

SIEMENS

SINAMICS

SINAMICS S120

Booksize Power Units

Manual

Edition

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Answers for industry.

SIEMENS

SINAMICS

S120 Booksize Power Units

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.

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

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

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

Trademarks

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

Disclaimer of Liability

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

Preface

Preface SINAMICS general

SINAMICS documentation

The SINAMICS documentation is organized in the following categories:

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

Additional information

The following link provides information on the topics:

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

<http://www.siemens.com/motioncontrol/docu>

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

docu.motioncontrol@siemens.com

My Documentation Manager

Under the following link there is information on how to create your own individual documentation based on Siemens' content, and adapt it for your own machine documentation:

<http://www.siemens.com/mdm>

Training

Information about SITRAIN (Siemens training on products, systems and solutions for automation and drives) is available under the following link:

<http://www.siemens.com/sitrain>

FAQs

You can find Frequently Asked Questions on the Service&Support pages under **Product Support**.

<http://support.automation.siemens.com>

SINAMICS

You can find information on SINAMICS at:

<http://www.siemens.com/sinamics>.

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

Table 1 Usage phases and the available documents/tools

| Usage phase | Document/tool |
|------------------------|--|
| Orientation | SINAMICS S Sales Documentation |
| Planning/configuration | <ul style="list-style-type: none"> • SIZER Engineering Tool • Configuration Manuals, Motors |
| Deciding/ordering | SINAMICS S120 catalogs <ul style="list-style-type: none"> • SIMOTION, SINAMICS S120 and Motors for Production Machines (Catalog PM 21) • SINAMICS and Motors for Single-axis Drives (Catalog D 31) • SINUMERIK & SINAMICS Equipment for Machine Tools (Catalog NC 61) • SINUMERIK 840D sl Type 1B Equipment for Machine Tools (Catalog NC 62) |
| Installation/assembly | <ul style="list-style-type: none"> • SINAMICS S120 Equipment Manual for Control Units and Additional System Components • SINAMICS S120 Equipment Manual for Booksize Power Units • SINAMICS S120 Equipment Manual for Chassis Power Units • SINAMICS S120 Equipment Manual for AC Drives • SINAMICS S120M Equipment Manual Distributed Drive Technology • SINAMICS HLA System Manual Hydraulic Drive |
| Commissioning | <ul style="list-style-type: none"> • STARTER Commissioning Tool • SINAMICS S120 Getting Started • SINAMICS S120 Commissioning Manual • SINAMICS S120 CANopen Commissioning Manual • SINAMICS S120 Function Manual • SINAMICS S120 Safety Integrated Function Manual • SINAMICS S120/S150 List Manual • SINAMICS HLA System Manual Hydraulic Drive |
| Usage/operation | <ul style="list-style-type: none"> • SINAMICS S120 Commissioning Manual • SINAMICS S120/S150 List Manual • SINAMICS HLA System Manual Hydraulic Drive |

| Usage phase | Document/tool |
|-----------------------|--|
| Maintenance/servicing | <ul style="list-style-type: none"> • SINAMICS S120 Commissioning Manual • SINAMICS S120/S150 List Manual |
| References | <ul style="list-style-type: none"> • SINAMICS S120/S150 List Manual |

Target group

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

Benefits

This manual describes all the information, procedures and operational instructions required for commissioning and servicing SINAMICS S120.

Standard scope

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

- It may be possible for other functions not described in this documentation to be executed in the drive system. However, no claim can be made regarding the availability of these functions when the equipment is first supplied or in the event of servicing.
- Functions that are not available in a particular product version of the drive system may be described in the documentation. The functionality of the supplied drive system should only be taken from the ordering documentation.
- Extensions or changes made by the machine manufacturer must be documented by the machine manufacturer.

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

Technical Support

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

<http://www.siemens.com/automation/service&support>

EC Declaration of Conformity

The EC Declarations of Conformity for the machinery directive can be found on the Internet at:

<http://support.automation.siemens.com/WW/view/de/21901735/67385845>

Alternatively, you can contact the Siemens office in your region in order to obtain the EC Declaration of Conformity.

Note

Complying with the low-voltage directive

When operated in dry areas, SINAMICS S units conform to Low-Voltage Directive 2006/95/EC.

Note

Fulfilling the EMC Directive

SINAMICS S units fulfill EMC Directive 2004/108/EC in the configuration specified in the associated EC Declaration of Conformity for EMC and when the EMC installation guideline provided in the Configuration Manual with Order No. 6FC5297-0AD30-0AP3 is implemented.

Note

Ensuring reliable operation

The manual describes a desired state. The required reliable operation and the compliance with EMC limit values can only be ensured when this is maintained.

EMC limit values in South Korea

| |
|---|
| <p>이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.</p> <p>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.</p> |
|---|

The EMC limit values to be complied with for South Korea correspond to the limit values of the EMC product standard for variable-speed electric drives EN 61800-3, Category C2 or limit value class A, Group 1 according to EN 55011. By applying suitable supplementary measures, the limit values according to Category C2 or according to limit value class A, Group 1, are maintained. Further, additional measures may be required, for instance, 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.

Spare parts

Spare parts are available on the Internet at:

<http://support.automation.siemens.com/WW/view/de/16612315>

Test certificates

Test certificates for functional safety functions ("Safety Integrated") can be found at:

<http://support.automation.siemens.com>

An up-to-date list of currently certified components is also available on request from your local Siemens office. If you have any questions relating to certifications that have not yet been completed, please ask your Siemens contact.

Grounding symbols

Table 2 Symbols

| Symbol | Meaning |
|---|---|
|  | Connection for protective conductor (PE) |
|  | Ground (e.g. M 24 V) |
|  | Connection for function equipotential bonding |

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Fundamental safety instructions

1.1 General safety instructions



DANGER

Danger to life due to live parts and other energy sources

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

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

Generally, six steps apply when establishing safety:

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

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



WARNING

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

Touching live components can result in death or severe injury.

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



! WARNING

Danger to life when live parts are touched on damaged devices

Improper handling of devices can cause damage.

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

Danger to life through electric shock due to unconnected cable shields

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

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



! WARNING

Danger to life due to electric shock when not grounded

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

- Ground the device in compliance with the applicable regulations.



! WARNING

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

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

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

! WARNING

Danger to life due to fire spreading if housing is inadequate

Fire and smoke development can cause severe personal injury or material damage.

- Install devices without a protective housing in a metal control cabinet (or protect the device by another equivalent measure) in such a way that contact with fire is prevented.
- Ensure that smoke can only escape via controlled and monitored paths.

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

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

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

 **WARNING****Danger to life due to the motor catching fire in the event of insulation overload**

There is higher stress on the motor insulation through a ground fault in an IT system. If the insulation fails, it is possible that death or severe injury can occur as a result of smoke and fire.

- Use a monitoring device that signals an insulation fault.
- Correct the fault as quickly as possible so the motor insulation is not overloaded.

 **WARNING****Danger to life due to fire if overheating occurs because of insufficient 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.

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

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

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

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|---|
| NOTICE |
| Device damage caused by incorrect voltage/insulation tests Incorrect voltage/insulation tests can damage the device. <ul style="list-style-type: none">• Before carrying out a voltage/insulation check of the system/machine, disconnect the devices as all converters and motors have been subject to a high voltage test by the manufacturer, and therefore it is not necessary to perform an additional test within the system/machine. |

| |
|---|
|  WARNING |
| Danger to life when safety functions are inactive Safety functions that are inactive or that have not been adjusted accordingly can cause operational faults on machines that could lead to serious injury or death. <ul style="list-style-type: none">• Observe the information in the appropriate product documentation before commissioning.• Carry out a safety inspection for functions relevant to safety on the entire system, including all safety-related components.• Ensure that the safety functions used in your drives and automation tasks are adjusted and activated through appropriate parameterizing.• Perform a function test.• Only put your plant into live operation once you have guaranteed that the functions relevant to safety are running correctly. |

Note
Important safety notices for safety functions
If you want to use safety functions, you must observe the safety notices in the safety manuals.

1.2 Safety instructions for electromagnetic fields (EMF)



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|  WARNING |
| Danger to life from electromagnetic fields Electromagnetic fields (EMF) are generated by the operation of electrical power equipment such as transformers, converters or motors. People with pacemakers or implants are at a special risk in the immediate vicinity of these devices/systems. <ul style="list-style-type: none">• Ensure that the persons involved are the necessary distance away (minimum 2 m). |

1.3 Handling electrostatic sensitive devices (ESD)

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



NOTICE

Damage through electric fields or electrostatic discharge

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

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

1.4 Industrial security

Note

Industrial security

Siemens provides automation and drive products with industrial security functions that support the secure operation of plants or machines. They are an important component in a holistic industrial security concept. With this in mind, our products undergo continuous development. We therefore recommend that you keep yourself informed with the latest information and updates of our product.

Information and newsletters can be found at:

<http://support.automation.siemens.com>

To ensure the secure operation of a plant or machine, it is also necessary to take suitable preventive action (e.g. cell protection concept) and to integrate the automation and drive components into a state-of-the-art holistic industrial security concept for the entire plant or machine. Any third-party products used must also be taken into account.

For more detailed information, go to:

<http://www.siemens.com/industrialsecurity>

 **WARNING**

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

Software manipulation (e.g. by viruses, Trojan horses, malware, worms) can cause unsafe operating states to develop in your installation which can lead to death, severe injuries and/or material damage.

- Keep the software up to date.
Information and newsletters can be found at:
<http://support.automation.siemens.com>
- Incorporate the automation and drive components into a state-of-the-art, integrated industrial security concept for the installation or machine.
For more detailed information, go to:
<http://www.siemens.com/industrialsecurity>
- Make sure that you include all installed products into the integrated industrial security concept.

1.5 Residual risks of power drive systems

The control and drive components of a drive system are approved for industrial and commercial use in industrial line supplies. Their use in public line supplies requires a different configuration and/or additional measures.

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

These components may only be handled by qualified and trained technical personnel who are knowledgeable and observe all of the safety instructions on the components and in the associated technical user documentation.

When assessing the machine's risk in accordance with the respective local regulations (e.g., EC Machinery Directive), the machine manufacturer 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 components during commissioning, operation, maintenance, and repairs caused by, for example:
 - Hardware defects and/or software errors in the sensors, controllers, actuators, and connection technology
 - Response times of the controller and drive
 - Operating and/or ambient conditions outside of the specification
 - Condensation / conductive contamination
 - Parameterization, programming, cabling, and installation errors
 - Use of radio devices / cellular phones in the immediate vicinity of the controller
 - External influences / damage

2. In the event of a fault, exceptionally high temperatures, including an open fire, as well as emissions of light, noise, particles, gases, etc. can occur inside and outside the inverter, e.g.:

- Component malfunctions
- Software errors
- Operating and/or ambient conditions outside of the specification
- External influences / damage

Inverters of the Open Type / IP20 degree of protection must be installed in a metal control cabinet (or protected by another equivalent measure) such that the contact with fire inside and outside the inverter is not possible.

3. Hazardous shock voltages caused by, for example:

- Component malfunctions
- Influence of electrostatic charging
- Induction of voltages in moving motors
- Operating and/or ambient conditions outside of 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.

Note

The components must be protected against conductive contamination (e.g. by installing them in a control cabinet with degree of protection IP54 according to IEC 60529 or NEMA 12).

Assuming that conductive contamination at the installation site can definitely be excluded, a lower degree of cabinet protection may be permitted.

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

System overview

2.1 Field of application

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

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

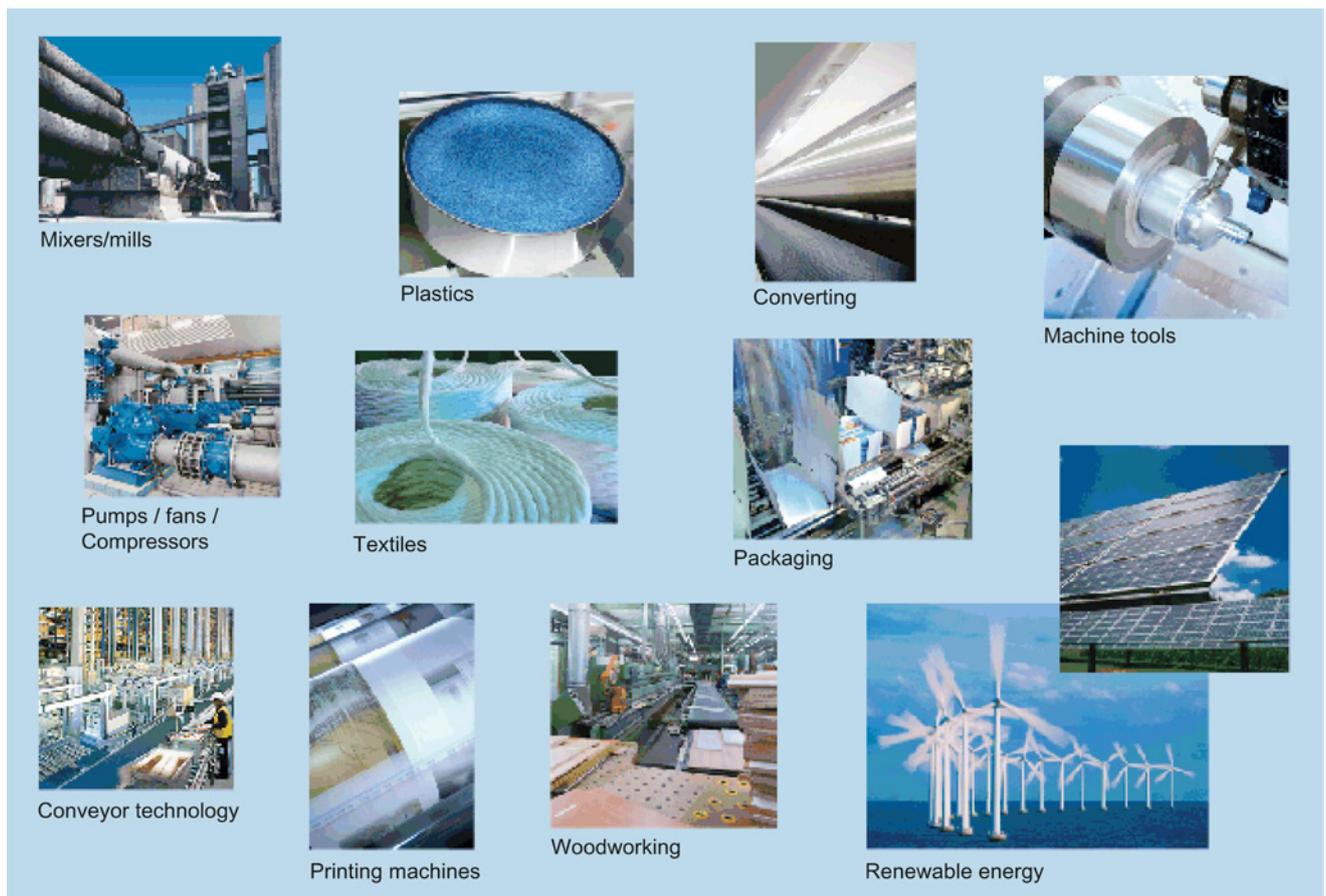


Figure 2-1 SINAMICS applications

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

- SINAMICS G is designed for standard applications with induction motors. These applications have less stringent requirements regarding the dynamic performance of the motor speed.
- SINAMICS S handles complex drive tasks with synchronous/induction motors and fulfills stringent requirements regarding:
 - the dynamic performance and accuracy
 - the integration of extensive technological functions in the drive control system
- SINAMICS DC MASTER is the DC drive belonging to the SINAMICS family. As a result of its standard expandability, it addresses both basic as well as demanding drive applications and in complementary markets.

2.2 Platform Concept and Totally Integrated Automation

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

Totally Integrated Automation (TIA) with SINAMICS S120

Apart from SIMATIC, SIMOTION and SINUMERIK, SINAMICS is one of the core components of TIA. The STARTER commissioning tool is an integral element of the TIA platform. It is thus possible to parameterize, program and commission all components in the automation system using a standardized engineering platform and without any gaps. The system-wide data management functions ensure consistent data and simplify archiving of the entire plant project.

SINAMICS S120 supports as standard PROFIBUS DP, the standard fieldbus for the TIA concept. It provides a high-performance, system-wide communication network which links all automation components:

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

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



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

2.3 Introduction

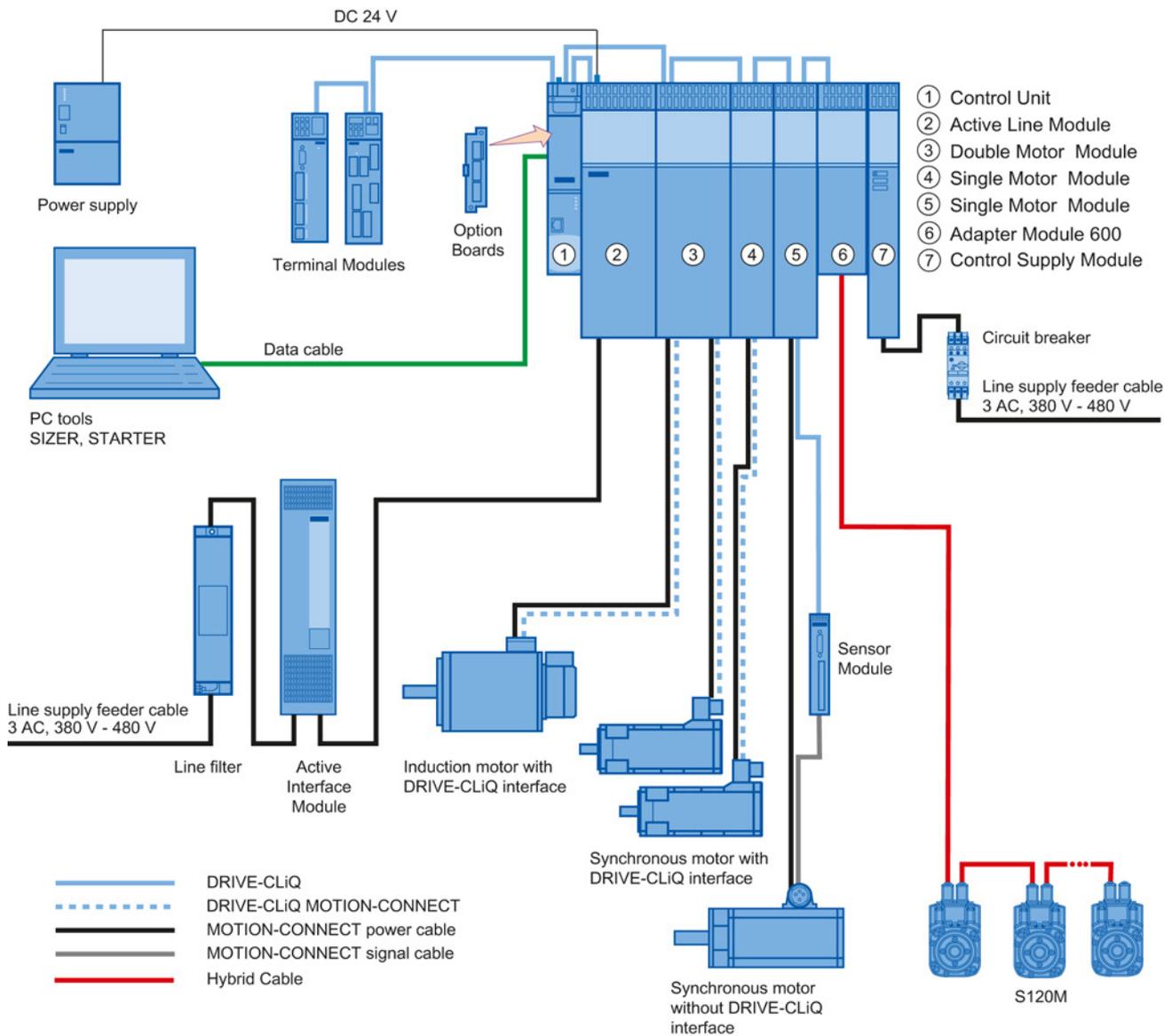


Figure 2-3 SINAMICS S120 system overview

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. Users can choose from many different harmonized components and functions to create a solution that best meets their requirements. SIZER, a high-performance engineering tool, makes it easier to choose and determine the optimum drive configuration.

SINAMICS S120 is supplemented by a wide range of motors. Whether torque, synchronous or induction motors, whether rotating or linear motors, all of these motors are optimally supported by SINAMICS S120.

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 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 in the STARTER commissioning tool using a mouse.

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

The SINAMICS S120 components, including the motors and encoders, are interconnected via a joint serial interface called DRIVE-CLiQ. 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. In the motors, for example, this data includes the parameters of the electric equivalent circuit diagram and characteristic values for the built-in motor encoder.

In addition to the technical data, the rating plate includes logistical data (manufacturer ID, order 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.

2.4 SINAMICS S120 components

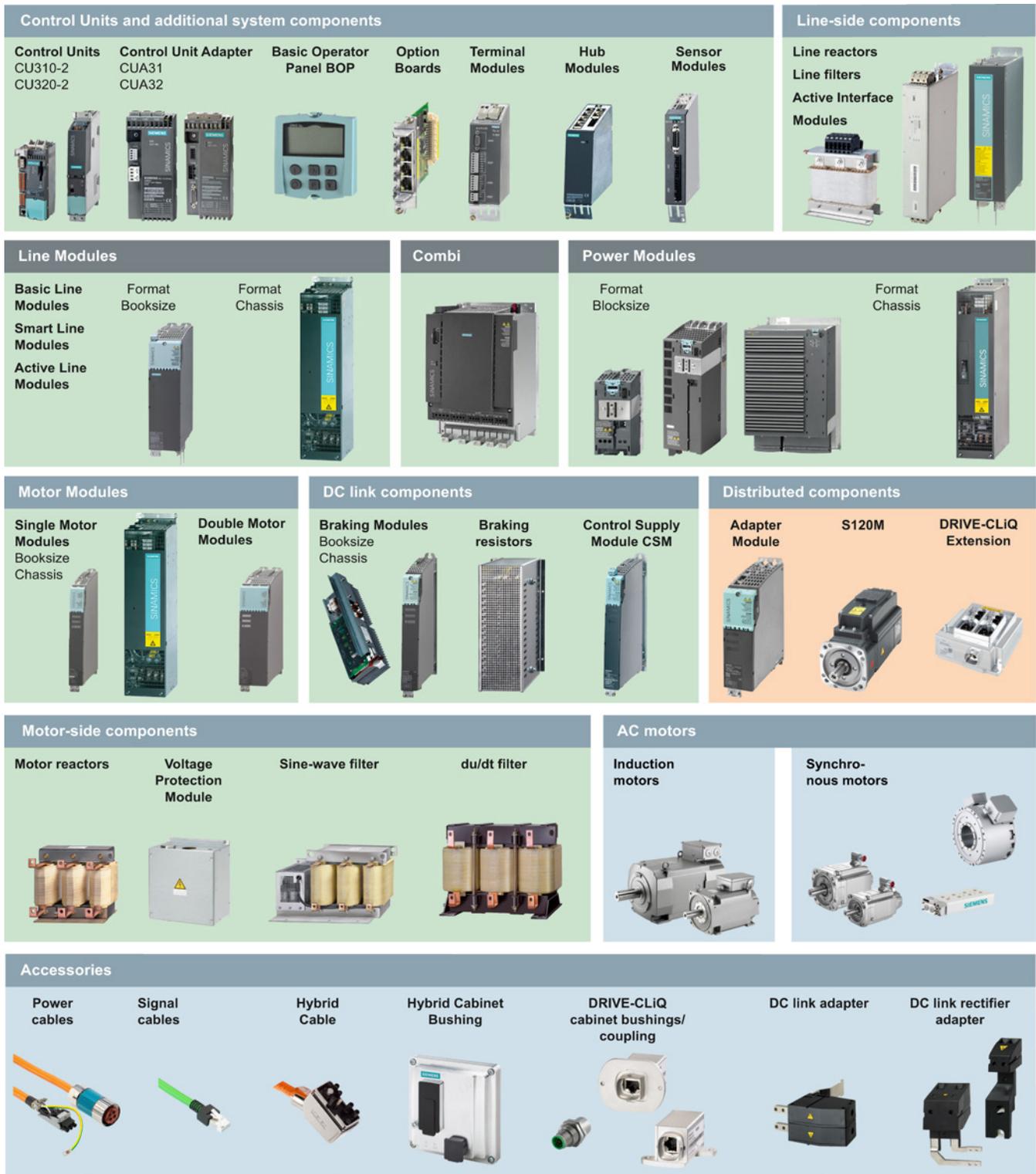


Figure 2-4 Overview of SINAMICS S120 components

System components

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

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

- Control Units that process the drive and technological functions across all axes
- Additional system components to expand the functionality and to 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

Installation location in the cabinet

The SINAMICS S120 components must always be mounted vertically in the cabinet. Other permissible installation locations are given in the descriptions for the individual components.

Booksize format

Booksize format units 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.

The booksize format offers various cooling options:

- Internal air cooling
- External air cooling
- Cold plate cooling
- Liquid Cooled

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 the following cooling options:

- Internal air cooling
- Cold plate cooling

2.4.1 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.

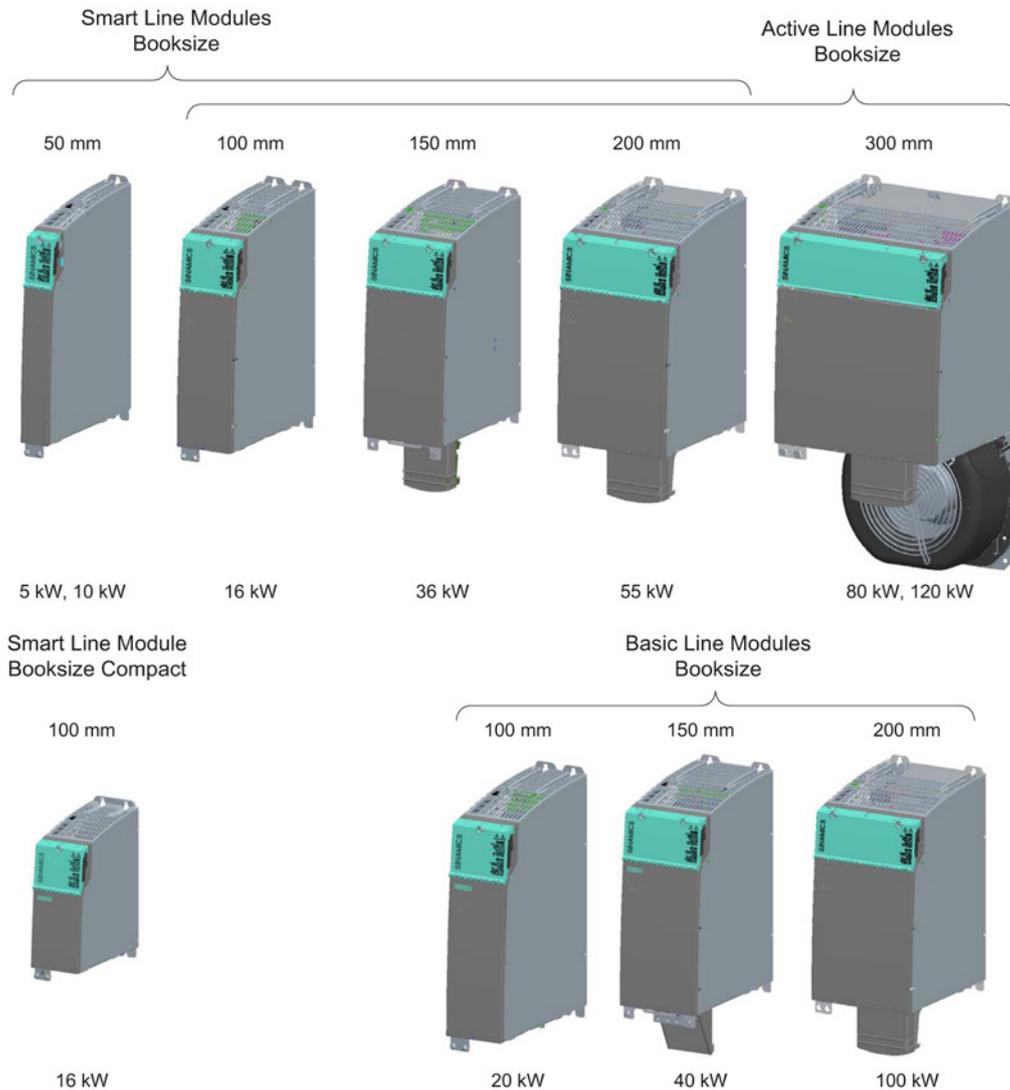


Figure 2-5 Overview of Line Modules

General characteristics of the Line Modules

- Supply voltage, 3 AC 380 V to 480 V $\pm 10\%$ (-15 % <1 min), 47 to 63 Hz
- Suitable for TN, TT, and IT supply systems
- Internal/external air cooling
- Liquid cooling and cold plate 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
- Regenerative feedback capability
- Sinusoidal line currents
- Electronic rating plate
- DRIVE-CLiQ interface for communicating with the Control Unit and/or other components in the drive line-up.
 - Integration in system diagnostics
- For all Active Line Modules with order numbers ending in 3 ((6SL...-...3)), outgoing circuit for DC link busbar possible on both sides.

Characteristics of the Smart Line Modules

- Unregulated DC link voltage
- Regenerative feedback capability
- Block-type network currents in feedback direction
- For 16 kW to 55 kW Smart Line Modules: outgoing circuit for DC link busbar possible on both sides.

Characteristics of the Basic Line Modules

- Unregulated DC link voltage
- No regenerative feedback capability
- For all Basic Line Modules, an outgoing circuit for DC link busbar is possible on both sides.

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:

$$\text{Number of pre-charging operations within 8 min} = \frac{\text{max. permissible DC link capacitance Line Module in } \mu\text{F}}{\Sigma\text{DC link capacitance of the configured drive group in } \mu\text{F}}$$

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

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

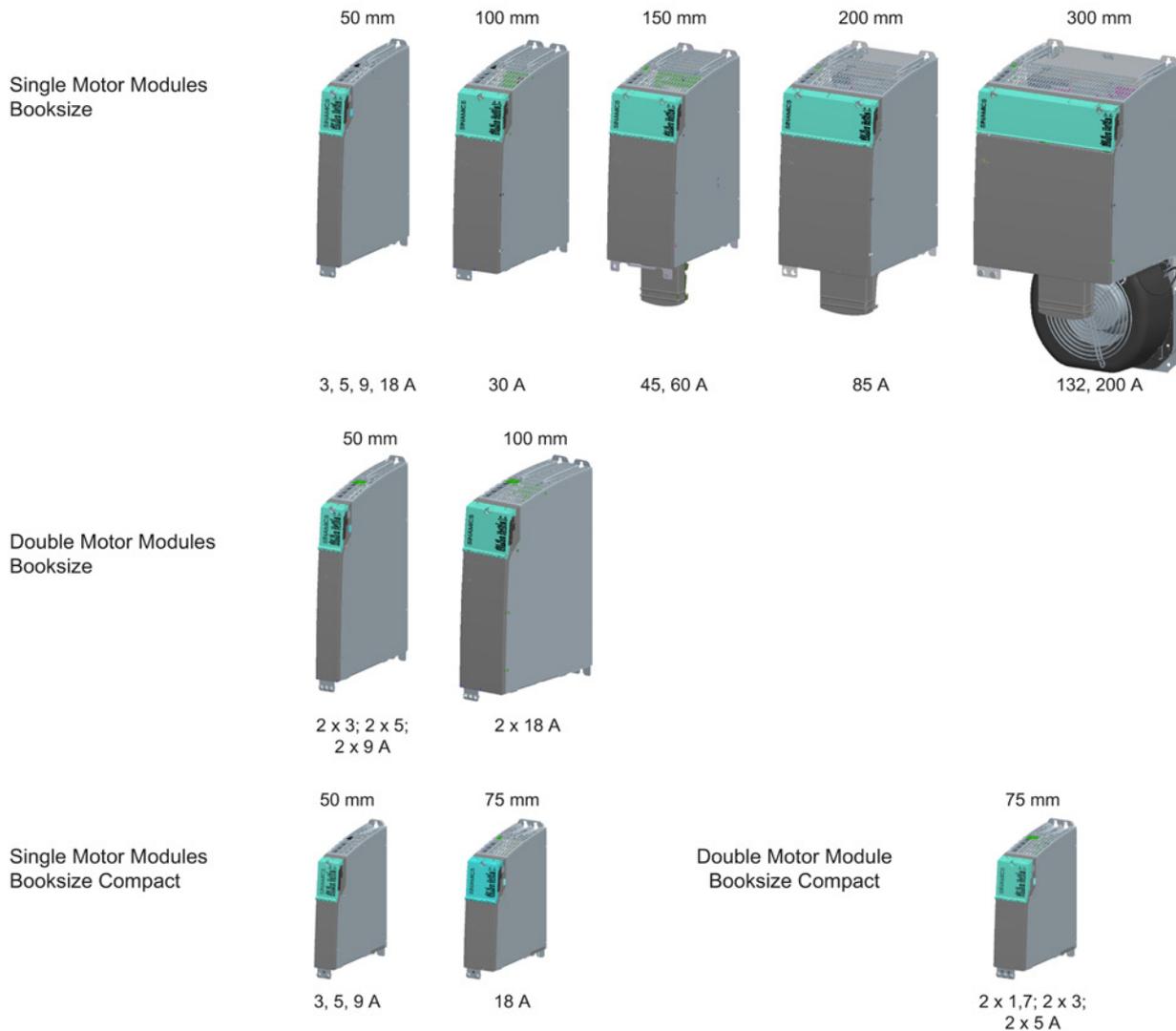


Figure 2-6 Overview of Motor Modules

Characteristics of the Motor Modules:

- Single type from 3 A to 200 A
- Double type from 1.7 A to 18 A
- Internal/external air cooling
- Liquid cooling and cold plate cooling
- Short-circuit/ground-fault-proof
- Integrated DC link and electronics current busbar connection
- Integrated "safety motor braking control"
- Electronic rating plate
- Operating status and error status via LEDs
- DRIVE-CLiQ interface for communication with the Control Unit and/or other components in the drive line-up.
 - Integration in system diagnostics

2.5 System data

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

Table 2- 1 Electrical data

| | |
|---|--|
| Line connection voltage | 3 AC 380 ... 480 V ± 10 % (-15 % < 1 min) |
| Line frequency | 47 ... 63 Hz |
| Electronics power supply | 24 V DC -15/+20 % ¹⁾ , Safety extra-low voltage (PELV or SELV) (see Chapter 24 V DC supply voltage (Page 719)) |
| Short-circuit current rating SCCR according to UL508C (up to 600 V) | <ul style="list-style-type: none"> • 1.1 ... 447 kW: 65 kA • 448 ... 671 kW: 84 kA • 672 ... 1193 kW: 170 kA • ≥ 1194 kW: 200 kA |
| Radio interference suppression acc. to EN 61800-3 | Category C2 (optional) for system versions conformant with documentation |
| Overvoltage category | III |
| Degree of contamination | 2 |

¹⁾ If a motor holding brake is used, restricted voltage tolerances (24 V ± 10 %) may have to be taken into account.

Table 2- 2 Modules

| | |
|--|---|
| Line Modules in the booksize format | |
| Max. permissible supply voltage | 3 AC 480 V |
| Rated pulse frequency (for Active Line Modules in booksize format only) | 8 kHz |
| Motor Modules in the booksize format | |
| DC link supply voltage | 510 ... 720 V DC |
| Rated pulse frequency | 4 kHz At higher pulse frequencies the corresponding characteristic for current derating must be taken into consideration |

2.5 System data

Table 2- 3 Environmental conditions

| | |
|--|--|
| Degree of protection | IPXXB acc. to EN 60529, open type according to UL508 |
| Protection class, line supply circuits Electronic circuits | I (with protective conductor connection) safety extra-low voltage PELV / SELV |
| Permissible cooling medium temperature (air) and installation altitude in operation | 0° C to +40° C and an installation altitude of up to 1000 m without derating, >40° C to +55° C see the characteristic for current derating. Installation altitude >1000 m up to 4000 m see characteristic for current derating or reduction of the ambient temperature by 3.5 °C per 500 m. |
| Chemically active substances | |
| Long-term storage in the transport packaging | Class 1C2 according to EN 60721-3-1 |
| Transport in the transport packaging | Class 2C2 according to EN 60721-3-2 |
| Operation | Class 3C2 according to EN 60721-3-3 |
| Biological environmental conditions | |
| Long-term storage in the transport packaging | Class 1B1 according to EN 60721-3-1 |
| Transport in the transport packaging | Class 2B1 according to EN 60721-3-2 |
| Operation | Class 3B1 according to EN 60721-3-3 |
| Vibratory load | |
| Long-term storage in the transport packaging | Class 1M2 according to EN 60721-3-1 |
| Transport in the transport packaging | Class 2M3 according to EN 60721-3-2 |
| Shock stressing | |
| Long-term storage in the transport packaging | Class 1M2 according to EN 60721-3-1 |
| Transport in the transport packaging | Class 2M3 according to EN 60721-3-2 |
| Operation Booksize format, Booksize Compact | Test values: 15 g / 11 ms |
| Climatic environmental conditions | |
| Long-term storage in the transport packaging | Class 1K4 acc. to EN 60721-3-1 Temperature: -25 ... +55 °C |
| Transport in the transport packaging | Class 2K4 acc. to EN 60721-3-2 Temperature: -40 ... +70 °C |
| Operation | Class 3K3 acc. to EN 60721-3-3 Temperature: 0 ... +40 °C Relative humidity: 5 ... 90 % Oil mist, salt mist, ice formation, condensation, dripping water, spraying water, splashing water and water jets are not permitted |

Table 2- 4 Certificates

| | |
|----------------------------|-------------------------------------|
| Declarations of Conformity | CE (Low-Voltage and EMC Directives) |
| Approvals | cULus cURus |

2.6 Derating as a function of the installation altitude and ambient temperature

The Booksize power units are designed for operation at an ambient temperature of 0° C to 40° C, installation altitudes up to 1000 m above sea level and the relevant specified pulse frequency.

Restrictions

The air pressure and therefore the air density reduce at higher altitudes above sea level. The same quantity of air does not have the same cooling effect and the air clearance between two electrical conductors can only insulate a lower voltage. Typical values for air pressure are summarized in the table below:

Table 2- 5 Air pressure for various installation altitudes

| | | | | | |
|--|-----|------|------|------|------|
| Installation altitude above sea level in [m] | 0 | 1000 | 2000 | 3000 | 4000 |
| Air pressure in mbar [kPa] | 100 | 90 | 80 | 70 | 62 |

Measures

- The output current must be reduced if the modules are operated at ambient temperatures above 40° C (see derating characteristics for the individual modules). The operation of the power units is not permitted above 55° C.
- The output current must be reduced if the modules are operated at installation altitudes above 1000 m (see derating characteristics for the individual modules). The operation of the power units is not permitted at altitudes above 4000 m.
- For an installation altitude above 2000 m, a TN or TT supply system with grounded neutral point is required (no grounded phase conductor). If the neutral point is not grounded, an isolating transformer must be connected upstream for which the secondary windings are grounded at the neutral point.

A reduction of the line supply voltage phase-phase is not necessary.

2.6 Derating as a function of the installation altitude and ambient temperature

Line connection and line-side power components

3.1 Introduction

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

- Disconnecter unit (for Active Line Modules, Basic Line Modules, Smart Line Modules)
- Overcurrent protection device (line fuse or circuit breaker)
- Line contactor (this is required for galvanic isolation)
- Line filter (optional)
- Line reactor (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
 - Wideband Line Filter for Active Line Modules
 - 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

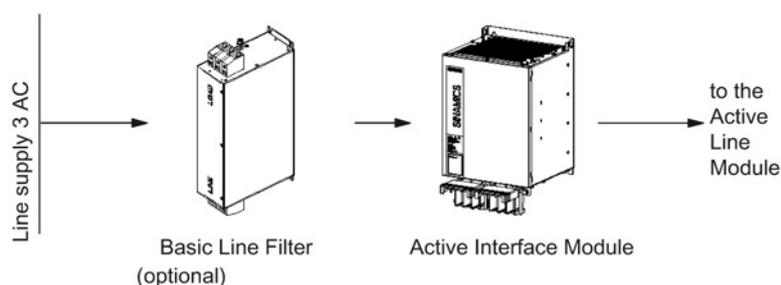


Figure 3-1 Overview diagram, line connection with Active Interface Module

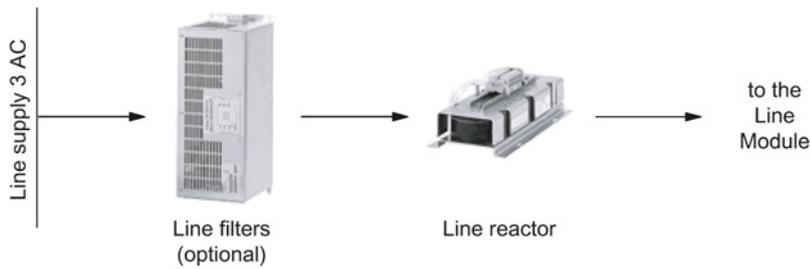


Figure 3-2 Overview diagram, line connection with line filter and line reactor

3.2 Information on the disconnecter unit

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

A disconnecter unit is required for disconnecting the drive line-up from the supply system correctly. The disconnecter unit of the machine's electrical equipment can be used for this purpose. The disconnecter unit must be selected in compliance with the requirements of the internationally binding standard relating to the electrical equipment of machines IEC 60204-1, Section 5.3. The relevant technical data and any other loads connected to the electrical equipment must be taken into account when making your selection.

NOTICE

Damage to the drive electronics when switching the line disconnection equipment under load

When switching the line disconnection equipment (type according to the recommended selection) 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 disconnecter unit must be selected from the manufacturer catalogs. Refer also to catalogs PM21 and NC61.

3.3 Overcurrent protection by means of line fuses and circuit breakers

Line fuses or circuit breakers must be used for cable protection/overcurrent protection. NH, D, and DO type fuses with a gL characteristic or suitable circuit breakers according to IEC 60947 can be used for this purpose.

Table 3- 1 Recommended line fuses and circuit breakers for Active Line Modules

| | 16 kW | 36 kW | 55 kW | 80 kW | 120 kW |
|-----------------------------|---------------|---------------|---------------|---------------|---------------|
| I _n fuse | 35 A | 80 A | 125 A | 160 A | 250 A |
| LV HRC line fuse | 3NA3 814 | 3NA3 824 | 3NA3 132 | 3NA3 136 | 3NA3 144 |
| Circuit breaker (IEC 60947) | 3RV1031-4FA10 | 3RV1041-4LA10 | 3VL2712-1DC33 | 3VL3720-1DC33 | 3VL3725-1DC36 |
| UL-application | | | | | |
| Rated current | 35 A | 80 A | 125 A | 175 A | 250 A |
| Line fuse ¹⁾ | AJT35 | AJT80 | AJT125 | AJT175 | AJT250 |
| Circuit breaker | 3VL1135-2KM30 | 3VL2108-2KN30 | 3VL2112-2KN30 | 3VL3117-2KN30 | 3VL3125-2KN30 |

¹⁾ Type AJT Class J, source: The Ferraz Shawmut company

Table 3- 2 Recommended line fuses and circuit breakers for Basic Line Modules

| | 20 kW | 40 kW | 100 kW |
|-----------------------------|---------------|---------------|---------------|
| I _n fuse | 63 A | 100 A | 250 A |
| LV HRC line fuse | 3NA3 822 | 3NA3 830 | 3NA3 144 |
| Circuit breaker (IEC 60947) | 3RV1041-4JA10 | 3VL2710-1DC33 | 3VL3725-1DC36 |
| UL-application | | | |
| Rated current | 60 A | 100 A | 250 A |
| Line fuse ¹⁾ | AJT60 | AJT100 | AJT250 |
| Circuit breaker | 3VL2106-2KN30 | 3VL2110-2KN30 | 3VL3125-2KN30 |

¹⁾ Type AJT Class J, source: The Ferraz Shawmut company

3.3 Overcurrent protection by means of line fuses and circuit breakers

Table 3- 3 Recommended line fuses and circuit breakers for Smart Line Modules booksize and booksize compact format

| | 5 kW | 10 kW | 16 kW | 36 kW | 55 kW |
|-----------------------------|---------------|---------------|---------------|---------------|---------------|
| I _n fuse | 16 A | 35 A | 35 A | 80 A | 125 A |
| LV HRC line fuse | 3NA3 805 | 3NA3 814 | 3NA3 814 | 3NA3 824 | 3NA3 132 |
| Circuit breaker (IEC 60947) | 3RV2021-4BA10 | 3RV1031-4FA10 | 3RV1031-4FA10 | 3RV1041-4LA10 | 3VL2712-1DC33 |
| UL-application | | | | | |
| Rated current | 17.5 A | 35 A | 35 A | 80 A | 125 A |
| Line fuse ¹⁾ | AJT17-1/2 | AJT35 | AJT35 | AJT80 | AJT125 |
| Rated current | 20 A | 35 A | 35 A | 80 A | 125 A |
| Circuit breaker | 3VL1102-2KM30 | 3VL1135-2KM30 | 3VL1135-2KM30 | 3VL2108-2KN30 | 3VL2112-2KN30 |

1) Type AJT Class J, source: The Ferraz Shawmut company

If used in conjunction with a residual-current monitor (RCM), circuit breakers providing an "undervoltage tripping" option must be used, with the following suffixes added to the order numbers:

...-2AJ0 for 380 VAC - 415 VAC

...-2AK0 for 440 VAC - 480 VAC



| |
|--|
|  WARNING |
| <p>Danger to life through electric shock as well as fire hazard due to overcurrent protective devices that trip too late</p> <p>Overcurrent protective devices that do not trip or trip too late can cause an electric shock or fire.</p> <ul style="list-style-type: none"> To protect personnel and for fire protection purposes, at the infeed point, the short-circuit rating and loop impedance must correspond to the specifications in the documentation in order for the installed overcurrent protection devices to trip within the specified time. In addition to suitable overcurrent protection devices, in TT line systems use ground-fault circuit interrupters (residual current devices - RCD); from an infeed power of 55 kW or for plants and systems extending over a wide area, in addition also use differential current monitoring devices (residual current monitors - RCM). |

Note

The devices can be connected to supply systems up to 480 VAC, which can feed a maximum of 65 kA symmetrical ("prospective current" according to EN 60269-1).

3.4 Line supply connection via residual-current devices

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

Residual-current devices 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 prescribed period if a fault occurs.

3.4.1 Residual-current operated circuit breakers (RCD)

Residual-current operated circuit breakers (RCD) can be used in addition to the overcurrent protection devices provided. They are the preferred solution for operation on TT systems.

Note

Operation on residual-current operated circuit breakers is currently only possible with Line Modules up to and including 36 kW.

Observe the following conditions when using residual-current operated circuit breakers:

- Only use a delayed tripping, selective AC/DC-sensitive residual-current operated circuit breaker, type B.
- 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.
- If you connect residual-current devices in series, then they must all have the same characteristics.
- Ensure that the switching elements (disconnecter unit, contactors) for connecting and disconnecting the drive system have max. 35 ms delay time between the closing/opening of the individual main contacts.

3.4 Line supply connection via residual-current devices

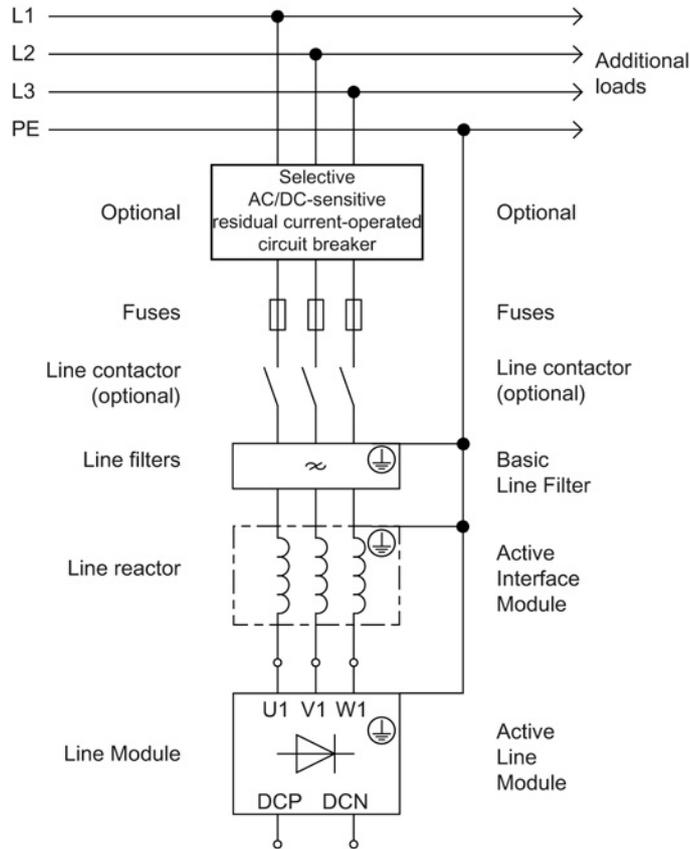


Figure 3-3 Connecting a residual-current operated circuit breaker

Recommendation

SIEMENS selectively switching AC/DC-sensitive residual-current circuit-breakers according to EN 61009-1 of the 5SM series (e.g. 5SM3646-5 or 5SM3646-5+5SW3300 with an auxiliary disconnector (1 NC contact / 1 NO contact) for a rated current of 63 A and rated fault current of 0.3 A (see Catalog "BETA Modular Installation Devices - ET B1").

Note

AC or pulse-sensitive RCCBs are not suitable.

3.4.2 Residual-current monitors (RCM)

Used in conjunction with appropriate circuit breakers, residual-current monitors (RCMs) provide fire and system protection even at high levels of grounding resistance (in TT systems, for example). When operating on TT systems for infeed powers exceeding 55 kW, and with systems that extend across a large area, residual current monitors must be installed in addition to the appropriate circuit breakers.

| |
|---|
|  WARNING |
| Fire hazard and danger of a plant standstill when residual currents occur |
| Residual currents in the power supply that are not detected can cause fires and failures in the entire system. |
| <ul style="list-style-type: none">• Always install residual-current monitors in conjunction with suitable circuit breakers. |

Note the points below when using residual-current monitors:

- Only use AC/DC-sensitive RCM type B devices with delayed tripping that guarantee reliable tripping even for smoothed DC residual currents.
- Connect parts of the power drive system and the machine that can be touched to the system's protective conductor.
- Do **not** route the protective conductor through the measuring current transformer, as this would cancel its protection function.

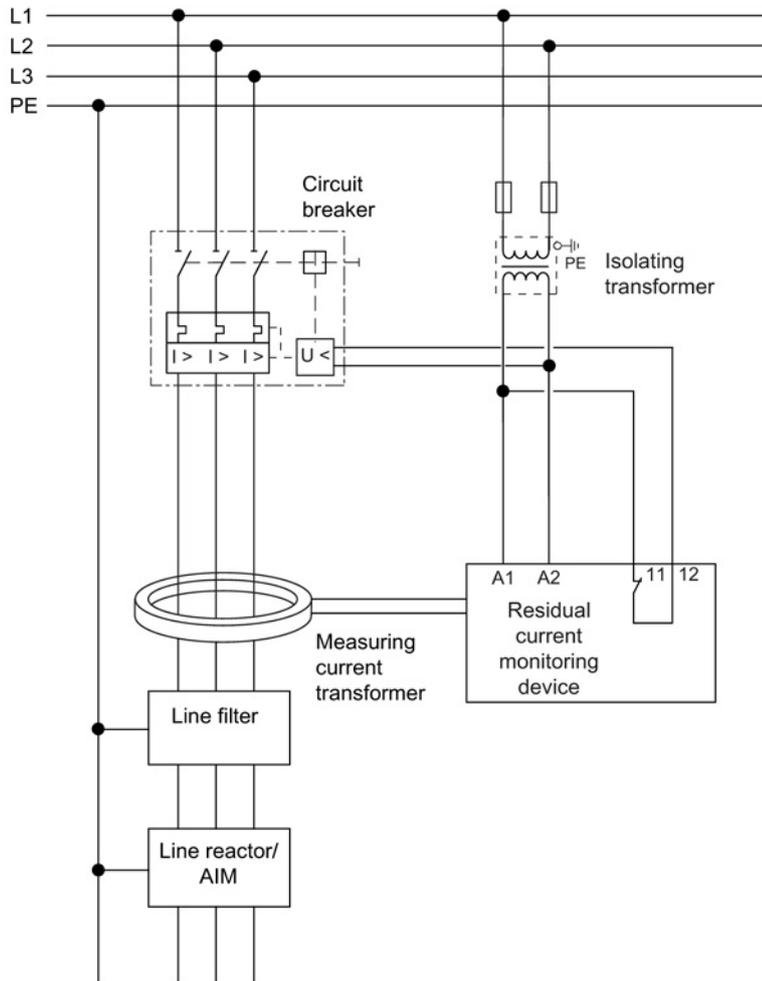


Figure 3-4 Connecting a differential current monitoring device

Recommendation

- AC/DC-sensitive differential current monitoring device RCMA423-D-2, Bender company, the 230 V supply voltage is tapped using an upstream isolating transformer
- Measuring current transformer W120AB (120 mm) or W210AB (210 mm), Bender company
- Circuit breaker with thermal overload release, short-circuit release, and undervoltage release

3.5 Overvoltage protection

To protect the units against line-side surge voltages, you are advised to install an overvoltage protection device directly at the infeed point (upstream of the main switch). To comply with the requirements of CSA C22.2 No. 14-05, a type VZCA or VZCA2 surge arrester is absolutely mandatory. The Raycap company has suitable surge arresters.

3.6 Line contactors

A line contactor is required if the drive line-up needs to be electrically isolated from the power supply.

The characteristic values in the technical data apply when the line contactor is selected. The cable routing, the bundling factor, and the factor for the ambient temperature according to EN 60204-1 must be taken into account when dimensioning the various cables.

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

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

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.

3.7 Line filters

3.7.1 Safety instructions for line filters



| |
|---|
|  WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed |
| If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. |
| <ul style="list-style-type: none">• Adhere to the fundamental safety instructions.• When assessing the risk, take into account residual risks. |

| |
|--|
|  DANGER |
| Danger to life due to electric shock in the event of missing touch protection |
| Death or serious injury can result when live parts are touched. |
| <ul style="list-style-type: none">• For the line filter, use touch protection according to IPXXA or corresponding to the local installation regulations. |

| |
|---|
|  CAUTION |
| Risk of burns due to high surface temperatures of the line filter |
| The line filter can become very hot. You can get seriously burnt when touching the surface. |
| <ul style="list-style-type: none">• Mount the line filter 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 line filter. |

| |
|---|
| NOTICE |
| Line filter damage by connecting to impermissible line supplies |
| Line filters are only suitable for direct connection to TN line supplies. Damage will occur if the line filter is connected to other line supplies. |
| <ul style="list-style-type: none">• Only connect the line filter when TN line supplies are being used. |

| |
|---|
| NOTICE |
| Line filter damage due to interchanged connections |
| The line filter will be damaged if the input and output connections are interchanged. |
| <ul style="list-style-type: none">• 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). |

 **WARNING****Fire hazard due to overheating because of inadequate ventilation clearances**

Inadequate ventilation clearances cause overheating with a risk for personnel through smoke development and fire. Damage can still occur on the line filter.

- For this reason, maintain the 100 mm clearances above and below the line filter.

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 lined reactors and line filter (Page 136).

NOTICE**Destruction or damage to additional loads as a result of undesirable line harmonics**

Line harmonics can occur if line filters that differ from those listed in this Manual are used. These can disturb or damage other loads connected to the line supply.

- Only use line filters that are listed in this Manual.

NOTICE**Destruction or damage to components by incorrectly connecting the line filter**

When incorrectly connecting the line filter, these components can be destroyed or damaged.

- Only connect the Line Module to the SINAMICS line filter via the associated line reactor.
- Connect additional loads upstream of the SINAMICS line filter (if required, via a separate line filter).

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.

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).

You must use shielded connecting 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.

Do not route any cables near the line filter. If this cannot be avoided, observe a minimum distance of 200 mm.

3.7.2 Overview of line filters

In conjunction with line reactors and a consistent 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. A separate line filter must be used for SINAMICS S120 drive line-ups according to the following table.

| |
|---|
| 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. |
| <ul style="list-style-type: none">• 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. Filter series B84144A*R120 (EPCOS) is recommended. |

| |
|--|
| 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, overvoltages, and irreparable damage to motors or other equipment. |
| <ul style="list-style-type: none">• 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. |

Line filter ranges that are coordinated with the different power stages are available for the SINAMICS S120 drive system. These line filters differ with regard to the frequency range in which they reduce the conducted emissions.

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

Table 3- 4 Overview of line filters

| | Order number |
|--|--------------------|
| Basic Line Filter for Active Line Modules with line reactor | |
| 16 kW | 6SL3000-0BE21-6DAx |
| 36 kW | 6SL3000-0BE23-6DA1 |
| 55 kW | 6SL3000-0BE25-5DAx |
| Basic Line Filter for Active Line Modules with Active Interface Modules | |
| 16 kW | 6SL3000-0BE21-6DAx |
| 36 kW | 6SL3000-0BE23-6DA1 |
| 55 kW | 6SL3000-0BE25-5DAx |
| 80 kW | 6SL3000-0BE28-0DAx |
| 120 kW | 6SL3000-0BE31-2DAx |
| Wideband Line Filter for Active Line Modules | |
| 16 kW | 6SL3000-0BE21-6AAx |
| 36 kW | 6SL3000-0BE23-6AAx |
| 55 kW | 6SL3000-0BE25-5AAx |
| 80 kW | 6SL3000-0BE28-0AAx |
| 120 kW | 6SL3000-0BE31-2AAx |
| Basic Line Filter for Basic Line Modules | |
| 20 kW | 6SL3000-0BE21-6DAx |
| 40 kW | 6SL3000-0BE23-6DA1 |
| 100 kW | 6SL3000-0BE31-2DAx |
| Basic Line Filter for Smart Line Modules | |
| 5 kW | 6SL3000-0HE15-0AAx |
| 10 kW | 6SL3000-0HE21-0AAx |
| 16 kW | 6SL3000-0BE21-6DAx |
| 36 kW | 6SL3000-0BE23-6DA1 |
| 55 kW | 6SL3000-0BE25-5DAx |

3.7.3 Basic Line Filters for Active Line Modules

3.7.3.1 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. Assuming that an EMC-compatible design is used, the interference voltage categories listed below will be achieved (see also Chapter Possible line reactor and line filter combinations (Page 136)).

Basic Line Filter for Active Line Modules and line reactor

- EN 61800-3 category C2 up to a total cable length¹⁾ of 150 m (shielded) for 16 kW, 36 kW and 55 kW components
- EN 61800-3 category C3 up to a total cable length¹⁾ of 150 m (shielded) for 16 kW, 36 kW and 55 kW components

Basic Line Filters for Active Line Modules and Active Interface Modules

- EN 61800-3 category C2 up to a total cable length¹⁾ of 350 m (shielded) for 16 kW, 36 kW, 55 kW, 80 kW, and 120 kW components
- EN 61800-3 category C3, up to a total cable length¹⁾ of
 - 630 m (shielded) for 16 kW and 36 kW components
 - 1000 m (shielded) for 55 kW, 80 kW and 120 kW components

Note

Use of unshielded cables for short distances

Shielded cables should always be laid 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 the Basic Line Filters to TN systems; otherwise an isolating transformer will be required
- Number of axes ≤ 12 when using a Basic Line Filter with an Active Line Module and a line reactor

Note

Basic Line Filters for Active Line Modules with line reactor must be approved (incurs a fee).

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

3.7.3.2 Interface description

Overview

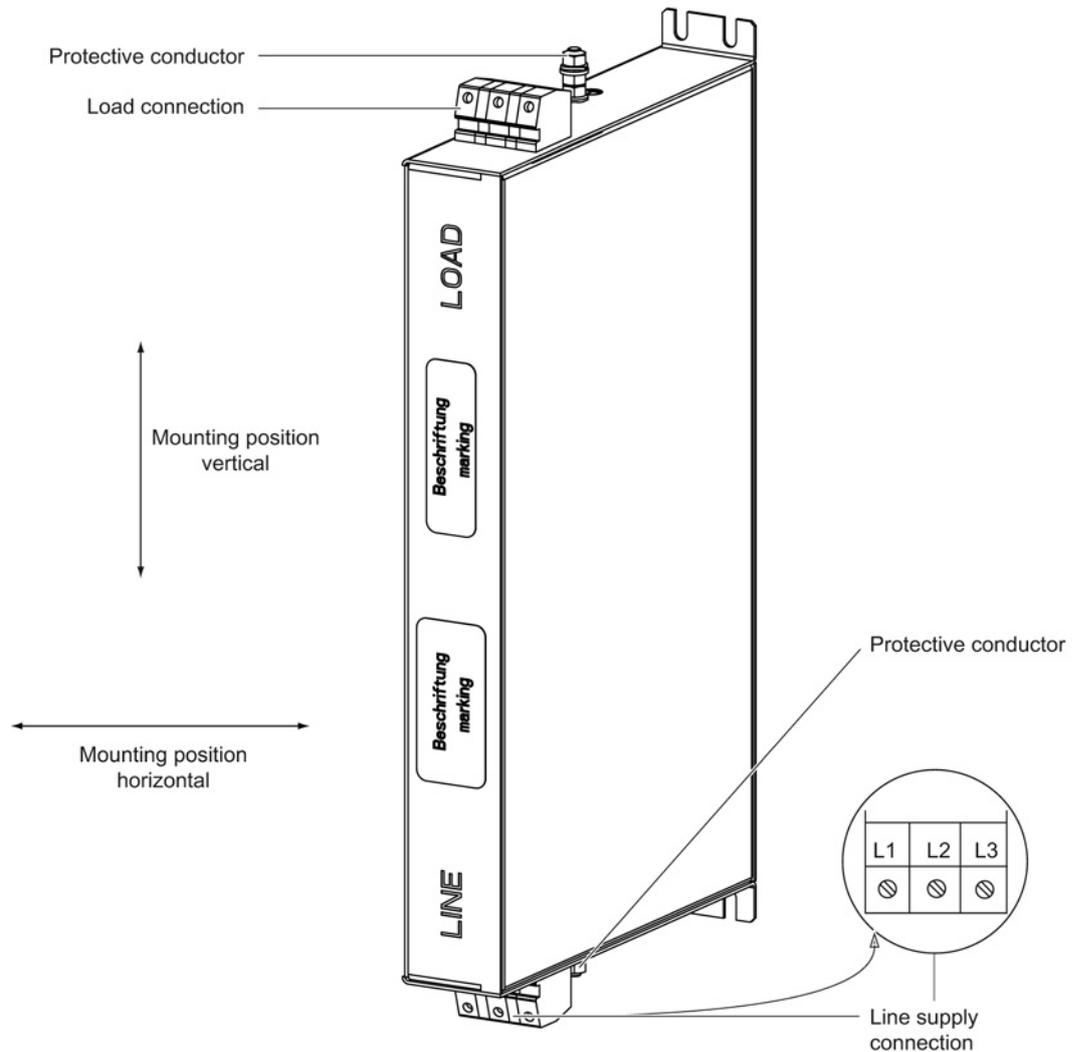


Figure 3-5 Interface overview, Basic Line Filter for Active Line Modules (example: 16 kW)

Either the upper or lower PE screw can be used for the connection. One of the screws remains unused. "Looping-through" the protective connection to the line reactor is not permissible.

3.7 Line filters

Line/load connection

Table 3- 5 Line and load connection, Basic Line Filter for Active Line Modules

| | 6SL3000-0BE21-6DAx | 6SL3000-0BE23-6DA1 | 6SL3000-0BE25-5DAx | 6SL3000-0BE28-0DAx | 6SL3000-0BE31-2DAx |
|--------------------------------------|---|---|---|--|--------------------|
| Rated power [kW] | 16 | 36 | 55 | 80 | 120 |
| Line supply connection L1, L2, L3 | Screw terminals: 10 mm ² 3 pole 1.5 ... 1.8 Nm | Screw terminals: 35 mm ² , 3 pole 3.2 ... 3.7 Nm | Screw terminals: 50 mm ² , 3 pole 6 ... 8 Nm | Screw terminals: 95 mm ² , 3-pole 15 ... 20 Nm | |
| Load connection L1', L2', L3', | | | | | |
| PE connection ¹⁾ | Terminal studs M6 / 6 Nm | Terminal studs M6 / 6 Nm | Terminal studs M8 / 8 Nm | Terminal studs M10 / 10 Nm | |

¹⁾ For ring cable lugs without insulation

3.7.3.3 Dimension drawings

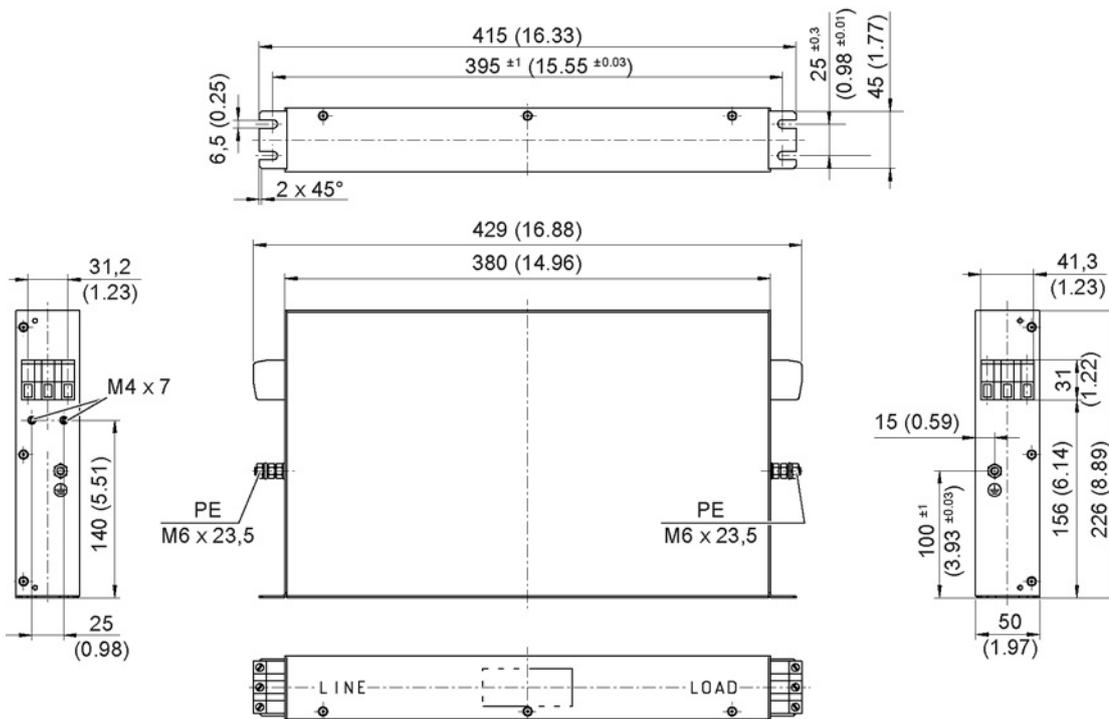


Figure 3-6 Dimension drawing of the Basic Line Filter for Active Line Modules 16 kW, all data in mm and (inches)

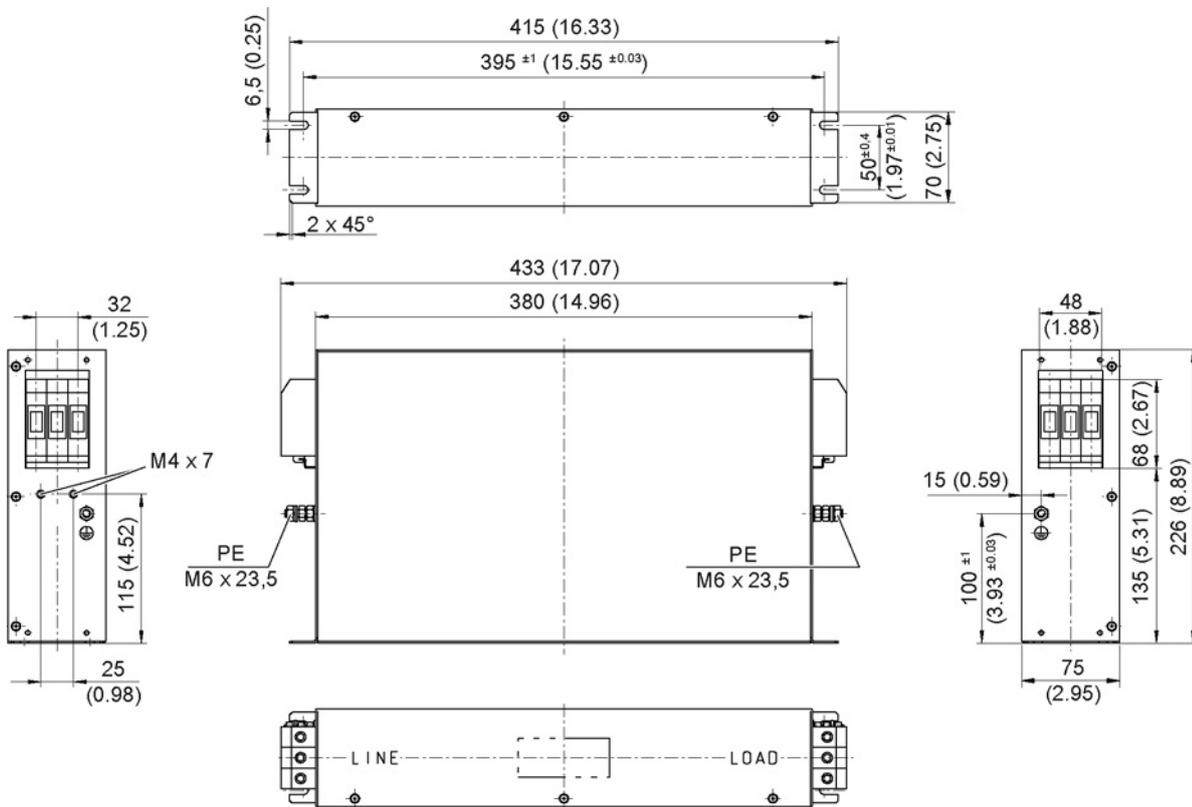


Figure 3-7 Dimension drawing of Basic Line Filter for Active Line Modules 36 kW, all data in mm and (inches)

3.7 Line filters

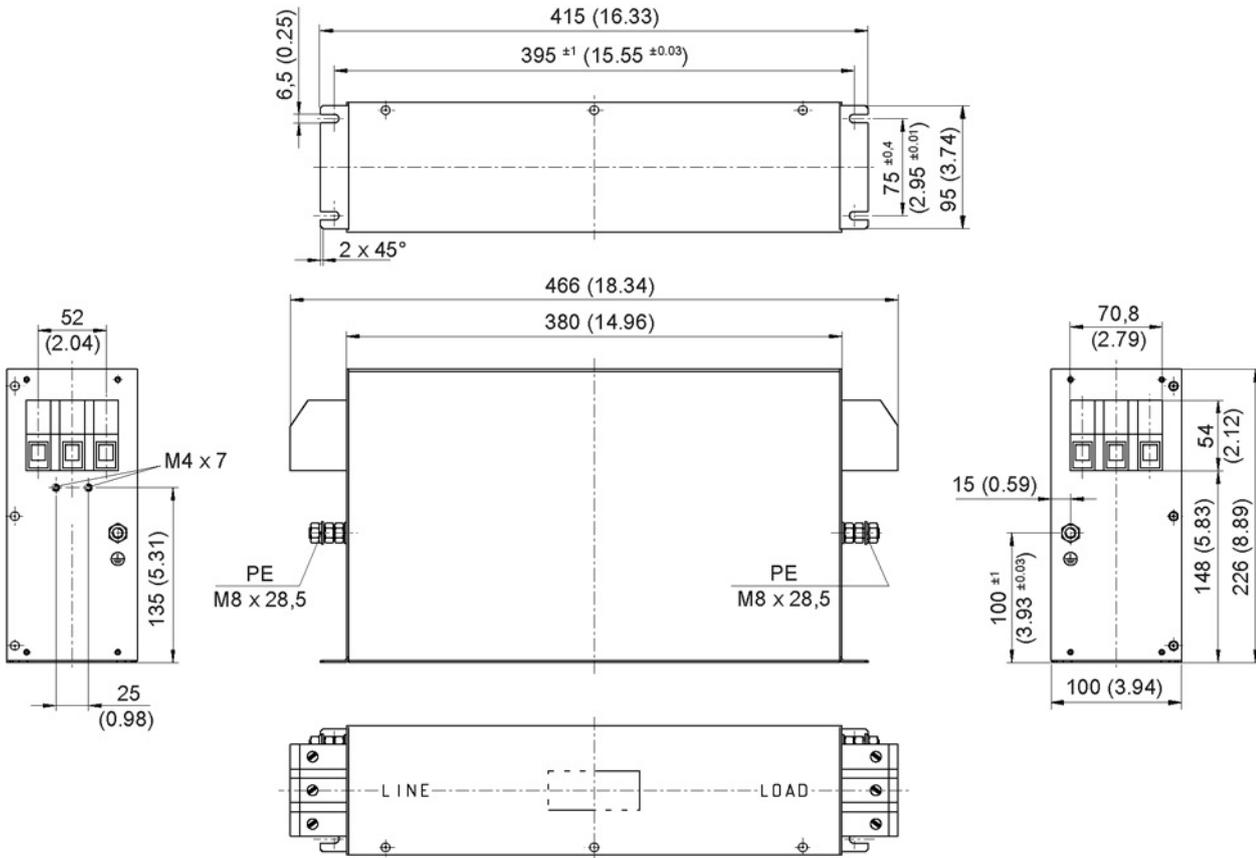


Figure 3-8 Dimension drawing of Basic Line Filter for Active Line Modules 55 kW, all data in mm and (inches)

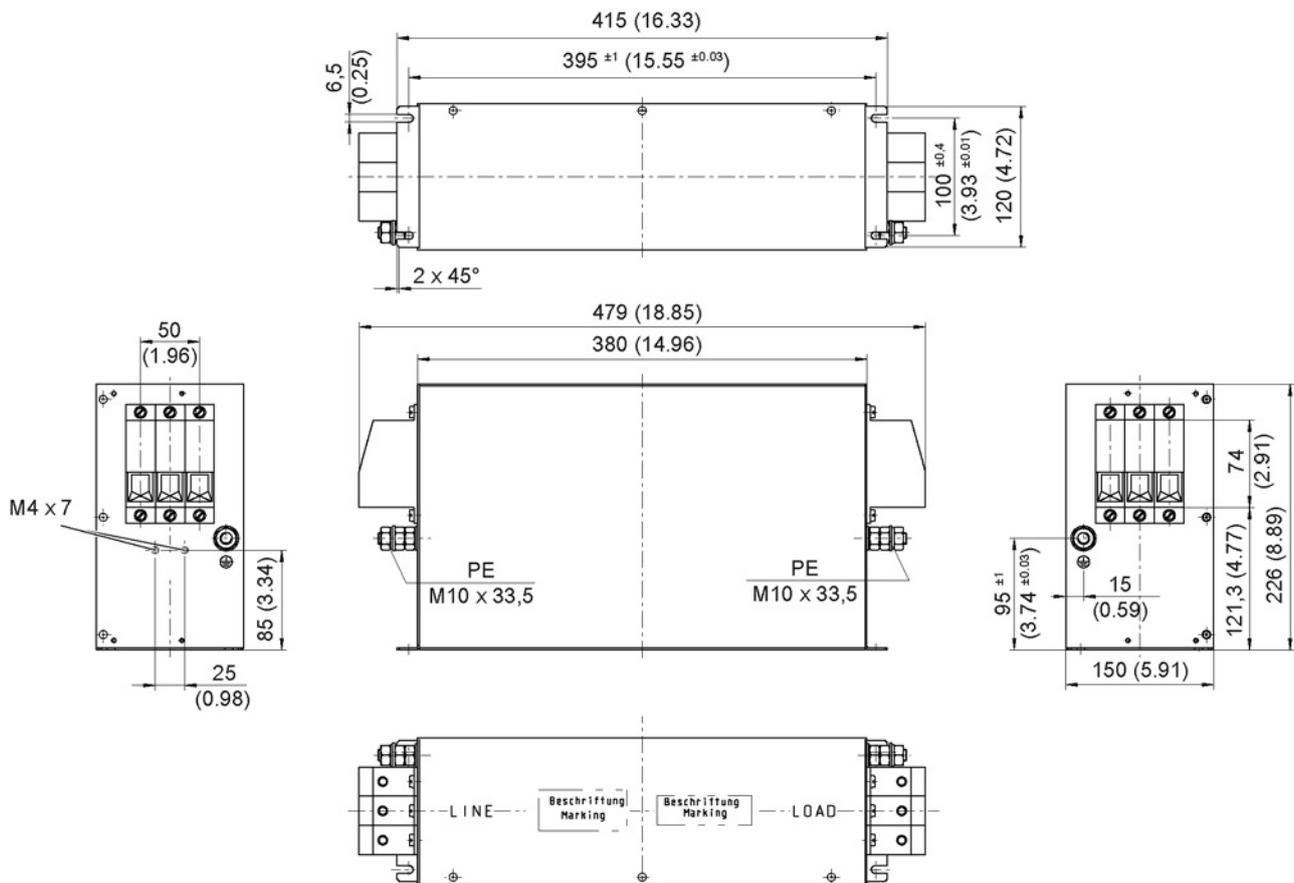


Figure 3-9 Dimension drawing of Basic Line Filter for Active Line Modules 80 kW and 120 kW, all dimensions in mm and (inches)

3.7.3.4 Technical data

Table 3- 6 Technical data of the Basic Line Filter for Active Line Modules with Active Interface Module

| | 6SL3000- | 0BE21-6DAx | 0BE23-6DA1 | 0BE25-5DAx | 0BE28-0DAx | 0BE31-2DAx |
|---|-----------------------|---|------------|------------|------------|------------|
| 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 781)) | W | 16 | 26 | 43 | 56 | 73 |
| Weight | kg | 5 | 7,5 | 11,5 | 17,5 | 18,5 |

3.7.4 Wideband Line Filter for Active Line Modules

3.7.4.1 Description

Wideband Line Filters for Active Line Modules 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. Wideband Line Filters can also effectively limit low-frequency line harmonics of 2 kHz and above; this protects additional loads connected to the same supply system against disturbances and damage. As a result, these line filters have an extended function range, with which a certain degree of independence can be achieved regarding the machine installation location with generally unknown line supply parameters (e.g. line impedance).

Wideband Line Filters must always be used in conjunction with a line reactor for Active Line Modules and not with an Active Interface Module.

Wideband Line Filters for Active Line Modules can achieve the interference voltage categories listed below, when used in conjunction with the associated line reactor and an EMC-compliant design (see also Chapter Combination options: Line reactors and line filters (Page 136)).

- EN 61800-3 category C3 up to a total cable length¹⁾ of 350 m (shielded) for 16 kW, 36 kW, 55 kW, 80 kW, and 120 kW components
- EN 61800-3 category C2 up to a total cable length¹⁾ of 350 m (shielded) for 16 kW, 36 kW, 55 kW, 80 kW, and 120 kW components

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

3.7.4.2 Interface description

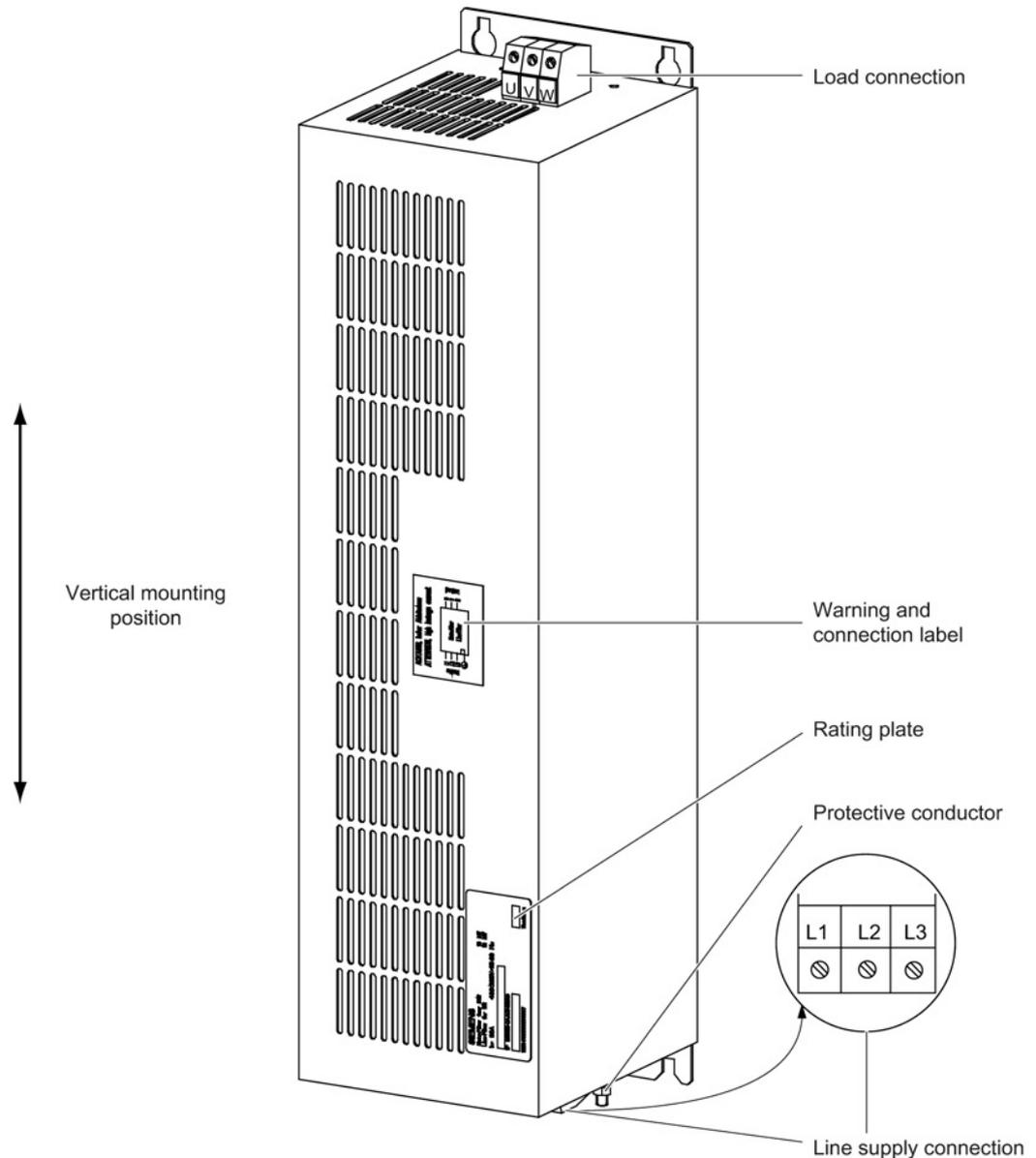


Figure 3-10 Interface overview, Wideband Line Filter for Active Line Modules (example: 16 kW)

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

If the component is not operated in a vertical position with the line supply terminals at the bottom, then the component can be damaged.

- Only operate the components in a vertical position with the line terminals at the bottom.

Line/load connection

Table 3- 7 Line and load connection, Wideband Line Filter for Active Line Modules

| | 6SL3000-0BE21-6AAx | 6SL3000-0BE23-6AAx | 6SL3000-0BE25-5AAx | 6SL3000-0BE28-0AAx | 6SL3000-0BE31-2AAx |
|--------------------------------------|--|---|------------------------------|---|---|
| Rated power [kW] | 16 | 36 | 55 | 80 | 120 |
| Line supply connection L1, L2, L3 | Screw terminals: 10 mm ² 3 pole M4 / 1.5 ... 1.8 Nm | Screw terminals 50 mm ² 3-pole M6 / 6 ... 8 Nm | | Screw terminals 95 mm ² 3-pole M8 / 15 ... 20 Nm | Connecting lugs d = 11 mm M10 / 25 Nm Note: No touch protection (IP00 acc. to EN 60529) |
| Load connection U, V, W | | | | | |
| PE connection ¹⁾ | Terminal studs M5 / 3 Nm | Terminal studs M8 / 13 Nm | Terminal studs M8 / 13 Nm | Terminal studs M8 / 13 Nm | Terminal studs M10 / 25 Nm |

¹⁾ For ring cable lugs without insulation

3.7.4.3 Dimension drawings

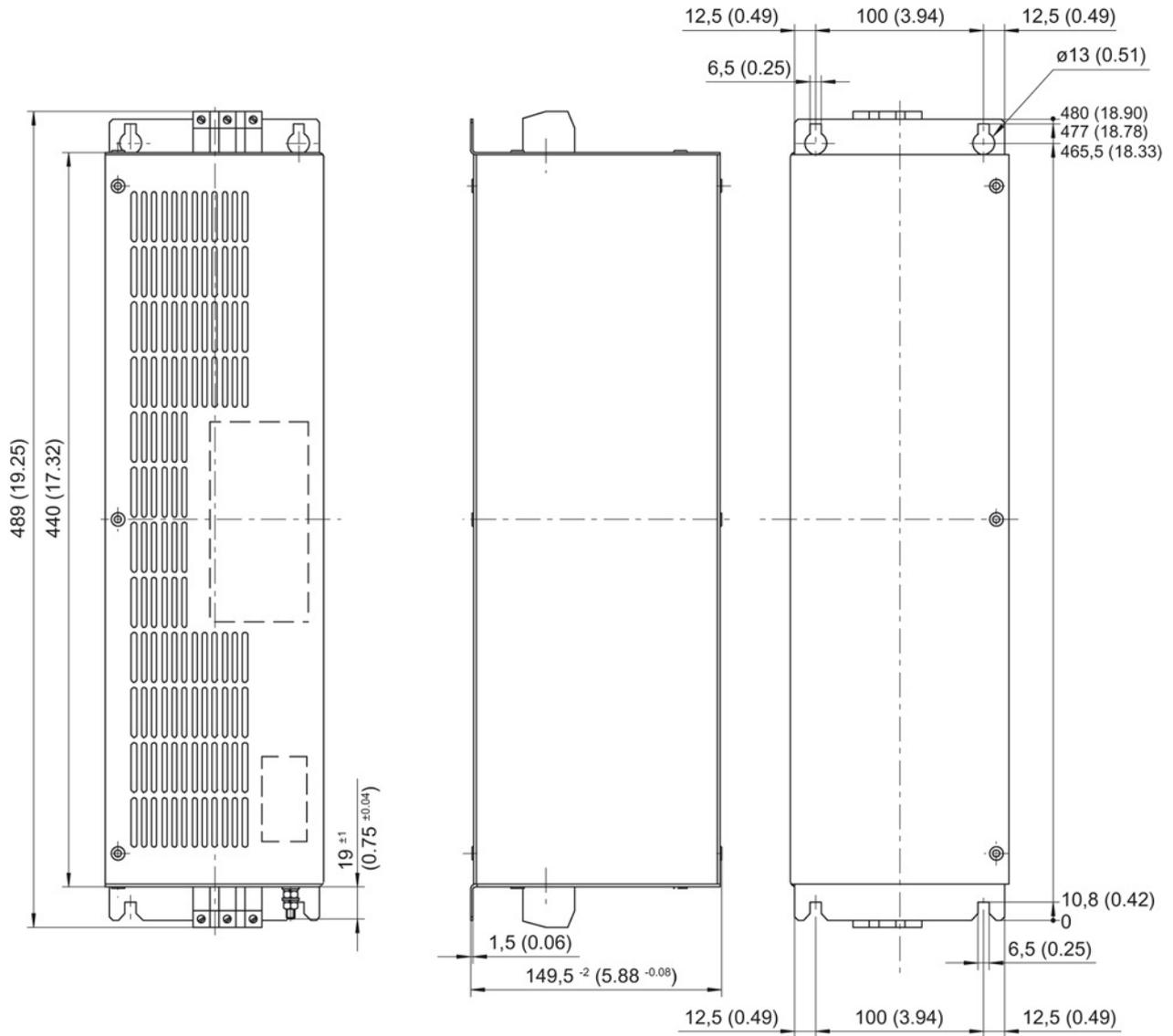


Figure 3-11 Dimension drawing of Wideband Line Filter 16 kW for Active Lines Modules, all dimensions in mm and (inches)

3.7 Line filters

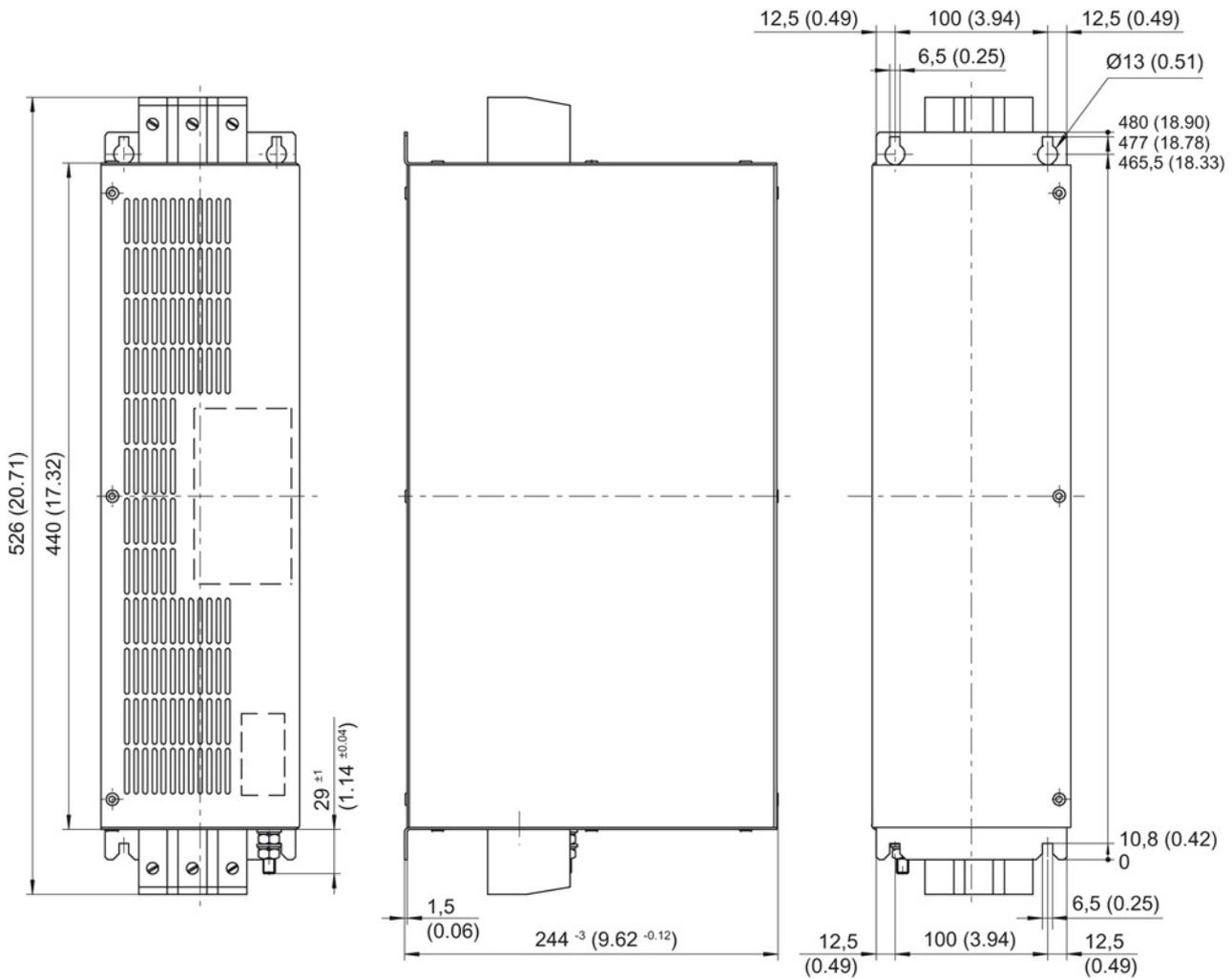


Figure 3-12 Dimension drawing of Wideband Line Filter 36 kW for Active Lines Modules, all dimensions in mm and (inches)

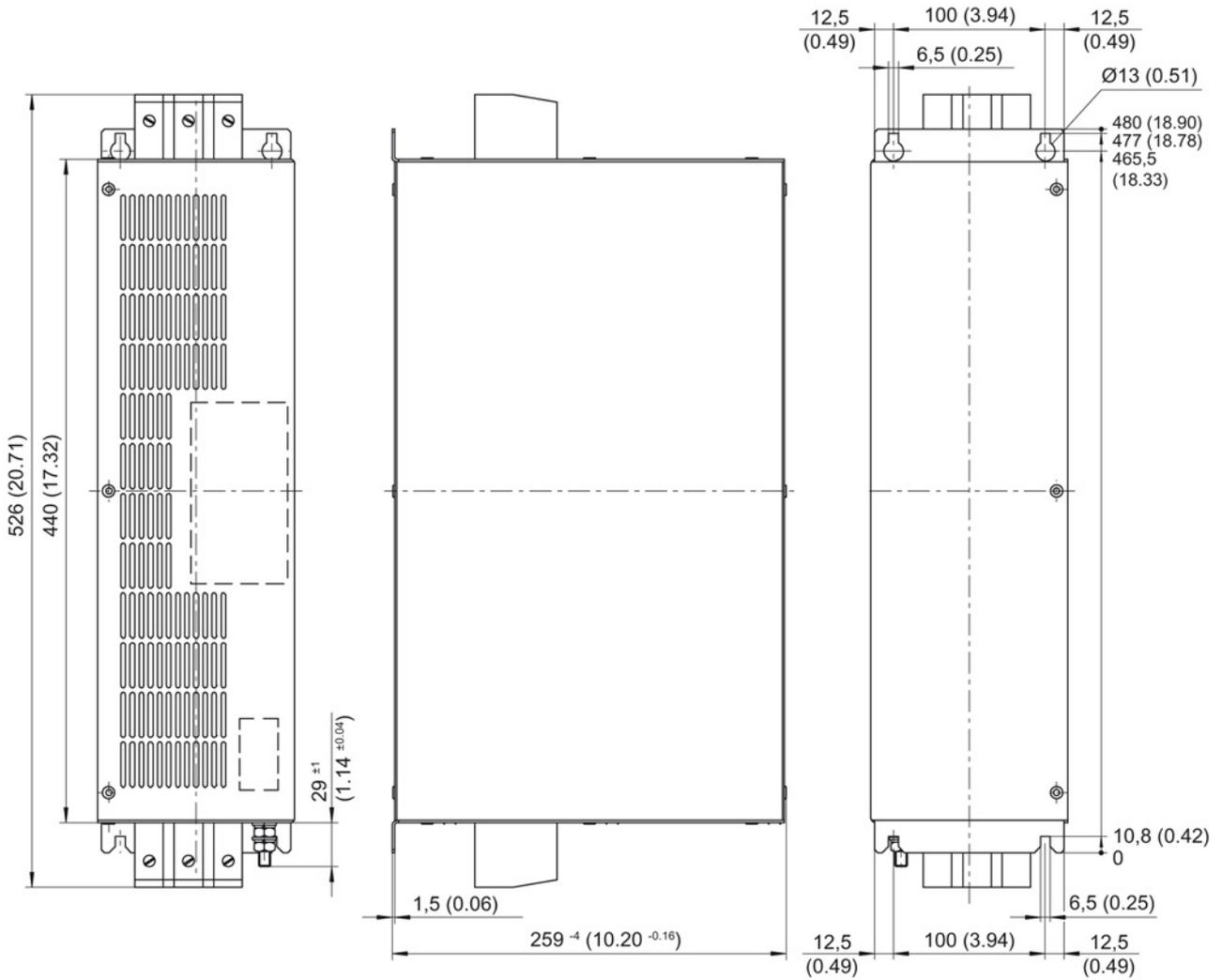


Figure 3-13 Dimension drawing of Wideband Line Filter 55 kW for Active Lines Modules, all dimensions in mm and (inches)

3.7 Line filters

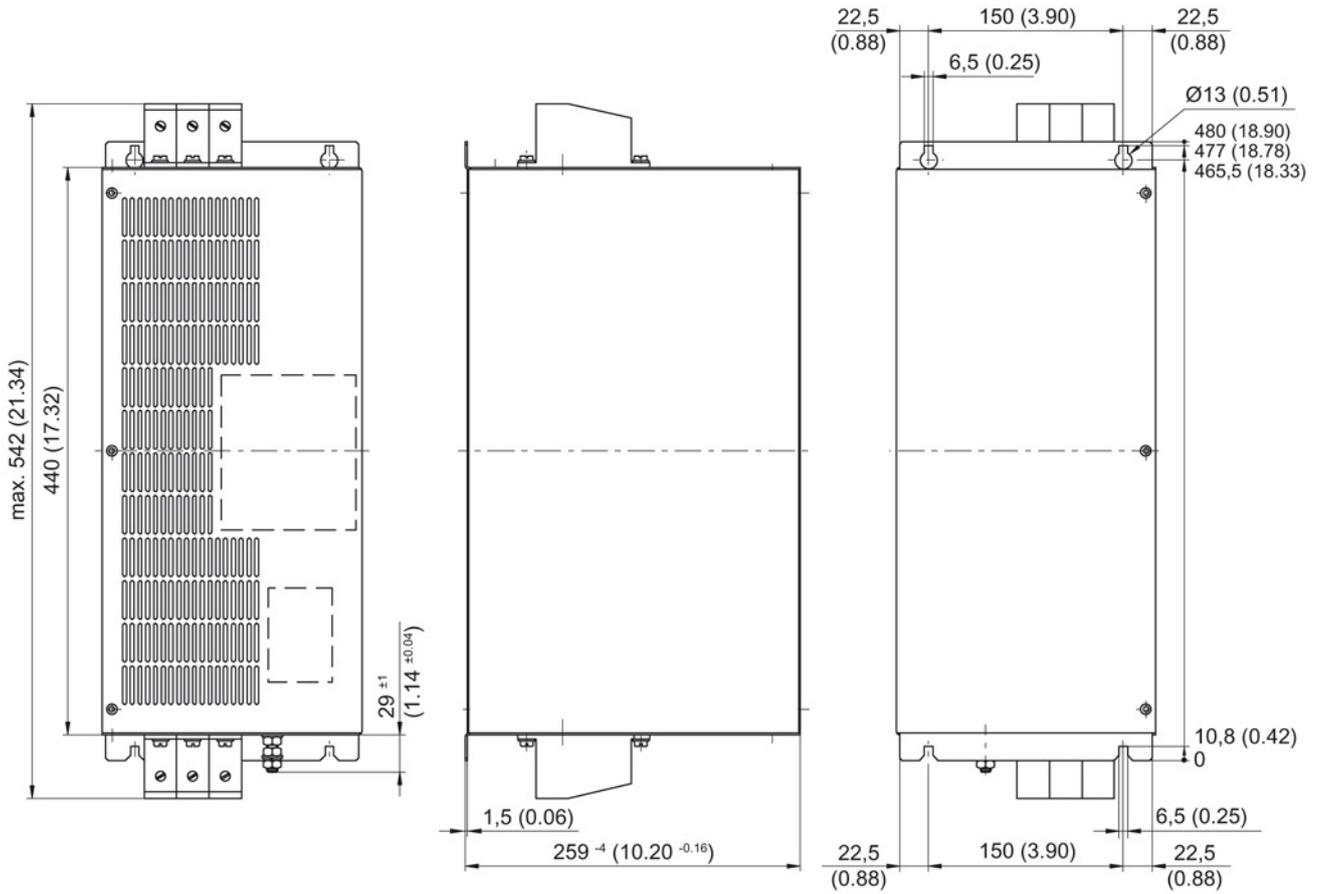


Figure 3-14 Dimension drawing of Wideband Line Filter 80 kW for Active Lines Modules, all dimensions in mm and (inches)

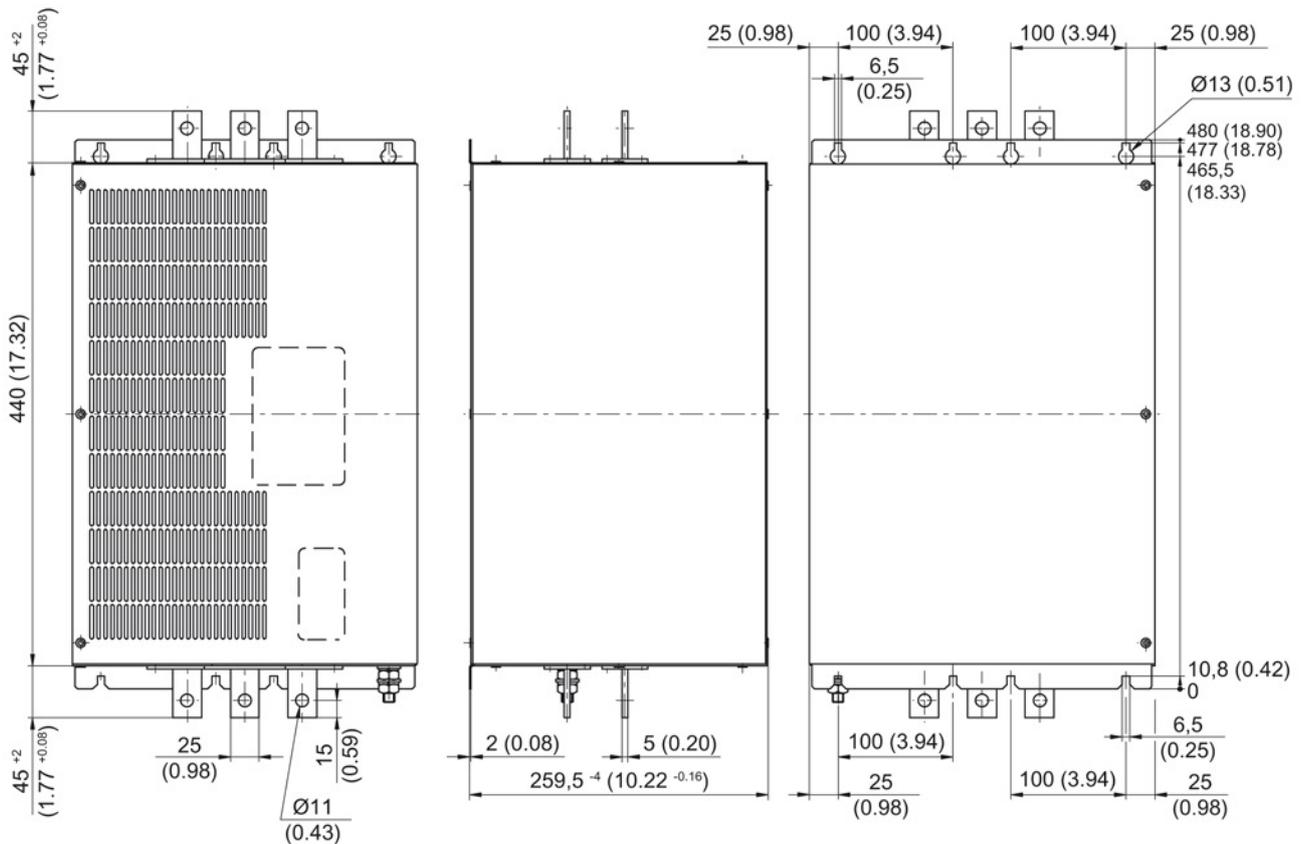


Figure 3-15 Dimension drawing of Wideband Line Filter 120 kW for Active Lines Modules, all dimensions in mm and (inches)

3.7.4.4 Technical data

Table 3- 8 Technical data: Wideband Line Filter for Active Line Modules

| | 6SL3000 unit | 0BE21-6AAx | 0BE23-6AAx | 0BE25-5AAx | 0BE28-0AAx | 0BE31-2AAx |
|--|-----------------------|---|------------|------------|------------|------------|
| Rated power | kW | 16 | 36 | 55 | 80 | 120 |
| Supply voltages: 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} | 30 | 67 | 103 | 150 | 225 |
| Power loss (see power loss tables (Page 781)) | W | 70 | 90 | 110 | 150 | 200 |
| Weight | kg | 8,5 | 14,5 | 15,5 | 26 | 34,5 |

3.7.5 Basic Line Filter for Basic Line Modules

3.7.5.1 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 achieve the interference voltage categories listed below, when used in conjunction with the associated line reactors and an EMC-compliant design (see also Chapter Possible line reactor and line filter combinations (Page 136)).

- EN 61800-3 category C2 up to a total cable length¹⁾ of 350 m (shielded) for 20 kW, 40 kW and 100 kW components
- EN 61800-3 category C3 up to a total cable length¹⁾ of 630 m (shielded) for 20 kW, 40 kW and 100 kW components

Basic Line Filters are only suitable for direct use on TN systems. 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

3.7.5.2 Interface description

Overview

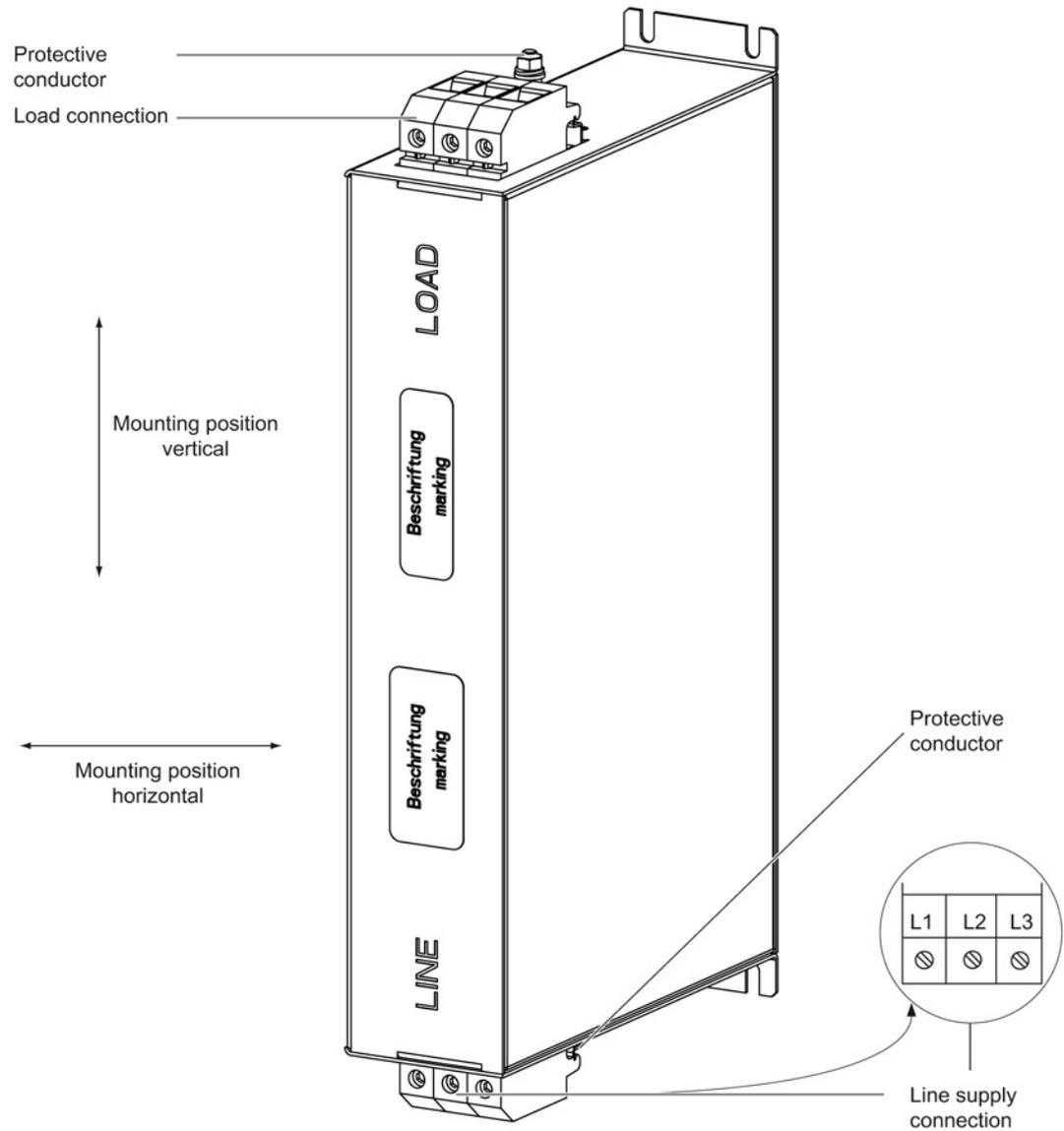


Figure 3-16 Interface overview, Basic Line Filter for Basic Line Modules (example: 40 kW)

Either the upper or lower PE screw can be used for the connection. One of the screws remains unused. "Looping-through" the protective connection to the line reactor is not permissible.

3.7 Line filters

Line/load connection

Table 3- 9 Line and load connection, Basic Line Filter for Basic Line Modules

| | 6SL3000-0BE21-6DAx | 6SL3000-0BE23-6DA1 | 6SL3000-0BE31-2DAx |
|--------------------------------------|--|--|--|
| Rated power [kW] | 20 | 40 | 100 |
| Line supply connection L1, L2, L3 | Screw terminals 10 mm ² , 3 pole 1.5 ... 1.8 Nm | Screw terminals 35 mm ² , 3 pole 3.2 ... 3.7 Nm | Screw terminals 95 mm ² , 3-pole 15 ... 20 Nm |
| Load connection L1', L2', L3' | | | |
| PE connection ¹⁾ | Terminal studs M6 / 6 Nm | Terminal studs M6 / 6 Nm | Terminal studs M10 / 10 Nm |

¹⁾ For ring cable lugs without insulation

3.7.5.3 Dimension drawings

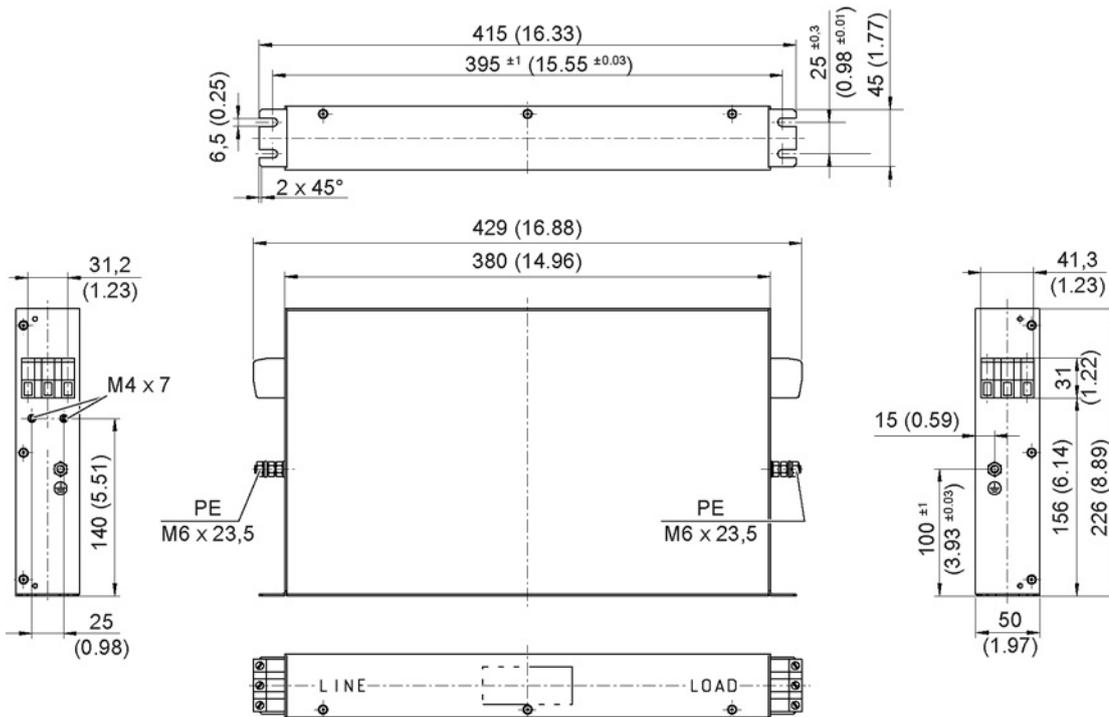


Figure 3-17 Dimension drawing of Basic Line Filter for Basic Line Modules 20 kW, all data in mm and (inches)

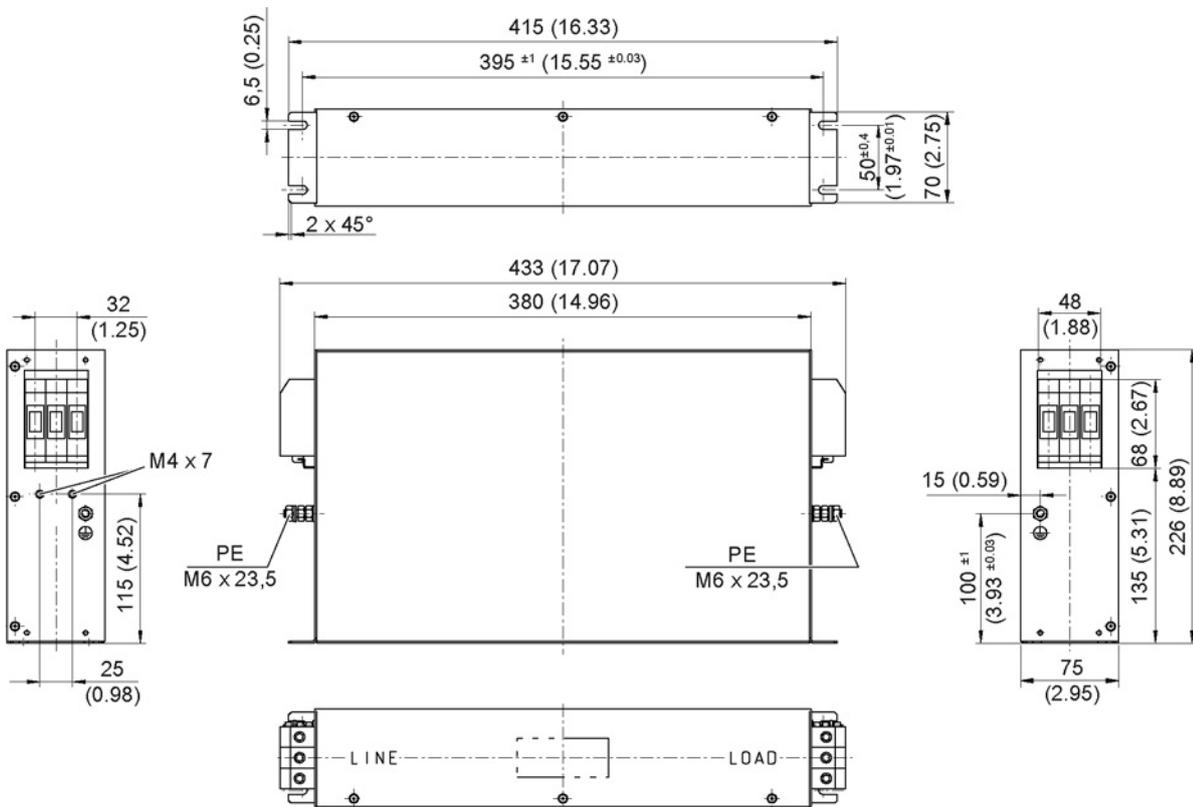


Figure 3-18 Dimension drawing of Basic Line Filter for Basic Line Modules 40 kW, all data in mm and (inches)

3.7 Line filters

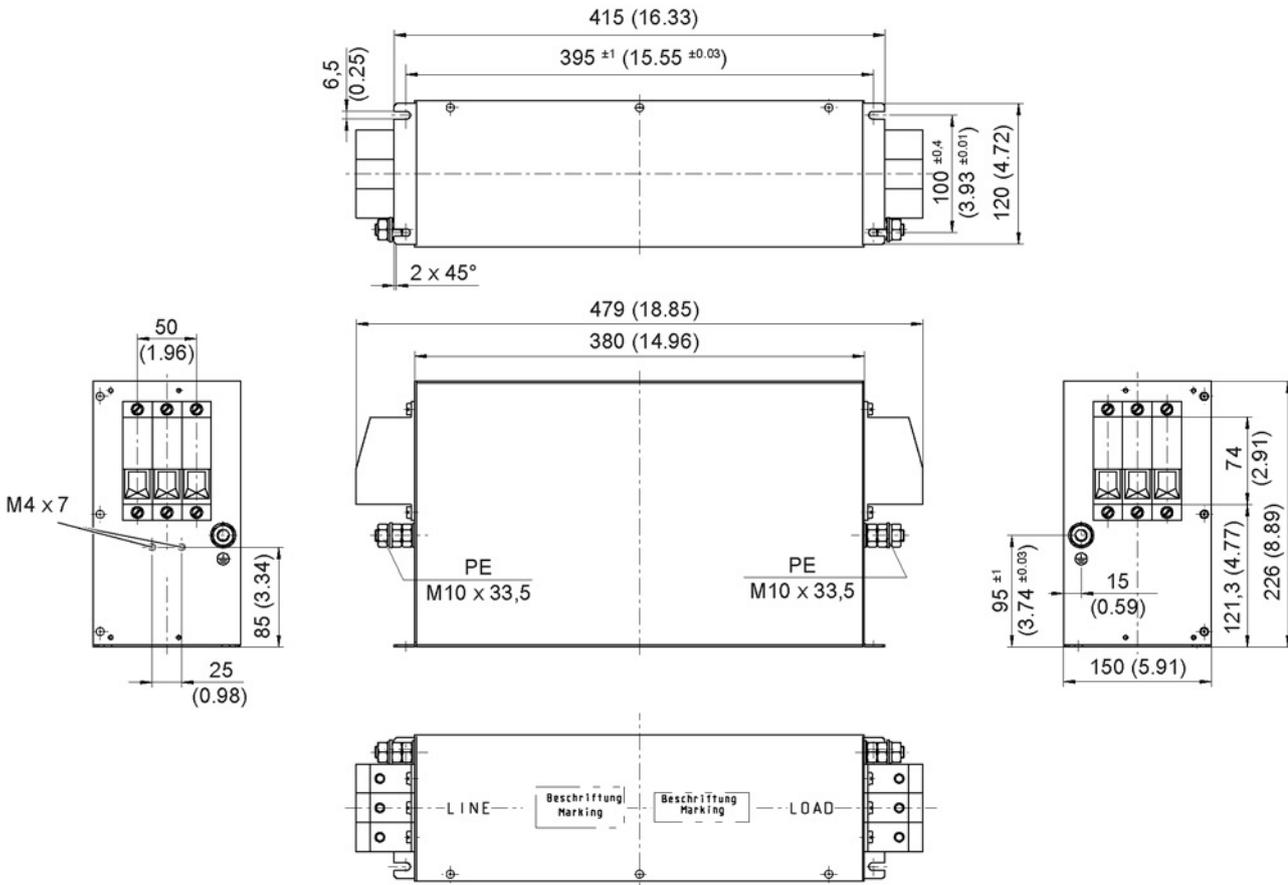


Figure 3-19 Dimension drawing of Basic Line Filter for Basic Line Modules 100 kW, all data in mm and (inches)

3.7.5.4 Technical specifications

Table 3- 10 Technical data for Basic Line Filter for Basic Line Modules

| | 6SL3000- | 0BE21-6DAx | 0BE23-6DA1 | 0BE31-2DAx |
|---|-----------------------|---|------------|------------|
| 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 781)) | W | 16 | 26 | 43 |
| Weight | kg | 5 | 7,5 | 18,5 |

3.7.6 Basic Line Filter for Smart Line Modules

3.7.6.1 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 achieve the interference voltage categories listed below, when used in conjunction with the associated line reactors and an EMC-compliant design (see Chapter Possible line reactor and line filter combinations (Page 136)).

- EN 61800-3 category C2 up to a total cable length¹⁾ of 350 m (shielded) for 5 kW to 55 kW components
- EN 61800-3 category C3 up to a total cable length¹⁾ of 350 m (shielded) for 5 kW to 55 kW components

Basic Line Filters are only suitable for direct connection to TN systems. 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

3.7.6.2 Interface description

Overview

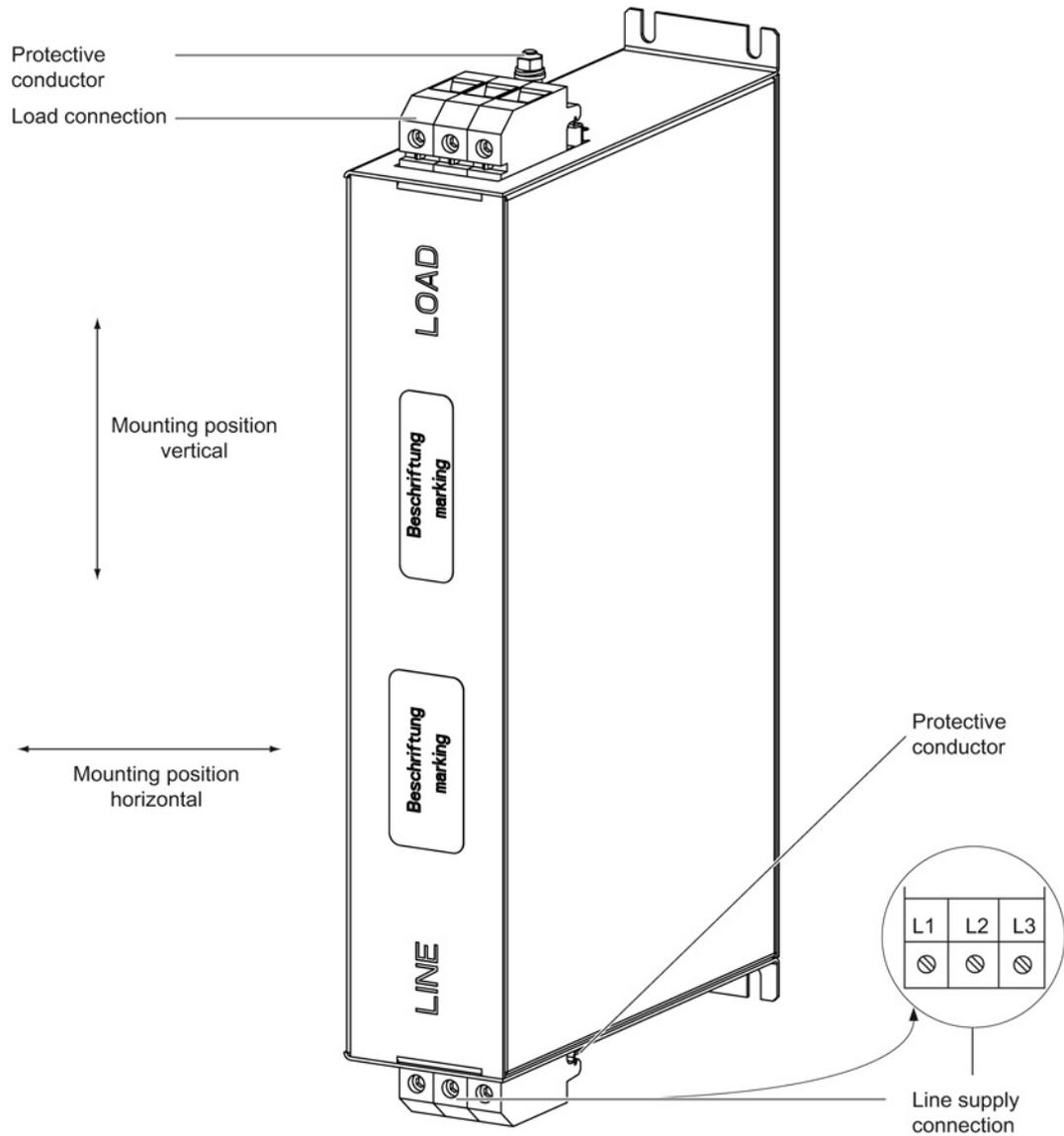


Figure 3-20 Interface overview, Basic Line Filter for Smart Line Modules (example: 36 kW)

Either the upper or lower PE screw can be used for the connection. One of the screws remains unused. "Looping-through" the protective connection to the line reactor is not permissible.

Line/load connection

Table 3- 11 Line and load connection, Basic Line Filter for Smart Line Modules

| | 6SL3000-0HE15-0AAx | 6SL3000-0HE21-0AAx | 6SL3000-0BE21-6DAx | 6SL3000-0BE23-6DA1 | 6SL3000-0BE25-5DAx |
|--------------------------------------|--|--------------------|--------------------|--|--|
| Rated power [kW] | 5 | 10 | 16 | 36 | 55 |
| Line supply connection L1, L2, L3 | Screw terminals 10 mm ² , 3 pole 1.2 ... 1.5 Nm | | | Screw terminals 35 mm ² , 3 pole 3.2 ... 3.7 Nm | Screw terminals 50 mm ² , 3 pole 6 ... 8 Nm |
| Load connection L1', L2', L3' | | | | | |
| PE connection ¹⁾ | Terminal studs M6 / 6 Nm | | | Terminal studs M6 / 6 Nm | Terminal studs M8 / 8 Nm |

1) For ring cable lugs without insulation

3.7.6.3 Dimension drawings

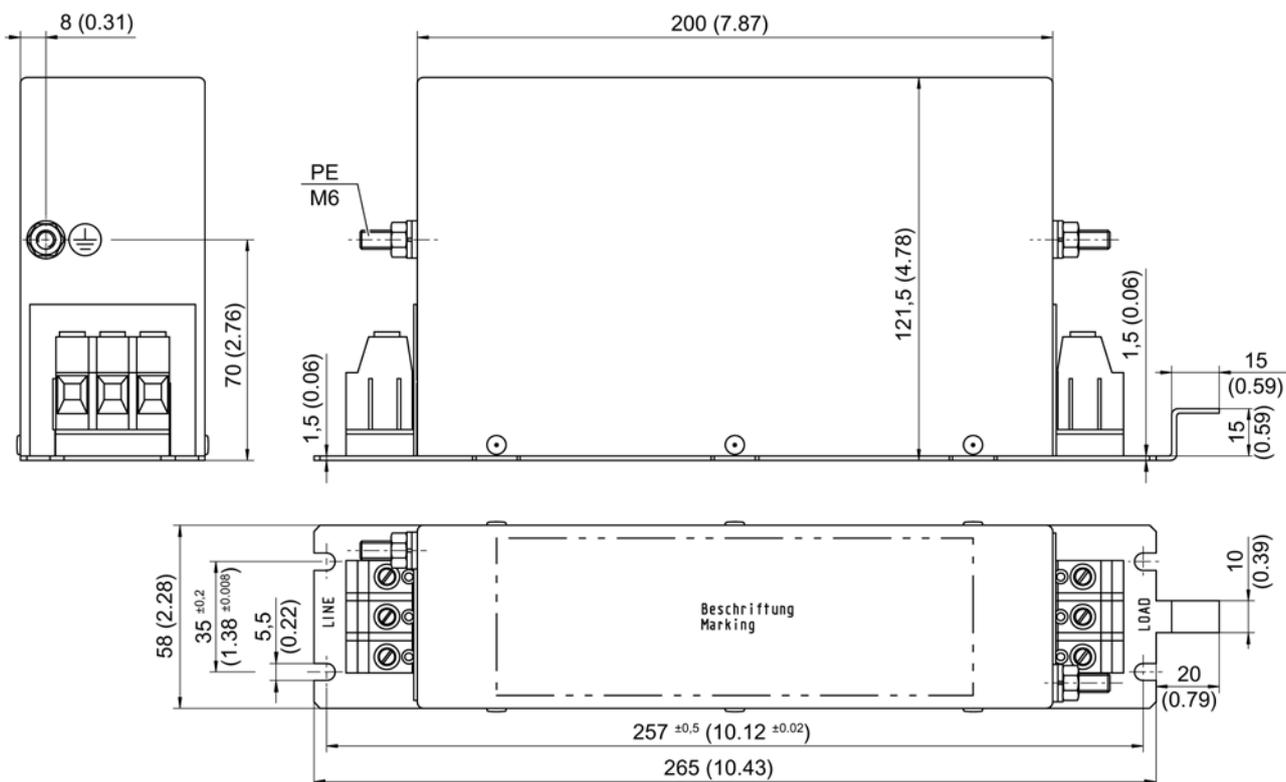


Figure 3-21 Dimension drawing of Basic Line Filter for 5 kW and 10 kW Smart Line Modules, all dimensions in mm and (inches)

3.7 Line filters

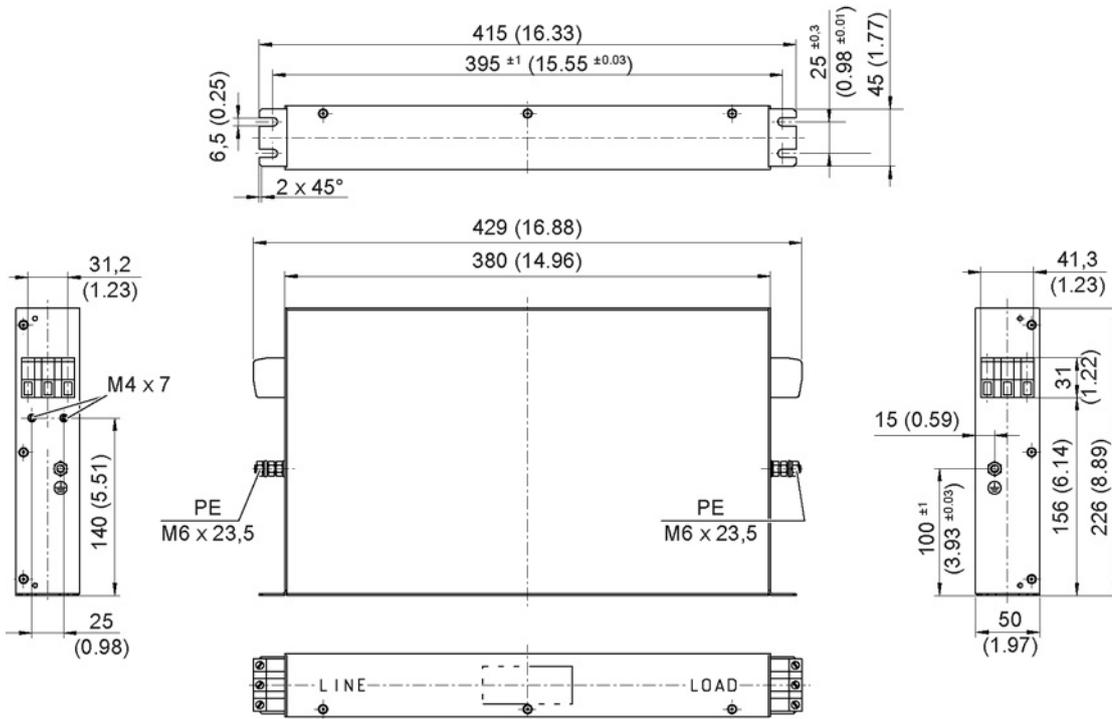


Figure 3-22 Dimension drawing of Basic Line Filter for Smart Line Modules 16 kW, all data in mm and (inches)

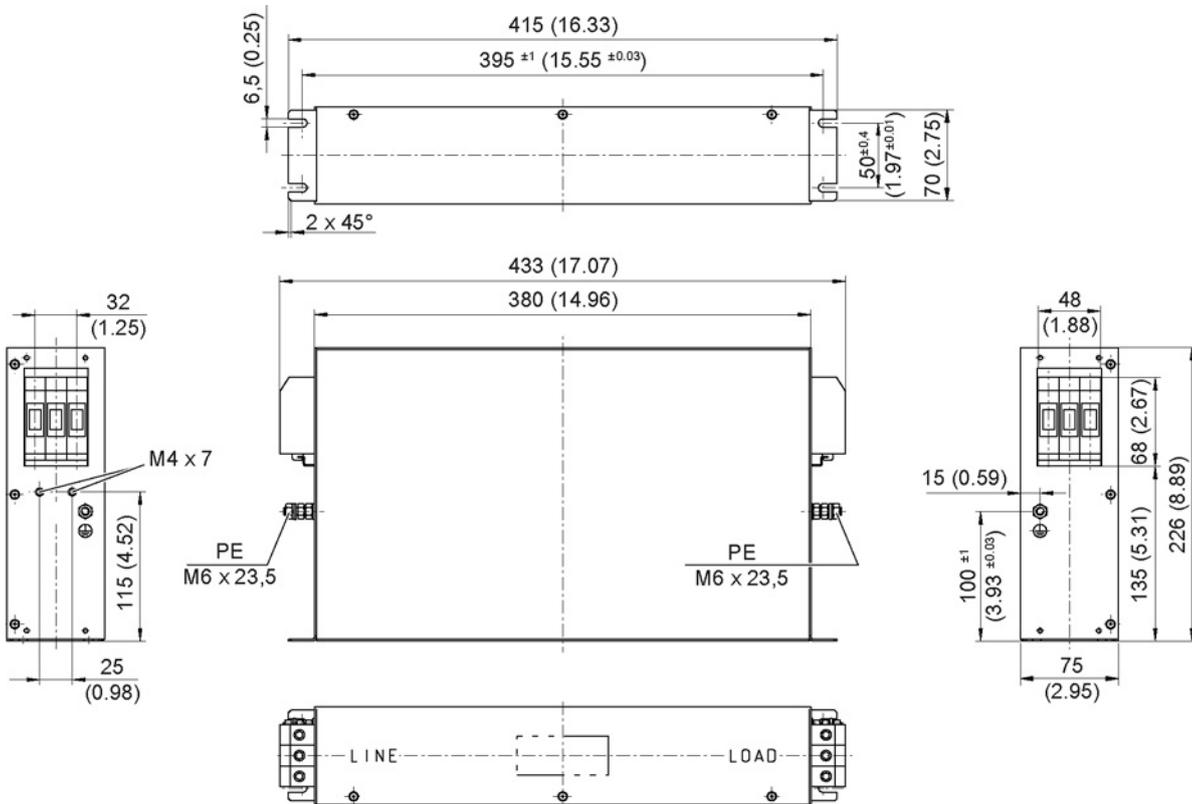


Figure 3-23 Dimension drawing of Basic Line Filter for Smart Line Modules 36 kW, all data in mm and (inches)

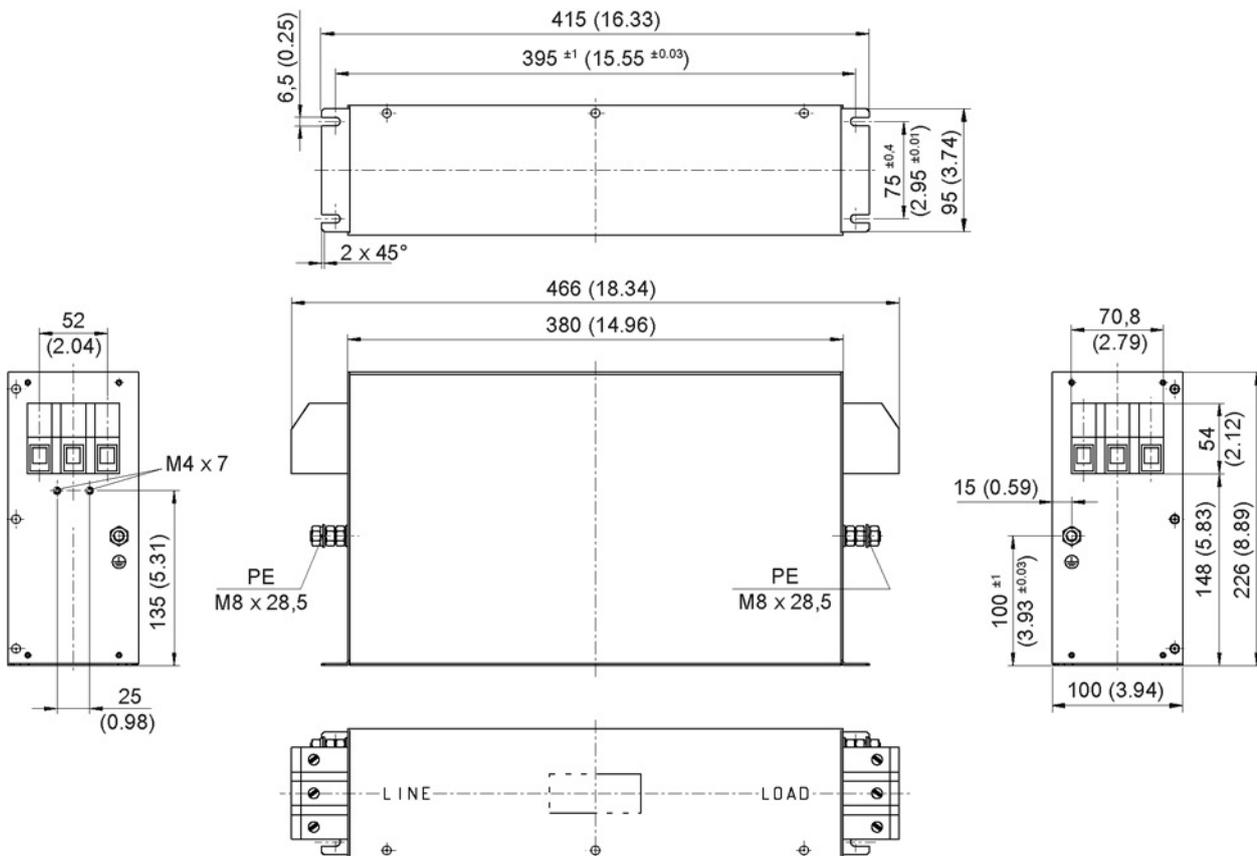


Figure 3-24 Dimension drawing of Basic Line Filter for Smart Line Modules 55 kW, all data in mm and (inches)

3.7.6.4 Technical Specifications

Table 3- 12 Technical data for: Basic Line Filter for Smart Line Modules

| | 6SL3000- | 0HE15-0AAx | 0HE21-0AAx | 0BE21-6DAx | 0BE23-6DA1 | 0BE25-5DAx |
|---|-----------------------|---|------------|------------|------------|------------|
| 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 Hz | | | | |
| Rated current | A _{AC} | 12 | 25 | 36 | 74 | 105 |
| Power loss (see power loss tables (Page 781)) | W | 20 | 20 | 16 | 26 | 43 |
| Weight | kg | 2.1 | 2.3 | 5 | 7.5 | 11.5 |

3.8 Line reactors

3.8.1 Safety instructions for line reactors

| |
|---|
|  WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed |
| If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. |
| <ul style="list-style-type: none">• Adhere to the fundamental safety instructions.• When assessing the risk, take into account residual risks. |



| |
|--|
|  DANGER |
| Danger to life due to electric shock in the event of missing touch protection |
| Death or serious injury can result when live parts are touched. |
| <ul style="list-style-type: none">• For the line reactors, use touch protection according to IPXXA or corresponding to the local installation regulations. |



| |
|--|
|  WARNING |
| Danger to life due to 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. |
| <ul style="list-style-type: none">• Connect a damping resistor to the HFD line reactor. |

| |
|--|
|  CAUTION |
| Risk of burns due to high surface temperature of the line reactor |
| The line reactors can become very hot. You can get seriously burnt when touching the surface. |
| <ul style="list-style-type: none">• 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).

You must 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.

Do not route any cables near the line reactor. If this cannot be avoided, observe a minimum distance of 200 mm.

3.8.2 Overview of the line reactors

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 feature for the step-up converter function.

HFD line reactors have an additional winding, to which a separate damping resistor must be connected. This device dampens any possible system oscillations (with voltage amplitudes that could shorten the equipment's service life because of parasitic points of resonance caused by line capacities and supply system characteristics) in converter systems to safe values. This results in increased operational reliability and extends the service life.

Note

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

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

Table 3- 13 Overview of line reactors

| Line reactors | Order number |
|---------------------------------------|--------------------|
| Line reactors for Active Line Modules | |
| 16 kW | 6SL3000-0DE21-6AAx |
| 36 kW | 6SL3000-0DE23-6AAx |
| 55 kW | 6SL3000-0DE25-5AAx |
| 80 kW | 6SL3000-0DE28-0AAx |
| 120 kW | 6SL3000-0DE31-2AAx |
| Line reactors for Smart Line Modules | |
| 5 kW | 6SL3000-0CE15-0AAx |
| 10 kW | 6SL3000-0CE21-0AAx |
| 16 kW | 6SL3000-0CE21-6AAx |
| 36 kW | 6SL3000-0CE23-6AAx |
| 55 kW | 6SL3000-0CE25-5AAx |
| Line reactors for Basic Line Modules | |
| 20 kW | 6SL3000-0CE22-0AAx |
| 40 kW | 6SL3000-0CE24-0AAx |
| 100 kW | 6SL3000-0CE31-0AAx |

3.8.3 Line reactors for Active Line Modules

3.8.3.1 Interface description

Overview

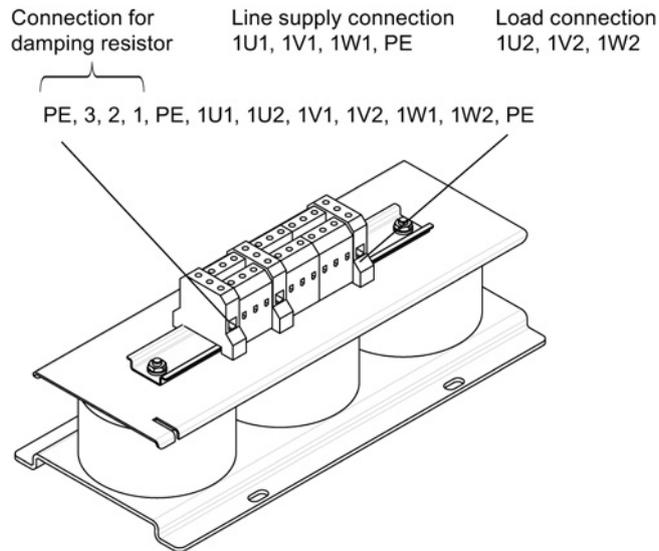


Figure 3-25 Interface overview, HFD line reactor 16 kW

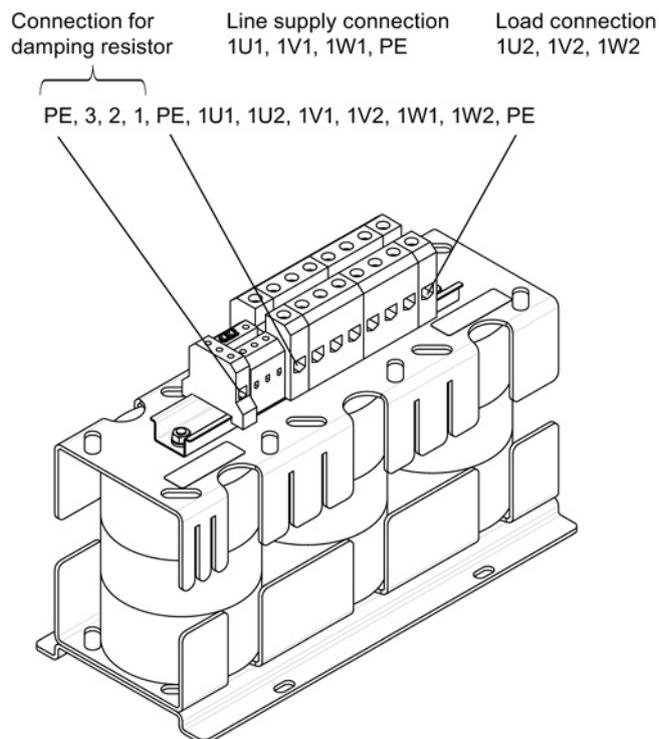


Figure 3-26 Interface overview, HFD line reactor 36 kW

3.8 Line reactors

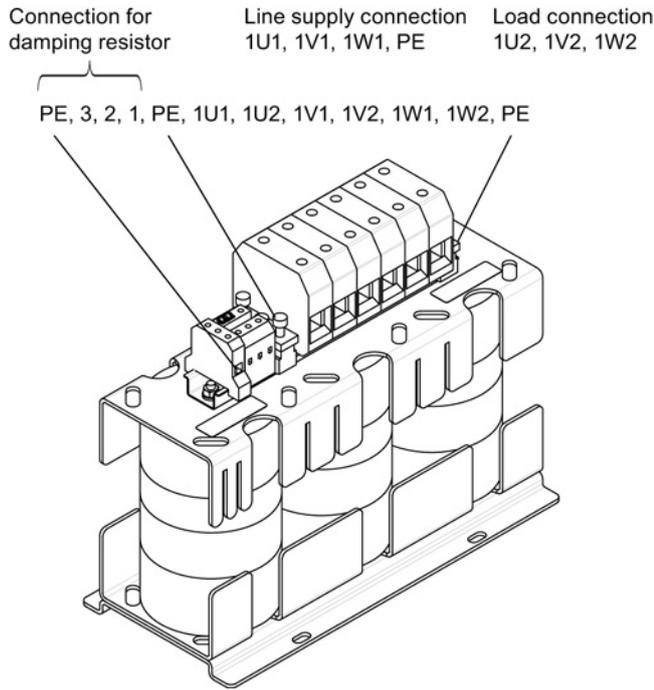


Figure 3-27 Interface overview, HFD line reactor 55 kW

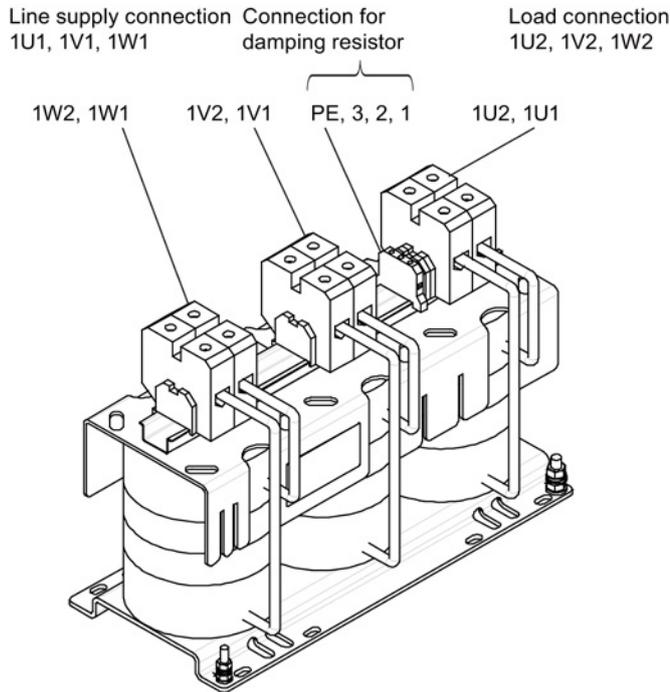


Figure 3-28 Interface overview, HFD line reactor 80 kW

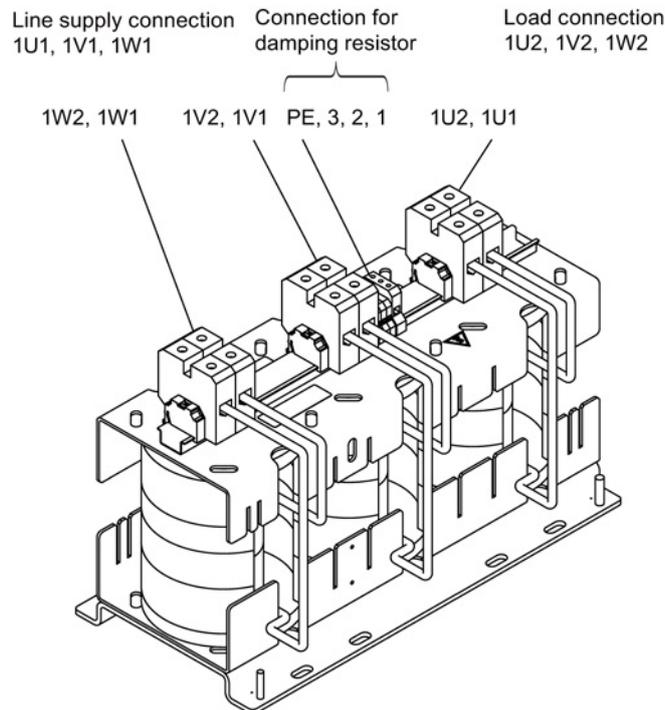


Figure 3-29 Interface overview, HFD line reactor 120 kW

Line/load connection

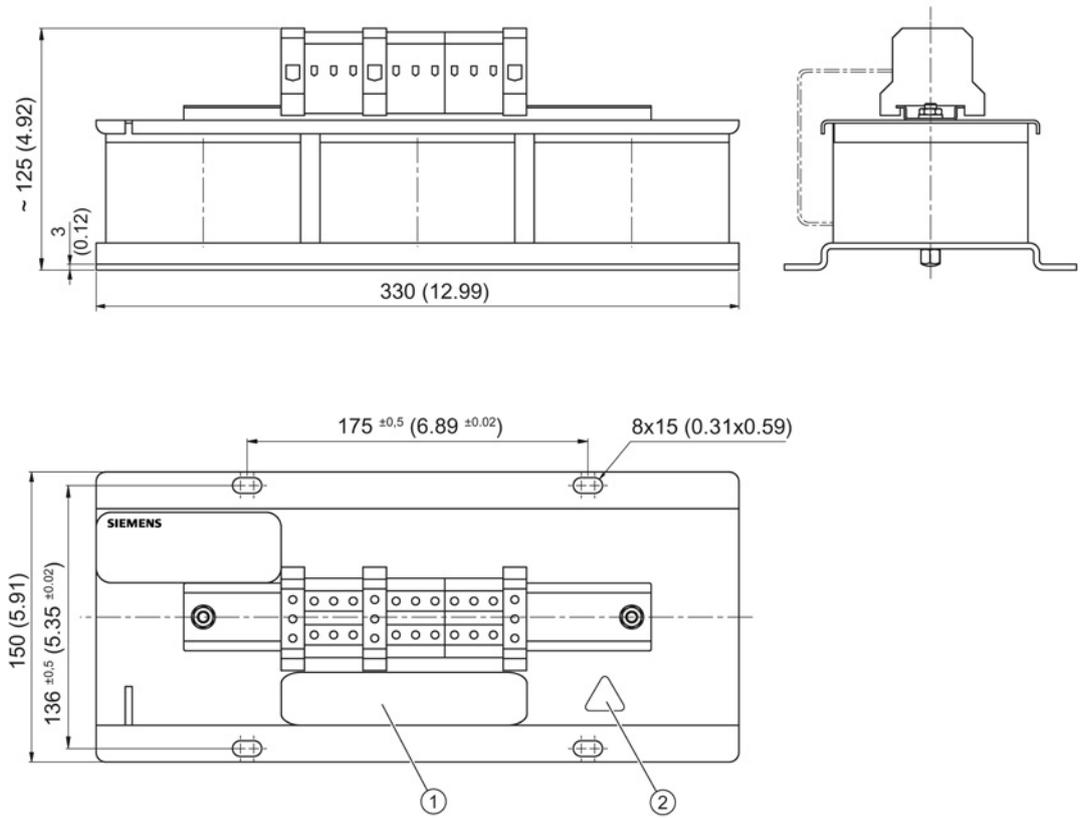
Table 3- 14 Connection of HFD line reactors

| Order number | 6SL3000-0DE21-6AAx | 6SL3000-0DE23-6AAx | 6SL3000-0DE25-5AAx | 6SL3000-0DE28-0AAx | 6SL3000-0DE31-2AAx |
|--|---|---|---|--|--------------------|
| Power [kW] | 16 | 36 | 55 | 80 | 120 |
| Line supply connection 1U1, 1V1, 1W1 | Screw terminal 16 mm ² /1.2 Nm | Screw terminal 35 mm ² /2.5 Nm | Screw terminal 70 mm ² 6 ... 10 Nm | Type: Spring-loaded terminal 4 (Page 754) Max. cross-section that can be connected: 95 mm ² | |
| Load connection 1U2, 1V2, 1W2 | | | | | |
| PE connection | Screw terminal 16 mm ² /1.2 Nm | | | | |
| Damping resistor connection 1, 2, 3 PE | Screw terminal 16 mm ² /1.2 Nm | | | | |

Note

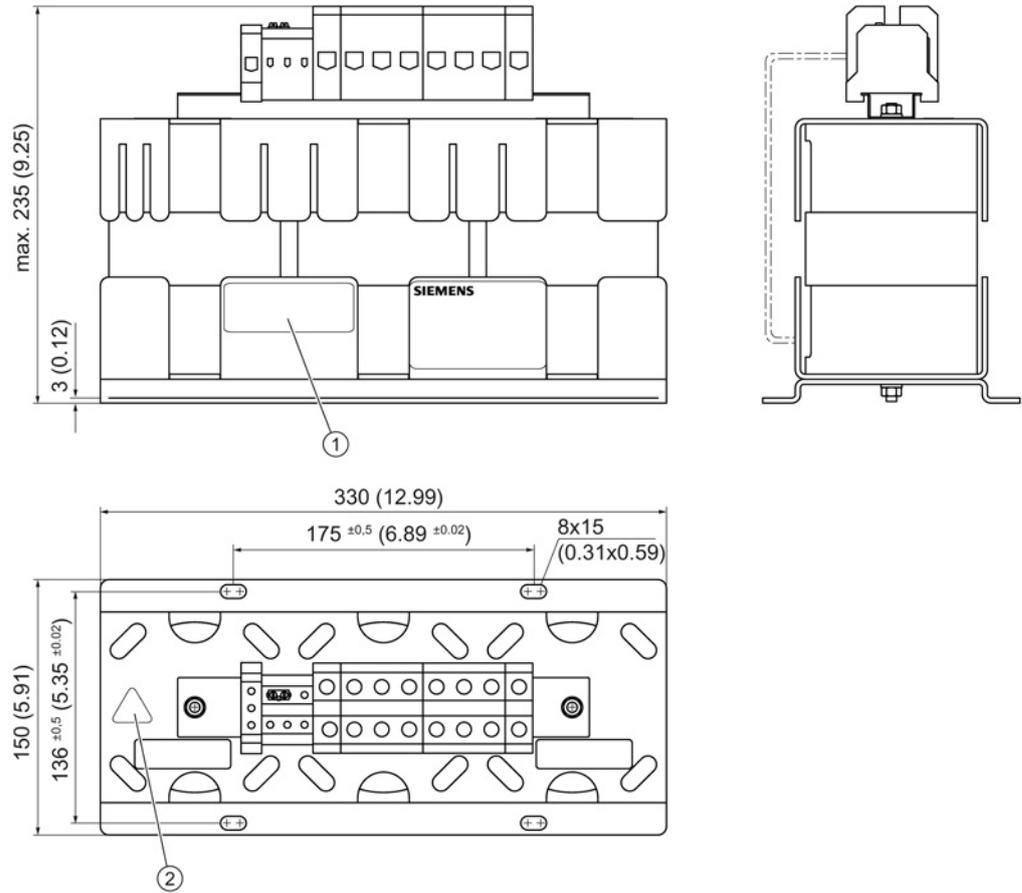
Data relating to the permissible tightening torques can also be found on the label showing the terminal layout of the screw terminal for the corresponding HFD line reactor.

3.8.3.2 Dimension drawings



- ① Terminal arrangement
- ② Warning label

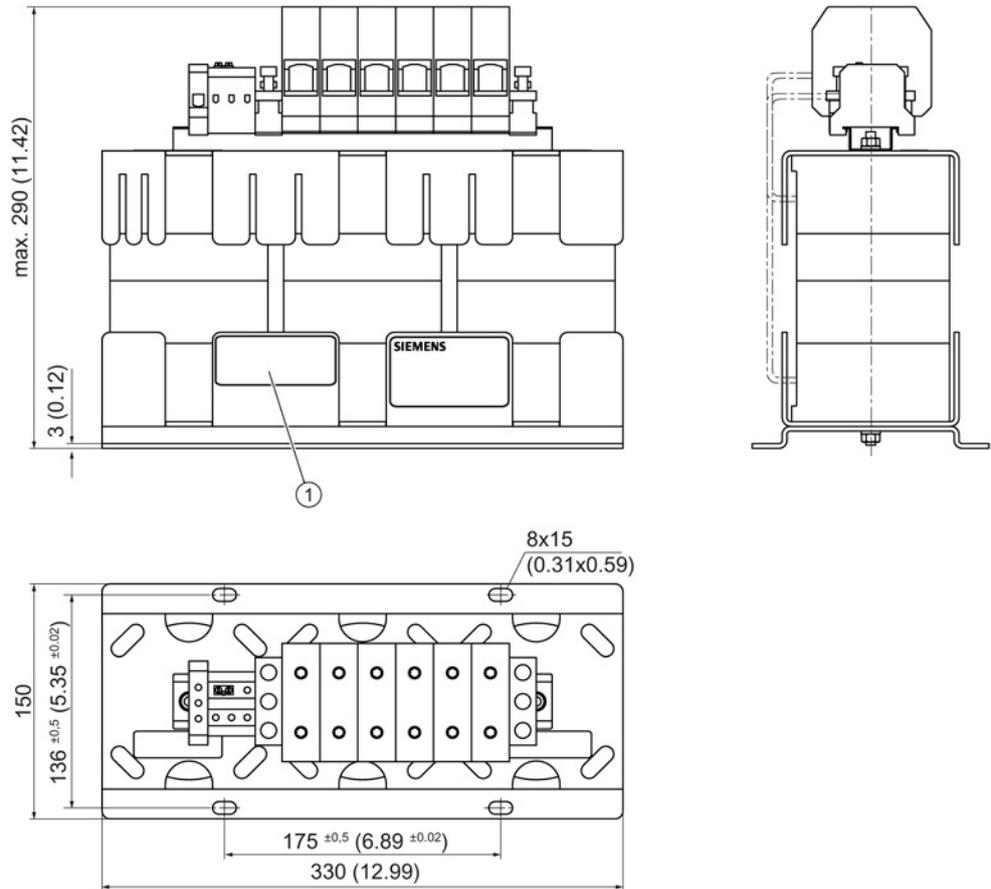
Figure 3-30 Dimension drawing of HFD line reactor 16 kW, all dimensions in mm and (inches)



- ① Terminal arrangement
- ② Warning label

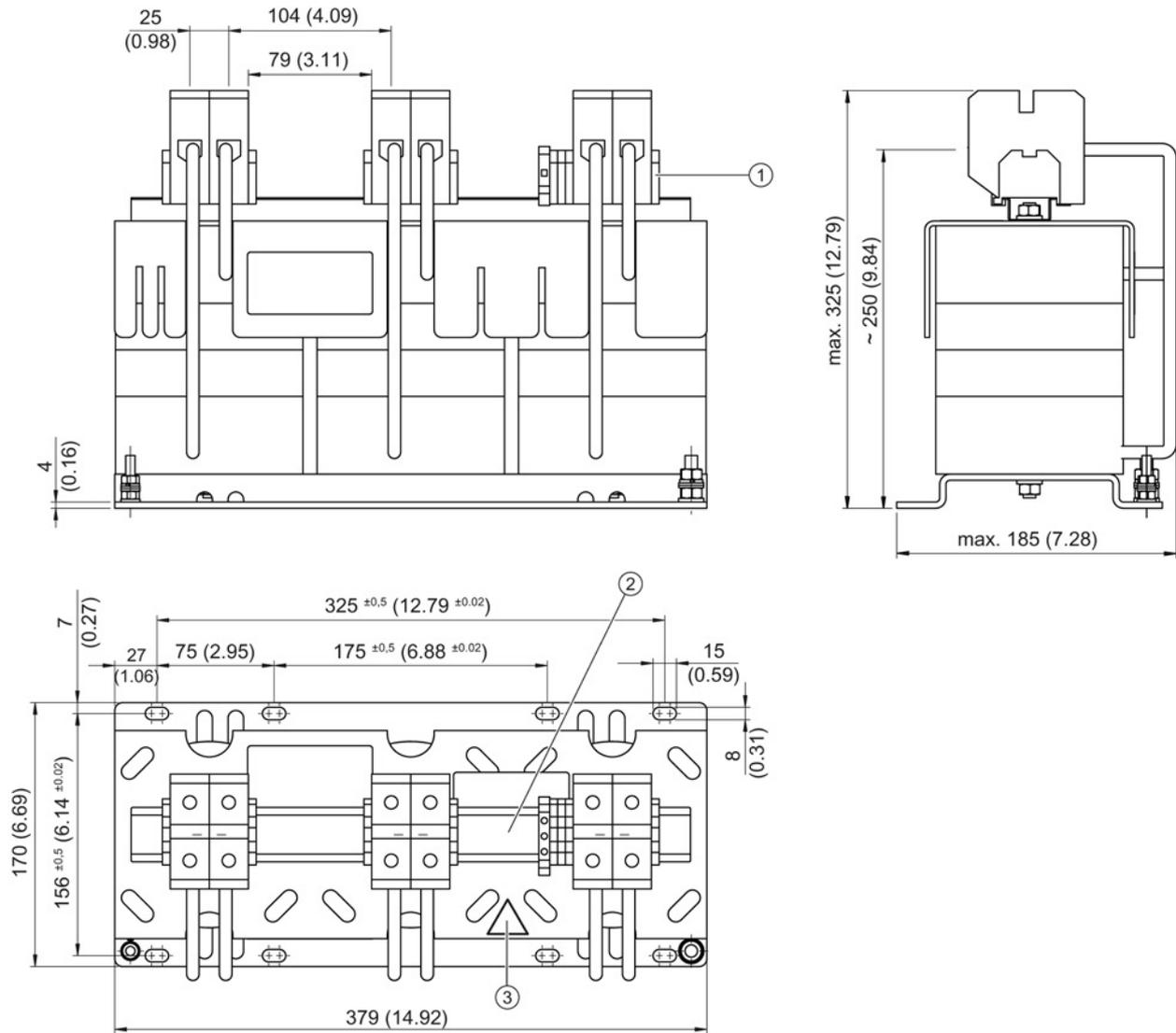
Figure 3-31 Dimension drawing of HFD line reactor 36 kW, all dimensions in mm and (inches)

3.8 Line reactors



① Terminal arrangement

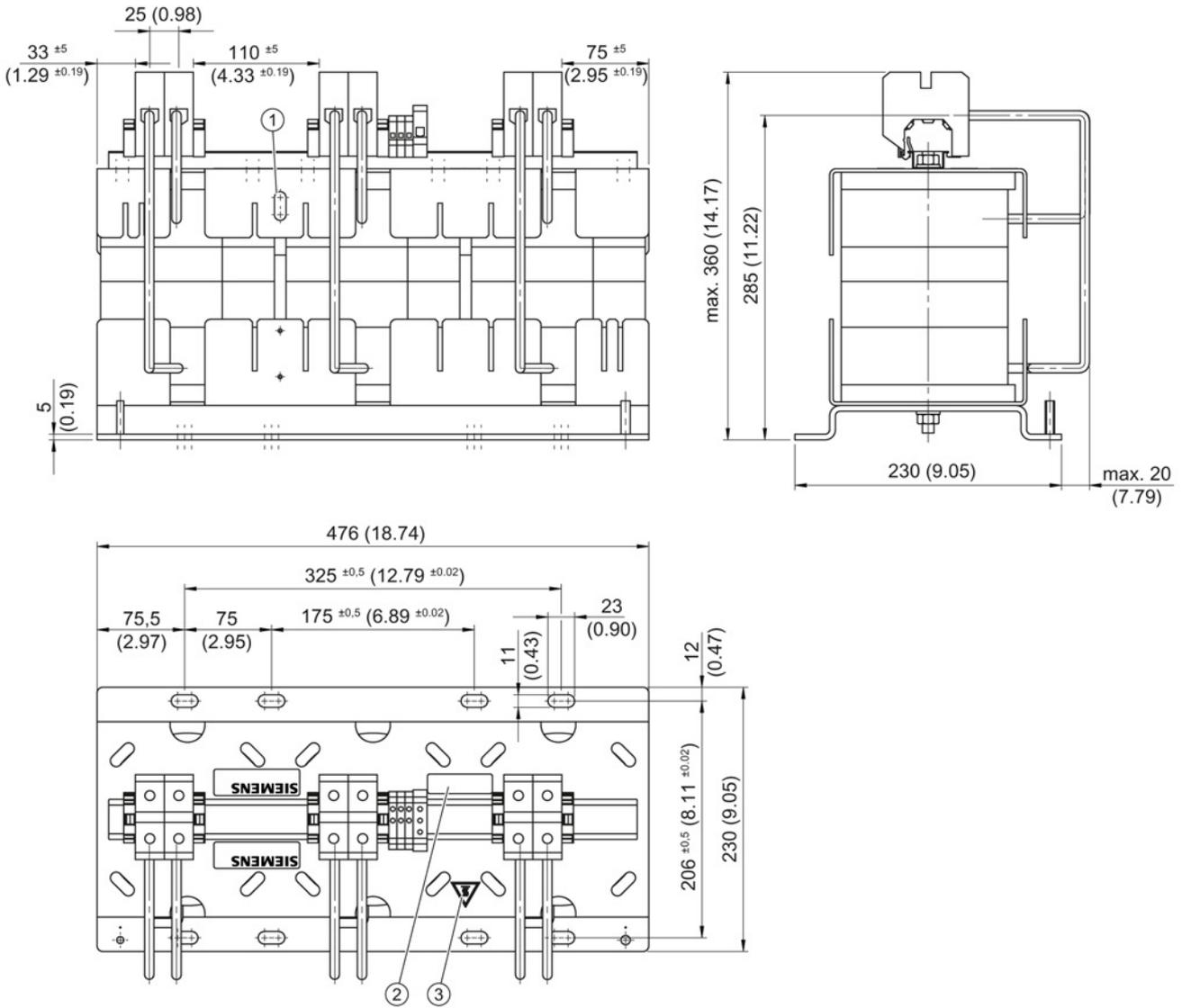
Figure 3-32 Dimension drawing of HFD line reactor 55 kW, all dimensions in mm and (inches)



- ① End retainers
- ② Terminal arrangement
- ③ Warning label

Figure 3-33 Dimension drawing of HFD line reactor 80 kW, all dimensions in mm and (inches)

3.8 Line reactors



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

Figure 3-34 Dimension drawing of HFD line reactor 120 kW, all dimensions in mm and (inches)

3.8.3.3 Technical data

Table 3- 15 Technical data for HFD line reactors

| | Unit | 6SL3000- 0DE21- 6AAx | 6SL3000- 0DE23- 6AAx | 6SL3000- 0DE25- 5AAx | 6SL3000- 0DE28- 0AAx | 6SL3000- 0DE31- 2AAx |
|--|------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| Power | kW | 16 | 36 | 55 | 80 | 120 |
| Rated current | A _{rms} | 30 | 67 | 103 | 150 | 225 |
| Power loss ¹⁾ (see power loss tables) | W | 170 | 250 | 350 | 450 | 590 |
| Weight | kg | 9 | 21 | 27 | 37 | 67 |
| Degree of protection according to EN 60529 | | IP20 | IP00 (no touch protection) | | IP00 (no touch protection) | |
| Mounting position | | Any | | | | |

¹⁾ Data for line operation

3.8 Line reactors

3.8.4 Damping resistor for HFD line reactors

3.8.4.1 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.

Note

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

3.8.4.2 Safety instructions for damping resistors for HFD reactors

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

- If possible, mount the damping resistors externally, i.e. outside of the control cabinet.
-

3.8.4.3 Dimension drawings

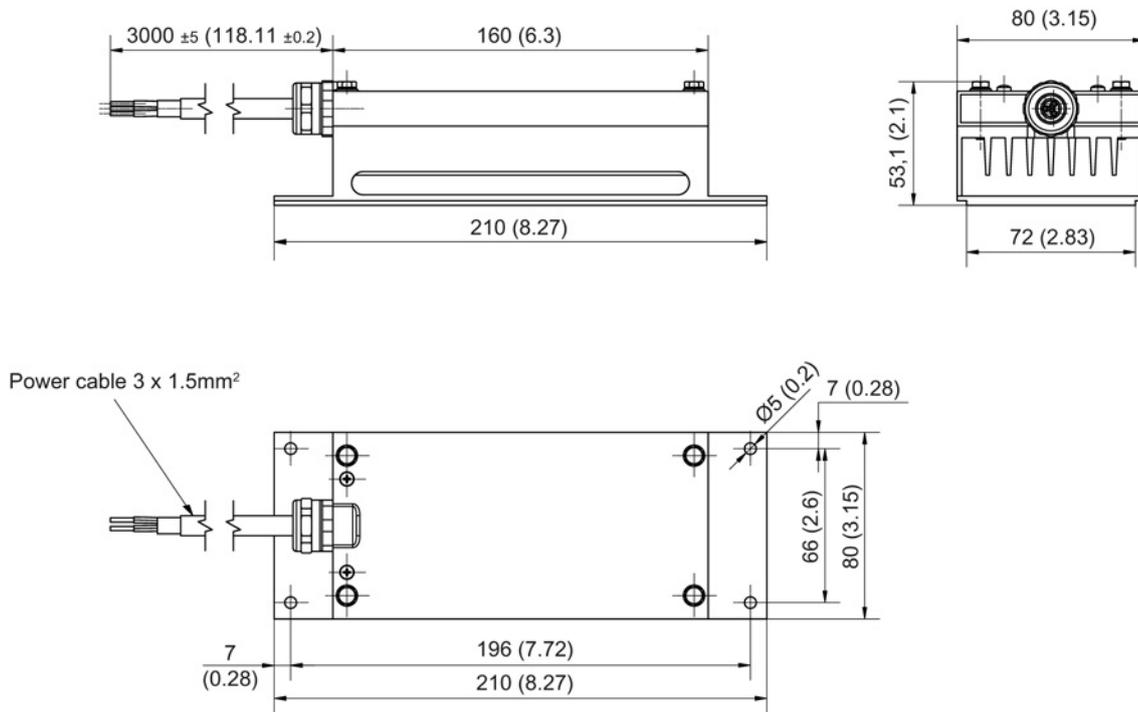


Figure 3-35 300 W damping resistor for HFD line reactors, all dimensions in mm and (inches)

3.8 Line reactors

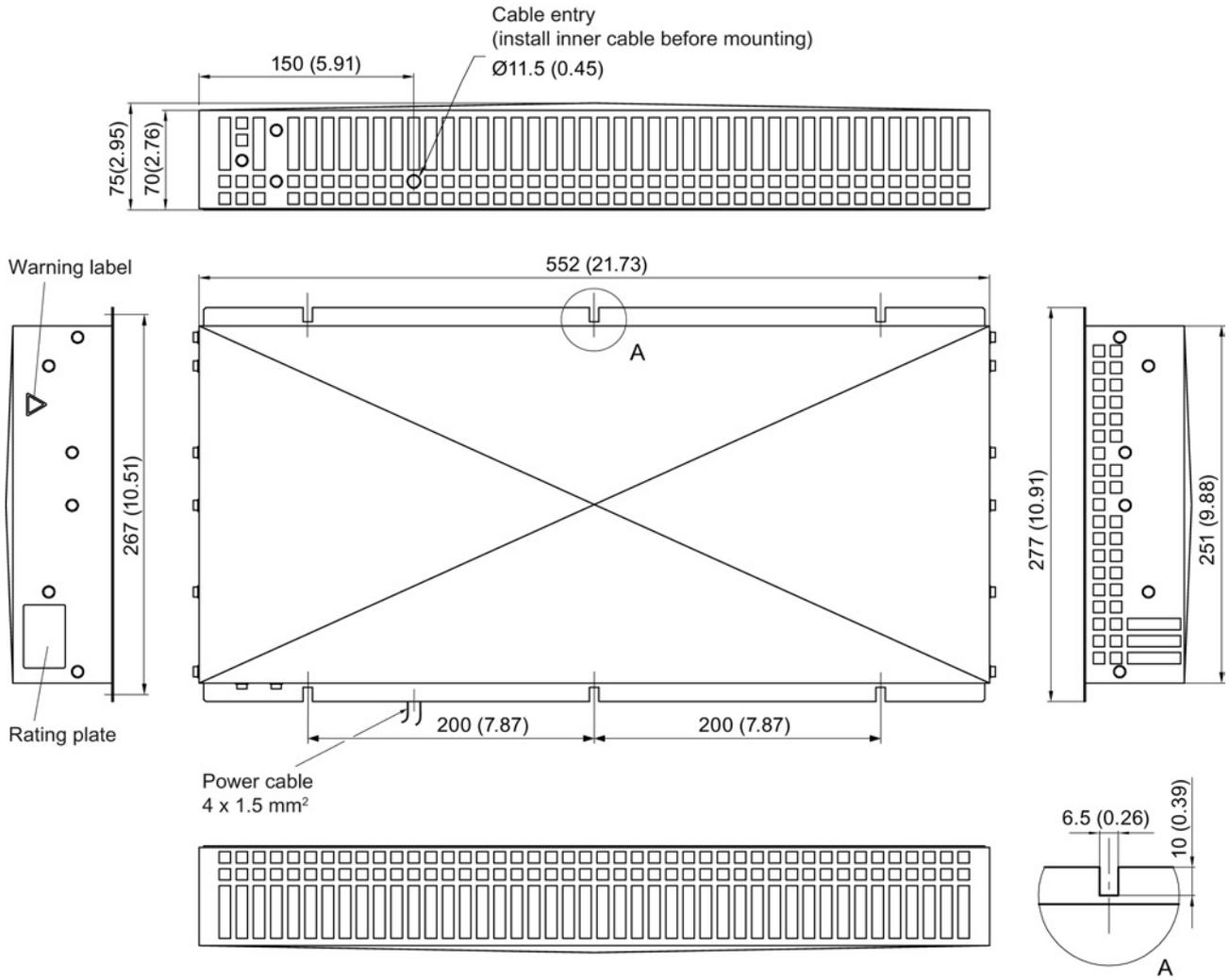


Figure 3-36 800 W damping resistor for HFD line reactors, all dimensions in mm and (inches)

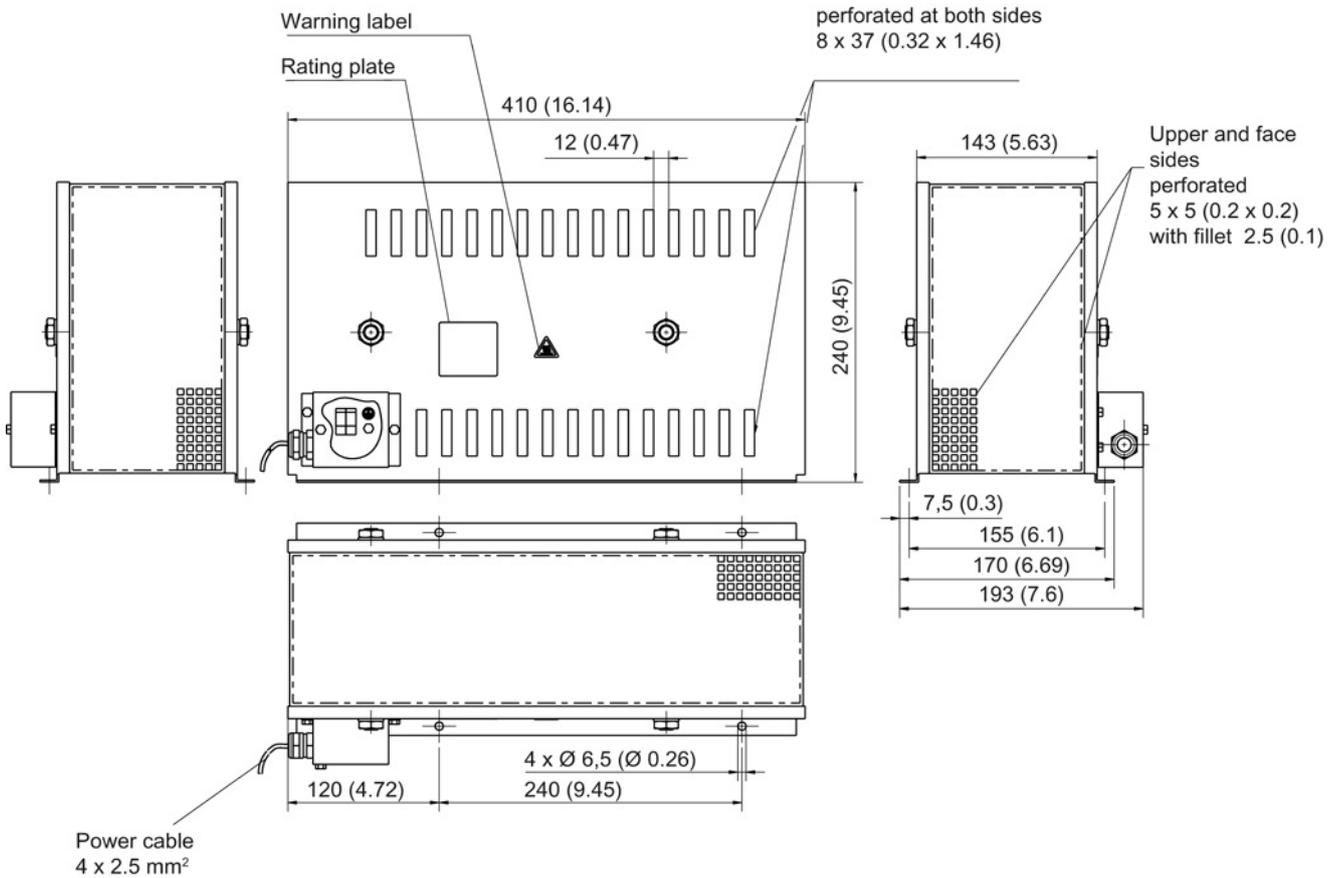


Figure 3-37 1500 W damping resistor for HFD line reactors, all dimensions in mm and (inches)

3.8.4.4 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 103)).

Table 3- 16 Technical data for HFD damping resistors

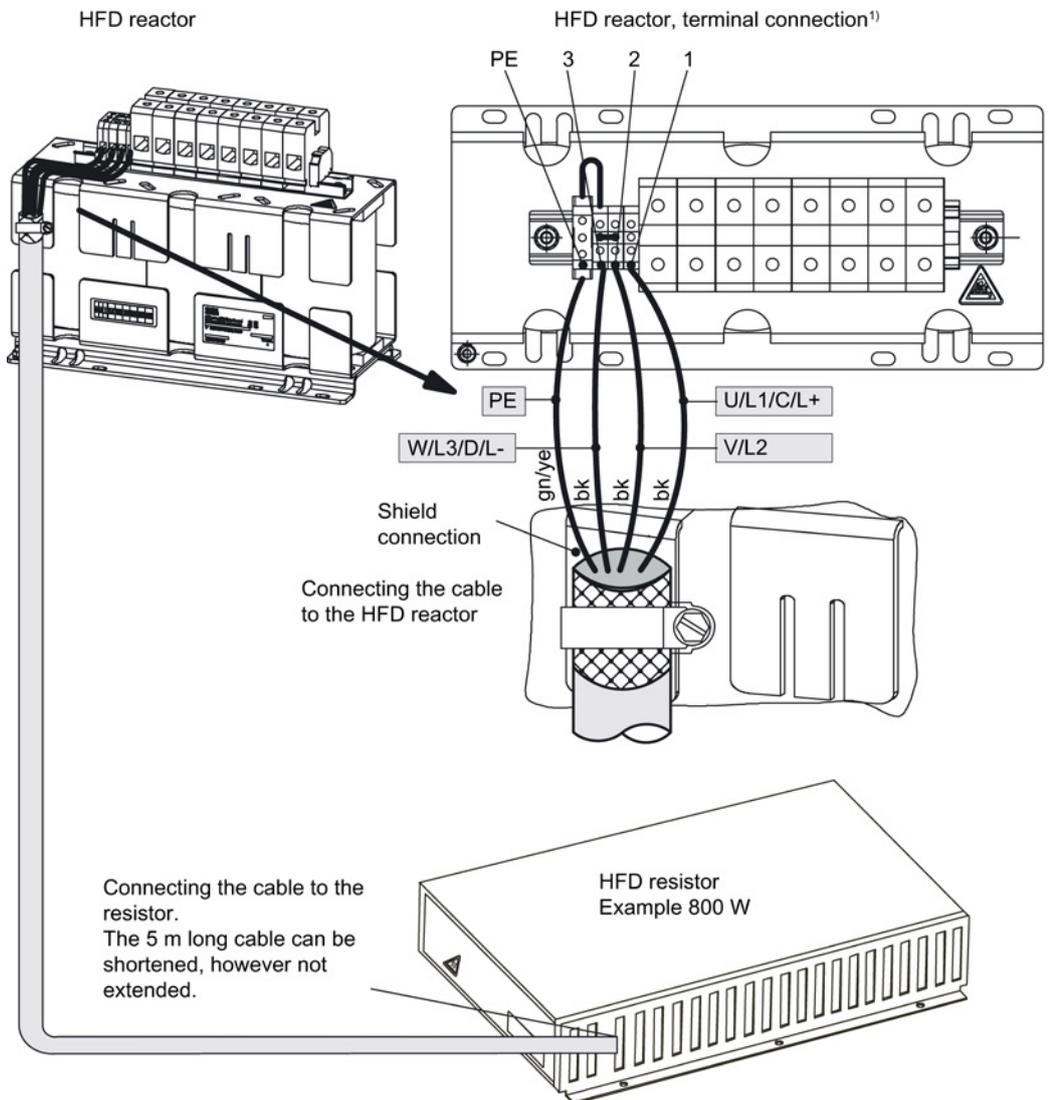
| Order number | 6SN1113-1AA00-0DAx ¹⁾ | 6SL3100-1BE21-3AAx ²⁾ | 6SL3100-1BE22-5AAx ³⁾ |
|---|----------------------------------|----------------------------------|----------------------------------|
| Rated power [W] | 300 | 800 | 1500 |
| Connection cable [m], included in scope of delivery | 3 | 5 | 5 |
| Connection | 3 x 1.5 mm ² | 4 x 1.5 mm ² | 4 x 1.5 mm ² |
| Weight [kg] | 1,45 | 5,5 | 5,6 |
| Degree of protection according to EN 60529 | IP54 | IP51 | IP20 |
| UL file | E-228809 | E-212934 | E-192450 |
| Ambient temperature [°C] | 0 ... 55 | | |
| Dimensions (W x H x D) [mm] | 80 x 210 x 53 | 277 x 552 x 75 | 193 x 410 x 240 |

- 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
- 3) Alternatively possible

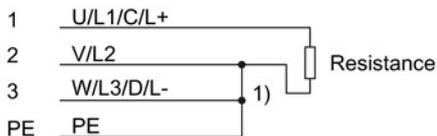
Note

Use of the 800 W damping resistor is preferable.

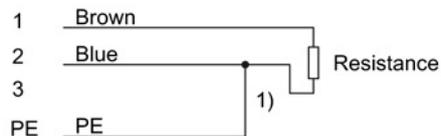
3.8.4.5 Wiring with the HFD line reactor



Connection circuit 800 / 1500 W resistors



Connection circuit 300 W resistor



1) Jumper, 2 (3) PE for potential connection (EMC) is provided as standard

Note:
It is not permissible that any cables are routed in the vicinity of the hot air flow of the damping resistor!

Mounting position:
Any mounting position, observe power loss data, if required, attach "Hot surface" warning label!

Figure 3-38 Wiring the HFD line reactor with a damping resistor

3.8.5 Line reactors for Basic Line Modules

3.8.5.1 Interface description

Overview

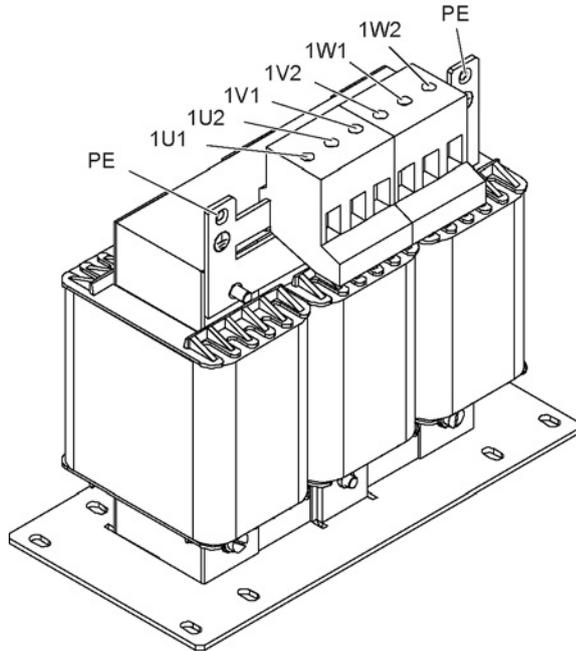


Figure 3-39 Interface overview, line reactor for Basic Line Modules (20 kW)

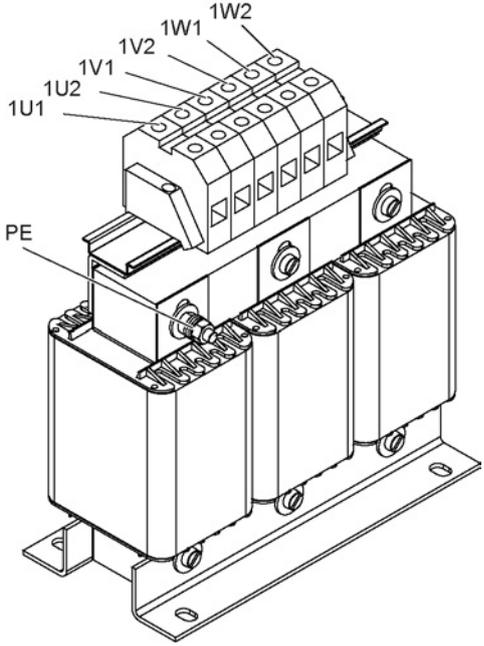


Figure 3-40 Interface overview, line reactor for Basic Line Modules (40 kW)

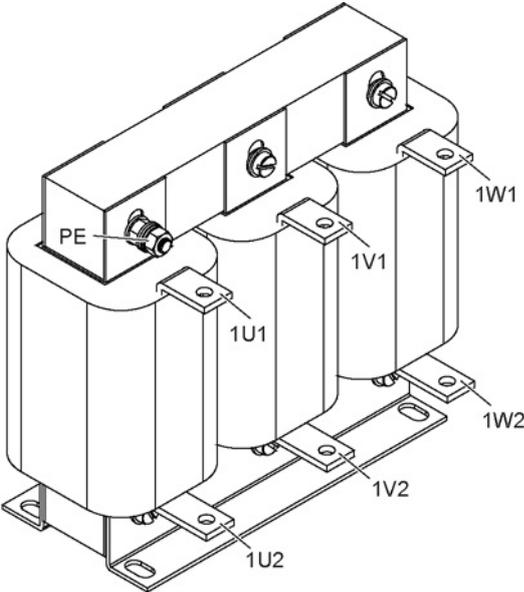


Figure 3-41 Interface overview, line reactor for Basic Line Modules (100 kW)

3.8 Line reactors

Line/load connection

Table 3- 17 Line and load connection line reactors for Basic Line Modules

| | 6SL3000-0CE22-0AAx | 6SL3000-0CE24-0AAx | 6SL3000-0CE31-0AAx |
|---|---|---|--|
| Power | 20 kW | 40 kW | 100 kW |
| Line supply connection 1U1, 1V1, 1W1 | Screw terminals 10 mm ² ; 1.5 ... 1.8 Nm | Screw terminals 35 mm ² ; 5 ... 6 Nm | Copper busbars with 8.5 mm diameter holes |
| Load connection 1U2, 1V2, 1W2 | | | |
| PE connection | Screw M4 2 Nm | Terminal studs M6 6 Nm | Terminal studs M8 12 Nm |

3.8.5.2 Dimension drawings

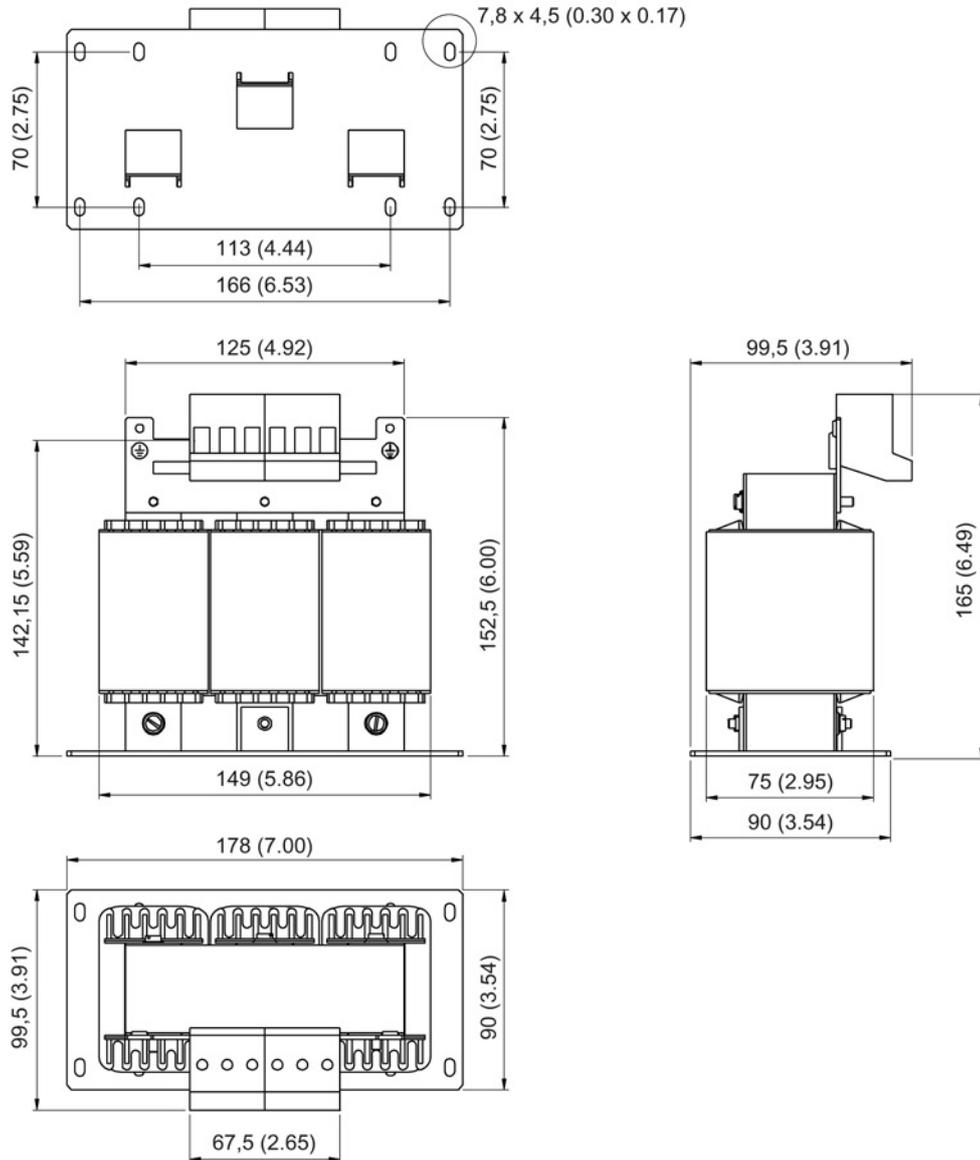


Figure 3-42 Dimension drawing of line reactor for Basic Line Module 20 kW, all dimensions in mm and (inches)

3.8 Line reactors

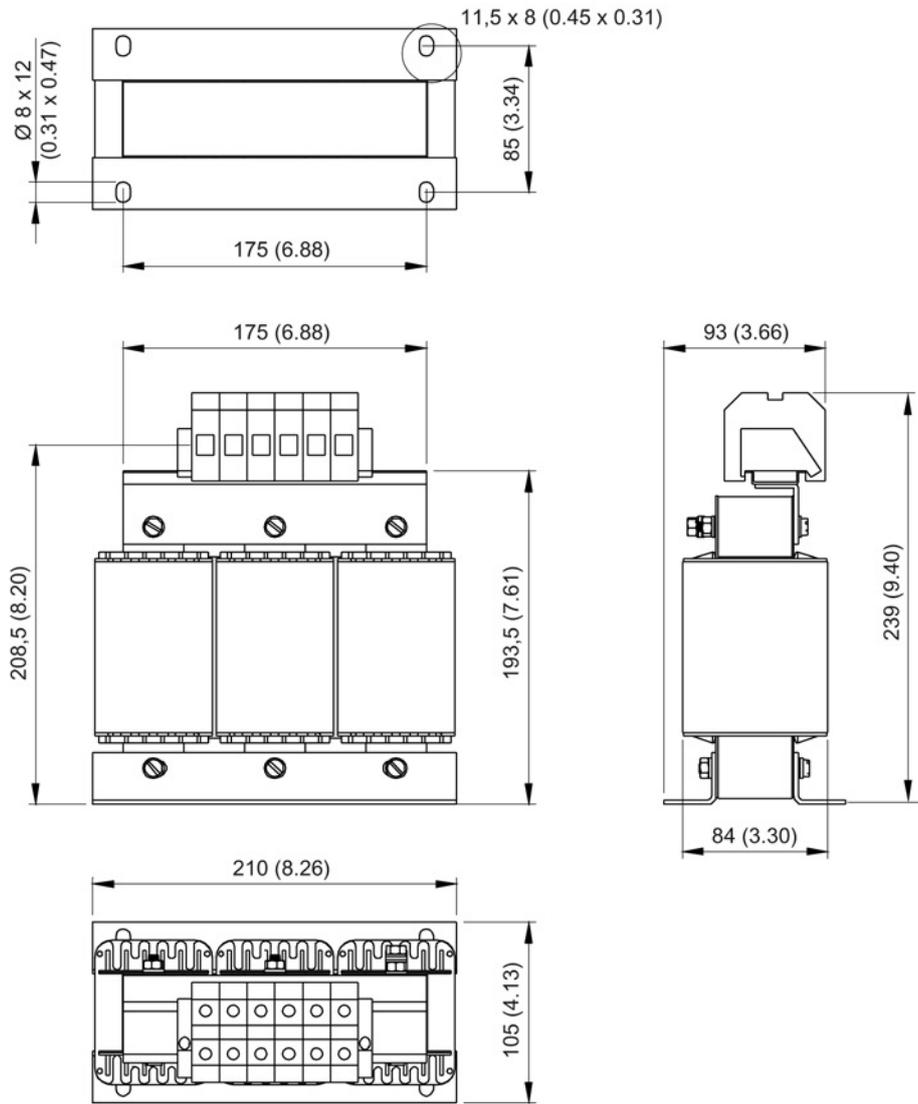


Figure 3-43 Dimension drawing of line reactor for Basic Line Module 40 kW, all dimensions in mm and (inches)

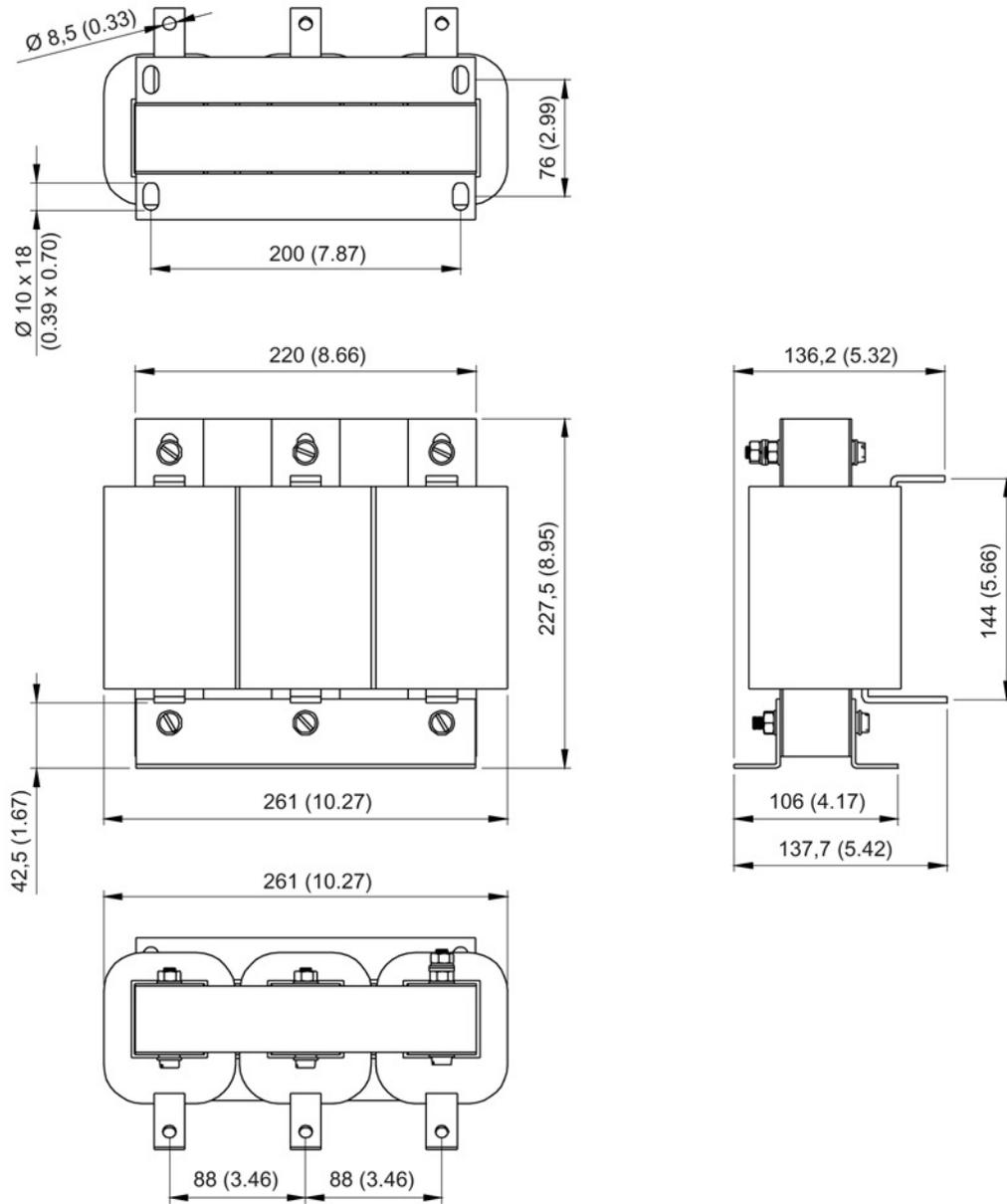


Figure 3-44 Dimension drawing of line reactor for Basic Line Module 100 kW, all dimensions in mm and (inches)

3.8.5.3 Technical data

Table 3- 18 Technical data of line reactors for the Basic Line Modules

| | Unit | 6SL3000-0CE22-0AAx | 6SL3000-0CE24-0AAx | 6SL3000-0CE31-0AAx |
|---|------------------|--------------------|--------------------|--------------------|
| Power | kW | 20 | 40 | 100 |
| Rated current | A _{rms} | 37 | 74 | 185 |
| Power loss (see power loss tables (Page 781)) | W | 130 | 270 | 480 |
| Weight | kg | 5.2 | 11.2 | 21.7 |

3.8.6 Line reactors for Smart Line Modules

3.8.6.1 Interface description

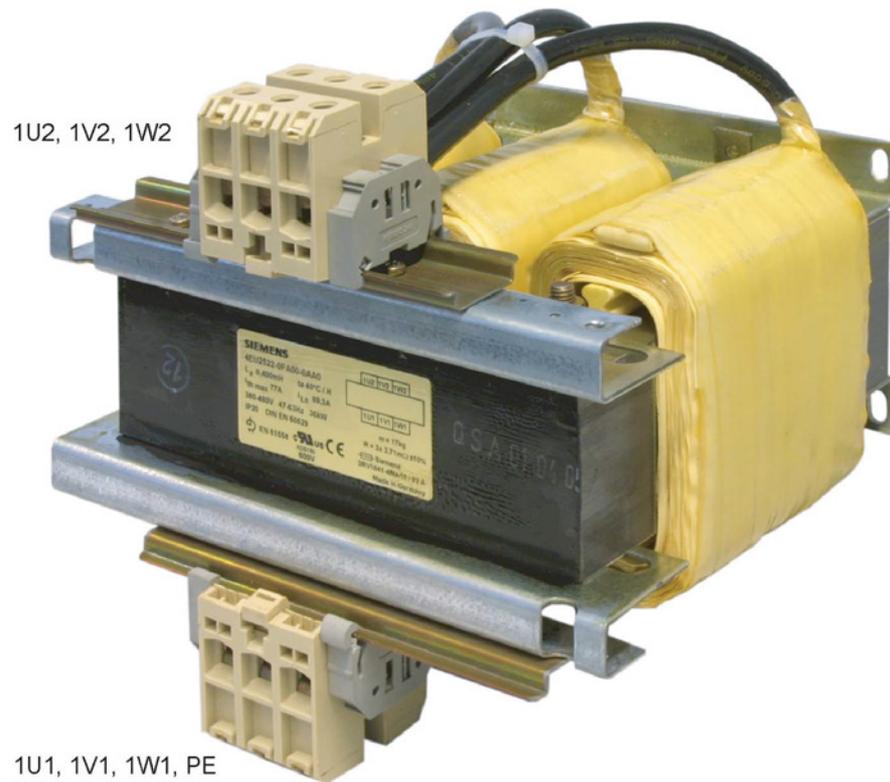


Figure 3-45 Interface overview, line reactors for Smart Line Modules (example: 36 kW)

3.8 Line reactors



Figure 3-46 Interface overview, line reactors for Smart Line Modules (example: 55 kW)

Line/load connection

Table 3- 19 Line and load connection line reactors for Smart Line Modules

| | 6SL3000-0CE15-0AAx | 6SL3000-0CE21-0AAx | 6SL3000-0CE21-6AAx | 6SL3000-0CE23-6AAx | 6SL3000-0CE25-5AAx |
|---|---|--|--|--|--|
| Power | 5 kW | 10 kW | 16 kW | 36 kW | 55 kW |
| Line supply connection 1U1, 1V1, 1W1 | Screw-type terminals 4 mm ² | Screw-type terminals 10 mm ² | Screw-type terminals 10 mm ² | Screw-type terminals 35 mm ² | Screw-type terminals 70 mm ² |
| Load connection 1U2, 1V2, 1W2 | 0.6 ... 0.8 Nm | 1.5 ... 1.8 Nm | 1.2 ... 1.5 Nm | 2.5 Nm | 8 ... 12 Nm |
| PE connection | Screw M4 2 Nm | Screw M4 2 Nm | Terminal studs M5 ¹⁾ | Terminal studs M6 ¹⁾ | Terminal studs M8 ¹⁾ |

1) For ring cable lugs without insulation

3.8.6.2 Dimension drawings

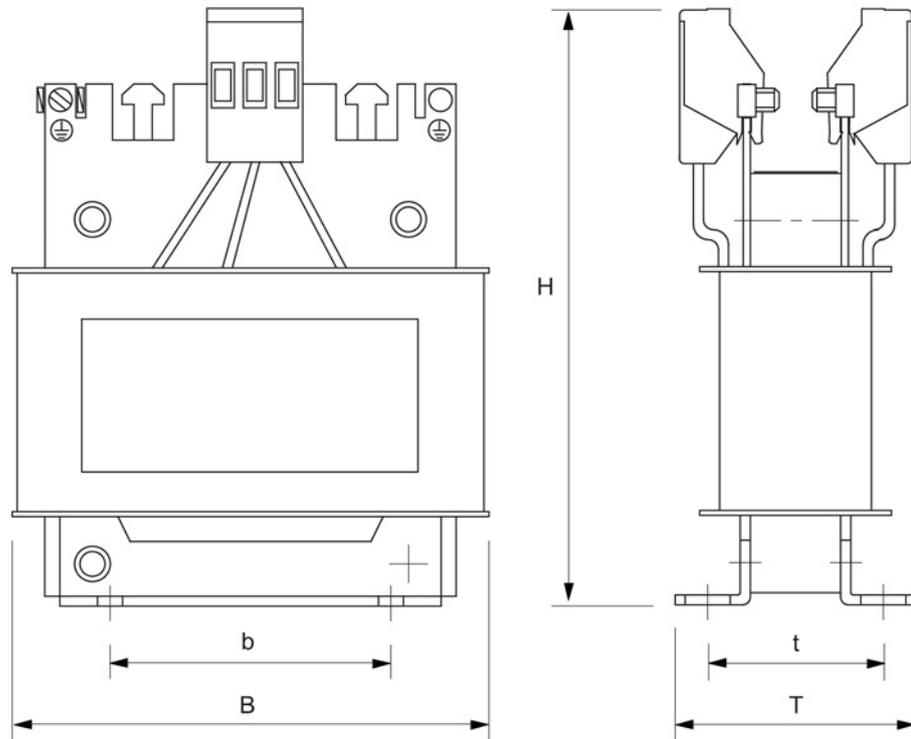


Figure 3-47 Dimension drawing of line reactor for Smart Line Modules 5 kW and 10 kW

Table 3- 20 Dimensions of line reactors for Smart Line Modules (5 kW and 10 kW)

| | Order number 6SL3000- | B [mm] (inches) | b [mm] ¹⁾ (inches) | H [mm] (inches) | D [mm] (inches) | t [mm] ¹⁾ (inches) |
|-------|--------------------------|--------------------|----------------------------------|--------------------|--------------------|----------------------------------|
| 5 kW | 0CE-15-0AAx | 150 (5.91) | 113 (4.53) | 175 (6.89) | 66,5 (2.62) | 49,5 (1.95) |
| 10 kW | 0CE-21-0AAx | 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

3.8 Line reactors

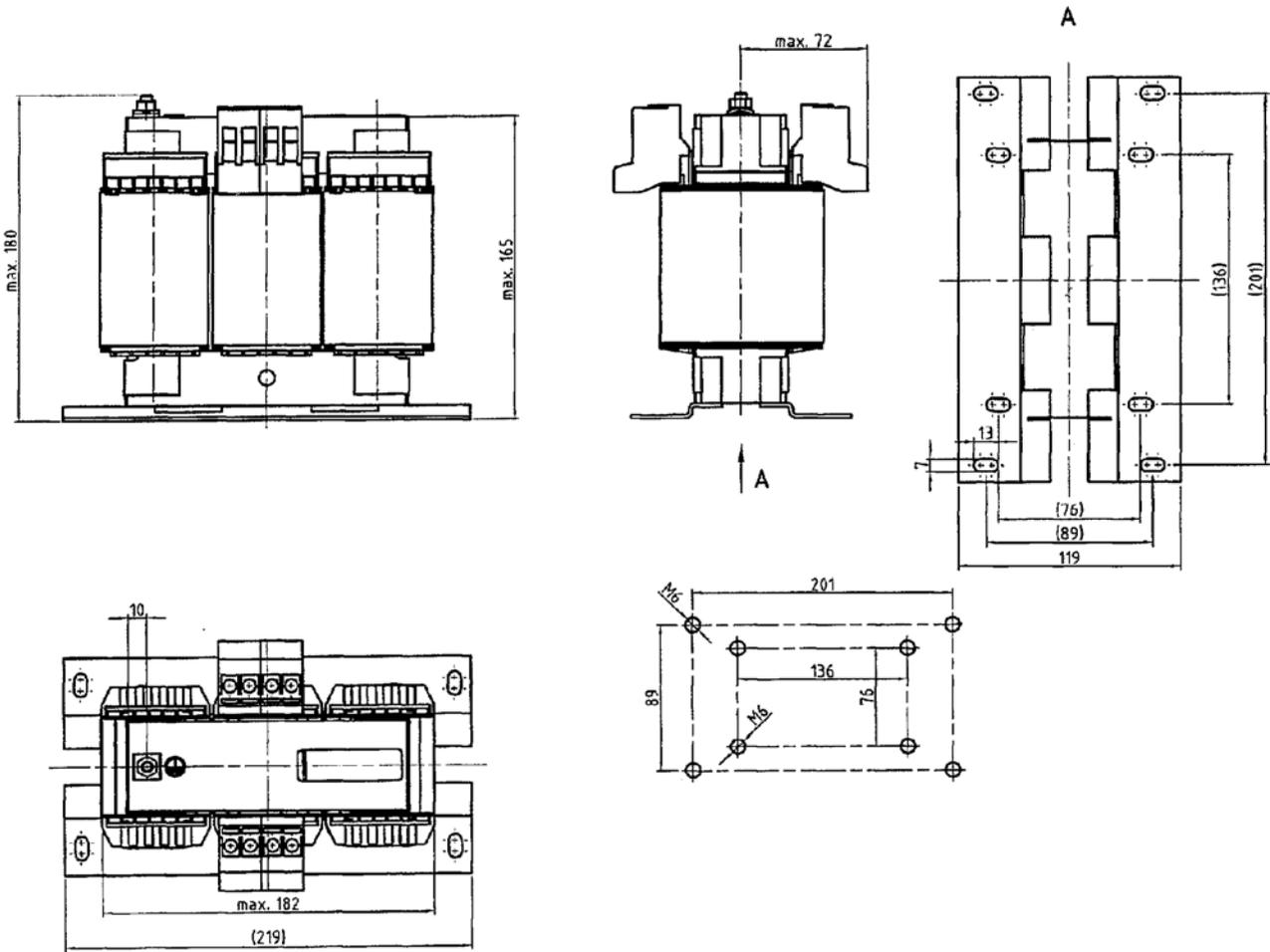


Figure 3-48 Dimension drawing of line reactor for Smart Line Module 16 kW

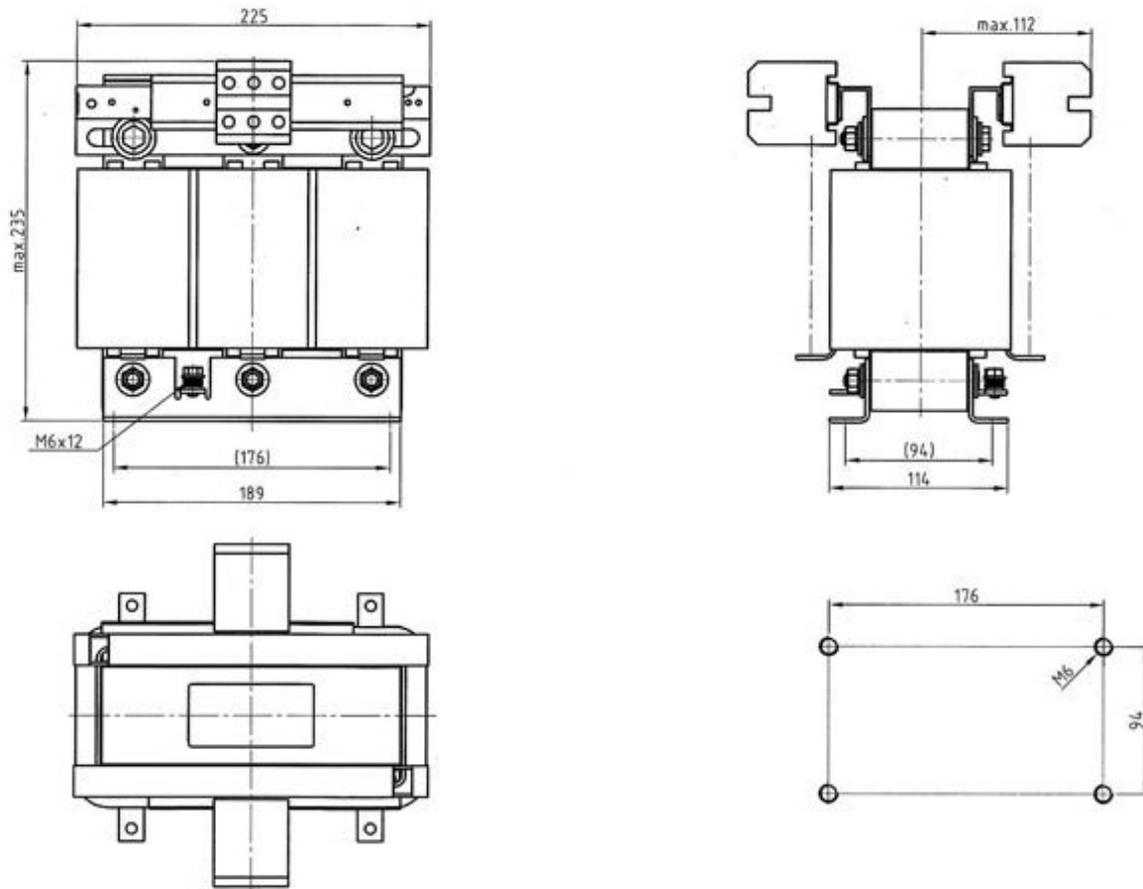


Figure 3-49 Dimension drawing of line reactor for Smart Line Module 36 kW

3.8 Line reactors

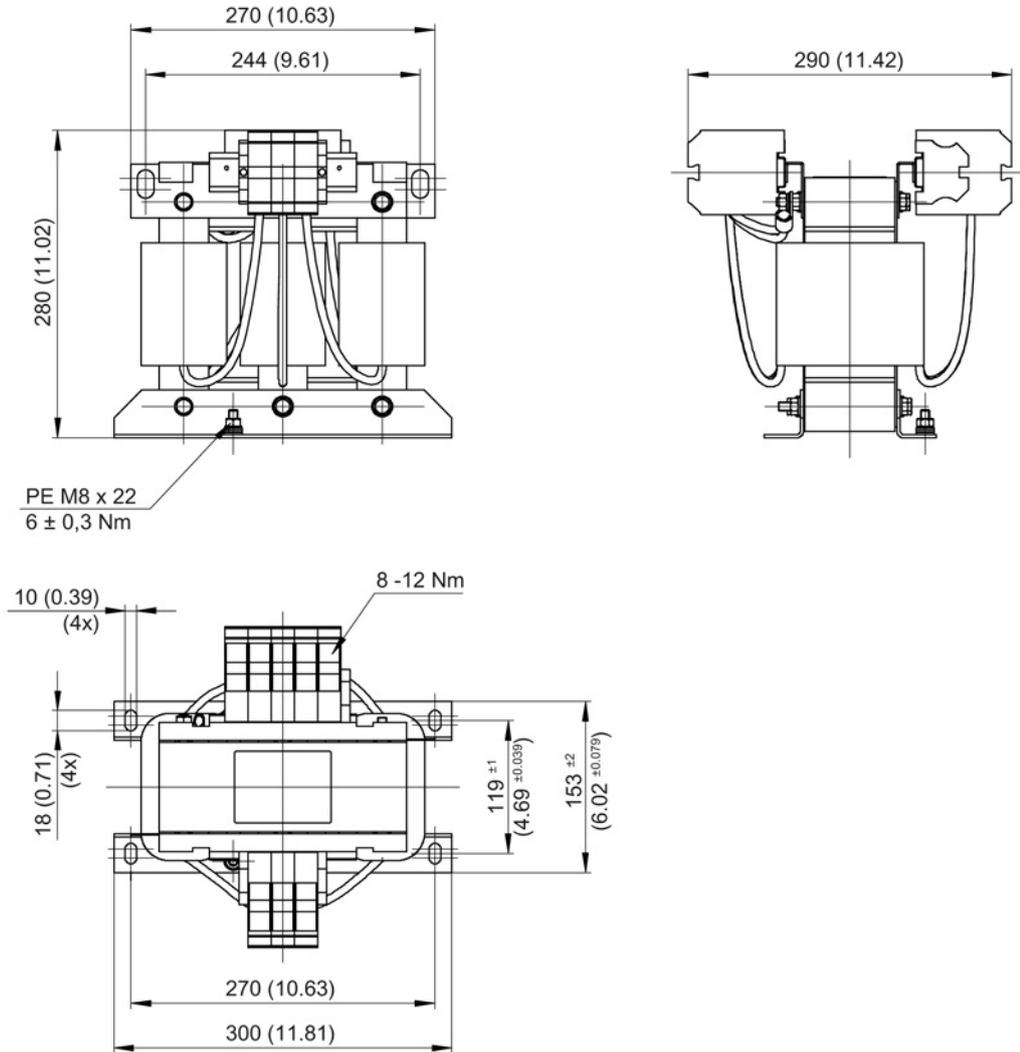


Figure 3-50 Dimension drawing of line reactor for Smart Line Module 55 kW, all dimensions in mm and (inches)

3.8.6.3 Technical data

Table 3- 21 Technical data of line reactors for the Smart Line Module

| | | 6SL3000-0CE15-0AAx | 6SL3000-0CE21-0AAx | 6SL3000-0CE21-6AAx | 6SL3000-0CE23-6AAx | 6SL3000-0CE25-5AAx |
|---|-----------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Power | kW | 5 | 10 | 16 | 36 | 55 |
| Rated current | I_{rms} | 14 | 28 | 35 | 69 | 103 |
| Power loss (see power loss tables (Page 781)) | W | 62 | 116 | 110 | 170 | 190 |
| Weight | kg | 3.7 | 7.5 | 9.5 | 17 | 37 |

3.9 Active Interface Modules internal air cooling

3.9.1 Description

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

They contain the following functional units:

- Line reactors
- Low-frequency/switching frequency filters
- Line filters to EN 61800-3, category C3, max. total motor cable length 350 m (shielded)
- Reduction of the stress on the motor insulation from system-dependent resonance factors

In conjunction with an Active Line Module and an EMC-compliant configuration the following radio interference voltage categories are achieved:

- EN 61800-3 category C3 without an additional line filter up to a total cable length of 350 m (shielded) for 16 kW, 36 kW, 55 kW, 80 kW and 120 kW components
- EN 61800-3 category C2 with an additional Basic Line Filter up to a total cable length of 350 m (shielded) for 16 kW, 36 kW, 55 kW, 80 kW and 120 kW components
- EN 61800-3, category C3, with an additional Basic Line Filter up to a total cable length of
 - 630 m (shielded) for 16 kW and 36 kW components
 - 1000 m (shielded) for 55 kW, 80 kW and 120 kW components.

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.

