	119 (4.68)	121 (4.76)
n_1	94 (3.70)	101 (3.97)	101 (3.97)
n_2	176 (6.92)	200 (7.87)	200 (7.87)

Motor reactors Article No.	**6SE7031-5ES87-1FE0**	**6SE7031-8ES87-1FE0**	**6SE7032-6ES87-1FE0**
Rated current [A]	**85**	**132**	**200**
d	M6	M8	M8
Lengths n_1 and n_2 correspond to the distances between holes.			

10.2.6 Technical data

10.2.6.1 Motor reactors for Motor Modules 3 ... 60 A

Technical data

Table 10-7 Motor reactors for Motor Modules 3 ... 60 A

Motor reactors Article No.	**Unit**	**6SE7021-0ES87-1FE0**	**6SL3000-2BE21-0AA0**	**6SE7022-6ES87-1FE0**	**6SE7024-7ES87-1FE0**	**6SE7027-2ES87-1FE0**	**6SL3000-2BE26-0AA0**
Suitable for Motor Module Article No. 6SL5120-		. UE13-0A . . . UE15-0A . .	. UE21-0A . .	. UE21-8A . .	1UE24-4A . . 1UE23-0A . .	1UE24-5A . .	1UE26-5A . .
Rated current	A	5	9	18	30	45	60
Maximum current	A	10	18	36	60	90	120
Power loss	W	80	90	110	165 / 190	200	105
Maximum motor cable length, shielded 1 reactor 2 reactors 3 reactors	m	100 - -	135 - -	160 320 -	190 380 -	200 400 600	
Cable connection		Screw terminals			Flat connector for M8 screw		
Degree of protection		IP00					
Weight	kg	5.5	4.8	7.8	13	11	10.5
Mounting position		Any					

10.2.6.2 Motor reactors for Motor Modules 85 ... 200 A

Technical data

Table 10-8 Motor reactors for Motor Modules 85 ... 200 A

Motor reactor Article No.	**Unit**	**6SE7031-5ES87-1FE0**	**6SE7031-8ES87-1FE0**	**6SE7032-6ES87-1FE0**
Suitable for Motor Module Article No. 6SL5120-		1UE28-5A . .	1UE31-3A . .	1UE32-0A . .
Rated current	A	85	132	200
Maximum current	A	170	264	400
Power loss	W	220	290	290
Maximum motor cable length, shielded				
1 reactor	m	200	200	200
2 reactors		400	400	400
3 reactors		600	600	600
Cable connection		Flat connector for M8 screw	Flat connector for M10 screw	
Degree of protection		IP00		
Weight	kg	20.5	27.2	30.6
Mounting position		Any		

Accessories 11

11.1 DRIVE-CLiQ signal cables

11.1.1 Overview

Description

To connect the DRIVE-CLiQ interfaces of the components, the following pre-assembled and unassembled DRIVE-CLiQ signal cables can be used:

Table 11-1 DRIVE-CLiQ signal cables

Type of DRIVE-CLiQ signal cable	Description
with RJ45 connector, IP20 degree of protection	They are used to connect components with DRIVE-CLiQ connection. They are mainly intended for use in control cabinets.
with RJ45 connector, IP67 degree of protection	They are used for components with DRIVE-CLiQ connection if higher requirements must be complied with, such as mechanical stress and resistance to oil. The signal cables are used for connections outside the control cabinet: • Connections between Motor Modules and Sensor Modules • Connections between Motor Modules and motors with DRIVE-CLiQ interface
with RJ45 connector and M12 socket	They establish the connection between components with a DRIVE-CLiQ connection and a direct measuring system equipped with DRIVE-CLiQ with 8-pin M12 plug. This means that measuring systems from third-party manufacturers can be directly connected to the SINAMICS S220 booksize system.
with M12 plug and M12 socket (extension)	They are used to extend DRIVE-CLiQ signal cables with M12 socket. A maximum of 3 extensions can be used (or 2 extensions if there is more than 1 cable in the line < 6 m).

More information

Wiring rules for DRIVE-CLiQ are provided in Chapter "Rules for wiring DRIVE-CLiQ" on the internet:

SINAMICS S120 Function Manual Drive Functions (https://support.industry.siemens.com/cs/ww/en/view/109781535)

11.1.2 Connecting a direct measuring system

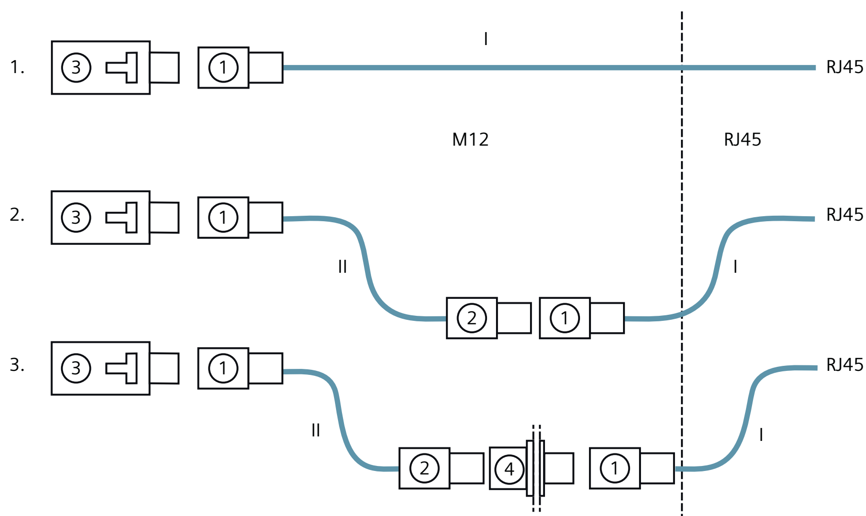
Overview

A direct measuring system with DRIVE-CLiQ ASIC and M12 plug can be connected via MOTION-CONNECT cables to a DRIVE-CLiQ component.

Description

There are various ways to connect a direct measuring system:

1. Direct connection via a basic cable
2. Connection via a basic cable and 1-3 extensions
3. Connection via a basic cable, cabinet bushing and a maximum of 2 extensions



①	M12 socket (IP67) connected to a MOTION-CONNECT DRIVE-CLiQ signal cable
②	M12 plug (IP67) connected to a MOTION-CONNECT DRIVE-CLiQ signal cable
③	M12 plug (IP67) connected to a third-party measuring system
④	DRIVE-CLiQ cabinet bushing M12
I	Basic cable
II	Extension

Figure 11-1 Connecting a direct measuring system with M12 plug to a DRIVE-CLiQ component with RJ45 socket (IP20)

11.1.3 Cable lengths when using DRIVE-CLiQ couplings

Overview

MOTION-CONNECT 500 cables and MOTION-CONNECT 800PLUS cables can be combined. DRIVE-CLiQ couplings are used to combine MOTION-CONNECT 500 and MOTION-CONNECT 800PLUS cables. When using DRIVE-CLiQ couplings, the maximum permissible cable length must be calculated.

Description

Calculate the maximum permissible cable lengths as follows if you use DRIVE-CLiQ couplings:

Cables with RJ45 connectors: $\Sigma MC500^{1)} + 4/3 * \Sigma MC800PLUS^{2)} + n_c^{3)} * 5\text{ m} \leq 100\text{ m}$

Cables with M12 plugs: $\Sigma MC500^{1)} + 4/3 * \Sigma MC800PLUS^{2)} \leq 100\text{ m}$

1) ΣMC500 = total length of all MOTION-CONNECT 500 cable segments (fixed routing)

2) ΣMC800PLUS = total length of all MOTION-CONNECT 800PLUS cable segments (cable carrier)

3) n_c = Number of DRIVE-CLiQ couplings (0 up to a maximum of 3)

With this combination, DRIVE-CLiQ cables with a maximum length exceeding 75 m can also be implemented for applications involving a cable carrier.

Table 11-2 Examples of maximum cable lengths when using a DRIVE-CLiQ coupling

ΣMC500 (fixed routing)	87 m	80 m	66 m	54 m	40 m	30 m	20 m	10 m	5 m
ΣMC800PLUS (cable carrier)	5 m	10 m	20 m	30 m	40 m	48 m	55 m	63 m	66 m
ΣMC500 + ΣMC800PLUS	92 m	90 m	86 m	84 m	80 m	78 m	75 m	73 m	71 m

11.1.4 Cable lengths when using DRIVE-CLiQ Hub modules

Overview

When using a DRIVE-CLiQ Hub Module (DMC20-2 or DME20-2), then you can use RJ45 connectors to double the maximum permissible cable length for MOTION-CONNECT cables.

Description

After the DRIVE-CLiQ Hub Module, the same length conditions apply as before the DRIVE-CLiQ Hub module. You calculate the maximum permissible cable length as follows:

$\Sigma MC500^{1)} + 4/3 * \Sigma MC800PLUS^{2)} + n_c^{3)} * 5\text{ m} \leq 100\text{ m}$ before the DRIVE-CLiQ Hub Module

$\Sigma MC500^{1)} + 4/3 * \Sigma MC800PLUS^{2)} + n_c^{3)} * 5\text{ m} \leq 100\text{ m}$ after the DRIVE-CLiQ Hub Module

It is possible to connect two DRIVE-CLiQ Hub Modules in series (cascading).

1) ΣMC500 = total length of all MOTION-CONNECT 500 cable segments (fixed routing)

2) ΣMC800PLUS = total length of all MOTION-CONNECT 800PLUS cable segments (cable carrier)

3) n_c = Number of DRIVE-CLiQ couplings (0 up to a maximum of 3)

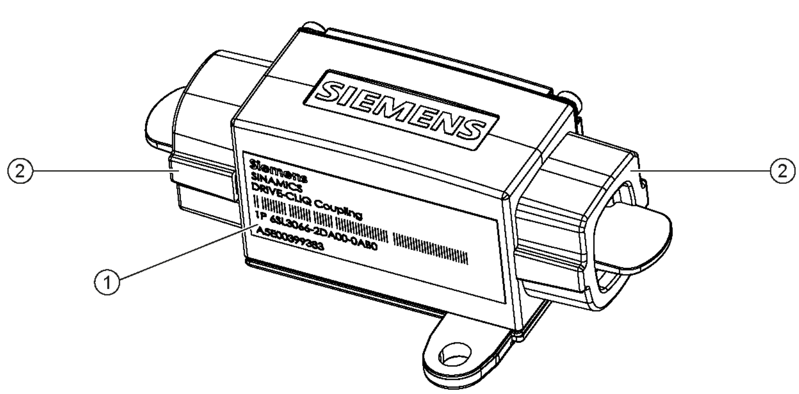
11.1.5 Order data DRIVE-CLiQ signal cables

Pre-assembled DRIVE-CLiQ signal cables				
Name		**Degree of protection**	**Connector type**	**Article number**
DRIVE-CLiQ signal cables	without 24 V cores	IP20 and IP67 available	with RJ45 plug	6SL3060-4A.. 6FX2002-1DC..
MOTION-CONNECT	with 24 V cores	IP20 and IP67 available	with RJ45 plug	6FX5002-2DC00.. to .. -2DC20.. 6FX8002-2DC00.. to .. -2DC20..
		Converting over from an RJ45 plug (IP20) to an M12 socket (IP67)		6FX5002-2DC30.. 6FX8002-2DC30..

11.2 DRIVE-CLiQ coupling

11.2.1 Description

Overview diagram



① Nameplate

② Protective cap, Yamaichi, Article No.: Y-ConAS-24-S

The DRIVE-CLiQ coupling (6SL3066-2DA00-0AB0) is used to connect 2 DRIVE-CLiQ cables in accordance with degree of protection IP67 acc. to IEC 60529.

In addition to the data cables, the power supply contacts of DRIVE-CLiQ are also routed via the coupling.

11.2.2 Dimension drawing

Dimension drawing

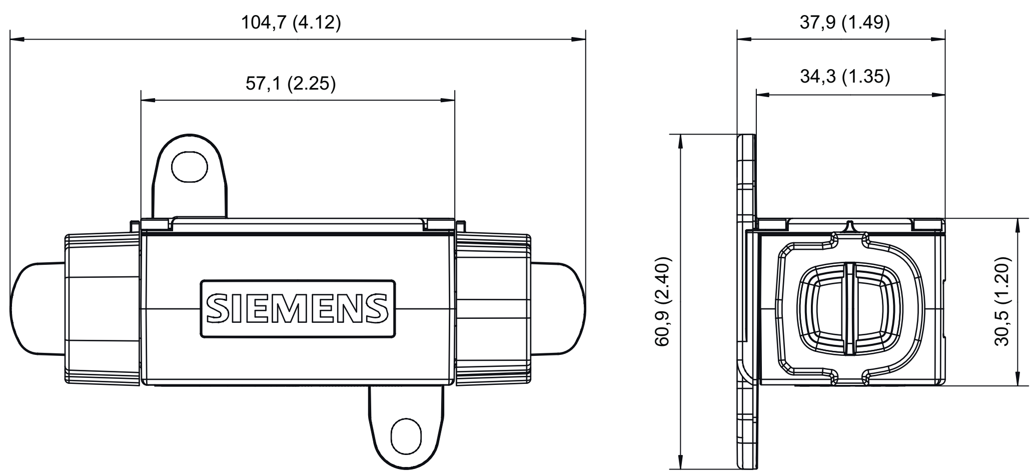
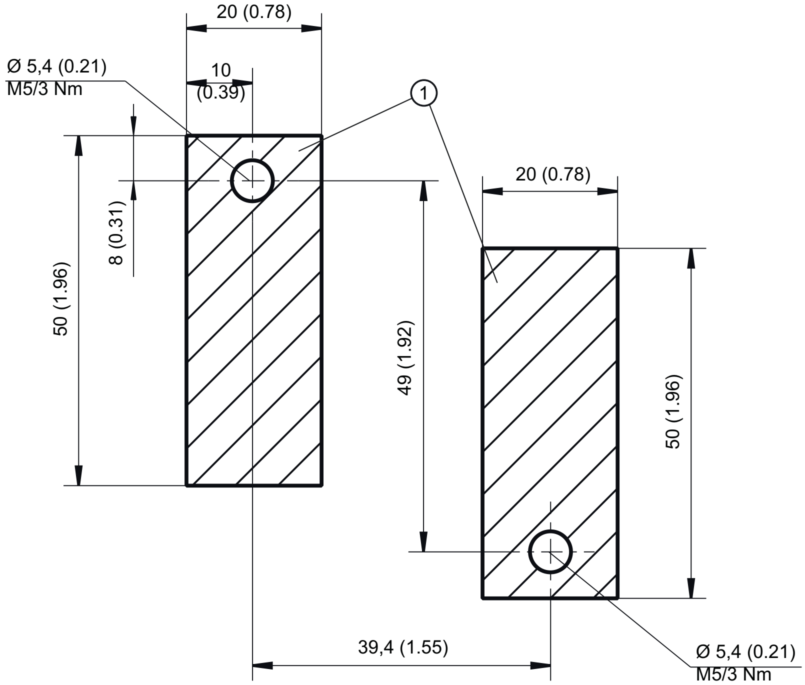


Figure 11-2 Dimension drawing of the DRIVE-CLiQ coupling, all dimensions in mm and (inches)

11.2.3 Mounting the DRIVE-CLiQ coupling

Procedure



① Contact surface

DRIVE-CLiQ coupling	Screw/tightening torque
6SL3066-2DA00-0AB0	M5 / 3 Nm (26.6 lbf in)

Proceed as follows to attach the DRIVE-CLiQ coupling to the control cabinet panel:

1. Prepare the mounting surface.
2. Mount the DRIVE-CLiQ coupling onto the mounting surface. Tightening torque: 3 Nm (26.6 lbf in)
3. Remove the protective caps of the DRIVE-CLiQ coupling.
4. Insert the DRIVE-CLiQ cable into both ends of the DRIVE-CLiQ coupling until they latch.

