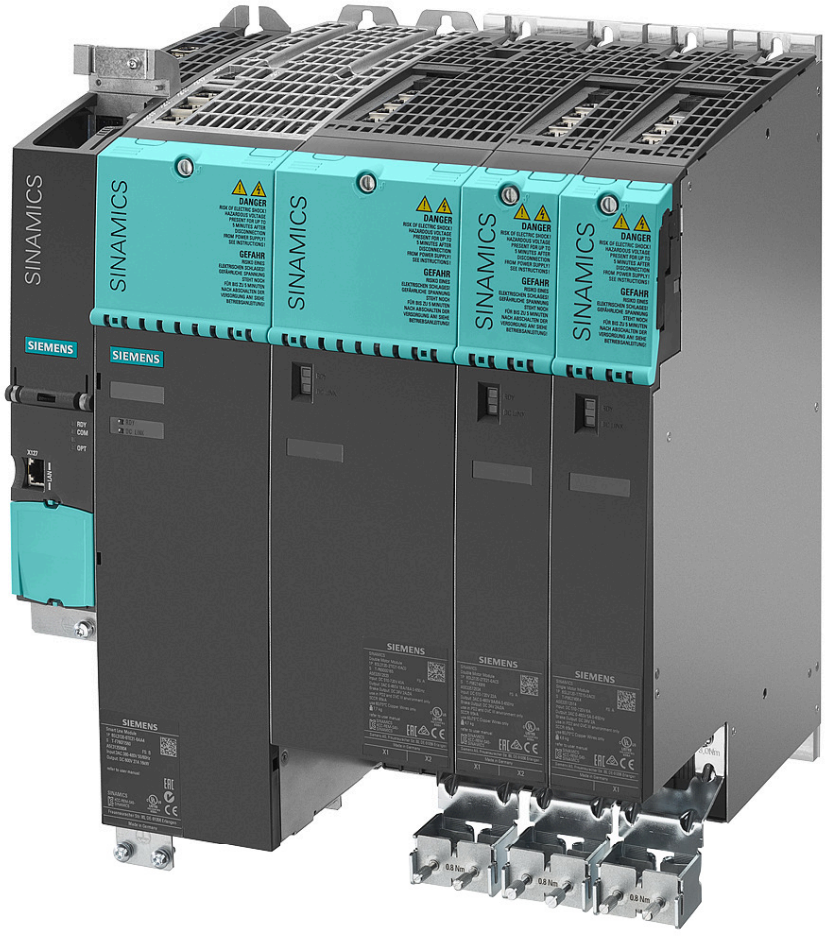


Edition 12/2024

Equipment Manual

SINAMICS

S120

Booksize power units
www.siemens.com

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S120
Booksize Power Units

Equipment Manual

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Legal information

Warning notice system

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

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⚠ **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.

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GERMANY

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1 Introduction

1.1 About SINAMICS

Description

With the SINAMICS converter series, you can solve drive tasks from low voltage through to DC voltage. 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

Description

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

Description

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.

1.6 Where can the various topics be found?

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

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

[1] Up to firmware version 5.1 SP1

[2] From firmware version 5.2

1.7 Directives, standards, certificates

Relevant directives and standards

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.

Certificates for download

The certificates can be downloaded from the Internet:

Certificates (https://support.industry.siemens.com/cs/ww/de/ps/13206/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, manufacturers declarations and test certificates for functions relating to functional safety ("Safety Integrated") on the Internet at the following address (https://support.industry.siemens.com/cs/ww/en/ps/13231/cert).

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

- **European Low Voltage Directive**
  SINAMICS S devices fulfil the requirements stipulated in the Low-Voltage Directive 2014/35/EU, insofar as they are covered by the application area of this directive.
- **European Machinery Directive**
  SINAMICS S devices fulfil the requirements stipulated in the Low-Voltage Directive 2006/42/EU, insofar as they are covered by the application area of this directive. However, the use of the SINAMICS S devices in a typical machine application has been fully assessed for compliance with the main regulations in this directive concerning health and safety.
- **Directive 2011/65/EU**
  SINAMICS S devices comply with the requirements of Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic devices (RoHS II).
- **European EMC Directive**
  SINAMICS S devices comply with the EMC Directive 2014/30/EU.
- **Great Britain**
  SINAMICS S devices comply with the requirements for the British market (England, Wales and Scotland).
- **EMC requirements for South Korea**
  SINAMICS S devices with the KC marking on the type plate satisfy the EMC requirements for South Korea.
- **Eurasian conformity**
  SINAMICS S comply with the requirements of the Russia/Belarus/Kazakhstan customs union (EAC).



- **North American market**
  SINAMICS S devices provided with one of the test symbols displayed fulfill the requirements stipulated for the North American market as a component of drive applications.
  You can find the relevant certificates on the Internet pages of the certifiers (https://iq.ulprospector.com).
- **Australia and New Zealand (RCM formerly C-Tick)**
  SINAMICS S devices showing the test symbols fulfill the EMC requirements for Australia and New Zealand.
- **Quality systems**
  Siemens AG employs a quality management system that meets the requirements of ISO 9001 and ISO 14001.

Not relevant standards



China Compulsory Certification

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

EMC limit values in South Korea

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

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

Fundamental safety instructions

2

2.1 General safety instructions



⚠ WARNING

Electric shock and danger to life due to other energy sources

Touching live components can result in death or severe injury.

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

Generally, the following 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:

Configuration Manual Industrial Cybersecurity (https://support.industry.siemens.com/cs/ww/en/view/109975311)

⚠ 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.

System overview

3

3.1 Introduction

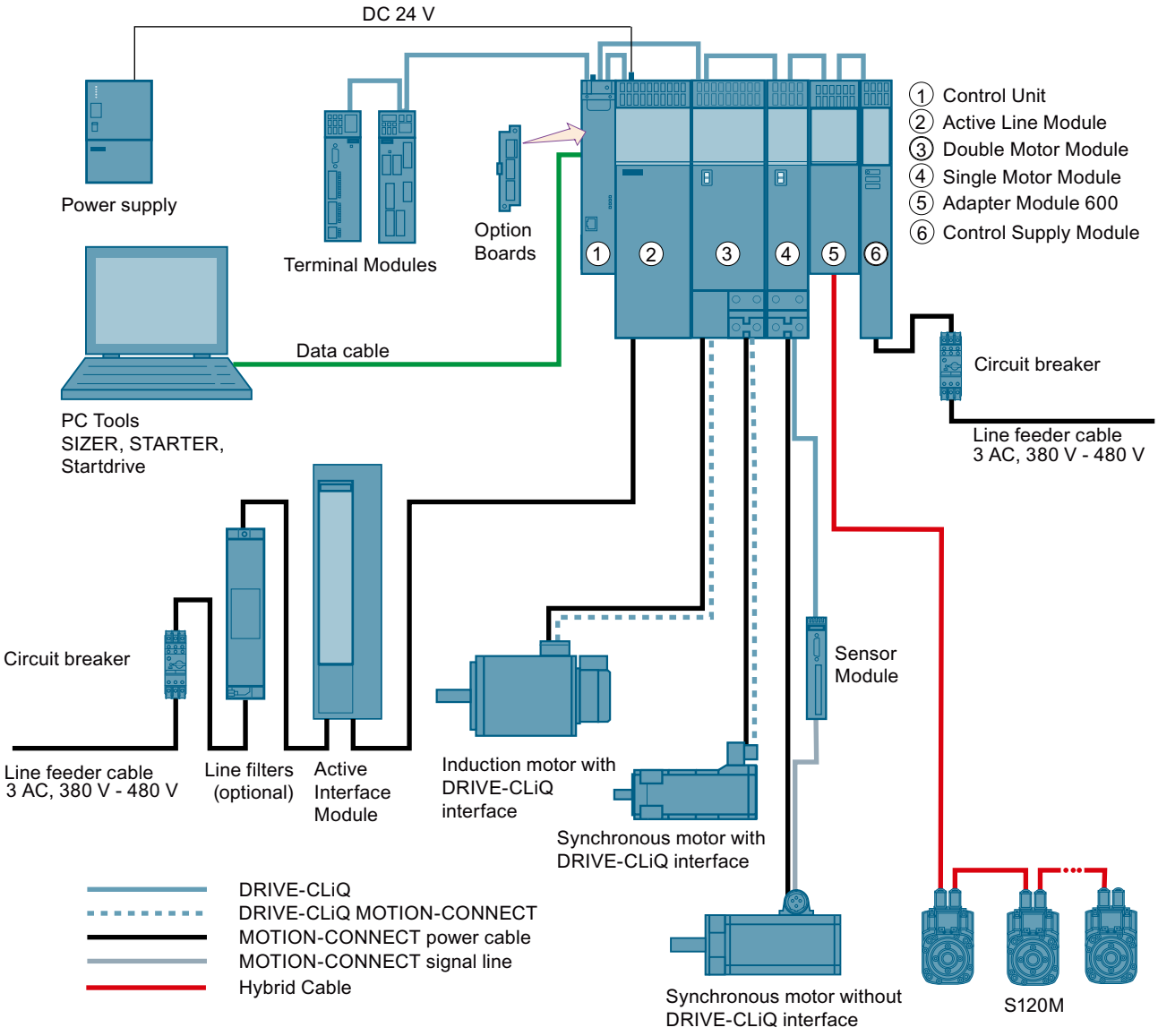


Figure 3-1 System overview, SINAMICS S120 with S120M distributed servo drive technology

Modular system for sophisticated drive tasks

SINAMICS S120 solves complex drive tasks for a wide range of industrial applications and is, therefore, designed as a modular system. Select from many different harmonized components and functions to create the combination that best meets your requirements.

SIZER, a high-performance engineering tool, makes it easier to select and determine the optimum drive configuration.

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

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

System architecture with a central Control Unit

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

Functions for higher efficiency

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

DRIVE-CLiQ – the digital interface between SINAMICS components

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

Electronic rating plates in all components

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

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

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

3.2 SINAMICS S120 components

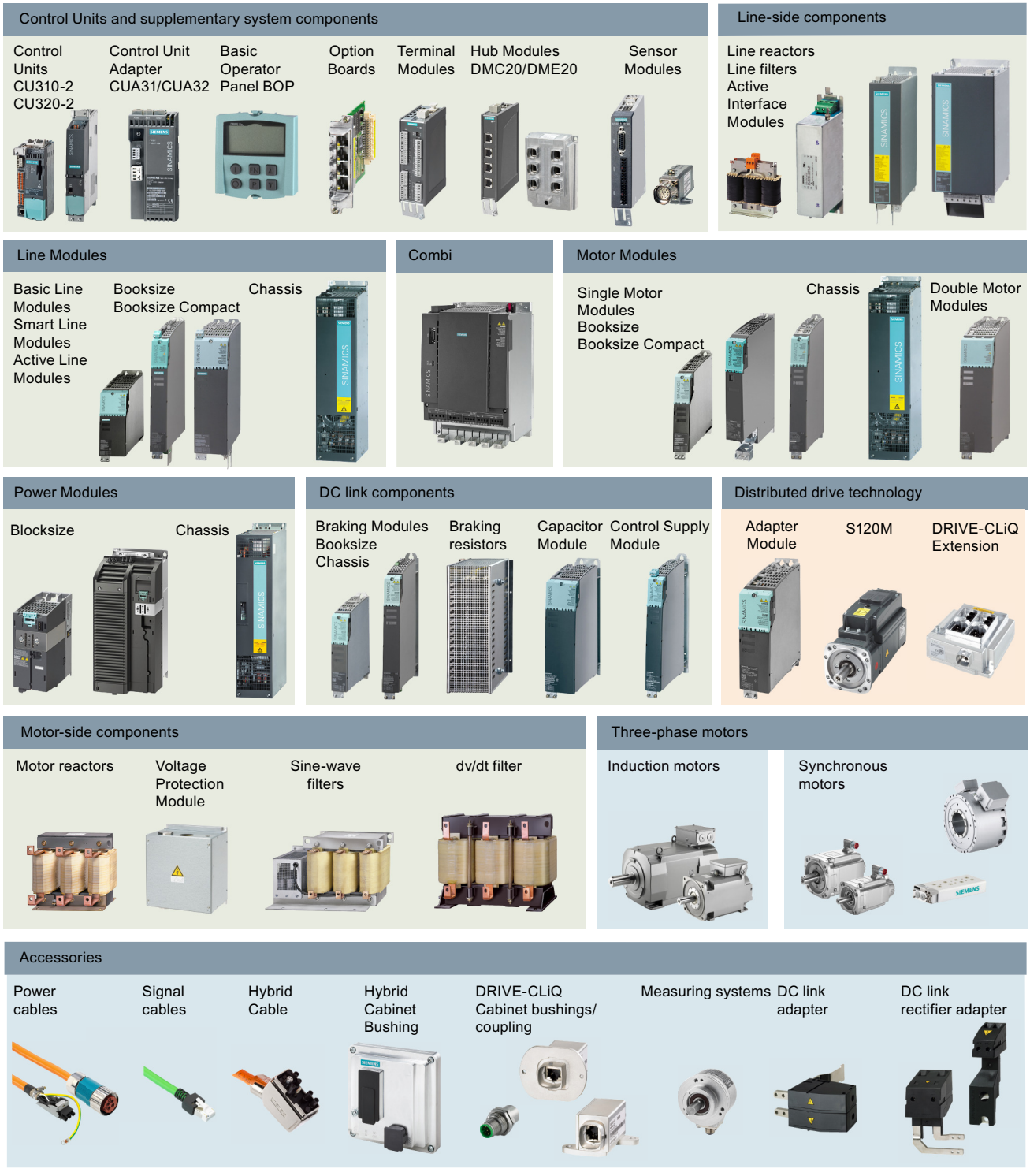


Figure 3-2 SINAMICS S120 components

System components

- Line-side power components, such as fuses, contactors, reactors, and filters for switching the power supply and meeting EMC requirements.
- Line Modules, which supply power centrally to the DC link
- DC link components (optional), which stabilize the DC link voltage.
- Motor Modules, which act as inverters, receive power from the DC link, and supply the connected motors
- Power components on the motor side, such as reactors and Voltage Protection Modules, which allow output currents and output voltages to be reduced

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

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

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

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

Note

Mounting position in the cabinet

As a general rule, SINAMICS S120 components must be mounted vertically in the control cabinet. If components can be mounted with alternative orientations, this is stated in the technical data.

NOTICE
Overheating of components due to incorrect mounting position Incorrectly installed components can overheat in operation. Overheating can lead to malfunctions and damage to components. • Install the components only in the permissible mounting position in the control cabinet.

Booksize format

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

Booksize format offers various air cooling options:

- Internal air cooling
- External air cooling (see note)
- Cold plate cooling (see note)

Booksize Compact format

The Booksize Compact format combines all benefits of the Booksize format and provides the same performance with an even smaller overall height. The Booksize Compact format is thus particularly well suited for integration into machines with high dynamic requirements and confined installation conditions.

The Booksize Compact format offers various air cooling options:

- Internal air cooling
- Cold plate cooling (see note)

Note

Devices with external air cooling or cold plate cooling

The ongoing development of the S120 Booksize drive system concentrates on internal air cooling.

Modules with external air cooling and cold plate will no longer be innovated.

The technical documentation SINAMICS S120 "Booksize power units" Edition 06/2019 (6SL3097-5AC00-0AP2) is still valid for these modules.

3.2.1 Overview of Line Modules

Line Modules generate a DC voltage from the connected rated voltage that is used to power the Motor Modules.

All Basic Line Modules and Active Line Modules as well as the 16 kW, 36 kW, and 55 kW Smart Line Modules are equipped with DRIVE-CLiQ interfaces for communicating with the Control Unit. The 5 kW and 10 kW Smart Line Modules must be connected with the Control Unit via terminals.

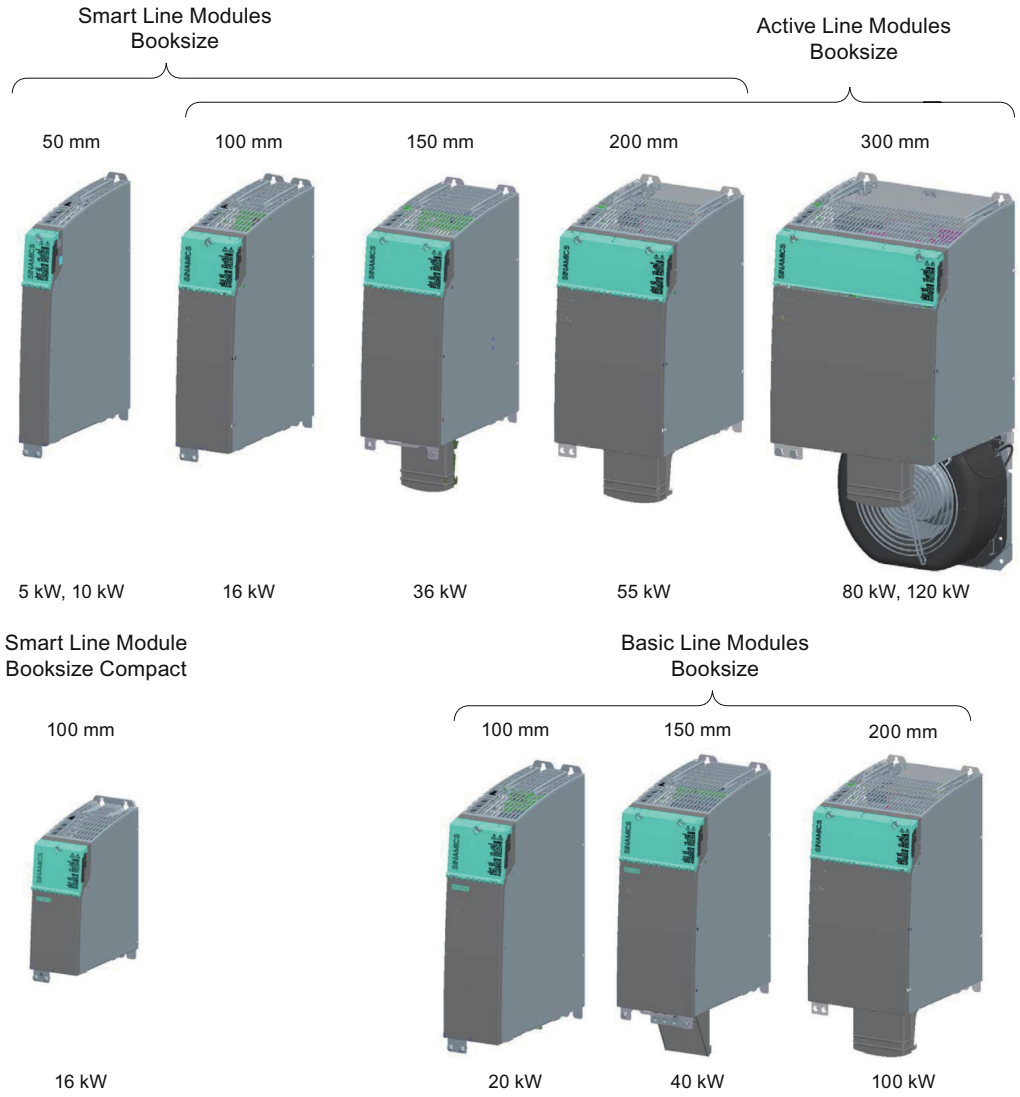


Figure 3-3 Overview of Line Modules

General characteristics of the Line Modules

- Supply voltage 3 AC 380 V to 480 V, 47 to 63 Hz
- Suitable for TN, TT, and IT supply systems

- Internal air cooling
- Short-circuit/ground-fault-proof during the precharge phase
- Integrated DC link and electronics current busbar connection
- LEDs for indicating statuses and for diagnostics

Characteristics of the Active Line Modules

- Regulated DC link voltage
- Energy recovery capability
- Sinusoidal line currents
- Electronic rating plate
- DRIVE-CLiQ interface for communication with the Control Unit and/or other components in the drive line-up.
  - Integration in system diagnostics

Characteristics of the Smart Line Modules

- Unregulated DC link voltage
- Energy recovery capability
- Block-type network currents in feedback direction

Characteristics of the Basic Line Modules

- Unregulated DC link voltage
- No energy recovery capability

3.2.2 Overview of Motor Modules

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

Depending on the version (Single or Double), each Motor Module has one or two DRIVE-CLiQ interfaces for connecting the motor encoder evaluation via Sensor Modules.

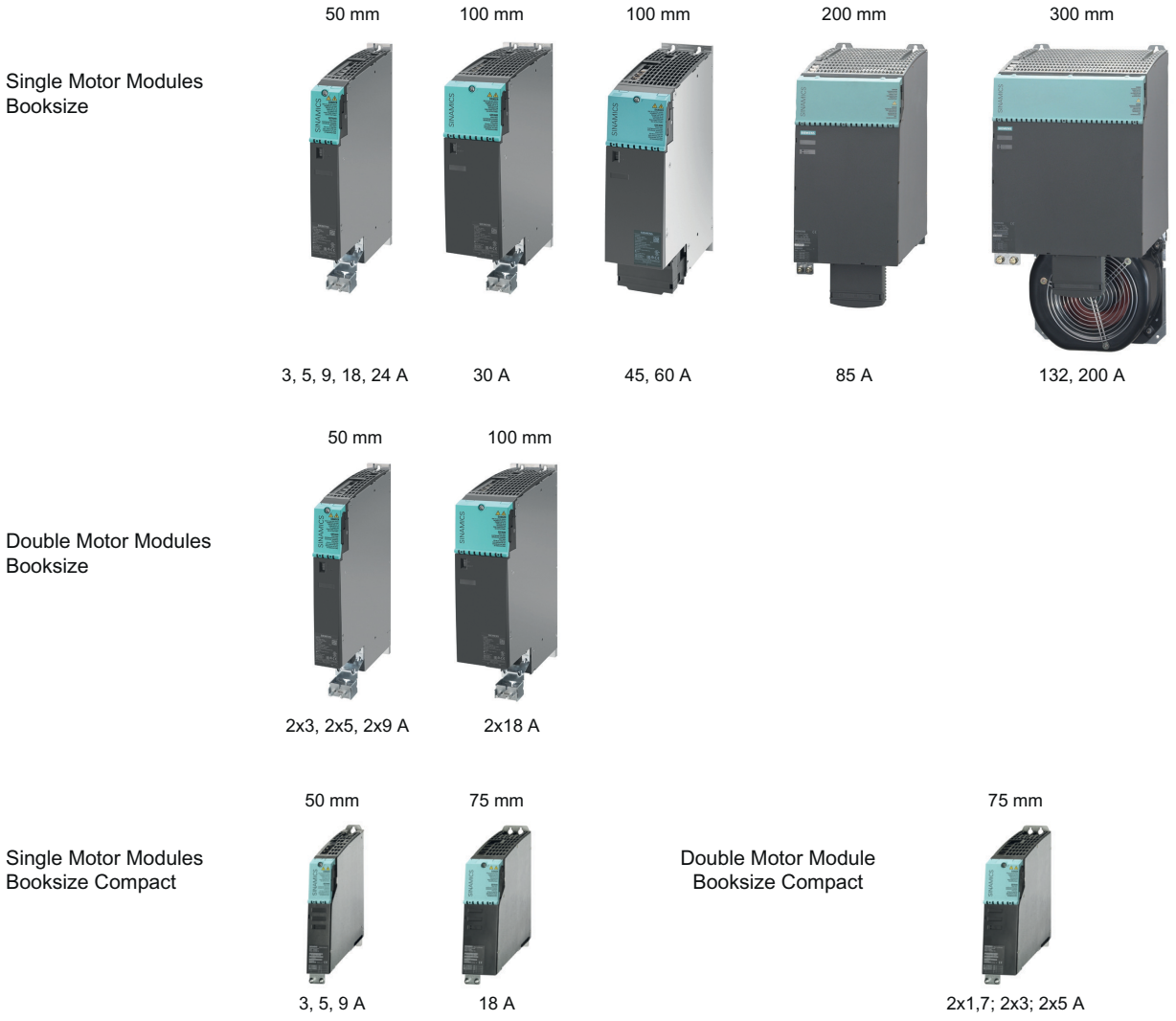


Figure 3-4 Overview of Motor Modules

Types of Booksize Motor Modules

Different types of SINAMICS S120 Motor Module Booksize are available depending on the size and performance:

- Classic: Inverters for output currents from 85 A up to 200 A. They can be operated with up to 200 percent overload.
- C type: Optimized for continuous load with up to 200 % overload (continuous motion).
- D type: Optimized for highly dynamic, intermittent load cycles with up to 300 % overload (discontinuous motion).
- Booksize Compact: Compact modules differ as a result of their format, especially their lower height. They can be operated with up to 300 percent overload.

Characteristics of the Motor Modules:

- Single type from 3 A to 200 A
- Double type from 2x1.7 A to 2x18 A
- Internal air cooling
- Integrated short-circuit protection for the motor circuit
- Integrated DC link and electronics current busbar connection
- Integrated "safety motor braking control"
- Electronic rating plate
- Operating status and error status via LEDs
- DRIVE-CLiQ interface for communication with the Control Unit and/or other components in the drive line-up
- Integration in system diagnostics

3.3 System data

Unless specified otherwise, the following technical data is valid for all components of the SINAMICS S120 Booksize drive system described in this manual.

Table 3-1 Electrical data

Line connection voltage	3 AC 380 ... 480 V ±10 % (-15 % < 1 min)
Line frequency	47 ... 63 Hz
Electronic power supply	24 V DC -15/+20%[1], safety extra-low voltage (PELV/SELV) (see Chapter 24 V DC supply voltage (Page 465))
Maximum rated short-circuit current (SCCR) according to UL 61800-5-1	100 kA at 480 V The SCCR value depends on the overcurrent protective device used, and can be taken from product information "Protective Devices for SINAMICS S120 Line Modules Booksize (https://support.industry.siemens.com/cs/de/de/view/109749282)".
Electromagnetic compatibility	According to IEC / EN 61800-3: Used in the second environment (industrial line supplies). As standard, Category C3. With additional components, Category C2 (see Chapter "Drive system applications (Page 444)").
Overvoltage category	III[2] According to IEC 61800-5-1, EN 61800-5-1, UL 61800-5-1 and CSA C22.2 No 274
Degree of contamination	2[3] According to IEC 61800-5-1, EN 61800-5-1, UL 61800-5-1 and CSA C22.2 No 274
Sound pressure level with internal air cooling	< 75 dB(A)

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

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

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

Table 3-2 Degree of protection / protection class

Degree of protection	IPXXB according to EN 60529, open type according to UL/CSA
Protection class	I (with PE/ground connection)

Table 3-3 Environmental conditions

Chemically active substances	
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
Biological environmental conditions	
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
Climatic environmental conditions	
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: 0 ... +40 °C without derating > 40 ... +55 °C with reduction of the output current by 2.67 % pro °C Relative humidity: 5 ... 95 % no condensation (better than Class 3K3) Oil mist, salt mist, ice formation, condensation, dripping water, spraying water, splashing water and water jets are not permitted
Mechanical environmental conditions	
Long-term storage	Class 1M2 according to 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) • 10 ... 57 Hz: 0.075 mm deflection amplitude • 57 ... 150 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
Installation altitude	
Operation	0 ... 1000 m above sea level without derating > 1000 ... 4000 m • Reduction of the output current by 10 % per 1000 meters, or • Reduction in the ambient temperature by 5 °C per 1000 meters > 2000 ... 4000 m • Operation on line supply systems with grounded neutral point, or • Operation on an isolating transformer with secondary grounded neutral point

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

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

Table 3-4 Certificates

Declarations of Conformity	EU Declaration of Conformity (LVD, EMC, Machinery Directive, RoHS), UKCA, China RoHS, RCM
Certifications[1)]	cULus, cURus, KC, EAC

1) Possible deviations are specified for the corresponding component.

Line connection and line-side power components

4

4.1 Introduction

The following components are used to connect a SINAMICS S120 drive line-up in booksize format to the line supply:

- Disconnector unit
- Overcurrent protection device
- Line contactor (optional)
- Line filter (optional)
- Line reactor or also Active Interface Module for Active Line Module (always required)

The following line filter and line reactor variants are available:

- Line filter variants:
  - Basic Line Filter for Active Line Modules with line reactor
  - Basic Line Filter for Active Line Modules with Active Interface Module
  - Basic Line Filter for Basic Line Modules
  - Basic Line Filter for Smart Line Modules
- Line reactor variants:
  - Line reactors for Active Line Modules
  - Line reactors for Smart Line Modules
  - Line reactors for Basic Line Modules

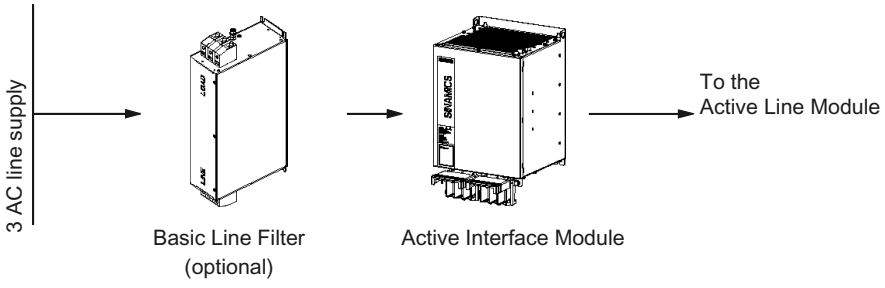


Figure 4-1 Overview diagram, line connection with Active Interface Module

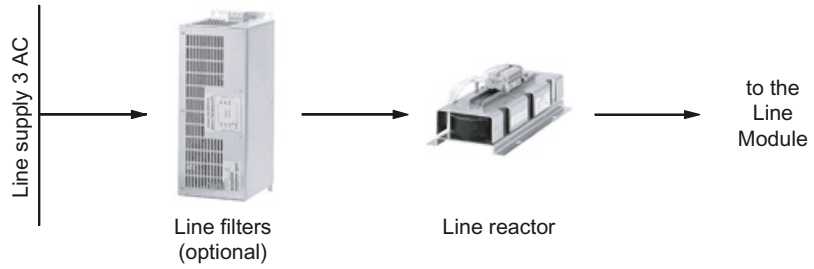


Figure 4-2 Overview diagram, line connection with line filter and line reactor

4.2 Information on the disconnector unit

Disconnector units for Active Line Modules, Basic Line Modules, and Smart Line Modules

A line disconnector is required for disconnecting the drive line-up from the supply system. This must be selected in compliance with local regulations.

NOTICE
Damage to the drive electronics when switching the line disconnection equipment under load When switching the line disconnector unit under load, then the contacts will be subject to premature wear. This can cause the line disconnection equipment to malfunction, with subsequent damage to the drive electronics. • Use a leading opening auxiliary contact or use a Voltage Sensing Module (VSM10). • If this is not possible, then avoid switching the line disconnection equipment under load.

The accessories required for the disconnector unit must be selected from the manufacturer catalogs.

4.3 Overcurrent protection using fuses and circuit breakers

You must use line fuses or circuit breakers for overcurrent protection. The following protective elements can result in reductions.

Detailed specifications regarding protective devices and their respective short-circuit ratings values can be obtained in the product information "Protective Devices for Line Modules Booksize (https://support.industry.siemens.com/cs/de/de/view/109749282)".



⚠ WARNING

Electric shock or fire due to overcurrent protective equipment that trips too late or not at all

Overcurrent protective equipment that trips 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 equipment used.
- You must additionally use a residual-current protective 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 equipment.

4.4 Connected to the line supply via residual current protective devices (RCD)

Terminology

Code	Meaning
RCD	= higher-level term • Residual current device • Residual-current protective device
RCCB	• Residual current circuit breaker • Residual current operated circuit breaker • Ground-fault circuit interrupter
MRCD	• Modular residual current device • Modular residual current device

Description

Selectively tripping, AC/DC-sensitive residual-current devices (type B) can be used in addition to the overcurrent protection devices.

Residual-current devices (RCDs) have to be installed if the power supply conditions in terms of short-circuit power and loop impedance at the infeed point are not such that the installed overcurrent protection devices will trip within the specified period if a fault occurs. Residual

current protection devices also offer preventative fire protection in the case of insulation faults, e.g. for use in high-fire-risk working environments.

Table 4-1 RCDs that can be used for Line Modules

	RCCB	RCD with 3VA1	MRCD
Rated current	≤80 A	80 ...160 A	>160 A
Active Line Modules	16 ... 36 kW	55 ... 80 kW	120 kW
Basic Line Modules	20 kW	40 kW	100 kW
Smart Line Modules	5 ... 36 kW	55 kW	-
Smart Line Modules Compact	36 kW	-	-

Conditions for using residual current protective devices

- Super-resistant (short time-delayed) universal current-sensitive RCDs, type B
- Rated residual current 300 mA
- Separate RCD for each Line Module
- Ensure that the loop impedance is maintained corresponding to local installation regulations.
- Check the total length of the shielded power cables (motor cables incl. line supply conductors from line filters to the connecting terminals of the Line Module) in the drive line-up. The total length must be less than 350 m.
- Only operate the system with the recommended line filters.
- Ensure that the switching elements (disconnector unit, contactors) for connecting and disconnecting the drive system have a delay time of max. 35 ms between the closing/ opening of the individual main contacts.



⚠ WARNING

Electric shock or fire when using unsuitable residual current protective devices

In the case of a fault, converters can generate smooth DC fault currents, which render type A or AC RCDs unusable.

- Use the recommended type B RCDs to protect converters.
- If higher-level RCDs are used, then these must also be type B devices.

Note

Nuisance tripping of RCDs

For unfavorable line supply situations, as a result of the system, converters can generate capacitive discharge currents, which means that RCDs can nuisance trip.

4.4.1 Residual current circuit breakers (RCCB)

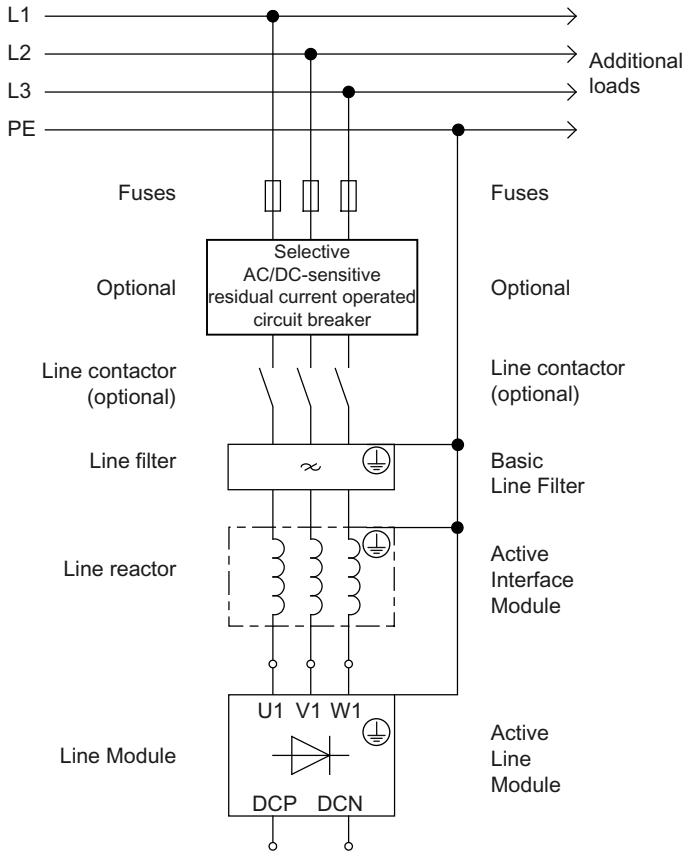


Figure 4-3 Connection of a residual-current protective device

Recommendation

- Siemens SIQUENCE RCCB (ground fault circuit interrupter), type B, super-resistant [K], 300 mA rated fault current, series 5SV364.-4.

4.4.2 RCD module mounted onto the 3VA1 switch

The RCD520B is a module that is directly mounted onto 3VA1 molded-case (compact) circuit breakers. 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 for a circuit breaker.



Figure 4-4 RCD520 with 3VA1 molded-case circuit breaker

It is connected in just the same way as a ground fault circuit interrupter (see Chapter "Residual current circuit breakers (RCCB) (Page 51)").

Recommendation

- Siemens residual current protective devices RCD520B (3VA9113-0RL21) mounted on a 3VA1 molded-case circuit breaker
  Recommended settings:
  - Type B, tripping characteristic
  - Differential response current 300 mA
  - Response delay ≥ 0.06 s

4.4.3 Modular residual current protective devices (MRCD)

Used in conjunction with the appropriate molded-case circuit breakers, modular residual current devices (MRCD) provide extended protection in case of insulation faults even at high infeed power ratings exceeding 55 kW.

Note

Do **not** route the protective conductor through the measuring current transformer, as this would cancel its protection function.

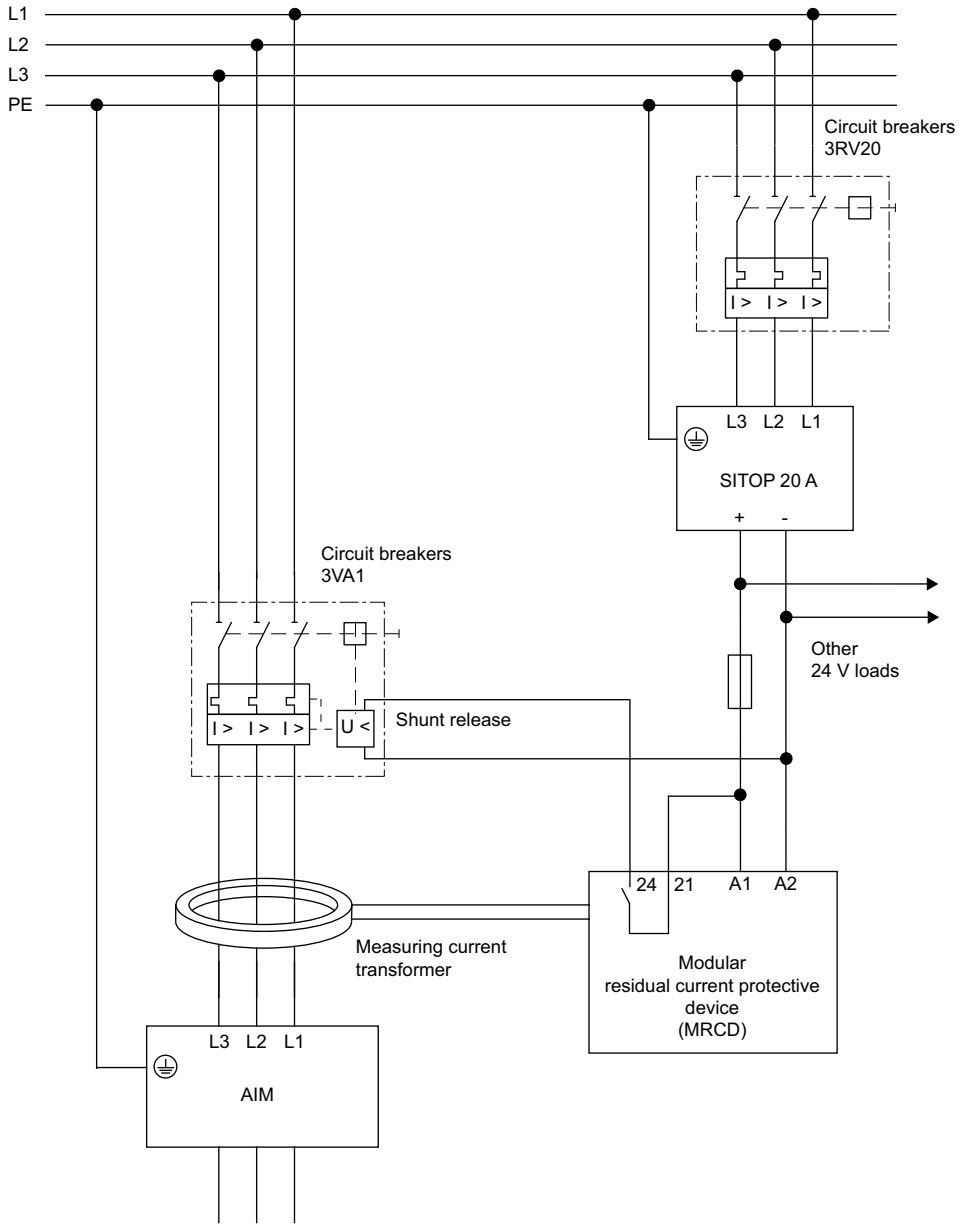


Figure 4-5 Connection of a modular residual current protective device (MRCD)

Recommendation

- Siemens modular residual current protective devices (MRCD), type B 5SV8111-4KK with 5SV870.-2K current transformer, 3VA1 circuit breaker and 3VA9988-0BL30 shunt release Recommend setup:
  - Differential response current 300 mA
  - Response delay ≥ 0.06 s

4.5 Line contactors

The characteristic values in the technical data apply when the line contactor is selected. The cables and conductors to be connected must be dimensioned in compliance with local installation regulations.

NOTICE

Damage to the drive electronics when switching the line contactor under load

When switching the line contactor (type according to the recommended selection) under load, then the contacts will be subject to premature wear. This can cause the contactor to malfunction, with subsequent damage to the drive electronics.

- Use a leading opening auxiliary contact or use a Voltage Sensing Module (VSM10).
- If this is not possible, then avoid switching the line contactor under load.

Note

To limit the switching overvoltage, the contactor coil must be connected to a surge suppression device (e.g. free-wheeling diode or varistor).

When the digital output is used to control the line contactor, its switching capacity must be taken into account.

4.6 Line filters

4.6.1 Description

In conjunction with line reactors and a consequence EMC-compliant system configuration, line filters limit the conducted electromagnetic emissions generated by the Line Modules to the limit values according to EN 61800-3.

4.6.2 Safety instructions for line filters



⚠ 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 feeder cable is interrupted

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

- Carefully comply with the applicable regulations for dimensioning the protective conductor (see Chapter "Protective connection and equipotential bonding (Page 492)").



⚠ 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 network 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 line to line reactor at LOAD L1´, L2´, L3´ (U, V, W).

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.

- Only use the line filter with the components specified in Chapter "Combination options of Line Modules with line reactors and line filters (Page 124)".

NOTICE

Damage caused by using third party filters

According to product standard EN 61800-3, RFI suppression commensurate with the relevant rated conditions must be provided and is a legal requirement 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 with respect to ground. A filter from the B84144A*R120 (EPCOS) series is recommended.

Note

Length of connecting cables

The connecting cables between the line filter via the Active Interface Module and the line reactor to the Line Module must be kept as short as possible (max. 10 m).

Use shielded connection cables. whose cable shields are attached at both ends.

Shielding can only be omitted if the following conditions are met:

- The cables do not exceed 1 m in length.
- The cables are laid flush with the rear metal wall 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 filter and from unshielded connection cables of the filter with a minimum clearance of 200 mm.

Note

Disconnect the line filter for a high-voltage test

If a high-voltage test is conducted with alternating voltage in the system, the existing line filters must be disconnected in order to obtain accurate measurements.

4.6.3 Overview of line filters

Line filter ranges that are coordinated with the different power stages are available for the SINAMICS S120 drive system.

The line filter versions listed below are available for use with Line Modules.

Table 4-2 Overview of line filters

Line filter	Article No.
Basic Line Filter for Active Line Modules with line reactor	
16 kW	6SL3000-0BE21-6DA.
36 kW	6SL3000-0BE23-6DA1
55 kW	6SL3000-0BE25-5DA.
Basic Line Filter for Active Line Modules with Active Interface Modules	
16 kW	6SL3000-0BE21-6DA.
36 kW	6SL3000-0BE23-6DA1
55 kW	6SL3000-0BE25-5DA.
80 kW	6SL3000-0BE28-0DA.
120 kW	6SL3000-0BE31-2DA.
Basic Line Filter for Basic Line Modules	
20 kW	6SL3000-0BE21-6DA.
40 kW	6SL3000-0BE23-6DA1
100 kW	6SL3000-0BE31-2DA.
Basic Line Filter for Smart Line Modules	
5 kW	6SL3000-0HE15-0AA.
10 kW	6SL3000-0HE21-0AA.
16 kW	6SL3000-0BE21-6DA.
36 kW	6SL3000-0BE23-6DA1
55 kW	6SL3000-0BE25-5DA.

4.6.4 Basic Line Filters for Active Line Modules

4.6.4.1 Description

Basic Line Filters for Active Line Modules are designed to attenuate conducted interference emissions in accordance with the specifications contained in the relevant EMC directive. They are mainly effective in the frequency range from 150 kHz to 30 MHz; this is the range relevant to ensure compliance with the appropriate standard.

Basic Line Filters can be used in conjunction with a line reactor for 16 kW, 36 kW, and 55 kW Active Line Modules or with an Active Interface Module for 16 kW, 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules. Data regarding the radio interference voltage categories and maximum total cable lengths that can be achieved[1)] see Chapter Combination options, Line Modules with line reactors and line filters (Page 124).

[1] Maximum total cable length = Σ motor cables, line feeder cable from line filter to Line Module

Note

Use of unshielded cables for short distances

Shielded cables should always be routed from the line filter via the Active Interface Module to the Active Line Module. Because the bending radiuses cannot be maintained for short distances, unshielded cables can also be used for cable lengths less than 1 m.

The Basic Line Filters can be used in accordance with the following general conditions for ensuring CE conformity with regard to cable-borne interference:

- The machine/system must only be used in industrial line supplies
- Only connect Basic Line Filters to line supplies with grounded neutral point (TN or TT), otherwise an isolating transformer is required
- Number of axes ≤ 12 when using a Basic Line Filter with an Active Line Module and a line reactor

4.6.4.2 Interface description

Overview

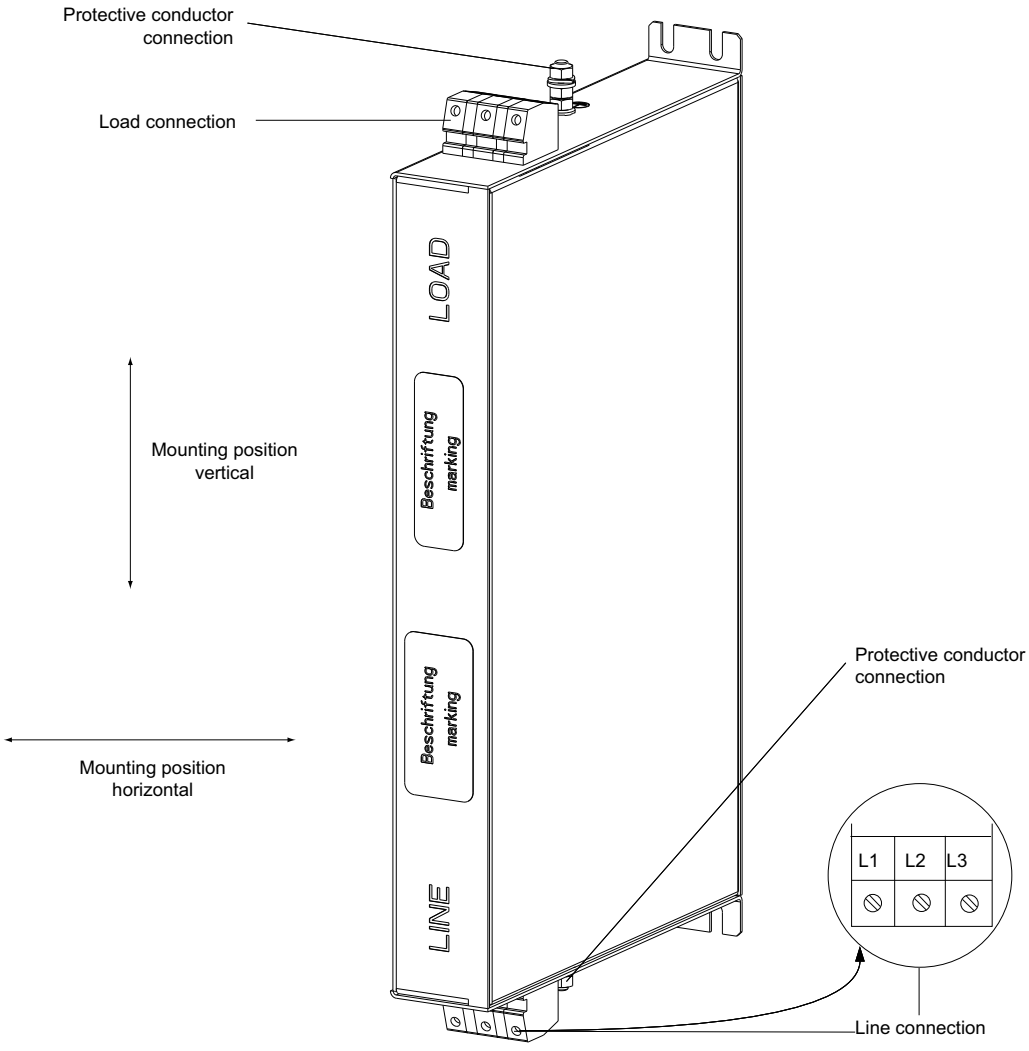


Figure 4-6 Interface overview, Basic Line Filter for Active Line Modules (example: 16 kW)

When connecting the protective conductor, either the upper or the lower screw can be used. One of the screws remains unused. "Looping-through" the protective connection to the line reactor is not permissible.

Line/load connection

Table 4-3 Line and load connection, Basic Line Filter for Active Line Modules

6SL3000-	0BE21-6DA.	0BE23-6DA1	0BE25-5DA.	0BE28-0DA.	0BE31-2DA.
Rated power [kW]	16	36	55	80	120
Line supply connection L1, L2, L3	Screw terminals 10 mm² (AWG 8), 3-pole 1.5 ... 1.8 Nm (15.9 lbf in)	Screw terminals 35 mm² (AWG 2), 3-pole 3.2 ... 3.7 Nm (32.7 lbf in)	Screw terminals 50 mm² (AWG 1), 3-pole 6 ... 8 Nm (70.1 lbf in)	Screw terminals 95 mm² (AWG 3/0), 3-pole 15 ... 20 Nm (177 lbf in)	
Load connection L1´, L2´, L3´,					
Protective conductor connection[1)]	Terminal stud M6 / 6 Nm (53.1 lbf in)		Terminal stud M8 / 8 Nm (70.1 lbf in)	Terminal stud M10 / 10 Nm (88.5 lbf in)	
[1)] For ring cable lugs without insulation (Page 487)					

4.6.4.3 Dimension drawings

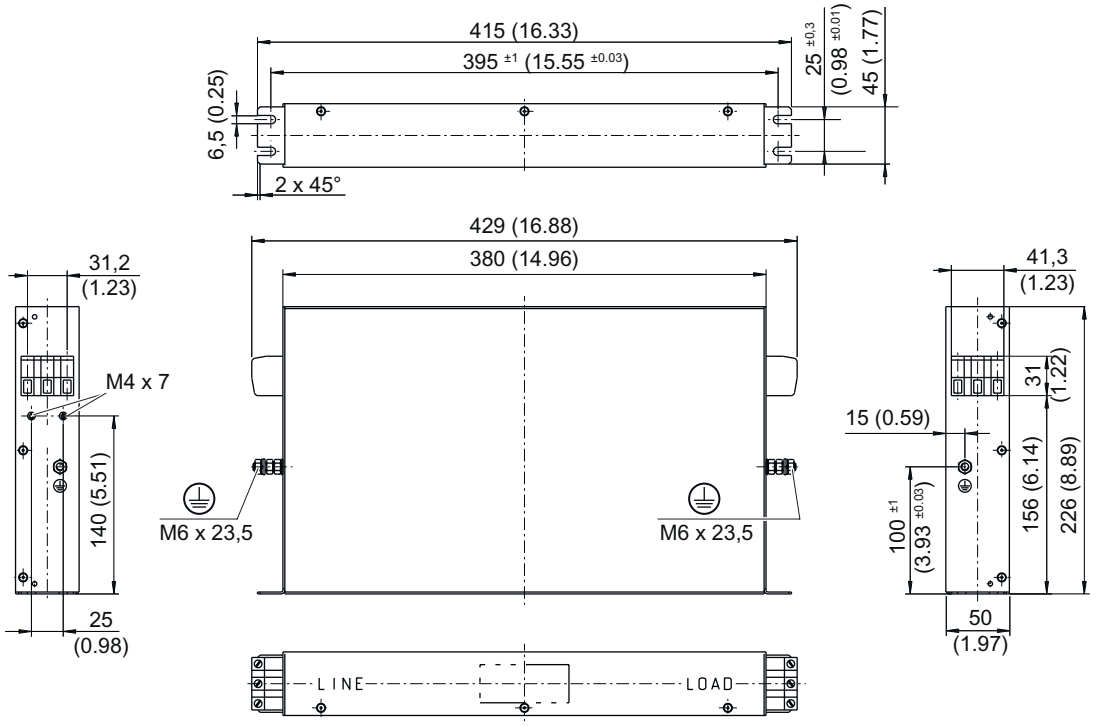


Figure 4-7 Dimension drawing of the Basic Line Filter for Active Line Modules 16 kW, all data in mm and (inches)

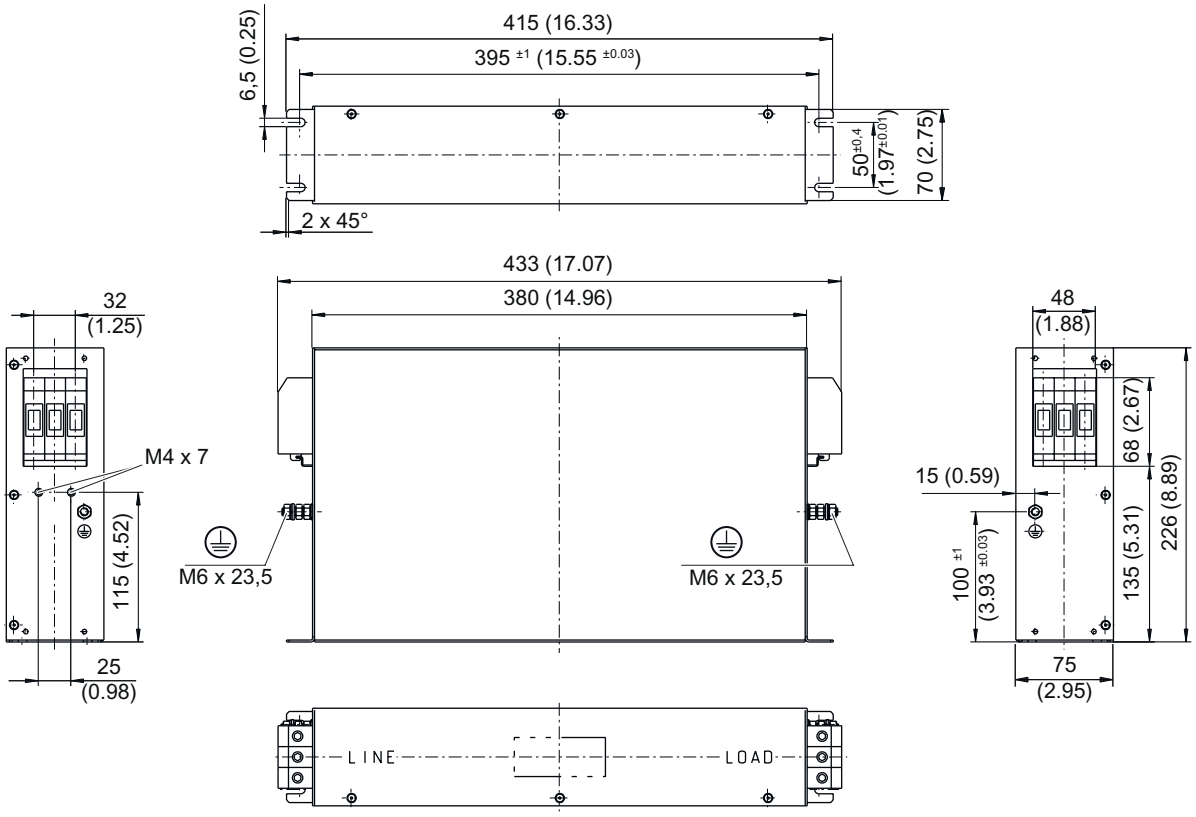


Figure 4-8 Dimension drawing of Basic Line Filter for Active Line Modules 36 kW, all data in mm and (inches)

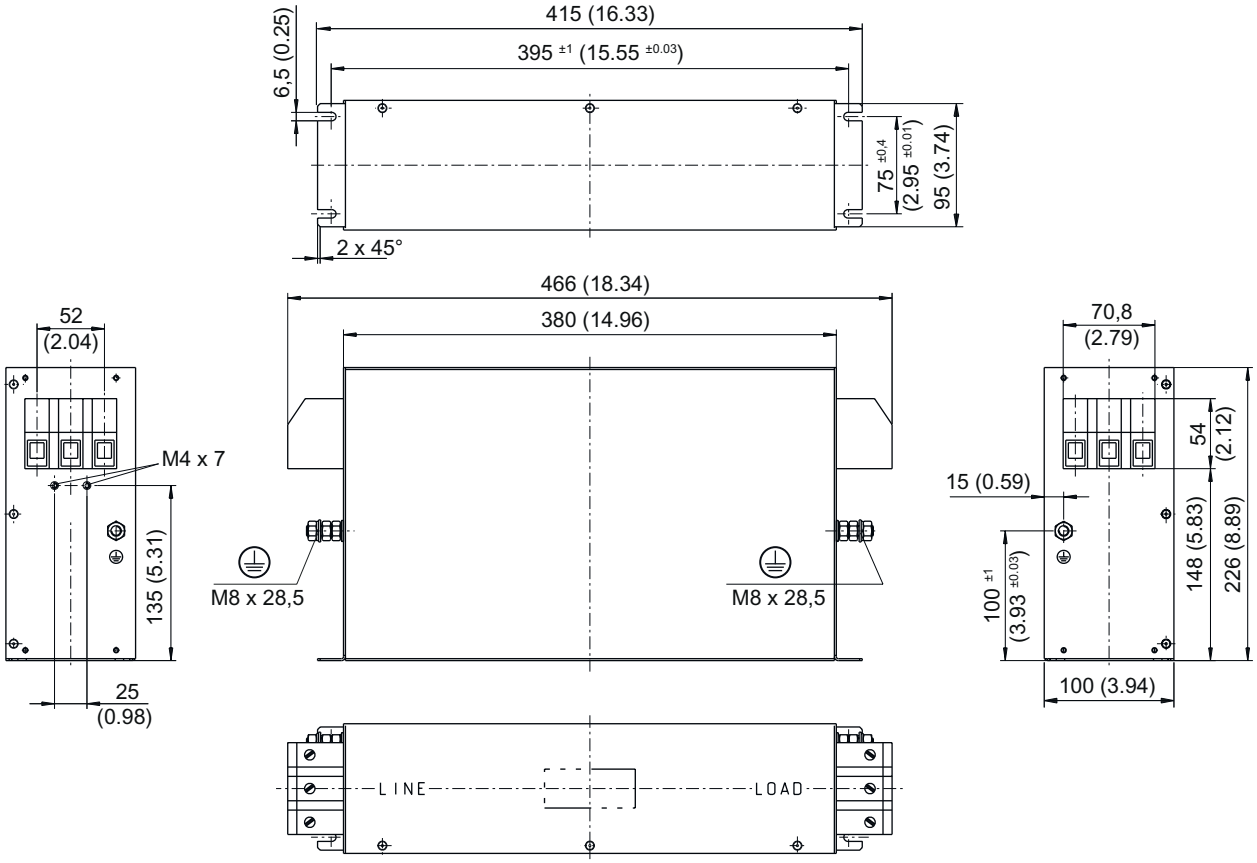


Figure 4-9 Dimension drawing of Basic Line Filter for Active Line Modules 55 kW, all data in mm and (inches)

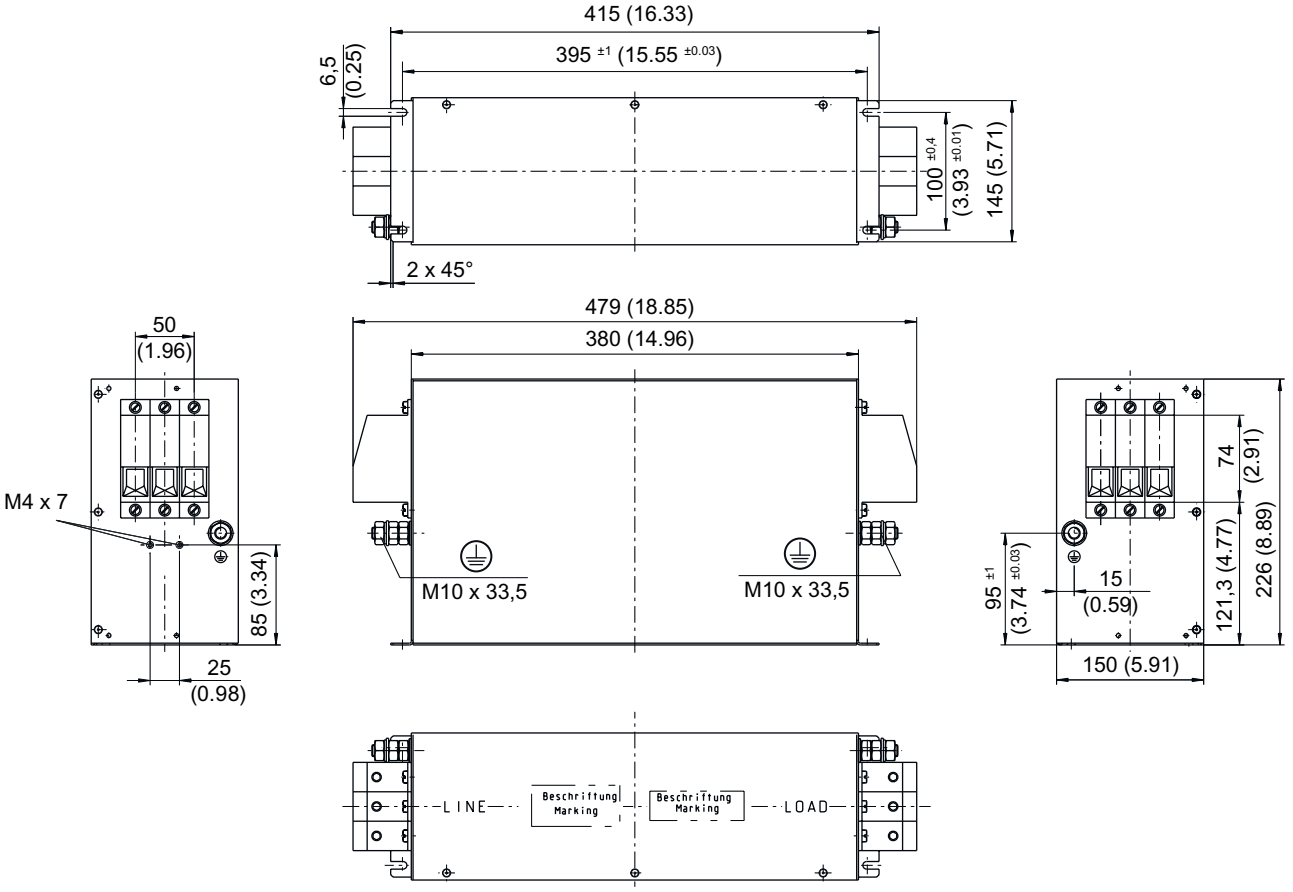


Figure 4-10 Dimension drawing of Basic Line Filter for Active Line Modules 80 kW and 120 kW, all dimensions in mm and (inches)

4.6.4.4 Technical data

Table 4-4 Technical data of the Basic Line Filter for Active Line Modules with Active Interface Module

	6SL3000-	0BE21-6DA.	0BE23-6DA1	0BE25-5DA.	0BE28-0DA.	0BE31-2DA.
Rated power	kW	16	36	55	80	120
Supply voltage: Line voltage Line frequency	 V_{AC} Hz	 3 AC 380 -10 % (-15 % < 1 min) ... 3 AC 480 +10 % 47 ... 63 Hz				
Rated current	A_{AC}	36	74	105	132	192
Power loss (see power loss tables (Page 503))	W	16	26	43	56	73
Weight	kg	5	7.5	11.5	17.5	18.5
Mounting position		Any				

4.6.5 Basic Line Filter for Basic Line Modules

4.6.5.1 Description

Basic Line Filters for Basic Line Modules are designed to attenuate conducted interference emissions in accordance with the specifications contained in the relevant EMC legislation. They are mainly effective in the frequency range from 150 kHz to 30 MHz; this is the range relevant to ensure compliance with the appropriate standard.
The machine manufacturer must certify that the machine to be launched on the market is in accordance with the EC EMC Directive.

Basic Line Filters for Basic Line Modules can be used in conjunction with the associated line reactors.

Data regarding the radio interference voltage categories and maximum total cable lengths that can be achieved[1)] see Chapter Combination options, Line Modules with line reactors and line filters (Page 124).

Basic Line Filters must always be connected to line supplies with grounded neutral point (TN or TT). An isolating transformer is required for other power systems.

[1)] Maximum total cable length = Σ motor cables, line supply conductor from line filter to Line Module

4.6.5.2 Interface description

Overview

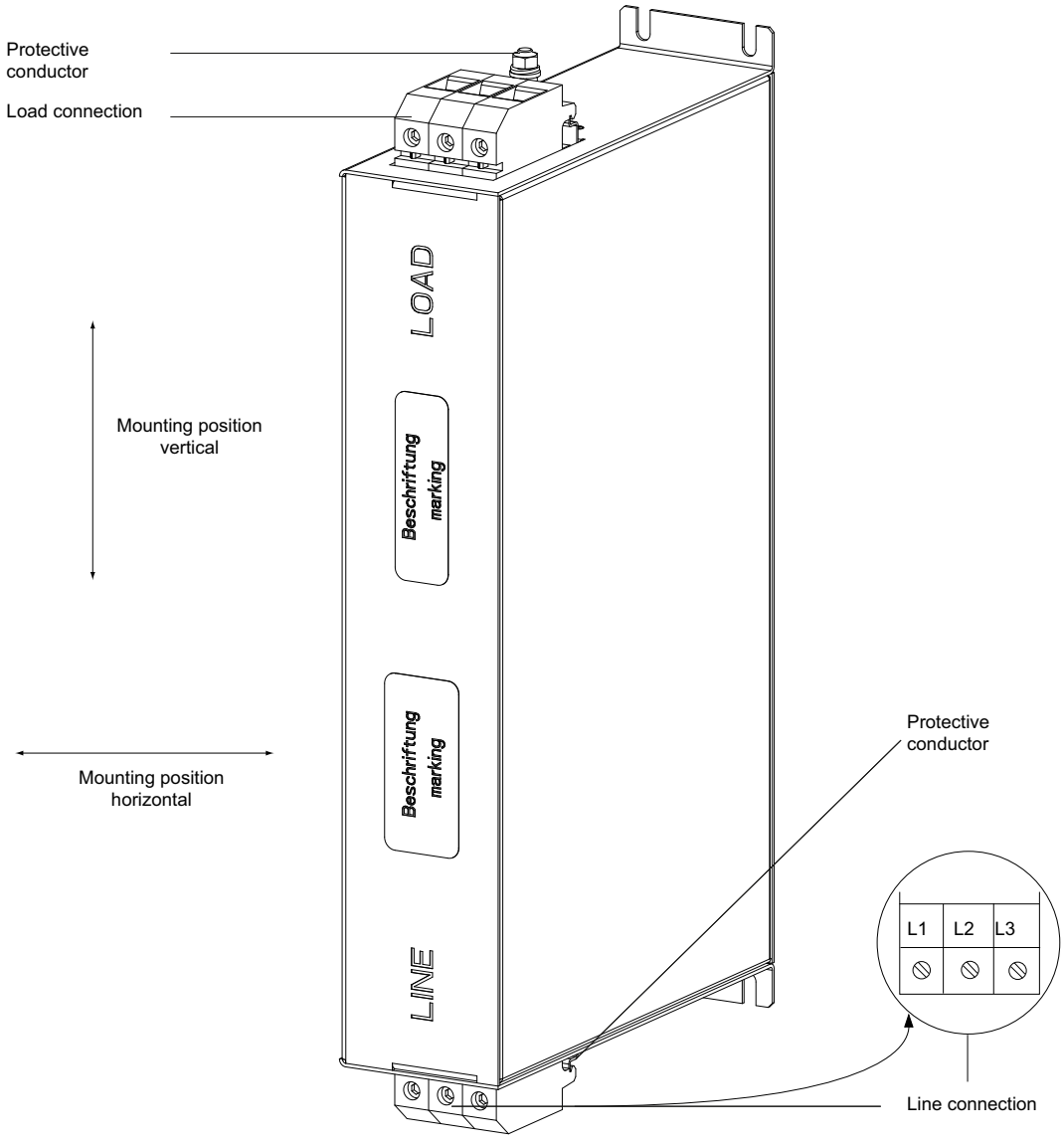


Figure 4-11 Interface overview, Basic Line Filter for Basic Line Modules (example: 40 kW)

When connecting the protective conductor, either the upper or the lower screw can be used. One of the screws remains unused. "Looping-through" the protective connection to the line reactor is not permissible.

Line/load connection

Table 4-5 Line and load connection, Basic Line Filter for Basic Line Modules

6SL3000-	0BE21-6DA.	0BE23-6DA1	0BE31-2DA.
Rated power [kW]	20	40	100
Line supply connection L1, L2, L3	Screw terminals 10 mm² (AWG 8), 3-pole 1.5 ... 1.8 Nm (15.9 lbf in)	Screw terminals 35 mm² (AWG 2), 3-pole 3.2 ... 3.7 Nm (32.7 lbf in)	Screw terminals 95 mm² (AWG 3/0), 3-pole 15 ... 20 Nm (177 lbf in)
Load connection L1´, L2´, L3´			
Protective conductor connection[1)]	Terminal stud M6 / 6 Nm (53.1 lbf in)	Terminal stud M6 / 6 Nm (53.1 lbf in)	Terminal stud M10 / 10 Nm (88.5 lbf in)
[1)] For ring cable lugs without insulation (Page 487)			

4.6.5.3 Dimension drawings

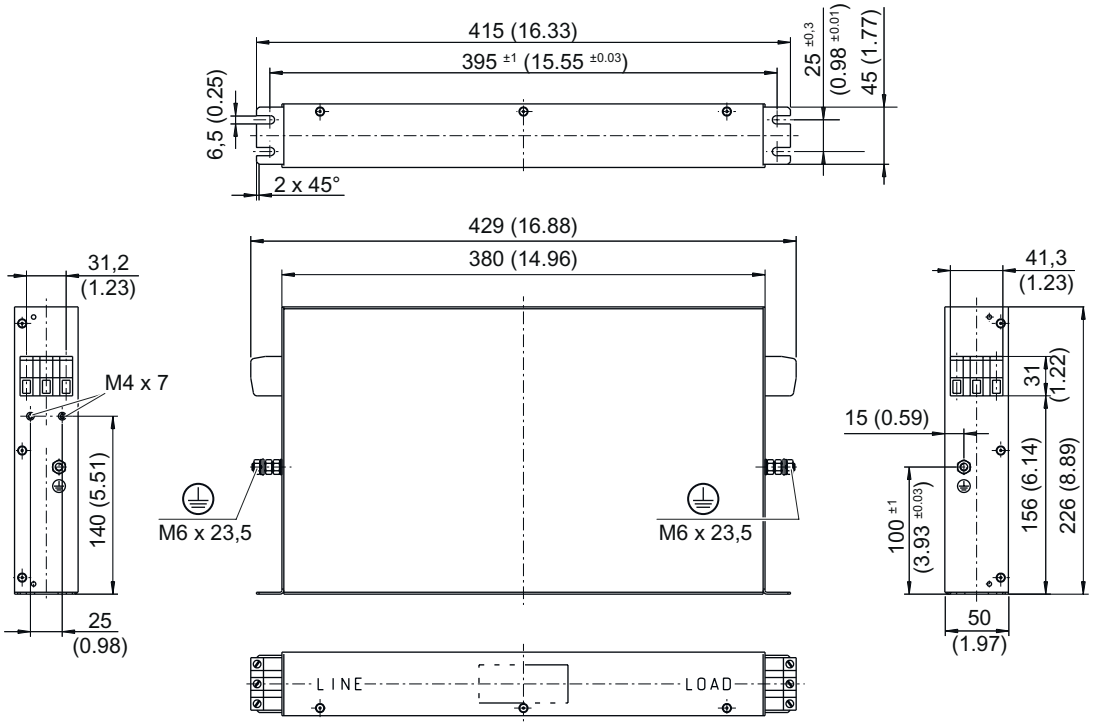


Figure 4-12 Dimension drawing of Basic Line Filter for Basic Line Modules 20 kW, all data in mm and (inches)

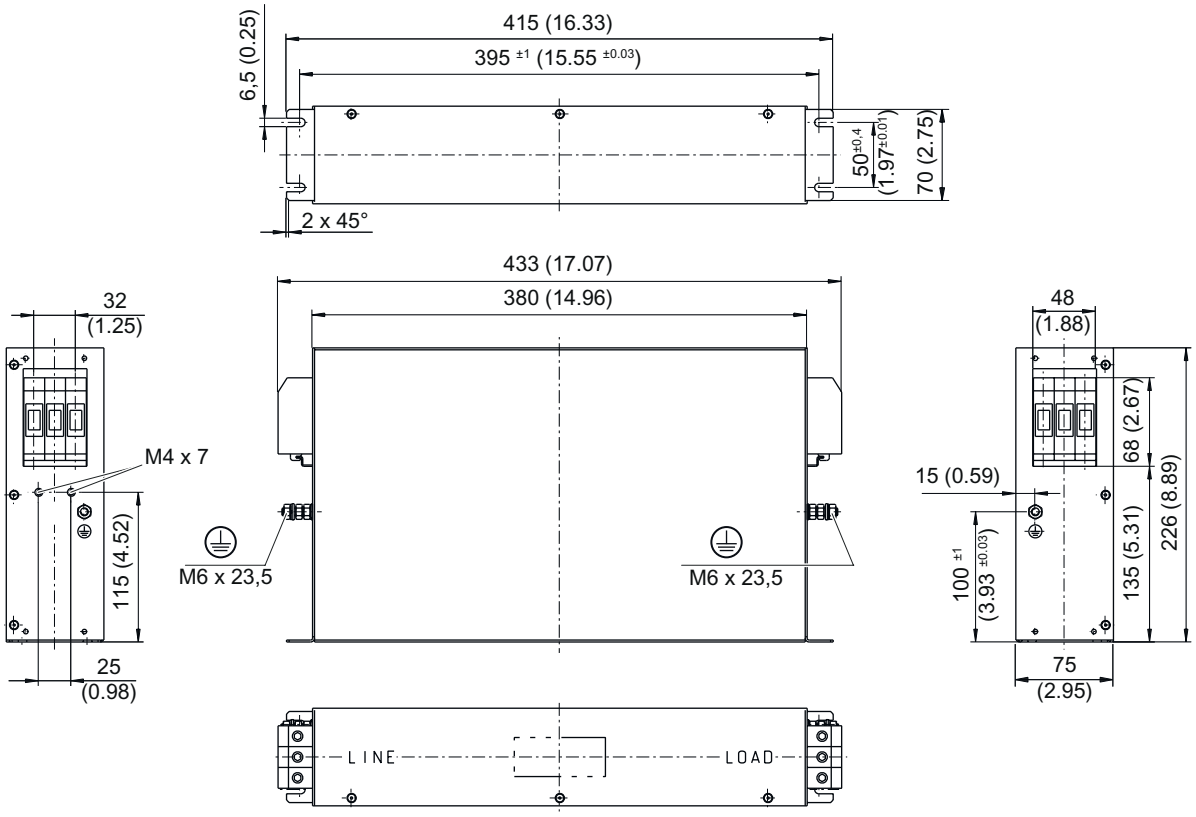


Figure 4-13 Dimension drawing of Basic Line Filter for Basic Line Modules 40 kW, all data in mm and (inches)

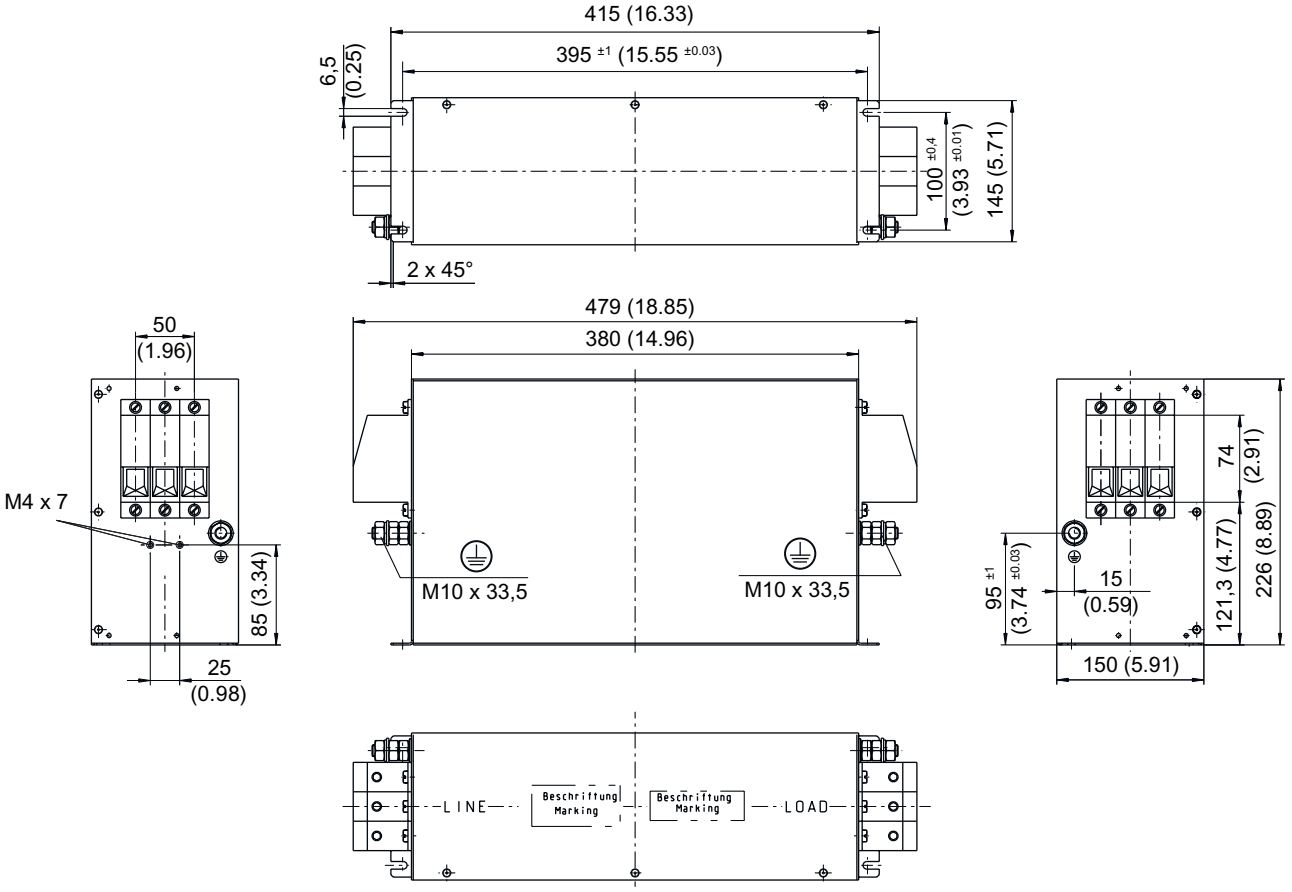


Figure 4-14 Dimension drawing of Basic Line Filter for Basic Line Modules 100 kW, all data in mm and (inches)

4.6.5.4 Technical specifications

Table 4-6 Technical data for Basic Line Filter for Basic Line Modules

	6SL3000-	**0BE21-6DA.**	**0BE23-6DA1**	**0BE31-2DA.**
Rated power	kW	20	40	100
Supply voltage: Line voltage Line frequency	 V_{AC} Hz	 3 AC 380 -10 % (-15 % < 1 min) ... 3 AC 480 +10 % 47 ... 63 Hz		
Rated current	A_{AC}	36	74	192
Power loss (see power loss tables (Page 503))	W	16	26	43
Weight	kg	5	7.5	18.5
Mounting position		Any		

4.6.6 Basic Line Filter for Smart Line Modules

4.6.6.1 Description

Basic Line Filters for Smart Line Modules are designed to attenuate conducted interference emissions in accordance with the specifications contained in the relevant EMC legislation. They are mainly effective in the frequency range from 150 kHz to 30 MHz; this is the range relevant to ensure compliance with the appropriate standard.

Basic Line Filters for Smart Line Modules can be used in conjunction with the associated line reactors.

Data regarding the radio interference voltage categories and maximum total cable lengths that can be achieved[1)] see Chapter Combination options, Line Modules with line reactors and line filters (Page 124).

Basic Line Filters must always be connected to line supplies with grounded neutral point (TN or TT). An isolating transformer is required for other power systems.

[1)] Maximum total cable length = Σ motor cables, line supply conductor from line filter to Line Module

4.6.6.2 Interface description

Overview

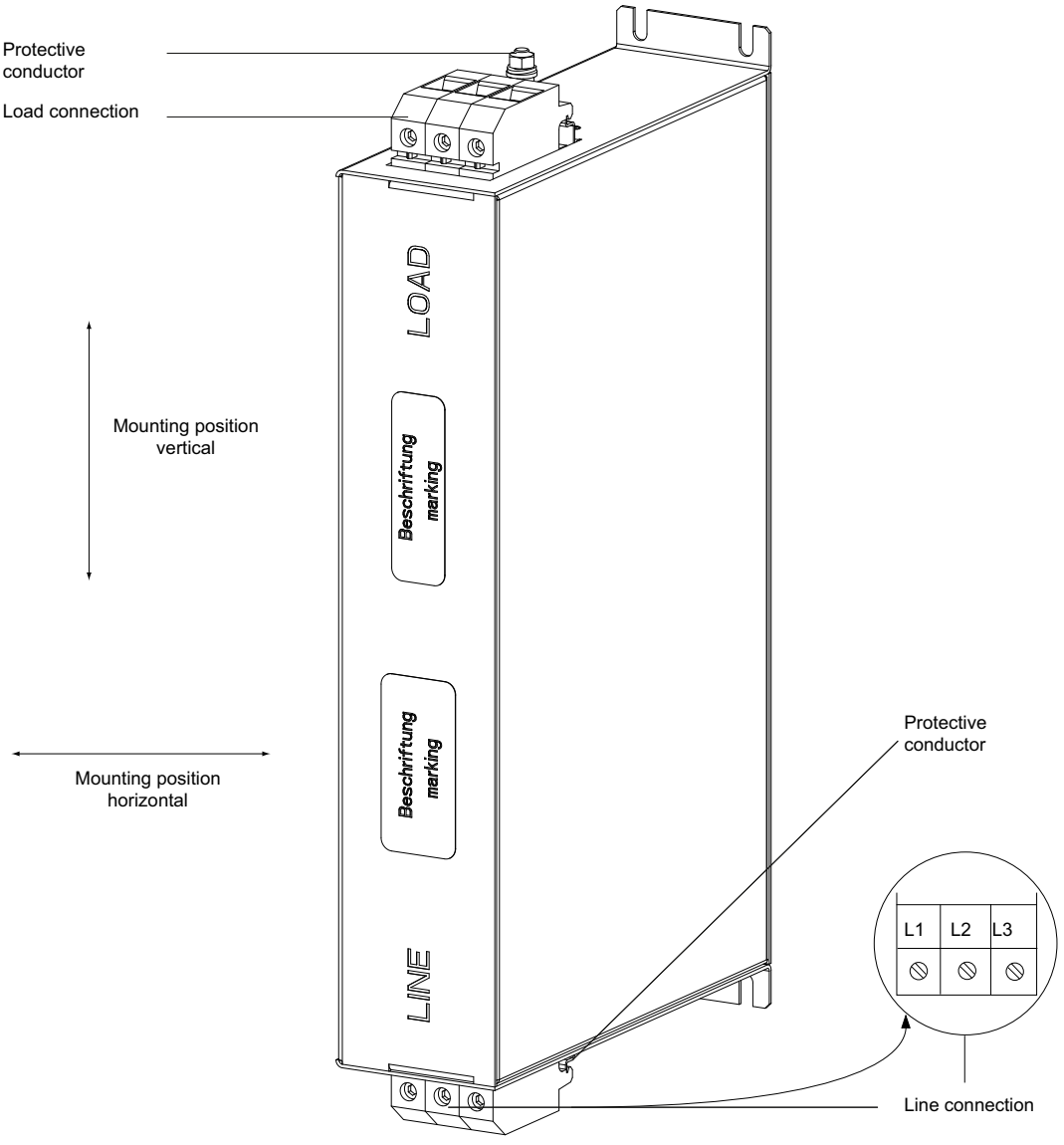


Figure 4-15 Interface overview, Basic Line Filter for Smart Line Modules (example: 36 kW)

When connecting the protective conductor, either the upper or the lower screw can be used. One of the screws remains unused. "Looping-through" the protective connection to the line reactor is not permissible.

Line/load connection

Table 4-7 Line and load connection, Basic Line Filter for Smart Line Modules

6SL3000-	0HE15-0AAx	0HE21-0AA.	0BE21-6DA.	0BE23-6DA1	0BE25-5DA.
Rated power [kW]	5	10	16	36	55
Line connection L1, L2, L3	Screw terminals 10 mm² (AWG 8), 3-pole 1.2 ... 1.5 Nm (15 lbf in)		Screw terminals 10 mm² (AWG 8), 3-pole 1.5 ... 1.8 Nm (15.9 lbf in)	Screw terminals 35 mm² (AWG 2), 3-pole 3.2 ... 3.7 Nm (32.7 lbf in)	Screw terminals 50 mm² (AWG 1), 3-pole 6 ... 8 Nm (70.1 lbf in)
Load connection L1´, L2´, L3´					
PE/ground connection[1)]	Terminal stud M6 / 6 Nm (53.1 lbf in)			Terminal stud M6 / 6 Nm (53.1 lbf in)	Terminal stud M8 / 8 Nm (70.1 lbf in)
[1)] For ring cable lugs without insulation (Page 487)					

4.6.6.3 Dimension drawings

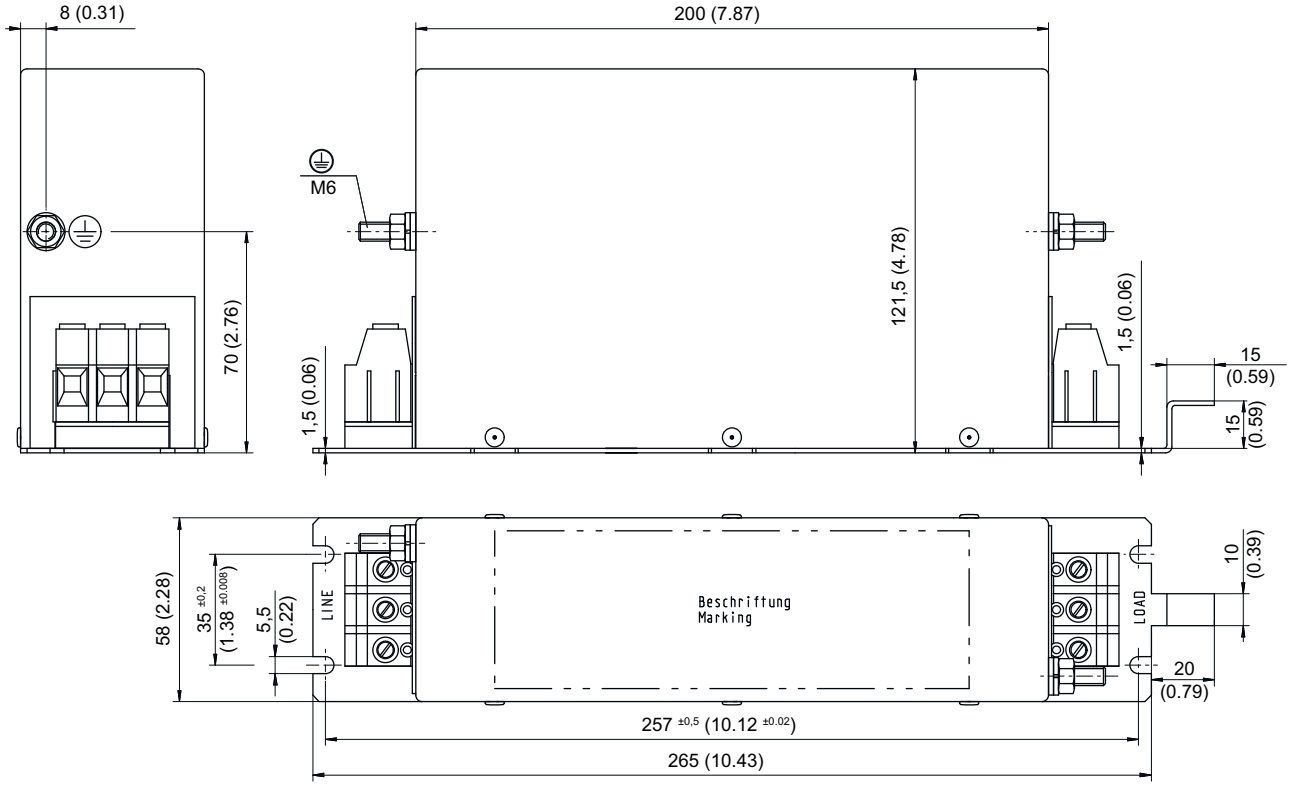


Figure 4-16 Dimension drawing of Basic Line Filter for 5 kW and 10 kW Smart Line Modules, all dimensions in mm and (inches)

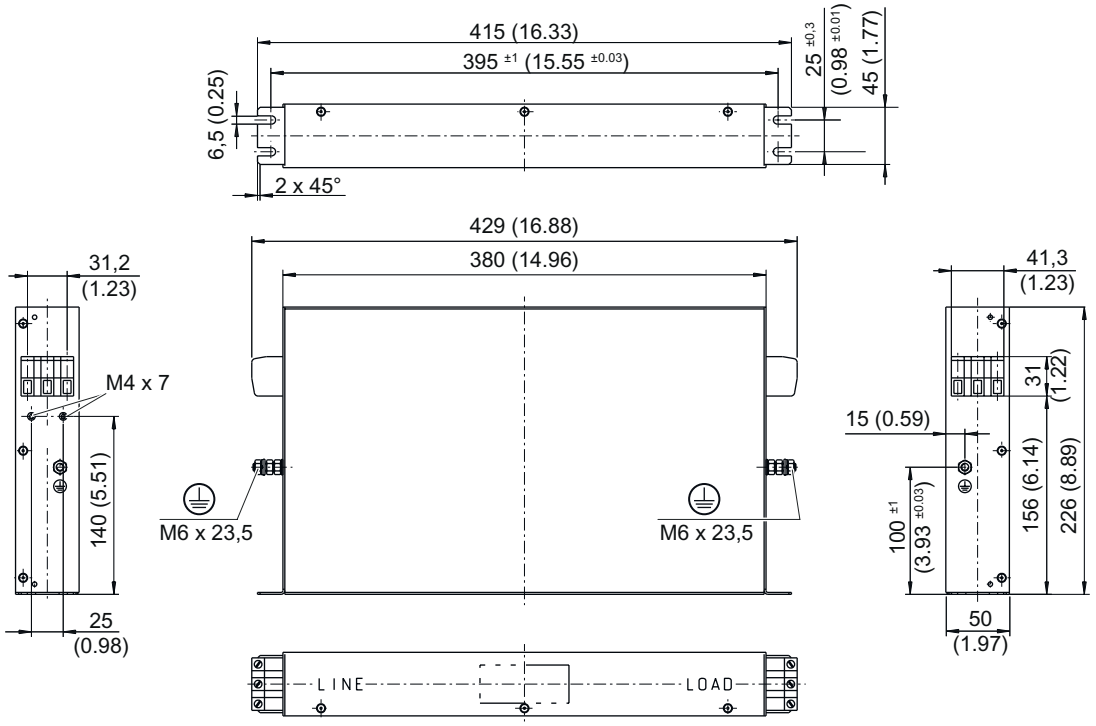


Figure 4-17 Dimension drawing of Basic Line Filter for Smart Line Modules 16 kW, all data in mm and (inches)

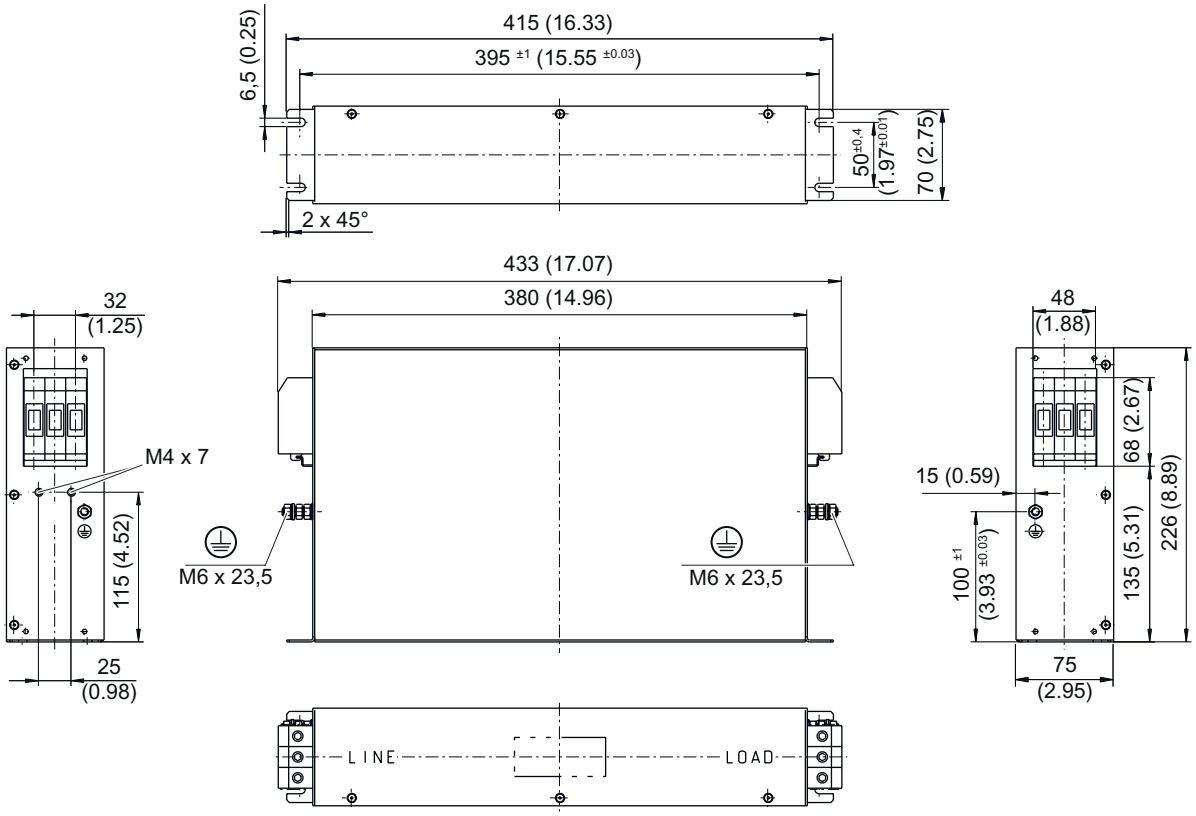


Figure 4-18 Dimension drawing of Basic Line Filter for Smart Line Modules 36 kW, all data in mm and (inches)

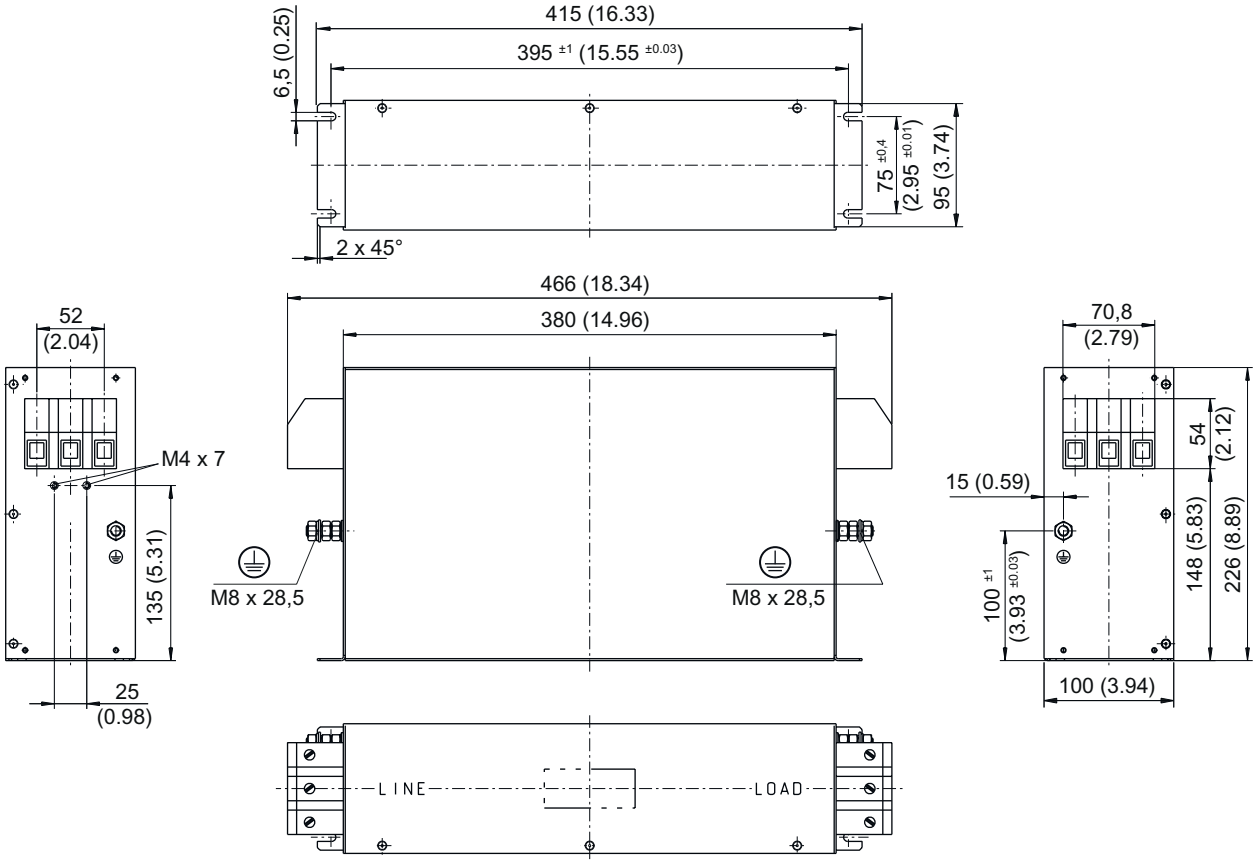


Figure 4-19 Dimension drawing of Basic Line Filter for Smart Line Modules 55 kW, all data in mm and (inches)

4.6.6.4 Technical data

Table 4-8 Technical data for: Basic Line Filter for Smart Line Modules

	6SL3000-	0HE15-0AA.	0HE21-0AA.	0BE21-6DA.	0BE23-6DA1	0BE25-5DA.
Rated power	kW	5	10	16	36	55
Supply voltage: Line voltage Line frequency	 V_{AC} Hz	 3 AC 380 -10 % (-15 % < 1 min) ... 3 AC 480 +10 % 47 ... 63				
Rated current	A_{AC}	12	24	36	74	105
Power loss (see power loss tables (Page 503))	W	20	20	16	26	43
Weight	kg	2.1	2.3	5	7.5	11.5
Mounting position		Any				

4.7 Line reactors

4.7.1 Description

Line reactors limit line harmonics to permissible values. For this reason, line reactors should always be used.

They must be used in conjunction with Active Line Modules as an energy storage device so that the modules can function.

4.7.2 Safety instructions for line reactors



⚠ WARNING

Electric shock in the event of missing touch protection

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

- For line reactors with degree of protection IP00, use touch protection according to IPXXA or corresponding to local installation regulations.



⚠ WARNING

High voltages on the additional winding of the HFD line reactor

If system oscillations do occur and no damping resistor is connected, impermissibly high voltages may arise on the additional winding of the HFD line reactor.

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

- Connect a damping resistor to the HFD line reactor.



⚠ 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 clearance of 100 mm on all sides of the line reactors.

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 or Active Interface Modules described in this manual.

Note

Malfunctions through magnetic fields

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 connection 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 can only be omitted if the following conditions are met:

- The cables do not exceed 1 m in length.
- The cables are laid flush with the rear metal wall 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 connection cables of the reactor with a minimum clearance of 200 mm.

4.7.3 Overview of the line reactors

HFD line reactors have an additional winding, to which a separate damping resistor must be connected.

This dampens any possible system oscillations in converter systems to non-critical values. This results in increased operational reliability and extends the service life.

Depending on the parasitic resonance points, as a result of cable capacitances and line supply characteristics, system oscillations can occur with voltage amplitudes that can possibly reduce the service life of components.

Note

Recommendation

Use an Active Interface Module as line connection component for new plants and systems equipped with Active Line Modules.

The line reactors listed below are available for use with Line Modules.

Table 4-9 Overview of line reactors

Line reactors	Article No.
Line reactors for Active Line Modules	
16 kW	6SL3000-0DE21-6AA.
36 kW	6SL3000-0DE23-6AA.
55 kW	6SL3000-0DE25-5AA.
80 kW	6SL3000-0DE28-0AA.
120 kW	6SL3000-0DE31-2AA.
Line reactors for Smart Line Modules	
5 kW	6SL3000-0CE15-0AA.
10 kW	6SL3000-0CE21-0AA.
16 kW	6SL3100-0EE21-6AA.
36 kW	6SL3000-0CE23-6AA.
55 kW	6SL3000-0CE25-5AA.
Line reactors for Basic Line Modules	
20 kW	6SL3000-0CE22-0AA.
40 kW	6SL3000-0CE24-0AA.
100 kW	6SL3000-0CE31-0AA.

4.7.4 Line reactors for Active Line Modules

4.7.4.1 Interface description

Overview

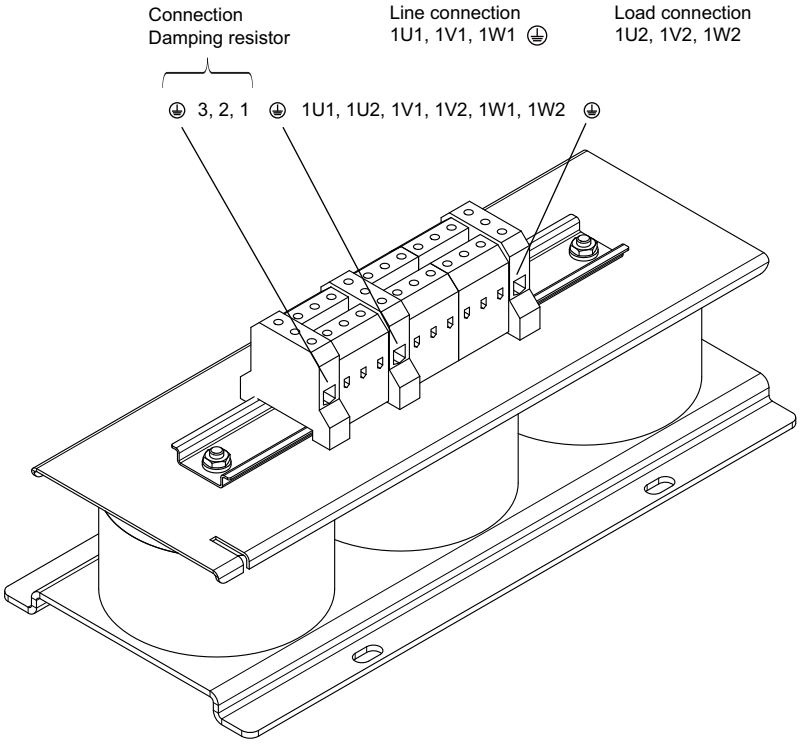


Figure 4-20 Interface overview, HFD line reactor 16 kW

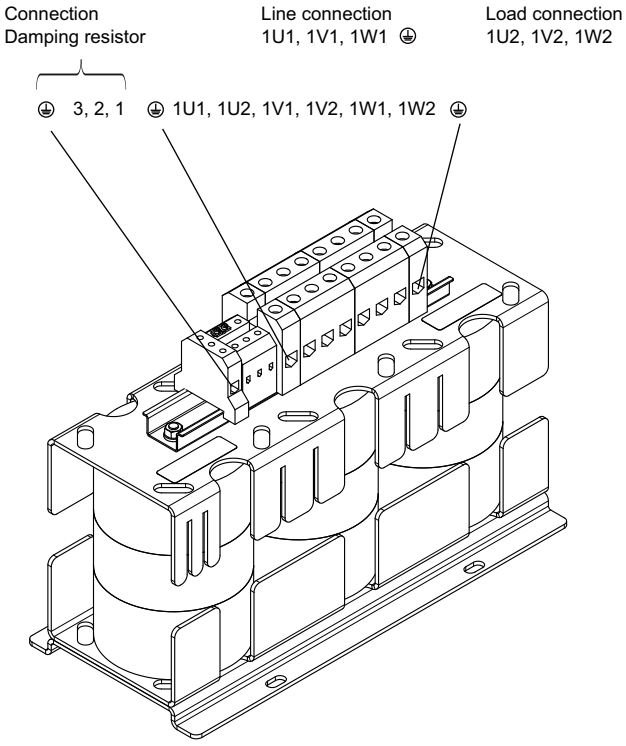


Figure 4-21 Interface overview, HFD line reactor 36 kW

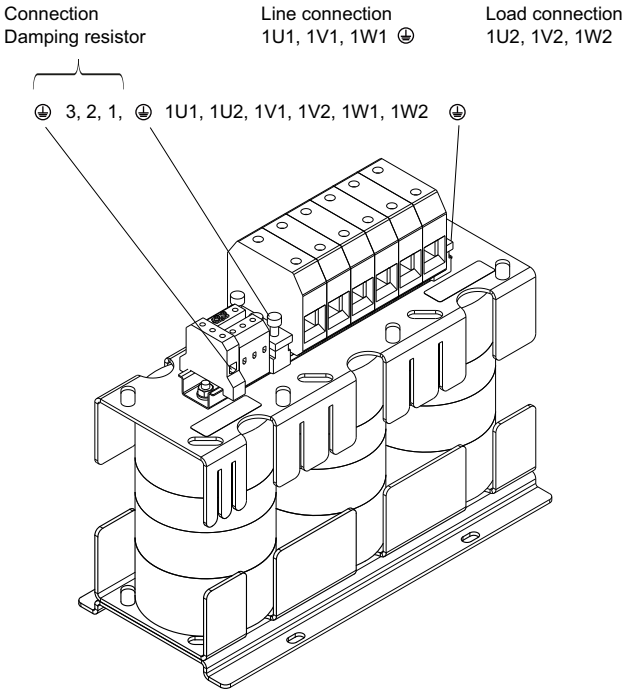


Figure 4-22 Interface overview, HFD line reactor 55 kW

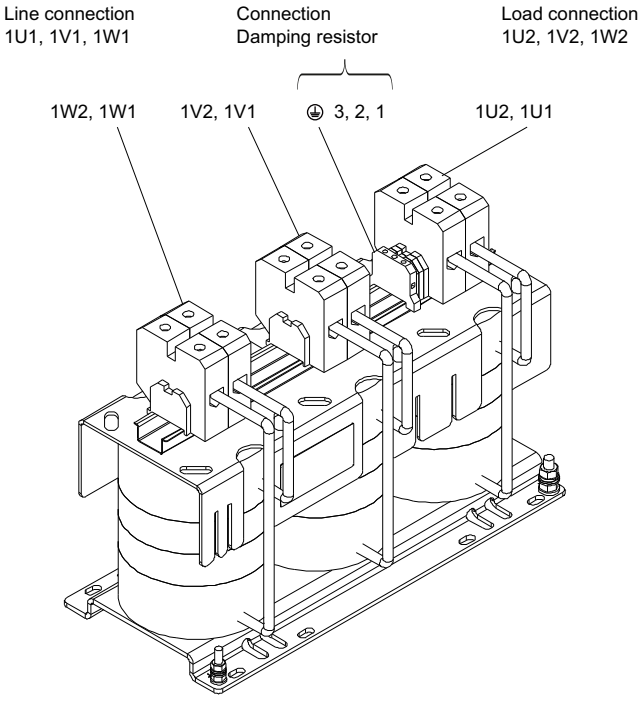


Figure 4-23 Interface overview, HFD line reactor 80 kW

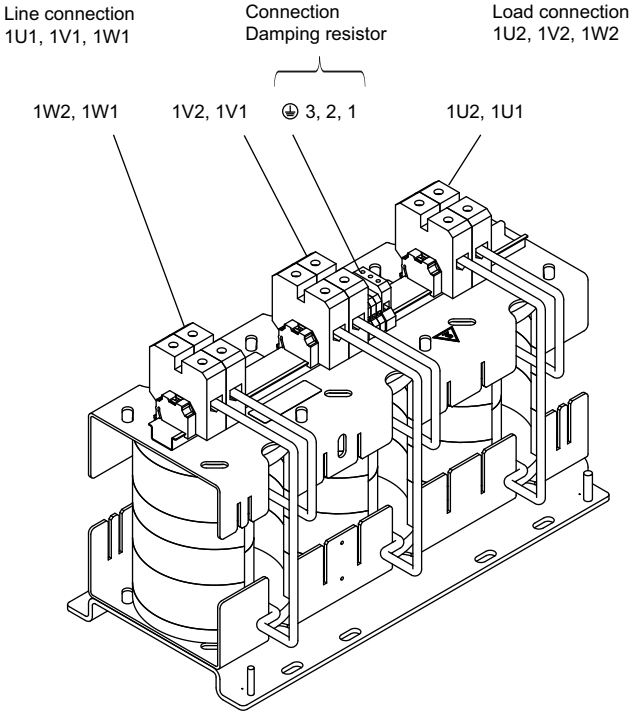


Figure 4-24 Interface overview, HFD line reactor 120 kW

Line/load connection

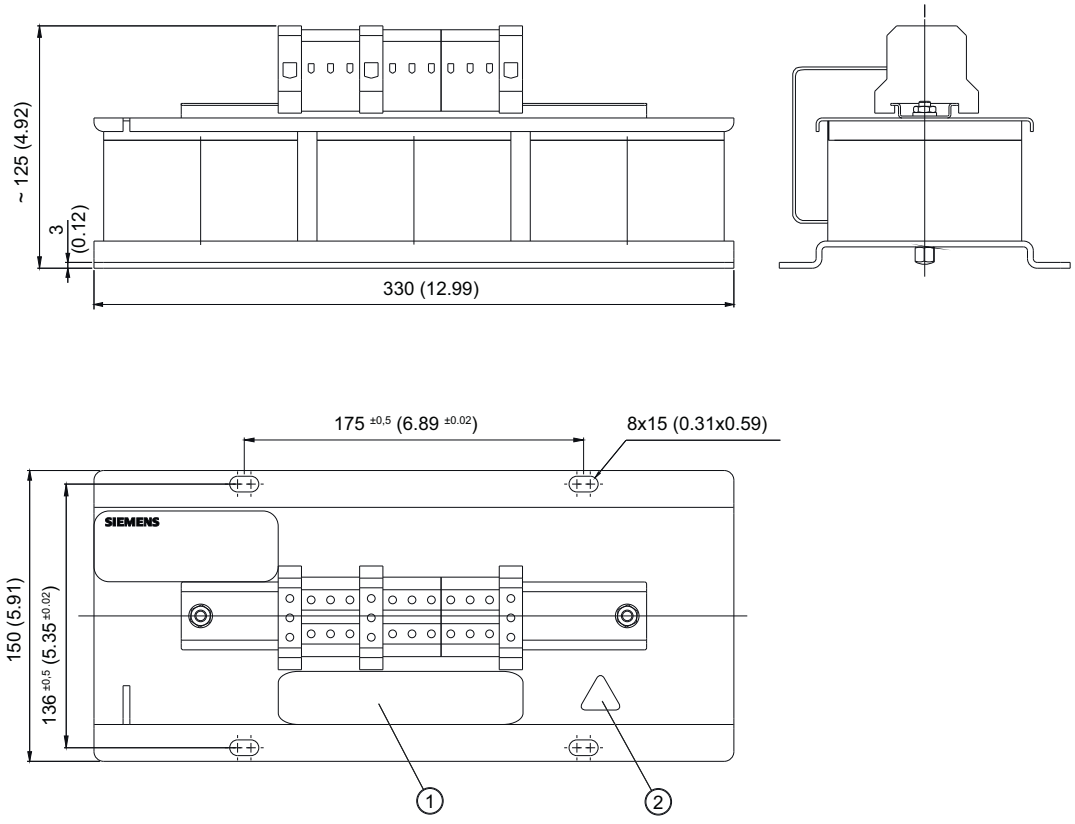
Table 4-10 Connection of HFD line reactors

Article No.	6SL3000-0DE21-6AA.	6SL3000-0DE23-6AA.	6SL3000-0DE25-5AA.	6SL3000-0DE28-0AA.	6SL3000-0DE31-2AA.
Power [kW]	16	36	55	80	120
Line supply connection 1U1, 1V1, 1W1	Screw terminal 16 mm² (AWG 6) 1.2 Nm (10.6 lbf in)	Screw terminal 35 mm² (AWG 2) 2.5 Nm (22.1 lbf in)	Screw terminal 70 mm² (AWG 2/0) 6 ... 10 Nm (53.1 ... 88.5 lbf in)	Type: Spring-loaded terminal 4 (Page 485) 25 ... 95 mm² (AWG 4 ... AWG 4/0)	
Load connection 1U2, 1V2, 1W2					
PE/ground connection	Screw terminal 16 mm²(AWG 6) 1.2 Nm (10.6 lbf in)	Screw terminal 35 mm² (AWG 2) 2.5 Nm (22.1 lbf in)	Screw terminal 35 mm² (AWG 2) 3.5 Nm (31.0 lbf in)	Terminal stud M8 13 Nm (115 lbf in)	Terminal stud M8 13 Nm (115 lbf in)
Damping resistor connection 1, 2, 3, PE	Screw terminal 16 mm² (AWG 6) 1.2 Nm (10.6 lbf in)	Screw terminal 16 mm² (AWG 6) 1.2 Nm (10.6 lbf in)	Screw terminal 16 mm² (AWG 6) 2.5 Nm (22.1 lbf in)	Screw terminal 4 mm² (AWG 6) 0.8 Nm (7.08 lbf in)	Screw terminal 16 mm² (AWG 6) 2.5 Nm (22.1 lbf in)

Note

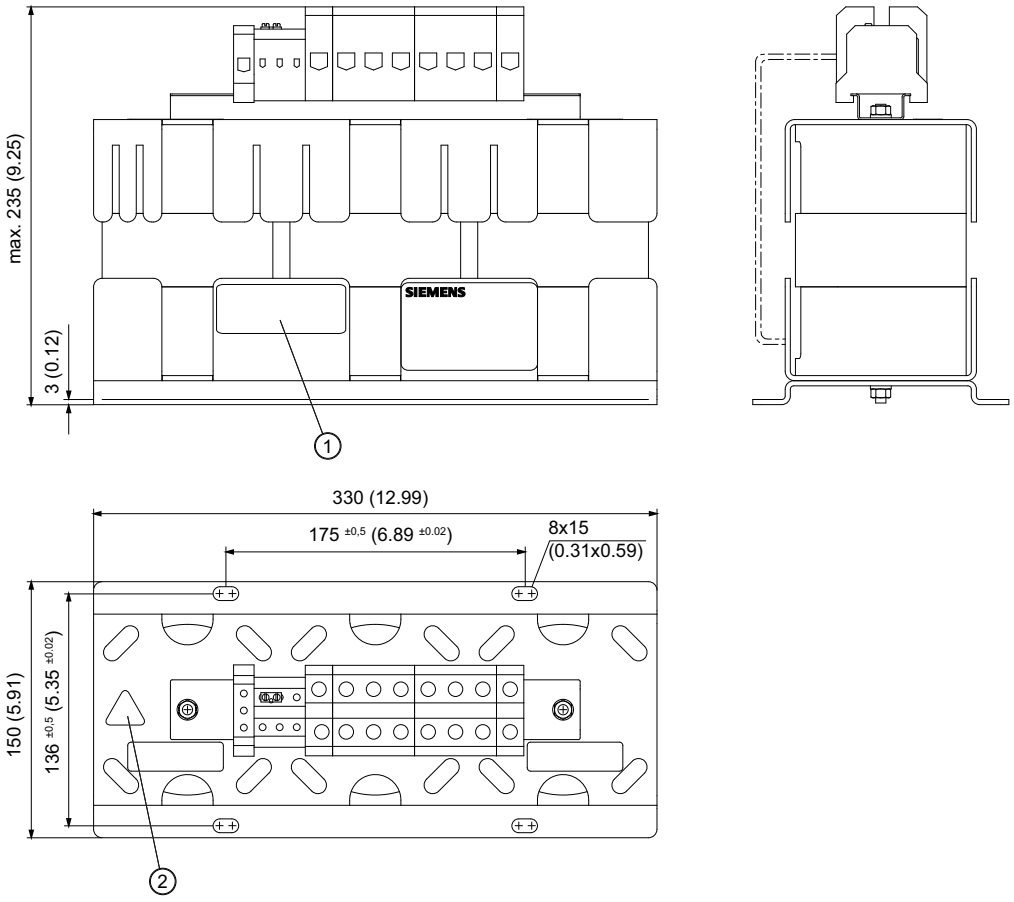
Data relating to the permissible tightening torques can also be found on the label showing the terminal layout of the screw terminal for the corresponding HFD line reactor.

4.7.4.2 Dimension drawings



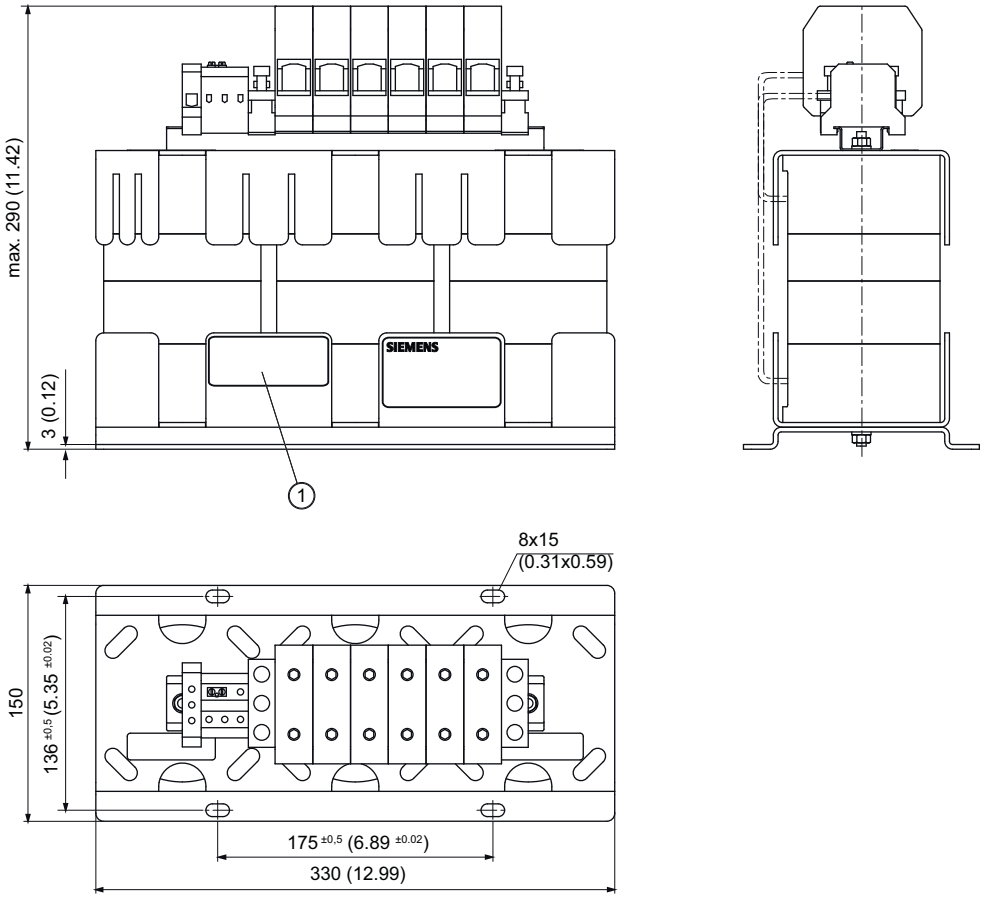
① Terminal arrangement
② Warning label

Figure 4-25 Dimension drawing of HFD line reactor 16 kW, all dimensions in mm and (inches)



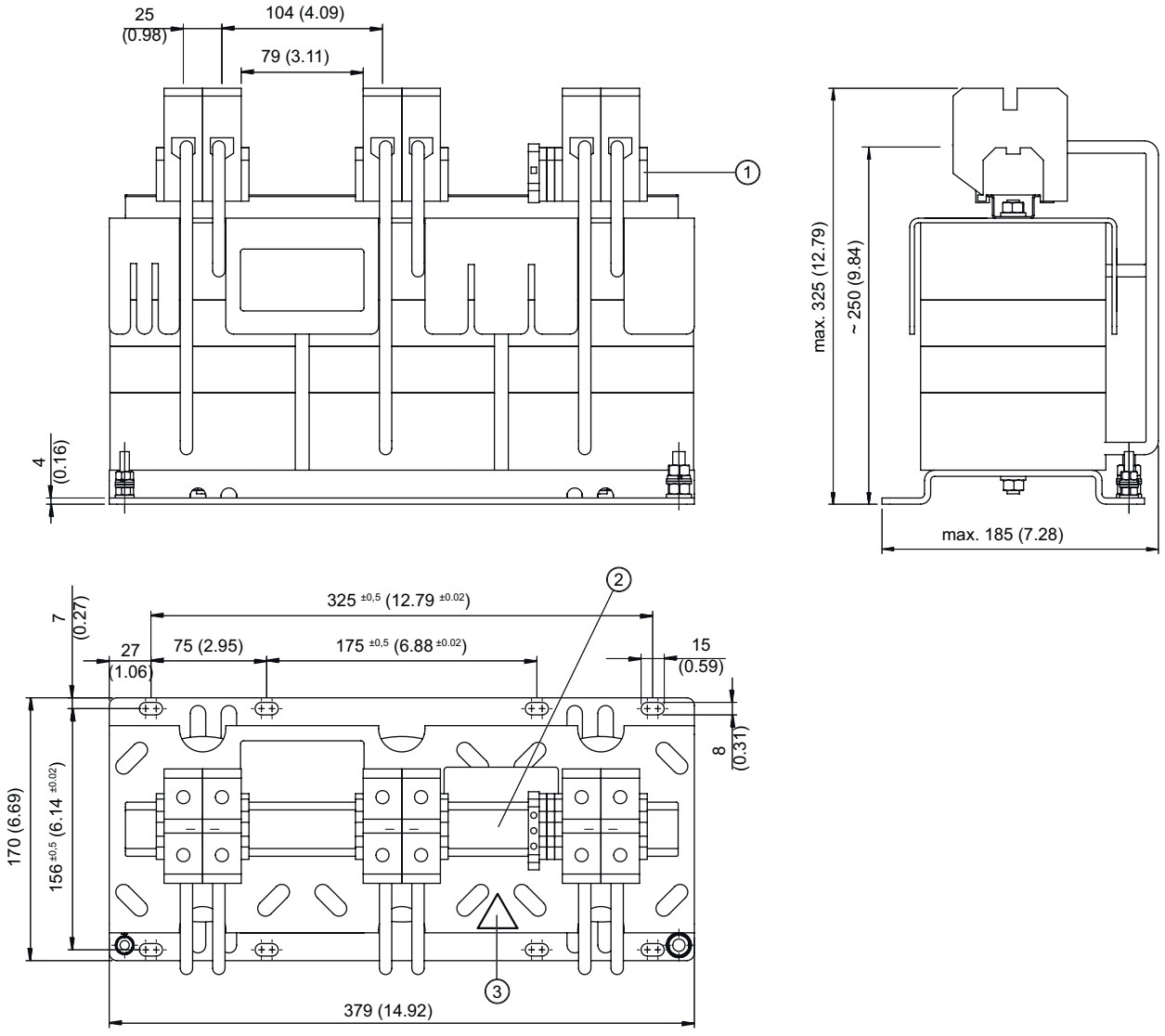
① Terminal arrangement
② Warning label

Figure 4-26 Dimension drawing of HFD line reactor 36 kW, all dimensions in mm and (inches)



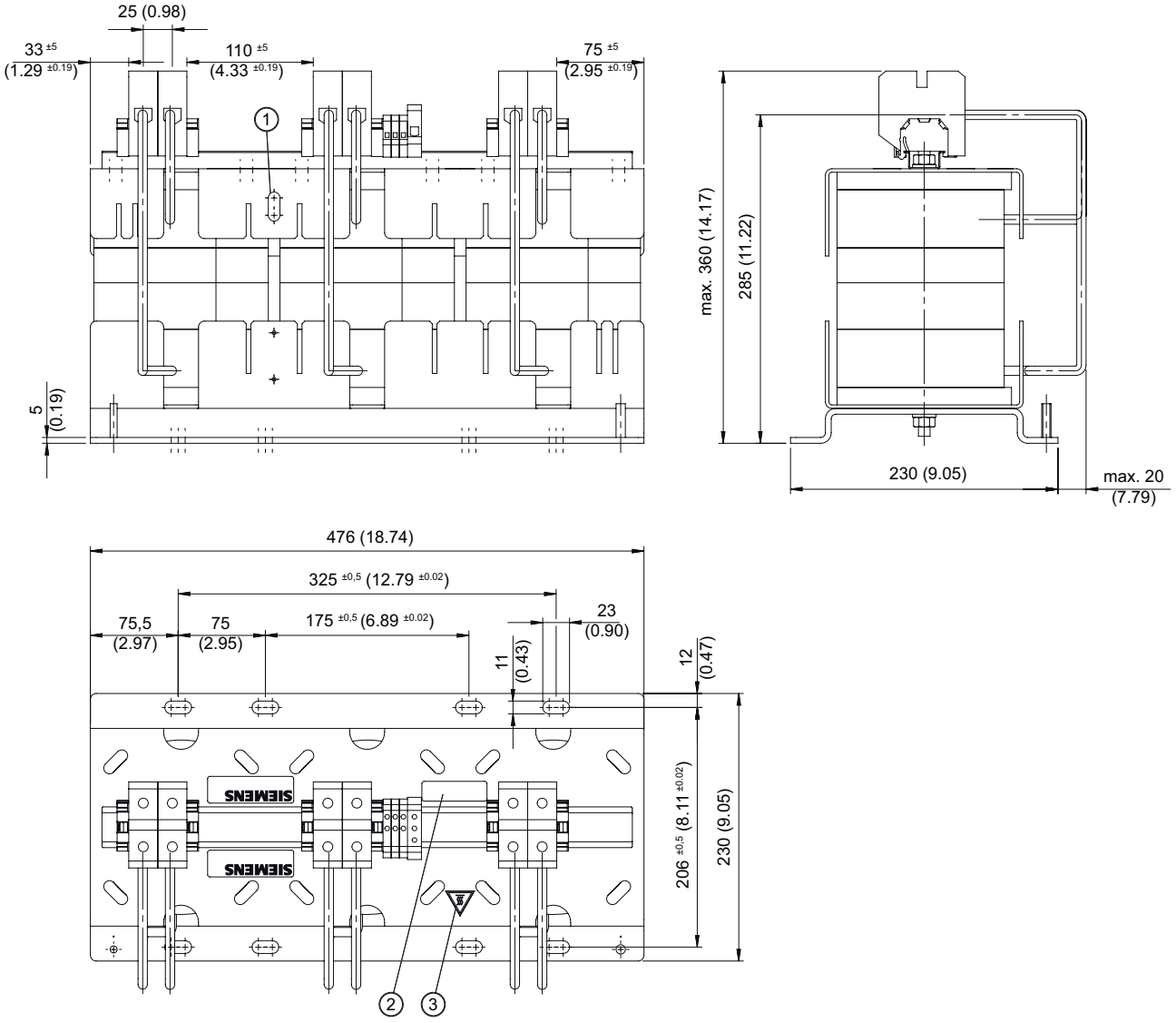
① Terminal arrangement

Figure 4-27 Dimension drawing of HFD line reactor 55 kW, all dimensions in mm and (inches)



① End retainers
② Terminal arrangement
③ Warning label

Figure 4-28 Dimension drawing of HFD line reactor 80 kW, all dimensions in mm and (inches)



① Transport eyebolts 10 x 25 mm (0.39 x 0.98 inch)
② Terminal arrangement
③ Warning label

Figure 4-29 Dimension drawing of HFD line reactor 120 kW, all dimensions in mm and (inches)

4.7.4.3 Technical data

Table 4-11 Technical specifications for HFD line reactors

	6SL3000-	0DE21-6AA.	0DE23-6AA.	0DE25-5AA.	0DE28-0AA.	0DE31-2AA.
Power	kW	16	36	55	80	120
Rated current[1)]	A_{rms}	See Chapter Technical specifications (Page 142)				
Power loss[2)] (see power loss tables (Page 504))	W	170	250	350	450	590
Degree of protection according to IEC 60529		IP00 (no touch protection)				
Weight	kg	9	23	27	37	67
Mounting position		Any				

1) The rated currents of the HFD line reactors correspond directly to the input currents of the corresponding Active Line Modules.

2) Data for rated operation

4.7.5 Damping resistor for HFD line reactors

4.7.5.1 Description

Using a damping resistor

In some systems, oscillations can be generated which place an impermissibly high strain on the insulation systems of the motors and converters involved. Connecting a damping resistor to the additional winding of the HFD line reactor is an effective means of damping just such system oscillations. Use of the 800 W damping resistor is preferable.

Note

Recommendation

Use an Active Interface Module as line connection component for new plants and systems equipped with Active Line Modules.

4.7.5.2 Safety instructions for damping resistors for HFD reactors



⚠ CAUTION

Burns due to high surface temperatures of the damping resistor

The damping resistor can become very hot. You can get seriously burnt when touching the surface.

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

Note

Installation

- Preferably mount the damping resistors outside of the control cabinet.

4.7.5.3 Dimension drawings

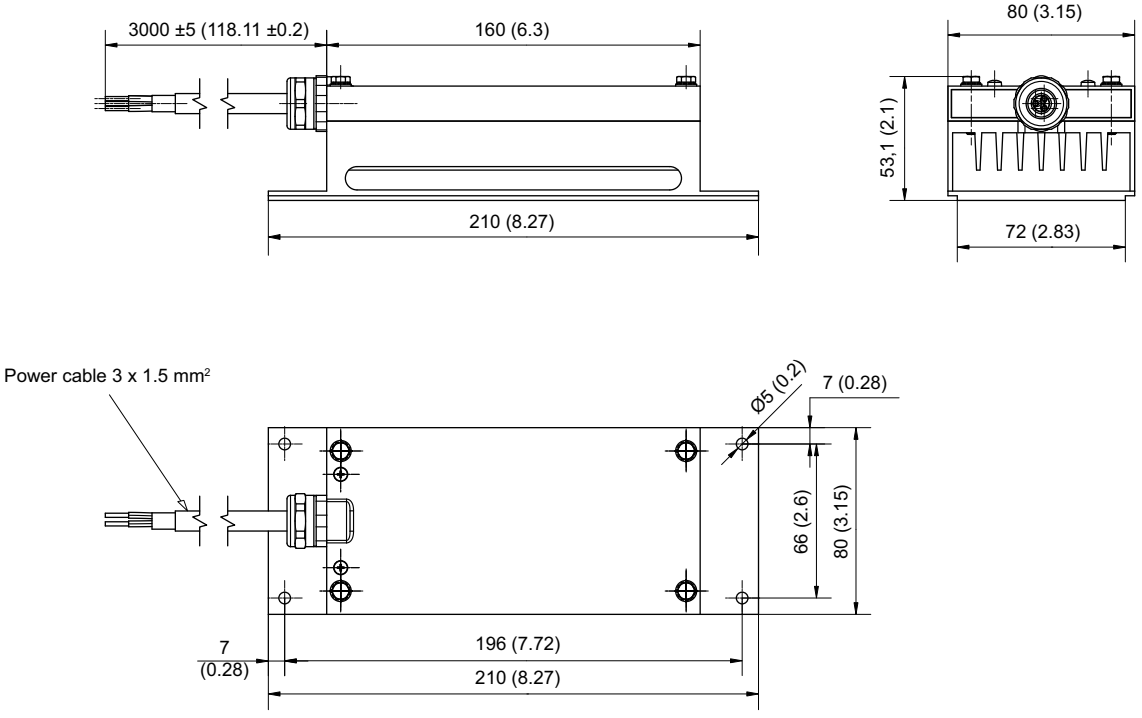


Figure 4-30 300 W damping resistor for HFD line reactors, all dimensions in mm and (inches)

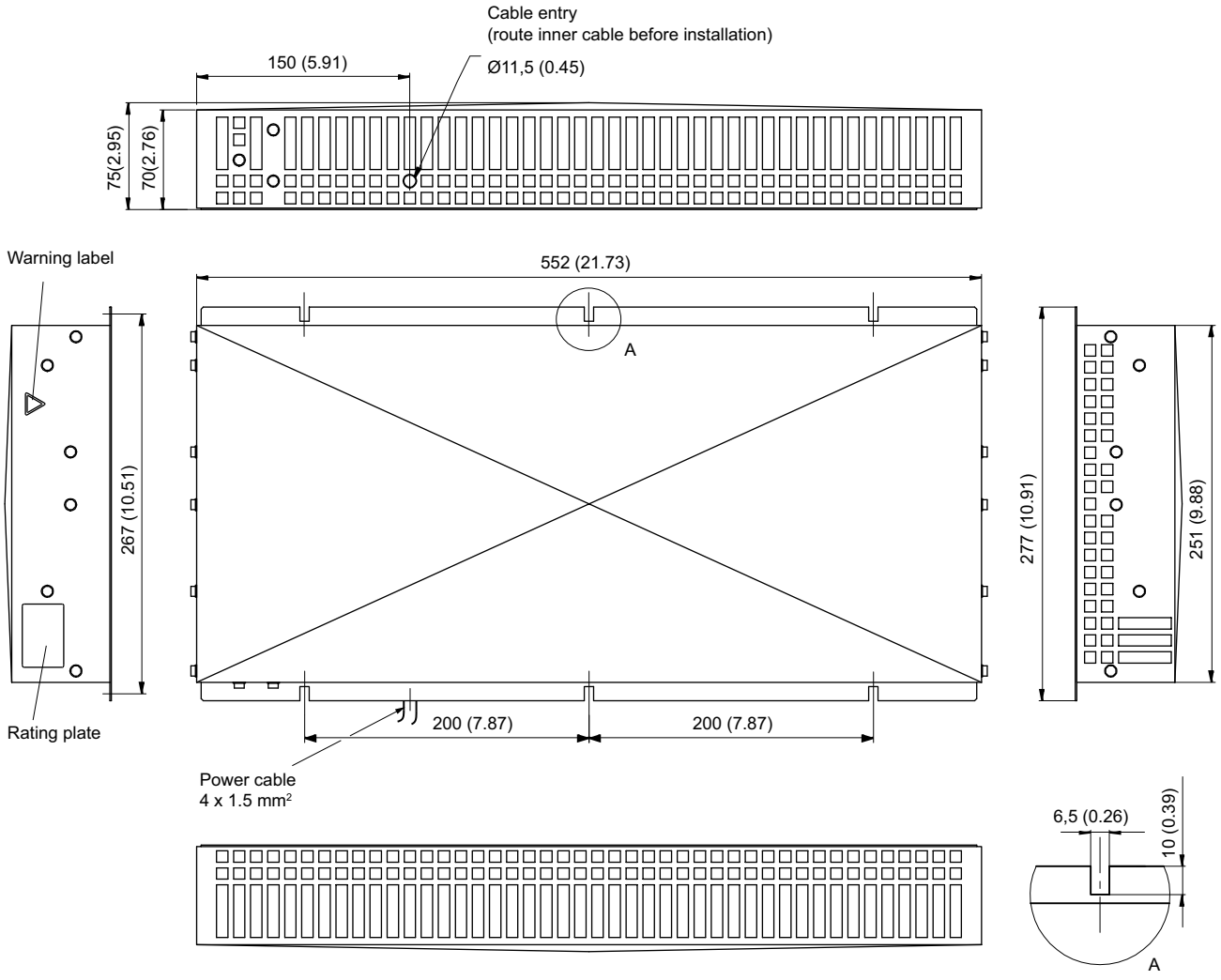
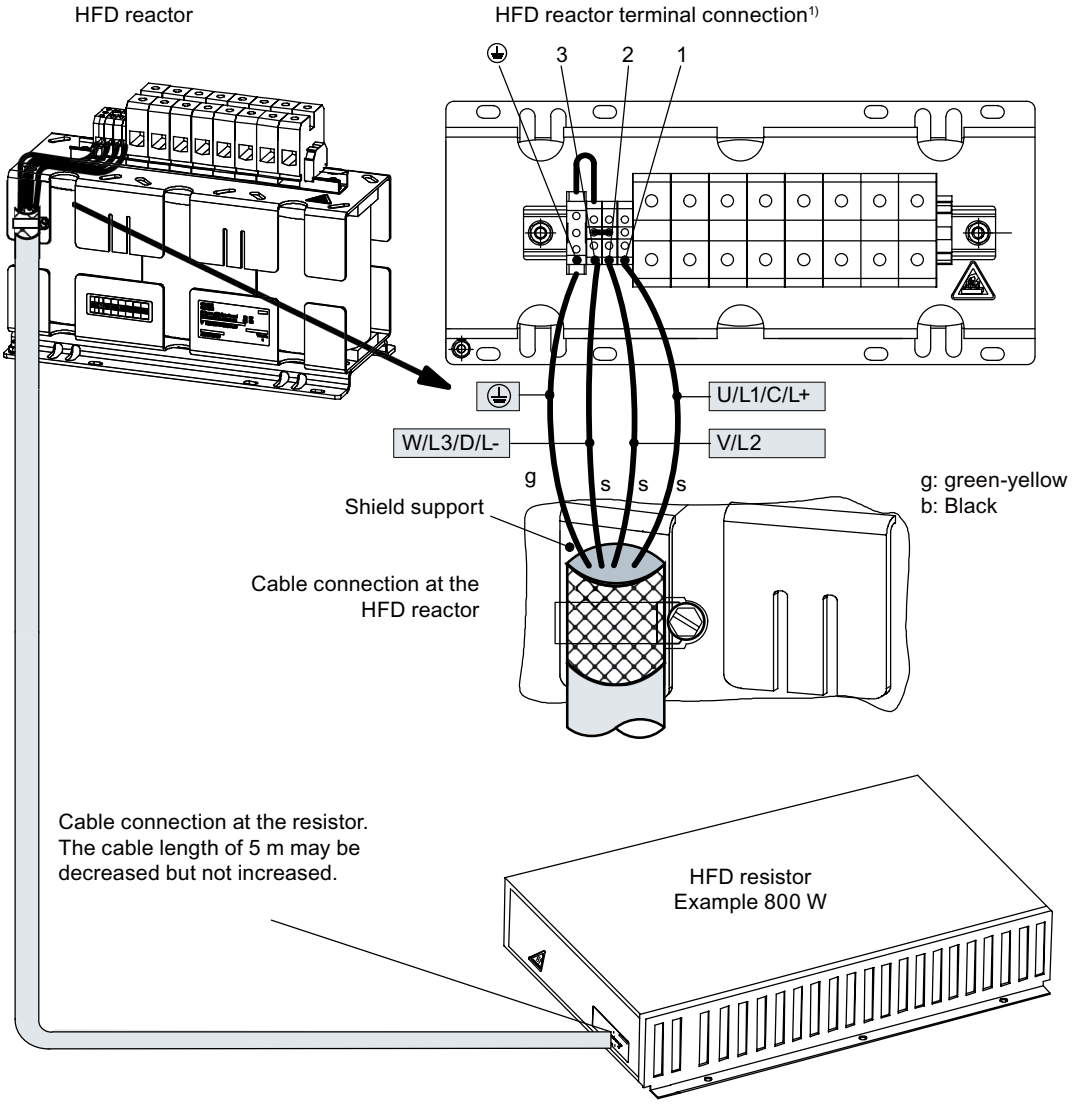
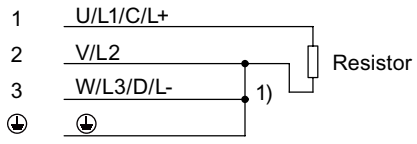


Figure 4-31 800 W damping resistor for HFD line reactors, all dimensions in mm and (inches)

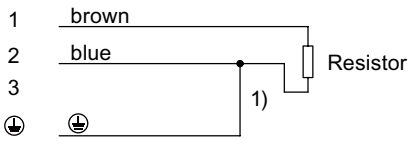
4.7.5.4 Wiring with the HFD line reactor



Connection circuit 800 W resistor



Connection circuit 300 W resistor



1) Terminals 2 and 3 are connected in the HFD reactor with protective conductor potential for the potential connection of the damping resistor and unused wires.