3.9.2 Safety instructions for Active Interface Modules

| |
|---|
|  WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed |
| If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. |
| <ul style="list-style-type: none">• Adhere to the fundamental safety instructions.• When assessing the risk, take into account residual risks. |

| |
|---|
| NOTICE |
| Destruction of the Active Interface Module through incorrect settings made during commissioning |
| The Active Interface Module can be destroyed through incorrect settings in the software. |
| <ul style="list-style-type: none">• Do not use any SINAMICS firmware version less than V2.5.• Operate Active Interface Modules only with the following settings in the commissioning wizard:<ul style="list-style-type: none">– Set the "Line filter available" option for the Active Line Module.– Select line filter "AIM 400 V xxkW (6SL3100-0BE**-*AB*)". |
| In conjunction with SINAMICS V2.6, the appropriate Active Interface Module is already preset by running the wizard in STARTER. |
| With firmware version SINAMICS V2.5, the default setting in STARTER/SCOUT is "Wideband Line Filter". Parameter p0220 must be set to "AIM". |

| |
|--|
| NOTICE |
| Destruction of the Active Interface Module through incorrect or missing wiring |
| The Active Interface Module can be destroyed through incorrect wiring or a missing 24 V supply. |
| <ul style="list-style-type: none">• Before commissioning the Active Interface Module, it is essential to connect the 24 V DC at connector X124 to supply the fans. Current required ≤ 1.2 A.• Connect the temperature signaling contact of the Active Interface Module to the temperature input of the associated Active Line Module. |

| |
|--|
|  WARNING |
| Fire hazard 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 development of smoke. |
| <ul style="list-style-type: none">• The total cable length between an Active Interface Module and Active Line Module as well as between an Active Interface Module and Basic Line Filter must not exceed 10 m. |



! WARNING

Danger to life through electric shock due to unconnected cable shields

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

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

NOTICE

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

If the Active Interface Module is not operated in a vertical position with the line supply terminals at the bottom, then the component can be damaged.

- Only operate the Active Interface Module in a vertical position with the line connection at the bottom.

Note

Functional disturbances as a result of line supply disturbances

The devices have been tested for standard line supplies according to EN 61800-3. For line supplies with significant disturbances (e.g. THD > 8 %; very high percentage of switching peaks in the range >1 kV), the filter of the line-up can be overloaded as a result of the additional filter power.

- 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

3.9.3 Interface description

3.9.3.1 Overview

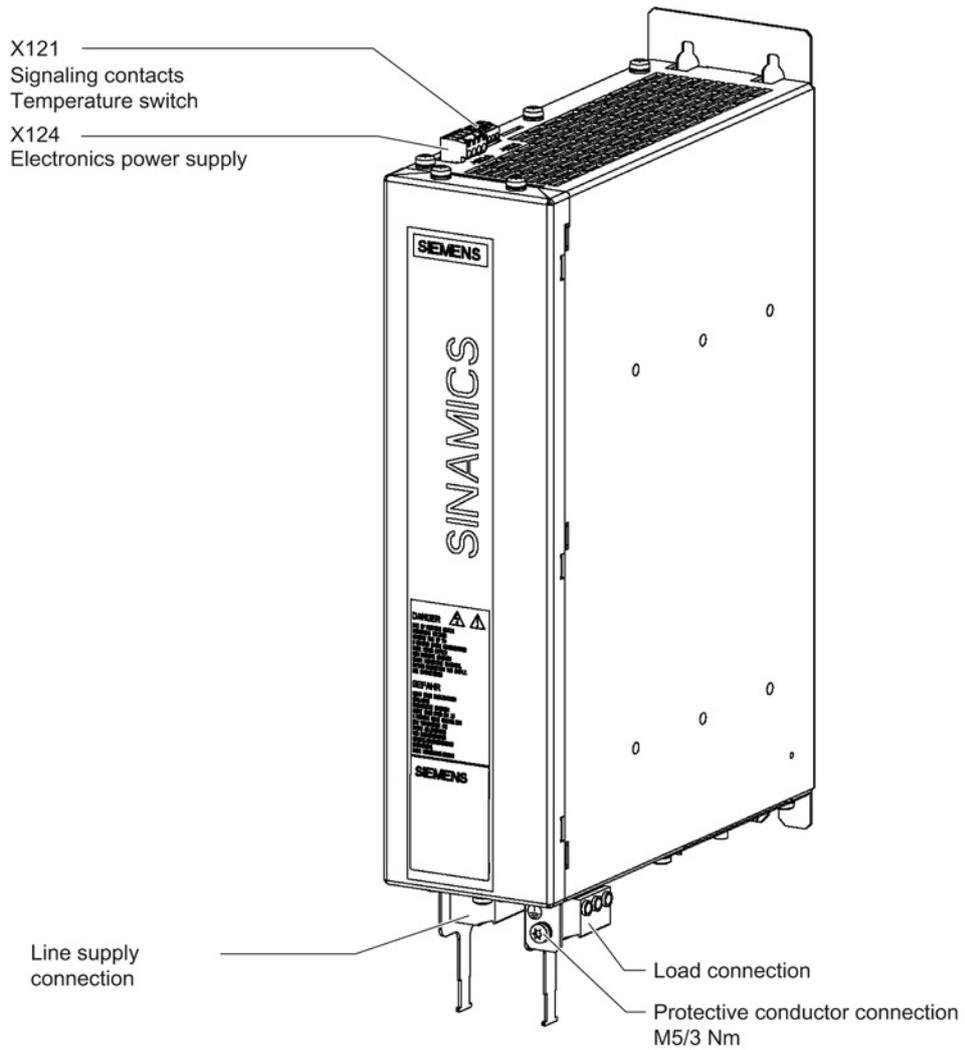


Figure 3-51 Interface overview, Active Interface Module 16 kW

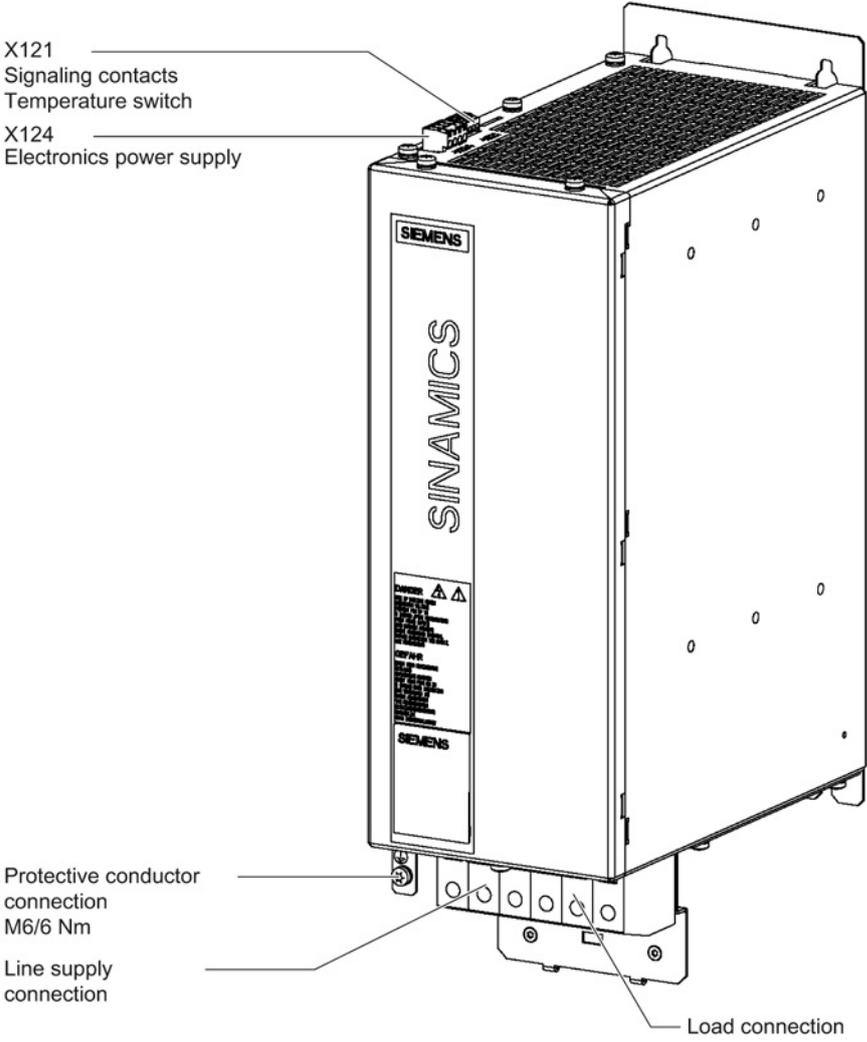


Figure 3-52 Interface overview, Active Interface Module 36 kW

3.9 Active Interface Modules internal air cooling

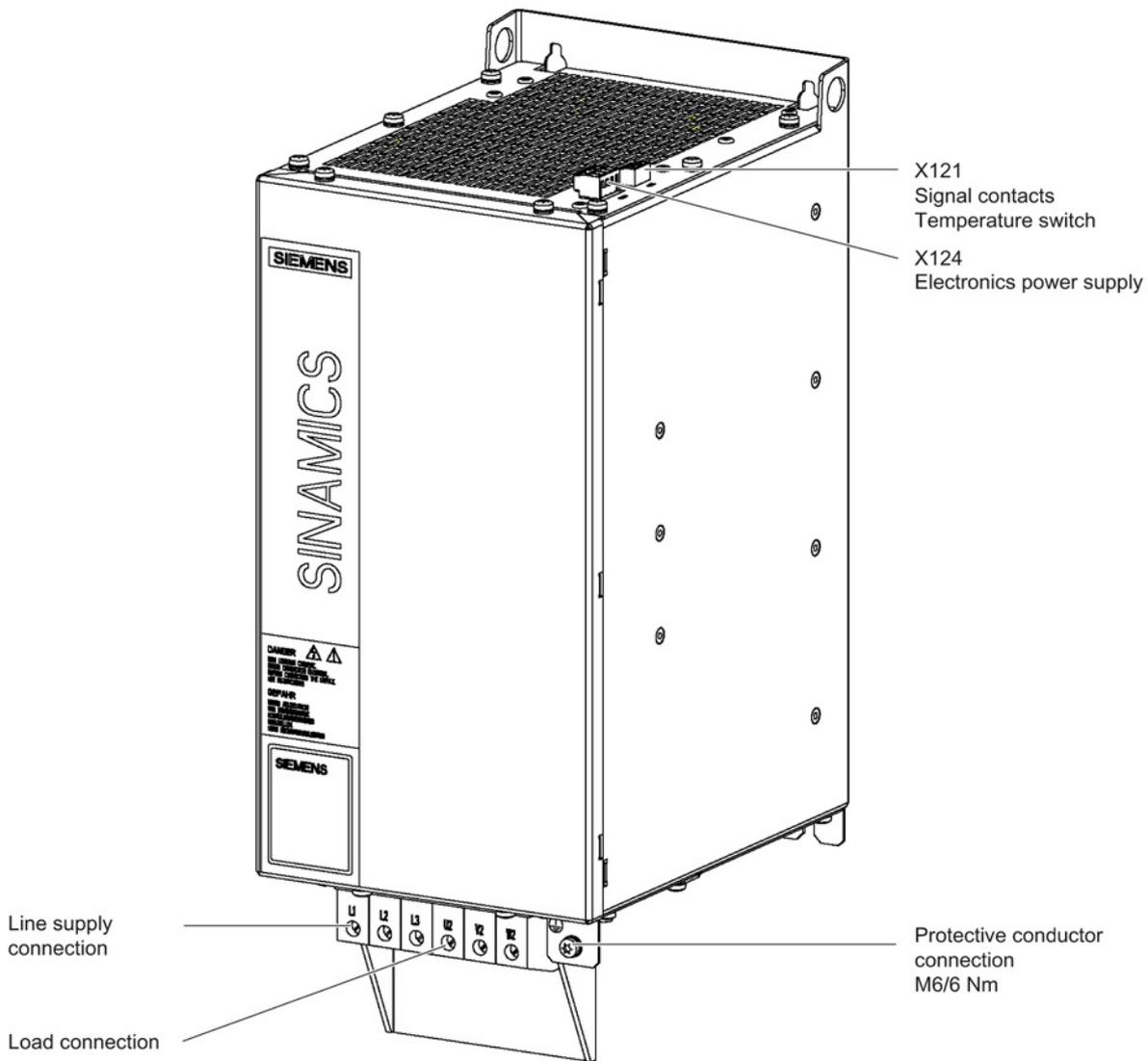


Figure 3-53 Interface overview, Active Interface Module 55 kW

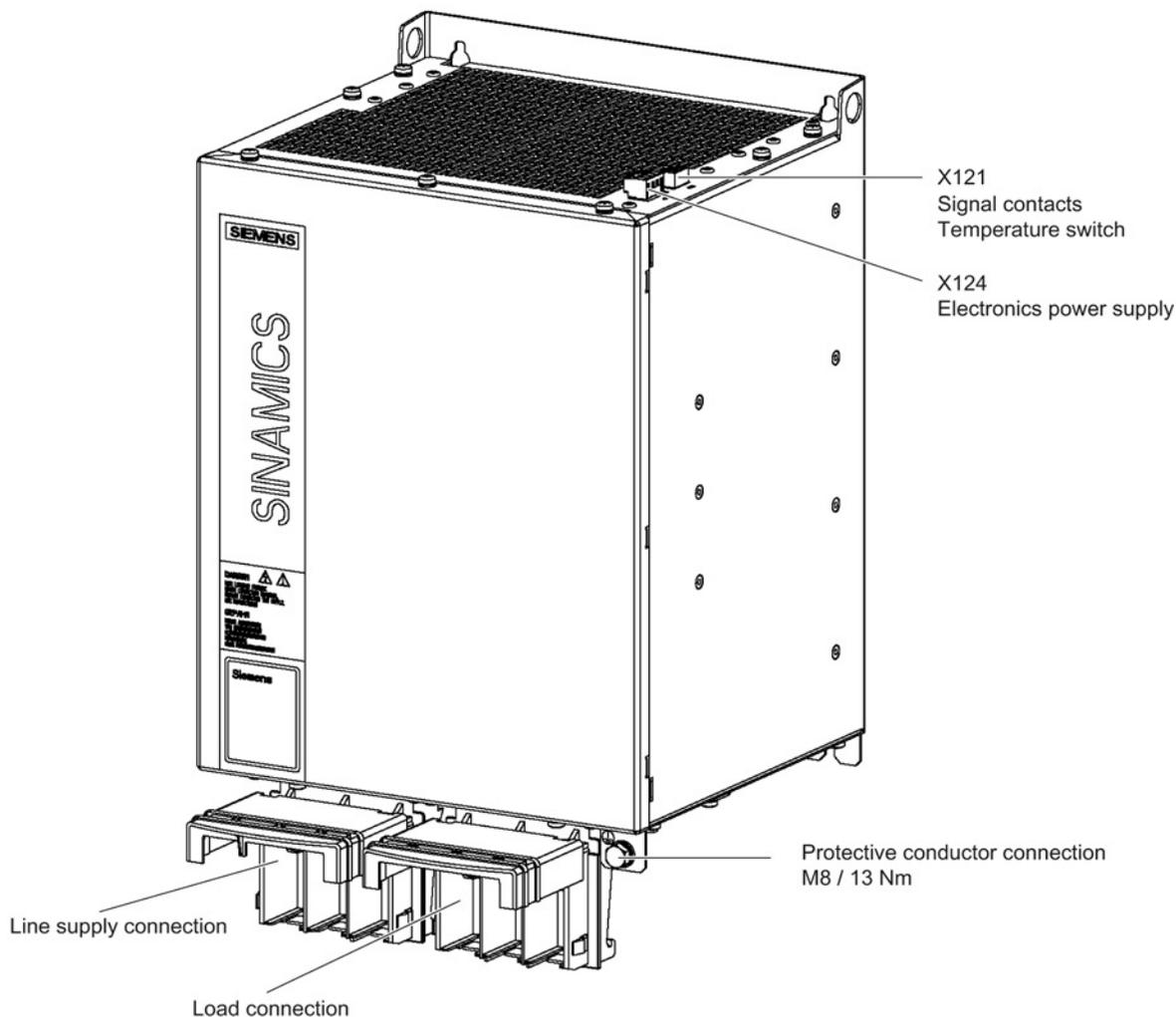


Figure 3-54 Interface overview, Active Interface Module 80 kW and 120 kW

3.9.3.2 Line/load connection

Table 3- 22 Line and load connection Active Interface Module

| | 6SL3100-0BE21-6ABx | 6SL3100-0BE23-6ABx | 6SL3100-0BE25-5ABx | 6SL3100-0BE28-0ABx | 6SL3100-0BE31-2ABx |
|--------------------------------------|--|---|---|--|--------------------|
| Power | 16 kW | 36 kW | 55 kW | 80 kW | 120 kW |
| Line supply connection L1, L2, L3 | Connector, 16 mm ² , 1.7 Nm | Screw terminal 50 mm ² , end sleeve, 6 Nm | Screw terminal 50 mm ² , end sleeve, 6 Nm | Threaded bolt M8, cross-section 120 / 2 x 50 mm ² , 13 Nm ¹⁾ | |
| Load connection U2, V2, W2 | | | | | |

1) For ring cable lugs without insulation

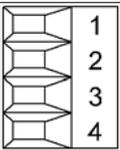
3.9 Active Interface Modules internal air cooling

Note

The connection terminals of the 36 kW Active Interface Module are only certain to be safe from touch protection according to EN 60529 if cables with a minimum cross-section of 25 mm² and insulated end sleeves are used.

3.9.3.3 X121 temperature sensor and fan control

Table 3- 23 Plug-in screw terminal X121

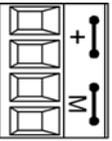
| | Terminal | Designation | Technical data |
|--|----------|---------------------------------------|--|
|  | 1 | +Temp | Output temperature switch Must be connected to interface X21 of the Active Line Module. |
| | 2 | -Temp | Temperature switch output |
| | 3 | +24 V power supply for digital inputs | Current carrying capacity: 500 mA |
| | 4 | Disable Fan | The fan can be disabled. The fan may be disabled only while the Active Line Module is disabled. |
| Type: Screw terminal 1 (Page 755) Max. connectable cross-section: 1.5 mm ² | | | |

Note

If the terminals are not connected (or connected with low level), the fan will run in continuous mode.

3.9.3.4 X124 Electronics power supply

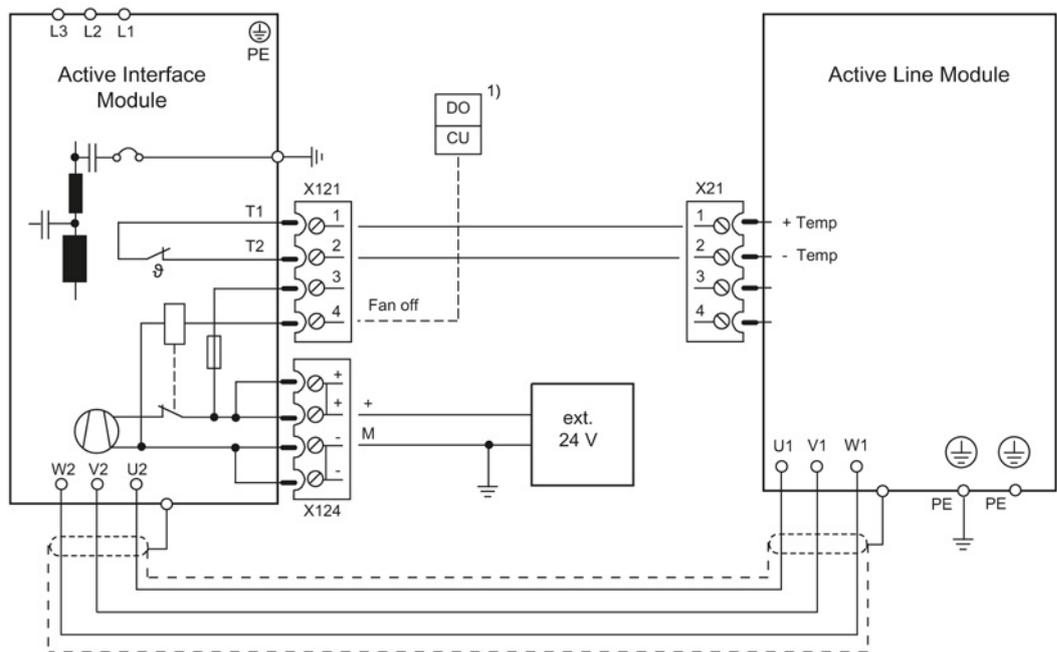
Table 3- 24 X124 Electronics power supply

| | Terminal | Function | Technical data |
|--|----------|--------------------------|--|
|  | + | Electronics power supply | Voltage: 24 VDC (20.4 ... 28.8 V) Current consumption: max. 1.6 A Max. current via jumper in connector: 20 A at 55° C |
| | + | Electronics power supply | |
| | M | Electronics ground | |
| | M | Electronics ground | |
| Type: Screw terminal 2 (Page 755) Max. connectable cross-section: 2.5 mm ² | | | |

Note

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

3.9.4 Connection example



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

Figure 3-55 Connection example: Active Interface Module

3.9.5 Dimension drawings

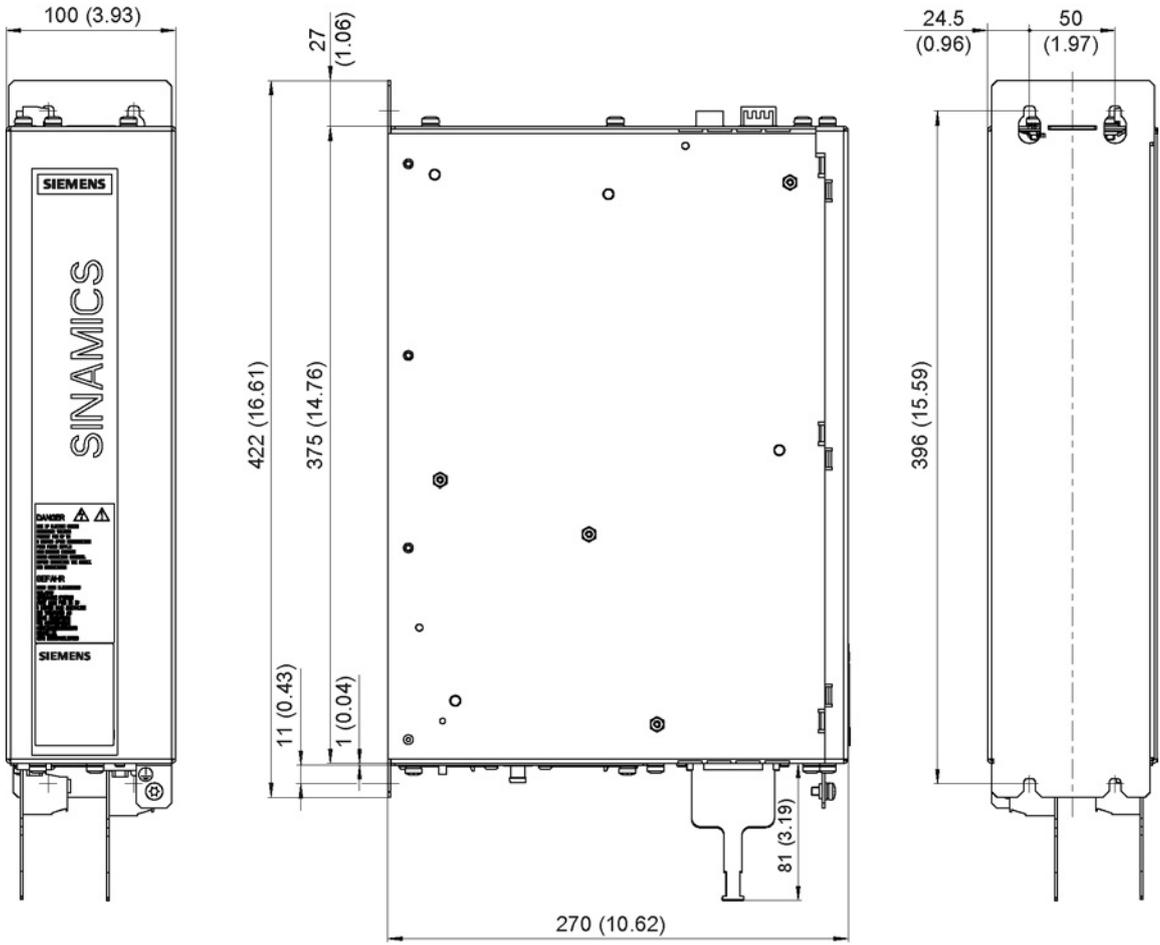


Figure 3-56 Dimension drawing of Active Interface Module 16 kW, all dimensions in mm and (inches)

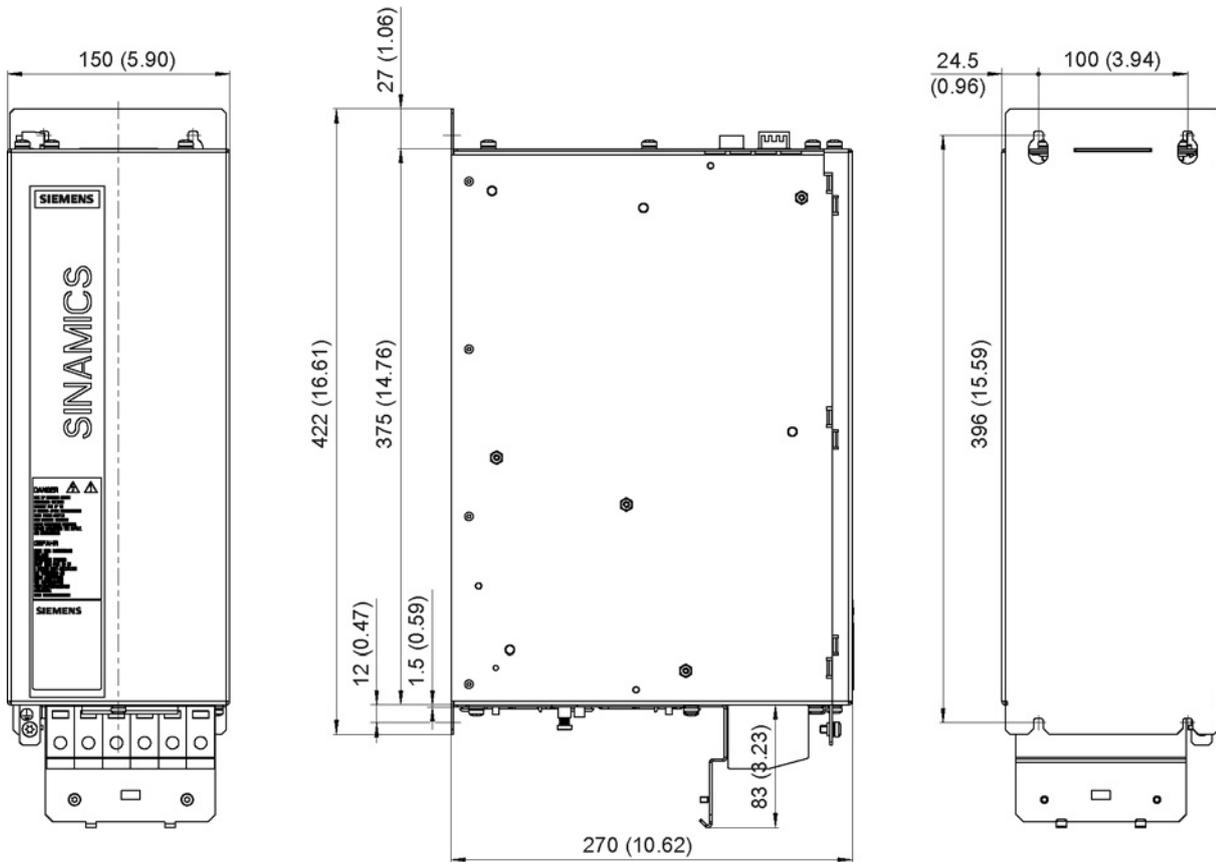


Figure 3-57 Dimension drawing of Active Interface Module 36 kW, all dimensions in mm and (inches)

3.9 Active Interface Modules internal air cooling

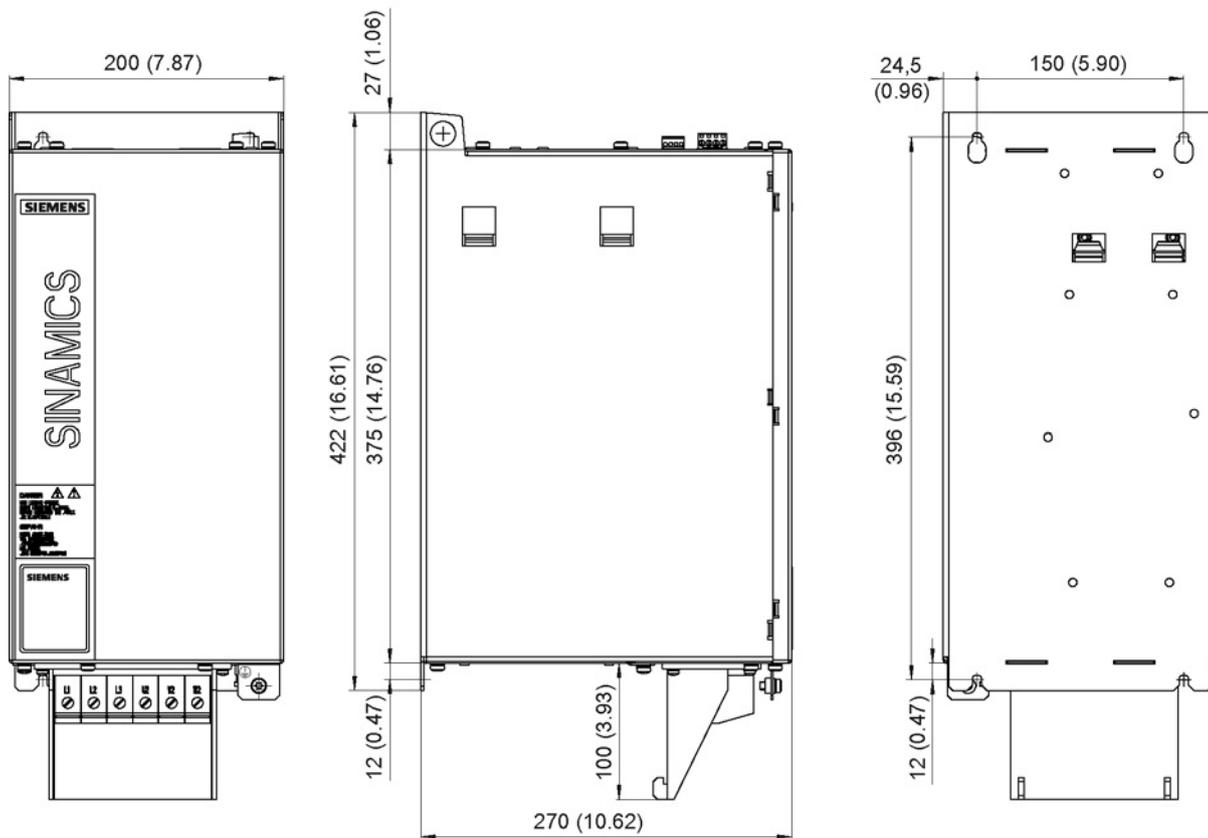


Figure 3-58 Dimension drawing of Active Interface Module 55 kW, all dimensions in mm and (inches)

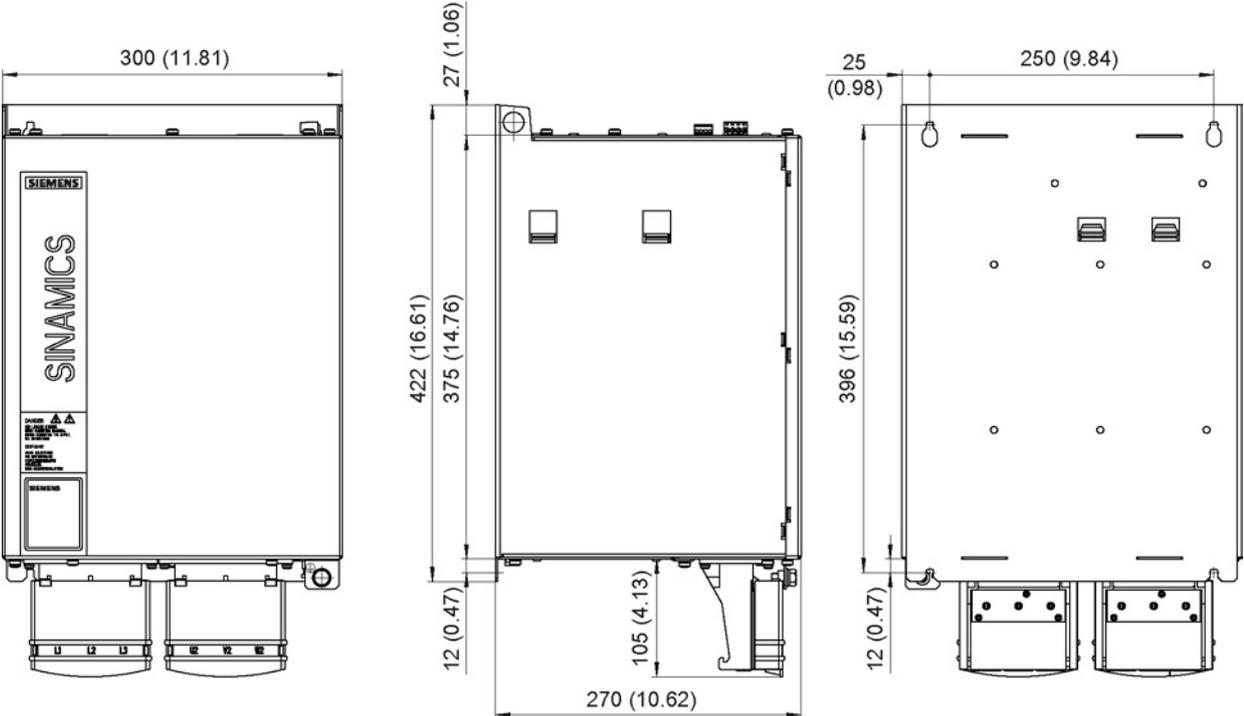
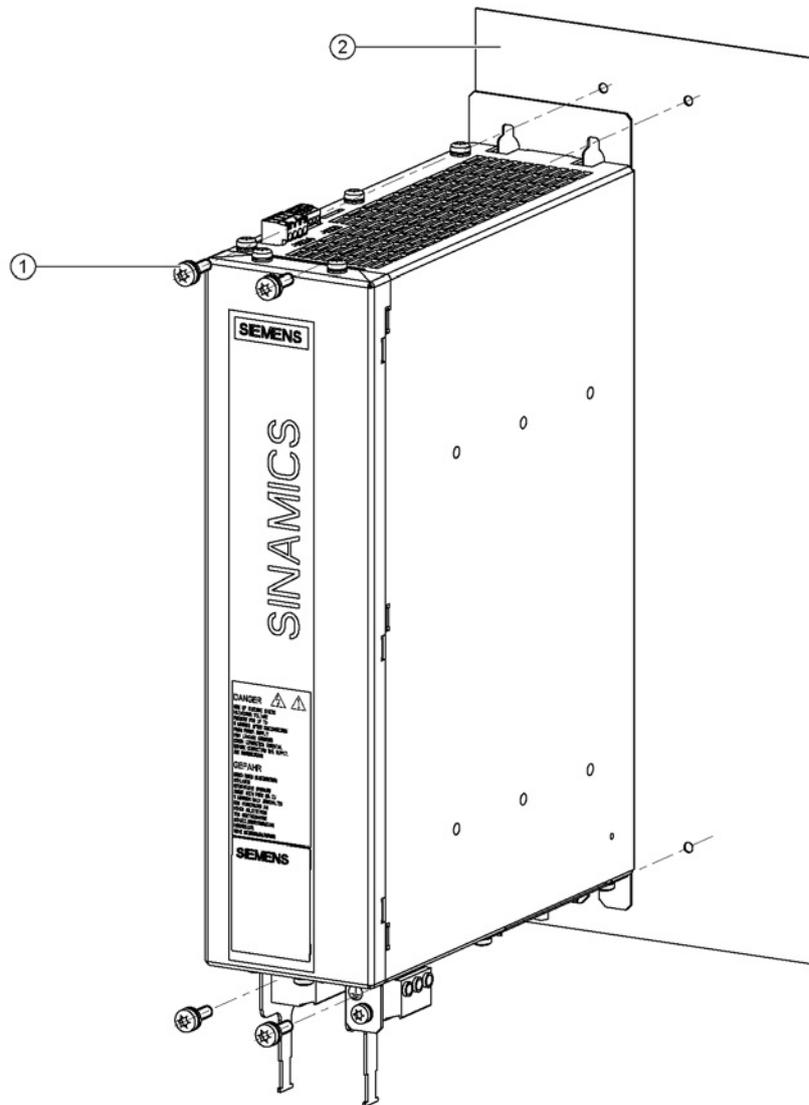


Figure 3-59 Dimension drawing of Active Interface Module 80 kW and 120 kW, all dimensions in mm and (inches)

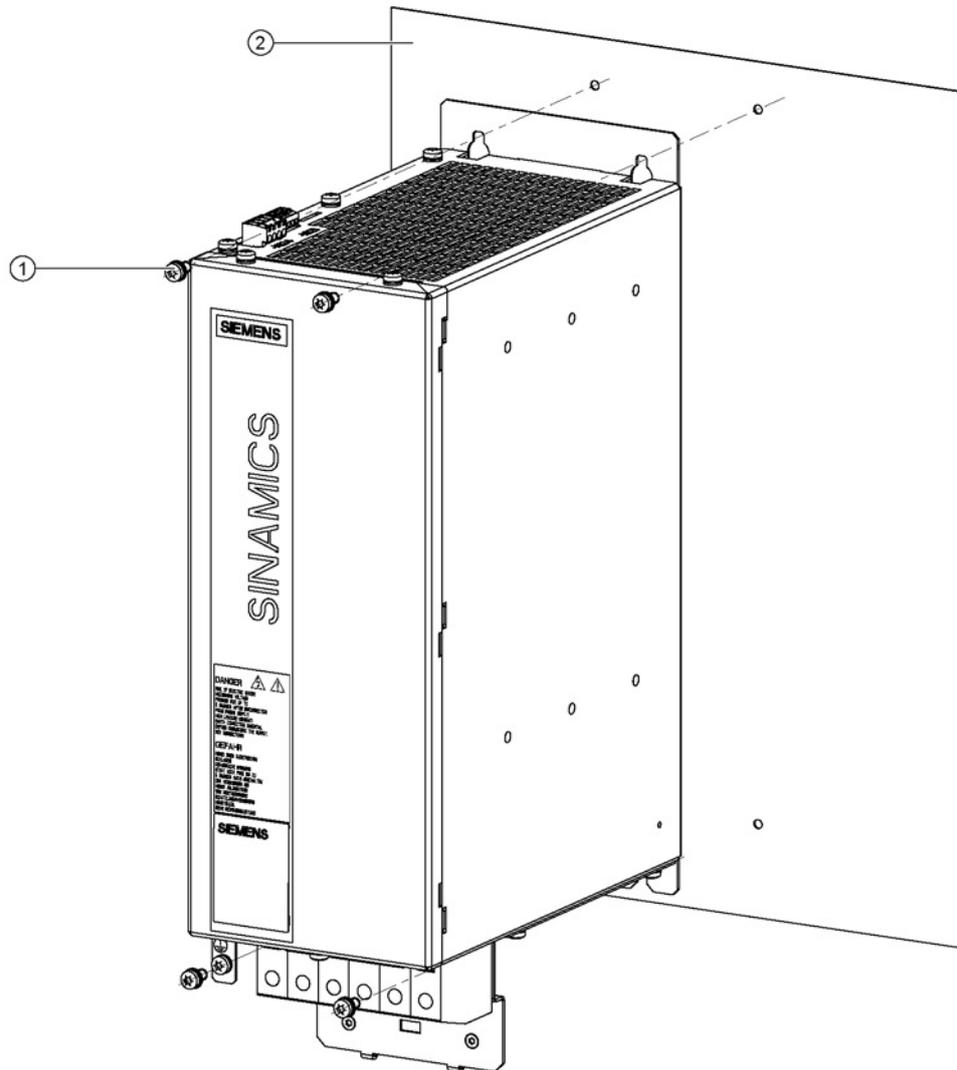
3.9.6 Installation

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 Mounting panel
- ② M6 screws, Torx T30 (not hexagon-head screws)

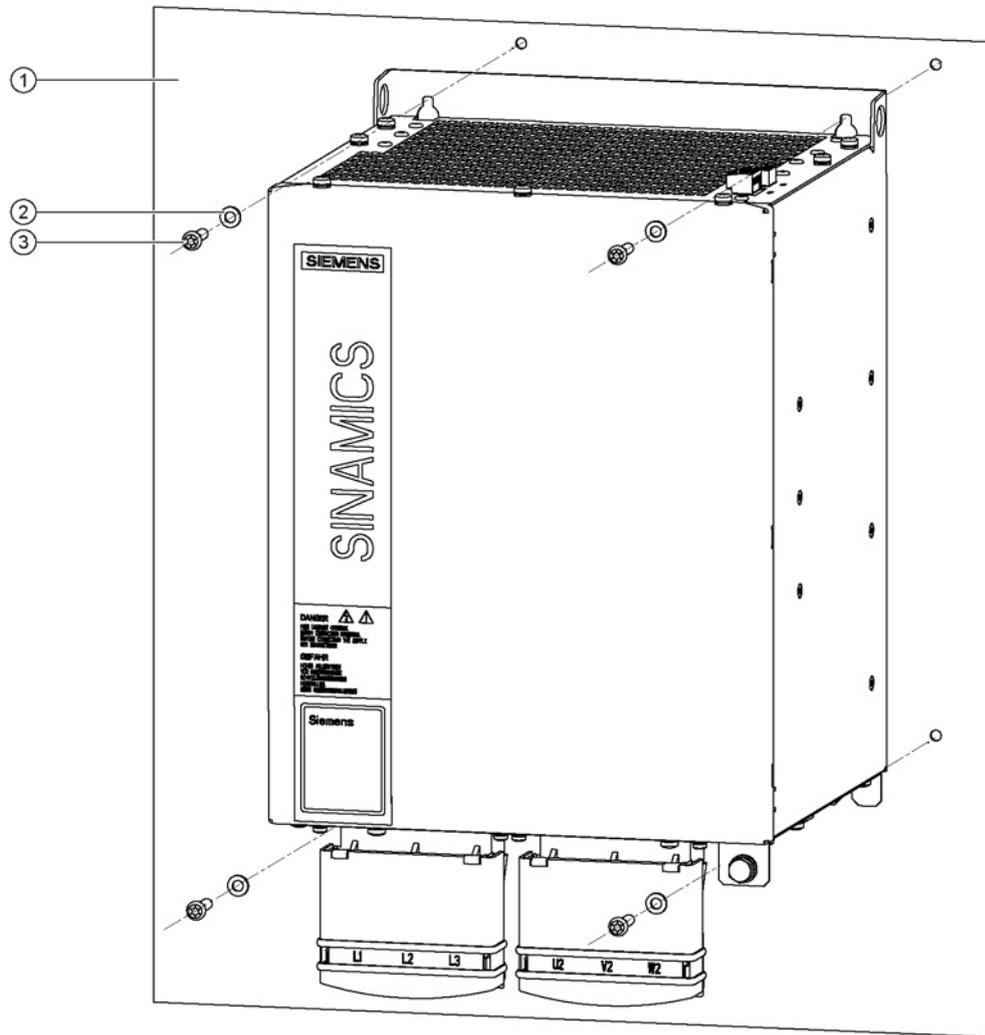
Figure 3-60 Installation of 16 kW Active Interface Module



- ① Mounting panel
- ② M6 screws, Torx T30 (not hexagon-head screws)

Figure 3-61 Installation of 36 kW Active Interface Module

3.9 Active Interface Modules internal air cooling



- ① Mounting panel
- ② Washer
- ③ M6 screws, Torx T30 (not hexagon-head screws)

Figure 3-62 Installation of 55 kW Active Interface Module

Tightening torque for all screws: 6 Nm

Table 3- 25 Protective conductor connection

| Active Interface Module | |
|-------------------------|--------------------------|
| 16 kW, 36 kW, 55 kW | Threaded hole M6 / 6 Nm |
| 80 / 120 kW | Threaded hole M8 / 13 Nm |

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

IT system

In IT systems, all live parts are isolated from ground, or one point is connected to ground through an impedance. The exposed conductive parts of the electrical installation are either grounded separately or grounded together, or jointly connected to the system ground.

Only Line Modules without line filters are to be operated on this system type. The emitted interference can exceed the limit values of category C3. The Active Interface Module must be set for operation on an IT 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 connection bracket for the interference-suppression capacitor in the Active Interface Module must be removed. The connection bracket for the interference-suppression capacitor is located on the lower side of the component.

If the connection bracket for the interference-suppression capacitor is not removed, an insulated supply will be grounded and may cause tripping of the isolation monitor in the case of failure.

There are no limits of interference for isolated-neutral systems. Removing the connection bracket to the interference-suppression capacitor eliminates the effect of the filter against ground. It nevertheless makes sense to install an Active Interface Module because the clock frequency filter is still active and also protects other loads on the same network from clock frequency disturbances.



DANGER

Danger to life caused by 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.

3.9 Active Interface Modules internal air cooling

| | | |
|--|---|--|
|  |  |  |
| <p>Remove the connection bracket to the noise suppression capacitor using a Tx25 screwdriver</p> | <p>Withdraw the connection bracket.</p> | <p>Connection bracket for the interference-suppression capacitor</p> |

Note

Installing the connection bracket for the interference-suppression capacitor

For operation in other line supplies, the connection bracket must be reinstalled and fixed with a tightening torque of 1.8 Nm.

3.9.8 Electrical tests

Tests on the 16 kW Active Interface Module

Electrical tests on the 16 kW Active Interface Module may only be performed via the associated terminal connectors. The socket contacts will expand if unsuitable testing equipment is used (e.g. 4 mm safety plugs inserted directly into device sockets).

Using such equipment will result in contact problems involving the Active Interface Module's power connections.

Table 3- 26 Electrical test on the 16 kW Active Interface Module

| | | |
|---|---|--|
|  |  |  |
| <p>Active Interface Module 16 kW</p> | <p>RIGHT: Measurement with original terminal connectors</p> | <p>WRONG: Measurement via the device sockets</p> |

3.9.9 Technical data

Table 3- 27 Technical data

| Active Interface Module | 6SL3100- | 0BE21-6ABx | 0BE23-6ABx | 0BE25-5ABx | 0BE28-0ABx | 0BE31-2ABx |
|---|-------------------|---------------------------------|--------------|--------------|--------------|---------------|
| | | 16 kW | 36 kW | 55 kW | 80 kW | 120 kW |
| P _{max} | kW | 35 | 70 | 110 | 131 | 175 |
| I _{rated} | A | 27 | 60 | 88 | 132 | 200 |
| I _{max} | A | 59 | 117 | 176 | 218 | 292 |
| Current requirement of the 24 VDC electronics power supply | A | 0,25 | 0,49 | 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 781)) | W | 270 | 340 | 380 | 490 | 585 |
| Weight | kg | 10,7 | 18,5 | 21 | 29 | 35,5 |
| Connection cross-section | mm ² | 10 | 35 | 50 | 120 | 120 |
| PE connecting studs | | M5 | M6 | M6 | M8 | M8 |

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

3.10 Combining line reactors and line filters

| Selected combinations | | | | | | | | Achievable characteristics | | | | Available for | | | | | | | | | | |
|-----------------------|-------------------|-------------------|-------------------|----------------------|------------------|-----------------|-------------------------|--|--|--|---|-------------------------------|------|-------|-------|-------|-------|-------|-------|-------|--------|--------|
| Active Line Module | Smart Line Module | Basic Line Module | Basic Line Filter | Wideband Line Filter | HFD line reactor | FE line reactor | Active Interface Module | DC link step-up factor or rectified value B6 | RFI suppression acc. to | | Integrated clock frequency filter 8 kHz | Can be operated on IT systems | 5 kW | 10 kW | 16 kW | 20 kW | 36 kW | 40 kW | 55 kW | 80 kW | 100 kW | 120 kW |
| | | | | | | | | | EN 61800-3-C2 total cable length, shielded | EN 61800-3-C3 total cable length, shielded | | | | | | | | | | | | |
| X | | | | | X | | | 1,4 - 1,6 | No ³⁾ | No ³⁾ | No | Yes | | | X | | | | X | | | X |
| X | | X | | | X | | | 1,4 - 1,6 | 150 m | 150 m | No | No | | | X | | X | | X | | | |
| X | | | X | | | | | 1,4 - 1,6 | 350 m | 350 m | Yes | No | | | X | | X | | X | | | X |
| X | | | | | X | | X | 1,4 - 2 ²⁾ | No ³⁾ | 350 m | Yes | Yes ¹⁾ | | | X | | X | | X | | | X |
| X | | | X | | | | X | 1,4 - 2 ²⁾ | 350 m | 630 m | Yes | No | | | X | | X | | X | | | X |
| | X | | X | | | X | | 1,35 | No ³⁾ | 1,000 m | Yes | No | | | X | | X | | X | | | |
| | X | | X | | X | | | 1,35 | 350 m | 350 m | Not relevant | Yes | | | X | | X | | X | | | |
| | | X | | | X | | | 1,35 | No ³⁾ | 350 m | Not relevant | No | | | X | | X | | X | | | X |
| | | X | X | | X | | | 1,35 | 350 m | 630 m | Not relevant | Yes ¹⁾ | | | | | | | | | | |
| | | | X | | X | | | 1,35 | 350 m | 630 m | Not relevant | No | | | X | | X | | X | | | X |

Figure 3-63 Combining line reactors and line filters

- 1) Remove connection bracket
- 2) Observe the insulation strength of the motors
- 3) Only permissible with vector control and sine-wave filter

Note

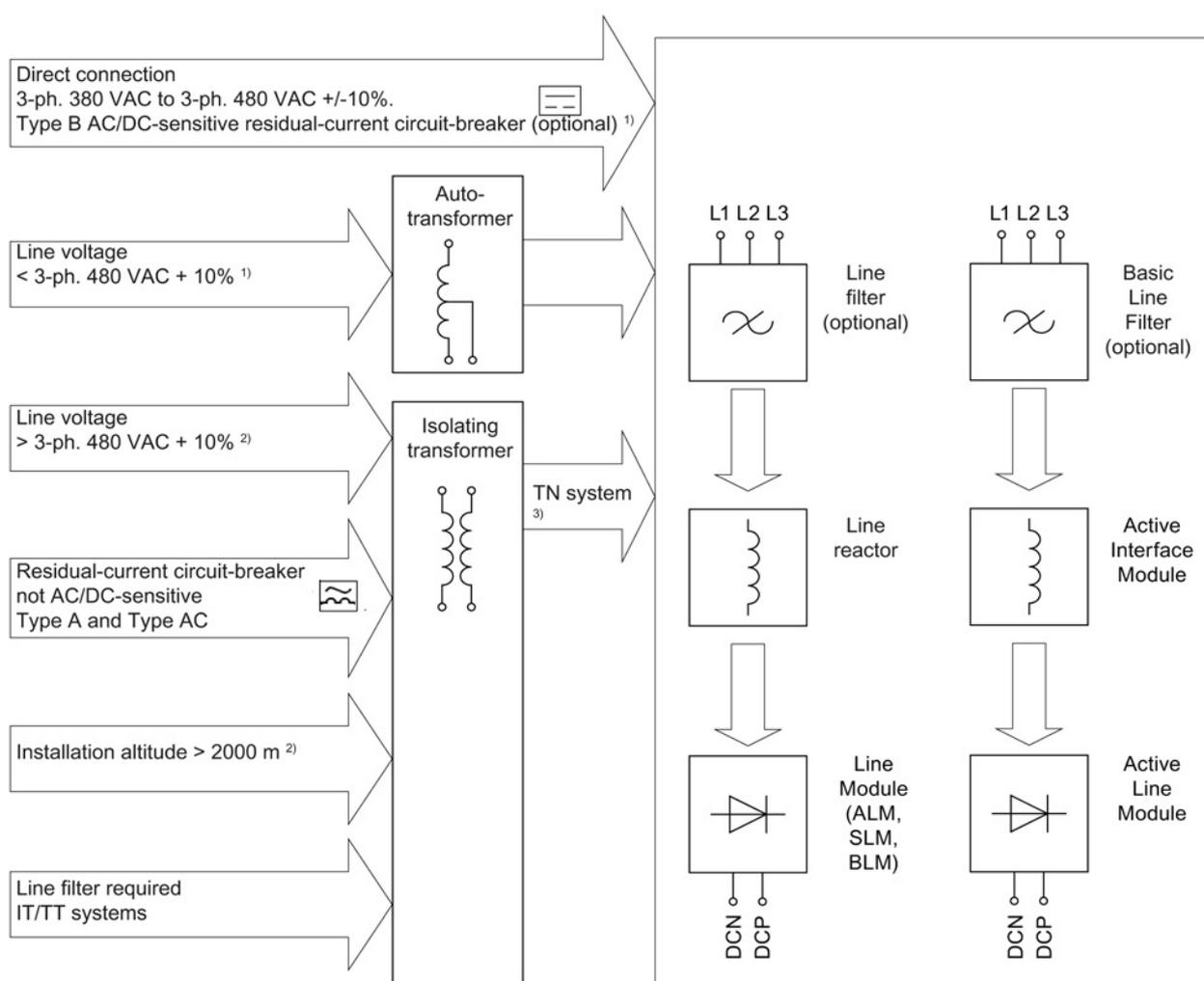
Ideally, new systems using Active Line Modules should be designed with Active Interface Modules as line connection components.

3.11 Line connection variants

3.11.1 Ways of connecting the line supply

A distinction is made between the following line connection versions:

- Line connection components to be directly connected to the line supply
- Operating line connection components via an autotransformer
- Operating line connection components via an isolating transformer



1) TN or TT systems with grounded neutral point or IT systems with monitoring

2) Any line system

3) With grounded neutral point

Figure 3-64 Overview of line connection versions

Note

Permissible line supplies

In combination with the drive system, the motors are generally approved for operation on TN and TT systems with grounded neutral point and on IT systems.

 **WARNING**

Fire hazard for the motor due to overload of the insulation

There is higher stress on the motor insulation through a ground fault in an IT system or grounded line the conductor.

TT line supply systems generally have a grounded line conductor.

A possible result is the failure of the insulation with a risk for personnel as a result of smoke and fire.

- For IT line supplies, use a monitoring device that signals an insulation fault.
- Correct the fault as quickly as possible in IT systems so the motor insulation is not overloaded.
- For line supplies with grounded line conductor, use an isolating transformer with grounded neutral point (on the secondary) between the line supply and the drive system.

NOTICE

Destruction of the motor when directly connected to the three-phase line supply

The motor will be destroyed if it directly connected to the three-phase line supply.

- Connect the motor according to the circuit diagram provided (see the connection examples for the Motor Module).

3.11.2 Operating line connection components on the line supply

The SINAMICS S Booksize converter system is rated for direct operation on TN, TT, and IT line supply systems with a rated voltage of 380 V 3 AC to 480 V 3 AC.

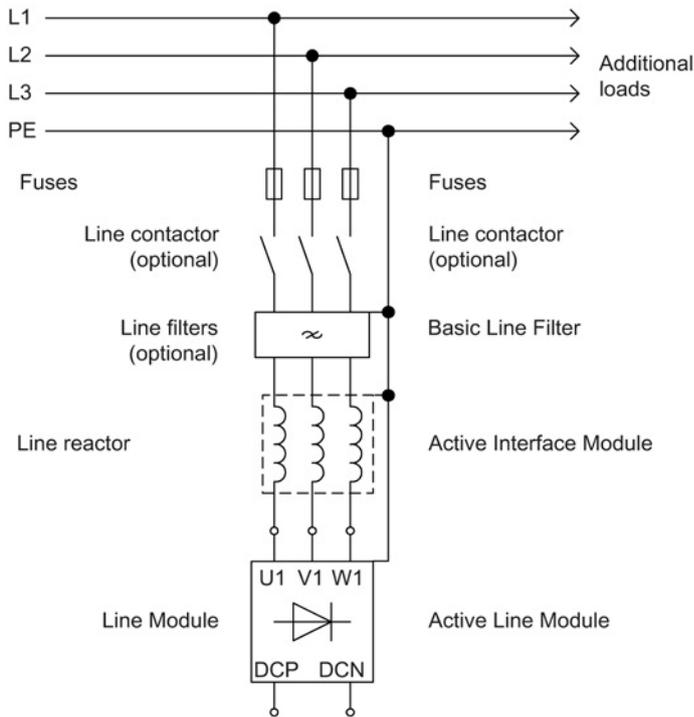


Figure 3-65 Direct operation on the line supply

3.11.3 Operation of the line connection components via a transformer

3.11.3.1 Safety instructions for line connection components

| |
|---|
| NOTICE |
| Destruction or damage to additional loads as a result of undesirable line harmonics |
| Line harmonics can occur if line filters that differ from those listed in this Manual are used. These can disturb or damage other loads connected to the line supply. |
| <ul style="list-style-type: none">• Only use line filters that are listed in this Manual. |

| |
|--|
| NOTICE |
| Destruction or damage to additional loads as a result of incorrect connection |
| When incorrectly connecting the line filter, other loads can be destroyed or damaged. |
| <ul style="list-style-type: none">• Connect additional loads upstream of the SINAMICS line filter (if required, via a separate line filter). |

| |
|--|
| NOTICE |
| Damage and faults of devices connected to the Line Module as a result of overcurrent protective devices that do not trip |
| Overcurrent protective devices that do not trip can result in faults at the SINAMICS Line Modules. It can also result in faults and damage to other devices that are connected at the same point of the line supply as the Line Module. |
| <ul style="list-style-type: none">• In order to avoid material damage, the short-circuit power must correspond to what is specified in the documentation. This then ensures that the installed overcurrent protective devices will trip. |

Note

If, for Line Modules, a transformer is used, this does not replace the external line reactor.

3.11.3.2 Line supply connection conditions for Line Modules

Table 3- 28 Line supply connection conditions for Line Modules

| Module | Description ¹⁾ |
|---|---|
| Basic Line Module | Operation on line supplies from $S_{Kline}/P_n \geq 30$ |
| Smart Line Module | Operation on line supplies from $S_{Kline}/P_n \geq 70$ |
| Active Line Modules with Active Interface Modules | Operation on line supplies from $S_{Kline}/P_n \geq 30$ ²⁾ |
| Active Line Module | Operation on line supplies from $S_{Kline}/P_n \geq 70$ |

1) S_{Kline} = 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 $\pm 10\%$, it must be checked as to whether the motor systems are suitable for this mode.

If a TN system is required on the secondary side, for example, when using a Wideband Line Filter, a transformer with grounded neutral point must be used. However, the loop resistance must be small enough to trigger the fuses as fast as required. Also see Chapter Overcurrent protection using line fuses and circuit breakers (Page 51).

Note

System fault level at the infeed point

In order to comply with EMC limit values, Category C2 according to EN 61800-3, the system fault level at the infeed point must be at least a factor 70 higher than the rated power of the integrated infeed.

Vector group

Any vector group with the neutral point brought out on the secondary side.

3.11 Line connection variants

3.11.3.3 Dimensioning an isolating transformer / autotransformer for several loads

A SINAMICS Line Module and other loads/machines should be connected via an isolating transformer / autotransformer (matching transformer) to the line supply. The following diagram shows the connection using an isolating transformer as an example.

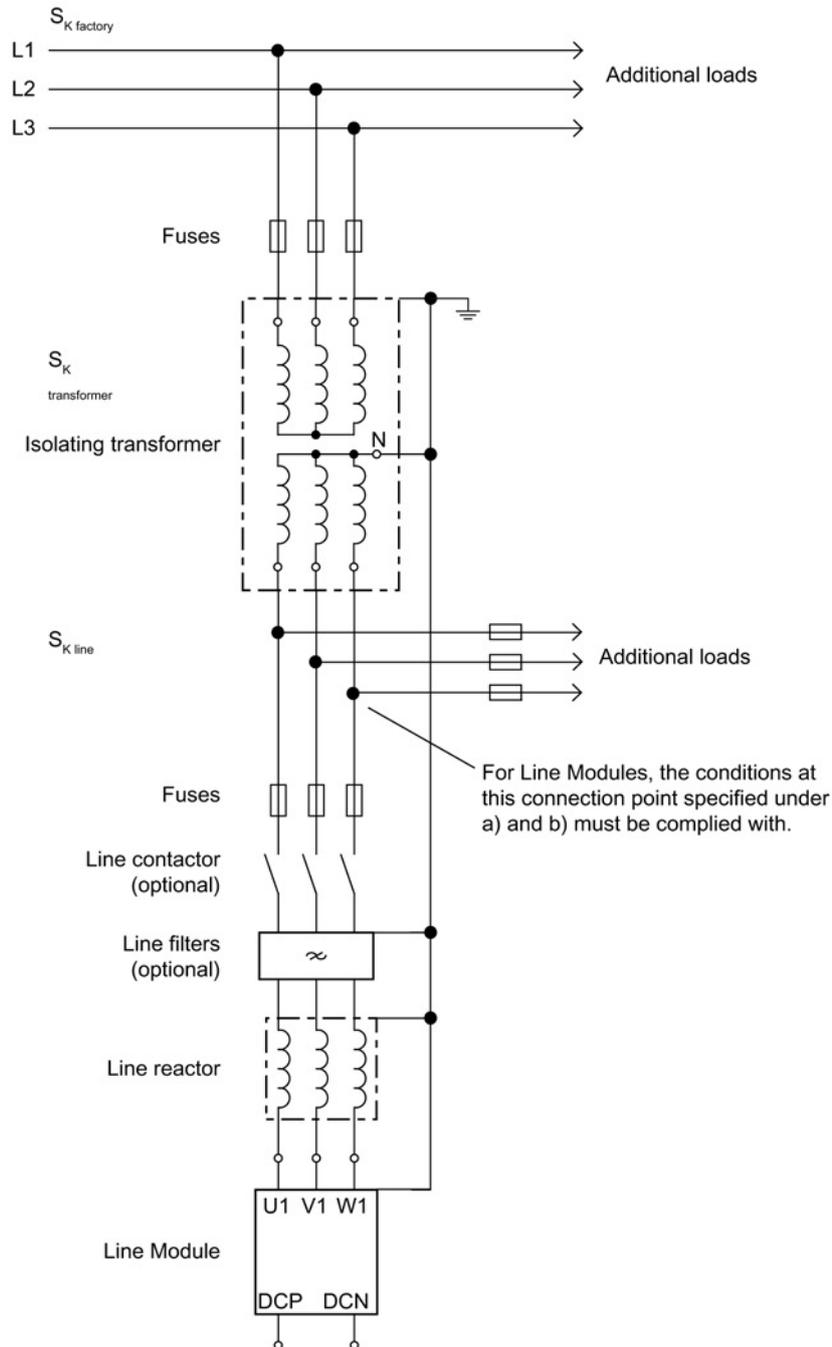


Figure 3-66 Operation of a Line Module and additional loads via an isolating transformer

An isolating transformer / autotransformer (matching transformer) must be dimensioned for the total of all loads connected to it. The apparent power required for the Line Modules must be determined and added as indicated in table "Transformer configuration instructions". If the transformer is underdimensioned (S_n or S_k), this can lead to increased line voltage dips and faults in the line supply and in other loads at this connecting point.

If other loads are connected to the secondary side of the matching transformer, the boundary conditions indicated under a) and b) must be complied with when selecting the matching transformer.

S_{n1}, S_{n2} = calculated rated power of the transformer resulting from a) and b)

u_k = short-circuit voltage of the matching transformer in %
(must be between 1% and 3% for Active Line Modules and Smart Line Modules)

S_k = short-circuit power.



! WARNING

Danger to life through electric shock as well as fire hazard due to overcurrent protective devices that trip too late

Overcurrent protective devices that do not trip or trip too late can cause an electric shock or fire.

- To protect personnel and for fire protection purposes, at the infeed point, the system fault level and loop impedance must correspond to the specifications in the documentation in order for the installed overcurrent protection devices to trip within the specified time.

Supplementary condition

Limitation a)

The rated power of the matching transformer S_{n1} must always be a factor of 1.27 higher than the rated power P_n of the Line Module.

$$S_{n1} \geq 1.27 \cdot P_n$$

Example:

The minimum rated power of a matching transformer for a 16 kW Line Modules is 21 kVA.

Limitations b)

In order to avoid faults and disturbances at the other loads that are connected to the secondary side of the matching transformer, the short-circuit power of the plant connection ($S_{k \text{ plant}}$) and that of the matching transformer at the connection point ($S_{k \text{ line}}$) must reach at least the following values.

$$S_{k \text{ line}} \geq 70 \cdot P_n \text{ (for Active Line Module and Smart Line Module)}$$

$$S_{k \text{ line}} \geq 30 \cdot P_n \text{ (for Basic Line Module)}$$

3.11 Line connection variants

Special case:

When operating with only one supply at a transformer, the values may be reduced by the factor 0.73.

$$S_{K \text{ line}} \geq 0.73 \cdot 70 \cdot P_n \text{ (for Active Line Module and Smart Line Module)}$$

$$S_{K \text{ line}} \geq 0.73 \cdot 30 \cdot P_n \text{ (for Basic Line Module)}$$

For example $S_{K \text{ line}}$ for 16 kW Active Line Module: $S_{K \text{ line}} = 0.82 \text{ MVA} = 820 \text{ kVA}$

The required rated power of the matching transformer can be calculated with the following formula.

$$S_{n2} = \frac{S_{K \text{ plant}} [\text{kVA}] \cdot S_{K \text{ line}} [\text{kVA}] \cdot u_k [\%]}{(S_{K \text{ plant}} [\text{kVA}] - S_{K \text{ line}} [\text{kVA}]) \cdot 100 [\%]} \quad [\text{kVA}]$$

Note:

The short-circuit power at the plant connection $S_{K \text{ plant}}$ plays a decisive role in dimensioning the matching transformer.

From the rated power (S_{n1} or S_{n2}) calculated under a) and b), the higher value must be used for the matching transformer.

Table 3- 29 Transformer configuration instructions

| Rated power of the used Active Module P_n | Required rated power of the isolating transformer / autotransformer $S_n (1.27 \cdot P_n)$ | Required short-circuit voltage U_k | Minimum system fault level required $S_{K \text{ line}} (70 \cdot P_n)$ |
|---|--|--------------------------------------|---|
| 16 kW | $\geq 21 \text{ kVA}$ | $\leq 3 \%$ | $\geq 1.12 \text{ MVA}$ |
| 36 kW | $\geq 46 \text{ kVA}$ | $\leq 3 \%$ | $\geq 2.52 \text{ MVA}$ |
| 55 kW | $\geq 70 \text{ kVA}$ | $\leq 3 \%$ | $\geq 3.85 \text{ MVA}$ |
| 80 kW | $\geq 102 \text{ kVA}$ | $\leq 3 \%$ | $\geq 5.6 \text{ MVA}$ |
| 120 kW | $\geq 153 \text{ kVA}$ | $\leq 3 \%$ | $\geq 8.4 \text{ MVA}$ |
| Rated power of the used Smart Line Module P_n | Required rated power of the isolating transformer / autotransformer $S_n (1.27 \cdot P_n)$ | Required short-circuit voltage U_k | Minimum system fault level required $S_{K \text{ line}} (70 \cdot P_n)$ |
| 5 kW | $\geq 6.4 \text{ kVA}$ | $\leq 3 \%$ | $\geq 0.35 \text{ MVA}$ |
| 10 kW | $\geq 13 \text{ kVA}$ | $\leq 3 \%$ | $\geq 0.7 \text{ MVA}$ |
| 16 kW | $\geq 21 \text{ kVA}$ | $\leq 3 \%$ | $\geq 1.12 \text{ MVA}$ |
| 36 kW | $\geq 46 \text{ kVA}$ | $\leq 3 \%$ | $\geq 2.52 \text{ MVA}$ |
| 55 kW | $\geq 70 \text{ kVA}$ | $\leq 3 \%$ | $\geq 3.85 \text{ MVA}$ |

| Rated power of the used Active Module P_n | Required rated power of the isolating transformer / autotransformer $S_n (1.27 \cdot P_n)$ | Required short-circuit voltage U_k | Minimum system fault level required $S_{Kline} (70 \cdot P_n)$ |
|---|--|--------------------------------------|--|
| Rated power of the used Basic Line Module P_n | Required rated power of the isolating transformer / autotransformer $S_n (1.27 \cdot P_n)$ | Required short-circuit voltage U_k | Minimum system fault level required $S_{Kline} (30 \cdot P_n)$ |
| 20 kW | ≥ 26 kVA | ≤ 10 % | ≥ 0.6 MVA |
| 40 kW | ≥ 51 kVA | ≤ 10 % | ≥ 1.2 MVA |
| 100 kW | ≥ 127 kVA | ≤ 10 % | ≥ 3.0 MVA |

Note

Ask your local power utility company for the short-circuit power at the plant connection S_{Kplant} .

Example 1

U_k matching transformer = 3%,
 $S_{Kplant} = 50,000$ kVA
 $S_{Kline} = 16 \text{ kW} \cdot 70 \cdot 0.73 = 820$ kVA

According to a)
 $S_{n1} = 1.27 \cdot 16 \text{ kW} = 21$ kVA

According to b)

$$S_{n2} = \frac{50000 \text{ kVA} \cdot 820 \text{ kVA} \cdot 3\%}{(50000 \text{ kVA} - 820 \text{ kVA}) \cdot 100\%} = 25 \text{ kVA}$$

$S_{n2} > S_{n1} \Rightarrow S_{n2}$ is decisive.

The matching transformer requires a rated power S_n of 25 kVA for a short-circuit voltage U_k of 3%.

Example 2:

U_k matching transformer = 1%,
 $S_{Kplant} = 50,000$ kVA
 $S_{Kline} = 16 \text{ kW} \cdot 70 \cdot 0.73 = 820$ kVA

According to a)
 $S_{n1} = 1.27 \cdot 16 \text{ kW} = 21$ kVA

According to b)

$$S_{n2} = \frac{50000 \text{ kVA} \cdot 820 \text{ kVA} \cdot 1\%}{(50000 \text{ kVA} - 820 \text{ kVA}) \cdot 100\%} = 8.3 \text{ kVA}$$

3.11 Line connection variants

$S_{n1} > S_{n2} \Rightarrow S_{n1}$ is decisive.

The matching transformer requires a rated power S_n of 21 kVA for a short-circuit voltage u_k of 1%.

Example 3:

If $S_{K\text{ plant}}$ is smaller, the transformer must be stronger.

u_k matching transformer = 3%,
 $S_{K\text{ plant}} = 3,000$ kVA
 $S_{K\text{ line}} = 16 \text{ kW} \cdot 70 \cdot 0.73 = 820$ kVA

According to a)
 $S_{n1} = 1.27 \cdot 16 \text{ kW} = 21$ kVA

According to b)

$$S_{n2} = \frac{3000 \text{ kVA} \cdot 820 \text{ kVA} \cdot 3\%}{(3000 \text{ kVA} - 820 \text{ kVA}) \cdot 100\%} = 33.9 \text{ kVA}$$

$S_{n2} > S_{n1} \Rightarrow S_{n2}$ is decisive

The matching transformer requires a rated power S_n of 34 kVA for a short-circuit voltage u_k of 3%.

Example 4:

If $S_{K\text{ plant}}$ is smaller, you can use, alternatively to example 3, a transformer with a smaller u_k .

u_k matching transformer = 1%,
 $S_{K\text{ plant}} = 3,000$ kVA
 $S_{K\text{ line}} = 16 \text{ kW} \cdot 70 \cdot 0.73 = 820$ kVA

According to a)
 $S_{n1} = 1.27 \cdot 16 \text{ kW} = 21$ kVA

According to b)

$$S_{n2} = \frac{3000 \text{ kVA} \cdot 820 \text{ kVA} \cdot 1\%}{(3000 \text{ kVA} - 820 \text{ kVA}) \cdot 100\%} = 11.3 \text{ kVA}$$

$S_{n1} > S_{n2} \Rightarrow S_{n1}$ is decisive

The matching transformer requires a rated power S_n of 21 kVA for a short-circuit voltage u_k of 1%.

Note

S_{n2} for the matching transformer can be reduced by reducing u_k . In the examples above, the power drawn from other loads has not been taken into account.

3.11.3.4 Operating line connection components via an autotransformer

An autotransformer can be used to adapt the voltage in the range up to 3-ph. 480 VAC +10%.



! DANGER

Danger to life due to electric shock in the event that an isolating transformer is not used

At high voltages an isolating transformer must be used in order to implement protective separation.

- Install an isolating transformer for voltages > 3 AC 480 V +10 %.

Applications:

- The motor insulation must be protected from excessive voltages.
- The Active Line Module must supply a regulated DC link voltage. This is possible with a rated voltage of 380 V to 415 V.
In conjunction with motors that may be operated with a DC link voltage of up to 660 V, and a line voltage > 415 V, a controlled DC link voltage is required.

3.11 Line connection variants

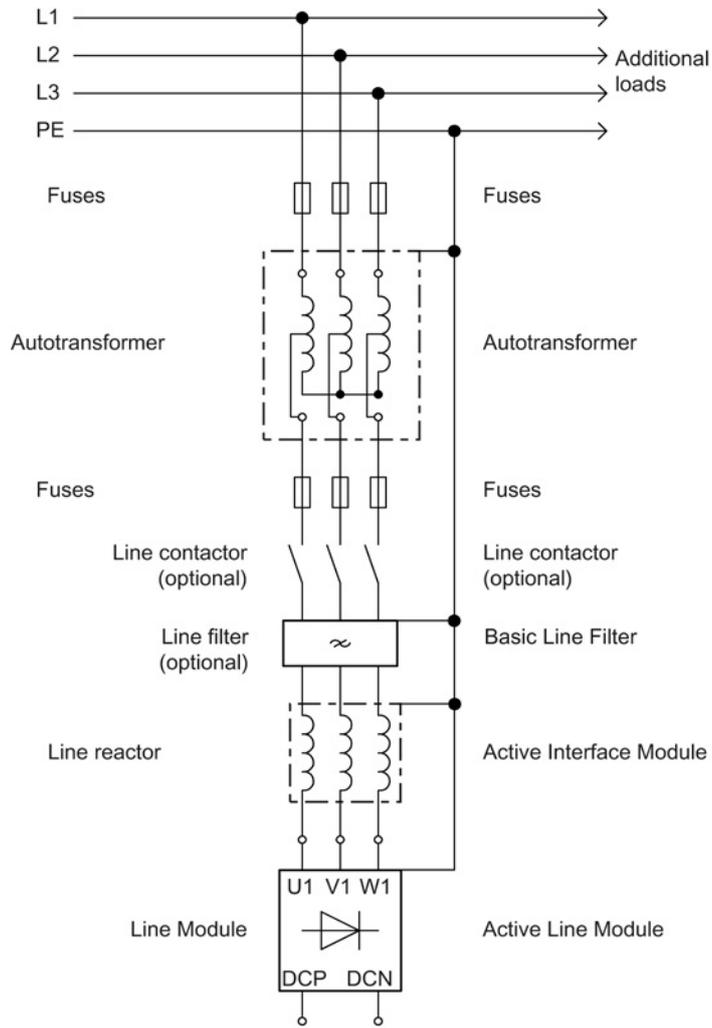


Figure 3-67 Operation of a Line Module via an autotransformer

3.11.3.5 Operating line connection components via an isolating transformer

An isolating transformer converts the line supply type of the plant or system (e.g. IT system) to a TN system. Additional voltage adaptation to the permissible voltage tolerance range is possible.

An isolating transformer must be used in the following cases:

- The insulation of the Motor Module and/or the motor is not suitable for the voltages that occur.
- There is no compatibility with an existing residual-current protective device.
- The installation altitude is greater than 2000 m above sea level.
- A line filter should be used in a line supply system that is not a TN line supply system with grounded neutral conductor.



DANGER

Danger to life due to electric shock in the event that an isolating transformer is not used

To implement safe electrical separation, an isolating transformer must be used with high voltages.

- Install an isolating transformer for voltages $> 480 \text{ V} + 10\%$.

An isolating transformer must have the following properties:

- The transformer secondary side must have the star connection (a delta connection is not permissible).
- The neutral conductor must be brought out. It must be connected to the PE of the line filter, line reactor or AIM and Line Module (infeed).

Caution: If the neutral conductor is not brought out and/or not connected, then all of the restrictions of an IT system apply.

3.11 Line connection variants

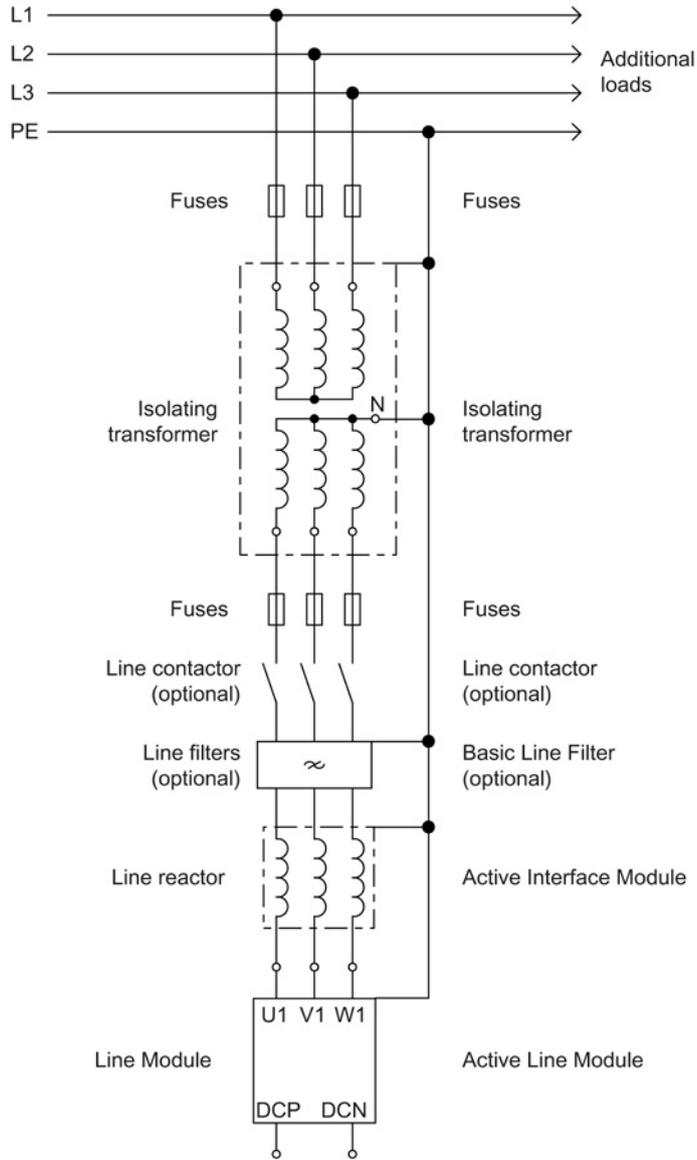


Figure 3-68 Operation of a Line Module via an isolating transformer

4.1 Safety instructions for Line Modules Booksize

| | |
|--|----------------|
|  | WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed | |
| If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. | |
| <ul style="list-style-type: none"> • Adhere to the fundamental safety instructions. • When assessing the risk, take into account residual risks. | |



| | |
|---|---------------|
|  | DANGER |
| Danger to life through electric shock as well as fire hazard due to overcurrent protective devices that trip too late | |
| Overcurrent protective devices that do not trip or trip too late can cause an electric shock or fire. | |
| <ul style="list-style-type: none"> • To protect personnel and for fire protection purposes, at the infeed point, the short-circuit rating and loop impedance must correspond to the specifications in the documentation in order for the installed overcurrent protection devices to trip within the specified time. | |



| | |
|---|---------------|
|  | DANGER |
| Danger to life through electric shock due to a high DC link voltage | |
| As long as the Line Module is connected to the line supply, the DC link is charged with a high voltage. Contact with components can result in death or serious injury. | |
| <ul style="list-style-type: none"> • Isolate the Line Module from the line supply during installation or maintenance work, e.g. via the line contactor or main switch. | |



| | |
|---|---------------|
|  | DANGER |
| Danger to life through 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 five minutes after the power supply has been switched off. | |
| Contact with live parts can result in death or serious injury. | |
| <ul style="list-style-type: none"> • Do not open the protective cover of the DC link until 5 minutes have elapsed. • Measure the voltage before starting work on the DCP and DCN DC link terminals. | |



⚠ DANGER

Danger to life through 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

Danger to life due to high leakage currents caused by an interrupted external protective conductor

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.

- Ensure that the external protective conductor satisfies at least one of the following conditions:
 - It has been laid so that it is protected against mechanical damage. ¹⁾
 - If it is a single conductor, it has a cross-section of at least 10 mm² Cu.
 - If it is a conductor of a multi-conductor cable, it has a cross-section of at least 2.5 mm² Cu.
 - It has a second protective conductor in parallel with the same cross-section.
 - It complies with the local regulations for equipment with increased leakage current.
- ¹⁾ Cables laid within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.



⚠ WARNING

Danger to life through electric shock due to incorrect connection to the DC link

Incorrect connections can lead to overheating and therefore a risk of 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

Danger to life through 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 modules¹⁾ (exception: Smart Line Module²⁾), 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 removed³⁾.

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

Danger to life through electric shock due to missing DC link side covers

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

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

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

! WARNING

Danger of an accident due to missing warning labels in the national language.

Missing warning labels in the national language can result in death or serious injury.

- Attach the component warning labels in the national language.

! WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

Inadequate ventilation clearances can cause overheating with a risk for personnel through smoke development and fire. This can also result in more downtimes and reduced service lives of Line Modules.

- Maintain the 80 mm clearances above and below the Line Modules.
- For the 80 kW and 120 kW Active Line Modules, a ventilation clearance of 50 mm must also be maintained in front of the fan.

! CAUTION

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

Overheating and a fire can result when the total length of the power cables is exceeded.

- Ensure that the total length of the power cables (motor supply cables and DC link cables) does not exceed the values specified in Section Possible line reactor and line filter combinations (Page 136).

NOTICE

Material damage due to loose power connections

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

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

NOTICE

Damage to the equipment when performing a voltage test as a result of connections that are not disconnected

SINAMICS S components are subject to a voltage test as part of the routine test. Connected devices can be damaged.

- Disconnect or unplug all SINAMICS devices before the voltage test of the machine equipment according to EN 60204-1, Section 18.4.

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.

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

Operation on line supplies where energy recovery is not possible

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

- Deactivate the energy recovery function of the 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, the regenerative feedback capability must be deactivated as follows:

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

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.

Special features for Line Modules with external air cooling

Note

Component failure due to the pollution of external heat sinks

For components with external air cooling, the fan and the heat sinks can accumulate a lot of pollution. If the cooling air requirement is not provided by the filtered fan, the components cannot output their specified power. This can cause the temperature monitoring function in the components to respond.

- Check the fans and heat sinks for pollution at regular intervals and clean them when necessary.
-

Note

Checking the seal

- After installation, check the seal on the rear of the device to ensure that it is tight.
 - If required, use additional sealing.
-

Note

Using an installation frame

- Only use an installation frame when the cabinet has an unpainted metal surface.
-

4.2 Active Line Modules with internal air cooling

4.2.1 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 the motors are in feedback mode, Active Line Modules supply power back to the line supply. The regenerative feedback capability of the modules can be deactivated by parameterization.

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. An optional main contactor is required for disconnecting the voltage.

Active Line Modules can be directly connected to TN, IT and TT systems. The Line Modules have an integrated overvoltage protection function.



WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

4.2.2 Interface description

4.2.2.1 Overview

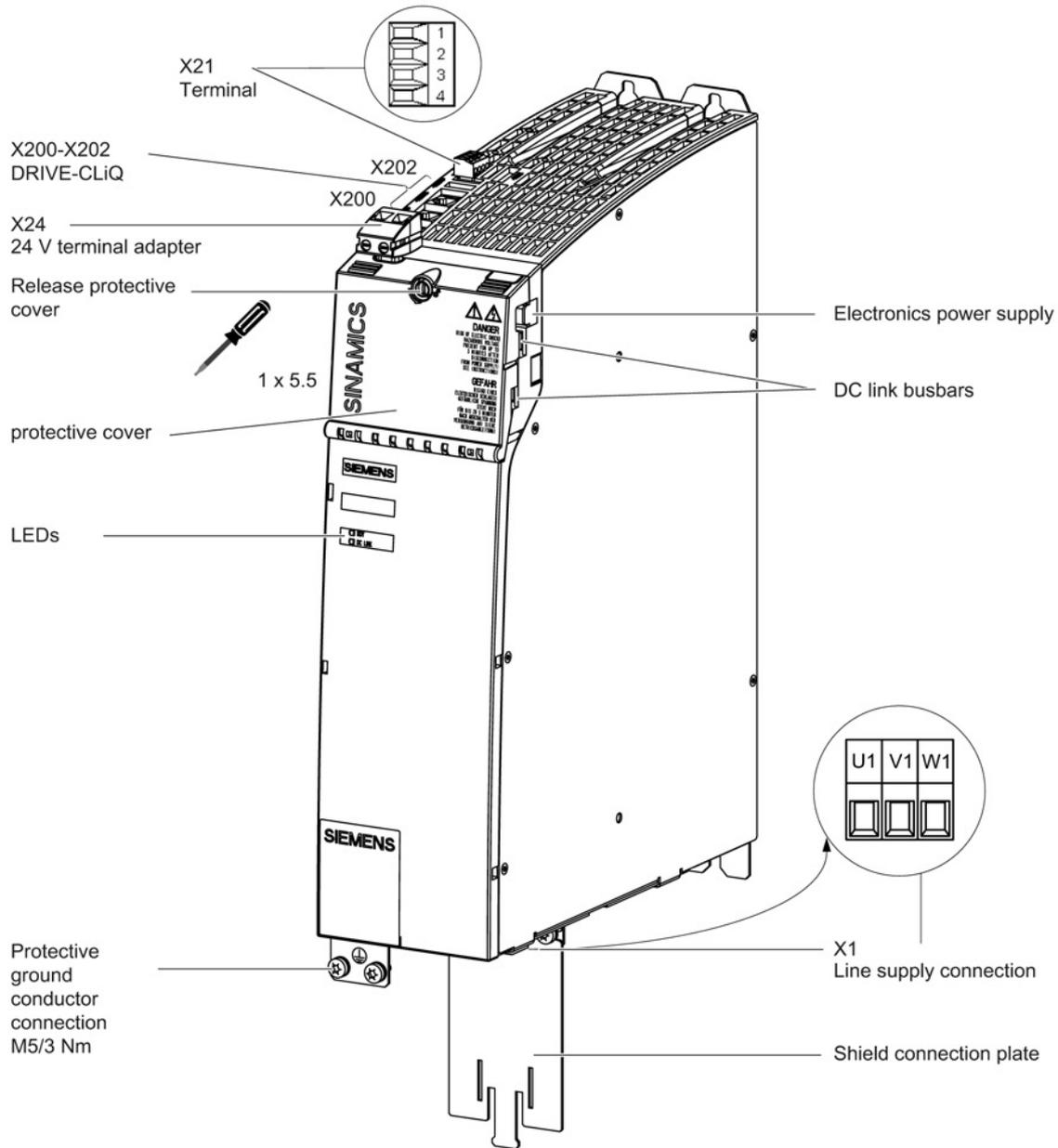
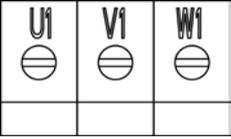
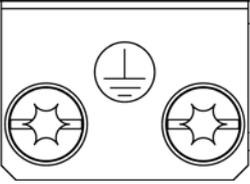


Figure 4-1 Interface overview, Active Line Module with internal air cooling (example: 16 kW)

4.2 Active Line Modules with internal air cooling

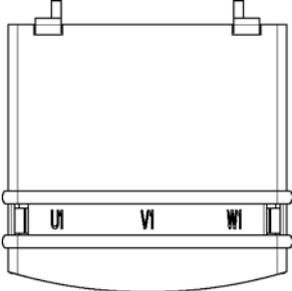
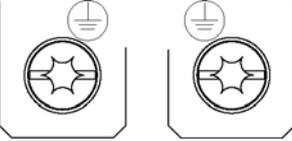
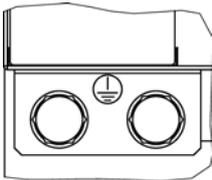
4.2.2.2 X1 line connection

Table 4- 1 X1: Line connection for Active Line Modules 16 kW

| | Terminal | Technical data |
|---|---------------|--|
|  | U1 | Max. connectable cross-section: 10 mm ² Type: Screw terminal 6 (Page 755) Tightening torque: 1.5 ... 1.8 Nm |
| | V1 | |
| | W1 | |
|  | PE connection | Threaded hole M5 / 3 Nm ¹⁾ |

1) For ring cable lugs without insulation

Table 4- 2 X1: Line supply connection for Active Line Modules 36 kW to 120 kW

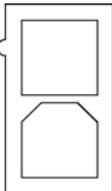
| | Terminal | Technical data |
|---|---------------|--|
|  | U1 | Supply voltage: 380 ... 480 V 3 AC, 50/60 Hz 36 kW: Threaded bolts M6 / 6 Nm ¹⁾ 55 kW, 80 kW and 120 kW: Threaded bolts M8 / 13 Nm ¹⁾ |
| | V1 | |
| | W1 | |
|  | PE connection | 36 kW and 55 kW: Threaded hole M6 / 6 Nm ¹⁾ |
| | |  |

1) For ring cable lugs without insulation

4.2.2.3 X12 fan connection

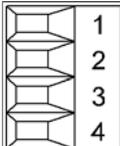
Active Line Modules 80 kW and 120 kW are equipped with an interface for connecting the sub-chassis fan. The interface is located on the underside of the Line Module.

Table 4- 3 X12 fan connection

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

4.2.2.4 X21 EP terminals

Table 4- 4 X21 EP terminal / temperature sensor

| | Terminal | Designation | Technical data |
|--|----------|-------------------------|---|
|  | 1 | + Temp | Temperature sensors ¹⁾ : KTY 84–1C130 ²⁾ /PTC ²⁾ /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 |
| | 4 | EP M (Enable Pulses) | Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm ² | | | |

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

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

Terminals X21.1 and X21.2

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

Terminals X21.3 and X21.4



| |
|---|
|  WARNING |
| Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected |
| 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. Regenerative feedback 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. |
| Death or serious injury can result when live parts are touched. |
| <ul style="list-style-type: none">• Neutralize the voltage in the DC link. |

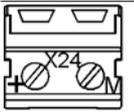
| |
|--|
| NOTICE |
| Damage to the drive electronics when switching the line contactor under load |
| When switching the line contactor (type according to the recommended selection) under load, then the contacts will be subject to premature wear. This can cause the contactor to malfunction, with subsequent damage to the drive electronics. |
| <ul style="list-style-type: none">• 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. |



| |
|---|
|  WARNING |
| Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor |
| Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors. |
| <ul style="list-style-type: none">• Use temperature sensors that fully comply with the specifications of the safety isolation.• 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. |

4.2.2.5 X24 24 V terminal adapter

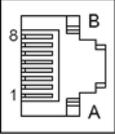
Table 4- 5 X24: 24 V terminal adapter

| | Terminal | Designation | Technical data |
|--|----------|-------------------|------------------------|
|  | + | 24 V power supply | 24 V DC supply voltage |
| | M | Ground | Electronics ground |
| Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm ² | | | |

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

4.2.2.6 X200-X202 DRIVE-CLiQ interfaces

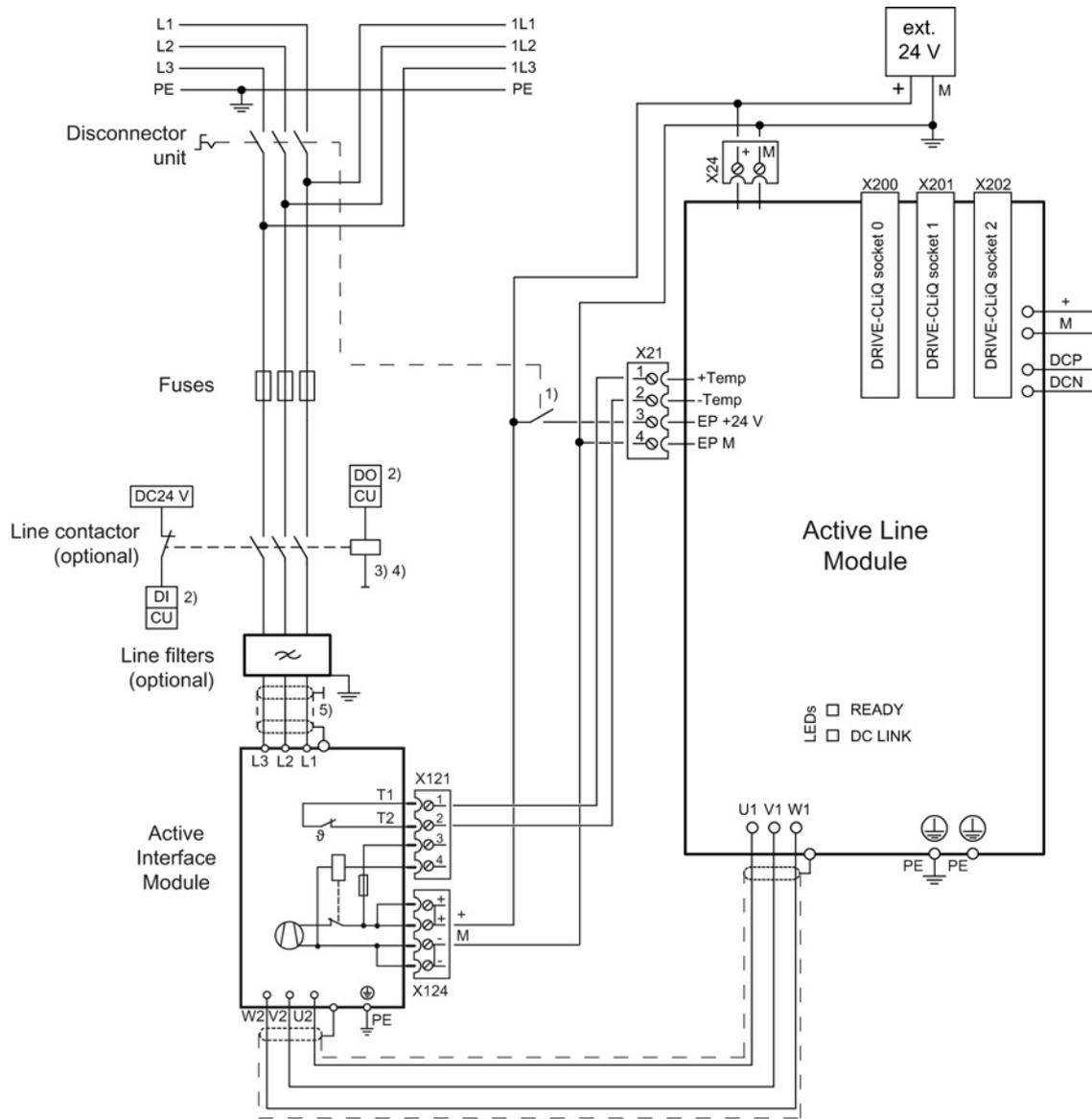
Table 4- 6 X200-X202: DRIVE-CLiQ interfaces

| | 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.) Order number: 6SL3066-4CA00-0AA0

4.2.3 Connection example



- 1) Leading NC contact $t > 10$ ms
- 2) DI/DO, controlled by the Control Unit.
- 3) No additional load permitted downstream of line contactor!
- 4) The current carrying capacity of the DO must be observed; an output coupling device must be used if required.
- 5) Contacting via rear mounting panel or shielding buses in accordance with EMC Directive.

Figure 4-2 Example connection of Active Line Module

Note

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

4.2.4 Meaning of LEDs

Table 4- 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 | -- | 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 | -- | This component has at least one fault. Note: The LED is activated regardless of whether the corresponding messages have been reconfigured. | Resolve and acknowledge the fault. |
| Green/ red (0.5 Hz) | -- | Firmware is being downloaded. | – |
| Green/red (2 Hz) | -- | Firmware download has been completed. The system waits for POWER ON. | Carry out a POWER ON. |
| Green/orange or red/orange | -- | Component recognition via LED is activated ¹⁾ . Note: Both options depend on the LED status when component recognition is activated. | – |

¹⁾ See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



WARNING

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

4.2.5 Dimension drawings

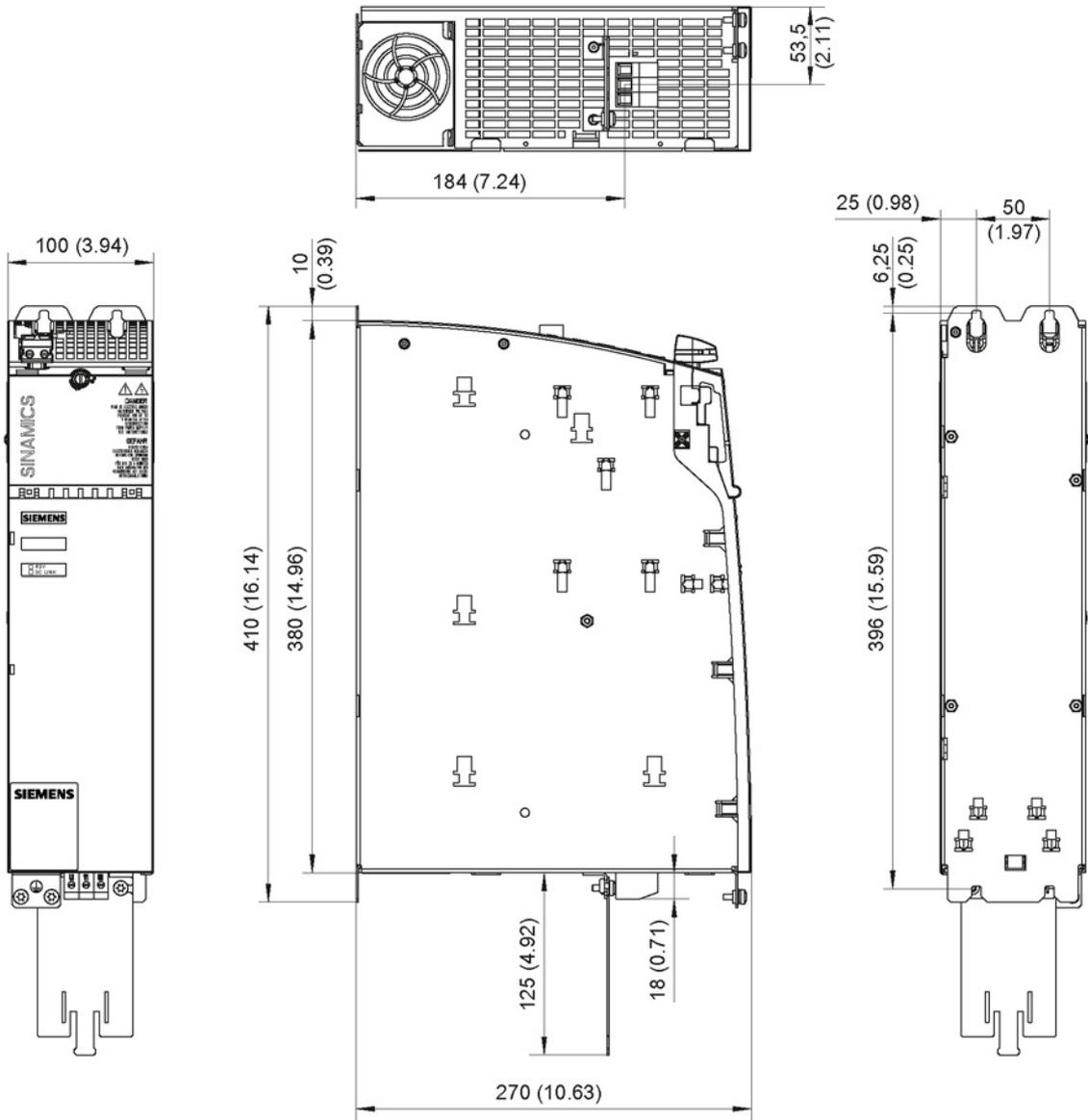


Figure 4-3 Dimension drawing of 16 kW Active Line Module with internal air cooling, all dimensions in mm and (inches)

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 617).

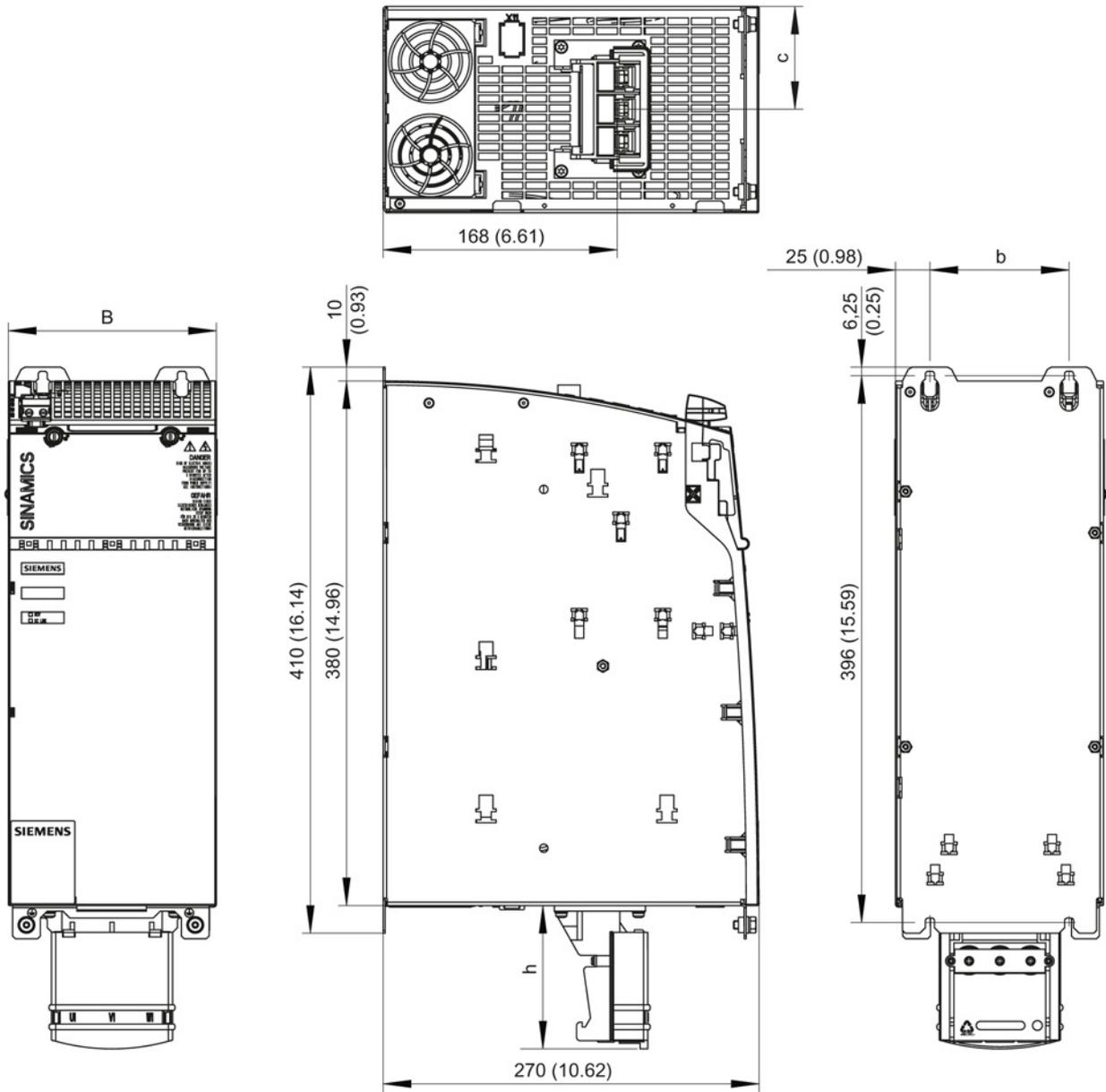


Figure 4-4 Dimension drawing of 36 kW and 55 kW Active Line Modules with internal air cooling (example, 36 kW), all dimensions in mm and (inches)

Table 4- 8 Dimensions of 36 kW and 55 kW Active Line Modules with internal air cooling

| Active Line Module | Order number | B [mm] (inches) | b [mm] (inches) | c [mm] (inches) | h [mm] (inches) |
|--------------------|--------------------|-----------------|-----------------|-----------------|-----------------|
| 36 kW | 6SL3130-7TE23-6AAx | 150 (5.91) | 100 (3.94) | 75 (2.95) | 105 (4.13) |
| 55 kW | 6SL3130-7TE25-5AAx | 200 (7.87) | 150 (5.91) | 100 (3.94) | 105 (4.13) |

4.2 Active Line Modules with internal air cooling

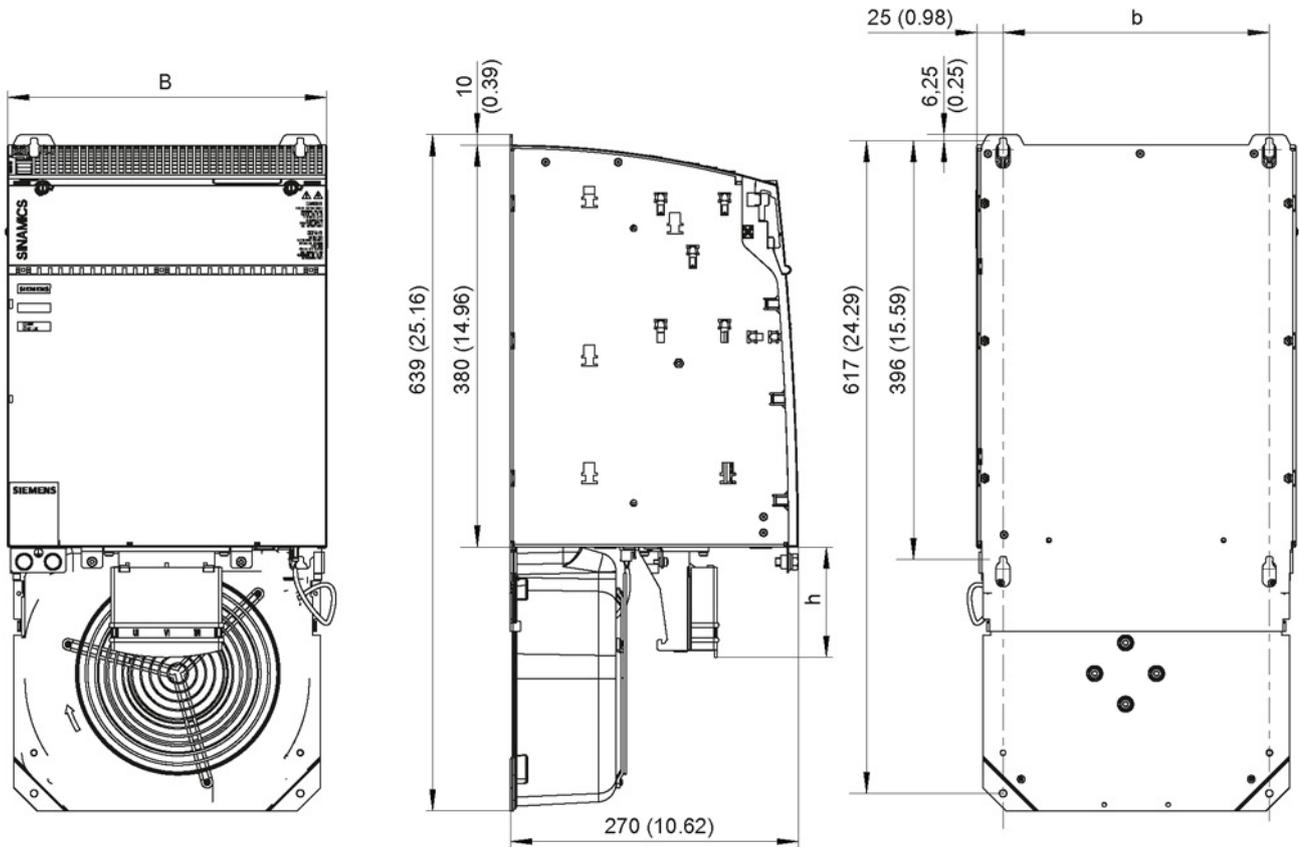


Figure 4-5 Dimension drawing of 80 kW and 120 kW Active Line Modules with internal air cooling, all dimensions in mm and (inches)

Table 4- 9 Dimensions of 80 kW and 120 kW Active Line Modules with internal air cooling

| Active Line Module | Order number | B [mm] (inches) | b [mm] (inches) | h [mm] (inches) |
|--------------------|--------------------|-----------------|-----------------|-----------------|
| 80 kW | 6SL3130-7TE28-0AAx | 300 (11.81) | 250 (9.84) | 105 (4.13) |
| 120 kW | 6SL3130-7TE31-2AAx | 300 (11.81) | 250 (9.84) | 105 (4.13) |

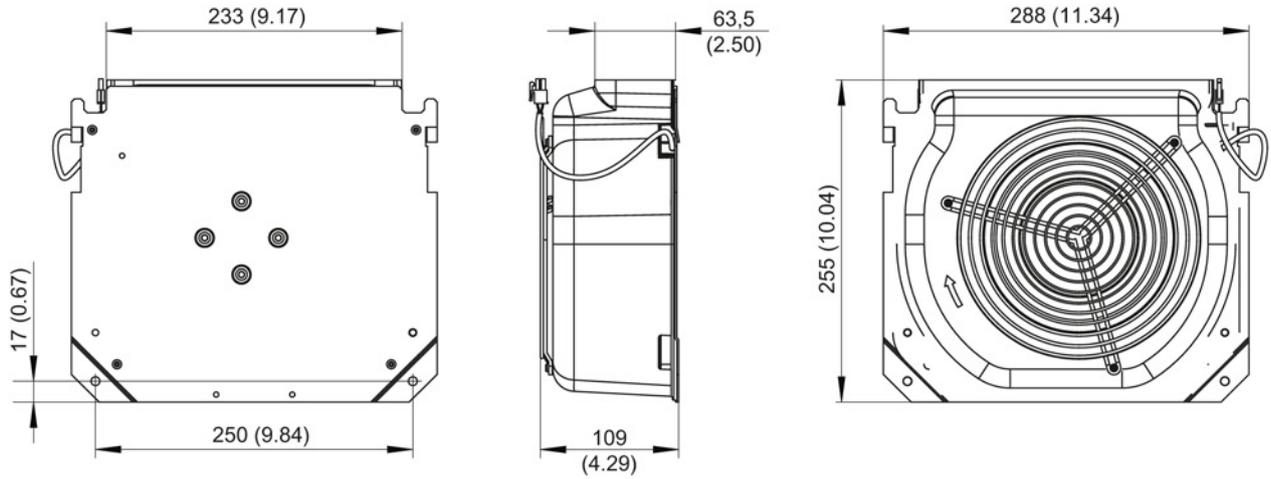


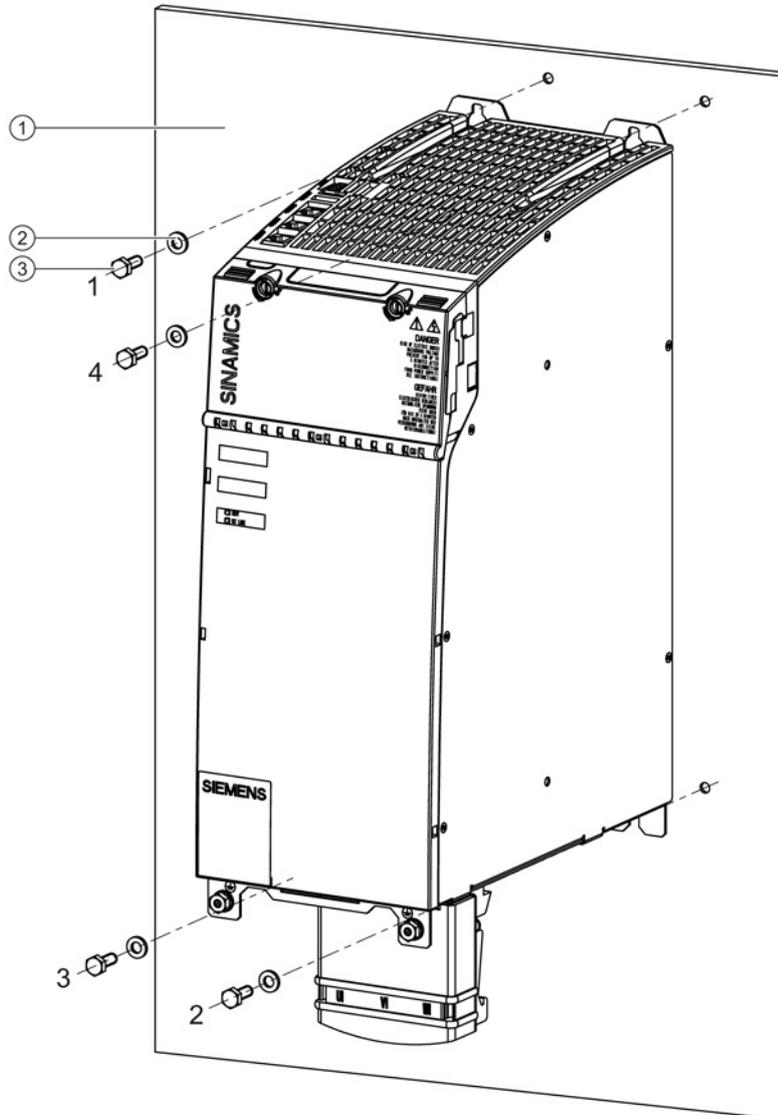
Figure 4-6 Dimension drawing of fan for 80 kW and 120 kW Active Line Modules with internal air cooling, all dimensions in mm and (inches)

Note

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

4.2.6 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 4-7 Mounting an Active Line Module with internal air cooling (example: 36 kW)

Tightening torques:

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

Installing the sub-chassis fan

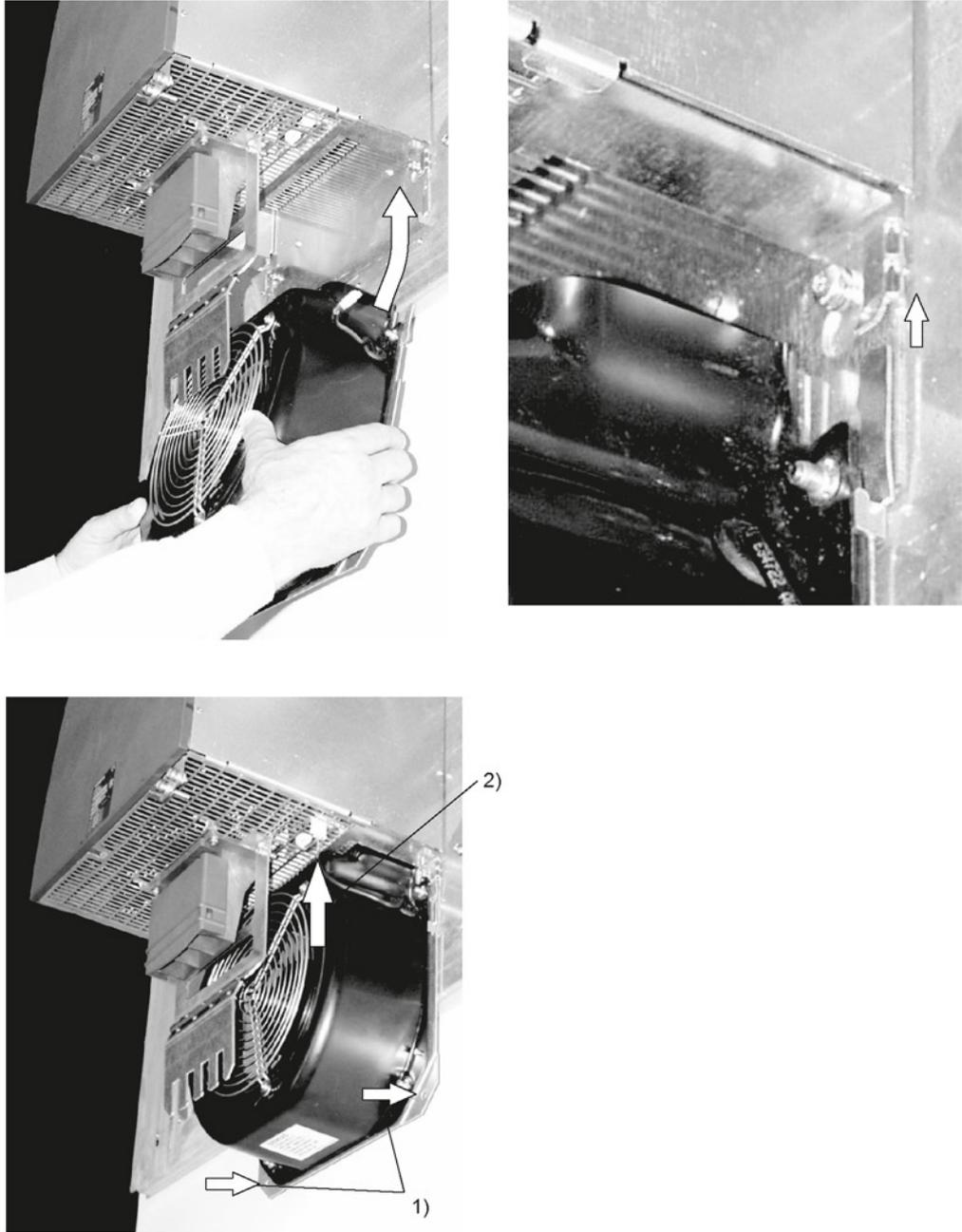


Figure 4-8 Mounting the fan for Active Line Modules 80 kW and 120 kW

1. Fix the fan with M6 screws (tightening torque: 6 Nm).
2. Connect the fan power supply.

4.2.7 Technical data

Table 4- 10 Technical data of Active Line Modules

| Internal air cooling | 6SL3130– | 7TE21–6AAx | 7TE23–6AAx | 7TE25–5AAx | 7TE25–5AA3 + Active Interface Module |
|--|------------------------|---|------------|------------|--|
| Rated power | kW | 16 | 36 | 55 | 55 |
| Infeed | | | | | |
| Rated power (S1) ¹⁾ | kW (P _n) | 16 | 36 | 55 | 55 |
| Infeed power (S6 - 40 %) ¹⁾ | kW (P _{S6}) | 21 | 47 | 71 | 71 |
| Peak infeed power ¹⁾ | kW (P _{max}) | 35 | 70 | 91 | 110 |
| Regenerative feedback | | | | | |
| Continuous regenerative power | kW | 16 | 36 | 55 | 55 |
| Peak regenerative 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 | | | |
| Electronics 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 - 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: for 600 V | A _{DC} | 27 | 60 | 92 | 92 |
| DC link current: for 600 V DC; for S6 - 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 |
| Reinforced DC link busbars | A _{DC} | 150 | -- | -- | -- |
| 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 781)) | W | 282.8 | 666 | 945.6 | 945.6 |
| Max. ambient temperature | | | | | |
| without derating | ° C | 40 | 40 | 40 | 40 |
| with derating | ° C | 55 | 55 | 55 | 55 |
| DC link capacitance | | | | | |
| Active Line Module | µF | 705 | 1410 | 1880 | 1880 |
| Drive line-up, max. | µF | 20000 | 20000 | 20000 | 20000 |
| Power factor | cosφ | 1 | 1 | 1 | 1 |

4.2 Active Line Modules with internal air cooling

| Internal air cooling | 6SL3130– | 7TE21–6AAx | 7TE23–6AAx | 7TE25–5AAx | 7TE25–5AA3 + Active Interface Module |
|--|-------------------|--|--------------|--------------|--|
| Rated power | kW | 16 | 36 | 55 | 55 |
| Circuit breaker (IEC 60947 and UL) | | See Section Overcurrent protection using line fuses and circuit breakers (Page 51) | | | |
| Rated short-circuit current SCCR ³⁾ | kA | 65 | 65 | 65 | 65 |
| Cooling method (internal air cooling) | | Internal fan | Internal fan | Internal fan | Internal fan |
| Max. permissible heat sink temperature | ° C | 85 | 90 | 83 | 83 |
| Sound pressure level | dB(A) | < 60 | < 65 | < 60 | < 60 |
| Cooling air requirement | m ³ /h | 56 | 112 | 160 | 160 |
| Rated voltage for rated data 3 AC 380 V | | | | | |
| Weight | kg | 7 | 10 | 17 | 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) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker – and the Line Module in the drive system.

Table 4- 11 Technical data of Active Line Modules

| Internal air cooling | 6SL3130– | 7TE28–0AAx | 7TE31–2AAx |
|---|------------------------|---|------------|
| Rated power | kW | 80 | 120 |
| Infeed | | | |
| Rated power (S1) ¹⁾ | kW (P _n) | 80 | 120 |
| Infeed power (S6 - 40 %) ¹⁾ | kW (P _{S6}) | 106 | 145 |
| Peak infeed power ¹⁾ | kW (P _{max}) | 131 | 175 |
| Regenerative feedback | | | |
| Continuous regenerative power | kW | 80 | 120 |
| Peak regenerative power | kW | 131 | 175 |
| Supply voltages | | | |
| Line voltage | V _{ACrms} | 3 AC 380 ... 480 ± 10 % (-15 % < 1 min) | |
| Line frequency | Hz | 47 ... 63 | |
| Electronics 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 - 40 % | A _{AC} | 161 | 220 |
| for AC 400 V; peak current | A _{AC} | 200 | 267 |

4.2 Active Line Modules with internal air cooling

| Internal air cooling | 6SL3130– | 7TE28–0AAx | 7TE31–2AAx |
|--|-------------------|--|-------------|
| Rated power | kW | 80 | 120 |
| DC link currents Rated DC link current: for 600 V: | A _{DC} | 134 | 200 |
| DC link current: for 600 V DC; for S6 - 40 % | A _{DC} | 176 | 244 |
| for 600 V DC; peak current | A _{DC} | 218 | 292 |
| Current carrying capacity DC link busbar: | A _{DC} | 200 | 200 |
| 24 V busbar: | A _{DC} | 20 | 20 |
| Electronics current drawn at 24 V DC | A _{DC} | 1.4 | 1.8 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 1383.6 | 2243.2 |
| Max. ambient temperature without derating | ° C | 40 | 40 |
| with derating | ° C | 55 | 55 |
| DC link capacitance Active Line Module | µF | 2820 | 3995 |
| Drive line-up, max. | µF | 20000 | 20000 |
| Power factor | cosφ | 1 | 1 |
| Circuit breaker (IEC 60947 and UL) | | See Section Overcurrent protection using line fuses and circuit breakers (Page 51) | |
| Rated short-circuit current SCCR ³⁾ | kA | 65 | 65 |
| Cooling method (internal air cooling) | | Mounted fan | Mounted fan |
| Sound pressure level | dB(A) | < 73 | < 73 |
| Cooling air requirement | m ³ /h | 520 | 520 |
| Max. permissible heat sink temperature | ° C | 70 | 75 |
| Rated voltage for rated data 3 AC 380 V | | | |
| 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) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker – and the Line Module in the drive system.

4.2.7.1 Characteristics

Rated duty cycles for Active Line Modules

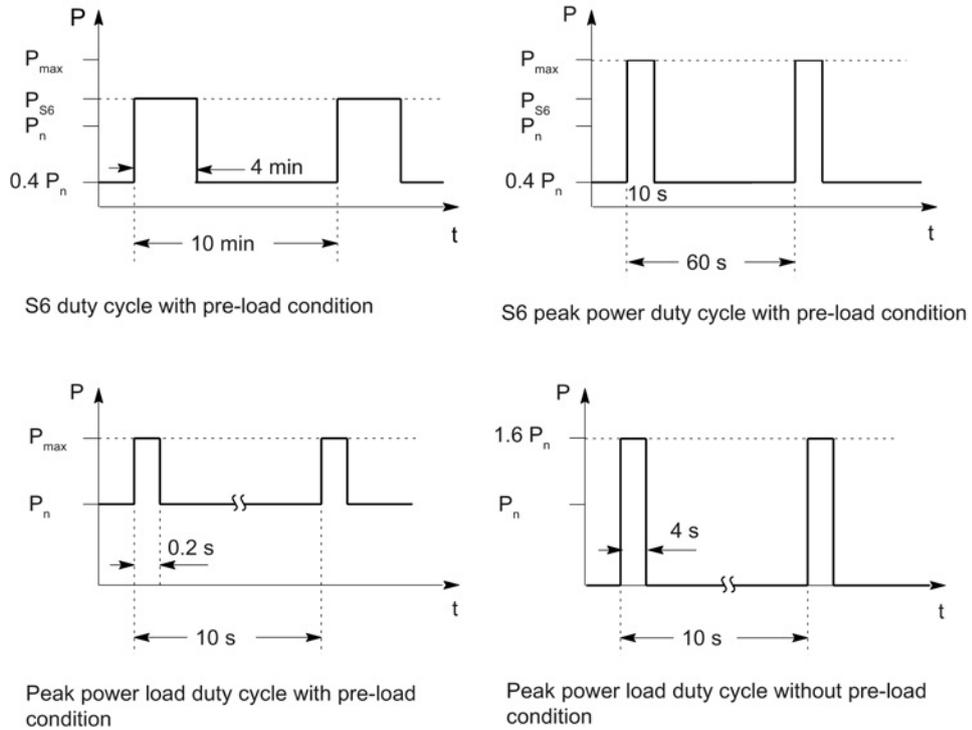


Figure 4-9 Rated duty cycles for Active Line Modules (**exception:** not applicable for 55 kW Active Line Module with Active Interface Module)

Rated duty cycles for Active Line Modules with Active Interface Modules

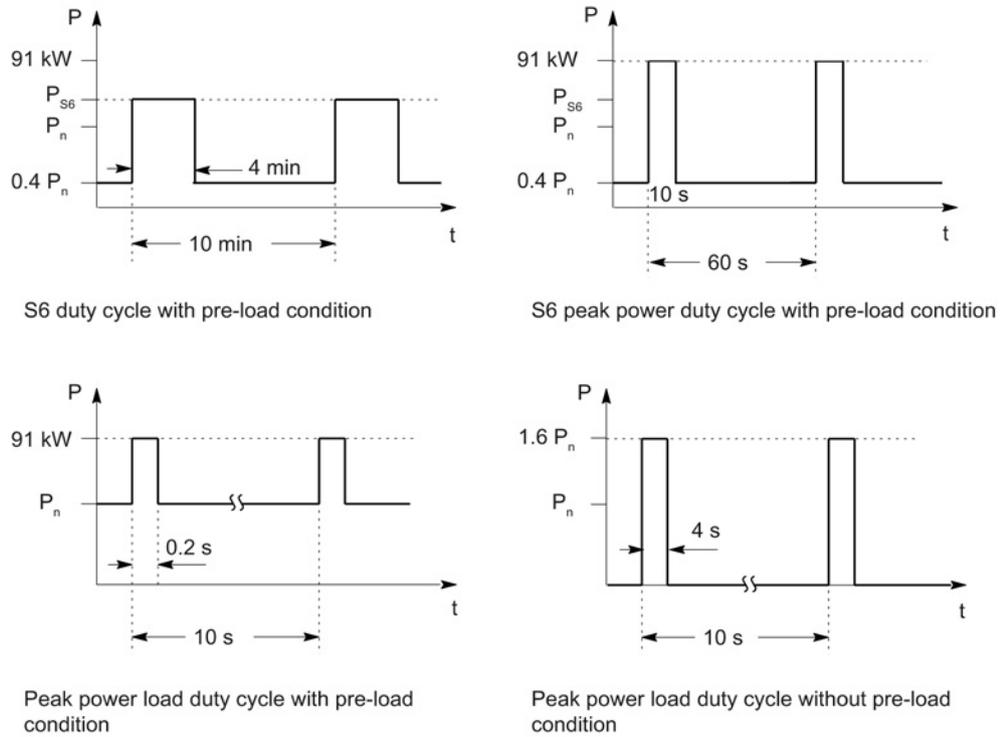


Figure 4-10 Load cycles for 55 kW Active Line Modules with Active Interface Module

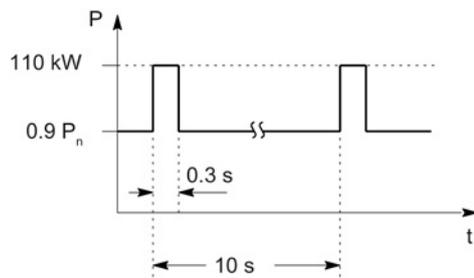


Figure 4-11 Peak load cycle with initial load for 55 kW Active Line Modules with Active Interface Module

Derating characteristics

Note

For additional information, see chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

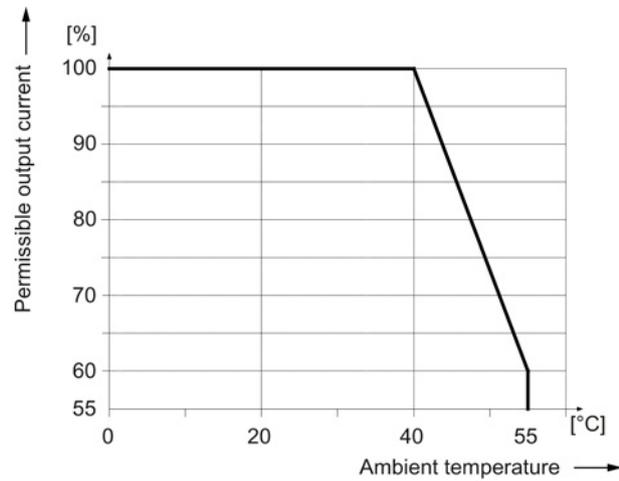


Figure 4-12 Output current as a function of the ambient temperature

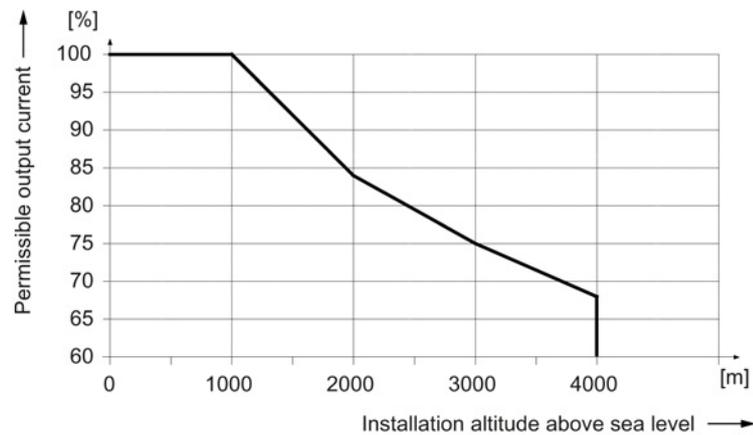


Figure 4-13 Output current as a function of the installation altitude

4.3 Active Line Modules with external air cooling

4.3.1 Description

The Motor Modules are connected to the power supply network via the Active Line Modules with external air cooling which provide the Motor Modules with a constant DC link voltage.

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

When the motors are in feedback mode, Active Line Modules supply power back to the line supply. The regenerative feedback capability of the modules can be deactivated by parameterization.

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. An optional main contactor is required for disconnecting the voltage.

Active Line Modules can be directly connected to TN, IT and TT systems. The Line Modules have an integrated overvoltage protection function.

External air cooling uses the "through-hole" method. The power unit and its heat sink can be inserted in a rectangular knockout at the rear of the control cabinet and mounted with a seal. The heat sink and the fan (included in the scope of supply) project beyond the rear of the control cabinet and the heat is dissipated outside the control cabinet or in a separate air duct.



WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

4.3.2 Interface description

4.3.2.1 Overview

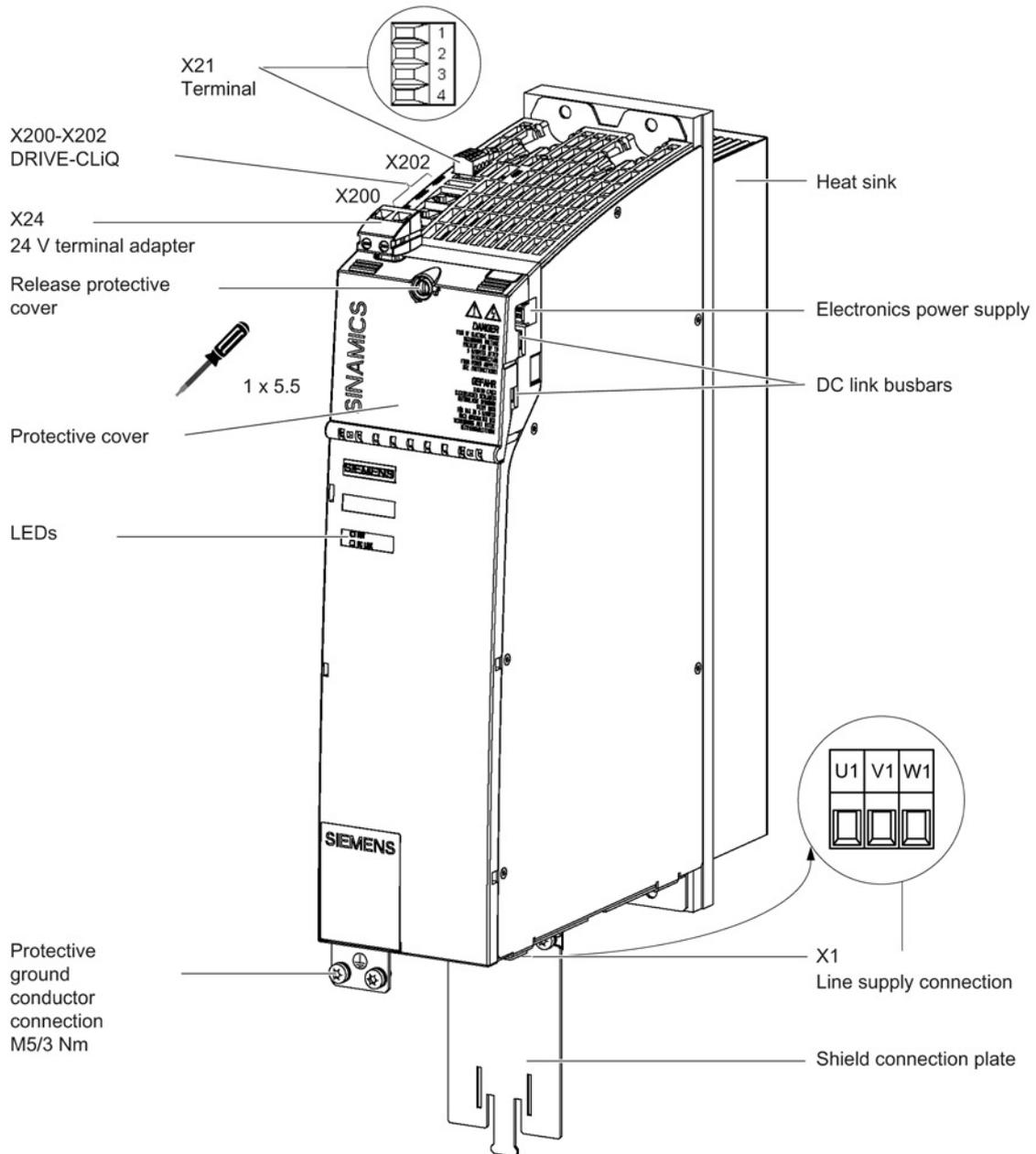
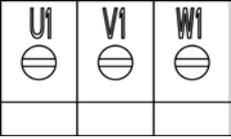
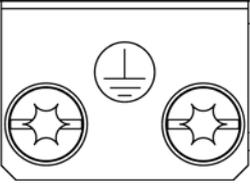


Figure 4-14 Interface overview, Active Line Module with external air cooling (example: 16 kW)

4.3 Active Line Modules with external air cooling

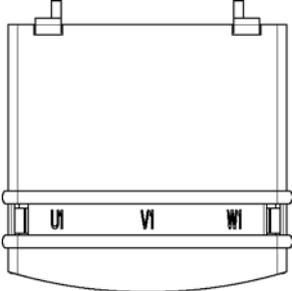
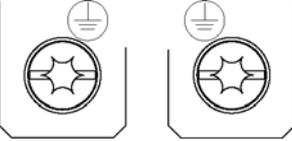
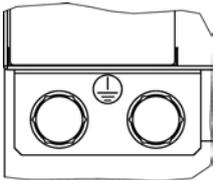
4.3.2.2 X1 line connection

Table 4- 12 X1: Line connection for Active Line Modules 16 kW

| | Terminal | Technical data |
|---|---------------|--|
|  | U1 | Max. connectable cross-section: 10 mm ² Type: Screw terminal 6 (Page 755) Tightening torque: 1.5 ... 1.8 Nm |
| | V1 | |
| | W1 | |
|  | PE connection | Threaded hole M5 / 3 Nm ¹⁾ |

1) For ring cable lugs without insulation

Table 4- 13 X1: Line supply connection for Active Line Modules 36 kW to 120 kW

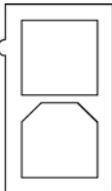
| | Terminal | Technical data |
|---|---------------|--|
|  | U1 | Supply voltage: 380 ... 480 V 3 AC, 50/60 Hz 36 kW: Threaded bolts M6 / 6 Nm ¹⁾ 55 kW, 80 kW and 120 kW: Threaded bolts M8 / 13 Nm ¹⁾ |
| | V1 | |
| | W1 | |
|  | PE connection | 36 kW and 55 kW: Threaded hole M6 / 6 Nm ¹⁾ |
| | |  |

1) For ring cable lugs without insulation

4.3.2.3 X12 fan connection

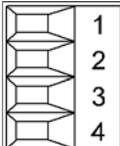
Active Line Modules 80 kW and 120 kW are equipped with an interface for connecting the sub-chassis fan. The interface is located on the underside of the Line Module.

Table 4- 14 X12 fan connection

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

4.3.2.4 X21 EP terminals

Table 4- 15 X21 EP terminal / temperature sensor

| | Terminal | Designation | Technical data |
|--|----------|-------------------------|---|
|  | 1 | + Temp | Temperature sensors ¹⁾ : KTY 84–1C130 ²⁾ /PTC ²⁾ /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 |
| | 4 | EP M (Enable Pulses) | Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm ² | | | |

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

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

Terminals X21.1 and X21.2

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

Terminals X21.3 and X21.4



| |
|---|
|  WARNING |
| Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected |
| 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. Regenerative feedback 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. |
| Death or serious injury can result when live parts are touched. |
| <ul style="list-style-type: none">• Neutralize the voltage in the DC link. |

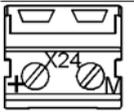
| |
|--|
| NOTICE |
| Damage to the drive electronics when switching the line contactor under load |
| When switching the line contactor (type according to the recommended selection) under load, then the contacts will be subject to premature wear. This can cause the contactor to malfunction, with subsequent damage to the drive electronics. |
| <ul style="list-style-type: none">• 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. |



| |
|---|
|  WARNING |
| Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor |
| Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors. |
| <ul style="list-style-type: none">• Use temperature sensors that fully comply with the specifications of the safety isolation.• 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. |

4.3.2.5 X24 24 V terminal adapter

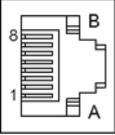
Table 4- 16 X24: 24 V terminal adapter

| | Terminal | Designation | Technical data |
|--|----------|-------------------|------------------------|
|  | + | 24 V power supply | 24 V DC supply voltage |
| | M | Ground | Electronics ground |
| Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm ² | | | |

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

4.3.2.6 X200-X202 DRIVE-CLiQ interfaces

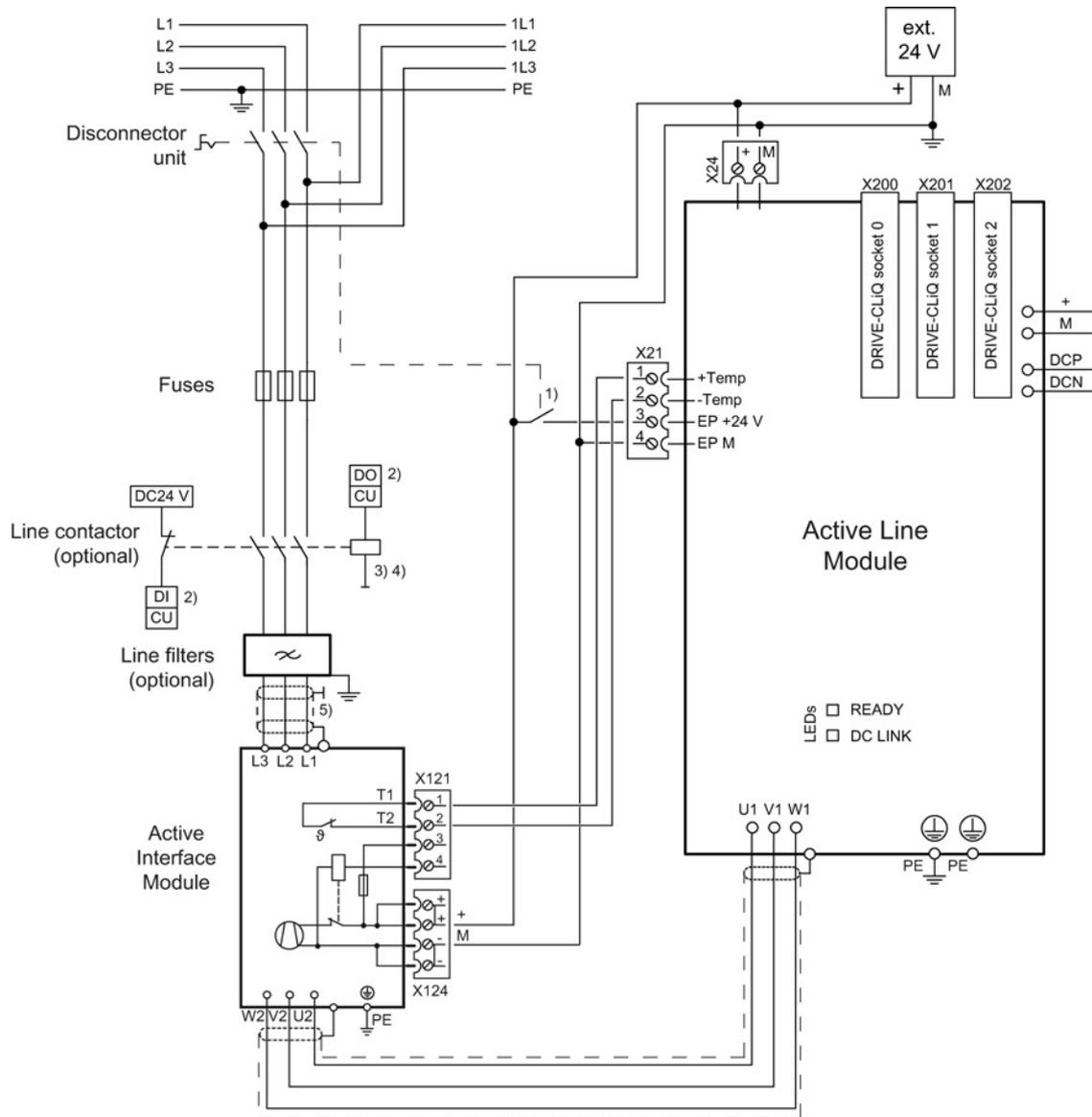
Table 4- 17 X200-X202: DRIVE-CLiQ interfaces

| | 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.) Order number: 6SL3066-4CA00-0AA0

4.3.3 Connection example



- 1) Leading NC contact $t > 10$ ms
- 2) DI/DO, controlled by the Control Unit.
- 3) No additional load permitted downstream of line contactor!
- 4) The current carrying capacity of the DO must be observed; an output coupling device must be used if required.
- 5) Contacting via rear mounting panel or shielding buses in accordance with EMC Directive.

Figure 4-15 Example connection of Active Line Module

Note

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

4.3.4 Meaning of LEDs

Table 4- 18 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 | -- | 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 | -- | This component has at least one fault. Note: The LED is activated regardless of whether the corresponding messages have been reconfigured. | Resolve and acknowledge the fault. |
| Green/ red (0.5 Hz) | -- | Firmware is being downloaded. | – |
| Green/red (2 Hz) | -- | Firmware download has been completed. The system waits for POWER ON. | Carry out a POWER ON. |
| Green/orange or red/orange | -- | Component recognition via LED is activated ¹⁾ . Note: Both options depend on the LED status when component recognition is activated. | – |

¹⁾ See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



WARNING

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

4.3.5 Dimension drawings

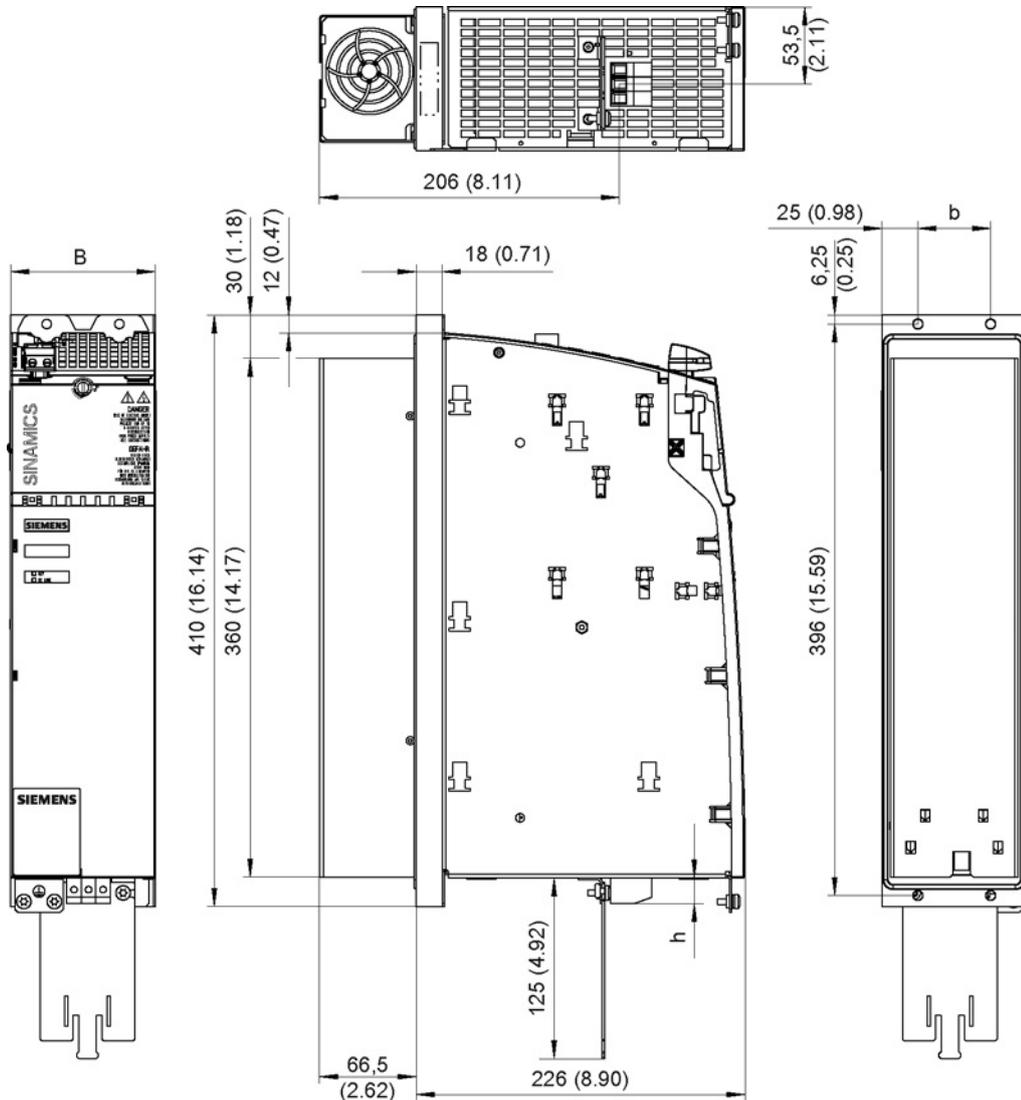


Figure 4-16 Dimension drawing of 16 kW Active Line Module with external air cooling, all dimensions in mm and (inches)

Table 4- 19 Dimensions of 16 kW Active Line Module with external air cooling

| Active Line Module | Order number | B [mm] (inches) | b [mm] (inches) | h [mm] (inches) |
|--------------------|--------------------|-----------------|-----------------|-----------------|
| 16 kW | 6SL3131-7TE21-6AAx | 100 (3.94) | 50 (1.97) | 18 (0.71) |

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 617).

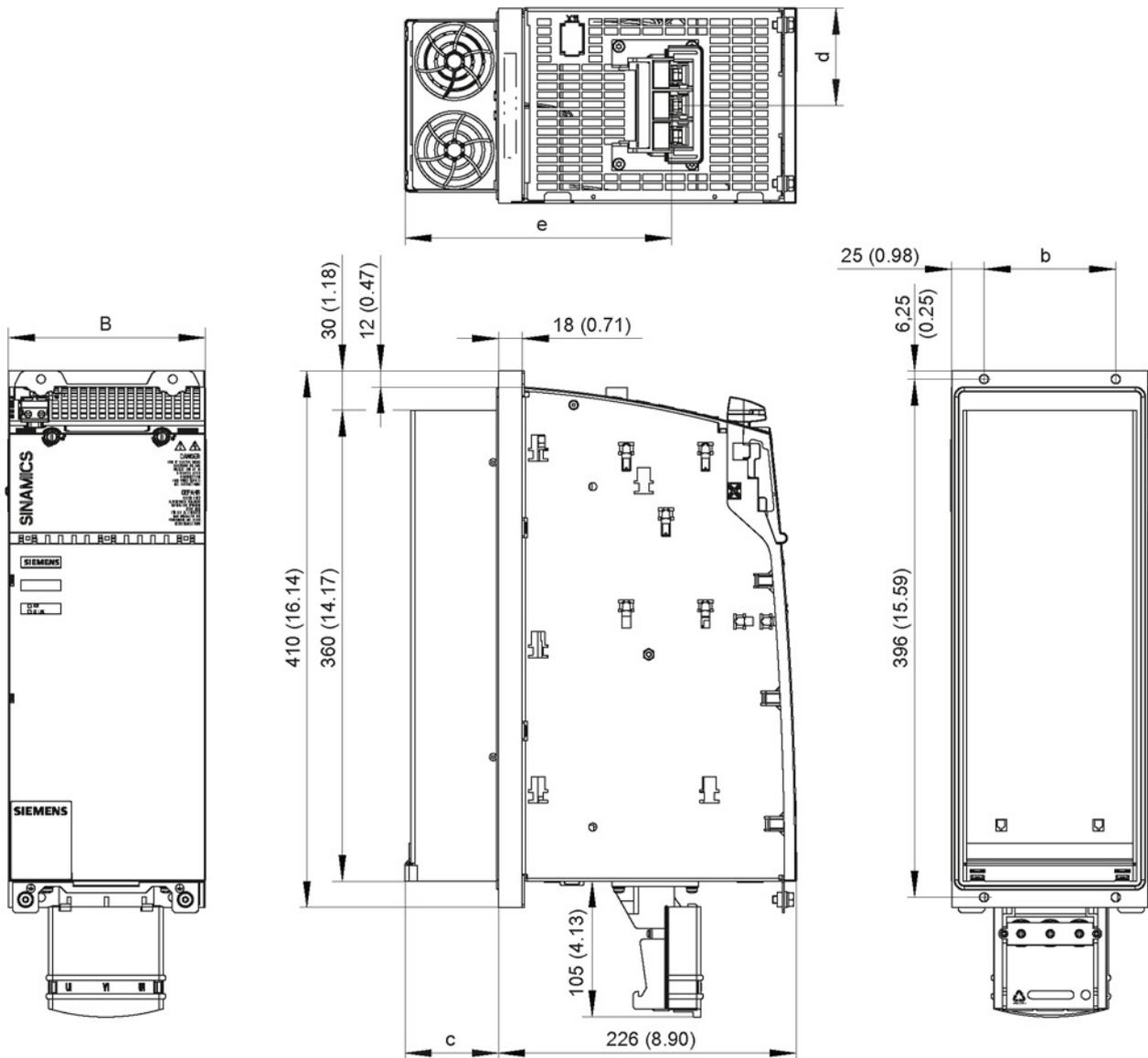


Figure 4-17 Dimension drawing of 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules with external air cooling (example 36 kW), all dimensions in mm and (inches)

Table 4- 20 Dimensions of 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules with external air cooling

| Active Line Module | Order number | B [mm] (inches) | b [mm] (inches) | c [mm] (inches) | d [mm] (inches) | e [mm] (inches) |
|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| 36 kW | 6SL3131-7TE23-6AAx | 150 (5.91) | 100 (3.94) | 71 (2.80) | 75 (2.95) | 203 (7.99) |
| 55 kW | 6SL3131-7TE25-5AAx | 200 (7.87) | 150 (5.91) | 92 (3.62) | 100 (3.94) | 224 (8.82) |
| 80 kW | 6SL3131-7TE28-0AAx | 300 (11.81) | 250 (9.84) | 82 (3.23) | 150 (5.91) | 214 (8.43) |
| 120 kW | 6SL3131-7TE31-2AAx | 300 (11.81) | 250 (9.84) | 82 (3.23) | 150 (5.91) | 214 (8.43) |

4.3 Active Line Modules with external air cooling

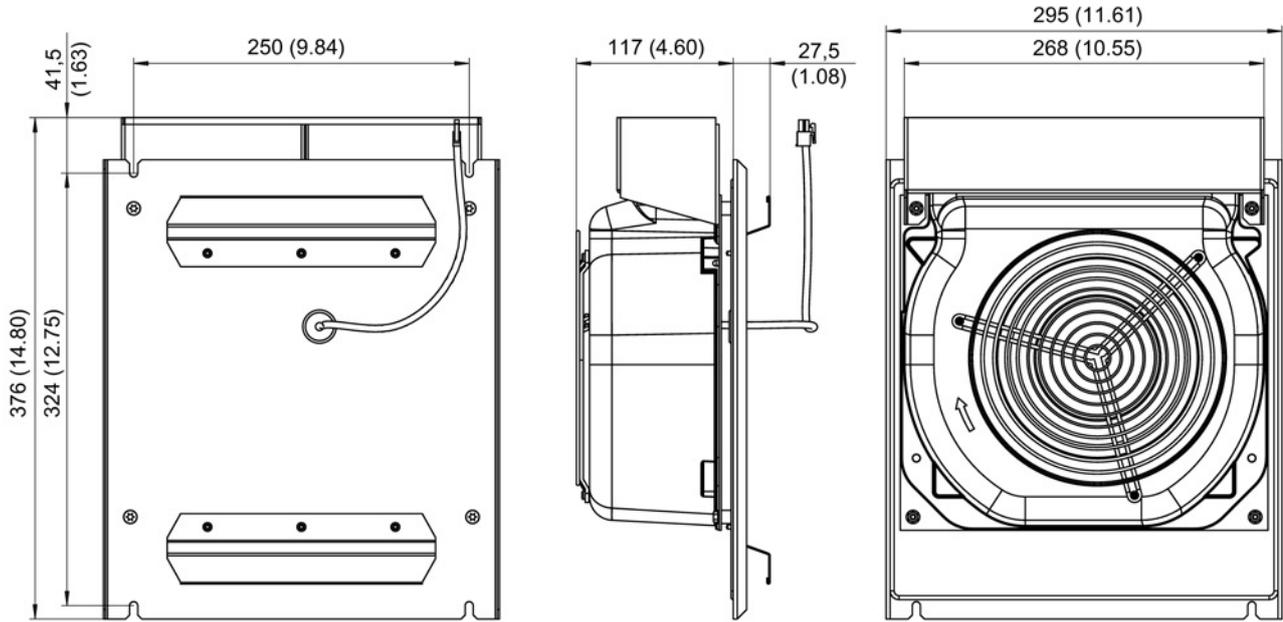
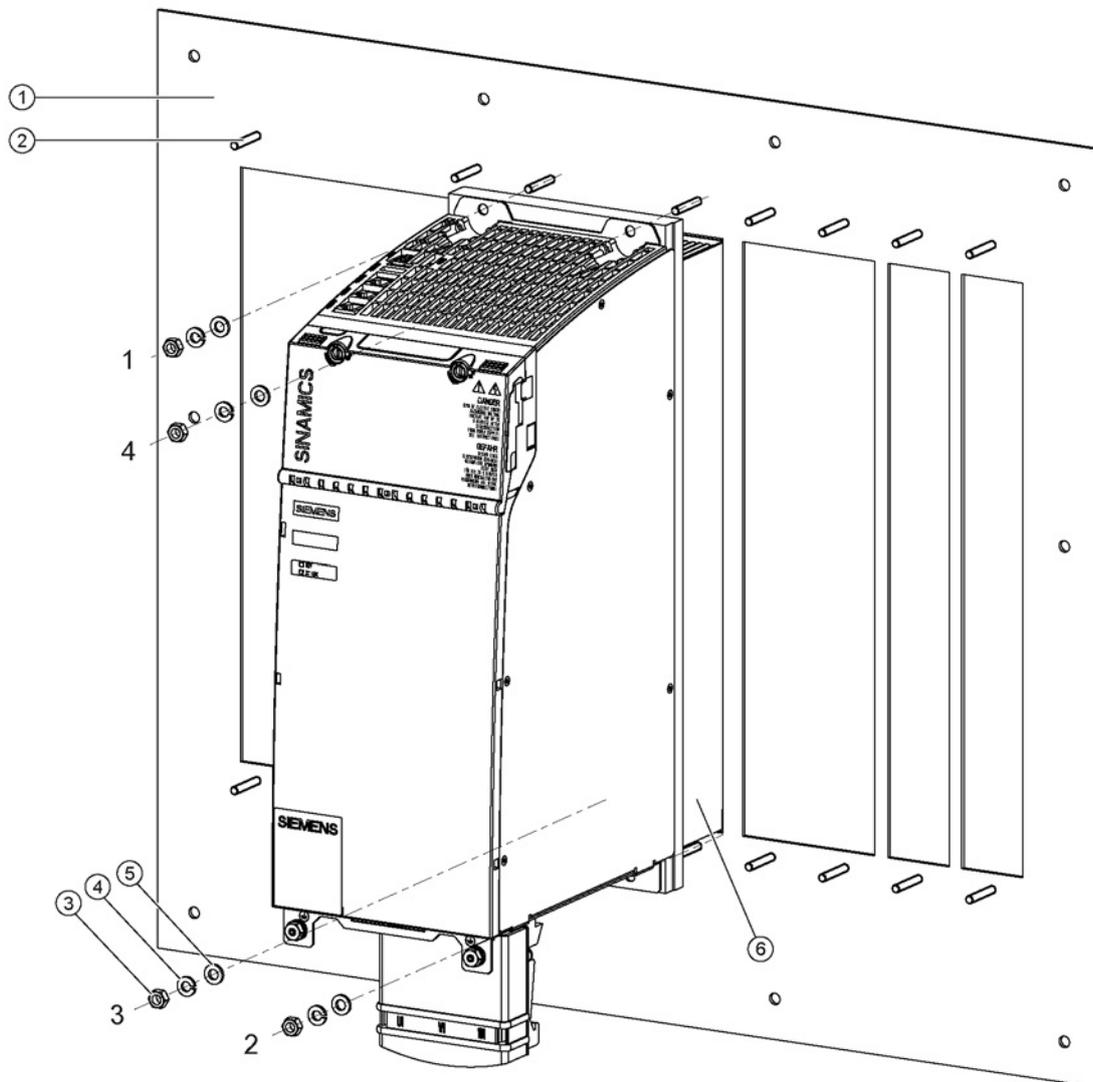


Figure 4-18 Dimension drawing of fan for 80 kW and 120 kW Active Line Modules with external air cooling, all dimensions in mm and (inches)

4.3.6 Mounting



- ① Mounting plate with openings for mounting
- ② M6 studs
- ③ M6 nut
- ④ Spring washer
- ⑤ Washer
- ⑥ Fan assembly

Figure 4-19 Mounting an Active Line Module with external air cooling (example: 36 kW)

Tightening torques:

- Firstly, tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
Tightening torque: 6 Nm

4.3 Active Line Modules with external air cooling

Help with the mechanical control cabinet design is available from:

Siemens AG
Industry Sector, IA DT MC MF - WKC AS
TCCCC (Technical Competence Center Cabinets Chemnitz)
Postfach 1124
09070 Chemnitz, Germany
e-mail: cc.cabinetcooling.aud@siemens.com

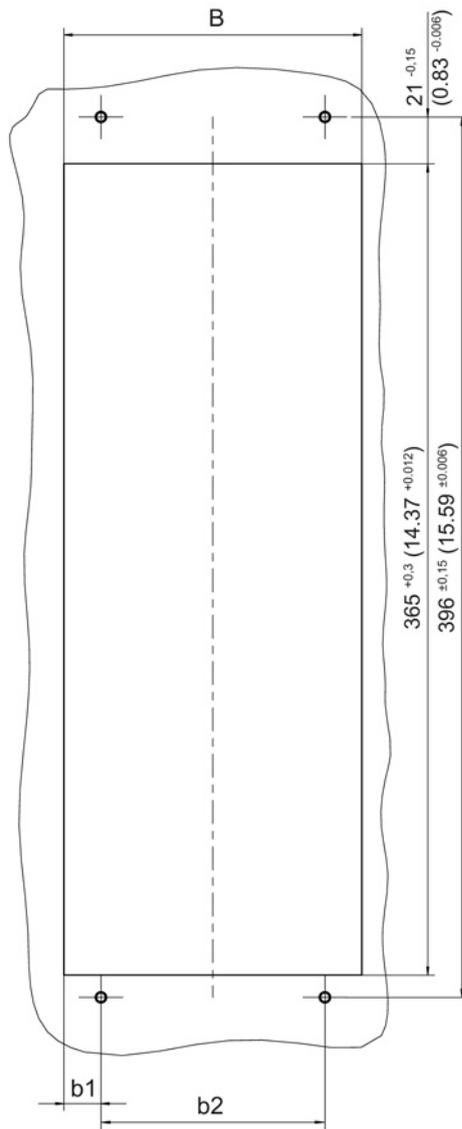
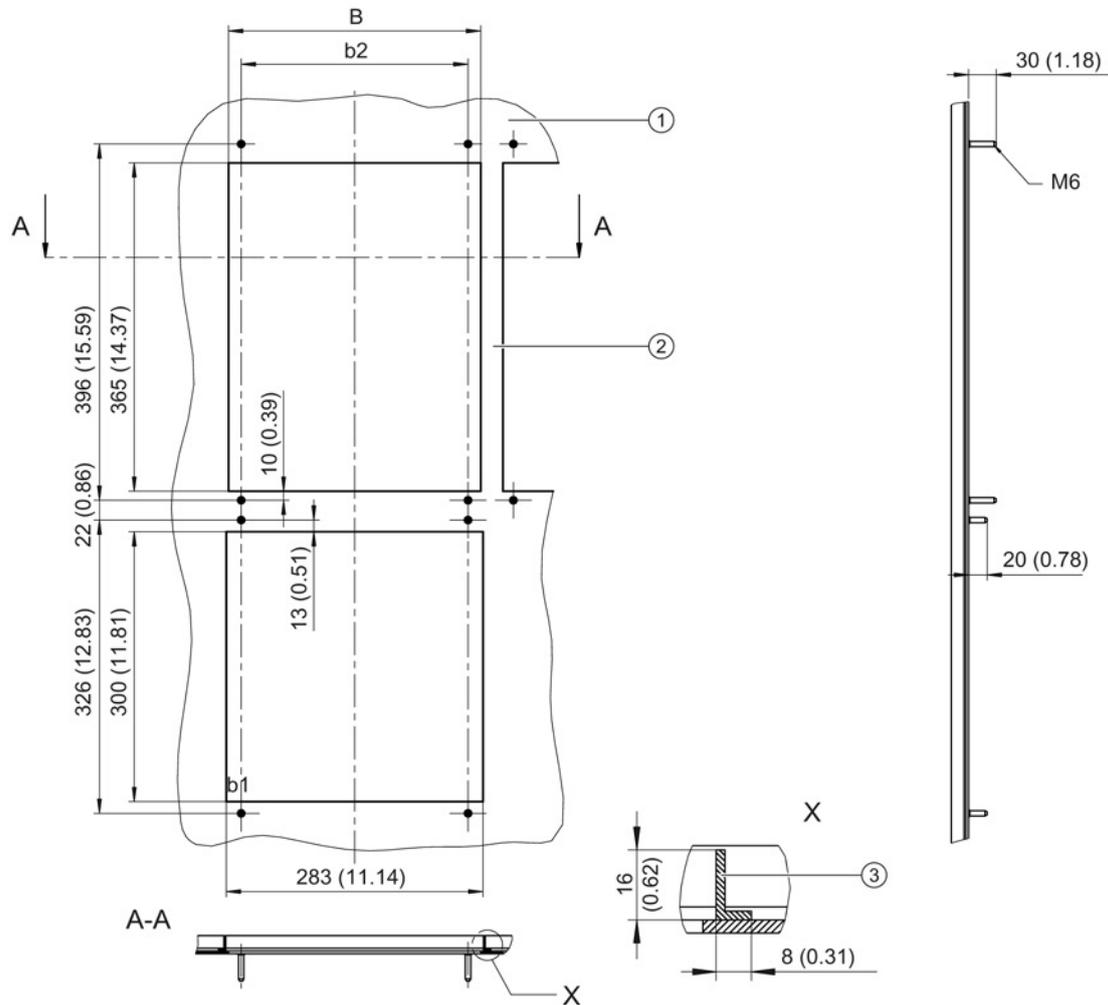


Figure 4-20 Openings to mount Active Line Modules 50 mm to 200 mm with external air cooling, all data in mm and (inches)



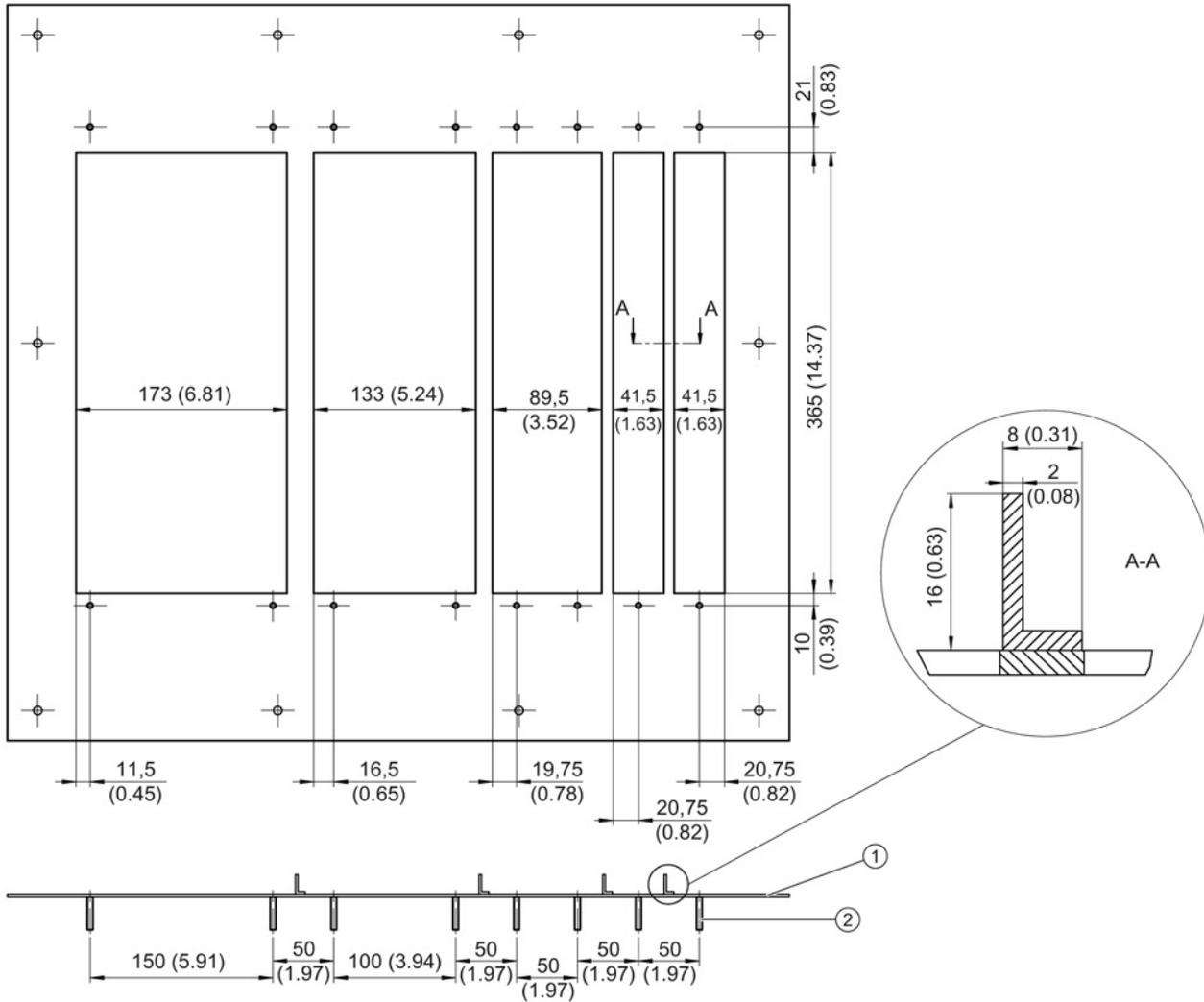
- ① Insert plate or mounting plate
- ② Cross-piece
- ③ Reinforcing bracket

Figure 4-21 Openings to mount an Active Line Module 300 mm with external air cooling, all data in mm and (inches)

Table 4- 21 Dimensions of openings to mount Active Line Modules with external air cooling

| Component width | B [mm] (inches) | w1 [mm] (inches) | w2 [mm] (inches) |
|-----------------|--|--|--|
| 50 mm | 41.5 ^{+0.3} (1.63 ^{+0.012}) | 20.75 ^{+0.15} (0.82 ^{+0.006}) | 0 |
| 100 mm | 89.5 ^{+0.3} (3.52 ^{+0.012}) | 19.75 ^{+0.15} (0.78 ^{+0.006}) | 50 ^{±0.15} (1.97 ^{±0.006}) |
| 150 mm | 133 ^{+0.3} (5.24 ^{+0.012}) | 16.5 ^{+0.15} (0.65 ^{+0.006}) | 100 ^{±0.15} (3.94 ^{±0.006}) |
| 200 mm | 173 ^{+0.3} (6.81 ^{+0.012}) | 11.5 ^{+0.15} (0.45 ^{+0.006}) | 150 ^{±0.15} (5.91 ^{±0.006}) |
| 300 mm | 278 ^{+0.3} (10.94 ^{+0.012}) | 14.0 ^{± 0.15} (0.55 ^{±0.006}) | 250 ^{+0.15} (9.84 ^{+0.006}) |

4.3 Active Line Modules with external air cooling

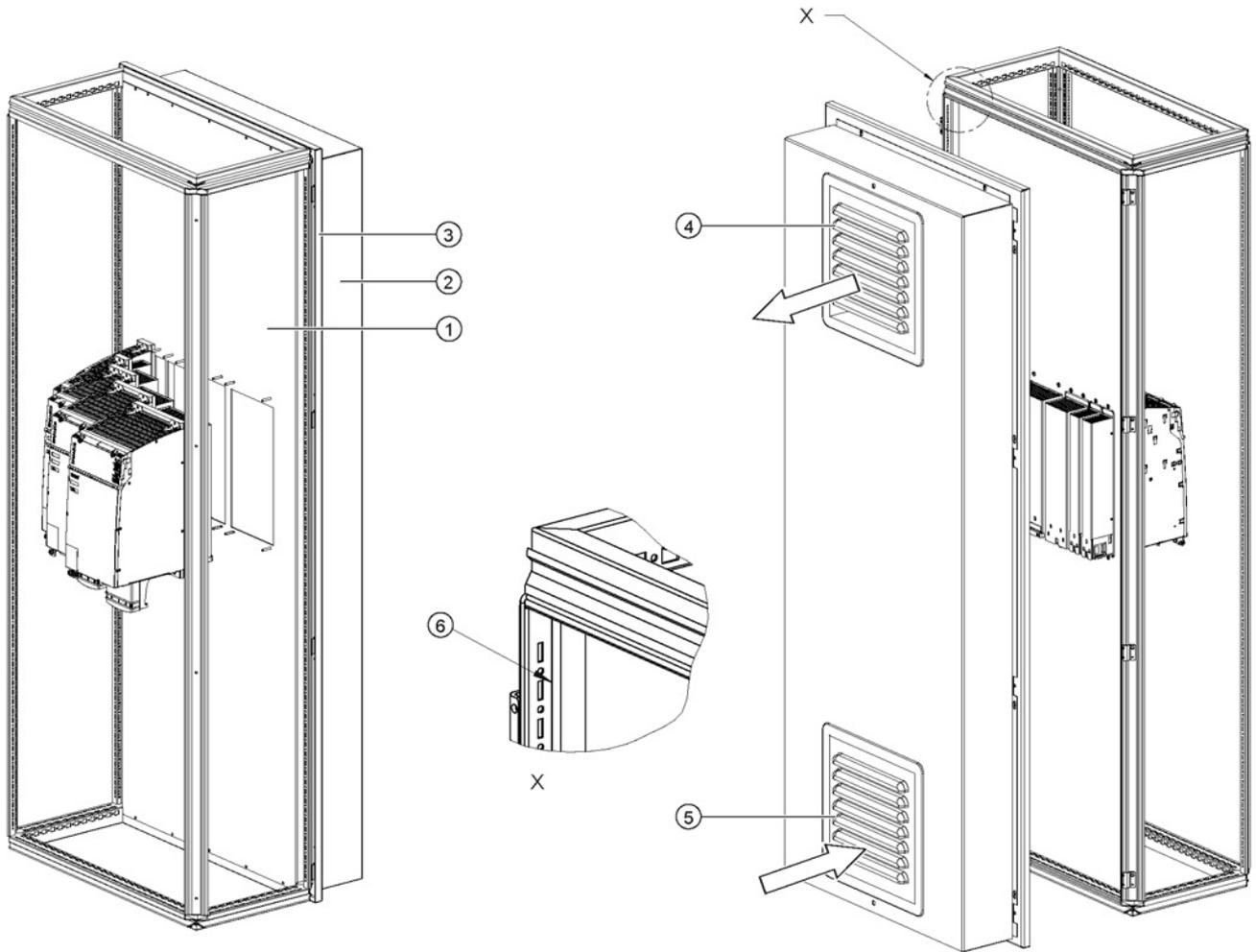


- ① Insert plate or mounting plate
- ② Threaded bolts M5 x 28

Figure 4-22 Example of a mounting plate for a drive line-up with external air cooling

When mounting it must be ensured that the component's seal is tight throughout. The cross-pieces must have the appropriate stability. If necessary, the cross-pieces of the openings must be reinforced.

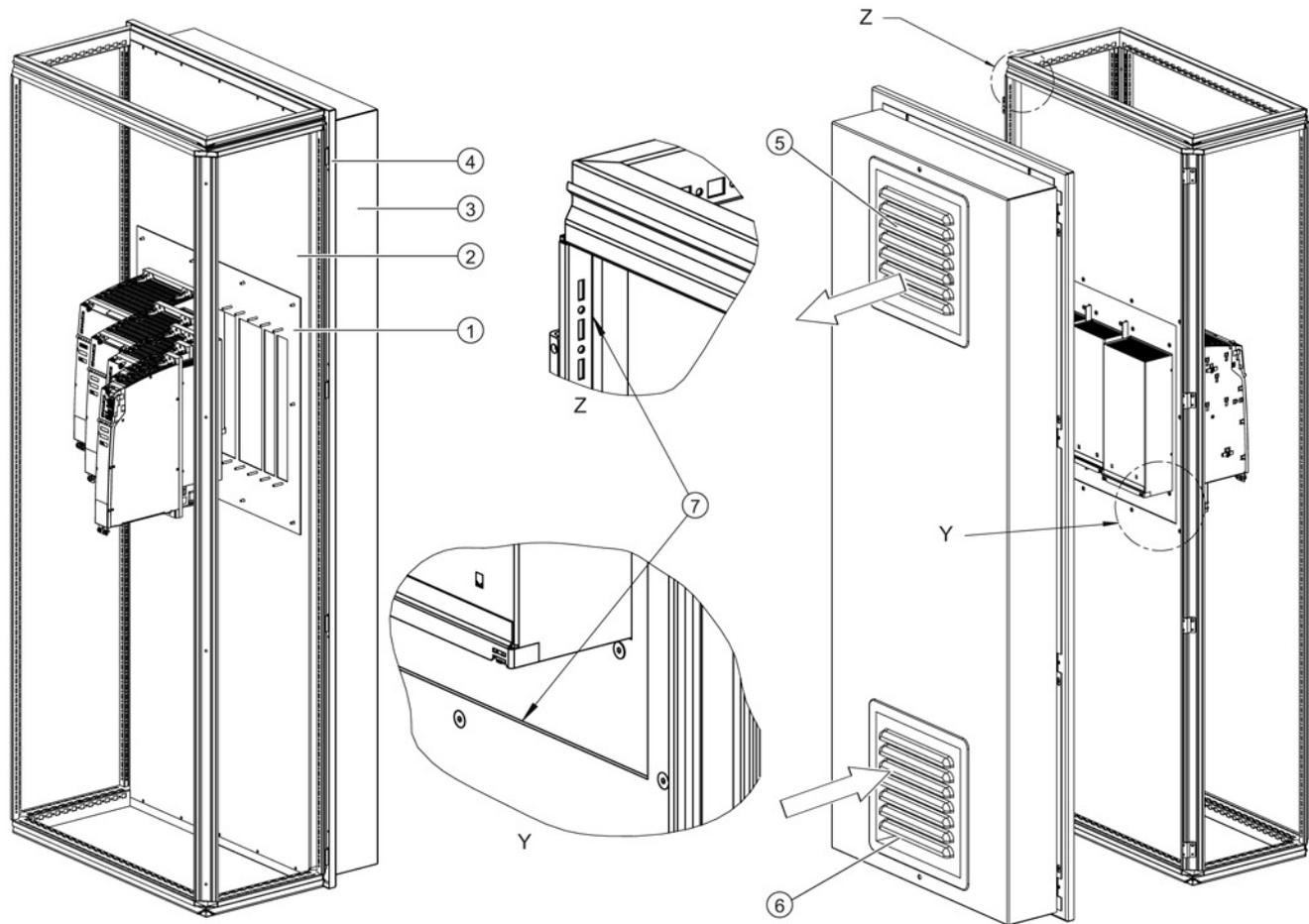
In the example, the cross-pieces have been reinforced using brackets according to EN 755-9. You are free to select the way that the bracket is attached to the insert.



- ① Mounting plate
- ② Cover
- ③ Rear panel
- ④ Air discharge
- ⑤ Air inlet - filter with filter fan
- ⑥ To comply with degree of protection IP54, the surfaces ⑥ between the mounting plate and the cabinet strip must be sealed all round. (for example, sealant Terostat-91 from the Teroson company)

Figure 4-23 Example 1: mounting in the cabinet with mounting plate

4.3 Active Line Modules with external air cooling



- ① Insert plate
- ② Mounting plate
- ③ Cover
- ④ Rear panel
- ⑤ Air discharge
- ⑥ Air inlet - filter with filter fan
- ⑦ To maintain the degree of protection IP54, the surfaces ⑦ between the mounting plate and the cabinet strip as well as between the mounting plate and insert plate must be sealed all around. (for example, sealant Terostat-91 from the Teroson company)

Figure 4-24 Example 2: mounting in the cabinet with mounting plate

We recommend that you attach a cover and filter fan to the cabinet.

The filtered fan must be fitted in such a way that the cooling air required by the drive line-up is not restricted. The overall cooling air requirement is obtained from the sum of the individual components (see Chapter Technical data (Page 193)).

Note

If the cooling air requirement is not covered by the filtered fan, the components cannot output their specified power.

The filters with filter fan must be regularly checked for dirt and cleaned if necessary.

4.3.7 Technical data

Table 4- 22 Technical data for Active Line Modules with external air cooling, part 1

| External air cooling | 6SL3131- | 7TE21-6AAx | 7TE23-6AAx | 7TE25-5AAx | 7TE25-5AA3 + Active Interface Module |
|---|------------------------|--|------------|------------|---|
| Rated power | kW | 16 | 36 | 55 | 55 |
| Infeed | | | | | |
| Rated power (S1) ¹⁾ | kW (P _n) | 16 | 36 | 55 | 55 |
| Infeed power (S6 - 40 %) ¹⁾ | kW (P _{s6}) | 21 | 47 | 71 | 71 |
| Peak infeed power ¹⁾ | kW (P _{max}) | 35 | 70 | 91 | 110 |
| Regenerative feedback | | | | | |
| Continuous regenerative power | kW | 16 | 36 | 55 | 55 |
| Peak regenerative 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 Hz | | | |
| Electronics 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 - 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: for 600 V | A _{DC} | 27 | 60 | 92 | 92 |
| DC link current: for 600 V DC; for S6 - 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 |
| Reinforced DC link busbars | A _{DC} | 150 | -- | -- | -- |
| 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 |

4.3 Active Line Modules with external air cooling

| External air cooling | 6SL3131- | 7TE21-6AAx | 7TE23-6AAx | 7TE25-5AAx | 7TE25-5AA3 + Active Interface Module |
|--|-----------|--|------------|------------|---|
| Rated power | kW | 16 | 36 | 55 | 55 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 282,8 | 666 | 945,6 | 945,6 |
| Max. ambient temperature without derating | ° C | 40 | 40 | 40 | 40 |
| with derating | ° C | 55 | 55 | 55 | 55 |
| DC link capacitance Active Line Module | µF | 705 | 1410 | 1880 | 1880 |
| Drive line-up, max. | µF | 20000 | 20000 | 20000 | 20000 |
| Power factor | cosφ | 1 | 1 | 1 | 1 |
| Circuit breaker (IEC 60947 and UL) | | See Section Overcurrent protection using line fuses and circuit breakers (Page 51) | | | |
| Rated short-circuit current SCCR ³⁾ | kA | 65 | 65 | 65 | 65 |
| Sound pressure level | dB(A) | < 60 | < 65 | < 60 | < 60 |
| Cooling air requirement | m³/h | 56 | 112 | 160 | 160 |
| Max. permissible heat sink temperature | ° C | 85 | 90 | 88 | 88 |
| Rated voltage for rated data 3 AC 380 V | | | | | |
| Weight | kg | 8,78 | 13,77 | 18,5 | 18,5 |

- 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) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker – and the Line Module in the drive system.

Table 4- 23 Technical data for Active Line Modules with external air cooling, part 2

| External air cooling | 6SL3131- | 7TE28-0AAx | 7TE31-2AAx |
|---|------------------------|--|------------|
| Rated power | kW | 80 | 120 |
| Infeed Rated power (S1) ¹⁾ | kW (P _n) | 80 | 120 |
| Infeed power (S6 - 40 %) ¹⁾ | kW (P _{s6}) | 106 | 145 |
| Peak infeed power ¹⁾ | kW (P _{max}) | 131 | 175 |
| Regenerative feedback Continuous regenerative power | kW | 80 | 120 |
| Peak regenerative power | kW | 131 | 175 |
| Supply voltages Line voltage | V _{ACrms} | 3 AC 380 ... 480 ± 10 % (15 % < 1 min) | |
| Line frequency | Hz | 47 ... 63 Hz | |
| Electronics power supply | V _{DC} | 24 (20.4 ... 28.8) | |

| External air cooling | 6SL3131– | 7TE28–0AAx | 7TE31-2AAx |
|--|-------------------|--|------------|
| Rated power | kW | 80 | 120 |
| DC link voltage | V _{DC} | 510 ... 720 | |
| Oversvoltage trip | V _{DC} | 820 ± 2 % | |
| Undervoltage trip ²⁾ | V _{DC} | 360 ± 2 % | |
| Input currents | | | |
| Rated input current at AC 400 V: | A _{AC} | 122 | 182 |
| Input current at AC 380 V / AC 480 V | A _{AC} | 128 / 102 | 192 / 152 |
| at AC 400 V; S6 - 40 % | A _{AC} | 161 | 220 |
| at AC 400 V; peak current | A _{AC} | 200 | 267 |
| DC link currents | | | |
| Rated DC link current at 600 V: | A _{DC} | 134 | 200 |
| DC link current: for 600 V DC; for S6 - 40 % | A _{DC} | 176 | 244 |
| for 600 V DC; peak current | A _{DC} | 218 | 292 |
| Current carrying capacity | | | |
| DC link busbar: | A _{DC} | 200 | 200 |
| 24 V busbar: | A _{DC} | 20 | 20 |
| Electronics current drawn at 24 V DC | A _{DC} | 1.4 | 1.8 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 1383.6 | 2243.2 |
| Max. ambient temperature | | | |
| without derating | ° C | 40 | 40 |
| with derating | ° C | 55 | 55 |
| DC link capacitance | | | |
| Active Line Module | µF | 2820 | 3995 |
| Drive line-up, max. | µF | 20000 | 20000 |
| Power factor | cosφ | 1 | 1 |
| Circuit breaker (IEC 60947 and UL) | | See Section Overcurrent protection using line fuses and circuit breakers (Page 51) | |
| Rated short-circuit current SCCR ³⁾ | kA | 65 | 65 |
| Sound pressure level | dB(A) | < 73 | < 73 |
| Cooling air requirement | m ³ /h | 520 | 520 |
| Max. permissible heat sink temperature | | 73 | 83 |
| Rated voltage for rated data 3 AC 380 V | | | |
| Weight | kg | 27.66 | 30.74 |

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) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker – and the Line Module in the drive system.

4.3.7.1 Characteristics

Rated duty cycles for Active Line Modules

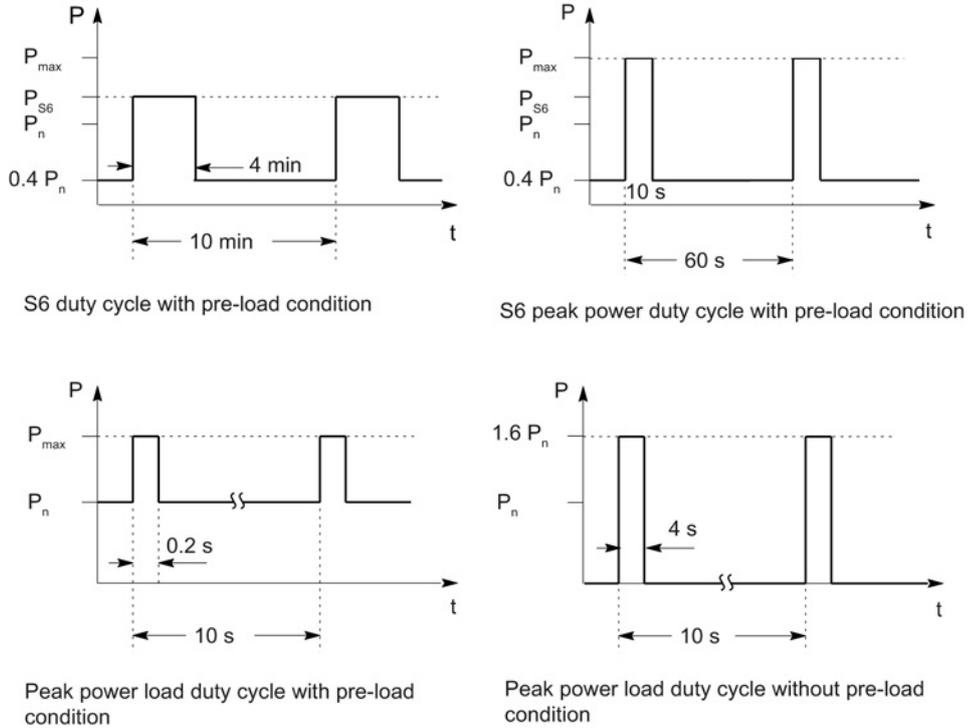
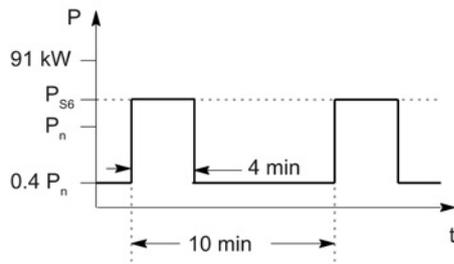
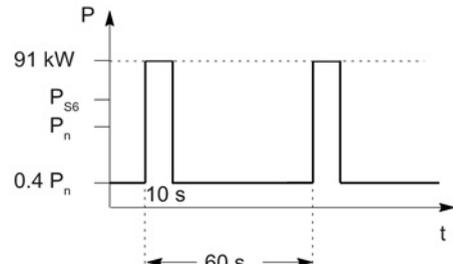


Figure 4-25 Rated duty cycles for Active Line Modules (exception: not applicable for 55 kW Active Line Module with Active Interface Module)

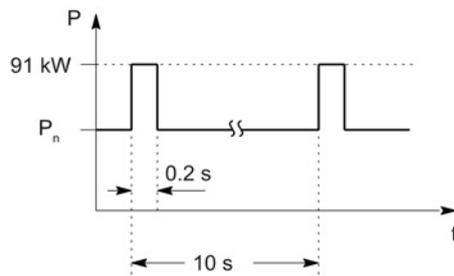
Rated duty cycles for Active Line Modules with Active Interface Modules



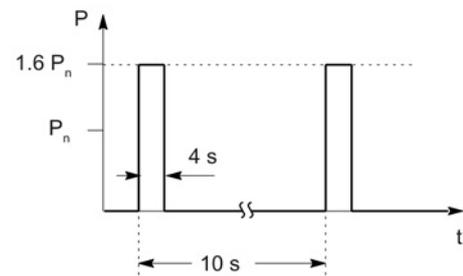
S6 duty cycle with pre-load condition



S6 peak power duty cycle with pre-load condition



Peak power load duty cycle with pre-load condition



Peak power load duty cycle without pre-load condition

Figure 4-26 Load cycles for 55 kW Active Line Modules with Active Interface Module

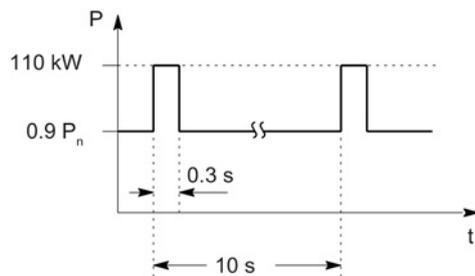


Figure 4-27 Peak load cycle with initial load for 55 kW Active Line Modules with Active Interface Module

Derating characteristics

Note

For additional information, see chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

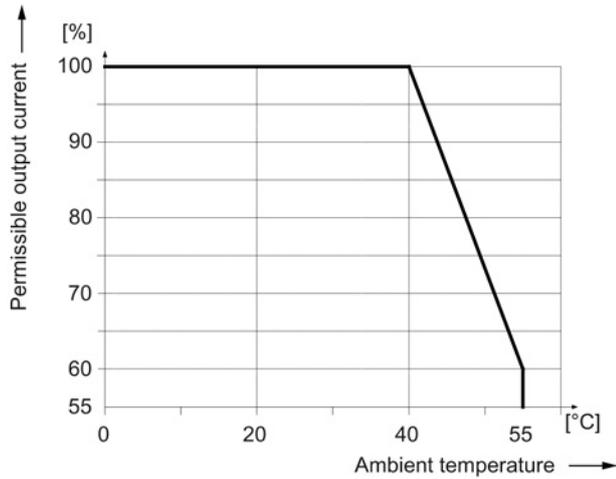


Figure 4-28 Output current as a function of the ambient temperature

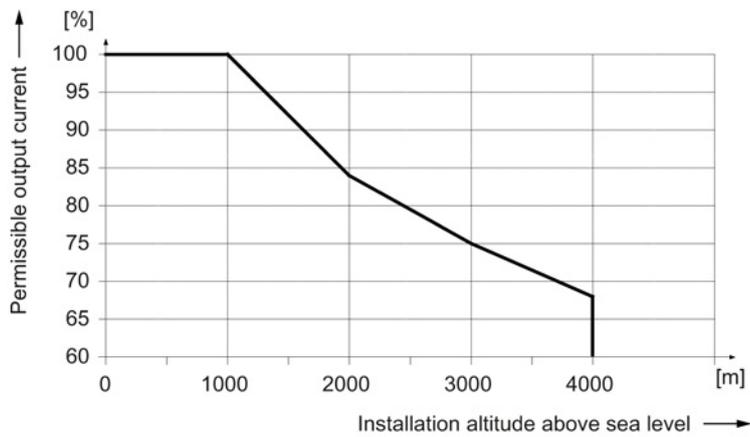


Figure 4-29 Output current as a function of the installation altitude

4.4 Active Line Modules with cold plate

4.4.1 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 the motors are in feedback mode, Active Line Modules supply power back to the line supply. The regenerative feedback capability of the modules can be deactivated by parameterization.

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. An optional main contactor is required for disconnecting the voltage.

Active Line Modules can be directly connected to TN, IT and TT systems. The Line Modules have an integrated overvoltage protection function.



WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

4.4.2 Interface description

4.4.2.1 Overview

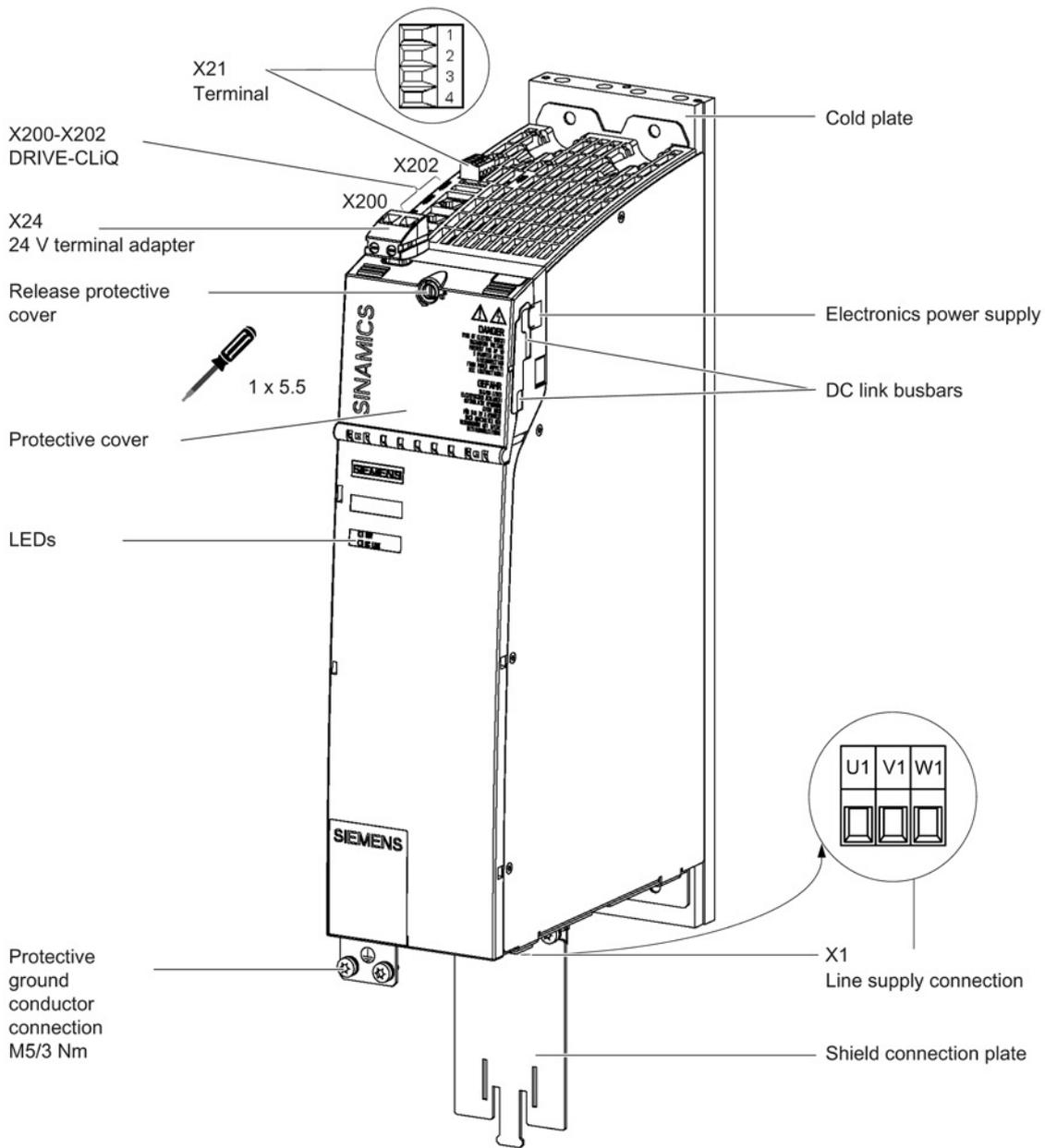
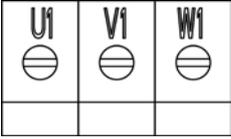
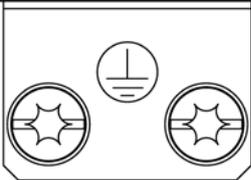


Figure 4-30 Interface overview, Active Line Module with cold plate (example: 16 kW)

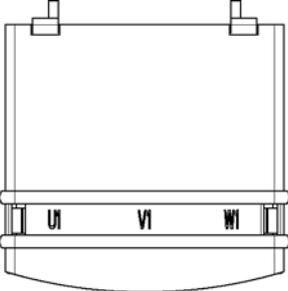
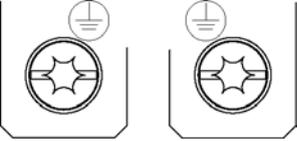
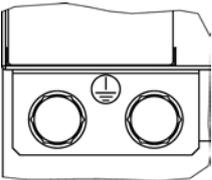
4.4.2.2 X1 line connection

Table 4- 24 X1: Line connection for Active Line Modules 16 kW

| | Terminal | Technical data |
|---|---------------|--|
|  | U1 | Max. connectable cross-section: 10 mm ² Type: Screw terminal 6 (Page 755) Tightening torque: 1.5 ... 1.8 Nm |
| | V1 | |
| | W1 | |
|  | PE connection | Threaded hole M5 / 3 Nm ¹⁾ |

1) For ring cable lugs without insulation

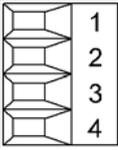
Table 4- 25 X1: Line supply connection for Active Line Modules 36 kW to 120 kW

| | Terminal | Technical data |
|---|---------------|--|
|  | U1 | Supply voltage: 380 ... 480 V 3 AC, 50/60 Hz 36 kW: Threaded bolts M6 / 6 Nm ¹⁾ 55 kW, 80 kW and 120 kW: Threaded bolts M8 / 13 Nm ¹⁾ |
| | V1 | |
| | W1 | |
|  | PE connection | 36 kW and 55 kW: Threaded hole M6 / 6 Nm ¹⁾ |
|  | | 80 kW and 120 kW: Threaded hole M8 / 13 Nm ¹⁾ |

1) For ring cable lugs without insulation

4.4.2.3 X21 EP terminals

Table 4- 26 X21 EP terminal / temperature sensor

| | Terminal | Designation | Technical data |
|--|----------|-------------------------|---|
|  | 1 | + Temp | Temperature sensors ¹⁾ : KTY 84–1C130 ²⁾ /PTC ²⁾ /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 Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs |
| | 4 | EP M (Enable Pulses) | |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm ² | | | |

- 1) The temperature sensor type and the temperature output can be selected by parameter (see the SINAMICS S120/S150 List Manual).
- 2) Temperatures are detected but not evaluated in the Active Line Module.

Terminals X21.1 and X21.2

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

Terminals X21.3 and X21.4



| |
|--|
| <p>⚠ WARNING</p> <p>Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected</p> <p>For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4.</p> <p>Pulse cancellation is activated if the power supply is disconnected. Regenerative feedback 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.</p> <p>Death or serious injury can result when live parts are touched.</p> <ul style="list-style-type: none"> • Neutralize the voltage in the DC link. |
|--|

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.

**! WARNING****Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor**

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that fully comply with the specifications of the safety isolation.
- 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.

4.4.2.4 X24 24 V terminal adapter

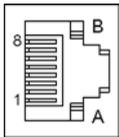
Table 4- 27 X24: 24 V terminal adapter

| | Terminal | Designation | Technical data |
|--|----------|-------------------|------------------------|
| | + | 24 V power supply | 24 V DC supply voltage |
| | M | Ground | Electronics ground |
| Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm ² | | | |

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

4.4.2.5 X200-X202 DRIVE-CLiQ interfaces

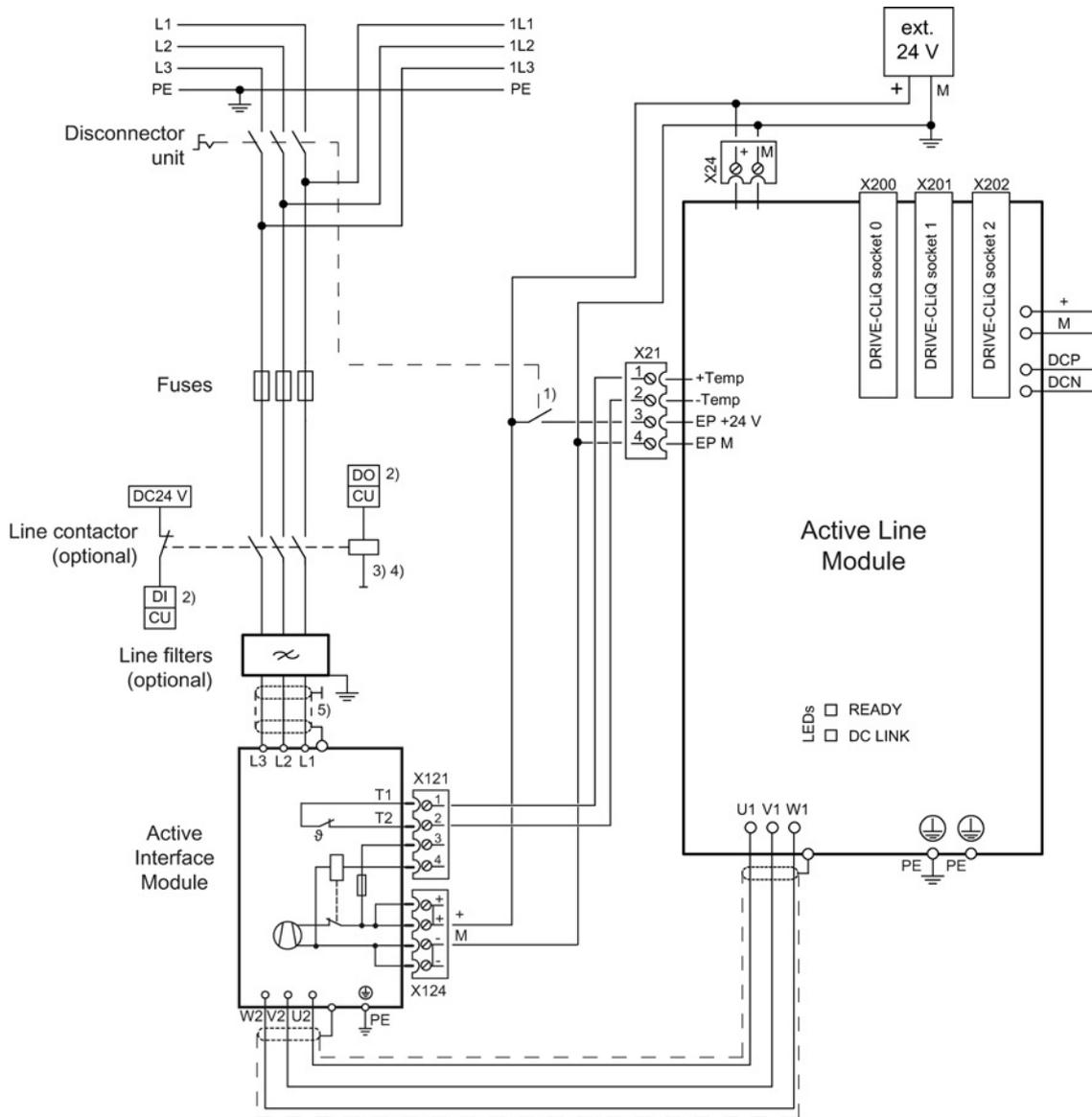
Table 4- 28 X200-X202: DRIVE-CLiQ interfaces

| | 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.) Order number: 6SL3066-4CA00-0AA0

4.4.3 Connection example



- 1) Leading NC contact $t > 10$ ms
- 2) DI/DO, controlled by the Control Unit.
- 3) No additional load permitted downstream of line contactor!
- 4) The current carrying capacity of the DO must be observed; an output coupling device must be used if required.
- 5) Contacting via rear mounting panel or shielding buses in accordance with EMC Directive.

Figure 4-31 Connection example: Active Line Module with cold plate

Note

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

4.4.4 Meaning of LEDs

Table 4- 29 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 | -- | 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 | -- | This component has at least one fault. Note: The LED is activated regardless of whether the corresponding messages have been reconfigured. | Resolve and acknowledge the fault. |
| Green/ red (0.5 Hz) | -- | Firmware is being downloaded. | – |
| Green/red (2 Hz) | -- | Firmware download has been completed. The system waits for POWER ON. | Carry out a POWER ON. |
| Green/orange or red/orange | -- | Component recognition via LED is activated ¹⁾ . Note: Both options depend on the LED status when component recognition is activated. | – |

¹⁾ See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



WARNING

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

4.4.5 Dimension drawings

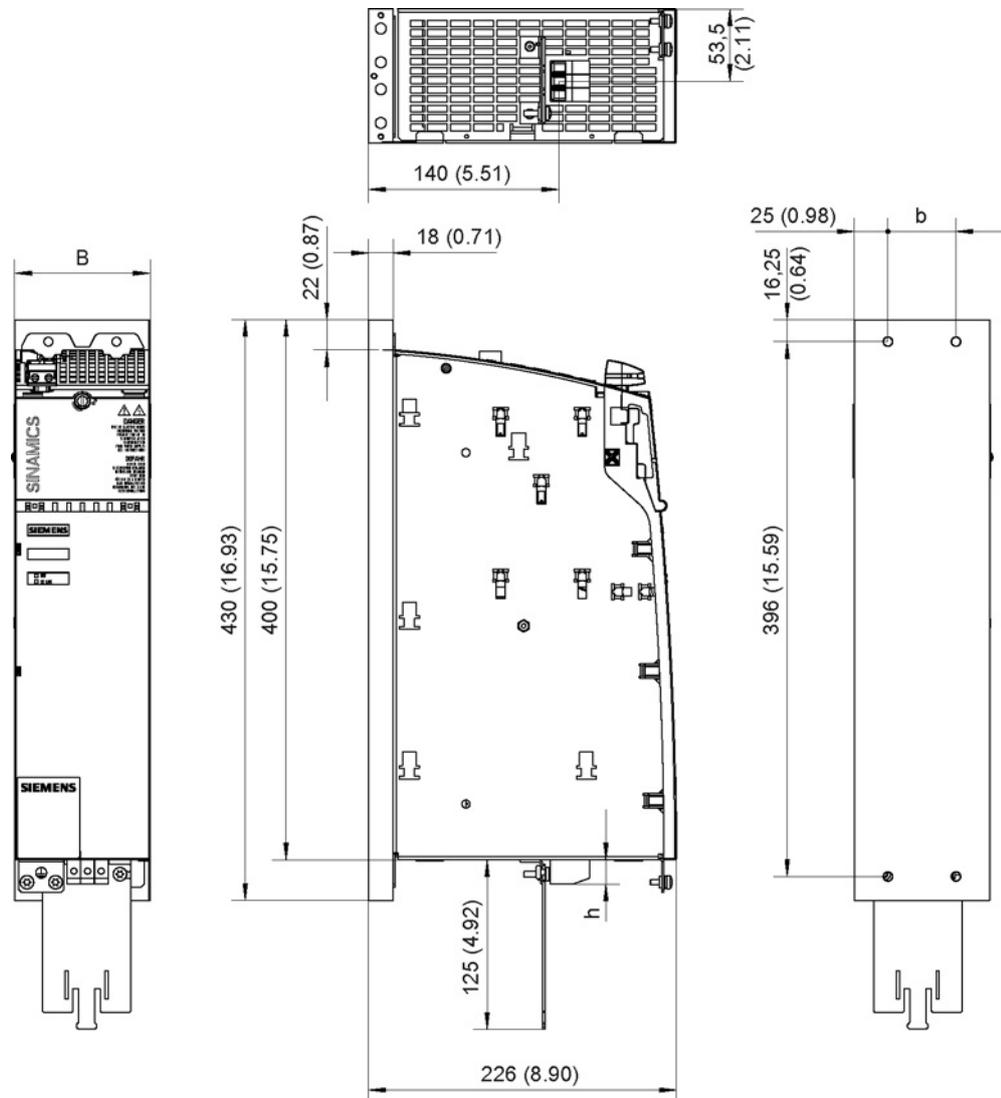


Figure 4-32 Dimension drawing of 16 kW Active Line Module with cold plate, all dimensions in mm and (inches)

Table 4- 30 Dimensions of 16 kW Active Line Module with cold plate

| Active Line Module | Order number | B [mm] (inches) | b [mm] (inches) | h [mm] (inches) |
|--------------------|--------------------|-----------------|-----------------|-----------------|
| 16 kW | 6SL3136-7TE21-6AAx | 100 (3.94) | 50 (1.97) | 18 (0.71) |

4.4 Active Line Modules with cold plate

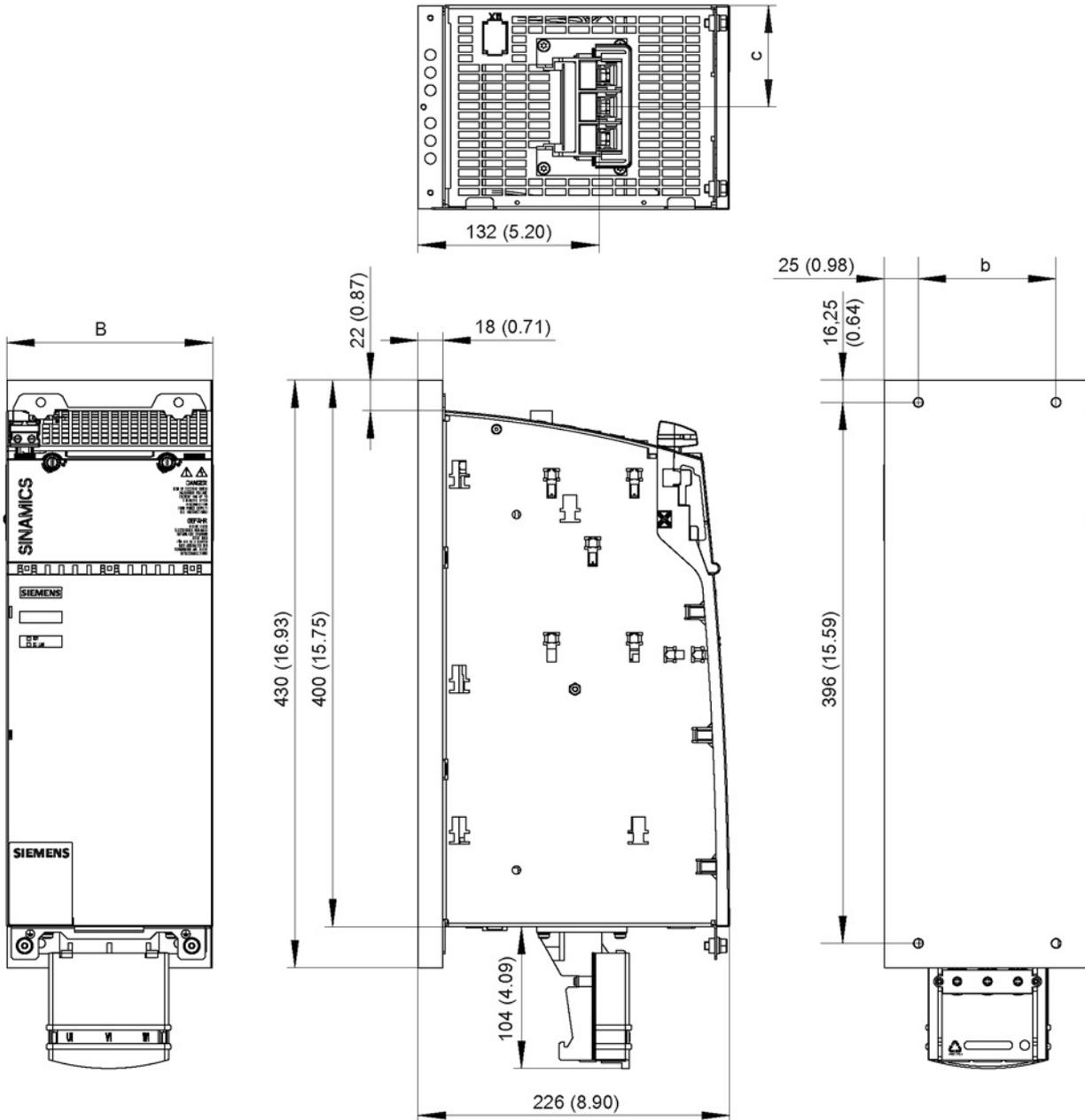


Figure 4-33 Dimension drawing of 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules with cold plate, all dimensions in mm and (inches)

Table 4- 31 Dimensions of 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules with cold plate

| Active Line Module | Order number | B [mm] (inches) | b [mm] (inches) | c [mm] (inches) |
|--------------------|--------------------|-----------------|-----------------|-----------------|
| 36 kW | 6SL3136-7TE23-6AAx | 150 (5.91) | 100 (3.94) | 75 (2.95) |
| 55 kW | 6SL3136-7TE25-5AAx | 200 (7.87) | 150 (5.91) | 100 (3.94) |
| 80 kW | 6SL3136-7TE28-0AAx | 300 (11.81) | 250 (9.84) | 150 (5.91) |
| 120 kW | 6SL3136-7TE31-2AAx | 300 (11.81) | 250 (9.84) | 150 (5.91) |

4.4.6 Mounting

Please note the following before mounting an Active Line Module with cold plate on a customer-specific heat sink:

- Check the surface of the heat sink to ensure that it is not damaged.
- To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every component with cold plate is supplied with heat-conducting foil cut to the right size. Note the mounting position of the heat-conducting foil (see diagram below).

Note

- Also replace the heat-conducting foil when replacing a component.
 - Only use heat-conducting foil released or supplied by Siemens.
-

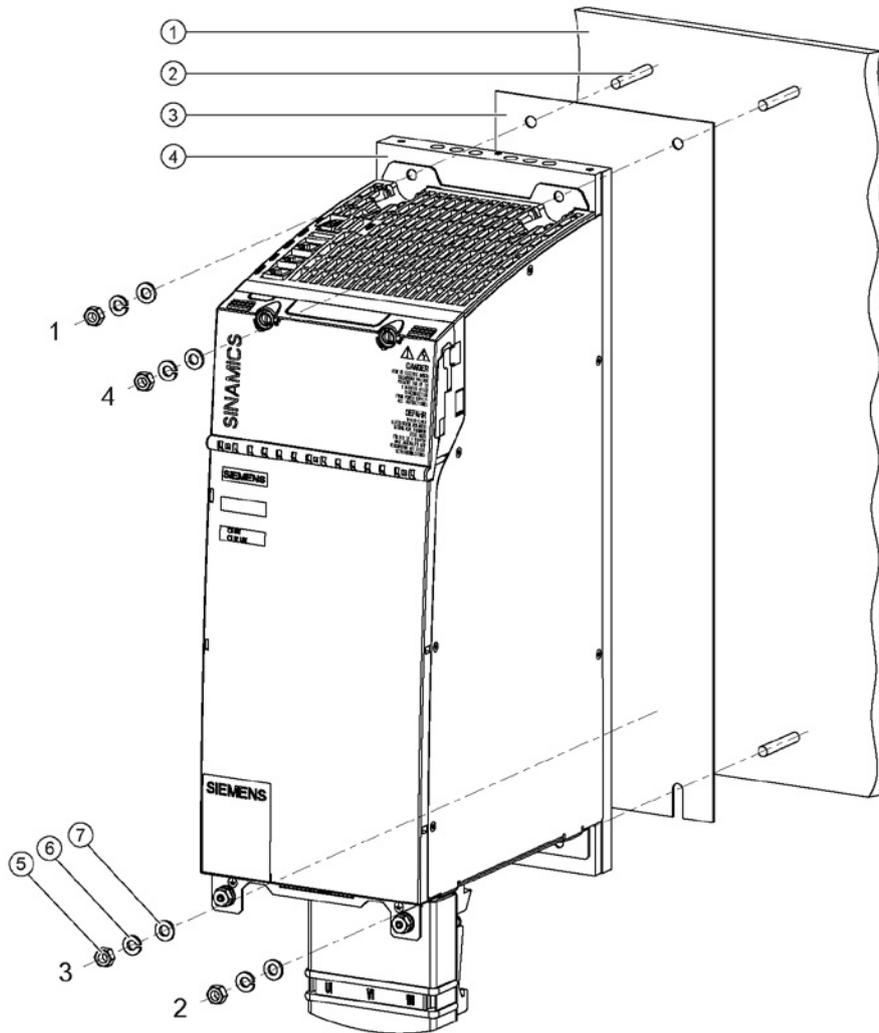
Table 4- 32 Overview of heat-conducting foils

| | Order number |
|------------------------------|--------------------|
| Heat-conducting foil, 50 mm | 6SL3162-6FB00-0AA0 |
| Heat-conducting foil, 100 mm | 6SL3162-6FD00-0AA0 |
| Heat-conducting foil, 150 mm | 6SL3162-6FF00-0AA0 |
| Heat-conducting foil, 200 mm | 6SL3162-6FH00-0AA0 |
| Heat-conducting foil, 300 mm | 6SL3162-6FM00-0AA0 |

Note

M6 studs and hexagon nuts or grub screws (ISO 7436-M6x40-14 H, property class 8.8) are recommended for mounting the components.

