SINAMICS S120

Booksize power units

Equipment Manual 11/2009

SINAMICS

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S120
Booksize Power Units

Manual

(GH2), 11.2009 Edition
6SL3097-4AC00-0BP2

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
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE
indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

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 for the specific task, 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 adhered to. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of the 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.

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Ordernumber: 6SL3097-4AC00-0BP2
℗ 01/2010

Preface

SINAMICS documentation

The SINAMICS documentation is organized in 2 parts:

- General documentation / Catalogs
- Manufacturer / Service documentation

You can find more information on the following topics at
http://www.siemens.com/motioncontrol/docu:

- Ordering documentation

Here you can find an up-to-date overview of publications

- Downloading documentation

Further links for downloading files from Service & Support

- Researching documentation online

Information on DOConCD and direct access to the publications in DOConWeb.

- For customizing documentation based on Siemens content using My Documentation Manager (MDM), see

http:// www.siemens.com/mdm

My Documentation Manager provides you with a range of features for creating your own machine documentation

- Training and FAQs

Information about training courses and FAQs (Frequently Asked Questions) can be found using the page navigation.

Usage phases

Table 1 Usage phase and the available documents/tools

Usage phase	Tools
Orientation	SINAMICS S Sales Documentation
Planning/configuration	SIZER configuration tool
Decision making/ordering	SINAMICS S Catalogs
Configuring/installation	• SINAMICS S120 Manuals • SINAMICS S150 Operating Instructions
Commissioning	• STARTER parameterization and commissioning tool • SINAMICS S120 Commissioning Manuals • SINAMICS S List Manual • SINAMICS S150 Operating Instructions
Usage/operation	• SINAMICS S120 Function Manuals • SINAMICS S List Manual • SINAMICS S150 Operating Instructions
Maintenance/Service	• SINAMICS S120 Commissioning Manuals • SINAMICS S List Manual • SINAMICS S120 Manuals • SINAMICS S150 Operating Instructions

Target group

This Manual addresses planners, installation technicians, design engineers.

Benefits

This manual provides information on the components and functions of devices so that the target group is capable of installing, setting up, testing, operating, and troubleshooting the devices safely and correctly.

Standard scope

This documentation only describes the functionality of the standard version. Extensions or changes made by the machine tool manufacturer are documented by the machine tool manufacturer.
Other functions not described in this documentation might be able to be executed in the drive system. This does not, however, represent an obligation to supply such functions with a new control or when servicing.

Further, for the sake of simplicity, this documentation does not contain all detailed information about all types of the product and cannot cover every conceivable case of installation, operation or maintenance.

Technical support

If you have any questions, please contact our hotline:

	Europe/Africa
Telephone	+49 180 5050 - 222
Fax	+49 180 5050 - 223
€ 0.14/min. from German landlines, max. € 0.42/min. for mobile calls within Germany	
Internet	http://www.siemens.de/automation/support-request

	Americas
Telephone	+1 423 262 2522
Fax	+1 423 262 2200
E-mail	mailto:techsupport.sea@siemens.com

	Asia/Pacific
Telephone	+86 1064 757575
Fax	+86 1064 747474
E-mail	mailto:support.asia.automation@siemens.com

Note

You will find telephone numbers for other countries for technical support on the Internet:
http://www.automation.siemens.com/partner

Spare parts

Spare parts are available on the Internet at:
http://support.automation.siemens.com/WW/view/de/16612315

Questions about the documentation

If you have any questions (suggestions, corrections) regarding this documentation, please fax or e-mail us at:

Fax	+49 9131 98 2176
E-mail	E-mail to: docu.motioncontrol@siemens.com

A fax form is available in the appendix of this document.

Internet address for SINAMICS

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

Test certificates

The Safety Integrated functions of SINAMICS components are generally certified by independent institutes. An up-to-date list of certified components is available on request from your local Siemens office. If you have any questions relating to certifications that have not been completed, please ask your Siemens contact.

EC Declarations of Conformity

The EC Declaration of Conformity for the EMC Directive can be found/obtained:

- on the Internet:
  http://support.automation.siemens.com
  under the Product/Order number 15257461
- at the relevant regional office of the I DT MC Business Unit of Siemens AG

The EC Declaration of Conformity for the Low Voltage Directive can be found/obtained

- on the Internet
  http://support.automation.siemens.com
  under the Product/Order number 22383669

Note

When operated in dry areas, SINAMICS S devices conform to the Low Voltage Directive 73/23/EEC or 2006/95/EEC.

Note

SINAMICS S devices fulfill EMC Directive 89/336/EEC or 2004/108/EC in the configuration specified in the associated EC Declaration of Conformity and when the EMC installation guideline is implemented, Order No. 6FC5297-0AD30-0□P□.

Note

The Equipment Manual describes a desired state which, if maintained, ensures reliable operation as desired and compliance with EMC limit values.

Should there be a deviation from the Equipment Manual requirements, appropriate actions (e.g. measurements) must be taken to check/prove that the desired reliable operation is ensured and EMC limit values are complied with.

DANGER

Electrical, magnetic and electromagnetic fields (EMF) that occur during operation can pose a danger to persons who are present in the direct vicinity of the product - especially persons with pacemakers, implants, or similar devices.

The relevant directives and standards must be observed by the machine/plant operators and persons present in the vicinity of the product. These are, for example, EMF Directive 2004/40/EEC and standards EN 12198-1 to -3 applying to the European Economic Area (EEA) and in Germany the accident prevention regulation BGV 11 and the associated rule BGR 11 "Electromagnetic fields" from the German employer's liability accident insurance association.

These state that a hazard analysis must drawn up for every workplace, from which measures for reducing dangers and their impact on persons are derived and applied, and exposure and danger zones are defined and observed.

The relevant safety notes in each chapter must be observed.

ESD information

CAUTION

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

Regulations for handling ESD components:

When handling electronic components, you must ensure that the person carrying out the work, the work place, and packaging are properly grounded.

Personnel may only come into contact with electronic components, if

- They are grounded with an ESD wrist band, or
- They are in ESD areas with conductive flooring, ESD shoes or ESD grounding straps.

Electronic boards should only be touched if absolutely necessary. They must only be handled on the front panel or, in the case of printed circuit boards, at the edge.

Electronic boards must not come into contact with plastics or items of clothing containing synthetic fibers.

Boards must only be placed on conductive surfaces (work surfaces with ESD surface, conductive ESD foam, ESD packing bag, ESD transport container).

Do not place boards near display units, monitors, or television sets (minimum distance from screen: 10 cm).

Measurements may only be taken on boards when the measuring device is grounded (via protective conductors, for example) or the measuring probe is briefly discharged before measurements are taken with an isolated measuring device (for example, touching a bare metal housing).

Safety information

DANGER

Commissioning is absolutely prohibited until it has been completely ensured that the machine, in which the components described here are to be installed, is in full compliance with the provisions of the EC Machinery Directive.

Only qualified personnel may install, commission and service SINAMICS S units.

The personnel must take into account the information provided in the technical customer documentation for the product, and be familiar with and observe the specified danger and warning notices.

Operational electrical equipment and motors have parts and components which are at hazardous voltage levels that may cause serious injuries or death when touched.

All work on the electrical system must be carried out when the system has been disconnected from the power supply.

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

In operation on IT systems, the occurrence of a first fault between an active part and ground must be signaled by a monitoring device. In accordance with IEC 60364-4-41 it is recommended that the first fault should be eliminated as quickly as practically possible.

In systems with a grounded external conductor, an isolating transformer with grounded neutral (secondary side) must be connected between the supply and the drive system to protect the motor insulation from excessive stress. The majority of TT systems have a grounded external conductor, so in this case an isolating transformer must be used.

DANGER

Correct and safe operation of SINAMICS S units assumes correct transportation in the transport packaging, correct long-term storage in the transport packaging, setup and installation, as well as careful operation and maintenance.

The details in the catalogs and proposals also apply to the design of special equipment versions.

In addition to the danger and warning information provided in the technical customer documentation, the applicable national, local, and system-specific regulations and requirements must be taken into account.

According to EN 61800-5-1 and UL 508 only safely isolated protective extra-low voltages of the electronic modules may be connected to all connections and terminals.

DANGER

Using protection against direct contact via DVC A (PELV) is only permissible in areas with equipotential bonding and in dry rooms indoors. If these conditions are not fulfilled, other protective measures against electric shock (e.g. protection through protective impedances or limited voltage, or use of protection class I and II) must be used.

DANGER

As part of routine tests, SINAMICS S components will undergo a voltage test in accordance with EN 61800-5-1. Before the voltage test is performed on the electrical equipment of machines to EN 60204-1, Section 18.4, all connections of SINAMICS units must be disconnected/unplugged to prevent them from being damaged.

Motors should be connected up corresponding to the circuit diagram supplied with the motor (refer to the connection examples of Motor Modules). They must not be connected directly to the three-phase supply because this will damage them.

WARNING

Operating the equipment in the immediate vicinity (< 1.8 m) of mobile telephones with a transmitter power of > 1 W may cause the equipment to malfunction.

Explanation of symbols

Table 2 Symbols

Symbol	Meaning
	Protective earth (PE)
	Ground (e.g. M 24 V)
	Functional ground Equipotential bonding

Residual risks of power drive systems

When carrying out a risk assessment of a machine in accordance with the EU Machinery Directive, the machine manufacturer must consider the following residual risks associated with the control and drive components of a power drive system (PDS).

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 not within the scope of the specification
   - Parameterization, programming, cabling, and installation errors
   - Use of radio devices / cellular phones in the immediate vicinity of the controller
   - External influences / damage
2. Exceptional temperatures as well as emissions of light, noise, particles, or gas caused by, for example:
   - Component malfunctions
   - Software errors
   - Operating and/or ambient conditions not within the scope of the specification
   - External influences / damage
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 not within the scope 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.

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

Table of contents

System overview 1

1.1 Field of application

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

- Simple pump and fan applications in the process industry.
- Complex individual 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.
- Highly dynamic servo drives for machine tools, as well as packaging and printing machines.

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

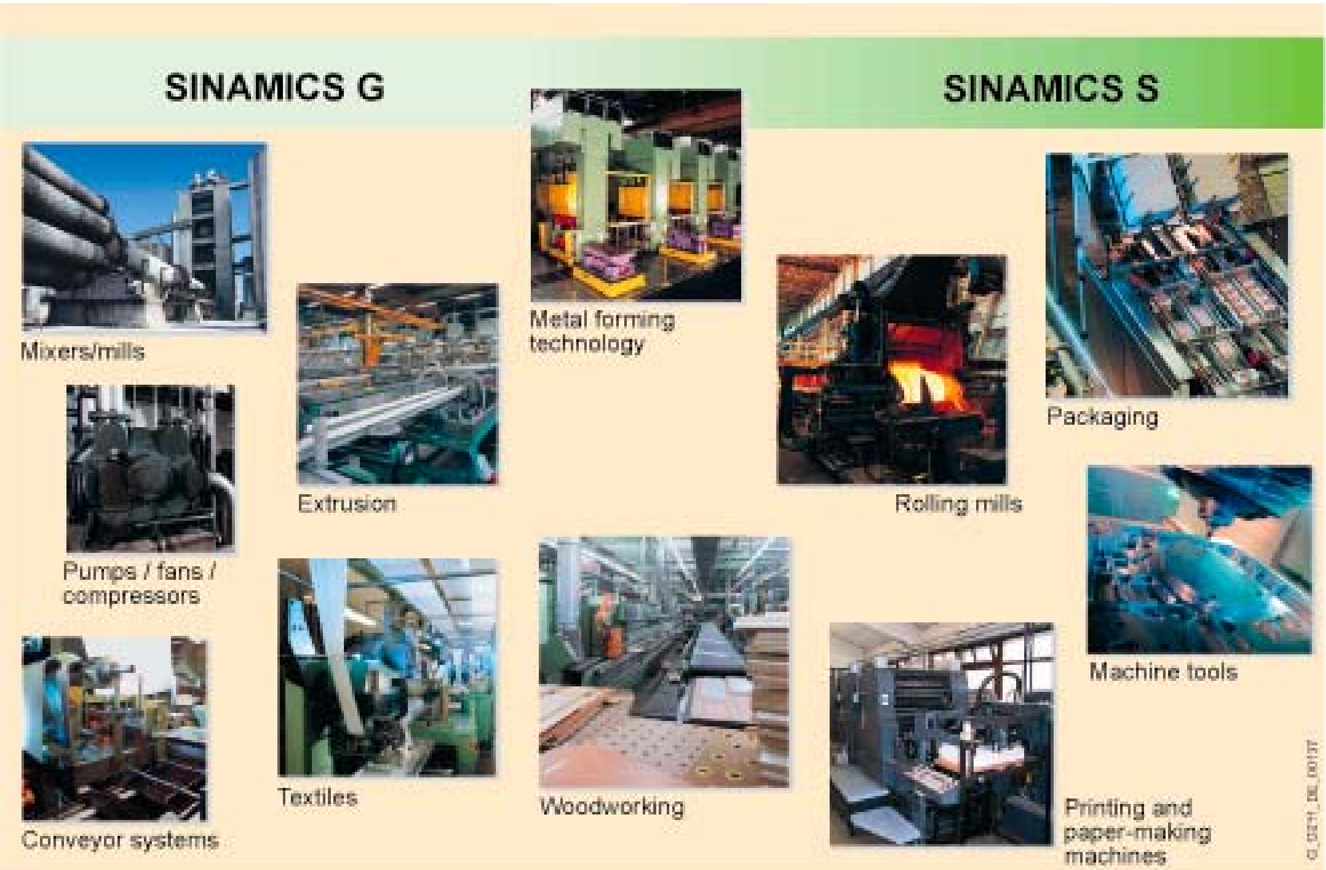


Figure 1-1 SINAMICS applications

1.2 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.

SINAMICS is part of the Siemens "Totally Integrated Automation" concept. Integrated SINAMICS systems covering configuration, data storage, and communication at automation level, ensure low-maintenance solutions with SIMATIC, SIMOTION, and SINUMERIK.

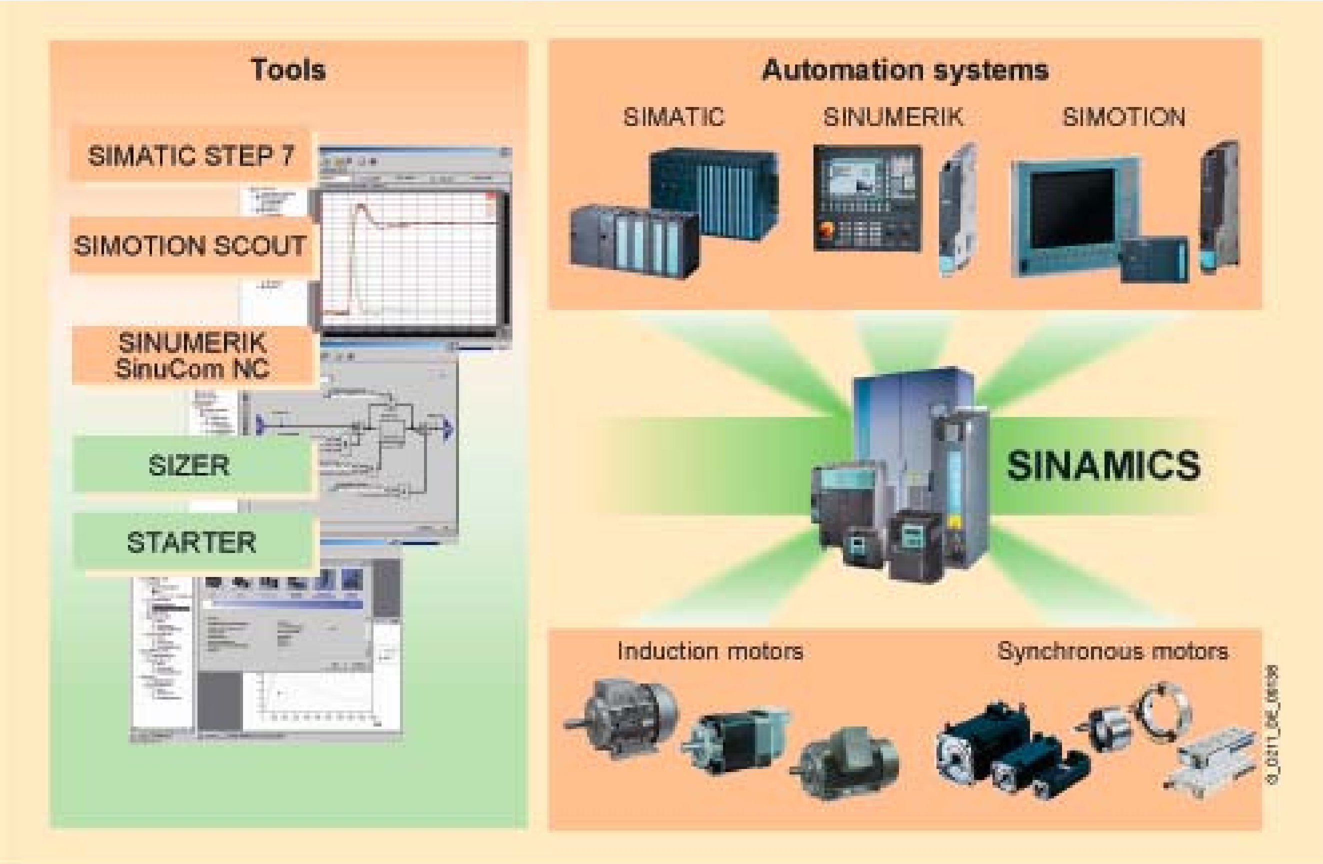


Figure 1-2 SINAMICS as part of the Siemens modular automation system

1.3 Introduction

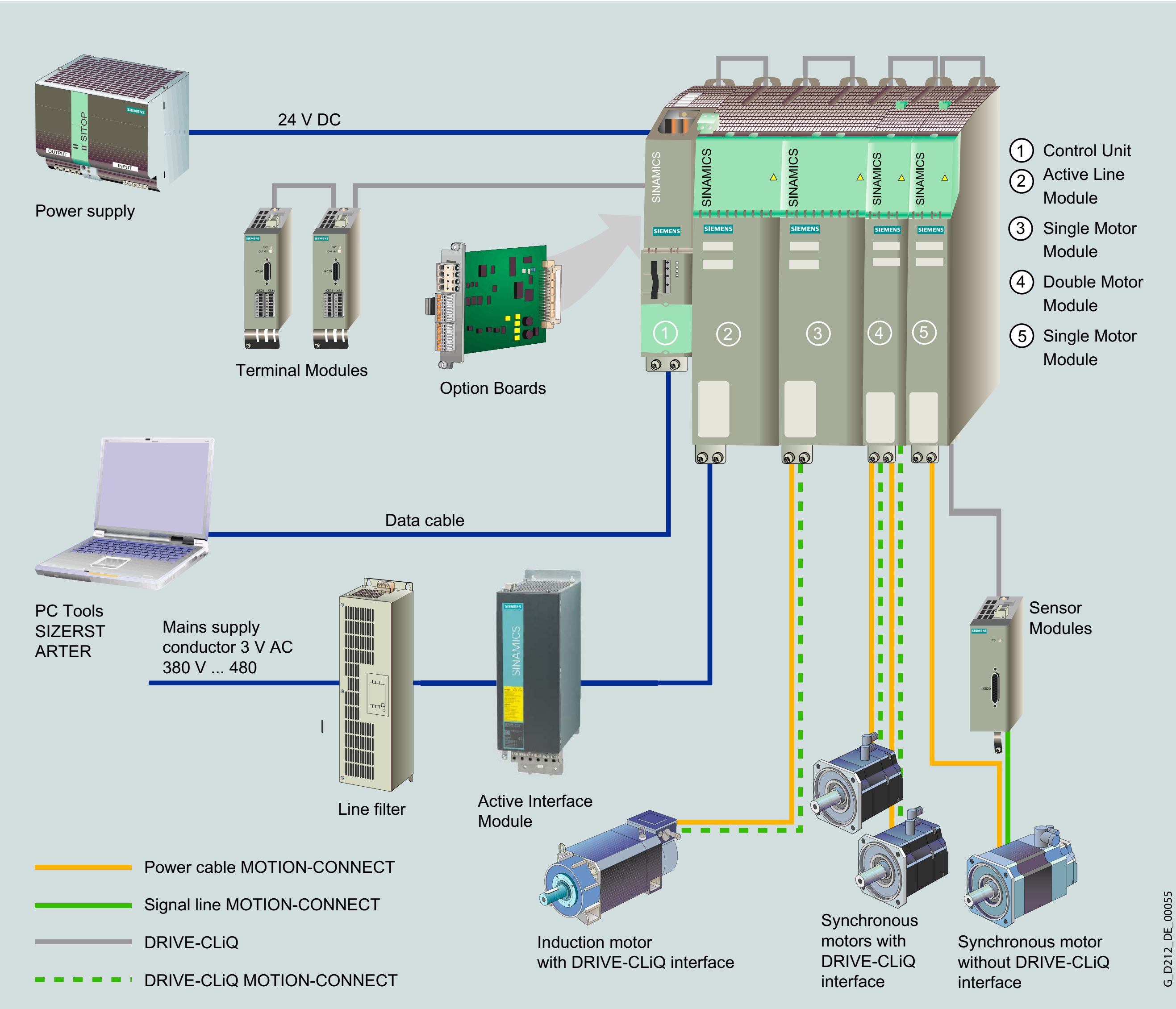


Figure 1-3 SINAMICS S120 system overview

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.

Drive for multi-axis applications

The trend towards separate axes in mechanical engineering is growing all the time. Where possible, central drives are being replaced by electronically coordinated servo drives. These require drives with a connected DC link, which allows cost-saving energy exchange between braking and driving axes.

SINAMICS S120 features infeeds and inverters that cover a broad power range, are designed for seamless integration, and enable space-saving, multi-axis drive configurations.

New system architecture with a central Control Unit

Electronically coordinated individual drives work together to perform your drive tasks. Higher-level controllers operate the drives to achieve the required coordinated movement. This requires cyclic data exchange between the control and all the drives. This exchange always had to take place via a field bus, which required a great deal of time and effort for installation and configuration. SINAMICS S120 takes a different approach. A central Control Unit controls the drive for all connected axes and also establishes the technological links between the axes. Since all the required data is stored in the central Control Unit, it does not need to be transferred. Inter-axis connections can be established within a component and easily configured in the STARTER commissioning tool using a mouse.

Simple technological tasks can be carried out by the SINAMICS S120 Control Unit itself. For complex numerical or motion-control tasks, high-performance SINUMERIK or SIMOTION D modules are used instead.

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

All SINAMICS S120 components have an electronic rating plate. This electronic 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. The Control Unit records this data automatically via DRIVE-CLiQ so that it does not need to be entered during commissioning or when the equipment is replaced.

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

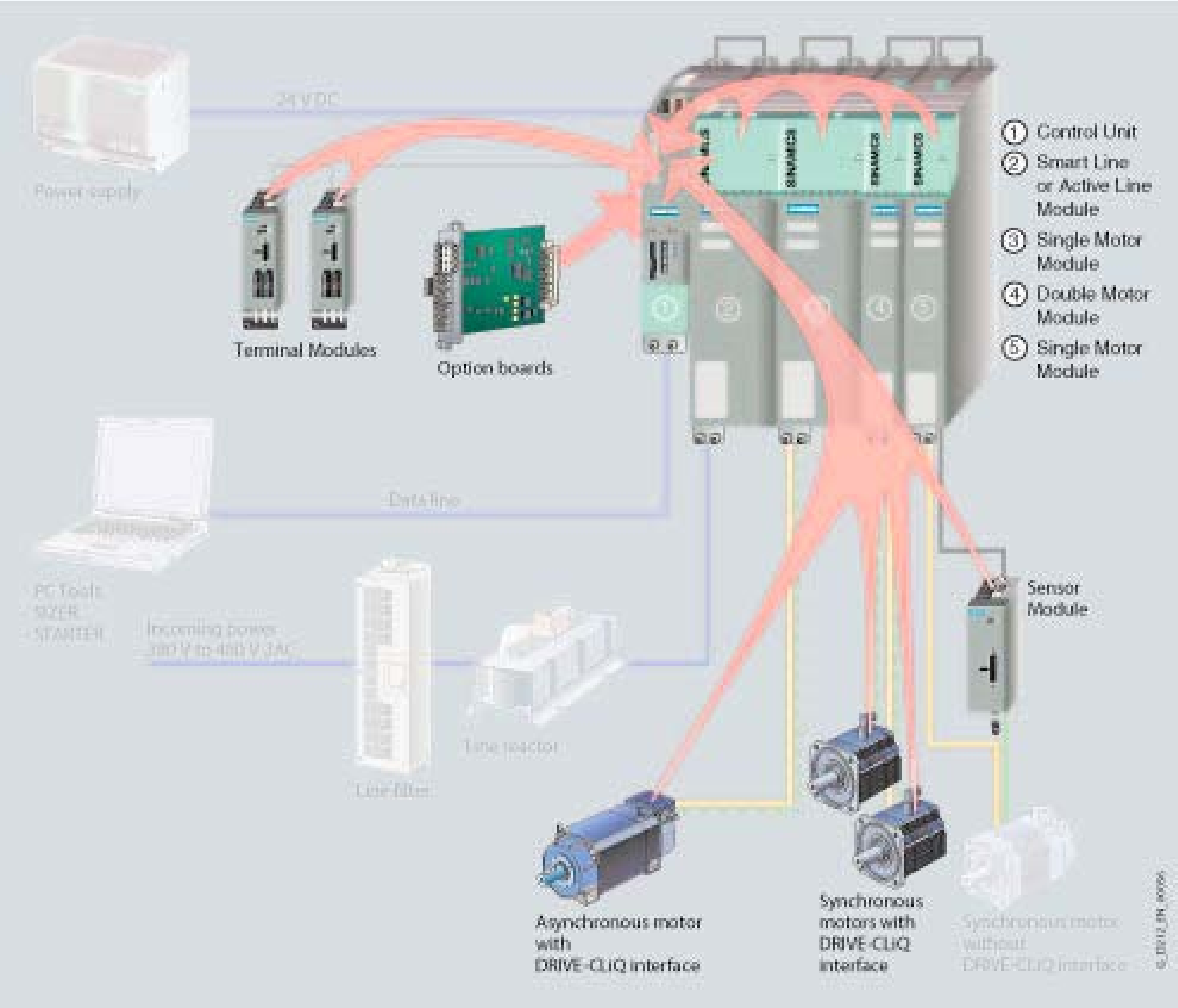


Figure 1-4 The electronic rating plate for SINAMICS S120

1.4 SINAMICS S120 components

The following system components are available:

- 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:

- A Control Unit that carries out all drive and technological functions across all axes.
- Supplementary system components that enhance functionality and offer different interfaces for encoders and process signals.

SINAMICS S120 components were developed 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, seamless integration

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 and an extended overload capability. 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

1.4.1 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 and 36 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.

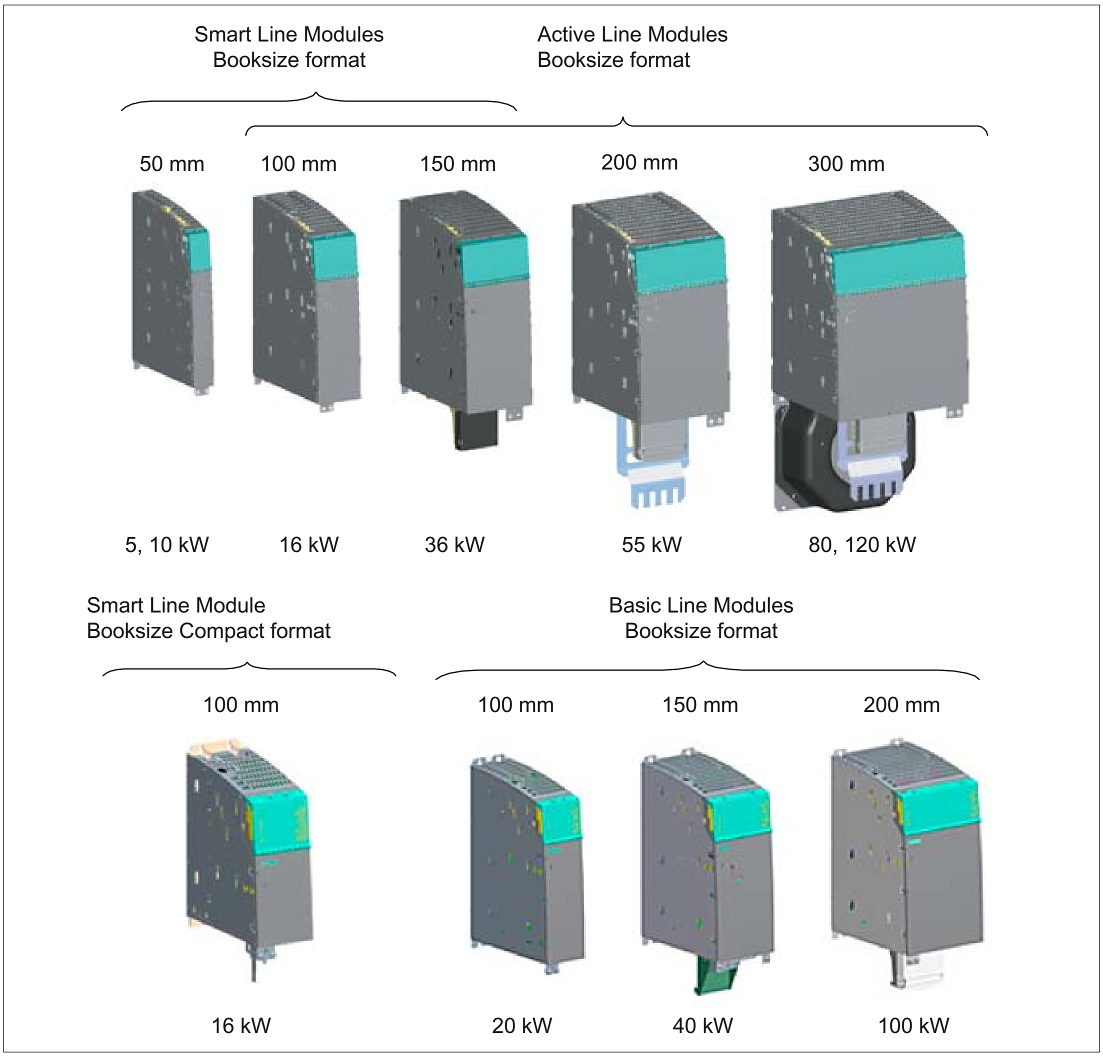


Figure 1-5 Overview of Line Modules

General characteristics of the Line Modules

- Connection voltage 3 AC 380 V –10% (-15% <1 min) to 3 AC 480 V +10% (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 Active Line Modules as of 55 kW: outgoing circuit for DC link busbar possible on both sides
- For all Active Line Modules with order numbers ending in 3 (6SL xxxxxxx 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 and 36 kW Smart Line Modules, the DC link busbars can exit at both sides

Characteristics of the Basic Line Modules

- Unregulated DC link voltage
- No regenerative feedback capability
- For all Basic Line Modules: outgoing circuit for DC link busbar 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.

1.4.2 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).

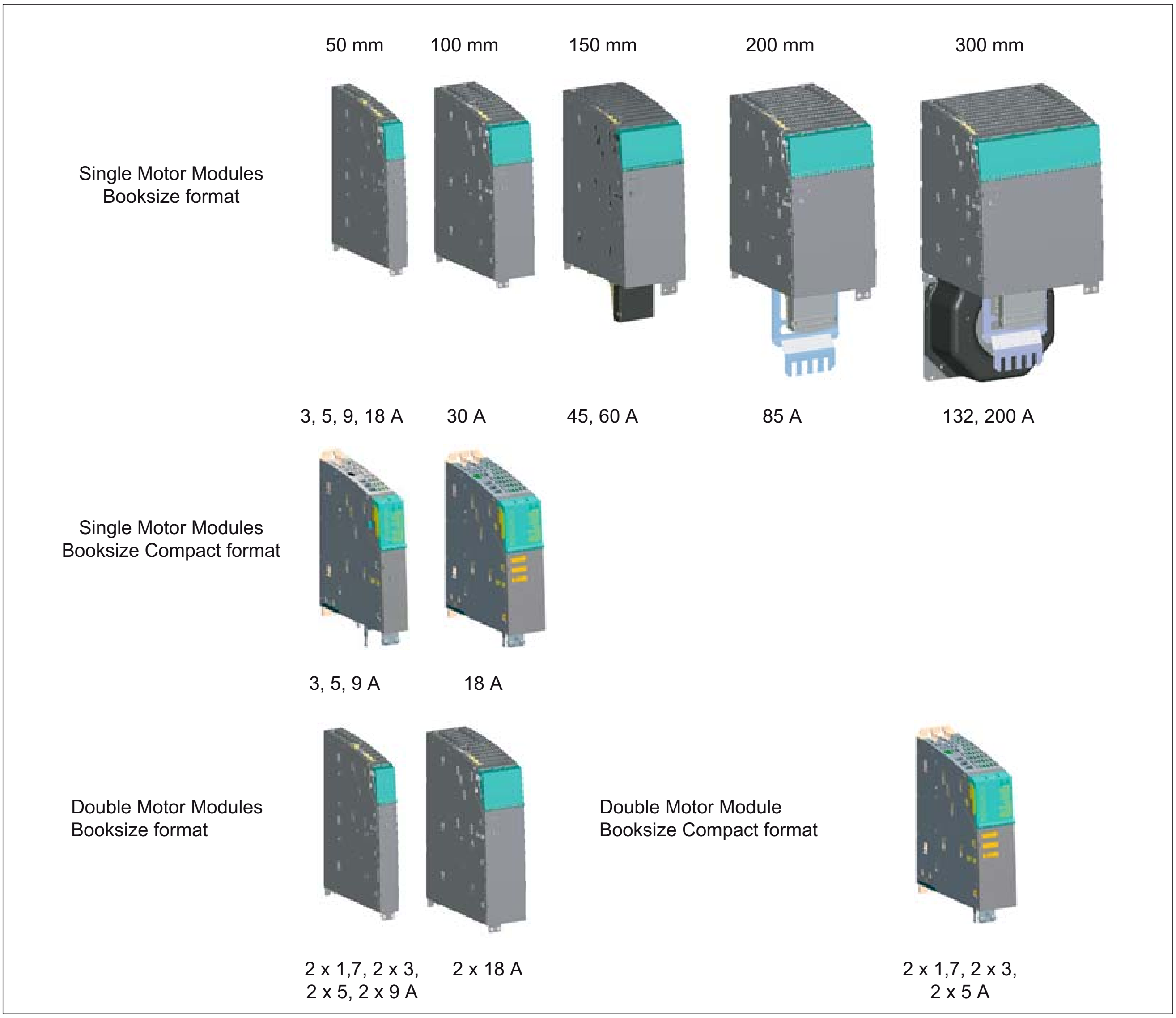


Figure 1-6 Overview of Motor Modules booksize (currents are continuous rms)

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

1.5 System data

Technical data

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

Electrical data	
Line connection voltage	3-ph. 380 V to 480 V AC ±10% (-15% < 1 min)
Line frequency	47 Hz to 63 Hz
Electronics power supply	24 VDC -15/+20%*, protective extra-low voltage DVC A (PELV)
Short-circuit current rating SCCR in accordance with UL508C (up to 600 V)	• 1.1 kW – 447 kW: 65 kA • 448 kW – 671 kW: 84 kA • 672 kW – 1193 kW: 170 kA • ≥ 1194 kW: 200 kA
Interference suppression to EN 61800-3	Category C2 (optional) for system versions conformant with documentation
Overvoltage category	III to EN 61800-5-1
Degree of contamination	2 to EN 61800-5-1

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

Modules	
Line Modules in booksize format • Max. permissible supply voltage • Rated pulse frequency (for Active Line Modules in booksize format only)	 480 V 3 AC For intallation altitudes above 2000 m see the characteristic for voltage derating 8 kHz
Motor Modules in booksize format • DC-link connection voltage • Rated pulse frequency	 510 VDC up to 720 V 4 kHz For higher pulse frequencies the corresponding characteristic for current derating must be taken into consideration.

Environmental conditions	
The Safety-Integrated safety function: The components must be protected against conductive pollution (e.g. by installing them in a cabinet with degree of protection IP54B acc. to EN 60529). Provided that conductive pollution can be prevented at the installation site, the degree of protection for the cabinet can be decreased accordingly.	
Degree of protection	IP20 or IPXXB to EN 60529, open type to UL508

Environmental conditions	
Protection class for network current circuits Protection class for electronic circuits	I (with protective conductor connection) and III (protective extra low voltage DVC A / PELV) acc. to EN 61800-5-1
Permissible coolant temperature (air) and installation altitude during 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 K per 500 m.
Chemically active substances • Long-term storage in the transport packaging • Transport in the transport packaging • Operation	 Class 1C2 to EN 60721-3-1 Class 2C2 to EN 60721-3-2 Class 3C2 to EN 60721-3-3
Biological environmental conditions • Long-term storage in the transport packaging • Transport in the transport packaging • Operation	 Class 1B1 to EN 60721-3-1 Class 2B1 to EN 60721-3-2 Class 3B1 to EN 60721-3-3
Vibratory load • Long-term storage in the transport packaging • Transport in the transport packaging • Operation	 Class 1M2 to EN 60721-3-1 Class 2M3 to EN 60721-3-2 Test values: Frequency range: 10 Hz to 58 Hz With constant deflection of 0.075 mm Frequency range: 58 Hz to 200 Hz With constant acceleration of 1 g
Shock load • Long-term storage in the transport packaging • Transport in the transport packaging • Operation Booksize format, booksize compact and blocksize frame sizes FSA to FSC Blocksize format frame sizes FSD to FSF Chassis format	 Class 1M2 to EN 60721-3-1 Class 2M3 to EN 60721-3-2 Test values: 15 g / 11 ms Test values: 5 g / 30 ms Test values: 10 g / 20 ms
Climatic environmental conditions • Long-term storage in the transport packaging • Transport in the transport packaging • Operation	 Class 1K4 to EN 60721-3-1 Temperature -25 °C to +55 °C Class 2K4 to EN 60721-3-2 Temperature -40 °C to +70 °C Class 3K3 to EN 60721-3-3 Temperature +0 °C to +40 °C Relative / absolute humidity 5% to 90% / 25 g/m^3. Oil mist saline fog, icing, condensation, dripping water, spray water, splash water and jet water not permissible.

Certificates	
Declarations of Conformity	CE (Low Voltage and EMC Directives)
Approvals	cULus

1.6 Standards

Note

The standards listed in the table below are non-binding and do not in any way claim to be complete. The standards listed do not represent a guaranteed property of the product.

Only the statements made in the Declaration of Conformity shall be deemed binding.

Table 1- 1 Fundamental, application-relevant standards in succession: EN, IEC/ISO, DIN, VDE

Standards*	Title
EN 1037 ISO 14118 DIN EN 1037	Safety of machinery; avoiding unexpected starting
EN ISO 9001 ISO 9001 DIN EN ISO 9001	Quality management systems - requirements
EN ISO 12100-x ISO 12100-x DIN EN ISO 12100-x	Safety of Machinery; General Design Guidelines; Part 1: Basic terminology, methodology Part 2: Technical Principles and Specifications
EN ISO 13849-x ISO 13849-x DIN EN ISO 13849-x	Safety of machinery; safety-related parts of control systems; Part 1: General basic design principles Part 2: Validation
EN ISO 14121-1 ISO 14121-1 DIN EN ISO 14121-1	Safety of Machinery - Risk Assessment; Part 1: Guidelines
EN 55011 CISPR 11 DIN EN 55011 VDE 0875-11	Industrial, scientific and medical high-frequency devices (ISM devices) - radio interference - limit values and measuring techniques
EN 60146-1-1 IEC 60146-1-1 DIN EN 60146-1-1 VDE 0558-11	Semiconductor converters; general requirements and line-commutated converters; Part 1-1: Defining the basic requirements
EN 60204-1 IEC 60204-1 DIN EN 60204-1 VDE 0113-1	Electrical equipment of machines; Part 1: General definitions
EN 60228 IEC 60228 DIN EN 60228 VDE0295	Conductors for cables and insulated leads
EN 60269-1 IEC 60269-1 DIN EN 60269-1 VDE 0636-1	Low-voltage fuses; Part 1: General requirements
IEC 60287-1 to -3	Cables - Calculation of the current carrying capacity Part 1: Current carrying capacity equations (100 % load factor) and calculating the losses Part 2: Thermal resistance - Part 3: Main sections for operating conditions

Standards*	Title
HD 60364-x-x IEC 60364-x-x DIN VDE 0100-x-x VDE 0100-x-x	Erection of power installations with nominal voltages up to 1000 V; Part 200: Definitions Part 410: Protection for safety, protection against electric shock Part 420: Protection for safety, protection against thermal effects Part 430: Protection of cables and conductors for over-current Part 450: Protection for safety, protection against undervoltage Part 470: Protection for safety; use of protection for safety Part 5xx: Selecting and erecting electrical equipment Part 520: Wiring systems Part 540: Earthing, protective conductor, potential bonding conductor Part 560: Electrical equipment for safety purposes
EN 60439 IEC 60439 DIN EN 60439 VDE 0660-500	Low-voltage switchgear assemblies; Part 1: Type-tested and partially type-tested assemblies
EN 60529 IEC 60529 DIN EN 60529 VDE 0470-1	Degrees of protection provided by enclosures (IP code)
EN 60721-3-x IEC 60721-3-x DIN EN 60721-3-x	Classification of environmental conditions Part 3-0: Classification of environmental parameters and their severities; Introduction Part 3-1: Classification of environmental parameters and their severities; Long-term storage Part 3-2: Classification of environmental parameters and their severities; Transport Part 3-3: Classification of environmental parameters and their severities; stationary use, weather protected
EN 60947-x-x IEC 60947 -x-x DIN EN 60947-x-x VDE 0660-x	Low-voltage switchgear
EN 61000-6-x IEC 61000-6-x DIN EN 61000-6-x VDE 0839-6-x	Electromagnetic compatibility (EMC) Part 6-1: Generic standard; Immunity for residential, commercial and light-industrial environments Part 6-2: Generic standards; Immunity for industrial environments Part 6-3: Generic standards; Generic standard emission for residential, commercial and light-industrial environments Part 6-4: Generic standards; Generic standard noise emission for industrial environments
EN 61140 IEC 61140 DIN EN 61140 VDE 0140-1	Protection against electric shock; Common aspects for installation and equipment
EN 61800-2 IEC 61800-2 DIN EN 61800-2 VDE 0160-102	Adjustable-speed electrical power drive systems; Part 2: General requirements - Rating specifications for low-voltage adjustable frequency a.c. power drive systems
EN 61800-3 IEC 61800-3 DIN EN 61800-3 VDE 0160-103	Adjustable-speed electrical power drive systems; Part 3: EMC - Requirements and specific test methods
EN 61800-5-x IEC 61800-5-x DIN EN 61800-5-x VDE 0160-105-x	Adjustable-speed electrical power drive systems; Part 5: Safety requirements; Main section 1: Electrical, thermal and energy requirements Main section 2: Functional safety requirements

Standards*	Title
EN 62061 IEC 62061 DIN EN 62061 VDE 0113-50	Safety of machinery; Functional safety of safety-related electrical, electronic and programmable electronic control systems
UL 50 CSA C22.2 No. 94.1	Enclosures for Electrical Equipment
UL 508 CSA C22.2 No. 142	Industrial Control Equipment Process Control Equipment
UL 508C CSA C22.2 No. 14	Power Conversion Equipment Industrial Control Equipment

* The technical requirements in the standards listed are not necessarily identical.

Line Connection Booksize 2

2.1 Introduction

The line connection for a SINAMICS booksize drive line-up comprises an optional line filter and a line reactor:

- 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 reactor for Basic Line Modules

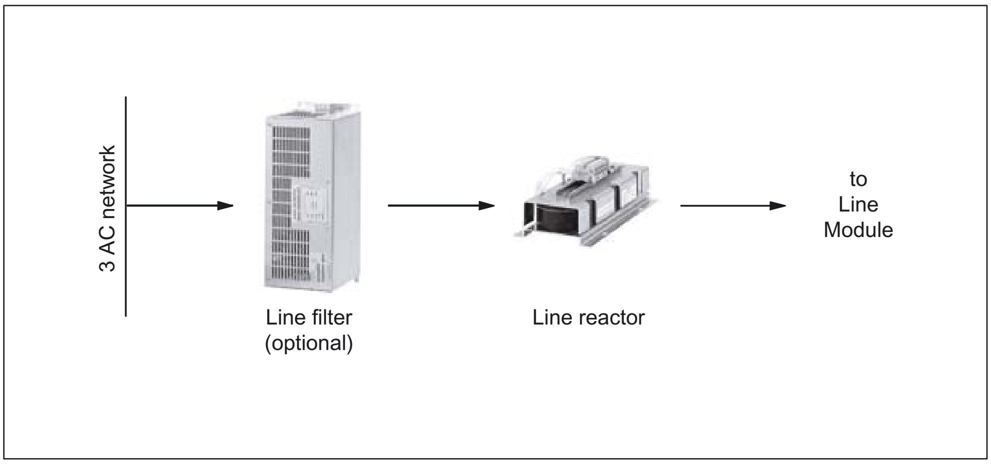


Figure 2-1 Overview: Line connection

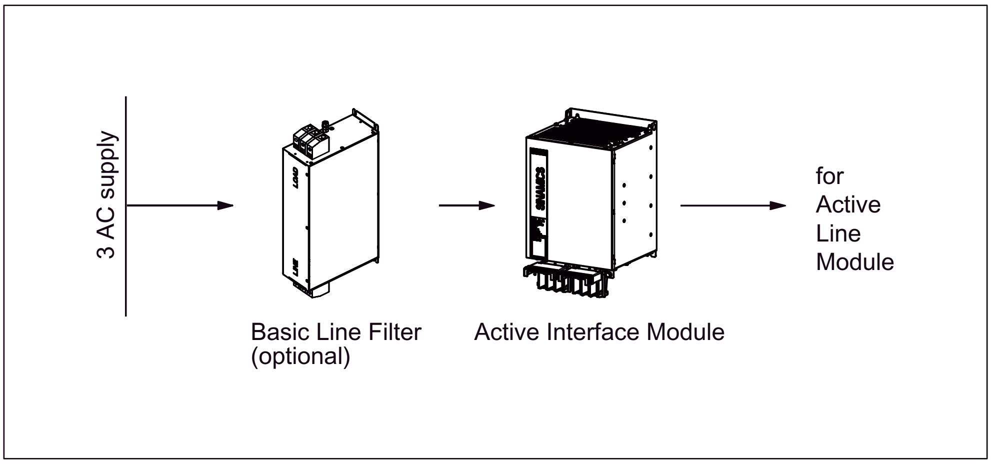


Figure 2-2 Overview: line connection with Active Interface Module

CAUTION
Using line filters not approved by SIEMENS for SINAMICS can lead to damage/interference to the Line Modules and line-side harmonics that can interfere with or damage other loads operated by the network.

2.2 Overview: 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 (see catalog) must be used for the SINAMICS S120 drive line-up.

NOTICE
An additional line filter must be used to suppress interference in other loads. To prevent mutual interference, this line filter must not be equipped with line-side capacitors with respect to ground. Filter series B84144A*R120 (EPCOS) is recommended.

Note

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. The machine manufacturer must provide verification that the machinery to be operated with the drive products and the installed suppression elements, e.g. line filters, are CE/EMC-compliant before the machines are approved for delivery.

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.

Basic Line Filter for Active Line Modules with line reactor

Basic Line Filters 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. They are designed for use with systems and equipment with a maximum total cable length of 150 m (shielded) of category C2 to EN 61800-3. See section "Basic Line Filter for Active Line Modules with line reactor" and section "Possible line reactor and line filter combinations".

Basic Line Filter for Active Line Modules with Active Interface Module

Basic Line Filters 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. In conjunction with an Active Interface Module these filters can be used for upgrading to category C2 according to EN 61800-3 for a maximum cable length of 350 m (shielded) or alternatively in order to extend the total cable length in the drive line-up while retaining category C3 to EN61800-3. Fore more information see section "Basic Line Filter for Active Line Modules with Active Interface Module" and section "Possible line reactor and line filter combinations".

Wideband Line Filter for Active Line Modules

Wideband Line Filters 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. These filters can also effectively limit low-frequency line harmonics from 2 kHz and above; this protects additional loads connected to the same line supply against disturbances and damage. The maximum total cable length is 350 m (shielded) of category C2 to EN 61800-3. See section "Wideband Line Filter for Active Line Modules" and section "Possible line reactor and line filter combinations".

Basic Line Filter for Basic Line Modules

Basic Line Filters 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. They are designed for use with systems and equipment with a maximum total cable length of 350 m (shielded) of category C2 to EN 61800-3. See section "Basic Line Filter for Basic Line Modules" and section "Possible line reactor and line filter combinations".

Basic Line Filter for Smart Line Modules

Basic Line Filters for Smart Line Modules are specified for total cable lengths of up to 350 m (shielded) of category C2 to EN 61800-3. See section "Basic Line Filter for Smart Line Modules" and section "Possible line reactor and line filter combinations".

Table 2- 1 Overview

	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

2.3 Combining line reactors and line filters

Selected combinations								Properties that can be reached					Available for									
								DC link step-up factor or rectified value B6	Radio interference suppression according to		Integrated Clock frequency filter 8 kHz	Operated on IT line supplies										
Active Line Module	Smart Line Module	Basic Line Module	Basic Line Filter	Wideband Line Filter	HFD line reactor	FE line reactor	Active Interface Module		EN 61800-3-C2 summing cable Shielded	EN 61800-3-C3 summing cable Shielded			5 kW	10 kW	16 kW	20 kW	36 kW	40 kW	55 kW	80 kW	100 kW	120 kW
X					X			1,4 - 1,6	no 3)	no 3)	No	Yes			X		X		X	X		X
X			X		X			1,4 - 1,6	150 m	150 m	No	No			X		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				X	1,4 - 2 2)	350 m	630 m	Yes	No			X		X					
X			X				X	1,4 - 2 2)	350 m	1000 m	Yes	No							X	X		X
	X					X		1,35	no 3)	no 3)	Not relevant	Yes	X	X	X		X					
	X		X			X		1,35	350 m	350 m	Not relevant	No	X	X	X		X					
		X				X		1,35	no 3)	350 m	Not relevant	yes 1)									X	
		X	X			X		1,35	350 m	630 m	Not relevant	No				X		X			X	

Figure 2-3 Combining line reactors and line filters

1) Remove the connection bridge
2) The insulation strength of the motors has to be taken into account
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.

2.4 Basic Line Filter for Active Line Modules with line reactor

2.4.1 Description

The Basic Line Filters for Active Line Modules are designed for limiting the cable-borne interference in accordance with the specifications of the EMC legislation.
The machine manufacturer must certify the machines that he plans to launch on the market in accordance with the EU EMC Directive.

General conditions regarding Basic Line Filters and line reactors for Active Line Modules

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 networks.
- No. of axes ≤12.
- Total cable lengths ≤150 m (motor cables, power supply cable between line filter and Line Module).

The Basic Line Filters are only suitable for connection to TN systems; otherwise an isolating transformer will be required.

Note

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

2.4.2 Safety information

⚠ WARNING

The 100 mm clearances for circulating air above and below the filter must be observed. This prevents thermal overloading of the filter.

⚠ WARNING

The input and output connections/terminals must not be interchanged:

Incoming line cable to LINE L1, L2, L3 and

Outgoing cable to line reactor at LOAD L1´, L2´, L3´

The line filter may be damaged if this is not observed.

CAUTION

The Line Module must only be connected to the SINAMICS line filter via the associated line reactor. Additional loads must be connected upstream of the SINAMICS line filter (if required, via a separate line filter). If this is not observed, other loads could be damaged or destroyed.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection on the cabinet or machine must be implemented in accordance with one of the following measures:

- stationary connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- stationary connection and automatic shutdown of the power supply if the protective conductor is interrupted

DANGER

Risk of electric shock. Dangerous voltages are still present for up to 5 minutes after the power supply has been switched off.

Note

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.

CAUTION

Only the line filters described in this Manual must be used. Other line filters can cause line harmonics that can interfere with or damage other loads powered from the line supply.

2.4.3 Interface description

2.4.3.1 Overview

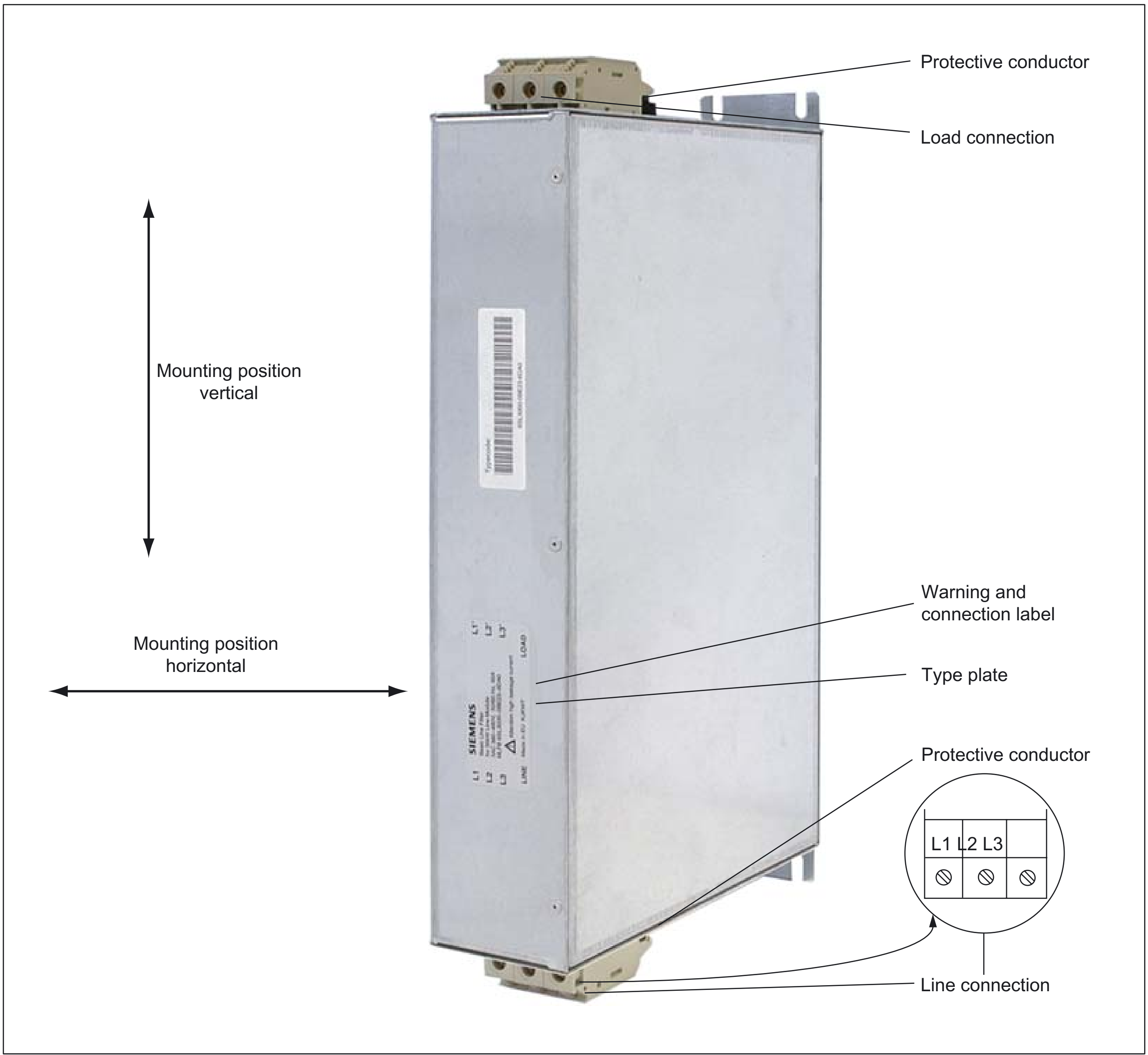


Figure 2-4 Basic Line Filter for Active Line Modules (example: 36 kW)

⚠ WARNING
The line/load connection must not be interchanged.