Note:
It is not permissible that any cables are routed in the area where hot air is dissipated from the damping resistor.

Mounting position:
Arbitrary mounting position but consider the heat dissipation, if necessary, provide a "Hot surface" warning notice!

Figure 4-32 Wiring the HFD line reactor with a damping resistor

4.7.5.5 Technical data

Together with the HFD line reactor, an external resistor must be used for damping purposes (refer to Chapter Wiring with the HFD line reactor (Page 89)).

Table 4-12 Technical data for HFD damping resistors

Article No.	**6SN1113-1AA00-0DA.**[1)]	**6SL3100-1BE21-3AA.**[2)]
Rated power [W]	300	800
Connection cable [m], included in scope of delivery	3	5
Connection	3 x 1.5 mm^2	4 x 1.5 mm^2
Weight [kg]	1.45	5.5
Degree of protection to IEC 60529	IP54	IP51
Ambient temperature [°C]	0 ... 55	
Dimensions (W x H x D) [mm]	80 x 210 x 53	277 x 552 x 75

1) The 300 W damping resistor can be used for HFD applications if the following is true after a heat run when all axes are shut down in a regulated way:
- After an operating period of over two hours, the surface temperature of resistor 6SN1113-1AA00-0DA0 must not exceed 150° C.
- This heat run must be repeated if the hardware configuration, e.g. motor cable lengths, is changed.

2) Preferred type

4.7.6 Line reactors for Basic Line Modules

4.7.6.1 Interface description

Overview

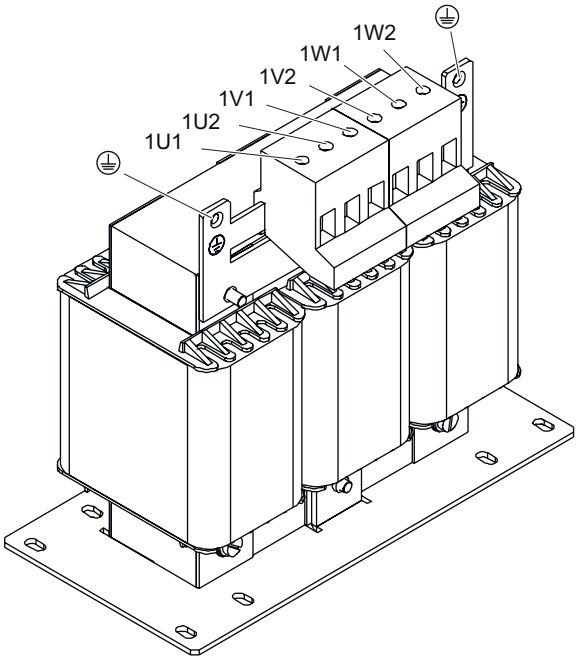


Figure 4-33 Interface overview, line reactor for Basic Line Modules (20 kW)

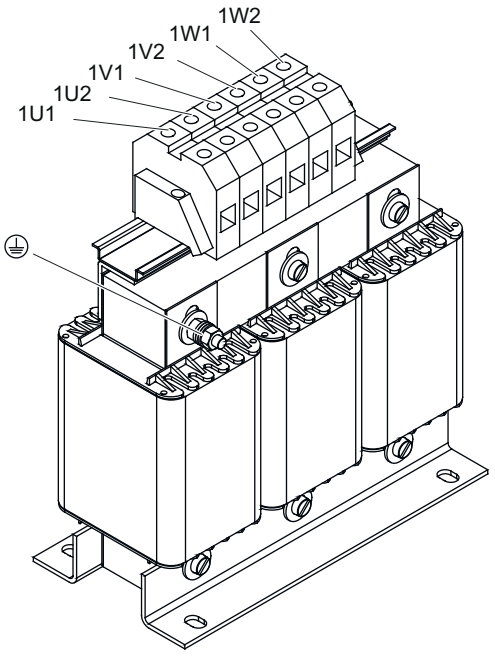


Figure 4-34 Interface overview, line reactor for Basic Line Modules (40 kW)

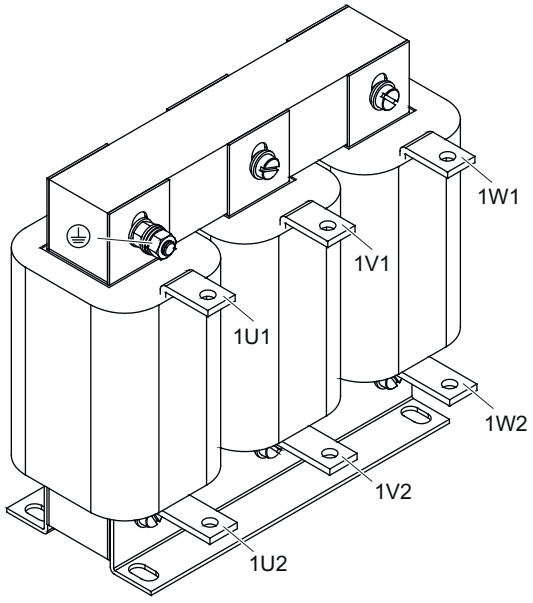


Figure 4-35 Interface overview, line reactor for Basic Line Modules (100 kW)

Line/load connection

Table 4-13 Line and load connection line reactors for Basic Line Modules

	6SL3000-0CE22-0AA.	**6SL3000-0CE24-0AA.**	**6SL3000-0CE31-0AA.**
Power	20 kW	40 kW	100 kW
Line supply connection 1U1, 1V1, 1W1	Screw terminals 10 mm^2 (AWG 8) 1.5 ... 1.8 Nm (15.9 lbf in)	Screw terminals 35 mm^2 (AWG 2) 5 ... 6 Nm (53.1 lbf in)	Copper busbars with 8.5 mm diameter holes
Load connection 1U2, 1V2, 1W2			
Protective conductor connection	Screw M4 2 Nm (17.7 lbf in)	Terminal stud M6[1)] 6 Nm (53.1 lbf in)	Terminal stud M8[1)] 12 Nm (106 lbf in)
[1)] For ring cable lugs without insulation (Page 487)			

4.7.6.2 Dimension drawings

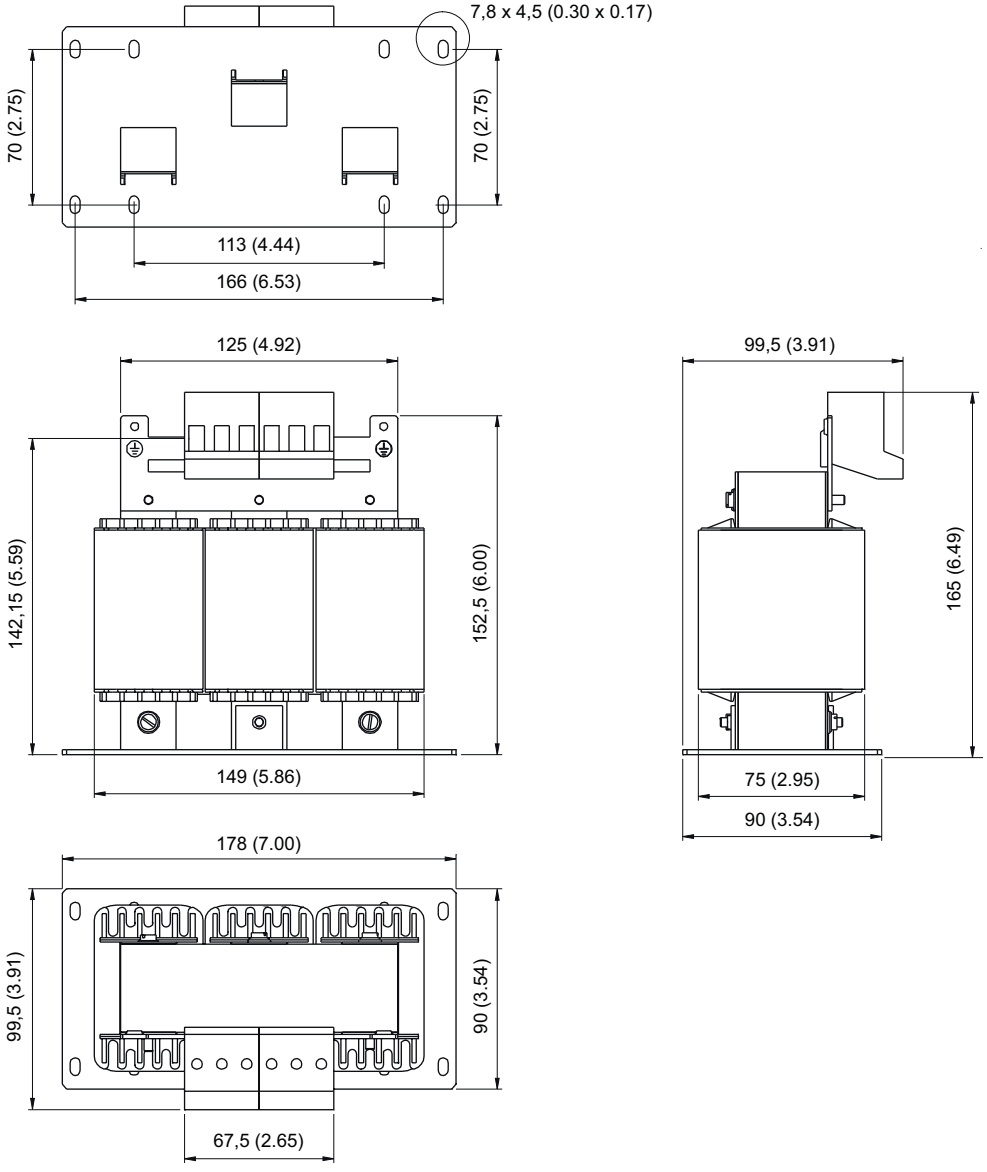


Figure 4-36 Dimension drawing of line reactor for Basic Line Module 20 kW, all dimensions in mm and (inches)

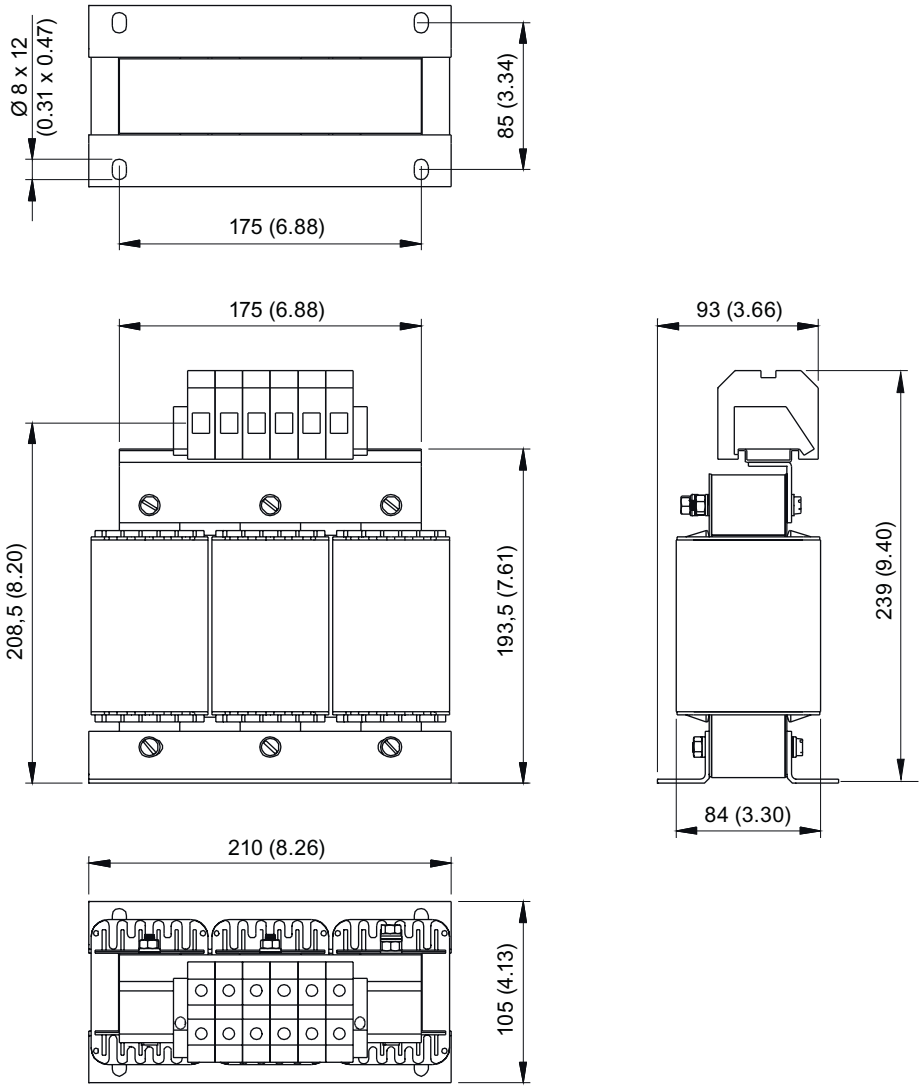


Figure 4-37 Dimension drawing of line reactor for Basic Line Module 40 kW, all dimensions in mm and (inches)

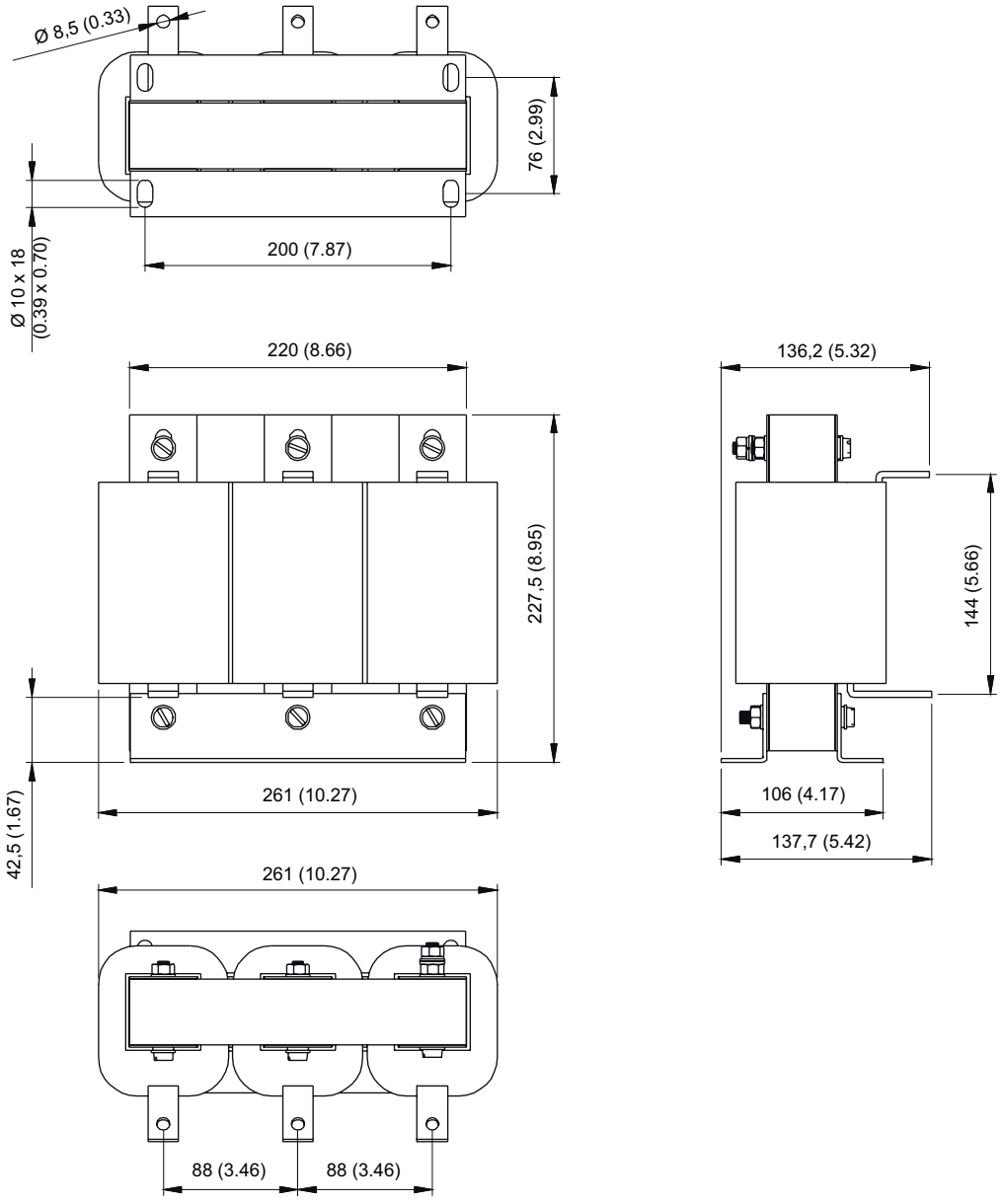


Figure 4-38 Dimension drawing of line reactor for Basic Line Module 100 kW, all dimensions in mm and (inches)

4.7.6.3 Technical data

Table 4-14 Technical specifications of line reactors for the Basic Line Modules

	Unit	6SL3000-0CE22-0AA.	6SL3000-0CE24-0AA.	6SL3000-0CE31-0AA.
Power	kW	20	40	100
Rated current[1)]	A_{rms}	See Chapter Technical specifications (Page 161)		
Power loss (see power loss tables (Page 503))	W	130	270	480

	Unit	6SL3000-0CE22-0AA.	6SL3000-0CE24-0AA.	6SL3000-0CE31-0AA.
Degree of protection according to IEC 60529		IPXXB	IPXXB	IP00
Weight	kg	5.2	11.2	21.7
Mounting position		Vertically upright or hanging horizontally		

[1] The rated currents of the line reactors for the Basic Line Modules correspond directly to the input currents of the corresponding Basic Line Modules.

4.7.7 Line reactors for Smart Line Modules

4.7.7.1 Interface description

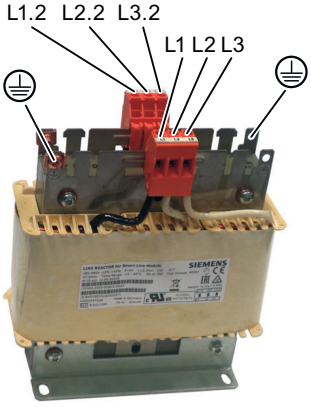


Figure 4-39 Interface overview, line reactor for Smart Line Modules (5 kW)

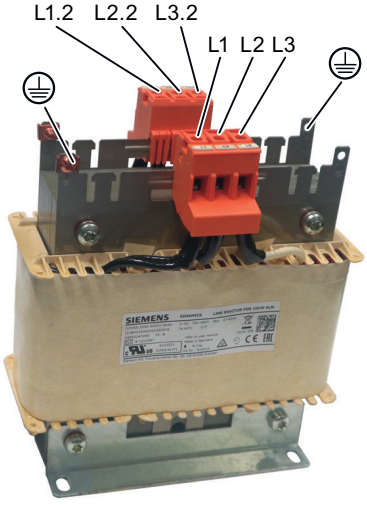


Figure 4-40 Interface overview, line reactor for Smart Line Modules (10 kW)

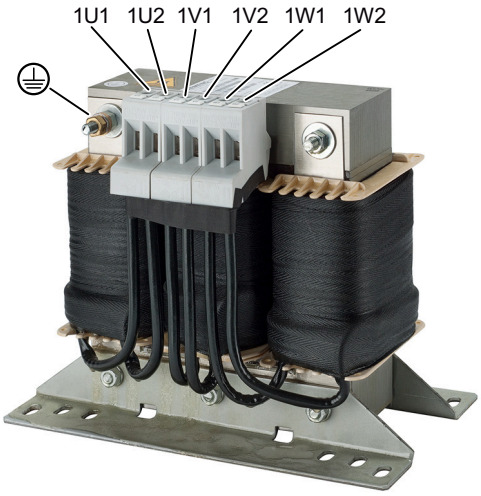


Figure 4-41 Interface overview, line reactor for Smart Line Modules (16 kW)

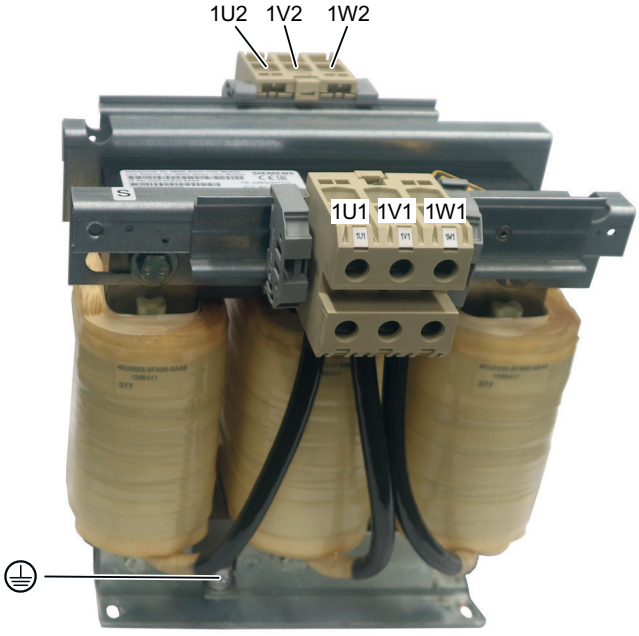


Figure 4-42 Interface overview, line reactor for Smart Line Modules (36 kW)

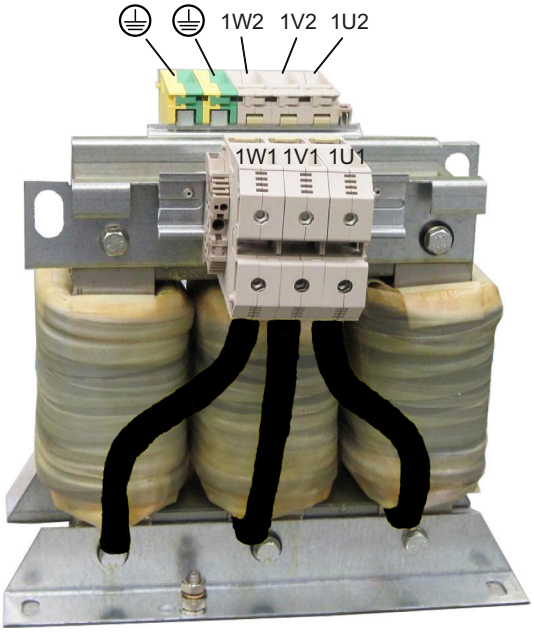


Figure 4-43 Interface overview, line reactor for Smart Line Modules (55 kW)

Line/load connection

Table 4-15 Line and load connection line reactors for Smart Line Modules

	6SL3000-0CE15-0AA.	**6SL3000-0CE21-0AA.**	**6SL3100-0EE21-6AA.**	**6SL3000-0CE23-6AA.**	**6SL3000-0CE25-5AA.**
Power	5 kW	10 kW	16 kW	36 kW	55 kW
Terminal designations Mains connection Load connection	 L1, L2, L3 L1.2, L2.2, L3.2	 L1, L2, L3 L1.2, L2.2, L3.2	 1U1, 1V1, 1W1 1U2, 1V2, 1W2	 1U1, 1V1, 1W1 1U2, 1V2, 1W2	 1U1, 1V1, 1W1 1U2, 1V2, 1W2
Line connection	Screw terminals 4 mm² (AWG 12) 0.6 ... 0.8 Nm (7.1 lbf in)	Screw terminals 10 mm² (AWG 8) 1.5 ... 1.8 Nm (15.9 lbf in)	Screw terminals 10 mm² (AWG 8) 1.5 ... 1.8 Nm (15.9 lbf in)	Screw terminals 35 mm² (AWG 2) 2.5 Nm (22.1 lbf in)	Screw terminals 70 mm² (AWG 2/0) 8 ... 12 Nm (106 lbf in)
Load connection					
Protective ground conductor connection	Screw M4 2 Nm (17.7 lbf in)	Screw M4 2 Nm (17.7 lbf in)	Terminal studs M6[1)]	Terminal studs M6[1)]	Terminal studs M8[1)]
[1)] For ring cable lugs without insulation (Page 487)					

4.7.7.2 Dimension drawings

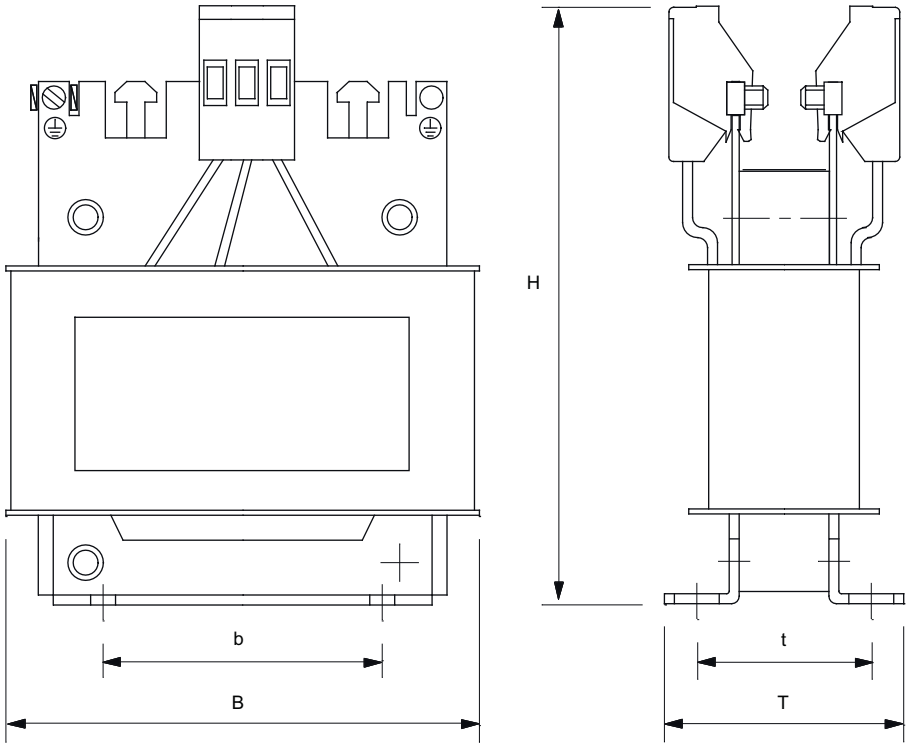


Figure 4-44 Dimension drawing of line reactor for Smart Line Modules 5 kW and 10 kW

Table 4-16 Dimensions of line reactors for Smart Line Modules (5 kW and 10 kW)

	Article number 6SL3000-	**B [mm] (inch)**	**b [mm] [1] (inch)**	**H [mm] (inch)**	**T [mm] (inch)**	**t [mm] [1] (inch)**
5 kW	0CE15-0AAx	150 (5.91)	113 (4.53)	175 (6.89)	66.5 (2.62)	49.5 (1.95)
10 kW	0CE21-0AAx	177 (6.97)	136 (5.35)	196 (7.72)	86 (3.39)	67 (2.64)

[1] Lengths b and t correspond to the distance between holes

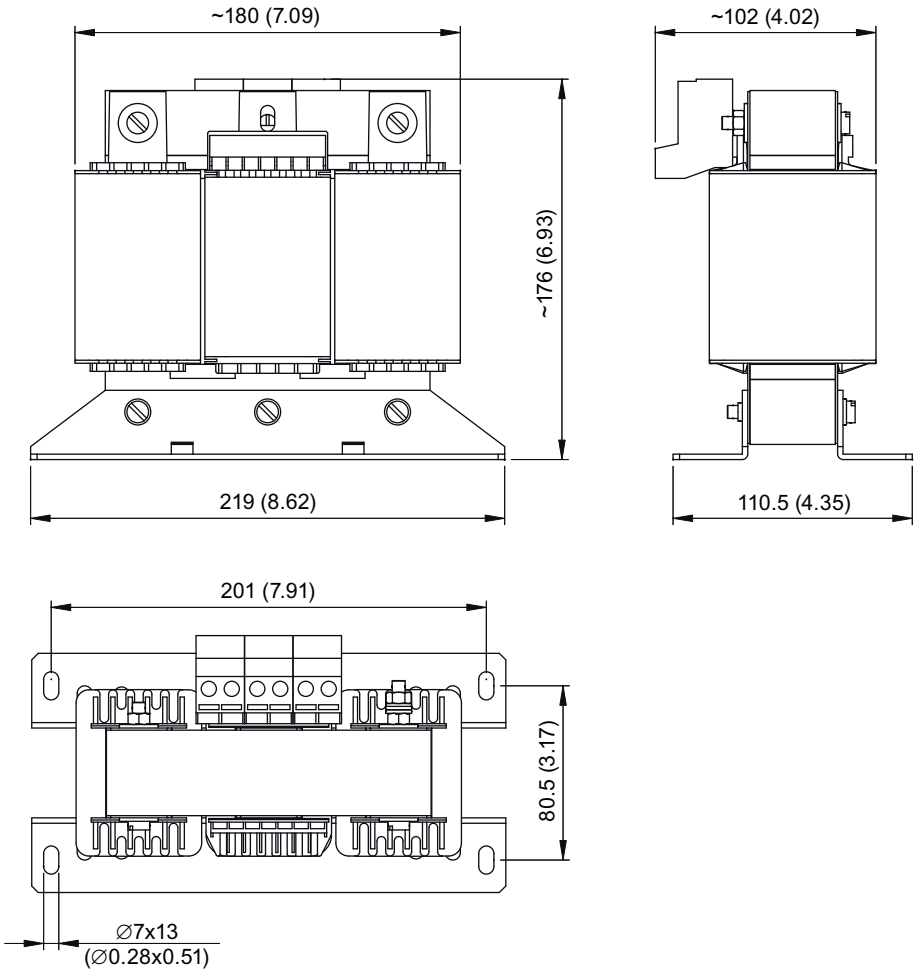


Figure 4-45 Dimension drawing of line reactor for Smart Line Module 16 kW

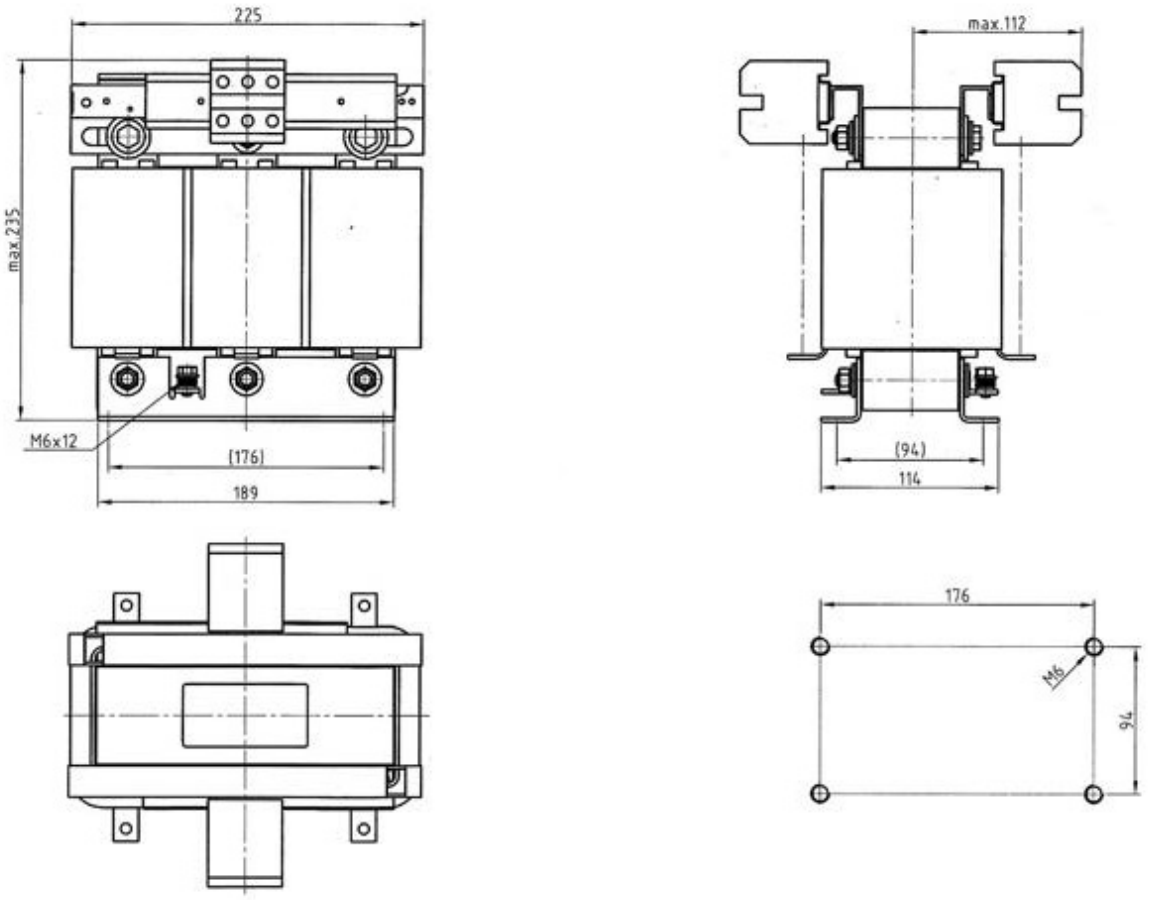


Figure 4-46 Dimension drawing of line reactor for Smart Line Module 36 kW

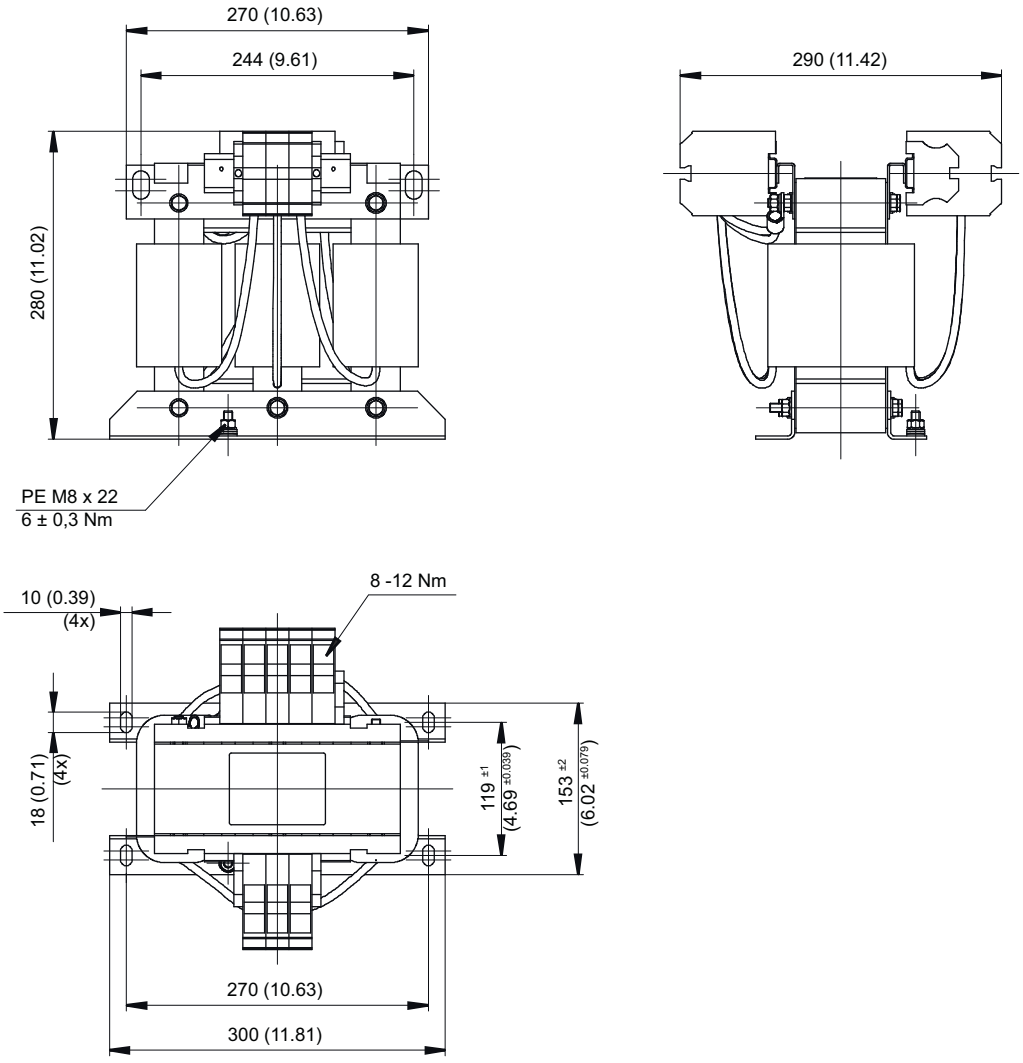


Figure 4-47 Dimension drawing of line reactor for Smart Line Module 55 kW, all dimensions in mm and (inches)

4.7.7.3 Technical data

Table 4-17 Technical specifications of line reactors for the Smart Line Module

		6SL3000-0CE15-0AA.	**6SL3000-0CE21-0AA.**	**6SL3100-0EE21-6AA.**	**6SL3000-0CE23-6AA.**	**6SL3000-0CE25-5AA.**
Power	kW	5	10	16	36	55
Rated current[1)]	A_{rms}	See Chapter Technical specifications (Page 184)				
Power loss (see power loss tables (Page 503))	W	62	116	75	170	190
Degree of protection according to IEC 60529		IPXXB	IPXXB	IPXXB	IPXXB	IPXXB

		6SL3000-0CE15-0AA.	**6SL3000-0CE21-0AA.**	**6SL3100-0EE21-6AA.**	**6SL3000-0CE23-6AA.**	**6SL3000-0CE25-5AA.**
Weight	kg	3.7	7.5	10.7	17	37
Mounting position		Vertically upright or hanging horizontally				

[1] The rated currents of the line reactors for the Smart Line Modules correspond directly to the input currents of the corresponding Smart Line Modules.

4.8 Active Interface Modules

4.8.1 Description

Active Interface Modules are line-side interfaces for the Active Line Modules.

They contain the following functional units:

- Line reactor
- Low frequency/switching frequency filter
- Line filter EN 61800-3 Category C3 up to 350 m total motor cable length[1)] (shielded)
- Reduction of the stress on the motor insulation from system-dependent resonance factors

Note

Active Interface Modules may only be operated in conjunction with the associated Active Line Modules from Siemens.

Data regarding the radio interference voltage categories and maximum total cable lengths that can be achieved[1)] see Chapter Combination options, Line Modules with line reactors and line filters (Page 124).

The Active Interface Module is fitted with a fan. The 24 V supply is essential for operating the component. Connection of the temperature signaling contact to the Active Line Module is also required.

[1)] Maximum total cable length = Σ motor cables, line feeder cable from line filter to the Line Module

4.8.2 Safety instructions for Active Interface Modules



⚠ WARNING

Electric shock as a result of a residual charge 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

Electric shock due to unconnected cable shields

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

- Connect cable shields and the conductors of power cables that are not used (e.g. brake conductors) at both ends at the grounded housing potential.



⚠ WARNING

High leakage currents when the protective conductor in the line feeder cable is interrupted

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

- Carefully comply with the applicable regulations for dimensioning the protective conductor (see Chapter "Protective connection and equipotential bonding (Page 492)").



⚠ 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

Damage to the Active Interface Module due to incorrect settings made during commissioning

The Active Interface Module can be damaged through incorrect settings in the software.

- Do not use any SINAMICS firmware version less than V2.5.
- Operate Active Interface Modules only with the following settings in the commissioning wizard:
  - Set the "Line filter available" option for the Active Line Module.
  - Select line filter "AIM 400 V ..kW (6SL3100-0BE..-.AB.)".

  With firmware version SINAMICS V2.5, the default setting in STARTER/SCOUT is "Wideband Line Filter". Switchover parameter p0220 to "AIM" (see SINAMICS S120/S150 List Manual). In conjunction with SINAMICS from V2.6 and higher, the appropriate Active Interface Module is already preset by running the wizard in STARTER.

NOTICE

Damage to the Active Interface Module due to incorrect or missing wiring

The Active Interface Module can be damaged through incorrect wiring or a missing 24 V supply.

- Before commissioning the Active Interface Module, it is essential to connect the 24 V DC at connector X124 to supply the fans.
- Connect the temperature signaling contact of the Active Interface Module to the temperature input of the associated Active Line Module.
- With the drive group switched off, electrically disconnect the Active Interface Module from the line supply.

NOTICE

Damage caused by overheating as a result of an inadmissible mounting position

When incorrectly mounted, the Active Interface Module can overheat and therefore be damaged.

- Only operate the Active Interface Module in a permissible mounting position.

Note

Functional disturbances as a result of line supply disturbances

The devices have been designed for operation on line supplies according to IEC 61000-2-4 Class 3. For line supplies with significant harmonic distortion (total harmonic distortion > 12%) or transient surge voltages > 1 kV, the filter integrated in the Active Interface Module can be overloaded.

- Decouple the drive line-ups using suitable measures:
  - Using a Basic Line Filter
  - Use an HFD line reactor with damping resistor instead of an Active Interface Module

4.8.3 Interface description

4.8.3.1 Overview

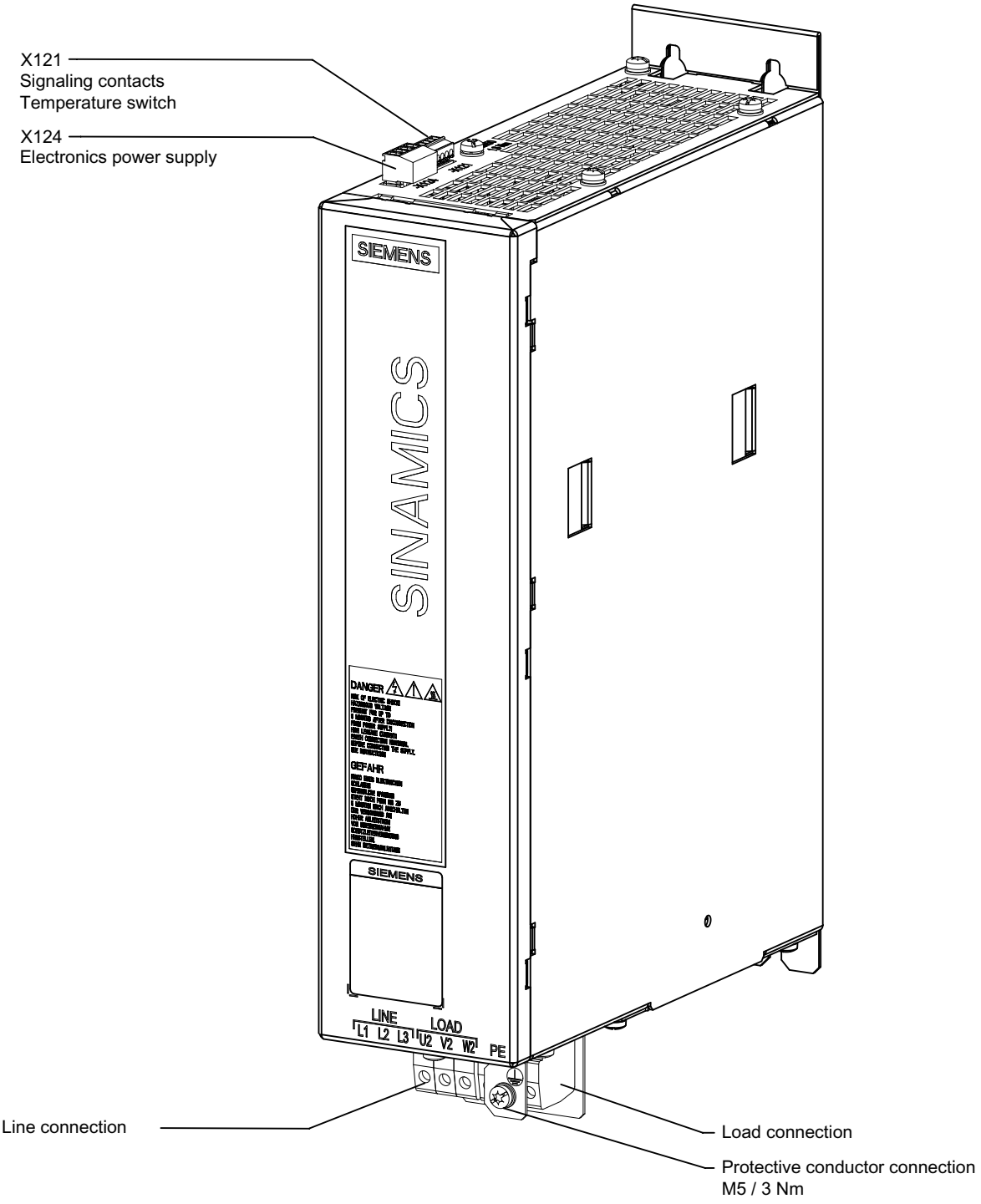


Figure 4-48 Interface overview, Active Interface Module 16 kW

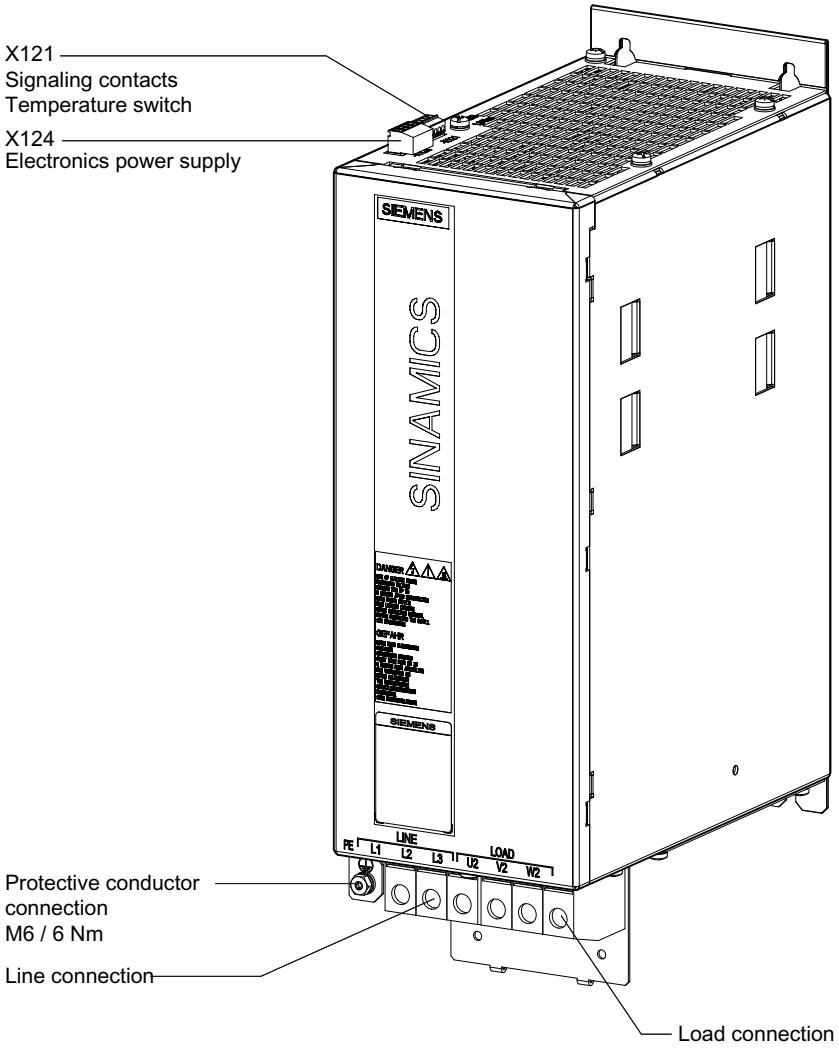


Figure 4-49 Interface overview, Active Interface Module 36 kW

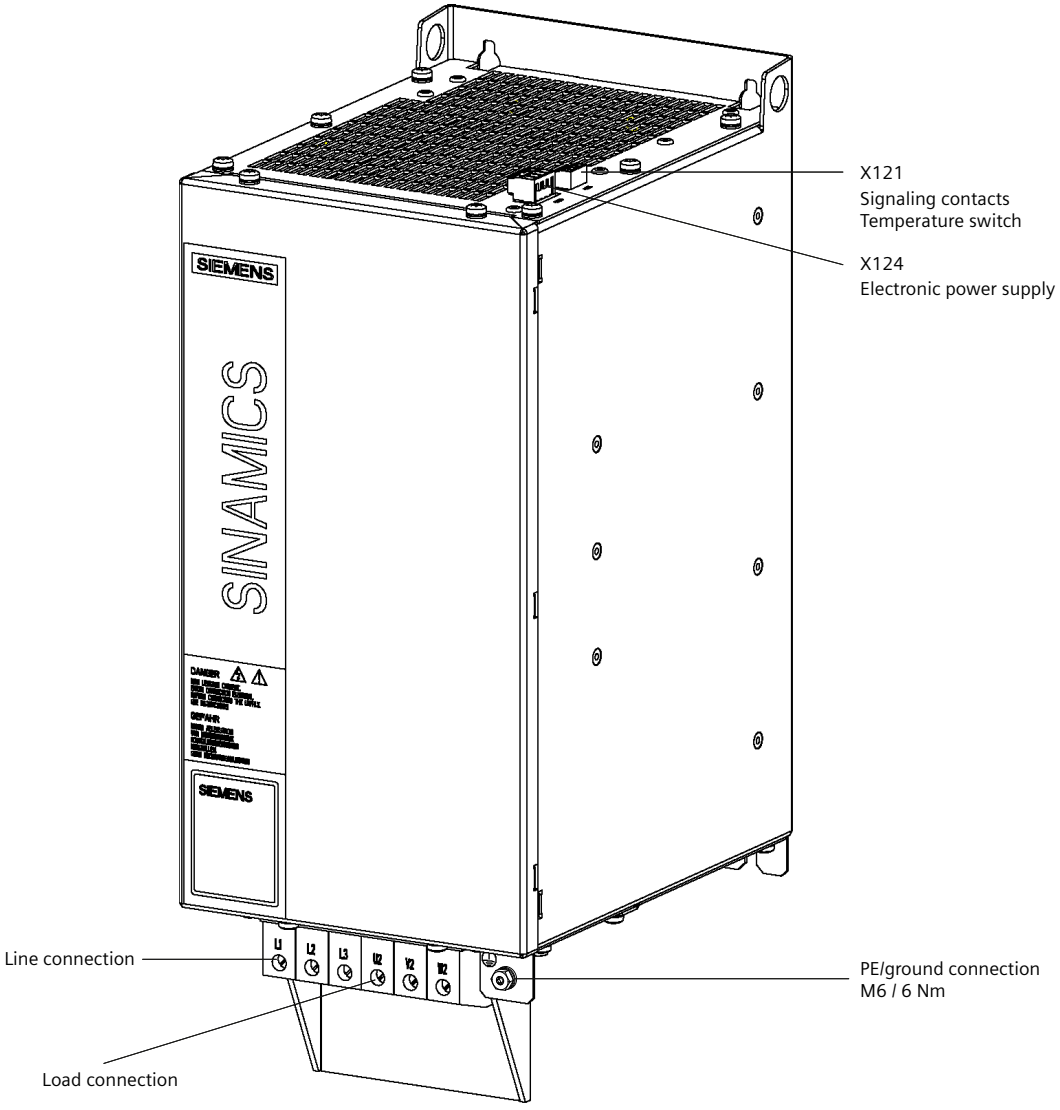


Figure 4-50 Interface overview, Active Interface Module 55 kW

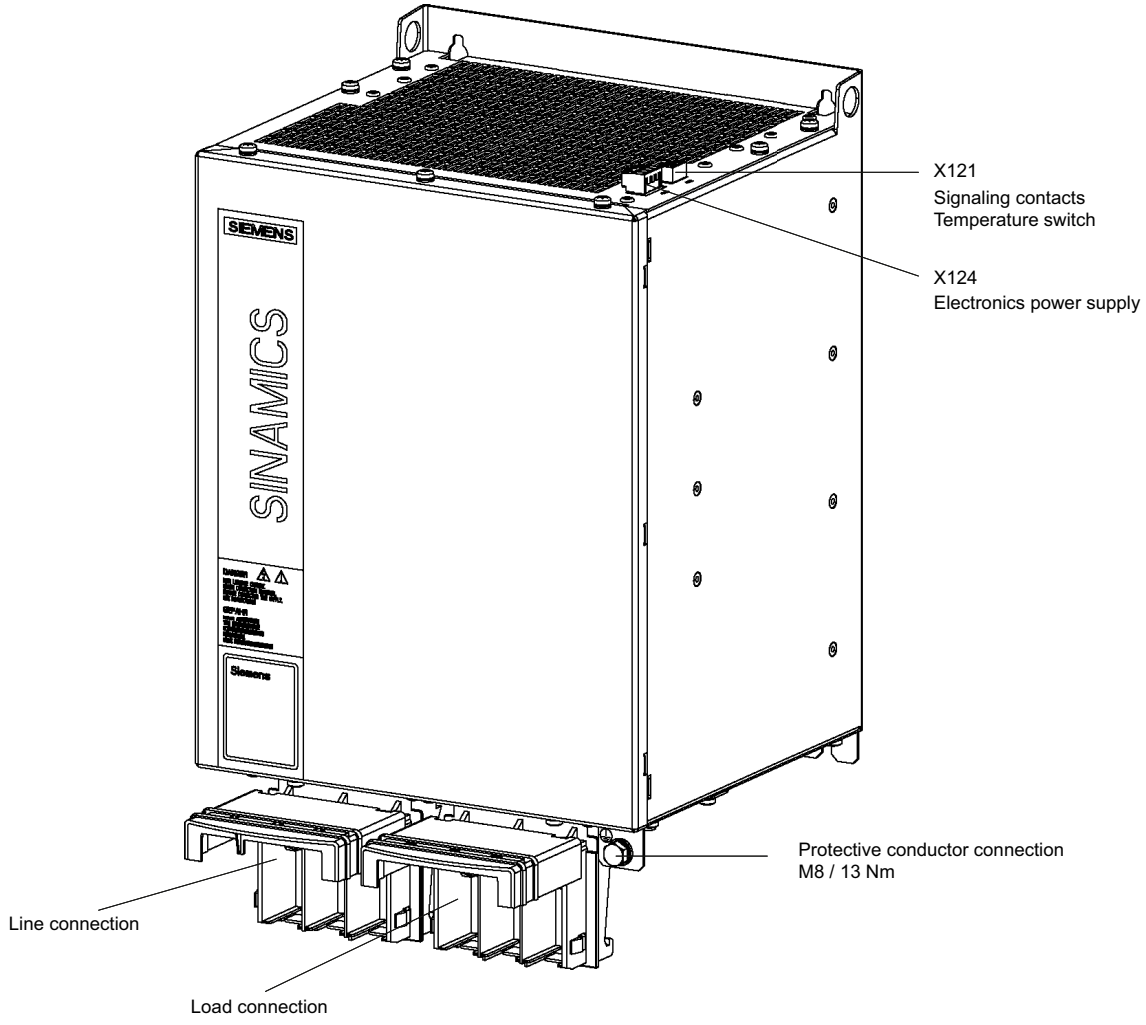


Figure 4-51 Interface overview, Active Interface Module 80 kW and 120 kW

4.8.3.2 Line/load connection

Table 4-18 Line and load connection Active Interface Module

	6SL3100-0BE21-6AB.	**6SL3100-0BE23-6AB.**	**6SL3100-0BE25-5AB.**	**6SL3100-0BE28-0AB.**	**6SL3100-0BE31-2AB.**
Power	16 kW	36 kW	55 kW	80 kW	120 kW
Line connection L1, L2, L3	Screw terminal 16 mm² (AWG 6), 1.7 Nm (15.0 lbf in)	Screw terminal 50 mm² (AWG 1), wire end ferrule, 6 Nm (53.1 lbf in)	Screw terminal 50 mm² (AWG 1), wire end ferrule, 6 Nm (53.1 lbf in)	Threaded bolt M8, cross-section 120 / 2 x 50 mm² (AWG 4/0 / 2 x AWG 1), 13 Nm (115 lbf in)[1)]	
Load connection U2, V2, W2					
Screwdrivers	1.0 x 4	1.2 x 6.5	1.2 x 8	-	
[1)] For ring cable lugs without insulation (Page 487)					

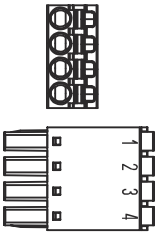
Note

Maintaining touch protection for Active Interface Modules 36 kW

The connection terminals of the 36 kW Active Interface Module are only certain to have touch protection IPXXB according to IEC 60529, if cables with a minimum cross-section of 25 mm² (AWG 4) and insulated end sleeves are used.

4.8.3.3 X121 temperature sensor and fan control

Table 4-19 Plug-in screw terminal X121

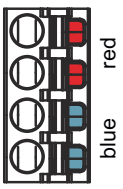
	Terminal	Function	Technical data
	1	+Temp	Output temperature switch Must be connected to interface X21 of the Active Line Module.
	2	-Temp	Temperature switch output
	3	+24 V power supply for digital inputs	Current-carrying capacity: 500 mA
	4	Disable Fan	AIM 16 kW and 36 kW: The fan can be disabled. The fan may only be switched off while the electricity supply network is disconnected via the main switch or line contactor. AIM 55 kW, 80 kW and 120 kW: The fan **cannot** be disabled.
Type: Spring-loaded terminal 7 (Page 485)			

Note

If terminal X121.4 is not connected (or connected with low level), the fan will run in the continuous mode.

4.8.3.4 X124 Electronics power supply

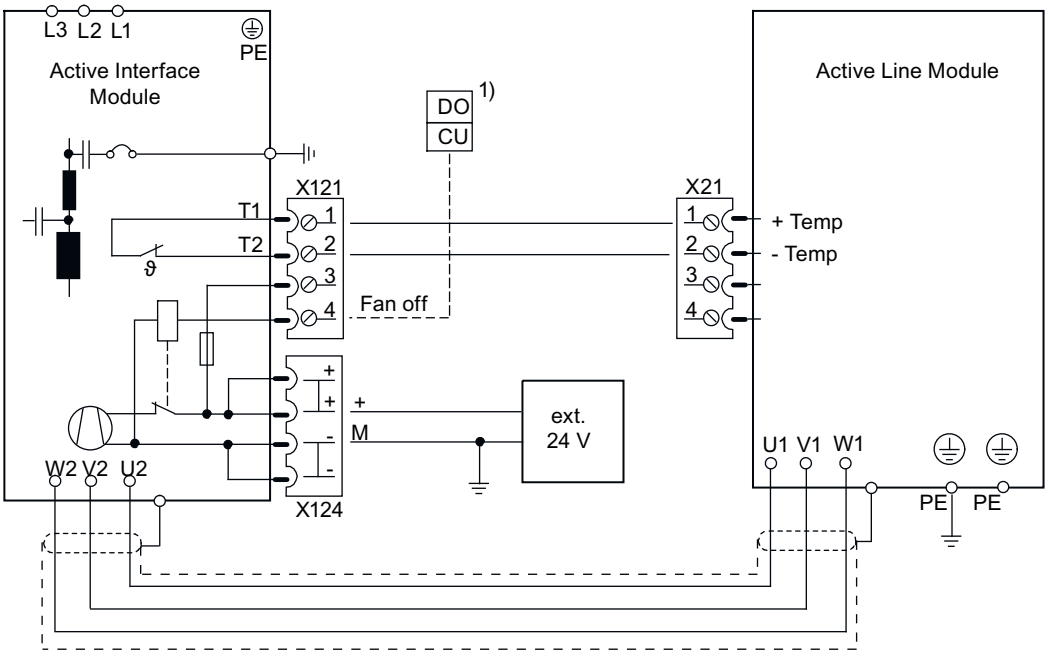
Table 4-20 X124 Electronics power supply

	Terminal	Function	Technical specifications
	+	Electronics power supply	Voltage: 24 VDC (20.4 ... 28.8 V) Current consumption: max. 1.6 A Max. current via jumper in the connector: 20 A at 55 °C (15 A according to UL/CSA)
	+	Electronics power supply	
	M	Electronics ground	
	M	Electronics ground	
Type: Spring-loaded terminal 6 (Page 485)			

Note

The two "+" and "M" terminals are jumpered in the connector. This ensures the supply voltage is looped through.

4.8.4 Connection example



1) Digital output (DO), controlled by the Control Unit

Figure 4-52 Connection example for 16 kW and 36 kW Active Interface Modules

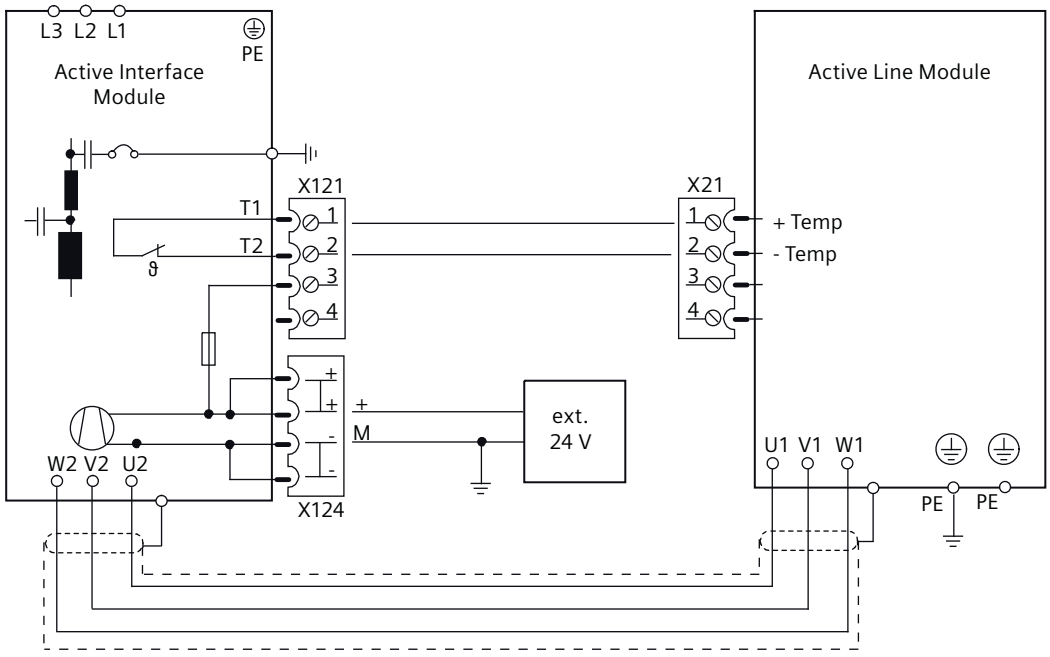


Figure 4-53 Connection example for 55 kW, 80 kW and 120 kW Active Interface Modules

4.8.5 Dimension drawings

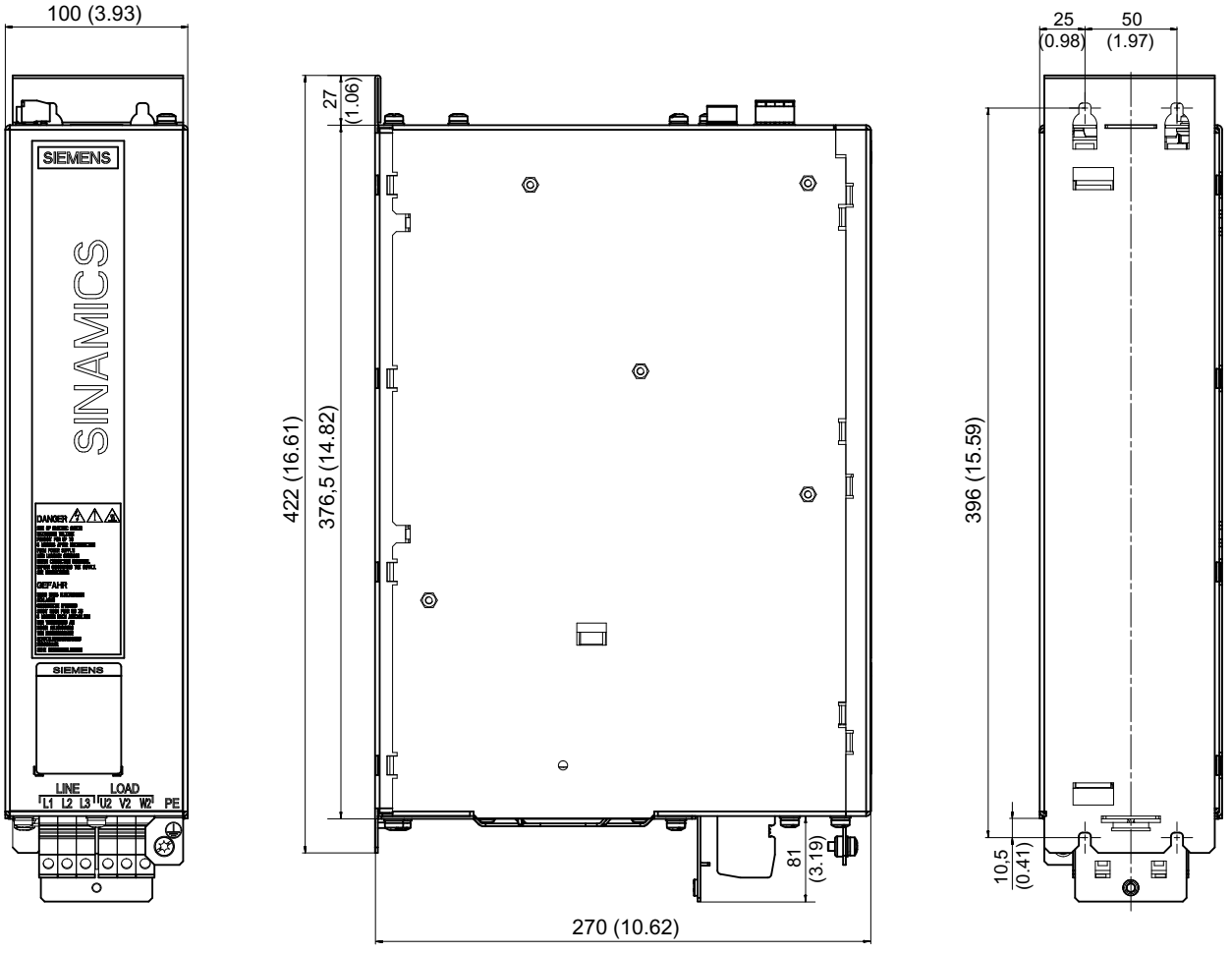


Figure 4-54 Dimension drawing of Active Interface Module 16 kW, all dimensions in mm and (inches)

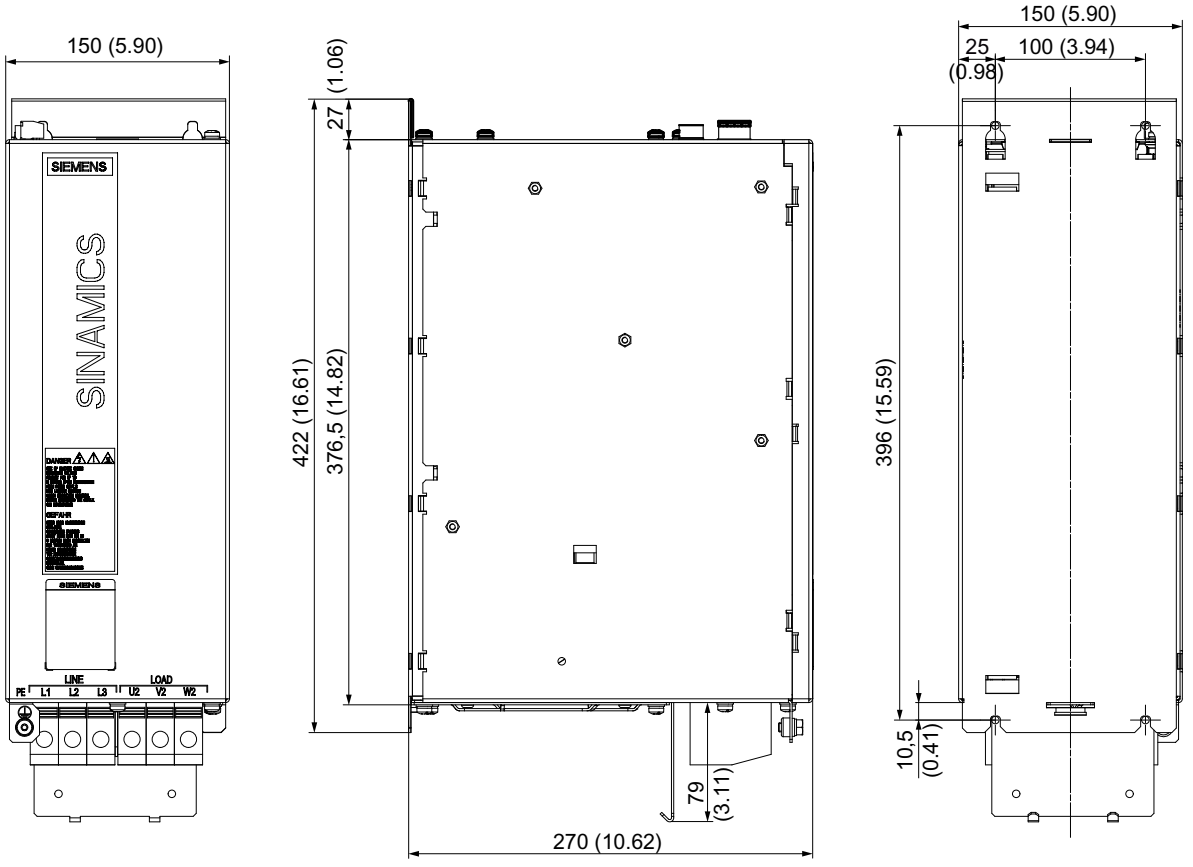


Figure 4-55 Dimension drawing of Active Interface Module 36 kW, all dimensions in mm and (inches)

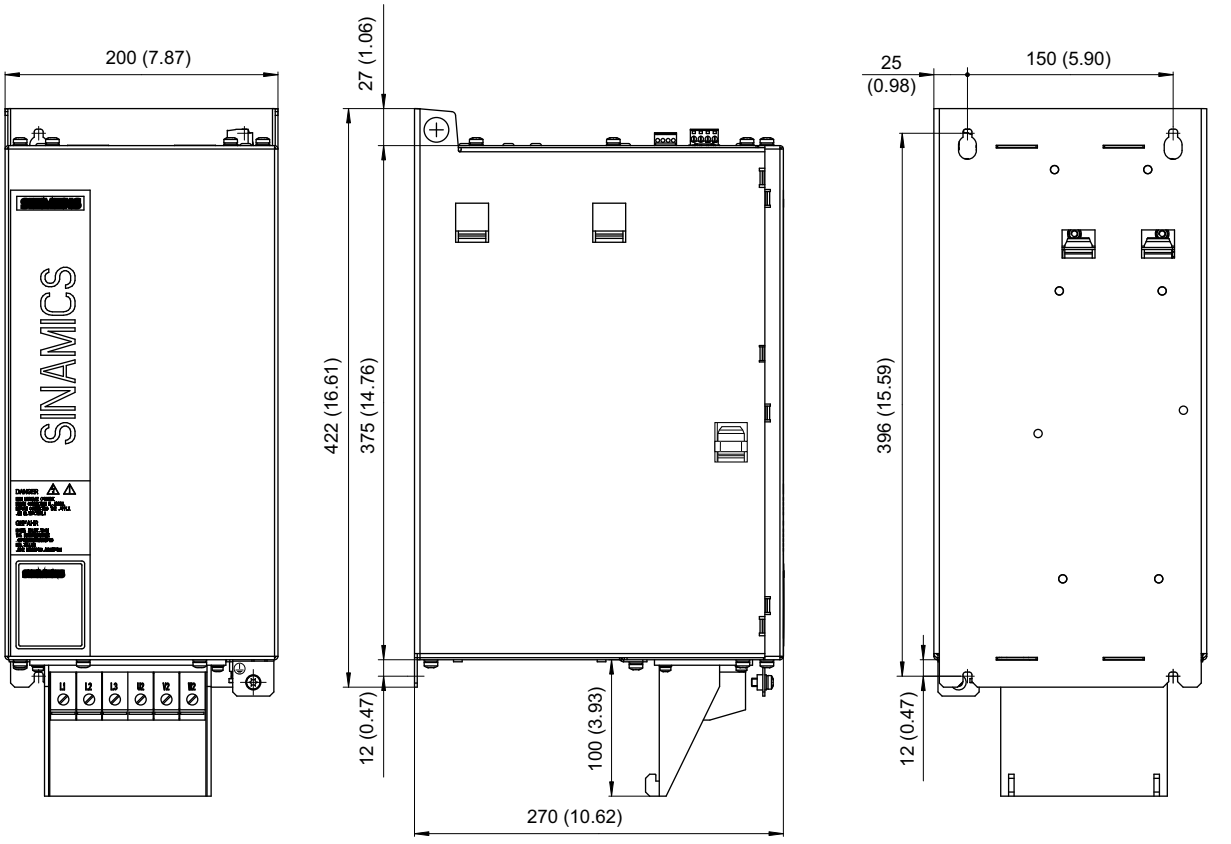


Figure 4-56 Dimension drawing of Active Interface Module 55 kW, all dimensions in mm and (inches)

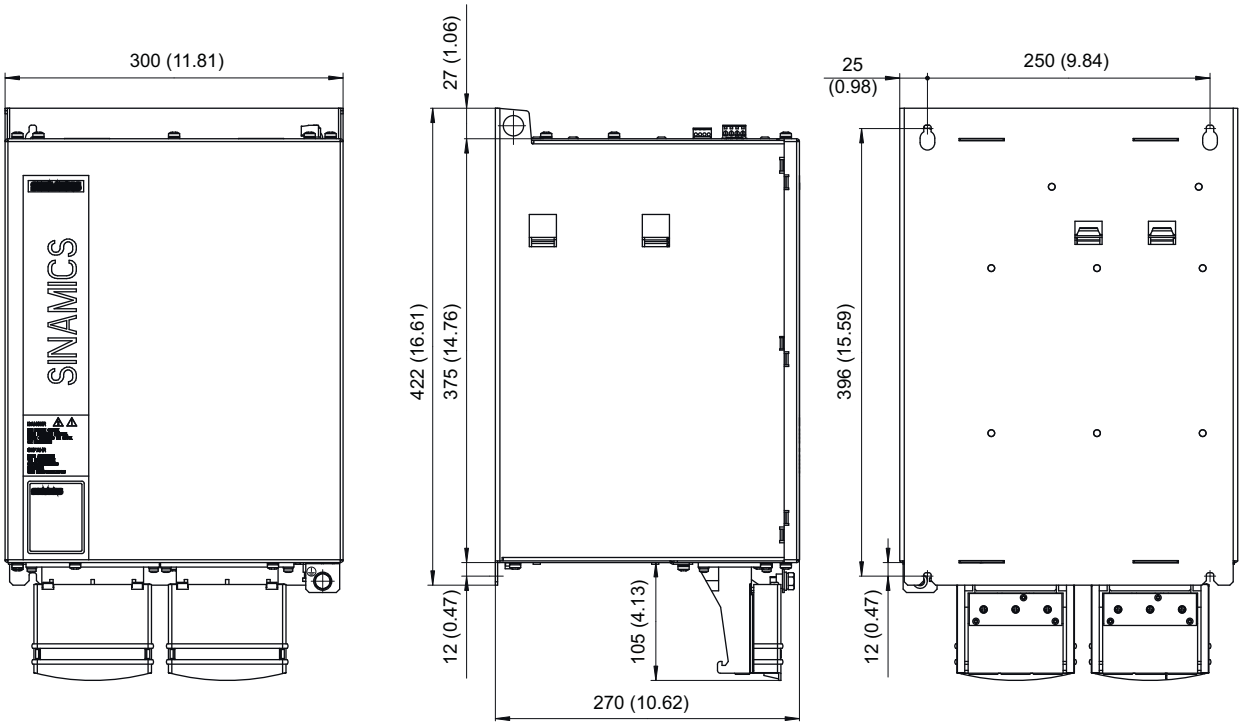
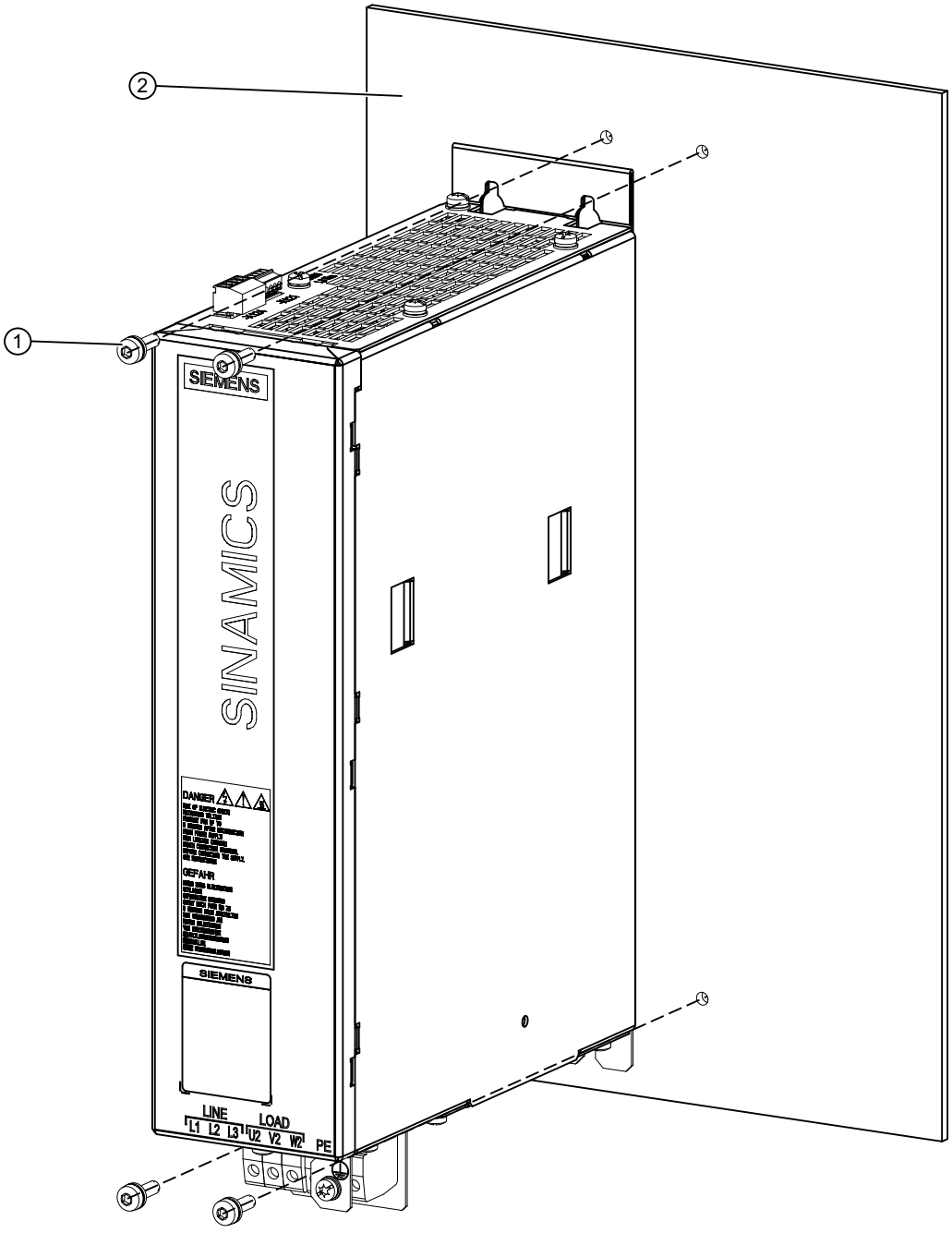


Figure 4-57 Dimension drawing of Active Interface Module 80 kW and 120 kW, all dimensions in mm and (inches)

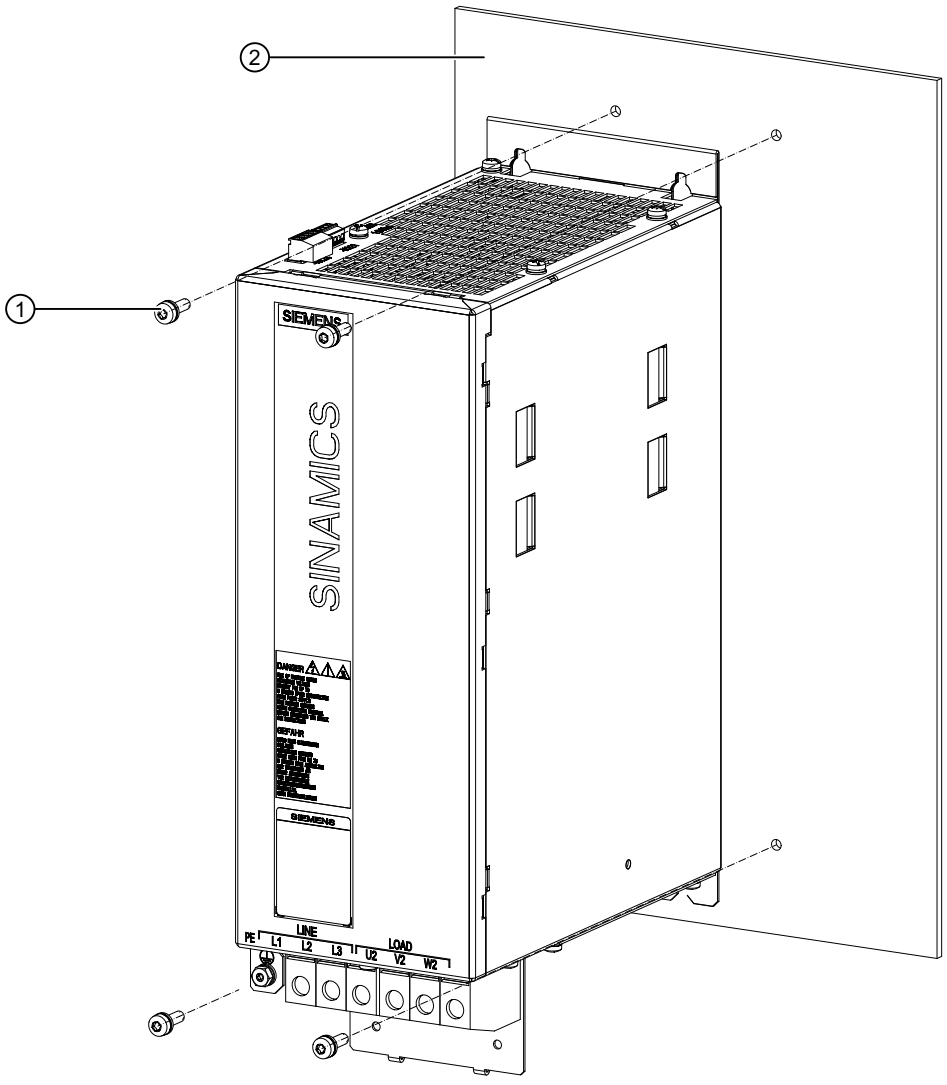
4.8.6 Installation

The Active Interface Modules are designed for installation in the control cabinet. The Active Interface Modules should if possible be mounted directly next to the Active Line Module.



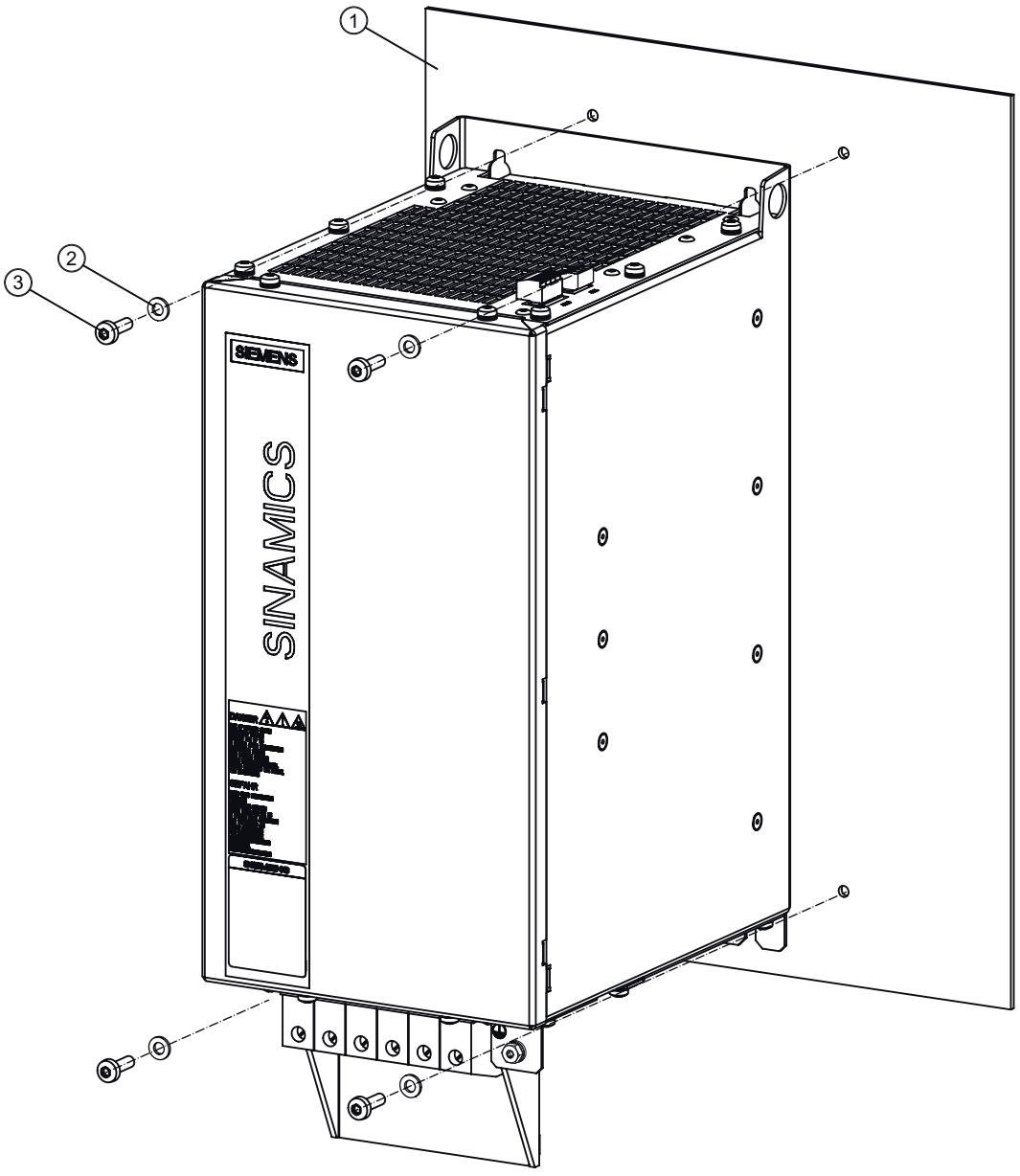
① M6 screw (no hexagon-head screw)
② Mounting panel

Figure 4-58 Installation of 16 kW Active Interface Module



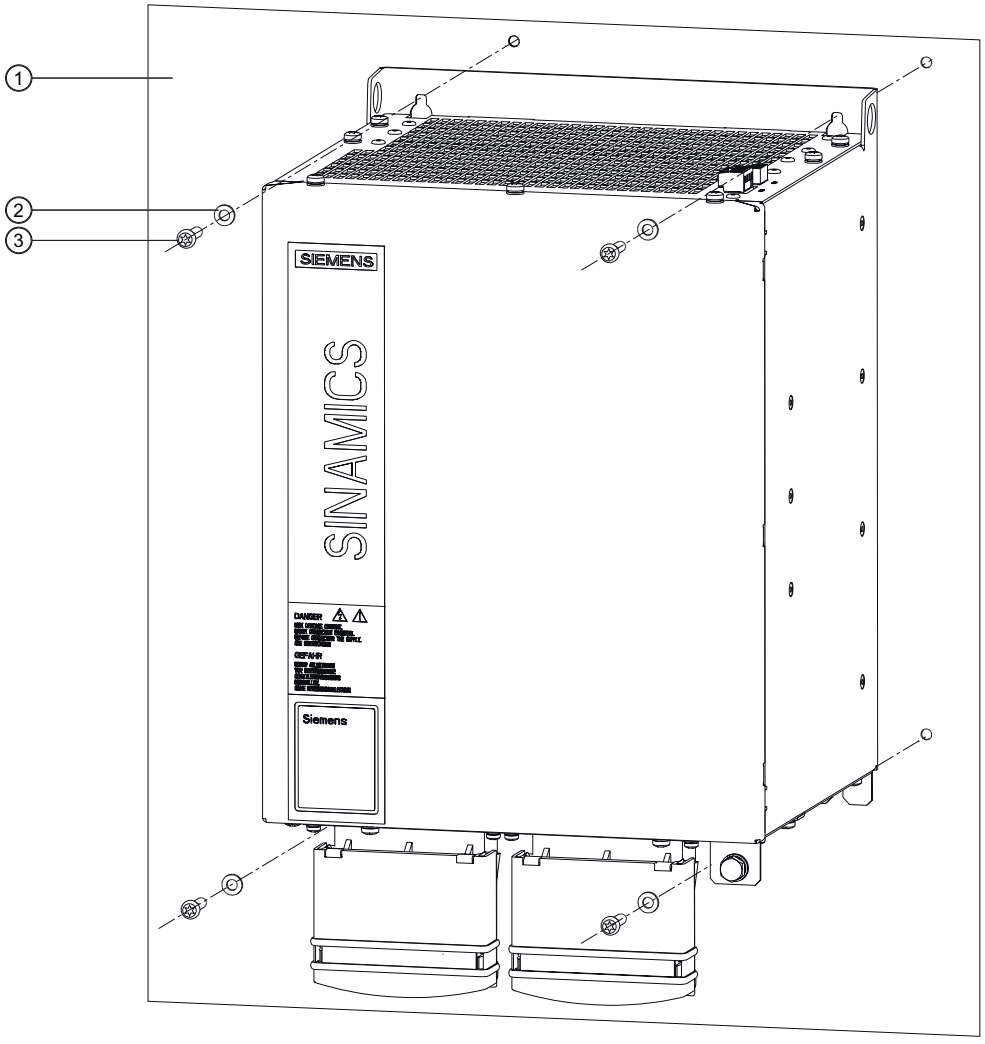
① M6 screw (no hexagon-head screw)
② Mounting panel

Figure 4-59 Installation of 36 kW Active Interface Module



① Mounting panel
② Washer
③ M6 screw (no hexagon-head screw)

Figure 4-60 Installation of 55 kW Active Interface Module



① Mounting panel
② Washer
③ M6 screw (no hexagon-head screw)

Figure 4-61 Installation of 80 kW or 120 kW Active Interface Module

Tightening torque for all screws: 6 Nm (53.1 lbf in)

Table 4-21 Protective ground conductor connection

Active Interface Module	
16 kW	Threaded hole M5 / 3 Nm (26.6 lbf in)
36 / 55 kW	Threaded hole M6 / 6 Nm (53.1 lbf in)
80 / 120 kW	Threaded hole M8 /13 Nm (115 lbf in)

4.8.7 Operation on an isolated-neutral system (IT system)

IT line system

In IT systems, all live parts are isolated from ground, or one point is connected to ground through an impedance. Housings of loads in the electrical plant or system are either individually grounded, jointly grounded or are all connected to the system ground. Only Line Modules without a line filter are to be operated on this type of line system.

According to EMC Product Standard IEC 61800-3, IT line systems are assigned Category C4. No limit values for interference emission are defined in this category. Instead, a customized EMC concept must be drawn-up.

The Active Interface Module must be set-up for operation on an IT line system.

Operating an Active Interface Module on an isolated-neutral line supply (IT line supply)

Note

When an Active Interface Module is operated on an isolated-neutral line supply (IT system), the connecting screw for the interference suppression capacitor (Page 122) in the Active Interface Module must be removed.

If it is not removed, then the insulation monitor will respond.

Removing the connecting screw to the interference-suppression capacitor eliminates the effect of the filter with respect to ground. The symmetrical filter branch and the clock frequency filter remain effective.

4.8.8 Operation on networks with asymmetrical grounding

TN or TT systems with asymmetrical grounding are not grounded at the neutral point, but rather at another reference point, for example at the line conductor.

For operation in such networks, the connecting screw to the interference suppression capacitor (Page 122) must be removed.

The symmetrical filter branch and the clock frequency filter remain effective.

NOTICE

Damage to equipment if operation is carried out on asymmetrically grounded networks without the connecting screw removed

With asymmetrical grounding, the interference suppression capacitors are subjected to voltage overload if the connecting screw has not been removed.

- Remove the connecting screw to the interference suppression capacitor before commissioning.

4.8.9 Removing the connecting screw for the interference suppression capacitor



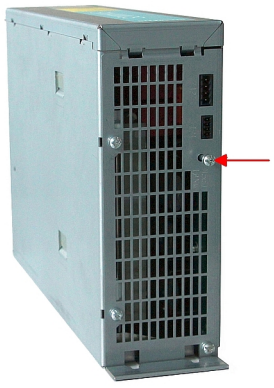
⚠ WARNING

Electric shock when the connecting screw is removed

Because of the capacitors, a hazardous voltage is present at the connecting screw 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 5 min. after the supply has been switched off before removing the connecting screw.

		
AIM 16/36: Connecting screw on the top side	AIM 55/80/120: Connecting screw on the bottom side	Connecting screw for the interference suppression capacitor (M5x55)
Remove the connecting screw to the interference suppression capacitor using a Tx25 screwdriver.		

Note

Insert the connecting screw to the interference suppression capacitor

For operation in other networks, the connecting screw must be reinserted and fixed with a tightening torque of 1.8 Nm (15.9 lbf in).

4.8.10 Shield connecting plates

Shield connecting plates are available as shield support elements for line feeder cables for all Active Interface Modules. A shield connection terminal and/or clamp is used to connect the cable shield to the shield connecting plate. Shield support elements must be correctly installed to ensure EMC compliance.

See Chapter "Accessories / shield connecting plates for line and motor feeder cables (Page 367)" for additional data on shield connecting plates.

4.8.11 Technical data

Table 4-22 Technical data

Active Interface Module	**6SL3100-**	**0BE21-6AB.**	**0BE23-6AB.**	**0BE25-5AB.**	**0BE28-0AB.**	**0BE31-2AB.**
		16 kW	**36 kW**	**55 kW**	**80 kW**	**120 kW**
Peak power	kW	35	70	110	131	175
Rated input current	A	26	58	88	128	192
Peak current	A	59	117	176	218	292
Current requirement of the 24 V DC electronics power supply	A	0.25	0.6	0.6	1.2	1.2
Line voltage	V	3-phase 380°V°...°480°VAC ±°10%				
Line frequency	Hz	47 ... 63				
Cooling air requirement	m^3/h	112	160	300	600	600
Power loss[1] (see power loss tables (Page 503))	W	270	340	380	490	585
Ventilation clearances above/below[2]	mm	≥ 80				
Weight	kg	13.0	18.5	23.2	31.9	36.6
Mounting position		Vertical with line connection at the bottom or horizontal				
Connection cross-section	mm^2	10	35	50	120	120
Protective ground conductor connection		M5 screw	M6 screw		M8 screw	

1) Referred to $U_{DC\ link}$ = 600 V

2) When mounted horizontally: ≥ 80 mm from the ventilation grilles

4.9 Combination options, Line Modules with line reactors and line filters

Table 4-23 Combination options, Active Line Modules with line filters, line reactors and Active Interface Modules

ALM type					combined with:			Features that can be achieved				
16 kW	36 kW	55 kW	80 kW	120 kW	Filter / reactor / AIM			DC link step up factor or rectified value B6	Total cable length for radio interference suppression according to EN 61800-3				Can be operated on an IT system (C4)
					BLF	HFD	AIM		Cat. C2 shielded in m	Cat. C3 shielded in m	No compliance with limit value category		
											shielded in m	unshielded in m	
●	●	●	●	●		x		1.4 ... 1.6	-	-	350	560	Yes
●	●	●			x	x			150	150	350	560	No
●	●						x	1.4 ... 2[2)]	-	350	630	850	Yes[1)]
		●	●	●			x		-	350	1000	1500	Yes[1)]
●	●				x		x		350	630	630	850	No
		●	●	●	x		x		350	1000	1000	1500	No

1) Remove connecting screw to the interference suppression capacitor

2) The motor insulation strength must be taken into account

Note

Ideally, new systems using Active Line Modules should be designed with Active Interface Modules as line connection components.

Table 4-24 Combination options, Smart Line Modules with line filters and line reactors

SLM type					combined with:		DC link step up factor or rectified value B6	Total cable length for radio interference suppression according to EN 61800-3				Can be operated on an IT system (C4)
5 kW	10 kW	16 kW	36 kW	55 kW	Filter/reactor			Cat. C2 shielded in m	Cat. C3 shielded in m	No compliance with limit value category		
					BLF	FE line reactor				shielded in m	unshielded in m	
●	●					x	1.35	-	-	350	560	Yes
		●	●	●		x		-	-	630	850	Yes
●	●				x	x		350	350	350	560	No
		●	●	●	x	x		350	630	630	850	No

Table 4-25 Combination options, Basic Line Modules with line filters and line reactors

BLM type			combined with:		Features that can be achieved					
20 kW	40 kW	100 kW	Filter/reactor		DC link step up factor or rectified value B6	Total cable length for radio interference suppression according to EN 61800-3				Can be operated on an IT system (C4)
			BLF	FE line reactor		Cat. C2 shielded in m	Cat. C3 shielded in m	No compliance with limit value category		
								shielded in m	unshielded in m	
●	●			x	1.35	-	-	1000	1500	Yes
		●		x		-	350	1000	1500	Yes[1]
●	●		x	x		350	630	1000	1500	No
		●	x	x		350	630	1000	1500	No

[1] Remove connection bracket to the interference suppression capacitor

Line Modules Booksize

5

5.1 Description

Line Modules are rectifiers that generate a DC voltage in the DC link from the 3-phase line voltage. The connected Motor Modules are supplied with power from this DC link.

Line Modules can be directly operated on TN, TT and IT line systems.

A distinction is made between:

- Active Line Modules for a controlled constant DC voltage, energy recovery capability
- Basic Line Modules for an uncontrolled DC voltage, without energy recovery capability
- Smart Line Modules for an uncontrolled DC voltage, with uncontrolled energy recovery capability

---

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 capability of the Active Line Modules and 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.

Exception: For 5 kW and 10 kW Smart Line Modules, you must deactivate the energy recovery capability as follows:

- Jumper between terminals X22.1 and X22.2
- Ground at X22.4

5.2 Safety instructions for Line Modules Booksize



⚠ WARNING

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

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

- Only operate the components with closed protective cover.



⚠ WARNING

High leakage currents when the protective conductor in the line feeder cable is interrupted

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

- Carefully comply with the applicable regulations for dimensioning the protective conductor (see Chapter "Protective connection and equipotential bonding (Page 492)").



⚠ 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.

- 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[1)] (exception: Smart Line Module[2)]), remove the DC link bridge, including the screws. Do not tighten the screws without the DC link bridges.
- For all components that are 75 mm wide or wider, the DC link bridges may neither be swung over to the left nor removed[3)].

[1)] For 50 mm wide modules, the DC link bridge cannot be swung inwards.
[2)] Smart Line Modules do not have a DC link bridge.
[3)] The DC link bridge guarantees the mechanical stability of the DC link busbars.



⚠ 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 cables and DC link cables) does not exceed the values specified in Section Combination options, Line Modules with line reactors and line filters (Page 124).

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

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

- Cover unused DRIVE-CLiQ interfaces with the supplied blanking covers.

5.3 Frequency with which the DC link is precharged

The frequency with which the DC link capacitance is precharged via the Line Module is determined using the following formula:

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

The DC link capacitances of the individual components can be taken from the relevant technical data.

5.4 Line failure buffer concept

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

The specified times can be extended a multiple number of times dependent on the drive constellation and the operating conditions. Significantly longer times can be obtained, also in drive line-ups, where some modules operate in the motoring mode and others in the generating mode. However, as a result of these influencing factors, no general statements can be made for the Booksize system, so that each individual drive line-up must be individually evaluated.

5.5 Active Line Modules

5.5.1 Description

Active Line Modules generate a constant, regulated DC voltage in the DC link from the 3-phase line supply voltage that supplies the connected Motor Modules with power.

This ensures that they are not influenced by line voltage fluctuations.

When motors brake, Active Line Modules feed energy back into the line supply. The energy recovery capability of the module can be deactivated using parameter p3533.

The DC link starts precharging as soon as the line voltage is applied and is independent of its phase sequence direction. Load can be applied to the DC link after the module has been enabled.

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

5.5.2 Interface description

5.5.2.1 Overview

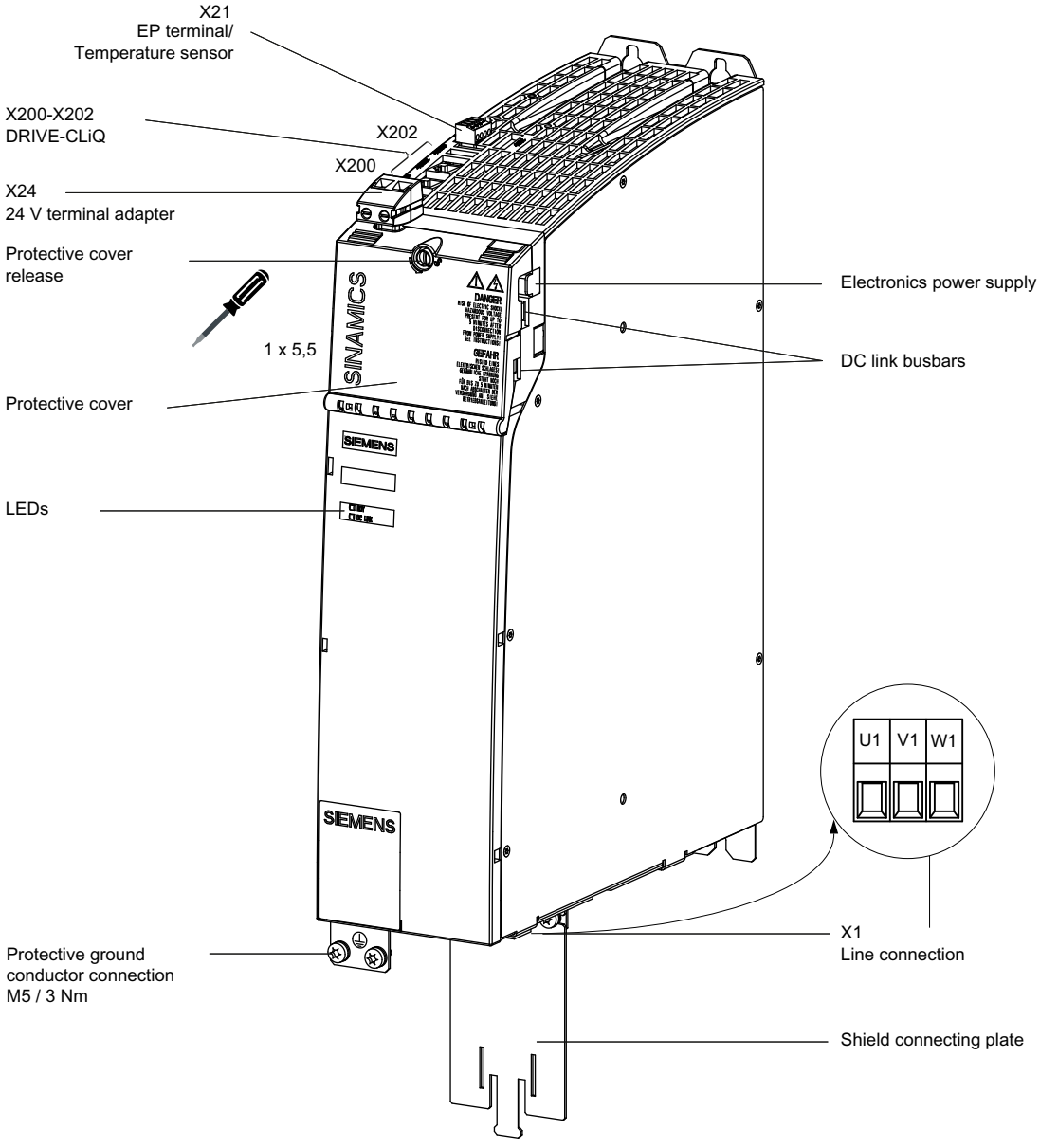


Figure 5-1 Interface overview, Active Line Module (example, 16 kW)

5.5.2.2 X1 line connection

Table 5-1 X1: Line connection for Active Line Modules 16 kW

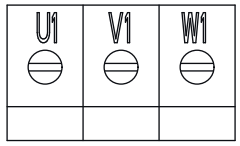
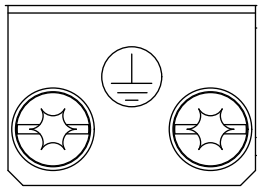
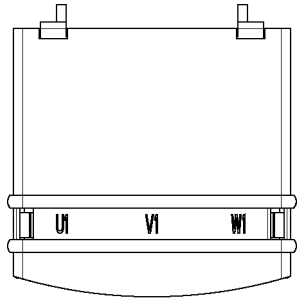
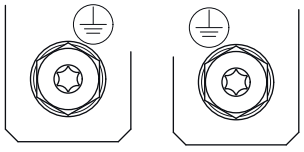
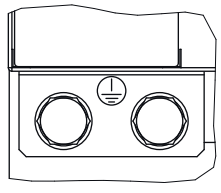
	Terminal	Technical data
	U1 V1 W1	Type: Screw terminal 6 (Page 486)
	Protective conductor connection	Threaded hole M5 / 3 Nm (26.6 lbf in)[1)]
[1)] For ring cable lugs without insulation (Page 487)		

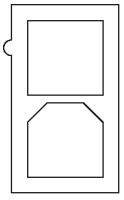
Table 5-2 X1: Line supply connection for Active Line Modules 36 kW to 120 kW

	Terminal	Technical data
	U1 V1 W1	Supply voltage: 380 ... 480 V 3 AC, 50/60 Hz **36 kW:** Threaded bolt M6 / 6 Nm (53.1 lbf in)[1)] **55 kW, 80 kW and 120 kW:** Threaded bolt M8 / 13 Nm (115 lbf in)[1)]
	Protective conductor connection	**36 kW and 55 kW:** Threaded hole M6 / 6 Nm (53.1 lbf in)[1)]
		**80 kW and 120 kW:** Threaded hole M8 / 13 Nm (115 lbf in)[1)]
[1)] For ring cable lugs without insulation (Page 487)		

5.5.2.3 X12 fan connection

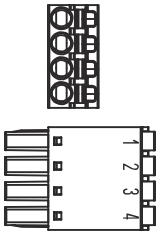
Active Line Modules 80 kW and 120 kW are equipped with an interface for connecting the sub-chassis fan. The interface is located on the underside of the Line Module.

Table 5-3 X12 fan connection

	Terminal	Function	Technical data
	1	Fan connection +	Voltage 48 V DC for the supplied fan
	2	Fan connection -	

5.5.2.4 X21 EP terminals

Table 5-4 X21 EP terminal / temperature sensor

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors[1)2)]: Pt1000[3)] / PTC[3)] / KTY84-130[3)] / bimetallic switch with NC contact If an Active Interface Module is used, the temperature input must be connected to the Active Interface Module sensor (bimetallic switch with NC contact).
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage: 24 V DC (20.4 ... 28.8 V) Current consumption, typical: 4 mA at 24 V Isolated input
	4	EP M (Enable Pulses)	
Type: Spring-loaded terminal 7 (Page 485)			

1) The temperature sensor type and the temperature output can be selected by parameter (see the SINAMICS S120/S150 List Manual).

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

3) Temperatures are detected but not evaluated in the Active Line Module

Terminals X21.1 and X21.2

When using an Active Interface Module, its temperature output must be connected at terminals X21.1 and X21.2.

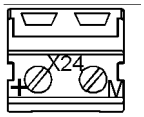
Terminals X21.3 and X21.4

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4.

Pulse cancellation is activated if the power supply is disconnected. As a consequence, energy recovery is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example, because a line contactor is not installed, then the DC link remains charged.

5.5.2.5 X24 24 V terminal adapter

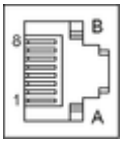
Table 5-5 X24: 24 V terminal adapter

	Terminal	Function	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Type: Screw terminal 5 (Page 486)			

The 24 V terminal adapter is included in the scope of supply.

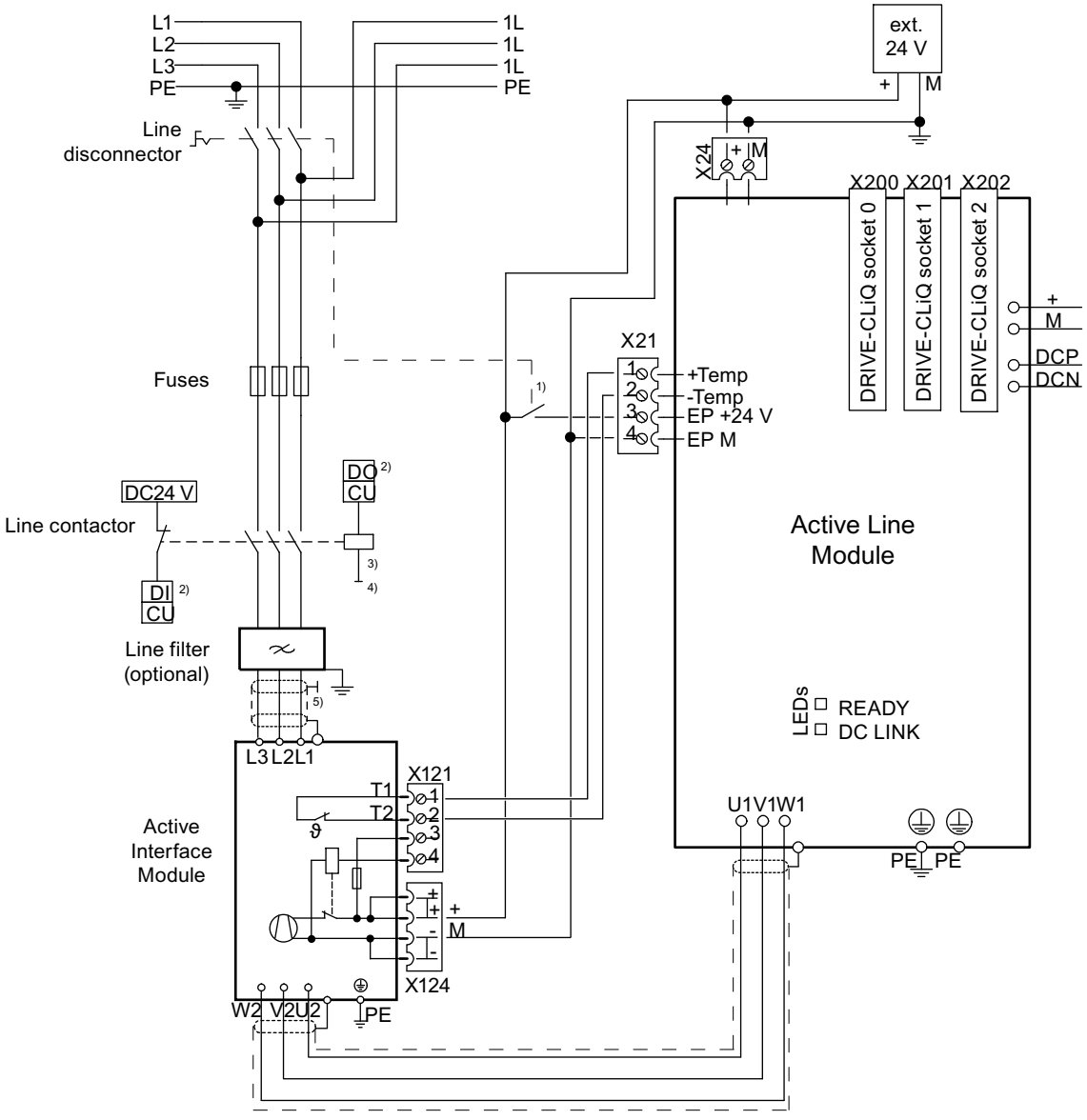
5.5.2.6 X200-X202 DRIVE-CLiQ interfaces

Table 5-6 X200-X202: DRIVE-CLiQ interfaces

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

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.
Blanking cover (50 pcs.) Article number: 6SL3066-4CA00-0AA0

5.5.3 Connection example



1) Leading opening contact t > 10 ms (when using a VSM10 V, the leading opening contact can be eliminated)

2) DI/DO, 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) Contacting via the rear mounting panel or shield busbars in accordance with the EMC guidelines

Figure 5-2 Example connection of Active Line Module

5.5.4 Meaning of LEDs

Table 5-7 Meaning of the LEDs on the Active Line Module

Status		Description, cause	Remedy
RDY	**DC LINK**		
Off	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
Green	--[1)]	The component is ready for operation. Cyclic DRIVE-CLiQ communication is established.	–
	Orange	The component is ready for operation. Cyclic DRIVE-CLiQ communication is established. The DC link voltage is present.	–
	Red	The component is ready for operation. Cyclic DRIVE-CLiQ communication is established. The DC link voltage is outside the permissible tolerance range.	Check the line supply voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--[1)]	This component has at least one fault.	Resolve and acknowledge the fault.
Green/ red (0.5 Hz)	--[1)]	Firmware is being downloaded.	–
Green/red (2 Hz)	--[1)]	Firmware download has been completed. The system waits for POWER ON.	Carry out a POWER ON.
Green/orange or red/orange (2 Hz)	--[1)]	Component recognition via LED is activated (p0124=1). **Note:** Whether the LED flashes green/orange or red/orange depends on the status the LED had during activation (setting of parameter p0124 to "1").	–

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

5.5.5 Dimension drawings

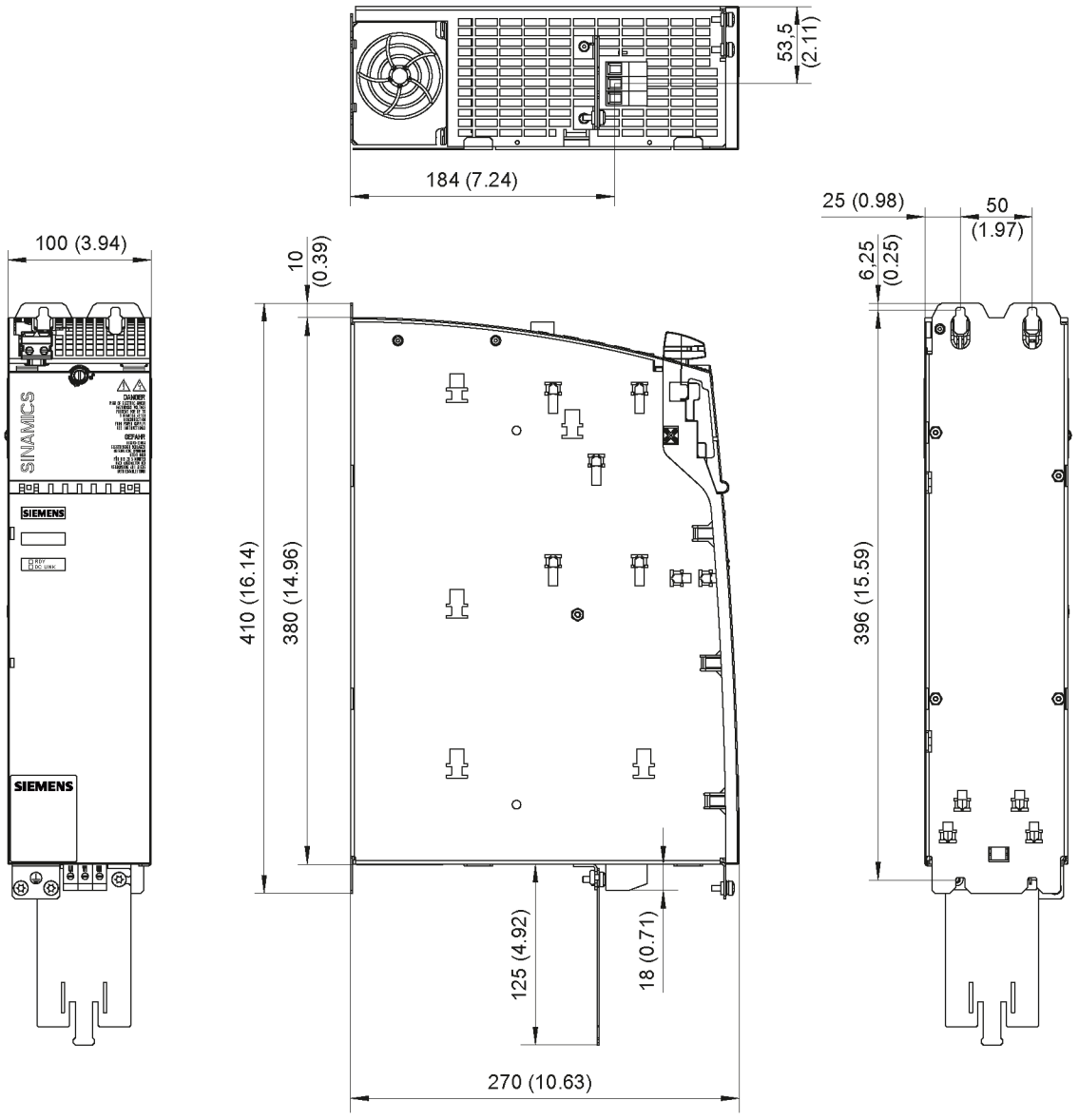


Figure 5-3 Dimension drawing of the 16 kW Active Line Module, all dimensions in mm and (inches)

Note

The shield connecting plate is supplied as standard with a 100 mm Line Module.
For more information, see Chapter Shield connecting plates for power supply and motor cables (Page 367).

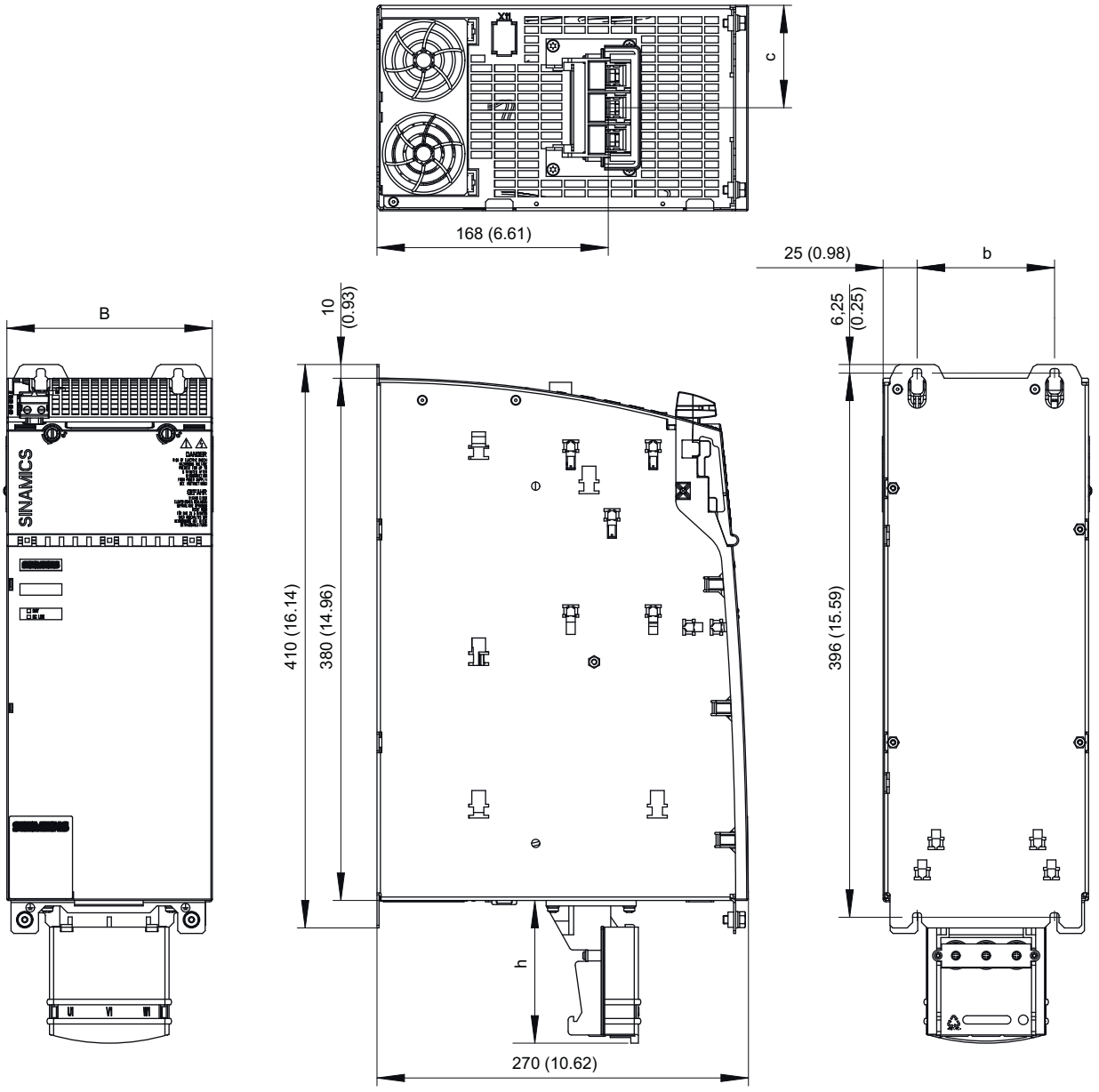


Figure 5-4 Dimension drawing of 36 kW and 55 kW Active Line Modules (example, 36 kW), all dimensions in mm and (inches)

Table 5-8 Dimensions of 36 kW and 55 kW Active Line Modules

Active Line Module	Article No.	B [mm] (inch)	b [mm] (inch)	c [mm] (inch)	h [mm] (inch)
36 kW	6SL3130-7TE23-6AA.	150 (5.91)	100 (3.94)	75 (2.95)	105 (4.13)
55 kW	6SL3130-7TE25-5AA.	200 (7.87)	150 (5.91)	100 (3.94)	105 (4.13)

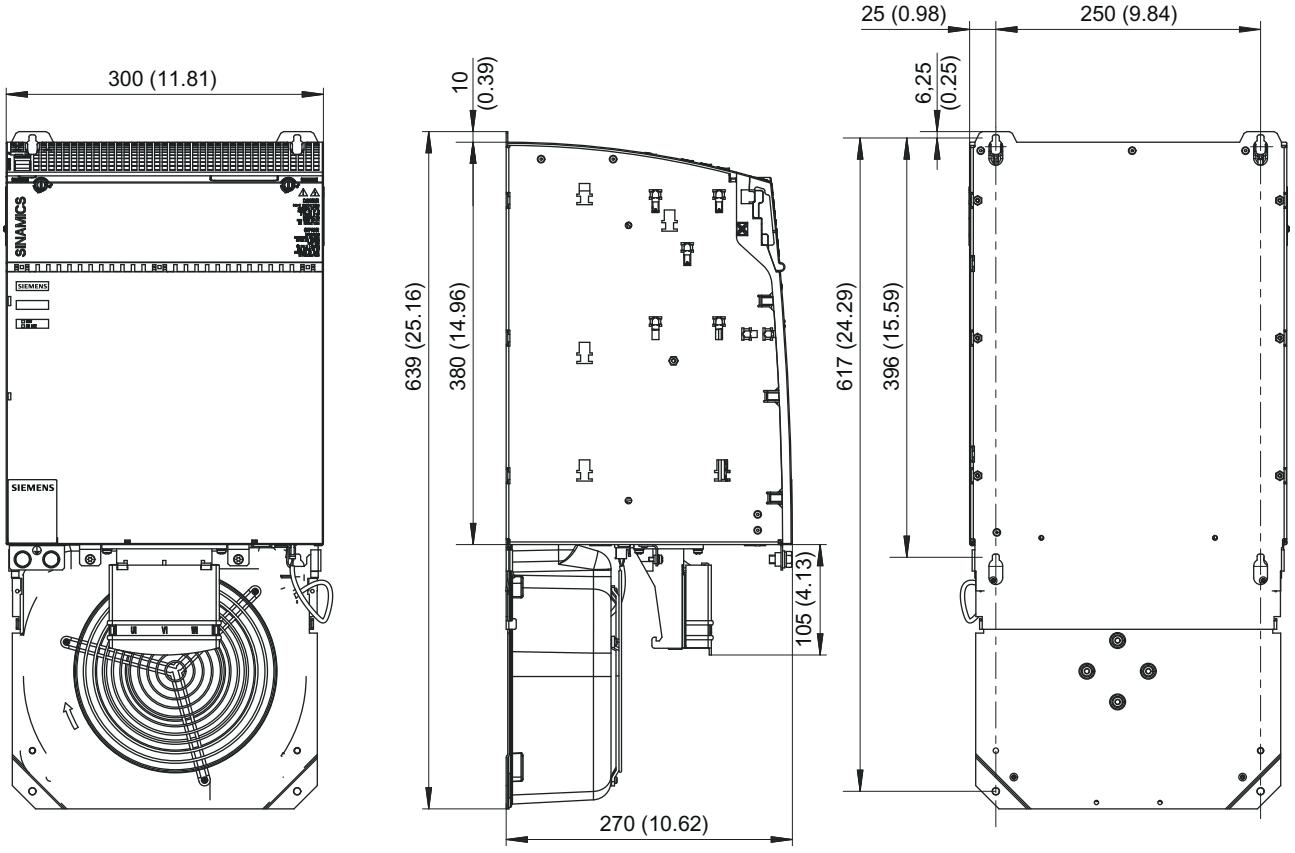


Figure 5-5 Dimension drawing of 80 kW and 120 kW Active Line Modules, all dimensions in mm and (inches)

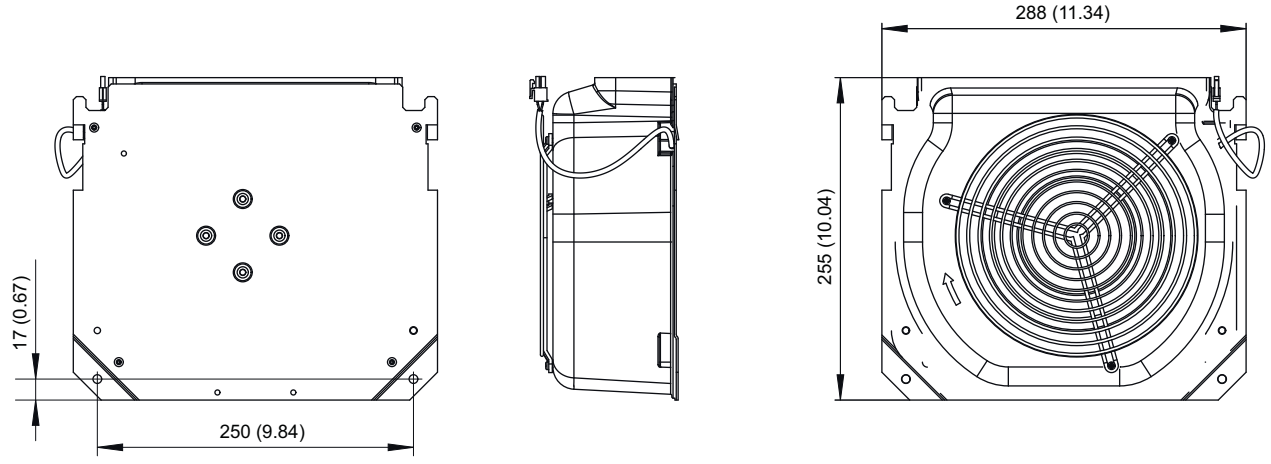


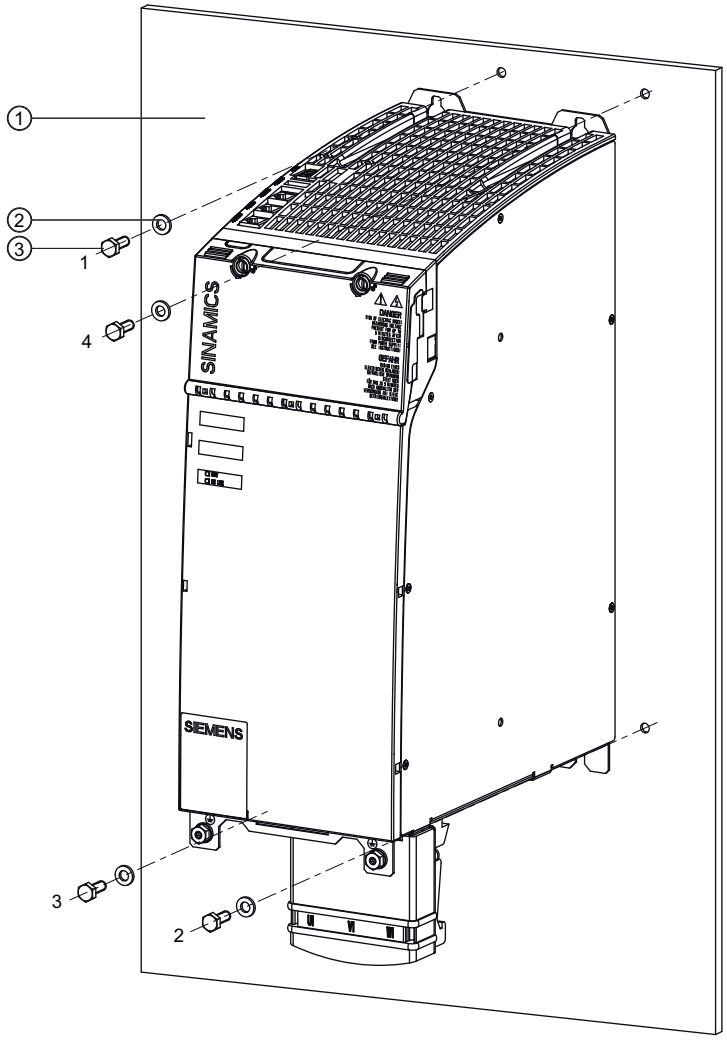
Figure 5-6 Dimension drawing of the fan for 80 kW and 120 kW Active Line Modules, all dimensions in mm and (inches)

Note

The fans for the 80 kW and 120 kW Active Line Modules are included in the scope of delivery.

5.5.6 Installation

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



① Control cabinet panel/mounting panel
② Washer
③ M6 screw

Figure 5-7 Installing an Active Line Module (example, 36 kW)

Tightening torques:

1. Firstly, tighten the nuts by hand.
   Tightening torque: 0.5 Nm (4.4 lbf in)
2. Then tighten the nuts in the specified sequence 1 to 4.
   Tightening torque: 6 Nm (53.1 lbf in)

Installing the sub-chassis fan

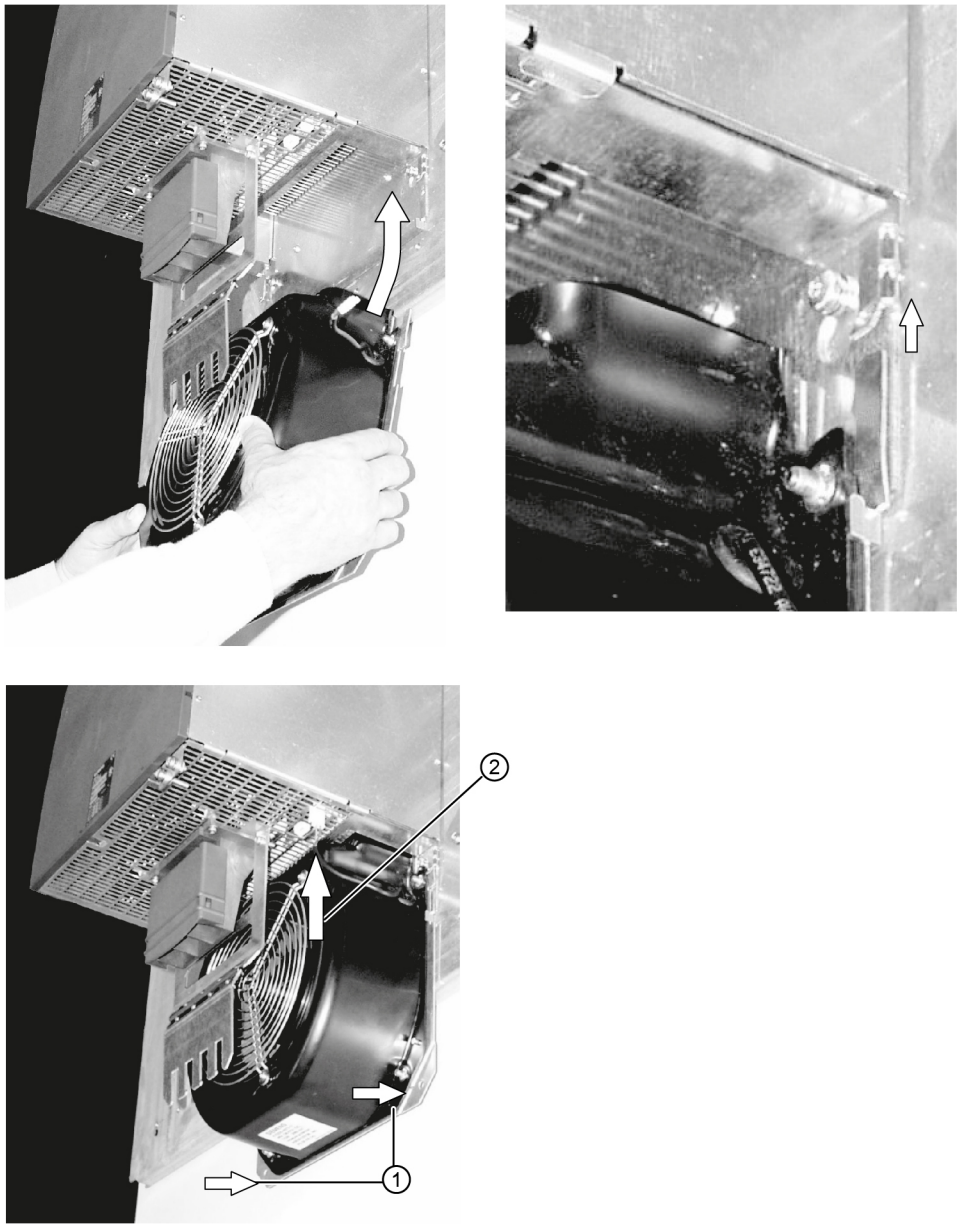


Figure 5-8 Mounting the fan for Active Line Modules 80 kW and 120 kW

① Fix the fan with M6 screws; tightening torque: 6 Nm (53.1 lbf in).

② Connect the fan power supply.