Mounting



- ① External heat sink (air or liquid)
- ② M6 studs
- ③ Heat-conducting foil
- ④ Cold plate
- ⑤ M6 nut
- ⑥ Spring washer
- ⑦ Washer

Figure 4-34 Mounting an Active Line Module with cold plate on an external heat sink (example: 36 kW)

Tightening torques:

- Firstly, tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
Tightening torque: 10 Nm

Help with the mechanical control cabinet design is available from:

Siemens AG
Industry Sector, IA DT MC MF - WKC AS
TCCCC (Technical Competence Center Cabinets Chemnitz)
Postfach 1124
09070 Chemnitz, Germany
e-mail: cc.cabinetcooling.aud@siemens.com

Properties of the heat sink

We recommend using AlMgSi 0.5 as the heat sink material.
The roughness of the external heat sink surface should be at least Rz 16. The contact surface between the heat sink and cold plate should have an evenness of 0.2 mm (applicable to a height of 450 mm and a width of 300 mm).

Note

Machine manufacturers can adapt the heat sink version to their special requirements. The specified rated data for the Line Modules can only be achieved if the power losses can be dissipated by the external heat sink under the specified general conditions.

| |
|---|
| NOTICE |
| Damage to the cold plate caused by incorrect mounting |
| The screw bolts can be damaged when mounting the cold plate. |
| <ul style="list-style-type: none">• Do not damage the cold plate. |

4.4.7 Technical data

Table 4- 33 Technical data for Active Line Modules with cold plate cooling

| Cold plate | 6SL3136-7TE | 21-6AAx | 23-6AAx | 25-5AAx | 25-5AA3 + Active Interface Module | 28-0AAx | 31-2AAx |
|--|------------------------|---|-----------|-----------|-----------------------------------|-----------------------------|------------------------------|
| Rated power | kW | 16 | 36 | 55 | 55 | 80 (64)¹⁾ | 120 (84)¹⁾ |
| Infeed | | | | | | | |
| Rated power (S1) ²⁾ | kW (P _n) | 16 | 36 | 55 | 55 | 80 (64) ¹⁾ | 120 (84) ¹⁾ |
| Infeed power (S6 - 40 %) ²⁾ | kW (P _{s6}) | 21 | 47 | 71 | 71 | 106 (85) ¹⁾ | 145 (116) ¹⁾ |
| Peak infeed power ²⁾ | kW (P _{max}) | 35 | 70 | 91 | 110 | 131 | 175 |
| Regenerative feedback | | | | | | | |
| Continuous regenerative power | kW | 16 | 36 | 55 | 55 | 80 (64) ¹⁾ | 120 (84) ¹⁾ |
| Peak regenerative power | kW | 35 | 70 | 91 | 110 | 131 | 175 |
| Supply voltages | | | | | | | |
| Line voltage | V _{ACrms} | 3 AC 380 ... 480 ±10 % (- 15 % < 1 min) | | | | | |
| Line frequency | Hz | 47 ... 63 | | | | | |
| Electronics power supply | V _{DC} | 24 (20.4 ... 28.8) | | | | | |
| DC link voltage | V _{DC} | 510 ... 720 | | | | | |
| Overvoltage trip | V _{DC} | 820 ± 2 % | | | | | |
| Undervoltage trip ³⁾ | V _{DC} | 360 ± 2 % | | | | | |
| Input currents | | | | | | | |
| Rated input current: for AC 400 V | A _{AC} | 25 | 55 | 84 | 84 | 122 (98) ¹⁾ | 182 (127) ¹⁾ |
| Input current: for AC 380 V | A _{AC} | 26 | 58 | 88 | 88 | 128 (102) ¹⁾ | 192 (134) ¹⁾ |
| for AC 480 V | A _{AC} | 21 | 46 | 70 | 70 | 102 (82) ¹⁾ | 152 (106) ¹⁾ |
| for AC 400 V; S6 - 40 % | A _{AC} | 32 | 71 | 108 | 108 | 161 (129) ¹⁾ | 220 (154) ¹⁾ |
| for AC 400 V; peak current | A _{AC} | 54 | 107 | 139 | 168 | 200 | 267 |
| DC link currents | | | | | | | |
| Rated DC link current: for 600 V | A _{DC} | 27 | 60 | 92 | 92 | 134 (99) ¹⁾ | 200 (140) |
| DC link current: for 600 V DC; for S6 - 40 % | A _{DC} | 35 | 79 | 121 | 121 | 176 (141) ¹⁾ | 244 (171) ¹⁾ |
| for 600 V DC; peak current | A _{DC} | 59 | 117 | 152 | 176 | 195 | 292 |
| Current carrying capacity | | | | | | | |
| DC link busbars | A _{ACrms} | 100 | 200 | 200 | 200 | 200 | 200 |
| Reinforced DC link busbars | A _{ACrms} | 150 | -- | -- | -- | -- | -- |
| 24 V DC busbars | A _{ACrms} | 20 | 20 | 20 | 20 | 20 | 20 |
| Electronics current drawn at 24 V DC | A _{DC} | 0.85 | 1.05 | 1.15 | 1.15 | 1.4 | 1.8 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 280.4 | 655.2 | 927.6 | 927.6 | 1383.6 | 2243.2 |

| Cold plate | 6SL3136-7TE | 21-6AAx | 23-6AAx | 25-5AAx | 25-5AA3 + Active Interface Module | 28-0AAx | 31-2AAx |
|---|--|--|---------------|---------------|-----------------------------------|---------------|---------------|
| DC link capacitance Active Line Module Drive line-up, max. | μF μF | 710 20000 | 1410 20000 | 1880 20000 | 1880 20000 | 2820 20000 | 3760 20000 |
| Power factor | $\cos\phi$ | 1 | 1 | 1 | 1 | 1 | 1 |
| Circuit breaker (IEC 60947 and UL) | | See Section Overcurrent protection using line fuses and circuit breakers (Page 51) | | | | | |
| Rated short-circuit-current SCCR ⁴⁾ | kA | 65 | 65 | 65 | 65 | 65 | 65 |
| Max. permissible heat sink temperature | $^{\circ}\text{C}$ | 70 | 73 | 83 | 83 | 75 | 80 |
| Max. ambient temperature without derating with derating | $^{\circ}\text{C}$ $^{\circ}\text{C}$ | 40 55 | 40 55 | 40 55 | 40 55 | 40 55 | 40 55 |
| Weight | kg | 6.1 | 10.2 | 13.8 | 13.8 | 20.3 | 20.4 |

- 1) Derating must be applied due to the transfer of heat to the external heat sink. At a temperature of 40° C at the interface to the power unit, 80% derating occurs for 6SL3136-7TE28-0AAx and 70% for 6SL3136-7TE31-2AAx
- 2) The specified power ratings apply to the line voltage range from 380 V to 480 V.
- 3) Default for 400 V line systems; undervoltage trip threshold is adjusted to the parameterized rated voltage
- 4) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker – and the Line Module in the drive system.

Note

New systems with 80 kW and 120 kW Active Line Modules should ideally be designed with 120 kW Active Line Modules Liquid Cooled in order to avoid power derating.

4.4.7.1 Characteristics

Rated duty cycles for Active Line Modules

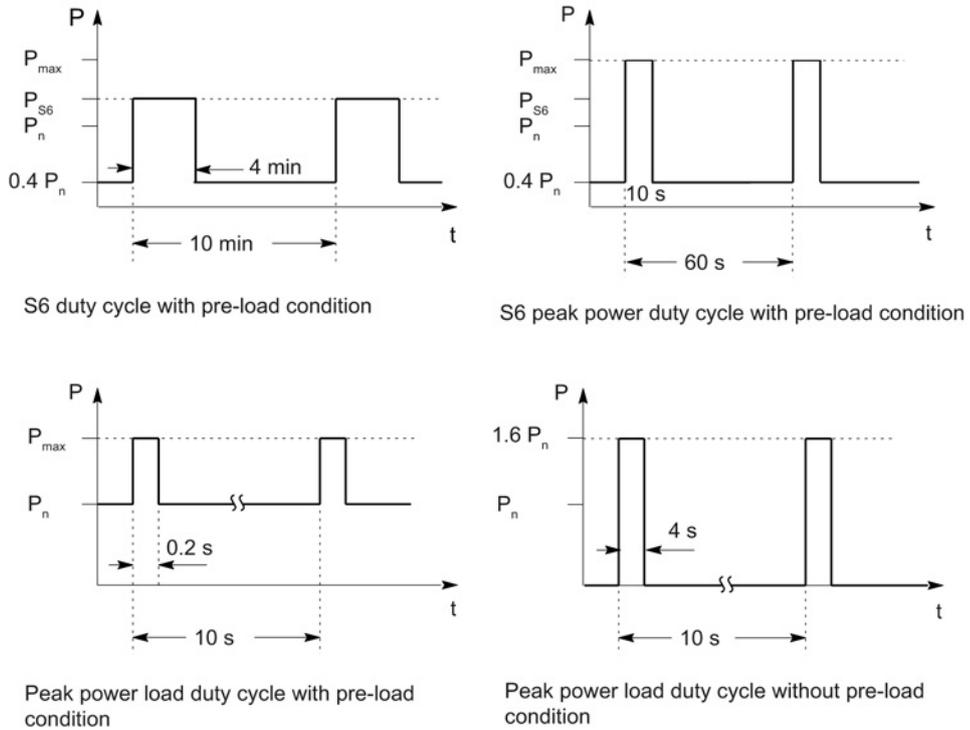
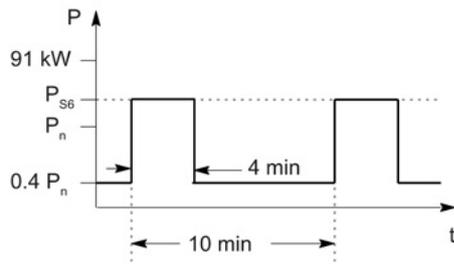
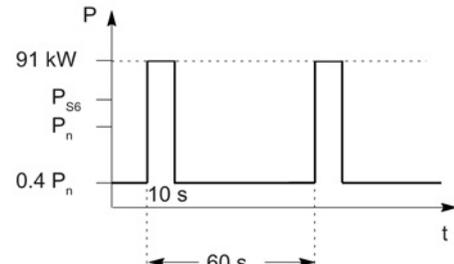


Figure 4-35 Rated duty cycles for Active Line Modules (**exception:** not applicable for 55 kW Active Line Module with Active Interface Module)

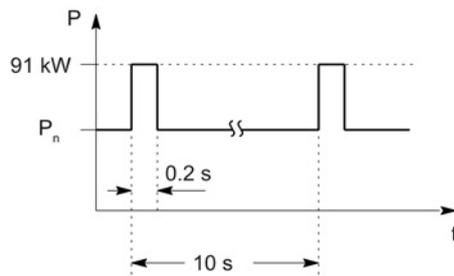
Rated duty cycles for Active Line Modules with Active Interface Modules



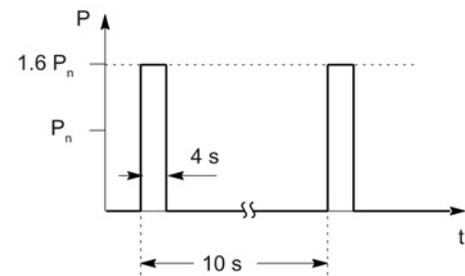
S6 duty cycle with pre-load condition



S6 peak power duty cycle with pre-load condition



Peak power load duty cycle with pre-load condition



Peak power load duty cycle without pre-load condition

Figure 4-36 Load cycles for 55 kW Active Line Modules with Active Interface Module

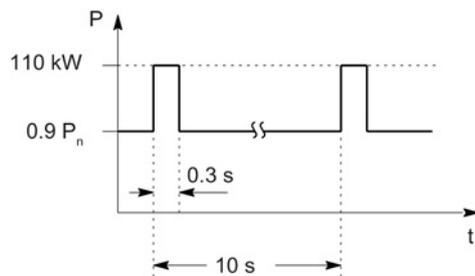


Figure 4-37 Peak load cycle with initial load for 55 kW Active Line Modules with Active Interface Module

Derating characteristics

Note

For additional information, see chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

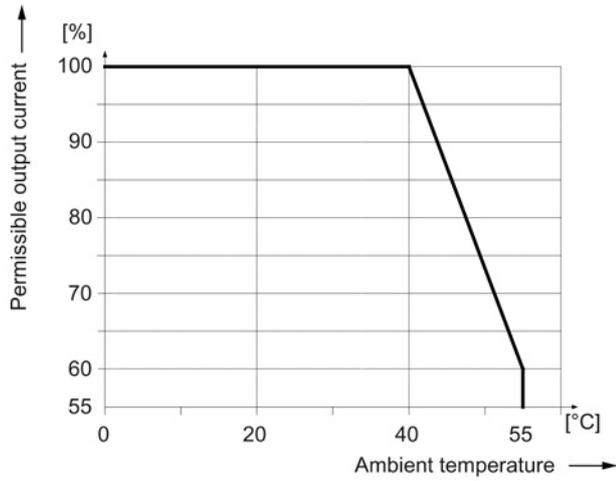


Figure 4-38 Output current as a function of the ambient temperature

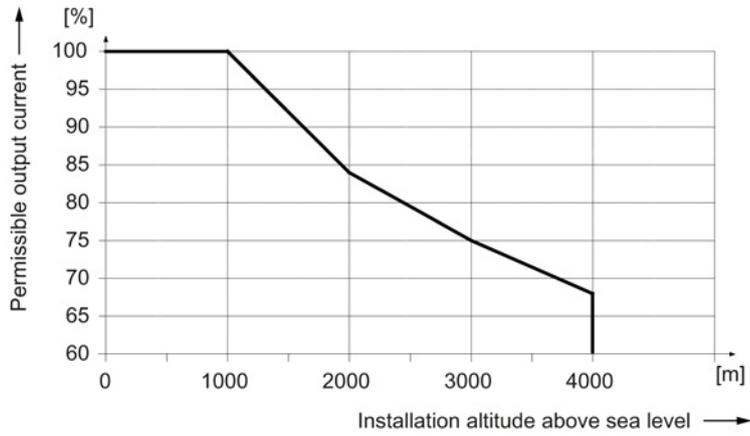


Figure 4-39 Output current as a function of the installation altitude

4.5 Active Line Modules Liquid Cooled

4.5.1 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 the motors are in feedback mode, Active Line Modules supply power back to the line supply. The regenerative feedback capability of the modules can be deactivated by parameterization.

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. An optional main contactor is required for disconnecting the voltage.

Active Line Modules can be directly connected to TN, IT and TT systems. The Line Modules have an integrated overvoltage protection function.



WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

4.5.2 Interface description

4.5.2.1 Overview

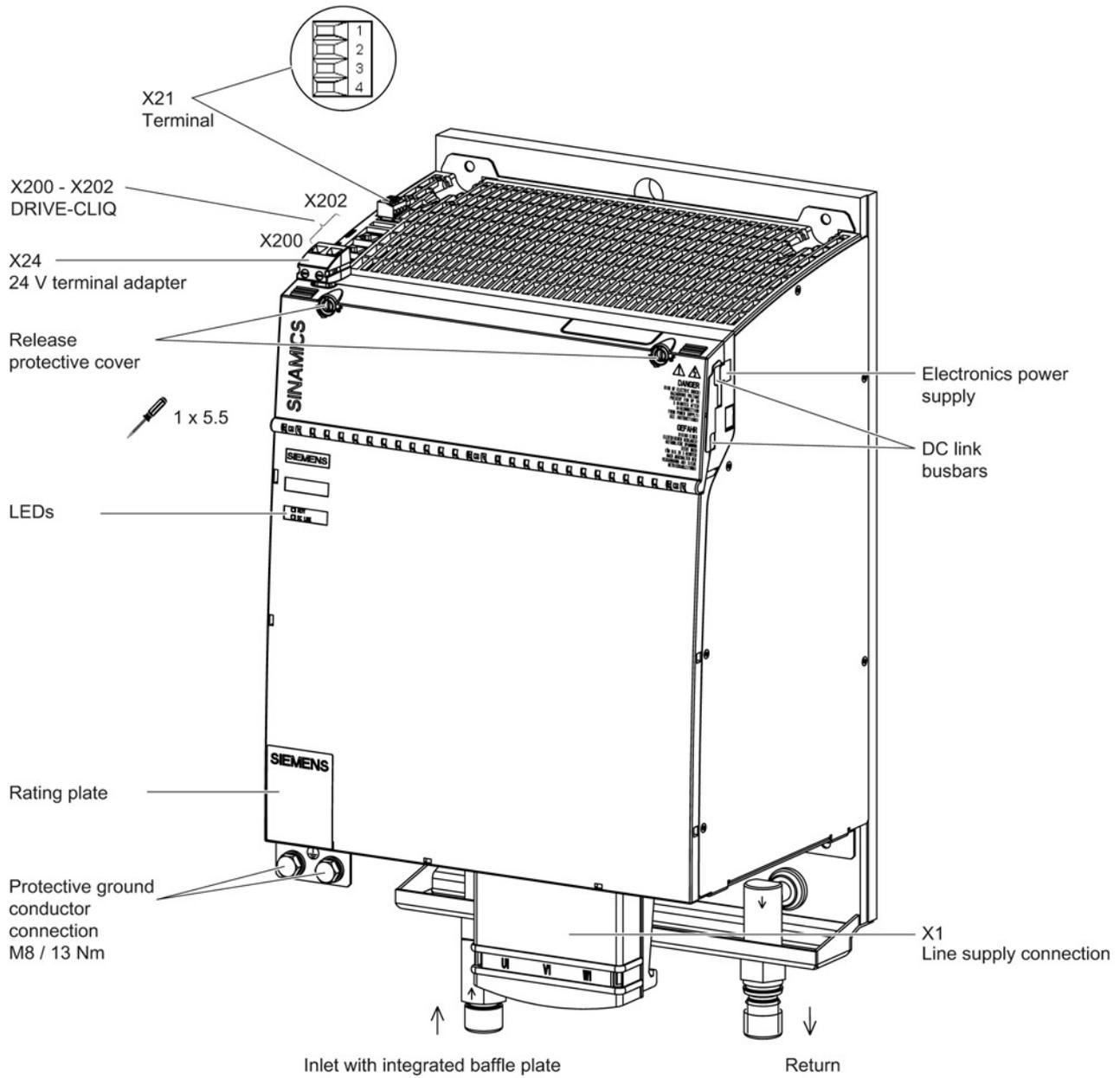
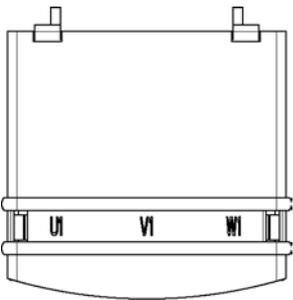
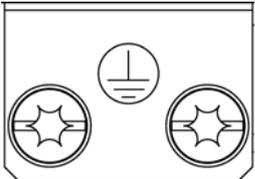


Figure 4-40 Interface overview, Active Line Module Liquid Cooled (120 kW)

4.5.2.2 X1 line connection

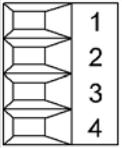
Table 4- 34 X1 line connection

| | Terminals | Technical data |
|--|---------------|--|
|  | U1 | Supply voltage: 3 AC 380 V ... 480 V, 50 / 60 Hz Threaded bolts M8 / 13 Nm ¹⁾ |
| | V1 | |
| | W1 | |
|  | PE connection | Threaded hole M8 / 13 Nm ¹⁾ |

1) For ring cable lugs without insulation

4.5.2.3 X21 EP terminals

Table 4- 35 X21 EP terminal / temperature sensor

| | Terminal | Designation | Technical data |
|--|----------|-------------------------|---|
|  | 1 | + Temp | Temperature sensors ¹⁾ : KTY 84– 1C130 ²⁾ /PTC ²⁾ /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 Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs |
| | 4 | EP M (Enable Pulses) | |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm ² | | | |

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

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

Terminals X21.1 and X21.2

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

Terminals X21.3 and X21.4



| |
|---|
|  WARNING |
| Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected |
| 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. Regenerative feedback 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. |
| Death or serious injury can result when live parts are touched. |
| <ul style="list-style-type: none">• Neutralize the voltage in the DC link. |

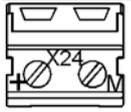
| |
|--|
| NOTICE |
| Damage to the drive electronics when switching the line contactor under load |
| When switching the line contactor (type according to the recommended selection) under load, then the contacts will be subject to premature wear. This can cause the contactor to malfunction, with subsequent damage to the drive electronics. |
| <ul style="list-style-type: none">• 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. |



| |
|---|
|  WARNING |
| Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor |
| Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors. |
| <ul style="list-style-type: none">• Use temperature sensors that fully comply with the specifications of the safety isolation.• 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. |

4.5.2.4 X24 24 V terminal adapter

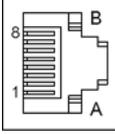
Table 4- 36 X24: 24 V terminal adapter

| | Terminal | Designation | Technical data |
|--|----------|-------------------|------------------------|
|  | + | 24 V power supply | 24 V DC supply voltage |
| | M | Ground | Electronics ground |
| Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm ² | | | |

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

4.5.2.5 X200-X202 DRIVE-CLiQ interfaces

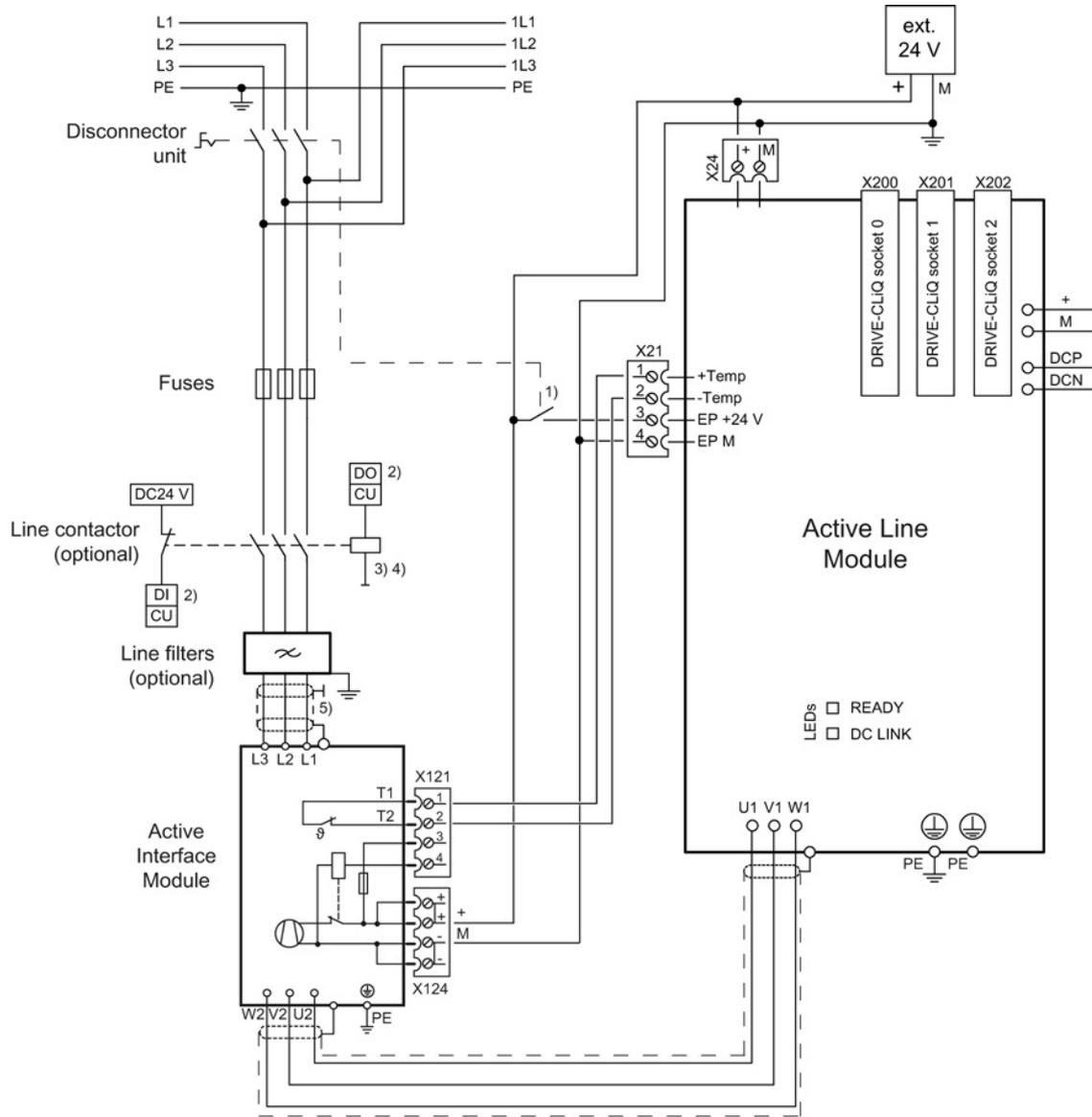
Table 4- 37 X200-X202: DRIVE-CLiQ interfaces

| | 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.) Order number: 6SL3066-4CA00-0AA0

4.5.3 Connection example



- 1) Leading NC contact $t > 10$ ms
- 2) DI/DO, controlled by the Control Unit.
- 3) No additional load permitted downstream of line contactor!
- 4) The current carrying capacity of the DO must be observed; an output coupling device must be used if required.
- 5) Contacting via rear mounting panel or shielding buses in accordance with EMC Directive.

Figure 4-41 Example connection of Active Line Module

Note

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

4.5.4 Meaning of LEDs

Table 4- 38 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 | -- | 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 | -- | This component has at least one fault. Note: The LED is activated regardless of whether the corresponding messages have been reconfigured. | Resolve and acknowledge the fault. |
| Green/ red (0.5 Hz) | -- | Firmware is being downloaded. | – |
| Green/red (2 Hz) | -- | Firmware download has been completed. The system waits for POWER ON. | Carry out a POWER ON. |
| Green/orange or red/orange | -- | Component recognition via LED is activated ¹⁾ . Note: Both options depend on the LED status when component recognition is activated. | – |

¹⁾ See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



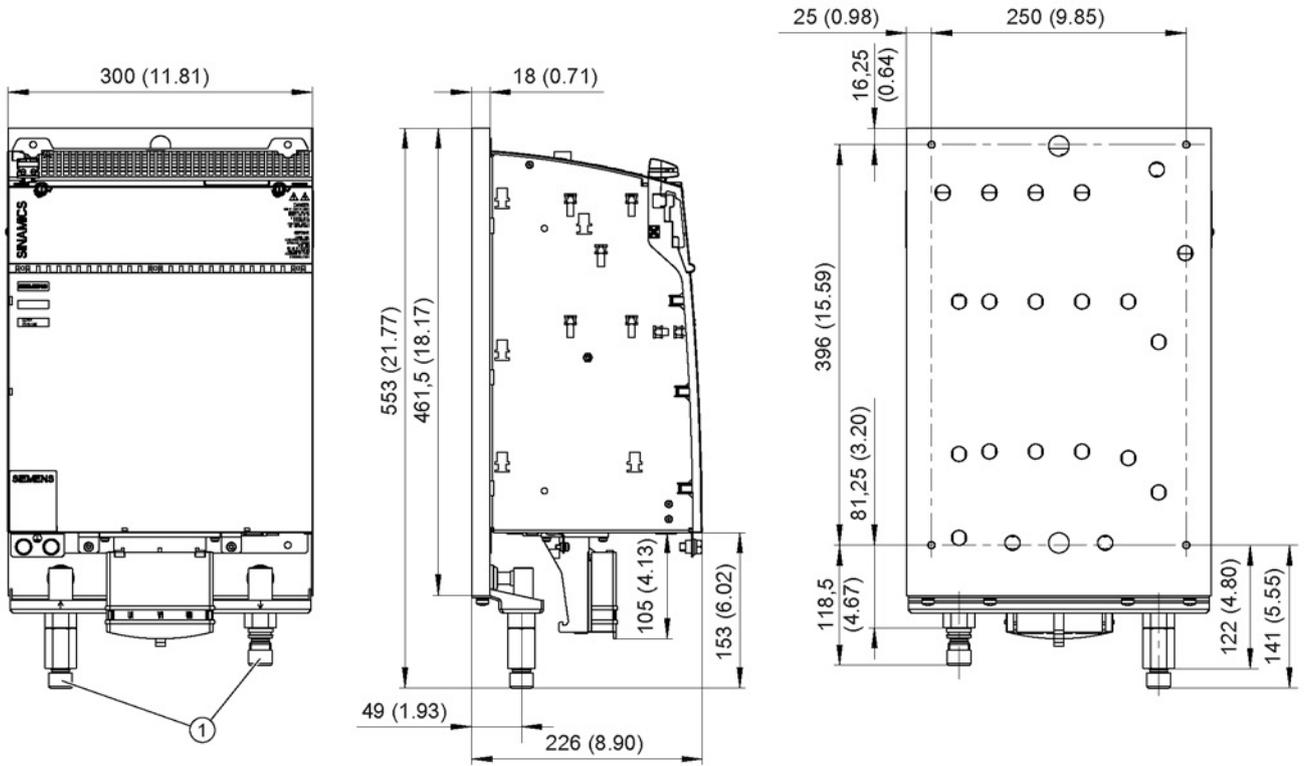
WARNING

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

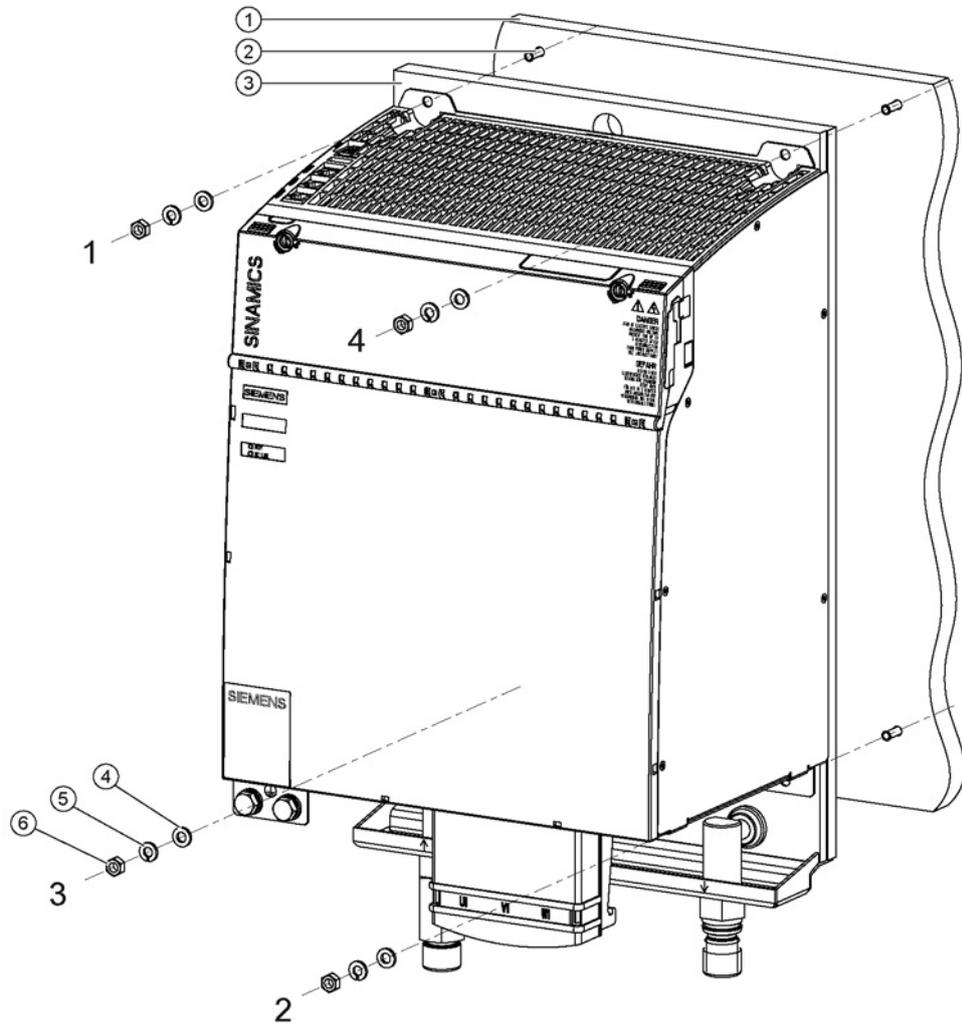
4.5.5 Dimension drawing



① Pipe thread ISO 228 G ½ B.

Figure 4-42 Dimension drawing of Active 120 kW Line Module Liquid Cooled, all dimensions in mm and (inches)

4.5.6 Installation



- ① Mounting surface
- ② M6 studs
- ③ Heat sink
- ④ Washer
- ⑤ Spring washer
- ⑥ M6 nut

Figure 4-43 Mounting an Active Line Module Liquid Cooled

Tightening torques:

- Firstly, tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
Tightening torque: 10 Nm

4.5 Active Line Modules Liquid Cooled

For installation, M6 screw bolts and hexagon nuts/grub screws ISO 7436-M6x40-14 H, property class 8.8 are recommended.

The coolant connections are located on the lower side of the components. All connection elements can be accessed using an appropriate tool.

- Thread type of water connections: Pipe thread ISO 228 G ½ B.

4.5.7 Technical data

Table 4- 39 Technical data for an Active Line Module Liquid Cooled

| Liquid Cooled | | 6SL3135-7TE31-2AA3 |
|---|------------------------|---|
| Rated power | kW | 120 |
| Infeed | | |
| Rated power (S1) ¹⁾ | kW (P _n) | 120 |
| Infeed power (S6 - 40 %) ¹⁾ | kW (P _{S6}) | 145 |
| Peak infeed power ¹⁾ | kW (P _{max}) | 175 |
| Regenerative feedback | | |
| Continuous regenerative power | kW | 120 |
| Peak regenerative power | kW | 175 |
| Supply voltages | | |
| Line voltage | V _{ACrms} | 3 AC 380 ... 480 ±10 % (- 15 % < 1 min) |
| Line frequency | Hz | 47 ... 63 |
| Electronics 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} | 182 |
| Input current for AC 380 V / AC 480 V | A _{AC} | 192 / 152 |
| for AC 400 V; S6 - 40 % | A _{AC} | 220 |
| for AC 400 V; peak current | A _{AC} | 267 |
| DC link currents | | |
| Rated DC link current: for 600 V: | A _{DC} | 200 |
| DC link current: for 600 V DC; for S6 - 40 % | A _{DC} | 244 |
| for 600 V DC; peak current | A _{DC} | 292 |
| Current carrying capacity | | |
| DC link busbars | A _{DC} | 200 |
| 24 V DC busbars | A _{DC} | 20 |
| Electronics current drawn at 24 V DC | A _{DC} | 1.8 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 2243.2 |

| | | |
|---|------------|--|
| Liquid Cooled | | 6SL3135-7TE31-2AA3 |
| Rated power | kW | 120 |
| Max. ambient temperature without derating with derating | ° C ° C | 40 55 |
| DC link capacitance: Active Line Module Drive line-up, max. | µF µF | 3995 20000 |
| Power factor | cosφ | 1 |
| Circuit breaker (IEC 60947 and UL) | | See Section Overcurrent protection using line fuses and circuit breakers (Page 51) |
| Rated short-circuit current SCCR ³⁾ | kA | 65 |
| Rated flow rate for water at 70 kPa pressure drop (for other coolants, see Cooling circuit and coolant properties (Page 795)) | l/min | 8 |
| Volume of liquid internal | ml | 100 |
| Max. coolant temperature without derating with derating | ° C ° C | 45 50 |
| Max. permissible heat sink temperature | ° C | 80 |
| Weight | kg | 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) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker – and the Line Module in the drive system.

4.5.7.1 Characteristics

Rated duty cycles of Active Line Modules Liquid Cooled

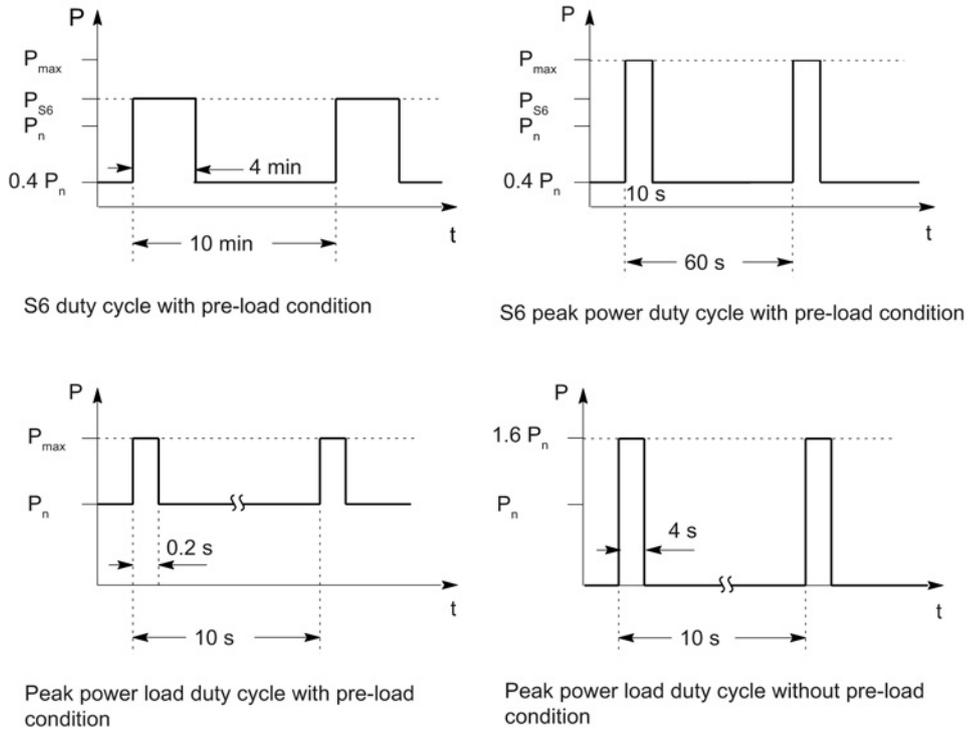


Figure 4-44 Rated duty cycles of Active Line Modules

Derating characteristics

Note

For additional information, see chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

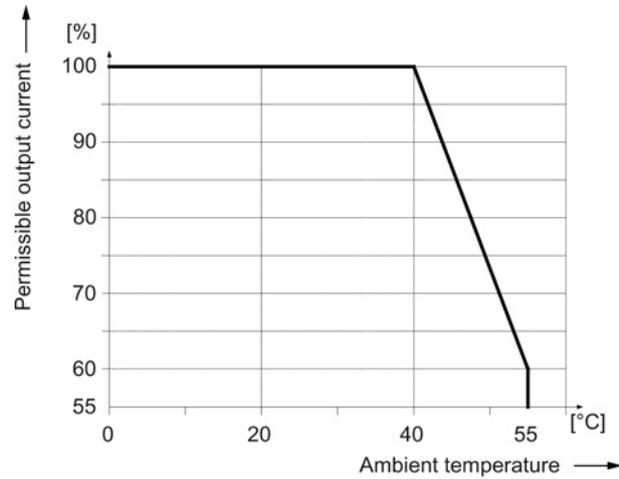


Figure 4-45 Output current as a function of the ambient temperature

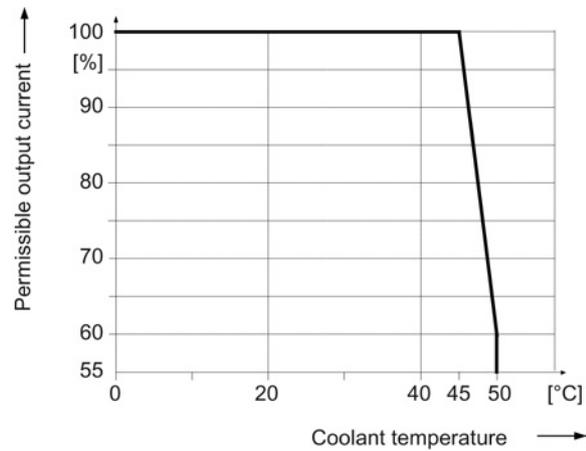


Figure 4-46 Output current as a function of the coolant temperature

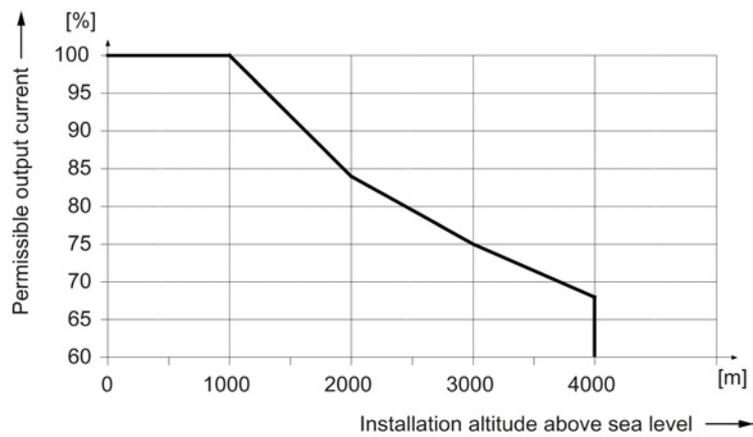


Figure 4-47 Output current as a function of the installation altitude

4.6 Basic Line Modules with internal air cooling

4.6.1 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 544)") can be used.

Basic Line Modules are suitable for direct operation on TN, IT and TT systems. The Line Modules have an integrated overvoltage protection function.

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 .

The maximum total cable length is as follows:

- For all Basic Line Modules with upstream Basic Line Filter:
 - 350 m shielded for radio interference voltage category C2
 - 630 m shielded for radio interference voltage category C3
- For 100 kW Basic Line Modules without upstream Basic Line Filter:
 - 350 m for radio interference voltage category C3
- For all Basic Line Modules without maintaining the limit values:
 - 630 m shielded

WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

4.6.2 Interface description

4.6.2.1 Overview

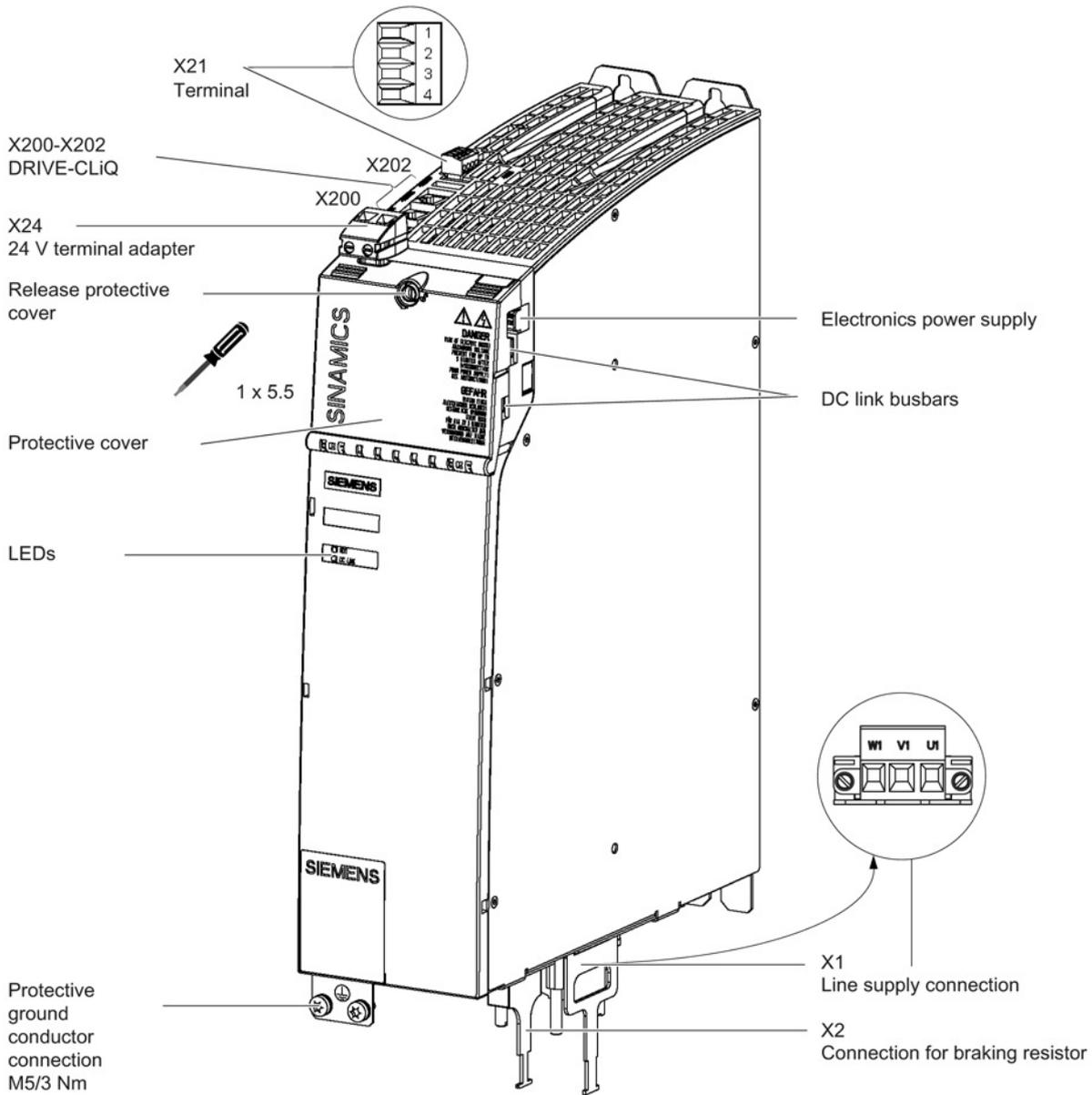
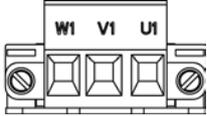
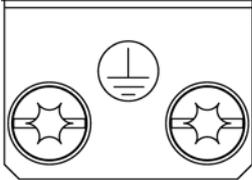


Figure 4-48 Interface overview, Basic Line Module with internal air cooling (example: 20 kW)

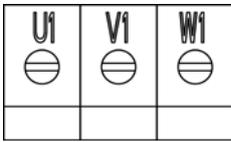
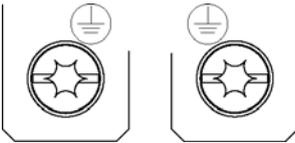
4.6.2.2 X1 line connection

Table 4- 40 X1: Line supply connection for Basic Line Modules 20 kW

| | Terminal | Technical data |
|---|---------------|---|
|  | U1 | Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Max. connectable cross-section: 16 mm ² Type: Screw terminal 7 (Page 755) Tightening torque: 1.5 ... 1.7 Nm |
| | V1 | |
| | W1 | |
|  | PE connection | Threaded hole M5 / 3 Nm ¹ |

1) For ring cable lugs without insulation

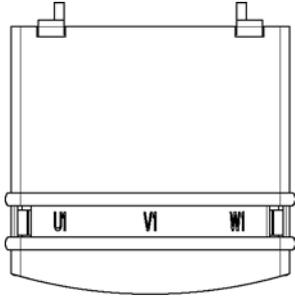
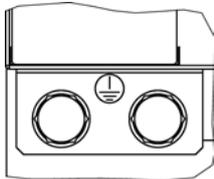
Table 4- 41 X1: Line supply connection for Basic Line Modules 40 kW

| | Terminal | Technical data |
|---|---------------|---|
|  | U1 | Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Max. connectable cross-section, 50 mm ² , end sleeves Tightening torque, min. 6 Nm |
| | V1 | |
| | W1 | |
|  | PE connection | Threaded hole M6 / 6 Nm ¹ |

1) For ring cable lugs without insulation

4.6 Basic Line Modules with internal air cooling

Table 4- 42 X1: Line supply connection for Basic Line Modules 100 kW

| | Terminal | Technical data |
|---|---------------|---|
|  | U1 | Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Type: Threaded bolts M8 ¹⁾ Max. connectable cross-section: 120 mm ² Tightening torque: 13 Nm |
| | V1 | |
| | W1 | |
|  | PE connection | Threaded hole M6 / 6 Nm ¹⁾ |

¹⁾ For ring cable lugs without insulation

4.6.2.3 X2 braking resistor connection

Table 4- 43 X2: Braking resistor connection at the Basic Line Module 20 kW

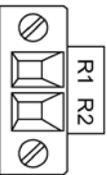
| | Terminal | Designation | Technical data |
|---|----------|--------------------------------|---|
|  | 1 | Braking resistor connection R1 | Type: Screw terminal 4 (Page 755) Max. cross-section that can be connected: 4 mm ² Tightening torque: 0.5 ... 0.6 Nm |
| | 2 | Braking resistor connection R2 | |

Table 4- 44 X2: Braking resistor connection at the Basic Line Module 40 kW

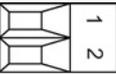
| | Terminal | Designation | Technical data |
|---|----------|--------------------------------|--|
|  | 1 | Braking resistor connection R1 | Type: Screw terminal 6 (Page 755) Max. cross-section that can be connected: 10 mm ² Tightening torque: min 1.5 ... 1.8 Nm |
| | 2 | Braking resistor connection R2 | |

Table 4- 45 Braking resistors with a thermostatic switch for 20 kW and 40 kW Basic Line Modules

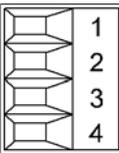
| Braking resistor | R in Ω | P _N in kW | 4 x P _N in kW | P _{max} in kW |
|----------------------------------|---------------|----------------------|--------------------------|------------------------|
| 6SE7018-0ES87-2DC0 | 80 | 1,25 | 5 | 7,5 |
| 6SE7021-6ES87-2DC0 | 40 | 2,5 | 10 | 15 |
| 6SE7023-2ES87-2DC0 | 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 577).

4.6.2.4 X21 EP terminals

Table 4- 46 X21 EP terminal / temperature sensor

| | Terminal | Designation | Technical data |
|--|----------|-------------------------|---|
|  | 1 | + Temp | Temperature sensors ¹⁾ : KTY84-1C130 ²⁾ / PTC ²⁾ / 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 reactions: 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 |
| | 4 | EP M (Enable Pulses) | Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm ² | | | |

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

²⁾ Temperatures are detected but not evaluated in the Basic Line Module.

Terminals X21.1 and X21.2

| |
|--|
| NOTICE |
| Risk of the resistor overheating if the temperature switch is not connected |
| If the temperature switch is not connected, this can cause the resistor to overheat. |
| <ul style="list-style-type: none">• Connect the temperature switch. |

Terminals X21.3 and X21.4



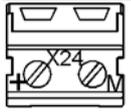
| |
|---|
|  WARNING |
| Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected |
| For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. |
| Pulse cancellation is activated if the power supply is disconnected. Regenerative feedback 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. |
| Death or serious injury can result when live parts are touched. |
| <ul style="list-style-type: none">• Neutralize the voltage in the DC link. |



| |
|---|
|  WARNING |
| Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor |
| Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors. |
| <ul style="list-style-type: none">• Use temperature sensors that fully comply with the specifications of the safety isolation.• 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. |

4.6.2.5 X24 24 V terminal adapter

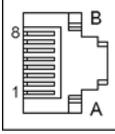
Table 4- 47 X24: 24 V terminal adapter

| | Terminal | Designation | Technical data |
|--|----------|-------------------|------------------------|
|  | + | 24 V power supply | 24 V DC supply voltage |
| | M | Ground | Electronics ground |
| Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm ² | | | |

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

4.6.2.6 X200-X202 DRIVE-CLiQ interfaces

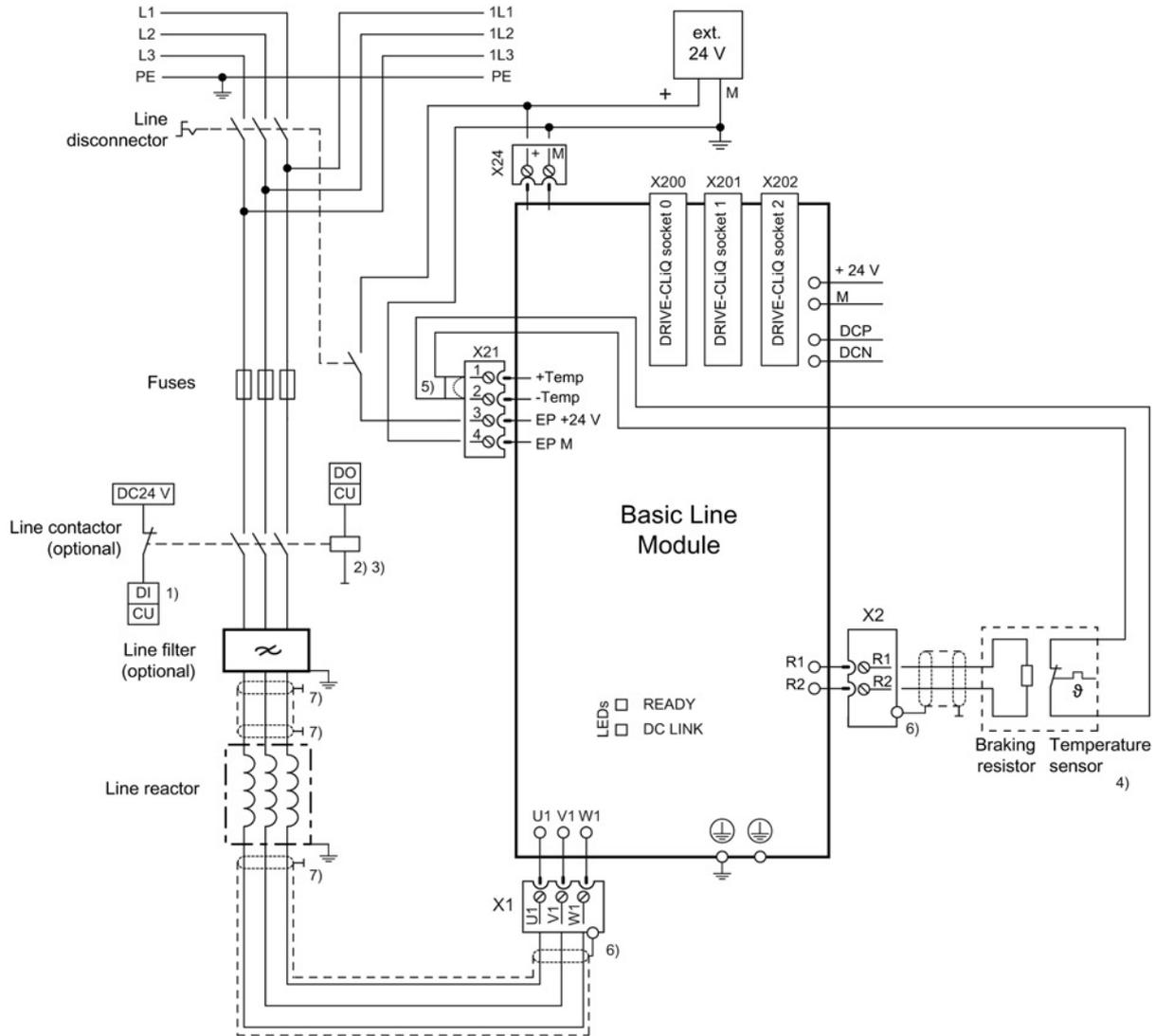
Table 4- 48 X200-X202: DRIVE-CLiQ interfaces

| | 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.) Order number: 6SL3066-4CA00-0AA0

4.6.3 Connection examples



- 1) DI/DO, controlled from 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 must be used if required.
- 4) When closed, the bimetallic switch with wiring must not exceed a resistance value of 100 Ohm.
- 5) Jumper to deactivate the temperature monitoring for the braking resistor.
- 6) Contact established through the connector (20 kW) or shield plate (40 kW).
- 7) Contact established via rear mounting panel or shield buses in accordance with the EMC installation guideline

Figure 4-49 Connection example: Basic Line Module (20 kW and 40 kW)

4.6.4 Meaning of LEDs

Table 4- 49 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 | -- | 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 | -- | This component has at least one fault. Note: The LED is activated regardless of whether the corresponding messages have been reconfigured. | Resolve and acknowledge the fault. |
| Green/ red (0.5 Hz) | -- | Firmware is being downloaded. | – |
| Green/red (2 Hz) | -- | Firmware download has been completed. The system waits for POWER ON. | Carry out a POWER ON. |
| Green/orange or red/orange | -- | Component recognition via LED is activated ¹⁾ . Note: Both options depend on the LED status when component recognition is activated. | – |

¹⁾ See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



| |
|---|
|  WARNING |
| <p>Danger of death when live parts of the DC link are touched</p> <p>Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.</p> <ul style="list-style-type: none"> • Observe the warning information on the component. |

4.6.5 Dimension drawings

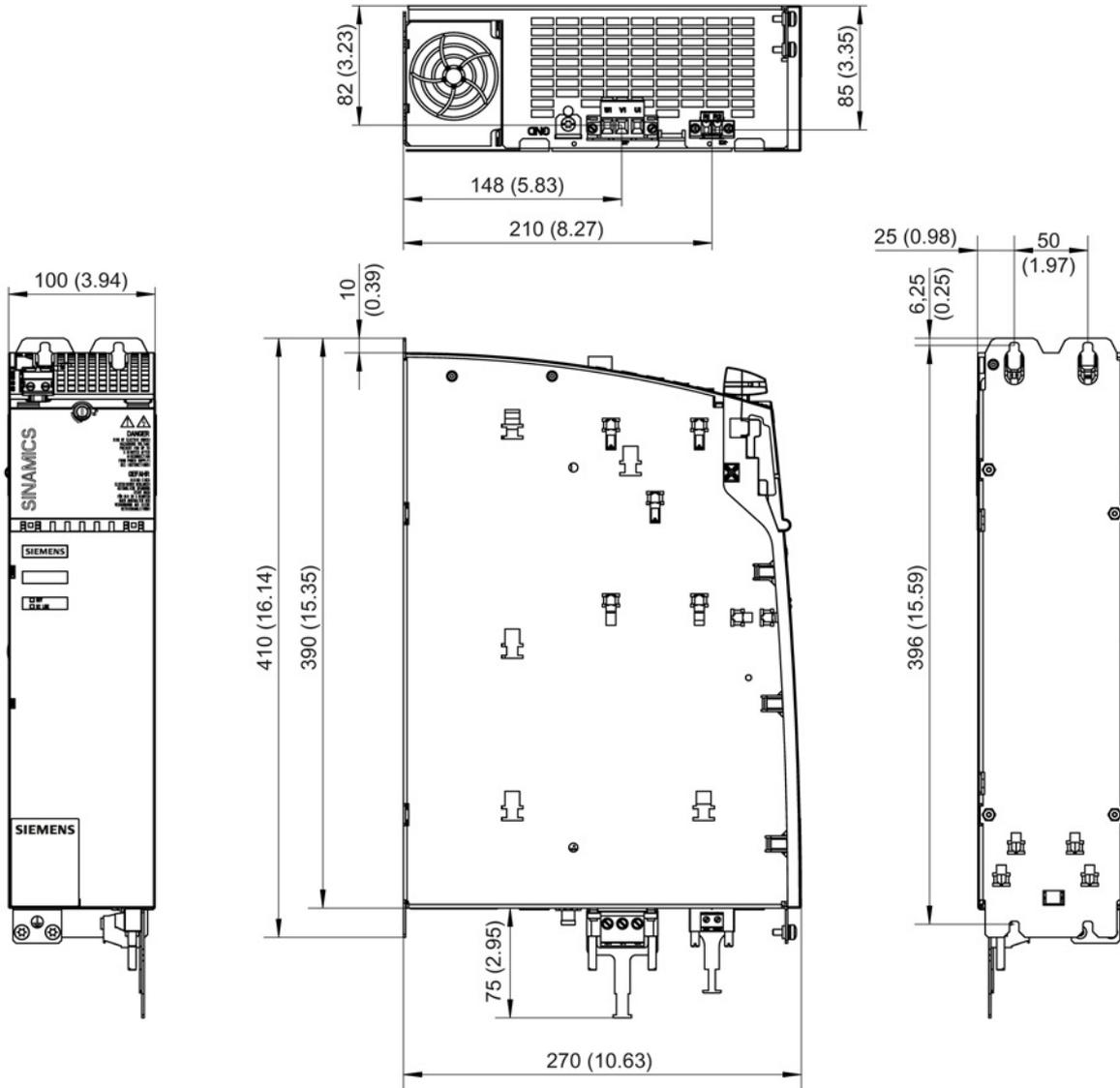


Figure 4-51 Dimension drawing of 20 kW Basic Line Module with internal air cooling, all dimensions in mm and (inches)

4.6 Basic Line Modules with internal air cooling

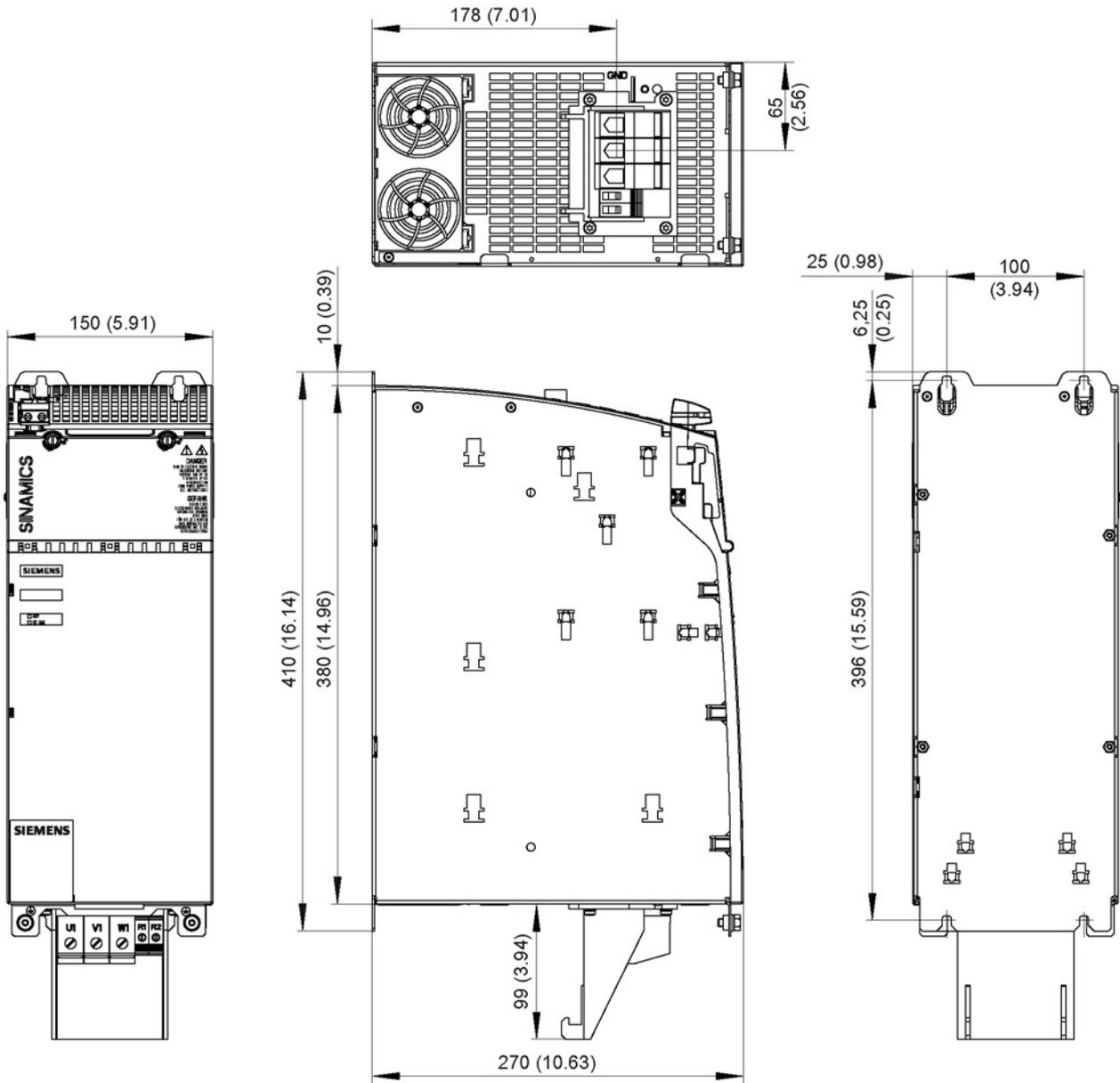


Figure 4-52 Dimension drawing of 40 kW Basic Line Module with internal air cooling, all dimensions in mm and (inches)

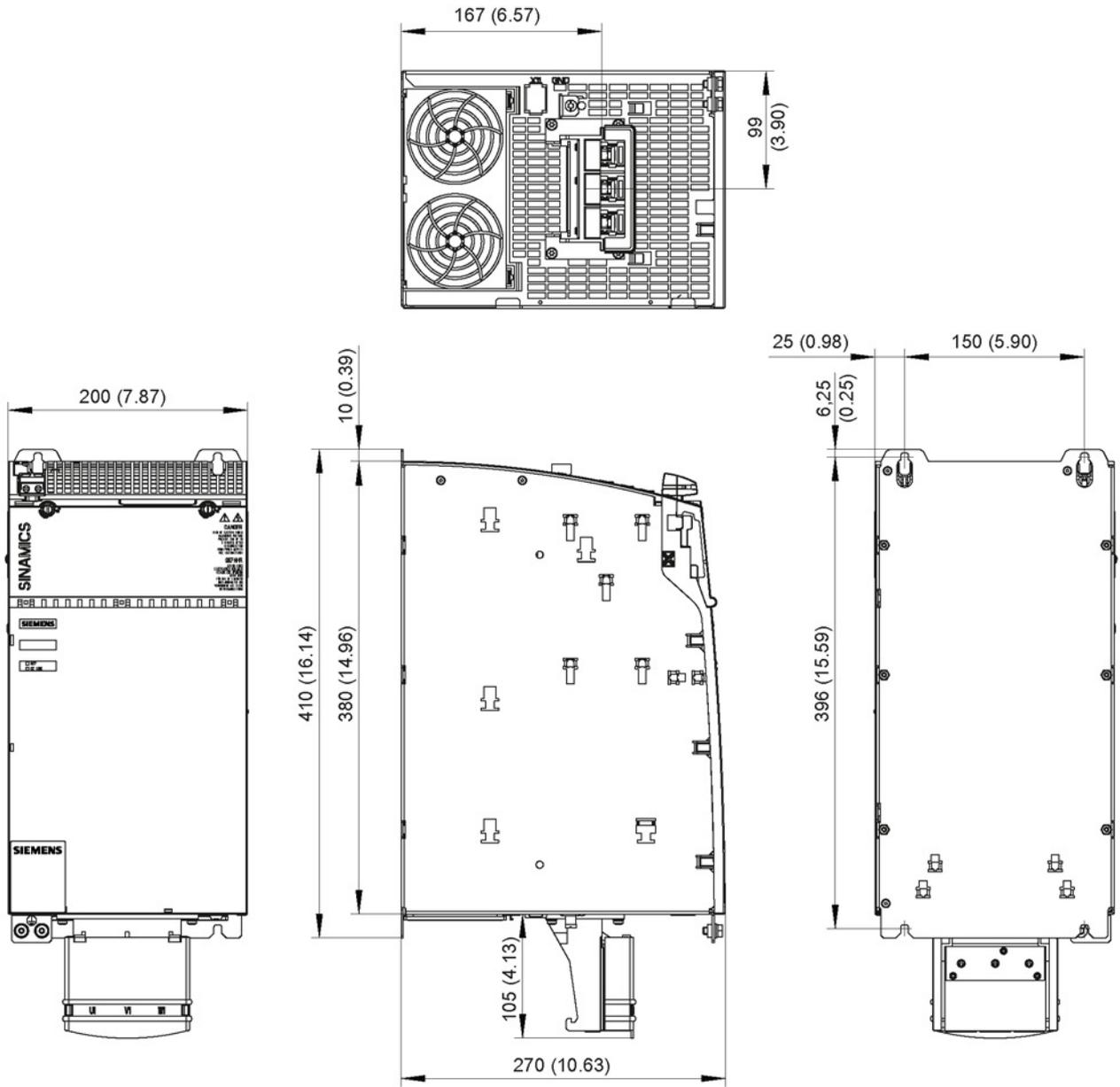
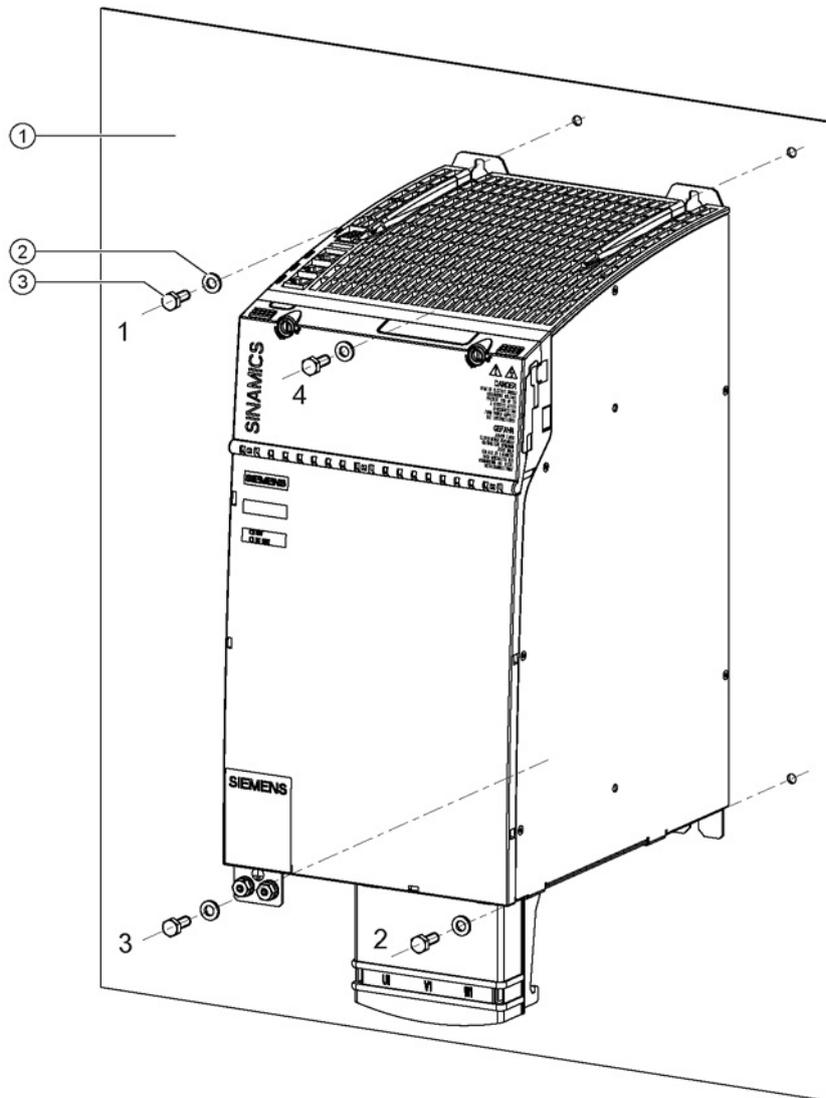


Figure 4-53 Dimension drawing of 100 kW Basic Line Module with internal air cooling, all dimensions in mm and (inches)

4.6.6 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 4-54 Mounting a Basic Line Module with internal air cooling (example: 100 kW)

Tightening torques:

- Firstly, tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence.
Tightening torque: 6 Nm

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

To operate a 100 kW Basic Line Module on an isolated-neutral (IT) system, the connection bracket for the interference suppression capacitor 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.

| | | |
|---|---|--|
|  |  |  |
| <p>Remove the connection bracket to the noise suppression capacitor using a Tx25 screwdriver.</p> | <p>Withdraw the connection bracket.</p> | <p>Connection bracket for the interference-suppression capacitor</p> |

Note

Installing the connection bracket for the interference-suppression capacitor

For operation in other line supplies, the connection bracket must be reinstalled and fixed with a tightening torque of 1.8 Nm.

4.6.8 Technical data

Table 4- 50 Technical data: Basic Line Modules

| Internal air cooling | 6SL3130- | 1TE22-0AA0 | 1TE24-0AA0 | 1TE31-0AA0 |
|---|------------------------|--|------------|------------|
| Rated power | kW | 20 | 40 | 100 |
| Infeed | | | | |
| Rated power (S1) ¹⁾ | kW (P _n) | 20 | 40 | 100 |
| Infeed power (S6 - 40 %) ¹⁾ | kW (P _{S6}) | 26 | 52 | 130 |
| Peak infeed power ¹⁾ | 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) ²⁾ | | |
| Line frequency | Hz | 47 ... 63 | | |
| Electronics power supply | V _{DC} | 24 (20.4 ... 28.8) | | |
| DC link voltage | V _{DC} | 480 ... 720 | | |
| Overvoltage trip | V _{DC} | 820 ± 2 % | | |
| Undervoltage trip ³⁾ | V _{DC} | 360 ± 2 % | | |
| 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 - 40 % | A _{AC} | 43 | 86 | 216 |
| for AC 400 V; peak current | A _{AC} | 100 | 199 | 290 |
| DC link currents | | | | |
| Rated DC link current: for 600 V | A _{DC} | 33.5 | 67 | 167 |
| DC link current: for 540 V | A _{DC} | 37 | 48 | 185 |
| for DC 600 V; S6 - 40 % | A _{DC} | 43 | 87 | 217 |
| for DC 600 V; peak current | A _{DC} | 100 | 200 | 292 |
| Current carrying capacity | | | | |
| DC link busbars | A _{DC} | 100 | 200 | 200 |
| Reinforced DC link busbars | A _{DC} | 150 | -- | -- |
| 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 781)) | W | 144 | 283.6 | 628 |
| Max. ambient temperature | | | | |
| without derating | ° C | 40 | 40 | 40 |
| with derating | ° C | 55 | 55 | 55 |
| DC link capacitance | | | | |
| Basic Line Module | µF | 940 | 1880 | 4100 |
| Drive line-up, max. | µF | 20000 | 20000 | 50000 |
| Power factor⁴⁾ | cosφ | 0.98 | 0.98 | 0.98 |
| Circuit breaker (IEC 60947 and UL) | | See Section Overcurrent protection using line fuses and circuit breakers (Page 51) | | |

| Internal air cooling | 6SL3130- | 1TE22-0AA0 | 1TE24-0AA0 | 1TE31-0AA0 |
|---|-------------------|--------------|------------|------------|
| Rated short-circuit current SCCR ⁵⁾ | kA | 65 | 65 | 65 |
| Cooling method (internal air cooling) | | Internal fan | | |
| Sound pressure level | dB(A) | < 60 | < 65 | < 65 |
| Cooling air requirement | m ³ /h | 56 | 112 | 180 |
| Max. permissible heat sink temperature | ° C | 65 | 70 | 70 |
| Rated voltage for rated data 3 AC 380 V | | | | |
| 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) Can also be operated on supply systems with 200 ... 240 V 3 AC $\pm 10\%$ with appropriate parameterization and reduced power.
- 3) Default for 400 V line systems; undervoltage trip threshold is adjusted to the parameterized rated voltage
- 4) Only the fundamental component
- 5) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker – and the Line Module in the drive system.

4.6.8.1 Characteristics

Rated duty cycles for Basic Line Modules

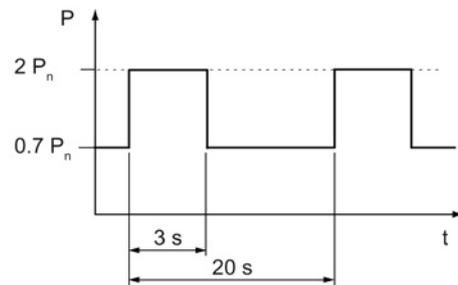
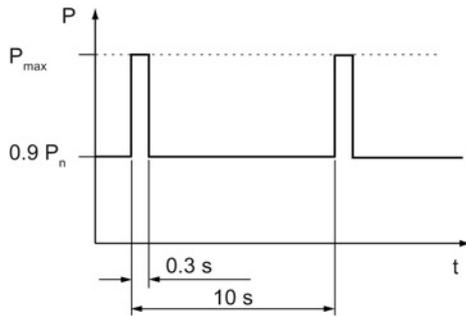


Figure 4-55 Duty cycles with initial load

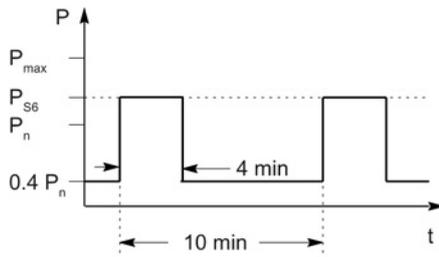


Figure 4-56 S6 duty cycle with pre-load condition

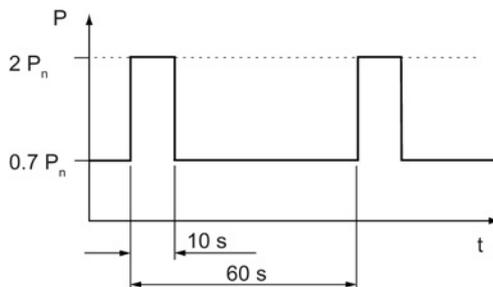


Figure 4-57 Duty cycle with pre-load condition for 20 kW and 40 kW Basic Line Modules

Braking duty cycle for Basic Line Modules

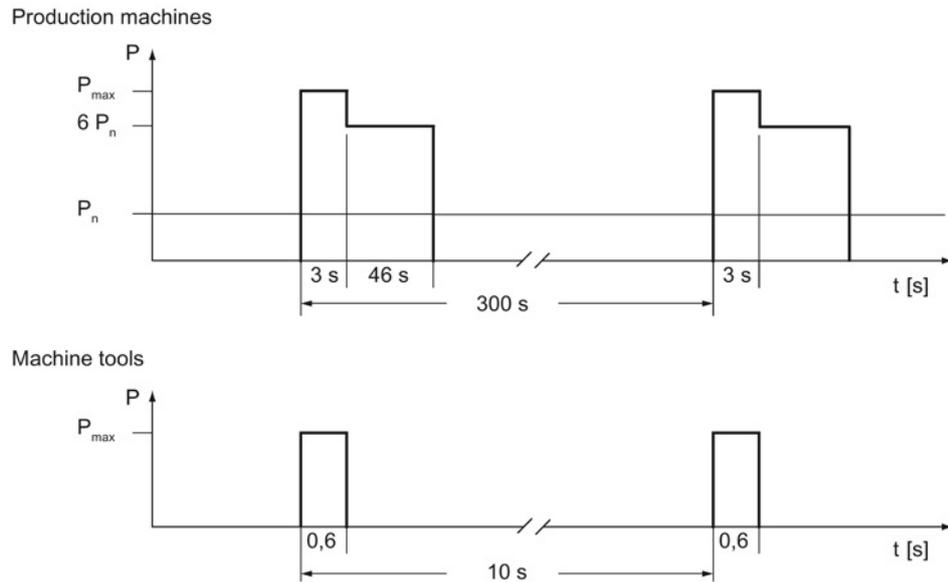


Figure 4-58 Braking duty cycle for Basic Line Modules

Derating characteristics

Note

For additional information, see chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

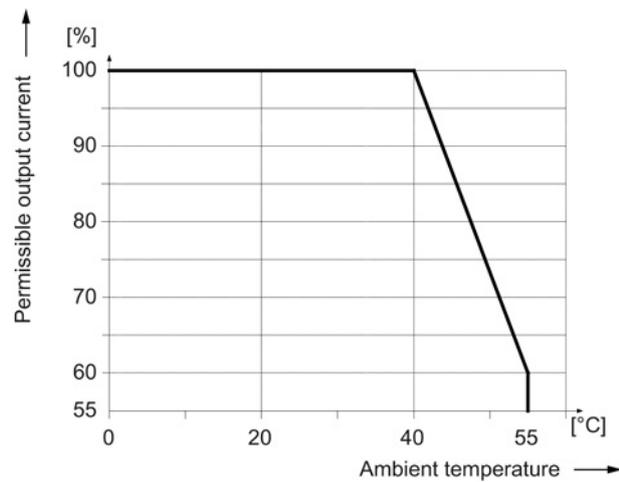


Figure 4-59 Output current as a function of the ambient temperature

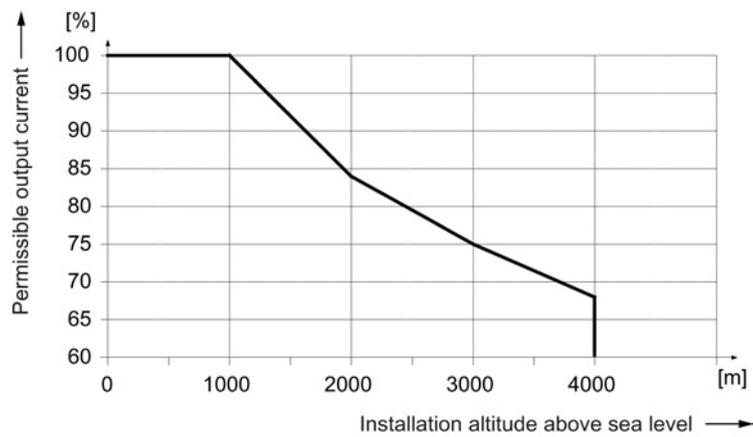


Figure 4-60 Output current as a function of the installation altitude

4.7 Basic Line Modules with cold plate

4.7.1 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 544)") can be used.

Basic Line Modules are suitable for direct operation on TN, IT and TT systems. The Line Modules have an integrated overvoltage protection function.

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 .

The maximum total cable length is as follows:

- For all Basic Line Modules with upstream Basic Line Filter:
 - 350 m shielded for radio interference voltage category C2
 - 630 m shielded for radio interference voltage category C3
- For 100 kW Basic Line Modules without upstream Basic Line Filter:
 - 350 m for radio interference voltage category C3
- For all Basic Line Modules without maintaining the limit values:
 - 630 m shielded

WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

4.7.2 Interface description

4.7.2.1 Overview

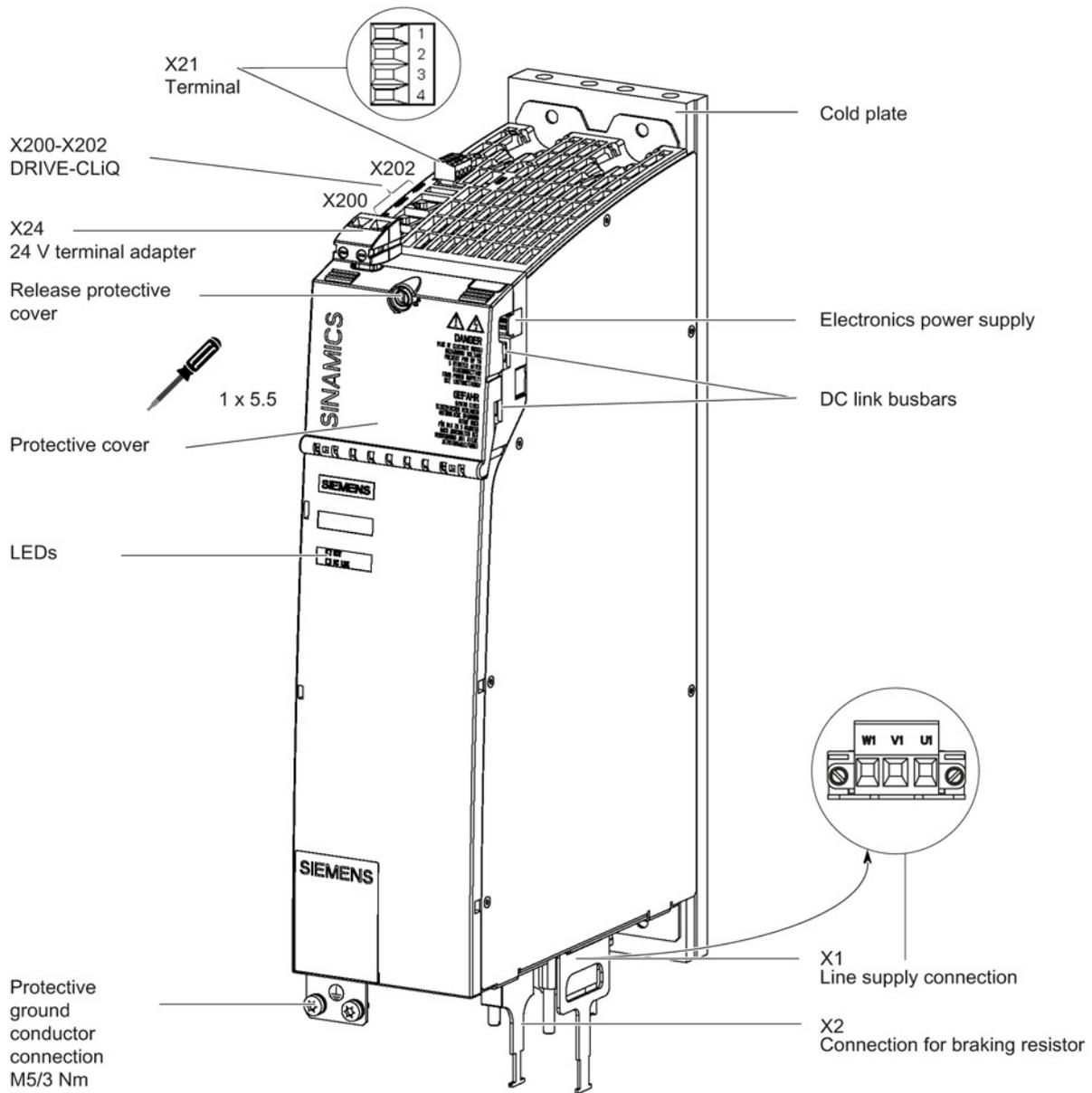
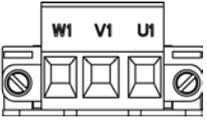
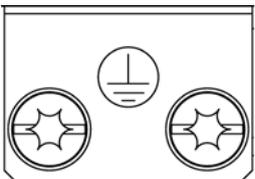


Figure 4-61 Interface overview, Basic Line Module with cold plate (example: 20 kW)

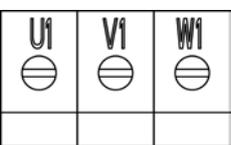
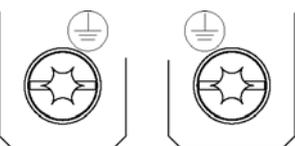
4.7.2.2 X1 line connection

Table 4- 51 X1: Line supply connection for Basic Line Modules 20 kW

| | Terminal | Technical data |
|---|---------------|---|
|  | U1 | Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Max. connectable cross-section: 16 mm ² Type: Screw terminal 7 (Page 755) Tightening torque: 1.5 ... 1.7 Nm |
| | V1 | |
| | W1 | |
|  | PE connection | Threaded hole M5 / 3 Nm ¹ |

1) For ring cable lugs without insulation

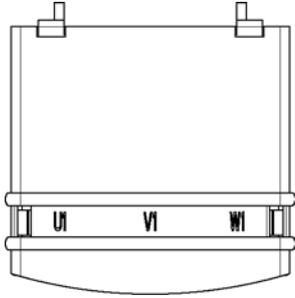
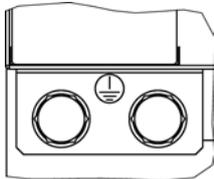
Table 4- 52 X1: Line supply connection for Basic Line Modules 40 kW

| | Terminal | Technical data |
|---|---------------|---|
|  | U1 | Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Max. connectable cross-section, 50 mm ² , end sleeves Tightening torque, min. 6 Nm |
| | V1 | |
| | W1 | |
|  | PE connection | Threaded hole M6 / 6 Nm ¹ |

1) For ring cable lugs without insulation

4.7 Basic Line Modules with cold plate

Table 4- 53 X1: Line supply connection for Basic Line Modules 100 kW

| | Terminal | Technical data |
|---|---------------|---|
|  | U1 | Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Type: Threaded bolts M8 ¹⁾ Max. connectable cross-section: 120 mm ² Tightening torque: 13 Nm |
| | V1 | |
| | W1 | |
|  | PE connection | Threaded hole M6 / 6 Nm ¹⁾ |

1) For ring cable lugs without insulation

4.7.2.3 X2 braking resistor connection

Table 4- 54 X2: Braking resistor connection at the Basic Line Module 20 kW

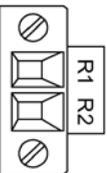
| | Terminal | Designation | Technical data |
|---|----------|--------------------------------|---|
|  | 1 | Braking resistor connection R1 | Type: Screw terminal 4 (Page 755) Max. cross-section that can be connected: 4 mm ² Tightening torque: 0.5 ... 0.6 Nm |
| | 2 | Braking resistor connection R2 | |

Table 4- 55 X2: Braking resistor connection at the Basic Line Module 40 kW

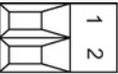
| | Terminal | Designation | Technical data |
|---|----------|--------------------------------|--|
|  | 1 | Braking resistor connection R1 | Type: Screw terminal 6 (Page 755) Max. cross-section that can be connected: 10 mm ² Tightening torque: min 1.5 ... 1.8 Nm |
| | 2 | Braking resistor connection R2 | |

Table 4- 56 Braking resistors with a thermostatic switch for 20 kW and 40 kW Basic Line Modules

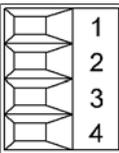
| Braking resistor | R in Ω | P _N in kW | 4 x P _N in kW | P _{max} in kW |
|----------------------------------|---------------|----------------------|--------------------------|------------------------|
| 6SE7018-0ES87-2DC0 | 80 | 1,25 | 5 | 7,5 |
| 6SE7021-6ES87-2DC0 | 40 | 2,5 | 10 | 15 |
| 6SE7023-2ES87-2DC0 | 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 577).

4.7.2.4 X21 EP terminals

Table 4- 57 X21 EP terminal / temperature sensor

| | Terminal | Designation | Technical data |
|--|----------|-------------------------|---|
|  | 1 | + Temp | Temperature sensors ¹⁾ : KTY84-1C130 ²⁾ / PTC ²⁾ / 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 reactions: 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 |
| | 4 | EP M (Enable Pulses) | Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm ² | | | |

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

²⁾ Temperatures are detected but not evaluated in the Basic Line Module.

Terminals X21.1 and X21.2

| |
|--|
| NOTICE |
| Risk of the resistor overheating if the temperature switch is not connected |
| If the temperature switch is not connected, this can cause the resistor to overheat. |
| <ul style="list-style-type: none">• Connect the temperature switch. |

Terminals X21.3 and X21.4



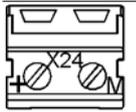
| |
|---|
|  WARNING |
| Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected |
| For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. |
| Pulse cancellation is activated if the power supply is disconnected. Regenerative feedback 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. |
| Death or serious injury can result when live parts are touched. |
| <ul style="list-style-type: none">• Neutralize the voltage in the DC link. |



| |
|---|
|  WARNING |
| Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor |
| Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors. |
| <ul style="list-style-type: none">• Use temperature sensors that fully comply with the specifications of the safety isolation.• 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. |

4.7.2.5 X24 24 V terminal adapter

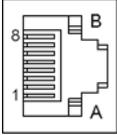
Table 4- 58 X24: 24 V terminal adapter

| | Terminal | Designation | Technical data |
|--|----------|-------------------|------------------------|
|  | + | 24 V power supply | 24 V DC supply voltage |
| | M | Ground | Electronics ground |
| Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm ² | | | |

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

4.7.2.6 X200-X202 DRIVE-CLiQ interfaces

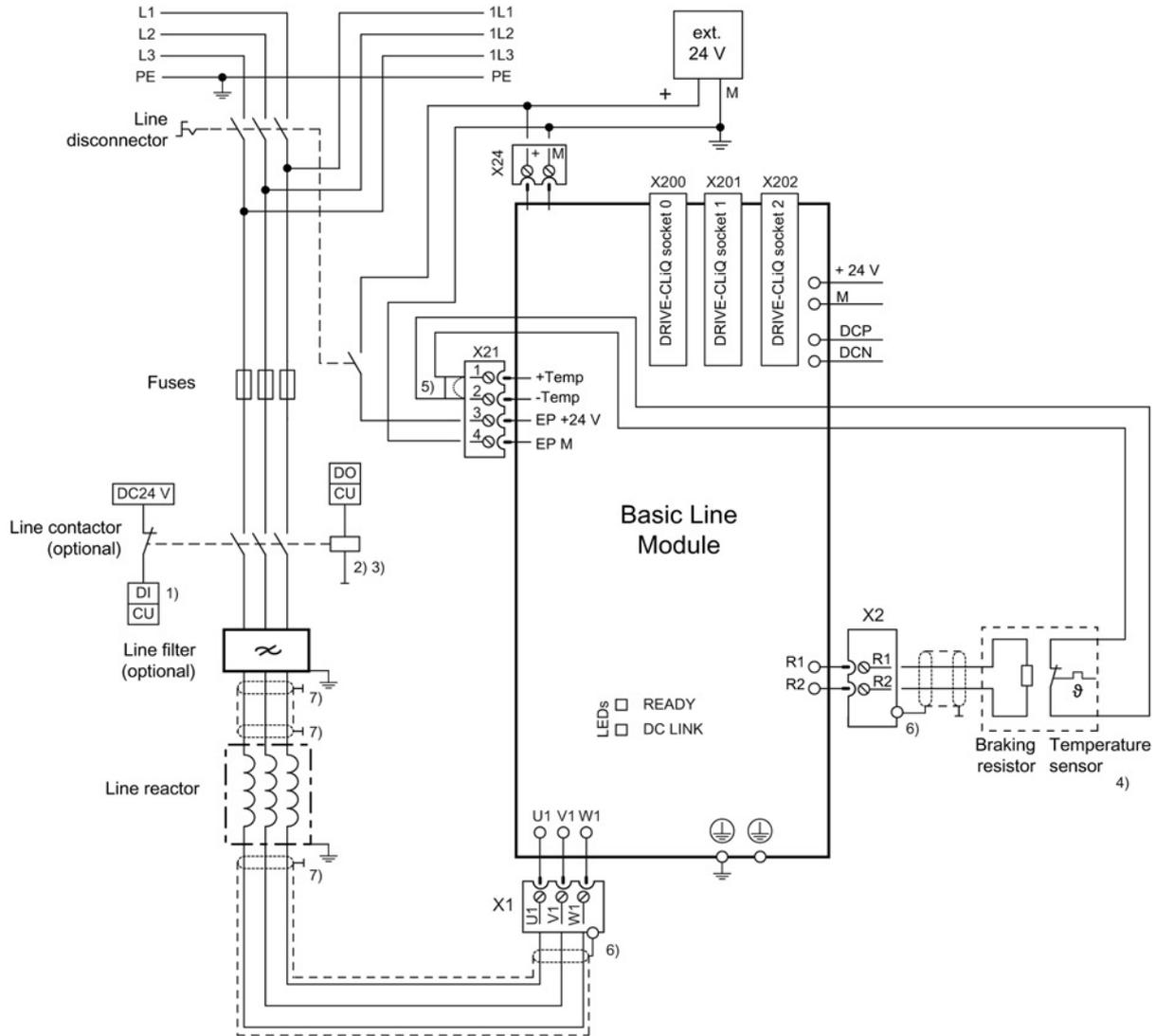
Table 4- 59 X200-X202: DRIVE-CLiQ interfaces

| | 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.) Order number: 6SL3066-4CA00-0AA0

4.7.3 Connection examples



- 1) DI/DO, controlled from 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 must be used if required.
- 4) When closed, the bimetallic switch with wiring must not exceed a resistance value of 100 Ohm.
- 5) Jumper to deactivate the temperature monitoring for the braking resistor.
- 6) Contact established through the connector (20 kW) or shield plate (40 kW).
- 7) Contact established via rear mounting panel or shield buses in accordance with the EMC installation guideline

Figure 4-62 Connection example: Basic Line Module (20 kW and 40 kW)

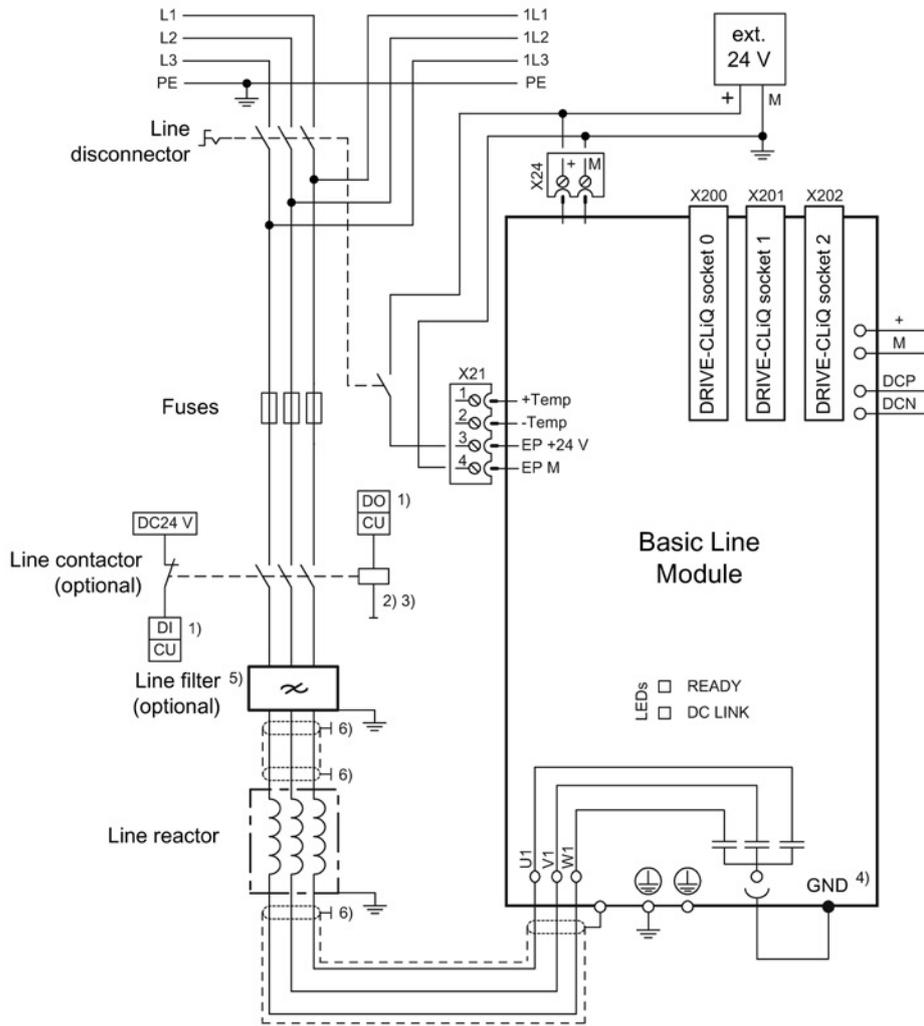


Figure 4-63 Connection example: Basic Line Module (100 kW)

4.7.4 Meaning of LEDs

Table 4- 60 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 | -- | 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 | -- | This component has at least one fault. Note: The LED is activated regardless of whether the corresponding messages have been reconfigured. | Resolve and acknowledge the fault. |
| Green/ red (0.5 Hz) | -- | Firmware is being downloaded. | – |
| Green/red (2 Hz) | -- | Firmware download has been completed. The system waits for POWER ON. | Carry out a POWER ON. |
| Green/orange or red/orange | -- | Component recognition via LED is activated ¹⁾ . Note: Both options depend on the LED status when component recognition is activated. | – |

¹⁾ See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



| |
|---|
|  WARNING |
| <p>Danger of death when live parts of the DC link are touched</p> <p>Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.</p> <ul style="list-style-type: none"> • Observe the warning information on the component. |

4.7.5 Dimension drawings

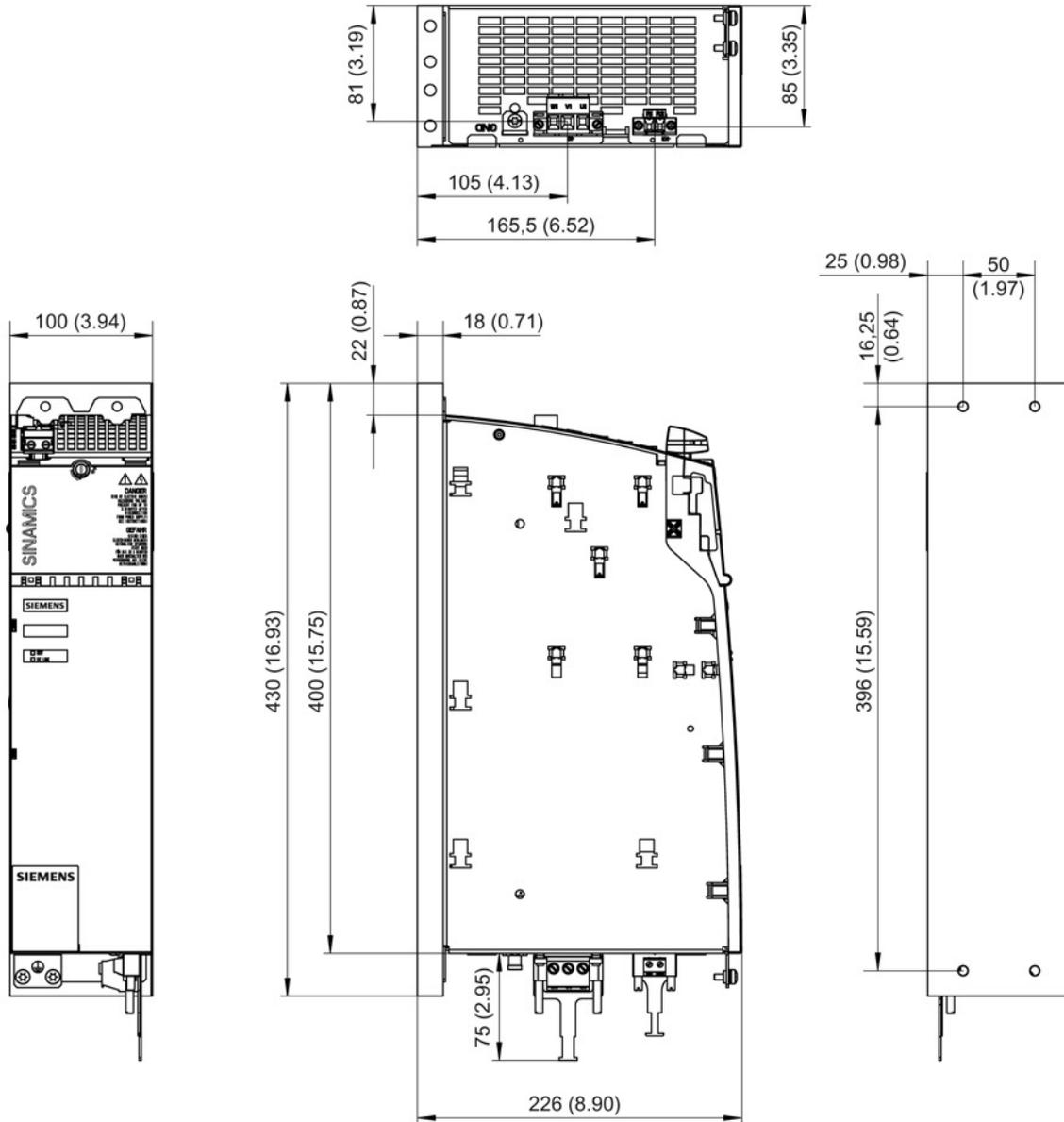


Figure 4-64 Dimension drawing of 20 kW Basic Line Module with cold plate, all dimensions in mm and (inches)

4.7 Basic Line Modules with cold plate

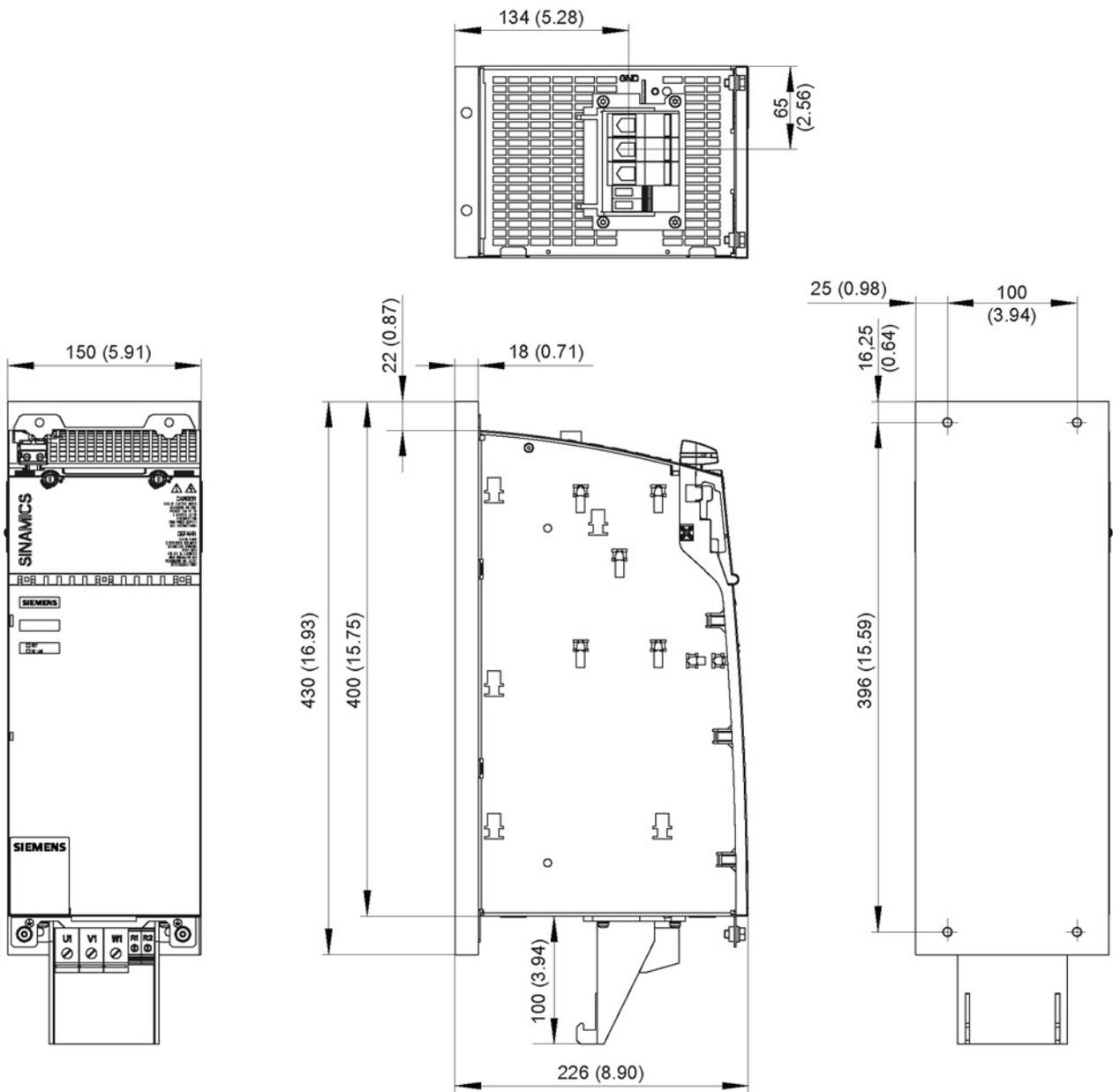


Figure 4-65 Dimension drawing of 40 kW Basic Line Module with cold plate, all dimensions in mm and (inches)

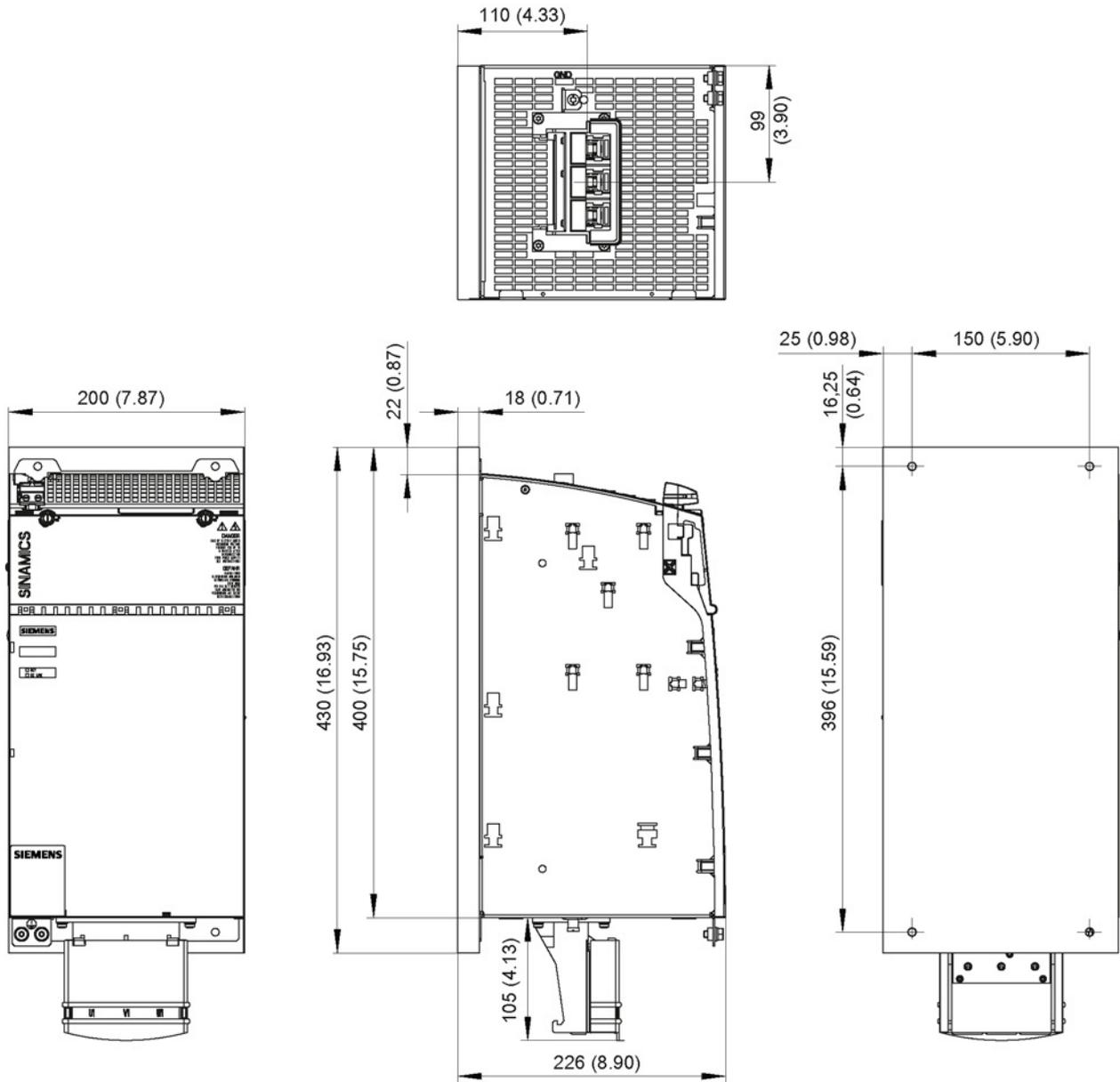


Figure 4-66 Dimension drawing of 100 kW Basic Line Module with cold plate, all dimensions in mm and (inches)

4.7.6 Mounting

Please note the following before mounting a Basic Line Module with cold plate onto a customer-specific heat sink:

- Before mounting, check the surface of the heat sink to ensure that it is not damaged.
- To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every Basic Line Module cold plate is supplied with heat-conducting foil cut to the right size. Note the mounting position of the heat-conducting foil (see figures below).

Note

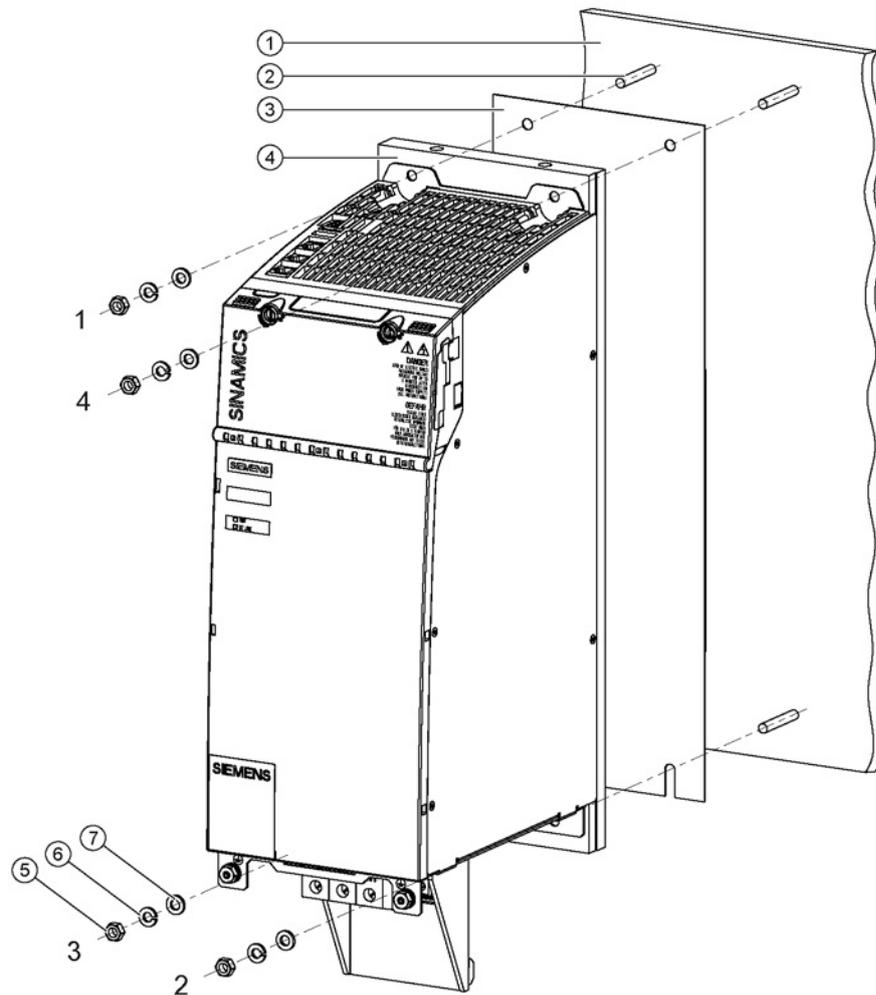
- Also replace the heat-conducting foil when replacing a component.
 - Only use heat-conducting foil released or supplied by Siemens.
-

Table 4- 61 Overview of heat-conducting foils

| | Order number |
|------------------------------|--------------------|
| Heat-conducting foil, 100 mm | 6SL3162-6FD00-0AA0 |
| Heat-conducting foil, 150 mm | 6SL3162-6FF00-0AA0 |
| Heat-conducting foil, 200 mm | 6SL3162-6FH00-0AA0 |

Note

M6 studs and hexagon nuts or grub screws (ISO 7436-M6x40-14 H, property class 8.8) are recommended for mounting the components.

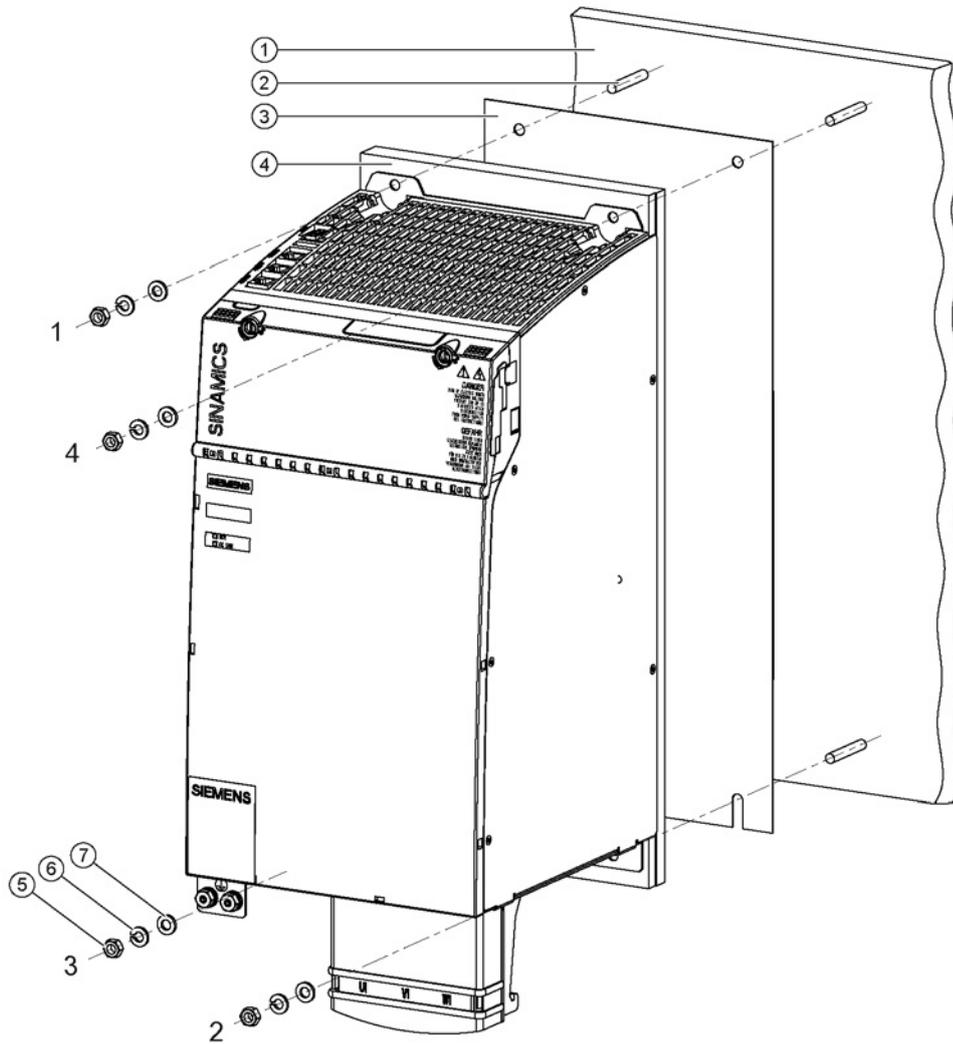


- ① External heat sink
- ② M6 studs
- ③ Heat-conducting foil
- ④ Cold plate
- ⑤ M6 nut
- ⑥ Spring washer
- ⑦ Washer

Figure 4-67 Mounting a Basic Line Module 40 kW with cold plate on an external heat sink

Tightening torques:

- Firstly, tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
Tightening torque: 10 Nm



- ① External heat sink
- ② M6 studs
- ③ Heat-conducting foil
- ④ Cold plate
- ⑤ M6 nut
- ⑥ Spring washer
- ⑦ Washer

Figure 4-68 Mounting a Basic Line Module 100 kW with cold plate on an external heat sink

Tightening torques:

- Firstly, tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
Tightening torque: 10 Nm

Help with the mechanical control cabinet design is available from:

Siemens AG
Industry Sector, IA DT MC MF - WKC AS
TCCCC (Technical Competence Center Cabinets Chemnitz)
Postfach 1124
09070 Chemnitz, Germany
E-mail: cc.cabinetcooling.aud@siemens.com

Properties of the heat sink

AlMgSi 0.5 is recommended as the heat sink material.

The roughness of the external heat sink surface should be at least Rz 16 and the contact surface between the heat sink and cold plate should have an evenness of 0.2 mm (applicable to a height of 450 mm and width of 300 mm).

Note

Machine manufacturers can adapt the heat sink version to their special requirements. The specified rated data for the Power Modules can only be achieved if the power losses can be dissipated by the external heat sink under the specified general conditions.

| |
|---|
| NOTICE |
| Damage to the cold plate caused by incorrect mounting |
| The screw bolts can be damaged when mounting the cold plate. |
| <ul style="list-style-type: none">• Do not damage the cold plate. |

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

To operate a 100 kW Basic Line Module on an isolated-neutral (IT) system, the connection bracket for the interference suppression capacitor 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.

| | | |
|--|--|--|
|  |  |  |
| Remove the connection bracket to the noise suppression capacitor using a Tx25 screwdriver. | Withdraw the connection bracket. | Connection bracket for the interference-suppression capacitor |

Note

Installing the connection bracket for the interference-suppression capacitor

For operation in other line supplies, the connection bracket must be reinstalled and fixed with a tightening torque of 1.8 Nm.

4.7.8 Technical data

Table 4- 62 Technical data for Basic Line Modules with cold plate cooling

| | 6SL3136- | 1TE22-0AA0 | 1TE24-0AA0 | 1TE31-0AA0 |
|---|------------------------|--|------------|------------|
| Rated power | kW | 20 | 40 | 100 |
| Infeed | | | | |
| Rated power (S1) ¹⁾ | kW (P _n) | 20 | 40 | 100 |
| Infeed power (S6 - 40 %) ¹⁾ | kW (P _{S6}) | 26 | 52 | 130 |
| Peak infeed power ¹⁾ | 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 | | |
| Electronics 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 % | | |
| Rated input currents | | | | |
| at AC 380 V | A _{AC} | 34,5 | 69 | 172 |
| at AC 480 V / AC 528 V | A _{AC} | 31 / 29 | 62 / 58 | 154 / 145 |
| at 480 V; S6 - 40 % | A _{AC} | 38 | 78 | 193 |
| Peak current | | | | |
| at AC 400 V / AC 480 V) | A _{AC} | 113 / 91 | 208 / 172 | 265 / 252 |
| DC link currents | | | | |
| Rated DC link current: for 600 V | A _{DC} | 33,5 | 67 | 167 |
| DC link current: for 540 V | A _{DC} | 37 | 48 | 185 |
| for DC 600 V; S6 - 40 % | A _{DC} | 43 | 87 | 217 |
| for DC 600 V; peak current | A _{DC} | 100 | 200 | 292 |
| Current carrying capacity | | | | |
| DC link busbars | A _{ACrms} | 100 | 200 | 200 |
| Reinforced DC link busbars | A _{ACrms} | 150 | -- | -- |
| 24 V DC busbars | A _{ACrms} | 20 | 20 | 20 |
| Electronics current drawn | | | | |
| at 24 V DC | A _{DC} | 0,9 | 1,1 | 1,6 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 141,6 | 276,4 | 618,4 |
| DC link capacitance | | | | |
| Basic Line Module | μF | 940 | 1880 | 4100 |
| Drive line-up, max. | μF | 20000 | 20000 | 20000 |
| Power factor³⁾ | cosφ | Approx. 0.98 | | |
| Circuit breaker (IEC 60947 and UL) | | See Section Overcurrent protection using line fuses and circuit breakers (Page 51) | | |
| Rated short-circuit current SCCR ⁴⁾ | kA | 65 | 65 | 65 |

4.7 Basic Line Modules with cold plate

| | 6SL3136- | 1TE22-0AA0 | 1TE24-0AA0 | 1TE31-0AA0 |
|---|----------|------------|------------|------------|
| Max. ambient temperature | | | | |
| without derating | ° C | 40 | 40 | 40 |
| with derating | ° C | 55 | 55 | 55 |
| Max. permissible heat sink temperature | ° C | 70 | 70 | 70 |
| Weight | kg | 6,4 | 10,9 | 16,4 |

- 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) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker – and the Line Module in the drive system.

4.7.8.1 Characteristics

Rated duty cycles for Basic Line Modules

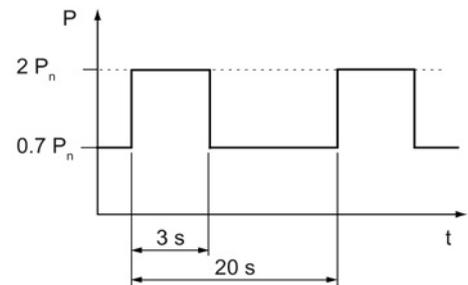
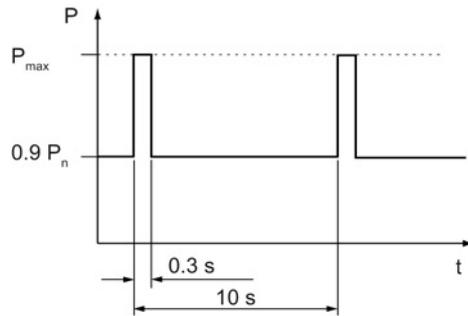


Figure 4-69 Duty cycles with initial load

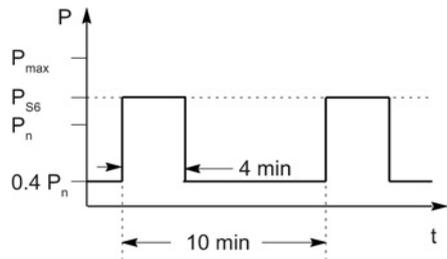


Figure 4-70 S6 duty cycle with pre-load condition

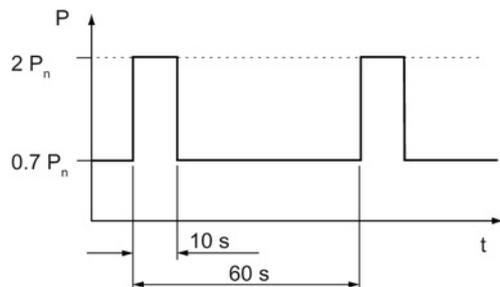


Figure 4-71 Duty cycle with pre-load condition for 20 kW and 40 kW Basic Line Modules

Braking duty cycle for Basic Line Modules

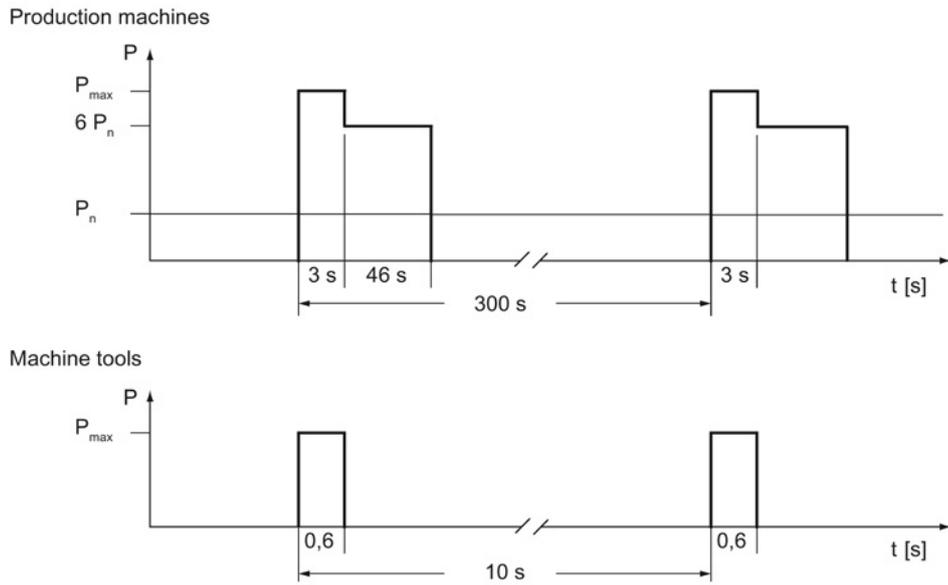


Figure 4-72 Braking duty cycle for Basic Line Modules

Derating characteristics

Note

For additional information, see chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

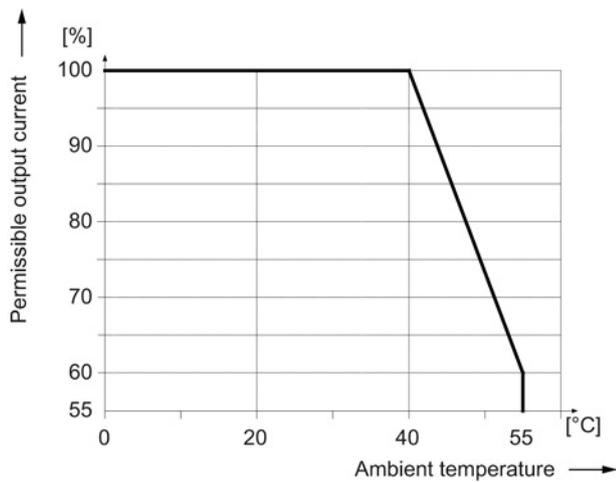


Figure 4-73 Output current as a function of the ambient temperature

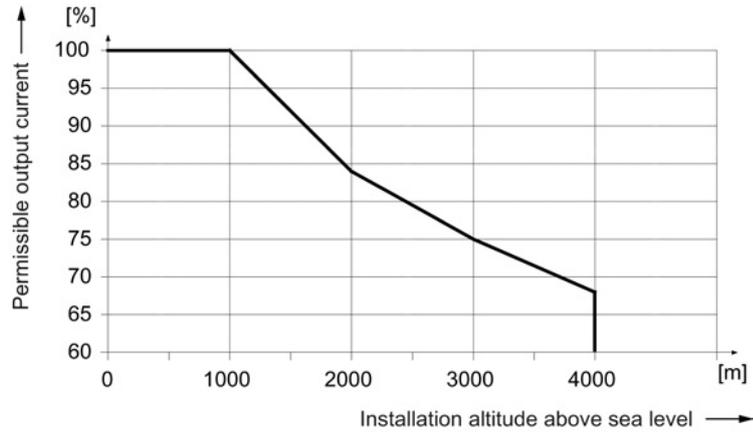


Figure 4-74 Output current as a function of the installation altitude

4.8 Smart Line Modules with internal air cooling

4.8.1 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 feedback mode, the current waveform is square waved. Regenerative feedback 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. On 16 kW to 55 kW Smart Line Modules, regenerative feedback can be deactivated via parameters, 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. An optional main contactor is required for disconnecting the voltage.

Smart Line Modules are suitable for direct operation on TN, IT and TT systems. The Line Modules have an integrated overvoltage protection function.

4.8.2 Safety instructions for Smart Line Modules Booksize

| |
|---|
|  WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed |
| If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. |
| <ul style="list-style-type: none">• Adhere to the fundamental safety instructions.• When assessing the risk, take into account residual risks. |

NOTICE**Destruction of the Smart Line Module for an incorrect switch-on or switch-off sequence**

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair.

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

Switch on:

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

Switch off:

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

Overload:

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

Note**Connected to the public low-voltage network**

Smart Line Modules have been designed for use in the industrial environment and generate current harmonics on the line side as a result of the rectifier circuit.

When connecting a machine with integrated Smart Line Modules to the public low-voltage line supply (grid), authorization is required in advance from the local power supply company (utility company) in the following cases:

- The rated current of the motor ≤ 16 A per conductor.
- The rated motor current does not comply with the requirements specified in EN 61000-3-2 regarding current harmonics.

4.8.3 Interface description

4.8.3.1 Overview

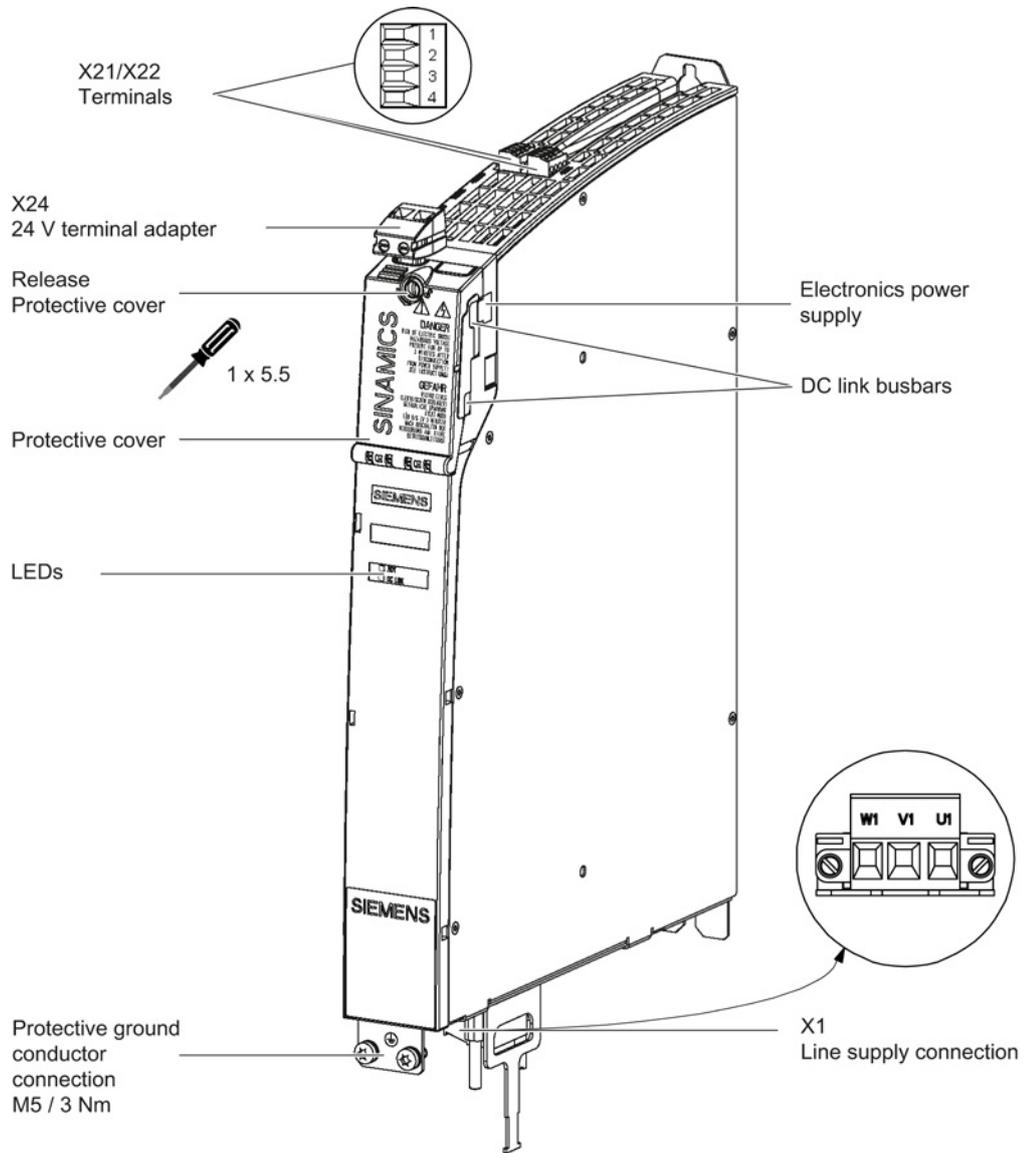


Figure 4-75 Interface overview, 5 kW and 10 kW Smart Line Modules with internal air cooling (example: 5 kW)

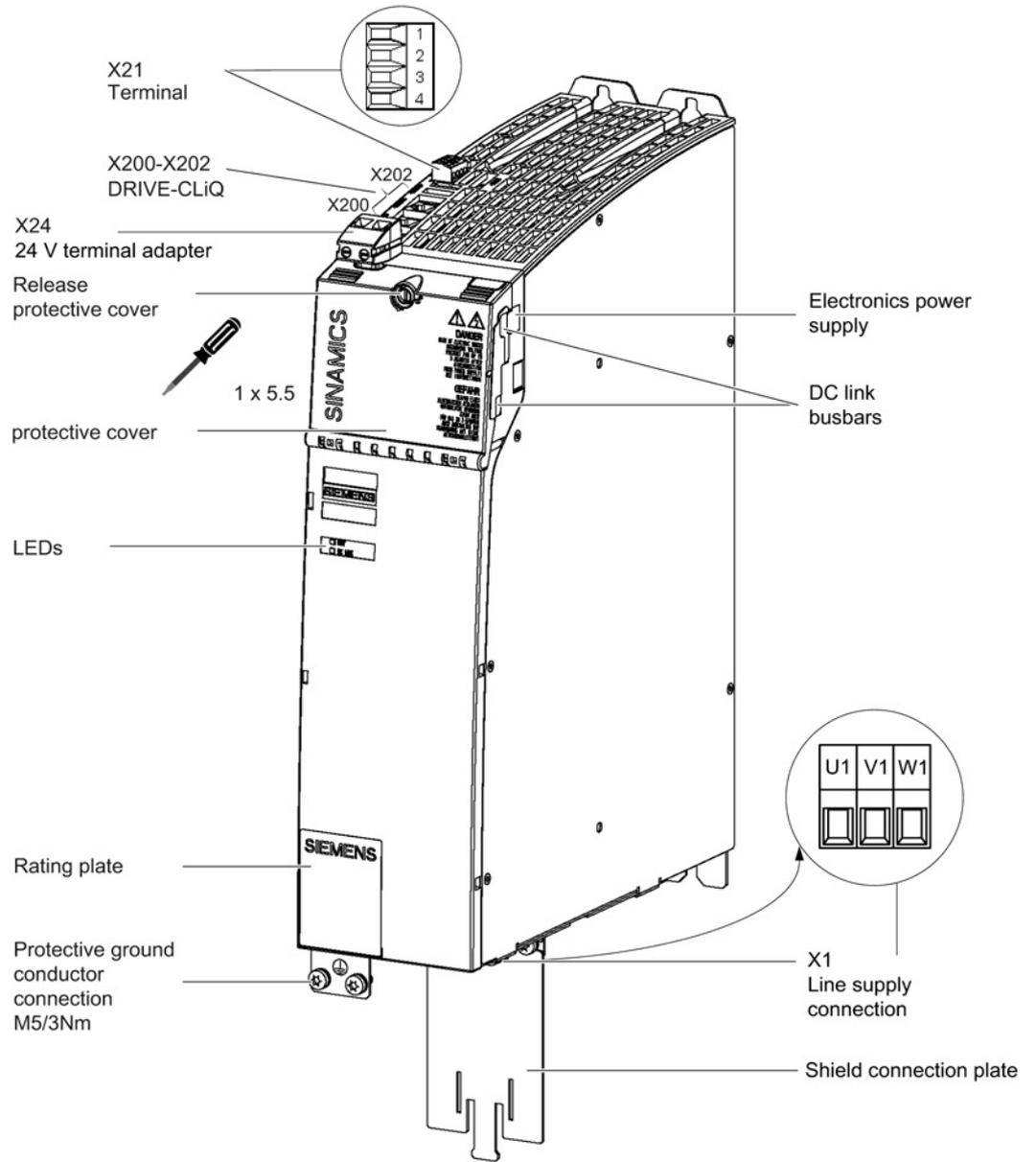


Figure 4-76 Interface overview, 16 kW Smart Line Module with internal air cooling

4.8 Smart Line Modules with internal air cooling

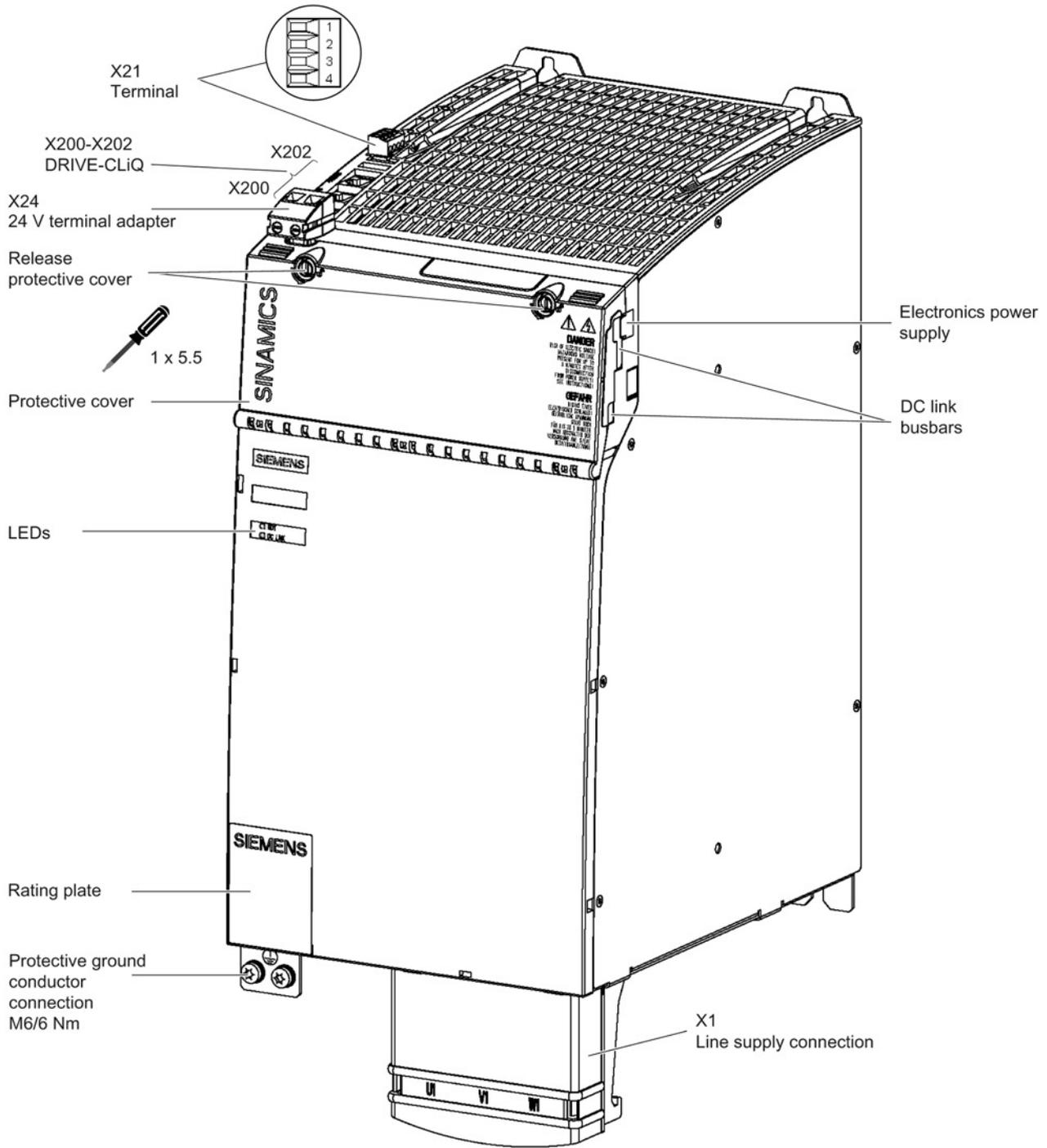
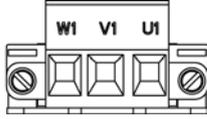
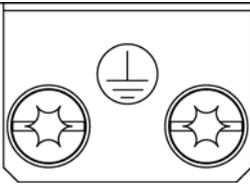


Figure 4-77 Interface overview, 36 kW and 55 kW Smart Line Modules with internal air cooling (example: 55 kW)

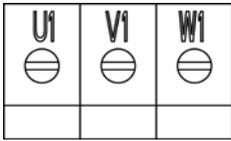
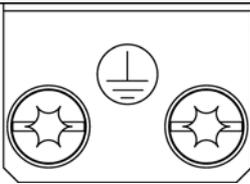
4.8.3.2 X1 line connection

Table 4- 63 X1: Line connection for Smart Line Modules 5 kW and 10 kW

| | Terminal | Technical data |
|---|---------------|--|
|  | U1 | Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm ² Tightening torque: 1.2 ... 1.5 Nm |
| | V1 | |
| | W1 | |
|  | PE connection | Threaded hole M5 / 3 Nm ¹ |

1) For ring cable lugs without insulation

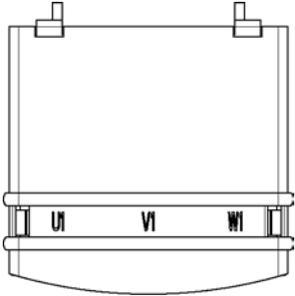
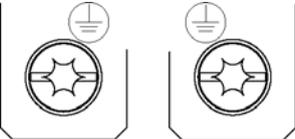
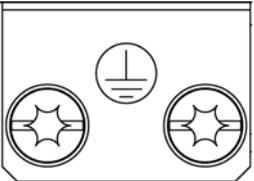
Table 4- 64 X1: Line supply connection for Smart Line Modules 16 kW

| | Terminal | Technical data |
|---|---------------|---|
|  | U1 | Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Type: Screw terminal 6 (Page 755) Max. cross-section that can be connected: 10 mm ² Tightening torque: 1.5 ... 1.8 Nm |
| | V1 | |
| | W1 | |
|  | PE connection | Threaded hole M5 / 3 Nm ¹ |

1) For ring cable lugs without insulation

4.8 Smart Line Modules with internal air cooling

Table 4- 65 X1: Line connection for Smart Line Modules 36 kW and 55 kW

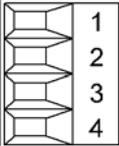
| | Terminal | Technical data |
|--|---------------|---|
|  | U1 | Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz 36 kW: Threaded bolt M6 / 6 Nm ¹⁾ 55 kW: Threaded bolts M8 / 13 Nm ¹⁾ |
| | V1 | |
| | W1 | |
|  | PE connection | 36 kW: Threaded hole M6 / 6 Nm ¹⁾ |
|  | | 55 kW: Threaded hole M6 / 6 Nm ¹⁾ |

1) For ring cable lugs without insulation

4.8.3.3 X21 EP terminals

Smart Line Modules 5 kW and 10 kW

Table 4- 66 X21 EP terminal for Smart Line Modules 5 kW and 10 kW

| | Terminal | Designation | Technical data |
|--|----------|-------------------------|---|
|  | 1 | DO: Ready | Feedback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: <ul style="list-style-type: none"> • Electronics power supply (X24) OK • DC link is precharged • Pulses enabled (X21.3/4) • No overtemperature • No overcurrent |
| | 2 | DO: Prewarning | DO: Prewarning High = no prewarning Low = prewarning <ul style="list-style-type: none"> • Overtemperature warning threshold/I^2t 5 kW prewarning: 64 °C, overtemperature threshold: 69 °C 10 kW prewarning: 68 °C, overtemperature threshold: 73 °C • No regenerative feedback capability due to a line fault [only monitored when feedback is activated (see terminal X22.2)] |
| | 3 | EP +24 V (pulse enable) | Voltage 24 V DC |
| | 4 | EP M (Enable Pulses) | Current consumption: 10 mA Isolated input |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm ² | | | |

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, 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 that it is "ready", even if one of the line conductors is not available. In this case, regenerative feedback is deactivated and an alarm is output at X21.2 (DO, Warning I²t). If regenerative feedback was deactivated by applying a "high" signal to terminal X22.2 (DI, Disable), no alarm will be output at X21.2 (DO, Warning I²t).

Terminals X21.3 and X21.4

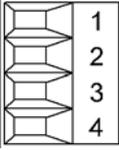


| |
|---|
| ! WARNING |
| Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected |
| For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. |
| Pulse cancellation is activated if the power supply is disconnected. Regenerative feedback 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. |
| Death or serious injury can result when live parts are touched. |
| <ul style="list-style-type: none">• Neutralize the voltage in the DC link. |

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

16 kW to 55 kW Smart Line Modules

Table 4- 67 X21 EP terminal / temperature sensor for 16 kW to 55 kW Smart Line Modules

| | Terminal | Function | Technical data |
|---|----------|-------------------------|--|
|  | 1 | + Temp | Temperature sensors ¹⁾ : KTY 84-1C130/PTC/bimetallic switch with NC contact |
| | 2 | - Temp | |
| | 3 | EP +24 V (pulse enable) | Voltage: 24 V DC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs |
| | 4 | EP M (Enable Pulses) | |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm ² : | | | |

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

Temperatures are sensed, but are not evaluated in the Smart Line Module.

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

**! WARNING**

Danger to life due to electric shock in the event of voltage flashovers on the temperature sensor cable

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Only use temperature sensors that fully comply with the specifications of the safety isolation.
- 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.

NOTICE

Risk of the motor overheating due to an incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY sensor with the correct polarity.

Terminals X21.3 and X21.4

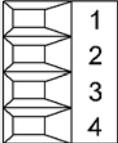


| |
|--|
|  WARNING |
| <p>Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected</p> <p>For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4.</p> <p>Pulse cancellation is activated if the power supply is disconnected. Regenerative feedback 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.</p> <p>Death or serious injury can result when live parts are touched.</p> <ul style="list-style-type: none"> • Neutralize the voltage in the DC link. |

| |
|---|
| NOTICE |
| <p>Damage to the drive electronics when switching the line contactor under load</p> <p>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.</p> <ul style="list-style-type: none"> • 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. |

4.8.3.4 X22 digital inputs

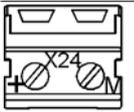
Table 4- 68 X22 digital inputs for Smart Line Modules 5 kW and 10 kW

| | Terminal | Designation ¹⁾ | Technical data |
|--|----------|---------------------------|---|
|  | 1 | 24 V power supply | Electronics power supply for controlling digital inputs X22.2 and 3 |
| | 2 | DI: Disable Regeneration | Deactivate regenerative feedback (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: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm ² | | | |

¹⁾ DI: Digital input

4.8.3.5 X24 24 V terminal adapter

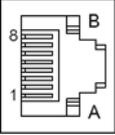
Table 4- 69 X24: 24 V terminal adapter

| | Terminal | Designation | Technical data |
|--|----------|-------------------|------------------------|
|  | + | 24 V power supply | 24 V DC supply voltage |
| | M | Ground | Electronics ground |
| Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm ² | | | |

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

4.8.3.6 X200-X202 DRIVE-CLiQ interfaces

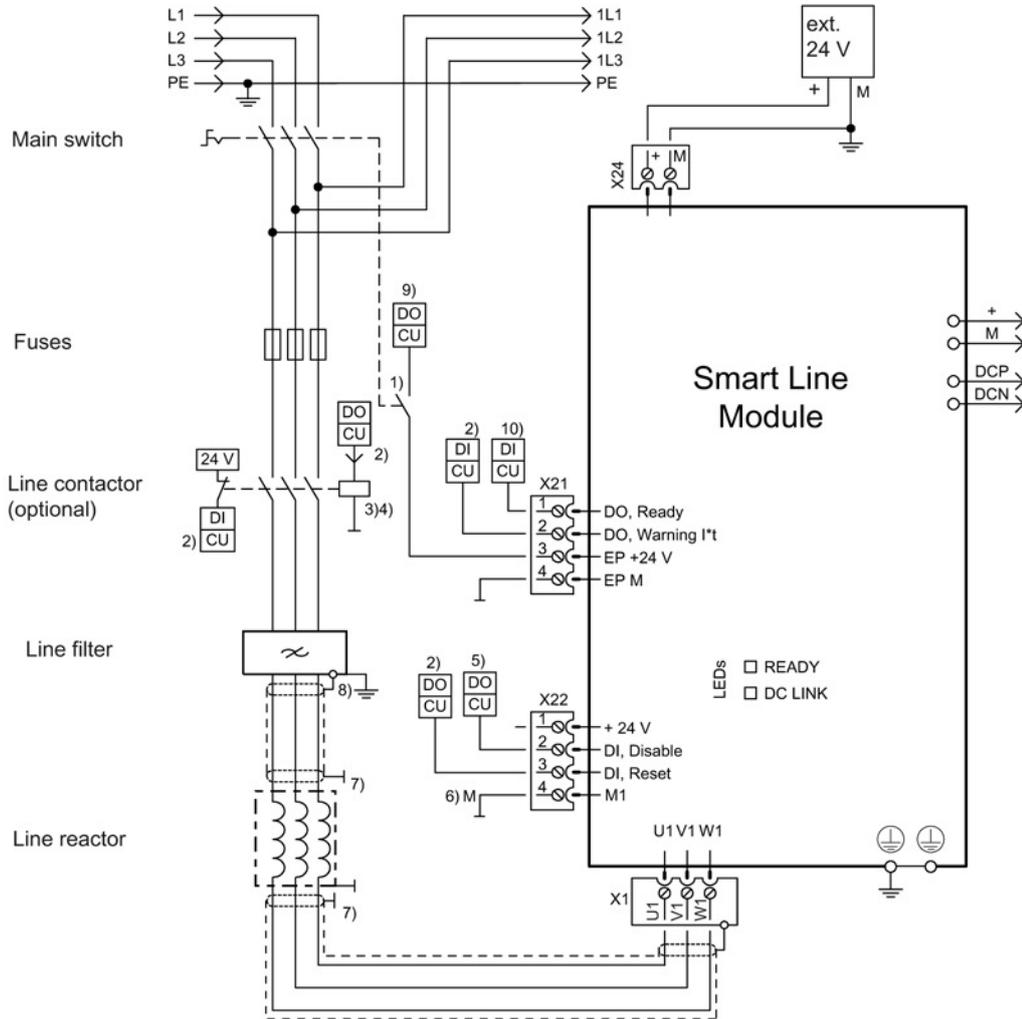
Table 4- 70 X200-X202: DRIVE-CLiQ interfaces

| | 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.

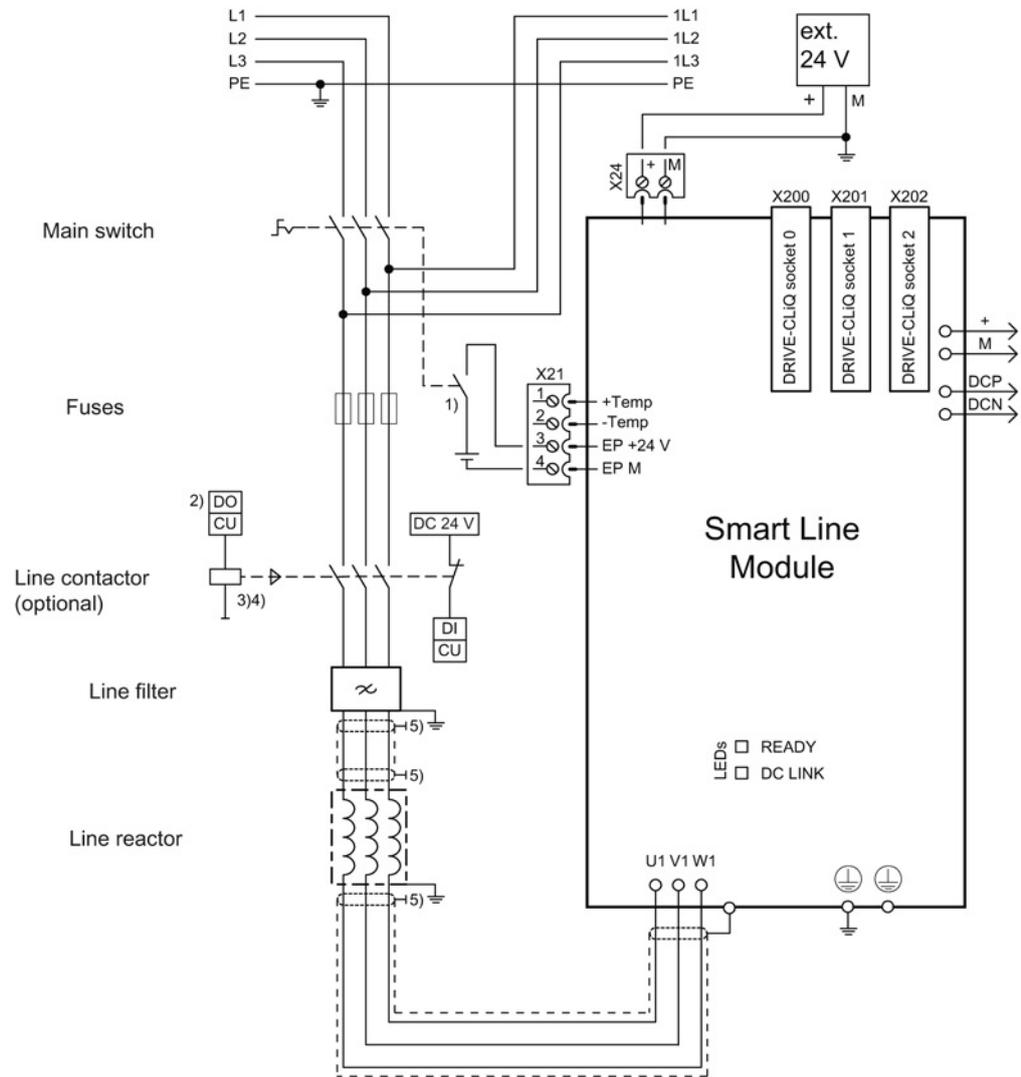
Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

4.8.4 Connection examples



- 1) Leading NC contact $t > 10$ ms, 24 VDC and ground must be set up for operation.
- 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 must be used if required.
- 5) DO high, regenerative feedback deactivated (a jumper can be inserted between X22 pin 1 and pin 2 for permanent deactivation).
- 6) X22 pin 4 must be connected to ground (ext. 24 V).
- 7) Contact established via rear mounting panel or shielding buses in accordance with the EMC installation guideline
- 8) 5 kW and 10 kW line filters via shield connection
- 9) Signal output of the control, to avoid interference of the 24 VDC supply on the EP terminal.
- 10) Interconnection via BICO to parameter p0864

Figure 4-78 Connection example for 5 kW and 10 kW Smart Line Modules



- 1) Leading NC 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 must be used if required.
- 5) Contact established via rear mounting panel or shielding buses in accordance with the EMC installation guideline

Figure 4-79 Connection example for 16 kW to 55 kW Smart Line Modules

Note

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

4.8.5 Meaning of LEDs

4.8.5.1 Smart Line Modules 5 kW and 10 kW

Table 4- 71 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. | – |
| | Yellow | 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 | – | Off | The electronics power supply is missing or outside the permissible tolerance range. | – |
| | Yellow | 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. |



| |
|---|
| <p>! WARNING</p> <p>Danger of death when live parts of the DC link are touched</p> <p>Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.</p> <ul style="list-style-type: none"> Observe the warning information on the component. |
|---|

4.8.5.2 16 kW to 55 kW Smart Line Modules

Table 4- 72 Meaning of the LEDs on Smart Line Modules \geq 16 kW

| Status | | Description, cause | Remedy |
|----------------------------------|---------|--|------------------------------------|
| RDY | DC LINK | | |
| Off | Off | The electronics power supply is missing or outside the permissible tolerance range. | – |
| Green | -- | 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 | -- | This component has at least one fault. Note: The LED is activated regardless of whether the corresponding messages have been reconfigured. | Resolve and acknowledge the fault. |
| Green/red (0.5 Hz) | -- | Firmware is being downloaded. | – |
| Green/red (2 Hz) | -- | Firmware download has been completed. The system waits for POWER ON. | Carry out a POWER ON. |
| Green/orange or red/orange | -- | Component recognition via LED is activated ¹⁾ . Note: Both options depend on the LED status when component recognition is activated. | – |

¹⁾ See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



 **WARNING**

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

4.8.6 Dimension drawings

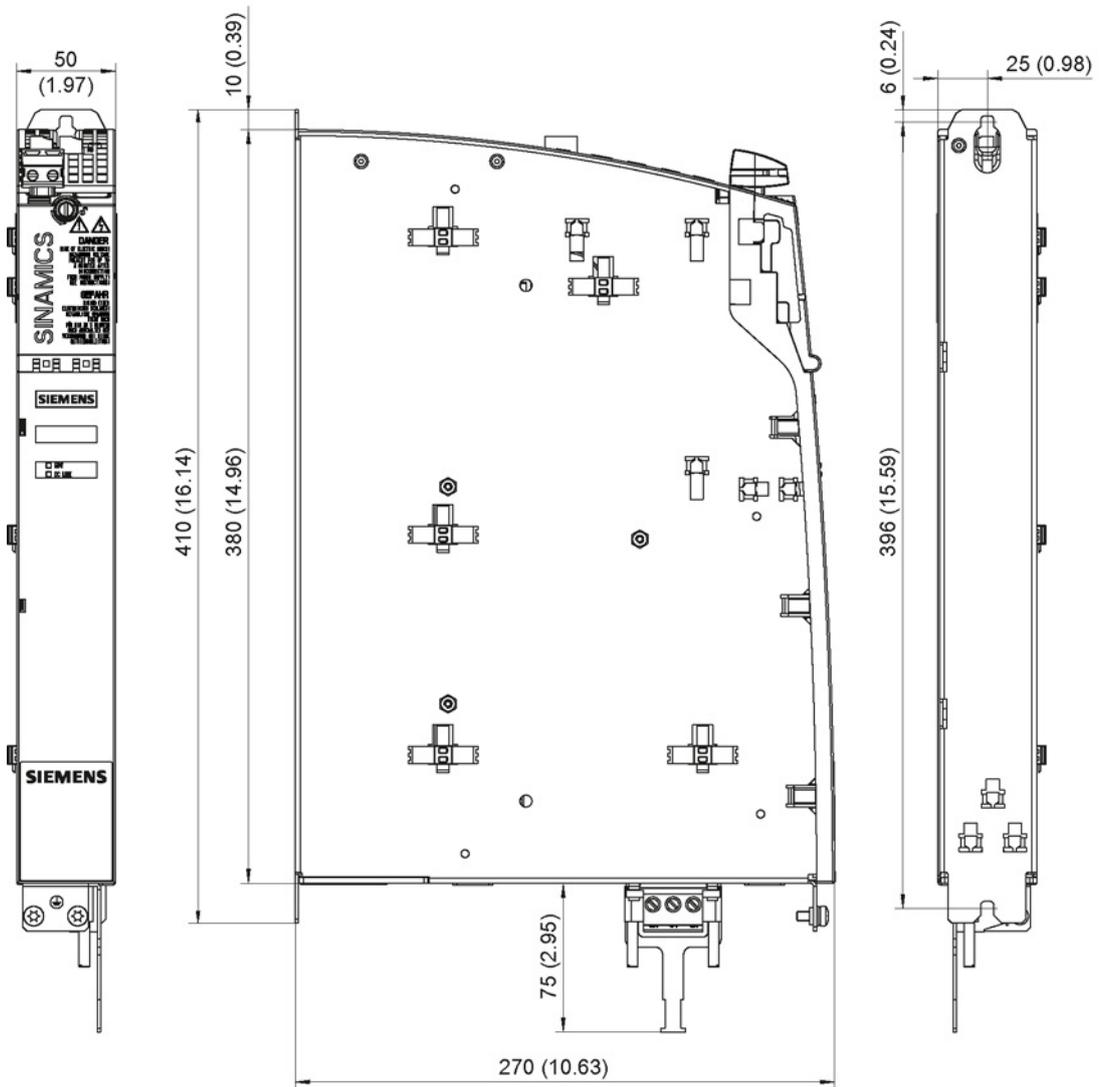


Figure 4-80 Dimension drawing of 5 kW and 10 kW Smart Line Modules with internal air cooling, all dimensions in mm and (inches)

Note

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

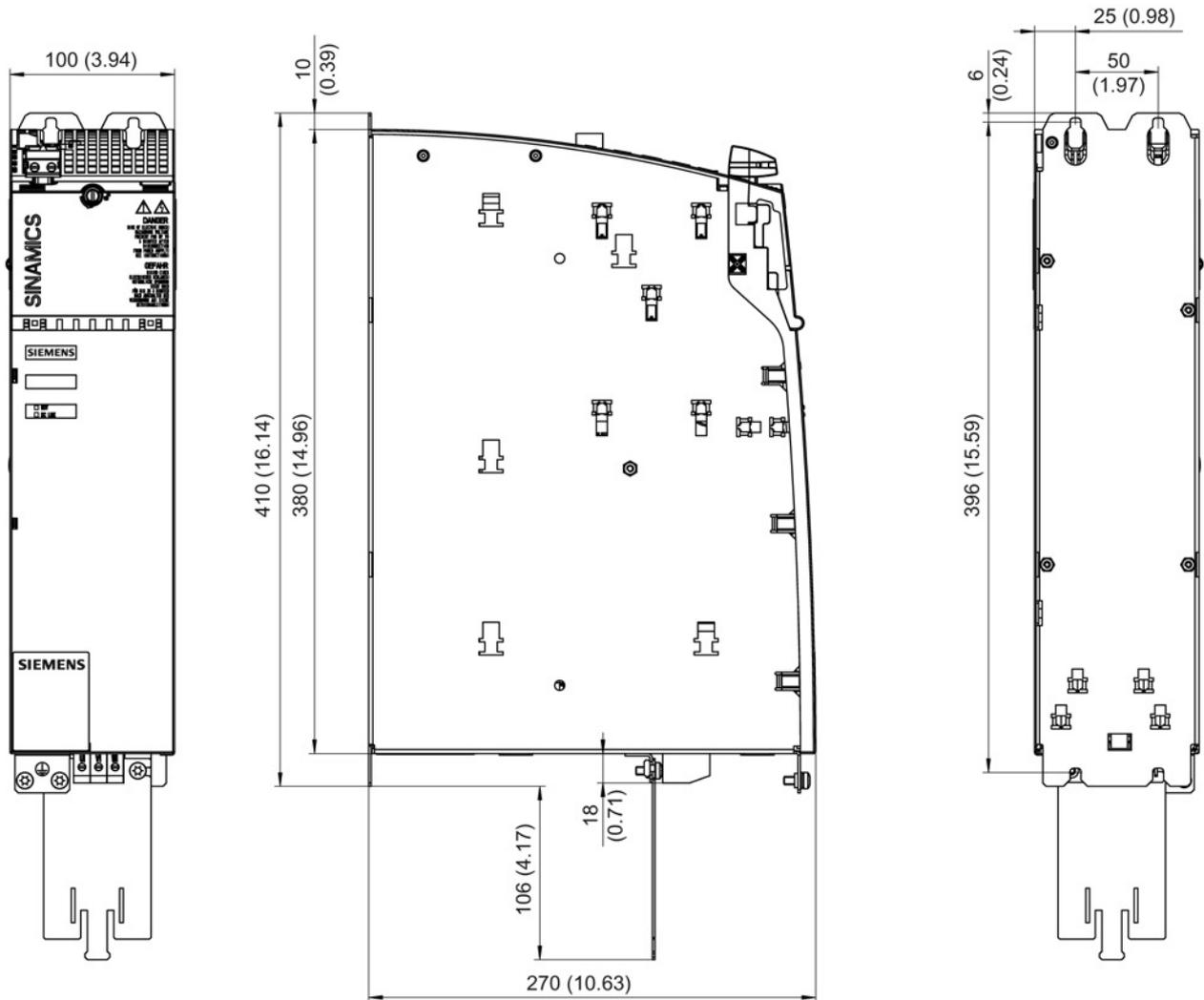


Figure 4-81 Dimension drawing of 16 kW Smart Line Module with internal air cooling, all dimensions in mm and (inches)

Note

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

4.8 Smart Line Modules with internal air cooling

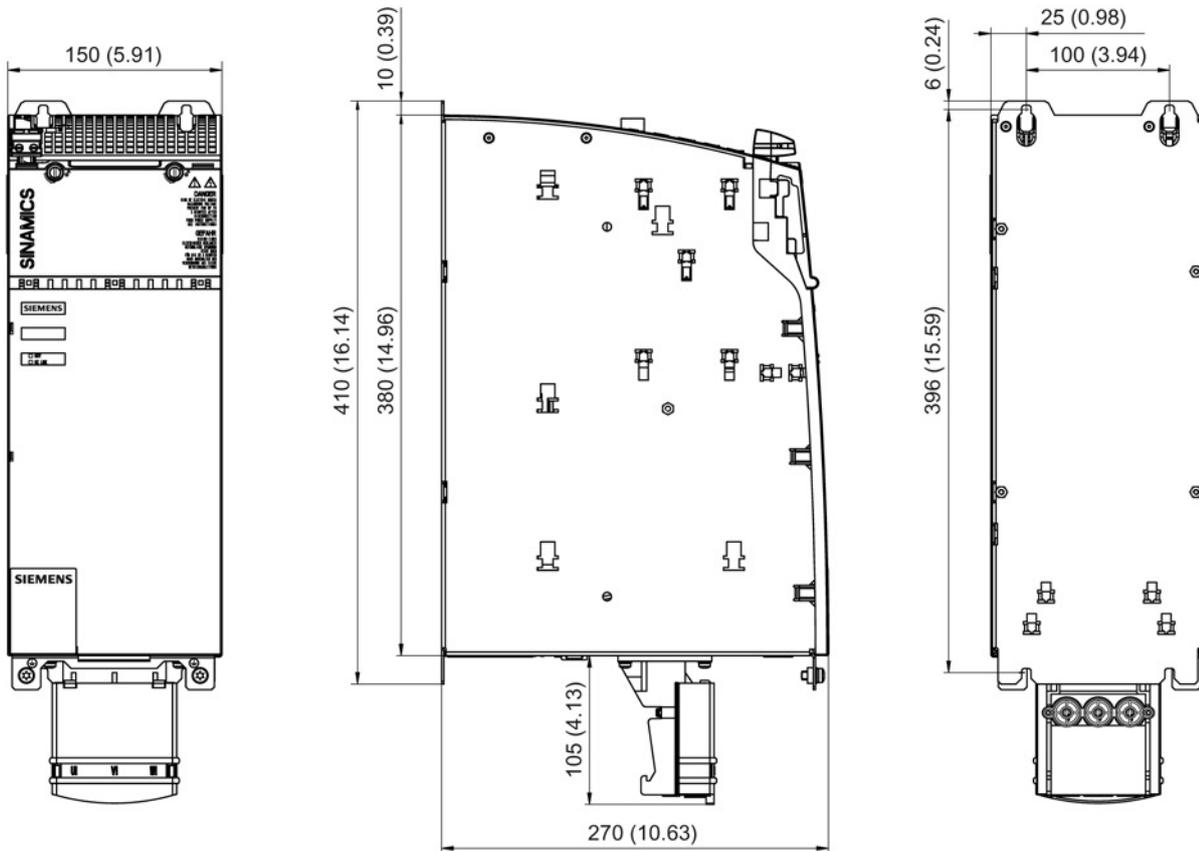


Figure 4-82 Dimension drawing of 36 kW Smart Line Module with internal air cooling, all dimensions in mm and (inches)

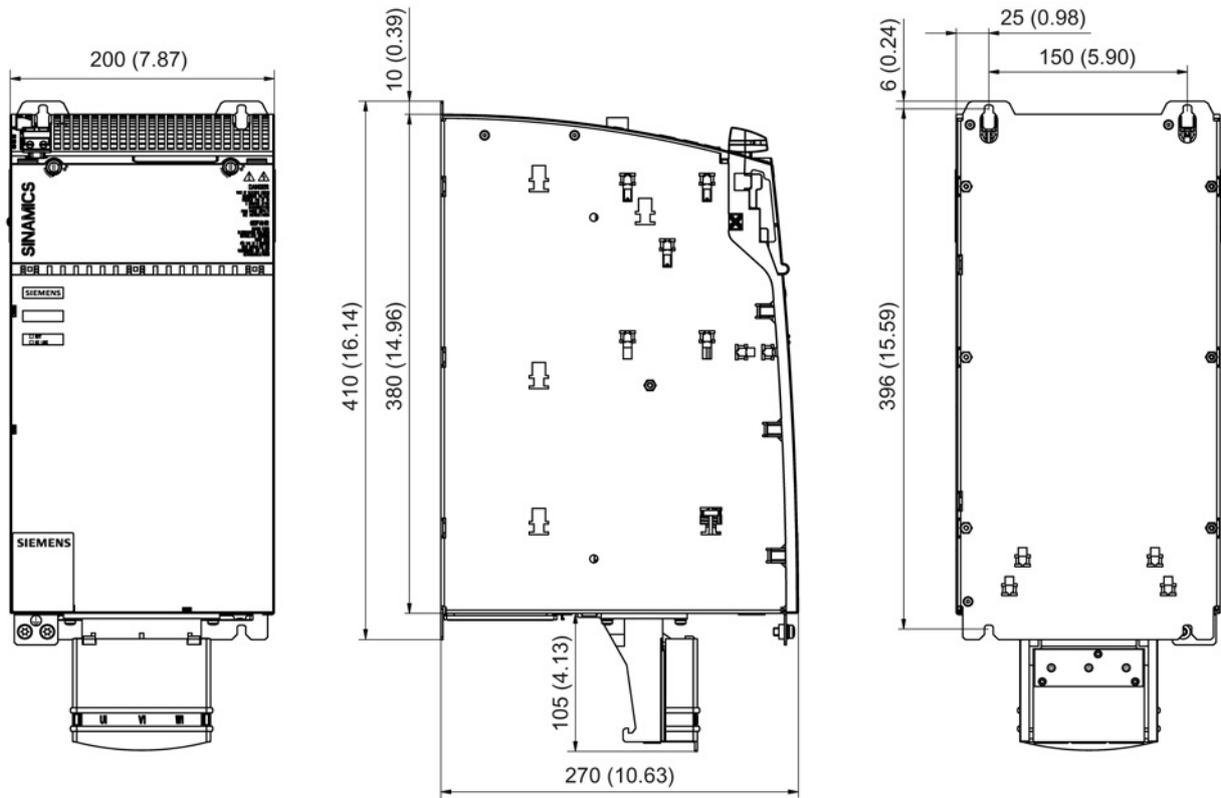
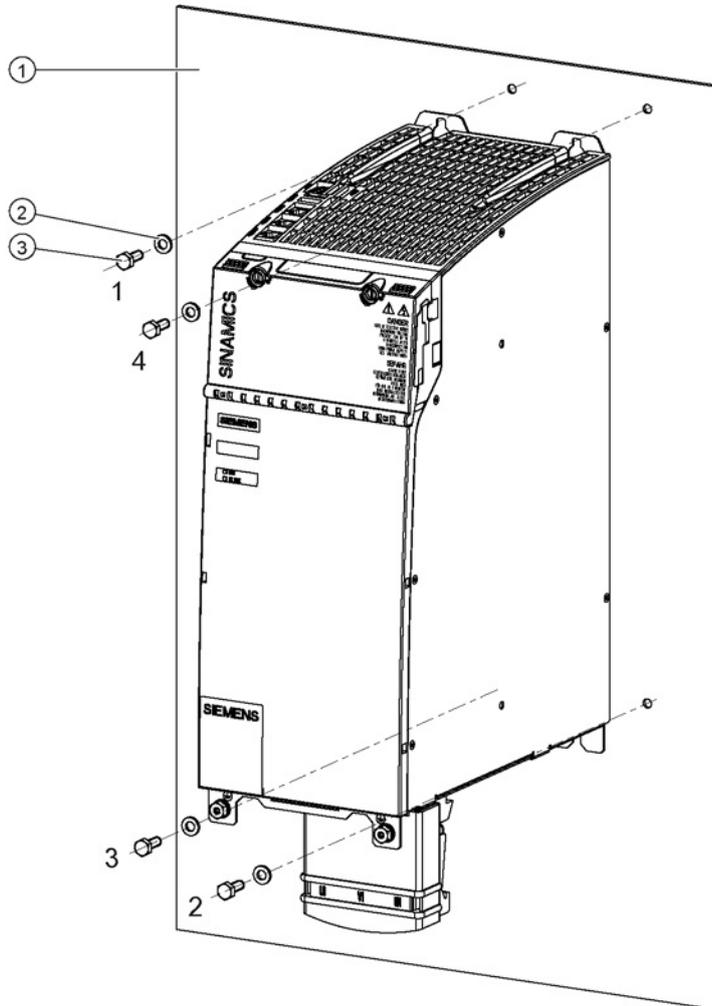


Figure 4-83 Dimension drawing of 55 kW Smart Line Module with internal air cooling, all dimensions in mm and (inches)

4.8.7 Installation

Smart 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 4-84 Mounting a Smart Line Module with internal air cooling (example: 36 kW)

Tightening torques:

- Firstly, tighten the nuts by hand.
Tightening torque. 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
Tightening torque: 6 Nm

4.8.8 Technical data

Table 4- 73 Technical data for Smart Line Modules in booksize format with internal air cooling

| Internal air cooling | 6SL3130– | 6AE15–0Axx | 6AE21–0Axx | 6TE21-6Axx | 6TE23-6Axx | 6TE25-5Axx |
|---|------------------------|---|------------|------------|------------|------------|
| Rated power | kW | 5 | 10 | 16 | 36 | 55 |
| Infeed | | | | | | |
| Rated power (S1) ¹⁾ | kW (P _n) | 5 | 10 | 16 | 36 | 55 |
| S6 operation (40 %) ¹⁾ | kW (P _{S6}) | 6,5 | 13 | 21 | 47 | 71 |
| Peak infeed power ¹⁾ | kW (P _{max}) | 10 | 20 | 35 | 70 | 91 |
| Regenerative feedback | | | | | | |
| Continuous regenerative power | kW | 5 | 10 | 16 | 36 | 55 |
| Peak regenerative power | kW | 10 | 20 | 35 | 70 | 91 |
| Supply voltages | | | | | | |
| Line voltage | V _{AC} | 3 AC 380 ... 480 ± 10 % (-15 % < 1 min) | | | | |
| Line frequency | Hz | 47 ... 63 | | | | |
| Electronics 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 (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 | A _{DC} | 8,3 | 16,6 | 27 | 60 | 92 |
| at 540 V | A _{DC} | 9,3 | 18,5 | 30 | 67 | 105 |
| S6 (40 %) | | | | | | |
| at DC 600 V | A _{DC} | 11 | 22 | 35 | 79 | 138 |
| Peak current | | | | | | |
| at DC 600 V | A _{DC} | 16,6 | 33,2 | 59 | 118 | 178 |
| Current carrying capacity | | | | | | |
| DC link busbars | A _{DC} | 100 | 100 | 100 | 200 | 200 |
| Reinforced DC link busbars | | | | | | |
| 24 V DC busbars | A _{DC} | 150 | 150 | 150 | -- | -- |
| | 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 781)) | W | 79,2 | 141,6 | 187,8 | 406 | 665,6 |
| Max. ambient temperature | | | | | | |
| without derating | ° C | 40 | | | | |
| with derating | ° C | 55 | | | | |

4.8 Smart Line Modules with internal air cooling

| Internal air cooling | 6SL3130- | 6AE15-0Axx | 6AE21-0Axx | 6TE21-6Axx | 6TE23-6Axx | 6TE25-5AAx |
|--|-------------------|---|------------------|------------|------------|------------|
| Rated power | kW | 5 | 10 | 16 | 36 | 55 |
| DC link capacitance | | | | | | |
| Smart Line Module | μF | 220 | 330 | 705 | 1410 | 1880 |
| Drive line-up, max. | μF | 6000 | 6000 | 20000 | 20000 | 20000 |
| Power factor | $\cos \phi$ | 0,98 | | | | |
| Circuit breaker (IEC 60947 and UL) | | See Section Overcurrent protection using line fuses and circuit breakers (Page 51) | | | | |
| Rated short-circuit current SCCR ³⁾ | kA | 65 | 65 | 65 | 65 | 65 |
| Cooling method (internal air cooling) | | Internal fan | | | | |
| Sound pressure level | dB(A) | < 60 | < 60 | < 60 | < 65 | < 60 |
| Cooling air requirement | m ³ /h | 29,6 | 29,6 | 56 | 112 | 160 |
| Max. permissible heat sink temperature | ° C | 69 ⁴⁾ | 73 ⁴⁾ | 77 | 80 | 75 |
| Rated voltage for rated data 3 AC 380 V | | | | | | |
| Weight | kg | 4,7 | 4,8 | 7 | 10 | 17 |

- 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) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker – and the Line Module in the drive system.
- 4) Values cannot be read out by the system (STARTER).

4.8.8.1 Characteristics

Rated duty cycles of Smart Line Modules

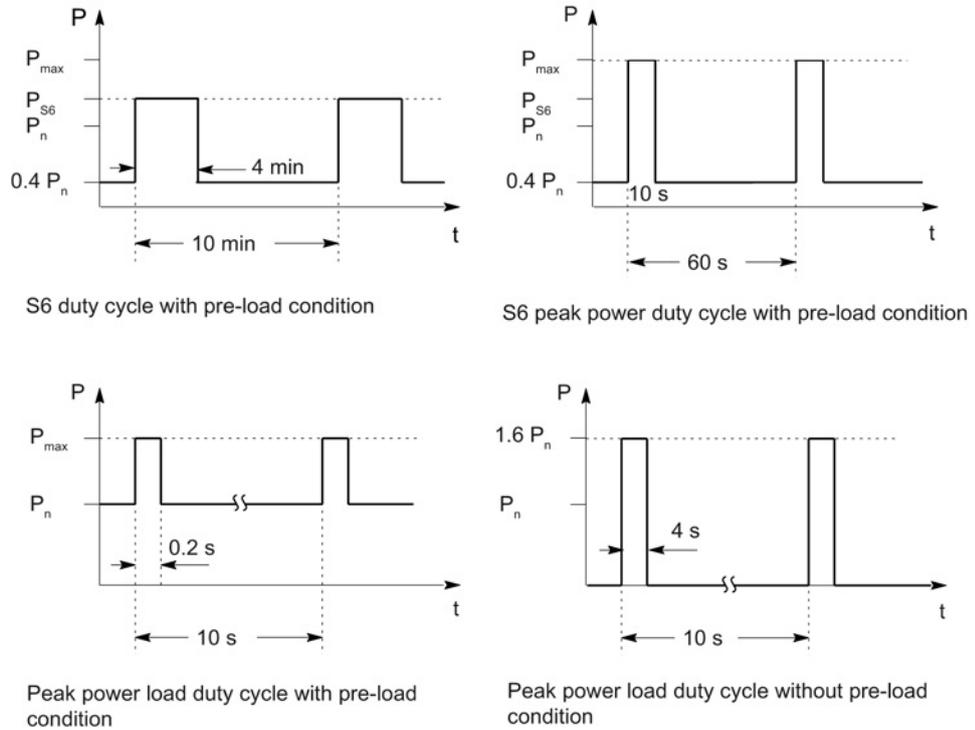


Figure 4-85 Rated duty cycles of Smart Line Modules

Derating characteristics

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

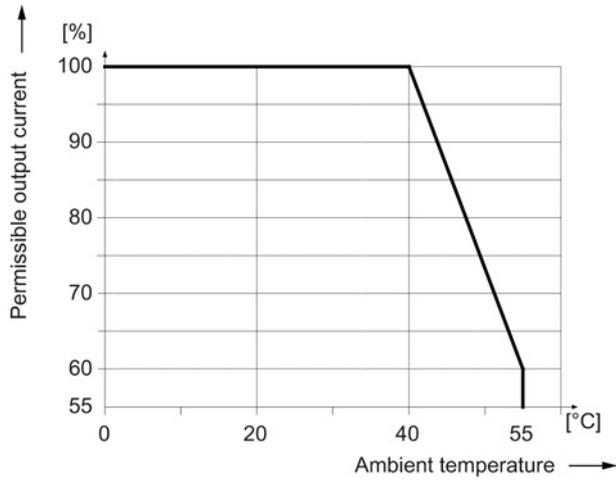


Figure 4-86 Output current as a function of the ambient temperature

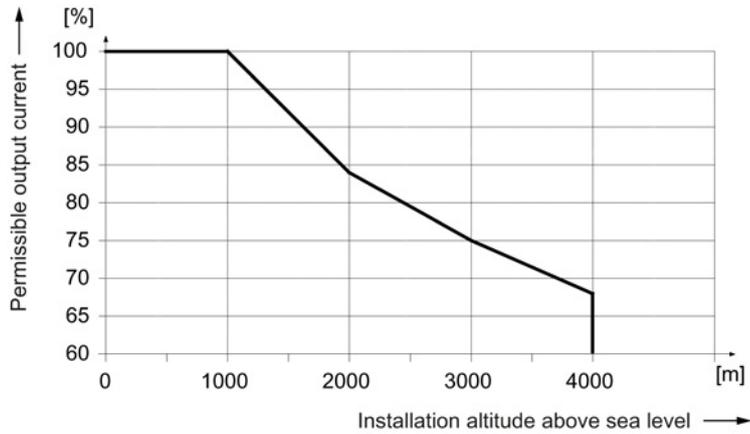


Figure 4-87 Output current as a function of the installation altitude

4.9 Smart Line Modules with external air cooling

4.9.1 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 feedback mode, the current waveform is square waved. Regenerative feedback can be deactivated if required. On 5 kW and 10 kW Smart Line Modules, this is done via a terminal, since these modules do not feature a DRIVE-CLiQ connection. On 16 kW to 55 kW Smart Line Modules, regenerative feedback can be deactivated via parameters, 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. An optional main contactor is required for disconnecting the voltage.

Smart Line Modules are suitable for direct operation on TN, IT and TT systems. The Line Modules have an integrated overvoltage protection function.

External air cooling uses the "through-hole" method. This is a cooling method that is only available for SINAMICS booksize units. The Smart Line Module and its heat sink can be inserted in a rectangular knockout at the rear of the control cabinet and mounted with a seal. The heat sink and the fan (included in the scope of supply) project beyond the rear of the control cabinet and the heat is dissipated outside the control cabinet or in a separate air duct.

4.9.2 Safety instructions for Smart Line Modules Booksize

| |
|--|
|  WARNING |
| <p>Danger to life if the fundamental safety instructions and remaining risks are not carefully observed</p> <p>If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.</p> <ul style="list-style-type: none"> • Adhere to the fundamental safety instructions. • When assessing the risk, take into account residual risks. |

NOTICE

Destruction of the Smart Line Module for an incorrect switch-on or switch-off sequence

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair.

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

Switch on:

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

Switch off:

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

Overload:

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

Note

Connected to the public low-voltage network

Smart Line Modules have been designed for use in the industrial environment and generate current harmonics on the line side as a result of the rectifier circuit.

When connecting a machine with integrated Smart Line Modules to the public low-voltage line supply (grid), authorization is required in advance from the local power supply company (utility company) in the following cases:

- The rated current of the motor ≤ 16 A per conductor.
- The rated motor current does not comply with the requirements specified in EN 61000-3-2 regarding current harmonics.

4.9.3 Interface description

4.9.3.1 Overview

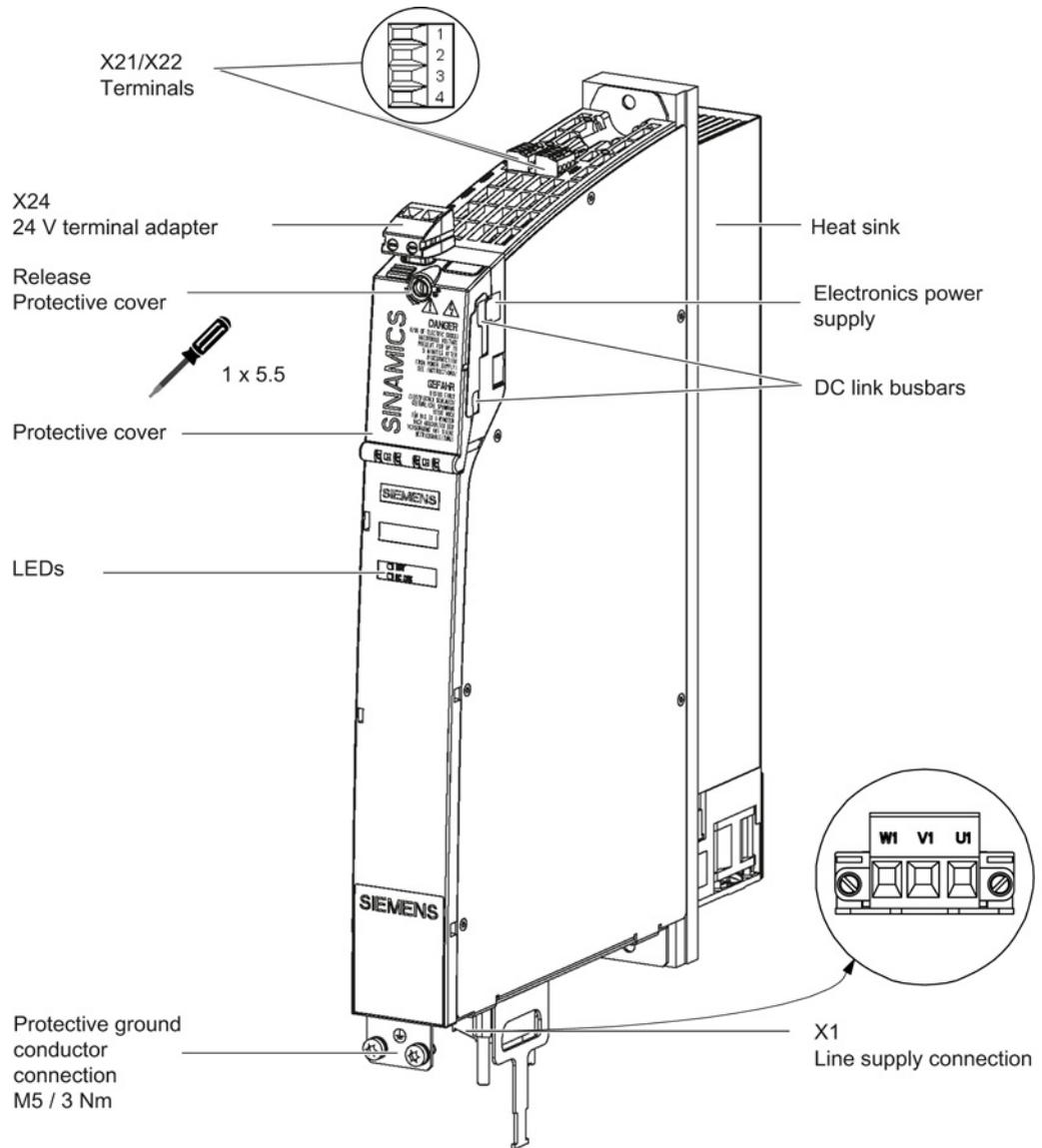


Figure 4-88 Interface overview, 5 kW and 10 kW Smart Line Modules with external air cooling (example: 5 kW)

4.9 Smart Line Modules with external air cooling

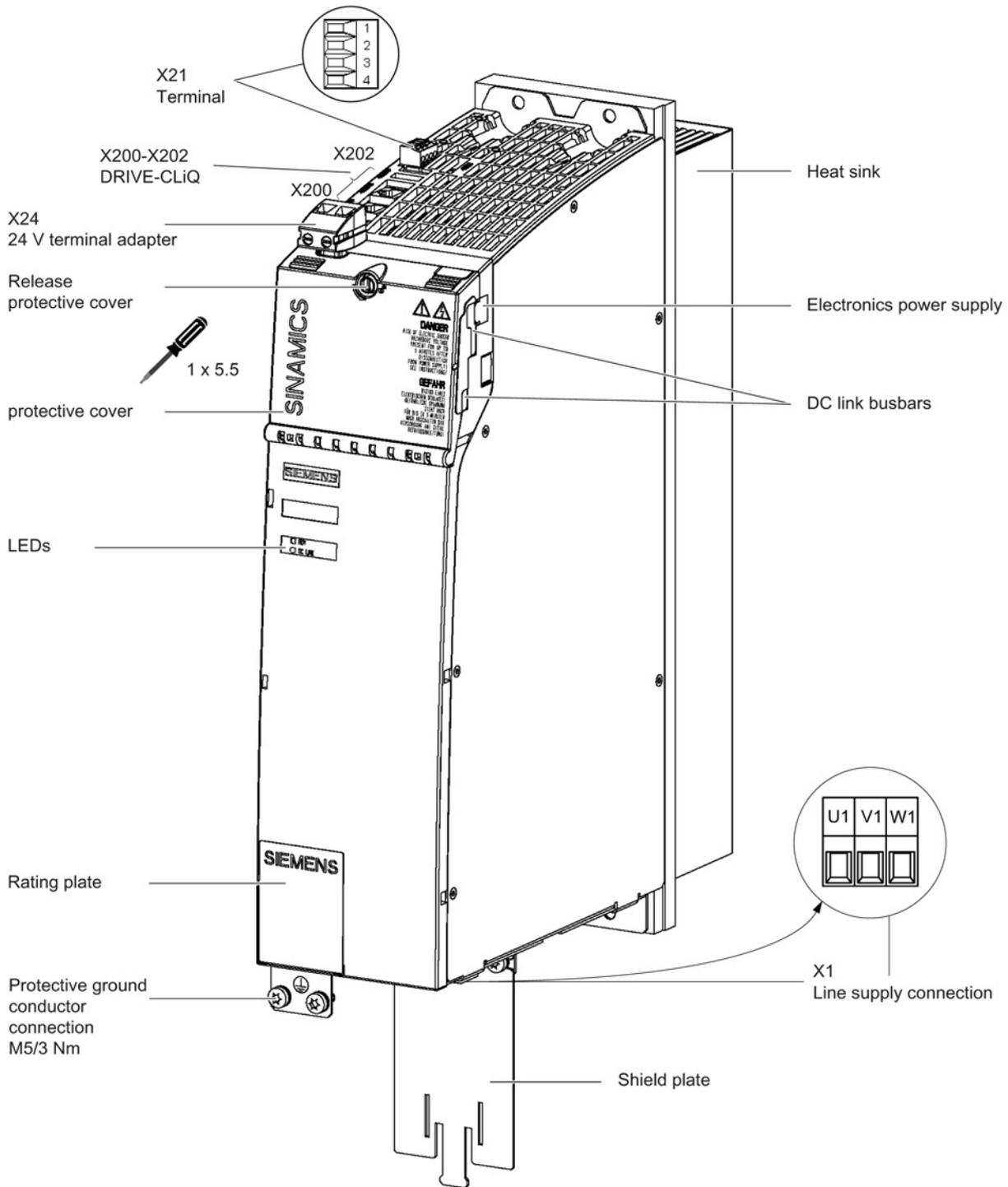


Figure 4-89 Interface overview, 16 kW Smart Line Module with external air cooling

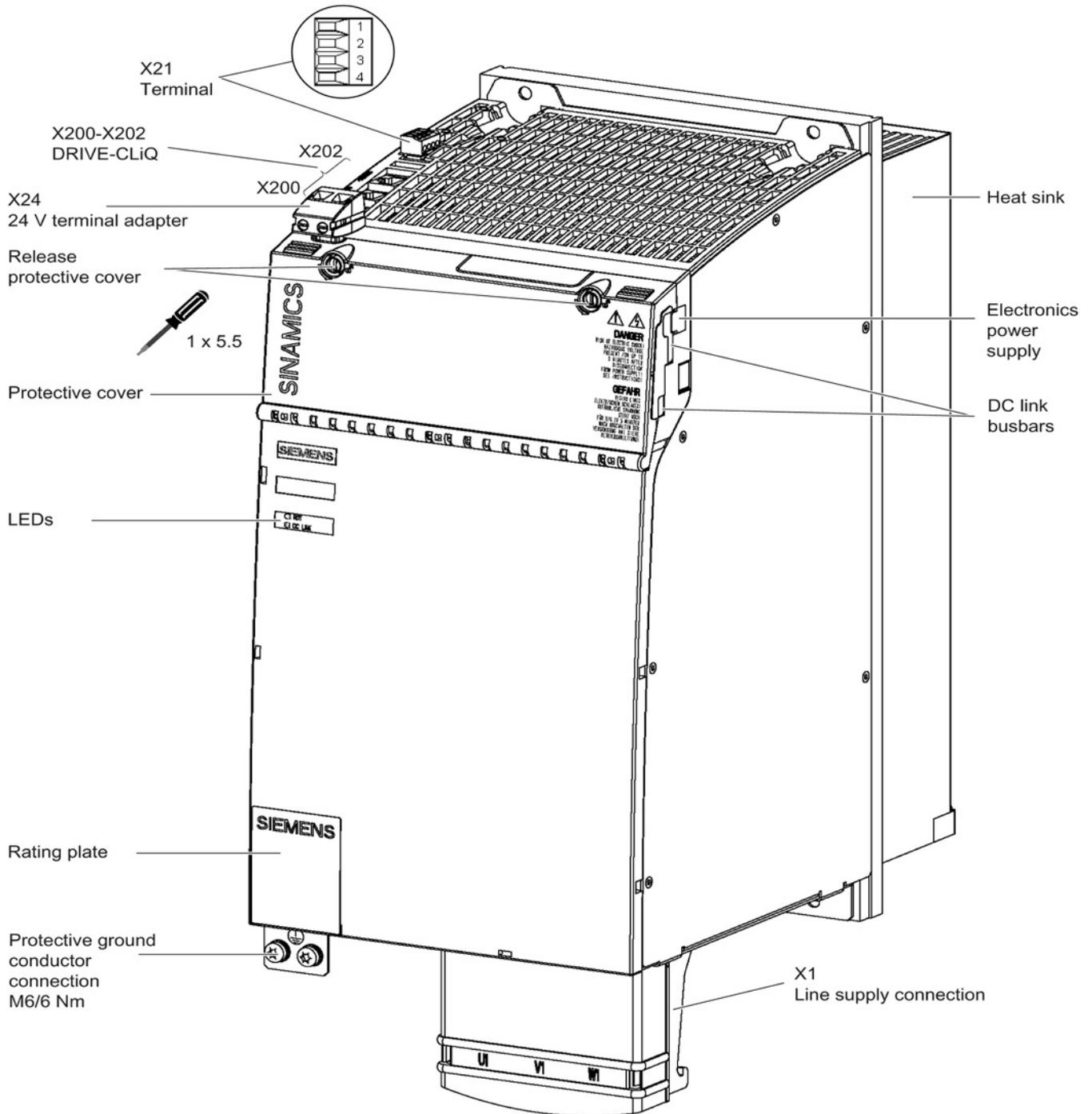
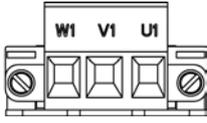
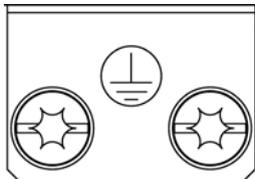


Figure 4-90 Interface overview, 36 kW and 55 kW Smart Line Modules with external air cooling (example: 55 kW)

4.9 Smart Line Modules with external air cooling

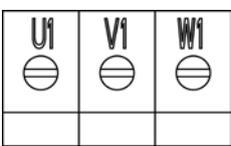
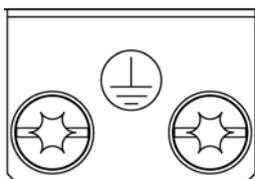
4.9.3.2 X1 line connection

Table 4- 74 X1: Line connection for Smart Line Modules 5 kW and 10 kW

| | Terminal | Technical data |
|---|---------------|--|
|  | U1 | Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm ² Tightening torque: 1.2 ... 1.5 Nm |
| | V1 | |
| | W1 | |
|  | PE connection | Threaded hole M5 / 3 Nm ¹ |

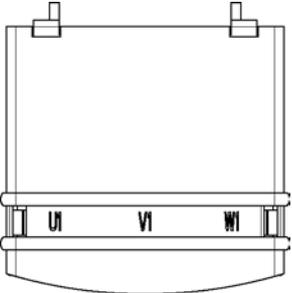
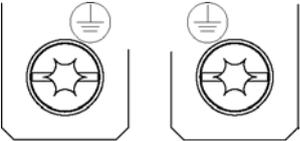
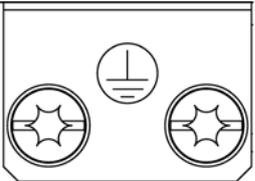
1) For ring cable lugs without insulation

Table 4- 75 X1: Line supply connection for Smart Line Modules 16 kW

| | Terminal | Technical data |
|---|---------------|---|
|  | U1 | Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Type: Screw terminal 6 (Page 755) Max. cross-section that can be connected: 10 mm ² Tightening torque: 1.5 ... 1.8 Nm |
| | V1 | |
| | W1 | |
|  | PE connection | Threaded hole M5 / 3 Nm ¹ |

1) For ring cable lugs without insulation

Table 4- 76 X1: Line connection for Smart Line Modules 36 kW and 55 kW

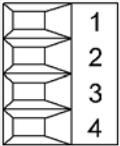
| | Terminal | Technical data |
|--|---------------|---|
|  | U1 | Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz 36 kW: Threaded bolt M6 / 6 Nm ¹⁾ 55 kW: Threaded bolts M8 / 13 Nm ¹⁾ |
| | V1 | |
| | W1 | |
|  | PE connection | 36 kW: Threaded hole M6 / 6 Nm ¹⁾ |
|  | | 55 kW: Threaded hole M6 / 6 Nm ¹⁾ |

1) For ring cable lugs without insulation

4.9.3.3 X21 EP terminals

Smart Line Modules 5 kW and 10 kW

Table 4- 77 X21 EP terminal for Smart Line Modules 5 kW and 10 kW

| | Terminal | Designation | Technical data |
|--|----------|-------------------------|---|
|  | 1 | DO: Ready | Feedback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: <ul style="list-style-type: none"> • Electronics power supply (X24) OK • DC link is precharged • Pulses enabled (X21.3/4) • No overtemperature • No overcurrent |
| | 2 | DO: Prewarning | DO: Prewarning High = no prewarning Low = prewarning <ul style="list-style-type: none"> • Overtemperature warning threshold/I^2t 5 kW prewarning: 64 °C, overtemperature threshold: 69 °C 10 kW prewarning: 68 °C, overtemperature threshold: 73 °C • No regenerative feedback capability due to a line fault [only monitored when feedback is activated (see terminal X22.2)] |
| | 3 | EP +24 V (pulse enable) | Voltage 24 V DC |
| | 4 | EP M (Enable Pulses) | Current consumption: 10 mA Isolated input |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm ² | | | |

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, 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 that it is "ready", even if one of the line conductors is not available. In this case, regenerative feedback is deactivated and an alarm is output at X21.2 (DO, Warning I²t). If regenerative feedback was deactivated by applying a "high" signal to terminal X22.2 (DI, Disable), no alarm will be output at X21.2 (DO, Warning I²t).

Terminals X21.3 and X21.4**! WARNING****Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected**

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. Regenerative feedback 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.

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

- Neutralize the voltage in the DC link.

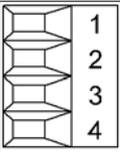
NOTICE**Damage to the drive electronics when switching the line contactor under load**

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.

16 kW to 55 kW Smart Line Modules

Table 4- 78 X21 EP terminal / temperature sensor for 16 kW to 55 kW Smart Line Modules

| | Terminal | Function | Technical data |
|---|----------|-------------------------|--|
|  | 1 | + Temp | Temperature sensors ¹⁾ : KTY 84-1C130/PTC/bimetallic switch with NC contact |
| | 2 | - Temp | |
| | 3 | EP +24 V (pulse enable) | Voltage: 24 V DC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs |
| | 4 | EP M (Enable Pulses) | |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm ² : | | | |

1) The temperature sensor type and the temperature output can be selected by parameter (see the SINAMICS S120/S150 List Manual).
 Temperatures are sensed, but are not evaluated in the Smart Line Module.

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



! WARNING

Danger to life due to electric shock in the event of voltage flashovers on the temperature sensor cable

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Only use temperature sensors that fully comply with the specifications of the safety isolation.
- 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.

NOTICE

Risk of the motor overheating due to an incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY sensor with the correct polarity.

Terminals X21.3 and X21.4


 **WARNING**
Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected

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. Regenerative feedback 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.

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

- Neutralize the voltage in the DC link.

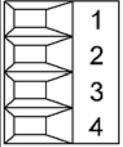
NOTICE**Damage to the drive electronics when switching the line contactor under load**

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.