11.2.4 Technical data

Technical data

Table 11-3 DRIVE-CLiQ coupling (6SL3066-2DA00-0AB0)

Feature	Unit	Value
Weight	kg	0.272
Degree of protection	-	IP67 according to IEC 60529

11.2.5 Order data

Connecting DRIVE-CLiQ components	
Name	**Article number**
DRIVE-CLiQ coupling	6SL3066-2DA00-0AB0

11.3 DRIVE-CLiQ cabinet bushings

11.3.1 Description

Overview

A DRIVE-CLiQ cabinet bushing is used to connect the DRIVE-CLiQ cables between the inside and outside of the control cabinet. The data cables and the power supply contacts of DRIVE-CLiQ are also routed through the control cabinet panel.

Two DRIVE-CLiQ cabinet bushings are available.

Overview diagram

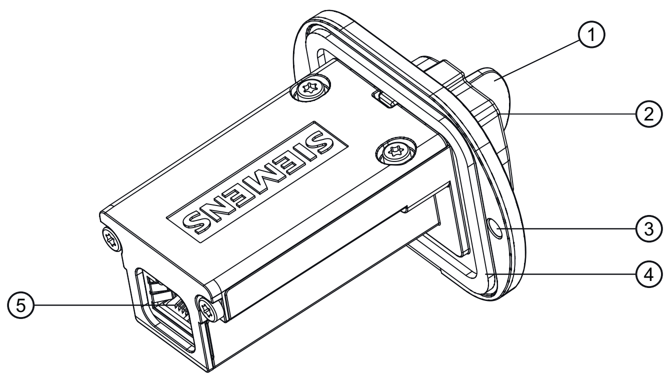
Table 11-4 DRIVE-CLiQ cabinet bushings

Description	Degree of protection according to IEC 60529	Article number
RJ45 socket	IP54 outside the control cabinet IP20 inside the control cabinet	6SL3066-2DA00-0AA0
M12 plug/socket Inside: Plug with male thread Outside: Socket with female thread	IP67 outside the control cabinet IP67 inside the control cabinet	6FX2003-0DT67

11.3.2 Interfaces and connections

11.3.2.1 DRIVE-CLiQ cabinet bushing for RJ45 plug

Description



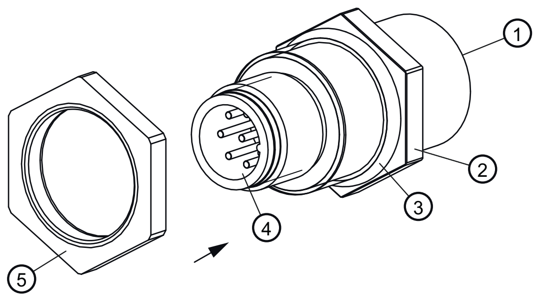
① Protective cap, Yamaichi, Article No.: Y-ConAS-24-S
② DRIVE-CLiQ interface outside
③ Fastening holes
④ Flange-type seal to ensure degree of protection IP54 on the outside of the control cabinet
⑤ DRIVE-CLiQ interface on the inside

Figure	Pin assignment	Technical data
②	DRIVE-CLiQ interface outside	To connect DRIVE-CLiQ signal cables MOTION-CONNECT with degree of protection IP54[1)]
⑤	DRIVE-CLiQ interface on the inside	To connect DRIVE-CLiQ signal cables MOTION-CONNECT with degree of protection IP20

1) To ensure that the complete outside of the cabinet bushing, including the DRIVE-CLiQ interface, has degree of protection IP54, a DRIVE-CLiQ cable must be used, which has at least degree of protection IP54.

11.3.2.2 DRIVE-CLiQ cabinet bushing for M12 plug/socket

Description



① DRIVE-CLiQ interface with M12 socket (8-pin)
② Flange, size 18
③ Seal (O-ring)
④ DRIVE-CLiQ interface with M12 plug (8-pin)
⑤ Nut, M16 x 1.5 / size 20, tightening torque: 3 ... 4 Nm (26.6 ... 35.4 lbf in)

Figure	Pin assignment	Technical data
①	DRIVE-CLiQ interface with M12 socket	8-pin to connect MOTION-CONNECT DRIVE-CLiQ signal cables with degree of protection IP67[1)]
④	DRIVE-CLiQ interface with M12 plug	

1) The IP67 degree of protection is only achieved with the DRIVE-CLiQ signal cables connected.

11.3.3 Dimension drawing

Dimension drawing

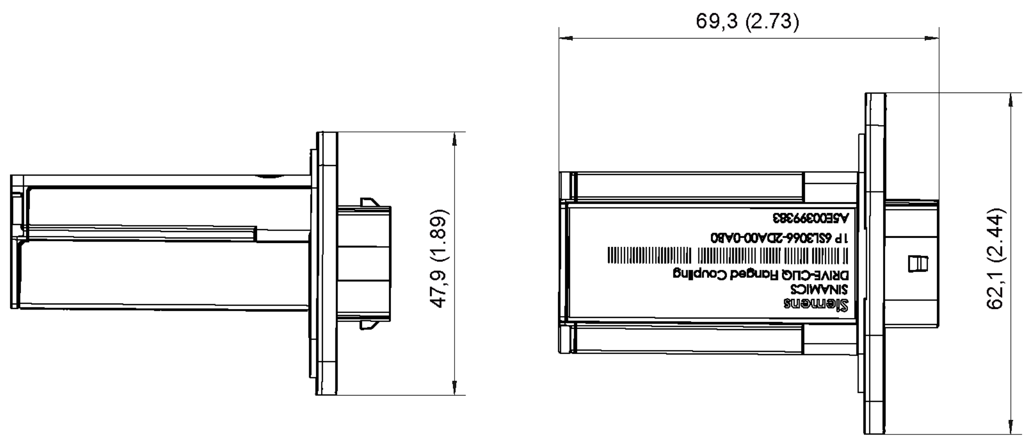


Figure 11-3 Dimension drawing, DRIVE-CLiQ cabinet bushing with RJ45 plug, all data in mm and (inch)

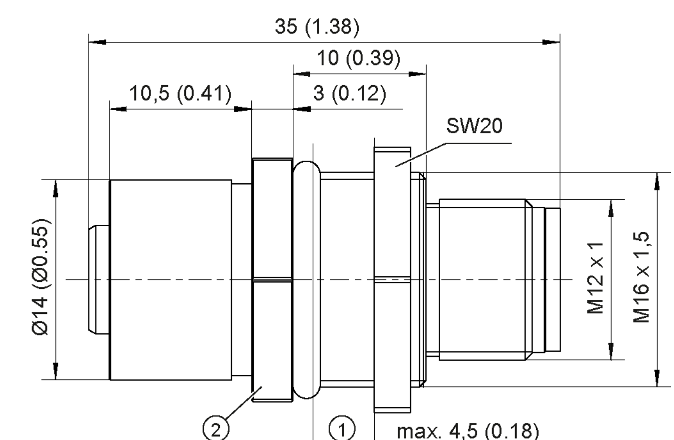


Figure 11-4 Dimension drawing, DRIVE-CLiQ cabinet bushing with M12 plug/socket, all data in mm and (inch)

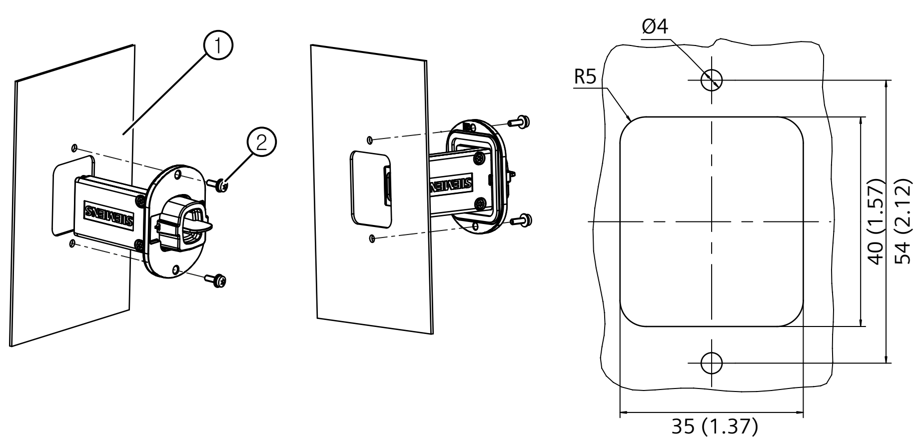
11.3.4 Installation

11.3.4.1 Installing the DRIVE-CLiQ cabinet bushing for RJ45 plug

Requirement

⚠ WARNING
Risk of injury as a result of foreign bodies in the device Parts (e.g.: drilling chips, end sleeves) falling into the device can cause short-circuits and damage the insulation. This can result in severe injury (arcing, loud bang, parts that are flung out). • Only perform installation and other work when the devices are current-free. • Cover the ventilation slots when mounting and installing the control cabinet and remove the cover before switching on.

Procedure



① Outside of the control cabinet

② M3 screw, tightening torque 0.8 Nm (7.1 lbf in)

Figure 11-5 Mounting and cutout in the control cabinet, all dimensions in mm and (inches)

Proceed as follows to install the DRIVE-CLiQ cabinet bushing in the control cabinet panel:

1. Prepare the cutout in the control cabinet.
2. Insert the DRIVE-CLiQ cabinet bushing from the outside of the control cabinet through the cutout in the control cabinet.
3. Attach the DRIVE-CLiQ cabinet bushing to the outside panel using 2 M3 screws and 2 nuts.
   - Tightening torque: 0.8 Nm (7.1 lbf in)
   - In order to ensure good electromagnetic compatibility, a good electrical connection must be established between the DRIVE-CLiQ cabinet bushing and the cabinet panel over a large surface area.

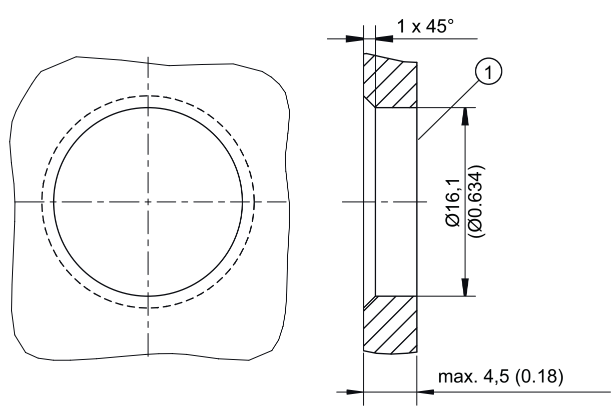
11.3.4.2 Installing the DRIVE-CLiQ cabinet bushing for M12 plug

Requirement

⚠ WARNING
Risk of injury as a result of foreign bodies in the device
Parts (e.g.: drilling chips, end sleeves) falling into the device can cause short-circuits and damage the insulation. This can result in severe injury (arcing, loud bang, parts that are flung out).
• Only perform installation and other work when the devices are current-free.
• Cover the ventilation slots when mounting and installing the control cabinet and remove the cover before switching on.

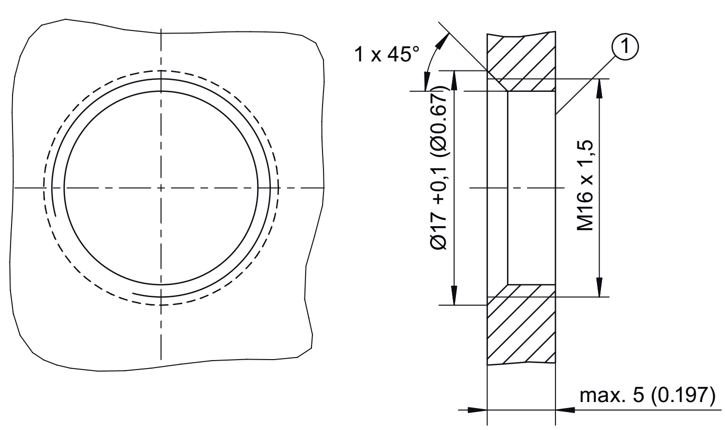
Installation wall thickness: max. 4.5 mm

Procedure



① Through-hole with chamfer

Figure 11-6 Drilling pattern for through-hole

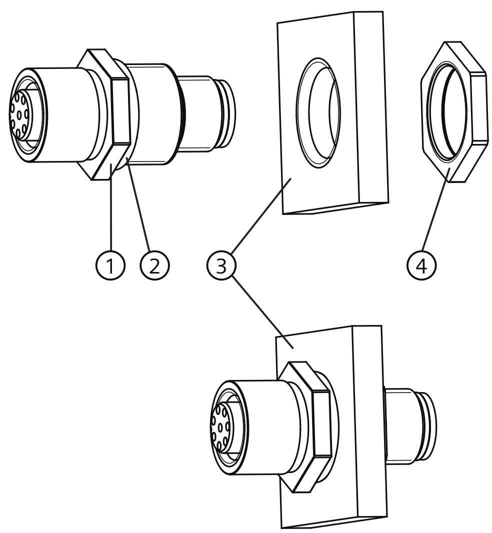


① Threaded hole with chamfer

Figure 11-7 Drilling pattern for threaded hole

Proceed as follows to install the DRIVE-CLiQ cabinet bushing in the cabinet panel:

1. Prepare the hole on the control cabinet.
2. Check that the seal (O-ring) is attached to the flange.
3. Insert the DRIVE-CLiQ cabinet bushing from the outside of the control cabinet through the cutout in the control cabinet.
   – Through-hole: Attach the DRIVE-CLiQ cabinet bushing by tightening the nut with a tightening torque of 3 ... 4 Nm (26.6 ... 35.4 lbf in) on the inside of the control cabinet.
   – Threaded hole: Screw the DRIVE-CLiQ cabinet bushing into place. The nut supplied is not required for this mounting type.



① Flange, size 18
② Seal (O-ring)
③ Cabinet panel
④ Nut, M16 x 1.5 / size 20, tightening torque: 3 ... 4 Nm (26.6 ... 35.4 lbf in)

Figure 11-8 Example: Installing the DRIVE-CLiQ cabinet bushing with a through-hole

11.3.5 Technical data

Technical data

Table 11-5 DRIVE-CLiQ cabinet bushing

Feature	Unit	6SL3066-2DA00-0AA0	6FX2003-0DT67
Weight	kg	0.165	0.035
Degree of protection	-	IP54 outside the control cabinet IP20 inside the control cabinet	IP67

11.3.6 Order data

Connecting DRIVE-CLiQ components		
Name	**Connector type and degree of protection**	**Article number**
DRIVE-CLiQ cabinet bushing for DRIVE-CLiQ signal cables	with RJ45 plug	6SL3066-2DA00-0AA0
	with M12 plug/socket	6FX2003-0DT67

11.4 DC link adapter

11.4.1 Overview

Overview diagram

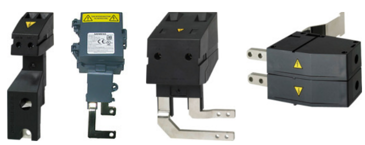


Figure 11-9 DC link adapters 43 A, 72 A, 200 A and 150/200 A

Article number	Technical data	Used for Line Modules / Motor Modules, width
6SL3162-2BD00-0AA0	Rated current: 43 A	50 mm, 100 mm
6SL3162-2BE00-0AA0	Rated current: 72 A	100 mm
6SL3162-2BM00-0AA0	Rated current: 200 A	150 mm, 200 mm
6SL3162-2BM01-0AA0	Rated current: 150 A/200 A	50 mm ... 200 mm (for multi-tier configuration)

11.4.2 Safety instructions

WARNING

Electric shock due to the residual charge of the DC link capacitors

Because of the DC link 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.