5.5.7 Technical data

Table 5-9 Technical specifications of Active Line Modules, Part 1

	6SL3130-	7TE21-6AA.	7TE23-6AA.	7TE25-5AA.	7TE25-5AA3 + Active Interface Module
Rated power	**kW**	**16**	**36**	**55**	**55**
Infeed[1]					
Rated power S1 duty	kW (P_n)	16	36	55	55
Infeed power S6 duty (40 %)	kW (P_{S6})	21	47	71	71
Peak infeed power	kW (P_{max})	35	70	91	110
Energy recovery into the line					
Continuous energy recovery	kW	16	36	55	55
Peak energy recovery power	kW	35	70	91	110
Supply voltages					
Line voltage	V_{ACrms}	3 AC 380 ... 480 ± 10 % (-15 % < 1 min)			
Line frequency	Hz	47 ... 63			
Electronic power supply	V_{DC}	24 (20.4 ... 28.8)			
DC link voltage	V_{DC}	510 ... 720			
Overvoltage trip	V_{DC}	820 ± 2 %			
Undervoltage trip[2]	V_{DC}	360 ± 2 %			
Input currents					
Rated input current:					
for AC 400 V	A_{AC}	25	55	84	84
input current:					
for AC 380 V / AC 480 V	A_{AC}	26 / 21	58 / 46	88 / 70	88 / 70
for AC 400 V; S6 duty (40 %)	A_{AC}	32	71	108	108
for AC 400 V; peak current	A_{AC}	54	107	139	168
DC link currents					
Rated DC link current:					
at 600 V DC	A_{DC}	27	60	92	92
at 510 V DC / 720 V DC	A_{DC}	27 / 22.2	60 / 50	92 / 76.4	92 / 76.4
DC link current:					
for 600 V DC; S6 duty (40 %)	A_{DC}	35	79	121	121
for 600 V DC; peak current	A_{DC}	59	117	152	176
Current-carrying capacity					
DC link busbars	A_{DC}	100	200	200	200
24 V DC busbars	A_{DC}	20	20	20	20
Electronics current drawn					
at 24 V DC	A_{DC}	0.95	1.5	1.9	1.9
Total power loss (including electronics losses, see Power loss tables (Page 503))	W	282.8	666	945.6	945.6
DC link capacitance					
Active Line Module	µF	705	1410	1880	1880
Drive line-up, max.	µF	20000	20000	20000	20000
Power factor	cos φ	1	1	1	1
Circuit breaker (IEC 60947 and UL)		See Chapter Overcurrent protection using fuses and circuit breakers (Page 49)			

	6SL3130-	7TE21-6AA.	7TE23-6AA.	7TE25-5AA.	7TE25-5AA3 + Active Interface Module
Rated power	**kW**	**16**	**36**	**55**	**55**
Max. total cable length[3]		See Chapter Combination options, Line Modules with line reactors and line filters (Page 124)			
Cooling method (internal air cooling)		Internal fan			
Cooling air requirement	m^3/h	56	112	160	160
Ventilation clearances above/below	mm	≥ 80			
Weight	kg	7	10.7	16	17

1) The specified power ratings apply to the line voltage range from 380 V to 480 V.

2) Default for 400 V line systems; undervoltage trip threshold is adjusted to the parameterized rated voltage

3) Maximum total cable length = Σ motor cables, line feeder cable from line filter to the Line Module

Table 5-10 Technical specifications of Active Line Modules, Part 2

	6SL3130-	7TE28-0AA.	7TE31-2AA.
Rated power	**kW**	**80**	**120**
Infeed[1]			
Rated power S1 duty	kW (P_n)	80	120
Infeed power S6 duty (40 %)	kW (P_{S6})	106	145
Peak infeed power	kW (P_{max})	131	175
Energy recovery into the line			
Continuous energy recovery	kW	80	120
Peak energy recovery power	kW	131	175
Supply voltages			
Line voltage	V_{ACrms}	3 AC 380 ... 480 ±10 % (-15 % < 1 min)	
Line frequency	Hz	47 ... 63	
Electronic power supply	V_{DC}	24 (20.4 ... 28.8)	
DC link voltage	V_{DC}	510 ... 720	
Overvoltage trip	V_{DC}	820 ± 2 %	
Undervoltage trip[2]	V_{DC}	360 ± 2 %	
Input currents			
Rated input current:			
for AC 400 V	A_{AC}	122	182
input current:			
for AC 380 V / AC 480 V	A_{AC}	128 / 102	192 / 152
for AC 400 V; S6 duty (40 %)	A_{AC}	161	220
for AC 400 V; peak current	A_{AC}	200	267
DC link currents			
Rated DC link current:			
at 600 V DC	A_{DC}	134	200
at 510 V DC / 720 V DC	A_{DC}	134 / 111	200 / 167
DC link current:			
for 600 V DC; S6 duty (40 %)	A_{DC}	176	244
for 600 V DC; peak current	A_{DC}	218	292
Current-carrying capacity			
DC link busbars	A_{DC}	200	200
24 V busbars	A_{DC}	20	20

	6SL3130-	**7TE28-0AA.**	**7TE31-2AA.**
Rated power	**kW**	**80**	**120**
Electronics current drawn at 24 V DC	 A_{DC}	 1.4	 1.8
Total power loss (including electronics losses, see Power loss tables (Page 503))	W	1383.6	2243.2
DC link capacitance Active Line Module Drive line-up, max.	 µF µF	 2820 20000	 3995 20000
Power factor	cos φ	1	1
Circuit breaker (IEC 60947 and UL)		See Chapter Overcurrent protection using fuses and circuit breakers (Page 49)	
Max. total cable length[3)]		See Chapter Combination options, Line Modules with line reactors and line filters (Page 124)	
Cooling method (internal air cooling)		Mounted fan	
Cooling air requirement	m^3/h	520	520
Ventilation clearances above/below in front of the mounted fan	 mm mm	 ≥ 80 ≥ 50	
Weight	kg	23	23

1) The specified power ratings apply to the line voltage range from 380 V to 480 V.

2) Default for 400 V line systems; undervoltage trip threshold is adjusted to the parameterized rated voltage

3) Maximum total cable length = Σ motor cables, line feeder cable from line filter to the Line Module

5.5.7.1 Characteristics

Rated duty cycles for Active Line Modules

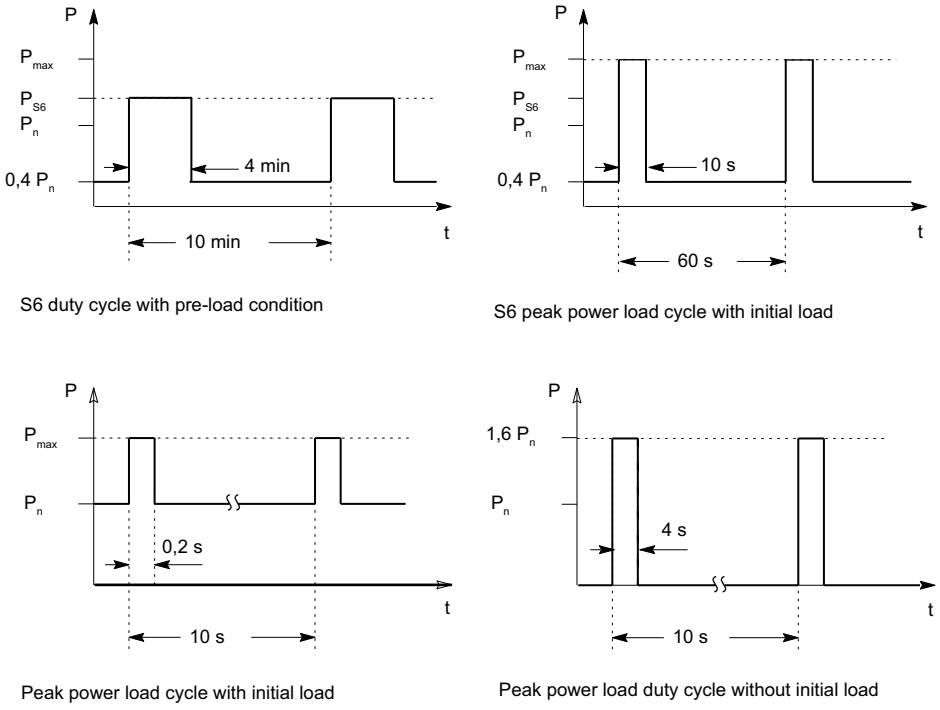


Figure 5-9 Rated duty cycles for Active Line Modules (**exception**: not applicable for 55 kW Active Line Module with Active Interface Module)

Rated duty cycles for Active Line Modules with Active Interface Modules

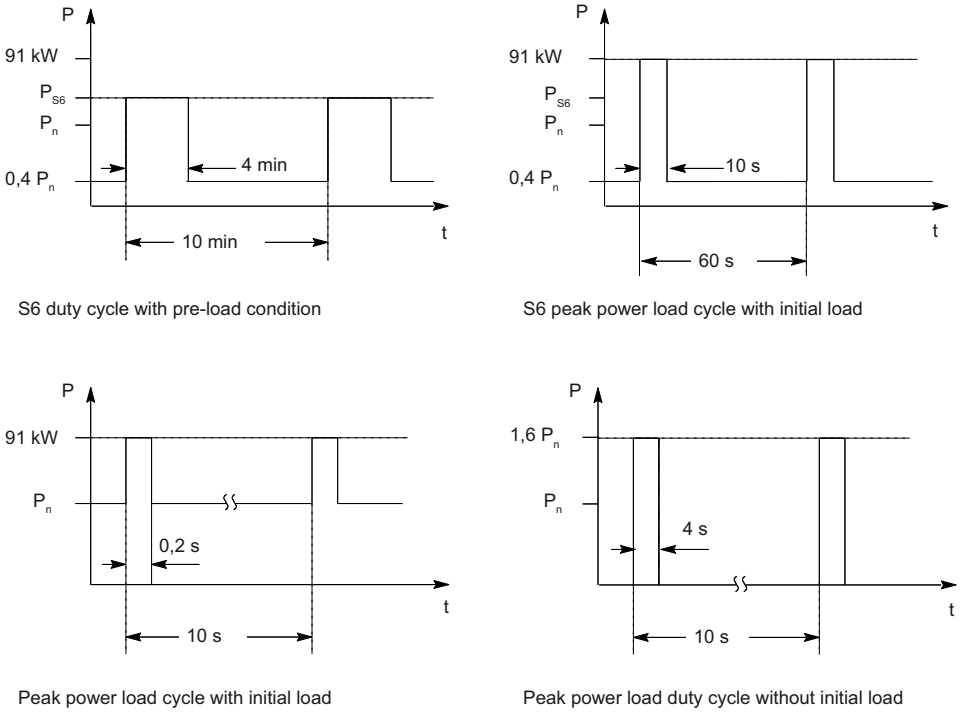


Figure 5-10 Load cycles for 55 kW Active Line Modules with Active Interface Module

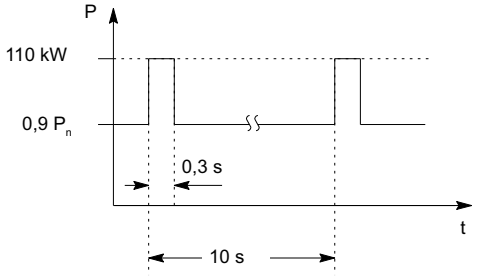


Figure 5-11 Peak load cycle with initial load for 55 kW Active Line Modules with Active Interface Module

5.6 Basic Line Modules

5.6.1 Description

The Basic Line Modules generate a non-regulated DC voltage, which matches the rectified line input voltage, from the 3-phase line voltage and feed this DC voltage into the DC link. One Basic Line Module can supply one or more Motor Modules with power via the DC link.

To reduce the energy, e.g. for emergency retraction, the 20 kW and 40 kW Basic Line Modules feature a control for an external braking resistor.

For 100 kW Basic Line Modules, an external braking unit is required for degradation of energy. Either Braking Modules Booksize Compact (also in a parallel connection) or a MASTERDRIVES braking unit (see Chapter "Braking units for 100 kW Basic Line Modules (Page 297)") can be used.

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

The 100 kW Basic Line Module features basic interference suppression, the 20 kW and 40 kW Basic Line Modules do not.

The ratio between the line short-circuit power (system fault level) and the rated power must be ≥ 30.

Data regarding the radio interference voltage categories and maximum total cable lengths that can be achieved, see Chapter "Combination options, Line Modules with line reactors and line filters (Page 124)".

5.6.2 Interface description

5.6.2.1 Overview

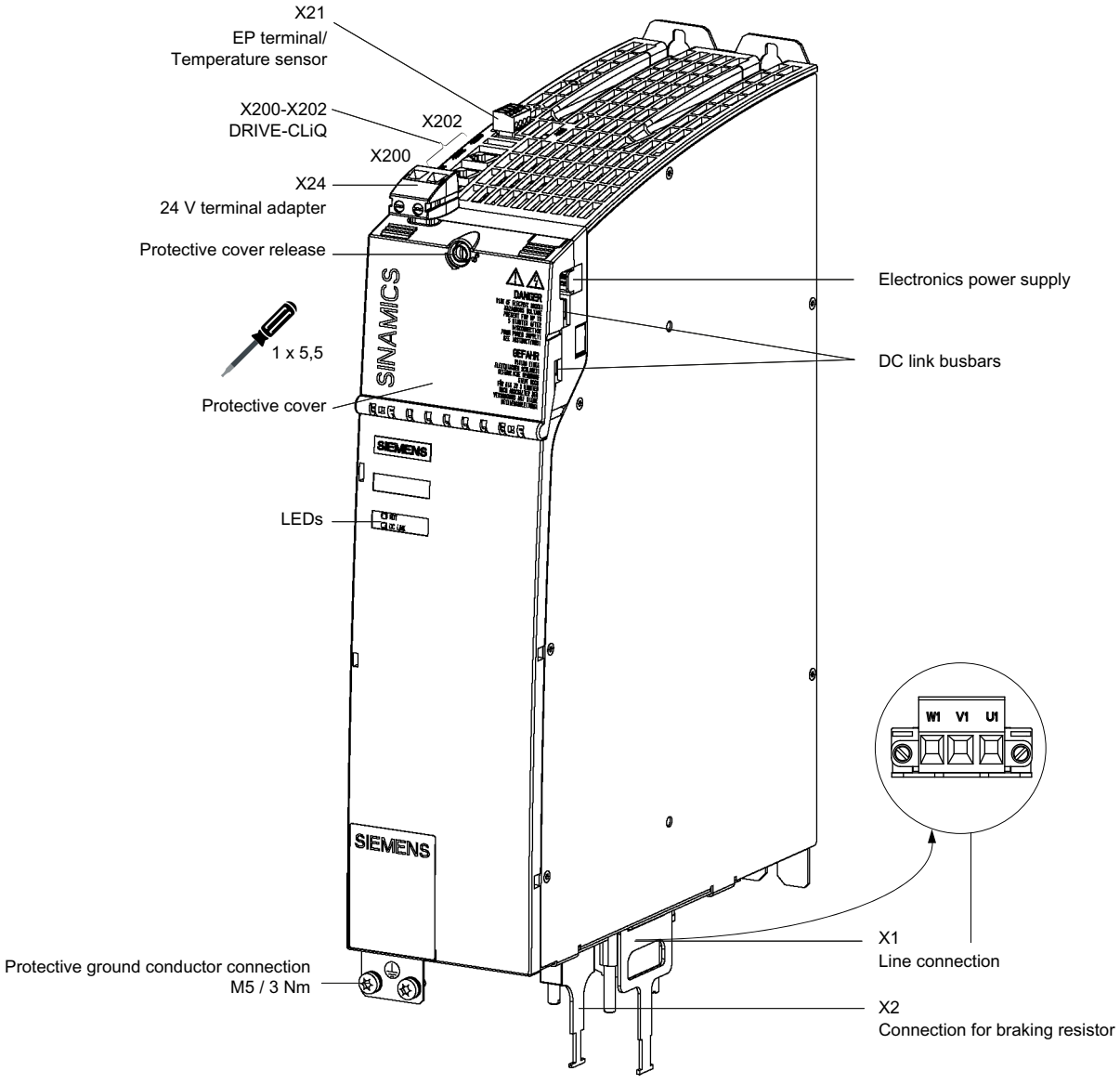


Figure 5-12 Interface overview of Basic Line Module (example: 20 kW)

5.6.2.2 X1 line connection

Table 5-11 X1: Line supply connection for Basic Line Modules 20 kW

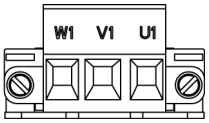
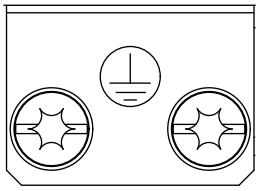
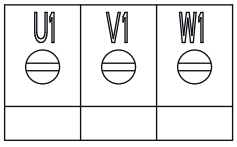
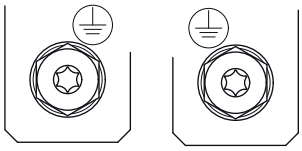
	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Type: Screw terminal 7 (Page 486)
	Protective conductor connection	Threaded hole M5 / 3 Nm (26.6 lbf in)[1)]
[1)] For ring cable lugs without insulation (Page 487)		

Table 5-12 X1: Line supply connection for Basic Line Modules 40 kW

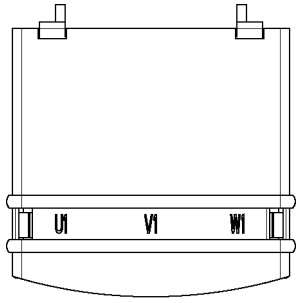
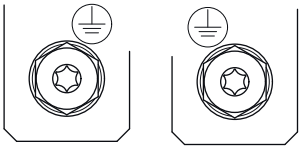
	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Max. connectable cross section 50 mm² (AWG 1), wire end ferrules Tightening torque min. 6 Nm (53.1 lbf in)
	Protective conductor connection	Threaded hole M6 / 6 Nm (53.1 lbf in)[1)]
[1)] For ring cable lugs without insulation (Page 487)		

Note

Compliance with IPXXB degree of protection for Basic Line Modules 40 kW

Degree of protection IPXXB according to EN 60529 for the Basic Line Module 40 kW is only obtained when power cables with insulated end sleeves and cross-sections > 25 mm² (AWG 4) are used.

Table 5-13 X1: Line supply connection for Basic Line Modules 100 kW

	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Type: Threaded bolts M8[1)] Max. connectable cross-section: 120 mm² (AWG 4/0) Tightening torque: 13 Nm (115 lbf in)
	Protective conductor connection	Threaded hole M6 / 6 Nm (53.1 lbf in)[1)]
[1)] For ring cable lugs without insulation (Page 487)		

5.6.2.3 X2 braking resistor connection

Table 5-14 X2: Braking resistor connection at the Basic Line Module 20 kW

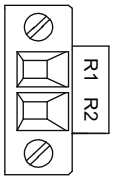
	Terminal	Function	Technical specifications
	1	Braking resistor connection R1	Type: Screw terminal 4 (Page 486)
	2	Braking resistor connection R2	

Table 5-15 X2: Braking resistor connection at the Basic Line Module 40 kW

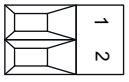
	Terminal	Function	Technical specifications
	1	Braking resistor connection R1	Type: Screw terminal 6 (Page 486)
	2	Braking resistor connection R2	

Table 5-16 Braking resistors with a thermostatic switch for 20 kW and 40 kW Basic Line Modules

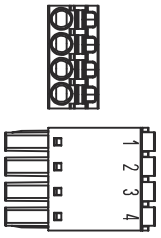
Braking resistor	R in Ω	P_{rated} in kW	4 x P_{rated} in kW	P_{max} in kW
6SE7018-0ES87-2DC0	80	1.25	5	7.5
6SE7021-6ES87-2DC0	40	2.5	10	15
6SE7023-2ES87-2DC0	20	5	20	30
6SE7028-0ES87-2DC0[1)]	8	12.5	50	75

[1)] Not suitable for 20 kW Basic Line Module

For detailed technical information on the braking resistors, see the section entitled Braking resistors (Page 327).

5.6.2.4 X21 EP terminals

Table 5-17 X21 EP terminal / temperature sensor

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors[1)2)]: Pt1000[3)] / PTC[3)] / KTY84-130[3)] / bimetallic switch with NC contact With the 20 kW and 40 kW Basic Line Modules, the temperature sensor of the braking resistor (bimetallic switch with NC contact) is connected to the temperature input. **Response thresholds** of the temperature input: Temperature at the braking resistor in the operating range → resistance value ≤ 100 ohms Overtemperature at the braking resistor → resistance value > 100 ohms **Fault responses**: An alarm is output and the Basic Line Module is deactivated with a fault after one minute, if overtemperature is still present at the braking resistor. If there is no braking resistor, terminals 1 and 2 must be jumpered to deactivate the overtemperature.
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage: 24 V DC (20.4 ... 28.8 V) Current consumption, typical: 4 mA at 24 V Isolated input
	4	EP M (Enable Pulses)	
Type: Spring-loaded terminal 7 (Page 485)			

1) The temperature sensor type and the temperature output can be selected by parameter (see the SINAMICS S120/S150 List Manual).

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

3) Temperatures are detected but not evaluated in the Basic Line Module.

Terminals X21.1 and X21.2

NOTICE
Overheating of the resistor if the temperature switch is not connected
If the temperature switch is not connected, this can cause the overheating and thus damage to the resistor. • Connect the temperature switch.

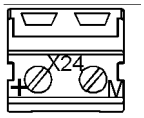
Terminals X21.3 and X21.4

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4.

The bypass relay drops out if the power supply is disconnected. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example, because a line contactor is not installed, then the DC link remains charged.

5.6.2.5 X24 24 V terminal adapter

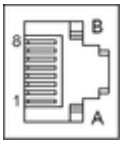
Table 5-18 X24: 24 V terminal adapter

	Terminal	Function	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Type: Screw terminal 5 (Page 486)			

The 24 V terminal adapter is included in the scope of supply.

5.6.2.6 X200-X202 DRIVE-CLiQ interfaces

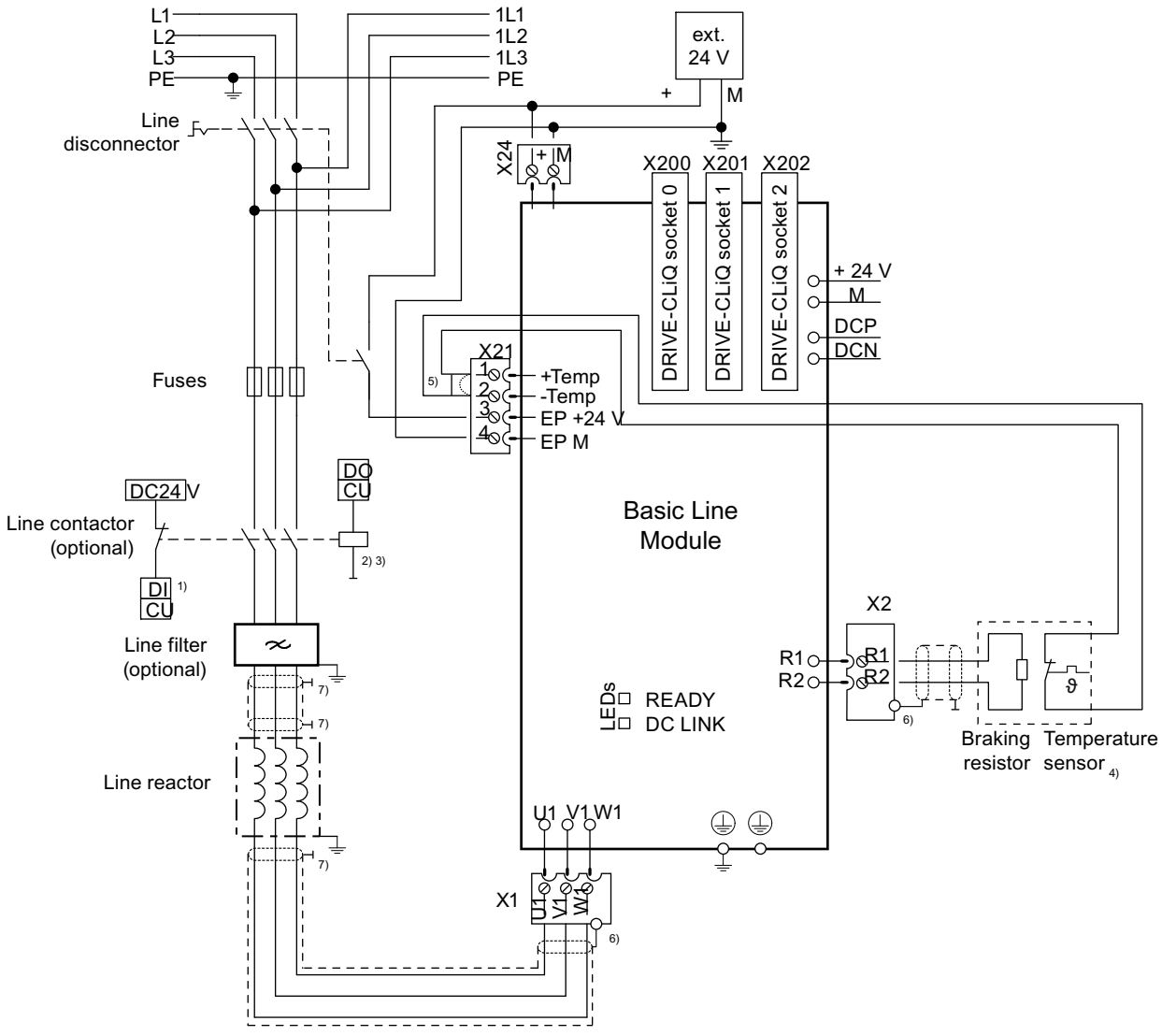
Table 5-19 X200-X202: DRIVE-CLiQ interfaces

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

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

Blanking cover (50 pcs.) Article number: 6SL3066-4CA00-0AA0

5.6.3 Connection examples



1) DI/DO, controlled by the Control Unit

2) No additional load permitted downstream of the line contactor

3) The current carrying capacity of the digital output (DO) must be observed. An output coupling device may have to be used.

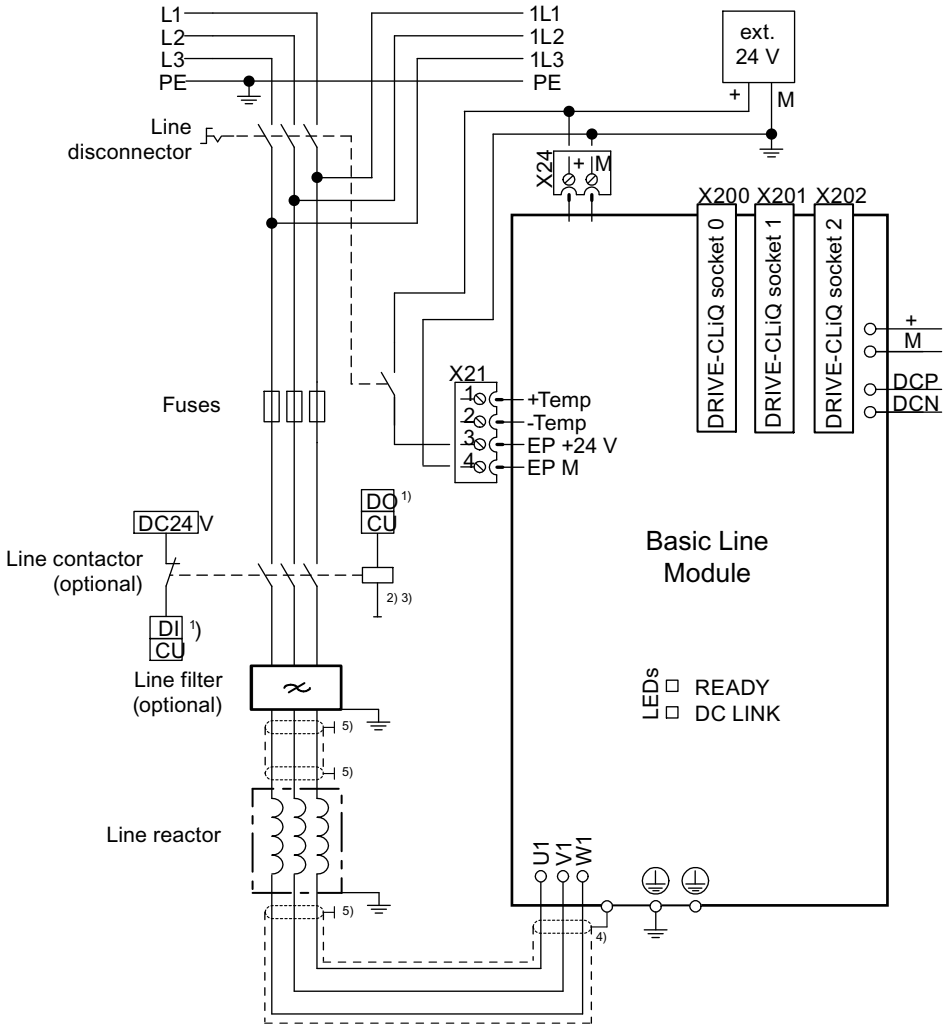
4) The bimetallic switch with wiring must not exceed a resistance value of 100 ohms in the closed state.

5) Jumper for deactivating temperature monitoring for the braking resistor

6) Contact established via connector (20 kW) or shield connecting plate (40 kW)

7) Contact established through the rear mounting panel or shield rails in accordance with the EMC installation guideline

Figure 5-13 Connection example: Basic Line Module (20 kW and 40 kW)



1) DI/DO, controlled by the Control Unit

2) No additional load permitted downstream of the line contactor

3) The current carrying capacity of the digital output (DO) must be observed. An output coupling device may have to be used.

4) Contact established via shield connecting plate

5) Contact established through the rear mounting panel or shield rails in accordance with the EMC installation guideline

Figure 5-14 Connection example: Basic Line Module (100 kW)

5.6.4 Meaning of LEDs

Table 5-20 Meaning of the LEDs on the Basic Line Module

Status		Description, cause	Remedy
RDY	**DC LINK**		
Off	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
Green	--[1)]	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is outside the permissible tolerance range.	Check the line supply voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--[1)]	This component has at least one fault.	Resolve and acknowledge the fault.
Green/ red (0.5 Hz)	--[1)]	Firmware is being downloaded.	–
Green/red (2 Hz)	--[1)]	Firmware download has been completed. The system waits for POWER ON.	Carry out a POWER ON.
Green/orange or red/orange (2 Hz)	--[1)]	Component recognition via LED is activated (p0124=1). **Note:** Whether the LED flashes green/orange or red/orange depends on the status the LED had during activation (setting of parameter p0124 to "1").	–

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

5.6.5 Dimension drawings

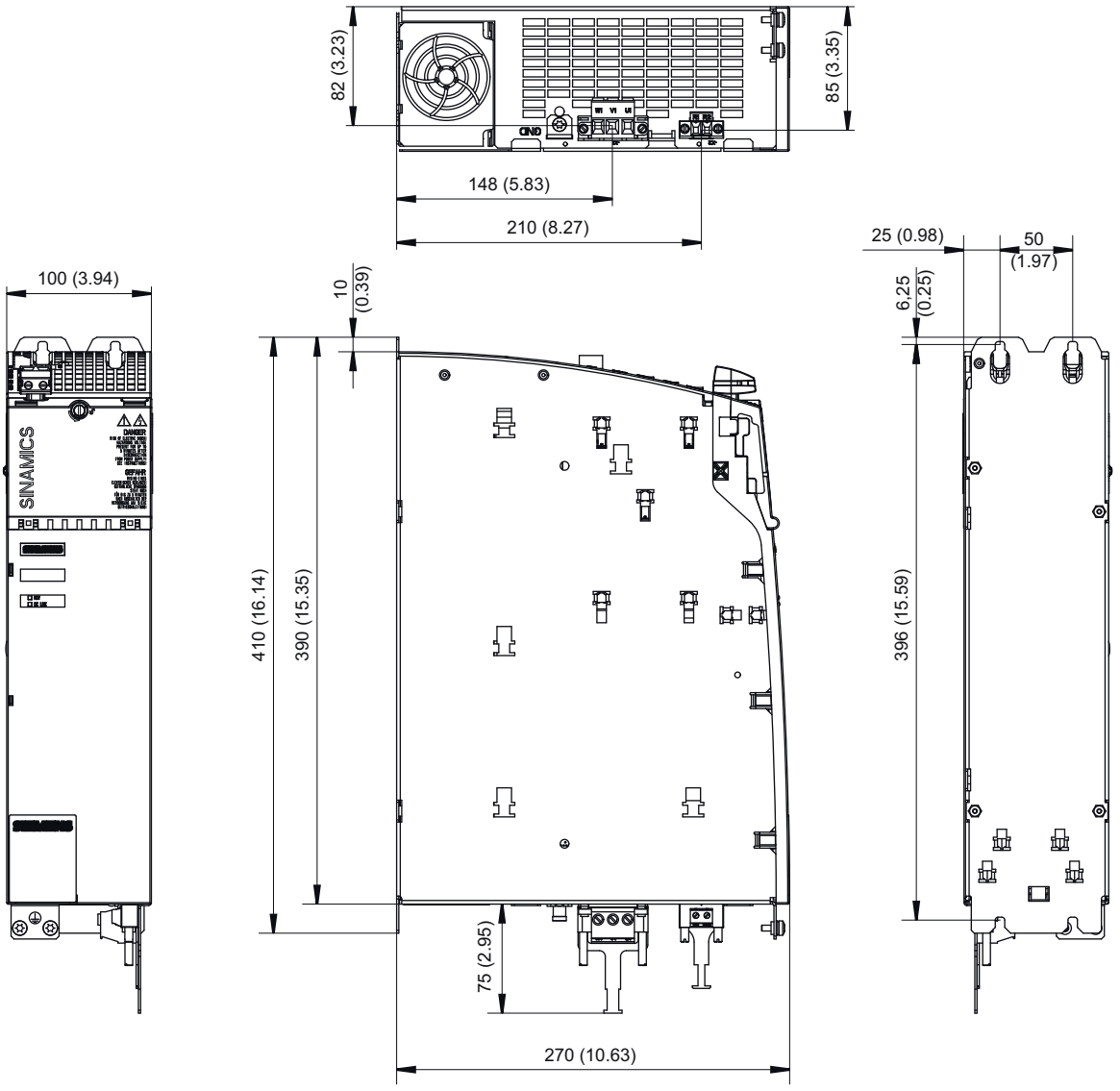


Figure 5-15 Dimension drawing of 20 kW Basic Line Module, all dimensions in mm and (inches)

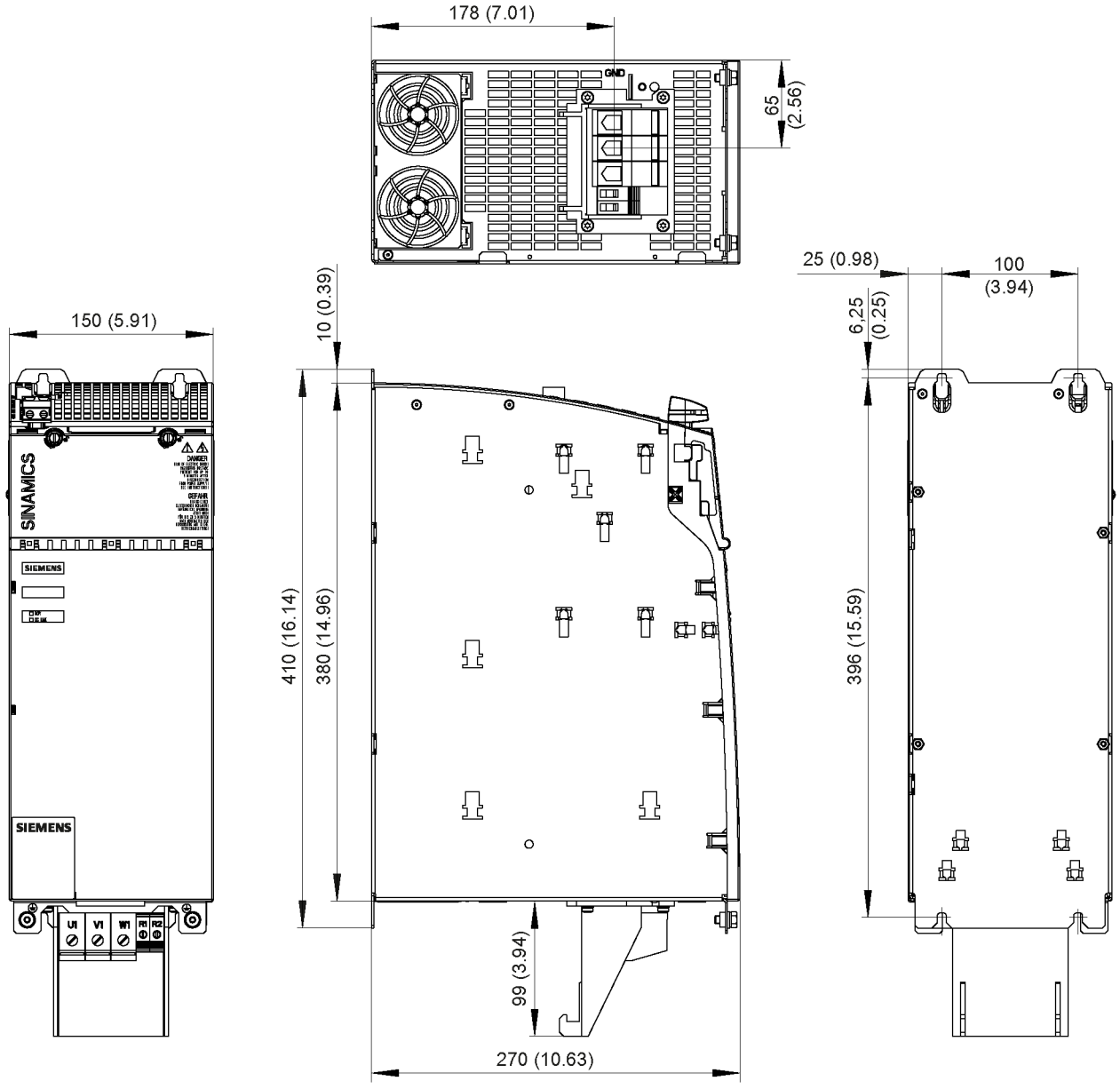


Figure 5-16 Dimension drawing of 40 kW Basic Line Module, all dimensions in mm and (inches)

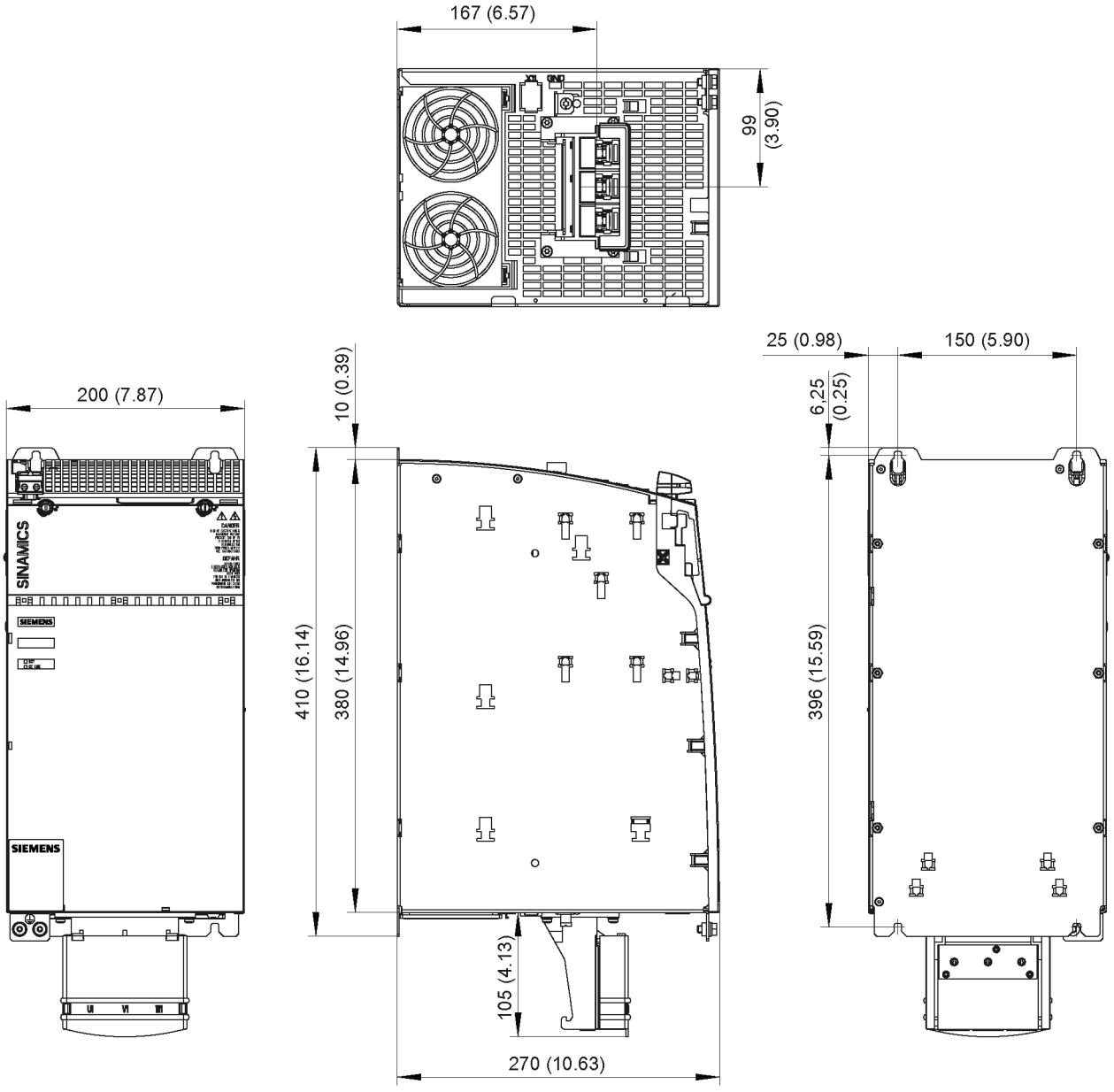
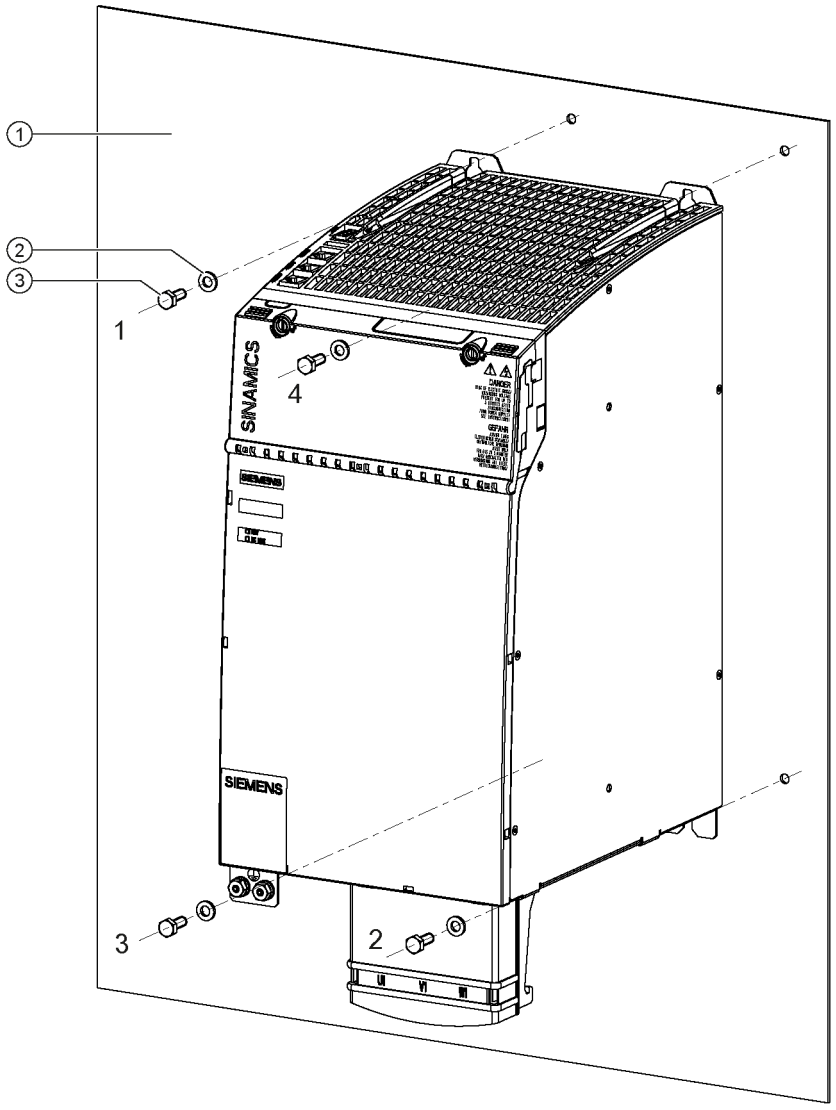


Figure 5-17 Dimension drawing of 100 kW Basic Line Module, all dimensions in mm and (inches)

5.6.6 Installation

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



① Control cabinet panel/mounting panel
② Washer
③ M6 screw

Figure 5-18 Mounting a Basic Line Module (example, 100 kW)

Tightening torques:

1. Firstly, tighten the nuts by hand.
   Tightening torque: 0.5 Nm (4.4 lbf in)
2. Then tighten the nuts in the specified sequence.
   Tightening torque: 6 Nm (53.1 lbf in)

5.6.7 Operation on an isolated-neutral system (IT system)

In IT systems, all live parts are isolated from ground, or one point is connected to ground through an impedance. Housings of loads in the electrical plant or system are either individually grounded, jointly grounded or are all connected to the system ground

To operate a 100 kW Basic Line Module on an isolated-neutral (IT) system, the connection bracket for the interference suppression capacitor (Page 160) must be removed. The connection bracket is located on the lower side of the component.

Note

Connection bracket to the interference suppression capacitor has not been removed

If the connection bracket for the interference suppression capacitor is not removed, an error message might be output via the insulation monitor in the system.

5.6.8 Operation on networks with asymmetrical grounding

TN or TT systems with asymmetrical grounding are not grounded at the neutral point, but rather at another reference point, for example at the line conductor.

For operation of a Basic Line Module 100 kW on such networks, the connection bracket for the interference suppression capacitor must be removed (see Chapter "Operation on an isolated network (IT system) (Page 160)".

The symmetrical filter branch and the clock frequency filter remain effective.

NOTICE

Damage to equipment if operation is carried out on asymmetrically grounded networks without the connecting bracket removed

With asymmetrical grounding, the interference suppression capacitors are subjected to voltage overload if the connection bracket has not been removed.

- Remove the connection bracket for the interference suppression capacitor before commissioning.

5.6.9 Removing the connection clip for the interference suppression capacitor



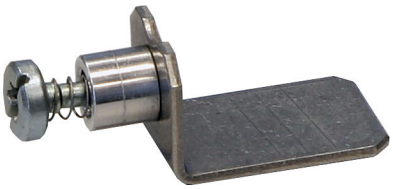
⚠ WARNING

Electric shock when the connection bracket is removed

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 5 min. after the supply has been switched off before removing the connection bracket.

		
1. Remove the connection bracket to the interference suppression capacitor using a Tx25 screwdriver.	2. Withdraw the connection bracket.	3. Connection bracket to the interference suppression capacitor

Note

Installing the connection bracket for the interference-suppression capacitor

For operation of the Basic Line Module in a TN or TT system with grounded neutral point, the connection bracket must be refitted and fastened with a tightening torque of 1.8 Nm (15.9 lbf in).

5.6.10 Technical data

Table 5-21 Technical specifications: Basic Line Modules

	6SL3130-	1TE22-0AA0	1TE24-0AA0	1TE31-0AA0
Rated power	kW	20	40	100
Infeed[1)]				
Rated power S1 duty	kW (P_n)	20	40	100
Infeed power S6 duty (40 %)	kW (P_{S6})	26	52	130
Peak infeed power	kW (P_{max})	60	120	175
Braking power				
Continuous power	kW (P_n)	5	10	-
Peak power	kW (P_{max})	40	80	-
Supply voltages				
Line voltage	V_{ACrms}	3 AC 380 ... 480 ±10 % (- 15 % < 1 min)		
Line frequency	Hz	47 ... 63		
Electronic power supply	V_{DC}	24 (20.4 ... 28.8)		
DC link voltage	V_{DC}	510 ... 720		
Overvoltage trip	V_{DC}	820 ± 2 %		
Undervoltage trip [2)]	V_{DC}	360 ± 2 %		

	6SL3130-	1TE22-0AA0	1TE24-0AA0	1TE31-0AA0
Input currents				
Rated input current:				
for AC 400 V	A_{AC}	33	66	166
input current:				
for AC 380 V / AC 480 V	A_{AC}	35 / 28	70 / 55	172 / 138
for AC 400 V; S6 duty (40 %)	A_{AC}	43	86	216
for AC 400 V; peak current	A_{AC}	100	199	290
DC link currents				
Rated DC link current:				
at 600 V DC	A_{DC}	33.5	67	167
DC link current:				
at 510 V DC / 720 V DC	A_{DC}	33.5 / 27.8	67 / 55.6	167 / 139
at 600 V DC; S6 duty (40%)	A_{DC}	43	87	217
at 600 V DC; peak current	A_{DC}	100	200	292
Current-carrying capacity				
DC link busbars	A_{DC}	100	200	200
24 V DC busbars	A_{DC}	20	20	20
Electronics current drawn at 24 V DC	A_{DC}	1	1.4	2.0
Total power loss (including electronics losses, see Power loss tables (Page 503))	W	144	283.6	628
DC link capacitance				
Basic Line Module	µF	940	1880	4100
Drive line-up, max.	µF	20000	20000	50000
Power factor[3]	cos φ	0.98	0.98	0.98
Circuit breaker (IEC 60947 and UL)		See Chapter Overcurrent protection using fuses and circuit breakers (Page 49)		
Max. total cable length[4]		See Chapter Combination options, Line Modules with line reactors and line filters (Page 124)		
Cooling method (internal air cooling)		Internal fan		
Cooling air requirement	m^3/h	56	112	180
Ventilation clearances above/below	mm	≥ 80		
Weight	kg	6.8	11.3	15.8

1) The specified power ratings apply to the line voltage range from 380 V to 480 V.

2) Default for 400 V line systems; undervoltage trip threshold is adjusted to the parameterized rated voltage

3) Only the fundamental component

4) Maximum total cable length = Σ motor cables, mains supply conductor from line filter to the Line Module

5.6.10.1 Characteristics

Rated duty cycles for Basic Line Modules

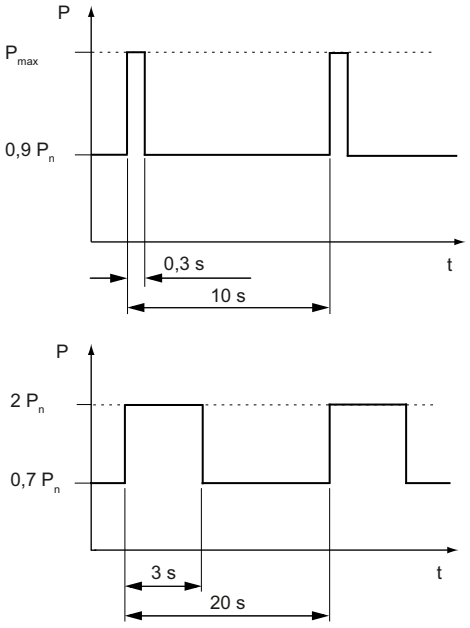


Figure 5-19 Duty cycles with initial load

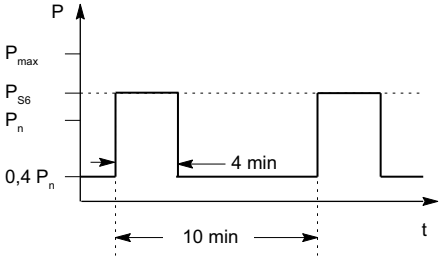


Figure 5-20 S6 duty cycle with pre-load condition

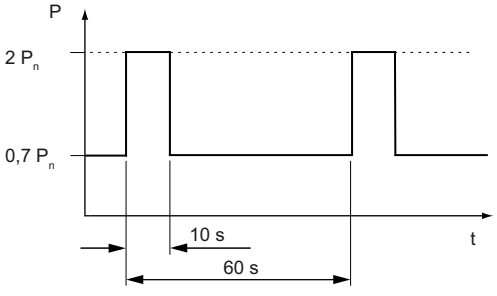


Figure 5-21 Duty cycle with pre-load condition for 20 kW and 40 kW Basic Line Modules

Braking duty cycle for Basic Line Modules

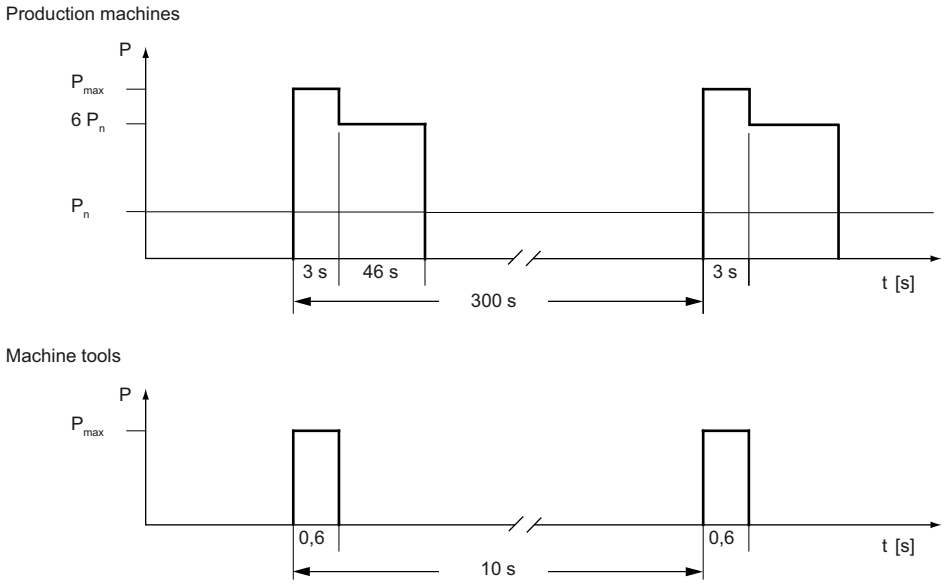


Figure 5-22 Braking duty cycle for Basic Line Modules

5.7 Smart Line Modules

5.7.1 Description

The Smart Line Module is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module with a non-regulated DC voltage at the DC output. In the infeed mode the Smart Line Module exhibits the typical current and voltage waveforms of a 6-pulse diode rectifier bridge.

In the energy recovery mode, the current waveform is square waved. Energy recovery can be deactivated if required. On 5 kW and 10 kW Smart Line Modules, this is realized via a terminal, since these modules do not feature a DRIVE-CLiQ connection. For 16 kW to 55 kW Smart Line Modules, energy recovery can be deactivated using parameter p3533, as, just like Active Line Modules, these modules are equipped with a DRIVE-CLiQ connection.

The DC link starts precharging as soon as the line voltage is applied and is independent of its phase sequence direction. Load can be applied to the DC link after the module has been enabled.

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

5.7.2 Switch-on/switch-off sequence for 5 kW and 10 kW Smart Line Modules

It is recommended that the switch-on and switch-off sequence described below be complied for control of the 5 kW and 10 kW Smart Line Modules.

Observe the "Ready" signal at output terminal X21.1:

Switching on

1. 24 V DC supply X24 ON
2. Line contactor ON
3. EP signal X21.3 and X21.4 ON
4. Wait until precharging has been completed
5. "Ready" signal at terminal X21.1 switched to high
6. Infeed is ready, pulse enable possible for motors

Switching off

1. Shut drives down
2. Cancel pulse enable for motors (OFF1 signal)
3. EP signal X21.3 and X21.4 OFF
4. Line contactor OFF
5. 24 V DC supply X24 OFF

Overload

1. "Prewarning" signal at terminal X21.2 switches to low
2. Shut drives down via the control system
3. "Ready" signal at terminal X21.1 switches to low
4. Pulse inhibit for all the drives supplied by this infeed within 4 ms

5.7.3 Interface description

5.7.3.1 Overview

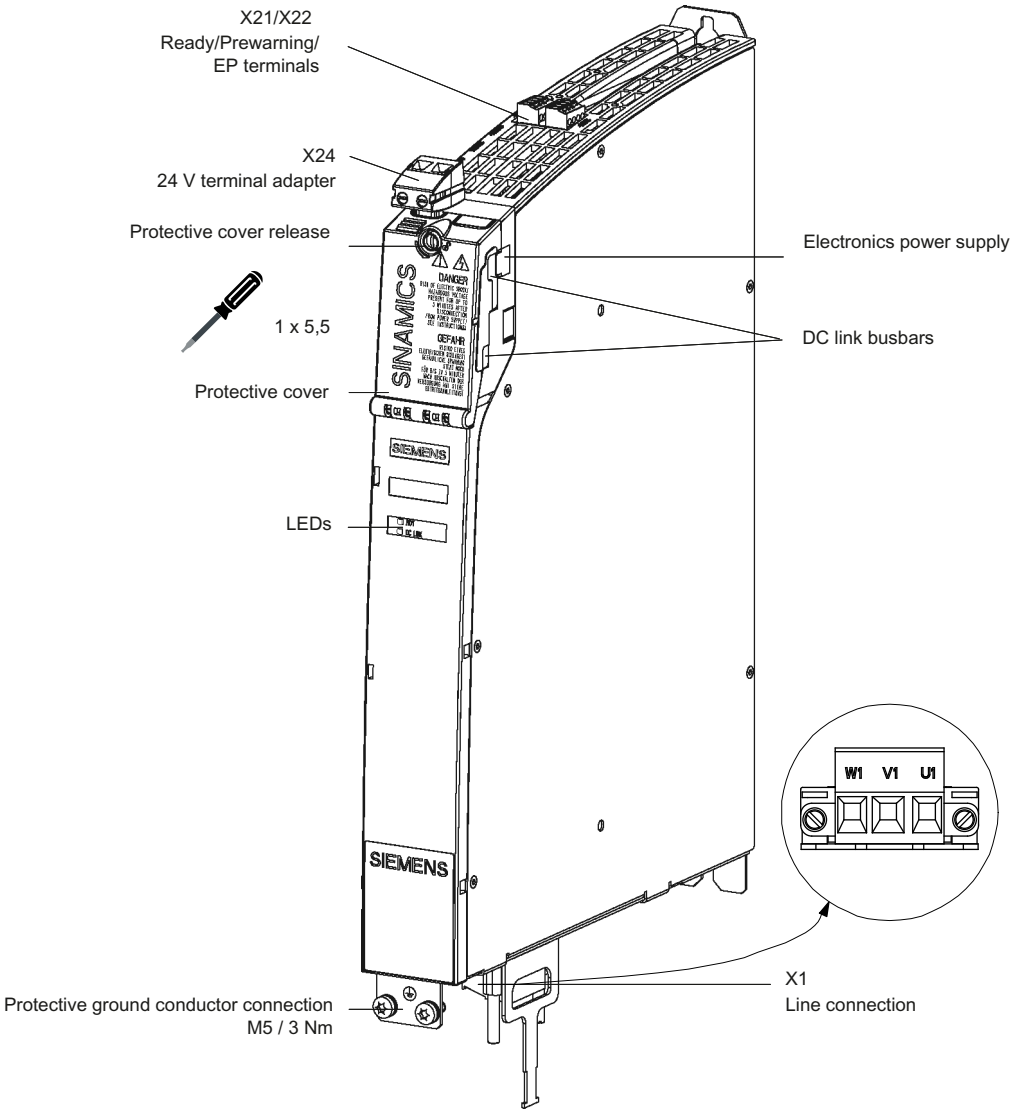


Figure 5-23 Interface overview of 5 kW and 10 kW Smart Line Modules (example, 5 kW)

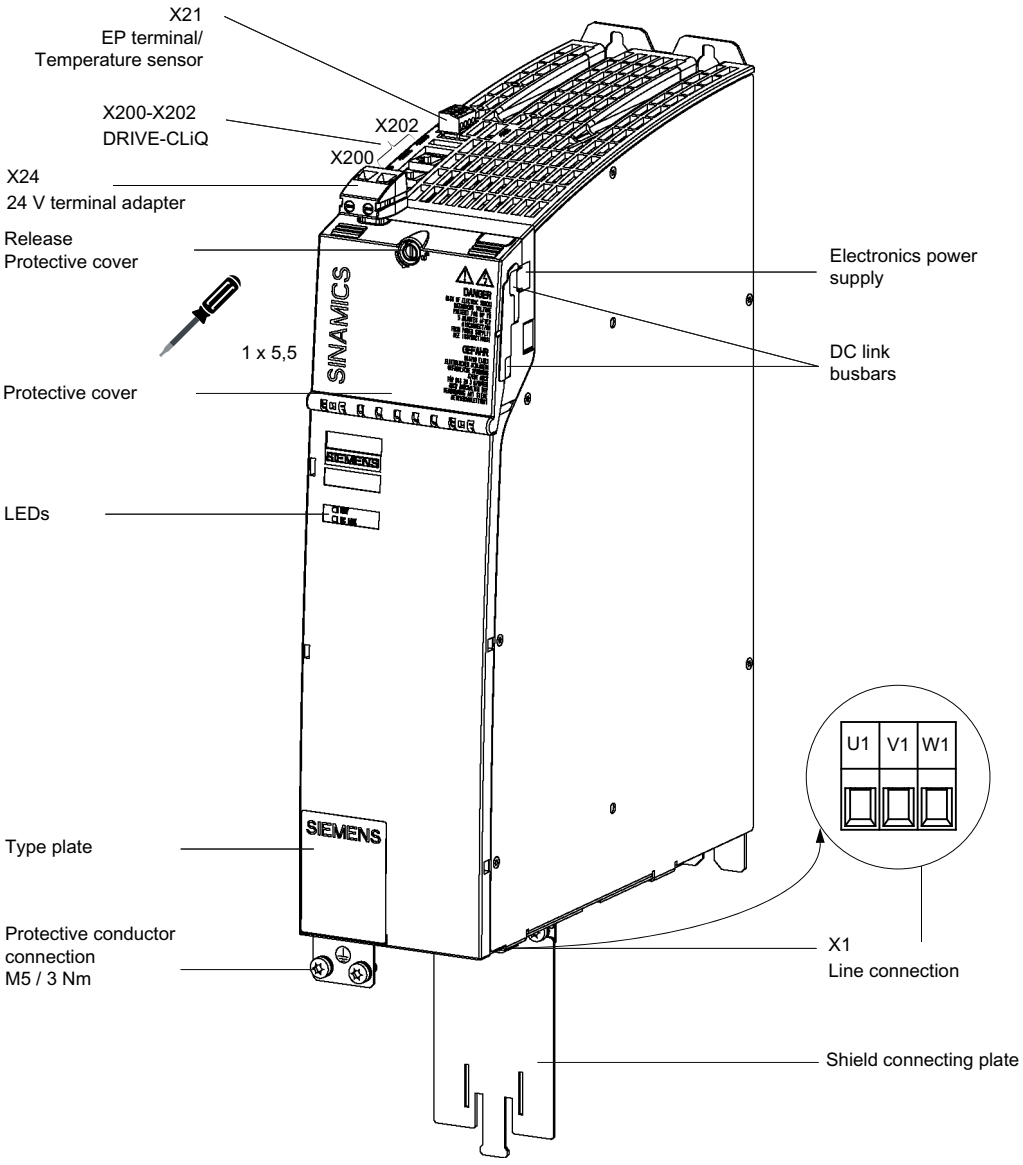


Figure 5-24 Interface overview of 16 kW Smart Line Module

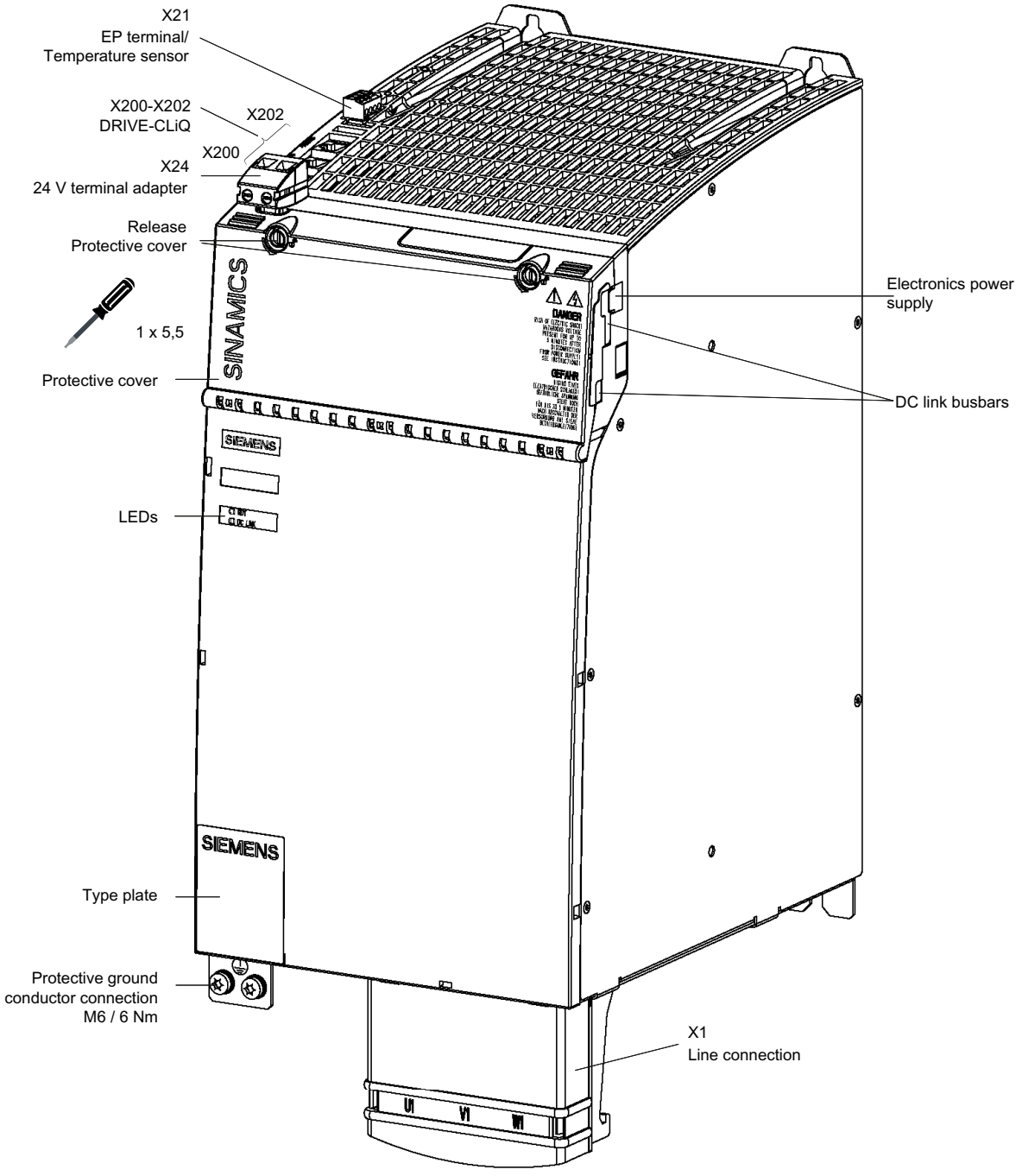


Figure 5-25 Interface overview of 36 kW and 55 kW Smart Line Modules (example, 55 kW)

5.7.3.2 X1 line connection

Table 5-22 X1: Line connection for Smart Line Modules 5 kW and 10 kW

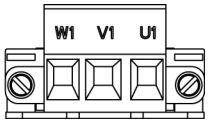
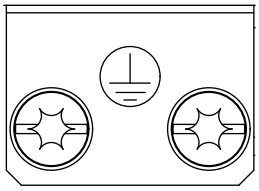
	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Type: Screw terminal 5 (Page 486)
	PE/ground connection	Threaded hole M5 / 3 Nm (26.6 lbf in)[1)]
[1)] For ring cable lugs without insulation (Page 487)		

Table 5-23 X1: Line supply connection for Smart Line Modules 16 kW

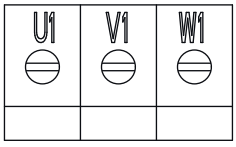
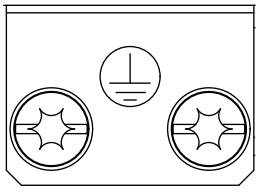
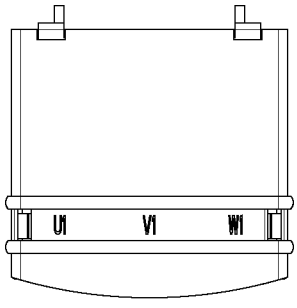
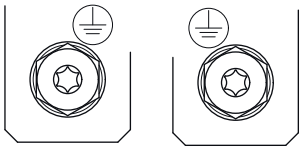
	Terminal	Technical data
	U1 V1 W1	Supply voltage: 380 ... 480 V 3 AC, 50/60 Hz Type: Screw terminal 6 (Page 486)
	PE/ground connection	Threaded hole M5 / 3 Nm (26.6 lbf in)[1)]
[1)]Forring cable lugs without insulation (Page 487)		

Table 5-24 X1: Line connection for Smart Line Modules 36 kW and 55 kW

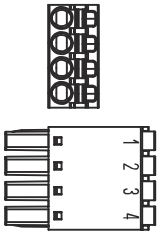
	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz **36 kW**: Threaded bolt M6 / 6 Nm (53.1 lbf in)[1)] **55 kW**: Threaded bolt M8 / 13 Nm (115 lbf in)[1)]

	Terminal	Technical data
	PE/ground connection	**36 kW and 55 kW**: Threaded hole M6 / 6 Nm (53.1 lbf in)[1)]
[1)] For ring cable lugs without insulation (Page 487)		

5.7.3.3 X21 EP terminals

Smart Line Modules 5 kW and 10 kW

Table 5-25 X21 EP terminal for Smart Line Modules 5 kW and 10 kW

	Terminal	Function	Technical data
	1	DO: Ready	Feedback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: • Electronic power supply (X24) OK • DC link is precharged • Pulses enabled (X21.3/4) • No overtemperature • No overcurrent Voltage: 24 V DC (20.4 ... 28.8 V) Load current: ≤ 500 mA Continuous short-circuit-proof
	2	DO: Prewarning	DO: Prewarning High = no prewarning Low = prewarning • Overtemperature warning threshold/I^2t 5 kW prewarning: 64 °C, overtemperature threshold: 69 °C 10 kW prewarning: 68 °C, overtemperature threshold: 73 °C • No energy recovery capability due to a line fault [only monitored when feedback is activated (see terminal X22.2)] Voltage: 24 V DC (20.4 ... 28.8 V) Load current: ≤ 500 mA Continuous short-circuit-proof
	3	EP +24 V (pulse enable)	Voltage: 24 V DC (20.4 ... 28.8 V) Current consumption, typical: 4 mA at 24 V Isolated input
	4	EP M (Enable Pulses)	
Type: Spring-loaded terminal 7 (Page 485)			

Terminals X21.1 and X21.2

Note

Wiring to a digital input of the Control Unit

Output terminal X21.1 must be wired to a digital input on the CU. The drives supplied with power from the Smart Line Module have to use this signal as a ready signal. This ensures that a pulse enable can only be issued for the drives (motor or generator operation) when the infeed is ready. If interconnection with a digital input on the CU is not possible, the signal must be evaluated by a higher-level control system instead. It is not permissible that the control system sets the drives to ready until the infeed "Ready" signal is present.

Note

Evaluating the "Prewarning" signal

The "Prewarning" signal at output terminal X21.2 warns against an overload. If this signal is set to low, the control system shuts the drives down before the "Ready" signal switches to low. If the "Ready" signal switches to "low", the drive pulses must be suppressed within 4 ms.

Note

The Smart Line Module signals "Ready" (X21.1 = High), even if one of the line conductor voltages is not available. In this case, energy recovery is deactivated and an alarm is output at X21.2 (DO, Warning I^2t low signal).

If energy recovery was deactivated by applying a "high" signal to terminal X22.2 (DI, Disable), no alarm will be output at X21.2 (DO, Warning I^2t).

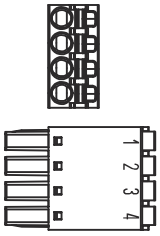
Terminals X21.3 and X21.4

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4.

Pulse cancellation is activated if the power supply is disconnected. As a consequence, energy recovery is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example, because a line contactor is not installed, then the DC link remains charged.

16 kW to 55 kW Smart Line Modules

Table 5-26 X21 EP terminal / temperature sensor for 16 kW to 55 kW Smart Line Modules

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors[1)2)]: Pt1000[3)] / PTC[3)] / KTY84-130[3)] / bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage: 24 V DC (20.4 ... 28.8 V) Current consumption, typical: 4 mA at 24 V Isolated input
	4	EP M (Enable Pulses)	
Type: Spring-loaded terminal 7 (Page 485)			

1) The temperature sensor type and the temperature output can be selected by parameter (see the SINAMICS S120/S150 List Manual).

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

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

Terminals X21.1 and X21.2 - temperature sensor connection



⚠ WARNING

Electric shock due to voltage flashovers on the temperature sensor cable

When using temperature sensors which are not isolated from the power circuit in accordance with safe electrical separation, voltage flashovers could occur in the signal electronics.

- Only use temperature sensors that fully comply with the specifications of protective separation.
- 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.

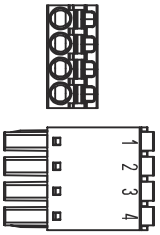
Terminals X21.3 and X21.4

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4.

Pulse cancellation is activated if the power supply is disconnected. As a consequence, energy recovery is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example, because a line contactor is not installed, then the DC link remains charged.

5.7.3.4 X22 digital inputs

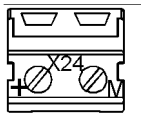
Table 5-27 X22 digital inputs for Smart Line Modules 5 kW and 10 kW

	Terminal	Function[1)]	Technical specifications
	1	24 V power supply	Electronics power supply for controlling digital inputs X22.2 and 3
	2	DI: Disable Regeneration	Deactivate energy recovery (high active) No power is supplied back to the network from the DC link. The regenerative energy of the motors may have to be reduced using a combination of the Braking Module and braking resistor.
	3	DI: Reset	Reset faults (negative edge)
	4	Ground	Electronics ground
Type: Spring-loaded terminal 7 (Page 485)			

1) DI: Digital input

5.7.3.5 X24 24 V terminal adapter

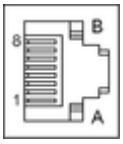
Table 5-28 X24: 24 V terminal adapter

	Terminal	Function	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Type: Screw terminal 5 (Page 486)			

The 24 V terminal adapter is included in the scope of supply.

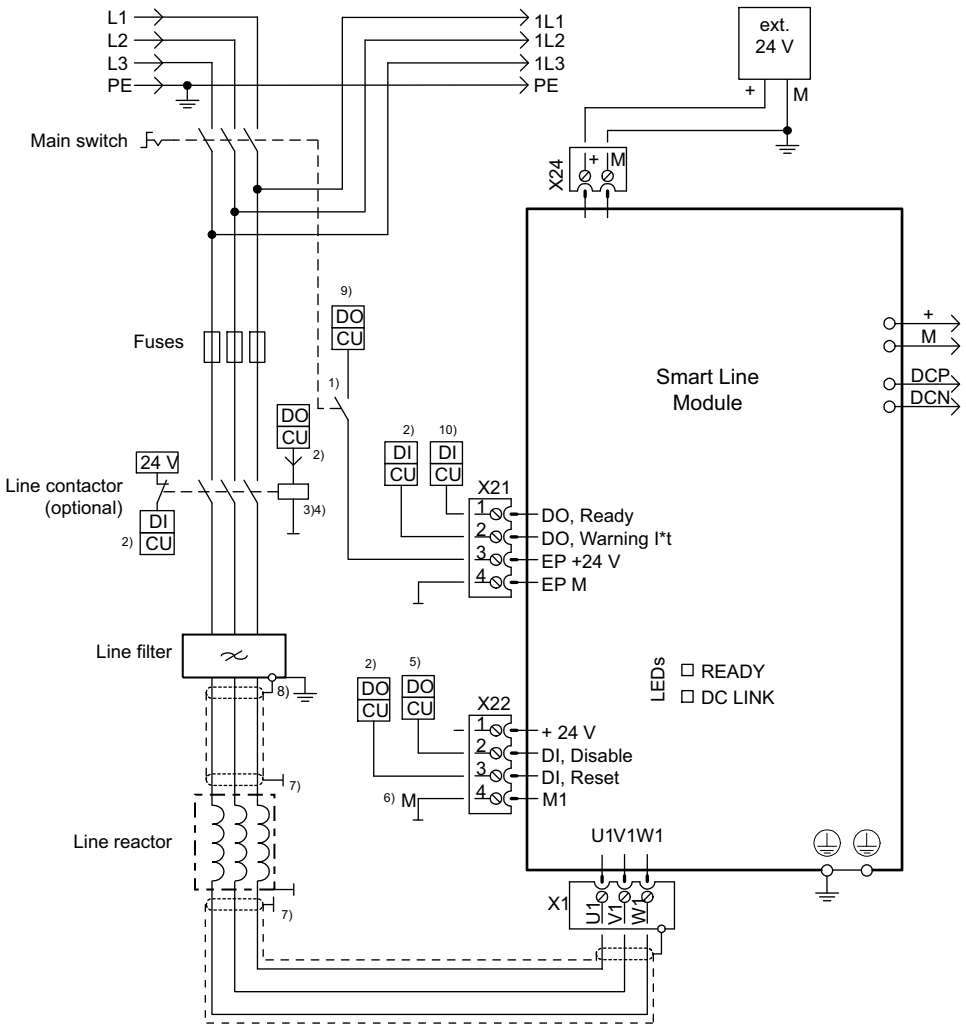
5.7.3.6 X200-X202 DRIVE-CLiQ interfaces

Table 5-29 X200-X202: DRIVE-CLiQ interfaces

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

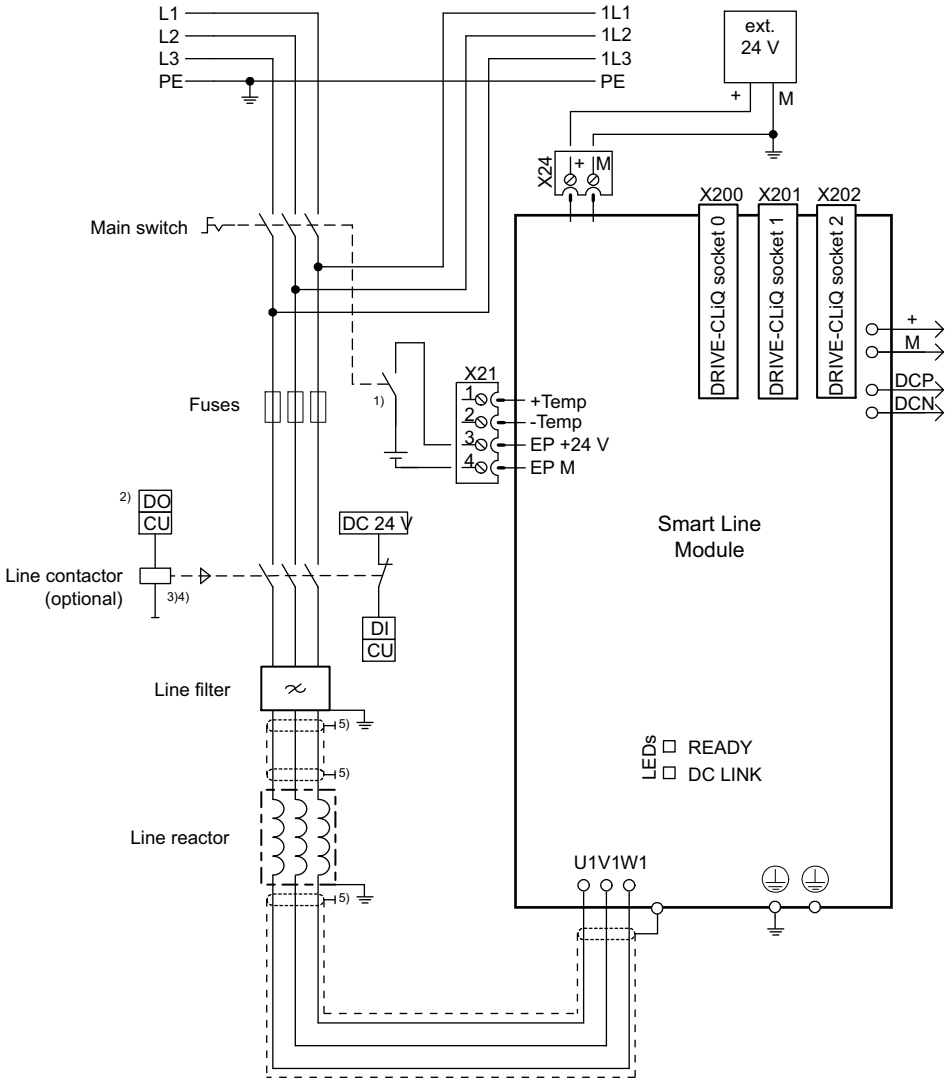
The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.
Blanking cover (50 pcs.) Article number: 6SL3066-4CA00-0AA0

5.7.4 Connection examples



1) Leading opening contact t>10 ms, 24 V DC must be connected for operation.
2) DI/DO, 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) DO high, energy recovery deactivated (a jumper can be installed between X22 pin 1 and 2 for permanent deactivation).
6) X22 pin 4 must be connected to ground (external 24 V).
7) Contact established through the rear mounting panel or shield rails in accordance with the EMC installation guideline
8) 5 kW and 10 kW line filter via shield connection
9) Signal output of the control system to avoid reaction of 24 V DC supply on EP terminal
10) Interconnection via BiCo to parameter p0864

Figure 5-26 Connection example for 5 kW and 10 kW Smart Line Modules



1) Leading opening contact t>10 ms
When using a VSM10 V, the leading opening contact can be eliminated.

2) DI/DO, 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 established through the rear mounting panel or shield rails in accordance with the EMC installation guideline

Figure 5-27 Connection example for 16 kW to 55 kW Smart Line Modules

5.7.5 Meaning of LEDs

5.7.5.1 Smart Line Modules 5 kW and 10 kW

Table 5-30 Meaning of the LEDs on 5 kW and 10 kW Smart Line Modules

LED	Color	Status	Description, cause	Remedy
RDY	–	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation.	–
	Orange	Continuous light	The precharging has not yet been completed. The bypass relay has dropped out. The EP terminals are not supplied with 24 V DC.	–
	Red	Continuous light	Overtemperature overcurrent	Diagnose the fault (using the output terminals) and acknowledge (using the input terminal).
DC LINK	Orange	Continuous light	The DC link voltage is within permissible tolerance range.	–
	Red	Continuous light	The DC link voltage is outside the permissible tolerance range or a line fault is present.	Check the line supply voltage.

5.7.5.2 16 kW to 55 kW Smart Line Modules

Table 5-31 Meaning of the LEDs on Smart Line Modules ≥ 16 kW

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
Green	--[1)]	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is outside the permissible tolerance range.	Check the line supply voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--[1)]	This component has at least one fault.	Resolve and acknowledge the fault.
Green/red (0.5 Hz)	--[1)]	Firmware is being downloaded.	–

Status		Description, cause	Remedy
RDY	**DC LINK**		
Green/red (2 Hz)	--[1)]	Firmware download has been completed. The system waits for POWER ON.	Carry out a POWER ON.
Green/orange or red/orange (2 Hz)	--[1)]	Component recognition via LED is activated (p0124=1). **Note:** Whether the LED flashes green/orange or red/orange depends on the status the LED had during activation (setting of parameter p0124 to "1").	–

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

5.7.6 Dimension drawings

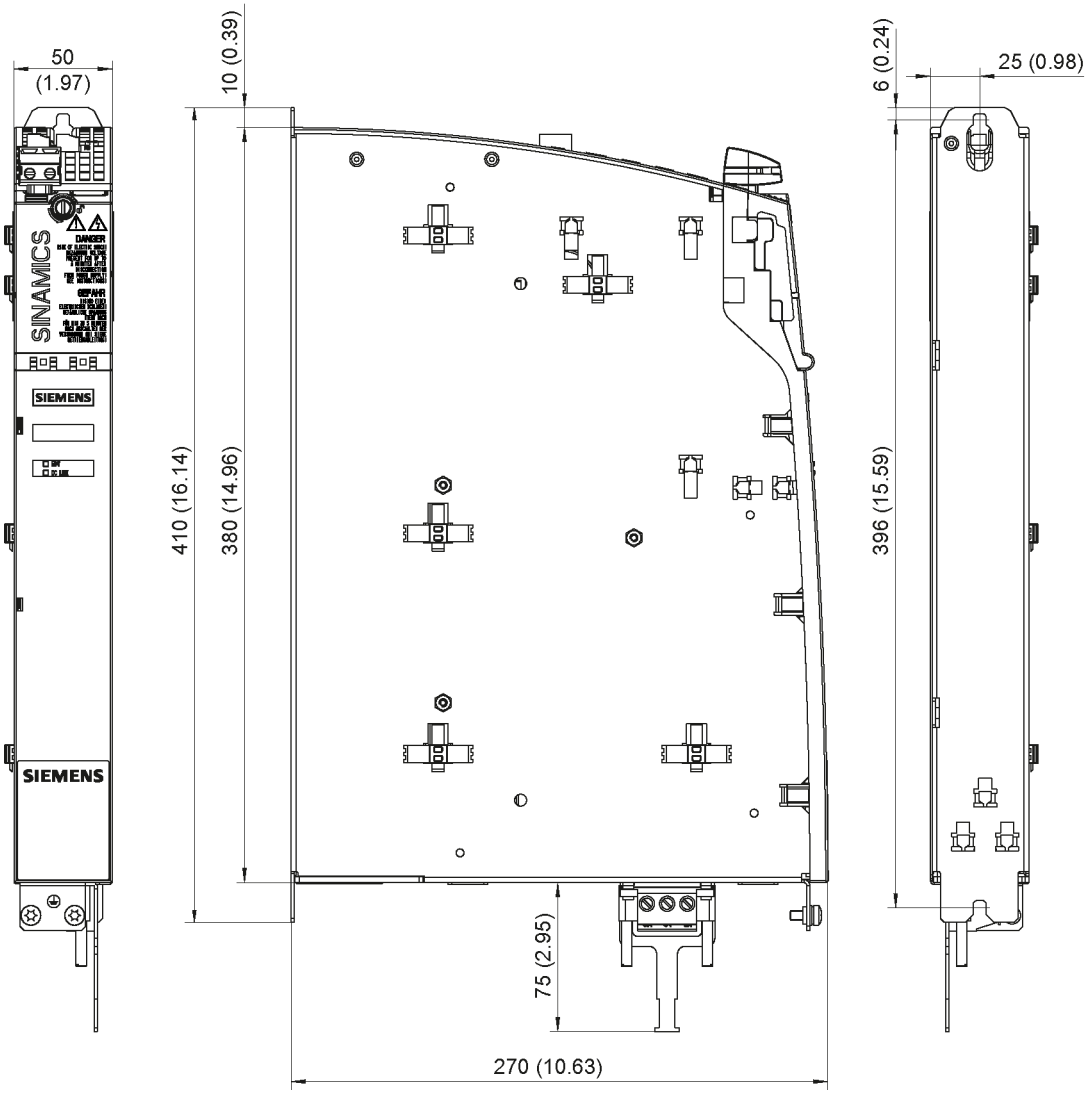


Figure 5-28 Dimension drawing of 5 kW and 10 kW Smart Line Modules, all dimensions in mm and (inches)

Note

The shield connecting plate is integrated in the line connector of the 50 mm Smart Line Modules.

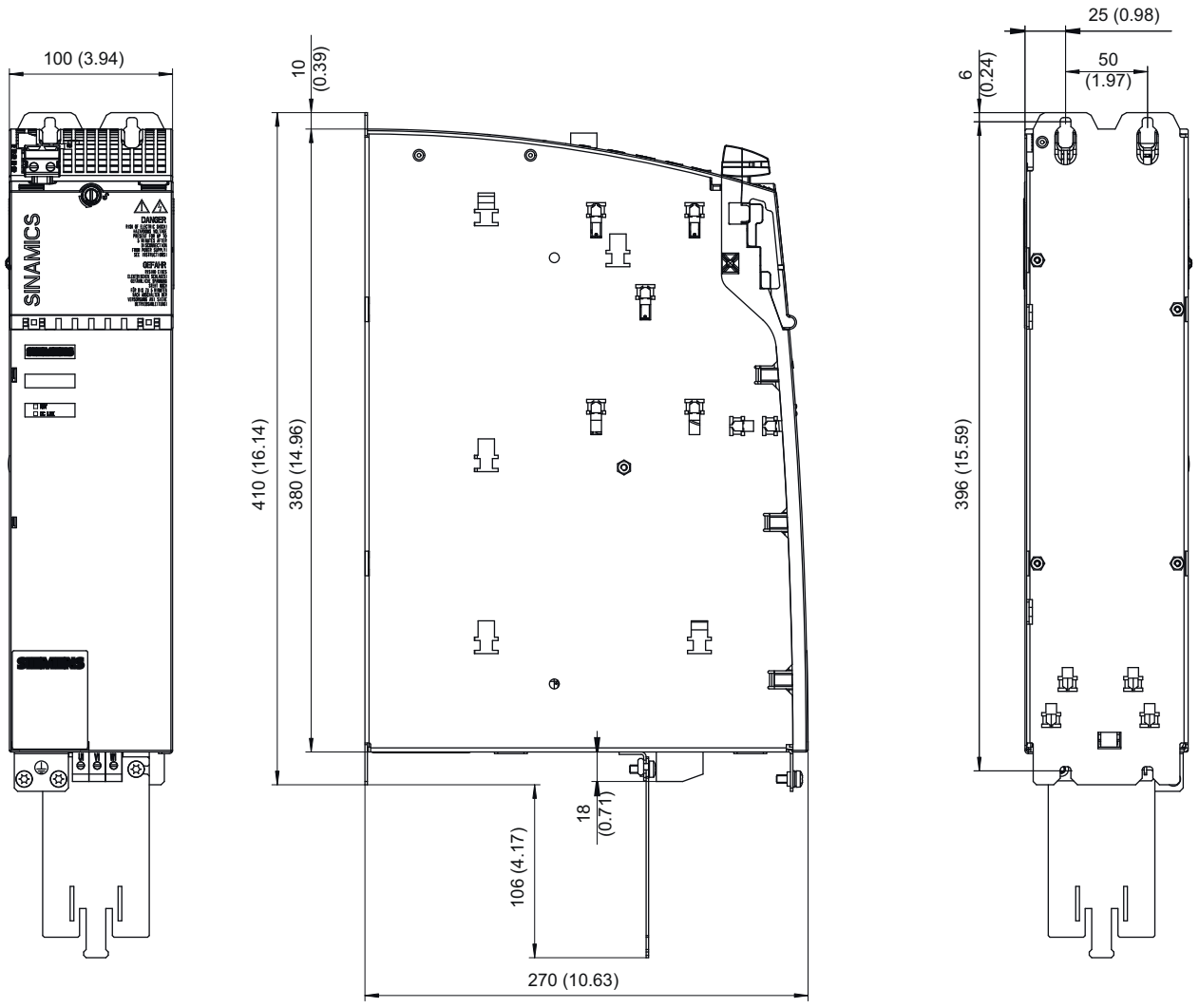


Figure 5-29 Dimension drawing of 16 kW Smart Line Module, all dimensions in mm and (inches)

Note

The shield connecting plate is part of the scope of delivery of the 100 mm Smart Line Modules.

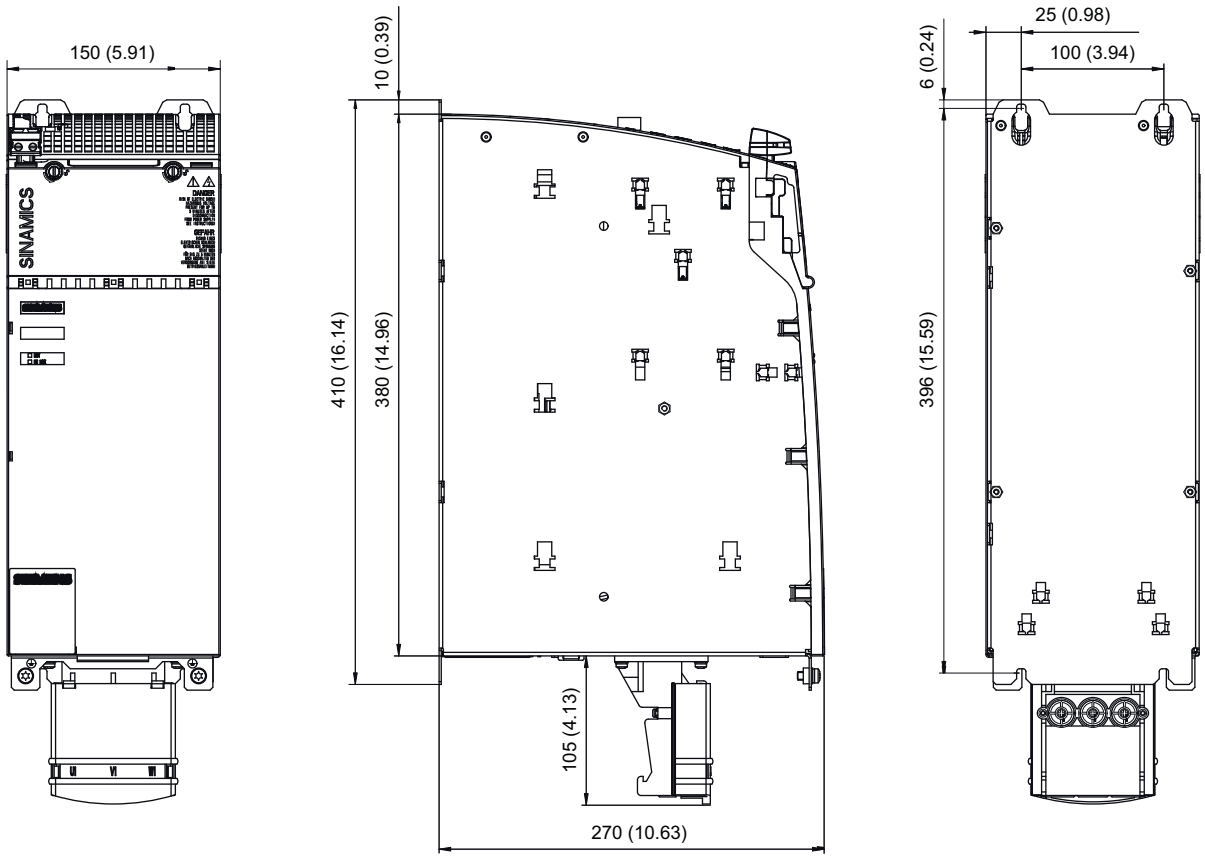


Figure 5-30 Dimension drawing of 36 kW Smart Line Module, all dimensions in mm and (inches)

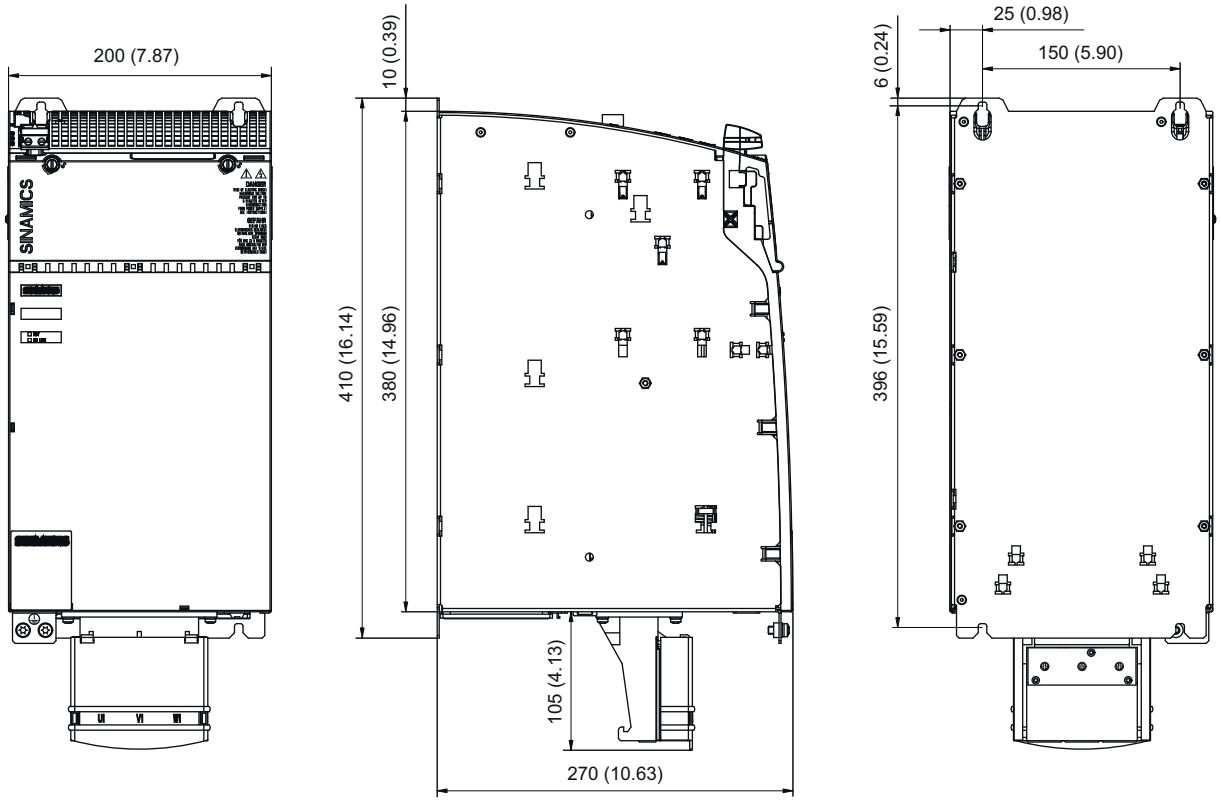
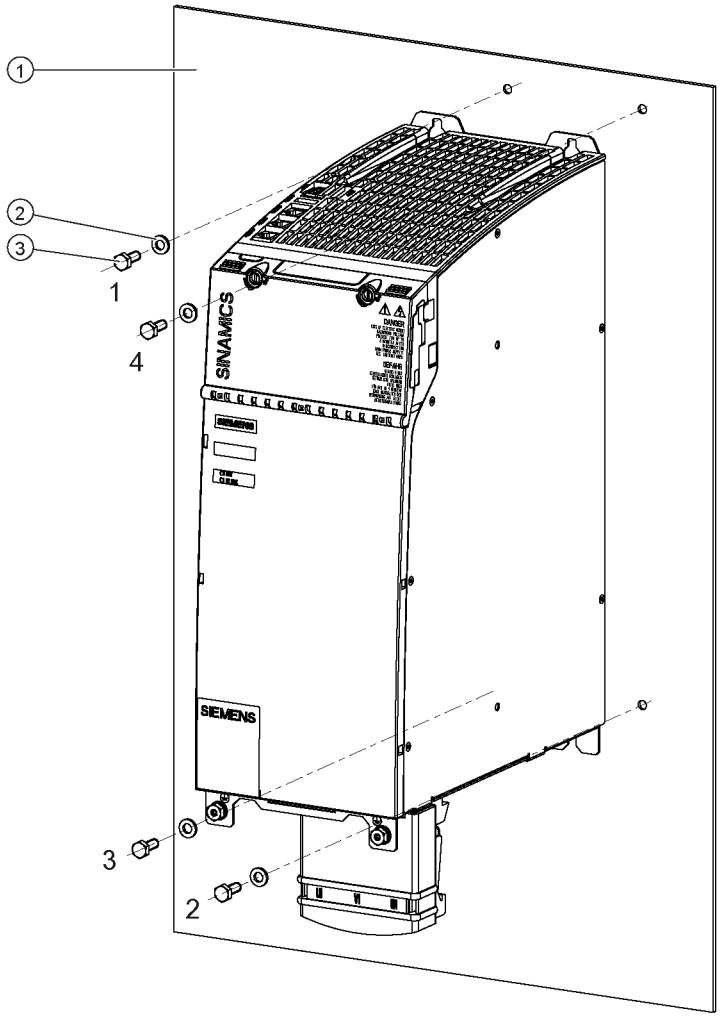


Figure 5-31 Dimension drawing of 55 kW Smart Line Module, all dimensions in mm and (inches)

5.7.7 Installation

Smart Line Modules are designed for mounting in the control cabinet. They are fixed to the control cabinet panel or a mounting panel using M6 screws.



① Control cabinet panel/mounting panel
② Washer
③ M6 screw

Figure 5-32 Mounting a Smart Line Module (example, 36 kW)

Tightening torques:

1. Firstly, tighten the nuts by hand.
   Tightening torque. 0.5 Nm (4.4 lbf in)
2. Then tighten the nuts in the specified sequence 1 to 4.
   Tightening torque: 6 Nm (53.1 lbf in)

5.7.8 Technical specifications

Table 5-32 Technical specifications of Smart Line Modules Booksize

	6SL3130-	6AE15-0A..	6AE21-0A..	6TE21-6A..	6TE23-6A..	6TE25-5AA.
Rated power	**kW**	**5**	**10**	**16**	**36**	**55**
Infeed[1]						
Rated power S1 duty	kW (P_n)	5	10	16	36	55
Infeed power S6 duty (40 %)	kW (P_{S6})	6.5	13	21	47	71
Peak infeed power	kW (P_{max})	10	20	35	70	91
Energy recovery into the line						
Continuous energy recovery	kW	5	10	16	36	55
Peak energy recovery power	kW	10	20	35	70	91
Supply voltages						
Line voltage	V_{ACrms}	3 AC 380 ... 480 ± 10 % (-15 % < 1 min)				
Line frequency	Hz	47 ... 63				
Electronic power supply	V_{DC}	24 (20.4 ... 28.8)				
DC link voltage	V_{DC}	510 ... 720				
Overvoltage trip	V_{DC}	820 ± 2 %				
Undervoltage trip[2]	V_{DC}	360 ± 2 %				
Input currents						
Rated input current						
at AC 400 V	A_{AC}	8.1	16.2	27.5	59	90
at AC 380 V / AC 480 V	A_{AC}	8.6 / 6.7	17 / 12.8	29 / 24.5	62 / 51	94 / 77
S6 duty (40 %) at AC 400 V	A_{AC}	10.6	21.1	35	76	106
Peak current at AC 400 V	A_{AC}	15.7	31.2	57.5	112	130
DC link currents						
DC link output current						
at 600 V DC	A_{DC}	8.3	16.6	27	60	92
at 510 V DC / 720 V DC	A_{DC}	9.3 / 6.9	19.6 / 13.9	30 / 22.2	67 / 50	92 / 76.4
S6 duty (40%) at 600 V DC	A_{DC}	11	22	35	79	138
Peak current at 600 V DC	A_{DC}	16.6	33.2	59	118	178
Current-carrying capacity						
DC link busbars	A_{DC}	100	100	100	200	200
24 V DC busbars	A_{DC}	20	20	20	20	20
Electronics current drawn						
at 24 V DC	A_{DC}	0.8	0.9	0.95	1.5	1.9
Total power loss (including electronics losses, see Power loss tables (Page 503))	W	79.2	141.6	187.8	406	665.6
DC link capacitance						
Smart Line Module	µF	220	330	705	1410	1880
Drive line-up, max.	µF	6000	6000	20000	20000	20000
Power factor	cos φ	0.98				
Circuit breaker (IEC 60947 and UL)		See Chapter Overcurrent protection using fuses and circuit breakers (Page 49)				
Max. total cable length[3]		See Chapter Combination options, Line Modules with line reactors and line filters (Page 124)				
Cooling method (internal air cooling)		Internal fan				
Cooling air requirement	m^3/h	29.6	29.6	56	112	160

	6SL3130-	6AE15-0A..	6AE21-0A..	6TE21-6A..	6TE23-6A..	6TE25-5AA.
Rated power	**kW**	**5**	**10**	**16**	**36**	**55**
Ventilation clearances above/below	mm	≥ 80				
Weight	kg	4.7	4.8	7	10.7	16

1) The specified power ratings apply to the line voltage range from 380 V to 480 V.

2) For 16 kW and 36 kW Smart Line Modules: Default for 400 V line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.

3) Maximum total cable length = Σ motor cables, line feeder cable from line filter to the Line Module

5.7.8.1 Characteristics

Rated duty cycles of Smart Line Modules

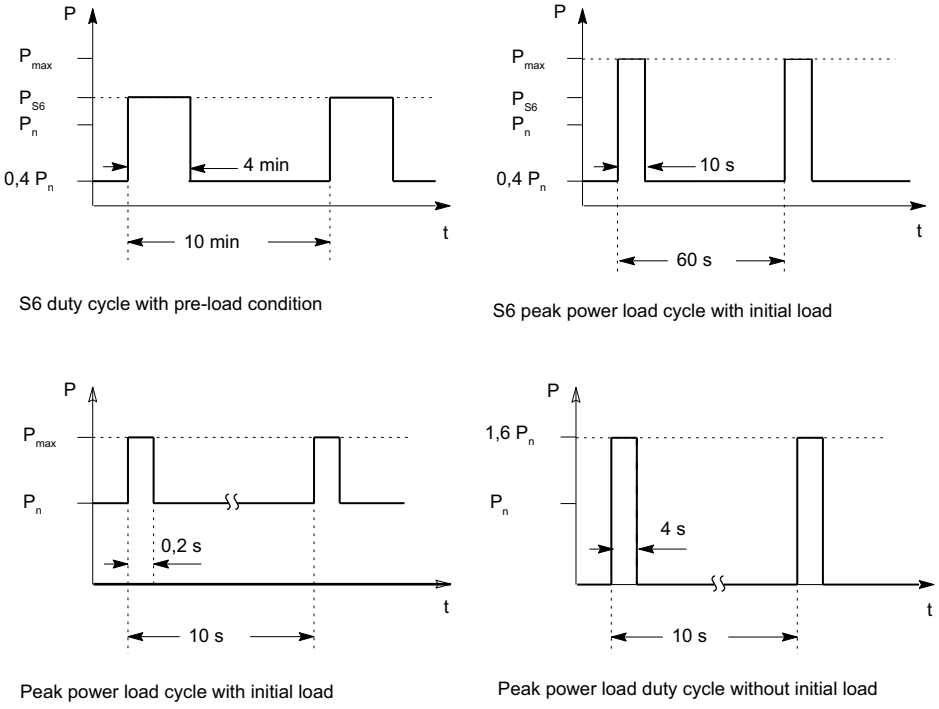


Figure 5-33 Rated duty cycles of Smart Line Modules

Line Modules Booksize Compact

6

6.1 Frequency with which the DC link is precharged

The frequency with which the DC link capacitance is precharged via the Line Module is determined using the following formula:

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

The DC link capacitances of the individual components can be taken from the relevant technical data.

6.2 Smart Line Modules Booksize Compact

6.2.1 Description

The Smart Line Module Booksize Compact is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module with a non-regulated DC voltage at the DC output. In the infeed mode the Smart Line Module exhibits the typical current and voltage waveforms of a 6-pulse diode rectifier bridge.

In the energy recovery mode, the current waveform is square waved. Energy recovery functionality of the module can be deactivated using parameter p3533.

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

Smart Line Modules are suitable for direct operation in TN, IT, and TT systems.

The Smart Line Module in Booksize Compact format can be used with cooling types "internal air cooling" or "cold plate". The cooling type is selected using parameter p0249 (see SINAMICS S120/S150 List Manual).

Refer to the SINAMICS S120 Equipment Manual "Booksize power units" up to and including Edition 06/2019 for a description on using cold plate cooling.

Note

UL certificate of the Smart Line Module Booksize Compact

The UL certificate is valid only for cooling method "Internal air cooling".

6.2.2 Safety instructions for Smart Line Modules Booksize Compact



⚠ WARNING

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

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

- Only operate the components with closed protective cover.



⚠ WARNING

Electric shock due to improper DC link connection

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

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



⚠ 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

High leakage currents when the protective conductor in the line feeder cable is interrupted

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

- Carefully comply with the applicable regulations for dimensioning the protective conductor (see Chapter "Protective connection and equipotential bonding (Page 492)").

⚠ 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 the power cables (motor supply cables and DC link cables) does not exceed the values specified in Chapter Combination options, Line Modules with line reactors and line filters (Page 124).

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.

- For line supplies without energy recovery capability (e.g. diesel generators), deactivate the energy recovery capability of the Line Modules using parameter p3533 (see SINAMICS S120/ S150 List Manual).
- The braking energy must then be dissipated via an additional Braking Module with braking resistor in the drive line-up.

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

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

- Cover unused DRIVE-CLiQ interfaces with the supplied blanking covers.

6.2.3 Interface description

6.2.3.1 Overview

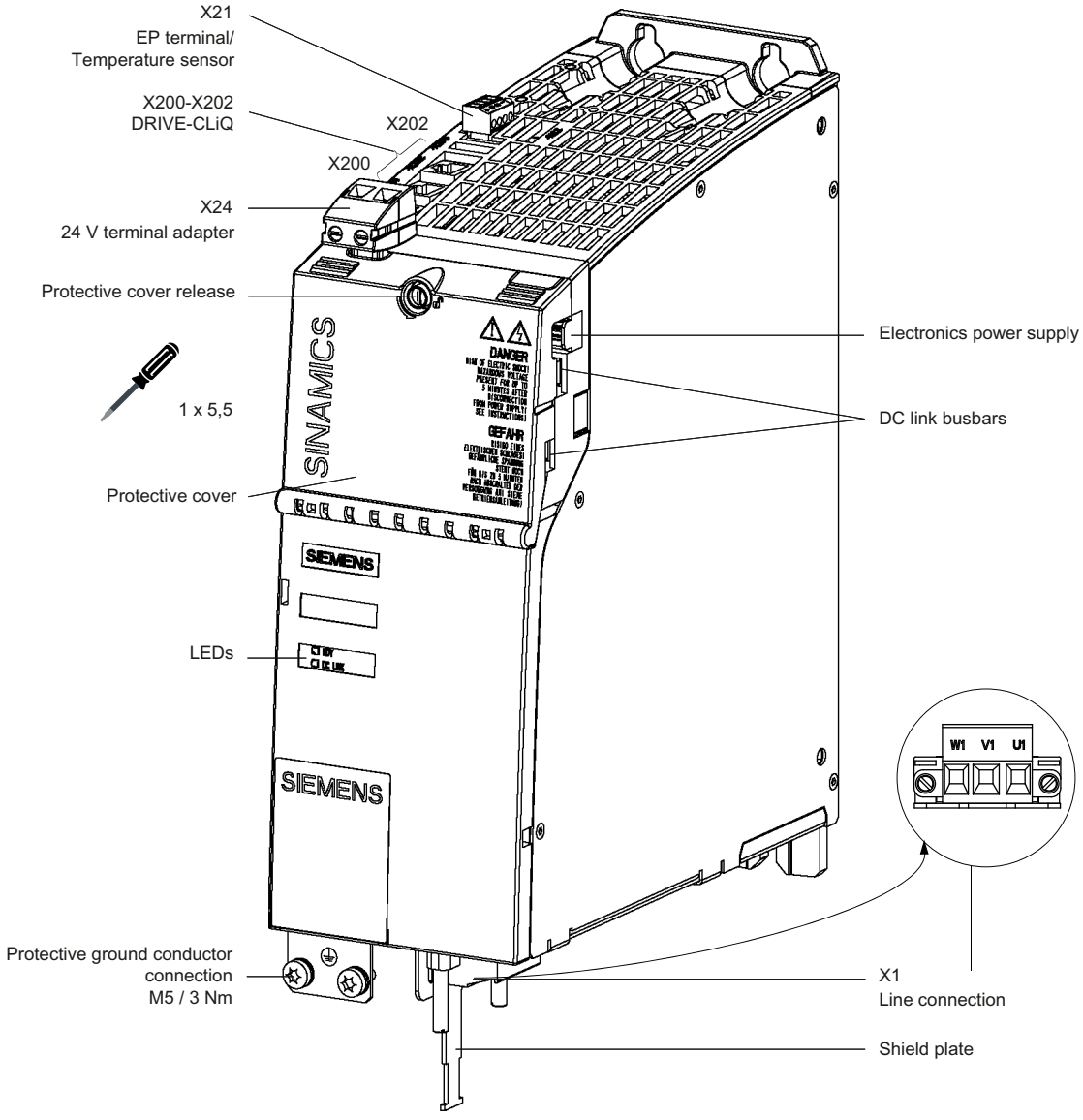
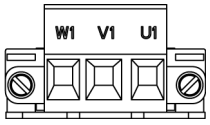
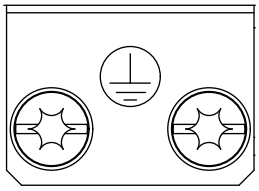


Figure 6-1 Interface overview, Smart Line Module in Booksize Compact format (16 kW)

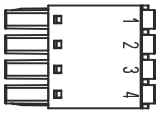
6.2.3.2 X1 line connection

Table 6-1 X1 line connection

	Terminal	Technical data
	U1	Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Type: Screw terminal 7 (Page 486)
	V1	
	W1	
	Protective conductor connection	Threaded hole M5 / 3 Nm (26.6 lbf in)[1]
[1] For ring cable lugs without insulation (Page 487)		

6.2.3.3 X21 EP terminals

Table 6-2 X21 EP terminal / temperature sensor

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors[1]: Pt1000[2] / PTC[2] / KTY84-130[2] / bimetallic switch with NC contact The temperature sensor type and the temperature display can be selected via parameter and/or read-out.[3]
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage: 24 V DC (20.4 ... 28.8 V) Current consumption, typical: 4 mA at 24 V Isolated input
	4	EP M (Enable Pulses)	
Type: Spring-loaded terminal 7 (Page 485)			

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

[2] The temperatures are detected but not evaluated in the Smart Line Module.

[3] For additional information see the SINAMICS S120, Commissioning Manual

Terminals X21.1 and X21.2 - temperature sensor connection



⚠ WARNING

Electric shock due to voltage flashovers on the temperature sensor cable

When using temperature sensors which are not isolated from the power circuit in accordance with safe electrical separation, voltage flashovers could occur in the signal electronics.

- Only use temperature sensors that fully comply with the specifications of protective separation.
- 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.

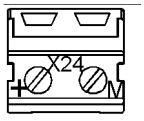
Terminals X21.3 and X21.4

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4.

Pulse cancellation is activated if the power supply is disconnected. As a consequence, energy recovery is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example, because a line contactor is not installed, then the DC link remains charged.

6.2.3.4 X24 24 V terminal adapter

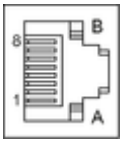
Table 6-3 X24: 24 V terminal adapter

	Terminal	Function	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Type: Screw terminal 5 (Page 486)			

The 24 V terminal adapter is included in the scope of supply.

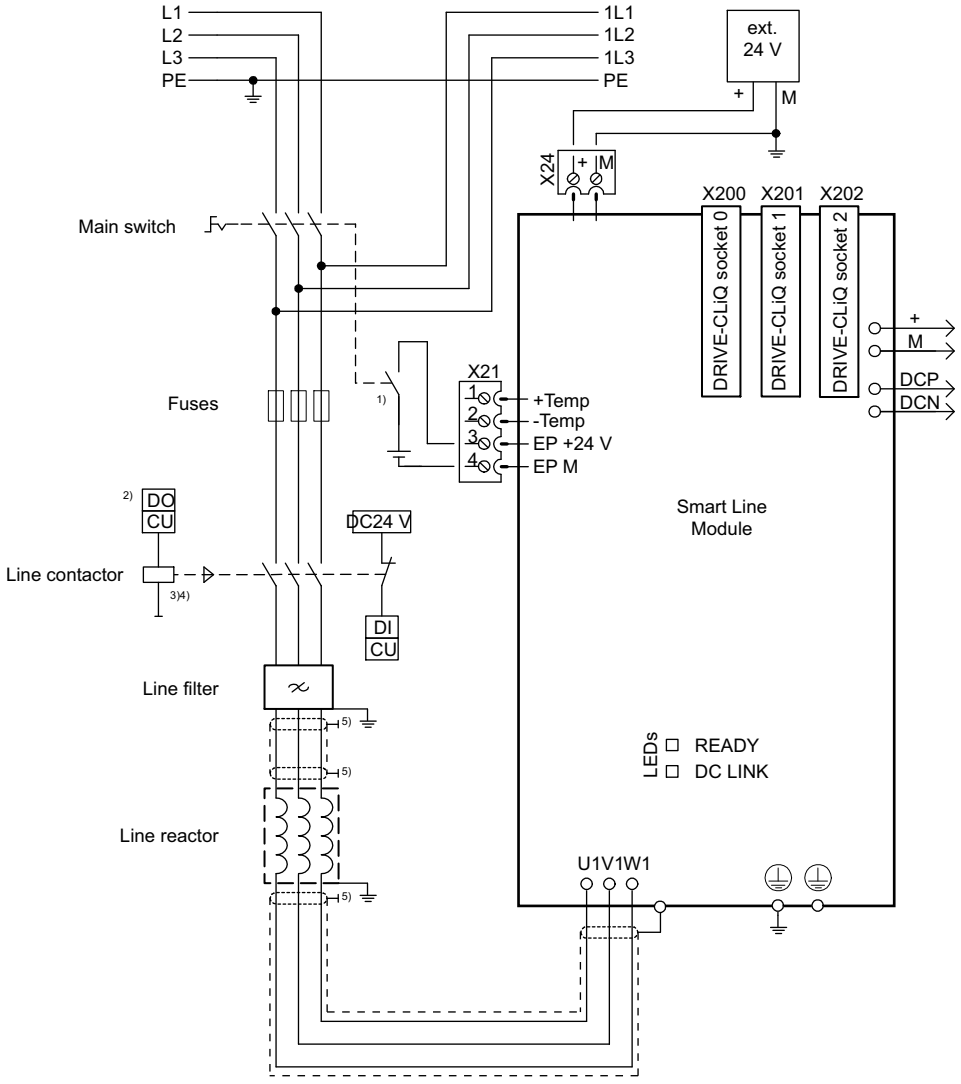
6.2.3.5 X200-X202 DRIVE-CLiQ interfaces

Table 6-4 X200-X202: DRIVE-CLiQ interfaces

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

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.
Blanking cover (50 pcs.) Article number: 6SL3066-4CA00-0AA0

6.2.4 Connection example



1) Leading opening contact, t >10 ms
2) DI/DO, controlled from 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 established through the rear mounting panel or shield rails in accordance with the EMC installation guideline

Figure 6-2 Connection example, Smart Line Module Booksize Compact 16 kW

Note

If you are using a VSM10 Voltage Sensing Module, the leading opening contact can be omitted.

6.2.5 Meaning of the LEDs

Table 6-5 Meaning of the LEDs on the Smart Line Module booksize compact

Status		Description, cause	Remedy
RDY	**DC LINK**		
Off	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
Green	--[1)]	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is outside the permissible tolerance range.	Check the line supply voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--[1)]	This component has at least one fault.	Resolve and acknowledge the fault.
Green/red (0.5 Hz)	--[1)]	Firmware is being downloaded.	–
Green/red (2 Hz)	--[1)]	Firmware download has been completed. The system waits for POWER ON.	Carry out a POWER ON.
Green/orange or red/orange (2 Hz)	--[1)]	Component recognition via LED is activated (p0124=1). **Note:** Whether the LED flashes green/orange or red/orange depends on the status the LED had during activation (setting of parameter p0124 to "1").	–

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

6.2.6 Dimension drawing

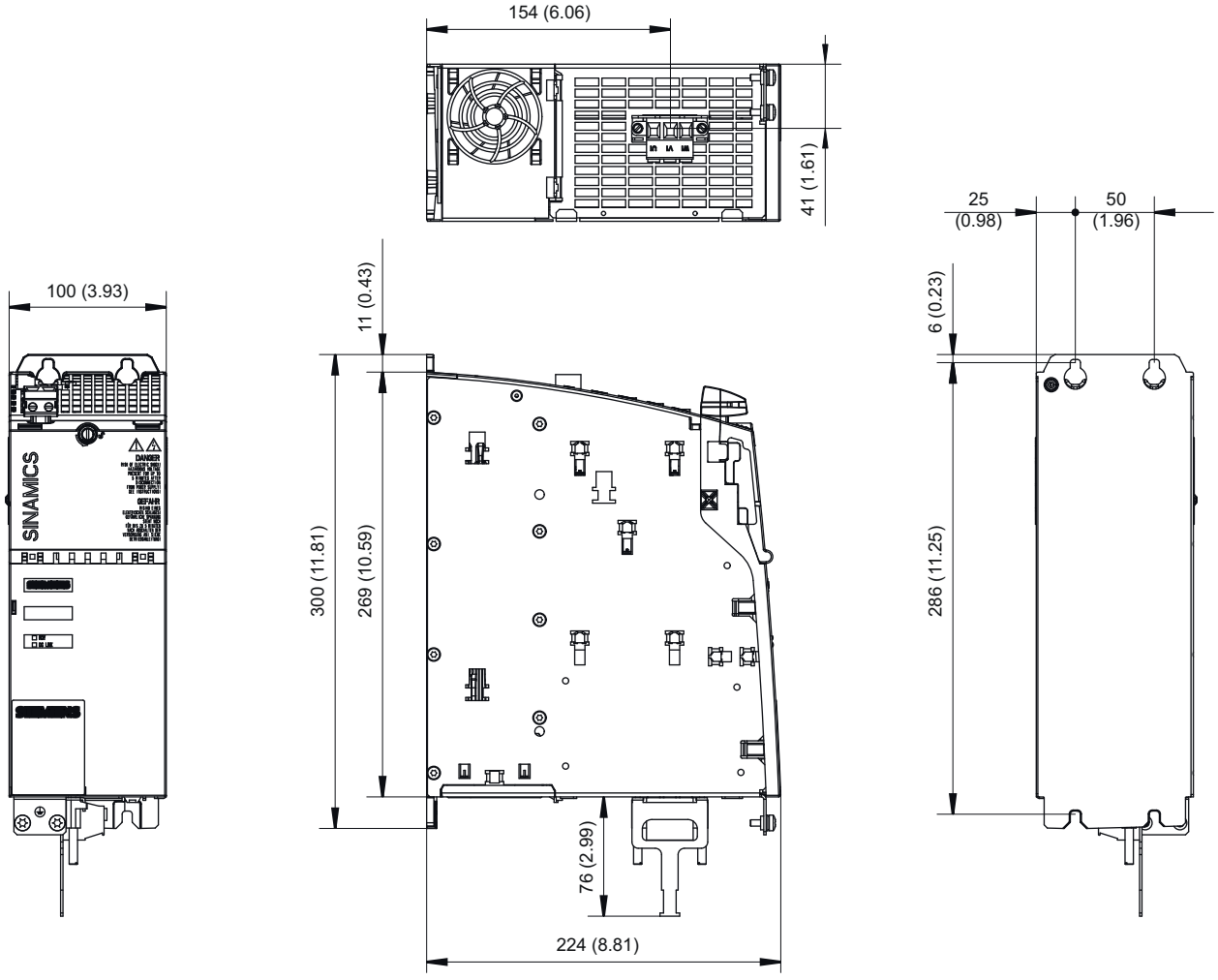
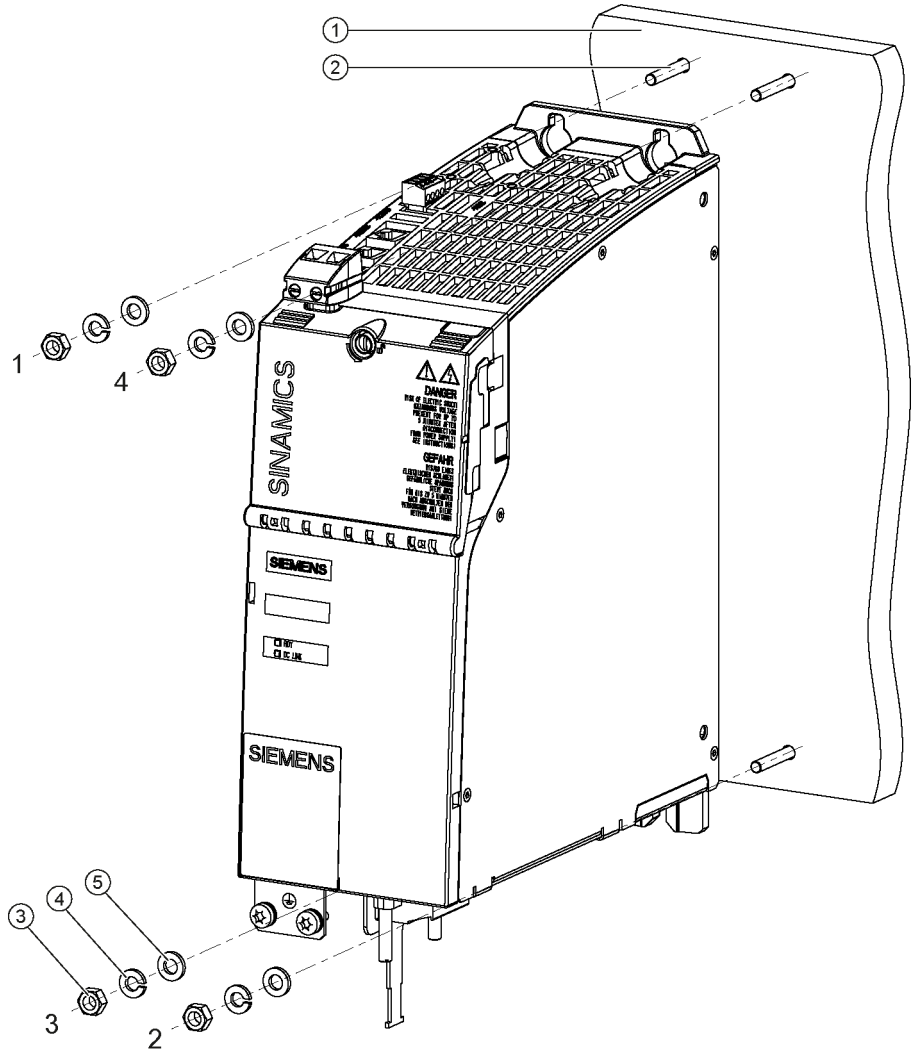


Figure 6-3 Dimension drawing Smart Line Module Booksize Compact format (16 kW), all dimensions in mm and (inches)

Note

The shield connecting plate is part of the scope of delivery of the Smart Line Modules Booksize Compact.

6.2.7 Mounting



① Mounting panel
② Threaded bolts M6
③ M6 nut
④ Spring washer
⑤ Washer

Figure 6-4 Mounting a Smart Line Module Booksize Compact with internal cooling

Tightening torques:

1. Firstly, only tighten the nuts by hand.
   Tightening torque: 0.5 Nm (4.4 lbf in)
2. Then tighten the nuts in the specified sequence 1 to 4.
   Tightening torque: 6 Nm (53.1 lbf in)

6.2.8 Technical data

Table 6-6 Technical specifications Smart Line Modules Booksize Compact

Smart Line Module Booksize Compact	**6SL3430–**	**6TE21-6AA.**
Rated power	**kW**	**16**
Infeed[1)]		
Rated power S1 duty	kW (P_n)	16
Infeed power S6 duty (40 %)	kW (P_{S6})	21
Peak infeed power	kW (P_{max})	35
Energy recovery into the line		
Continuous energy recovery	kW	16
Peak energy recovery power	kW	35
Supply voltages		
Line voltage	V_{ACrms}	3 AC 380 ... 480 ± 10 % (-15 % < 1 min)
Line frequency	Hz	47 ... 63
Electronic power supply	V_{DC}	24 (20.4 ... 28.8)
DC link voltage	V_{DC}	510 ... 720
Overvoltage trip	V_{DC}	820 ± 2 %
Undervoltage trip[2)]	V_{DC}	360 ± 2 %
Input currents		
Rated input current		
at AC 400 V	A_{AC}	27.5
Input current		
at AC 380 V / AC 480 V	A_{AC}	29 / 24.5
at AC 400 V; S6 duty (40 %)	A_{AC}	35
at AC 400 V; peak current	A_{AC}	57.5
DC link currents		
Rated DC link current		
at 600 V DC	A_{DC}	27
DC link current		
at 510 V DC / 720 V DC	A_{DC}	30 / 22.2
at 600 V DC; S6 duty (40%)	A_{DC}	35
at 600 V DC; peak current	A_{DC}	59
Current-carrying capacity		
DC link busbars	A_{DC}	100
24 V busbar	A_{DC}	20
Electronics current consumption at 24 V DC		
For internal air cooling	A_{DC}	0.95
For cold plate cooling	A_{DC}	0.85
Total power loss internal air cooling (including electronics losses, see Power loss tables (Page 503))	W	187.8
Power loss distribution for cold plate (including electronics losses)		
Internal	W	56.6
External	W	130
DC link capacitance		
Smart Line Module	µF	705
Drive line-up, max.	µF	6000
Power factor	cos φ	0.98

Smart Line Module Booksize Compact	**6SL3430–**	**6TE21-6AA.**
Rated power	**kW**	**16**
Circuit breaker (IEC 60947 and UL)		See Chapter Overcurrent protection using line fuses and circuit breakers (Page 49)
Max. total cable length[3)]		See Chapter Combination options, Line Modules with line reactors and line filters (Page 124)
Cooling methods		Internal air cooling Cold plate cooling
Cooling air requirement with internal air cooling	m^3/h	56
Ventilation clearances above/below	mm	≥ 80
Weight	kg	5.3

1) The specified power ratings apply to the line voltage range from 380 V to 480 V.

2) Default for 400 V line systems; undervoltage trip threshold is adjusted to the parameterized rated voltage

3) Maximum total cable length = Σ motor cables, line feeder cable from line filter to the Line Module

6.2.8.1 Characteristics

Rated duty cycles of Smart Line Modules

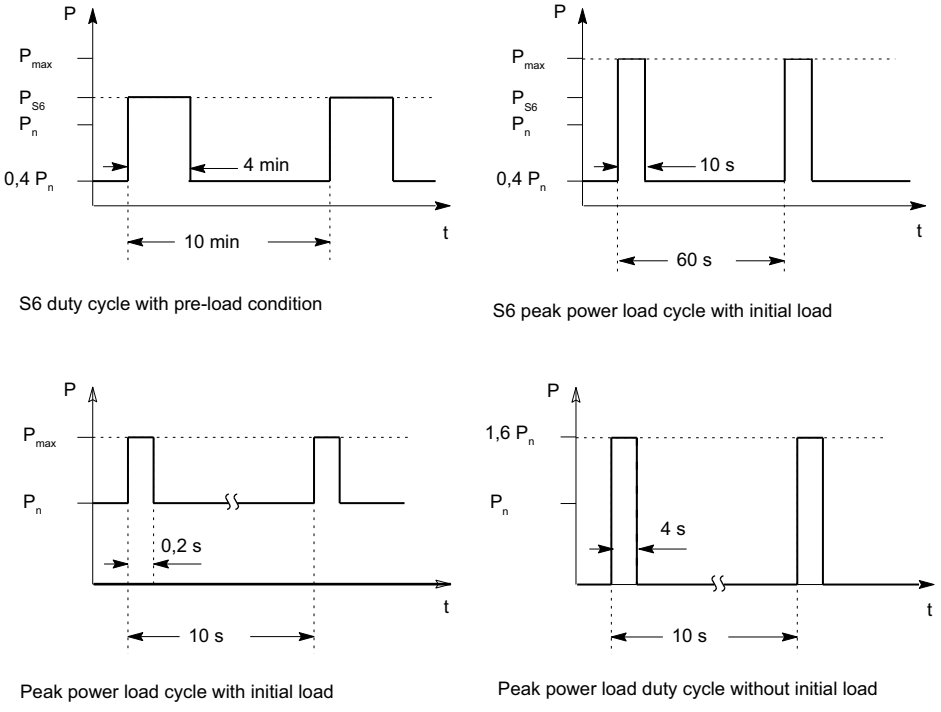


Figure 6-5 Rated duty cycles of Smart Line Modules

Motor Modules Booksize

7

7.1 Description

A Motor Module is a power unit (inverter) that provides the power for the connected motors. Power is supplied by the DC link of the drive unit. A Motor Module must be connected to a Control Unit via DRIVE-CLiQ. The open-loop and closed-loop control functions for the Motor Module are stored in the Control Unit.

Exactly one motor can be connected to and operated on a Single Motor Module. A Double Motor Module provides two independent power supplies for connection of two motors.

Table 7-1 Booksize Motor Modules (overview)

Output current [A]	Width [mm]	Classic	C type	D type
3	50			x
5	50			x
9	50			x
18	50		x	x
24	50		x	x
30	100		x	x
45	100		x	
60	100		x	
85	200	x		
132	300	x		
200	300	x		
2x3	50			x
2x5	50			x
2x9	50			x
2x18	100		x	x

7.2 Safety instructions for Motor Modules Booksize



⚠ WARNING

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

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

- Only operate the components with closed protective cover.



⚠ WARNING

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

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



⚠ WARNING

Electric shock due to missing DC link side covers

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

- Mount the side covers on the first and last component in the drive line-up.
- 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 conductors with insulation properties that comply with safe electrical separation or separately route the brake conductors to absolutely ensure safe electrical separation.

⚠ WARNING

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

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

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

⚠ 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.

NOTICE

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

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

- Always use a stabilized DC power supply to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars.
- Take note of the motor holding brake voltage tolerances (24 V ± 10%) and the connecting cable voltage losses. If the voltage is too high, the brake can close.
- Set the DC power supply to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:
  - Siemens three-phase motors are used
  - Using Siemens MOTION-CONNECT power cables
  - Note that there are motor 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 "Requirements placed on third-party motors (https://support.industry.siemens.com/cs/document/79690594)".

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.
- Order any additional blanking covers with the article number 6SL3066-4CA00-0AA0 (50 covers).

Notes for UL applications

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.
- **Additional information**
  Additional information on parameterizing thermal motor models can be found in Chapter "Thermal motor protection" in the SINAMICS S120 Function Manual Drive Functions.

7.3 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

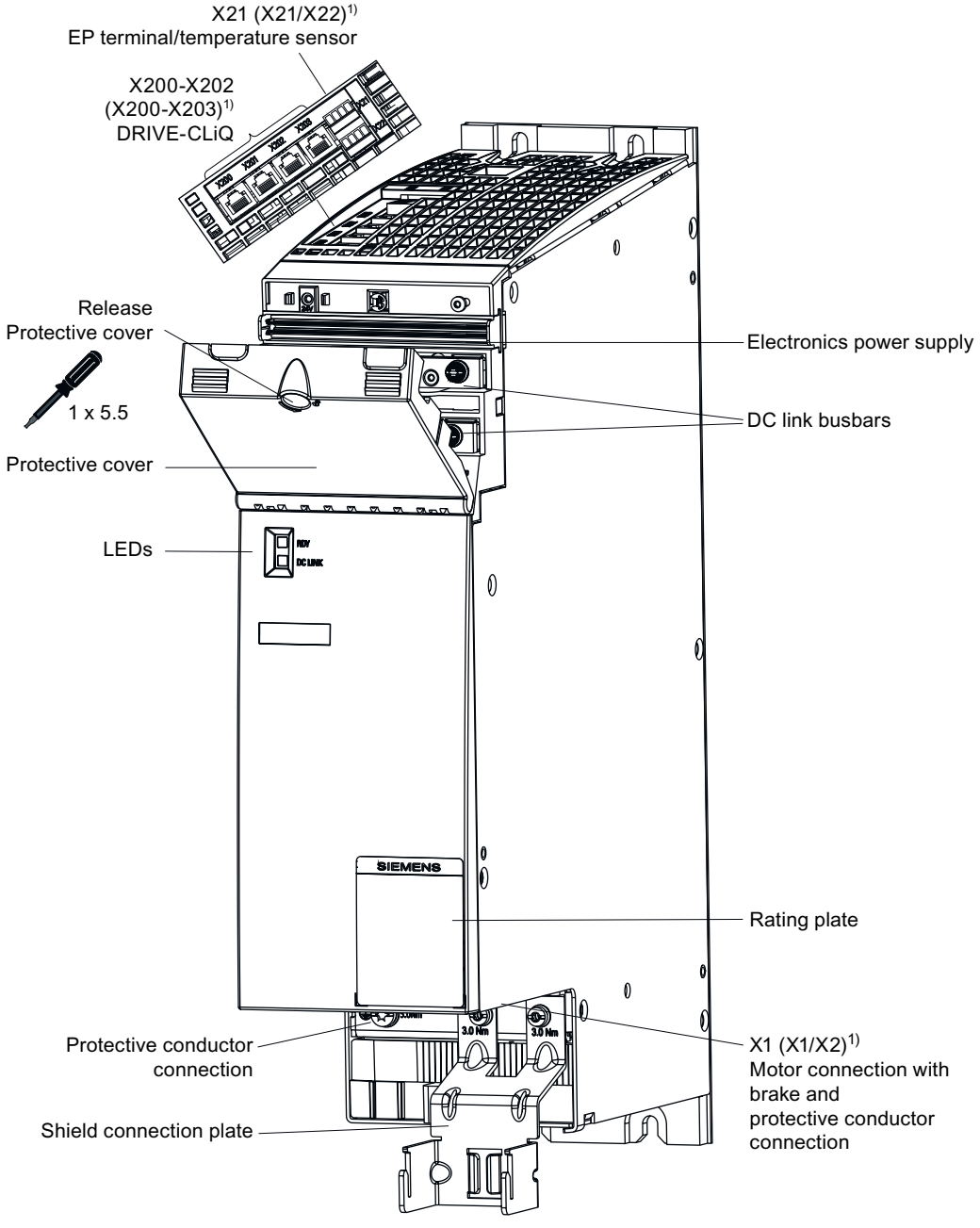
You can find more information on the Internet:

AUTOHOTSPOT

7.4 Interface description

7.4.1 Overview

Interfaces of the 50 mm modules and 100 mm modules (30 A and 2x18 A)



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

Figure 7-1 Interface overview of Motor Modules Booksize C/D type (3 ... 30 A, 2x3 ... 2x18 A)

Note

Shield connection

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

Note

Protective ground conductor connection

On the 100 mm module illustrated above, the protective conductor connection is located on the left next to the shield connecting plate. On a 50 mm module, the protective conductor connection is behind the shield connecting plate. For more details, see Chapter "Protective conductor connection" (Page 218).