4.9.3.4 X22 digital inputs

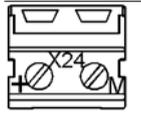
Table 4- 79 X22 digital inputs for Smart Line Modules 5 kW and 10 kW

| | Terminal | Designation ¹⁾ | Technical data |
|--|----------|---------------------------|---|
|  | 1 | 24 V power supply | Electronics power supply for controlling digital inputs X22.2 and 3 |
| | 2 | DI: Disable Regeneration | Deactivate regenerative feedback (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: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm ² | | | |

¹⁾ DI: Digital input

4.9.3.5 X24 24 V terminal adapter

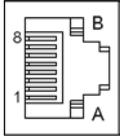
Table 4- 80 X24: 24 V terminal adapter

| | Terminal | Designation | Technical data |
|--|----------|-------------------|------------------------|
|  | + | 24 V power supply | 24 V DC supply voltage |
| | M | Ground | Electronics ground |
| Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm ² | | | |

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

4.9.3.6 X200-X202 DRIVE-CLiQ interfaces

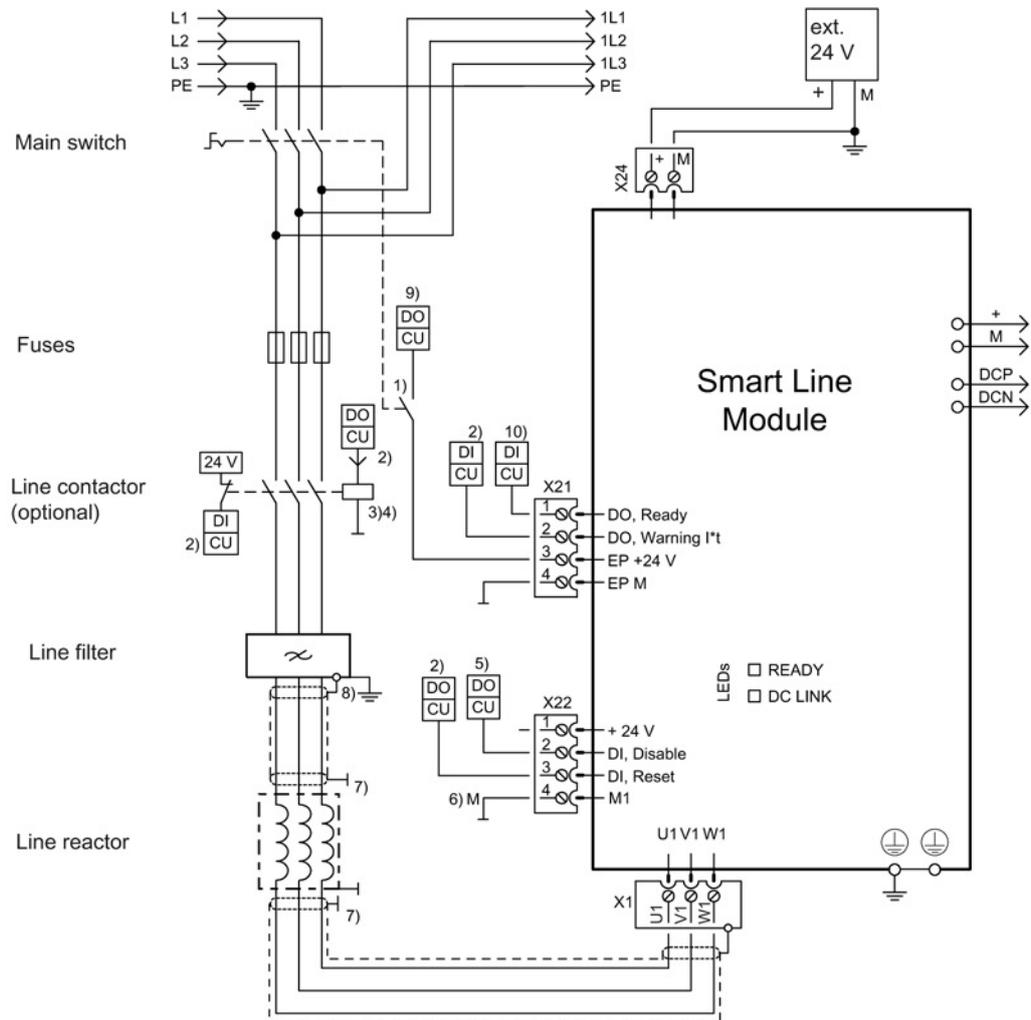
Table 4- 81 X200-X202: DRIVE-CLiQ interfaces

| | 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.) Order number: 6SL3066-4CA00-0AA0

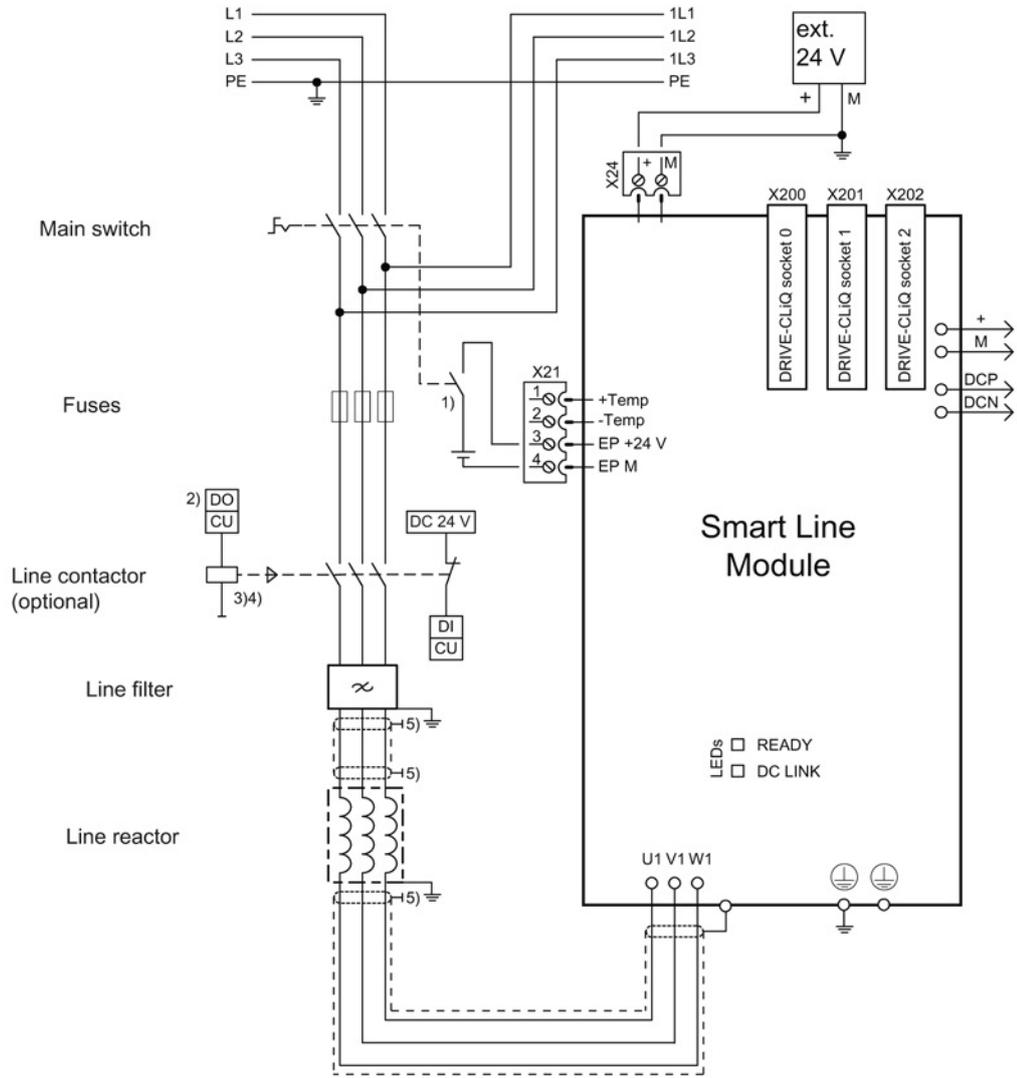
4.9.4 Connection examples



- 1) Leading NC contact $t > 10$ ms, 24 VDC and ground must be set up for operation.
- 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 must be used if required.
- 5) DO high, regenerative feedback deactivated (a jumper can be inserted between X22 pin 1 and pin 2 for permanent deactivation).
- 6) X22 pin 4 must be connected to ground (ext. 24 V).
- 7) Contact established via rear mounting panel or shielding buses in accordance with the EMC installation guideline
- 8) 5 kW and 10 kW line filters via shield connection
- 9) Signal output of the control, to avoid interference of the 24 VDC supply on the EP terminal.
- 10) Interconnection via BICO to parameter p0864

Figure 4-91 Connection example for 5 kW and 10 kW Smart Line Modules

4.9 Smart Line Modules with external air cooling



- 1) Leading NC 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 must be used if required.
- 5) Contact established via rear mounting panel or shielding buses in accordance with the EMC installation guideline

Figure 4-92 Connection example for 16 kW to 55 kW Smart Line Modules

Note

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

4.9.5 Meaning of LEDs

4.9.5.1 Smart Line Modules 5 kW and 10 kW

Table 4- 82 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. | – |
| | Yellow | 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 | – | Off | The electronics power supply is missing or outside the permissible tolerance range. | – |
| | Yellow | 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. |



WARNING

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

4.9.5.2 16 kW to 55 kW Smart Line Modules

Table 4- 83 Meaning of the LEDs on Smart Line Modules \geq 16 kW

| Status | | Description, cause | Remedy |
|----------------------------------|---------|--|------------------------------------|
| RDY | DC LINK | | |
| Off | Off | The electronics power supply is missing or outside the permissible tolerance range. | – |
| Green | -- | 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 | -- | This component has at least one fault. Note: The LED is activated regardless of whether the corresponding messages have been reconfigured. | Resolve and acknowledge the fault. |
| Green/red (0.5 Hz) | -- | Firmware is being downloaded. | – |
| Green/red (2 Hz) | -- | Firmware download has been completed. The system waits for POWER ON. | Carry out a POWER ON. |
| Green/orange or red/orange | -- | Component recognition via LED is activated ¹⁾ . Note: Both options depend on the LED status when component recognition is activated. | – |

1) See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



! WARNING

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

4.9.6 Dimension drawings

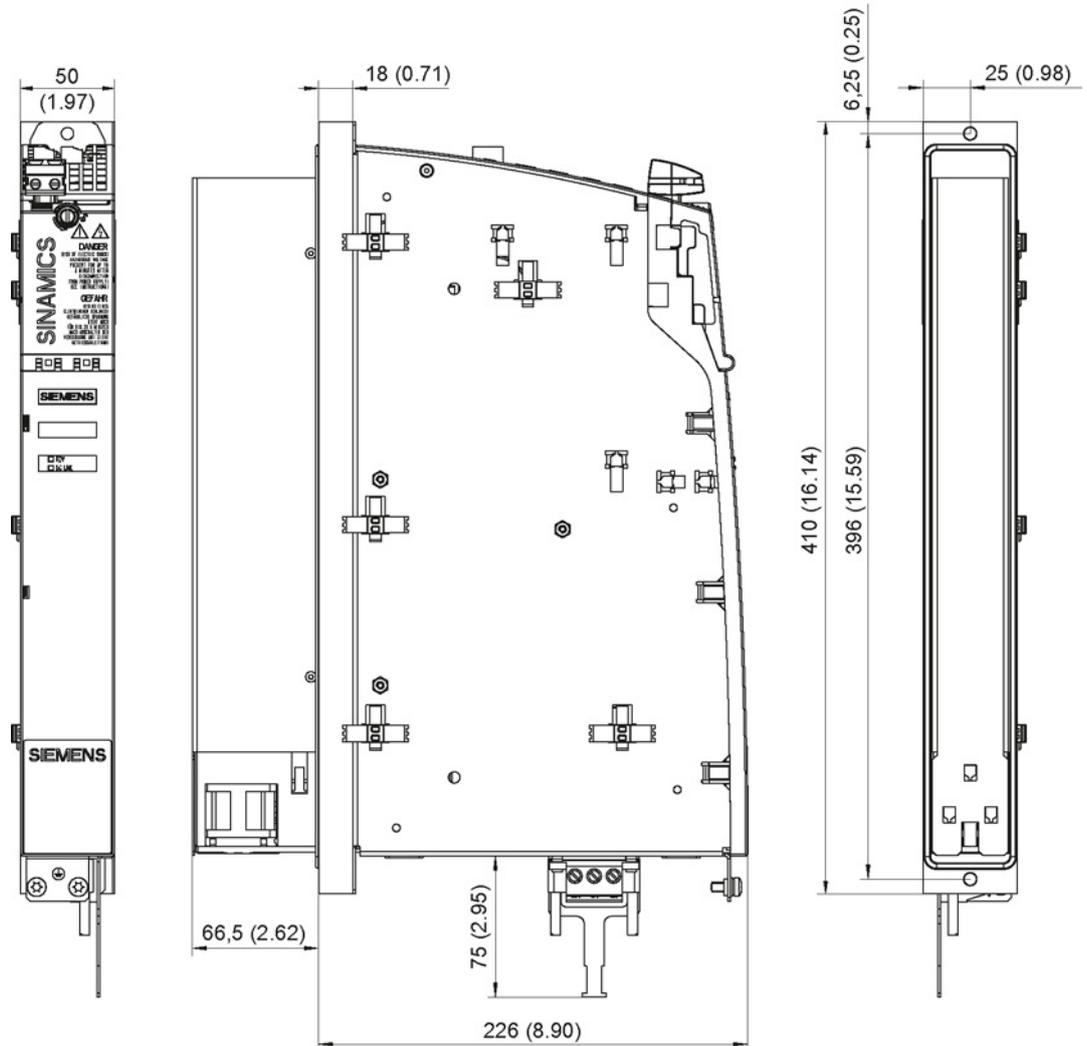


Figure 4-93 Dimension drawing of 5 kW and 10 kW Smart Line Modules with external air cooling, all dimensions in mm and (inches)

Note

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

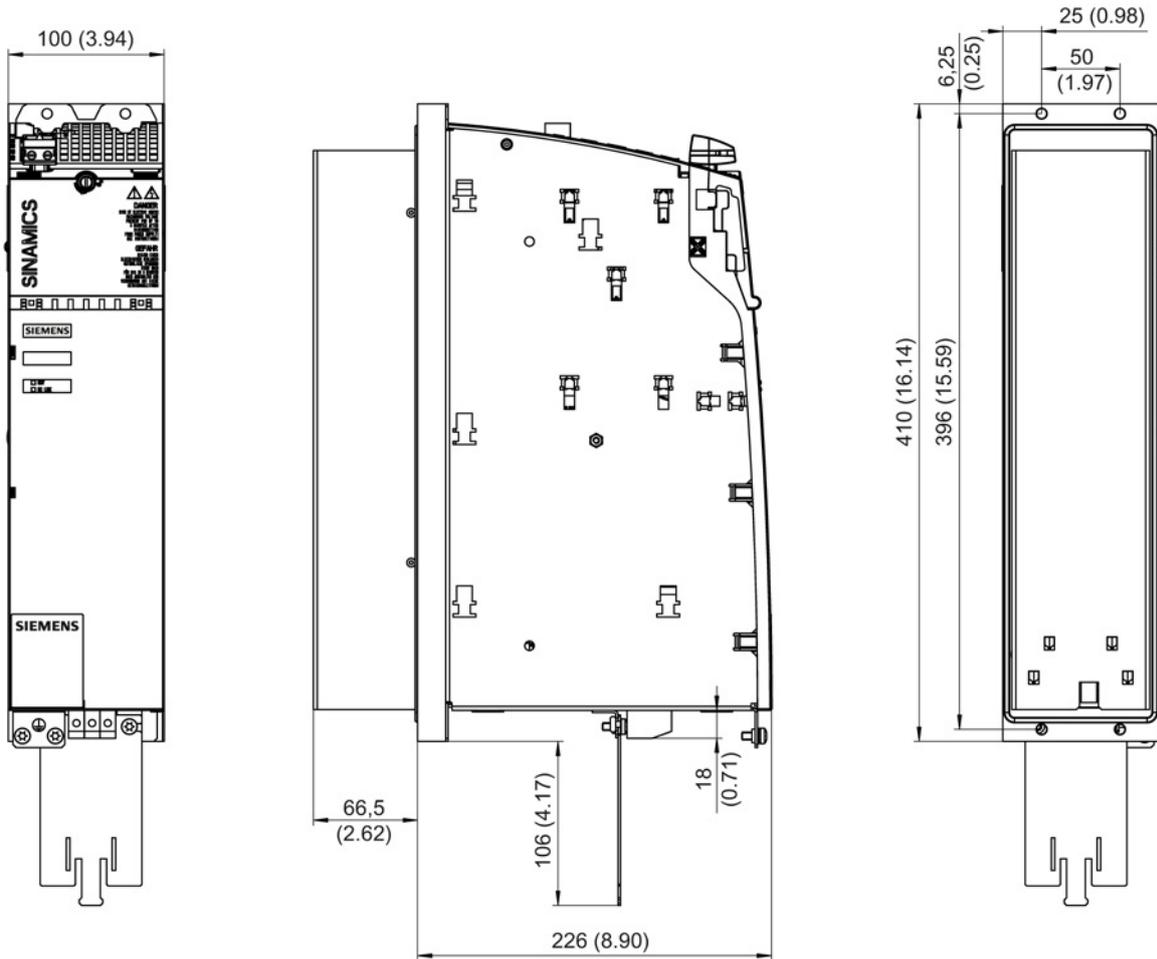


Figure 4-94 Dimension drawing of 16 kW Smart Line Module with external air cooling, all dimensions in mm and (inches)

Note

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

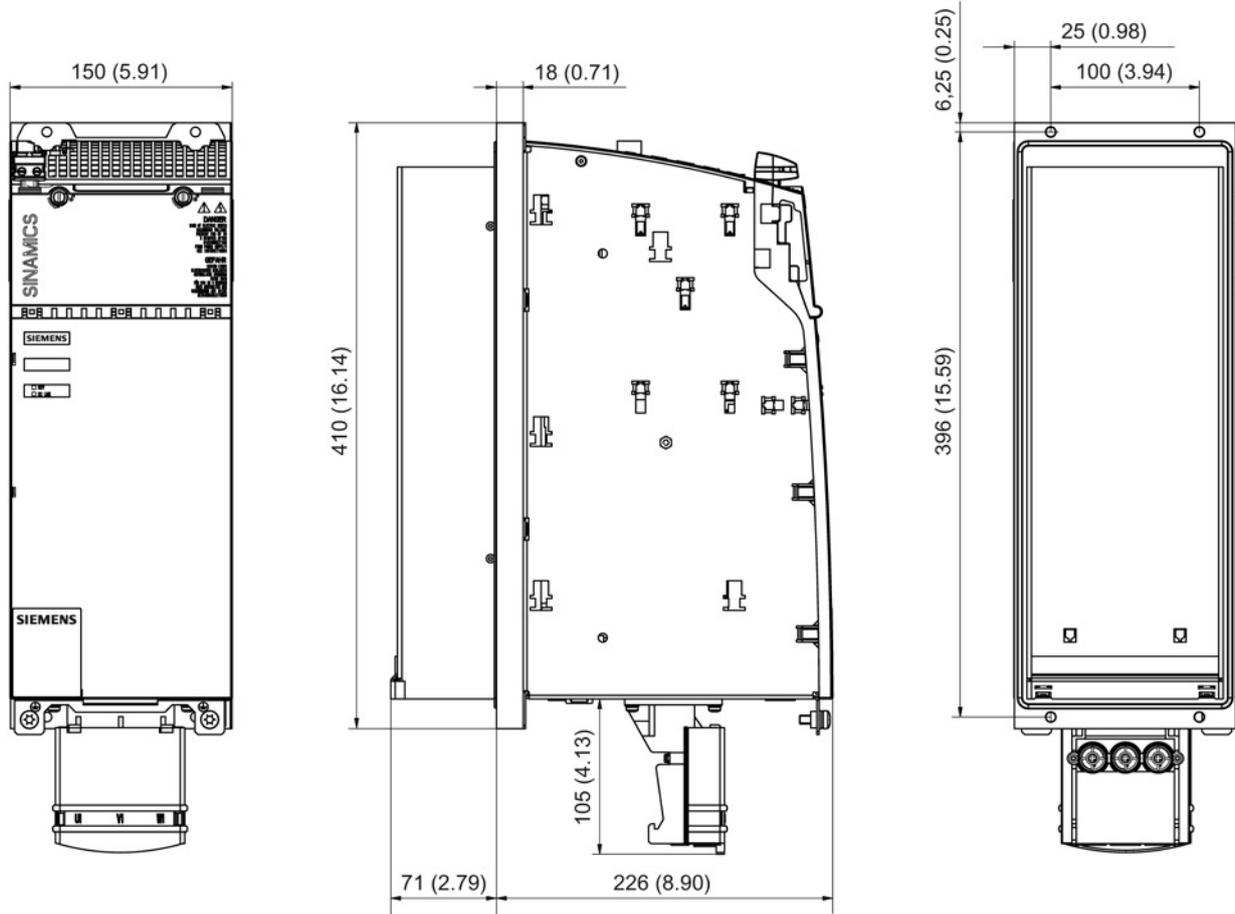


Figure 4-95 Dimension drawing of 36 kW Smart Line Module with external air cooling, all dimensions in mm and (inches)

4.9 Smart Line Modules with external air cooling

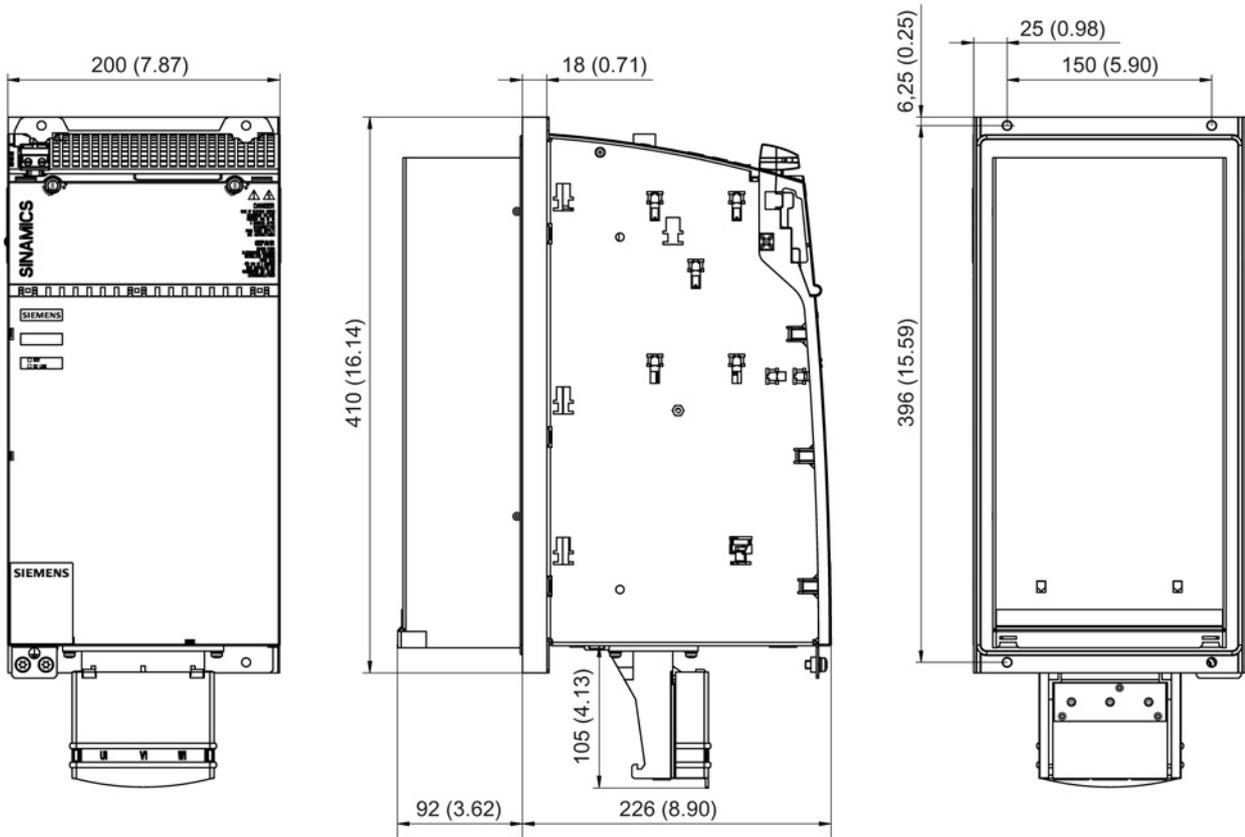
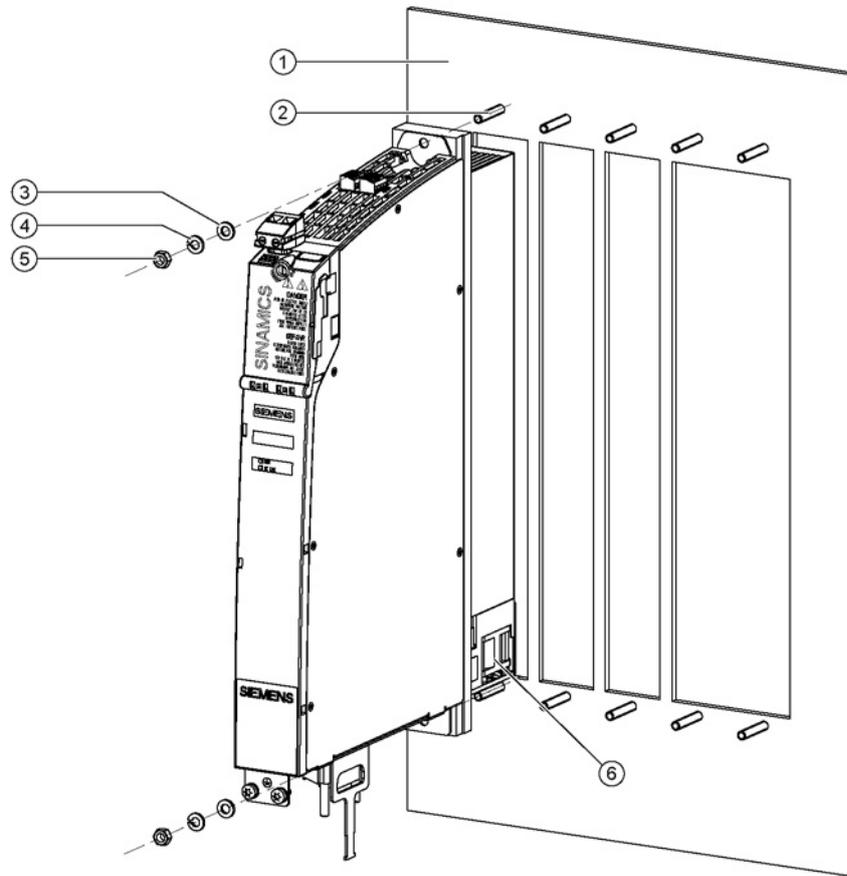


Figure 4-96 Dimension drawing of 55 kW Smart Line Module with external air cooling, all dimensions in mm and (inches)

4.9.7 Mounting



- ① Mounting plate with openings
- ② M6 studs
- ③ Washer
- ④ Spring washer
- ⑤ M6 nut, width A/F 10 (hexagon head)
- ⑥ Fan assembly

Figure 4-97 Mounting a Smart Line Module with external air cooling on a mounting plate, using a 5 kW Smart Line Module as an example

Tightening torques:

- Firstly, tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts.
Tightening torque: 6 Nm

4.9 Smart Line Modules with external air cooling

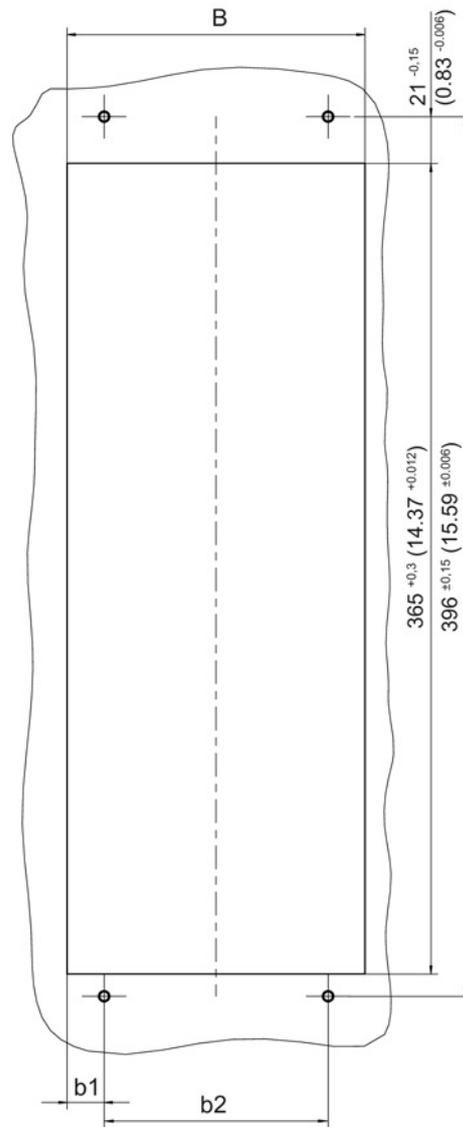


Figure 4-98 Opening to mount Smart Line Modules 50 mm to 200 mm with external air cooling, all data in mm and (inches)

Table 4- 84 Dimensions of openings to mount Smart Line Modules with external air cooling

| Module width | W in mm (inches) | w1 in mm (inches) | w2 in mm (inches) |
|--------------|--|--|--|
| 50 mm | 41.5 ^{+0.3} (1.63 ^{+0.012}) | 20.75 ^{+0.15} (0.82 ^{+0.006}) | -- |
| 100 mm | 89.5 ^{+0.3} (3.52 ^{+0.012}) | 19.75 ^{+0.15} (0.78 ^{+0.006}) | 50 ^{±0.15} (1.97 ^{±0.006}) |
| 150 mm | 133 ^{+0.3} (5.24 ^{+0.012}) | 16.5 ^{+0.15} (0.65 ^{+0.006}) | 100 ^{±0.15} (3.94 ^{±0.006}) |
| 200 mm | 173 ^{+0.3} (6.81 ^{+0.012}) | 11.5 ^{+0.15} (0.45 ^{+0.006}) | 150 ^{±0.15} (5.91 ^{±0.006}) |

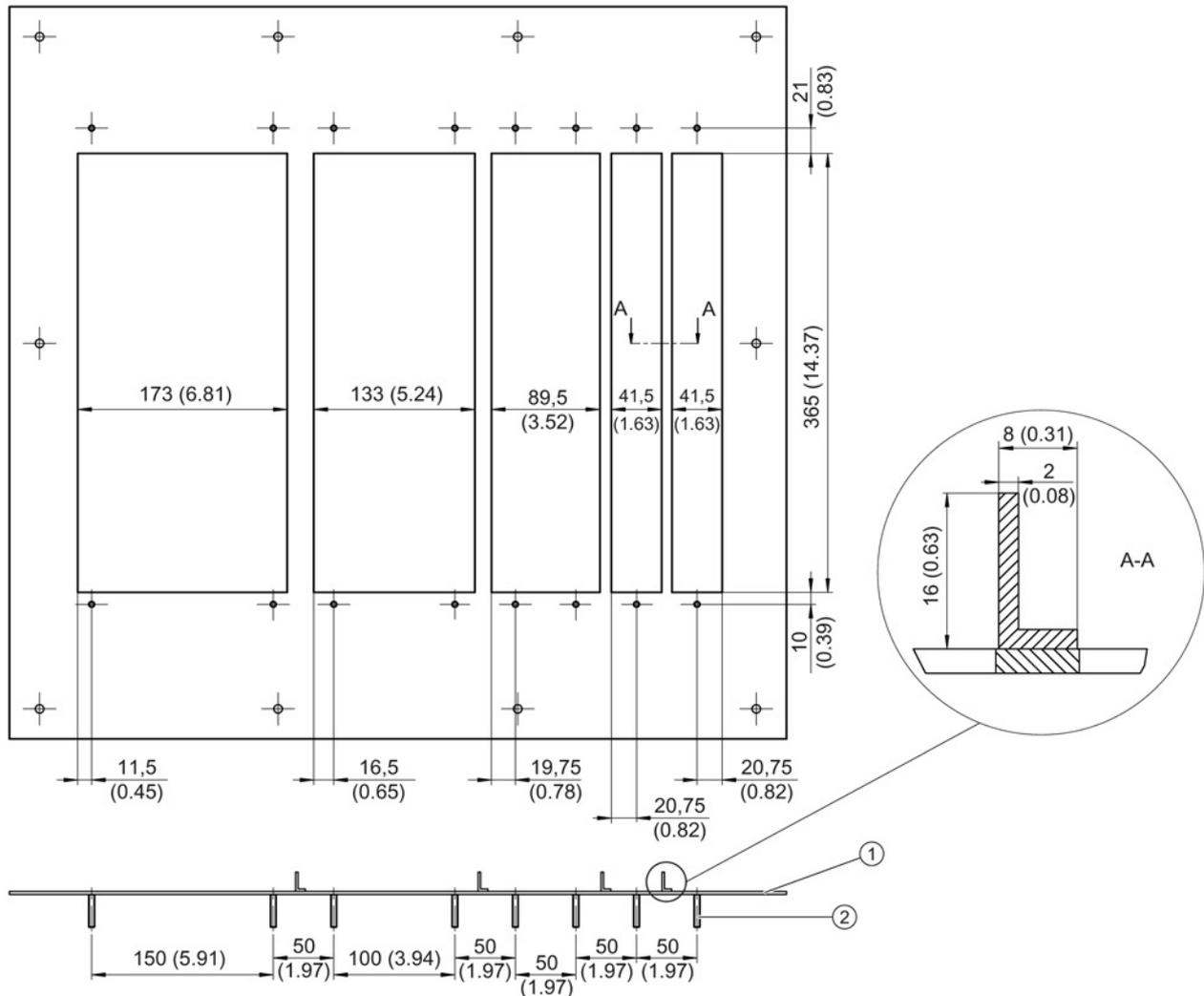
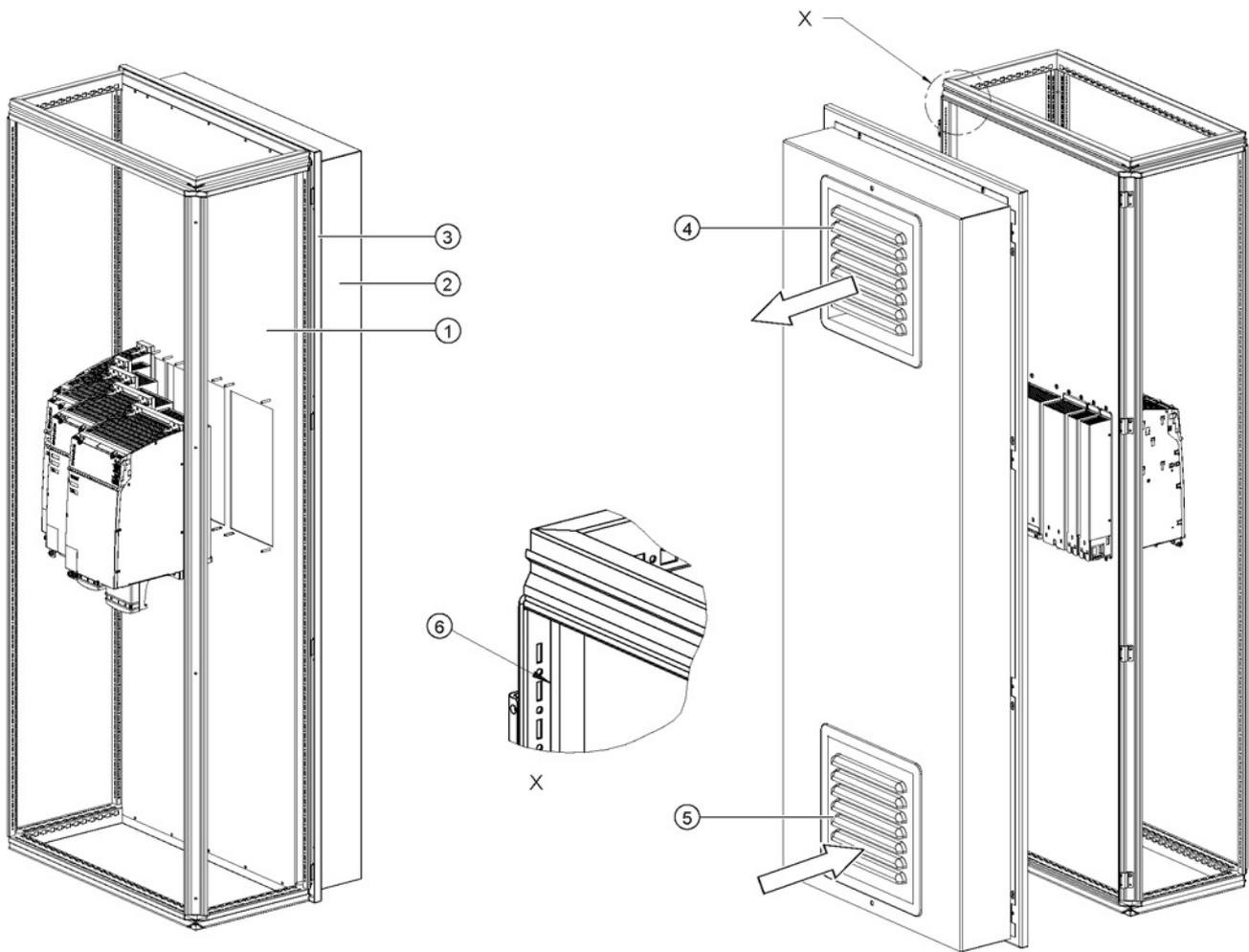


Figure 4-99 Example of a mounting plate for a drive line-up with external air cooling

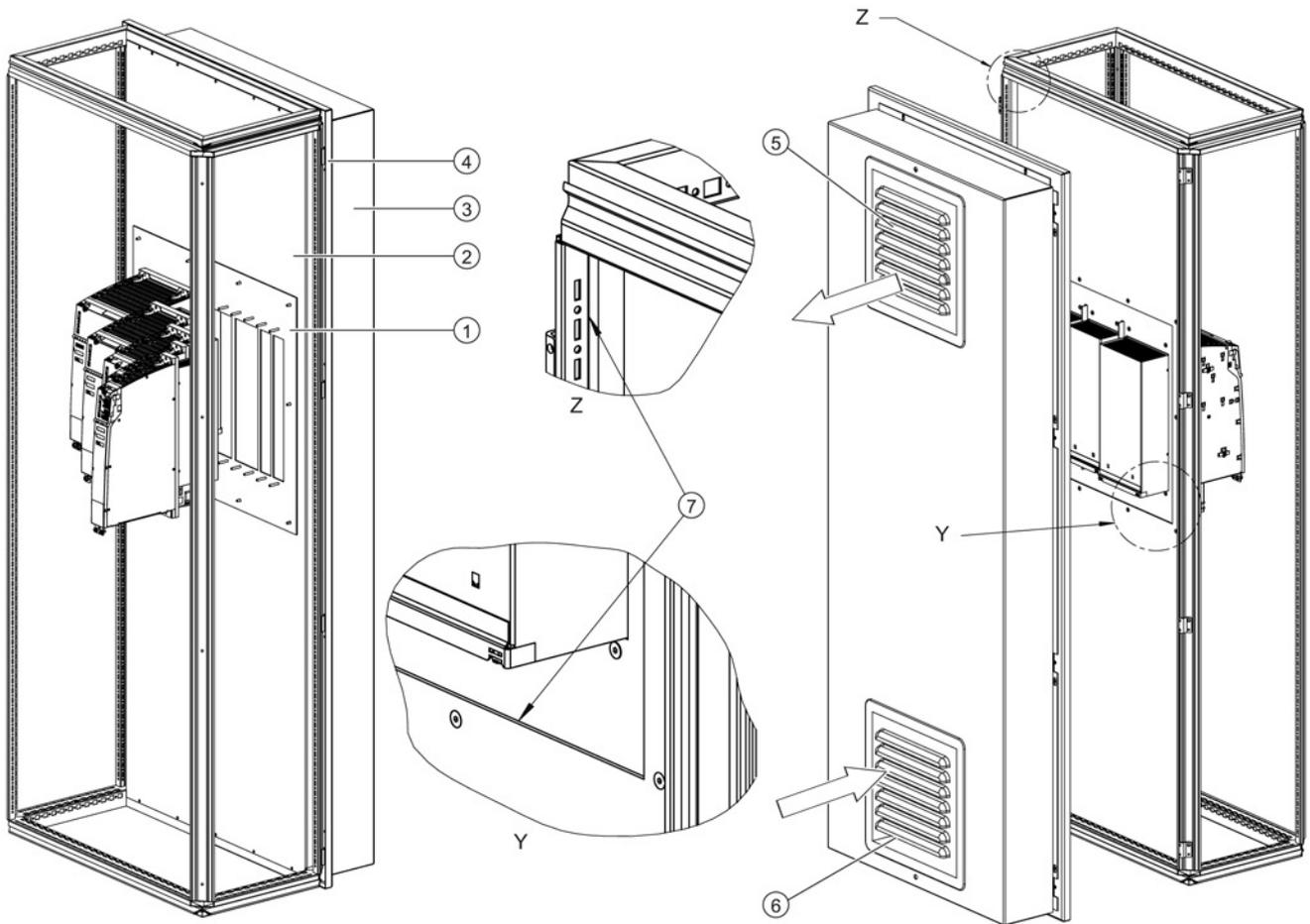
When mounting it must be ensured that the component's seal is tight throughout. The cross-pieces must have the appropriate stability. If necessary, the cross-pieces of the openings must be reinforced.

In the example, the cross-pieces have been reinforced using brackets according to EN 755-9. You are free to select the way that the bracket is attached to the insert.



- ① Mounting plate
- ② Cover
- ③ Rear panel
- ④ Air discharge
- ⑤ Air inlet - filter with filter fan
- ⑥ To comply with degree of protection IP54, the surfaces ⑥ between the mounting plate and the cabinet strip must be sealed all round. (for example, sealant Terostat-91 from the Teroson company)

Figure 4-100 Example 1: mounting in the cabinet with mounting plate



- ① Insert plate
- ② Mounting plate
- ③ Cover
- ④ Rear panel
- ⑤ Air discharge
- ⑥ Air inlet - filter with filter fan
- ⑦ To maintain the degree of protection IP54, the surfaces ⑦ between the mounting plate and the cabinet strip as well as between the mounting plate and insert plate must be sealed all around. (for example, sealant Terostat-91 from the Teroson company)

Figure 4-101 Example 2: mounting in the cabinet with mounting plate

It is recommended that you attach a cover and filter fan to the cabinet.

The filtered fan must be fitted in such a way that the cooling air required by the drive line-up is not restricted. The overall cooling air requirement is obtained from the sum of the individual components (see Section "Technical data").

Note

If the cooling air requirement is not covered by the filtered fan, the components cannot output their specified power.

The filters with filter fan must be regularly checked for dirt and cleaned if necessary.

Help with the mechanical control cabinet design is available from:

Siemens AG
 Industry Sector, IA DT MC MF - WKC AS
 TCCCC (Technical Competence Center Cabinets Chemnitz)
 Postfach 1124
 09070 Chemnitz, Germany
 E-mail: cc.cabinetcooling.aud@siemens.com

4.9.8 Technical data

Table 4- 85 Technical data Smart Line Modules Booksize external air cooling

| Internal air cooling | 6SL3131- | 6AE15-0AAx | 6AE21-0AAx | 6TE21-6AAx | 6TE23-6AAx | 6TE25-5AAx |
|-----------------------------------|------------------------|---|------------|------------|------------|------------|
| Rated power | kW | 5 | 10 | 16 | 36 | 55 |
| Infeed | | | | | | |
| Rated power (S1) ¹⁾ | kW (P _n) | 5 | 10 | 16 | 36 | 55 |
| S6 operation (40 %) ¹⁾ | kW (P _{s6}) | 6,5 | 13 | 21 | 47 | 71 |
| Peak infeed power ¹⁾ | kW (P _{max}) | 10 | 20 | 35 | 70 | 91 |
| Regenerative feedback | | | | | | |
| Continuous regenerative power | kW | 5 | 10 | 16 | 36 | 55 |
| Peak regenerative power | kW | 10 | 20 | 35 | 70 | 91 |
| Supply voltages | | | | | | |
| Line voltage | V _{AC} | 3 AC 380 ... 480 ± 10 % (-15 % < 1 min) | | | | |
| Line frequency | Hz | 47 ... 63 | | | | |
| Electronics 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 (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 |

| Internal air cooling | 6SL3131- | 6AE15-0AAx | 6AE21-0AAx | 6TE21-6AAx | 6TE23-6AAx | 6TE25-5AAx |
|--|-------------------|--|------------------|------------|------------|------------|
| Rated power | kW | 5 | 10 | 16 | 36 | 55 |
| DC link currents | | | | | | |
| DC link output current at DC 600 V | A _{DC} | 8,3 | 16,6 | 27 | 60 | 92 |
| at DC 540 V S6 (40 %) | A _{DC} | 9,3 | 18,5 | 30 | 67 | 105 |
| at DC 600 V | A _{DC} | 11 | 22 | 35 | 79 | 138 |
| Peak current at DC 600 V | A _{DC} | 16,6 | 33,2 | 59 | 118 | 178 |
| Current carrying capacity | | | | | | |
| DC link busbars | A _{DC} | 100 | 100 | 100 | 200 | 200 |
| Reinforced DC link busbars | A _{DC} | 150 | 150 | 150 | -- | -- |
| 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 (incl. electronics losses) | W | 79,2 | 141,6 | 187,8 | 406 | 665,6 |
| internal | W | 41,2 | 66,6 | 64,8 | 116 | 185,6 |
| external | W | 38 | 75 | 123 | 290 | 480 |
| (see power loss tables (Page 781)) | | | | | | |
| Max. ambient temperature without derating | ° C | 40 | | | | |
| with derating | ° C | 55 | | | | |
| 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 | 0.98 | 0.98 | 0.98 | 0.98 |
| Circuit breaker (IEC 60947 and UL) | | See Section Overcurrent protection using line fuses and circuit breakers (Page 51) | | | | |
| Rated short-circuit current SCCR³⁾ | kA | 65 | 65 | 65 | 65 | 65 |
| Sound pressure level | dB(A) | < 60 | < 60 | < 60 | < 65 | < 60 |
| Cooling air requirement | m ³ /h | 29.6 | 29.6 | 56 | 112 | 160 |
| Max. permissible heat sink temperature | ° C | 69 ⁴⁾ | 73 ⁴⁾ | 77 | 80 | 75 |
| Rated voltage for rated data 3 AC 380 V | | | | | | |
| Weight | kg | 5.3 | 5.4 | 8.8 | 13.8 | 18.5 |

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) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker – and the Line Module in the drive system.

4) Values cannot be read out by the system (STARTER).

4.9.8.1 Characteristics

Rated duty cycles of Smart Line Modules

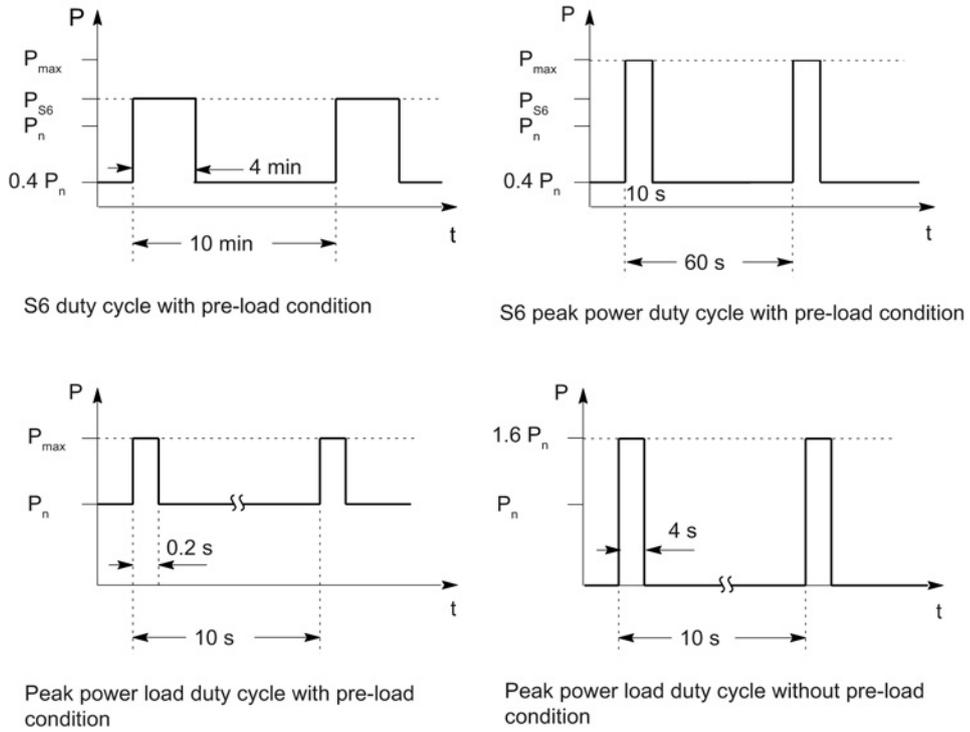


Figure 4-102 Rated duty cycles of Smart Line Modules

Derating characteristics

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

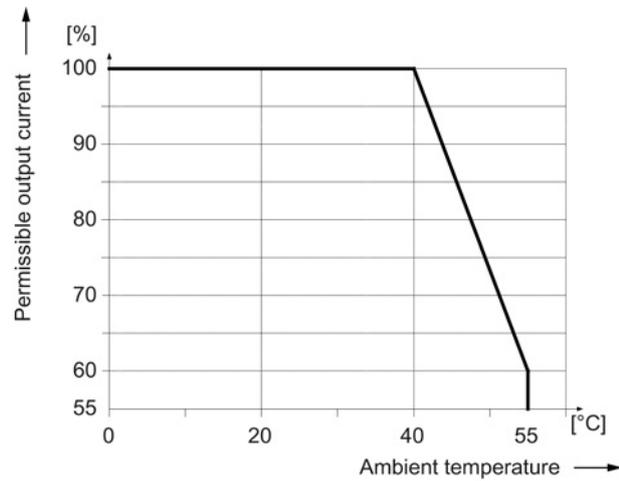


Figure 4-103 Output current as a function of the ambient temperature

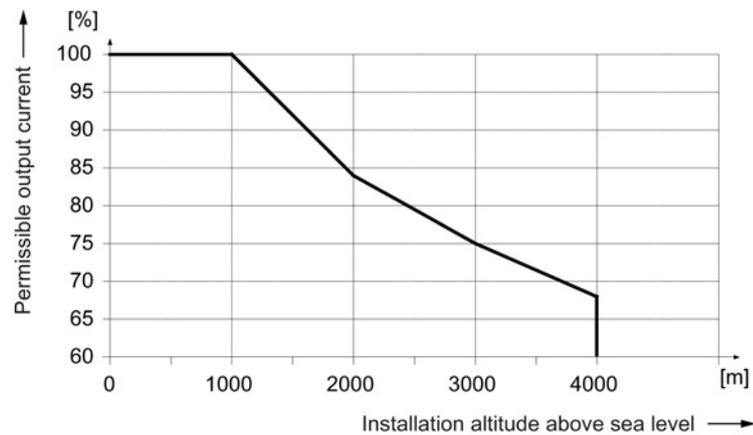


Figure 4-104 Output current as a function of the installation altitude

4.10 Smart Line Modules with cold plate

4.10.1 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 feedback mode, the current waveform is square waved. Feedback can be deactivated by means of a terminal because these Smart Line Modules are not 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. An optional main contactor is required for disconnecting the voltage.

Smart Line Modules are suitable for direct operation on TN, IT and TT systems. The Line Modules have an integrated overvoltage protection function.

4.10.2 Safety instructions for Smart Line Modules Booksize

| |
|---|
|  WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed |
| If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. |
| <ul style="list-style-type: none">• Adhere to the fundamental safety instructions.• When assessing the risk, take into account residual risks. |

NOTICE**Destruction of the Smart Line Module for an incorrect switch-on or switch-off sequence**

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair.

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

Switch on:

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

Switch off:

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

Overload:

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

Note**Connected to the public low-voltage network**

Smart Line Modules have been designed for use in the industrial environment and generate current harmonics on the line side as a result of the rectifier circuit.

When connecting a machine with integrated Smart Line Modules to the public low-voltage line supply (grid), authorization is required in advance from the local power supply company (utility company) in the following cases:

- The rated current of the motor ≤ 16 A per conductor.
- The rated motor current does not comply with the requirements specified in EN 61000-3-2 regarding current harmonics.

4.10.3 Interface description

4.10.3.1 Overview

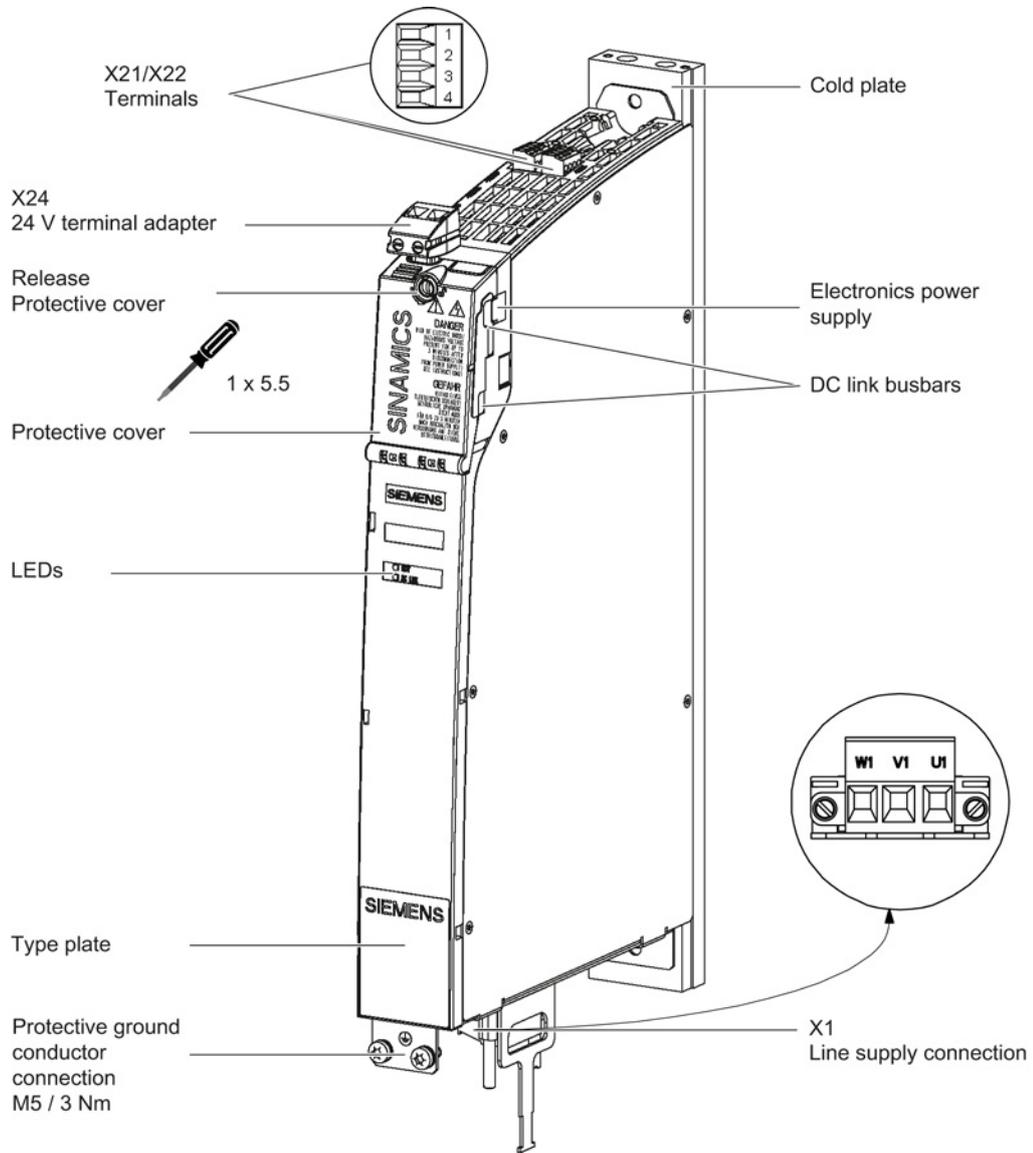
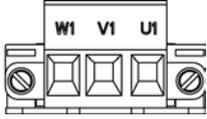
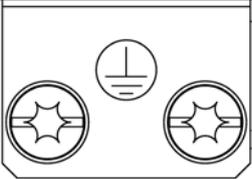


Figure 4-105 Interface overview, Smart Line Module with cold plate (example: 5 kW)

4.10.3.2 X1 line connection

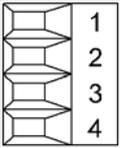
Table 4- 86 X1 line connection

| | Terminal | Technical data |
|---|---------------|---|
|  | U1 | Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Max. connectable cross-section: 6 mm ² Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm ² Tightening torque: 1.2 ... 1.5 Nm |
| | V1 | |
| | W1 | |
|  | PE connection | Threaded hole M5 / 3 Nm ¹ |

1) For ring cable lugs without insulation

4.10.3.3 X21 EP terminals

Table 4- 87 X21 EP terminals

| | Terminal | Designation | Technical data |
|--|----------|-------------------------|---|
|  | 1 | DO: Ready | Feedback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: <ul style="list-style-type: none"> • Electronics power supply (X24) OK • DC link is precharged • Pulses enabled (X21.3/.4) • No overtemperature • No overcurrent switch-off |
| | 2 | DO: Prewarning | DO: Prewarning High = no prewarning Low = prewarning <ul style="list-style-type: none"> • Overtemperature warning threshold / I*t 5 kW prewarning: 64° C, disconnection: 69° C 10 kW prewarning: 68° C, disconnection: 73° C • No regenerative feedback capability due to a line fault [only monitored when feedback is activated (see terminal X22.2)] |
| | 3 | EP +24 V (pulse enable) | Voltage 24 V DC |
| | 4 | EP M (Enable Pulses) | Current consumption: 10 mA Isolated input |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm ² | | | |

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, 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 that it is ready, even if one of the line conductors is not available. In this case, regenerative feedback is deactivated and an alarm is output at X21.2 (DO, Warning I²t). If regenerative feedback was deactivated by applying a "high" signal to terminal X22.2 (DI, Disable), no alarm will be output at X21.2 (DO, Warning I²t).

Terminals X21.3 and X21.4**! WARNING****Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected**

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. Regenerative feedback 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.

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

- Neutralize the voltage in the DC link.

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

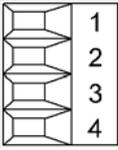
When switching the line contactor (type according to the recommended selection) under load, then the contacts will be subject to premature wear. This can cause the contactor to malfunction, with subsequent damage to the drive electronics.

- 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.

4.10 Smart Line Modules with cold plate

4.10.3.4 X22 digital inputs

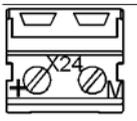
Table 4- 88 X22 digital inputs for Smart Line Modules 5 kW and 10 kW

| | Terminal | Designation ¹⁾ | Technical data |
|--|----------|---------------------------|---|
|  | 1 | 24 V power supply | Electronics power supply for controlling digital inputs X22.2 and 3 |
| | 2 | DI: Disable Regeneration | Deactivate regenerative feedback (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: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm ² | | | |

1) DI: Digital input

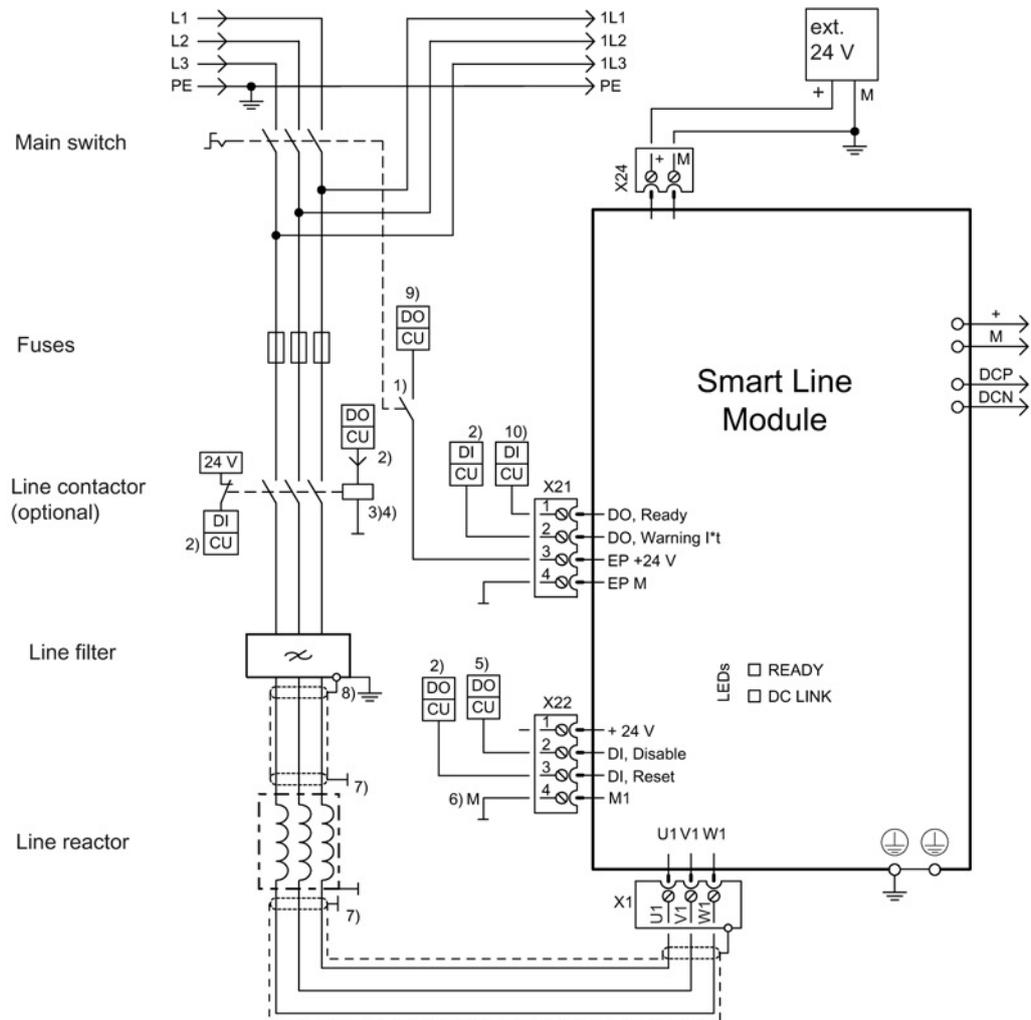
4.10.3.5 X24 24 V terminal adapter

Table 4- 89 X24: 24 V terminal adapter

| | Terminal | Designation | Technical data |
|--|----------|-------------------|------------------------|
|  | + | 24 V power supply | 24 V DC supply voltage |
| | M | Ground | Electronics ground |
| Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm ² | | | |

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

4.10.4 Connection example



- 1) Leading NC contact $t > 10$ ms, 24 VDC and ground must be set up for operation.
- 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 must be used if required.
- 5) DO high, regenerative feedback deactivated (a jumper can be inserted between X22 pin 1 and pin 2 for permanent deactivation).
- 6) X22 pin 4 must be connected to ground (ext. 24 V).
- 7) Contact established via rear mounting panel or shielding buses in accordance with the EMC installation guideline
- 8) 5 kW and 10 kW line filters via shield connection
- 9) Signal output of the control, to avoid interference of the 24 VDC supply on the EP terminal.
- 10) Interconnection via BICO to parameter p0864

Figure 4-106 Connection example for 5 kW and 10 kW Smart Line Modules

Note

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

4.10.5 Meaning of LEDs

Table 4- 90 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. | – |
| | Yellow | 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 | – | Off | The electronics power supply is missing or outside the permissible tolerance range. | – |
| | Yellow | 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. |



| |
|---|
| <p>! WARNING</p> <p>Danger of death when live parts of the DC link are touched</p> <p>Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.</p> <ul style="list-style-type: none"> Observe the warning information on the component. |
|---|

4.10.6 Dimension drawings

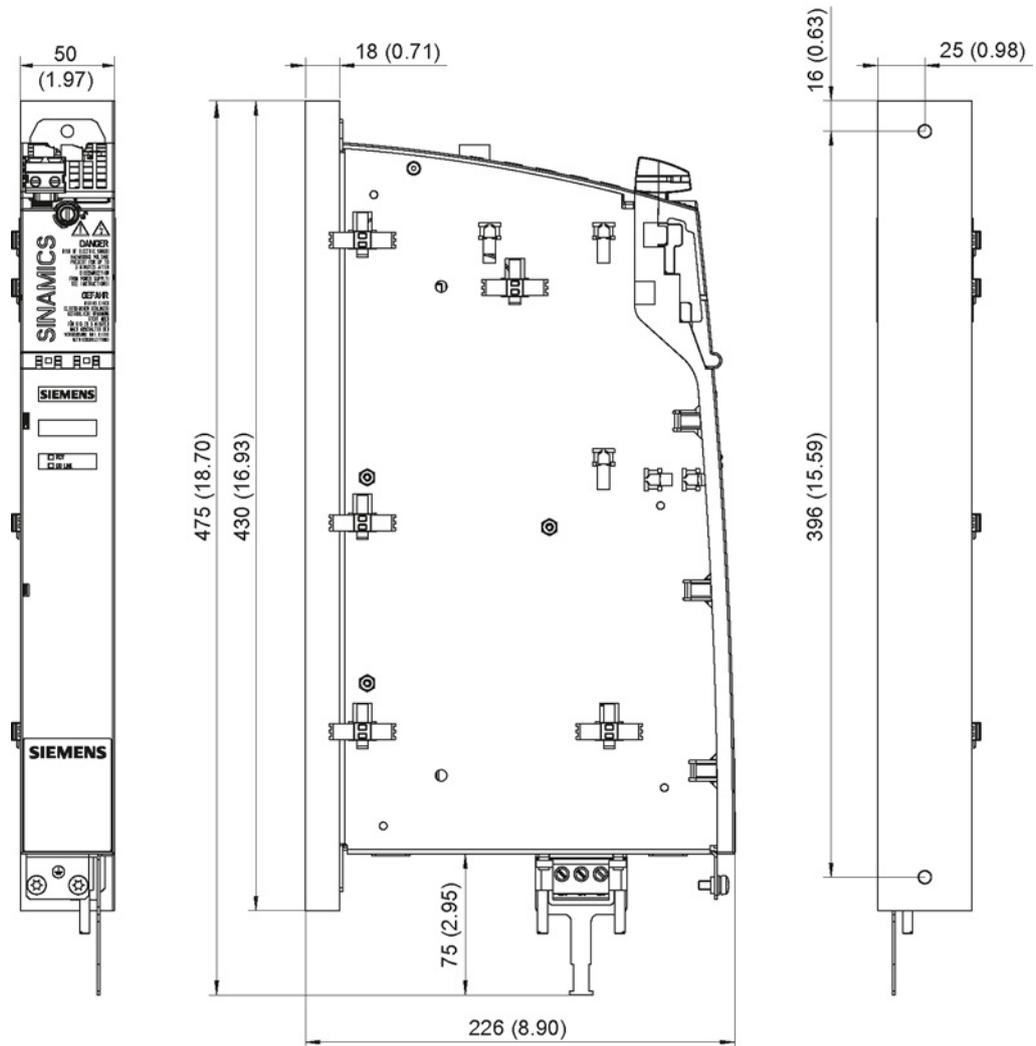


Figure 4-107 Dimension drawing of Smart Line Module with cold plate (5 kW and 10 kW), all dimensions in mm and (inches)

Note

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

4.10.7 Mounting

Please note the following before mounting a Smart Line Module with cold plate on a customer-specific heat sink:

- Before mounting, check the surface of the heat sink to ensure that it is not damaged.
- To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every cold plate power unit is supplied with heat-conducting foil cut to the right size. Note the mounting position of the heat-conducting foil (see figures below).

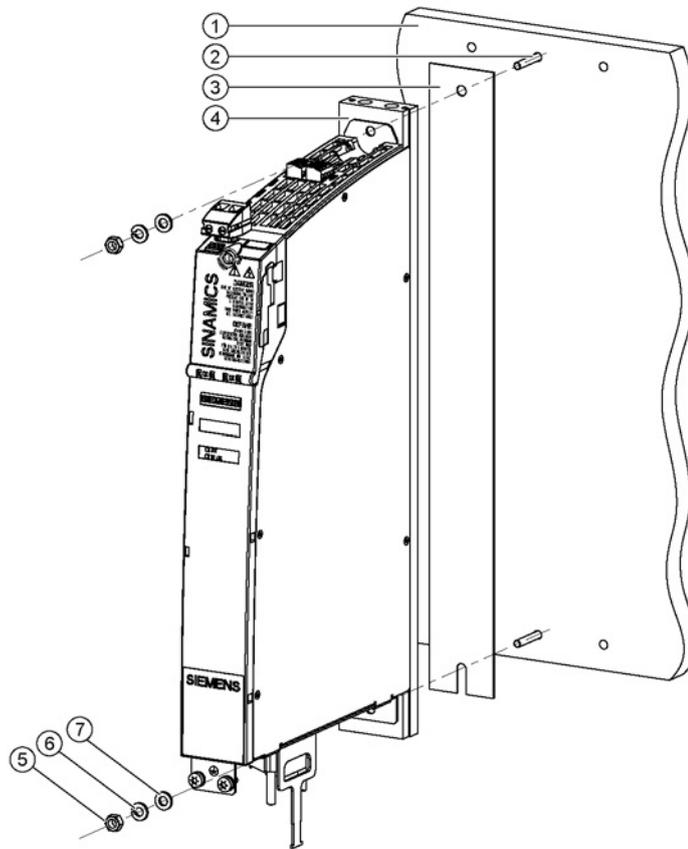
Note

- Also replace the heat-conducting foil when replacing a component.
 - Only use heat-conducting foil released or supplied by Siemens.
-

| | Order number |
|-----------------------------|--------------------|
| Heat-conducting foil, 50 mm | 6SL3162-6FB00-0AA0 |

Note

M6 studs and hexagon nuts or grub screws (ISO 7436-M6x40-14 H, property class 8.8) are recommended for mounting the components.



- ① External heat sink (air or liquid)
- ② M6 studs
- ③ Heat-conducting foil
- ④ Cold plate
- ⑤ M6 nut
- ⑥ Spring washer
- ⑦ Washer

Figure 4-108 Mounting a Smart Line Module with cold plate on an external heat sink, using a 5 kW Smart Line Module as an example

Tightening torques:

- Firstly, only tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts.
Tightening torque: 10 Nm

4.10 Smart Line Modules with cold plate

Help with the mechanical control cabinet design is available from:

Siemens AG
 Industry Sector, IA DT MC MF - WKC AS
 TCCCC (Technical Competence Center Cabinets Chemnitz)
 Postfach 1124
 09070 Chemnitz, Germany
 E-mail: cc.cabinetcooling.aud@siemens.com

Properties of the heat sink

We recommend using AlMgSi 0.5 as the heat sink material.
 The roughness of the external heat sink surface should be at least Rz 16 and the contact surface between the heat sink and cold plate should have an evenness of 0.2 mm.

Note

Machine manufacturers can adapt the heat sink version to their special requirements. The specified rated data for the Power Modules can only be achieved if the power losses can be dissipated by the external heat sink under the specified general conditions.

NOTICE

Damage to the cold plate caused by incorrect mounting

The screw bolts can be damaged when mounting the cold plate.

- Do not damage the cold plate.

4.10.8 Technical data

Table 4- 91 Technical data for Smart Line Modules with cold plate cooling

| | 6SL3136- | 6AE15-0AAx | 6AE21-0AAx |
|--|------------------------|---|------------|
| Rated power | kW | 5 | 10 |
| Infeed | | | |
| Rated power (S1) ¹⁾ | kW (P _n) | 5 | 10 |
| Infeed power (S6 - 40 %) ¹⁾ | kW (P _{S6}) | 6,5 | 13 |
| Peak infeed power ¹⁾ | kW (P _{max}) | 10 | 20 |
| Regenerative feedback | | | |
| Continuous regenerative power | kW | 5 | 10 |
| Peak regenerative power | kW | 10 | 20 |
| Supply voltages | | | |
| Line voltage | V _{AC} | 3 AC 380 ... 480 ± 10 % (-15 % < 1 min) | |
| Line frequency | Hz | 47 ... 63 | |
| Electronics power supply | V _{DC} | 24 (20.4 ... 28.8) | |
| DC link voltage | V _{DC} | 510 ... 720 | |
| Overvoltage trip | V _{DC} | 820 ± 2 % | |
| Undervoltage trip | V _{DC} | 360 ± 2 % | |

| | 6SL3136- | 6AE15-0AAx | 6AE21-0AAx |
|--|-----------------|--|------------|
| Input currents | | | |
| Rated input current at AC 400 V | A _{AC} | 8,1 | 16,2 |
| Input current at AC 380 V / AC 480 V | A _{AC} | 8,6 / 6,7 | 17 / 12,8 |
| at AC 400 V; S6 - 40 % | A _{AC} | 10,6 | 21,1 |
| at AC 400 V; peak current | A _{AC} | 15,7 | 31,2 |
| DC link currents | | | |
| Rated DC link current at 600 V | A _{DC} | 8.3 | 16.6 |
| DC link current at 540 V | A _{DC} | 9.3 | 18.5 |
| at DC 600 V; S6 - 40 % | A _{DC} | 11 | 22 |
| at DC 600 V; peak current | A _{DC} | 16.6 | 33.2 |
| Current carrying capacity | | | |
| DC link busbars | A _{DC} | 100 | 100 |
| Reinforced DC link busbars | A _{DC} | 150 | 150 |
| 24 V DC busbars | A _{DC} | 20 | 20 |
| Electronics current drawn at 24 V DC | A _{DC} | 0.6 | 0.7 |
| Power loss distribution (incl. electronics losses) | | | |
| internal | W | 34.4 | 56.8 |
| external | W | 40 | 80 |
| (see power loss tables (Page 781)) | | | |
| DC link capacitance | | | |
| Smart Line Module | μF | 220 | 330 |
| Drive line-up, max. | μF | 6000 | 6000 |
| Power factor | cosφ | 1 | 1 |
| Circuit breaker (IEC 60947 and UL) | | See Section Overcurrent protection using line fuses and circuit breakers (Page 51) | |
| Rated short-circuit current SCCR ²⁾ | kA | 65 | 65 |
| Max. permissible heat-sink temperature | ° C | 60 | 65 |
| Max. ambient temperature | | | |
| without derating | ° C | 40 | 40 |
| with derating | ° C | 55 | 55 |
| Weight | kg | 4,0 | 4,0 |

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

2) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker – and the Line Module in the drive system.

4.10.8.1 Characteristics

Rated duty cycles of Smart Line Modules

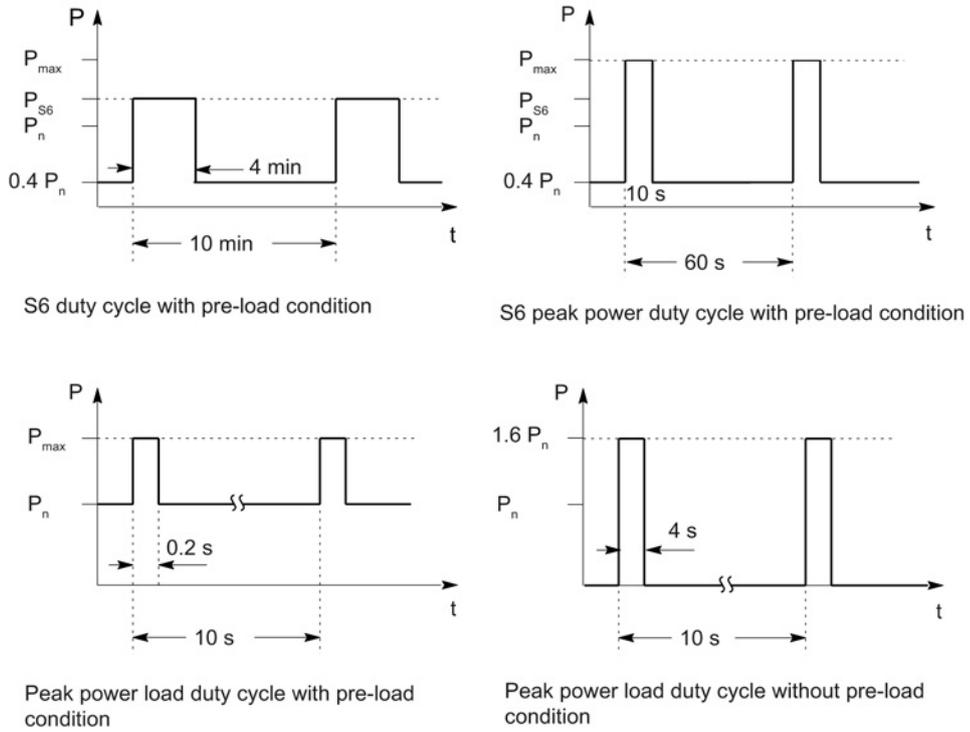


Figure 4-109 Rated duty cycles of Smart Line Modules

Derating characteristics

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

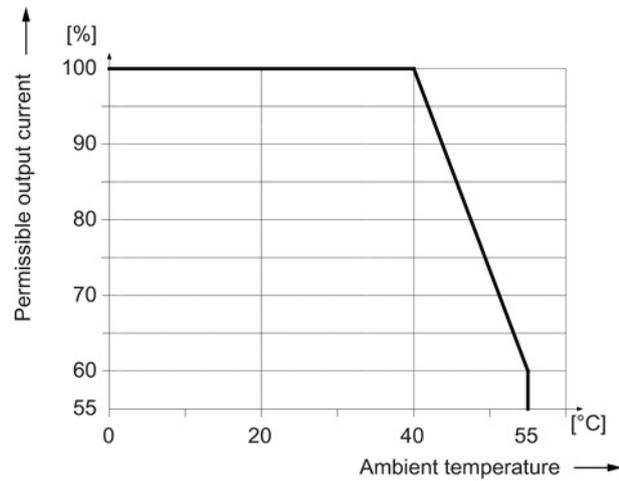


Figure 4-110 Output current as a function of the ambient temperature

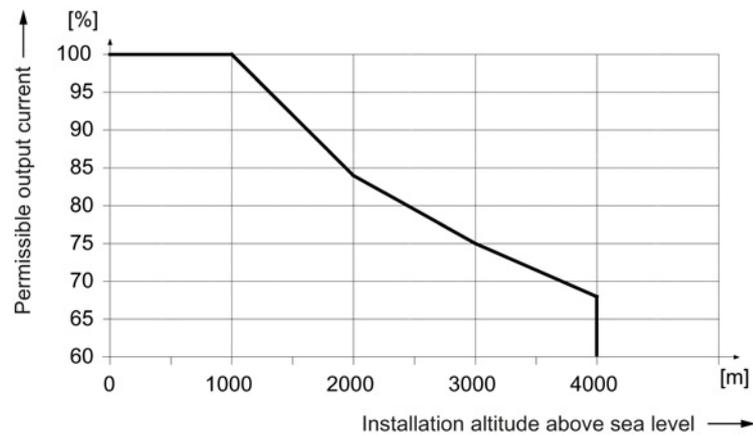


Figure 4-111 Output current as a function of the installation altitude

4.10.8.2 Measuring the heat sink temperature

The maximum permissible heat sink temperature is calculated at the cold plate in the measuring range shown below.

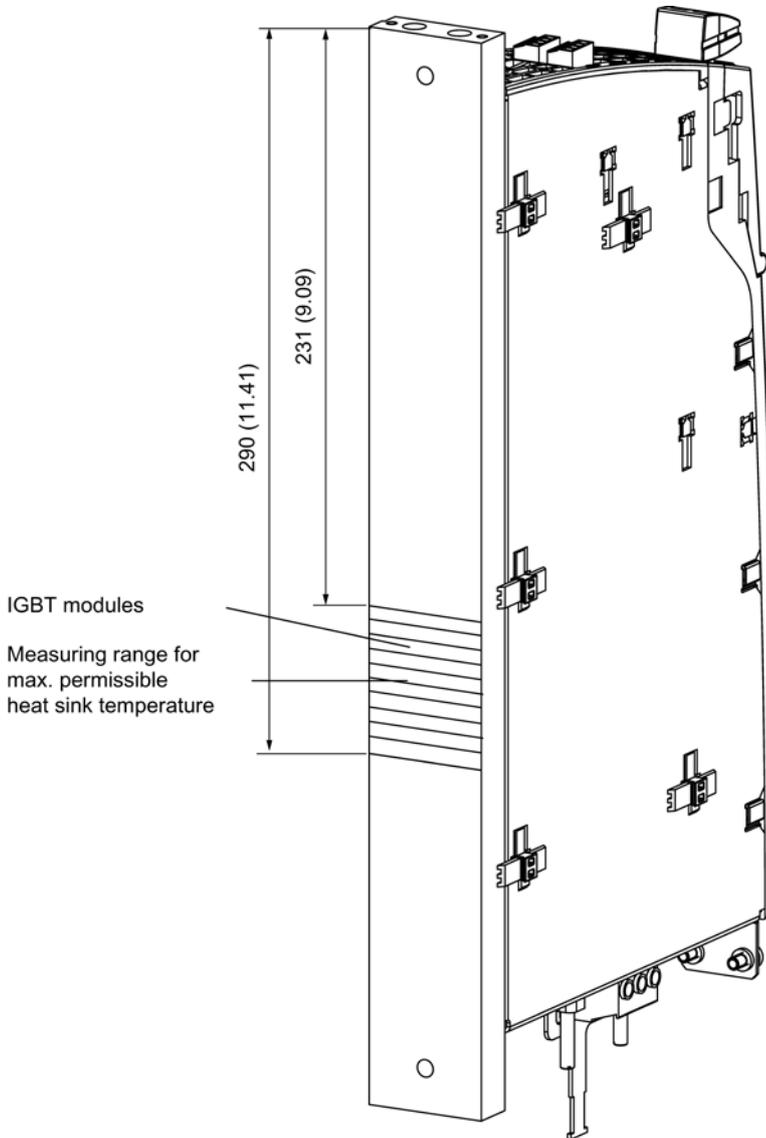


Figure 4-112 Measuring range for max. permissible heat-sink temperature for a Smart Line Module with cold plate

Line Modules Booksize Compact

5.1 Smart Line Modules Booksize Compact

5.1.1 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 feedback mode, the current waveform is square waved. The regenerative feedback can be deactivated by means of parameters.

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

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 by parameter (see the SINAMICS S120/S150 List Manual).

Smart Line Modules are suitable for direct operation in TN, IT, and TT systems. The Line Modules have an integrated overvoltage protection function.

5.1.2 Safety instructions for Smart Line Modules Booksize Compact

| |
|---|
|  WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed |
| If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. |
| <ul style="list-style-type: none">• Adhere to the fundamental safety instructions.• When assessing the risk, take into account residual risks. |



! WARNING

Danger to life through electric shock as well as fire hazard due to overcurrent protective devices that trip too late

Overcurrent protective devices that do not trip or trip too late can cause an electric shock or fire.

- To protect personnel and for fire protection purposes, at the infeed point, the short-circuit rating and loop impedance must correspond to the specifications in the documentation in order for the installed overcurrent protection devices to trip within the specified time.



! DANGER

Danger to life through electric shock due to a high DC link voltage

As long as the Line Module is connected to the line supply, the DC link is charged with a high voltage. Contact with components can result in death or serious injury.

- Isolate the Line Module from the line supply during installation or maintenance work, e.g. via the line contactor or main switch.



! DANGER

Danger to life through 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 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.
- Measure the voltage before starting work on the DCP and DCN DC link terminals.



! DANGER

Danger to life through 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

Danger to life through electric shock due to incorrect connection to the DC link

Incorrect connections can lead to overheating and therefore a risk of 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**

Danger to life through electric shock due to missing DC link side covers

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

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

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



 **WARNING**

Danger to life due to high leakage currents caused by an interrupted external protective conductor

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.

- Ensure that the external protective conductor satisfies at least one of the following conditions:
 - It has been laid so that it is protected against mechanical damage.¹⁾
 - If it is a single conductor, it has a cross-section of at least 10 mm² Cu.
 - If it is a conductor of a multi-conductor cable, it has a cross-section of at least 2.5 mm² Cu.
 - It has a second protective conductor in parallel with the same cross-section.
 - It complies with the local regulations for equipment with increased leakage current.

¹⁾ Cables laid within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.

 **WARNING**

Danger of an accident due to missing warning labels in the national language.

Missing warning labels in the national language can result in death or serious injury.

- Attach the component warning labels in the national language.

 **WARNING**

Fire hazard due to overheating because of inadequate ventilation clearances

Inadequate ventilation clearances can cause overheating with a risk for personnel due to smoke and fire. This can also result in increased failure rates and a shorter service life for Line Modules.

- Maintain the 80 mm clearances above and below the Line Modules.

 **CAUTION**

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

Overheating and a fire can result when the total length of the power cables is exceeded.

- Ensure that the total length of the power cables (motor supply cables and DC link cables) does not exceed the values specified in Chapter Combining line reactors and line filters (Page 136).

Note

Operation on line supplies where energy recovery is not possible

In 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 regenerative feedback capability (e.g. diesel generator), deactivate the regenerative feedback capability of the Line Modules using the appropriate parameter (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.

Exception: For 5 kW and 10 kW Smart Line Modules, the regenerative feedback capability must be deactivated as follows:

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

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.

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.

Note

Fan operation

Activation of the fan is dependent on heat sink temperature and pulse enable.

5.1.3 Interface description

5.1.3.1 Overview

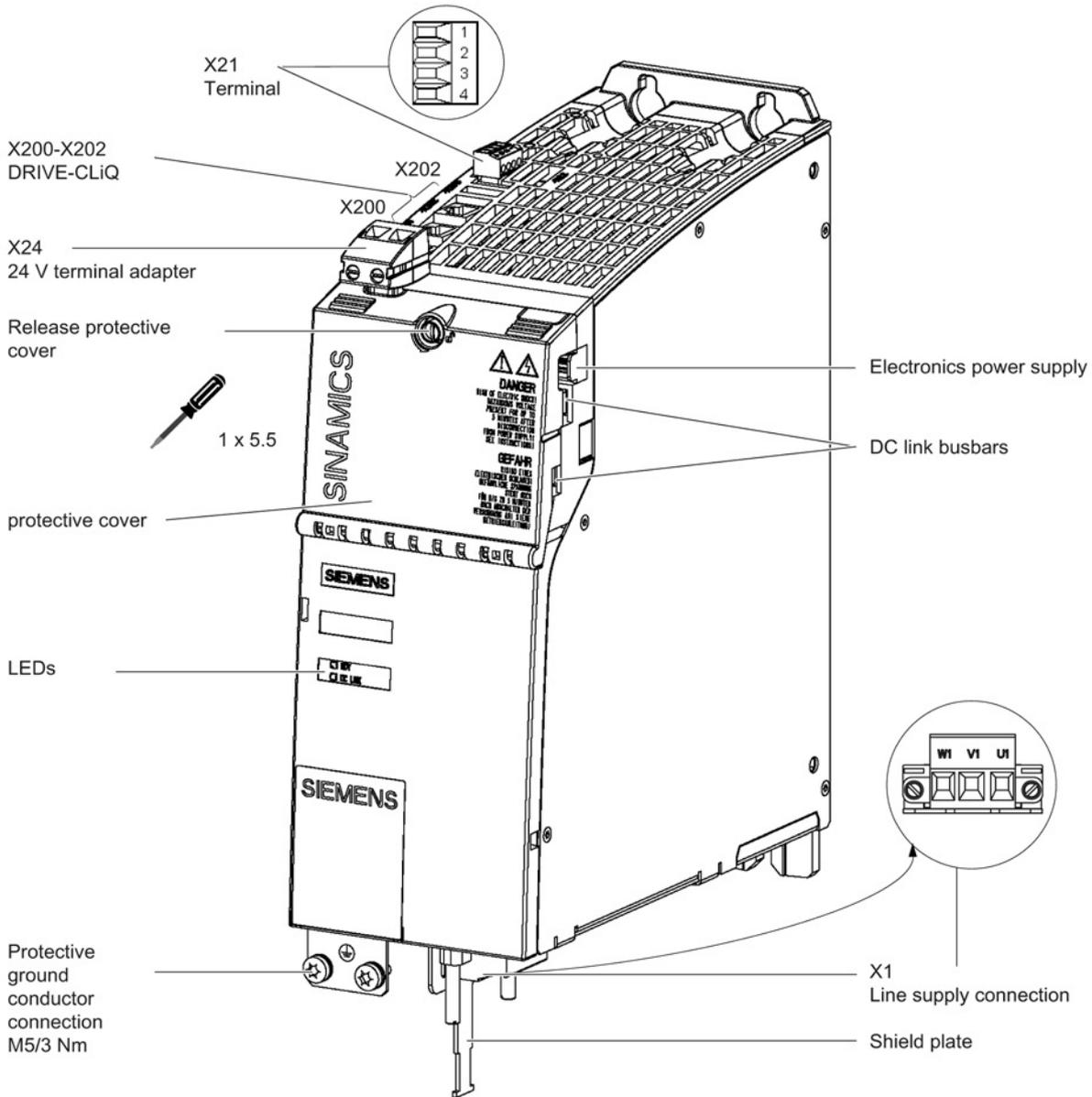
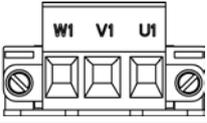
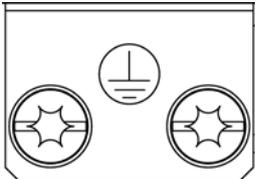


Figure 5-1 Interface overview, Smart Line Module in Booksize Compact format (16 kW)

5.1.3.2 X1 line connection

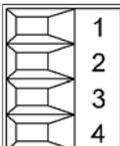
Table 5- 1 X1 line connection

| | Terminal | Technical data |
|---|---------------|---|
|  | U1 | Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Type: Screw terminal 7 (Page 755) Max. cross-section that can be connected: 16 mm ² Tightening torque: 1.5 ... 1.8 Nm |
| | V1 | |
| | W1 | |
|  | PE connection | Threaded hole M5 / 3 Nm ¹ |

1) For ring cable lugs without insulation

5.1.3.3 X21 EP terminals

Table 5- 2 X21 EP terminal / temperature sensor

| | Terminal | Function | Technical data |
|---|----------|-------------------------|--|
|  | 1 | + Temp | Temperature sensors: KTY 84–1C130 ¹⁾ / PTC ¹⁾ /bimetallic switch with NC contact The temperature sensor type and the temperature display can be selected via parameter and read-out. ²⁾ |
| | 2 | - Temp | |
| | 3 | EP +24 V (pulse enable) | Voltage: 24 V DC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs |
| | 4 | EP M (Enable Pulses) | |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm ² : | | | |

1) The temperatures are detected but not evaluated in the Smart Line Module.

2) For further information see SINAMICS S120, Commissioning Manual

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



| |
|--|
|  WARNING |
| Danger to life due to electric shock in the event of voltage flashovers on the temperature sensor cable |
| Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors. |
| <ul style="list-style-type: none">• Only use temperature sensors that fully comply with the specifications of the safety isolation.• 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. |

| |
|--|
| NOTICE |
| Risk of the motor overheating due to an incorrectly connected KTY temperature sensor |
| A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats. |
| <ul style="list-style-type: none">• Always connect the KTY sensor with the correct polarity. |

Terminals X21.3 and X21.4

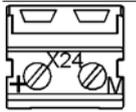


| |
|---|
|  WARNING |
| Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected |
| For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. |
| Pulse cancellation is activated if the power supply is disconnected. Regenerative feedback 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. |
| Death or serious injury can result when live parts are touched. |
| <ul style="list-style-type: none">• Neutralize the voltage in the DC link. |

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

5.1.3.4 X24 24 V terminal adapter

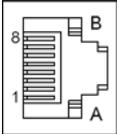
Table 5- 3 X24: 24 V terminal adapter

| | Terminal | Designation | Technical data |
|--|----------|-------------------|------------------------|
|  | + | 24 V power supply | 24 V DC supply voltage |
| | M | Ground | Electronics ground |
| Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm ² | | | |

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

5.1.3.5 X200-X202 DRIVE-CLiQ interfaces

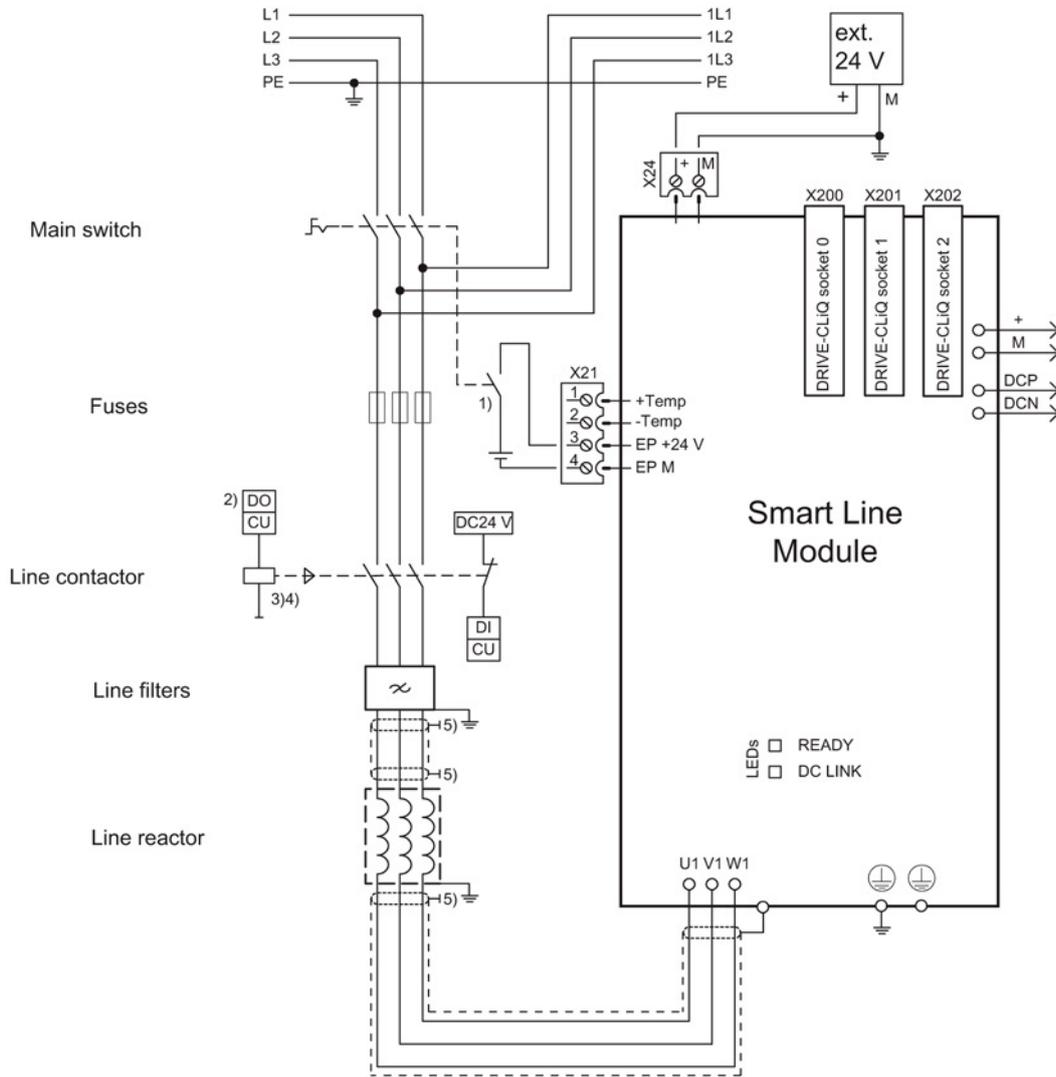
Table 5- 4 X200-X202: DRIVE-CLiQ interfaces

| | 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.) Order number: 6SL3066-4CA00-0AA0

5.1.4 Connection example



- 1) Leading opening contact $t > 10$ ms
- 2) DI/DO, controlled by the Control Unit
- 3) No additional load permitted downstream of line contactor
- 4) The current carrying capacity of the DO must be observed; an output interface must be used if required.
- 5) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline

Figure 5-2 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.

5.1.5 Meaning of the LEDs

Table 5- 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 | -- | 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 | -- | This component has at least one fault. Note: The LED is activated regardless of whether the corresponding messages have been reconfigured. | Resolve and acknowledge the fault. |
| Green/red (0.5 Hz) | -- | Firmware is being downloaded. | – |
| Green/red (2 Hz) | -- | Firmware download has been completed. The system waits for POWER ON. | Carry out a POWER ON. |
| Green/orange or Red/orange | -- | Component recognition via LED is activated ¹⁾ . Note: Both options depend on the LED status when component recognition is activated. | – |

¹⁾ See SINAMICS S120/150 List Manual for the parameters to activate the recognition of components via LED



| |
|---|
|  WARNING |
| <p>Danger of death when live parts of the DC link are touched</p> <p>Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.</p> <ul style="list-style-type: none"> • Observe the warning information on the component. |

5.1.6 Dimension drawing

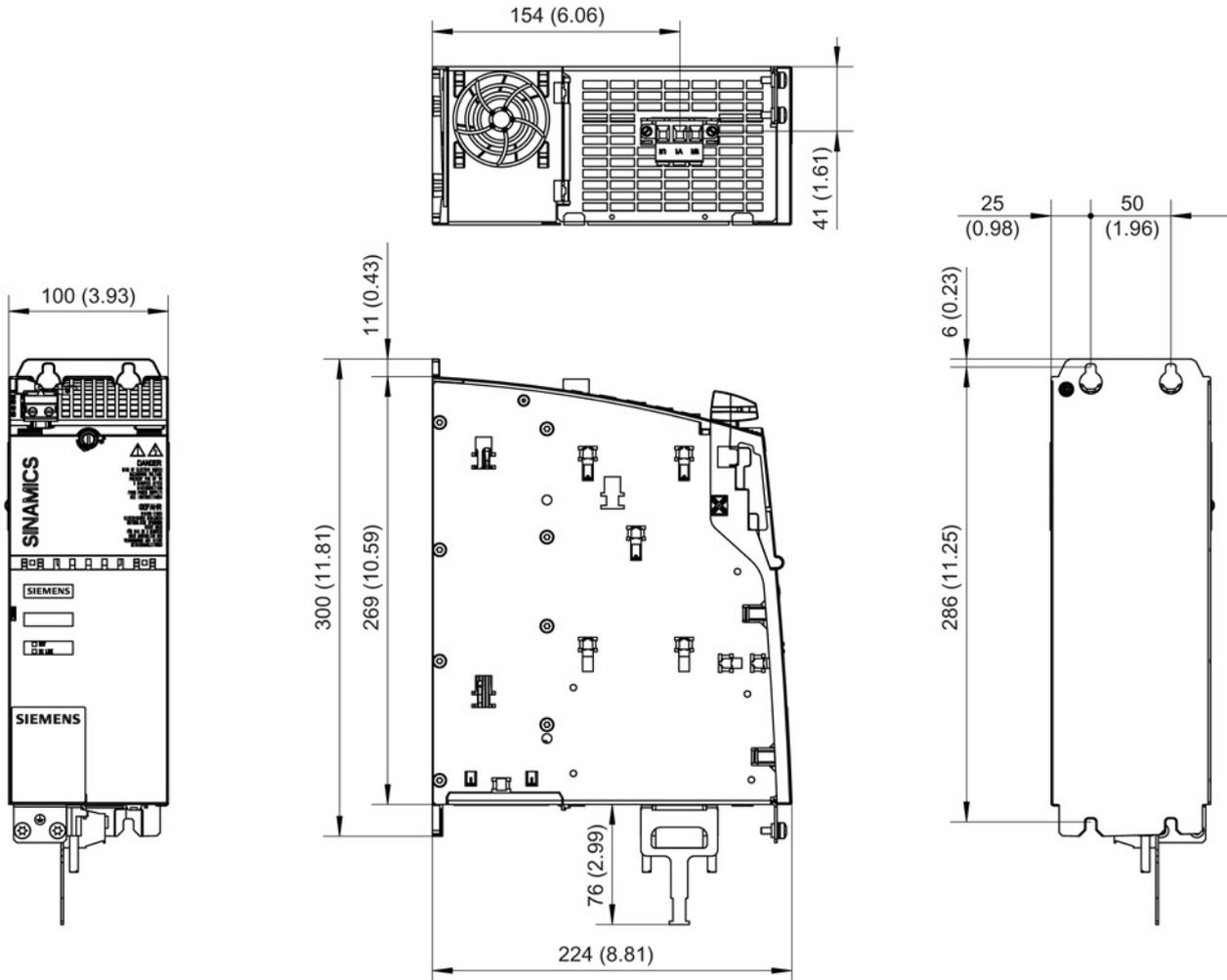


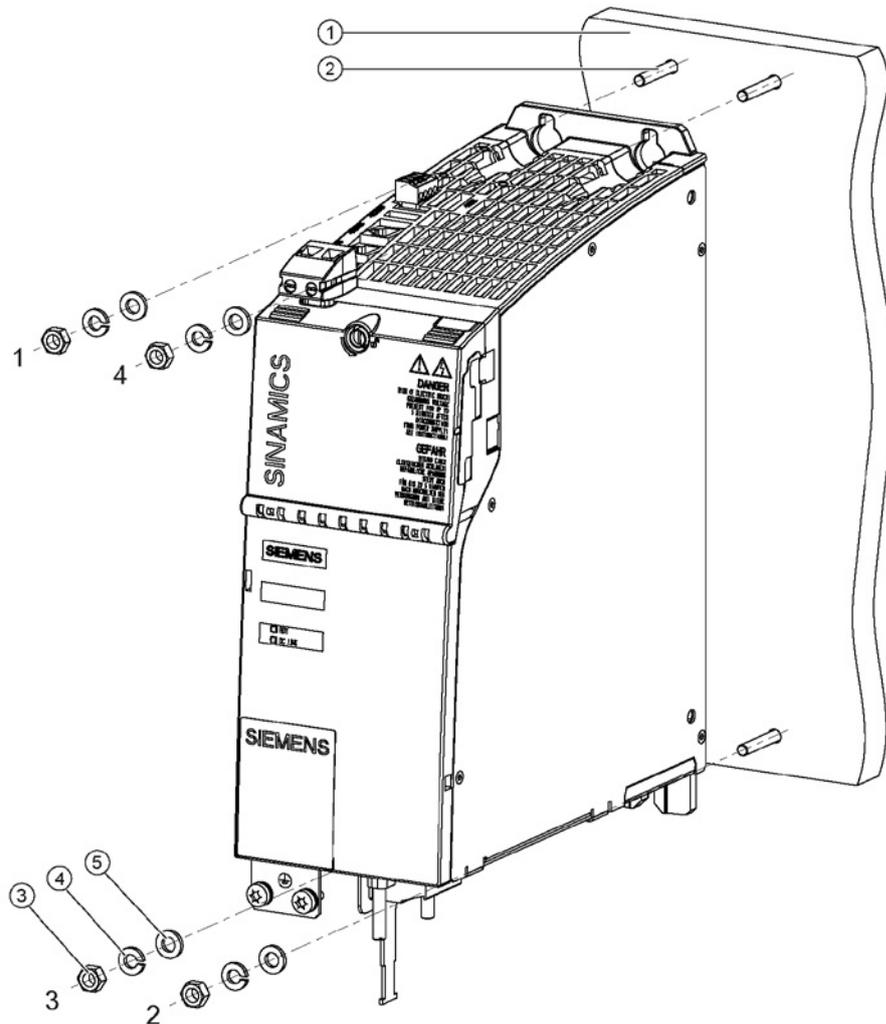
Figure 5-3 Dimension drawing Smart Line Module Booksize Compact format (16 kW), all dimensions in mm and (inches)

Note

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

5.1.7 Mounting

Mounting a Smart Line Module Booksize Compact with internal air cooling



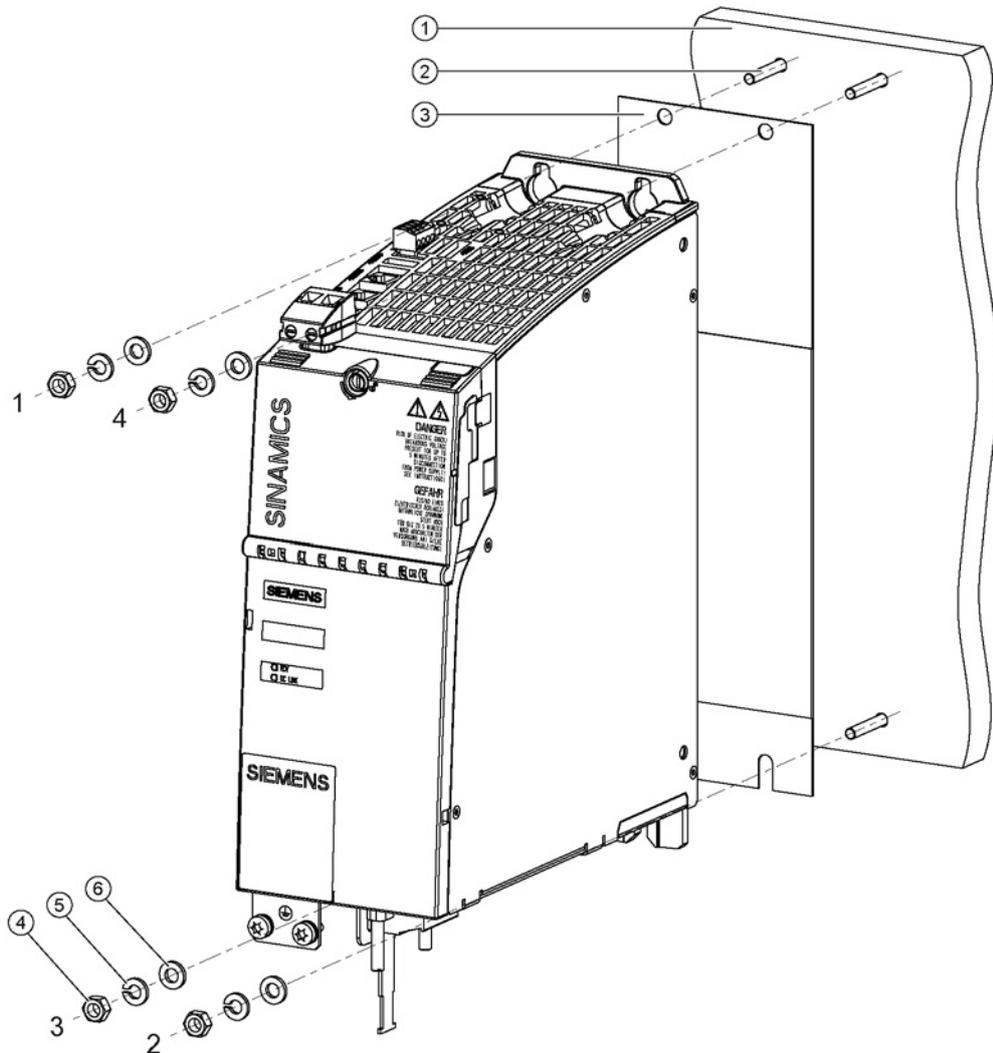
- ① Mounting panel
- ② M6 studs
- ③ M6 nut
- ④ Spring washer
- ⑤ Washer

Figure 5-4 Mounting a Smart Line Module Booksize Compact with internal cooling

Tightening torques:

- Firstly, only tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
Tightening torque: 6 Nm

Mounting a Smart Line Module Booksize Compact on a cold plate



- ① Cold plate
- ② M6 studs
- ③ Heat-conducting foil
- ④ M6 nut
- ⑤ Spring washer
- ⑥ Washer

Figure 5-5 Mounting a Smart Line Module Booksize Compact on a cold plate

Tightening torques:

- Firstly, only tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
Tightening torque: 10 Nm

Special points to note in relation to mounting on a cold plate

To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every Smart Line Module Booksize Compact is supplied with heat-conducting foil cut to the right size. Note the mounting position of the heat-conducting foil.

Note

- Also replace the heat-conducting foil when replacing a component.
- Only use heat-conducting foil released or supplied by Siemens.

Table 5- 6 Heat-conducting foil

| | Order number |
|------------------------------|--------------------|
| Heat-conducting foil, 100 mm | 6SL3162-6FD01-0AA0 |

5.1.8 Technical data

Table 5- 7 Technical data Smart Line Modules Booksize Compact

| Smart Line Module Booksize Compact | 6SL3430– | 6TE21-6AAx |
|---|------------------------|---|
| Rated power | kW | 16 |
| Infeed | | |
| Rated power (S1) ¹⁾ | kW (P _n) | 16 |
| Infeed power (S6 - 40 %) ¹⁾ | kW (P _{S6}) | 21 |
| Peak infeed power ¹⁾ | kW (P _{max}) | 35 |
| Regenerative feedback | | |
| Continuous regenerative power | kW | 16 |
| Peak regenerative power | kW | 35 |
| Supply voltages | | |
| Line voltage | V _{AC} | 3 AC 380 ... 480 ± 10 % (-15 % < 1 min) |
| Line frequency | Hz | 47 ... 63 |
| Electronics 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 - 40 % | A _{AC} | 35 |
| at AC 400 V; peak current | A _{AC} | 57.5 |

| Smart Line Module Booksize Compact | 6SL3430– | 6TE21-6AAx |
|---|-------------------|---|
| Rated power | kW | 16 |
| DC link currents Rated DC link current at 600 V | A _{DC} | 27 |
| DC link current at 540 V | A _{DC} | 30 |
| at DC 600 V; S6 - 40 % | A _{DC} | 35 |
| at DC 600 V; peak current | A _{DC} | 59 |
| Current carrying capacity DC link busbar | A _{DC} | 100 |
| Reinforced DC link busbar: | A _{DC} | 150 |
| 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 781)) | W | 187.8 |
| Power loss distribution for cold plate (including electronics losses) ³⁾ Internal | W | 56.6 |
| External | | 130 |
| Max. ambient temperature without derating | °C | 40 |
| with derating | °C | 55 |
| DC link capacitance Smart Line Module | µF | 705 |
| Drive line-up, max. | µF | 6000 |
| Power factor | cos φ | 0.98 |
| Circuit breaker (IEC 60947 and UL) | | See Chapter Overcurrent protection using line fuses and circuit breakers (Page 51) |
| Rated short-circuit current SCCR ³⁾ | kA | 65 |
| Cooling methods | | Internal air cooling Cold plate cooling |
| Cooling air requirement with internal air cooling | m ³ /h | 56 |
| Max. permissible heat-sink temperature cold plate | ° C | 71 |
| Sound pressure level | dB(A) | < 60 |
| 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) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker – and the Line Module in the drive system.

5.1.8.1 Characteristics

Rated duty cycles of Smart Line Modules

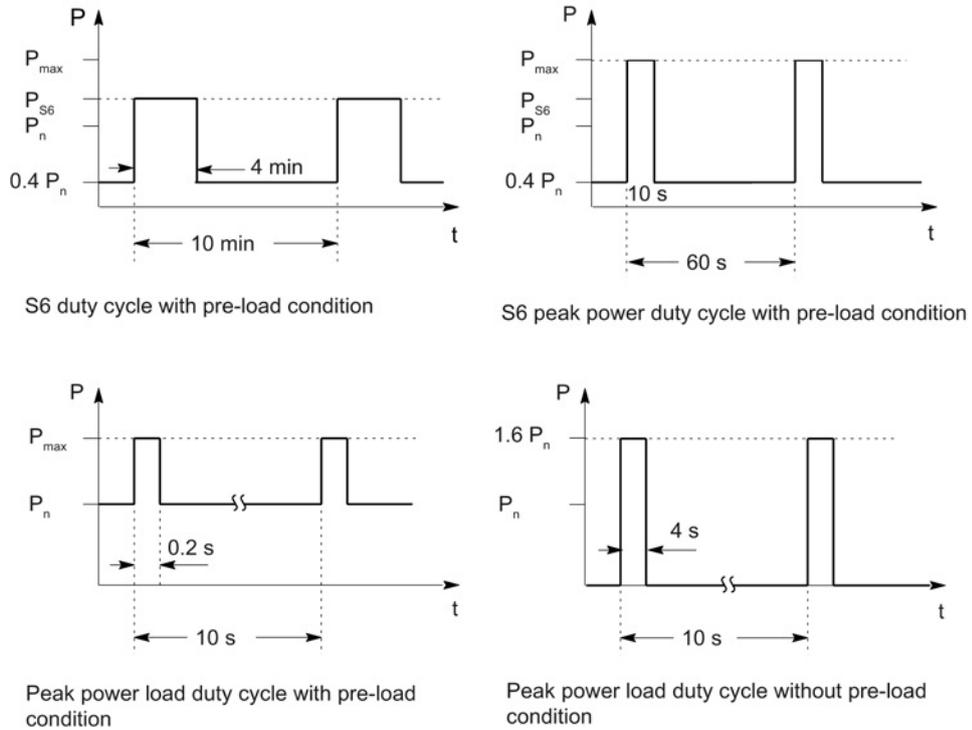


Figure 5-6 Rated duty cycles of Smart Line Modules

Derating characteristics

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

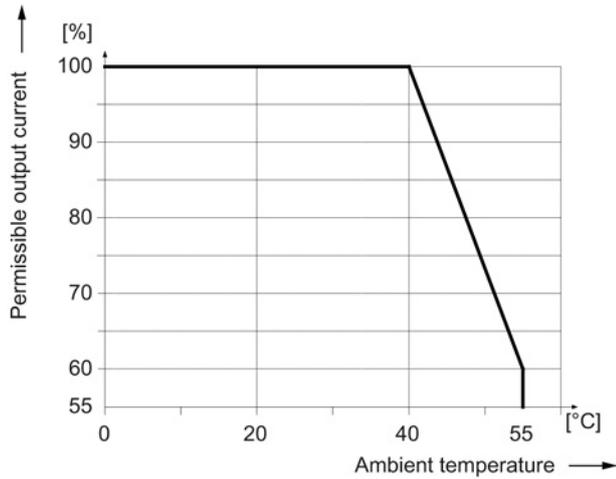


Figure 5-7 Output current as a function of the ambient temperature

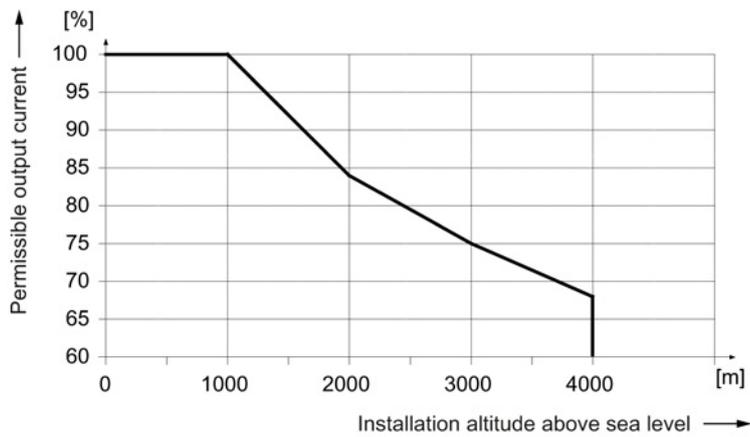


Figure 5-8 Output current as a function of the installation altitude

Motor Modules Booksize

6.1 Safety instructions for Motor Modules Booksize

| | |
|---|--|
|  | WARNING |
| | <p>Danger to life if the fundamental safety instructions and remaining risks are not carefully observed</p> <p>If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.</p> <ul style="list-style-type: none"> • Adhere to the fundamental safety instructions. • When assessing the risk, take into account residual risks. |



| | |
|---|--|
|  | DANGER |
| | <p>Danger to life through electric shock due to the residual charge of the DC link capacitors</p> <p>Because of the DC link capacitors, a hazardous voltage is present for up to five minutes after the power supply has been switched off.</p> <p>Contact with live parts can result in death or serious injury.</p> <ul style="list-style-type: none"> • Do not open the protective cover of the DC link until 5 minutes have elapsed. • Measure the voltage before starting work on the DCP and DCN DC link terminals. |



| | |
|---|--|
|  | DANGER |
| | <p>Danger to life through electric shock when the protective cover of the DC link is open</p> <p>Contact with live parts can result in death or serious injury.</p> <ul style="list-style-type: none"> • Only operate the components with closed protective cover. |



| | |
|---|---|
|  | WARNING |
| | <p>Danger to life through electric shock due to incorrect connection to the DC link</p> <p>Incorrect connections can lead to overheating and therefore a risk of fire. There is also a risk of an electric shock. This can result in serious injury or death.</p> <ul style="list-style-type: none"> • Only use adapters (DC link adapters and DC link rectifier adapters) released by Siemens for the connection to the DC link. |



! WARNING

Danger to life through 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 modules¹⁾ (exception: Smart Line Module²⁾), 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 removed³⁾.

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

Danger to life through electric shock due to missing DC link side covers

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

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

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



! WARNING

Danger to life due to high leakage currents caused by an interrupted external protective conductor

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.

- Ensure that the external protective conductor satisfies at least one of the following conditions:
 - It has been laid so that it is protected against mechanical damage.¹⁾
 - If it is a single conductor, it has a cross-section of at least 10 mm² Cu.
 - If it is a conductor of a multi-conductor cable, it has a cross-section of at least 2.5 mm² Cu.
 - It has a second protective conductor in parallel with the same cross-section.
 - It complies with the local regulations for equipment with increased leakage current.

¹⁾ Cables laid within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.



! WARNING

Danger to life through electric shock due to incorrectly laid brake cables

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

- 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

Danger of an accident due to missing warning labels in the national language.

Missing warning labels in the national language can result in death or serious injury.

- Attach the component warning labels in the national language.

! WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

Inadequate ventilation clearances can cause overheating with a risk for personnel due to smoke and fire. This can also result in increased failure rates and a shorter service life for Motor Modules.

- Maintain the 80 mm clearances above and below the Motor Modules.
- For the 132 A and 200 A Motor Modules, a ventilation clearance of 50 mm must also be maintained in front of the fan.

NOTICE

Material damage due to loose power connections

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

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

NOTICE

Damage to the equipment when performing a voltage test as a result of connections that are not disconnected

SINAMICS S components are subject to a voltage test as part of the routine test. Connected devices can be damaged.

- Disconnect or unplug all SINAMICS devices before the voltage test of the machine equipment according to EN 60204-1, Section 18.4.

| |
|---|
| NOTICE |
| Temperature signal disturbances and failure of components as a result of unshielded or incorrectly routed cables |
| With unshielded or incorrectly laid cables, it can be expected that interference will be coupled into the signal processing electronics from the power side. This can result in significant disturbances (fault messages) up to failure of individual components (destruction of the devices). |
| <ul style="list-style-type: none">• 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 to the chassis potential at both ends over a large surface area. |

| |
|--|
| NOTICE |
| Destruction of the motor or brake due to incorrect power supply |
| With an incorrect power supply, the brake can malfunction, i.e. the brake does not open reliably. If the motor constantly runs against the closed brake, the brake and/or the motor will be destroyed. |
| <ul style="list-style-type: none">• Always use a regulated 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 drop.• 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:<ul style="list-style-type: none">– Siemens three-phase motors must be used– Siemens MOTION-CONNECT power cables must be used– Motor cable lengths, max. 100 m |

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

Special features for Motor Modules with external air cooling

Note

Insufficient cooling power when the external heat sinks are polluted

For components with external air cooling, the fan and the heat sinks can accumulate a lot of pollution. If the cooling air requirement is not provided by the filter fan, the components cannot output their specified power. This can cause the temperature monitoring function in the components to respond.

- Check the fans and heat sinks for pollution at regular intervals and clean them when necessary.

Note

Checking the seal

- After installation, check the seal on the rear of the device to ensure that it is tight.
- If required, use additional sealing.

Note

Using an installation frame

- Only use an installation frame when the cabinet has an unpainted metal surface.
-

Notes for UL applications

Note

The SINAMICS S120 Motor Modules Booksize provide short-circuit protection at the motor output terminals.

6.2 Motor Modules with internal air cooling

6.2.1 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.

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



WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

6.2.2 Interface description

6.2.2.1 Overview

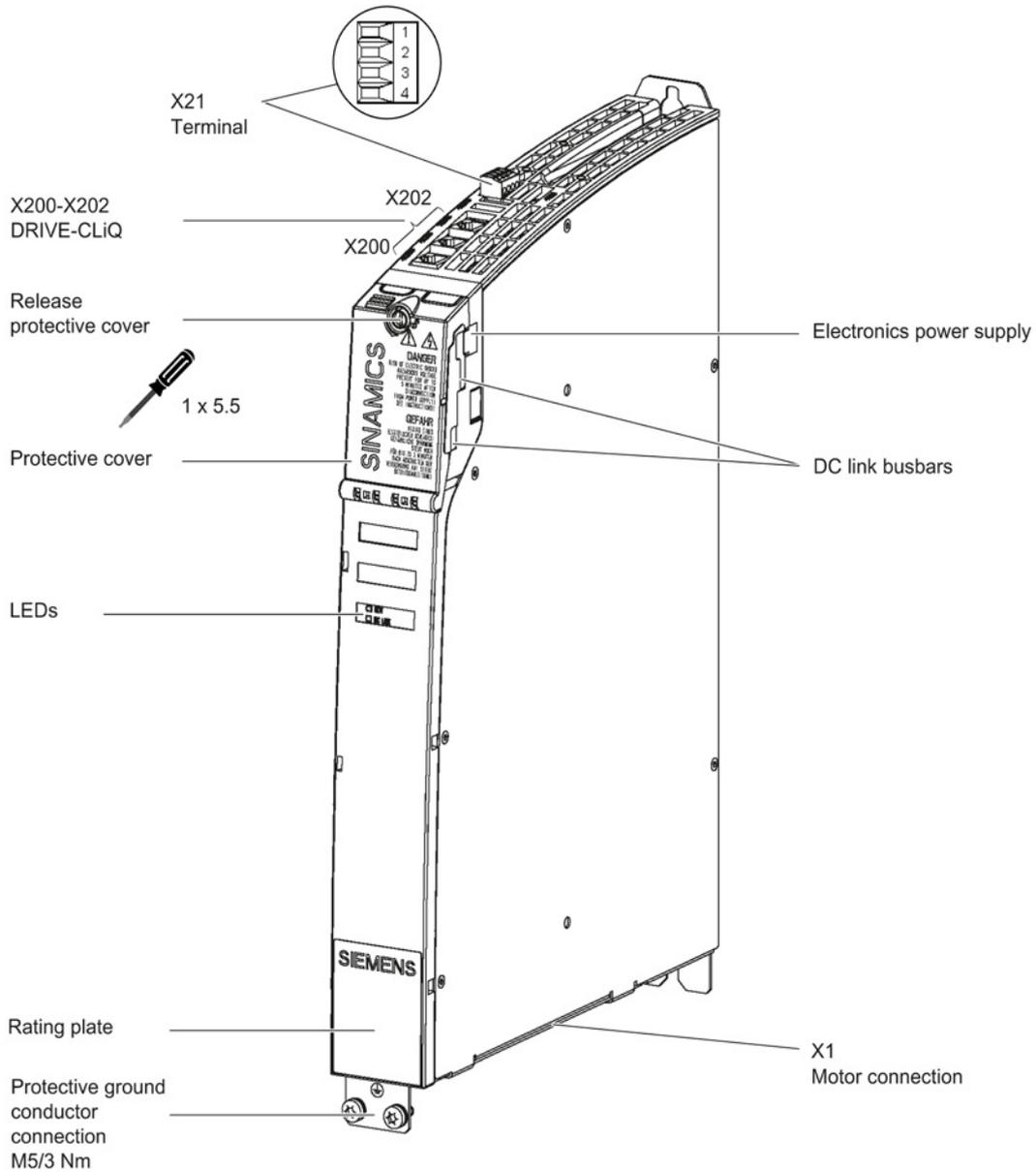


Figure 6-1 Interface overview, Single Motor Module Booksize with internal air cooling (example: 5 A)

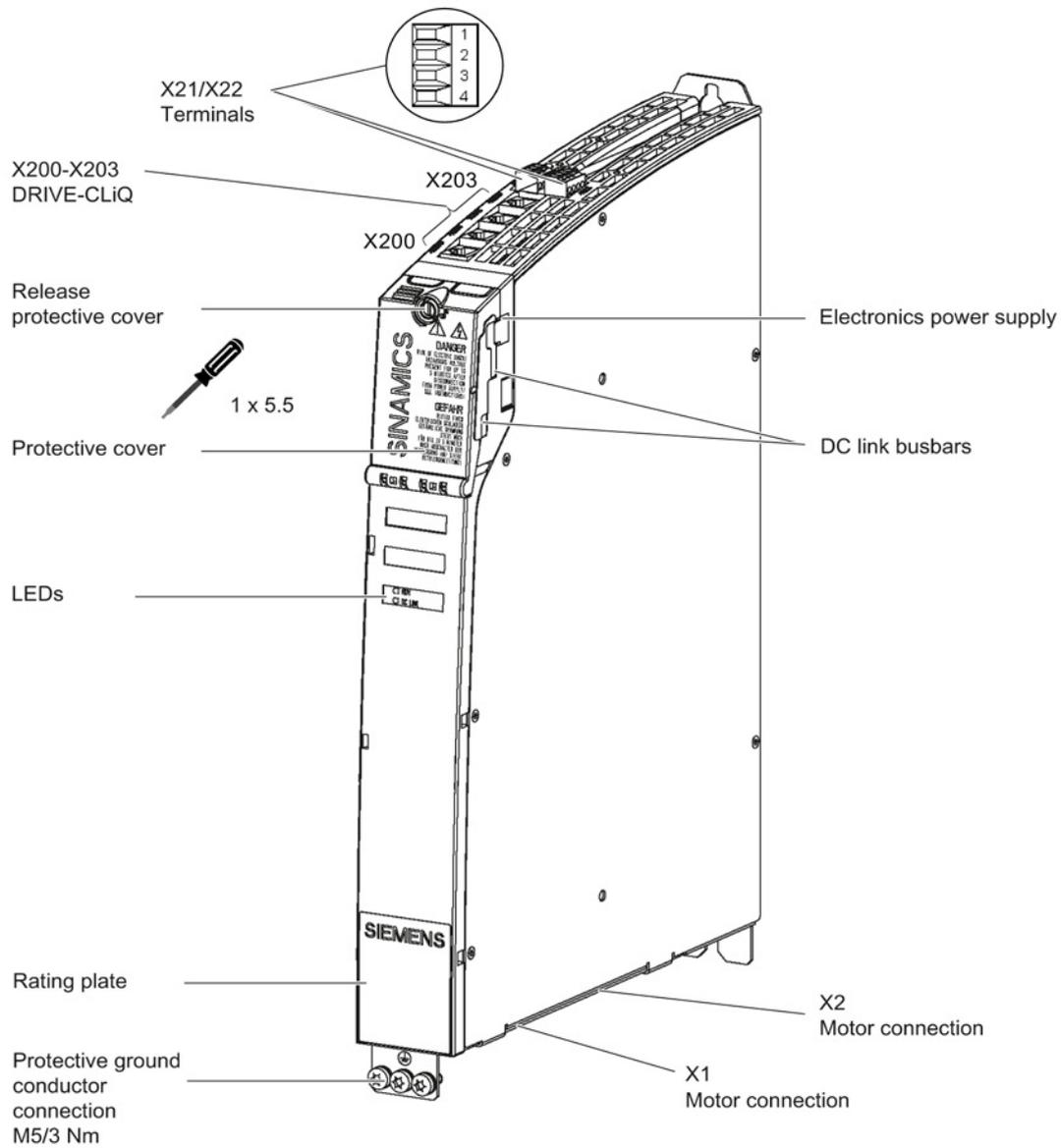
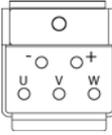
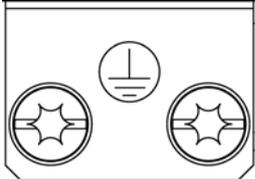
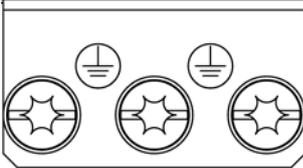


Figure 6-2 Interface overview, Double Motor Module Booksize with internal air cooling (example: 2 x 5 A)

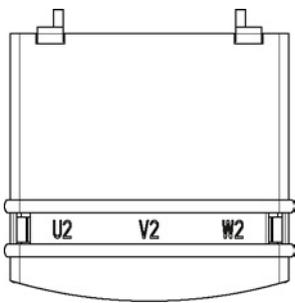
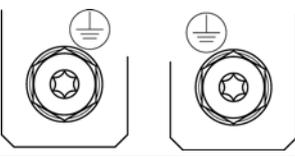
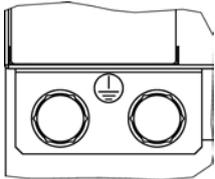
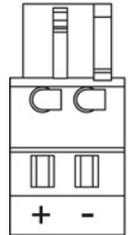
6.2.2.2 Motor and brake connection

Table 6- 1 X1/X2 motor and brake connection for Single Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

| | Terminal | Technical data |
|---|---------------|--|
|  | U (U2) | Motor connection |
| | V (V2) | |
| | W (W2) | |
| | + (BR+) | Brake connection Max. load current: 2 A Minimum load current: 0.1 A |
| | - (BR-) | |
|  | PE connection | Single Motor Modules 3 ... 30 A: Threaded hole M5 / 3 Nm ¹⁾ |
| | |  |

1) For ring cable lugs without insulation

Table 6- 2 X1 motor connection and X11 brake connection for Single Motor Modules 45 A to 200 A

| | Terminal | Technical data |
|---|---------------|---|
|  | U2 | 45 ... 60 A: Threaded bolts M6 / 6 Nm ¹⁾ 85 A: Threaded bolts M8 / 13 Nm ¹⁾ 132 ... 200 A: Threaded bolts M8 / 13 Nm ¹⁾ |
| | V2 | |
| | W2 | |
|  | PE connection | 45 ... 60 A: Threaded bolts for motor cables: M6 / 6 Nm ¹⁾ Threaded hole for PE: M6 / 6 Nm ¹⁾ |
| | |  |
|  | + (BR+) | X11 brake connector²⁾: Voltage: 24 V DC Max. load current: 2 A Minimum load current: 0.1 A Type: Spring-loaded terminal 2 (Page 754) Max. cross-section that can be connected 2.5 mm ² : The brake connector is part of the prefabricated cable. |
| | - (BR-) | |

1) For ring cable lugs without insulation

2) The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.



| |
|--|
| <p>⚠ WARNING</p> <p>Danger to life as a result of a hazardous voltage at the 0 V to 48 V DC terminals</p> <p>Death or serious injury can result when live parts are touched in the event of a fault.</p> <ul style="list-style-type: none"> Only connect protective extra-low voltages (PELV / SELV) to all connections and terminals between 0 to 48 V DC. |
|--|

| |
|---|
| <p>NOTICE</p> <p>Destruction of the motor or motor holding brake as a result of high voltage tolerances of the motor holding brakes</p> <p>If the voltage tolerances of the motor holding brakes are not complied with (24 V ± 10 %), then the brake will malfunction, i.e. the brake will not reliably open. If the motor constantly runs against the closed brake, the brake or the motor will be destroyed.</p> <ul style="list-style-type: none"> • Set the DC power supply to 26 V. <p>The following general conditions must be satisfied:</p> <ul style="list-style-type: none"> • Siemens three-phase motors must be used • Siemens MOTION-CONNECT power cables must be used • Motor cable lengths, max. 100 m |
|---|

Note

The total length of the power cables (motor feeder cables and DC link cables) must not exceed the values listed in Chapter Combining line reactors and line filters (Page 136).

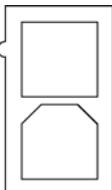
Note

The motor brake must be connected via connector X11. It is not permitted to directly connect the cable BR – to the electronics ground M.

6.2.2.3 X12 fan connection

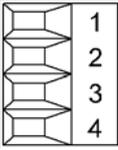
The Motor Modules 132 A and 200 A are equipped with an interface to connect a sub-chassis fan. The interface is located on the underside of the Motor Module.

Table 6- 3 X12 fan connection

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

6.2.2.4 X21/X22 EP terminals/temperature sensor

Table 6- 4 X21/X22 EP terminals / temperature sensor

| | Terminal | Function | Technical data |
|---|----------|-------------------------|---|
|  | 1 | + Temp | Temperature sensors: KTY 84-1C130/PTC/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: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled. |
| | 4 | EP M1 (enable pulses) | |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm ² | | | |

EP terminals

Parameters are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4 (see 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 is only available when Safety Integrated Basic Functions are enabled.

Temperature sensor connection

| |
|--|
| <p>NOTICE</p> <p>Risk of the motor overheating due to an incorrectly connected KTY temperature sensor</p> <p>A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.</p> <ul style="list-style-type: none"> Always connect the KTY 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

Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that fully comply with the specifications of the safety isolation.
- 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.

6.2.2.5 X200-X203 DRIVE-CLiQ interface

Table 6- 5 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules
X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

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

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

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

6.2.3 Connection examples

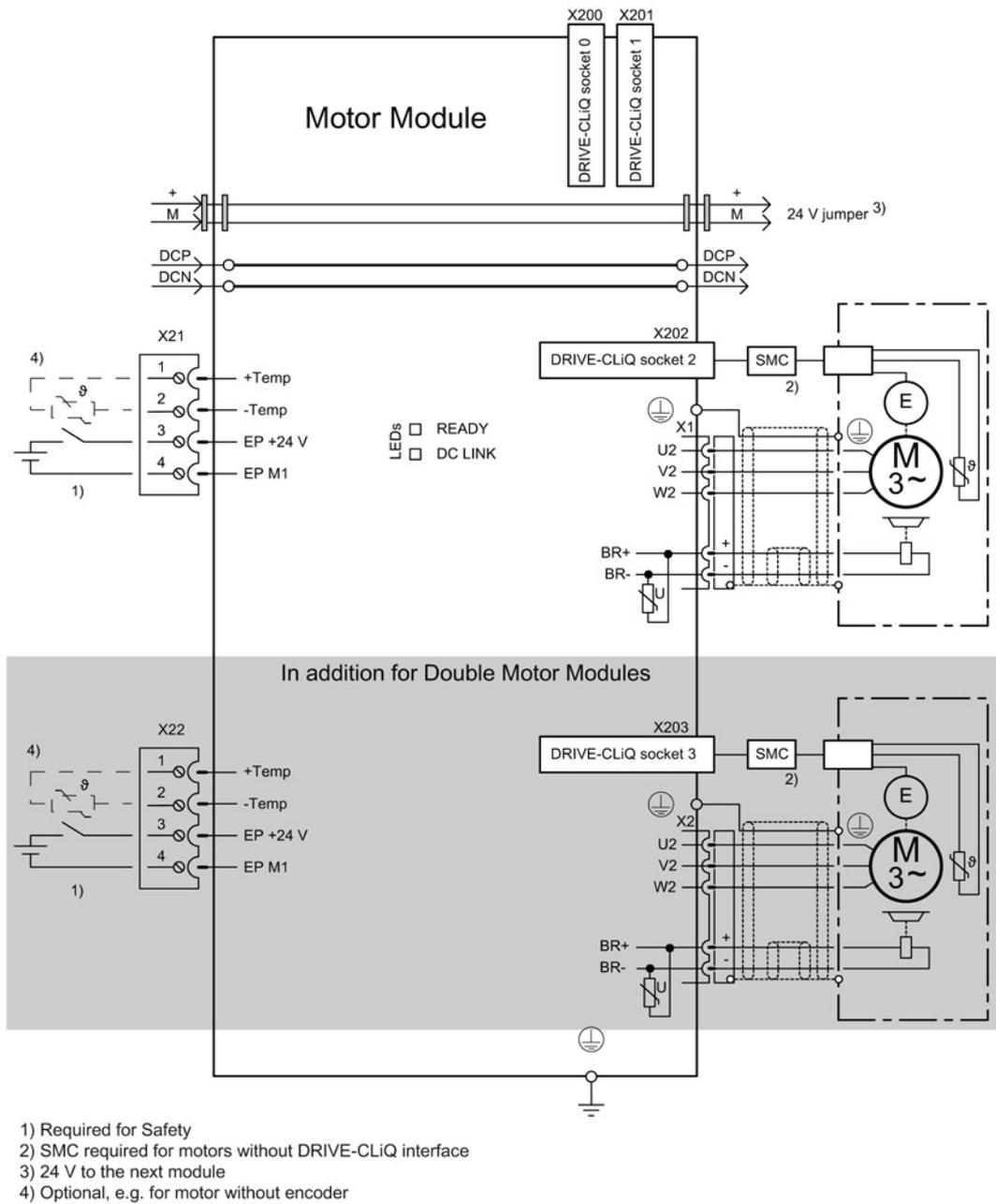
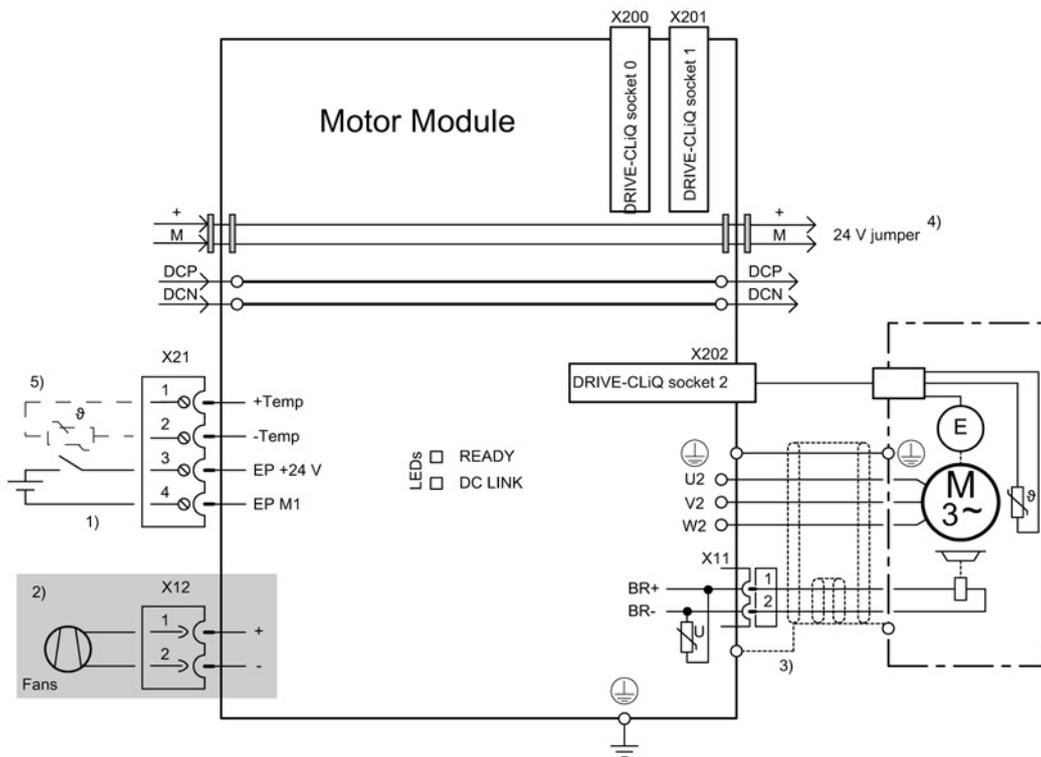


Figure 6-3 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A



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

Figure 6-4 Example connection of Single Motor Modules 45 A to 200 A

6.2.4 Meaning of LEDs

Table 6- 6 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 | -- | 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 | -- | At least one fault is present in this component. Note: The LED is driven irrespective of the corresponding messages being reconfigured. | Resolve and acknowledge the fault. |
| Green/red (0.5 Hz) | -- | Firmware is being downloaded. | – |
| Green/red (2 Hz) | -- | Firmware download has been completed. The system waits for POWER ON. | Carry out a POWER ON. |
| Green/orange or red/orange | -- | Component recognition via LED is activated ¹⁾ . Note: Both options depend on the LED status when component recognition is activated. | – |

1) See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



| |
|---|
| <p>! WARNING</p> <p>Danger of death when live parts of the DC link are touched</p> <p>Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.</p> <ul style="list-style-type: none"> Observe the warning information on the component. |
|---|

6.2.5 Dimension drawings

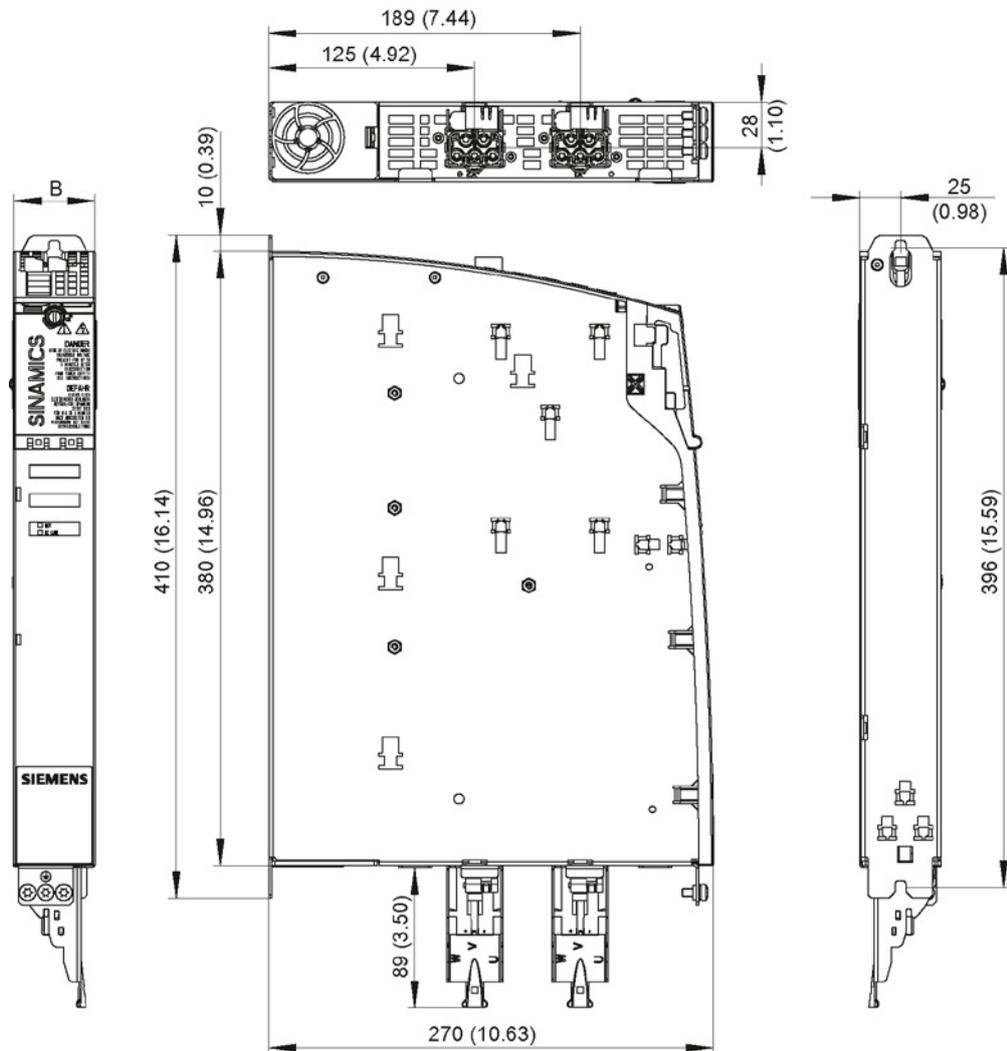


Figure 6-5 Dimension drawing of Motor Modules Booksize with internal air cooling 3 A to 18 A and 2 x 3 A to 2 x 9 A, all dimensions in mm and (inches); example: Double Motor Module 2 x 5 A

Table 6- 7 Dimensions of Motor Modules Booksize with internal air cooling 3 A to 18 A and 2 x 3 A to 2 x 9 A

| Motor Module | Order number | B [mm] (inches) |
|--------------------------|--------------------|-----------------|
| Single Motor Module 3 A | 6SL3120-1TE13-0AAx | 50 (1.97) |
| Single Motor Module 5 A | 6SL3120-1TE15-0AAx | |
| Single Motor Module 9 A | 6SL3120-1TE21-0AAx | |
| Single Motor Module 18 A | 6SL3120-1TE21-8AAx | |
| Double Motor Module 3 A | 6SL3120-2TE13-0AAx | |
| Double Motor Module 5 A | 6SL3120-2TE15-0AAx | |
| Double Motor Module 9 A | 6SL3120-2TE21-0AAx | |

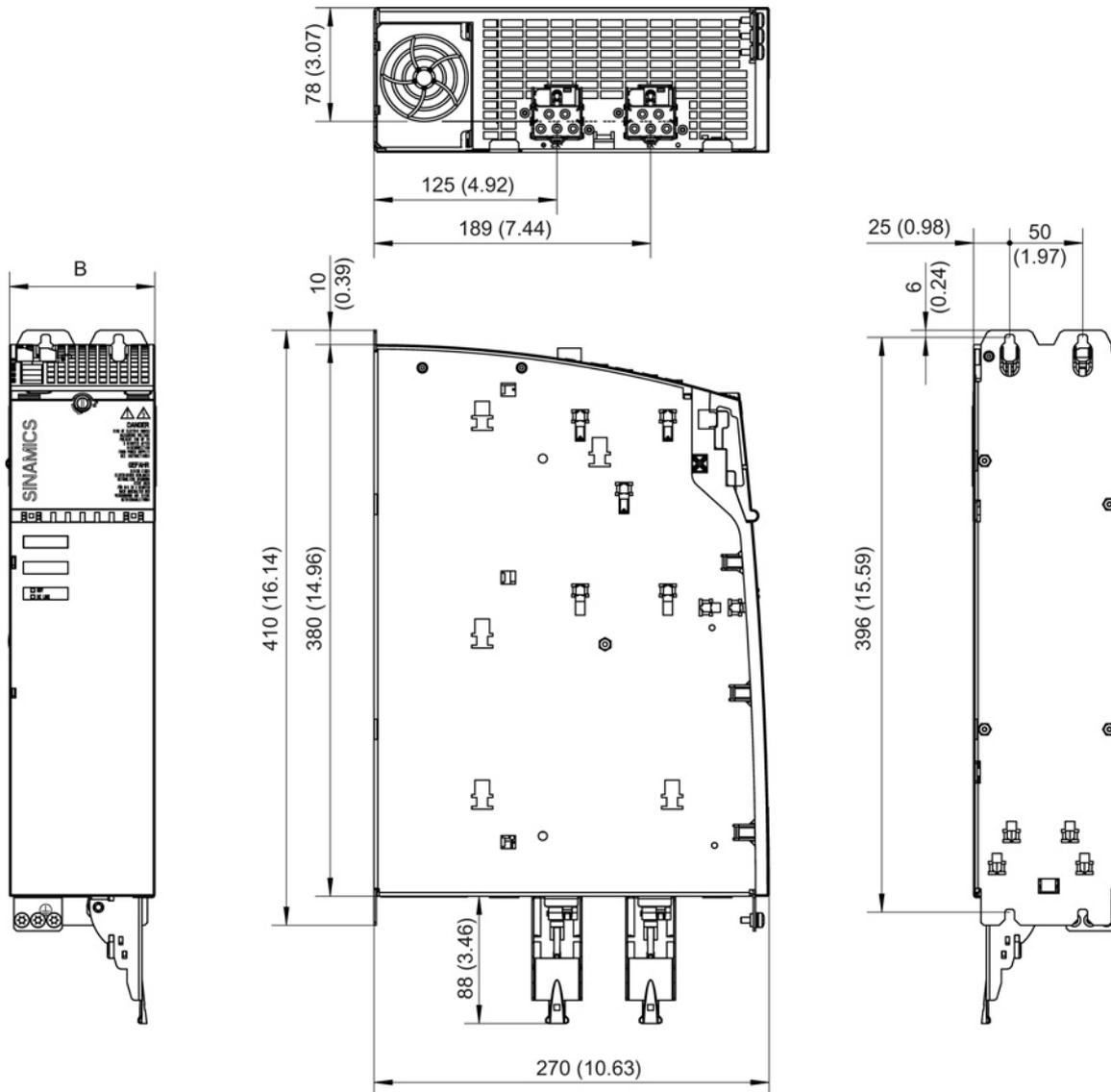


Figure 6-6 Dimension drawing of Motor Modules Booksize with internal air cooling 30 A and 2 x 18 A, all dimensions in mm and (inches); example: Double Motor Module 2 x 18 A

Table 6- 8 Dimensions of Motor Modules Booksize with internal air cooling 30 A and 2 x 18 A

| Motor Module | Order number | B [mm] (inches) |
|--------------------------|--------------------|-----------------|
| Single Motor Module 30 A | 6SL3120-1TE23-0AAx | 100 (3.94) |
| Double Motor Module 18 A | 6SL3120-2TE21-8AAx | |

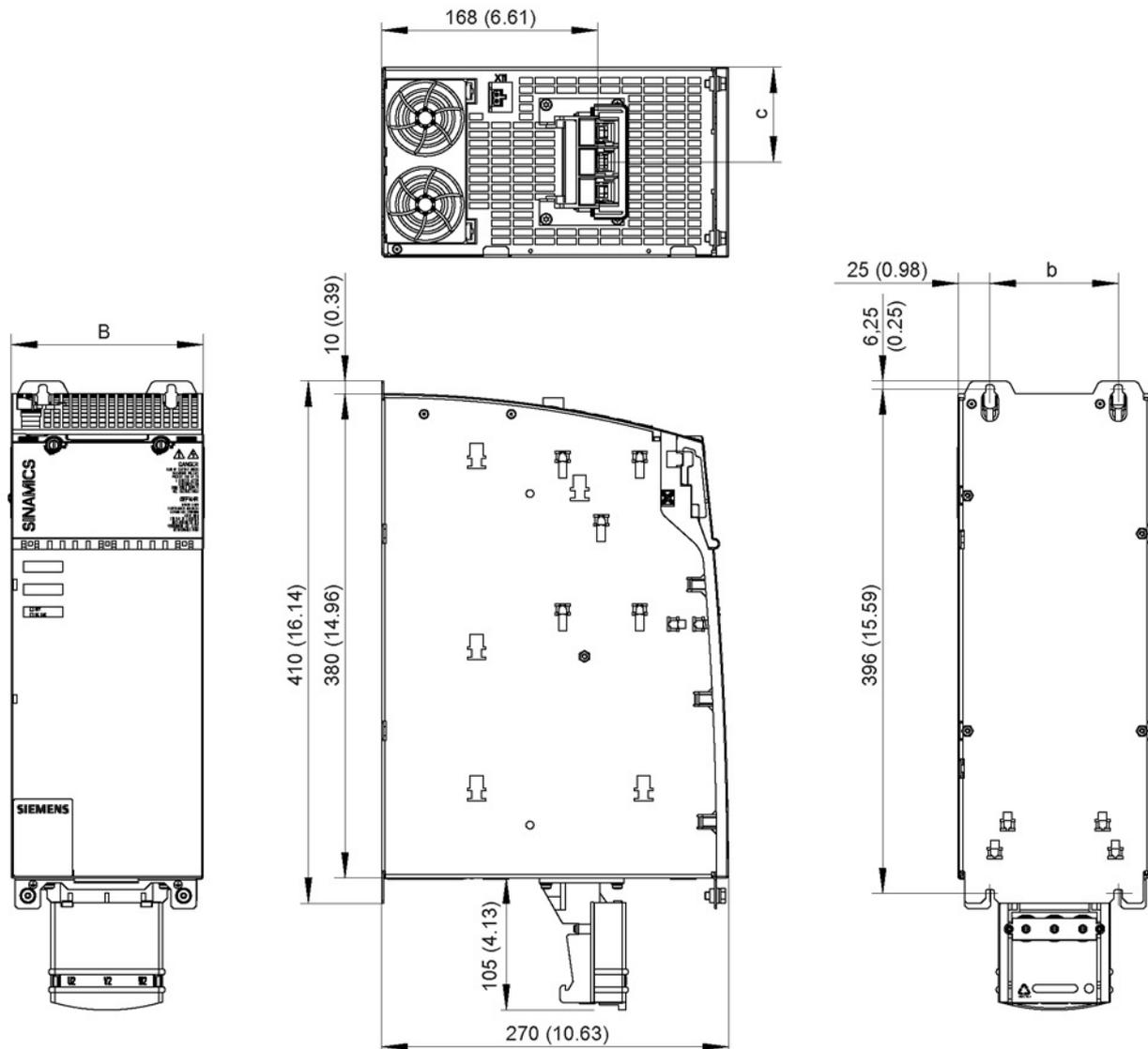


Figure 6-7 Dimension drawing of Motor Modules Booksize with internal air cooling 45 A to 85 A, all dimensions in mm and (inches); example 45 A

Table 6-9 Dimensions of Motor Modules Booksize with internal air cooling 45 A to 85 A

| Motor Module | Order number | B [mm] (inches) | b [mm] (inches) | c [mm] (inches) |
|--------------------------|--------------------|-----------------|-----------------|-----------------|
| Single Motor Module 45 A | 6SL3120-1TE24-5AAx | 150 (5.91) | 100 (3.94) | 75 (2.95) |
| Single Motor Module 60 A | 6SL3120-1TE26-0AAx | | | |
| Single Motor Module 85 A | 6SL3120-1TE28-5AAx | 200 (7.87) | 150 (5.91) | 100 (3.94) |

6.2 Motor Modules with internal air cooling

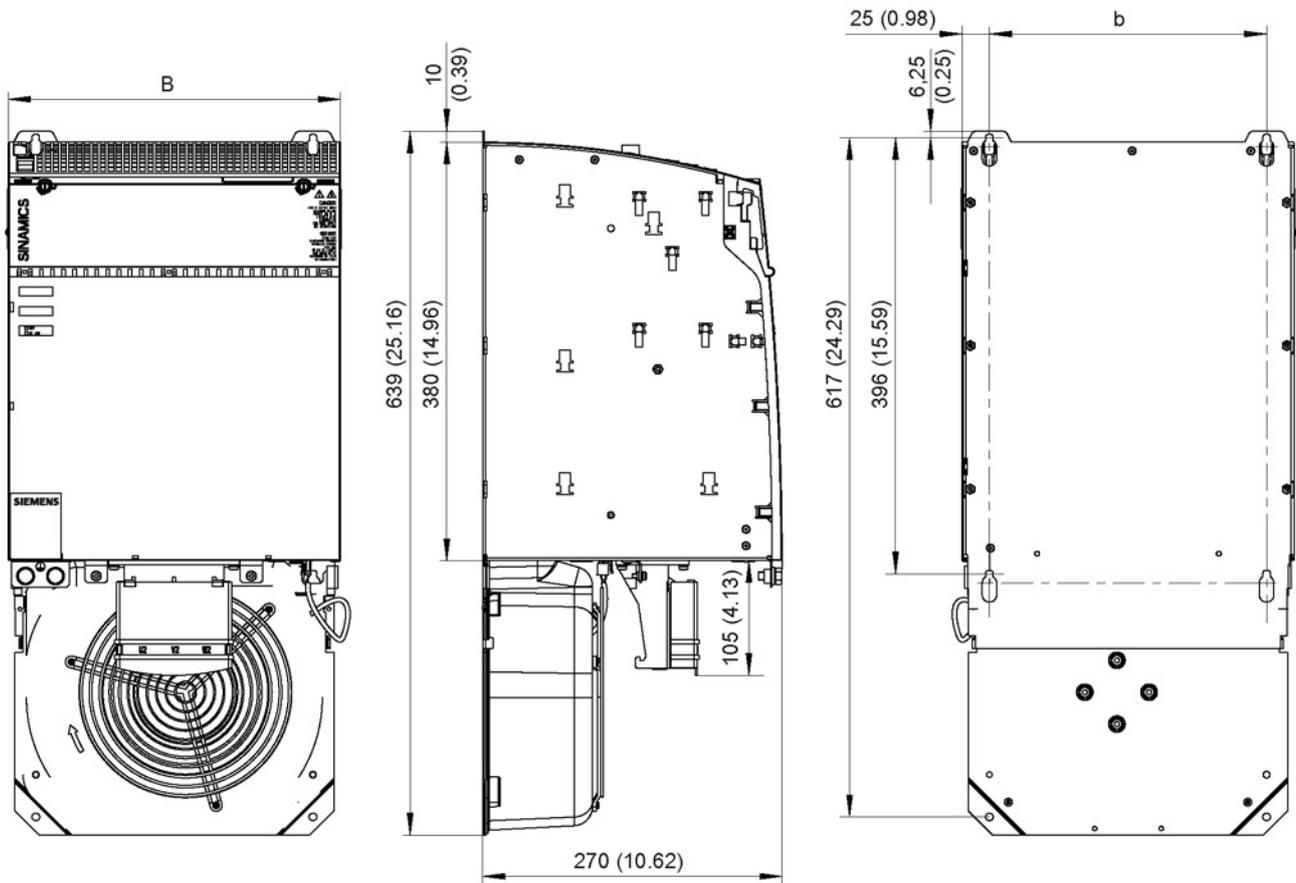


Figure 6-8 Dimension drawing of Motor Modules Booksize with internal air cooling 132 A and 200 A, all dimensions in mm and (inches)

Table 6- 10 Dimensions of Motor Modules Booksize with internal air cooling 132 A and 200 A

| Motor Module | Order number | B [mm] (inches) | b [mm] (inches) |
|---------------------------|--------------------|-----------------|-----------------|
| Single Motor Module 132 A | 6SL3120-1TE31-3AAx | 300 (11.81) | 250 (9.84) |
| Single Motor Module 200 A | 6SL3120-1TE32-0AAx | | |

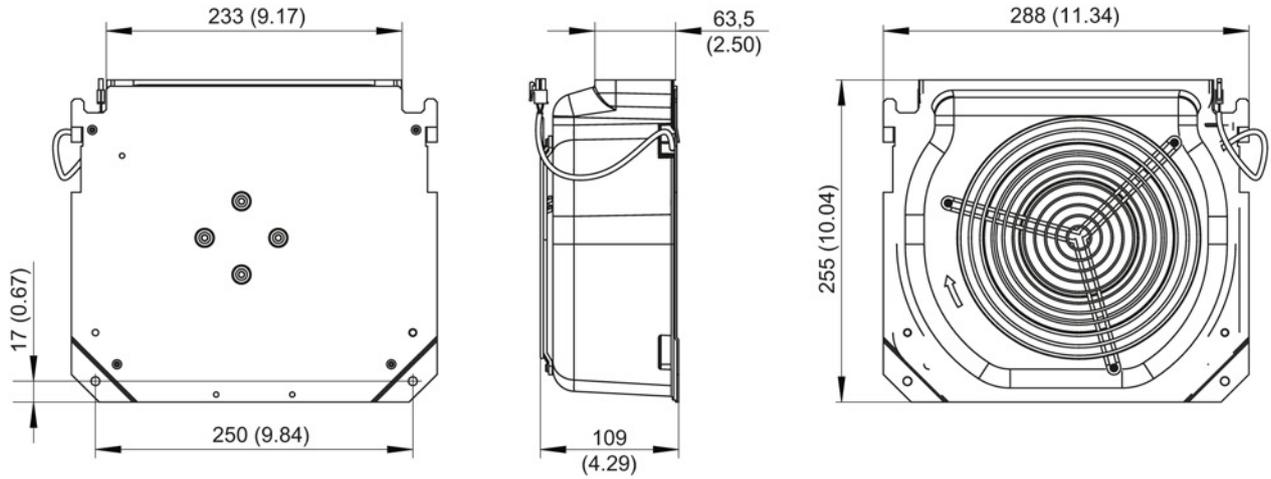


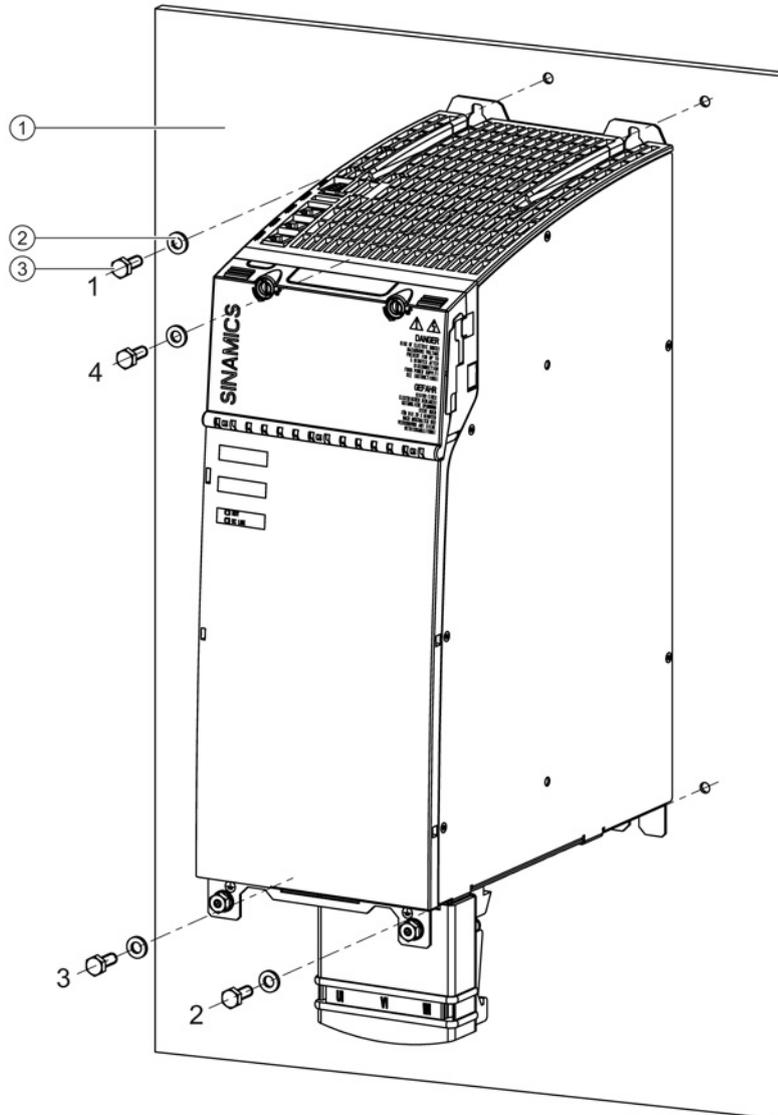
Figure 6-9 Dimension drawing of fans for Motor Modules 132 A and 200 A with internal air cooling, all dimensions in mm and (inches)

Note

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

6.2.6 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 6-10 Installation of a Motor Module with internal air cooling (example 45 A)

Tightening torques:

- Firstly, tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
Tightening torque: 6 Nm

Mounting the sub-chassis fan

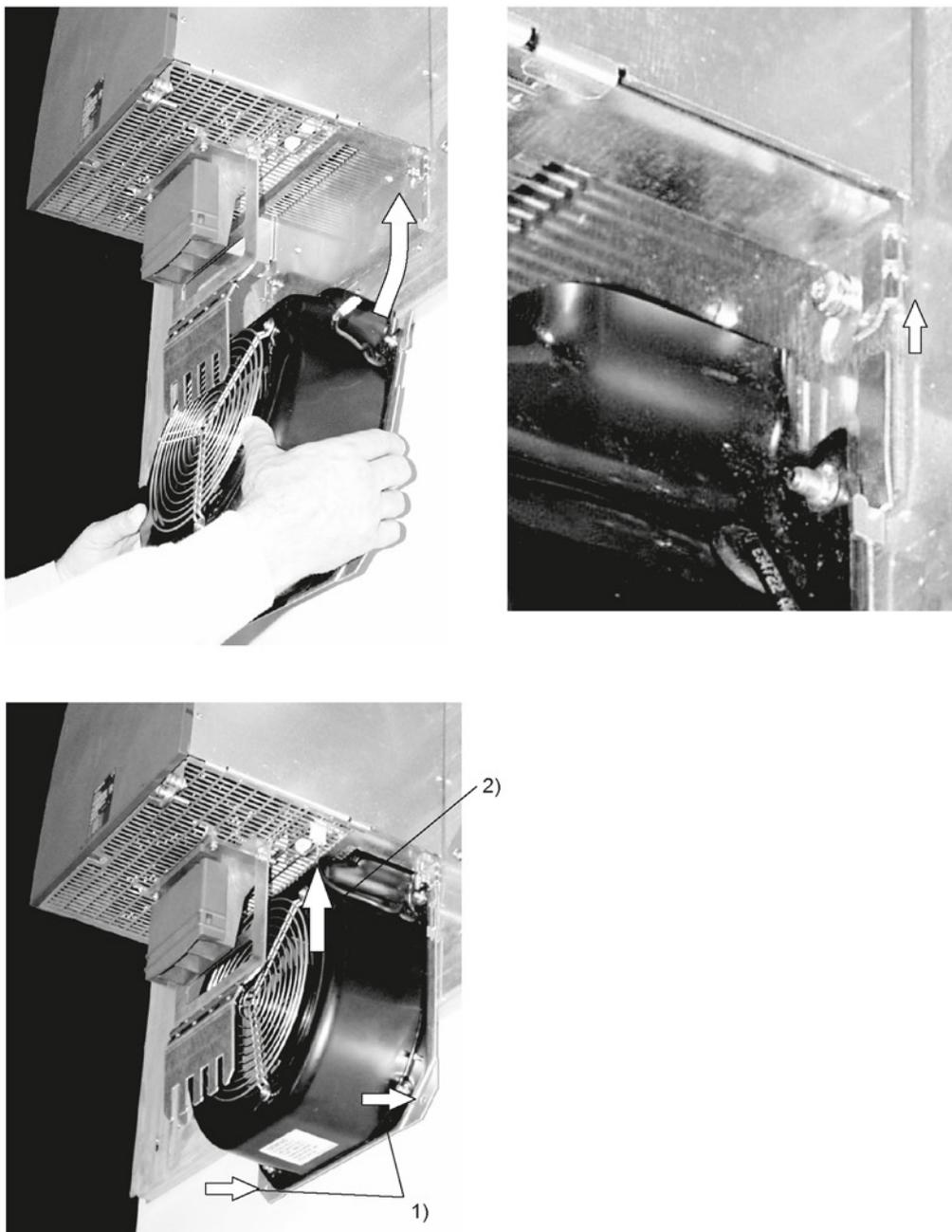


Figure 6-11 Mounting the fan for Motor Modules 132 A and 200 A

1. Fix the fan with M6 screws
Tightening torque: 6 Nm
2. Connect the fan power supply.

6.2.7 Technical data

6.2.7.1 Single Motor Modules

Table 6- 11 Technical data Single Motor Modules Booksize (3 to 30 A)

| Internal air cooling | 6SL3120- | 1TE13-0AAx ¹⁾ | 1TE15-0AAx ¹⁾ | 1TE21-0AAx ¹⁾ | 1TE21-8AAx ¹⁾ | 1TE23-0AAx |
|---|--------------------|-------------------------------|--------------------------|--------------------------|--------------------------|------------|
| Output current | | | | | | |
| Rated current (I _N) | A _{ACrms} | 3 | 5 | 9 | 18 | 30 |
| Base-load current (I _H) | A | 2,6 | 4,3 | 7,7 | 15,3 | 25,5 |
| Intermittent duty current (I _{s6}) 40% | A _{ACrms} | 3,5 | 6 | 10 | 24 | 40 |
| Peak current (I _{max}) | A _{ACrms} | 6 | 10 | 18 | 36 | 56 |
| Output voltage | V _{ACrms} | 0 ... 0.717 x DC-link voltage | | | | |
| DC-link current I _{d max} | A _{DC} | 3,6 | 6 | 11 | 22 | 36 |
| DC-link voltage (up to 2000 m above sea level) | V _{DC} | 510 ... 720 | | | | |
| DC-link capacitance | µF | 110 | 110 | 110 | 220 | 705 |
| Overvoltage trip | V _{DC} | 820 ± 2 % | | | | |
| Undervoltage trip ²⁾ | V _{DC} | 380 ± 2 % | | | | |
| Electronics power supply | V _{DC} | 24 (20,4 ... 28,8) | | | | |
| Electronics current drawn at 24 VDC | A _{DC} | 0,85 | 0,85 | 0,85 | 0,85 | 0,8 |
| Current carrying capacity | | | | | | |
| DC-link busbars | A _{DC} | 100 | | | | |
| Reinforced DC-link busbars | A _{DC} | 150 | | | | |
| 24 VDC busbars | A _{DC} | 20 | | | | |
| Unit rating³⁾ | | | | | | |
| Based on I _N (600 VDC; 4 kHz) | kW | 1,6 | 2,7 | 4,8 | 9,7 | 16 |
| Based on I _H | kW | 1,4 | 2,3 | 4,1 | 8,2 | 13,7 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 50,4 | 73,4 | 100,4 | 185,4 | 309,2 |
| Max. pulse frequency without derating | kHz | 4 | | | | |
| with derating | kHz | 16 | | | | |
| Max. ambient temperature without derating | ° C | 40 | | | | |
| with derating | ° C | 55 | | | | |
| Sound pressure level | dB(A) | < 60 | < 60 | < 60 | < 60 | < 60 |
| Cooling method | | Internal fan | | | | |
| Cooling air requirement | m ³ /h | 29,6 | 29,6 | 29,6 | 29,6 | 56 |
| Max. permissible heat sink temperature | ° C | 75 | 75 | 79 | 82 | 85 |
| Weight | kg | 5 | 5 | 5 | 5 | 6,9 |

1) Applies only to order numbers with x = 0 .. 3

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

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

Table 6- 12 Technical data Single Motor Modules Booksize (45 to 200 A)

| Internal air cooling | 6SL3120 | 1TE24-5AAx | 1TE26-0AAx | 1TE28-5AAx | 1TE31-3AAx | 1TE32-0AAx |
|--|--------------|-------------------------------|------------|------------|-------------|-------------------------|
| | – | | | | | |
| Output current | | | | | | |
| Rated current (I_n) | A_{ACrms} | 45 | 60 | 85 | 132 | 200 |
| Base-load current (I_H) | A | 38 | 51 | 68 | 105 | 141 |
| Intermittent duty current (I_{s6}) | A_{ACrms} | 60 | 80 | 110 | 150 | 230 |
| 40% | A_{ACrms} | 85 | 113 | 141 | 210 | 282 |
| Peak current (I_{max}) | | | | | | |
| Output voltage | V_{ACrms} | 0 ... 0.717 x DC-link voltage | | | | |
| DC-link current $I_{d max}$ | A_{DC} | 54 | 72 | 102 | 158 | 200 |
| DC-link voltage (up to 2000 m above sea level) | V_{DC} | 510 ... 720 | | | | |
| DC-link capacitance | μF | 1175 | 1410 | 1880 | 2820 | 3995 |
| Overvoltage trip | V_{DC} | 820 \pm 2 % | | | | |
| Undervoltage trip ¹⁾ | V_{DC} | 380 \pm 2 % | | | | |
| Electronics power supply | V_{DC} | 24 (20,4 ... 28,8) | | | | |
| Electronics current drawn at 24 VDC | A_{DC} | 1,05 | 1,05 | 1,5 | 0,85 | 0,85 |
| Current carrying capacity | | | | | | |
| DC-link busbars | A_{DC} | 200 | 200 | 200 | 200 | 200 |
| 24 VDC busbars | A_{DC} | 20 | 20 | 20 | 20 | 20 |
| Unit rating²⁾ | | | | | | |
| Based on I_n (600 VDC; 4 kHz) | kW | 24 | 32 | 46 | 71 | 107 |
| Based on I_H | kW | 21 | 28 | 37 | 57 | 76 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 455,2 | 615,2 | 786 | 1270,4 | 2070,4 |
| Max. pulse frequency | | | | | | |
| without derating | kHz | 4 | | | | |
| with derating | kHz | 16 | | | | |
| Max. ambient temperature | | | | | | |
| without derating | $^{\circ} C$ | 40 | | | | |
| with derating | $^{\circ} C$ | 55 | | | | |
| Sound pressure level | dB(A) | < 65 | < 65 | < 60 | < 73 | < 73 |
| Cooling method (with fan) | | Internal fan | | | Mounted fan | |
| Cooling air requirement | m^3/h | 112 | 112 | 160 | 520 | 520 |
| Max. permissible heat sink temperature | $^{\circ} C$ | 85 | 90 | 83 | 70 | 80 (70% derating) |
| Weight | kg | 9 | 9 | 15 | 21 | 21 |

1) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V (exception: 132 A and 200 A Motor Modules) and is adjusted to the parameterized rated voltage.

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

6.2.7.2 Double Motor Modules

Table 6- 13 Double Motor Modules Booksize (3 to 18 A) technical data

| Internal air cooling | 6SL3120- | 2TE13-0AAx ¹⁾ | 2TE15-0AAx ¹⁾ | 2TE21-0AAx ¹⁾ | 2TE21-8AAx |
|---|--------------------|-------------------------------|--------------------------|--------------------------|------------|
| Output current | | | | | |
| Rated current (I _N) | A _{ACrms} | 2 x 3 | 2 x 5 | 2 x 9 | 2 x 18 |
| Base-load current (I _H) | A | 2 x 2.6 | 2 x 4.3 | 2 x 7.7 | 2 x 15.3 |
| Intermittent duty current (I _{s6}) 40% | A _{ACrms} | 2 x 3.5 | 2 x 6 | 2 x 10 | 2 x 24 |
| Peak current (I _{max}) | A _{ACrms} | 2 x 6 | 2 x 10 | 2 x 18 | 2 x 36 |
| Output voltage | V _{ACrms} | 0 ... 0.717 x DC-link voltage | | | |
| DC-link current I _{d max} | A _{DC} | 7,2 | 12 | 22 | 43 |
| DC-link voltage | V _{DC} | 510 ... 720 | | | |
| DC-link capacitance | µF | 220 | 220 | 220 | 705 |
| Overvoltage trip | V _{DC} | 820 ± 2 % | | | |
| Undervoltage trip ²⁾ | V _{DC} | 380 ± 2 % | | | |
| Electronics power supply | V _{DC} | 24 (20,4 28,8) | | | |
| Electronics current drawn at 24 VDC | A _{DC} | 1,15 | 1,15 | 1,15 | 1,3 |
| Current carrying capacity | | | | | |
| DC-link busbars | A _{DC} | 100 | | | |
| Reinforced DC-link busbars | A _{DC} | 150 | | | |
| 24 VDC busbars | A | 20 | | | |
| Unit rating³⁾ | | | | | |
| Based on I _N (600 VDC; 4 kHz) | kW | 2 x 1.6 | 2 x 2.7 | 2 x 4.8 | 2 x 9.7 |
| Based on I _H | kW | 2 x 1.4 | 2 x 2.3 | 2 x 4.1 | 2 x 8.2 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 97,6 | 132,6 | 187,6 | 351,2 |
| Max. pulse frequency | | | | | |
| without derating | kHz | 4 | | | |
| with derating | kHz | 16 | | | |
| Max. ambient temperature | | | | | |
| without derating | ° C | 40 | | | |
| with derating | ° C | 55 | | | |
| Sound pressure level | dB(A) | < 60 | < 60 | < 60 | < 60 |
| Cooling method | | Internal fan | | | |
| Cooling air requirement | m ³ /h | 29,6 | 29,6 | 29,6 | 56 |
| Max. permissible heat sink temperature | ° C | 85 | 90 | 89 | 90 |
| Weight | kg | 5,3 | 5,3 | 5,5 | 6,8 |

1) Applies only to order numbers with x = 0 .. 3

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.

6.2.7.3 Characteristics

Rated duty cycles Motor Modules Booksize

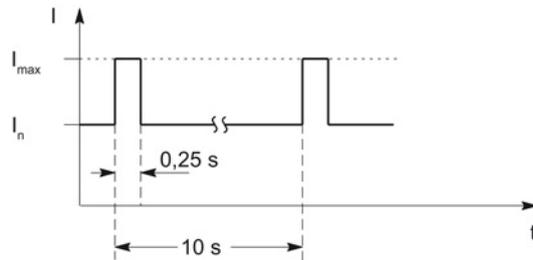


Figure 6-12 Duty cycle with initial load (for servo drives)

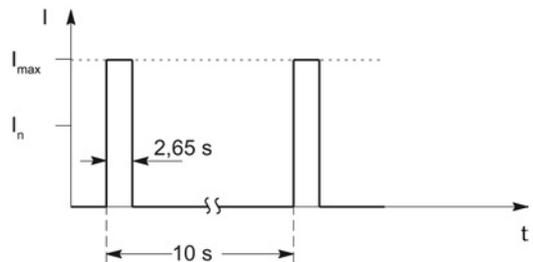


Figure 6-13 Duty cycle without initial load (for servo drives)

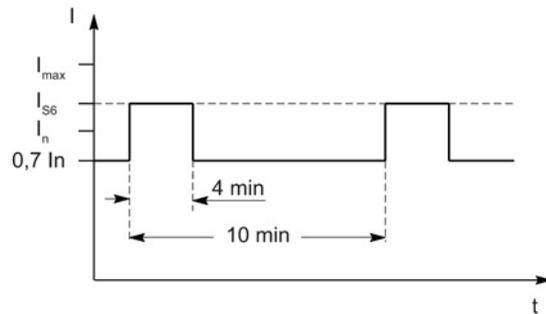


Figure 6-14 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

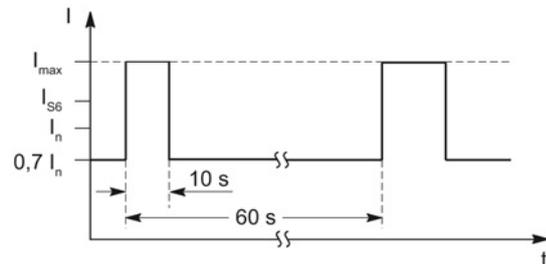


Figure 6-15 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

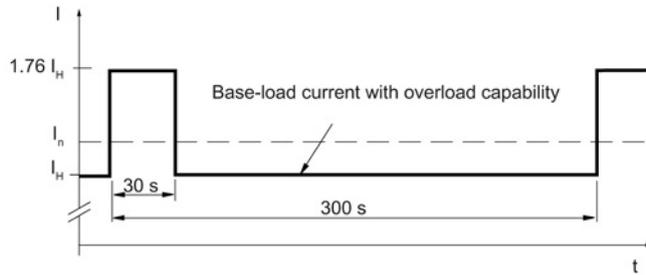


Figure 6-16 Duty cycle with 30 s overload for a duty cycle duration of 300 s

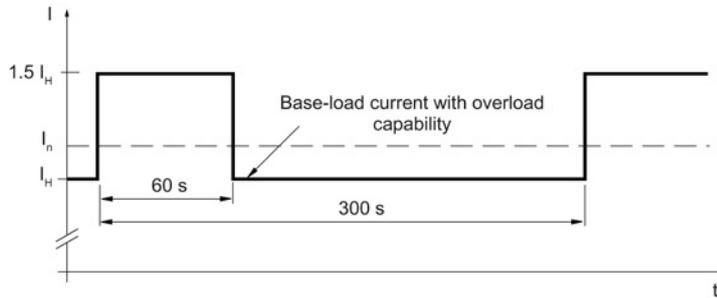


Figure 6-17 Duty cycle with 60 s overload for a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

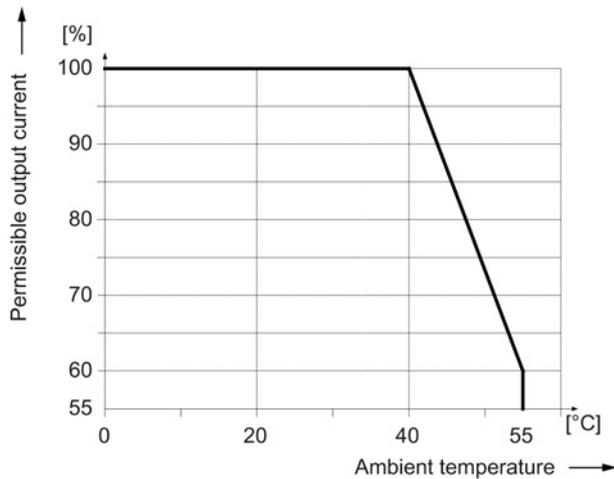


Figure 6-18 Output current as a function of the ambient temperature

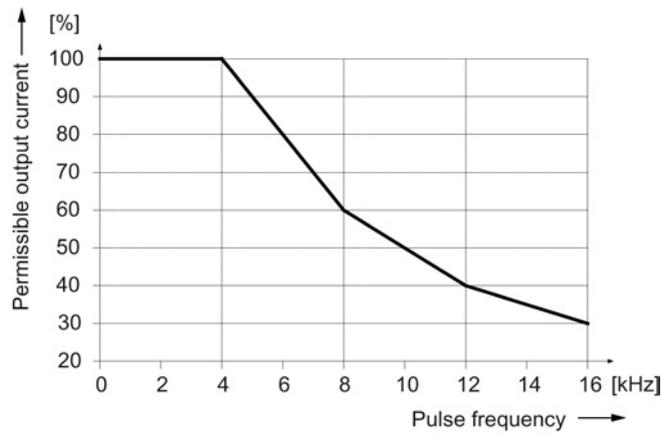


Figure 6-19 Output current as a function of the pulse frequency

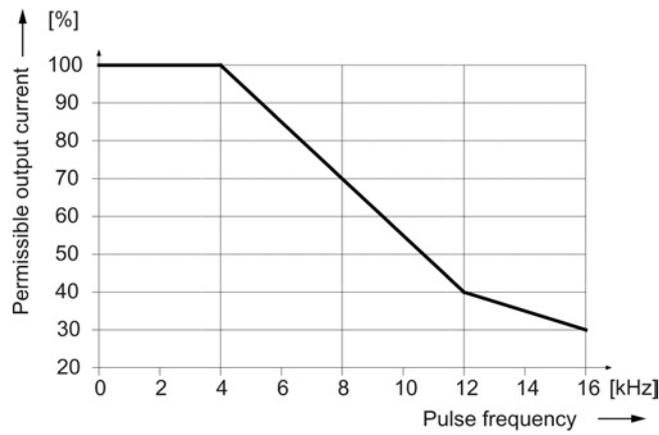


Figure 6-20 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

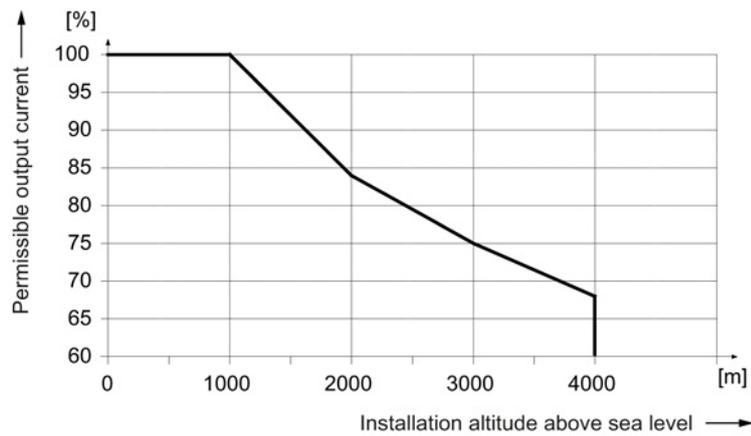


Figure 6-21 Output current as a function of the installation altitude

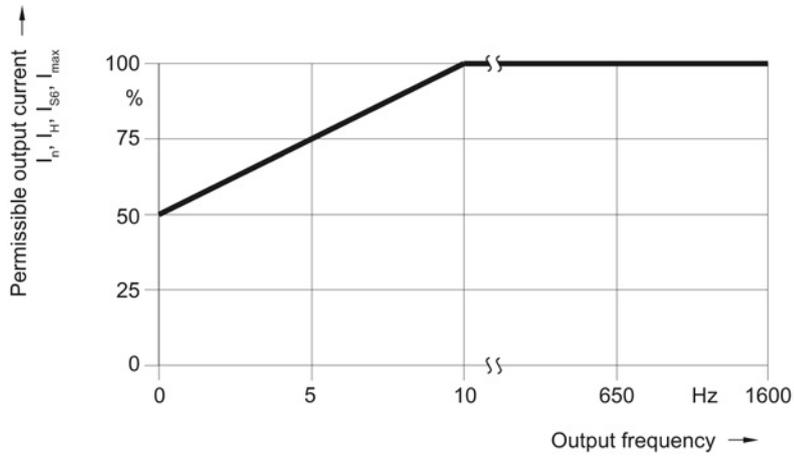


Figure 6-22 Output current as a function of the output frequency

6.2.8 Technical data for Motor Modules Booksize with 300% overload

6.2.8.1 Single Motor Modules (300% overload)

Table 6- 14 Technical data Single Motor Modules Booksize (3 to 18 A) with 300% overload

| Internal air cooling | 6SL3120- | 1TE13-0AA4 | 1TE15-0AA4 | 1TE21-0AA4 | 1TE21-8AA4 |
|---|--------------|-------------------------------|------------|------------|------------|
| Output current | | | | | |
| Rated current (I_n) | A_{ACrms} | 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_{ACrms} | 3,5 | 6 | 10 | 24 |
| Peak current (I_{max}) | A_{ACrms} | 9 | 15 | 27 | 54 |
| Output voltage | V_{ACrms} | 0 ... 0.717 x DC-link voltage | | | |
| DC-link current $I_{d max}$ | A_{DC} | 3,6 | 6 | 11 | 22 |
| DC-link voltage (up to 2000 m above sea level) | V_{DC} | 510 ... 720 | | | |
| DC-link capacitance | μF | 110 | 110 | 110 | 220 |
| Overvoltage trip | V_{DC} | 820 \pm 2 % | | | |
| Undervoltage trip ¹⁾ | V_{DC} | 380 \pm 2 % | | | |
| Electronics power supply | V_{DC} | 24 (20,4 ... 28,8) | | | |
| Electronics current drawn at 24 VDC | A_{DC} | 0,85 | 0,85 | 0,85 | 0,85 |
| Current carrying capacity | | | | | |
| DC-link busbars | A_{DC} | 100 | | | |
| Reinforced DC-link busbars | A_{DC} | 150 | | | |
| 24 VDC busbars | A_{DC} | 20 | | | |
| Unit rating²⁾ | | | | | |
| Based on I_n (600 VDC; 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 781)) | W | 50,4 | 73,4 | 100,4 | 185,4 |
| Max. pulse frequency | | | | | |
| without derating | kHz | 4 | | | |
| with derating | kHz | 16 | | | |
| Max. ambient temperature | | | | | |
| without derating | $^{\circ} C$ | 40 | | | |
| with derating | $^{\circ} C$ | 55 | | | |
| Sound pressure level | dB(A) | < 60 | | | |
| Cooling method | | Internal fan | | | |
| Cooling air requirement | m^3/h | 29,6 | | | |
| Max. permissible heat sink temperature | $^{\circ} C$ | 74 | 74 | 75 | 90 |
| Weight | kg | 5 | 5 | 5 | 5 |

1) 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

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

Note

Disturbance of the 18 A Single Motor Module with 300% overload during operation on a 16 kW Line Module

The maximum output of a 16 kW Line Module is not sufficient for the operation of an 18 A Single Motor Module with 300% overload.

- Do NOT operate the 18 A Single Motor Module with 300% overload on a 16 kW Line Module.
 - Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.
 - Only operate an 18 A Single Motor Module on a 16 kW Line Module when the maximum current is limited to $2 \times I_{rated}$.
-

6.2.8.2 Double Motor Modules (300% overload)

Table 6- 15 Technical data Double Motor Modules Booksize (2 x 3 to 2 x 9 A) with 300% overload

| Internal air cooling | 6SL3120- | 2TE13-0AA4 | 2TE15-0AA4 | 2TE21-0AA4 |
|---|--------------------|-------------------------------|------------|------------|
| Output current | | | | |
| Rated current (I_n) | A _{ACrms} | 2 x 3 | 2 x 5 | 2 x 9 |
| Base-load current (I_H) | A | 2 x 2.6 | 2 x 4.3 | 2 x 7.7 |
| Intermittent duty current (I_{s6}) 40% | A _{ACrms} | 2 x 3.5 | 2 x 6 | 2 x 10 |
| Peak current (I_{max}) | A _{ACrms} | 2 x 9 | 2 x 15 | 2 x 27 |
| Output voltage | V _{ACrms} | 0 ... 0.717 x DC-link voltage | | |
| DC-link current $I_{d max}$ | A _{DC} | 7,2 | 12 | 22 |
| DC-link voltage (up to 2000 m above sea level) | V _{DC} | 510 ... 720 | | |
| DC-link capacitance | μF | 220 | | |
| Overvoltage trip | V _{DC} | 820 ± 2 % | | |
| Undervoltage trip ¹⁾ | V _{DC} | 380 ± 2 % | | |
| Electronics power supply | V _{DC} | 24 (20,4 ... 28,8) | | |
| Electronics current drawn at 24 VDC | A _{DC} | 1,15 | | |
| Current carrying capacity | | | | |
| DC-link busbars | A _{DC} | 100 | | |
| Reinforced DC-link busbars | A _{DC} | 150 | | |
| 24 VDC busbars | A | 20 | | |
| Unit rating²⁾ | | | | |
| Based on I_n (600 VDC; 4 kHz) | kW | 2 x 1.6 | 2 x 2.7 | 2 x 4.8 |
| Based on I_H | kW | 2 x 1.4 | 2 x 2.3 | 2 x 4.1 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 97,6 | 132,6 | 187,6 |
| Max. pulse frequency | | | | |
| without derating | kHz | 4 | | |
| with derating | kHz | 16 | | |
| Max. ambient temperature | | | | |
| without derating | ° C | 40 | | |
| with derating | ° C | 55 | | |
| Sound pressure level | dB(A) | < 60 | | |
| Cooling method | | Internal fan | | |
| Cooling air requirement | m ³ /h | 29,6 | | |
| Max. permissible heat sink temperature | ° C | 84 | 78 | 92 |
| Weight | kg | 5,3 | 5,3 | 5,5 |

1) 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

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

Note

Disturbance of the 2 x 9 A Double Motor Module with 300% overload during operation on a 16 kW Line Module

The maximum output of a 16 kW Line Module is not sufficient for the operation of a 2 x 9 A Double Motor Module with 300% overload.

- Do NOT operate the 2 x 9 A Double Motor Module with 300% overload on a 16 kW Line Module.
 - Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.
 - Only operate a 2 x 9 A Double Motor Module on a 16 kW Line Module when the maximum current is limited to $2 \times I_{\text{rated}}$.
-

6.2.8.3 Characteristics for Motor Modules Booksize with 300% overload

Rated duty cycles Motor Modules Booksize with 300% overload

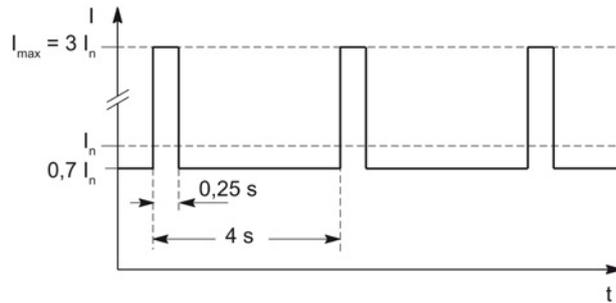


Figure 6-23 Peak current duty cycle with initial load (300% overload)

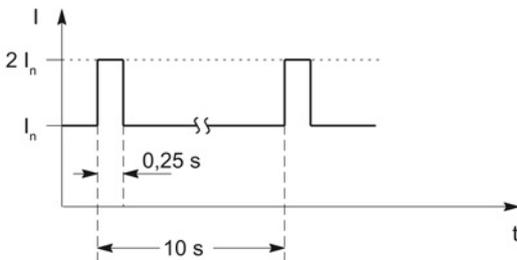


Figure 6-24 Duty cycle with initial load

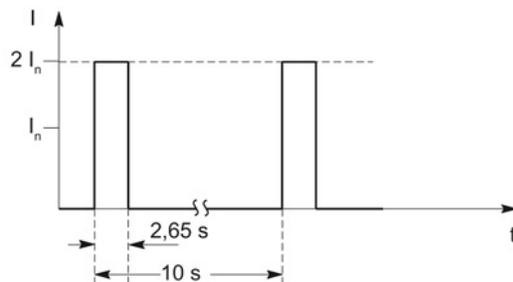


Figure 6-25 Duty cycle without initial load

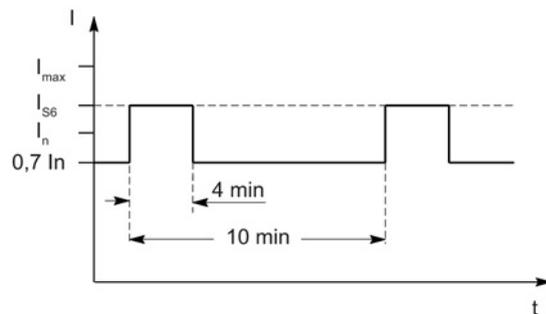


Figure 6-26 S6 duty cycle with initial load for a duty cycle duration of 600 s

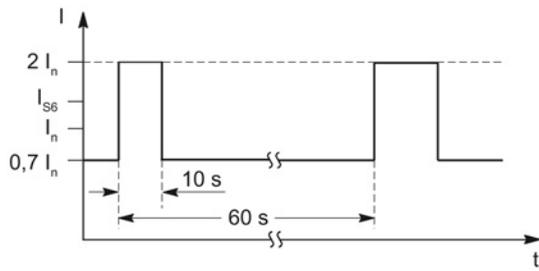


Figure 6-27 S6 duty cycle with initial load for a duty cycle duration of 60 s

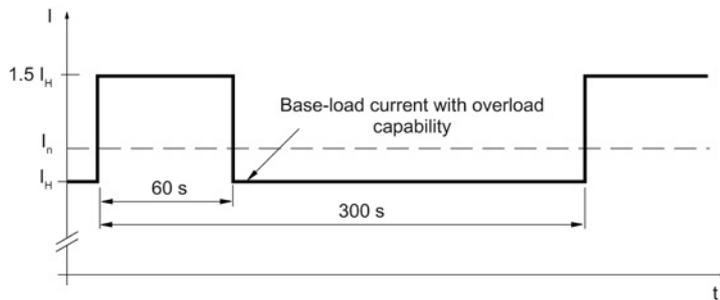


Figure 6-28 Duty cycle with 60 s overload for a duty cycle duration of 300 s

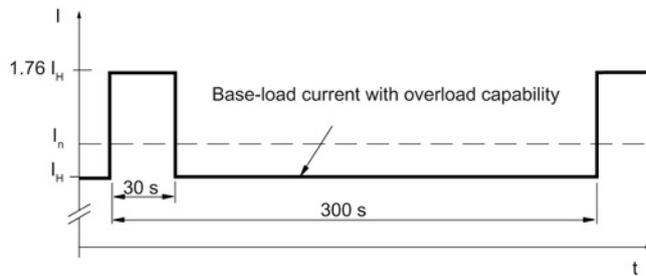


Figure 6-29 Duty cycle with 30 s overload for a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize with 300% overload

Note

For additional information, see Chapter Combining line reactors and line filters (Page 136).

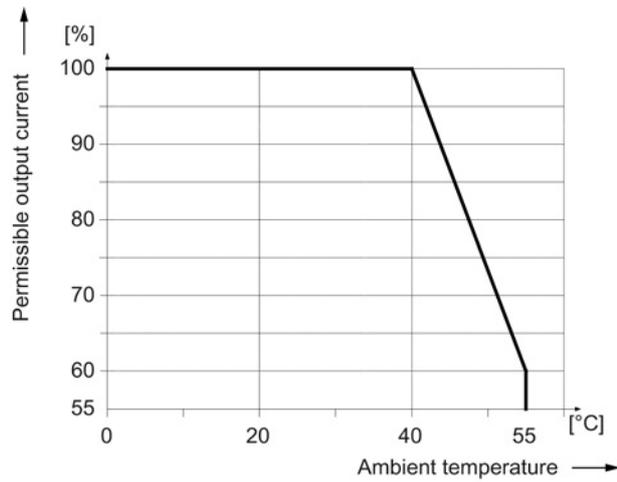


Figure 6-30 Output current as a function of the ambient temperature

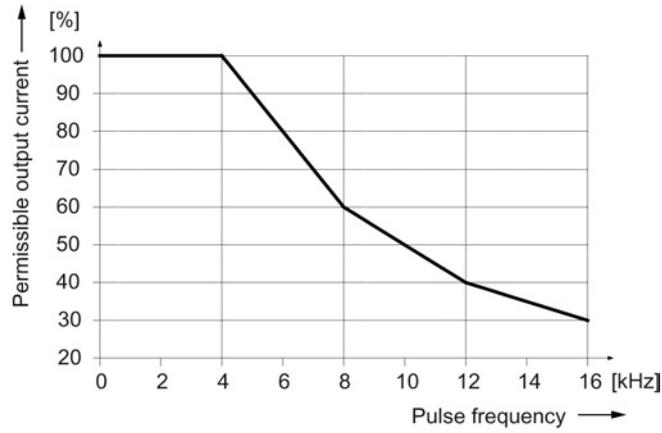


Figure 6-31 Output current as a function of the pulse frequency

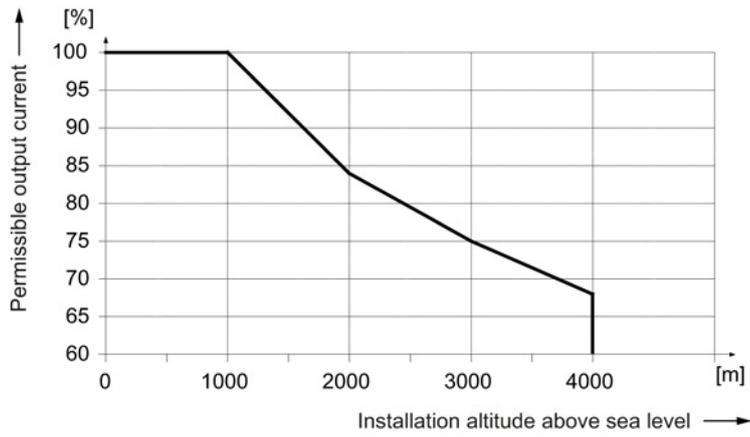


Figure 6-32 Output current as a function of the installation altitude

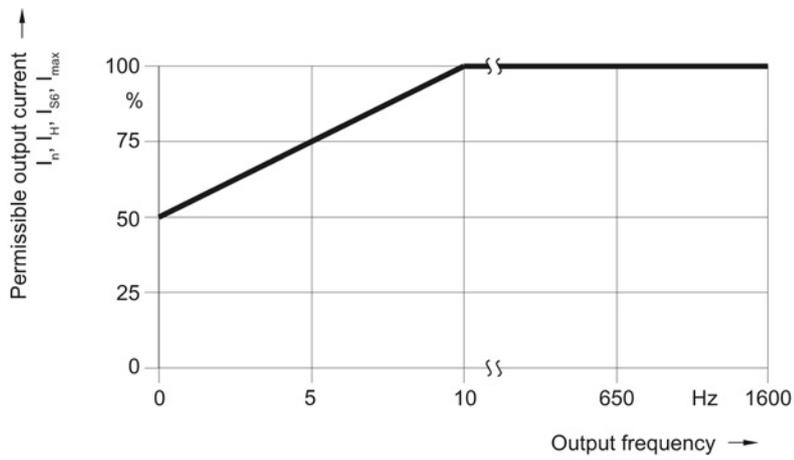


Figure 6-33 Output current as a function of the output frequency

6.3 Motor Module with external air cooling

6.3.1 Description

A Motor Module with external cooling 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.

Motor Modules with external air cooling are offered as Single Motor Modules and Double Motor Modules. One motor can be connected to Single Motor Modules and 2 motors can be connected to Double Motor Modules.

External air cooling uses the "through-hole" method. The power unit and its heat sink can be inserted in a rectangular knockout at the rear of the control cabinet and mounted with a seal. The heat sink fins and the fan (included in the scope of delivery) project beyond the rear of the control cabinet and the heat is dissipated outside the control cabinet or in a separate air duct.



WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

6.3.2 Interface description

6.3.2.1 Overview

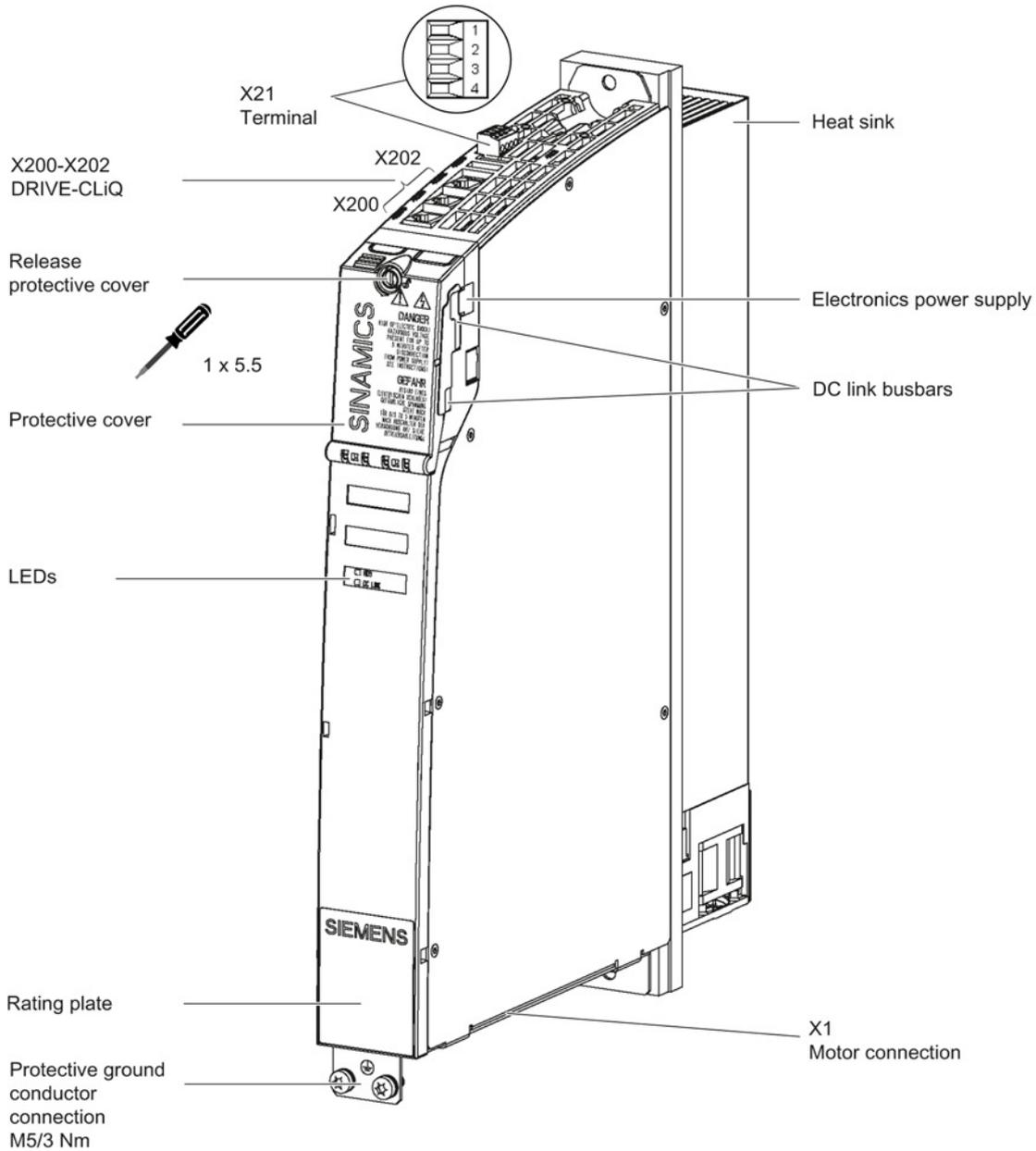


Figure 6-34 Interface overview, Single Motor Module Booksize with external air cooling (example: 5 A)

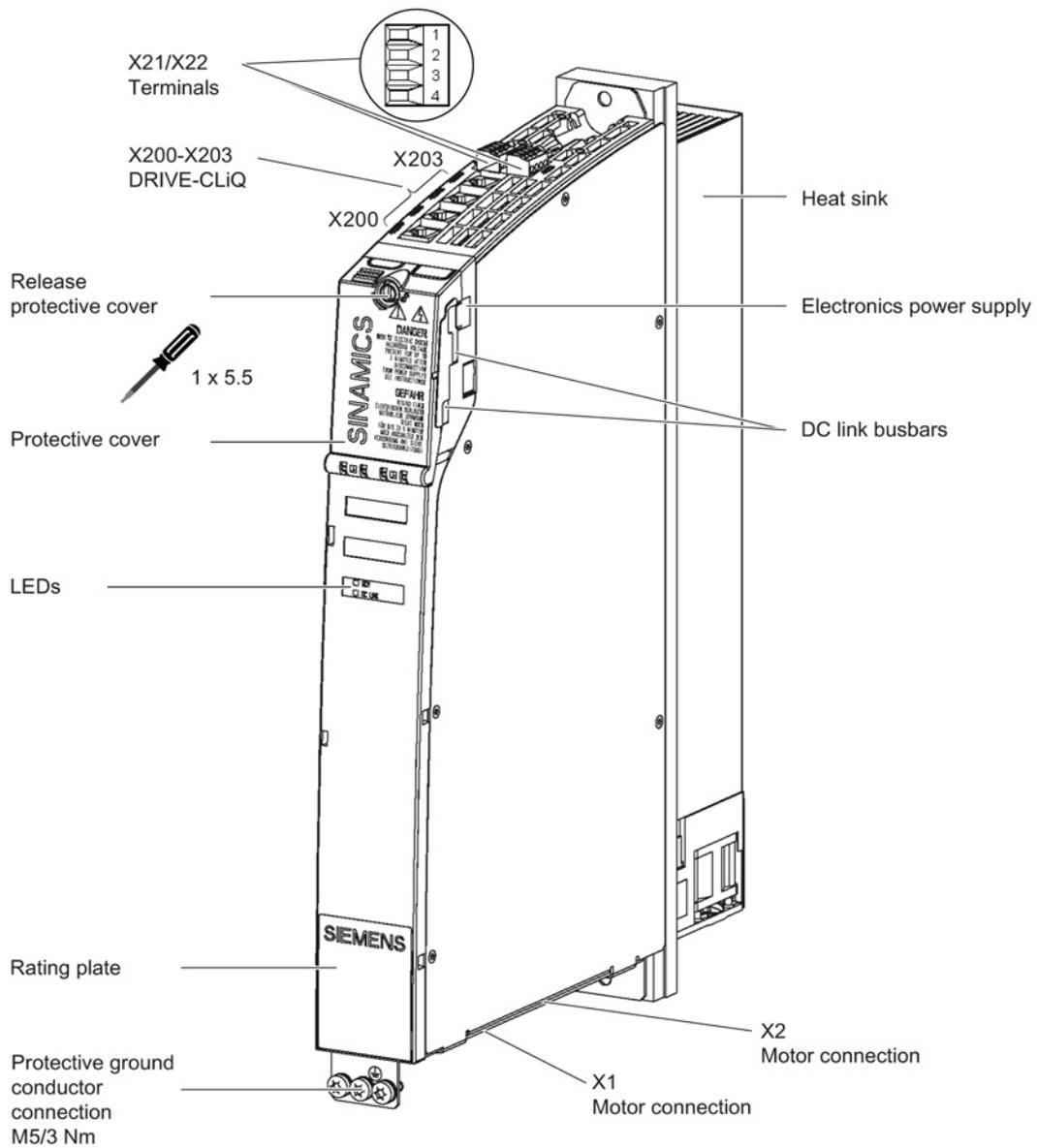
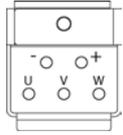
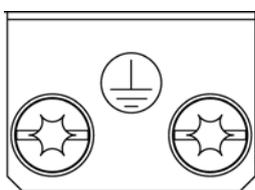
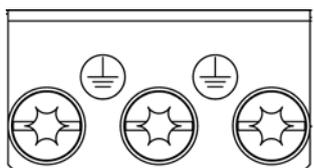


Figure 6-35 Interface overview, Double Motor Module Booksize with external air cooling (example: 2 x 5 A)

6.3 Motor Module with external air cooling

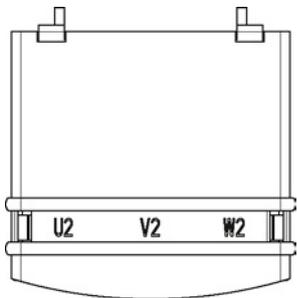
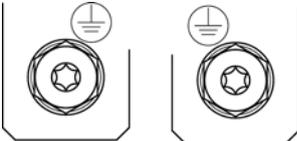
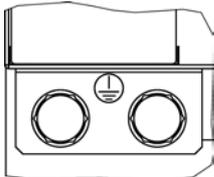
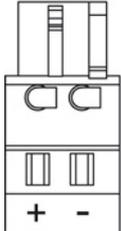
6.3.2.2 Motor and brake connection

Table 6- 16 X1/X2 motor and brake connection for Single Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

| | Terminal | Technical data |
|--|---------------|--|
|  | U (U2) | Motor connection |
| | V (V2) | |
| | W (W2) | |
| | + (BR+) | Brake connection |
| | - (BR-) | Max. load current: 2 A Minimum load current: 0.1 A |
|  | PE connection | Single Motor Modules 3 ... 30 A: Threaded hole M5 / 3 Nm ¹⁾ |
| | | Double Motor Modules 3 ... 18 A: Threaded hole M5 / 3 Nm ¹⁾ |
|  | | |

1) For ring cable lugs without insulation

Table 6- 17 X1 motor connection and X11 brake connection for Single Motor Modules 45 A to 200 A

| | Terminal | Technical data |
|---|---------------|---|
|  | U2 | 45 ... 60 A: Threaded bolts M6 / 6 Nm ¹⁾ 85 A: Threaded bolts M8 / 13 Nm ¹⁾ 132 ... 200 A: Threaded bolts M8 / 13 Nm ¹⁾ |
| | V2 | |
| | W2 | |
|  | PE connection | 45 ... 60 A: Threaded bolts for motor cables: M6 / 6 Nm ¹⁾ Threaded hole for PE: M6 / 6 Nm ¹⁾ |
| | |  |
|  | + (BR+) | X11 brake connector²⁾: Voltage: 24 V DC Max. load current: 2 A Minimum load current: 0.1 A Type: Spring-loaded terminal 2 (Page 754) Max. cross-section that can be connected 2.5 mm ² : The brake connector is part of the prefabricated cable. |
| | - (BR-) | |

1) For ring cable lugs without insulation

2) The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.



! WARNING

Danger to life as a result of a hazardous voltage at the 0 V to 48 V DC terminals

Death or serious injury can result when live parts are touched in the event of a fault.

- Only connect protective extra-low voltages (PELV / SELV) to all connections and terminals between 0 to 48 V DC.

| |
|---|
| <p>NOTICE</p> <p>Destruction of the motor or motor holding brake as a result of high voltage tolerances of the motor holding brakes</p> <p>If the voltage tolerances of the motor holding brakes are not complied with (24 V ± 10 %), then the brake will malfunction, i.e. the brake will not reliably open. If the motor constantly runs against the closed brake, the brake or the motor will be destroyed.</p> <ul style="list-style-type: none"> • Set the DC power supply to 26 V. <p>The following general conditions must be satisfied:</p> <ul style="list-style-type: none"> • Siemens three-phase motors must be used • Siemens MOTION-CONNECT power cables must be used • Motor cable lengths, max. 100 m |
|---|

Note

The total length of the power cables (motor feeder cables and DC link cables) must not exceed the values listed in Chapter Combining line reactors and line filters (Page 136).

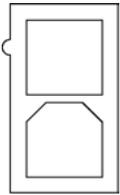
Note

The motor brake must be connected via connector X11. It is not permitted to directly connect the cable BR – to the electronics ground M.

6.3.2.3 X12 fan connection

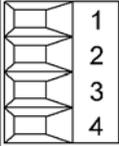
The Motor Modules 132 A and 200 A are equipped with an interface to connect a sub-chassis fan. The interface is located on the underside of the Motor Module.

Table 6- 18 X12 fan connection

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

6.3.2.4 X21/X22 EP terminals/temperature sensor

Table 6- 19 X21/X22 EP terminals / temperature sensor

| | Terminal | Function | Technical data |
|---|----------|-------------------------|---|
|  | 1 | + Temp | Temperature sensors: KTY 84-1C130/PTC/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: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled. |
| | 4 | EP M1 (enable pulses) | |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm ² | | | |

EP terminals

Parameters are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4 (see 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 is only available when Safety Integrated Basic Functions are enabled.

Temperature sensor connection**NOTICE****Risk of the motor overheating due to an incorrectly connected KTY temperature sensor**

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY sensor with the correct polarity.

Note

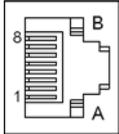
The temperature sensor input is not needed if the motors feature an integrated DRIVE-CLiQ interface or if temperature values are detected by means of a different module (SMC, SME, TM).



| |
|---|
|  WARNING |
| <p>Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor</p> <p>Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.</p> <ul style="list-style-type: none"> • Use temperature sensors that fully comply with the specifications of the safety isolation. • 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. |

6.3.2.5 X200-X203 DRIVE-CLiQ interface

Table 6- 20 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules
 X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

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

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

6.3.3 Connection examples

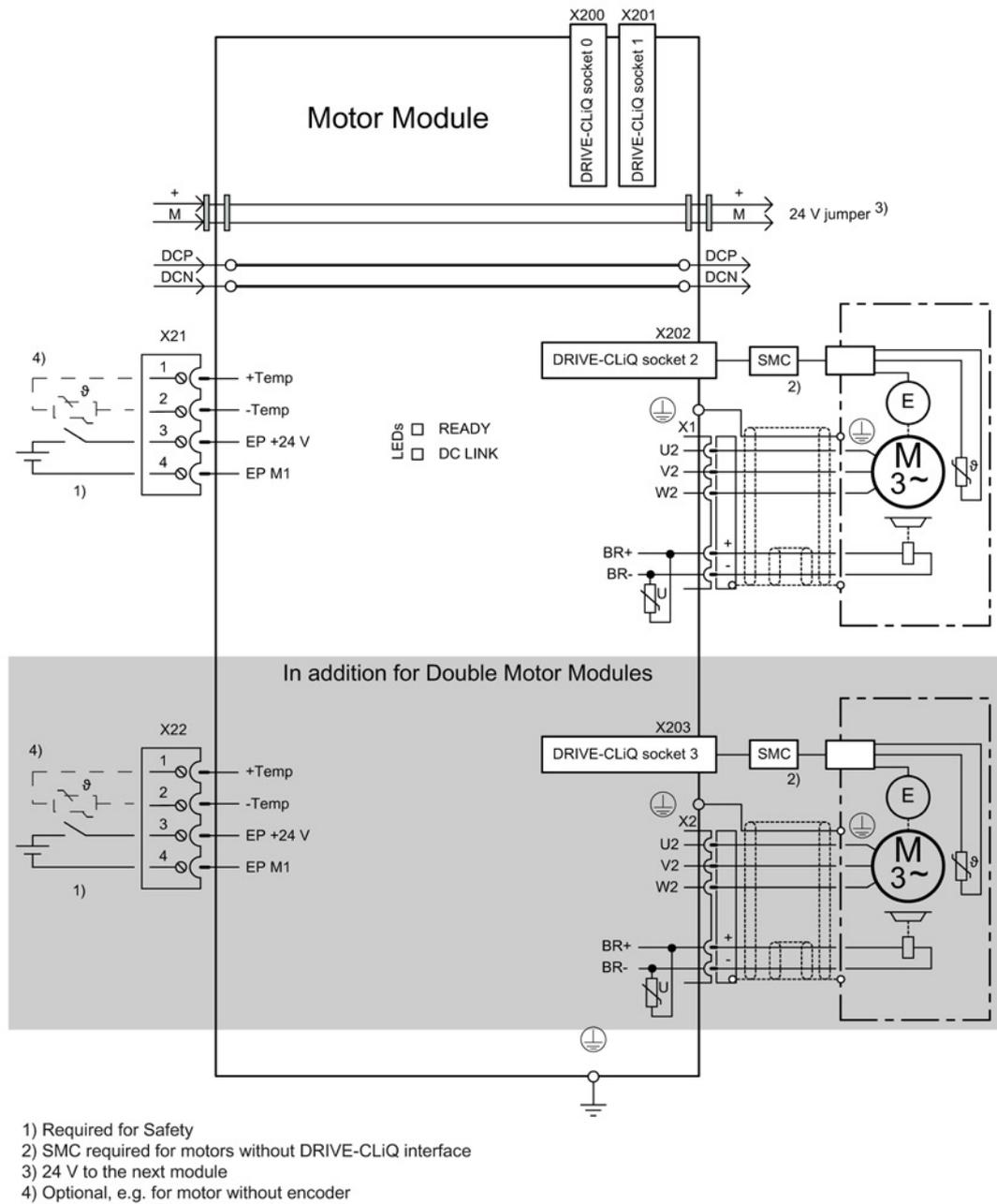


Figure 6-36 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

6.3 Motor Module with external air cooling

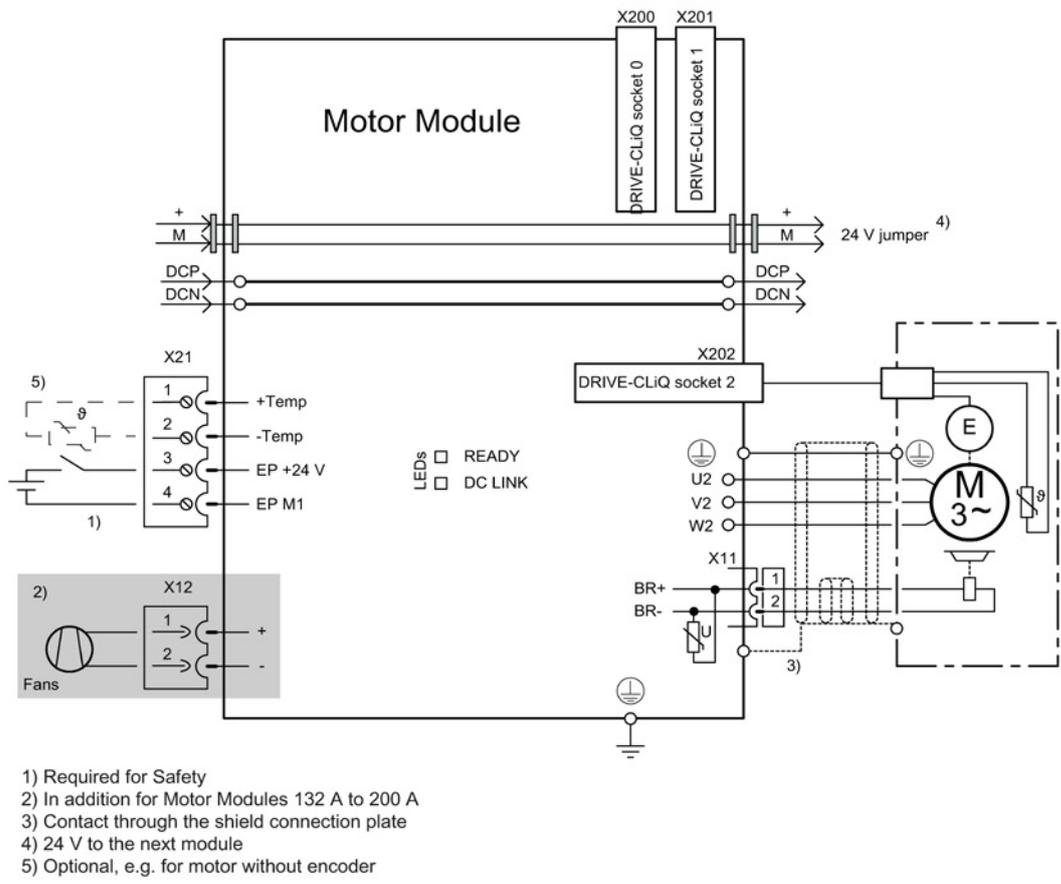


Figure 6-37 Example connection of Single Motor Modules 45 A to 200 A

6.3.4 Meaning of LEDs

Table 6- 21 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 | -- | 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 | -- | At least one fault is present in this component. Note: The LED is driven irrespective of the corresponding messages being reconfigured. | Resolve and acknowledge the fault. |
| Green/red (0.5 Hz) | -- | Firmware is being downloaded. | – |
| Green/red (2 Hz) | -- | Firmware download has been completed. The system waits for POWER ON. | Carry out a POWER ON. |
| Green/orange or red/orange | -- | Component recognition via LED is activated ¹⁾ . Note: Both options depend on the LED status when component recognition is activated. | – |

¹⁾ See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



WARNING

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

6.3.5 Dimension drawings

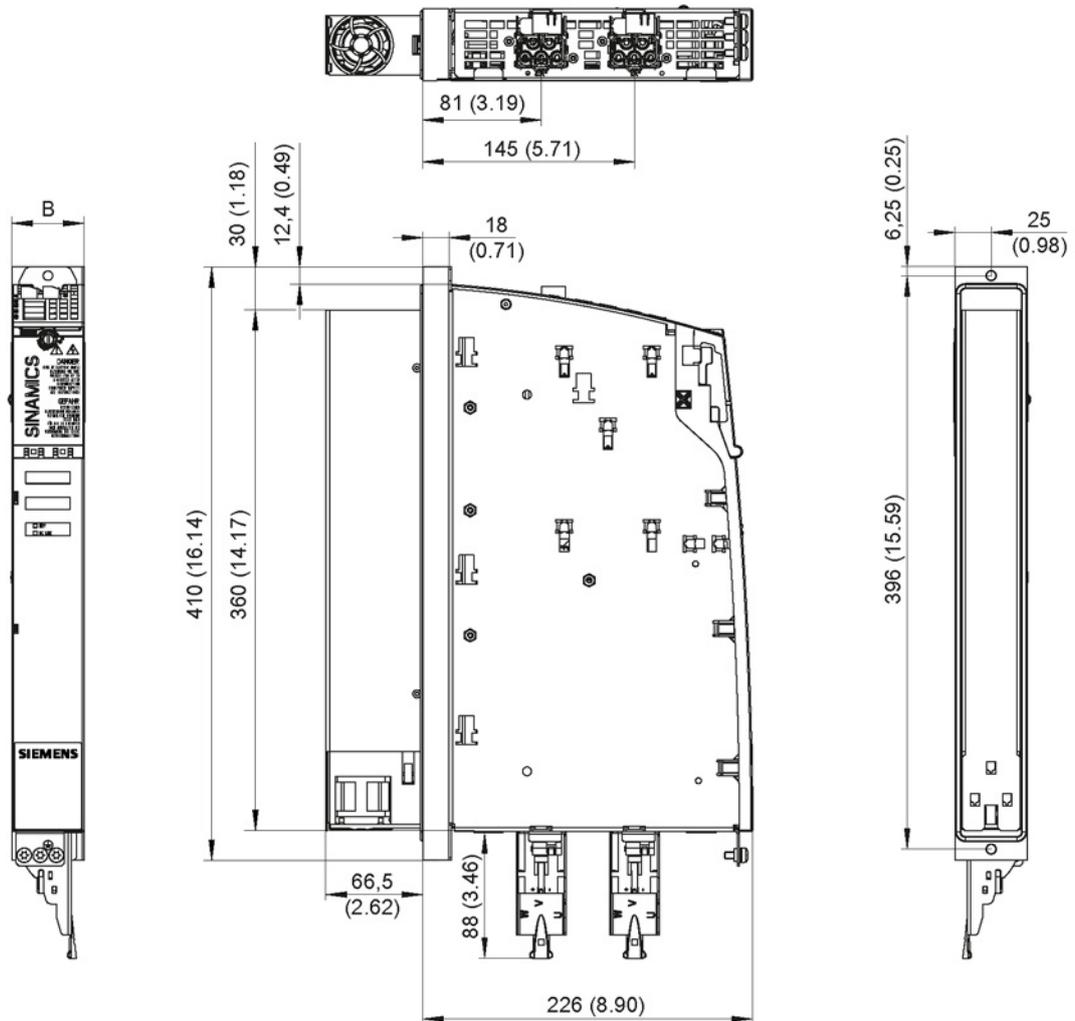


Figure 6-38 Dimension drawing of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches); example: 2 x 5 A Double Motor Module

Table 6- 22 Dimensions of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with external air cooling

| Motor Module | Order number | B [mm] (inches) |
|--------------------------|--------------------|-----------------|
| Single Motor Module 3 A | 6SL3121-1TE13-0AAx | 50 (1.97) |
| Single Motor Module 5 A | 6SL3121-1TE15-0AAx | |
| Single Motor Module 9 A | 6SL3121-1TE19-0AAx | |
| Single Motor Module 18 A | 6SL3121-1TE21-8AAx | |
| Double Motor Module 3 A | 6SL3121-2TE13-0AAx | |
| Double Motor Module 5 A | 6SL3121-2TE15-0AAx | |
| Double Motor Module 9 A | 6SL3121-2TE21-0AAx | |

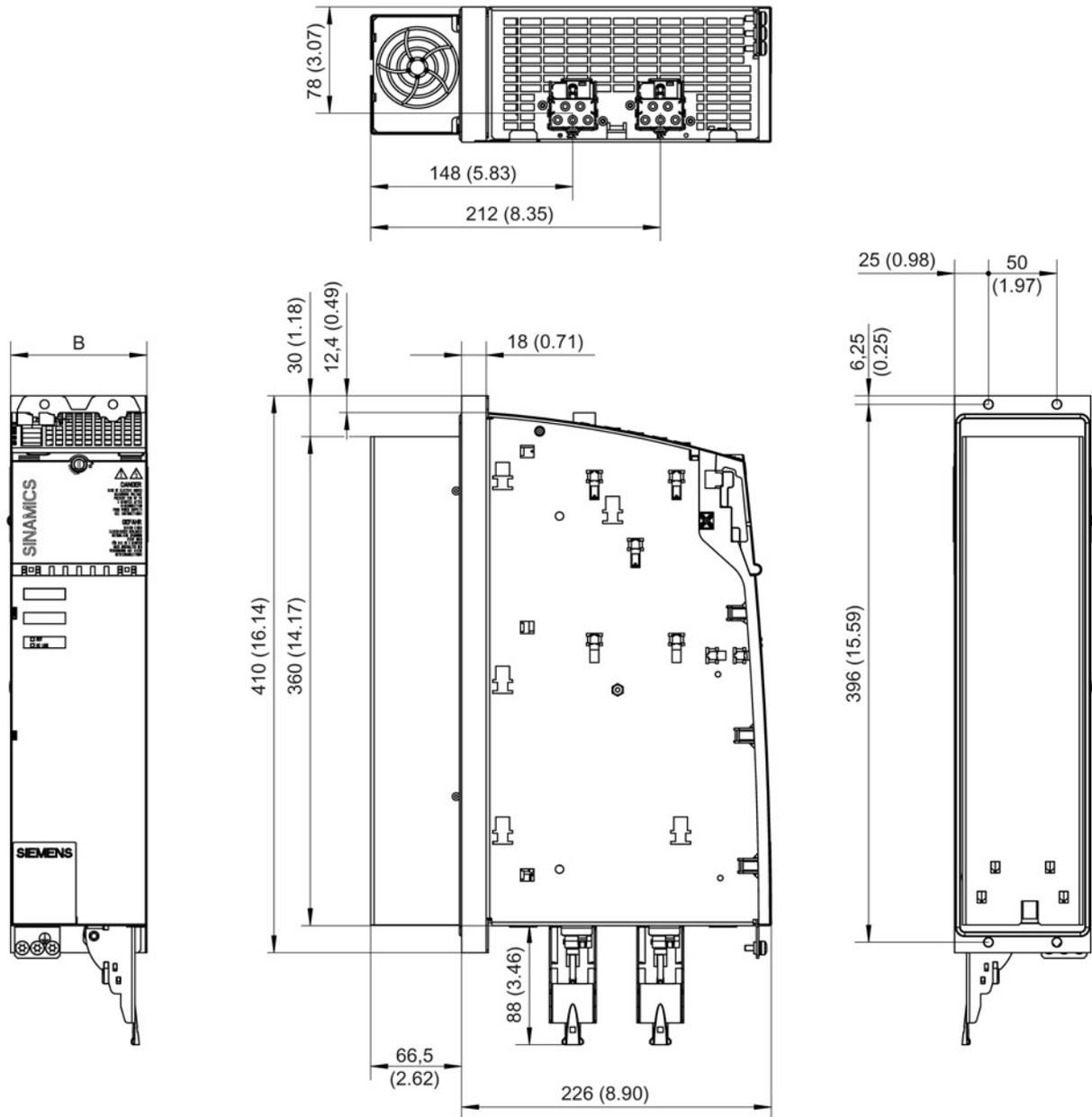


Figure 6-39 Dimension drawing of 30 A and 2 x 18 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches); example: 2 x 18 A Double Motor Module

Table 6- 23 Dimensions of 30 A and 2 x 18 A Motor Modules Booksize with external air cooling

| Motor Module | Order number | B [mm] (inches) |
|--------------------------|--------------------|-----------------|
| Single Motor Module 30 A | 6SL3121-1TE23-0AAx | 100 (3.94) |
| Double Motor Module 18 A | 6SL3121-2TE21-8AAx | |

6.3 Motor Module with external air cooling

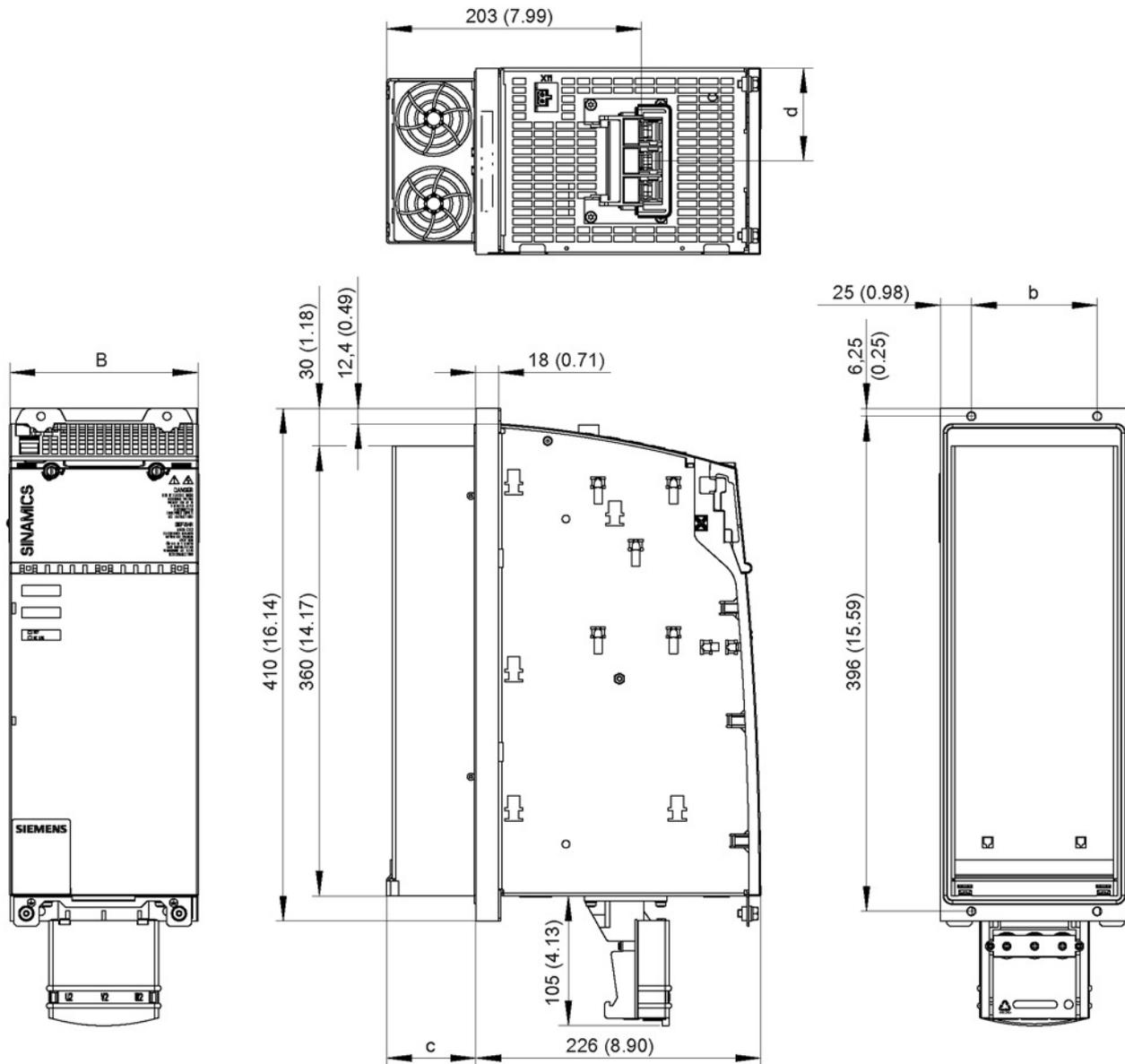


Figure 6-40 Dimension drawing of 45 A, 60 A and 85 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches); example 45 A

Table 6- 24 Dimensions of 45 A, 60 A and 85 A Motor Modules Booksize with external air cooling

| Motor Module | Order number | B [mm] (inches) | b [mm] (inches) | c [mm] (inches) | d [mm] (inches) |
|--------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Single Motor Module 45 A | 6SL3121-1TE24-5AAx | 150 (5.91) | 100 (3.94) | 71 (2.80) | 75 (2.95) |
| Single Motor Module 60 A | 6SL3121-1TE26-0AAx | | | | |
| Single Motor Module 85 A | 6SL3121-1TE28-5AAx | 200 (7.87) | 150 (5.91) | 92 (3.62) | 100 (3.94) |

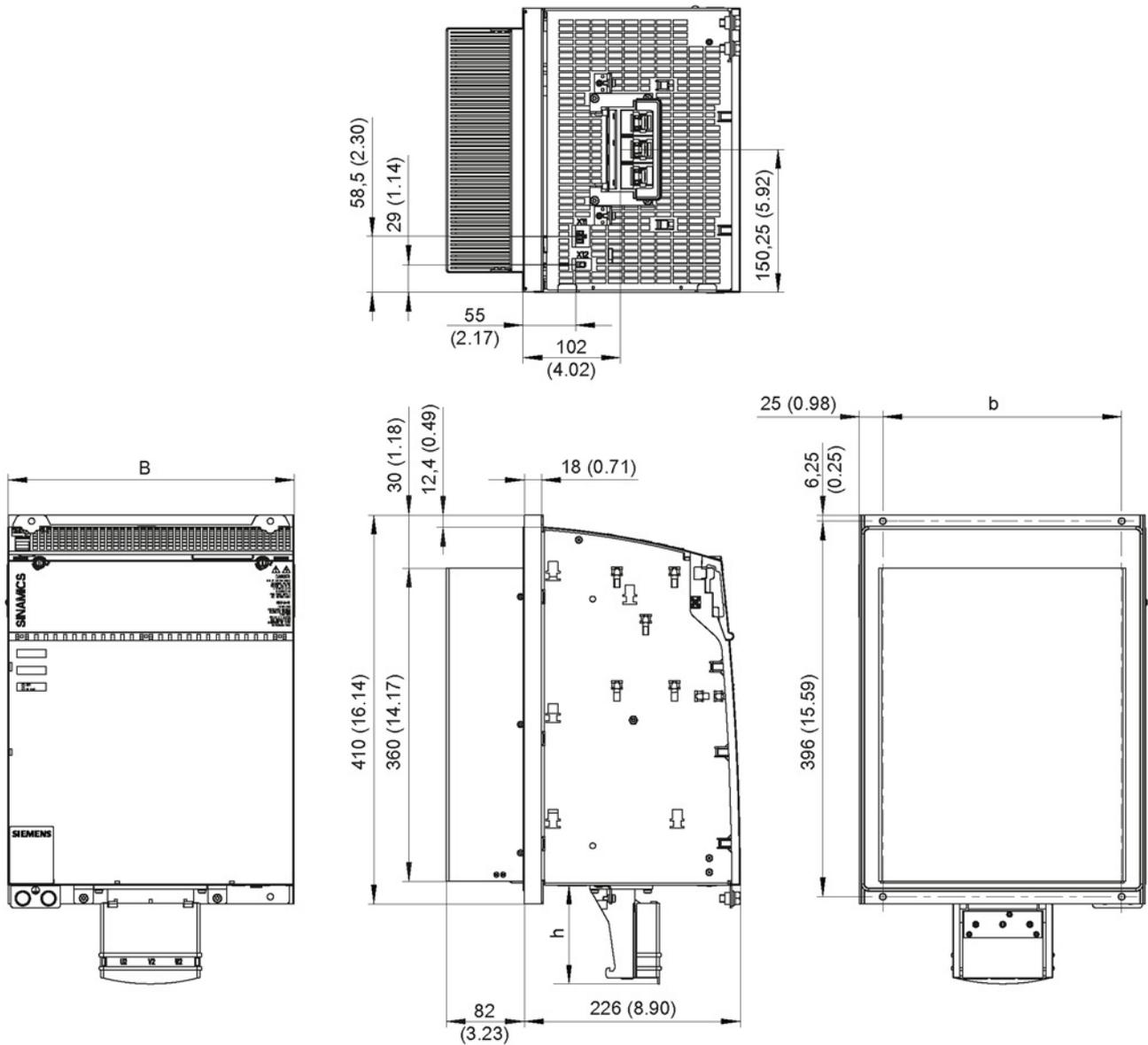


Figure 6-41 Dimension drawing of 132 A and 200 A Motor Modules Booksize, all dimensions in mm and (inches); example: 200 A Single Motor Module

Table 6- 25 Dimensions of 132 A and 200 A Motor Modules Booksize with external air cooling

| Motor Module | Order number | B [mm] (inches) | b [mm] (inches) | h [mm] (inches) |
|---------------------------|--------------------|-----------------|-----------------|-----------------|
| Single Motor Module 132 A | 6SL3121-1TE31-3AAx | 300 (11.81) | 250 (9.84) | 105 (4.13) |
| Single Motor Module 200 A | 6SL3121-1TE32-0AAx | | | |

6.3 Motor Module with external air cooling

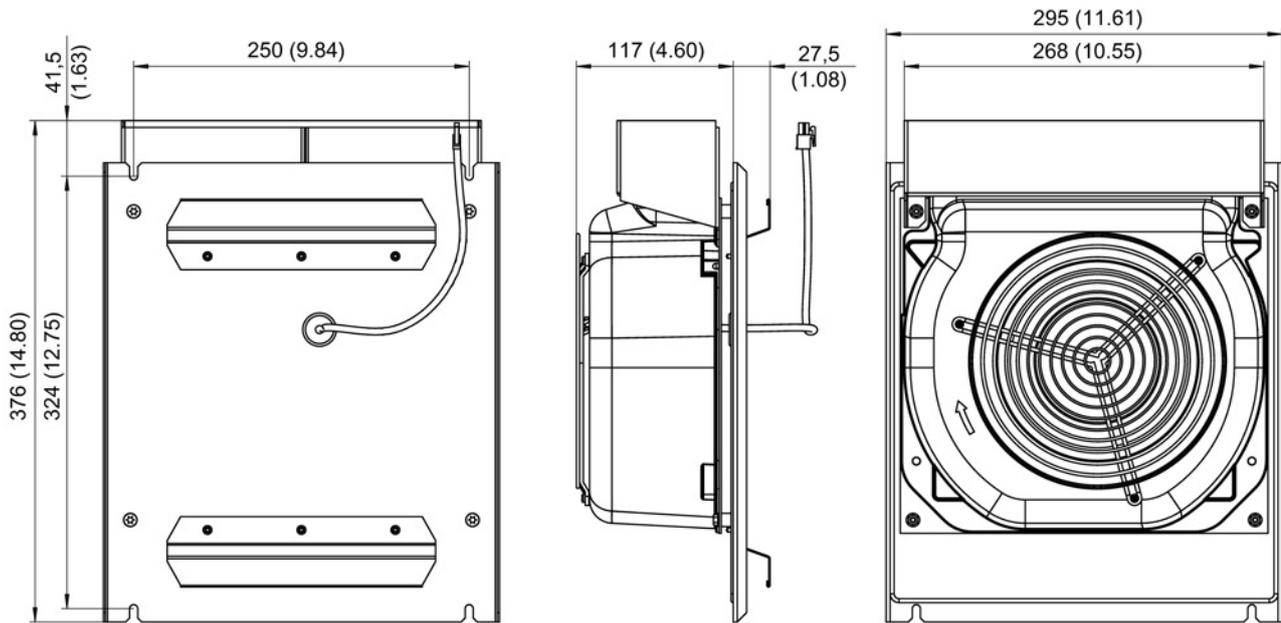
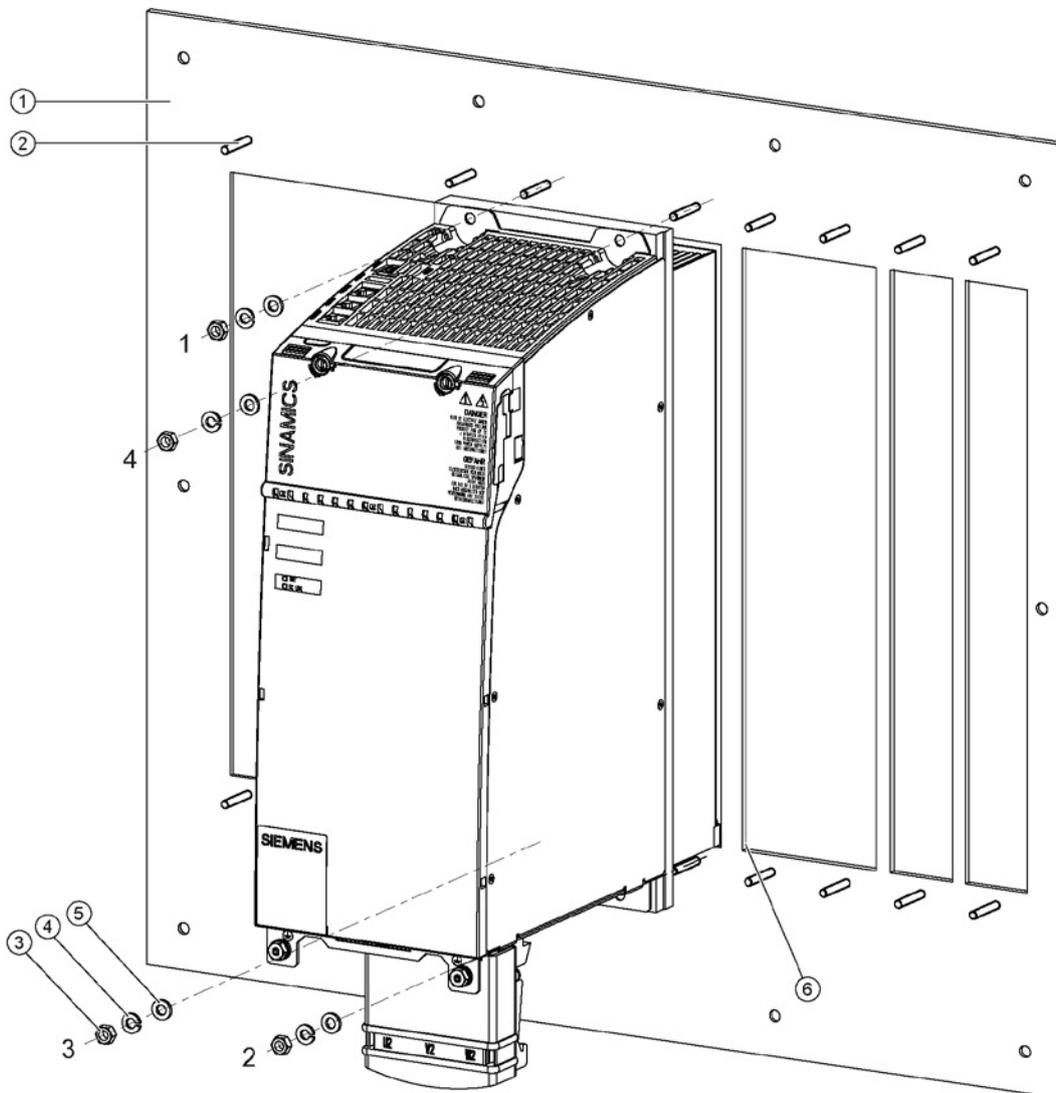


Figure 6-42 Dimension drawing of fan for 132 A and 200 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches)

Note

The fans for the 132 kW and 200 kW Motor Modules are included in the scope of delivery.