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.

2.4.3.2 Line/load connection

Table 2- 2 Type of connection

Terminals	Designations
Line supply connection (line supply)	L1, L2, L3, PE
Load connection (load)	L1´, L2´, L3´, PE
Basic Line Filter for Active Line Modules	
16 kW	Screw terminal: 10 mm^2 3-pin/1.5 -1.8 Nm (see chapter Screw terminals) PE connection: M6/6 Nm [1)]
36 kW	Screw terminal: 35 mm^2 PE connection: M6/6 Nm [1)]
55 kW	Screw terminal: 50 mm^2/6 - 8 Nm PE connection: M6/6 Nm [1)]

1) For ring cable lugs in accordance with DIN 46234

2.4.4 Dimension drawings

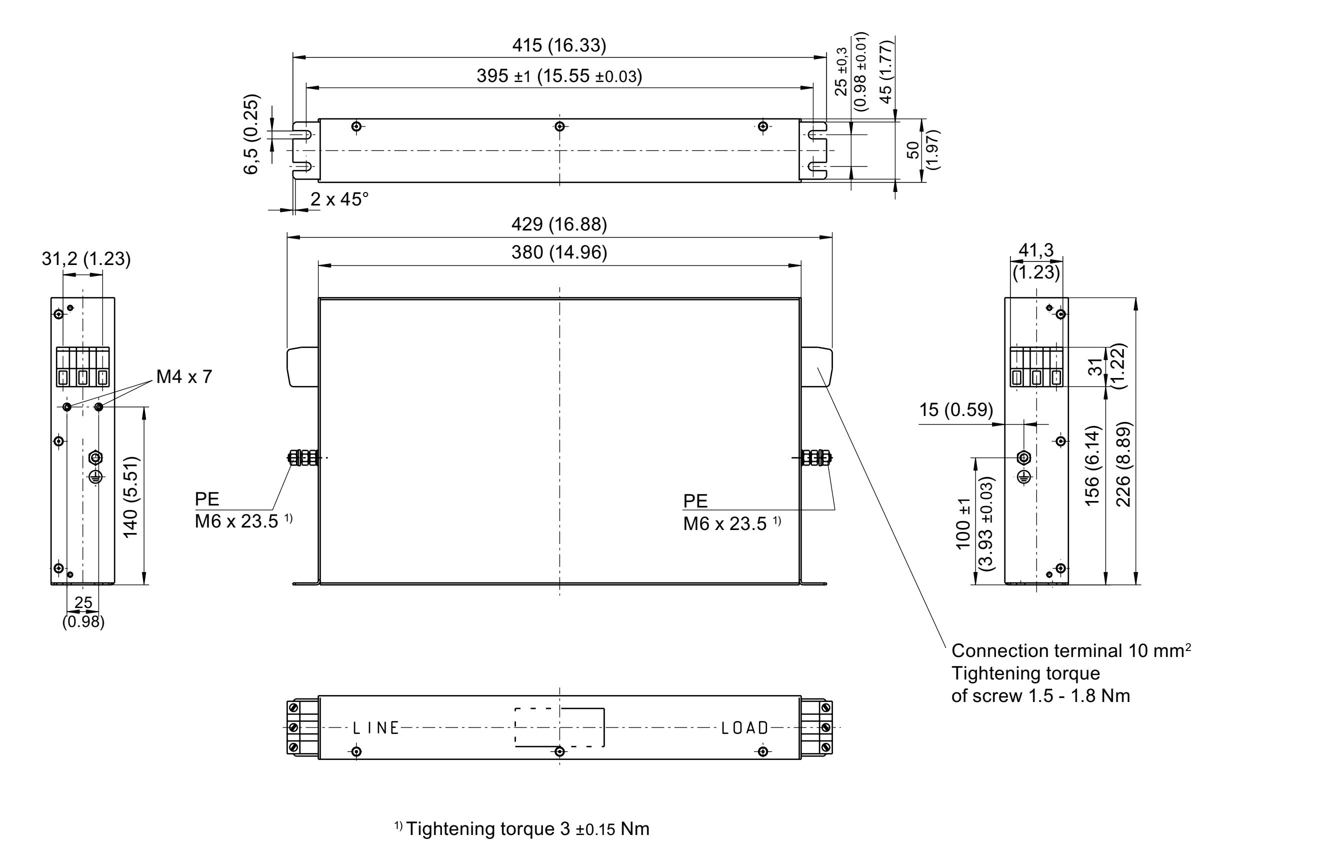


Figure 2-5 Dimension drawing of Basic Line Filter 16 kW, order number 6SL3000-0BE21-6DAx, all dimensions in mm and (inches)

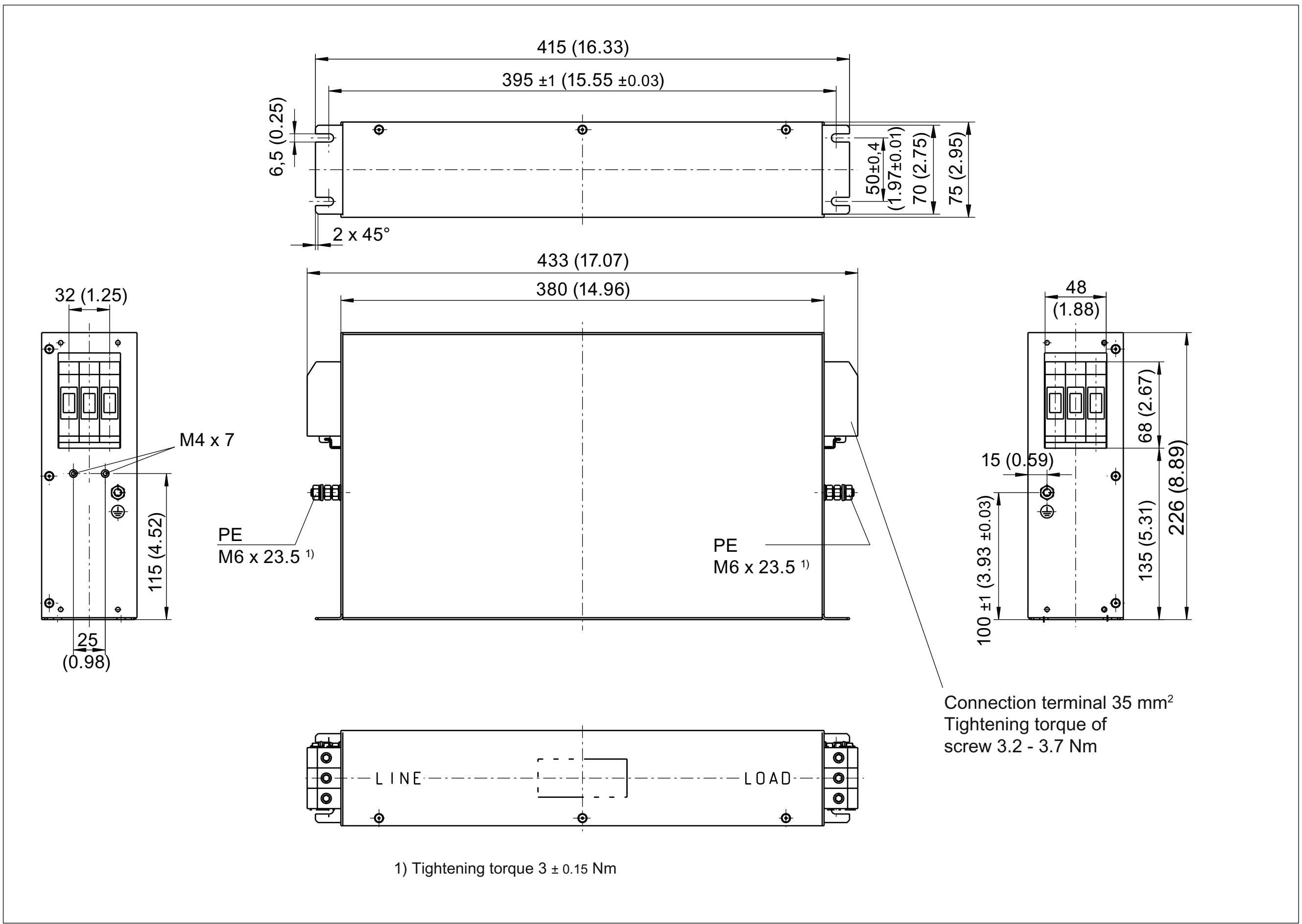


Figure 2-6 Dimension drawing of Basic Line Filter 36 kW, order number 6SL3000-0BE23-6DA1, all dimensions in mm and (inches)

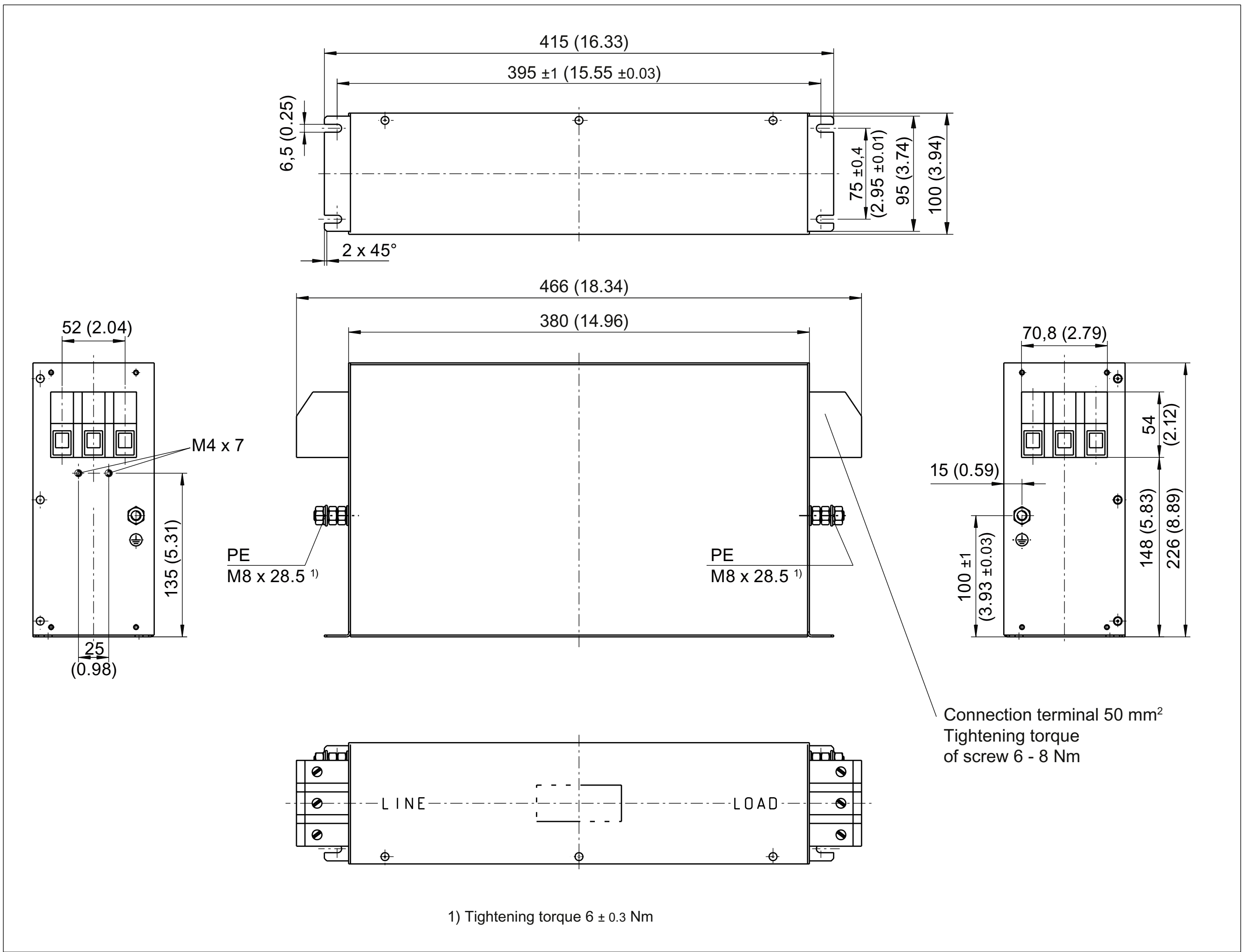


Figure 2-7 Dimension drawing of Basic Line Filter 55 kW, order number 6SL3000-0BE25-5DAx, all dimensions in mm and (inches)

2.4.5 Technical data

Table 2- 3 Technical data of Basic Line Filter for Active Line Modules with line reactor

	6SL3000 unit	0BE21-6DAx	0BE23-6DA1	0BE25-5DAx
Rated power	kW	16	36	55
Connection voltage: Supply voltage Line frequency	 V_{AC} Hz	 3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10% 47 to 63 Hz		
Rated current	A_{AC}	36	74	105
Power loss1)	W	16	26	43
Weight	kg	5	7.5	11.5

1) For an overview, see the power loss tables in chapter Control cabinet installation

2.5 Basic Line Filter for Active Line Modules with Active Interface Module

2.5.1 Description

Basic Line Filters 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 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 networks.
- Only connect the Basic Line Filters to TN systems; otherwise an isolating transformer will be required.

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

- EN 61800-3 category C2 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, 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.

2.5.2 Safety information

CAUTION
Line filters are only suitable for direct connection to TN line supplies.

WARNING
Basic line filters may only be used in combination with the components listed in Chapter "Combination options line reactors and line filters".

WARNING
The cooling clearances of 100 mm above and below the components must be observed. This prevents thermal overloading of the filter.

WARNING

The input and output connections/terminals must not be interchanged:

Incoming line cable to LINE L1, L2, L3 and

outgoing cable to line reactor at LOAD L1´, L2´, L3´

The line filter may be damaged if this is not observed.

NOTICE

The associated Line Module must only be connected to the SINAMICS line filter via the associated line reactor. Additional loads must be connected upstream of the SINAMICS line filter (if required, via a separate line filter). If this is not observed, other loads could be damaged or destroyed.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection on the cabinet or machine must be implemented in accordance with one of the following measures:

- stationary connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- stationary connection and automatic shutdown of the power supply if the protective conductor is interrupted

DANGER

Risk of electric shock. Dangerous voltages are still present for up to 5 minutes after the power supply has been switched off.

Note

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.

CAUTION

Only the line filters described in this Manual must be used. Other line filters can cause line harmonics that can interfere with or damage other loads powered from the line supply.

2.5.3 Interface description

2.5.3.1 Overview

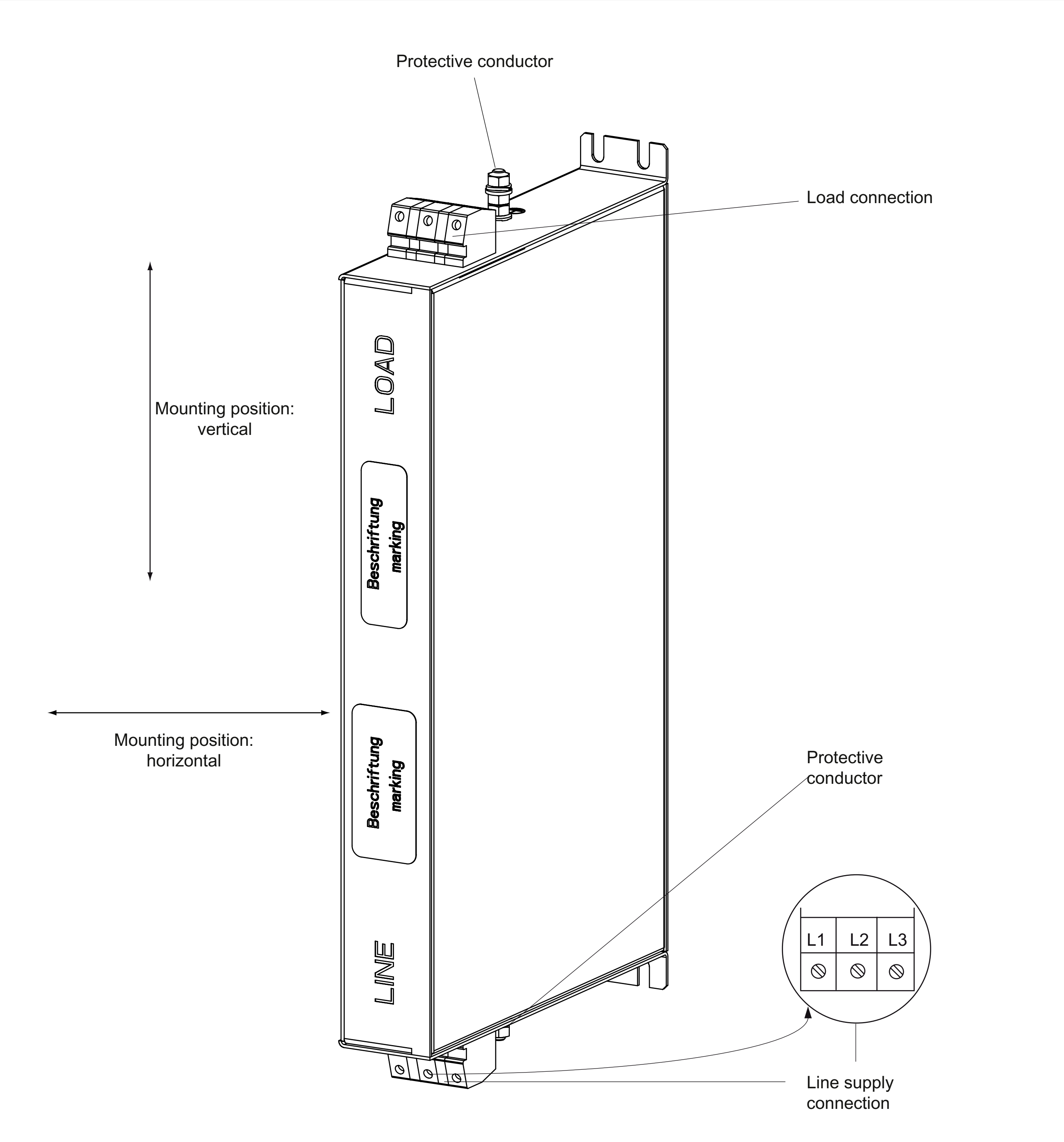


Figure 2-8 Basic Line Filter for Active Line Modules with Active Interface Module 16 kW

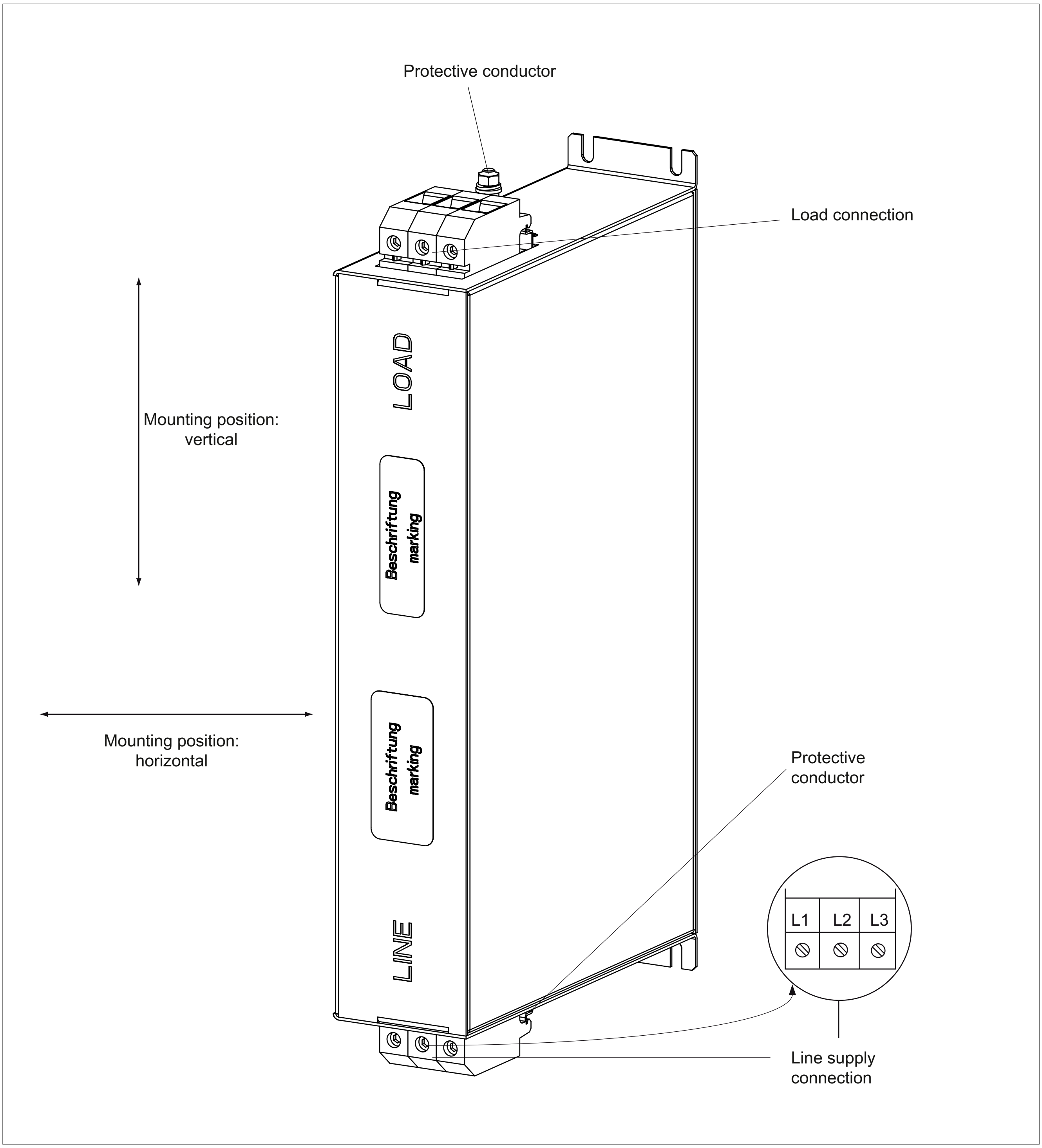


Figure 2-9 Basic Line Filter for Active Line Modules with Active Interface Module 36 kW

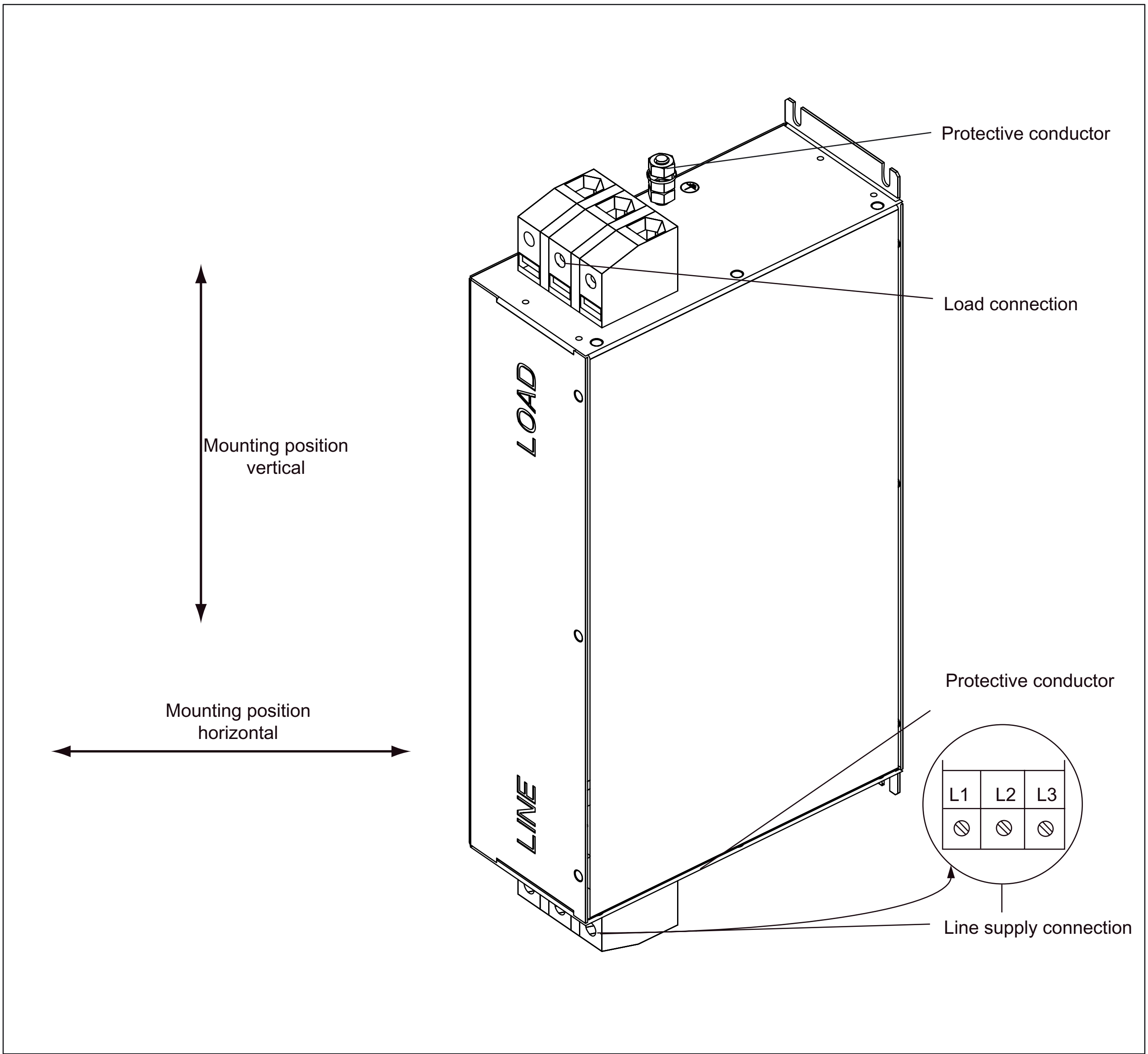


Figure 2-10 Basic Line Filter for Active Line Modules with Active Interface Module 55 kW

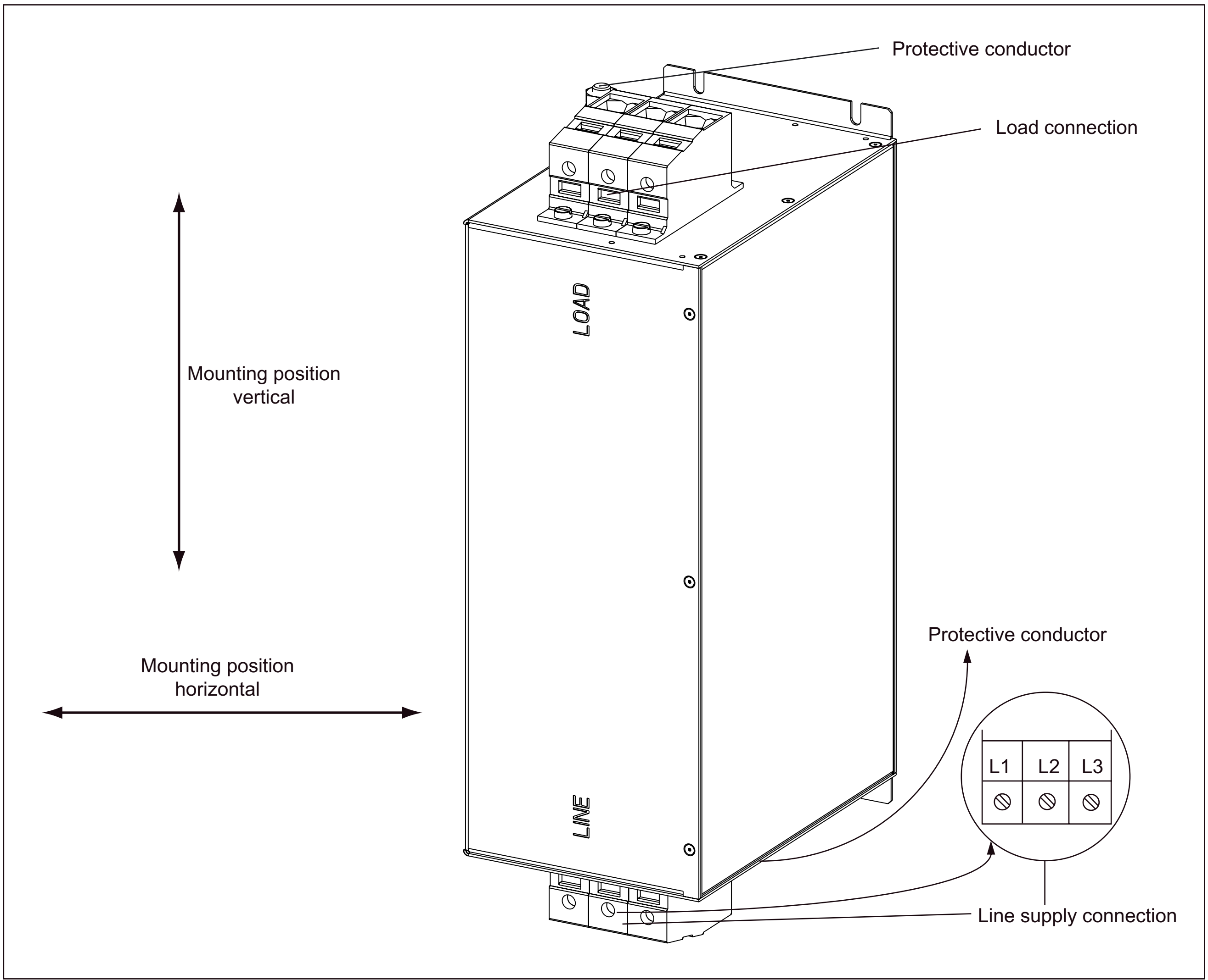


Figure 2-11 Basic Line Filter for Active Line Modules with Active Interface Module 80 kW and 120 kW

NOTICE
The line/load connection must not be interchanged.

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.

2.5.3.2 Line/load connection

Table 2- 4 Type of connection

<table>
<tr><th>Terminals</th><th>Designations</th></tr>
<tr><td>Line supply connection (line supply)</td><td>L1, L2, L3, PE</td></tr>
<tr><td>Load connection (load)</td><td>L1´, L2´, L3´, PE</td></tr>
<tr><td colspan="2">Basic Line Filter for Active Line Module with Active Interface Module</td></tr>
<tr><td>16 kW</td><td>Screw terminal: 10 mm^2 3-pin / 1.5 - 1.8 Nm (see chapter Screw terminals)
PE connection: M6 / 6 Nm [1)]</td></tr>
<tr><td>36 kW</td><td>Screw terminal: 35 mm^2
PE connection: M6 / 6 Nm [1)]</td></tr>
<tr><td>55 kW</td><td>Screw terminal: 50 mm^2
PE connection: M8 / 8 Nm [1)]</td></tr>
<tr><td>80 kW</td><td rowspan="2">Screw terminal: 95 mm^2
PE connection: M10 / 10 Nm [1)]</td></tr>
<tr><td>120 kW</td></tr>
</table>

1) For ring cable lugs in accordance with DIN 46234

2.5.4 Dimension drawings

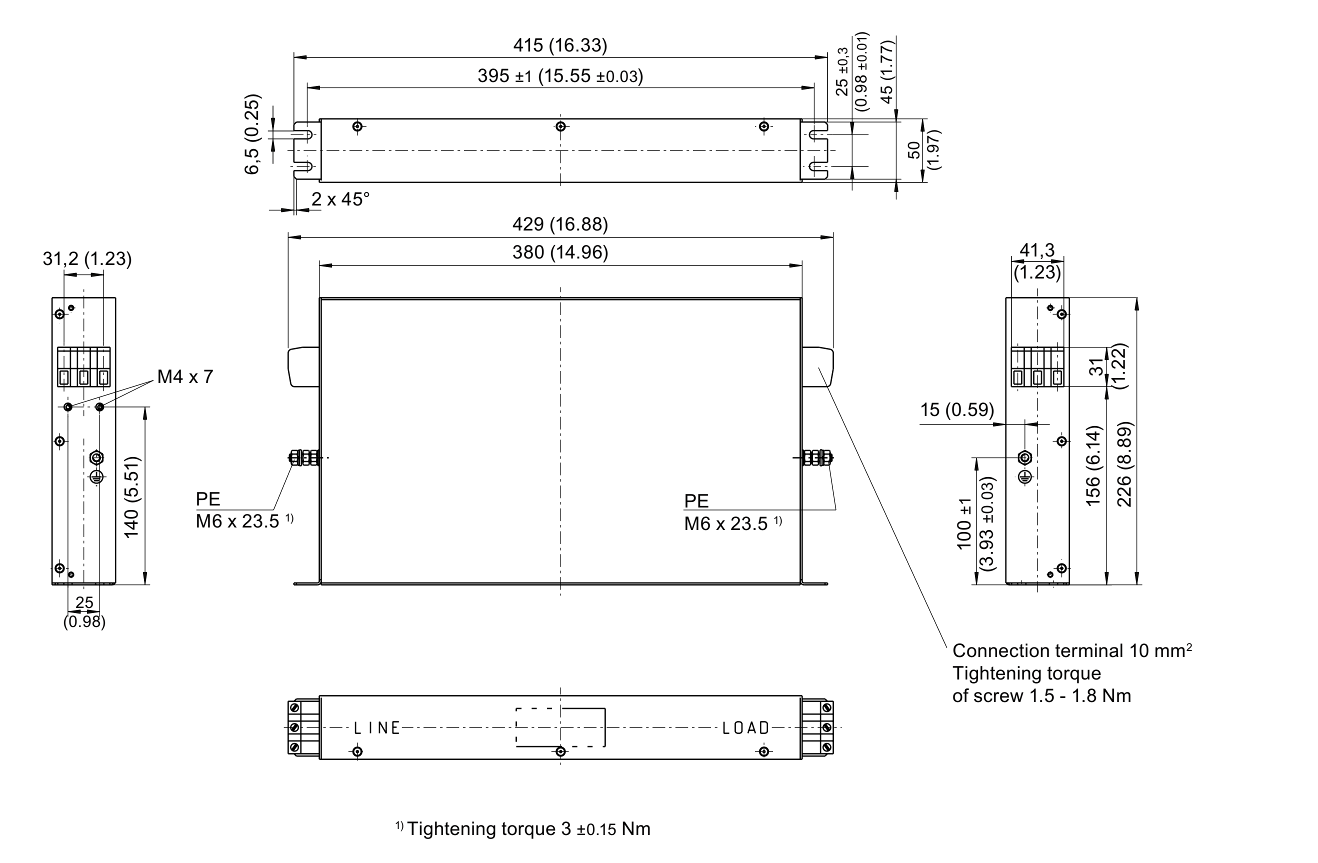


Figure 2-12 Dimension drawing of Basic Line Filter 16 kW, order number 6SL3000-0BE21-6DAx, all dimensions in mm and (inches)

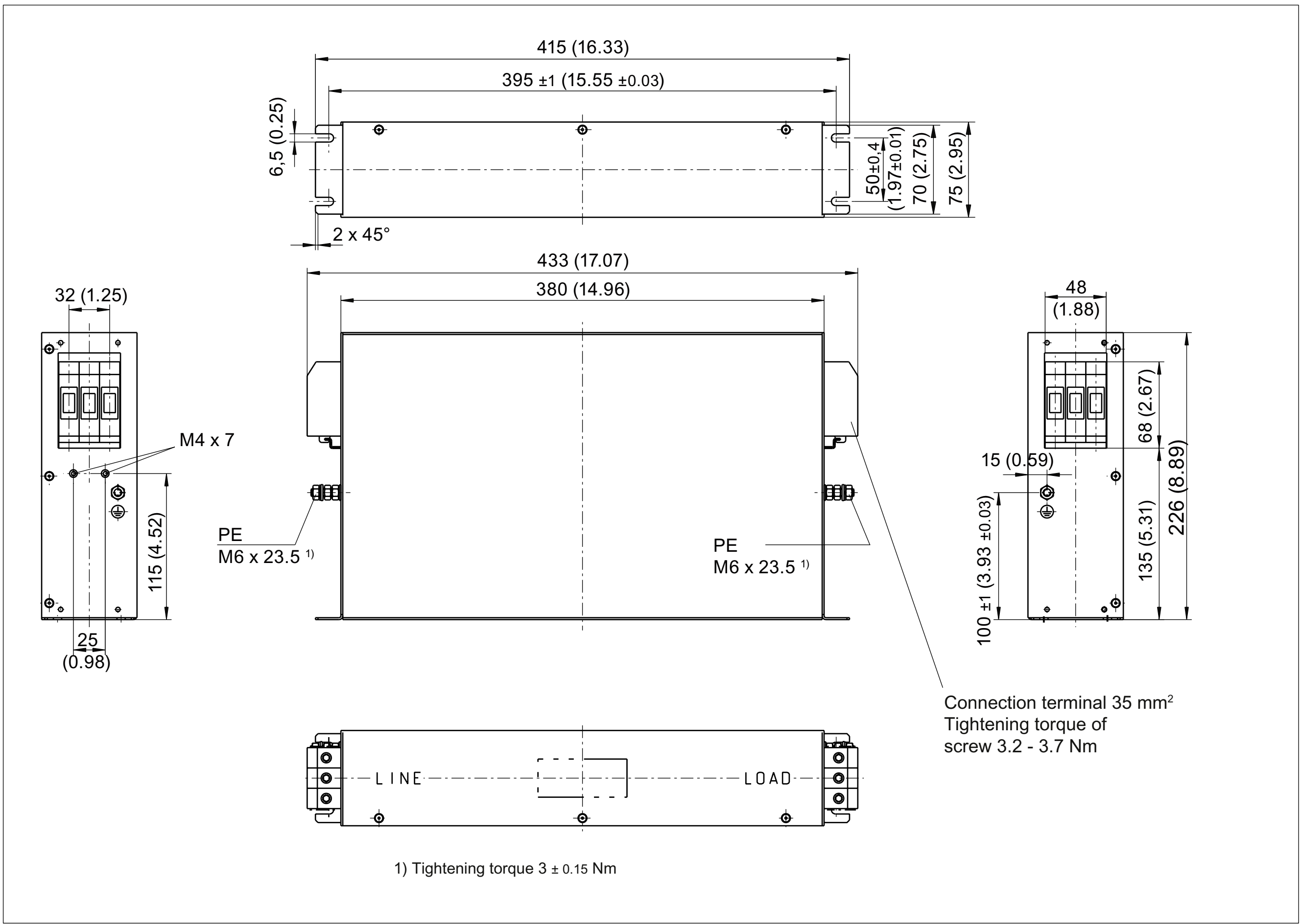


Figure 2-13 Dimension drawing of Basic Line Filter 36 kW, order number 6SL3000-0BE23-6DA1, all dimensions in mm and (inches)

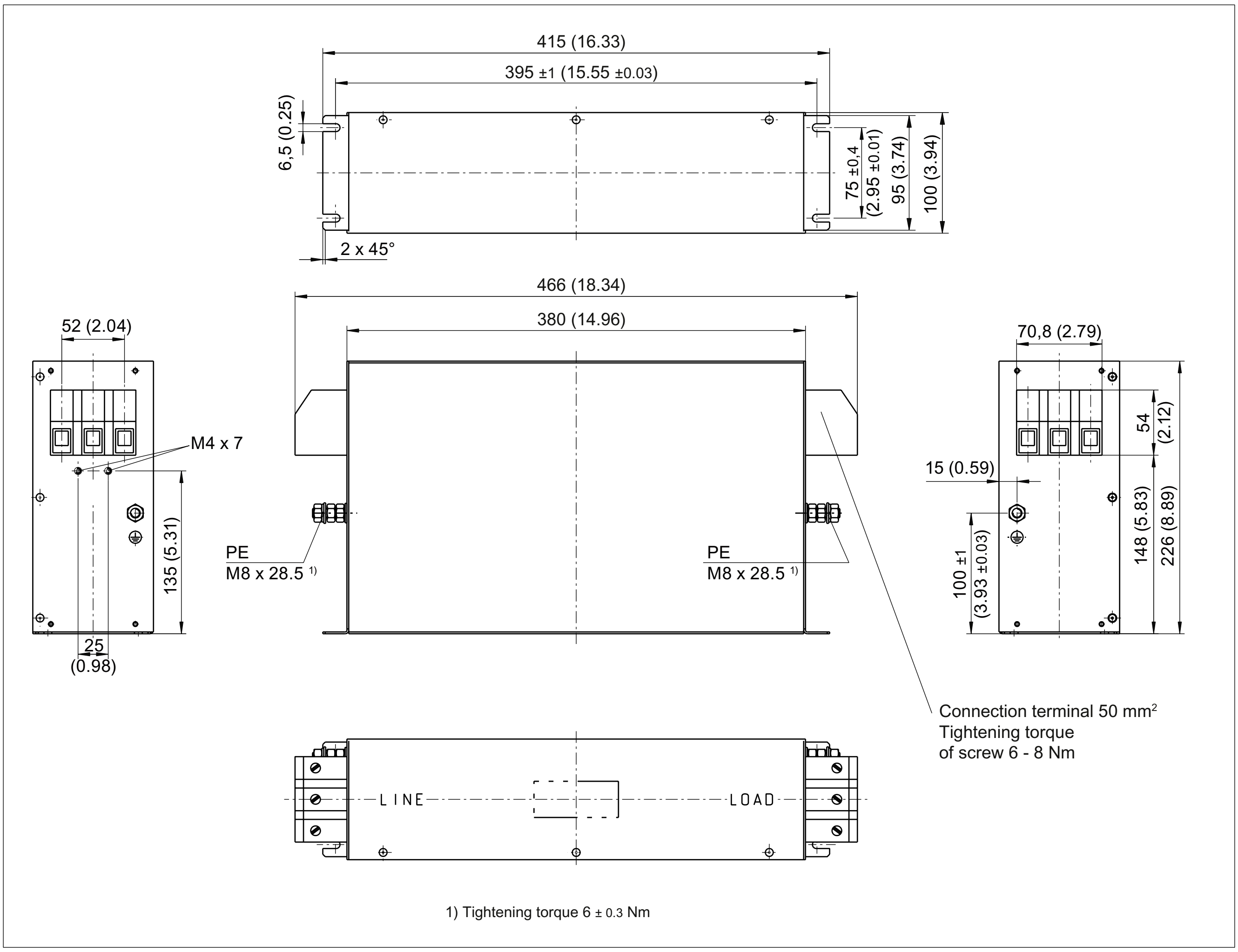


Figure 2-14 Dimension drawing of Basic Line Filter 55 kW, order number 6SL3000-0BE25-5DAx, all dimensions in mm and (inches)

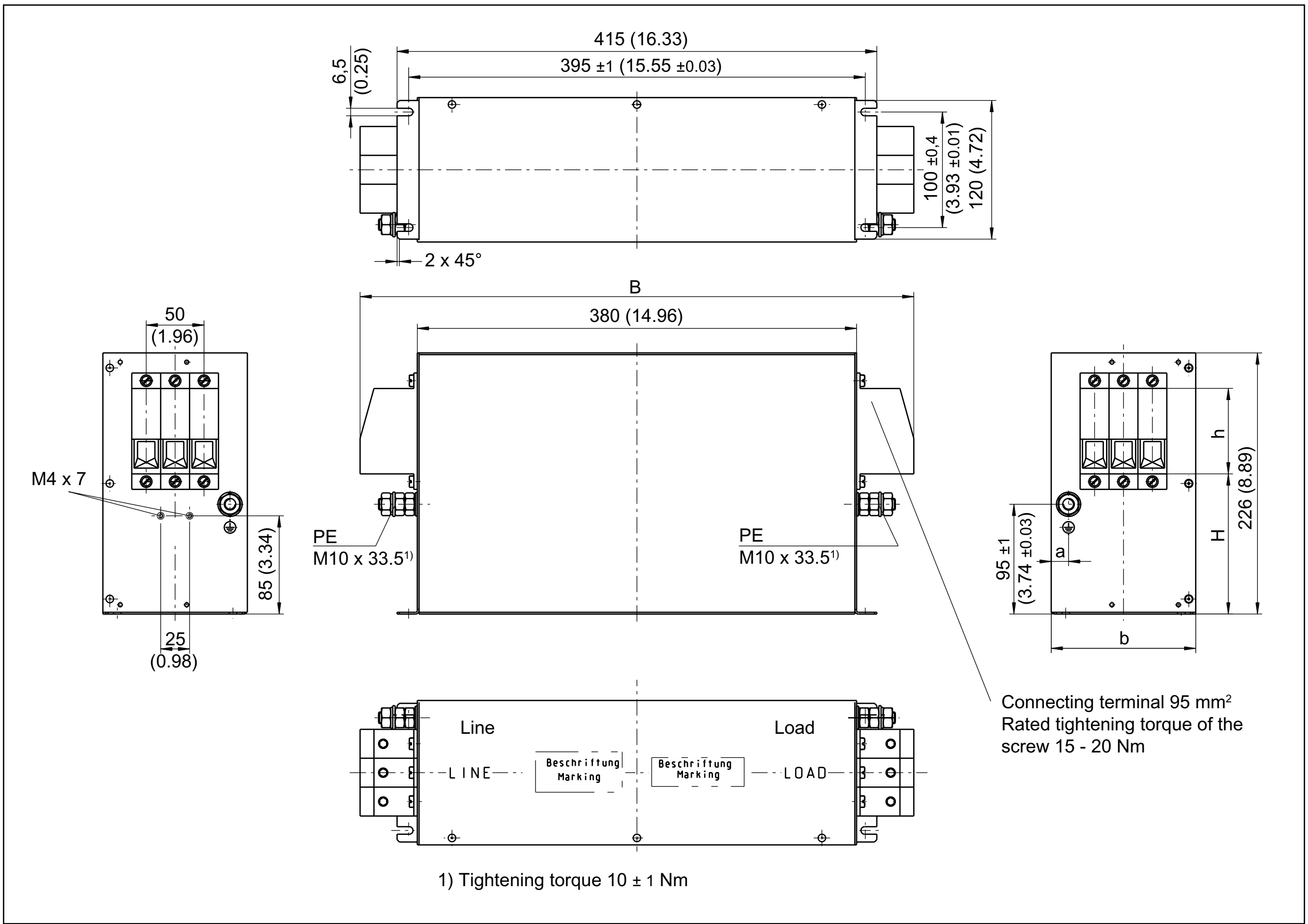


Figure 2-15 Dimension drawing of Basic Line Filter 80 kW and 120 kW, all dimensions in mm and (inches)

Table 2- 5 Dimensions: Basic Line Filter for Active Line Modules

Basic Line Filter	Order number	W [mm] (inches)	w [mm] (inches)	a [mm] (inches)	H [mm] (inches)	h [mm] (inches)
80 kW	6SL3000-0BE28-0DAx	479 (18.85)	150 (5.90)	15 (0.59)	121.3 (4.77)	74 (2.91)
120 kW	6SL3000-0BE31-2DAx					

2.5.5 Technical data

Table 2- 6 Technical data of the Basic Line Filter for Active Line Modules with Active Interface Module

	6SL3000- Unit	0BE21-6DA0	0BE23-6DA1	0BE25-5DA0	0BE28-0DAx	0BE31-2DAx
Rated power	kW	16	36	55	80	120
Connection voltage: Supply voltage Line frequency	 V_{AC} Hz	 3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10% 47 to 63 Hz				
Rated current	A_{AC}	36	74	105	132	192
Power loss 1)	W	16	26	43	56	73
Weight	kg	5	7.5	11.5	17.5	18.5

1) For an overview, see the power loss tables in chapter Control cabinet installation

2.6 Wideband Line Filter for Active Line Modules

2.6.1 Description

The damping characteristics of Wideband Line Filters for Active Line Modules not only conform with the requirements of EMC standards for the frequency range of 150 kHz to 30 MHz but also include low frequencies as of 2 kHz. As a result, these line filters have an extended function area, which means that they can, to a certain extent, be used regardless of the machine installation location and any unknown line properties (e.g. line impedance).

Wideband Line Filters must always be used in conjunction with line reactors for Active Line Modules (not with Active Interface Modules).

The maximum total cable length (motor cables, mains supply conductor line filter to Line Module) is 350 m (shielded) of category C2 to EN 61800-3.

2.6.2 Safety information

CAUTION

Line filters are only suitable for direct connection to TN line supplies.

WARNING

The cooling clearances of 100 mm above and below the components must be observed. The mounting position must ensure that cool air flows vertically through the filter. This prevents thermal overloading of the filter.

WARNING

The input and output connections/terminals must not be interchanged:

- incoming line supply cable to LINE L1, L2, L3
- outgoing cable to the line reactor to LOAD U, V, W

The line filter may be damaged if this is not observed.

NOTICE

The associated Line Module must only be connected to the SINAMICS line filter via the associated line reactor. Additional loads must be connected upstream of the SINAMICS line filter (if required, via a separate line filter). If this is not observed, other loads could be damaged or destroyed.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been switched off.

Note

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.

CAUTION

Only the line filters described in this Equipment Manual must be used. Other line filters can lead to line harmonics that can interfere with or damage other loads powered from the line supply.

2.6.3 Interface description

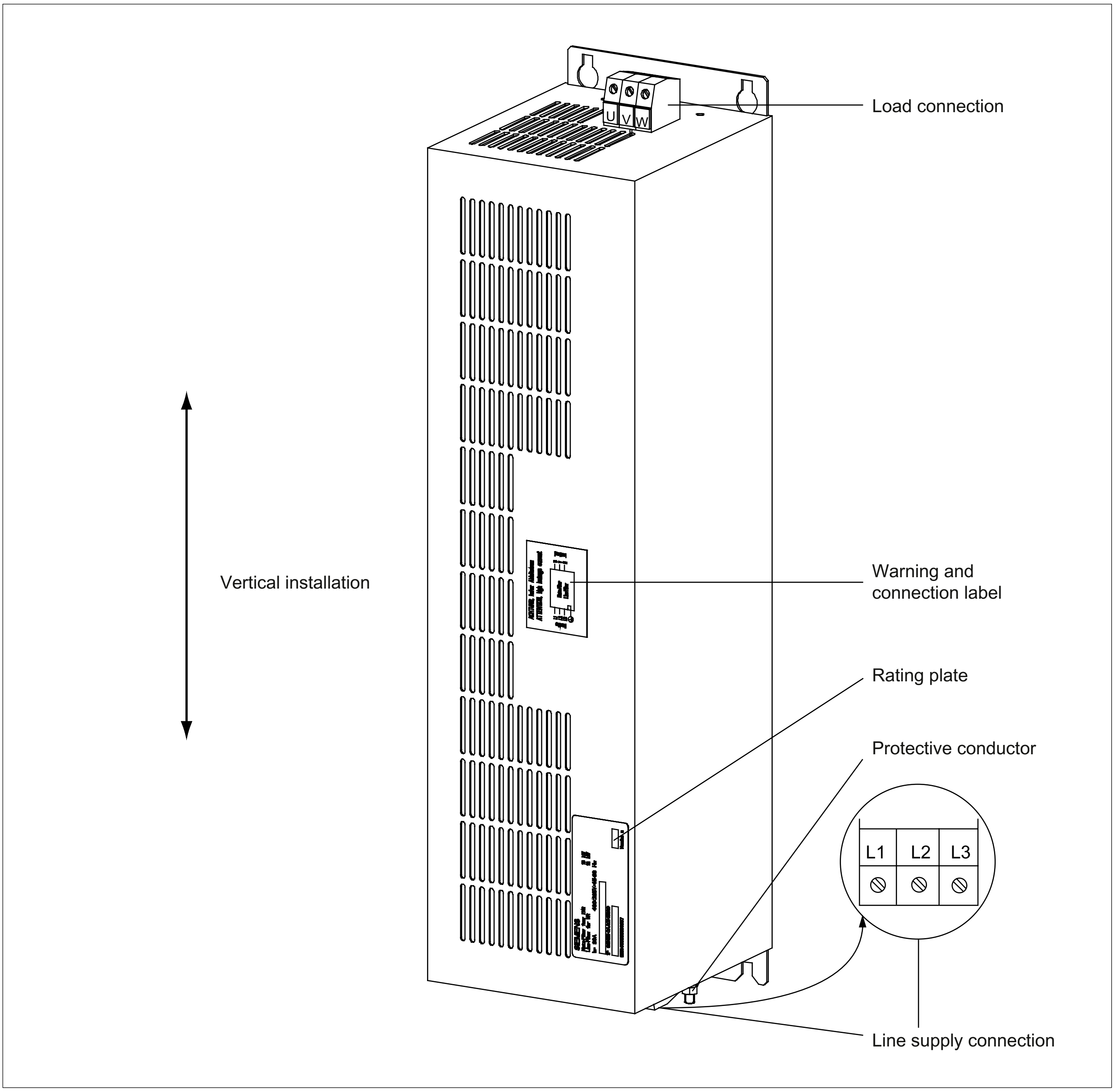


Figure 2-16 Wideband Line Filter for Active Line Module (example: 16 kW)

NOTICE
The line/load connection must not be interchanged. The component must only be operated when installed in a vertical position with the line terminals "at the bottom".