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

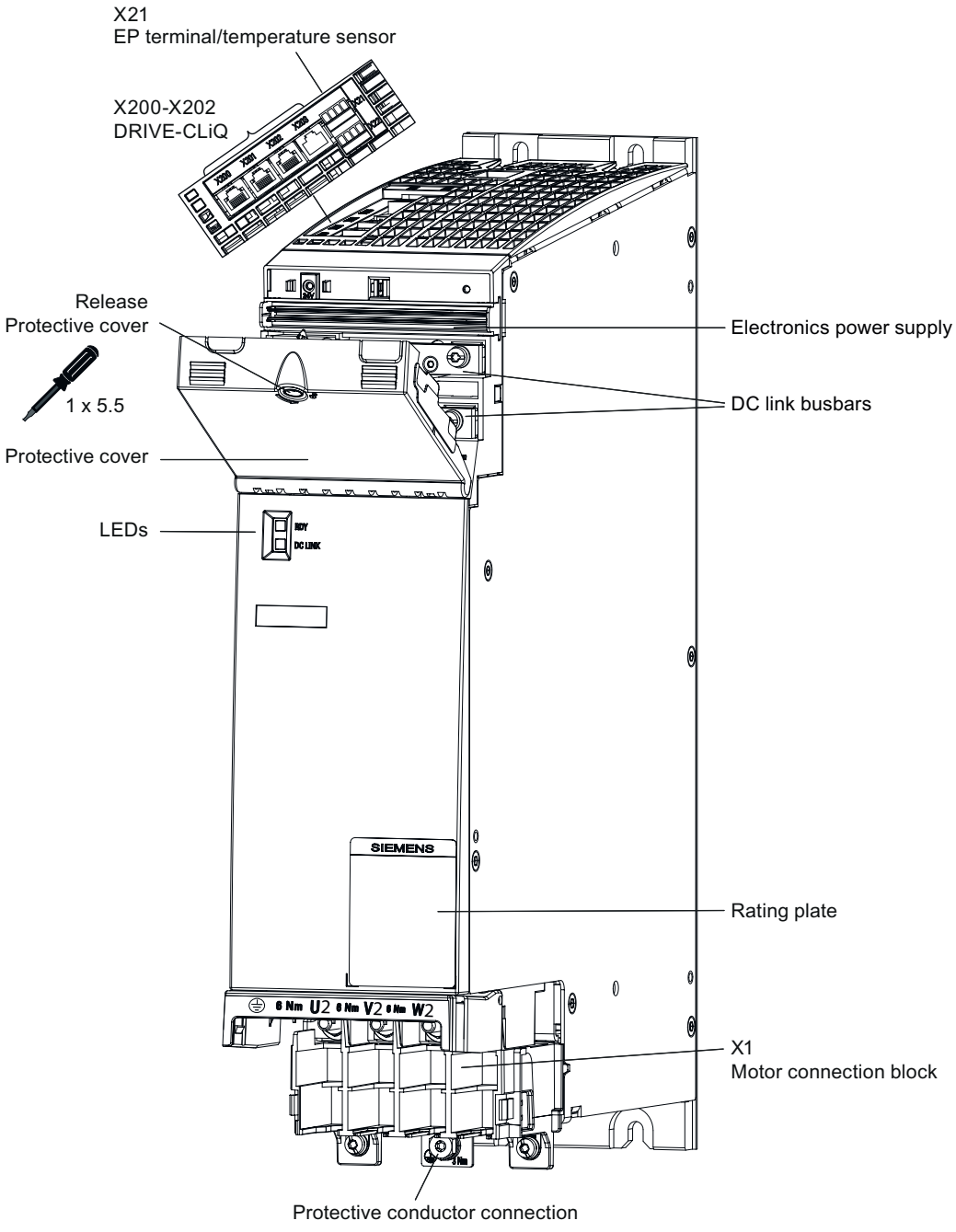
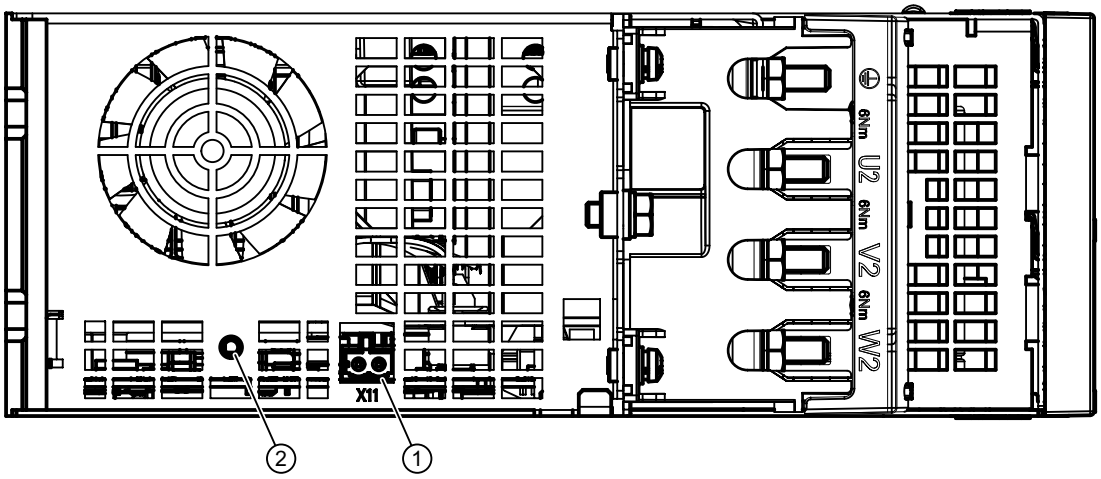


Figure 7-2 Interface overview of Motor Modules Booksize C type (45 A ... 60 A)



① Interface X11 to connect the motor holding brake

② Threaded socket M4 for attachment of the shield connection clamp (Page 379)

Figure 7-3 Motor Module 45 ... 60 A (view from below)

Interfaces of the 200 ... 300 mm modules (85 ... 200 A)

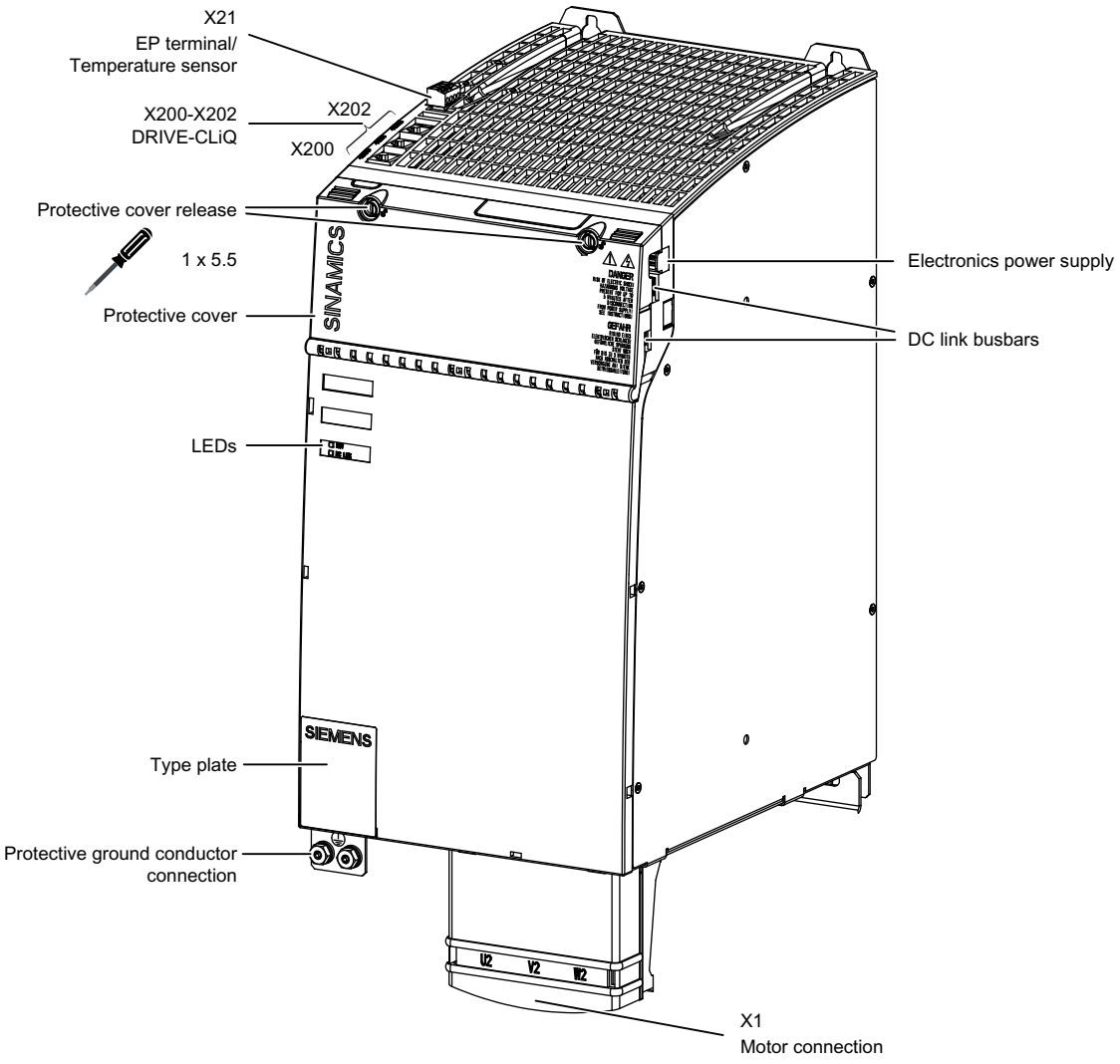
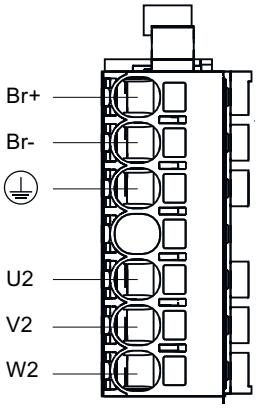


Figure 7-4 Interface overview of Motor Modules Booksize Classic (85 ... 200 A)

7.4.2 Motor and brake connection

Single Motor Modules up to 30 A, Double Motor Modules up to 2x18 A

Table 7-2 X1: Motor and brake connection for Single Motor Modules 3 A to 30 A
X1/X2: Motor and brake connection for Double Motor Modules 2x3 A to 2x18 A

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

Note

Motor connector

For information about the motor connector, please refer to Chapter "Motor connector" (Page 416).

Note

Shielding

Attach the motor cable shield to the shield connecting plate on the Motor Module using the shield connection clamp supplied in the terminal kit. You can find more detailed information in Chapters "Motor connector" (Page 416) and "Shielding and routing cables" (Page 489).

Single Motor Modules 45 / 60 A

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

Table 7-3 X1 motor connection and X11 brake connection for Single Motor Modules 45 A and 60 A

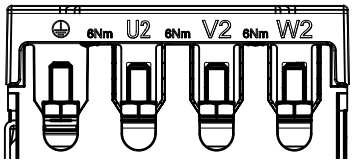
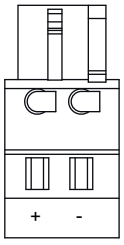
	Terminal	Technical data
	⏚	Threaded bolts: M6 / 6 Nm (53.1 lbf in)[1]
	U2	
	V2	
	W2	
	+ (BR+)	**X11 brake connection connector**:
	- (BR-)	Module output voltage: 24 V DC Max. load current: 2 A Minimum load current: 0.1 A Type: Spring-loaded terminal 2 (Page 485) The brake connector is part of the prefabricated cable.
[1] For ring cable lugs without insulation (Page 487)		

Table 7-4 Connectable cross-sections

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

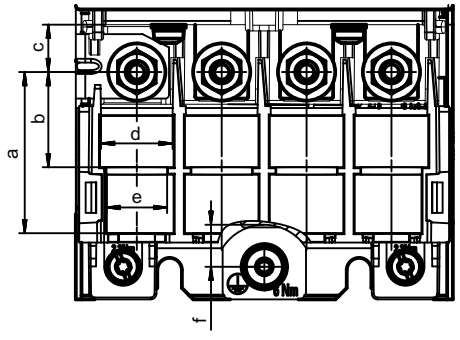
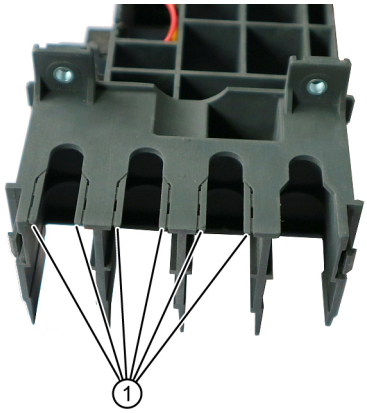


Figure 7-5 Dimension drawing of the motor connection block

Table 7-5 Dimensions of the motor connection block in mm (inch)

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



① Fillets at the motor connection block that can be removed to connect cables from a diameter of 9.5 mm (0.37 in) and higher.

Figure 7-6 Fan unit for 45 A / 60 A Motor Modules

Note

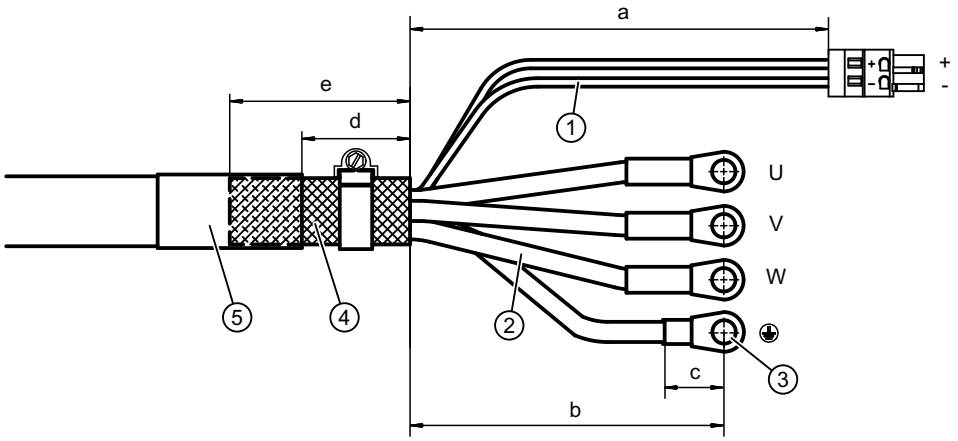
Cable lugs for 50 mm² cables

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

Prefabricating a motor connecting cable

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

1. Remove the cable sheath to 205 mm (8.07 in) length with a tolerance of ±10 mm (±0.4 in).
2. Shorten the braided shield to 80 mm (3.15 in) and fold it back.
3. If you are using a motor cable with brake conductors, then the braided shield of the brake conductors must be unbraided. This is then folded back against the outer shield.
4. Fix the braided shield using heat-shrink tubing. Preferably use shrink-on sleeving, which has hot-melt adhesive on the inside.
5. Shorten the individual conductors as indicated in the drawing and table below.
6. Use suitable ring or pipe-type cable lugs (see Chapter "Cable lugs (Page 487)").



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

Figure 7-7 Motor connection cables

Table 7-6 Required insulation stripping lengths in mm (inches)

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

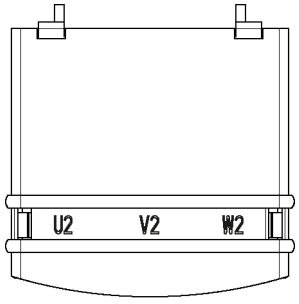
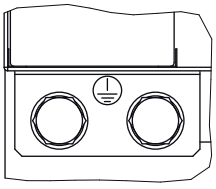
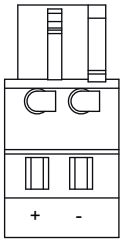
Note

Cables for UL applications

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

Single Motor Modules 85 ... 200 A

Table 7-7 X1 motor connection and X11 brake connection for Single Motor Modules 85 A to 200 A

	Terminal	Technical data
	U2 V2 W2	**85 A:** Threaded bolts M8 / 13 Nm (115 lbf in)[1] **132 ... 200 A:** Threaded bolts M8 / 13 Nm (115 lbf in)[1]
	Protective conductor connection	**85 A:** Threaded bolts for motor cables: M8 / 13 Nm (115 lbf in)[1] Threaded hole for protective conductor: M6 / 6 Nm (53.1 lbf in)[1] **132 ... 200 A:** Threaded bolts for motor cables: M8 / 13 Nm (115 lbf in)[1] Threaded hole for protective conductor: M8 / 13 Nm (115 lbf in)[1]
	+ (BR+) - (BR-)	**X11 brake connector**[2]: Module output voltage: 24 V DC Max. load current: 2 A Minimum load current: 0.1 A Type: Spring-loaded terminal 2 (Page 485) The brake connector is part of the prefabricated cable.

[1] For ring cable lugs without insulation (Page 487)

[2] The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally.

Motor holding brake connection

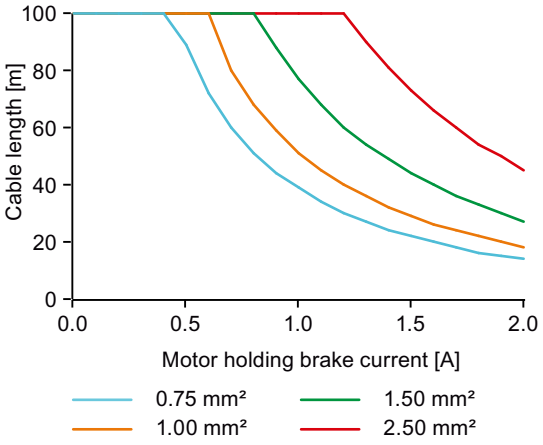
Note

The motor holding brake must be connected via outputs BR+ and BR- of connector X11. The BR cable must not be connected directly to electronics ground (M).

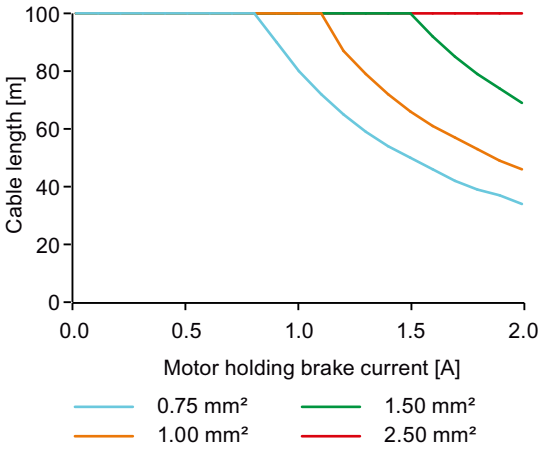
To ensure reliable opening of the motor holding brake, it requires a typical voltage of 24 V ± 10% at the motor connection. Refer to the data sheet of the motor for the motor holding brake voltage and tolerance.

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

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



Module input voltage 24 V



Module input voltage 26 V

Note

Protective circuit against overvoltage

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

⚠ WARNING

Electric shock caused by high touch voltage on brake cables

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

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

NOTICE

Premature wear of the motor holding brake when improperly operated

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

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

NOTICE

Faulty brake function due to inadmissible wear

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

- Comply with the predefined EMERGENCY STOP characteristics.
- Avoid repeated brief acceleration of the motor against a holding brake that is still closed. Consider the operating times of the brakes and the relays in the drive control and enable.

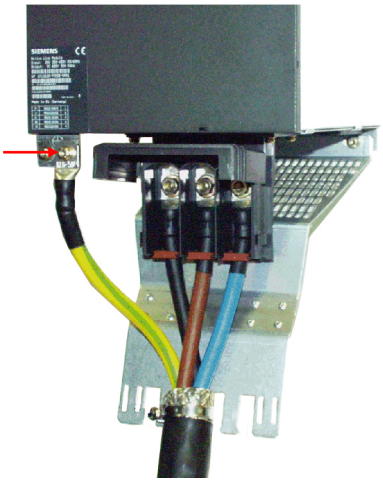
Note

The total length of the power cables (motor feeder cables and DC link cables) must not exceed the values listed in Chapter "Combination options, Line Modules with line reactors and line filters (Page 124)".

7.4.3 Protective conductor connection

	50 mm modules	100 mm modules (30 A, 2 x 18 A)	100 mm modules (45 A / 60 A)	200 mm modules	300 mm modules
Screw	M5	M5	M6	M6	M8
Ring/pipe-type cable lug	M5[1)]	M5	M6	M6	M8
Tightening torque	3 Nm (26.6 lbf in)	3 Nm (26.6 lbf in)	6 Nm (53.1 lbf in)	6 Nm (53.1 lbf in)	13 Nm (115 lbf in)
Screwdriver	Torx 25	Torx 25	Hexagon width across flats 10 Torx 25	Hexagon width across flats 10	Hexagon width across flats 13

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

			
50 mm modules: PE/ ground connection behind the shield connecting plate	100 mm modules (30 A, 2 x 18 A): PE/ground connection to the left, adjacent to the shield connecting plate	100 mm modules (45 A / 60 A): PE/ground connection at the motor connection block	200/300 mm modules (85 ... 200 A) PE/ground connection at the front left of the module

Note

PE/ground connection for 45 A and 60 A modules

The connection block cover partially covers the PE/ground connection screw.

- Open the flap to connect the protective conductor.

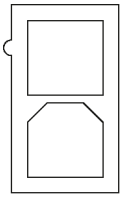
Note

For further information about protective connections, please refer to Chapter "Protective connection and equipotential bonding" (Page 492).

7.4.4 X12 fan connection

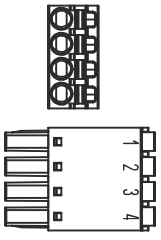
The Motor Modules 132 A and 200 A are equipped with an interface to connect a sub-chassis fan. The interface is located on the underside of the Motor Module.

Table 7-8 X12 fan connection

	Terminal	Function	Technical data
	1	Fan connection +	Voltage 48 V DC for the supplied fan
	2	Fan connection -	

7.4.5 X21/X22 EP terminals/temperature sensor

Table 7-9 X21/X22 EP terminals / temperature sensor

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors[1]: Pt1000 / PTC / KTY84-130 / bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (pulse enable)	Supply voltage: 24 V DC (20.4 ... 28.8 V) Current consumption, typical: 4 mA at 24 V Isolated input
	4	EP M1 (enable pulses)	
Type: Spring-loaded terminal 7 (Page 485)			

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

EP terminals

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

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

Note

Function of the EP terminals

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

Temperature sensor connection

NOTICE

Damage to motor in the event of incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats. Overheating can cause damage to the motor.

- Connect the KTY temperature sensor with the correct polarity.

Note

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



⚠ WARNING

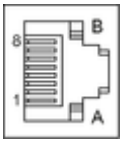
Electric shock when the motor temperature sensor insulation fails

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

- Use motors whose temperature sensors have safe electrical separation.
- Use only connecting cables and connectors with safe electrical separation between the wires of the temperature sensor and the wires 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.

7.4.6 X200-X203 DRIVE-CLiQ interface

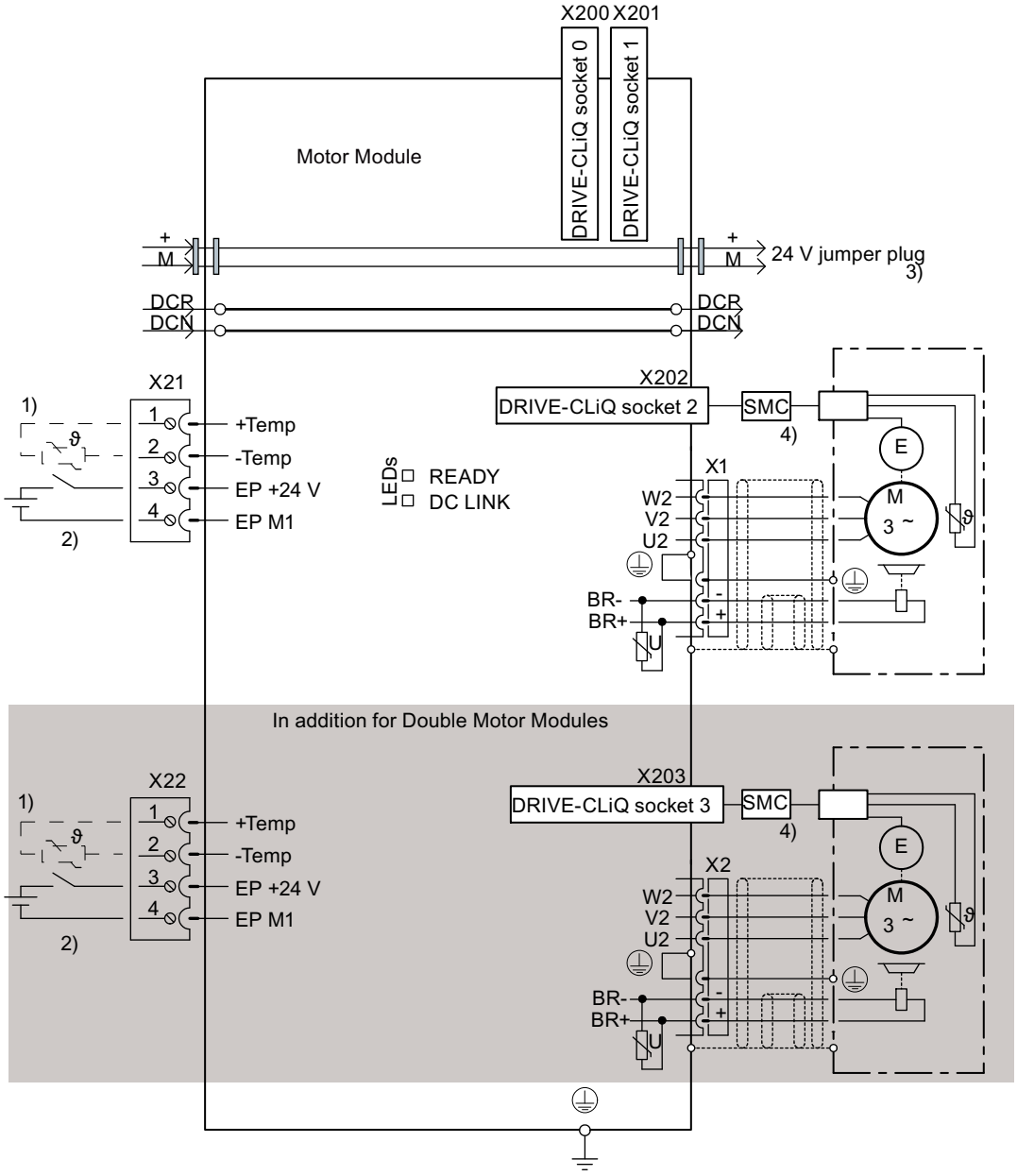
Table 7-10 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules
X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

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

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

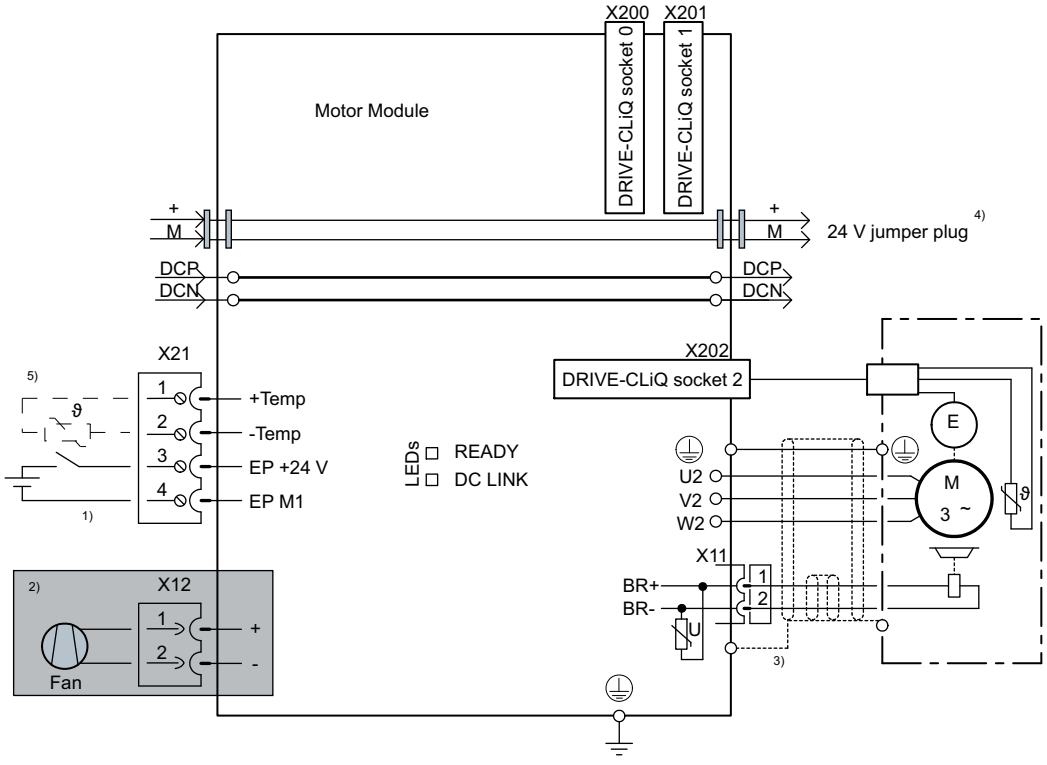
Order the missing blanking cover (50 covers) using Article number: 6SL3066-4CA00-0AA0

7.5 Connection examples



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

Figure 7-8 Connection example for Motor Modules Book a room size format C/D type, 3 A ... 30 A, 2x3 A ... 2x18 A



1) Required for safety
2) In addition for Motor Modules 132 A to 200 A
3) Contact via a shield connecting plate
4) 24 V to the next module
5) Optional, e.g. for motor without encoder

Figure 7-9 Example connection of Single Motor Modules 45 A to 200 A

7.6 Meaning of LEDs

Table 7-11 Meaning of the LEDs on the Motor Module

Status		Description, cause	Remedy
RDY	**DC LINK**		
Off	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
Green	--[1)]	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is outside the permissible tolerance range.	Check the line supply voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--[1)]	This component has at least one fault. **Note:** The LED is activated irrespective of whether the corresponding messages have been reconfigured.	Resolve and acknowledge the fault.
Green/red (0.5 Hz)	--[1)]	Firmware is being downloaded.	–
Green/red (2 Hz)	--[1)]	Firmware download has been completed. The system waits for POWER ON.	Carry out a POWER ON.
Green/orange or red/orange (2 Hz)	--[1)]	Component recognition via LED is activated (p0124=1). **Note:** Whether the LED flashes green/orange or red/orange depends on the status the LED had during activation (setting of parameter p0124 to "1").	–

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

7.7 Dimension drawings

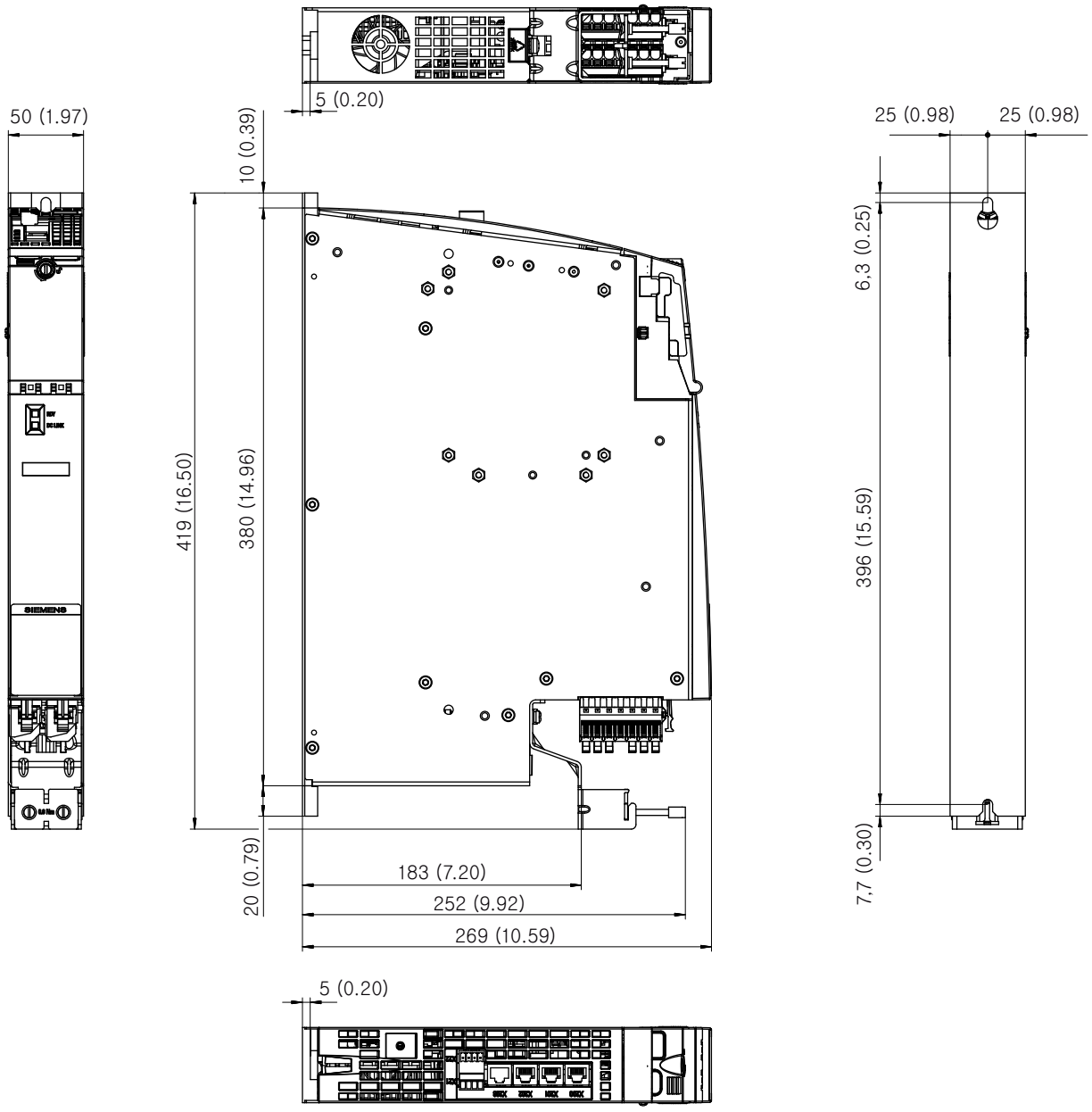


Figure 7-10 Dimension drawing Motor Modules Booksize C/D type 50 mm, all dimensions in mm and (inches)

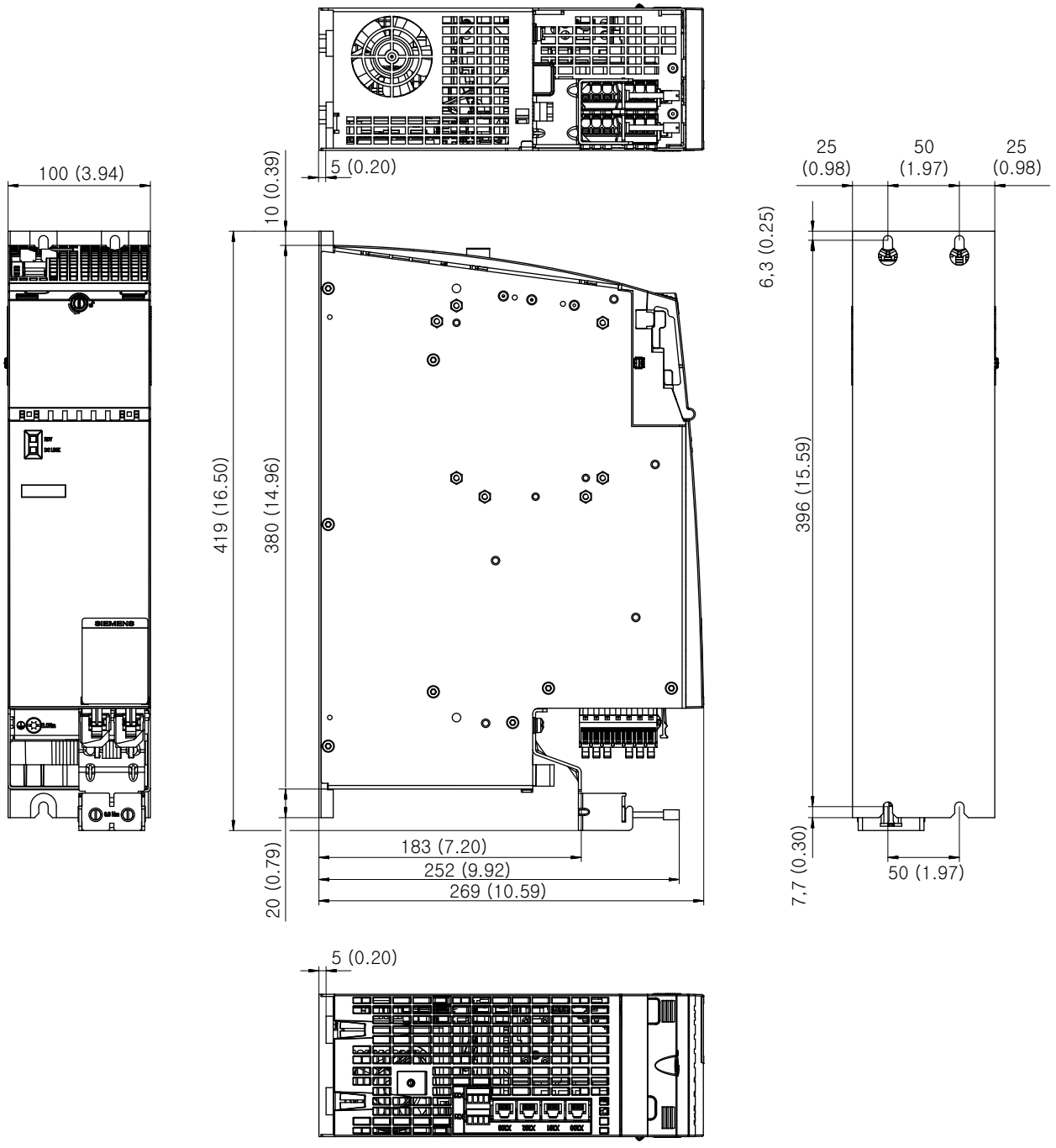


Figure 7-11 Dimension drawing of Motor Modules Booksize C/D type 100 mm 30 A / 2 x 18 A in mm and (inches)

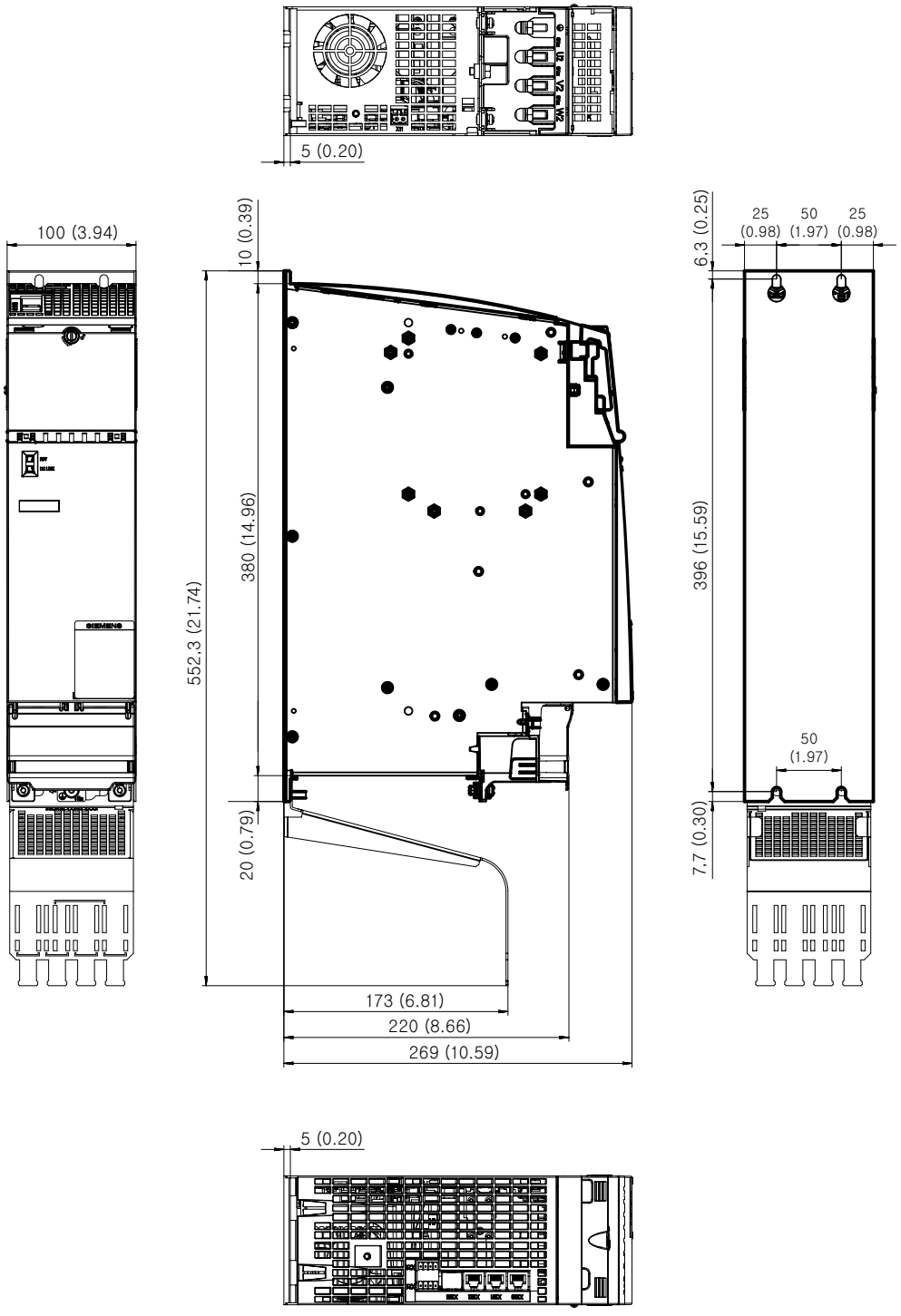


Figure 7-12 Dimension drawing of Motor Modules Booksize C type 100 mm, 45 A / 60 A, all dimensions in mm and (inches)

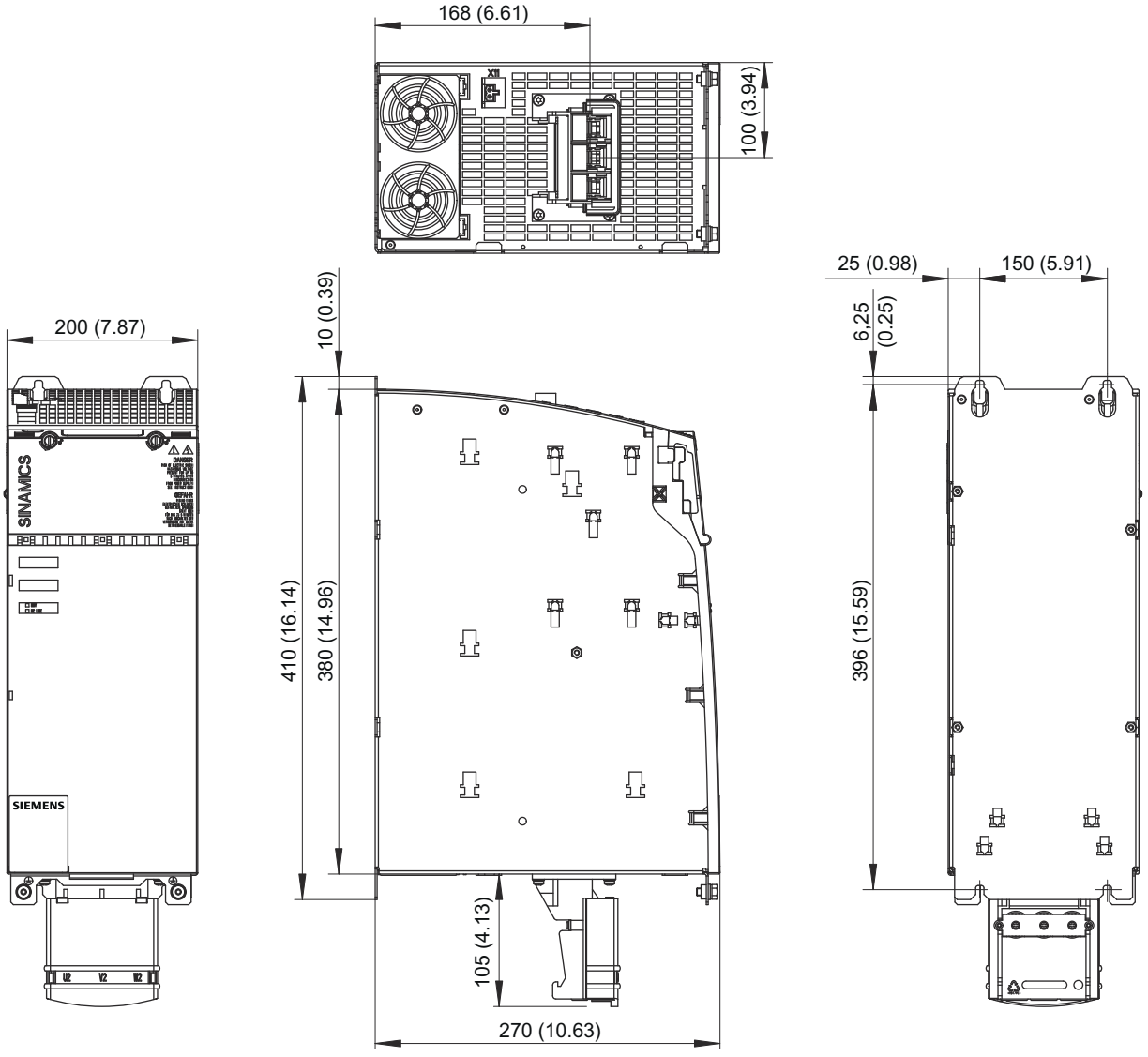


Figure 7-13 Dimension drawing of Motor Modules Booksize 85 A, all dimensions in mm and (inches)

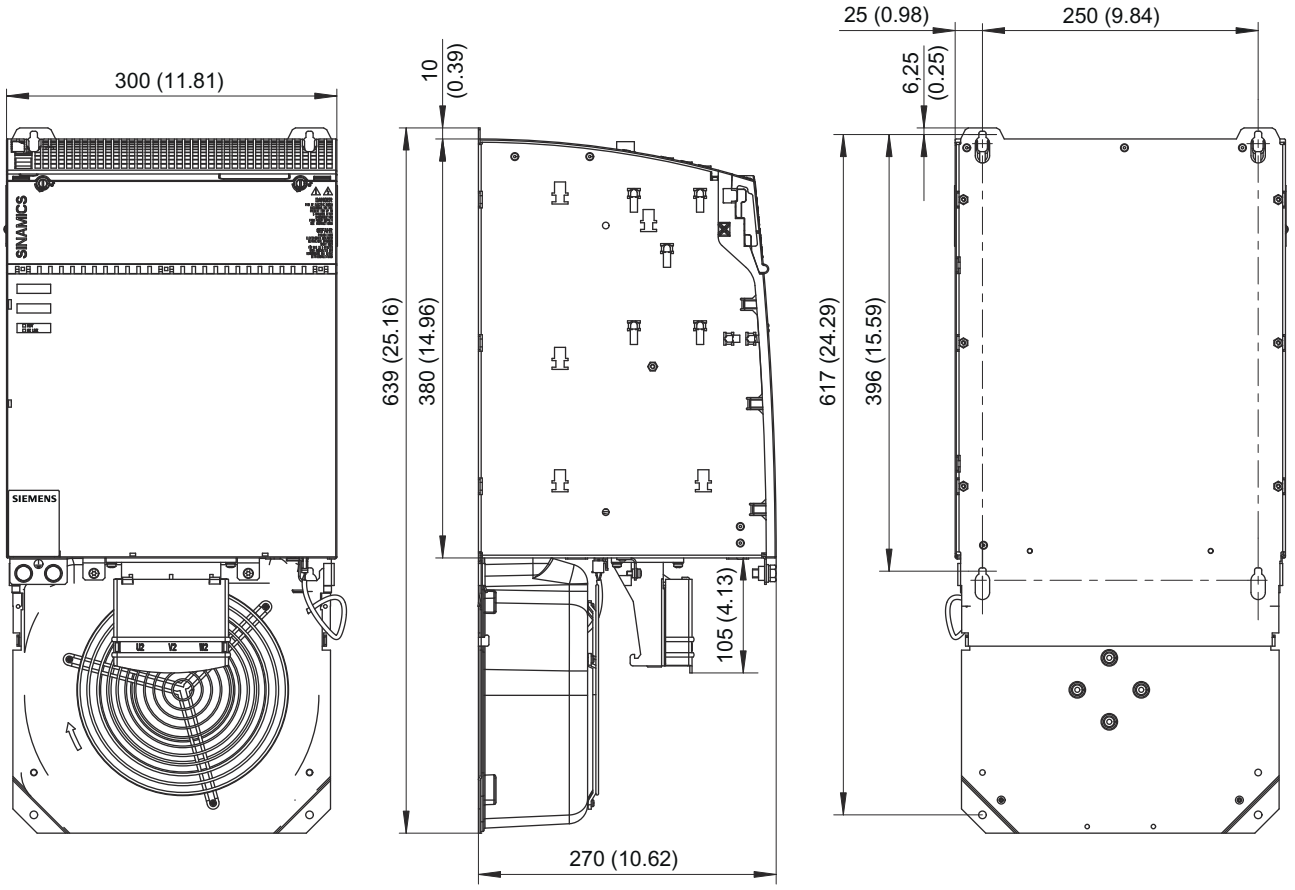


Figure 7-14 Dimension drawing of Motor Modules Booksize 132 A and 200 A, all dimensions in mm and (inches)

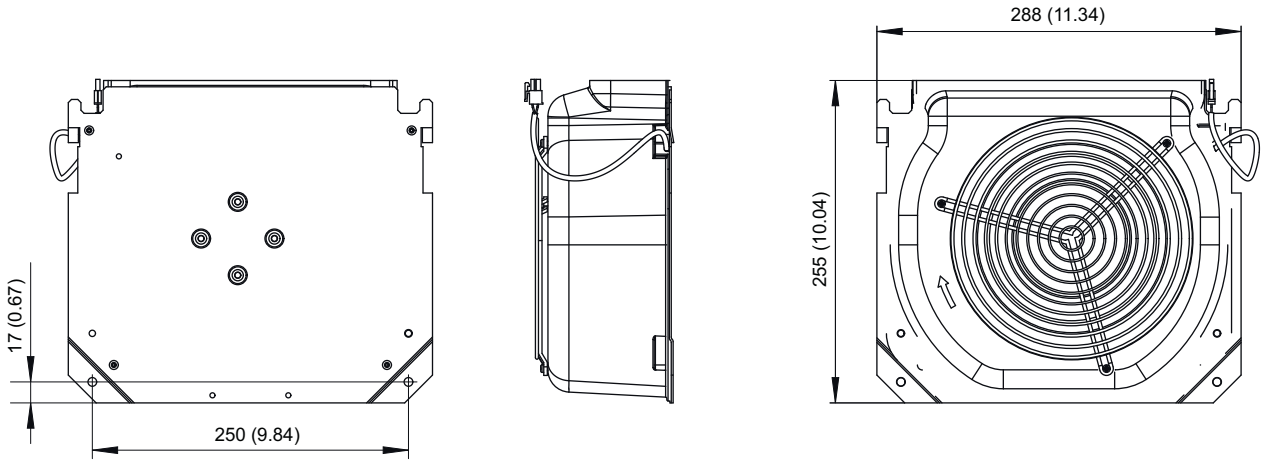


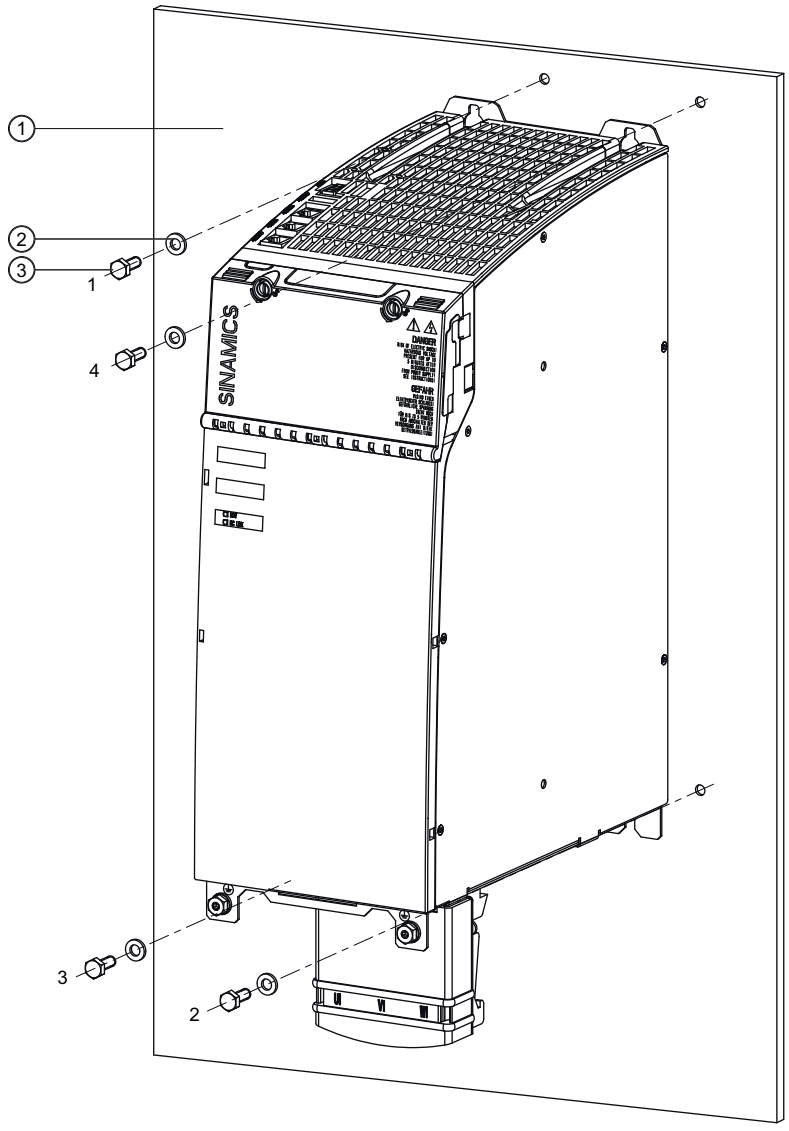
Figure 7-15 Dimension drawing of fans for Motor Modules 132 A and 200 A, all dimensions in mm and (inches)

Note

The fan for the Motor Modules 132 A and 200 A is included in the scope of supply.

7.8 Installation

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



① Control cabinet panel/mounting panel
② Washer
③ M6 screw

Figure 7-16 Mounting a Motor Module (here, using a 200 mm module as example)

Requirements relating to the cabinet panel or mounting panel:

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

Tightening torques

1. Firstly, tighten the nuts by hand.
   Tightening torque. 0.5 Nm (4.4 lbf in)
2. Then tighten the screws in the specified sequence 1 to 4.
   Tightening torque: 6 Nm (53.1 lbf in)

Mounting a sub-chassis fan for 132 A and 200 A Motor Modules

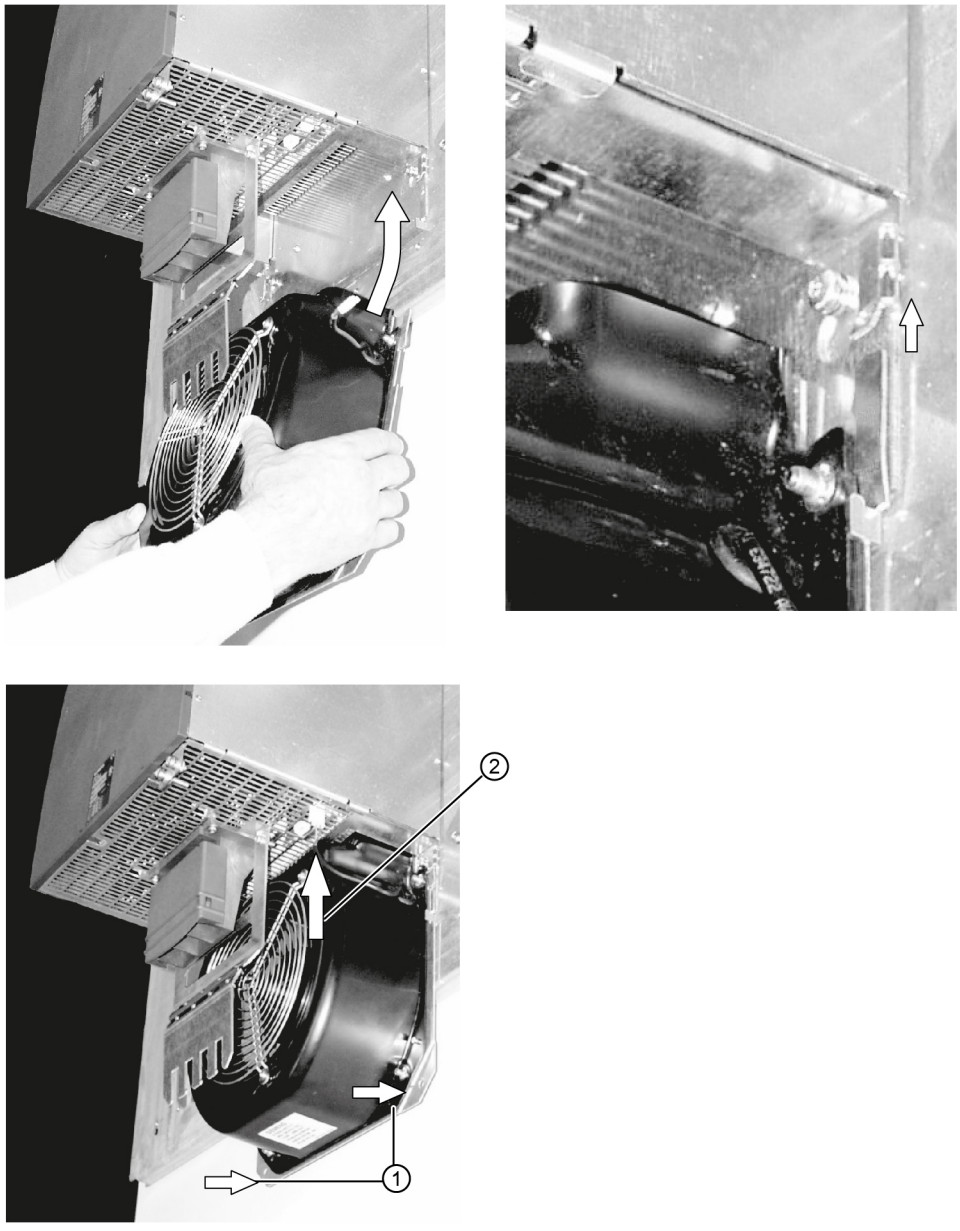


Figure 7-17 Mounting a fan for 132 A and 200 A Motor Modules

1. Fix the fan with M6 screws
   Tightening torque: 6 Nm (53.1 lbf in)
2. Connect the fan power supply.

7.9 Technical data

7.9.1 Single Motor Modules

Table 7-12 Technical specifications of Single Motor Modules Booksize D type (3 A to 30 A)

D type	**6SL3120-**	**1TE13-0AD.**	**1TE15-0AD.**	**1TE21-0AD.**	**1TE21-8AD.**	**1TE22-4AD.**	**1TE23-0AD.**
Output current							
Rated current (I_n)	A_{AC}	3	5	9	18	24	30
Base load current (I_H)	A_{AC}	2.6	4.3	7.7	15.3	20.4	25.5
Intermittent duty current (I_{s6}) 40 %	A_{AC}	4	6.7	12	24	32	40
Peak current (I_{max})	A_{AC}	9	15	27	54	72	90
Rated duty cycles (overload)		Maximum 3x (Page 239)					
Output voltage 3 AC	V_{AC}	0 ... 0.717 x DC link voltage (0 ... 480 V at 670 V DC)					
Output frequency	Hz	0 ... 550[1)]					
DC link current	A_{DC}	3.6	6	11	22	29	36
DC link voltage	V_{DC}	510 ... 720					
Overvoltage trip	V_{DC}	820 ± 2 %					
Undervoltage trip[2)]	V_{DC}	380 ± 2 %					
DC link capacitance	µF	110	110	110	220	390	705
Electronics power supply	V_{DC}	24 (20.4 ... 28.8)					
Electronics current drawn at 24 V DC	A_{DC}	0.75	0.75	0.75	0.75	1.00	0.80
Current-carrying capacity							
DC link busbars	A_{DC}	100[3)]					200
24 V DC busbars	A_{DC}	20					20
Unit rating[4)]							
Based on I_n (600 V DC; 4 kHz)	kW	1.6	2.7	4.8	9.7	12.9	16
Based on I_H	kW	1.4	2.3	4.1	8.2	10.9	13.7
Typical power loss see also Power losses of the components (Page 503)	W	26	36	60	140	190	263
Max. pulse frequency							
without derating	kHz	4					
with derating	kHz	16					
Cooling method		Internal fan					
Cooling air requirement	m^3/h	33.3	33.3	33.3	33.3	53	56

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

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

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

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

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

Note

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

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

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

Table 7-13 Technical specifications of Single Motor Modules Booksize C type (18 A to 60 A)

C type	6SL3120-	1TE21-8AC.	1TE22-4AC.	1TE23-0AC.	1TE24-5AC.	1TE26-0AC.
Output current						
Rated current (I_n)	A_{AC}	18	24	30	45	60
Base load current (I_H)	A_{AC}	15.3	20.4	25.5	38	51
Intermittent duty current (I_{s6}) 40 %	A_{AC}	24	32	40	60	80
Peak current (I_{max})	A_{AC}	36	48	56	90	120
Rated duty cycles (overload)		Maximum 2x (Page 237)				
Output voltage 3 AC	V_{AC}	0 ... 0.717 x DC link voltage (0 ... 480 V at 670 V DC)				
Output frequency	Hz	0 ... 550[1]				
DC link current	A_{DC}	22	29	36	54	72
DC link voltage	V_{DC}	510 ... 720				
Overvoltage trip	V_{DC}	820 ± 2 %				
Undervoltage trip[2]	V_{DC}	380 ± 2 %				
DC link capacitance	µF	220	390	705	1230	1410
Electronics power supply	V_{DC}	24 (20.4 ... 28.8)				
Electronics current drawn at 24 V DC	A_{DC}	0.75	1.00	0.80	0.90	0.90
Current-carrying capacity						
DC link busbars	A_{DC}	100[3]		200		
24 V DC busbars	A_{DC}	20		20		

C type	6SL3120-	1TE21-8AC.	1TE22-4AC.	1TE23-0AC.	1TE24-5AC.	1TE26-0AC.
Unit rating[4]						
Based on I_n (600 V DC; 4 kHz)	kW	9.7	12.9	16	24	32
Based on I_H	kW	8.2	10.9	13.7	21	28
Typical power loss see also Power losses of the components (Page 503)	W	140	189	263	342	460
Max. pulse frequency						
without derating	kHz	4				
with derating	kHz	16				
Cooling method		Internal fan				
Cooling air requirement	m^3/h	33.3	53	56	84	84
Ventilation clearances above/below	mm	≥ 80				
Weight	kg	4.6	4.7	7.9	8.5	8.6

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

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

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

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

Table 7-14 Technical specifications of Single Motor Modules Booksize (85 to 200 A)

Classic	6SL3120-	1TE28-5AA.	1TE31-3AA.	1TE32-0AA.
Output current (at 600 V DC)				
Rated current (I_n)	A_{AC}	**85**	**132**	**200**
Base-load current (I_H)	A	68	105	141
Intermittent duty current (I_{s6}) 40%	A_{AC}	110	150	230
Peak current (I_{max})	A_{AC}	141	210	282
Rated duty cycles (overload)		Maximum 2x (Page 237)		
Output voltage	V_{AC}	0 ... 0.717 x DC link voltage		
Output frequency	Hz	0 ... 550[1]		
DC link current	A_{DC}	102	158	200
DC link voltage	V_{DC}	510 ... 720		
Overvoltage trip	V_{DC}	820 ± 2 %		
Undervoltage trip[2]	V_{DC}	380 ± 2 %		
DC link capacitance	µF	1880	2820	3995
Electronics power supply	V_{DC}	24 (20.4 ... 28.8)		
Electronics current drawn at 24 V DC	A_{DC}	1.5	0.85	0.85
Current-carrying capacity				
DC link busbars	A_{DC}	200	200	200
24 V DC busbars	A_{DC}	20	20	20
Unit rating[3]				
Based on I_n (600 V DC; 4 kHz)	kW	46	71	107
based on I_H	kW	37	57	76

Classic	6SL3120-	1TE28-5AA.	1TE31-3AA.	1TE32-0AA.
Total power loss (including electronics losses, see Power loss tables (Page 503))	W	786	1270.4	2070.4
Max. pulse frequency without derating with derating	 kHz kHz	 4 16		
Cooling method (with fan)		Internal fan	Mounted fan	
Cooling air requirement	m^3/h	160	520	520
Ventilation clearances above/below in front of the component	 mm mm	 ≥ 80 ---	 ≥ 80 ≥ 50	
Weight	kg	14.6	20.7	21.6

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

2) Default for 400 V line systems; for 85 A Motor Modules, the undervoltage trip threshold can be reduced by up to 80 V; it is adjusted to the parameterized rated voltage.

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

7.9.2 Double Motor Modules

Table 7-15 Technical specifications of Double Motor Modules Booksize D type (2 x 3 A to 2 x 18 A)

D type	6SL3120-	2TE13- 0AD.	2TE15- 0AD.	2TE21- 0AD.	2TE21- 8AD.
Output current Rated current (I_n) Base load current (I_H) Intermittent duty current (I_{s6}) 40 % Peak current (I_{max})	 A_{AC} A_{AC} A_{AC} A_{AC}	 2 x 3 2 x 2.6 2 x 4 2 x 9	 2 x 5 2 x 4.3 2 x 6.7 2 x 15	 2 x 9 2 x 7.7 2 x 12 2 x 27	 2 x 18 2 x 15.3 2 x 24 2 x 54
Rated duty cycles (overload)		Maximum 3x (Page 239)			
Output voltage 3 AC	V_{AC}	0 ... 0.717 x DC link voltage (0 ... 480 V at 670 V DC)			
Output frequency	Hz	0 ... 550[1]			
DC link current	A_{DC}	7.2	12	22	43
DC link voltage	V_{DC}	510 ... 720			
Overvoltage trip Undervoltage trip[2]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %			
DC link capacitance	µF	220	220	220	705
Electronics power supply	V_{DC}	24 (20.4 ... 28.8)			
Electronics current drawn at 24 V DC	 A_{DC}	 0.9	 0.9	 0.9	 1.1
Current-carrying capacity DC link busbars 24 V DC busbars	 A_{DC} A_{DC}	 100[3] 20			 200 20
Unit rating[4] Based on I_n (600 V DC, 4 kHz) Based on I_H	 kW kW	 2 x 1.6 2 x 1.4	 2 x 2.7 2 x 2.3	 2 x 4.8 2 x 4.1	 2 x 9.7 2 x 8.2

D type	6SL3120-	2TE13- 0AD.	2TE15- 0AD.	2TE21- 0AD.	2TE21- 8AD.
Typical power loss See also Power losses of the components (Page 506)	W	54	81	152	281
Max. pulse frequency without derating with derating	 kHz kHz	 4 16			
Cooling method		Internal fan			
Cooling air requirement	m^3/h	33.3	33.3	33.3	56
Ventilation clearances above/below	 mm	 ≥ 80			
Weight	kg	4.7	4.7	4.7	8.1

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

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

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

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

Note

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

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

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

Table 7-16 Technical specifications of Double Motor Modules Booksize C type (2 x 18 A)

C type	6SL3120-	2TE21-8AC.
Output current Rated current (I_n) Base load current (I_H) Intermittent duty current (I_{s6}) 40 % Peak current (I_{max})	 A_{AC} A_{AC} A_{AC} A_{AC}	 2 x 18 2 x 15.3 2 x 24 2 x 36
Rated duty cycles (overload)		Maximum 2x (Page 237)
Output voltage 3 AC	V_{AC}	0 ... 0.717 x DC link voltage (0 ... 480 V at 670 V DC)
Output frequency	Hz	0 ... 550[1]
DC link current	A_{DC}	43
DC link voltage	V_{DC}	510 ... 720
Overvoltage trip Undervoltage trip[2]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %

C type	6SL3120-	2TE21-8AC.
DC link capacitance	µF	705
Electronics power supply	V_{DC}	24 (20.4 ... 28.8)
Electronics current drawn at 24 V DC	 A_{DC}	 1.1
Current-carrying capacity DC link busbars 24 V DC busbars	 A_{DC} A_{DC}	 200 20
Unit rating[3] Based on I_n (600 V DC; 4 kHz) Based on I_H	 kW kW	 2 x 9.7 2 x 8.2
Typical power loss See also Power losses of the components (Page 506)	W	281
Max. pulse frequency without derating with derating	 kHz kHz	 4 16
Cooling method		Internal fan
Cooling air requirement	m^3/h	56
Ventilation clearances above/below	 mm	 ≥ 80
Weight	kg	8.1

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

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

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

7.10 Characteristics

7.10.1 Rated load cycles for Motor Modules Booksize C type and Classic

The following rated load cycles are applicable for operation with up to a maximum of twice the overload.

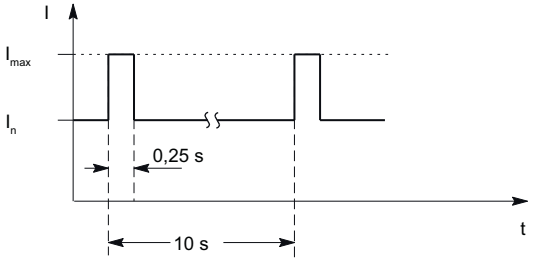


Figure 7-18 Duty cycle with initial load (for servo drives)

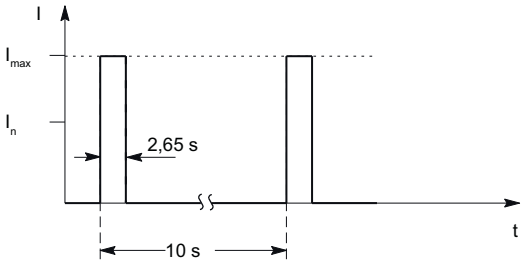


Figure 7-19 Duty cycle without initial load (for servo drives)

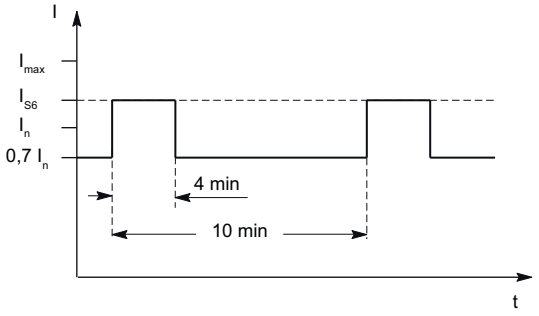


Figure 7-20 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

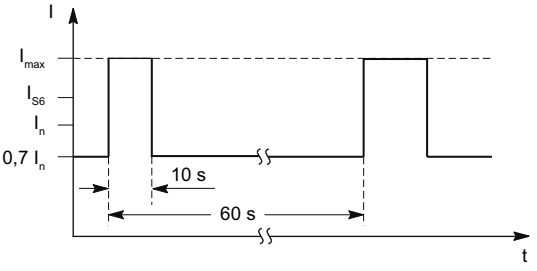


Figure 7-21 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

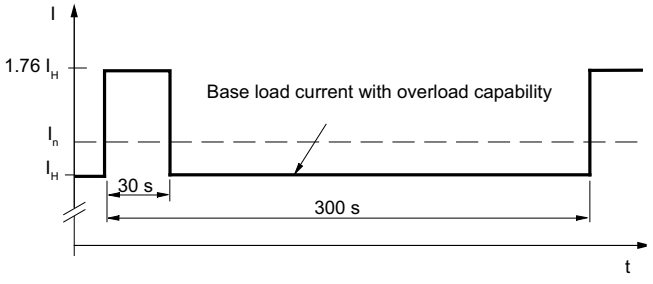


Figure 7-22 Duty cycle with 30 s overload for a duty cycle duration of 300 s

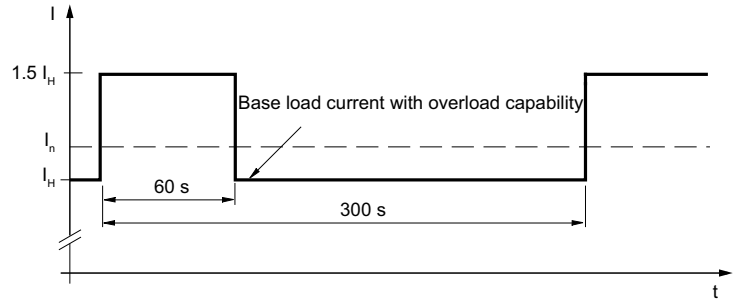


Figure 7-23 Duty cycle with 60 s overload for a duty cycle duration of 300 s

7.10.2 Rated load cycles for Motor Modules Booksize D type

The following rated load cycles are applicable for operation with up to a maximum of three times the overload.

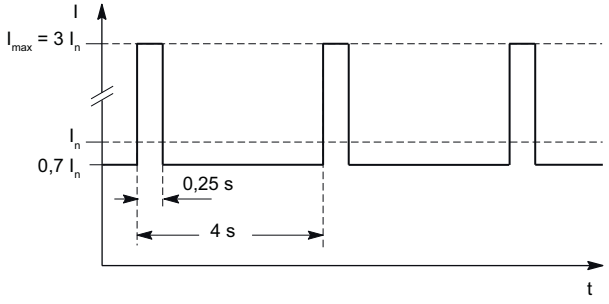


Figure 7-24 Peak current duty cycle with initial load (300 % overload)

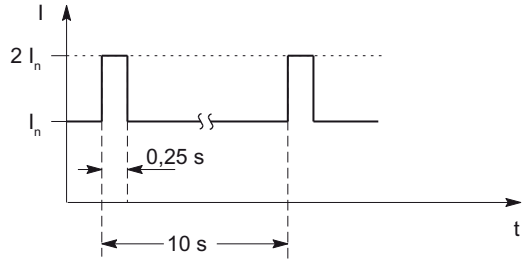


Figure 7-25 Duty cycle with initial load

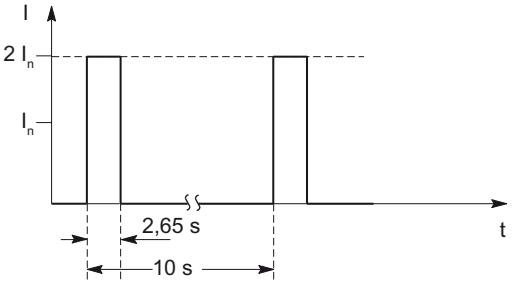


Figure 7-26 Duty cycle without initial load for a duty cycle duration of 10 s

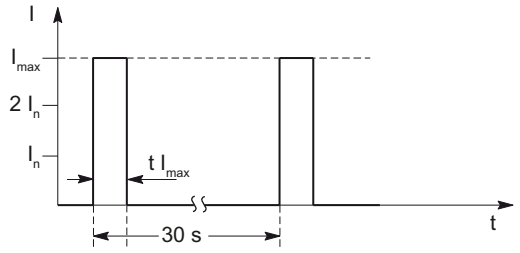


Figure 7-27 Duty cycle without initial load for a duty cycle duration of 30 s

Table 7-17 Times I_{max} for the duty cycle

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

Note

Supplementary condition

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

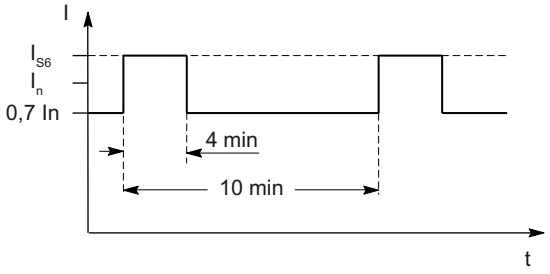


Figure 7-28 S6 duty cycle with initial load for a duty cycle duration of 600 s

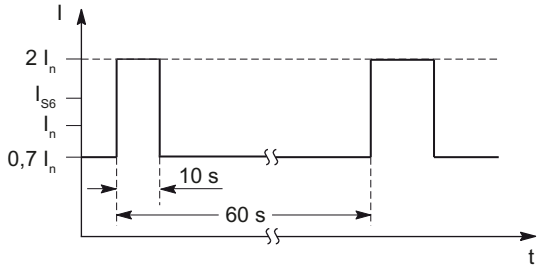


Figure 7-29 S6 duty cycle with initial load for a duty cycle duration of 60 s

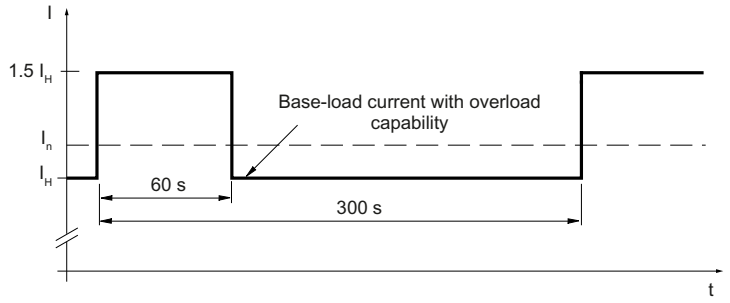


Figure 7-30 Duty cycle with 60 s overload for a duty cycle duration of 300 s

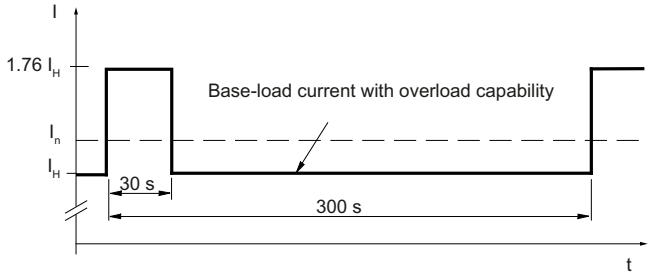


Figure 7-31 Duty cycle with 30 s overload for a duty cycle duration of 300 s

7.10.3 Derating characteristics for Motor Modules Booksize

Dependent on the pulse frequency

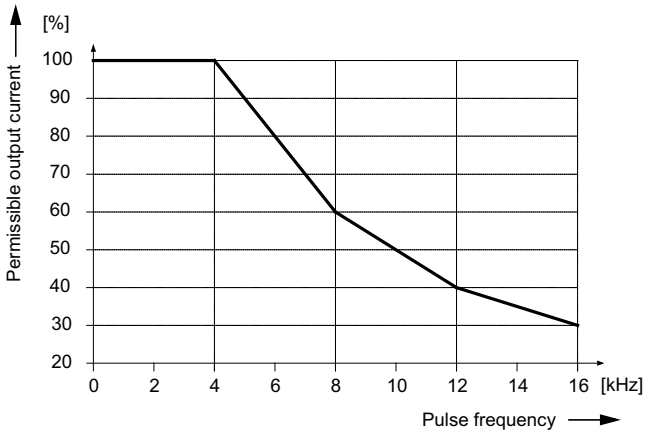


Figure 7-32 Output current as a function of the pulse frequency

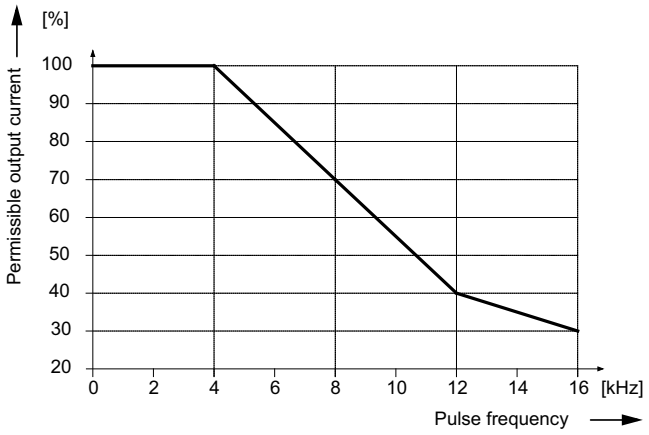


Figure 7-33 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from article number 6SL312.-1TE32-0AA4)

Note

Operation at a pulse frequency of 16 kHz

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

Motor Modules Classic at low output frequencies

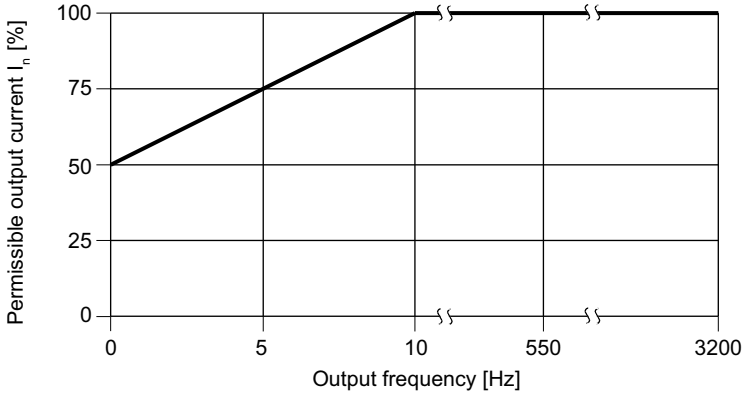


Figure 7-34 Output current at low frequencies

Dimensioning notes

- A current derating is only applicable for output frequencies < 10 Hz.
- A current derating must be taken into account if the percentage time of operation at frequencies < 10 Hz is more than 2 % of the total daily operating time.
- The current specified here must also not be exceeded during load cycles.
- When quickly passing through frequencies 0 to 10 Hz, derating can be ignored (e.g. for positioning applications).

Motor Modules C/D type at low output frequencies

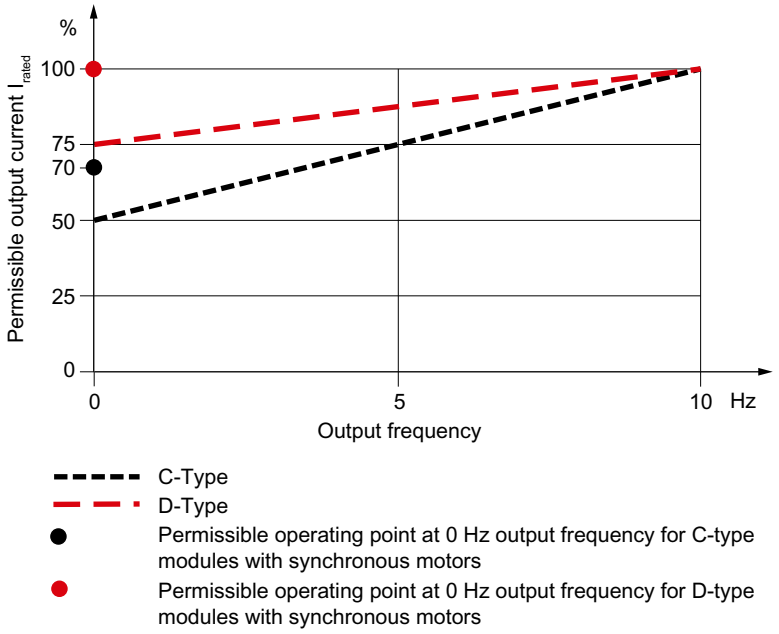


Figure 7-35 Output current for operation at low output frequencies

Supplementary conditions

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

Note

Operating Motor Modules up to and including 30 A

D type modules are the preferred solution for Motor Modules up to and including 30 A for high alternating load levels [power cycling capability] (for output frequencies <10 Hz).

Operating 45 ... 200 A Motor Modules in the process industry

For applications **with a constant load**, e.g. in paper machines, rolling mills etc., the current derating can be reduced as a function of the output frequency by reducing the pulse frequency to 2.5 kHz. The vector control mode is especially suitable for these types of applications.

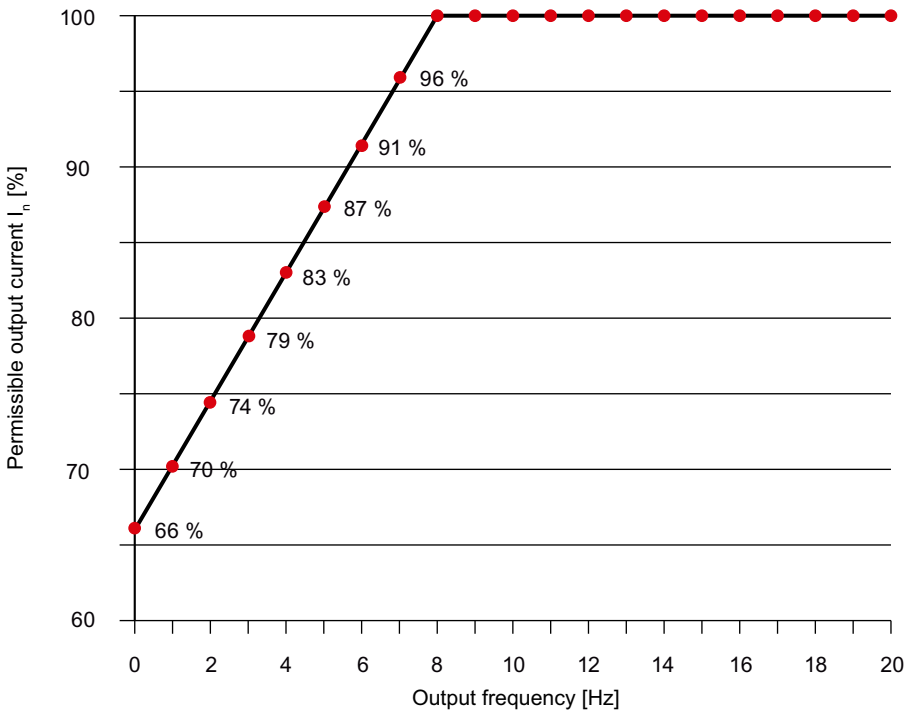


Figure 7-36 Output current of 45 ... 200 Motor Modules at a 2.5 kHz pulse frequency

Note

Information about derating the output current as a function of the ambient temperature and installation altitude is provided in the Chapter "System data (Page 44)".

Motor Modules Booksize Compact

8

8.1 Description

A Motor Module Booksize Compact is a power unit (inverter) that provides the power supply for one motor or several motors. Power is supplied by the DC link of the drive unit. A Motor Module must be connected to a Control Unit via DRIVE-CLiQ. The open-loop and closed-loop control functions for the Motor Module are stored in the Control Unit.

Exactly one motor can be connected to and operated on a Single Motor Module. A Double Motor Module provides two independent power supplies for connection of two motors.

Motor Modules Booksize Compact can be used either with cooling type "internal air cooling" or cooling type "cold plate". The cooling type is selected using parameter p0249 (see SINAMICS S120/S150 List Manual).

Refer to the SINAMICS S120 Equipment Manual "Booksize power units" up to and including Edition 06/2019 for a description on using cold plate cooling.

Note

UL certificate for the Motor Module Booksize Compact

The UL certificate is valid only for cooling method "Internal air cooling".

8.2 Safety instructions for Motor Modules Booksize Compact



⚠ 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 cover 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 cover of the DC link is open

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

- Only operate the components with closed protective cover.



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

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



⚠ WARNING

Electric shock due to missing DC link side covers

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

Electric shock due to incorrectly laid brake cables

If brake cables are laid without safe electrical separation, the insulation can fail and cause an electric shock.

Install the brake in one of the following ways:

- Connect the holding brake with the specified MOTION-CONNECT cable.
- Only use third-party cables with safe electrically separated brake cores or lay the brake cores with safe electrical separation.

⚠ WARNING

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

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 smaller cross-sections are selected, you must ensure the appropriate level of conductor protection in another way, e.g. by suitably setting the control parameters.

NOTICE

Device failure as a result of unshielded or incorrectly routed cables to temperature sensors

Unshielded or incorrectly routed cables to temperature sensors can result in interference being coupled into the signal processing electronics from the power side. This can result in significant disturbance of all signals (fault messages) up to failure of individual components (destruction of the devices).

- Only use shielded cables as temperature sensor cables.
- If temperature sensor cables are routed together with the motor cable, use separately shielded cables twisted in pairs.
- Connect the cable shield to ground potential at both ends through a large surface area.
- Recommendation: Use suitable Motion Connect cables.

NOTICE

Premature wear of the motor holding brake when operated outside its permissible voltage range

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

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

NOTICE

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.

NOTICE

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

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

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

Note

Malfunctions due to polluted DRIVE-CLiQ interfaces

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

- Cover unused DRIVE-CLiQ interfaces with the supplied blanking covers.

Notes for UL applications

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.
- **Additional information**
  Additional information on parameterizing thermal motor models can be found in Chapter "Thermal motor protection" in the SINAMICS S120 Function Manual Drive Functions.

Note

Validity of the UL certificate

The UL certificate is valid only for cooling method "Internal air cooling".

8.3 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:

AUTOHOTSPOT

8.4 Interface description

8.4.1 Overview

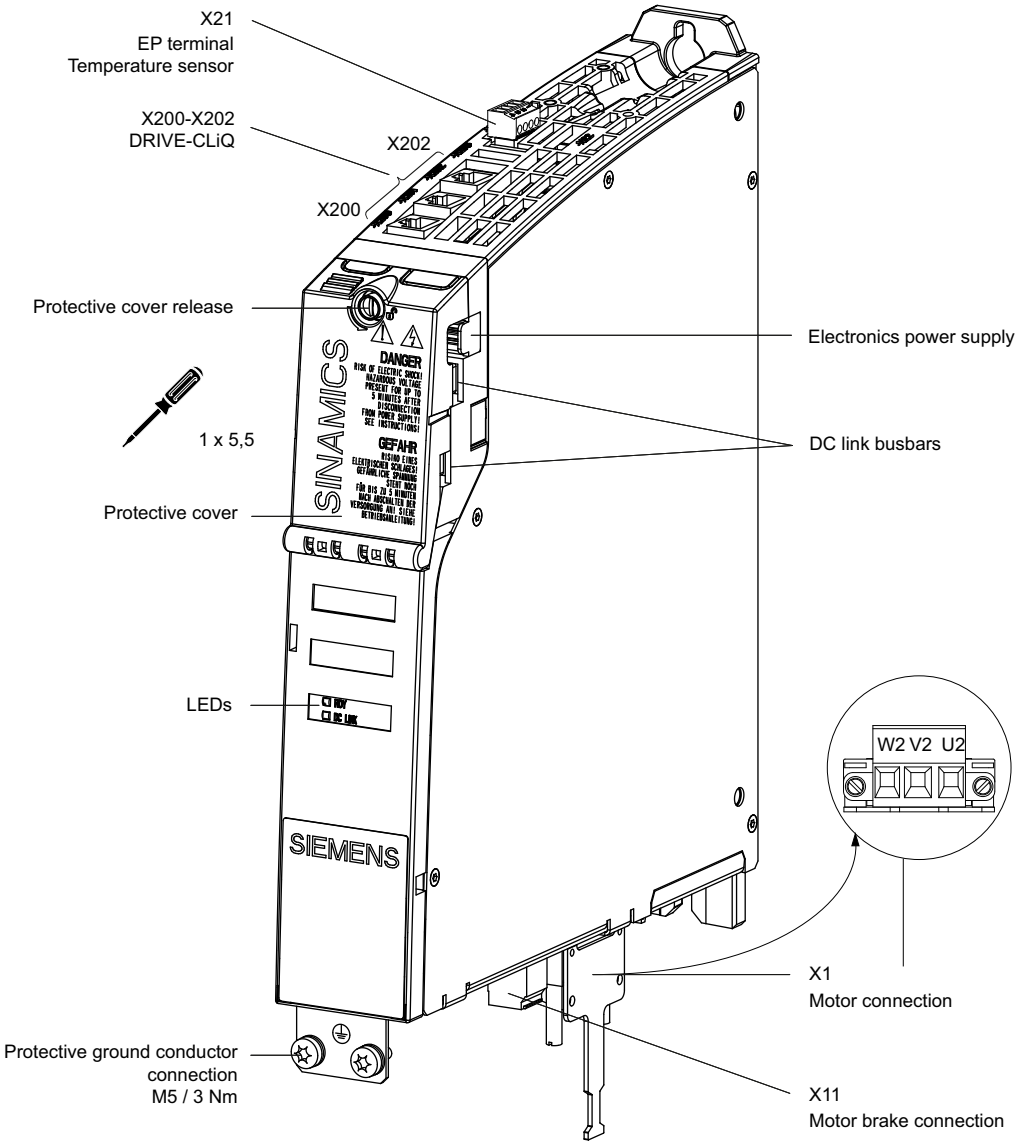


Figure 8-1 Interface overview, Single Motor Module Booksize Compact (example: 5 A)

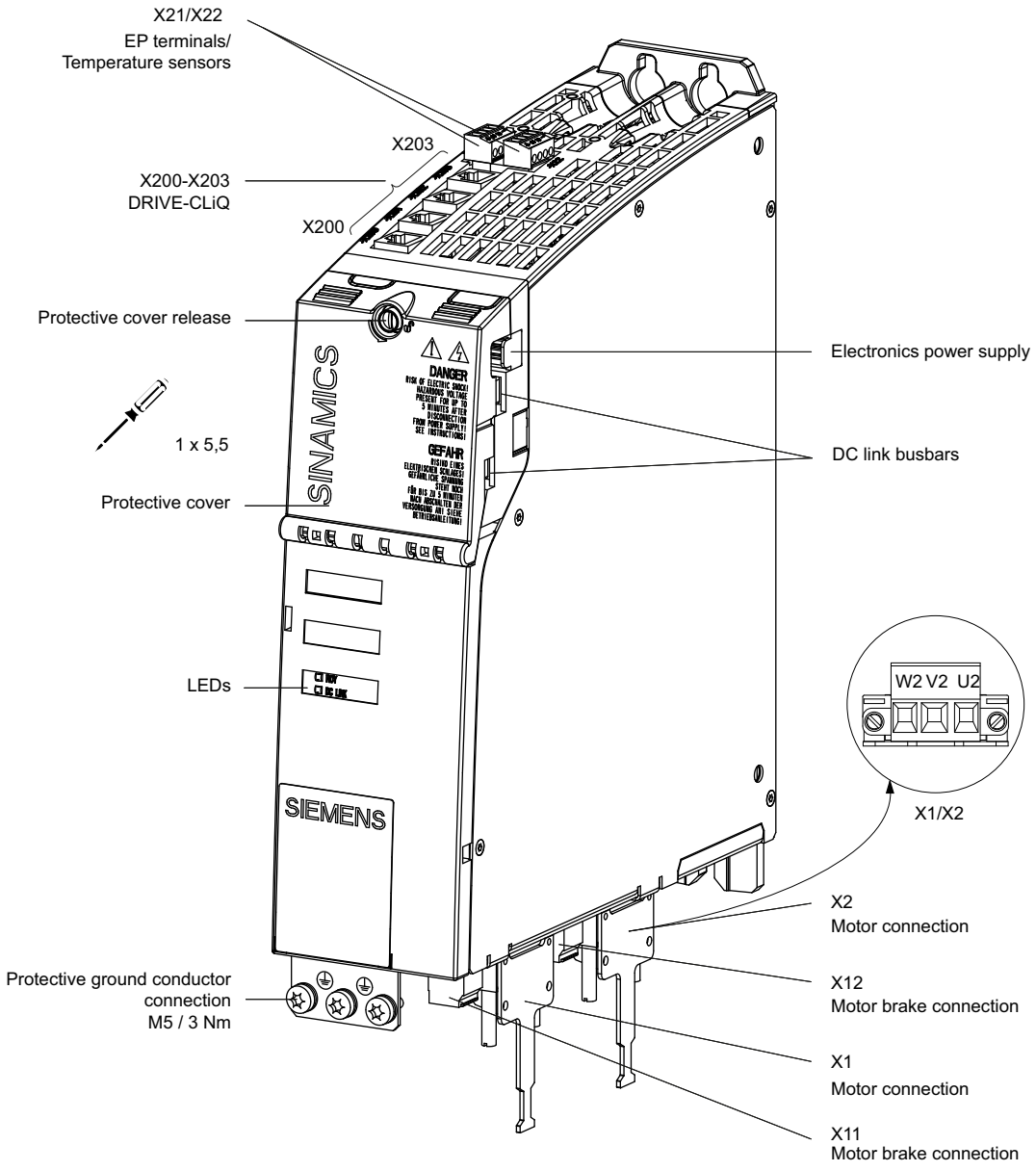
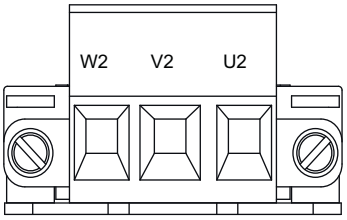
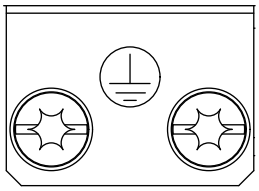
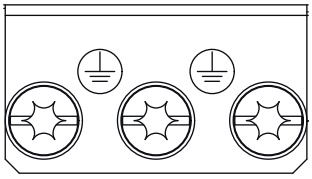


Figure 8-2 Interface overview, Double Motor Module Booksize Compact (example: 2 x 5 A)

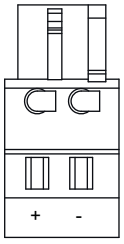
8.4.2 X1/X2 motor connection

Table 8-1 X1/X2 motor connection

	Terminal	Technical specifications
	U2	Type: Screw terminal 5 (Page 486)
	V2	
	W2	
	Protective ground conductor connection	**Single Motor Modules 3 ... 18 A** Threaded hole M5 / 3 Nm (26.6 lbf in)[1)]
		**Double Motor Modules 2 x 1.7 ... 2 x 5 A** Threaded hole M5 / 3 Nm (26.6 lbf in)[1)]
[1)] For ring cable lugs without insulation (Page 487)		

8.4.3 X11/X12 motor brake connection

Table 8-2 X11/X12 motor brake connection

	Terminals	Technical data
	+ (BR+)	Brake connector[1)]:
	- (BR-)	Module output voltage: 24 V DC Max. Load current 2 A Minimum load current 0.1 A Type: Spring-loaded terminal 2 (Page 485) Manufacturer: Wago; Article number: 721-102/026-000/56-000 The brake connector is part of the scope of delivery.

[1)] The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally.

Motor holding brake connection

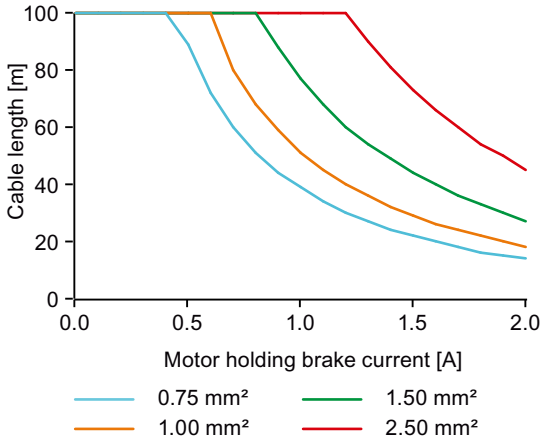
Note

The motor brake must be connected via connector X11 and X12 on Double Motor Modules. It is not permitted to directly connect the cable BR- to the electronics ground M.

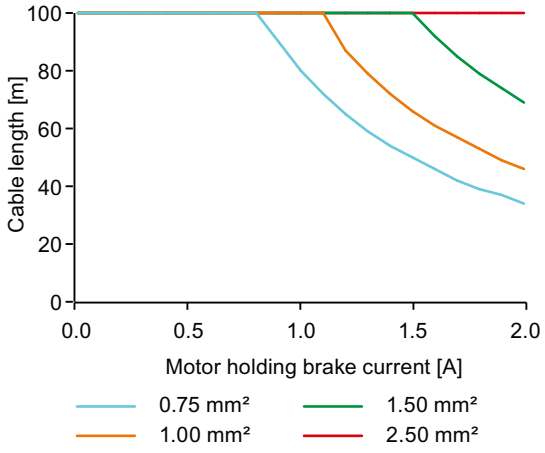
To ensure reliable opening of the motor holding brake, it requires a typical voltage of 24 V ± 10% at the motor connection. Refer to the data sheet of the motor for the motor holding brake voltage and tolerance.

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

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



Module input voltage 24 V



Module input voltage 26 V

Note

Protective circuit against overvoltage

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

⚠ WARNING

Electric shock caused by high touch voltage on brake cables

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

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

NOTICE

Premature wear of the motor holding brake when improperly operated

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

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

NOTICE

Faulty brake function due to inadmissible wear

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

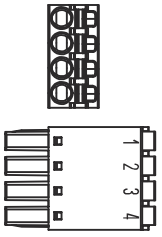
- Comply with the predefined EMERGENCY STOP characteristics.
- Avoid repeated brief acceleration of the motor against a holding brake that is still closed. Consider the operating times of the brakes and the relays in the drive control and enable.

Note

The total length of the power cables (motor feeder cables and DC link cables) must not exceed the values listed in Chapter "Combination options, Line Modules with line reactors and line filters (Page 124)".

8.4.4 X21/X22 EP terminals/temperature sensor

Table 8-3 X21/X22 EP terminals / temperature sensor

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors[1]: Pt1000 / PTC / KTY84-130 / bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (pulse enable)	Supply voltage: 24 V DC (20.4 ... 28.8 V) Current consumption, typical: 4 mA at 24 V Isolated input
	4	EP M1 (enable pulses)	
Type: Spring-loaded terminal 7 (Page 486)			

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

EP terminals

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

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

Note

Function of the EP terminals

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

Temperature sensor connection

NOTICE

Damage to motor in the event of incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats. Overheating can cause damage to the motor.

- Connect the KTY temperature sensor with the correct polarity.

Note

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



⚠ WARNING

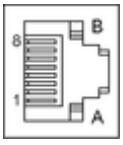
Electric shock when the motor temperature sensor insulation fails

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

- Use motors whose temperature sensors have safe electrical separation.
- Use only connecting cables and connectors with safe electrical separation between the wires of the temperature sensor and the wires 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.

8.4.5 X200-X203 DRIVE-CLiQ interface

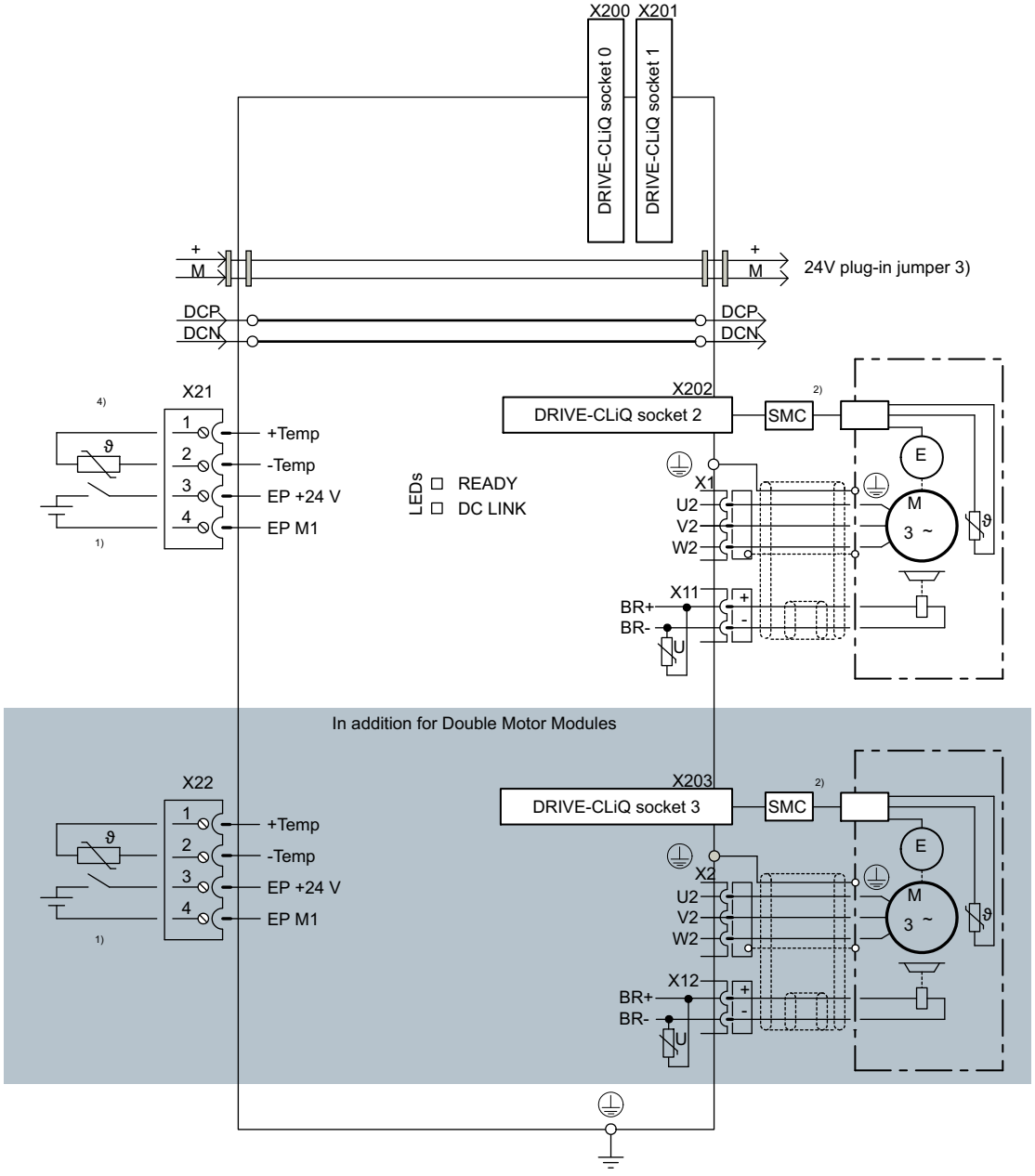
Table 8-4 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules
X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

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

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

Order the missing blanking cover (50 covers) using Article number: 6SL3066-4CA00-0AA0

8.5 Connection example



[1] Required for safety
[2] SMC required for motors without DRIVE-CLiQ interface
[3] 24 V to the next module
[4] Alternative to evaluate the motor temperature

Figure 8-3 Connection example, Single Motor Modules Booksize Compact 3 A to 18 A and Double Motor Modules Booksize Compact 2 x 1.7 A to 2 x 5 A

8.6 Meaning of LEDs

Table 8-5 Meaning of the LEDs on the Motor Module booksize compact

Status		Description, cause	Remedy
RDY	**DC LINK**		
Off	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
Green	–[1)]	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is outside the permissible tolerance range.	Check the line supply voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–[1)]	This component has at least one fault.	Resolve and acknowledge the fault.
Green/red (0.5 Hz)	–[1)]	Firmware is being downloaded.	–
Green/red (2 Hz)	–[1)]	Firmware download has been completed. The system waits for POWER ON.	Carry out a POWER ON.
Green/ orange or red/orange (2 Hz)	–[1)]	Component recognition via LED is activated (p0124=1). **Note:** Whether the LED flashes green/orange or red/orange depends on the status the LED had during activation (setting of parameter p0124 to "1").	–

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

8.7 Dimension drawings

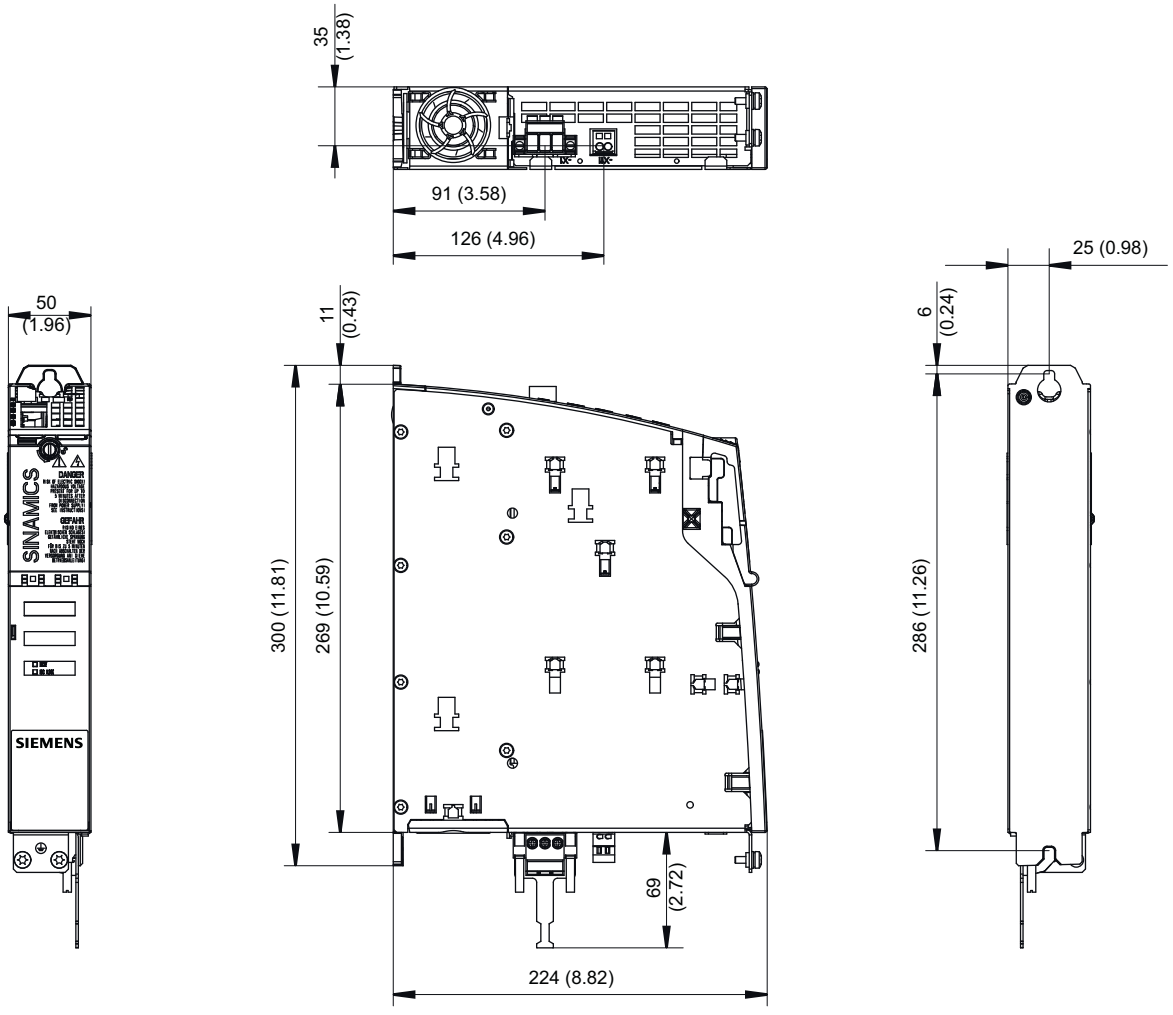


Figure 8-4 Dimension drawing of 3 A, 5 A, and 9 A Motor Modules Booksize Compact, all dimensions in mm and (inches); example: 5 A Single Motor Module

Table 8-6 Motor Modules Booksize Compact 3 A, 5 A, and 9 A

Motor Module	Article No.
Single Motor Module 3 A	6SL3420-1TE13-0AA.
Single Motor Module 5 A	6SL3420-1TE15-0AA.
Single Motor Module 9 A	6SL3420-1TE21-0AA.

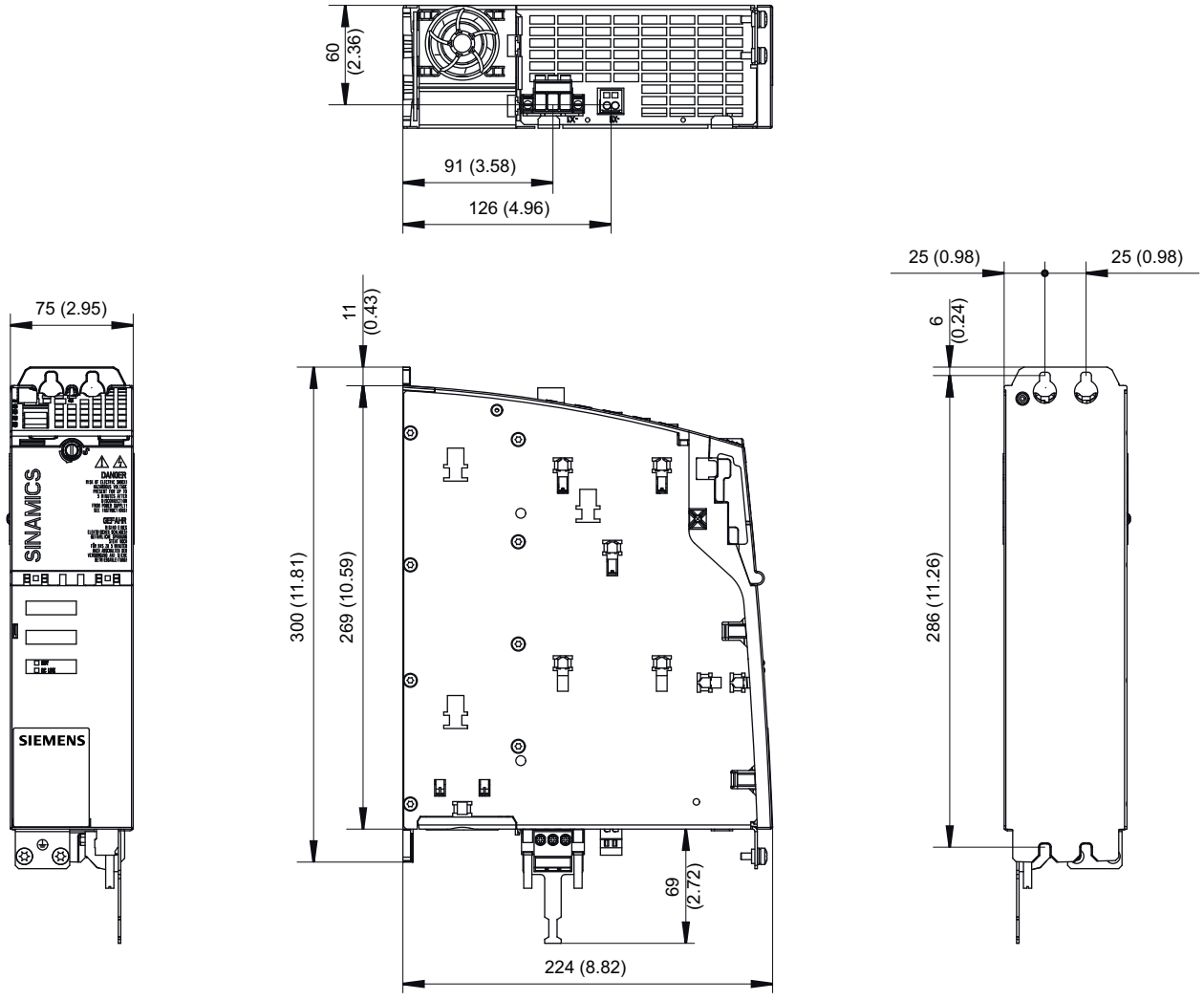


Figure 8-5 Dimension drawing of 18 A Motor Module Booksize Compact, all dimensions in mm and (inches)

Table 8-7 Motor Module Booksize Compact 18 A

Motor Module	Article No.
Single Motor Module 18 A	6SL3420-1TE21-8AA.

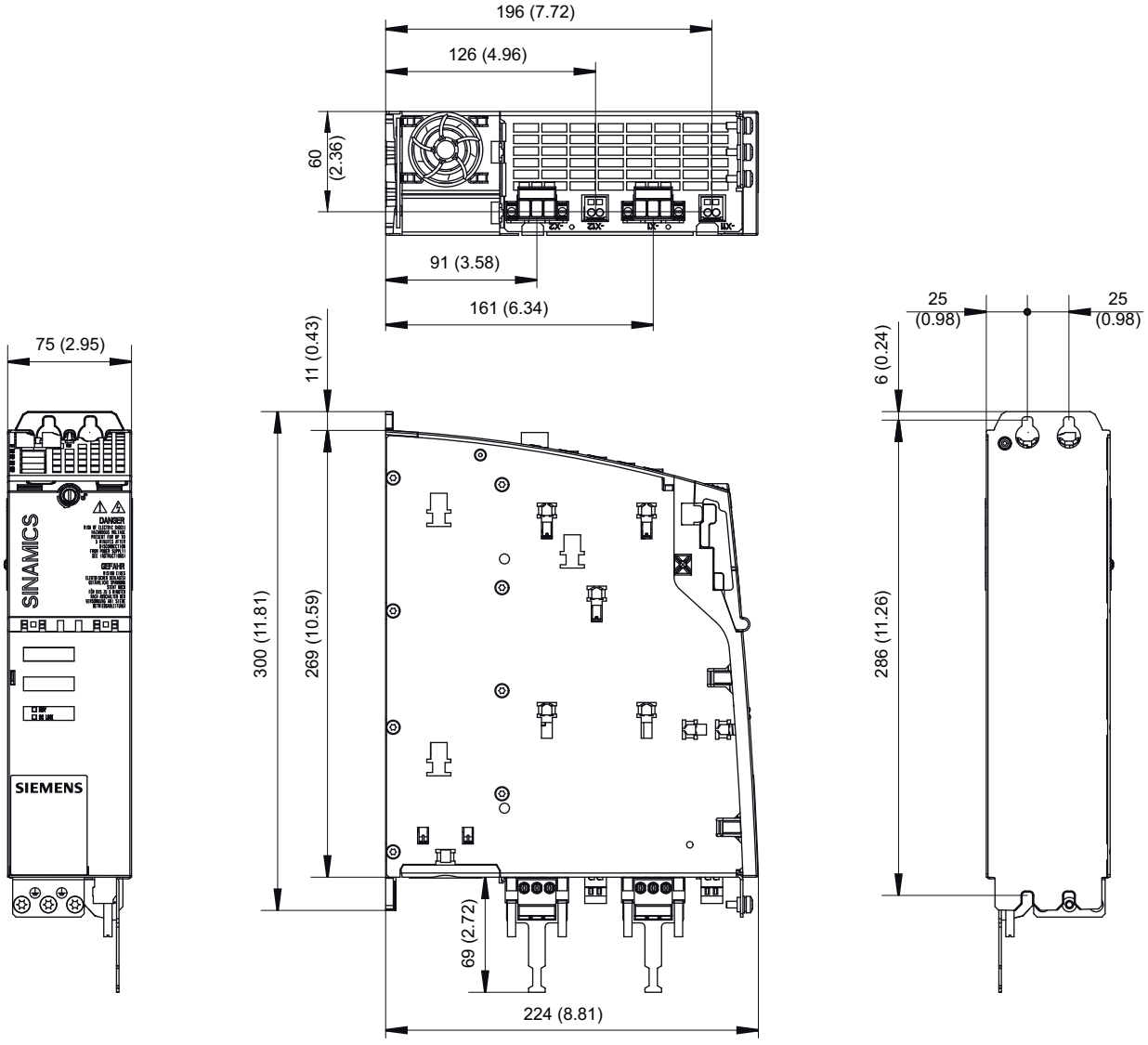


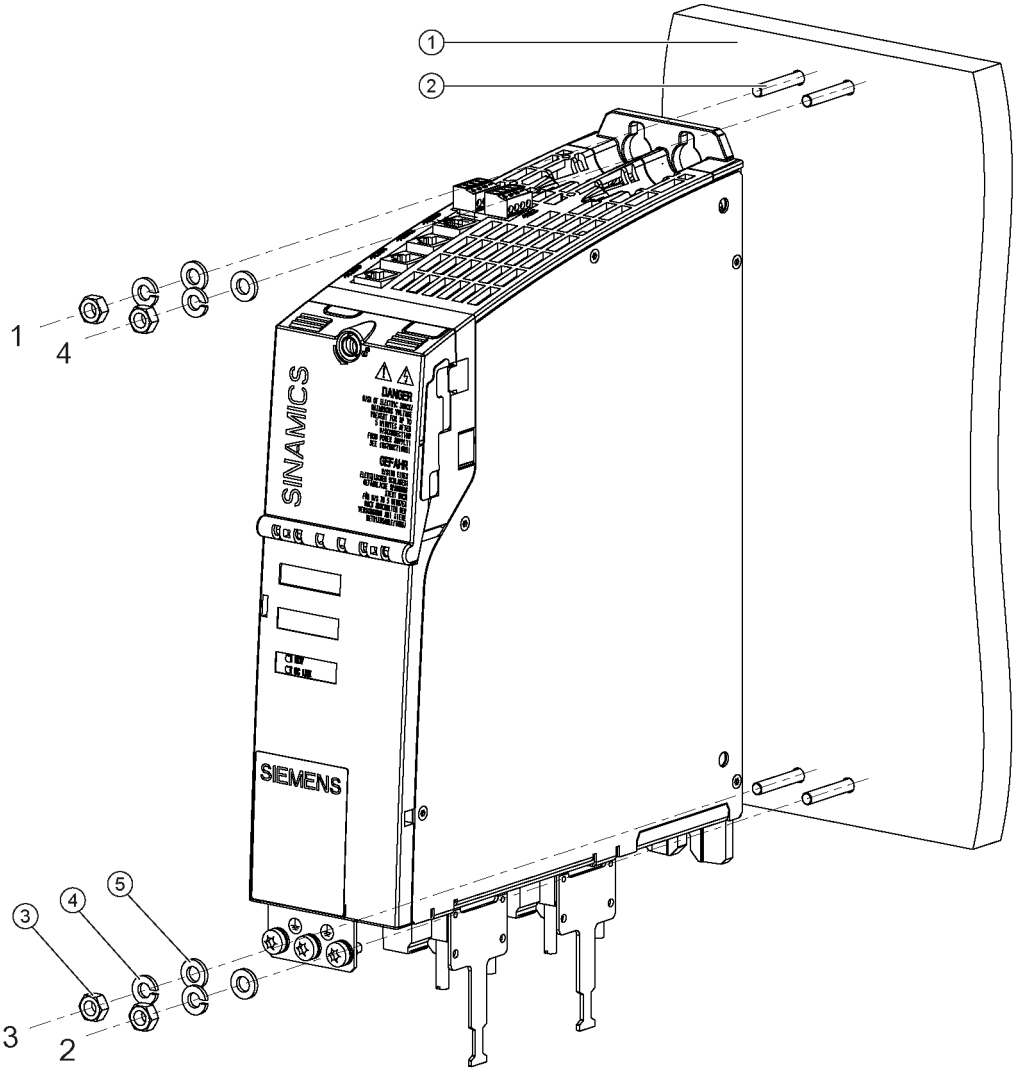
Figure 8-6 Dimension drawing of 2 x 1.7 A, 2 x 3 A, and 2 x 5 A Double Motor Modules Compact, all dimensions in mm and (inches); example: 2 x 5 A Double Motor Module

Table 8-8 2 x 1.7 A, 2 x 3 A, and 2 x 5 A Double Motor Modules Booksize Compact

Double Motor Module	Article No.
2 x 1.7 A Double Motor Module	6SL3420-2TE11-7AA.
2 x 3 A Double Motor Module	6SL3420-2TE13-0AA.
2 x 5 A Double Motor Module	6SL3420-2TE15-0AA.

8.8 Mounting

Mounting a Motor Module Booksize Compact with internal air cooling



① Mounting wall
② Threaded bolts M6
③ M6 nut
④ Spring washer
⑤ Washer

Figure 8-7 Mounting a Motor Module Booksize Compact with internal air cooling

Tightening torques:

1. Firstly, only tighten the nuts by hand.
   Tightening torque: 0.5 Nm (4.4 lbf in)
2. Then tighten the nuts in the specified sequence 1 to 4.
   Tightening torque: 6 Nm (53.1 lbf in)

8.9 Technical data

8.9.1 Single Motor Modules

Table 8-9 Technical specifications Single Motor Modules Booksize Compact (3 A to 18 A)

Motor Modules Booksize Compact	**6SL3420–**	**1TE13-0AA.**	**1TE15-0AA.**	**1TE21–0AA.**	**1TE21–8AA.**
Output current (at 600 V DC)					
Rated current (I_n)	A_{AC}	**3**	**5**	**9**	**18**
Base-load current (I_H)	A	2.6	4.3	7.7	15.3
Intermittent duty current (I_{S6}) 40%	A_{AC}	3.5	6	10	24
Peak current (I_{max})	A_{AC}	9	15	27	54
Output voltage	V_{AC}	0 ... 0.717 x DC link voltage			
Output frequency	Hz	0 ... 550[1)]			
DC link current	A_{DC}	3.6	6	11	22
DC link voltage	V_{DC}	510 ... 720			
Overvoltage trip Undervoltage trip[2)]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %			
DC link capacitance	µF	110	110	110	235
Electronics power supply	V_{DC}	24 (20.4 ... 28.8)			
Electronics current consumption at 24 V DC					
For internal air cooling	A_{DC}	0.85	0.85	0.85	0.85
For cold plate cooling	A_{DC}	0.65	0.65	0.65	0.65
Current-carrying capacity					
DC link busbars	A_{DC}	100	100	100	100
24 V DC busbars	A_{DC}	20	20	20	20
Max. current motor brake	A	2	2	2	2
Unit rating[3)]					
Based on I_n (600 V DC; 4 kHz)	kW	1.6	2.7	4.8	9.7
based on I_H	kW	1.4	2.3	4.1	8.2
Total power loss (including electronics losses, see Power loss tables (Page 503))					
Internal air cooling	W	68 (8 kHz)	98 (8 kHz)	100.4 (4 kHz)	185.4 (4 kHz)
Cold plate internal/external	W	25.6/40	30.6/65	45.6/50	80.6/100
Max. pulse frequency					
without derating	kHz	8	8	4	4
with derating	kHz	16	16	16	16

Motor Modules Booksize Compact	**6SL3420–**	**1TE13-0AA.**	**1TE15-0AA.**	**1TE21–0AA.**	**1TE21–8AA.**
Cooling methods		Internal air cooling Cold plate cooling			
Cooling air requirement with internal air cooling	m^3/h	29.6	29.6	29.6	29.6
Ventilation clearances above/below	mm	≥ 80			
Weight	kg	2.7	2.7	2.7	3.4

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

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

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

8.9.2 Double Motor Modules

Table 8-10 Technical specifications Double Motor Modules Booksize Compact (2 x 1.7 A to 2 x 5 A)

Double Motor Modules Booksize Compact	**6SL3420-**	**2TE11-7AA.**	**2TE13-0AA.**	**2TE15-0AA.**
Output current (at 600 V DC) Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{S6}) 40% Peak current (I_{max})	 A_{AC} A A_{AC} A_{AC}	 **2 x 1.7** 2 x 1.5 2 x 2 2 x 5.1	 **2 x 3** 2 x 2.6 2 x 3.5 2 x 9	 **2 x 5** 2 x 4.3 2 x 6 2 x 15
Output voltage	V_{AC}	0 ... 0.717 x DC link voltage		
Output frequency	Hz	0 ... 550[1]		
DC link current	A_{DC}	4.1	7.2	12
DC link voltage	V_{DC}	510 ... 720		
Overvoltage trip Undervoltage trip[2]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %		
DC link capacitance	µF	165	165	165
Electronics power supply	V_{DC}	24 (20.4 ... 28.8)		
Electronics current consumption at 24 V DC For internal air cooling For cold plate cooling	 A_{DC} A_{DC}	 1.15 0.9	 1.15 0.9	 1.15 0.9
Current-carrying capacity DC link busbars 24 V DC busbars	 A_{DC} A_{DC}	 100 20	 100 20	 100 20
Max. current motor brake	A	2 x 2	2 x 2	2 x 2
Unit rating[3] Based on I_n (600 V, 8 kHz) Based on I_H	 kW kW	 2 x 0.9 2 x 0.8	 2 x 1.6 2 x 1.4	 2 x 2.7 2 x 2.3
Total power loss (including electronics losses, see Power loss tables (Page 503)) Internal air cooling Cold plate internal/external	 W W	 114 (8 kHz) 42/72	 134 (8 kHz) 44/90	 194 (8 kHz) 59/135

Double Motor Modules Booksize Compact	6SL3420-	2TE11-7AA.	2TE13-0AA.	2TE15-0AA.
Max. pulse frequency without derating with derating	 kHz kHz	 8 16		
Cooling methods		Internal air cooling with mounted fan Cold plate cooling		
Cooling air requirement with internal air cooling	m^3/h	29.6	29.6	29.6
Ventilation clearances above/below	 mm	 ≥ 80		
Weight	kg	3.4	3.4	3.4

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

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

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

8.10 Characteristics

Rated duty cycles Motor Modules Booksize Compact

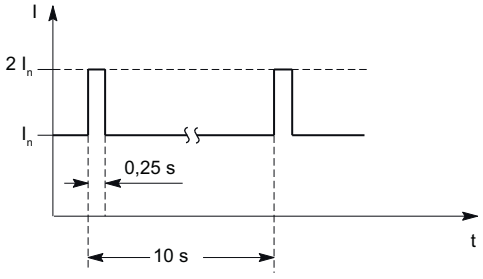


Figure 8-8 Duty cycle with initial load

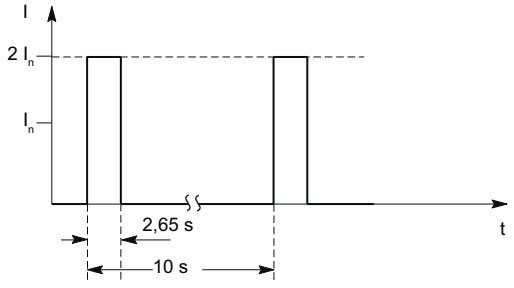


Figure 8-9 Duty cycle without initial load

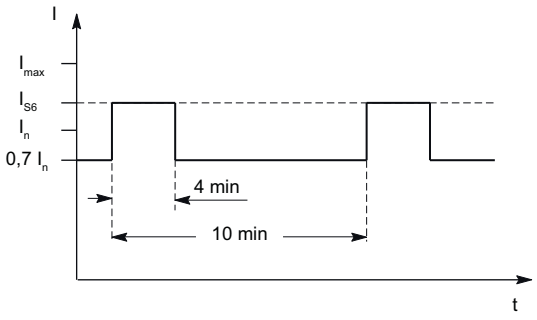


Figure 8-10 S6 duty cycle with initial load for a duty cycle duration of 600 s

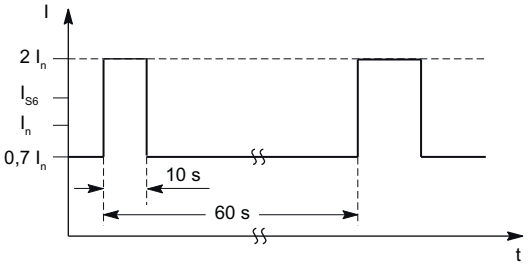


Figure 8-11 S6 duty cycle with initial load for a duty cycle duration of 60 s

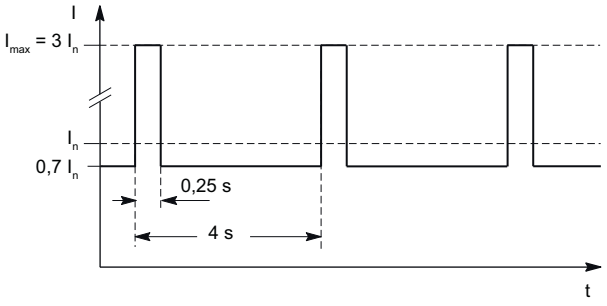


Figure 8-12 Peak current duty cycle with initial load

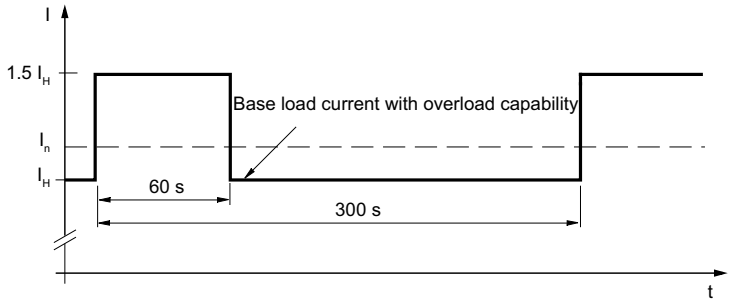


Figure 8-13 Duty cycle with 60 s overload for a duty cycle duration of 300 s

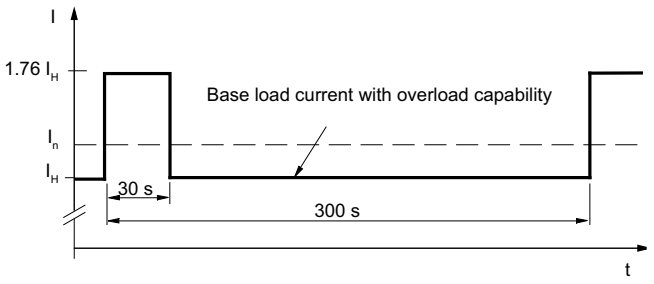


Figure 8-14 Duty cycle with 30 s overload for a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize Compact

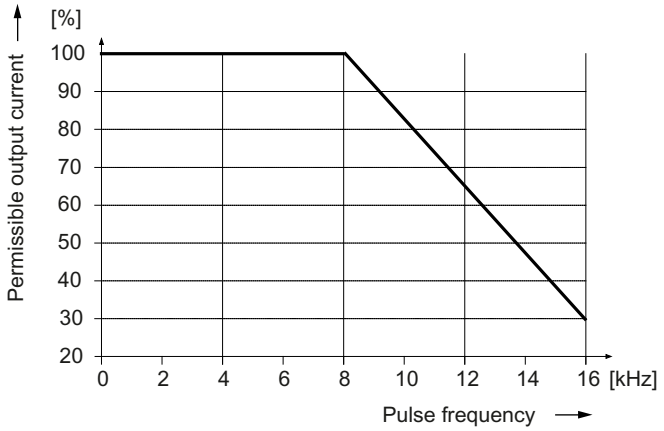


Figure 8-15 Output current as a function of the pulse frequency for the Motor Module ≤ 5 A

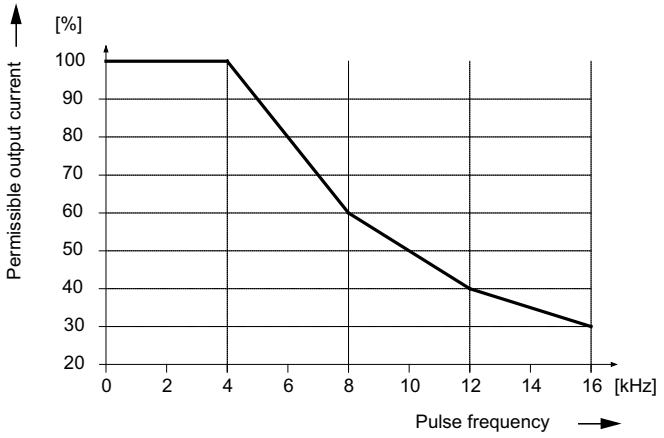


Figure 8-16 Output current as a function of the pulse frequency for the Motor Module ≥ 9 A

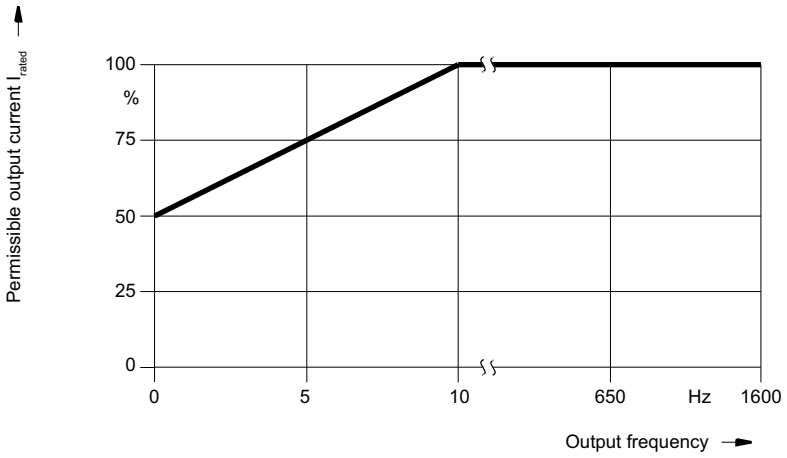


Figure 8-17 Output current at low frequencies

Dimensioning notes

- A current derating is only applicable for output frequencies < 10 Hz.
- Current derating should be taken into account if the percentage time of operation at frequencies < 10 Hz is more than 2 % of the daily total operating time.
- Also during load cycles, the current specified here must not be exceeded.
- When quickly passing through frequencies 0 to 10 Hz, derating does not have to be taken into account (e.g. for positioning applications).

Note

Information about derating the output current as a function of the ambient temperature and installation altitude is provided in Chapter "System data (Page 44)".

DC link components

9

9.1 Description

In the S120 drive line-up, in addition to Line and Motor Modules, DC link components are also installed and connected to the other components via the DC link.

Component	Function
• Braking Modules or Braking Modules Compact	Stopping the drives when the line supply fails and limiting the DC link voltage
• Braking units for 100 kW Basic Line Modules	External braking unit, which when using 100 kW BLMs, together with a braking resistor ensures that when the line supply fails, the drives are stopped and the DC link voltage is limited.
• 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 CSM requires its own dedicated AC supply when starting.

9.2 Safety instructions for DC link components



⚠ WARNING

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

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

- Only operate the components with closed protective cover.



⚠ 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.

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

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



⚠ WARNING

Electric shock due to missing DC link side covers

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

High leakage currents when the protective conductor in the line feeder cable is interrupted

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

- Carefully comply with the applicable regulations for dimensioning the protective conductor (see Chapter "Protective connection and equipotential bonding (Page 492)").

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

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

- Cover unused DRIVE-CLiQ interfaces with the supplied blanking covers.

9.3 Braking Module Booksize

9.3.1 Description

The Braking Module Booksize is always used together with an external braking resistor. It has the following tasks:

- Controlled stop of the drives in the event of a power failure (e.g. emergency retraction or EMERGENCY OFF Category 1)
- Limiting of DC-link voltage for brief periods of generator operation (e.g. if the regenerative feedback capability of the Line Module is deactivated, not adequately dimensioned, or restricted due to brief line interruption)

The Braking Module includes the necessary power electronics and control. When the Braking Module is in operation, the power which is fed back into the DC link is dissipated via an external braking resistor.