6.3.6 Mounting



- ① Mounting plate with openings for mounting
- ② M6 studs
- ③ M6 nut
- ④ Spring washer
- ⑤ Washer
- ⑥ Fan assembly

Figure 6-43 Mounting a Motor Module with external air cooling

Tightening torques:

- Firstly, tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
Tightening torque: 6 Nm

6.3 Motor Module with external air cooling

Help with the mechanical control cabinet design is available from:

Siemens AG
Industry Sector, IA DT MC MF - WKC AS
TCCCC (Technical Competence Center Cabinets Chemnitz)
P.O. Box 1124
09070 Chemnitz, Germany
e-mail: cc.cabinetcooling.aud@siemens.com

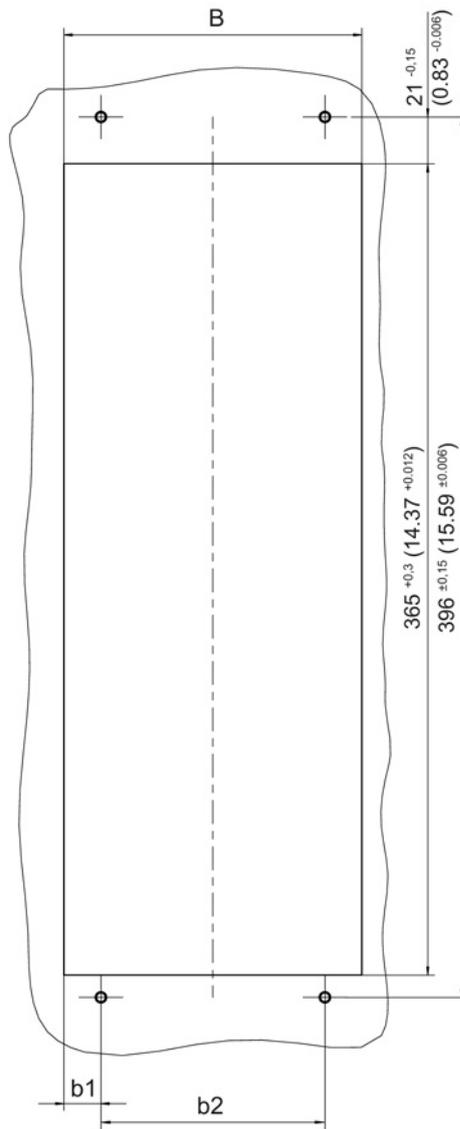
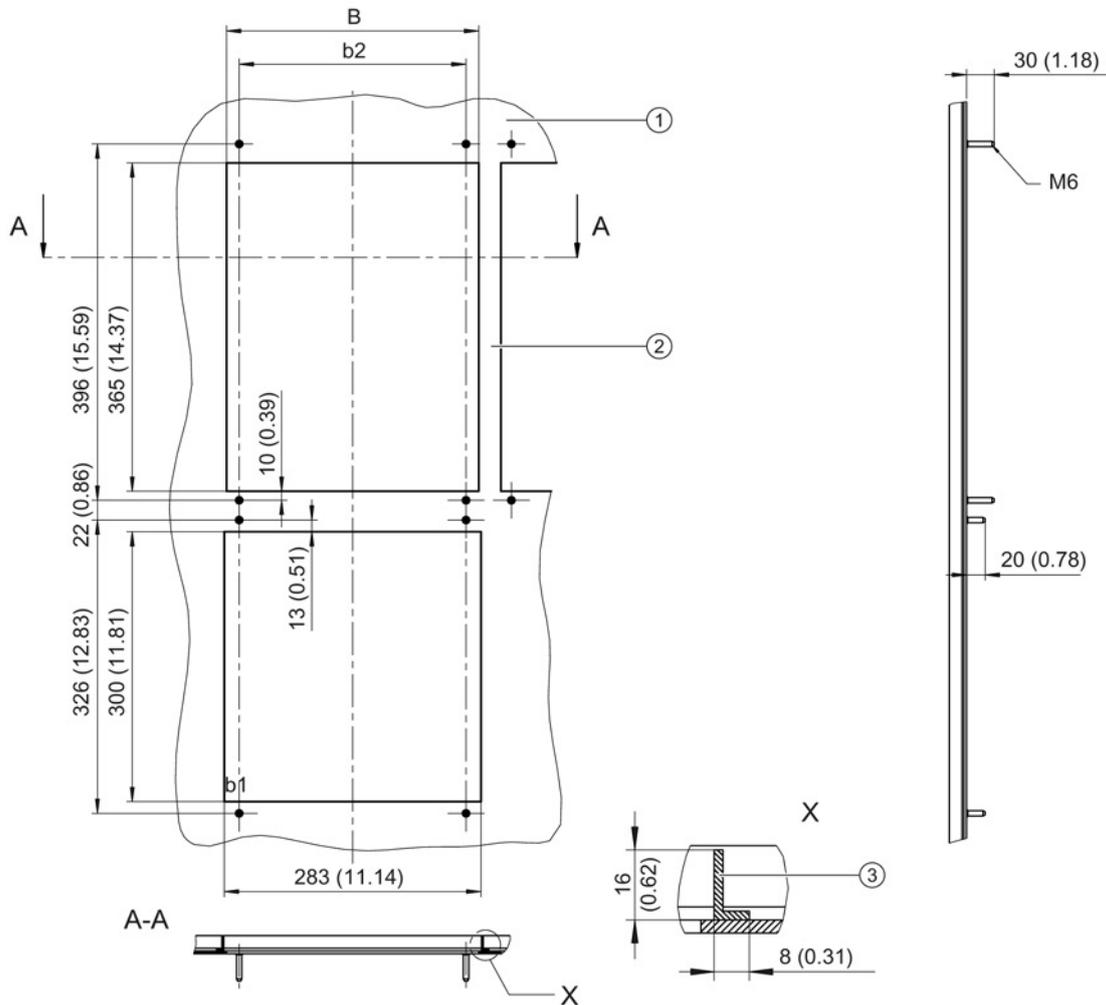


Figure 6-44 Opening to mount Motor Modules 50 mm to 200 mm with external air cooling, all data in mm and (inches)



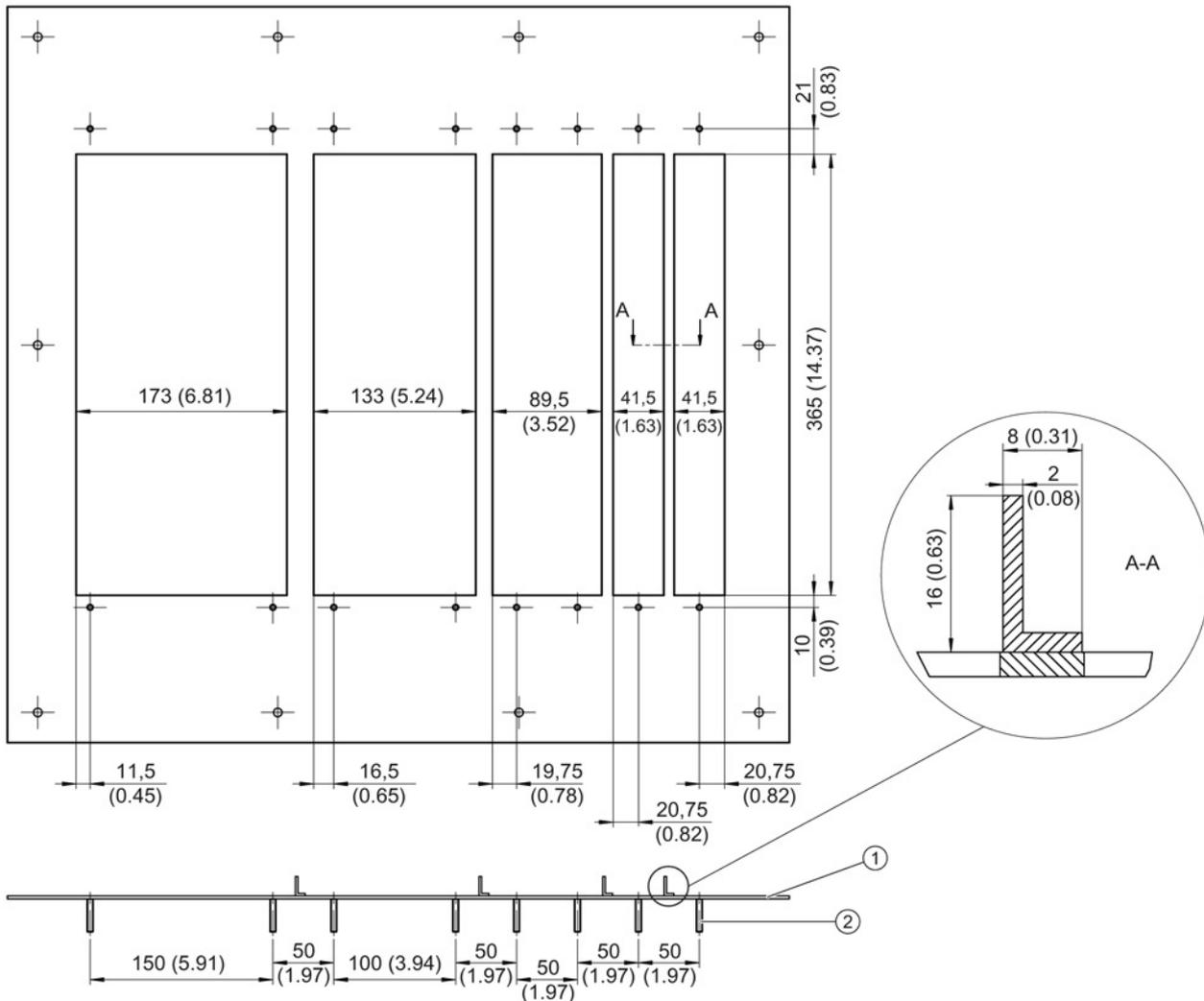
- ① Insert plate or mounting plate
- ② Cross-piece
- ③ Reinforcing bracket

Figure 6-45 Openings to mount a Motor Module 300 mm with external air cooling, all data in mm and (inches)

Table 6- 26 Dimensions of openings to mount Motor Modules with external air cooling

| Component width | W [mm] (inches) | b1 [mm] (inch) | b2 [mm] (inch) |
|-----------------|--|--|--|
| 50 mm | 41.5 ^{+0.3} (1.63 ^{+0.012}) | 20.75 ^{+0.15} (0.82 ^{+0.006}) | 0 |
| 100 mm | 89.5 ^{+0.3} (3.52 ^{+0.012}) | 19.75 ^{+0.15} (0.78 ^{+0.006}) | 50 ^{±0.15} (1.97 ^{±0.006}) |
| 150 mm | 133 ^{+0.3} (5.24 ^{+0.012}) | 16.5 ^{+0.15} (0.65 ^{+0.006}) | 100 ^{±0.15} (3.94 ^{±0.006}) |
| 200 mm | 173 ^{+0.3} (6.81 ^{+0.012}) | 11.5 ^{+0.15} (0.45 ^{+0.006}) | 150 ^{±0.15} (5.91 ^{±0.006}) |
| 300 mm | 278 ^{+0.3} (10.94 ^{+0.012}) | 14.0 ^{± 0.15} (0.55 ^{±0.006}) | 250 ^{+0.15} (9.84 ^{+0.006}) |

6.3 Motor Module with external air cooling

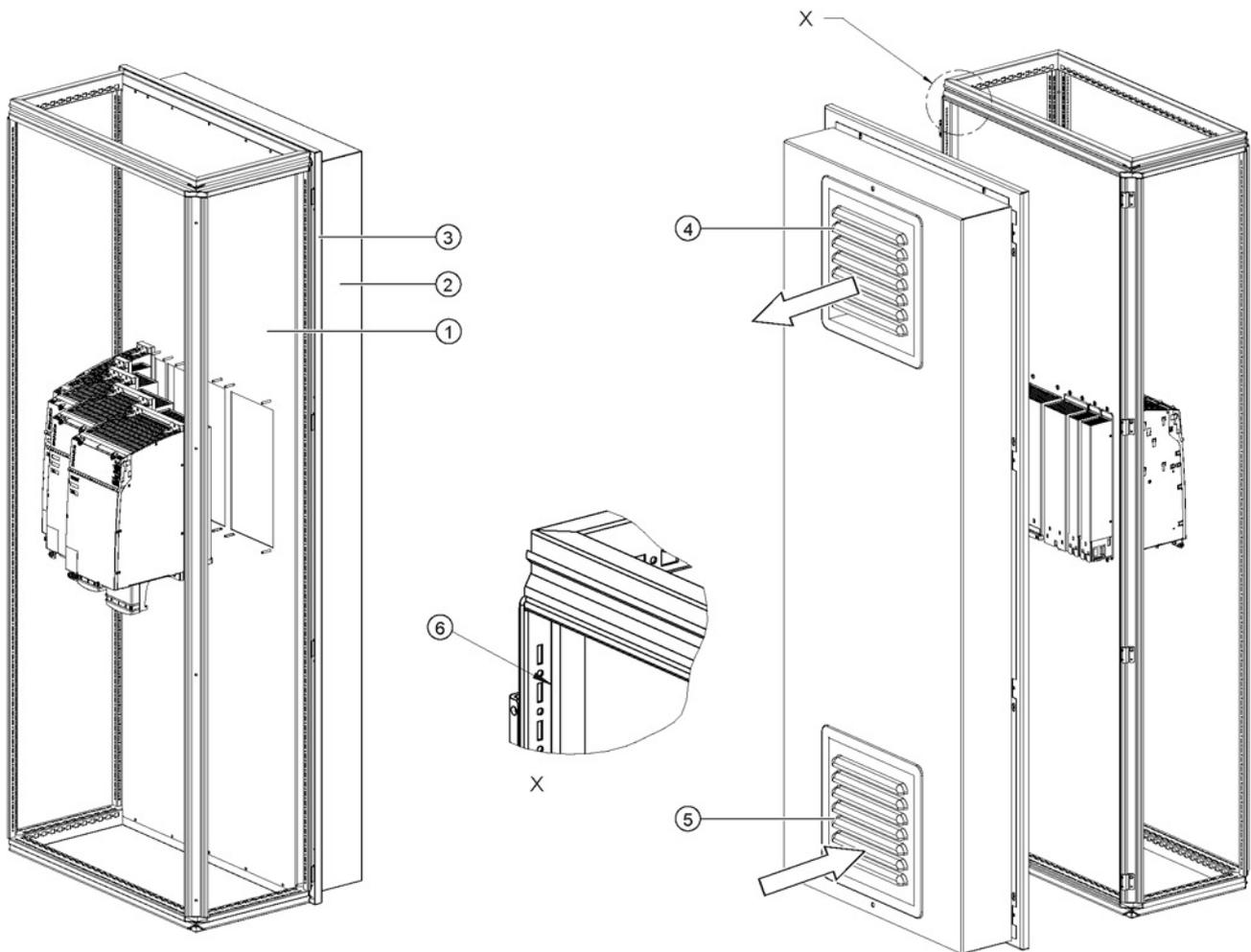


- ① Insert plate or mounting plate
- ② Threaded bolts M5 x 28

Figure 6-46 Example of a mounting plate for a drive line-up with external air cooling

When mounting it must be ensured that the component's seal is tight throughout. The cross-pieces must have the appropriate stability. If necessary, the cross-pieces of the openings must be reinforced.

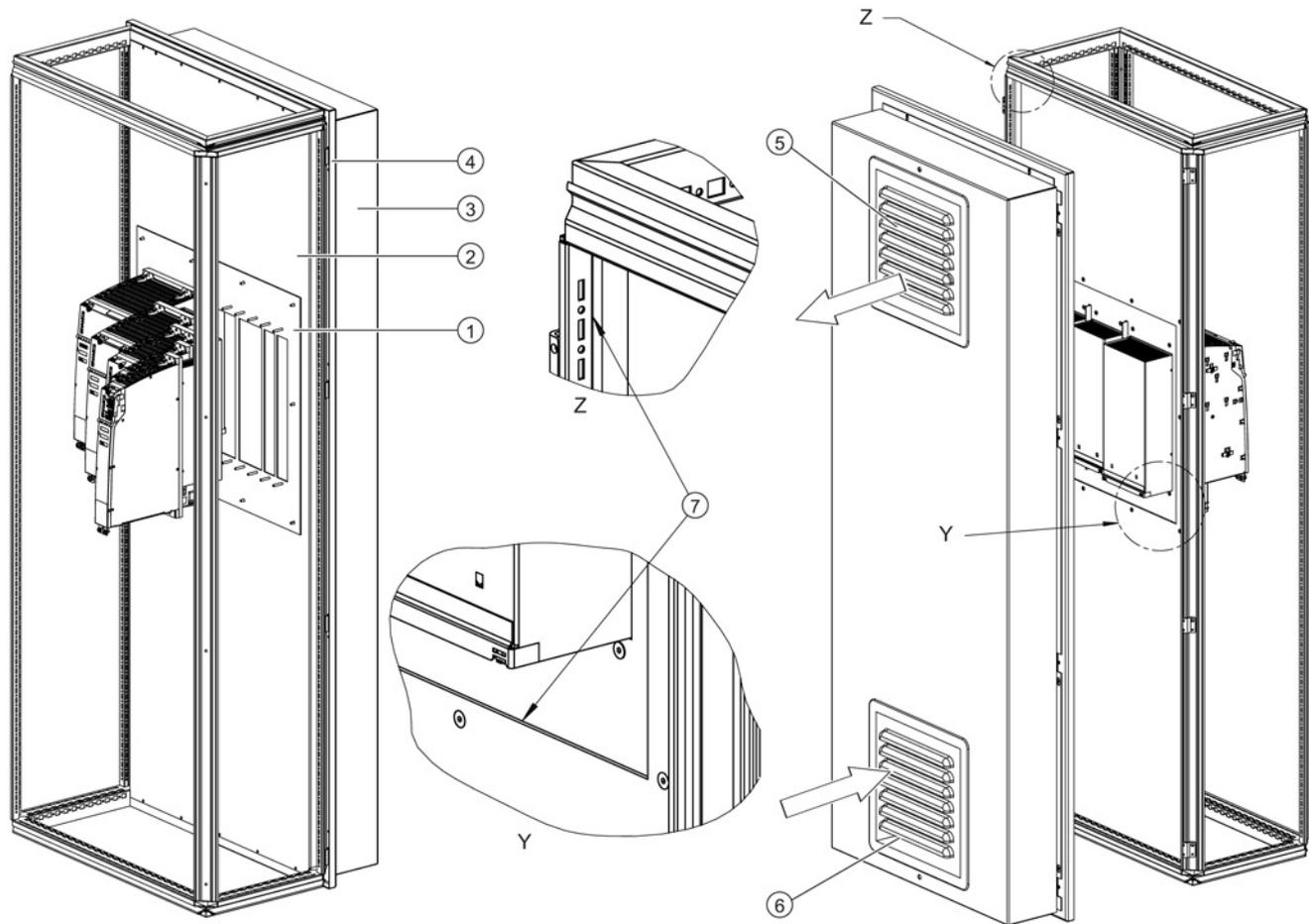
In the example, the cross-pieces have been reinforced using brackets according to EN 755-9. You are free to select the way that the bracket is attached to the insert.



- ① Mounting plate
- ② Cover
- ③ Rear panel
- ④ Air discharge
- ⑤ Air inlet - filter with filter fan
- ⑥ To comply with degree of protection IP54, the surfaces ⑥ between the mounting plate and the cabinet strip must be sealed all round. (for example, sealant Terostat-91 from the Teroson company)

Figure 6-47 Example 1: mounting in the cabinet with mounting plate

6.3 Motor Module with external air cooling



- ① Insert plate
- ② Mounting plate
- ③ Cover
- ④ Rear panel
- ⑤ Air discharge
- ⑥ Air inlet - filter with filter fan
- ⑦ To maintain the degree of protection IP54, the surfaces ⑦ between the mounting plate and the cabinet strip as well as between the mounting plate and insert plate must be sealed all around. (for example, sealant Terostat-91 from the Teroson company)

Figure 6-48 Example 2: mounting in the cabinet with mounting plate

It is recommended that you attach a cover and filter fan to the cabinet.

The filtered fan must be fitted in such a way that the cooling air required by the drive line-up is not restricted. The overall cooling air requirement is obtained from the sum of the individual components (see Chapter Technical data (Page 423)).

Note

If the cooling air requirement is not covered by the filtered fan, the components cannot output their specified power.

The filters with filter fan must be regularly checked for dirt and cleaned if necessary.

6.3.7 Technical data**6.3.7.1 Single Motor Modules**

Table 6- 27 Technical data Single Motor Modules Booksize (3 to 30 A)

| External air cooling | 6SL3121– | 1TE13-0AAx ¹⁾ | 1TE15-0AAx ¹⁾ | 1TE21–0AAx ¹⁾ | 1TE21–8AAx ¹⁾ | 1TE23-0AAx |
|---|-------------|-------------------------------|--------------------------|--------------------------|--------------------------|------------|
| Output current | | | | | | |
| Rated current (I_n) | A_{ACrms} | 3 | 5 | 9 | 18 | 30 |
| Base-load current (I_H) | A | 2,6 | 4,3 | 7,7 | 15,3 | 25,5 |
| Intermittent duty current (I_{s6}) | A_{ACrms} | 3,5 | 6 | 10 | 24 | 40 |
| 40% | A_{ACrms} | 6 | 10 | 18 | 36 | 56 |
| Peak current (I_{max}) | | | | | | |
| Output voltage | V_{ACrms} | 0 ... 0.717 x DC-link voltage | | | | |
| DC-link current $I_{d max}$ | A_{DC} | 3,6 | 6 | 11 | 22 | 36 |
| DC-link voltage | V_{DC} | 510 ... 720 | | | | |
| DC-link capacitance | μF | 110 | 110 | 110 | 220 | 705 |
| Overvoltage trip | V_{DC} | 820 \pm 2 % | | | | |
| Undervoltage trip ²⁾ | V_{DC} | 380 \pm 2 % | | | | |
| Electronics power supply | V_{DC} | 24 (20,4 ... 28,8) | | | | |
| Electronics current drawn at 24 VDC | A_{DC} | 0,85 | 0,85 | 0,85 | 0,85 | 0,8 |
| Current carrying capacity | | | | | | |
| DC-link busbars | A_{DC} | 100 | 100 | 100 | 100 | 100 |
| Reinforced DC-link busbars | A_{DC} | 150 | 150 | 150 | 150 | 150 |
| 24 VDC busbars | A_{DC} | 20 | 20 | 20 | 20 | 20 |
| Unit rating³⁾ | | | | | | |
| Based on I_n (600 VDC; 4 kHz) | kW | 1,6 | 2,7 | 4,8 | 9,7 | 16 |
| Based on I_H | kW | 1,4 | 2,3 | 4,1 | 8,2 | 13,7 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 50,4 | 73,4 | 100,4 | 185,4 | 309,2 |
| Max. pulse frequency | | | | | | |
| without derating | kHz | 4 | | | | |
| with derating | kHz | 16 | | | | |

6.3 Motor Module with external air cooling

| External air cooling | 6SL3121- | 1TE13-0AAx ¹⁾ | 1TE15-0AAx ¹⁾ | 1TE21-0AAx ¹⁾ | 1TE21-8AAx ¹⁾ | 1TE23-0AAx |
|---|-------------------|--------------------------|--------------------------|--------------------------|--------------------------|------------|
| Max. ambient temperature without derating | ° C | 40 | | | | |
| with derating | ° C | 55 | | | | |
| Sound pressure level | dB(A) | < 60 | < 60 | < 60 | < 60 | < 60 |
| Cooling air requirement | m ³ /h | 29,6 | 29,6 | 29,6 | 29,6 | 56 |
| Max. permissible heat sink temperature | ° C | 70 | 70 | 73 | 82 | 85 |
| Weight | kg | 5,7 | 5,7 | 5,7 | 5,7 | 8,4 |

- 1) Applies only to order numbers with x = 0 .. 3
- 2) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage
- 3) Rated power of a typical standard induction motor at 400 V 3 AC.

Table 6- 28 Technical data Single Motor Modules Booksize (45 to 200 A)

| External air cooling | 6SL3121- | 1TE24-5AAx | 1TE26-0AAx | 1TE28-5AAx | 1TE31-3AAx | 1TE32-0AAx |
|---|--------------------|-------------------------------|------------|------------|------------|------------|
| Output current | | | | | | |
| Rated current (I _n) | A _{ACrms} | 45 | 60 | 85 | 132 | 200 |
| Base-load current (I _H) | A | 38 | 51 | 68 | 105 | 141 |
| Intermittent duty current (I _{sb}) | A _{ACrms} | 60 | 80 | 110 | 150 | 230 |
| 40% | A _{ACrms} | 85 | 113 | 141 | 210 | 282 |
| Peak current (I _{max}) | | | | | | |
| Output voltage | V _{ACrms} | 0 ... 0.717 x DC-link voltage | | | | |
| DC-link current I_{d max} | A _{DC} | 54 | 72 | 102 | 158 | 200 |
| DC-link voltage | V _{DC} | 510 ... 720 | | | | |
| DC-link capacitance | µF | 1175 | 1410 | 1880 | 2820 | 3995 |
| Overvoltage trip | V _{DC} | 820 ± 2 % | | | | |
| Undervoltage trip ¹⁾ | V _{DC} | 380 ± 2 % | | | | |
| Electronics power supply | V _{DC} | 24 (20,4 - 28,8) | | | | |
| Electronics current drawn at 24 VDC | A _{DC} | 1,05 | 1,05 | 1,5 | 0,85 | 0,85 |
| Current carrying capacity | | | | | | |
| DC-link busbars | A _{DC} | 200 | 200 | 200 | 200 | 200 |
| 24 VDC busbars | A _{DC} | 20 | 20 | 20 | 20 | 20 |
| Unit rating²⁾ | | | | | | |
| Based on I _n (600 VDC; 4 kHz) | kW | 24 | 32 | 46 | 71 | 107 |
| Based on I _H | kW | 21 | 28 | 37 | 57 | 76 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 455,2 | 615,2 | 786 | 1270,4 | 2070,4 |
| Max. pulse frequency | | | | | | |
| without derating | kHz | 4 | | | | |
| with derating | kHz | 16 | | | | |

| External air cooling | 6SL3121- | 1TE24-5AAx | 1TE26-0AAx | 1TE28-5AAx | 1TE31-3AAx | 1TE32-0AAx |
|--|-------------------|------------|------------|------------|------------|-------------------------|
| Max. ambient temperature without derating | ° C | 40 | | | | |
| with derating | ° C | 55 | | | | |
| Sound pressure level | dB(A) | < 65 | < 65 | < 60 | < 73 | < 73 |
| Cooling air requirement | m ³ /h | 112 | 112 | 160 | 520 | 520 |
| Max. permissible heat sink temperature | ° C | 85 | 90 | 88 | 73 | 80 (70% derating) |
| Weight | kg | 13,2 | 13,3 | 17,2 | 27,1 | 28 |

- 1) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V (exception: 132 A and 200 A Motor Modules) and is adjusted to the parameterized rated voltage.
- 2) Rated power of a typical standard induction motor at 400 V 3 AC.

6.3.7.2 Double Motor Modules

Table 6- 29 Technical data Double Motor Modules Booksize (3 to 18 A)

| External air cooling | 6SL3121- | 2TE13-0AAx ¹⁾ | 2TE15-0AAx ¹⁾ | 2TE21-0AAx ¹⁾ | 2TE21-8AAx |
|---|--------------------|--------------------------|--------------------------|--------------------------|------------|
| Output current | | | | | |
| Rated current (I _n) | A _{ACrms} | 2 x 3 | 2 x 5 | 2 x 9 | 2 x 18 |
| Base-load current (I _H) | A | 2 x 2.6 | 2 x 4.3 | 2 x 7.7 | 2 x 15.3 |
| Intermittent duty current (I _{s6}) 40% | A _{ACrms} | 2 x 3.5 | 2 x 6 | 2 x 10 | 2 x 24 |
| Peak current (I _{max}) | A _{ACrms} | 2 x 6 | 2 x 10 | 2 x 18 | 2 x 36 |
| Output voltage | V _{ACrms} | 0 ... 480 | | | |
| DC-link current I_{d max} | A _{DC} | 7,2 | 12 | 22 | 43 |
| DC-link voltage | V _{DC} | 510 ... 720 | | | |
| DC-link capacitance | μF | 110 | 220 | 220 | 705 |
| Overvoltage trip | V _{DC} | 820 ± 2 % | | | |
| Undervoltage trip ²⁾ | V _{DC} | 380 ± 2 % | | | |
| Electronics power supply | V _{DC} | 24 (20,4 ... 28,8) | | | |
| Electronics current drawn at 24 VDC | A _{DC} | 1,15 | 1,15 | 1,15 | 1,3 |
| Current carrying capacity | | | | | |
| DC-link busbars | A _{DC} | 100 | 100 | 100 | 100 |
| Reinforced DC-link busbars | A _{DC} | 150 | 150 | 150 | 150 |
| 24 VDC busbars | A | 20 | 20 | 20 | 20 |
| Unit rating³⁾ | | | | | |
| Based on I _n (600 VDC; 4 kHz) | kW | 2 x 1.6 | 2 x 2.7 | 2 x 4.8 | 2 x 9.7 |
| Based on I _H | kW | 2 x 1.4 | 2 x 2.3 | 2 x 4.4 | 2 x 8.2 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 97,6 | 132,6 | 187,6 | 351,2 |
| Max. pulse frequency | | | | | |
| without derating | kHz | 4 | | | |
| with derating | kHz | 16 | | | |
| Max. ambient temperature | | | | | |
| without derating | ° C | 40 | | | |
| with derating | ° C | 55 | | | |
| Sound pressure level | dB(A) | < 60 | < 60 | < 60 | < 60 |
| Cooling air requirement | m ³ /h | 29,6 | 29,6 | 29,6 | 56 |
| Max. permissible heat sink temperature | ° C | 80 | 85 | 89 | 90 |
| Weight | kg | 5,8 | 5,8 | 5,7 | 8,6 |

1) Applies only to order numbers with x = 0 .. 3

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.

6.3.7.3 Characteristics

Rated duty cycles Motor Modules Booksize

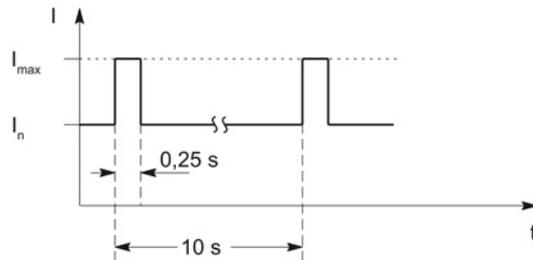


Figure 6-49 Duty cycle with initial load (for servo drives)

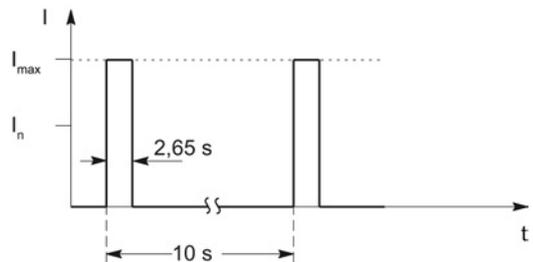


Figure 6-50 Duty cycle without initial load (for servo drives)

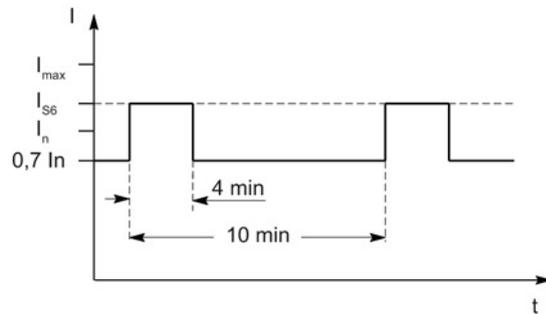


Figure 6-51 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

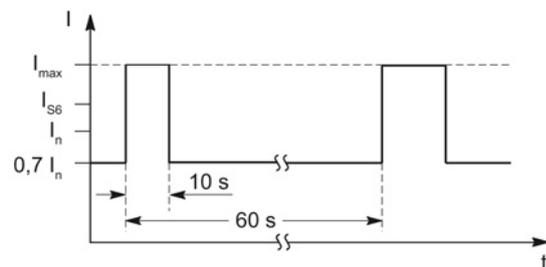


Figure 6-52 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

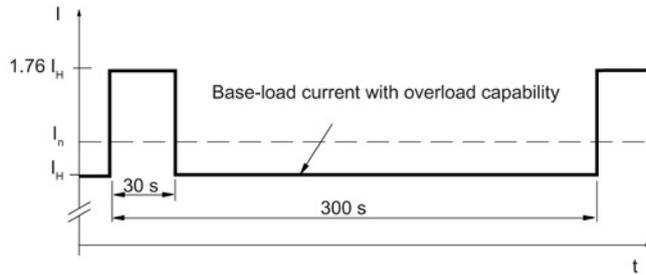


Figure 6-53 Duty cycle with 30 s overload for a duty cycle duration of 300 s

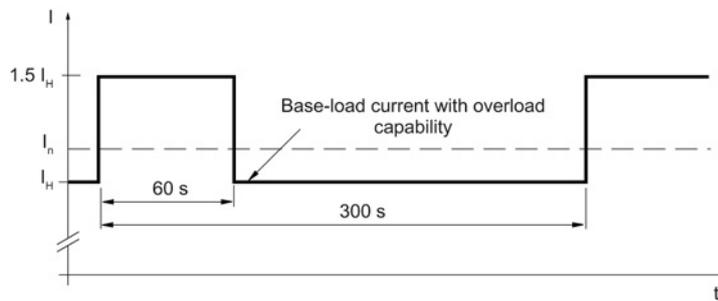


Figure 6-54 Duty cycle with 60 s overload for a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

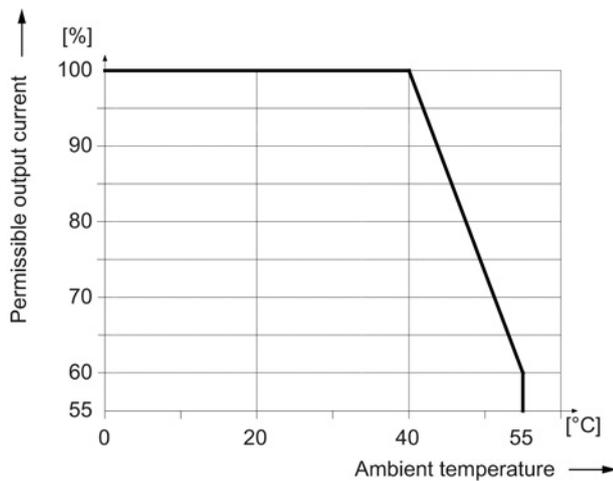


Figure 6-55 Output current as a function of the ambient temperature

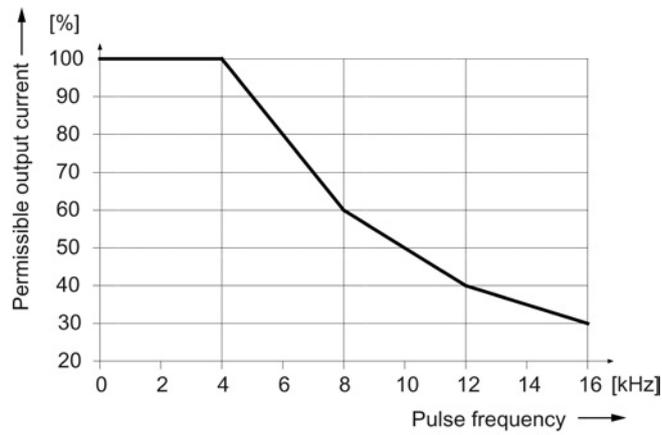


Figure 6-56 Output current as a function of the pulse frequency

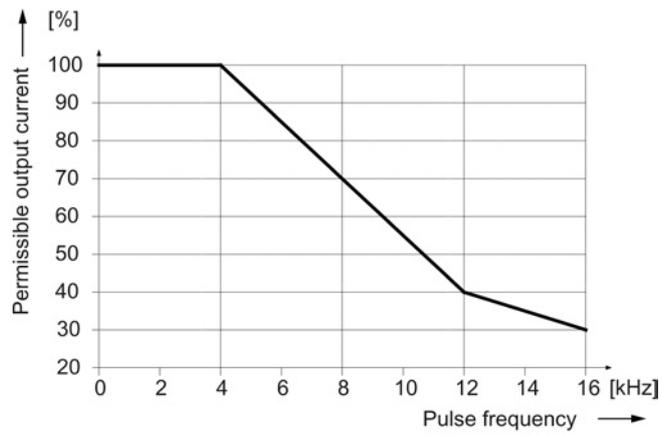


Figure 6-57 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

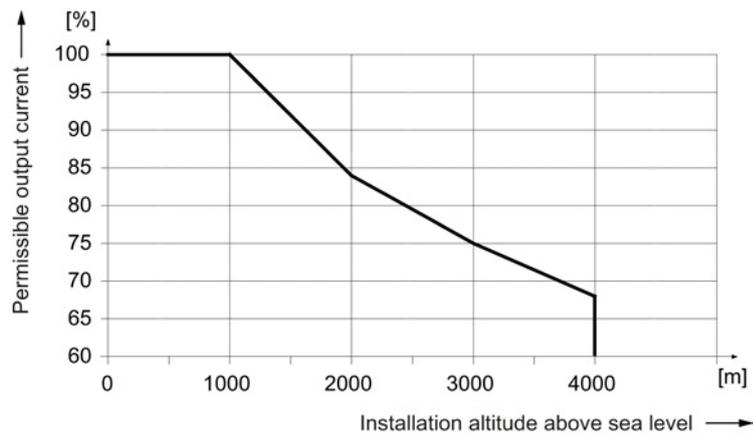


Figure 6-58 Output current as a function of the installation altitude

6.3 Motor Module with external air cooling

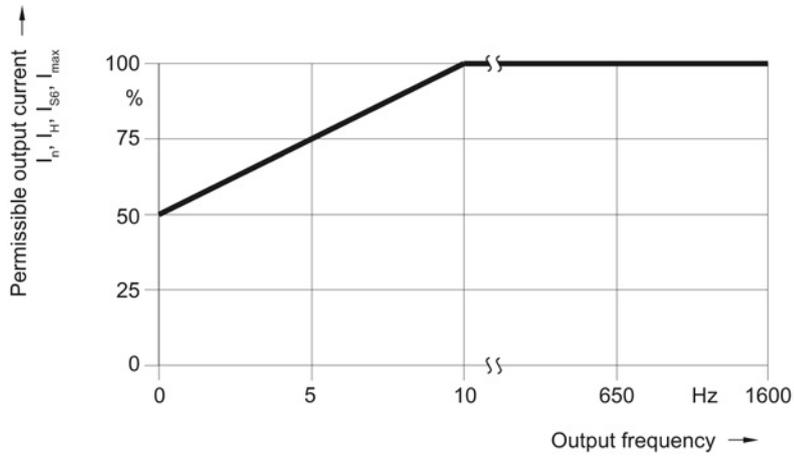


Figure 6-59 Output current as a function of the output frequency

6.3.8 Technical data for Motor Modules Booksize with 300% overload

6.3.8.1 Single Motor Modules (300% overload)

Table 6- 30 Technical data Single Motor Modules Booksize (3 to 18 A) with 300% overload

| External air cooling | 6SL3121- | 1TE13-0AA4 | 1TE15-0AA4 | 1TE21-0AA4 | 1TE21-8AA4 |
|---|--------------|-------------------------------|------------|------------|------------|
| Output current | | | | | |
| Rated current (I_n) | A_{ACrms} | 3 | 5 | 9 | 18 |
| Base-load current (I_H) | A | 2,6 | 4,3 | 7,7 | 15,3 |
| Intermittent duty current (I_{s0}) 40% | A_{ACrms} | 3,5 | 6 | 10 | 24 |
| Peak current (I_{max}) | A_{ACrms} | 9 | 15 | 27 | 54 |
| Output voltage | V_{ACrms} | 0 ... 0.717 x DC-link voltage | | | |
| DC-link current $I_{d max}$ | A_{DC} | 3,6 | 6 | 11 | 22 |
| DC-link voltage | V_{DC} | 510 ... 720 | | | |
| DC-link capacitance | μF | 110 | 110 | 110 | 220 |
| Overvoltage trip | V_{DC} | 820 \pm 2 % | | | |
| Undervoltage trip ¹⁾ | V_{DC} | 380 \pm 2 % | | | |
| Electronics power supply | V_{DC} | 24 (20,4 ... 28,8) | | | |
| Electronics current drawn at 24 VDC | A_{DC} | 0,85 | | | |
| Current carrying capacity | | | | | |
| DC-link busbars | A_{DC} | 100 | | | |
| Reinforced DC-link busbars | A_{DC} | 150 | | | |
| 24 VDC busbars | A_{DC} | 20 | | | |
| Unit rating²⁾ | | | | | |
| Based on I_n (600 VDC; 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 781)) | W | 50,4 | 73,4 | 100,4 | 185,4 |
| Max. pulse frequency | | | | | |
| without derating | kHz | 4 | | | |
| with derating | kHz | 16 | | | |
| Max. ambient temperature | | | | | |
| without derating | $^{\circ} C$ | 40 | | | |
| with derating | $^{\circ} C$ | 55 | | | |
| Sound pressure level | dB(A) | < 60 | | | |
| Cooling air requirement | m^3/h | 29,6 | | | |
| Max. permissible heat sink temperature | $^{\circ} C$ | 70 | 70 | 70 | 90 |
| Weight | kg | 5,7 | 5,7 | 5,7 | 5,7 |

1) 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

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

Note

Disturbance of the 18 A Single Motor Module with 300% overload during operation on a 16 kW Line Module

The maximum output of a 16 kW Line Module is not sufficient for the operation of an 18 A Single Motor Module with 300% overload.

- Do NOT operate the 18 A Single Motor Module with 300% overload on a 16 kW Line Module.
 - Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.
 - Only operate an 18 A Single Motor Module on a 16 kW Line Module when the maximum current is limited to $2 \times I_{\text{rated}}$.
-

Table 6- 31 Technical data Double Motor Modules Booksize (2 x 3 to 2 x 9 A) with 300% overload

| External air cooling | 6SL3121- | 2TE13-0AA4 | 2TE15-0AA4 | 2TE21-0AA4 |
|---|-----------------------------|--------------------|--------------|--------------|
| Output current | | | | |
| Rated current (I_n) | A_{ACrms} | 2 x 3 | 2 x 5 | 2 x 9 |
| Base-load current (I_H) | A | 2 x 2.6 | 2 x 4.3 | 2 x 7.7 |
| Intermittent duty current (I_{s6}) 40% | A_{ACrms} | 2 x 3.5 | 2 x 6 | 2 x 10 |
| Peak current (I_{max}) | A_{ACrms} | 2 x 9 | 2 x 15 | 2 x 27 |
| Output voltage | V_{ACrms} | 0 ... 480 | | |
| DC-link current $I_{d max}$ | A_{DC} | 7,2 | 12 | 22 |
| DC-link voltage | V_{DC} | 510 ... 720 | | |
| DC-link capacitance | μF | 110 | 220 | 220 |
| Overvoltage trip | V_{DC} trip | 820 \pm 2 % | | |
| Undervoltage trip ¹⁾ | V_{DC} trip ¹⁾ | 380 \pm 2 % | | |
| Electronics power supply | V_{DC} | 24 (20,4 ... 28,8) | | |
| Electronics current drawn at 24 VDC | A_{DC} | 1,15 | | |
| Current carrying capacity | | | | |
| DC-link busbars | A_{DC} | 100 | | |
| Reinforced DC-link busbars | A_{DC} | 150 | | |
| 24 VDC busbars | A | 20 | | |
| Unit rating²⁾ | | | | |
| Based on I_n (600 VDC; 4 kHz) | kW | 2 x 1.6 | 2 x 2.7 | 2 x 4.8 |
| Based on I_H | kW | 2 x 1.4 | 2 x 2.3 | 2 x 4.4 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 97,6 | 132,6 | 187,6 |
| Max. pulse frequency | | | | |
| without derating | kHz | 4 | | |
| with derating | kHz | 16 | | |
| Max. ambient temperature | | | | |
| without derating | $^{\circ} C$ | 40 | | |
| with derating | $^{\circ} C$ | 55 | | |
| Sound pressure level | dB(A) | < 60 | | |
| Cooling air requirement | m^3/h | 29,6 | | |
| Max. permissible heat sink temperature | $^{\circ} C$ | 78 | 78 | 78 |
| Weight | kg | 5,8 | 5,8 | 5,7 |

1) 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

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

Note

Disturbance of the 2 x 9 A Double Motor Module with 300% overload during operation on a 16 kW Line Module

The maximum output of a 16 kW Line Module is not sufficient for the operation of a 2 x 9 A Double Motor Module with 300% overload.

- Do NOT operate the 2 x 9 A Double Motor Module with 300% overload on a 16 kW Line Module.
 - Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.
 - Only operate a 2 x 9 A Double Motor Module on a 16 kW Line Module when the maximum current is limited to $2 \times I_{\text{rated}}$.
-

6.3.8.2 Characteristics for Motor Modules Booksize with 300% overload

Rated duty cycles Motor Modules Booksize with 300% overload

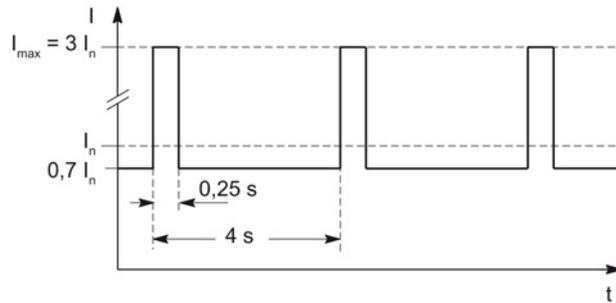


Figure 6-60 Peak current duty cycle with initial load (300% overload)

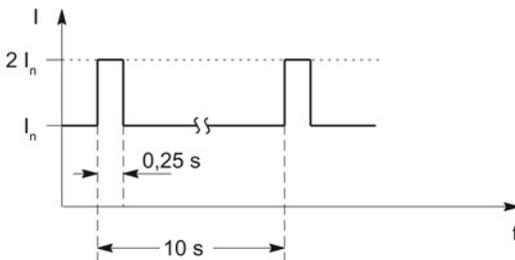


Figure 6-61 Duty cycle with initial load

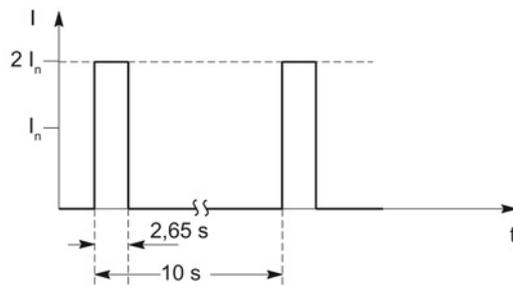


Figure 6-62 Duty cycle without initial load

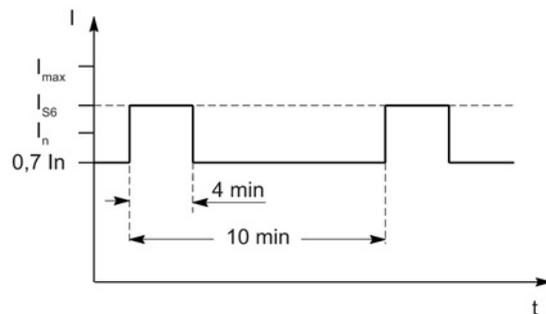


Figure 6-63 S6 duty cycle with initial load for a duty cycle duration of 600 s

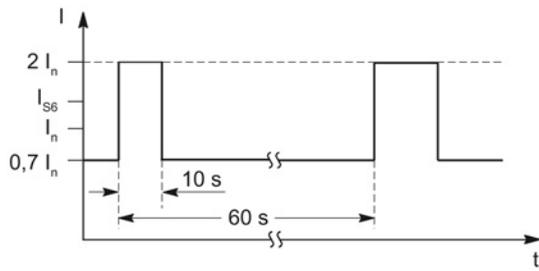


Figure 6-64 S6 duty cycle with initial load for a duty cycle duration of 60 s

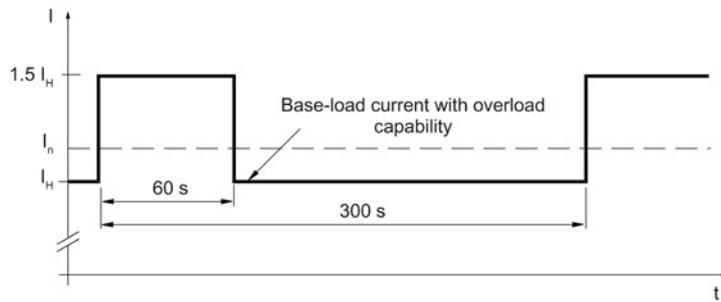


Figure 6-65 Duty cycle with 60 s overload for a duty cycle duration of 300 s

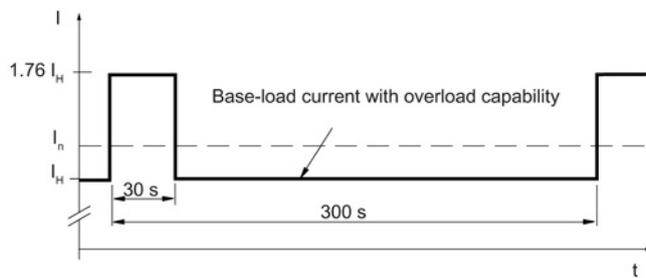


Figure 6-66 Duty cycle with 30 s overload for a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize with 300% overload

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

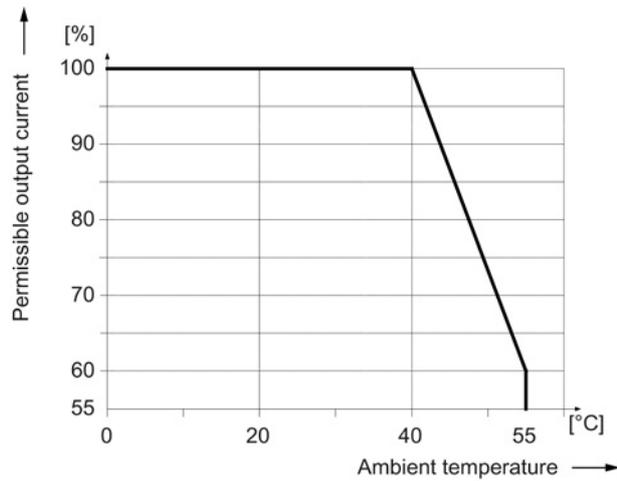


Figure 6-67 Output current as a function of the ambient temperature

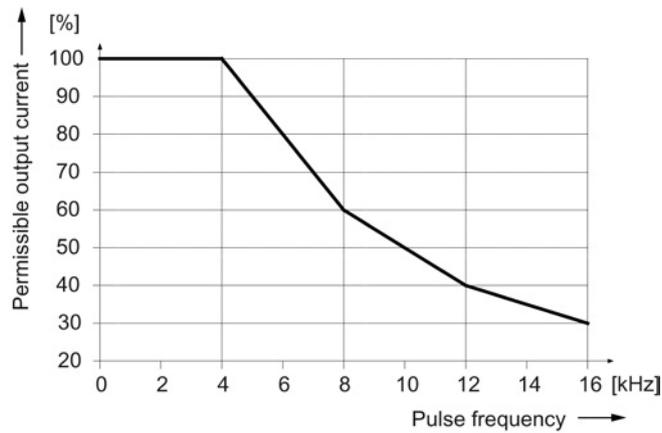


Figure 6-68 Output current as a function of the pulse frequency

6.3 Motor Module with external air cooling

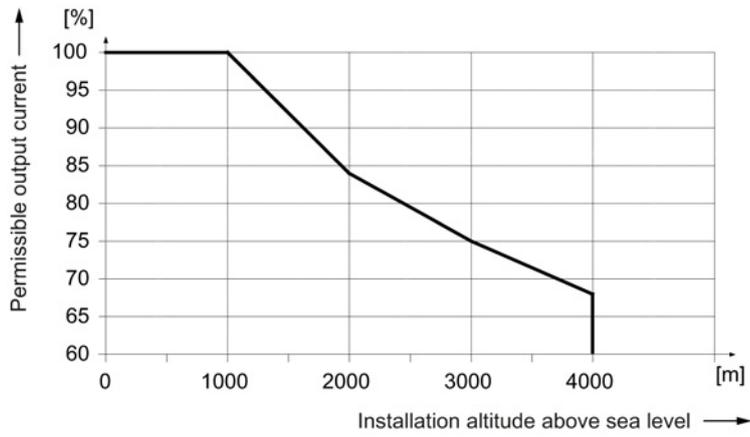


Figure 6-69 Output current as a function of the installation altitude

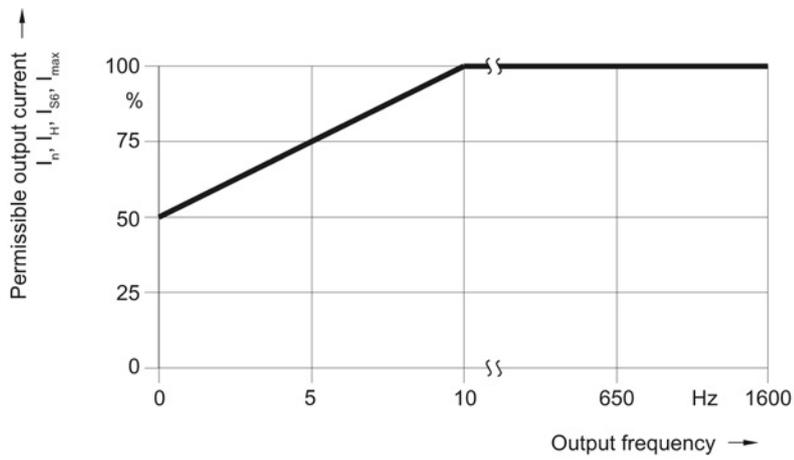


Figure 6-70 Output current as a function of the output frequency

6.4 Motor Modules with cold plate

6.4.1 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.

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

 **WARNING**

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

6.4.2 Interface description

6.4.2.1 Overview

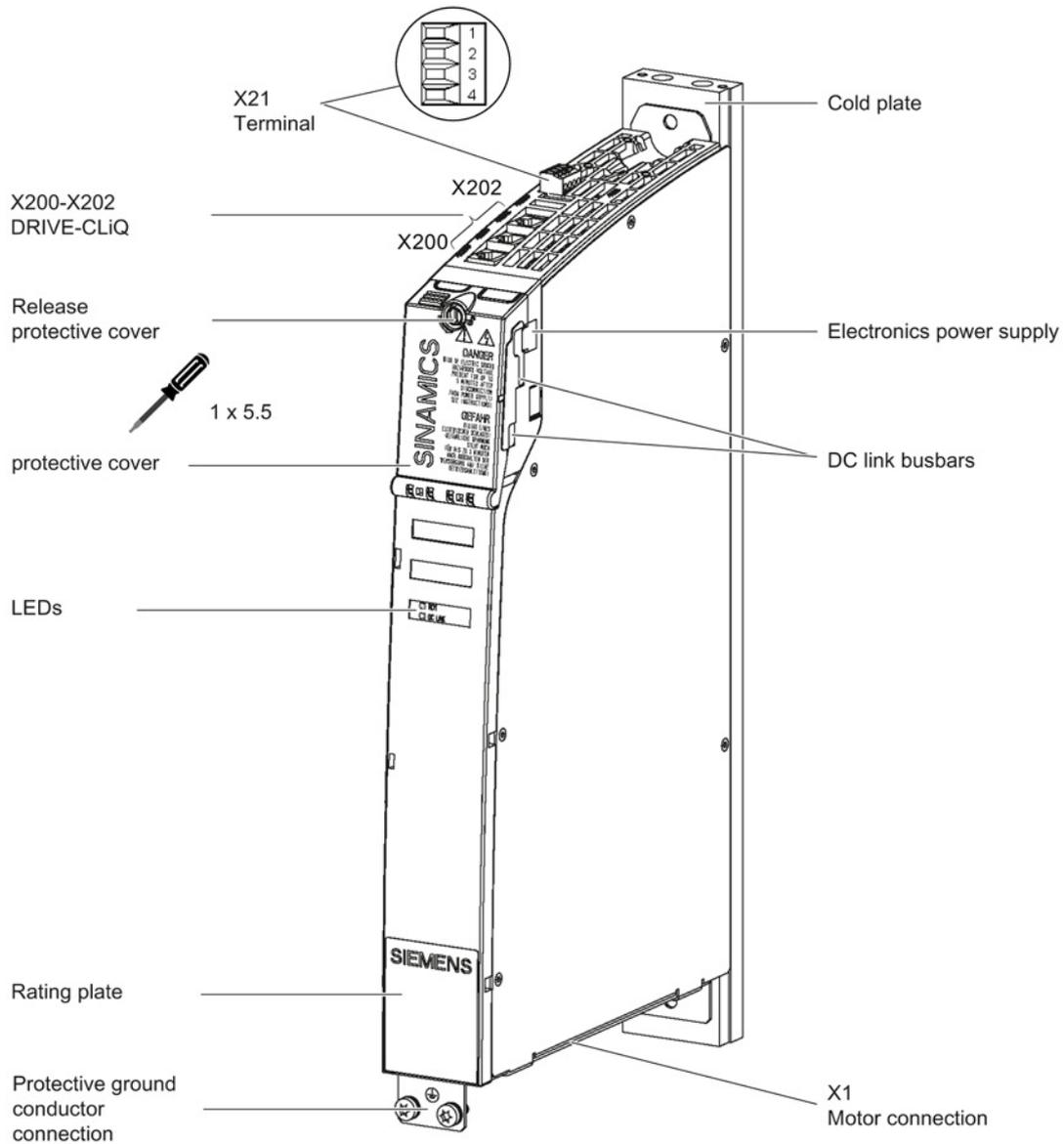


Figure 6-71 Interface overview, Single Motor Module Booksize with cold plate (example: 5 A)

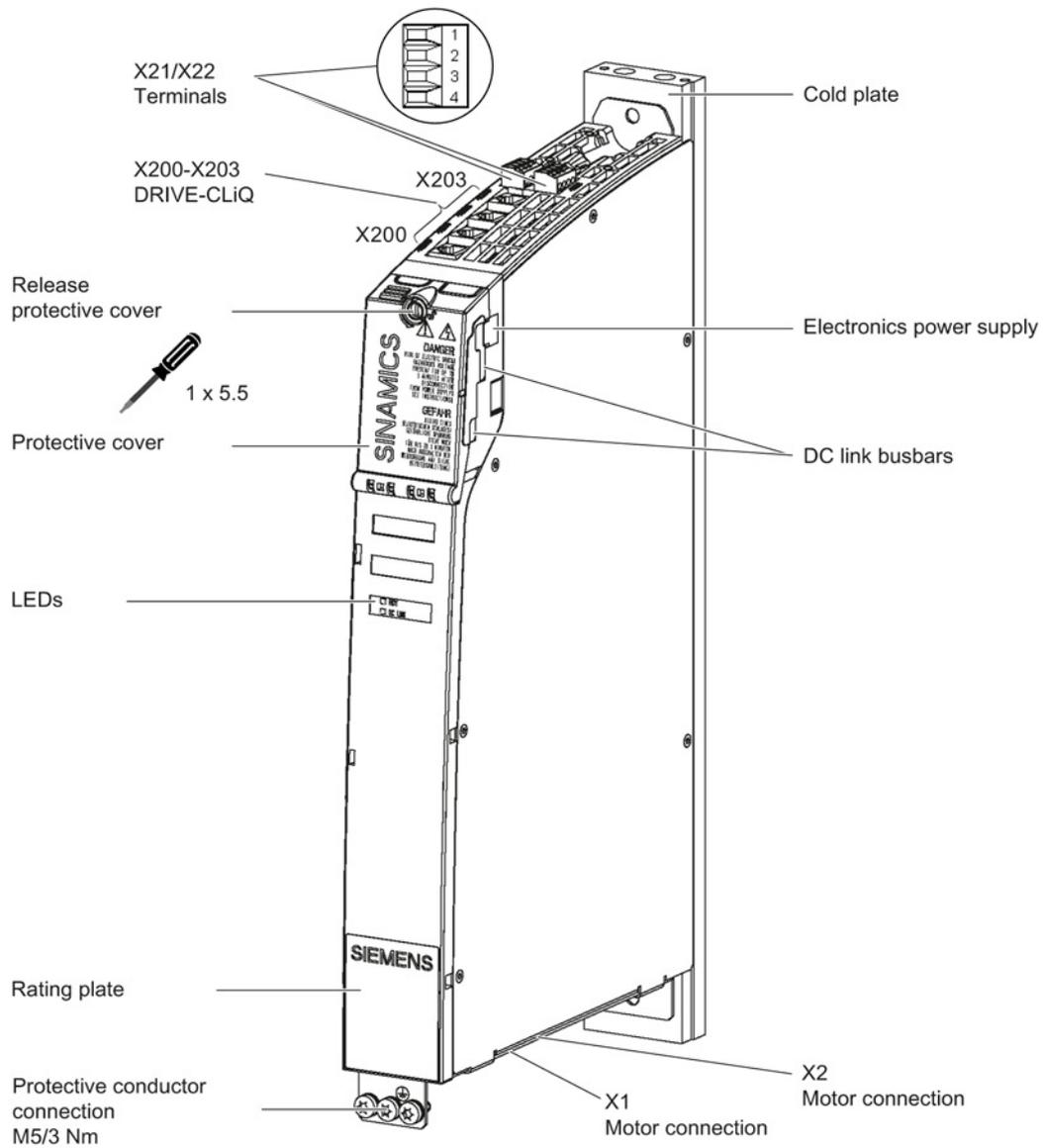


Figure 6-72 Interface overview, Double Motor Module Booksize with cold plate (example: 2 x 5 A)

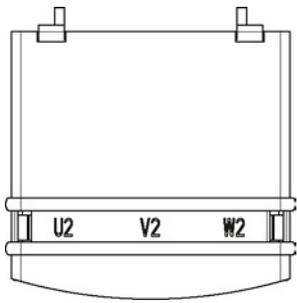
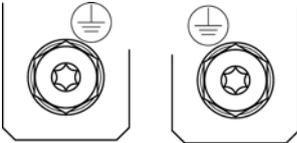
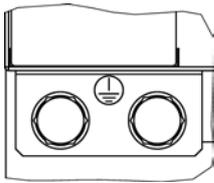
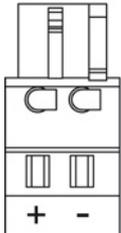
6.4.2.2 Motor and brake connection

Table 6- 32 X1/X2 motor and brake connection for Single Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

| | Terminal | Technical data |
|--|---------------|--|
| | U (U2) | Motor connection |
| | V (V2) | |
| | W (W2) | |
| | + (BR+) | Brake connection |
| | - (BR-) | Max. load current: 2 A Minimum load current: 0.1 A |
| | PE connection | Single Motor Modules 3 ... 30 A: Threaded hole M5 / 3 Nm ¹⁾ |
| | | |

1) For ring cable lugs without insulation

Table 6- 33 X1 motor connection and X11 brake connection for Single Motor Modules 45 A to 200 A

| | Terminal | Technical data |
|---|---------------|---|
|  | U2 | 45 ... 60 A: Threaded bolts M6 / 6 Nm ¹⁾ 85 A: Threaded bolts M8 / 13 Nm ¹⁾ 132 ... 200 A: Threaded bolts M8 / 13 Nm ¹⁾ |
| | V2 | |
| | W2 | |
|  | PE connection | 45 ... 60 A: Threaded bolts for motor cables: M6 / 6 Nm ¹⁾ Threaded hole for PE: M6 / 6 Nm ¹⁾ |
| | |  |
|  | + (BR+) | X11 brake connector²⁾: Voltage: 24 V DC Max. load current: 2 A Minimum load current: 0.1 A Type: Spring-loaded terminal 2 (Page 754) Max. cross-section that can be connected 2.5 mm ² : The brake connector is part of the prefabricated cable. |
| | - (BR-) | |

1) For ring cable lugs without insulation

2) The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.



! WARNING

Danger to life as a result of a hazardous voltage at the 0 V to 48 V DC terminals

Death or serious injury can result when live parts are touched in the event of a fault.

- Only connect protective extra-low voltages (PELV / SELV) to all connections and terminals between 0 to 48 V DC.

| |
|---|
| <p>NOTICE</p> <p>Destruction of the motor or motor holding brake as a result of high voltage tolerances of the motor holding brakes</p> <p>If the voltage tolerances of the motor holding brakes are not complied with (24 V ± 10 %), then the brake will malfunction, i.e. the brake will not reliably open. If the motor constantly runs against the closed brake, the brake or the motor will be destroyed.</p> <ul style="list-style-type: none"> • Set the DC power supply to 26 V. <p>The following general conditions must be satisfied:</p> <ul style="list-style-type: none"> • Siemens three-phase motors must be used • Siemens MOTION-CONNECT power cables must be used • Motor cable lengths, max. 100 m |
|---|

Note

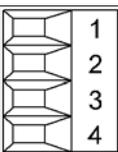
The total length of the power cables (motor feeder cables and DC link cables) must not exceed the values listed in Chapter Combining line reactors and line filters (Page 136).

Note

The motor brake must be connected via connector X11. It is not permitted to directly connect the cable BR – to the electronics ground M.

6.4.2.3 X21/X22 EP terminals/temperature sensor

Table 6- 34 X21/X22 EP terminals / temperature sensor

| | Terminal | Function | Technical data |
|---|----------|-------------------------|---|
|  | 1 | + Temp | Temperature sensors: KTY 84-1C130/PTC/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: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled. |
| | 4 | EP M1 (enable pulses) | |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm ² | | | |

EP terminals

Parameters are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4 (see 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 is only available when Safety Integrated Basic Functions are enabled.

Temperature sensor connection

NOTICE

Risk of the motor overheating due to an incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY 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

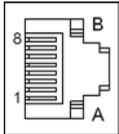
Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that fully comply with the specifications of the safety isolation.
- 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.

6.4.2.4 X200-X203 DRIVE-CLiQ interface

Table 6- 35 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules
 X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

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

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

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

6.4.3 Connection examples

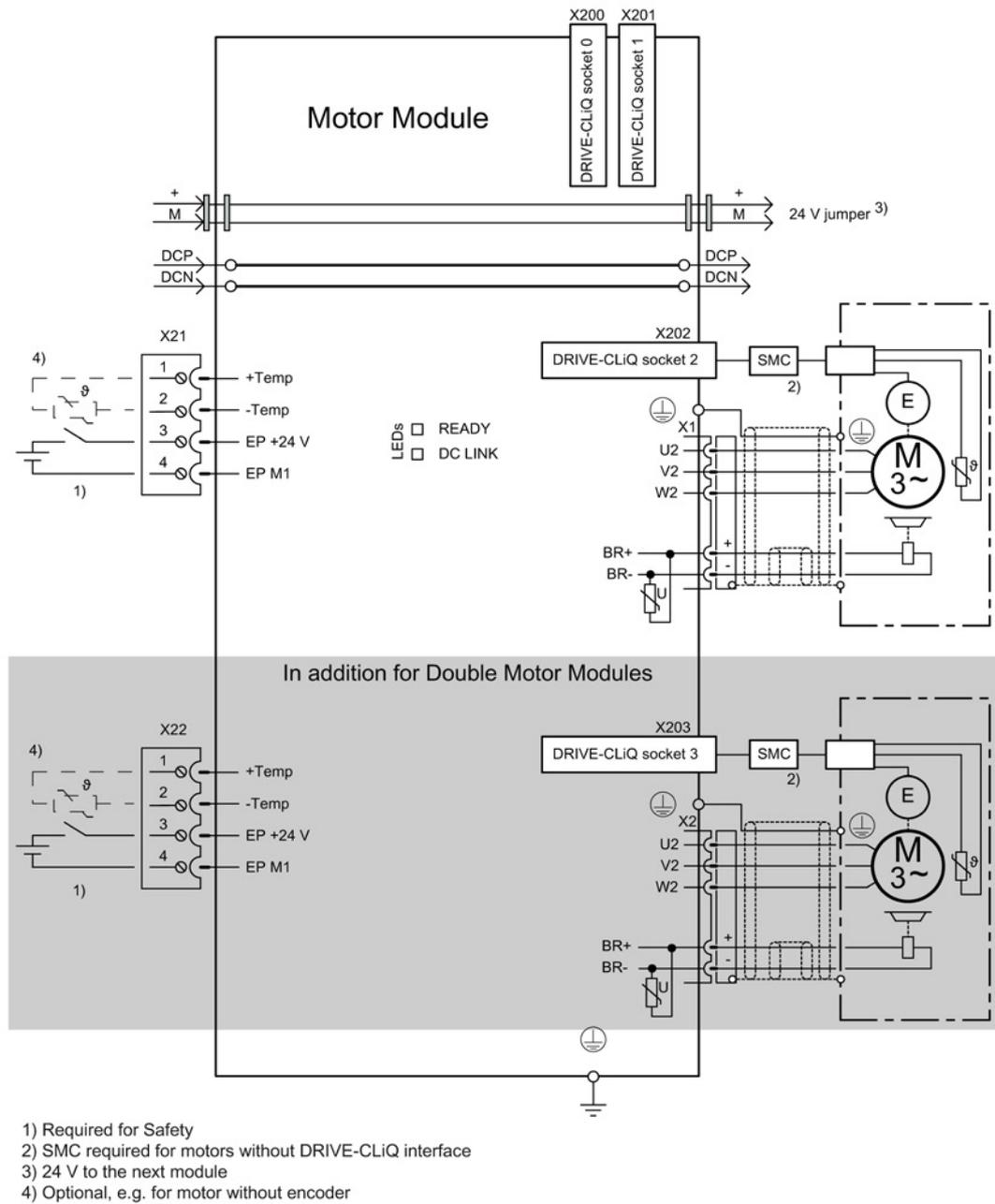


Figure 6-73 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

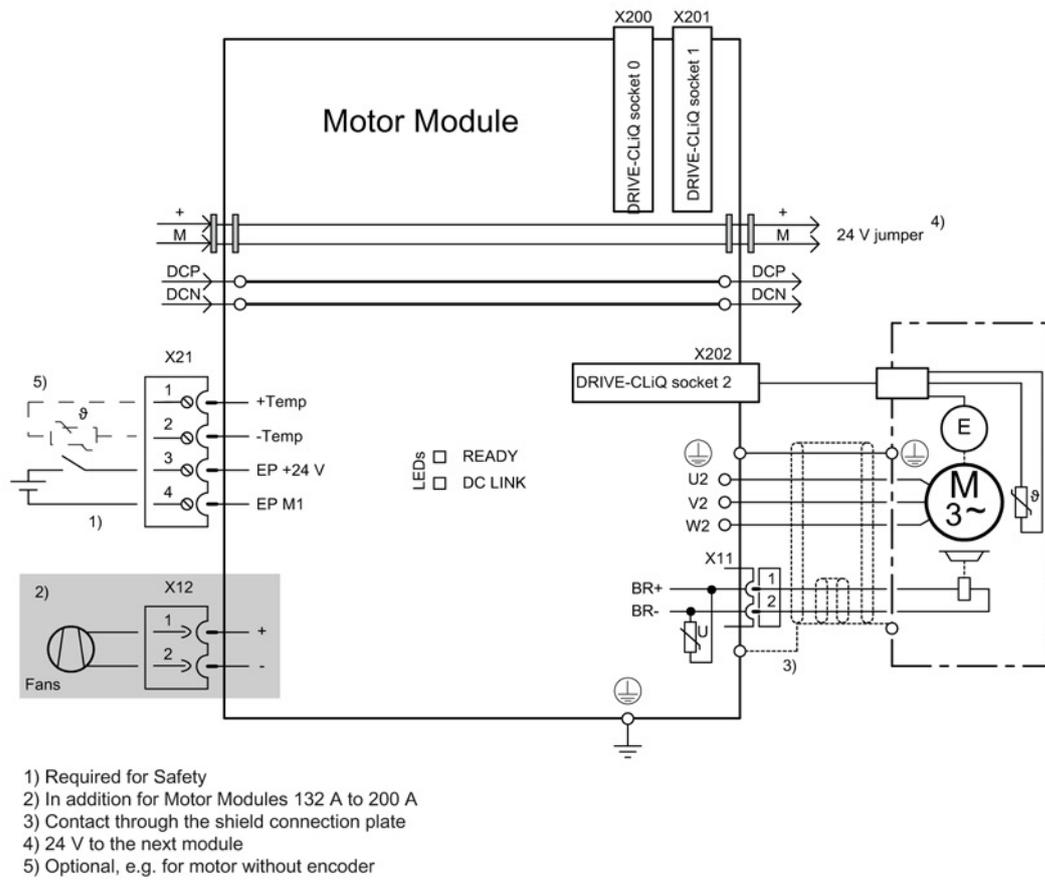


Figure 6-74 Example connection of Single Motor Modules 45 A to 200 A

6.4.4 Meaning of LEDs

Table 6- 36 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 | -- | 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 | -- | At least one fault is present in this component. Note: The LED is driven irrespective of the corresponding messages being reconfigured. | Resolve and acknowledge the fault. |
| Green/red (0.5 Hz) | -- | Firmware is being downloaded. | – |
| Green/red (2 Hz) | -- | Firmware download has been completed. The system waits for POWER ON. | Carry out a POWER ON. |
| Green/orange or red/orange | -- | Component recognition via LED is activated ¹⁾ . Note: Both options depend on the LED status when component recognition is activated. | – |

¹⁾ See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



! WARNING

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

6.4.5 Dimension drawings

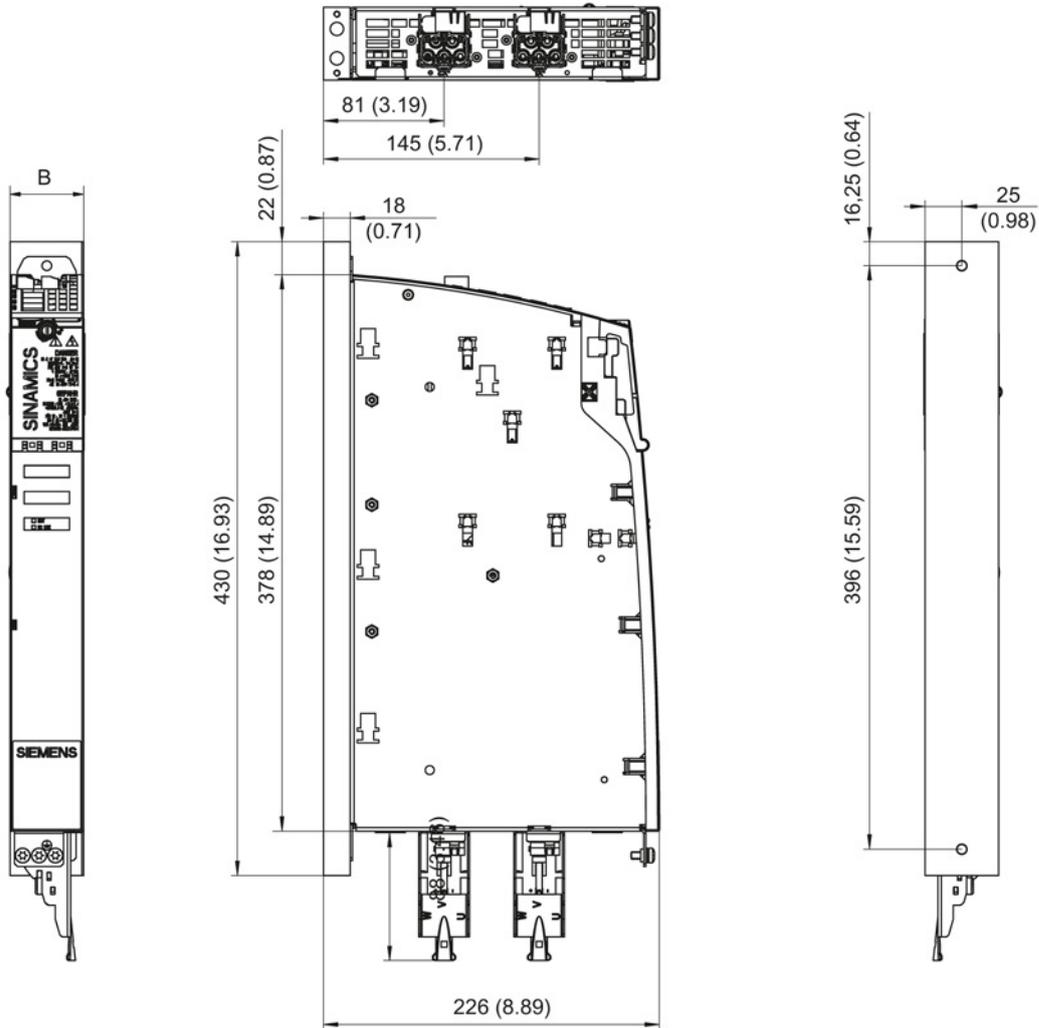


Figure 6-75 Dimension drawing of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with cold plate, all dimensions in mm and (inches); example: 2 x 5 A Double Motor Module

Table 6- 37 Dimensions of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with cold plate

| Motor Module | Order number | B [mm] (inches) |
|--------------------------|--------------------|-----------------|
| 3 A Single Motor Module | 6SL3126-1TE13-0AAx | 50 (1.97) |
| 5 A Single Motor Module | 6SL3126-1TE15-0AAx | |
| 9 A Single Motor Module | 6SL3126-1TE21-0AAx | |
| 18 A Single Motor Module | 6SL3126-1TE21-8AAx | |
| 3 A Double Motor Module | 6SL3126-2TE13-0AAx | |
| 5 A Double Motor Module | 6SL3126-2TE15-0AAx | |
| 9 A Double Motor Module | 6SL3126-2TE21-0AAx | |

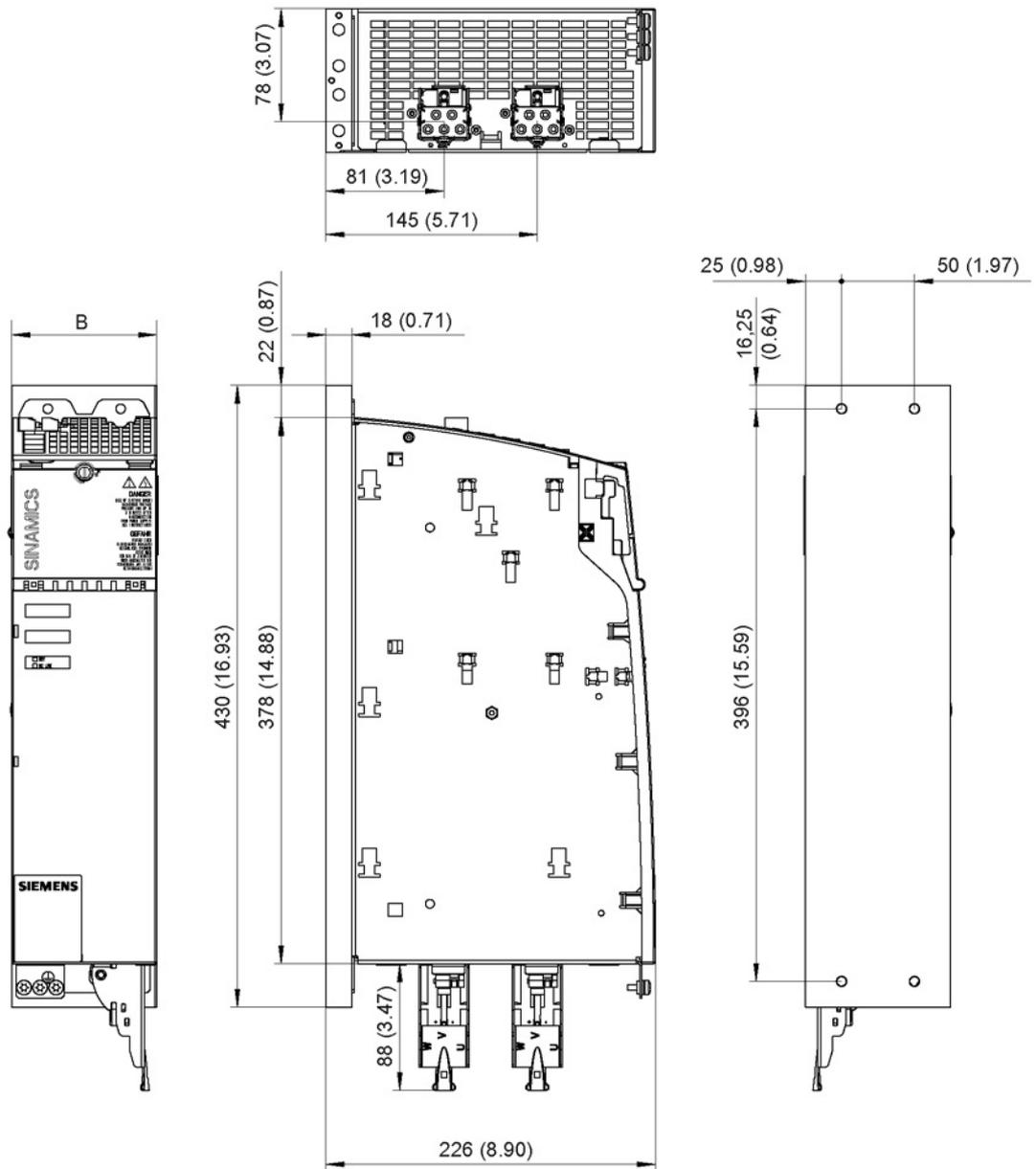


Figure 6-76 Dimension drawing of 30 A and 2 x 18 A Motor Modules Booksize with cold plate, all dimensions in mm and (inches)

Table 6- 38 Dimensions of 30 A and 2 x 18 A Motor Modules Booksize with cold plate

| Motor Module | Order number | B [mm] (inches) |
|--------------------------|--------------------|-----------------|
| 30 A Single Motor Module | 6SL3126-1TE23-0AAx | 100 (3.94) |
| 18 A Double Motor Module | 6SL3126-2TE21-8AAx | |

6.4 Motor Modules with cold plate

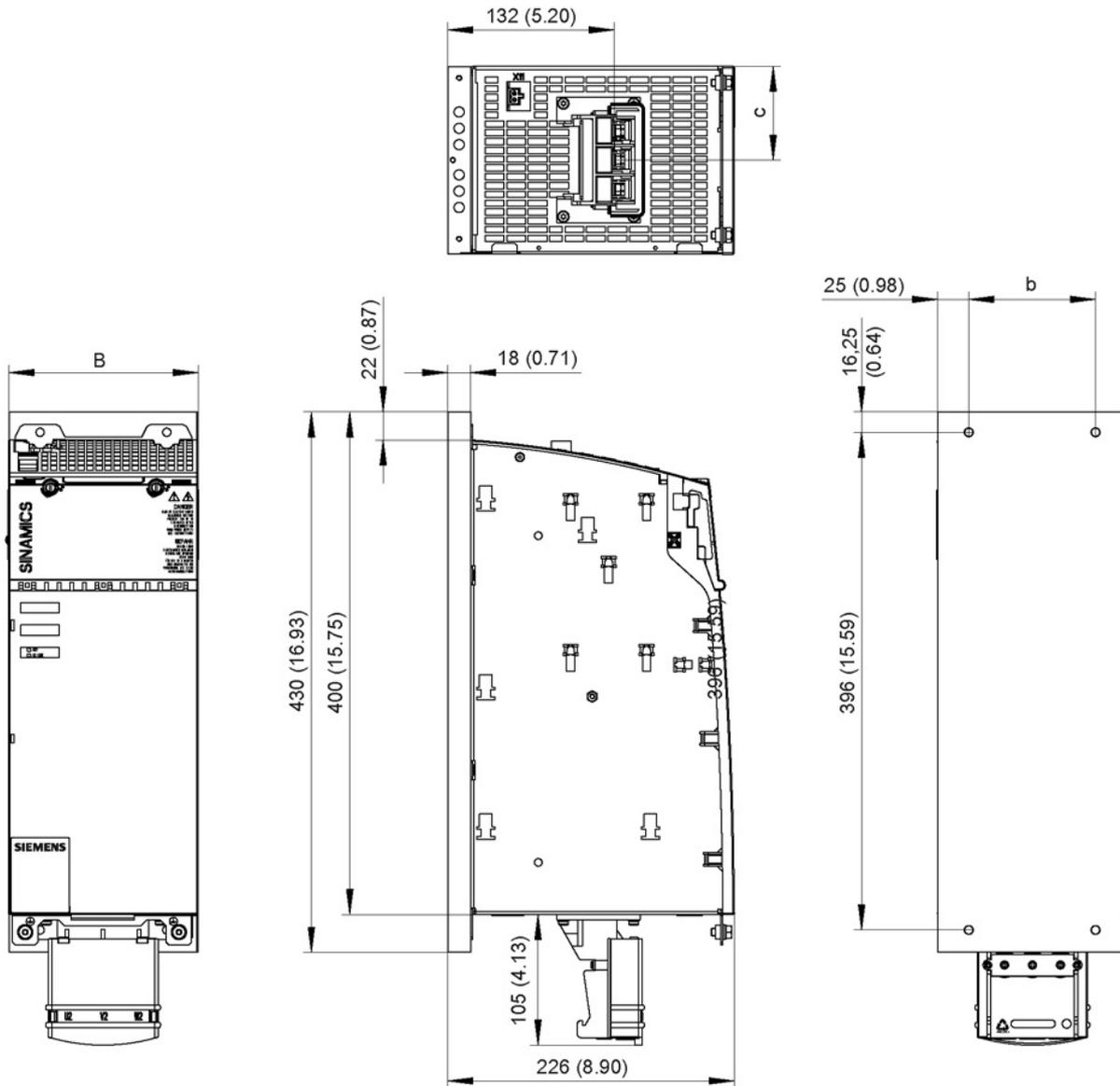


Figure 6-77 Dimension drawing of Motor Modules Booksize 45 A, 60 A, and 85 A with cold plate, all dimensions in mm and (inches); example for Motor Module 45 A

Table 6- 39 Dimensions of 45 A, 60 A, and 85 A Motor Modules Booksize with cold plate

| Motor Modules | Order number | B [mm] (inches) | b [mm] (inches) | c [mm] (inches) |
|--------------------------|--------------------|-----------------|-----------------|-----------------|
| Single Motor Module 45 A | 6SL3126-1TE24-5AAx | 150 (5.91) | 100 (3.94) | 75 (2.95) |
| Single Motor Module 60 A | 6SL3126-1TE26-0AAx | | | |
| Single Motor Module 85 A | 6SL3126-1TE28-5AAx | 200 (7.87) | 150 (5.91) | 100 (3.94) |

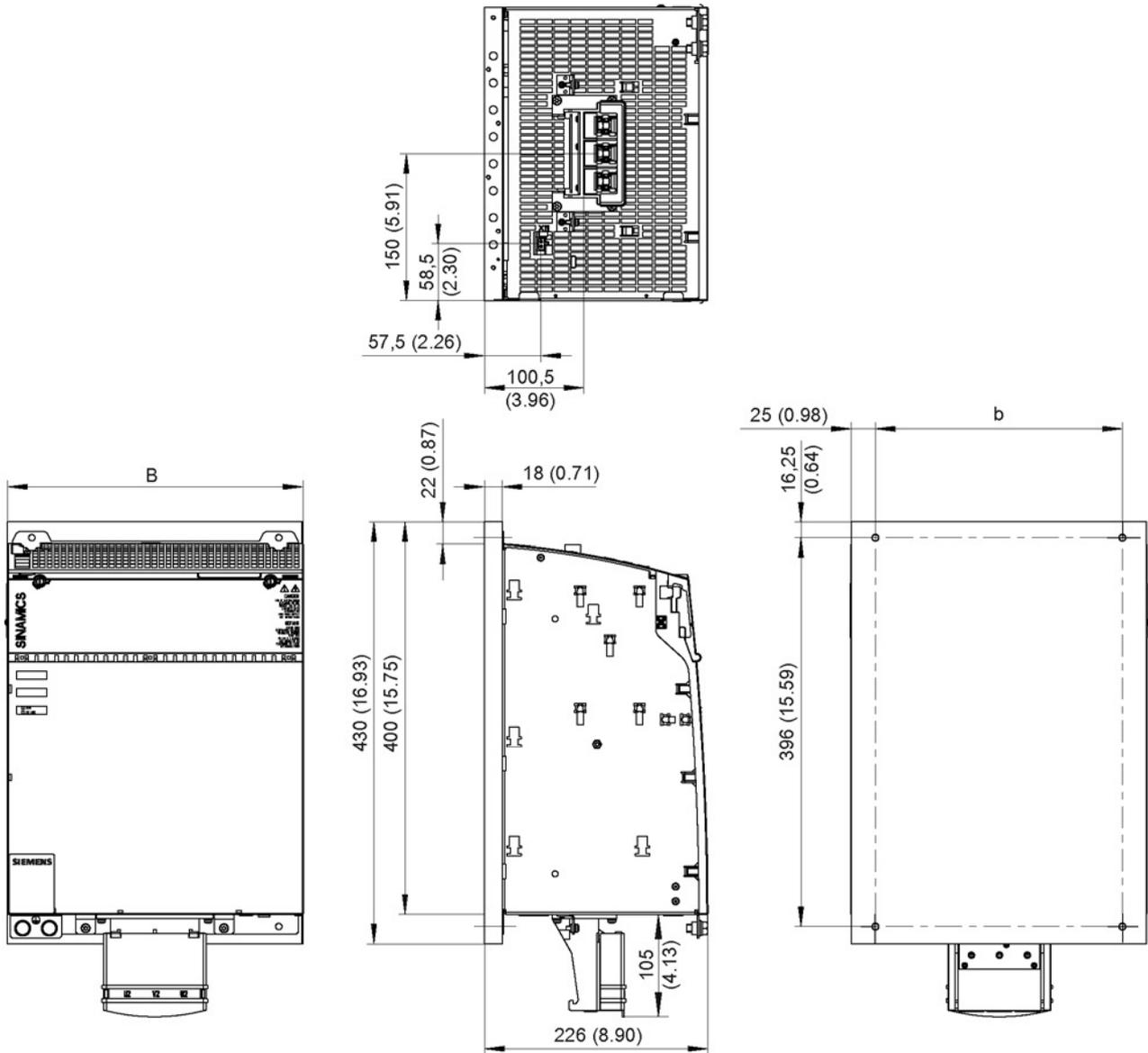


Figure 6-78 Dimension drawing of Motor Modules Booksize 132 A and 200 A with cold plate, all dimensions in mm and (inches); example for Motor Module 200 A

Table 6- 40 Dimensions of 132 A and 200 A Motor Modules Booksize with cold plate

| Motor Module | Order number | B [mm] (inches) | b [mm] (inches) |
|---------------------------|--------------------|-----------------|-----------------|
| Single Motor Module 132 A | 6SL3126-1TE31-3AAx | 300 (11.81) | 250 (9.84) |
| Single Motor Module 200 A | 6SL3126-1TE32-0AAx | | |

6.4.6 Mounting

Please note the following before mounting a Motor Module with cold plate on a customer-specific heat sink:

- Check the surface of the heat sink to ensure that it is not damaged.
- To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every component with cold plate is supplied with heat-conducting foil cut to the right size. Note the mounting position of the heat-conducting foil (see diagram below).

Note

- Also replace the heat-conducting foil when replacing a component.
 - Only use heat-conducting foil released or supplied by Siemens.
-

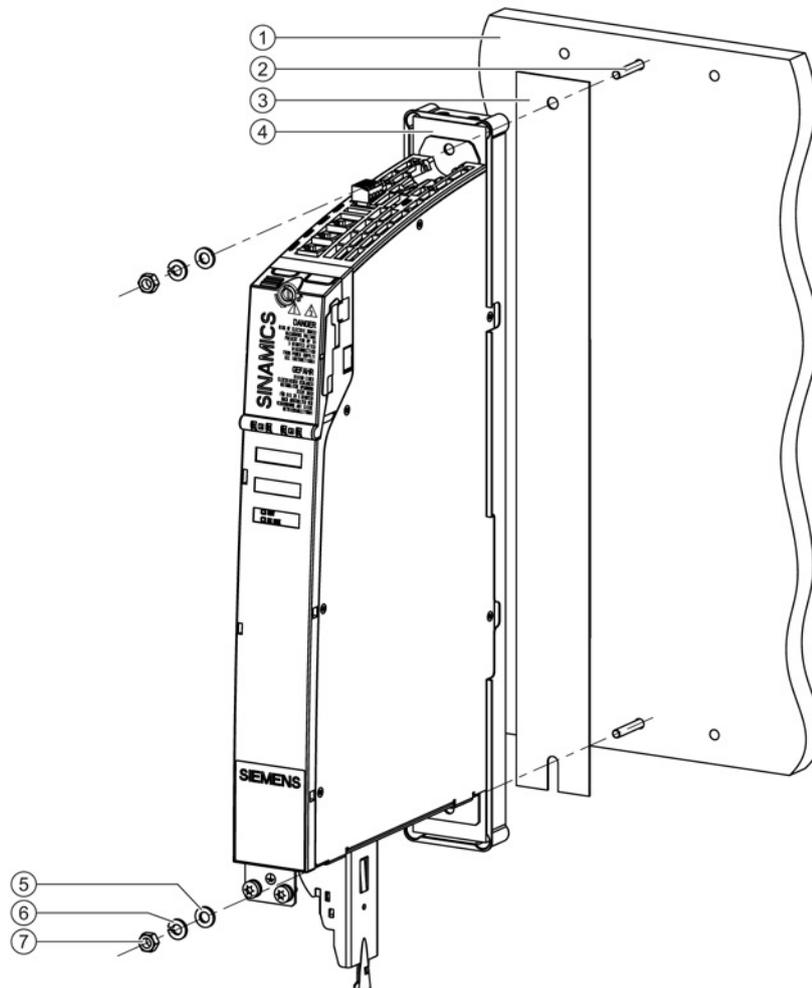
Table 6- 41 Overview of heat-conducting foils

| | Order number |
|------------------------------|--------------------|
| Heat-conducting foil, 50 mm | 6SL3162-6FB00-0AA0 |
| Heat-conducting foil, 100 mm | 6SL3162-6FD00-0AA0 |
| Heat-conducting foil, 150 mm | 6SL3162-6FF00-0AA0 |
| Heat-conducting foil, 200 mm | 6SL3162-6FH00-0AA0 |
| Heat-conducting foil, 300 mm | 6SL3162-6FM00-0AA0 |

Note

M6 studs and hexagon nuts or grub screws (ISO 7436-M6x40-14 H, property class 8.8) are recommended for mounting the components.

Mounting



- ① External heat sink (air or liquid)
- ② M6 studs
- ③ Heat-conducting foil
- ④ Cold plate
- ⑤ Washer
- ⑥ Spring washer
- ⑦ M6 nut

Figure 6-79 Mounting a Motor Module with cold plate on an external heat sink (example: 3 A Motor Module)

Tightening torques:

- Firstly, tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts.
Tightening torque: 10 Nm

Note

- Where components have four fixing points, the nuts must be tightened evenly by alternating diagonally between them.
-

Help with the mechanical control cabinet design is available from:

Siemens AG
Industry Sector, IA DT MC MF - WKC AS
TCCCC (Technical Competence Center Cabinets Chemnitz)
P.O. Box 1124
09070 Chemnitz, Germany
e-mail: cc.cabinetcooling.aud@siemens.com

Properties of the heat sink

We recommend using AlMgSi 0.5 as the heat sink material.
The roughness of the external heat sink surface should be at least Rz 16. The contact surface between the heat sink and cold plate should have an evenness of 0.2 mm (applicable to a height of 450 mm and a width of 300 mm).

Note

Machine manufacturers can adapt the heat sink version to their special requirements. The specified rated data for the Motor Modules can only be achieved if the power losses can be dissipated by the external heat sink under the specified general conditions.

| |
|---|
| NOTICE |
| Damage to the cold plate caused by incorrect mounting |
| The screw bolts can be damaged when mounting the cold plate. |
| <ul style="list-style-type: none">• Do not damage the cold plate. |

6.4.7 Technical data

6.4.7.1 Single Motor Modules

Table 6- 42 Technical data Single Motor Modules Booksize (3 to 30 A)

| Cold plate | 6SL3126- | 1TE13- 0AAx ¹⁾ | 1TE15- 0AAx ¹⁾ | 1TE21- 0AAx ¹⁾ | 1TE21- 8AAx ¹⁾ | 1TE23- 0AAx |
|--|--------------------|-------------------------------|------------------------------|------------------------------|------------------------------|----------------|
| Output current | | | | | | |
| Rated current (I _n) | A _{ACrms} | 3 | 5 | 9 | 18 | 30 |
| Base-load current (I _H) | A | 2,6 | 4,3 | 7,7 | 15,3 | 25,5 |
| Intermittent duty current (I _{S6}) | A _{ACrms} | 3,5 | 6 | 10 | 24 | 40 |
| 40% | A _{ACrms} | 6 | 10 | 18 | 36 | 56 |
| Peak current (I _{max}) | | | | | | |
| Output voltage | V _{ACrms} | 0 ... 0.717 x DC-link voltage | | | | |
| DC-link current I_{d max} | A _{DC} | 3,6 | 6 | 11 | 22 | 36 |
| DC-link voltage (up to 2000 m above sea level) | V _{DC} | 510 ... 720 | | | | |
| DC-link capacitance | μF | 110 | 110 | 110 | 220 | 710 |
| Overvoltage trip | V _{DC} | 820 ± 2 % | | | | |
| Undervoltage trip ²⁾ | V _{DC} | 380 | | | | |
| Electronics power supply | V _{DC} | 24 (20,4 ... 28,8) | | | | |
| Electronics current drawn at 24 VDC | A _{DC} | 0,65 | | | | |
| Current carrying capacity | | | | | | |
| DC-link busbars | A _{DC} | 100 | | | | |
| Reinforced DC-link busbars | A _{DC} | 150 | | | | |
| 24 VDC busbars | A _{DC} | 20 | | | | |
| Unit rating³⁾ | | | | | | |
| Based on I _n (600 VDC; 4 kHz) | kW | 1,6 | 2,7 | 4,8 | 9,7 | 16 |
| Based on I _H | kW | 1,1 | 2,3 | 4,1 | 8,2 | 13,7 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 45,5 | 70,6 | 95,6 | 180,6 | 305,6 |
| Max. pulse frequency | | | | | | |
| without derating | kHz | 4 | | | | |
| with derating | kHz | 16 | | | | |
| Max. ambient temperature | | | | | | |
| without derating | ° C | 40 | | | | |
| with derating | ° C | 55 | | | | |
| Max. permissible heat sink temperature | ° C | 80 | 80 | 80 | 80 | 70 |
| Weight | kg | 4,2 | 4,2 | 4,5 | 4,5 | 6,1 |

1) Applies only to order numbers with x = 0 .. 3

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

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

Table 6- 43 Technical data Single Motor Modules (45A to 200A)

| Cold plate | 6SL3126- | 1TE24-5AAx | 1TE26-0AAx | 1TE28-5AAx | 1TE31-3AAx | 1TE32-0AAx |
|---|------------------------------------|--------------------|------------|------------|-------------------------|-------------------------|
| Output current | | | | | | |
| Rated current (I _n) | A _{ACrms} | 45 | 60 | 85 | 132 (105) ¹⁾ | 200 (140) ¹⁾ |
| Base-load current (I _H) | A | 38 | 51 | 68 | 105 (84) ¹⁾ | 141 (99) ¹⁾ |
| Intermittent duty current (I _{S6}) | A _{ACrms} | 60 | 80 | 110 | 150 (120) ¹⁾ | 230 (161) ¹⁾ |
| 40% | A _{ACrms} | 85 | 113 | 141 | 210 | 282 |
| Peak current (I _{max}) | | | | | | |
| Output voltage | V _{ACrms} | 0 ... 480 | | | | |
| DC-link current I_{d max} | A _{DC} | 54 | 72 | 102 | 158 | 200 |
| DC-link voltage (up to 2000 m above sea level) | V _{DC} | 510 ... 720 | | | | |
| DC-link capacitance | µF | 1175 | 1410 | 1880 | 2820 | 3995 |
| Overvoltage trip Undervoltage trip ²⁾ | V _{DC} V _{DC} | 820 ± 2 % 380 | | | | |
| Electronics power supply | V _{DC} | 24 (20,4 ... 28,8) | | | | |
| Electronics current drawn at 24 VDC | A _{DC} | 0,75 | 0,75 | 0,8 | 0,85 | 0,85 |
| Current carrying capacity | | | | | | |
| DC-link busbars | A _{DC} | 200 | | | | |
| 24 VDC busbars | A _{DC} | 20 | | | | |
| Unit rating³⁾ | | | | | | |
| Based on I _n (600 VDC; 4 kHz) | kW | 24 | 32 | 46 | 71 (57) ¹⁾ | 107 (75) ¹⁾ |
| Based on I _H | kW | 21 | 28 | 37 | 57 (46) ¹⁾ | 76 (53) ¹⁾ |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 448 | 608 | 769,2 | 1270,4 | 2070,4 |
| Max. pulse frequency | | | | | | |
| without derating | kHz | 4 | | | | |
| with derating | kHz | 16 | | | | |
| Max. ambient temperature | | | | | | |
| without derating | ° C | 40 | | | | |
| with derating | ° C | 55 | | | | |
| Max. permissible heat sink temperature | ° C | 80 | 73 | 83 | 75 | 79 (70% derating) |
| Weight | kg | 9,1 | 9,1 | 12,5 | 18,0 | 18,0 |

- 1) Derating must be applied due to the transfer of heat to the external heat sink. At a temperature of 40° C at the interface to the power unit, 80% derating occurs for 6SL3126-1TE31-3AAx and 70% for 6SL3126-1TE32-0AAx.
- 2) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V (exception: 132 A and 200 A Motor Modules) and is adjusted to the parameterized rated voltage.
- 3) Rated power of a typical standard induction motor at 400 V 3 AC.

Note

New systems with 132 A and 200 A Motor Modules should ideally be designed with 200 A liquid-cooled Motor Modules in order to avoid current derating.

6.4.7.2 Double Motor Modules

Table 6- 44 Technical data Double Motor Modules (2 x 3 to 2 x 18 A)

| Cold plate | 6SL3126- | 2TE13-0AAx ¹⁾ | 2TE15-0AAx ¹⁾ | 2TE21-0AAx ¹⁾ | 2TE21-8AAx |
|---|--------------|--------------------------|--------------------------|--------------------------|---------------|
| Output current | | | | | |
| Rated current (I_n) | A_{ACrms} | 2 x 3 | 2 x 5 | 2 x 9 | 2 x 18 |
| Base-load current (I_H) | A | 2 x 2.6 | 2 x 4.3 | 2 x 7.7 | 2 x 15.3 |
| Intermittent duty current (I_{S6}) 40% | A_{ACrms} | 2 x 3.5 | 2 x 6 | 2 x 10 | 2 x 24 |
| Peak current (I_{max}) | A_{ACrms} | 2 x 6 | 2 x 10 | 2 x 18 | 2 x 36 |
| Output voltage | V_{ACrms} | 0 ... 480 | | | |
| DC-link current $I_{d max}$ | A_{DC} | 7,2 | 12 | 22 | 43 |
| DC-link voltage | V_{DC} | 510 ... 720 | | | |
| DC-link capacitance | μF | 110 | 220 | 220 | 705 |
| Overvoltage trip | V_{DC} | 820 \pm 2 % | | | |
| Undervoltage trip ²⁾ | V_{DC} | 380 | | | |
| Electronics power supply | V_{DC} | 24 (20,4 ... 28,8) | | | |
| Electronics current drawn at 24 VDC | A_{DC} | 0,9 | 0,9 | 0,9 | 1,05 |
| Current carrying capacity | | | | | |
| DC-link busbars | A_{DC} | 100 | 100 | 100 | 100 |
| Reinforced DC-link busbars | A_{DC} | 150 | 150 | 150 | 150 |
| 24 VDC busbars | A_{DC} | 20 | 20 | 20 | 20 |
| Unit rating³⁾ | | | | | |
| Based on I_n (600 VDC; 4 kHz) | kW | 2 x 1.6 | 2 x 2.7 | 2 x 4.8 | 2 x 9.7 |
| Based on I_H | kW | 2 x 1.4 | 2 x 2.3 | 2 x 4.1 | 2 x 8.2 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 91,6 | 126,6 | 181,6 | 345,2 |
| Max. pulse frequency | | | | | |
| without derating | kHz | 4 | | | |
| with derating | kHz | 16 | | | |
| Max. ambient temperature | | | | | |
| without derating | $^{\circ} C$ | 40 | | | |
| with derating | $^{\circ} C$ | 55 | | | |
| Max. permissible heat sink temperature | $^{\circ} C$ | 80 | 80 | 90 | 90 |
| Weight | kg | 4,5 | 4,5 | 4,5 | 5,9 |

1) Applies only to order numbers with x = 0 .. 3

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.

6.4.7.3 Characteristics

Rated duty cycles Motor Modules Booksize

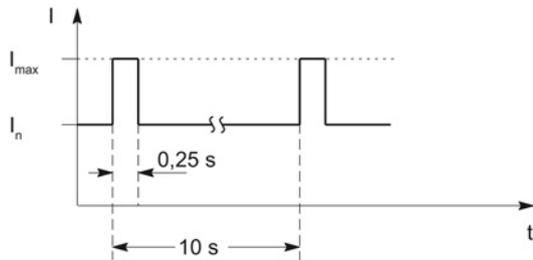


Figure 6-80 Duty cycle with initial load (for servo drives)

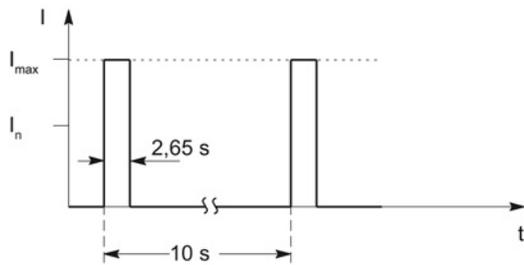


Figure 6-81 Duty cycle without initial load (for servo drives)

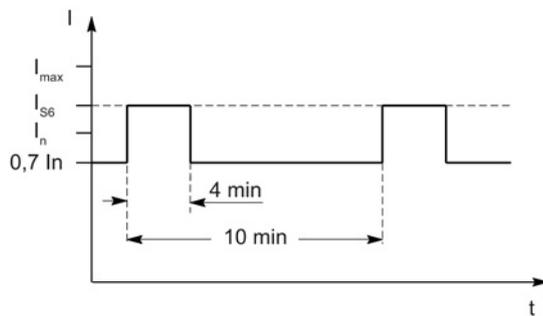


Figure 6-82 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

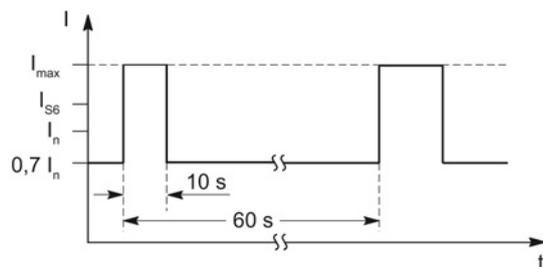


Figure 6-83 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

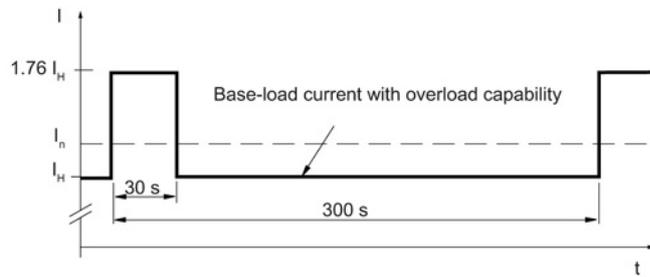


Figure 6-84 Duty cycle with 30 s overload for a duty cycle duration of 300 s

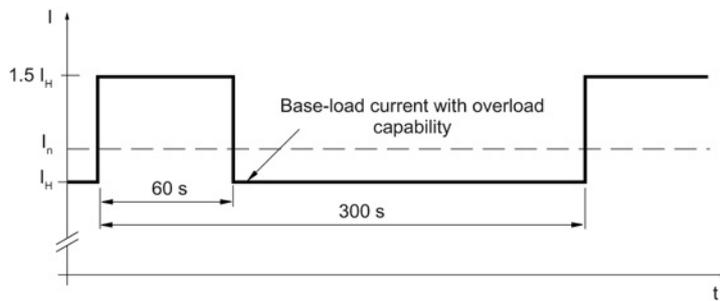


Figure 6-85 Duty cycle with 60 s overload for a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

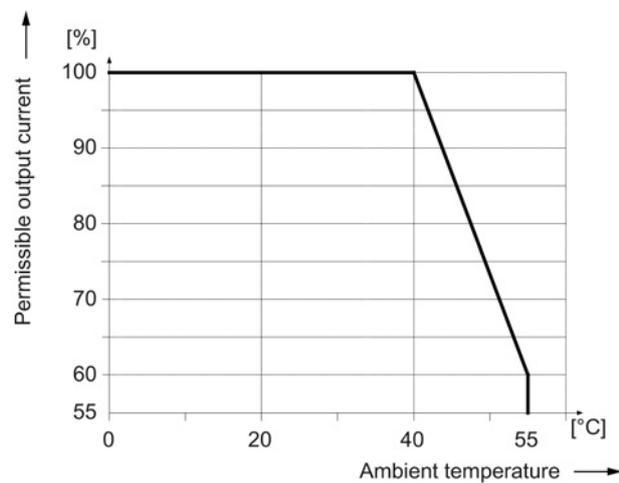


Figure 6-86 Output current as a function of the ambient temperature

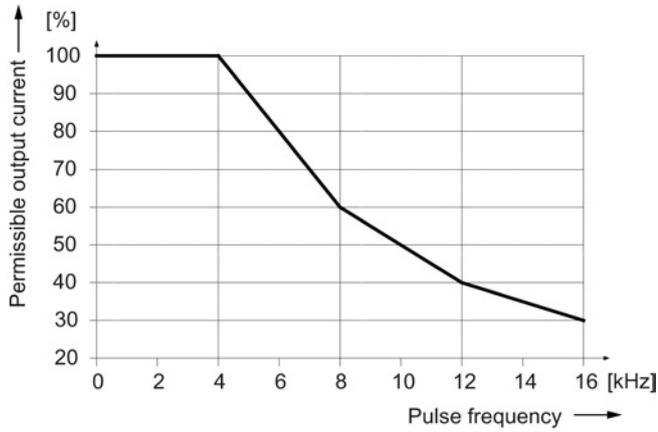


Figure 6-87 Output current as a function of the pulse frequency

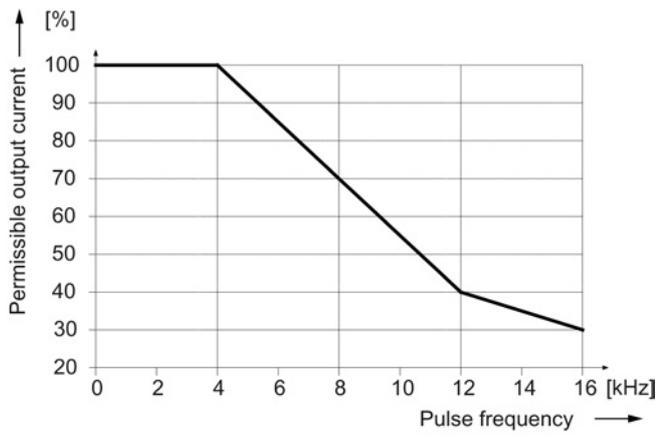


Figure 6-88 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

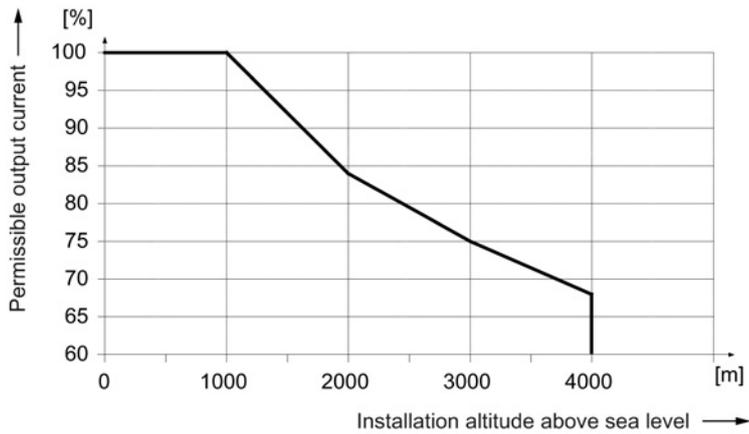


Figure 6-89 Output current as a function of the installation altitude

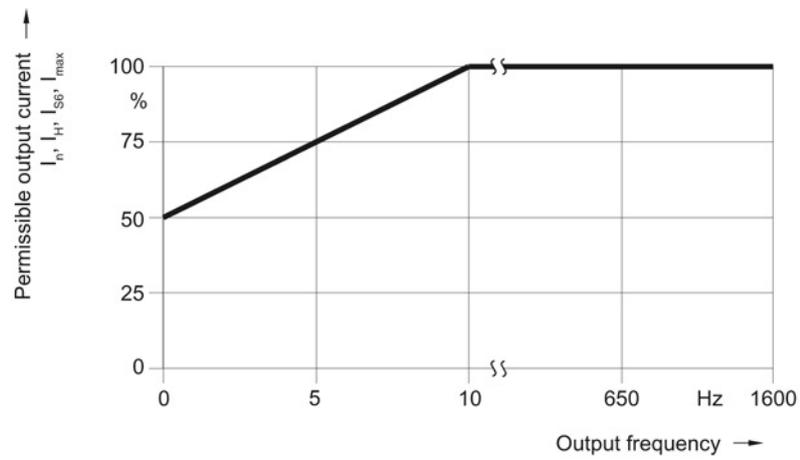


Figure 6-90 Output current as a function of the output frequency

6.4.8 Technical data for Motor Modules Booksize with 300% overload

6.4.8.1 Single Motor Modules (300% overload)

Table 6- 45 Technical data Single Motor Modules (3 to 18 A) with 300% overload

| Cold plate | 6SL3126- | 1TE13-0AA4 | 1TE15-0AA4 | 1TE21-0AA4 | 1TE21-8AA4 |
|---|--------------------|-------------------------------|------------|------------|------------|
| Output current | | | | | |
| Rated current (I _n) | A _{ACrms} | 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 _{ACrms} | 3,5 | 6 | 10 | 24 |
| Peak current (I _{max}) | A _{ACrms} | 9 | 15 | 27 | 54 |
| Output voltage | V _{ACrms} | 0 ... 0.717 x DC-link voltage | | | |
| DC-link current I_{d max} | A _{DC} | 3,6 | 6 | 11 | 22 |
| DC-link voltage (up to 2000 m above sea level) | V _{DC} | 510 ... 720 | | | |
| DC-link capacitance | μF | 110 | 110 | 110 | 220 |
| Overvoltage trip | V _{DC} | 820 ± 2 % | | | |
| Undervoltage trip ¹⁾ | V _{DC} | 380 | | | |
| Electronics power supply | V _{DC} | 24 (20,4 ... 28,8) | | | |
| Electronics current drawn at 24 VDC | A _{DC} | 0,65 | | | |
| Current carrying capacity | | | | | |
| DC-link busbars | A _{DC} | 100 | | | |
| Reinforced DC-link busbars | A _{DC} | 150 | | | |
| 24 VDC busbars | A _{DC} | 20 | | | |
| Unit rating²⁾ | | | | | |
| Based on I _n (600 VDC; 4 kHz) | kW | 1,6 | 2,7 | 4,8 | 9,7 |
| Based on I _H | kW | 1,1 | 2,3 | 4,1 | 8,2 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 45,5 | 70,6 | 95,6 | 180,6 |
| Max. pulse frequency | | | | | |
| without derating | kHz | 4 | | | |
| with derating | kHz | 16 | | | |
| Max. ambient temperature | | | | | |
| without derating | ° C | 40 | | | |
| with derating | ° C | 55 | | | |
| Max. permissible heat sink temperature | ° C | 70 | 70 | 70 | 70 |
| Weight | kg | 4,2 | 4,2 | 4,5 | 4,5 |

1) 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

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

Note

Disturbance of the 18 A Single Motor Module with 300% overload during operation on a 16 kW Line Module

The maximum output of a 16 kW Line Module is not sufficient for the operation of an 18 A Single Motor Module with 300% overload.

- Do NOT operate the 18 A Single Motor Module with 300% overload on a 16 kW Line Module.
 - Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.
 - Only operate an 18 A Single Motor Module on a 16 kW Line Module when the maximum current is limited to $2 \times I_{\text{rated}}$.
-

6.4.8.2 Double Motor Modules (300% overload)

Table 6- 46 Technical data Double Motor Modules (2 x 3 to 2 x 9 A) with 300% overload

| Cold plate | 6SL3126- | 2TE13-0AA4 | 2TE15-0AA4 | 2TE21-0AA4 |
|---|--------------------|--------------------|--------------|--------------|
| Output current | | | | |
| Rated current (I _n) | A _{ACrms} | 2 x 3 | 2 x 5 | 2 x 9 |
| Base-load current (I _H) | A | 2 x 2.6 | 2 x 4.3 | 2 x 7.7 |
| Intermittent duty current (I _{Is6}) 40% | A _{ACrms} | 2 x 3.5 | 2 x 6 | 2 x 10 |
| Peak current (I _{max}) | A _{ACrms} | 2 x 9 | 2 x 15 | 2 x 27 |
| Output voltage | V _{ACrms} | 0 ... 480 | | |
| DC-link current I _{d max} | A _{DC} | 7,2 | 12 | 22 |
| DC-link voltage (up to 2000 m above sea level) | V _{DC} | 510 ... 720 | | |
| DC-link capacitance | μF | 110 | 220 | 220 |
| Overvoltage trip | V _{DC} | 820 ± 2 % | | |
| Undervoltage trip ¹⁾ | V _{DC} | 380 | | |
| Electronics power supply | V _{DC} | 24 (20,4 ... 28,8) | | |
| Electronics current drawn at 24 VDC | A _{DC} | 0,9 | 0,9 | 0,9 |
| Current carrying capacity | | | | |
| DC-link busbar | A _{DC} | 100 | 100 | 100 |
| Reinforced DC-link busbars | A _{DC} | 150 | 150 | 150 |
| 24 V busbar | A _{DC} | 20 | 20 | 20 |
| Unit rating²⁾ | | | | |
| Based on I _n (600 VDC; 4 kHz) | kW | 2 x 1.6 | 2 x 2.7 | 2 x 4.8 |
| Based on I _H | kW | 2 x 1.4 | 2 x 2.3 | 2 x 4.1 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 91,6 | 126,6 | 181,6 |
| Max. pulse frequency | | | | |
| without derating | kHz | 4 | | |
| with derating | kHz | 16 | | |
| Max. ambient temperature | | | | |
| without derating | ° C | 40 | | |
| with derating | ° C | 55 | | |
| Max. permissible heat sink temperature | ° C | 77 | 77 | 77 |
| Weight | kg | 4,5 | 4,5 | 4,5 |

1) 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

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

Note

Disturbance of the 2 x 9 A Double Motor Module with 300% overload during operation on a 16 kW Line Module

The maximum output of a 16 kW Line Module is not sufficient for the operation of a 2 x 9 A Double Motor Module with 300% overload.

- Do NOT operate the 2 x 9 A Double Motor Module with 300% overload on a 16 kW Line Module.
 - Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.
 - Only operate a 2 x 9 A Double Motor Module on a 16 kW Line Module when the maximum current is limited to $2 \times I_{\text{rated}}$.
-

6.4.8.3 Characteristics for Motor Modules Booksize with 300% overload

Rated duty cycles Motor Modules Booksize with 300% overload

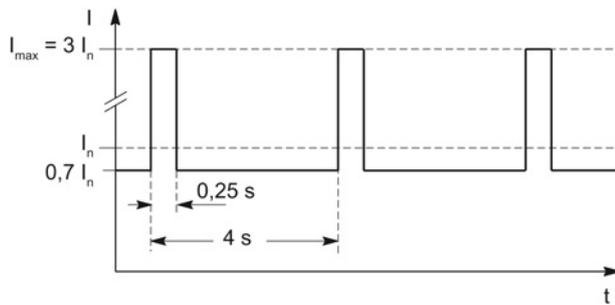


Figure 6-91 Peak current duty cycle with initial load (300% overload)

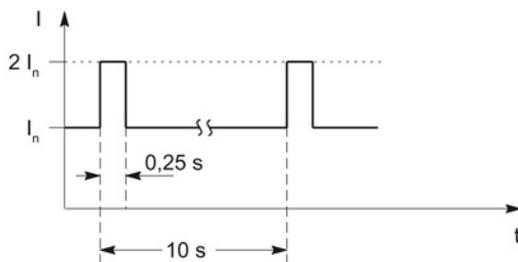


Figure 6-92 Duty cycle with initial load

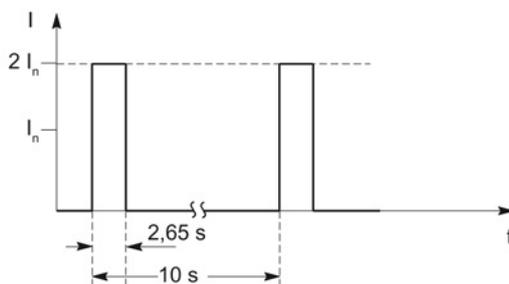


Figure 6-93 Duty cycle without initial load

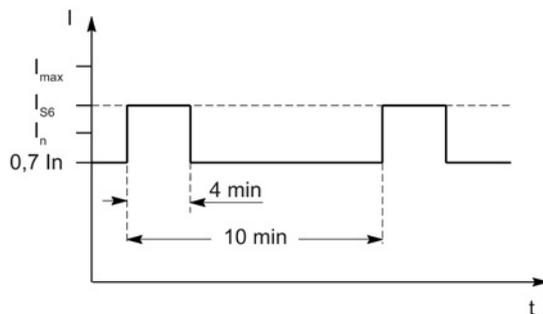


Figure 6-94 S6 duty cycle with initial load for a duty cycle duration of 600 s

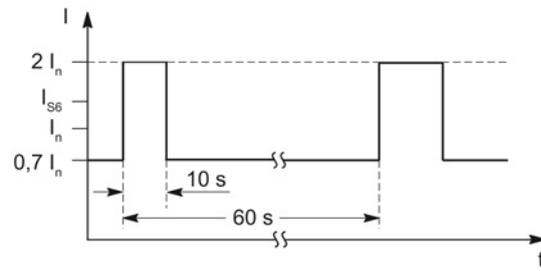


Figure 6-95 S6 duty cycle with initial load for a duty cycle duration of 60 s

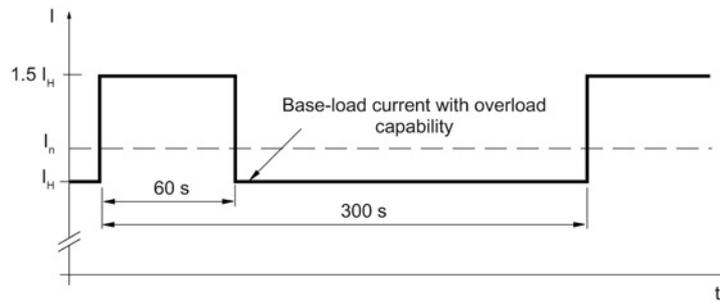


Figure 6-96 Duty cycle with 60 s overload for a duty cycle duration of 300 s

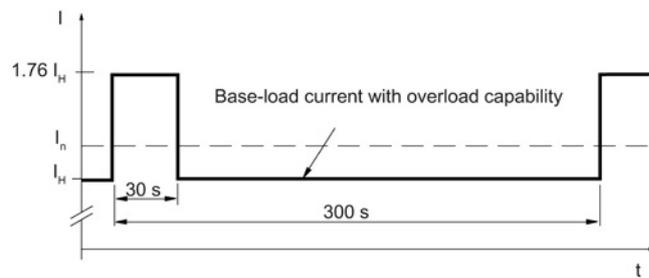


Figure 6-97 Duty cycle with 30 s overload for a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize with 300% overload

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

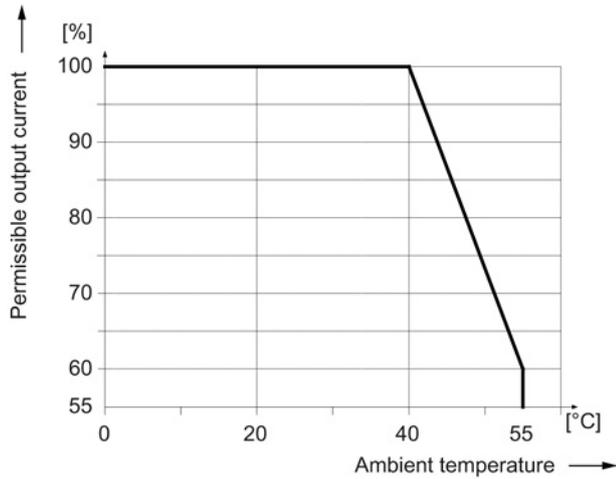


Figure 6-98 Output current as a function of the ambient temperature

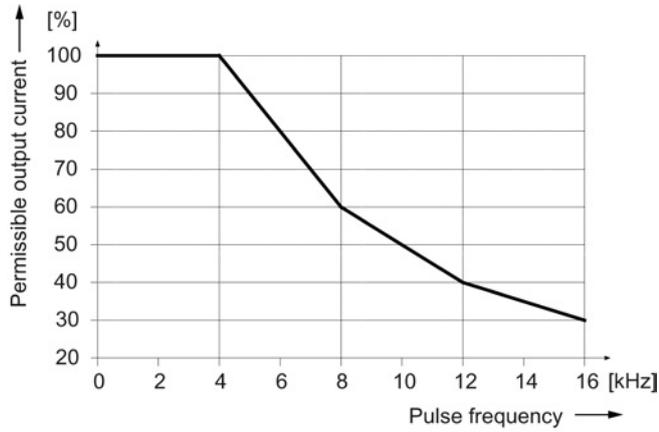


Figure 6-99 Output current as a function of the pulse frequency

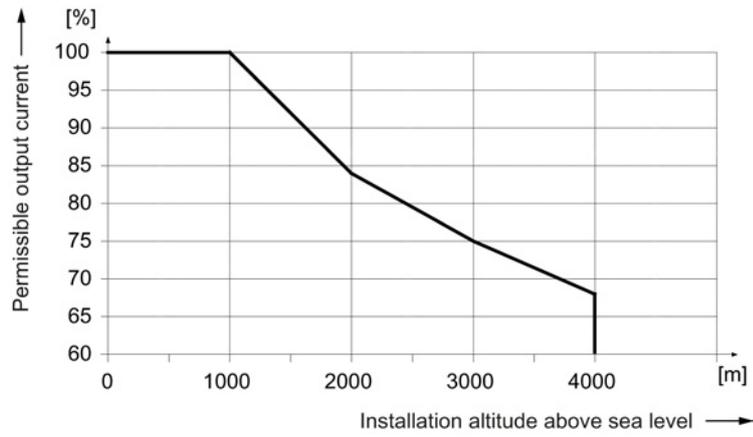


Figure 6-100 Output current as a function of the installation altitude

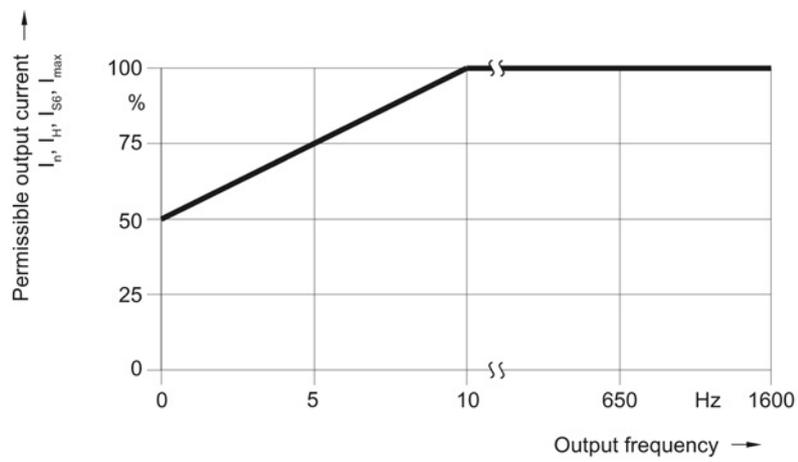


Figure 6-101 Output current as a function of the output frequency

6.5 Motor Modules Liquid Cooled

6.5.1 Description

A Motor Module is a power unit (inverter) that provides the power for the connected motor or 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.



WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

6.5.2 Interface description

6.5.2.1 Overview

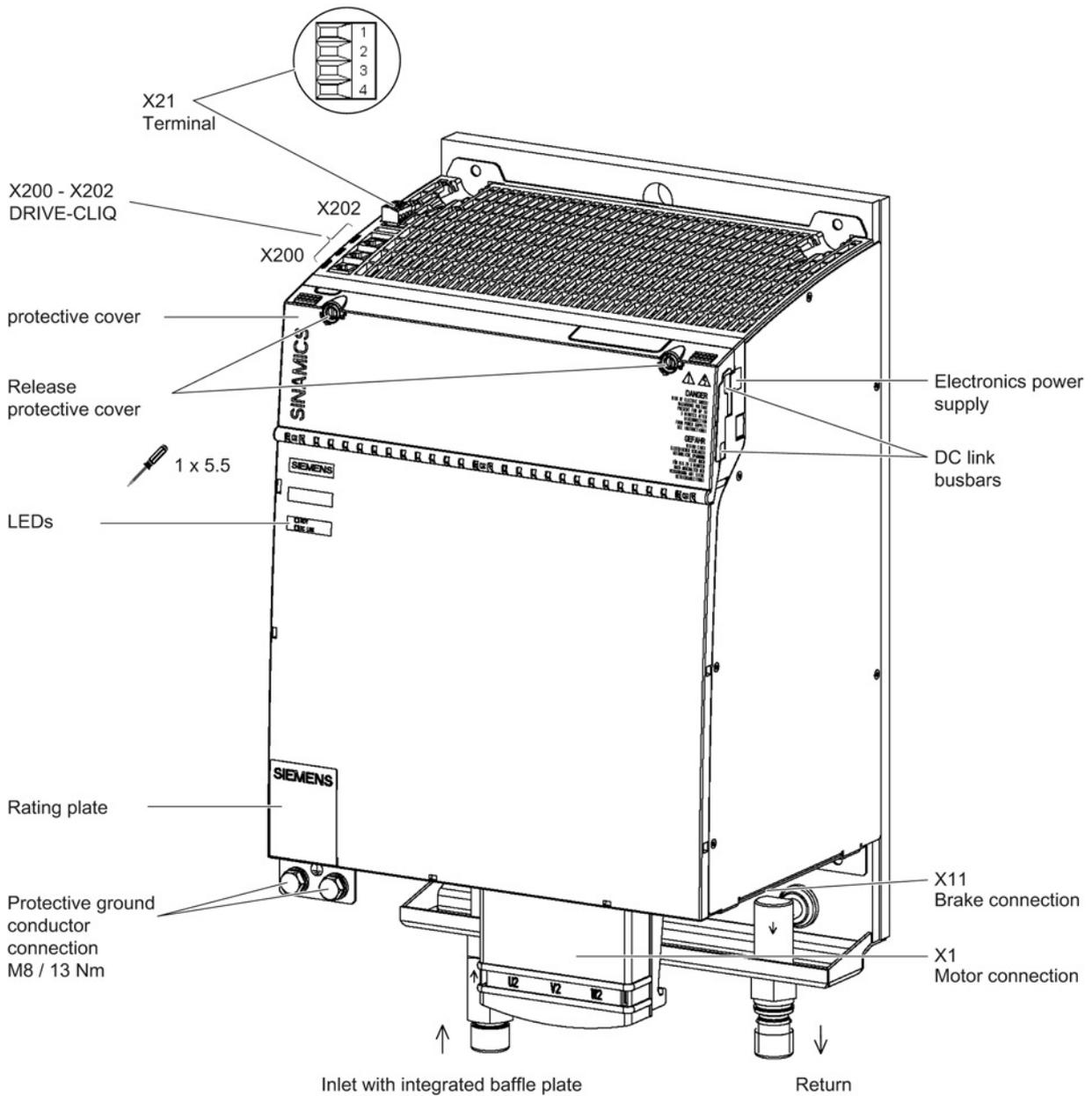
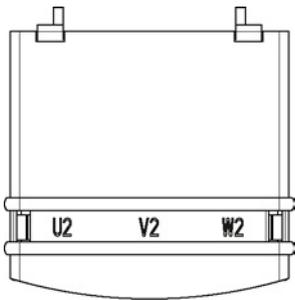
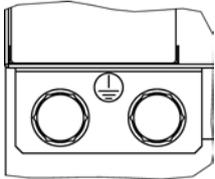


Figure 6-102 Interface overview, Motor Module Liquid Cooled (200 A)

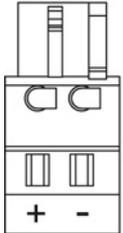
6.5.2.2 Motor and brake connection

Table 6- 47 X1 Motor connection

| | Terminal | Technical data |
|--|---------------|---|
|  | U2 | Threaded bolts M8 / 13 Nm ¹⁾ (refer to Chapter Connection systems (Page 731)) |
| | V2 | |
| | W2 | |
| | - (BR-) | |
|  | PE connection | Threaded hole M8 / 13 Nm ¹⁾ |

1) For ring cable lugs without insulation

Table 6- 48 X11 brake connector

| | Terminal | Technical data |
|---|----------|---|
|  | + (BR+) | Voltage 24 V DC Max. load current 2 A Min. load current 0.1 A Type: Spring-loaded terminal 2 (Page 754) Max. cross-section that can be connected 2.5 mm ² : The brake connector is part of the prefabricated cable. |
| | - (BR-) | |

The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.



| |
|--|
| <p>! WARNING</p> <p>Danger to life as a result of a hazardous voltage at the 0 V to 48 V DC terminals</p> <p>Death or serious injury can result when live parts are touched in the event of a fault.</p> <ul style="list-style-type: none"> • Only connect protective extra-low voltages (PELV / SELV) to all connections and terminals between 0 to 48 V DC. |
|--|

| NOTICE |
|--|
| <p>Destruction of the motor or motor holding brake as a result of high voltage tolerances of the motor holding brakes</p> <p>If the voltage tolerances of the motor holding brakes are not complied with ($24\text{ V} \pm 10\%$), then the brake will malfunction, i.e. the brake will not reliably open. If the motor constantly runs against the closed brake, the brake or the motor will be destroyed.</p> <ul style="list-style-type: none"> Set the DC power supply to 26 V. <p>The following general conditions must be satisfied:</p> <ul style="list-style-type: none"> Siemens three-phase motors must be used Siemens MOTION-CONNECT power cables must be used Motor cable lengths, max. 100 m |

Note

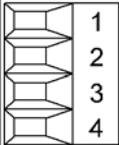
The motor brake must be connected via connector X11. It is not permitted to directly connect the cable BR – to the electronics ground M.

Note

The total length of the power cables (motor feeder cables and DC link cables) must not exceed the values listed in Chapter Combining line reactors and line filters (Page 136).

6.5.2.3 X21 EP terminal/temperature sensor

Table 6- 49 X21 EP terminal / temperature sensor

| | Terminal | Function | Technical data |
|---|----------|-------------------------|---|
|  | 1 | + Temp | Temperature sensors: KTY 84-1C130/PTC/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: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled. |
| | 4 | EP M1 (enable pulses) | |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm ² | | | |

EP terminals

The filter times to debounce terminals X21.3 and X21.4 can be parameterized (see 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 is only available when Safety Integrated Basic Functions are enabled.

Temperature sensor connection

NOTICE

Risk of the motor overheating due to an incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY 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

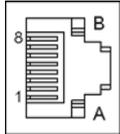
Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that fully comply with the specifications of the safety isolation.
- 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.

6.5.2.4 X200-X202 DRIVE-CLiQ interface

Table 6- 50 X200-X202: DRIVE-CLiQ interfaces

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

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

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

6.5.3 Connection example

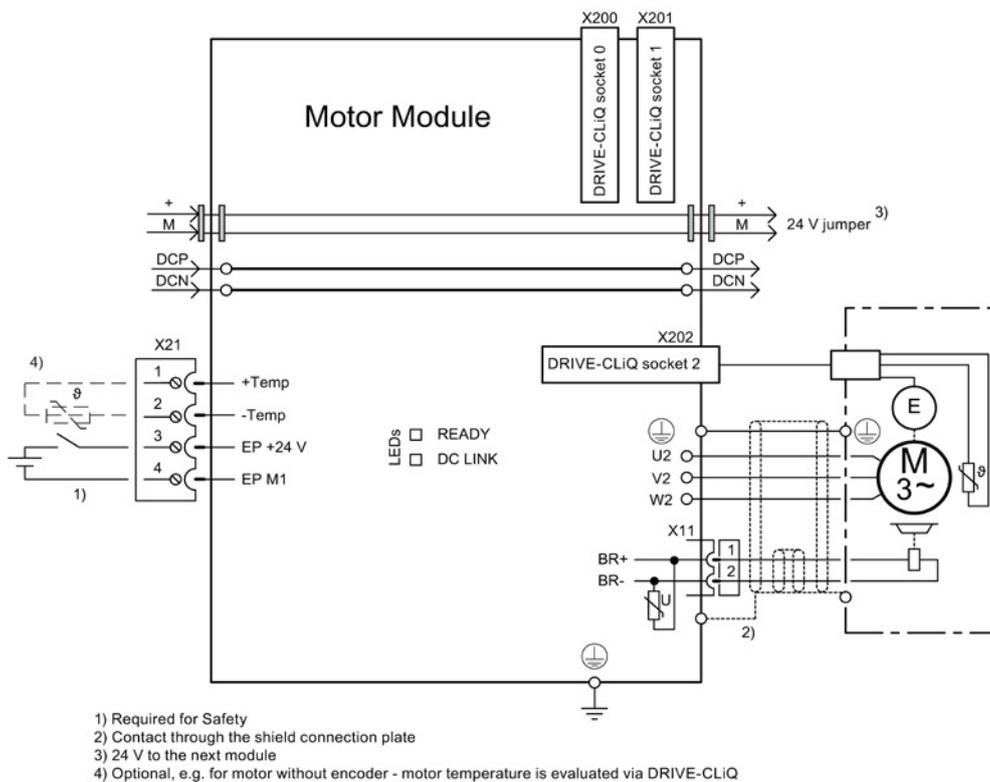


Figure 6-103 Connection example for Motor Module Liquid Cooled (200 A)

6.5.4 Meaning of LEDs

Table 6- 51 Meaning of LEDs

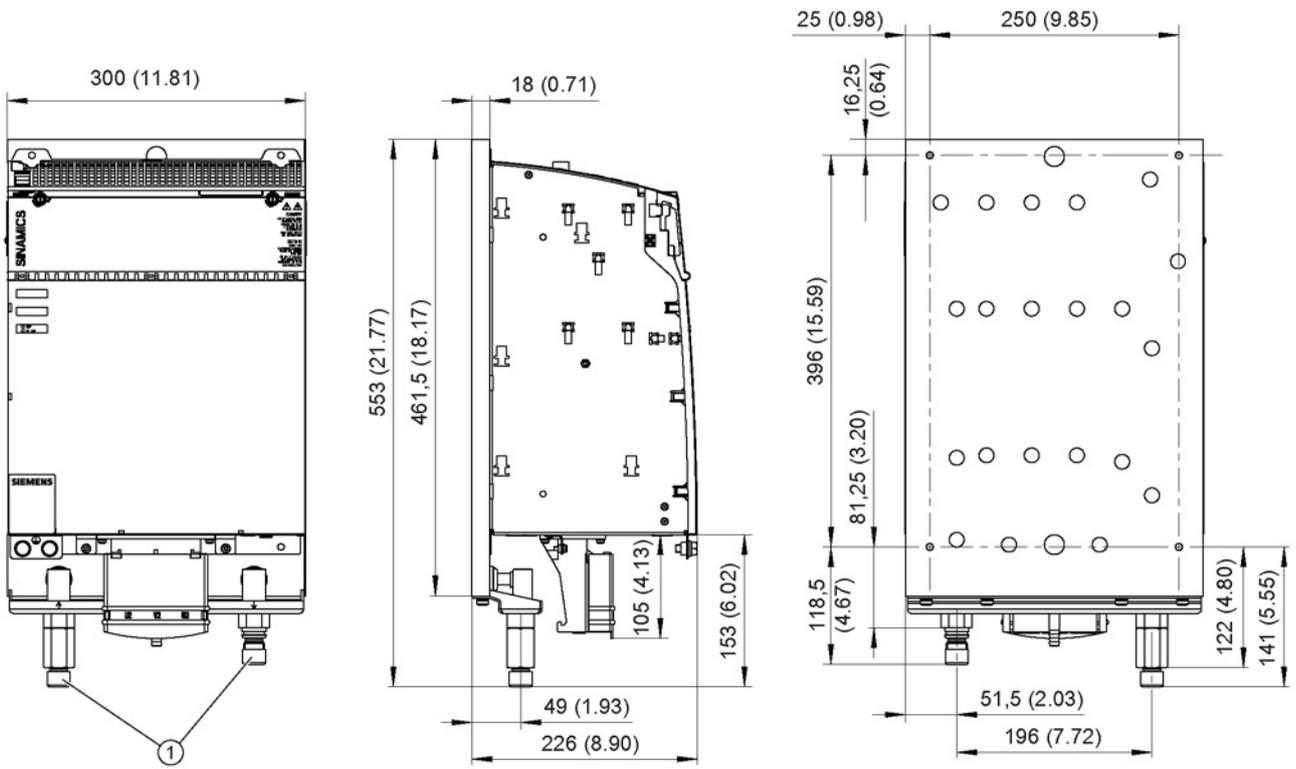
| Status | | Description, cause | Remedy |
|----------------------------|---------|---|------------------------------------|
| RDY | DC LINK | | |
| Off | Off | The electronics power supply is missing or outside the permissible tolerance range. | – |
| Green | -- | The component is ready for operation. 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 | -- | This component has at least one fault. Note: The LED is activated regardless of whether the corresponding messages have been reconfigured. | Resolve and acknowledge the fault. |
| Green/red (0.5 Hz) | -- | Firmware is being downloaded. | – |
| Green/red (2 Hz) | -- | Firmware download has been completed. The system waits for POWER ON. | Carry out a POWER ON. |
| Green/orange or Red/orange | -- | Detection of the components via LED is activated ¹⁾ . Note: Both options depend on the LED status when activated. | – |

1) See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



| |
|---|
| <p>! WARNING</p> <p>Danger of death when live parts of the DC link are touched</p> <p>Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.</p> <ul style="list-style-type: none"> Observe the warning information on the component. |
|---|

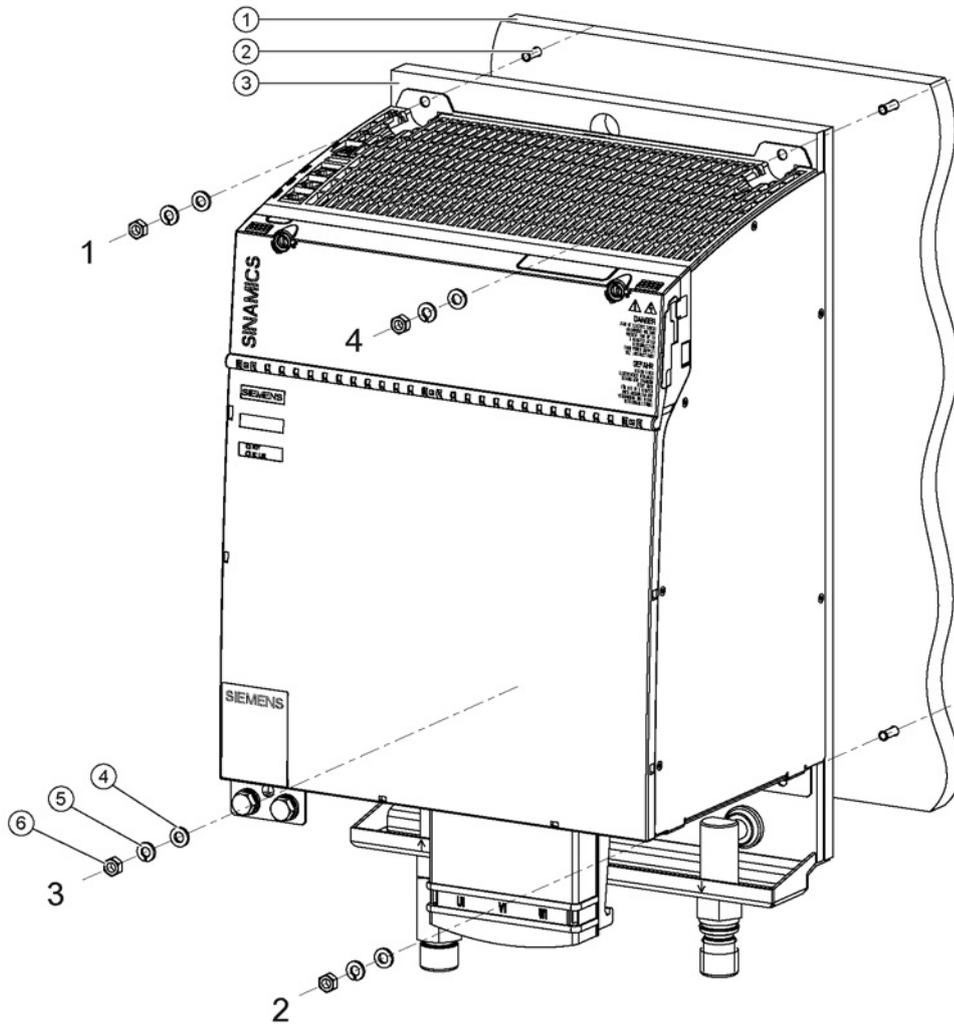
6.5.5 Dimension drawing



① Pipe thread ISO 228 G ½ B.

Figure 6-104 Dimension drawing of Motor Module Liquid Cooled (200 A), all dimensions in mm and (inches)

6.5.6 Installation



- ① Mounting surface
- ② M6 studs
- ③ Heat sink
- ④ Washer
- ⑤ Spring washer
- ⑥ M6 nut

Figure 6-105 Installing a Motor Module Liquid Cooled

Tightening torques:

- Firstly, tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
Tightening torque: 10 Nm

For installation, M6 screw bolts and hexagon nuts/grub screws ISO 7436-M6x40-14 H, property class 8.8 are recommended.

The coolant connections are located on the lower side of the components. All connection elements can be accessed using an appropriate tool.

- Thread type of water connections: Pipe thread ISO 228 G ½ B.

6.5.7 Technical data

Table 6- 52 Technical data for Motor Module Liquid Cooled 200 A

| Liquid Cooled | | 6SL3125-1TE32-0AAx |
|---|-------------------------------------|--------------------|
| Output current | | |
| Rated current (I _n) | A _{ACrms} | 200 |
| Base-load current (I _H) | A | 141 |
| Intermittent duty current (I _{s6}) 40% | A _{ACrms(I_{s6})} | 230 |
| Peak current (I _{max}) | A _{ACrms(I_{max})} | 282 |
| Output voltage | V _{ACrms} | 0 ... 480 |
| DC-link current I_{d max} | A _{DC} | 200 |
| DC-link voltage (up to 2000 m above sea level) | V _{DC} | 510 ... 720 |
| DC-link capacitance | μF | 3995 |
| Overvoltage trip | V _{DC} | 820 ± 2 % |
| Undervoltage trip ¹⁾ | V _{DC} | 380 ± 2 % |
| Electronics power supply | V _{DC} | 24 (20,4 ... 28,8) |
| Electronics current drawn at 24 VDC | A _{DC} | 0,85 |
| Current carrying capacity | | |
| DC-link busbars | A _{DC} | 200 |
| 24 VDC busbars | A _{DC} | 20 |
| Unit rating²⁾ | | |
| Based on I _n (600 VDC; 4 kHz) | kW | 107 |
| Based on I _H | kW | 76 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | W | 2070,4 |
| Max. pulse frequency | | |
| without derating | kHz | 4 |
| with derating | kHz | 16 |
| Max. ambient temperature | | |
| without derating | ° C | 40 |
| with derating | ° C | 55 |
| Max. coolant temperature | | |
| without derating | ° C | 45 |
| with derating | ° C | 50 |
| Max. permissible heat sink temperature | ° C | 79 (70% derating) |
| Rated flow rate for water at 70 kPa pressure drop (for other coolant (Page 795)) | l/min | 8 |
| Volume of liquid internal | ml | 100 |
| Weight | kg | 21 |

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

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

6.5.7.1 Characteristics

Motor Modules Booksize Liquid Cooled

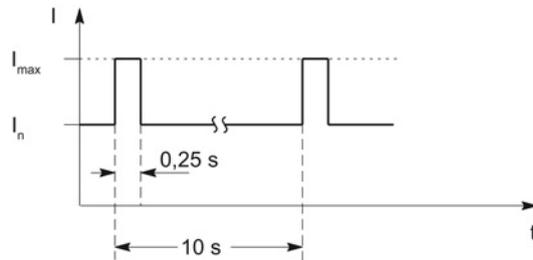


Figure 6-106 Duty cycle with initial load (for servo drives)

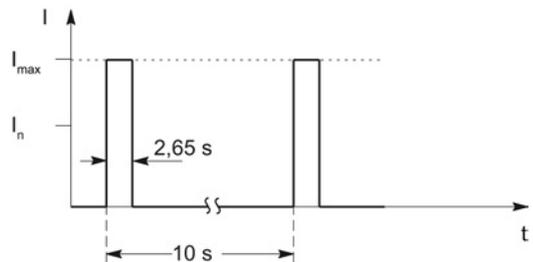


Figure 6-107 Duty cycle without initial load (for servo drives)

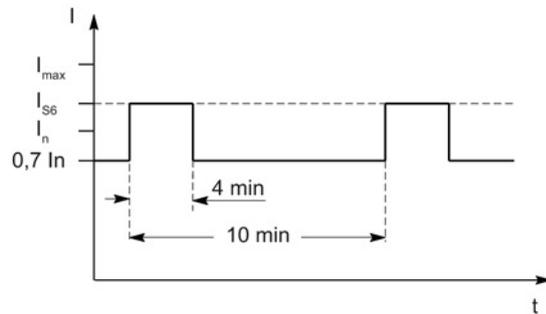


Figure 6-108 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

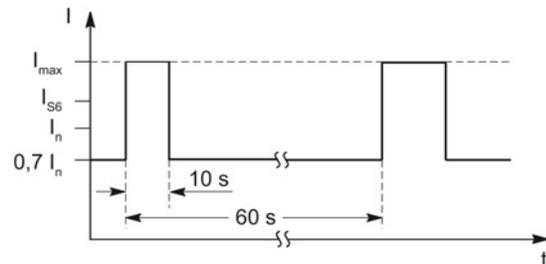


Figure 6-109 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

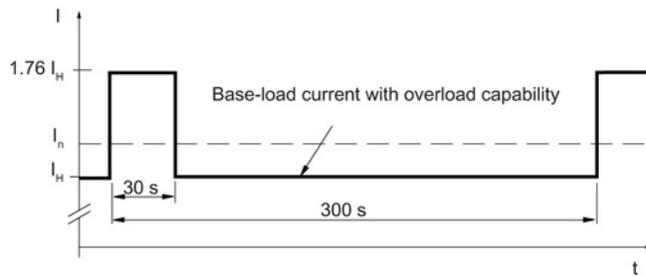


Figure 6-110 Duty cycle with 30 s overload for a duty cycle duration of 300 s

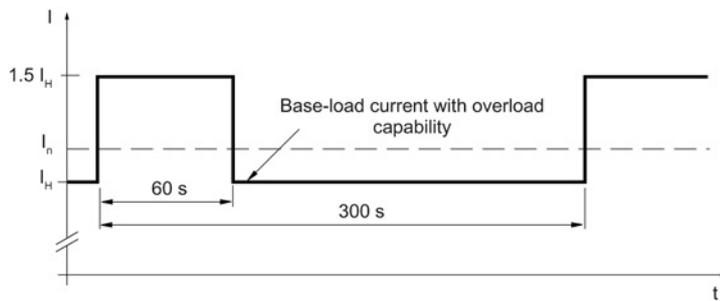


Figure 6-111 Duty cycle with 60 s overload for a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize Liquid Cooled

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

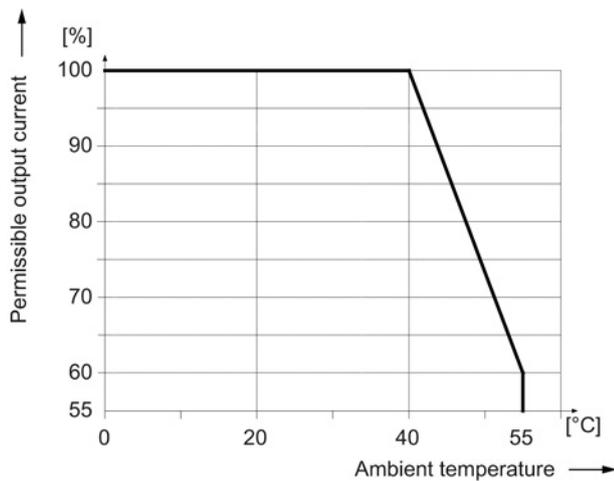


Figure 6-112 Output current as a function of the ambient temperature

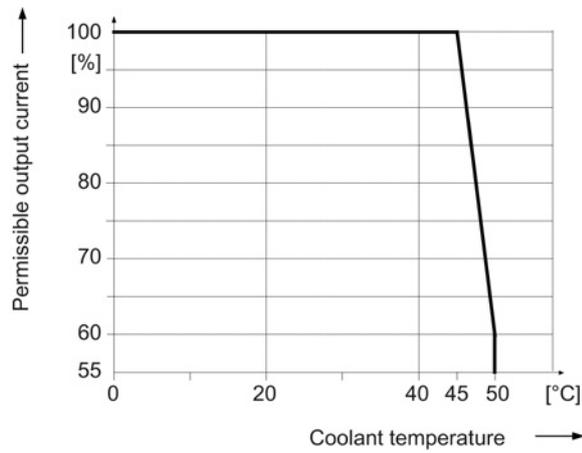


Figure 6-113 Output current as a function of the coolant temperature

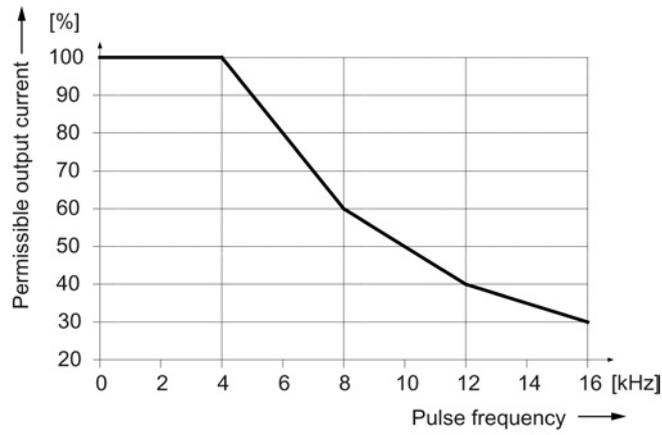


Figure 6-114 Output current as a function of the pulse frequency

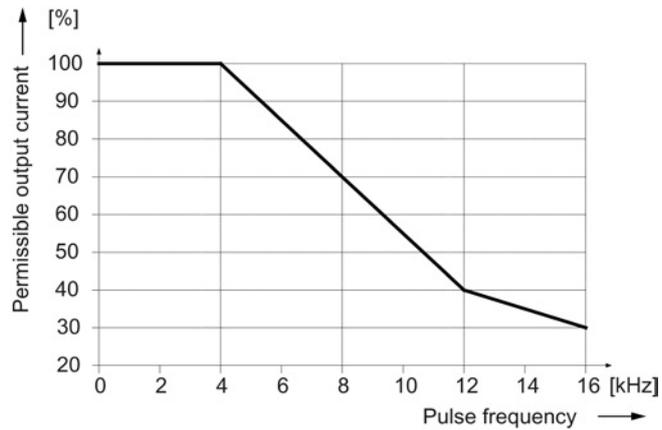


Figure 6-115 Output current as a function of the pulse frequency
(applies from order number 6SL312x-1TE32-0AA4)

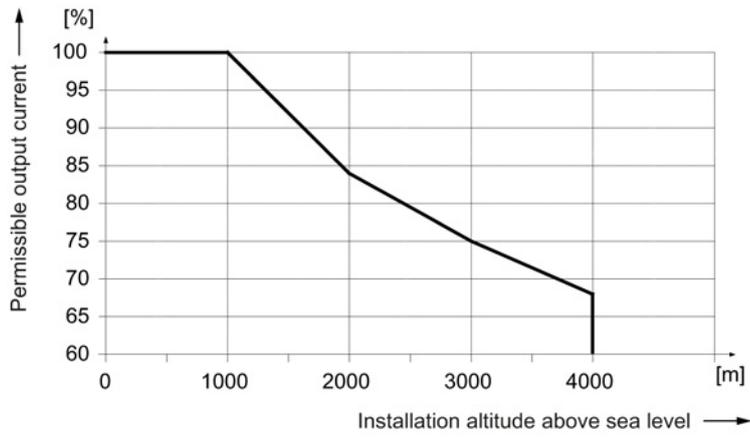


Figure 6-116 Output current as a function of the installation altitude

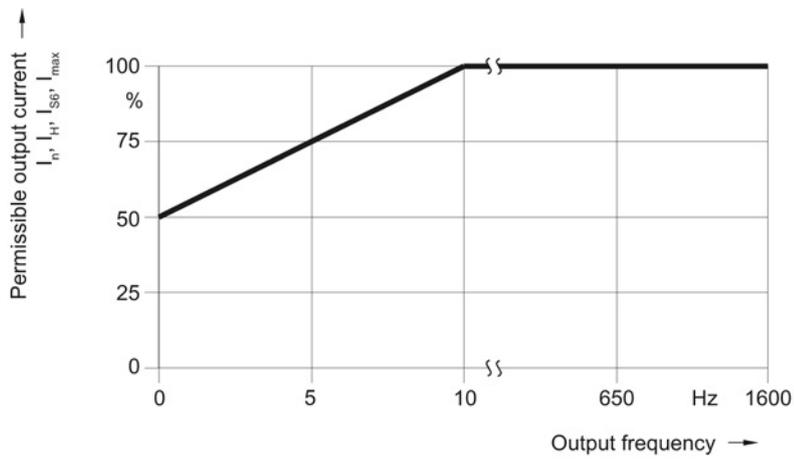


Figure 6-117 Current derating as a function of the output frequency

Motor Modules Booksize Compact

7.1 Safety instructions for Motor Modules Booksize Compact

| |
|--|
|  WARNING |
| <p>Danger to life if the fundamental safety instructions and remaining risks are not carefully observed</p> <p>If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.</p> <ul style="list-style-type: none"> • Adhere to the fundamental safety instructions. • When assessing the risk, take into account residual risks. |



| |
|--|
|  DANGER |
| <p>Danger to life through electric shock due to the residual charge of the DC link capacitors</p> <p>Because of the DC link capacitors, a hazardous voltage is present for up to five minutes after the power supply has been switched off.</p> <p>Contact with live parts can result in death or serious injury.</p> <ul style="list-style-type: none"> • Do not open the protective cover of the DC link until 5 minutes have elapsed. • Measure the voltage before starting work on the DCP and DCN DC link terminals. |



| |
|--|
|  DANGER |
| <p>Danger to life through electric shock when the protective cover of the DC link is open</p> <p>Contact with live parts can result in death or serious injury.</p> <ul style="list-style-type: none"> • Only operate the components with closed protective cover. |



| |
|---|
|  WARNING |
| <p>Danger to life through electric shock due to incorrect connection to the DC link</p> <p>Incorrect connections can lead to overheating and therefore a risk of fire. There is also a risk of an electric shock. This can result in serious injury or death.</p> <ul style="list-style-type: none"> • Only use adapters (DC link adapters and DC link rectifier adapters) released by Siemens for the connection to the DC link. |



! WARNING

Danger to life through 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 modules¹⁾ (exception: Smart Line Module²⁾), 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 removed³⁾.

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

Danger to life through electric shock due to missing DC link side covers

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

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

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



! WARNING

Danger to life due to high leakage currents caused by an interrupted external protective conductor

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.

- Ensure that the external protective conductor satisfies at least one of the following conditions:
 - It has been laid so that it is protected against mechanical damage.¹⁾
 - If it is a single conductor, it has a cross-section of at least 10 mm² Cu.
 - If it is a conductor of a multi-conductor cable, it has a cross-section of at least 2.5 mm² Cu.
 - It has a second protective conductor in parallel with the same cross-section.
 - It complies with the local regulations for equipment with increased leakage current.

¹⁾ Cables laid within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.



! WARNING

Danger to life through electric shock due to incorrectly laid brake cables

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

- 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

Danger of an accident due to missing warning labels in the national language.

Missing warning labels in the national language can result in death or serious injury.

- Attach the component warning labels in the national language.

! WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

Inadequate ventilation clearances can cause overheating with a risk for personnel due to smoke and fire. This can also result in increased failure rates and a shorter service life for Motor Modules.

- Maintain the 80 mm clearances above and below the Motor Modules.

NOTICE

Material damage due to loose power connections

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

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

NOTICE

Damage to the equipment when performing a voltage test as a result of connections that are not disconnected

SINAMICS S components are subject to a voltage test as part of the routine test. Connected devices can be damaged.

- Disconnect or unplug all SINAMICS devices before the voltage test of the machine equipment according to EN 60204-1, Section 18.4.

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.

Note

Operating motors with a built-in holding brake

A regulated DC power supply is required to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars.

- Take note of the motor holding brake voltage tolerances ($24\text{ V} \pm 10\%$) and the connecting cable voltage drop.
- 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 must be used
 - Siemens MOTION-CONNECT power cables must be used
 - Motor cable lengths, max. 100 m

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.

Notes for UL applications

Note

The SINAMICS S120 Motor Modules Booksize Compact provide short-circuit protection at the motor output terminals.

7.2 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.

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

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

7.3 Interface description

7.3.1 Overview

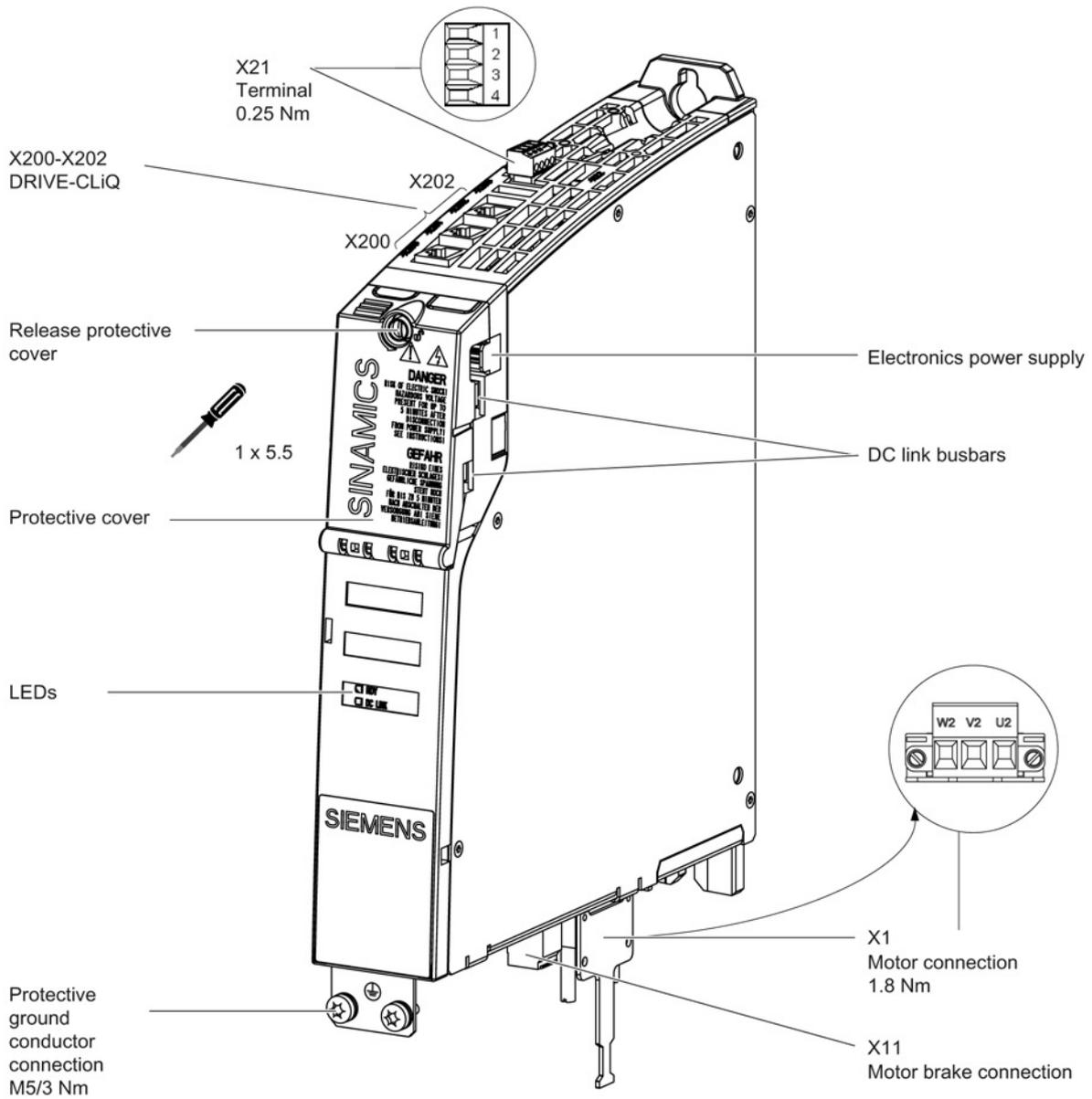


Figure 7-1 Interface overview, Single Motor Module Booksize Compact (example: 5 A)

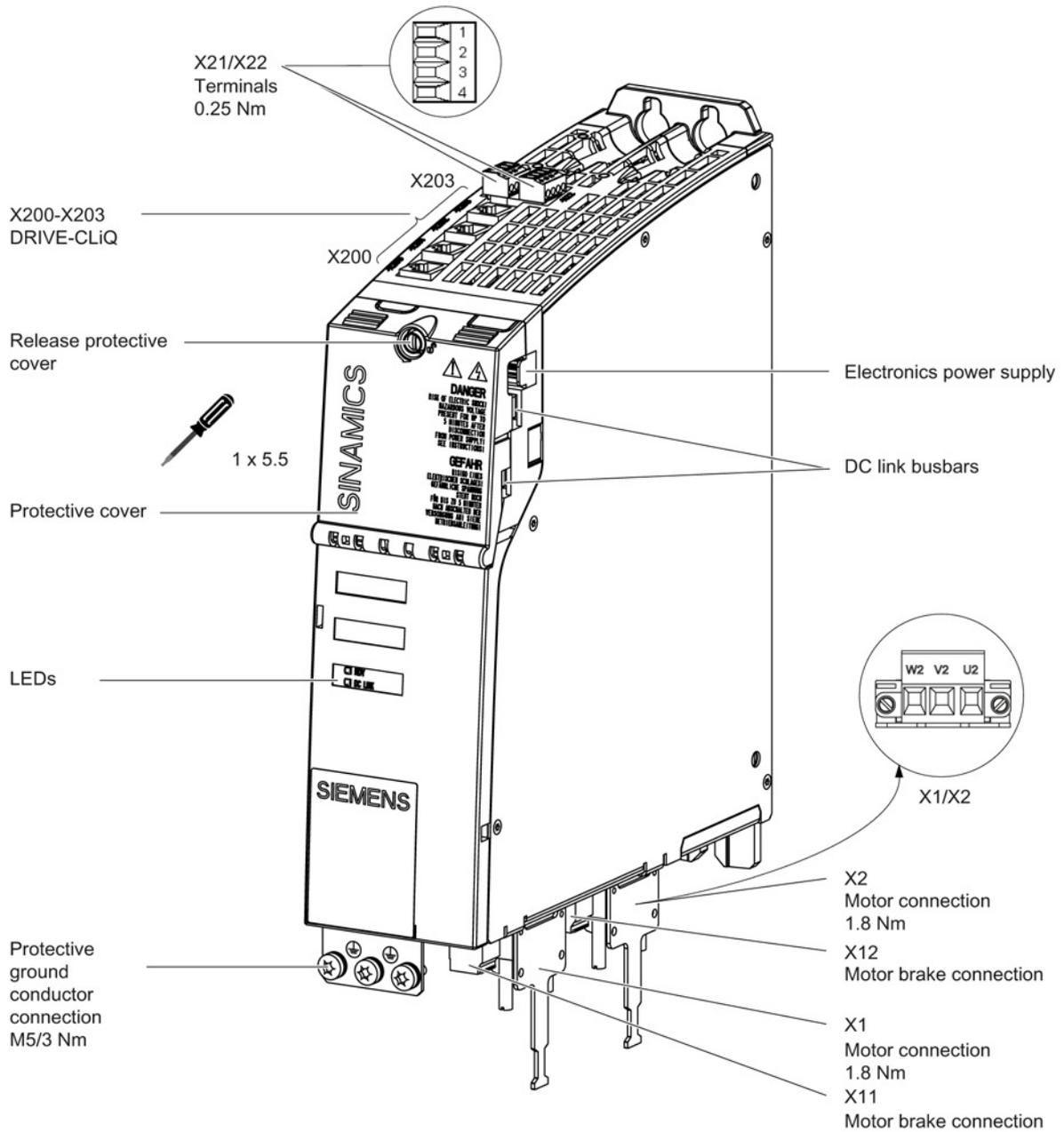
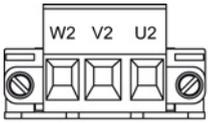
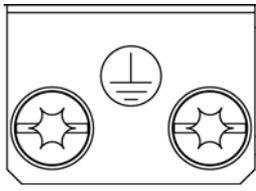
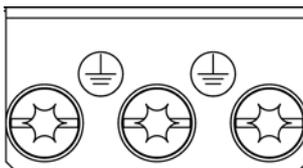


Figure 7-2 Interface overview, Double Motor Module Booksize Compact (example: 2 x 5 A)

7.3 Interface description

7.3.2 X1/X2 motor connection

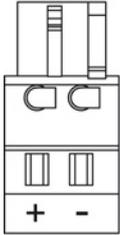
Table 7- 1 X1/X2 motor connection

| | Terminal | Technical data |
|---|---------------|---|
|  | U2 | Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm ² Tightening torque: 1.2 ... 1.5 Nm |
| | V2 | |
| | W2 | |
|  | PE connection | Single Motor Modules 3 ... 18 A Threaded hole M5 / 3 Nm ¹ |
| | |  |

1) For ring cable lugs without insulation

7.3.3 X11/X12 motor brake connection

Table 7- 2 X11/X12 motor brake connection

| | Terminals | Technical data |
|---|-----------|--|
|  | + (BR+) | Brake connector ¹⁾ : Voltage 24 V DC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm ² Type: Spring-loaded terminal 2 (Page 754) Manufacturer: Wago; order number: 721-102/026-000/56-000 The brake connector is part of the scope of delivery. |
| | - (BR-) | |

1) The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.

Note

The total length of the power cables (motor feeder cables and DC link cables) must not exceed the values listed in Chapter Combining line reactors and line filters (Page 136).

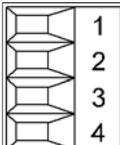
Note

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.

| |
|--|
| NOTICE |
| <p>Destruction of the motor or motor holding brake as a result of high voltage tolerances of the motor holding brakes</p> <p>If the voltage tolerances of the motor holding brakes are not complied with (24 V ± 10 %), then the brake will malfunction, i.e. the brake will not reliably open. If the motor constantly runs against the closed brake, the brake or the motor will be destroyed.</p> <ul style="list-style-type: none"> • Set the DC power supply to 26 V. <p>The following general conditions must be satisfied:</p> <ul style="list-style-type: none"> • Siemens three-phase motors must be used • Siemens MOTION-CONNECT power cables must be used • Motor cable lengths, max. 100 m |

7.3.4 X21/X22 EP terminals/temperature sensor

Table 7- 3 X21/X22 EP terminals / temperature sensor

| | Terminal | Function | Technical data |
|---|----------|-------------------------|---|
|  | 1 | + Temp | Temperature sensors: KTY 84-1C130/PTC/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: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled. |
| | 4 | EP M1 (enable pulses) | |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm ² | | | |

EP terminals

Parameters are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4 (see 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 is only available when Safety Integrated Basic Functions are enabled.

Temperature sensor connection

| |
|--|
| NOTICE |
| Risk of the motor overheating due to an incorrectly connected KTY temperature sensor A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats. <ul style="list-style-type: none">• Always connect the KTY sensor with the correct polarity. |

Note

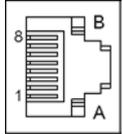
The temperature sensor input is not needed if the motors feature an integrated DRIVE-CLiQ interface or if temperature values are detected by means of a different module (SMC, SME, TM).



| |
|---|
| ⚠ WARNING |
| Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors. <ul style="list-style-type: none">• Use temperature sensors that fully comply with the specifications of the safety isolation.• 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. |

7.3.5 X200-X203 DRIVE-CLiQ interface

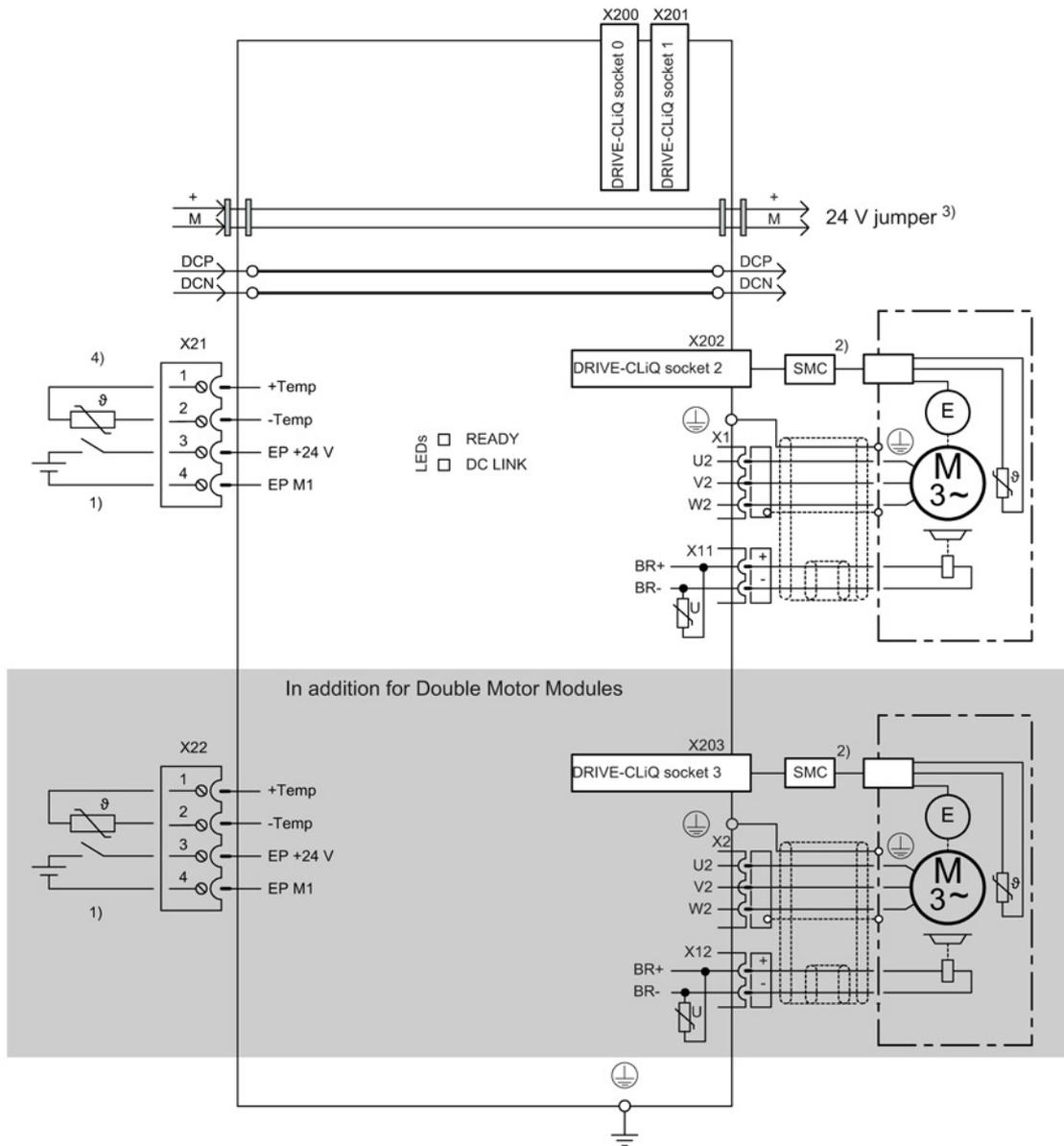
Table 7- 4 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules
X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

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

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

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

7.4 Connection example



- 1) Required for safety
- 2) SMC required for motors without DRIVE-CLiQ interface
- 3) 24 V to the next module
- 4) Alternative possibility of evaluating the motor temperature

Figure 7-3 Connection example, Single Motor Modules Booksize Compact 3 A to 18 A and Double Motor Modules Booksize Compact 1.7 A to 5 A

7.5 Meaning of LEDs

Table 7- 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 | – | 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 | – | This component has at least one fault. Note: The LED is activated regardless of whether the corresponding messages have been reconfigured. | Resolve and acknowledge the fault. |
| Green/red (0.5 Hz) | – | Firmware is being downloaded. | – |
| Green/red (2 Hz) | – | Firmware download has been completed. The system waits for POWER ON. | Carry out a POWER ON. |
| Green/orange or red/orange | – | Component recognition via LED is activated ¹⁾ . Note: Both options depend on the LED status when component recognition is activated using the parameter. | – |

¹⁾ See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED

| |
|---|
|  WARNING |
| <p>Danger of death when live parts of the DC link are touched</p> <p>Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.</p> <ul style="list-style-type: none"> • Observe the warning information on the component. |

7.6 Dimension drawings

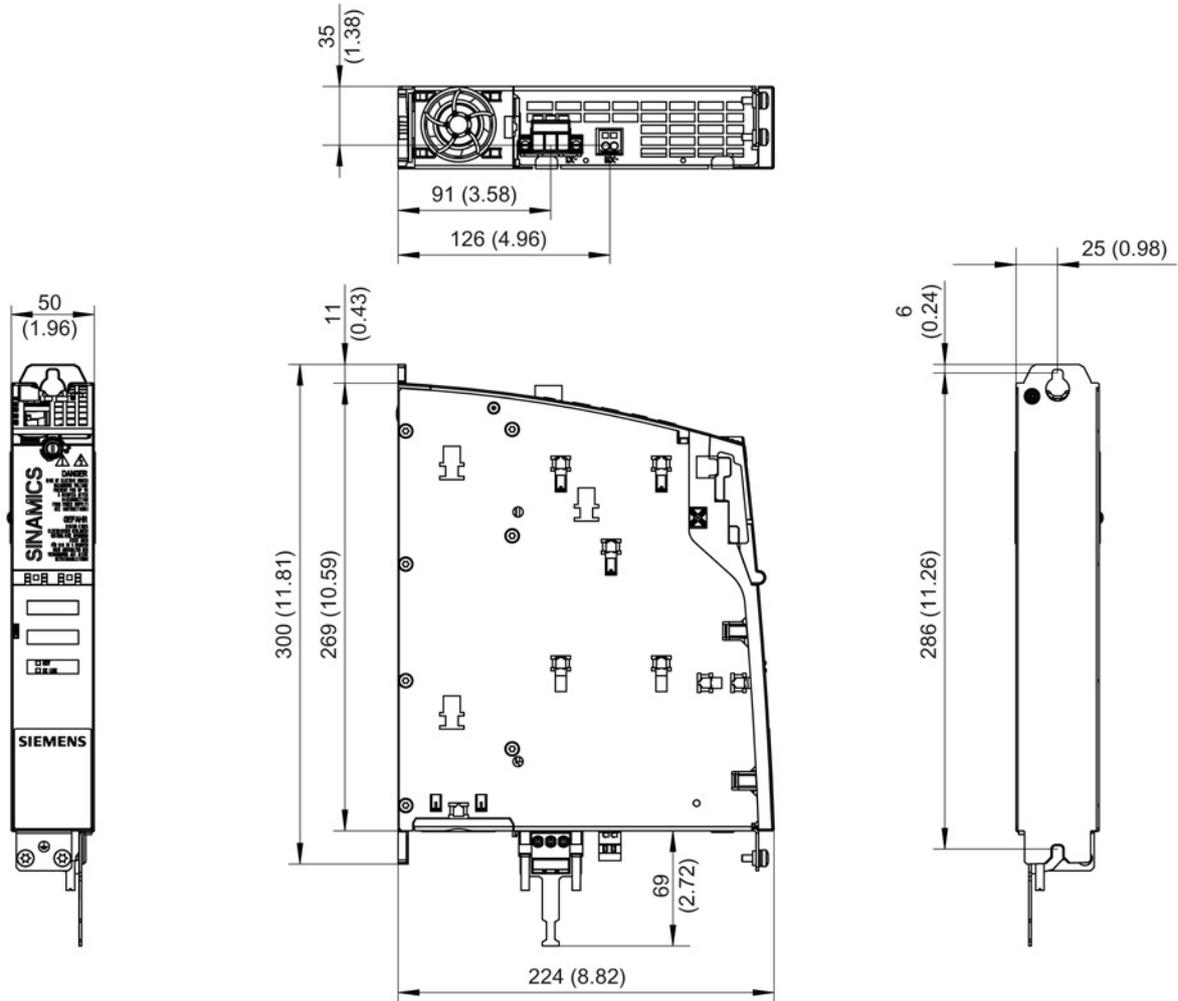


Figure 7-4 Dimension drawing of 3 A, 5 A, and 9 A Motor Modules Booksize Compact, all dimensions in mm and (inches); example: 5 A Single Motor Module

Table 7- 6 Motor Modules Booksize Compact 3 A, 5 A, and 9 A

| Motor Module | Order number |
|-------------------------|--------------------|
| Single Motor Module 3 A | 6SL3420-1TE13-0AAx |
| Single Motor Module 5 A | 6SL3420-1TE15-0AAx |
| Single Motor Module 9 A | 6SL3420-1TE21-0AAx |

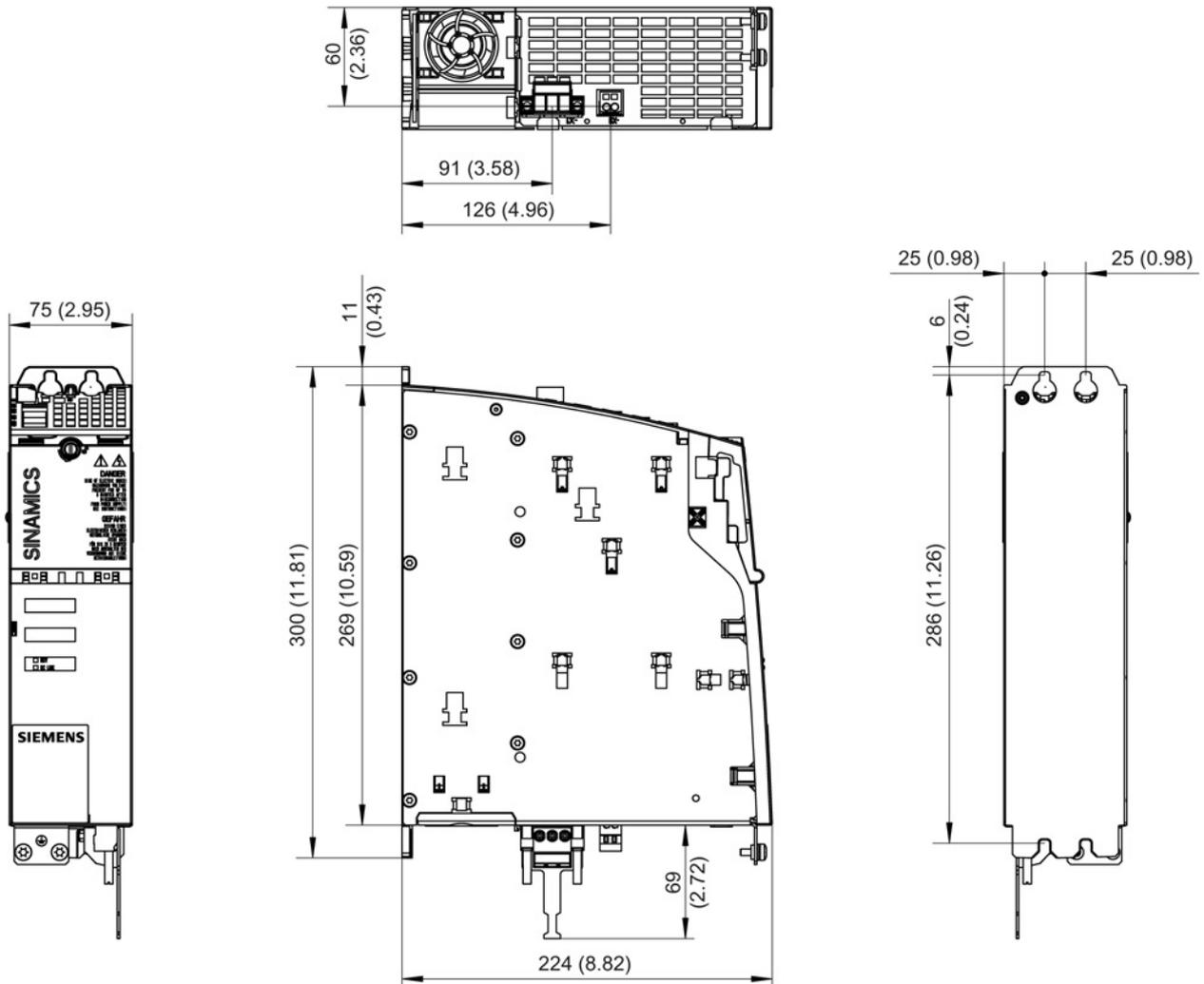


Figure 7-5 Dimension drawing of 18 A Motor Module Booksize Compact, all dimensions in mm and (inches)

Table 7- 7 Motor Module Booksize Compact 18 A

| Motor Module | Order number |
|--------------------------|--------------------|
| Single Motor Module 18 A | 6SL3420-1TE21-8AAx |

7.6 Dimension drawings

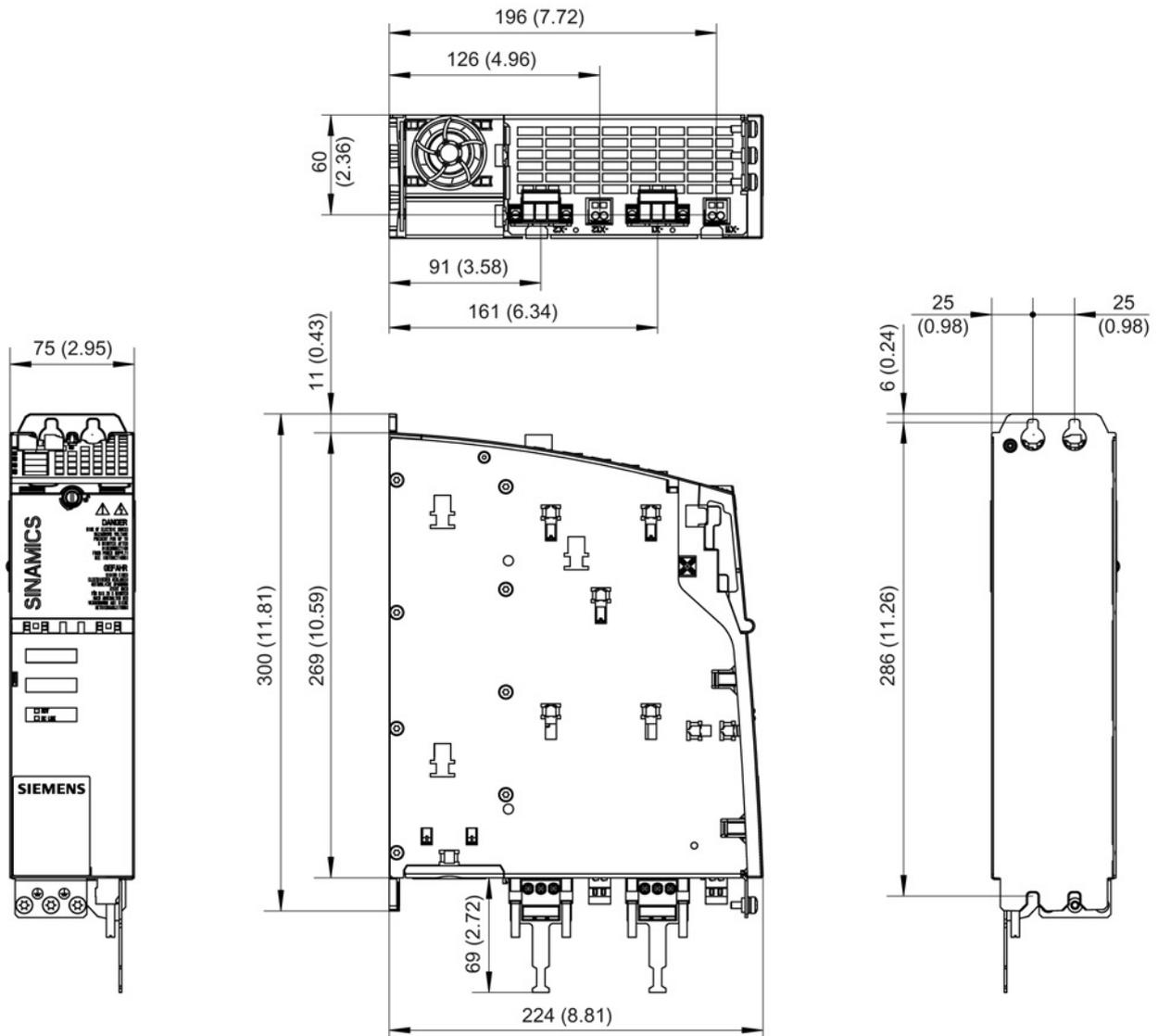


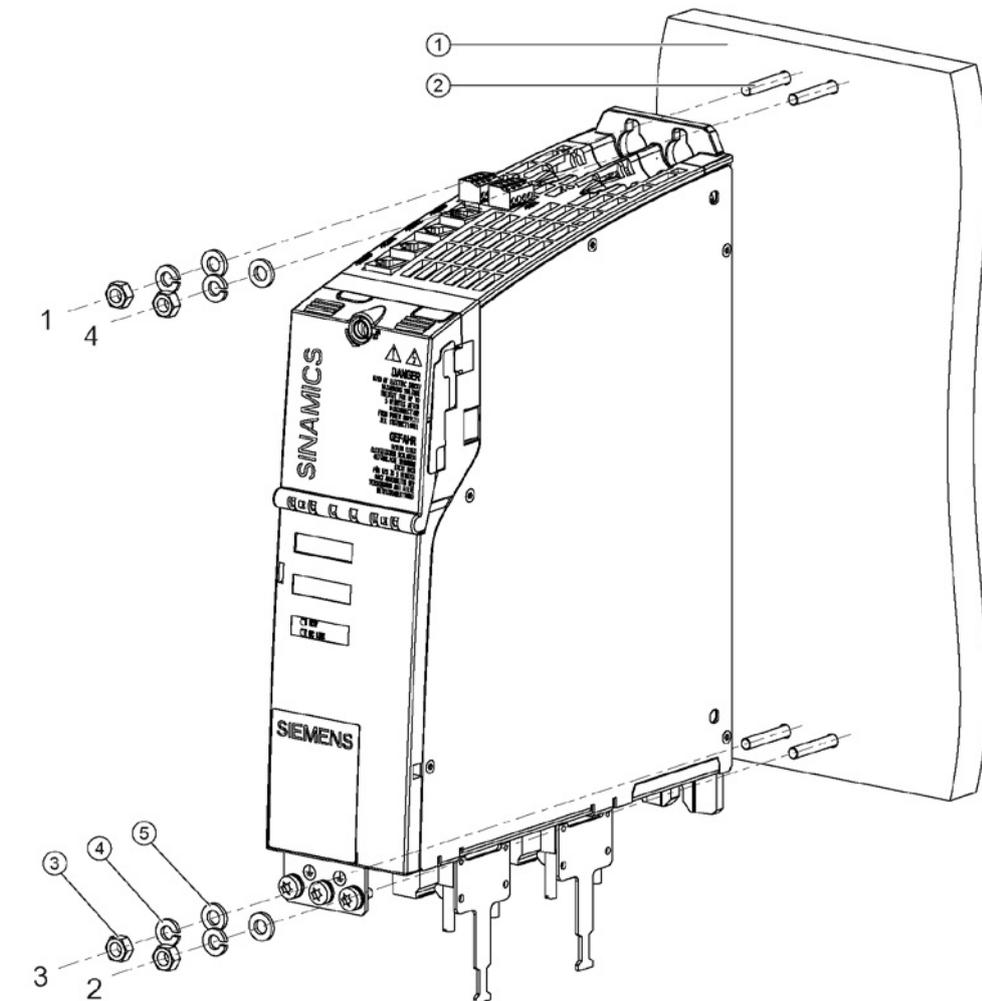
Figure 7-6 Dimension drawing of 2 x 1.7 A, 2 x 3 A, and 2 x 5 A Double Motor Modules Compact, all dimensions in mm and (inches); example: 2 x 5 A Double Motor Module

Table 7-8 2 x 1.7 A, 2 x 3 A, and 2 x 5 A Double Motor Modules Booksize Compact

| Double Motor Module | Order number |
|-------------------------------|--------------------|
| 2 x 1.7 A Double Motor Module | 6SL3420-2TE11-7AAx |
| 2 x 3 A Double Motor Module | 6SL3420-2TE13-0AAx |
| 2 x 5 A Double Motor Module | 6SL3420-2TE15-0AAx |

7.7 Mounting

Mounting a Motor Module Booksize Compact with internal air cooling



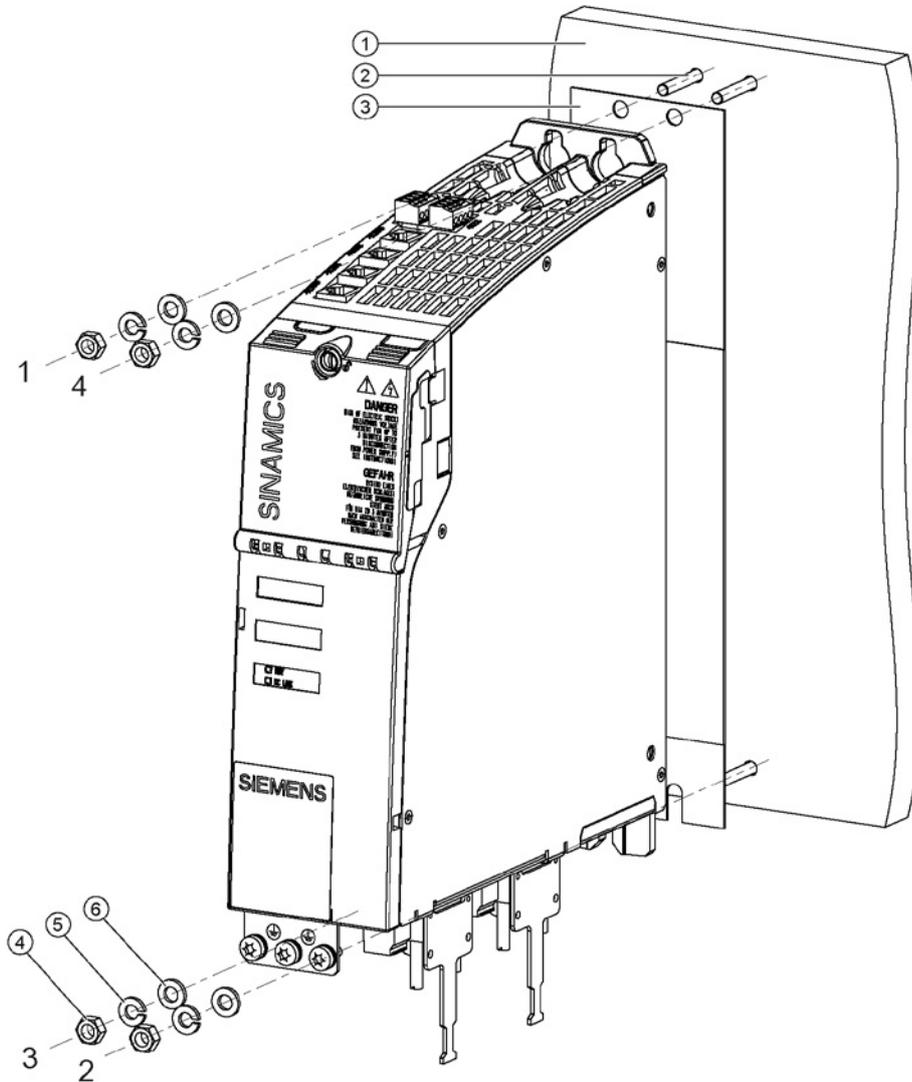
- ① Mounting wall
- ② M6 studs
- ③ M6 nut
- ④ Spring washer
- ⑤ Washer

Figure 7-7 Mounting a Motor Module Booksize Compact with internal air cooling

Tightening torques:

- Firstly, only tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
Tightening torque: 6 Nm

Mounting a Motor Module Booksize Compact on a cold plate



- ① Cold plate (air or liquid cooling)
- ② M6 studs
- ③ Heat-conducting foil
- ④ M6 nut
- ⑤ Spring washer
- ⑥ Washer

Figure 7-8 Mounting a Motor Module Booksize Compact on a cold plate

Tightening torques:

- Firstly, only tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
Tightening torque: 6 Nm

Special points to note in relation to mounting on a cold plate

To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every Motor Module Booksize Compact is supplied with heat-conducting foil cut to the right size. Note the mounting position of the heat-conducting foil.