2.6.3.1 Line/load connection

Table 2- 7 Type of connection

Terminals	Designations
Line supply connection (line supply)	L1, L2, L3, PE
Load connection (load)	U, V, W
Wideband Line Filter for Active Line Modules	
16 kW	Screw terminal: 10 mm² 3-pin/1.5 -1.8 Nm (see chapter Screw terminals) Grounding stud: M5/3 Nm 1)
36 and 55 kW	Screw terminal: 50 mm² 3–pin / 6 - 8 Nm Grounding stud: M8/13 Nm 1)
80 kW	Screw terminal: 95 mm² 3–pin / 15 - 20 Nm Grounding stud: M8/13 Nm 1)
120 kW	Connection strap: d = 11 mm (M10/25 Nm) Grounding stud: M8/13 Nm 1) Note: No shock-hazard protection (IP00B acc. to 60529)

1) For ring cable lugs in accordance with DIN 46234

2.6.4 Dimension drawings

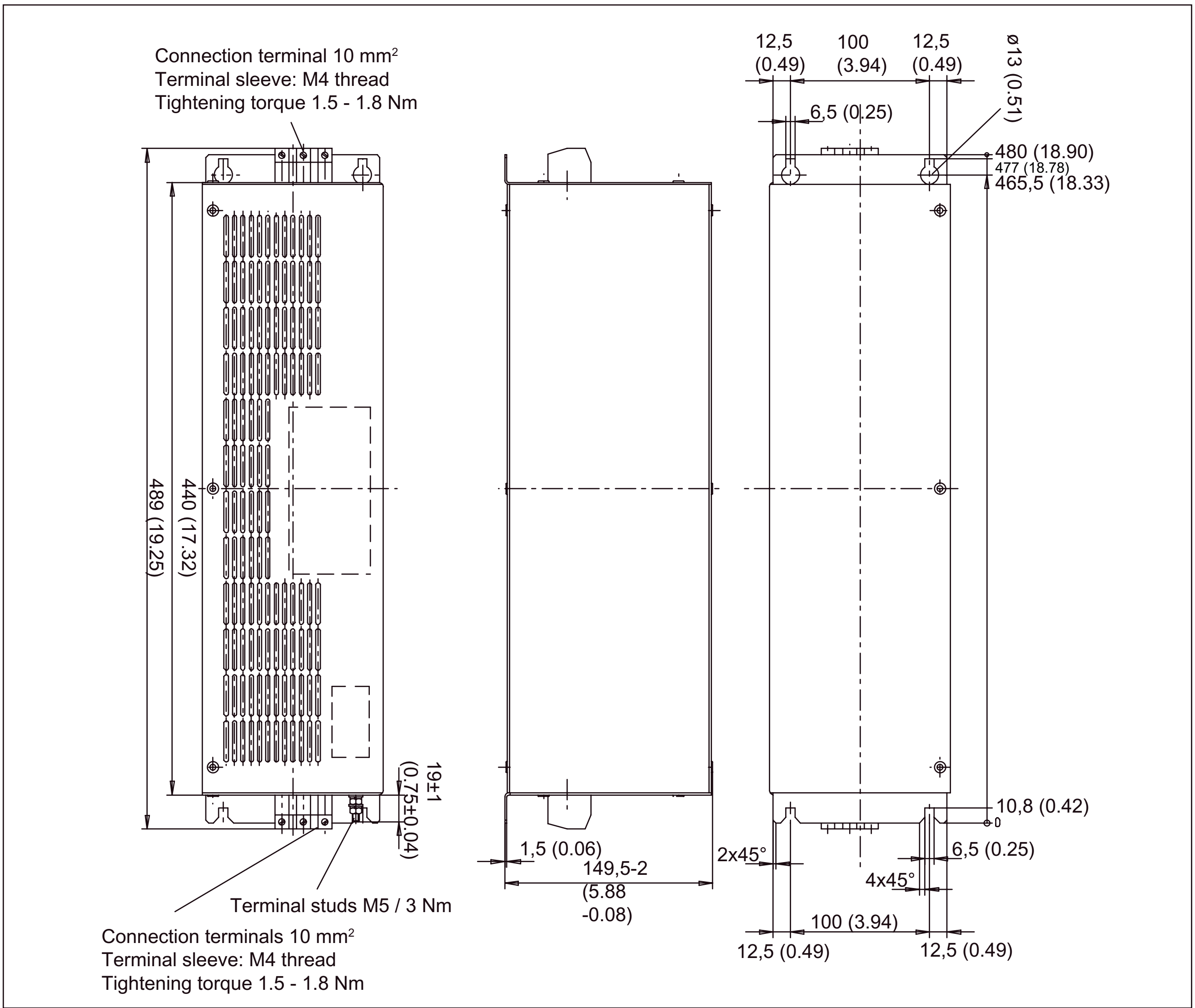


Figure 2-17 Dimension drawing of Wideband Line Filter 16 kW for Active Lines Modules, all dimensions in mm and (inches)

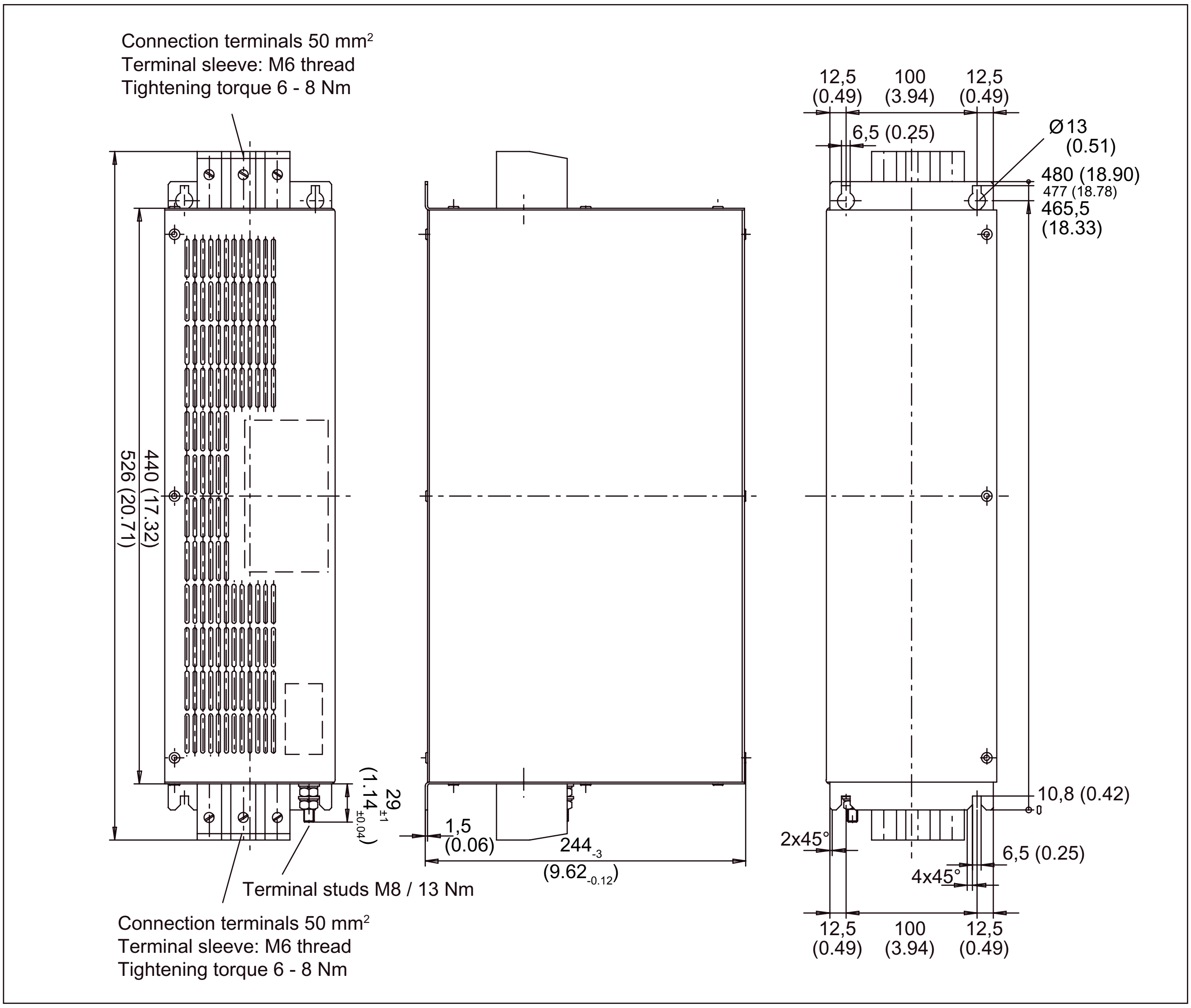


Figure 2-18 Dimension drawing of Wideband Line Filter 36 kW for Active Lines Modules, all dimensions in mm and (inches)

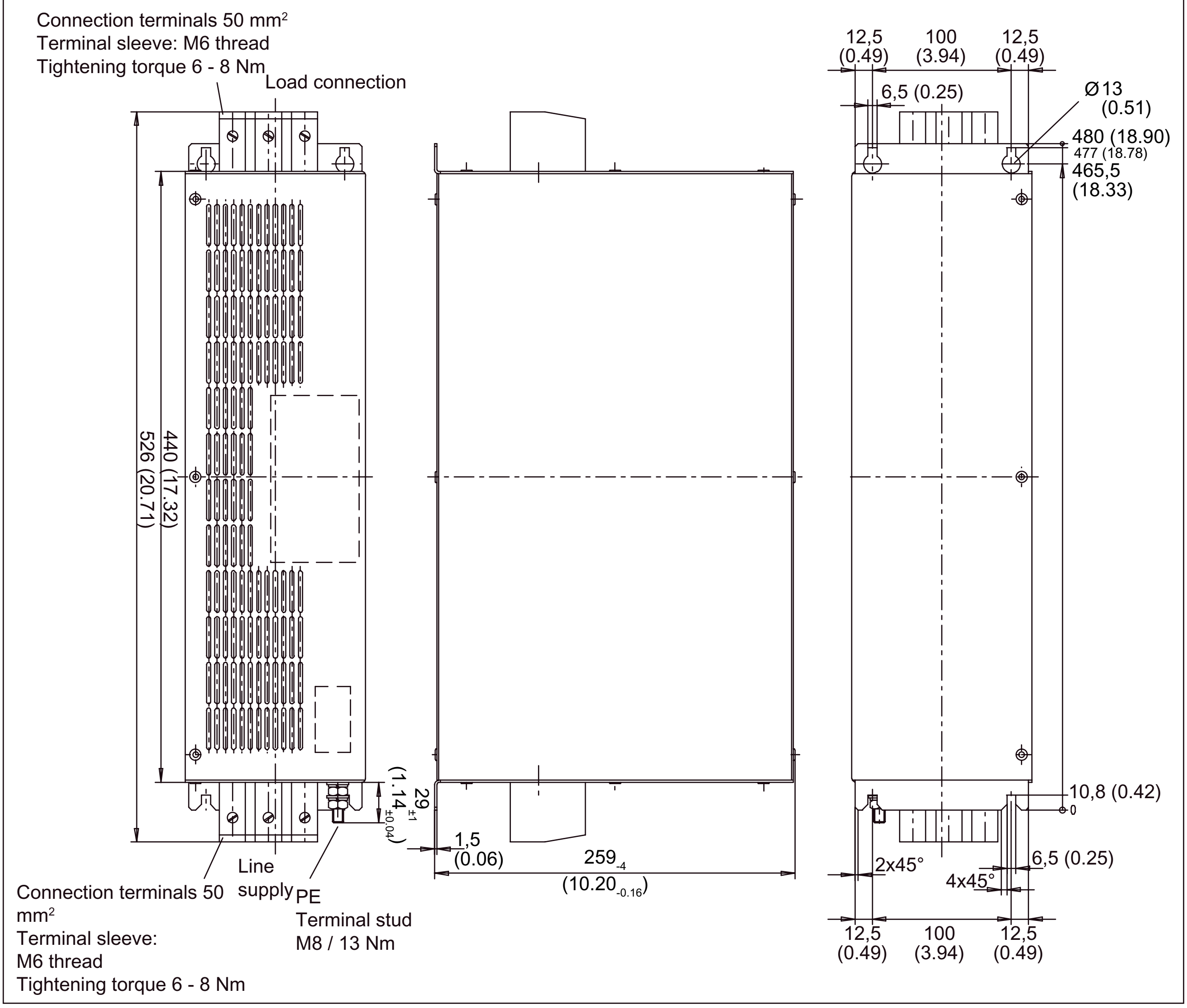


Figure 2-19 Dimension drawing of Wideband Line Filter 55 kW for Active Lines Modules, all dimensions in mm and (inches)

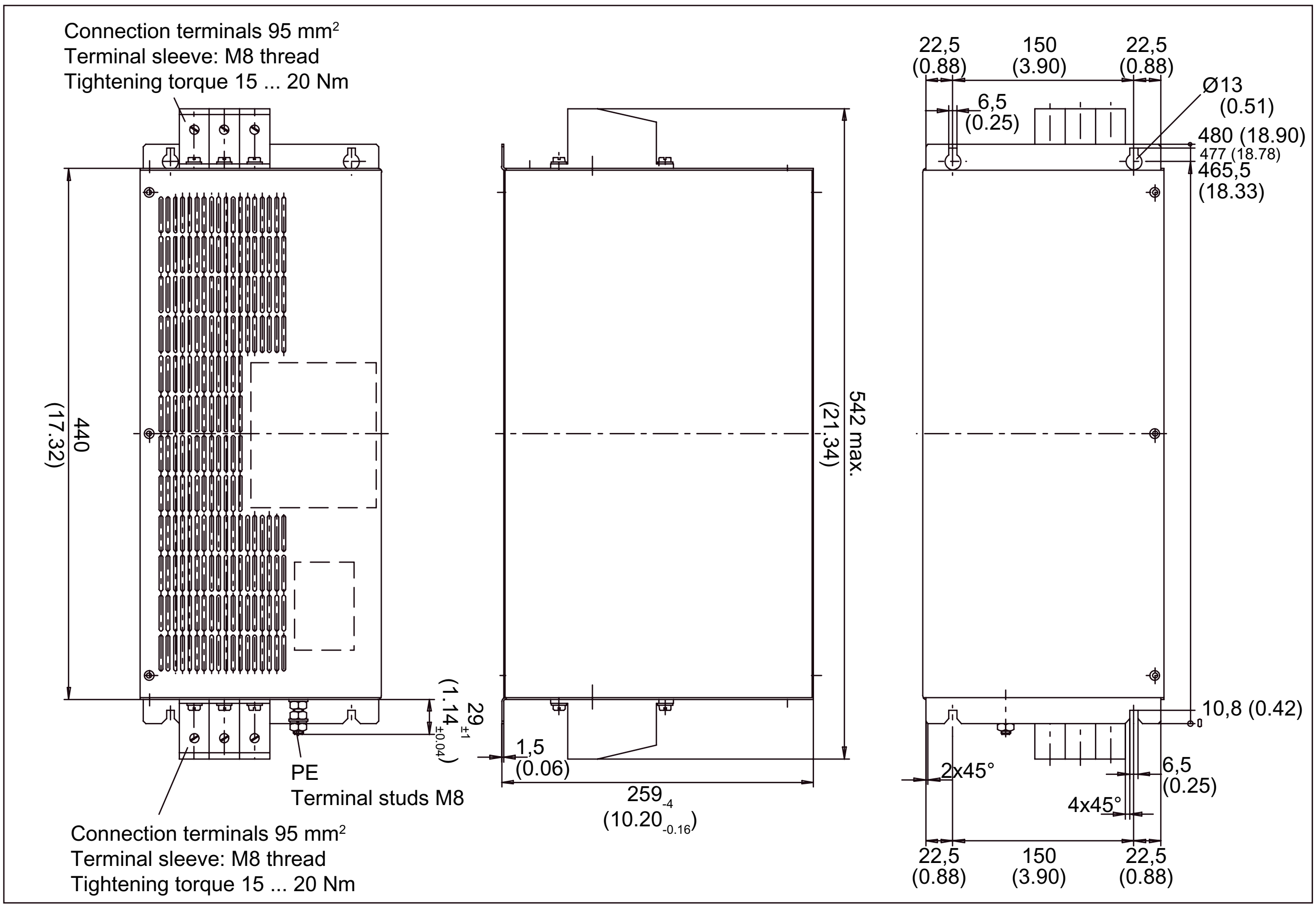


Figure 2-20 Dimension drawing of Wideband Line Filter 80 kW for Active Lines Modules, all dimensions in mm and (inches)

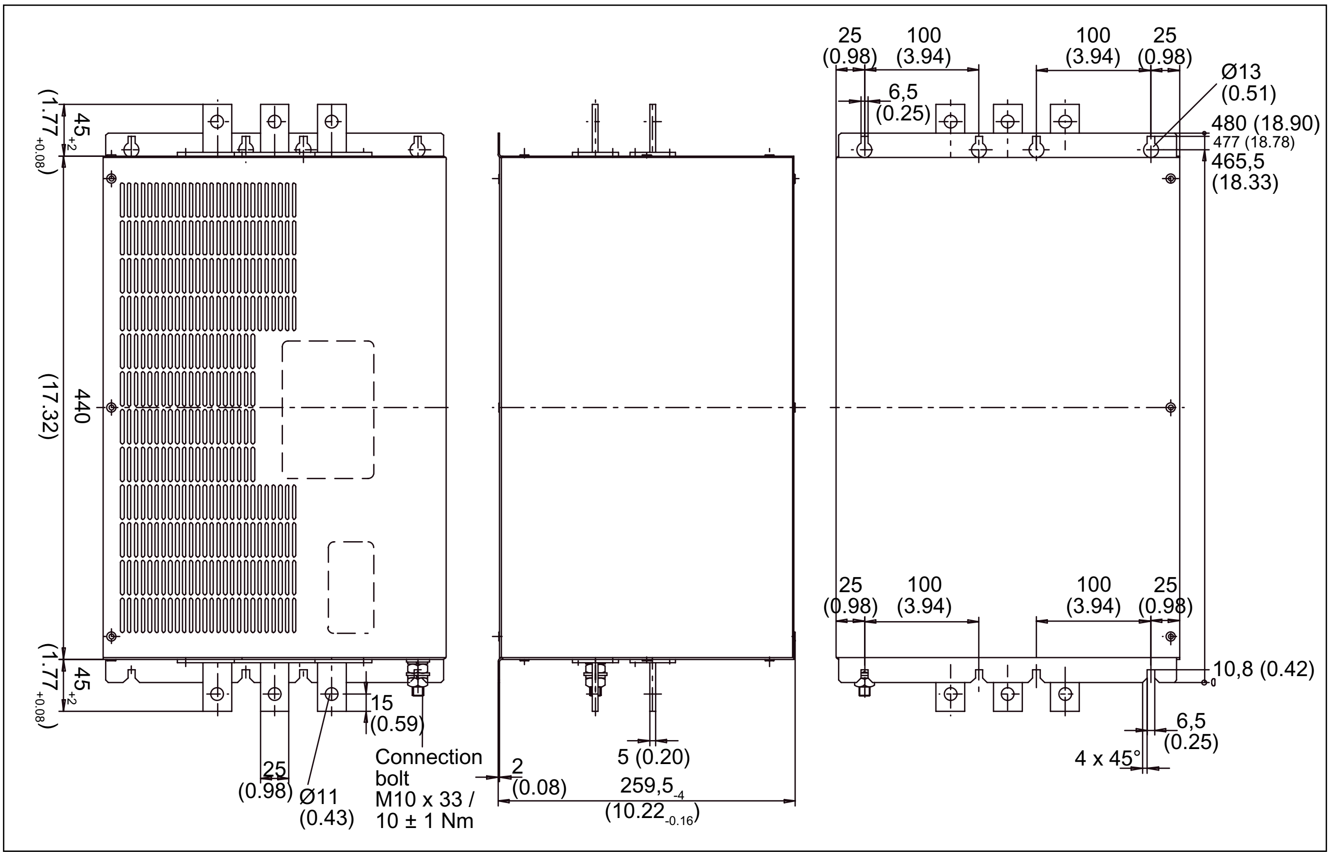


Figure 2-21 Dimension drawing of Wideband Line Filter 120 kW for Active Lines Modules, all dimensions in mm and (inches)

Table 2- 8 Wideband Line Filter

For Active Line Modules	Order number
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

2.6.5 Technical data

Table 2- 9 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
Connection voltages: Supply voltage Line frequency	 V_{AC} Hz	 380 3 AC -10% (-15% < 1 min) to 480 3 AC +10% 47 to 63 Hz				
Rated current	A_{AC}	30	67	103	150	225
Power loss[1]	W	70	90	110	150	200
Weight	kg	8.5	14.5	15.5	26	34.5

1) For an overview, see the power loss tables in chapter Control cabinet installation

2.7 Basic Line Filter for Basic Line Modules

2.7.1 Description

The Basic Line Filters for Basic Line Modules are designed for limiting the cable-borne interference in the frequency range in accordance with the specifications of the EMC legislation.
The machine manufacturer must certify the machines that he plans to launch on the market in accordance with the EU EMC Directive.

Basic Line Filters 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. They are designed for use with systems and equipment with a maximum total cable length of 350 m (shielded) of category C2 to EN 61800-3.

2.7.2 Safety information

CAUTION
Line filters are only suitable for direct connection to TN line supplies.

WARNING
The cooling clearances of 100 mm above and below the components must be observed. This prevents thermal overloading of the filter.

WARNING
The input and output connections/terminals must not be interchanged: Incoming line cable to LINE L1, L2, L3 and outgoing cable to line reactor at LOAD L1´, L2´, L3´ The line filter may be damaged if this is not observed.

NOTICE
The associated Line Module must only be connected to the SINAMICS line filter via the associated line reactor. Additional loads must be connected upstream of the SINAMICS line filter (if required, via a separate line filter). If this is not observed, other loads could be damaged or destroyed.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection on the cabinet or machine must be implemented in accordance with one of the following measures:

- stationary connection and protective conductor connection by means of ≥ 10 mm² Cu or ≥ 16 mm² Al
- stationary connection and automatic shutdown of the power supply if the protective conductor is interrupted

DANGER

Risk of electric shock. Dangerous voltages are still present for up to 5 minutes after the power supply has been switched off.

Note

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.

CAUTION

Only the line filters described in this Manual must be used. Other line filters can cause line harmonics that can interfere with or damage other loads powered from the line supply.

2.7.3 Interface description

2.7.3.1 Overview

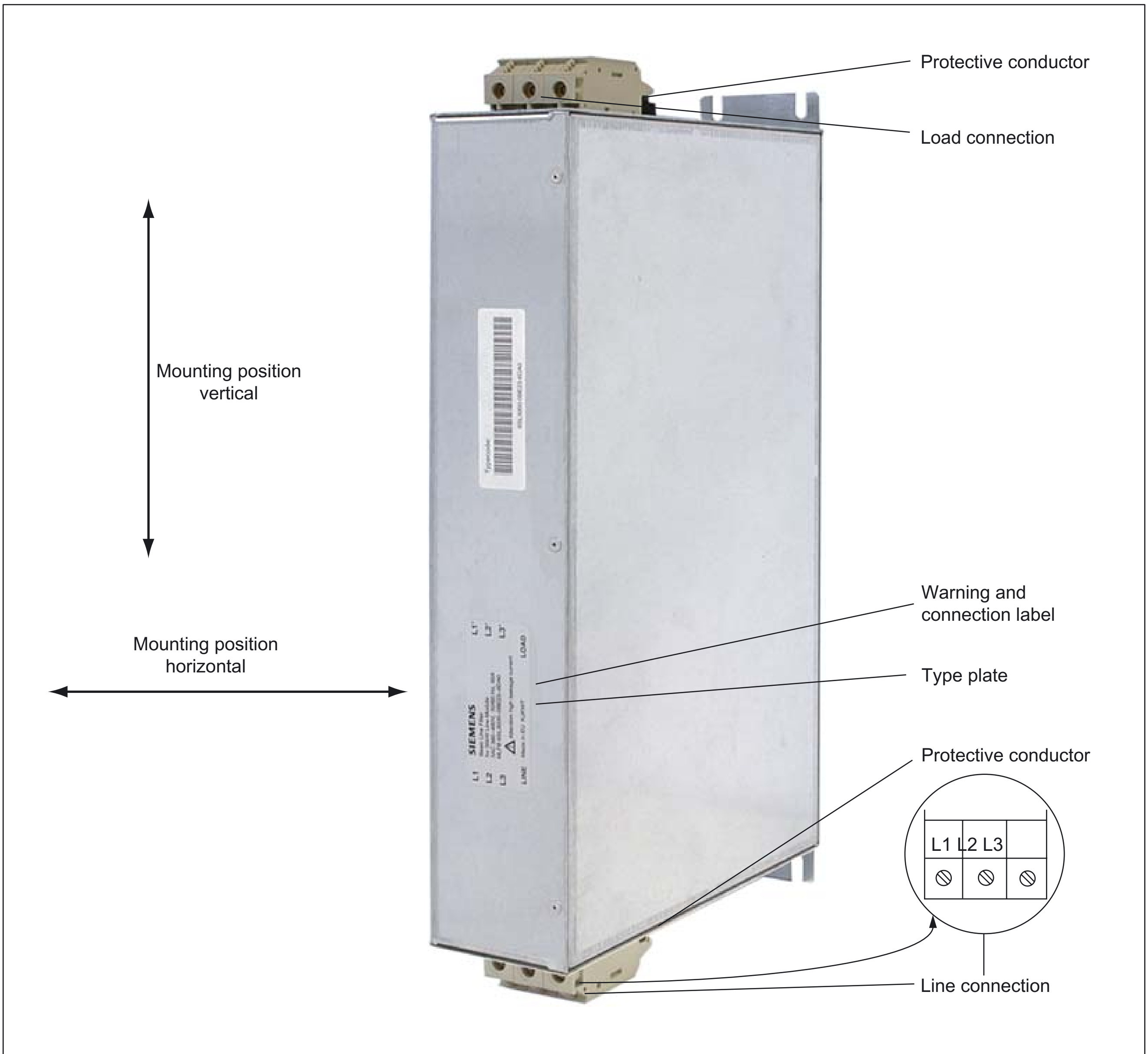


Figure 2-22 Line filters for Basic Line Modules (example: 40 kW)

NOTICE
The line/load connection must not be interchanged.

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.

2.7.3.2 Line/load connection

Table 2- 10 Type of connection

Terminals	Designations
Line supply connection (line supply)	L1, L2, L3, PE
Load connection (load)	L1´, L2´, L3´, PE
Basic Line Filter for Basic Line Modules	
20 kW	Screw terminal: 10 mm² 3-pin / 1.5 - 1.8 Nm (see chapter Screw terminals) PE connection: M6 / 6 Nm [1)]
40 kW	Screw terminal: 35 mm² PE connection: M6 / 6 Nm [1)]
100 kW	Screw terminal: 95 mm² PE connection: M6 / 6 Nm [1)]

1) For ring cable lugs in accordance with DIN 46234

2.7.4 Dimension drawings

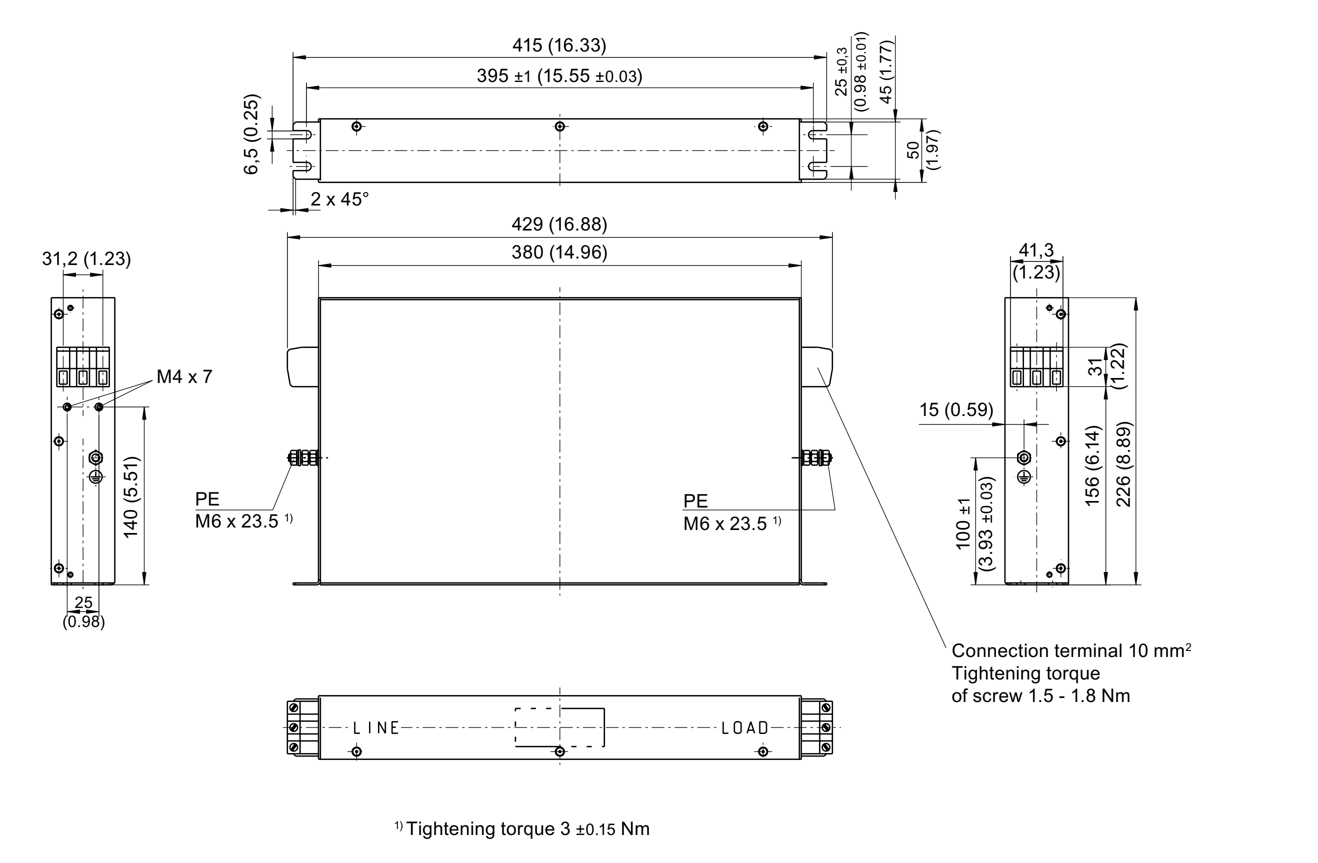


Figure 2-23 Dimension drawing of Basic Line Filter for Basic Line Modules 20 kW, order number 6SL3000-0BE21-6DAx, all dimensions in mm and (inches)

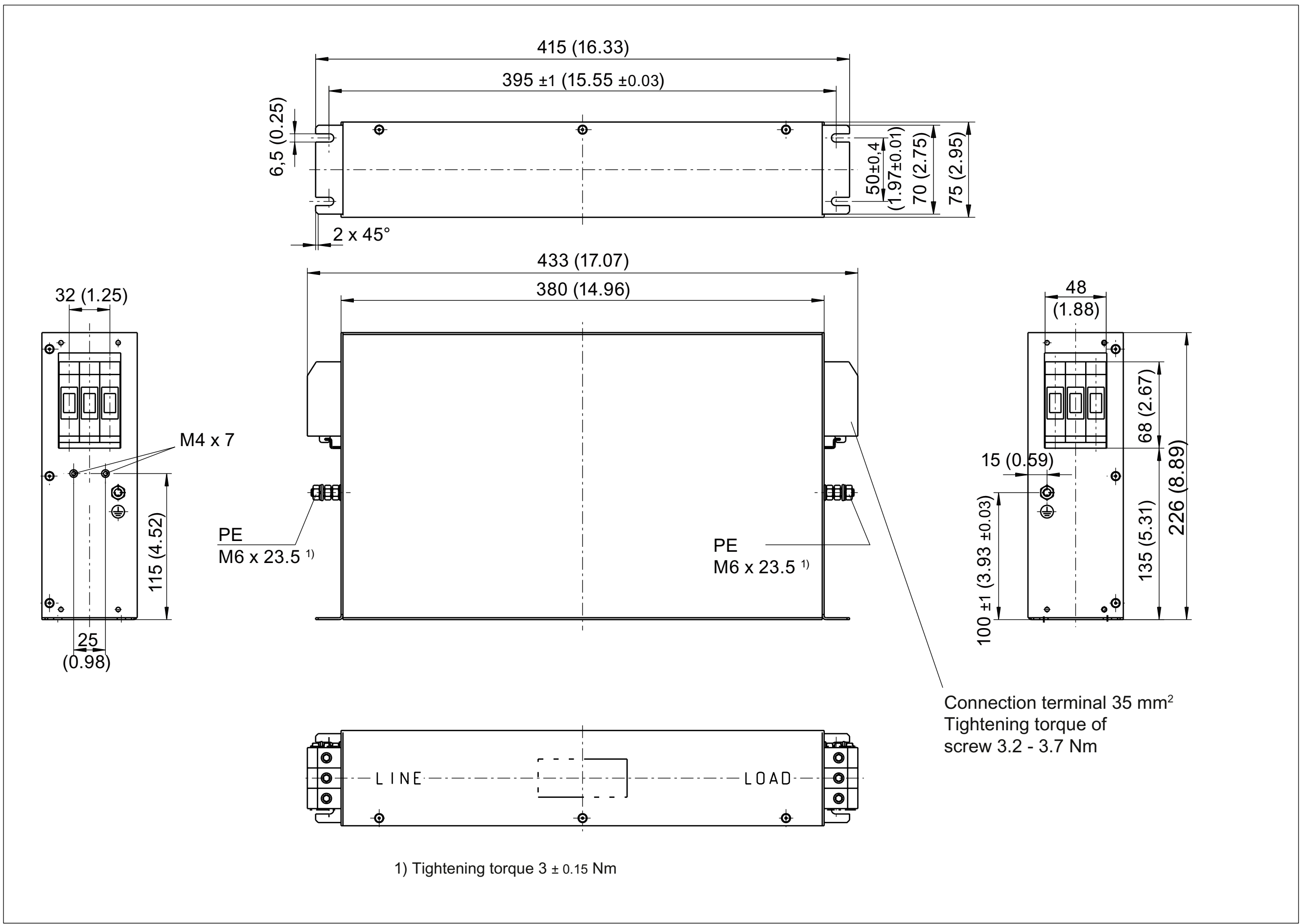


Figure 2-24 Dimension drawing of Basic Line Filter for Basic Line Modules 40 kW, order number 6SL3000-0BE23-6DA1, all dimensions in mm and (inches)

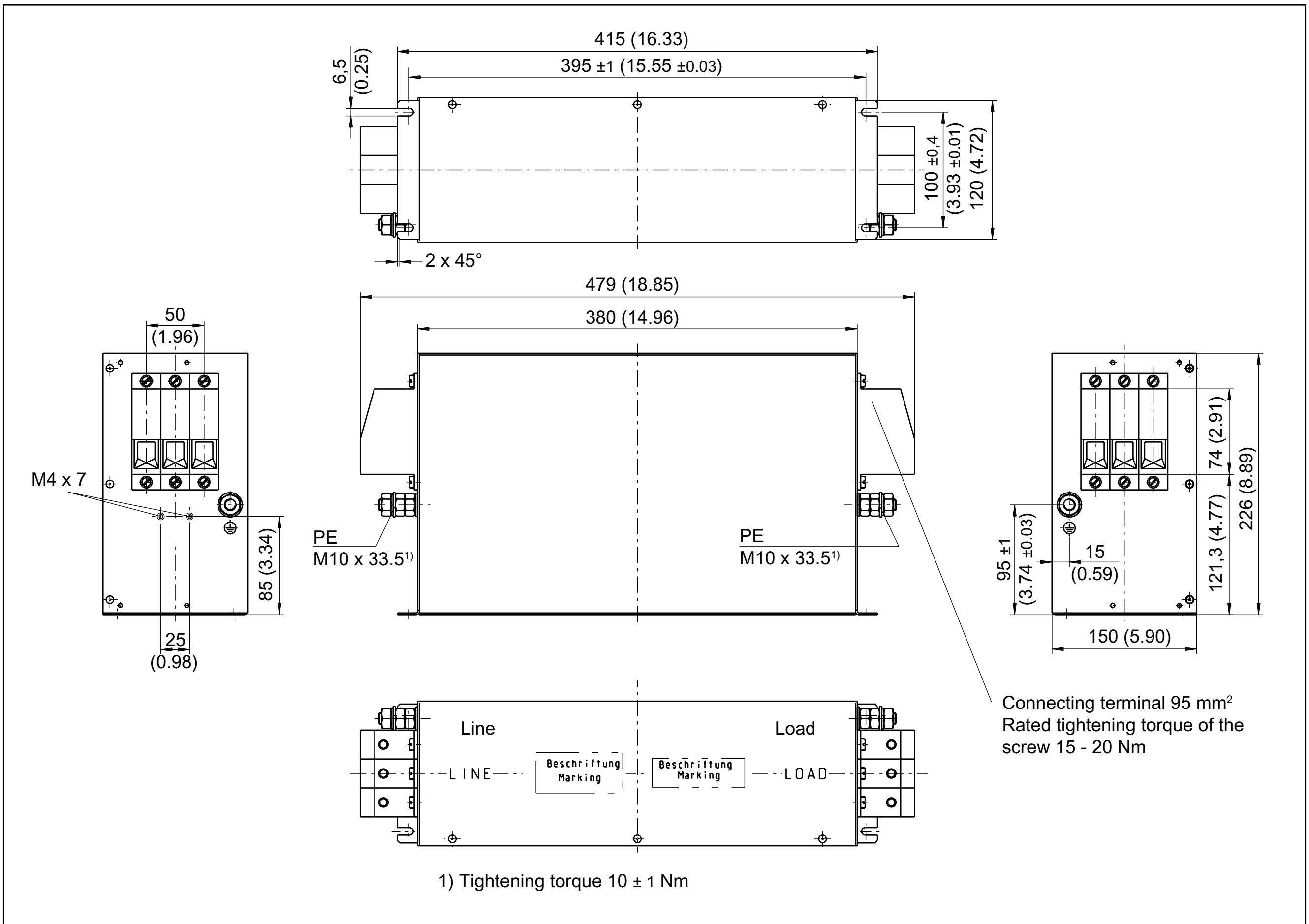


Figure 2-25 Dimension drawing of Basic Line Filter for Basic Line Modules 100 kW, order number 6SL3000-0BE31-2DAx, all dimensions in mm and (inches)

2.7.5 Technical data

Table 2- 11 Technical data for Basic Line Filter for Basic Line Modules

	6SL3000 unit	0BE21-6DAx	0BE23-6DA1	0BE31-2DAx
Rated power	kW	20	40	100
Connection voltage: Supply voltage Line frequency	 V_{AC} Hz	 3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10% 47 to 63 Hz		
Rated current	A_{AC}	36	74	192
Power loss[1)]	W	16	26	43
Weight	kg	5	7.5	18.5

1) For an overview, see the power loss tables in chapter Control cabinet installation

2.8 Basic Line Filter for Smart Line Modules

2.8.1 Description

In conjunction with the associated line reactors, the Basic Line Filters for Smart Line Modules limit the cable-borne interference to a level in compliance with EN61800-3 category C2.

In conjunction with the line filters and the associated line reactors, drive line-ups with Smart Line Modules fulfill the requirements of category C2 to EN 61800-3.

The 5 kW, 10 kW, 16 kW and 36 kW Basic Line Filters for the Smart Line Modules are designed for total cable lengths of up to 350 m (shielded).

Basic Line Filters are suitable for direct connection to TN systems; otherwise an isolating transformer will be required.

2.8.2 Safety information

WARNING

The 100 mm clearances for circulating air above and below the filter must be observed. This prevents thermal overloading of the filter.

WARNING

The input and output connections/terminals must not be interchanged:

Incoming line cable to LINE L1, L2, L3 and

Outgoing cable to line reactor at LOAD L1´, L2´, L3´

The line filter may be damaged if this is not observed.

CAUTION

The Line Module must only be connected to the SINAMICS line filter via the associated line reactor. Additional loads must be connected upstream of the SINAMICS line filter (if required, via a separate line filter). If this is not observed, other loads could be damaged or destroyed.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection on the cabinet or machine must be implemented in accordance with one of the following measures:

- stationary connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- stationary connection and automatic shutdown of the power supply if the protective conductor is interrupted

DANGER

Risk of electric shock. Dangerous voltages are still present for up to 5 minutes after the power supply has been switched off.

Note

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.

CAUTION

Only the line filters described in this Manual must be used. Other line filters can cause line harmonics that can interfere with or damage other loads powered from the line supply.

2.8.3 Interface description

2.8.3.1 Overview

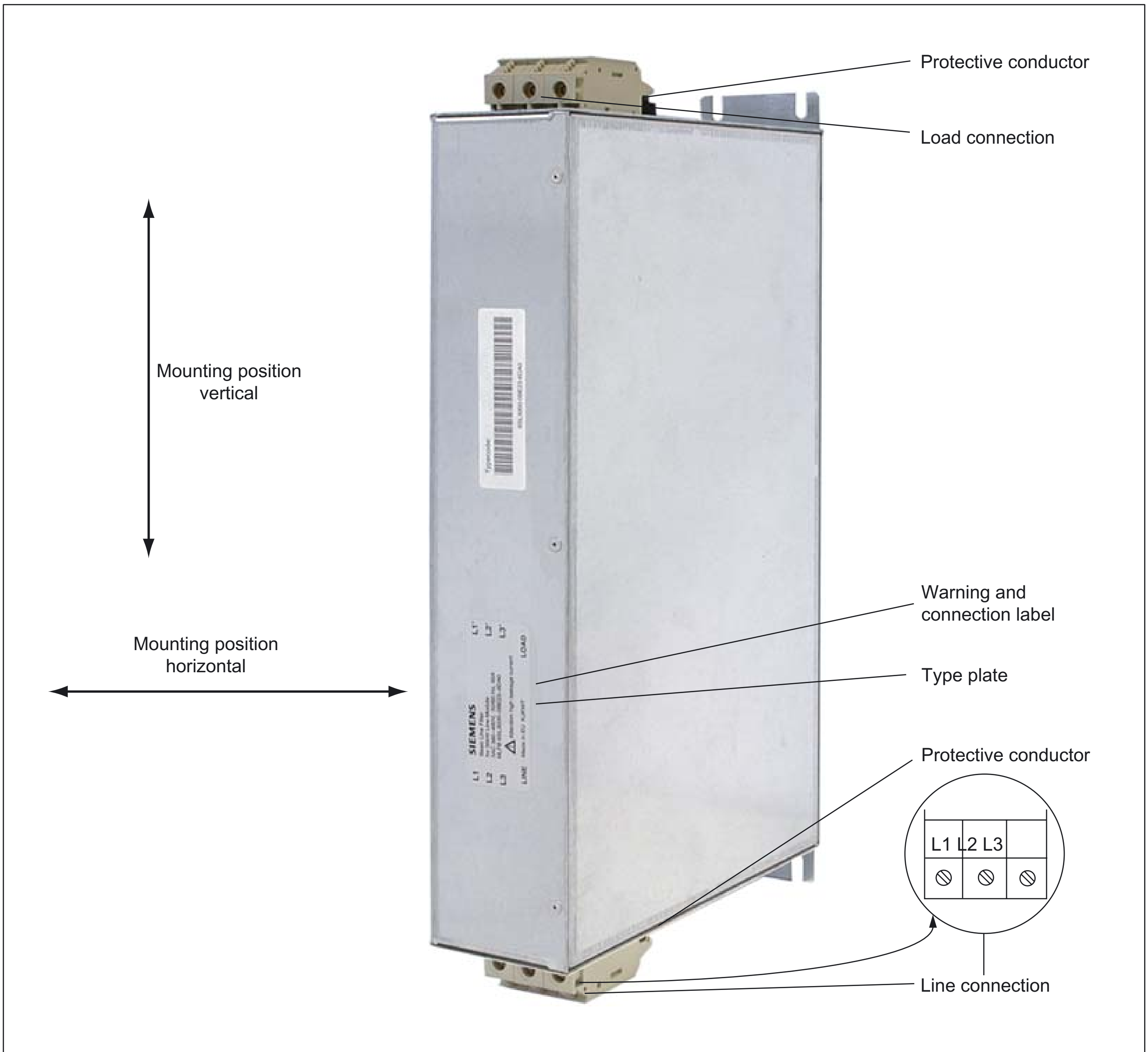


Figure 2-26 Basic Line Filter for Smart Line Modules (example: 36 kW)

NOTICE
The line/load connection must not be interchanged.

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.

2.8.3.2 Line/load connection

Table 2- 12 Type of connection

Terminals	Designations
Line supply connection (line supply)	L1, L2, L3, PE
Load connection (load)	L1´, L2´, L3´, PE
Basic Line Filter for Smart Line Modules	
5 kW	Screw terminal: 10 mm² 3-pin/1.5 -1.8 Nm (see chapter Screw terminals) Grounding bolt: M6 / 6 Nm 1)
10 kW	
16 kW	
36 kW	Screw terminal: 35 mm² Grounding bolt: : M6 / 6 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

2.8.4 Dimension drawings

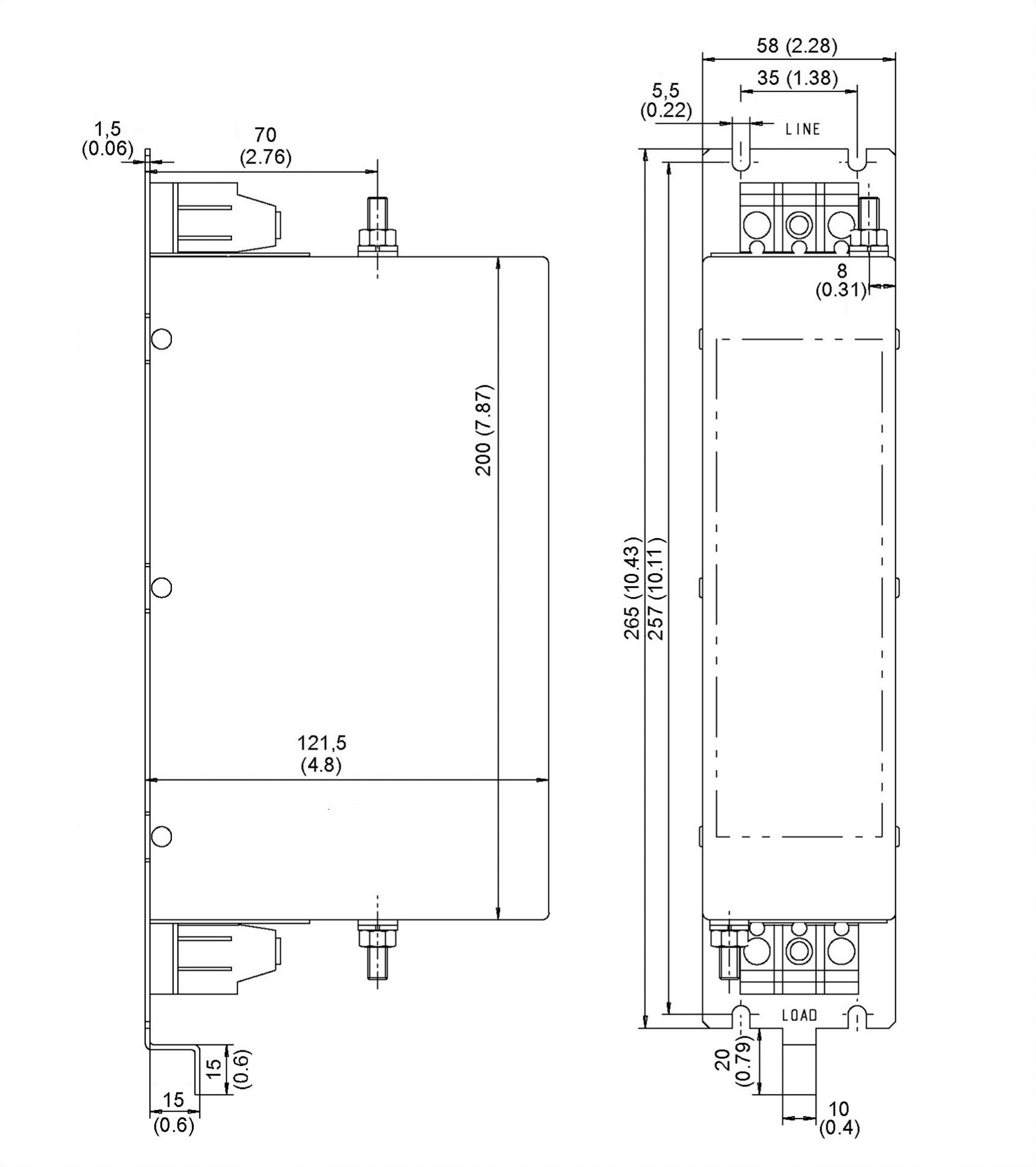


Figure 2-27 Dimension drawing of Basic Line Filter for Smart Line Modules 5 and 10 kW, all dimensions in mm and (inches)

Table 2- 13 Basic Line Filter for Smart Line Modules

Basic Line Filter for Smart Line Modules	Order number
5 kW	6SL3000-0HE15-0AAx
10 kW	6SL3000-0HE21-0AAx

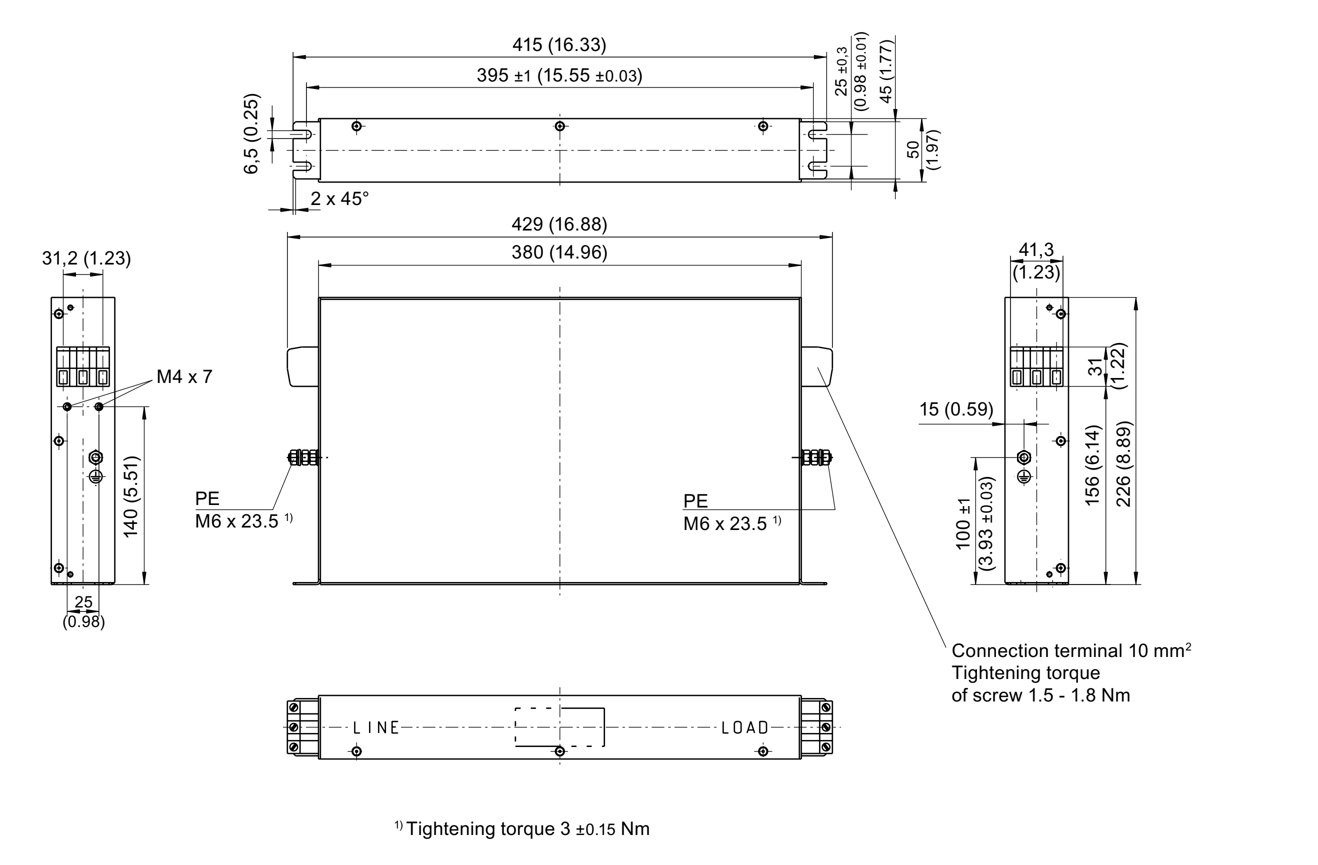


Figure 2-28 Dimension drawing of Basic Line Filter for Smart Line Modules 16 kW, order number 6SL3000-0BE21-6DAx, all dimensions in mm and (inches)

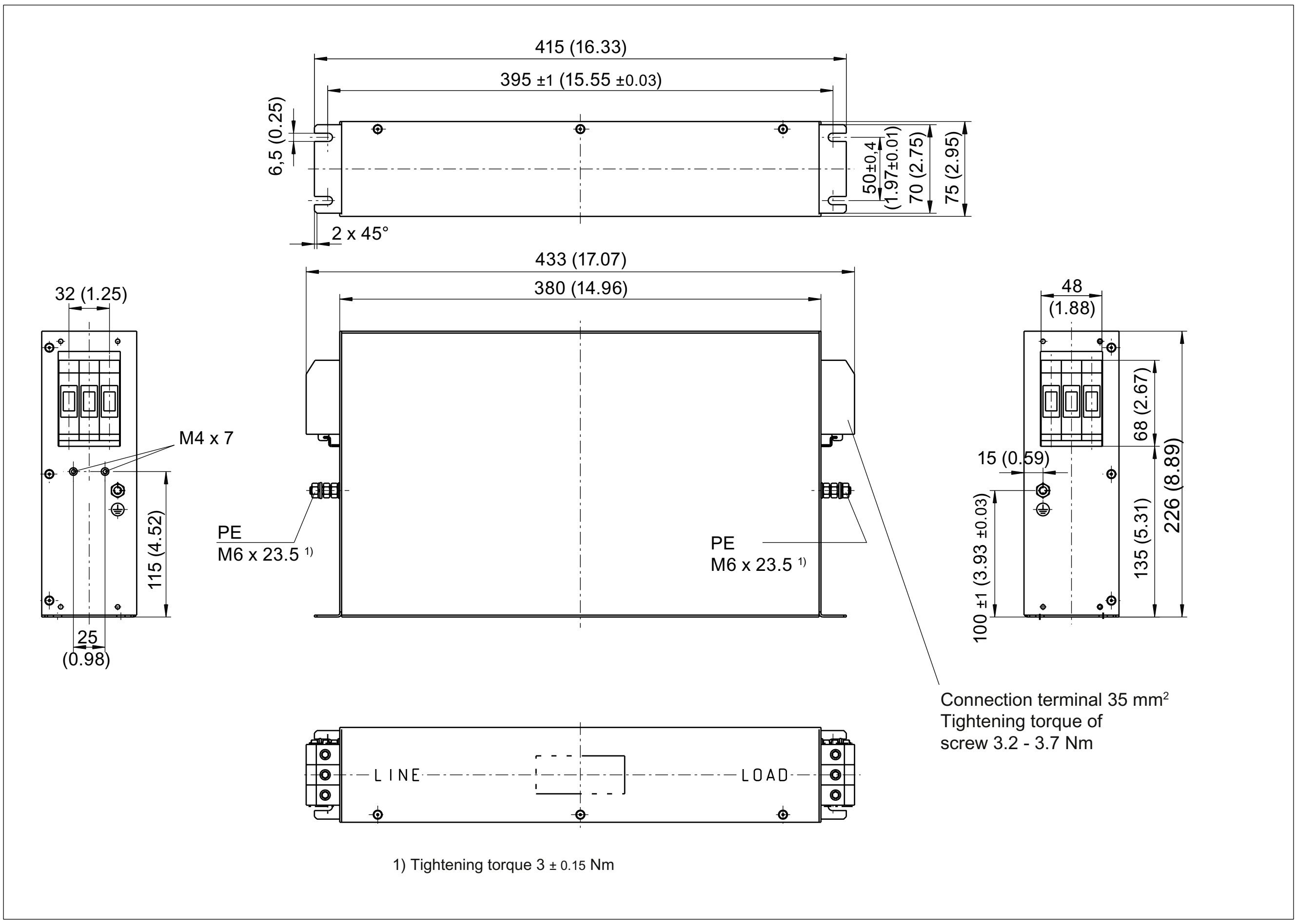


Figure 2-29 Dimension drawing of Basic Line Filter for Smart Line Modules 36 kW, order number 6SL3000-0BE23-6DA1, all dimensions in mm and (inches)

2.8.5 Technical data

Table 2- 14 Technical data for: Basic Line Filter for Smart Line Modules

	6SL3000- Unit	0HE15-0AAx	0HE21-0AAx	0BE21-6DAx	0BE23-6DA1
Rated power	kW	5	10	16	36
Connection voltage: Supply voltage Line frequency	 V_{AC} Hz	 3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10% 47 to 63 Hz			
Rated current	A_{AC}	16	25	36	74
Power loss[1)]	W	20	20	16	26
Weight	kg	2.1	2.3	5	7.5

1) For an overview, see the power loss tables in chapter Control cabinet installation

2.9 Active Interface Modules internal air cooling

2.9.1 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 EN61800-3, 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.