- Do not open the protective flap of the DC link until 5 minutes have elapsed.
- Verify that the DCP and DCN DC link terminals are de-energized before starting any work.

WARNING

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

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

- Only operate the components with closed protective flap.

WARNING

Electric shock due to improper DC link connection

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

- When connecting to the DC link, only use the adapter that has been approved by Siemens (DC link adapter).

WARNING

Electric shock due to missing DC link side covers

Live parts are exposed if the DC link side covers are not fitted. Contact could give you an electric shock.

- Mount the side covers on the first and last component in the drive line-up.
- Order any missing side covers (Article number: 6SL3162-5AA00-0AA0).

WARNING

Electric shock if the cutout in the protective flap has been broken out

Live components are exposed and accessible if the DC link adapters are removed. Contact with live parts can result in death or serious injury.

- Replace the protective flap with the broken out cutouts with a new protective flap.

WARNING

Electric shock or fire if the necessary clearances and creepage distances are not complied with

When using end sleeves without protective collar, the required clearances and creepage distances for the DC link adapter (6SL3162-2BD00-0AA0, 6SL3162-2BM01-0AA0) are not complied with. This can result in flashover between the cables and the undesirable formation of arcs. As a consequence, there is a risk of electric shock and fire.

- Only use DC link connecting cables with end sleeves with protective collars.

WARNING

Fire and device damage as a result of ground fault/short-circuit

The DC link connecting cables must be laid so that a ground fault or short-circuit is impossible. A ground fault can cause a fire with smoke development.

- Comply with local installation regulations, which allow this fault to be ruled out.
- Protect the cables against mechanical damage.

Also implement one of the following measures:

- Use cables with double insulation.
- Maintain adequate clearance, e.g. by using spacers.
- Lay the cables in separate cable ducts or conduits.

WARNING

Fire due to overheating when permissible power cable lengths are exceeded

Excessively long power cable lengths can cause components to overheat with the associated risk of fire and smoke.

- Ensure that the total length of the DC link including the connecting cables does not exceed 10 m.

WARNING

Electric shock due to incorrectly laid 24 V supply cables

If supply cables are laid without safe electrical separation, the insulation can fail with an electric shock.

- Maintain a clearance of at least 100 mm between the 24 V supply cables and the DC link connecting cables.
- Or use cables with double insulation (e.g. sheathed cables) for the 24 V supply cables.

WARNING

Fire as a result of incorrectly dimensioned overcurrent protective devices in the DC link connecting cable

Incorrectly dimensioned overcurrent protective devices can result in a fire and associated smoke.

- Protect personnel and prevent fires by dimensioning the overcurrent protective devices in the DC link connecting cable corresponding to the particular application.
- Comply with local installation regulations.
- Carefully check the overcurrent protective device to ensure that it functions perfectly, and maintain it regularly in accordance with local installation regulations.

11.4.3 43 A DC link adapter

11.4.3.1 Description

Overview

The 43 A DC link adapter is used to directly supply the DC link voltage. It is preferably used for supplying an individual component. For a direct infeed, each component is connected to the DC link separately and the DC link busbars are not connected.

Overview diagram

Figure 11-10 43 A DC link adapter

Article number	Technical data
6SL3162-2BD00-0AA0	Rated current: 43 A

11.4.3.2 Dimension drawing

Dimension drawing

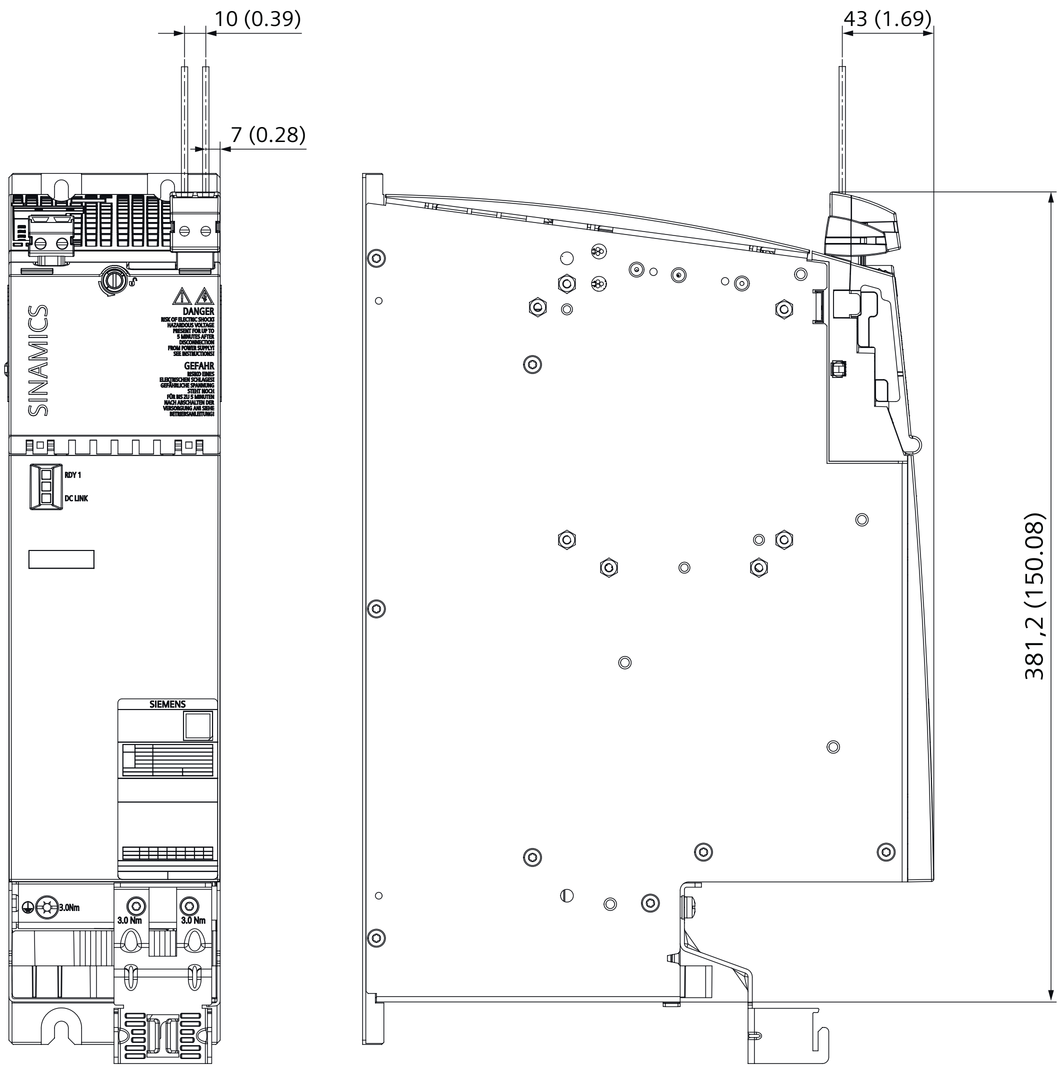


Figure 11-11 Dimension drawing of a 100 mm wide component (Motor Module) with 43 A DC link adapter, all dimensions in mm and (inch)

11.4.3.3 Connectable cable cross-sections

Description

Table 11-6 Connection cross-sections of the cable for the DC link adapter 43 A

Feature	Cable cross-sections
Cable cross-sections	Single core connection: 0.5 ... 10 mm^2 (AWG 20 ... 6)
Stripped length	11 mm

11.4.3.4 Mounting the DC link adapter

Requirement

You can use the DC link adapter to supply one or several components. If you use the DC link adapter to supply several components that are mounted directly adjacent to one another, then the following requirements apply to the installation:

- The component line-up is established to the left.
- The DC link adapter must be mounted onto the component at the far right.

Required tools:

- Slotted screwdriver 1.0 x 5.5 mm to release the protective flap
- Torx screwdriver TX 20
- Torx screwdriver TX 10 to fasten the DC link adapter
- Pliers for breaking out the cutout

Procedure

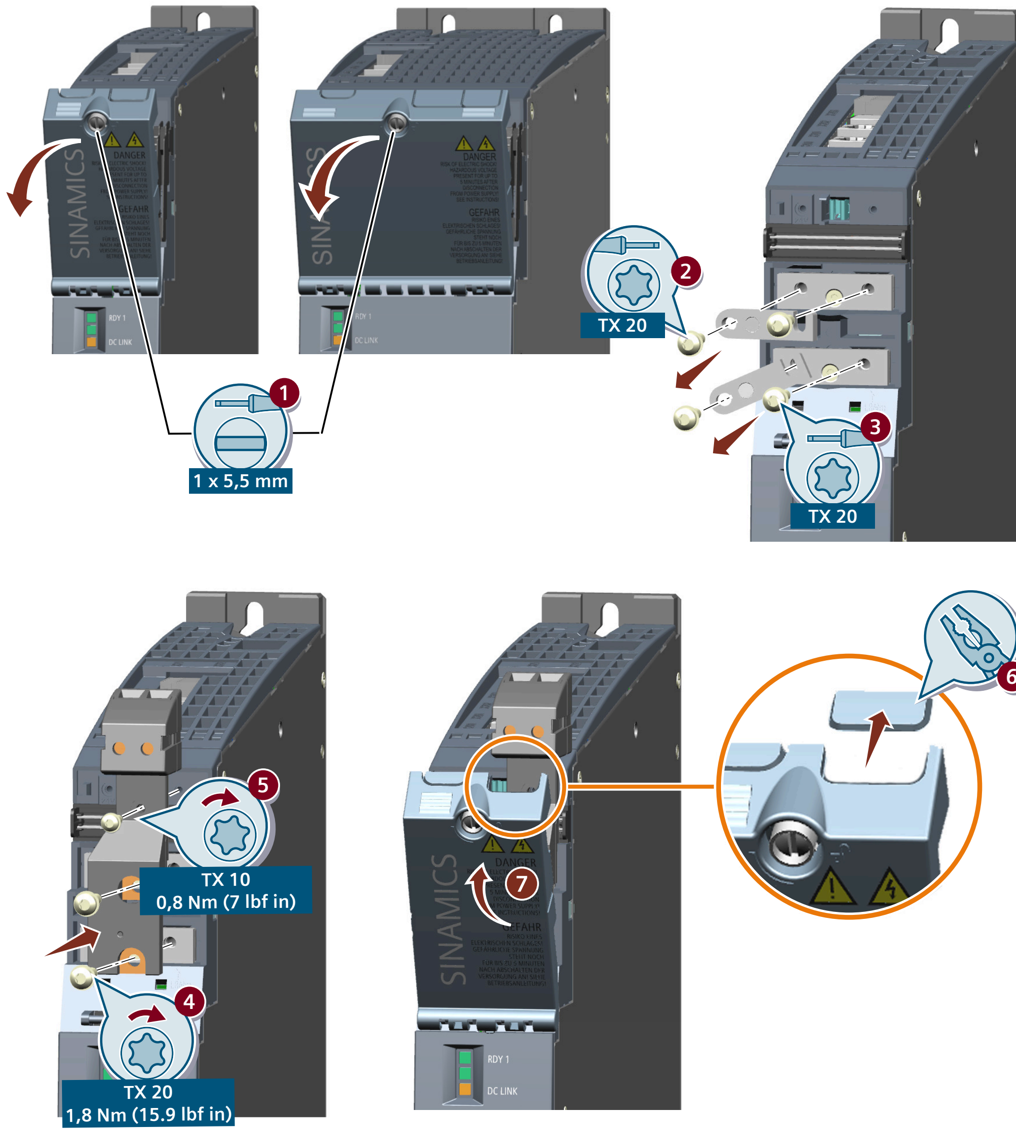


Figure 11-12 Mounting the 43 A DC link adapter

Proceed as follows to mount the DC link adapter:

1. Release and open the protective flap. Slotted screwdriver 1.0 x 5.5 mm
2. Remove the upper and lower left-hand screws and the two DC link bridges. Torx screwdriver TX 20
3. Remove the upper and lower right-hand DC link screws. Torx screwdriver TX 20
4. Install the DC link adapter on the right-hand side of the component and screw it in using the previously removed M4x20 DC link screws. Torx screwdriver TX 20. Tightening torque: 1.8 Nm (15.9 lbf in)
5. Fasten the DC link adapter using the screw provided. Torx screwdriver TX 10. Tightening torque: 0.8 Nm (7.1 lbf in)

6. Using pliers, break out the cutout in the protective flap.
7. Close the protective flap until you hear it snap into place.

11.4.3.5 Connecting cables

Requirement

The following requirements apply when connecting the cables to the DC link adapter:

- Dimension the cross-section of the connecting cables according to the current demand of all connected components.
- Appropriately protect the connecting cables.

Required tools:

- Slotted screwdriver 0.8 x 4.0 mm

Procedure

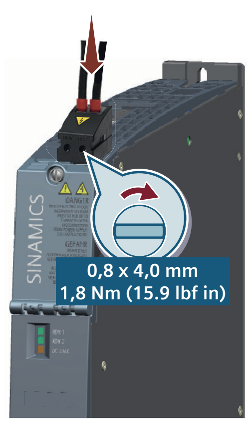


Figure 11-13 Connecting cables to the 43 A DC link adapter

Proceed as follows to connect the cables to the DC link adapter:

Attach the DC link connecting cables to the DC link adapter. Slotted screwdriver 0.8 x 4.0 mm. Tightening torque: 1.8 Nm (15.9 lbf in)

11.4.3.6 Technical data

Technical data

Table 11-7 DC link adapter 43A (6SL3162-2BD00-0AA0)

Feature	Unit	Value
Supply voltage	V	495 ... 720
Continuous current-carrying capacity at 55 °C	A	43

Feature	Unit	Value
Maximum ambient temperature	°C	55
DC link connection		Slotted screwdriver 0.8 x 4.0
Tightening torque	Nm (lbf in)	1.8 (15.9)
DC link busbars		
Fixing screw		Torx-slotted screw TX 20
Tightening torque	Nm (lbf in)	1.8 (15.9)
DC link adapter		
Fixing screw		Torx-slotted screw TX 10
Tightening torque	Nm (lbf in)	0.8 (7.1)
Weight	kg	0.05

11.4.4 72 A DC link adapter

11.4.4.1 Description

Overview

The 72 A DC link adapter is used to directly supply the DC link voltage. It is preferably used for supplying an individual component. For a direct infeed, each component is connected to the DC link separately and the DC link busbars are not connected.