Note

- Also replace the heat-conducting foil when replacing a component.
- Only use heat-conducting foil released or supplied by Siemens.

| | Order number |
|-----------------------------|--------------------|
| Heat-conducting foil, 50 mm | 6SL3162-6FB01-0AA0 |
| Heat-conducting foil, 75 mm | 6SL3162-6FC01-0AA0 |

7.8 Technical data

7.8.1 Single Motor Modules

Table 7-9 Technical data Single Motor Modules Booksize Compact (3 A to 18 A)

| Motor Modules Booksize Compact | 6SL3420- | 1TE13-0AAx | 1TE15-0AAx | 1TE21-0AAx | 1TE21-8AAx |
|--|-------------|-------------------------------|------------|------------|------------|
| Output current | | | | | |
| Rated current (I_n) | A_{ACrms} | 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_{ACrms} | 3,5 | 6 | 10 | 24 |
| Peak current (I_{max}) | A_{ACrms} | 9 | 15 | 27 | 54 |
| Output voltage | V_{ACrms} | 0 ... 0.717 x DC-link voltage | | | |
| DC-link current $I_{d max}$ | A_{DC} | 3,6 | 6 | 11 | 22 |
| DC-link voltage (up to 2000 m above sea level) | V_{DC} | 510 ... 720 | | | |
| DC-link capacitance | μF | 110 | 110 | 110 | 235 |
| Overvoltage trip | V_{DC} | 820 \pm 2 % | | | |
| Undervoltage trip ¹⁾ | V_{DC} | 380 \pm 2 % | | | |
| Electronics power supply | V_{DC} | 24 (20,4 ... 28,8) | | | |
| Electronics current consumption at 24 VDC | | | | | |
| 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 |
| Reinforced DC-link busbars | A_{DC} | 150 | 150 | 150 | 150 |
| 24 VDC busbars | A_{DC} | 20 | 20 | 20 | 20 |

7.8 Technical data

| Motor Modules Booksize Compact | 6SL3420- | 1TE13-0AAx | 1TE15-0AAx | 1TE21-0AAx | 1TE21-8AAx |
|---|-------------------|--|-----------------------|--------------------------|---------------------------|
| Max. current motor brake | A | 2 | 2 | 2 | 2 |
| Unit rating²⁾ Based on I _n (600 VDC; 4 kHz) Based on I _H | kW kW | 1,6 1,4 | 2,7 2,3 | 4,8 4,1 | 9,7 8,2 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) Internal air cooling Cold plate int./ext. | W W | 68 (8 kHz) 25.6/40 | 98 (8 kHz) 30.6/65 | 100.4 (4 kHz) 45.6/50 | 185.4 (4 kHz) 80.6/100 |
| Max. pulse frequency without derating with derating | kHz kHz | 8 16 | 8 16 | 4 16 | 4 16 |
| Max. ambient temperature without derating with derating | ° C ° C | 40 55 | | | |
| Sound pressure level with internal air cooling | dB(A) | < 60 | < 60 | < 60 | < 60 |
| 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 |
| Max. permissible heatsink temperature For internal air cooling For cold plate cooling | ° C ° C | 73 71 | 82 75 | 85 75 | 90 77 |
| Weight | kg | 2,7 | 2,7 | 2,7 | 3,4 |

1) Default setting for 400 V line supplies, undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized line voltage

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

7.8.2 Double Motor Modules

Table 7- 10 Technical data Double Motor Modules Booksize Compact (2 x 1.7 A to 2 x 5 A)

| Double Motor Modules Booksize Compact | 6SL3420- | 2TE11-7AAx | 2TE13-0AAx | 2TE15-0AAx |
|---|---|---|---|--|
| Output current Rated current (I _n) Base-load current (I _H) Intermittent duty current (I _{sb}) 40% Peak current (I _{max}) | A _{ACrms} A A _{ACrms} A _{ACrms} | 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 _{ACrms} | 0 ... 0.717 x DC-link voltage | | |
| DC-link current I _{d max} | A _{DC} | 4,1 | 7,2 | 12 |
| DC-link voltage (up to 2000 m above sea level) | V _{DC} | 510 ... 720 | | |
| DC-link capacitance | µF | 165 | 165 | 165 |
| Overvoltage trip Undervoltage trip ¹⁾ | V _{DC} V _{DC} | 820 ± 2 % 380 ± 2 % | | |
| Electronics power supply | V _{DC} | 24 (20,4 ... 28,8) | | |

| Double Motor Modules Booksize Compact | 6SL3420- | 2TE11-7AAx | 2TE13-0AAx | 2TE15-0AAx |
|---|-------------------|---|-------------|-------------|
| Electronics current consumption at 24 VDC | | | | |
| For internal air cooling | A _{DC} | 1,15 | 1,15 | 1,15 |
| For cold plate cooling | A _{DC} | 0,9 | 0,9 | 0,9 |
| Current carrying capacity | | | | |
| DC-link busbars | A | 100 | 100 | 100 |
| Reinforced DC-link busbars | A | 150 | 150 | 150 |
| 24 VDC busbars | A | 20 | 20 | 20 |
| Max. current motor brake | A | 2 x 2 | 2 x 2 | 2 x 2 |
| Unit rating²⁾ | | | | |
| Based on I _n (600 V, 8 kHz) | kW | 2 x 0.9 | 2 x 1.6 | 2 x 2.7 |
| Based on I _H | kW | 2 x 0.8 | 2 x 1.4 | 2 x 2.3 |
| Total power loss (including electronics losses, see Power loss tables (Page 781)) | | | | |
| Internal air cooling | W | 114 (8 kHz) | 134 (8 kHz) | 194 (8 kHz) |
| Cold plate int./ext. | W | 42/72 | 44/90 | 59/135 |
| Max. pulse frequency | | | | |
| without derating | kHz | 8 | 8 | 8 |
| with derating | kHz | 16 | 16 | 16 |
| Max. ambient temperature | | | | |
| without derating | ° C | 40 | | |
| with derating | ° C | 55 | | |
| Sound pressure level with internal air cooling | dB(A) | < 60 | < 60 | < 60 |
| 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 |
| Max. permissible heatsink temperature | | | | |
| For internal air cooling | ° C | 84 | 88 | 93 |
| For cold plate cooling | ° C | 71 | 75 | 75 |
| Weight | kg | 3,4 | 3,4 | 3,4 |

1) Default setting for 400 V line supplies, undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized line voltage

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

7.8.3 Characteristics

Rated duty cycles Motor Modules Booksize Compact

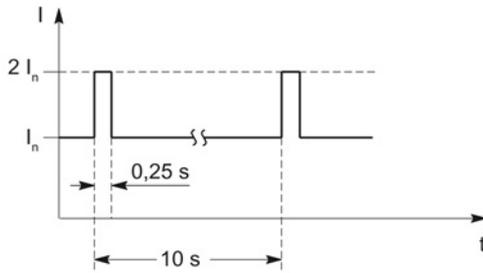


Figure 7-9 Duty cycle with initial load

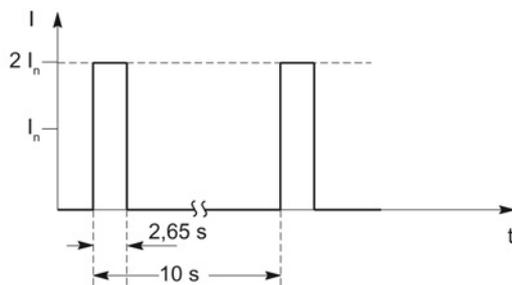


Figure 7-10 Duty cycle without initial load

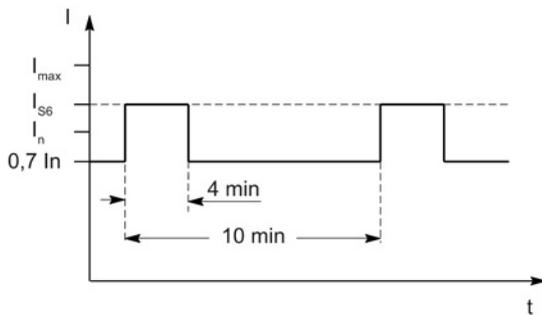


Figure 7-11 S6 duty cycle with initial load for a duty cycle duration of 600 s

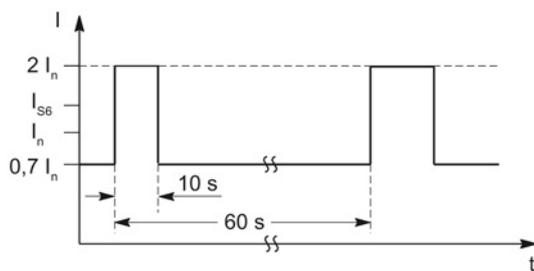


Figure 7-12 S6 duty cycle with initial load for a duty cycle duration of 60 s

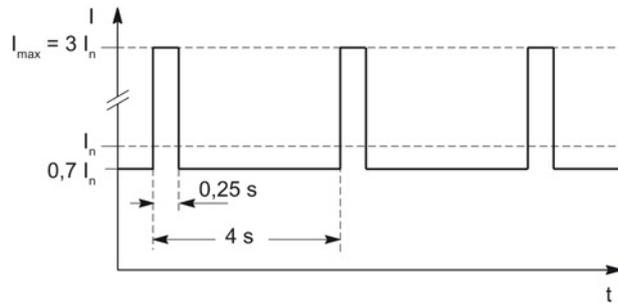


Figure 7-13 Peak current duty cycle with initial load

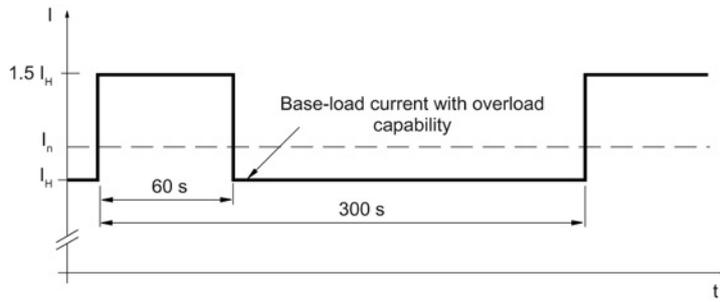


Figure 7-14 Duty cycle with 60 s overload for a duty cycle duration of 300 s

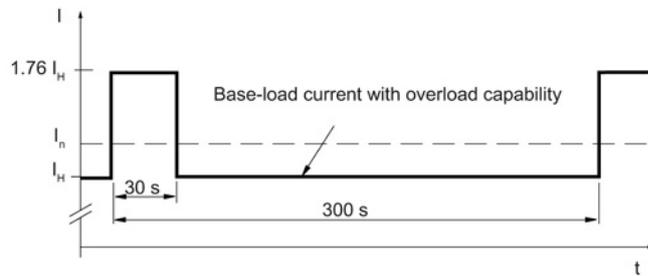


Figure 7-15 Duty cycle with 30 s overload for a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize Compact

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

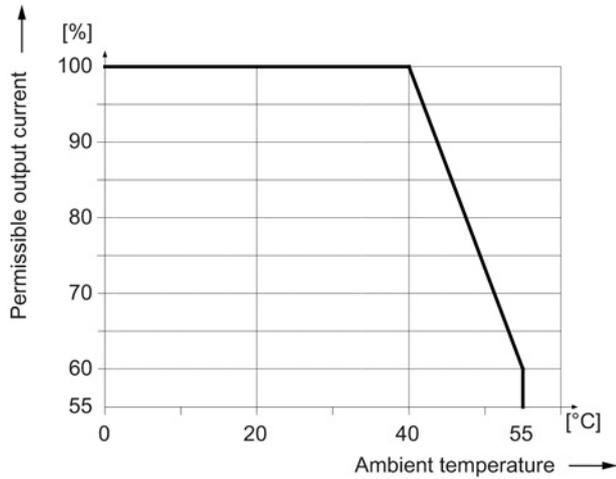


Figure 7-16 Output current as a function of the ambient temperature

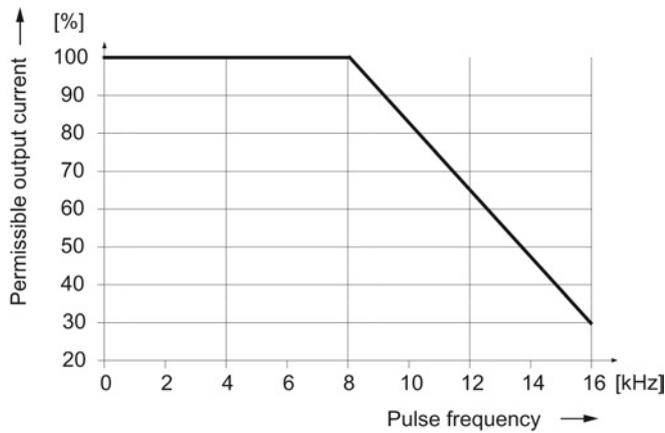


Figure 7-17 Output current as a function of the pulse frequency for the Motor Module ≤ 5 A

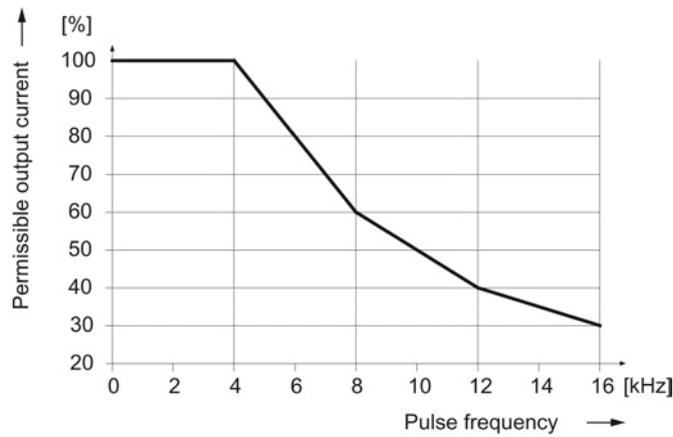


Figure 7-18 Output current as a function of the pulse frequency for the Motor Module ≥ 9 A

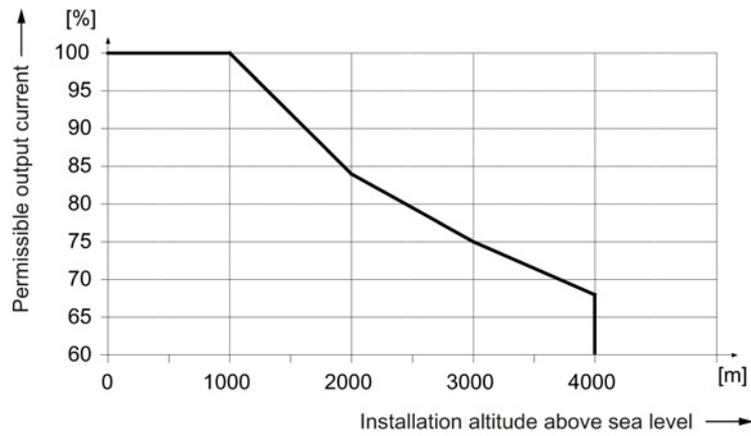


Figure 7-19 Output current as a function of the installation altitude

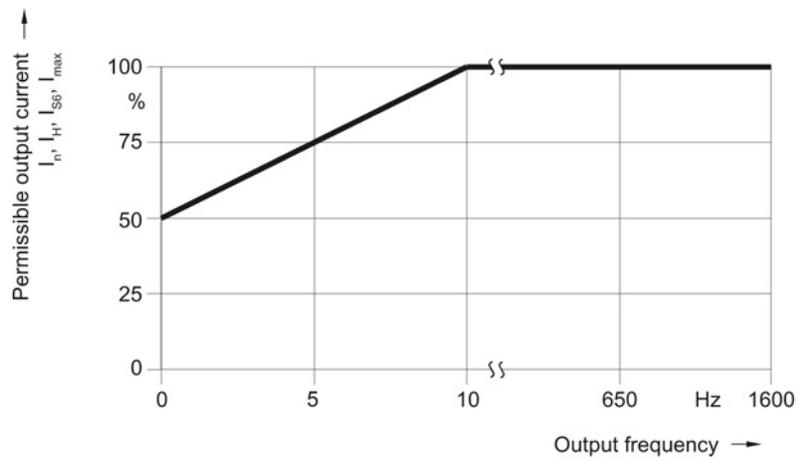


Figure 7-20 Current derating as a function of the output frequency

DC link components

8.1 Safety instructions for DC link components

| | |
|--|----------------|
|  | WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed | |
| If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. | |
| <ul style="list-style-type: none"> • Adhere to the fundamental safety instructions. • When assessing the risk, take into account residual risks. | |



| | |
|---|---------------|
|  | DANGER |
| Danger to life through 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 five minutes after the power supply has been switched off. | |
| Contact with live parts can result in death or serious injury. | |
| <ul style="list-style-type: none"> • Do not open the protective cover of the DC link until 5 minutes have elapsed. • Measure the voltage before starting work on the DCP and DCN DC link terminals. | |



| | |
|---|---------------|
|  | DANGER |
| Danger to life through electric shock when the protective cover of the DC link is open | |
| Contact with live parts can result in death or serious injury. | |
| <ul style="list-style-type: none"> • Only operate the components with closed protective cover. | |



| | |
|--|----------------|
|  | WARNING |
| Danger to life through electric shock due to incorrect connection to the DC link | |
| Incorrect connections can lead to overheating and therefore a risk of fire. There is also a risk of an electric shock. This can result in serious injury or death. | |
| <ul style="list-style-type: none"> • Only use adapters (DC link adapters and DC link rectifier adapters) released by Siemens for the connection to the DC link. | |



! WARNING

Danger to life through 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 modules¹⁾ (exception: Smart Line Module²⁾), 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 removed³⁾.

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

Danger to life through electric shock due to missing DC link side covers

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

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

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



! WARNING

Danger to life due to high leakage currents caused by an interrupted external protective conductor

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.

- Ensure that the external protective conductor satisfies at least one of the following conditions:
 - It has been laid so that it is protected against mechanical damage.¹⁾
 - If it is a single conductor, it has a cross-section of at least 10 mm² Cu.
 - If it is a conductor of a multi-conductor cable, it has a cross-section of at least 2.5 mm² Cu.
 - It has a second protective conductor in parallel with the same cross-section.
 - It complies with the local regulations for equipment with increased leakage current.

¹⁾ Cables laid within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.

! WARNING

Danger of an accident due to missing warning labels in the national language.

Missing warning labels in the national language can result in death or serious injury.

- Attach the component warning labels in the national language.

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

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

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

NOTICE**Damage to the equipment when performing a voltage test as a result of connections that are not disconnected**

SINAMICS S components are subject to a voltage test as part of the routine test. Connected devices can be damaged.

- Disconnect or unplug all SINAMICS devices before the voltage test of the machine equipment according to EN 60204-1, Section 18.4.

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.

8.2 Braking Module Booksize

8.2.1 Description

The Braking Module Booksize is always used together with an external braking resistor. It has the following tasks:

- Specific stop of the drives in the event of a line failure (e.g. emergency retraction or EMERGENCY OFF category 1).
- Limit the DC link voltage for brief periods of generator operation (e.g. if the regenerative feedback capability of the Line Module is deactivated or is not adequately dimensioned).

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 ($P_N = 0.3 \text{ kW}$) and 6SL3100-1BE31-0AA0 ($P_N = 1.5 \text{ kW}$) 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 mm²).

Rapid discharge

Furthermore, the Braking Module Booksize can be 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).

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.

Monitoring functions

- Automatic detection of braking resistors and braking power monitoring
- I²t monitoring of the braking resistors.
- Temperature monitoring of the Braking Module
- Short circuit and overload detection
- Ground fault detection

8.2.2 Safety instructions for Braking Modules Booksize

| |
|---|
|  WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed |
| If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. |
| <ul style="list-style-type: none">• Adhere to the fundamental safety instructions.• When assessing the risk, take into account residual risks. |

| |
|--|
|  WARNING |
| Fire hazard due to overheating because of inadequate ventilation clearances |
| Inadequate ventilation clearances can cause overheating with a risk for personnel due to smoke and fire. This can also result in increased failure rates and a shorter service life of the components. |
| <ul style="list-style-type: none">• Maintain the 80 mm clearances above and below the components. |

| |
|---|
| 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). |
| <ul style="list-style-type: none">• 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. |
| <ul style="list-style-type: none">• Only use braking resistors approved by Siemens. |

8.2.3 Interface description

8.2.3.1 Overview

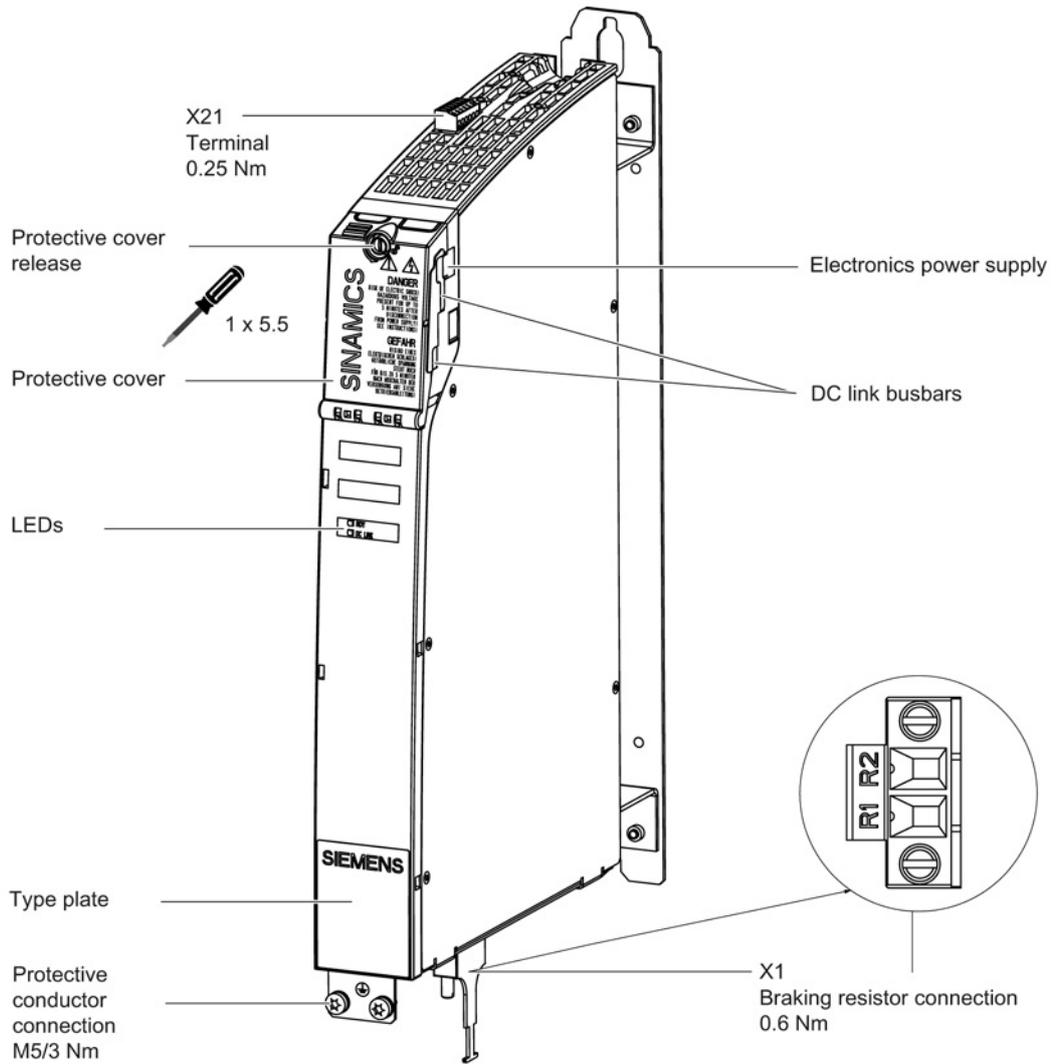


Figure 8-1 Interface overview, Braking Module Booksize

8.2.3.2 X1 braking resistor connection

Table 8- 1 X1 braking resistor connection

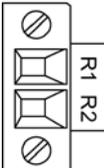
| | Terminal | Designation | Technical data |
|--|----------|--------------------------------|----------------------------------|
|  | 1 | Braking resistor connection R1 | Continuously short-circuit proof |
| | 2 | Braking resistor connection R2 | |
| Type: Screw terminal 4 (Page 755) Max. cross-section that can be connected: 4 mm ² | | | |

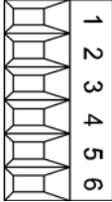
Table 8- 2 Braking resistors without a thermostatic switch for Braking Modules

| Braking resistor | R in Ω | P _N in kW | P _{max} in kW |
|--------------------|---------------|----------------------|------------------------|
| 6SN1113-1AA00-0DA0 | 17 | 0,3 | 25 |
| 6SL3100-1BE31-0AA0 | 5,7 | 1,5 | 100 |

For detailed technical information on the braking resistors, see the section entitled Braking resistors (Page 577).

8.2.3.3 X21 digital inputs/outputs

Table 8- 3 X21 digital inputs/outputs

| | Terminal | Designation ¹⁾ | Technical data |
|---|----------|---|--|
|  | 1 | DI low: Enable Braking Module DI high: inhibit/acknowledge Edge change, high → low: fault acknowledgement | Voltage: -3 ... +30 V Typical current consumption: 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 | Max. load current per output: 100 mA Continuously short-circuit proof Voltage: 24 V DC |
| | 4 | DO high: ready for operation, no fault DO low: Fault | |
| | 5 | Ground | |
| | 6 | | |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm ² : | | | |

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. The function 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 identified automatically).

Terminal X21.4 - fault

The fault can have the following causes:

- Electronics power supply is missing or outside permissible tolerance range
- Enable missing (input terminal)
- Overtemperature

- Overcurrent trip
- I²t 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**

Danger to life as a result of a hazardous voltage at terminals X21

Death or serious injury can result when live parts are touched in the event of a fault.

- Only connect protective extra low voltages at terminals X21.

8.2.4 Connection example

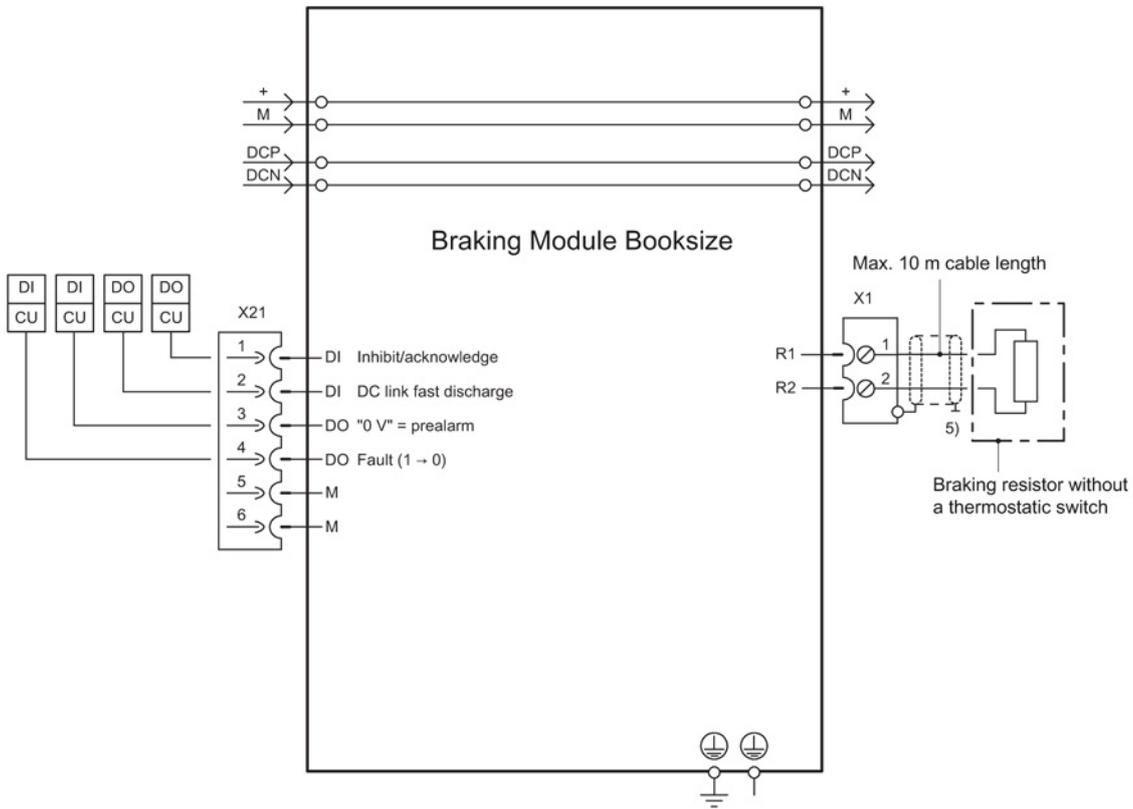


Figure 8-2 Connection example of a Braking Module Booksize

To parameterize the digital inputs or digital outputs, see the SINAMICS S120/S150 List Manual.

8.2.5 Meaning of LEDs

Table 8- 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 ² t monitoring activated Ground fault/short circuit Note: In the event of an overtemperature, the error cannot be acknowledged until a cooling 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). | - |

8.2.6 Dimension drawing

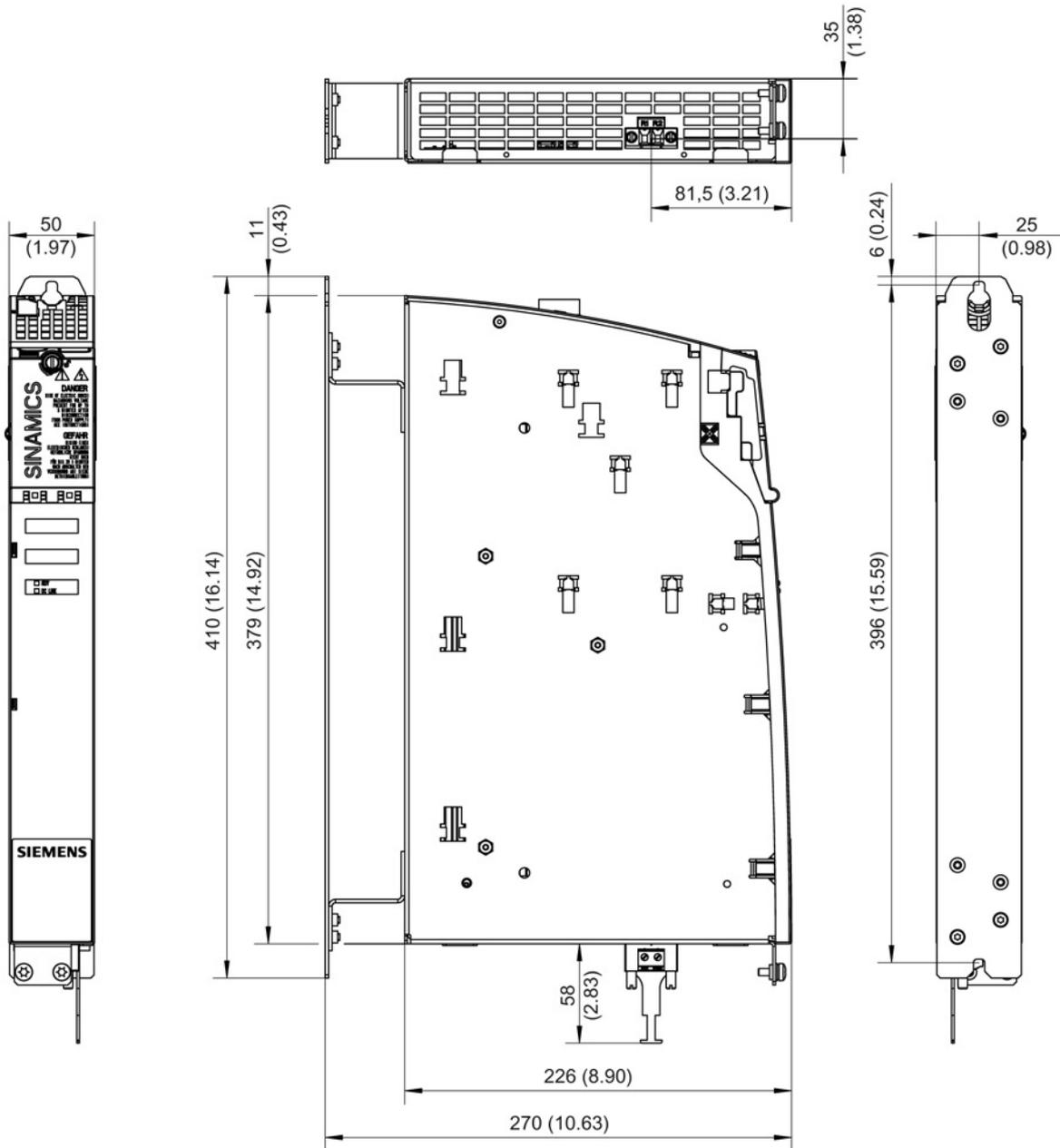
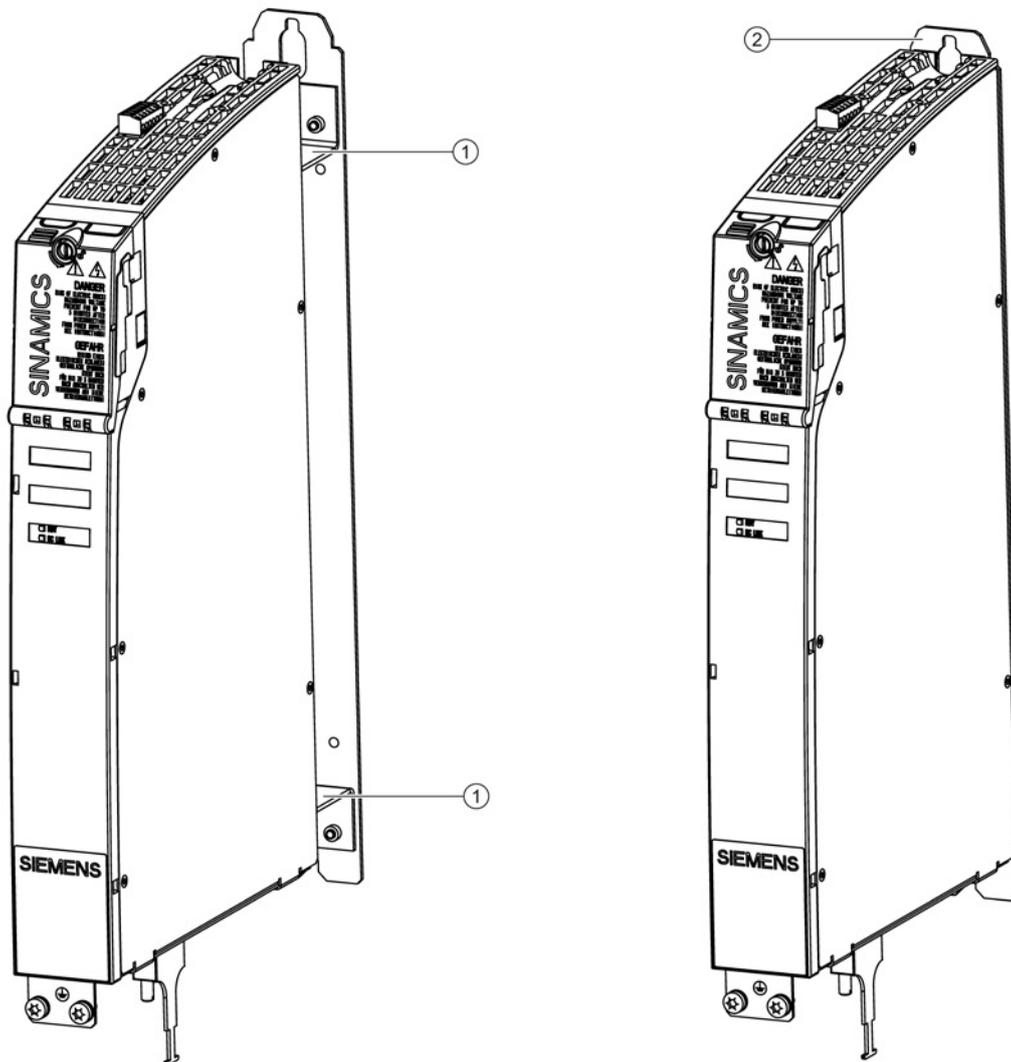


Figure 8-3 Dimension drawing of Braking Module, all dimensions in mm and (inches)

8.2.7 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 8-4 Methods of installing Braking Modules with/without spacer elements

8.2.8 Technical data

Table 8- 5 Technical data

| | | |
|---|-----------------|--------------------|
| 6SL3100-1AE31-0ABx | | |
| DC link voltage | V _{DC} | 510 ... 720 |
| DC link capacitance | μF | 110 |
| 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 | A _{DC} | 100 |
| 24 V busbars | A _{DC} | 20 |
| Braking power | | |
| Max. | kW | 100 |
| Continuous braking power | kW | 1.5 |
| Power loss (see power loss tables (Page 781)) | W | 20 |
| Cooling method | | Natural convection |
| Weight | kg | 4.1 |

8.2.8.1 Characteristic curves

Duty cycle for braking resistors without a thermostatic switch

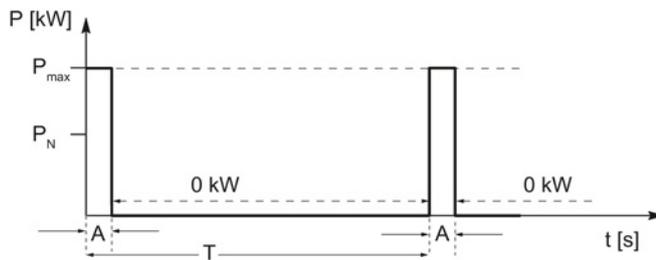


Figure 8-5 Duty cycle for braking resistors without a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

P_N [W] rated power (continuous power) of braking resistor

P_{max} [W] peak power of braking resistor (6 x P_N)

Table 8- 6 Duty cycles

| | 6SN1113-1AA00-0DA0 | | 6SL3100-1BE31-0AAx | |
|-------|--------------------|-----------------|--------------------|-----------------|
| | 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 |

The following applies when connecting Braking Modules in parallel:

$P_{N\ total} = 0.9 \times \text{total } P_N \text{ of single devices}$

$P_{\max\ total} = \text{total } P_{\max} \text{ of single devices}$

8.2.9 Configuration instructions

DC link capacitance

To operate the Braking Modules, a minimum capacitance is required in the DC link. The DC link capacitance for each braking resistor is 440 μF .

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 two-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 6SL3400-1AE31-0AAx is recommended for the parallel connection of Braking Modules.

Parallel connection of the Braking Module 6SL3100-1AE31-0AAx is not recommended because a power distribution between the modules is not guaranteed.

Note

When Braking Modules are connected in parallel, the DC link capacitance specified above must be available for each Braking Module.

8.3 Braking Module Booksize Compact

8.3.1 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).
- Limit the DC link voltage for brief periods of generator operation, for example, if the regenerative feedback capability of the Line Module is deactivated or is not adequately dimensioned.

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 532)). 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.

**! DANGER****Danger to life when live parts are touched after rapid discharge**

On completion of quick discharge, a voltage of 30 V is still present at the DC link. If quick discharge is canceled before it has been completed, this voltage can still be >60 V. Death or serious injury can result when live parts are touched.

- 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

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)
- I²t 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 543).

A parallel connection of the Braking Module Booksize Compact to SINAMICS S120 Basic Line Modules 20 kW and 40 kW is also possible.

8.3.2 Safety instructions for Braking Modules Booksize Compact

| |
|---|
|  WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed |
| If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. |
| <ul style="list-style-type: none">• Adhere to the fundamental safety instructions.• When assessing the risk, take into account residual risks. |

| |
|--|
|  WARNING |
| Fire hazard due to overheating because of inadequate ventilation clearances |
| Inadequate ventilation clearances can cause overheating with a risk for personnel due to smoke and fire. This can also result in increased failure rates and a shorter service life of the components. |
| <ul style="list-style-type: none">• Maintain the 80 mm clearances above and below the components. |

| |
|---|
| 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). |
| <ul style="list-style-type: none">• 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. |
| <ul style="list-style-type: none">• Only use braking resistors approved by Siemens. |

8.3.3 Interface description

8.3.3.1 Overview

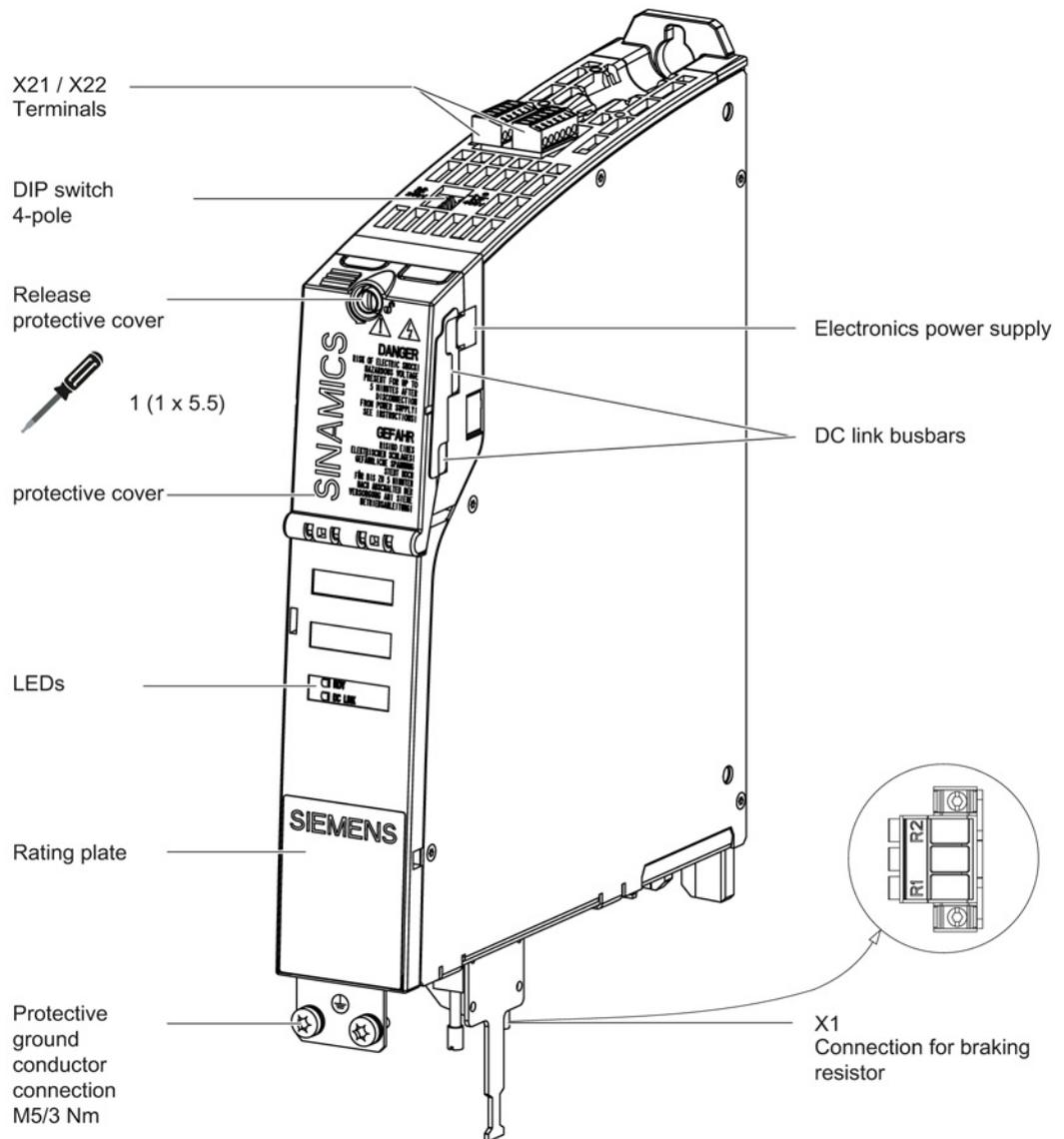
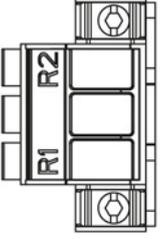


Figure 8-6 Interface overview, Braking Module Booksize Compact

8.3.3.2 X1 braking resistor connection

Table 8- 7 X1 braking resistor connection

| | Terminal | Designation | Technical data |
|--|----------|--------------------------------|----------------------------------|
|  | 1 | Braking resistor connection R1 | Continuously short-circuit proof |
| | 2 | Not assigned | |
| | 3 | Braking resistor connection R2 | |
| Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm ² | | | |

Braking resistors without a thermostatic switch

The Braking Module Booksize Compact is only designed for operation with the braking resistors listed below.

Table 8- 8 Braking resistors without a thermostatic switch

| Braking resistor | R in Ω | P _N in kW | P _{max} in kW |
|--------------------|---------------|----------------------|------------------------|
| 6SN1113-1AA00-0DA0 | 17 | 0,3 | 25 |
| 6SL3100-1BE31-0AA0 | 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.

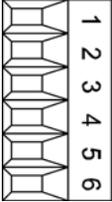
Table 8- 9 Braking resistors with a thermostatic switch

| Braking resistor | R in Ω | P _N 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 577).

8.3.3.3 X21 digital inputs/outputs

Table 8- 10 X21 digital inputs/outputs

| | Terminal | Designation ¹⁾ | Technical data |
|---|----------|---|--|
|  | 1 | DI low: Enable Braking Module DI high: inhibit/acknowledge Edge change, high → low: fault acknowledgement | Voltage: -3 ... +30 V Typical current consumption: 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: | Max. load current per output: 100 mA Continuously short-circuit proof Voltage: 24 V DC |
| | 4 | DO high: ready for operation, no fault DO low: Fault | |
| | 5 | Ground | |
| | 6 | | |
| Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm ² : | | | |

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 I²t 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

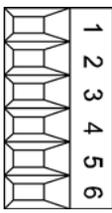
In the event of an overtemperature fault, I²t monitoring, or braking power monitoring, the fault will be acknowledged automatically after a cooling phase. Manual acknowledgment is not necessary!



| | |
|--|----------------|
|  | WARNING |
| Danger to life as a result of a hazardous voltage at terminals X21 | |
| Death or serious injury can result when live parts are touched in the event of a fault. | |
| <ul style="list-style-type: none"> Only connect protective extra low voltages at terminals X21. | |

8.3.3.4 X22 digital output/temperature switch

Table 8- 11 X22 digital output/temperature switch, braking resistor

| | Terminal | Designation ¹⁾ | Technical data |
|--|----------|---|--|
|  | 1 | + Temp | Temperature switch of the braking resistor |
| | 2 | - Temp | |
| | 3 | Reserved | Not assigned! |
| | 4 | Reserved | |
| | 5 | DO high: 200 V supply system is selected DO low: 400 V supply system is selected | |
| | 6 | Reserved | Not assigned! |

Type: Screw terminal 1 (Page 755)
Max. cross-section that can be connected 1.5 mm²:

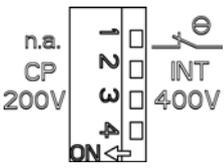
¹⁾ DO: digital output

8.3.3.5 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 8- 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.

8.3.4 Connection examples

Braking resistor without thermostatic switch connected to a Braking Module Booksize Compact

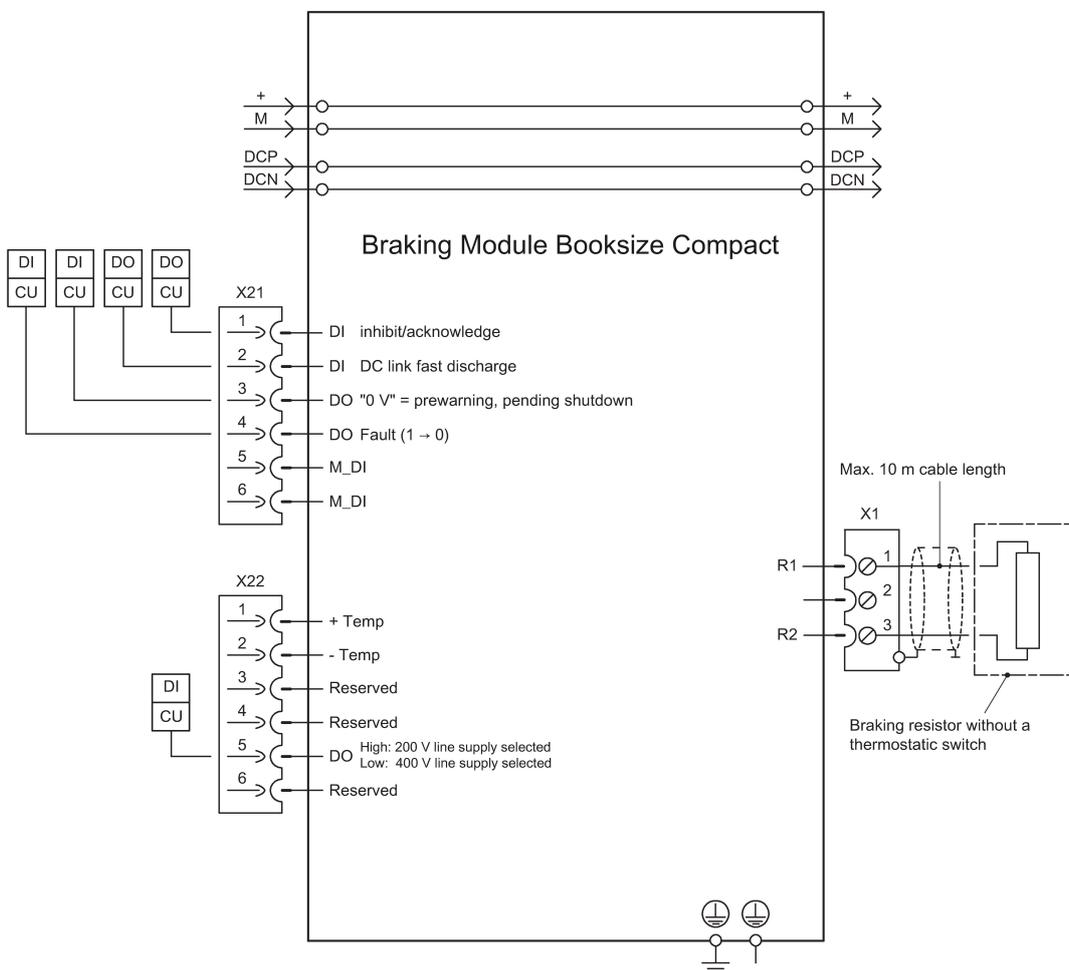


Figure 8-7 Connection example for Braking Module Booksize Compact and braking resistor without a thermostatic switch

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.

The connections for the temperature switches (X22.1 and X22.2) must not be assigned for "braking resistor without a thermostatic switch" mode for the Braking Module to work.

Braking resistor with thermostatic switch connected to a Braking Module Booksize Compact

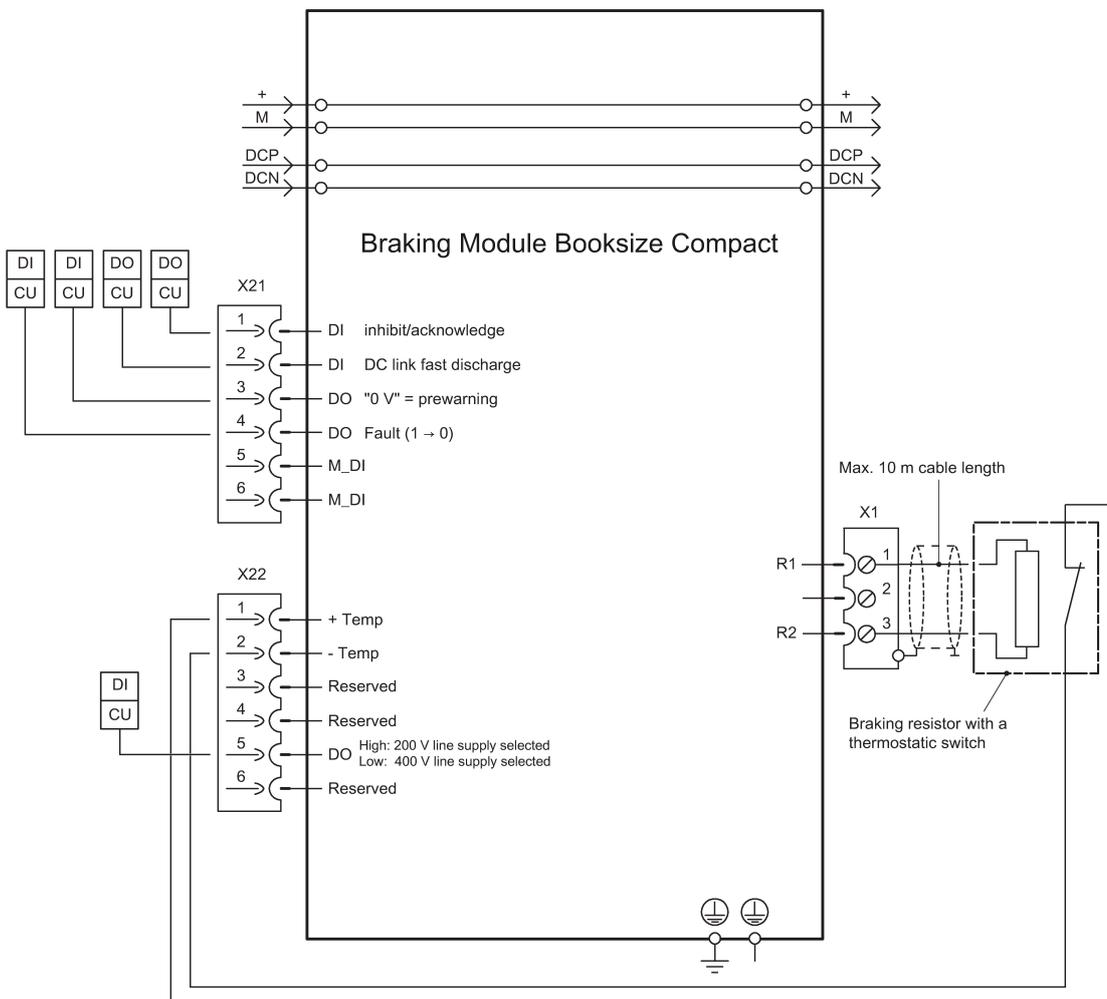


Figure 8-8 Connection example for Braking Module Booksize Compact and braking resistor with a thermostatic switch

Note

The digital inputs DI are isolated and refer 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.

To parameterize the digital inputs or digital outputs, see the SINAMICS S120/S150 List Manual.

8.3.5 Meaning of LEDs

Table 8- 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 of IGBT/braking resistor Overcurrent trip I ² t monitoring activated Braking power monitoring triggered Ground fault/short circuit Note: In the event of overtemperature, I ² t 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. | - |

8.3.6 Dimension drawing

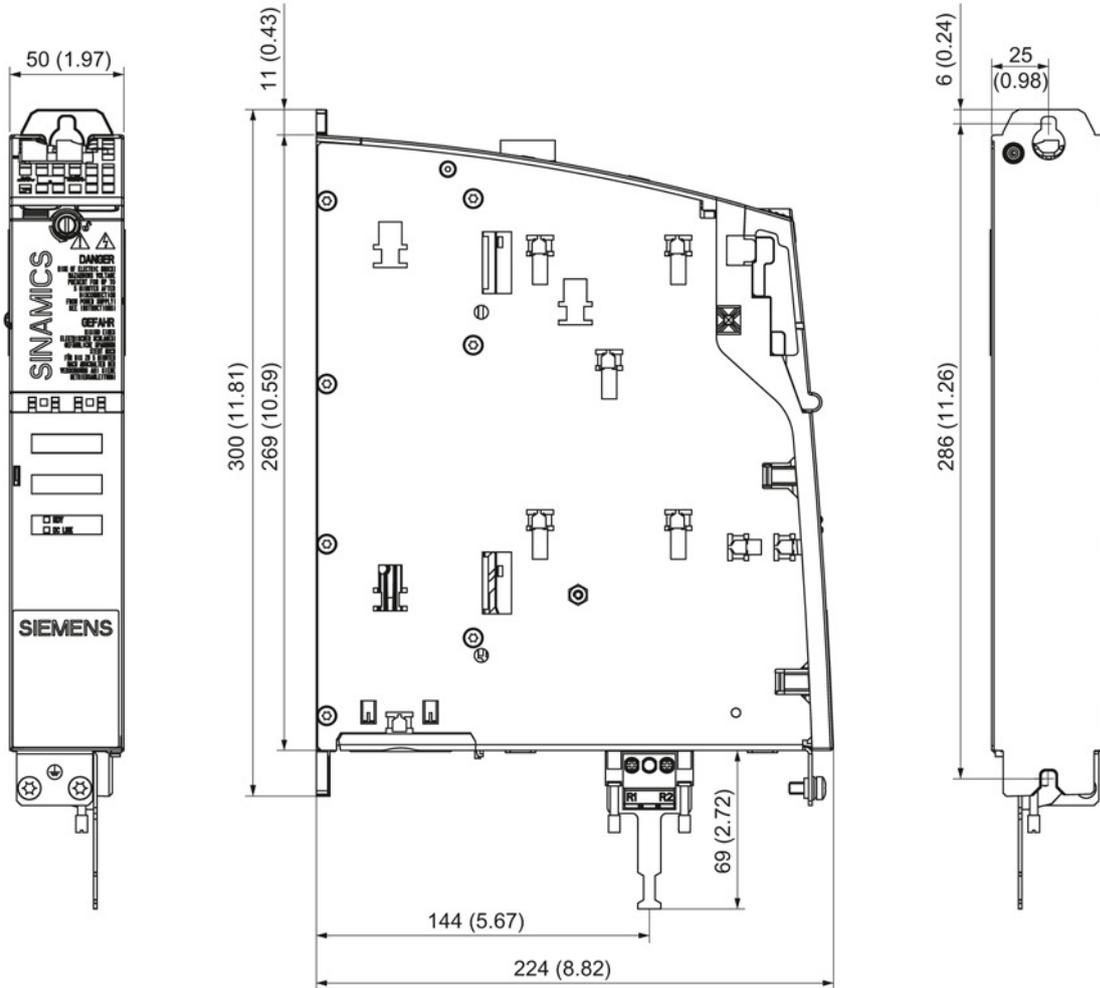
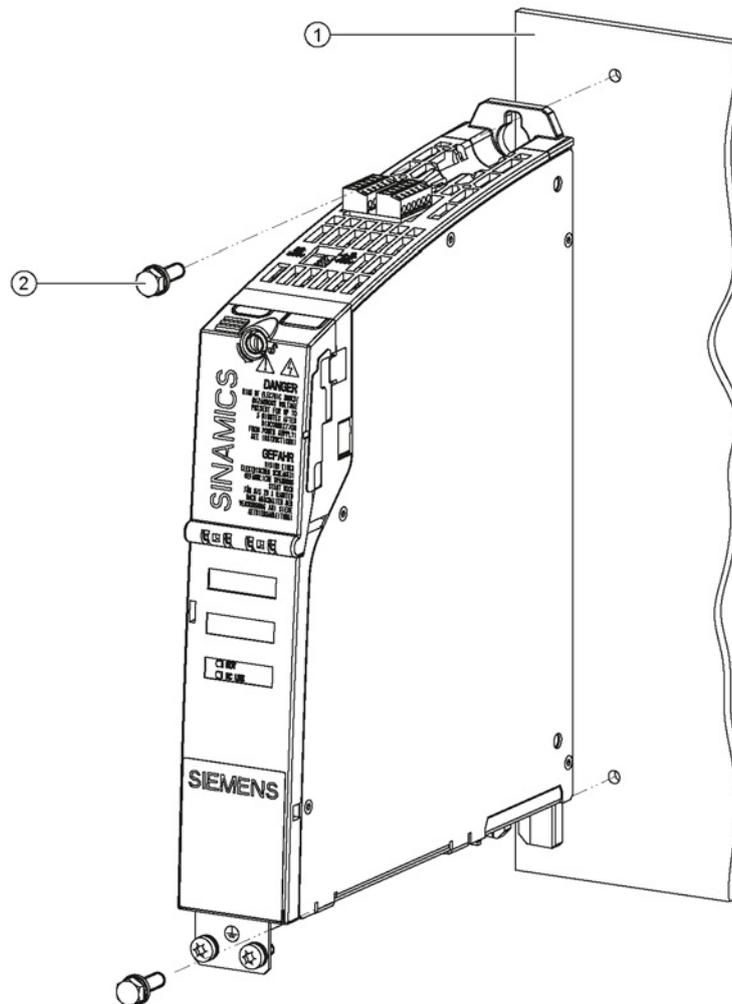


Figure 8-9 Dimension drawing of Braking Module Booksize Compact, all dimensions in mm and (inches)

8.3.7 Mounting

Mounting a Braking Module Booksize Compact with internal air cooling



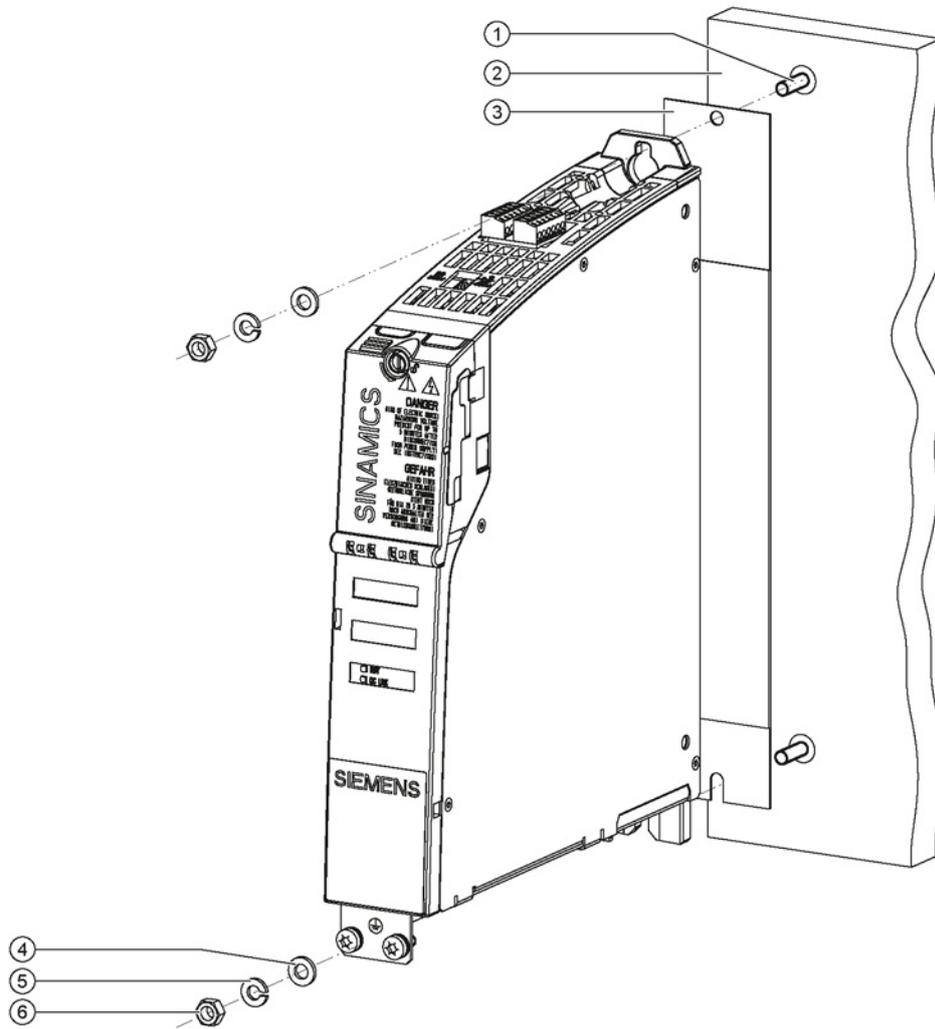
- ① Mounting wall
- ② M6 x 16 screw
Hex combination screw or hex screw with spring washer and plain washer

Figure 8-10 Mounting a Braking Module Booksize Compact with internal air cooling

Tightening torques:

- Firstly, tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts.
Tightening torque: 6 Nm

Mounting a Braking Module Booksize Compact with cold plate



- ① M6 studs
- ② Cold plate (air or liquid cooling)
- ③ Heat-conducting foil
- ④ Washer
- ⑤ Spring washer
- ⑥ M6 nut

Figure 8-11 Mounting a Braking Module Booksize Compact with cold plate

Tightening torques:

- Firstly, tighten the nuts by hand.
Tightening torque: 0.5 Nm
- Then tighten the nuts.
Tightening torque: 10 Nm

Special points to note in relation to mounting on a cold plate

To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every Braking Module Booksize Compact is supplied with heat-conducting foil cut to the right size. Note the mounting position of the heat-conducting foil.

Note

- Also replace the heat-conducting foil when replacing a component.
- Only use heat-conducting foil released or supplied by Siemens.

| | Order number |
|-----------------------------|--------------------|
| Heat-conducting foil, 50 mm | 6SL3162-6FB01-0AA0 |

8.3.8 Technical specifications

Table 8- 14 Technical data

| 6SL3400-1AE31-0AAx | | | |
|---|-----------------|--|-------------|
| Line supply | | 200 V | 400 V |
| DC link voltage | V _{DC} | 250 ... 360 | 510 ... 720 |
| ON threshold | V _{DC} | 400 | 760 |
| Braking power | | | |
| Maximum ¹⁾ | kW | 50 | 100 |
| Continuous braking power | kW | 2,5 | 5 |
| Electronics power supply | V _{DC} | 24 (20.4 ... 28.8) | |
| Electronics current consumption (at DC 24 V) | A _{DC} | 0,2 | |
| Standby mode | A _{DC} | 0,4 | |
| Current carrying capacity: | | | |
| DC link busbars | A _{DC} | 100 | |
| 24 V busbar | A _{DC} | 20 | |
| Power loss (see power loss tables (Page 781)) | | | |
| Standby operation | W | 5 | |
| | W | 25 | |
| Switching frequency | Hz | 2000 | |
| Cooling methods | | Internal air cooling Cold plate cooling | |
| Max. ambient temperature | ° C | 55 | |
| Weight | kg | 2,7 | |

¹⁾ At the upper switch-on threshold

8.3.8.1 Characteristic curves

Duty cycle for braking resistors without a thermostatic switch

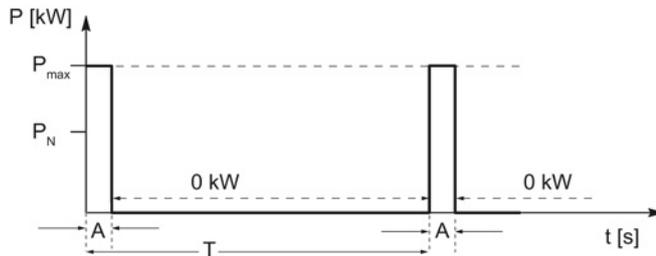


Figure 8-12 Duty cycle for braking resistors without a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

P_N [W] rated power (continuous power) of braking resistor

P_{max} [W] peak power of braking resistor ($6 \times P_N$)

Table 8- 15 Duty cycles

| | 6SN1113-1AA00-0DA0 | | 6SL3100-1BE31-0AAx | |
|-------|--------------------|-----------------|--------------------|-----------------|
| | 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

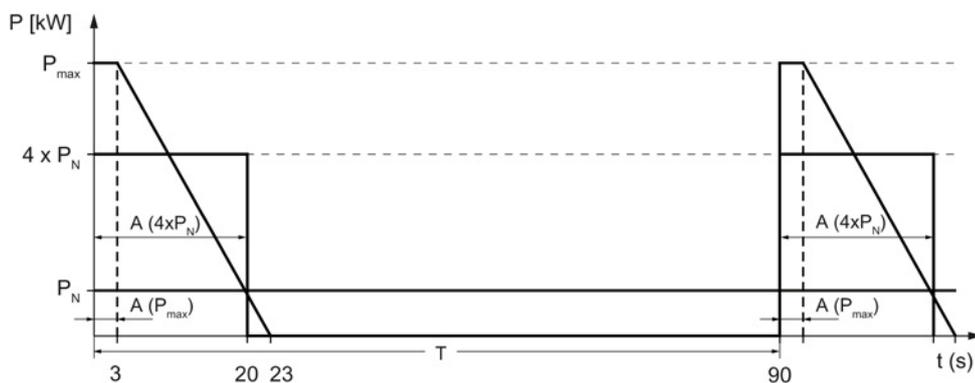


Figure 8-13 Duty cycles for braking resistors with a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

P_N [W] rated power (continuous power) of braking resistor

P_{\max} [W] peak power of braking resistor ($6 \times P_N$)

$4 \times P_N$ [W] = power permitted every 90 s for 20 s

Table 8- 16 Duty cycles

| | 6SE7018-0ES87-2DC0 | | 6SE7021-6ES87-2DC0 | | 6SE7023-2ES87-2DC0 | |
|-------|-----------------------|---------------------------|-----------------------|---------------------------|-----------------------|---------------------------|
| | Duty cycle P_{\max} | Duty cycle $4 \times P_N$ | Duty cycle P_{\max} | Duty cycle $4 \times P_N$ | Duty cycle P_{\max} | Duty cycle $4 \times P_N$ |
| A [s] | 3 | 20 | 3 | 20 | 3 | 20 |
| T [s] | 90 | 90 | 90 | 90 | 90 | 90 |

8.3.9 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 8- 17 Configuration examples

| DC link capacitance in μF | Max. number of Braking Modules |
|--------------------------------------|--------------------------------|
| 900 | 1 |
| 2400 | 4 |
| 9800 | 19 |

DC link cable

In a two-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:

$P_{N \text{ total}} = 0.9 \times \text{total } P_N \text{ of single devices}$

$4 \times P_{N \text{ total}} = 0.9 \times \text{sum } (4 \times P_N) \text{ of single devices}$

$P_{\max \text{ total}} = \text{total } P_{\max} \text{ of single devices}$

8.4 Braking units for 100 kW Basic Line Modules

8.4.1 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.

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:

- $4 \times P_N = 100 \text{ kW}$ (order number 6SE7031-6EB87-2DA1)
- $4 \times P_N = 170 \text{ kW}$ (order number 6SE7032-7EB87-2DA1)

For detailed information about the MASTERDRIVES braking unit, see operating instructions "MASTERDRIVES braking unit" with order number 6SE7087-6CX87-2DA0.

8.4.2 Safety instructions for Braking Modules for the 100 kW Basic Line Module

| |
|---|
|  WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed |
| If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. |
| <ul style="list-style-type: none">• Adhere to the fundamental safety instructions.• When assessing the risk, take into account residual risks. |

| |
|--|
|  WARNING |
| Fire hazard due to overheating because of inadequate ventilation clearances |
| Inadequate ventilation clearances can cause overheating with a risk for personnel due to smoke and fire. This can also result in increased failure rates and a shorter service life of the components. |
| <ul style="list-style-type: none">• Maintain the 80 mm clearances above and below the components. |

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 ($< 360 \text{ V} \pm 2\%$), 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.

8.4.3 Interface description

8.4.3.1 X3 DC link connection

Table 8- 18 X3: Connection for the DC link

| Connection/Meaning | Remarks | Tightening torque [Nm] |
|---|---|------------------------|
| C/L+ input (plus DC link) | Busbar C/L+ | 16 |
| D/L- input (minus DC link) | Busbar D/L | 16 |
|  Protective conductor | Busbar PE  | 16 |
| Shield connection | M6 bolts at top of housing | 8 |
| NOTE | | |
| Connection via | Cable lug without insulation With shrink-on sleeve Cable is connected using the supplied M8 x 25 screws | |
| AWG | Max. 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.

8.4.3.2 X6 braking resistor connection

Table 8- 19 X6: Connection for the braking resistor

| Connection/Meaning | Remarks | Tightening torque [Nm] |
|---|---|------------------------|
| G/R+ external braking resistor | Busbar G/R+ | 16 |
| H/R external braking resistor | Busbar H/R | 16 |
|  Protective conductor | Busbar PE  | 16 |
| Shield connection | M6 bolts at bottom of housing | 8 |
| NOTE | | |
| Connection via | Cable lug without insulation With shrink-on sleeve Cable is connected using the supplied M8 x 25 screws | |
| AWG | Max. 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 8- 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 |

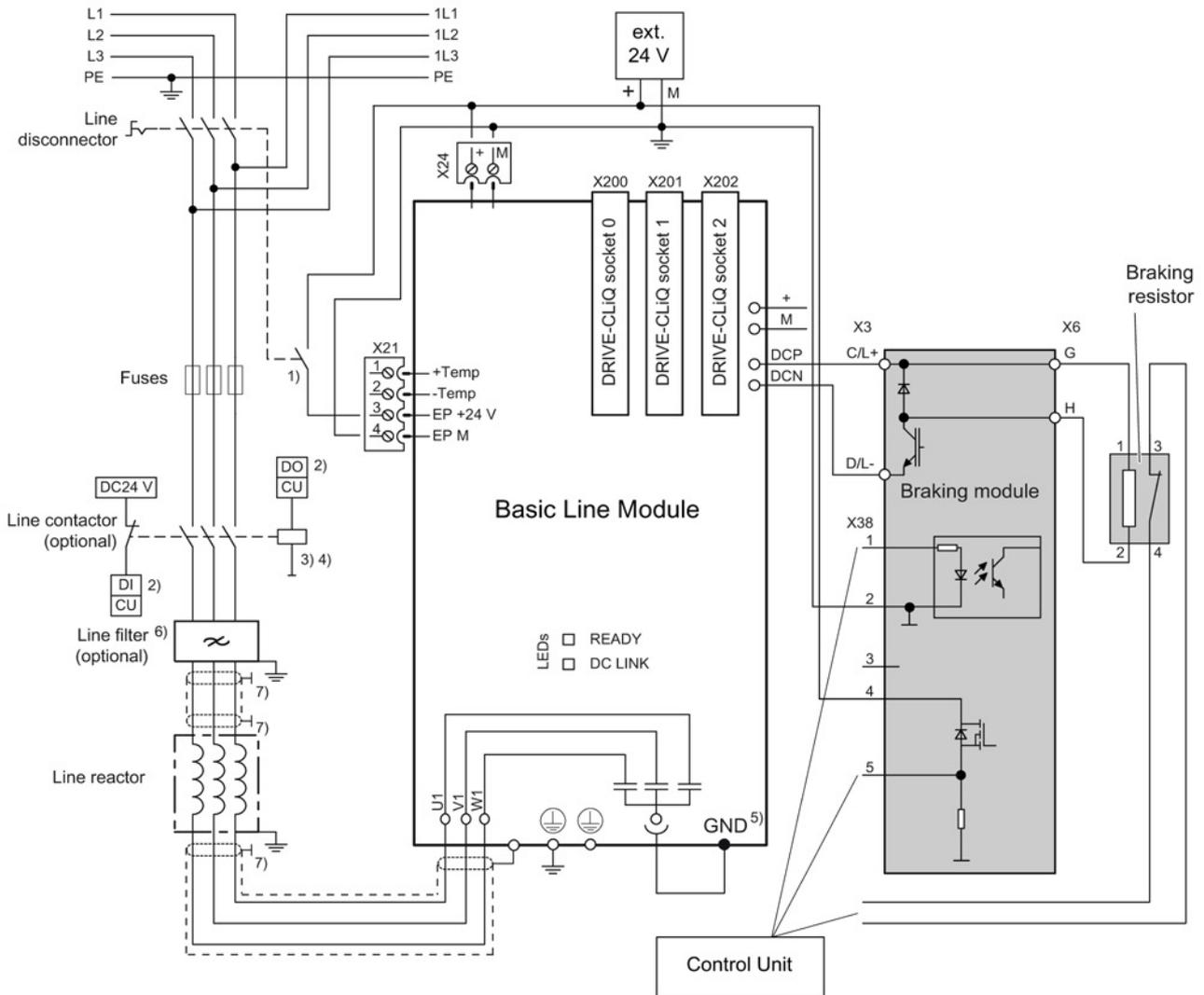
8.4.3.3 Switch S1

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.

8.4.4 Connection example



- 1) 24 V DC and ground must be connected for operation.
- 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 must be used if required.
- 5) The connection bracket must be removed when the component is connected to an IT line supply.
- 6) Line filter is required so that the radio interference voltage complies with Category C2.
- 7) Contact established via rear mounting panel or shield buses in accordance with the EMC installation guideline

Figure 8-14 Connection example for MASTERDRIVES braking unit

8.4.6 Connection to the Basic Line Module 100 kW

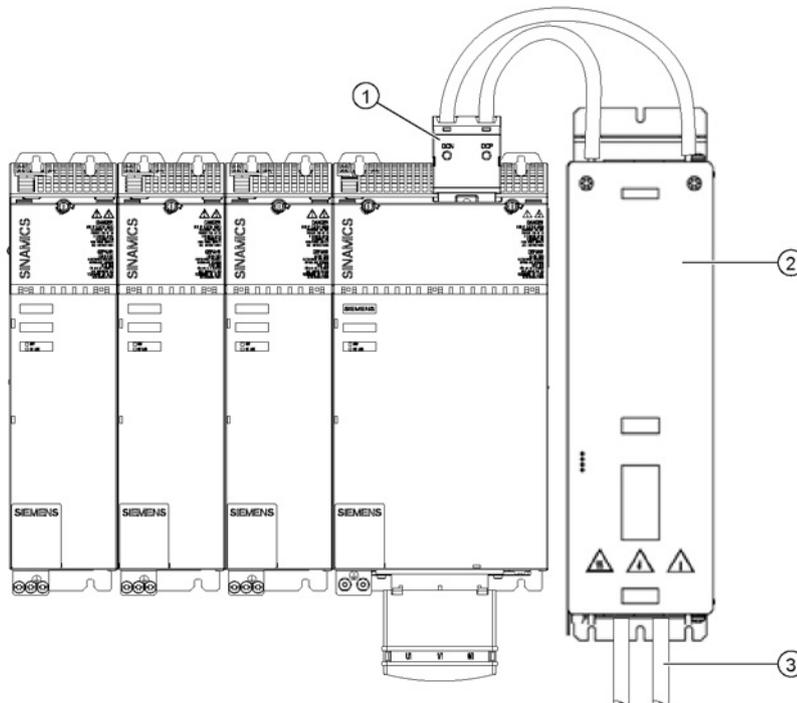
Connecting the braking unit to the DC link

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, order number 6SL3162-2BM00-0AA0
- DC link adapter, order 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 651) and DC link adapter (Page 664).



- ① DC link rectifier adapter
- ② MASTERDRIVES braking unit
- ③ Cable routing to the braking resistor

Figure 8-16 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. The cross-section of the protective conductor connection must be at least 50 mm².

The connecting cable between the braking unit and the DC link rectifier adapter or DC link adapter must be dimensioned with a cross-section of 95 mm² in accordance with EN 60439-1 (short-circuit-proof cable routing). 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.

NOTICE

Damage to the drive units or DC link terminals by interchanging or short-circuiting the 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

Risk of burns as a result of the high braking unit temperature

The air discharge temperature of the braking units and the housing can become very hot. You can be slightly injured if you come into contact with them.

- 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.

8.5 Capacitor Module

8.5.1 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.

8.5.2 Safety instructions for Capacitor Modules

| |
|---|
|  WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed |
| If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. |
| <ul style="list-style-type: none">• Adhere to the fundamental safety instructions.• When assessing the risk, take into account residual risks. |

| |
|--|
|  WARNING |
| Fire hazard due to overheating because of inadequate ventilation clearances |
| Inadequate ventilation clearances can cause overheating with a risk for personnel due to smoke and fire. This can also result in increased failure rates and a shorter service life of the components. |
| <ul style="list-style-type: none">• Maintain the 80 mm clearances above and below the components. |

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.
-

8.5.3 Interface description

8.5.3.1 Overview

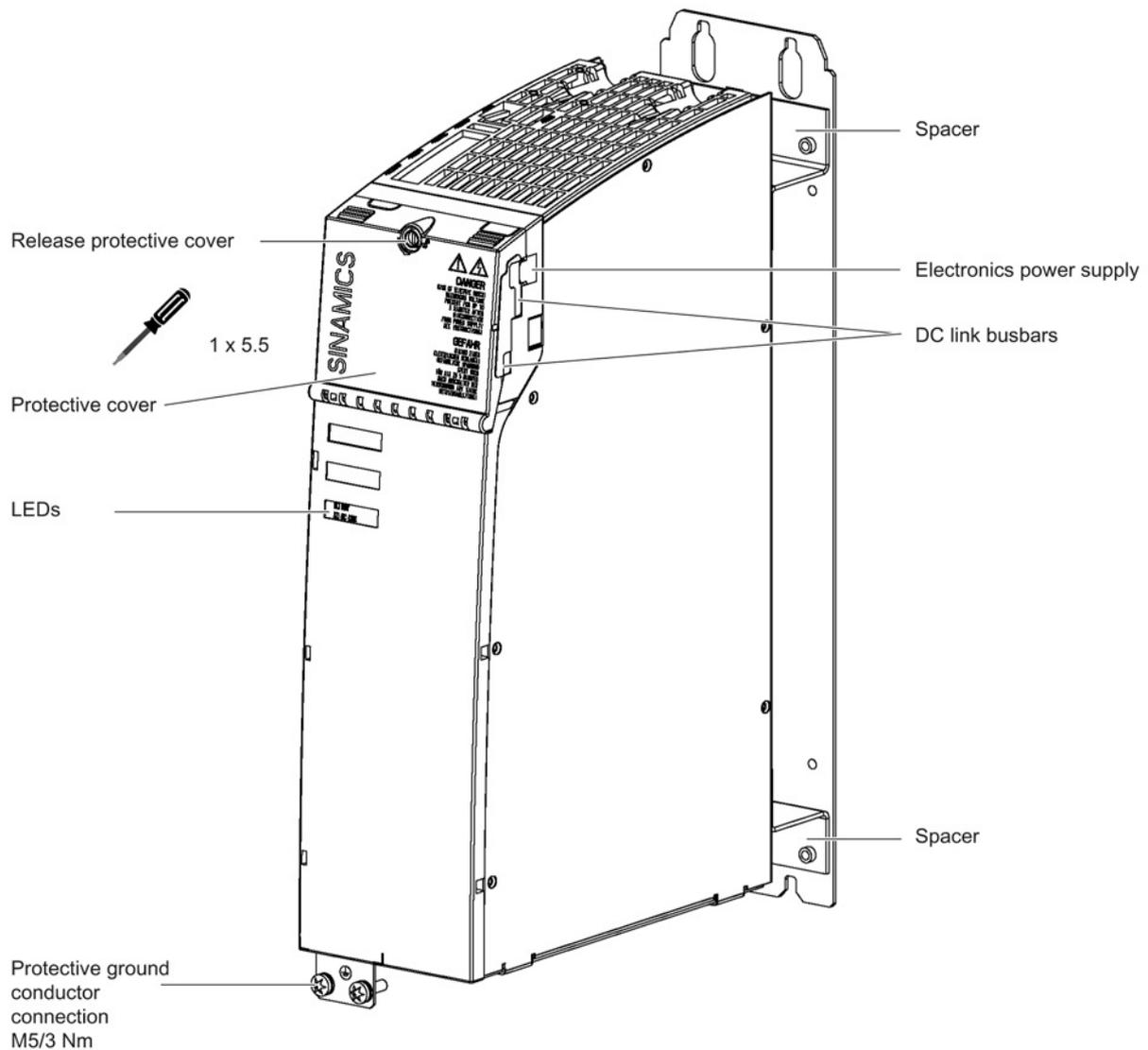


Figure 8-17 Interface overview, Capacitor Module

8.5.4 Dimension drawing

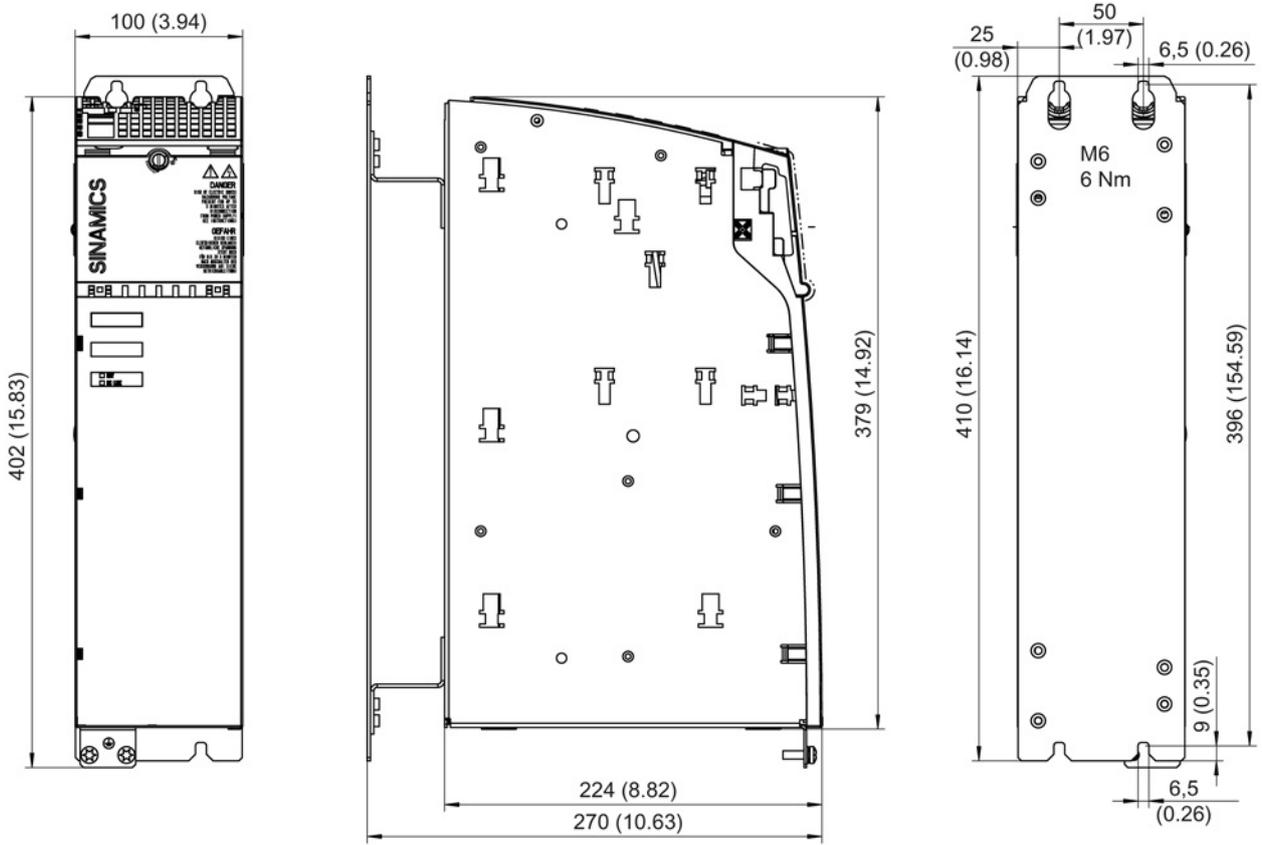
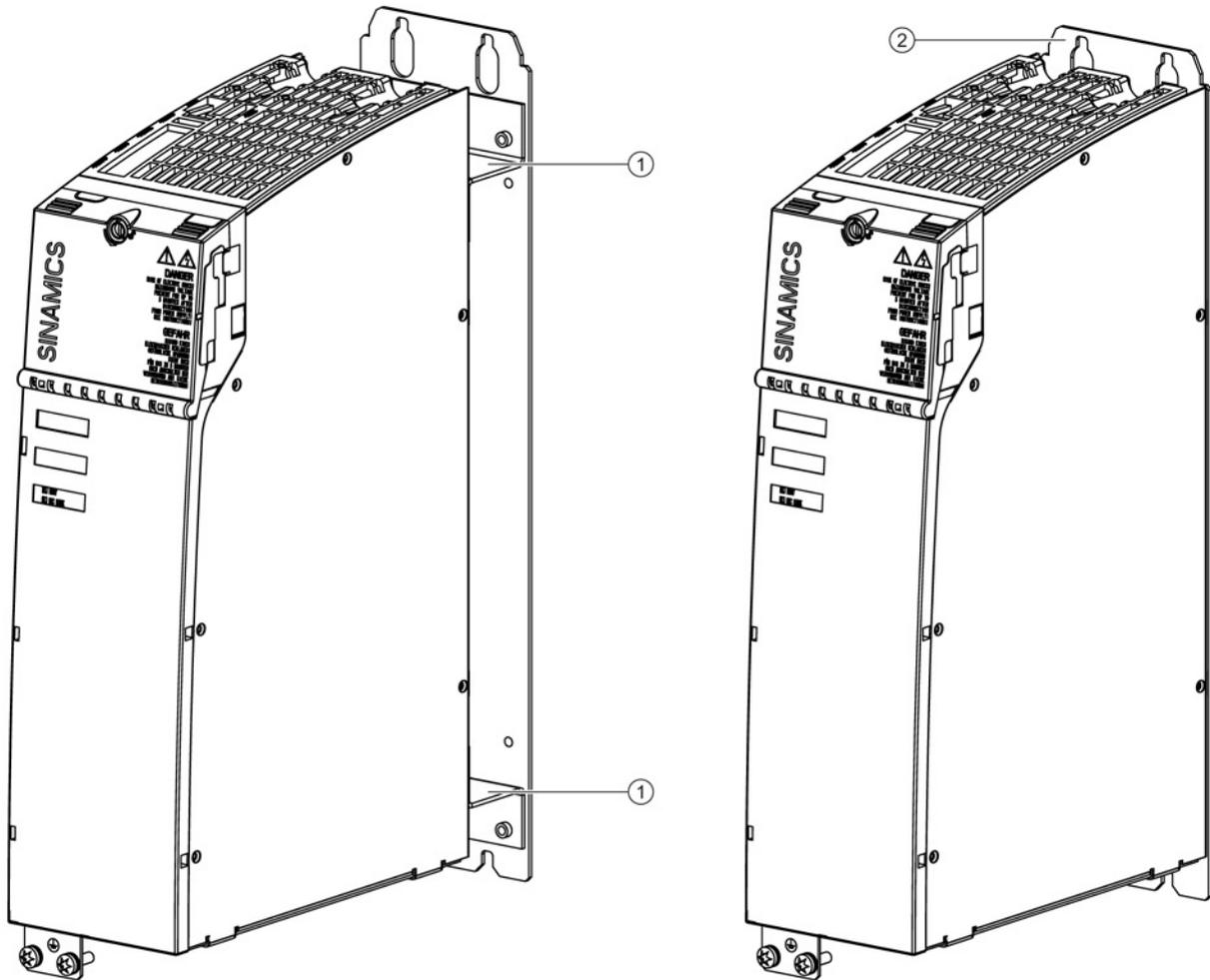


Figure 8-18 Dimension drawing of Capacitor Module, all dimensions in mm and (inches)

8.5.5 Mounting



- ① Delivered 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 8-19 Mounting methods for Capacitor Module with and without spacer elements

The Capacitor Module can be attached to the cabinet panel with or without spacer elements.

8.5.6 Technical Specifications

Table 8- 21 Technical data

| | | |
|---|-----------------|--------------------|
| 6SL3100-1CE14-0AA0 | | |
| DC link voltage | V _{DC} | 510 ... 720 |
| Electronics power supply | V _{DC} | 24 (20.4 ... 28.8) |
| Capacitance | μF | 4000 |
| Current carrying capacity | | |
| DC link busbar | A | 100 |
| 24 V busbar | A | 20 |
| Power loss (see power loss tables (Page 781)) | W | 25 |
| Weight | kg | 7.2 |

8.6 Control Supply Module CSM

8.6.1 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.

In normal operation, the Control Supply Module is supplied from the line voltage. 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.

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 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.

Note

Compatibility

The new Control Supply Module 6SL3100-1DE22-0AA1 with extended functions described here replaces Control Supply Module 6SL3100-1DE22-0AA0. The modules are downwards compatible (-0AA1 can be used as spare part for -0AA0).

8.6.2 Safety instructions for Control Supply Modules

| |
|--|
|  WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. <ul style="list-style-type: none">• Adhere to the fundamental safety instructions.• When assessing the risk, take into account residual risks. |



| |
|---|
|  DANGER |
| Danger to life when live parts are touched when using the control supply module The Control Supply Module has 2 supply circuits. Death or serious injury can result when live parts are touched. <ul style="list-style-type: none">• Switch off both supply circuits before you start any work. |



| |
|--|
|  DANGER |
| Danger to life through 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. <ul style="list-style-type: none">• Do not open the protective cover of the DC link until 5 minutes have elapsed.• Measure the voltage before starting work on the DCP and DCN DC link terminals. |



| |
|---|
|  DANGER |
| Danger to life through electric shock when the protective cover of the DC link is open Contact with live parts can result in death or serious injury. <ul style="list-style-type: none">• Only operate the components with closed protective cover. |



| |
|--|
|  WARNING |
| Danger to life through 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. <ul style="list-style-type: none">• Mount the side covers on the first and last component in the drive line-up. You can order missing side covers (order number: 6SL3162-5AA00-0AA0). |

 **WARNING****Danger of an accident due to missing warning labels in the national language.**

Missing warning labels in the national language regarding the DC link discharge time can result in death or serious injury.

- Attach the component warning labels in the national language.

 **WARNING****Fire hazard due to overheating because of inadequate ventilation clearances**

Inadequate ventilation clearances can cause overheating with a risk for personnel due to smoke and fire. This can also result in increased failure rates and a shorter service life for Line Modules.

- Maintaining 80 mm ventilation clearances above and below the component is essential.

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

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

- Tighten all the DC link busbar screws with the specified tightening torques (1.8 Nm tolerance +30 %).
- Check the tightening torques of all power connections at regular intervals and tighten them when required. This applies in particular after transport.

NOTICE**Material damage due to 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).
- Check the tightening torques of all power connections at regular intervals and tighten them when required. This applies in particular after transport.

8.6.3 Interface description

8.6.3.1 Overview

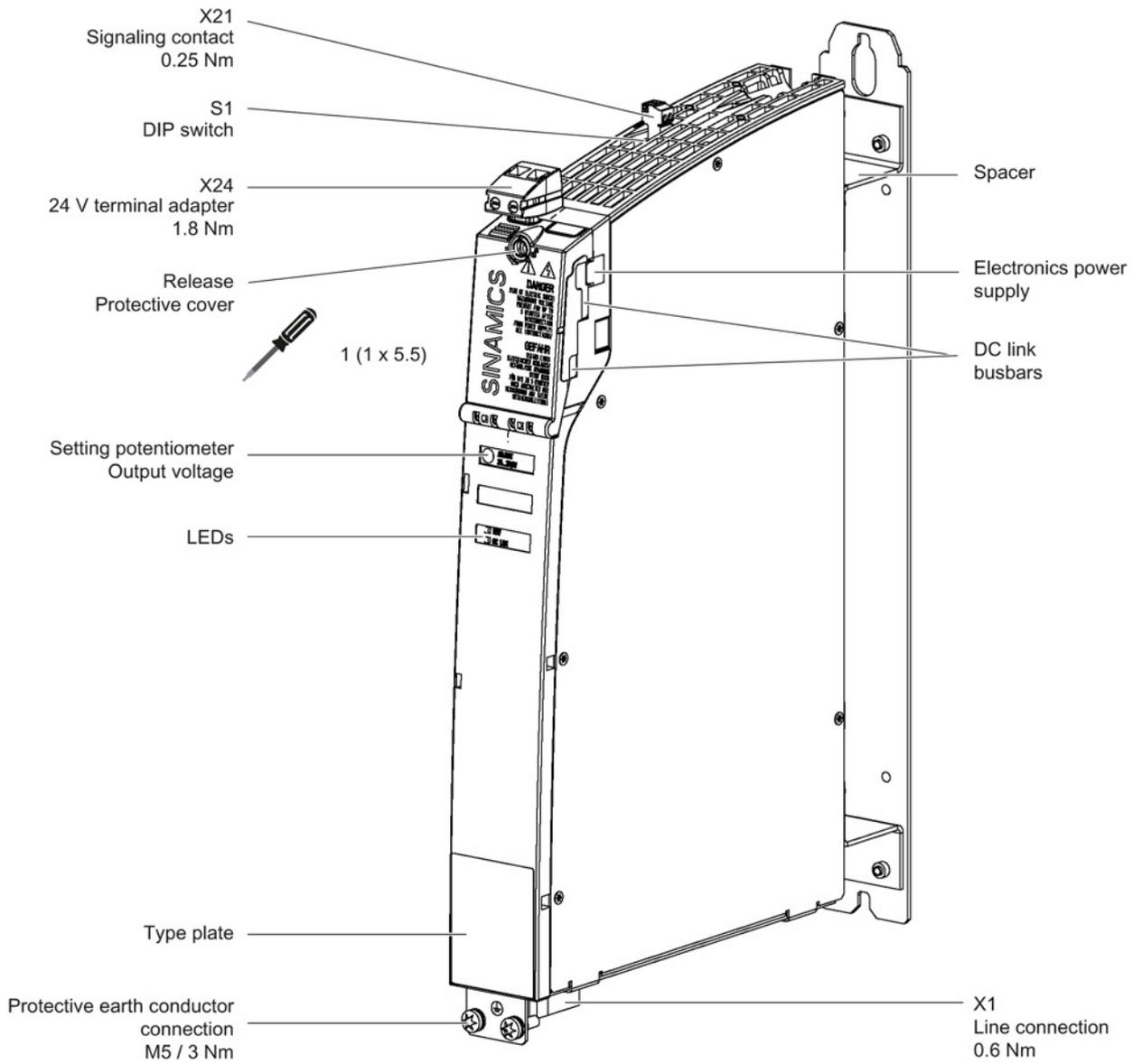
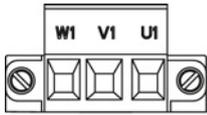
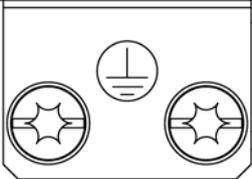


Figure 8-20 Interface overview, Control Supply Module

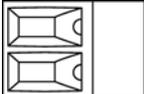
8.6.3.2 X1 line connection

Table 8- 22 X1 line connection

| | Terminal | Technical data |
|---|---------------|--|
|  | U1 | Supply voltage: 3 AC 380 V ... 480 V, 50 / 60 Hz Type: Screw terminal 4 (Page 755) Max. cross-section that can be connected: 4 mm ² Tightening torque: 0.5 ... 0.6 Nm |
| | V1 | |
| | W1 | |
|  | PE connection | M5 screw / 3 Nm at the housing |

8.6.3.3 X21 signaling contact

Table 8- 23 X21 signaling contact

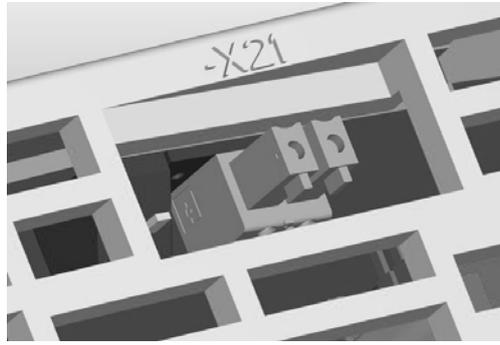
| | Terminal | Technical data |
|---|----------|---|
|  | 1 | Voltage: 24 V DC Max. load current: 0.5 A (ohmic load) |
| | 2 | |
| Type: Screw terminal 1_1 (Page 755) Max. cross-section that can be connected 1.5 mm ² | | |

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.

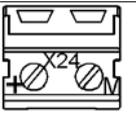
The signaling contact operates as an isolated NO contact. When the switch is closed, the Control Supply Module is "OK" and provides the output voltage. The switch opens in the event of a fault "Not OK" – when the overtemperature condition is still present, after a pre-warning, wire breakage, short-circuit etc. The Control Supply Module is correspondingly switched off.

Table 8- 24 Installing the signaling contact

| | |
|---|--|
|  |  |
| <p>Signaling contact without terminal connector in the delivery condition</p> | <p>Signaling contact, complete with terminal connector</p> |

8.6.3.4 X24 24 V terminal adapter

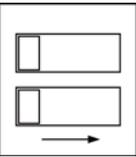
Table 8- 25 X24 24 V terminal adapter

| | Terminal | Designation | Technical data |
|--|----------|-------------------|---------------------------------|
|  | + | 24 V power supply | Supply voltage 24 ... 28.8 V DC |
| | M | Ground | Electronics ground |
| <p>Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm²</p> | | | |

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

8.6.3.5 S1 DIP switch

Table 8- 26 DIP switch S1

| | Terminal | Designation | Technical data |
|---|----------|--|--|
|  | 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.

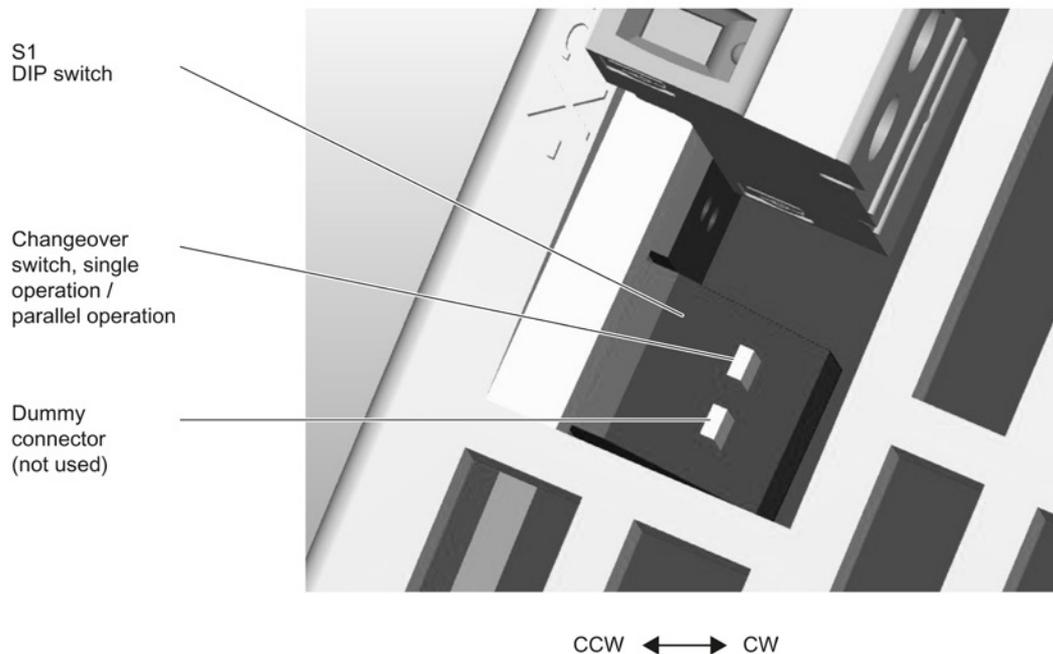


Figure 8-21 DIP switch on the upper side of the component

When delivered, "single operation" is set. Both switches are set to the left.

8.6.4 Connection examples

The Control Supply Module is connected to the line supply (3-ph. 380 V AC -10 % to 480 V AC +10 %) via interface X1 (screw terminals 0.2 to 4 mm²). This connection should preferably be made without using an isolating device (e.g. contactor).

The Control Supply Module has an internal line filter (Class A for TN systems), and the pre-charging circuit for the DC link inside the device is electrically isolated from the 24 V supply.

The Control Supply Module also features a current limitation function.

Note

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

- 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

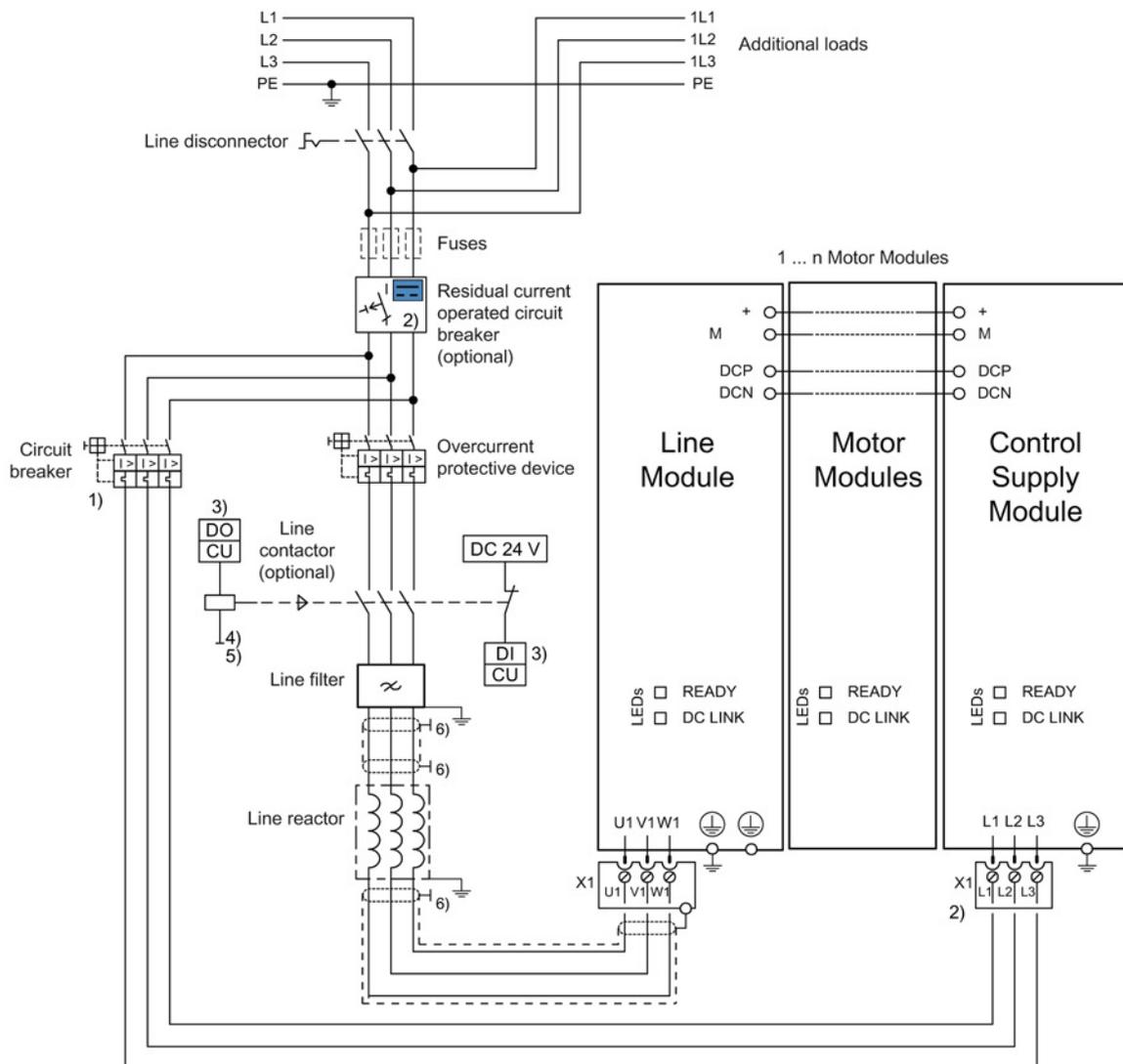
Observe the connection sequence

If a selectively tripping, AC/DC-sensitive RCCB is used for the drive line-up, the Control Supply Module must always be connected to the line supply downstream of this circuit breaker. Otherwise, the residual current operated circuit breaker will trip erroneously if the direct-current component is asymmetrically drawn in certain operating states.

8.6.4.1 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 red 24 V connector from the accessories pack provided must be inserted under all circumstances. 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 the 24 V terminal adapter (do not insert the red 24 V connector).



- 1) Permissible types:
 - a) SIRIUS circuit breaker, 3RV 1021 1DA10, set to 3A
 - b) KTS-R-6-type branch circuit fuse (class RK1)
- 2) The line supply connection must always be available
- 3) DI/DO, controlled from the Control Unit.
- 4) No additional load permitted downstream of the line contactor!
- 5) The current carrying capacity of the DO must be observed; an output coupling device must be used if required.
- 6) Contact established via rear mounting panel or shielding buses in accordance with the EMC installation guideline

Figure 8-22 Connection example for Control Supply Module in single operation

8.6.4.2 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.

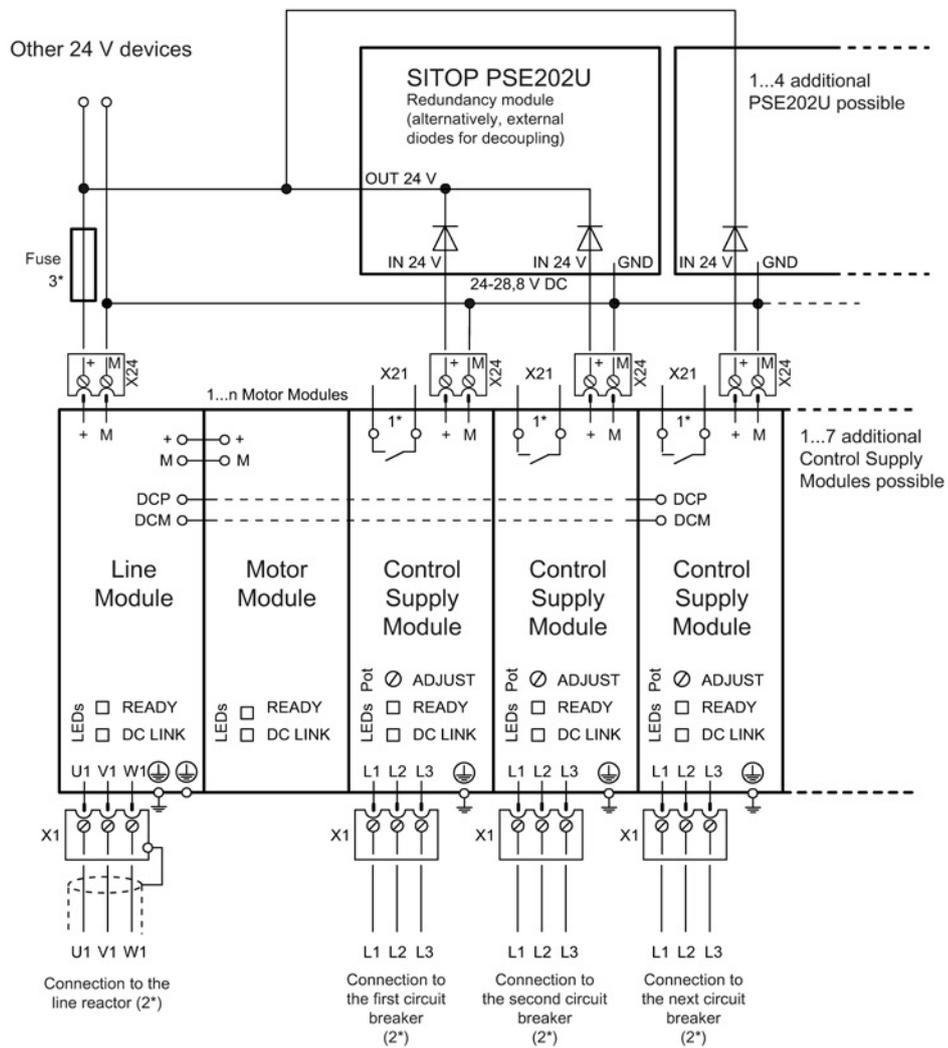
In the parallel mode, each Control Supply Module should supply the 24 V DC voltage via the 24 V terminal adapter. For this reason, the red 24 V connector must **not** be used (see connection examples).

For a parallel connection we recommend that a SITOP redundancy module (6EP1961-3BA20) 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

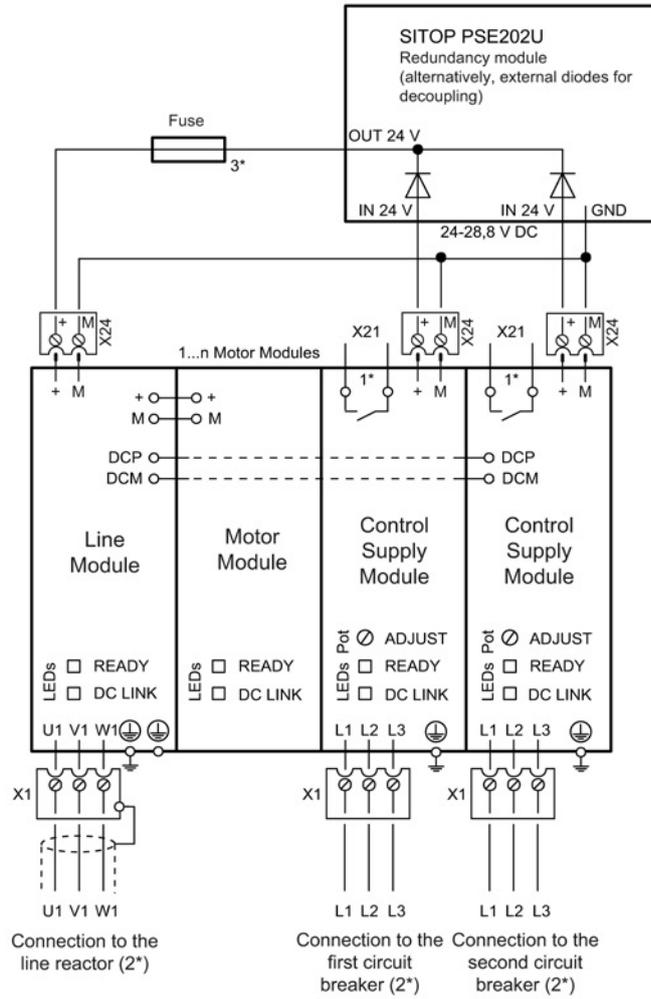
Parallel connection

Only Control Supply Modules with order number 6SL3100-1DE22-0AA1 may be used for parallel connection.



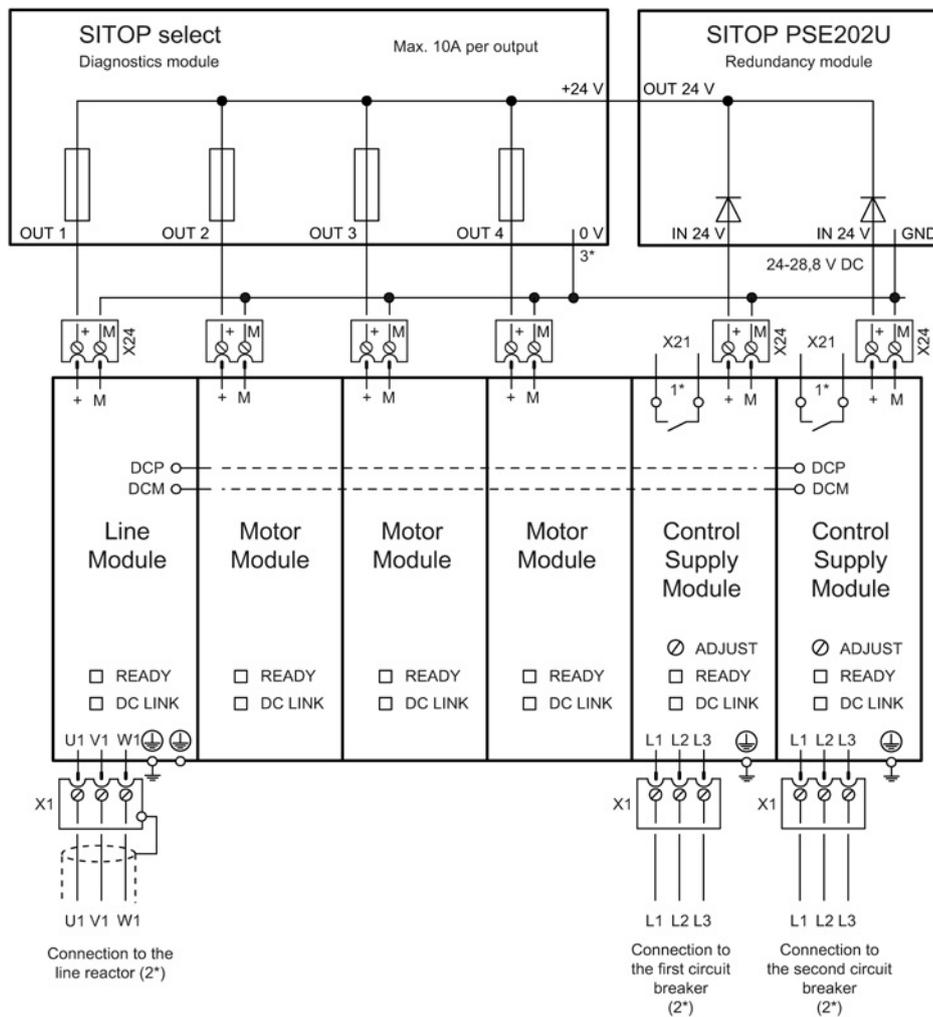
1* connection to the digital interface (SCADA or PLC); closed means the following: 24 V OK
 2* continue, as in "connection example Control Supply Module in single operation"
 3* max. permissible 20A continuous current (see fuse characteristics)

Figure 8-23 Connection example for parallel connection of 2 to 10 Control Supply Modules via a SITOP PSE202U redundancy module



1* connection to the digital interface (SCADA or PLC); closed means the following: 24 V OK
 2* continue, as in "connection example Control Supply Module in single operation"
 3* max. permissible 20A continuous current (see fuse characteristics)

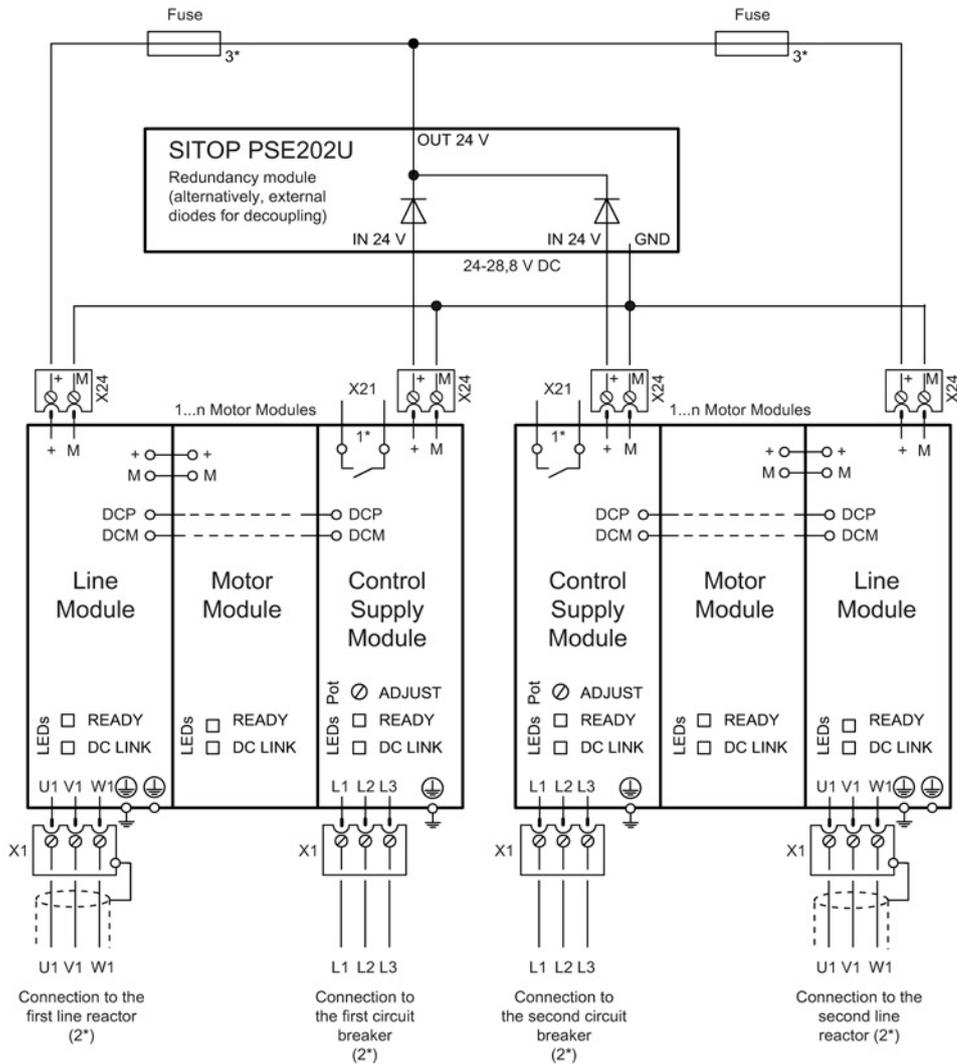
Figure 8-24 Connection example for a redundancy circuit with 2 Control Supply Modules via a SITOP PSE202U redundancy module



1* connection to the digital interface (SCADA or PLC); closed means the following: 24 V OK
 2* continue, as in "connection example Control Supply Module in single operation"
 3* functional reference point (do not load with high currents)

Figure 8-25 Connection example for parallel connection of Control Supply Modules via a SITOP PSE202U redundancy module and a SITOP select diagnostic module (6EP1961-2BA00)

8.6 Control Supply Module CSM



1* connection to the digital interface (SCADA or PLC); closed means the following: 24 V OK
 2* continue, as in "connection example Control Supply Module in single operation"
 3* max. permissible 20A continuous current (see fuse characteristics)

Figure 8-26 Connection example for operation of 2 units with Control Supply Modules via a SITOP PSE202U redundancy module

8.6.5 Meaning of LEDs

Table 8- 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 $U_{E\ DC} < 280 \dots 300\ V$ Buffer operation is not possible. |
| | Yellow | Continuous light | DC input voltage in the range $360 \dots 380\ V < U_{E\ DC} < 820\ V \pm 3\ \%$ Buffer operation is possible |
| | Red | Continuous light | DC input voltage outside the tolerance range: $U_{E\ DC} < 360 \dots 380\ V$ or $V_{E\ DC} > 820\ V \pm 3\ \%$ |

8.6.6 Dimension drawing

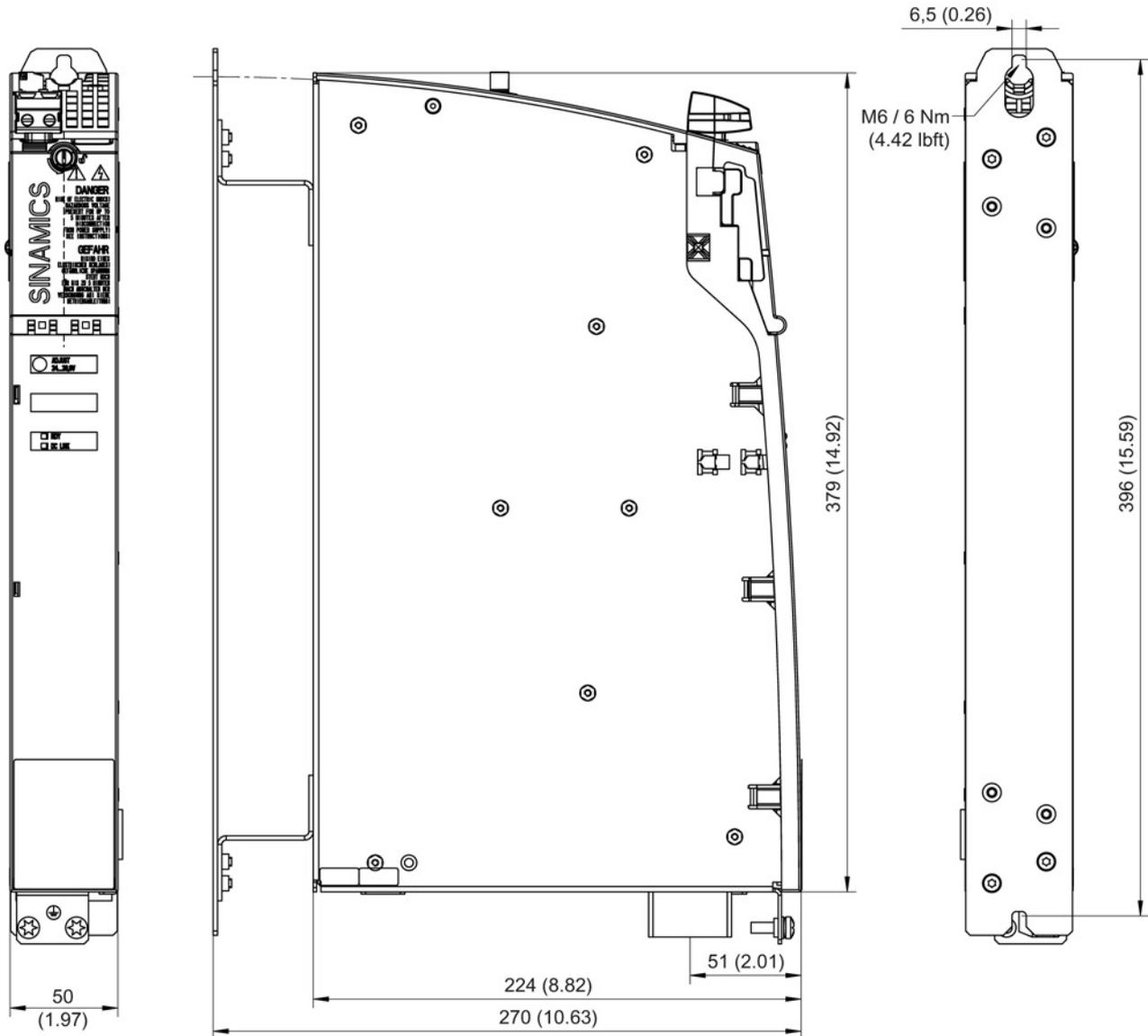
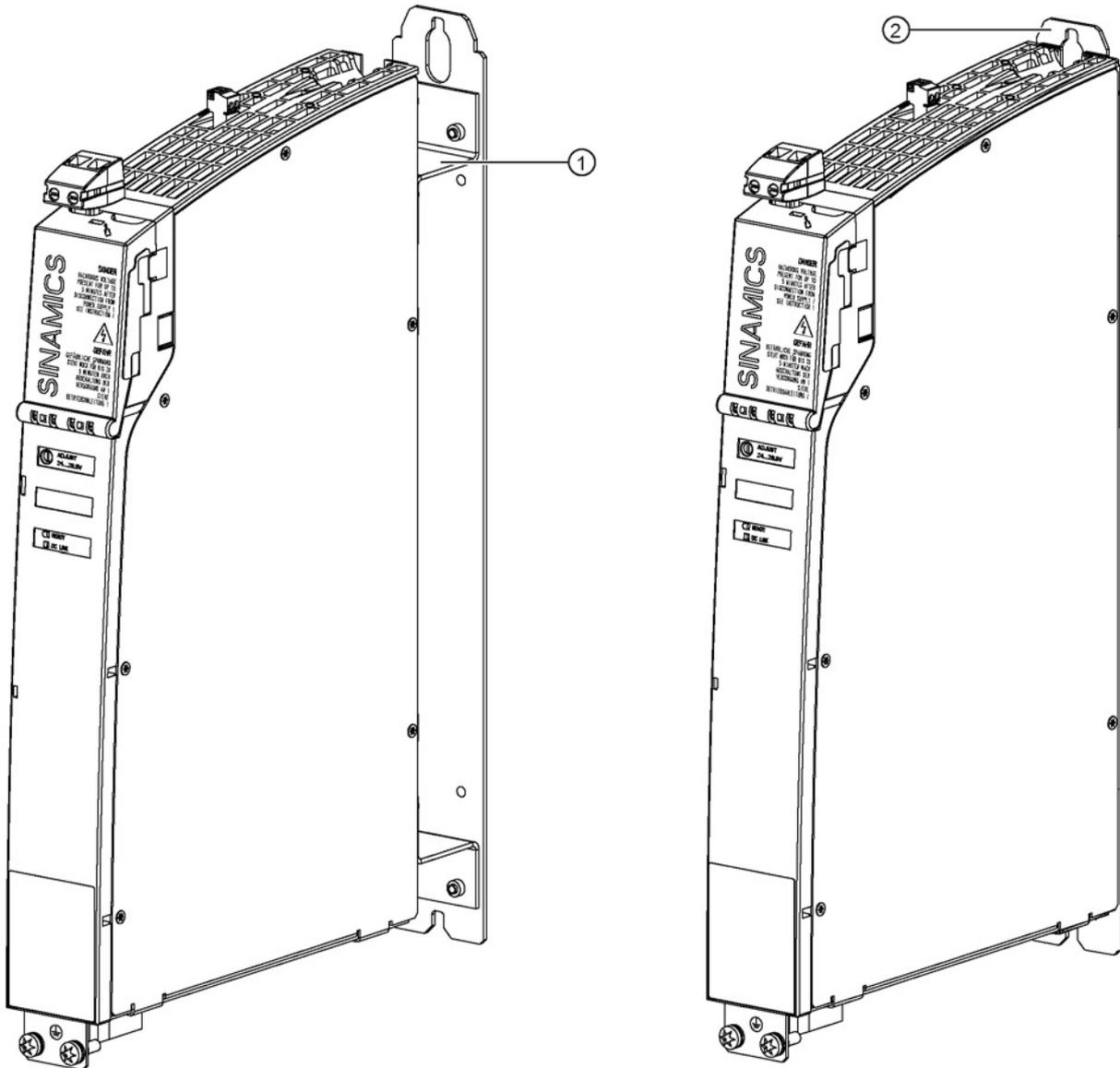


Figure 8-27 Dimension Control Supply Module, all dimensions in mm and (inches)

8.6.7 Installation



- ① Delivered 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 8-28 Methods of installing the Control Supply Module with and without spacer

The Control Supply Module can be attached to the control cabinet panel with or without spacers.

8.6.8 Technical data

Table 8- 28 Technical data

| 6SL3100-1DE22-0AA1 | Unit | Value |
|---|------------------|---|
| Input data, AC input | | |
| Line voltage | V _{AC} | 3 AC 380 ... 480 ± 15 % |
| Line frequency | Hz | 45 ... 66 |
| Rated input current Rated value (at V _{E rated}) | A _{AC} | ≤ 2 |
| Starting current inrush | A _{AC} | ≤ 28 at > 5 ms |
| Input data, DC input | | |
| Rated input voltage | V _{DC} | 600 |
| Input voltage range | V _{DC} | 300 ... 882 |
| DC link voltage (continuous input voltage) | V _{DC} | 430 ... 800 300 ... 430 < 1 min 800 ... 853 < 1 min 853 ... 882 < 10 s |
| Supply current (at 600 V) | A _{DC} | 1.1 |
| Overvoltage tripping | V _{DC} | > 882 |
| Undervoltage tripping | V _{DC} | 280 ± 3 % |
| Output data | | |
| Rated output voltage V _{A rated} | V _{DC} | 24 ... 28.8 |
| Rated output current I _{A rated} ¹⁾ | 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 |
| Power loss ride-through (at 400 V AC) | ms | 5 |
| Power loss | | |
| Line | W | 70 |
| DC link | W | 65 |
| (see Power loss tables (Page 781)) | | |
| Efficiency | % | > 83 |
| Circuit breaker (UL) | | |
| Type designation: | | 3RV1021-1DA10 |
| Rated current: | A | 2.2 ... 3.2 (setting value 3) |
| Resulting rated short-circuit current | | |
| SCCR at 480 V AC: | kA | 100 |
| Fuses (UL) | | |
| Class RK1, listed JDDZ | | |
| Rated current: | A | 6 |
| resulting rated short-circuit current | | |
| SCCR at 480 V AC: | kA | 200 |

| 6SL3100-1DE22-0AA1 | Unit | Value |
|--|------|----------------------|
| Cooling method | | Internal air cooling |
| Max. ambient temperature without derating | ° C | ≤ 40 |
| with derating as of 26 V output voltage | ° C | > 40 ... 55 |
| Weight | kg | 4.8 |

1) Above 40° C, a linear derating of the output current above a 26 V output voltage and higher must be observed

8.6.8.1 Characteristics

Derating characteristic

For ambient temperatures > 40 °C, a linear derating for the output current must be observed as of 26 output voltage.

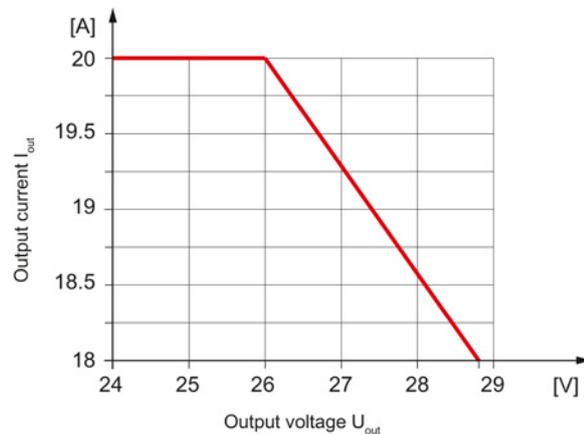


Figure 8-29 Current derating for ambient temperatures >40 °C as a function of the output voltage

Braking resistors

9.1 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 9- 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 _N : 0.3 kW | X | X | | |
| 6SL3100-1BE31-0AA0 Resistance: 5.7 Ω P _N : 1.5 kW | X | X | | |
| Braking resistors with a thermostatic switch | | | | |
| 6SE7018-0ES87-2DC0 Resistance: 80 Ω P _N : 1.25 kW | | X | X | X |
| 6SE7021-6ES87-2DC0 Resistance: 40 Ω P _N : 2.5 kW | | X | X | X |
| 6SE7023-2ES87-2DC0 Resistance: 20 Ω P _N : 5 kW | | X | X | X |
| 6SE7028-0ES87-2DC0 Resistance: 8 Ω P _N : 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 mm²) 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.

9.2 Safety instructions for braking resistors

| |
|---|
|  WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed |
| If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. |
| <ul style="list-style-type: none">• Adhere to the fundamental safety instructions.• When assessing the risk, take into account residual risks. |

| |
|---|
|  WARNING |
| Risk of fire due to 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. |
| <ul style="list-style-type: none">• Use the local installation regulations to avoid this fault.• Protect the cables against mechanical damage.• Also implement one of the following measures:<ul style="list-style-type: none">– Use cables with double insulation.– Maintain adequate clearance, e.g. by using spacers.– Lay the cables in separate cable ducts or conduits. |

| |
|--|
|  CAUTION |
| Risk of burns due to high surface temperatures |
| The braking resistor can become very hot. You can get seriously burnt when touching the surface. |
| <ul style="list-style-type: none">• 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.• To prevent adjacent components from suffering damage due to these high temperatures, maintain a clearance of 100 mm on all sides of the braking resistor. |

9.3 Dimension drawings

Braking resistors without a thermostatic switch

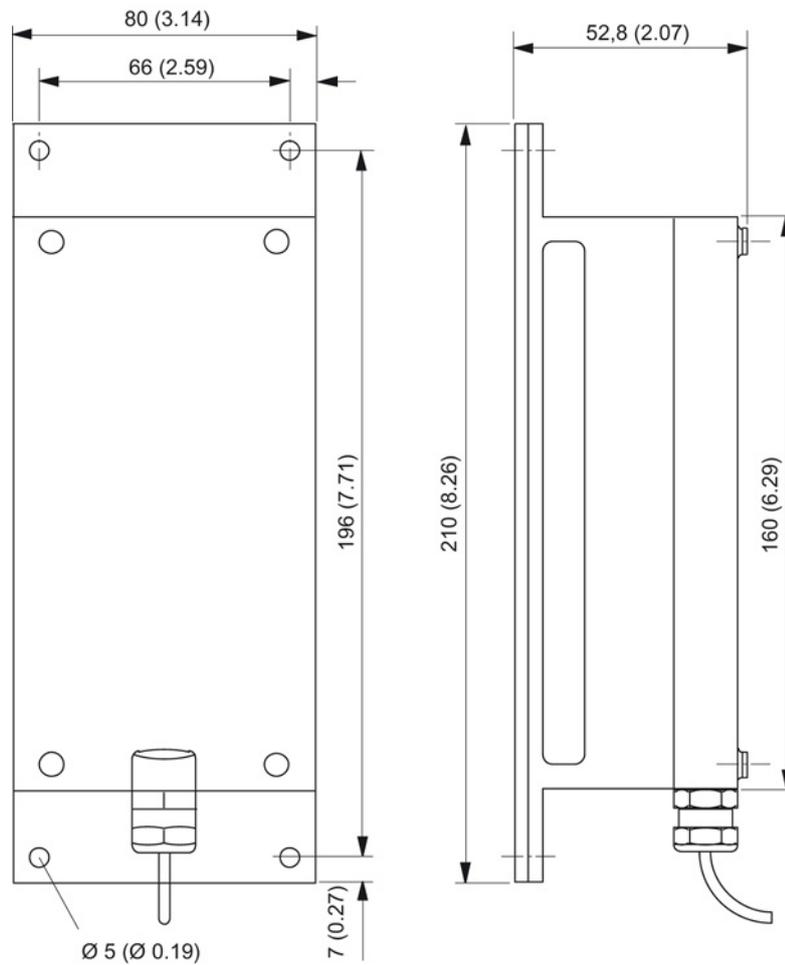


Figure 9-1 Dimension drawing of braking resistor 6SN1113-1AA00-0DA0 where $P_n/P_{max} = 0.3 \text{ kW}/25 \text{ kW}$, all dimensions in mm and (inches)

9.3 Dimension drawings

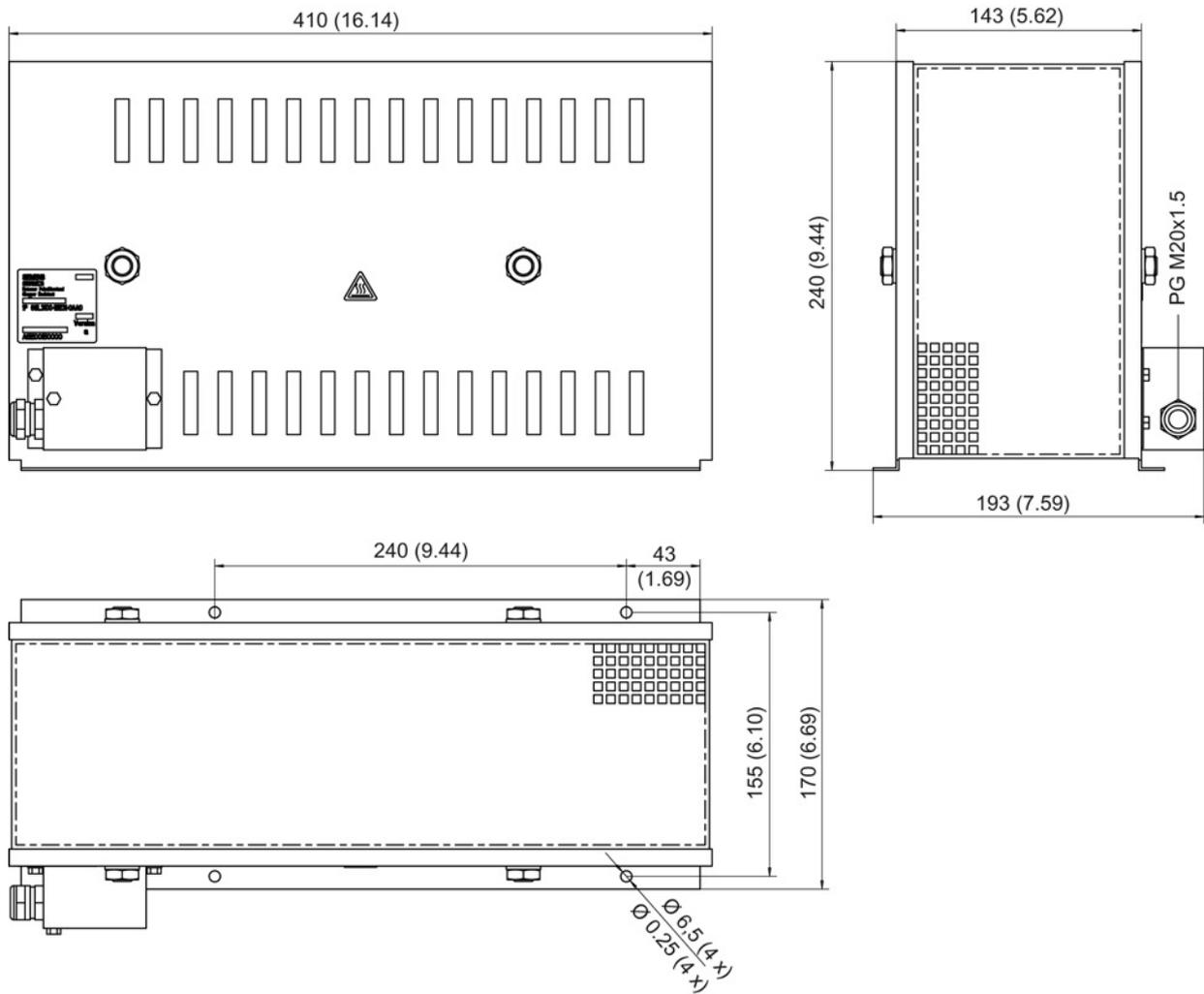


Figure 9-2 Dimension drawing of braking resistor 6SL3100-1BE31-0AA0 where $P_n/P_{max} = 1.5 \text{ kW}/100 \text{ kW}$, all dimensions in mm and (inches)

Braking resistors with a thermostatic switch

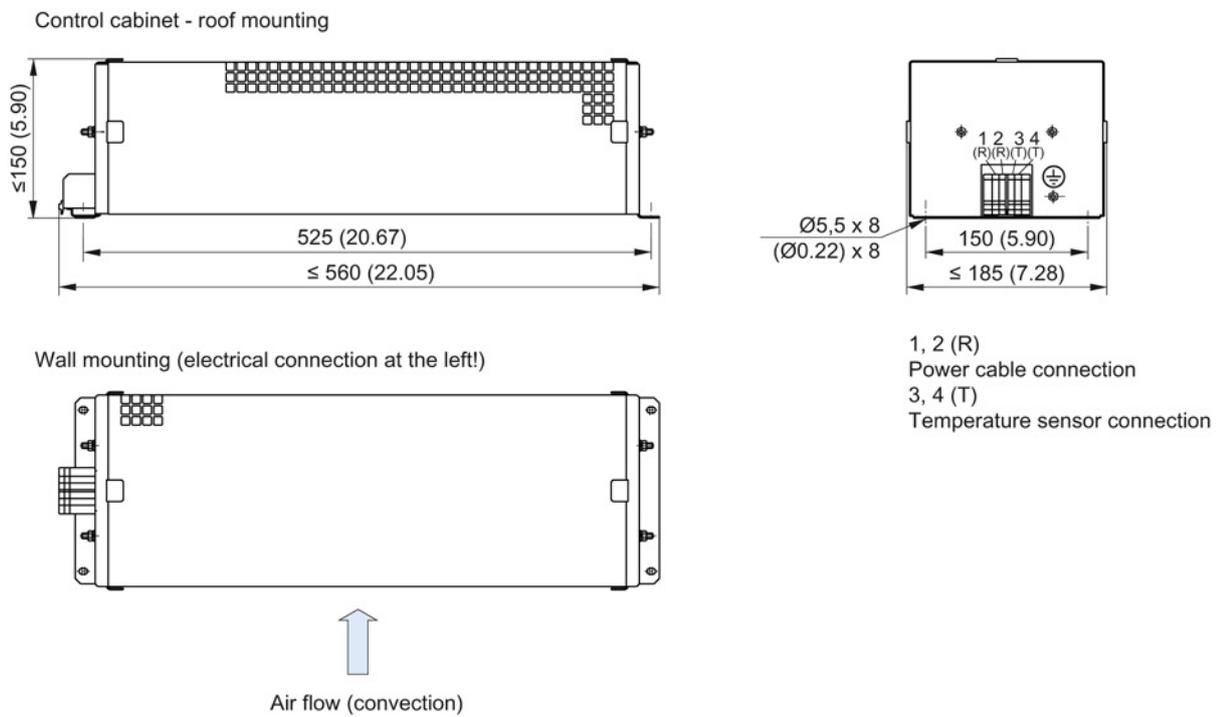


Figure 9-3 Dimension and installation drawing (roof and wall mounting) of braking resistor 6SE7018-0ES87-2DC0 where $P_n/P_{max} = 1.25 \text{ kW}/7.5 \text{ kW}$, all dimensions in mm and (inches)

9.3 Dimension drawings

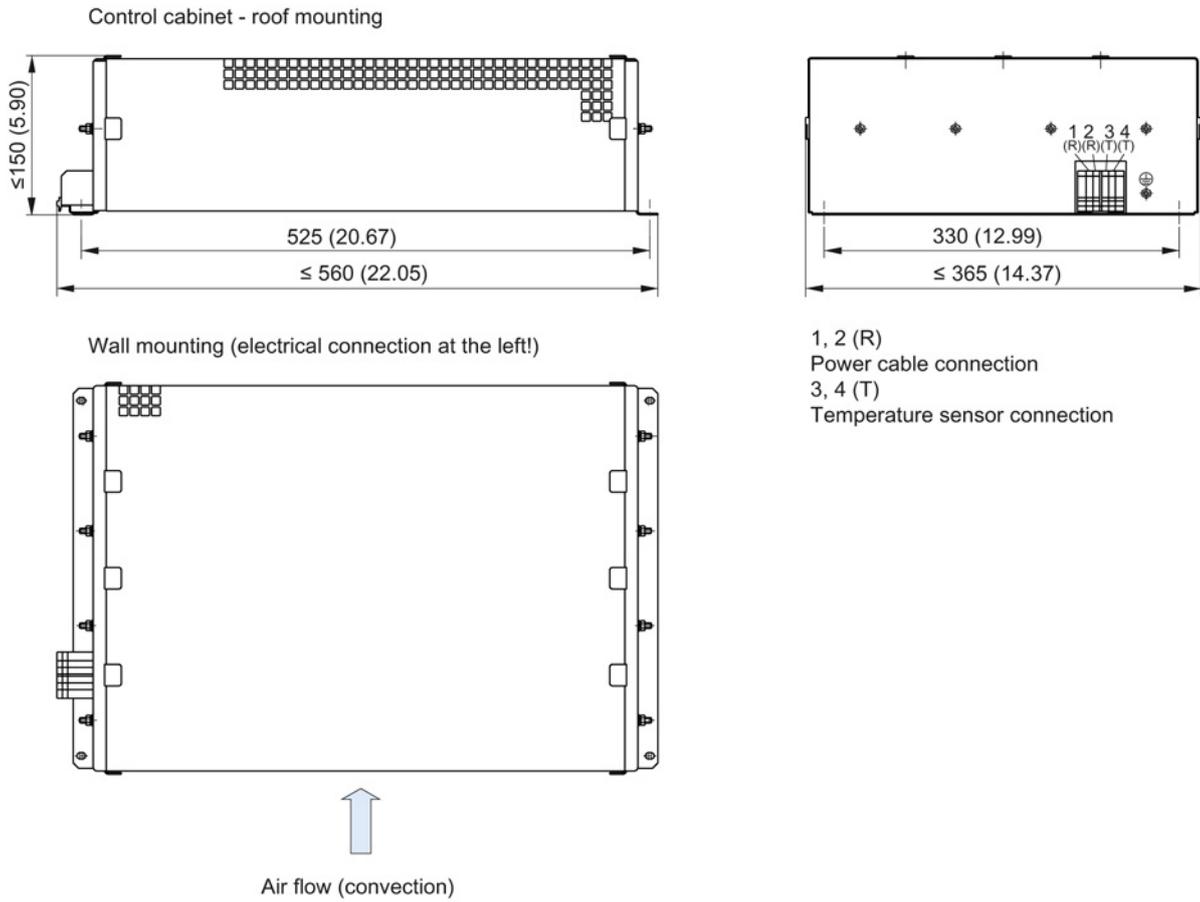
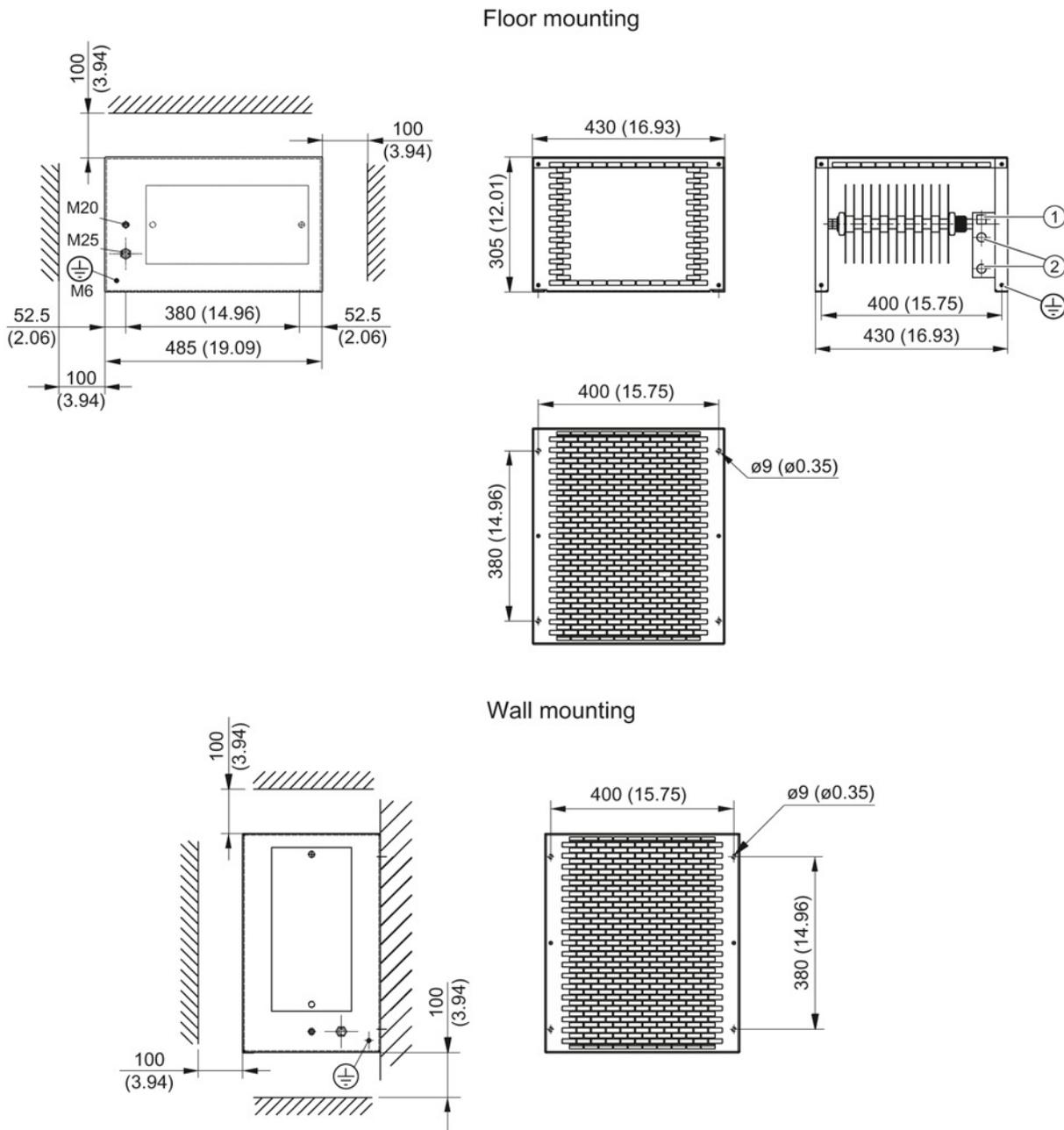


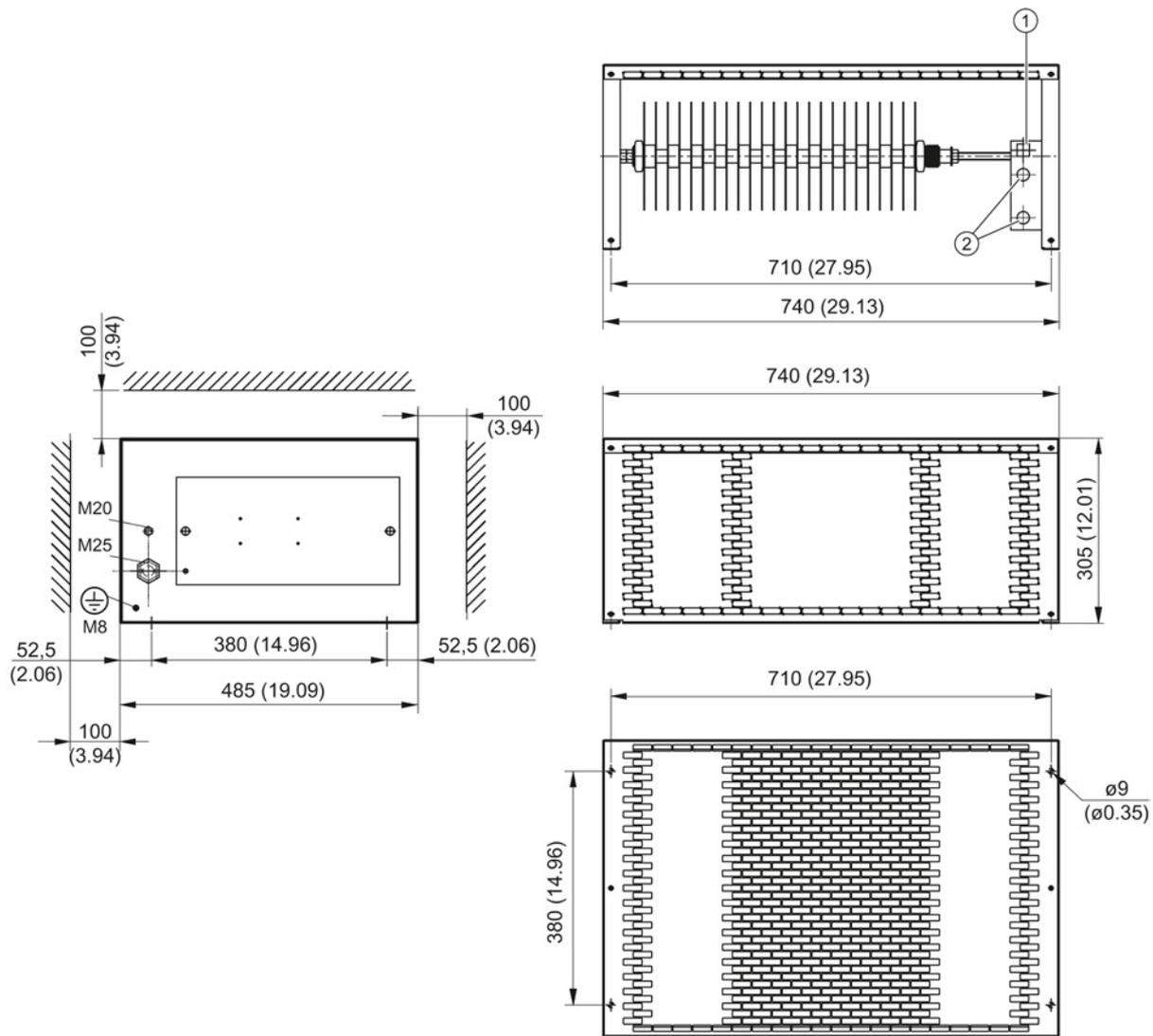
Figure 9-4 Dimension and installation drawing (roof and wall mounting) of braking resistor 6SE7021-6ES87-2DC0 where $P_n/P_{max} = 2.5 \text{ kW}/15 \text{ kW}$, all dimensions in mm and (inches)



- ① Connection for thermostatic switch T1/T2 with conductor cross-section 2.5 mm²
- ② Connection for power cable, 2 x M6 bolts

Figure 9-5 Dimension and installation drawing (floor and wall mounting) of braking resistor 6SE7023-2ES87-2DC0 where $P_n/P_{max} = 5 \text{ kW}/30 \text{ kW}$, all dimensions in mm and (inches)

9.3 Dimension drawings



- ① Connection for thermostatic switch T1/T2 with conductor cross-section 2.5 mm²
- ② Connection for power cable, 2 x M6 bolts

Figure 9-6 Dimension and installation drawing (floor mounting) of braking resistor 6SE7028-0ES87-2DC0 where $P_n/P_{max} = 12.5 \text{ kW}/75 \text{ kW}$, all dimensions in mm and (inches)

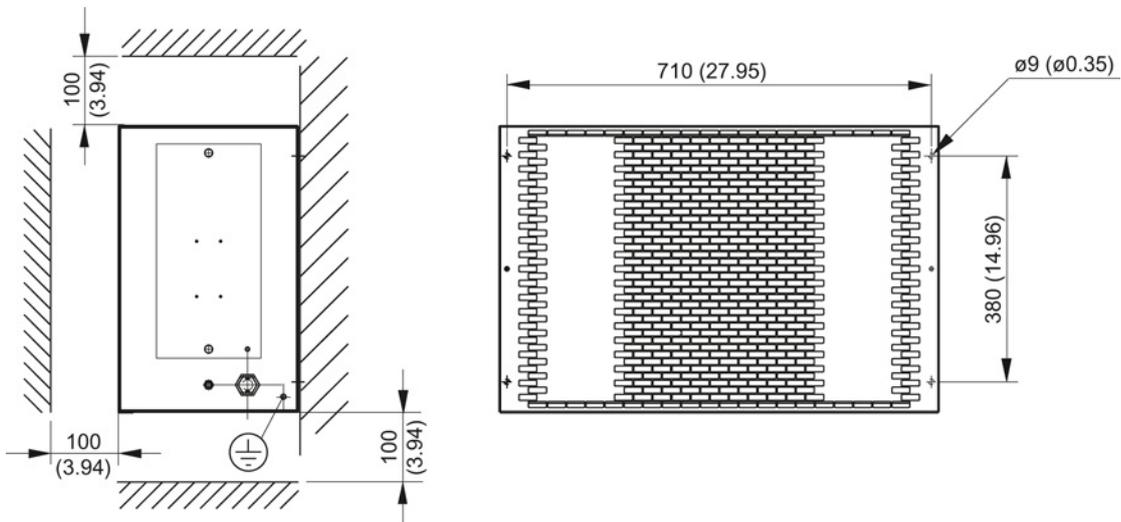


Figure 9-7 Installation drawing (wall mounting) of braking resistor 6SE7028-0ES87-2DC0 where $P_n/P_{max} = 12.5 \text{ kW}/75 \text{ kW}$, all dimensions in mm and (inches)

9.4 Technical data

Table 9- 2 Technical data for braking resistors without a thermostatic switch

| | Unit | 6SN1113-1AA00-0DA0 | 6SL3100-1BE31-0AAx |
|--|------|--|--|
| Resistance R | Ω | 17 | 5.7 |
| Rated power P _N | kW | 0.3 | 1.5 |
| Peak power P _{max} | kW | 25 | 100 |
| Max. energy consumption E _{max} | kWs | 7.5 | 200 |
| Power cable connection | | Included in the scope of delivery; length 3 m, 3 x 1.5 mm ² | Screw terminal ¹⁾ , 4 mm ² |
| Weight | kg | 3.4 | 5.6 |
| Dimensions (W x H x D) | mm | 80 x 210 x 53 | 193 x 410 x 240 |
| Degree of protection according to EN 60529 | | IP54 | IP20 |

1) Recommended connection cross-section: 4 mm²

Table 9- 3 Technical data 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 _N | kW | 1.25 | 2.5 | 5 | 12.5 |
| Braking power 4 x P _N | 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 mm ² | Screw terminal ²⁾ , 4 mm ² | Screw terminal, 2.5 mm ² | Screw terminal, 2.5 mm ² |
| Power cable connection | | Screw terminal ³⁾ , 4 mm ² | Screw terminal ³⁾ , 4 mm ² | M6 screw bolt for ring cable lug ⁴⁾ | M8 screw bolt for ring cable lug ⁵⁾ |
| PE connection | | M5 bolt | M5 bolt | M6 bolt | M8 bolt |
| 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 according to EN 60529 | | IP20 | IP20 | IP20 | IP20 |

1) Applies to a DC-link voltage of 760 V

2) Recommended connection cross-section: 0.75 to 1.5 mm²

3) Recommended connection cross-section: 2.5 mm²

4) Recommended connection cross-section: 4 mm²

5) Recommended connection cross-section: 16 mm²

Recommendation

The MC500 or MC800 motor cable should be used as connecting cable.

9.4.1 Characteristic curves

Duty cycle for braking resistors without a thermostatic switch

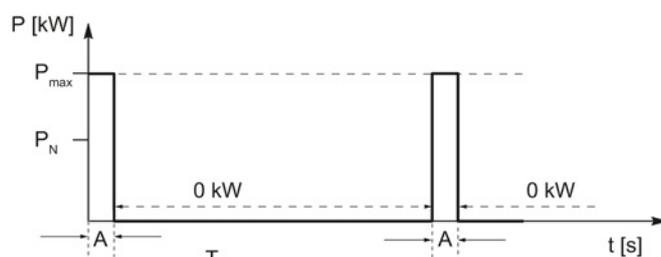


Figure 9-8 Duty cycle for braking resistors without a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

P_N [W] rated power (continuous power) of braking resistor

P_{max} [W] peak power of braking resistor ($6 \times P_N$)

Table 9- 4 Duty cycles for Braking Module Booksize

| | 6SN1113-1AA00-0DA0 | | 6SL3100-1BE31-0AAx | |
|-------|--------------------|-----------------|--------------------|-----------------|
| | 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 9- 5 Duty cycles for Braking Module Booksize Compact

| | 6SN1113-1AA00-0DA0 | | 6SL3100-1BE31-0AAx | |
|-------|--------------------|-----------------|--------------------|-----------------|
| | 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 |

The following applies when connecting Braking Modules in parallel:

$P_{N\ total} = 0.9 \times \text{total } P_N \text{ of single devices}$

$P_{max\ total} = \text{total } P_{max} \text{ of single devices}$

Duty cycles for braking resistors with a thermostatic switch

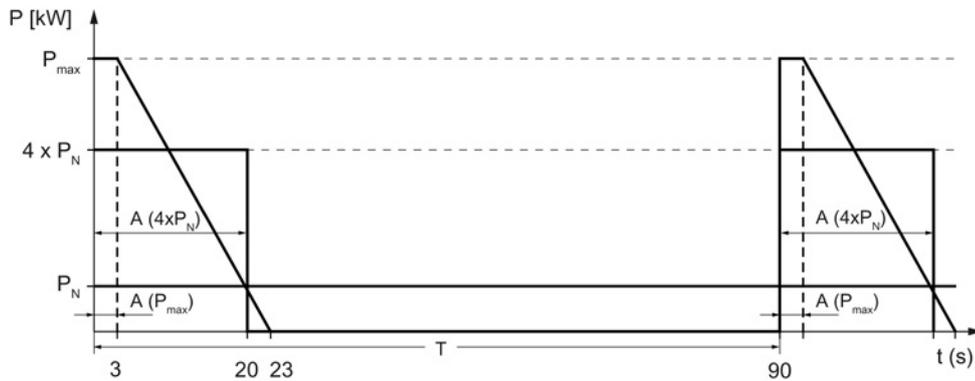


Figure 9-9 Duty cycles for braking resistors with a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

P_N [W] rated power (continuous power) of braking resistor

P_{max} [W] peak braking power of the braking resistor

$4 \times P_N$ [W] = power permitted every 90 s for 20 s

Table 9- 6 Duty cycles

| | 6SE7018-0ES87-2DC0 | | 6SE7021-6ES87-2DC0 | | 6SE7023-2ES87-2DC0 | | 6SE7028-0ES87-2DC0 | |
|-------|----------------------|---------------------------|----------------------|---------------------------|----------------------|------------------------------|----------------------|---------------------------|
| | Duty cycle P_{max} | Duty cycle $4 \times P_N$ | Duty cycle P_{max} | Duty cycle $4 \times P_N$ | Duty cycle P_{max} | Duty cycle $4 \times P_{N0}$ | Duty cycle P_{max} | Duty cycle $4 \times P_N$ |
| 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:

$P_{N \text{ total}} = 0.9 \times \text{total } P_N \text{ of single devices}$

$4 \times P_{N \text{ total}} = 0.9 \times \text{sum } (4 \times P_N) \text{ of single devices}$

$P_{max \text{ total}} = \text{total } P_{max} \text{ of single devices}$

Motor-side power components

10.1 Motor reactors

10.1.1 Description

Motor reactors reduce the voltage stress on the motor windings by reducing the voltage gradients at the motor terminals that occur when motors are fed from drive converters. At the same time, the capacitive charge/discharge currents that also occur on the output of the Motor Module when long motor cables are used are reduced.

Motor reactors can be operated in the VECTOR and SERVO control modes.

Prerequisites

- Ambient temperature 40 °C
- Pulse frequency $f_{\max} = 4$ kHz.
- Output frequency $f_{\max} = 120$ kHz.
- Supported in STARTER from Version 2.4 up to 1 motor reactor
- Supported in STARTER from Version 2.5 up to 3 motor reactors

Note

In SERVO control mode, the maximum output frequency of the converter must not be higher than the maximum motor reactor frequency.

10.1.2 Safety instructions for motor reactors

| |
|---|
|  WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed |
| If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. |
| <ul style="list-style-type: none">• Adhere to the fundamental safety instructions.• When assessing the risk, take into account residual risks. |



| |
|---|
|  DANGER |
| Danger to life due to electric shock in the event of missing touch protection Death or serious injury can result when live parts are touched. <ul style="list-style-type: none">• For the motor reactors, use touch protection according to IPXXA or corresponding to the local installation regulations. |

| |
|---|
|  WARNING |
| Fire hazard due to overheating because of inadequate ventilation clearances Inadequate ventilation clearances can cause overheating with a risk for personnel due to smoke and fire. This can also result in increased failure rates and a shorter service life of the components. <ul style="list-style-type: none">• Maintain the 100 mm clearances above and below the components. |

| |
|--|
|  CAUTION |
| Risk of burns due to high surface temperatures The motor reactors can become very hot. You can get seriously burnt when touching the surface. <ul style="list-style-type: none">• 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. |

Note
Maximum permissible output frequency
The maximum permissible output frequency when motor reactors are used is 120 Hz.

| |
|--|
| NOTICE |
| Damage caused by using incorrect motor reactors When using motor reactors that have not been approved by Siemens for SINAMICS, the motor reactors can be damaged. <ul style="list-style-type: none">• 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).

10.1.3 Dimension drawings

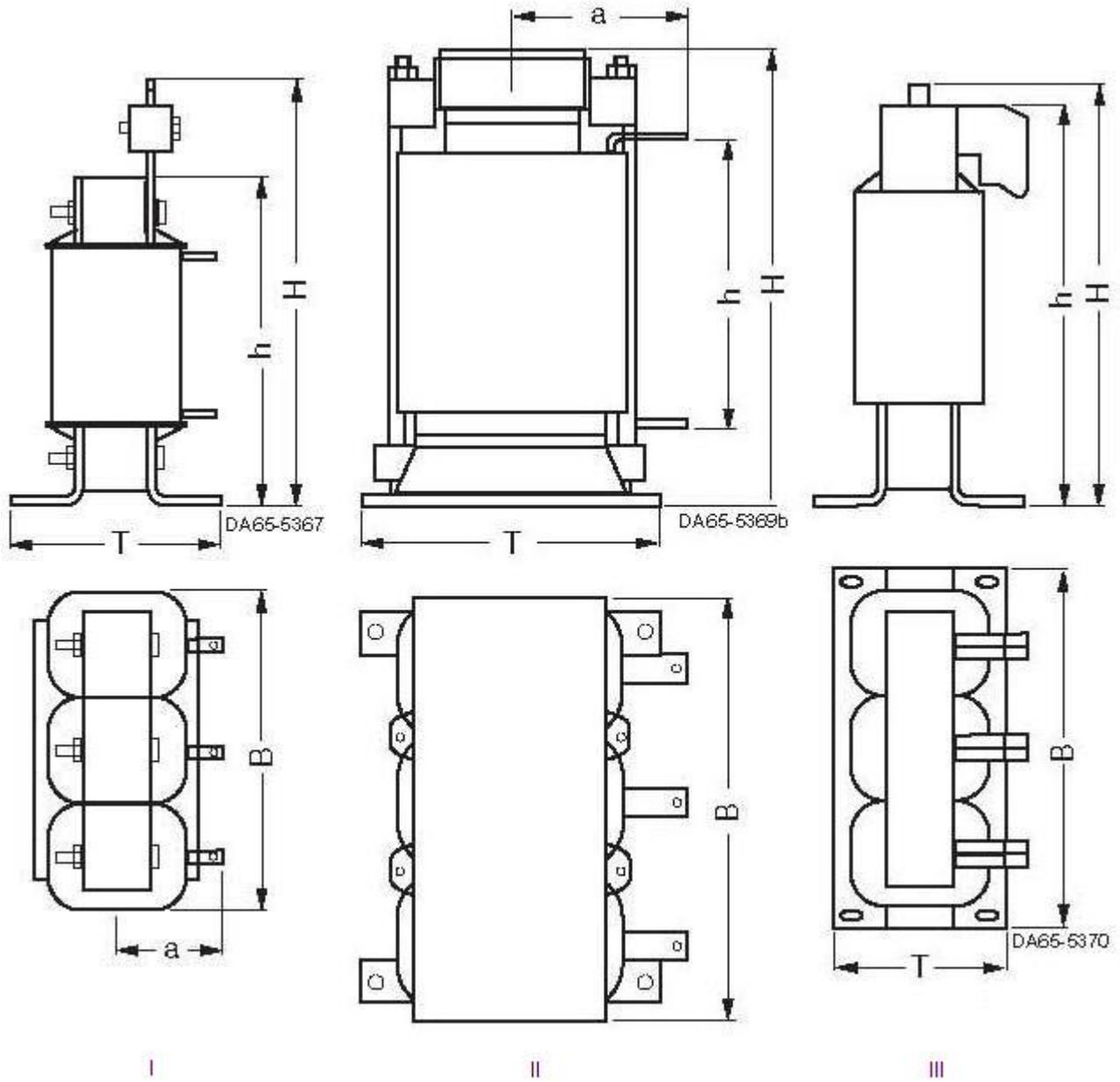


Figure 10-1 Dimension drawings of motor reactors

10.1 Motor reactors

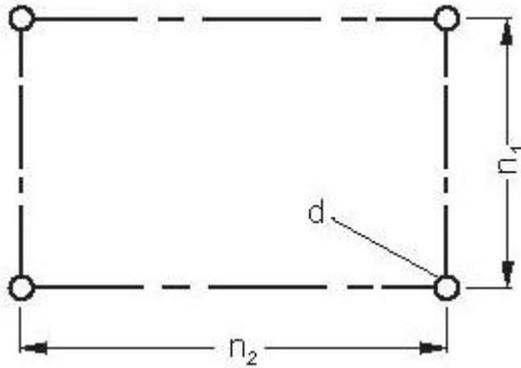


Figure 10-2 Mounting hole

Table 10- 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 distance between holes

Table 10- 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 distance between holes

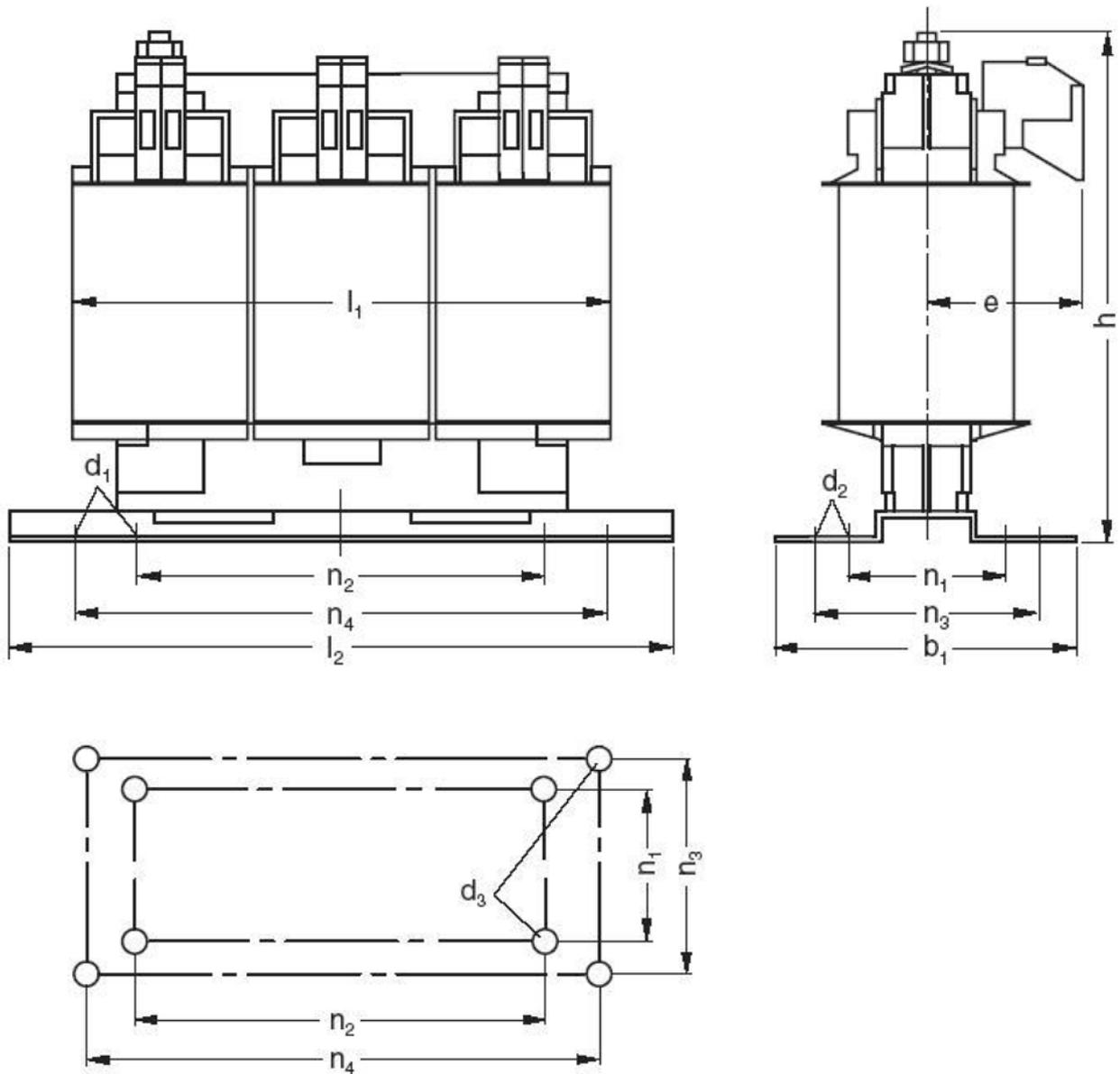


Figure 10-3 Dimension drawing and mounting hole of motor reactor 9 A (6SL3000-2BE21-0AA0)

Table 10- 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) |

10.1 Motor reactors

| | |
|---|------------|
| 6SL3000-2BE21-0AA0 | |
| n ₂ | 113 (4.44) |
| n ₃ | 68 (2.67) |
| n ₄ | 166 (6.53) |
| d ₁ | 5,8 (0.22) |
| d ₂ | 11 (0.43) |
| d ₃ | M5 |
| PE | M6 |
| Lengths n ₁ , n ₂ , n ₃ and n ₄ corresponds to the distance between holes | |

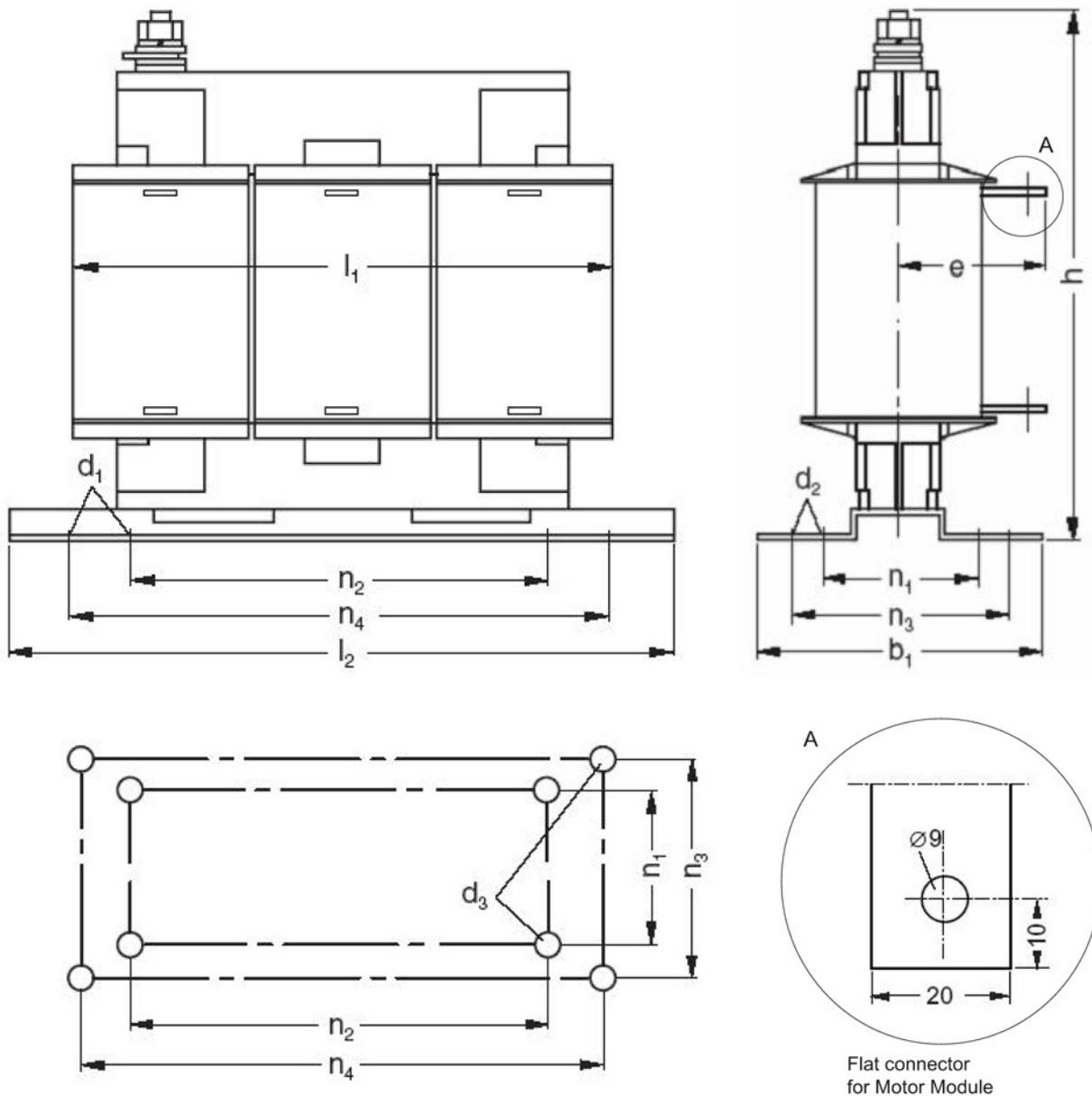


Figure 10-4 Dimension drawing and mounting hole of motor reactor 60 A (6SL3000-2BE26-0AA0)

Table 10- 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 |
| PE | M6 |
| Lengths n_1 , n_2 , n_3 and n_4 corresponds to the distance between holes | |

10.1.4 Technical data

Table 10- 5 Technical data, motor reactors, part 1

| Order number | | 6SE7021-0ES87-1FE0 | 6SL3000-2BE21-0AA0 | 6SE7022-6ES87-1FE0 | 6SE7024-7ES87-1FE0 | 6SE7027-2ES87-1FE0 |
|-------------------------------|----|--|--|--|-----------------------------|--------------------|
| Matching the Motor Module | | 6SL312x-1TE13-0AAx 6SL312x-2TE13-0AAx 6SL312x-1TE15-0AAx 6SL312x-2TE15-0AAx 6SL342x-1TE13-0AAx 6SL342x-2TE13-0AAx 6SL342x-1TE15-0AAx 6SL342x-2TE15-0AAx | 6SL312x-1TE21-0AAx 6SL312x-2TE21-0AAx 6SL342x-1TE21-0AAx | 6SL312x-1TE21-8AAx 6SL312x-2TE21-8AAx 6SL342x-1TE21-8AAx | 6SL312x-1TE23-0AAx | 6SL312x-1TE24-5AAx |
| Rated current | A | 5 | 9 | 18 | 30 | 45 |
| Inductance | μH | 1243 | 1000 | 332 | 180 | 59 |
| Power loss | W | 80 | 90 | 110 | 190 | 200 |
| Motor Module/motor connection | | Screw-type terminals 4 mm ² | Screw-type terminals 16 mm ² | Screw-type terminals 16 mm ² | Flat connector for M8 screw | |
| PE connection | | M6 studs | | | | |
| Degree of protection | | IP00 | IP00 | IP00 | IP00 | IP00 |
| Weight | kg | 5,5 | 4,8 | 7,8 | 13 | 11 |

Table 10- 6 Technical data, motor reactors, part 2

| Order number | | 6SL3000-2BE26-0AA0 | 6SE7031-5ES87-1FE0 | 6SE7031-8ES87-1FE0 | 6SE7032-6ES87-1FE0 | |
|-------------------------------|----|-----------------------------|--------------------|------------------------------|--------------------|--|
| Matching the Motor Module | | 6SL312x-1TE26-0AAx | 6SL312x-1TE28-5AAx | 6SL312x-1TE31-3AAx | 6SL312x-1TE32-0AAx | |
| Rated current | A | 60 | 85 | 132 | 200 | |
| Inductance | μH | 62 | 29 | 23 | 16 | |
| Power loss | W | 105 | 222 | 291 | 291 | |
| Motor Module/motor connection | | Flat connector for M8 screw | | Flat connector for M10 screw | | |
| PE connection | | M6 studs | | | | |
| Degree of protection | | IP00 | IP00 | IP00 | IP00 | |
| Weight | kg | 10,5 | 20,5 | 27,2 | 30,6 | |

Table 10-7 Cable lengths, Part 1

| Order number | 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 10-8 Cable lengths, Part 2

| Order number | 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 |

10.2 Voltage Protection Module VPM

10.2.1 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 10- 9 Overview of the Voltage Protection Modules available

| Designation | Rated current |
|----------------|---------------|
| VPM120 | 120 A |
| VPM200 | 200 A |
| VPM200 Dynamic | 200 A |

Table 10- 10 Interface overview for Voltage Protection Modules

| Type | Number VPM120/VPM200 | Number VPM200 Dynamic |
|------------------------------|-------------------------|--------------------------|
| Signaling interface | 1 | 1 |
| PE connection | 2 | 4 |
| Load connecting bolt, input | 3 | 5 |
| Load connecting bolt, output | 3 | 5 |

10.2.2 Safety instructions for Voltage Protection Modules

| |
|---|
|  WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed |
| If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. |
| <ul style="list-style-type: none">• Adhere to the fundamental safety instructions.• When assessing the risk, take into account residual risks. |



| |
|--|
|  DANGER |
| Danger to life through 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. |
| <ul style="list-style-type: none">• Avoid contact with the Voltage Protection Module as long as it is under voltage. |



| |
|---|
|  WARNING |
| Danger to life through electric shock due to high speed of the motor while the VPM is being ramped up |
| If the motor is operated with a speed higher than the field weakening threshold speed while the Voltage Protection Module is ramping up (see the technical data), the protection function of the VPM is inactive during this phase. As a consequence, high voltages can be injected into the DC link. |
| Contact with live parts can result in death or serious injury. |
| <ul style="list-style-type: none">• Only operate the motor below the field weakening threshold speed while the VPM is ramping up. |



| |
|--|
|  WARNING |
| Danger to life through electric shock due to the insulation voltage being exceeded |
| An excessively high voltage will damage the insulation resulting in death or severe injury. |
| <ul style="list-style-type: none">• 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

Danger to life through electric shock when using 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

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 when using motors that are not short-circuit proof

Use of motors that are not short-circuit proof in conjunction with a Voltage Protection Module can result in their destruction.

- Only use motor that are short-circuit proof.

! WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

Inadequate ventilation clearances can cause overheating with a risk for personnel through smoke development and fire. This can also result in more downtimes and reduced service lives of components.

- Maintain the 200 mm clearances above and below the components.

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.

10.2.3 Interface description

10.2.3.1 Overview

The drawings below show the basic positions of interfaces and the housing openings of the Voltage Protection Modules VPM120, VPM200 and VPM200 Dynamic.

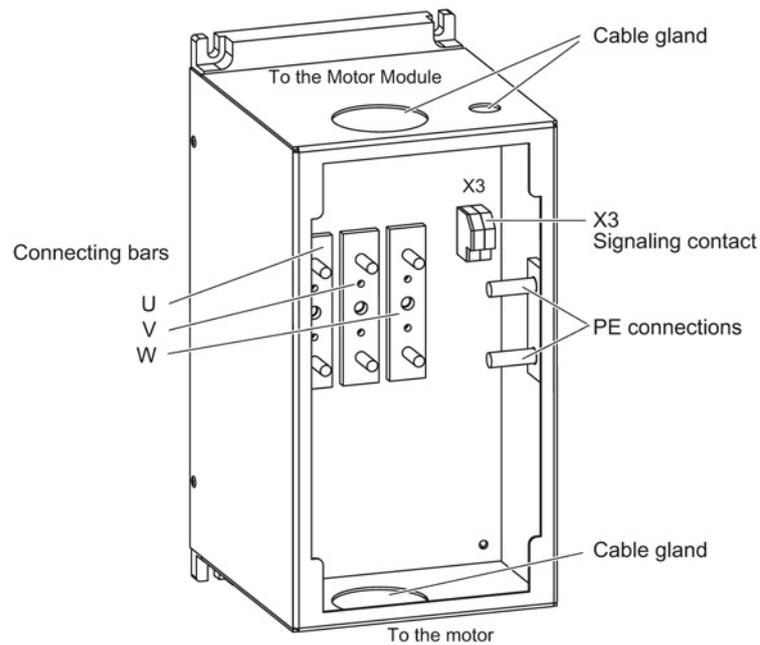


Figure 10-5 Interface overview, Voltage Protection Modules VPM120 (without cover)

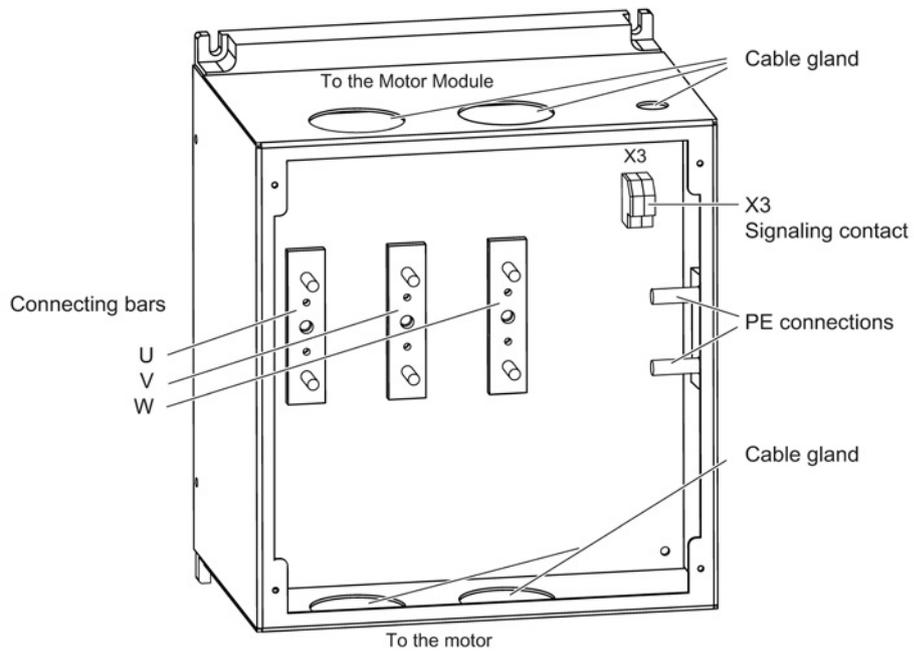


Figure 10-6 Interface overview, Voltage Protection Modules VPM200 (without cover)

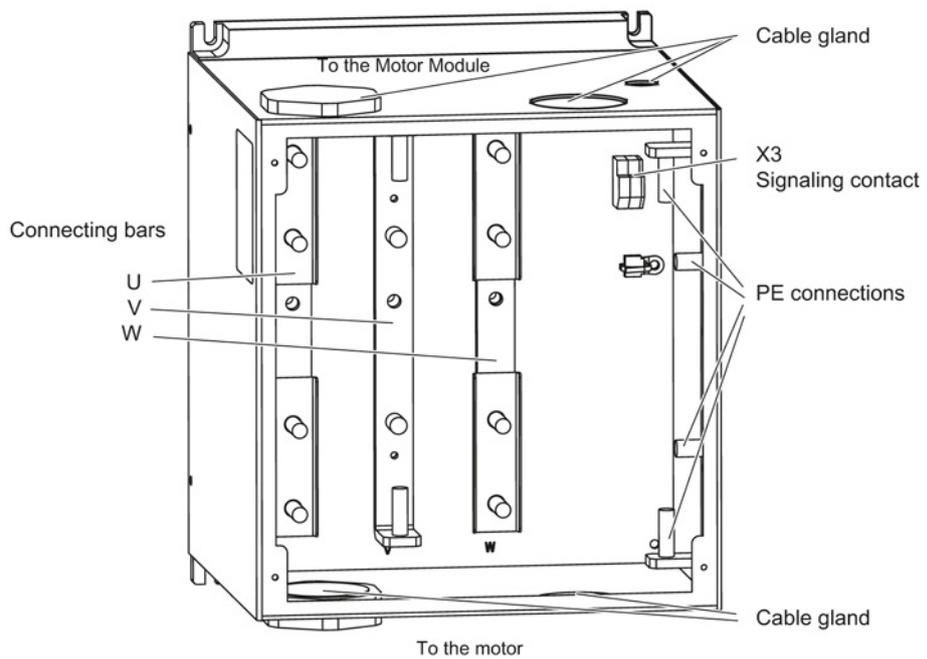


Figure 10-7 Interface overview, Voltage Protection Modules VPM200 Dynamic (without cover)

The housing is closed during operation to ensure the electrical terminals are covered.

10.2.3.2 Signaling interface X3

The signaling interface has the following assignments:

Table 10- 11 Signaling interface X3

| Terminal | Designation | Technical data |
|---|--|--|
| 1 | Operating message for Control Unit | <ul style="list-style-type: none"> 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 , shielded cable | | |
| Cable gland: Max. 9 mm Ø Types VPM120, VPM200 and VPM200 Dynamic | | |
| <ul style="list-style-type: none"> Screwed joint: 1 x M16, e.g. from Pflitsch, order 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.

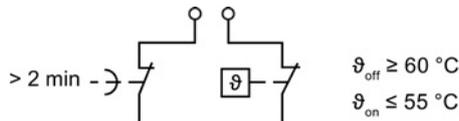


Figure 10-8 Signaling contact X3 of the Voltage Protection Module

| |
|--|
| WARNING |
| <p>Danger to life through automatic start of the drive</p> <p>An uncontrolled automatic start of the drive can result in death or severe injury.</p> <ul style="list-style-type: none"> Take measures to prevent the drive starting automatically, as signal contact X3 restores the pulse enable after 2 minutes. |

10.2.3.3 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 10- 12 Connections U, V, W, and PE

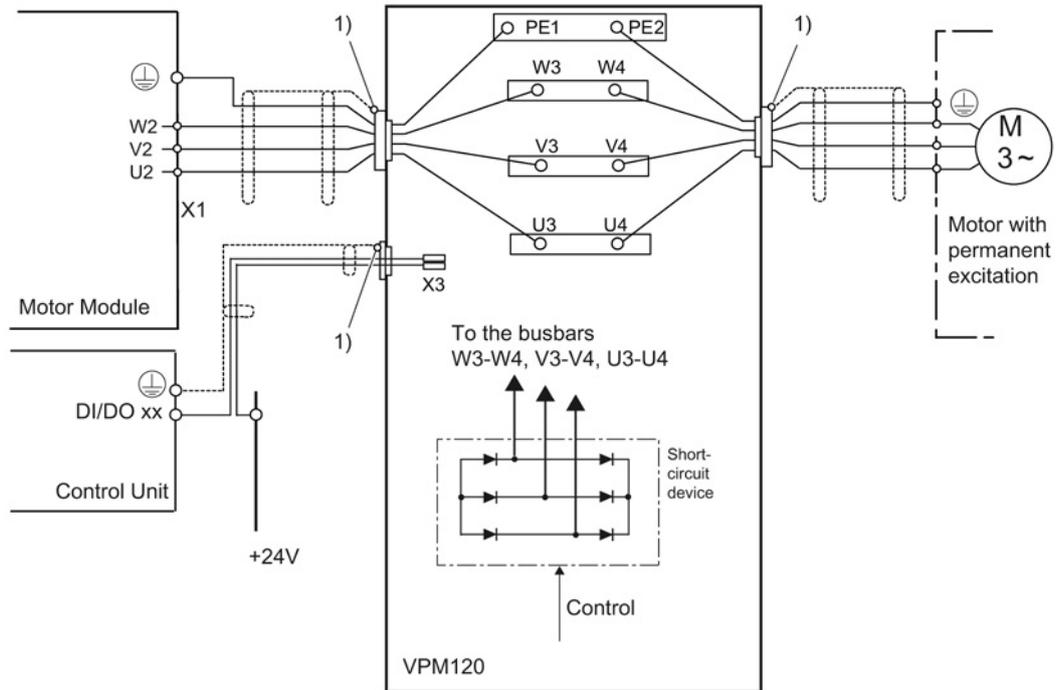
| | VPM120 | VPM200 | VPM200 Dynamic |
|---------------------|---|---|---|
| Connection bolt | 8 x M6 ¹⁾ | 8 x M8 ¹⁾ | 14 x M8 ²⁾ |
| Cable lug | Crimp-type cable lug M6 | Crimp-type cable lug M8 | Tubular cable lug M8, 90° angled |
| Cable cross-section | ≤ 50 mm ² | ≤ 50 mm ² | ≤ 50 mm ² |
| Tightening torque | 10 Nm | 25 Nm | 25 Nm |
| Cable entry | For cables with max. 40 mm Ø | | |
| Gland ³⁾ | 2 x M50 e.g. from Pflitsch, order designation: UNI DICHT EMV 250584117 Locknut M50: GM250PA | 4 x M50 e.g. from Pflitsch, order designation: UNI DICHT EMV 250584117 Locknut M50: GM250PA | 4 x M50 e.g. from Pflitsch, order 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

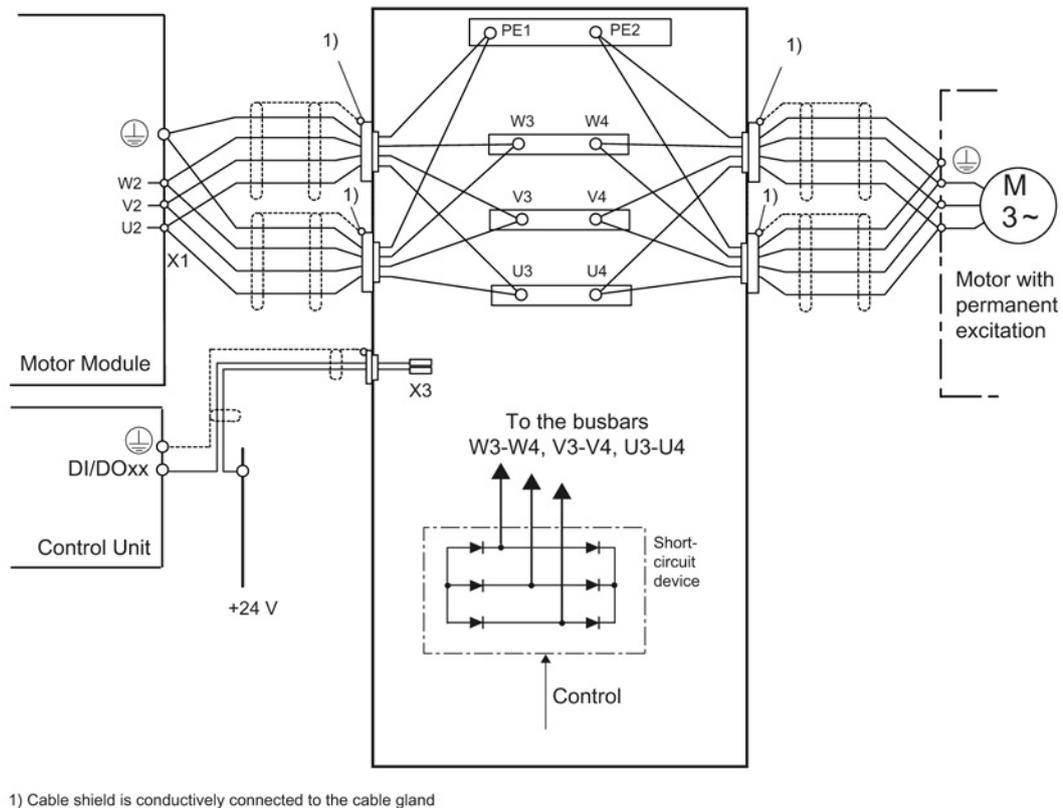
Cable lengths with cross-sections of > 50 mm² between the Motor Module and the Voltage Protection Module or between the Voltage Protection Module and the motor are implemented using two cables connected in parallel.

10.2.4 Connection examples



1) Cable shield is conductively connected to the cable gland

Figure 10-9 Connection example for Voltage Protection Module VPM120



1) Cable shield is conductively connected to the cable gland

Figure 10-10 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.

The length of the signal cable must not exceed 10 m.

Signaling contact

Signaling interface X3 on the Voltage Protection Module is wired to a digital input (DI) on the Control Unit, which controls this spindle. 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 interface is operated with +24 V.

10.2.5 Dimension drawings

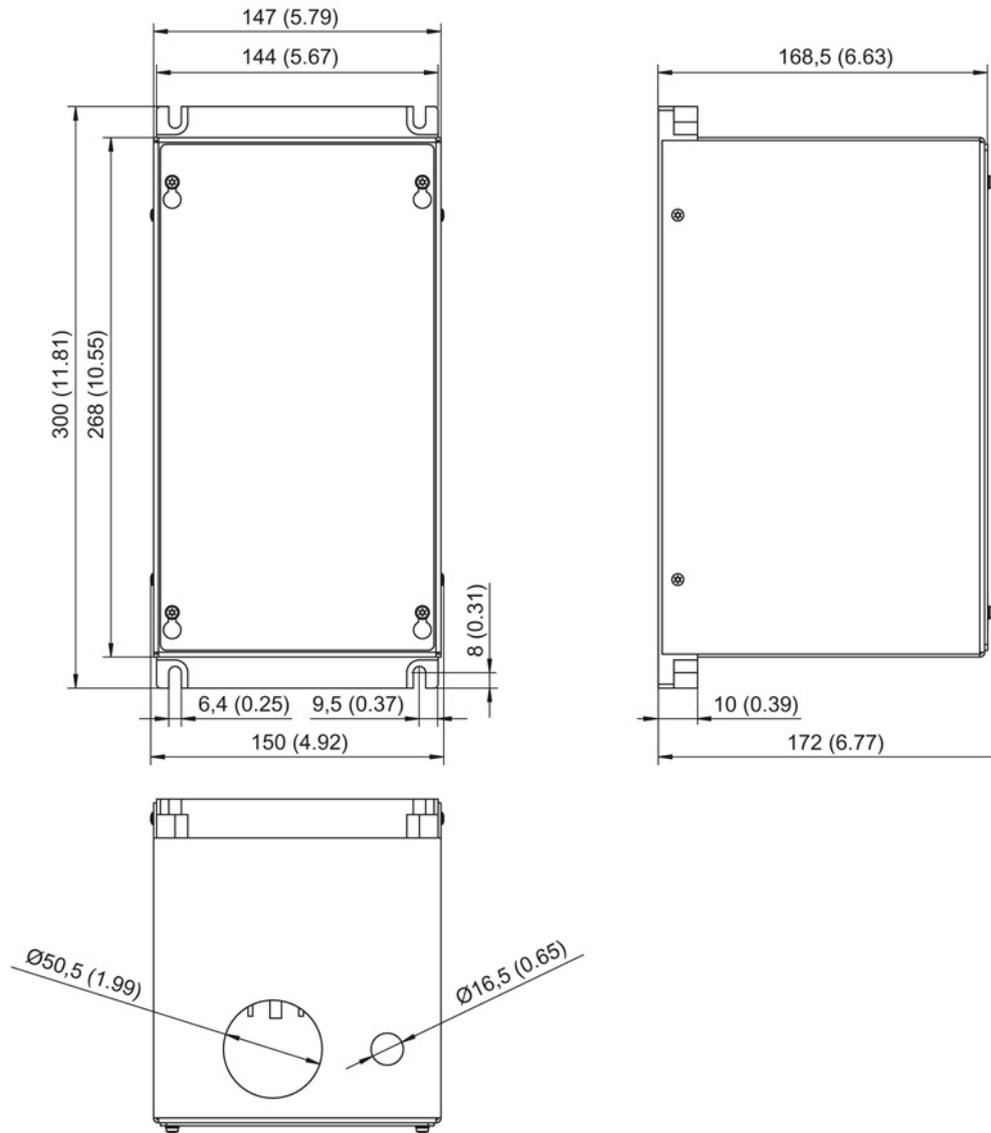


Figure 10-11 Dimension drawing of the Voltage Protection Module VPM120, all data in mm and (inches)

10.2 Voltage Protection Module VPM

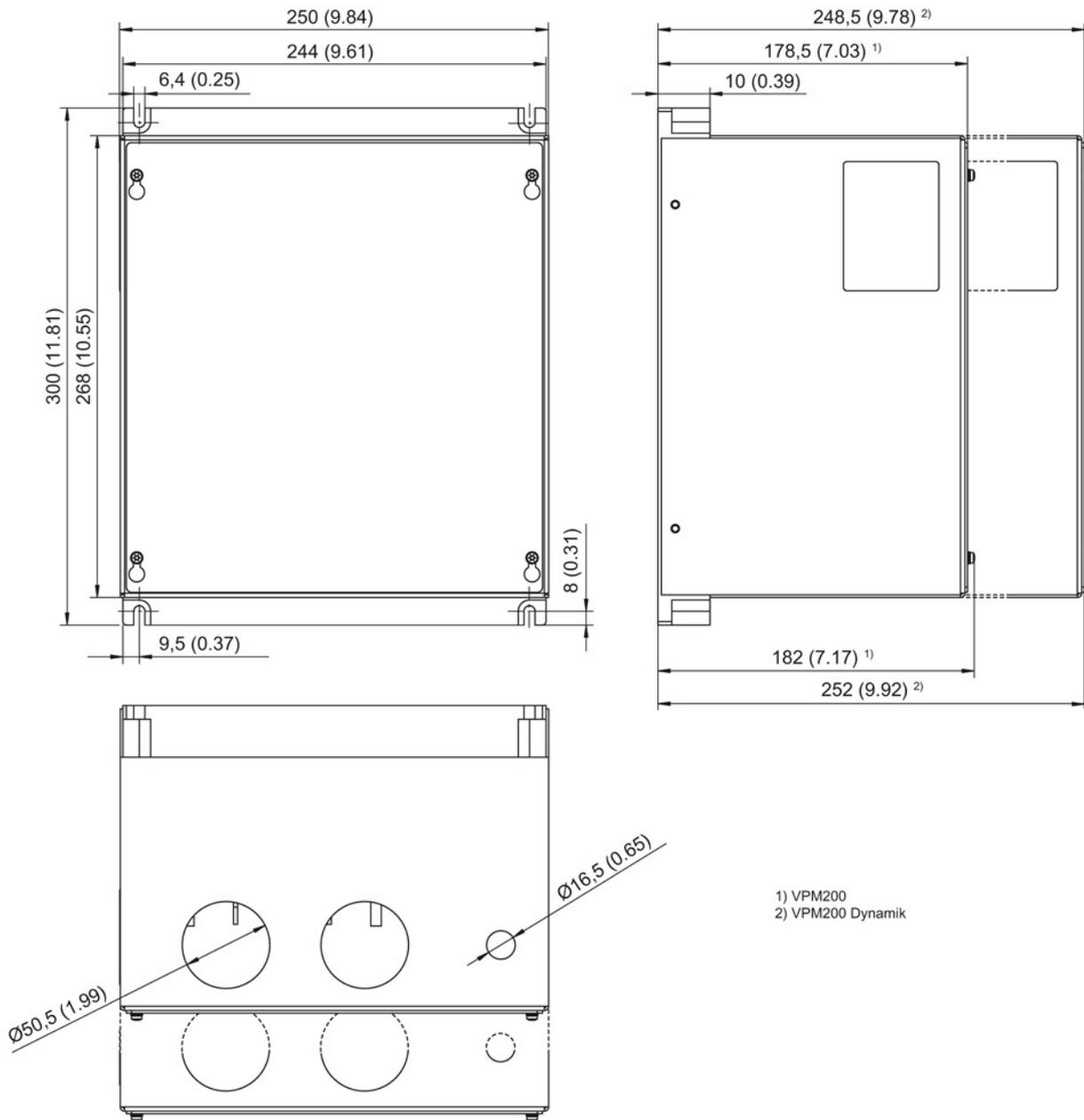


Figure 10-12 Dimension drawing of the Voltage Protection Module VPM200 and VPM200 Dynamic, all data in mm and (inches)

10.2.6 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.

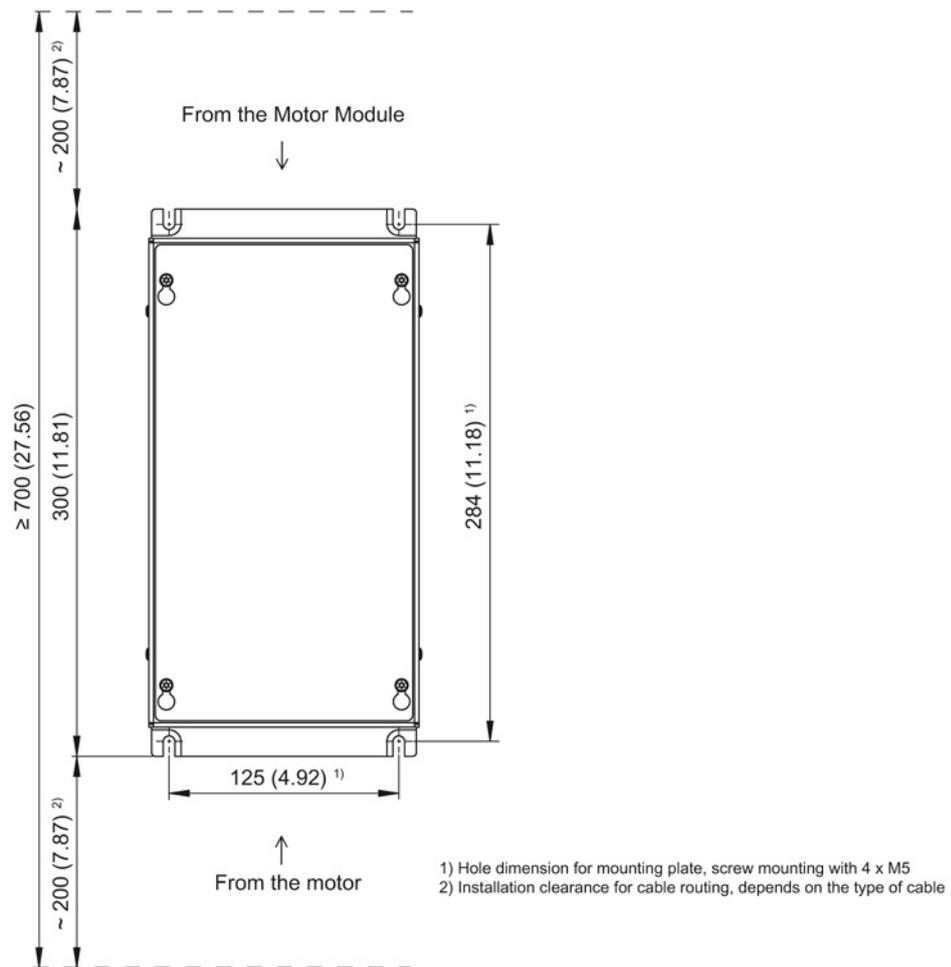


Figure 10-13 Mounting dimension for a Voltage Protection Module VPM120

10.2 Voltage Protection Module VPM

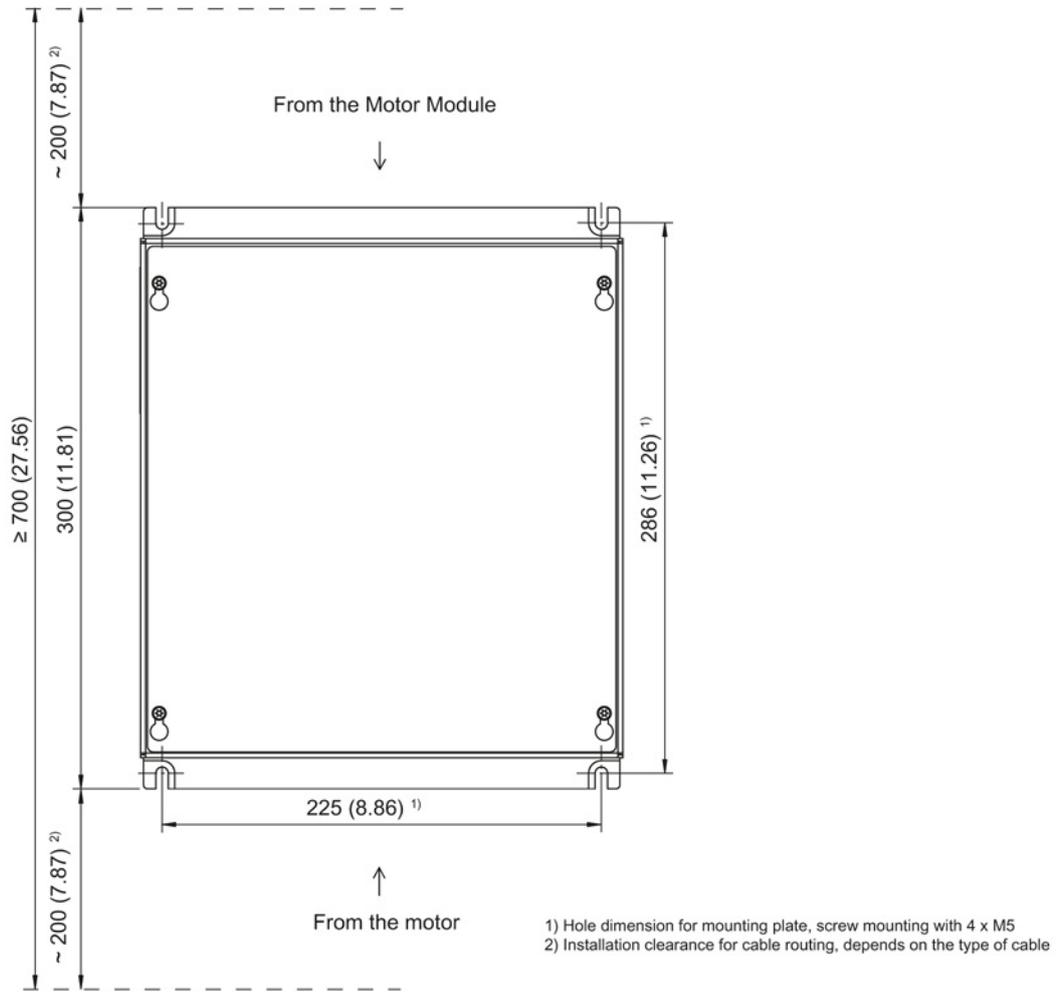


Figure 10-14 Mounting dimensions for a Voltage Protection Module VPM200

10.2.7 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 mm² for each conductor. An installation sequence for individual conductors is outlined below. It is particularly relevant for larger cross-sections.



DANGER

Danger to life when live parts are touched

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

- Bring the system into a no-voltage condition by opening the main switch.
- Secure the energy sources against switching on again.

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.

10.2.7.1 Connecting signaling contact X3

The signaling contact X3 must be wired before connecting the power cables.



Figure 10-15 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, Order No.: A5E00302281B

Operating Instructions for Voltage Protection Module VPM200, Order No.: A5E00777655A

Operating Instructions for Voltage Protection Module VPM200 Dynamic, Order No.: A5E00302261B

10.2.7.2 Connecting power cables (using the VPM 200 Dynamik as an example)

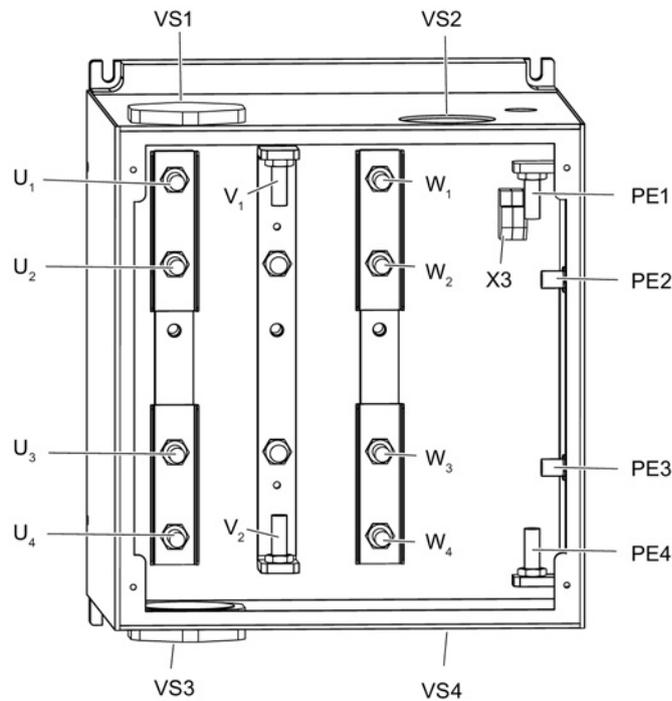


Figure 10-16 Connection points of the Voltage Protection Module VPM200 Dynamic

Table 10- 13 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 10-17 Wired Voltage Protection Module VPM200 Dynamic with short designations

Table 10- 14 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. |

| Cable glands | Cable | Conductor/Phase | Installation step |
|--------------|-------|---|---|
| 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. |
| | 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 L ₃ 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. |

10.2.8 Technical data

Table 10- 15 Technical data

| | VPM 120 | VPM 200 | VPM 200 Dynamic |
|---|--|----------------------|--------------------|
| Order number | 6SN1113-1AA00-1JAx | 6SN1113-1AA00-1KAx | 6SN1113-1AA00-1KCx |
| Type of voltage | 3-phase pulsed AC voltage, motor EMF | | |
| Ramp-up time for VPM | 1 s (from pulse enable) | | |
| Normal range of the DC link voltage: | | | |
| - lower limit | 490 V DC | | |
| - upper limit | 795 V DC | | |
| Operating range for VPM | 830 ... 2000 V (peak value) | | |
| Motor EMF | < 1.4 kV _{rms} | | |
| Clock frequency | 3,2 ... 8 kHz | | |
| Rated current | 120 A _{rms} | 200 A _{rms} | |
| Time range | Maximum permissible short-circuit current | | |
| 0 ... 10 ms | 1500 A | 2000 A | |
| 10 ... 500 ms | 255 A | 600 A | |
| 500 ms ... 2 min | 90 A | 200 A | |
| > 2 min | 0 A | 0 A | |
| Max. perm. short-circuit time | 120 s | | |
| Protection class in accordance with EN 61140 | I | | |
| Safe electrical separation | Between the signal contact and motor cables U, V, W, UL 508 C | | |
| Degree of protection according to EN 60529 | IP20 | | |
| Permitted humidity | < 90 % | | |
| Humidity classification according to EN 60721-3-3 | Cl. 3K5, condensation and icing excluded Low air temperature 0 °C | | |
| Permissible ambient temperature, min. / max. | 0 °C / 55 °C | | |
| Cooling method | Air-cooled, free convection | | |
| Weight | Approx. 6 kg | Approx. 11 kg | Approx. 13 kg |
| Dimensions (H x W x D) [mm] | 300 x 150 x 180 | 300 x 250 x 190 | 300 x 250 x 260 |

Accessories

11.1 Shield connecting plates for power supply and motor cables

11.1.1 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.