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 network (IT system)

Note

When an Active Interface Module is operated on an isolated-neutral network (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 effective and also protects other loads on the same network from clock frequency disturbances.

DANGER

The connecting bracket may only be removed in the de-energized state.
Risk of electric shock. Dangerous voltages are still present for up to 5 minutes after the power supply has been switched off.

		
Remove the connection bracket for the interference-suppression capacitor with a Tx25 screwdriver.	Remove the connection bracket	Connection bracket for the interference-suppression capacitor

Note

Installing the connection bracket for the interference-suppression capacitor

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

2.9.2 Safety information

NOTICE

Active Interface Modules must only be operated if the option "Line filter available" has been set for the Active Line Module in the commissioning wizard, and if "AIM 400 V xxkW (6SL3100-0BE**-*AB*)" has been selected as the line filter. With SINAMICS V2.6, the appropriate Active Interface Module is already set by default when the wizard is run in Starter.
With the SINAMICS V2.5 software release, the default is "Wideband Line Filter" and must be changed manually to "AIM (P220=4*)".
Operation with SINAMICS software lower than V2.5 is not permitted.

Before putting the Active Interface Module into operation, it is essential to connect 24 VDC at connector X124 to supply the fans. Current required ≤ 1.2 A.

The temperature signaling contact of the Active Interface Module must be connected to the temperature input of the associated Active Line Module.

If this is not the case, the Active Interface Module may be destroyed.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm² Cu or ≥ 16 mm² Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

(See connection example: Active Interface Module)

CAUTION

The surface temperatures of the component may be high.

DANGER

The cooling clearances of 80 mm above and below the components must be observed.

Note

The Active Interface Modules must only be operated in a vertical position ("hanging").

2.9.3 Interface description

2.9.3.1 Overview

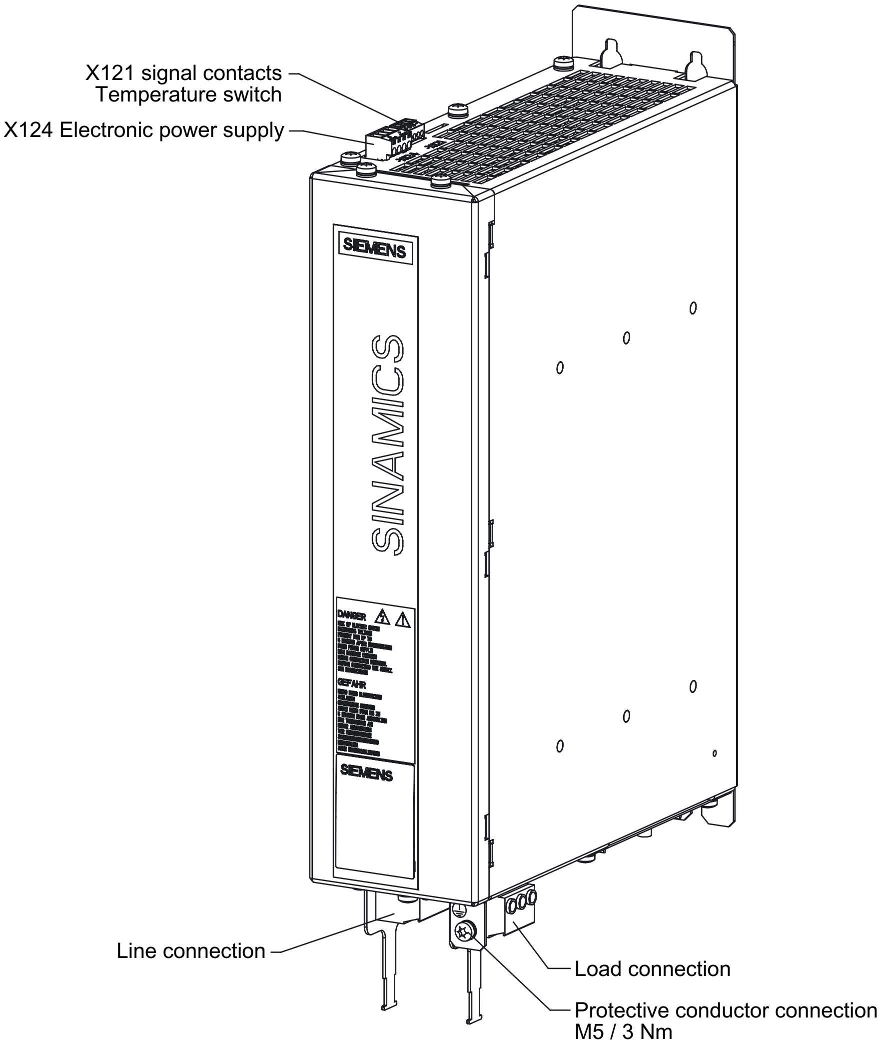


Figure 2-30 Interface description: Active Interface Module 16 kW

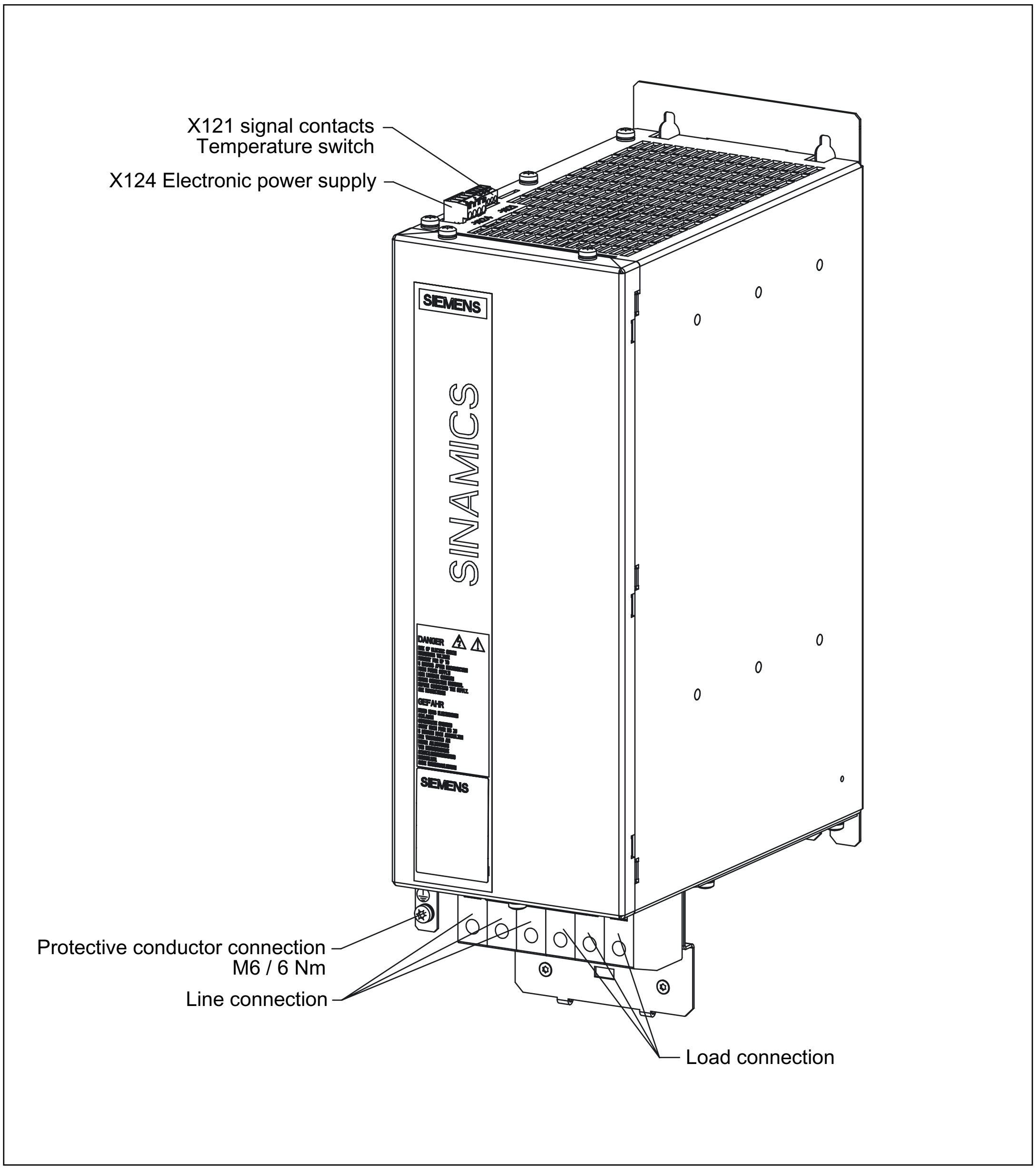


Figure 2-31 Interface description: Active Interface Module 36 kW

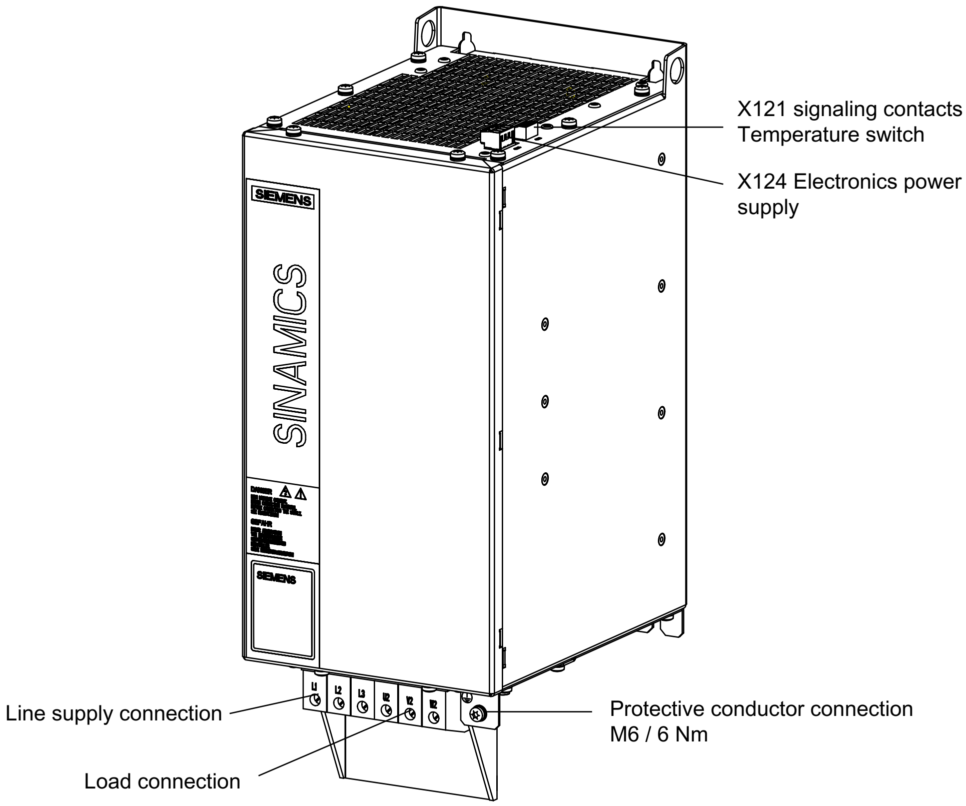


Figure 2-32 Interface description: Active Interface Module 55 kW

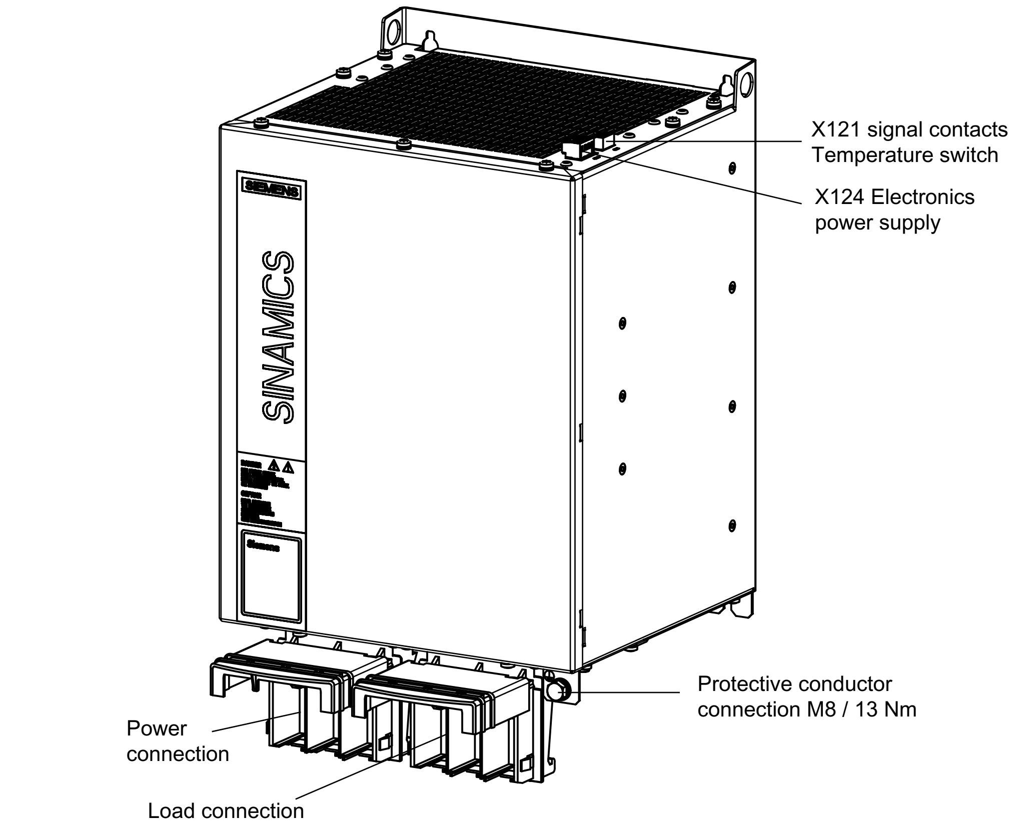


Figure 2-33 Interface description: Active Interface Module (80 kW and 120 kW)

2.9.3.2 Connection example

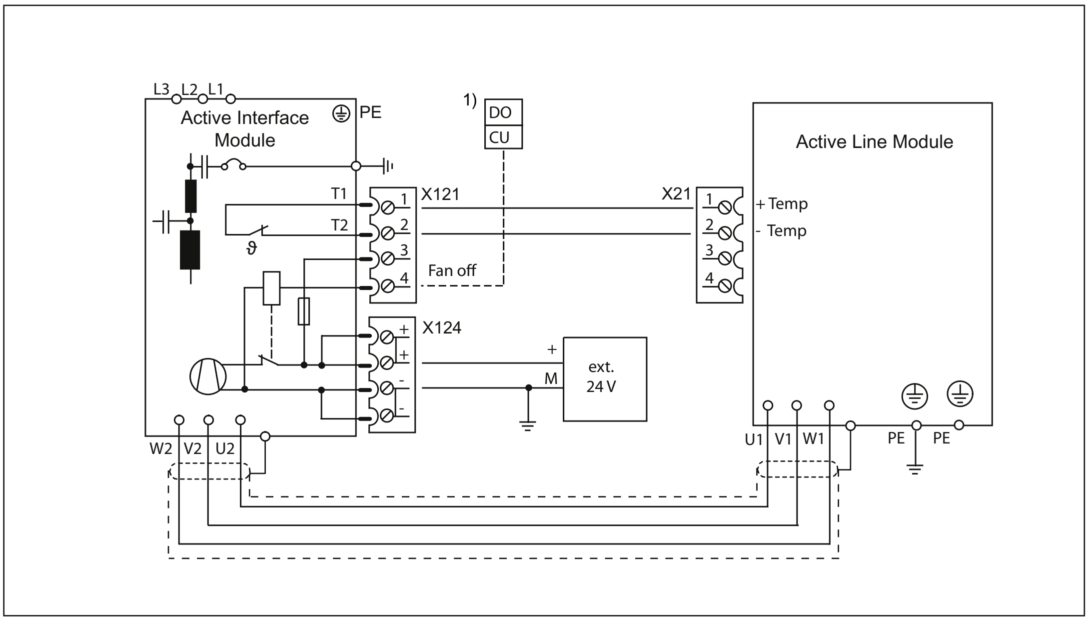
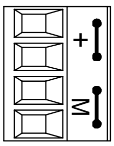


Figure 2-34 Connection example: Active Interface Module

1) Digital input (DI) or digital output (DO) controlled by the Control Unit

2.9.3.3 Electronics power supply X124

Table 2- 15 Terminal block X124

	Terminal	Function	Technical specifications
	+	Electronics power supply	Voltage: 24 V DC (20.4 V - 28.8 V) Current consumption: max. 1.6 A Max. current via jumper in connector: 20 A at 55 °C
	+	Electronics power supply	
	M	Electronic ground	
	M	Electronic ground	
Max. connectable cross-section: 2.5 mm²			

Note

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

2.9.3.4 Line/load connection

Table 2- 16 Type of connection

Terminals	Designations
Line supply connection (line supply)	L1, L2, L3
Load connection (load)	U2, V2, W2
Active Interface Module	
16 kW	Connector, cross-section 16 mm² Tightening torque 1.7 Nm
36 kW	Screw terminal, cross-section 50 mm², end sleeve Tightening torque 6 Nm
55 kW	Screw terminal, cross-section 50 mm², end sleeve Tightening torque 6 Nm
80 / 120 kW	Threaded bolt M8, cross-section 120 / 2 x 50 mm², tightening torque 13 Nm 1)

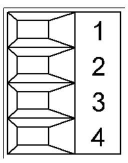
1) For ring cable lugs in accordance with DIN 46234

Note

The connection terminals of the 36 kW and 55 kW Active Interface Modules are only certain to be safe from finger touch if cables with a minimum cross-section of 25 mm² and insulated ferrule are used.

2.9.3.5 X121 temperature sensor and fan control

Table 2- 17 Plug-in screw terminal X121

	Terminal	Designation	Technical specifications
	1	+Temp	Output Temperature switch must be connected to 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 only be switched off while the Active Line Module is disabled.
Max. connectable cross-section: 1.5 mm²			

Note

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

2.9.4 Dimension drawings

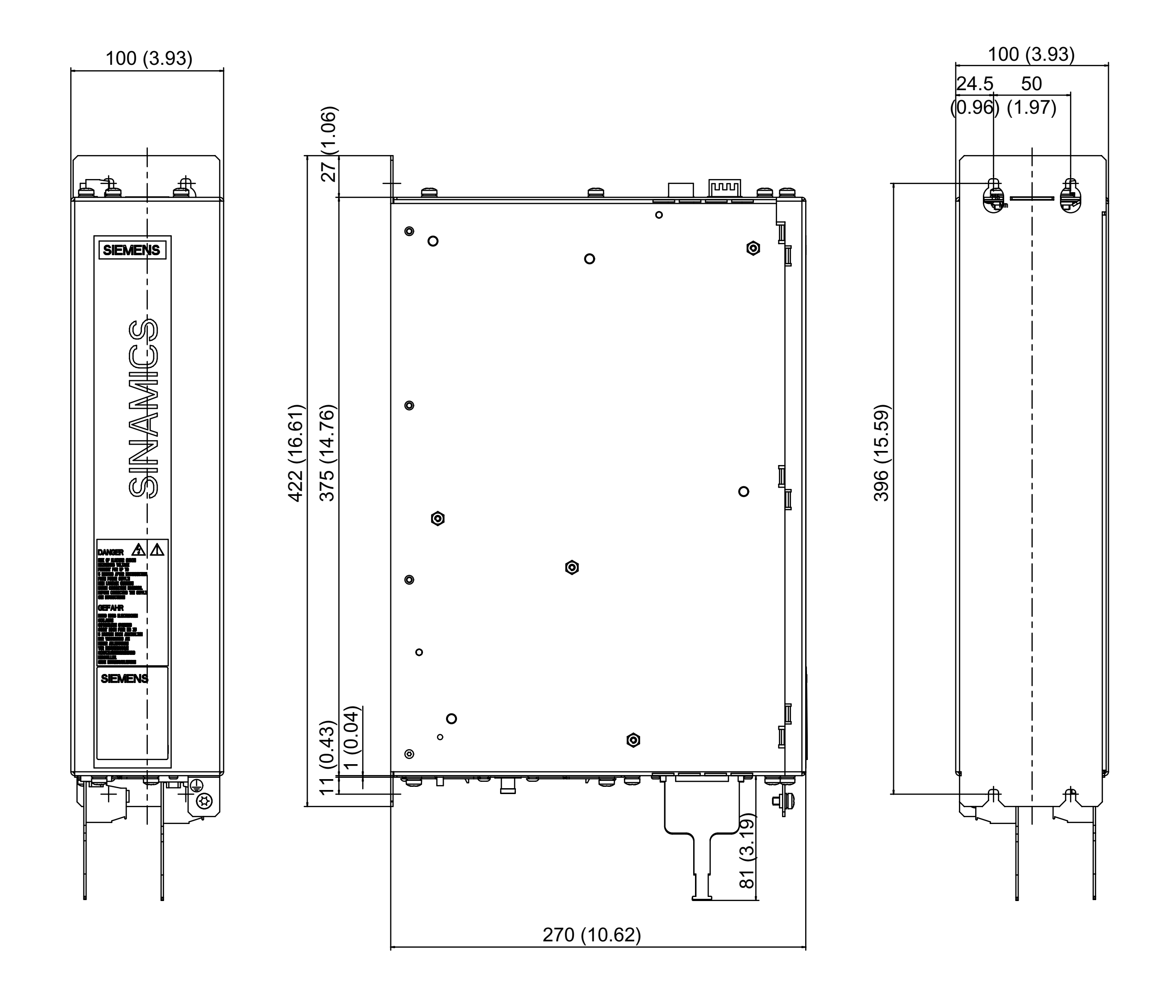


Figure 2-35 Dimension drawing of Active Interface Module 16 kW, all dimensions in mm and (inches)

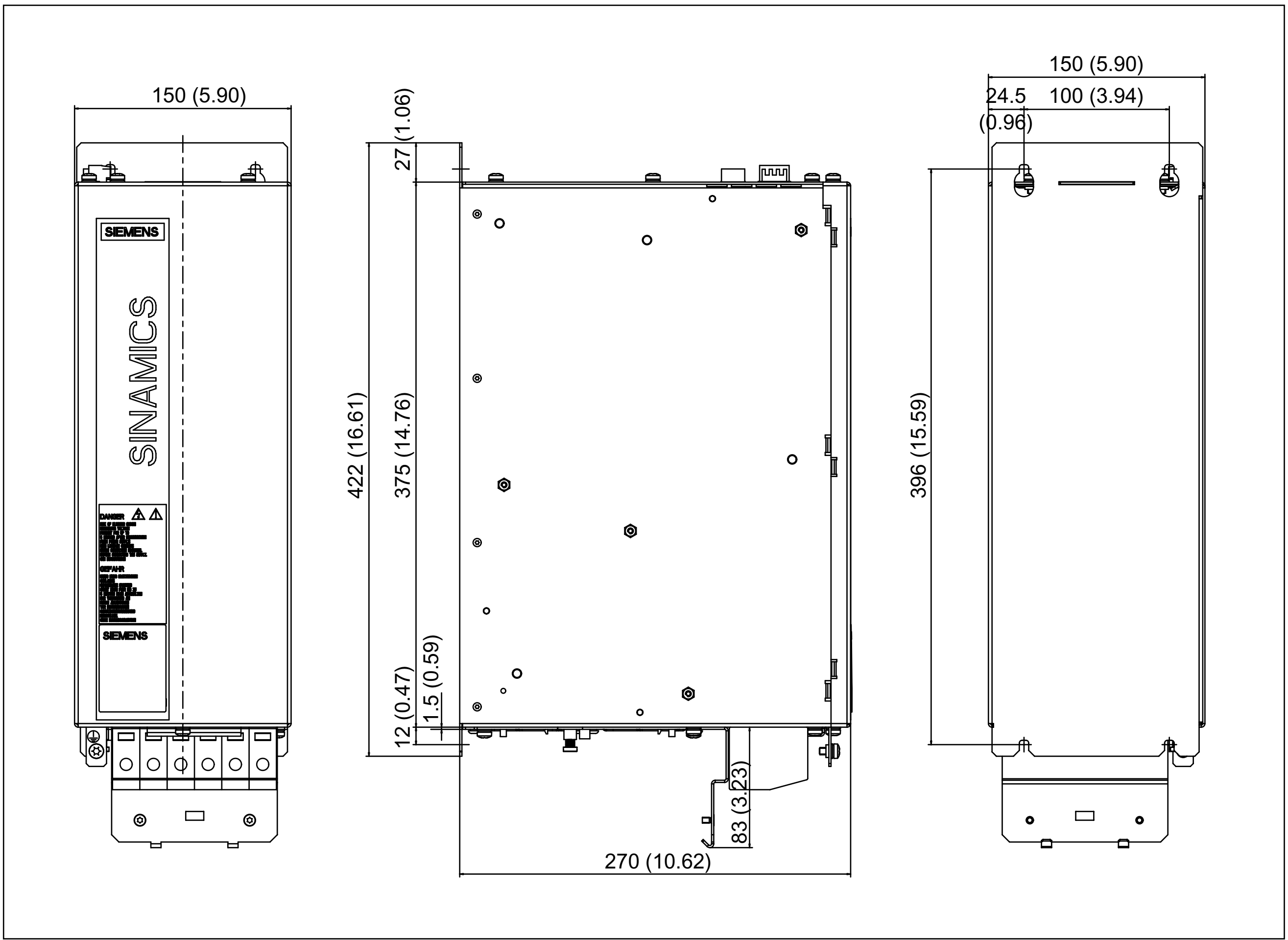


Figure 2-36 Dimension drawing of Active Interface Module 36 kW, all dimensions in mm and (inches)

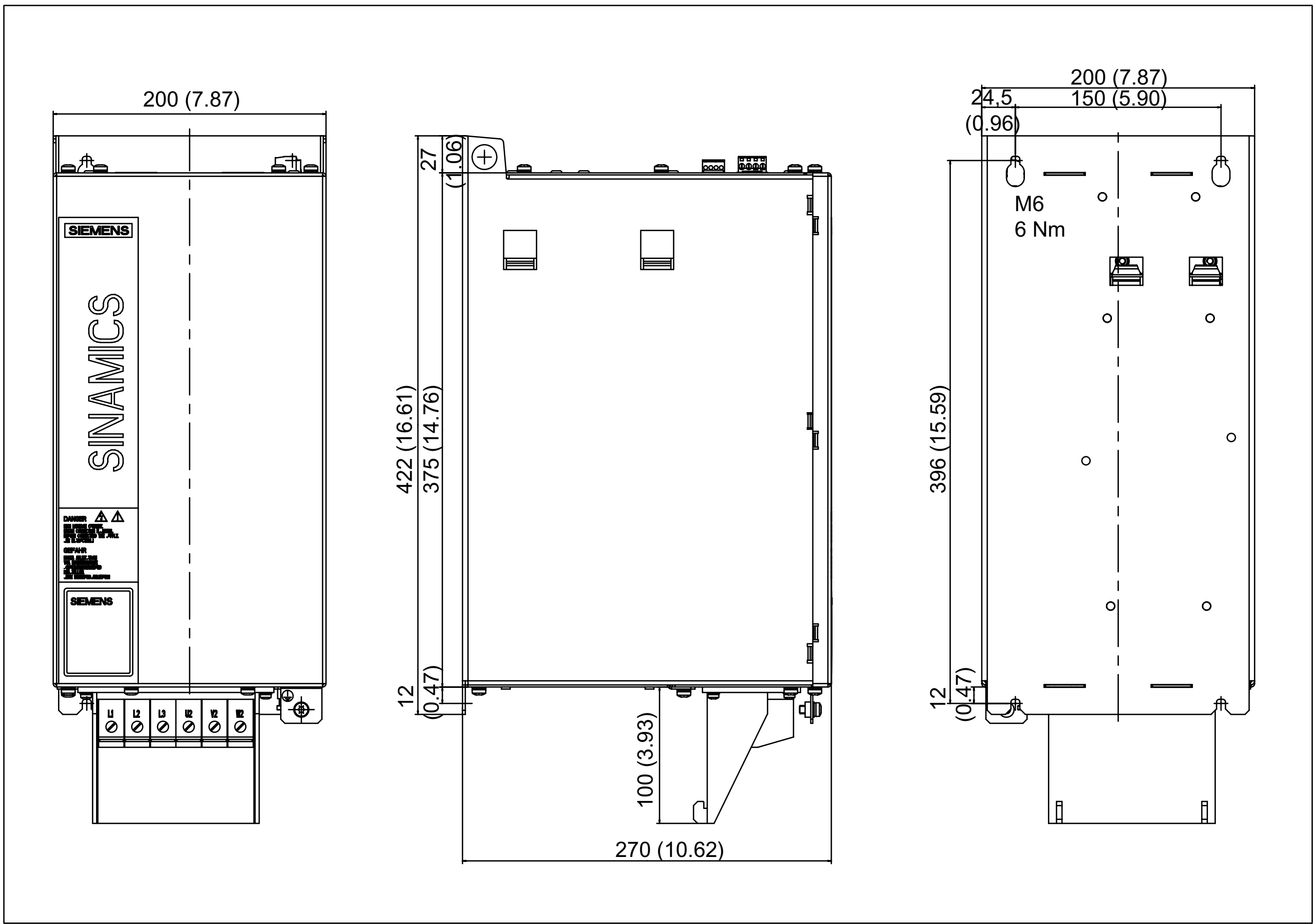


Figure 2-37 Dimension drawing of Active Interface Module 55 kW, all dimensions in mm and (inches)

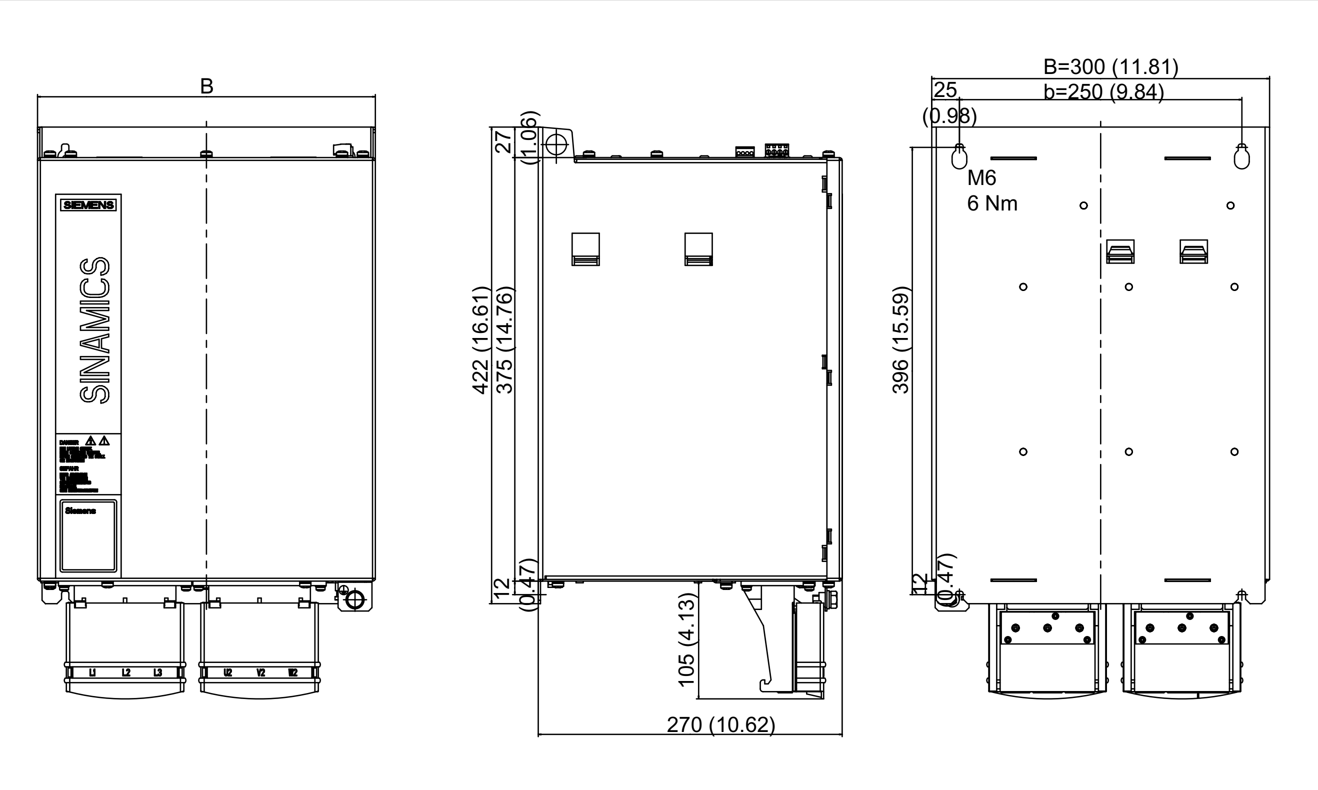


Figure 2-38 Dimension drawing of Active Interface Module 80 kW and 120 kW, all dimensions in mm and (inches)

2.9.5 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.

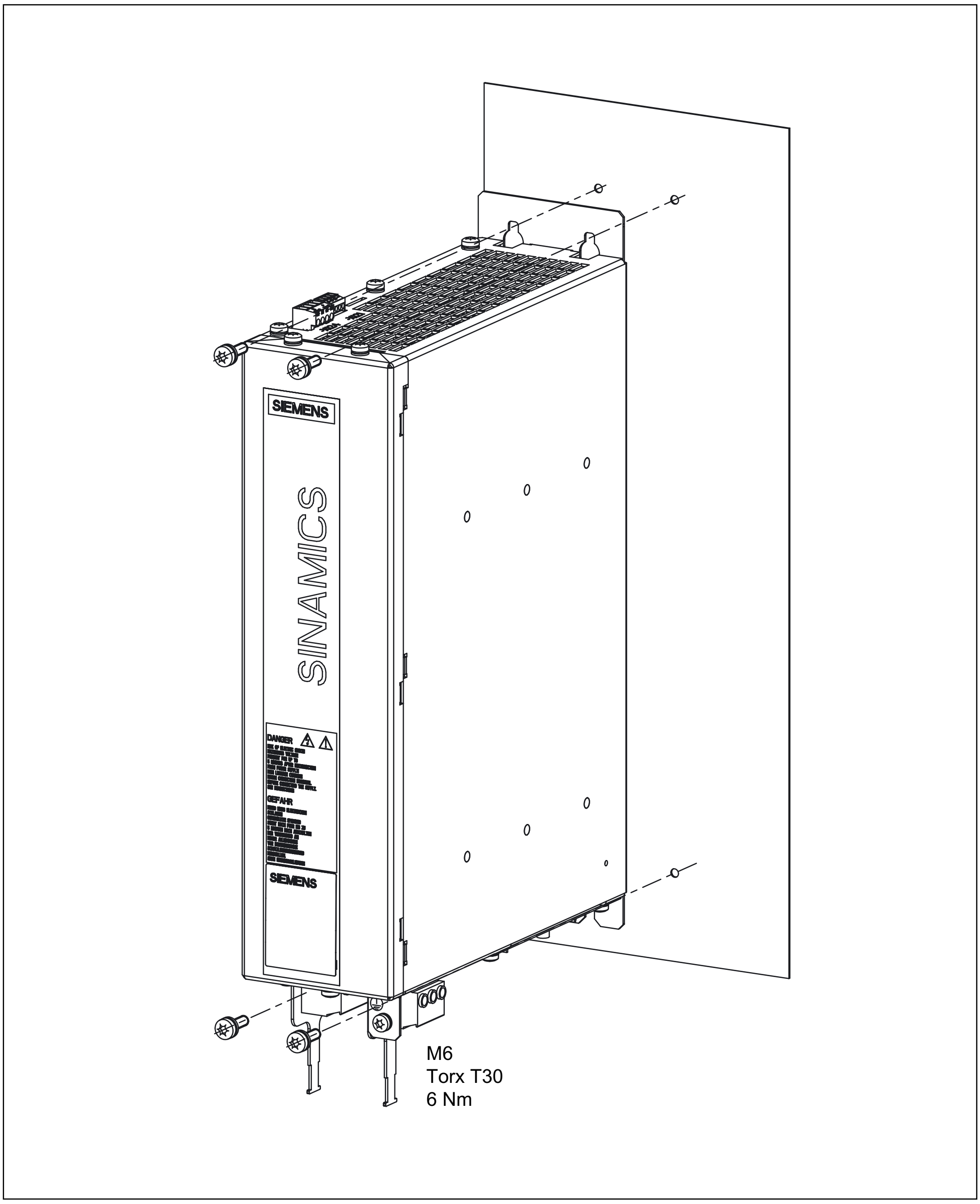


Figure 2-39 Mounting: Active Interface Module 16 kW

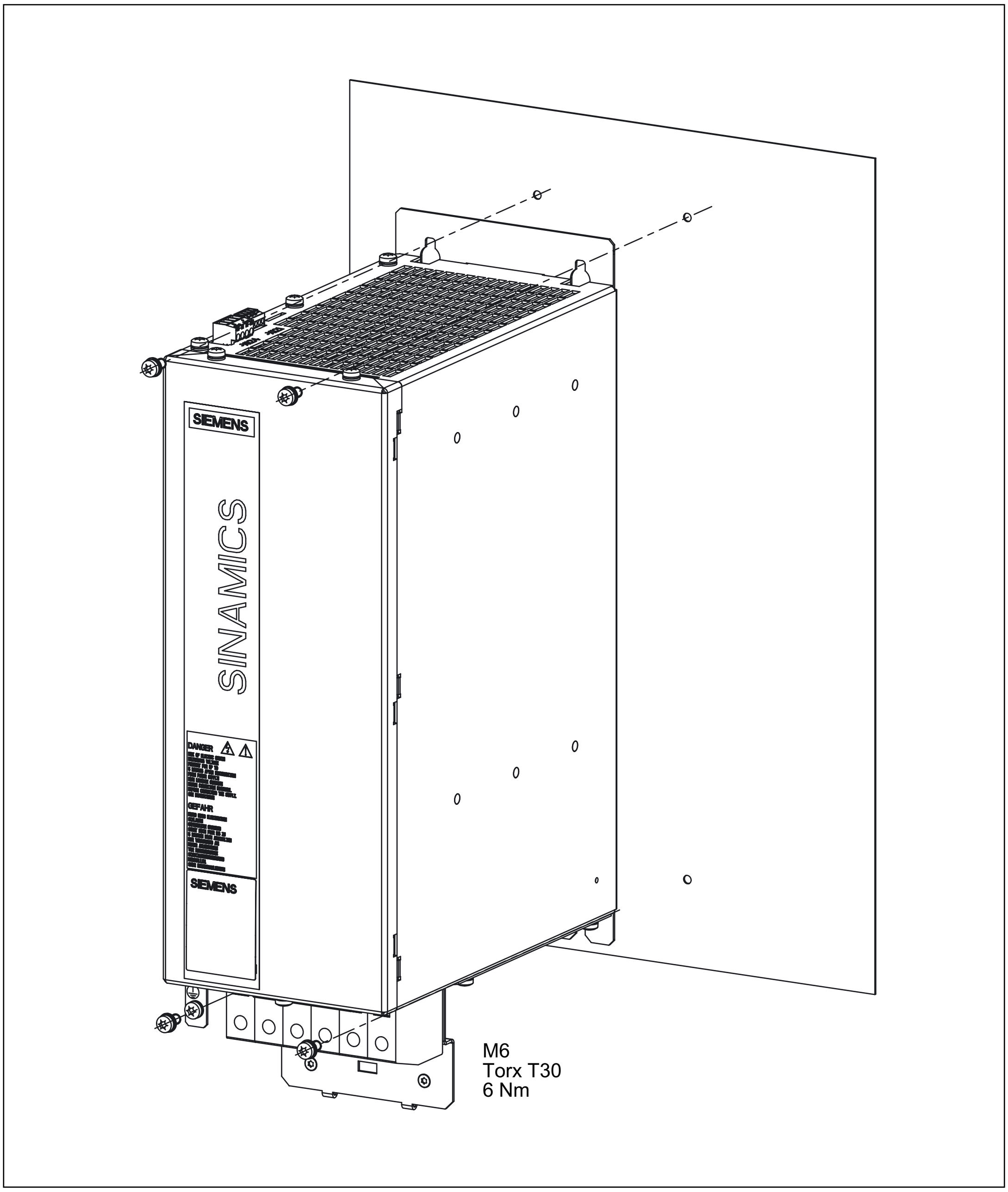


Figure 2-40 Mounting: Active Interface Module 36 kW

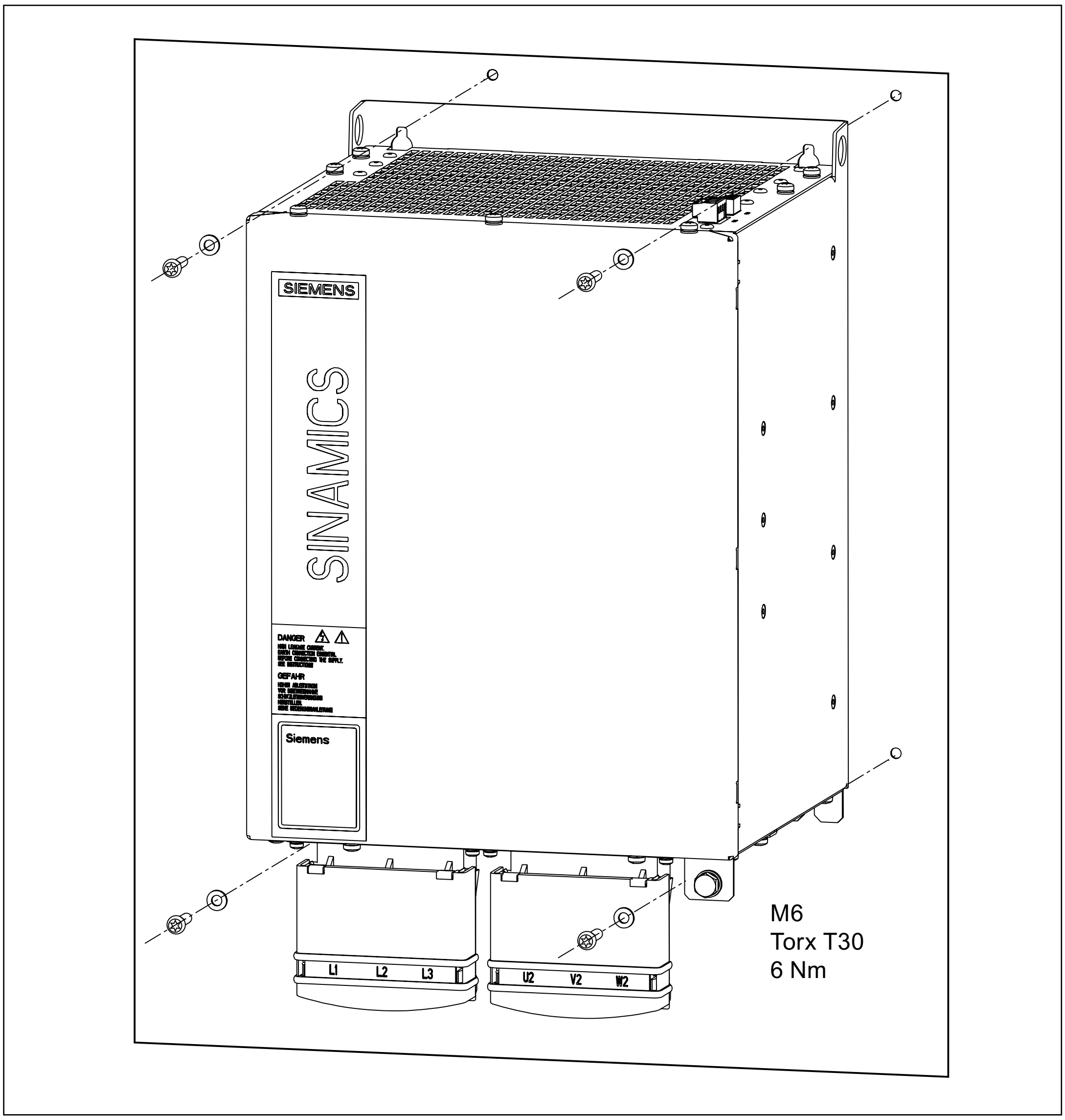


Figure 2-41 Mounting: Active Interface Module 55 kW

M6 screws (not hexagon-head screws)

Table 2- 18 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

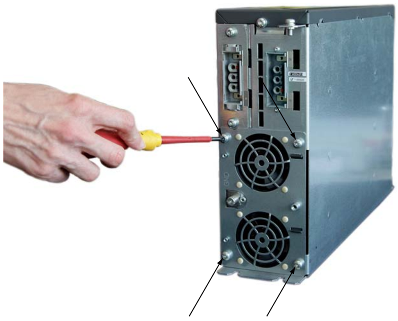
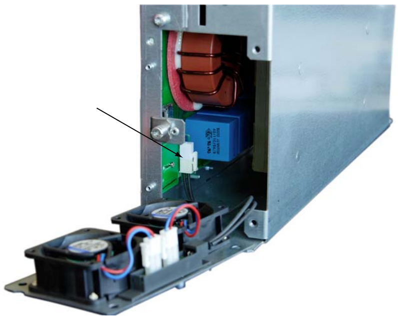
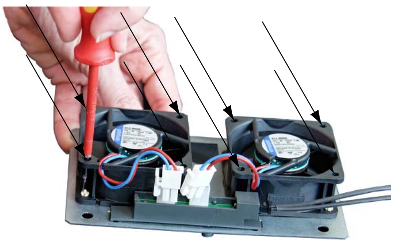
Replacing the fan in an Active Interface Module

NOTICE
When replacing the fan, you must observe the ESD regulations.

NOTICE
Parts must only be replaced by trained personnel (danger of damage to sensitive components due to electrostatic charging)!

DANGER
Before replacing the fan, you must switch off the power supplies (24 V DC and 400 V AC). Risk of electric shock. Dangerous voltages are still present for up to 5 minutes after the power supply has been switched off. The fan cover must not be opened until this time has elapsed.

Table 2- 19 Replacing the fan in an Active Interface Module, 16 kW

	
Open the fan cover. Unscrew the combination screws M5 / 3 Nm	Open the fan cover and remove the connector
	
Break through the 8 expansion rivets	Remove the fans
	
Secure the fans with 8 new expansion rivets	

To install, carry out the above steps in reverse order. The torques must be carefully observed.

Table 2- 20 Replacing the fan in an Active Interface Module, 36 kW

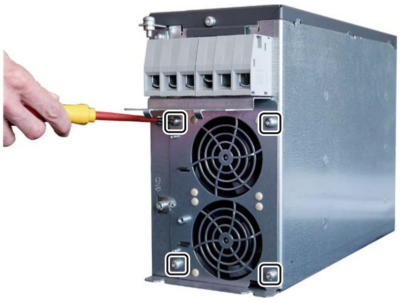
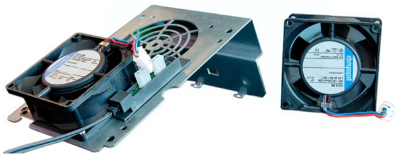
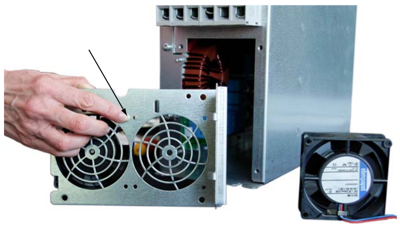
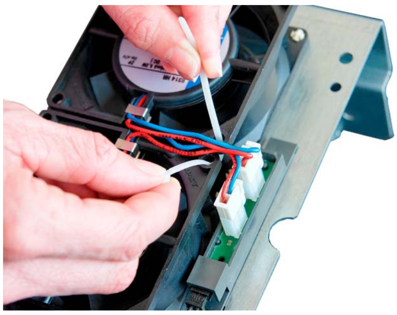
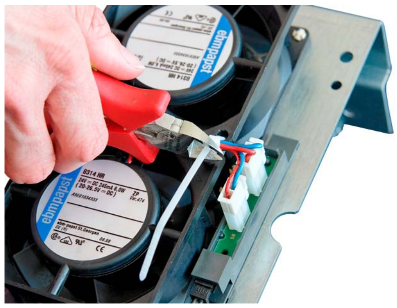
	
Open the fan cover. Unscrew the combination screws M5 / 3 Nm	Open the fan cover and remove the connector
	
Remove the connection cable	Remove the 7 expansion rivets
	
Remove the fans	Secure the fans with 7 new expansion rivets
	
Attach a cable tie around the connection cables	Cut off the protruding end of the cable tie

Table 2- 21 Replacing the fan in an Active Interface Module, 55 kW

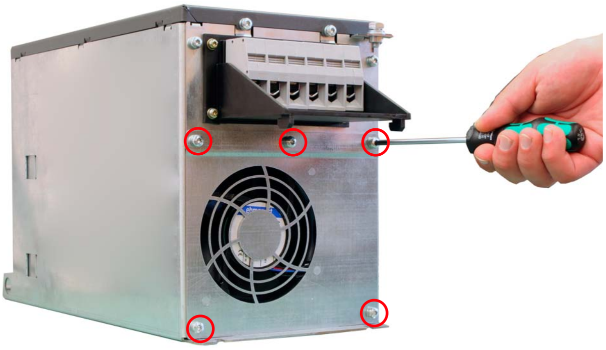
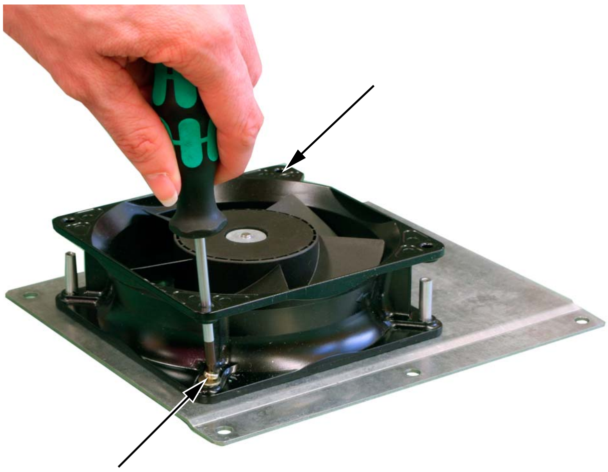
	
Open the fan cover. Unscrew the combination screws M5 / 3 Nm	Open the fan cover and remove the connector
	
Unscrew the screws M3 / 1.8 Nm	Remove the fan

Table 2- 22 Replacing the fan in an Active Interface Module, 80 kW, 120 kW

		
Open the fan cover. Unscrew the combination screws M5 / 3 Nm	Open the fan cover.	Remove the connector.
		
Unscrew the screws M3 / 1.8 Nm	Release the connection cables	Remove the fan

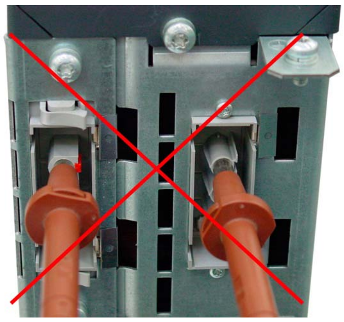
2.9.6 Electrical tests

Tests on the 16 kW Active Interface Module

Electrical tests on the 16 kW Active Interface Module may only be performed via the associated plug 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 2- 23 Electrical test on the 16 kW Active Interface Module

		
Active Interface Module 16 kW	**RIGHT**: Measurement with the original connector accessories supplied	**WRONG**: Measurement via the device sockets

2.9.7 Technical data

Table 2- 24 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 requirements of the 24 VDC electronic power supply	A	0.25	0.49	0.6	1.2	1.2
Line voltage	V	380 V to 480 V 3 AC ±10%				
Line frequency	Hz	47 - 63				
Cooling air requirement	m³/h	112	160	300	600	600
Power loss[1)]	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	M5	M6	M8	M8

1) Based on U_{dc} of 600 V

2.10 Line reactors for Active Line Modules

2.10.1 Description

Line reactors limit line harmonics to permissible values. For this reason, line reactors should always be used. They must be used in conjunction with Active Line Modules as an energy storage feature for the step-up converter function.

HFD line reactors have an additional winding (if compared to HF line reactors), to which the 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. Hence, the damping resistor improves 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.

2.10.2 Safety information

CAUTION

Only the line reactors or Active Interface Modules described in this Equipment Manual are to be used.

The following can occur if line reactors are used that have not been approved for SINAMICS S120 by SIEMENS:

- The Line Modules may become damaged/faulty.

- Line reactions can occur that can damage or interfere with other loads powered from the same network.