External braking resistors

Braking resistors without thermostatic switch 6SN1113-1AA00-0DA0 (P_N = 0.3 kW) and 6SL3100-1BE31-0AA1 (P_N = 1.5 kW) can be operated at the Braking Module Booksize.
The cable lengths between the Braking Module and braking resistor is limited to a maximum of 10 m.
The scope of delivery of the braking resistor 6SN1113-1AA00-0DA0 includes a shielded connection cable (3 m, 3 x 1.5 mm^2).

Rapid discharge

Furthermore, the Braking Module Booksize can used with a braking resistor to quickly discharge the DC link capacitors The DC link is discharged in a controlled manner via the braking resistor once the infeed unit has been switched off and the line-up has been disconnected from the line supply (e.g. via the main switch or line contactor). The function can be activated via a digital input on the Braking Module. A quick discharge makes sense, for example, when maintenance tasks are to be performed at the Motor Module and/or motor installation (reduction of the discharge time).



⚠ WARNING

Electric shock when live parts are touched after a rapid discharge

On completion of quick discharge, a voltage of 30 V is still present at the DC link. If the fast discharge is interrupted before it has been completed, then this voltage can be more than 60 V. Touching live components can result in death or severe injury.

- Check the DC link to ensure that it is in a no voltage state before starting any work.

NOTICE
Damage to equipment or motors in the event of rapid discharge For a fast discharge, the Motor Module or the connected motors can be damaged. • Ensure that all permanently excited synchronous motors are at a complete standstill, and that the drive system is completely disconnected from the supply system before activating the rapid discharge.

Monitoring functions

- Automatic detection of braking resistors and braking power monitoring
- I^2t monitoring of the braking resistors.
- Temperature monitoring of the Braking Module
- Short circuit and overload detection
- Ground fault detection

9.3.2 Safety instructions for Braking Modules Booksize

NOTICE
Device failure as a result of unshielded or incorrectly routed cables to braking resistors Unshielded or incorrectly routed cables to braking resistors can result in interference being coupled into the signal processing electronics from the power side. This can result in significant disturbance of all signals (fault messages) up to failure of individual components (destruction of the devices). • Only use shielded cables for cables to braking resistors.

NOTICE
Danger to life through the use of non-approved braking resistors Braking resistors can be damaged when using braking resistors other than those specified in this Manual. • Only use braking resistors approved by Siemens.

9.3.3 Interface description

9.3.3.1 Overview

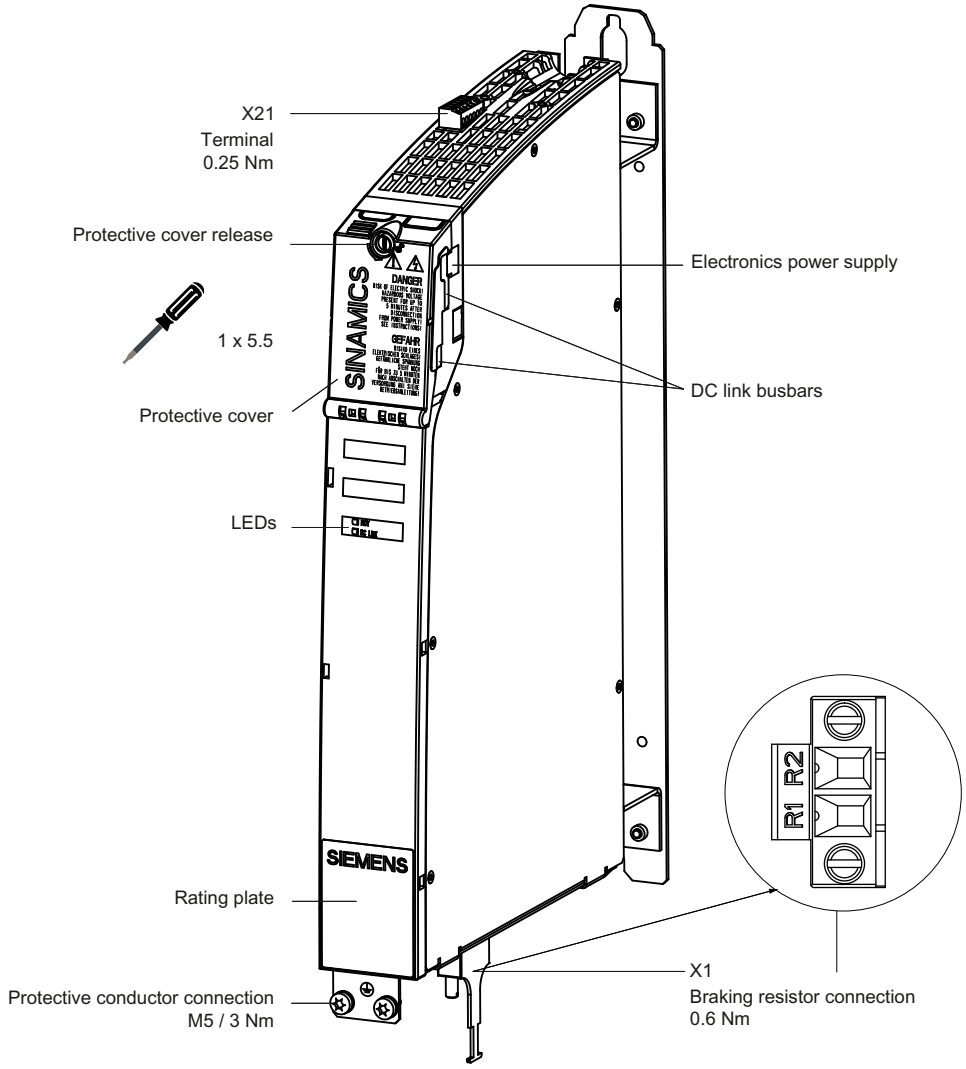


Figure 9-1 Interface overview, Braking Module Booksize

9.3.3.2 X1 braking resistor connection

Table 9-1 X1 braking resistor connection

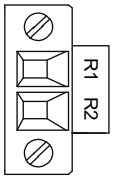
	Terminal	Function	Technical specifications
	1	Braking resistor connection R1	Continuously short-circuit proof
	2	Braking resistor connection R2	
Type: Screw terminal 4 (Page 486)			

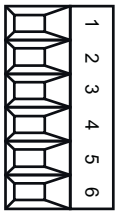
Table 9-2 Braking resistors without a thermostatic switch for Braking Modules

Braking resistor	R in Ω	P_{rated} in kW	P_{max} in kW
6SN1113-1AA00-0DA0	17	0.3	25
6SL3100-1BE31-0AA1	5.7	1.5	100

For detailed technical information on the braking resistors, see the section entitled Braking resistors (Page 327).

9.3.3.3 X21 digital inputs/outputs

Table 9-3 X21 digital inputs/outputs

	Terminal	Function[1)]	Technical data
	1	DI low: Enable Braking Module DI high: Inhibit/acknowledgement Edge change, high → low: fault acknowledgement	Voltage: -3 ... +30 V Typical current drain: 10 mA at 24 V DC Level (incl. ripple) High level: 15 ... 30 V Low level: -3 ... +5 V
	2	DI low: braking resistor, not controlled manually DI high: Braking resistor controlled manually (quick discharge)[2)]	
		If X21.1 and X21.2 are activated simultaneously, the Braking Module inhibit has priority.	
	3	DO high: no prewarning DO low: Prewarning, disconnection imminent	Voltage: 24 V DC (20.4 ... 28.8 V) Load current per output: ≤ 100 mA Continuous short-circuit-proof
	4	DO high: ready for operation, no fault DO low: Fault	
	5	Ground	
	6		
Type: Screw terminal 1 (Page 486)			

1) DI: digital input; DO: digital output; M: Electronics ground

2) The "fast discharge function" is used for discharging the capacitors in the DC link after the line supply has been interrupted. It may only be used a maximum of once or twice per week.

Terminal X21.1 - inhibit/acknowledge

Applying a high signal to terminal X21.1 inhibits the Braking Module. Fault messages that are available are acknowledged with a falling edge.

Terminal X21.3 - prewarning

When a prewarning is sent, disconnection of the braking module is imminent. This may be due to the following causes:

- The temperature of the Braking Module is 80 % of the maximum value.
- 80 % of the maximum switch on duration of the braking resistor has been reached (I^2t monitoring).
- 80 % of the maximum braking energy of the braking resistor has been reached.
- An incorrect braking resistor is connected (only braking resistors approved by Siemens for this component are automatically identified).

Terminal X21.4 - fault

The fault can have the following causes:

- Electronic power supply is missing or outside permissible tolerance range
- Enable missing (input terminal)
- Overtemperature
- Overcurrent trip
- I^2t monitoring has responded.
- Ground fault/short-circuit

In the event of an overtemperature, the fault can only be acknowledged with X21.1 = high after a cooling-down time.



⚠ WARNING

Electric shock due to hazardous voltage at terminals X21

Hazardous voltages can be present at terminals X21 in the case of a fault. Touching live components can result in death or severe injury.

- Only connect protective extra low voltages at terminals X21.

9.3.4 Connection example

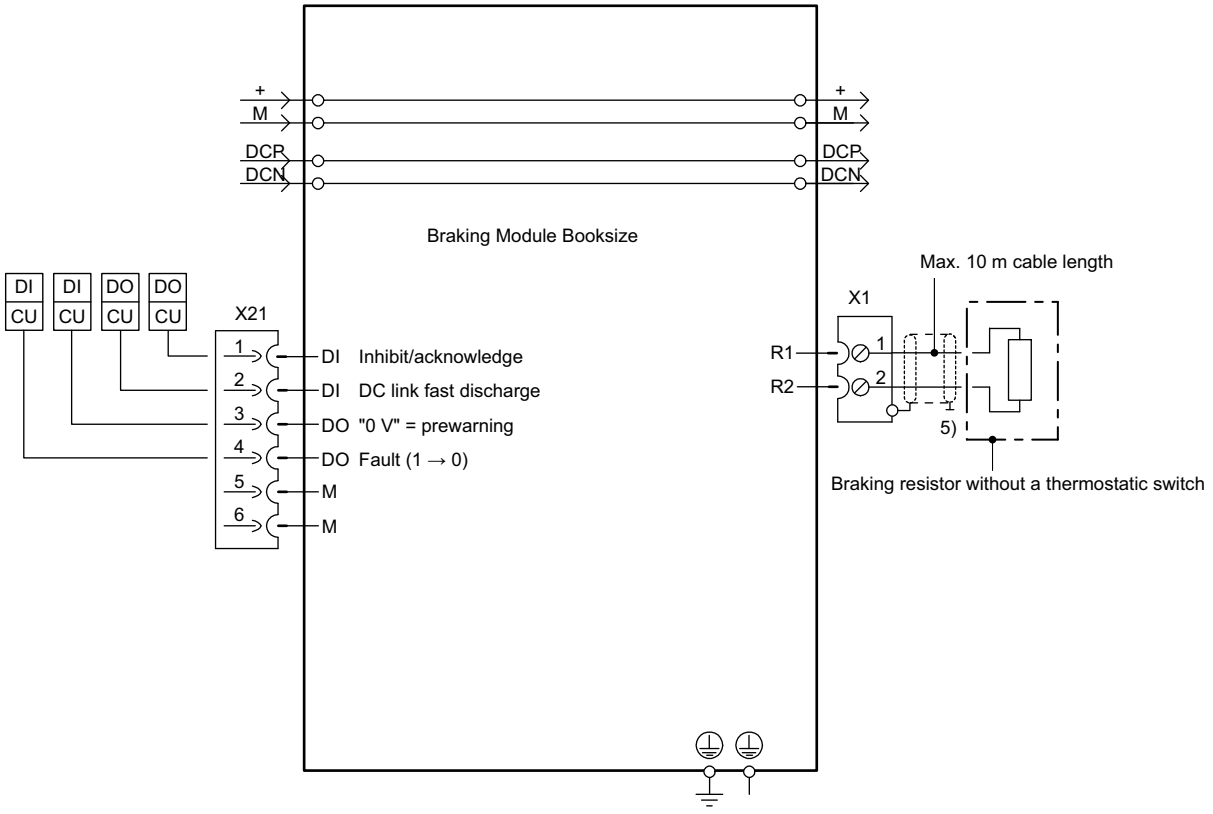


Figure 9-2 Connection example of a Braking Module Booksize

Information on how to parameterize the digital inputs or digital outputs, see the SINAMICS S120/S150 List Manual.

9.3.5 Meaning of LEDs

Table 9-4 Meaning of the LEDs on the Braking Module Booksize

LED	Color	Status	Description, cause	Remedy
READY	-	Off	The electronics power supply is missing or outside the permissible tolerance range. The component is deactivated via terminal.	–
	Green	Continuous light	The component is ready for operation.	–
	Red	Continuous light	Enable missing (input terminal) Overtemperature Overcurrent trip I^2t monitoring activated Ground fault/short circuit **Comment:** In the event of an overtemperature, the error cannot be acknowledged until after a cooling down time has elapsed.	Troubleshoot the fault using the output terminals and acknowledge it using the input terminal.
DC LINK	-	Off	Only braking resistors approved by Siemens for this component are identified automatically. The component is not active.	–
	Green	Flashing light	The component is active (DC link is being discharged via the braking resistor).	–

9.3.6 Dimension drawing

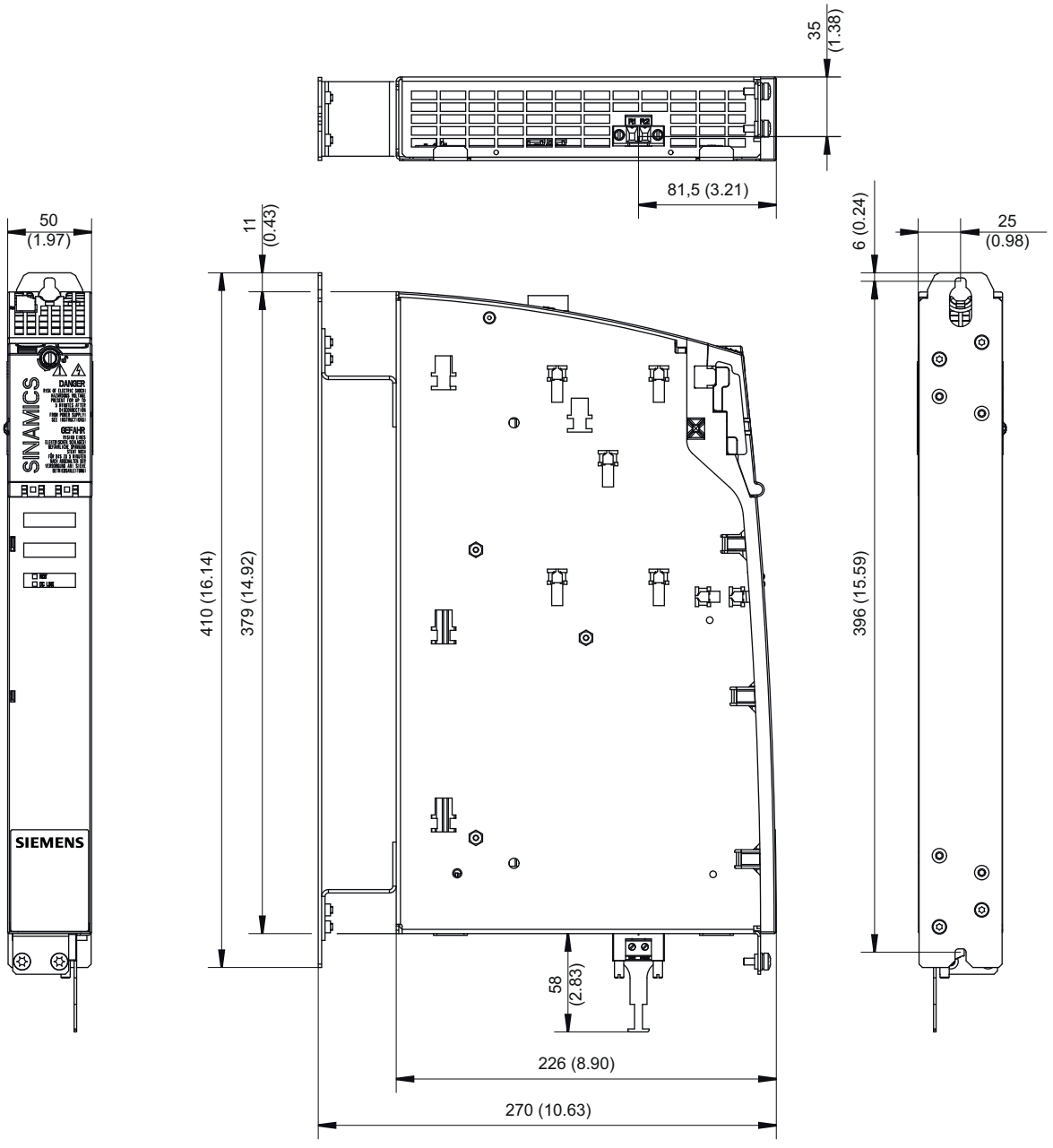
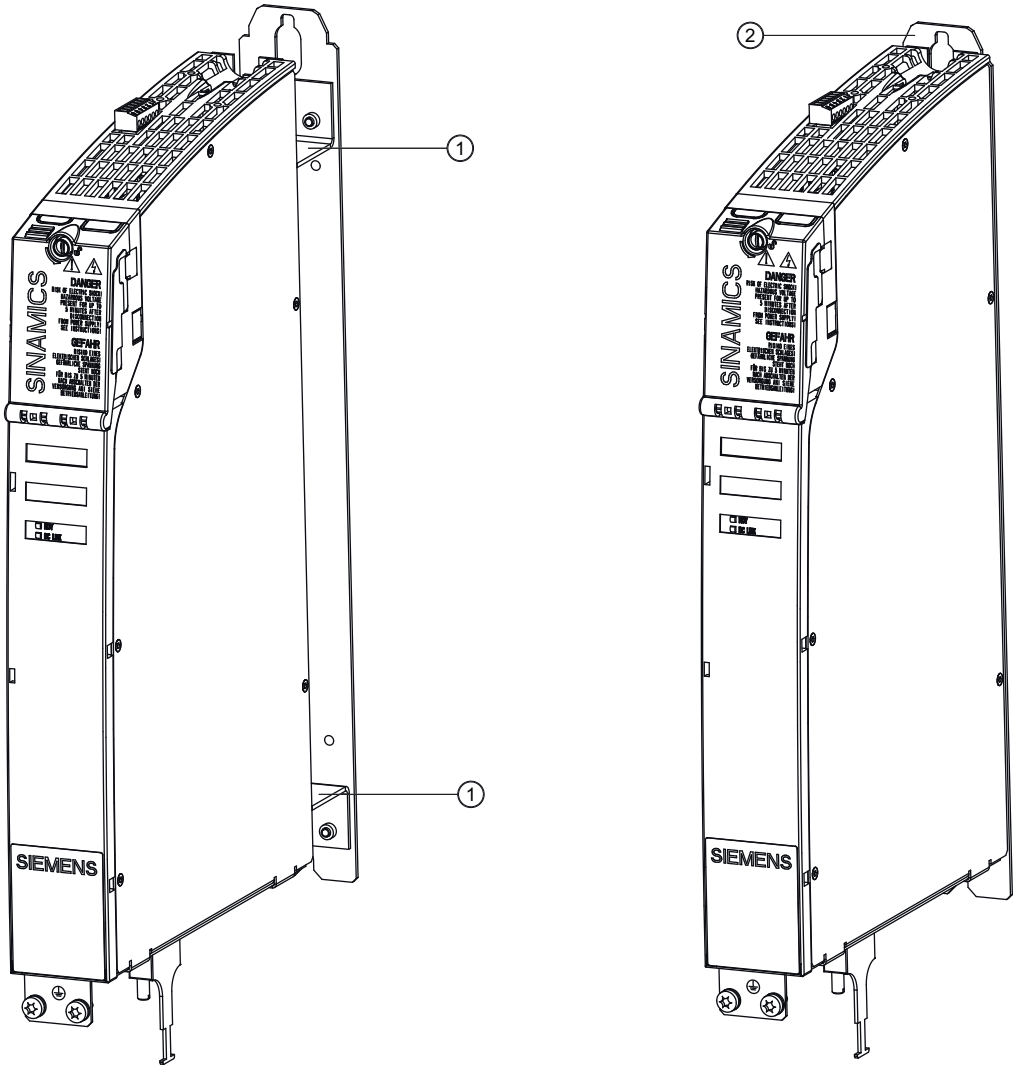


Figure 9-3 Dimension drawing of Braking Module, all dimensions in mm and (inches)

9.3.7 Installation



① Delivery condition with spacer - mounting depth for drive line-up in booksize format with internal air cooling
② Spacer removed - mounting depth for drive line-up in booksize format with external air cooling

Figure 9-4 Methods of installing Braking Modules with/without spacer elements

9.3.8 Technical data

Table 9-5 Technical data

6SL3100-1AE31-0A..		
DC link voltage	V_{DC}	510 ... 720
DC link capacitance	µF	110

6SL3100-1AE31-0A..		
ON threshold	V	770
Electronics power supply	V_{DC}	24 (20.4 ... 28.8)
Electronics current consumption (at 24 V DC)	A_{DC}	0.5
Current carrying capacity DC link busbars 24 V busbars	 A_{DC} A_{DC}	 100 20
Braking power Maximum continuous braking power	 kW kW	 100 1.5
Power loss (see power loss tables (Page 503))	W	20
Cooling method		Natural convection
Ventilation clearances (above/below)	mm	≥ 80
Max. ambient temperature	°C	55 (without derating)
Weight	kg	4.1

9.3.8.1 Characteristic curves

Duty cycle for braking resistors without a thermostatic switch

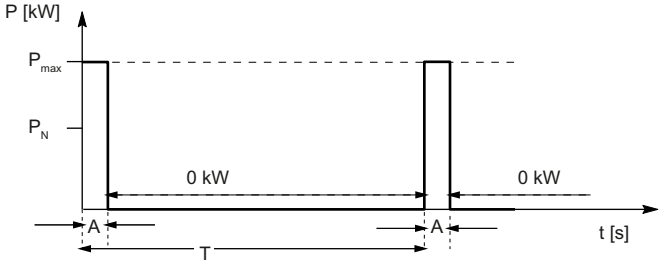


Figure 9-5 Duty cycle for braking resistors without a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

P_{rated} [kW] rated power (continuous power) of the braking resistor

P_{max} [kW] peak braking power of the braking resistor

Table 9-6 Duty cycles

	6SN1113-1AA00-0DA0		**6SL3100-1BE31-0AA.**	
	Short duty cycle	Long duty cycle	Short duty cycle	Long duty cycle
A [s]	0.1	0.4	1	2
T [s]	11.5	210	68	460

9.3.9 Configuration instructions

DC link capacitance

To operate Braking Modules, a minimum capacitance of 440 µF is required in the DC link for each Braking Module.

The capacitance of the Braking Module of 110 µF is included in the total capacitance value.

Note

Only the components that are connected to each other via the DC link busbar can be included in the total capacitance.

DC link cable

In a multi-row or distributed drive line-up, the DC links are connected to each other via a DC link cable. When using a Braking Module in the drive line-up, this cable must not be longer than 10 m. The DC link cable must be twisted and have a minimum cross-section of at least 10 mm^2.

Parallel connection

The Braking Module Booksize Compact 6SL3400-1AE31-0AA. Is recommended for connecting Braking Modules in series.

Connecting Braking Modules 6SL3100-1AE31-0A.. in parallel should be avoided, as it cannot be guaranteed that the power will be evenly divided between the modules.

Note

When Braking Modules are connected in parallel, the DC link capacitance specified above must be available for each Braking Module.

9.4 Braking Module Booksize Compact

9.4.1 Description

The Braking Module Booksize Compact is always used together with a braking resistor. It has the following tasks:

- Controlled stop of the drives in the event of a power failure (e.g. emergency retraction or EMERGENCY OFF Category 1).
- Limiting of DC link voltage for brief periods of generator operation (e.g. if the energy recovery capability of the Line Module is deactivated, not adequately dimensioned, or restricted due to brief line interruption)

The Braking Module includes the necessary power electronics and control. When the module is in operation, the power which is fed back into the DC link is dissipated via an external braking resistor.

The Braking Module can be operated on 200 V or 400 V line supply systems; the 4-pin DIP switch on the top of the module is used to select which one applies in each case. The factory setting is 400 V.

When spacers (6SL3462-1CC00-0AA0) are used, the Braking Module Booksize Compact can be integrated into a drive line-up in booksize format with internal air cooling.

External braking resistors

Braking resistors with or without a thermostatic switch can be used with the Braking Module Booksize Compact (List of braking resistors that can be connected (Page 286)). The DIP switch sets the type of braking resistor being used in each case. The factory setting is "braking resistor with a thermostatic switch".

The cable length between the Braking Module and the braking resistor is limited to 10 m.

Rapid discharge

Furthermore, the Braking Module Booksize Compact can be used with a braking resistor to quickly discharge the DC link. The DC link is discharged in a controlled manner via the braking resistor once the infeed unit has been switched off and the line-up has been disconnected from the line supply (e.g. via the main switch or line contactor). The function can be activated via a digital input on the Braking Module. A quick discharge makes sense, for example, when maintenance tasks are to be performed at the Motor Module and/or motor installation (reduction of the discharge time).

NOTICE

Damage to the Motor Module or connected motors for a fast discharge

For a fast discharge, the Motor Module or the connected motors can be damaged.

- For a rapid discharge, fully disconnect the drive system from the line supply.
- The motors must be at a standstill.



⚠ WARNING

Electric shock when live parts are touched after a rapid discharge

On completion of quick discharge, a voltage of 30 V is still present at the DC link. If the fast discharge is interrupted before it has been completed, then this voltage can be more than 60 V. Touching live components can result in death or severe injury.

- Check the DC link to ensure that it is in a no voltage state before starting any work.

Cooling methods

The Braking Module Booksize Compact can be operated with the following cooling methods:

- Internal air cooling
- Cold plate cooling (refer to the SINAMICS S120 Equipment Manual "Booksize power units" up to and including Edition 06/2019 for a description on using cold plate cooling)

The required cooling method is set using the DIP switch The factory setting is "internal air cooling".

Internal fan

When the Braking Module is being used with internal air cooling, the internal fan starts up immediately and is subsequently controlled by the temperature.

If the DIP switch is set to cold plate cooling by mistake, the fan will still start up when a certain temperature threshold is reached, in order to prevent the Braking Module shutting down due to overtemperature. If this threshold is exceeded, an alarm is issued via the digital output "Prewarning". This ensures that an emergency stop can be performed if necessary.

Monitoring functions

- Automatic detection of braking resistors without thermostatic switch and corresponding braking power monitoring (only if the "Braking resistor without thermostatic switch" setting is used)
- I^2t monitoring of the Braking Module
- Temperature monitoring of the Braking Module
- Temperature monitoring of the connected braking resistor with thermostatic switch (only for setting "Braking resistor with thermostatic switch")
- Short-circuit and overload detection (for all braking resistors)
- Ground fault detection (for all braking resistors)

Parallel operation

Several Braking Modules Booksize Compact can be connected in parallel to increase the braking power. In this case, the braking energy is divided between the modules. Formulas for calculating the parallel connection are given in Chapter Notes on configuration (Page 297).

A parallel connection of the Braking Module Booksize Compact to SINAMICS S120 Basic Line Modules 20 kW and 40 kW is also possible.

9.4.2 Safety instructions for Braking Modules Booksize Compact

NOTICE

Device failure as a result of unshielded or incorrectly routed cables to braking resistors

Unshielded or incorrectly routed cables to braking resistors can result in interference being coupled into the signal processing electronics from the power side. This can result in significant disturbance of all signals (fault messages) up to failure of individual components (destruction of the devices).

- Only use shielded cables for cables to braking resistors.

NOTICE

Danger to life through the use of non-approved braking resistors

Braking resistors can be damaged when using braking resistors other than those specified in this Manual.

- Only use braking resistors approved by Siemens.

9.4.3 Interface description

9.4.3.1 Overview

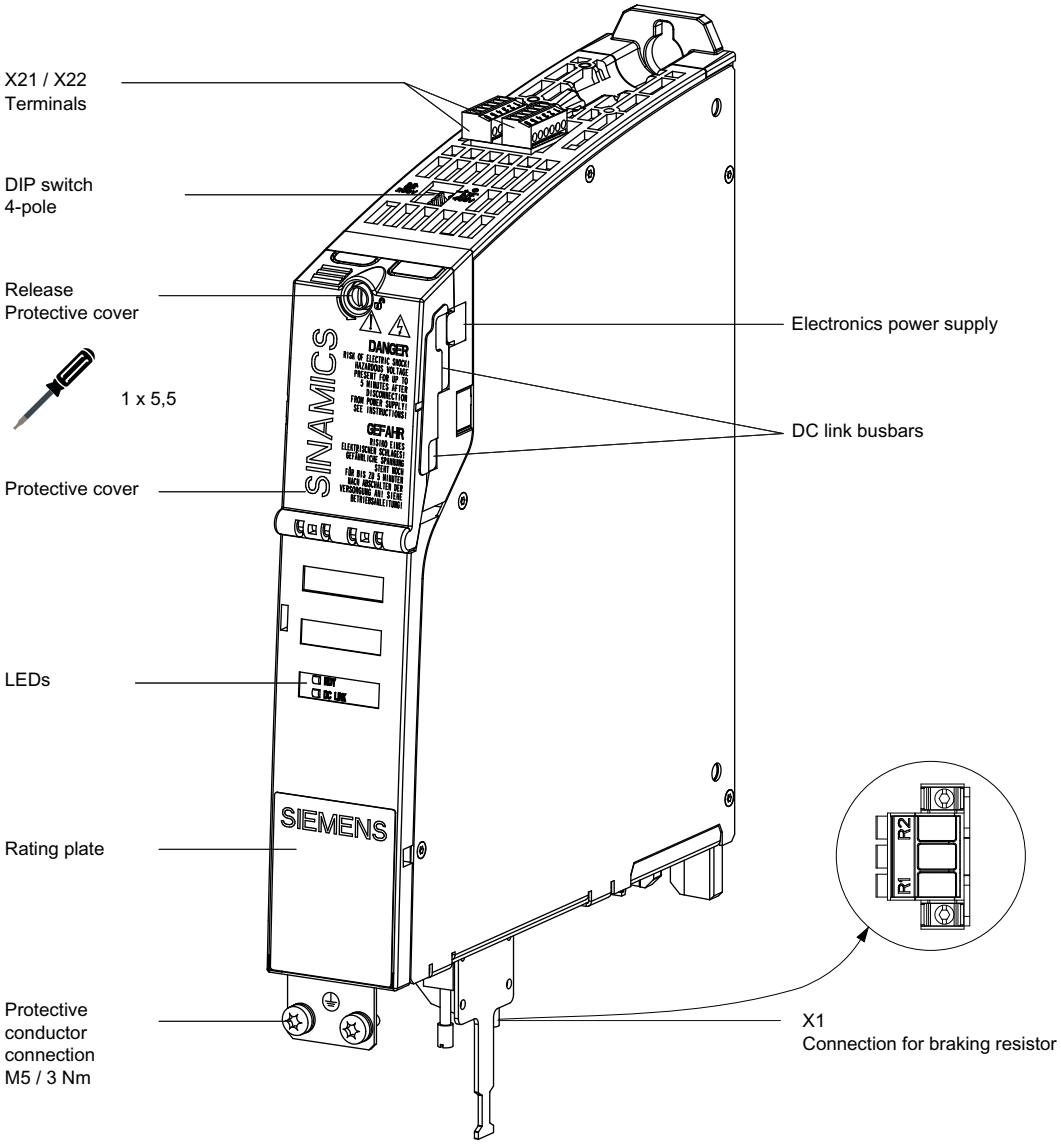
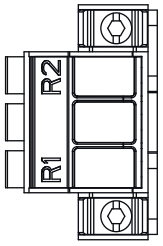


Figure 9-6 Interface overview, Braking Module Booksize Compact

9.4.3.2 X1 braking resistor connection

Table 9-7 X1 braking resistor connection

	Terminal	Function	Technical specifications
	1	Braking resistor connection R1	Continuously short-circuit proof
	2	Not assigned	
	3	Braking resistor connection R2	
Type: Screw terminal 5 (Page 486)			

Braking resistors without a thermostatic switch

The Braking Module Booksize Compact is only designed for operation with the braking resistors listed below.

Table 9-8 Braking resistors without a thermostatic switch

Braking resistor	R in Ω	P_{rated} in kW	P_{max} in kW
6SN1113-1AA00-0DA0	17	0.3	25
6SL3100-1BE31-0AA1	5.7	1.5	100

Braking resistors with a thermostatic switch

The Braking Module Booksize Compact is only designed for operation with the braking resistors listed below.

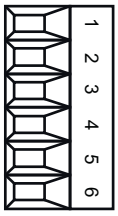
Table 9-9 Braking resistors with a thermostatic switch

Braking resistor	R in Ω	P_{rated} in kW	P_{20} in kW	P_{max} in kW
6SE7018-0ES87-2DC0	80	1.25	5	7.5
6SE7021-6ES87-2DC0	40	2.5	10	15
6SE7023-2ES87-2DC0	20	5	20	30

For detailed technical information on the braking resistors, see Chapter Braking resistors (Page 327).

9.4.3.3 X21 digital inputs/outputs

Table 9-10 X21 digital inputs/outputs

	Terminal	Function[1]	Technical data
	1	DI low: Enable Braking Module DI high: Inhibit/acknowledgement Edge change, high → low: fault acknowledgement	Voltage: -3 ... +30 V Typical current drain: 10 mA at 24 V DC Level (incl. ripple) High level: 15 ... 30 V Low level: -3 ... +5 V
	2	DI low: braking resistor, not controlled manually DI high: Braking resistor controlled manually (quick discharge)[2]	
		If X21.1 and X21.2 are activated simultaneously, the Braking Module inhibit has priority.	
	3	DO high: no prewarning DO low: Prewarning:	Voltage: 24 V DC (20.4 ... 28.8 V) Load current per output: ≤ 100 mA Continuous short-circuit-proof
	4	DO high: ready for operation, no fault DO low: Fault	
	5	Ground	
	6		
Type: Screw terminal 1 (Page 486)			

[1] DI: digital input; DO: digital output; M: Electronics ground

[2] The "fast discharge function" is used for discharging the capacitors in the DC link after the line supply has been interrupted.

Terminal X21.1 - inhibit/acknowledge

Applying a high signal to terminal X21.1 inhibits the Braking Module. Fault messages that are available are acknowledged with a falling edge.

Terminal X21.3 - prewarning

When a prewarning is sent, disconnection of the braking module is imminent. This may be due to the following causes:

- The temperature switch braking resistor has triggered (only if the "Braking resistor with thermostatic switch" setting is used)
- The temperature of the Braking Module is 80 % of the maximum value.
- The I^2t counter of the Braking Module has reached 80 % of the maximum value.
- The braking resistor has reached 80 % of the maximum permissible braking energy (only for setting "Braking resistor without thermostatic switch").
- An incorrect braking resistor is connected (only if the "braking resistor without a thermostatic switch" setting is used).

Terminal X21.4 - fault

In the event of an overtemperature fault, I^2t monitoring, or braking power monitoring, the fault will be acknowledged automatically after a cooling phase. Manual acknowledgment is not necessary!



⚠ WARNING

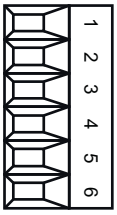
Electric shock due to hazardous voltage at terminals X21

Hazardous voltages can be present at terminals X21 in the case of a fault. Touching live components can result in death or severe injury.

- Only connect protective extra low voltages at terminals X21.

9.4.3.4 X22 digital output/temperature switch

Table 9-11 X22 digital output/temperature switch, braking resistor

	Terminal	Function[1)]	Technical data
	1	+ Temp	Temperature switch of the braking resistor
	2	- Temp	
	3	Reserved, do not use	
	4	Reserved, do not use	
	5	DO high: 200 V supply system is selected DO low: 400 V supply system is selected	Voltage: 24 V DC (20.4 ... 28.8 V) Load current: ≤ 100 mA Continuous short-circuit-proof
	6	Reserved, do not use	
Type: Screw terminal 1 (Page 486)			

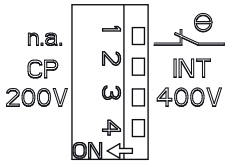
1) DO: digital output

9.4.3.5 DIP switch

The 4-pin DIP switch is located at the top of the Braking Module and sets the braking resistor being used, the cooling method, and the line voltage.

Make the required settings before the Braking Module is mounted in the control cabinet; once the module is mounted, the DIP switch can no longer be accessed from the front.

Table 9-12 DIP switch for Braking Module Booksize Compact

	Switch	Switch position	Function	Factory setting
	1	ON	Braking resistor without a thermostatic switch	OFF
		OFF	Braking resistor with a thermostatic switch	
	2	ON	Cold plate cooling	OFF
		OFF	Internal air cooling	
	3	ON	200 V line voltage	OFF
		OFF	400 V line voltage	
	4	ON	Reserved	OFF
		OFF		

Note

Terminal assignment for "Braking resistor without a thermostatic switch" mode

For "braking resistor without a thermostatic switch" mode (switch 1 = ON) , terminals X22.1 and X22.2 must not be assigned for the Braking Module to work.

9.4.4 Connection examples

Braking resistor without thermostatic switch connected to a Braking Module Booksize Compact

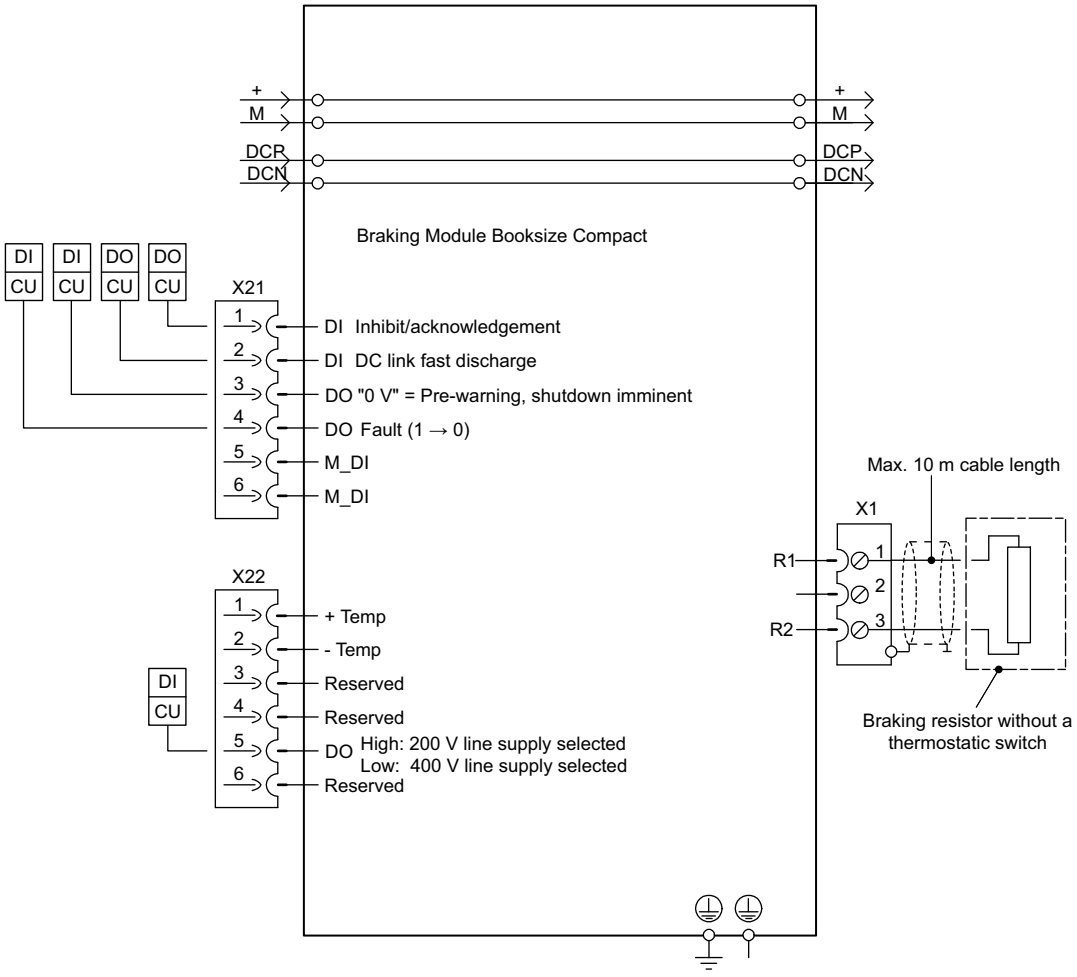


Figure 9-7 Connection example for Braking Module Booksize Compact and braking resistor without a thermostatic switch

Note

The digital inputs DI are isolated and are referenced to M_DI (X21.5 and X21.6).
The reference point of the digital outputs DO is the ground GND of the 24 V supply.

It is not permissible that the connections for the temperature switches (X22.1 and X22.2) are used/assigned for "braking resistor without a thermostatic switch" operation. Otherwise, malfunctions occur.

Braking resistor with thermostatic switch connected to a Braking Module Booksize Compact

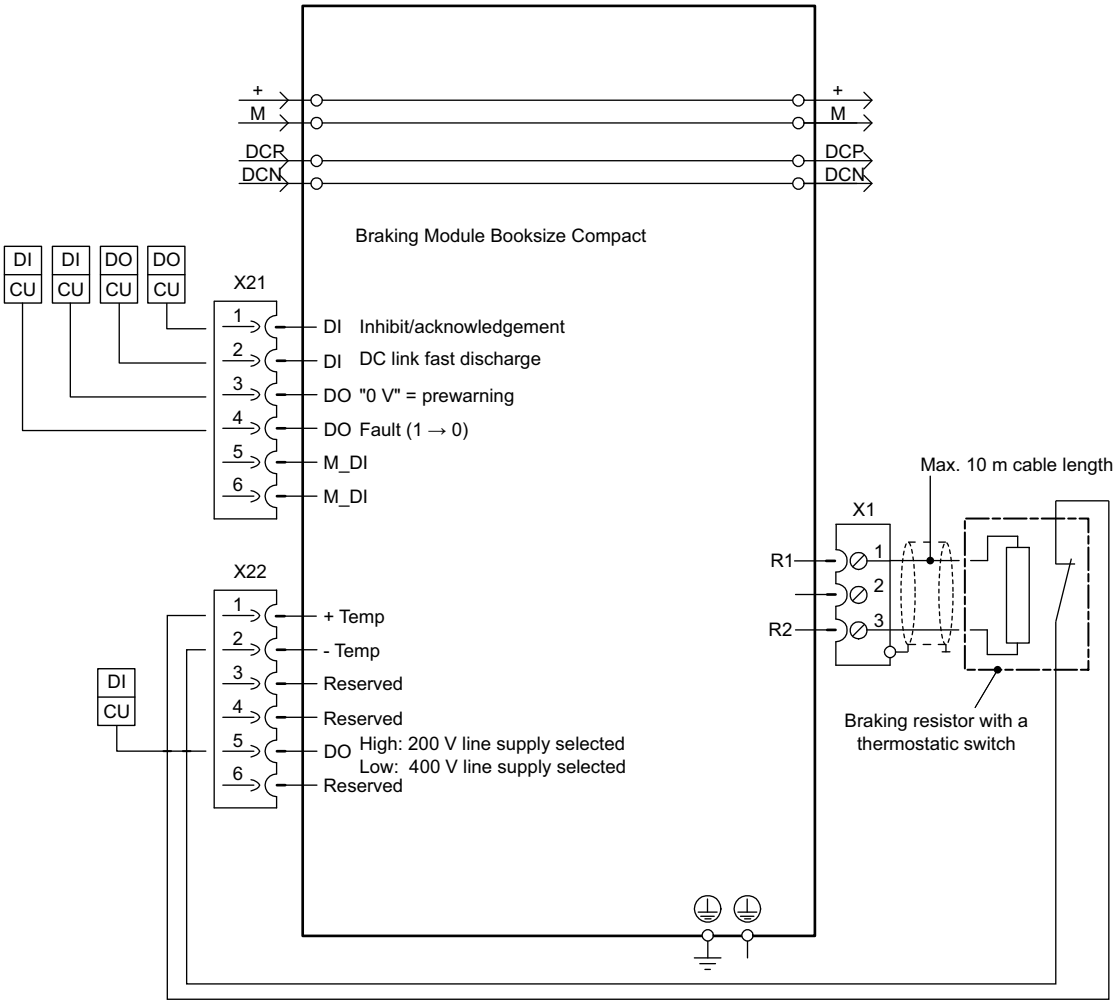


Figure 9-8 Connection example for Braking Module Booksize Compact and braking resistor with a thermostatic switch

Note

The digital inputs (DI) are isolated and are referenced to M_DI (X21.5 and X21.6).
The reference point of the digital outputs (DO) is the ground GND of the 24 V supply.

Information on how to parameterize the digital inputs or digital outputs, see the SINAMICS S120/S150 List Manual.

9.4.5 Meaning of LEDs

Table 9-13 Meaning of LEDs on the Braking Module Booksize Compact

LED	Color	Status	Description	Remedy
READY	-	Off	The electronics power supply is missing or outside the permissible tolerance range.	Check the electronics power supply.
	Green	Continuous light	The component is ready for operation.	-
	Red	Continuous light	Enable missing (input terminal) Overtemperature IGBT/braking resistor Overcurrent trip I^2t monitoring activated Braking power monitoring activated Ground fault/short-circuit **Comment:** In the event of overtemperature, I^2t monitoring or braking power monitoring, the fault will be acknowledged automatically after a cooling down phase. Manual acknowledgment is not possible.	Troubleshoot the fault using the output terminals and acknowledge it using the input terminal.
DC LINK	-	Off	The DC link voltage is not available, the electronics power supply is missing or is outside the permissible tolerance range. The component is not active.	
	Orange	Continuous light	The DC link voltage is present.	-
	Orange	Flashing light	The component is active. The DC link is being discharged via the braking resistor.	-

9.4.6 Dimension drawing

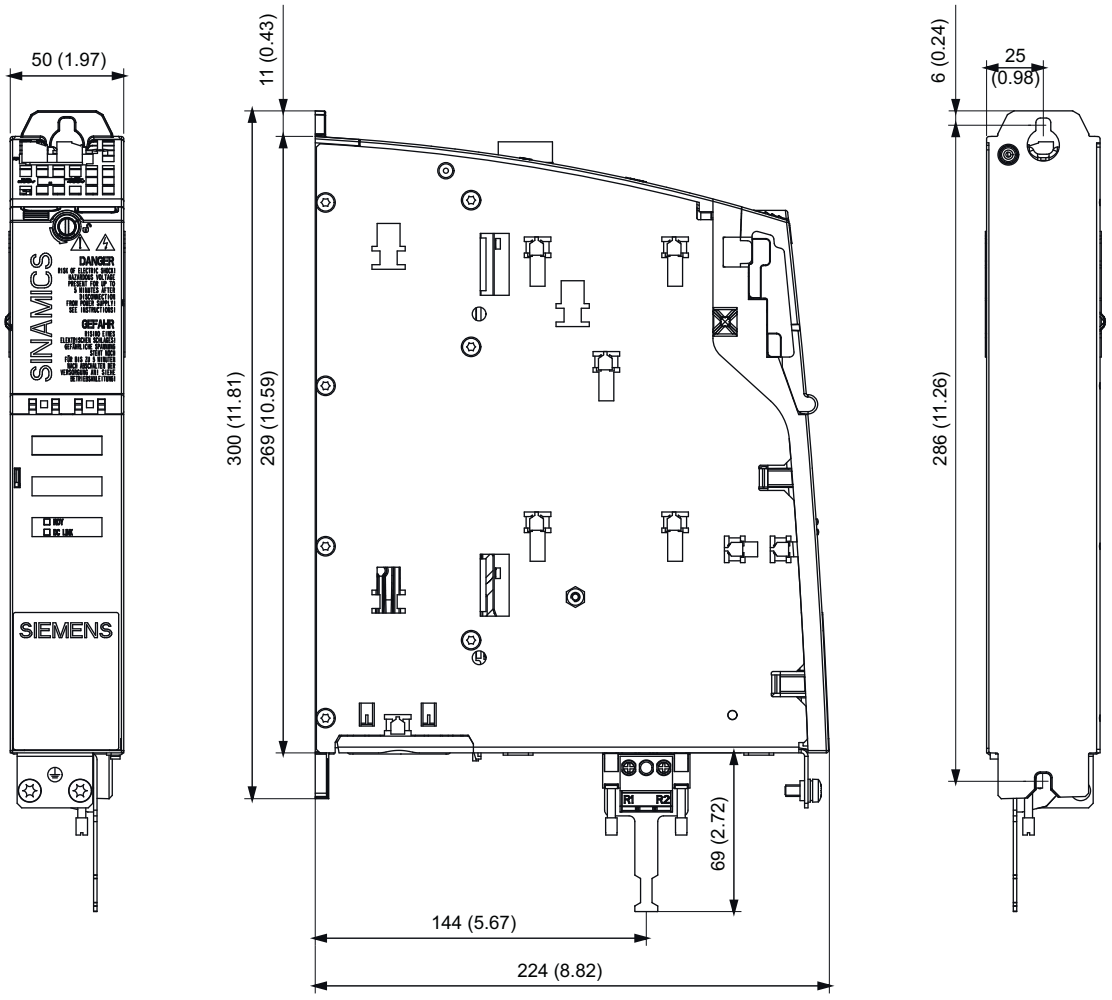
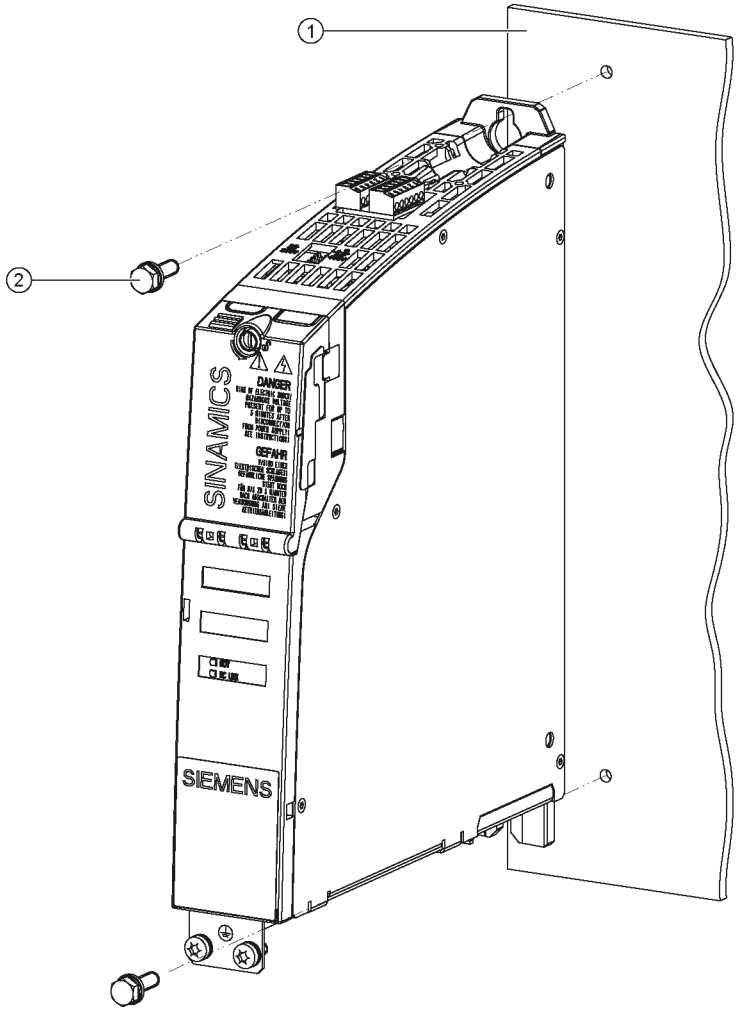


Figure 9-9 Dimension drawing of Braking Module Booksize Compact, all dimensions in mm and (inches)

9.4.7 Mounting

Mounting a Braking Module Booksize Compact with internal air cooling



① Mounting wall
② M6 x 16 screw
Hex combination screw or hex screw with spring washer and plain washer

Figure 9-10 Mounting a Braking Module Booksize Compact with internal air cooling

Tightening torques:

1. Firstly, tighten the nuts by hand.
   Tightening torque: 0.5 Nm (4.4 lbf in)
2. Then tighten the nuts.
   Tightening torque: 6 Nm (53.1 lbf in)

9.4.8 Technical specifications

Table 9-14 Technical specifications

6SL3400-1AE31-0AA.		200 V AC	400 V AC
DC link voltage	V_{DC}	250 ... 360	510 ... 720
ON threshold	V_{DC}	400	760
Electronics power supply	V_{DC}	24 (20.4 ... 28.8)	
Electronics current consumption (at 24 V DC) Standby operation	 A_{DC} A_{DC}	 0.2 0.4	
Current-carrying capacity DC link busbars 24 V busbars	 A_{DC} A_{DC}	 100 20	
Braking power Maximum[1)] Continuous braking power	 kW kW	 50 2.5	 100 5
Power loss (see power loss tables (Page 503)) Standby operation	 W W	 5 25	
Switching frequency	Hz	2000	
Cooling methods		Internal air cooling Cold plate cooling	
Ventilation clearances (above/below)	mm	≥ 80	
Maximum ambient temperature	°C	55 (without derating)	
Weight	kg	2.7	

1) At the upper switch-on threshold

9.4.8.1 Characteristic curves

Duty cycle for braking resistors without a thermostatic switch

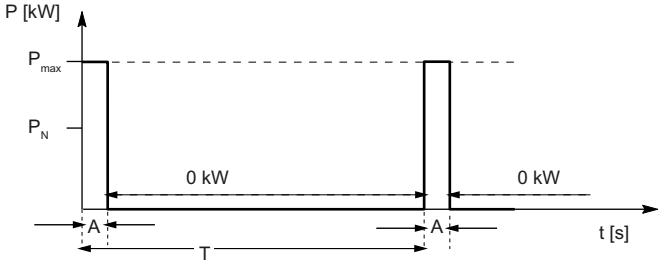


Figure 9-11 Duty cycle for braking resistors without a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

P_{rated} [kW] rated power (continuous power) of the braking resistor

P_{max} [kW] peak braking power of the braking resistor

Table 9-15 Duty cycles

	6SN1113-1AA00-0DA0		6SL3100-1BE31-0AA.	
	Short duty cycle	Long duty cycle	Short duty cycle	Long duty cycle
A [s]	0.1	0.4	1	2
T [s]	11.5	46	68	136

Duty cycles for braking resistors with a thermostatic switch

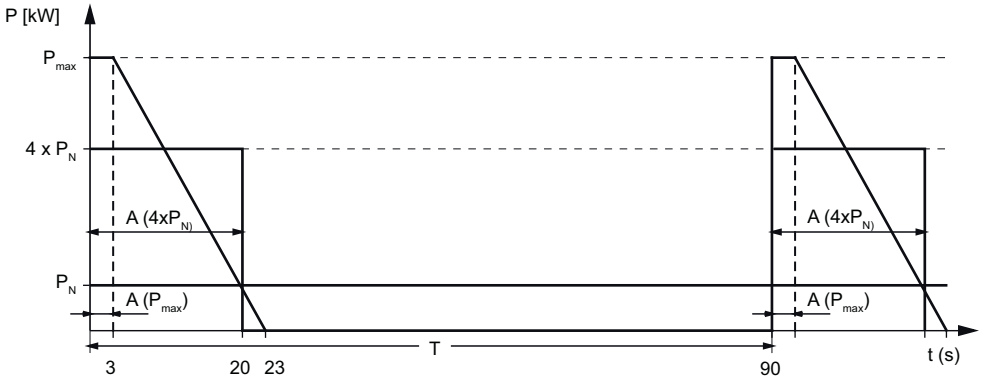


Figure 9-12 Duty cycles for braking resistors with a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

P_{rated} [kW] rated power (continuous power) of the braking resistor

P_{max} [kW] peak power of braking resistor (6 x P_{rated})

4 x P_{rated} [kW] = power permitted every 90 s for 20 s

Table 9-16 Duty cycles

	6SE7018-0ES87-2DC0		6SE7021-6ES87-2DC0		6SE7023-2ES87-2DC0	
	Duty cycle P_{max}	Duty cycle 4 x P_{rated}	Duty cycle P_{max}	Duty cycle 4 x P_{rated}	Duty cycle P_{max}	Duty cycle 4 x P_{rated}
A [s]	3	20	3	20	3	20
T [s]	90	90	90	90	90	90

9.4.9 Configuration instructions

DC link capacitance

When configuring the drive line-up, please note that only one Braking Module Booksize Compact may be used per complete 500 µF DC link capacitance.

Table 9-17 Configuration examples

DC link capacitance in µF	Max. number of Braking Modules
900	1
2400	4
9,800	19

DC link cable

In a multi-row or distributed drive line-up, the DC links are connected to each other via a DC link cable. When using a Braking Module Booksize Compact in the drive line-up, this cable must not be longer than 10 m. In all cases, the DC link cable must have low impedance and a cross-section of at least 10 mm^2.

Parallel operation

During configuration of parallel operation for Braking Modules Booksize Compact, dimensioning can only take 90% of the specified braking power into account. Only the peak powers may be added without derating.

The following applies when connecting Braking Modules in parallel:

$P_{N\ total}$ = 0.9 x total P_N of single devices

4 x $P_{N\ total}$ = 0.9 x sum (4 x P_N) of single devices

$P_{max\ total}$ = total P_{max} of single devices

9.5 Braking units for 100 kW Basic Line Modules

9.5.1 Description

Since Basic Line Modules 100 kW cannot feed power back into the supply system, an external braking unit together with a braking resistor is required for the following tasks:

- When the power fails, the drives are stopped in a controlled fashion (e.g. EMERGENCY OFF Category 1).
- The DC link voltage is limited during brief generator operation.

Either Braking Modules Booksize Compact (also in a parallel connection) or a MASTERDRIVES braking module can be used.

Conditions for MASTERDRIVES braking modules

The MASTERDRIVES braking unit includes the necessary power electronics and control. When the braking unit is in operation, the power which is fed back into the DC link is dissipated via an external braking resistor.

For the operation of a Basic Line Module 100 kW, only MASTERDRIVES braking units with the following rated braking powers are permitted:

- 4 x P_N = 100 kW (Article number 6SE7031-6EB87-2DA1)
- 4 x P_N = 170 kW (Article number 6SE7032-7EB87-2DA1)

For more detailed information about the MASTERDRIVES braking module, see operating instructions "MASTERDRIVES braking module (https://support.industry.siemens.com/cs/ww/en/view/109792718)" with article number 6SE7087-6CX87-2DA1.

9.5.2 Safety instructions for Braking Modules for the 100 kW Basic Line Module

NOTICE

Device failure as a result of unshielded or incorrectly routed cables to braking resistors

Unshielded or incorrectly routed cables to braking resistors can result in interference being coupled into the signal processing electronics from the power side. This can result in significant disturbance of all signals (fault messages) up to failure of individual components (destruction of the devices).

- Only use shielded cables for cables to braking resistors.

Note

Note the starting time for the electronics

The electronics of the Braking Module is supplied from the DC link. As long as no DC-link voltage is present (< 360 V ± 2%), the electronics are not active and an external control or the Control Unit receives the "fault" signal from the fault output. This means that it is not just the 2 seconds that has to be taken into account, which the electronics requires to run up as soon as the DC-link voltage is present.

NOTICE

Danger to life through the use of non-approved braking resistors

Braking resistors can be damaged when using braking resistors other than those specified in this Manual.

- Only use braking resistors approved by Siemens.

9.5.3 Interface description

9.5.3.1 X3 DC link connection

Table 9-18 X3: Connection for the DC link

Connection/Meaning	Remarks	Tightening torque
C/L+ input (plus DC link)	Busbar C/L+	16 Nm (142 lbf in)
D/L- input (minus DC link)	Busbar D/L	16 Nm (142 lbf in)
⏚ Protective conductor	Busbar PE ⏚	16 Nm (142 lbf in)
Shield connection	M6 bolts at top of housing	8 Nm (70.8 lbf in)
Connection via	Cable lug without insulation (Page 487) With shrink-on sleeve Cable is connected using the supplied M8 x 25 screws	
AWG	Maximum 2/0	

Note

After the DC-link voltage is applied, fault output -X38/5 is "low" for approx. 2 seconds (self-test), i.e. in the "fault" state. The Control Unit must suppress this state when the system is switched on.

9.5.3.2 X6 braking resistor connection

Table 9-19 X6: Connection for the braking resistor

Connection/Meaning	Remarks	Tightening torque
G/R+ external braking resistor	Busbar G/R+	16 Nm (142 lbf in)
H/R external braking resistor	Busbar H/R	16 Nm (142 lbf in)
⏚ Protective conductor	Busbar PE ⏚	16 Nm (142 lbf in)
Shield connection	M6 bolts at bottom of housing	8 Nm (70.8 lbf in)
Connection via	Cable lug without insulation (Page 487) With shrink-on sleeve Cable is connected using the supplied M8 x 25 screws	
AWG	Maximum 2/ 0	

Note

The cable length between the braking unit and the braking resistor is limited to 15 m.

The following braking resistors are suitable for connecting to the MASTERDRIVES braking unit:

Table 9-20 Braking resistors for MASTERDRIVES braking unit

Braking resistor	**P_N in kW**	**P_{20} in kW**	**P_{max} in kW**	**R in Ω**
6SE7031-6ES87-2DC0	25	100	150	4
6SE7032-7ES87-2DC0	42.5	170	255	2.35

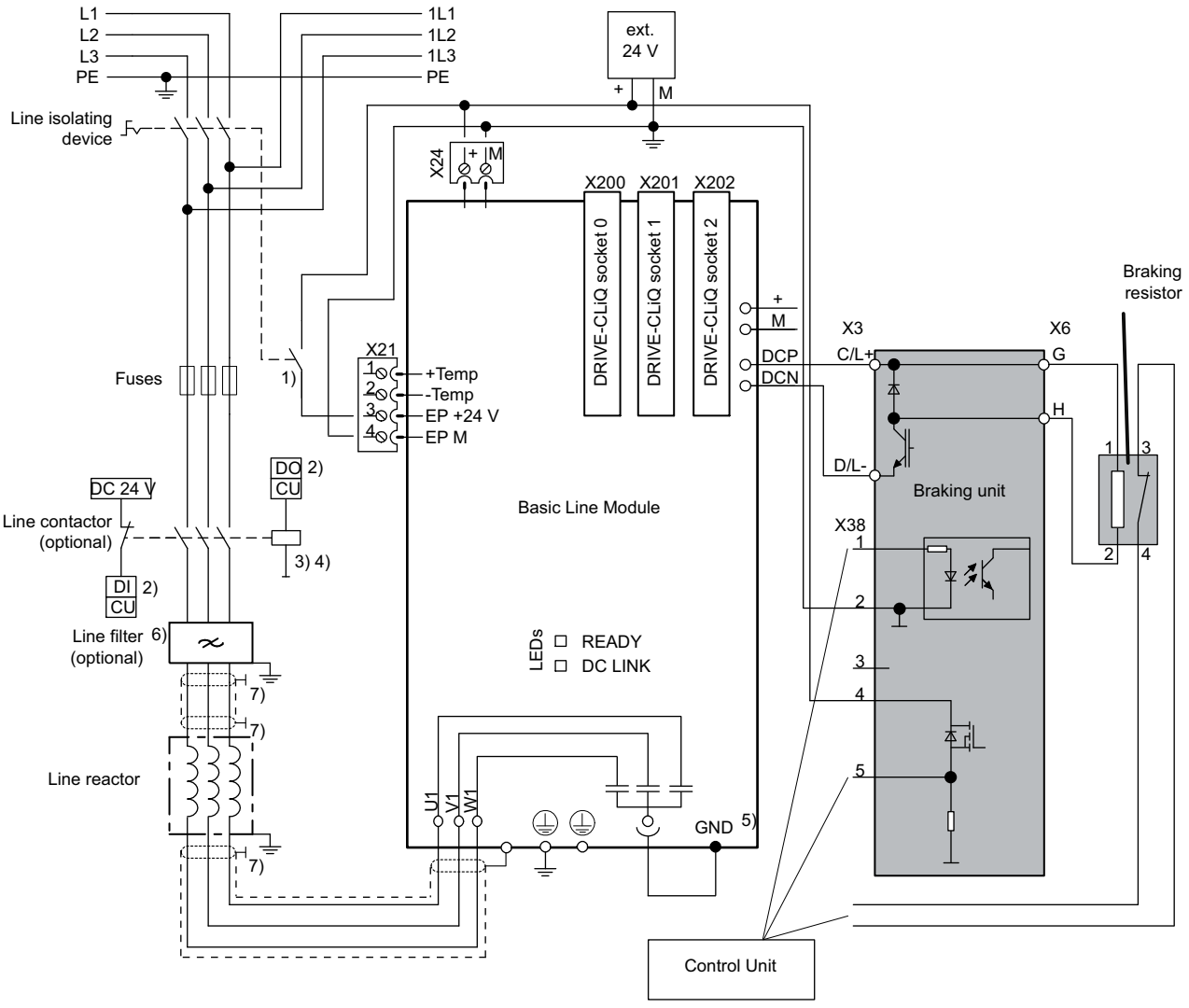
9.5.3.3 Switch S1

Switch S1 on the MASTERDRIVES braking unit is used to set the switch-on threshold. It is located behind the front panel.

Switch S1 should be set to "high" (factory setting) in order to operate the braking unit on a SINAMICS S120 drive line-up in booksize format. This means that the switch-on threshold is at 757 V DC.

For more information, refer to the operating instructions for the MASTERDRIVES braking unit.

9.5.4 Connection example



1) 24 V DC and ground must be connected for operation.
2) DI/DO, 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) The connection bracket must be removed for operation of the components in the IT system.
6) Line filter is required to ensure compliance with radio interference voltage of Category C2.
7) Contact is established via the rear of the mounting plate - or shield bars according to the EMC installation directive.

Figure 9-13 Connection example for MASTERDRIVES braking unit

9.5.5 Dimension drawing

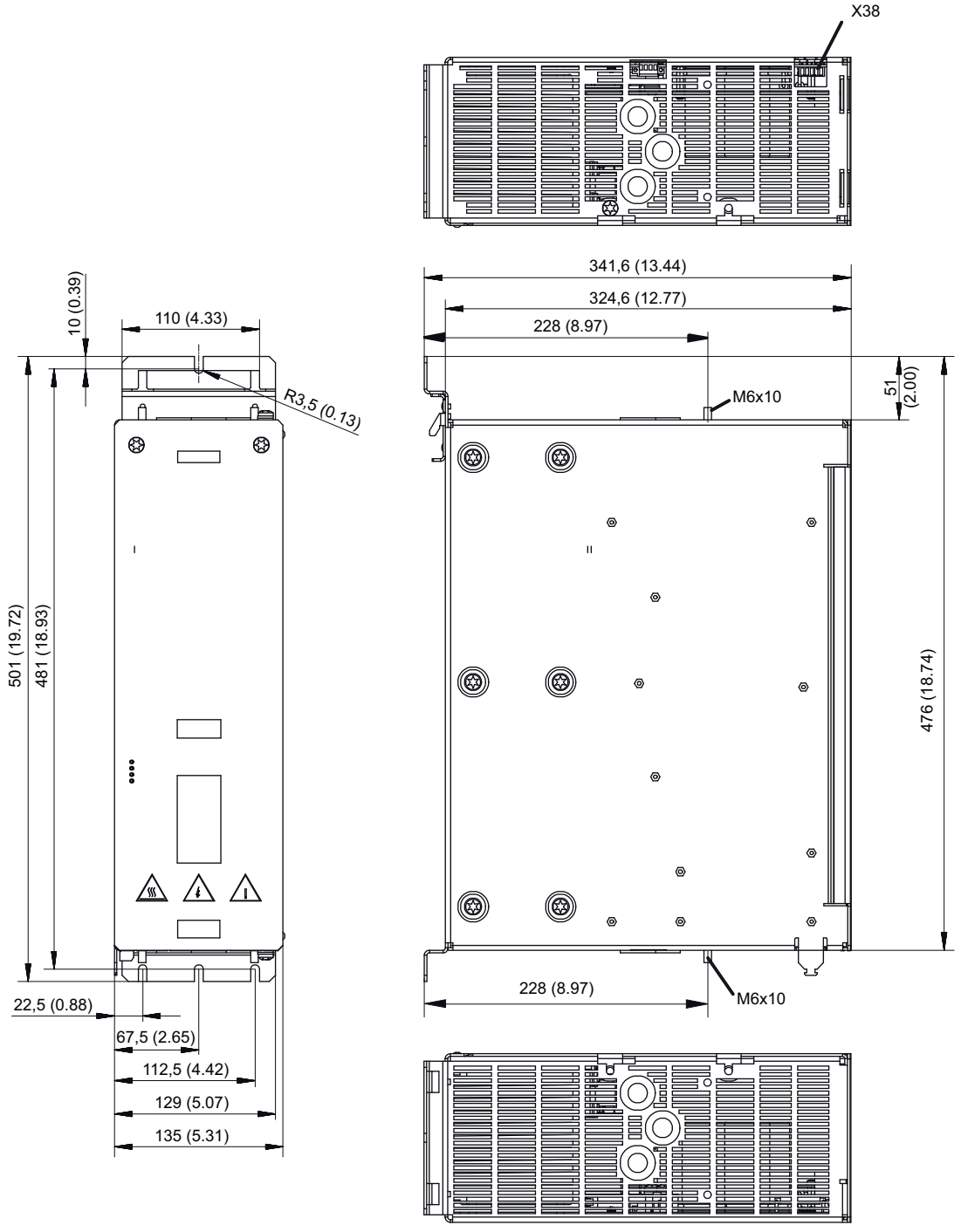


Figure 9-14 Dimension drawing of 100 kW and 170 kW MASTERDRIVES braking unit, all dimensions in mm and (inches)

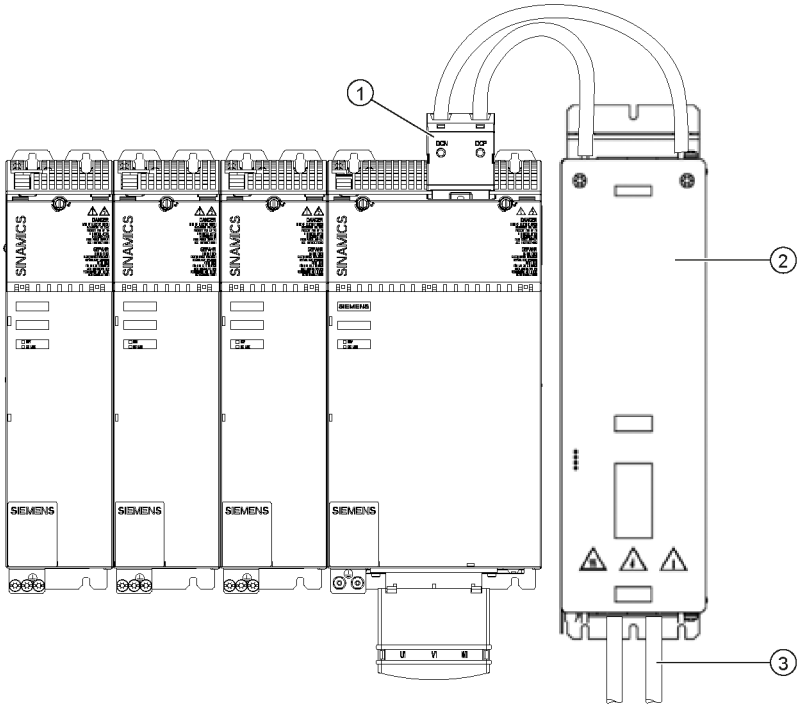
9.5.6 Connection to the Basic Line Module 100 kW

Connecting the braking unit to the DC link

The following adapters can be used to connect the MASTERDRIVES braking unit to a SINAMICS S120 line-up in booksize format:

- DC link rectifier adapter, Article number 6SL3162-2BM00-0AA0
- DC link adapter, Article number 6SL3162-2BM01-0AA0

The connecting cables used to connect the braking unit to the DC link rectifier adapter or DC link adapter must be kept as short as possible.
Please observe the instructions contained in Chapters DC link rectifier adapter (Page 387) and DC link adapter (Page 404).



① DC link rectifier adapter
② MASTERDRIVES braking unit
③ Cable routing to the braking resistor

Figure 9-15 Connecting a MASTERDRIVES braking unit via a DC link rectifier adapter

Connecting the braking unit to the DC link adapter or DC link rectifier adapter

1. Connect the C/L+ connection on the braking unit to the DCP terminal on the DC link rectifier adapter or DC link adapter.
2. Connect the D/L- connection on the braking unit to the DCN terminal on the DC link rectifier adapter or DC link adapter.
3. Connect the protective conductor between the S120 drive line-up and the braking unit. According to diagram "Grounding concept SINAMICS S120 Booksize" (Page 492) the cross-section of the protective conductor connection must be 6 mm^2 (AWG 10).

The connecting cable between the braking module and the DC link rectifier adapter or DC link adapter must be dimensioned with a cross-section of 95 mm^2 (AWG 3/0). The electric strength of the cable must be rated to the line voltage. The maximum permissible length of the connecting cables to the DC link is 3 m.

⚠ 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.

NOTICE

Damage to equipment resulting from interchanging or short circuiting of DC link terminals

The drive equipment or braking unit may be damaged if the DC link terminals are interchanged or short-circuited.

- Carefully ensure that the DC link terminals are correctly connected.
- Do not short-circuit the DC link terminals.



⚠ CAUTION

Burns due to high braking unit temperature

The air discharge temperature of the braking units and the housing can become very hot. Contact could cause injury.

- Avoid coming into contact with the discharged air and the housing of the braking units.
- Mount the motor braking units so that they cannot be touched. If this is not possible, attach a clearly visible and understandable warning notice at hazardous positions.
- To prevent adjacent components from being damaged due to these high temperatures, maintain a clearance around all sides of the braking units.

9.6 Capacitor Module

9.6.1 Description

Capacitor modules are used to increase the DC link capacitance to bridge momentary power losses.

Capacitor modules are connected to the DC-link voltage via the integrated DC link busbars. Capacitor modules function autonomously.

Several capacitor modules can be operated in parallel.

Note

Maximum permissible DC link capacitance

The Capacitor Module is precharged by the Line Module.

- Observe the respective maximum permissible DC link capacitances of the Line Modules.

9.6.2 Interface description

9.6.2.1 Overview

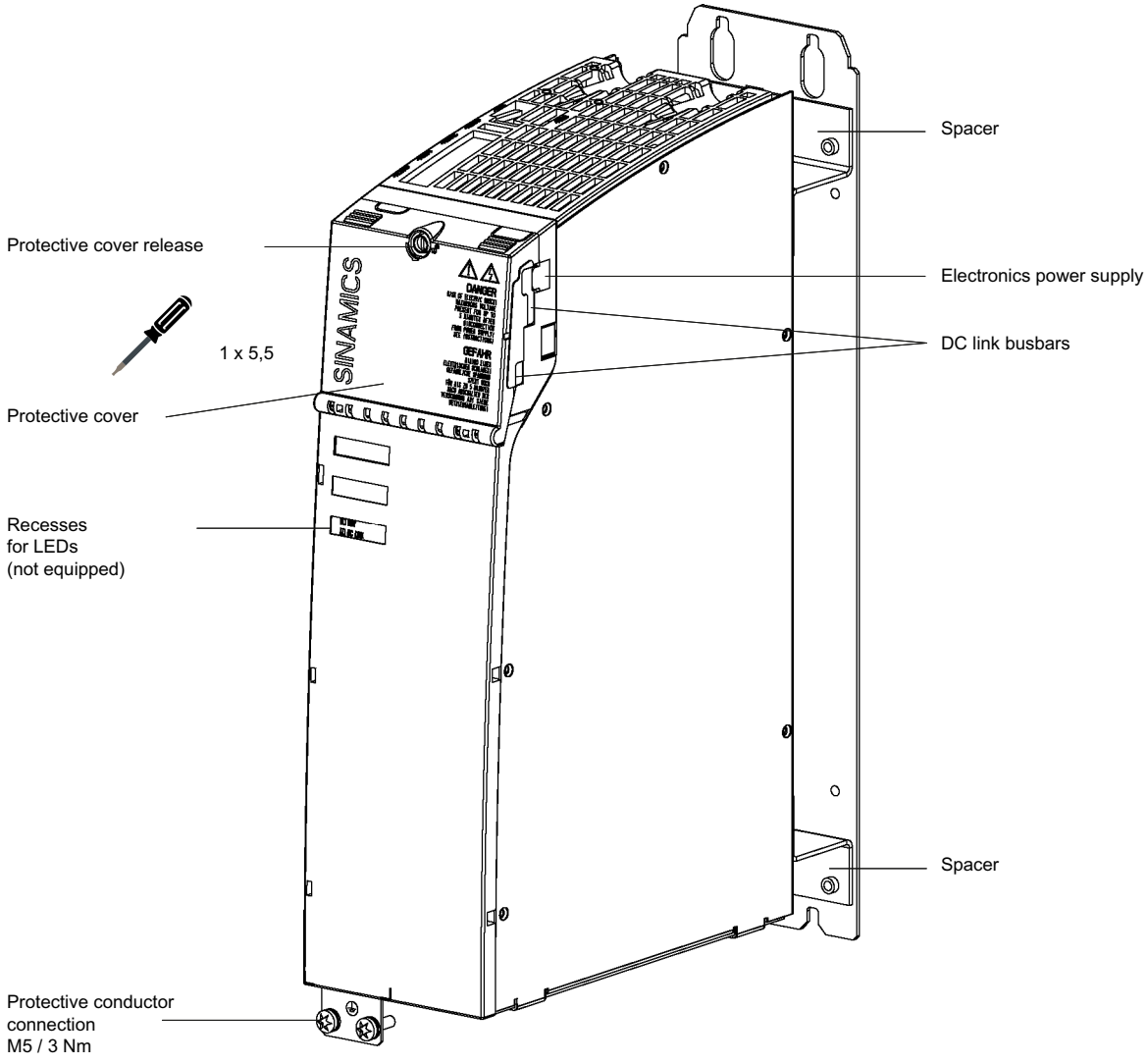


Figure 9-16 Interface overview, Capacitor Module

9.6.3 Dimension drawing

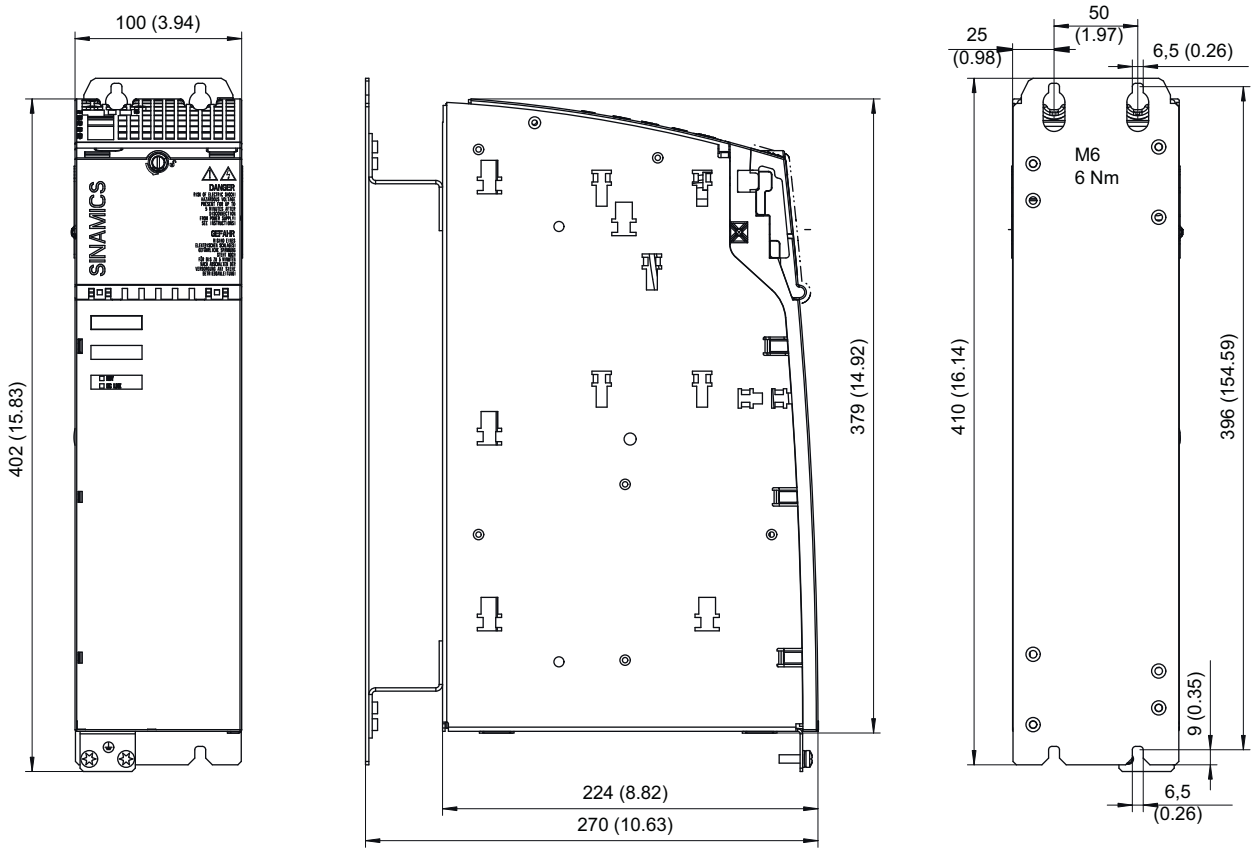
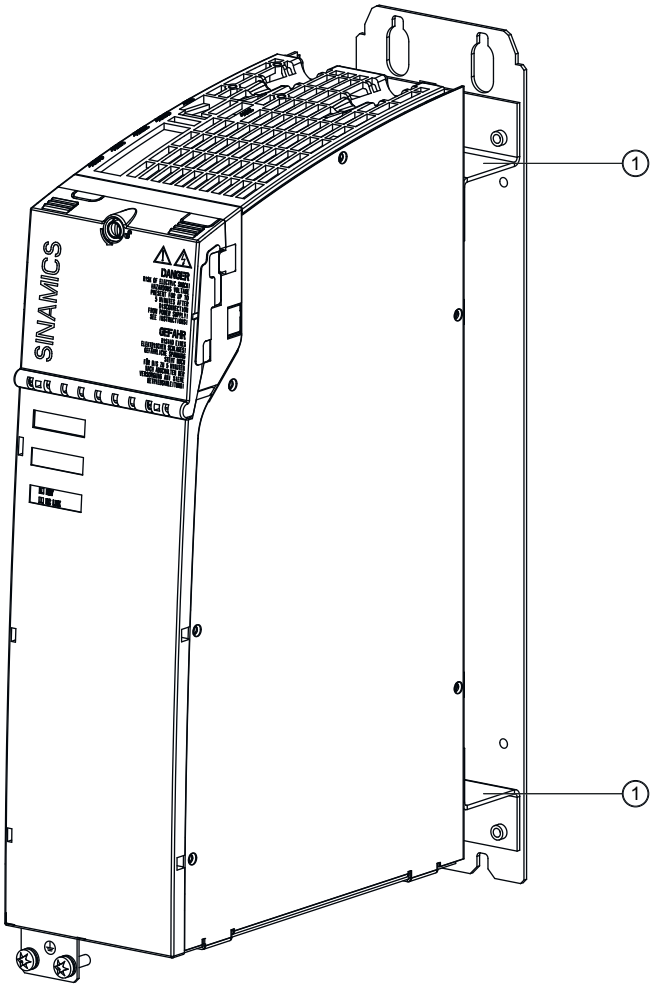


Figure 9-17 Dimension drawing of Capacitor Module, all dimensions in mm and (inches)

9.6.4 Mounting



① Delivered with spacers - mounting depth for drive line-up in booksize format with internal air cooling

Figure 9-18 Mounting a Capacitor Module using spacers

The Capacitor Module can be attached to the cabinet panel or a mounting panel with or without spacers.

9.6.5 Technical Specifications

Table 9-21 Technical specifications

	Unit	6SL3100-1CE14-0AA0
DC link voltage	V_{DC}	510 ... 720
Electronics power supply	V_{DC}	24 (20.4 ... 28.8)
Capacitance	µF	4100

	Unit	6SL3100-1CE14-0AA0
Current-carrying capacity DC link busbars 24 V busbars	 A A	 100 20
Power loss (see power loss tables (Page 503))	W	25
Ventilation clearances (above/below)	mm	≥ 80
Weight	kg	7.3

9.7 Control Supply Module CSM

9.7.1 Description

The Control Supply Module provides an output voltage of 24 V - 28.8 V DC. The output voltage can be adjusted using an integrated potentiometer.

The Control Supply Module absolutely requires the AC line voltage for start-up, from which it continues to be supplied during normal operation. When the power fails, the module automatically changes over to supply from the DC link. This makes it possible, for example, to execute retraction movements in the event of a power failure. If the AC line voltage is once again within the permissible range, the equipment switches back to the line voltage, ensuring that the DC link is only loaded if the line voltage is either not available or is not within the permissible range.

The Control Supply Module has an integrated line filter for the AC input (Category C2 according to IEC 61800-3 for line supplies with grounded neutral point) and a precharging circuit for the DC link in the device, from which the isolated 24 V voltage is generated.

Note

Start-up of the Control Supply Module from the DC link voltage is not possible to prevent an uncontrolled start-up with residual voltage at the DC link.

The Control Supply Module has safe electrical separation between the line potential and the DC link potential. This therefore ensures that the DC link is not unintentionally charged. The Control Supply Module can therefore remain connected to the supply if the Line Module is galvanically isolated from the line supply, for example using a line contactor.

The 24 V ground of the Control Supply Module is internally grounded.
The Control Supply Module is air cooled using an internal fan.

Temperature and voltages are internally monitored.

Temperature monitoring:
In the event of an overtemperature in the Control Supply Module, a temperature advance warning is issued via a signaling contact. If the temperature falls below the limit value within the advance warning time, then the module remains operational and the signaling contact is de-energized. If the overtemperature condition persists, the module is switched off and restarted.

Voltage monitoring:
When the monitoring threshold (32 V) of the output voltage is exceeded for > 20 ms, the Control Supply Module switches off and attempts a restart after 10 s. This is supplemented by a hardware-based overvoltage limiting. This prevents that more than 35 V can be output in the case of a fault.

The Control Supply Module can either be operated individually or in a parallel connection with a maximum of 10 devices. The switchover between single and parallel operation is realized in a no-current state using a DIP switch on the upper side of the module.

9.7.2 Safety instructions for Control Supply Modules



⚠ WARNING

Electric shock when live parts are touched when using the Control Supply Module

The Control Supply Module has 2 supply circuits. Touching live components can result in death or severe injury.

- Switch off both supply circuits before you start any work.



⚠ 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 cover 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 cover of the DC link is open

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

- Only operate the components with closed protective cover.



⚠ 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

Electric shock or fire due to missing or unsuitable overcurrent protective device

Overcurrent protective equipment that trips too late or not all can cause electric shock or fire.

- Connect each Control Supply Module via a suitable circuit breaker or safety fuses.
- The types specified in the technical data for the respective module are to be used in this regard. For applications according to IEC, equivalent fuses and circuit breakers are permissible.
- To protect personnel and for fire protection purposes, at the infeed point, the short-circuit rating and loop impedance must match the specifications in the documentation so that the installed overcurrent protection devices trip within the specified time.

NOTICE

Damage to equipment as a result of loose power connections when using the 24 V terminal adapter

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

- When using the 24 V terminal adapter, it must be screwed onto the Control Supply Module. Tighten the enclosed EJOT-PT K30 x 16 screw with the specified tightening torque (0.5 Nm / 4.4 lbf in).
- Check the tightening torques of all power connections at regular intervals and tighten them when required. This applies in particular after transport.

9.7.3 Interface description

9.7.3.1 Overview

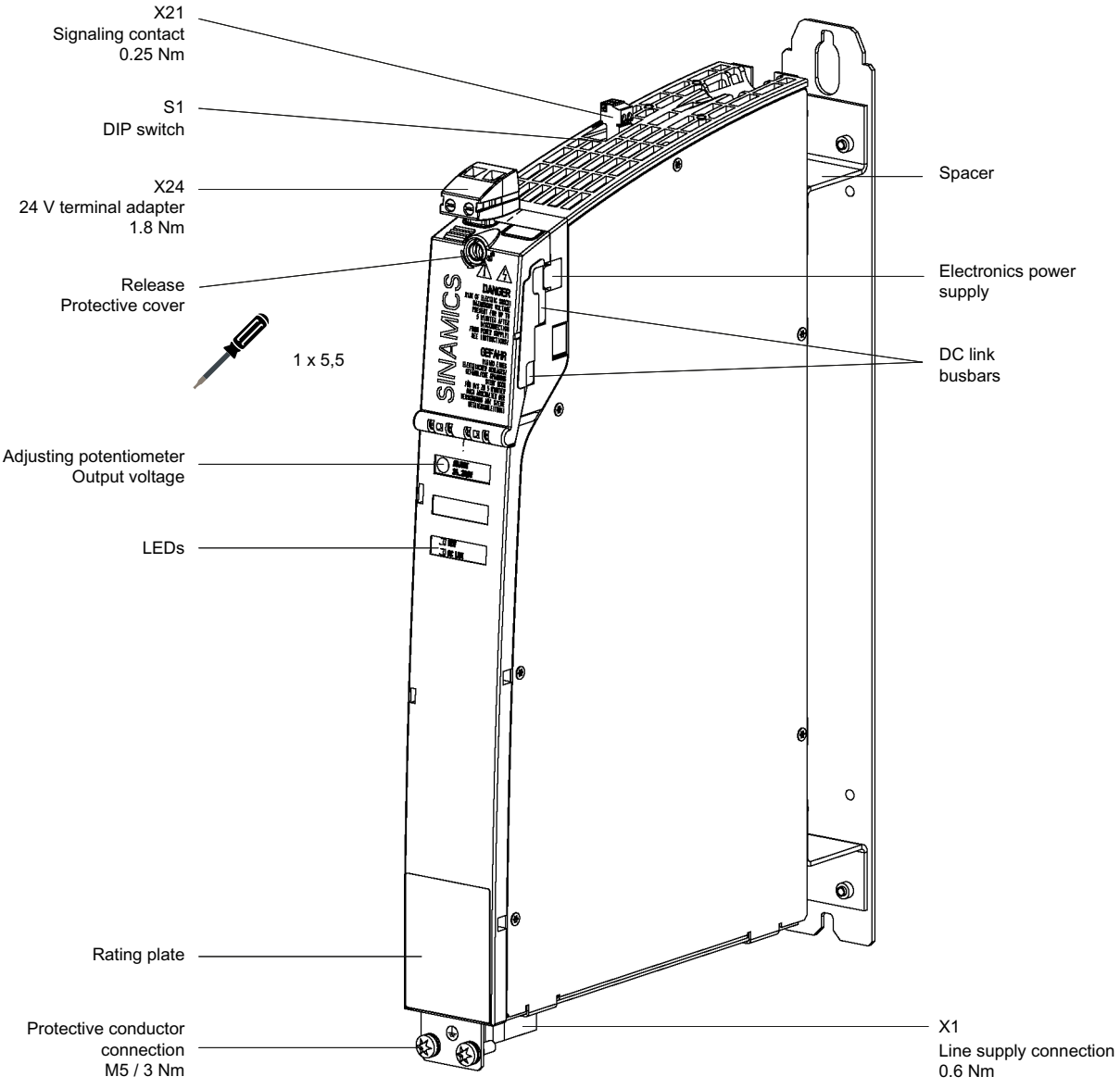
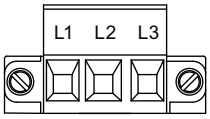
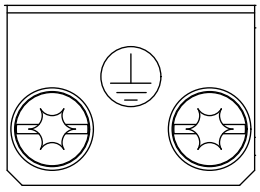


Figure 9-19 Interface overview, Control Supply Module

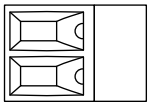
9.7.3.2 X1 line connection

Table 9-22 X1 line connection

	Terminal	Technical specifications
	L1 L2 L3	Supply voltage: 3 AC 380 V ... 480 V, 50 / 60 Hz Type: Screw terminal 4 (Page 486)
	Protective conductor connection	Screw M5 / 3 Nm (26.6 lbf in) on enclosure

9.7.3.3 X21 signaling contact

Table 9-23 X21 signaling contact

	Terminal	Technical data
	1 2	Voltage: 24 V DC (20.4 ... 28.8 V) Load current: ≤ 500 mA (ohmic load)
Type: Screw terminal 1_1 (Page 486) Max. cross-section that can be connected 1.5 mm^2 (AWG 16)		

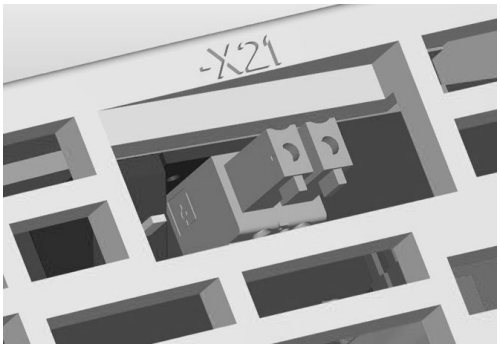
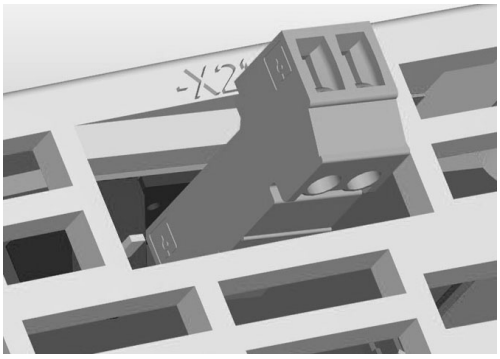
The 2-pole terminal connector for the signaling contact is included in the Completion Kit provided.

The signaling contact can be connected with a digital input (DI) on the Control Unit or other digital interface (PLC, SCADA). In parallel or redundant operation the failure of a Control Supply Module is indicated in order to initiate a service call, for example.

The signaling contact operates as an isolated NO contact. The contact is closed ("OK") if the Control Supply Module is operating without fault. For a module output voltage that deviates from the specification, or an overtemperature condition, then the contact opens ("not OK").

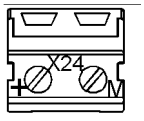
The Control Supply Module is shutdown if an overtemperature condition remains after this warning.

Table 9-24 Installing the signaling contact

	
Signaling contact without terminal connector in the delivery condition	Signaling contact, complete with terminal connector

9.7.3.4 X24 24 V terminal adapter

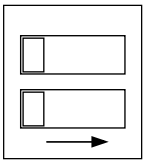
Table 9-25 X24 24 V terminal adapter

	Terminal	Function	Technical specifications
	+	24 V power supply	Supply voltage 24 ... 28.8 V DC
	M	Ground	Electronics ground
Type: Screw terminal 5 (Page 486)			

The 24 V terminal adapter is included in the scope of supply.

9.7.3.5 S1 DIP switch

Table 9-26 DIP switch S1

	Terminal	Function	Technical specifications
	1	Changeover switch, single operation / parallel operation	Left: Single operation Right: Parallel operation Changing over the output characteristic
	2	Dummy contact (not used)	-

It is only permissible to changeover when in the no-voltage state.

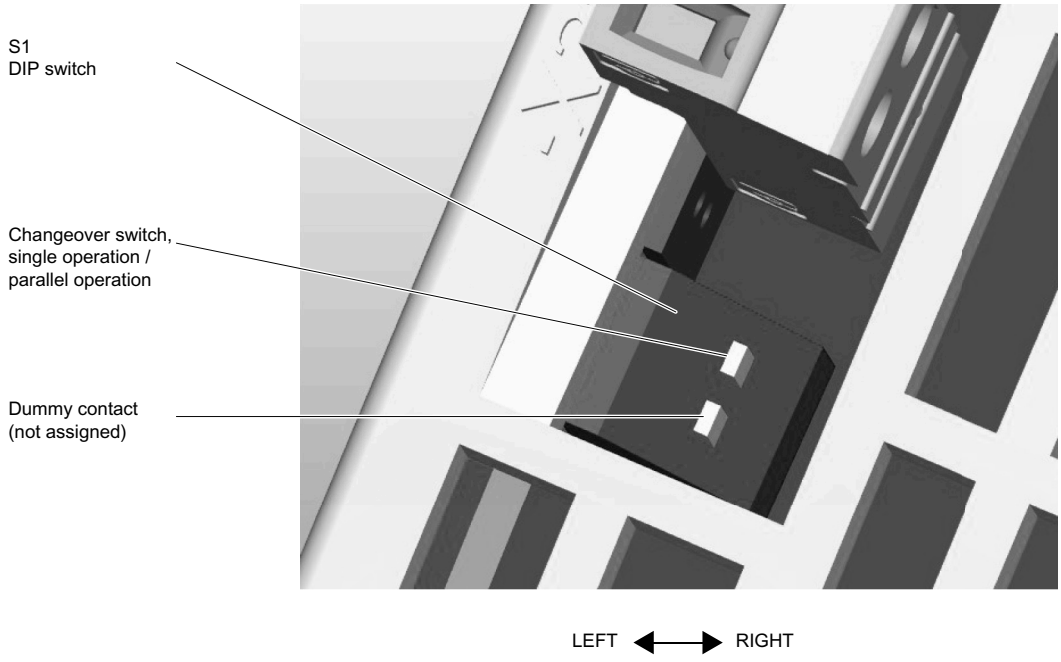


Figure 9-20 DIP switch on the upper side of the component

When delivered, "single operation" is set. Both switches are set to the left.

9.7.4 Connection examples

The Control Supply Module is connected to the line supply via interface X1 (screw terminals 0.2 to 4 mm^2).

Note

Each Control Supply Module is to be connected via a suitable circuit breaker, or alternatively a safety fuse.

The types specified in the "Technical data (Page 325)" for the respective module are to be used in this regard. For applications according to IEC, equivalent fuses and circuit breakers are permissible.

The Control Supply Module also features a current limitation function.

Note

If you use cables with a cross-section of 2.5 mm^2, no additional protection is required on the 24 V side for the following cable types:

- Cables of the XLPE type
- Cables of the EPR type
- Cable with a similar properties and which is thermally stable up to 90 °C

Note

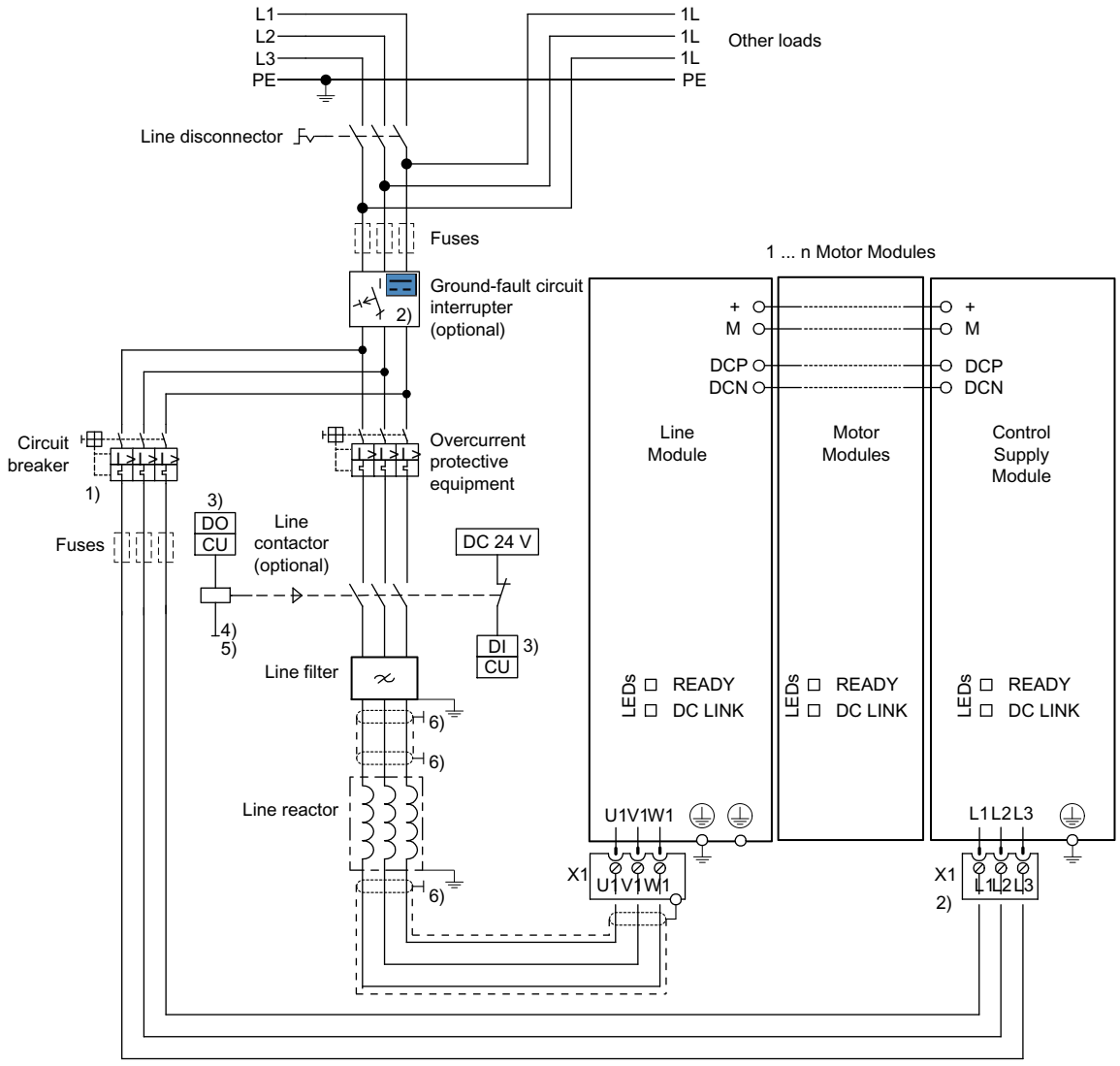
Observe the connection sequence

If a selectively tripping, AC/DC-sensitive residual current operated circuit breaker is used for the drive line-up, connect the Control Supply Module to the line supply on the drive end of this circuit breaker. Otherwise, the residual current operated circuit breaker can trip erroneously if the direct-current component is asymmetrically withdrawn in certain operating states.

9.7.4.1 Single operation

Within the drive line-up, the Control Supply Module must be connected to the drive line-up via the DC link busbars as well as the 24 V busbars. The 24 V connector from the accessories pack must always be inserted. The DIP switch on the Control supply Module must be set to "single mode" The connection can be established as shown below.

The supply for other 24 V loads outside the drive line-up using additional Control Supply Modules, whose outputs are not connected in parallel, must be realized using a separate 24 V terminal adapter. Do not insert the 24 V connector.



1) Permissible types, see "Technical data"
2) The line connection must always be available.
3) DI/DO, controlled from the Control Unit
4) No additional load/consumer is permitted after the line contactor
5) The current carrying capacity of the DO should be taken into account; it may be necessary to use an output interface relay.
6) Contact established through the rear mounting panel or shield rails in accordance with the EMC installation guideline

Figure 9-21 Connection example for Control Supply Module in single operation

9.7.4.2 Parallel operation

A maximum of 10 Control Supply Modules can be connected in parallel.

The DIP switch of the Control Supply Module must be set to "parallel mode". The same output voltage must be set for all modules at the potentiometer.

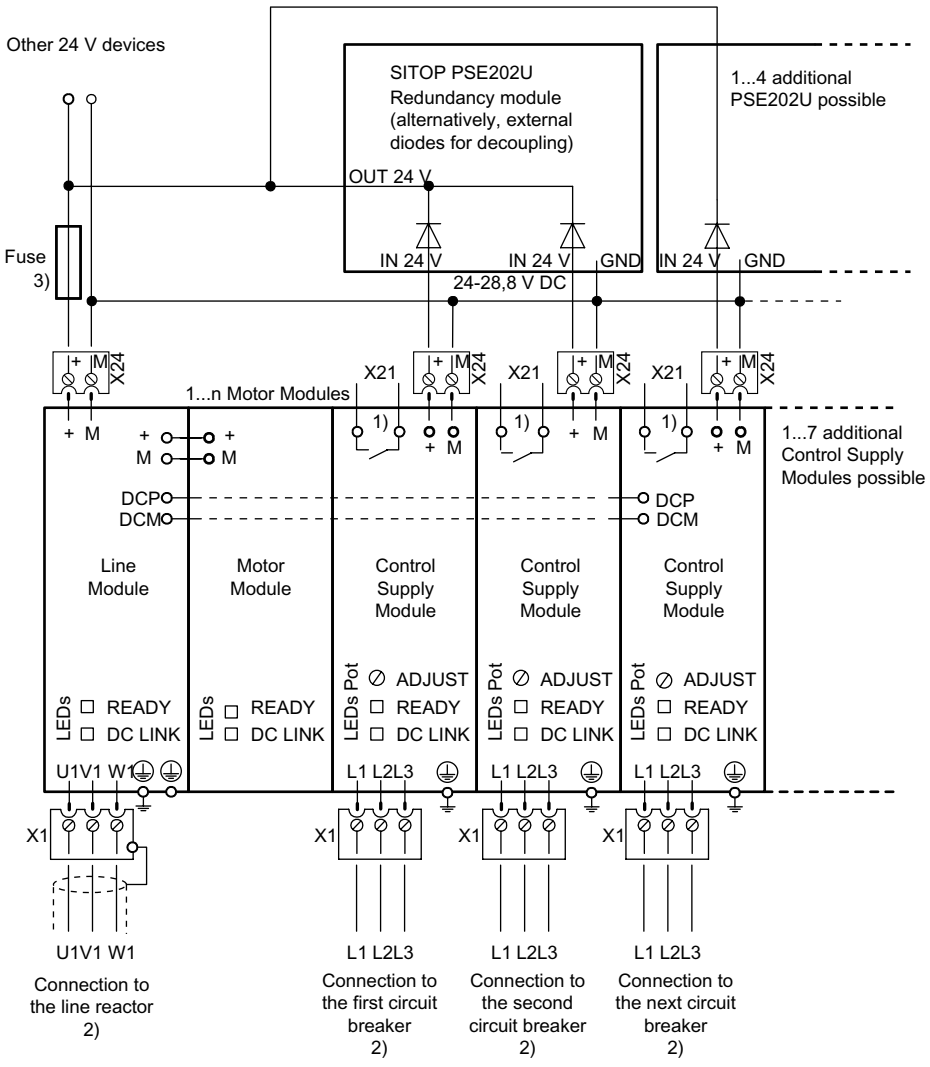
In the parallel mode, each Control Supply Module should supply the 24 V DC voltage via the 24 V terminal adapter. This is the reason that the 24 V connector must **not** be used (see connection examples).

For a parallel connection, we recommend that a SITOP redundancy module (6EP1961-3BA2.) is used. One SITOP redundancy module must be used for two Control Supply Modules in this case. Alternatively, a connection with external diodes to decouple the individual Control Supply Modules is possible. If a Control Supply Module fails, an alarm is generated and provided via the X21 signaling contact. The 24 V supply is maintained via the second module.

Note

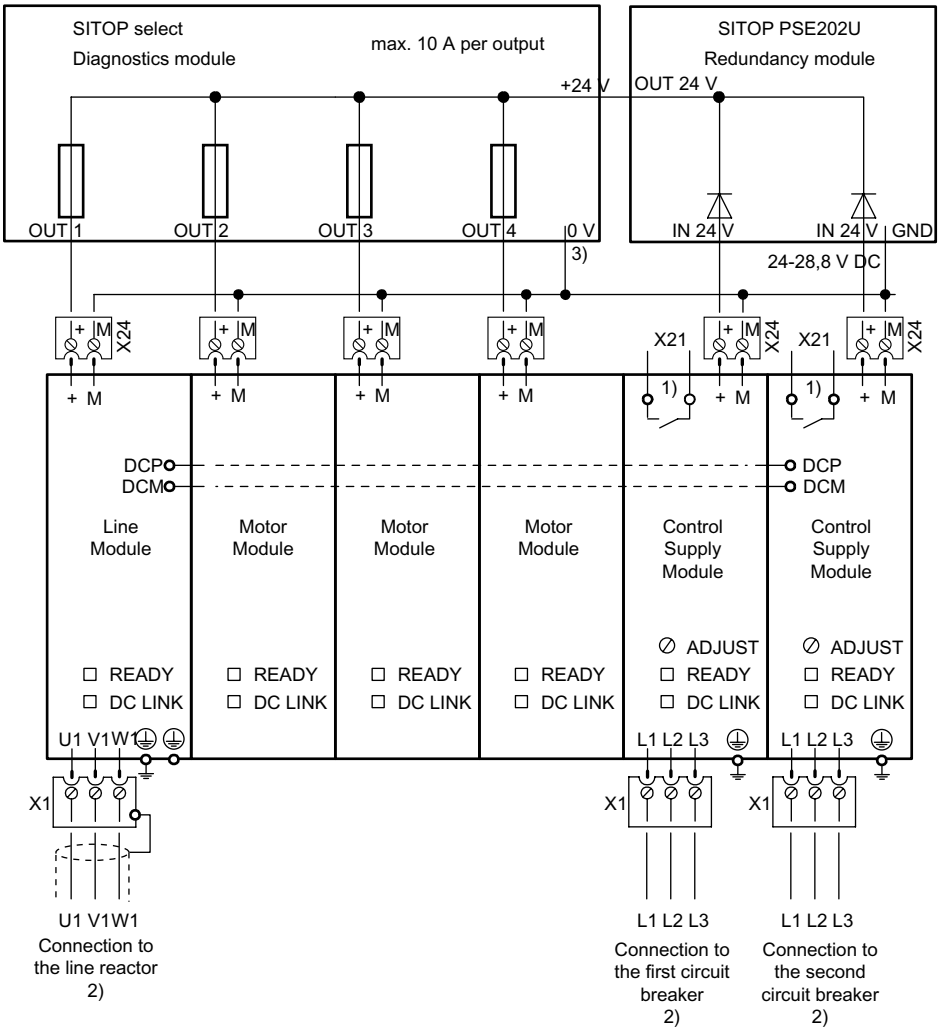
Parallel connection

Only Control Supply Modules with article number 6SL3100-1DE22-0AA1 may be used for parallel connection.



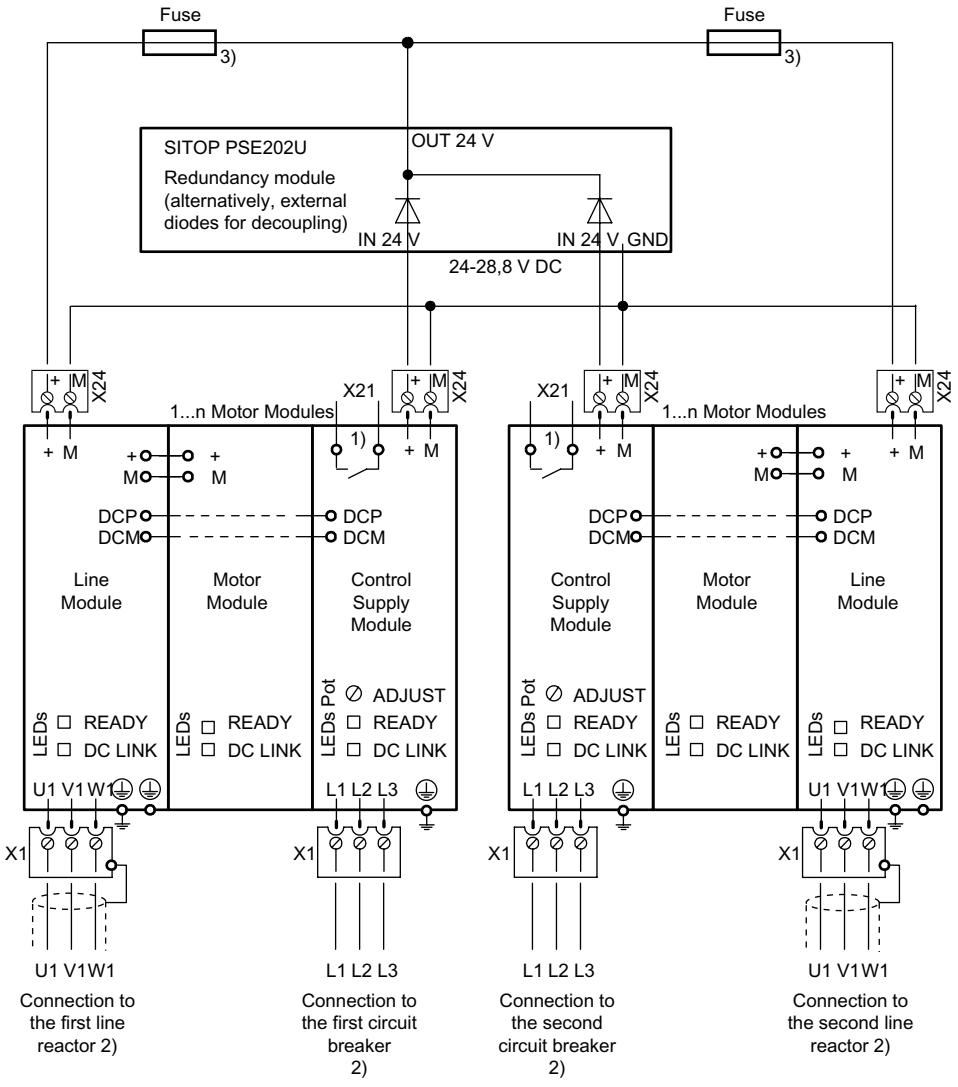
1) Connection to digital interface (SCADA or PLC); closed means: 24 V OK
2) Continue as in "Connection example for Control Supply Module in single operation"
3) Max. permissible 20 A continuous current (refer to the fuse characteristics)

Figure 9-22 Connection example for parallel connection of 2 to 10 Control Supply Modules via a SITOP PSE202U redundancy module



1* Connection to digital interface (SCADA or PLC); closed means: 24 V OK
2* Continue as in "Connection example for Control Supply Module in single operation"
3* Functional reference point (not capable of a high current load)

Figure 9-23 Connection example for parallel connection of Control Supply Modules via a SITOP PSE202U redundancy module and a SITOP select diagnostic module (6EP1961-2BA00)



1) Connection to digital interface (SCADA or PLC); closed means: 24 V OK
2) Continue as in "Connection example for Control Supply Module in single operation"
3) Max. permissible 20 A continuous current (refer to the fuse characteristics)

Figure 9-24 Connection example for operation of 2 units with Control Supply Modules via a SITOP PSE202U redundancy module

9.7.5 Meaning of LEDs

Table 9-27 Meaning of the LEDs on the Control Supply Module

LED	Color	Status	Description
READY	-	Off	The electronics power supply is outside the permissible tolerance range or the temperature prewarning is active.
	Green	Continuous light	Ready The output voltage is in the tolerance range and the temperature prewarning is inactive.
DC LINK	-	Off	DC input voltage $U_{E\,DC}$ < 280 ... 300 V Buffer operation is not possible.
	Orange	Continuous light	DC input voltage in the range 360 ... 380 V < $U_{E\,DC}$ < 820 V ± 3 % Buffer operation is possible
	Red	Continuous light	DC input voltage outside the tolerance range: $U_{E\,DC}$ < 360 ... 380 V or $V_{E\,DC}$ > 820 V ± 3 %

9.7.6 Dimension drawing

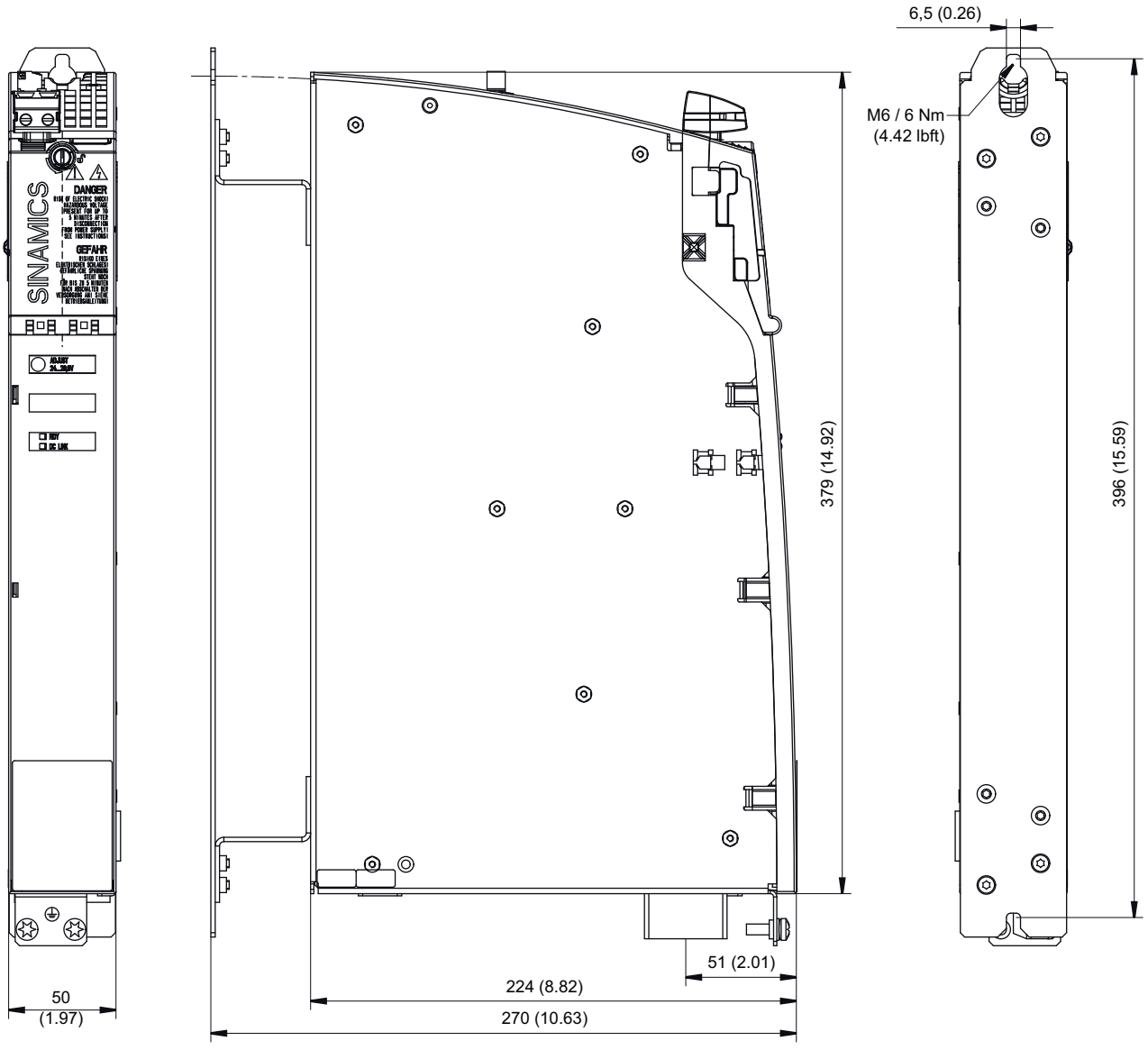
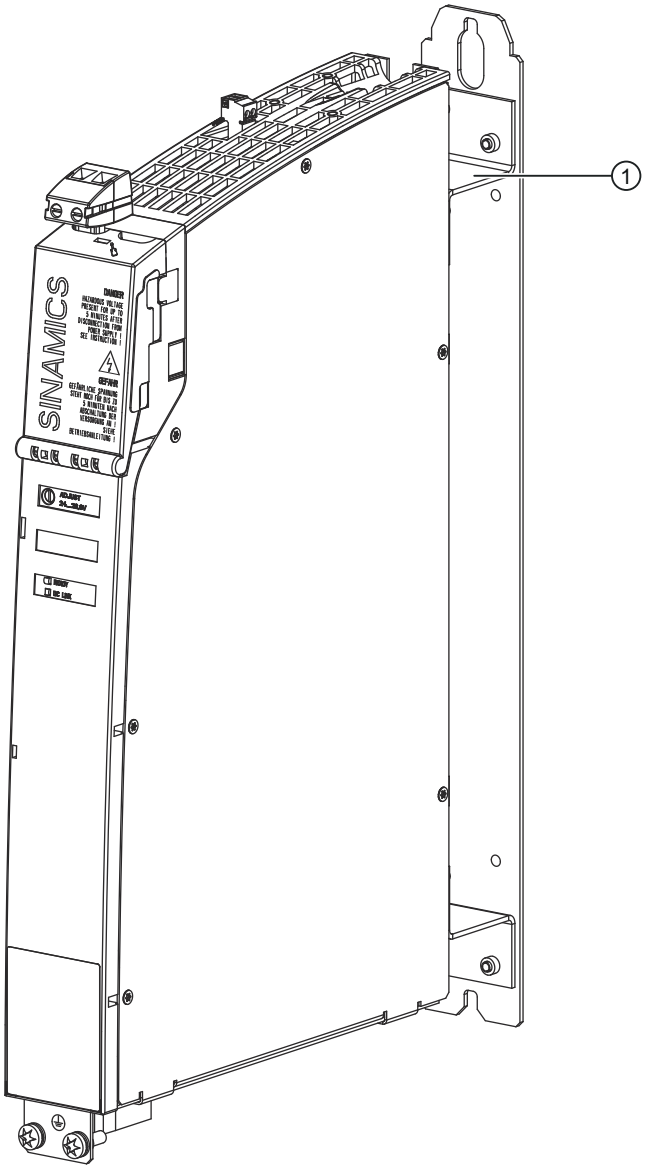


Figure 9-25 Dimension Control Supply Module, all dimensions in mm and (inches)

9.7.7 Installation



① Delivered with spacers - mounting depth for drive line-up in booksize format with internal air cooling

Figure 9-26 Mounting the Control Supply Module with spacers

The Control Supply Module can be attached to the control cabinet panel or mounting panel with or without spacers.

9.7.8 Technical data

Table 9-28 Technical specifications

6SL3100-1DE22-0AA1	Unit	Value
Input data, AC input		
Line voltage Line frequency	V_{AC} Hz	3 AC 380 ... 480 ± 15% 47 ... 63
Input currents at AC 380 V / AC 480 V	 A_{AC}	 1.8 / 1.4
Starting current inrush	A_{AC}	≤ 28 at > 5 ms
Input data, DC input		
Input voltage range (continuous)	V_{DC}	430 ... 800 (acc. to IEC and UL 61800-5-1 max. 800 V_{DC})
DC link voltage	V_{DC}	300 ... 430 < 1 min 800 ... 853 < 1 min 853 ... 882 < 10 s
Overvoltage trip Undervoltage trip	V_{DC} V_{DC}	> 882 280 ± 3 %
DC link current at 510 V DC / 720 V DC at 430 V DC / 800 V DC	 A_{DC} A_{DC}	 1.3 / 0.9 1.5 / 0.8
Output data		
Rated output voltage $V_{A\ rated}$	V_{DC}	26 (24 ... 28.8)
Rated output current $I_{A\ rated}$	A_{DC}	20
Rated output power $P_{A\ rated}$	W	520
Overcurrent limitation for short-circuit	A_{DC}	approx. 23
Surge suppression	V	< 35
Current-carrying capacity of the 24 V busbar	A_{DC}	20
Residual ripple (clock frequency approx. 50 kHz)	mV_{pp}	< 100
Switching peaks (bandwidth 20 MHz)	mV_{pp}	< 200
Line failure buffer (at 400 V AC)	ms	5
Power loss Line DC link	 W W	 70 65
Efficiency	%	> 83
Circuit breaker[1)] UL listed DIVQ / IEC: 3RV2711-1D... - 3RV2711-4A...	 A	 3.2 ... 15 (AC 480Y / 277 V)
Motor circuit breaker (type E, combination motor controller)[1)] UL listed NKJH / IEC: 3RV2011-1DA.. - 3RV2021-1DA.. (only UL: additional terminal block 3RV2928-1H)	A	2.2 ... 3.2 (AC 480Y / 277 V), setting value: 3.2
Fuses (UL)[1)] UL listed JDDZ: Class RK1, J, CC, CF IEC: 3NA3801, 3NC1006, 3NW6001	 A A	 6 (≥ 480 V_{AC}) 6
Miniature circuit breaker IEC: 5SY7306-7	 A	 6
Ambient temperature	°C	0 ... 55

6SL3100-1DE22-0AA1	Unit	Value
Cooling method		Internal air cooling
Ventilation clearances above/below	mm	≥ 80
Weight	kg	4.8

[1] When using circuit breakers for protection, UL approval is only possible in TN/TT line systems with grounded neutral point.
Conventional fuses are required for UL approval in line supplies with grounded line conductor.
The specified circuit breakers are permissible for UL and IEC.
For applications according to IEC, equivalent circuit breakers and fuses are permissible.

9.7.8.1 Characteristics

Output current derating

For output voltages > 26 V, the output current must be linearly derated from 20 A @ 26 V to 18 A @ 28.8 V. The maximum output power must not exceed 520 W.

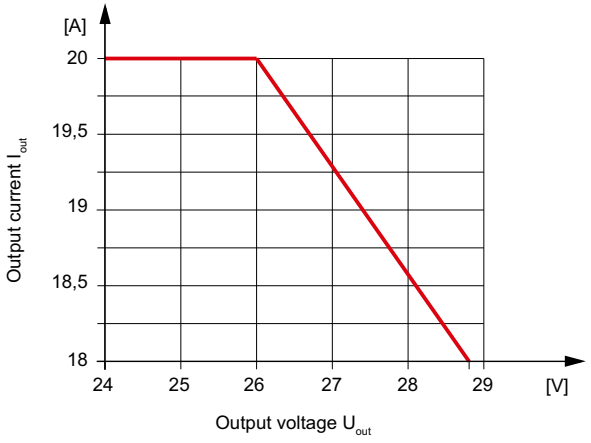


Figure 9-27 Current derating for output voltages > 26 V

Derating of the output current as a function of the installation altitude

Derating is not required up to an installation altitude of 2000 m

Above an installation altitude of 2000 m, a linear derating of 10 % per 1000 meters is required.

Braking resistors

10

10.1 Description

A braking resistor is used to dissipate the excess DC link energy in generator operation. The braking resistors can be connected to a Braking Module or directly to a 20 kW or 40 kW Basic Line Module.

Resistors with and without a thermostatic switch are available with various rated powers. The thermostatic switch monitors the braking resistors for overtemperature and issues a signal at an isolated contact if the limit value is exceeded.

Table 10-1 Assignment of braking resistors

Braking resistor	Braking Module Booksize	Braking Module Booksize Compact	Basic Line Module 20 kW	Basic Line Module 40 kW
Braking resistors without a thermostatic switch				
6SN1113-1AA00-0DA0 Resistance: 17 Ω P_{rated}: 0.3 kW	X	X	-	-
6SL3100-1BE31-0AA1 Resistance: 5.7 Ω P_{rated}: 1.5 kW	X	X	-	-
Braking resistors with a thermostatic switch				
6SE7018-0ES87-2DC0 Resistance: 80 Ω P_{rated}: 1.25 kW	-	X	X	X
6SE7021-6ES87-2DC0 Resistance: 40 Ω P_{rated}: 2.5 kW	-	X	X	X
6SE7023-2ES87-2DC0 Resistance: 20 Ω P_{rated}: 5 kW	-	X	X	X
6SE7028-0ES87-2DC0 Resistance: 8 Ω P_{rated}: 12.5 kW	-	-	-	X

Installation

The braking resistors can be installed standing on the floor of the control cabinet or suspended. You must ensure that the braking resistors do not obstruct the flow of cooling air to the drive line-up.

Positioning the braking resistor outside the control cabinet or switchgear room enables the resulting thermal losses to be routed away. This reduces the level of air conditioning required.

Connection cables

A shielded connecting cable (3 m, 3 x 1.5 mm^2) is supplied with braking resistor 6SN1113-1AA00-0DA0.

All other braking resistors are supplied without a connection cable. The maximum conductor cross-sections are listed in the technical data.

The maximum cable length for all braking resistors is 10 m.

10.2 Safety instructions for braking resistors

⚠ WARNING

Fire as a result of ground fault/short-circuit

Inadequate installation of the cables to the braking resistor can result in a ground fault/short-circuit and place persons at risk as a result of the associated smoke and fire.

- Use the local installation regulations to avoid this fault.
- 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.



⚠ CAUTION

Burns due to high surface temperatures

The braking resistor can become very hot. You can get seriously burnt when touching the surface.

- Mount the braking resistors so that contact is not possible. If this is not possible, attach a clearly visible and understandable warning notice at hazardous positions.