Overview diagram

Figure 11-14 72 A DC link adapter

Article number	Technical data
6SL3162-2BE00-0AA0	Rated current: 72 A

11.4.4.2 Dimension drawing

Dimension drawing

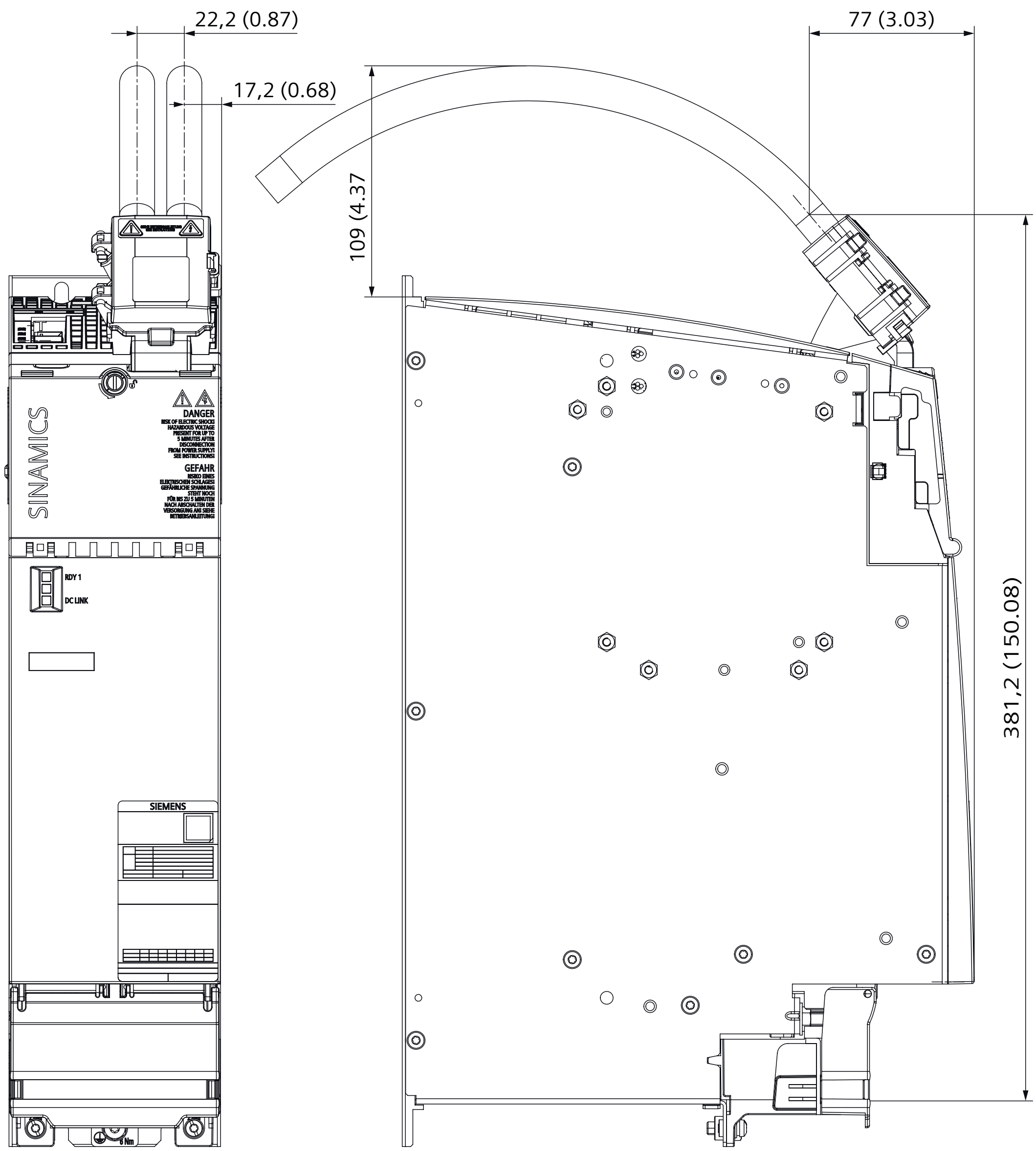


Figure 11-15 Dimension drawing of a 100 mm wide component (Motor Module) with 72 A DC link adapter, all dimensions in mm and (inch)

11.4.4.3 Connectable cable cross-sections

Description

Table 11-8 Connection cross-sections of the cable for the DC link adapter 72 A

Feature	Cable cross-sections
Cable cross-sections	Single core connection: 10 ... 35 mm² (AWG 8 ... 2)
Stripped length	According to the cable lug

11.4.4.4 Selecting cable lugs

Description

Here you can see the dimensions of the DC link adapter for selecting the ring or pipe-type cable lug.

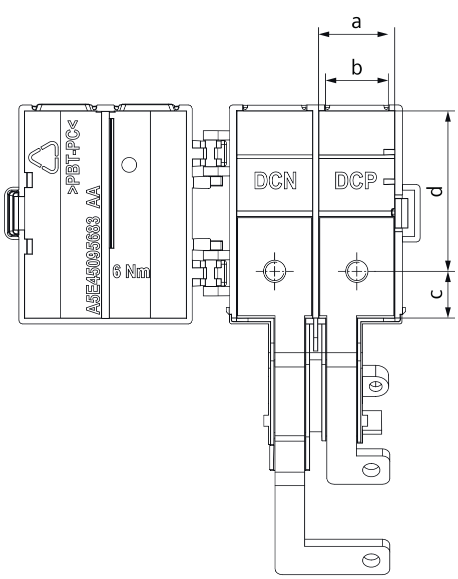


Figure 11-16 Mounting the 72 A DC link adapter

Table 11-9 Dimensions of the DC link adapter 72 A in mm (inch)

	a	b	c	d
Maximum dimensions	20.4 (0.8)	17 (0.67)	12.6 (0.5)	43.4 (1.71)

For UL applications, only use UL-approved ring or pipe-type cable lugs (ZMVV) certified for the particular voltage. The permissible current must be at least 125% of the input or output current. Use the higher value as basis.

11.4.4.5 Mounting the DC link adapter

Requirement

You can use the DC link adapter to supply one or several components. If you use the DC link adapter to supply several components that are mounted directly adjacent to one another, then the following requirements apply to the installation:

- The component line-up is established to the left.
- The DC link adapter must be mounted onto the component at the far right.

Required tools:

- Slotted screwdriver 1.0 x 5.5 mm to release the protective flap
- Torx screwdriver TX 20
- Torx screwdriver TX 10 to fasten the DC link adapter
- Pliers for breaking out the cutout

Procedure

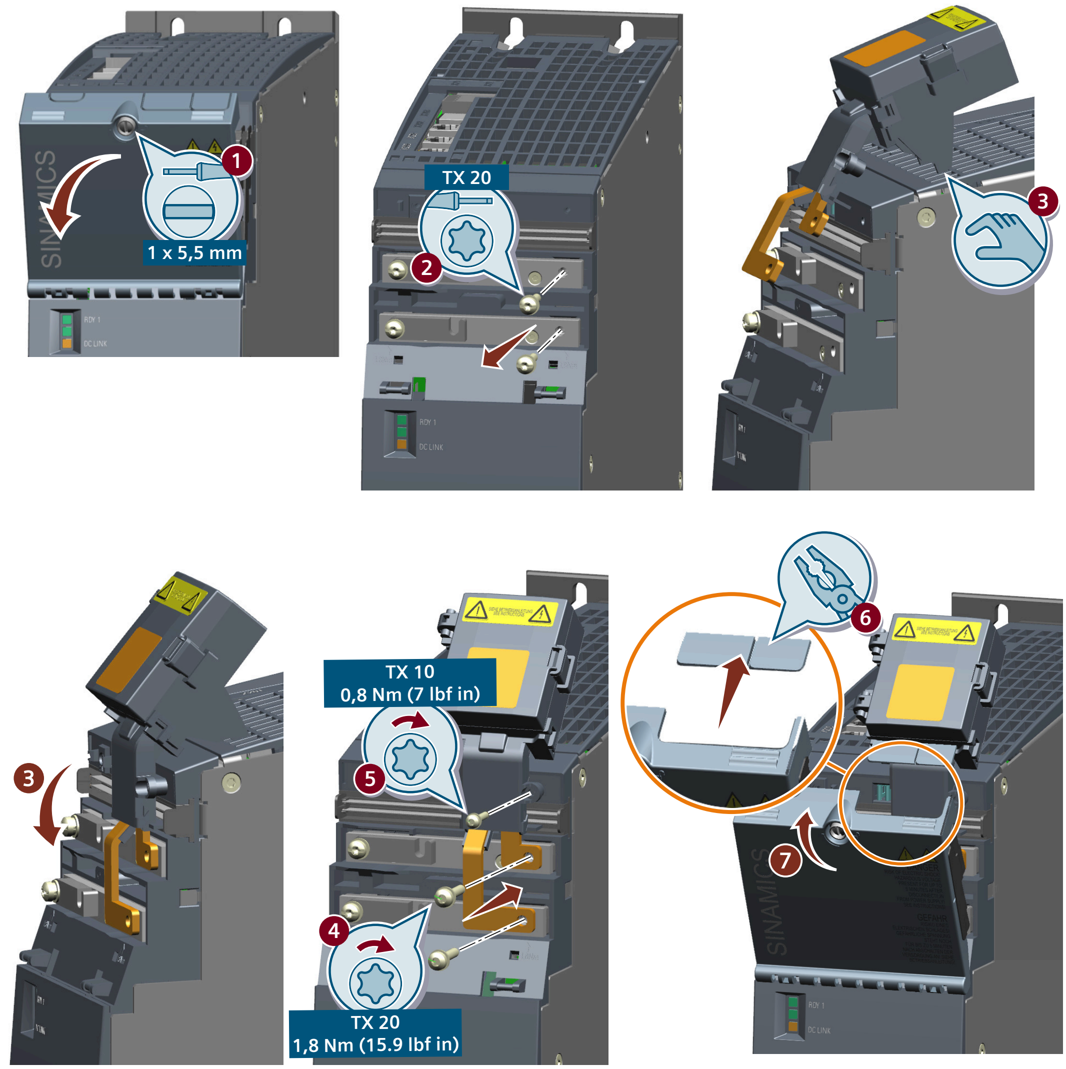


Figure 11-17 Mounting the 72 A DC link adapter

Proceed as follows to mount the DC link adapter:

1. Release and open the protective flap. Slotted screwdriver 1.0 x 5.5 mm
2. Remove the upper and lower right-hand DC link screws. Torx screwdriver TX 20
3. Engage the DC link adapter in the grille and press it downward.
4. Screw the DC link adapter onto the right-hand side of the component using the previously removed M4x20 DC link screws. Torx screwdriver TX 20. Tightening torque: 1.8 Nm (15.9 lbf in)
5. Fasten the DC link adapter using the screw provided. Torx screwdriver TX 10. Tightening torque: 0.8 Nm (7.1 lbf in)
6. Using pliers, break out the cutout in the protective flap.
7. Close the protective flap until you hear it snap into place.

11.4.4.6 Connecting cables

Requirement

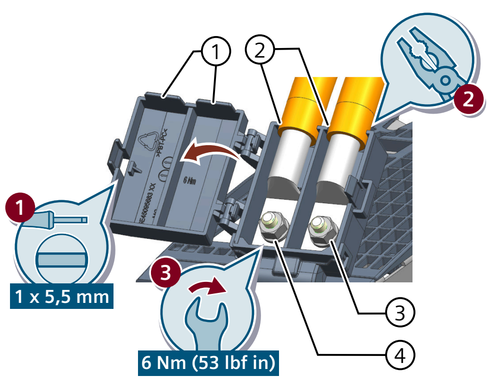
The following requirements apply when connecting the cables to the DC link adapter:

- Dimension the cross-section of the connecting cables according to the current demand of all connected components.
- Appropriately protect the connecting cables.
- Use shrink-on sleeves to maintain touch protection for all non-insulated, live parts of cable lugs and cables with a clearance to studs exceeding 32 mm (1.26 inch).

Required tools:

- Slotted screwdriver 1.0 x 5.5 mm to release the protective flap
- Pliers for breaking out the cutout
- Socket wrench size 10

Procedure



① Cutouts on the upper side of the housing (cover)
② Cutouts on the lower side of the housing (in this case, already broken out)
③ DCP
④ DCN

Figure 11-18 Connecting cables to the 72 A DC link adapter

Proceed as follows to connect the cables to the DC link adapter:

1. Attach a ring/pipe-type cable lug to the cables.
2. Open the cover of the DC link adapter using a slotted screwdriver 1.0 x 5.5 mm.

3. Break out the cutouts.
   - The cutouts on the lower side of the housing must be broken out for all cable cross-sections.
   - The cutouts at the upper side of the housing may only be broken out for larger cable cross-sections.
4. Using a socket wrench, size 10, connect the DC link adapter connecting cables to the terminal studs using M6 nuts. Tightening torque: 6 Nm (53 lbf in)

11.4.4.7 Technical data

Technical data

Table 11-10 DC link adapter 72A (6SL3162-2BE00-0AA0)

Feature	Unit	Value
Supply voltage	V	495 ... 720
Continuous current-carrying capacity at 55 °C	A	72
Maximum ambient temperature	°C	55
DC link connection Tightening torque	 Nm (lbf in)	Threaded bolts M6 6 (53)
DC link busbars Fixing screw Tightening torque	 Nm (lbf in)	 Torx-slotted screw TX 20 1.8 (15.9)
DC link adapter Fixing screw Tightening torque	 Nm (lbf in)	 Torx-slotted screw TX 10 0.8 (7.1)
Weight	kg	0.10

11.4.5 DC link adapter 200 A

11.4.5.1 Description

Overview

The 200 A DC link adapter is used to directly supply the DC link voltage. It is preferably used for supplying an individual component. For a direct infeed, each component is connected to the DC link separately and the DC link busbars are not connected.