CAUTION

If system oscillations do occur and no damping resistor is connected, impermissibly high voltages may arise at the additional winding of the HFD line reactors. For this reason, it is essential that a damping resistor be connected.

CAUTION

The surfaces of the line reactors can become extremely hot. To prevent adjacent components from suffering damage due to these high temperatures, a clearance of 100 mm must be left on all sides of the reactors. If this clearance cannot be observed, additional measures such as shielding plates or a cooling function must be put in place.

CAUTION
Reactors generate magnetic fields. Components and cables which could be subject to interference or be affected by these fields must, therefore, be located a sufficient distance (at least 100 mm) away or be shielded accordingly.

Note

Connection 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 150 mm.

2.10.3 HF line reactors

2.10.3.1 Connection description

Overview

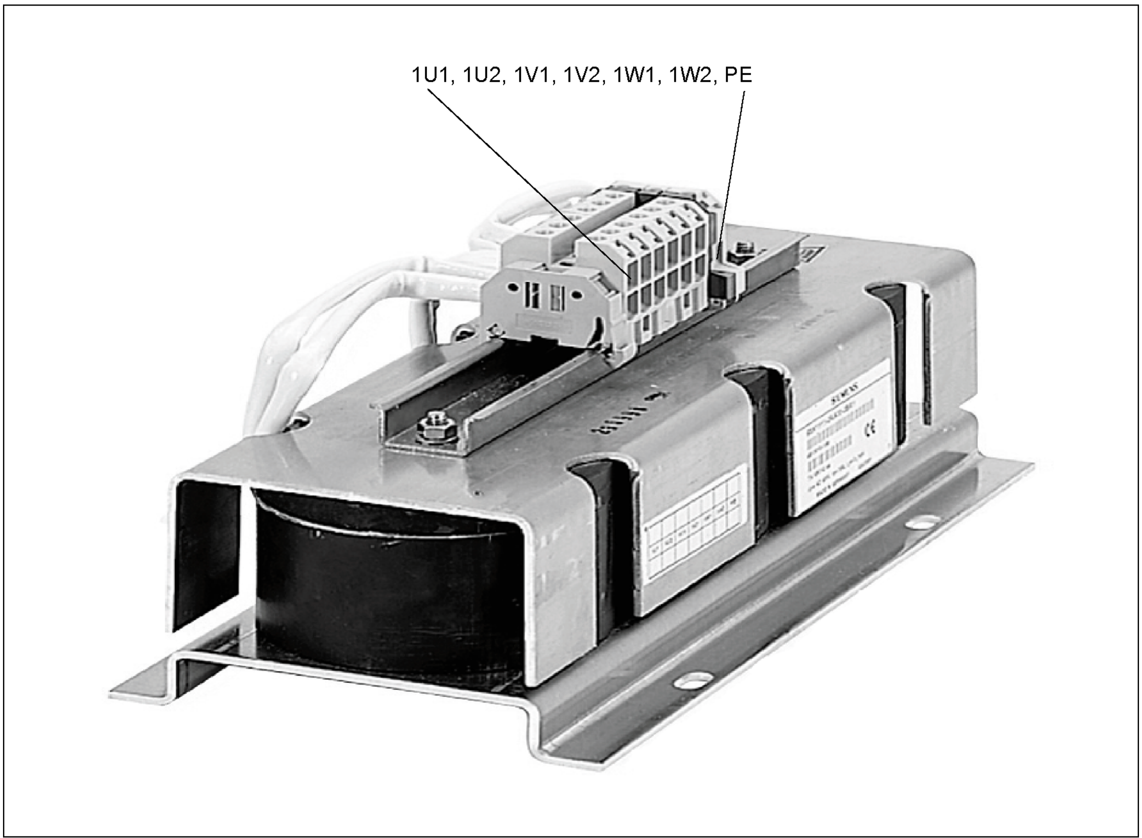


Figure 2-42 Line reactor (example: 16 kW)

Line/load connection

Table 2- 25 Connection of HF line reactors

Order number	6SN1111-0AA00-0AB1	6SN1111-0AA00-0CA1	6SN1111-0AA00-0DA1	6SN1111-0AA00-1EAx	6SL3000-0DE31-2BAx
Power [kW]	16	36	55	80	120
Line supply connection 1U1, 1V1, 1W1	Screw terminal 16 mm² 3-pin/ 6 Nm	Screw terminal 35 mm² 3-pin/ 6 Nm	Screw terminal 70 mm² 3-pin/ 6 Nm	Connecting lug d = 9 mm (M10/25 Nm)	Connecting lug d = 10 mm (M10/25 Nm)
Load connection 1U2, 1V2, 1W2				For ring cable lugs in accordance with DIN 46234 **Note: No touch protection (IP00B acc. to EN 60529)**	
PE connection	Screw terminal 16 mm²/6 Nm	Screw terminal 35 mm²/6 Nm	Screw terminal 70 mm²/6 Nm	Connecting lug d = 9 mm (M10/25 Nm)	Connecting lug d = 10 mm (M10/25 Nm)
				For ring cable lugs in accordance with DIN 46234 **Note: No touch protection (IP00B acc. to EN 60529)**	

2.10.3.2 Dimension drawings

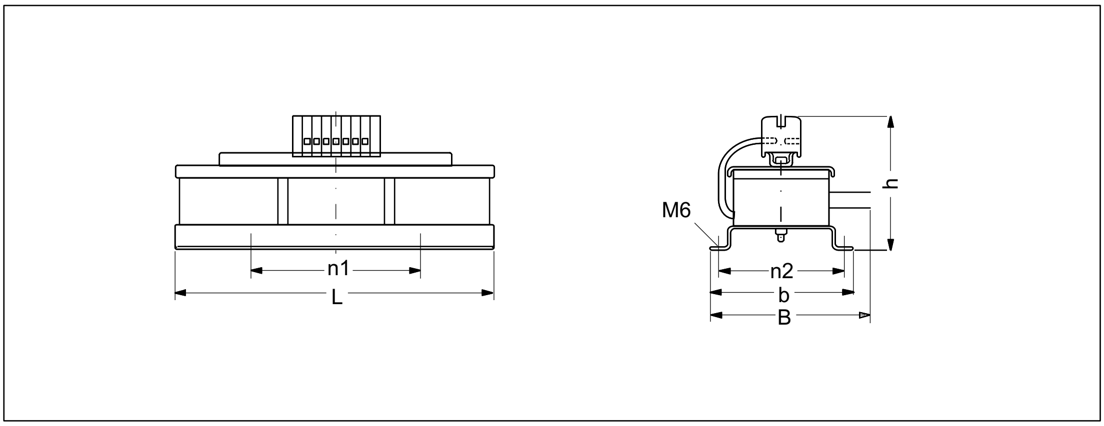


Figure 2-43 Dimension drawing of HF line reactor for Active Line Modules up to 55 kW

Table 2- 26 Dimensions of the line reactor for Active Line Modules

	Order number 6SN1111-	L [mm] (inches)	W [mm] (inches)	h [mm] (inches)	w [mm] (inches)	n_1 [mm] [1)] (inches)	n_2 [mm] [1)] (inches)
16 kW	0AA00-0BA1	330 (12.99)	150 (5.91)	145 (5.71)	150 (5.91)	175 (6.89)	136 (5.35)
36 kW	0AA00-0CA1	330 (12.99)	150 (5.91)	230 (9.06)	150 (5.91)	175 (6.89)	136 (5.35)
55 kW	0AA00-0DA1	330 (12.99)	150 (5.91)	280 (11.02)	150 (5.91)	175 (6.89)	136 (5.35)

1) Dimensions n1 and n2 correspond to the hole spacing

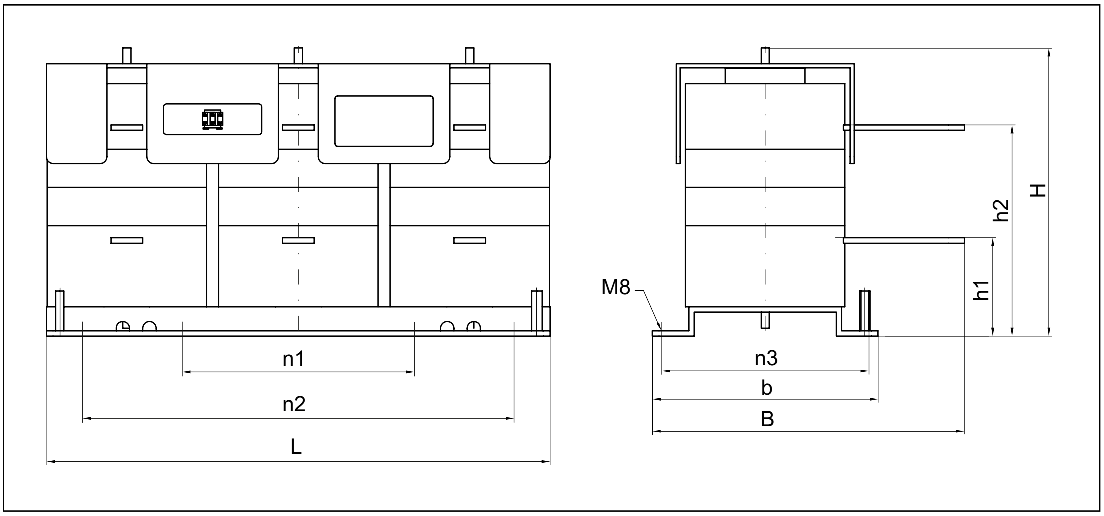


Figure 2-44 Dimension drawing of HF line reactor for Active Line Modules over 80 kW

Table 2- 27 Dimensions of the line reactor for Active Line Modules

	Order number	L [mm] (inches)	W [mm] (inches)	h1 [mm] (inches)	h2 [mm] (inches)	H [mm] (inches)	w [mm] (inches)	n_1 [mm] 1) (inches)	n_2 [mm] 1) (inches)	n_3 [mm] 1) (inches)
80 kW	6SN1111-0AA00-1EAx	380 (14.96)	225 (8.86)	50 (1.70)	170 (6.69)	220 (8.66)	170 (6.69)	175 (6.89)	325 (12.80)	156 (6.14)
120 kW	6SL3000-0DE31-2BAx	476 (18.74)	275 (10.82)	80 (3.14)	215 (8.46)	265 (10.43)	230 (9.05)	175 (6.89)	325 (12.80)	206 (8.11)

1) Dimensions n1, n2 and n3 correspond to the hole spacing

2.10.3.3 Technical data

Table 2- 28 Technical data of HF line reactors for the Active Line Module

	Unit	6SN1111–0AA00-0BA1	6SN1111–0AA00-0CA1	6SN1111–0AA00-0DA1	6SN1111–0AA00-1EAx	6SL3000-0DE31-2BAx
Power	kW	16	36	55	80	120
Rated current	A_{rms}	30	67	103	150	225
Power loss 1)	W	170	250	350	450	590
Weight	kg	13	20	27	35	67
Degree of protection		IP20	IP20	IP20	IP00	IP00

1) For the data for rated operation/an overview, see the power loss tables in the chapter titled "Control cabinet installation".

2.10.4 HFD line reactors

2.10.4.1 Connection description

Overview

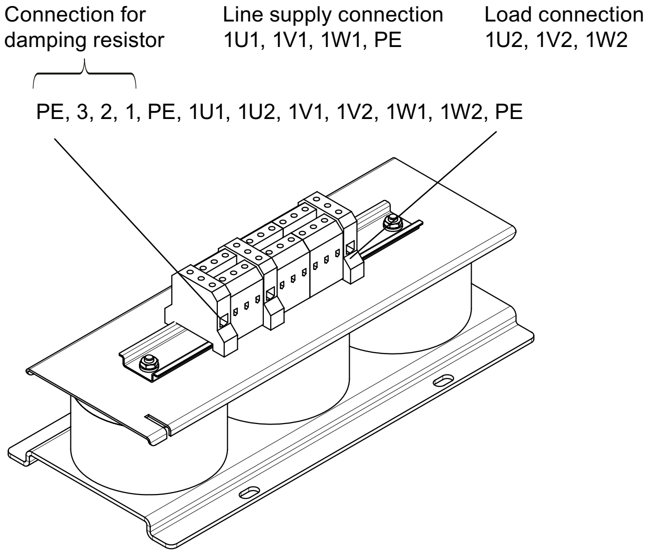


Figure 2-45 HFD line reactor 16 kW

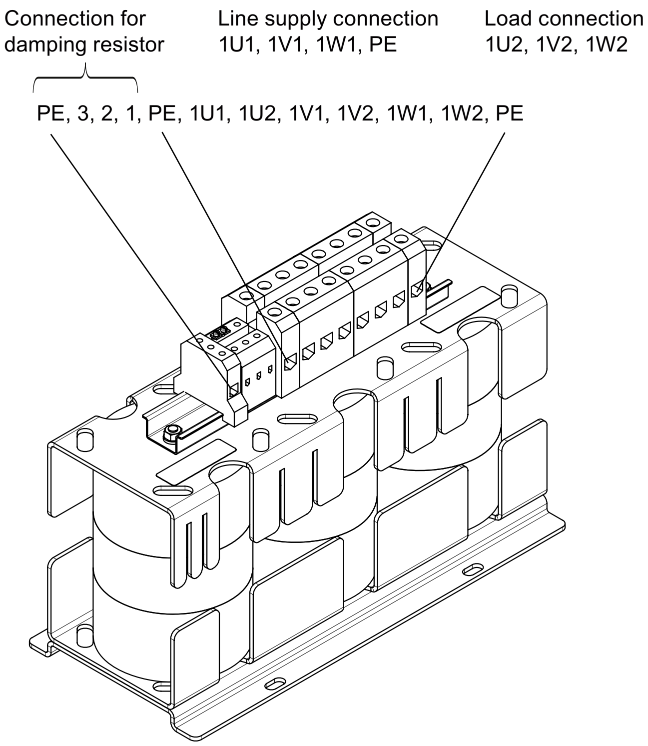


Figure 2-46 HFD line reactor 36 kW

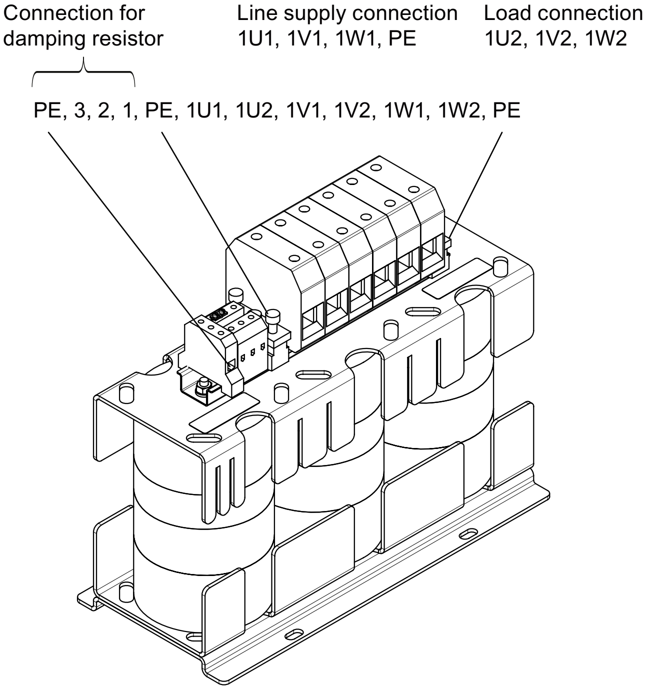


Figure 2-47 HFD line reactor 55 kW

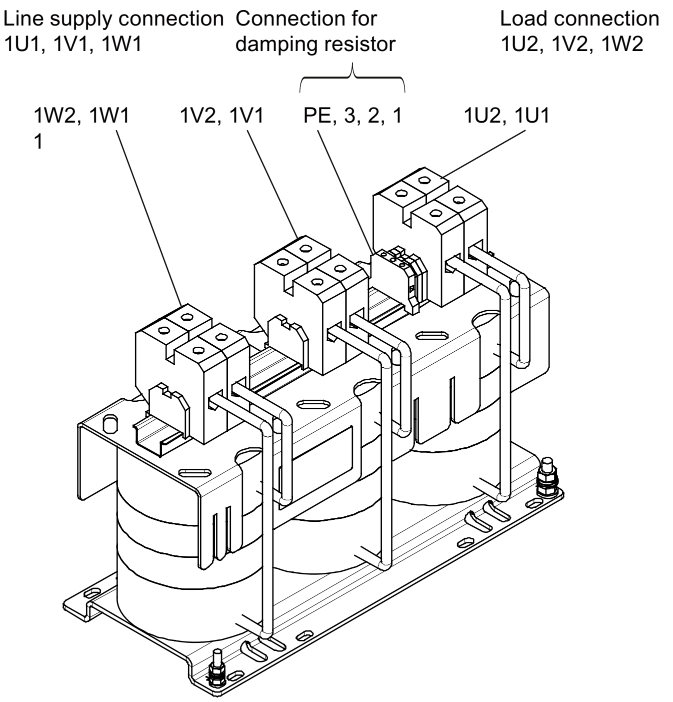


Figure 2-48 HFD line reactor 80 kW

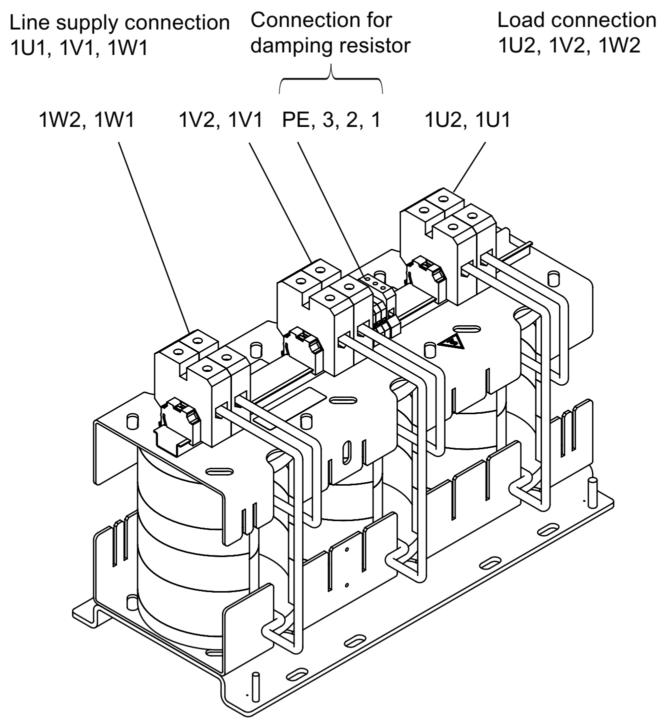


Figure 2-49 HFD line reactor 120 kW

Line/load connection

Table 2- 29 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 mm²/1.2 Nm	Screw terminal 35 mm²/2.5 Nm	Screw terminal 70 mm²/7 Nm	POWER CAGE CLAMPS 95 mm²/self-locking 1)	
Load connection 1U2, 1V2, 1W2				POWER CAGE CLAMPS 95 mm²/self-locking 1)	
PE connection	Screw terminal 16 mm²/1.2 Nm	Screw terminal 35 mm²/2.5 Nm	Screw terminal 70 mm²/3.5 Nm	PE connecting lug M10/25 Nm for ring cable lugs in accordance with DIN 46234	
				Note: No touch protection (IP00B acc. to EN 60529)	
Damping-resistor connection 1, 2, 3 PE	Screw terminal max. 1.5 mm²/1.2 Nm				

1) See chapter Spring-loaded terminals

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.

2.10.4.2 Dimension drawings

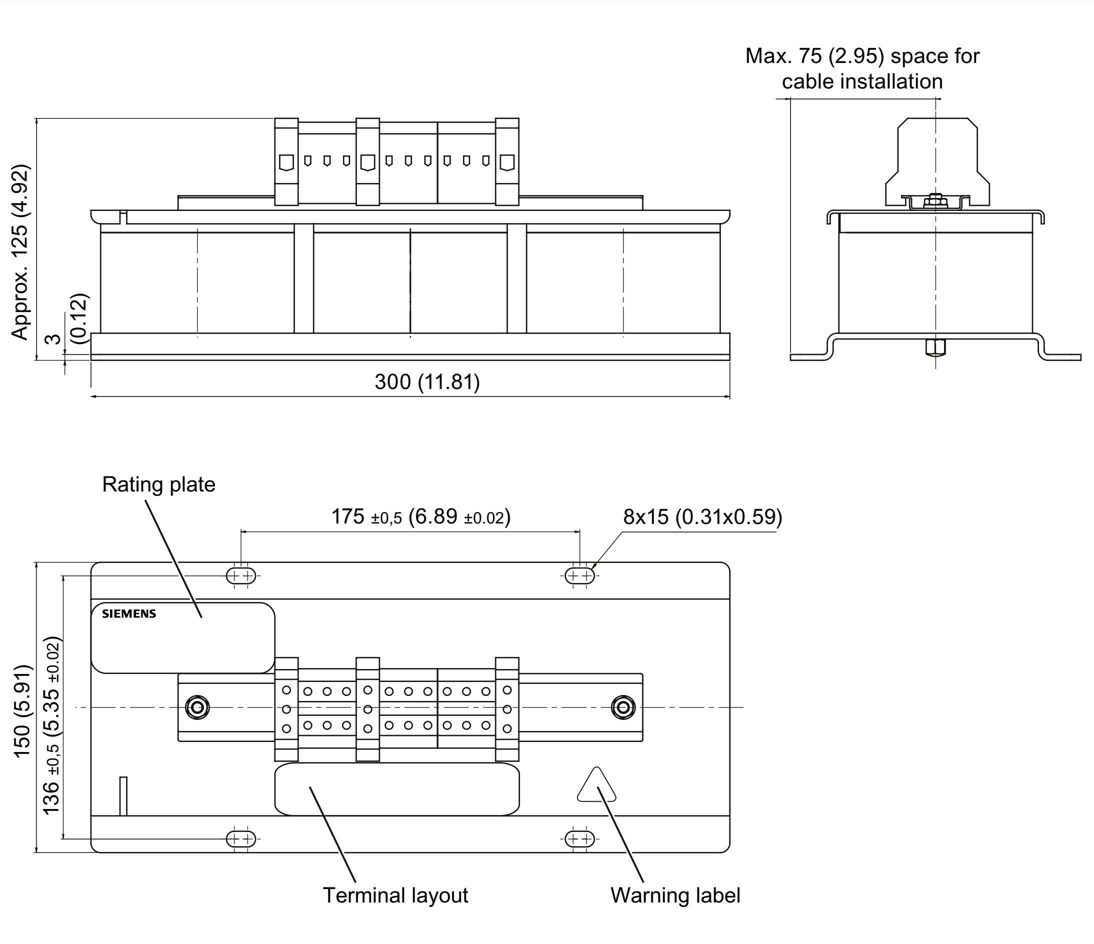


Figure 2-50 Dimension drawing of HFD line reactor 16 kW, all dimensions in mm and (inches)

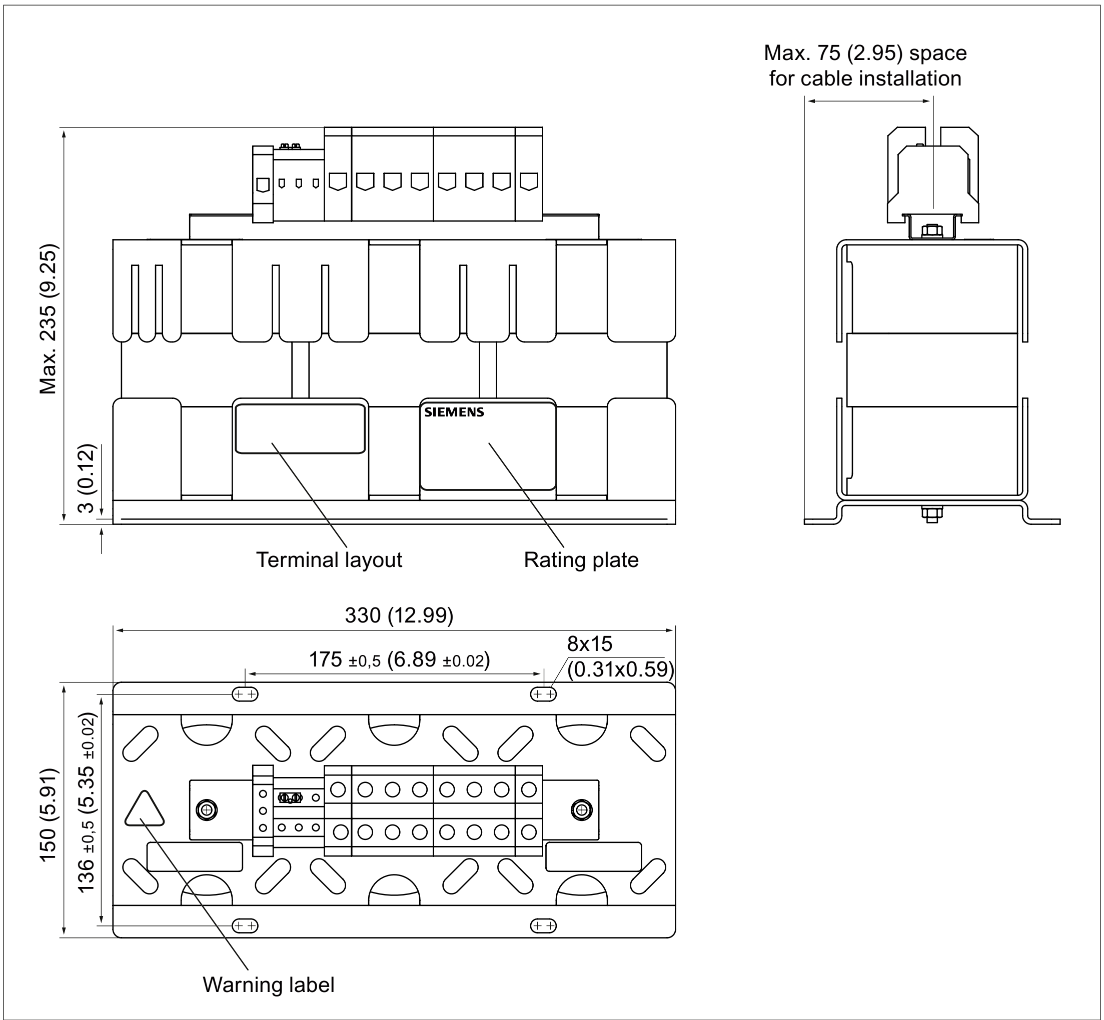


Figure 2-51 Dimension drawing of HFD line reactor 36 kW, all dimensions in mm and (inches)

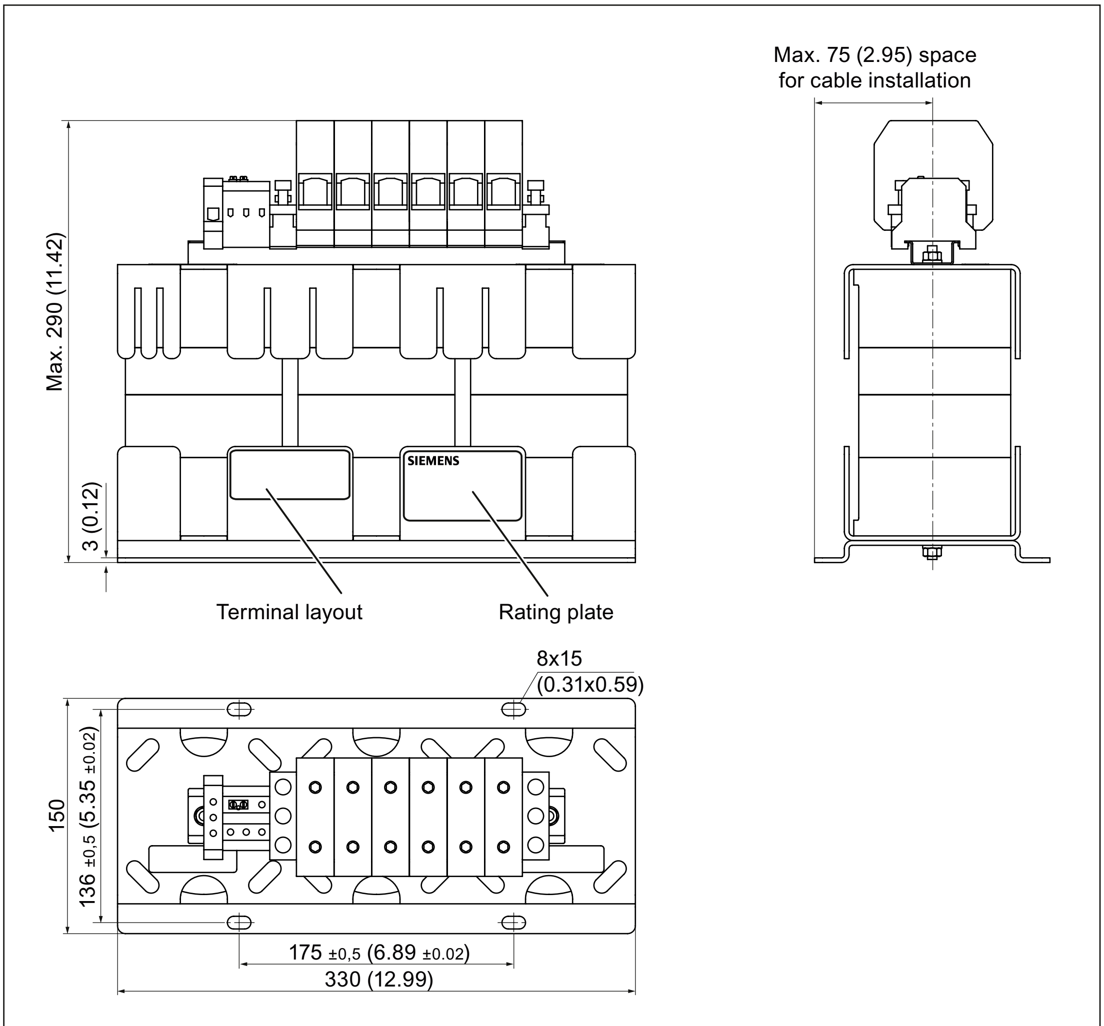


Figure 2-52 Dimension drawing of HFD line reactor 55 kW, all dimensions in mm and (inches)

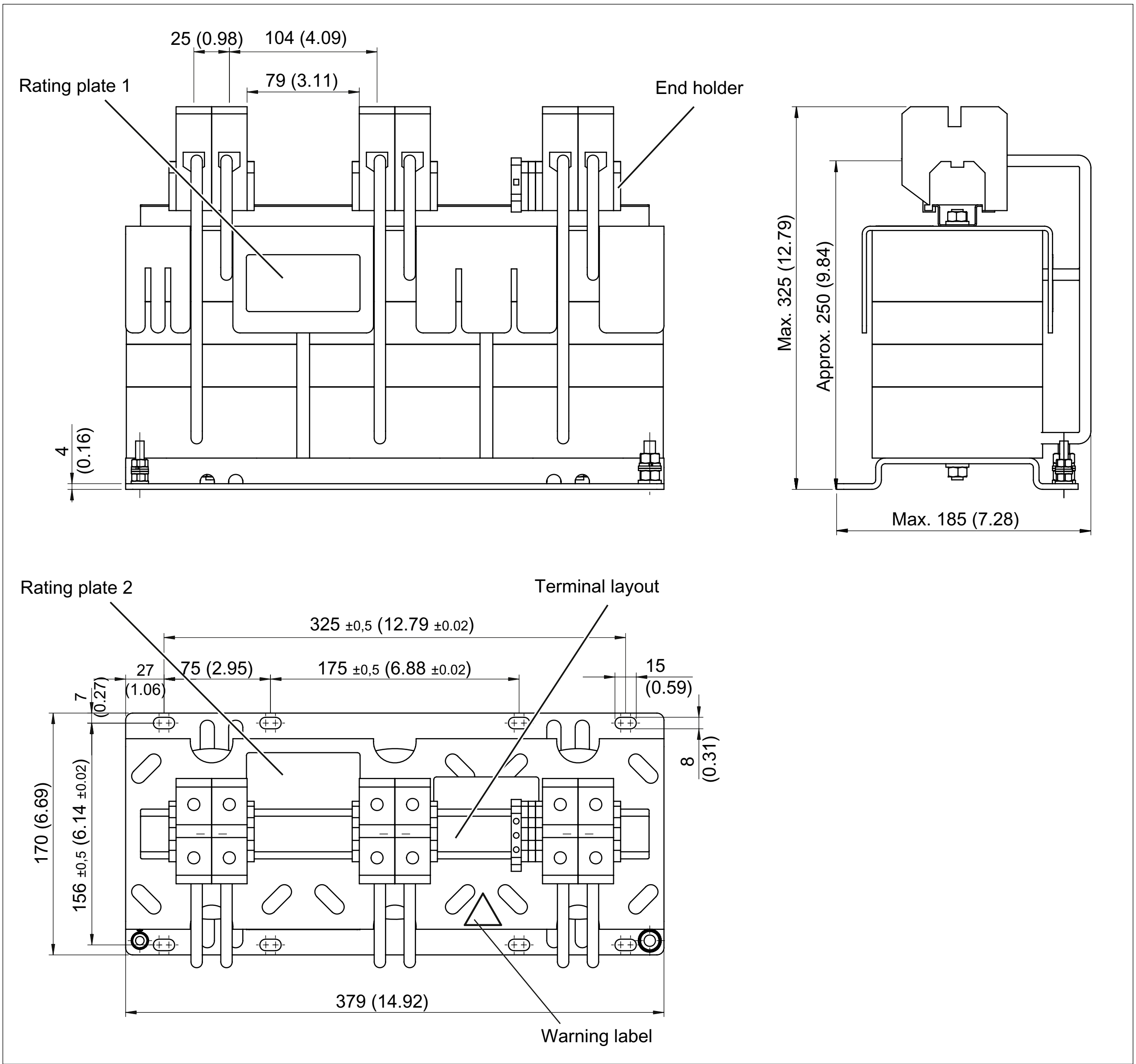


Figure 2-53 Dimension drawing of HFD line reactor 80 kW, all dimensions in mm and (inches)

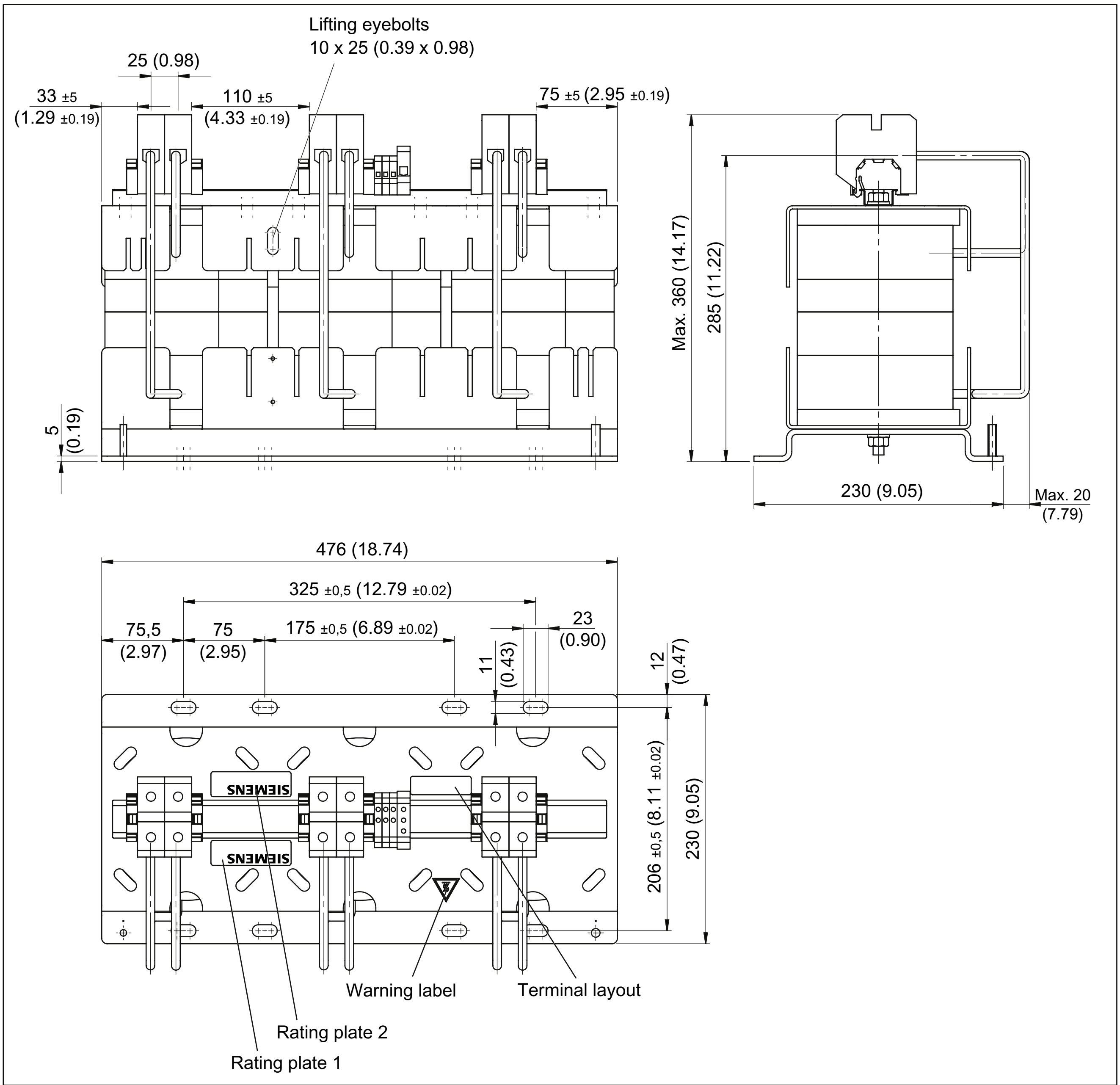


Figure 2-54 Dimension drawing of HFD line reactor 120 kW, all dimensions in mm and (inches)

2.10.4.3 Technical data

Table 2- 30 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)]	W	170	250	350	450	590
Weight	kg	13	21	27	37	67
Mounting position		Any				

1) For the data for rated operation/an overview, see the power loss tables in the chapter titled "Control cabinet installation".

2.10.5 Damping resistor for HFD line reactors

2.10.5.1 Description

Using a damping resistor

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

Note

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

2.10.5.2 Safety information

CAUTION

The damping resistor can become very hot. Consequently, it must be installed so that it cannot be touched or, if this is not possible, an appropriate warning notice must be attached to it.

Note

Ideally, the damping resistor should be mounted externally, i.e. outside of the control cabinet.

2.10.5.3 Dimension drawings

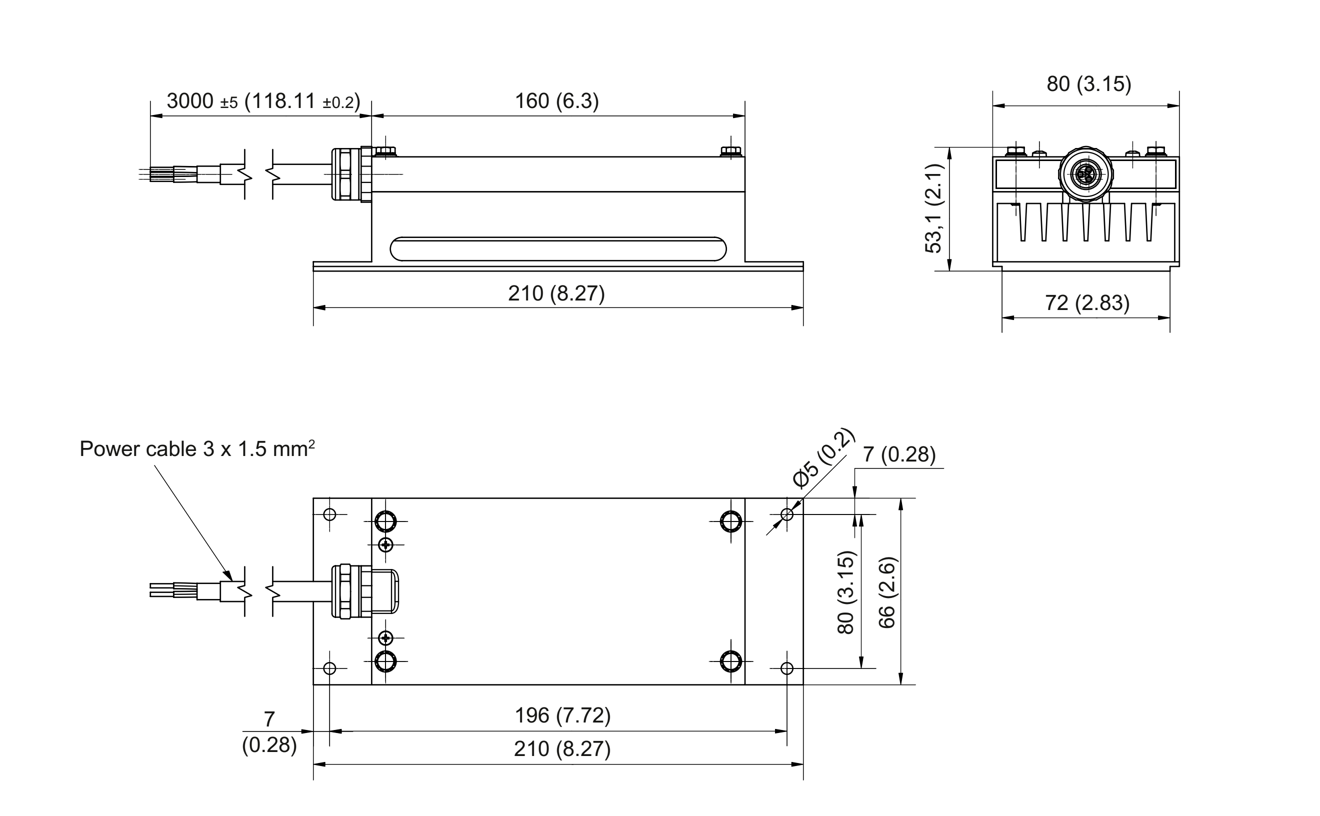


Figure 2-55 300 W damping resistor for HFD line reactors, all dimensions in mm and (inches)

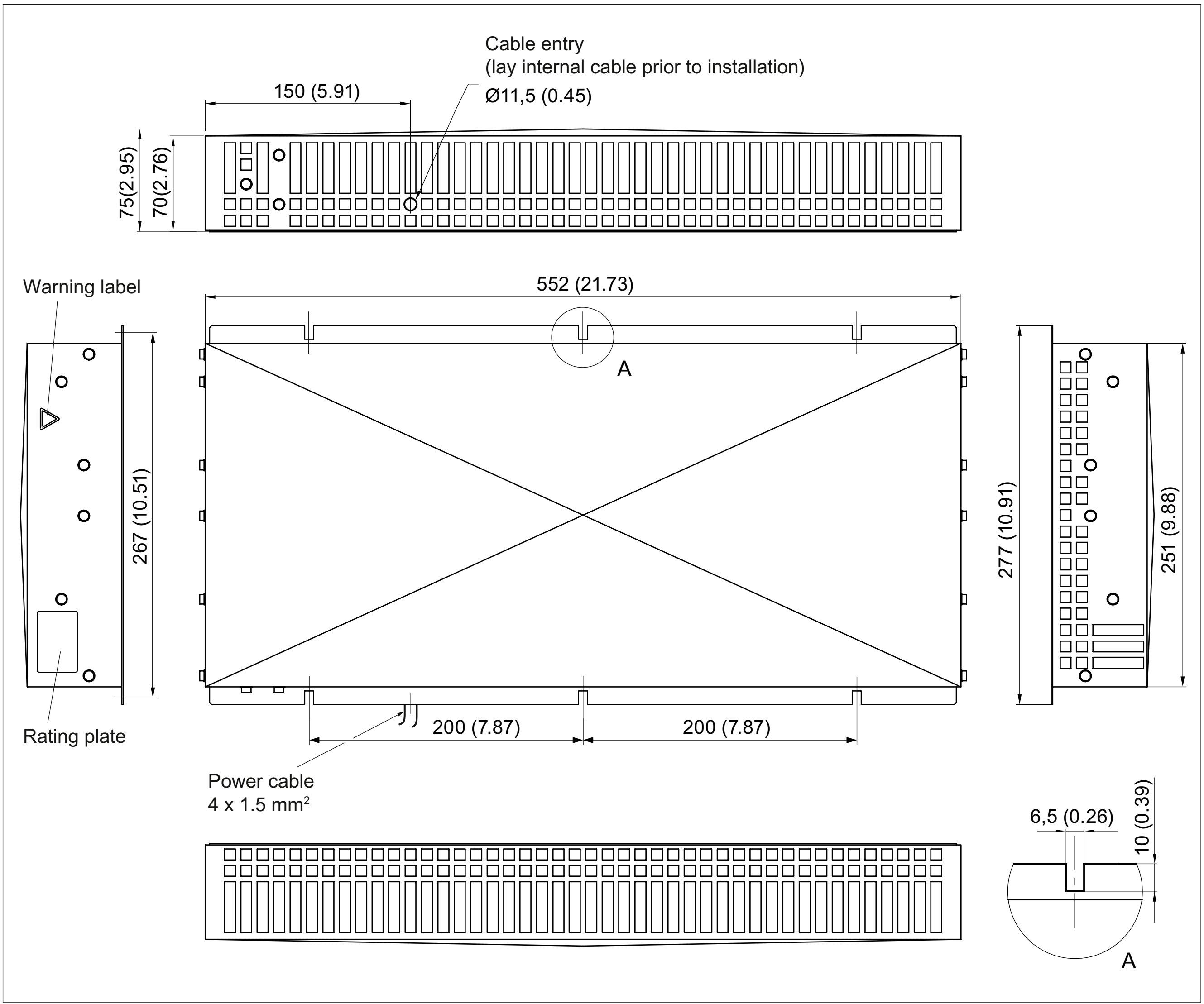


Figure 2-56 800 W damping resistor for HFD line reactors, all dimensions in mm and (inches)

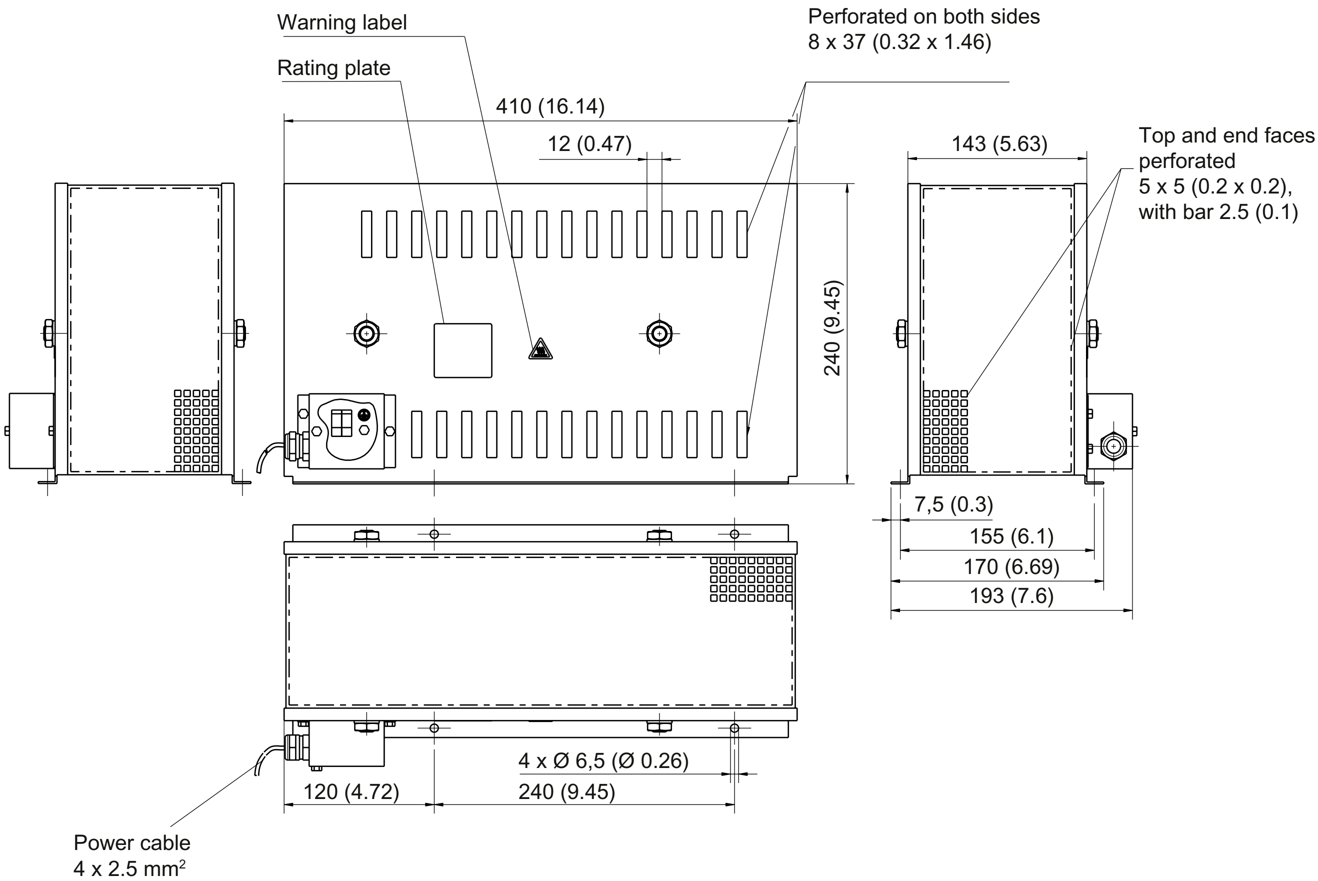


Figure 2-57 1500 W damping resistor for HFD line reactors, all dimensions in mm and (inches)

2.10.5.4 Technical data

Together with the HFD line reactor, an external resistor must be used for damping purposes (see also chapter "Wiring with the HFD line reactor").

Table 2- 31 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
Damping resistor	0 to 230 kHz ≤ 3 dB		
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 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 warm-up run when all axes are shut down in a regulated way:

- After an operating period of over 2 hours, the surface temperature of resistor 6SN1113-1AA00-0DA0 must not exceed 150 °C.
- This warm-up run must be repeated if the hardware configuration, e.g. motor cable lengths, is changed.

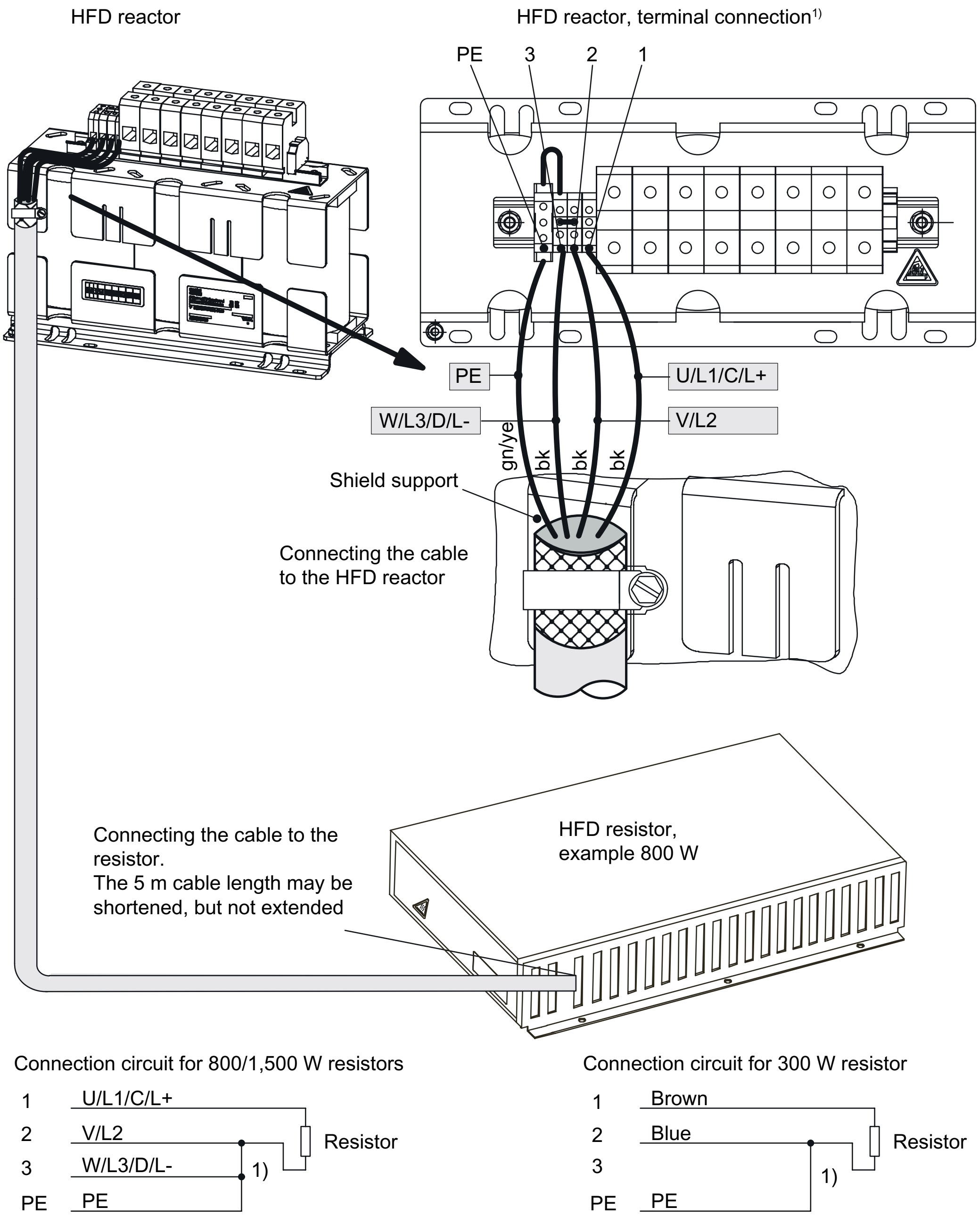
2) Preferred type

3) Alternative possible

Note

Ideally, the 800 W damping resistor should be used.

2.10.5.5 Wiring with the HFD line reactor



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

Note:
No cables may be laid in the immediate vicinity of the damping resistor's warm air flow.

Mounting position:
Any mounting position, take the lost power output into account, attach a "Hot surface" warning notice, if necessary.

Figure 2-58 Wiring the HFD line reactor with a damping resistor

2.11 Line reactors for Smart Line Modules

2.11.1 Description

Line reactors for Smart Line Modules limit low-frequency line harmonics to permissible values. For this reason, line reactors should always be used.

2.11.2 Safety information

CAUTION

A clearance of 100 mm must be maintained around the reactor in order to minimize the influence of magnetic fields in other components and cables.

Note

The connection lines between line reactor and Line Module must be kept as short as possible (max. 10 m).

If at all possible, shielded connecting cables should be used.

Do not route any cables near the line reactor. If this cannot be avoided, observe a minimum distance of 150 mm.