10.3 Dimension drawings and installation

Braking resistors without a thermostatic switch

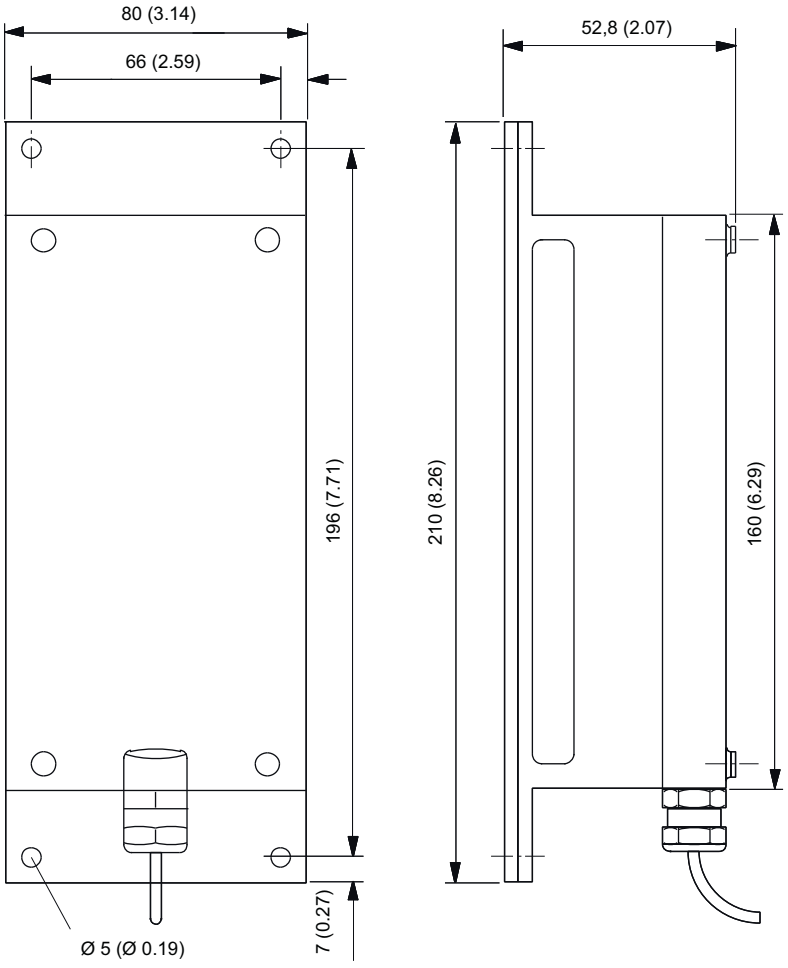


Figure 10-1 Dimension drawing of braking resistor 6SN1113-1AA00-0DA0 where P_n/P_{max} = 0.3 kW/25 kW, all dimensions in mm and (inches)

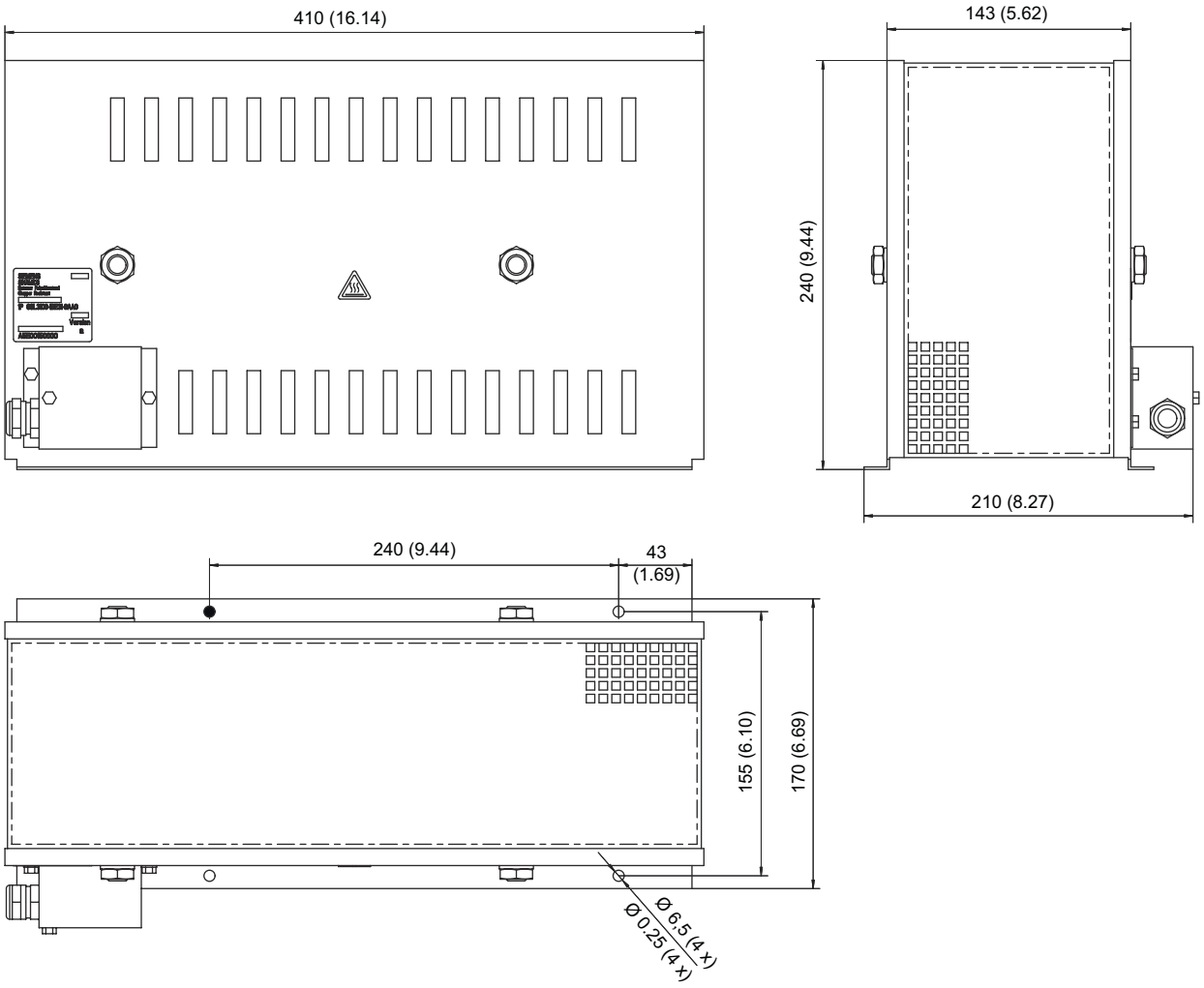


Figure 10-2 Dimension drawing of braking resistor 6SL3100-1BE31-0AA1 where P_n / P_{max} = 1.5 kW / 100 kW, all dimensions in mm and (inches)

Braking resistors with a thermostatic switch

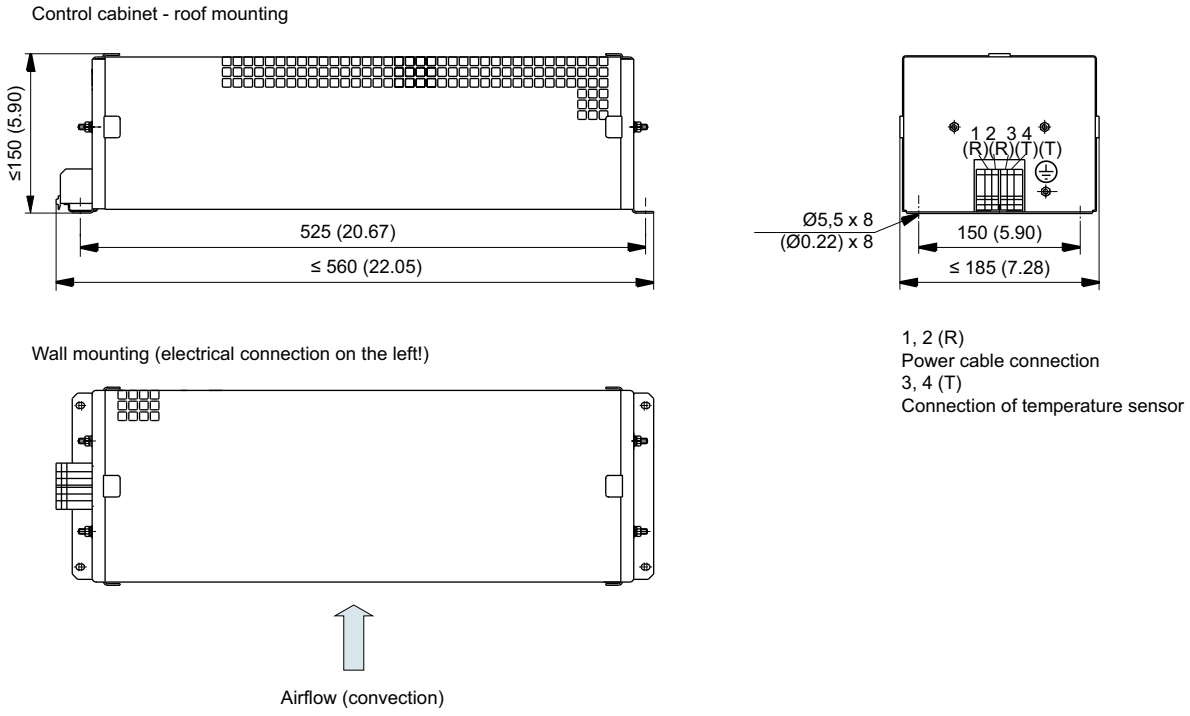


Figure 10-3 Dimension and installation drawing (roof and wall mounting) of braking resistor 6SE7018-0ES87-2DC0 where P_n/P_{max} = 1.25 kW/7.5 kW, all dimensions in mm and (inches)

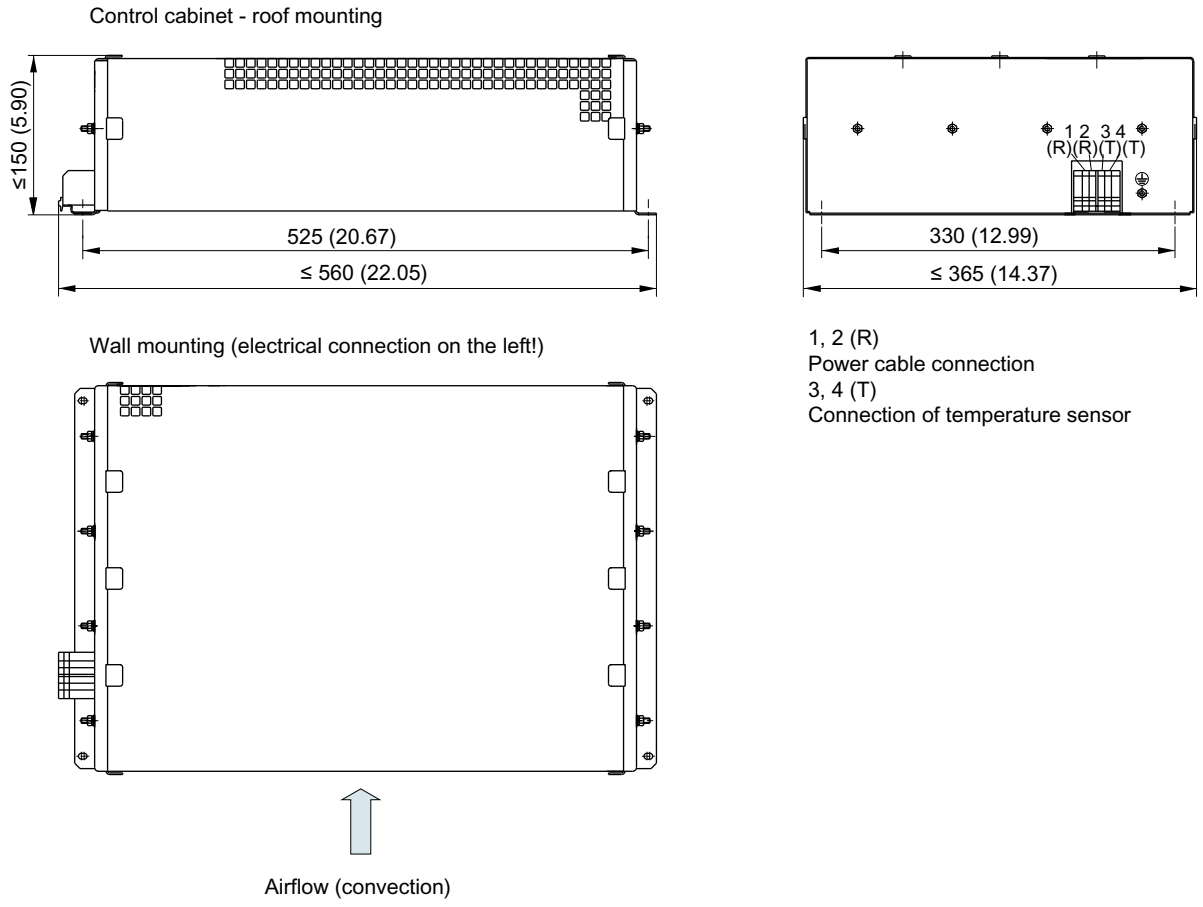
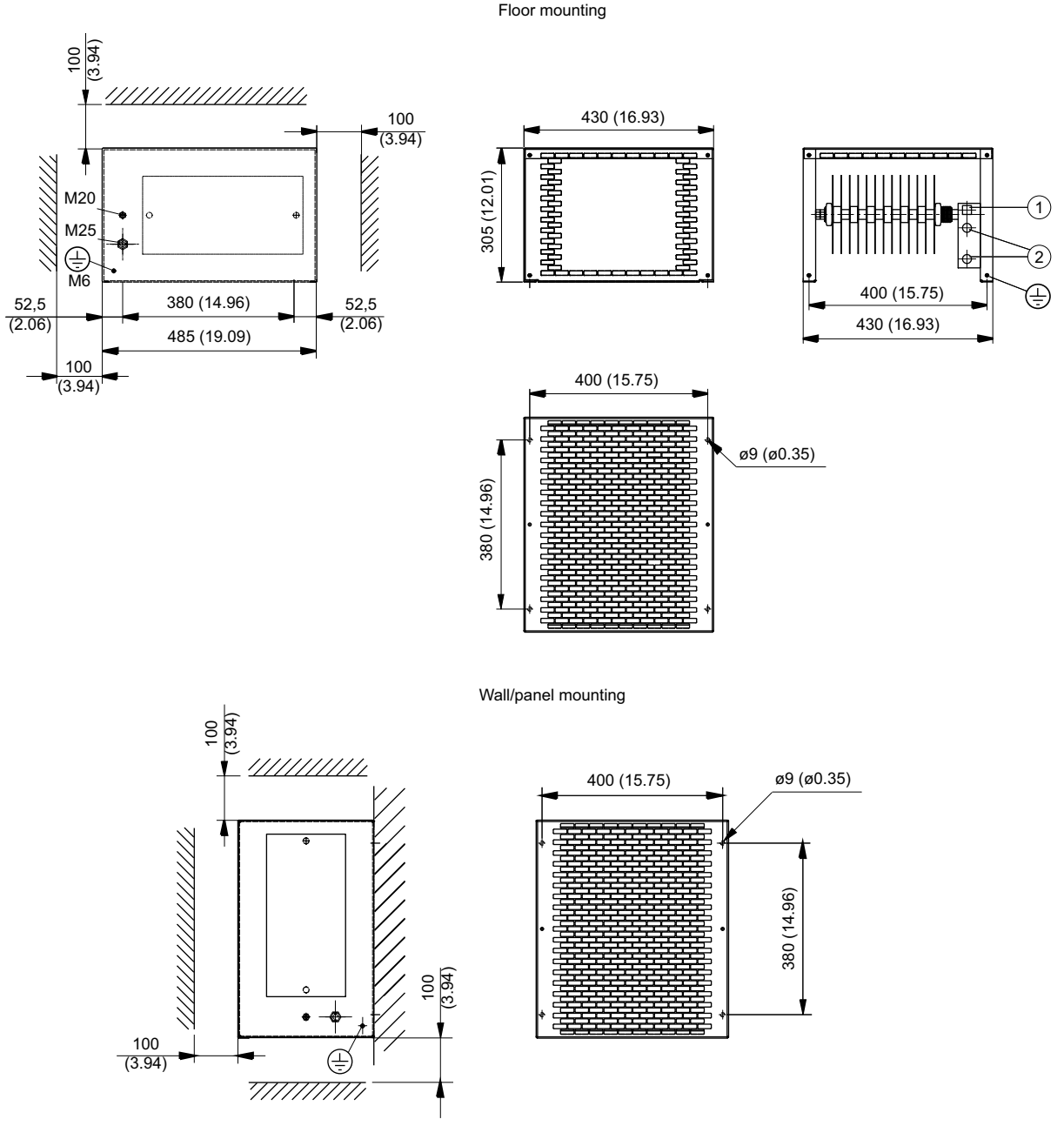


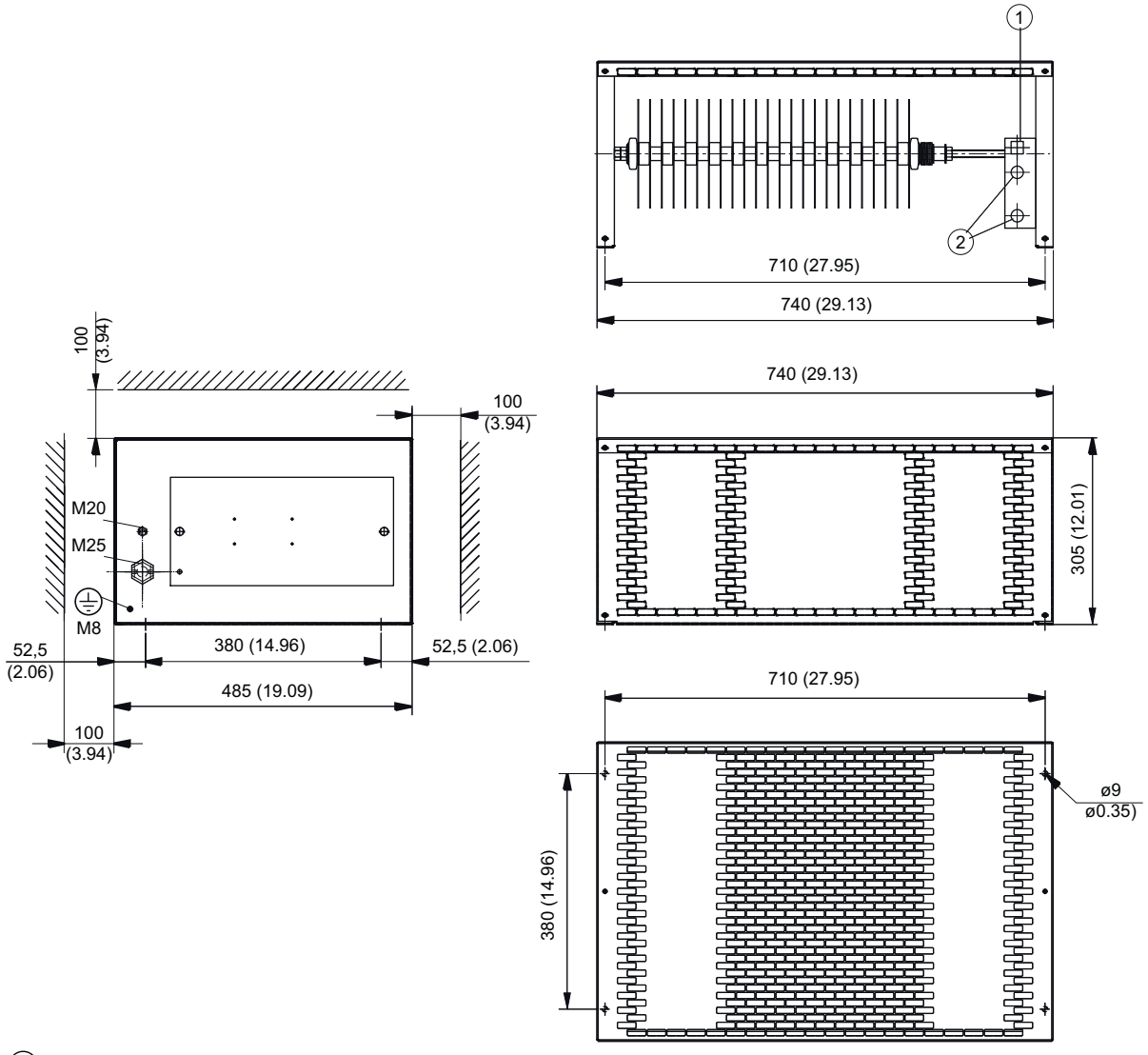
Figure 10-4 Dimension and installation drawing (roof and wall mounting) of braking resistor 6SE7021-6ES87-2DC0 where P_n/P_{max} = 2.5 kW/15 kW, all dimensions in mm and (inches)



① Connection for thermostatic switch T1/T2 with conductor cross-section 2.5 mm^2

② Connection for power cable, 2 x M6 bolts

Figure 10-5 Dimension and installation drawing (floor and wall mounting) of braking resistor 6SE7023-2ES87-2DC0 where P_n/P_{max} = 5 kW/30 kW, all dimensions in mm and (inches)



① Connection for thermostatic switch T1/T2 with conductor cross-section 2.5 mm²

② Connection for power cable, 2 x M6 bolts

Figure 10-6 Dimension and installation drawing (floor mounting) of braking resistor 6SE7028-0ES87-2DC0 where P_n/P_{max} = 12.5 kW/75 kW, all dimensions in mm and (inches)

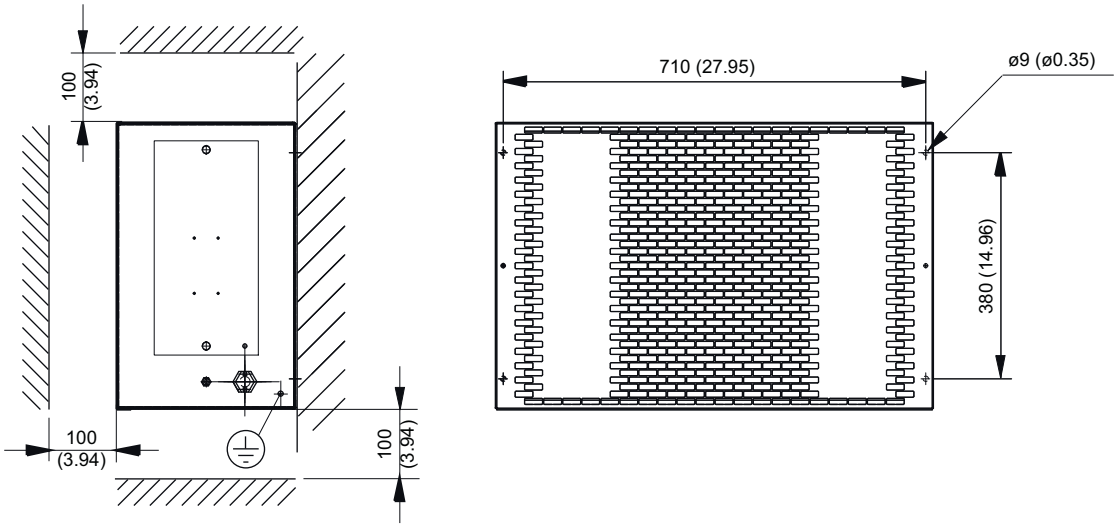


Figure 10-7 Installation drawing (wall mounting) of braking resistor 6SE7028-0ES87-2DC0 where P_n/P_{max} = 12.5 kW/75 kW, all dimensions in mm and (inches)

10.4 Technical data

Table 10-2 Technical specifications for braking resistors without a thermostatic switch

	Unit	6SN1113–1AA00–0DA0	6SL3100–1BE31–0AA1
Resistance R	Ω	17	5.7
Rated power P_{rated}	kW	0.3	1.5
Peak power P_{max}	kW	25	100
Max. energy consumption E_{max}	kWs	10	200
Power cable connection		Included in scope of delivery; length 3 m, 3 x 1.5 mm² (3 x AWG 16)	Screw terminal[1], 4 mm² (AWG 12)
Ventilation clearances (all around)	mm	≥ 100	
Weight	kg	3.4	5.8
Dimensions (W x H x D)	mm	80 x 210 x 53	210 x 410 x 240
Degree of protection to IEC 60529		IP54	IPXXB
Approvals		cULus	cULus

[1] Recommended connection cross-section: 4 mm² (AWG 12)

Table 10-3 Technical specifications for braking resistors with a thermostatic switch

	Unit	6SE7018-0ES87-2DC0	6SE7021-6ES87-2DC0	6SE7023-2ES87-2DC0	6SE7028-0ES87-2DC0
Resistance R	Ω	80	40	20	8
Rated power P_{rated}	kW	1.25	2.5	5	12.5

	Unit	6SE7018-0ES87-2DC0	6SE7021-6ES87-2DC0	6SE7023-2ES87-2DC0	6SE7028-0ES87-2DC0
Braking power 4 x P_{rated}	kW	5	10	20	50
Peak power P_{max} [1]	kW	7.5	15	30	75
Max. energy consumption E_{max} at P_{max} at $4xP_n$	 kWs kWs	 22.5 100	 45 200	 90 400	 225 1000
Thermostatic switch connection		Screw terminal [2], 4 mm² (AWG 12)	Screw terminal [2], 4 mm² (AWG 12)	Screw terminal [2], 2.5 mm² (AWG 14)	Screw terminal [2], 1.5 mm² (AWG 16)
Power cable connection		Screw terminal [3], 4 mm² (AWG 12)	Screw terminal [3], 4 mm² (AWG 12)	M6 threaded bolts for ring cable lug [4]	M6 threaded bolts for ring cable lug [5]
PE/ground connection		M5 bolt	M5 bolt	M6 bolt	M6 bolt
Ventilation clearances (all around)	mm	≥ 100			
Weight	kg	6	12	17	27
Dimensions (W x H x D)	mm	145 x 180 x 540	145 x 360 x 540	450 x 305 x 485	745 x 305 x 485
Degree of protection to IEC 60529		IPXXB	IPXXB	IPXXB	IPXXB

[1] Applies to a DC link voltage of 760 V

[2] Recommended connection cross-section: 0.75 to 1.5 mm² (AWG 19 ... 16)

[3] Recommended connection cross-section: 2.5 mm² (AWG 14)

[4] Recommended connection cross-section: 4 mm² (AWG 12)

[5] Recommended connection cross-section: 10 mm² (AWG 6)

Recommendation

The MC500 or MC800 motor cable should be used as connecting cable.

10.4.1 Characteristic curves

Duty cycle for braking resistors without a thermostatic switch

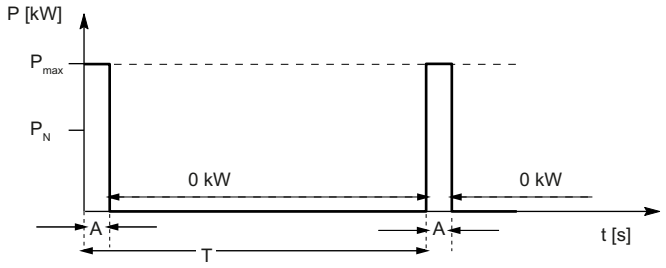


Figure 10-8 Duty cycle for braking resistors without a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

P_{rated} [kW] rated power (continuous power) of the braking resistor

P_{max} [kW] peak braking power of the braking resistor

Table 10-4 Duty cycles for Braking Module Booksize

	6SN1113–1AA00–0DA0		**6SL3100–1BE31–0AA.**	
	Short duty cycle	Long duty cycle	Short duty cycle	Long duty cycle
A [s]	0.1	0.4	1	2
T [s]	11.5	210	68	460

Table 10-5 Duty cycles for Braking Module Booksize Compact

	6SN1113–1AA00–0DA0		**6SL3100–1BE31–0AA.**	
	Short duty cycle	Long duty cycle	Short duty cycle	Long duty cycle
A [s]	0.1	0.4	1	2
T [s]	11.5	46	68	136

The following applies when connecting Braking Modules in parallel:

$P_{rated\ total}$ = 0.9 x total P_{rated} of single devices

$P_{max\ total}$ = total P_{max} of single devices

Duty cycles for braking resistors with a thermostatic switch

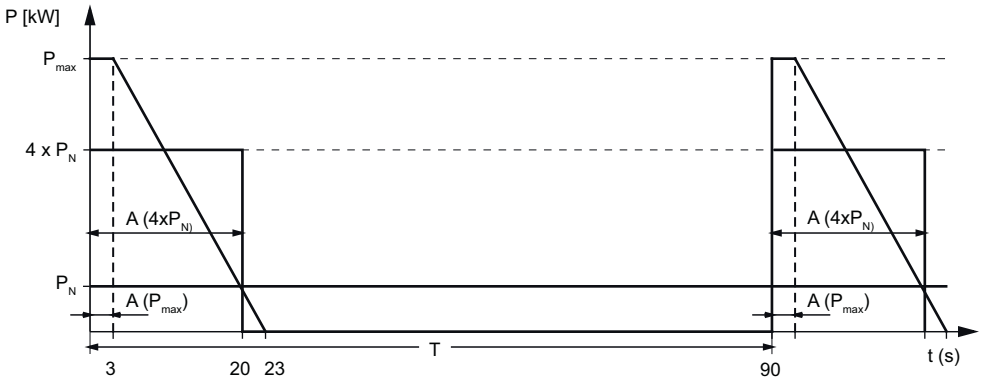


Figure 10-9 Duty cycles for braking resistors with a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

P_{rated} [kW] rated power (continuous power) of the braking resistor

P_{max} [kW] peak braking power of the braking resistor

4 x P_{rated} [kW] = power permitted every 90 s for 20 s

Table 10-6 Duty cycles

	6SE7018-0ES87-2DC0		**6SE7021-6ES87-2DC0**		**6SE7023-2ES87-2DC0**		**6SE7028-0ES87-2DC0**	
	Duty cycle P_{max}	Duty cycle 4 x P_{rated}	Duty cycle P_{max}	Duty cycle 4 x P_{rated}	Duty cycle P_{max}	Duty cycle 4 x P_{N0}	Duty cycle P_{max}	Duty cycle 4 x P_{rated}
A [s]	3	20	3	20	3	20	3	20
T [s]	90	90	90	90	90	90	90	90

The following applies when connecting Braking Modules in parallel:

$P_{rated\ total}$ = 0.9 x total P_{rated} of single devices

4 x $P_{rated\ total}$ = 0.9 x sum (4 x P_{rated}) of single devices

$P_{max\ total}$ = total P_{max} of single devices

Motor-side power components

11

11.1 Motor reactors

11.1.1 Description

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

At the same time, the stress on the motor windings caused by rates of voltage rise (dv/dt) is also diminished.

Preconditions

• Maximum ambient temperature:	40 °C without derating 55 °C with derating
• Maximum pulse frequency	4 kHz
• Maximum output frequency:	120 Hz
• Maximum current limit:	2 x rated current
• Operating modes:	Vector control and U/f control

Support in STARTER

• From Version 2.4 and higher:	up to 1 motor reactor
• From Version 2.5 and higher:	up to 3 motor reactors

Support in Startdrive

• From Version 4.8 and higher	up to 3 motor reactors

11.1.2 Safety instructions for motor reactors



⚠ WARNING

Electric shock in the event of missing touch protection

Touching live components can result in death or severe injury.

- For 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 suffering damage due to these high temperatures, maintain a clearance of 100 mm on all sides of the motor reactors.

NOTICE

Damaged device due to use of incorrect motor reactors

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

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

Note

Maximum cable length of the connection cables

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

11.1.3 Interface description

Depending on the type, the motor reactors are connected via socket outlets or flat connectors.

Motor reactors with connecting terminals

The smaller motor reactors have clearly designated connecting terminals (1U1, 1V1, 1W1, 1U2, 1V2 and 1W2).

Article No.	Rated current [A]	Connecting terminals
6SE7021-0ES87-1FE0	5	Screw terminals 4 mm^2 (AWG 12)
6SL3000-2BE21-0AA0	9	Screw terminals 16 mm^2 (AWG 6)
6SE7022-6ES87-1FE0	18	Screw terminals 16 mm^2 (AWG 6)

Motor reactors with flat connectors

Motor reactors for Motor Modules with rated currents from 30 ... 200 A are connected using flat connectors.

Article No.	Rated current [A]	Flat connector
6SE7024-0ES87-1FE0	30	M8 screw
6SE7027-2ES87-1FE0	45	M8 screw
6SE7031-5ES87-1FE0	85	M8 screw
6SE7031-8ES87-1FE0	132	M10 screw
6SE7032-6ES87-1FE0	200	M10 screw



Figure 11-1 Connections of motor reactors 6SE70xx-... ab 30 A

Article No.	Rated current [A]	Flat connector
6SL3000-2BE26-0AA0	60	M8 screw

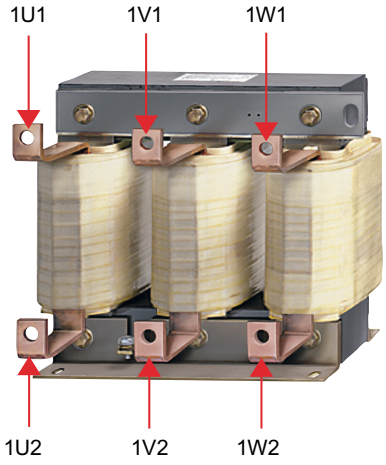


Figure 11-2 Connections of motor reactor 6SL3000-2BE26-0AA0

11.1.4 Dimension drawings

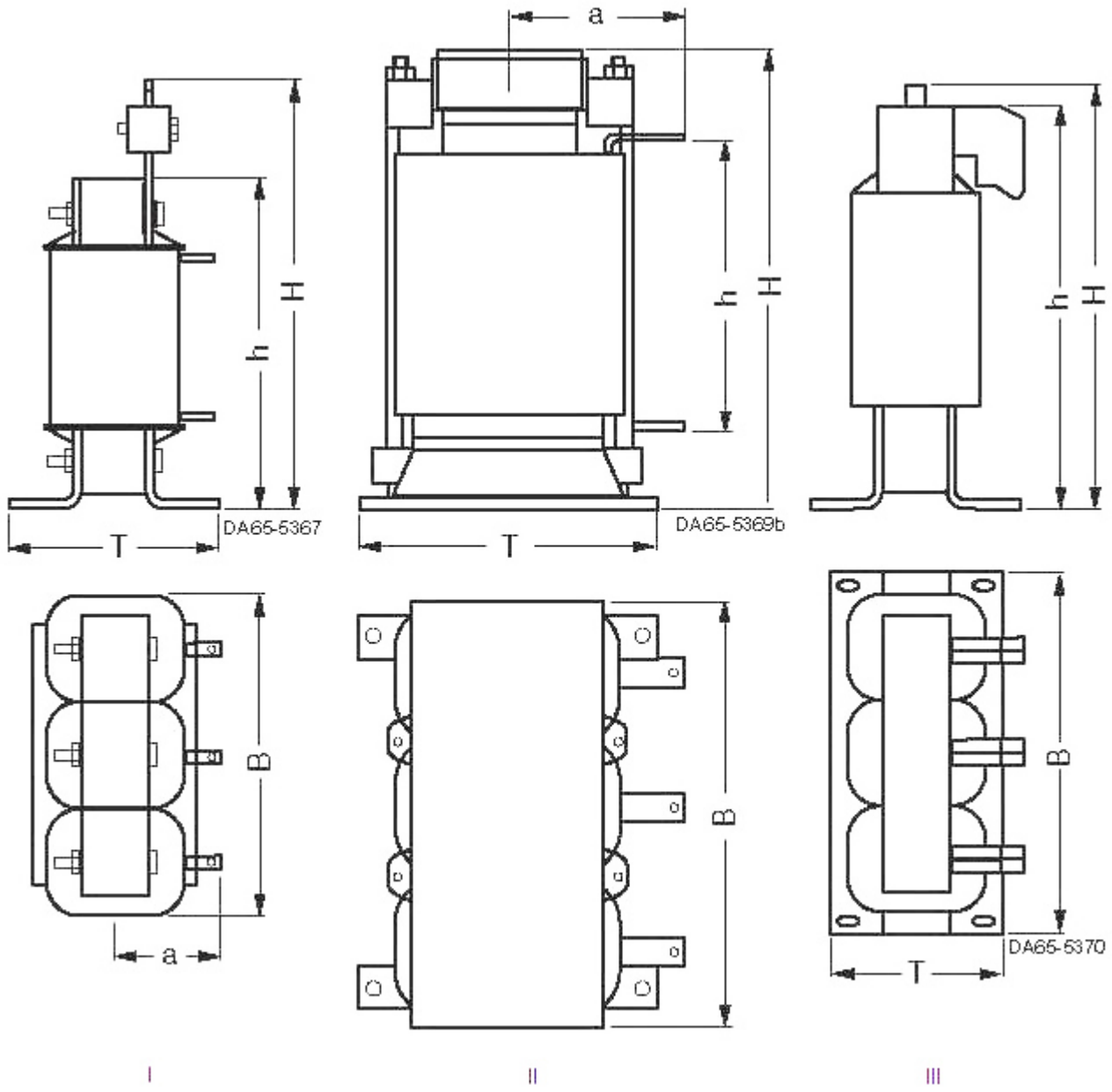


Figure 11-3 Dimension drawings of motor reactors

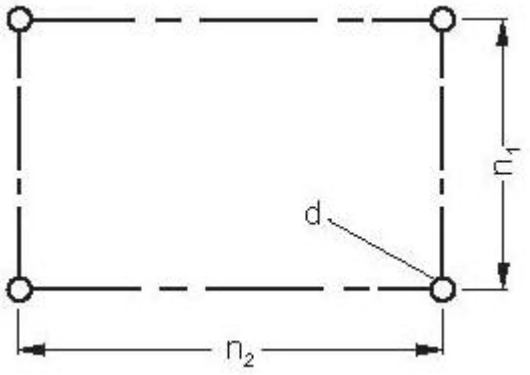


Figure 11-4 Mounting hole

Table 11-1 Dimensions of motor reactors, all dimensions in mm and (inches)

	6SE7021-0ES87-1FE0	**6SE7022-6ES87-1FE0**	**6SE7024-7ES87-1FE0**	**6SE7027-2ES87-1FE0**
	Fig. III	**Fig. III**	**Fig. II**	**Fig. I**
B	178 (7.00)	219 (8.62)	197 (7.75)	267 (10.51)
H	153 (6.02)	180 (7.08)	220 (8.66)	221 (8.70)
T	88 (3.46)	119 (4.68)	104 (4.09)	107 (4.21)
a	-	-	69 (2.71)	77 (3.03)
h	146 (5.74)	181 (7.12)	103 (4.05)	206 (8.11)
n_1	68 (2.67)	89 (3.50)	70 (2.75)	77 (3.03)
n_2	166 (6.53)	201 (7.91)	176 (6.92)	249 (9.80)
d	M5	M6	M6	M6
Lengths n1 and n2 correspond to the distances between holes				

Table 11-2 Dimensions of motor reactors, all dimensions in mm and (inches)

	6SE7031-5ES87-1FE0	**6SE7031-8ES87-1FE0**	**6SE7032-6ES87-1FE0**
	Fig. II	**Fig. II**	**Fig. II**
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)
d	M6	M8	M8
Lengths n1 and n2 correspond to the distances between holes			

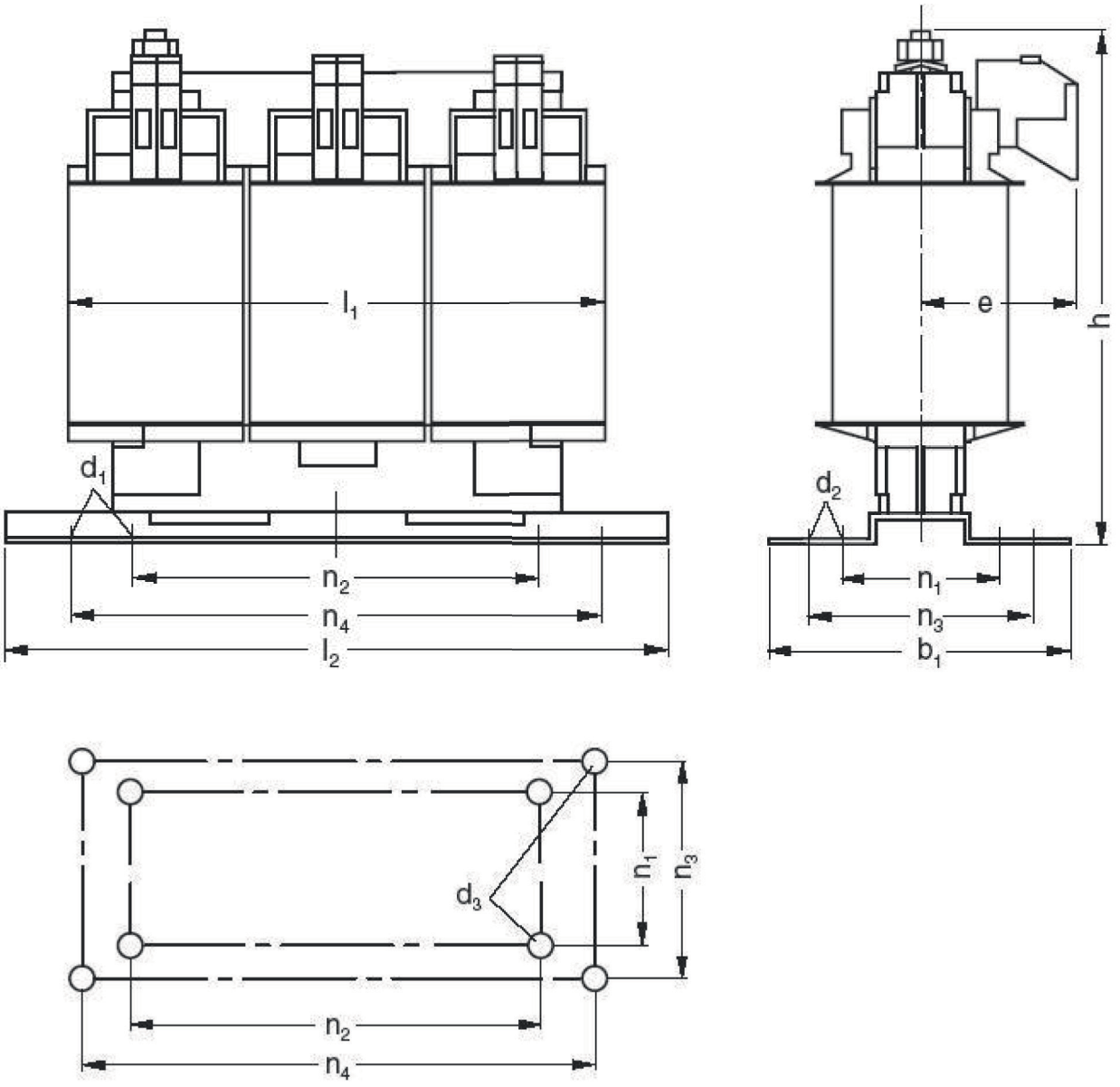


Figure 11-5 Dimension drawing and mounting hole of motor reactor 9 A (6SL3000-2BE21-0AA0)

Table 11-3 Dimensions of motor reactor 9 A, all dimensions in mm and (inches)

6SL3000-2BE21-0AA0	
l_1	150 (5.90)
l_2	178 (7.00)
b_1	88 (3.46)
b_{max}	111 (4.37)
e	67 (2.63)
h	159 (6.25)
n_1	64 (2.51)
n_2	113 (4.44)

6SL3000-2BE21-0AA0	
n_3	68 (2.67)
n_4	166 (6.53)
d_1	5.8 (0.22)
d_2	11 (0.43)
d_3	M5
Protective conductor	M6
Lengths n_1, n_2, n_3 and n_4 correspond to the distances between holes	

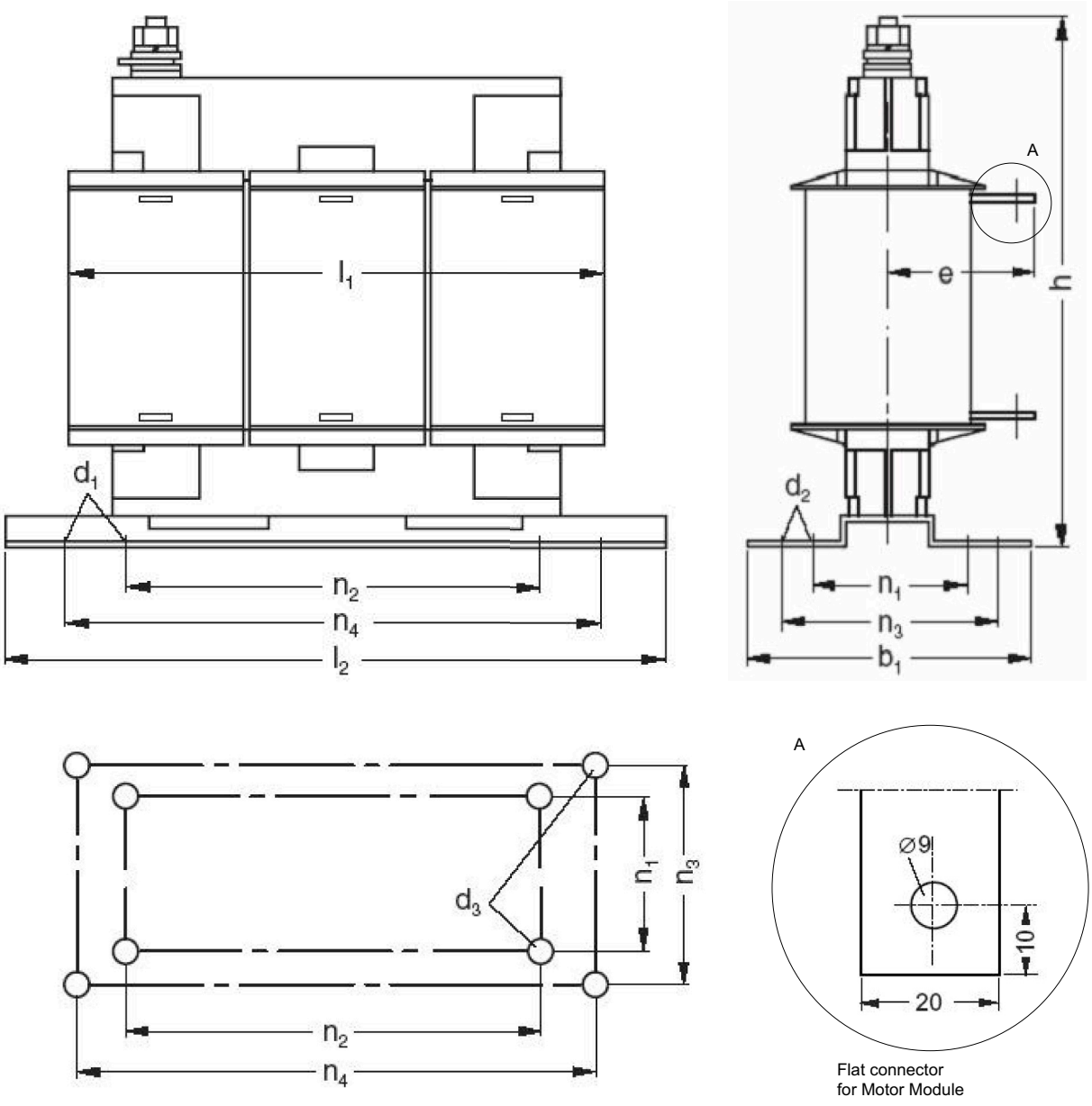


Figure 11-6 Dimension drawing and mounting hole of motor reactor 60 A (6SL3000-2BE26-0AA0)

Table 11-4 Dimensions of motor reactor 60 A, all dimensions in mm and (inches)

6SL3000-2BE26-0AA0	
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)
d_1	36 (1.41)
d_2	3.5 (0.13)
d_3	M6
Protective conductor	M6
Lengths n_1, n_2, n_3 and n_4 correspond to the distances between holes	

11.1.5 Technical data

Table 11-5 Technical data, motor reactors, part 1

Article No.		**6SE7021-0ES87-1FE0**	**6SL3000-2BE21-0AA0**	**6SE7022-6ES87-1FE0**
Suitable for Motor Module		6SL3120-1TE13-0AD. 6SL3120-2TE13-0AD. 6SL3120-1TE15-0AD. 6SL3120-2TE15-0AD. 6SL3420-2TE11-7AA. 6SL3420-1TE13-0AA. 6SL3420-2TE13-0AA. 6SL3420-1TE15-0AA. 6SL3420-2TE15-0AA.	6SL3120-1TE21-0AD. 6SL3120-2TE21-0AD. 6SL3420-1TE21-0AA.	6SL3120-1TE21-8A.. 6SL3120-2TE21-8A.. 6SL3420-1TE21-8AA.
Rated current	A	5	9	18
Maximum current	A	10	18	36
Inductance	µH	1243	1000	332
Power loss	W	80	90	110
Motor Module / Motor connection		Screw terminals 4 mm^2 (AWG 12)	Screw terminals 16 mm^2 (AWG 6)	Screw terminals 16 mm^2 (AWG 6)
Protective ground conductor connection		Threaded bolts M6		
Degree of protection		IP00	IP00	IP00

Article No.		**6SE7021-0ES87-1FE0**	**6SL3000-2BE21-0AA0**	**6SE7022-6ES87-1FE0**
Ventilation clearances above/below	mm	≥ 100		
Weight	kg	5.5	4.8	7.8
Mounting position		Any		

Table 11-6 Technical data, motor reactors, part 2

Article No.		**6SE7024-7ES87-1FE0**		**6SE7027-2ES87-1FE0**	**6SL3000-2BE26-0AA0**
Suitable for Motor Module		6SL3120-1TE22-4A..	6SL3120-1TE23-0A..	6SL312.-1TE24-5AC.	6SL3120-1TE26-0AC.
Rated current	A	30		45	60
Maximum current	A	60		90	120
Inductance	µH	180		59	62
Power loss	W	165	190	200	105
Motor Module / Motor connection		Flat connector for M8 screw			
Protective ground conductor connection		Threaded bolts M6			
Degree of protection		IP00			
Ventilation clearances above/below	mm	≥ 100			
Weight	kg	13		11	10.5
Mounting position		Any			

Table 11-7 Technical data, motor reactors, part 3

Article No.		**6SE7031-5ES87-1FE0**	**6SE7031-8ES87-1FE0**	**6SE7032-6ES87-1FE0**
Suitable for Motor Module		6SL3120-1TE28-5AA.	6SL3120-1TE31-3AA.	6SL3120-1TE32-0AA.
Rated current	A	85	132	200
Maximum current	A	170	264	400
Inductance	µH	29	23	16
Power loss	W	222	291	291
Motor Module / Motor connection		Flat connector for M8 screw	Flat connector for M10 screw	
Protective ground conductor connection		Threaded bolts M6		
Degree of protection		IP00		
Ventilation clearances above/below	mm	≥ 100		
Weight	kg	20.5	27.2	30.6
Mounting position		Any		

Table 11-8 Cable lengths, Part 1

Article No.	**6SE7021-0ES87 -1FE0**	**6SL3000-2BE21 -0AA0**	**6SE7022-6ES87 -1FE0**	**6SE7024-7ES87 -1FE0**	**6SE7027-2ES87 -1FE0**
Rated current [A]	5	9	18	30	45
Shielded cables					
Maximum motor cable length, 1 reactor	100	135	160	190	200
Maximum motor cable length, 2 reactors	-	-	320	375	400
Maximum motor cable length, 3 reactors	-	-	-	-	600
Unshielded cables					
Maximum motor cable length, 1 reactor	150	200	240	280	300
Maximum motor cable length, 2 reactors	-	-	480	560	600
Maximum motor cable length, 3 reactors	-	-	-	-	900

Table 11-9 Cable lengths, Part 2

Article No.	**6SL3000-2BE26 -0AA0**	**6SE7031-5ES87 -1FE0**	**6SE7031-8ES87 -1FE0**	**6SE7032-6ES87 -1FE0**
Rated current [A]	60	85	132	200
Shielded cables				
Maximum motor cable length, 1 reactor	200	200	200	200
Maximum motor cable length, 2 reactors	400	400	400	400
Maximum motor cable length, 3 reactors	600	600	600	600
Unshielded cables				
Maximum motor cable length, 1 reactor	300	300	300	300
Maximum motor cable length, 2 reactors	600	600	600	600
Maximum motor cable length, 3 reactors	900	900	900	900

11.2 Voltage Protection Module VPM

11.2.1 Description

The Voltage Protection Module (VPM) is a component for limiting voltage. It is used for both 1FE1 and 2SP1 motors and those with an electromagnetic force (EMF) of between 800 V and 2000 V to limit DC-link voltage if a fault occurs.

The Voltage Protection Module 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 of the power failure, the motor regenerates at high voltage into the DC link. The Voltage Protection Module recognizes that the motor voltage is too high (> 800 V) and uses an electronic switch to short-circuit the three phases of the motor at its supply lines. The power remaining in the motor is converted to heat via the short circuit between the Voltage Protection Module and motor cables.

The Voltage Protection Module is available in 3 versions.

Table 11-10 Overview of the Voltage Protection Modules available

Designation	Rated current
VPM120	120 A
VPM200	200 A
VPM200 Dynamic	200 A

Table 11-11 Interface overview for Voltage Protection Modules

Type	Number VPM120/VPM200	Number VPM200 Dynamic
Signaling contact	1	1
Protective conductor connection	2	4
Load connecting bolt, input	3	5
Load connecting bolt, output	3	5

11.2.2 Safety instructions for Voltage Protection Modules



⚠ WARNING

Electric shock due to the residual charge of the DC link capacitors

Due to the DC link capacitors of the converter, a hazardous voltage is present in the DC link for up to 30 minutes after the power supply has been switched off.

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

- Avoid contact with the Voltage Protection Module as long as it is under voltage.



⚠ WARNING

Electric shock as a result of excessive motor speed while the VPM runs up

The protective function of the Voltage Protection Module only becomes active 1 s after the pulse enable. If the motor accelerates in this phase to speeds higher than the speed at the start of field weakening, then the high electromotive force (EMF) can result in device damage and voltage flashovers.

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

- Only operate the motor below the field weakening threshold speed while the VPM is ramping up.



⚠ WARNING

Electric shock if the insulation voltage is exceeded

An excessively high voltage will damage the insulation resulting in death or severe injury.

- Do not connect any motors whose electromotive force (EMF) exceeds the permissible value at the highest speed used.
- Route the cables so that they are protected to rule out any damage.



⚠ WARNING

Electric shock due to using unsuitable third-party motors

VPM can be used with third-party motors. If, when using third-party motors, the VPM does not limit the DC link voltage, this can result in death or severe injury.

- Please observe the following when using third-party motors:
  - Carry out a risk analysis.
  - Ensure that the third-party motors correspond to the electrical properties of the specified Siemens components.
  - Check the correct functioning of the VPM.



⚠ 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 for dimensioning the protective conductor (see Chapter "Protective connection and equipotential bonding (Page 492)").

⚠ WARNING

Danger to life through automatic start of the drive

An uncontrolled automatic start of the drive can result in fatal accidents.

- Take precautions against an automatic start of the drive.

NOTICE

Damage caused by an unsuitable line system

When operating on line systems with grounded line conductor, damage due to fire, damage to the device or malfunctions can occur. As the Voltage Protection Module is not designed for operation on a line supply with grounded line conductor with overvoltage category III, carefully ensure that one of the following preconditions is satisfied:

- Operation on a line supply with grounded neutral point
- Operation with an isolating transformer with secondary grounded neutral point
- Operation on a line supply with overvoltage Category II

NOTICE

Damage when using motors that are not short-circuit proof

Using motors that are not short-circuit proof in conjunction with a Voltage Protection Module can result in damage.

- Only use motor that are short-circuit proof.

NOTICE

Damage to devices as a result of incorrect connecting cables

Using incorrect connecting cables for Voltage Protection Modules can damage the connected components.

- Use shielded MOTION-CONNECT 800PLUS motor cables, type 6FX8.

11.2.3 Interface description

11.2.3.1 Overview

The drawings below show the basic positions of interfaces and the housing openings of the Voltage Protection Modules VPM120, VPM200 and VPM200 Dynamic.

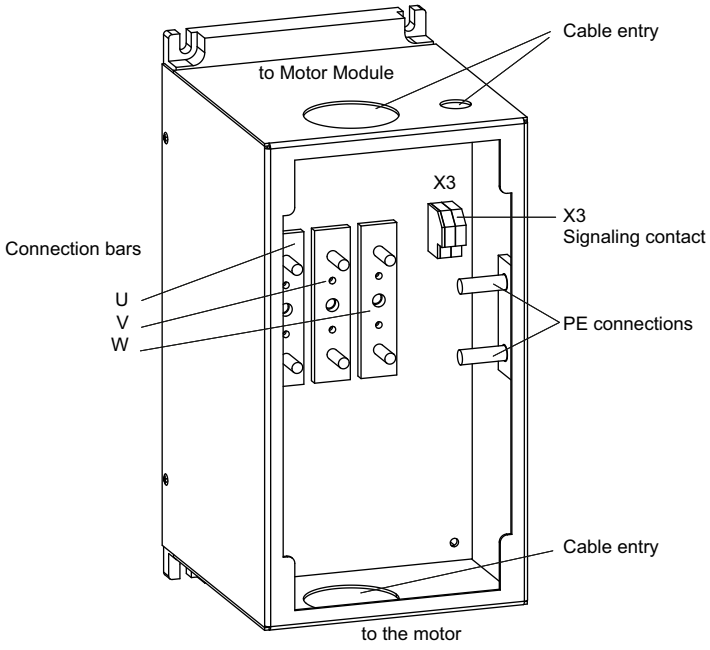


Figure 11-7 Interface overview, Voltage Protection Modules VPM120 (without cover)

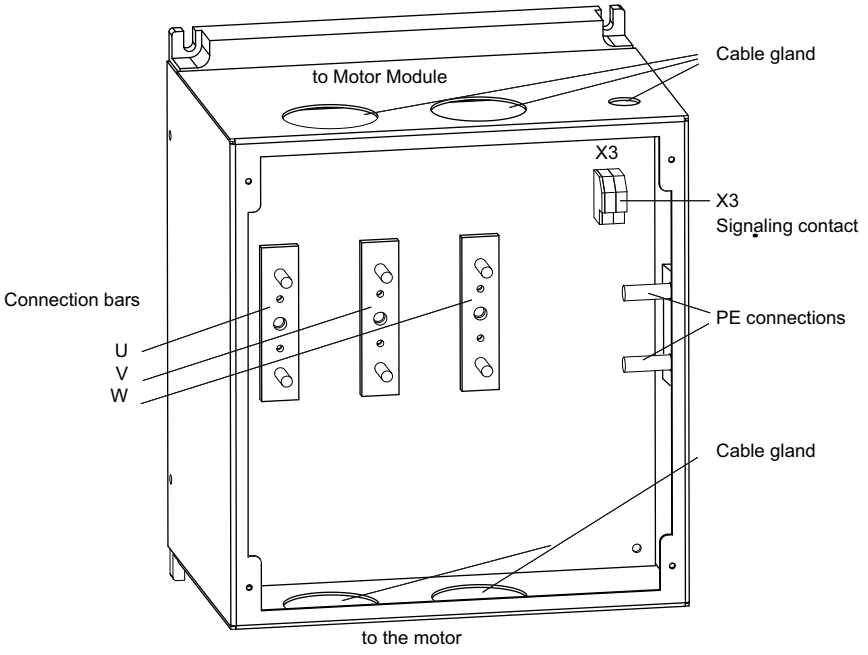


Figure 11-8 Interface overview, Voltage Protection Modules VPM200 (without cover)

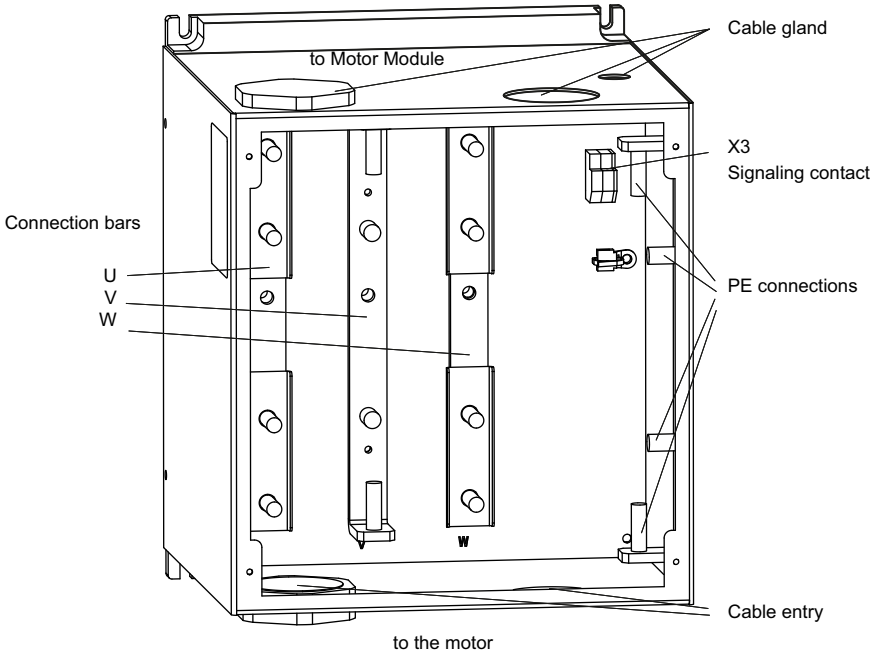


Figure 11-9 Interface overview, Voltage Protection Modules VPM200 Dynamic (without cover)

The housing is closed during operation to ensure the electrical terminals are covered.

11.2.3.2 X3 signaling contact

The signaling contact has the following assignments:

Table 11-12 X3 signaling contact

Terminal	Function	Technical specifications
1	Operating message for Control Unit	• The cable shield is connected to the VPM housing via the cable entry. • Isolated contact, current carrying capacity: 30 V DC at 0.1 A
2	Operating voltage +24 V (from external source)	
Type: WAGO spring-loaded terminal, type 226-111 Max. conductor cross-section: 1.5 mm^2 (AWG 16) Shielded cable		
Cable gland: Max. 9 mm ∅ Types VPM120, VPM200 and VPM200 Dynamic • Screwed joint: 1 x M16, e.g. from Pflitsch, article designation: UNI DICHT EMV 2165211S05 • Locknut M16: GM216PA		

Operating message via signaling contact X3

After a Voltage Protection Module response or in the event of a temperature error, signaling contact X3 opens and interrupts the inverter system's pulse enable.

The X3 signal contact automatically closes after t > 120 s or after resetting the temperature switch.

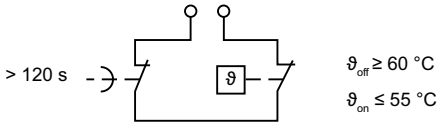


Figure 11-10 Signaling contact X3 of the Voltage Protection Module

⚠ WARNING

Danger to life when the drive automatically starts to run in an uncontrolled fashion

An uncontrolled automatic start of the drive can result in death or severe injury.

- Take measures to prevent the drive starting automatically in an uncontrolled fashion, as signal contact X3 restores the pulse enable after 2 minutes.

11.2.3.3 Connection bars U, V, W, PE

The cables to the Motor Module and motor are routed through the cable entry of the Voltage Protection Module and attached to the connection bars inside the unit.

Table 11-13 Connections U, V, W, and PE

	VPM120	**VPM200**	**VPM200 Dynamic**
Connection bolt	8 x M6[1)]	8 x M8[1)]	14 x M8[2)]
Cable lug	Crimp-type cable lug M6	Crimp-type cable lug M8	Tubular cable lug M8, 90° angled
Cable cross-section	≤ 50 mm² (AWG 1)	≤ 50 mm² (AWG 1)	≤ 50 mm² (AWG 1)
Tightening torque	6 Nm (53.1 lbf in)	13 Nm (115 lbf in)	13 Nm (115 lbf in)
Cable entry	For cables with max. 40 mm ∅		
Gland[3)]	2 x M50 e.g. from Pflitsch, article designation: UNI DICHT EMV 250584117 Locknut M50: GM250PA	4 x M50 e.g. from Pflitsch, article designation: UNI DICHT EMV 250584117 Locknut M50: GM250PA	4 x M50 e.g. from Pflitsch, article designation: UNI DICHT EMV 250584117 Locknut M50: GM250PA

1) There are 2 connection points for each phase and for PE.

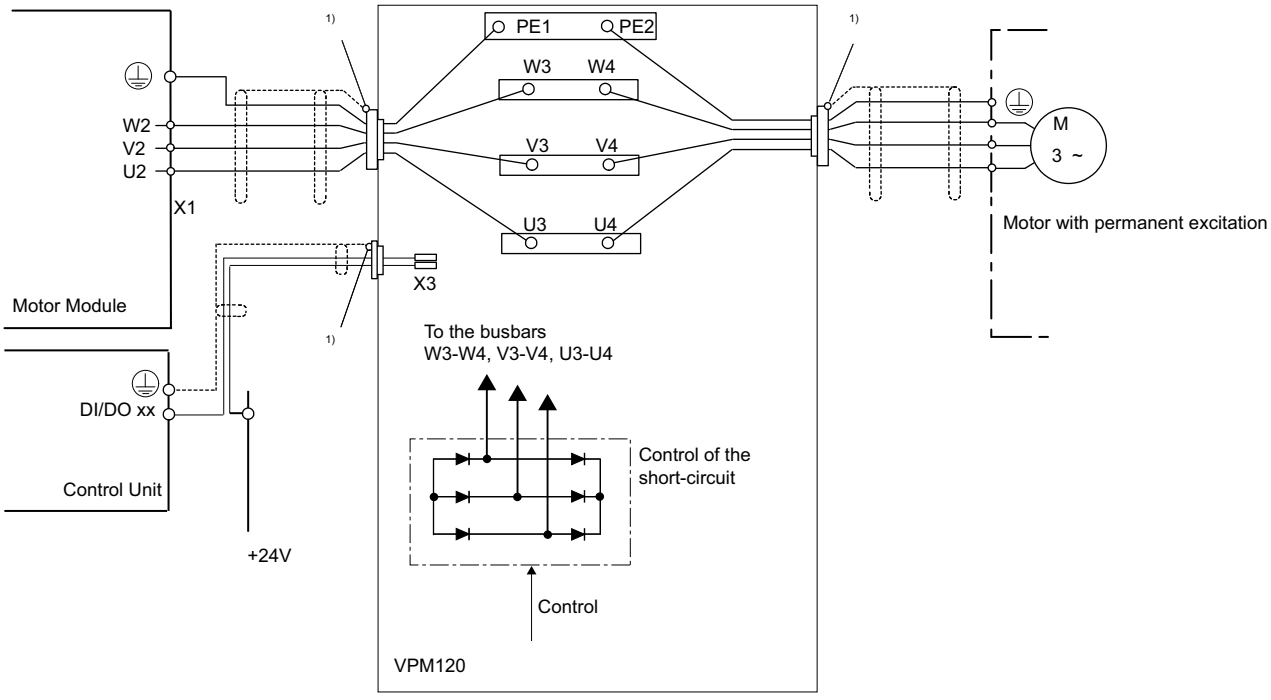
2) There are 4 connection points for each of the phases U, W, and PE and 2 connection points for phase V.

3) The glands must be separately ordered.

Note

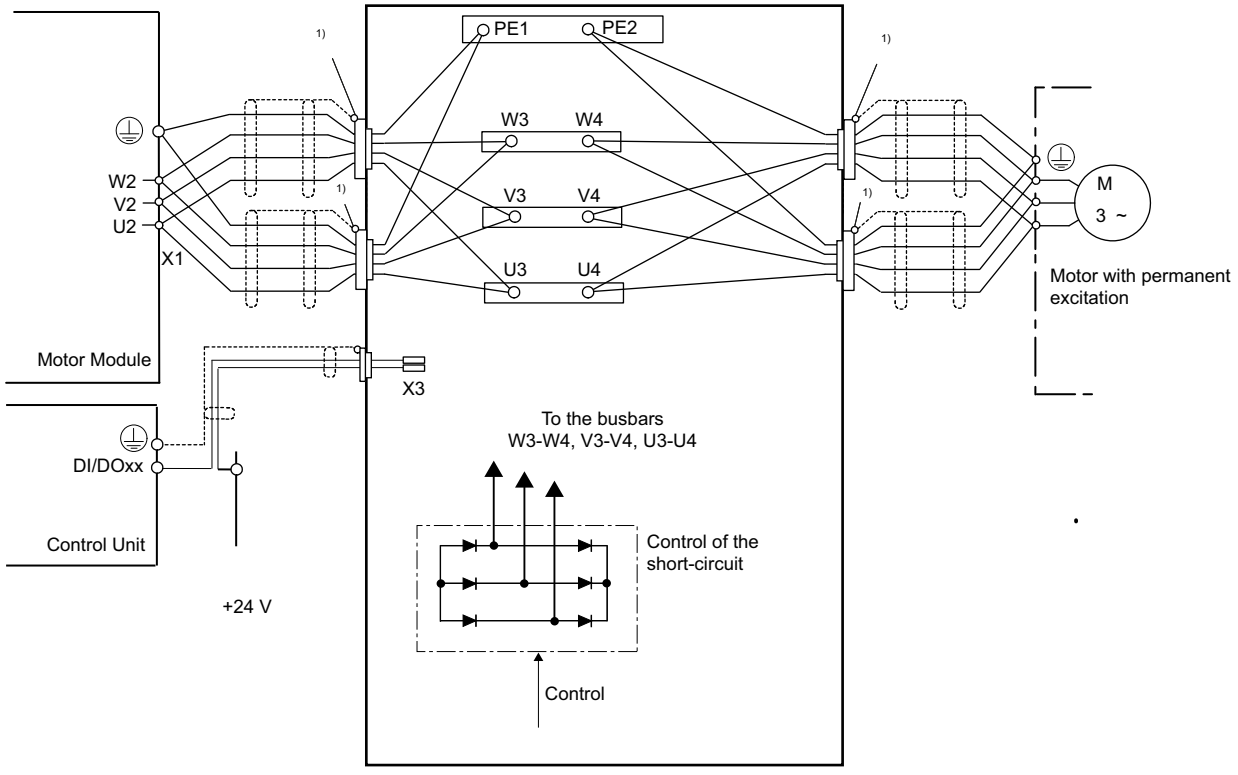
Cable lengths with cross-sections of > 50 mm² (AWG 1) between the Motor Module and the Voltage Protection Module or between the Voltage Protection Module and the motor are implemented using two cables connected in parallel.

11.2.4 Connection examples



[1] Conductive connection of cable shield with cable bushing

Figure 11-11 Connection example for Voltage Protection Module VPM120



1) Conductive connection of cable shield with the cable bushing

Figure 11-12 Connection example for Voltage Protection Module VPM200

Cable lengths

The maximum length of the power cable between the Motor Module and the Voltage Protection Module is 1.5 m and must not include any switching elements.
The power cable between the Voltage Protection Module and the motor must not exceed a length of 50 m.

Signaling contact

Signaling contact X3 on the Voltage Protection Module is wired to a digital input (DI) on the Control Unit, which controls this axis. If more than one Voltage Protection Module is used, each X3 terminal is wired to the respective Control Unit. If an armature short-circuit occurs, the pulses of the axis involved must remain inhibited. To do this, the connected digital input is interconnected to control bit OFF2 (pulse inhibit) (see SINAMICS S120/S150 List Manual). The signaling contact is operated with +24 V.

11.2.5 Dimension drawings

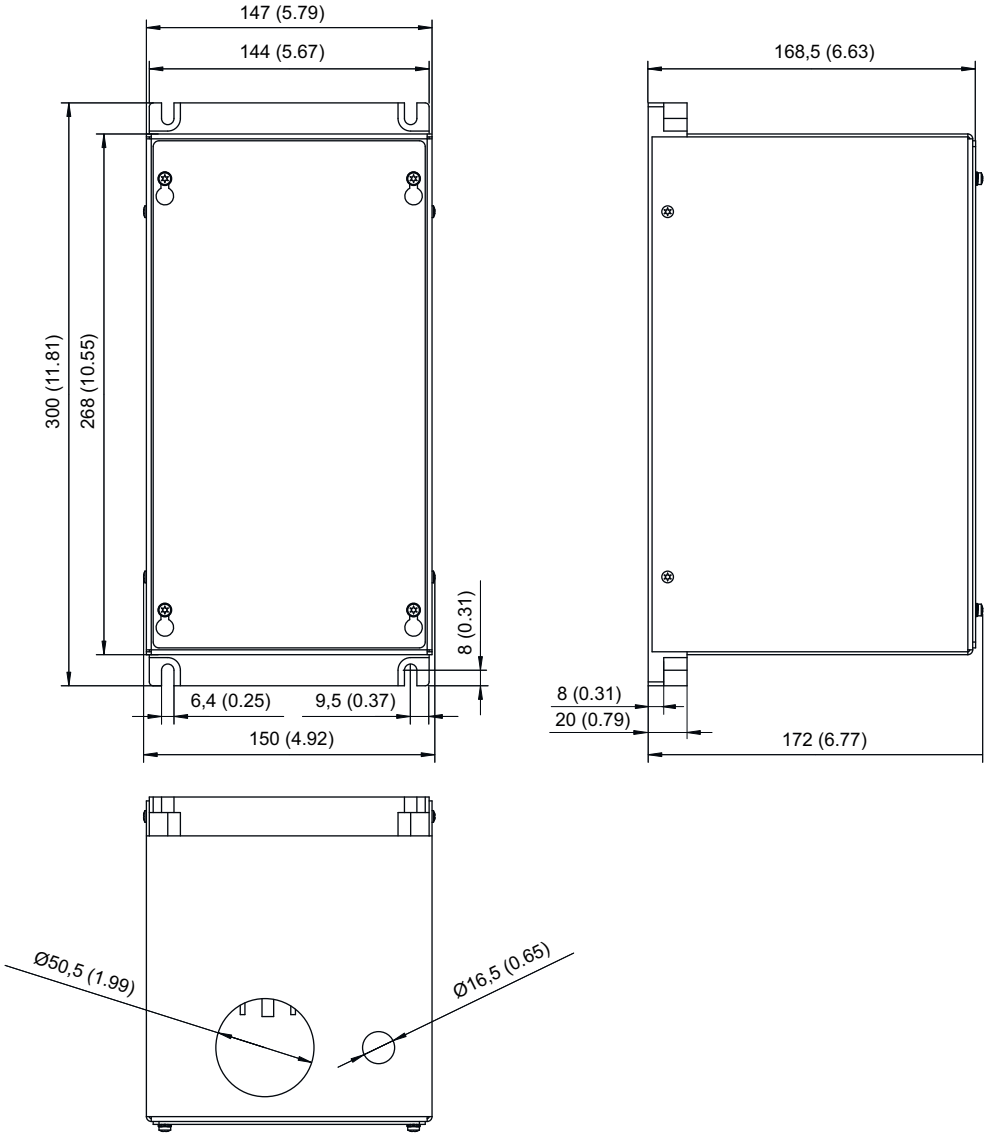


Figure 11-13 Dimension drawing of the Voltage Protection Module VPM120, all data in mm and (inches)

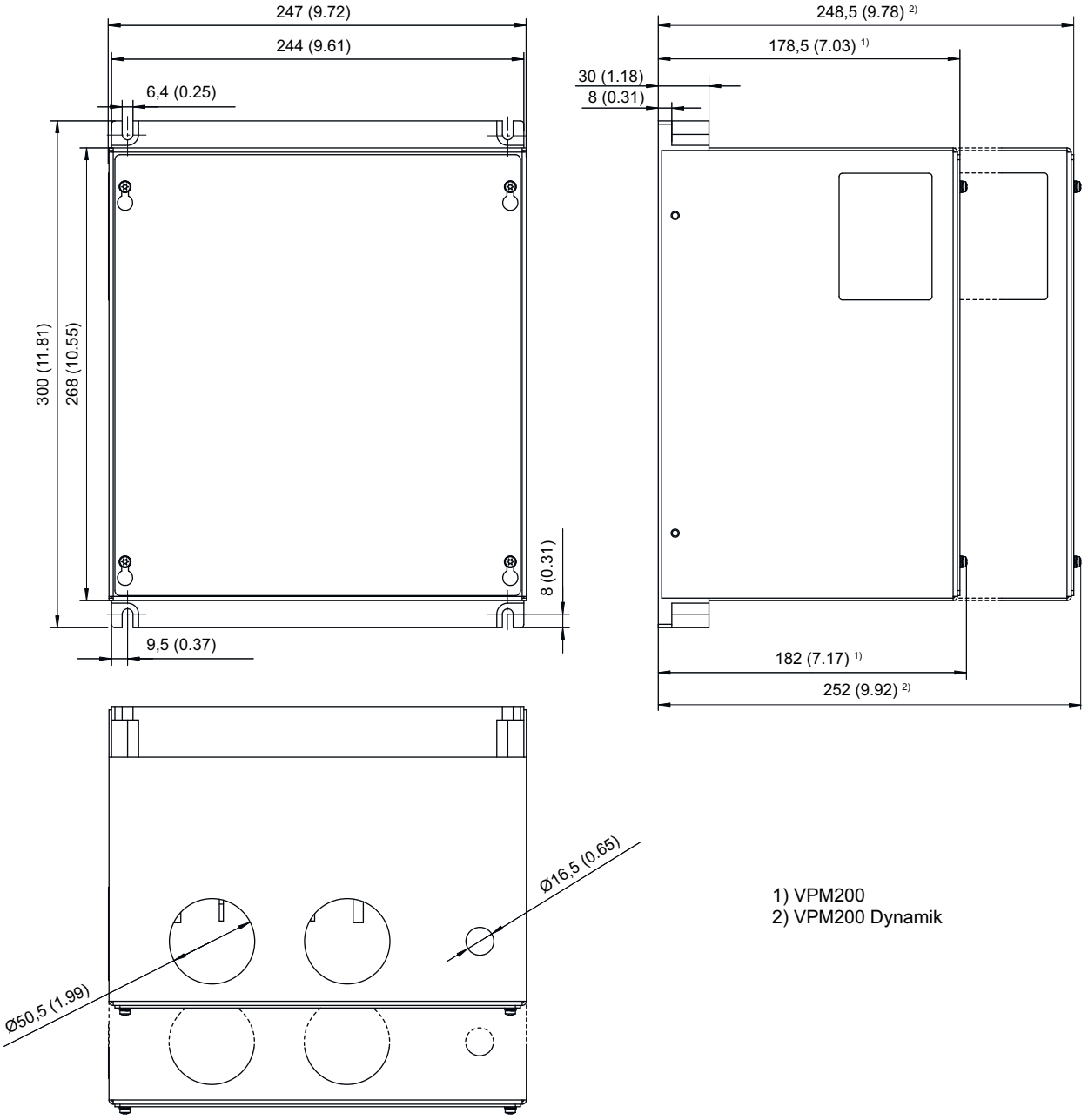


Figure 11-14 Dimension drawing of the Voltage Protection Module VPM200 and VPM200 Dynamic, all data in mm and (inches)

11.2.6 Installation

The Voltage Protection Module is installed in the control cabinet close to the drive.

Note

Connecting motor reactors

Motor reactors may only be connected between the Voltage Protection Module and motor.

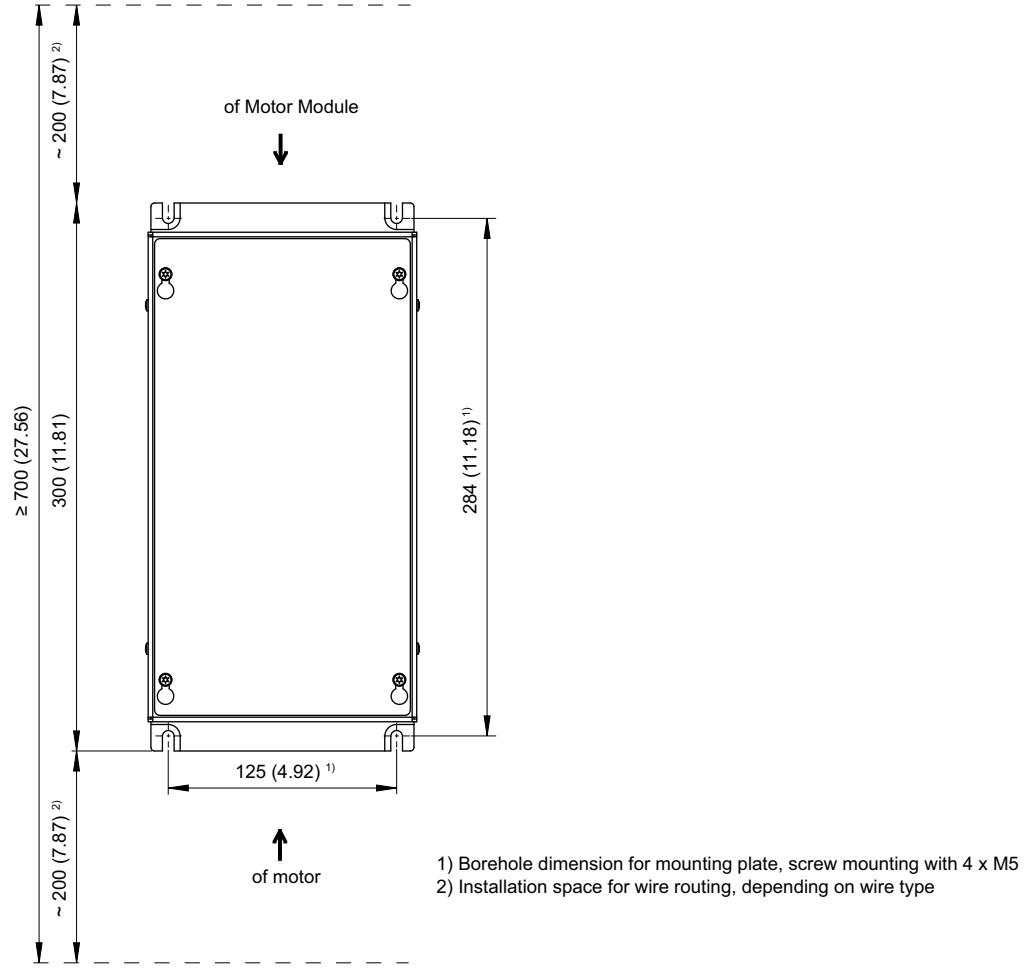


Figure 11-15 Mounting dimension for a Voltage Protection Module VPM120

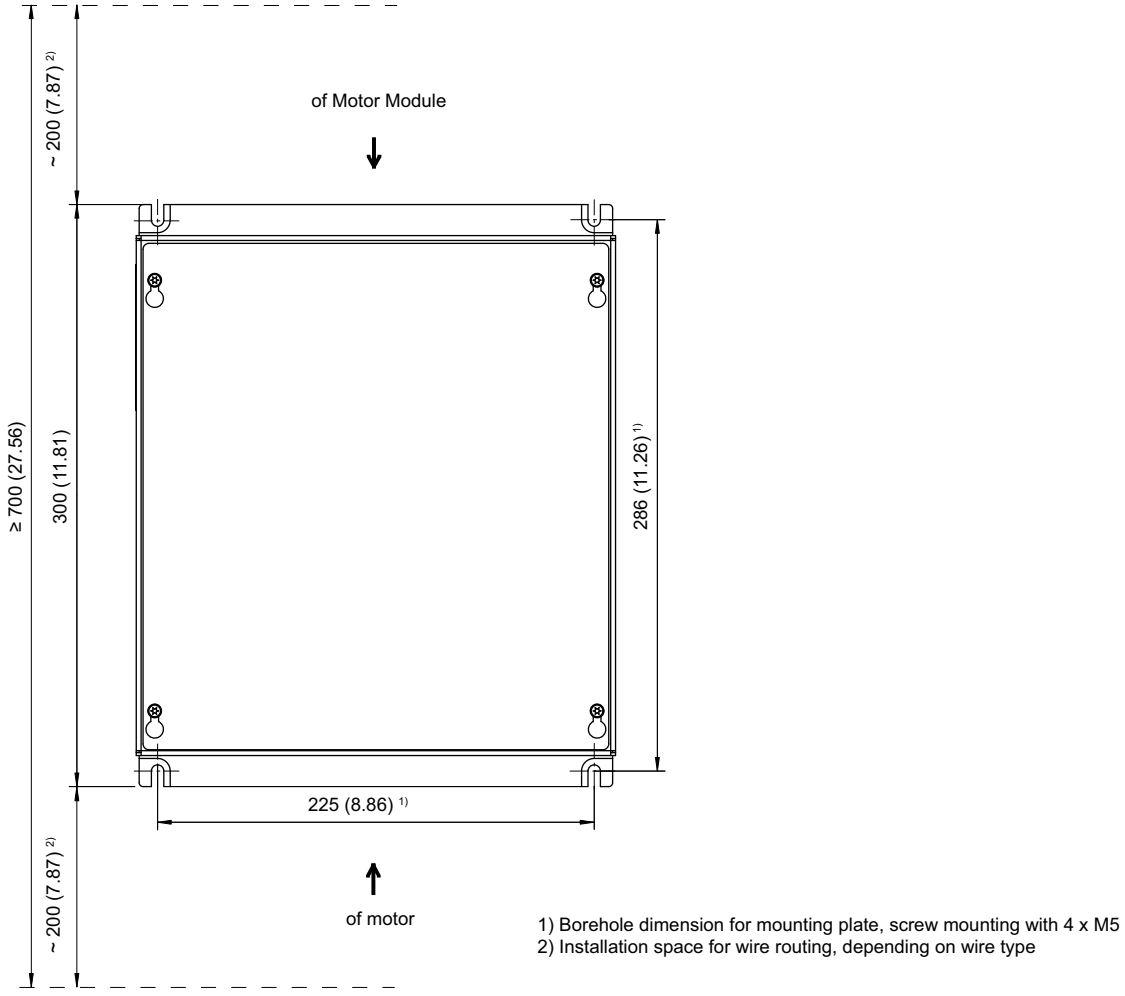


Figure 11-16 Mounting dimensions for a Voltage Protection Module VPM200

11.2.7 Electrical connection

Note

Only the enclosure cover may be opened when electrically connecting the Voltage Protection Module.

Introduction

Various types of cabling work must be carried out in order to integrate a Voltage Protection Module into a motor feeder circuit. All connections must be set up inside the VPM housing. Cable cross-sections are determined by the rated motor power and may be as much as 2 x 50 mm^2 for each conductor. An installation sequence for individual conductors is outlined below. It is particularly relevant for larger cross-sections.

Preparation

The following preparations must be made before setting up connections:

- Loosen the 4 screws on the cover of the housing, so that the cover can be shifted in the cutouts.
- Move the enclosure cover to the point where the cutout widens out so it can be lifted over the screw heads.
- Attach the cable glands for the signal cable and power cables (2x for the VPM120, 4x for the VPM200) at the entries into the housing of the Voltage Protection Module.
- Remove 300 mm of the cable sheath of the power cables and expose the shield to match the housing gland being used.
- Remove the insulation at the ends of the individual conductors and attach cable lugs.
- Attach the signal cable to X3 and secure the cable with cable ties inside the Voltage Protection Module.

11.2.7.1 Connecting signaling contact X3

The signaling contact X3 must be wired before connecting the power cables.



① Cable tie
② Signaling contact X3

Figure 11-17 Connection of the signaling contact using the VPM200 as an example

The X3 signaling contact is routed via a bistable relay. The relay may shift to the other switching state if subjected to excessive movement during transportation and installation. This may prevent the system from starting.

NOTICE
Damage as the short-circuit thyristor is still conducting When a Voltage Protection Module is tripped and the short-circuit thyristor is still conducting before the converter is switched on again, then this can result in damage to the system. • The motor must have come to a standstill. • Signal contact X3 must have closed again. • Check that the thyristor is in a no voltage condition.

Cause and rectification of faults

The "Installation" sections in the documents referred to below contain additional information on the causes of faults and how they can be rectified:

- Operating Instructions for Voltage Protection Module VPM120, Article No.: A5E00302281B
- Operating Instructions for Voltage Protection Module VPM200, Article No.: A5E00302261B
- Operating Instructions for Voltage Protection Module VPM200 Dynamic, Article No.: A5E00777655A

11.2.7.2 Connecting power cables (using the VPM 200 Dynamik as an example)

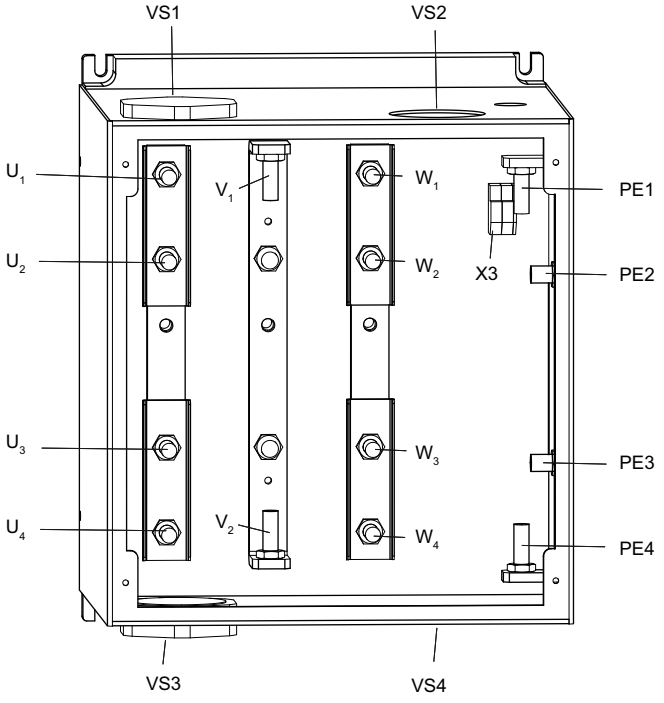


Figure 11-18 Connection points of the Voltage Protection Module VPM200 Dynamic

Table 11-14 Short designations

Short designation	Explanation
VS1, VS2	Cable screwed joint 1 or 2 in the housing entry of the VPM, towards Motor Module
VS3, VS4	Cable screwed joint 3 or 4 in the housing entry of the VPM, towards motor
K1, K2	Cable 1 or 2 to the Motor Module
K3, K4	Cable 3 or 4 to the motor
U_1, U_2	Connection bolts on busbar U
U_3, U_4	Connection bolts on busbar U
V_1, V_2	Connection bolts on busbar V
W_1, W_2	Connection bolts on busbar W
W_3, W_4	Connection bolts on busbar W
PE_1, PE_2, PE_3, PE_4	Connection bolts on busbar PE
U	Busbar U in the VPM
V	Busbar V in the VPM
W	Busbar W in the VPM

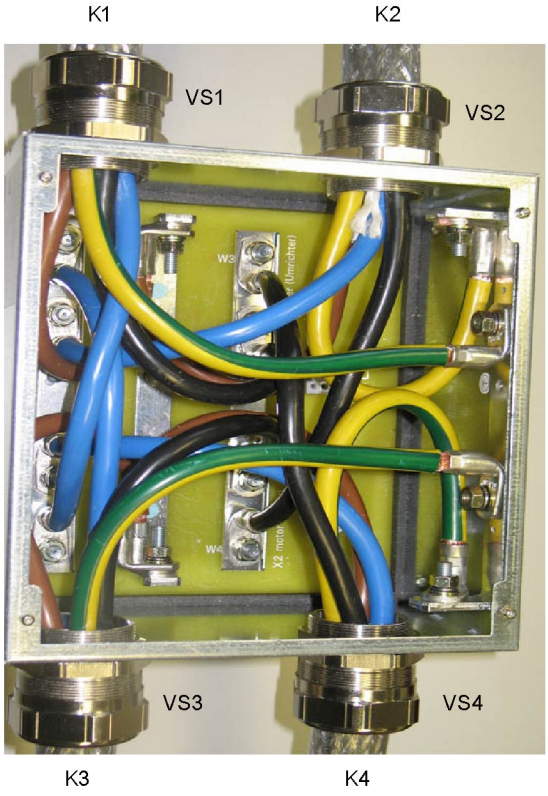


Figure 11-19 Wired Voltage Protection Module VPM200 Dynamic with short designations

Table 11-15 Installation steps

Cable glands	Cable	Conductor/ Phase	Installation step
VS1	K1	L_1, L_2, L_3, PE	Introduce the cable with all the conductors and shield, tighten the gland and lay conductors L_1 (black) and PE (green/yellow) on top of the other conductors.
VS2	K2	L_1, L_2, L_3, PE	Introduce the cable with all the conductors and shield, tighten the gland and lay conductors L_1 (black) and PE (green/yellow) on top of the other conductors.
	K1	L_2 (blue)	Lay L_2 on V1 and screw these together.
	K2	L_2 (blue)	Lay L_2 on V1 and screw these together.
	K2	PE (green/ yellow)	Lay PE on PE1 and screw these together.
	K1	L_3 (brown)	Lay L_3 on W2 and screw these together.
	K2	L_1 (black)	Lay L_1 on U2 and screw these together.
	3 separate cable ends for cables K1 and K2 are connected later.		
VS3	K3	L_1, L_2, L_3, PE	Introduce the cable with all the conductors and shield, tighten the gland and lay conductors L_1 (black) and PE (green/yellow) on top of the other conductors.
VS4	K4	L_1, L_2, L_3, PE	Introduce the cable with all the conductors and shield, tighten the gland and lay conductors L_1 (black) and PE (green/yellow) on top of the other conductors.
	K3	L_2 (blue)	Lay L_2 on V2 and screw these together.
	K4	L_2 (blue)	Lay L_2 on V2 and screw these together.

Cable glands	Cable	Conductor/ Phase	Installation step
	K3	L_3 (brown)	Lay L_3 on W3 and screw these together.
	K4	PE (green/ yellow)	Lay PE on PE4 and screw these together.
	K4	L_1 (black)	Lay L_1 on U3 and screw these together.
	K1	L_1 (black)	Lay L_1 on U4 and screw these together.
	K3	L_1 (black)	Lay L_1 on U1 and screw these together.
	K2	L_3 (brown)	Lay L_3 on W4 and screw these together.
	K4	L_3 (brown)	Lay L3 on W1 and screw these together.
	K3	PE (green/ yellow)	Lay PE on PE3 and screw these together.
	K1	PE (green/ yellow)	Lay PE on PE2 and screw these together.

11.2.8 Technical data

Table 11-16 Technical specifications

	Unit	VPM 120	VPM 200	VPM 200 Dynamic
Article No.		6SN1113-1AA00-1JA.	6SN1113-1AA00-1KA.	6SN1113-1AA00-1KC.
Type of voltage		3-phase pulsed AC voltage, motor EMF		
Ramp-up time for VPM	s	1 (from pulse enable)		
Normal range of the DC link voltage - lower limit - upper limit	 V_{DC} V_{DC}	 490 795		
Operating range for VPM	V	830 ... 2000 (peak value)		
Motor EMF	kV_{rms}	< 1.4		
Clock frequency	kHz	3.2 ... 8		
Rated current	A_{rms}	120	200	
Time range		Maximum permissible short-circuit current		
0 ... 10 ms 10 ... 500 ms 500 ms ... 2 min > 2 min	A A A A	1500 255 90 0	2000 600 200 0	
Maximum short-circuit time	s	120		
Safe electrical separation		Between the signal contact and motor cables U, V, W, UL 508 C		
Permitted humidity Humidity classification according to IEC 60721-3-3:2002	%	< 90 Cl. 3K5, condensation and icing excluded Low air temperature 0 °C		
Permissible ambient temperature	°C	0 ... 55		
Cooling method		Air-cooled, free convection		
Weight	kg	approx. 6	approx. 11	approx. 13
Dimensions (W x H x D)	mm	300 x 150 x 180	300 x 250 x 190	300 x 250 x 260

Accessories

12

12.1 Shield connecting plates for power supply and motor cables

12.1.1 Description

Shield connection plates are available to connect the shields of line and motor power cables as well as brake cables for all Line Modules, Motor Modules, and Active Interface Modules.

A shield connection terminal and/or clamp is used to connect the cable shield to the shield connection plate. Shield supports must be properly arranged to ensure EMC compliance.

12.1.2 Shield connecting plates

Table 12-1 Shield connecting plates and terminals

Component	Power	Total width of component	Shield connecting plate	Recommended shield connection
Line Module	5 kW / 10 kW	50 mm	Integrated in the connector	Hose clamp
	16 kW	100 mm	Included in the scope of delivery	KLBÜ CO4[1)] or hose clamp
	36 kW	150 mm	6SL3162-1AF00-0AA1	KLBÜ CO4[1)] or hose clamp
	55 kW	200 mm	6SL3162-1AH01-0AA0	Hose clamp
	80 kW / 120 kW	300 mm	6SL3162-1AH00-0AA0	Hose clamp
Motor Module	3 A ... 24 A 2x3 ... 2x9 A	50 mm	Included in the scope of delivery	Included in the scope of delivery
	30 A 2x18 A	100 mm	Included in the scope of delivery	Included in the scope of delivery
	45 A / 60 A	100 mm	6SL3162-1AD00-0AA0	Shield connecting terminal Phoenix 8WH9130-0MA00 (SK14) 8WH9130-0PA00 (SK35)
	85 A	200 mm	6SL3162-1AH01-0AA0	KLBÜ CO1[1)] for brake cable clamps for motor cable
	132 A / 200 A	300 mm	6SL3162-1AH00-0AA0	KLBÜ CO1[1)] for brake cable clamps for motor cable
	18 A (compact) 2x1.7 A ... 2x5 A	75 mm	Integrated in the connector	Hose clamp

Component	Power	Total width of component	Shield connecting plate	Recommended shield connection
Active Interface Module	16 kW	100 mm	Included in the scope of delivery	KLBÜ CO4[1] or hose clamp
	36 kW	150 mm	6SL3163-1AF00-0AA0	KLBÜ CO4[1] or hose clamp
	55 kW	200 mm	6SL3163-1AH00-0AA0	Hose clamp
	80 kW / 120 kW	300 mm	6SL3163-1AM00-0AA0	Hose clamp

[1] Shield connection terminal, Weidmüller Company

12.1.3 Dimension drawings

12.1.3.1 Line Modules and Motor Modules (type: Classic)

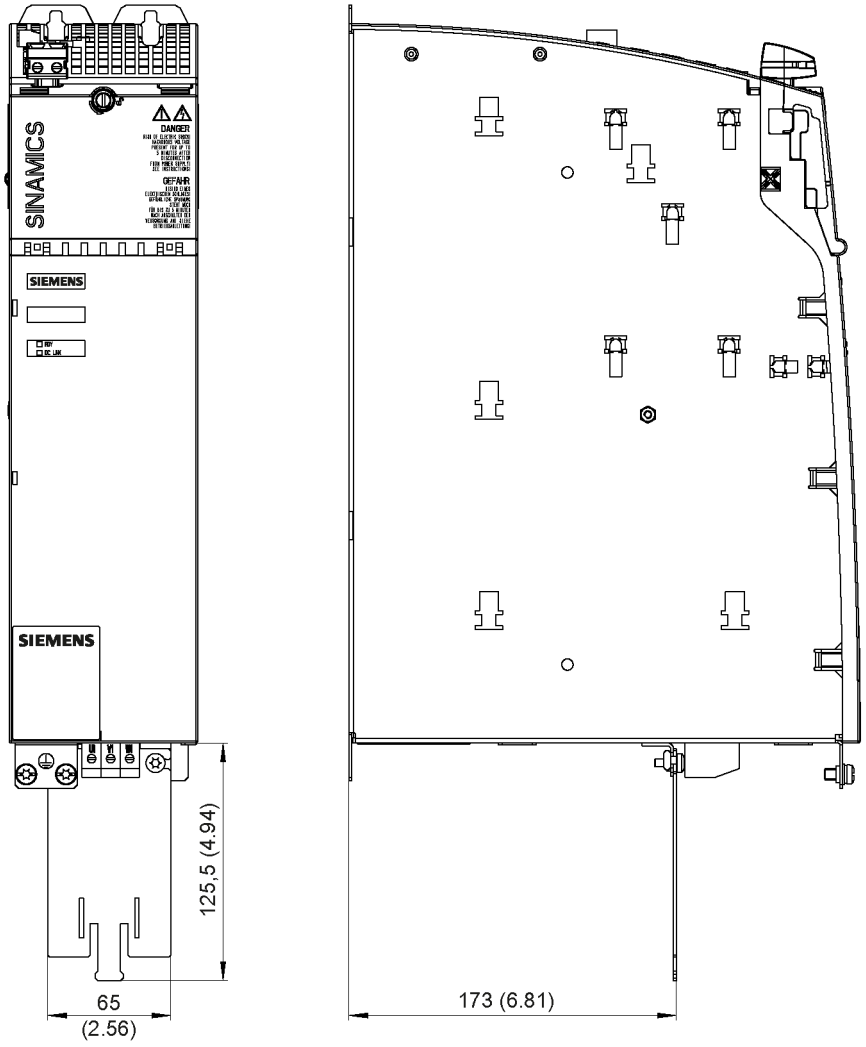


Figure 12-1 Dimension drawing of shield connecting plate on a 100 mm Line Module, all dimensions in mm and (inches)

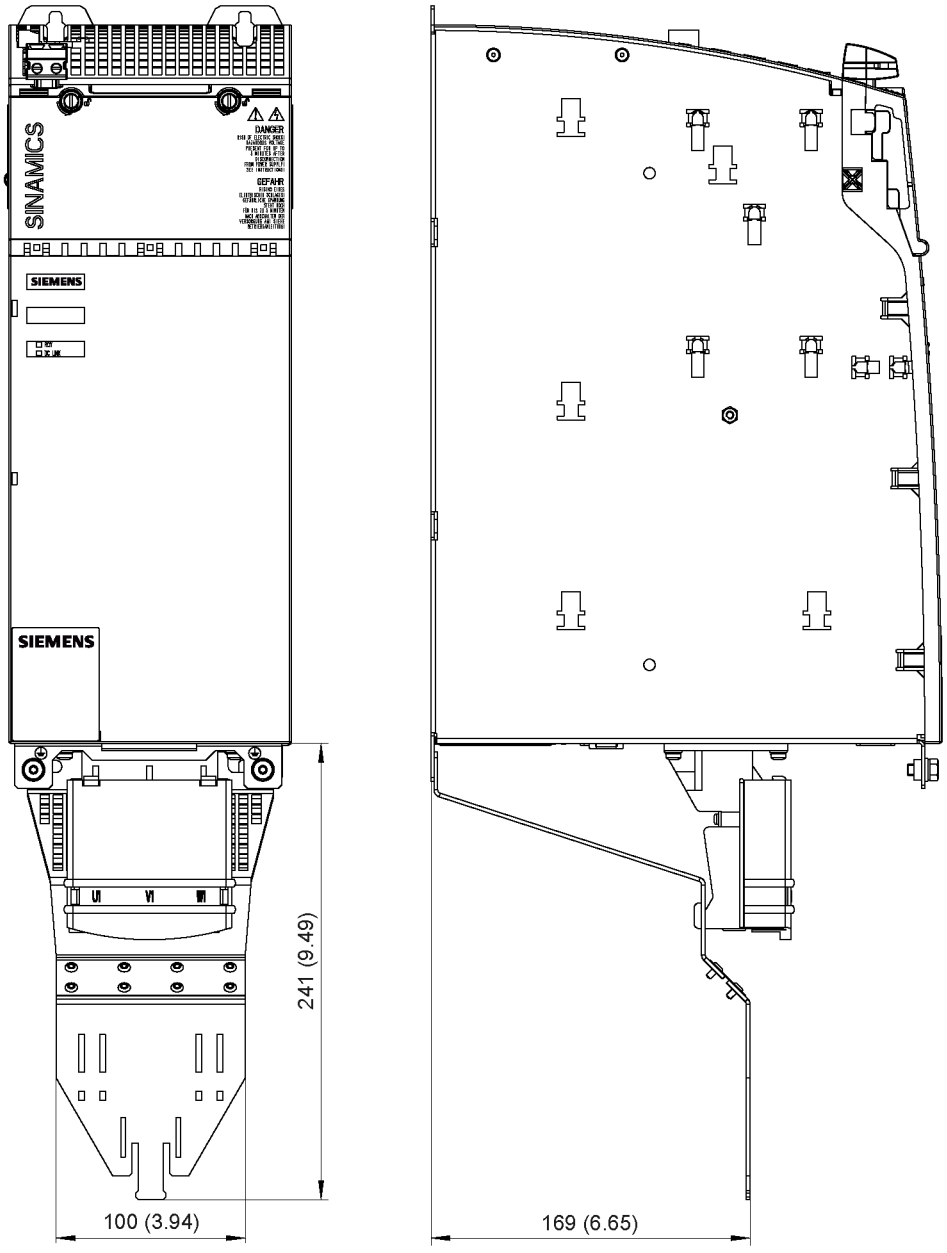


Figure 12-2 Dimension drawing of shield connecting plate on a 150 mm Line Module, all dimensions in mm and (inches)

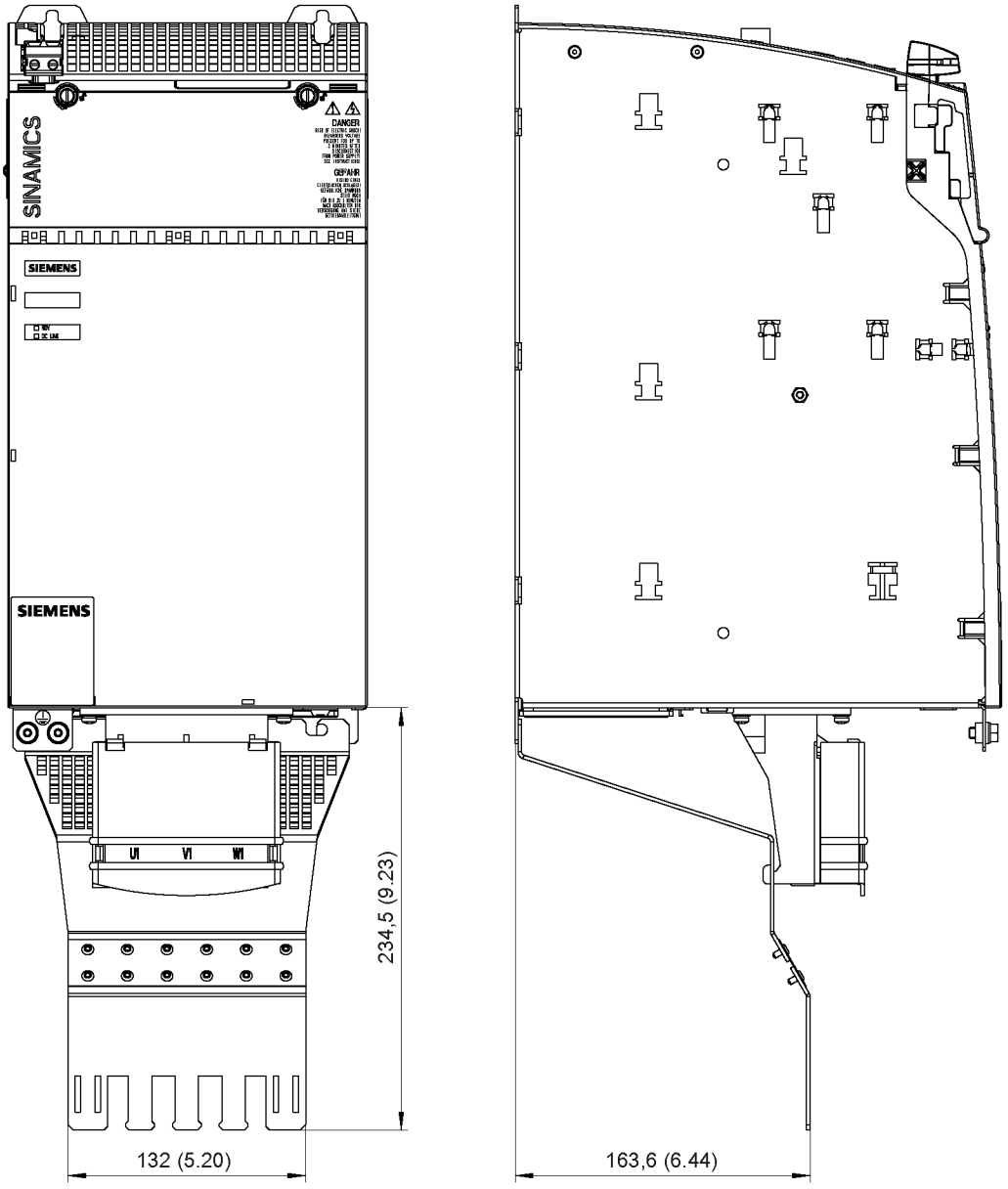


Figure 12-3 Dimension drawing of shield connecting plate on a 200 mm component, all dimensions in mm and (inches)

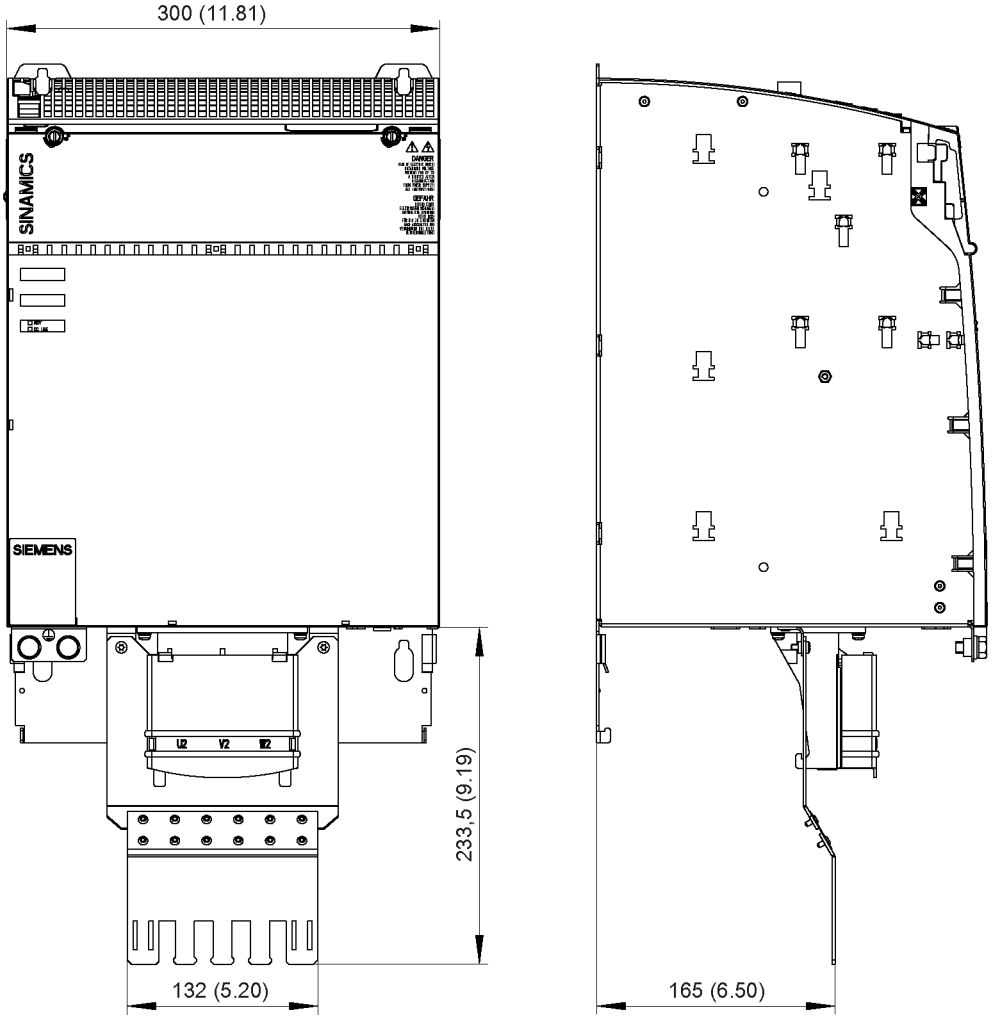


Figure 12-4 Dimension drawing of shield connecting plate on a 300 mm component, all dimensions in mm and (inches)

12.1.3.2 Active Interface Modules

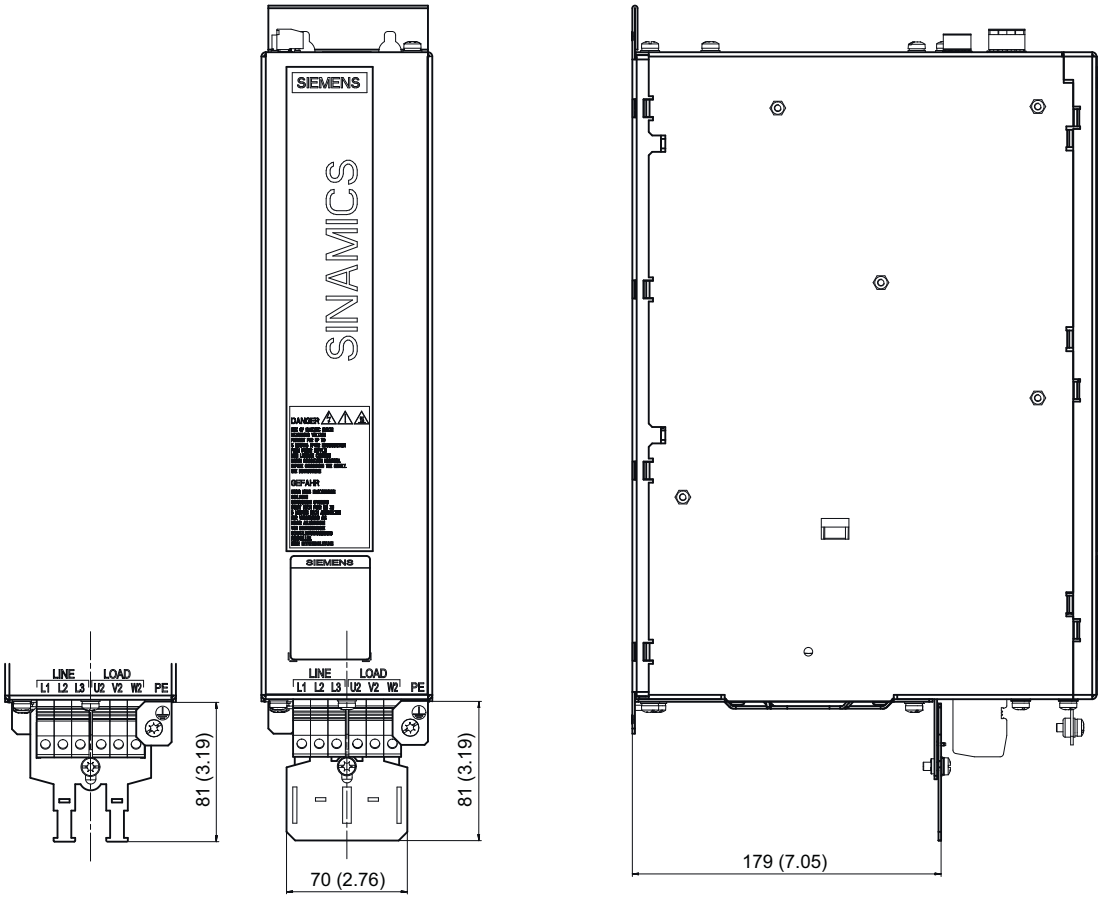


Figure 12-5 Dimension drawing of shield connecting plate on a 16 kW Active Interface Module, dimensions in mm and (inches)

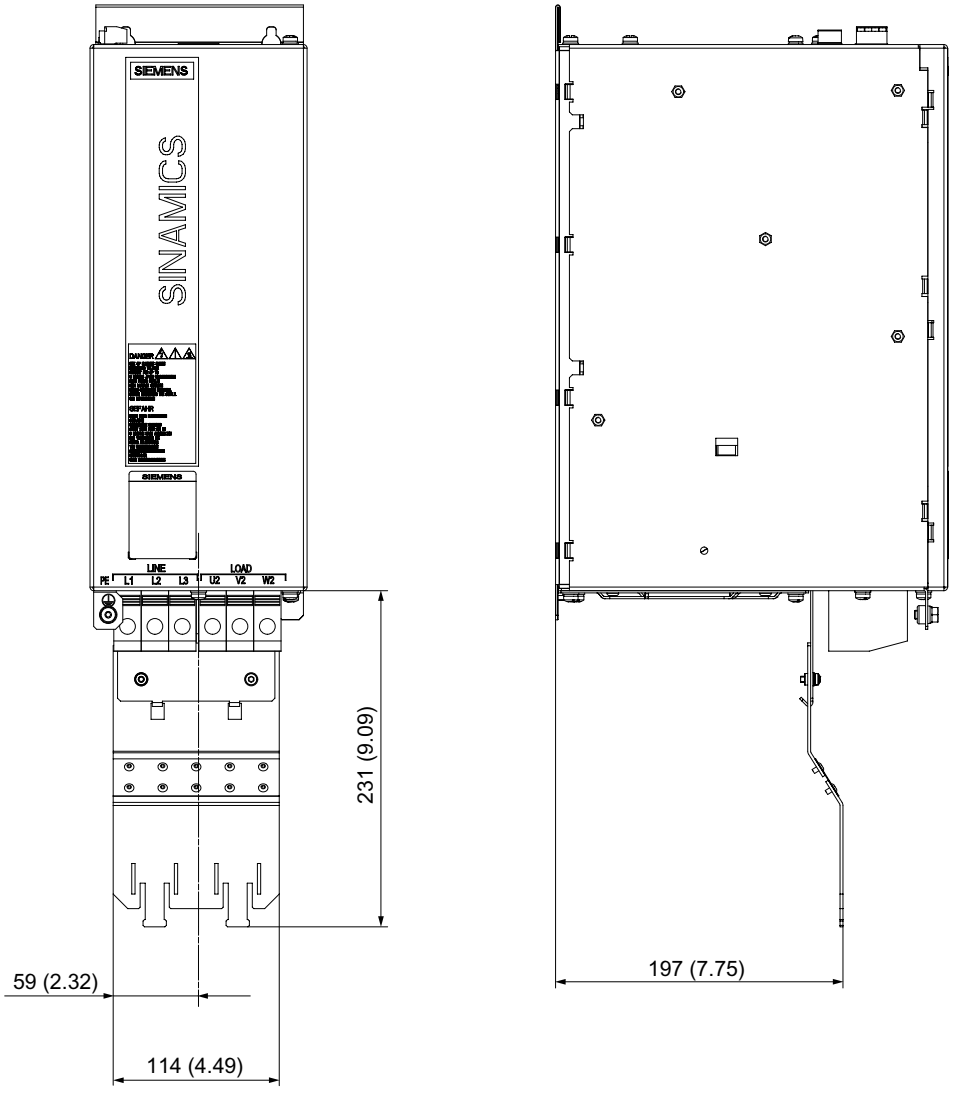


Figure 12-6 Dimension drawing of shield connecting plate on a 36 kW Active Interface Module, dimensions in mm and (inches)

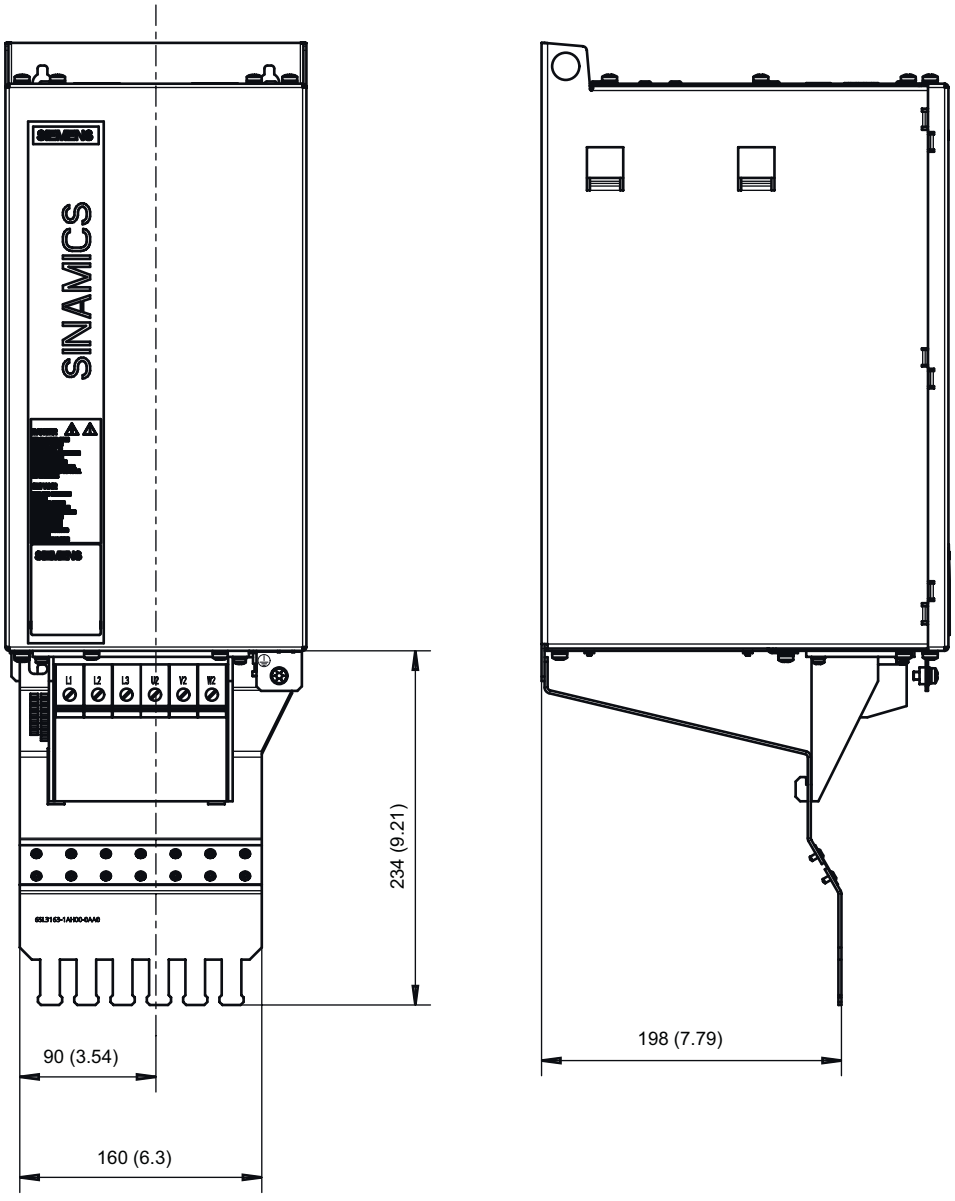


Figure 12-7 Dimension drawing of shield connecting plate on a 55 kW Active Interface Module, dimensions in mm and (inches)

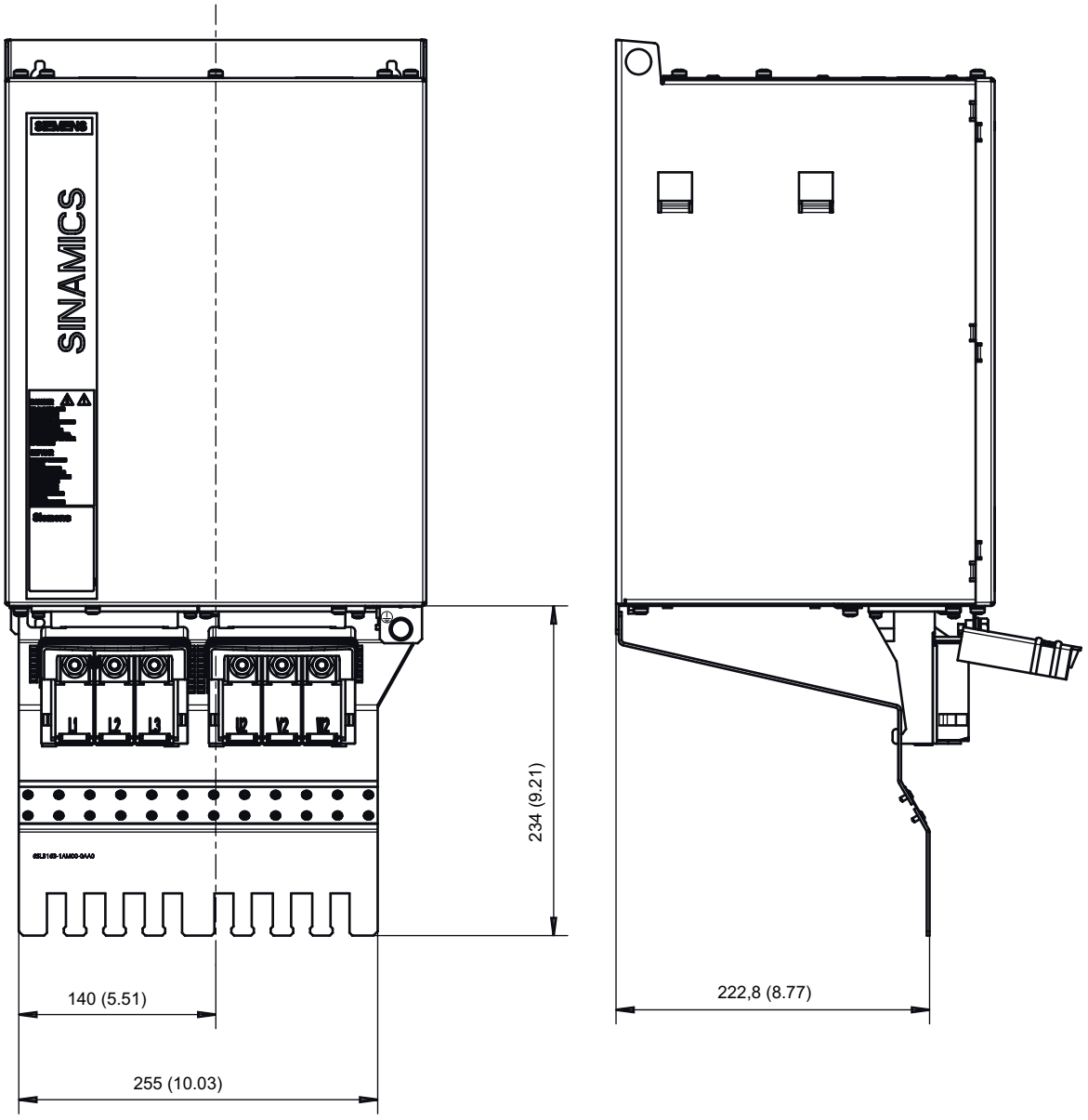


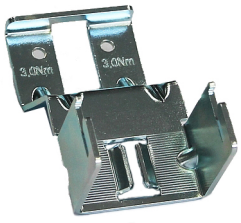
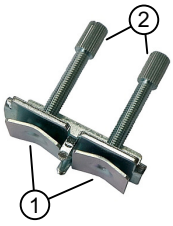
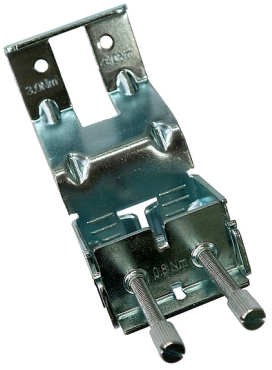
Figure 12-8 Dimension drawing of shield connecting plate on the 80 and 120 kW Active Interface Module, dimensions in mm and (inches)

12.1.4 Mounting

12.1.4.1 Shield connection for Motor Modules C/D type 50 and 100 mm (30 A and 2x18 A)

Shield connection

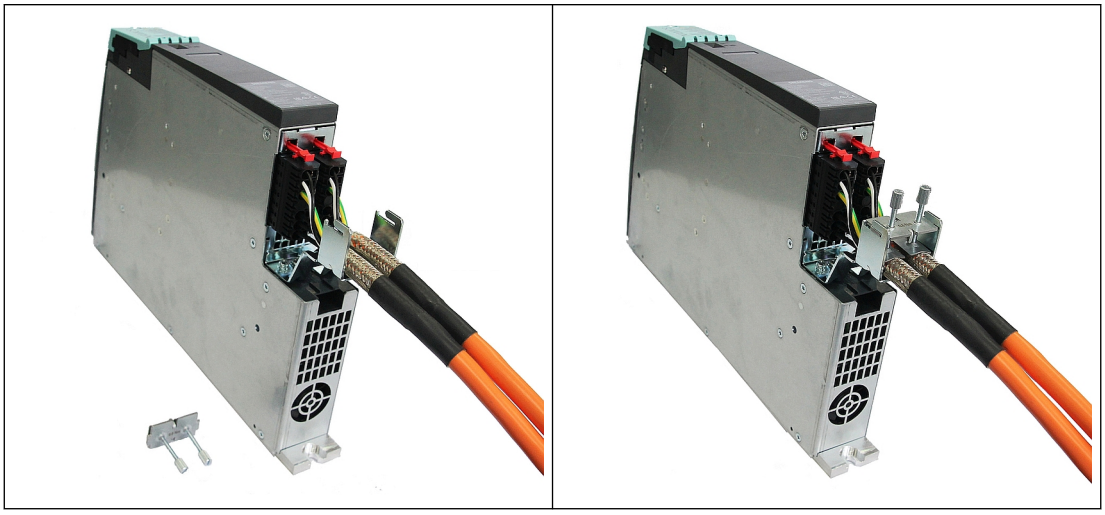
The shield is connected through the shield connecting plate, which is screwed to the Motor Module, and a shield connecting terminal. A shield connecting terminal with two clamping plates for a Double Motor Module is shown below

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

Shield support

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

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



Note

Pressure plate twist prevention

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

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

Note

Further information about shielding can be found in the Chapter "Shielding and routing cables" (Page 489).

12.1.4.2 Shield connection for Motor Modules C type 100 mm (45 ... 60 A)

Note

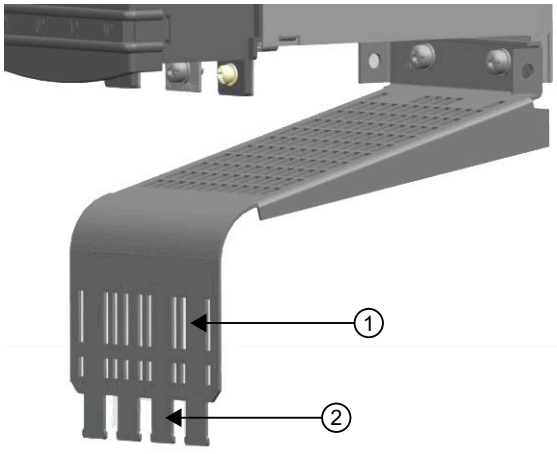
The shield connecting plate, shield connecting terminals and hose clamps are not included in the scope of supply of the Motor Module.

Table 12-2 Accessories for the shield support

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

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

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



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

Figure 12-9 Shield connecting plate block for 45 A / 60 A Motor Modules

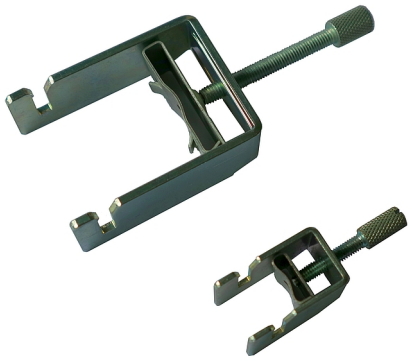
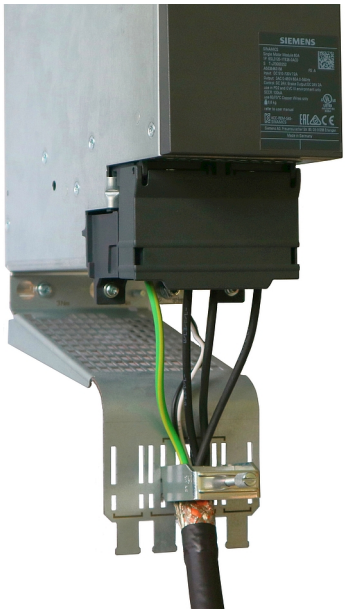
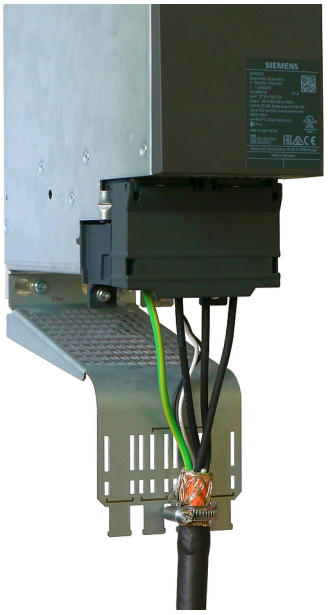


Figure 12-10 SK35 and SK14 shield connection terminals



Connection using a shield connection clamp at the shield connecting plate



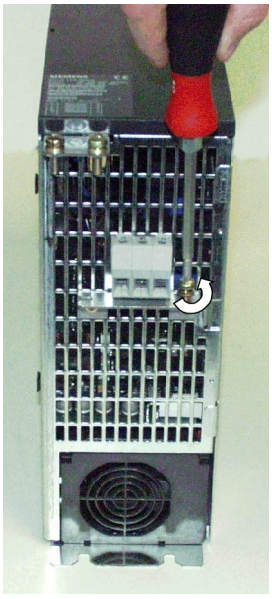
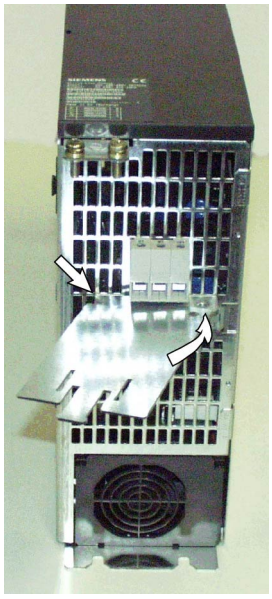
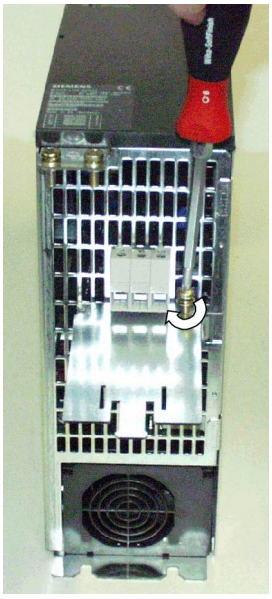
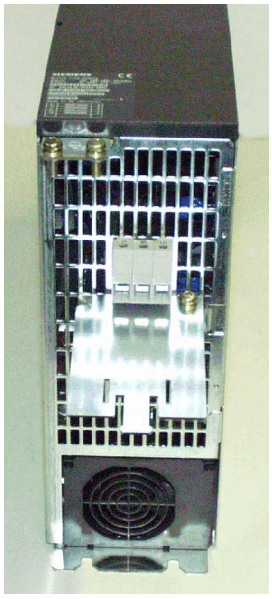
Connection using a hose clamp at the shield connecting plate

12.1.4.3 Shield connection for Line Modules 50 ... 100 mm

Tool required:

- Torx screwdriver T25 for shield connecting plate

Table 12-3 Mounting the shield connecting plate onto a 100 mm wide component

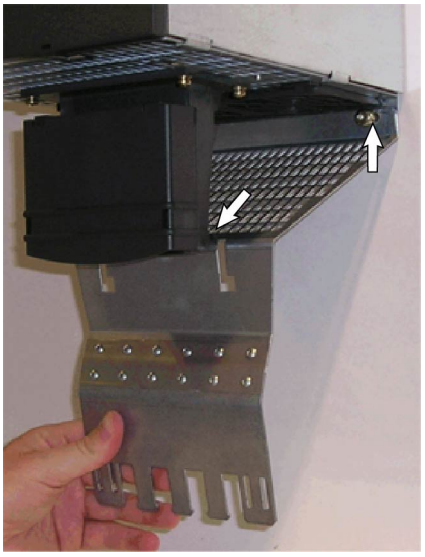
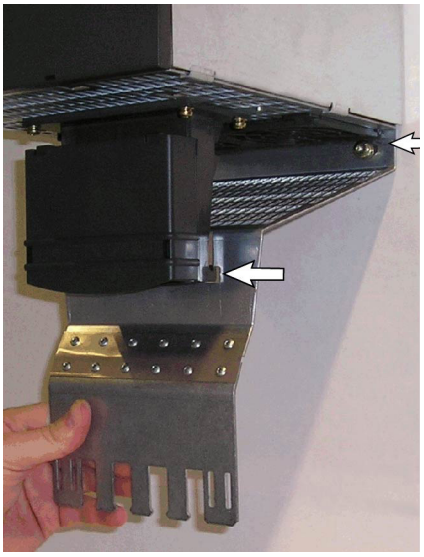
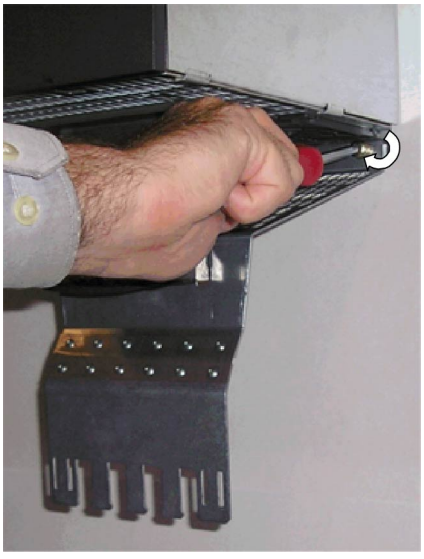
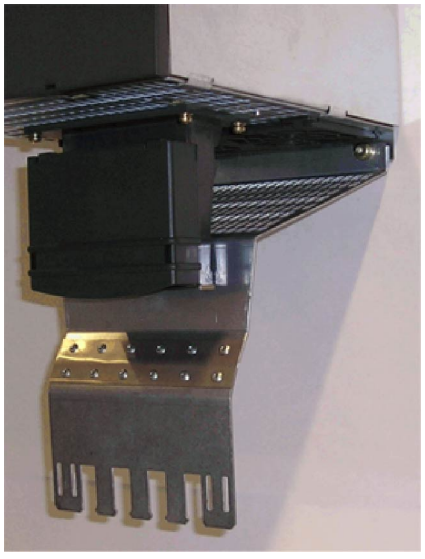
			
1. Remove the screw.	2. Engage the shield connecting plate.	3. Tighten the shield connecting plate. Tightening torque: 3 Nm (26.6 lbf in)	Result: Installed shield connecting plate

12.1.4.4 Shield connection for Line Modules and Motor Modules Classic 200 mm

Tool required:

- Screwdriver for fixing screws used

Table 12-4 Mounting the shield connecting plate onto a 200 mm wide component

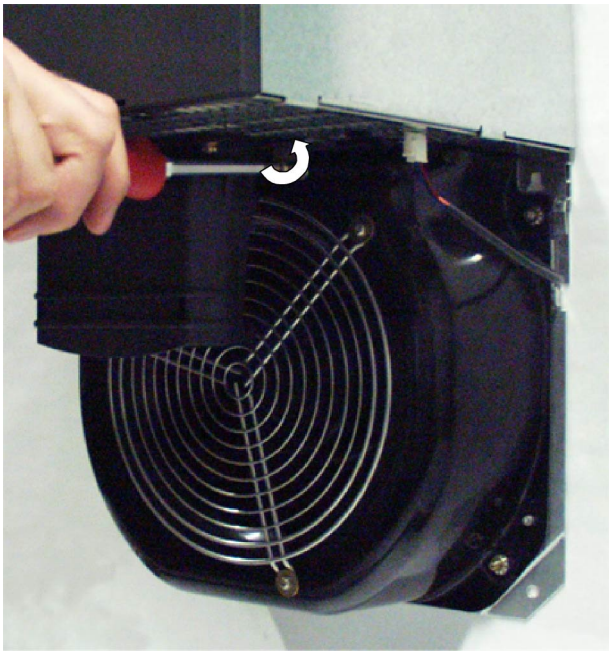
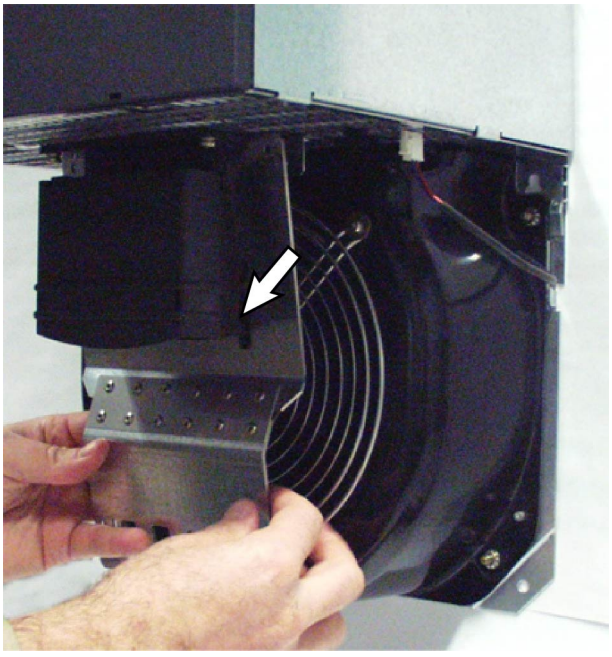
		
1. Loosen the lower screw.	2. Engage the shield connecting plate into the screws and at the line/motor connection	3. Attach the shield connecting plate by pulling it to the left
		
4. Tighten the shield connecting plate. Tightening torque: 6 Nm (53.1 lbf in)	Result: Installed shield connecting plate	

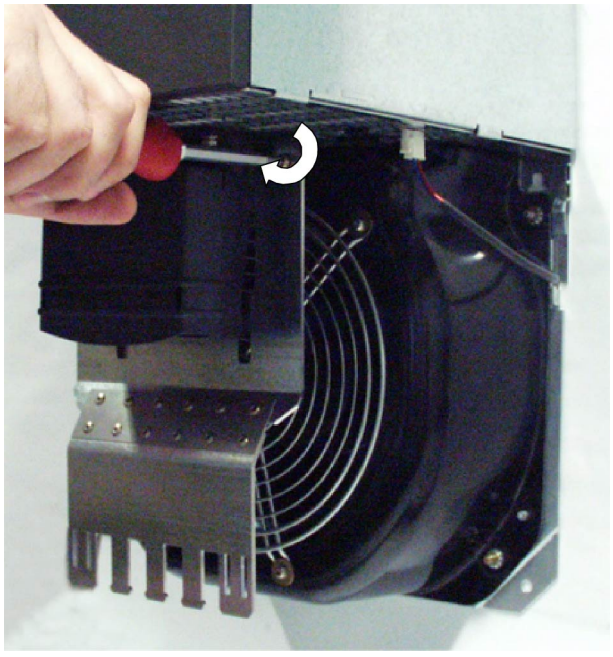
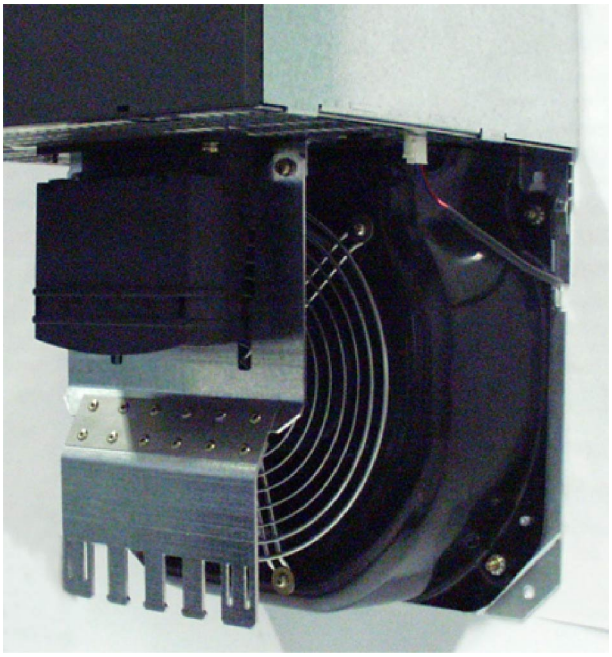
12.1.4.5 Shield connection for Line Modules and Motor Modules Classic 300 mm

Tool required:

- Torx screwdriver T25 for shield connecting plate

Table 12-5 Mounting the shield connecting plate onto a 300 mm wide component

	
1. Remove the screw.	2. Engage the shield connecting plate into the line/motor connection

	
3. Tighten the shield connecting plate. Tightening torque: 3 Nm (26.6 lbf in)	Result: Installed shield connecting plate

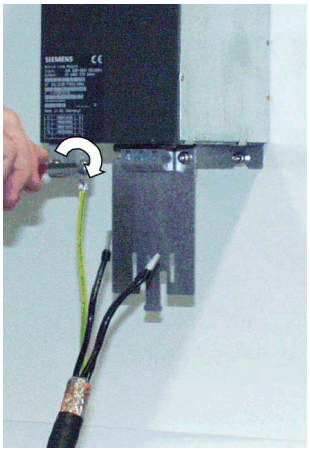
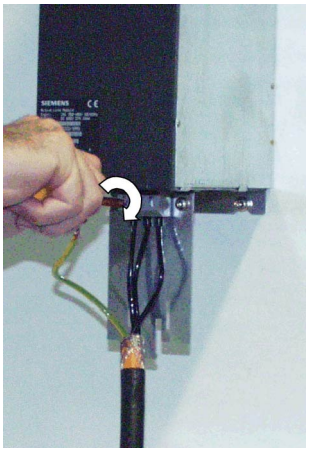
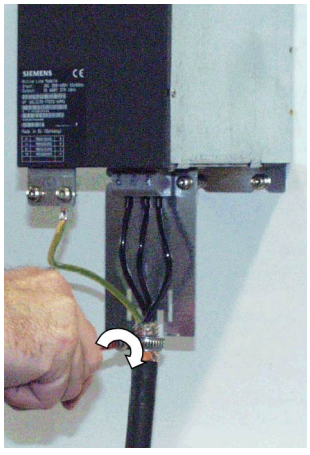
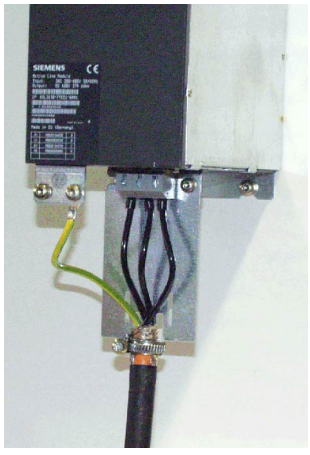
12.1.5 Connecting the power cables

Example 1: 100 mm wide component (type: Classic)

Required tools:

- Torx screwdriver T25 for protective conductor connection (Torx slot)
- Flat-bladed screwdriver size 4 for power cables
- Flat-bladed screwdriver for hose clamp

Table 12-6 Connecting the power cable for a 100 mm wide component (type: Classic)

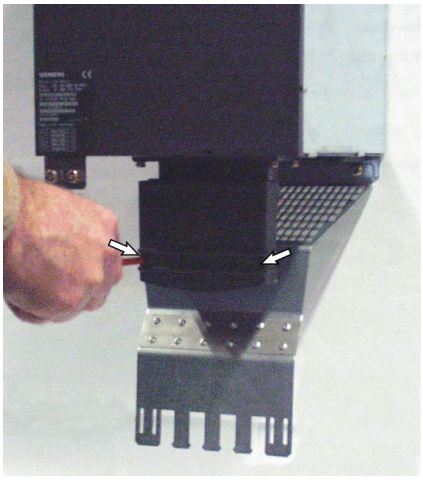
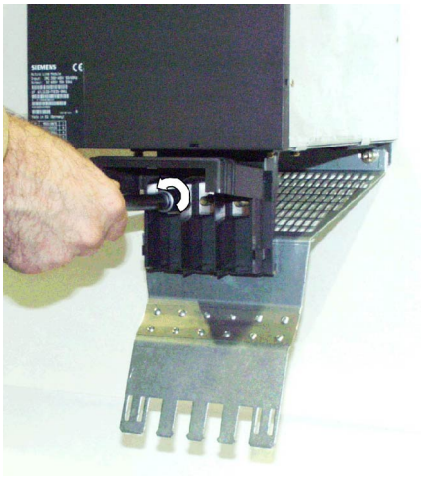
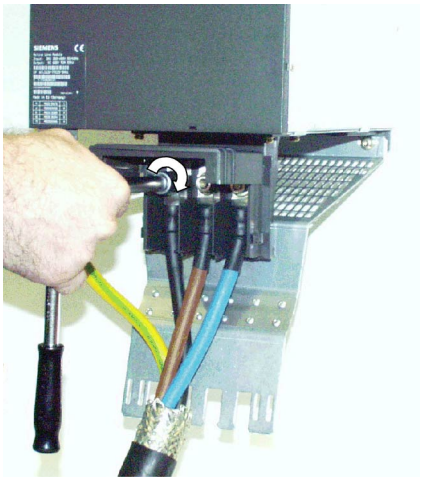
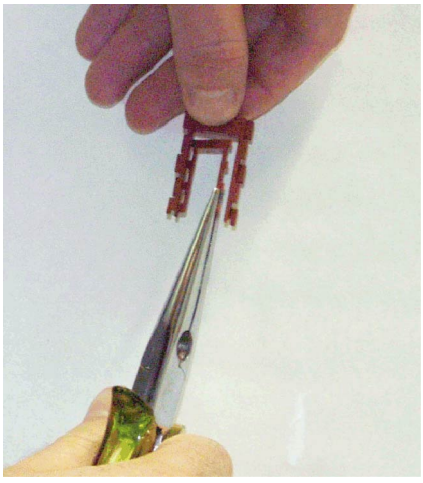
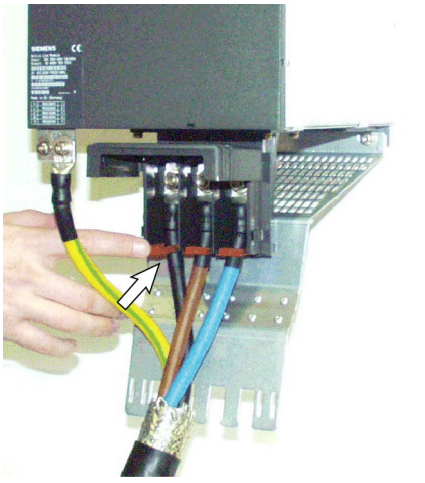
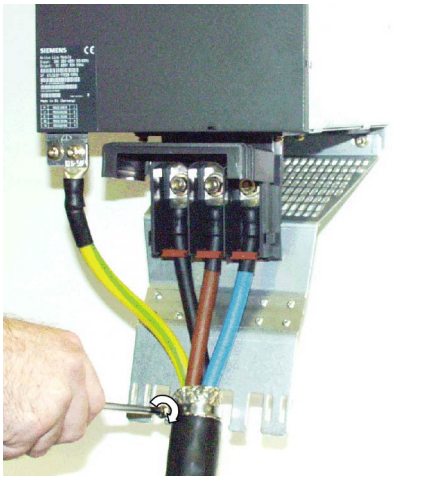
			
1. Attach the protective conductor. Tightening torque: 3 Nm (26.6 lbf in)	2. Attach the power cable. Tightening torque: 1.8 Nm (15.9 lbf in)	3. Tighten the hose clamp at the shield connecting plate.	Result: The power cable is connected.