Overview diagram

Figure 11-19 DC link adapter 200 A

Article number	Technical data
6SL3162-2BM00-0AA0	Rated current: 200 A

11.4.5.2 Dimension drawing

Dimension drawing

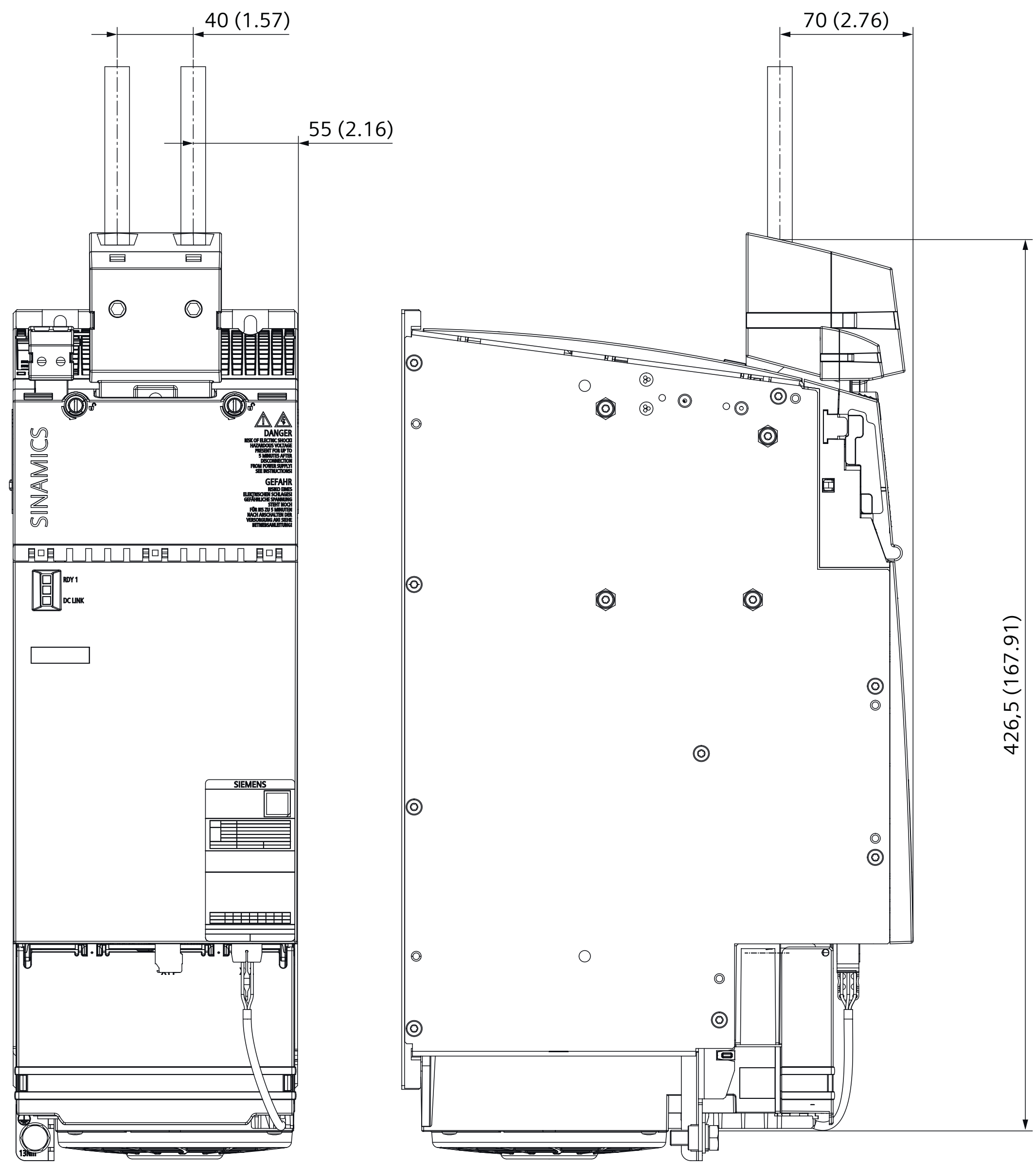


Figure 11-20 Dimension drawing of a 150 mm wide component (Motor Module) with 200 A DC link adapter, all dimensions in mm and (inch)

11.4.5.3 Connectable cable cross-sections

Description

Table 11-11 Conductor cross-sections of the cable for the DC link adapter 200 A

Feature	Cable cross-sections
Cable cross-sections	Single core connection: 35 ... 120 mm^2 (finely stranded) (AWG 4 ...4/0)
Stripped length	27 mm

11.4.5.4 Mounting the DC link adapter

Requirement

You can use the DC link adapter to supply one or several components. If you use the DC link adapter to supply several components that are mounted directly adjacent to one another, then the following requirements apply to the installation:

- The component line-up is established to the left.
- The DC link adapter must be mounted onto the component at the far right.

Required tools:

- Slotted screwdriver 1.0 x 5.5 mm to release the protective flap
- Torx screwdriver TX 20
- Torx screwdriver TX 10 to fasten the DC link adapter
- Pliers for breaking out the cutout

Procedure

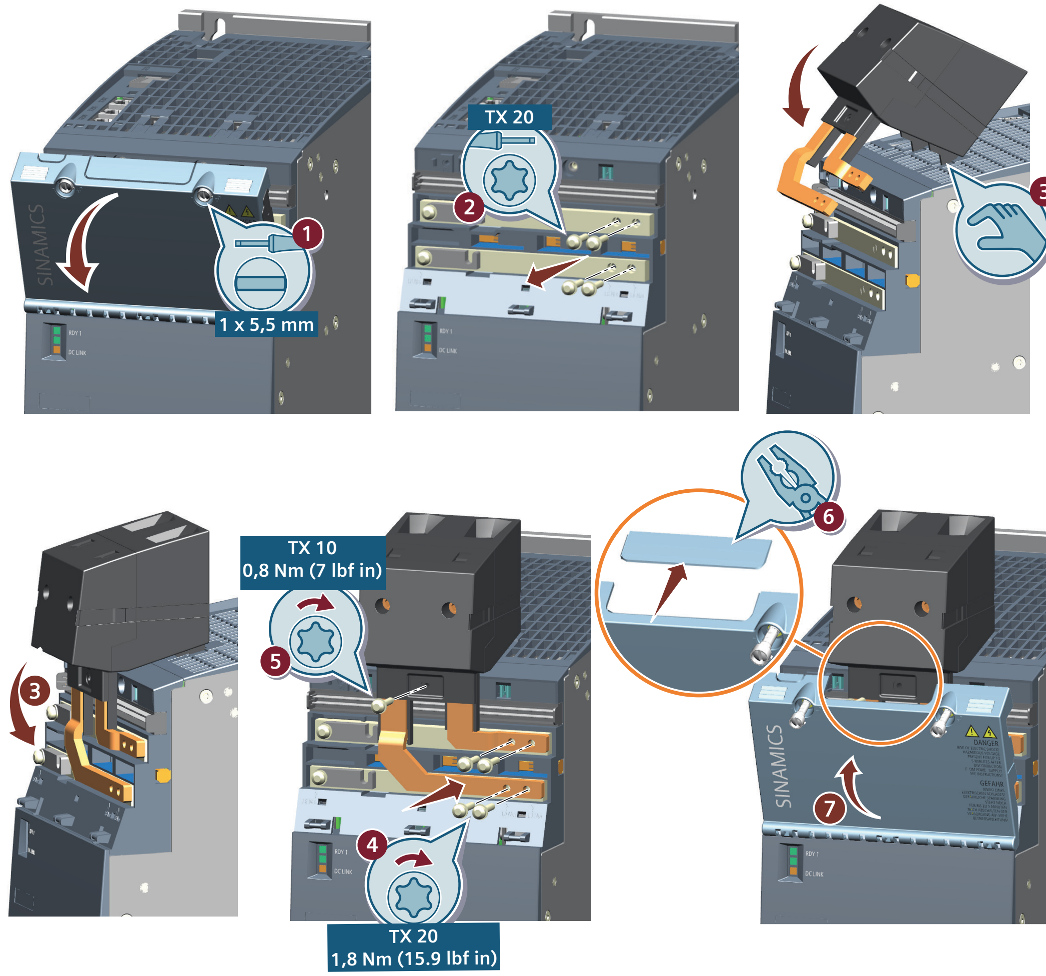


Figure 11-21 Mounting the 200 A DC link adapter

Proceed as follows to mount the DC link adapter:

1. Release and open the protective flap. Slotted screwdriver 1.0 x 5.5 mm
2. On the right-hand side of the component, remove the 2 upper and 2 lower DC link screws. Torx screwdriver TX 20
3. Engage the DC link adapter in the grille and press it downward.
4. Screw the DC link adapter onto the right-hand side of the component using the 4 previously removed M4x20 DC link screws. Torx screwdriver TX 20. Tightening torque: 1.8 Nm (15.9 lbf in)
5. Fasten the DC link adapter using the screw provided. Torx screwdriver TX 10. Tightening torque: 0.8 Nm (7.1 lbf in)
6. Using pliers, break out the cutout in the protective flap.
7. Close the protective flap until you hear it snap into place.

11.4.5.5 Connecting cables

Requirement

The following requirements apply when connecting the cables to the DC link adapter:

- Dimension the cross-section of the connecting cables according to the current demand of all connected components.
- Appropriately protect the connecting cables or route the connecting cables so that a short-circuit or ground fault is completely ruled out.

Required tools:

- Allen key size 6

Procedure

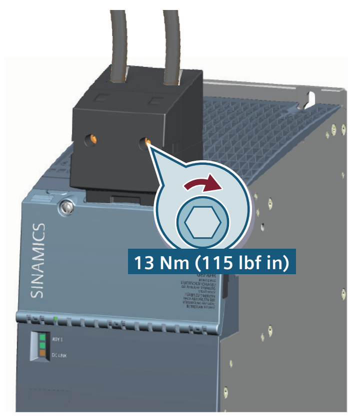


Figure 11-22 Connecting cables to the 200 A DC link adapter

Proceed as follows to connect the cables to the DC link adapter:

Attach the DC link connecting cables to the DC link adapter. Allen key size 6. Tightening torque: 13 Nm (115 lbf in)

11.4.5.6 Technical data

Technical data

Table 11-12 DC link adapter 200 A (6SL3162-2BM00-0AA0)

Feature	Unit	Value
Supply voltage	V	495 ... 720
Continuous current-carrying capacity at 55 °C	A	200
Maximum ambient temperature	°C	55
DC link connection Tightening torque	 Nm (lbf in)	Hexagon socket head screw size 6 13 (115)

Feature	Unit	Value
DC link busbars		
Fixing screw		Torx-slotted screw TX 20
Tightening torque	Nm (lbf in)	1.8 (15.9)
DC link adapter		
Fixing screw		Torx-slotted screw TX 10
Tightening torque	Nm (lbf in)	0.8 (7.1)
Weight	kg	0.48

11.4.6 DC link adapter for a multi-tier configuration

11.4.6.1 Description

Overview

DC link adapter 150 A/200 A is required to feed-in the DC link voltage if the drive line-up is distributed over two or more tiers.

Overview diagram

Figure 11-23 DC link adapter for a multi-tier configuration (150/200 A)

Article number	Technical data
6SL3162-2BM01-0AA0	Rated current: 150 A/200 A

This DC link adapter is supplied in unit quantities of 2.

11.4.6.2 Dimension drawing

Dimension drawing

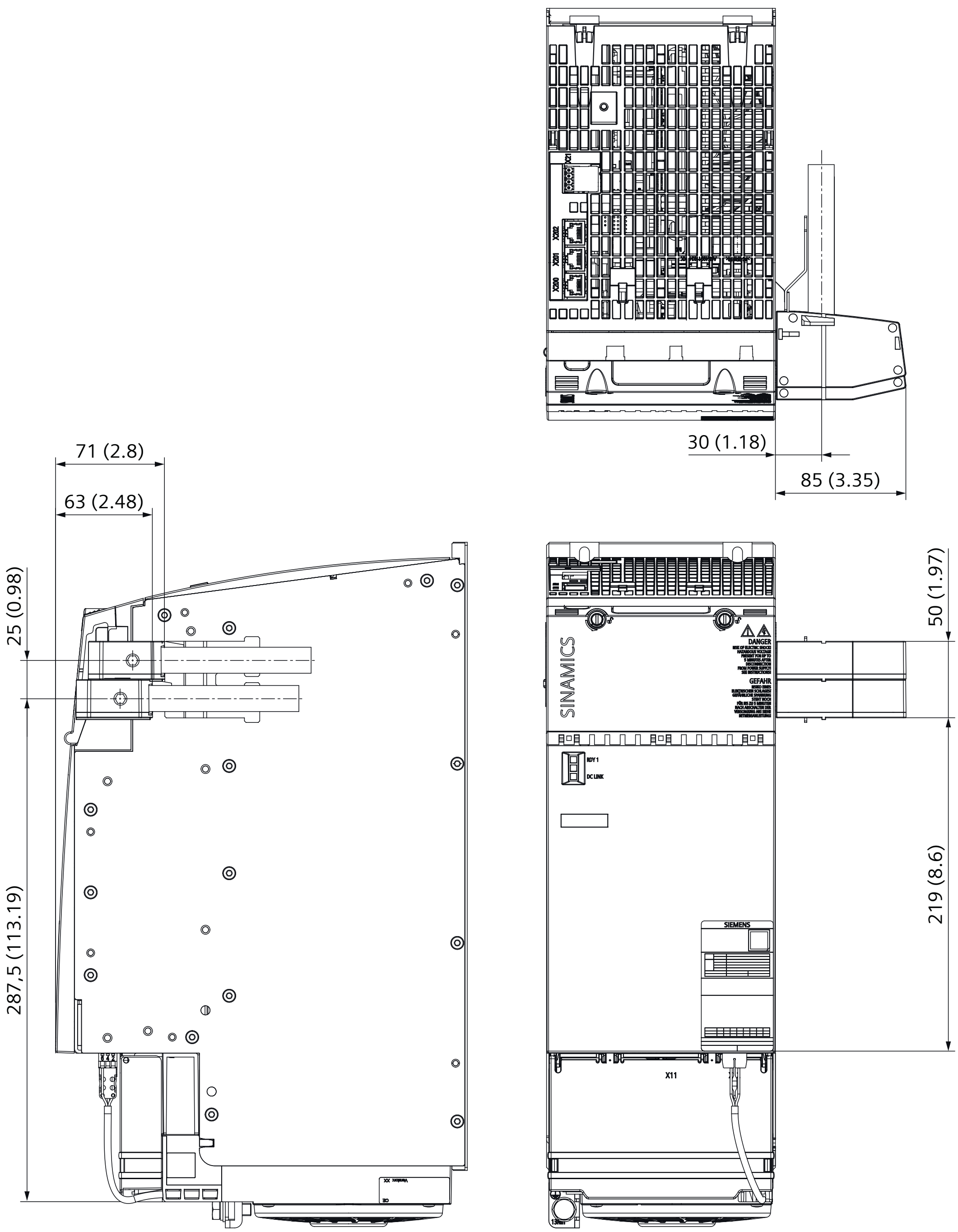


Figure 11-24 Dimension drawing of a 150 mm wide component (Motor Module) with 150/200 A DC link adapter, all dimensions in mm and (inch)

11.4.6.3 Connectable cable cross-sections

Description

Table 11-13 Conductor cross-sections of the cable for the multi-tier DC link adapter 150/200 A

Feature	Cable cross-sections
Cable cross-sections	Single core connection: 35 ... 120 mm² (AWG 4 ...4/0)
Stripped length	27 mm

11.4.6.4 Mounting types of the DC link adapter

Overview

Various options are available to mount the DC link adapter for a multi-tier configuration. These depend on the width of the components used as well as how the drive line-up is configured.

Requirement

NOTICE
Damage when mounting using 2 screws
For DC link adapters that are mounted using 2 screws, currents above 150 A result in a high temperature rise. This can damage the DC link adapter and the component. • You must limit the current to 150 A if the DC link adapter is mounted using 2 screws.

Description

Depending on the configuration of the drive line-up, the DC link adapter can be mounted onto the component to the far left or to the far right.

Depending on the mounting side and width of the component, 2 or 4 screws are available for mounting:

Mounting left	Mounting right	Number of screws
Modules 50 mm - 200 mm	Modules 50 mm, 100 mm	2
-	Modules 150 mm, 200 mm	4

11.4.6.5 Mounting the DC link adapter (2 screws)

Overview

For a multi-tier configuration, if you wish to mount the DC link adapter on the left-hand side of the drive line-up or - for a 50 mm or 100 mm wide component - on the right-hand side, then it is mounted using 2 screws.

Requirement

⚠ WARNING
Electric shock when touching the DC link busbars Contact with live parts can result in death or serious injury. • When mounting the DC link adapter using 2 screws, it is crucial that you only use the two inside holes of the adapter busbars, so that after the protective flap is closed, the DC link busbars cannot protrude and can be touched.

⚠ WARNING
Electric shock due to incorrectly installed DC link bridges Incorrectly installed DC link bridges at the left-hand end of the drive lineup can cause an electric shock. • Remove for all 50 mm wide components (exception: Smart Line Modules) the DC link bridges including the screws (as here, the DC link bridge cannot be swung inward). Do not screw in the screws without DC link bridges. • For all other components, you must neither swing the DC link bridge to the left out of the component nor remove it, as the DC link bridge ensures the mechanical stability of the DC link busbars.

To use a DC link adapter, the following requirements apply to the installation:

- The component line-up has a two or multi-tier configuration.
- The DC link adapter is supplied with shims. These are required for SINAMICS S120 booksize components, and are not relevant for mounting on SINAMICS S220 booksize components.