CAUTION

Only the line reactors or Active Interface Modules described in this Manual should be used.

The following can occur if line reactors are used that have not been approved for SINAMICS S120 by SIEMENS:

- The Line Modules may become damaged/faulty.

- Line reactions can occur that can damage or interfere with other loads powered from the same network.

CAUTION

The surface temperature of the line reactors may exceed 80 °C.

2.11.3 Connection description

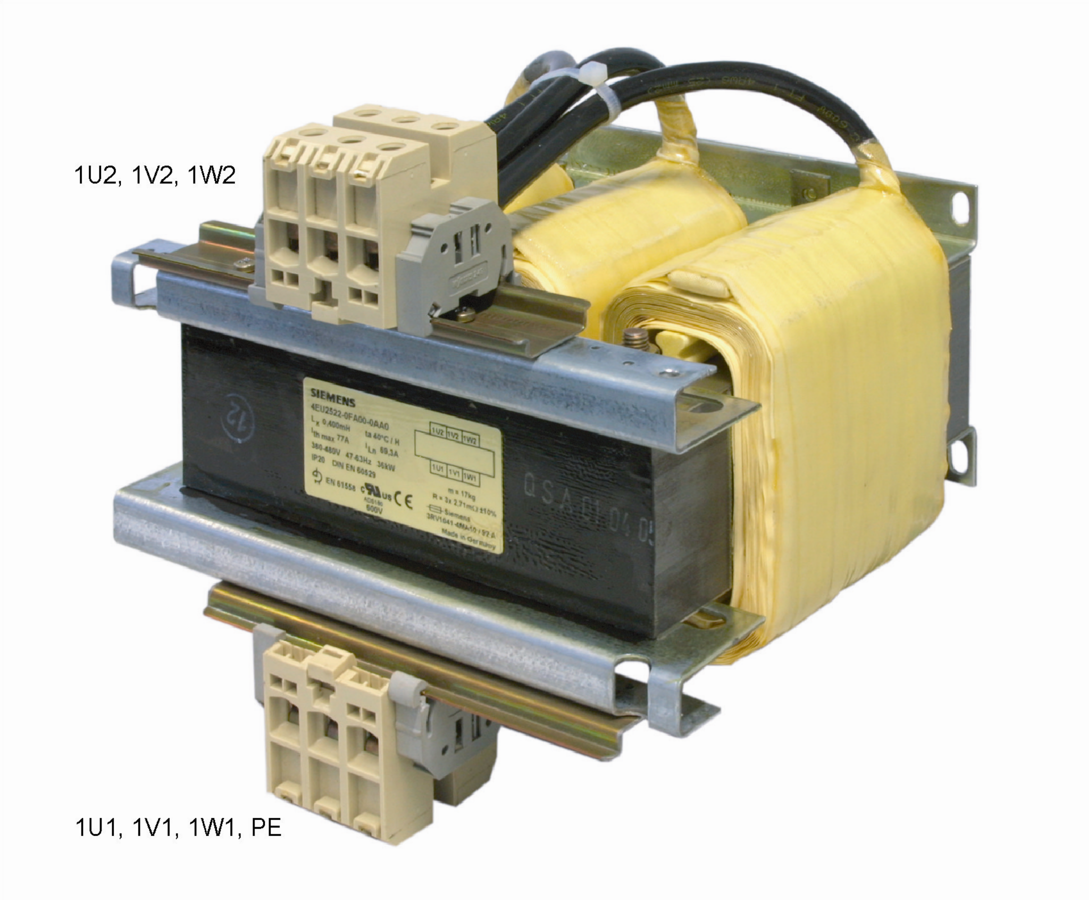


Figure 2-59 Line reactors for Smart Line Modules (example: 36 kW)

2.11.3.1 Line/load connection

Table 2- 32 Connection types for line reactors

Terminals	Designations
Line supply connection	1U1, 1V1, 1W1, PE
Load connection	1U2, 1V2, 1W2
Line reactors for Smart Line Modules	
5 kW	Screw terminal 4 mm² 3-pin[1)]
10 kW	Screw terminal 10 mm² 3-pin[1)]
16 kW	Screw terminal 10 mm² 3-pin with PE connection for ring cable lug M5 to DIN 46234
36 kW	Screw terminal 16 mm² 3-pin with PE connection for ring cable lug M6 to DIN 46234

1) See chapter Screw terminals

2.11.4 Dimension drawings

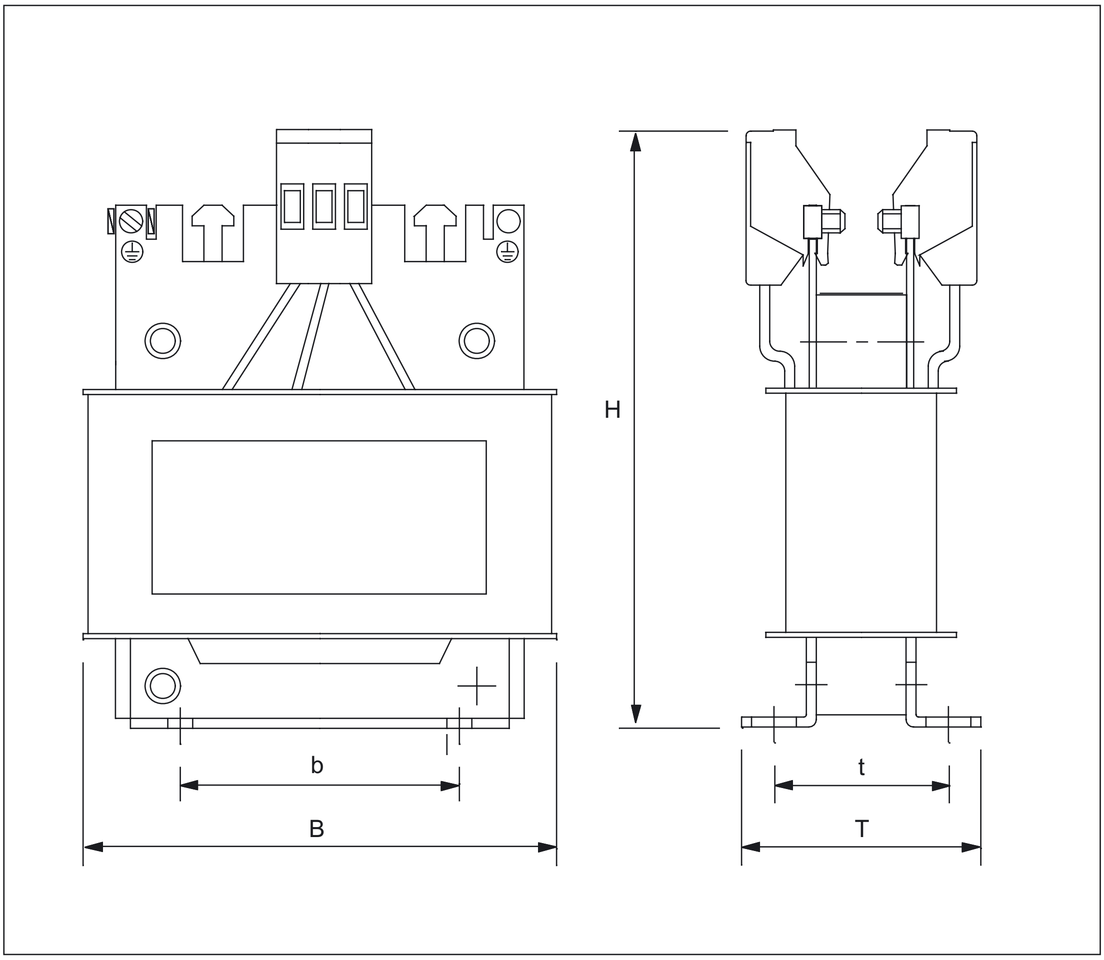


Figure 2-60 Dimension drawing: line reactor for Smart Line Modules (5 and 10 KW)

Table 2- 33 Dimensions of the line filter for Smart Line Modules

	Order number 6SL3000-	W [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) The lengths b and t correspond to the hole spacing						

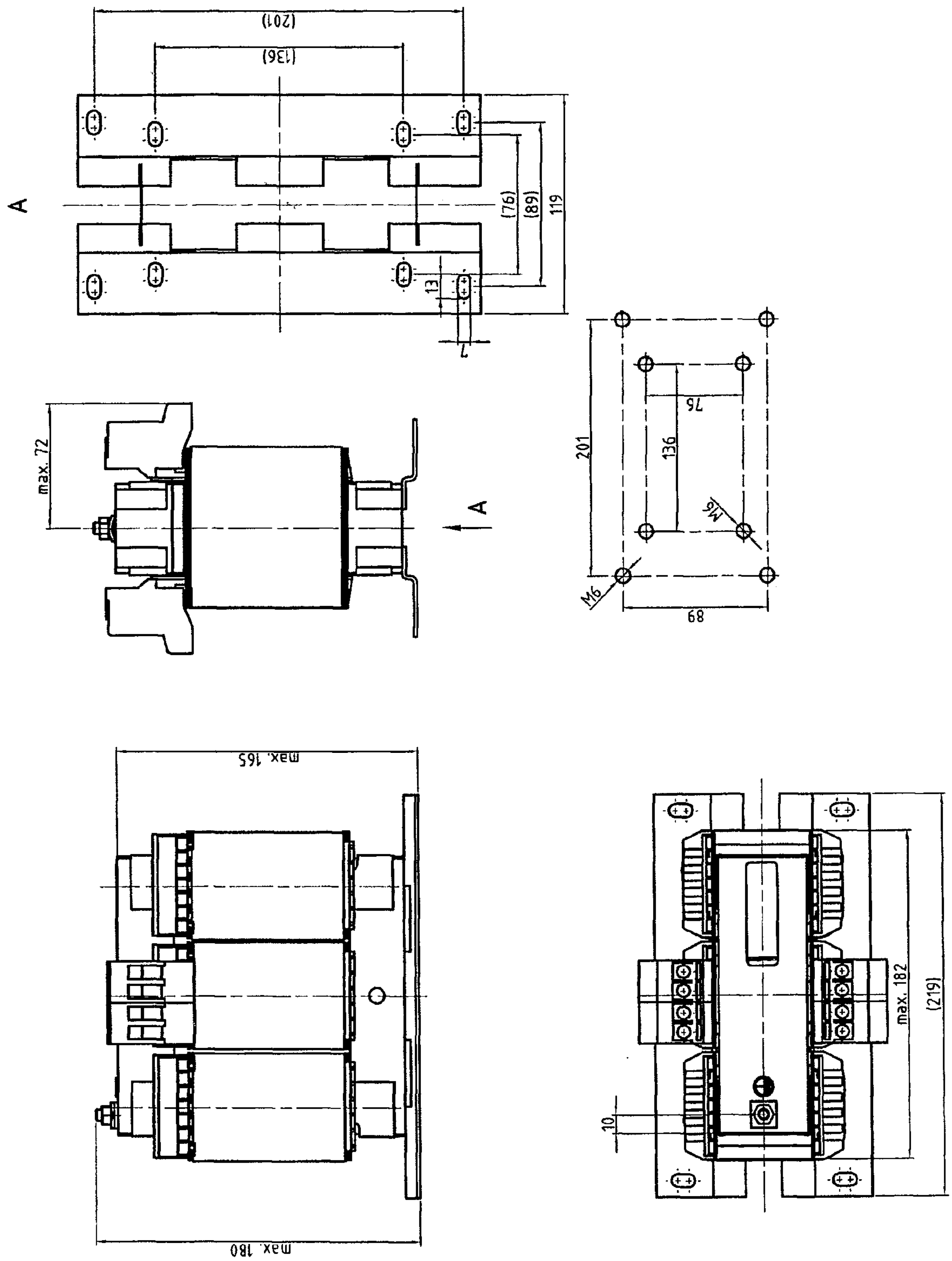
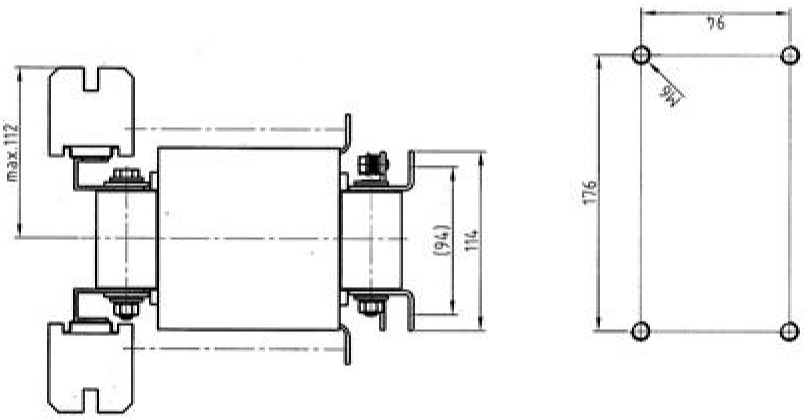


Figure 2-61 Dimension drawing of line reactor for the Smart Line Module 16 kW



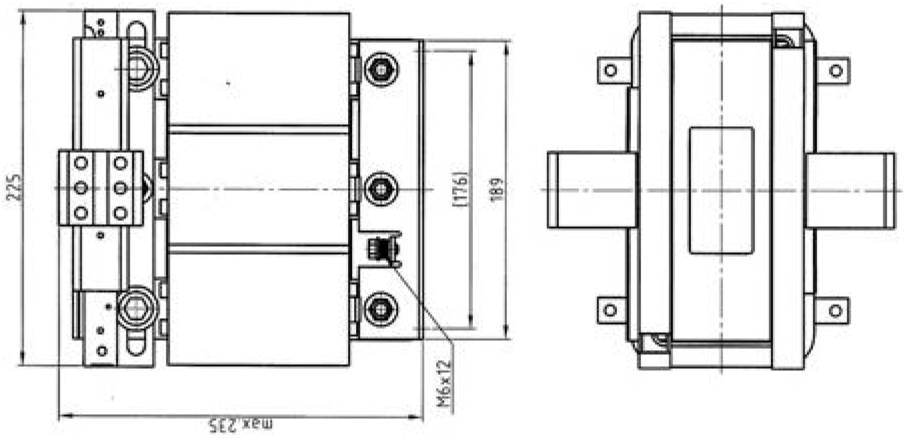


Figure 2-62 Dimension drawing of the line reactor for the Smart Line Module 36 kW

Table 2- 34 Line reactor for the Smart Line Modules 16 kW and 36 kW

	Order No.
16 kW	6SL3000-0CE-21-6AAx
36 KW	6SL3000-0CE-23-6AAx

2.11.5 Technical specifications

Table 2- 35 Technical data of line reactors for the Smart Line Module

	6SL3000- unit	0CE15-0AAx	0CE21-0AAx	0CE21-6AAx	0CE23-6AAx
Power	kW	5	10	16	36
Rated current	A_{rms}	14	28	35	69
Power loss[1]	W	62	116	110	170
Weight	kg	3.7	7.5	9.5	17

[1] For an overview, see the power loss tables in chapter Cabinet Design

2.12 Line reactors for Basic Line Modules

2.12.1 Description

Line reactors for Basic Line Modules limit low-frequency line harmonics to permissible values. For this reason, line reactors should always be used.

2.12.2 Safety information

CAUTION
A clearance of 100 mm must be maintained around the reactor to minimize the influence of magnetic fields in other components and cables.

Note

The connection cables to the Line Module must be as short as possible (max. 10 m).
If possible, they should be shielded.
Unless it can otherwise be avoided, cables must be routed past the line reactor at a minimum distance of 150 mm.

CAUTION
Only the line reactors described in this Manual must be used. The following can occur if line reactors are used that have not been approved for SINAMICS S120 by SIEMENS: - The Line Modules may become damaged/faulty. - Line reactions can occur that can damage or interfere with other loads powered from the same network.

⚠ CAUTION
The surface temperature of the line reactors may exceed 80 °C.

2.12.3 Connection description

2.12.3.1 Overview

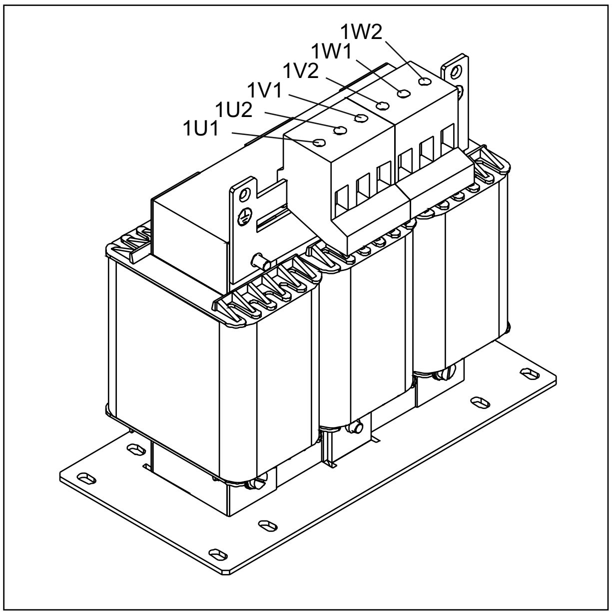


Figure 2-63 Line reactor for Basic Line Module (20 kW)

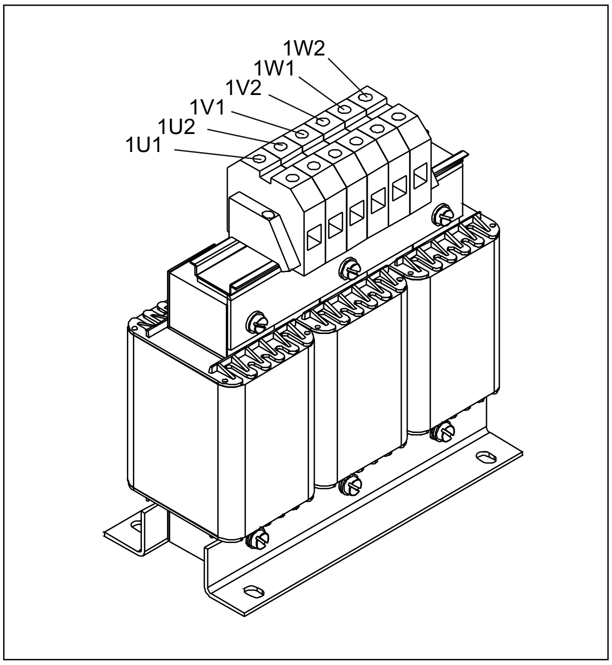


Figure 2-64 Line reactor for Basic Line Module (40 kW)

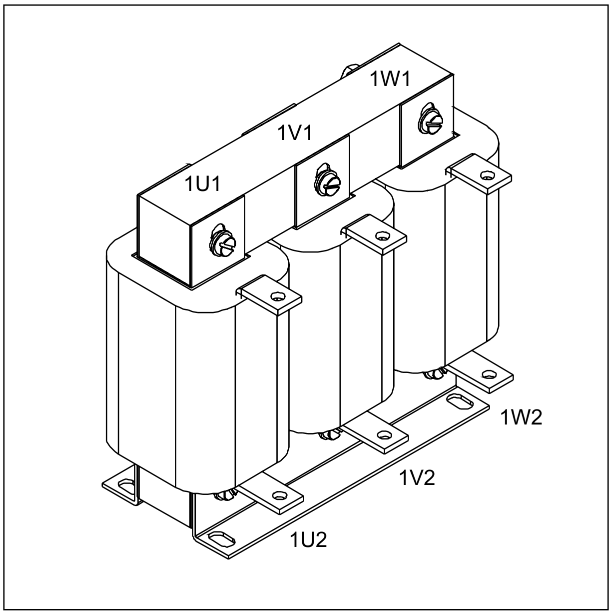


Figure 2-65 Line reactor for Basic Line Module (100 kW)

2.12.3.2 Line/power connection

Table 2- 36 Connection types for line reactors

Terminals	Designations
Line connection	1U1, 1V1, 1W1, PE
Load connection	1U2, 1V2, 1W2
Line reactors for Basic Line Modules	
20 kW	Max. conductor cross-section 16 mm²/0.6 - 0.8 Nm
40 kW	Max. conductor cross-section 35 mm²/2.5 - 5.0 Nm
100 kW	Copper rails with 8.5 mm holes

2.12.4 Dimension drawings

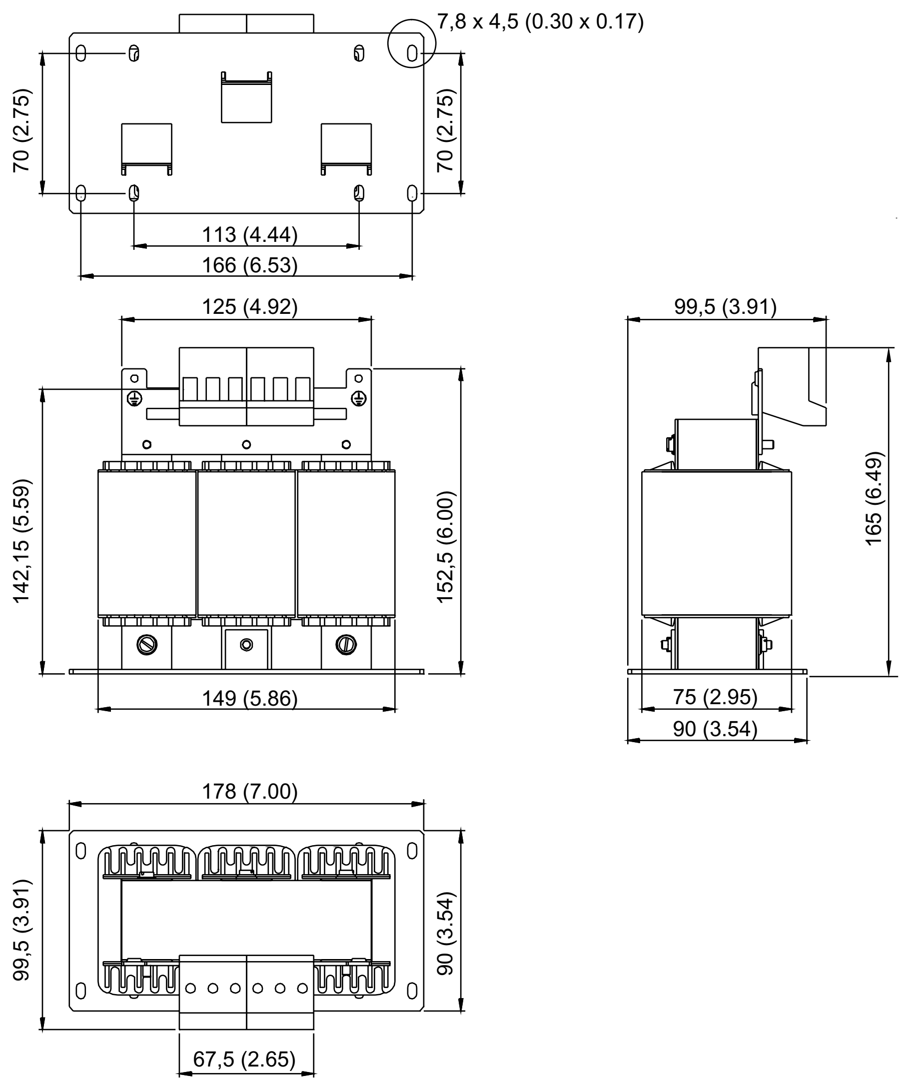


Figure 2-66 Dimension drawing of line reactor for Basic Line Module 20 kW, all dimensions in mm and (inches)

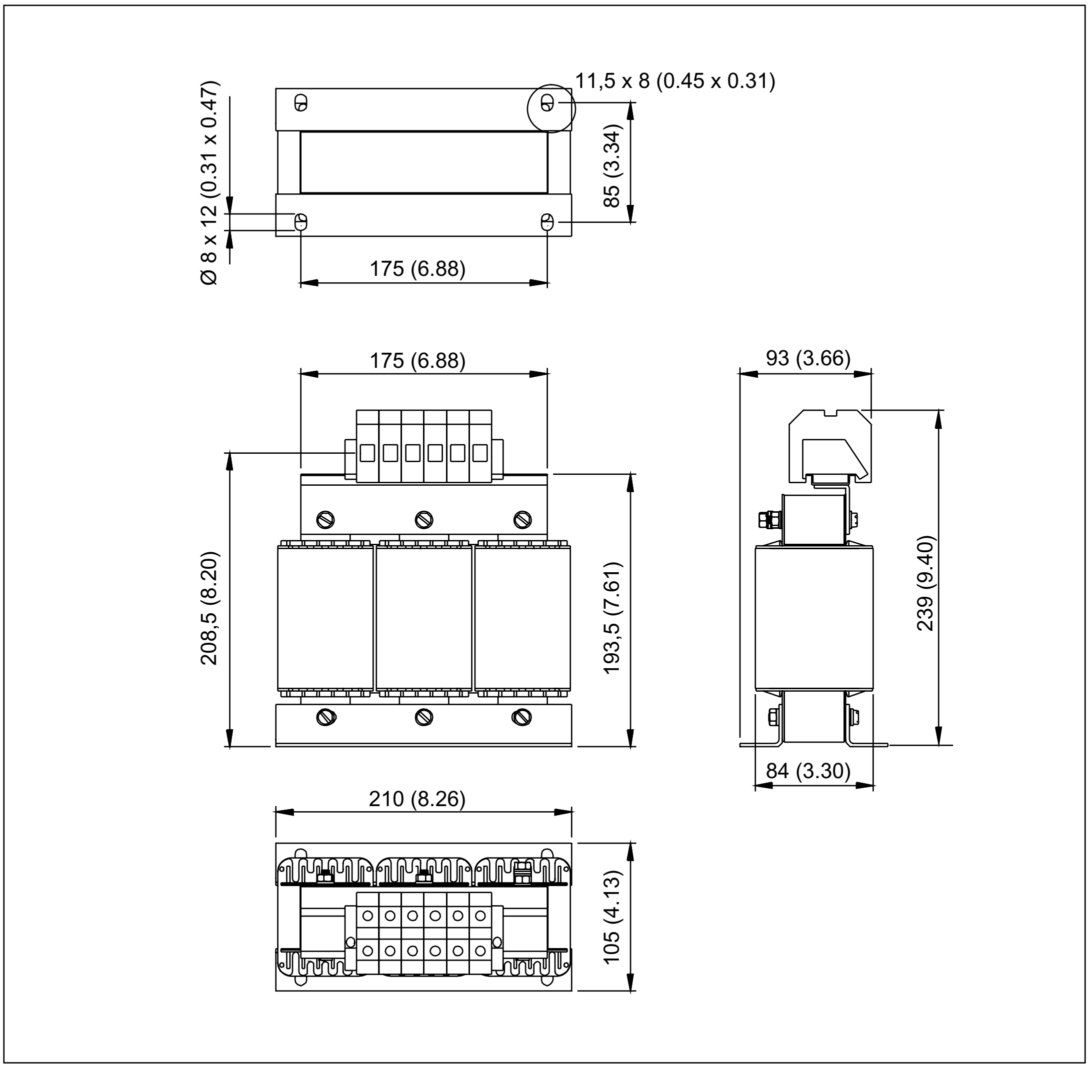


Figure 2-67 Dimension drawing of line reactor for Basic Line Module 40 kW, all dimensions in mm and (inches)

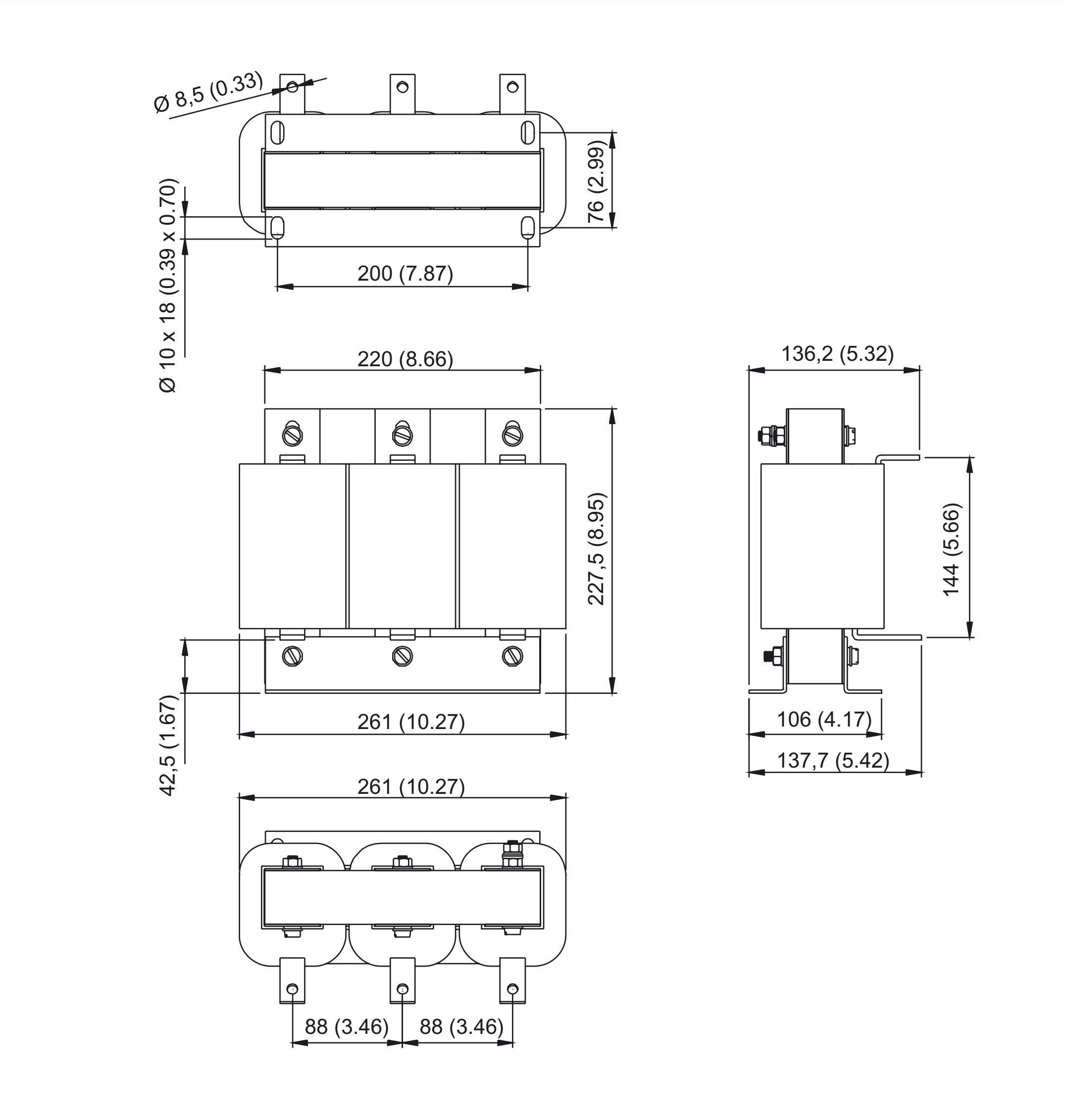


Figure 2-68 Dimension drawing of line reactor for Basic Line Module 100 kW, all dimensions in mm and (inches)

2.12.5 Technical data

Table 2- 37 Technical specifications of line reactors for the Basic Line Modules

	6SL3000 unit	0CE22-0AAx	0CE24-0AAx	0CE31-0AAx
Power	kW	20	40	100
Rated current	A_{rms}	37	74	185
Power loss	W	130	270	480
Weight	kg	5.2	11.2	21.7

2.13 Line connection variants

2.13.1 Ways of connecting the line supply

A distinction is made between:

- Direct operation of the line connection components on the supply system
- Operating line connection components via an autotransformer
- Operating line connection components via an isolating transformer

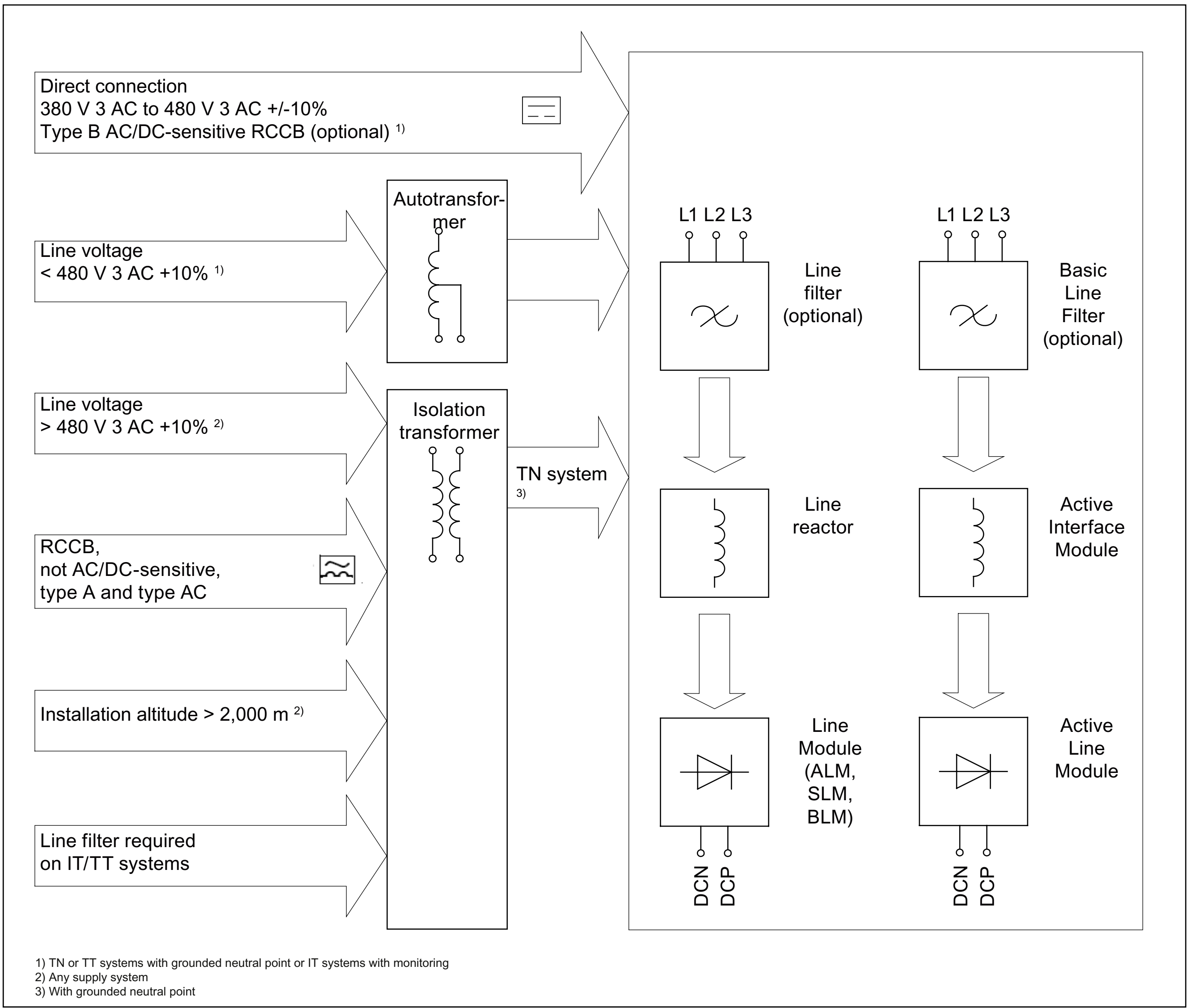


Figure 2-69 Overview of line connection versions

Note

Line connection of motors

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.

In operation on IT systems, the occurrence of a first fault between an active part and ground must be signaled by a monitoring device. In accordance with IEC 60364-4-41, it is recommended that the first fault be eliminated as quickly as is practically possible in order to minimize the temporary overload of the motor insulation.

In all other systems, except TN and TT systems with grounded neutral point and IT systems, such as systems with a grounded line conductor, an isolation transformer with grounded neutral point (secondary side) must be connected between the supply and the drive system in order to protect the motor insulation from excessive stress.

2.13.2 Operation of the line connection components on the supply network

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.

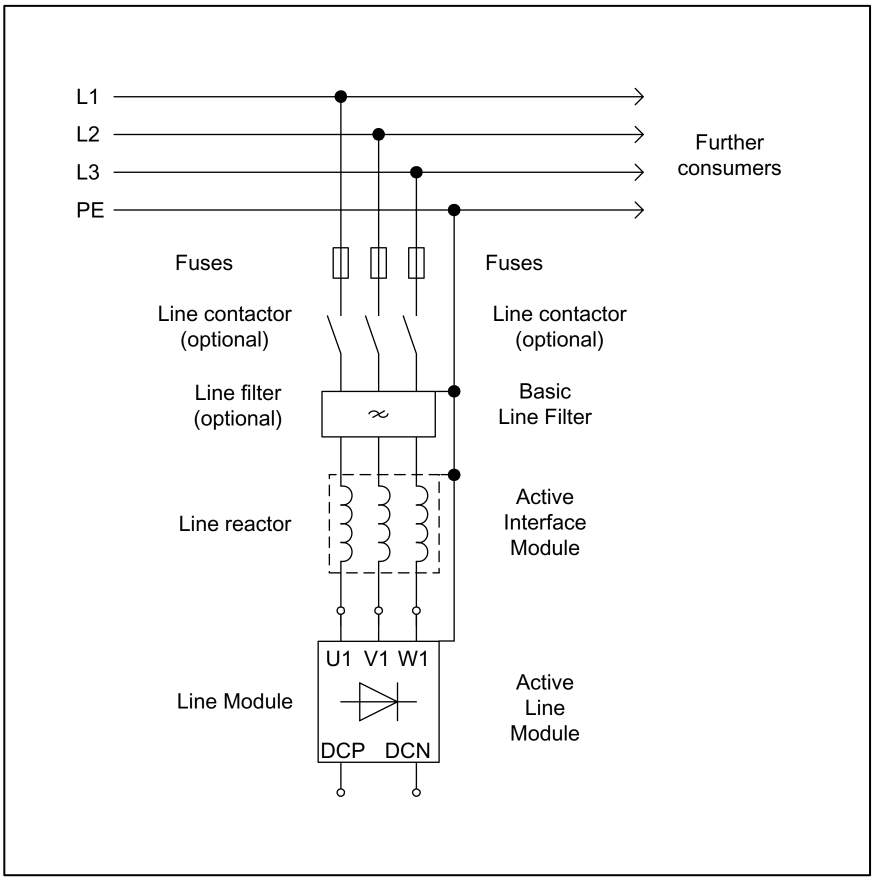


Figure 2-70 Direct operation on the line supply

2.13.3 Operation of the line connection components via a transformer

2.13.3.1 Safety information

NOTICE
If line filters are used that SIEMENS has not certified for use with SINAMICS S120, this can result in harmonics being fed back into the line supply. These harmonics can damage/disturb other equipment connected to this line supply. It is not permissible to connect other loads after the line filter.

NOTICE
If the system fault level is too low, this can result in faults/disturbances at the SINAMICS Line Module. It can also result in faults and damage to other equipment and devices that are connected at the same point of the line supply as the Line Module.

Note

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

2.13.3.2 Line supply connection conditions for Line Modules

Table 2- 38 Line supply connection conditions for Line Modules

Module	Description
Basic Line Module	Operation on line supplies from $S_{Kline}/Pn \geq 30$
Smart Line Module	Operation on line supplies from $S_{Kline}/Pn \geq 70$
Active Line Module	Operation on line supplies from $S_{Kline}/Pn \geq 70$

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.

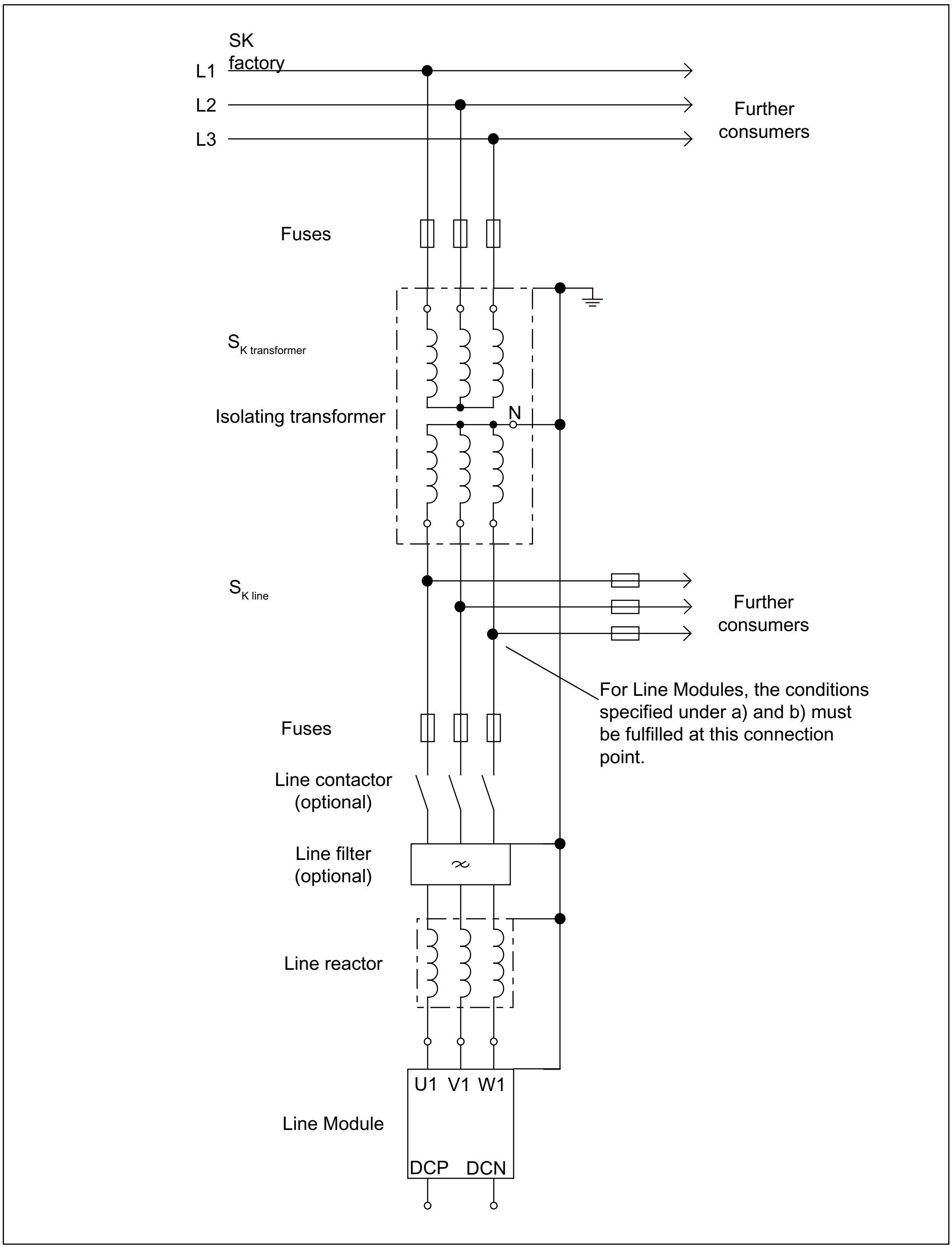
See the chapter titled "Overcurrent protection by means of line fuses and circuit breakers", under the heading "Control cabinet installation and EMC booksize".

Vector group

Suggestion: Dyn0 or Yyn0; this means either a delta or star circuit on the primary side and star circuit on the secondary side where the neutral point is brought-out.

Dimensioning and selecting the matching transformer for several loads

A SINAMICS Line Module and other loads / machines are connected to the matching transformer.



A matching transformer must be dimensioned for the total of all loads connected to it. The apparent powers required for the Line Modules must be determined and added as indicated in the table titled "Transformer configuration instructions". If the transformer S_n or S_k is too small, this can lead to increased line voltage dips and faults in the system 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 followed 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
A sufficiently high system fault level (short-circuit power) is required to ensure that when a fault does occur, the fuses rupture in the specified time. An insufficient system fault level (short-circuit power) increases the time to trip beyond permissible levels (e.g. a fire is possible).

Boundary condition a) Rated power

The rated power (S_{n1}) of the matching transformer must always be 1.27 x P_n Line Module.

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

Example:

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

Boundary condition b) Short-circuit power

In order to avoid faults and disturbances at the other loads that are connected to the secondary side of the matching transformer, the total short-circuit power of the plant connection and that of the matching transformer at the connection point must reach the following values:

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

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

Special case:

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

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

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

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

From $S_{K\ transformer}$ the required rated power of the matching transformer can be calculated.

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

Note:

The system fault level (short-circuit power) at the plant connection $S_{K\ plant}$ plays a decisive role in dimensioning/selecting 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 2- 39 Transformer configuration instructions

Used Active Line Module P_n	Required rated power S_n of the isolation transformer/autotransformer	Required short-circuit voltage u_k	Required system fault level $S_{K\ line}$
16 kW	$S_n \geq 21$ kVA	$u_k \leq 3\%$	$S_{K\ line} \geq 1.12$ MVA
36 kW	$S_n \geq 46$ kVA	$u_k \leq 3\%$	$S_{K\ line} \geq 2.52$ MVA
55 kW	$S_n \geq 70$ kVA	$u_k \leq 3\%$	$S_{K\ line} \geq 3.85$ MVA
80 kW	$S_n \geq 102$ kVA	$u_k \leq 3\%$	$S_{K\ line} \geq 5.6$ MVA
120 kW	$S_n \geq 153$ kVA	$u_k \leq 3\%$	$S_{K\ line} \geq 8.4$ MVA
Used Smart Line Module P_n	**Required rated power S_n of the isolation transformer/autotransformer**	**Required short-circuit voltage u_k**	**Minimum system fault level $S_{K\ line}$ required**
5 kW	$S_n \geq 6.4$ kVA	$u_k \leq 3\%$	$S_{K\ line} \geq 0.35$ MVA
10 kW	$S_n \geq 13$ kVA	$u_k \leq 3\%$	$S_{K\ line} \geq 0.7$ MVA
16 kW	$S_n \geq 21$ kVA	$u_k \leq 3\%$	$S_{K\ line} \geq 1.12$ MVA
36 kW	$S_n \geq 46$ kVA	$u_k \leq 3\%$	$S_{K\ line} \geq 2.52$ MVA
Used Basic Line Module P_n	**Required rated power S_n of the isolation transformer/autotransformer**	**Required short-circuit voltage u_k**	**Minimum system fault level $S_{K\ line}$ required**
20 kW	$S_n \geq 26$ kVA	$u_k \leq 10\%$	$S_{K\ line} \geq 1.4$ MVA
40 kW	$S_n \geq 51$ kVA	$u_k \leq 10\%$	$S_{K\ line} \geq 2.8$ MVA
100 kW	$S_n \geq 127$ kVA	$u_k \leq 10\%$	$S_{K\ line} \geq 7.0$ MVA

Note

Ask your relevant energy provider for the system fault level $S_{K\ line}$.

Example 1

u_k matching transformer = 3%,
$S_{K\ plant}$ = 50,000 kVA
$S_{K\ line}$ = 16 kW • 70 • 0.73 = 820 kVA

According to a)
S_{n1} = 1.27 • 16 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 at a u_k of 3%.

Example 2:

u_k matching transformer = 1%,
$S_{K\ plant}$ = 50,000 kVA
$S_{K\ line}$ = 16 kW • 70 • 0.73 = 820 kVA

According to a)
S_{n1} = 1.27 • 16 kW = 21 kVA

According to b)

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

$S_{n1} > S_{n2} \Rightarrow S_{n1}$ is decisive
The matching transformer requires a rated power S_n of 21 kVA at a u_k of 1%.

Example 3:

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

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

According to a)
S_{n1} = 1.27 • 16 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 at a uk of 3%.

Example 4:

If $S_{K\ plant}$ is smaller, you can use, alternatively to example 3, a transformer with a smaller u_k.
u_k matching transformer = 1%,
$S_{K\ plant}$ = 3,000 kVA
$S_{K\ line}$ = 16 kW • 70 • 0.73 = 820 kVA

According to a)
S_{n1} = 1.27 • 16 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 at a 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.

2.13.3.3 Operation via an autotransformer

Operation of the line connection components via an autotransformer

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

DANGER

To ensure protective separation an isolating transformer must be used for voltages greater than 3-ph. AC 480 V AC +10 %.

Applications:

- The motor insulation must be protected from excessive voltages.
- The active line module must provide a stabilized DC link voltage. This is possible with a rated voltage of 380 V to 415 V.
  A combination with motors that may be operated with a DC link voltage of up to 660 V, and a line voltage > 415 V requires a controlled DC link voltage.