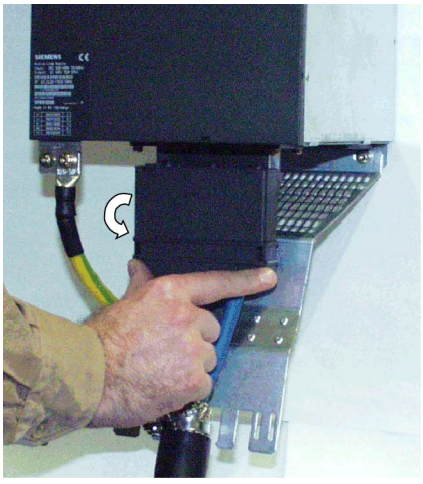
Example 2: 200 mm wide component

Required tools:

- Torx screwdriver T25 for protective conductor connection (Torx slot)
- (Torque) wrench M8 for power cables
- Flat-bladed screwdriver for hose clamp

Table 12-7 Connecting the power cable for a 200 mm wide component

		
1. Release and open the cover of the terminal strip.	2. Remove the M8 nuts.	3. Attach the protective conductor and the power cable. Tightening torque: 13 Nm (115 lbf in)
		
4. Adapt a restrictor collar (using a suitable tool) for the touch protection.	5. Push on the reduction collar.	6. Tighten the hose clamp at the shield connecting plate.



7. Close the cover of the terminal strip.

12.2 DC link rectifier adapter for Booksize format

12.2.1 Description

The DC link rectifier adapter supplies the DC link voltage directly. It is best used for supplying an individual component. With a direct supply, each component is connected to the DC link separately. The internal DC link busbar is not used here.

If the DC link rectifier adapter is to be used for supplying several components, it is important to remember that it can only be installed on the component on the far right. The choice of connection cable diameter should be based on the required summation current for all the connected components.

The connection cables must be fused accordingly.

Note

When a DC link rectifier adapter and DC busbars are used, the limit values for radio interference suppression of Category C2 according to EN 61800-3 can no longer be guaranteed.

Table 12-8 Available DC link rectifier adapters

Article No.	Rated current	Used for Line/Motor Modules with these sizes
6SL3162-2BD00-0AA0	43 A	50 mm, 100 mm
6SL3162-2BE00-0AA0	72 A	100 mm
6SL3162-2BM00-0AA0	200 A	150 mm, 200 mm, 300 mm



DC link rectifier adapter
6SL3162-2BD00-0AA0



DC link rectifier adapter
6SL3162-2BE00-0AA0



DC link rectifier adapter
6SL3162-2BM00-0AA0

12.2.2 Safety instructions for DC link rectifier adapters



⚠ 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 cover 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 cover of the DC link is open

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

- Only operate the components with closed protective cover.



⚠ WARNING

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

Live components are exposed and accessible if the 24 V terminal adapter or the DC link rectifier adapter are removed. Touching live components can result in death or severe injury.

- Replace the protective cover with the broken out cutouts by a new protective cover.

⚠ WARNING

Fire and device damage as a result of ground fault/short-circuit

The DC link connection cables must be laid so that a ground fault or short-circuit is impossible. A ground fault can cause a fire with smoke development.

- Use the local installation regulations to avoid this fault.
- 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 cable lengths are exceeded

Excessively long cable lengths can cause components to overheat with the associated risk of fire and smoke.

- The total length of the DC link (including the connection cables) must 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

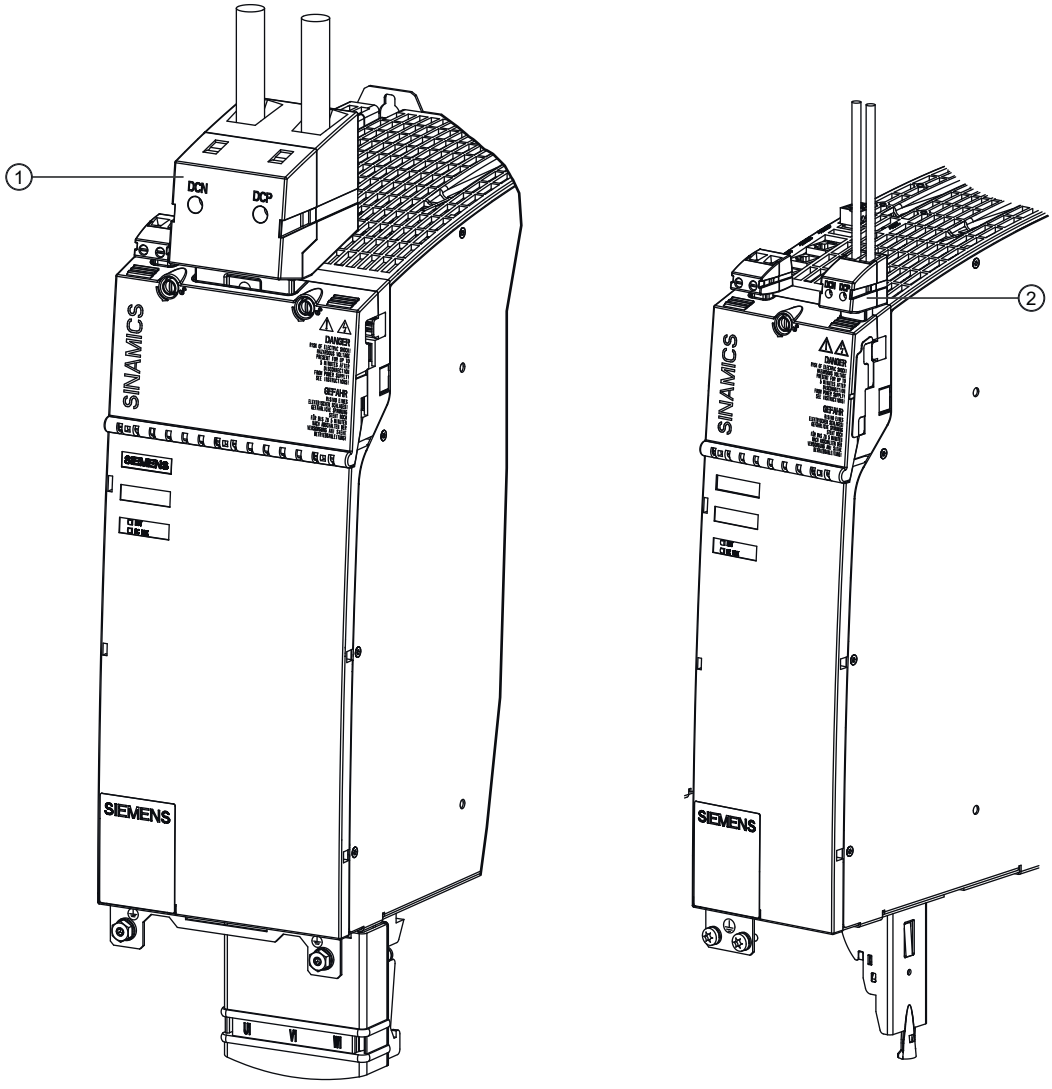
Fire as a result of incorrectly dimensioned overcurrent protection in the DC link connecting cable

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 protection device to ensure that it functions perfectly, and maintain it regularly in accordance with local installation regulations.

12.2.3 Interface description

12.2.3.1 Overview



① DC link rectifier adapter (200 A) on a 150 mm component
② DC link rectifier adapter (43 A) on a 100 mm component

Figure 12-11 Installed DC link rectifier adapter on components with a width of 100 mm and 150 mm

12.2.3.2 DC link connection

Table 12-9 DC link rectifier adapter – description of the terminals

Terminal	Function	Technical data
DCP	DC link positive	**Supply voltage:** 720 V_{DC}
DCN	DC link negative	

12.2.4 Dimension drawings

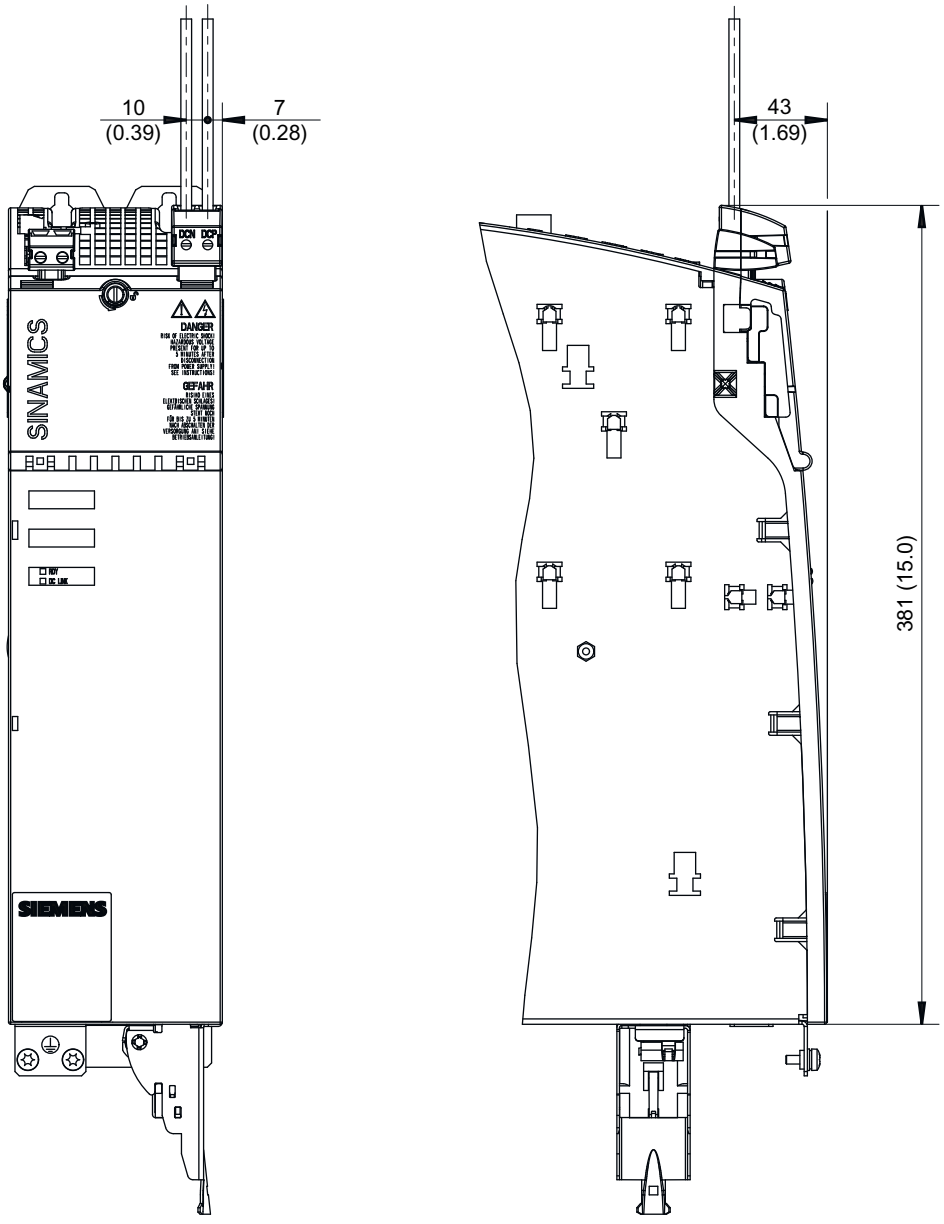


Figure 12-12 Dimension drawing of a 100 mm wide component with DC link rectifier adapter 43 A, all dimensions in mm and (inches)

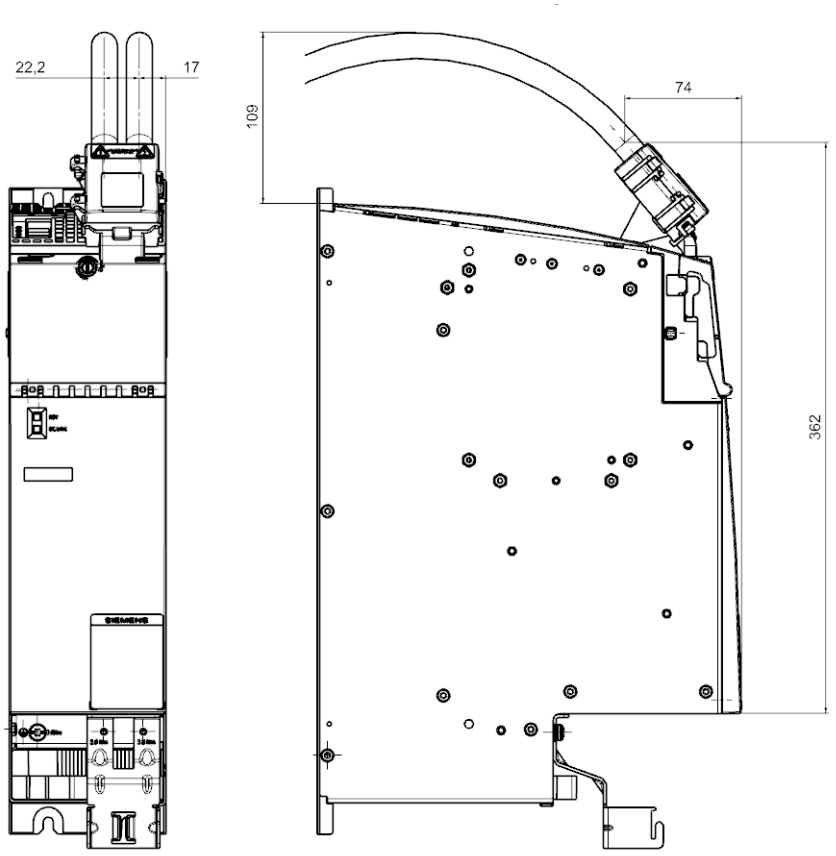


Figure 12-13 Dimension drawing of a 100 mm wide component with DC link rectifier adapter 72 A

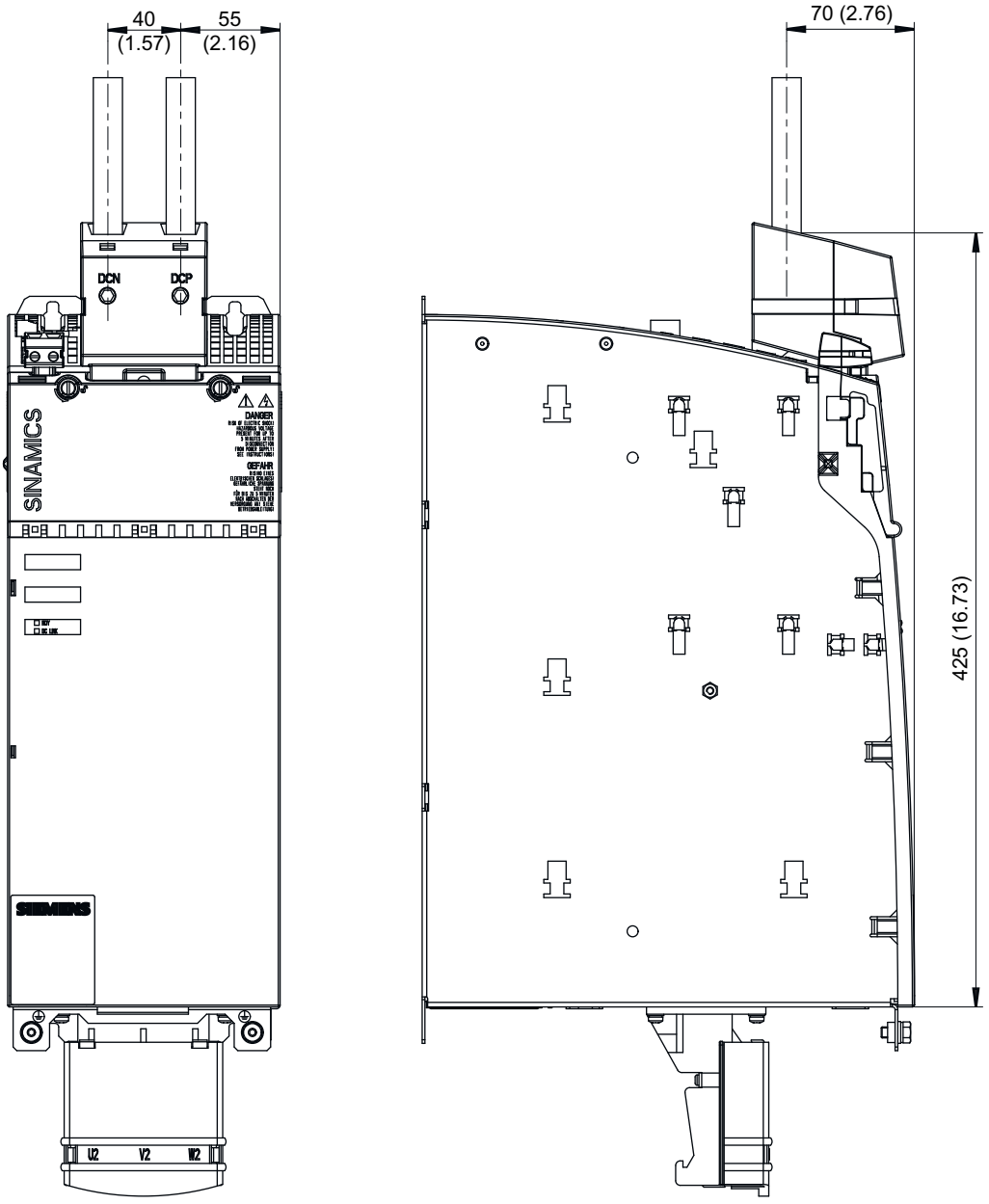


Figure 12-14 Dimension drawing of a 150 mm wide component with DC link rectifier adapter 200 A, all dimensions in mm and (inches)

12.2.5 Mounting

12.2.5.1 Mounting a 43 A DC link rectifier adapter

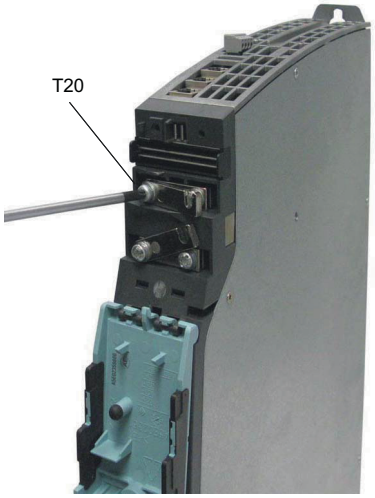
Range of applications

- Active Line Modules: 16 kW
- Basic Line Modules: 20 kW
- Smart Line Modules: 5 ... 16 kW
- Motor Modules: 3 ... 30 A, 2x3 ... 2x18 A

Required tools:

- Flat bladed screwdriver (1 x 5.5) for releasing the protective cover
- Torx T10 screwdriver to fasten the 24 V terminal adapter
- Torx screwdriver T20 for DC link screws (Torx slot)
- Pliers for breaking out the cutouts

Table 12-10 Removing the DC link busbars

		
1. Release and open the protective cover.	2. Remove the upper left-hand screw and the DC link bridge	3. Remove the lower left-hand screw and the DC link bridge

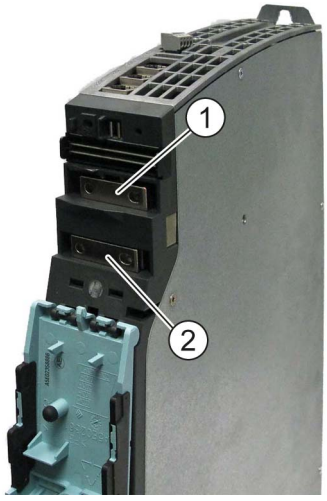
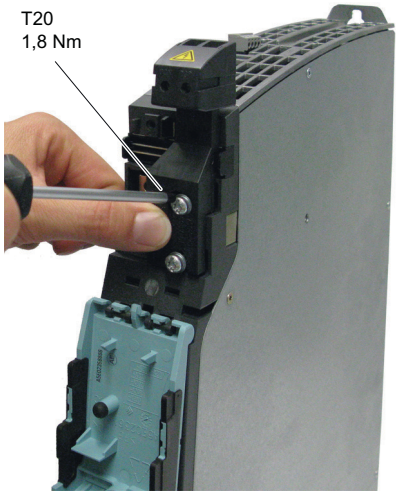
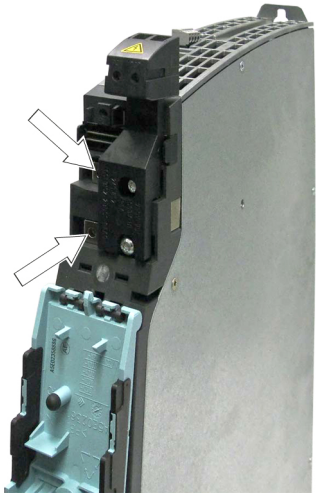
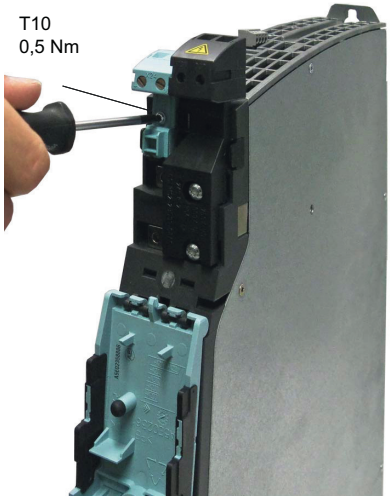
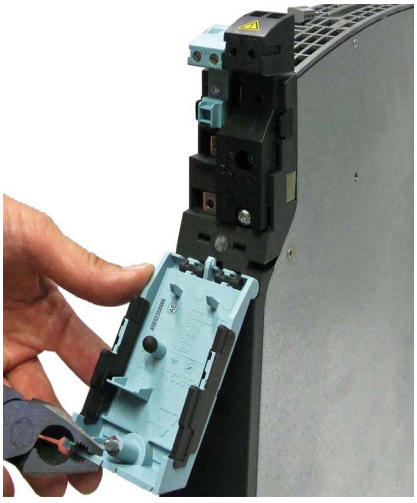
		To install the DC link rectifier adapter, it is essential to leave the DC link busbars ① and ② in the components (hold firmly to prevent them falling out).
4. Remove the upper and lower right-hand DC link screw.		

Table 12-11 Installing the DC link rectifier adapter and 24 V terminal adapter

		
1. Fix and screw (top and bottom) the DC link rectifier adapter on the right-hand side of the component using the original M4x20 screws.	2. Do **NOT** use the screw holes on the left-hand side of the component.	3. Attach and screw on the 24 V terminal adapter using the associated screw (provided in the accessories pack).

		
4. Breakout the cutouts in the protective cover.	5. Close the protective cover until you hear it snap into place.	6. Component with installed DC link rectifier adapter and 24 V terminal adapter

12.2.5.2 Mounting a 72 A DC link rectifier adapter

Range of applications

- Active Line Modules: 16 kW
- Basic Line Modules: 20 kW
- Smart Line Modules: 16 kW
- Motor Modules: 30 ... 60 A, 2x18 A

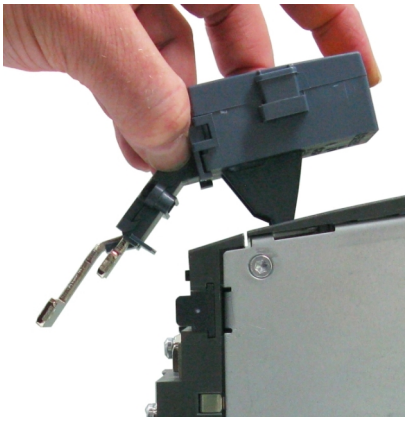
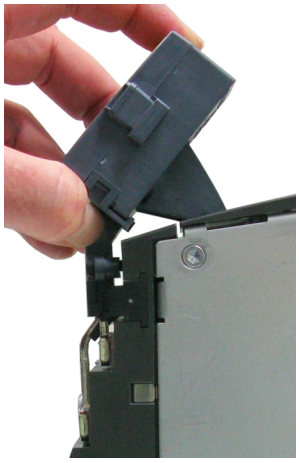
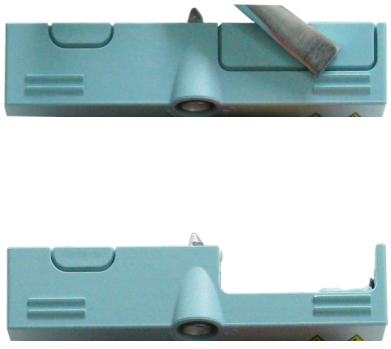
Required tools:

- Flat bladed screwdriver (1 x 5.5) for releasing the protective cover
- Torx T10 screwdriver to attach the adapter
- Torx screwdriver T20 for DC link screws (Torx slot)
- Pliers for knocking out the cutouts

Note

Opening the protective flap and removing the DC link screws is described in the previous chapter. Also mounting a 24 V terminal adapter.

Table 12-12 Mounting a 72 A DC link rectifier adapter

		
Engage the DC link rectifier adapter in the grille.	Press the DC link rectifier adapter downward.	Fasten the adapter busbars using the previously removed M4x20 DC link screws (Torx 20; 1.8 Nm / 16 lbf-in).
		
Fasten the DC link rectifier adapter using the associated screw provided in the accessory pack (Torx 10; 0.8 Nm / 7 lbf-in).	Break out the cutout in the protective cover.	Mounted DC link rectifier adapter with closed protective flap.

12.2.5.3 Mounting a 200 A DC link rectifier adapter

Range of applications

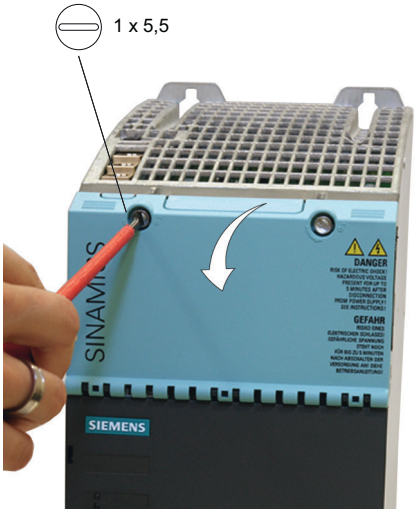
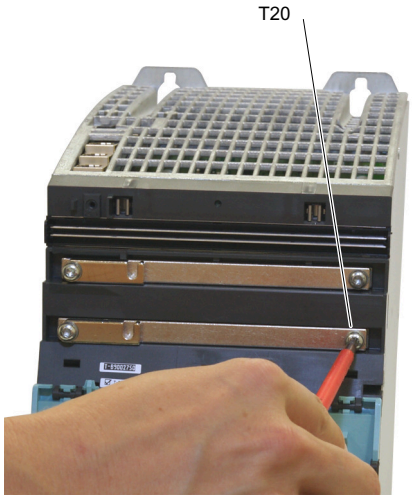
- Active Line Modules: 36 ... 120 kW
- Basic Line Modules: 40 ... 100 kW
- Smart Line Modules: 36 ... 55 kW
- Motor Modules: 85 ... 200 A

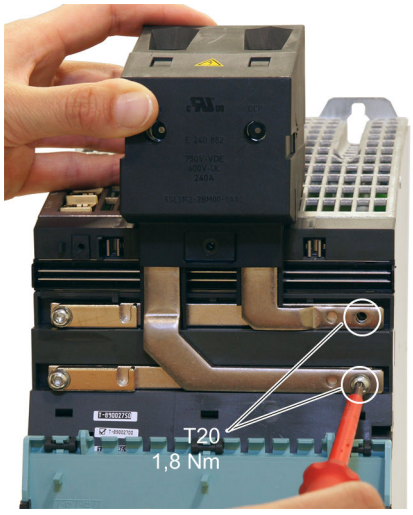
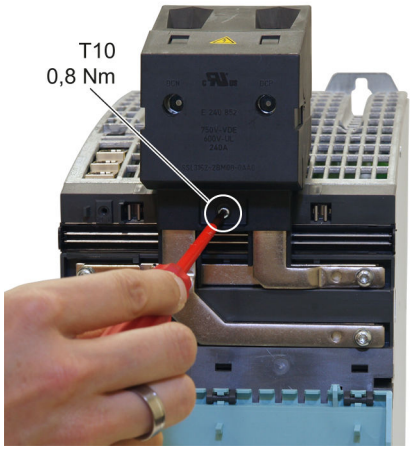
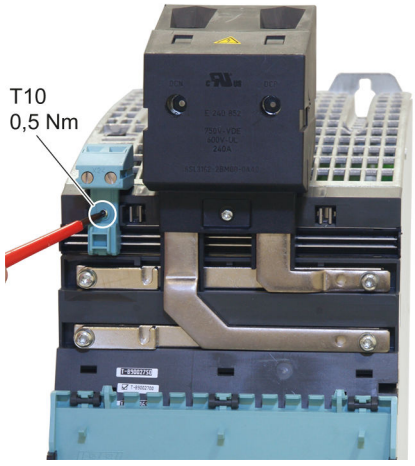
NOTICE
Damage when mounting using 2 screws For DC link rectifier adapters that are mounted using only 2 screws, currents above 150 A result in a high temperature rise. This can damage the DC link rectifier adapter or the component. • If the DC link rectifier adapter is mounted using only 2 screws, then you must limit the current to 150 A.

Required tools:

- Flat bladed screwdriver (1 x 5.5) for releasing the protective cover
- Torx T10 screwdriver to attach the adapter
- Torx screwdriver T20 for DC link screws (Torx slot)
- Pliers for knocking out the cutouts

Table 12-13 Mounting a 200 A DC link rectifier adapter

		
1. Release and open the protective cover.	2. Remove the DC link screws.	3. Engage the adapter in the grille.

		
4. Fix the adapter bars with the DC link screws previously removed.	5. Fix the adapter with the associated screw (accessories pack).	6. Insert and screw on the 24 V terminal adapter using the associated screw (provided in the accessories pack).
		
7. Breakout the cutouts in the protective cover.	8. Close the protective cover until you hear it snap into place.	

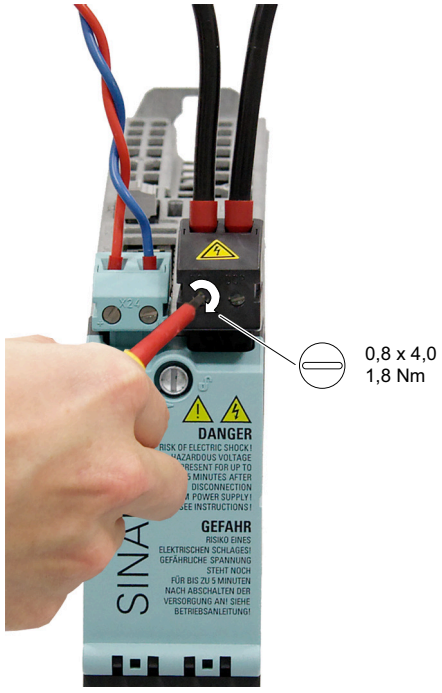
12.2.6 Electrical connection

43 A DC link rectifier adapter

Tool required:

- Flat bladed screwdriver (0.8 x 4.0)

Table 12-14 Electrical connection of the 43 A DC link rectifier adapter

	
Install the cables at the DC link rectifier adapter (0.8 x 4.0).	Connected DC link rectifier adapter

72 A DC link rectifier adapter

Required tools:

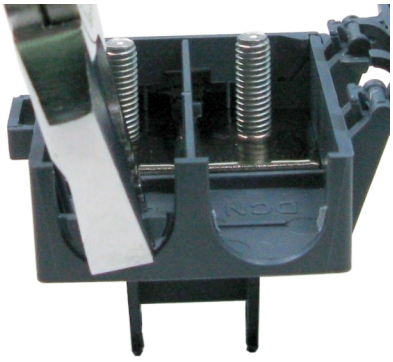
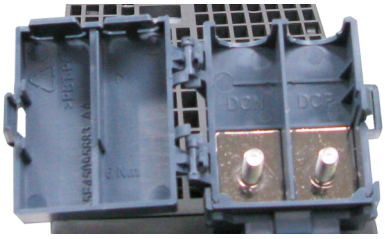
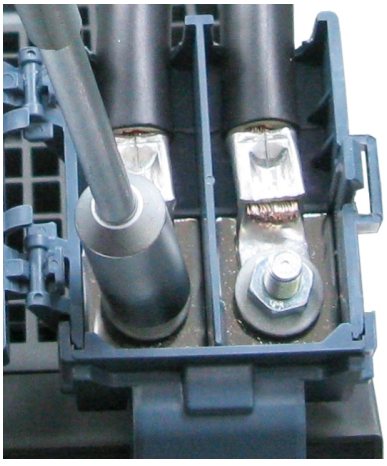
- Flat bladed screwdriver (1 x 5.5) for releasing the protective cover
- Socket wrench, 10 mm socket
- Pliers for knocking out the cutouts

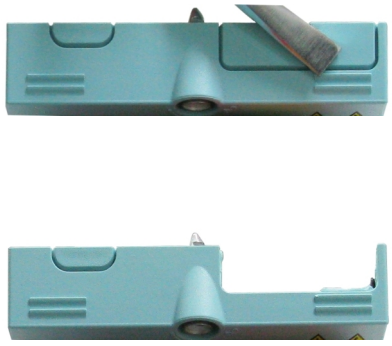
Note

Using shrink sleeving

Shrink sleeving must be used for all non-insulated current carrying parts of cable lugs and cables with a clearance from bolts exceeding 32 mm (1.26 inch).

Table 12-15 Electrical connection of the 72 A DC link rectifier adapter

	
Release the protective cover of the DC link rectifier adapter using a flat bladed screwdriver 1 x 5.5.	Open adapter housing with terminal studs
	 
Break out the cutouts at the upper side of the DC link rectifier adapter housing (required for all cable cross-sections).	Break out the cutouts at the upper side of the DC link rectifier adapter cover (only for larger cable cross-sections).
	

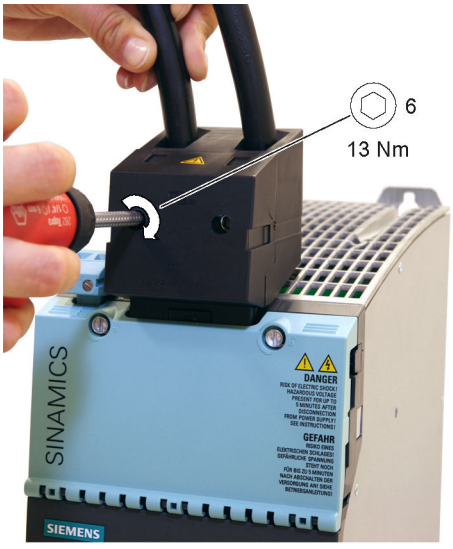
Connect the DC link rectifier adapter cables at the terminal studs using M6 combination nuts: DCN left, DCP right Tool: 10 mm wrench socket; 6 Nm (53 lbf-in)	Attach the second DC link rectifier adapter cable.
	
Break out the cutout in the protective cover.	Mounted DC link rectifier adapter with closed protective flap.

200 A DC link rectifier adapter

Tool required:

- Size 6 Allen key

Table 12-16 Electrical connection of the 200 A DC link rectifier adapter

	
Install the cables at the DC link rectifier adapter (hexagon socket-head screw)	Connected DC link rectifier adapter

12.2.7 Technical specifications

Table 12-17 Technical specifications DC link rectifier adapter

DC link rectifier adapter	6SL3162-	2BD00-0AA0	2BE00-0AA0	2BM00-0AA0
Supply voltage	V_{DC}	510 ... 720	510 ... 720	510 ... 720
Current-carrying capacity at 55 °C	A_{DC}	43	72	200[1)]
Conductor cross-section (flexible)	mm^2 (AWG)	0.5 ... 10 (20 ... 6)	10 ... 35 (8 ... 2)	35 ... 120 (4 ... 4/0)
Stripped length	mm	11	acc. to cable lug	27
DC link connection Tightening torque	Nm (lbf in)	Slotted (0.8x4.0) 1.8 (15.9)	Threaded bolt M6 6 (53)	Hexagon socket-head screw size 6 13 (115)
DC link busbars Fixing screw Tightening torque	Nm (lbf in)	Torx T20 1.8 (15.9)	Torx T20 1.8 (15.9)	Torx T20 1.8 (15.9)
DC link adapter Fixing screw Tightening torque	Nm (lbf in)	Torx T10 0.8 (7.1)	Torx T10 0.8 (7.1)	Torx T10 0.8 (7.1)
Weight	kg	0.05	0.10	0.48

1) If only one of the two screws is used to connect the DC link rectifier adapter with DCP and DCN, then the current-carrying capacity is reduced to 150 A.

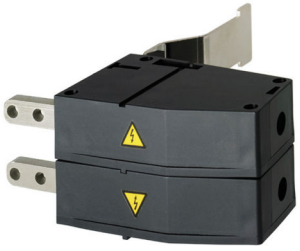
12.3 DC link adapter

12.3.1 Description

DC-link adapters are required if the drive line-up is to be subdivided between two or more rows.

The DC link adapter can be mounted on all Line Modules and Motor Modules in the booksize format.

To connect the various sub line-ups, use shielded individual conductors that are mechanically secured.



DC link adapter
6SL3162-2BM01-0AA0

12.3.2 Safety instructions for DC link adapters



⚠ 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 cover 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 cover of the DC link is open

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

- Only operate the components with closed protective cover.



⚠ WARNING

Electric shock due to incorrectly installed DC link bridges

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

- For all 50 mm wide modules[1] (exception: Smart Line Module[2]), remove the DC link bridge, including the screws. Do not tighten the screws without the DC link bridges.
- For all components that are 75 mm wide or wider, the DC link bridges may neither be swung over to the left nor removed[3].

[1] For 50 mm wide modules, the DC link bridge cannot be swung inwards.
[2] Smart Line Modules do not have a DC link bridge.
[3] The DC link bridge guarantees the mechanical stability of the DC link busbars.



⚠ 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

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 or fire if the necessary clearances and creepage distances are not complied with

When using non-insulated end sleeves, the required clearances and creepage distances 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 insulated end sleeves.

⚠ WARNING

Fire and device damage as a result of ground fault/short-circuit

The DC link connection cables must be laid so that a ground fault or short-circuit is impossible. A ground fault can cause a fire with smoke development.

- Protect the cables against mechanical damage.
- Use the local installation regulations to avoid this fault.

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 cable lengths are exceeded

Excessively long 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.

12.3.3 Interface description

12.3.3.1 Overview

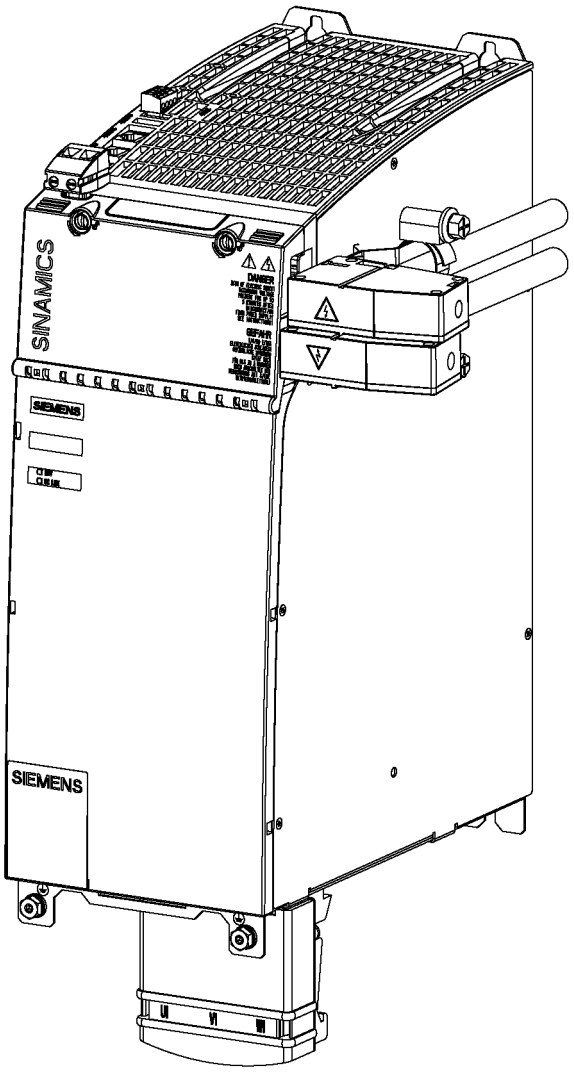


Figure 12-15 150 mm wide components with DC link adapter for multi-tier configurations

12.3.4 Dimension drawing

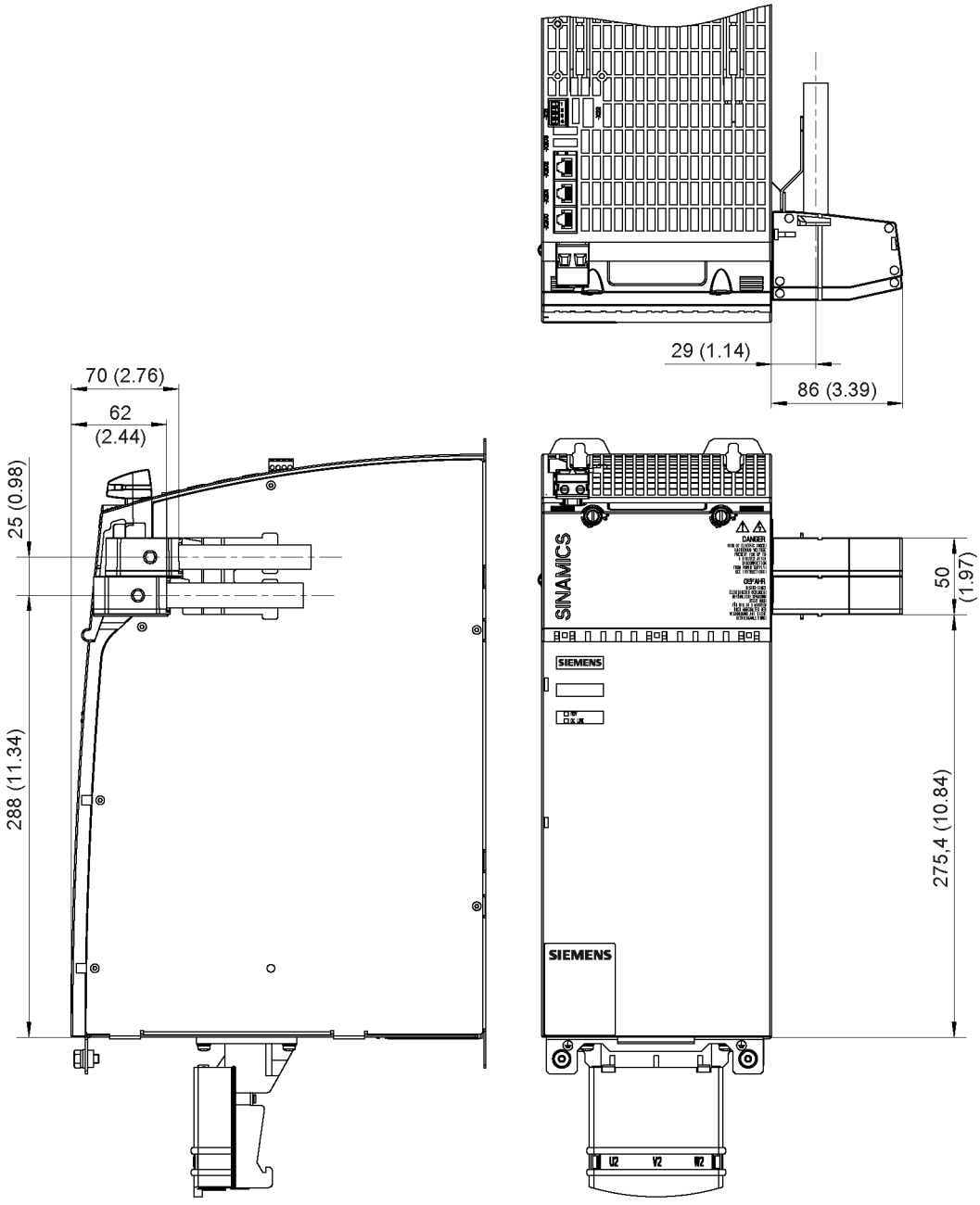


Figure 12-16 Dimension drawing of a 150 mm wide component with DC link adapter, all dimensions in mm and (inches)

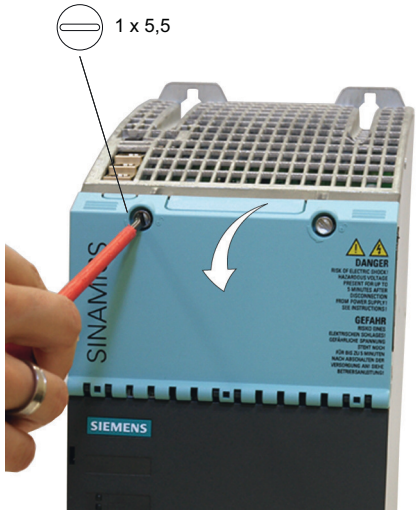
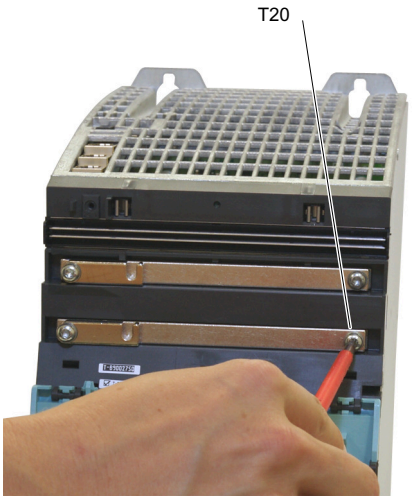
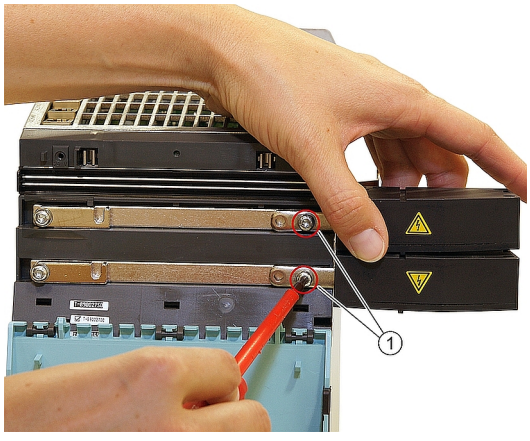
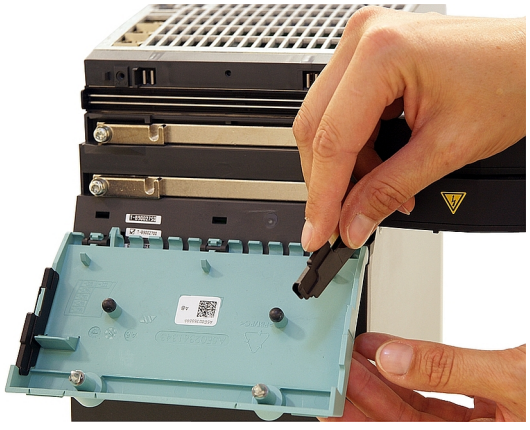
12.3.5 Installation

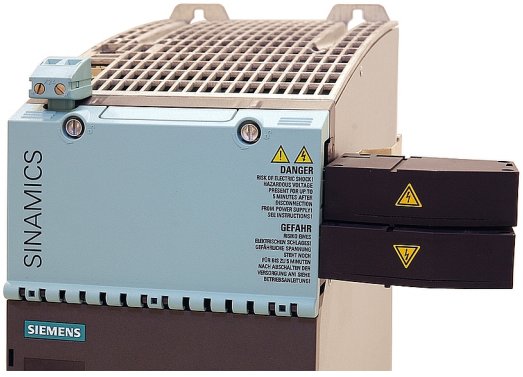
By moving the adapter housing, the DC link adapter can be fitted on either the left-hand or right-hand side of the component.

Required tools:

- Flat bladed screwdriver (1 x 5.5) for releasing the protective cover
- Torx screwdriver T20 for DC link screws (Torx slot)

Table 12-18 Mounting the DC link adapter

	
1. Release and open the protective cover of the DC link.	2. Remove the DC link screws.
	

3. Mount the DC link adapter (1.8 Nm / 15.9 lbf in) with the previously removed DC link screws. When installing using two screws, use the **right-hand** holes ①.	4. Remove the DC link side cover, install the 24 V terminal adapter (if required) and close the protective cover until it audibly clicks into place.
	Result: Installed DC link adapter and 24 V terminal adapter



⚠ WARNING

Electric shock when touching the DC link busbars

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

- The DC link adapters must be installed so that after closing the DC link cover they cannot 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 line-up can cause an electric shock.

- For all 50 mm wide modules (exception: Smart Line Modules), remove the DC link bridge, including the screws. Do not tighten the screws without the DC link bridges.
- For all components that are 75 mm wide or wider, the DC link bridges must neither be moved to the left nor swung out from the module.

NOTICE

Damage when mounting using 2 screws

For DC link adapters that are mounted using only 2 screws, currents above 150 A result in a high temperature rise. This can damage the DC link adapter or the component.

- If the DC link adapter is only mounted using 2 screws, then you must limit the current to 150 A.

Note

- When mounting with only 2 screws, use the inner hole of the adapter busbar.

Using washers when mounting the DC link adapter

⚠ WARNING

Overheating and fire when mounting the DC link adapter without washers

Mounting the DC link adapter with combination screws M4x20 without using the washers provided can result in the DC link busbar overheating and causing a fire. This can result in death or severe injury.

- For 150 to 300 mm modules, use one of the washers provided for each screw for the DC link adapter connection on the left.

DC link adapters are supplied with washers, which are attached using a securing strap at the inner hole of the DC link busbar. These washers must be used if a DC link adapter is mounted on the left-hand side of a 150 to 300 mm wide module (one for each screw). It is not permissible that they are used for other mounting scenarios.

	DC link adapter connection	
Module width	Connection left	Connection right
50 ... 100 mm	No washers	No washers
150 ... 300 mm	Washers	No washers

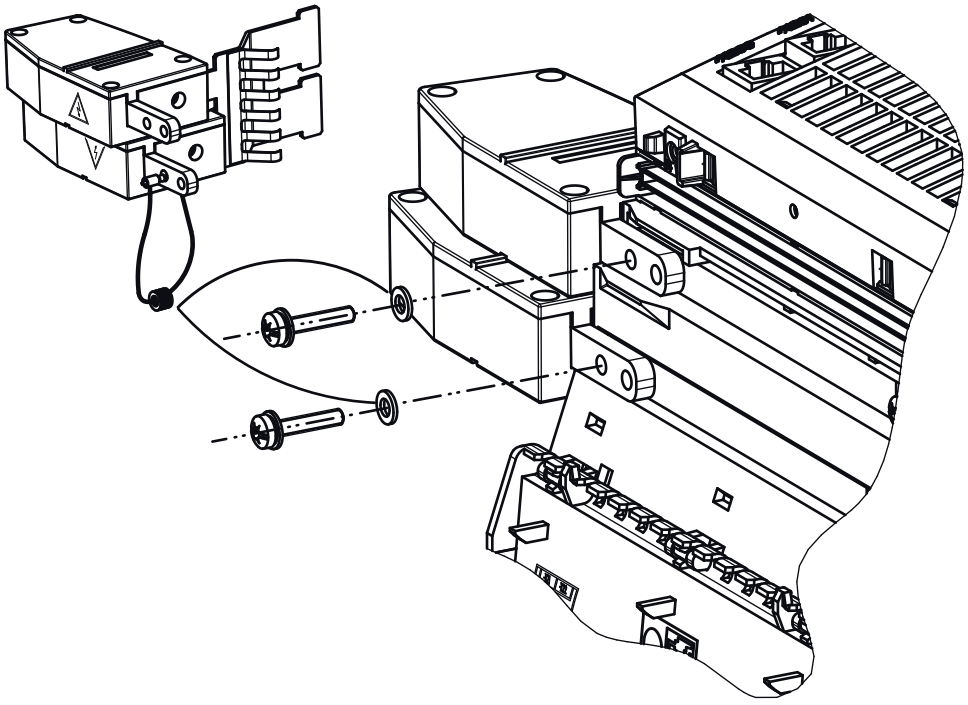
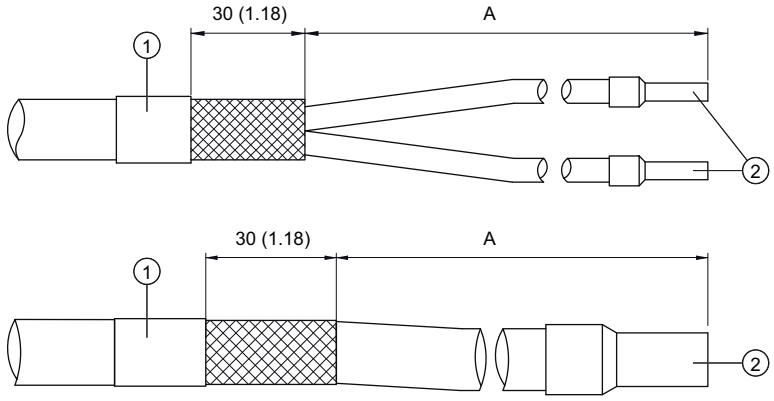


Figure 12-17 Mounting a DC link adapter on the left-hand side for module widths of 150 to 300 mm using 2 screws

12.3.6 Electrical connection

12.3.6.1 Preparing the cables

1. Prepare the DC link connecting cables as shown below.
2. Only use shielded cables with insulated end sleeves.



① Protective braided shield folded back and fixed using shrink-on sleeve
② Insulated end sleeve

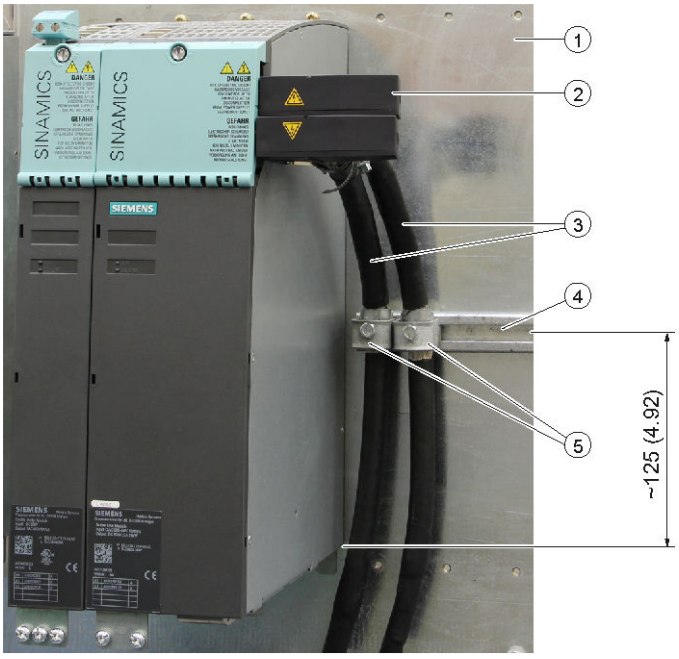
Figure 12-18 Single-core and two-core DC link connecting cable with insulated end sleeves, all dimensions in mm and (inch)

Refer to the table below for dimension A:

Conductor cross-section [mm²]	Mounting location of the DC link adapter at the drive line-up	Connection	A [mm]
35 / 50 / 70 / 95 / 120	Left	DCP	60
		DCN	70
	Right	DCP	60
		DCN	70

12.3.6.2 Fixing the cables to the rear cabinet panel

1. Fix the DC link connecting cables directly next to the last component at the rear control cabinet panel. Use the C-profile rails and the appropriate cable clamps from the Rittal company. The distance between the C profile rail and the lower side of the component is approximately 125 mm.
2. Appropriately insulate the cable cores at the connection location before mounting.



① Control cabinet panel
② DC link adapter
③ Cores of the DC link connecting cable
④ C-profile rail from Rittal company (article number 7831.570 / 7831.571)
⑤ Cable clamps for C profile rails from the Rittal company.

Figure 12-19 Fixing the DC link connecting cable to the control cabinet panel, dimensions in mm and (inch)

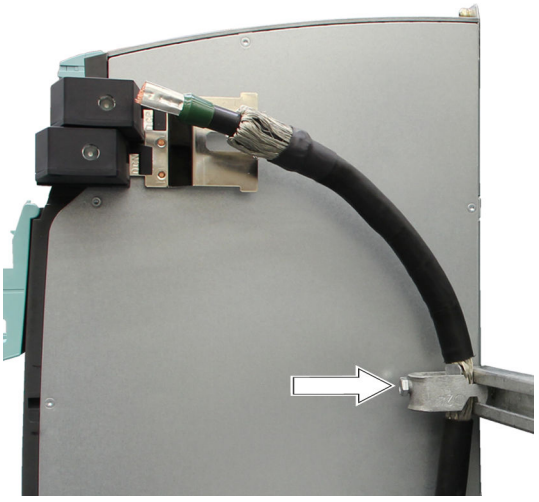
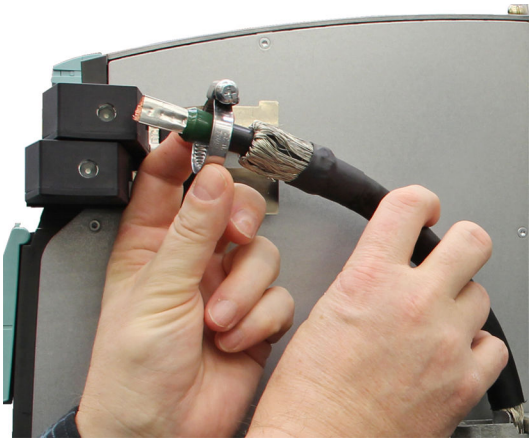
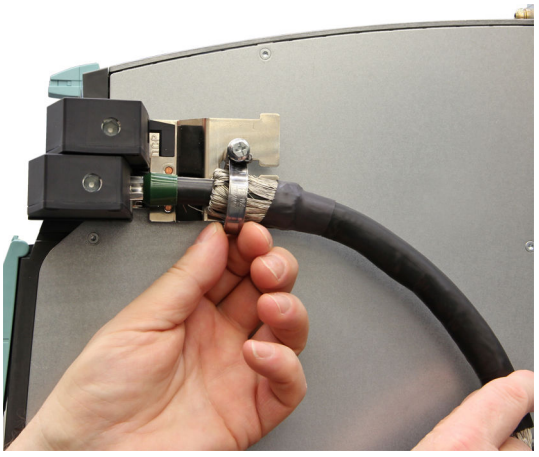
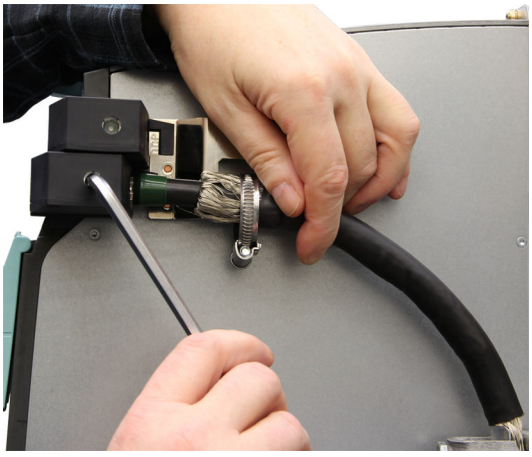
12.3.6.3 Cable connection and shield support

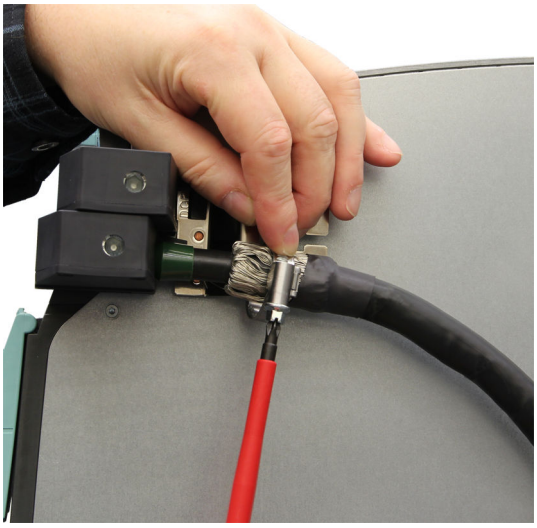
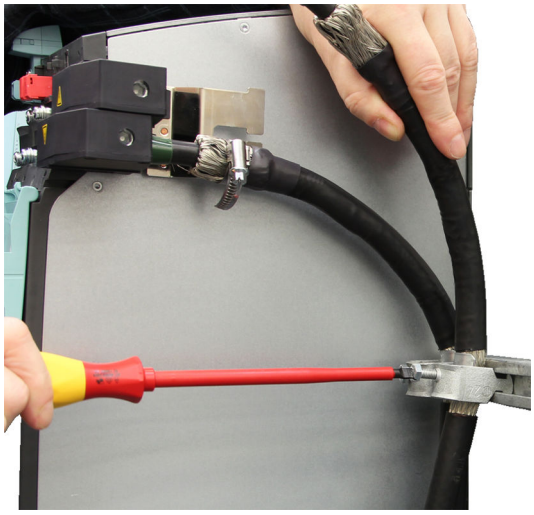
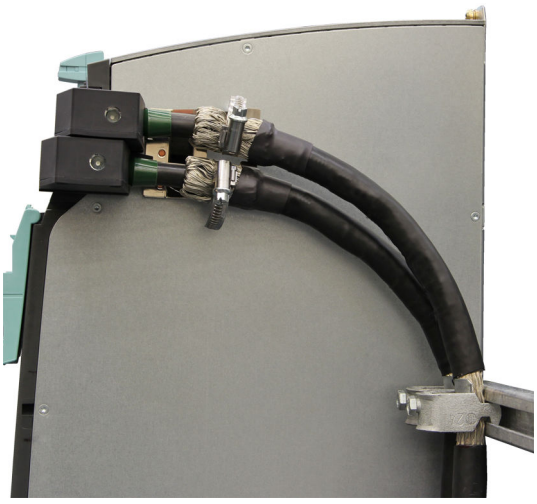
In order to simplify installing the DC link connecting cables at the DC link adapter, first fix the cables to the control cabinet panel (see above).

Required tools:

- Size 6 Allen key to attach the cables
- Suitable tool for hose clamps, e.g. flat-bladed screwdriver

Table 12-19 Connecting the DC link connecting cables to the DC link adapter

	
1. Fix the first conductor of the DC link connecting cable to the profile rail using a cable clamp.	2. Route the cable end through an appropriate cable clamp.
	
3. Slide the cable clamp onto the tongue, and then insert the end of the cable into the DCN connection of the DC link adapter.	4. Tighten the cable using an Allen key.

	
5. Tighten the screw of the hose clamp using a suitable screwdriver.	6. Fix the second conductor of the DC link connecting cable to the profile rail using a cable clamp. Connect the cable for the DCP connection as described under Points 2 to 5.
	The installed DC link connecting cable is shown in the adjacent diagram.

Note

After installing the cables, ensure that the EMC tongues of the DC link adapter are in contact with the side panel of the component.

12.3.7 Technical specifications

Table 12-20 Technical specifications DC link adapter

6SL3162-	Unit	2BM01-0AA0
Supply voltage	V_{DC}	510 ... 720
Current-carrying capacity attached using 2 screws attached using 4 screws	 A_{DC} A_{DC}	 150 200
Maximum ambient temperature	°C	55
Rated short-circuit current (SCCR)	kA	100
Conductor cross-section flexible	 mm^2 (AWG)	 35 ... 120 (4 ... 4/0)
Stripped length	mm	27
DC link connection Tightening torque	 Nm (lbf in)	Hexagon socket-head screw size 6 13 (115)
DC link busbars Mounting Tightening torque	 Nm (lbf in)	 Torx-slotted screw T20 1.8 (15.9)
Weight	kg	0.34

12.4 Motor plug connector for Motor Modules C/D type (3 ... 30 A)

12.4.1 Description

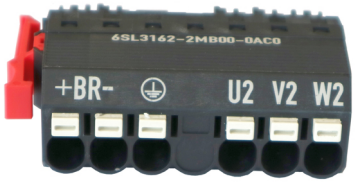
Motor Modules up to 30 A or 2 x 18 A are connected to motors using a motor plug connector (power connector). The motor plug connector is not included in the scope of supply.

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

Connect the conductors of the motor connecting cable to it:

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

The following connector versions are available:

	Motor plug connector, screw connection type Connection type: Screw terminals Article No.: 6SL3162-2MA00-0AC0
	Motor plug connector, type "Push-in", with locking levers that can engage Connection type: Spring-loaded terminals Article No.: 6SL3162-2MB00-0AC0

Note

Using identical plug connector variants for Double Motor Modules

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

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

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



⚠ WARNING

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

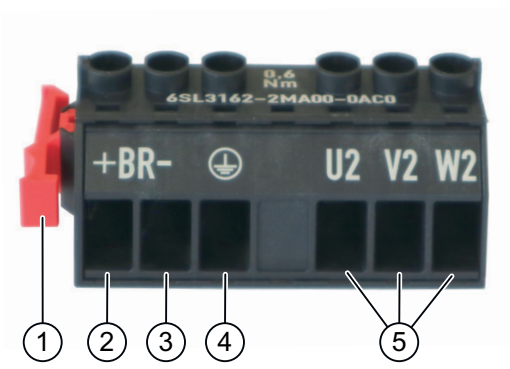
If non-certified plug connectors are used in the power circuit, this can result in overheating, fire and/or electric shock.

- Only use approved plug connectors in the power circuit.

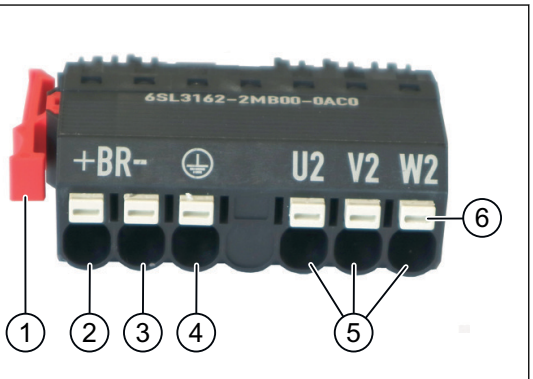
12.4.2 Electrical connection

12.4.2.1 Connection assignment:

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



Connections for screw connector



Connections for connector with push-in terminals

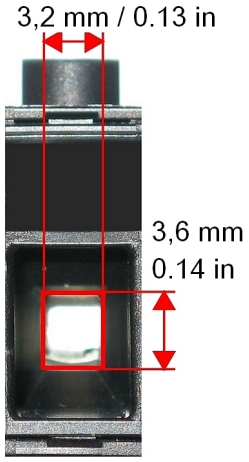
① Catch
② BR+ (black)
③ BR- (white)
④ Motor protective conductor connection
⑤ U2, V2, W2
⑥ Locking lever (only for push-in connectors "...-2MB00-...")

		Screw terminal	Spring-loaded terminal (push-in)
U2, V2, W2, protective conductor, BR+, BR-	Conductor cross-section for cables with conductor end sleeves	0.75 ... 6 mm² AWG 19 ... AWG 10	0.75 ... 6 mm² AWG 19 ... AWG 10
	Screwdriver	Slotted 0.8 x 4.0 mm	-
	Tightening torque	0.5 ... 0.6 Nm 4.4 lbf in	-

12.4.2.2 Cable cross-sections and end sleeves

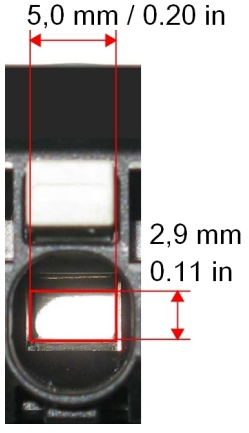
To assemble the motor cable, refer to the tables below for the connectable cable cross-sections, the possible end sleeves and the terminal openings for the individual motor connector variants.

Table 12-21 Connector with screw connection

	0.75 mm² AWG 19	1.5 mm² AWG 16	2.5 mm² AWG 14	4 mm² AWG 12	6 mm² AWG 10	Dimensions of the terminal openings
	✓	✓	✓	✓	✓[1]	
	✓	✓	✓	✓	✓[1]	
	✓ 2x	✓ 2x	✓ 2x	✓ 2x	Not possible	

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

Table 12-22 Connector with push-in connection

	0.75 mm² AWG 19	1.5 mm² AWG 16	2.5 mm² AWG 14	4 mm² AWG 12	6 mm² AWG 10	Dimensions of the terminal openings
	✓	✓	✓	✓	✓[1]	
	✓	✓	✓	✓	✓[1]	

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

Note

Motor cables with 10 mm²

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

12.4.2.3 Crimping conductor end sleeves

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

- Type PZ 6/5, Article No. 9011460000

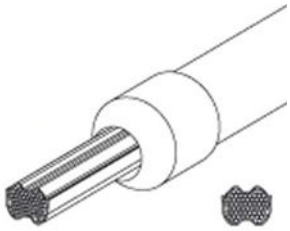


Figure 12-20 Crimp shape PZ 6/5

Note

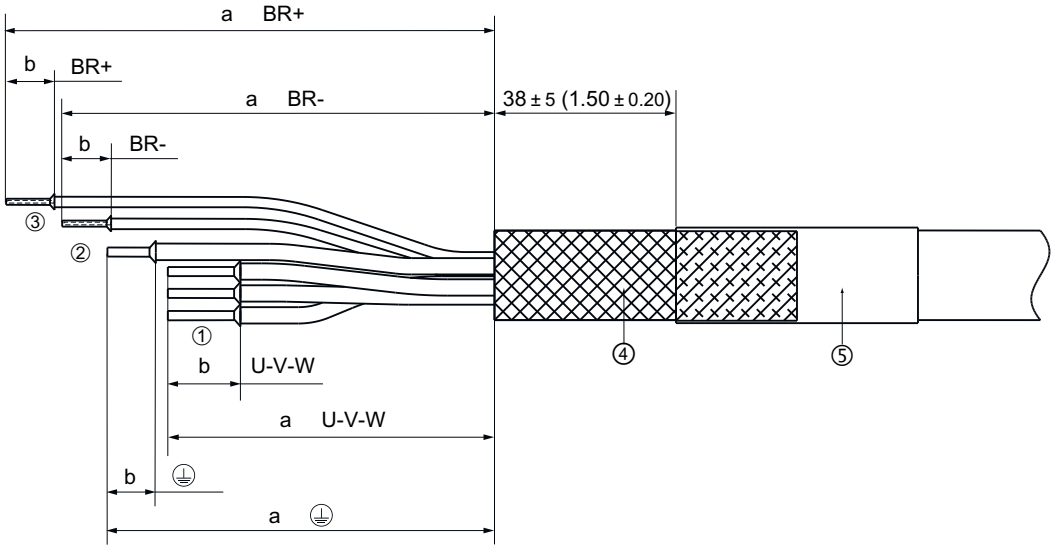
Crimping 6 mm² conductor end sleeves (AWG 10)

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

12.4.3 Preparing the power cables

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

1. Remove the cable sheath to a length of 85 mm (3.35 in) with a tolerance of ±5 mm (±0.2 in).
2. Fold back the braided shield. If you are using a motor cable with brake conductors, then the braided shield of the brake conductors must be unbraided. This is then folded back against the outer shield.
3. Fix the braided shield. Preferably use shrink tubing with hot melt adhesive.
4. Shorten the individual conductors as indicated in the drawing and table below.
5. Remove the insulation of the individual conductors to a length of "b" corresponding to the table below.
6. Use conductor end sleeves according to DIN 46228 with the appropriate cross-section.



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

Figure 12-21 Conductor and stripped insulation lengths

Table 12-23 Conductor and stripped insulation lengths as a function of the cable cross-section, data in mm and (inch)

	0.75 / 1.5 / 2.5 / 4 / 6 mm² (AWG 19 / AWG 16 / AWG 14 / AWG 12 / AWG 10)	
	a	**b**
U	55 +2/-3 (2.17 +0.08/-0.12)	12 ±0.5 (0.47 ±0.02)
V		
W		
Protective conductor	63 +2/-3 (2.48 +0.08/-0.12)	12 ±0.5 (0.47 ±0.02)
BR-	73 ±5 (2.87 ±0.20)	12 ±0.5 (0.47 ±0.02)
BR+	79 ±5 (3.11 ±0.20)	12 ±0.5 (0.47 ±0.02)

Note

Adherence to conductor and stripped insulation lengths

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

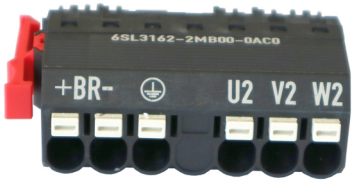
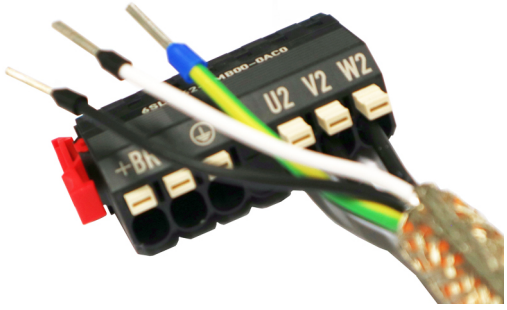
Note

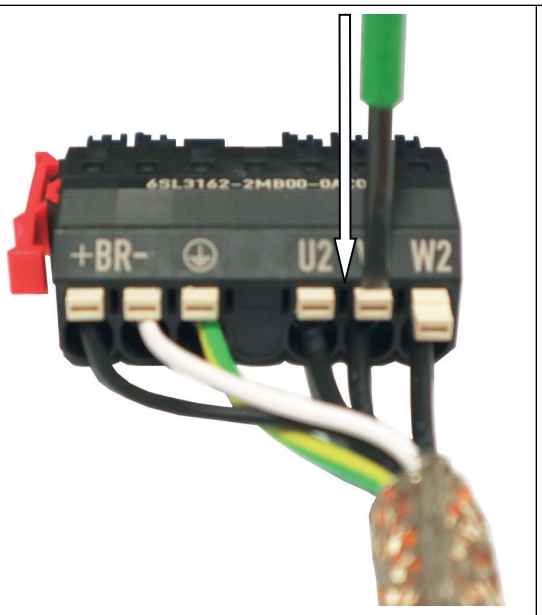
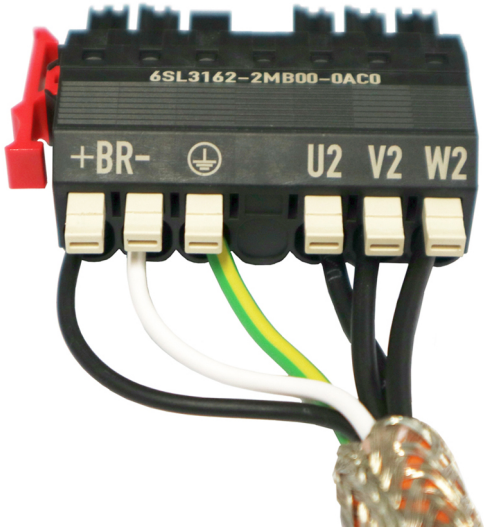
Cables for UL applications

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

12.4.4 Connecting the motor cable

Connecting conductors to the push-in connector

	
The state of the push-in plug connector when it is delivered: The 6 locking levers are locked in the engaged state, the terminals open.	Insert the conductors into the open terminals. For cross-sections from 4 mm² and higher it is helpful if U2, V2, W2 are simultaneously inserted.

	
Lock the terminals by pressing a 0.8 x 4 mm flat bladed screwdriver down vertically on the locking lever. Make sure that the conductor has been inserted as far as it will go. Start with W2, V2, U2, and by gently pulling on the conductors ensure that they are securely engaged in the terminals before you continue with the protective conductor and the brake conductors in the same way.	Assembled push-in connector

Opening the terminals/releasing the motor cables



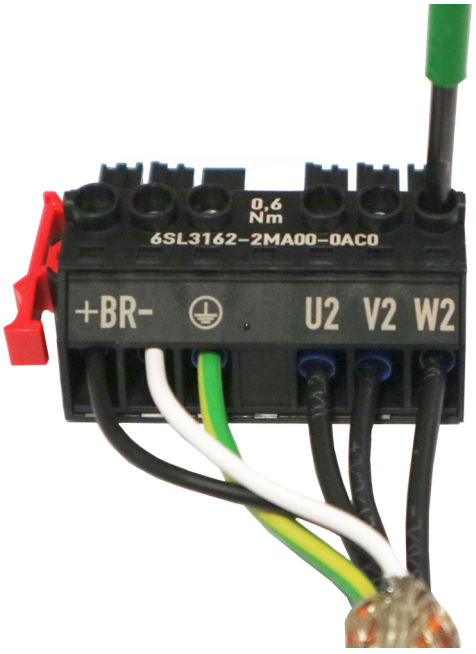
To release the terminals, press the individual locking levers up using a flat bladed screwdriver (0.8 x 4 mm) until the lever snaps back into the motor connector casing.

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

Note

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

Connecting conductors to connectors with screw terminals



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

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

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

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

12.4.5 Mounting and coding

12.4.5.1 Installation

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

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

Note

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

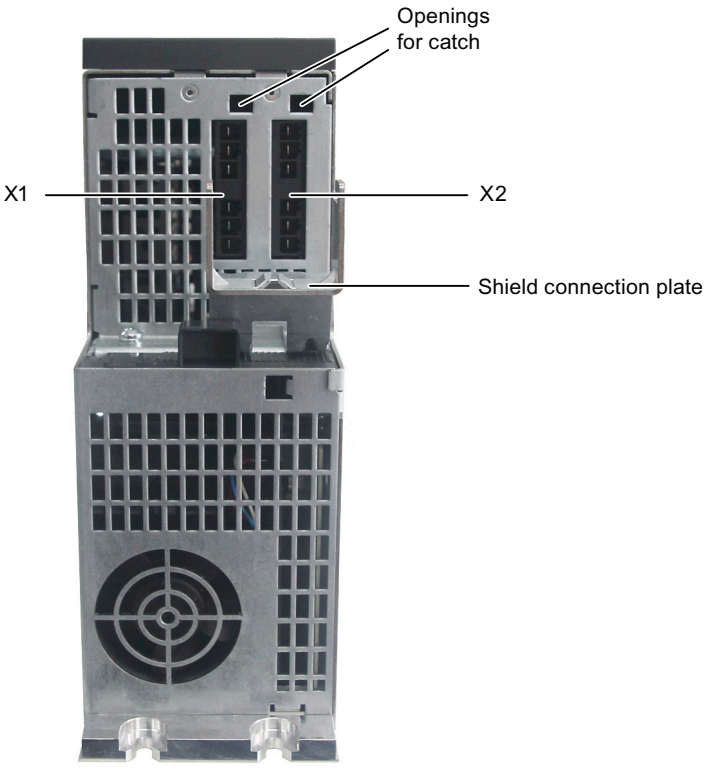


Figure 12-22 Latching the motor connector into position

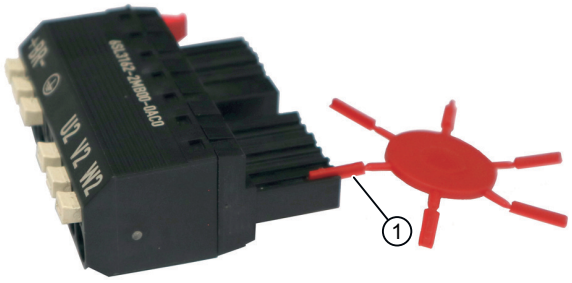
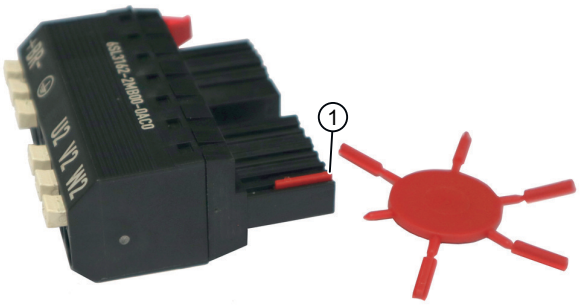
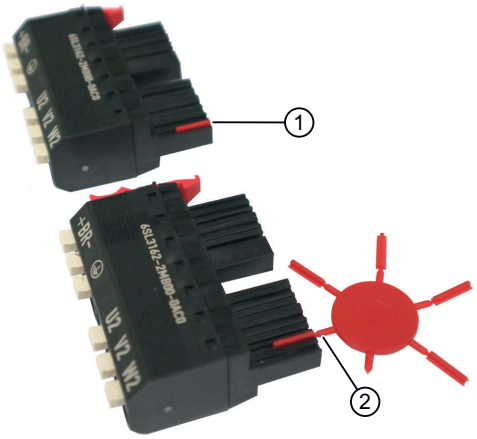
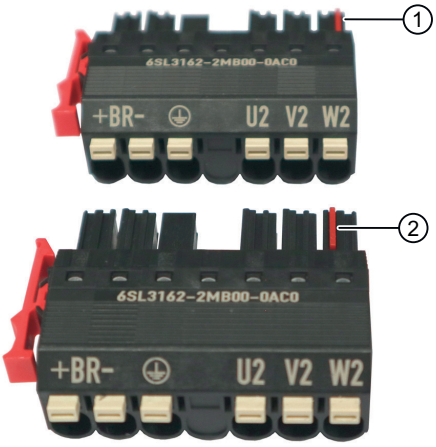


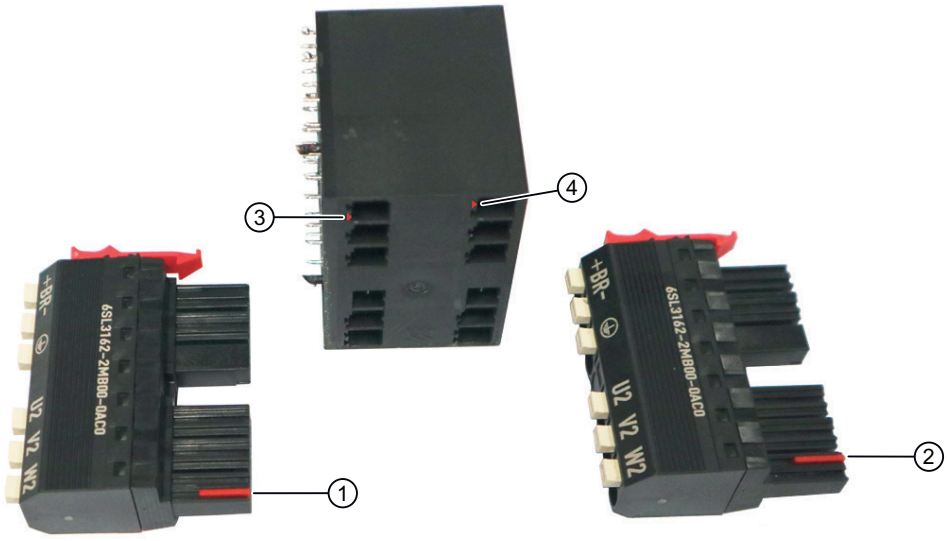
Figure 12-23 Connecting the power cables to the Motor Module

12.4.5.2 Coding

You can use coding elements to distinguish between different motor connectors, especially those for Double Motor Modules. The terminal kit contains a coding star with 6 coding elements. For additional, system-specific coding, you can purchase coding elements from Weidmüller (Article No.: 2007300000, type: BV/SV 7.62HP KO RD 2022).

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

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



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

This means that only plug connectors with coding keys ① and ③ as well as ② and ④ are possible.

12.4.6 Pre-assembled power cables

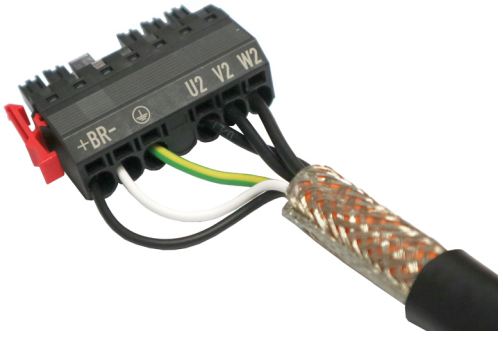
Description

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

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

Detaching the preassembled power cable from the motor connector

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

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

Note

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

12.5 DRIVE-CLiQ cabinet bushings

12.5.1 Description

A DRIVE-CLiQ cabinet bushing is used to connect the DRIVE-CLiQ cables between the inside and outside of the control cabinet. It is used in a control cabinet panel. The data lines and the voltage supply contacts of the DRIVE-CLiQ are also routed through the bushing. The DRIVE-CLiQ cabinet bushing is available for DRIVE-CLiQ cables with RJ45 connector and M12 plug/socket.

DRIVE-CLiQ cabinet bushing for RJ45 connector

The cabinet bushing has degree of protection IP54 according to IEC 60529 from the outside towards the inside. Inside the control cabinet, a connection is established according to degree of protection IP20 or IPXXB acc. to IEC 60529. So 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 as a minimum must also have degree of protection IP54.

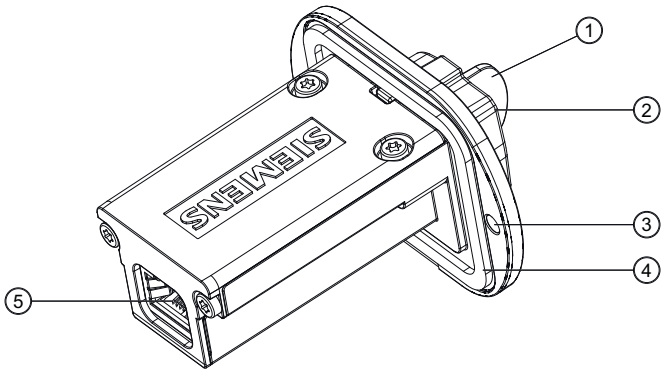
DRIVE-CLiQ cabinet bushing for M12 connector/socket

The cabinet bushing has degree of protection IP67 according to IEC 60529 from the outside towards the inside. Inside the cabinet a connection according to degree of protection IP67 in compliance with IEC 60529 is realized.

12.5.2 Interface description

12.5.2.1 Overview

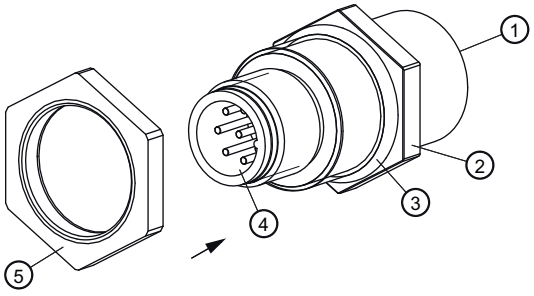
DRIVE-CLiQ cabinet bushing for DRIVE-CLiQ cables with RJ45 connector



① Protective cap, Yamaichi, Article No.: Y-ConAS-24-S
② DRIVE-CLiQ interface on the outside (to connect DRIVE-CLiQ signal cables MOTION-CONNECT with IP67 degree of protection)
③ Mounting holes
④ Flange-type seal to ensure degree of protection IP54 on the outside of the cabinet
⑤ DRIVE-CLiQ interface on the inside (to connect DRIVE-CLiQ signal cables MOTION-CONNECT with IP20 degree of protection)

Figure 12-24 Interface overview, DRIVE-CLiQ cabinet bushing

DRIVE-CLiQ cabinet bushing for DRIVE-CLiQ cables with M12 plug/socket



① DRIVE-CLiQ interface with M12 socket (8-pin)
② Flange, SW18
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 12-25 Interface overview, DRIVE-CLiQ cabinet bushing M12

12.5.3 Dimension drawings

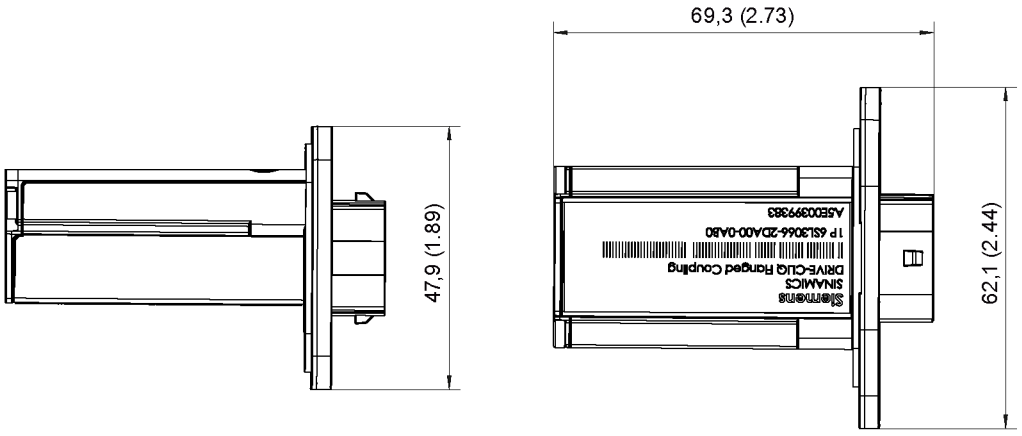
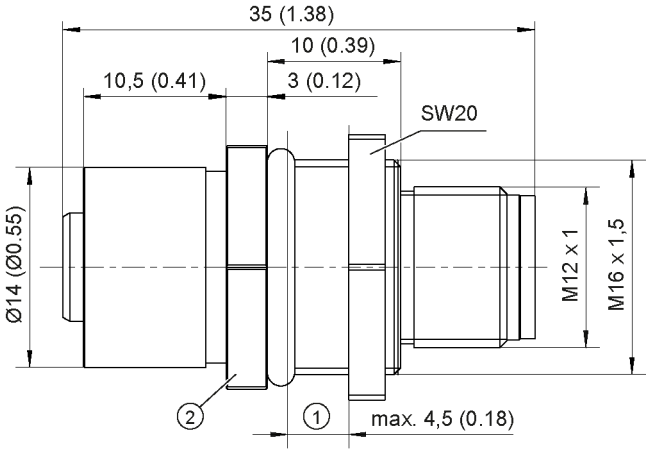


Figure 12-26 Dimension drawing of the DRIVE-CLiQ cabinet gland, all dimensions in mm and (inches)



① Cabinet panel
② Flange, SW18

Figure 12-27 Dimension drawing of the DRIVE-CLiQ cabinet bushing M12, all dimensions in mm and (inches)

12.5.4 Mounting

12.5.4.1 DRIVE-CLiQ cabinet bushing for cables with RJ45 connectors

In order to install the DRIVE-CLiQ cabinet gland, you must make a cutout in the control cabinet panel as shown in the diagram below.

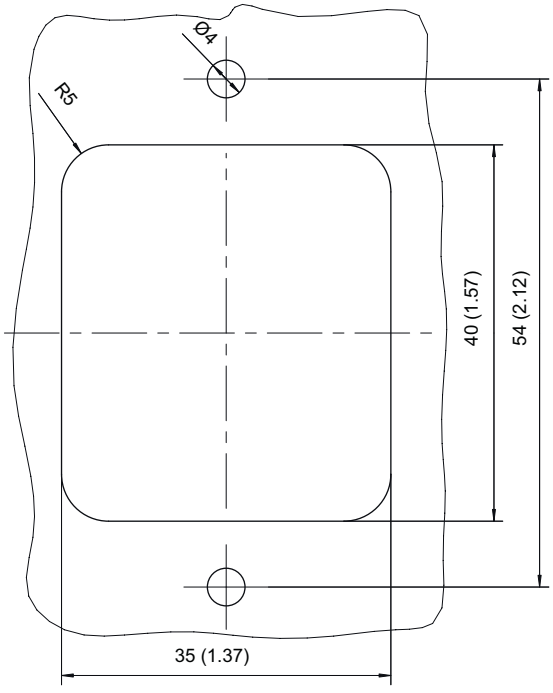
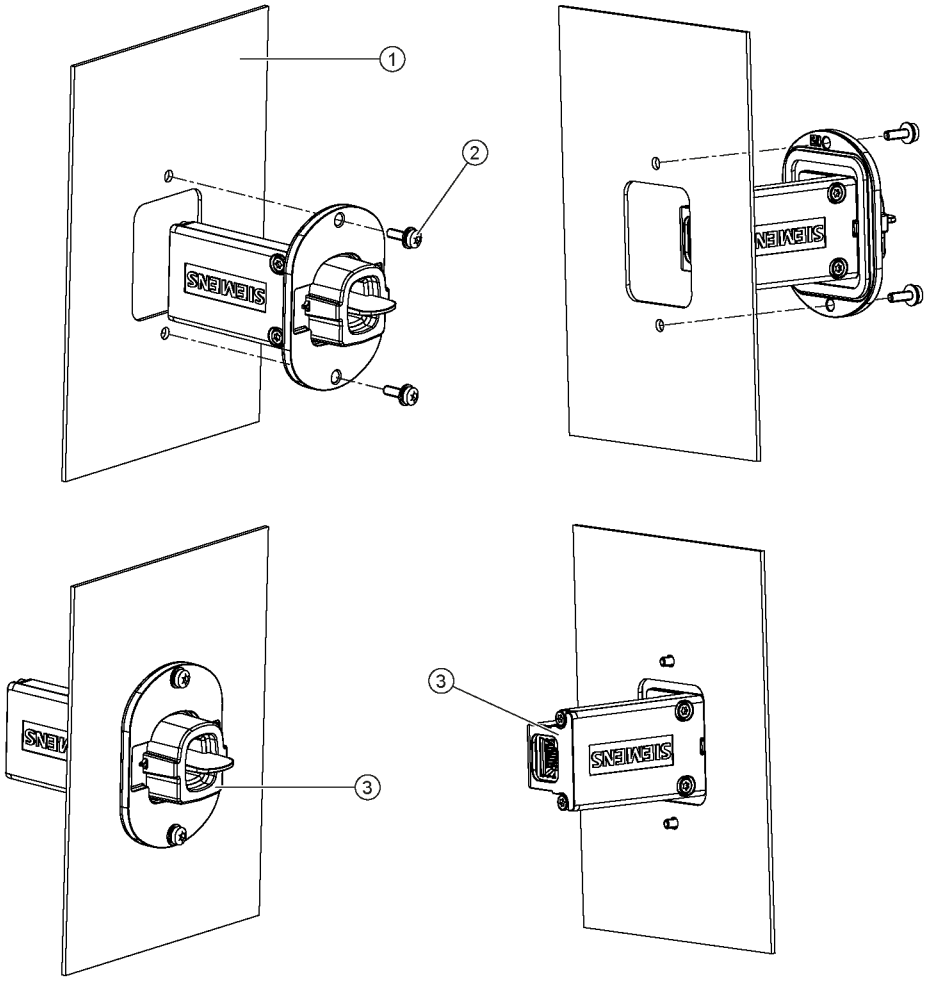


Figure 12-28 Cutout in the control cabinet, all dimensions in mm and (inches)

1. Insert the DRIVE-CLiQ cabinet bushing from the outside of the control cabinet through the cutout in the control cabinet.
2. Attach the DRIVE-CLiQ cabinet bushing to the outer control cabinet panel using 2 M3 screws and 2 nuts. In order to ensure good electromagnetic compatibility, a good electrical connection must be established between the DRIVE-CLiQ cabinet gland and the cabinet panel over a large surface area.

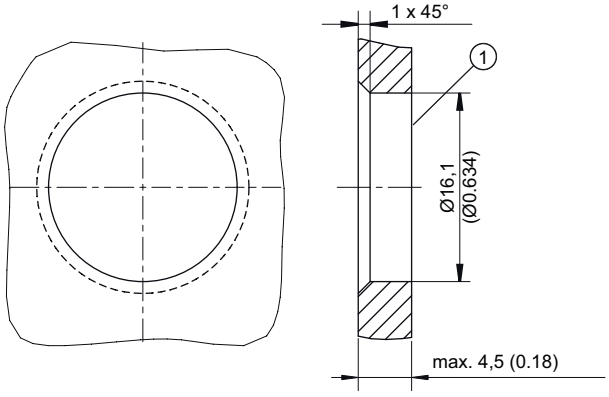


① Control cabinet panel
② Screw M3, tightening torque 0.8 Nm (7.1 lbf in)
③ DRIVE-CLiQ cabinet bushing

Figure 12-29 Mounting the DRIVE-CLiQ cabinet bushing for cables with RJ45 connector

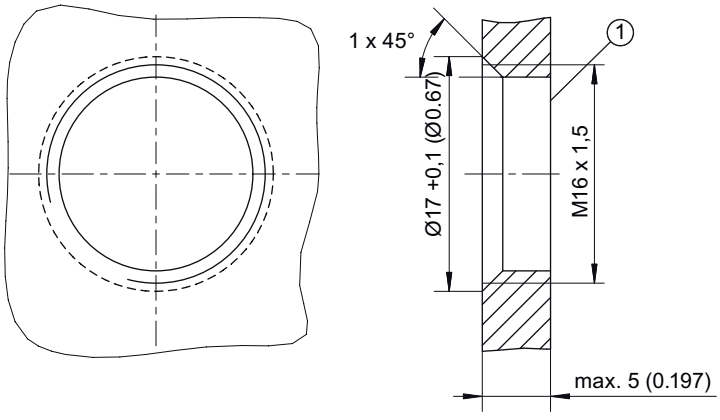
12.5.4.2 DRIVE-CLiQ cabinet bushing for cables with M12 plug/socket

Prepare the cabinet panel for mounting the DRIVE-CLiQ cabinet bushing M12 as shown below.



① Through hole with chamfer

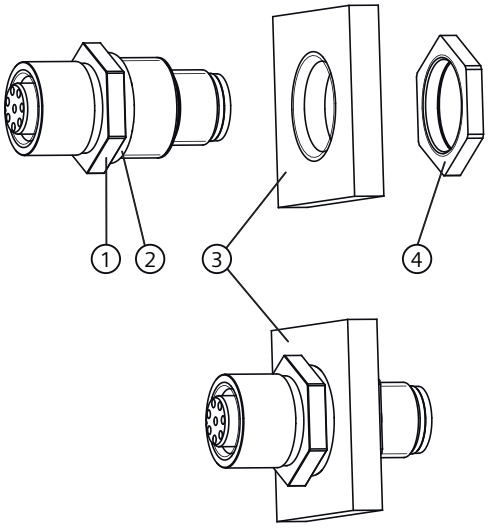
Figure 12-30 Through hole for mounting the DRIVE-CLiQ cabinet bushing M12 using a nut that is screwed from the inside



① Threaded hole with chamfer

Figure 12-31 Threaded hole for mounting the DRIVE-CLiQ cabinet bushing M12 that is screwed from the outside

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, SW18
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 12-32 Example: Installing the DRIVE-CLiQ cabinet bushing M12 for a through hole

12.5.5 Technical data

Table 12-24 Technical data of DRIVE-CLiQ cabinet bushings

	Unit	6SL3066-2DA00-0AA0 DRIVE-CLiQ	6FX2003-0DT67 M12
Weight	kg	0.165	0.035
Degree of protection to IEC 60529		IP54 outside the control cabinet IP20 or IPXXB inside the control cabinet	IP67

12.6 DRIVE-CLiQ coupling

12.6.1 Description

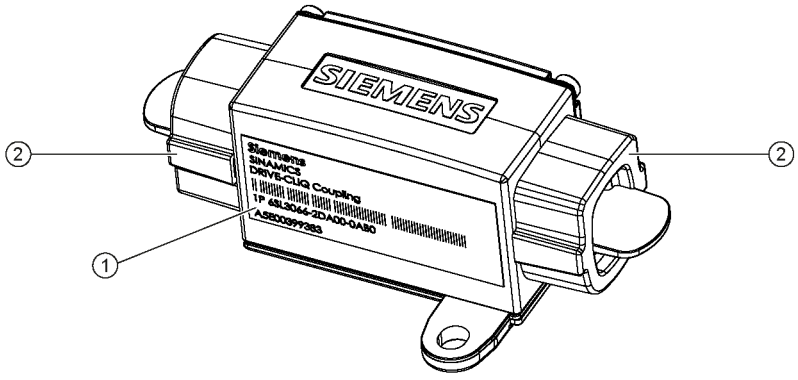
The DRIVE-CLiQ coupling is used to connect 2 DRIVE-CLiQ cables in accordance with degree of protection IP67 acc. to IEC 60529.

In addition to the data lines, the power supply contacts of DRIVE-CLiQ are also routed via the coupling.

You can find information on the permissible cable length in Chapter DRIVE-CLiQ signal cables (Page 475)

12.6.2 Interface description

12.6.2.1 Overview



① Rating plate
② Protective cap, Yamaichi, Article No.: Y-ConAS-24-S

Figure 12-33 Interface overview, DRIVE-CLiQ coupling

12.6.3 Dimension drawing

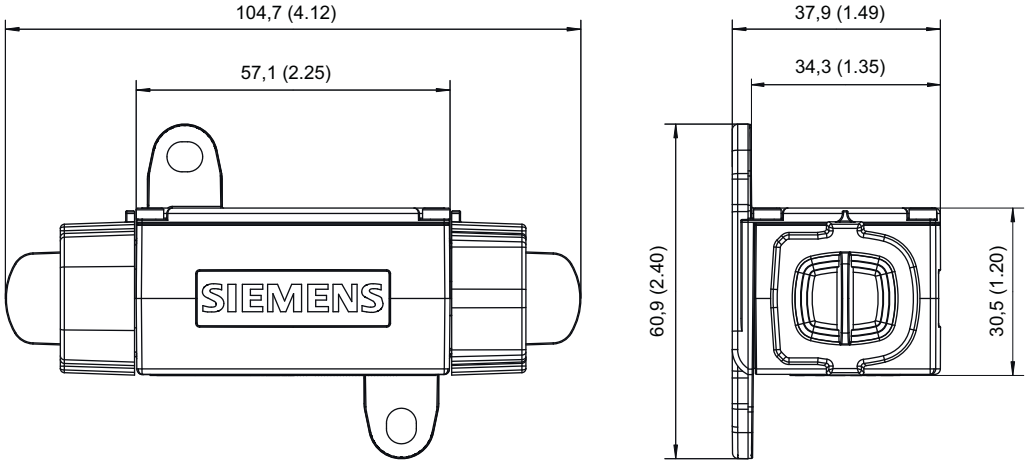
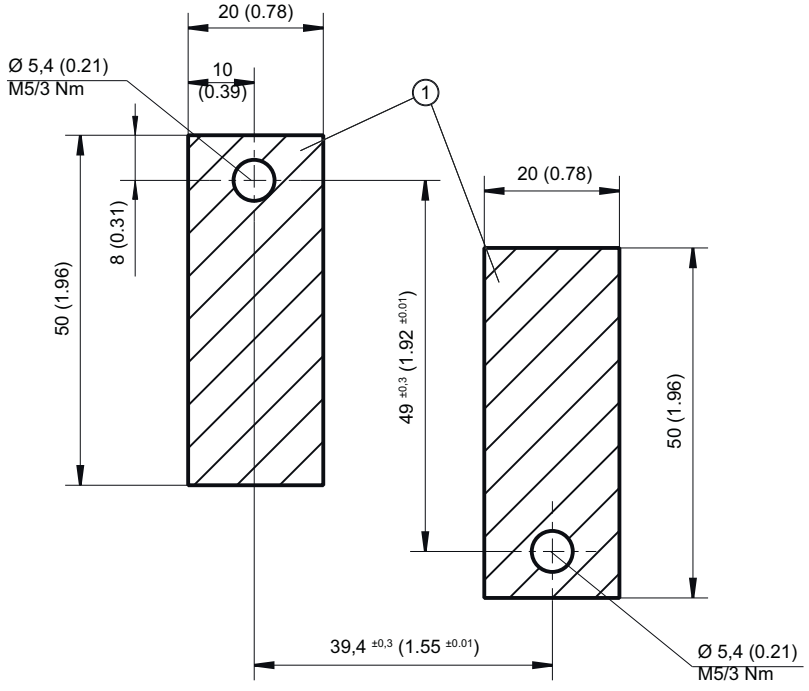


Figure 12-34 Dimension drawing of the DRIVE-CLiQ coupling, all dimensions in mm and (inches)

12.6.4 Mounting



① Contact surface

Figure 12-35 Hole drilling pattern for installation

1. Attach the DRIVE-CLiQ coupling to the mounting surface as shown in the drilling pattern.
2. Remove the protective caps of the DRIVE-CLiQ coupling.
3. Latch the RJ45 connectors on both ends of the DRIVE-CLiQ coupling.

12.6.5 Technical data

Table 12-25 Technical data

DRIVE-CLiQ coupling 6SL3066-2DA00-0AB0	Unit	
Weight	kg	0.272
Degree of protection	IP67 according to IEC 60529	

12.7 Spacing bolt for Booksize Compact components

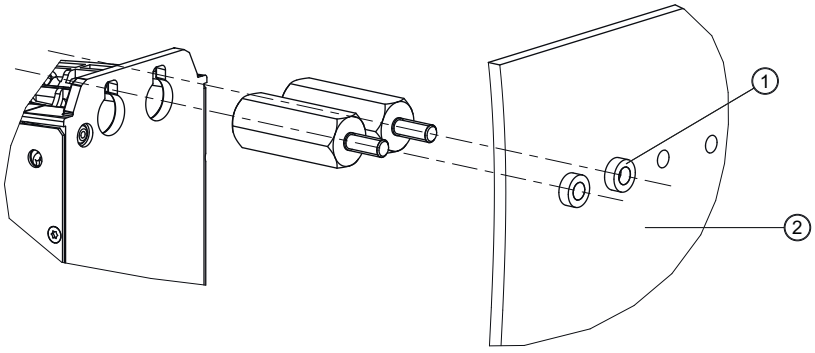
To increase the mounting depth of modules in Booksize Compact format, use spacer bolts (article number: 6SL3462-1CC00-0AA0). In this way, it is possible to combine modules in Booksize Compact format directly with booksize modules with internal air cooling.

Table 12-26 Number of spacing bolts and holes for various module widths

Module width in [mm]	Number of spacing bolts	Number of holes/press-in nuts
50	2	2
75	4	4
100	4	4

Mounting the spacing bolts with press-in nuts

- Inserting M6 press-in nuts into the mounting panel
- Distance 25 mm ± 0.15 mm for module width 75 mm
- Distance 50 mm ± 0.15 mm for module width 100 mm



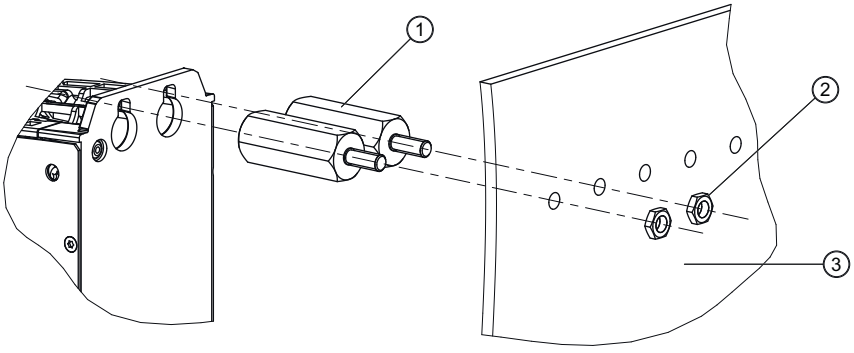
① M6 press-in nuts
② Mounting panel

Figure 12-36 Mounting the M6 press-in nuts on the rear of the mounting panel

As an alternative to press-in nuts, you can secure spacing bolts with M6 nuts to the rear of the mounting panel.

Mounting spacing bolts with nuts

- Drill Ø 6.5 mm holes for spacing bolts
- Distance 25 mm ± 0.15 mm for module width 75 mm
- Distance 50 mm ± 0.15 mm for module width 100 mm

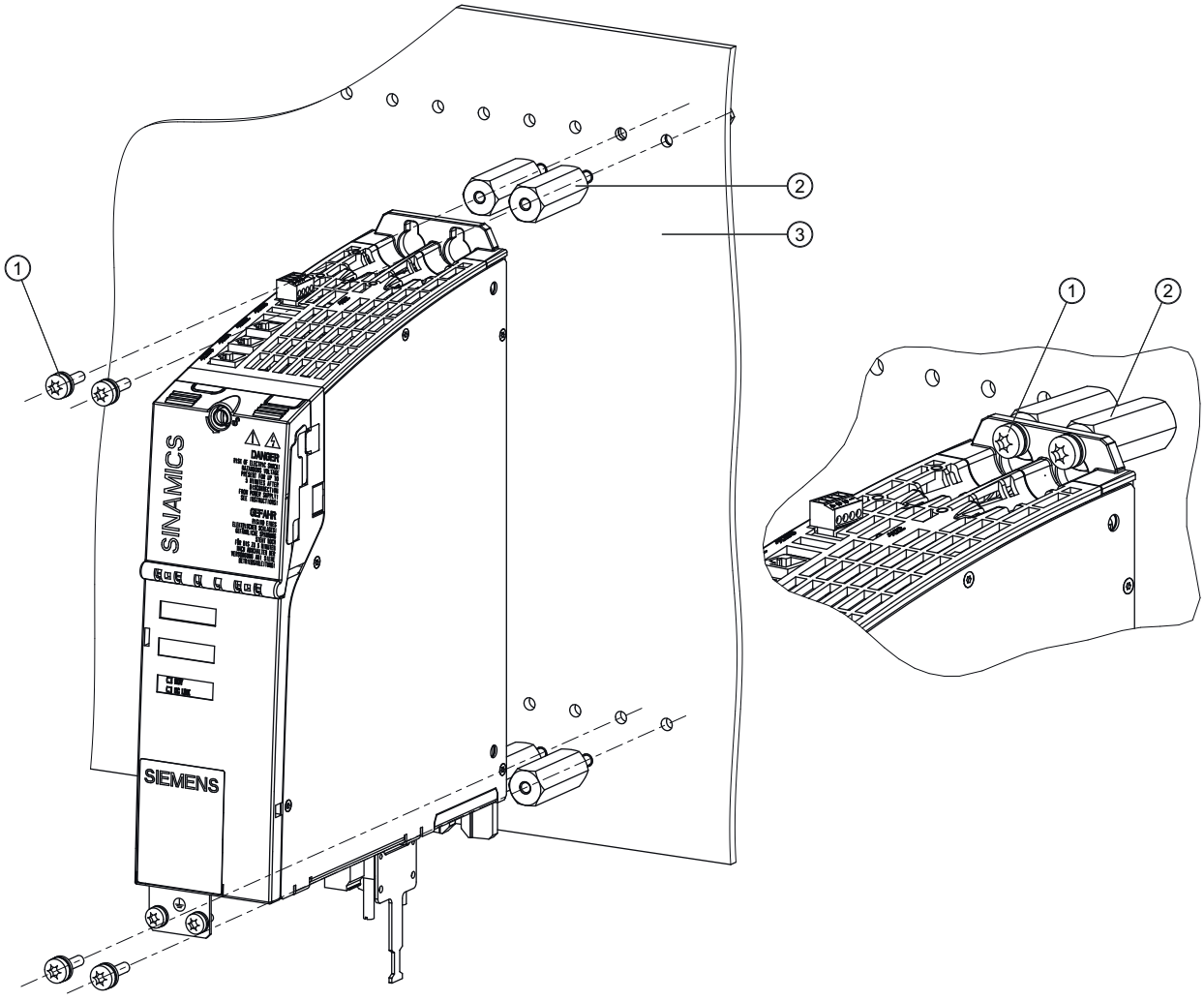


① Spacing bolt
② M6 nuts
③ Mounting panel

Figure 12-37 Mounting the spacing bolts with M6 nuts on the rear of the mounting panel

Tightening torque: 6 Nm (53.1 lbf in)

Mounting a component in booksize compact format with spacing bolts



① Screw M6 x 20
② Spacing bolts, SW 17 (6SL3462-1CC00-0AA0)
③ Mounting panel

Figure 12-38 Mounting a component in booksize compact format with spacing bolts (example: Motor Module Booksize Compact, 18 A)

Tightening torque: 6 Nm (53.1 lbf in)

Cabinet design and EMC Booksize 13

13.1 General information

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

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

Note

Protection against the spread of fire

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

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

Note

Protection against condensation and electrically conductive contamination

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

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

Low-voltage switchgear and controlgear assemblies

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

Safety of machinery - electrical equipment of machines

All information relating to device selection in this section applies to

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

13.2 Safety instructions when mounting and installing the control cabinet

⚠ 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.

13.3 Electromagnetic compatibility

13.3.1 General information

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

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

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

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

Note

EMC requirements for Safety Integrated

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

13.3.2 Line supply connection conditions

Table 13-1 Line supply connection conditions for Line Modules

Module	Description[1)]
Basic Line Module	Operation on line supplies from $S_{K\,line}/P_n \geq 30$
Smart Line Module	Operation on line supplies from $S_{K\,line}/P_n \geq 70$
Active Line Modules with Active Interface Modules	Operation on line supplies from $S_{K\,line}/P_n \geq 30$[2)]
Active Line Module	Operation on line supplies from $S_{K\,line}/P_n \geq 70$

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

2) Applies only for operation in the active mode. For line supplies 3-ph 480 VAC ±10%, it must be checked as to whether the motor systems are suitable for this mode.

13.3.3 Classification of EMC behavior

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

Environments

First environment (public systems)

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

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

Second environment (industrial systems)

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

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

Categories

Category C1

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

Category C2

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

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

Note

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

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

Category C3

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

Note

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

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

Category C4

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

13.3.4 Drive system applications

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

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

Note

Appropriately trained and qualified personnel

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

Carefully observe the information in the "EMC installation guideline (https://support.industry.siemens.com/cs/ww/de/view/60612658)" Configuration Manual for EMC-compliant installation.

With regard to interference immunity, the drive system is suitable for operation in the second environment.

Category C2

To ensure that the drive system satisfies the requirements of Category C2, you have to

- Use RFI suppression filters
- Operate drive system in a network with grounded neutral point
- Use motor cables with shielding and observe the maximum total line lengths:
  - ALM with HF reactor and Basic Line Filter up to 150 m
  - ALM with AIM and Basic Line Filter up to 350 m
  - SLM with line reactor and Basic Line Filter up to 350 m
  - BLM with line reactor and Basic Line Filter up to 350 m

Note

Conducted interference emissions above 1 MHz

In individual cases, additional measures may be necessary for the reduction of conducted interference emissions above 1 MHz. This applies in particular for operation of Motor Modules with 16 kHz pulse frequency at 720 V DC link voltage.

All wires (three line conductors and the protective conductor) of the mains supply conductor to the control cabinet must be routed together through ferrite ring cores.

Series T60006 ring cores from VAC Vacuumschmelze featuring VITROPERM core material, for example T60006-L2080-W531, or similar ring cores from other manufacturers are recommended in this regard.

Category C3

To ensure that the drive system satisfies the requirements of Category C3, you have to

- Use RFI suppression filters
- Operate drive system in a network with grounded neutral point
- Use motor cables with shielding and observe the maximum total line lengths:
  - ALM with AIM up to 350 m
  - ALM (16-36 kW) with AIM and Basic Line Filter to 630 m
  - ALM (55-120 kW) with AIM and Basic Line Filter to 1000 m
  - SLM (5-10 kW) with line reactor and Basic Line Filter up to 350 m
  - SLM (16-55 kW) with line reactor and Basic Line Filter up to 630 m
  - BLM with line reactor up to 350 m
  - BLM with line reactor and Basic Line Filter up to 630 m

Category C4

The following combinations are permissible for operation in IT systems (Category C4):

- ALM with HF reactor without Line Filter
- ALM with AIM (remove connecting screw for interference suppression capacitor)
- SLM with line reactor without Line Filter
- BLM (remove the connection bracket for interference suppression capacitor) with line reactor without Line Filter

Note

Special characteristics of networks which are not grounded at the neutral point

The following conditions apply for operation in networks which are not grounded at the neutral point (e.g. IT systems or networks with grounded line conductor):

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

13.3.5 Emitted interference/interference immunity

Limiting interference emission

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

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

Interference immunity

Note

Integrating SINAMICS S120 in other plants/machines

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

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

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

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

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

Note

Malfunctions when not using original Siemens accessories

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

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

Note

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

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

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

13.4 Electromagnetic fields in the workplace

13.4.1 Preliminary remarks

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

General conditions for correct assessment or measurement

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

13.4.2 Measurements/assessments for SINAMICS S120 Booksize Power Units

Note

Validity

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

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

Table 13-2 Information for frequency range 0 Hz to 300 GHz

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

Table 13-3 Minimum distances from SINAMICS S120 power units at 0 Hz ... 100 kHz in cm (inch)

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

Note

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

13.4.3 Measurements/evaluations for 24 V components

The 24 V components, e.g. Control Units, Terminal Modules, Sensor Modules, Hub Modules and Voltage Sensing Modules, do not emit any significant electromagnetic fields.

No minimum clearance has to be maintained for 24 V components.

13.5 Arrangement of components and equipment

13.5.1 General information

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

- Space requirements
- Cable routing
- Bending radii of the connection cables
  MOTION-CONNECT cables, refer to Catalog D21.4 or NC62

- Air cooling method
- EMC

The components of the drive line-up should preferably be installed on a conductive mounting surface to ensure low impedance between the component and the mounting surface. Mounting plates with a galvanized surface are suitable.

Components are usually located centrally in a cabinet. The necessary mounting and installation clearances above and below the components can possibly exceed the minimum clearances specified in the product documentation.

The components can be arranged in one or more tiers. In a multiple-tier arrangement, vertical mounting or, in a cabinet row, side-by-side mounting in different cabinet sections is possible.

To determine the cross-section, the DC link busbar current carrying capacity is used as basis, which is specified in the relevant technical data. A ventilation clearance of 100 mm must be maintained around the line reactor (not including the mounting surface).

Support relating to the mechanical control cabinet design is available from:

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

13.5.2 DC link busbar current carrying capacity

The current-carrying capacity of the DC link busbar must be carefully observed when engineering and installing the drive line-up. The maximum current carrying capacity of the DC link busbar differs for the various components.

Table 13-4 Current-carrying capacity of the DC link busbars

DC link busbar or bridge	Current-carrying capacity [A]
Line Modules from 50 ... 100 mm	100
Line Modules from 150 ... 300 mm	200
Motor Modules from 50 ... 75 mm[1)]	100
Motor Modules from 100 ... 300 mm	200
DC link components	100

1) For Motor Modules C/D type, by using 6 mm thick DC link jumpers (Article No. 6SL3162-2BB00-0AA0), the current-carrying capacity increases up to 200 A.

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

To calculate the load of the DC link busbar, add the DC link currents I_d of the connected Motor Modules. If the current-carrying capacity of the DC link busbars is exceeded for the planned configuration, two solutions are possible:

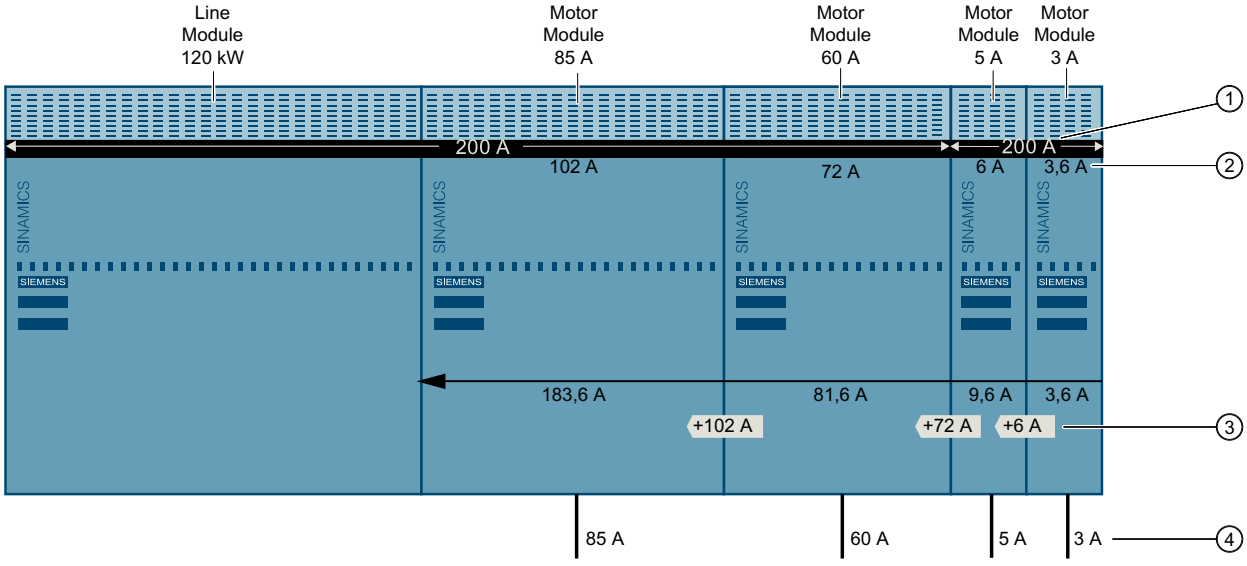
- Center infeed: Arrangement of the drive line-up with infeed to the left and right (example 2)
- Use of another Line Module

Note

The following examples are based on the simultaneous use and loading of the Motor Modules with the rated current I_n. The values of the DC link current were taken from the technical specifications of the Motor Modules in the Power Units Booksize Manual.

Example 1:

Connection of several Motor Modules with different current-carrying capacity of the DC link busbar to a Line Module.

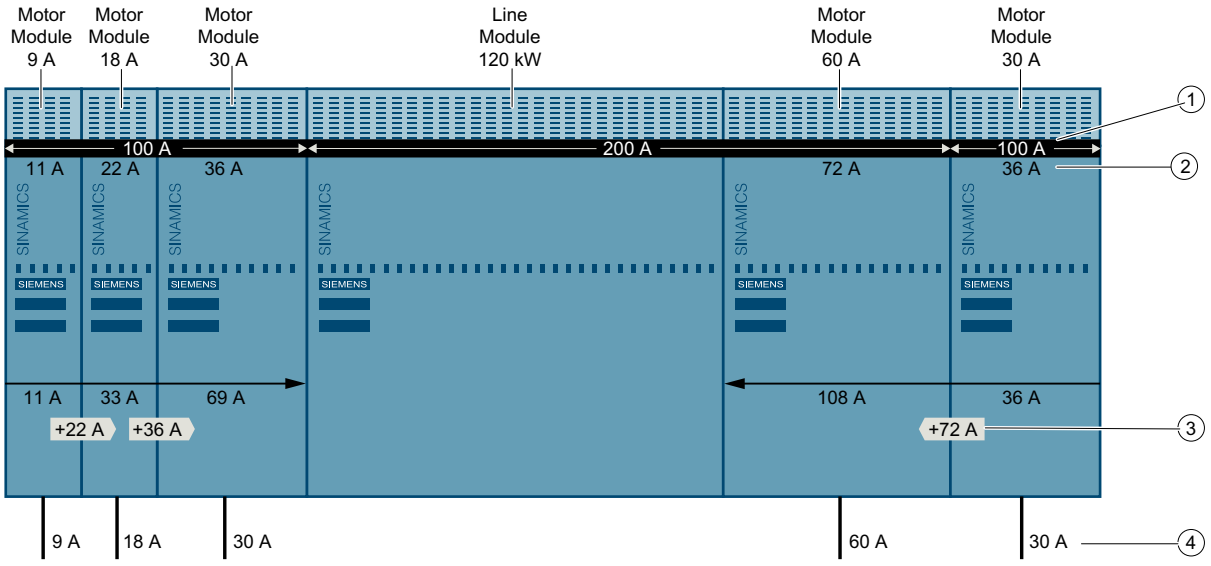


① DC link busbar current-carrying capacity
② DC link busbar load: DC link current I_d at the rated current I_n of the Motor Module
③ Increased load of the DC link busbar
④ Motor current = rated output current I_n of the Motor Module

Figure 13-1 Regular arrangement with infeed to the right of the DC link, DC link busbar not overloaded

Example 2:

Connection of several Motor Modules with different current-carrying capacity of the DC link busbar to a Line Module with center infeed



① DC link busbar current-carrying capacity

② DC link busbar load: DC link current I_d at the rated current I_n of the Motor Module

③ Increased load of the DC link busbar

④ Motor current = rated output current I_n of the Motor Module

Figure 13-2 Center infeed - infeed from left and right to the DC link

A center infeed with Motor Modules to the right and left of the Line Module can be configured for all Line Modules in compliance with current-carrying capacity.
Exception: Smart Line Modules 5 kW and 10 kW

Note

For Smart Line Modules 5 kW and 10 kW, the arrangement of the drive line-up must be made to the right!

13.5.3 Single-tier drive line-up

Due to the current carrying capacity of the DC link busbars and their function in particular, the components should be arranged according to the following rule. From left to right:

- 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

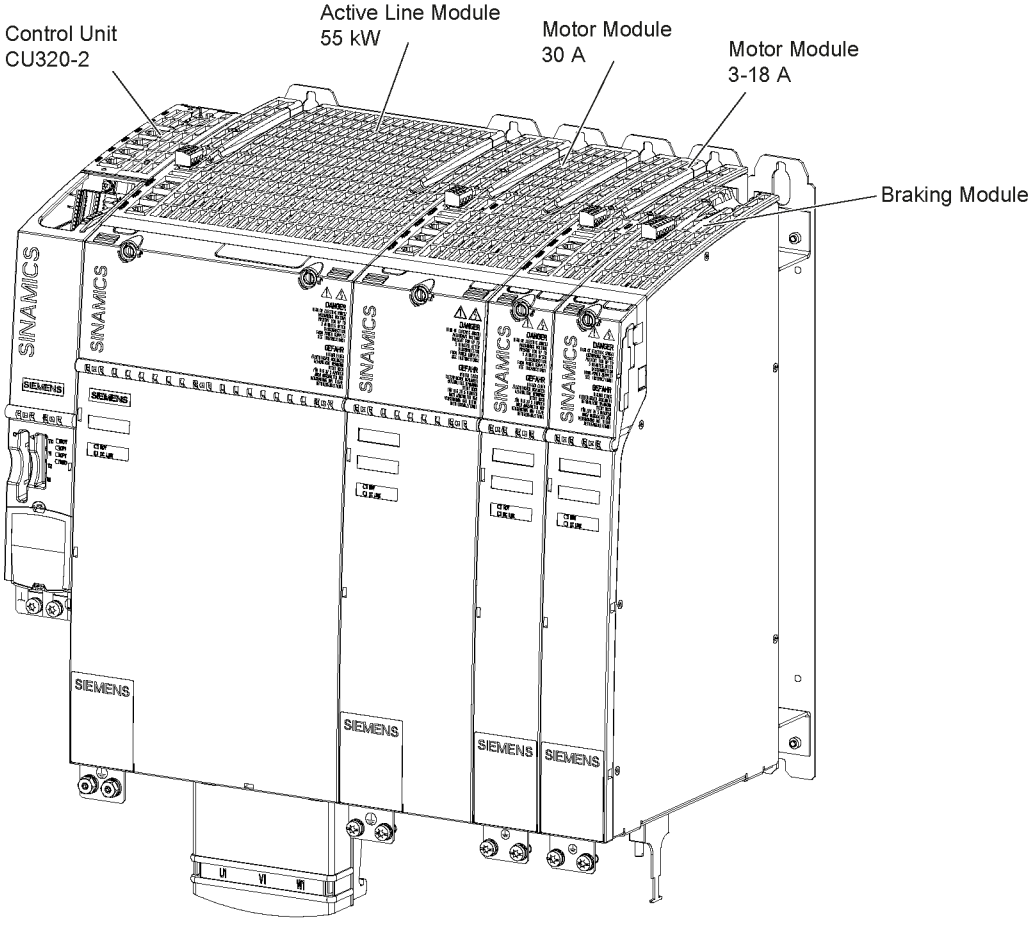


Figure 13-3 Example of a single tier drive line-up

13.5.4 Multi-tier drive line-up

13.5.4.1 Arrangement rules

The following points must be observed for the arrangement of a multi-tier drive line-up:

- The individual wires must be shielded, and the shield must be attached at both ends.
- The DC link is continued outside the components using the DC link adapter (for information on mounting, see Chapter Accessories (Page 367)) and single conductor, finely-stranded, shielded cables.
  The cables must be laid according to IEC 61800-5-2 so that a ground fault or short-circuit is completely ruled out.
- The distance between the tiers of components primarily depends on the wiring, the cable cross-section and the bending radius of the power cables to be connected.
- The intake temperature of the air drawn-in for cooling the components must not exceed 40 °C (with derating, it must not exceed 55 °C). This must be ensured by using suitable air guidance, by the distance between the module tiers (levels) or by using air baffle plates.

Note

Operating faults due to incorrectly laid cables

Particularly with regard to satisfying the EMC requirements, signal cables should not be laid parallel to power cables.

Note

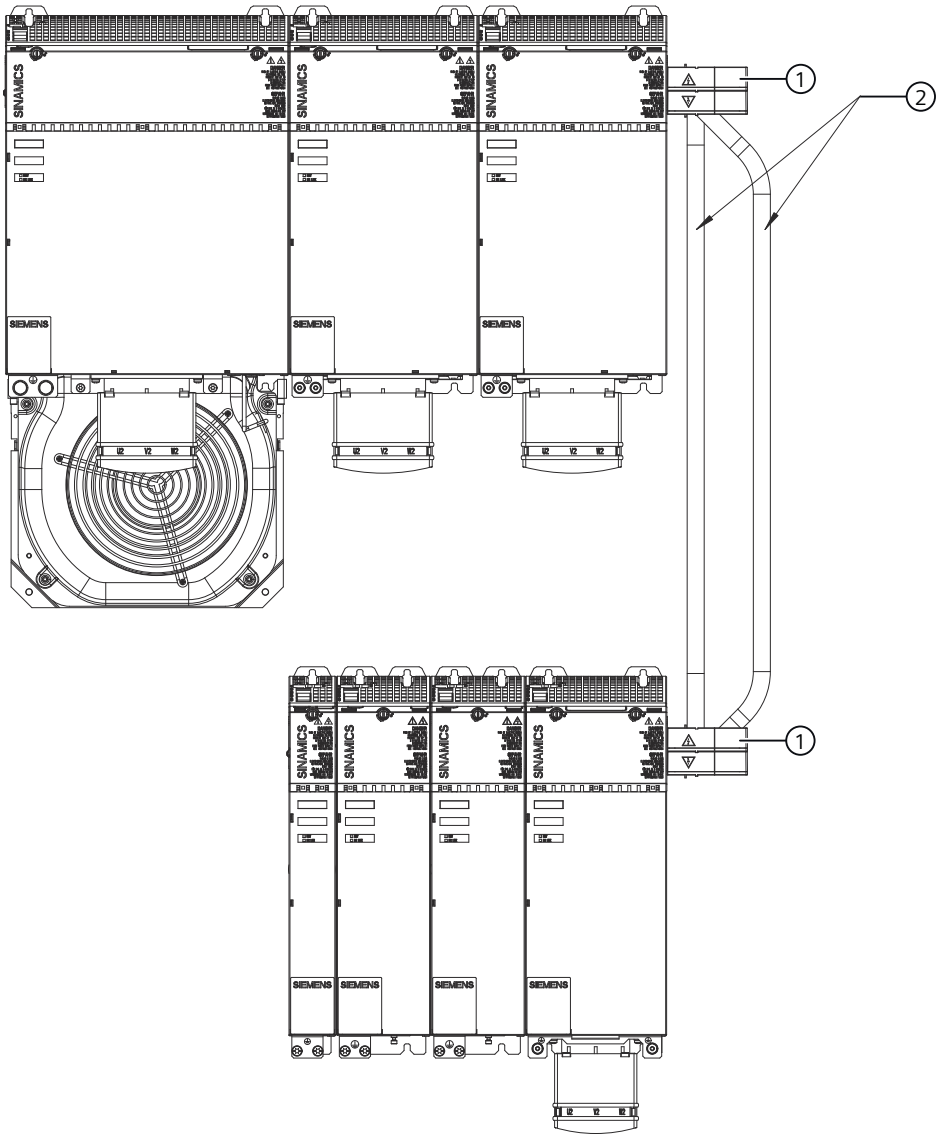
Arrangement of the components for infeed of the DC link voltage from the right

If the infeed is on the right-hand side of the drive line-up (e.g. in a multi-tier configuration), the rules described in Chapter Single-tier drive line-up (Page 453) apply in the inverse sequence.