Required tools:

- Slotted screwdriver 1.0 x 5.5 mm to release the protective flap
- Torx screwdriver TX 20

Procedure

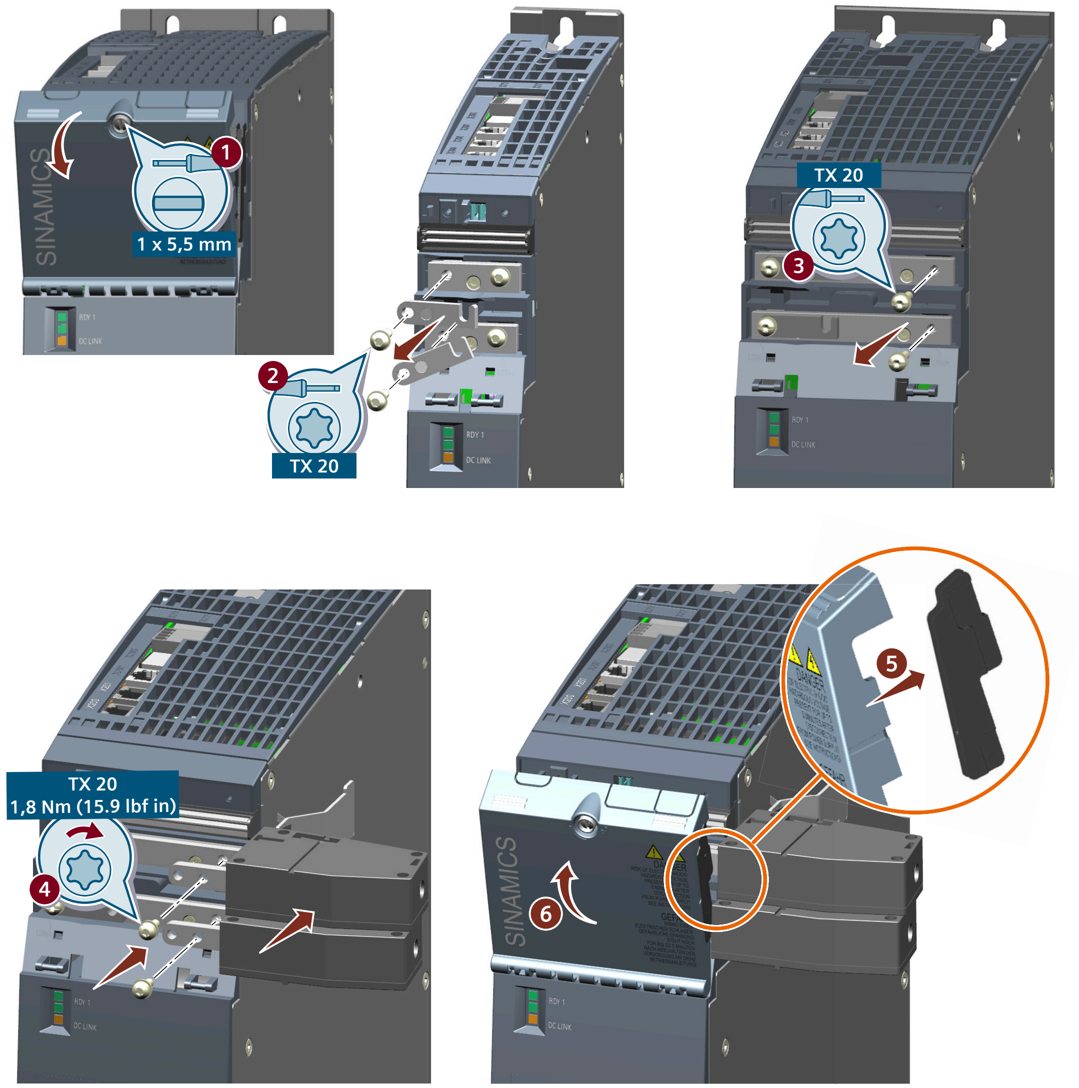


Figure 11-25 Mounting a DC link adapter for a multi-tier configuration (2 screws)

Proceed as follows to mount the DC link adapter:

1. Release and open the protective flap. Slotted screwdriver 1.0 x 5.5 mm
2. For a 50 mm wide component, remove the upper and lower left-hand screws and the two DC link bridges. Torx screwdriver TX 20
3. On the required side of the component, remove the upper and lower DC link screws. Torx screwdriver TX 20
4. Install the DC link adapter at this position and screw it in using the previously removed 2 x M4x20 DC link screws. Torx screwdriver TX 20. Tightening torque: 1.8 Nm (15.9 lbf in)
   - When using 2 screws for mounting, the two holes on the inside of the adapter busbar must be used

5. Remove the side covers from the protective flap
6. Close the protective flap until you hear it snap into place.

11.4.6.6 Mounting the DC link adapter (4 screws)

Overview

For a multi-tier configuration, if you wish to mount the DC link adapter on the right-hand side of a 150 mm or 200 mm wide component, then it is mounted using 4 screws.

Requirement

To use a DC link adapter, the following requirements apply to the installation:

- The component line-up has a two or multi-tier configuration.
- The DC link adapter is supplied with shims. These are required for SINAMICS S120 booksize components, and are not relevant for mounting on SINAMICS S220 booksize components.

Required tools:

- Slotted screwdriver 1.0 x 5.5 mm to release the protective flap
- Torx screwdriver TX 20

Procedure

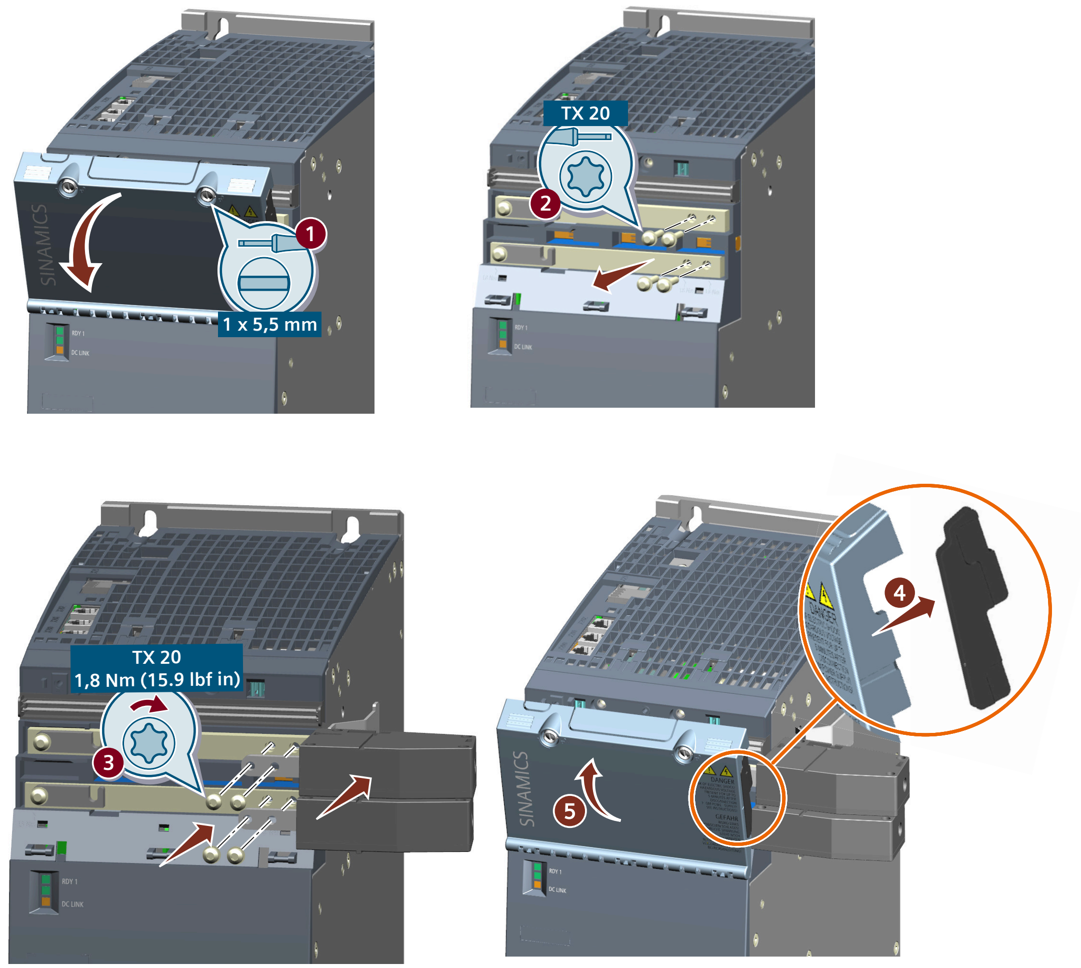


Figure 11-26 Mounting a DC link adapter for a multi-tier configuration (4 screws)

Proceed as follows to mount the DC link adapter:

1. Release and open the protective flap. Slotted screwdriver 1.0 x 5.5 mm
2. On the right-hand side of the component, remove the 2 upper and 2 lower DC link screws. Torx screwdriver TX 20
3. Install the DC link adapter at this position and screw it in using the previously removed 4 x M4x20 DC link screws. Torx screwdriver TX 20. Tightening torque: 1.8 Nm (15.9 lbf in)
4. Remove the side covers from the protective flap
5. Close the protective flap until you hear it snap into place.

11.4.6.7 Preparing cables

Overview

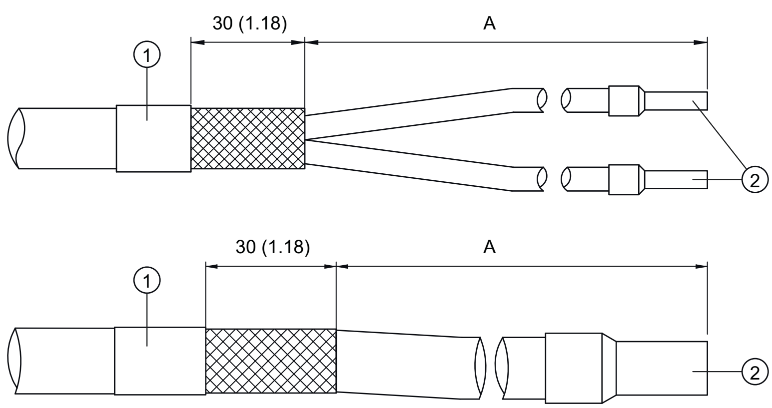
DC link adapters in a two or multi-tier configuration are connected with one another using DC link connecting cables. Assemble these first.

Requirement

The following apply when connecting the cables to the DC link adapter:

- Dimension the cross-section of the connecting cables according to the current demand of all connected components.
- Only use shielded cables with end sleeves.
- Appropriately protect the connecting cables.

Procedure



① Protective braided shield folded back and fixed using a shrink-on sleeve
② End sleeves with protective collar

Figure 11-27 Single-core and two-core cables, all dimensions in mm and (inch)

Connection	Unit	A
DCP connection (= upper connection of the DC link adapter)	mm	60
DCN connection (= lower connection of the DC link adapter)	mm	70

To connect the cables to the DC link adapter, prepare the two cables as follows:

1. Remove the appropriate length of cable sheath for the DCP connection and the DCN connection according to the table above.
2. Fold back the protective braided shield.
3. Fix the protective braided shield. Preferably use a shrink-on sleeve with hot melt adhesive.
4. Shorten the single cores.
5. Strip the insulation from the single cores.

11.4.6.8 Connecting cables

Overview

Now connect the DC link connecting cables to the DC link adapter and connect the cable shield.

Requirement

NOTICE
EMC contact springs on the shield support of the DC link adapter
When connecting the cables it is possible that the EMC contact springs (these are located on the shield support of the DC link adapter) are no longer properly in contact with the side panel of the component. • After installing the cables, ensure that the EMC contact springs of the shield support of the DC link adapter are in contact (large surface area/low impedance) with the side panel of the component.

The following requirements apply when connecting the cables to the DC link adapter:

- Fix the cables directly next to the last component at the rear control cabinet panel.
- Use C-mounting rails for attaching cables to the control cabinet panel.
- Use suitable cable clamps to fasten the cables to the C-mounting rail.
- Use suitable hose clamps to fasten the cable shields to the shield support of the DC link adapter.
- The clearance between the C mounting rail and the lower side of the component must be approximately 125 mm.
- Use conductor end sleeves according to DIN 46228 with the appropriate cross-section.
- Appropriately protect the connecting cables.

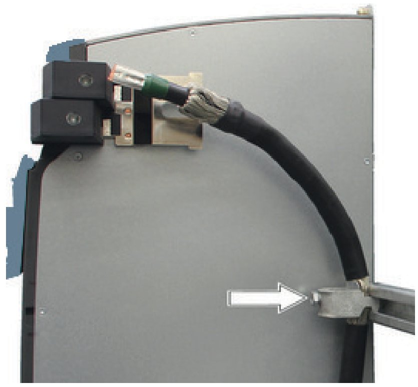
Required tools:

- Allen key size 6
- Suitable tool for hose clamps, e.g. slotted screwdriver

Procedure

Proceed as follows to connect the cables to the DC link adapter and to connect the cable shields:

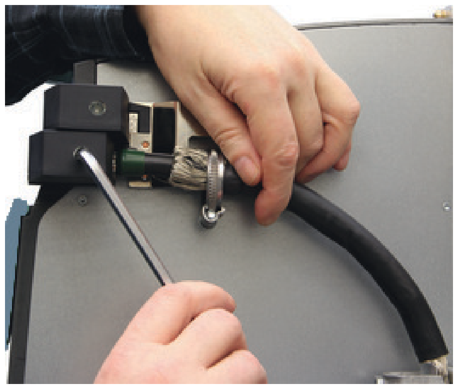
1. Fix the first core of the cable to the mounting rail using a cable clamp.



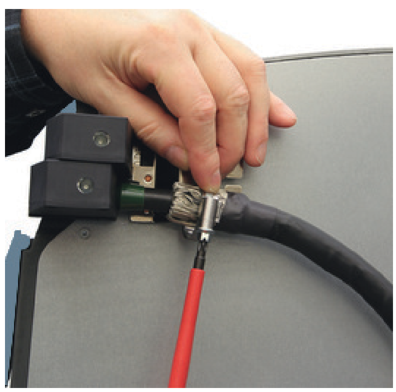
2. Route the cable end through an appropriate hose clamp.

3. Attach the hose clamp to the shield support of the DC link adapter and slide the end of the cable into the DCN connection of the DC link adapter (= lower connection).

4. Attach the DC link connecting cable to the DC link adapter. Allen key size 6. Tightening torque: 13 Nm (115 lbf in)



5. Tighten the screw of the hose clamp using a suitable tool.



6. Repeat steps 1 to 5, and in the same way attach the cable for the DCP connection of the DC link adapter (= upper connection).

11.4.6.9 Technical data

Technical data

Table 11-14 DC link adapter (6SL3162-2BM01-0AA0)

Feature	Unit	Value
Supply voltage	V	495 ... 720
Current-carrying capacity		
Mounting using 2 screws	A	150
Mounting using 4 screws	A	200
Maximum ambient temperature	°C	55
DC link connection		Hexagon socket head screw size 6
Tightening torque	Nm (lbf in)	13 (115)
DC link busbars		
Fixing		Torx-slotted screw TX 20
Tightening torque	Nm (lbf in)	1.8 (15.9)
Weight	kg	0.34

Service and maintenance 12

12.1 Cleaning the components

Description

It is not intended that the device is cleaned. Do not use any cleaning agents for the devices.