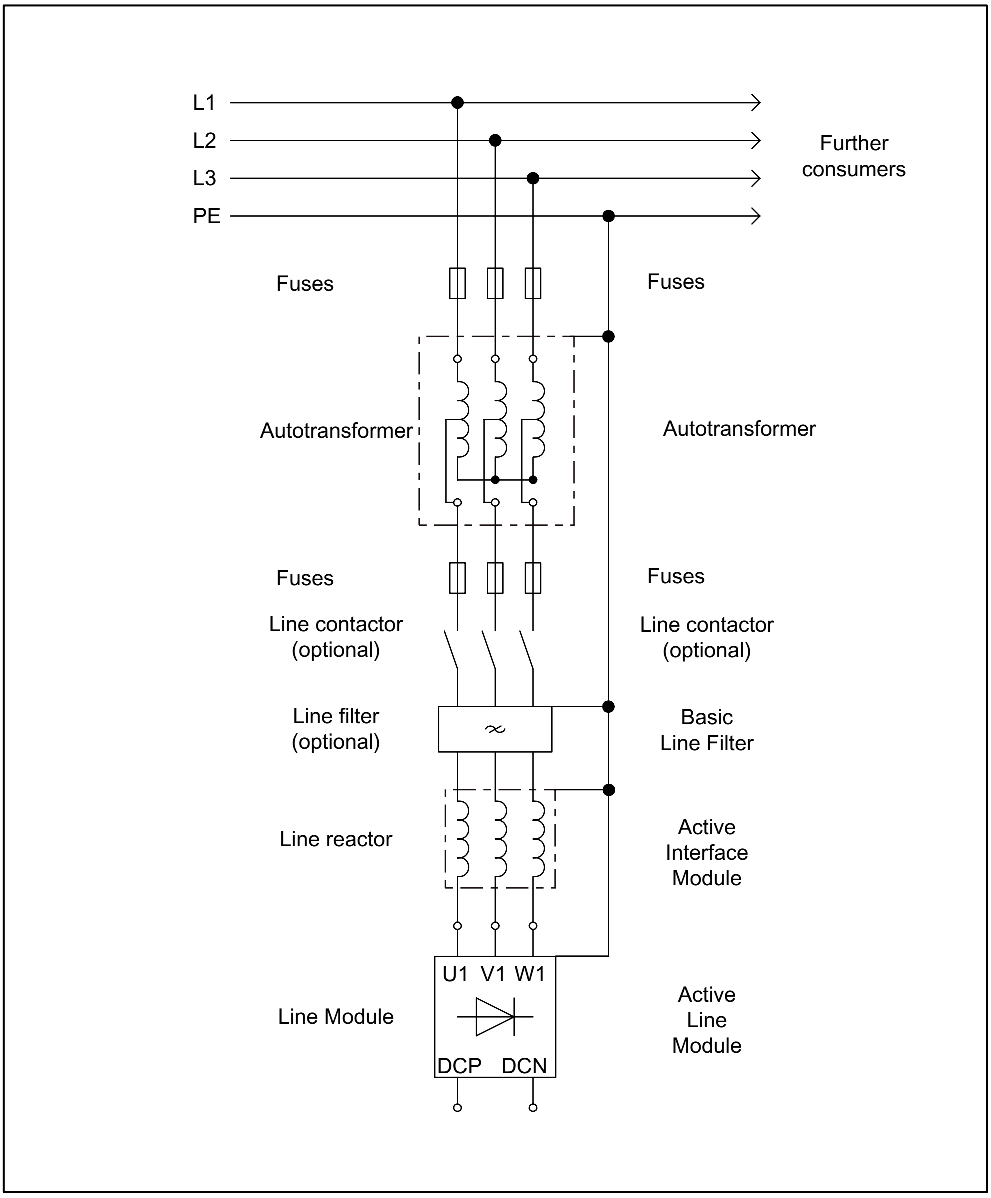


Figure 2-71 Autotransformer

Assignment of autotransformers to Active Line Modules

Table 2- 40 Autotransformers for 480 / 440 V input voltage

	Active Line Module				
	16 kW	**36 kW**	**55 kW**	**80 kW**	**120 kW**
Rated power [kVA] Autotransformer IP00	21	46.5	70.3	104	155
Input voltage [V]	480 / 440 V AC 3-phase ± 10%; 50 Hz - 5% to 60 Hz + 5%				
Output voltage [V]	400 V AC, 3-phase				
Vector group	Yna0				
Permiss. ambient temperature Operation [°C]	-25 to +40, for power de-rating up to +55 °C, ISOKL: H, t_a = 40				
Humidity rating in accordance with EN 60721-3-3	Cl. 3K5, Condensation and icing excluded Low air temperature 0 °C (+32 °F)				
Degree of protection to EN 60529 IP00	Degree of protection IP00: _ → Order no. A				
Order no.	4AP2796-0EL40-2X_0 2)	4AU3696-0ER20-2X_0	4AU3696-2NA00-2X_0	4AU3996-0EQ80-2X_0	4BU4395-0CB50-8B
Power loss [W] Autotransformer IP00	160	430	550	700	700
Short-circuit voltage u_k [%]	≤ 1.5				
Conn. cross-section, max. primary/secondary sides	16 mm²	35 mm²	70 mm²	Flat termination 1)	
Fuse, primary side	35 A gL	80 A gL	125 A gL	160 A gL	224 A gL
Weight [kg], approx. for Degree of protection IP00	29	52	66	95	135
Terminal arrangement	1U1 / 1U3 / 1V1 / 1V3 / 1W1 / 1W3 / 2U1 / 2V1 / 2W1 / N		Flat termination connections 1)		
	1U1 to 1W1 = 480 V input, 1U3 to 1W3 = 440 V input, 2U1 to 2W1 = 400 V output, N = neutral point				

1) FL = flat-type terminal, drill hole Ø 9 mm

2) ISOKL: B, t_a = 40

Table 2- 41 Autotransformers for 220 V input voltage

	Active Line Module				
	16 kW	36 kW	55 kW	80 kW	120 kW
Rated power [kVA] Autotransformer IP00	21	46.5	70.3	104	155
Input voltage [V]	220 V AC 3-phase ± 10%; 50 Hz - 5% to 60 Hz + 5%				
Output voltage [V]	400 V AC, 3-phase				
Vector group	Yna0				
Permiss. ambient temperature Operation [°C]	-25 to +40, for power de-rating up to +55 °C, ISOKL: H, t_a = 40				
Humidity rating in accordance with EN 60721-3-3	Cl. 3K5, Condensation and icing excluded Low air temperature 0 °C (+32 °F)				
Degree of protection to EN 60529 IP00	Degree of protection IP00: _ → Order no. 0				
Order no.	4AU3696-0ER30-2XA0[2]	4BU4395-0CB6_-8B	4BU4595-0BD0_-8B	4BU5295-0AE4_-8B	4BU5495-1AA1_-8B
Power loss [W] Autotransformer IP00	550	900	980	1350	1650
Short-circuit voltage u_k [%]	≤ 1.5				
Conn. cross-section, max. primary/secondary sides	16/16 mm²	70/50 mm²	95/70 mm²	Flat termination 1)	
Fuse, primary side	63 A gL	160 A gL	224 A gL	300 A gL	500 A gL
Weight [kg], approx. for Degree of protection IP00	57	110	155	215	310
Terminal arrangement	1U1 to 1W1 = 220 V input, 2U1 to 2W1 = 400 V output, N = neutral point				

1) FL = flat-type terminal, drill hole Ø 9 mm

2) ISOKL: B, t_a = 40

Assignment of autotransformers to Smart Line Modules

Table 2- 42 Autotransformers for 480 / 440 V input voltage

	Smart Line Module	
	5 kW /10 kW /16 kW	36 kW
Rated power [kVA] Autotransformer IP00	21	46.5
Input voltage [V]	480 / 440 V AC 3-phase ± 10%; 50 Hz - 5% to 60 Hz + 5%	
Output voltage [V]	400 V AC, 3-phase	
Vector group	Yna0	
Permiss. ambient temperature Operation [°C]	-25 to +40, for power de-rating up to +55 °C, ISOKL: H, t_a = 40	
Humidity rating in accordance with EN 60721-3-3	Cl. 3K5, Condensation and icing excluded Low air temperature 0 °C (+32 °F)	
Degree of protection to EN 60529 IP00	Degree of protection IP00: _ → Order no. A	
Order no.	4AP2796-0EL40-2X_0	4AU3696-0ER20-2X_0
Power loss [W] Autotransformer IP00	160	430
Short-circuit voltage u_k [%]	≤ 1.5	
Conn. cross-section, max. primary/secondary sides	16 mm²	35 mm²
Fuse, primary side	35 A gL	80A gL
Weight [kg], approx. for Degree of protection IP00	29	52
Terminal arrangement	1U1 / 1U3 / 1V1 / 1V3 / 1W1 / 1W3 / 2U1 / 2V1 / 2W1 / N	
	1U1 to 1W1 = 480 V input, 1U3 to 1W3 = 440 V input, 2U1 to 2W1 = 400 V output, N = neutral point	

Table 2- 43 Autotransformers for 220 V input voltage

	Smart Line Module	
	5 kW /10 kW /16 kW	36 kW
Rated power [kVA] Autotransformer IP00	21	46.5
Input voltage [V]	220 V AC 3-phase ± 10%; 50 Hz - 5% to 60 Hz + 5%	
Output voltage [V]	400 V AC, 3-phase	
Vector group	Yna0	
Permiss. ambient temperature Operation [°C]	-25 to +40, for power de-rating up to +55 °C, ISOKL: H, t_a = 40	
Humidity rating in accordance with EN 60721-3-3	Cl. 3K5, Condensation and icing excluded Low air temperature 0 °C (+32 °F)	
Degree of protection to EN 60529 IP00	Degree of protection IP00: _ → Order no. 0	
Order no.	4AU3696-0ER30-2XA0	4BU4395-0CB6_-8B
Power loss [W] Autotransformer IP00	550	900
Short-circuit voltage u_k [%]	≤ 1.5	
Conn. cross-section, max. primary/secondary sides	16/16 mm²	70/50 mm²
Fuse, primary side	63 A gL	160 A gL
Weight [kg], approx. for Degree of protection IP00	57	110
Terminal arrangement	1U1 to 1W1 = 220 V input, 2U1 to 2W1 = 400 V output, N = neutral point	

Assignment of autotransformers to Basic Line Modules

Table 2- 44 Autotransformers for 480 / 440 V input voltage

	Basic Line Modules		
	20 kW	40 kW	100 kW
Rated power [kVA] Autotransformer IP00	46.5	70.3	155
Input voltage [V]	480 / 440 V AC 3-phase ± 10%; 50 Hz - 5% to 60 Hz + 5%		
Output voltage [V]	400 V AC, 3-phase		
Vector group	Yna0		
Permiss. ambient temperature Operation [°C]	-25 to +40, for power de-rating up to +55 °C, ISOKL: H, t_a = 40		
Humidity rating in accordance with EN 60721-3-3	Cl. 3K5, Condensation and icing excluded Low air temperature 0 °C (+32 °F)		
Degree of protection to EN 60529 IP00	Degree of protection IP00: _ → Order no. A		
Order no.	4AU3696- 0ER20-2X_0	4AU3696- 2NA00-2X_0	IP00: 4BU4395- 0CB50-8B
Power loss [W] Autotransformer IP00	430	550	700
Short-circuit voltage u_k [%]	≤ 1.5		
Conn. cross-section, max. primary/secondary sides	35 mm²	70 mm²	Flat termination 1)
Fuse, primary side	80 A gL	125 A gL	224 A gL
Weight [kg], approx. for Degree of protection IP00	52	66	135
Terminal arrangement	1U1 / 1U3 / 1V1 / 1V3 / 1W1 / 1W3 / 2U1 / 2V1 / 2W1 / N		Flat termination connections
	1U1 to 1W1 = 480 V input, 1U3 to 1W3 = 440 V input, 2U1 to 2W1 = 400 V output, N = neutral point		

1) FL = flat-type terminal, drill hole Ø 9 mm

Table 2- 45 Autotransformers for 220 V input voltage

	Basic Line Modules		
	20 kW	40 kW	100 kW
Rated power [kVA] Autotransformer IP00	46.5	70.3	155
Input voltage [V]	220 V AC 3-phase ± 10%; 50 Hz - 5% to 60 Hz + 5%		
Output voltage [V]	400 V AC, 3-phase		
Vector group	Yna0		
Permiss. ambient temperature Operation [°C]	-25 to +40, for power de-rating up to +55 °C, ISOKL: H, t_a = 40		
Humidity rating in accordance with EN 60721-3-3	Cl. 3K5, Condensation and icing excluded Low air temperature 0 °C (+32 °F)		
Degree of protection to EN 60529 IP00	Degree of protection IP00: _ --> Order no. 0		
Order no.	4BU4395-0CB6_-8B	4BU4595-0BD0_-8B	4BU5495-1AA1_-8B
Power loss [W] Autotransformer IP00	900	980	1650
Short-circuit voltage u_k [%]	≤ 1.5		
Conn. cross-section, max. primary/secondary sides	70/50 mm²	95/70 mm²	Flat termination 1)
Fuse, primary side	160 A gL	224 A gL	500 A gL
Weight [kg], approx. for Degree of protection IP00	110	155	310
Terminal arrangement	1U1 to 1W1 = 220 V input, 2U1 to 2W1 = 400 V output, N = neutral point		

1) FL = flat-type terminal, drill hole Ø 9 mm

2.13.3.4 Operation via an isolation transformer

Operation of the line connection components via an isolating transformer

The isolating transformer converts the network configuration of the system (e.g. IT/TT 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 higher 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.

CAUTION
If the supply voltage is greater than 480 V +10 %, it is not permissible to use an autotransformer. An isolating transformer must be used to ensure protective separation.

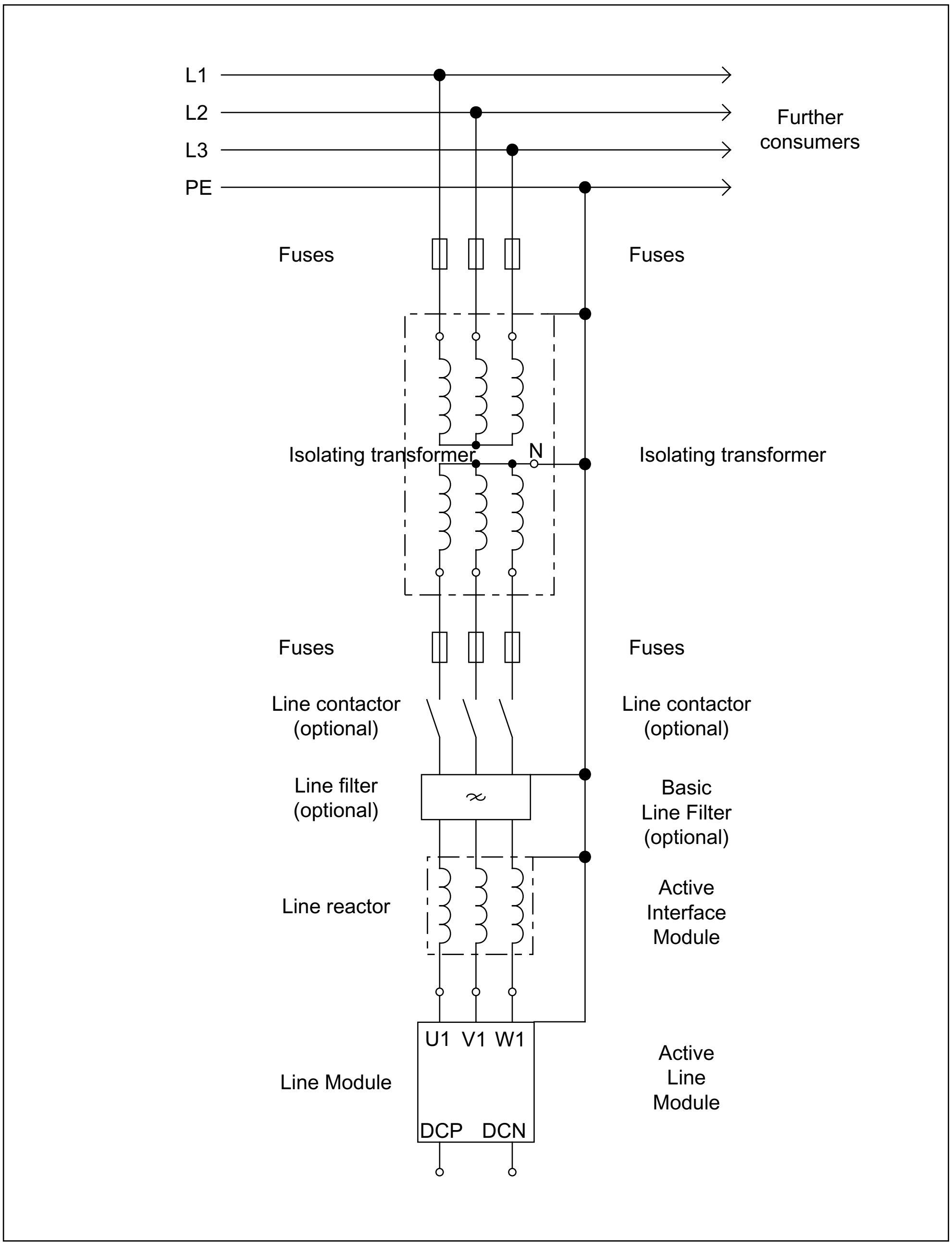


Figure 2-72 Isolating transformer

Assignment of isolating transformers to Active Line Modules

Table 2- 46 Matching transformers with isolated windings for 50/60 Hz supply systems

	Active Line Module				
	16 kW	**36 kW**	**55 kW**	**80 kW**	**120 kW**
Rated power [kVA]	21	47	70	104	155
Power loss, max. [W]	650	1200	2020	2650	3050
Vector group	Yyn0				
Degree of protection acc. to DIN EN 60529 (IEC 60529)	Degree of protection IP00: _ → Order No. 0				
Humidity rating in accordance with DIN EN 60721-3-3	Cl. 3K5, Condensation and icing excluded Low air temperature 0 °C (+32 °F)				
Permiss. ambient temperature Operation [°C]	-25 to +40, for power de-rating up to +55, ISOKL: H, t_a = 40				
Approx. weight for degree of protection IP00	120	200	300	425	600
Max. conn., secondary [mm²]	16	35	70	Cable lug according to DIN 46235	
Input voltage, 3-ph. 575 V AC - 500 V AC - 480 V AC ± 10%; 50 Hz - 5% to 60 Hz + 5%					
Rated input current [A]	26	58	87	127	189
Max. conn., primary [mm²]	16	35	50	70	Cable lug according to DIN 46235
Short-circuit voltage uk [%]	2.49	2.64	2.41	2.26	2.05
Order No.:	4BU4395-0SA7_-0C	4BU4795-0SC3_-0C	4BU5595-0SA4_-0C	4BU5895-0SA6_-0C	4BU6095-0SA6_-0C
Input voltage, 3-ph. 440 V AC - 415 V AC - 400 V AC ± 10%; 50 Hz - 5% to 60 Hz + 5%					
Rated input current [A]	31	69.5	104	154	228
Max. conn., primary [mm²]	16	35	70	70	Cable lug according to DIN 46235
Short-circuit voltage uk [%]	2.47	2.63	2.4	2.24	2.09
Order No.	4BU4395-0SA8_-0C	4BU4795-0SC4_-0C	4BU5595-0SA5_-0C	4BU5895-0SA7_-0C	4BU6095-0SA7_-0C
Input voltage, 3-ph. 240 V AC - 220 V AC - 200 V AC ± 10%; 50 Hz - 5% to 60 Hz + 5%					
Rated input current [A]	62	138.5	210	309	450
Max. conn., primary [mm²]	35	70	Cable lug according to DIN 46235		
Short-circuit voltage uk [%]	2.43	2.59	2.61	2.2	2.16
Order No.	4BU4395-0SB0_-0C	4BU4795-0SC5_-0C	4BU5595-0SA6_-0C	4BU5895-0SA8_-0C	4BU6095-0SA8_-0C

Assignment of isolating transformers to Smart Line Modules

Table 2- 47 Matching transformers with isolated windings for 50/60 Hz supply systems

	Smart Line Module			
	5 kW	10 kW	16 kW	36 kW
Rated power [kVA]	21			47
Power loss, max. [W]	650			1200
Vector group	Yyn0			
Degree of protection acc. to DIN EN 60529 (IEC 60529)	Degree of protection IP00: _ → Order No. 0			
Humidity rating in accordance with DIN EN 60721-3-3	Cl. 3K5, Condensation and icing excluded Low air temperature 0 °C (+32 °F)			
Permiss. ambient temperature Operation [°C]	-25 to +40, for power de-rating up to +55, ISOKL: H, t_a = 40			
Approx. weight for degree of protection IP00	120			200
Max. conn., secondary [mm²]	16			35
Input voltage, 3-ph. 575 V AC - 500 V AC - 480 V AC ± 10%; 50 Hz - 5% to 60 Hz + 5%				
Rated input current [A]	26			58
Max. conn., primary [mm²]	16			35
Short-circuit voltage uk [%]	2.49			2.64
Order No.	4BU4395-0SA7_-0C			4BU4795-0SC3_-0C
Input voltage, 3-ph. 440 V AC - 415 V AC - 400 V AC ± 10%; 50 Hz - 5% to 60 Hz + 5%				
Rated input current [A]	31			69.5
Max. conn., primary [mm²]	16			35
Short-circuit voltage uk [%]	2.47			2.63
Order No.	4BU4395-0SA8_-0C			4BU4795-0SC4_-0C
Input voltage, 3-ph. 240 V AC - 220 V AC - 200 V AC ± 10%; 50 Hz - 5% to 60 Hz + 5%				
Rated input current [A]	62			138.5
Max. conn., primary [mm²]	35			70
Short-circuit voltage uk [%]	2.43			2.59
Order No.	4BU4395-0SB0_-0C			4BU4795-0SC5_-0C

Assignment of isolating transformers to Basic Line Modules

Table 2- 48 Matching transformers with isolated windings for 50/60 Hz supply systems

	Basic Line Modules		
	20 kW	40 kW	100 kW
Rated power [kVA]	47	70	155
Power loss, max. [W]	1200	2020	3050
Degree of protection acc. to EN 60529 (IEC 60529)	Degree of protection IP00: _ → Order No. 0		
Humidity rating in accordance with DIN EN 60721-3-3	Cl. 3K5, Condensation and icing excluded Low air temperature 0 °C (+32 °F)		
Permiss. ambient temperature Operation [°C]	-25 to +40, for power de-rating up to +55, ISOKL: H, t_a = 40		
Approx. weight for degree of protection IP00	200	300	600
Max. conn., secondary [mm²]	35	70	Cable lug according to DIN 46235
Input voltage, 3-ph. 575 V AC - 500 V AC - 480 V AC ± 10%; 50 Hz - 5% to 60 Hz + 5%			
Rated input current [A]	58	87	189
Max. conn., primary [mm²]	35	50	Cable lug according to DIN 46235
Short-circuit voltage uk [%]	2.64	2.41	2.05
Order No.:	4BU47 95-0SC3_-0C	4BU55 95-0SA4_-0C	4BU60 95-0SA6_-0C
Input voltage, 3-ph. 440 V AC - 415 V AC - 400 V AC ± 10%; 50 Hz - 5% to 60 Hz + 5%			
Rated input current [A]	69.5	104	228
Max. conn., primary [mm²]	35	70	Cable lug according to DIN 46235
Short-circuit voltage uk [%]	2.63	2.4	2.09
Order No.:	4BU47 95-0SC4_-0C	4BU55 95-0SA5_-0C	4BU60 95-0SA7_-0C
Input voltage, 3-ph. 240 V AC - 220 V AC - 200 V AC ± 10%; 50 Hz - 5% to 60 Hz + 5%			
Rated input current [A]	138.5	210	450
Max. conn., primary [mm²]	70	Cable lug according to DIN 46235	Cable lug according to DIN 46235
Short-circuit voltage uk [%]	2.59	2.61	2.16
Order No.:	4BU47 95-0SC5_-0C	4BU55 95-0SA6_-0C	4BU60 95-0SA8_-0C

2.13.3.5 Dimension drawings of the transformers

Safety, isolating, control and line transformers 4AP, 4AU

Safety, isolating, control and line transformers 4AP and
safety, isolating, control and mains transformers as well as autotransformers with selectable voltages 4AP ≤ 16 kVA

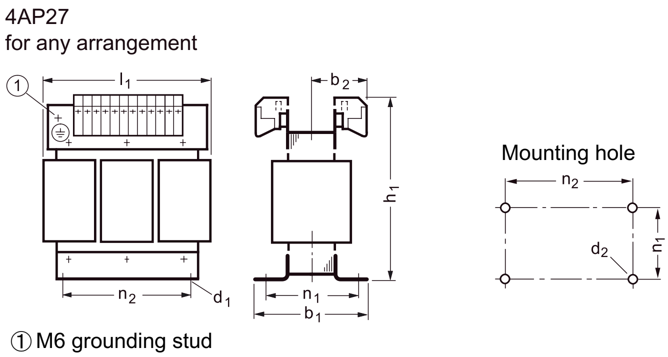


Figure 2-73 Dimension drawing: 4AP27

Table 2- 49 Dimensions 4AP27, part 1

Type	Rated power kVA[1)]	Designation as per DIN 41302	b_1	b_2 max.	d_1	d_2	h1 max.	l_1
4AP27	2.5	3UI 132/70	133	103	10 x 18	M8	242	264

1) The rated power only applies to transformers with isolated windings (not to autotransformers).

Table 2- 50 Dimensions 4AP27, part 2

Type	Fastening According to DIN 41308-4		Max. no. of terminals per side		
	n1	n2	24 A	32 A	60 A
4AP27	101	200	27	21	15

Safety, isolating, control and line transformers 4AP, 4AU ≤ 16 kVA (continued)
Safety, isolating, control and line transformers 4AU and
Safety, isolating, control and line transformers as well as autotransformers with selectable voltages 4AU ≤ 16 kVA

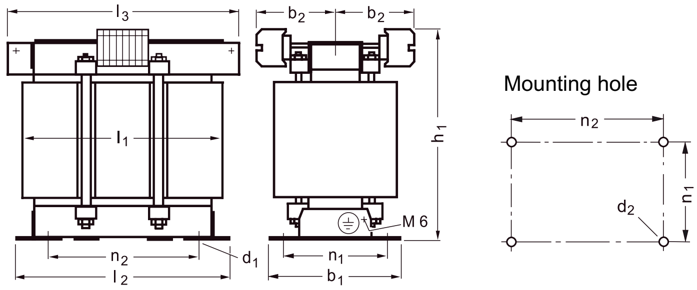


Figure 2-74 Dimension drawing: 4AU30 to 4AU39

Table 2- 51 Dimensions 4AU30 to 4AU39, part 1

Type	Rated power kVA1)	Designation as per DIN 41302	b_1	b_2	d_1	d_2	h1	l_1
4AU36	8; 10	3UI 180/75	169	134	10 × 18	M8	320	360
4AU39	12.5; 16	3UI 210/70	174	131	12 × 18	M10	370	420

1) The rated power only applies to transformers with isolated windings (not to autotransformers).

Table 2- 52 Dimensions 4AU30 to 4AU39, part 2

Type	l2	l3	n1	n2	Max. no. of terminals per side			
					18 A	23 A	43 A	81 A
4AU36	314	360	138	264	43	38	28	17
4AU39	366	410	141	316	50	45	33	20

Power transformers 4BU > 16 kVA
Matching transformers and transformers with selectable voltages 4BU > 16 kVA

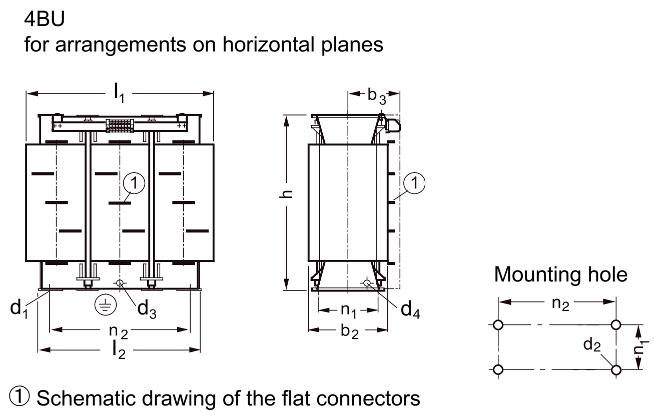


Figure 2-75 Dimension drawing: 4BU

Terminal size	Screw connection for cross section			Current carrying capacity	
	solid mm²	stranded mm²	fine-stranded mm²	t_a = 40 °C A	t_a = 55 °C A
4	0.5 ... 6	--	1.5 ... 4	24	18
6	2.5 ... 10	--	1.5 ... 6	32	23
16	1.5 ... 16	10 ... 25	4 ... 16	60	43
35	10 ... 16	10 ... 50	10 ... 35	114	81

Table 2- 53 Dimensions 4BU, part 1

Type	Rated power kVA[1)]	Type size in line with DIN 41302	b1	b2	b3 ± 3 for terminal size				d1	d2
					4	6	16	35		
4BU43	18; 20; 22.5	3UI 230/80	203	194	153	157	160	170	15	M12
4BU45	25; 28	3UI 230/107	230	221	162	166	169	179	15	M12
4BU47	31.5; 35.5; 40	3UI 230/137	260	251	182	186	189	199	15	M12
4BU52	45	3UIS 220/120	295	225	169	173	176	186	12.5	M10
4BU54	63; 71	3UIS 305/125	265	240	176	180	183	193	15	M12
4BU55	80	3UIS 305/140	280	255	184	188	191	201	15	M12
4BU58	112; 125; 140	3UIS 395/150	315	269	191	195	198	208	15	M12
4BU60	180	3UIS 395/195	360	314	213	217	220	230	15	M12

1) The rated power only applies to transformers with isolated windings (not to autotransformers).

Table 2- 54 Dimensions 4BU, part 2

Type	d3	d4	h	l1	l2	n1	n2	Max. no. of terminals for terminal size			
								4	6	16	35
4BU43	--	M6	422	450	400	155	340	44	36	24	18
4BU45	--	M6	422	450	400	182	340	44	36	24	18
4BU47	--	M6	422	450	400	212	340	44	36	24	18
4BU52	M12	--	512	420	382	183	316	--	35	23	17
4BU54	M12	--	602	630	537	198	465	--	52	35	26
4BU55	M12	--	602	630	537	213	465	--	52	35	26
4BU58	M12	--	686	855	712	227	630	--	70	45	35
4BU60	M12	--	686	855	712	272	630	--	70	45	35

2.13.3.6 Technical specifications of the transformers

Basic reference conditions under which the transformers can be loaded with the rated power P_n indicated in the selection tables:

- Continuous operation P_n
- Frequency 50 Hz to 60 Hz
- Degree of protection IP00
- Installation altitude up to 1000 m above sea level
- Rated ambient temperature t_a

Installation and operating conditions that deviate from these values, influence the permissible continuous loads. For example, a lower ambient temperature of 30 °C enables a higher utilization.

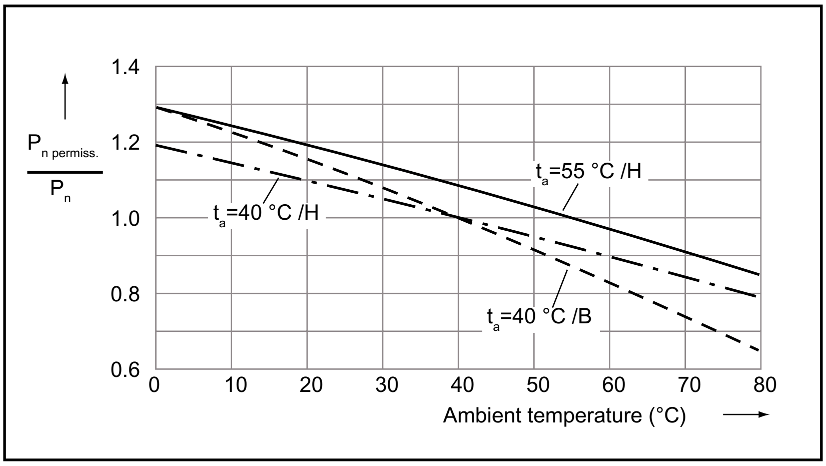


Figure 2-76 Load characteristics in relation to the ambient temperature

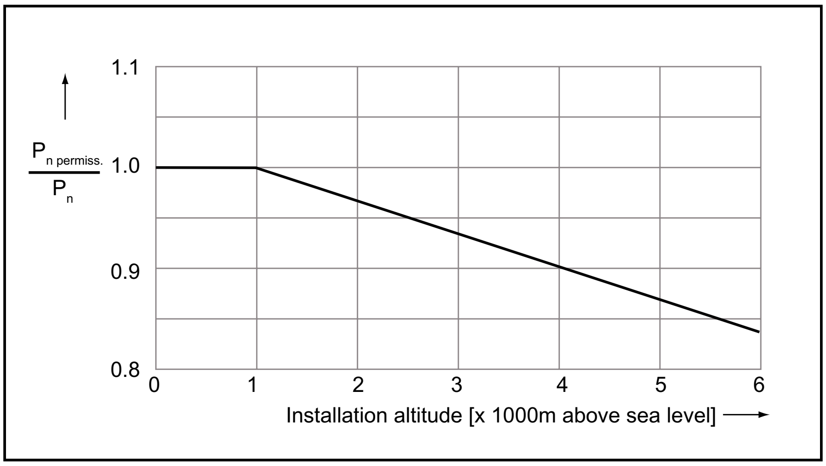


Figure 2-77 Load characteristics in relation to the installation altitude

The mentioned transformers have a neutral point that can be loaded with 10%. They are mainly designed for secondary-side symmetrical supply systems.

3 Line Modules Booksize

3.1 Active Line Modules with internal air cooling

3.1.1 Description

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

This ensures that they are not influenced by network fluctuations.

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

The DC link starts precharging as soon as the supply voltage is applied and is independent of its phase sequence direction. Load can be applied to the DC link after the modules have been enabled. An optional main contactor is required for disconnecting the voltage.

Active Line Modules can be directly connected to TN and TT line supplies - both with grounded neutral point and also with grounded protective conductor; they can also be connected to IT line supplies. The Line Modules have an integrated overvoltage protection function.

3.1.2 Safety information

DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

DANGER

DC-link discharge time

A DC-link discharge time danger notice in the relevant national language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 70 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm² Cu or ≥ 16 mm² Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC-link adapter and DC-link rectifier adapter).

DANGER

If the Line Module is not disconnected from the supply system (e.g. via the line contactor or main switch), the DC link remains charged.

CAUTION

The cooling clearances of 80 mm above and below the components must be observed.

For the 80 kW and 120 kW Active Line Modules, a cooling clearance of 50 mm must be observed in front of the fan.

CAUTION
The tightening torque of the DC-link busbar screws (1.8 Nm, tolerance: +30 %) must be checked before startup when the system is disconnected from the power supply and the DC link is discharged. After transportation, the screws must be tightened. For lines without regenerative feedback capability (e.g. a diesel generator), the regenerative feedback capability of the Active Line Module must be deactivated by means of parameters (see Description of functions). The braking energy must then be dissipated via an additional Braking Module with braking resistor provided in the drive line-up.

CAUTION
The overall length of all power cables (motor supply cables and DC-link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION
Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION
DC-link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

3.1.3 Interface description

3.1.3.1 Overview

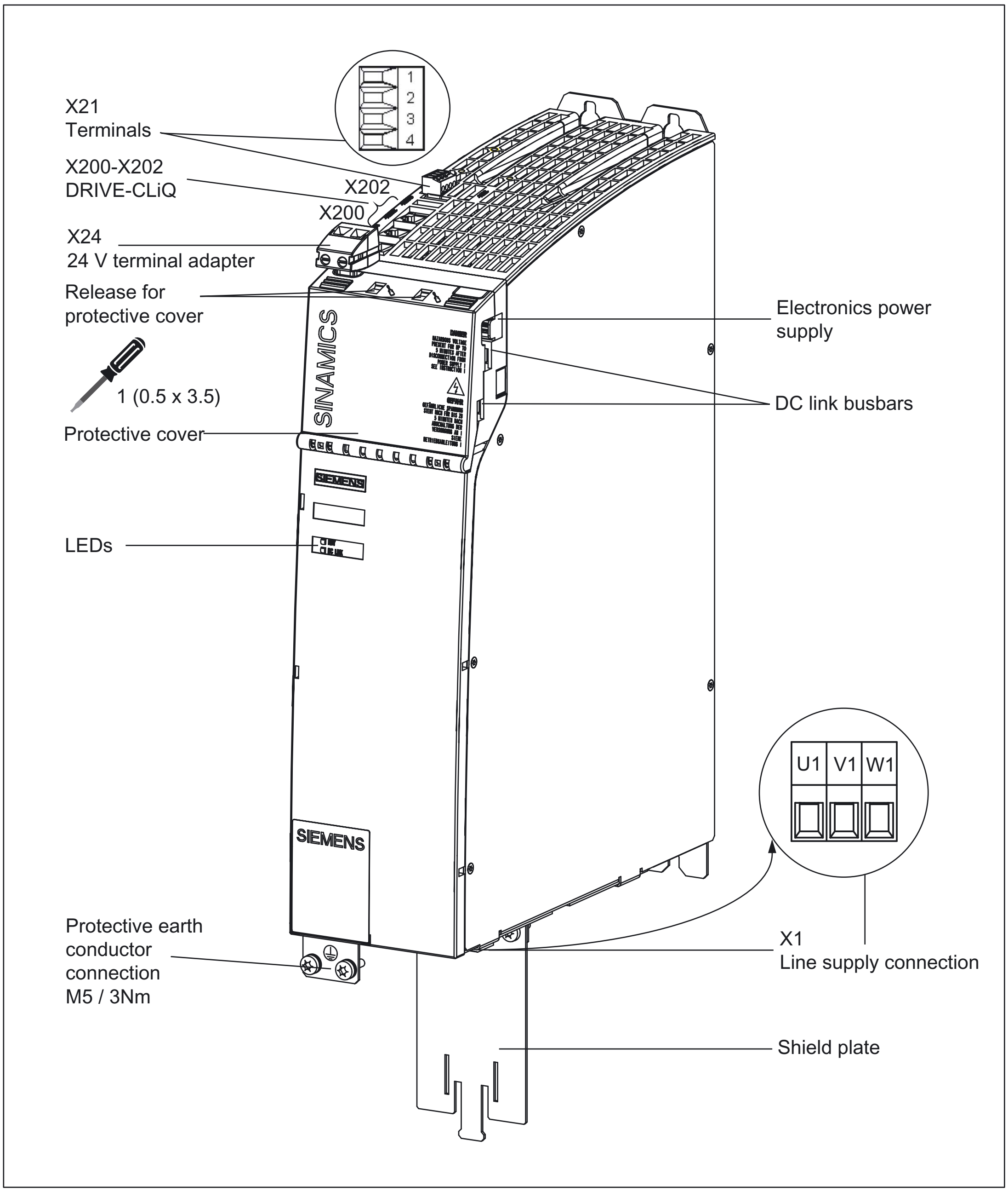
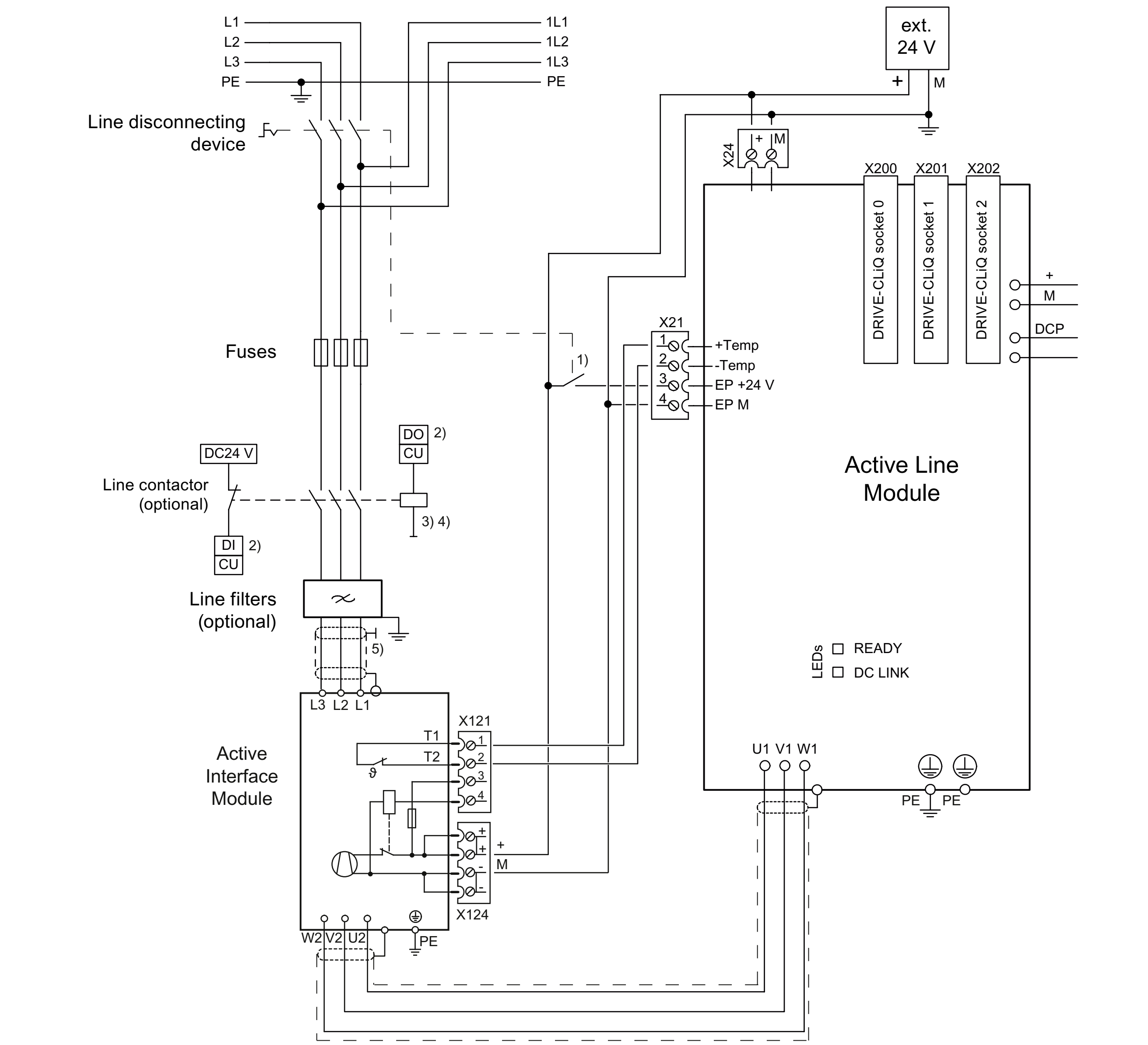


Figure 3-1 Active Line Module with internal air cooling (example: 16 kW)

3.1.3.2 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 coupling device must be used if required.
5) Contact through installation backplane or shield buses in accordance with EMC directive.

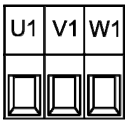
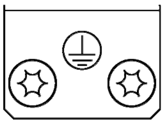
Figure 3-2 Example connection of Active Line Module

Note

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

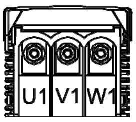
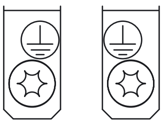
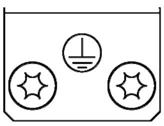
3.1.3.3 X1 line connection

Table 3- 1 Terminal block X1 Active Line Module 16 kW

	Terminal	Technical specifications
	U1 V1 W1	Max. connectable cross-section: 10 mm^2 Type: Screw terminal 6 (see chapter Connection methods) Tightening torque: 1.5 - 1.8 Nm
	PE connection	Threaded hole M5/3 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

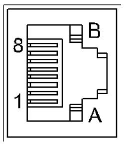
Table 3- 2 Terminal block for the Active Line Module (36 kW to 120 kW)

	Terminals	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50 / 60 Hz **36 kW:** Threaded bolt M6/6 Nm [1)] (see chapter Connection methods) **55 kW, 80 kW and 120 kW** Threaded bolt M8/13 Nm [1)]
	PE connection	**36 kW:** Threaded hole M6/6 Nm [1)]
		**55 kW:** Threaded hole M6/6 Nm [1)] **80 kW and 120 kW:** Threaded hole M8/13 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

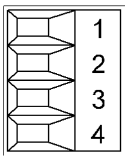
3.1.3.4 X200-X202 DRIVE-CLiQ interfaces

Table 3- 3 DRIVE-CLiQ interface X200-X202 for 16 kW and 36 kW Smart Line Modules

	PIN	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 V power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces included in the scope of delivery; blanking plate (50 pieces) Order number: 6SL3066-4CA00-0AA0			

3.1.3.5 X21 EP terminals

Table 3- 4 Terminal strip X21

	Terminal	Designation	Technical specifications
	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 (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm² Type: Screw terminal 1 (see chapter Connection methods)			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual LH1).

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

> **⚠ CAUTION**
>
> If an Active Interface Module is connected, the temperature output of the Active Interface Module must be connected to terminals 1 and 2.

⚠ WARNING

For operation, 24 VDC must be connected to terminal 3 and ground to terminal 4. Upon removal, pulse suppression is activated. Feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

NOTICE

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals 3 (EP +24 V) and 4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

This protects external loads located parallel to the drive on the same switching component.

⚠ DANGER

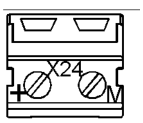
Risk of electric shock!

Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), a Sensor Module External (SME120 or SME125) or Terminal Module TM120 must be used.

If these instructions are not complied with, there is a risk of electric shock!

3.1.3.6 X24 24 V terminal adapter

Table 3- 5 Terminal block X24

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronic ground
The 24 V terminal adapter is supplied as standard Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see Connection Methods)			

3.1.3.7 Description of the LEDs on the Active Line Module

Table 3- 6 Active Line Module - description of the LEDs

Status		Description, cause	Remedy
Ready (H200)	DC link (H201)		
off	off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	off	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.	Check line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/ red (0.5 Hz)	-	Firmware is being downloaded.	–
Green/red (2 Hz)	-	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	–	Component detection via LED is activated (p0124). **Note:** Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC link" LED.
The warning information on the components must be carefully observed!

3.1.4 Dimension drawing

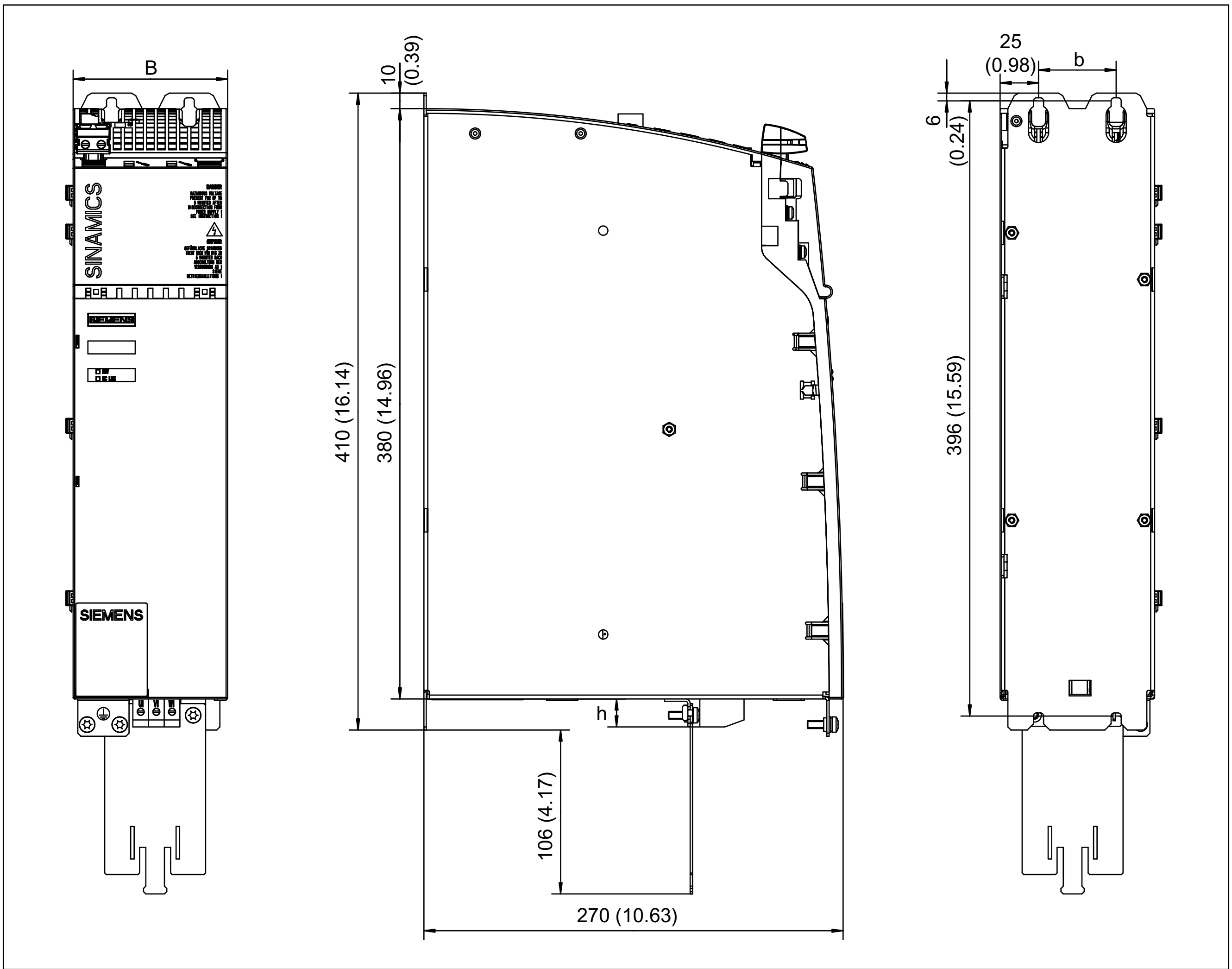


Figure 3-3 Dimension drawing of Active Line Module 16 kW with internal air cooling, all data in mm and (inches)

Table 3- 7 Dimensions of Active Line Module with internal air cooling

Active Line Module type	Order number	W [mm] (inches)	b [mm] (inches)	h [mm] (inches)
16 kW	6SL3130-7TE21-6AAx	100 (3.94)	50 (1.97)	18 (0.71)

Note

The shield connecting plate is part of the scope of supply for a 100 mm Line Module.

For more information, see "Accessories".

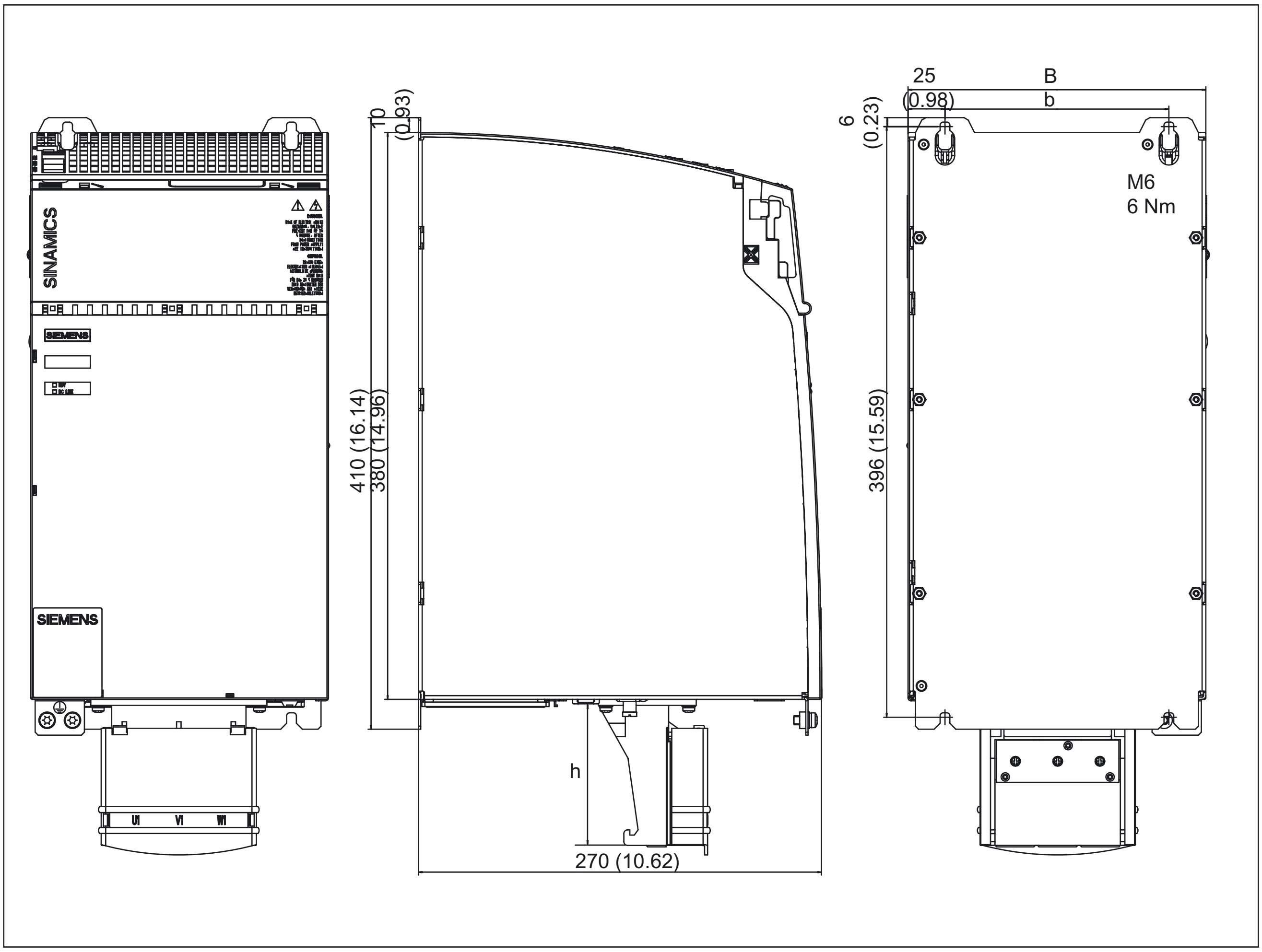


Figure 3-4 Dimension drawing of Active Line Module 36 kW and 55 kW with internal air cooling, all data in mm and (inches)

Table 3- 8 Dimensions of Active Line Module with internal air cooling

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

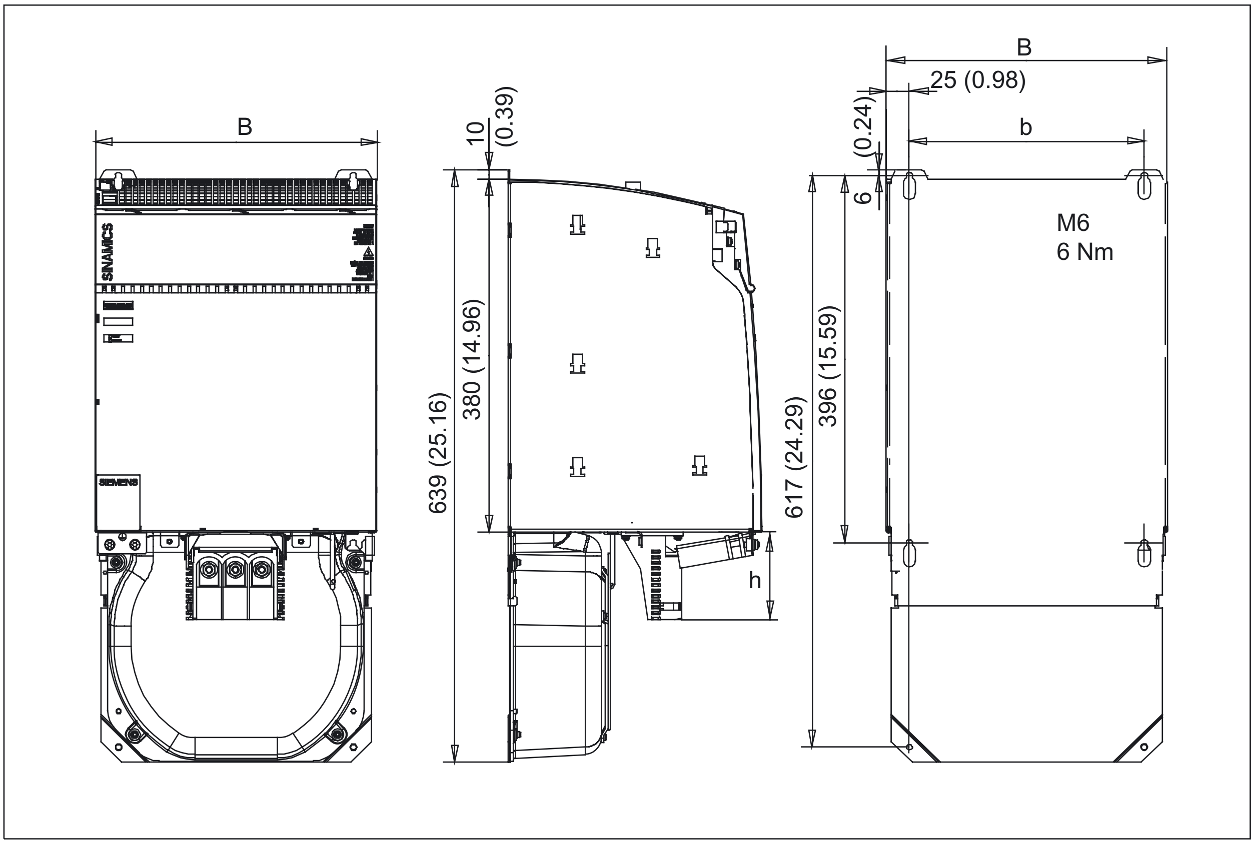


Figure 3-5 Dimension drawing of Active Line Modules 80 kW and 120 kW with internal air cooling, all data in mm and (inches)

Table 3- 9 Dimensions of Active Line Module with internal air cooling

Active Line Module type	Order number	W [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)

3.1.5 Installation

Active Line Modules are designed for installation in the control cabinet. They are fixed to the control cabinet's installation panel with M6 screws.