This means:

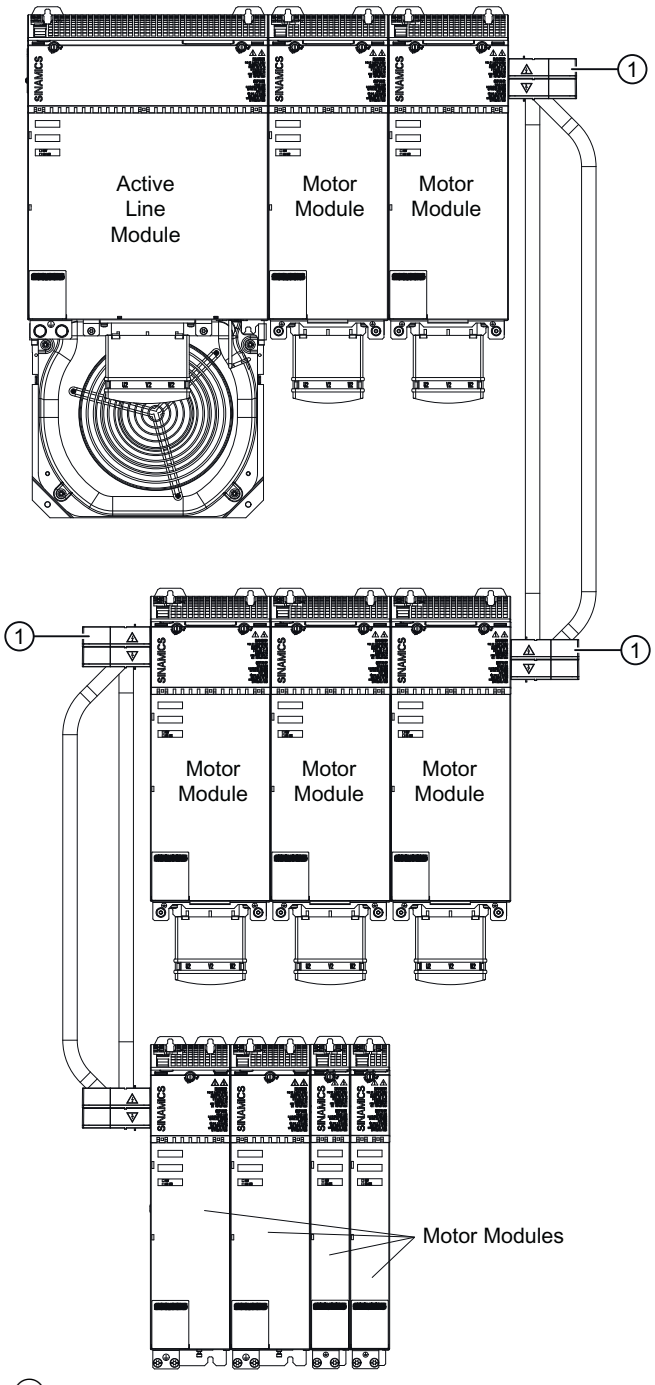
- Arrangement of the Motor Modules depending on their power, starting with the highest power
- DC link components, such as Braking Modules, at the end of the tier

13.5.4.2 Examples of a multi-tier configuration



① DC link adapter
② Power cable shielded

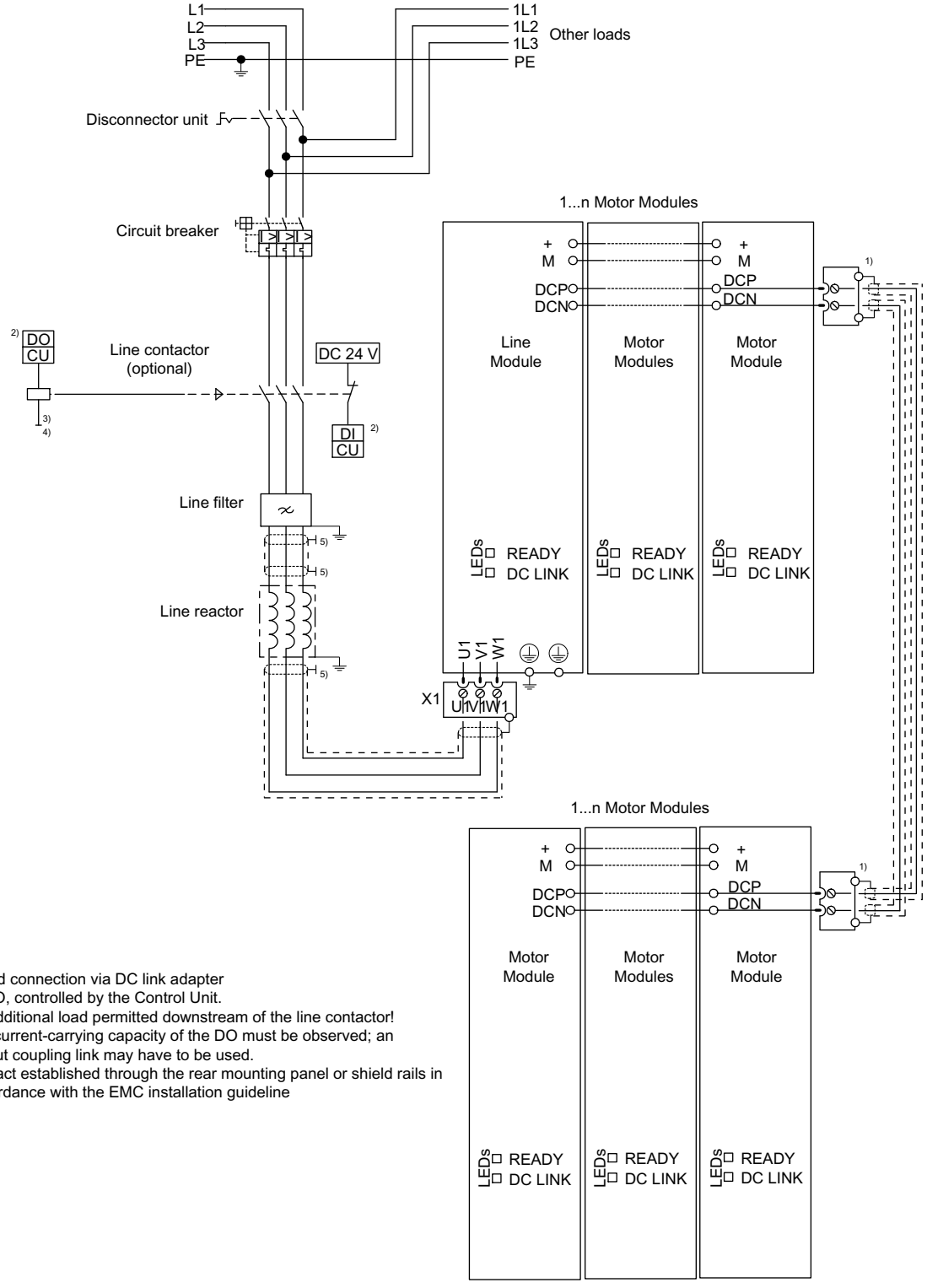
Figure 13-4 Example of a two-tier drive line-up configuration



① DC link adapter

Figure 13-5 Example of a three-tier drive line-up configuration

13.5.4.3 Connection example



[1] Shield connection via DC link adapter
[2] DI/DO, 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 link may have to be used.
[5] Contact established through the rear mounting panel or shield rails in accordance with the EMC installation guideline

Figure 13-6 Connection example for a two-tier drive line-up

13.6 Electrical connection

13.6.1 Connecting DC link busbars

The DC link busbars and 24 V busbars of the components must be connected in a drive line-up before commissioning. Note the information about the arrangement of the components as well as the current carrying capacity of the DC link busbars in the previous sections.



⚠ WARNING

Electric shock due to incorrectly installed DC link bridges

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

- For all 50 mm wide modules[1)] (exception: Smart Line Module[2)]), remove the DC link bridge, including the screws. Do not tighten the screws without the DC link bridges.
- For all components that are 75 mm wide or wider, the DC link bridges must not be moved to the left or removed[3)].

[1)] For 50 mm wide modules, the DC link bridge cannot be swung inwards.
[2)] Smart Line Modules do not have a DC link bridge.
[3)] The DC link bridge guarantees the mechanical stability of the DC link busbars.

NOTICE

Damage of the devices caused by the use of unsuitable screws

For Line Modules, with widths 50 to 100 mm, using unsuitable screws to fasten the DC link busbars can damage the devices.

- Only use the original M4x16 screws on the left-hand side of these Line Modules.
- Only use the original M4x20 screws on the right-hand side of these Line Modules.
- For Line Modules from 150 mm and higher and for all Motor Modules, only use M4x20 screws.

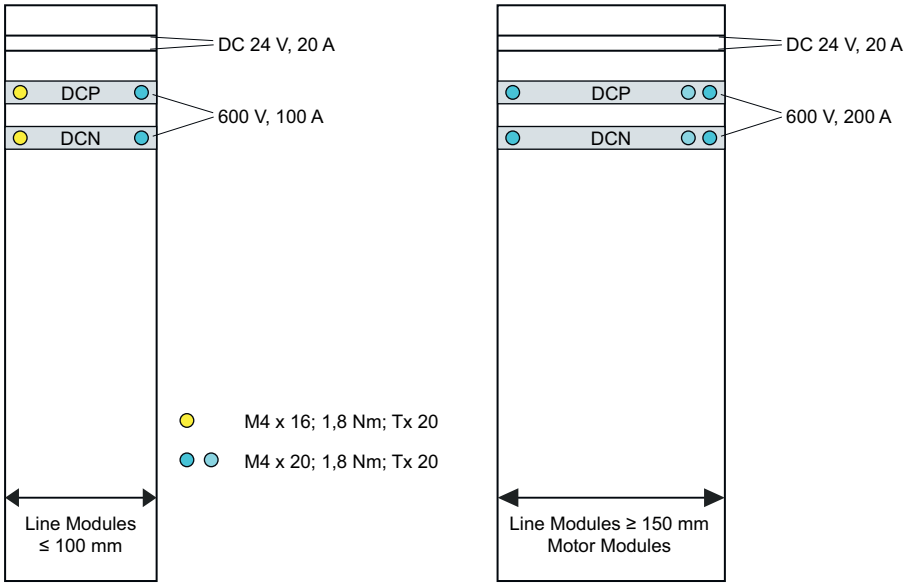


Figure 13-7 DC link busbar screw connections dependent on the module width

Releasing the DC link protective cover

The protective flaps for the DC link of the components have an interlocking mechanism, which must be opened using a flat bladed screwdriver (1 x 5.5).

Table 13-5 Opening the protective cover for the DC link using a screwdriver

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

Connecting DC link busbars

The connection of a Line Module to a Motor Module is shown in the following.

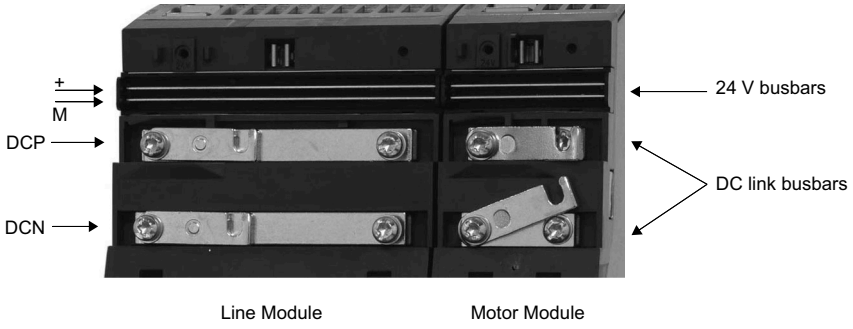


Figure 13-8 Line Module and Motor Module as delivered

Always connect the lower DC link busbars first and then the upper DC link busbars.

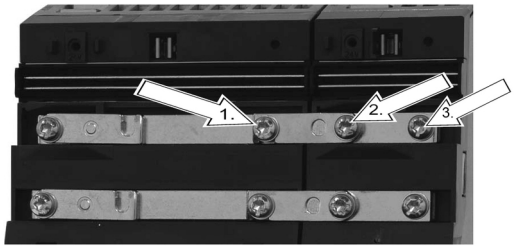
Tool: Screwdriver Torx T20

Working steps:

1. Loosen the DC link busbar screws.
2. Turn over the DC link bridge.
3. Fasten the DC link screws with a tightening torque of 1.8 Nm (15.9 lbf in). It is essential that you follow the sequence shown below (1 and 2).
4. Tighten the DC link screw on the right-hand side of the module for the components of the drive line-up arranged on the far right with a tightening torque of 1.8 Nm (15.9 lbf in). The power connection of the DC link busbar with the module is established via the right-hand screw mounting (3).



1. Connection of the lower DC link busbars



2. Connection of the upper DC link busbars

13.6.2 Connection of the 24 V busbars

Connection of the 24 V busbars

The 24 V busbars of the components are connected using the 24 V connectors provided in the accessories pack. A 24 V connector must be plugged onto the 24 V busbars between the Line Module, Motor Module and DC link component. The 24 V connectors must be attached before the drive line-up is commissioned.

Working steps:

1. Place the 24 V connectors on to the 24 V busbars.
2. Press the 24 V connectors down until they click into place.
3. If required, mount the 24 V terminal adapter to supply the 24 V DC.



① Mounted 24 V terminal adapter (Torx T10, tightening torque 0.5 Nm (4.4 lbf in))
② Mounted 24 V connector

⚠ WARNING

Fire hazard for 24 V connectors and unconnected DC link busbars

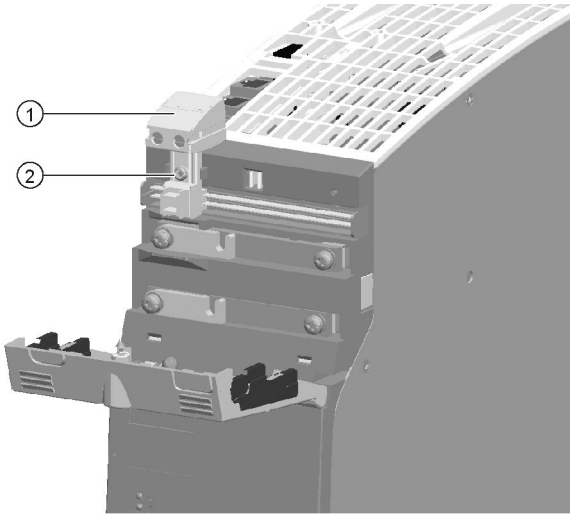
For drive lineups in series, whose DC link busbars are not connected with one another, it is not permissible to insert 24 V connectors between these drive lineups. Otherwise the 24 V connectors can burn and cause severe injury or death as result of fire or smoke.

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

13.6.3 Installation of the 24 V terminal adapter

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

The 24 V terminal adapter is suitable for connecting cable cross-sections of 0.5 up to 6 mm^2. The 24 V terminal adapter is included in the scope of delivery of Line Modules and Control Supply Modules. It can be ordered as replacement part (article number: 6SL3162-2AA00-0AA0).



① 24 V terminal adapter

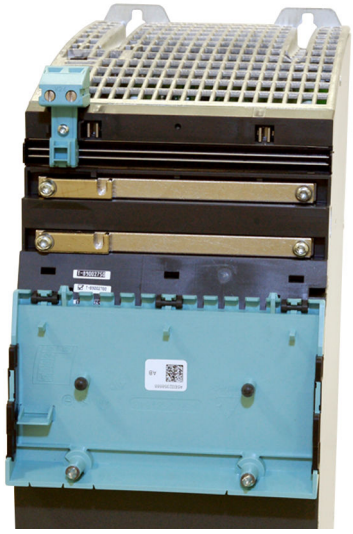
② Screw for fixing: SHR, PT-TORX K30-3, 0X16-ST-A2F WN1452 / EJ company
Tightening torque: 0.5 Nm (4.4 lbf in)

NOTICE
Damage to the 24 V connector as a result of incorrect insertion/withdrawal
Incorrect insertion/withdrawal of the 24 V connector can damage it. • Only withdraw the 24 V terminal adapter vertically in relation to the front plate. • It is only permissible to withdraw or insert the 24 V connectors a maximum of 5 times.

You require the following tools to install the 24 V terminal adapter:

- Slot-head screwdriver 1 x 5.5 for releasing the protective cover
- Torx T10 screwdriver to fasten the 24 V terminal adapter
- Suitable pliers to break out the cutout in the protective cover

Table 13-6 Installing the 24 V terminal adapter using an Active Line Module (36 kW) as example

		
Release the protective cover.	Open the protective cover.	Clip the 24 V terminal adapter on to the 24 V busbars. Screw the 24 V terminal adapter tight with the supplied screw. **Tightening torque**: 0.5 Nm (4.4 lbf in)

	
Break out the cutout in the protective cover.	Close the protective cover. The protective cover must latch into place audibly.

⚠ WARNING

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

Live components are open and accessible if the 24 V terminal adapter or the DC link infeed adapter are removed. Touching live components can result in death or severe injury.

- Replace the protective cover with the broken out cutouts by a new protective cover.

Note

The 24 V terminal adapter should be installed to the left of the component located at the far left, because if it is positioned anywhere else there may not be enough space for the 24 V plug-in jumpers.

If necessary, the 24 V terminal adapter can also be located at the right for 50 mm and 100 mm modules.

13.6.4 Shield connection for terminals X21/X22 on the Motor Module

The diagram below shows a typical shield connection terminal for the shield support of the cables to terminal X21.

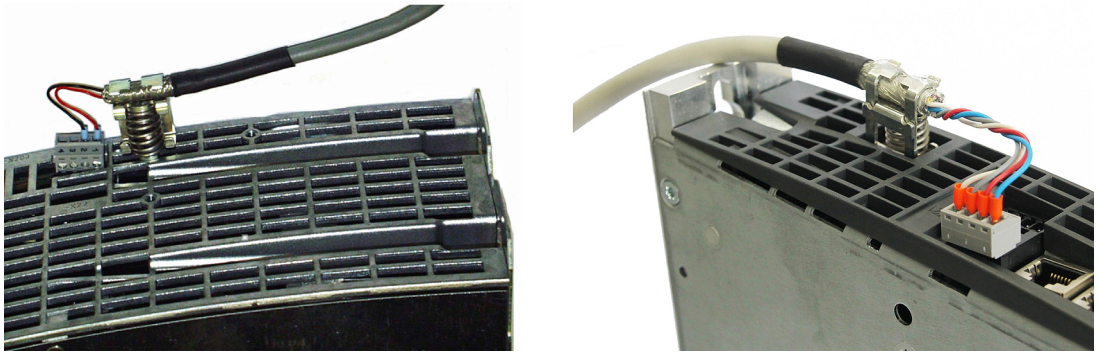


Figure 13-9 Examples for the shield support with shield connection clamps from Weidmüller, type KLBUE 3-8 SC

⚠ WARNING

Electric shock due to impermissible screw length

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.

13.6.5 Shield connection for the motor holding brake

For the 45 A / 60 A Motor Modules, there is an M4 threaded bushing in the housing next to the X11 interface. A shield support, type KLBÜ 3-8 SC (Weidmüller) can be screwed into the bushing to connect the motor holding brake shield (see Fig. "Figure 7-3 Motor Module 45 ... 60 A (view from below) (Page 209)").

13.7 24 V DC supply voltage

13.7.1 General information

The 24 V DC voltage is required for:

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

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

Note

The electronics power supply should be implemented by the user, as described in Chapter System data (Page 44).

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

Note

Grounding the 24 V electronics power supply

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



⚠ WARNING

Electric shock due to incorrectly laid brake cables

If brake cables are laid without safe electrical separation, the insulation can fail and cause an electric shock.

Install the brake in one of the following ways:

- Connect the holding brake with the specified MOTION-CONNECT cable.
- Only use third-party cables with safe electrically separated brake cores or lay the brake cores with safe electrical separation.

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 and devices.

Note

Malfunction because 24 V supply voltage is too low

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

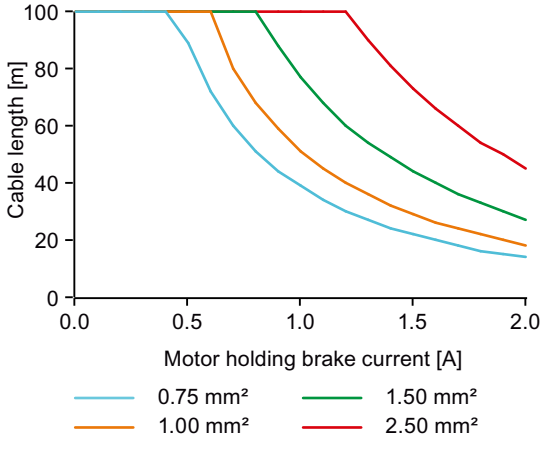
- Select an input voltage that is high enough for there to be sufficient voltage at the last device. Do not exceed the maximum value for the supply voltage. If required, supply the voltage to the assembly at various locations in the lineup.

Motor holding brake connection

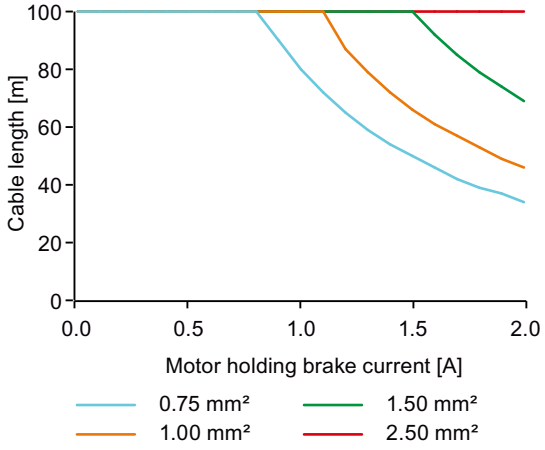
To ensure reliable opening of the motor holding brake, it requires a typical voltage of 24 V ± 10% at the motor connection. Refer to the data sheet of the motor for the motor holding brake voltage and tolerance.

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

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



Module input voltage 24 V



Module input voltage 26 V

Protective circuit against overvoltage

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

13.7.2 Options for the 24 V supply of the components

In a drive line-up, the Line Modules, Motor Modules and DC link components are connected to the 24 V power supply via the integrated 24 V busbars. The current-carrying capacity of these busbars is 20 A. The 24 V infeed can be realized in two ways:

- Using a Control Supply Module
- Using an external 24 V power supply (e.g. SITOP)

Using a Control Supply Module

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

Note

If you use cables with a cross-section of 2.5 mm^2, no additional protection is required on the 24 V side for the following cable types:

- Cables of the XLPE type
- Cables of the EPR type
- Cable with a similar properties and which is thermally stable up to 90 °C

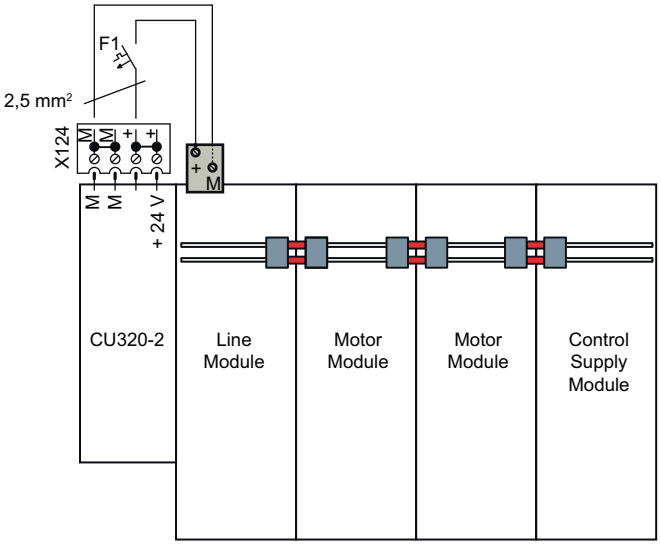


Figure 13-10 Example of a 24 V supply via a Control Supply Module

Using an external 24 V power supply

SELV or PELV power supplies can be used for the external 24 V volt supply, e.g. SITOP. The ground potential must be connected to the protective conductor system at the power supply output (PELV). The cross-section of this connection must be at least as large as the cross-section of the 24 V conductors.

The 24 V terminal adapter must be used to supply the Booksize modules. The external power supply should be located very close to the load.

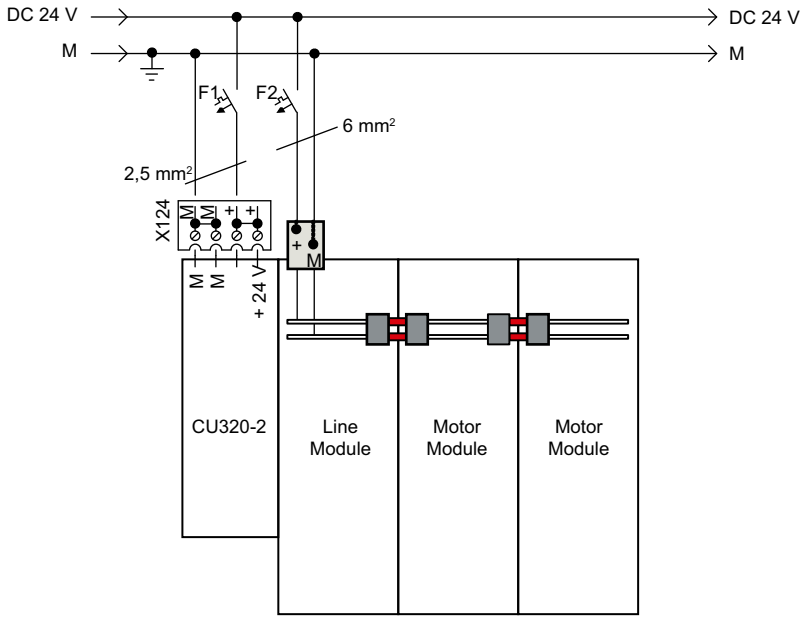


Figure 13-11 Example of a 24 V supply via an external power supply

13.7.3 Overcurrent protection

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

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

Secondary side protection depends on the prevailing situation. Please note the following:

- Loading due to loads, including simultaneity factor depending on machine operation
- Current carrying capacity of the conductors used and cables in normal and short-circuit conditions
- Ambient temperature
- Cable bundling (laying cables in a common duct)
- Type of cable routing

The overcurrent protection devices can be determined according to EN 60204-1, Section 14.

The following are recommended as overload protection devices:

- On the primary side: Circuit breakers
- On the secondary side: Miniature circuit breakers or SITOP select (article number 6EP1961-2BA00)

More detailed specifications can be obtained in the "Siemens Industry Mall (https://mall.industry.siemens.com/goos/WelcomePage.aspx?regionUrl=/de&language=en)".

When selecting the miniature circuit breaker, local installation regulations must be carefully complied with.

Table 13-7 MCBs by conductor cross-section and temperature

Conductor cross-section	Max. value up to 40° C	Max. value 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

The trip characteristic of the MCBs must be selected to match the loads to be protected and the max. current provided by the power supply unit in the event of a short-circuit.

13.7.4 Overvoltage protection

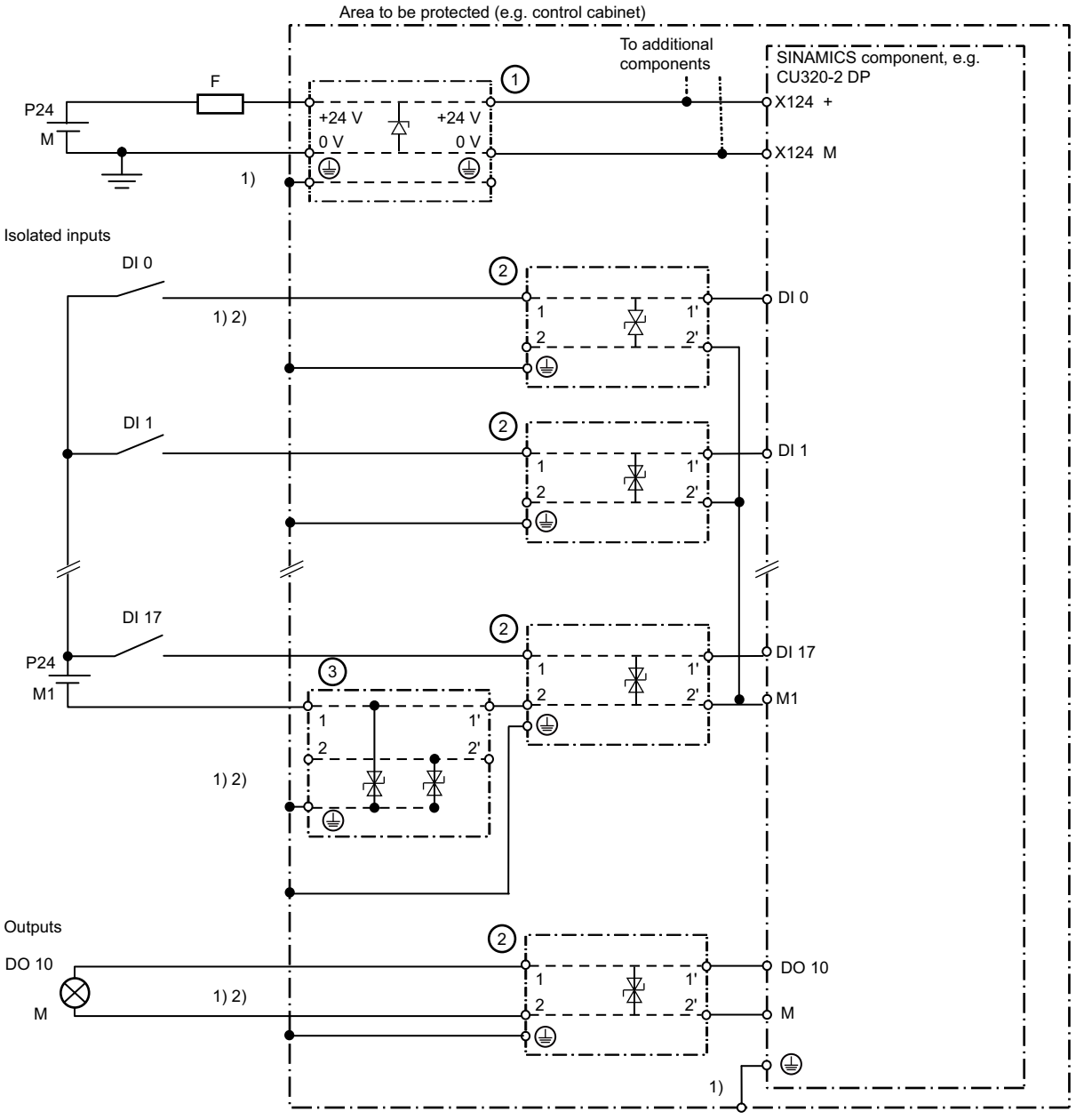
Surge arresters are required for cable lengths > 30 m.

The following Dehn surge arresters are recommended for protecting the 24 V power supply of the components and the 24 V signal cables against overvoltage:

Table 13-8 Recommendations for overvoltage protection

24 V power supply	24 V signal cables
Manufacturer: Dehn Article: BVT AVD 24 Article No.: 918422	**For digital inputs and outputs up to 0.1 A** Manufacturer: Dehn Article: BXT ML4 BE C 24 and BSP BAS 4 Article Nos.: 920364 and 926304 **For digital inputs and outputs up to 0.5 A** Manufacturer: Dehn Article: DCO SD2 ME 24 and DCO SD2 MD 24 Article Nos.: 917921 and 917941

The overvoltage protection components must always be placed next to the area to be protected, e.g. at the entry point to the control cabinet. All 24 V cables which exit the protected area must be routed through an overvoltage protection element.
The diagram below uses a CU320-2 DP as an example to show how the overvoltage protection components are connected.



1 24 V surge voltage protection supply
2 24 V surge voltage protection signal cable differential
3 24 V surge voltage protection signal cable protective conductor

1) The metallic enclosure of the SINAMICS components and the protective conductor connection of the surge arrester must be connected with one another to ensure a good electrical connection (equipotential bonding). This can be achieved by installing the SINAMICS components on a metallic mounting plate and connecting the protective conductor connections of the surge arrester elements to the mounting plate through the shortest distance.

2) By snapping the surge arrester element for the signal cables onto a metal mounting rail, the protective conductor connection is connected to the mounting rail. It is then sufficient to establish a good conductive connection between the DIN rail and the metallic enclosure of the SINAMICS component (equipotential bonding). This is the case when both the DIN rail and the SINAMICS component are mounted on a common metal mounting plate.

Figure 13-12 Connection example: Surge arrester elements connected to SINAMICS components

13.7.5 Typical 24 V current consumption of the components

A separate 24 V power supply must be used for the SINAMICS S120 drive line-up.

The following table can be used to calculate the 24 V DC power supply for the components. The values for typical current consumption are used as a basis for configuration.

Table 13-9 Overview of the 24 V DC current consumption

Component	Typical current consumption [A_{DC}]
Control Units	
CU320-2 (without load)	1.00
Per digital output	0.10
Sensor Modules Cabinet	
SMC10 without/with encoder system	0.20 / 0.35
SMC20 without/with encoder system	0.20 / 0.35
SMC30 without/with encoder system	0.20 / 0.55
SMC40 without/with encoder system	0.10 / 0.35
Sensor Modules External	
SME20 without/with encoder system	0.15 / 0.25
SME25 without/with encoder system	0.15 / 0.25
SME120 without/with encoder system	0.20 / 0.30
SME125 without/with encoder system	0.20 / 0.30
Terminal Modules	
TM15 (without digital outputs, without DRIVE-CLiQ)	0.15
Per digital output / DRIVE-CLiQ	0.5
TM31 (without digital outputs, without DRIVE-CLiQ)	0.5
Sum of all digital outputs	0.1/1 (with switchover to current limitation)
Per DRIVE-CLiQ	0.5
TM41 (without digital outputs, without DRIVE-CLiQ)	0.5
Per digital output / DRIVE-CLiQ	0.5
TM54F (without digital outputs, without DRIVE-CLiQ)	0.2
Per digital output / DRIVE-CLiQ	0.5
TM120 (without DRIVE-CLiQ)	0.2
Per DRIVE-CLiQ	0.5
TM150 (without DRIVE-CLiQ)	0.1
Per DRIVE-CLiQ	0.5
Additional system components	

Component	Typical current consumption [A_{DC}]
TB30 (without digital outputs)	0.05
Per digital output	0.1
DMC20 (without DRIVE-CLiQ)	0.2
Per DRIVE-CLiQ	0.5
DME20 (without DRIVE-CLiQ)	0.2
Per DRIVE-CLiQ	0.5
VSM10	0.3
CBC10	0.1
CBE20	0.1
Active Interface Modules	
16 kW	0.25
36 kW	0.6
55 kW	0.6
80 kW	1.2
120 kW	1.2
Active Line Modules	
16 kW	0.95
36 kW	1.5
55 kW	1.9
80 kW	1.4
120 kW	1.8
Smart Line Modules	
5 kW	0.8
10 kW	0.9
16 kW	0.95
36 kW	1.5
55 kW	1.9
Smart Line Modules Booksize Compact	
16 kW	0.95
Basic Line Modules	
20 kW	1.0
40 kW	1.4
100 kW	2.0
DRIVE-CLiQ and brake	
DRIVE-CLiQ (e.g. motors with DRIVE-CLiQ interface)	0.19
Brake (e.g. motor holding brake)	Typical 0.4 to 1.1; max. 2.0
Single Motor Modules	
3 A (+1 x DRIVE-CLiQ; +1 x brake)	0.75
5 A (+1 x DRIVE-CLiQ; +1 x brake)	0.75
9 A (+1 x DRIVE-CLiQ; +1 x brake)	0.75
18 A (+1 x DRIVE-CLiQ; +1 x brake)	0.75
24 A (+1 x DRIVE-CLiQ; +1 x brake)	1.00
30 A (+1 x DRIVE-CLiQ; +1 x brake)	0.80

Component	Typical current consumption [A_{DC}]
45 A (+1 x DRIVE-CLiQ; +1 x brake)	0.9
60 A (+1 x DRIVE-CLiQ; +1 x brake)	0.9
85 A (+1 x DRIVE-CLiQ; +1 x brake)	1.50
132 A (+1 x DRIVE-CLiQ; +1 x brake)	0.85
200 A (+1 x DRIVE-CLiQ + 1 x brake)	0.85
Single Motor Modules Booksize Compact	
3 A (+1 x DRIVE-CLiQ; +1 x brake)	0.85
5 A (+1 x DRIVE-CLiQ; +1 x brake)	0.85
9 A (+1 x DRIVE-CLiQ; +1 x brake)	0.85
18 A (+1 x DRIVE-CLiQ; +1 x brake)	0.85
Double Motor Modules	
2 x 3 A (+2 x DRIVE-CLiQ; +2 x brake)	0.9
2 x 5 A (+2 x DRIVE-CLiQ; +2 x brake)	0.9
2 x 9 A (+2 x DRIVE-CLiQ; +2 x brake)	0.9
2 x 18 A (+2 x DRIVE-CLiQ; +2 x brake)	1.1
Double Motor Modules Booksize Compact	
2 x 1.7 A (+2 x DRIVE–CLiQ; +2 x brake)	1.15
2 x 3 A (+2 x DRIVE–CLiQ; +2 x brake)	1.15
2 x 5 A (+2 x DRIVE–CLiQ; +2 x brake)	1.15
Braking Module Booksize	0.50
Braking Module Booksize Compact	0.40

If not specified otherwise, the listed Line Modules and Motor Modules are Booksize components.

Example: Calculating the 24 V current requirement

Table 13-10 Example of 24 V current requirements

Component	Quantity	Current consumption [A]	Total current consumption [A]
CU320-2	1	1.0	1.0
8 digital outputs	8	0.1	0.8
Active Line Module 36 kW	1	1.5	1.5
Motor Module 18 A	2	0.85	1.7
Motor Module 30 A	3	0.8	2.4
Encoders	5	0.25	1.25
Brake	5	1.1	5.5
Total:			14.15

13.7.6 Selecting power supply units

You are advised to use the devices in the following table. These devices meet the applicable requirements of EN 60204-1.

Table 13-11 Recommended SITOP Power

Rated output current [A]	Phases	Rated input voltage [V] Operating voltage range [V]	Short-circuit current [A]	Article No.
5	1 / 2	AC 120 ... 230/230 ... 500 85 ... 264/176 ... 550	Approx. 5.5 (powering 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 (powering up) Typ. 30 for 25 ms (in operation)	6EP1334-3BA00-8AB0
20	1 / 2	AC 120 / 230 85 ... 132/176 ... 264	Approx. 23 (powering up) Typ. 60 for 25 ms (in operation)	6EP1336-3BA00-8AA0
	3	3 AC 230/400 ... 288/500 320 ... 550		6EP1436-3BA00-8AA0
40	1 / 2	AC 120/230 85 ... 132/176 ... 264	Approx. 46 (powering up) Typ. 120 for 25 ms (in operation)	6EP1337-3BA00-8AA0
	3	3 AC 230/400 ... 288/500 320 ... 550		6EP1437-3BA00-8AA0

Table 13-12 Recommendation for Control Supply Module

Rated output current [A]	Phases	Input voltage range [V]	Short-circuit current [A]	Article No.
20	3	3 AC 380 -10 % (-15 % < 1 min) to 3 AC 480 +10 % DC 300 ... 800	< 24	6SL3100-1DE22-0AA.



⚠ WARNING

Hazardous voltage when connecting an unsuitable power supply

If a power supply is connected that is not suitable, parts and components of the device could be live (under voltage). Touching live components can result in death or severe injury.

- Connect the ground potential to the PE conductor connection.
- Mount the power supply close to the drive lineup.
  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 Configuration Manual, "EMC installation guideline".

13.8 Connection systems

Note

Conditions for UL applications

- Only use copper cables rated for 60 °C or 75 °C.
- Wherever ring cable lugs are used for the connection of line and motor, only use UL-listed ring cable lugs (ZMVV) that are approved for the respective voltage. The permissible current must be at least 125% of the input or output current. Use the higher value as basis.

13.8.1 DRIVE-CLiQ signal cables

13.8.1.1 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 13-13 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

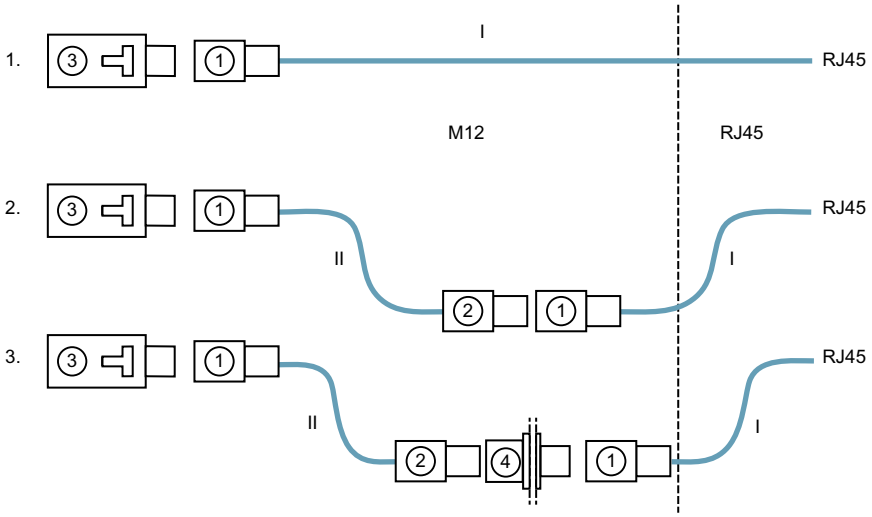
Wiring rules for DRIVE-CLiQ are provided in Chapter "Rules for wiring DRIVE-CLiQ" on the internet:

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

13.8.1.2 Connecting a direct measuring system

The various options of connecting a direct measuring system with DRIVE-CLiQ ASIC and M12 plug via MOTION-CONNECT cables to a DRIVE-CLiQ component are shown in the following diagram.

1. Direct connection via the basic cable
2. Basic cable and 1-3 extensions
3. Basic cable, cabinet bushing and a maximum of two 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 13-13 Connecting a direct measuring system with M12 plug to a DRIVE-CLiQ component with RJ45 socket (IP20)

13.8.1.3 Combined use of MOTION-CONNECT 500 and MOTION-CONNECT 800PLUS

In principle, MOTION-CONNECT 500 cables and MOTION-CONNECT 800PLUS cables be used together.

Basic cables and extensions for MOTION-CONNECT cables with RJ45 plug and M12 socket can be combined without any restrictions.

For the combined use of MOTION-CONNECT cables, the conditions below apply.

Use of DRIVE-CLiQ couplings

DRIVE-CLiQ couplings are used to combine MOTION-CONNECT 500 cables and MOTION-CONNECT 800PLUS cables. The maximum permissible cable length is calculated as follows:

Cables with RJ45 connectors: ΣMC500 + 4/3 * ΣMC800PLUS + nc * 5 m ≤ 100 m
Cables with M12 connectors: ΣMC500 + 4/3 * ΣMC800PLUS ≤ 100 m

ΣMC500: Total length of all MC500 cable segments (fixed routing)

ΣMC800PLUS: Total length of all MC800PLUS cable segments (tow chain)

n_c: Number of DRIVE-CLiQ couplings (0 to max. of 3)

With this combination, DRIVE-CLiQ cables with a maximum length of over 75 m can also implemented for applications involving a tow chain.

Table 13-14 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 (tow chain)	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

Using a DRIVE CLiQ Hub Module

A DRIVE-CLiQ Hub Module (DMC20 or DME20) can be used to double the maximum permissible cable length for MOTION-CONNECT cables with RJ45 connectors. After the hub, the same length conditions apply as before the hub.

ΣMC500 + 4/3 * ΣMC800PLUS + n_c * 5 m ≤ 100 m before the hub

ΣMC500 + 4/3 * ΣMC800PLUS + n_c * 5 m ≤ 100 m after the hub

It is possible to connect two DRIVE-CLiQ Hub Modules in series (cascade connection).

13.8.2 Comparison of MOTION-CONNECT power cables

MOTION-CONNECT 500 power cables are mainly suitable for permanent routing. MOTION-CONNECT 800PLUS power cables fulfill all of the high mechanical requirements for use in tow chains. They are resistant to cutting oils.

Table 13-15 Comparison of the MOTION-CONNECT 500 and MOTION-CONNECT 800PLUS power cables

Power cable	**MOTION-CONNECT 500**	**MOTION-CONNECT 800PLUS**
Approvals		
CE cURus or UR/CSA[1)] In conformance with RoHS	Yes Yes Yes	Yes Yes Yes
Rated voltage V_0/V in accordance with EN 50395		

Power cable	**MOTION-CONNECT 500**	**MOTION-CONNECT 800PLUS**
Supply conductors Signal conductors	600 V / 1000 V 24 V (EN) 1000 V (UL/CSA)	600 V / 1000 V 24 V (EN) 1000 V (UL/CSA)
Test voltage, rms		
Supply conductors Signal conductors	4 kV 2 kV	4 kV 2 kV
Operating temperature at the surface		
Permanently installed Moveable	-20 ... +80 °C 0 ... 60 °C	-50 ... +80 °C -20 ... +60 °C
Tensile load, max.		
Permanently installed Moveable	50 N/mm² 20 N/mm²	50 N/mm² 20 N/mm²
Smallest bending radius		
Permanently installed Moveable	5 x D_{max} approx. 18 x D_{max}	4 x D_{max} approx. 8 x D_{max}
Torsional stress	30 °/m absolute	30 °/m absolute
Bending operations	100000	10 million
Max. travel velocity	30 m/min	Up to 300 m/min
Max. acceleration	2 m/s²	50 m/s² (3 m)[2)]
insulation material	CFC/silicon-free	CFC/halogen/silicon-free IEC 60754-1 / DIN VDE 0472-815
Oil resistance	IEC 60811-100 and IEC 60811-404 (mineral oil only)	IEC 60811-100 and IEC 60811-404
Protective jacket	PVC DESINA color, orange RAL 2003	PUR, HD22.10 S2 (VDE 0282, Part 10) DESINA color, orange, RAL 2003
Flame retardant	EN 60332-1-1 to 1-3	EN 60332-1-1 to 1-3

1) The UR/CSA file number is stamped on the cable sheath.

2) Characteristics for acceleration can be found in Catalog D21.4 in Chapter "MOTION-CONNECT connection system".

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

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

Table 13-16 Routing types

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

Table 13-17 Current carrying capacity according to EN 60204-1 for 40° C ambient temperature

Cross-section	**Current carrying capacity, effective; AC 50/60 Hz or DC** **For routing type**		
mm²	**B1** **A**	**B2** **A**	**C** **A**
Signal cables			
0.20	–	4.3	4.4
0.50	–	7.5	7.5
0.75	–	9	9.5
Power cables			
0.75	8.6	8.5	9.8
1.00	10.3	10.1	11.7
1.50	13.5	13.1	15.2
2.50	18.3	17.4	21
4	24	23	28
6	31	30	36
10	44	40	50
16	59	54	66
25	77	70	84
35	96	86	104
50	117	103	125
70	149	130	160
95	180	165	194
120	208	179	225

Table 13-18 Current carrying capacity according to IEC 60364-5-52 for 40° C ambient temperature

Cross-section	**Current carrying capacity, effective; AC 50/60 Hz or DC** **For routing type**		
mm²	**B1** **A**	**B2** **A**	**C** **A**
Power cables			
150	–	–	260
185	–	–	297
> 185	Values must be taken from the standard		

Table 13-19 Derating factors for the current load-carrying capacity for deviating ambient temperatures

Ambient air temperature [° C]	**Derating factor according to EN 60204-1, Table D1**
30	1.15
35	1.08

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

13.8.4 Cable length

13.8.4.1 Configuring the cable length

Where a motor cable longer than 50 m is required, a higher rating Motor Module must be selected, or the permissible continuous output current $I_{continuous}$ must be reduced in relation to the rated output current I_{rated}. The configuring data for Motor Modules in the booksize format are given in the following table:

Table 13-20 Permissible cable lengths for shielded motor cables

Motor Module	Length of motor cable (shielded)		
Rated output current I_{rated}	**> 50 ... 100 m**	**> 100 ... 150 m**	**> 150 ... 200 m**
3 ... 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 $I_{max} \leq 2.2 \times I_{rated}$ $I_{continuous} \leq 0.95\ I_{rated}$	Use Motor Module 18 A C type	Not permissible
18 ... 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 ... 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	$I_{max} \leq 1.4 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	$I_{max} \leq 1.3 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$
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 ... 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 ... 132 A Classic	Always permitted	$I_{max} \leq 1.35 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	$I_{max} \leq 1.1 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$
200 A Classic	Always permitted	$I_{max} \leq 1.25 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	$I_{max} \leq 1.1 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$

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

When using a motor holding brake, the maximum motor cable length is 100 m. Voltage drops may occur as a function of the motor cable length, motor holding brake current and cross-section of the motor holding brake cables. Additional information on connection of the motor holding brake can be found in Chapter "24 V DC supply / General (Page 465)".

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

When motor reactors are used, longer motor cables are possible. For more information on this, see Chapter "Motor reactors (Page 339)".

13.8.4.2 Maximum cable lengths

The table below provides an overview of the maximum permissible cable lengths for signal and supply cables, power cables, and DC link cables.

Note

Total cable lengths for Line Modules

For data regarding maximum total cable lengths of Line Modules and general conditions for maintaining the corresponding radio interference suppression category, see Chapter "Combination options of Line Modules with line reactors and line filters" (Page 124).

Table 13-21 Maximum cable lengths

Type	Maximum length [m]
24 V DC power supply cables	30[1] (Page 469)
24 V signal cables	30[1] (Page 469)
DRIVE-CLiQ signal cables MC500	100
DRIVE-CLiQ signal cables MC800PLUS	75
DC link, including extensions	10
Power cable between line filter and line reactor	10 (shielded/unshielded)[2]
Power cable between line reactor and Line Module	10 (shielded/unshielded)[2]
Power cable between Motor and Motor Module with I_{rated} = 3 ... 9 A	50 (shielded) 75 (unshielded)
Power cable between Motor and Motor Module with I_{rated} = 18 ... 24 A	70 (shielded) 105 (unshielded)
Power cable between Motor and Motor Module with $I_{rated} \geq 30$ A	100 (shielded) 150 (unshielded)
Power cable between Motor and Motor Module Booksize Compact	50 (shielded) 75 (unshielded)
Power cable between Braking Module and braking resistor	10

[1] For longer lengths, users must connect suitable protective circuitry in order to provide surge voltage protection (refer to Chapter "24 V DC supply/surge voltage protection").

[2] To comply with EMC limit values, shielded cables (preferably MOTION-CONNECT cables) must be used.

When motor reactors are used, longer motor cables are possible. For more information on this, see Chapter "Motor reactors (Page 339)".

13.8.5 Connectable conductor cross-sections and tightening torques for motor and power cables

Table 13-22 Connectable conductor cross-sections Part 1: Line cable/motor cable

Component	Terminal type/ Tightening torque		Conductor cross-section [mm²/AWG]						
			0.75 19	1.5 16	2.5 14	4 12	6 10[1]	10 8	16 6
Motor Module Booksize 3 ... 30 A 2 x 3 A ... 2 x 18 A	Motor plug connector (Page 416)	Push-in connector	X	X	X	X	X[1]	-	-
		Screw connector	X	X	X	X	X[1]	-	-
Motor Module Booksize Compact 1.7 A ... 18 A	Screw terminal 1.2 ... 1.5 Nm (10.6 ... 13.3 lbf in)		-	X	X	X	X	-	-
Motor Module 45 ... 60 A	Threaded bolt M6 6 Nm (53.1 lbf in)[2]		-	-	-	-	X	X	X
Motor Module 85 A	Threaded bolt M8 13 Nm (115 lbf in)[3]		-	-	-	-	-	-	X
Smart Line Module Booksize 5 ... 10 kW	Screw terminal 1.2 ... 1.5 Nm (10.6 ... 13.3 lbf in)		-	X	X	X	X	-	-
Smart Line Module Booksize Compact 16 kW	Screw terminal 1.5 ... 1.8 Nm (13.3 ... 15.9 lbf in)		-	-	-	-	X	X	X
Active Line Module 16 kW Smart Line Module 16 kW	Screw terminal 1.5 ... 1.8 Nm (13.3 ... 15.9 lbf in)		-	-	-	-	X	X	-
Active Line Module 36 kW Smart Line Module 36 kW	Threaded bolt M6 6 Nm (53.1 lbf in)[1]		-	-	-	-	-	-	X
Active Interface Module 16 kW	Screw terminal 1.7 Nm (15.0 lbf in)		-	-	-	-	X	X	X
Active Interface Module 36 kW	Screw terminal 6 Nm (53.1 lbf in)		-	-	-	-	-	-	X

1) Connection with AWG 8 is also possible.

2) For ring cable lugs without insulation; ring cable lug M6 or M8; IP2XB guaranteed according to IEC 60529
Note: The restrictor collar installed as standard for the purpose of touch protection must be used or adapted as required.

3) Alternatively, 2 ring cable lugs without insulation for the parallel connection of 2 cables with a maximum cross-section of 50 mm² can also be connected to the threaded bolts respectively. Both cable lugs should be mounted "back to back".

Note

Compliance with IPXXB degree of protection for Active Interface Modules 36 kW

The connection terminals of the 36 kW Active Interface Module are only certain to have degree of protection IPXXB according to IEC 60529, if cables with a minimum cross-section of 25 mm² and insulated end sleeves are used.

Table 13-23 Connectable conductor cross-sections Part 2: Line cable/motor cable

Component	Terminal type/ Tightening torque	Conductor cross-section [mm²/AWG]							
		25 4	35 2	50 1	70 2/0	2x35 2x2	95 3/0	2x50 2x1	120 4/0
Motor Module 45 ... 60 A	Threaded bolt M6 6 Nm (53.1 lbf in)[1]	X	X	X	-	-	-	-	-
Motor Module 85 A	Threaded bolt M8 13 Nm (115 lbf in)[2]	X	X	X	X	X	X	X	X
Motor Module 132 ... 200 A	Threaded bolt M8 13 Nm (115 lbf in)[2]	X	X	X	X	X	X	X	X
Active Line Module 36 kW Smart Line Module 36 kW	Threaded bolt M6 6 Nm (53.1 lbf in)	X	X	X	-	-	-	-	-
Active Line Module 55 kW Smart Line Module 55 kW	Threaded bolt M8 13 Nm (115 lbf in)[2]	-	X	X	X	X	X	X	X
Active Line Module 80 ... 120 kW	Threaded bolt M8 13 Nm (115 lbf in)[2]	-	-	-	X	X	X	X	X
Active Interface Module 36 kW	Screw terminal 6 Nm (53.1 lbf in)	X	X	X	-	-	-	-	-
Active Interface Module 55 kW	Screw terminal 6 Nm (53.1 lbf in)	-	X	X	-	-	-	-	-
Active Interface Module 80 ... 120 kW	Threaded bolt M8 13 Nm (115 lbf in)[2]	-	-	-	X	X	X	X	X

[1] For ring cable lugs without insulation; ring cable lug M6 or M8; IP2XB guaranteed according to IEC 60529
Note: The restrictor collar installed as standard for the purpose of touch protection must be used or adapted as required.

[2] Alternatively, two ring cable lugs without insulation for the parallel connection of 2 cables with a maximum cross-section of 50 mm² can also be connected to the threaded bolts respectively. Both cable lugs should be mounted "back to back".

Table 13-24 Connectable conductor cross-sections Part 3: Line cable/connection for braking resistor

Component	Terminal type/ Tightening torque	Conductor cross-section [mm²/AWG]					
		1.5 16	2.5 14	4 12	6 10	10 8	16 6
Basic Line Module 20 kW Line cable connection	Screw terminal 1.5 ... 1.7 Nm (13.3 ... 15.0 lbf in)	-	-	-	X	X	X
Basic Line Module 20 kW Braking resistor connection	Screw terminal 0.5 ... 0.6 Nm (4.4 ... 5.3 lbf in)	X	X	X	-	-	-
Basic Line Module 40 kW Braking resistor connection	Screw terminal 1.5 ... 1.8 Nm (13.3 ... 15.9 lbf in)	-	-	X	X	X	-

Table 13-25 Connectable conductor cross-sections Part 4: Line supply cable

Component	Terminal type/ Tightening torque	Conductor cross-section [mm²/AWG]							
		25 4	35 2	50 1	70 2/0	2x35 2x2	95 3/0	2x50 2x1	120 4/0
Basic Line Module 40 kW Line cable connection	Screw terminal 6 Nm (53.1 lbf in)	X	X	X	-	-	-	-	-
Basic Line Module 100 kW Line cable connection[1)]	Threaded bolt M8 13 Nm (115 lbf in)	-	-	-	X	X	X	X	X

1) Alternatively, two ring cable lugs without insulation for the parallel connection of 2 cables with a maximum cross-section of 50 mm² can also be connected to the threaded bolts respectively. Both cable lugs should be mounted "back to back".

⚠ 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 the control parameters.

Note

Compliance with IPXXB degree of protection for Basic Line Modules 40 kW

Degree of protection IPXXB according to IEC 60529 for the Basic Line Module 40 kW is only obtained when power cables with insulated end sleeves and cross-sections > 25 mm² are used.

Note

Selection of the line supply conductor

When selecting the line supply conductor, note the loop resistance so that the relevant protective components (line fuse, RCCB, etc.) function properly and that no hazardous shock currents or voltages occur in the event of a fault.

If the apparent impedance of the line supply at the infeed point is not suitable, so that fuses do not rupture in the specified time in the case of insulation failure (ground fault, fault to frame), then you must use additional fault current protective devices RCD (RCCB or MRCD), Type B to protect personnel and protect against fire.

13.8.6 Spring-loaded terminals

The type of spring-loaded terminal can be taken from the interface description of the particular component.

Table 13-26 Connectable conductor cross-sections for spring-loaded terminals

Spring-loaded terminal type			
1	Connectable cable cross-sections	Rigid, flexible Flexible with conductor end sleeve without plastic sleeve AWG / kcmil	0.14 ... 0.5 mm² 0.25 ... 0.5 mm² 26 ... 20
	Stripped length	8 mm (0.31 inch)	
2	Connectable cable cross-sections	Flexible Flexible with conductor end sleeve without plastic sleeve Flexible with conductor end sleeve with plastic sleeve 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)	
3	Connectable cable cross-sections	Rigid, flexible Flexible with conductor end sleeve without plastic sleeve Flexible with conductor end sleeve with plastic sleeve AWG / kcmil	0.2 ... 1.5 mm² 0.25 ... 1.5 mm² 0.25 ... 0.75 mm² 24 ... 16
	Stripped length	10 mm (0.39 inch)	
4	Connectable cable cross-sections	 AWG	25 ... 95 mm² 4 ... 4/0
	Stripped length	35 mm (1.38 inch)	
5	Connectable cable cross-sections	Rigid Flexible Flexible with end sleeve without plastic sleeve Flexible with end sleeve with plastic sleeve AWG/kcmil	0.2 ... 10 mm² 0.2 ... 6 mm² 0.25 ... 6 mm² 0.25 ... 4 mm² 24 ... 8
	Stripped length	15 mm (0.59 inch)	
6	Connectable cable cross-sections	Rigid, flexible Flexible with conductor end sleeve without plastic sleeve Flexible with conductor end sleeve with plastic sleeve AWG / kcmil	0.2 ... 2.5 mm² 0.25 ... 2.5 mm² 0.25 ... 1.5 mm² 24 ... 12
	Stripped length	8 mm (0.31 inch)	
7	Connectable cable cross-sections	Rigid, flexible Flexible with conductor end sleeve without plastic sleeve Flexible with conductor end sleeve with plastic sleeve AWG / kcmil	0.25 ... 1.5 mm² 0.25 ... 1.5 mm² [1)] 0.25 ... 0.75 mm² 24 ... 16
	Stripped length	8 mm (0.31 inch)	

[1)] The maximum of 1.5 mm² is only possible for trapezoidal crimping Otherwise, the maximum cable cross-sections reduced to 1.0 mm².

13.8.7 Screw terminals

The type of screw terminal can be taken from the interface description of the particular component.

Table 13-27 Connectable conductor cross-sections and tightening torques for screw terminals

Screw terminal type			
1	Connectable cable cross-sections	Rigid, flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve AWG / kcmil	0.08 ... 1.5 mm² 0.25 ... 1.5 mm² 0.25 ... 0.5 mm² 28 ... 14
	Stripped length	7 mm (0.28 inch)	
	Tool	Screwdriver 0.4 x 2.0 mm	
	Tightening torque	0.22 ... 0.25 Nm (1.9 ... 2.2 lbf in)	
1_1	Connectable cable cross-sections	Rigid, flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve AWG / kcmil	0.14 ... 1.5 mm² 0.25 ... 1.5 mm² 0.25 ... 0.5 mm² 26 ... 14
	Stripped length	7 mm (0.28 inch)	
	Tool	Screwdriver 0.4 x 2.5 mm	
	Tightening torque	0.22 ... 0.25 Nm (1.9 ... 2.2 lbf in)	
2	Connectable cable cross-sections	Rigid, flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve AWG / kcmil	0.2 ... 2.5 mm² 0.2 ... 2.5 mm² 0.2 ... 1.5 mm² 22 ... 12
	Stripped length	6 ... 7 mm (0.24 ... 0.28 inch)	
	Tool	Screwdriver 0.5 x 3 mm	
	Tightening torque	0.4 ... 0.5 Nm (3.5 ... 4.4 lbf in)	
3	Connectable cable cross-sections	Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve AWG / kcmil	0.2 ... 2.5 mm² 0.25 ... 1 mm² 0.25 ... 1 mm² 22 ... 12
	Stripped length	9 mm (0.35 inch)	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 ... 0.6 Nm (4.4 ... 5.3 lbf in)	
4	Connectable cable cross-sections	Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve AWG / kcmil	0.2 ... 4 mm² 0.25 ... 4 mm² 0.25 ... 4 mm² 22 ... 10
	Stripped length	7 mm (0.28 inch)	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 ... 0.6 Nm (4.4 ... 5.3 lbf in)	

Screw terminal type			
5	Connectable cable cross-sections	Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve AWG / kcmil	0.5 ... 6 mm² 0.5 ... 6 mm² 0.5 ... 6 mm² 20 ... 8
	Stripped length	12 mm (0.47 inch)	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.2 ... 1.5 Nm (10.6 ... 13.3 lbf in)	
6	Connectable cable cross-sections	Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve AWG / kcmil	0.5 ... 10 mm² 0.5 ... 10 mm² 0.5 ... 10 mm² 20 ... 6
	Stripped length	11 mm (0.43 inch)	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.5 ... 1.8 Nm (13.3 ... 15.9 lbf in)	
7	Connectable cable cross-sections	0.5 ... 16 mm² (AWG 20 ... 4)	
	Stripped length	14 mm (0.55 inch)	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.5 ... 1.7 Nm (13.3 ... 15.0 lbf in)	

13.8.8 Cable lugs

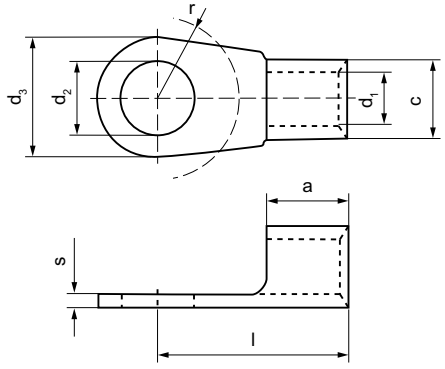


Figure 13-14 Dimension drawing of cable lugs

Table 13-28 Dimensions of cable lugs

Screw/bolt	Cable cross-section [mm²]	a [mm]	c [mm]	d_1 [mm]	d_2 [mm]	d_3 [mm]	l [mm]	r [mm]	s [mm]
M5	1 - **2.5**	5	4.5	2.3	5.3	10	14	6.5	0.8
M5	2.5 - **6**	6	6	3.6	5.3	10	15	6.5	1
M5	6 - **10**	8	8	4.5	5.3	10	16	6.5	1.1
M5	10 - **16**	10	10.5	5.8	5.3	11	20	7.5	1.2
M6	2.5 - **6**	6	6	3.6	6.5	11	16	7.5	1
M6	6 - **10**	8	8	4.5	6.5	11	17	7.5	1.1
M6	10 - **16**	10	10.5	5.8	6.5	11	20	7.5	1.2

Screw/bolt	Cable cross-section [mm²]	a [mm]	c [mm]	d_1 [mm]	d_2 [mm]	d_3 [mm]	l [mm]	r [mm]	s [mm]
M6	16 - **25**	11	12	7.5	6.5	12	25	7.5	1.5
M6	25 - **35**	12	15	9	6.5	15	26	9.5	1.6
M6	35 - **50**	16	17	11	6.5	15	26	9.5	1.6
M6	50 - **70**	18	21	13	6.5	22	38	12	2
M8	10 - **16**	10	10.5	5.8	8.4	14	22	10	1.2
M8	16- **25**	11	12	7.5	8.4	16	25	10	1.5
M8	25 - **35**	12	15	9	8.4	16	26	10	1.6
M8	35 - **50**	16	17	11	8.4	18	34	10	1.8
M8	50 - **70**	18	21	13	8.4	22	38	12	2
M8	70 - **95**	20	23	15	8.4	24	42	12	2.5
M8	95 - **120**	22	24	16.5	8.4	24	44	12	3
M10	35 - **50**	16	17	11	10.5	18	34	12	1.8

13.8.9 Handling restrictor collars for touch protection

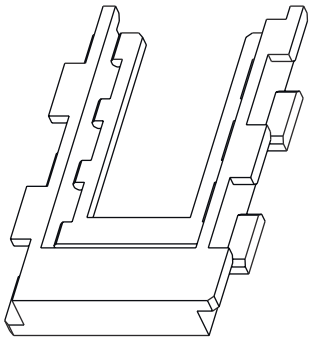
Handling restrictor collars for touch protection and when connecting cables

Restrictor collars serve to provide touch protection according to IEC 60529. They must be removed and adapted if necessary before the line supply conductor and/or motor cable is connected, after which they must be reattached. To adapt the touch protection, see Connecting the power cables (Page 385).

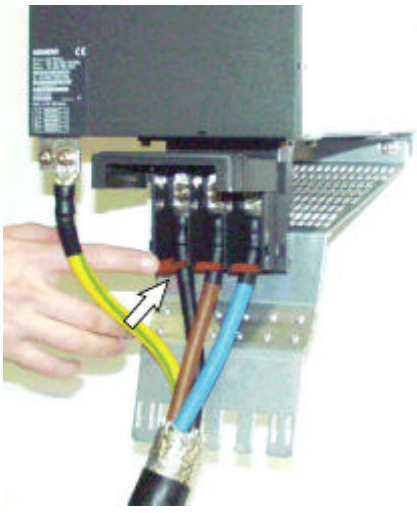
Exception: The cross-section of the connected cables is large enough to ensure that the threaded bolts and the ends of the cables cannot be touched when the cover is closed.

The following components are supplied with restrictor collars as standard:

- Active Line Modules 36 kW and higher
- Smart Line Modules 36 kW and higher
- Basic Line Modules 100 kW and higher
- Motor Modules 85 A and higher
- Active Interface Modules 80 kW and higher



Restrictor collar



Power unit with cables and restrictor collars attached

- Motor Modules C type 45/60 A have fillets at the motor connection block that can be removed to connect cables with diameters of 9.5 mm and higher.

13.9 Cable shielding and routing

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

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

Supplementary conditions

- Alternative measures (e.g. routing behind mounting plates, suitable clearances) can also be used provided they have similar results. This excludes measures that relate to the design, installation, and routing of motor power cables and signal cables.
- If unshielded cables are used between the line supply connection point and line filter, make sure that no interfering cables are routed in parallel.

- Power and signal cables must always be routed separately. For this purpose, it is practical to arrange the various cables according to cable groups. Cables belonging to a group can be combined in a bundle. The various cable groups must be routed with the necessary clearance between them. A minimum clearance of 20 cm has proven itself in practice. As an alternative, shield connecting plates equipped with multiple contact points can be used between the cable bundles.
- Route all cables as close as possible to mechanical 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 back wall) should provide adequate shielding.
- All cables must be kept as short as possible, to minimize the antenna effect.
- Signal and power cables may cross each other (if absolutely necessary), but must never be routed closely to one and other in parallel over longer distances.
- Signal cables must be routed with a minimum clearance of 20 cm from strong magnetic fields (motors, transformers). As an alternative, shield connecting plates equipped with multiple contact points can be used.
- Cables for the 24 V supply should be treated just like signal cables.
- Avoid, where possible, routing unshielded cables, connected to the drive line-up, in the immediate vicinity of noise sources, e.g. transformers. Signal cables (shielded and unshielded) connected to the drive line-up must be laid at a great distance from strong external magnetic sources (e.g. transformers, line reactors). In both cases, a distance of ≥ 300 mm is usually sufficient.

Shield support

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

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

Shield connecting plates with preconfigured clamp contacts are available for connecting the shields of power cables for Line Modules, Motor Modules and Active Interface Modules.

For Line Modules and Active Interface Modules up to and including 16 kW - as well as for Motor Modules up to and including 30 A or 2x18 A - these plates are included with the components or they are integrated in the plug connector. For larger modules, the shield connecting plates must to be separately ordered (see Chapter "Shield connecting plates (Page 367)").

Routing 24 V cables

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

- A maximum of one conductor pair may be bundled together.
- 24 V conductors must be routed separately from other cables and conductors that could conduct the operating current.

- 24 V cables must never be routed parallel to power cables.
- 24 V cables as well as power cables should be routed to the components so that they never cover ventilation slots.

Conditions of use for 24 V cables

- Ambient temperature: 55 °C
- Conductor limit temperature: ≤ 70° C for operation with the rated load current
- Max. cable length: 30 m for 24 V power supply cables and for signal cables without additional circuitry
  Surge voltage protection devices must be used for longer cable lengths.

13.10 Protective connection and equipotential bonding

Protective connections

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

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

Table 13-29 Conductor cross-section for copper protective connections

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

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

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

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

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

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



⚠ WARNING

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

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

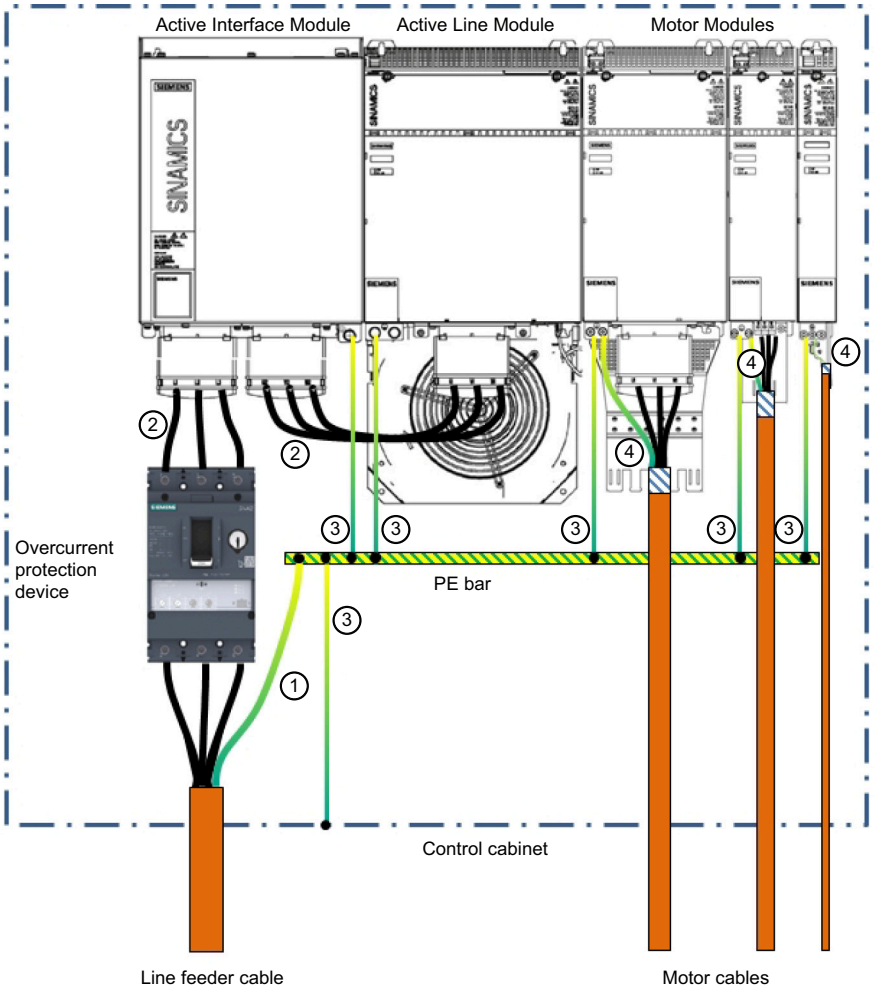
- Carefully comply with the applicable regulations for dimensioning the protective conductor (see below).

Protective connection concept, SINAMICS S120 Booksize power units

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

Note

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



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

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

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

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

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

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

Figure 13-15 Protective connection concept, SINAMICS S120 Booksize

Protective connection via the mounting plate

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

Conditions

- Only permissible for Motor Modules and Line Modules with internal air cooling from Chapters Line Modules Booksize (Page 127) and Motor Modules Booksize (Page 201).
- Use a bare metal mounting plate that is resistant to corrosion, e.g. galvanized with a minimum thickness of 2 mm.
- Electrically conductive connection between the mounting plate and the electrical cabinet corresponding to the specifications of the electrical cabinet manufacturer.
- All module fixing screws must be screwed-in with spring washer and washer - and then tightened with the specified tightening torque. Equivalent screw fittings are permissible.
- At least one fixing screw of the module is designated as PE/ground connection with the symbol ⏚ (IEC 60417–5019).
- The continuity of the protective conductor connection must be checked, e.g. according to IEC 60204-1 Chapter 18.2.2 or IEC 60364-6 Chapter 6.4.3.2.
- Just like all power connections, the fixing screws of the modules are regularly re-tightened with the specified tightening torques.

Functional equipotential bonding

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

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

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

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

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

No functional equipotential bonding conductors are required for PROFIBUS inside a control cabinet. For PROFIBUS connections between different buildings or parts of buildings, a

functional equipotential bonding must be routed in parallel to the PROFIBUS cable. The following cross-sections must be observed in accordance with IEC 60364-5-54:

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

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

Note

PROFINET

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

13.11 Notes on electrical cabinet cooling

13.11.1 Control cabinet cooling options

The following options are available for cooling the control cabinet:

- Filter fans
- Heat exchangers
- Cooling unit
- Liquid cooling[1)]
- External air cooling[1)]
- External liquid cooling[1)]

[1)] Devices with this cooling method are no longer described in this edition of the Manual. Information on this topic is provided in the SINAMICS S120 Equipment Manual "Booksize Power Units" up to and including Edition 06/2019.

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

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

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

- Ventilation clearance
- Wiring and cabling
- Air guidance, air-conditioner

NOTICE
Reduction of the component service lives through incorrect mounting If you do not observe the guidelines for mounting SINAMICS components in the cabinet, this can reduce the service life of the equipment and result in premature component failure. • Observe the guidelines for installing SINAMICS components.

13.11.2 General information on ventilation

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

Fan operation up to firmware version 2.5

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

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

Fan operation as of firmware version 2.6

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

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

Note

For the 5 kW and 10 kW Smart Line Modules, the fan runs permanently.

Air guidance

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

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

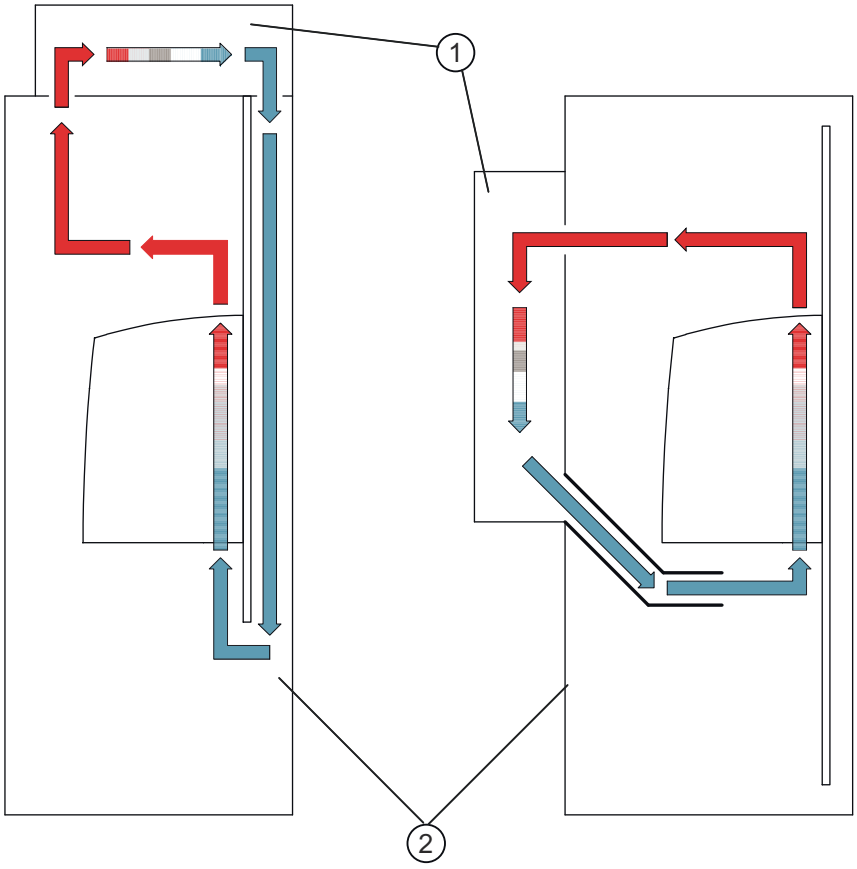
NOTICE
Damage caused by overheating resulting from covered ventilation slots Covered ventilation slots can cause the system to overheat. • Route the connected signal and power cables to the components in such a way that they do not cover the ventilation slots.

Note

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

Note

If the components are mounted in a sealed cabinet, an internal air cooling system must be installed to circulate the air and prevent hot spots. It is best to mount the fan above the components to optimize the air flow (suction).



① Cooling unit
② Control cabinet

Figure 13-16 Examples of cabinet ventilation

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. • If required, an anti-condensation heater must be installed in the cabinet.

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

13.11.3 Cooling clearances

Table 13-30 Cooling clearances required above and below SINAMICS components

Component	Clearance [mm]
CU320-2	80
Sensor Modules Cabinet-Mounted SMCxx	50
Terminal Modules TMx	50
Line filter for Line Modules	100
Active Interface Modules	80
Line reactors for Line Modules	100
Active Line Modules 16 ... 55 kW 80 ... 120 kW	 80 80 (additional 50 in front of fan)
Smart Line Modules Booksize	80
Smart Line Modules Booksize Compact	80
Basic Line Modules	80
Motor Modules Booksize < 132 A 132 A/200 A	 80 80 (additional 50 in front of fan)
Motor Modules Booksize Compact	80
Braking Module Booksize	80
Braking Module Booksize Compact	80
Control Supply Module	80
Capacitor Module	80
Voltage Protection Module	200

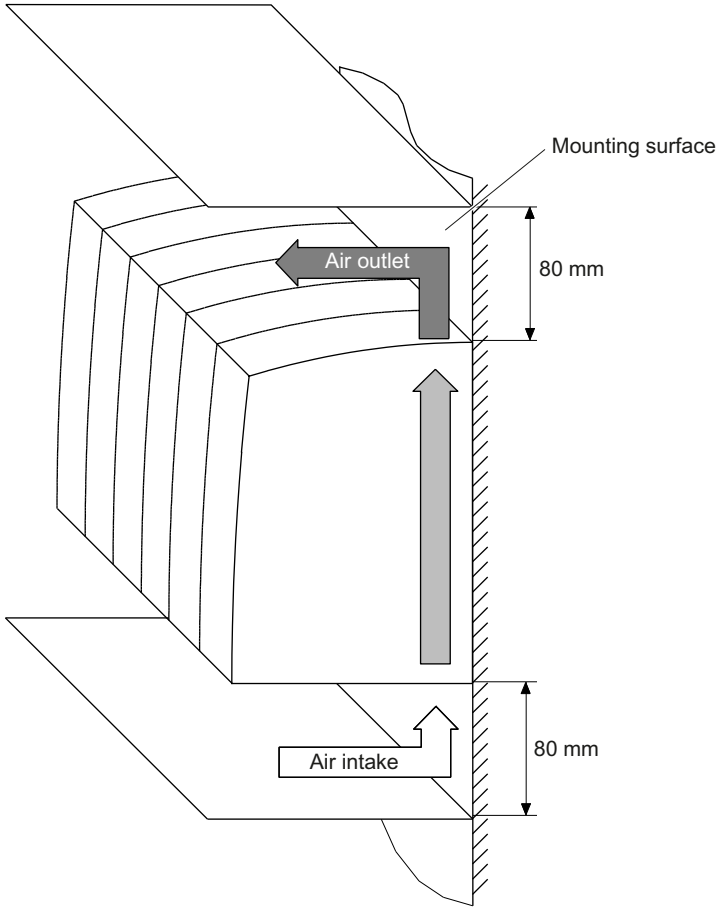


Figure 13-17 Cooling clearances for a drive line-up (components up to 200 mm wide)

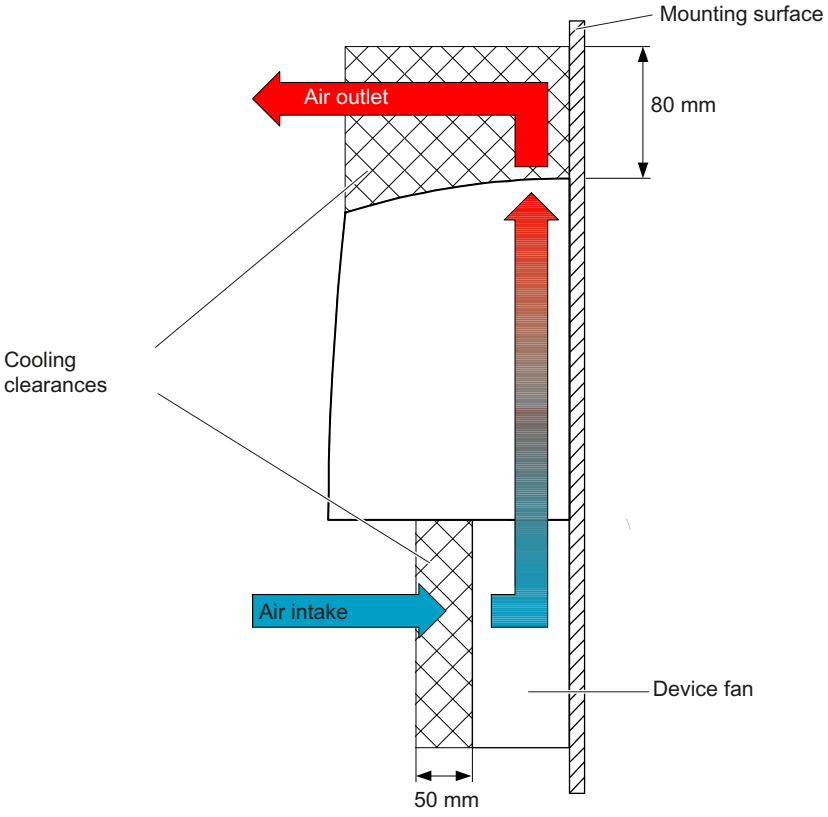


Figure 13-18 Cooling clearances for 300 mm wide components with mounted unit fan

Rail-mounted components

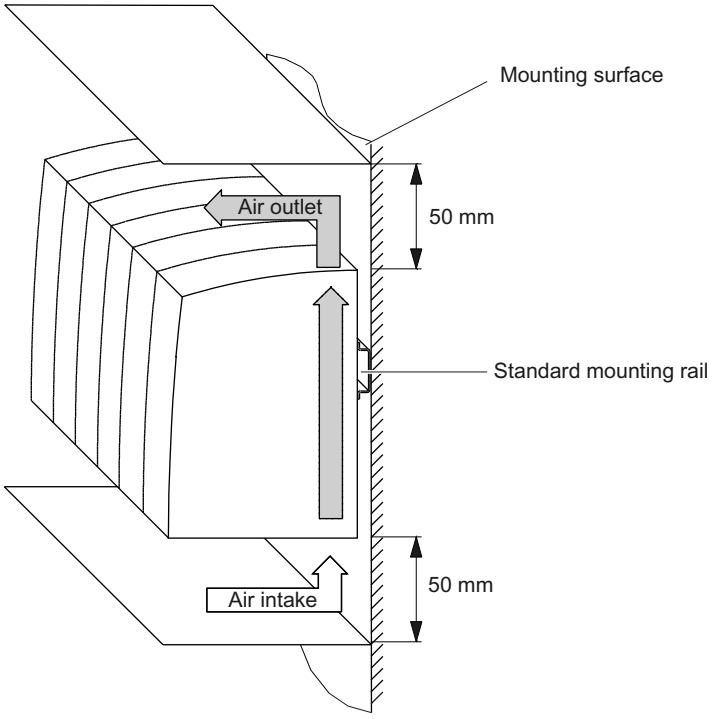


Figure 13-19 Cooling clearances for rail-mounted components (e.g. VSM, SMC, TM, DMC)

13.11.4 Dimensioning Climate Control Equipment

Cabinet manufacturers provide calculation programs for selecting climate control equipment. It is always necessary to know the power loss of the components and equipment installed in the cabinet.

The physical relationship is shown in the following example.

$q = Q - k \cdot A \cdot \Delta T$

Formula to calculate the power loss

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

Q = power loss [W]

ΔT = temperature difference between the room and cabinet interior [K]

k = thermal resistance coefficient [W / (m^2 K)]
(example: sheet steel, painted: k = 5.5 W / ($m^2 \cdot$ K))

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

Table 13-31 Example, calculating the power loss of a drive configuration

Component	Quanti-ty	Total power loss [W] (including electronic losses)	Total power loss [W]
CU320-2	1	24	24
Basic Line Filter for AIM / ALM 36 kW	1	26	26
Active Interface Module	1	340	340
Active Line Module 36 kW	1	666	666
Motor Module 18 A	2	140	280
Motor Module 30 A	3	263	789
SMC	5	10	50
SITOP 20	1	53	53
Line contactor	1	12	12
Total:			**2240**

Assumption:

Free-standing cabinet surface area A = 5 m^2

Temperature difference between the room and cabinet interior ΔT = 10 K

q = 2240 W - 5.5 W / (m^2 · K) · 5 m^2 · 10 K = 1965 W

13.12 Power losses of the components

13.12.1 General information

The tables below provide an overview of the power loss of all components during rated operation. The characteristic values apply for the following conditions:

- Line voltage for Line Modules 400 V
- Pulse frequency of the Motor Modules 4 kHz
- Rated pulse frequency of the Active Line Modules 8 kHz
- Operating components at their rated power

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.

13.12.2 Power loss for Control Units, Sensor Modules, and other system components

Table 13-32 Overview of power loss during rated operation for Control Units, Sensor Modules, and other system components

	Unit	Power loss
Control Units and Option Boards		
CU320-2	W	24
TB30	W	< 3
CBC10	W	< 3
CBE20	W	2.8
Sensor Modules		
SMC10	W	< 10
SMC20	W	< 10
SMC30	W	< 10
SME20/25	W	≤ 4
SME120/125	W	≤ 4.5
Terminal Modules		
TM15	W	< 3
TM31	W	< 10
TM41	W	12
TM54F	W	4.5
Additional system components		
VSM10	W	< 10
DC link components		
Braking Module Booksize	W	20
Braking Module Booksize Compact	W	25
Capacitor Module	W	25
Control Supply Module Line DC link	 W W	 70 65

13.12.3 Power loss for line filters and line reactors

Table 13-33 Overview of power loss during rated operation for line filters and line reactors

	Unit	Power loss
Basic Line Filters for Active Line Modules		
16 kW	W	16
36 kW	W	26
55 kW	W	43
80 kW	W	56
120 kW	W	73
Basic Line Filter for Active Line Modules with Active Interface Module		

	Unit	Power loss
16 kW	W	16
36 kW	W	26
55 kW	W	43
80 kW	W	56
120 kW	W	73
Basic Line Filter for Smart Line Modules		
5 kW	W	5
10 kW	W	9
16 kW	W	16
36 kW	W	26
55 kW	W	43
Basic Line Filter for Basic Line Modules		
20 kW	W	16
40 kW	W	26
100 kW	W	73
Active Interface Modules		
16 kW	W	270[1)]
36 kW	W	340[1)]
55 kW	W	380[1)]
80 kW	W	490[1)]
120 kW	W	585[1)]
Line reactors for Active Line Modules		
16 kW	W	170
36 kW	W	250
55 kW	W	350
80 kW	W	450
120 kW	W	590
Line reactors for Smart Line Modules		
5 kW	W	62
10 kW	W	116
16 kW	W	75
36 kW	W	170
55 kW	W	190
Line reactors for Basic Line Modules		
20 kW	W	130
40 kW	W	270
100 kW	W	480

1) Referred to $U_{DC\ link}$ = 600 V

13.12.4 Power losses of the power units

Table 13-34 Overview of power losses for power units operated at their rated power (including losses of the electronics)

	Unit	Power loss
Active Line Modules		
16 kW	W	282.8
36 kW	W	666
55 kW	W	945.6
80 kW	W	1383.6
120 kW	W	2243.2
Smart Line Modules Booksize		
5 kW	W	79.2
10 kW	W	141.6
16 kW	W	187.8
36 kW	W	406
55 kW	W	665.6
Smart Line Modules Booksize Compact		
16 kW	W	187.8
Basic Line Modules		
20 kW	W	144
40 kW	W	283.6
100 kW	W	628
Single Motor Modules Booksize		
3 A	W	26
5 A	W	36
9 A	W	60
18 A	W	140
24 A	W	189
30 A	W	263
45 A	W	342
60 A	W	460
85 A	W	786
132 A	W	1270.4
200 A	W	2070.4
Double Motor Modules Booksize		
2 x 3 A	W	54
2 x 5 A	W	81
2 x 9 A	W	152
2 x 18 A	W	281
Single Motor Modules Booksize Compact		
3 A	W	68[1)]
5 A	W	98[1)]

	Unit	Power loss
9 A	W	100.4
18 A	W	185.4
Double Motor Modules Booksize Compact		
2 x 1.7 A	W	114[1)]
2 x 3 A	W	134[1)]
2 x 5 A	W	194[1)]

[1)] Power loss at 8 kHz

13.12.5 Electronics losses of power units

Table 13-35 Losses of the electronics for power units

Component		Power loss [W]
Single Motor Modules	3 A	14
	5 A	14
	9 A	14
	18 A	14
	24 A	24
	30 A	20
	45 A	22
	60 A	22
	85 A	36.0
	132 A	20.4
	200 A	20.4
Single Motor Modules Booksize Compact	3 A	20.4
	5 A	20.4
	9 A	20.4
	18 A	20.4
Double Motor Modules	2 x 3 A	19
	2 x 5 A	19
	2 x 9 A	19
	2 x 18 A	22
Double Motor Modules Booksize Compact	2 x 1.7 A	27.6
	2 x 3 A	27.6
	2 x 5 A	27.6
Active Line Modules	16 kW	22.8
	36 kW	36.0
	55 kW	45.6
	80 kW	33.6
	120 kW	43.2

Component		Power loss [W]
Basic Line Modules	20 kW	24
	40 kW	33.6
	100 kW	48
Smart Line Module	5 kW	19.2
	10 kW	21.6
	16 kW	22.8
	36 kW	36.0
	55 kW	45.6
Smart Line Module Booksize Compact	16 kW	22.8

13.12.6 Maximum power losses in the partial load range

Losses in the partial load range for Line Modules and Motor Modules

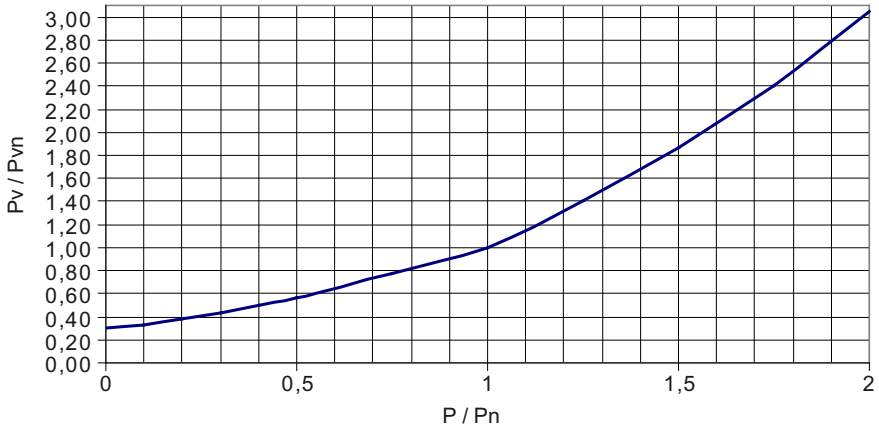


Figure 13-20 Losses in the partial load range for Active Line Modules and Smart Line Modules

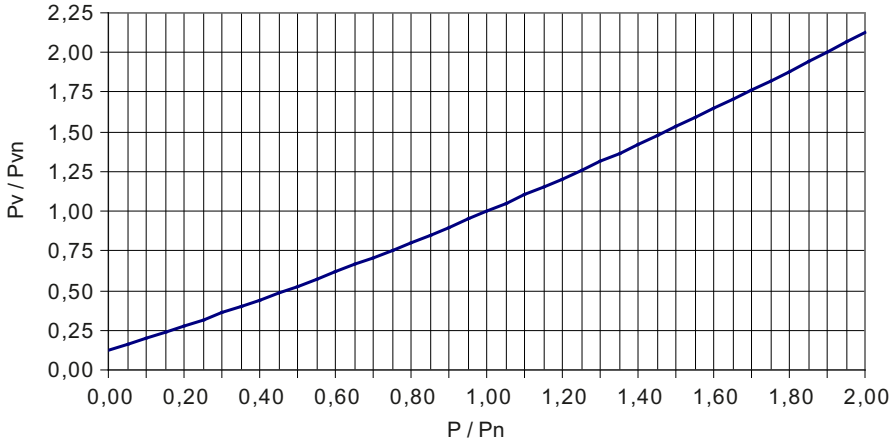


Figure 13-21 Losses in the partial load range for Basic Line Modules

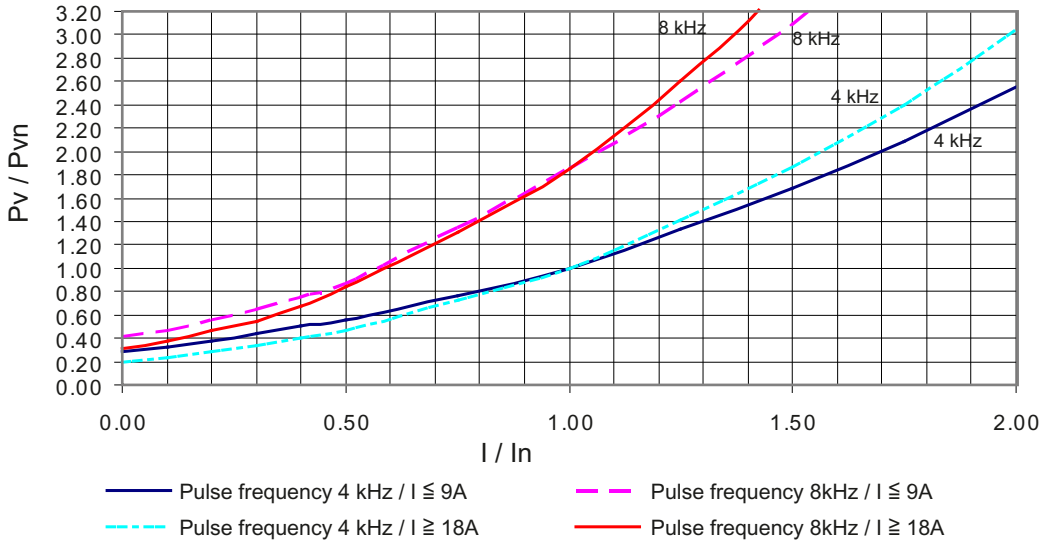


Figure 13-22 Losses in the partial load range for Motor Modules

Losses in the partial load range for line reactors and Active Interface Modules

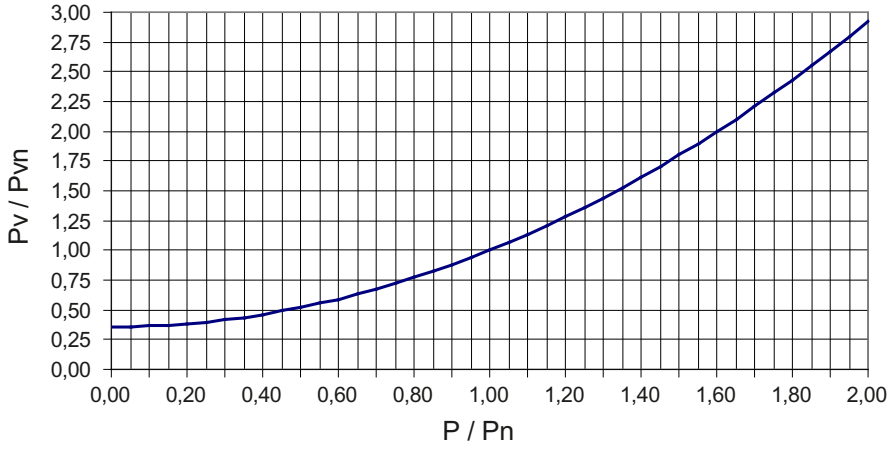


Figure 13-23 Losses in the partial load range for Active Interface Modules

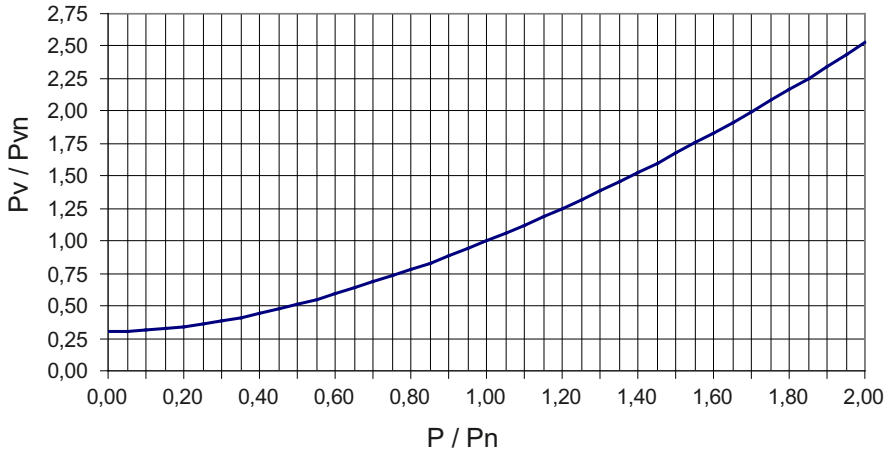


Figure 13-24 Losses in the partial load range for line reactors for Smart Line Modules

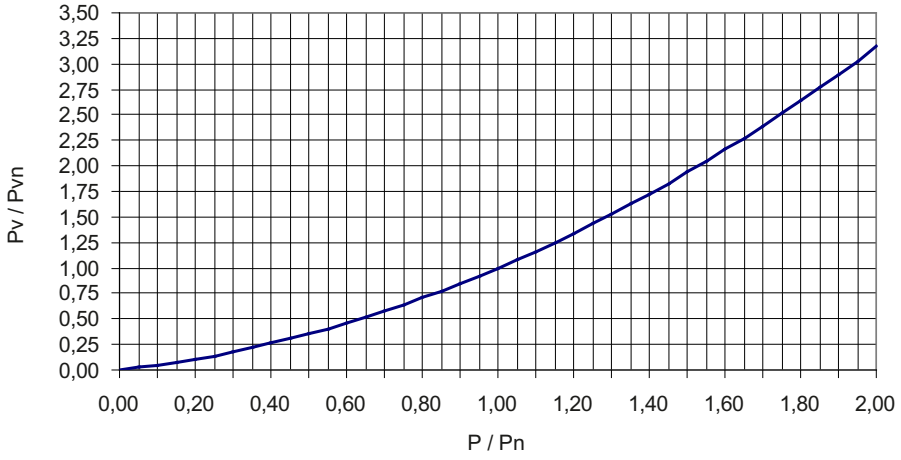


Figure 13-25 Losses in the partial load range for line reactors for Basic Line Modules

13.12.7 Typical power losses for Motor Modules

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

The following applies as typical application:

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

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

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

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 13-36 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/A^2]
Single Motor Module 3 A	14	3.29	0.205
Single Motor Module 5 A	14	3.29	0.205
Single Motor Module 9 A	14	3.29	0.205
Single Motor Module 18 A	14	3.29	0.205
Single Motor Module 24 A	24	3.50	0.140
Single Motor Module 30 A	20	4.71	0.113
Single Motor Module 45 A	22	4.40	0.060
Single Motor Module 60 A	22	4.40	0.055
Single Motor Module 85 A	36	6.11	0.030
Single Motor Module 132 A	150	6.01	0.018
Single Motor Module 200 A	150	6.01	0.017
Double Motor Module 2 x 3 A	19	5.20	0.200
Double Motor Module 2 x 5 A	19	5.20	0.200
Double Motor Module 2 x 9 A	19	5.18	0.247
Double Motor Module 2 x 18 A	22	5.57	0.091

Overview of typical power losses at the rated operating point

Table 13-37 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	26
Single Motor Module 5 A	36
Single Motor Module 9 A	60
Single Motor Module 18 A	140
Single Motor Module 24 A	189
Single Motor Module 30 A	263
Single Motor Module 45 A	342
Single Motor Module 60 A	460
Single Motor Module 85 A	772
Single Motor Module 132 A	1257
Single Motor Module 200 A	2032
Double Motor Module 2 x 3 A	54
Double Motor Module 2 x 5 A	81
Double Motor Module 2 x 9 A	152
Double Motor Module 2 x 18 A	281

Service and Support Booksize

14

14.1 Replacing the fan

14.1.1 Safety instructions when replacing a fan

Note

Service life and replacement interval of the fan module

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

Smart Line Modules 5/10 kW and the Control Supply Module do not have an operating hours counter. For these modules, it is recommended that the fan be replaced after 40000 operating hours or 10 years.

Active Interface Modules do not have an operating hours counter. Replace the fan together with the Active Line Module fan, but no later than after 40000 operating hours.

Accumulated dirt has a negative impact on the fan function. If the fan is dirty, replace it before the maximum operating time elapses.



⚠ WARNING

Electric shock when live parts are touched

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

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

- Remove the device cover or the fan cover only after a certain time.
- Check for zero voltage before removing the component.

Note

When replacing the fan, you must observe the ESD regulations.

Only qualified personnel are permitted to install spare parts.

14.1.2 Replacing the fan for Motor Modules C/D type

Note

Service life and replacement intervals of the fan module

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

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

Table 14-1 Fan modules as replacement part when replacing a fan

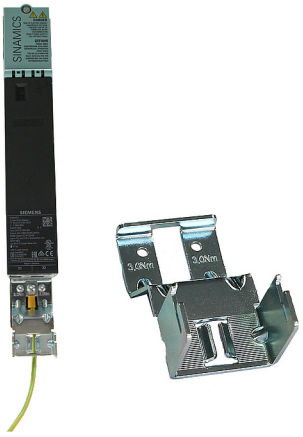
Module width	Type	Article No.	Rated fan voltage
50 mm	3 A ... 18 A 2 x 3 A ... 2 x 9 A	6SL3162-0AN00-0AA0	24 V
50 mm	24 A	6SL3162-0AS00-0AA0	12 V
100 mm	30 A / 2 x 18 A	6SL3162-0AP00-0AA0	24 V
100 mm	45 A / 60 A	6SL3162-0AT00-0AA0	12 V

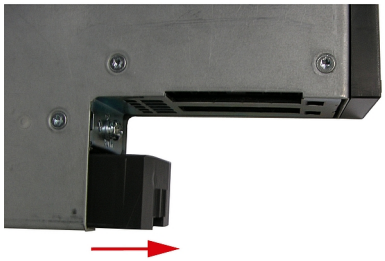
Required tools:

- Torx screwdrivers T20 and T25
- Slotted screwdriver 0.8 x 5.5 mm

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

Removing the existing fan module

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

		
Detach the protective conductor from the Motor Module. Screwdriver: Torx 25	Pull the fan module out forwards out of the Motor Module.	Motor Module with removed fan module (12 V or 24 V)

Installing a new fan module

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

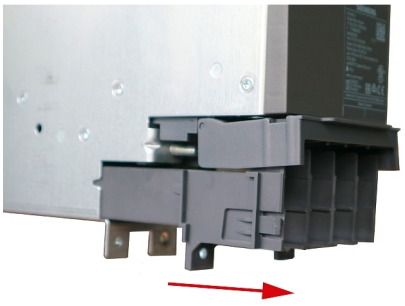
NOTICE
Defective fan when using a wrong fan module 24 V and 12 V fans are available for 50 mm Motor Modules (see the table above). If, when replacing the fan at a Motor Module 3 A ... 18 A or 2 x 3 A ... 2 x 9 A, a 12 V fan is used, then this can be damaged when operated. If a 24 V fan is used as replacement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

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

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

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

The fan assembly is integrated in the motor connection block.

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

		
Motor Module without fan	Removed fan module	

Installing a new fan module

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

14.1.3 Replacing the fan for Line Modules and Motor Modules Classic

Replacing the fan for components, sizes 50 to 200 mm

Table 14-2 Removing the fan

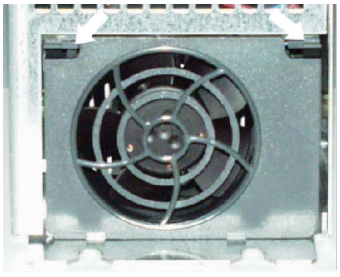
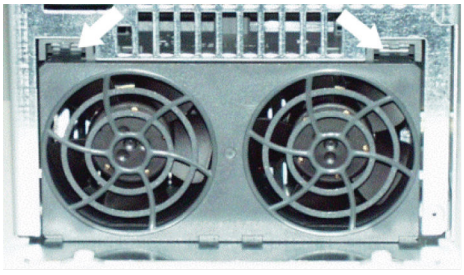
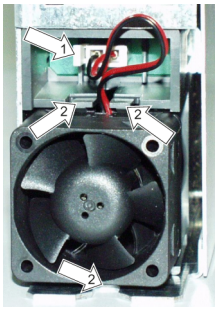
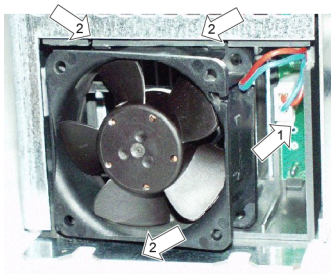
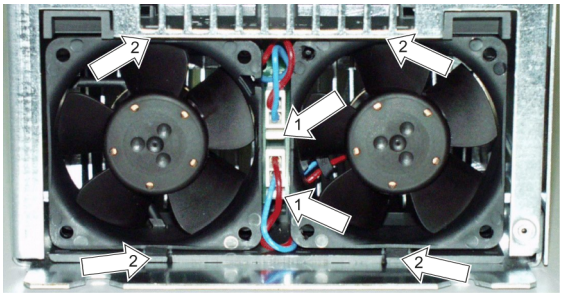
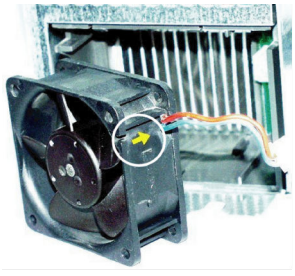
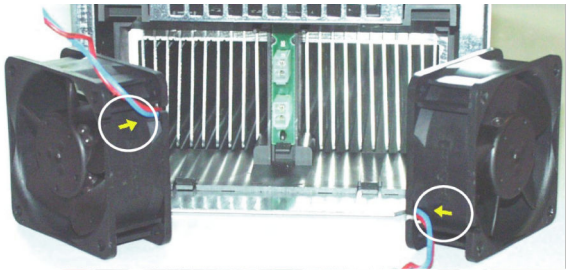
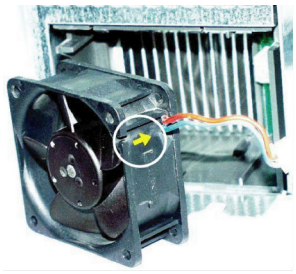
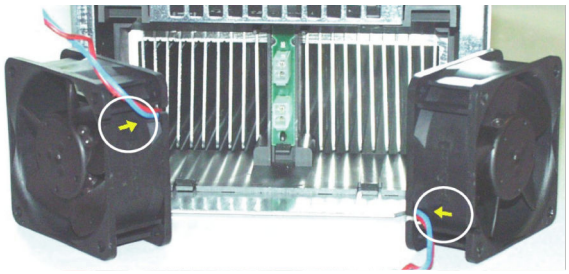
Size 50 mm	**Size 100 mm**	**Sizes 150 mm and 200 mm**
		
1. Remove the module from the drive line-up. 2. Release the catches to open the fan cover.		
		
3. Release and withdraw the connector (1). 4. Release the catch (2) and remove the fan.		
		

Table 14-3 Installing a fan

Size 50 mm	Size 100 mm	Sizes 150 mm and 200 mm
		
1. Before installing the fan, please note the airflow direction. The arrow on the fan must point toward the cooling ribs. 2. Push the fan into a position where it is completely latched. When doing this, do not crush the connecting cables! 3. Insert the connector until it latches into place. 4. Attach the fan cover.		

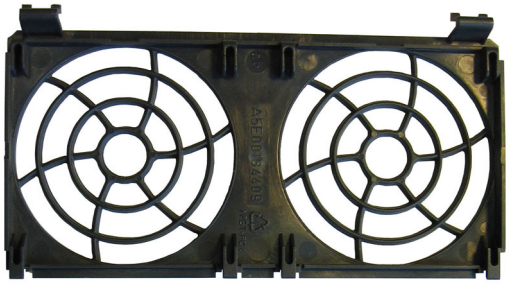
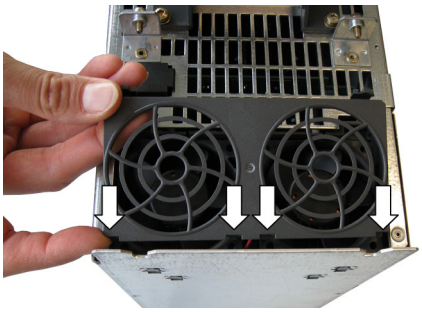
Note

The spare parts pack for components sized 150 mm and 200 mm contains two different fan covers:

- One fan cover for components with internal air cooling
- One fan cover for components with external air cooling

Use the fan cover for components with internal air cooling.

Table 14-4 Attaching the fan cover on components, sizes 150 mm and 200 mm

 1. Fan cover for components with internal air cooling	 2. Attach the fan cover.
 3. Press on the fan cover until the catches engage.	

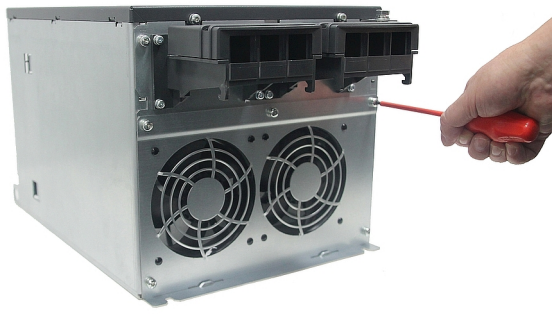
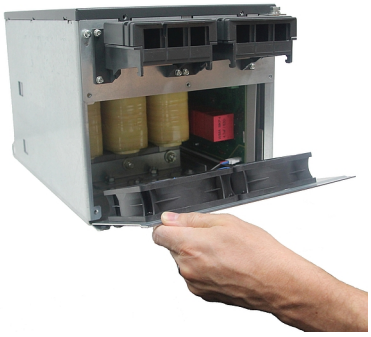
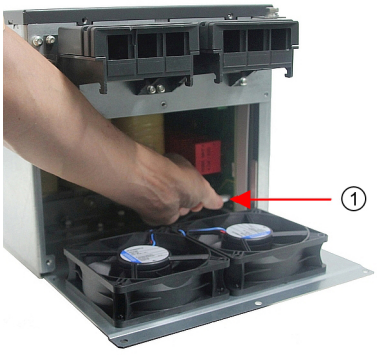
Replacing the fan for components, size 300 mm

Installing the fan module on 300 mm wide components is described in the associated Chapter "Installation (Page 140)".

The fan module is removed in the inverse sequence to installing.

14.1.4 Replacing the fan on an Active Interface Module

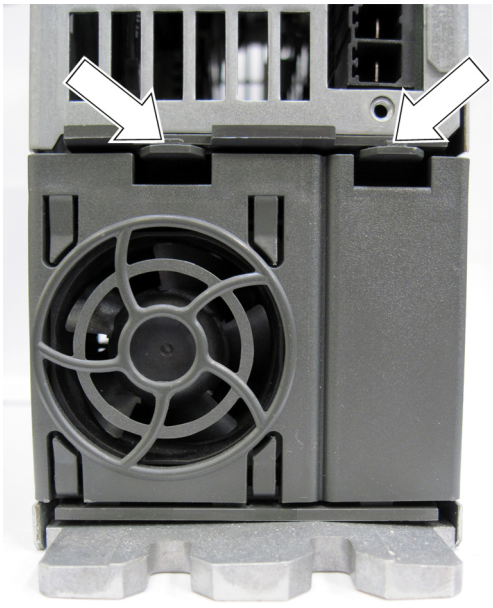
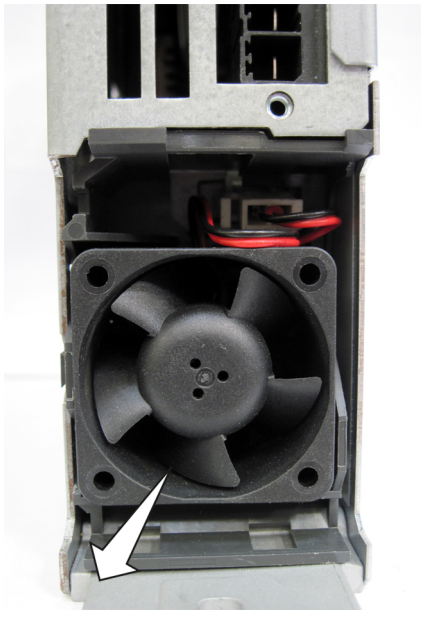
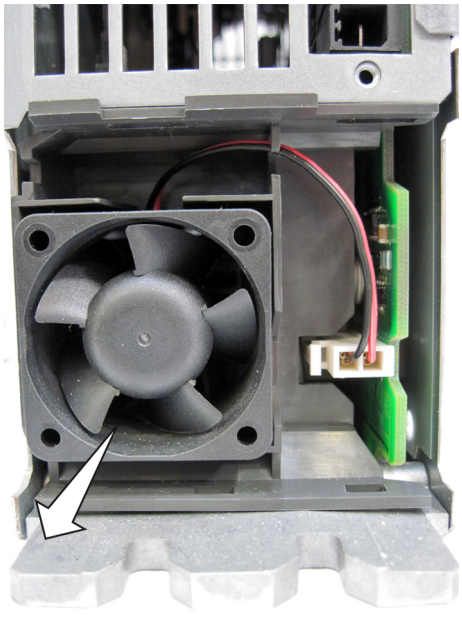
For Active Interface Modules, the fan and fan cover are designed as one compact unit. Active Interface Modules 16 kW, 36 kW and 55 kW each have one fan, Active Interface Modules 80 kW and 120 kW have 2 fans. Removal and installation are the same for all module types. Removal based on an 80 kW module is described below.

	
1. Open the fan cover. To do this, release the combination screws M5 (3.5 Nm / 31.0 lbf in).	2. Open the fan cover.
	
3. Release the connector ①.	

To install, carry out the above steps in reverse order. The torques must be carefully observed.

14.1.5 Replacing the fan for Booksize Compact components

Table 14-5 Removing the fan

Size 50 mm	**Size 75 mm**
1. Remove the component from the drive line-up.	
	
2. Remove the fan cover at the lower side of the component by releasing the catches.	
	
3. Carefully withdraw the fan.	

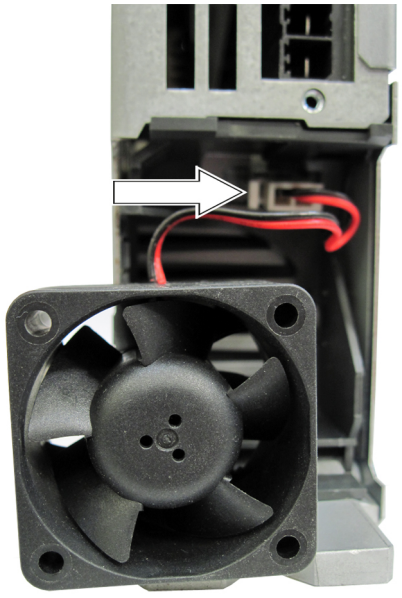
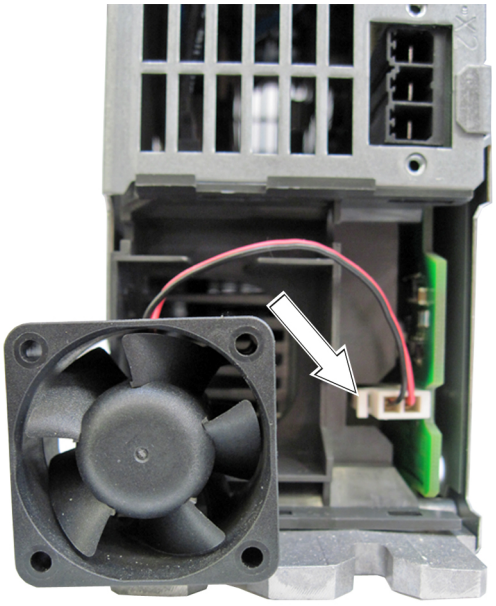
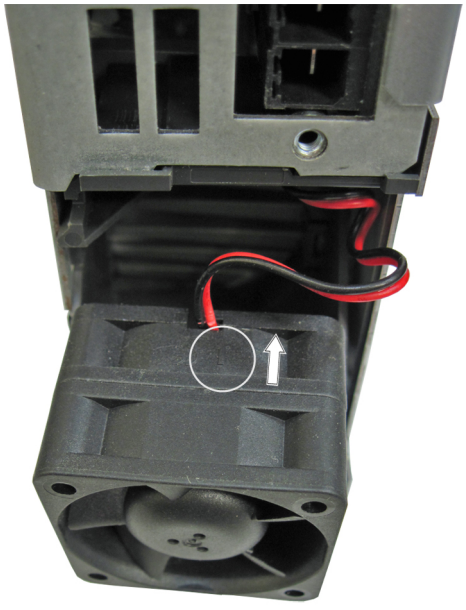
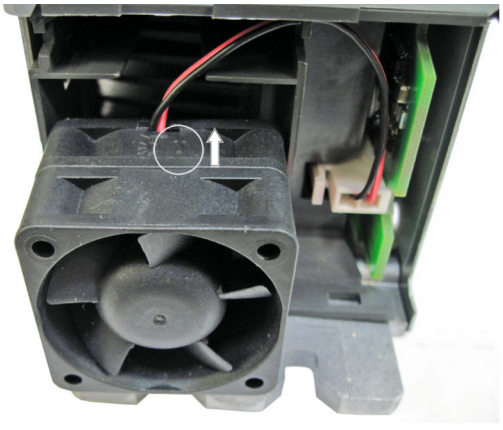
	
4. Release the connector and remove the connecting cable.	

Table 14-6 Installing a fan

Size 50 mm	**Size 75 mm**
	
1. Observed the air flow direction before installing the fan (the arrow on the fan must point towards the cooling ribs). 2. Insert the connector until it latches into place. 3. Install the fan. When doing this ensures that the connecting cables are not crushed. 4. Attach the fan cover.	

14.2 Forming the DC link capacitors

Description

If the Line Modules and Motor Modules are kept in storage for more than two years, the DC link capacitors have to be reformed. If this is not performed, the units could be damaged when they are switched on.

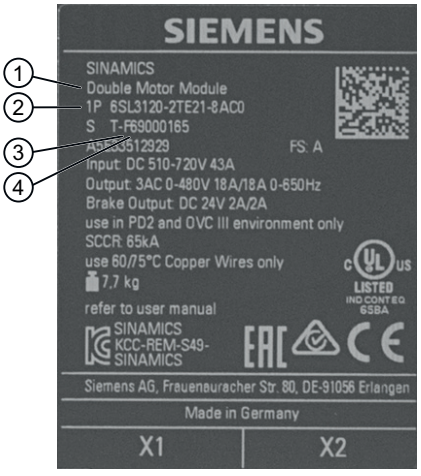
If the cabinet is commissioned within two years of its date of manufacture, the DC link capacitors do not need to be reformed. The date of manufacture can be taken from the serial number on the rating plate.

Note

The storage period is calculated from the date of manufacture and not from the date that the equipment was shipped.

Type plate

① Device designation
② Article No.
③ Year of manufacture (here, F = 2015)
④ Month of manufacture (here, 6 = June)



Rating plate using a Double Motor Module as example

Date of manufacture

The date of manufacture can be determined as follows:

Table 14-7 Production year and month

Character	Year of manufacture	Character	Month of manufacture
A	2010	1 ... 9	January to September
B	2011	O	October
C	2012	N	November
D	2013	D	December

Character	Year of manufacture	Character	Month of manufacture
E	2014		
F	2015		
H	2016		
J	2017		
K	2018		
L	2019		
M	2020		
N	2021		
P	2022		
R	2023		
S	2024		
T	2025		
U	2026		
V	2027		
W	2028		
X	2029		

The serial number is found on the rating plate.

Forming circuit

A defined voltage and a limited current are applied to the DC link capacitors when forming them. As a consequence, the internal relationships required for the DC link capacitors to function correctly are re-established.

The forming circuit is set up using PTC resistors, or alternatively incandescent lamps.

Components required (recommendation)

- 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)
- Alternative to PTC resistors: 3 incandescent lamps 230 V / 100 W
- Various small components, such as lamp socket, etc.



⚠ 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 five 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 cover of the DC link until 5 minutes have elapsed.
- Check that the cabinet is de-energized.

Note

Line Modules are formed by means of a connected Motor Module. See Forming circuits of Line Modules.

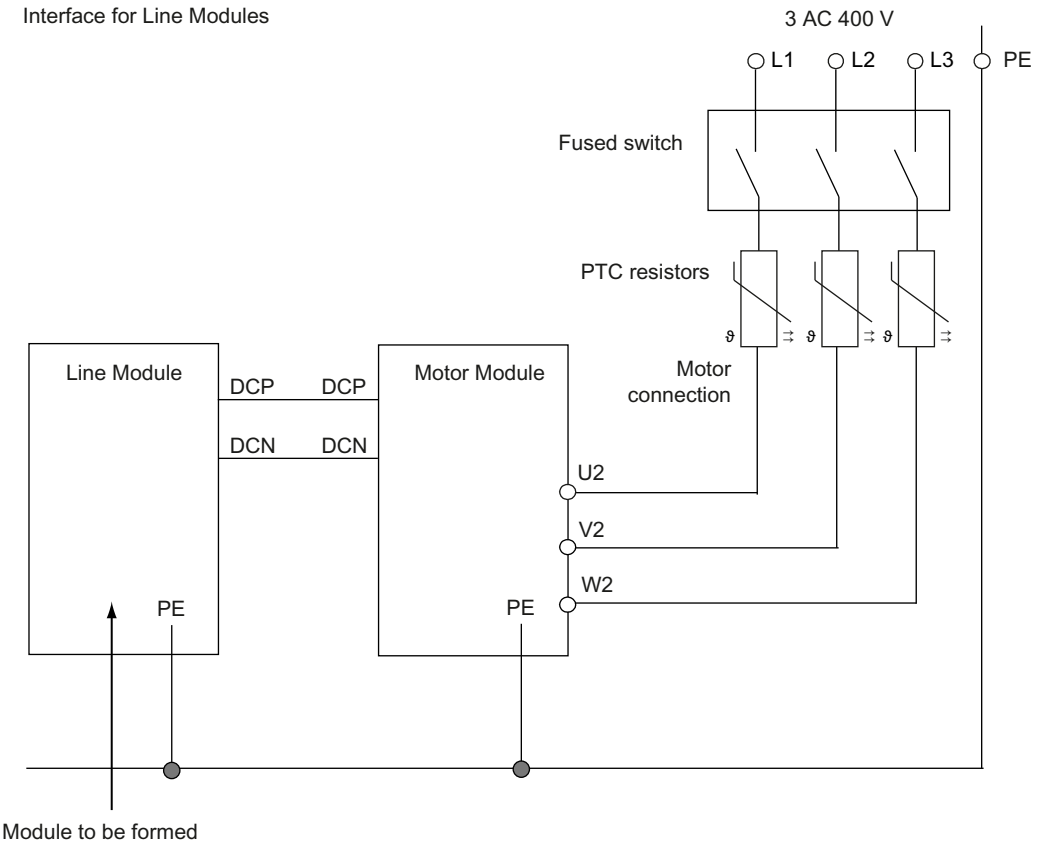


Figure 14-1 Forming circuit for Line Modules with PTC resistors

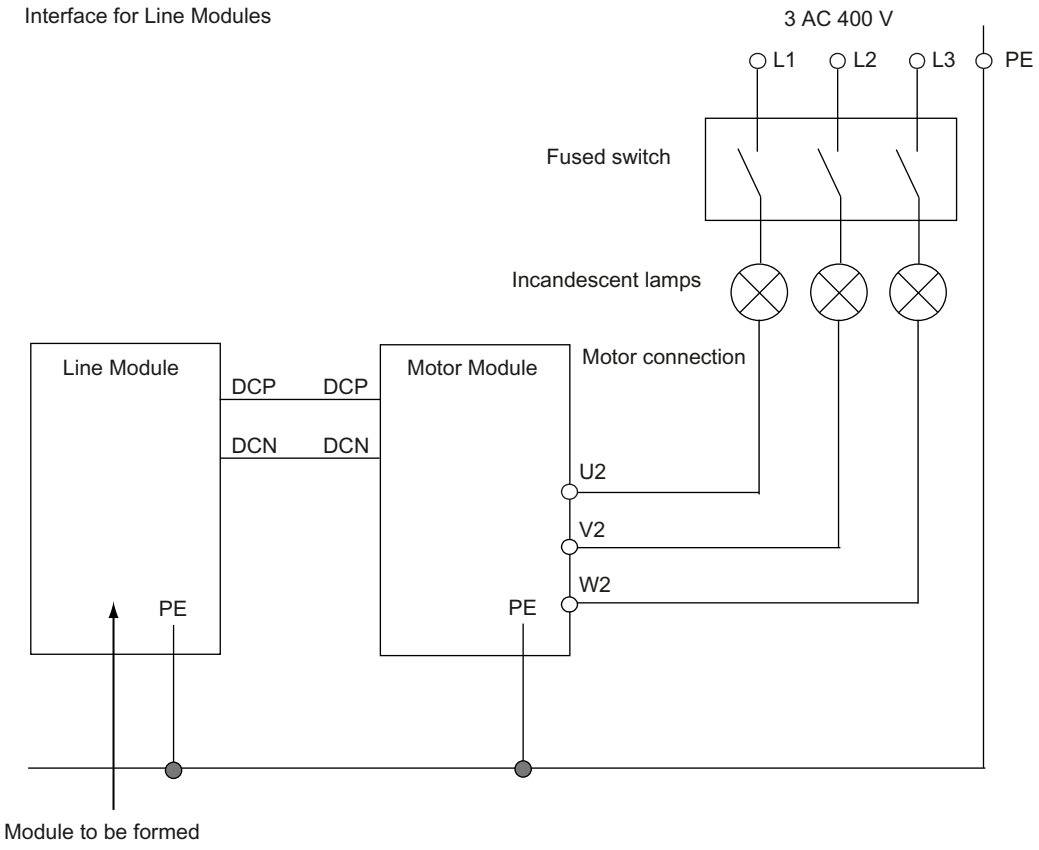


Figure 14-2 Forming circuit for Line Modules with incandescent lamps

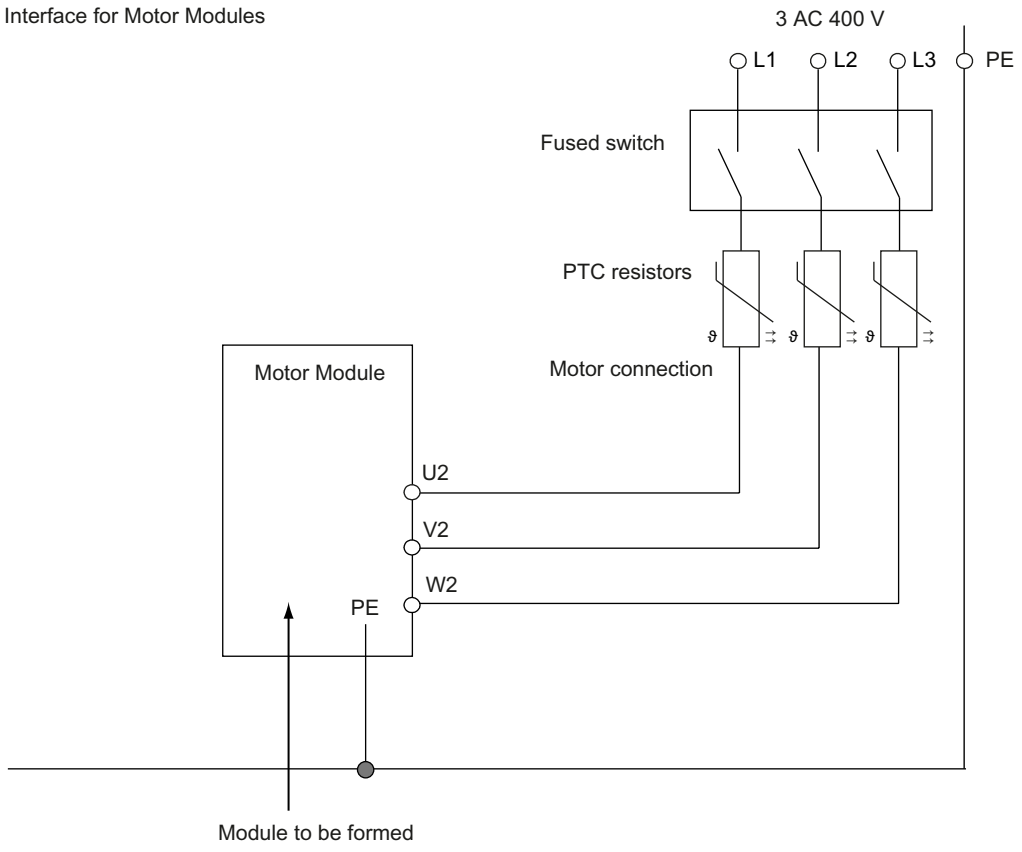


Figure 14-3 Forming circuit for Motor Modules with PTC resistors

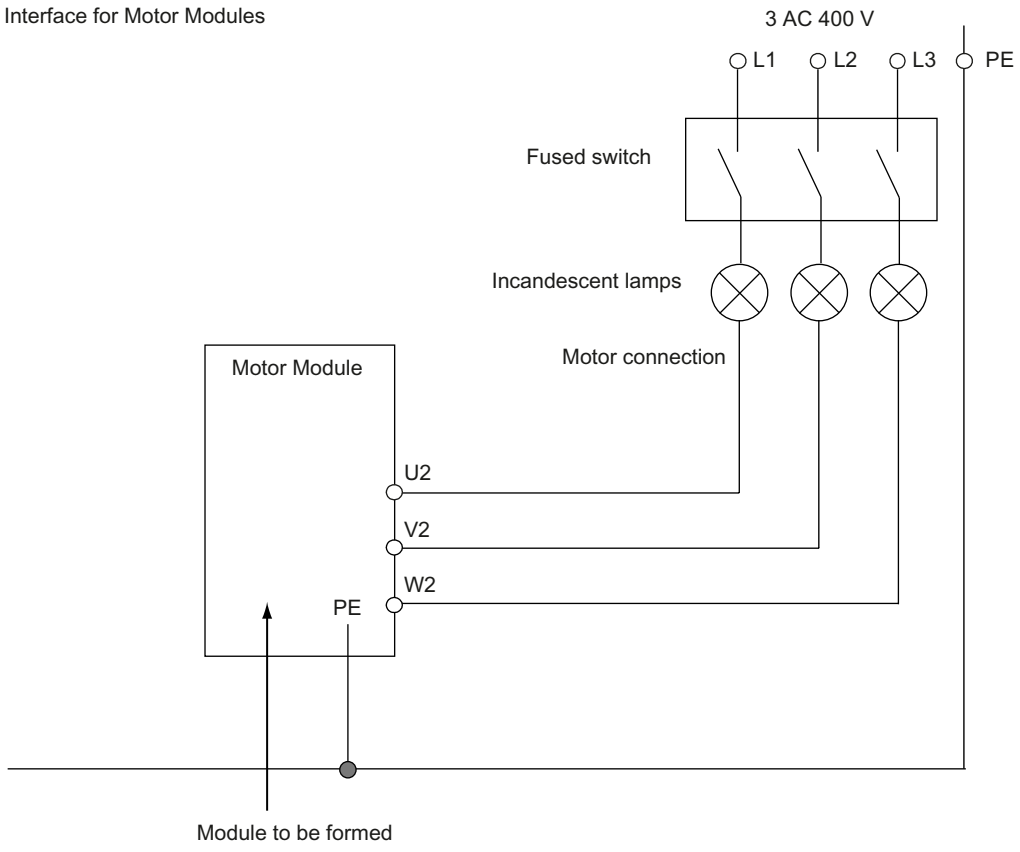


Figure 14-4 Forming circuit for Motor Modules with incandescent lamps

Procedure

1. Be sure to remove the DC link bridge before forming the DC-link capacitors.
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.
   For forming using PTC resistors, the modules must remain in the circuit for approx. 1h. The resistors will become very hot if there is a fault in the unit (surface temperature > 80° C). While forming, the incandescent lamps must go dark or go out completely. If the incandescent lamps continue to be brightly lit, a fault has occurred in the drive unit or in the wiring.

14.3 Recycling and disposal



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

14.4 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).

Appendix

A

A.1 List of abbreviations

Note

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

A

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

B

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

Abbreviation	Derivation of abbreviation	Meaning
BLM	Basic Line Module	Basic Line Module
BO	Binector Output	Binector output
BOP	Basic Operator Panel	Basic operator panel

C

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

D

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

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

E

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

Abbreviation	Derivation of abbreviation	Meaning
ESD	Electrostatic Sensitive Devices	Electrostatic sensitive devices
ESM	Essential Service Mode	Essential service mode
ESR	Extended Stop and Retract	Extended stop and retract

F

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

G

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

H

Abbreviation	Derivation of abbreviation	Meaning
HF	High frequency	High frequency
HFD	Hochfrequenzdrossel	Radio frequency reactor
HLA	Hydraulic Linear Actuator	Hydraulic linear actuator

Abbreviation	Derivation of abbreviation	Meaning
HLG	Hochlaufgeber	Ramp-function generator
HM	Hydraulic Module	Hydraulic Module
HMI	Human Machine Interface	Human Machine Interface
HTL	High-Threshold Logic	Logic with high interference threshold
HTTP	Hypertext Transfer Protocol	Hypertext Transfer Protocol (communication protocol)
HTTP	Hypertext Transfer Protocol Secure	Hypertext Transfer Protocol Secure (communication protocol)
HW	Hardware	Hardware

I

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

J

Abbreviation	Derivation of abbreviation	Meaning
JOG	Jogging	Jogging

K

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

L

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

M

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

N

Abbreviation	Derivation of abbreviation	Meaning
N. C.	Not Connected	Not connected
N...	No Report	No report or internal message
NAMUR	Interessengemeinschaft Automatisierungstechnik der Prozessindustrie	User association of automation technology in the process industry
NC	Normally Closed (contact)	NC contact
NC	Numerical Control	Numerical control
NEMA	National Electrical Manufacturers Association	Standardization association in USA (United States of America)
NM	Nullmarke	Zero mark
NO	Normally Open (contact)	NO contact
NSR	Netzstromrichter	Line-side converter
NTP	Network Time Protocol	Standard for synchronization of the time of day
NVRAM	Non-Volatile Random Access Memory	Non-volatile read/write memory

O

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

P

Abbreviation	Derivation of abbreviation	Meaning
p...	-	Adjustable parameters
P1	Processor 1	CPU 1
P2	Processor 2	CPU 2
PB	PROFIBUS	PROFIBUS
PcCtrl	PC Control	Master control
PD	PROFIdrive	PROFIdrive
PDC	Precision Drive Control	Precision Drive Control
PDS	Power unit Data Set	Power unit data set
PDS	Power Drive System	Drive system

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

Q

Abbreviation	Derivation of abbreviation	Meaning
No entries		

R

Abbreviation	Derivation of abbreviation	Meaning
r...	-	Display parameters (read-only)
RAM	Random Access Memory	Memory for reading and writing
RCCB	Residual Current Circuit Breaker	Residual current operated circuit breaker
RCD	Residual Current Device	Residual current device
RCM	Residual Current Monitor	Residual current monitor
REL	Reluctance motor textile	Reluctance motor textile
RESM	Reluctance synchronous motor	Synchronous reluctance motor
RFG	Ramp-Function Generator	Ramp-function generator

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

S

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

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

T

Abbreviation	Derivation of abbreviation	Meaning
TB	Terminal Board	Terminal Board
TEC	Technology Extension	Software component which is installed as an additional technology package and which expands the functionality of SINAMICS (previously OA application)
TIA	Totally Integrated Automation	Totally Integrated Automation
TLS	Transport Layer Security	Encryption protocol for secure data transfer (previously SSL)
TM	Terminal Module	Terminal Module
TN	Terre Neutre	Grounded three-phase line supply
Tn	-	Integral time

Abbreviation	Derivation of abbreviation	Meaning
TPDO	Transmit Process Data Object	Transmit Process Data Object
TSN	Time-Sensitive Networking	Time-Sensitive Networking
TT	Terre Terre	Grounded three-phase line supply
TTL	Transistor-Transistor-Logic	Transistor-transistor logic
Tv	-	Rate time

U

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

V

Abbreviation	Derivation of abbreviation	Meaning
VC	Vector Control	Vector control
Vdc	-	DC link voltage
VdcN	-	Partial DC link voltage negative
VdcP	-	Partial DC link voltage positive
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik	Association of Electrical Engineering, Electronics and Information Technology
VDI	Verein Deutscher Ingenieure	Verein Deutscher Ingenieure [Association of German Engineers]
VPM	Voltage Protection Module	Voltage Protection Module
Vpp	Volt peak to peak	Volt peak to peak
VSM	Voltage Sensing Module	Voltage Sensing Module

W

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

X

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

Y

Abbreviation	Derivation of abbreviation	Meaning
No entries		

Z

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

A.2 Documentation overview

General documentation/catalogs			
SINAMICS	G110	D 11	- Converter Chassis Units 0.12 kW up to 3 kW
	G120	D 31	- SINAMICS Converters for Single-Axis Drives and SIMOTICS Motors
	G130, G150	D 11	- Converter Chassis Units - Converter Cabinet Units
	S120, S150	D 21.3	- SINAMICS S120 Chassis Units and Cabinet Modules - SINAMICS S150 Converter Cabinet Units
	S120	D 21.4	- SINAMICS S120 and SIMOTICS
Manufacturer/service documentation			
SINAMICS	G110		- Getting Started - Operating Instructions - List Manuals
	G120		- Getting Started - Operating Instructions - Installation Manuals - Function Manual Safety Integrated - List Manuals
	G130		- Operating Instructions - List Manual
	G150		- Operating Instructions - List Manual
	GM150, SM120/SM150, GL150, SL150		- Operating Instructions - List Manuals
	S110		- Equipment Manual - Getting Started - Function Manual - List Manual
	S120		- Getting Started - Commissioning Manual - Function Manual Drive Functions - Function Manual Communication (from firmware V5.2) - Function Manual Safety Integrated - Function Manual DCC - List Manual - Equipment Manual for Control Units and Supplementary System Components - Equipment Manual for Booksize Power Units - Equipment Manual for Air-Cooled Chassis Power Units - Equipment Manual for Liquid-Cooled Chassis Power Units - Equipment Manual for Water-Cooled Chassis Power Units for Common Cooling Circuits - Equipment Manual Combi - Equipment Manual for Cabinet Modules - Equipment Manual for AC Drives - SINAMICS S120M Equipment Manual Distributed Drive Technology - SINAMICS HLA System Manual Hydraulic Drive
	S150		- Operating Instructions - List Manual
	S210		- SINAMICS S210 Operating Instructions
Motors			- Configuration Manuals, Motors
General			- Configuration Manual, EMC Installation Guideline

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More information

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www.siemens.com/sinamics

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