12.2 Forming the DC link capacitors

12.2.1 Description

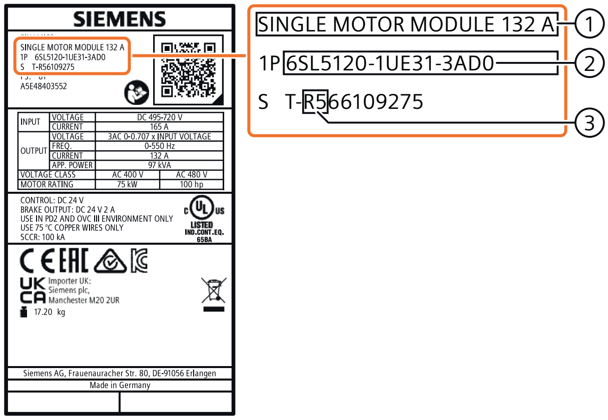
Overview

If the Line Modules and Motor Modules have exceeded their storage period of 2 years, the DC link capacitors have to be reformed. If this is not performed, the components could be damaged when they are switched on.

Description

You can determine the date for forming DC link capacitors as follows:

- The two-year storage period is calculated from the date of manufacture and not from the date that the equipment was shipped.
- Refer to the serial number on the rating plate for the date of manufacture.



① Designation

② Article number

③ Year of manufacture (here R = 2023) and month of manufacture (here 5 = May)

Figure 12-1 Rating plate (example)

Table 12-1 Year and month of manufacture on the rating plate

Year of manufacture		Month of manufacture	
Character	**Year**	**Character**	**Month**
P	2022	1 … 9	January to September
R	2023	O	October
S	2024	N	November
T	2025	D	December
U	2026		
V	2027		
W	2028		
X	2029		

12.2.2 Forming DC link capacitors for Line Modules

Requirement

⚠ WARNING

Electric shock due to the residual charge of the DC link capacitors

Due to the DC link capacitors, a hazardous voltage is present in the DC link for up to 5 minutes after the power supply has been switched off.

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

- Do not open the protective flap of the DC link until 5 minutes have elapsed.
- Check that the cabinet is in a no-voltage condition.

CAUTION

Burns resulting from high surface temperature of the PTC resistors

The resistors can reach a high temperature if there is a fault in the component (surface temperature > 80 °C). You can get seriously burnt when touching the surface.

- Mount the PTC resistors so that contact is not possible. If this is not possible, attach clearly visible and understandable warning notices at hazardous positions.

Components required:

- 1 fuse switch 3-phase 400 V / 10 A
- Cable 1.5 mm^2
- 3 PTC resistors 350 Ω / 35 W
  (recommendation: PTC-35W PTC800620-350 Ohm, Michael Koch GmbH)
- 1 SINAMICS booksize Motor Module

Procedure

Proceed as follows to reform DC link capacitors of a Line Module:

1. Connect the Line Module to the Motor Module via the DC link busbars.
2. Make sure that the device **does not** receive a switch-on command (e.g. via PROFINET/PROFIBUS, BOP20 or terminal block).
3. Connect the forming circuit. When forming with PTC resistors, the component must remain in the circuit for approx. 1 h.

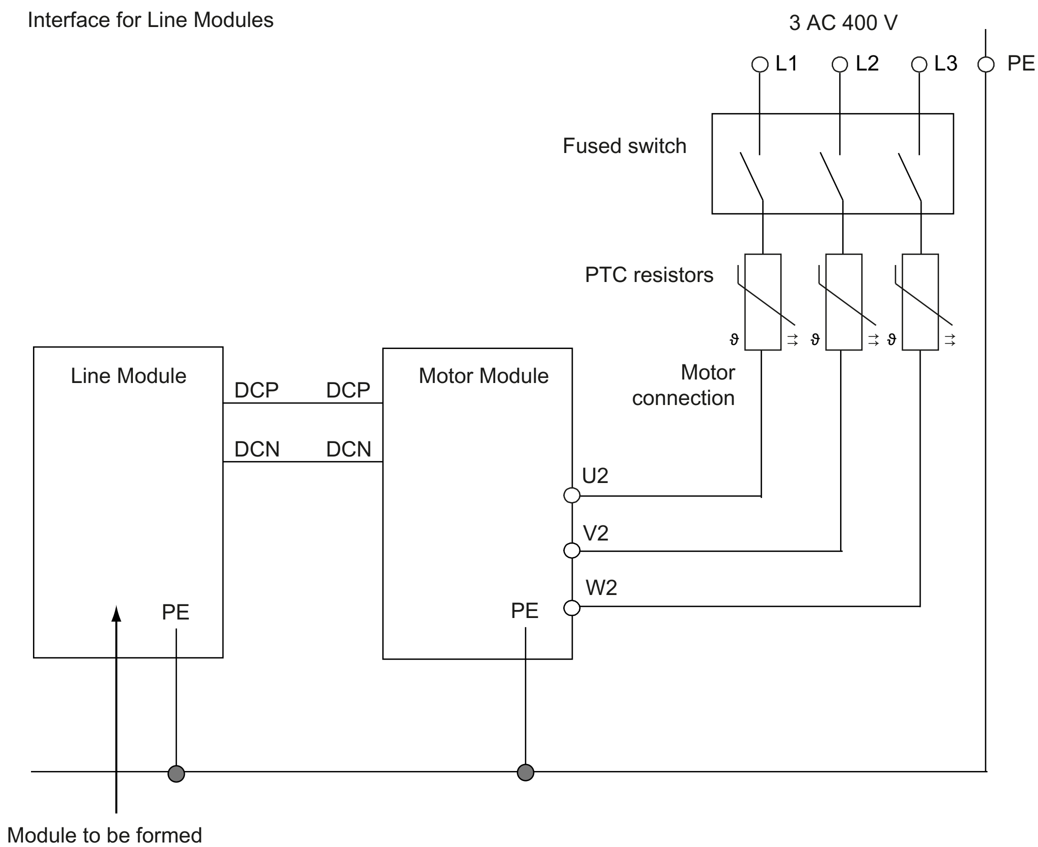


Figure 12-2 Forming circuit for Line Modules with PTC resistors

12.2.3 Forming DC link capacitors for Motor Modules

Requirement

WARNING

Electric shock due to the residual charge of the DC link capacitors

Due to the DC link capacitors, a hazardous voltage is present in the DC link for up to 5 minutes after the power supply has been switched off.

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

- Do not open the protective flap of the DC link until 5 minutes have elapsed.
- Check that the cabinet is in a no-voltage condition.

CAUTION

Burns resulting from high surface temperature of the PTC resistors

The resistors can reach a high temperature if there is a fault in the component (surface temperature > 80 °C). You can get seriously burnt when touching the surface.

- Mount the PTC resistors so that contact is not possible. If this is not possible, attach clearly visible and understandable warning notices at hazardous positions.

Components required:

- 1 fuse switch 3-phase 400 V / 10 A
- Cable 1.5 mm^2
- 3 PTC resistors 350 Ω / 35 W
  (recommendation: PTC-35W PTC800620-350 Ohm, Michael Koch GmbH)

Procedure

Proceed as follows to reform DC link capacitors of a Motor Module:

1. For a 50 mm wide component, first remove the DC link bridge.
2. Make sure that the device **does not** receive a switch-on command (e.g. via PROFINET/ PROFIBUS, BOP20 or terminal block).
3. Connect the forming circuit. When forming with PTC resistors, the component must remain in the circuit for approx. 1 h.

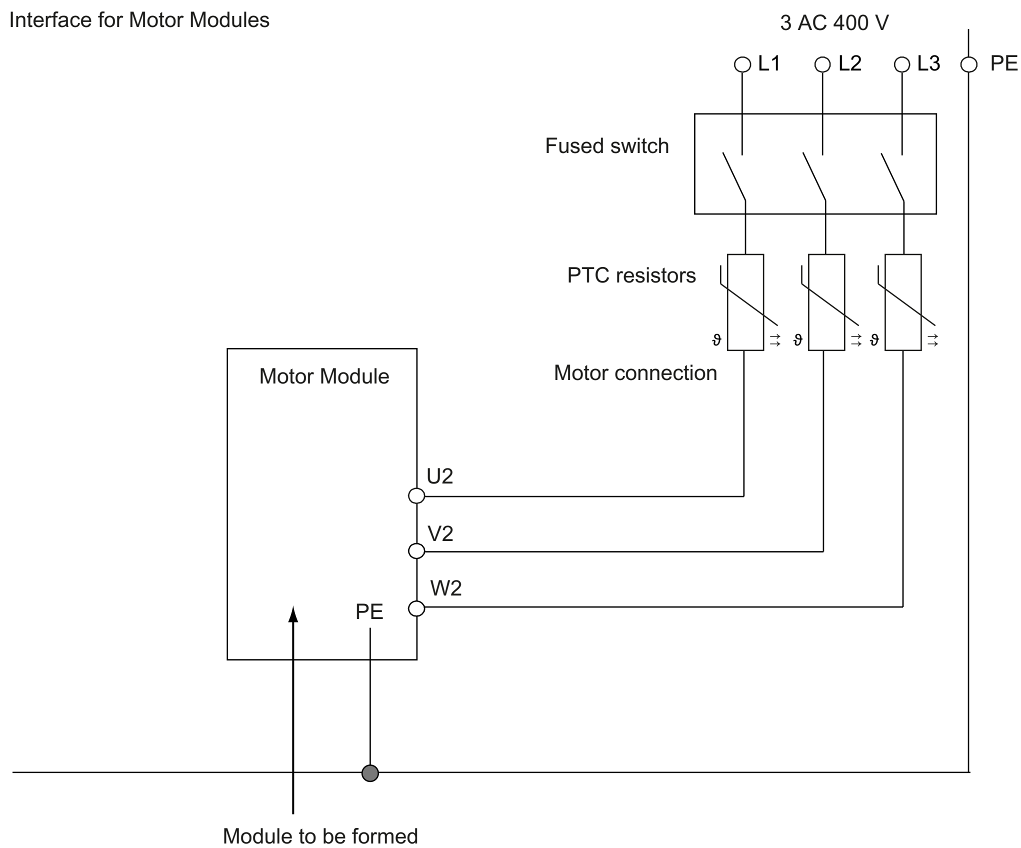


Figure 12-3 Forming circuit for Motor Modules with PTC resistors

12.3 Replacing components

12.3.1 Replacing the fan, 16 kW and 24 kW Smart Line Modules

Overview

The Smart Line Modules have an operating hours counter (p0251) to determine when the fan needs to be replaced and will issue a message (A30042) as soon as the maximum operating time is reached.

The fan modules of Smart Line Modules can be ordered as replacement parts.

Requirement

WARNING

Electric shock when live parts are touched

You must switch off the supply voltages (400 V AC and 24 V DC) before replacing the fan. A hazardous voltage (residual charge) is still 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 at least this long before starting work to replace the fan.
- Check that the drive line-up is in a no-voltage condition before removing the component.

The following requirements apply when replacing the fan:

- Only qualified personnel are permitted to install spare parts.
- When replacing the fan, you must observe the ESD regulations.
- Always use the following fan module when replacing the fan:

Table 12-2 Fan modules for replacing a fan

Smart Line Modules		Fan module	
Width	**Rated current**	**Article number**	**Fan rated voltage**
100 mm	16 kW / 24 kW	6SL5166-0AD00-0AA0	12 V

Required tools:

- Torx screwdriver TX 20
- Torx screwdriver TX 25

Procedure

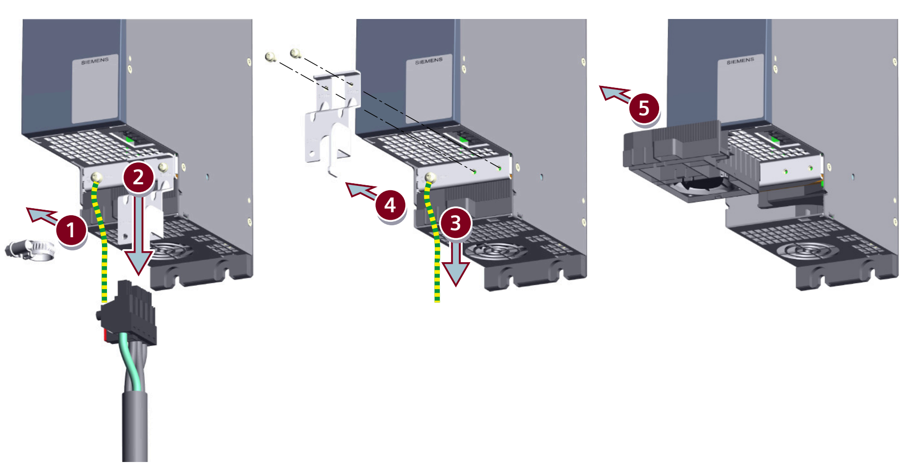


Figure 12-4 Replacing the fan for Smart Line Modules 16 kW and 24 kW

Replace the existing fan module as follows:

1. Remove the strain relief or the shield connection clamp.
2. Release the power connector catch and withdraw this from the Smart Line Module.
3. Remove the shield connection plate from the Smart Line Module. Torx screwdriver TX 20
4. Release the protective conductor from the Smart Line Module if this is connected at the component and not at the power connector. Torx screwdriver TX 25
5. Withdraw the fan module from the Smart Line Module toward the front.
6. Insert a new fan module into the Smart Line Module. The power supply for the fan is automatically established.
7. The Smart Line Module is connected up again by following the reverse procedure once the new fan module has been installed.
   – Screw the shield connection plate into place. Tightening torque: 3 Nm (26.6 lbf in)
   – Connect the protective conductor to the Smart Line Module. Tightening torque: 3 Nm (26.6 lbf in)
   – Reinsert the power connector completely into the Smart Line Module until it audibly latches.
   – Secure the line supply cable to the shield connection plate using a cable tie.
   – If you are using a shielded line supply cable, connect the line supply cable shield using the hose clamp or shield connection clamp.

12.3.2 Replacing the fan, 36 kW and 55 kW Smart Line Modules

Overview

The Smart Line Modules have an operating hours counter (p0251) to determine when the fan needs to be replaced and will issue a message (A30042) as soon as the maximum operating time is reached.

The fan modules of Smart Line Modules can be ordered as replacement parts.

Requirement

WARNING

Electric shock when live parts are touched

You must switch off the supply voltages (400 V AC and 24 V DC) before replacing the fan. A hazardous voltage (residual charge) is still 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 at least this long before starting work to replace the fan.
- Check that the drive line-up is in a no-voltage condition before removing the component.