11.1.2 Shield connecting plates

Table 11- 1 Shield connection for components with internal air cooling

| Component | Power | Total width of component | Shield connection plate | Recommended shield connection |
|--------------|---|--------------------------|-----------------------------------|--|
| Line Module | 5 kW / 10 kW | 50 mm | Included in the scope of delivery | |
| | 16 kW | 100 mm | Included in the scope of delivery | KLBÜ CO4 ¹⁾ |
| | 36 kW | 150 mm | 6SL3162-1AF00-0AA1 | KLBÜ CO4 ¹⁾ |
| | 55 kW | 200 mm | 6SL3162-1AH01-0AA0 | Clamps |
| | 80 kW / 120 kW | 300 mm | 6SL3162-1AH00-0AA0 | Clamps |
| Motor Module | 3 ... 18 A 2 x 3 A ... 2 x 9 A | 50 mm | Integrated in the motor connector | |
| | 18 A (compact) 2 x 1.7 A ... 2 x 5 A | 75 mm | Integrated in the motor connector | |
| | 30 A and 2 x 18 A | 100 mm | Included in the scope of delivery | KLBÜ CO4 ¹⁾ |
| | 45 A and 60 A | 150 mm | 6SL3162-1AF00-0AA1 | KLBÜ CO1 ¹⁾ for the brake cable KLBÜ CO4 ¹⁾ for the motor cable |
| | 85 A | 200 mm | 6SL3162-1AH01-0AA0 | KLBÜ CO1 ¹⁾ for brake cable clamps for motor cable |
| | 132 A and 200 A | 300 mm | 6SL3162-1AH00-0AA0 | KLBÜ CO1 ¹⁾ for brake cable clamps for motor cable |

11.1 Shield connecting plates for power supply and motor cables

| Component | Power | Total width of component | Shield connection plate | Recommended shield connection |
|-------------------------|----------------|--------------------------|-----------------------------------|-------------------------------|
| Active Interface Module | 16 kW | 100 mm | Integrated in the motor connector | |
| | 36 kW | 150 mm | 6SL3163-1AF00-0AA0 | KLBÜ CO4 ¹⁾ |
| | 55 kW | 200 mm | 6SL3163-1AH00-0AA0 | Clamps |
| | 80 kW / 120 kW | 300 mm | 6SL3163-1AM00-0AA0 | Clamps |

1) Shield connection terminal, Weidmüller Company

Table 11-2 Shield connection for components with external air cooling

| Component | Power | Total width of component | Shield connection plate | Recommended shield connection |
|--------------|-----------------------------------|--------------------------|-----------------------------------|--|
| Line Module | 5 kW / 10 kW | 50 mm | Included in the scope of delivery | |
| | 16 kW | 100 mm | | KLBÜ CO4 ¹⁾ |
| | 36 kW | 150 mm | 6SL3162-1AF00-0BA1 | KLBÜ CO4 ¹⁾ |
| | 55 kW | 200 mm | 6SL3162-1AH01-0BA0 | Clamps |
| | 80 kW / 120 kW | 300 mm | 6SL3162-1AH00-0AA0 | Clamps |
| Motor Module | 3 ... 18 A 2 x 3 A ... 2 x 9 A | 50 mm | Integrated in the motor connector | |
| | 30 A and 2 x 18 A | 100 mm | Included in the scope of delivery | KLBÜ CO4 ¹⁾ |
| | 45 A and 60 A | 150 mm | 6SL3162-1AF00-0BA1 | KLBÜ CO1 ¹⁾ for the brake cable KLBÜ CO4 ¹⁾ for the motor cable |
| | 85 A | 200 mm | 6SL3162-1AH01-0BA0 | KLBÜ CO1 ¹⁾ for brake cable clamps for motor cable |
| | 132 A and 200 A | 300 mm | 6SL3162-1AH00-0AA0 | KLBÜ CO1 ¹⁾ for brake cable clamps for motor cable |

1) Shield connection terminal, Weidmüller Company

11.1 Shield connecting plates for power supply and motor cables

Table 11-3 Shield connection for components with cold plate

| Component | Power | Total width of component | Shield connection plate | Recommended shield connection |
|--------------|---|--------------------------|-----------------------------------|--|
| Line Module | 5 kW / 10 kW | 50 mm | Included in the scope of delivery | KLBÜ CO4 ¹⁾ |
| | 16 kW | 100 mm | | |
| | 36 kW | 150 mm | 6SL3162-1AF00-0BA1 | KLBÜ CO1 ¹⁾ and KLBÜ CO4 ¹⁾ |
| | 55 kW | 200 mm | 6SL3162-1AH01-0BA0 | Clamps |
| | 80 kW / 120 kW | 300 mm | 6SL3162-1AH00-0AA0 | Clamps |
| Motor Module | 3 ... 18 A 2 x 3 A ... 2 x 9 A | 50 mm | Integrated in the motor connector | |
| | 18 A (compact) 2 x 1.7 A ... 2 x 5 A | 75 mm | | |
| | 30 A and 2 x 18 A | 100 mm | Included in the scope of delivery | KLBÜ CO4 ¹⁾ |
| | 45 A and 60 A | 150 mm | 6SL3162-1AF00-0BA1 | KLBÜ CO1 ¹⁾ for the brake cable KLBÜ CO4 ¹⁾ for the motor cable |
| | 85 A | 200 mm | 6SL3162-1AH01-0BA0 | KLBÜ CO1 ¹⁾ for brake cable clamps for motor cable |
| | 132 A and 200 A | 300 mm | 6SL3162-1AH00-0AA0 | KLBÜ CO1 ¹⁾ for brake cable clamps for motor cable |

¹⁾ Shield connection terminal, Weidmüller Company

Table 11-4 Shield connection for liquid-cooled components

| Component | Power | Total width of component | Shield connection plate | Recommended shield connection |
|--------------|--------|--------------------------|-------------------------|--|
| Line Module | 120 kW | 300 mm | 6SL3162-1AH00-0AA0 | Clamps |
| Motor Module | 200 A | 300 mm | 6SL3162-1AH00-0AA0 | KLBÜ CO1 ¹⁾ for brake cable clamps for motor cable |

¹⁾ Shield connection terminal, Weidmüller Company

11.1.3 Overview examples

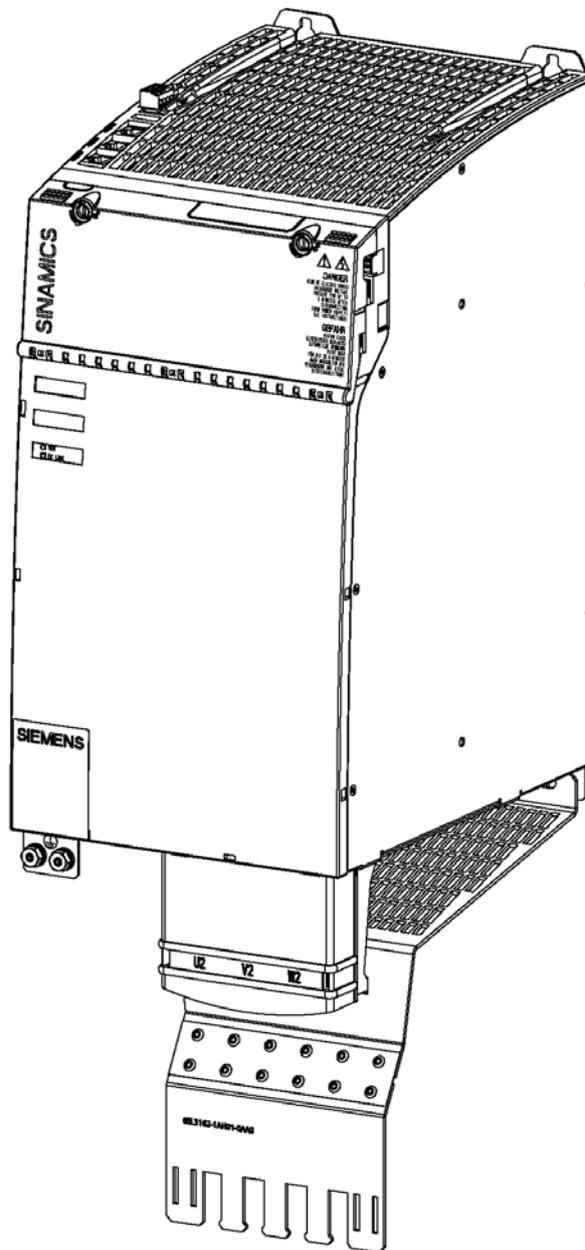


Figure 11-1 Shield connecting plate for a 200 mm module with internal air cooling

11.1 Shield connecting plates for power supply and motor cables

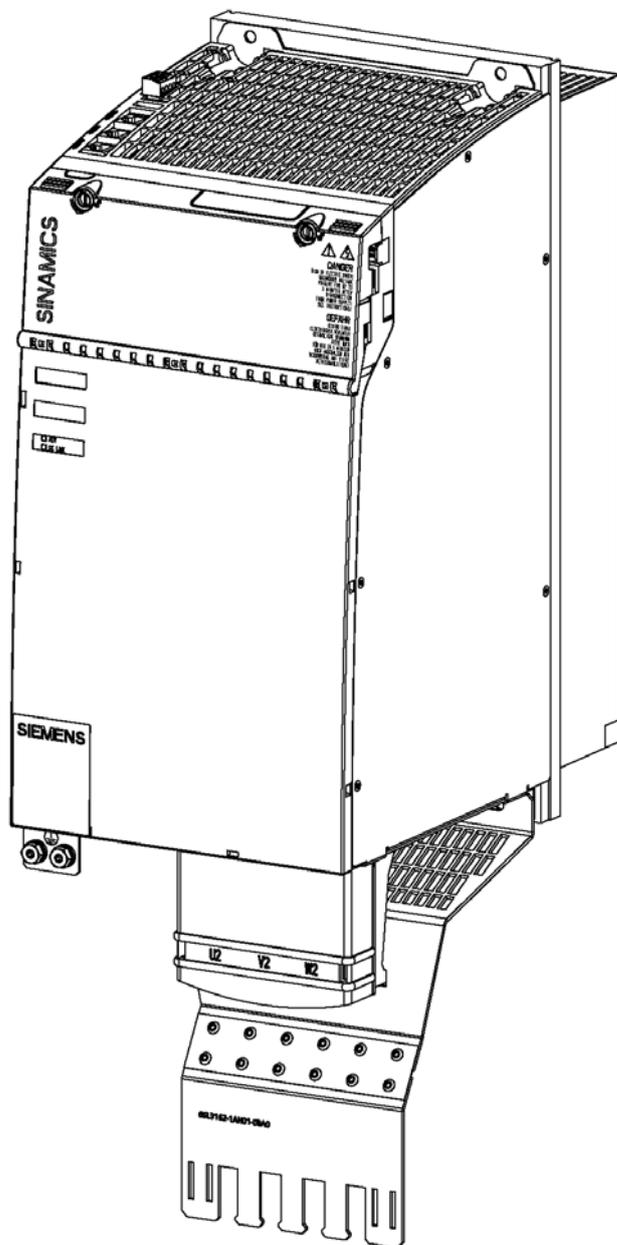


Figure 11-2 Shield connecting plate for a 200 mm module with external air cooling

11.1 Shield connecting plates for power supply and motor cables

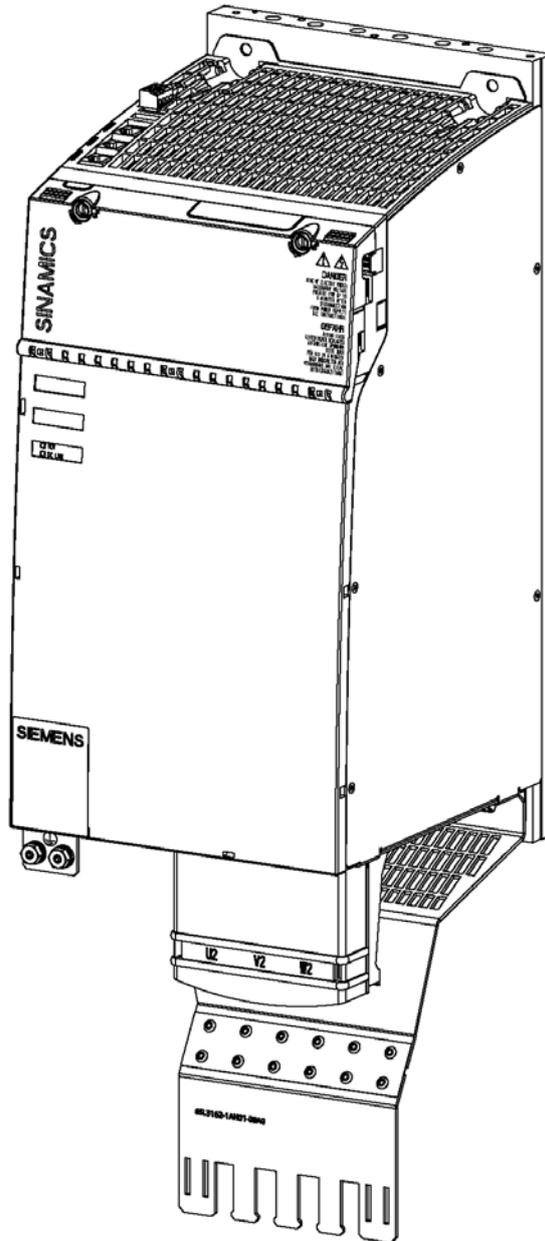


Figure 11-3 Shield connecting plate for a 200 mm module with a cold plate

11.1 Shield connecting plates for power supply and motor cables

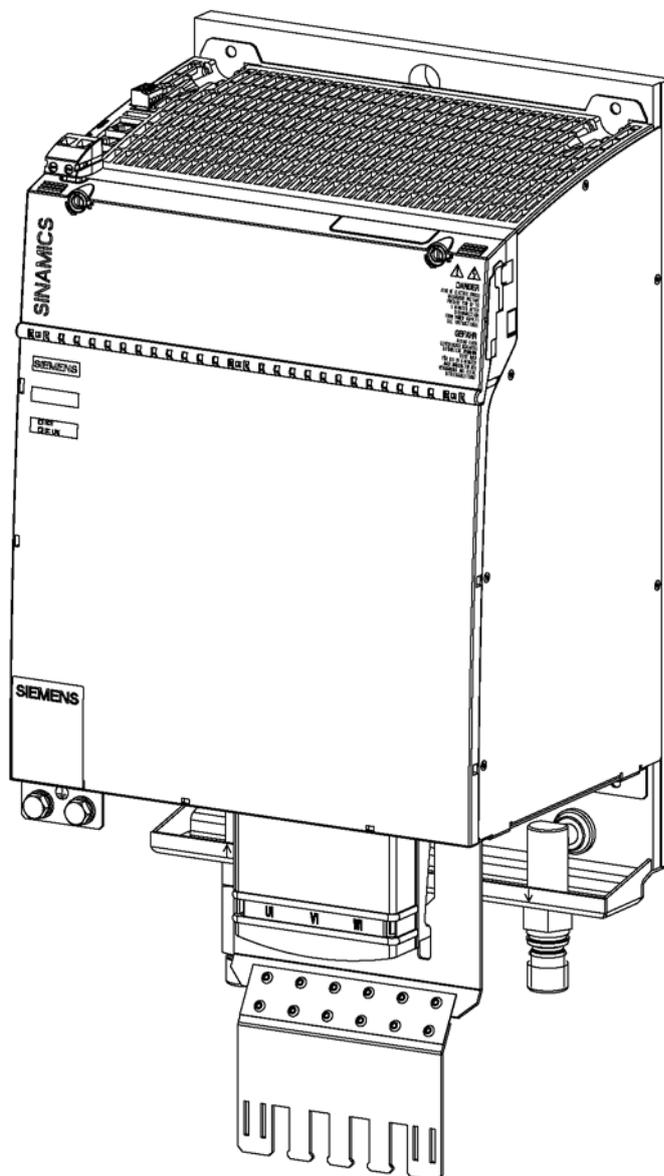


Figure 11-4 Shield connecting plate on a 300 mm module Liquid Cooled

11.1.4 Dimension drawings

11.1.4.1 Line Modules and Motor Modules with internal air cooling

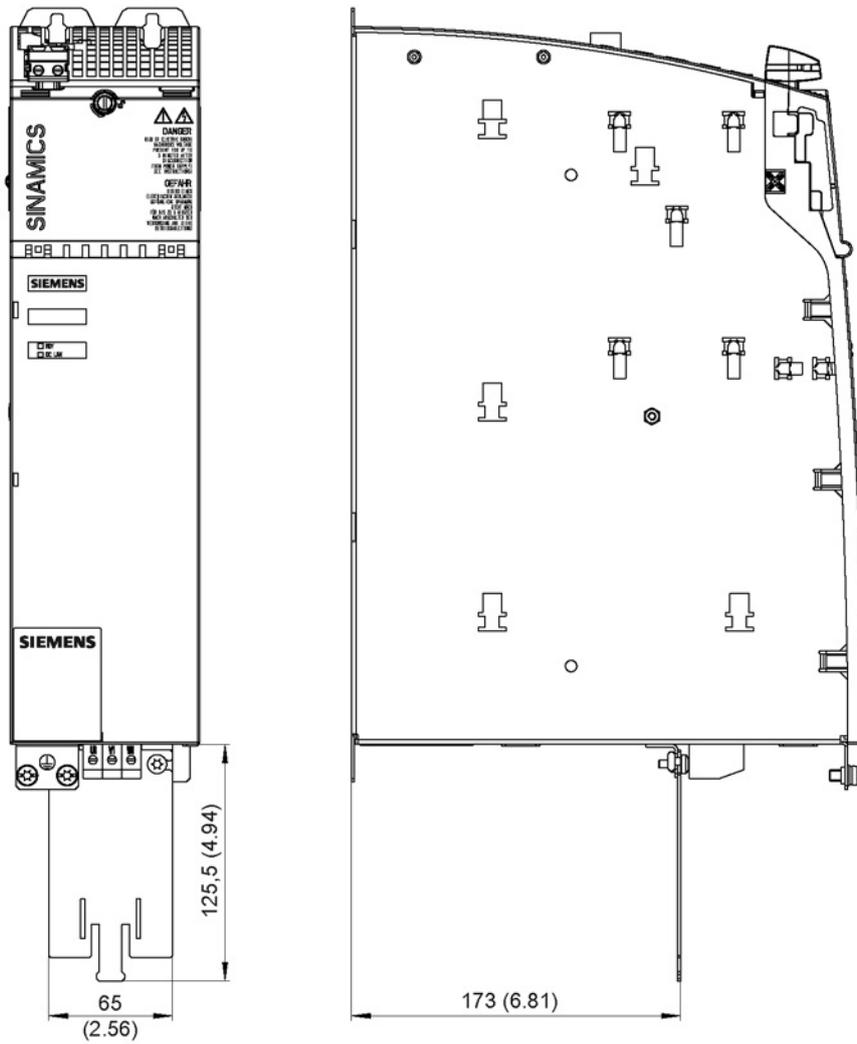


Figure 11-5 Dimension drawing of shield connecting plate on a 100 mm component with internal air cooling, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

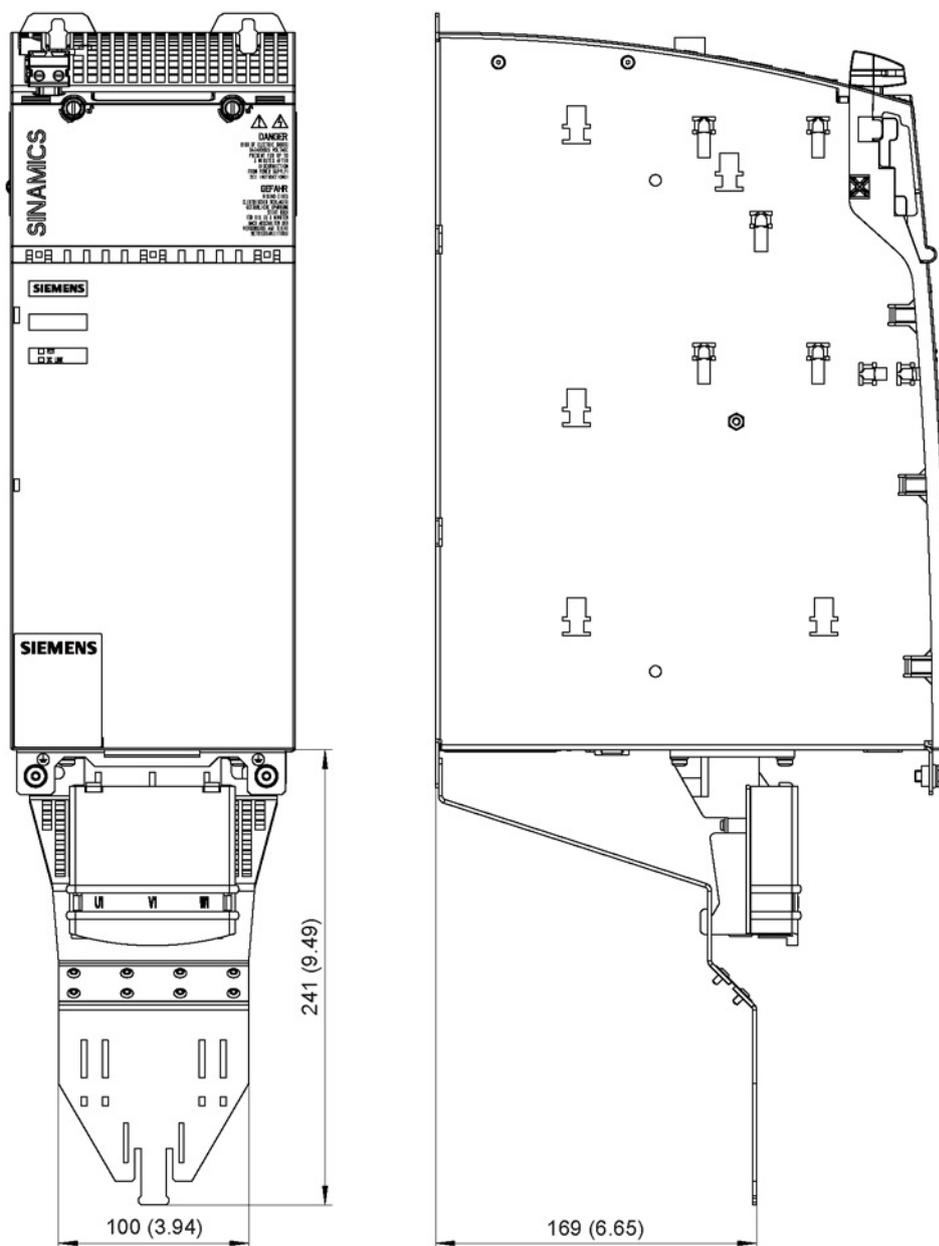


Figure 11-6 Dimension drawing of shield connecting plate on a 150 mm component with internal air cooling, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

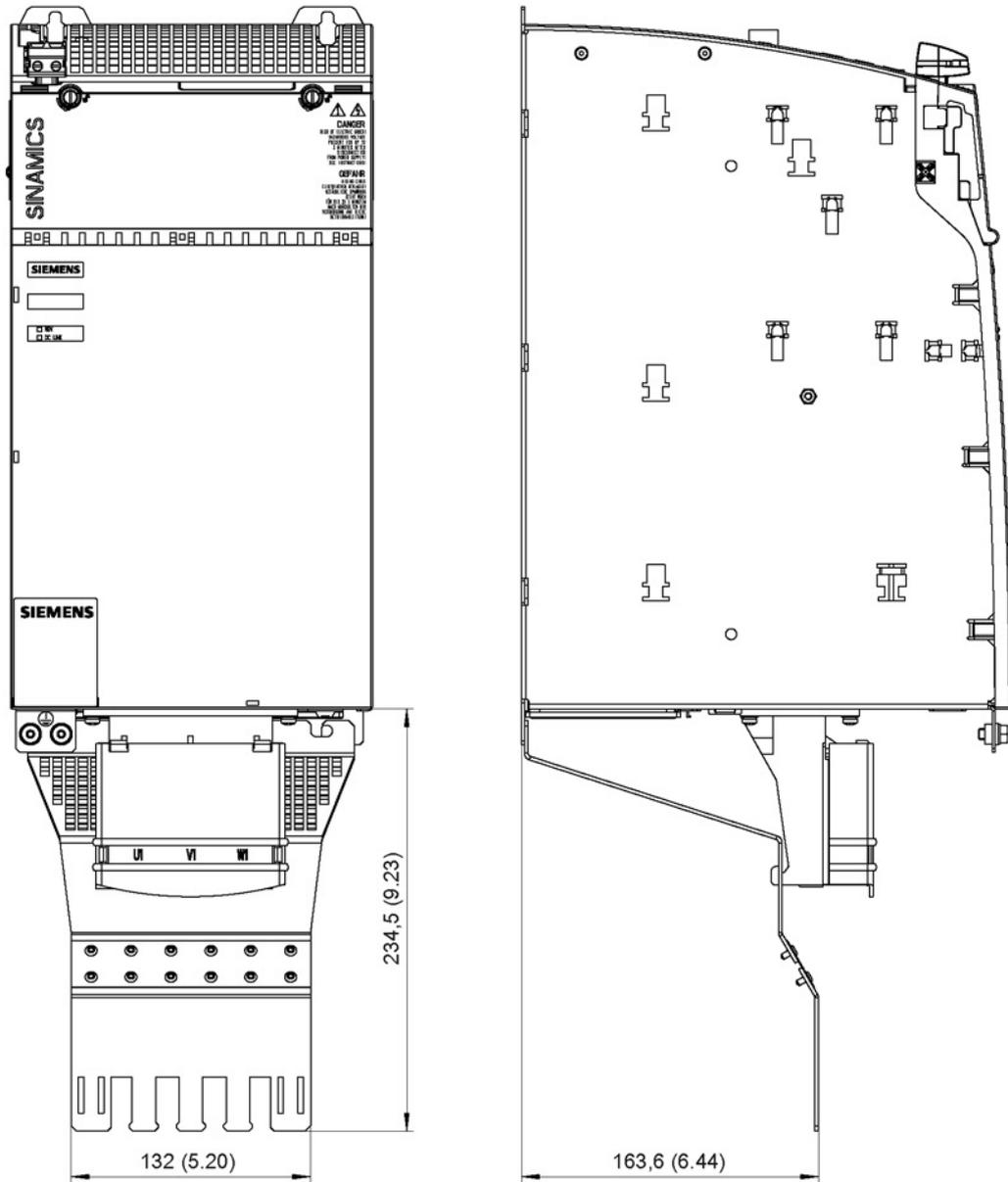


Figure 11-7 Dimension drawing of shield connecting plate on a 200 mm component with internal air cooling, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

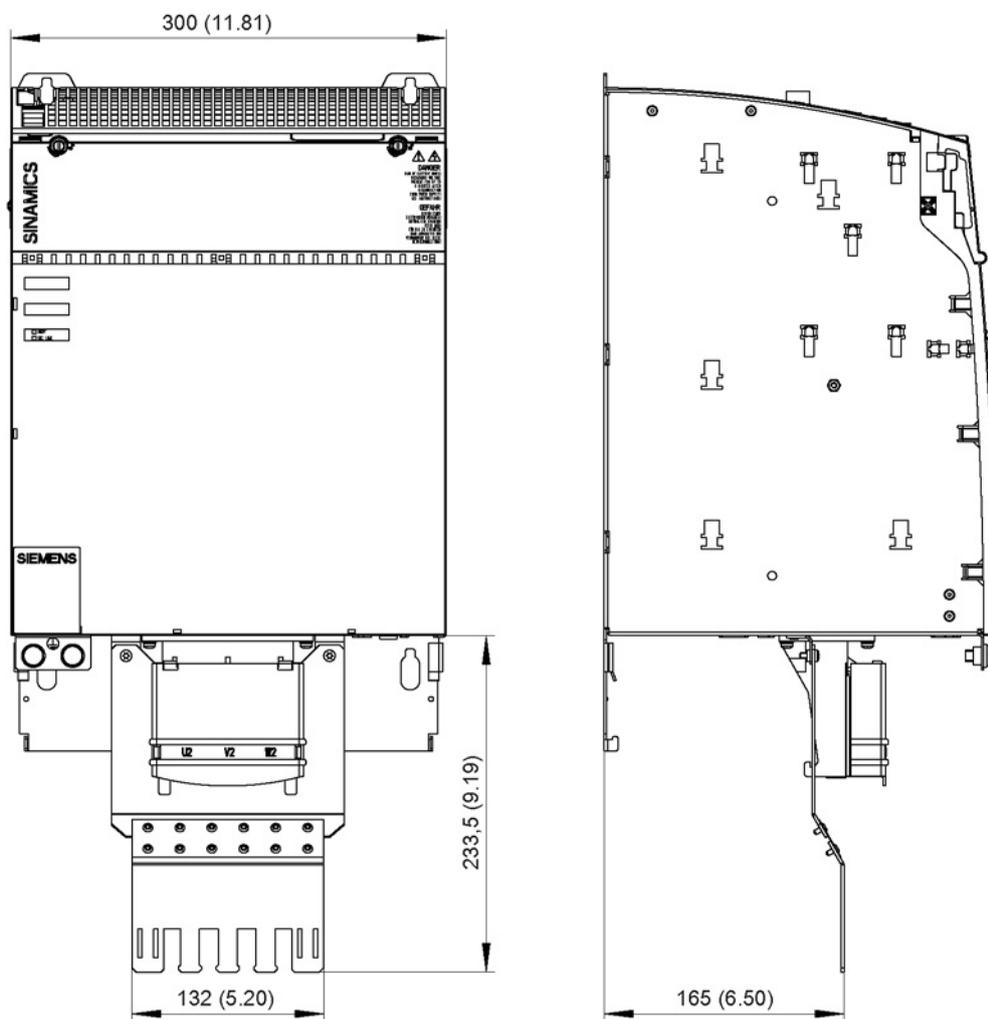


Figure 11-8 Dimension drawing of shield connecting plate on a 300 mm component with internal air cooling, all dimensions in mm and (inches)

11.1.4.2 Line Modules and Motor Modules with external air cooling

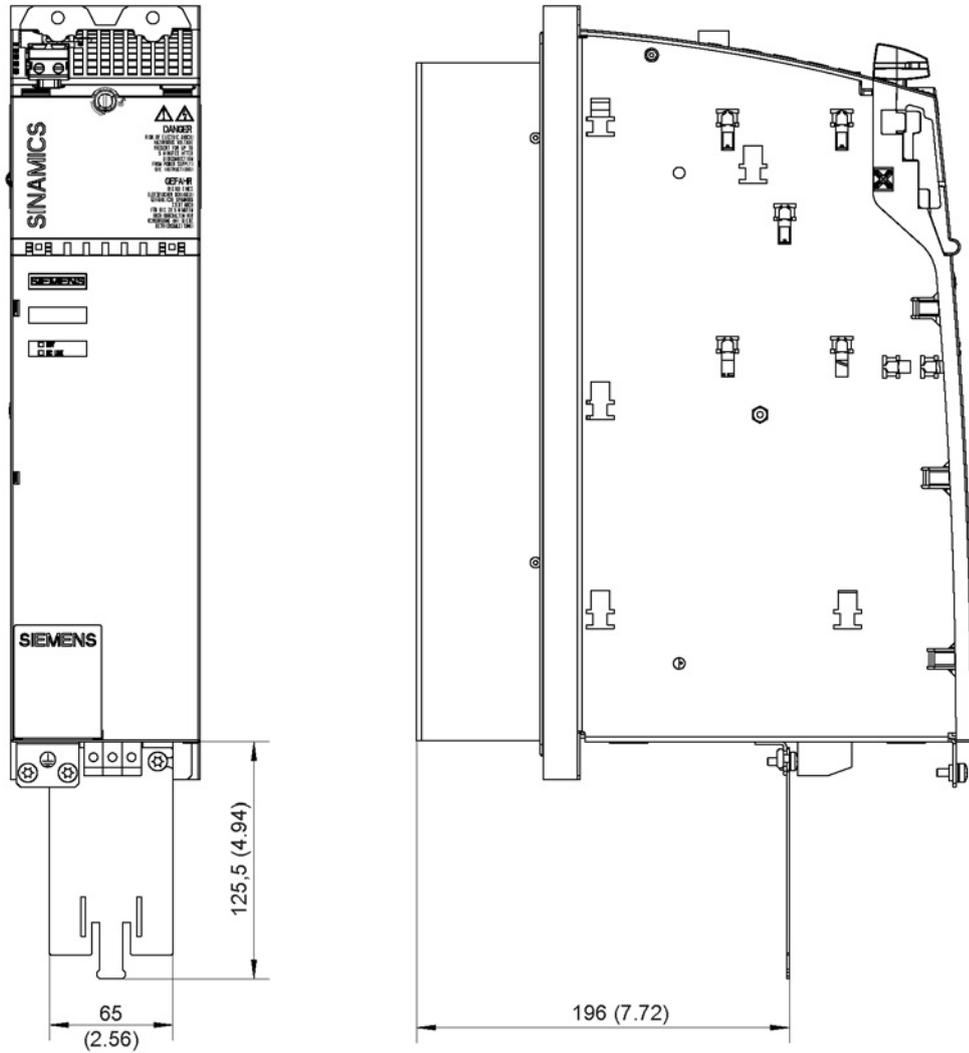


Figure 11-9 Dimension drawing of shield connecting plate on a 100 mm component with external air cooling, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

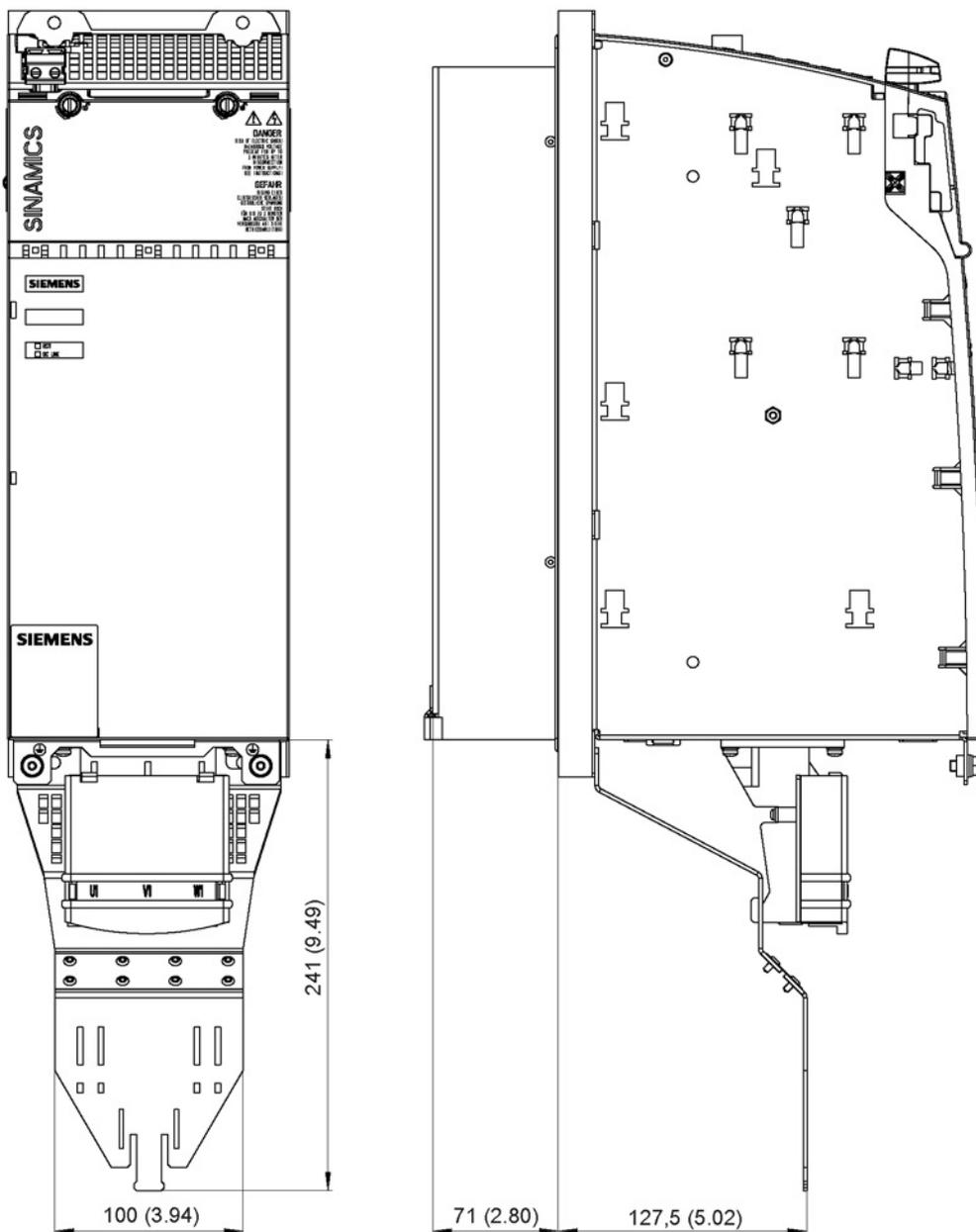


Figure 11-10 Dimension drawing of shield connecting plate on a 150 mm component with external air cooling, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

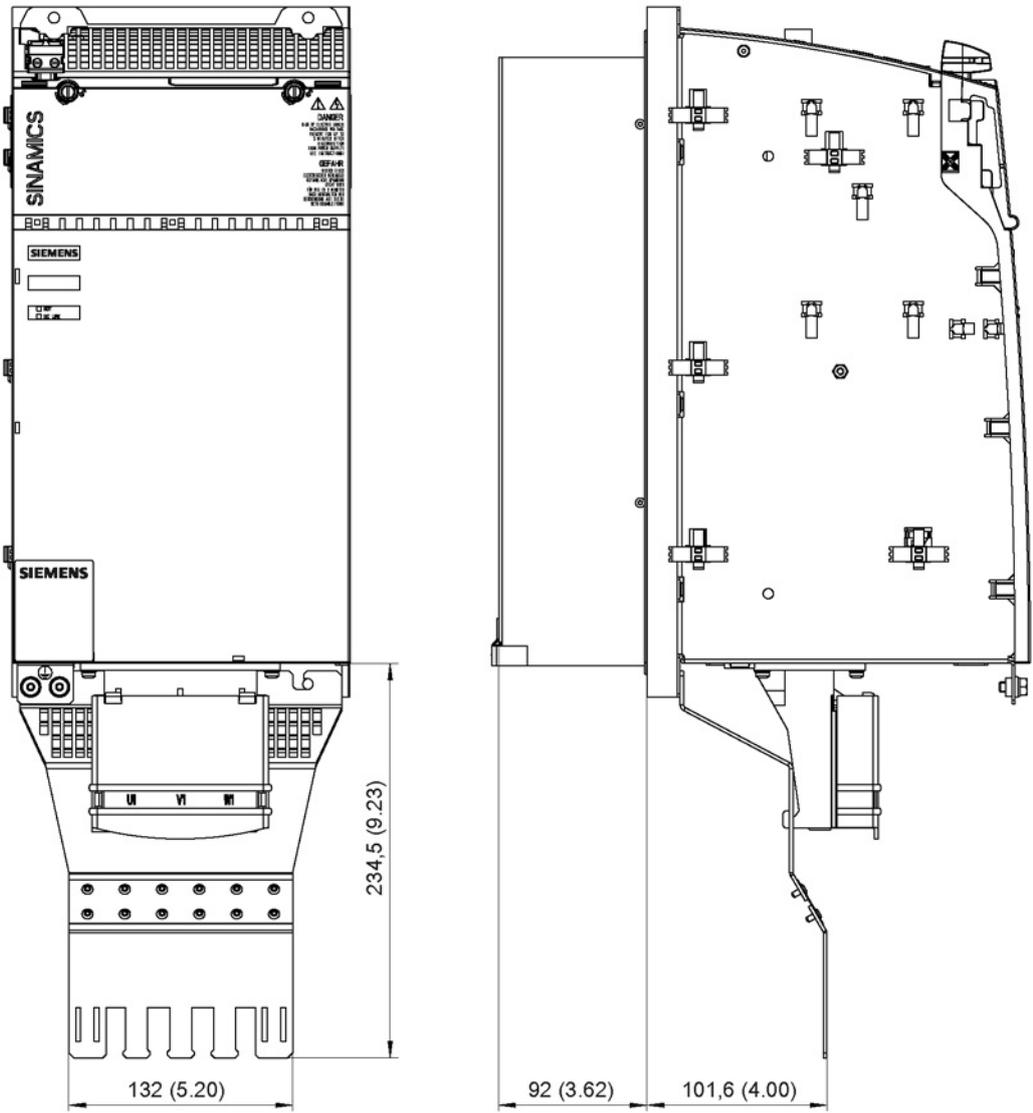


Figure 11-11 Dimension drawing of shield connecting plate on a 200 mm component with external air cooling, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

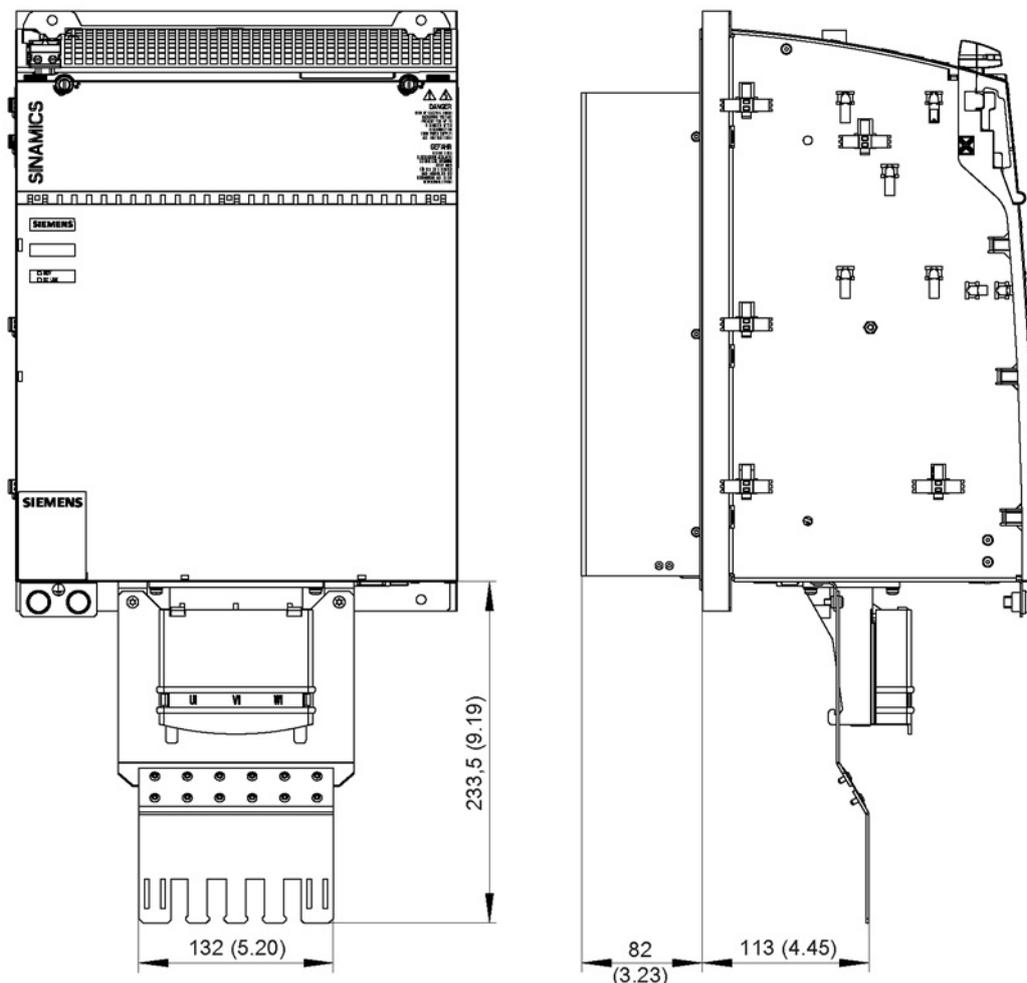


Figure 11-12 Dimension drawing of shield connecting plate on a 300 mm component with external air cooling, all dimensions in mm and (inches)

11.1.4.3 Line Modules and Motor Modules with cold plate

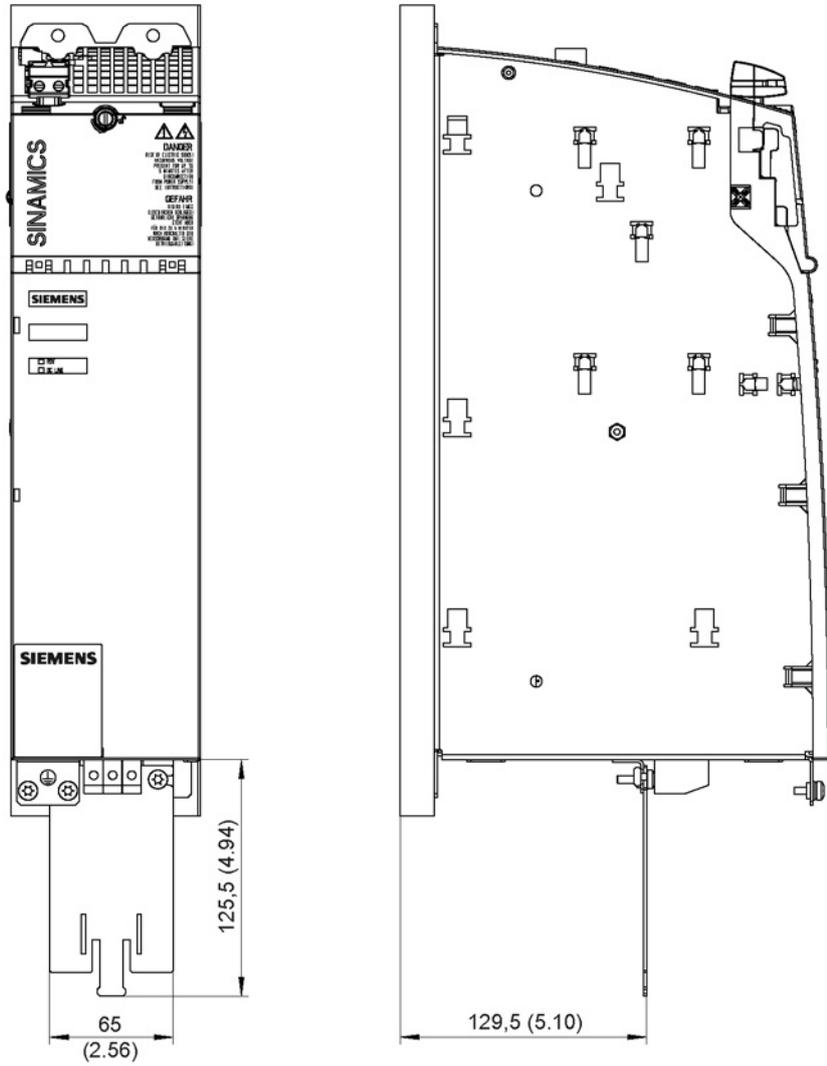


Figure 11-13 Dimension drawing of shield connecting plate on a 100 mm component with cold plate, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

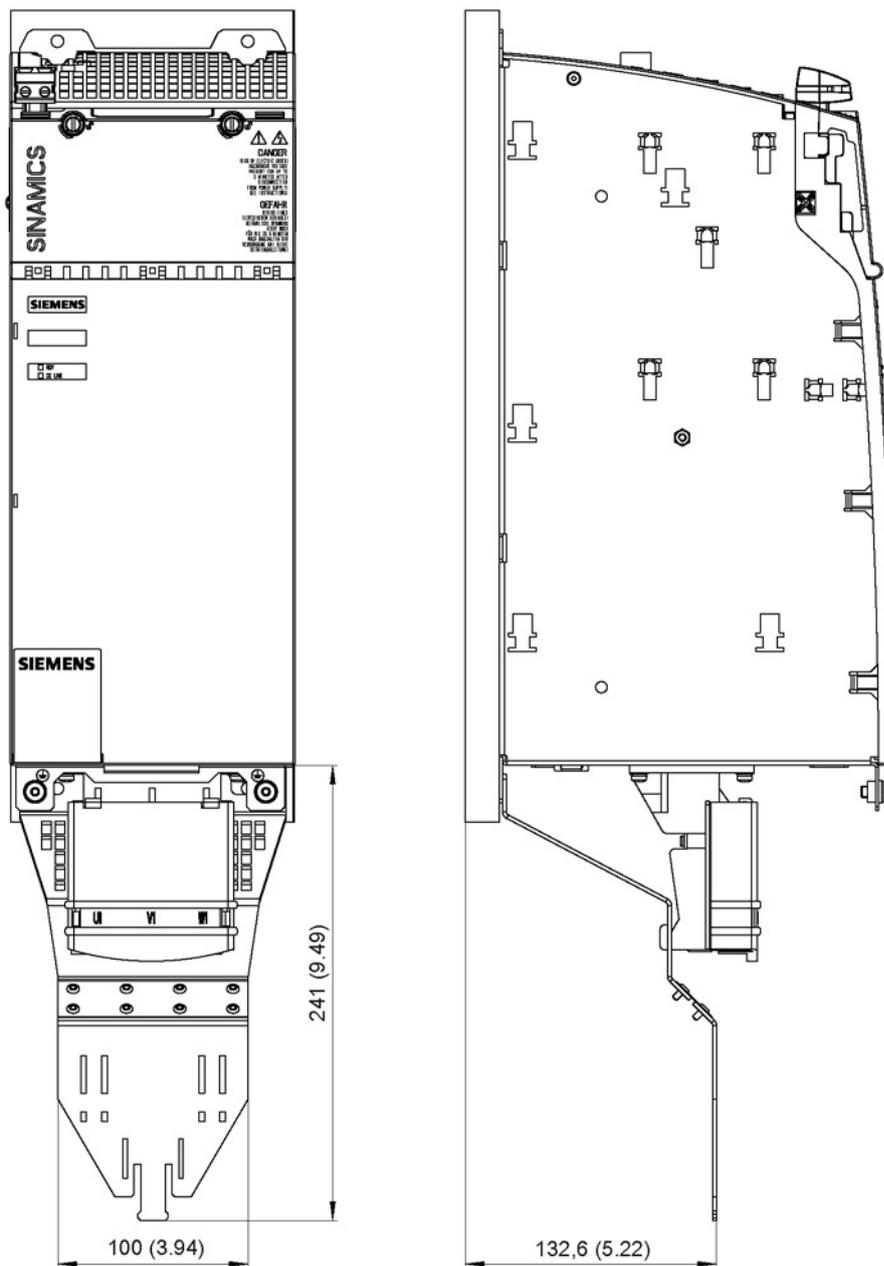


Figure 11-14 Dimension drawing of shield connecting plate on a 150 mm component with cold plate, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

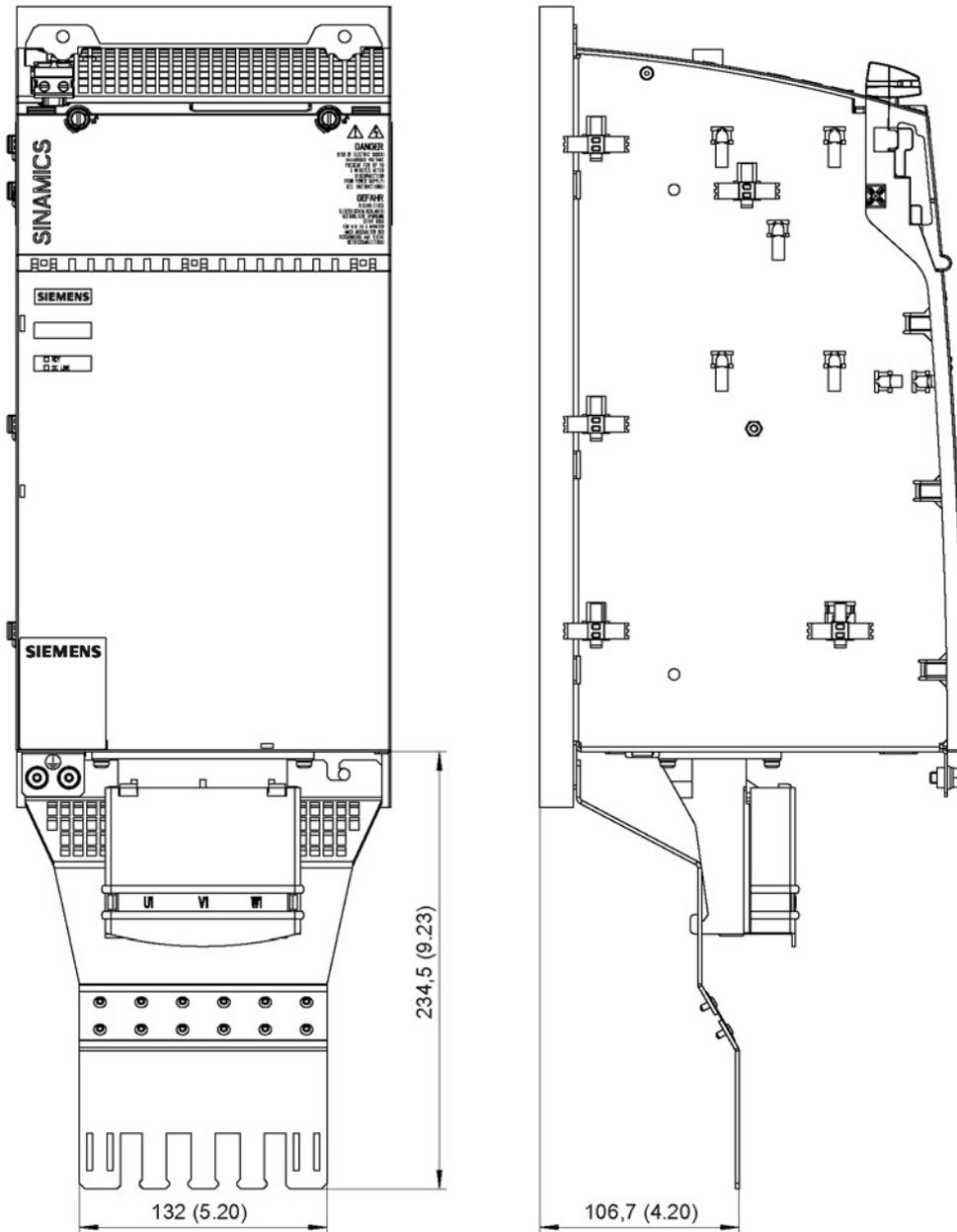


Figure 11-15 Dimension drawing of shield connecting plate on a 200 mm component with cold plate, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

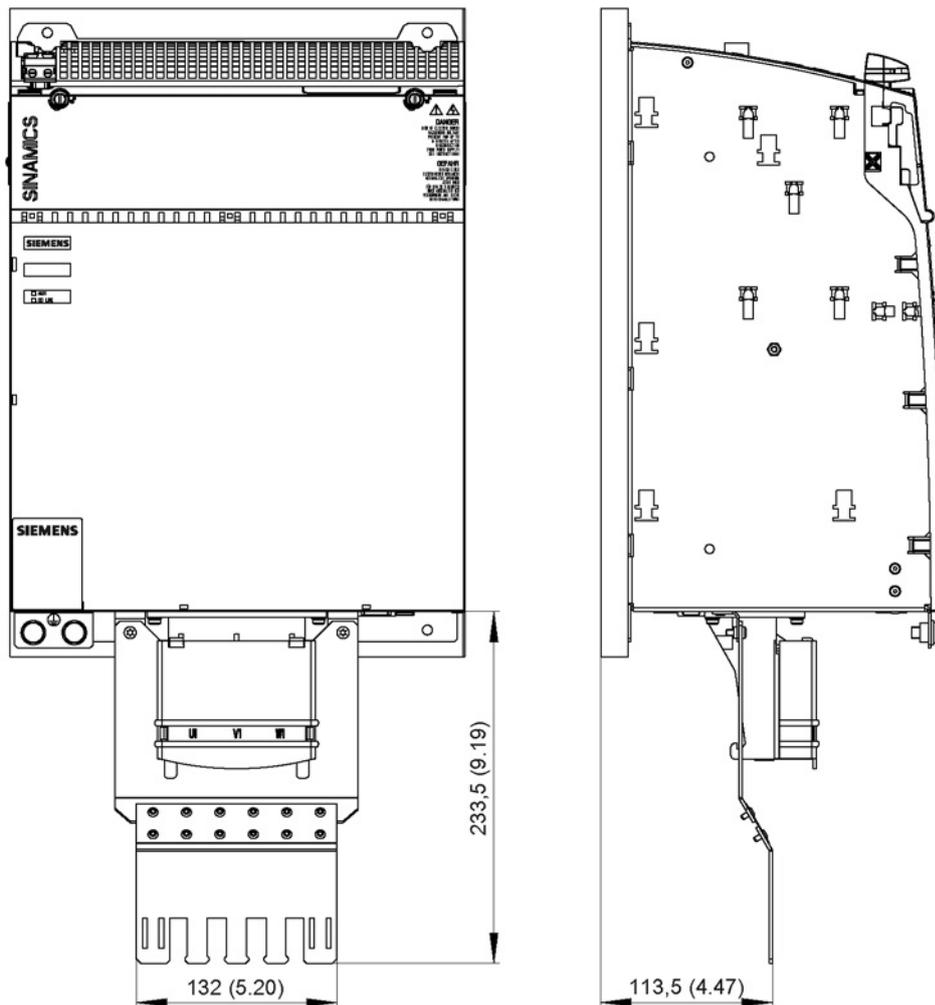


Figure 11-16 Dimension drawing of shield connecting plate on a 300 mm component with cold plate, all dimensions in mm and (inches)

11.1.4.4 Line Modules and Motor Modules, Liquid Cooled

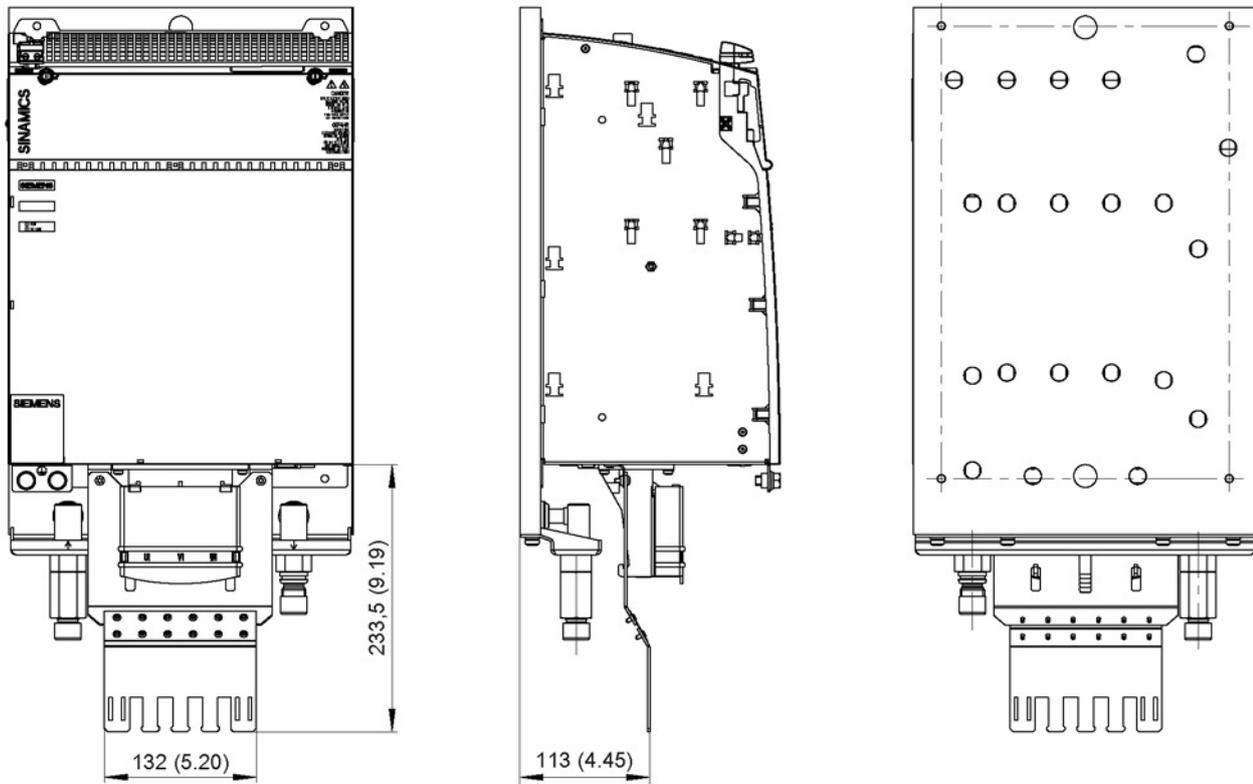


Figure 11-17 Dimension drawing of shield connecting plate on a 300 mm Liquid Cooled component, all dimensions in mm and (inches)

11.1.4.5 Active Interface Modules

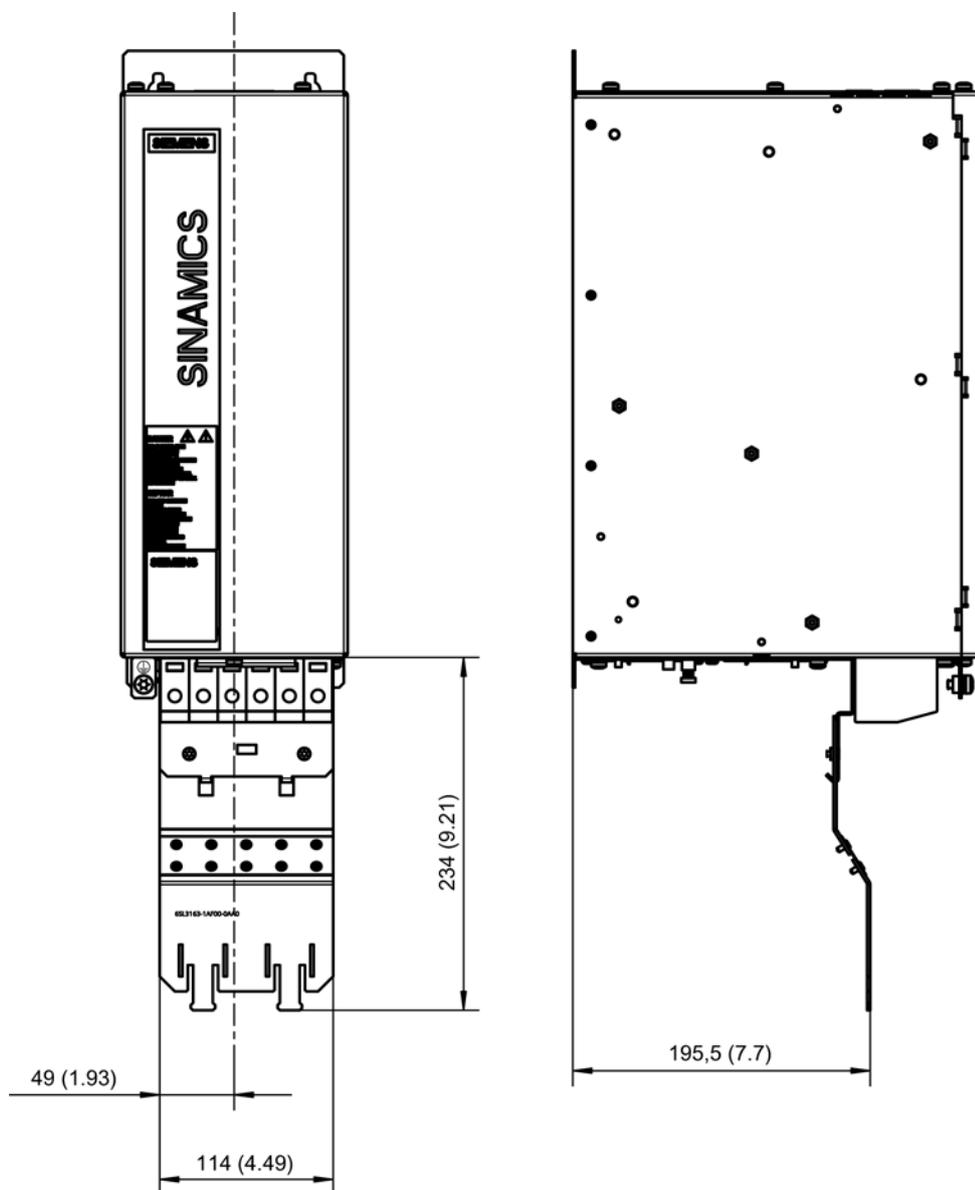


Figure 11-18 Dimension drawing of shield connecting plate on the 36 kW Active Interface Module, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

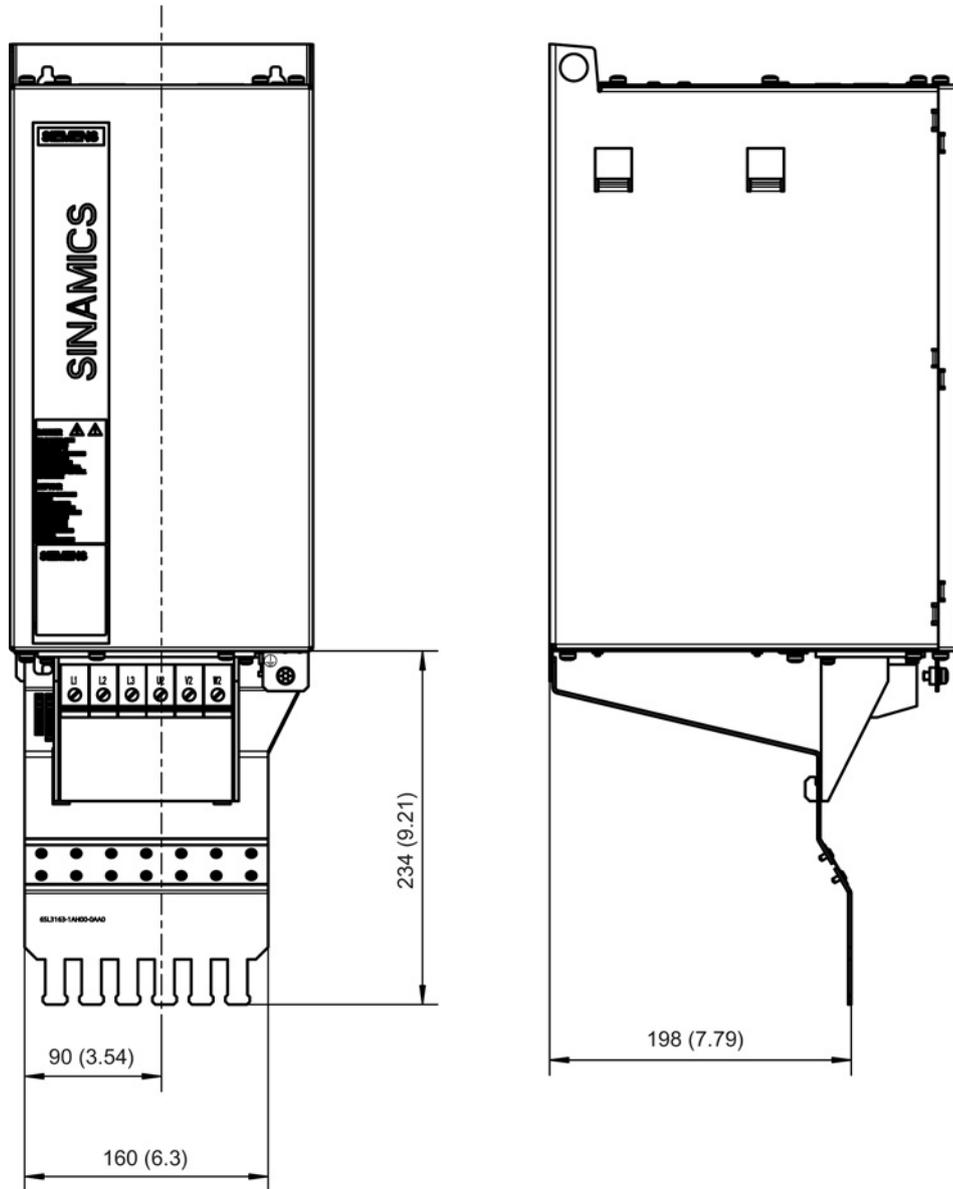


Figure 11-19 Dimension drawing of shield connecting plate on the 55 kW Active Interface Module, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

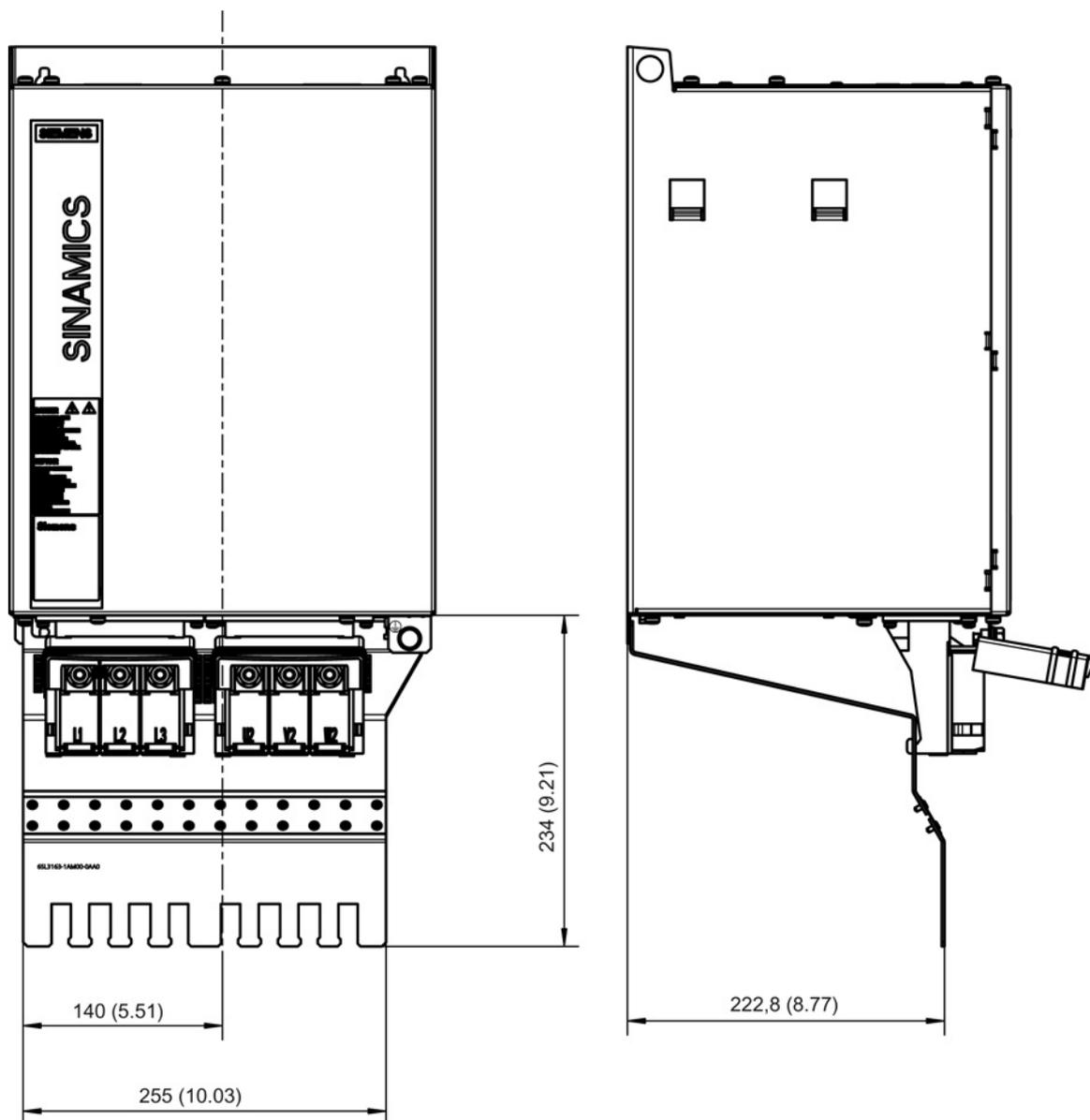


Figure 11-20 Dimension drawing of shield connecting plate on the 80 and 120 kW Active Interface Module, all dimensions in mm and (inches)

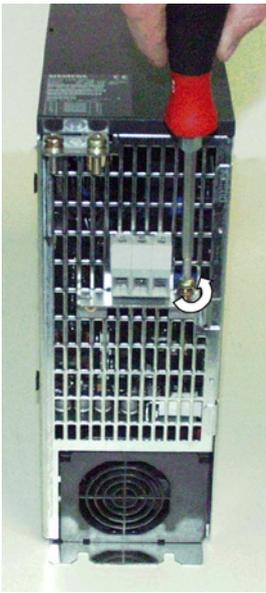
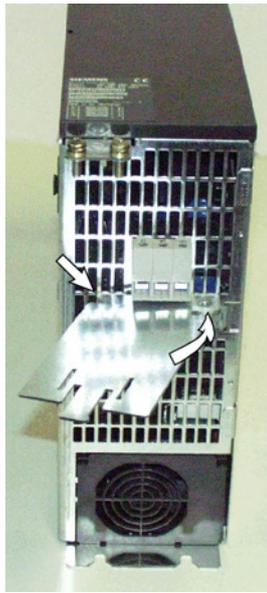
11.1 Shield connecting plates for power supply and motor cables

11.1.5 Installation

Tools required:

- Torx screwdriver T25 for shield connecting plate

Table 11- 5 Installing the shield connecting plate to a 100 mm wide component using as an example, internal air cooling

| | | | |
|--|--|---|--|
|  |  |  |  |
| Remove the screw. | Engage the shield connecting plate. | Tighten the shield connecting plate. Tightening torque: 3 Nm | Installed shield connecting plate |

Tools required:

- Screwdriver for fixing screws used

11.1 Shield connecting plates for power supply and motor cables

Table 11-6 Installing the shield connecting plate to a 200 mm wide component using as an example internal air cooling

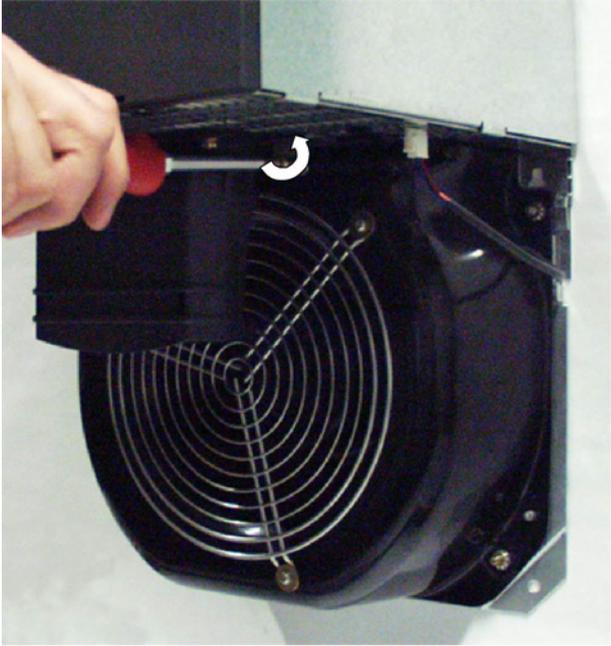
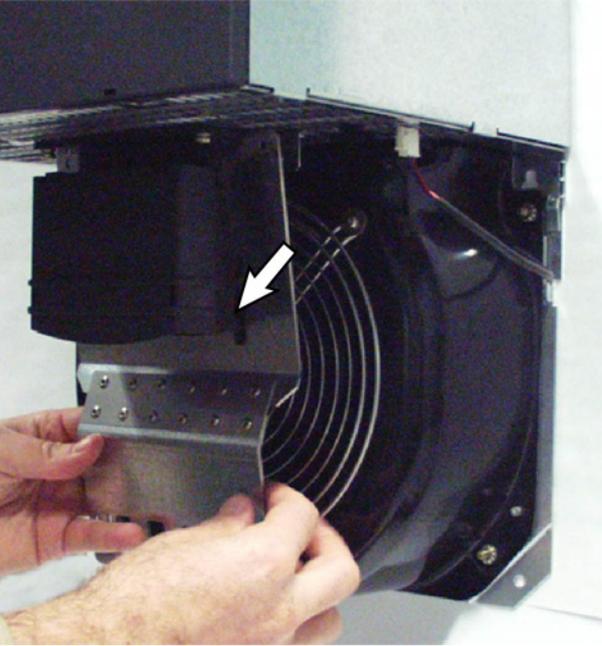
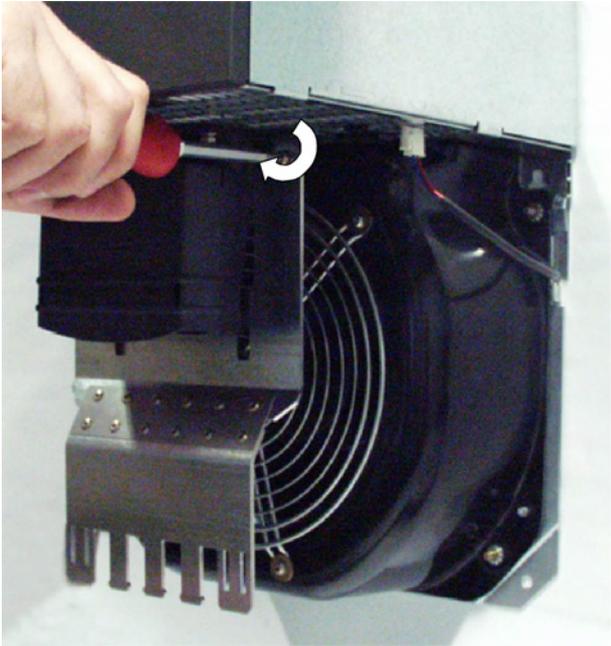
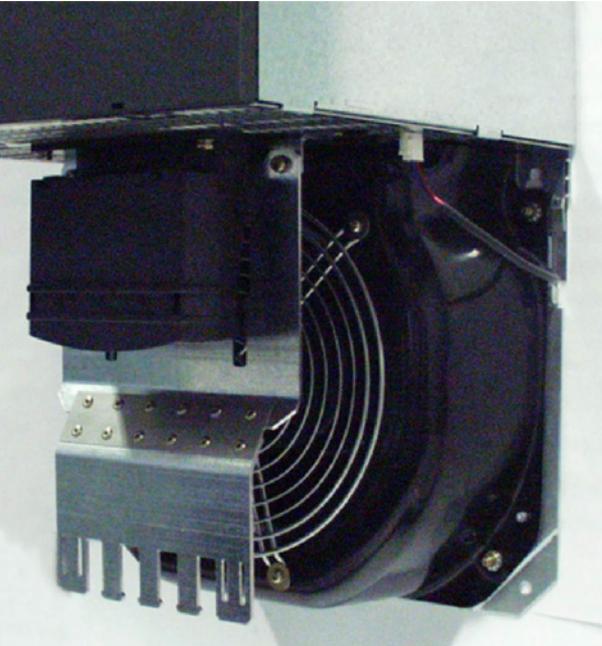
| | | |
|---|--|---|
| | | |
| <p>Loosen the lower screw.</p> | <p>Engage the shield connecting plate into the screws and at the line/motor connection</p> | <p>Secure the shield connecting plate by pulling it to the left</p> |
| | | |
| <p>Tighten the shield connecting plate. Tightening torque: 6 Nm</p> | <p>Installed shield connecting plate</p> | |

Tools required:

- Torx screwdriver T25 for shield connecting plate

11.1 Shield connecting plates for power supply and motor cables

Table 11- 7 Installing the shield connecting plate to a 300 mm wide component using as an example internal air cooling

| | |
|---|--|
|  |  |
| <p>Remove the screw.</p> | <p>Engage the shield connecting plate into the line/motor connection</p> |
|  |  |
| <p>Tighten the shield connecting plate. Tightening torque: 3 Nm</p> | <p>Installed shield connecting plate</p> |

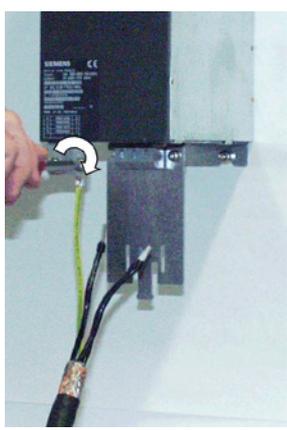
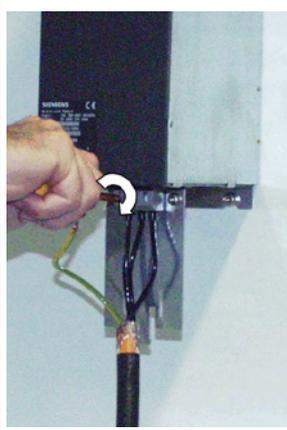
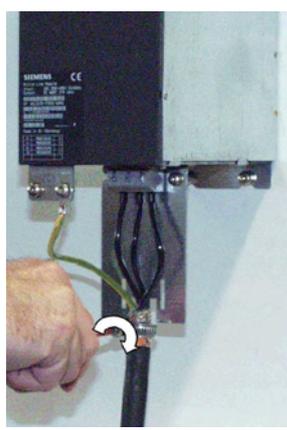
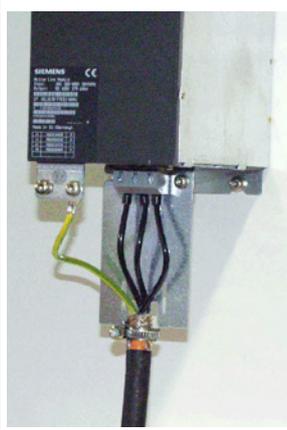
11.1 Shield connecting plates for power supply and motor cables

11.1.6 Connecting the power cables

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

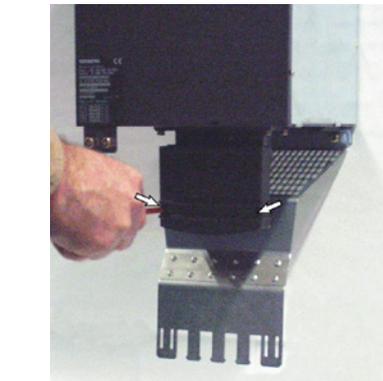
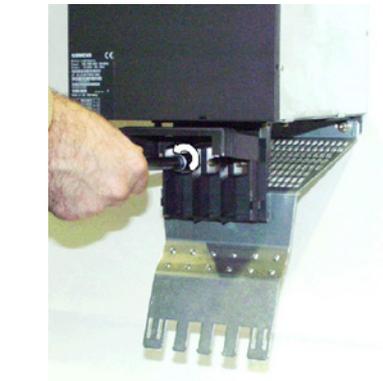
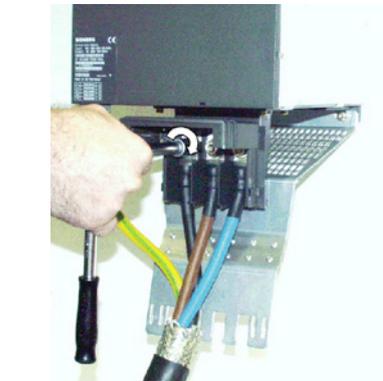
Table 11- 8 Connecting power cables for a 100 mm wide component using internal air cooling as an example

| | | | |
|--|--|---|--|
|  |  |  |  |
| Attach the protective conductor (PE) Tightening torque: 3 Nm | Attach the power cable. Tightening torque: 1.8 Nm | Tighten the hose clamp at the shield connecting plate. | The power cable is connected. |

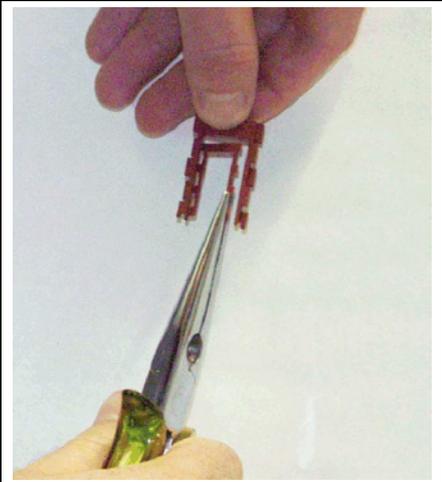
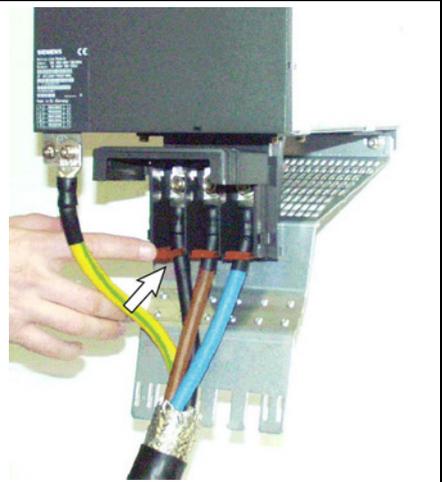
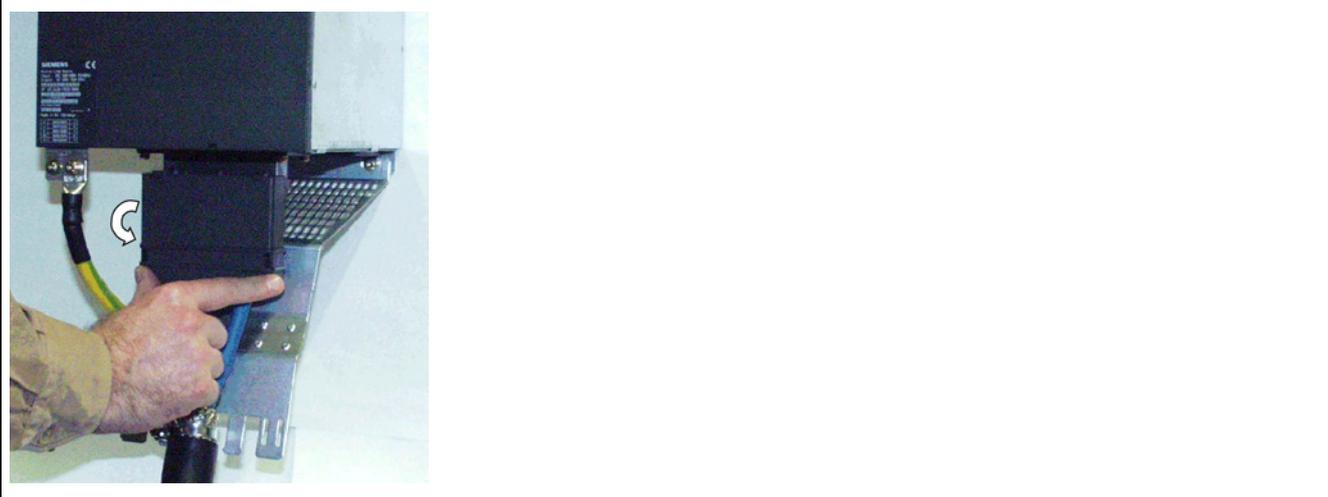
Required tools:

- Torx screwdriver T25 for protective conductor connection (Torx slot)
- (Torque) wrench M8 for power cables
- Flat-bladed screwdriver for hose clamp

Table 11- 9 Connecting power cables for a 200 mm wide component using internal air cooling as an example

| | | |
|---|---|---|
|  |  |  |
| Release and open the cover of the terminal strip. | Remove the M8 screws. | Attach the protective conductor and the power cable. Tightening torque: 13 Nm |

11.1 Shield connecting plates for power supply and motor cables

| | | |
|---|--|---|
|  |  |  |
| <p>Adapt a restrictor collar (using a suitable tool) for the touch protection.</p> | <p>Push on the reduction collar.</p> | <p>Tighten the hose clamp at the shield connecting plate.</p> |
|  | | |
| <p>Close the cover of the terminal strip.</p> | | |

11.2 Releasing the DC link protective cover

The protective covers for the DC link on the SINAMICS S120 components feature an interlocking mechanism, which is operated using a flat bladed screwdriver (1 x 5.5).

Table 11- 10 Opening the protective cover for the DC link using a screwdriver

| | | |
|---|---|--|
|  <p>The image shows the front of a SINAMICS DC link protective cover. It is light blue with a black base. The cover has a circular interlocking screw at the top. Safety warnings are printed on the cover in English and German. The English text reads: "DANGER RISK OF ELECTRIC SHOCK! HAZARDOUS VOLTAGE PRESENT FOR UP TO 5 MINUTES AFTER DISCONNECTION FROM POWER SUPPLY! SEE INSTRUCTIONS!". The German text reads: "GEFAHR RISIKO EINES ELEKTRISCHEN SCHLAGES! GEFAHRLICHE SPANNUNG STEHT NOCH FÜR BIS ZU 5 MINUTEN NACH ABSCHALTEN DER VERSORGLUNG ANI SIEHE BETRIEBSANLEITUNG!".</p> |  <p>The image shows the same protective cover as in the first image, but with a red-handled screwdriver inserted into the interlocking screw. A yellow arrow on the screwdriver's handle points counter-clockwise, indicating the direction to turn the screw to open the cover.</p> |  <p>The image shows the protective cover removed from the SINAMICS component, revealing the internal DC link terminals and electrical connections.</p> |
| <p>Protective cover with interlock mechanism</p> | <p>To open the protective cover, use the screwdriver to slightly turn the interlocking screw in the direction of the arrow (counter-clockwise)</p> | <p>Opened protective cover</p> |

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

11.3 Reinforced DC link busbars

11.3.1 Description

Reinforced DC-link busbars are available for 50 mm and 100 mm wide components of the Booksize and Booksize Compact series. They are used to increase the current carrying capacity of the components used to conduct the DC-link current from 100 A to 150 A.

Table 11- 11 Reinforced DC-link busbars

| Reinforced DC-link busbars | Order number |
|--------------------------------|--------------------|
| Suitable for 50 mm components | 6SL3162-2DB00-0AAx |
| Suitable for 100 mm components | 6SL3162-2DD00-0AAx |

Notes on configuration and arrangement of the components in the drive line-up can be found in the Chapter, Arrangement of components and devices (Page 696).

Note

DC-link rectifier adapter / DC-link adapter

The following must be taken into account when using reinforced DC-link busbars:

- It is not possible to use a DC-link rectifier adapter!
 - Use DC-link adapter 6SL3162-2BM10-0AA0 (2-hole adapter).
-

11.3.2 Safety instructions for reinforced DC link busbars

| | |
|--|----------------|
|  | WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed | |
| If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. | |
| <ul style="list-style-type: none"> • Adhere to the fundamental safety instructions. • When assessing the risk, take into account residual risks. | |



| | |
|---|---------------|
|  | DANGER |
| Danger to life through 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 five minutes after the power supply has been switched off. | |
| Contact with live parts can result in death or serious injury. | |
| <ul style="list-style-type: none"> • Do not open the protective cover of the DC link until 5 minutes have elapsed. • Measure the voltage before starting work on the DCP and DCN DC link terminals. | |



| | |
|---|---------------|
|  | DANGER |
| Danger to life through electric shock when the protective cover of the DC link is open | |
| Contact with live parts can result in death or serious injury. | |
| <ul style="list-style-type: none"> • Only operate the components with closed protective cover. | |



| | |
|--|----------------|
|  | WARNING |
| Danger to life through 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. | |
| <ul style="list-style-type: none"> • For all 50 mm wide modules¹⁾ (exception: Smart Line Module²⁾), 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 removed³⁾. | |
| <p>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.</p> | |

11.3.3 Dimension drawings

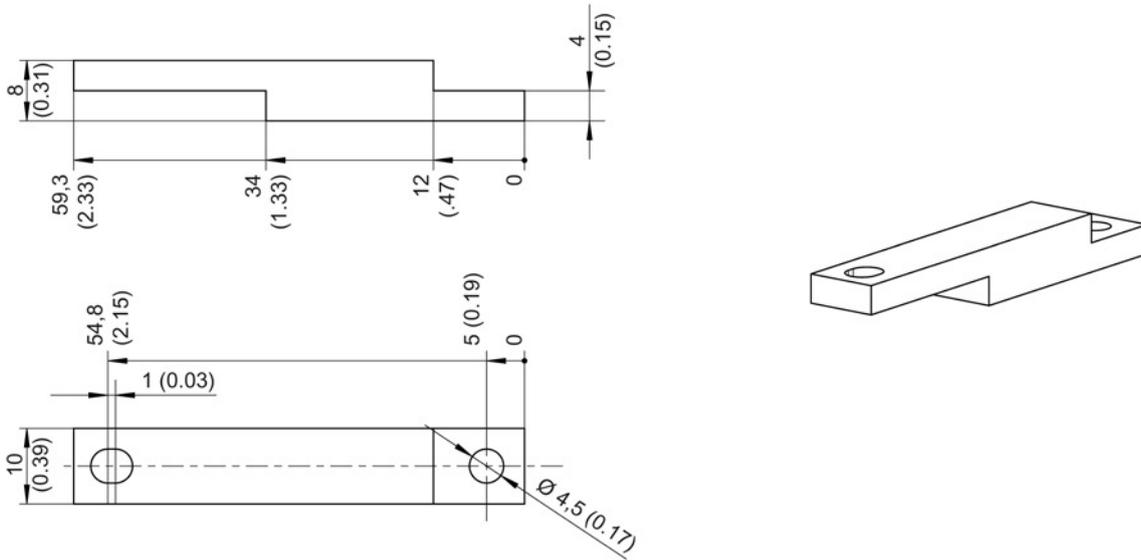


Figure 11-21 Dimension drawing of reinforced DC link busbar 50 mm, all dimensions in mm and (inches)

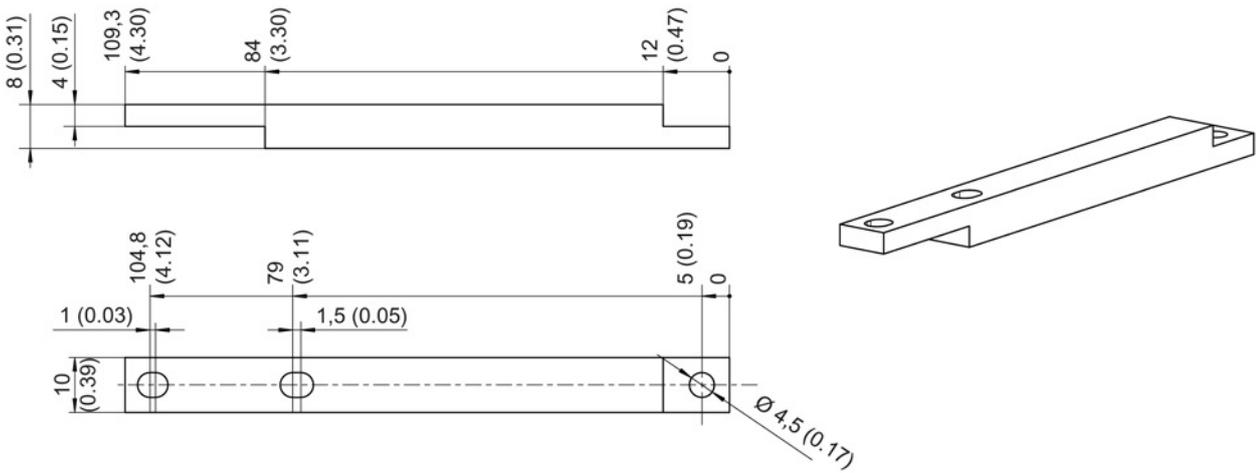


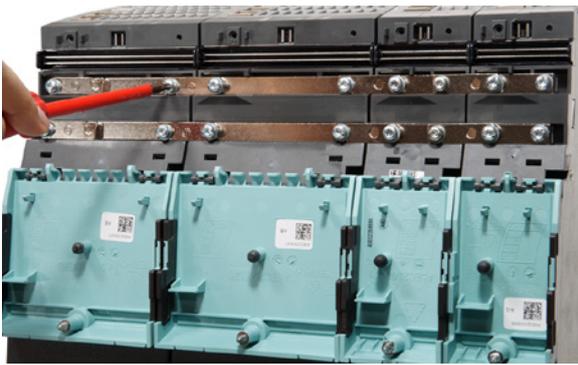
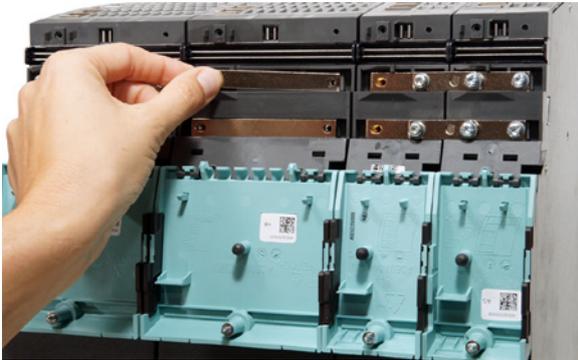
Figure 11-22 Dimension drawing of reinforced DC link busbar 100 mm, all dimensions in mm and (inches)

11.3.4 Removing the DC link busbars

Required tools:

- Torx screwdriver T20 for DC link screws (Torx slot)

Table 11- 12 Removing the DC link busbars

| | |
|---|--|
|  |  |
| <p>Remove the installed DC link bridges and busbars, starting at the second component. Do not remove the DC link bridge and the busbars of the first component.</p> | <p>Loosen the screws and remove the installed DC link bridge of the component.</p> |
|  |  |
| <p>Remove the DC link busbar of the component.</p> | |
|  |  |
| <p>Release the screws and remove the DC link bridges and busbars at all of the other components.</p> | <p>View with the DC link busbars removed</p> |

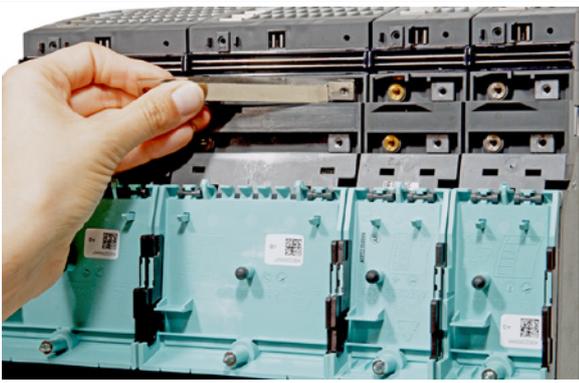
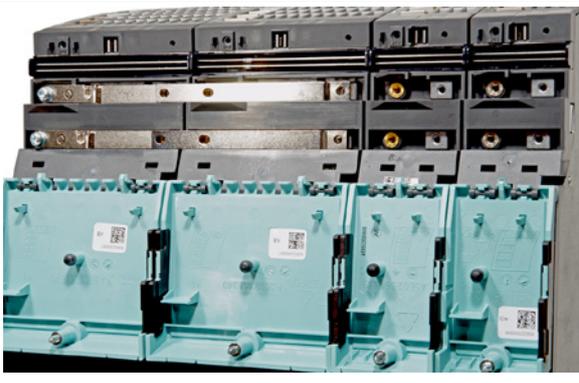
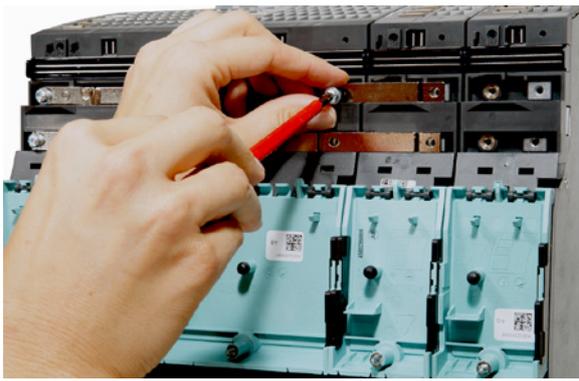
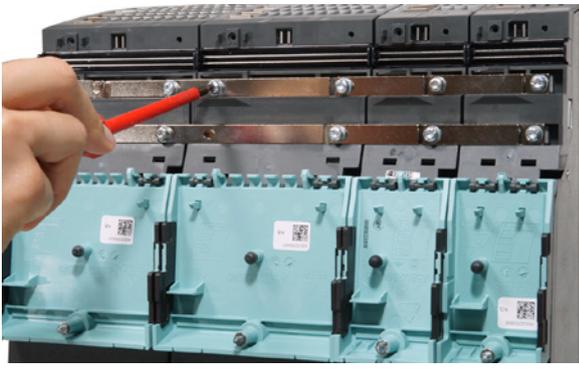
11.3 Reinforced DC link busbars

11.3.5 Installing the reinforced DC link busbars

Required tools:

- Torx screwdriver T20 for DC link screws (Torx slot)

Table 11- 13 Installing the reinforced DC link busbars

| | |
|---|--|
|  |  |
| <p>Install the reinforced DC link busbars, starting at the left.</p> | |
|  |  |
| <p>Attach the DC link busbars using the original M4x20 screws at the right-hand side of the component. Do not tighten the screws with their final tightening torque.</p> | <p>Install the reinforced DC link busbars, and attach these at the right-hand side of all of the remaining components.</p> |
|  |  |
| <p>For 100 mm wide components, additionally attach the DC link busbars using the original M4x16 screws at the left-hand side of the component. Finally tighten the screws with 1.8 Nm + 30 %.</p> | <p>View of the mounted reinforced DC link busbars with 24 V connectors and 24 V terminal adapter</p> |

Note

To connect the 24 V busbars of the individual components, use the red 24 V connector provided in the accessories pack.

11.4 DC link rectifier adapter for Booksize format

11.4.1 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.

Mounting on components with reinforced DC link busbars is **not** possible.

Note

When a DC link rectifier adapter and DC busbars are used, the limit values for radio interference suppression under Category C2 according to EN 61800-3 can no longer be observed.

11.4 DC link rectifier adapter for Booksize format

Table 11- 14 Available DC link rectifier adapters

| Order number | Screw terminals | Used for Line/Motor Modules with these sizes |
|--------------------|----------------------------|--|
| 6SL3162-2BD00-0AA0 | 0.5 ... 10 mm ² | 50 mm, 100 mm |
| 6SL3162-2BM00-0AA0 | 35 ... 95 mm ² | 150 mm, 200 mm, 300 mm |



DC link rectifier adapter
6SL3162-2BD00-0AA0



DC link rectifier adapter
6SL3162-2BM00-0AA0

11.4.2 Safety instructions for DC link rectifier adapters

 **WARNING**
Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.


 **DANGER**
Danger to life through 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 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.
- Measure the voltage before starting work on the DCP and DCN DC link terminals.


 **DANGER**
Danger to life through 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**
Danger to life through 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 modules¹⁾ (exception: Smart Line Module²⁾), 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 removed³⁾.

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**

Fire hazard and device damage through 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 hazard 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 development of smoke.

- The total length of the DC link (including the connection cables) must not exceed 10 m.



 **WARNING**

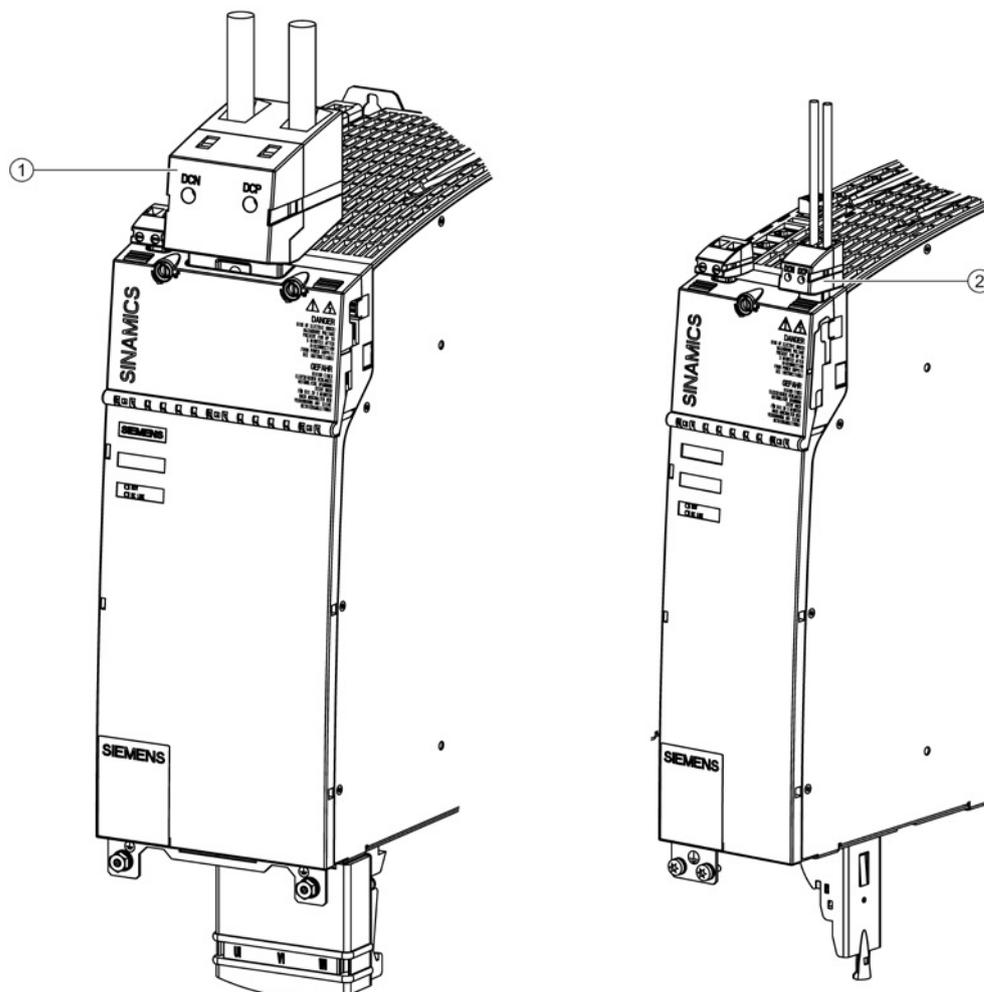
Danger to life through electric shock due to incorrectly laid 24 V supply cables

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.

11.4.3 Interface description

11.4.3.1 Overview



- ① DC link rectifier adapter (35 to 95 mm²) on a 150 mm component
- ② DC link rectifier adapter (0.5 to 10 mm²) on a 100 mm component

Figure 11-23 Installed DC link rectifier adapter, using the example of components with a width of 100 mm and 150 mm

11.4.3.2 DC link connection

Table 11- 15 DC link rectifier adapter – description of the terminals

| Terminal | Function | Technical data |
|----------|------------------|--|
| DCP | DC link positive | Supply voltage: 720 V-VDE/600 V-UL |
| DCN | DC link negative | |

11.4.4 Dimension drawings

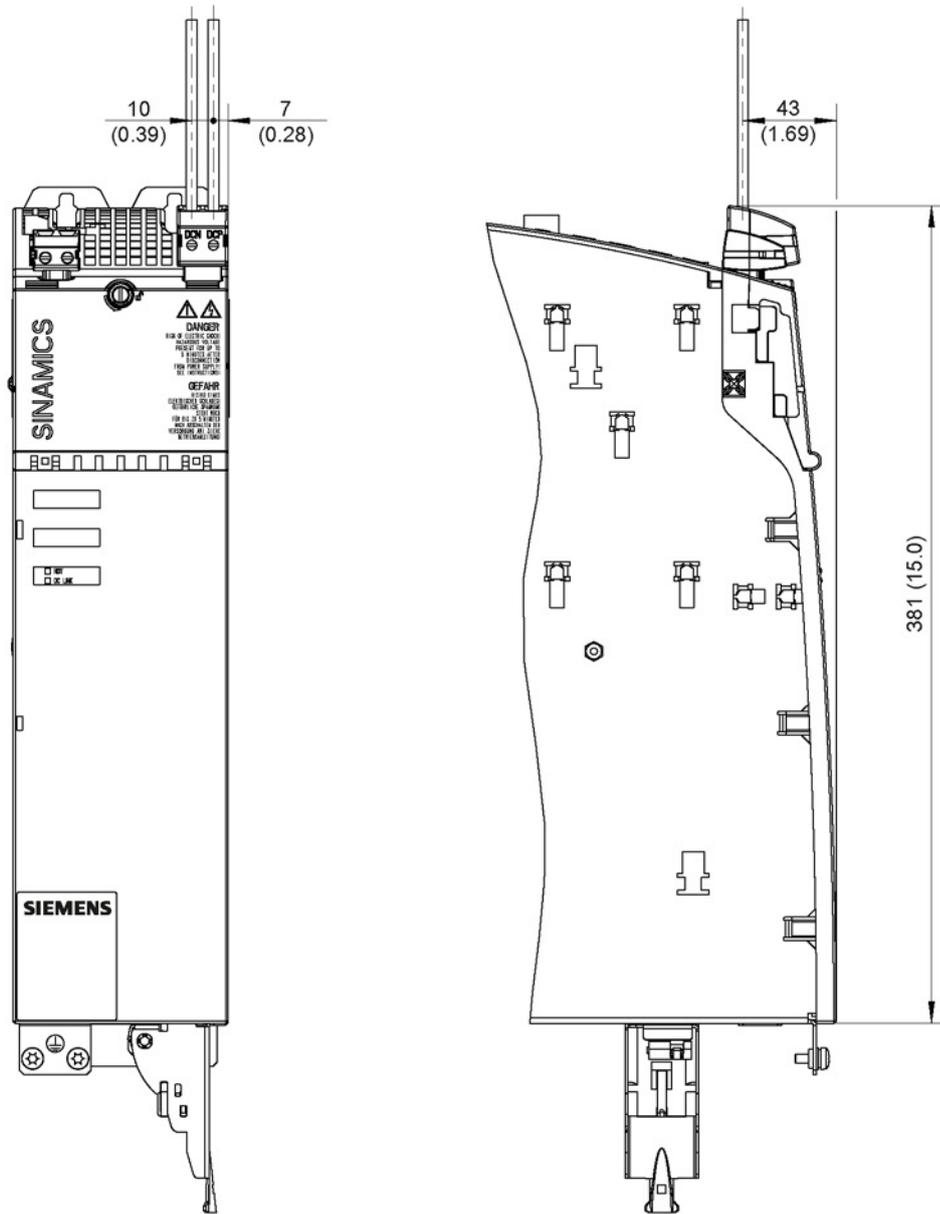


Figure 11-24 Dimension drawing of 100 mm wide component with DC link rectifier adapter for 0.5 to 10 mm², all dimensions in mm and (inch)

11.4 DC link rectifier adapter for Booksize format

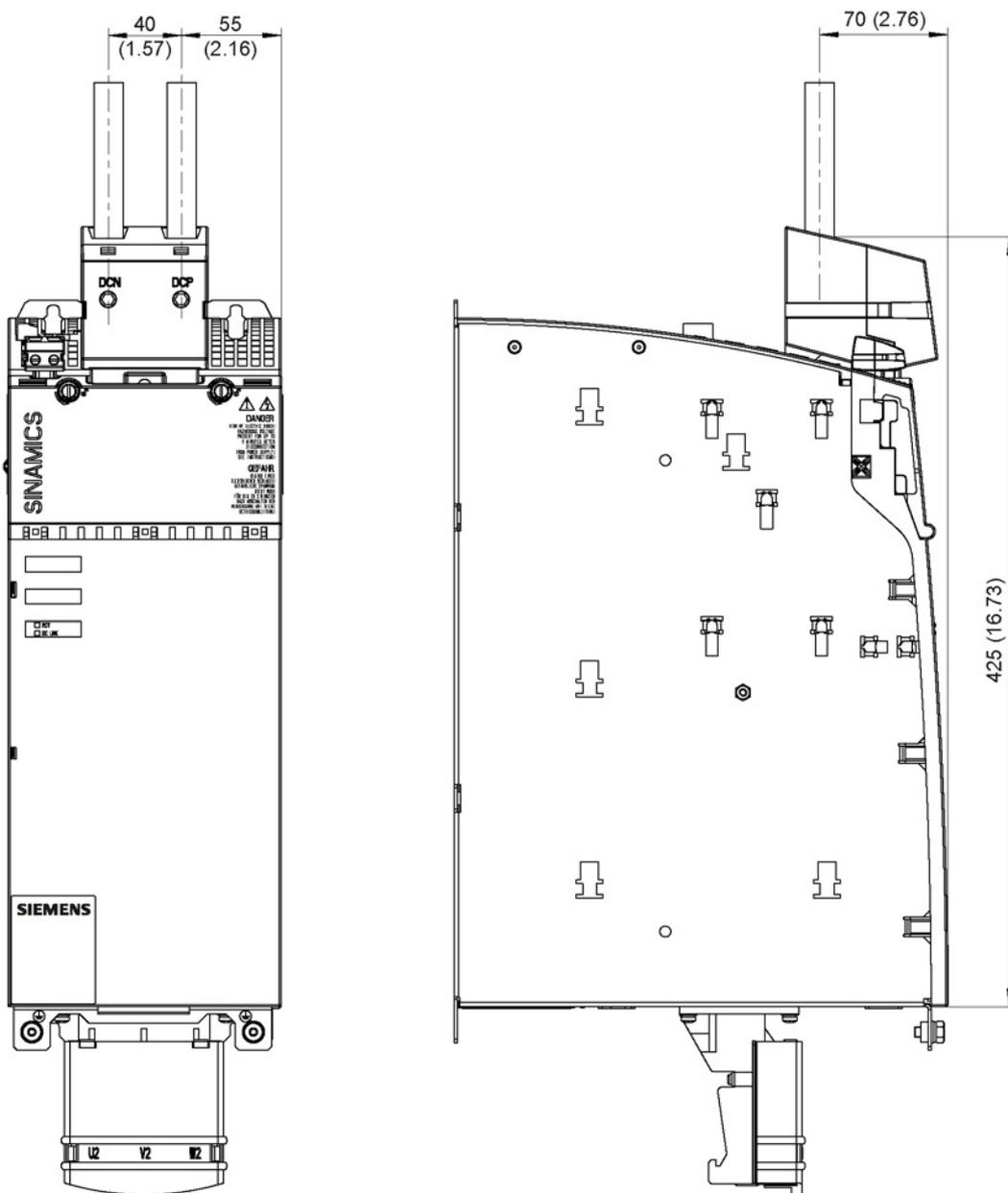


Figure 11-25 Dimension drawing of 150 mm wide component with DC link rectifier adapter for 35 to 95 mm², all dimensions in mm and (inch)

11.4.5 Mounting



! WARNING

Danger to life through electric shock if the cutout in the protective cover has been broken out

If the 24 V terminal adapter or the DC link infeed adapter is removed, and you touch live parts this will result in death or severe injury.

- Replace the protective cover with the broken out cutouts by a new protective cover.

11.4.5.1 Installation on components that are 50 mm and 100 mm wide

Required tools:

- Slot-head 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 11- 16 Removing the DC link busbars

| | | |
|---|--|--|
| | | |
| <p>Release and open the protective cover.</p> | <p>Remove the upper left-hand screw and the DC link bridge</p> | <p>Remove the lower left-hand screw and the DC link bridge</p> |

11.4 DC link rectifier adapter for Booksize format

| | | |
|--|--|--|
| | | <p>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).</p> |
| <p>Remove the upper and lower right-hand DC link screws.</p> | | |

Table 11- 17 Installing the DC link rectifier adapter and 24 V terminal adapter

| | | |
|---|--|---|
| | | |
| <p>Attach and screw (upper and lower screws) the DC link rectifier adapter at the right-hand side of the component using the original M4x20 screws.</p> | <p>Do NOT use the screw holes at the left-hand side of the component.</p> | <p>Attach and screw on the 24 V terminal adapter using the associated screw (provided in the accessories pack).</p> |

11.4 DC link rectifier adapter for Booksize format

| | | |
|---|--|---|
| | | |
| <p>Break out the cutouts in the protective cover.</p> | <p>Close the protective cover until you hear it snap into place.</p> | <p>Component with installed DC link rectifier adapter and 24 V terminal adapter</p> |

11.4.5.2 Installation on components that are 150 mm, 200 mm and 300 mm wide

Required tools:

- Slot-head 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 11- 18 Installation of the DC link rectifier adapter for 150 mm, 200 mm and 300 mm components

| | | |
|---|-----------------------------------|--|
| | | |
| <p>Release and open the protective cover.</p> | <p>Remove the DC link screws.</p> | <p>Engage the adapter in the grille.</p> |

11.4 DC link rectifier adapter for Booksize format

| | | |
|--|---|---|
| | | |
| <p>Attach the adapter busbars using the previously removed DC link screws.</p> | <p>Attached the adapter with the associated screw (accessories pack).</p> | <p>Insert and screw on the 24 V terminal adapter using the associated screw (provided in the accessories pack).</p> |
| | | |
| <p>Break out the cutouts in the protective cover.</p> | <p>Close the protective cover until you hear it snap into place.</p> | |

11.4.6 Electrical connection

Required tools:

- Flat-bladed screwdriver (0.8 x 4.0) for 50 mm and 100 mm components
- Size 6 Allen key for 150 mm, 200 mm and 300 mm components

Table 11- 19 Electrically connecting the DC link rectifier adapter for 50 mm and 100 mm components

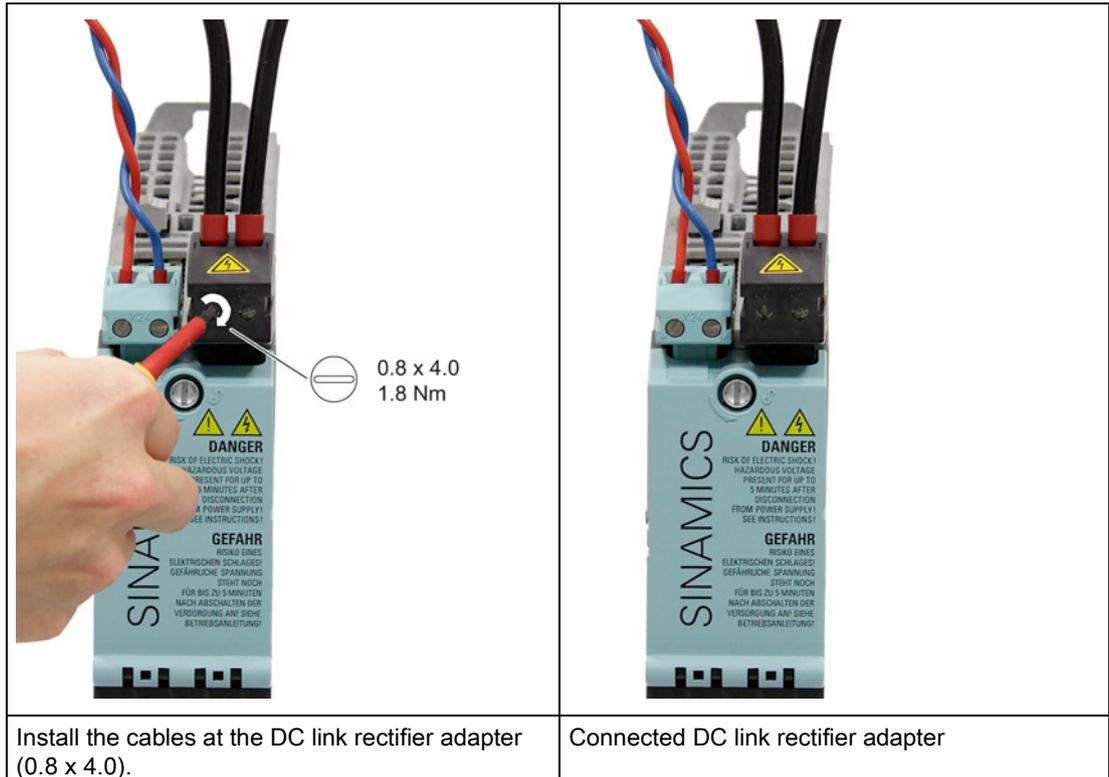


Table 11- 20 Electrically connecting the DC link rectifier adapter for 150 mm, 200 mm and 300 mm components

| | |
|---|--|
|  |  |
| Install the cables at the DC link rectifier adapter (hexagon socket-head screw) | Connected DC link rectifier adapter |

11.4.7 Technical specifications

Table 11- 21 Technical data DC link rectifier adapter

| DC link rectifier adapter | Unit | 6SL3162-2BD00-0AA0 | 6SL3162-2BM00-0AA0 |
|---|-----------------|---|---|
| Current carrying capacity | A | 43 | 240 |
| Connection cross-section | mm ² | 0.5 ... 10 | 35 ... 95 |
| Stripped length | mm | 11 | 27 |
| Attaching - Terminals - DC link busbars | | Slotted screw (0.8 x 4.0) Torx screw T20 | Hexagonal screw, size 6 Torx screw T20 |
| Tightening torque - Terminals - DC link busbars | Nm Nm | 1,8 1,8 | 13 1,8 |

11.5 DC link adapter

11.5.1 Description

DC-link adapters are required if the drive line-up is to be subdivided between two or more rows.

The 6SL3162-2BM01-0AA0 DC-link adapter can be mounted on all Line Modules and Motor Modules in the Booksize format without reinforced DC-link busbars.

The 6SL3162-2BM10-0AA0 DC-link adapter can be mounted on 50 mm and 100 mm wide Line Modules and Motor Modules in the Booksize format with reinforced DC-link busbars.

To connect the various sub line-ups, use shielded individual conductors that are mechanically secured.



DC-link adapter
6SL3162-2BM01-0AA0
(4-hole adapter)



DC-link adapter
6SL3162-2BM10-0AA0
for installation using reinforced DC-link
busbars
(2-hole adapter)

11.5.2 Safety instructions for DC link adapters

 **WARNING**

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.



⚠ DANGER

Danger to life through 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 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 five minutes have elapsed.
- Measure the voltage before starting work on the DCP and DCN DC-link terminals.



⚠ DANGER

Danger to life through 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

Danger to life through 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 modules¹⁾ (exception: Smart Line Module²⁾), 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 removed³⁾.

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

Danger to life through electric shock due to missing DC-link side covers

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

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

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



⚠ WARNING

Danger to life through electric shock due to incorrect connection to the DC link

Incorrect connections can lead to overheating and therefore a risk of fire. 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 |
| Risk of fire and damage to equipment due to short-circuit /ground fault 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. <ul style="list-style-type: none">• Protect the cables against mechanical damage.• Use the local installation regulations to avoid this fault. Also implement one of the following measures: <ul style="list-style-type: none">• Use cables with double insulation.• Maintain adequate clearance, e.g. by using spacers.• Lay the cables in separate cable ducts or conduits. |

| |
|---|
|  WARNING |
| Fire hazard 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 development of smoke. <ul style="list-style-type: none">• Ensure that the total length of the DC link including the connecting cables does not exceed 10 m. |

| |
|--|
| NOTICE |
| Material damage due to loose power connections Insufficient tightening torques or vibration can result in faulty electrical connections. This can cause fire damage or malfunctions. <ul style="list-style-type: none">• Tighten all power connections with the specified tightening torques, e.g. line supply connection, motor connection, DC-link connections.• Check the tightening torques of all power connections at regular intervals and tighten them when required. This applies in particular after transport. |

11.5.3 Interface description

11.5.3.1 Overview

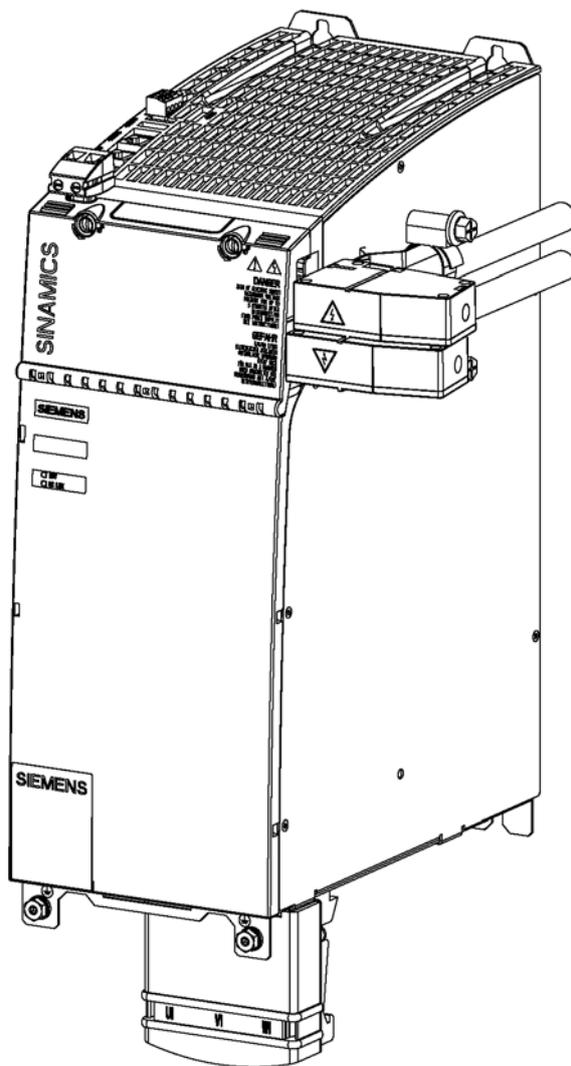


Figure 11-26 150 mm wide components with DC link adapter for multi-tier configurations

11.5.3.2 DC link connection

Table 11- 22 DC link connection

| Terminal | Function |
|----------|------------------|
| DCP | DC link positive |
| DCN | DC link negative |



 **WARNING**

Danger to life due to electric shock and risk of fire when 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.

11.5.4 Dimension drawing

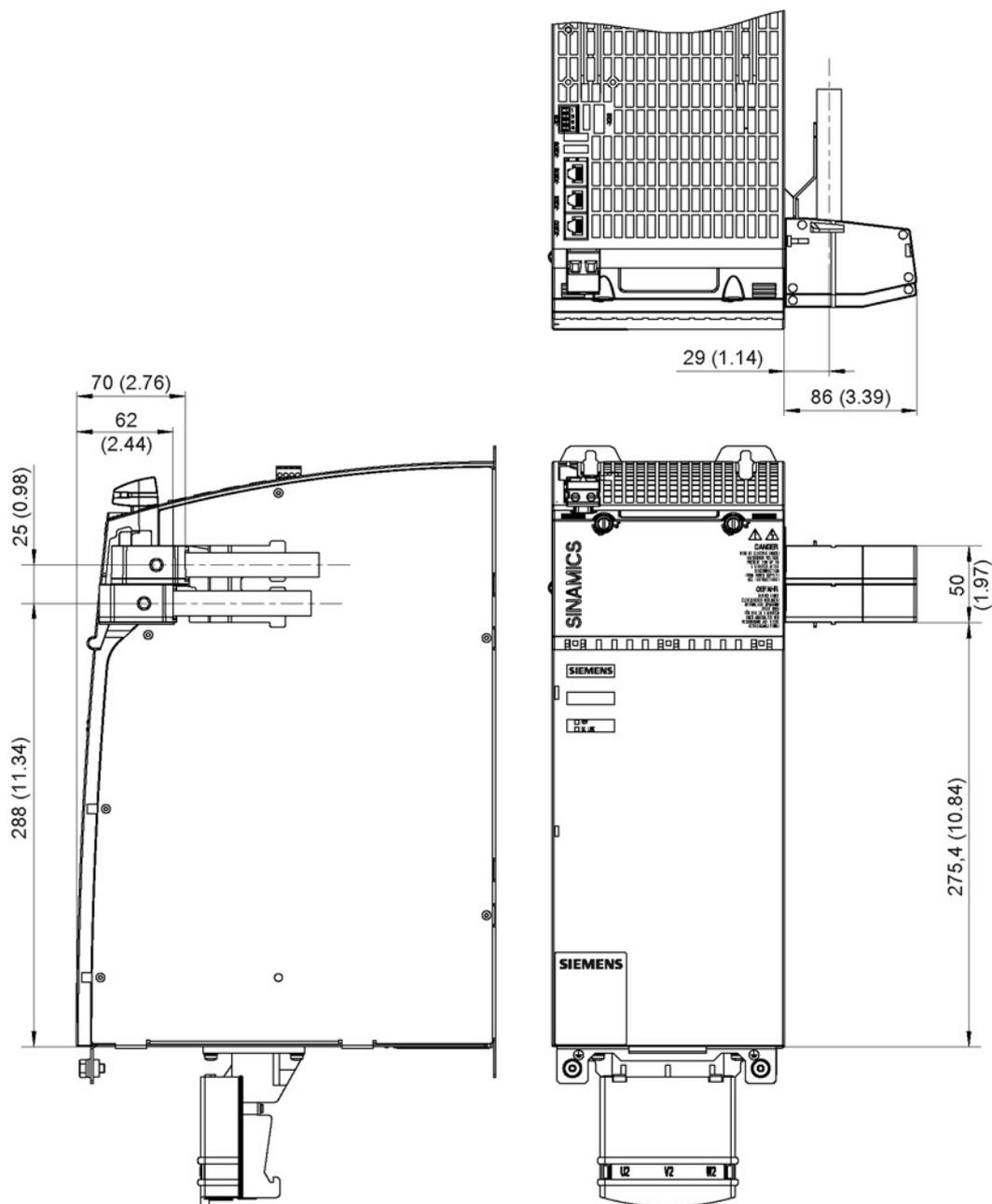


Figure 11-27 Dimension drawing of a 150 mm wide component with DC link adapter, all dimensions in mm and (inches)

11.5.5 Installation

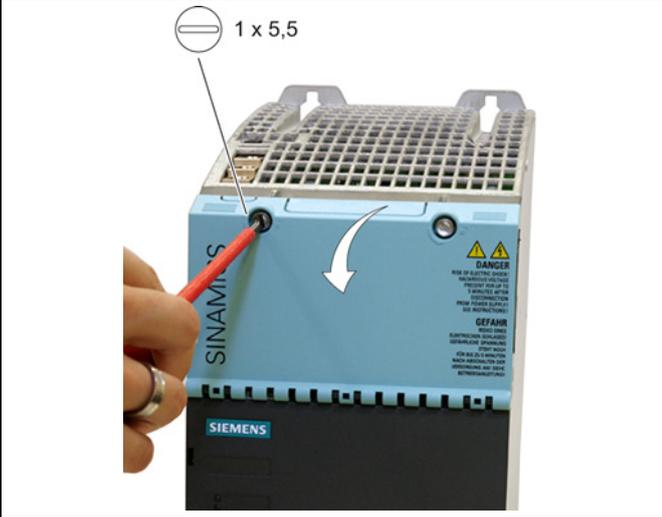
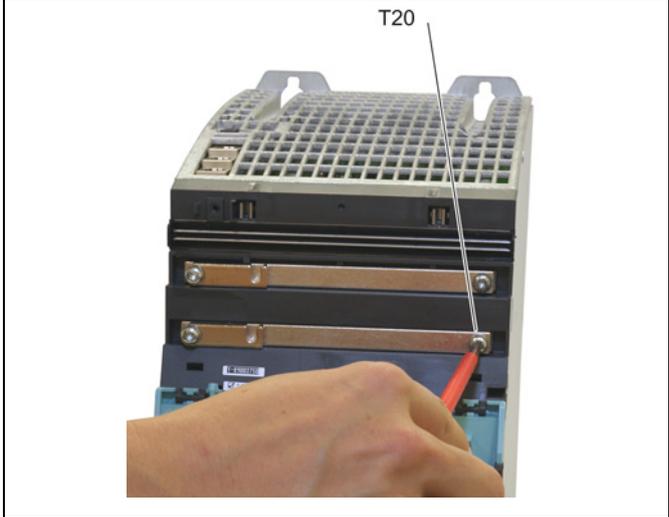
Note

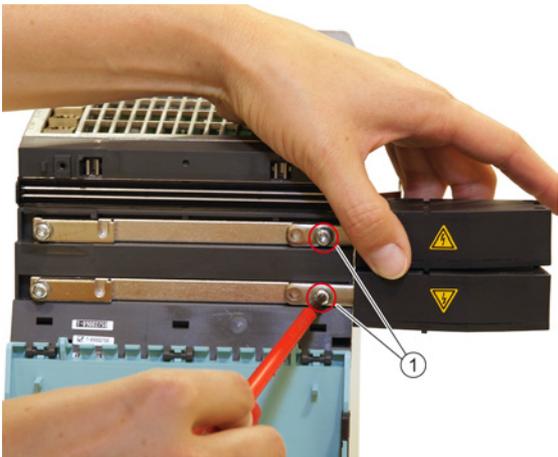
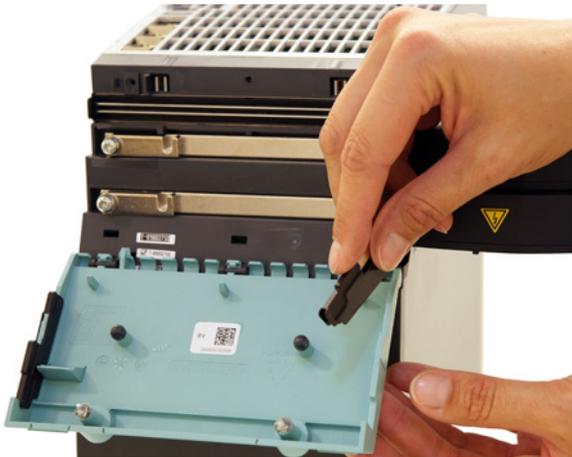
By moving the adapter housing, the DC-link adapter can be fitted on either the left-hand or right-hand side of the component. This configuration is possible for all Active Line Modules.

Required tools:

- Slot-head screwdriver (1 x 5.5) for releasing the protective cover
- Torx screwdriver T20 for DC-link screws (Torx slot)

Table 11- 23 Mounting the DC-link adapter

| | |
|--|---|
|  |  |
| <p>Release and open the protective cover of the DC link.</p> | <p>Remove the DC-link screws.</p> |

| | |
|--|--|
|  |  |
| <p>Attach the DC-link adapter (1.8 Nm) with the DC-link screws that were previously removed¹⁾. Use the right-hand holes ① when using two screws for mounting.</p> <p>¹⁾ Observe the special issues when using reinforced DC-link busbar (refer below)</p> | <p>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.</p> |
|  | |

Installed DC-link adapter and 24 V terminal adapter



! DANGER

Danger to life through 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

Danger to life through 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.

Note

- When mounting with only two screws, use the inner hole of the adapter busbar.

NOTICE

Damage when mounting using two screws

For DC-link adapters that are mounted using only two 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 two screws, then you must limit the current to 150 A.

Using washers when mounting the DC-link adapter

! WARNING

Danger to life as a result of overheating and risk of fire when mounting the DC-link adapter without washers

When 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.

- Use one of the washers provided for each screw.

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.

| Module width | DC-link adapter connection | |
|--------------|----------------------------|------------|
| | Left | Right |
| 50 - 100 mm | No washers | No washers |
| 150 - 300 mm | Washers | No washers |

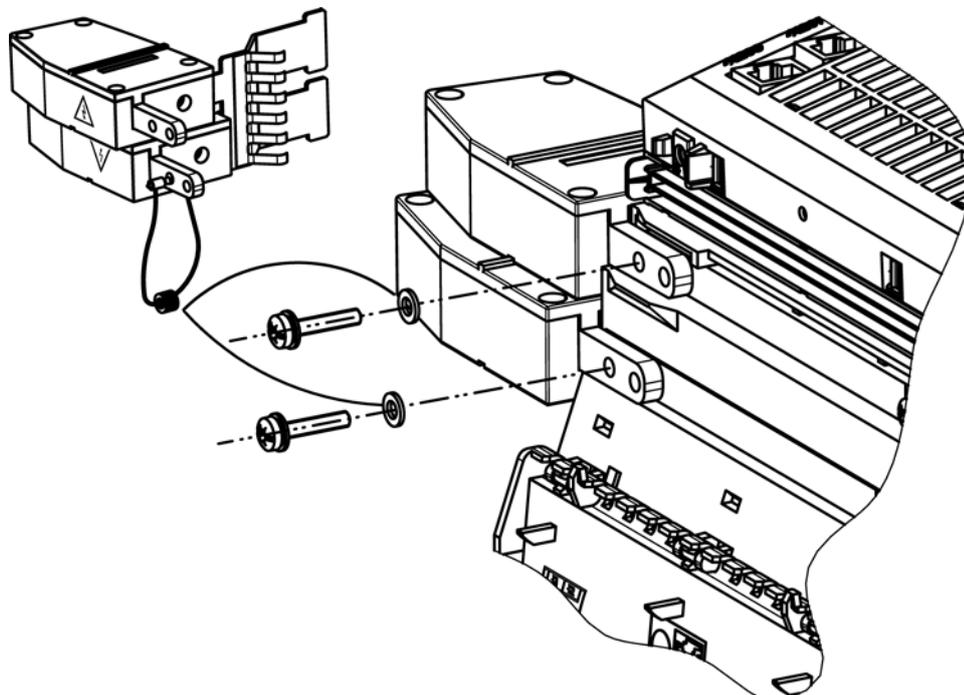


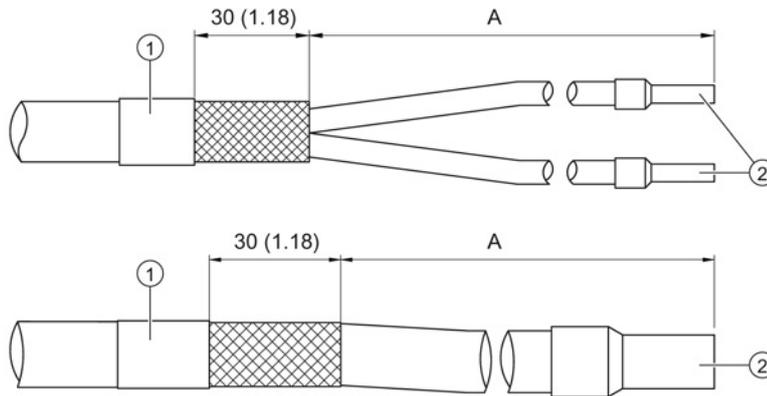
Figure 11-28 Mounting a DC-link adapter on the left-hand side for module widths of 150 to 300 mm using two screws

11.5.6 Electrical connection

11.5.6.1 Preparing the cables

Prepare the DC link connecting cables as shown below.

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 11-29 Single-core and two-core DC link connecting cable with insulated end sleeves, all dimensions in mm and (inch)

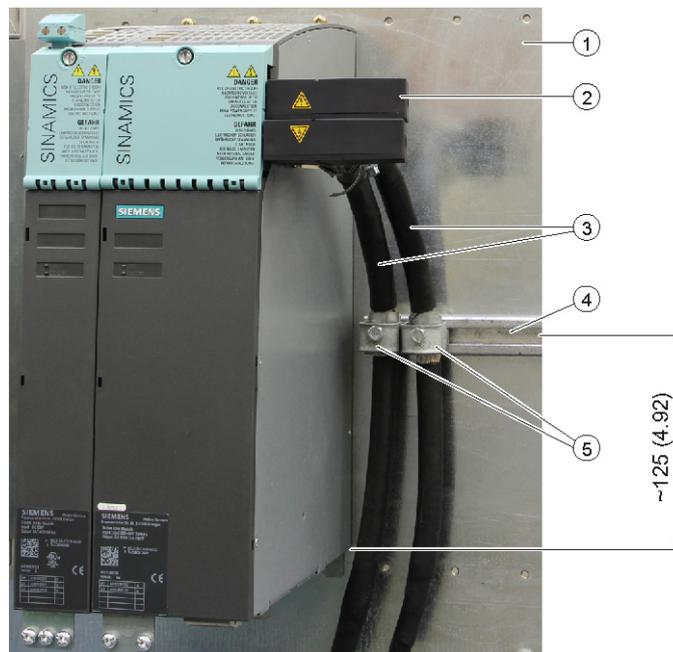
Refer to the table below for dimension A:

| Conductor cross-section [mm ²] | Mounting location of the DC link adapter at the drive line-up | Connection | A [mm] |
|--|---|------------|--------|
| 50 / 70 / 95 | Left | DCP | 70 |
| | | DCN | 60 |
| | Right | DCP | 60 |
| | | DCN | 70 |

11.5.6.2 Fixing the cables to the rear cabinet panel

Fix the DC link connecting cables directly next to the last component at the rear control cabinet panel. To do this, use C profile rails and matching cable clamps from the Rittal company. The distance between the C profile rail and the lower side of the component is approximately 125 mm.

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 the Rittal company (order number 7831.570 / 7831.571)
- ⑤ Cable clamps for C profile rails from the Rittal company

Figure 11-30 Fixing the DC link connecting cable to the control cabinet panel, dimensions in mm and (inch)

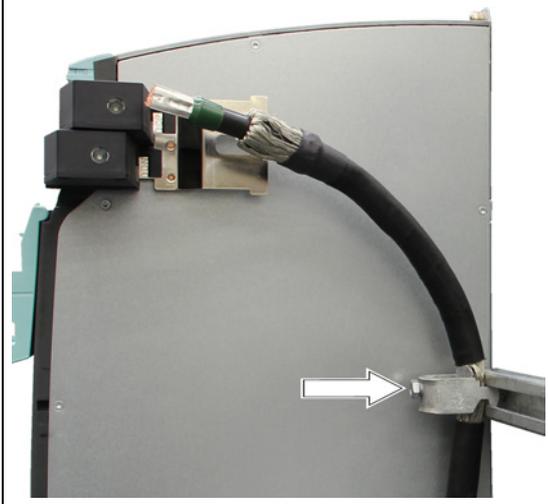
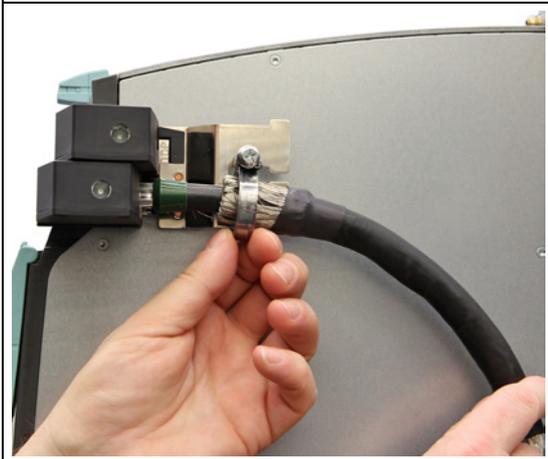
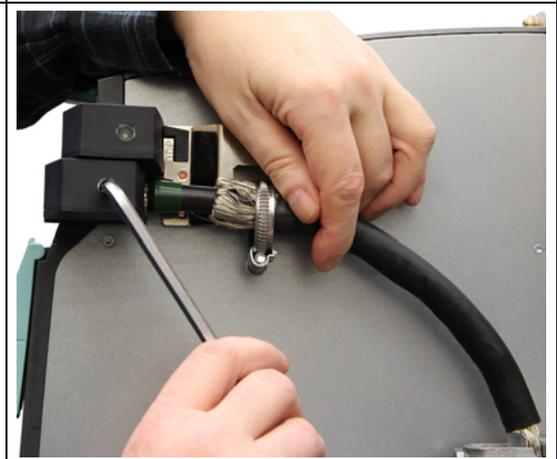
11.5.6.3 Cable connection and shield support

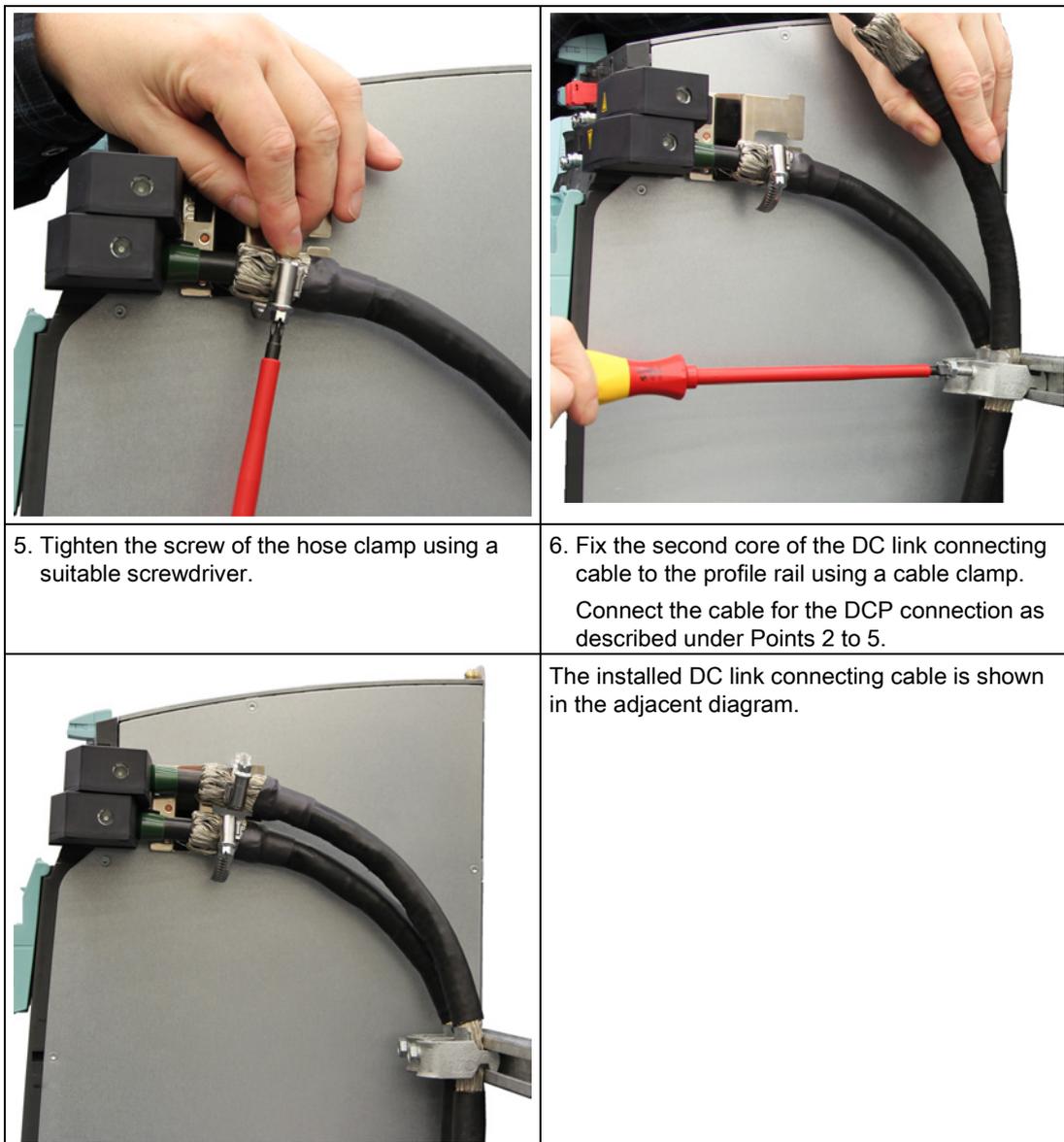
In order to simplify installing the DC link connecting cables at the DC link adapter, first fix the cables to the control cabinet panel (also see Chapter Fixing cables to the control cabinet panel (Page 675)).

Required tools:

- Size 6 Allen key to attach the cables
- Suitable tool for hose clamps, e.g. flat-bladed screwdriver

Table 11- 24 Connecting the DC link connecting cables to the DC link adapter

| | |
|---|--|
|  |  |
| <p>1. Fix the first core of the DC link connecting cable to the profile rail using a cable clamp.</p> | <p>2. Route the cable end through an appropriate cable clamp.</p> |
|  |  |
| <p>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.</p> | <p>4. Tighten the cable using an Allen key.</p> |

**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.

11.5.7 Technical specifications

Table 11- 25 Technical data DC link adapter

| 6SL3162- | Unit | 2BM01-0AA0 | 2BM10-0AA0 |
|---|-----------------|------------|------------|
| Current-carrying capacity – attached using 2 screws – attached using 4 screws | A A | 150 240 | 150 --- |
| Connection cross-section | mm ² | 35 ... 95 | 35 ... 95 |
| Stripped length | mm | 27 | 27 |
| Tightening torque – terminals – DC link busbars | Nm Nm | 13 1.8 | 13 1.8 |
| Weight | kg | 0.34 | 0.33 |

11.6 DRIVE-CLiQ cabinet bushings

11.6.1 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 for DRIVE-CLiQ cables is available with DRIVE-CLiQ connector and M12 connector/socket.

DRIVE-CLiQ cabinet bushing for DRIVE-CLiQ connectors

The cabinet bushing has degree of protection IP54 according to EN 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 EN 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.

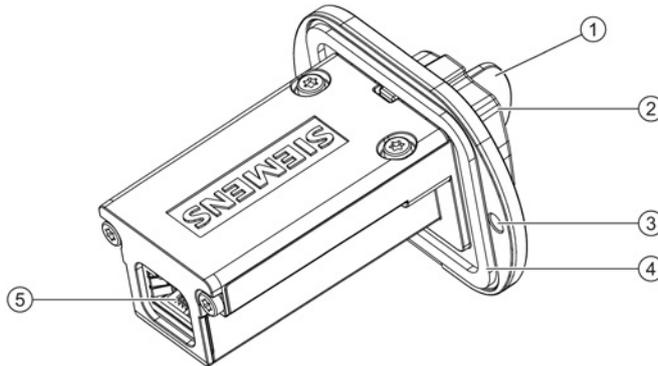
DRIVE-CLiQ cabinet bushing for M12 plug/socket

The cabinet bushing has degree of protection IP67 according to EN 60529 from the outside towards the inside. Inside the cabinet a connection according to degree of protection IP67 in compliance with EN 60529 is realized.

11.6.2 Interface description

11.6.2.1 Overview

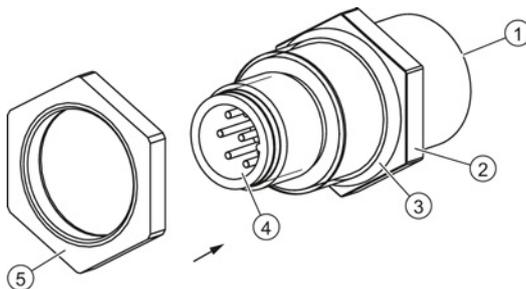
DRIVE-CLiQ cabinet bushing for DRIVE-CLiQ cables with DRIVE-CLiQ connectors



- ① Protective cap, Yamaichi, order number: 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 control cabinet
- ⑤ DRIVE-CLiQ interface on the inside (to connect DRIVE-CLiQ signal cables MOTION-CONNECT with IP20 degree of protection)

Figure 11-31 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
- ④ DRIVE-CLiQ interface with M12 plug (8-pin)
- ⑤ O ring, SW20, tightening torque: 3 to 4 Nm

Figure 11-32 Interface overview, DRIVE-CLiQ cabinet bushing M12

11.6.3 Dimension drawings

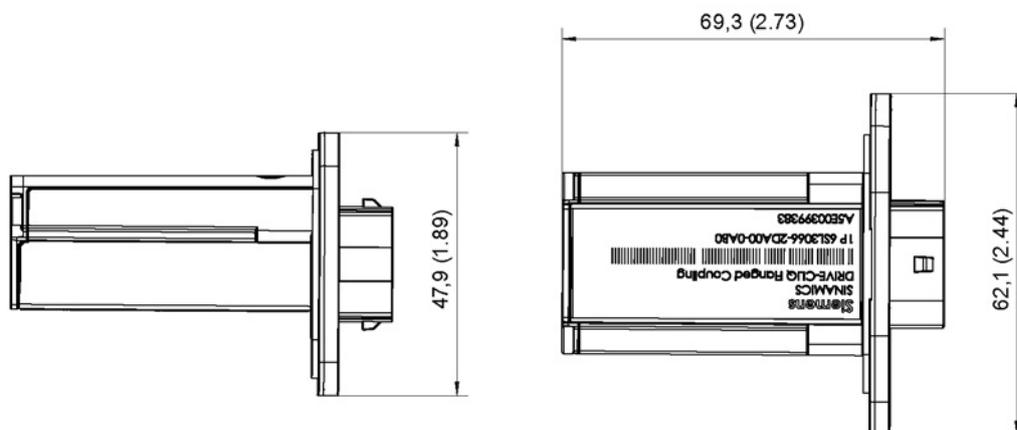
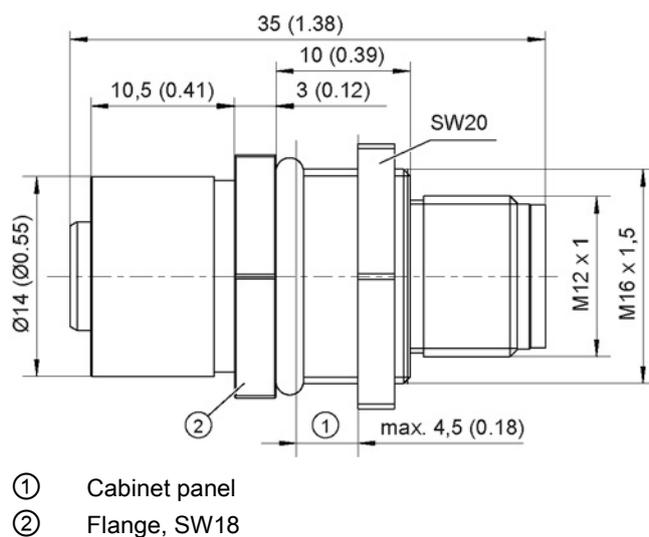


Figure 11-33 Dimension drawing of the DRIVE-CLiQ cabinet gland, all dimensions in mm and (inches)



- ① Cabinet panel
- ② Flange, SW18

Figure 11-34 Dimension drawing of the DRIVE-CLiQ cabinet bushing M12, all dimensions in mm and (inches)

11.6.4 Mounting

11.6.4.1 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.

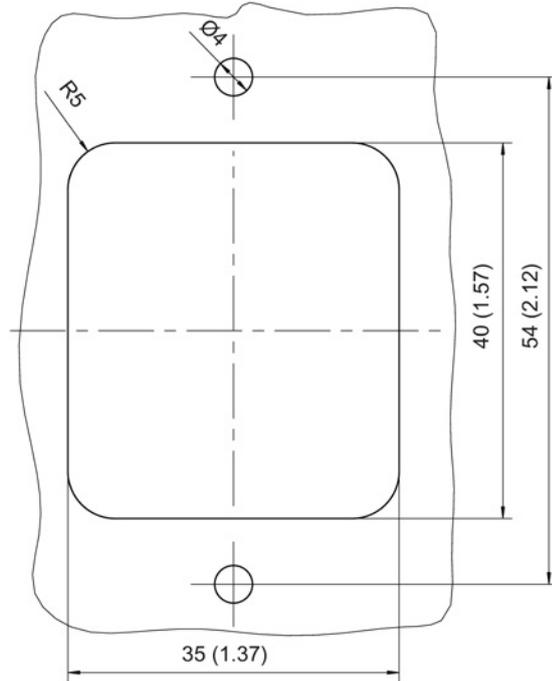
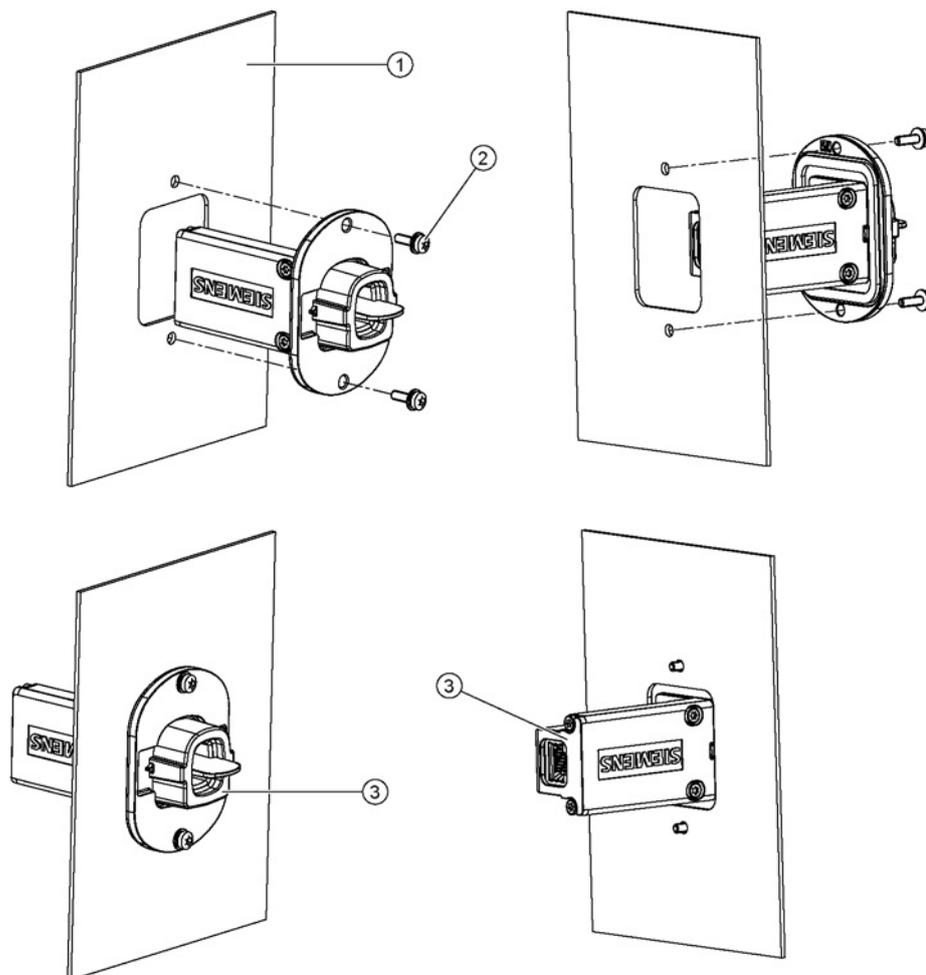


Figure 11-35 Cutout in the control cabinet, all dimensions in mm and (inches)

Installation

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.



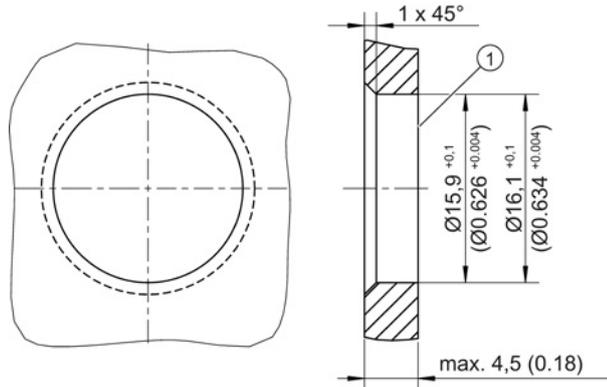
- ① Control cabinet panel
- ② M3 screw, tightening torque 0.8 Nm
- ③ DRIVE-CLiQ cabinet bushing

Figure 11-36 Installing the DRIVE-CLiQ cabinet bushing for cables with DRIVE-CLiQ connectors

11.6.4.2 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. The removable O ring can be screwed from the inside or the outside.

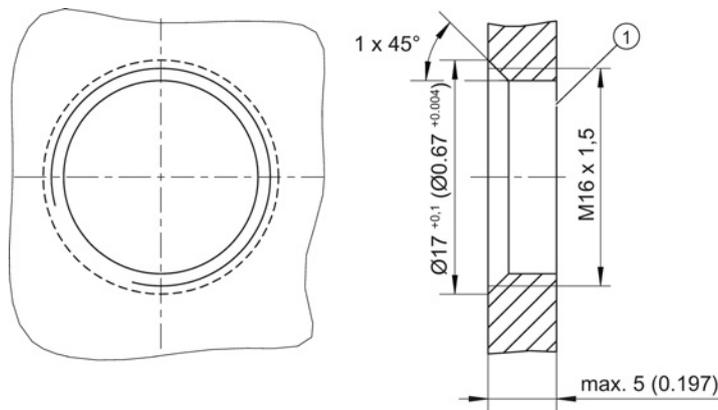
Mounting from the inside using an O ring that can be screwed



① Through-hole with chamfer

Figure 11-37 Through-hole for mounting the DRIVE-CLiQ cabinet bushing M12 with an O-ring that can be screwed from the inside

Mounting from the outside using an O ring that can be screwed

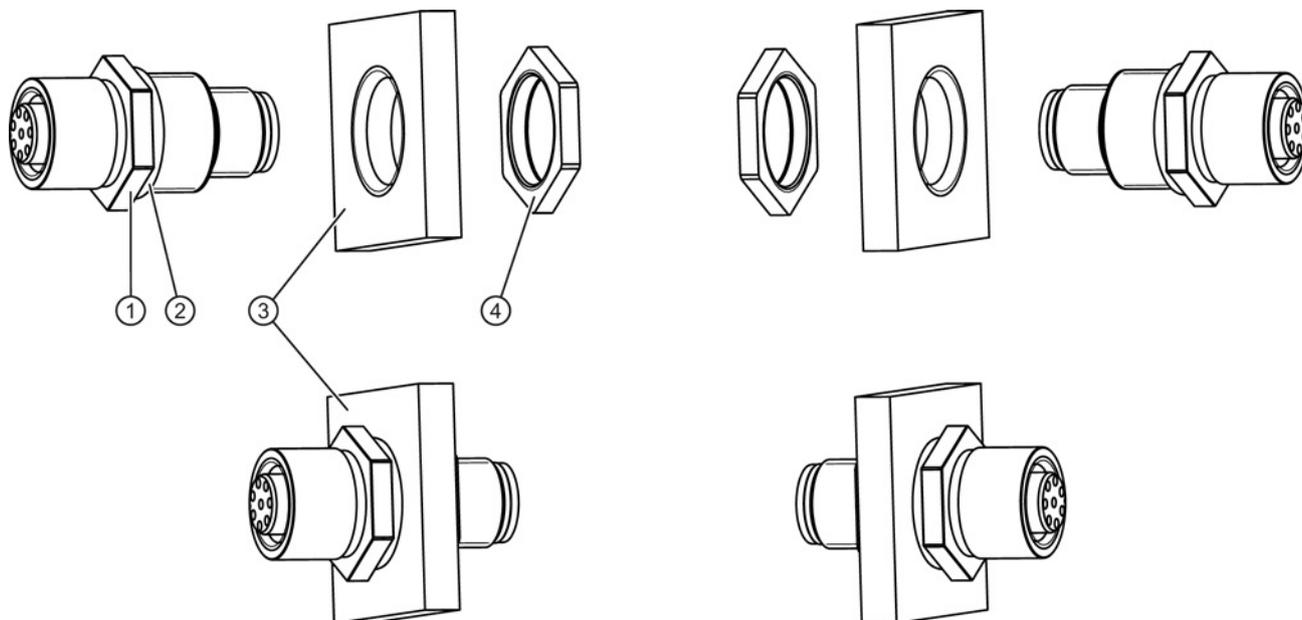


① Threaded hole with chamfer

Figure 11-38 Threaded hole for mounting the DRIVE-CLiQ cabinet bushing M12 with an O-ring that can be screwed from the outside

Installation

1. Insert the DRIVE-CLiQ cabinet bushing through the opening in the cabinet.
2. Fasten the DRIVE-CLiQ cabinet bushing using the associated O ring with a tightening torque of 3 to 4 Nm



- ① Flange, SW18
- ② Seal
- ③ Cabinet panel
- ④ O ring, SW20, tightening torque: 3 to 4 Nm

Figure 11-39 Mounting DRIVE-CLiQ cabinet bushings for cables with M12 connectors

11.6.5 Technical data

Table 11- 26 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 according to EN 60529 | | IP54 outside the control cabinet IP20 or IPXXB inside the control cabinet | IP67 |

11.7 DRIVE-CLiQ coupling

11.7.1 Description

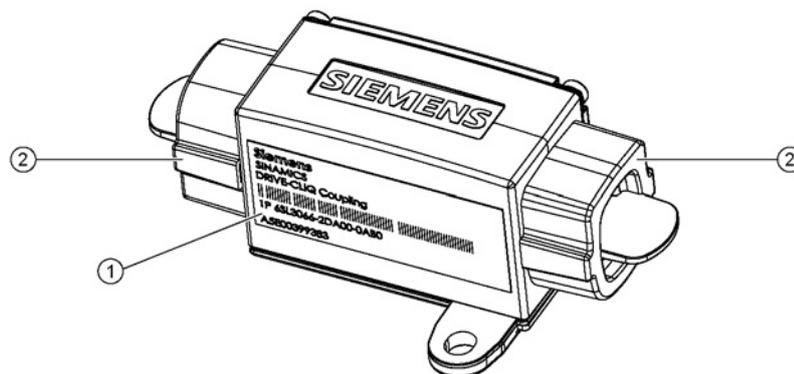
The DRIVE-CLiQ coupling is used to connect 2 DRIVE-CLiQ cables in accordance with degree of protection IP67 acc. to EN 60529.

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 731)

11.7.2 Interface description

11.7.2.1 Overview



- ① Rating plate
- ② Protective cap, Yamaichi, order number: Y-ConAS-24-S

Figure 11-40 Interface overview, DRIVE-CLiQ coupling

11.7.3 Dimension drawing

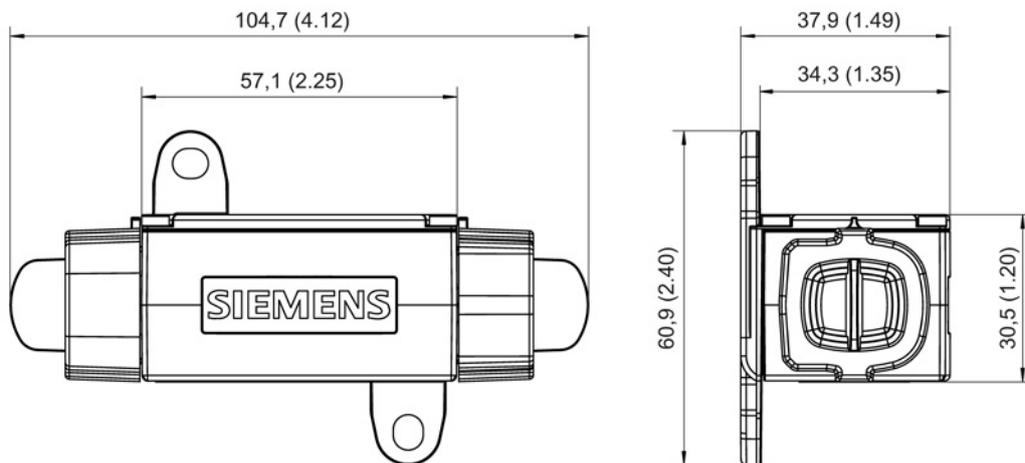
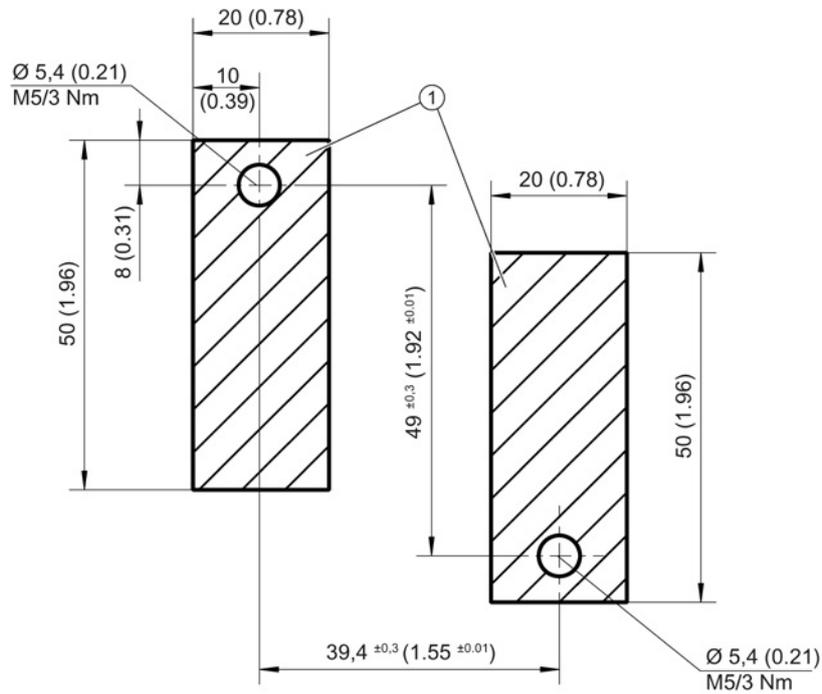


Figure 11-41 Dimension drawing of the DRIVE-CLiQ coupling, all dimensions in mm and (inches)

11.7.4 Mounting



① Contact surface

Figure 11-42 Hole drilling pattern for installation

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 DRIVE-CLiQ connectors at both sides of the DRIVE-CLiQ coupling.

11.7.5 Technical data

Table 11- 27 Technical data

| DRIVE-CLiQ coupling 6SL3066-2DA00-0AB0 | Unit | |
|--|-----------------------|-------|
| Weight | kg | 0,272 |
| Degree of protection | IP67 acc. to EN 60529 | |

11.8 Spacing bolt for Booksize Compact components

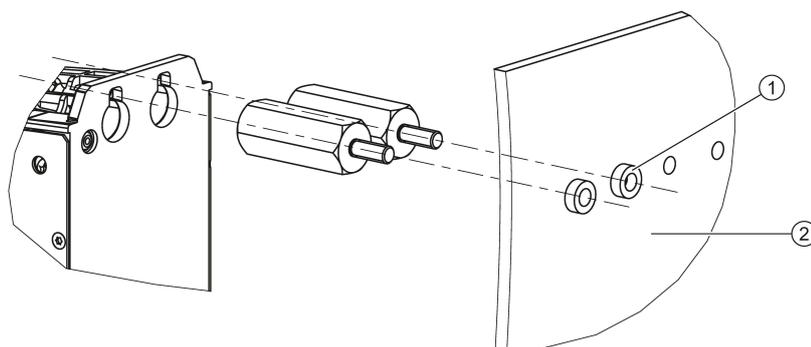
To increase the mounting depth of modules in Booksize Compact format, use spacing bolts (order number: 6SL3462-1CC00-0AA0). In this way, it is possible to combine modules in Booksize Compact format directly with booksize modules with internal air cooling.

Table 11- 28 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 \pm 0.15 mm for module width 75 mm
- Distance 50 mm \pm 0.15 mm for module width 100 mm



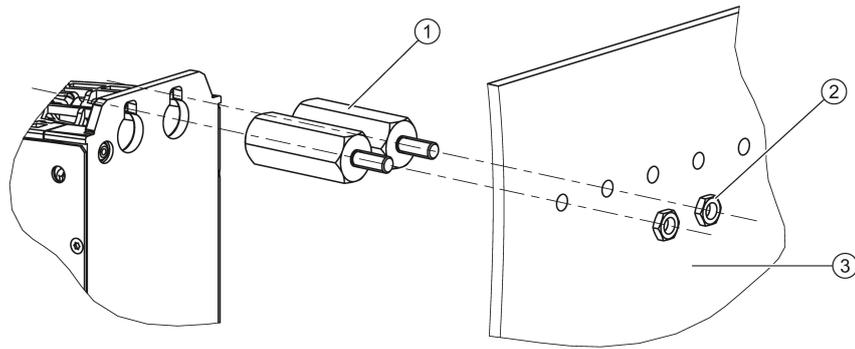
- ① M6 press-in nuts
- ② Mounting wall

Figure 11-43 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 \varnothing 6.5 mm holes for spacing bolts
- Distance 25 mm \pm 0.15 mm for module width 75 mm
- Distance 50 mm \pm 0.15 mm for module width 100 mm

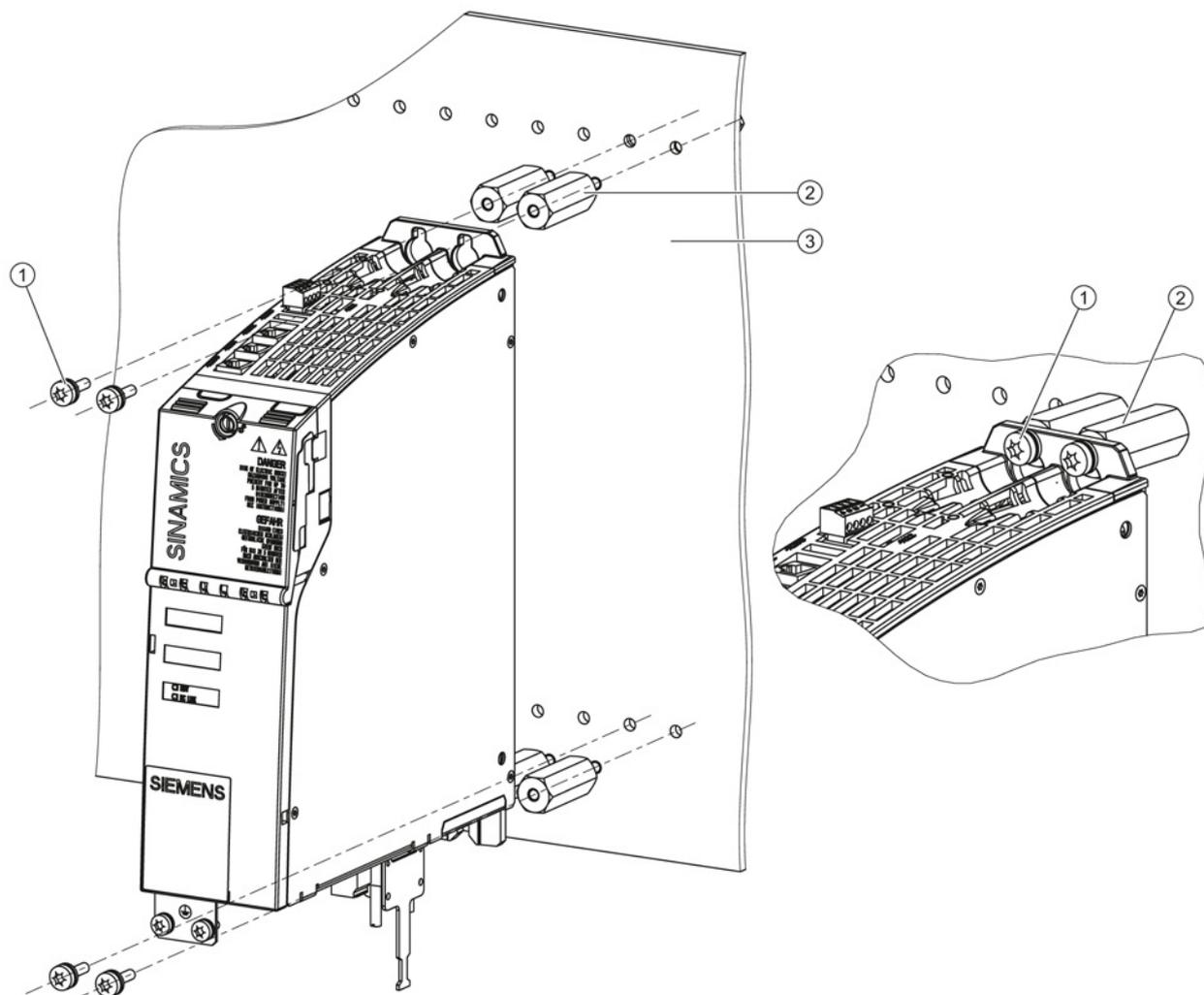


Spacing bolt
M6 nuts
Mounting wall

Figure 11-44 Mounting the spacing bolts with M6 nuts on the rear of the mounting panel

Tightening torque: 6 Nm

Mounting a component in booksize compact format with spacing bolts



- 1 M6 x 20 screw, Torx T27
- 2 Spacing bolts, SW 17 (6SL3462-1CC00-0AA0)
- 3 Mounting wall

Figure 11-45 Mounting a component in booksize compact format with spacing bolts (example: Motor Module Booksize Compact, 18 A)

Tightening torque: 6 Nm

12.1 General information

The SINAMICS S components are designed in accordance with degree of protection IP20 or IPXXB according to EN 60529 and as open-type devices to UL 50. This ensures protection against electric shocks.

To ensure protection against mechanical stress and climatic conditions too, the components should only be operated in housing, cabinets or enclosed electrical operating areas that fulfill at least degree of protection IP54 and, as enclosure type 12, are designed to UL 50.

Prefabricated MOTION-CONNECT cables are recommended.

Note

Functional safety of SINAMICS components

Installation in a cabinet with degree of protection IP54 according to EN 60529 is recommended to ensure the safety functions of Safety Integrated are not compromised.

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 for 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 360 V 3 AC to 440 V 3 AC

12.2 Safety instructions when mounting and installing the control cabinet

| |
|--|
|  WARNING |
| <p>Danger to life if the fundamental safety instructions and remaining risks are not carefully observed</p> <p>If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.</p> <ul style="list-style-type: none"> • Adhere to the fundamental safety instructions. • When assessing the risk, take into account residual risks. |

| |
|---|
|  WARNING |
| <p>Risk of injury as a result of foreign bodies in the device</p> <p>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).</p> <ul style="list-style-type: none"> • 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. |

12.3 Directives

The product satisfies the protection targets of the following EU Directives applicable within the European Economic Area (EEA):

Table 12- 1 Directives

| Directive | Description |
|-------------|---|
| 2006/95/EC | Directive of the European Parliament and Council of December 12, 2006, on the approximation of the laws of the member states relating to electrical equipment designed for use within certain voltage limits (Low-Voltage Directive). |
| 2004/108/EC | Directive of the European Parliament and Council of December 15, 2004, which repeals directive 89/336/EEC, on the approximation of laws of the member states relating to electromagnetic compatibility (EMC Directive). |

12.4 Notes on electromagnetic compatibility (EMC)

Requirements to implement the EMC are listed in EN 61000-6-2, EN 61000-6-4, EN 61800-3, EN 60204-1 and in the Configuration Manual "EMC Installation Guideline" (order number 6FC5297-0AD30-0□P□). Conformance with the EMC Directive of the EC is ensured by following the measures described in the Configuration Manual, "EMC installation guideline". When installing components in cabinets, in order to fulfill the EMC Directive, the following conditions must be additionally observed:

- Operation on TN and TT line supply systems with grounded neutral point and grounded protective conductor as well as to IT line supply systems
- 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

Radio service interference due to radio disturbances in residential environments

In a residential environment this product can cause radio disturbances, which may make interference suppression measures necessary.

This device is not designed for unrestricted operation in the first environment (residential environment) and may not be used in the first environment without suitable interference suppression measures.

- Have qualified personnel carry out the installation and commissioning with suitable interference suppression measures.

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 DRIVE-CLiQ coupling and DRIVE-CLiQ cabinet bushing described in Chapter Accessories (Page 617)

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.
-

12.5 Arrangement of components and equipment

12.5.1 General information

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

- Space requirements
- Cable routing
- Bending radii of the connecting cables
MOTION-CONNECT cables, refer to catalog PM21 or NC61
- Heat dissipation
- 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).

12.5.2 Current carrying capacity of the DC link busbar

The current carrying capacity of the DC link busbar must be observed for the configuration and arrangement of the drive line-up. The maximum current carrying capacity of the DC link busbar differs for the various module widths.

Table 12- 2 Maximum current carrying capacity of the DC link busbar

| Current carrying capacity of the DC link busbar | Components |
|---|---|
| 100 A | <ul style="list-style-type: none"> • Motor Modules from 50 mm to 100 mm wide • DC link components |
| 150 A | <ul style="list-style-type: none"> • Motor Modules from 50 to 100 mm wide with reinforced DC link busbars |
| 200 A | <ul style="list-style-type: none"> • Motor Modules from 150 to 300 mm wide |

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:

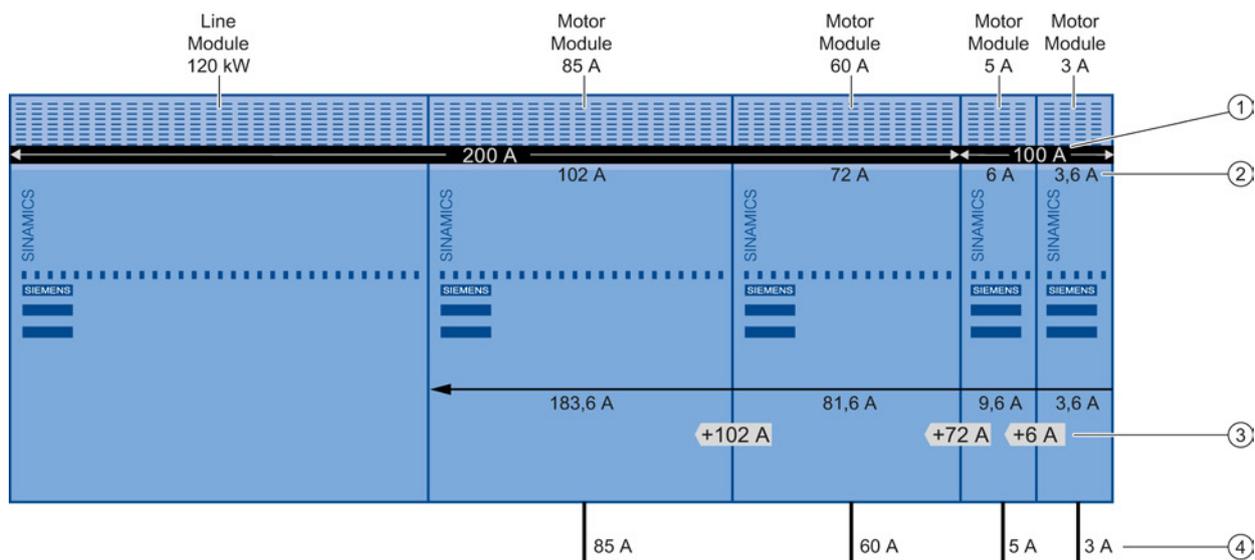
- Center infeed: Arrangement of the drive line-up with infeed to the left and right (example 2)
- Use of another Line Module

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 data 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.

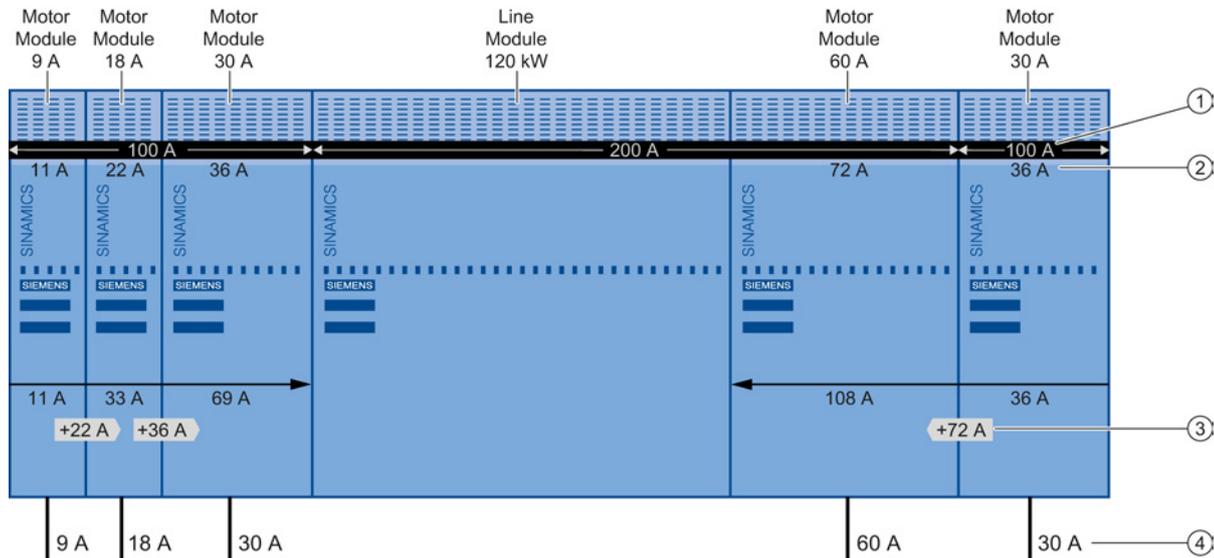


- ① DC link busbar current carrying capacity
- ② DC link busbar load: DC link current I_d at the rated current I_n of the Motor Module
- ③ Increased load of the DC link busbar
- ④ Motor current = rated output current I_n of the Motor Module

Figure 12-1 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 12-2 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!

12.5.3 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

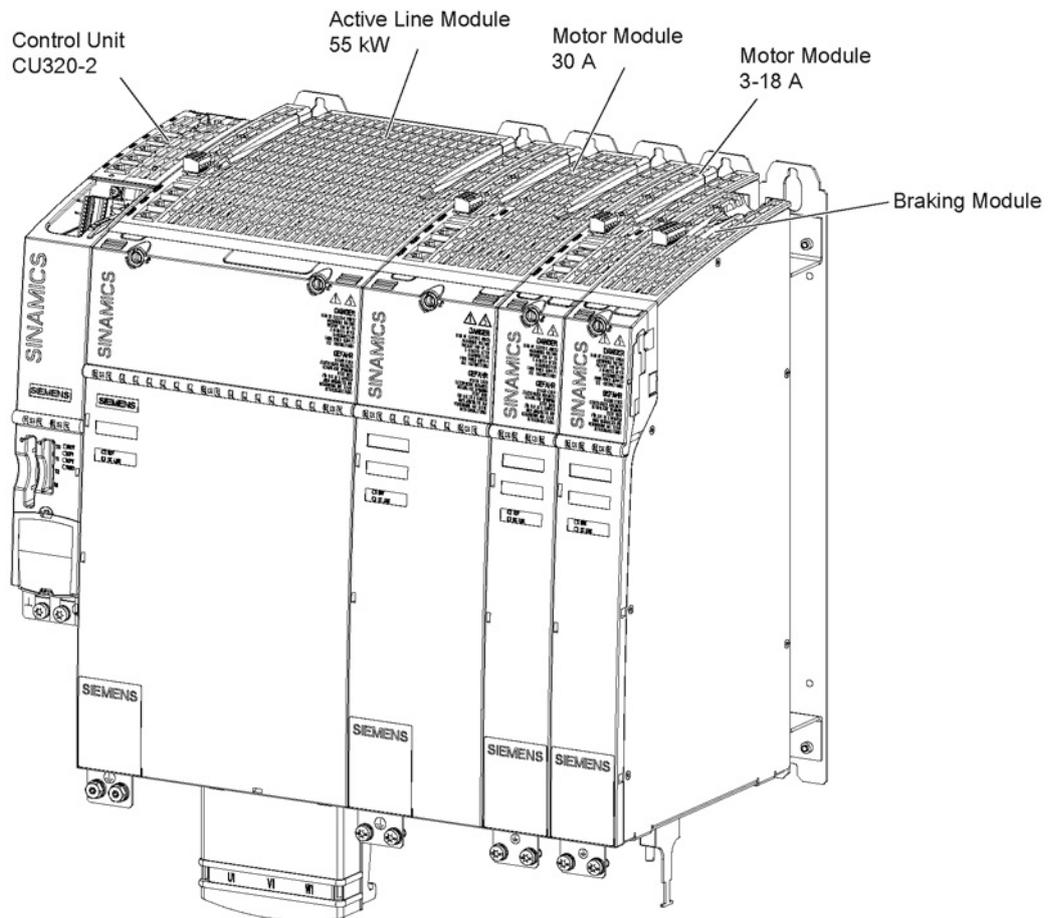


Figure 12-3 Example of a single drive line-up with internal air cooling

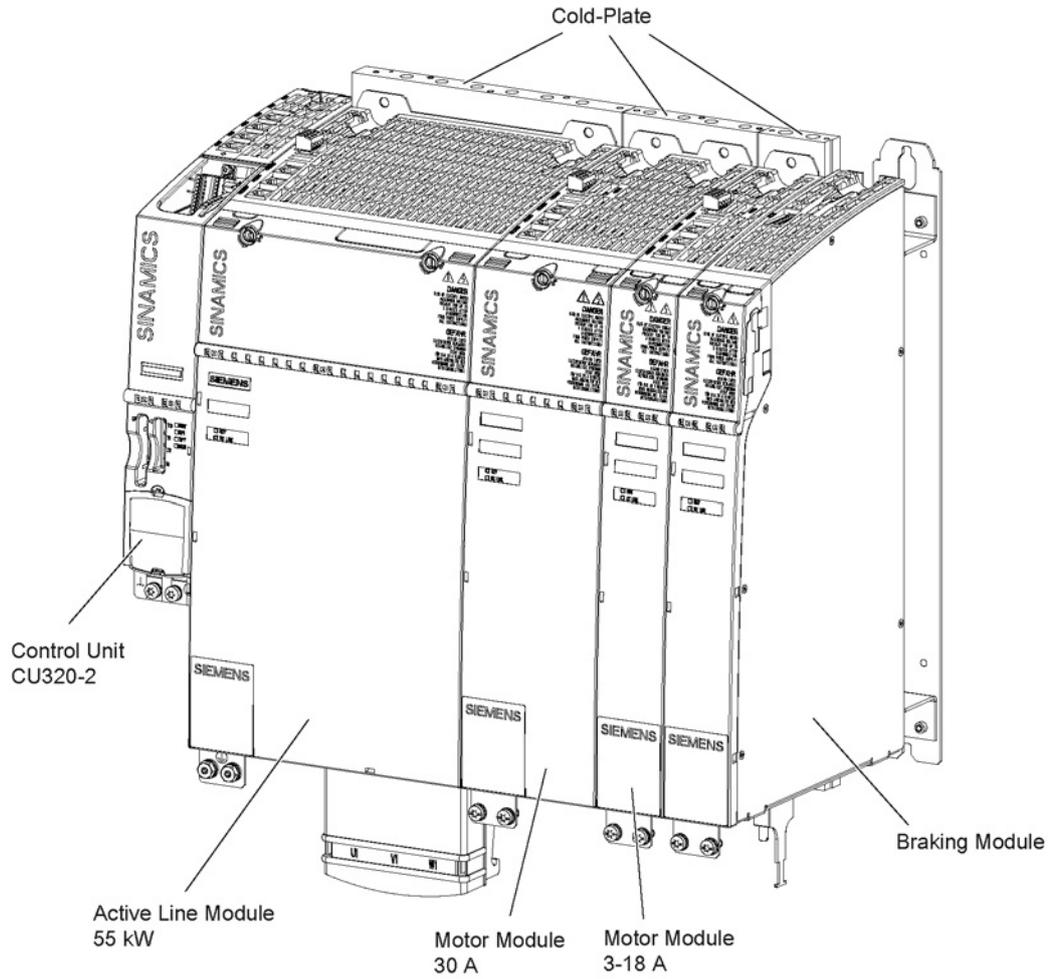


Figure 12-4 Example of a single drive line-up with cold plate

12.5.4 Multi-tier drive line-up

12.5.4.1 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 617)) 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 modules primarily depends on the wiring, the cable cross-section and the bending radius of the power cables to be connected.
- The inlet temperature of the air sucked in for cooling the module must not exceed 40° C (with derating, it must not exceed 55° C). This must be ensured by means of suitable air guidance, the distance between the module rows, or by 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 699) 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
-

Note

Wiring rules for DRIVE-CLiQ

Refer to the Commissioning Manual.

12.5.4.2 Selecting the DC link rectifier adapter and DC link adapter

Table 12- 3 Overview of the DC link rectifier adapter and DC link adapter

| | Suitable for module width | Max. connectable cross-section | Max. current carrying capacity |
|--|---------------------------|--------------------------------|--------------------------------|
| DC link rectifier adapter (cable outlet on top) | | | |
| 6SL3162-2BD00-0AAx | 50 mm, 100 mm | 10 mm ² | 43 A |
| 6SL3162-2BM00-0AAx | 150 mm, 200 mm, 300 mm | 95 mm ² | 240 A |
| DC link adapter (cable outlet on side) | | | |
| 6SL3162-2BM01-0AAx | All module widths | 95 mm ² | 240 A |
| 6SL3162-2BM10-0AAx | 50 mm, 100 mm | 95 mm ² | 150 A |

Note

Using DC link adapters

DC link adapters are only required to configure a multi-tier drive line-up.

12.5.4.3 Connection versions for the DC link adapter

Depending on the technical requirements and the space available in the control cabinet, for multi-tier drive line-ups, there are different options when it comes to connecting the DC-link adapter.

Note

Special feature: Short DC-link screws

Because of the compact construction and the required voltage separations, the left-hand DC-link screws are shorter (16 mm) than the other DC-link screws (20 mm) for modules with 50-100 mm installation width.

Note

Special feature: Different number of DC-link screws

Modules with an installation width of 200 mm or larger require two screws per DC-link busbar on the right-hand DC-link connection side in order to carry the higher amperages.

Note

Special feature: Washers during installation of the DC-link adapter

The supplied washers must also be installed on the left-hand side during the installation of the DC-link adapter for modules with an installation width of 150 mm or greater.

Table 12-4 Comparison of the connection versions

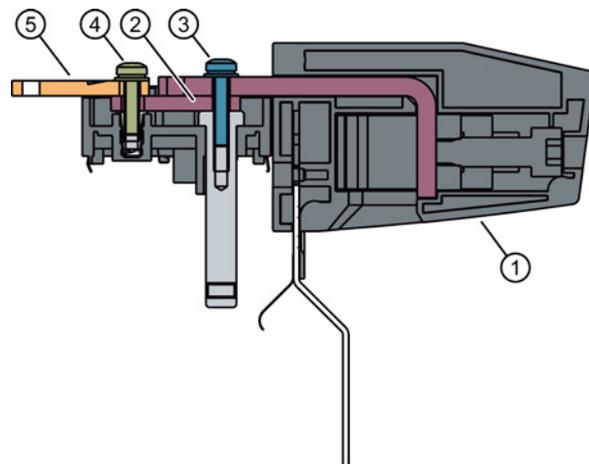
| Var. | Module width [mm] | Installation | Current-carrying capacity of the DC-link busbar [A] | DC-link adapter 6SL3162-... | DC-link busbar | Fastening of the DC-link adapter to two DC-link busbars | Screws | Washers |
|------|-------------------|--------------|---|-----------------------------|-------------------|---|--------------|------------|
| 1 | 50 ... 100 | Right | ≤ 100 | 2BM01-0AA0 | Standard | 2 screws | M4x20 | No |
| 2 | 50 ... 100 | Right | ≤ 150 | 2BM10-0AA0 | Reinforced | 2 screws | M4x20 | No |
| 3 | 50 ... 100 | Left | ≤ 100 | 2BM01-0AA0 | Standard | 2 screws | M4x16 | No |
| 4 | 150 | Right | ≤ 150 | 2BM01-0AA0 | Standard | 2 screws | M4x20 | No |
| 5 | 150 ... 300 | Left | ≤ 150 | 2BM01-0AA0 | Standard | 2 screws | M4x20 | Yes |
| 6 | 200 ... 300 | Right | ≤ 200 | 2BM01-0AA0 | Standard | 4 screws | M4x20 | No |

Connections as cross-sectional drawings (view from below)

Note

The different connection versions of the DC-link adapter are shown in the following cross-sectional drawings. Special features are highlighted in bold in the table above.

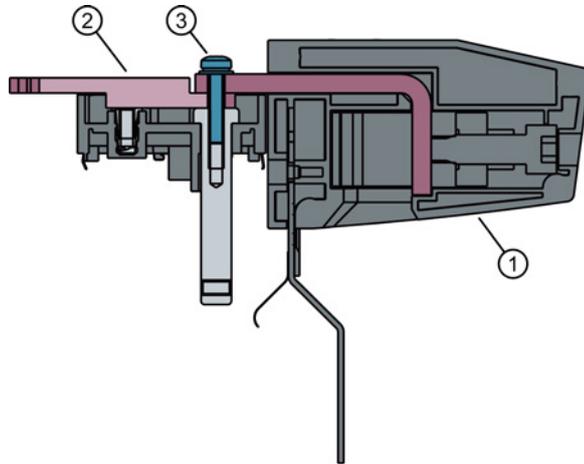
Variant 1: Module width 50-100 mm, connected to the drive line-up from the right, standard DC-link busbar



- ① DC-link adapter 6SL3162-2BM01-0AA0 (4 hole)
- ② Standard DC-link busbar (4 mm)
- ③ Connecting the DC-link adapter to the module using 2 M4x20 screws
- ④ Connecting the DC-link busbar to the module using 2 M4x16 screws
- ⑤ DC-link bridge

Figure 12-5 Variant 1 (representation from below)

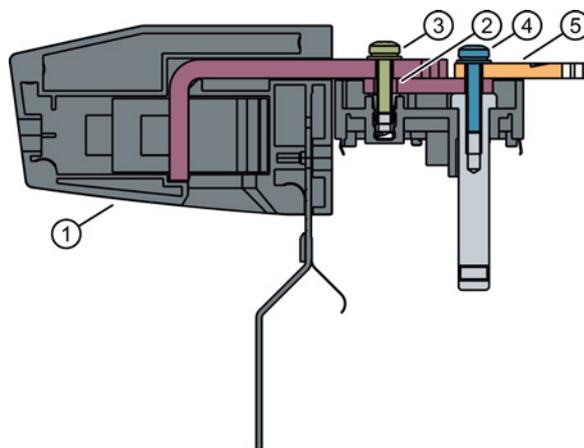
Variant 2: Module width 50-100 mm, connected to the drive line-up from the right, reinforced DC-link busbar



- ① DC-link adapter 6SL3162-2BM10-0AA0 (2 hole)
- ② Reinforced DC-link busbar (8 mm)
- ③ Connecting the DC-link adapter to the DC-link busbar using 2 M4x20 screws

Figure 12-6 Variant 2 (representation from below)

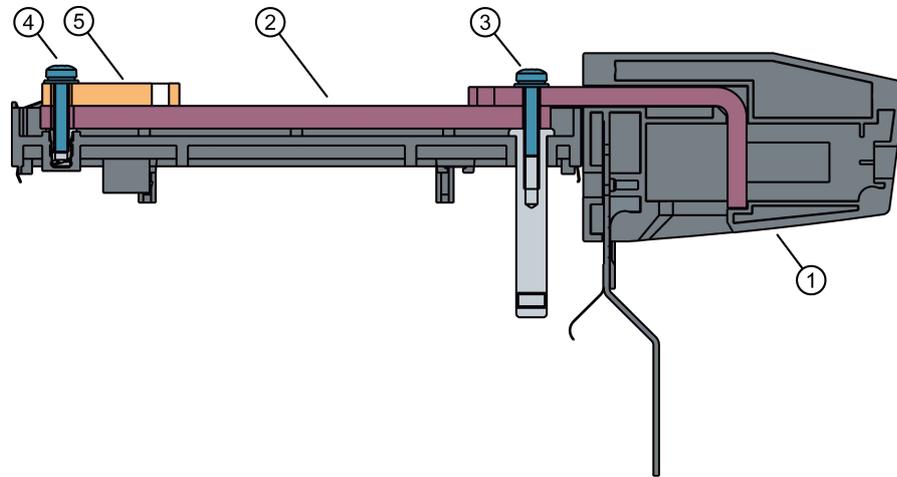
Variant 3: Module width 50-100 mm, connected to the drive line-up from the left, standard DC-link busbar



- ① DC-link adapter 6SL3162-2BM01-0AA0 (4 hole)
- ② Standard DC-link busbar (4 mm)
- ③ Connecting the DC-link adapter to the module using 2 M4x16 screws
- ④ Connecting the DC-link busbar to the module using 2 M4x20 screws
- ⑤ DC-link bridge

Figure 12-7 Variant 3 (representation from below)

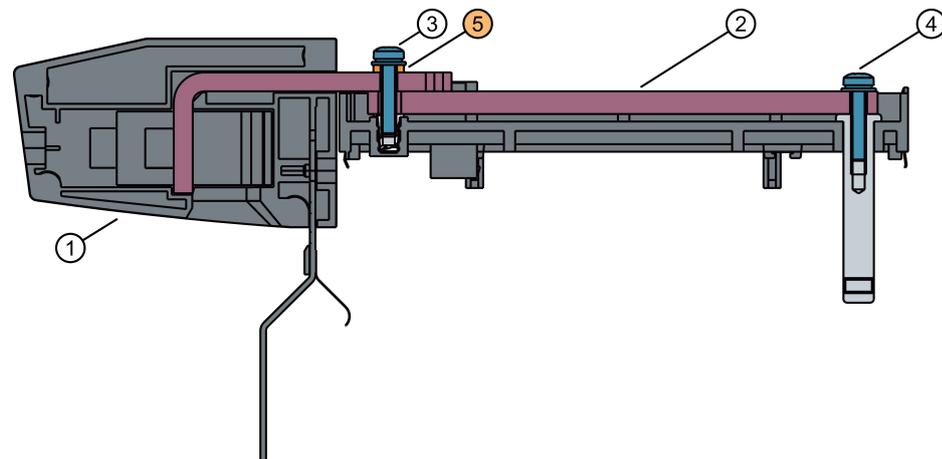
Variant 4: Module width 150 mm, connected to the drive line-up from the right, standard DC-link busbar



- ① DC-link adapter 6SL3162-2BM01-0AA0 (4 hole)
- ② Standard DC-link busbar (6 mm)
- ③ Connecting the DC-link adapter to the module using 2 M4x20 screws
- ④ Connecting the DC-link busbar to the module using 2 M4x20 screws
- ⑤ DC-link bridge

Figure 12-8 Variant 4 (representation from below)

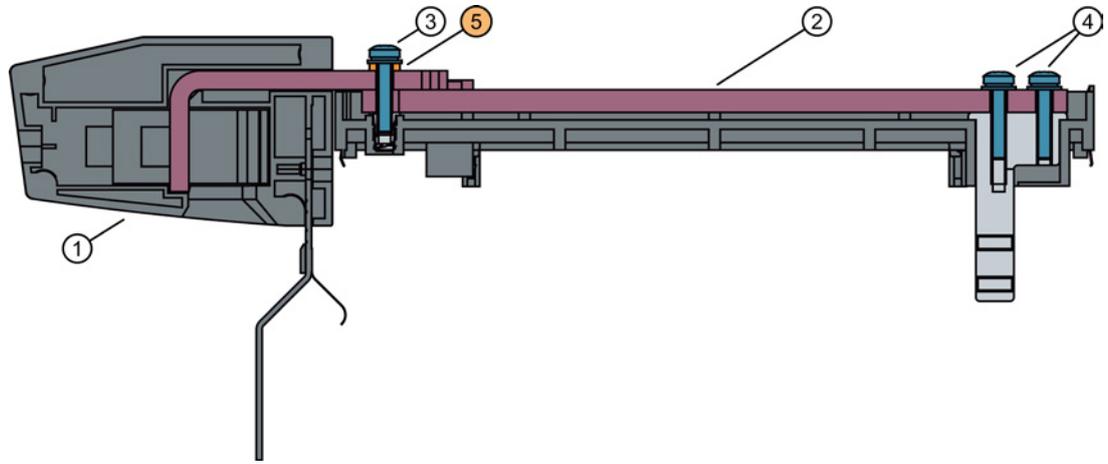
Variant 5a: Module width 150 mm, connected to the drive line-up from the left, standard DC-link busbar



- ① DC-link adapter 6SL3162-2BM01-0AA0 (4 hole)
- ② Standard DC-link busbar (6 mm)
- ③ Connecting the DC-link adapter to the module using 2 M4x20 screws
- ④ Connecting the DC-link busbar to the module using 2 M4x20 screws
- ⑤ Washer

Figure 12-9 Variant 5a (representation from below)

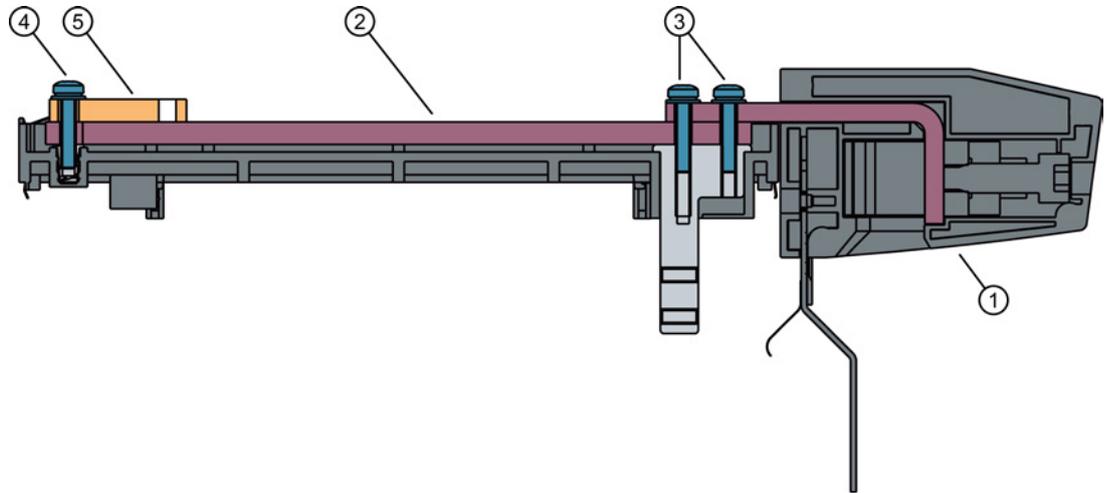
Variant 5b: Module width 200-300 mm, connected to the drive line-up from the left, standard DC-link busbar



- ① DC-link adapter 6SL3162-2BM01-0AA0 (4 hole)
- ② Standard DC-link busbar (6 mm)
- ③ Connecting the DC-link adapter to the module using 2 M4x20 screws
- ④ Connecting the DC-link busbar to the module using 4 M4x20 screws
- ⑤ Washer

Figure 12-10 Variant 5b (representation from below)

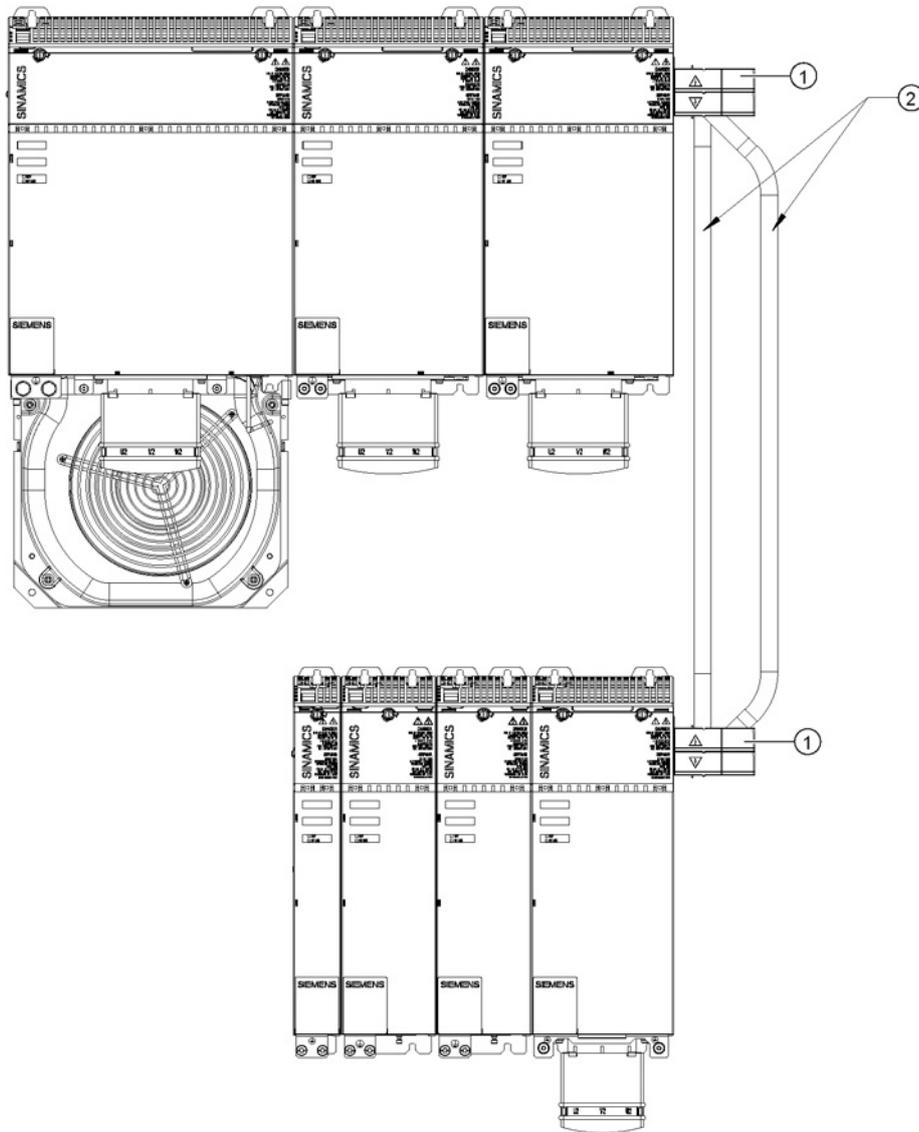
Variant 6: Module width 200-300 mm, connected to the drive line-up from the right, standard DC-link busbar



- ① DC-link adapter 6SL3162-2BM01-0AA0 (4 hole)
- ② Standard DC-link busbar (6 mm)
- ③ Connecting the DC-link adapter to the module using 4 M4x20 screws
- ④ Connecting the DC-link busbar to the module using 2 M4x20 screws
- ⑤ DC-link bridge

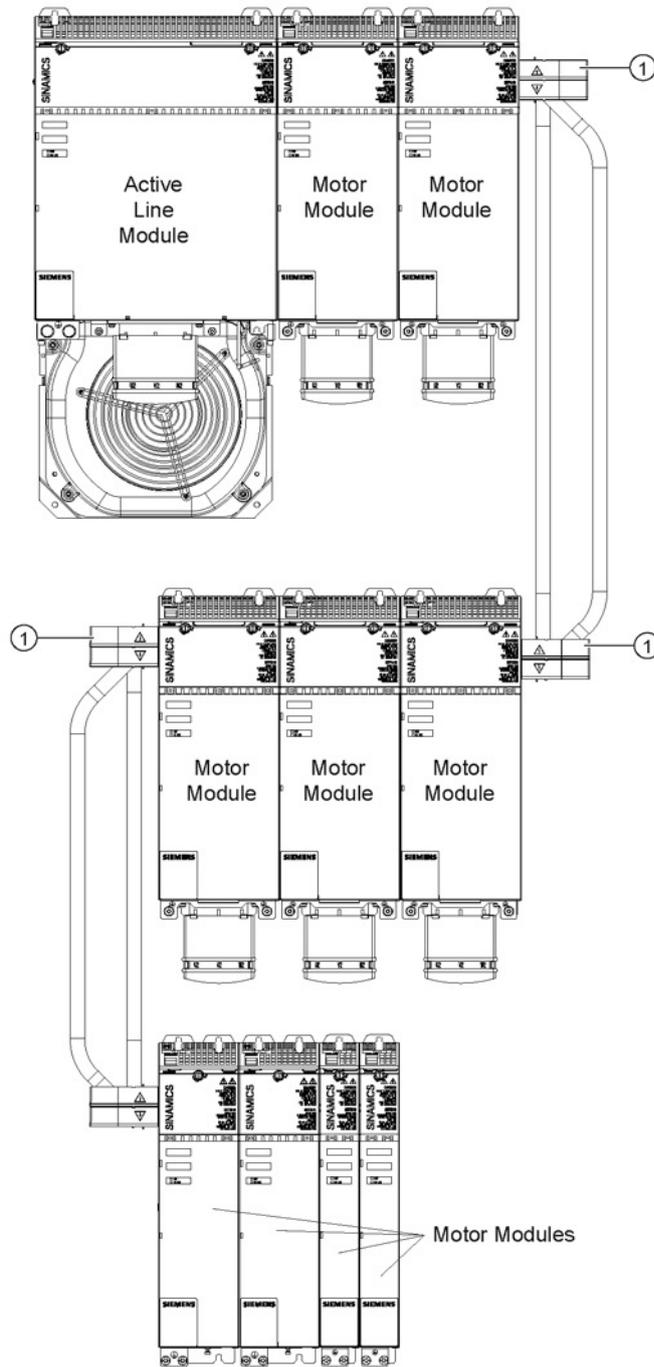
Figure 12-11 Variant 6 (representation from below)

12.5.4.4 Examples of a multi-tier configuration



- ① DC link adapter
- ② Power cable shielded

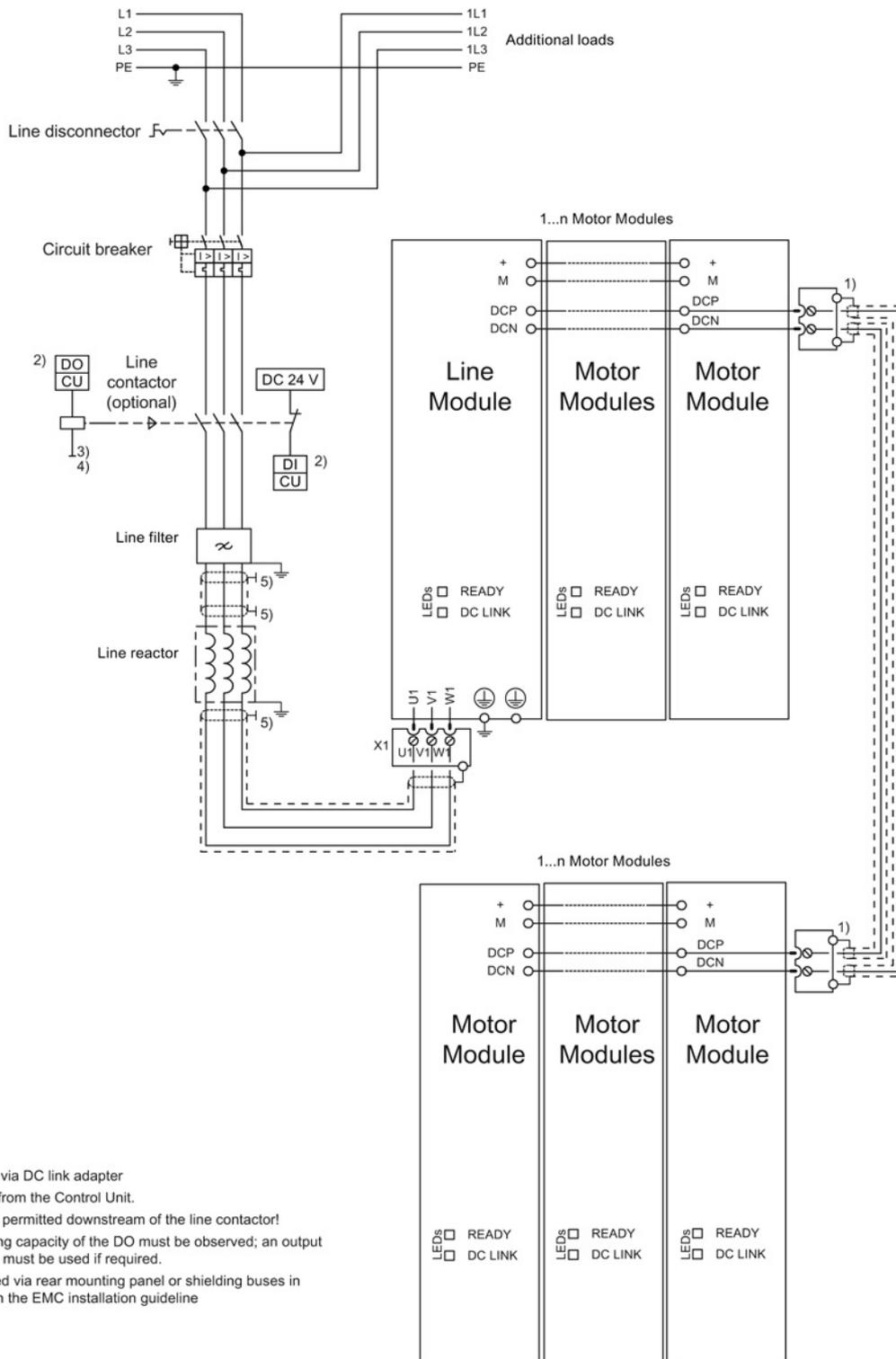
Figure 12-12 Example of a two-tier configuration for a drive line-up with internal air cooling



① DC link adapter

Figure 12-13 Example of a three-tier configuration for a drive line-up with internal air cooling

12.5.4.5 Connection example



- 1) Shield connection via DC link adapter
- 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 must be used if required.
- 5) Contact established via rear mounting panel or shielding buses in accordance with the EMC installation guideline

Figure 12-14 Connection example for a two-tier drive line-up

12.6 Electrical connection

12.6.1 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. The connection of components with reinforced DC-link busbars is described in Chapter Reinforced DC-link busbars (Page 646).



! WARNING

Danger to life through 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 modules¹⁾ (exception: Smart Line Module²⁾), 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 removed³⁾.

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

Possible damage of the devices caused by the use of unsuitable screws

Using unsuitable screws to attach the DC-link busbar for components with widths of between 50 and 100 mm can result in damage to the devices.

- Only use the original M4x16 screws on the left-hand side of the module.
- Only use the original M4x20 screws on the right-hand side of the module.

The connection of a Line Module to a Motor Module is shown in the following.

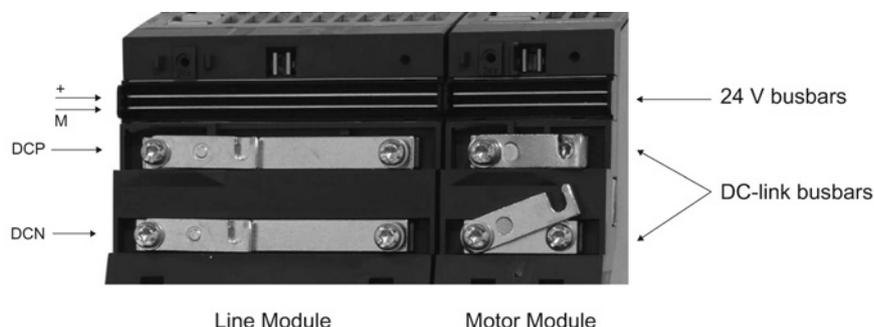


Figure 12-15 Line Module and Motor Module as delivered

Connecting DC-link busbars

Always connect the lower DC-link busbars first and then the upper DC-link busbars.

Tool: Screwdriver Torx T20

Working steps:

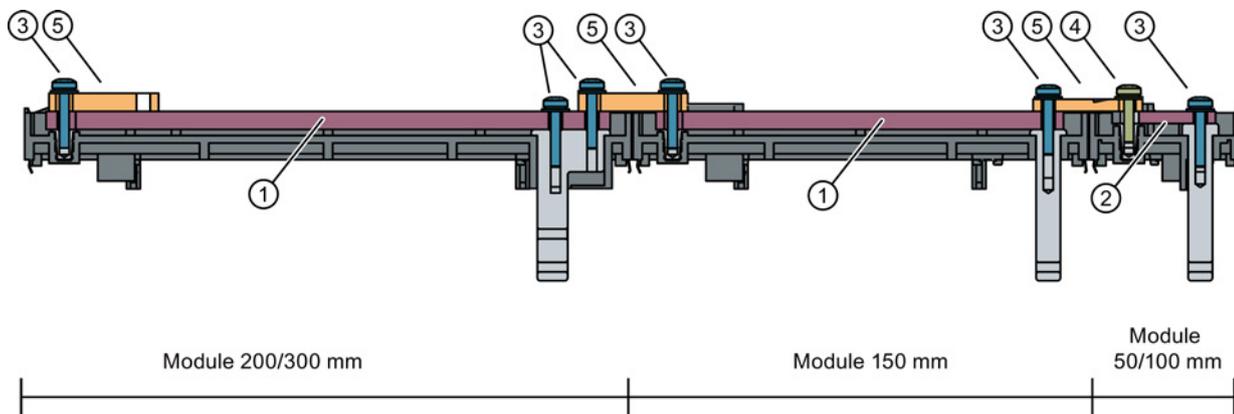
- Loosen the DC-link busbar screws.
- Turn over the DC-link bridge.
- Screw the DC-link busbar screws tight. It is important that you follow the sequence shown below (1 and 2).

Tightening torque: 1.8 Nm



1. Connection of the lower DC-link busbars 2. Connection of the upper DC-link busbars

DC-link connections as cross-sectional drawings (view from below)



- ① Standard DC-link busbar (6 mm)
- ② Standard DC-link busbar (4 mm)
- ③ Connecting the DC-link busbar to the module using a M4x20 screw
- ④ Connecting the DC-link busbar to the module using a M4x16 screw
- ⑤ DC-link bridge

Figure 12-16 DC-link busbar connection using a standard DC-link busbar at a 50/100 mm module

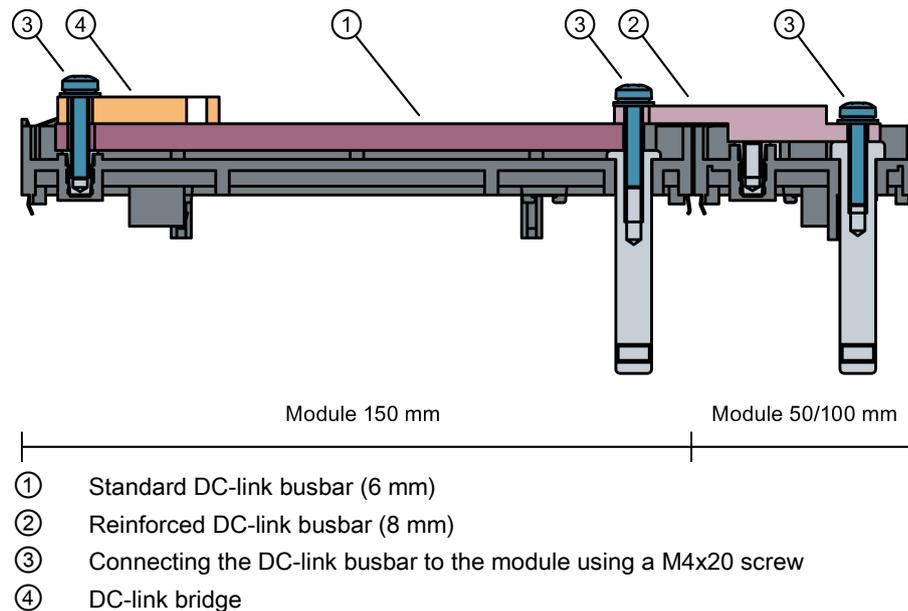


Figure 12-17 DC-link busbar connection using a reinforced DC-link busbar at a 50/100 mm module

12.6.2 Connection of the 24 V busbars

Connection of the 24 V busbars

The 24 V busbars of the components are connected using the red 24 V connectors 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:

- Place the 24 V connectors on to the 24 V busbars.
- Press the 24 V connectors down until they click into place.
- If required, mount the 24 V terminal adapter to supply the 24 VDC.



- ① Mounted 24 V terminal adapter (Torx T10, tightening torque 0.5 Nm)
- ② Mounted 24 V connector

 **WARNING**

Fire hazard for 24 V connectors and unconnected DC-link busbars

The red 24 V connectors may only be used when the DC-link busbars of the components are also connected. 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.



 **WARNING**

Danger to life due to electric shock when connecting and disconnecting 24 V connections in operation

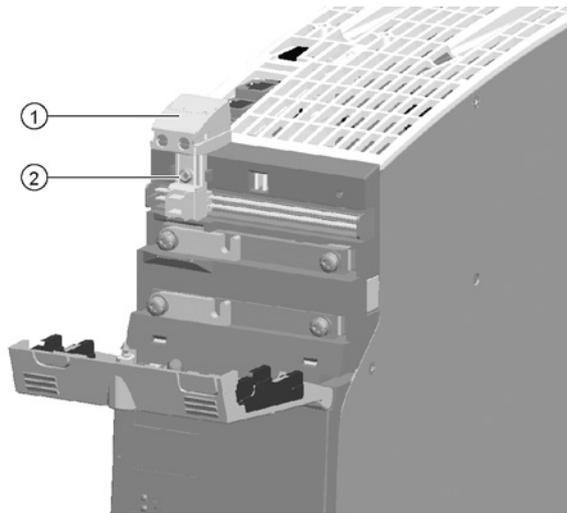
When opening plug connections in operation, arcs can result in severe injury or death.

- Only withdraw or insert the 24 V connectors in a no-voltage state.

12.6.3 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 mm². The 24 V terminal adapter is included in the scope of delivery of Line Modules and Control Supply Modules. It can be ordered as a spare part (order number: 6SL3162-2AA00-0AA0).



- ① 24 V terminal adapter
- ② Screw for fixing: SHR, PT-TORX K30-3, 0X16-ST-A2F WN1452 / from the EJ company

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

12.6 Electrical connection

Table 12- 5 Installing the 24 V terminal adapter using an Active Line Module (36 kW) as example

| | | |
|--|--|---|
|  |  |  |
| <p>Release the protective cover.</p> | <p>Open the protective cover.</p> | <p>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</p> |

| | |
|---|--|
|  |  |
| <p>Break out the cutout in the protective cover.</p> | <p>Close the protective cover. The protective cover must latch into place audibly.</p> |

**! WARNING**

Danger to life through electric shock if the cutout in the protective cover has been broken out

If the 24 V terminal adapter or the DC link infeed adapter is removed, and you touch live parts this will 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 always 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 red 24 V jumpers.

If necessary, the 24 V terminal adapter can also be located at the right for 50 mm and 100 mm modules.

12.6.4 Attaching the motor cable

The Motor Modules are ideal for the operation of Siemens motors.

NOTICE

Damage to the components caused by switching overvoltages when third-party motors are used

If the brake is controlled using the brake connection of the Motor Module, overvoltages can result when the brake is switched off. These overvoltages can damage connected components.

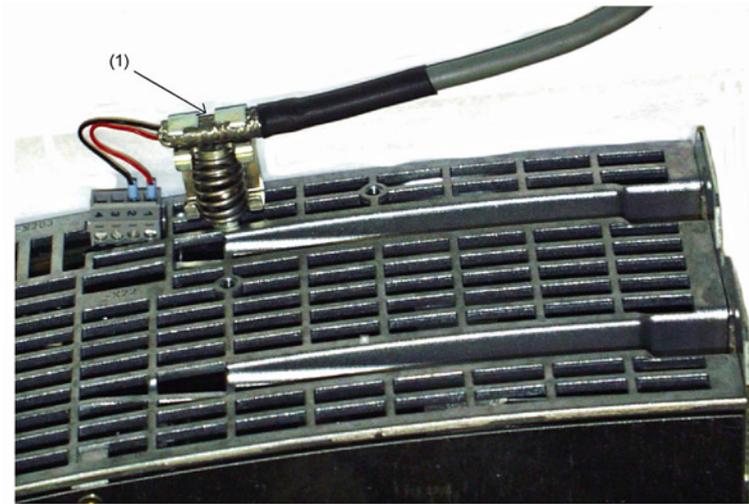
- To prevent switching overvoltages, deploy a free-wheeling diode for third-party motors.

Note

Connections with free-wheeling diodes extend the switching times of the brakes.

12.6.5 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.



① Shield connection clamp: Weidmüller, type KLBÜ 3-8 SC

Figure 12-18 Shield connection terminal for the shield support



! WARNING

Danger to life due to electric shock when using screws with the incorrect 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.

12.7 24 V DC supply voltage

12.7.1 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 45).

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.



| |
|--|
|  WARNING |
|--|

| |
|--|
| <p>Danger to life through electric shock due to incorrectly laid brake cables</p> |
|--|

| |
|--|
| <p>If brake cables are laid without safe electrical separation, the insulation can fail and cause an electric shock.</p> |
|--|

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

| |
|----------------------|
| <p>NOTICE</p> |
|----------------------|

| |
|--|
| <p>Damage to other loads as a result of overvoltage</p> |
|--|

| |
|--|
| <p>Overvoltages of switched inductances (contactors, relays) can damage connected loads.</p> |
|--|

- | |
|---|
| <ul style="list-style-type: none"> • Install suitable overvoltage protection circuits and devices. |
|---|

Note

Malfunction because 24 V supply voltage is too low

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

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

Note

A regulated DC power supply is required to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars. The voltage tolerances of the motor holding brakes ($24\text{ V} \pm 10\%$) and the voltage drops of the connection cables must be taken into account.

The DC power supply should be set to 26 V. The Control Supply Module supplies 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 must be used
 - Siemens MOTION-CONNECT power cables are used
 - Motor cable lengths, max. 100 m
-

12.7.2 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:

1. Using a Control Supply Module

When a Current 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
-

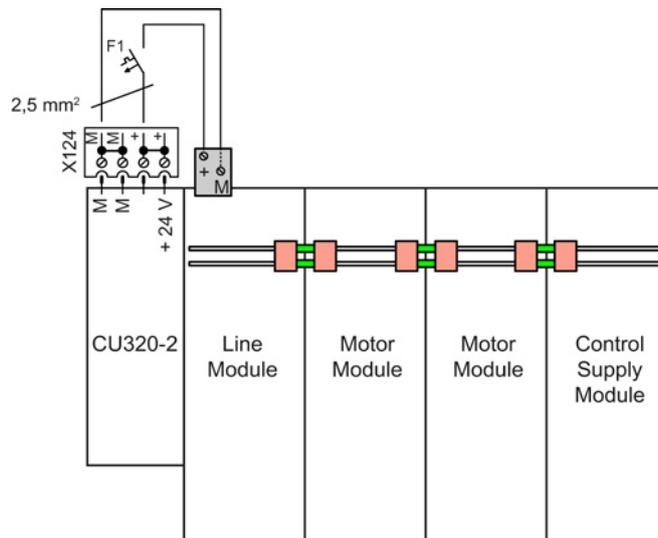


Figure 12-19 Example of a 24 V supply via a Control Supply Module

2. Using an external 24 V power supply

When using an external 24 V power supply, e.g. SITOP, the 24 V terminal adapter must be used. The external power supply should be located very close to the load (max. cable length 10 m). We recommend using miniature circuit breakers with tripping characteristic D as overcurrent protection devices for the cables and busbars. The ground potential M must be connected to the protective conductor system (PELV/SELV).

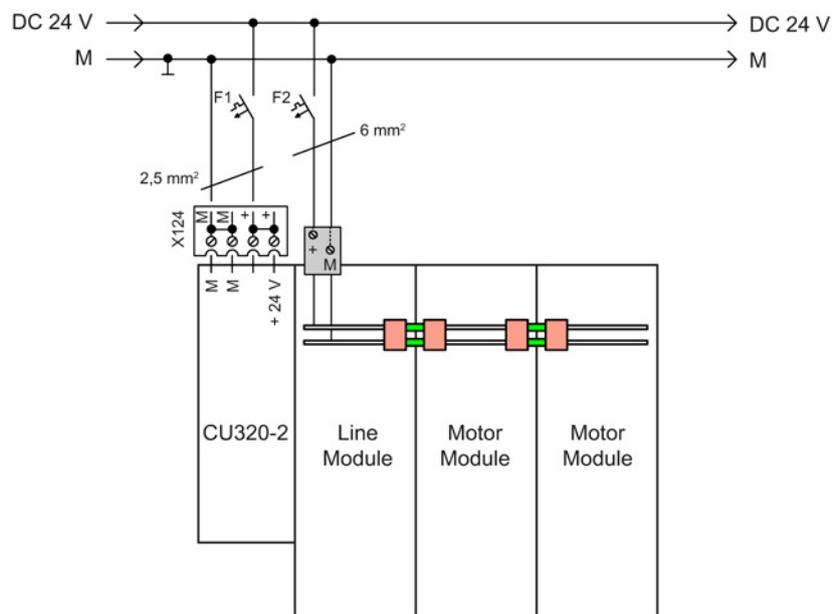


Figure 12-20 Example of a 24 V supply via an external power supply

12.7.3 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.

Circuit breakers from the Siemens "NSK" catalog are recommended as overcurrent protection devices on the primary side.

Miniature circuit breakers or SITOP select (order number 6EP1961-2BA00) are recommended as overcurrent protection devices on the secondary side. The MCBs can be selected according to Siemens catalog "BETA Modular Installation Devices - ET B1".

When selecting the miniature circuit breaker, local installation regulations must be carefully complied with.

Table 12- 6 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.

12.7.4 Overvoltage protection

Overvoltage protection devices are needed if long cables are used.

- Supply cables > 10 m
- Signal cables > 30 m

The following Weidmüller overvoltage protectors are recommended for protecting the components' 24 V power supply and the 24 V signal cables from overvoltage:

Table 12- 7 Recommendations for overvoltage protection

| DC power supply | 24 V signal cables |
|--|--|
| Weidmüller Item No.: PU III R 24V Order number: 8860360000 | Weidmüller Item No.: MCZ OVP TAZ Order number: 844915 0000 |

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.

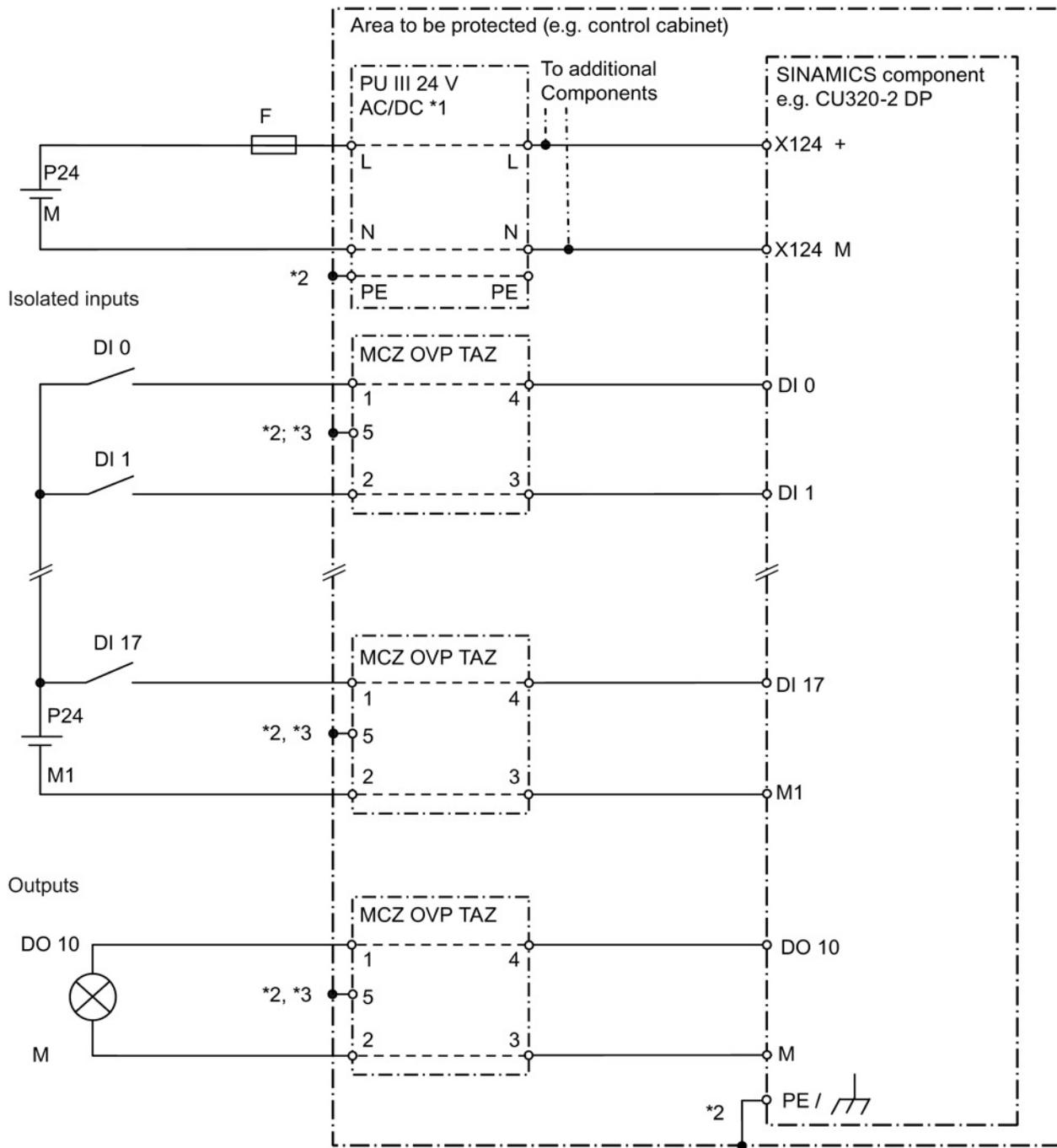


Figure 12-21 Connection example: Overvoltage protection components from Weidmüller connected to SINAMICS components

*1 Terminals 11, 12, 14 of the "PU III 24 VAC/DC" are isolated monitoring contacts (11 C, 12 NC, 14 NO). In the case of a thermal overload of the varistor installed, contacts 11-12 are opened and contacts 11-14 are closed.

*2 The metallic enclosure of the SINAMICS components and the PE connection of the overvoltage protector must be interconnected in a manner that ensures good conductivity (equipotential bonding). This can be achieved by installing the SINAMICS components on a metallic mounting plate and connecting the PE connections of the overvoltage protection elements as directly as possible to the mounting plate.

*3 Snap the overvoltage protector (MCZ OVP TAZ) onto the metallic DIN rail to make the PE connection (terminal 5) to the 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.

12.7.5 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 12- 8 Overview of the 24 V DC current consumption

| Component | Typical current consumption [A _{dc}] |
|---------------------------------------|--|
| Control Units | |
| CU320-2 (without load) | 1,0 |
| Per digital output | 0,1 |
| 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 | 0,1 / 0,3 |
| 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 |

| Component | Typical current consumption [A _{DC}] |
|--|---|
| Terminal Modules | |
| TM15 (without digital outputs, without DRIVE-CLiQ) Per digital output / DRIVE-CLiQ | 0,15 0,5 |
| TM31 (without digital outputs, without DRIVE-CLiQ) Sum of all digital outputs Per DRIVE-CLiQ | 0,2 0.1/1 (with switchover to current limitation) 0,5 |
| TM41 (without digital outputs, without DRIVE-CLiQ) Per digital output / DRIVE-CLiQ | 0,2 0,5 |
| TM54F (without digital outputs, without DRIVE-CLiQ) Per digital output / DRIVE-CLiQ | 0,2 0,5 |
| TM120 (without DRIVE-CLiQ) Per DRIVE-CLiQ | 0,1 0,5 |
| TM150 (without DRIVE-CLiQ) Per DRIVE-CLiQ | 0,07 0,5 |
| Additional system components | |
| TB30 (without digital outputs) Per digital output | < 0,05 0,1 |
| DMC20 (without DRIVE-CLiQ) Per DRIVE-CLiQ | 0,15 0,5 |
| DME20 (without DRIVE-CLiQ) Per DRIVE-CLiQ | 0,15 0,5 |
| VSM10 (without DRIVE-CLiQ) DRIVE-CLiQ | 0,3 0,5 |
| CBC10 | 0,1 |
| CBE20 | 0,1 |
| Active Interface Modules | |
| 16 kW | 0,25 |
| 36 kW | 0,49 |
| 55 kW | 0,6 |
| 80 kW | 1,2 |
| 120 kW | 1,2 |
| Active Line Modules (internal/external air cooling) | |
| 16 kW | 0,95 |
| 36 kW | 1,5 |
| 55 kW | 1,9 |
| 80 kW | 1,4 |
| 120 kW | 1,8 |

| Component | Typical current consumption [A _{DC}] |
|---|--|
| Active Line Module (cold plate) | |
| 16 kW | 0,85 |
| 36 kW | 1,05 |
| 55 kW | 1,15 |
| 80 kW | 1,4 |
| 120 kW | 1,8 |
| Active Line Module (liquid-cooled) | |
| 120 kW | 1,8 |
| Smart Line Modules (internal/external air cooling) | |
| 5 kW | 0,8 |
| 10 kW | 0,9 |
| 16 kW | 0,95 |
| 36 kW | 1,5 |
| 55 kW | 1,9 |
| Smart Line Modules (cold plate) | |
| 5 kW | 0,6 |
| 10 kW | 0,7 |
| Smart Line Modules Booksize Compact | |
| 16 kW (internal air cooling) | 0,95 |
| 16 kW (cold plate cooling) | 0,85 |
| Basic Line Modules (internal/external air cooling) | |
| 20 kW | 1 |
| 40 kW | 1,4 |
| 100 kW | 2 |
| Basic Line Modules (cold plate) | |
| 20 kW | 0,9 |
| 40 kW | 1,1 |
| 100 kW | 1,6 |
| DRIVE-CLiQ and brake | |
| DRIVE-CLiQ (e.g. motors with DRIVE-CLiQ interface) | 0,19 |
| Brake (e.g. motor holding brake) | Typ. 0.4 to 1.1; max. 2 |
| Single Motor Modules (internal/external air cooling) | |
| 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 |
| 30 A (+1 x DRIVE-CLiQ; +1 x brake) | 0,8 |
| 45 A (+1 x DRIVE-CLiQ; +1 x brake) | 1,05 |
| 60 A (+1 x DRIVE-CLiQ; +1 x brake) | 1,05 |
| 85 A (+1 x DRIVE-CLiQ; +1 x brake) | 1,5 |
| 132 A (+1 x DRIVE-CLiQ; +1 x brake) | 0,85 |
| 200 A (+1 x DRIVE-CLiQ + 1 x brake) | 0,85 |

| Component | Typical current consumption [A _{bc}] |
|---|--|
| Single Motor Modules (cold plate) | |
| 3 A (+1 x DRIVE-CLiQ; +1 x brake) | 0,65 |
| 5 A (+1 x DRIVE-CLiQ; +1 x brake) | 0,65 |
| 9 A (+1 x DRIVE-CLiQ; +1 x brake) | 0,65 |
| 18 A (+1 x DRIVE-CLiQ; +1 x brake) | 0,65 |
| 30 A (+1 x DRIVE-CLiQ; +1 x brake) | 0,65 |
| 45 A (+1 x DRIVE-CLiQ; +1 x brake) | 0,75 |
| 60 A (+1 x DRIVE-CLiQ; +1 x brake) | 0,75 |
| 85 A (+1 x DRIVE-CLiQ; +1 x brake) | 0,8 |
| 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 (liquid-cooled) | |
| 200 A (+1 x DRIVE-CLiQ; +1 x brake) | 0,85 |
| Single Motor Modules Booksize Compact (internal air cooling) | |
| 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 |
| Single Motor Modules Booksize Compact (cold plate) | |
| 3 A (+1 x DRIVE-CLiQ; +1 x brake) | 0,65 |
| 5 A (+1 x DRIVE-CLiQ; +1 x brake) | 0,65 |
| 9 A (+1 x DRIVE-CLiQ; +1 x brake) | 0,65 |
| 18 A (+1 x DRIVE-CLiQ; +1 x brake) | 0,65 |
| Double Motor Modules (internal and external air cooling) | |
| 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 |
| 2 x 9 A (+2 x DRIVE-CLiQ; +2 x brake) | 1,15 |
| 2 x 18 A (+2 x DRIVE-CLiQ; +2 x brake) | 1,3 |
| Double Motor Modules (cold plate) | |
| 2 x 3 A (+2 x DRIVE-CLiQ; +2 x brake) | 1,0 |
| 2 x 5 A (+2 x DRIVE-CLiQ; +2 x brake) | 1,0 |
| 2 x 9 A (+2 x DRIVE-CLiQ; +2 x brake) | 1,0 |
| 2 x 18 A (+2 x DRIVE-CLiQ; +2 x brake) | 1,15 |
| Double Motor Modules Booksize Compact (internal air cooling) | |
| 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 |

| Component | Typical current consumption [A _{bc}] |
|---|--|
| Double Motor Modules Booksize Compact (cold plate) | |
| 2 x 1.7 A (+2 x DRIVE-CLiQ; +2 x brake) | 0,9 |
| 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 |
| Braking Module Booksize | 0,5 |
| Braking Module Booksize Compact | 0,4 |

If no other specifications are made to the contrary, the Line Modules and Motor Modules listed here are components in booksize format.

Example: Calculating the 24 V current requirement

Table 12- 9 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 |

12.7.6 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 12- 10 Recommended SITOP Power

| Rated output current [A] | Phases | Rated input voltage [V] Operating voltage range [V] | Short-circuit current [A] | Order number |
|--------------------------|--------|--|---|--------------------|
| 5 | 1 / 2 | AC 120 ... 230 / 230 ... 500 85 ... 264 / 176 ... 550 | Approx. 5.5 (power up) Typ. 15 for 25 ms (operation) | 6EP1333-3BA00-8AC0 |
| 10 | 1 / 2 | AC 120 ... 230 / 230 ... 500 85 ... 264 / 176 ... 550 | Approx. 12 (power up) Typ. 30 for 25 ms (operation) | 6EP1334-3BA00-8AB0 |
| 20 | 1 / 2 | AC 120 / 230 85 ... 132 / 176 ... 264 | Approx. 23 (power up) Typ. 60 for 25 ms (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 (power up) Typ. 120 for 25 ms (operation) | 6EP1337-3BA00-8AA0 |
| | 3 | 3 AC 230 / 400 ... 288 / 500 320 ... 550 | | 6EP1437-3BA00-8AA0 |

Table 12- 11 Recommendation for Control Supply Module

| Rated output current [A] | | Input voltage range [V] | Short-circuit current [A] | Order number |
|--------------------------|---|---|---------------------------|--------------------|
| 20 | 3 | 380 V 3 AC -10 % (-15 % < 1 min) to 480 V 3 AC +10% DC 300 ... 800 | < 24 | 6SL3100-1DE22-0AAx |

Refer also to Catalog PM21 or NC61.



| |
|---|
| <p>! WARNING</p> <p>Danger to life through a hazardous voltage when connecting an unsuitable power supply</p> <p>Touching live components can result in death or severe injury.</p> <ul style="list-style-type: none"> • Connect the ground potential to the protective conductor connection. • Mount the power supply close to the drive lineup. <p>Ideally, they should be mounted on a common mounting plate. If different mounting plates are used, their electrical interconnection must comply with the EMC installation guideline.</p> |
|---|

12.8 Connection systems

12.8.1 DRIVE-CLiQ signal cables

12.8.1.1 Overview

To connect DRIVE-CLiQ components, various pre-assembled and non-assembled DRIVE-CLiQ signal cables are available. The following pre-assembled DRIVE-CLiQ signal cables will be discussed in more detail in the next sections:

- Signal cables without 24 V cores with RJ45 connectors
- MOTION-CONNECT signal cables with DRIVE-CLiQ connectors
- MOTION-CONNECT signal cables with DRIVE-CLiQ connector and M12 socket

Table 12- 12 Overview of pre-assembled DRIVE-CLiQ signal cables

| Type of DRIVE-CLiQ signal cable | 24 V cores | Degree of protection | | Connector type |
|--|------------|----------------------|------------|---------------------|
| | | IP20 | IP67 | |
| 6SL3060-4A.. 6FX2002-1DC.. | -- | x | x | RJ45 |
| 6FX5002-2DC00.. to .. -2DC20.. 6FX8002-2DC00.. to .. -2DC20.. | x | x | x | DRIVE-CLiQ |
| 6FX5002-2DC30.. 6FX8002-2DC30.. | x | X (DRIVE-CLiQ) | X (M12) | DRIVE-CLiQ / M12 |

12.8.1.2 DRIVE-CLiQ signal cables without 24 V DC cores

Pre-assembled DRIVE-CLiQ signal cables without 24 V DC cores are used to connect components with DRIVE-CLiQ connection, which have a separate or external 24 V DC power supply. They are mainly intended for use in control cabinets. The signal cables are available with RJ45 connectors in degrees of protection IP20 and IP67.

Table 12- 13 Actual lengths of the DRIVE-CLiQ jumpers for Line Modules and Motor Modules

| DRIVE-CLiQ bridge | Cable length L ¹⁾ |
|-------------------|------------------------------|
| 50 mm | 110 mm |
| 100 mm | 160 mm |
| 150 mm | 210 mm |
| 200 mm | 260 mm |
| 250 mm | 310 mm |
| 300 mm | 360 mm |
| 350 mm | 410 mm |

¹⁾ Cable length without connector

Cable lengths from 600 mm and higher are used to connect to other applications (e.g. establish a 2nd line in the drive line-up, establish wiring in a star configuration etc.)

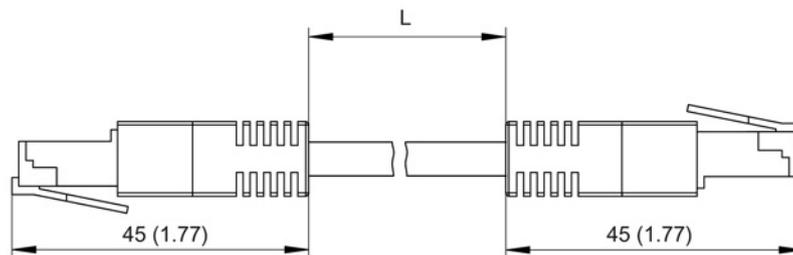


Figure 12-22 DRIVE-CLiQ signal cables without 24 V DC cores (IP20)

12.8.1.3 DRIVE-CLiQ signal cables MOTION-CONNECT with RJ45 connectors

The MOTION-CONNECT DRIVE-CLiQ signal cables with RJ45 plugs have 24 V cores. They are used for components with DRIVE-CLiQ connection if higher requirements must be complied with, such as mechanical stress and resistance to oil. For example, 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

The maximum length of the DRIVE-CLiQ MOTION-CONNECT signal cables with RJ45 plugs is:

- 100 m for MOTION-CONNECT 500 cables
- 75 m for MOTION-CONNECT 800PLUS cables

The signal cables are available in degrees of protection IP20 and IP67.

Note

DRIVE-CLiQ cabinet bushing for RJ45 connectors

For information on the cabinet bushings, see Chapter DRIVE-CLiQ cabinet bushings (Page 679).

12.8.1.4 DRIVE-CLiQ signal cables MOTION-CONNECT with RJ45 plug and M12 socket

The MOTION-CONNECT DRIVE-CLiQ signal cables with RJ45 plug and M12 socket have 24 VDC cores. They establish the connection between components with a DRIVE-CLiQ connection and a direct measuring system equipped with DRIVE-CLiQ ASIC with 8-pin M12 connector. Measuring systems from third-party manufacturers can be directly connected to the SINAMICS S120.

Basic cable

The pre-assembled basic cable has eight cores, of which four are used for data transmission and two for the 24 V supply. It is used to convert from a RJ45 plug (IP20) to an M12 socket (IP67).



Figure 12-23 DRIVE-CLiQ basic cable with RJ45 plug and M12 socket

Extension

The pre-assembled extension of a basic cable has an M12 plug (IP67) and an M12 socket (IP67).



Figure 12-24 DRIVE-CLiQ extension with M12 plug and M12 socket

Note

Maximum permissible total cable length

The maximum permissible total cable length between the measuring system and the RJ45 socket of the SINAMICS S120 device is 30 m. For a longer total cable length data transfer errors may occur. This is the reason that no additional extension can be connected to a 30 m long basic cable.

Note

Maximum number of extensions

A maximum of two extensions can be used. More than two extensions can result in data transfer errors.

Note

DRIVE-CLiQ cabinet bushing with M12 plug

For information on the cabinet bushings, see Chapter DRIVE-CLiQ cabinet bushings (Page 679).

12.8.1.5 Comparison of DRIVE-CLiQ signal cables

DRIVE-CLiQ signal cables are designed for various applications. The following table provides an overview of the most important properties.

Table 12- 14 Properties of DRIVE-CLiQ signal cables

| DRIVE-CLiQ signal cable | DRIVE-CLiQ | DRIVE-CLiQ MOTION-CONNECT 500 | DRIVE-CLiQ MOTION-CONNECT 800PLUS |
|---|--|--|--|
| Approvals | | | |
| VDE cURus or UR/CSA | Yes UL STYLE 2502/CSA- N.210.2-M90 | Yes UL STYLE 2502/CSA- N.210.2-M90 | Yes UL STYLE 2502/CSA- N.210.2-M90 |
| UR-CSA File No. ¹⁾ in conformance with RoHS | Yes Yes | Yes Yes | Yes Yes |
| Rated voltage V_0/V in accordance with EN 50395 | 30 V | 30 V | 30 V |
| Test voltage, rms | 500 V | 500 V | 500 V |
| Operating temperature at the surface | | | |
| Permanently installed | -20 ... +80 °C | -20 ... +80 °C | -20 ... +80 °C |
| Moveable | - | 0 ... 60 °C | -20 ... +60 °C |
| Tensile load, max. | | | |
| Permanently installed | 45 N/mm ² | 80 N/mm ² | 50 N/mm ² |
| Moveable | - | 30 N/mm ² | 20 N/mm ² |
| Smallest bending radius | | | |
| Permanently installed | 50 mm | 35 mm | 35 mm |
| Moveable | - | 125 mm | 75 mm |
| Torsional stress | - | 30°/m absolute | 30°/m absolute |
| Bending operations | - | 100000 | 10 million |
| Max. moving speed | - | 30 m/min | 300 m/min |
| Max. acceleration | - | 2 m/s ² | 50 m/s ² (3 m distance moved through) ²⁾ |
| insulation material | CFC/silicone-free | CFC/silicone-free | CFC/halogen/silicone-free IEC 60754-1 / DIN VDE 0472-815 |
| Oil resistance | EN 60811-2-1 | EN 60811-2-1 (mineral oil only) | EN 60811-2-1 |
| Protective jacket | PVC Gray RAL 7032 | PVC DESINA color green RAL 6018 | PUR, HD22.10 S2 (VDE 0282, Part 10) DESINA color green, RAL 6018 |
| Flame retardant | EN 60332-1-1 to 1-3 | EN 60332-1-1 to 1-3 | EN 60332-1-1 to 1-3 |

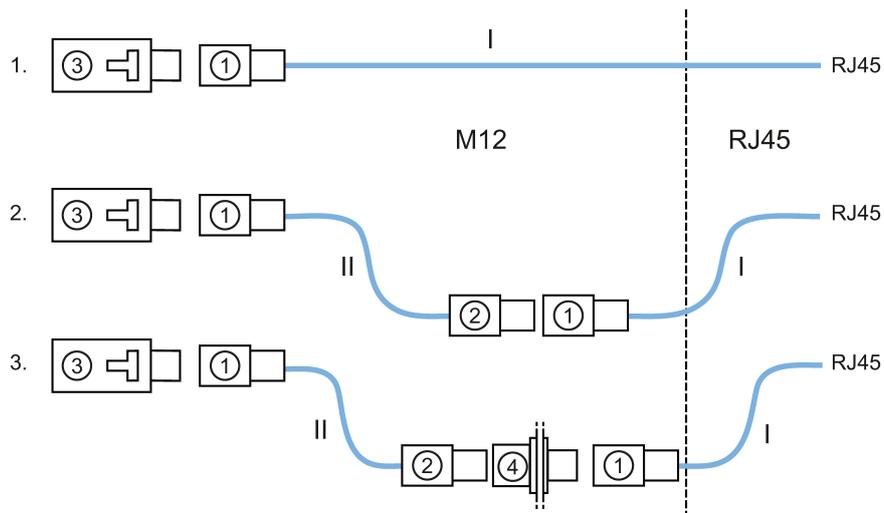
¹⁾ The file number is printed on the cable jacket.

²⁾ Characteristic curves for accelerating can be found in Catalog "D31" in Chapter "MOTION-CONNECT connection system".

12.8.1.6 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 1-2 extensions
3. Basic cable, cabinet bushing and a maximum of one extension



- 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 12-25 Connecting a direct measuring system with M12 plug to a DRIVE-CLiQ component with RJ45 socket (IP20)

12.8.1.7 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 DRIVE-CLiQ connector and M12 socket can be combined without any restrictions.

For the combined use of MOTION-CONNECT cables with DRIVE-CLiQ connectors, 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 with DRIVE-CLiQ connectors. The maximum permissible cable length is calculated as follows:

$$\Sigma MC500 + 4/3 * \Sigma MC800PLUS + n_c * 5 \text{ m} \leq 100 \text{ m}$$

$\Sigma MC500$: Total length of all MC500 cable segments (fixed routing)

$\Sigma MC800PLUS$: 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 12- 15 Examples of maximum cable lengths when using a DRIVE-CLiQ coupling

| | | | | | | | | | |
|---------------------------------------|------|------|------|------|------|------|------|------|------|
| $\Sigma MC500$ (fixed routing) | 87 m | 80 m | 66 m | 54 m | 40 m | 30 m | 20 m | 10 m | 5 m |
| $\Sigma MC800PLUS$ (tow chain) | 5 m | 10 m | 20 m | 30 m | 40 m | 48 m | 55 m | 63 m | 66 m |
| $\Sigma MC500+$ $\Sigma MC800PLUS$ | 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 DRIVE-CLiQ connectors. After the hub, the same length conditions apply as before the hub.

$$\Sigma MC500 + 4/3 * \Sigma MC800PLUS + n_c * 5 \text{ m} \leq 100 \text{ m before the hub}$$

$$\Sigma MC500 + 4/3 * \Sigma MC800PLUS + n_c * 5 \text{ m} \leq 100 \text{ m after the hub}$$

It is possible to connect two DRIVE-CLiQ Hub Modules in series (cascade connection).

12.8.2 Power cables for motors

12.8.2.1 Configuring the cable length

Where a long motor cable is required, a higher rating of Motor Module must be selected or the permissible continuous output current $I_{\text{continuous}}$ must be reduced in relation to the rated output current I_{rated} . The configuring data for booksize format Motor Modules are given in the following table:

Table 12- 16 Permissible cable lengths for shielded motor cables

| Motor Module | Length of motor cable (shielded) | | | |
|----------------------------|---|---|--|-----------------|
| | > 50 ... 100 m | > 100 ... 150 m | > 150 ... 200 m | > 200 m |
| Rated output current I_N | | | | |
| 3 A/5 A | Use 9 A Motor Module | Use 9 A Motor Module | Not permissible | Not permissible |
| 9 A | Use 18 A Motor Module | Use 18 A Motor Module | Not permissible | Not permissible |
| 18 A | Use 30 A Motor Module or $I_{\text{max}} \leq 1.5 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.95 \times I_{\text{rated}}$ | Use 30 A Motor Module | Not permissible | Not permissible |
| 30 A | Always permitted | $I_{\text{max}} \leq 1.35 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.9 \times I_{\text{rated}}$ | $I_{\text{max}} \leq 1.1 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.85 \times I_{\text{rated}}$ | Not permissible |
| 45 A/60 A | Always permitted | $I_{\text{max}} \leq 1.75 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.9 \times I_{\text{rated}}$ | $I_{\text{max}} \leq 1.5 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.85 \times I_{\text{rated}}$ | Not permissible |
| 85 A/132 A | Always permitted | $I_{\text{max}} \leq 1.35 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.95 \times I_{\text{rated}}$ | $I_{\text{max}} \leq 1.1 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.9 \times I_{\text{rated}}$ | Not permissible |
| 200 A | Always permitted | $I_{\text{max}} \leq 1.25 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.95 \times I_{\text{rated}}$ | $I_{\text{max}} \leq 1.1 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.9 \times I_{\text{rated}}$ | Not permissible |

When using a motor holding brake, the maximum motor cable length is 100 m.

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

Motor reactors can also be used on motors operating in vector and V/f control modes to allow the use of longer motor cables.

12.8.2.2 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 12- 17 Comparison of the MOTION-CONNECT 500 and MOTION-CONNECT 800PLUS power cables

| Power cable | MOTION-CONNECT 500 | MOTION-CONNECT 800PLUS |
|---|---|--|
| Approvals | | |
| VDE ¹⁾ cURus or UR/CSA UR-CSA File No. ²⁾ in conformance with RoHS | Yes UL758-CSA-C22.2-N.210.2-M90 Yes Yes | Yes UL758-CSA-C22.2-N.210.2-M90 Yes Yes |
| Rated voltage V_0/V in accordance with EN 50395 | | |
| 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/mm ² 20 N/mm ² | 50 N/mm ² 20 N/mm ² |
| 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. moving speed | 30 m/min | Up to 300 m/min |
| Max. acceleration | 2 m/s ² | 50 m/s ² (3 m) ³⁾ |
| insulation material | CFC/silicone-free | CFC/halogen/silicone-free IEC 60754-1 / DIN VDE 0472-815 |
| Oil resistance | EN 60811-2-1 (mineral oil only) | EN 60811-2-1 |
| 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 registration number is printed on the cable jacket.

2) The file number is printed on the cable jacket.

3) Characteristic curves for accelerating can be found in Catalog "D31" or "PM21" in Chapter "MOTION-CONNECT connection system".

12.8.3 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.

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 12- 18 Current carrying capacity according to EN 60204-1 for 40° C ambient temperature

| Cross-section mm ² | Current carrying capacity, effective; AC 50/60 Hz or DC For routing type | | |
|----------------------------------|---|---------|--------|
| | 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 12- 19 Current carrying capacity according to IEC 60364-5-52 for 40° C ambient temperature

| Cross-section mm ² | Current carrying capacity, effective; AC 50/60 Hz or DC For routing type | | |
|----------------------------------|---|---------|--------|
| | B1 A | B2 A | C A |
| Power cables | | | |
| 150 | – | – | 344 |
| 185 | – | – | 392 |
| > 185 | Values must be taken from the standard | | |

Table 12- 20 Derating factors for deviating ambient temperatures

| Ambient air temperature [° C] | Derating factor according to EN 60204-1, Table D1 |
|-------------------------------|---|
| 30 | 1,15 |
| 35 | 1,08 |
| 40 | 1,00 |
| 45 | 0,91 |
| 50 | 0,82 |
| 55 | 0,71 |
| 60 | 0,58 |

12.8.4 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.

Table 12- 21 Maximum cable lengths

| Type | Maximum length [m] |
|---|--|
| 24 V DC supply cables ¹⁾ | 10 |
| 24 V signal cables ¹⁾ | 30 |
| DRIVE-CLiQ signal cables MC500 (RJ45) | 100 |
| DRIVE-CLiQ signal cables MC500 (M12) | 30 |
| DRIVE-CLiQ signal cables MC800PLUS (RJ45) | 75 |
| DRIVE-CLiQ signal cables MC800PLUS (M12) | 30 |
| DC link, including extensions | 10 |
| Total cable length for Active Line Modules 16 ... 36 kW with Active Interface Module ⁴⁾ | 630 (shielded) ³⁾ |
| Total cable length for Active Line Modules 55 ... 120 kW with Active Interface Module ⁴⁾ | 1000 (shielded) ³⁾ |
| Total cable length for Active Line Modules with line reactor ⁴⁾ | 350 (shielded) ³⁾ |
| Total cable length for Basic Line Modules ⁴⁾ | 630 (shielded) ³⁾ |
| Total cable length for Smart Line Modules ⁴⁾ | 350 (shielded) ³⁾ |
| 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 up to $I_n = 9$ A | 50 (shielded) 75 (unshielded) |
| Power cable between motor and Motor Module $I_n = 18$ A | 70 (shielded) 100 (unshielded) |
| Power cable between motor and Motor Module $I_n \geq 30$ A | 100 (shielded) 150 (unshielded) |
| Cable between the Braking Module and braking resistor | 10 |

- 1) For longer lengths, the user must connect a suitable protective circuit in order to provide overvoltage protection (refer to the chapter "Overvoltage protection" under "24 V DC supply")
- 2) To comply with EMC limit values, shielded cables (preferably MOTION CONNECT cables) must be used.
- 3) Restrictions regarding the total cable length and the secondary conditions required to comply with the corresponding radio interference suppression category are listed in Chapter "Possible line reactor and line filter combinations".
- 4) The total lengths specified for power cables in the drive line-up include motor cables, DC link cables, and the line feeder cable, line filter to the Line Module.

Note

Total cable lengths

also referred to Basic Line filter for Active Line Modules (Page 62) as well as Possible line reactor and line filter combinations (Page 136).

12.8.5 Connectable conductor cross-sections and tightening torques for motor and power cables

Table 12- 22 Connectable conductor cross-sections Part 1: Line cable / motor cable

| Component | Terminal type / tightening torque | Connection cross-section [mm ²] | | | | | |
|---|---|---|-----|---|---|----|-----------------|
| | | 1,5 | 2,5 | 4 | 6 | 10 | 16 |
| Motor Module Booksize 3 ... 30 A 2 x 3 A ... 2 x 18 A | Motor connection connector Crimped connector | X | X | X | X | X | |
| | 30 A, 3+2 pole Screw connector | X | X | X | X | | |
| Motor Module Booksize Compact 1.7 A ... 18 A | Screw terminal 1.2 ... 1.5 Nm | X | X | X | X | | |
| Motor Module 45 ... 60 A | Threaded bolts M6 6 Nm ¹⁾ | | | | X | X | X |
| Motor Module 85 A | Threaded bolts M8 13 Nm ²⁾ | | | | | | X |
| Smart Line Module Booksize 5 ... 10 kW | Screw terminal 1.2 ... 1.5 Nm | X | X | X | X | | |
| Smart Line Module Booksize Compact 16 kW | Screw terminal 1.5 ... 1.8 Nm | | | | X | X | X |
| Active Line Module 16 kW Smart Line Module 16 kW | Screw terminal 1.5 ... 1.8 Nm | | | | X | X | |
| Active Line Module 36 kW Smart Line Module 36 kW | Threaded bolts M6 6 Nm ¹⁾ | | | | | | X |
| Active Interface Module 16 kW | Screw terminal 1.7 Nm | | | | X | X | X |
| Active Interface Module 36 kW | Screw terminal 6 Nm | | | | | | X ³⁾ |

- 1) For ring cable lugs without insulation clamping area ensured for flexible cable with end sleeve, ring cable lug M6 or M8 IP2xB according to EN 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 two 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".
- 3) The connection terminals of the 36 kW Active Interface Module are only certain to be safe from touch protection according to EN 60529 if cables with a minimum cross-section of 25 mm² and insulated end sleeves are used.

12.8 Connection systems

Table 12- 23 Connectable conductor cross-sections Part 2: Line cable / motor cable,

| Component | Terminal type / tightening torque | Connection cross-section [mm ²] | | | | | |
|---|--|---|----|----|----|----|-----|
| | | 25 | 35 | 50 | 70 | 95 | 120 |
| Motor Module 45 ... 60 A | Threaded bolts M6 6 Nm ¹⁾ | X | X | X | | | |
| Motor Module 85 A | Threaded bolts M8 13 Nm ²⁾ | X | X | X | X | X | X |
| Motor Module 132 ... 200 A | Threaded bolts M8 13 Nm ²⁾ | X | X | X | X | X | X |
| Active Line Module 36 kW Smart Line Module 36 kW | Threaded bolts M6 6 Nm | X | X | X | | | |
| Active Line Module 55 kW Smart Line Module 55 kW | Threaded bolts M8 13 Nm ²⁾ | | X | X | X | X | X |
| Active Line Module 80 ... 120 kW | Threaded bolts M8 13 Nm ²⁾ | | | | X | X | X |
| Active Interface Module 36 kW | Screw terminal 6 Nm | X | X | X | | | |
| Active Interface Module 55 kW | Screw terminal 6 Nm | | X | X | | | |
| Active Interface Module 80 ... 120 kW | Threaded bolts M8 13 Nm ²⁾ | | | | X | X | X |

- 1) For ring cable lugs without insulation clamping area ensured for flexible cable with end sleeve, ring cable lug M6 or M8 IP2xB according to EN 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 two 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 12- 24 Connectable conductor cross-sections Part 3: Line cable / connection for braking resistor

| Component | Terminal type / tightening torque | Connection cross-section [mm ²] | | | | | |
|--|-----------------------------------|---|-----|---|---|----|----|
| | | 1,5 | 2,5 | 4 | 6 | 10 | 16 |
| Basic Line Module 20 kW Line cable connection | Screw terminal 1.5 ... 1.7 Nm | | | | x | x | x |
| Basic Line Module 20 kW Braking resistor connection | Screw terminal 0.5 ... 0.6 Nm | x | x | x | | | |
| Basic Line Module 40 kW Braking resistor connection | Screw terminal 1.5 ... 1.8 Nm | | | x | x | x | |

Table 12- 25 Connectable conductor cross-sections Part 4: Line supply cable

| Component | Terminal type / tightening torque | Connection cross-section [mm ²] | | | | | |
|---|-----------------------------------|---|----|----|----|----|-----|
| | | 25 | 35 | 50 | 70 | 95 | 120 |
| Basic Line Module 40 kW Line cable connection | Screw terminal 6 Nm | x | x | x | | | |
| Basic Line Module 100 kW Line cable connection ¹⁾ | Threaded bolts M8 13 Nm | | | | x | x | x |

¹⁾ Alternatively, two ring cable lugs without insulation for the parallel connection of two 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 |
| Danger to life as a result of overheated motor cables if permissible cross-sections are fallen below |
| Motor cables with inadequate cross-section can cause components to overheat. This can result in severe injury or death due to fire and smoke. |
| <ul style="list-style-type: none"> • Use cables that correspond to the Motor Module currents. • 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 the IP20 degree of protection for Basic Line Modules 40 kW

The 40 kW Basic Line Module only has an IP20 degree of protection when used with power cables with insulated end sleeves and a cross-section > 25 mm².

Note

Cross-section of the protective conductor

The cross-section of the PE conductor must be selected according to DIN EN 60204-1, DIN EN 61800-5-1 and VDE 0100-540 (IEC 60364-5-54). Some components result in an increased leakage current. In this case, regulation EN 61800-5-1 must be taken into account.

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.

12.8.6 Motor connection connector

Motor Modules 3 A to 30 A are supplied without a motor connector. Prefabricated MOTION-CONNECT power cables with pre-assembled motor connectors or unassembled power cables can be used to connect motors. In this case, the motor connector must be ordered separately.

The motor connector is equipped with a locking mechanism. Mounting on the Motor Module is described in the following.

12.8.6.1 Mounting on the Motor Module

Motor connectors with locking mechanism are available in two versions:

- Crimp plug for pre-assembled motor cables
- Screw connector for motor cables that need to be assembled

The way in which motor connectors are installed depends on the type of Motor Module used.

Note

With Double Motor Modules, the rear motor connector must be installed first and then locked.

Installation on Motor Modules without pre-assembled interlock bolt

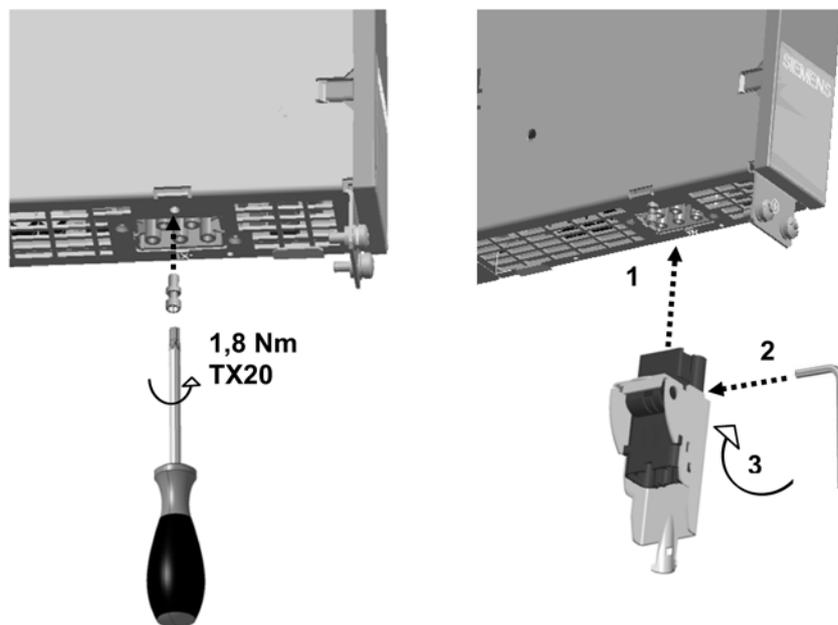


Figure 12-26 Installation example: Crimp plug

1. Screw the interlocking bolts into the thread provided in the housing.
2. Insert the connector, including the motor cable, and lock it in place using a screwdriver or size 4 hexagon socket-head screw clockwise by turning a ¼ turn (90°).

Installation on Motor Modules with pre-assembled interlock bolt

If Motor Modules with a pre-assembled interlock bolt are used, step 1 described above can be omitted.

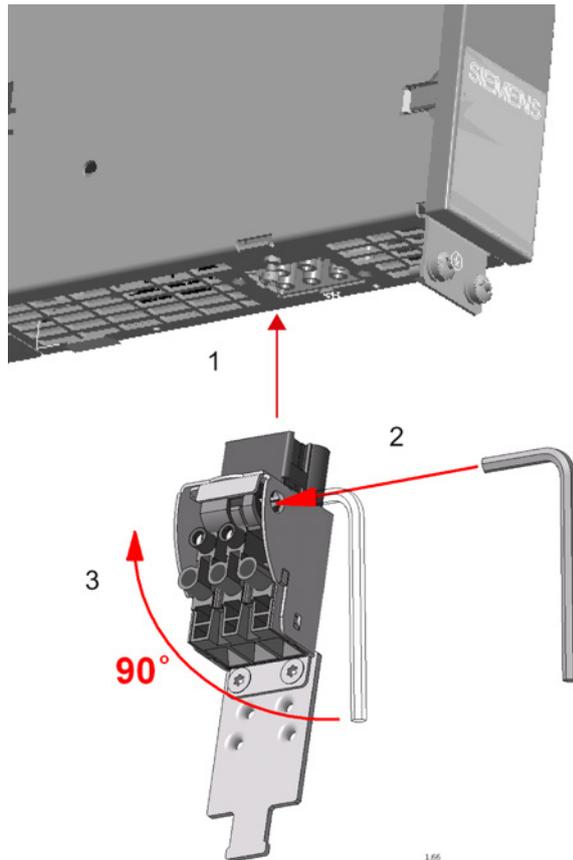


Figure 12-27 Installation example: Screw connector

Simply insert the connector, including the motor cable, and lock it in place using a screwdriver or size 4 hexagon socket-head screw clockwise by turning a ¼ turn (90°).

12.8.6.2 Attaching the motor connector to self-fabricated cables

Preparing the power cable

Non-assembled power cables must be appropriately prepared before the motor connector is connected.

1. Remove the cable sheath to 200 mm ± 5 mm.
2. Fix the braided shield, e.g. with heat-shrink tubing
3. Remove the insulation from the individual U, V, W conductors and the motor holding brake connecting cables and shorten these corresponding to the drawing shown below.
4. Remove the insulation from the single PE conductor, and crimp this with a ring cable lug without insulation.

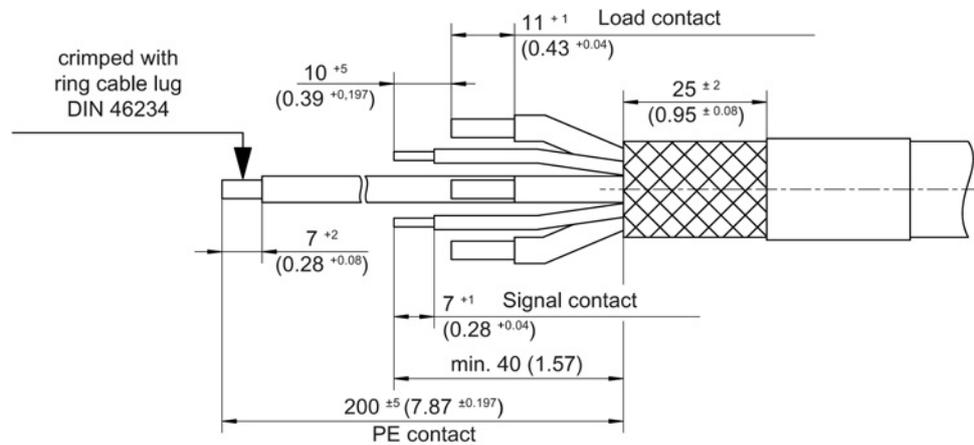
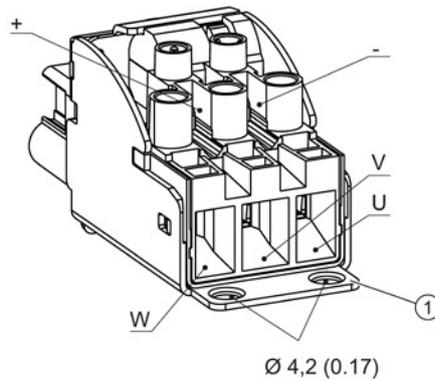


Figure 12-28 Stripped lengths for self-fabricated motor power cables, all data in mm and (inches)

Attaching the motor connector

The connections for the single conductors at the motor connector can be taken from the following diagram.

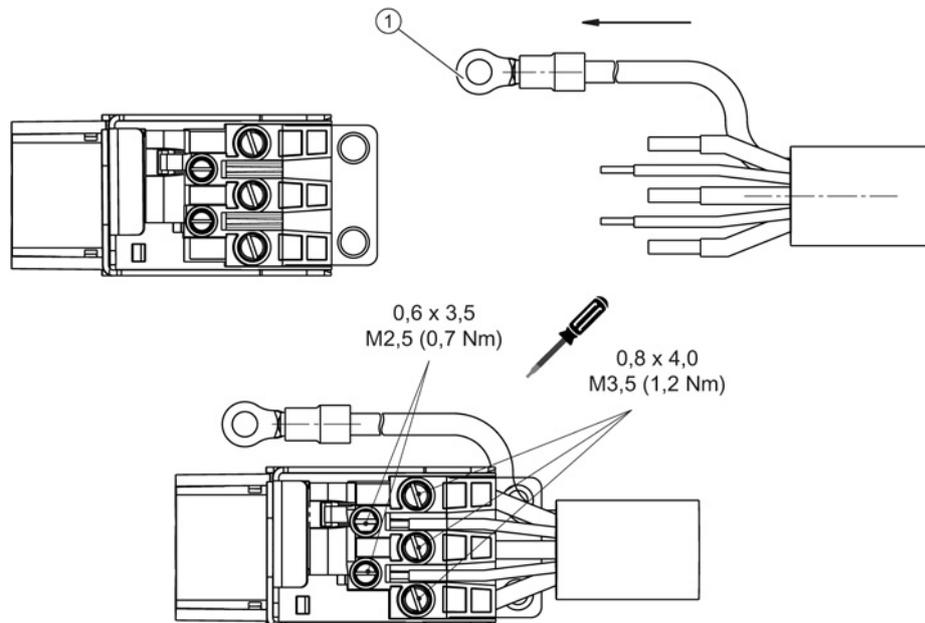


- ① Connection for shield plate supplied with the equipment

Figure 12-29 Connections at the motor connector, screw version

The motor connector is connected as shown below.

1. Insert the individual U, V, W conductors into the associated terminals of the motor connector (maximum cross-section for cables with end sleeves: 6.0 mm^2).
2. Insert the individual conductors of the motor holding brake into the associated terminals of the motor connector (maximum cross-section for cables with end sleeves: 2.5 mm^2).



- ① Insulated ring cable lug

Figure 12-30 Attaching the motor connector screw version

12.8.6.3 Removing the motor connector from prefabricated power cables

The motor connector of a pre-assembled motor cable might have to be removed if the cable needs to be routed through narrow cable glands, for example.

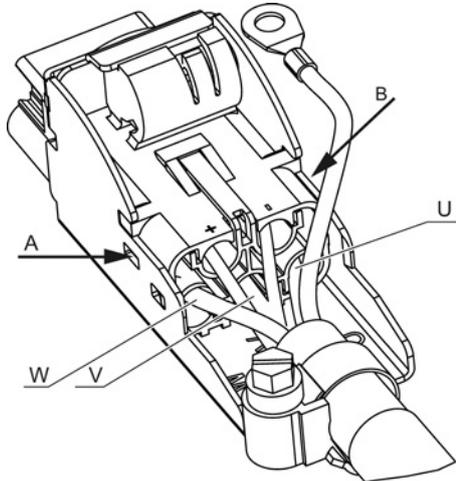


Figure 12-31 Motor connector, crimped version

Removing the motor connector

1. First loosen the clamp.
2. Simultaneously press the tabs A and B on both sides of the connector using a screwdriver.
3. Keep both tags pressed and lift the interlock mechanism e.g. using a screwdriver.
4. Remove the Insert and withdraw the motor cable out of the connector.

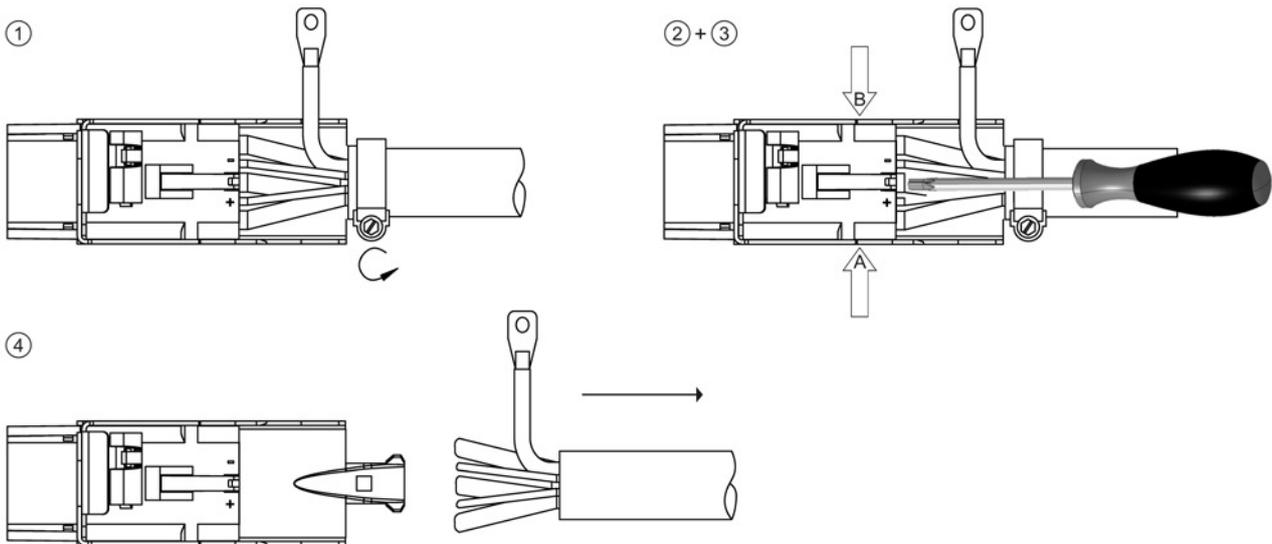


Figure 12-32 Removing the motor connector, crimped version

12.8.6.4 Coding

The motor connector is coded using coding plugs. The coding plugs are included in the scope of supply of the motor connector. Coding can be used to prevent motor cables being incorrectly connected, particularly in the case of Double Motor Modules.

The coding of a motor connector is illustrated below, using the example of a connector with screwed joint.



Motor connector with associated coding plugs Motor connector with coding plugs inserted from the accessories pack

12.8.6.5 Shield connection

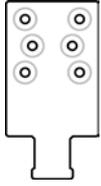
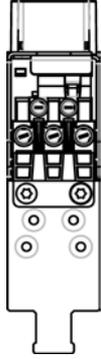
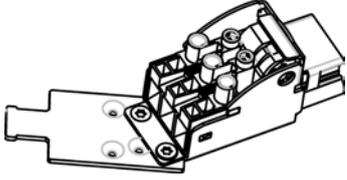
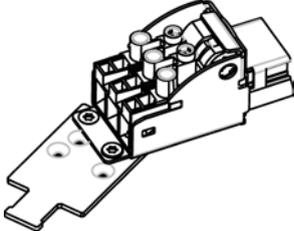
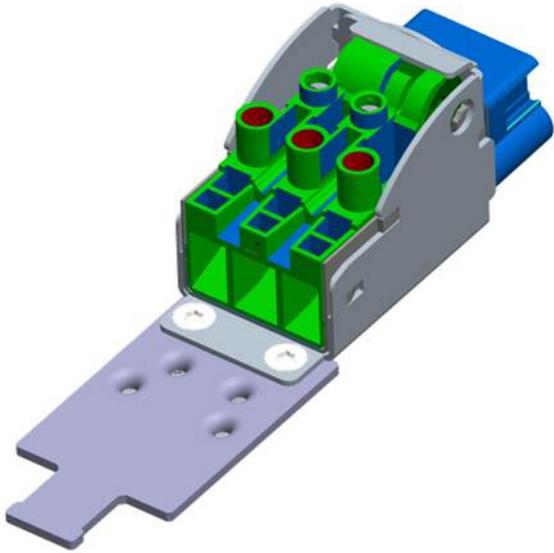
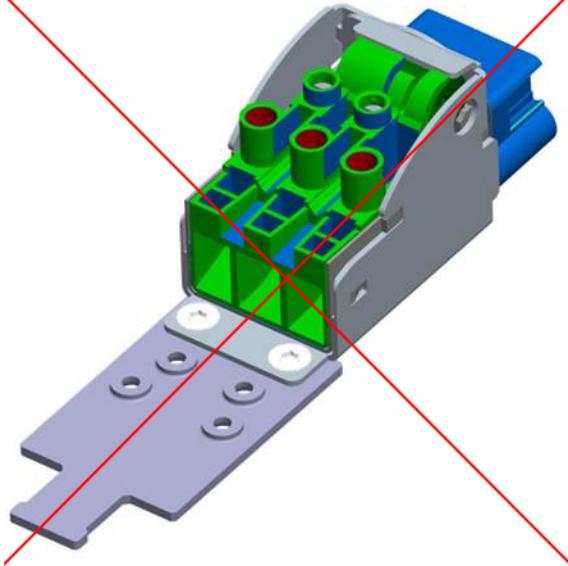
The following options are available for cable shield support:

1. Shield support with shield plate supplied
2. Shield support on a toothed rail
3. Fixing your own shield support at the shield connection of the motor connector

Shield support with shield plate supplied

A shield plate is always provided with the screw version of the motor connector. The shield of a prefabricated motor power cable should be preferably connected at this shield plate that is provided.

Table 12- 26 Possible installations of the shield plate

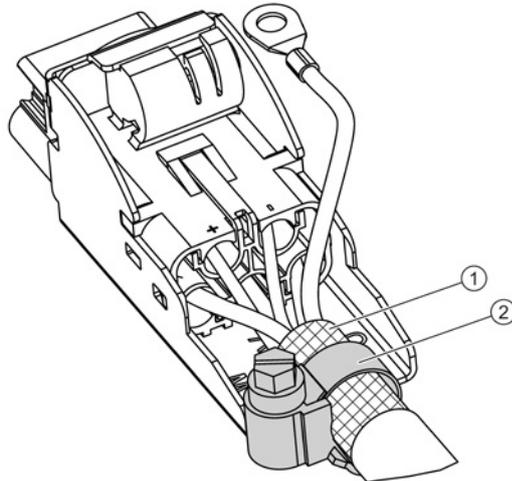
| | |
|--|--|
|  |  |
| <p>Shield plate supplied for the motor connector</p> | <p>Frontal alignment of the shield plate</p> |
|  |  |
| <p>Lateral alignment of the shield plate</p> | <p>Lateral alignment of the shield plate</p> |
| <p>Mount the shield plate with the recesses facing upwards. Otherwise the shield plate will not be able to be tightened. It is then no longer guaranteed that the shield plate is mounted so that there is a reliable electrical connection.</p> | |
|  |  |
| <p>Correct</p> | <p>Incorrect</p> |

The shield plate can be mounted at various angles at the motor connector using two screws (M4) that are provided (tightening torque: 1.8 Nm).

Note

In order to guarantee that the cable shield is connected through a large surface area, the motor power cable is attached with a steel hose clamp at the shield plate.

The shield is connected as shown below.



- ① Protective braided shield
- ② Steel hose clamp

Figure 12-33 Shield connection using a motor connector, crimped version, as example

Shield support on a toothed rail

The toothed rail should be mounted at a distance of ≤ 150 mm below the drive line-up to ensure a good contact. Wherever possible, the brake cores must be kept physically separate from U/V/W connections.

Note

Measures must be taken on site to relieve strain on the cables.
The maximum permissible tensile load in the insertion direction is 100 N.

With these versions, the shield for the brake connection conductors must be routed together with the cable shield.

12.8.7 Spring-loaded terminals

The type of spring-loaded terminal can be taken from the interface description of the particular component.

Table 12- 27 Connectable conductor cross-sections for spring-loaded terminals

| Spring-loaded terminal type | | | |
|-----------------------------|----------------------------------|---|--|
| 1 | Connectable cable cross-sections | Rigid Flexible Flexible with end sleeve without plastic sleeve AWG/kcmil | 0.14 ... 0.5 mm ² 0.14 ... 0.5 mm ² 0.25 ... 0.5 mm ² 26 ... 20 |
| | Stripped length | 8 mm | |
| 2 | Connectable cable cross-sections | Flexible | 0.08 ... 2.5 mm ² |
| | Stripped length | 8 ... 9 mm | |
| 3 | Connectable cable cross-sections | Rigid Flexible Flexible with end sleeve without plastic sleeve Flexible with end sleeve with plastic sleeve AWG/kcmil | 0.2 ... 1.5 mm ² 0.2 ... 1.5 mm ² 0.25 ... 1.5 mm ² 0.25 ... 0.75 mm ² 24 ... 16 |
| | Stripped length | 10 mm | |
| 4 | Connectable cable cross-sections | AWG | 25 ... 95 mm ² 4 ... 4/0 |
| | Stripped length | 35 mm | |
| 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 mm ² 0.2 ... 6 mm ² 0.25 ... 6 mm ² 0.25 ... 4 mm ² 24 ... 8 |
| | Stripped length | 15 mm | |

12.8.8 Screw terminals

The type of screw terminal can be taken from the interface description of the particular component.

Table 12- 28 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 | 0.08 ... 1.5 mm ² 0.25 ... 1.5 mm ² 0.25 ... 0.5 mm ² |
| | Stripped length | 7 mm | |
| | Tool | Screwdriver 0.4 x 2.0 mm | |
| | Tightening torque | 0.22 ... 0.25 Nm | |
| 1_1 | Connectable cable cross-sections | Rigid, flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve | 0.14 ... 1.5 mm ² 0.25 ... 1.5 mm ² 0.25 ... 0.5 mm ² |
| | Stripped length | 7 mm | |
| | Tool | Screwdriver 0.4 x 2.5 mm | |
| | Tightening torque | 0.22 ... 0.25 Nm | |
| 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 mm ² 0.2 ... 2.5 mm ² 0.2 ... 1.5 mm ² 22 ... 12 |
| | Stripped length | 6 ... 7 mm | |
| | Tool | Screwdriver 0.5 x 3 mm | |
| | Tightening torque | 0.4 ... 0.5 Nm | |
| 3 | Connectable cable cross-sections | Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve | 0.2 ... 2.5 mm ² 0.25 ... 1 mm ² 0.25 ... 1 mm ² |
| | Stripped length | 9 mm | |
| | Tool | Screwdriver 0.6 x 3.5 mm | |
| | Tightening torque | 0.5 ... 0.6 Nm | |
| 4 | Connectable cable cross-sections | Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve | 0.2 ... 4 mm ² 0.25 ... 4 mm ² 0.25 ... 4 mm ² |
| | Stripped length | 7 mm | |
| | Tool | Screwdriver 0.6 x 3.5 mm | |
| | Tightening torque | 0.5 ... 0.6 Nm | |
| 5 | Connectable cable cross-sections | Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve | 0.5 ... 6 mm ² 0.5 ... 6 mm ² 0.5 ... 6 mm ² |
| | Stripped length | 12 mm | |
| | Tool | Screwdriver 1.0 x 4.0 mm | |
| | Tightening torque | 1.2 ... 1.5 Nm | |

| Screw terminal type | | | |
|----------------------------|----------------------------------|---|--|
| 6 | Connectable cable cross-sections | Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve | 0.5 ... 10 mm ² 0.5 ... 10 mm ² 0.5 ... 10 mm ² |
| | Stripped length | 11 mm | |
| | Tool | Screwdriver 1.0 x 4.0 mm | |
| | Tightening torque | 1.5 ... 1.8 Nm | |
| 7 | Connectable cable cross-sections | 0.5 ... 16 mm ² | |
| | Stripped length | 14 mm | |
| | Tool | Screwdriver 1.0 x 4.0 mm | |
| | Tightening torque | 1.5 ... 1.7 Nm | |

12.8.9 Handling restrictor collars for touch protection

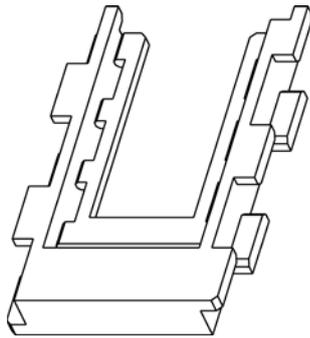
Handling restrictor collars for touch protection and when connecting cables

Restrictor collars are used to provide touch protection in accordance with EN 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 643).

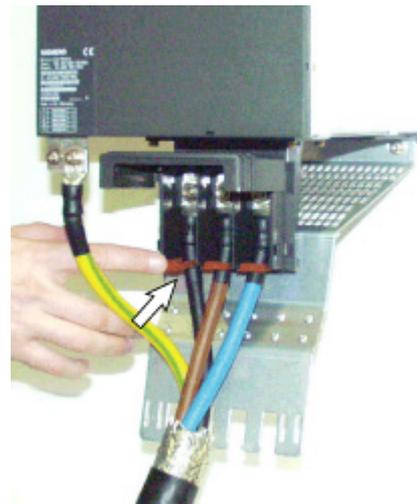
Exception: The cross-section of the connected cables is large enough to ensure that the threaded bolts and the ends of the cables cannot be touched when the cover is closed.

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 45 A and higher
- Active Interface Modules 80 kW and higher



Restrictor collar



Power unit with cables and restrictor collars attached

12.9 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

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, shielding plates with the appropriate contacts at several locations can be used between the cable bundles.

All cables inside the cabinet must be routed as closely as possible to parts connected with cabinet ground, such as a mounting plate or cabinet wall. Ducts made of sheet steel or cables routed between steel sheets (e.g. between the mounting plate and back wall) should provide adequate shielding.

All cables must be kept as short as possible, to minimize the antenna effect.

Signal and power cables may cross each other (if absolutely necessary), but must never be routed closely to one 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). Alternatively, shield plates with the appropriate contacts at several locations along their length can be used to provide the appropriate clearance.

Note: 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.

**! WARNING****Danger to life due to high leakage currents caused by an interrupted external protective conductor**

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.

- Ensure that the external protective conductor satisfies at least one of the following conditions:
 - It has been laid so that it is protected against mechanical damage.¹⁾
 - If it is a single conductor, it has a cross-section of at least 10 mm² Cu.
 - If it is a conductor of a multi-conductor cable, it has a cross-section of at least 2.5 mm² Cu.
 - It has a second protective conductor in parallel with the same cross-section.
 - It complies with the local regulations for equipment with increased leakage current.
- ¹⁾ Cables laid within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.

Shield connection

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

Routing 24 V cables

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

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

Conditions of use for 24 V cables

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

12.10 Protective connection and equipotential bonding

Protective connections

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

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

Table 12- 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 |

For materials other than copper, the cross-section should be increased so that as a minimum, the same conductivity is attained.

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

The protective connection (PE connection) for the motors used must be established through the motor cable. 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 common bright mounting plate in order to comply with the EMC limit values. The mounting plate must be connected to the protective conductor connection of the control cabinet through a low impedance.

Copper cables with appropriate cross-sections (> 2.5 mm²) must be used for the ground connection of PROFIBUS nodes.

For more information about grounding PROFIBUS, see:

http://www.profibus.com/fileadmin/media/wbt/WBT_Assembly_V10_Dec06/index.html



! DANGER

Danger to life when live parts are touched

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

- Only operate the components in electrical equipment rooms or control cabinets that can be securely locked.



! WARNING

Danger to life due to high leakage currents caused by an interrupted external protective conductor

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.

- Ensure that the external protective conductor satisfies at least one of the following conditions:
 - It has been laid so that it is protected against mechanical damage.¹⁾
 - If it is a single conductor, it has a cross-section of at least 10 mm² Cu.
 - If it is a conductor of a multi-conductor cable, it has a cross-section of at least 2.5 mm² Cu.
 - It has a second protective conductor in parallel with the same cross-section.
 - It complies with the local regulations for equipment with increased leakage current.
- ¹⁾ Cables laid within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.

Functional equipotential bonding

A mounting plate, which is connected with the protective conductor connection of the control cabinet through a low impedance connection, simultaneously serves as the functional equipotential bonding surface. This means that no additional functional equipotential bonding is required within the drive line-up.

If a common bright 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 also apply to the functional equipotential bonding. If only smaller conductor cross-sections are permissible on components, the largest cross-section must be used (e.g. 6 mm² 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.

12.10 Protective connection and equipotential bonding

The following cross-sections must be observed in accordance with IEC 60364-5-54:

- Copper 6 mm²
- Aluminum 16 mm²
- Steel 50 mm²

Additional 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>

12.11 Information on cold plate cooling

12.11.1 General information

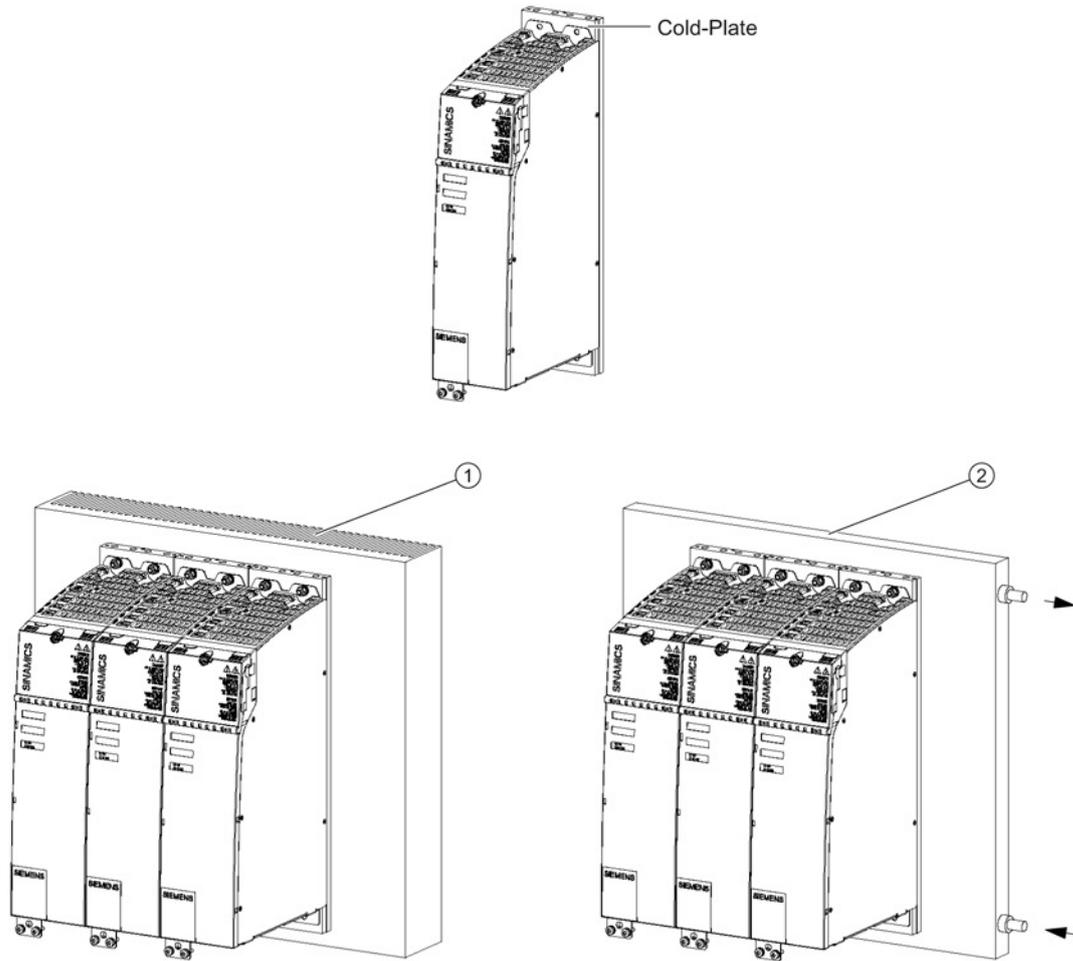
Cold plate cooling is a cooling method that can be used for SINAMICS S120 power units in booksize format. The flat aluminum cold plate (cold plate), which is located on the rear of the device, acts as a thermal interface in cold plate cooling.

The cold plate cooling is especially suitable for the following machine concepts:

- Plants and systems with high degree of pollution in the vicinity of the machine (e.g. in the textiles or timber industry).
 - Reducing cabinet-internal thermal losses facilitates cooling within a sealed cabinet (IP54).
- Plants and systems where liquid cooling is already being used in the process.
 - The existing cooling circuit can be used to externally cool the power components with cold plate.

There are two ways of configuring this type of cooling:

1. Cold plate cooling with an external air heat sink
The components of the drive line-up are typically all screwed on to the cooling fins of an air heat sink located outside the control cabinet.
2. Cold plate cooling with an external liquid heat sink
The components of the drive line-up are typically all screwed on to a liquid heat sink located outside the control cabinet.



- ① Cold plate components on an external air heat sink
- ② Cold plate components on an external liquid heat sink

Figure 12-34 Overview of cooling types for drive line-ups with cold plate

12.11.2 Cold plate with external air heat sink

12.11.2.1 Configuration and conditions

The conditions described below must be taken into account when cooling a cold-plate drive line-up by means of an external air heat sink.

General conditions to be observed:

1. The maximum temperature within the cabinet is 40 °C (inlet air temperature of the power sections). The maximum temperature inside the cabinet for derating is 55 °C. For the relevant specifications, refer to the "Technical data".
2. The maximum permissible heat-sink temperature is module-dependent. Refer to the "Technical data" for more information. A temperature sensor in the power unit measures the temperature and can be read via parameter (see SINAMICS S120/S150 List Manual).
3. The customer must take measures to protect the devices against condensation (see Anti-condensation measures (Page 807)).

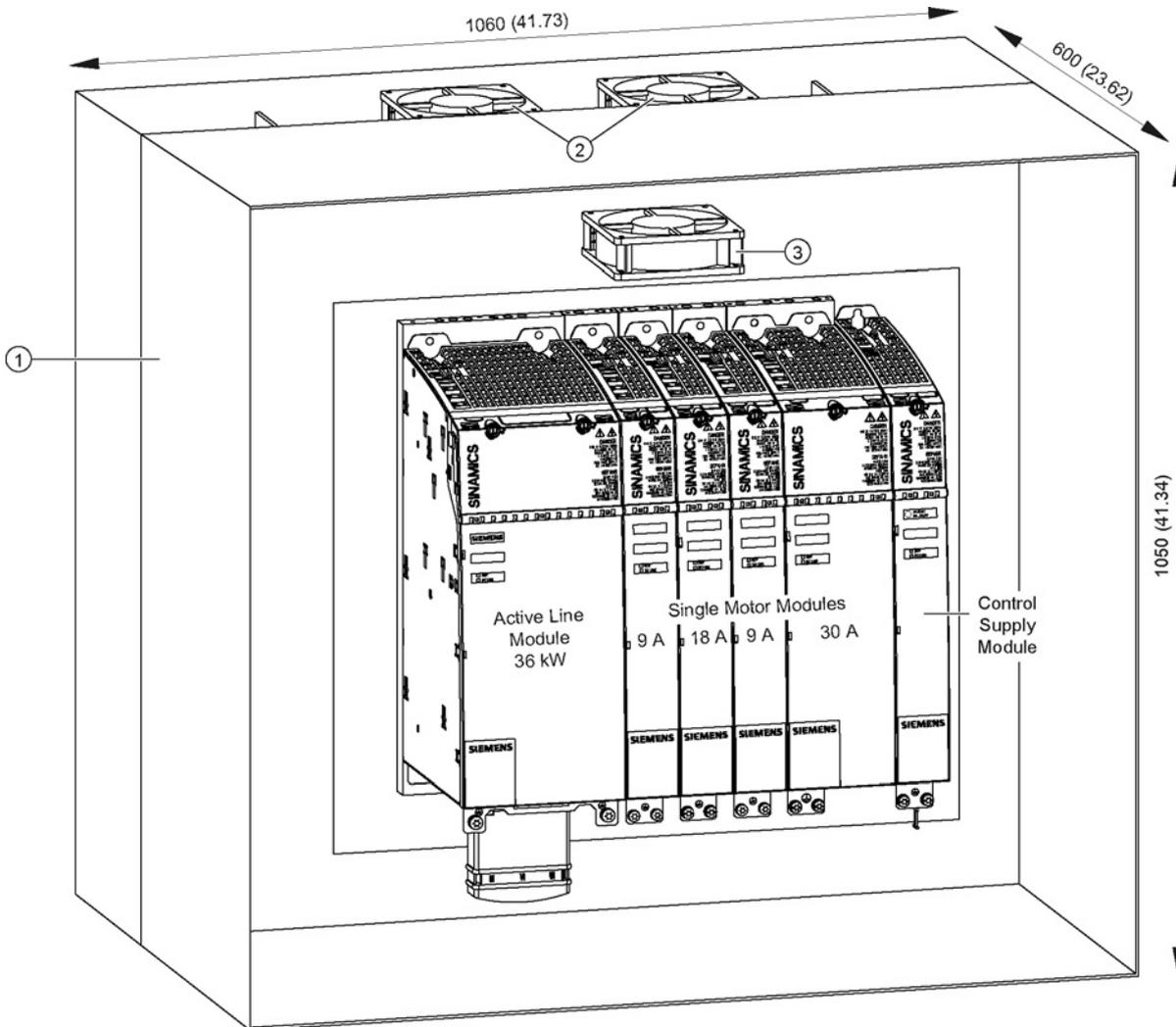
Note

If the components are installed in a sealed cabinet, an internal fan must be installed to prevent hot spots. It is best to install the fan above the modules to optimize the air flow (suction).

If the conditions in the plant do not allow the temperature in the cabinet to be limited to a maximum of 40 °C, further measures must be taken. Please contact the hotline for more information (see the Preface).

The power units must be arranged in such a way that the power (loss) is distributed equally. The permissible current carrying capacities of the DC link busbars in the different modules must be taken into account (see "Technical data" for the various modules).

12.11.2.2 Setup example, drive line-up, cold plate with external air heat sink



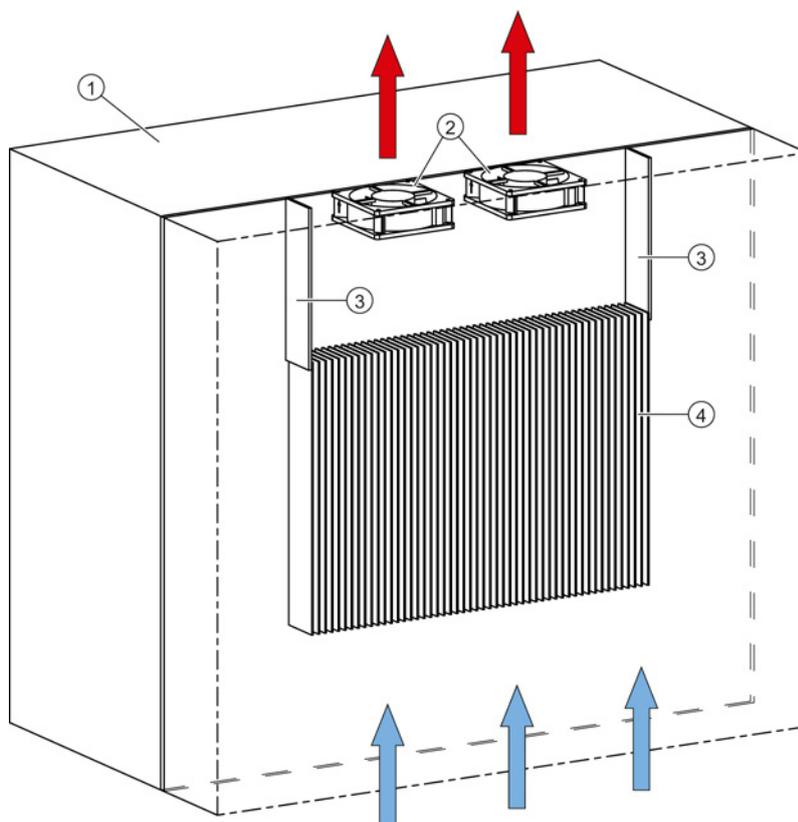
- ① Control cabinet
- ② External fan
- ③ Internal fan

Figure 12-35 Front view of a control cabinet with drive line-up, cold plate and external air heat sink

Setup:

- Infeed: Active Line Module 36 kW
- 4 Single Motor Modules
- Control Supply Module for 24 V supply
- Internal fan at the top of the control cabinet
- One shared external air heat sink

To optimize usage of the external air heat sink, it is best to arrange the components in such a way that the heat is dissipated equally over the surface of the external heat sink. This means that, if possible, a large power section should be situated next to a smaller one. The current carrying capacity of the DC-link busbars must be taken into account here.



- ① Control cabinet
- ② External fan
- ③ Air baffle plates
- ④ External air heat sink

Figure 12-36 Rear view of a control cabinet with drive line-up, cold plate and external air heat sink

In this example, two axial fans with a diameter of 150 mm ensure forced convection. The ribbed heat sink, which is attached to the rear, is located in an air duct (approx. 150 mm deep). Additional air guides at the sides improve air guidance and significantly optimize the power unit cooling.

Note

The external heat sink must be sealed with respect to the control cabinet in accordance with IP65.

Example: external air heat sink

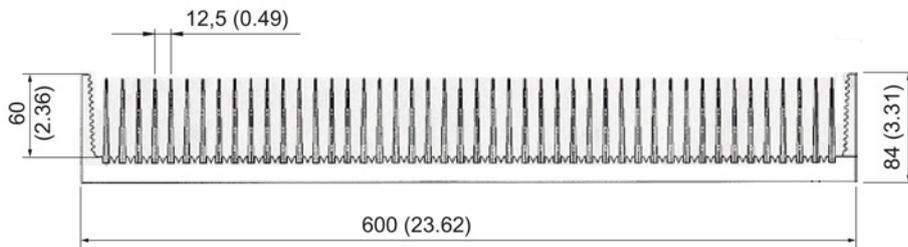


Figure 12-37 External air heat sink, all data in mm and (inches); height: 500 mm (19.69 inch)

Aluminum air heat sinks are recommended.

The heat sinks and fans must be dimensioned for the power loss to be dissipated. For the component-specific power loss in rated operation, refer to "Technical data". (Mean power loss in periodic duty is lower.)

The heat sinks and fans are not part of the scope of supply.

Recommended suppliers for heat sinks include:

- Alcan company, Singen:
- Sykatec company, Erlangen:

Note

The mounting surface for the heat sink (roughness, evenness) must fulfill the requirements for the corresponding cold plate component described in the chapter titled "Installation".

12.11.3 Cold plate with an external liquid heat sink

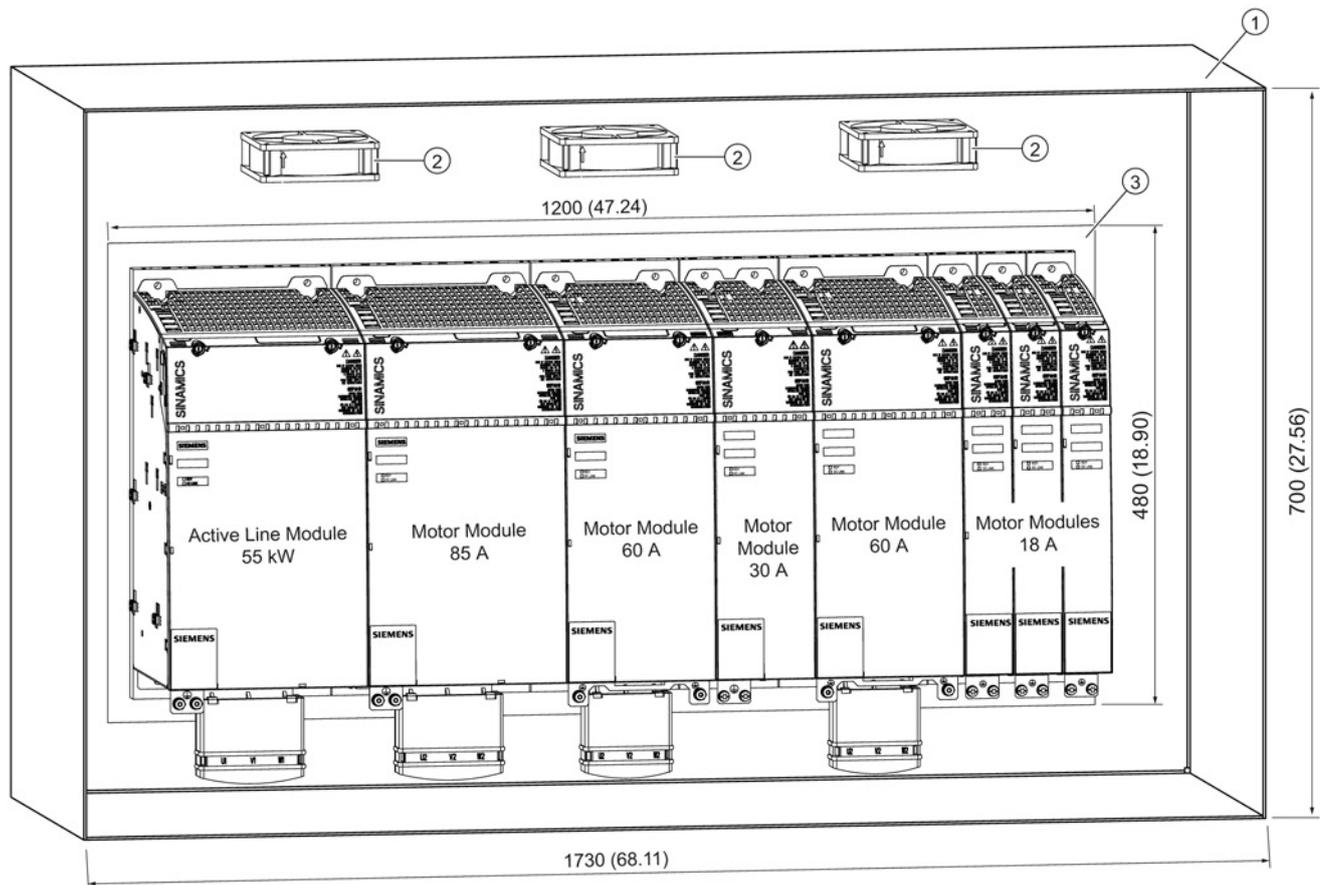
12.11.3.1 Configuration and conditions

When an external liquid heat sink is used, the power sections are all installed on a plate through which cooling water flows to cool the power units. The size of the liquid heat sink can be adjusted in line with the size of the drive line-up.

General conditions to be observed

1. The maximum temperature within the cabinet is 40 °C (inlet air temperature of the power sections). The maximum temperature inside the cabinet for derating is 55 °C. For the relevant specifications, refer to the "Technical data".
2. The maximum permissible heat-sink temperature is module-dependent. Refer to the "Technical data" for more information. A temperature sensor in the power unit measures the temperature and can be read via parameter (see SINAMICS S120/S150 List Manual).
3. The customer must take measures to protect the devices against condensation (see Anti-condensation measures (Page 807))

12.11.3.2 Setup example, drive-line-up, cold plate with external liquid heat sink



- ① Control cabinet
- ② Fan inside the control cabinet
- ③ External liquid heat sink

Figure 12-38 Example: cold plate drive line-up with external liquid cooling

Setup:

- Infeed: Active Line Module 55 kW
- 7 Single Motor Modules
- 3 internal fans at the top of the control cabinet
- 1 common external liquid heat sink (1200 mm x 480 mm)

The heat sinks and fans are not part of the scope of supply.
Recommended suppliers for liquid heat sinks include:

- Company DAU Ges.m.b.H & CO.KG., Ligist (Austria)
- Company Rittal GmbH & Co. KG, Herborn

12.12 Notes on electrical cabinet cooling

12.12.1 Control cabinet cooling options

The following options are available for cooling the control cabinet:

- Filter fans
- Heat exchangers
- Cooling unit
- Liquid cooling
- External air cooling
- External liquid cooling

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

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

Note

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.

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

- Ventilation clearance
- Wiring and cabling
- Air guidance, air-conditioner

12.12.2 General information on ventilation

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

Fan operation up to firmware version 2.5

The fans are switched on and 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.

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.

| |
|---|
|  WARNING |
| Danger to life if the fundamental safety instructions and remaining risks are not carefully observed |
| If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur. |
| <ul style="list-style-type: none">• Adhere to the fundamental safety instructions.• When assessing the risk, take into account residual risks. |

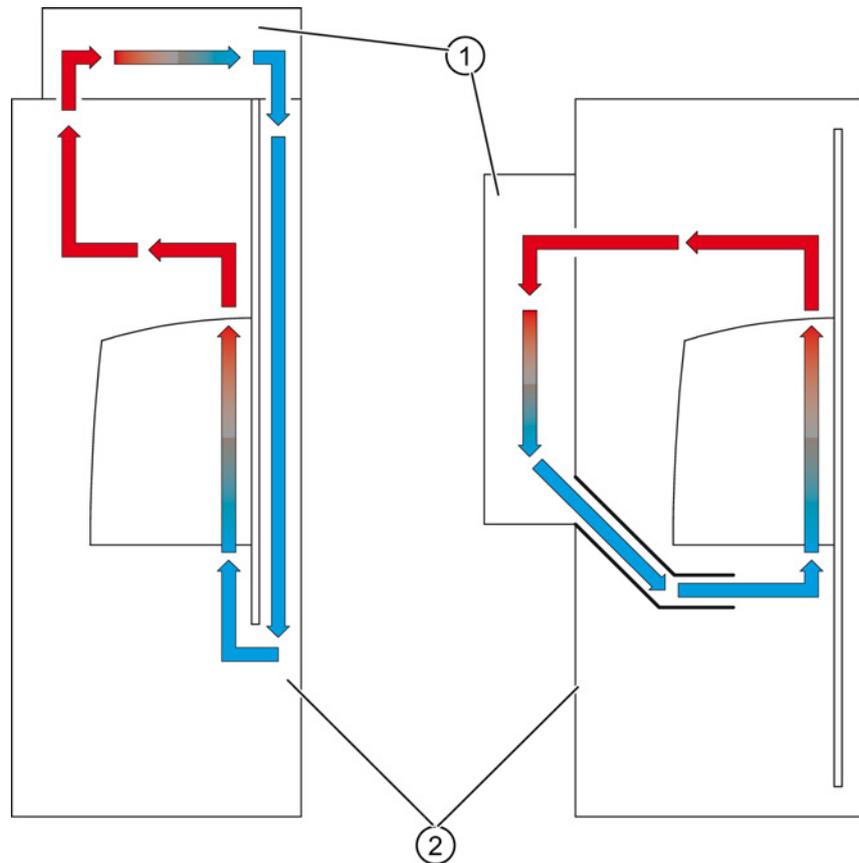
| |
|---|
| NOTICE |
| Damage caused by overheating resulting from covered ventilation slots |
| Covered ventilation slots can cause the system to overheat. |
| <ul style="list-style-type: none">• Route the connected signal and power cables to the components in such a way that they do not cover the ventilation 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 12-39 Examples of cabinet ventilation

NOTICE

Damage to the component through condensation

Condensation on the components can result in their failure.

- Select the air circuit and arrangement of the cooling equipment in such a way that no condensation can form on the components.
- If required, an anti-condensation heater must be installed in the cabinet.

If air conditioners are used, the relative air humidity of the expelled air increases as the air in the air conditioner cools and may exceed the dew point. If the relative humidity of the air entering the SINAMICS components is over 80% for an extended period of time, it can be assumed that the insulation of the components will fail as a result of electrochemical reactions (see System overview (Page 33)). Using air baffle plates, for example, you must ensure that the cold air expelled from the air conditioner mixes with warm air in the cabinet before it enters the components. This reduces the relative air humidity to uncritical values.

12.12.3 Cooling clearances

Table 12- 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 |
| 80 ... 120 kW | 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 | 80 |
| 132 A/200 A | 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 |

Drive line-up with internal air cooling

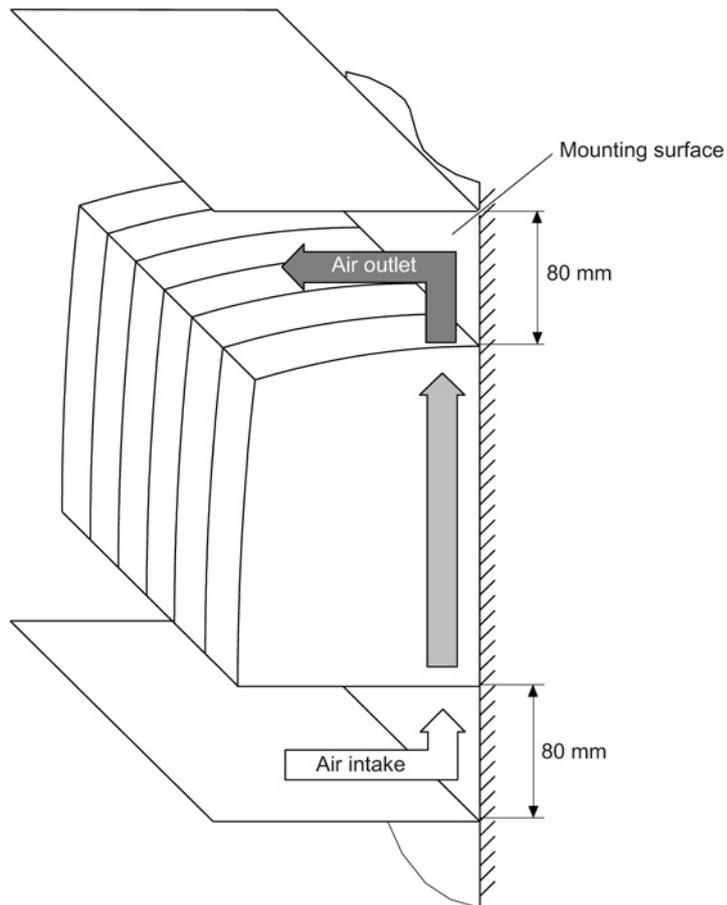


Figure 12-40 Cooling clearances for a drive line-up with internal air cooling (components up to 200 mm width)

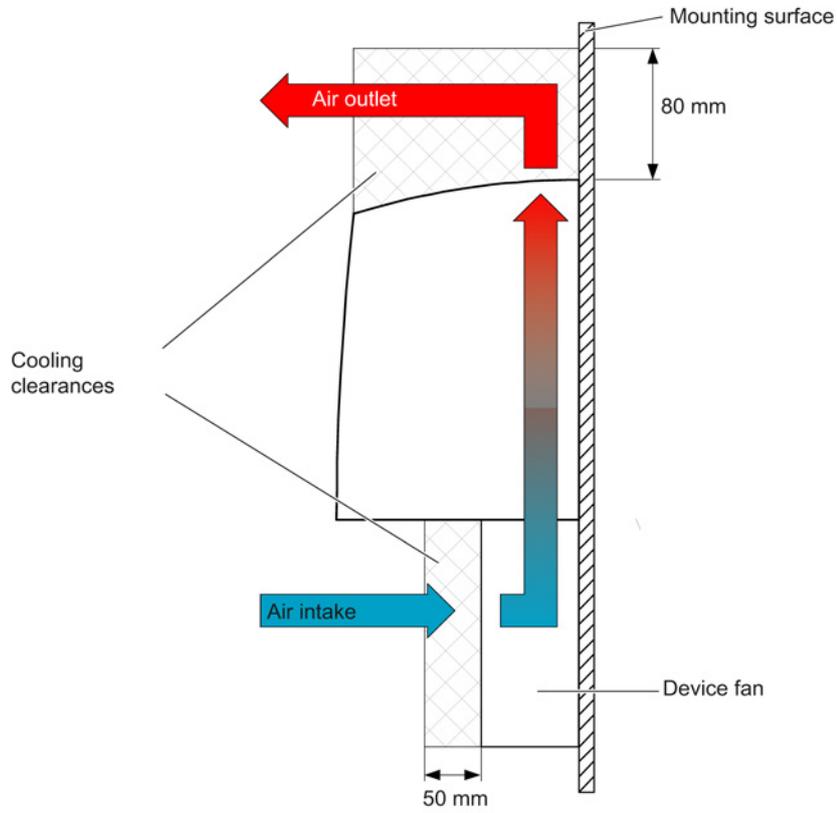


Figure 12-41 Cooling clearances for 300 mm wide components with internal air cooling with mounted unit fan

Drive line-up with external air cooling

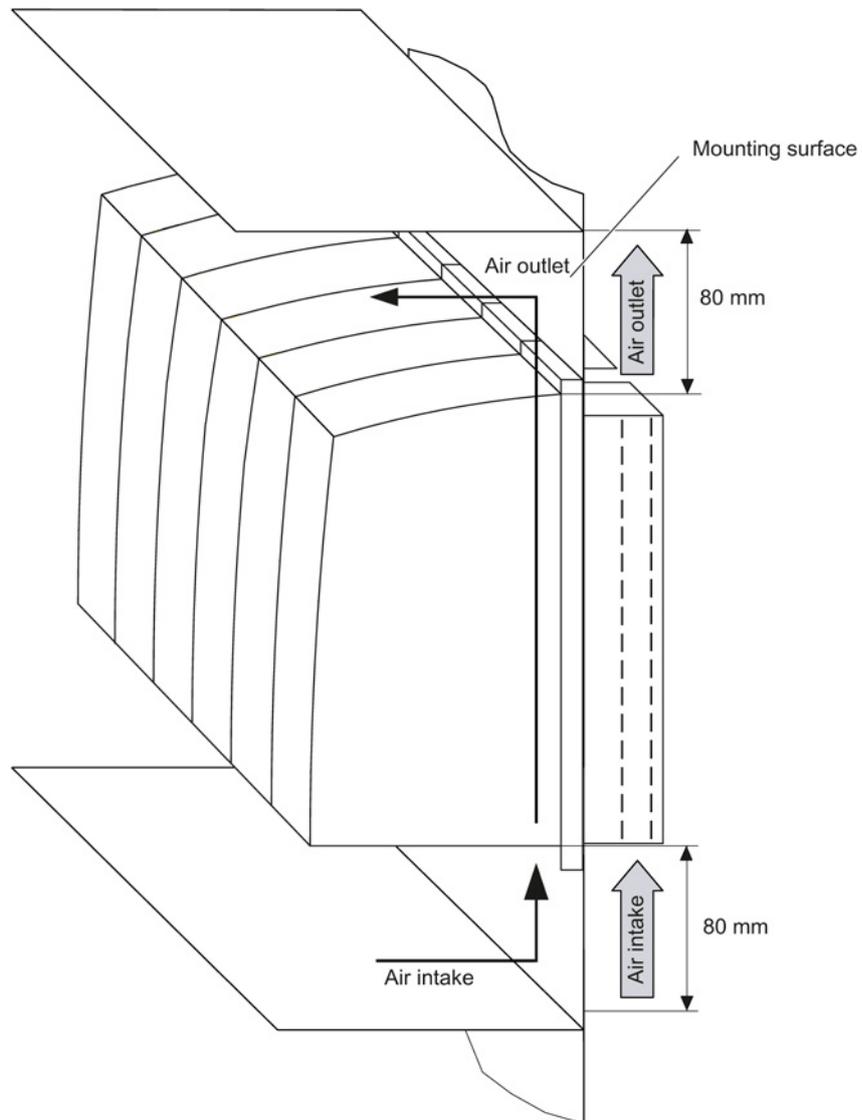


Figure 12-42 Cooling clearances for a drive line-up with external air cooling (components up to 200 mm width)

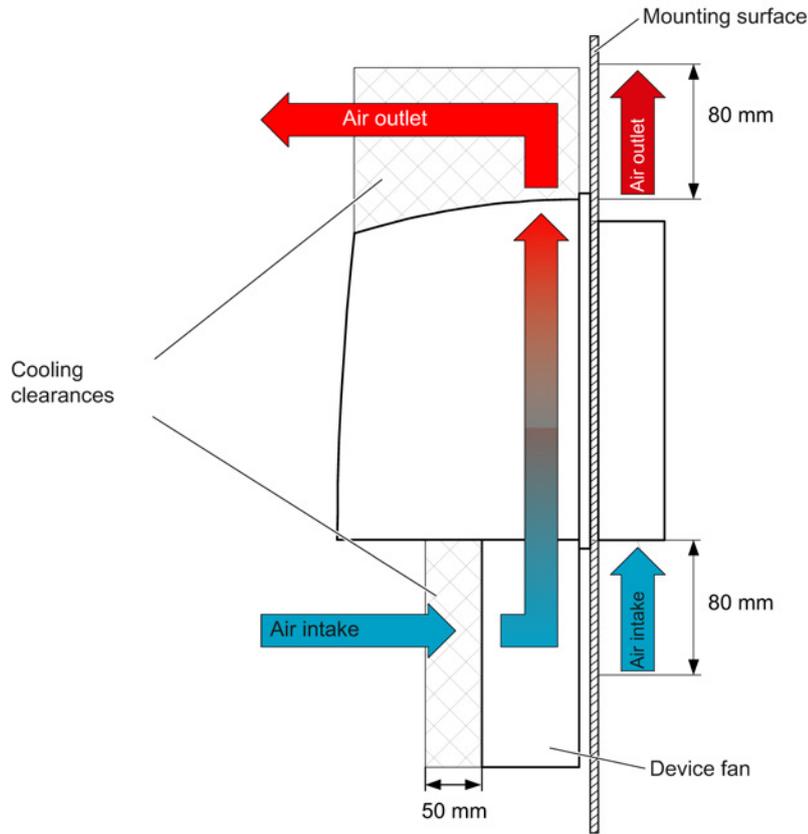


Figure 12-43 Cooling clearances for 300 mm wide components with external air cooling with mounted unit fan

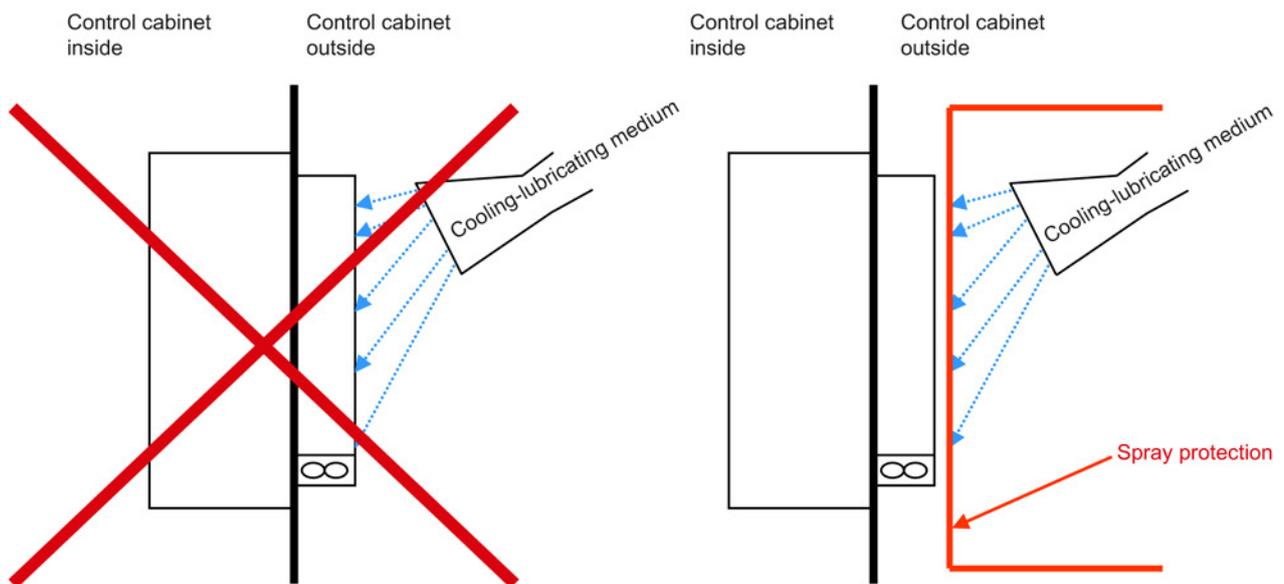


Figure 12-44 Spray protection for a drive line-up with external air cooling

Rail-mounted components

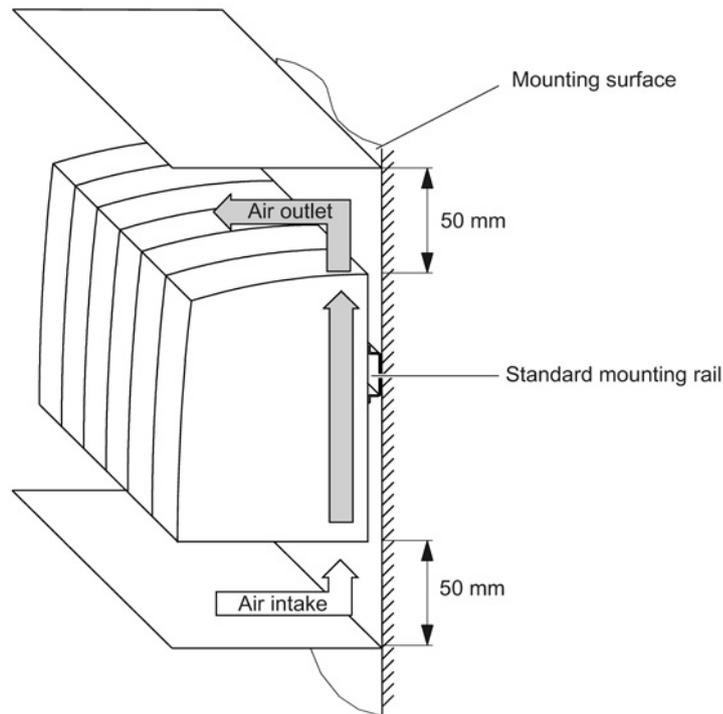


Figure 12-45 Cooling clearances for rail-mounted components (e.g. VSM, SMC, TM, DMC)

12.12.4 Notes on ventilation with cold plate

Notes on ventilation with cold plate

With cold-plate cooling, the SINAMICS devices must always be ventilated separately by means of a fan in the cabinet. Other suitable measures can be alternatively employed.

When using an external air heat sink, fans located outside the control cabinet must be additionally used. Other suitable measures can be alternatively employed.

Temperature measurement

The temperature of the power units can be read out using a parameter (see the SINAMICS S120/S150 List Manual).

Temperature limits

1. For the maximum heat sink temperature, see the "Technical data" for the power units.
2. For the maximum temperature inside the control cabinet, see the "Technical data" for the power units.

Measures for remaining within temperature limits

1. One or more fans should be installed.
2. If necessary, the drive line-up can be operated with derating.

12.12.5 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.

$$q = Q - k \times A \times \Delta T$$

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 / (m² * K)] (example: Painted sheet steel k = 5.5 W / (m² * K))

A = free-standing cabinet surface area [m²]

Table 12- 31 Example, calculating the power loss of a drive configuration

| Component | Quantity | 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 | 185.4 | 370.8 |
| Motor Module 30 A | 3 | 309.2 | 927.6 |
| SMC | 5 | 10 | 50 |
| SITOP 20 | 1 | 53 | 53 |
| Line contactor | 1 | 12 | 12 |
| Total: | | | 2469.4 |

Assumption:

Free-standing cabinet surface area A = 5 m²

Temperature difference between the room and cabinet interior ΔT = 10 K

$$q = 2469.4 \text{ W} - 5.5 \text{ W} / (\text{m}^2 \text{ K}) * 5 \text{ m}^2 * 10 \text{ K} = 2194.4 \text{ W}$$

12.13 Power losses of the components

12.13.1 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.

12.13.2 Power loss for Control Units, Sensor Modules, and other system components

Table 12- 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 |

12.13 Power losses of the components

| | Unit | Power loss |
|---------------------------------|------|------------|
| DC link components | | |
| Braking Module Booksize | W | 20 |
| Braking Module Booksize Compact | W | < 40 |
| Capacitor Module | W | 25 |
| Control Supply Module | W | 70 |
| Line DC link | | 65 |

12.13.3 Power loss for line filters and line reactors

Table 12- 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 | | |
| 16 kW | W | 16 |
| 36 kW | W | 26 |
| 55 kW | W | 43 |
| 80 kW | W | 56 |
| 120 kW | W | 73 |
| Wideband Line Filter for Active Line Modules | | |
| 16 kW | W | 70 |
| 36 kW | W | 90 |
| 55 kW | W | 110 |
| 80 kW | W | 150 |
| 120 kW | W | 200 |
| 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 |

| | Unit | Power loss |
|--|------|-------------------|
| 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 | 110 |
| 36 kW | W | 170 |
| 55 kW | W | 200 |
| Line reactors for Basic Line Modules | | |
| 20 kW | W | 130 |
| 40 kW | W | 270 |
| 100 kW | W | 480 |

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

12.13.4 Power loss for power units with internal air cooling

Table 12- 34 Overview of power loss at rated operation for power units with internal air cooling (including electronics losses)

| | 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 | 50.4 |
| 5 A | W | 73.4 |
| 9 A | W | 100.4 |
| 18 A | W | 185,4 |
| 30 A | W | 309.2 |
| 45 A | W | 455.2 |
| 60 A | W | 615.2 |
| 85 A | W | 786 |
| 132 A | W | 1270.4 |
| 200 A | W | 2070.4 |
| Single Motor Modules Booksize Compact | | |
| 3 A | W | 68 ¹⁾ |
| 5 A | W | 98 ¹⁾ |
| 9 A | W | 100.4 |
| 18 A | W | 185.4 |

| | Unit | Power loss |
|---------------------------------------|------|-------------------|
| Double Motor Modules Booksize | | |
| 3 A | W | 97.6 |
| 5 A | W | 132.6 |
| 9 A | W | 187.6 |
| 18 A | W | 351.2 |
| Double Motor Modules Booksize Compact | | |
| 1.7 A | W | 114 ¹⁾ |
| 3 A | W | 134 ¹⁾ |
| 5 A | W | 194 ¹⁾ |

¹⁾ Power loss at 8 kHz

12.13.5 Power loss for power units with external air cooling

Table 12- 35 Overview of power loss at rated operation for power units with external air cooling (including electronics losses)

| | Unit | Internal Power loss ¹⁾ | External power loss | Total power loss |
|----------------------|------|-----------------------------------|---------------------|------------------|
| Active Line Modules | | | | |
| 16 kW | W | 82.8 (60 + 22.8) | 200 | 282.8 |
| 36 kW | W | 171 (135 + 36.0) | 495 | 666 |
| 55 kW | W | 245.6 (200 + 45.6) | 700 | 945.6 |
| 80 kW | W | 338.6 (305 + 33.6) | 1045 | 1383.6 |
| 120 kW | W | 533.2 (490 + 43.2) | 1710 | 2243.2 |
| Smart Line Modules | | | | |
| 5 kW | W | 41.2 (22 + 19.2) | 38 | 79.2 |
| 10 kW | W | 66.6 (45 + 21.6) | 75 | 141.6 |
| 16 kW | W | 64.8 (42 + 22.8) | 123 | 187.8 |
| 36 kW | W | 116 (80 + 36) | 290 | 406 |
| 55 kW | W | 185.6 (140 + 45.6) | 480 | 665.6 |
| Single Motor Modules | | | | |
| 3 A | W | 35.4 (15 + 20.4) | 15 | 50.4 |
| 5 A | W | 43.4 (23 + 20.4) | 30 | 73.4 |
| 9 A | W | 55.4 (35 + 20.4) | 45 | 100.4 |
| 18 A | W | 95.4 (75 + 20.4) | 90 | 185.4 |
| 30 A | W | 99.2 (80 + 19.2) | 210 | 309.2 |
| 45 A | W | 135.2 (110 + 25.2) | 320 | 455.2 |
| 60 A | W | 160.2 (135 + 25.2) | 455 | 615.2 |
| 85 A | W | 196 (160 + 36.0) | 590 | 786 |
| 132 A | W | 270.4 (250 + 20.4) | 1000 | 1270.4 |
| 200 A | W | 455.4 (435 + 20.4) | 1615 | 2070.4 |

12.13 Power losses of the components

| | Unit | Internal Power loss ¹⁾ | External power loss | Total power loss |
|----------------------|------|-----------------------------------|---------------------|------------------|
| Double Motor Modules | | | | |
| 3 A | W | 62.6 (35 + 27.6) | 35 | 97.6 |
| 5 A | W | 72.6 (45 + 27.6) | 60 | 132.6 |
| 9 A | W | 92.6 (65 + 27.6) | 95 | 187.6 |
| 18 A | W | 111.2 (80 + 31.2) | 240 | 351.2 |

¹⁾ Power loss of the power electronics + power loss of the 24 V electronics

12.13.6 Power loss for power units with cold plate

With cold-plate cooling, only part of the power loss remains in the cabinet.
The table below shows the internal and external power loss of the components.

Table 12- 36 Overview of power loss at rated operation for power units with cold plate (including electronics losses)

| | Unit | Internal power loss ¹⁾ | External power loss | Total power loss |
|-------------------------------------|------|-----------------------------------|---------------------|------------------|
| Active Line Modules | | | | |
| 16 kW | W | 70.4 (50 + 20.4) | 210 | 280.4 |
| 36 kW | W | 135.2 (110 + 25.2) | 520 | 655.2 |
| 55 kW | W | 187.6 (160 + 27.6) | 740 | 927.6 |
| 80 kW | W | 283.6 (250 + 33.6) | 1100 | 1383.6 |
| 120 kW | W | 443.2 (400 + 43.2) | 1800 | 2243.2 |
| Smart Line Modules Booksize | | | | |
| 5 kW | W | 34.4 (20 + 14.4) | 40 | 74.4 |
| 10 kW | W | 56.8 (40 + 16.8) | 80 | 136.8 |
| Smart Line Modules Booksize Compact | | | | |
| 16 kW | W | 56.6 (36.2 + 20.4) | 130 | 186.6 |
| Basic Line Modules | | | | |
| 20 kW | W | 46.6 (25 + 21.6) | 95 | 141.6 |
| 40 kW | W | 71.4 (45 + 26.4) | 205 | 276.4 |
| 100 kW | W | 168.4 (130 + 38.4) | 450 | 618.4 |
| Single Motor Modules Booksize | | | | |
| 3 A | W | 27.6 (12 + 15.6) | 18 | 45.6 |
| 5 A | W | 35.6 (20 + 15.6) | 35 | 70.6 |
| 9 A | W | 45.6 (30 + 15.6) | 50 | 95.6 |
| 18 A | W | 80.6 (65 + 15.6) | 100 | 180.6 |
| 30 A | W | 85.6 (70 + 15.6) | 220 | 305.6 |
| 45 A | W | 108 (90 + 18.0) | 340 | 448 |
| 60 A | W | 128 (110 + 18.0) | 480 | 608 |
| 85 A | W | 149.2 (130 + 19.2) | 620 | 769.2 |

| | Unit | Internal power loss ¹⁾ | External power loss | Total power loss |
|---------------------------------------|------|-----------------------------------|---------------------|------------------|
| 132 A | W | 220.4 (200 + 20.4) | 1050 | 1270.4 |
| 200 A | W | 370.4 (350 + 20.4) | 1700 | 2070.4 |
| Single Motor Modules Booksize Compact | | | | |
| 3 A | W | 25.6 (10 + 15.6) | 40 | 65.6 |
| 5 A | W | 30.6 (15 + 15.6) | 65 | 95.6 |
| 9 A | W | 45.6 (30 + 15.6) | 50 | 95.6 |
| 18 A | W | 80.6 (65 + 15.6) | 100 | 180.6 |
| Double Motor Modules Booksize | | | | |
| 2x3 A | W | 55.6 (34 + 21.6) | 36 | 91.6 |
| 2x5 A | W | 61.6 (40 + 21.6) | 65 | 126.6 |
| 2x9 A | W | 81.6 (60 + 21.6) | 100 | 181.6 |
| 2x18 A | W | 95.2 (70 + 25.2) | 250 | 345.2 |
| Double Motor Modules Booksize Compact | | | | |
| 2x1.7 A | W | 42 (20.4 + 21.6) | 72 | 114 |
| 2x3 A | W | 44 (22.4 + 21.6) | 90 | 134 |
| 2x5 A | W | 59 (37.4 + 21.6) | 135 | 194 |

¹⁾ Power loss of the power electronics + power loss of the 24 V electronics

Note

Lower average power losses are obtained for intermittent duty.

12.13.7 Power loss for liquid-cooled power units

Table 12- 37 Overview of power loss during rated operation for liquid-cooled power units (including electronics losses)

| | Unit | Internal power loss ¹⁾ | External power loss | Total power loss |
|----------------------|------|-----------------------------------|---------------------|------------------|
| Active Line Modules | | | | |
| 120 kW | W | 443.2 (400 + 43.2) | 1800 | 2243.2 |
| Single Motor Modules | | | | |
| 200 A | W | 370.4 (350 + 20.4) | 1700 | 2070.4 |

¹⁾ Power loss of the power electronics + power loss of the 24 V electronics

12.13.8 Electronics losses of power units

Table 12- 38 Electronics losses for power units with internal/external air cooling

| Component | | Internal/external air cooling Power loss [W] |
|---------------------------------------|--------|---|
| Single Motor Modules | 3 A | 20.4 |
| | 5 A | 20.4 |
| | 9 A | 20.4 |
| | 18 A | 20.4 |
| | 30 A | 19.2 |
| | 45 A | 25.2 |
| | 60 A | 25.2 |
| | 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 | 3 A | 27.6 |
| | 5 A | 27.6 |
| | 9 A | 27.6 |
| | 18 A | 31.2 |
| Double Motor Modules Booksize Compact | 1.7 A | 27.6 |
| | 3 A | 27.6 |
| | 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 |
| 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 |

Table 12- 39 Electronics losses for power units with cold plate

| Component | | Cold plate Power loss [W] |
|------------------------------------|---------|------------------------------|
| Motor Modules Booksize | 3 A | 15.6 |
| | 5 A | 15.6 |
| | 9 A | 15.6 |
| | 18 A | 15.6 |
| | 30 A | 15.6 |
| | 45 A | 18.0 |
| | 60 A | 18.0 |
| | 85 A | 19.2 |
| | 132 A | 20.4 |
| | 200 A | 20.4 |
| | 2x3 A | 21.6 |
| | 2x5 A | 21.6 |
| | 2x9 A | 21.6 |
| 2x18 A | 25.2 | |
| Motor Modules Booksize Compact | 3 A | 15.6 |
| | 5 A | 15.6 |
| | 9 A | 15.6 |
| | 18 A | 15.6 |
| | 2x1.7 A | 21.6 |
| | 2x3 A | 21.6 |
| | 2x5 A | 21.6 |
| Active Line Modules | 16 kW | 20.4 |
| | 36 kW | 25.2 |
| | 55 kW | 27.6 |
| | 80 kW | 33.6 |
| | 120 kW | 43.2 |
| Smart Line Module Booksize | 5 kW | 14.4 |
| | 10 kW | 16.8 |
| Smart Line Module Booksize Compact | 16 kW | 20.4 |
| Basic Line Modules | 20 kW | 21.6 |
| | 40 kW | 26.4 |
| | 100 kW | 38.4 |

Table 12- 40 Electronics losses for liquid-cooled power units

| Component | | Liquid cooled Power loss [W] |
|--------------------|--------|---------------------------------|
| Motor Module | 200 A | 20.4 |
| Active Line Module | 120 kW | 43.2 |

12.13.9 Maximum power losses in the partial load range

Losses in the partial load range for Line Modules and Motor Modules

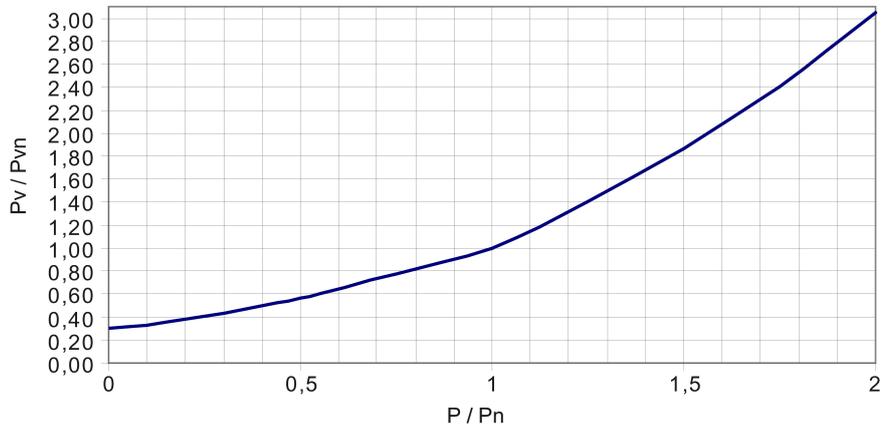


Figure 12-46 Losses in the partial load range for Active Line Modules and Smart Line Modules

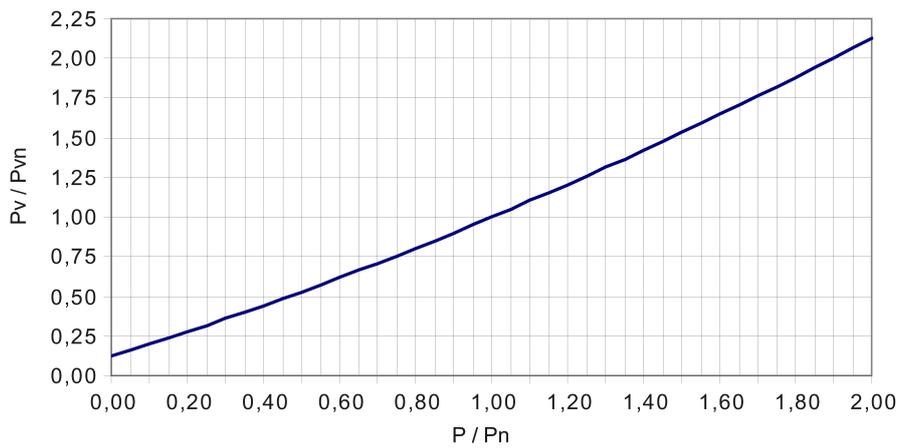


Figure 12-47 Losses in the partial load range for Basic Line Modules

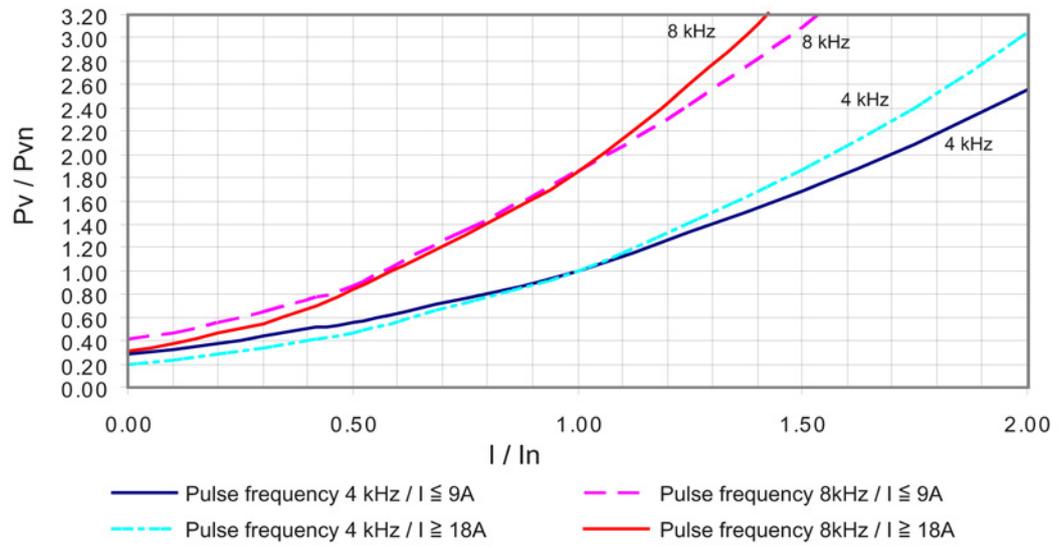


Figure 12-48 Losses in the partial load range for Motor Modules

Losses in the partial load range for line reactors and Active Interface Modules

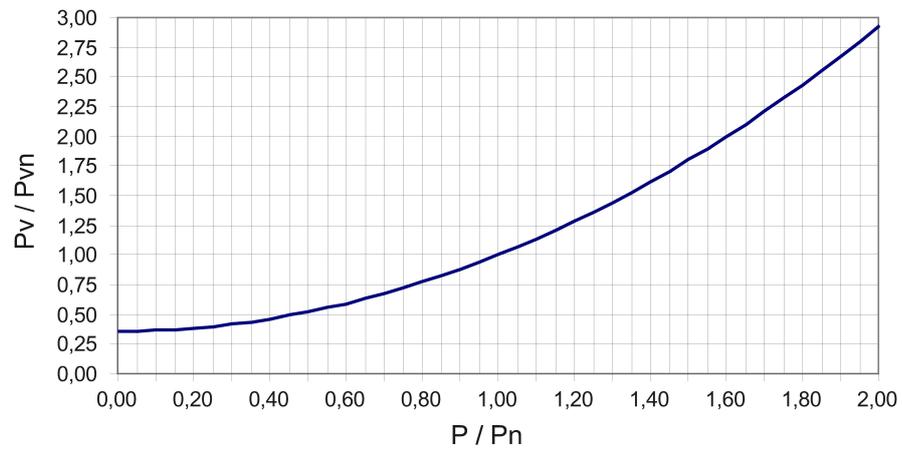


Figure 12-49 Losses in the partial load range for Active Interface Modules

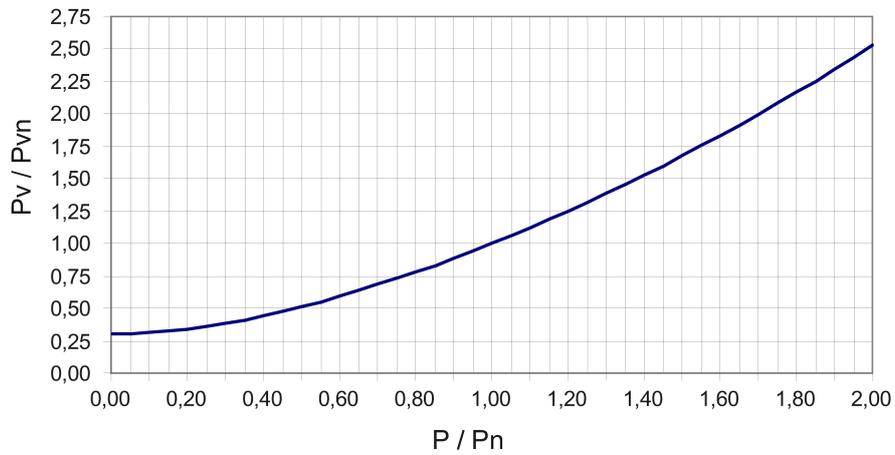


Figure 12-50 Losses in the partial load range for line reactors for Smart Line Modules

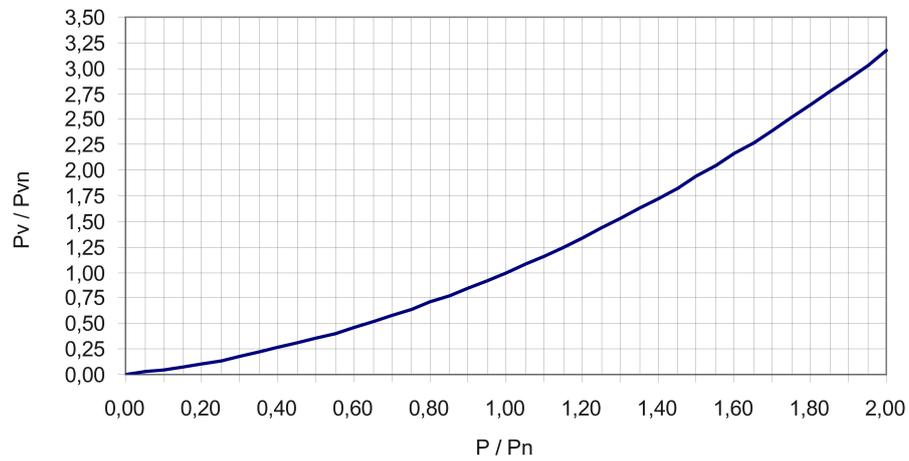


Figure 12-51 Losses in the partial load range for line reactors for Basic Line Modules

12.13.10 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:

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

- a Electronics losses of the Motor Module
- S₁, S₂ Coefficients to calculate power loss
- I₁ Current (arithmetic mean value) of the 1st axis
- I₂ Current (arithmetic mean value) of the 2nd axis

Overview of required coefficients

Table 12- 41 Coefficients to calculate the power loss in the control cabinet for internally cooled Motor Modules for typical applications

| Motor Module | a [W] | S ₁ [W/A] | S ₂ [W/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 30 A | 20 | 4,71 | 0,113 |
| Single Motor Module 45 A | 25 | 5,50 | 0,054 |
| Single Motor Module 60 A | 25 | 5,50 | 0,054 |
| 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 3 A | 19 | 5,20 | 0,200 |
| Double Motor Module 5 A | 19 | 5,20 | 0,200 |
| Double Motor Module 9 A | 19 | 5,18 | 0,247 |
| Double Motor Module 18 A | 22 | 5,57 | 0,091 |

12.13 Power losses of the components

Table 12- 42 Coefficients to calculate the power loss in the control cabinet for externally cooled Motor Modules for typical applications

| Motor Module | a [W] | S ₁ [W/A] | S ₂ [W/A ²] |
|---------------------------|-------|----------------------|------------------------------------|
| Single Motor Module 3 A | 10 | 2,30 | 0,100 |
| Single Motor Module 5 A | 10 | 2,30 | 0,100 |
| Single Motor Module 9 A | 10 | 2,30 | 0,100 |
| Single Motor Module 18 A | 10 | 2,34 | 0,101 |
| Single Motor Module 30 A | 16 | 1,29 | 0,057 |
| Single Motor Module 45 A | 21 | 1,31 | 0,015 |
| Single Motor Module 60 A | 27 | 1,37 | 0,006 |
| Single Motor Module 85 A | 32 | 1,37 | 0,006 |
| Single Motor Module 132 A | 50 | 1,06 | 0,004 |
| Single Motor Module 200 A | 50 | 1,06 | 0,004 |
| | | | |
| Double Motor Module 3 A | 15 | 1,37 | 0,240 |
| Double Motor Module 5 A | 15 | 1,37 | 0,240 |
| Double Motor Module 9 A | 15 | 1,37 | 0,240 |
| Double Motor Module 18 A | 18 | 1,56 | 0,056 |

Overview of typical power losses at the rated operating point

Table 12- 43 Typical power losses in the control cabinet for operation at the rated operating point for internally and externally cooled Motor Modules

| Motor Module | P _{Vn} [W] internal air cooling | P _{Vn} [W] external air cooling |
|---------------------------|---|---|
| Single Motor Module 3 A | 26 | 18 |
| Single Motor Module 5 A | 36 | 24 |
| Single Motor Module 9 A | 60 | 39 |
| Single Motor Module 18 A | 140 | 85 |
| Single Motor Module 30 A | 263 | 106 |
| Single Motor Module 45 A | 382 | 110 |
| Single Motor Module 60 A | 550 | 130 |
| Single Motor Module 85 A | 772 | 192 |
| Single Motor Module 132 A | 1257 | 260 |
| Single Motor Module 200 A | 2032 | 422 |
| | | |
| Double Motor Module 3 A | 54 | 28 |
| Double Motor Module 5 A | 81 | 41 |
| Double Motor Module 9 A | 152 | 79 |
| Double Motor Module 18 A | 281 | 110 |

Cooling circuit and coolant properties

13.1 Cooling circuit requirements

13.1.1 Technical cooling circuits

Technical cooling circuits can be divided into three systems:

1. **Closed cooling circuits (recommended)**

In closed systems, the circuit coolant is separated from the surrounding atmosphere, which prevents the ingress of oxygen. The coolant is only routed through SINAMICS devices, the components required for cooling and, if necessary, a motor. The heat is dissipated to the atmosphere indirectly by means of heat exchangers. The system should ideally function without losing any coolant and, once filled, should not need any water to be added. The composition of the coolant can be adjusted as required (e.g. by using desalinated water and adding anti-corrosion agents). It either does not change at all during operation, or changes only in a defined manner.

The closed cooling circuit is recommended as a standard solution.

2. **Open cooling circuit**

The coolant is routed not only through the SINAMICS devices and components required for cooling, but also through external devices.

The heat transferred to the circuit coolant evaporates via a cooling tower. This evaporation causes the coolant to become more concentrated (densification) because water molecules escape, while dissolved substances remain in the coolant. During operation, therefore, the composition of the coolant changes significantly, which means that it must be monitored and topped up continuously.

3. **Semi-open cooling circuit**

Oxygen can only enter the coolant via the pressure compensator. Otherwise, see 1. Semi-open cooling circuits are permitted.

13.1.2 Cooling system requirements

Open cooling systems must never be used for liquid-cooled power units. A closed cooling circuit with a membrane expansion tank, safety valve, and heat exchanger is recommended, which connects the cooling circuit to an external cooler (refer also to Chapter Using heat exchangers (Page 808)).

Requirements

- A particle filter (particle size < 100 µm) must be installed in the cooling circuit to prevent foreign particles from being washed in.
- Mixed installations should be avoided wherever possible.
- The permissible pressures in the cooling system must be observed.
- Cavitation must be prevented in the cooling system.
- Equipotential bonding must be provided between the components in the cooling system.
- The customer must take measures to protect the devices against condensation.
- An anti-corrosion agent and, if necessary, a biocide should be mixed into the coolant.
- If there is a risk of frost, preventive measures must be taken during operation, storage, and transportation (e.g. emptying and blowing out with air, additional heating).
- The requirements of the coolant in terms of its properties (temperature, chemical characteristics, etc.) must be observed.

Recommendations

- To ensure mechanical decoupling, the devices should be connected by means of hoses.
- To prevent blockages and corrosion, you are advised to install a flushback filter in the circuit (so that residues can be rinsed out when the system is running).
- The power units should be connected to the cooling circuit by means of shut-off fittings so that they can be disconnected from the cooling circuit for servicing or repair without having to empty the entire cooling system. A cooling water hose (EPDM) can be used to connect the shut-off fitting to the power unit. The coolant connections must never be closed if cooling liquid is still present in the device. Reason: If the cooling fluid expands due to heat, the pressure can build up beyond permissible levels and cause the heat sink to burst.

13.1.3 Cooling circuit configuration

The liquid-cooled power units are designed to be connected in parallel to the cooling circuit. The pressure drop in the joint supply and return lines is to be kept at negligible levels by choosing a sufficiently large pipe diameter. The supply line has a differential pressure p compared to the return line; this pressure is usually generated by a pump.

The pressure of a pump depends on the flow rate. Therefore, depending on the number of connected components, a different pressure is obtained. At the minimum differential pressure p_1 (measured between the supply and return lines of the individual component), the volume of coolant required to enable the component to achieve its rated power or rated current is to flow through each component. At the maximum differential pressure p_2 (measured between the supply and return lines of the individual component), the volumetric flow must not result in damage to the component, for example, by means of cavitation. If necessary, pressure reducing valves such as baffle plates will have to be installed in the piping; these must be easy to access, clean, and/or replace.

When the pump is switched off, static pressure occurs in the system. The static pressure can be influenced by the primary pressure of the membrane expansion tank and should be at least 30 kPa on the pump's suction side. If the static pressure is too low, there is the risk that the pump will be damaged by cavitation when operational. Otherwise, minimum pressure values different than those specified by the pump manufacturer must be observed. When components are installed at different heights, the geodesic pressure caused by the height difference must be taken into account (1 m height difference corresponds to 10 kPa).

When the pump is switched on, a (location-dependent) flow pressure is present in the cooling circuit, which must be determined from the pump characteristic curve and the volume-flow-dependent pressure drop. The pressure drop in the filter and, if applicable, an additional pressure drop in the connection pipes must be added to the pressure drop of the liquid-cooled power units (70 kPa for H₂O). Up to 50 kPa must be added for the pressure drop in a (contaminated) filter and in connection pipes. The intersection of the pump characteristic curve and the pressure drop of the whole cooling system yields the volumetric flow V_n of the coolant at this operating point.

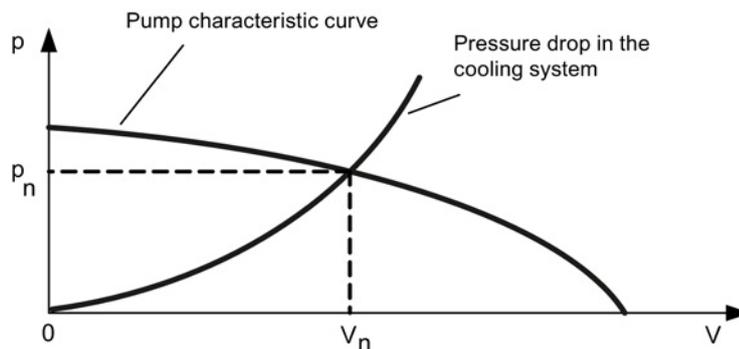


Figure 13-1 Pump characteristic curve

Permissible system pressure

The maximum permissible system pressure is 600 kPa.

If a pump that is capable of exceeding this maximum permissible system pressure is used, the customer must take steps (e.g. safety valve $p \leq 600$ kPa, pressure control, or similar) to ensure that the maximum pressure limit is not exceeded.

Permissible pressure difference

The maximum permissible pressure difference for a heat sink is 200 kPa. Higher pressure differences significantly increase the risk of cavitation and abrasion. The lowest possible differential pressure between the coolant in the supply and return lines should be selected to allow pumps with a flat characteristic to be used.

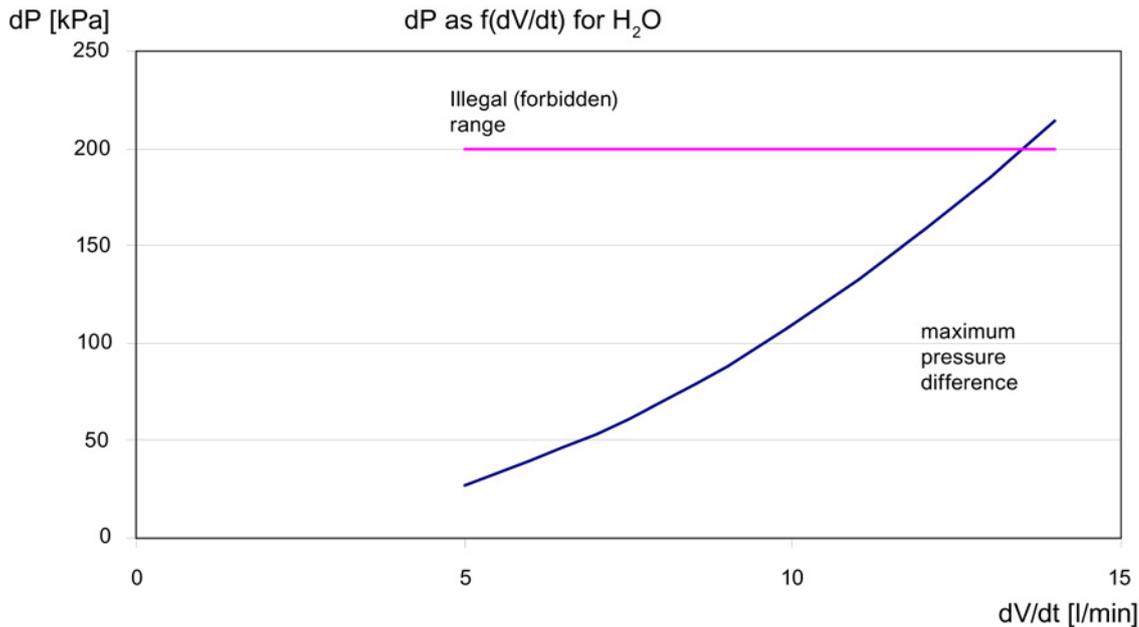


Figure 13-2 Pressure difference as a function of volumetric flow

Pressure difference and pressure drop when using coolant mixtures

If a mixture of Antifrogen N and H₂O is used as a coolant, the rated pressure must be calculated according to the mixing ratio. The following table specifies the pressure drop across components at different coolant temperatures for a coolant with mixing ratio 45 % Antifrogen N.

Table 13- 1 Pressure drop at different coolant temperatures for Antifrogen N/H₂O: 45 %

| dV/dt H ₂ O [l/min] | dP H ₂ O [kPa] | dP Antifrogen N 0 °C [kPa] | dP Antifrogen N 20 °C [kPa] | dP Antifrogen N 45 °C [kPa] | dP Antifrogen N 50 °C [kPa] |
|--------------------------------|---------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|
| 8 | 70 | 121 | 97 | 81 | 78 |

The characteristic curves for the pressure drop across the heatsinks as a function of volumetric flow vary depending on the temperature and the Antifrogen N / water coolant mix.

dp as dV/dt for various coolants

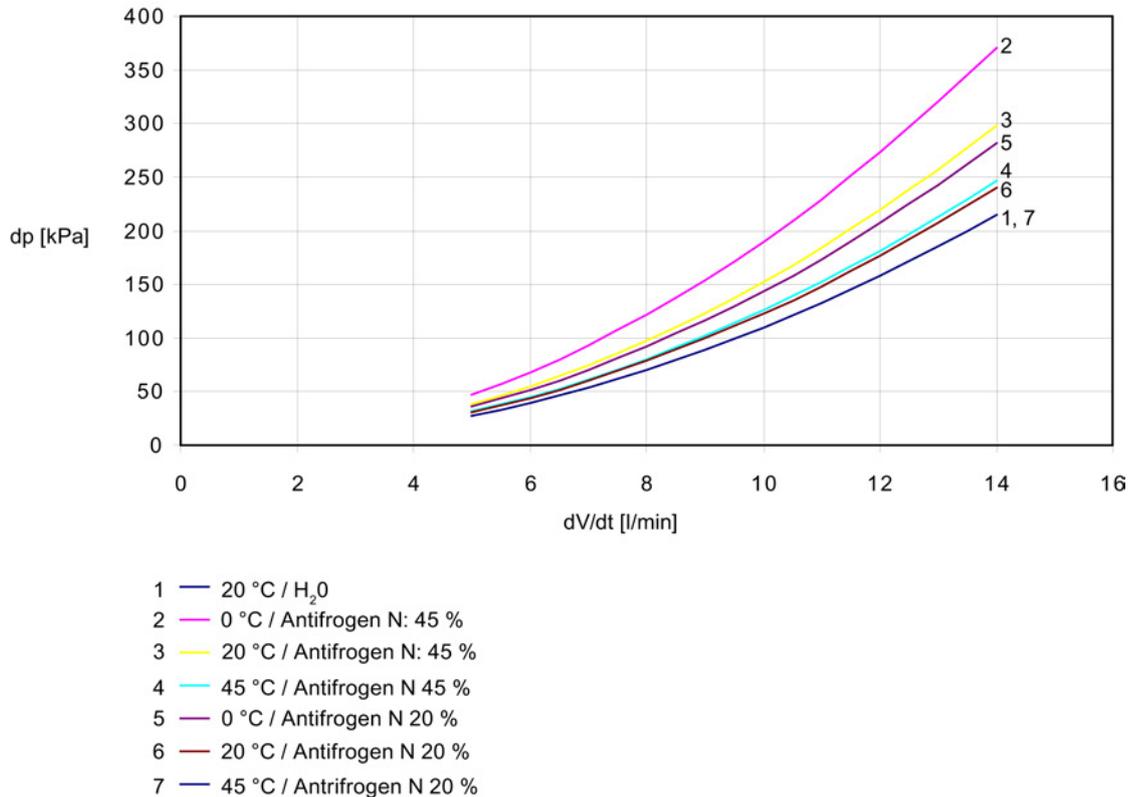


Figure 13-3 Pressure difference as a function of volumetric flow

Operating pressure

The **operating pressure** must be set according to the flow conditions in the supply and return lines of the cooling circuit. The required coolant flow rate per time unit must be set according to the technical data of the components. The components are normalized to a rated pressure of 70 kPa (for coolant type H₂O) via a baffle plate.

Layout of the components

The components should be arranged in the system in such a way that the overall length of the supply and discharge lines is the same for every SINAMICS component.

Water cooling systems with series-connected SINAMICS devices are not permitted.

Dimensioning the cooling circuit

Recommendation for dimensioning the cooling circuit:

The differential pressure between the supply and return lines should be selected so that:

$$\sum dP_i < dP_{\text{Syst}} < \sum dP_i + 30 \text{ kPa}$$

The individual pressure drops P_i represent the pressure drops of components (heat exchanger, piping, 70 kPa for the SINAMICS devices connected in parallel, valves, dirt traps, pipe bends, etc.).

Coolant pipes must be routed with extreme care. The pipes must never come into contact with electrically live components. An insulation clearance of $> 13 \text{ mm}$ must always be maintained between pipes and live parts. The pipes must be securely mounted and checked for leaks.

13.1.4 Installation

A closed stainless-steel cooling circuit, preferably combined with monitoring of the coolant quality, is strongly recommended to ensure the longest possible service life for the heat sink.

NOTICE

Damage caused by incorrectly routed coolant lines

Leaking coolant can cause a short circuit.

- Route the coolant pipes very carefully.
- Fix the pipes securely and check them for leaks.
- Ensure that the pipes never come into contact with live components.

Materials and connections

Stainless-steel pipes are used to route the coolant through the cooling plates on the liquid-cooled power units. For power units with cold plate, the coolant is routed by means of integrated channels in the aluminum cold plate.

To minimize the electrochemical processes taking place in the cooling system, the materials must be coordinated with one another accordingly. Mixed installations, i.e. a combination of different materials, such as copper, brass, iron, or halogenated plastic (PVC hoses and seals), should therefore be avoided or limited to the absolutely essential minimum.

The valves and connections required in the cooling system must be made of stainless steel (V2A or V4A steel; NIROSTA austenite).

The following materials can be used for the cooling system piping:

- Pipes and corrugated piping made of stainless steel (V2A or V4A steel; NIROSTA austenite)
- Hoses made of EPDM/EPDM with an electrical resistance $<10^9$ ohms (e.g. Semperflex FKD; the Semperit company, Wimpassing - Austria)
- DEMITEL® hoses made of PE / EPDM (the Telle company, Nuremberg)
- Clips according to DIN 2871, available for example from Telle.

All control cabinets must be designed with a PE busbar and a good electrical connection must be established between them.

Note

The sealing materials must be free of chlorides, graphite, and carbon (Viton® or EPDM).

Teflon-based seals are not permitted.

Note

When non-conductive hoses are used, particular attention must be paid to the equipotential bonding of all components (refer to Chapter Equipotential bonding in the cooling system (Page 808))

Note

- Check the cooling system for tightness after installation.
-

13.1.5 Preventing cavitation

The following applies to all cooling circuits:

- The cooling circuit must always be designed in such a way that the pressure compensator is located on the suction side of the pump (if possible, directly at the pump).
- The minimum pressure on the suction side of the pump must be approximately 30 kPa, or the geodesic height from the reservoir to the pump suction side must be > 3 m.
- The pressure drop across a SINAMICS device must not exceed 200 kPa in continuous operation, otherwise the high volumetric flow can increase the risk of cavitation and/or abrasion damage.
- The guidelines given in Chapter Cooling circuit configuration (Page 797) regarding series connections and maximum pressure must also be followed.

13.1.6 Commissioning

When commissioning the cooling water circuit, the following sequence must be observed:

- Ventilate the heat sink the first time the devices are filled.
- Remove the fixing glands located in front of the vent valve.
- Perform ventilation.
- Close the vent valve.
- Screw the fixing glands tight again.
- Check the seals.
- Set the operating pressure according to the flow conditions of the cooling water system in the supply and return lines.
- Set the required cooling water flow rate per time unit.



WARNING

Danger to life through electric shock due leaking coolant

Death or serious injury can result when coolant is touched that is at a specific voltage (i.e. is live).

- Before venting, switch the plant or system into a no-voltage condition.

13.2 Coolant requirements

13.2.1 Coolant properties

Properties of the cooling medium

Water or a water/anti-freeze mixture that meets the relevant requirements can be used as a cooling medium. The cooling medium must be chemically neutral, clean, and not contain any solids.

The cooling water must fulfill the following requirements over the long term:

Table 13-2 Cooling water specifications

| | | Liquid Cooled |
|--|-------|---|
| Properties | | Chemically neutral, clean, free of solids |
| Max. inlet temperature (in operation) | ° C | 45 (55 with derating) |
| Max. coolant temperature | ° C | 55 |
| Operating pressure | kPa | 100 ... 600 |
| System pressure (with respect to the atmosphere) | kPa | 600 |
| Test pressure (with respect to the atmosphere) | kPa | 1200 |
| Minimum differential pressure p1 | kPa | 70 |
| Nominal differential pressure p _n | kPa | 100 |
| Maximum differential pressure p2 | kPa | 200 |
| Flow rate | l/min | 5 ... 8 |
| Max. size of any particles in the coolant | mm | 0,1 |
| pH value | | 6,5 ... 9 |
| Chloride | ppm | < 200 |
| Sulfate | ppm | < 240 |
| Nitrate | ppm | < 50 |
| Dissolved solids | ppm | < 340 |
| Total hardness | ppm | < 170 |
| Electrical conductivity | µS/cm | < 2000 |

NOTICE

Damage to the component through condensation

Condensation on the components can result in their failure.

- Appropriately control the cooling water temperature.

NOTICE

Cooling circuit damage caused by seawater

The heat sink material is damaged by seawater.

- Do not use seawater as coolant.

Note

As a general rule, tap water is not suitable for use in the cooling circuit, although it can be mixed with de-ionized water. Losses must always be replenished with de-ionized water.

Note

The flow created when the heat sinks are filled results in automatic ventilation, so there is no need for the devices to be ventilated separately.

The coolant should be checked 3 months after the cooling circuit is filled for the first time and, subsequently, once a year. If the cooling water becomes cloudy, is colored, or becomes contaminated by mould spores, the cooling circuit must be cleaned and refilled.

An inspection glass should be provided in the cooling circuit to make it easier to check the cooling water.

13.2.2 Corrosion Inhibitor Additive (Inhibiting)

Nalco 00GE056 (Nalco company) is recommended as anti-corrosion agent. The concentration of anti-corrosion agent in the cooling water must be at least 2500 ppm (250 ml/100 liters cooling water).

The water quality must correspond to Chapter Coolant properties (Page 803), or the water used must be de-ionized.

Note

Corrosion inhibitor does not need to be added if the anti-freeze Antifrogen N is used in the right concentration (refer to Chapter Anti-Freeze Additive (Page 805))

13.2.3 Anti-Freeze Additive

Antifrogen N (the Clariant company) is recommended as antifreeze. The percentage of antifreeze must be between 20% and 30%. This ensures frost protection down to a temperature of at least -10 °C.

NOTICE

Damage caused by overheating when using antifreeze

The cooling system no longer functions if an excessively high percentage of antifreeze is used.

- The maximum percentage of antifreeze must not exceed 30 %.



⚠ WARNING

Danger to life through electric shock caused by a cooling system leak

Cooling water mixtures with Antifrogen N are highly conductive. If the insulation does not function, this will result in death or severe injury if you come into contact with it.

- After a coolant leak, clean the insulation system.

NOTICE

Damage to EPDM hoses as a result of additives containing oil

EPDM is destroyed by anticorrosion agents.

- When using EPDM hoses, do not use oily anticorrosion agents.

Note

Adapting the pump power

The kinematic viscosity of the cooling water is changed when adding antifreeze.

- Correspondingly adapt the pump power.

13.2.4 Biocide additives (only if required)

Closed cooling circuits with soft water ($^{\circ}\text{DH} > 4$) are susceptible to microbes. The risk of corrosion caused by microbes is virtually non-existent in chlorinated drinking water systems.

If Antifrogen N antifreeze is used with a concentration of 20% or higher, it can be assumed that there is an adequate biocide effect.

The following types of bacteria are encountered in practice:

- Bacteria that cause the formation of slime
- Corrosive bacteria
- Bacteria that cause deposits of iron

13.2 Coolant requirements

The type of bacteria determines the suitability of a biocide. A water analysis must be carried out once a year to determine the number of bacterial colonies. Suitable biocides are available, for example, from Nalco.

Recommendation

Twice a month Nalco N 77352 is added intermittently. The dosing quantity is 5 to 15 mg/100 liters of cooling water. This product has no adverse effect on Nalco 00GE056 corrosion inhibitor.

Note

The type of bacteria determines the biocide.

The manufacturer's recommendations must be followed regarding the dosage and compatibility with any inhibitor used.

It is not permissible that biocides and Antifrogen N are mixed.

Antifrogen N has a biocidal effect even at the minimum required concentration of > 20%.

13.3 Anti-condensation measures

The customer must take measures to protect the devices against condensation

Condensation occurs when the inlet temperature of the cooling medium is significantly lower than room temperature (ambient temperature). The permissible temperature difference between coolant and air varies as a function of the relative humidity Φ of the ambient air. The air temperature at which the aqueous phase precipitates is referred to as the "dew point".

The table below shows the dew points (in °C) for an atmospheric pressure of 100 kPa (\approx installation altitude, 0 to 500 m). If the temperature of the coolant is below the specified value, condensation may occur (i.e. the coolant temperature must always be \geq the dew point temperature).

Table 13-3 Dew point temperature as a function of the relative air humidity (Φ) and the room temperature at an installation altitude of between 0 and 500 m

| T _{room} [°C] | Dew point temperature in °C at a relative humidity Φ in % | | | | | | | | | | |
|---------------------------|--|------|------|------|------|------|------|------|------|------|-------|
| | 20 % | 30 % | 40 % | 50 % | 60 % | 70 % | 80 % | 85 % | 90 % | 95 % | 100 % |
| 10 | < 0 | < 0 | < 0 | 0,2 | 2,7 | 4,8 | 6,7 | 7,6 | 8,4 | 9,2 | 10 |
| 20 | < 0 | 2 | 6 | 9,3 | 12 | 14,3 | 16,4 | 17,4 | 18,3 | 19,1 | 20 |
| 25 | 0,6 | 6,3 | 10,5 | 13,8 | 16,7 | 19,1 | 21,2 | 22,2 | 23,2 | 24,1 | 25 |
| 30 | 4,7 | 10,5 | 14,9 | 18,4 | 21,3 | 23,8 | 26,1 | 27,1 | 28,1 | 29,1 | 30 |
| 35 | 8,7 | 14,8 | 19,3 | 22,9 | 26,1 | 28,6 | 30,9 | 32,1 | 33,1 | 34,1 | 35 |
| 38 | 11,1 | 17,4 | 22 | 25,7 | 28,8 | 31,5 | 33,8 | 34,9 | 36,1 | 36,9 | 38 |
| 40 | 12,8 | 19,1 | 23,7 | 27,5 | 30,6 | 33,4 | 35,8 | 36,9 | 37,9 | 38,9 | 40 |
| 45 | 16,8 | 23,3 | 28,2 | 32,1 | 35,3 | 38,1 | 40,6 | 41,8 | 42,9 | 43,9 | 45 |
| 50 | 20,8 | 27,5 | 32,6 | 36,6 | 40,1 | 42,9 | 45,5 | 46,6 | 47,8 | 48,9 | 50 |
| 55 | 24,9 | 31,9 | 37,1 | 41,2 | 44,7 | 47,7 | 50,4 | 51,7 | 52,8 | 53,9 | 55 |

The dew point also depends on the absolute pressure (i.e. the installation altitude).

The dew points for lower atmospheric pressures lie below the dew points for a height=0 m. Therefore, selecting the coolant intake temperature for a height 0 m always sufficient.

Various measures can be taken to prevent condensation:

1. Temperature-controlled valves in the supply line.
In the cooling circuit, a temperature-controlled valve must be provided in the supply line.
2. Water temperature control.
The water temperature is adjusted depending on the room temperature. This is the preferred method with high room temperatures, low water temperatures, and high air humidity.
3. Physical dehumidification.
A physical dehumidification is only effective in closed spaces. This method involves condensing the air humidity in an air-to-water heat exchanger, which is continuously operated using the cold cooling water.
4. Installing a heater with a sufficient capacity in the cabinet.

13.4 Equipotential bonding in the cooling system

To prevent condensation, a humidity detector can be used to monitor the air humidity. The humidity detector is not included in the scope of delivery.

13.4 Equipotential bonding in the cooling system

Equipotential bonding between the components in the cooling system is required (SINAMICS S120, heat exchanger, piping, pump, etc.). This must be effected using a copper bar or stranded copper with the appropriate conductor cross-sections to prevent the electrochemical processes.

All cabinets must be bolted together in such a way as to ensure good conductivity (e.g. cabinet beams directly connected to ensure a good electrical connection) to prevent potential differences and, in turn, avoid the risk of electrochemical corrosion. As a consequence, a PE bar must also be installed in all the cabinets, including the cooling system.

13.5 Using heat exchangers

13.5.1 Water-to-water heat exchanger

If a cooling circuit that does not exceed 35 °C but does not fulfill the cooling water requirements is already installed in the system, the two cooling circuits can be linked via a water-to-water heat exchanger.

The coolers for the Line Modules are attached via a distributor in such a way as to ensure the required flow rate without exceeding the maximum permissible pressure. Conditions, such as height differences and distances, must be taken into account here.

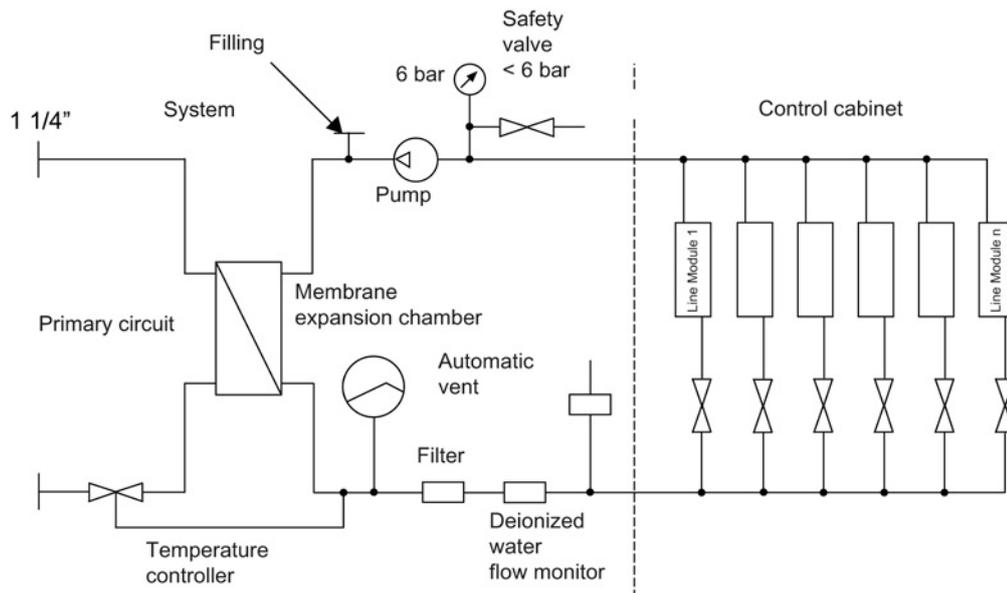


Figure 13-4 Water-to-water heat exchanger

13.5.2 Air-to-water heat exchanger

If no process water is available, but it is nonetheless best to use water-cooled Line Modules, an air-to-water cooling system can be used. The temperature of the ambient air must not be excessively high, e.g. $> 35^{\circ}\text{C}$ (in accordance with the technical data for the air-to-water heat exchanger).

During setup, you must ensure that a primary air cooling circuit and not a process water circuit is installed.

Measures to prevent excessive cooling must only be taken on the secondary side by means of closed-loop temperature control involving a thermostat or a solenoid valve.

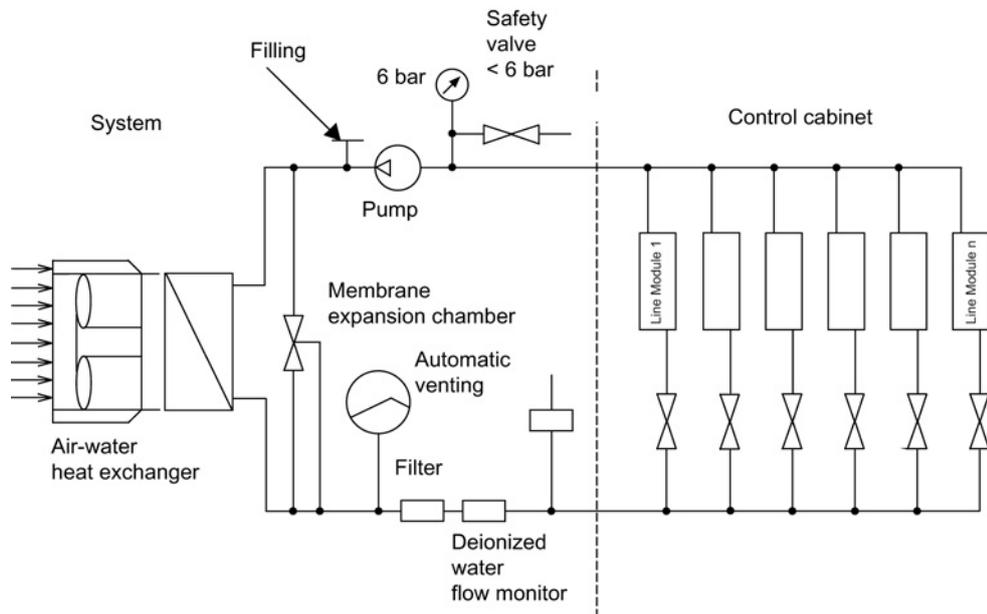


Figure 13-5 Air-to-water heat exchanger

13.5.3 Active cooling unit

If no process water is available and the ambient air is $> 35\text{ }^{\circ}\text{C}$ ($35\text{ }^{\circ}\text{C} < \tau < 40\text{ }^{\circ}\text{C}$), an active cooling unit can be used. This unit works in the same way as a refrigerator.

The following diagram shows the configuration of the cooling circuit in respect of Line Modules.

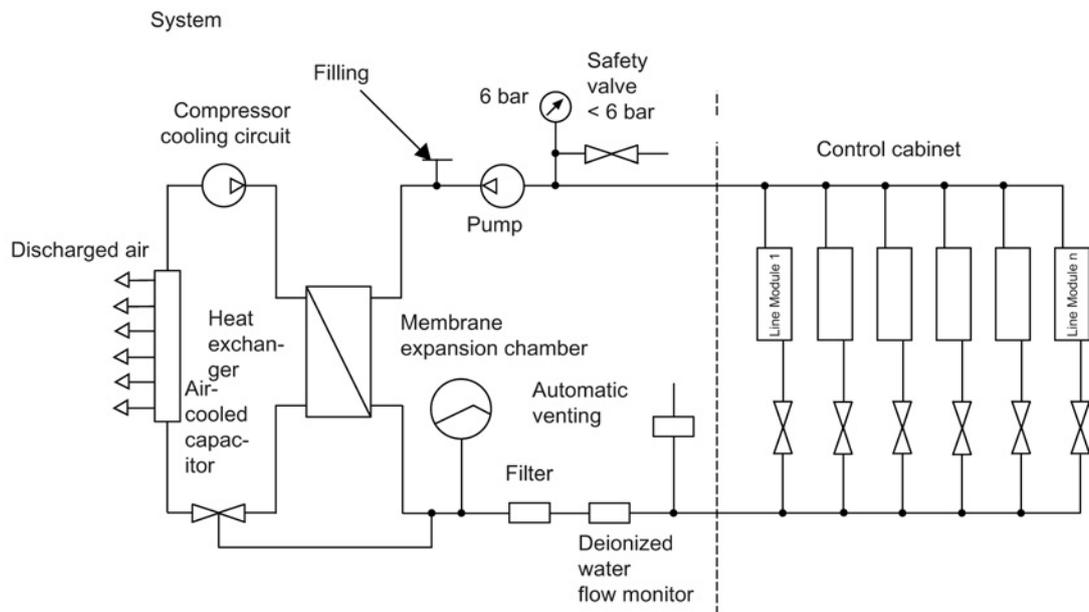


Figure 13-6 Active cooling unit

Service and Support Booksize

14.1 Spare parts

Spare parts are available on the Internet at:

<http://support.automation.siemens.com/WW/view/de/16612315>

14.2 Replacing the fan

14.2.1 Safety instructions when replacing a fan



! DANGER

Danger to life when live parts are touched

Before replacing the fan, you must switch off the power supplies (400 VAC and 24 VDC). 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

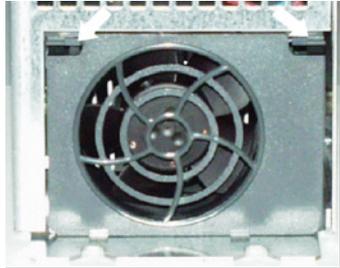
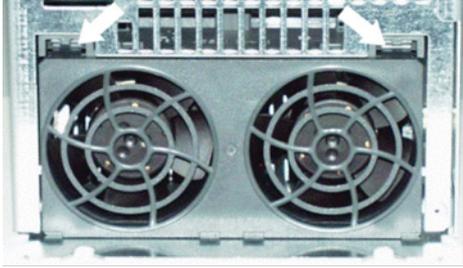
When replacing the fan, you must observe the ESD regulations (Page 29).

Only qualified personnel are permitted to install spare parts.

14.2.2 Replacing the fan for components with internal and external air cooling

Replacing the fan for components, sizes 50 to 200 mm

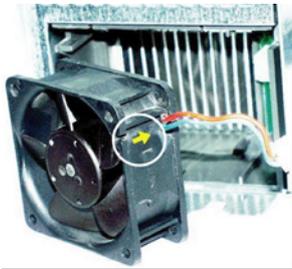
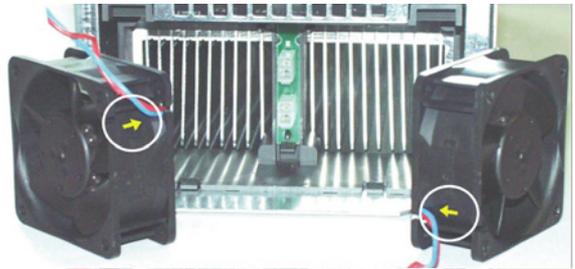
Table 14- 1 Removing the fan

| Size 50 mm | Size 100 mm | Sizes 150 mm and 200 mm |
|---|---|--|
| <ul style="list-style-type: none"> • Remove the module from the drive line-up. • Release the catches to open the fan cover. | | |
|  |  |  |

- Release and withdraw the connector (1).
- Release the catch (2) and remove the fan.



Table 14- 2 Installing a fan

| Size 50 mm | Size 100 mm | Sizes 150 mm and 200 mm |
|---|---|--|
| <ul style="list-style-type: none"> • Before installing the fan, please note the airflow direction. The arrow on the fan must point toward the cooling ribs. | | |
|  |  |  |
| <ul style="list-style-type: none"> • Push the fan into a position where it is completely latched. • Caution: Do not crush the connecting cables! • Insert the connector until it latches into place. • Attach the fan cover. | | |

14.2 Replacing the fan

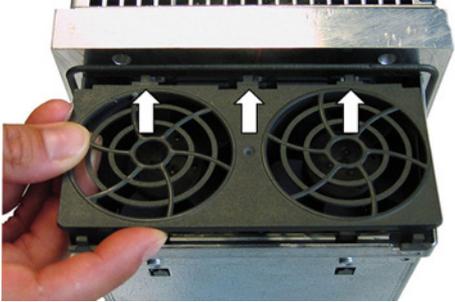
Note

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

Make sure you use the right fan cover!

Table 14- 3 Attaching the fan cover on components, sizes 150 mm and 200 mm

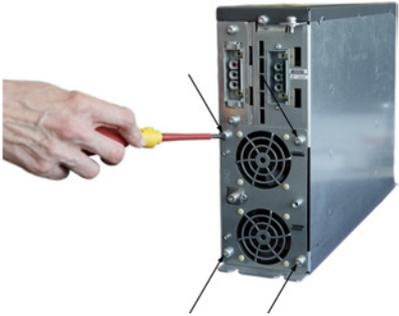
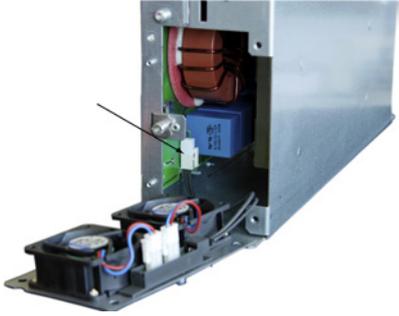
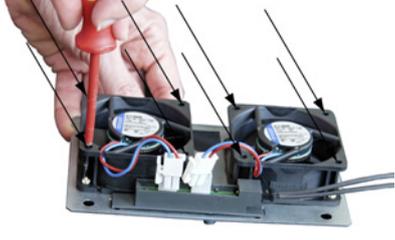
| Internal air cooling | External air cooling |
|---|---|
|  <p>Fan cover for components with internal air cooling.</p> |  <p>Fan cover with three installation lugs for components with external air cooling.</p> |
|  <p>Attach the fan cover.</p> |  <p>Attach the fan cover (the lugs first).</p> |
|  <p>Press on the fan cover until the catches engage.</p> |  <p>Press on the fan cover until the catches engage.</p> |

Replacing the fan for components, size 300 mm

Installing the fan module on 300 mm wide components is described in Chapter "Installation" of the respective component. The fan module is removed in the inverse sequence to installing.

14.2.3 Replacing the fan on an Active Interface Module

Table 14- 4 Replacing the fan in an Active Interface Module, 16 kW

| | |
|---|--|
|  |  |
| <p>Open the fan cover. To do this, release the combination screws M5 (3 Nm).</p> | <p>Open the fan cover and release the connector.</p> |
|  |  |
| <p>Push out the 8 expansion rivets.</p> | <p>Remove the fan.</p> |
|  | |
| <p>Fix the fan with 8 new expansion rivets.</p> | |

To install, carry out the above steps in reverse order. The torques must be carefully observed.

14.2 Replacing the fan

Table 14- 5 Replacing the fan in an Active Interface Module, 36 kW

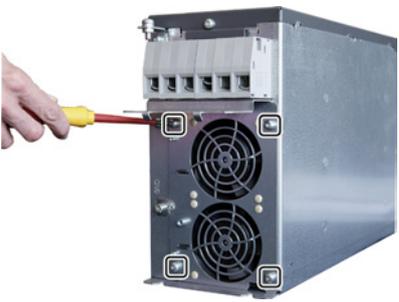
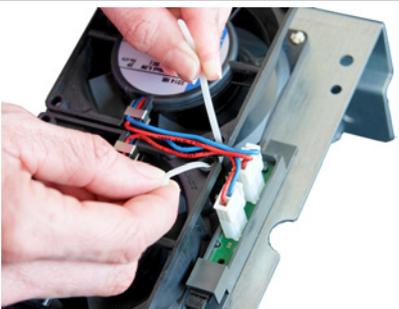
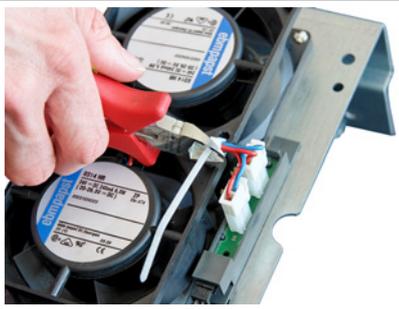
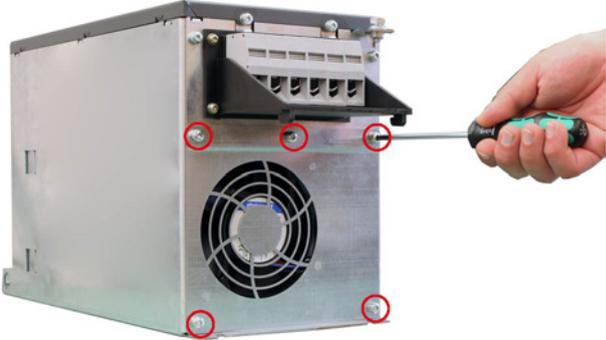
| | |
|---|--|
|  |  |
| <p>Open the fan cover. To do this, remove the combination screws M5 (3 Nm).</p> | <p>Open the fan cover and release the connector.</p> |
|  |  |
| <p>Remove the connecting cable.</p> | <p>Remove the 7 expansion rivets.</p> |
|  |  |
| <p>Remove the fan.</p> | <p>Fix the fan with 7 new expansion rivets.</p> |
|  |  |
| <p>Use a cable tie to tie up the connecting cables.</p> | <p>Cutoff excess cable tie length.</p> |

Table 14- 6 Replacing the fan in an Active Interface Module, 55 kW

| | |
|--|--|
|  |  |
| <p>Open the fan cover. To do this, release the combination screws M5 (3 Nm).</p> | <p>Open the fan cover and release the connector.</p> |
|  |  |
| <p>Release the M3 screws (1.8 Nm).</p> | <p>Remove the fan.</p> |

14.2 Replacing the fan

Table 14- 7 Replacing the fan in an Active Interface Module, 80 kW, 120 kW

| | | |
|--|--|--|
|  |  |  |
| <p>Open the fan cover. To do this, release the combination screws M5 (3 Nm).</p> | <p>Open the fan cover.</p> | <p>Release the connector.</p> |
|  |  |  |
| <p>Release the M3 screws (1.8 Nm).</p> | <p>Remove the connecting cable.</p> | <p>Remove the fan.</p> |

14.2.4 Replacing the fan on the Control Supply Module

Replacement fan (Order. No. 6SL3160-0AB00-0AA0)



! WARNING

Danger of death when live parts with several supply circuits are touched

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

- Switch off all of the supply circuits before you start any work.

Table 14- 8 Removing the fan

- Remove the component from the drive line-up.
- Remove the 6 screws (Torx T10) from the enclosure cover and open the component.



- Release and withdraw the connector.



- Release the 2 screws on the fan (Torx T20).



- Remove the fan.

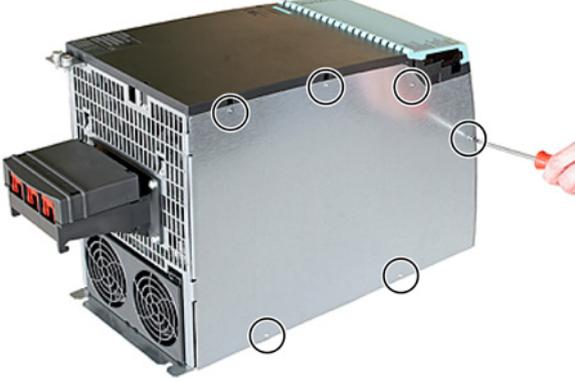
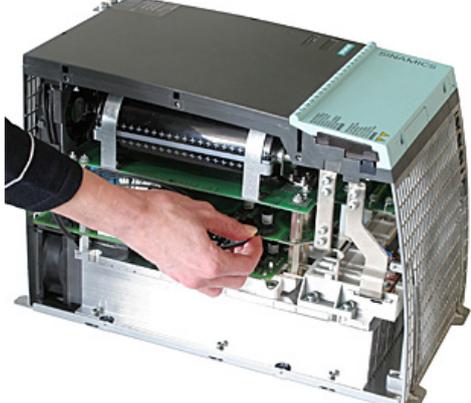
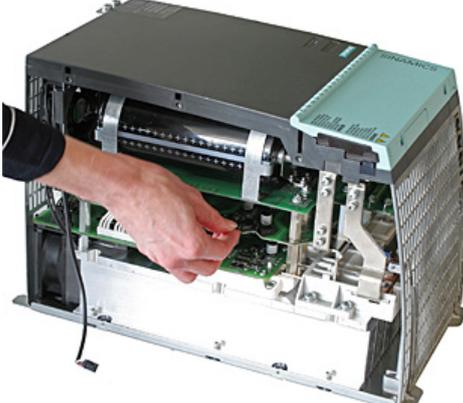
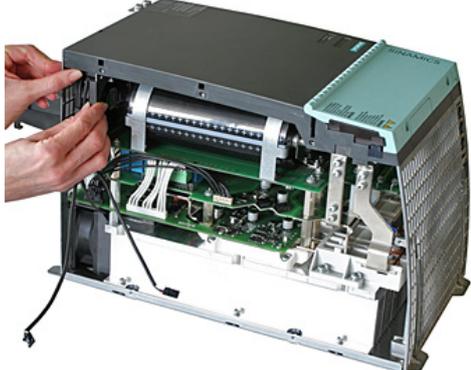
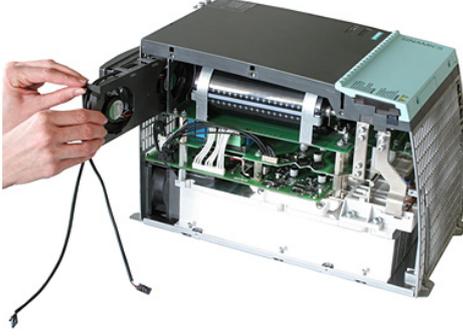


Installing a fan

1. Check 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. Screw the 2 screws on the fan (Torx T20).
Tightening torque: 1.2 Nm
4. Close the enclosure cover and tighten the 6 screws (Torx T10).
Tightening torque: 0.8 Nm

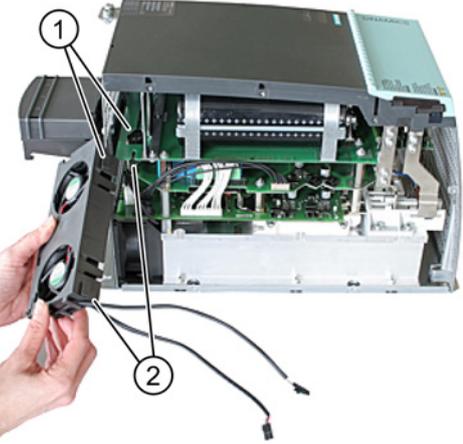
14.2.5 Replacing the fan on the 100 kW Basic Line Module for capacitor cooling

Table 14- 9 Removing the fan

| | |
|---|--|
|  |  |
| <p>Open the right housing cover by loosening the six marked screws.</p> | <p>Withdraw the first fan cable by lightly pressing the connector together.</p> |
|  |  |
| <p>Withdraw the second fan cable.</p> | <p>Release the fan unit.</p> |
|  |  |
| <p>Completely remove the fan unit.</p> | <p>Slightly expand the fan holding mechanism and remove the fan.</p> |

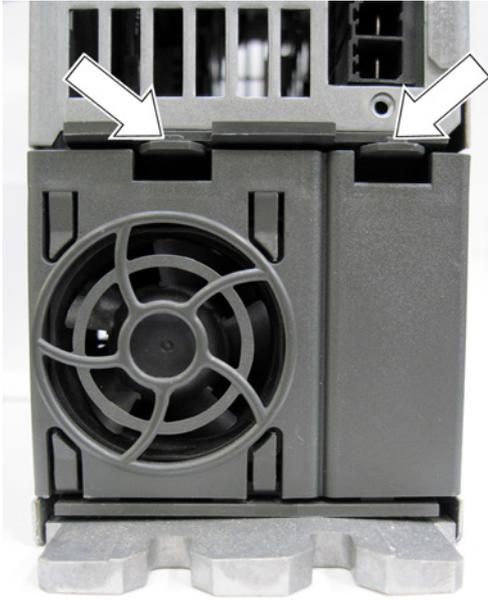
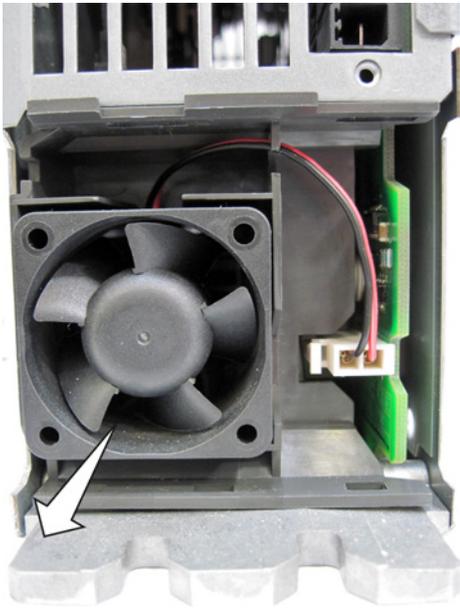
14.2 Replacing the fan

Table 14- 10 Installing a fan

| | |
|--|--|
|  |  |
| <p>When using the new fan, observe the marking for the airflow direction.</p> | <p>Observe the cable routing.</p> |
|  | <p>Connect the second fan cable. Close the housing cover and tighten the six screws. Tightening torque: 0.8 Nm</p> |
| <p>Insert the fan holding mechanism in the guide rails ① and ②.</p> | |

14.2.6 Replacing the fan for Booksize Compact components

Table 14- 11 Removing the fan

| Size 50 mm | Size 75 mm |
|---|--|
| <ul style="list-style-type: none">Remove the component from the drive line-up. | |
|  |  |
| <ul style="list-style-type: none">Remove the fan cover at the lower side of the component by releasing the catches. | |
|  |  |
| <ul style="list-style-type: none">Carefully withdraw the fan. | |

14.2 Replacing the fan

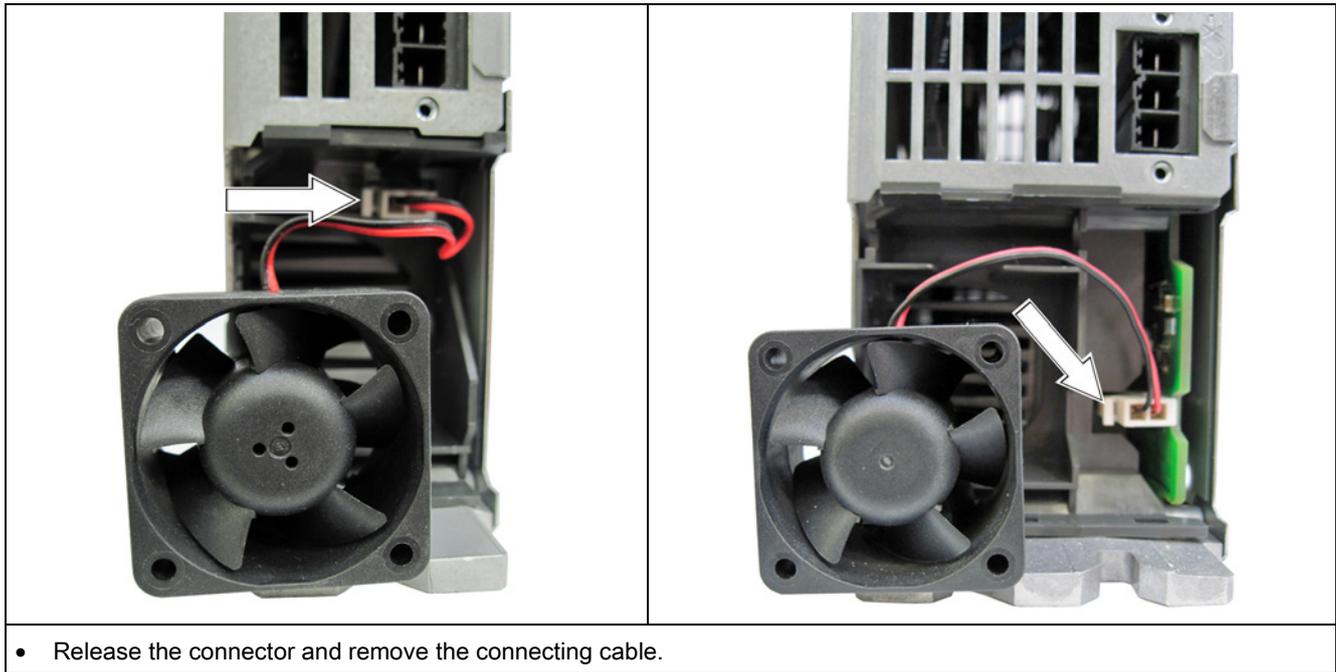
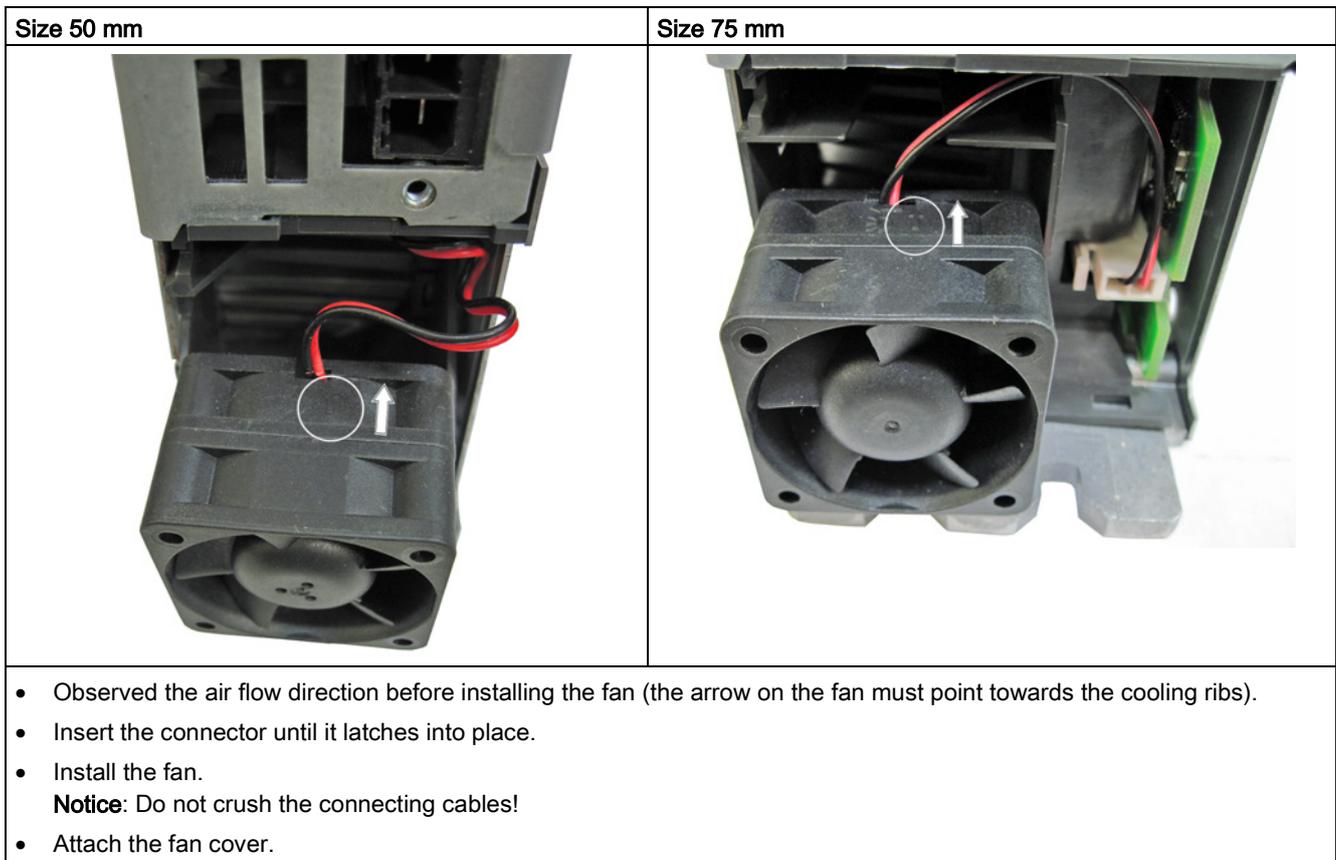


Table 14- 12 Installing a fan



14.3 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.

Rating plate

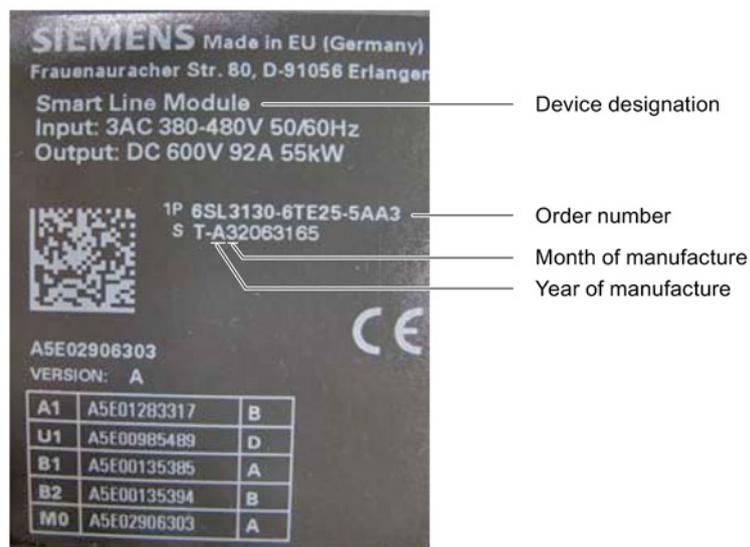


Figure 14-1 Rating plate using a Smart Line Module as example

Date of manufacture

The date of manufacture can be determined as follows:

Table 14- 13 Production year and month

| Character | Year of manufacture | Character | Month of manufacture |
|-----------|---------------------|-----------|----------------------|
| S | 2004 | 1 to 9 | January to September |
| T | 2005 | O | October |
| U | 2006 | N | November |
| V | 2007 | D | December |
| W | 2008 | | |
| X | 2009 | | |
| A | 2010 | | |
| B | 2011 | | |
| C | 2012 | | |
| D | 2013 | | |
| E | 2014 | | |
| F | 2015 | | |

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 configured using incandescent lamps or alternatively, PTC resistors.

Components required (recommendation)

- 1 fuse switch 3-phase 400 V / 10 A
- Cable 1.5 mm²
- 3 PTC resistors 350 Ω / 35 W
(recommendation: PTC-35W PTC800620-350 Ohm, Michael Koch GmbH)
- 3 incandescent lamps 230 V / 100 W
- Various small components, such as lamp socket, etc.



| |
|---|
|  DANGER |
| <p>Danger to life through electric shock due to the residual charge of the DC-link capacitors</p> <p>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.</p> <p>Contact with live parts can result in death or serious injury.</p> <ul style="list-style-type: none"> • Do not open the protective cover of the DC link until five 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.

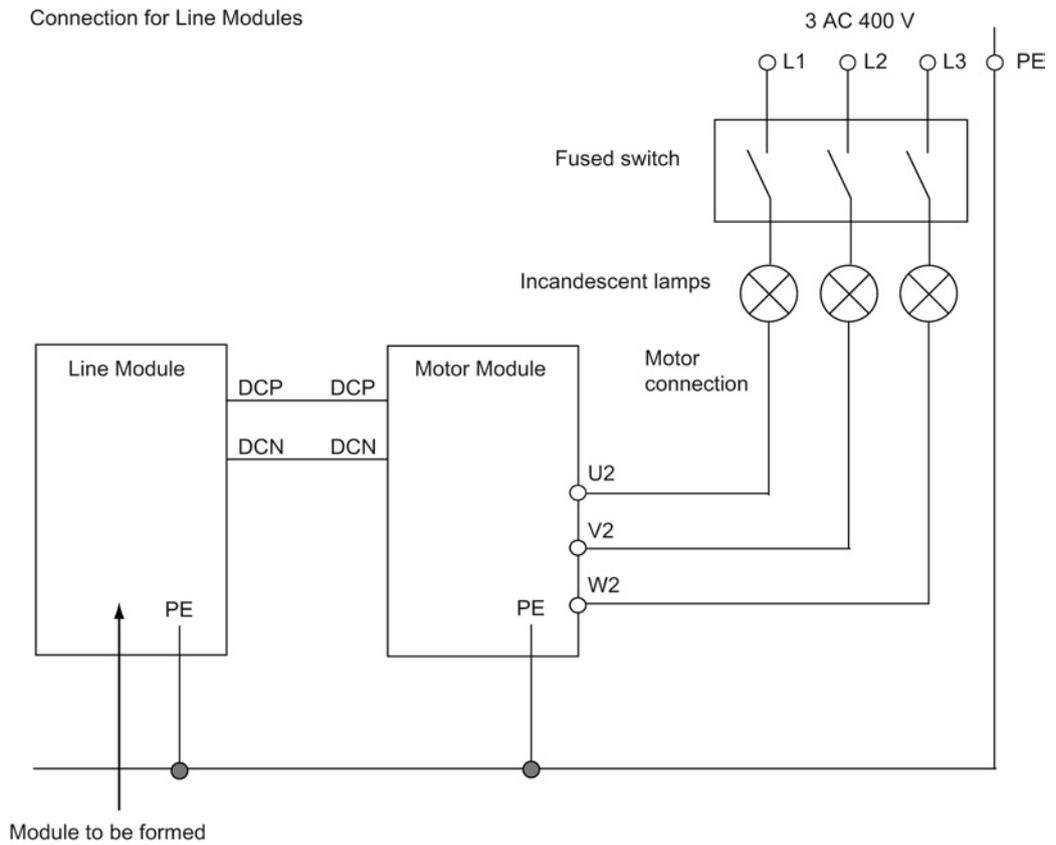


Figure 14-2 Forming circuit for Line Modules with incandescent lamps

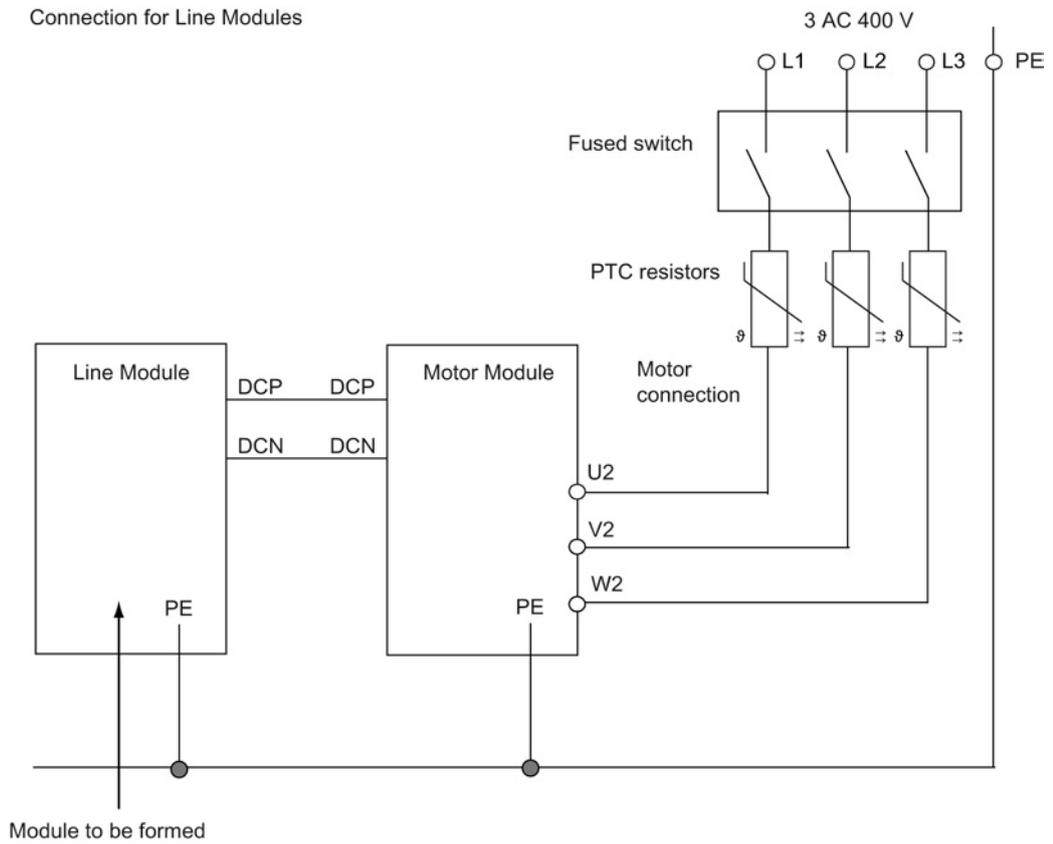


Figure 14-3 Forming circuit for Line Modules with PTC resistors

Connection for Motor Modules

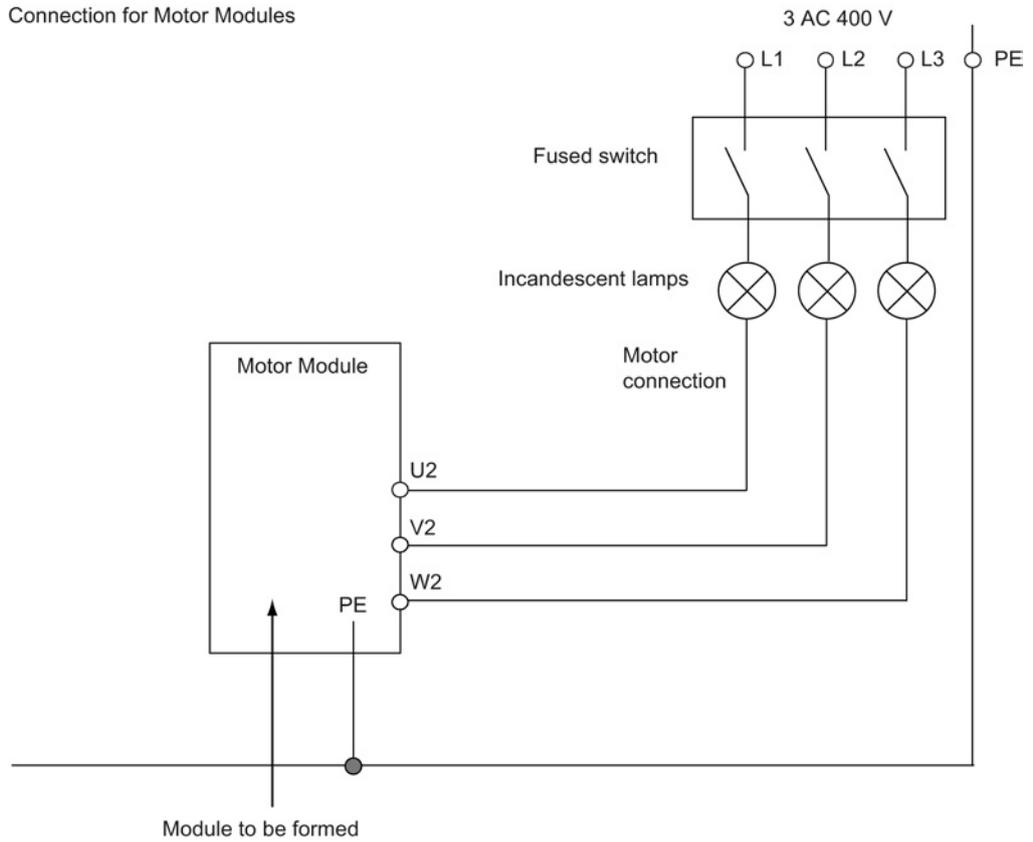


Figure 14-4 Forming circuit for Motor Modules with incandescent lamps

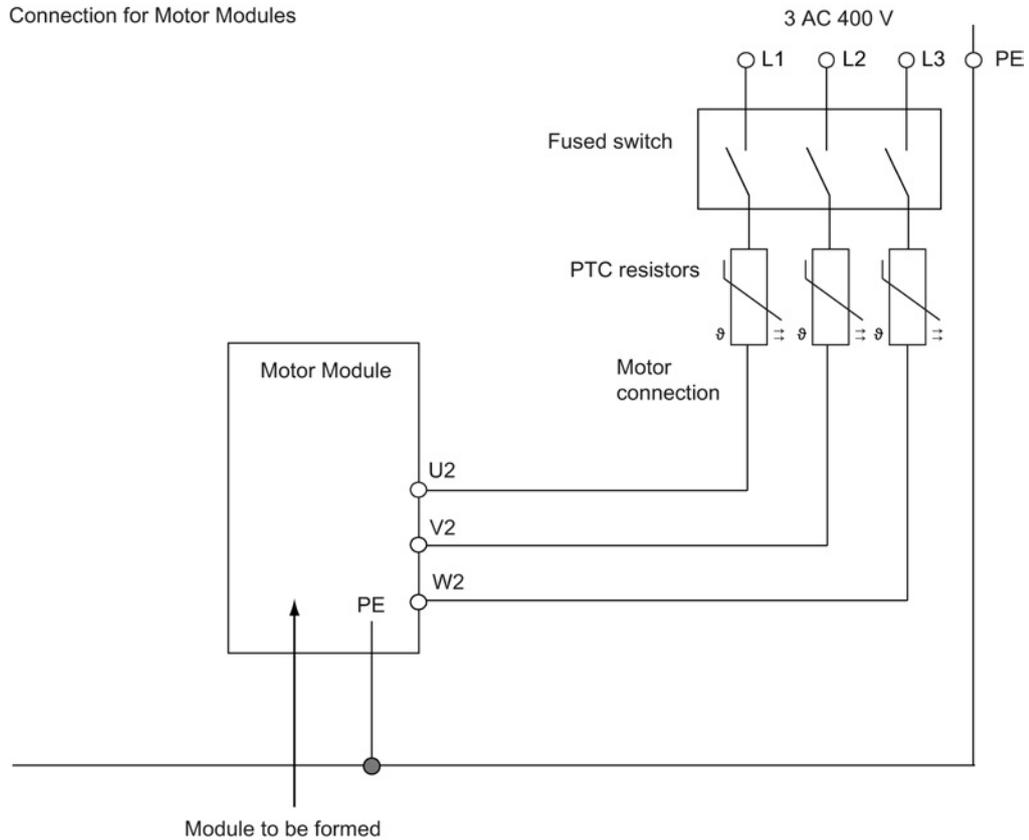


Figure 14-5 Forming circuit for Motor Modules with PTC resistors

Procedure

- Be sure to remove the DC-link bridge before forming the DC-link capacitors.
- Make sure that the device **does not** receive a switch-on command (e.g. from the keyboard, BOP20 or terminal block).
- Connect the forming circuit.
- While forming, the incandescent lamps must become less bright or go completely dark. If the incandescent lamps continue to be brightly lit, a fault has occurred in the drive unit or in the wiring.
- 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).

14.4 Recycling and disposal

Dispose of the product according to the applicable national regulations.

The products described in this Equipment Manual are extensively recyclable on account of the low-toxic composition of the materials used. To recycle and dispose of your old device in an environmentally friendly way, please contact a company that disposes of electronic waste.

Appendix

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.

| Abbreviation | Source of the abbreviation | Meaning |
|--------------|---|---|
| A | | |
| A... | Alarm | Alarm |
| 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 standard code for information interchange |
| AS-i | AS-Interface (Actuator Sensor Interface) | AS interface (open bus system in automation technology) |
| ASM | Asynchronmotor | Induction motor |
| B | | |
| BB | Betriebsbedingung | Operating condition |
| BERO | - | 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 |
| BLM | Basic Line Module | Basic Line Module |

A.1 List of abbreviations

| Abbreviation | Source of the abbreviation | Meaning |
|---------------------|---------------------------------------|--|
| BO | Binector Output | Binector output |
| BOP | Basic Operator Panel | Basic Operator Panel |
| C | | |
| 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 disk |
| CDS | Command Data Set | Command data set |
| CF Card | CompactFlash Card | CompactFlash card |
| CI | Connector Input | Connector Input |
| CLC | Clearance Control | Clearance control |
| CNC | Computer Numerical Control | Computerized 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 on a changeover 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 MASTER | Control Unit DC MASTER |
| D | | |
| 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 |
| DDS | Drive Data Set | Drive data set |
| DI | Digital Input | Digital input |
| DI/DO | Digital Input/Digital Output | Bidirectional digital input/output |
| DMC | DRIVE-CLiQ Hub Module Cabinet | DRIVE-CLiQ Hub Module Cabinet |
| DME | DRIVE-CLiQ Hub Module External | DRIVE-CLiQ Hub Module External |

| Abbreviation | Source of the abbreviation | Meaning |
|---------------------|---|---|
| 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 |
| DTC | Digital Time Clock | Timer |
| E | | |
| 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 |
| ESD | Elektrostatisch gefährdete Baugruppen | Electrostatic sensitive devices |
| 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 | Enable pulses |
| EPOS | Einfachpositionierer | Basic positioner |
| ES | Engineering System | Engineering System |
| ESB | Ersatzschaltbild | Equivalent circuit diagram |
| ESD | Electrostatic Sensitive Devices | Electrostatic sensitive devices |
| ESM | Essential Service Mode | Essential service mode |
| ESR | Extended Stop and Retract | Extended stop and retract |
| F | | |
| 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 |

| Abbreviation | Source of the abbreviation | Meaning |
|--------------|---|---|
| FEM | Fremderregter Synchronmotor | Separately excited synchronous motor |
| FEPROM | Flash-EPROM | Non-volatile write and read memory |
| FG | Function Generator | Function generator |
| FI | - | Residual current |
| FOC | Fiber-Optic Cable | Fiber-optic cable |
| FP | Funktionsplan | Function diagram |
| FPGA | Field Programmable Gate Array | Field programmable gate array |
| FW | Firmware | Firmware |
| G | | |
| 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 | Gerätstammdatei | Generic station description: describes the features of a PROFIBUS slave |
| GSV | Gate Supply Voltage | Gate supply voltage |
| GUID | Globally Unique Identifier | Globally Unique Identifier |
| H | | |
| HF | High frequency | High frequency |
| HFD | Hochfrequenzdrossel | High-frequency reactor |
| HLA | Hydraulic Linear Actuator | Hydraulic linear drive |
| HLG | Hochlaufgeber | Ramp-function generator |
| HM | Hydraulic Module | Hydraulic Module |
| HMI | Human Machine Interface | Human machine interface |
| HTL | High-Threshold Logic | Logic with high fault threshold |
| HW | Hardware | Hardware |
| I | | |
| 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 | Bipolar transistor with insulated control electrode |
| IGCT | Integrated Gate-Controlled Thyristor | Semiconductor power switch with integrated control electrode |

| Abbreviation | Source of the abbreviation | Meaning |
|---------------------|---------------------------------------|---|
| IL | Impulslöschung | Pulse suppression |
| IP | Internet Protocol | Internet Protocol |
| IPO | Interpolator | Interpolator |
| IT | Isolé Terre | Non-grounded three-phase line supply |
| IVP | Internal Voltage Protection | Internal voltage protection |
| J | | |
| JOG | Jogging | Jog |
| K | | |
| KDV | Kreuzweiser Datenvergleich | Crosswise data comparison |
| KHP | Know-how protection | Know-how protection |
| KIP | Kinetische Pufferung | Kinetic buffering |
| Kp | - | Proportional gain |
| KTY | - | Special temperature sensor |
| 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 |
| FO cable | Lichtwellenleiter | Fiber-optic cable |
| M | | |
| 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 |
| MSB | Most Significant Bit | Most significant bit |
| MSC | Motor-Side Converter | Motor-side converter |
| MSCY_C1 | Master Slave Cycle Class 1 | Cyclic communication between master (class 1) and slave |

A.1 List of abbreviations

| Abbreviation | Source of the abbreviation | Meaning |
|---------------------|--|---|
| MSC | Motorstromrichter | Motor-side converter |
| MT | Messtaster | Probe |
| N | | |
| N. C. | Not Connected | Not connected |
| N... | No Report | No report or internal message |
| NAMUR | Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie | Standardization association for measurement and control in chemical industries |
| NC | Normally Closed (contact) | NC contact |
| NC | Numerical Control | Numerical control |
| NEMA | National Electrical Manufacturers Association | Standardization body in the US |
| NM | Nullmarke | Zero mark |
| NO | Normally Open (contact) | NO contacts |
| LSC | Netzstromrichter | Line-side converter |
| NVRAM | Non-Volatile Random Access Memory | Non-volatile read/write memory |
| O | | |
| OA | Open Architecture | Software component (technology package) which provides additional functions for the SINAMICS drive system |
| OAIF | Open Architecture Interface | Version of the SINAMICS firmware from which the OA-application can be used |
| OASP | Open Architecture Support Package | Expands the STARTER commissioning tool by the corresponding OA-application |
| OC | Operating Condition | Operating condition |
| 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 | | |
| p... | - | Adjustable parameters |
| P1 | Processor 1 | CPU 1 |
| P2 | Processor 2 | CPU 2 |
| PB | PROFIBUS | PROFIBUS |
| PcCtrl | PC Control | Master control |
| PD | PROFIdrive | PROFIdrive |
| PDS | Power unit Data Set | Power unit data set |
| PE | Protective Earth | Protective ground |
| PELV | Protective Extra Low Voltage | Safety extra-low voltage |
| PEM | Permanenterregter Synchronmotor | Permanent-magnet synchronous motor |
| PG | Programmiergerät | Programming device |
| PI | Proportional Integral | Proportional integral |
| PID | Proportional Integral Differential | Proportional integral differential |
| PLC | Programmable Logical Controller | Programmable logic controller |

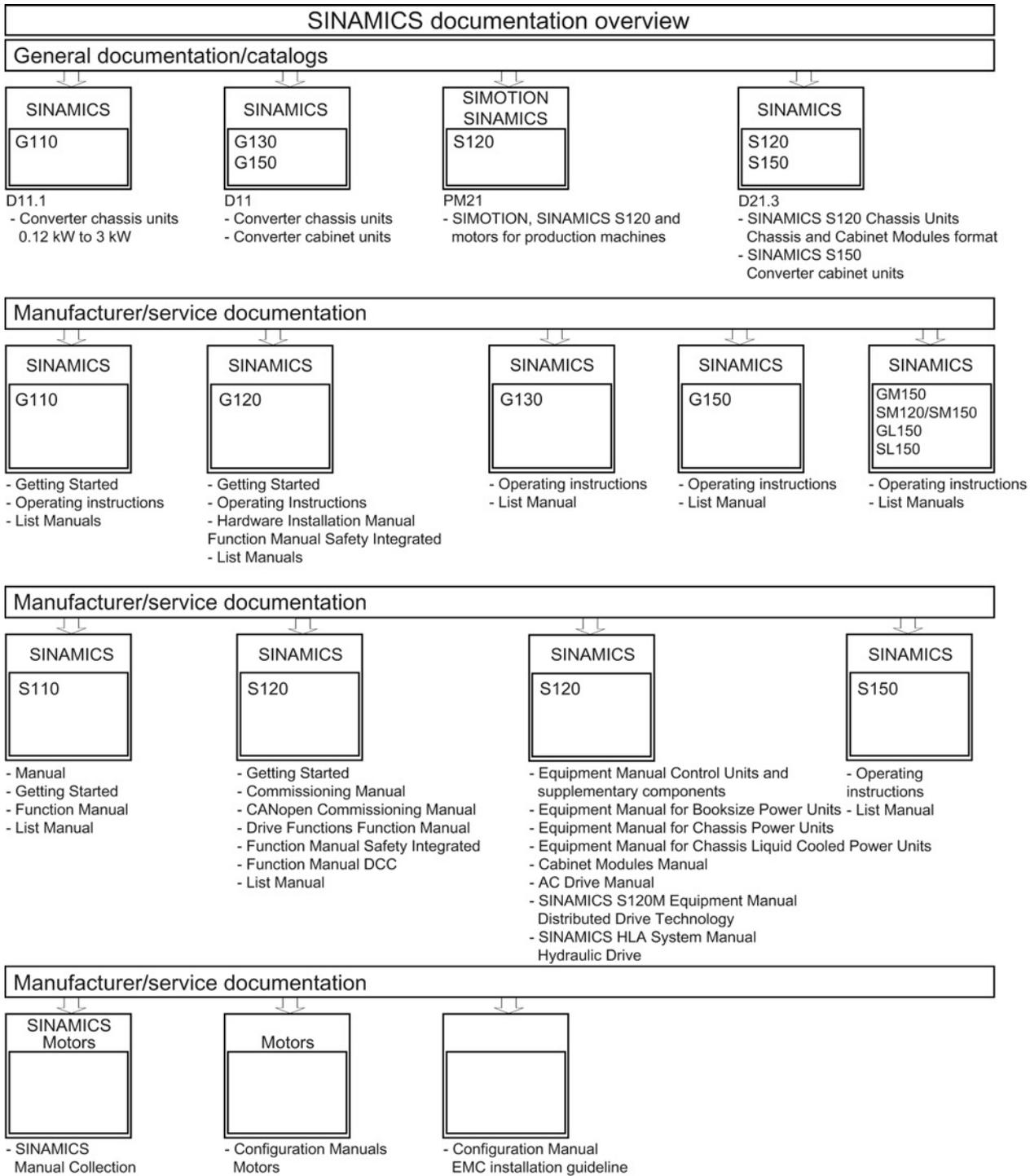
| Abbreviation | Source of the abbreviation | Meaning |
|---------------------|-----------------------------------|---|
| PLL | Phase-Locked Loop | Phase-locked loop |
| PM | Power Module | Power Module |
| PN | PROFINET | PROFINET |
| PNO | PROFIBUS Nutzerorganisation | PROFIBUS user organization |
| 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 |
| 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 | | |
| R | | |
| r... | - | Display parameters (read only) |
| RAM | Random Access Memory | Read/write memory |
| RCCB | Residual Current Circuit Breaker | Residual current operated circuit breaker |
| RCD | Residual Current Device | Residual current operated circuit breaker |
| RCM | Residual Current Monitor | Residual current monitor |
| RFG | Ramp-Function Generator | Ramp-function generator |
| RJ45 | Registered Jack 45 | Term for an 8-pin socket system for data transmission with shielded or non-shielded multi-wire copper cables |
| RKA | Rückkühlanlage | Cooling unit |
| RLM | Renewable Line Module | Renewable Line Module |
| RO | Read Only | Read only |
| ROM | Read-Only Memory | Read-only memory |
| RPDO | Receive Process Data Object | Receive Process Data Object |
| RS232 | Recommended Standard 232 | Interface standard for cable-connected serial data transmission between a sender and receiver (also known as EIA232) |
| RS485 | Recommended Standard 485 | Interface standard for a cable-connected differential, parallel, and/or serial bus system (data transmission between a number of senders and receivers, also known as EIA485) |
| RTC | Real Time Clock | Realtime clock |
| RZA | Raumzeigerapproximation | Space vector approximation |
| S | | |
| S1 | - | Continuous duty |
| S3 | - | Intermittent duty |
| SAM | Safe Acceleration Monitor | Safe acceleration monitoring |

A.1 List of abbreviations

| Abbreviation | Source of the abbreviation | Meaning |
|---------------------|-----------------------------------|--|
| 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 |
| SD Card | SecureDigital Card | Secure digital memory card |
| SDI | Safe Direction | Safe motion direction |
| SE | Sicherer Software-Endschalter | Safe software limit switch |
| SG | Sicher reduzierte Geschwindigkeit | Safely-limited speed |
| SGA | Sicherheitsgerichteter Ausgang | Safety-related output |
| SGE | Sicherheitsgerichteter Eingang | Safety-related input |
| SH | Sicherer Halt | Safe standstill |
| SI | Safety Integrated | Safety Integrated |
| SIL | Safety Integrity Level | Safety Integrity Level |
| 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 | Vector control without encoder (sensorless) |
| 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 (monitored for time and ramping up) |
| SS2 | Safe Stop 2 | Safe Stop 2 |
| SSI | Synchronous Serial Interface | Synchronous serial interface |
| 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 |

| Abbreviation | Source of the abbreviation | Meaning |
|---------------------|-------------------------------------|---|
| T | | |
| TB | Terminal Board | Terminal board |
| TIA | Totally Integrated Automation | Totally Integrated Automation |
| TM | Terminal Module | Terminal Module |
| TN | Terre Neutre | Grounded three-phase line supply |
| T _n | - | Integral time |
| TPDO | Transmit Process Data Object | Transmit process data object |
| TT | Terre Terre | Grounded three-phase line supply |
| TTL | Transistor-Transistor-Logic | Transistor-transistor logic |
| T _v | - | Rate time |
| U | | |
| UL | Underwriters Laboratories Inc. | Underwriters Laboratories Inc. |
| UPS | Uninterruptible Power Supply | Uninterruptible power supply |
| UPS | Unterbrechungsfreie Stromversorgung | Uninterruptible power supply |
| UTC | Universal Time Coordinated | Universal time coordinated |
| V | | |
| VC | Vector Control | Vector control |
| V _{dc} | - | DC-link voltage |
| V _{dcN} | - | Partial DC link voltage, negative |
| V _{dcP} | - | Partial DC link voltage, positive |
| VDE | Verband Deutscher Elektrotechniker | Verband Deutscher Elektrotechniker [Association of German Electrical Engineers] |
| VDI | Verein Deutscher Ingenieure | Verein Deutscher Ingenieure [Association of German Engineers] |
| VPM | Voltage Protection Module | Voltage Protection Module |
| V _{pp} | Volt peak to peak | Volt peak to peak |
| VSM | Voltage Sensing Module | Voltage Sensing Module |
| W | | |
| WEA | Wiedereinschaltautomatik | Automatic restart |
| WZM | Werkzeugmaschine | Machine tool |
| X | | |
| XML | Extensible Markup Language | Extensible markup language (standard language for web publishing and document management) |
| Y | | |
| Z | | |
| ZK | DC Link | DC Link |
| ZM | Zero Mark | Zero mark |
| ZSW | Status word | Status word |

A.2 Documentation overview



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