The following requirements apply when replacing the fan:

- Only qualified personnel are permitted to install spare parts.
- When replacing the fan, you must observe the ESD regulations.
- Always use the following fan module when replacing the fan:

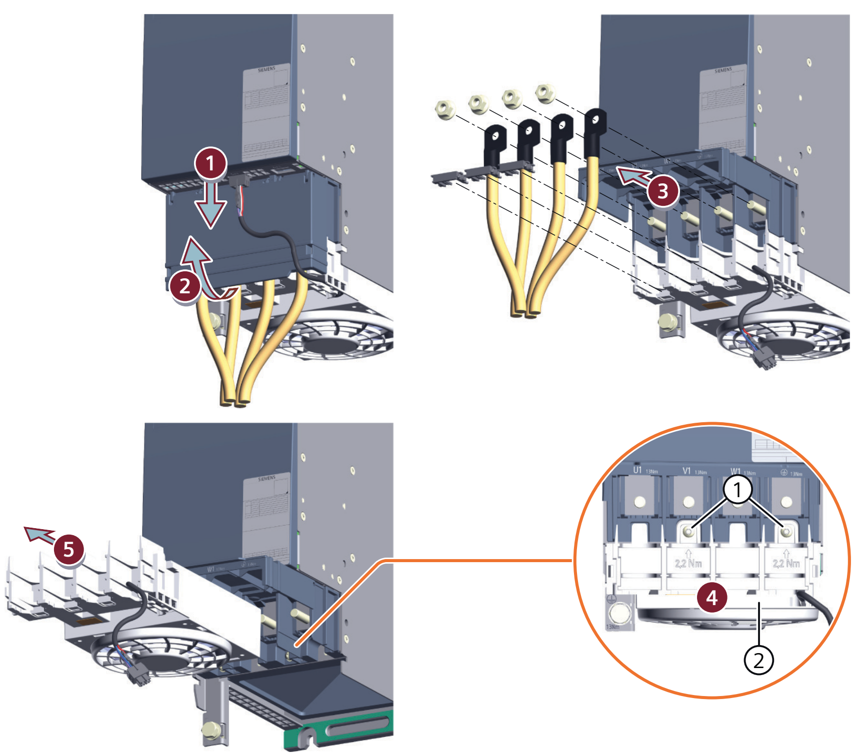
Table 12-3 Fan modules for replacing a fan

Smart Line Modules		**Fan module**	
Width	**Rated current**	**Article number**	**Fan rated voltage**
150 mm	36 kW / 55 kW	6SL5166-0AF01-0AA0	12 V

Required tools:

- T20 torx screwdriver
- Slotted screwdriver 0.8 x 5.5 mm
- Socket wrench size 13

Procedure



① Fixing screws of the fan module
② Fan module

Figure 12-5 Replacing the fan for Smart Line Modules 36 kW and 55 kW

The fan module is integrated in the line connection block. Replace the existing fan module as follows:

1. Withdraw the fan connection plug.
2. Open the locking of the cover of the line connection block left and right and swing it upwards. Slotted screwdriver 0.8 x 5.5 mm
3. Remove the cores of the line supply cable. Socket wrench size 13
4. Remove the two fixing screws of the fan module. T20 torx screwdriver. The protective conductor of the Smart Line Module does not have to be removed.
5. Withdraw the fan module from the Smart Line Module toward the front.
6. Insert a new fan module into the Smart Line Module.
7. Cut out the detachable tabs at the line connection block if required.
8. After the new fan module has been installed, reconnect the Smart Line Module in the inverse sequence:
   – Screw the fan module into place. T20 torx screwdriver. Tightening torque: 2.2 Nm (19.5 lbf in)
   – Attach the cores of the line supply cable and tighten the nuts. Socket wrench size 13. Tightening torque: 13 Nm (115 lbf in)
   – Close the line connection block cover.
   – Insert the fan connection plug into socket X12.

12.3.3 Replacing the fan, 3 A ... 30 A and 2x3 A ... 2x18 A Motor Modules

Overview

Motor Modules have an operating hours counter (p0251) to determine when the fan needs to be replaced, and a message (A30042) is output as soon as the maximum operating time is reached.

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

Requirement

WARNING

Electric shock when live parts are touched

You must switch off the supply voltages (400 V AC and 24 V DC) before replacing the fan. A hazardous voltage (residual charge) is still 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 at least this long before starting work to replace the fan.
- Check that the drive line-up is in a no-voltage condition before removing the component.

The following requirements apply when replacing the fan:

- Only qualified personnel are permitted to install spare parts.
- When replacing the fan, you must observe the ESD regulations.
- Always use the following fan module when replacing the fan:

Table 12-4 Fan modules for replacing a fan

Motor Modules		Fan modules	
Width	**Rated current**	**Article number**	**Fan rated voltage**
50 mm	3 A ... 24 A, 30 A (slim) 2x3 A ... 2x9 A, 2x18 A (slim)	6SL3162-0AS00-0AA0	12 V[1)]
100 mm	30 A 2x18 A	6SL5166-0AD00-0AA0	12 V[1)]

[1)] Contrary to SINAMICS S120 booksize Motor Modules 3 A ... 30 A and 2x3 A ... 2x18 A, for SINAMICS S220 booksize Motor Modules only fans with a fan rated voltage of 12 V are used. Using a fan module with a fan rated voltage of 24 V as replacement part means that this will not start.

Required tools:

- Torx screwdriver TX 20 and TX 25
- Slotted screwdriver 0.8 x 5.5 mm

Procedure

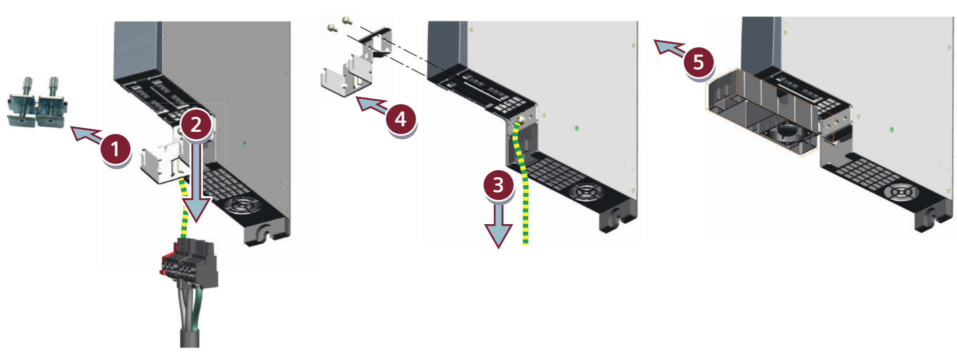


Figure 12-6 Replacing the fan for a 50 mm wide Motor Module

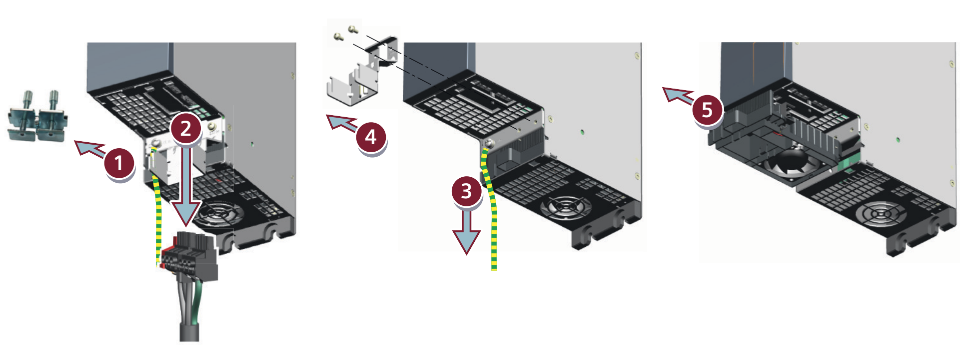


Figure 12-7 Replacing the fan for a 100 mm wide Motor Module

Replace the existing fan module as follows:

1. Remove the shield connection clamp.
2. Release the catch of the power connector or both power connectors for a Double Motor Module, and withdraw this/these from the Motor Module.
3. Detach the protective conductor from the Motor Module. Torx screwdriver TX 25
4. Remove the shield connection plate from the Motor Module. Torx screwdriver TX 20
5. Withdraw the fan module out of the Motor Module towards the front.
6. Insert a new fan module into the Motor Module. The power supply for the fan is automatically established.
7. After the new fan module has been installed, re-connect the Motor Module in the inverse sequence:
   – Screw the shield connection plate into place. Tightening torque: 3 Nm (26.6 lbf in)
   – Connect the protective conductor to the Motor Module. Tightening torque: 3 Nm (26.6 lbf in)
   – Fully reinsert the power connector, or for a Double Motor Module both power connectors, into the Motor Module until it latches into place.
   – Reattach the shield connection clamp and tighten the fastening screws. Tightening torque: 0.8 Nm (7.08 lbf in)

12.3.4 Replacing the fan, 45 A and 60 A Motor Modules

Overview

Motor Modules have an operating hours counter (p0251) to determine when the fan needs to be replaced, and a message (A30042) is output as soon as the maximum operating time is reached.

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

Requirement

⚠ WARNING

Electric shock when live parts are touched

You must switch off the supply voltages (400 V AC and 24 V DC) before replacing the fan. A hazardous voltage (residual charge) is still 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 at least this long before starting work to replace the fan.
- Check that the drive line-up is in a no-voltage condition before removing the component.

The following requirements apply when replacing the fan:

- Only qualified personnel are permitted to install spare parts.
- When replacing the fan, you must observe the ESD regulations.
- Always use the following fan module when replacing the fan:

Table 12-5 Fan modules for replacing a fan

Motor Modules		Fan modules	
Width	**Rated current**	**Article number**	**Fan rated voltage**
100 mm	45 A, 60 A	6SL3162-0AT00-0AA0	12 V

Required tools:

- Torx screwdriver TX 20
- Slotted screwdriver 0.8 x 5.5 mm
- Socket wrench size 10

Procedure

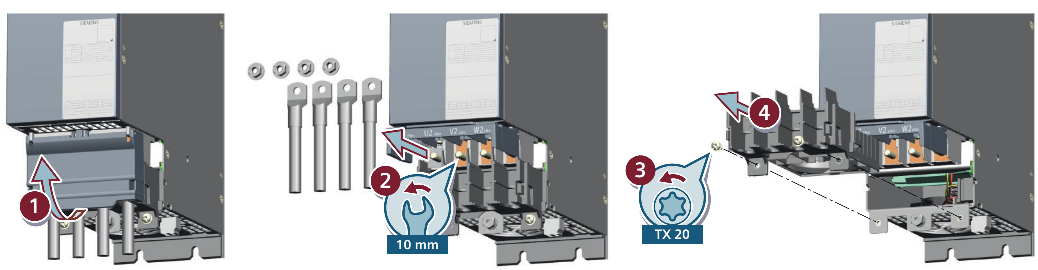


Figure 12-8 Replacing the fan for Motor Modules 45 A and 60 A

The fan module is integrated in the motor connection block. Replace the existing fan module as follows:

1. Open the locking of the cover of the motor connection block left and right and swing it upwards. Slotted screwdriver 0.8 x 5.5 mm
2. Remove the cores of the motor connection cable. Socket wrench size 10
3. Remove the two fixing screws of the fan module. Torx screwdriver TX 20. The protective conductor of the Motor Module does not have to be removed.
4. Withdraw the fan module out of the Motor Module towards the front.
5. Insert a new fan module into the Motor Module. The power supply for the fan is automatically established.
6. Cut out the detachable tabs at the motor connection block if required.

7. After the new fan module has been installed, re-connect the Motor Module in the inverse sequence:
   - Screw the fan module into place. Torx screwdriver TX 20. Tightening torque: 2.2 Nm (19.5 lbf in)
   - Attach the cores of the motor connection cable and tighten the nuts. Socket wrench size 10. Tightening torque: 6 Nm (53.1 lbf in)
8. Close the motor connection block cover.

12.3.5 Replacing the fan, 85 A ... 200 A Motor Modules

Overview

Motor Modules have an operating hours counter (p0251) to determine when the fan needs to be replaced, and a message (A30042) is output as soon as the maximum operating time is reached.

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

Requirement

WARNING

Electric shock when live parts are touched

You must switch off the supply voltages (400 V AC and 24 V DC) before replacing the fan. A hazardous voltage (residual charge) is still 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 at least this long before starting work to replace the fan.
- Check that the drive line-up is in a no-voltage condition before removing the component.

The following requirements apply when replacing the fan:

- Only qualified personnel are permitted to install spare parts.
- When replacing the fan, you must observe the ESD regulations.
- Always use the following fan module when replacing the fan:

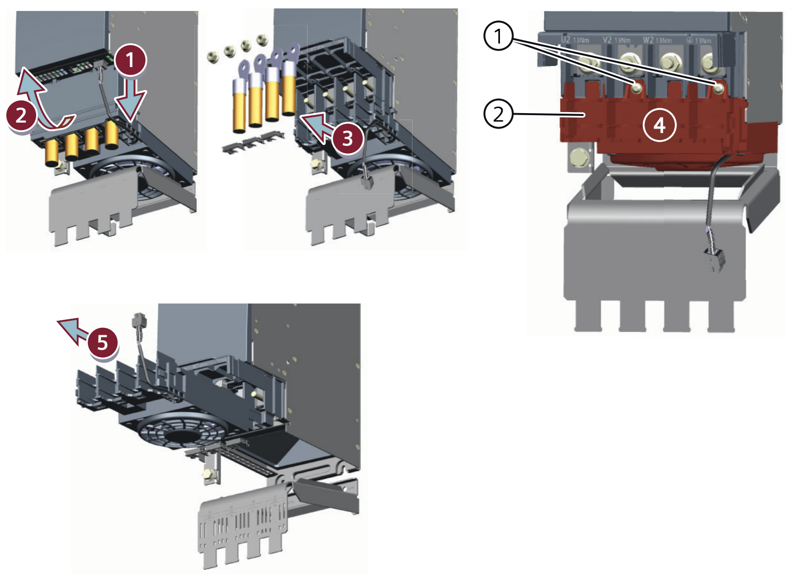
Table 12-6 Fan modules for replacing a fan

Motor Modules		Fan module	
Width	**Rated current**	**Article number**	**Fan rated voltage**
150 mm	85 A, 132 A	6SL5166-0AF00-0AA0	48 V
200 mm	200 A	6SL5166-0AH00-0AA0	48 V

Required tools:

- T20 torx screwdriver
- Slotted screwdriver 0.8 x 5.5 mm
- Socket wrench size 13

Procedure



① Fixing screws of the fan module

② Fan module

Figure 12-9 Replacing the fan for Motor Modules 85 A, 132 A and 200 A

The fan module is integrated in the motor connection block. Replace the existing fan module as follows:

1. Withdraw the fan connection plug.
2. Open the locking of the cover of the motor connection block left and right and swing it upwards. Slotted screwdriver 0.8 x 5.5 mm
3. Remove the cores of the motor connection cable. Socket wrench size 13
4. Remove the two fixing screws of the fan module. T20 torx screwdriver. The protective conductor of the Motor Module does not have to be removed.
5. Withdraw the fan module out of the Motor Module towards the front.
6. Insert a new fan module into the Motor Module.

7. Cut out the detachable tabs at the motor connection block if required.
8. After the new fan module has been installed, re-connect the Motor Module in the inverse sequence:
   – Screw the fan module into place. T20 torx screwdriver. Tightening torque: 2.2 Nm (19.5 lbf in)
   – Attach the cores of the motor connection cable and tighten the nuts. Socket wrench size 13. Tightening torque: 13 Nm (115 lbf in)
   – Close the motor connection block cover.
   – Insert the fan connection plug into socket X12.

12.4 Device disposal

Description

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

12.5 Spare parts compatibility

Description

Converter components are being continuously developed within the scope of product maintenance.

Product maintenance includes, for example, measures to increase the ruggedness or hardware changes that become necessary as components are discontinued.

In the scope of such spare parts-compatible ongoing development, connectors or connection positions are sometimes slightly modified. This does not cause any problems when the component is used as intended. Please take this fact into consideration in special installation situations (e.g. allow sufficient reserve regarding the cable length).

More information

SINAMICS:
www.siemens.com/sinamics

Industry Mall:
www.siemens.com/industrymall

Industry Online Support:
www.siemens.com/online-support