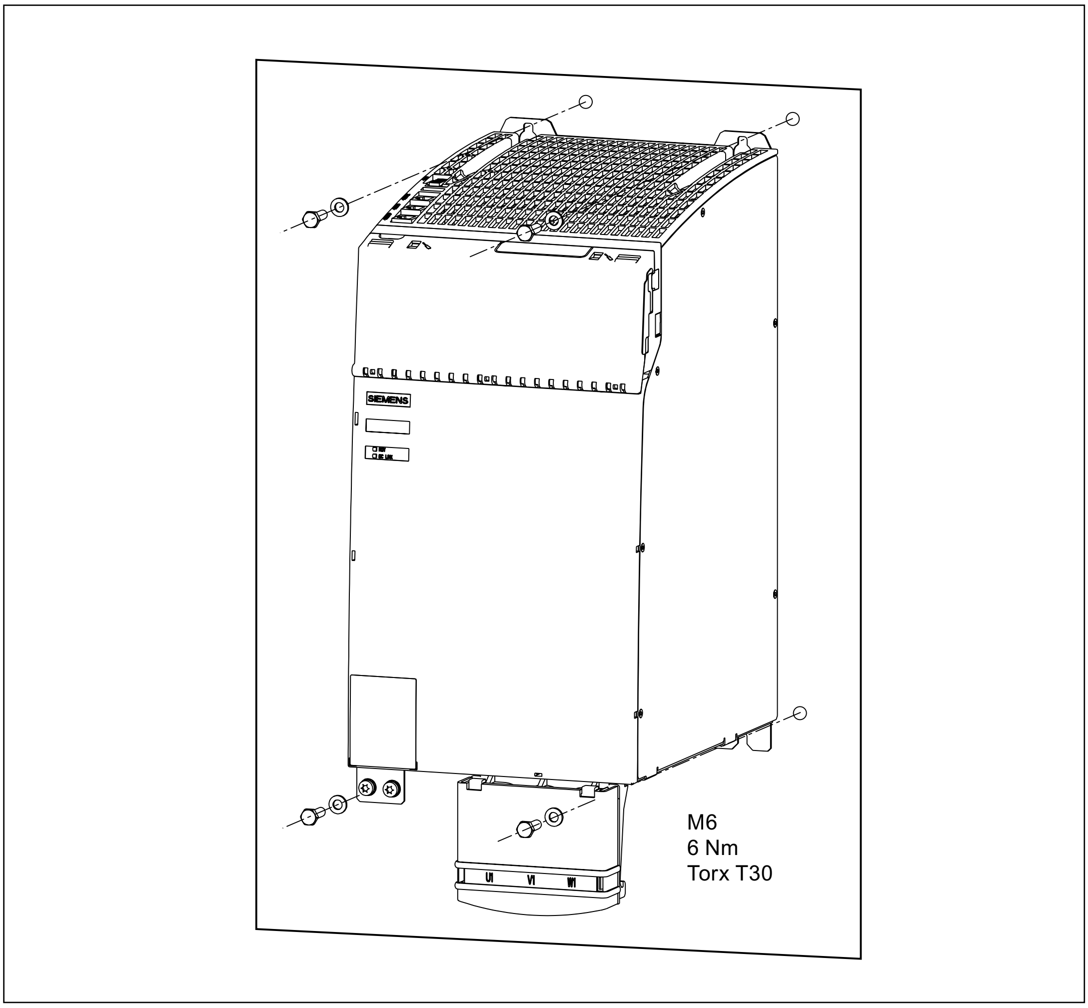


Figure 3-6 Installing a power unit with internal air cooling

Installing the fan on Active Line Modules (80 kW and 120 kW)

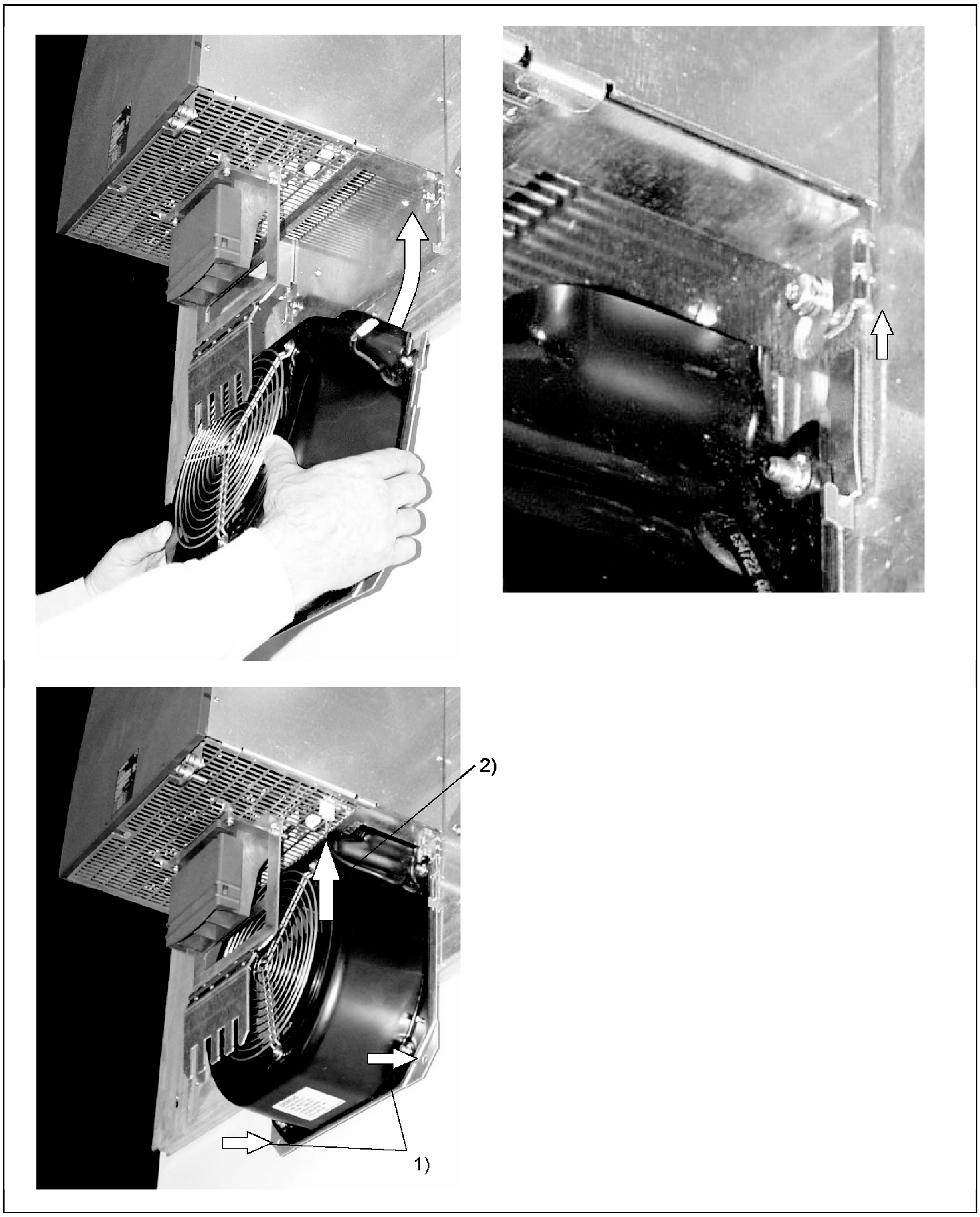


Figure 3-7 Installing the fan for 300 mm modules

1) Secure with M6 / 6 Nm screws

2) Connect the power supply for the fan

Note

The fans are power-up and power-down as a function of the heatsink temperature.

The fans start up at the heat-sink temperature specified in the power stack data (normally 56°C) and are switched off with a slight hysteresis when the heat-sink temperature decreases again. The length of time it takes for the fans to stop once they have been switched off depends on a number of factors (ambient temperature, output current, duty cycle, etc.) and, therefore, cannot be determined directly.

The fans are not equipped with temperature-dependent speed control; only the states "on" or "off" exist.

3.1.6 Technical data

Table 3- 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 (Pn)	16	36	55	55
Infeed power (S6-40%) [1)]	kW (Ps6)	21	47	71	71
Peak infeed power [1)]	kW (Pmax)	35	70	91	110
Regenerative feedback					
Continuous regenerative power	kW	16	36	55	55
Peak regenerative power	kW	35	70	91	110
Supply voltages					
Rated voltage	V_{ACrms}	3 AC 380 -10 % (-15% < 1 min) to 3 AC 480 +10 %			
Line frequency	Hz	47 to 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 400 V_{AC}:	A_{AC}	25	55	84	84
Input current at 380 V_{AC} / 480 V_{AC}	A_{AC}	26 / 21	58 /46	88 / 70	88 /70
at 400 V_{AC}; S6-40%	A_{AC}	32	71	108	108
at 400 V_{AC}; peak current	A_{AC}	54	107	139	168
DC link currents					
Rated DC link current at 600 V:	A_{DC}	27	60	92	92
DC link current: at 600 V_{DC}; at S6-40%	A_{DC}	35	79	121	121
at 600 V_{DC}; peak current	A_{DC}	59	117	152	176

Internal air cooling	6SL3130–	7TE21–6AAx	7TE23–6AAx	7TE25–5AAx	7TE25–5AA3 + Active Interface Module
Rated power	kW	16	36	55	55
Current carrying capacity DC link busbar: reinforced DC link busbars: 24 V busbar:	 A_{DC} A_{DC} A_{DC}	 100 150 20	 100 / 200 3) -- 20	 200 -- 20	 200 -- 20
Electronics current consumption at 24 V DC	A_{DC}	0.95	1.5	1.9	1.9
Total power loss (including electronics losses) 4)	W	282.8	666	945.6	945.6
Max. ambient temperature Without derating With derating	 °C °C	 40 55	 40 55	 40 55	 40 55
DC link capacitance Active Line Module Drive line-up, max.	 µF µF	 705 20 000	 1 410 20 000	 1 880 20 000	 1 880 20 000
Power factor	cosφ	1	1	1	1
Circuit breaker (UL) Type designation Rated current: Resulting rated short-circuit current 6) SCCR at 480 V_{AC}:	 A kA	 3VL1135- 2KM30 35 65	 3VL2108- 2KN30 80 65	 3VL2112- 2KN30 125 65	 3VL2112- 2KN30 125 65
Safety fuse (UL) Type AJT Class J 5) Rated current Resulting rated short-circuit current 6) SCCR at 480 V_{AC}:	 A kA	 AJT35 35 65	 AJT80 80 65	 AJT125 125 65	 AJT125 125 65
Cooling method (internal air cooling)		Internal fan	Internal fan	Internal fan	Internal fan
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 powers specified apply to the rated voltage range from 380 V to 480 V.
2) Default for 400 V supply systems; undervoltage trip threshold is adjusted to the parameterized rated voltage.
3) For components where the final digit in the order number is ≥ 3.
4) For an overview, see the power loss tables in chapter Control cabinet installation
5) Source of supply: Ferraz Shawmut, http://de.ferrazshawmut.com
6) 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 3- 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)] Infeed power (S6-40%) [1)] Peak infeed power[1)]	 kW (Pn) kW (Ps6) kW (Pmax)	 80 106 131	 120 145 175
Regenerative feedback Continuous regenerative power Peak regenerative power	 kW kW	 80 131	 120 175
Supply voltages Rated voltage Line frequency Electronics power supply	 V_{ACrms} Hz V_{DC}	 3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10% 47 to 63 24 (20.4 - 28.8)	
DC link voltage Overvoltage trip Undervoltage trip [2)]	V_{DC} V_{DC} V_{DC}	510 - 720 820 ± 2% 360 ± 2%	
Input currents Rated input current at 400 V_{AC}: Input current at 380 V_{AC} / 480 V_{AC} at 400 V_{AC}; S6-40% at 400 V_{AC}; peak current	 A_{AC} A_{AC} A_{AC} A_{AC}	 122 128 / 102 161 200	 182 192 / 152 220 267
DC link currents Rated DC link current at 600 V: DC link current: at 600 V_{DC}; at S6-40% at 600 V_{DC}; peak current	 A_{DC} A_{DC} A_{DC}	 134 176 218	 200 244 292
Current carrying capacity DC link busbar: 24 V busbar:	 A_{DC} A_{DC}	 200 20	 200 20
Electronics current consumption at 24 V DC	A_{DC}	1.4	1.8
Total power loss (including electronics losses) [3)]	W	1383.6	2243.2
Max. ambient temperature Without derating With derating	 °C °C	 40 55	 40 55
DC link capacitance Active Line Module Drive line-up, max.	 μF μF	 2 820 20 000	 3 995 20 000
Power factor	cosϕ	1	1
Circuit breaker (UL) Type designation Rated current: Resulting rated short-circuit current [5)] SCCR at 480 V_{AC}:	 A kA	 3VL3117-2KN30 175 65	 3VL3125-2KN30 250 65

Internal air cooling	6SL3130–	7TE28–0AAx	7TE31–2AAx
Rated power	kW	80	120
Safety fuse (UL) Type AJT Class J [4)] Rated current Resulting rated short-circuit current [5)] SCCR at 480 V_{AC}:	 A kA	 AJT175 175 65	 AJT250 250 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
Rated voltage for rated data 3 AC 380 V			
Weight	kg	23	23

1) The powers specified apply to the rated voltage range from 380 V to 480 V.
2) Default for 400 V supply systems; undervoltage trip threshold is adjusted to the parameterized rated voltage.
3) For an overview, see the power loss tables in chapter Control cabinet installation
4) Source of supply: Ferraz Shawmut, http://de.ferrazshawmut.com
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.

3.1.6.1 Characteristics

Rated duty cycles of Active Line Modules

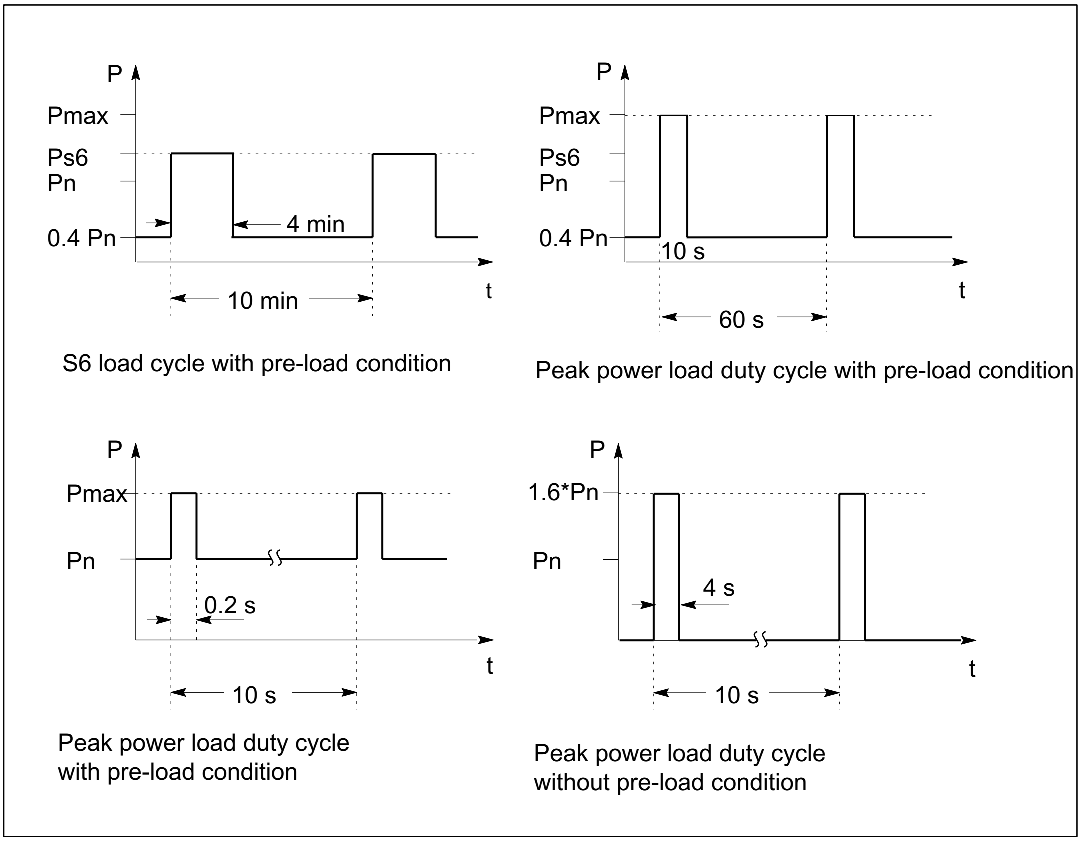


Figure 3-8 Rated duty cycles of Active Line Modules (**exception**: not applicable for 55 kW Active Line Module with Active Interface Module)

Rated duty cycles of Active Line Modules with Active Interface Modules

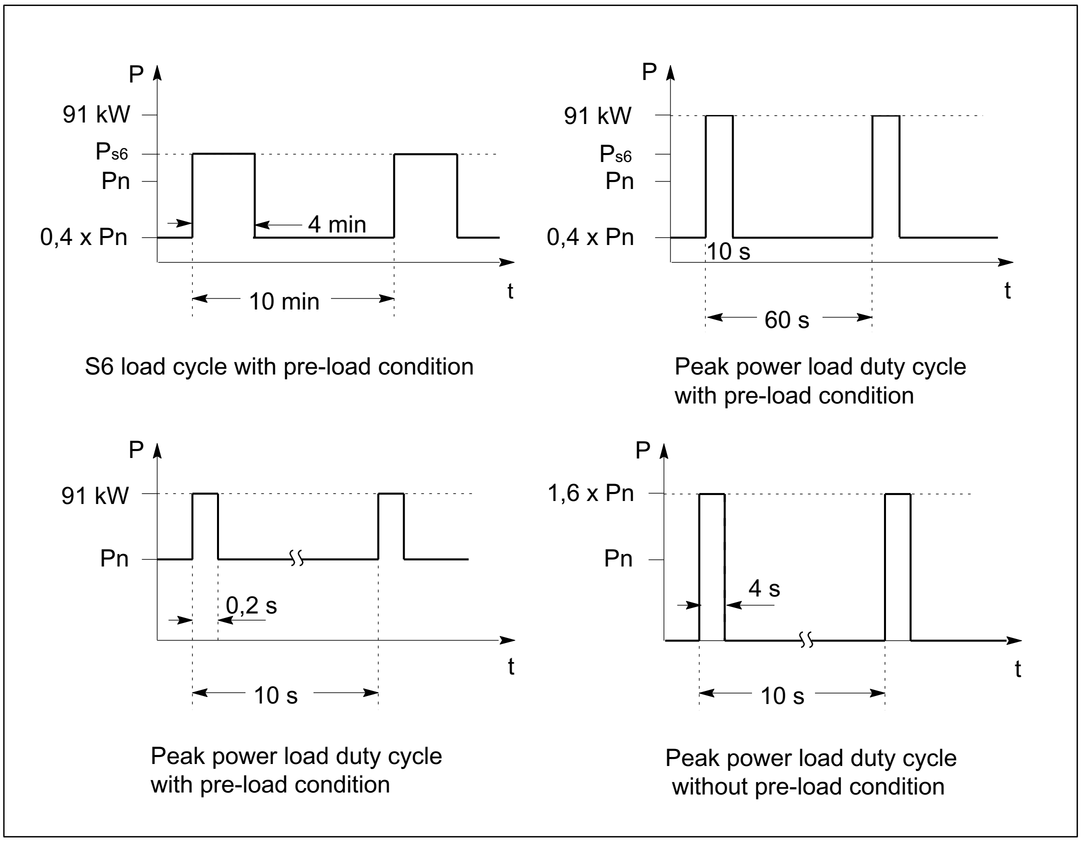


Figure 3-9 Rated duty cycles of 55 kW Active Line Modules with Active Interface Module

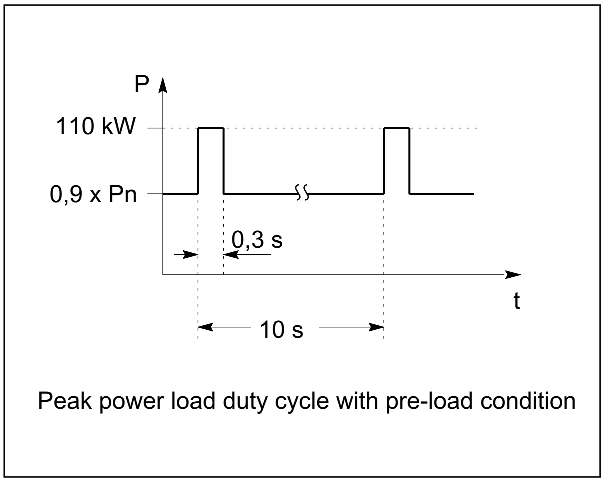


Figure 3-10 Rated duty cycle of 55 kW Active Line Modules with Active Interface Module

Derating characteristics

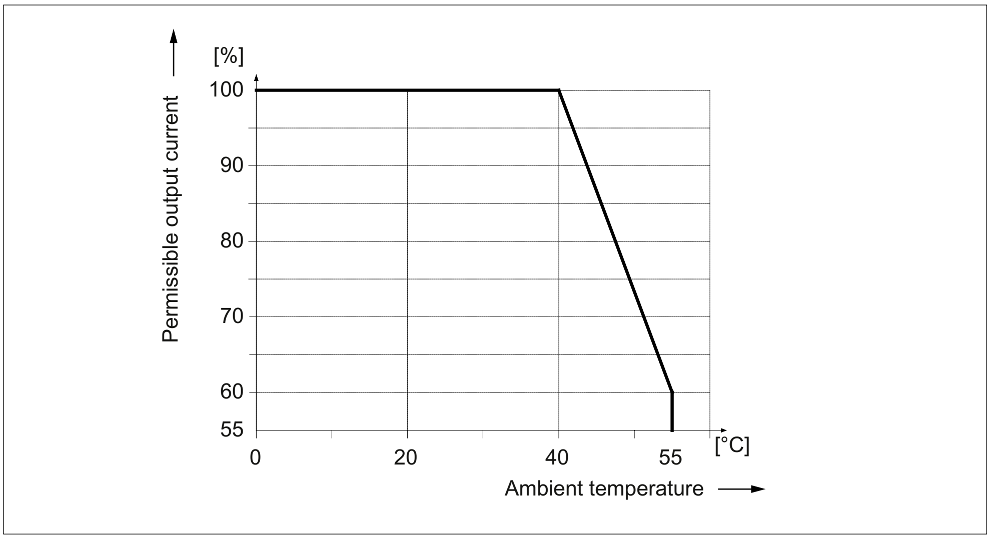


Figure 3-11 Output current as a function of the ambient temperature

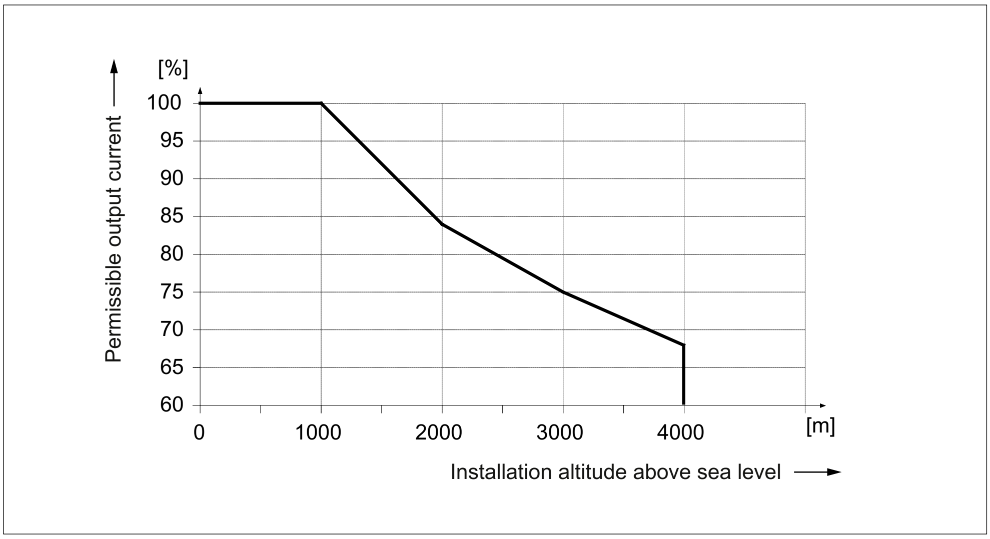


Figure 3-12 Output current as a function of the installation altitude

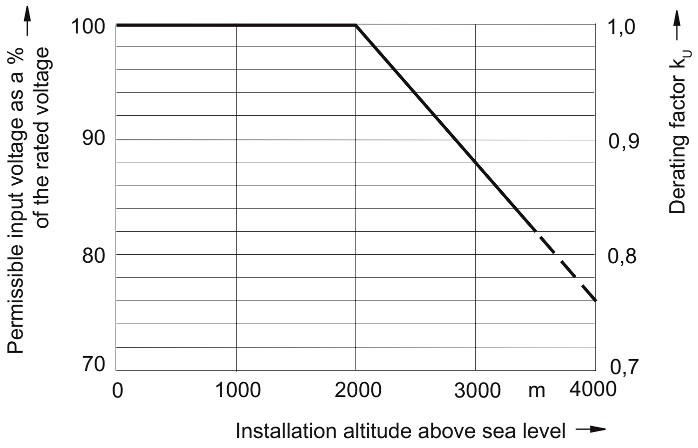


Figure 3-13 Voltage derating as a function of the installation altitude

3.2 Active Line Modules with external air cooling

3.2.1 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 network fluctuations.

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

The DC link starts precharging as soon as the supply voltage is applied and is independent of its phase sequence direction. Load can be applied to the DC link after the modules have been enabled. An optional main contactor is required for disconnecting the voltage.

The Active 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 for SINAMICS power units that is only available for booksize devices. 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.

3.2.2 Safety information

⚠ DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

⚠ DANGER

DC-link discharge time

A DC-link discharge time danger notice in the relevant national language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 70 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC-link adapter and DC-link rectifier adapter).

DANGER

If the Line Module is not disconnected from the network (e.g. via the line contactor or main switch), the DC link remains charged.

CAUTION

The cooling clearances of 80 mm above and below the components must be observed.

CAUTION

The tightening torque of the DC-link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning with the complete system in a no-voltage condition (powered-down) and with the DC link discharged. After transportation, the screws must be tightened.

For lines without regenerative feedback capability (e.g. a diesel generator), the regenerative feedback capability of the Active Line Module must be deactivated by means of parameters (see Description of functions). The braking energy must then be dissipated via an additional Braking Module with braking resistor provided in the drive line-up.

CAUTION

The overall length of the power cables (motor supply cables and DC-link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION

Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION

DC-link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

NOTICE

The external air cooling can cause the fans and the heat sink to become heavily contaminated, which may trigger the temperature monitor in the power unit. The fans and heat sink must be checked for contamination at regular intervals and, if necessary, cleaned.

Note

After installation, the seal on the rear of the device must be checked to ensure that it is tight. Additional sealing can be used, if necessary.

3.2.3 Interface description

3.2.3.1 Overview

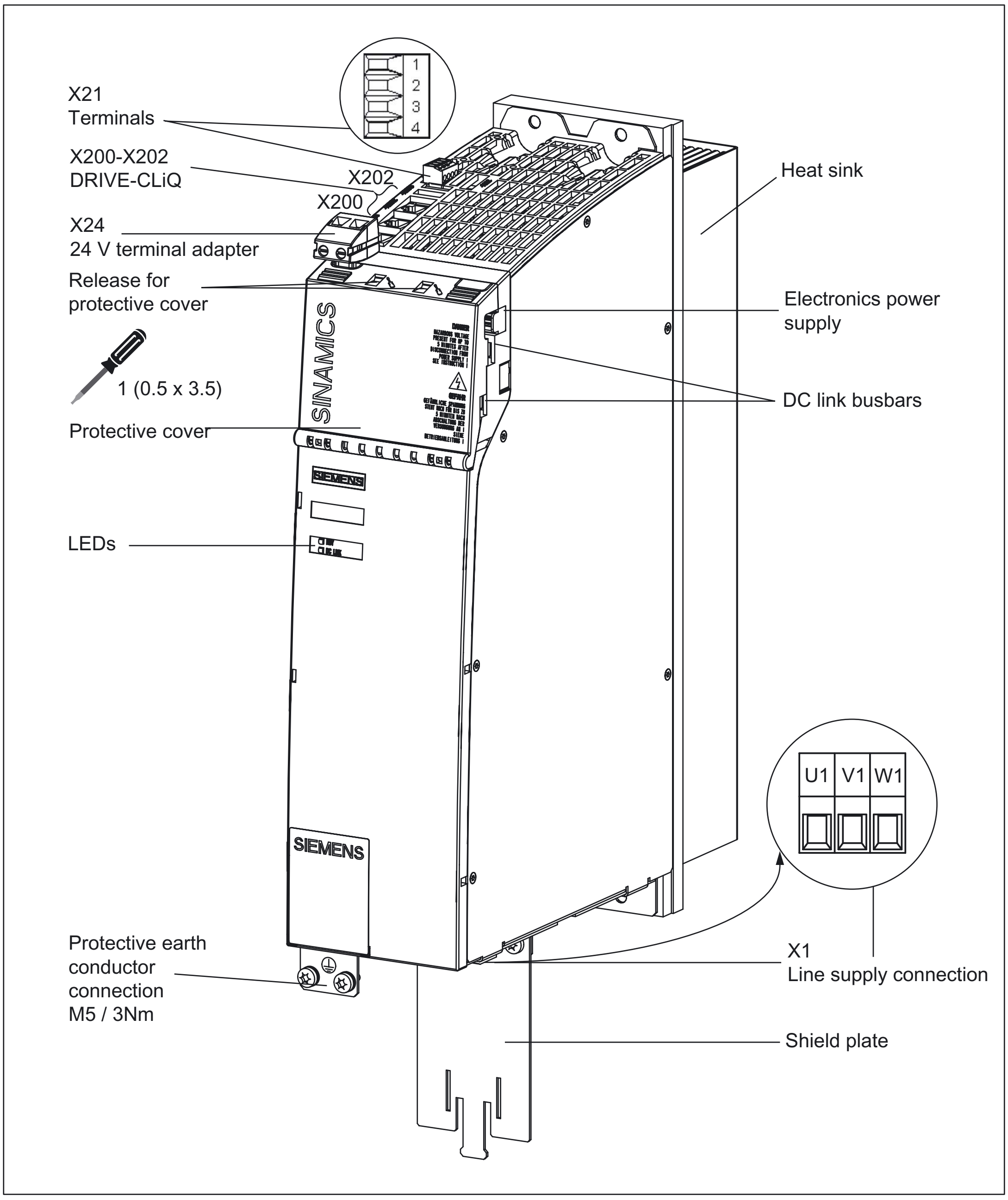
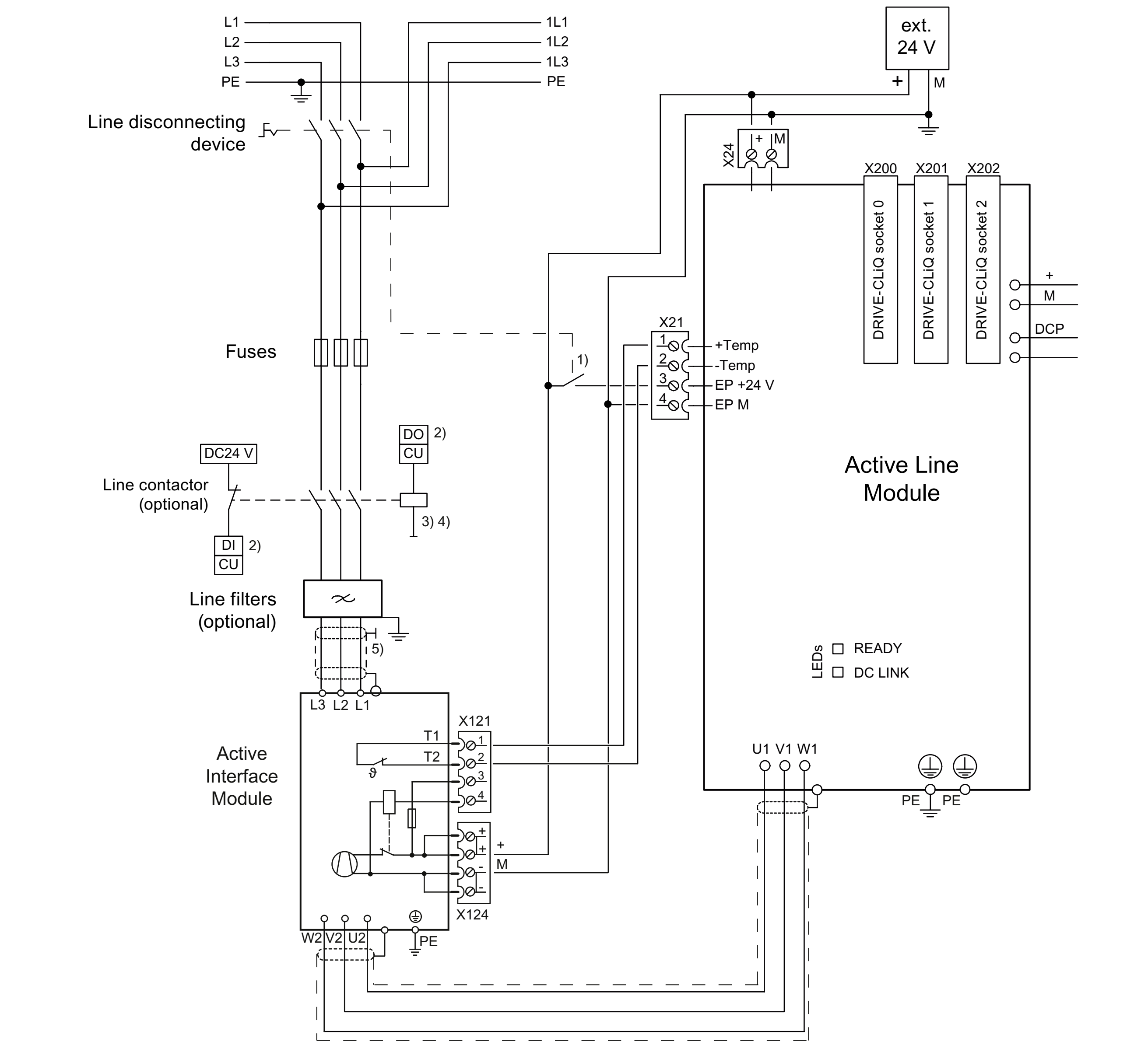


Figure 3-14 Active Line Module with external air cooling (example: 16 kW)

3.2.3.2 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 coupling device must be used if required.
5) Contact through installation backplane or shield buses in accordance with EMC directive.

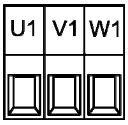
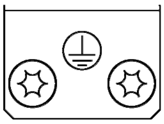
Figure 3-15 Example connection of Active Line Module

Note

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

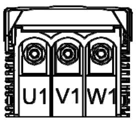
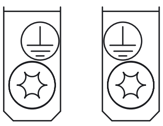
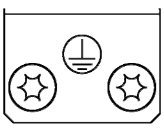
3.2.3.3 X1 line connection

Table 3- 12 Terminal block X1 Active Line Module 16 kW

	Terminal	Technical specifications
	U1	Supply voltage: 380 V - 480 V 3 AC, 50 / 60 Hz Max. connectable cross-section: 10 mm^2 Type: Screw terminal 6 (see chapter Connection methods) Tightening torque: 1.5 - 1.8 Nm
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

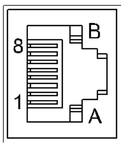
Table 3- 13 Terminal block for the Active Line Module (36 kW to 120 kW)

	Terminals	Technical specifications
	U1	Supply voltage: 380 V - 480 V 3 AC, 50 / 60 Hz **36 kW:** Threaded bolt M6/6 Nm [1)] (see chapter Connection methods) **55 kW:** Threaded bolt M8/13 Nm [1)] **80 kW to 120 kW:** Threaded bolt M8/13 Nm [1)]
	V1	
	W1	
	PE connection	**36 kW:** Threaded hole M6/6 Nm [1)]
		**55 kW:** Threaded hole M6/6 Nm [1)] **80 kW to 120 kW:** Threaded hole M8/13 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

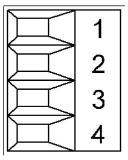
3.2.3.4 X200-X202 DRIVE-CLiQ interfaces

Table 3- 14 DRIVE-CLiQ interface X200-X202 for 16 kW and 36 kW Smart Line Modules

	PIN	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 V power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces included in the scope of delivery; blanking plate (50 pieces) Order number: 6SL3066-4CA00-0AA0			

3.2.3.5 X21 EP terminals

Table 3- 15 Terminal strip X21

	Terminal	Designation	Technical specifications
	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 (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm² Type: Screw terminal 1 (see chapter Connection methods)			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual LH1).

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

> **CAUTION**
>
> If an Active Interface Module is connected, the temperature output of the Active Interface Module must be connected to terminals 1 and 2.

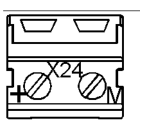
> **⚠ WARNING**
>
> For operation, 24 VDC must be connected to terminal 3 and ground to terminal 4. Upon removal, pulse suppression is activated. Feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

> **NOTICE**
>
> If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals 3 (EP +24 V) and 4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.
>
> This protects external loads located parallel to the drive on the same switching component.

> **⚠ DANGER**
>
> **Risk of electric shock!**
>
> Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), a Sensor Module External (SME120 or SME125) or Terminal Module TM120 must be used.
>
> If these instructions are not complied with, there is a risk of electric shock!

3.2.3.6 X24 24 V terminal adapter

Table 3- 16 Terminal block X24

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronic ground
The 24 V terminal adapter is supplied as standard Max. connectable cross-section: 6 mm² Type: Screw terminal 5 (see Connection Methods)			

3.2.3.7 Meaning of the LEDs on the Active Line Module

Table 3- 17 Active Line Module - description of the LEDs

Status		Description, cause	Remedy
Ready (H200)	DC link (H201)		
off	off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	off	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.	Check line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/ red (0.5 Hz)	-	Firmware is being downloaded.	–
Green/red (2 Hz)	-	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	–	Component detection via LED is activated (p0124). **Note:** Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC link" LED.
The warning information on the components must be carefully observed!

3.2.4 Dimension drawings

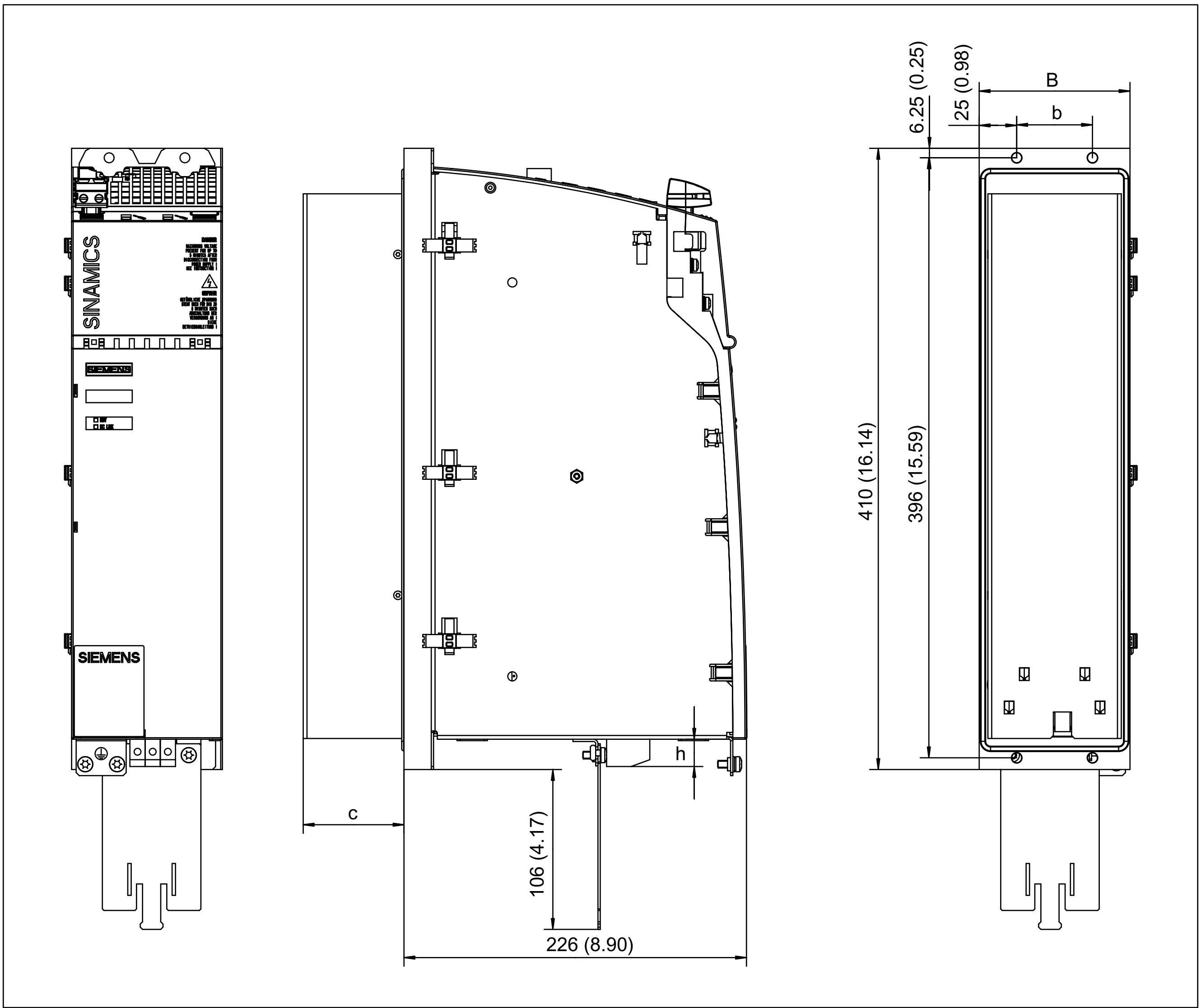


Figure 3-16 Dimension drawing of Active Line Module 16 kW with exernal air cooling, all data in mm and (inches)

Table 3- 18 Dimensions of Active Line Module with external air cooling (16 kW)

Line module type	Order number	W [mm] (inches)	b [mm] (inches)	c [mm] (inches)	h [mm] (inches)
16 kW	6SL3131-7TE21-6AAx	100 (3.94)	50 (1.97)	66.5 (2.62)	18 (0.71)

Note

The shield connecting plate is part of the scope of supply for a 100 mm Line Module.

For more information, see "Accessories".

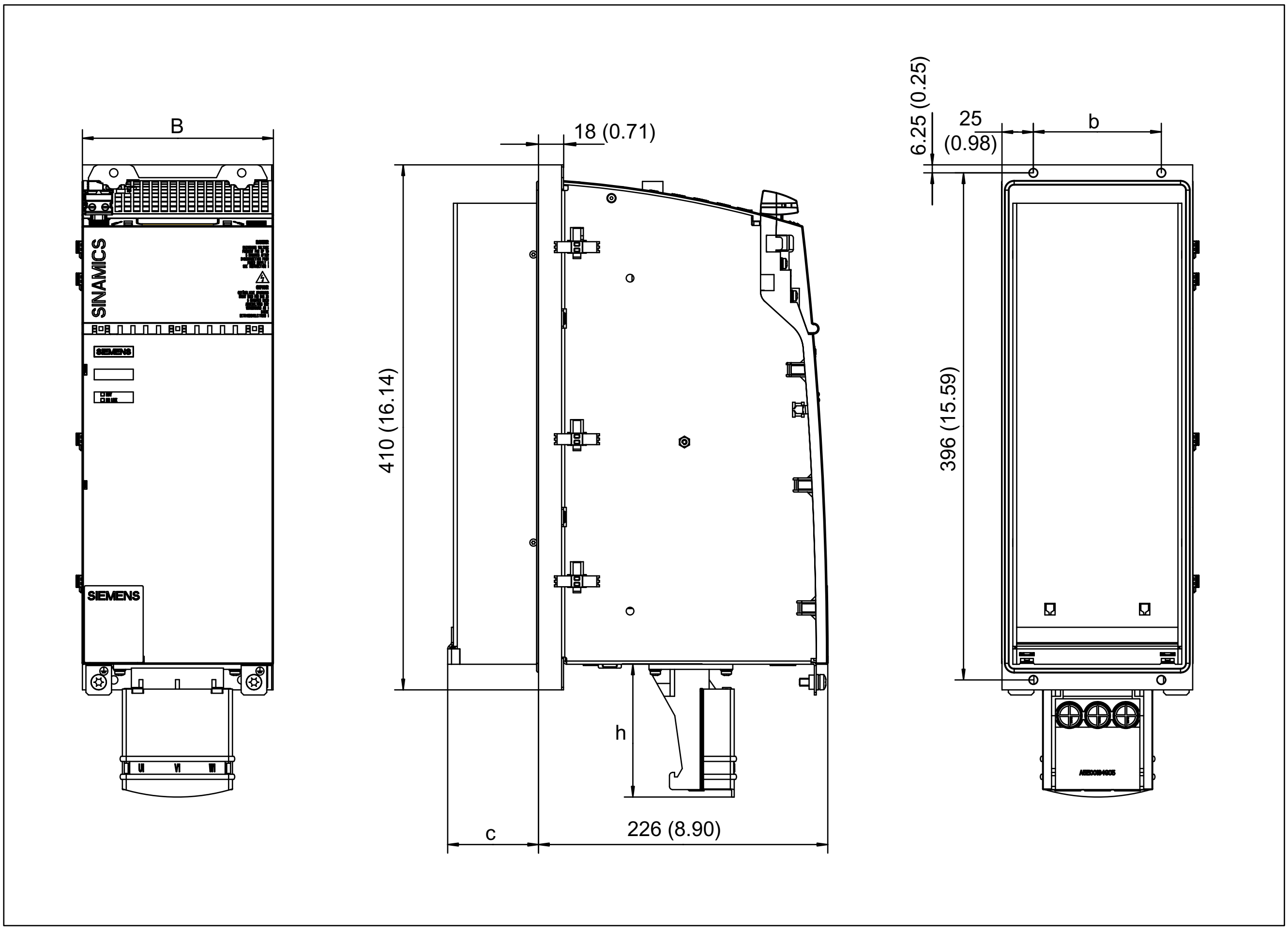


Figure 3-17 Dimension drawing of Active Line with external air cooling 36 kW, 55 kW, 80 kW, und 120 kW, all data in mm and (inches)

Table 3- 19 Dimensions of Active Line Modules with external air cooling (36 kW, 55 kW, 80 kW, and 120 kW)

Line module type	Order number	W [mm] (inches)	b [mm] (inches)	h [mm] (inches)	c [mm] (inches)
36 kW	6SL3131-7TE23-6AAx	150 (5.91)	100 (3.94)	105 (4.13)	71 (2.80)
55 kW	6SL3131-7TE25-5AAx	200 (7.87)	150 (5.91)	105 (4.13)	92 (3.62)
80 kW	6SL3131-7TE28-0AAx	300 (11.81)	250 (9.84)	105 (4.13)	82 (3.23)
120 kW	6SL3131-7TE31-2AAx	300 (11.81)	250 (9.84)	105 (4.13)	82 (3.23)

3.2.5 Installation

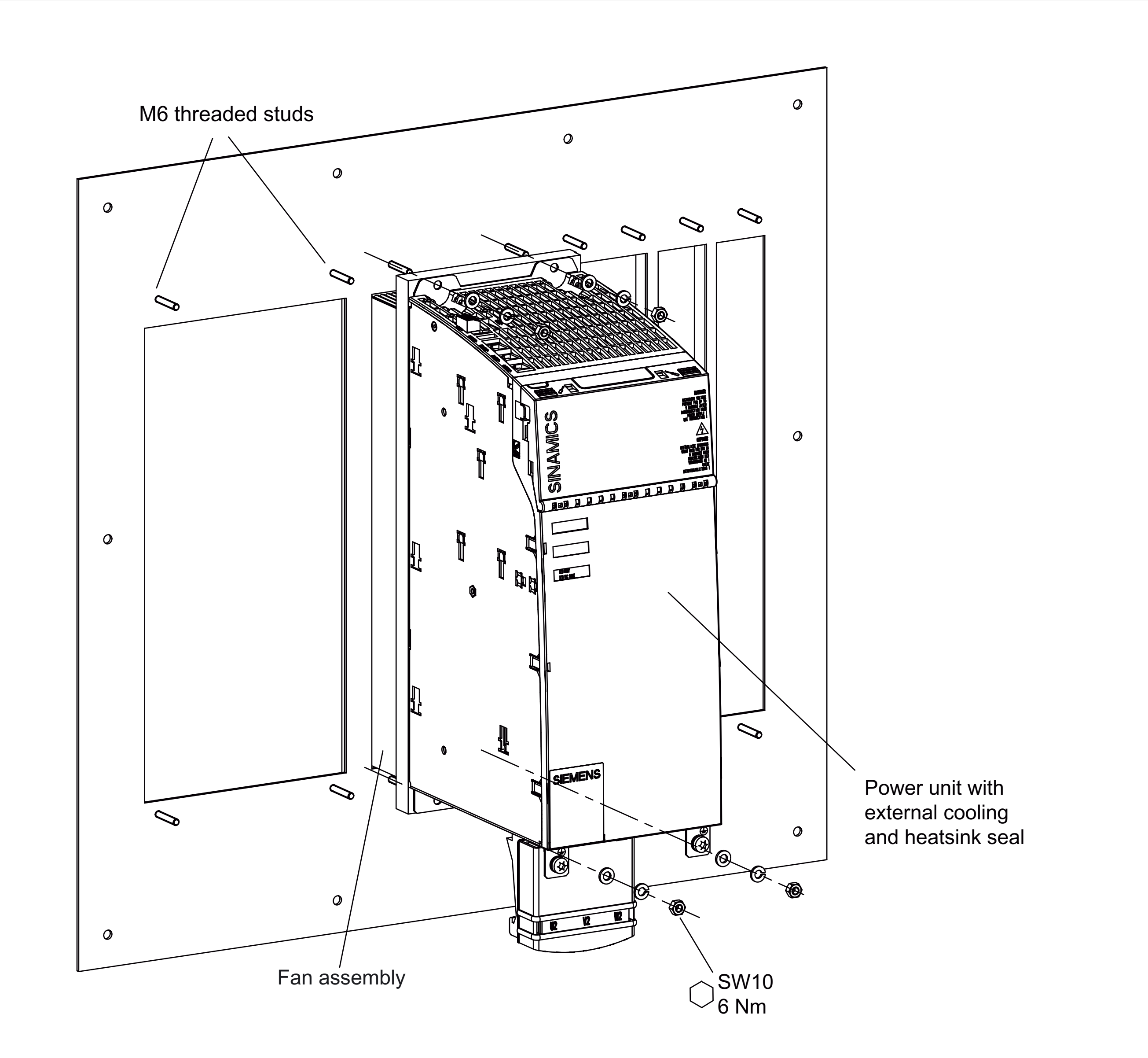


Figure 3-18 Example: Installation of the power unit with external air cooling

Help with the mechanical control cabinet installation is available from:

Siemens AG
Industry Sector, IA SE WKC
TCCCC (Technical Competence Center Cabinets Chemnitz)
P.O. Box 1124
09070 Chemnitz, Germany

E-mail: cc.cabinetcooling.aud@siemens.com

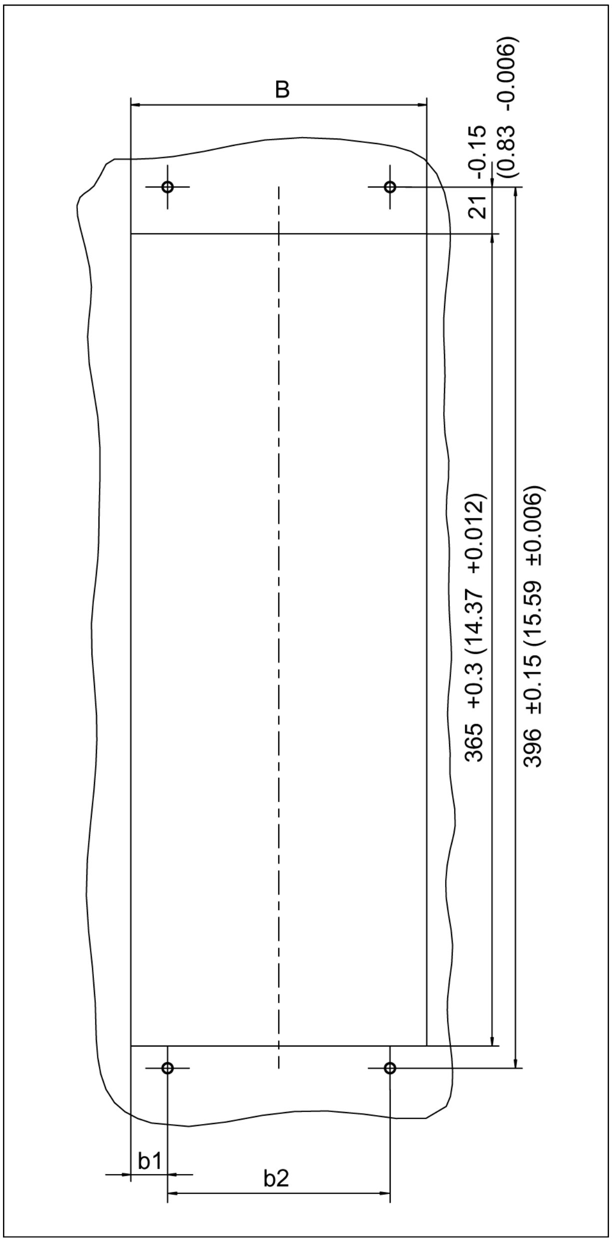


Figure 3-19 Installation openings for the power unit with external air cooling, 50 mm to 200 mm

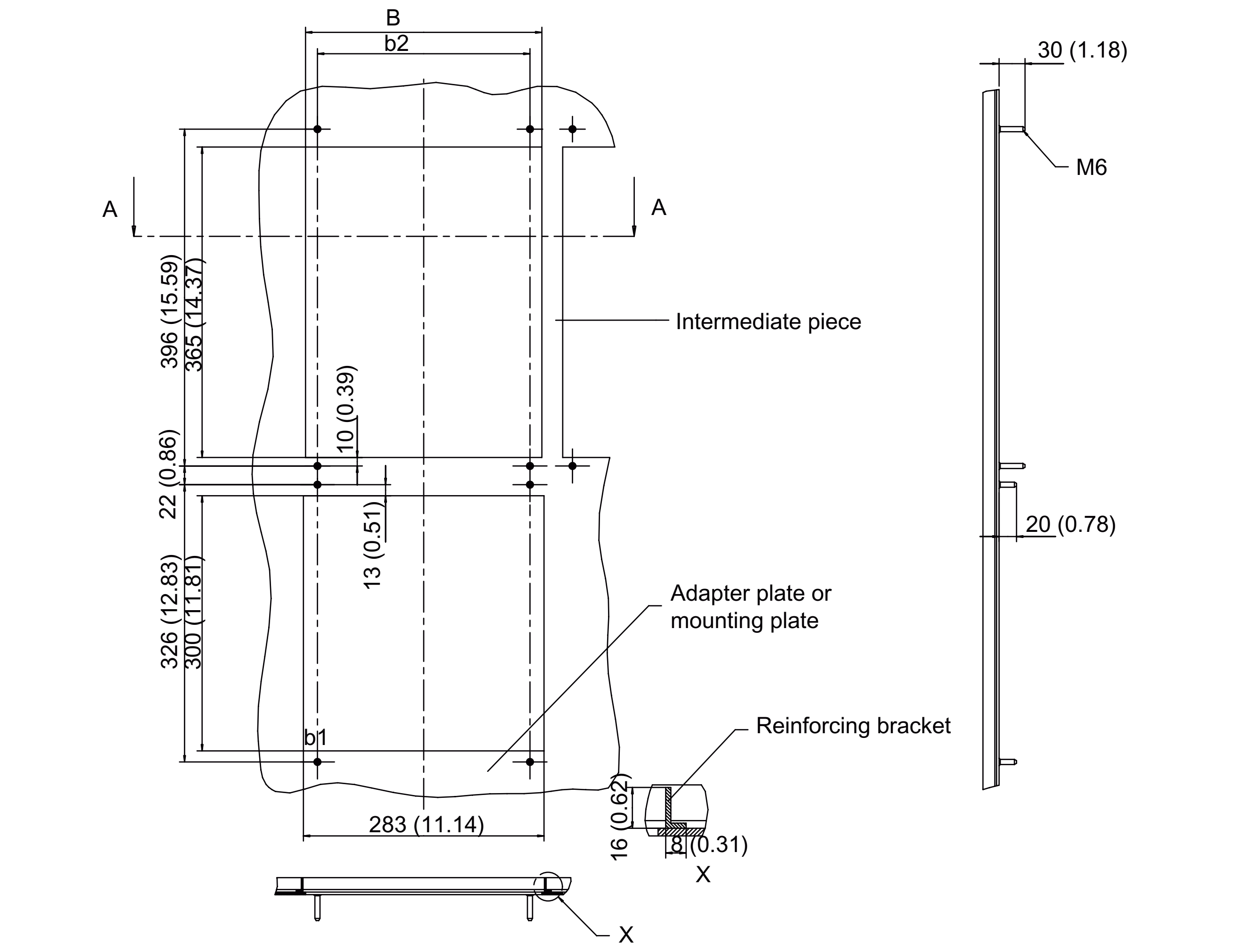


Figure 3-20 Installation openings for the power unit with external air cooling, 300 mm

Table 3- 20 Dimensions of the installation openings for the power unit with external air cooling

Component width	W [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)

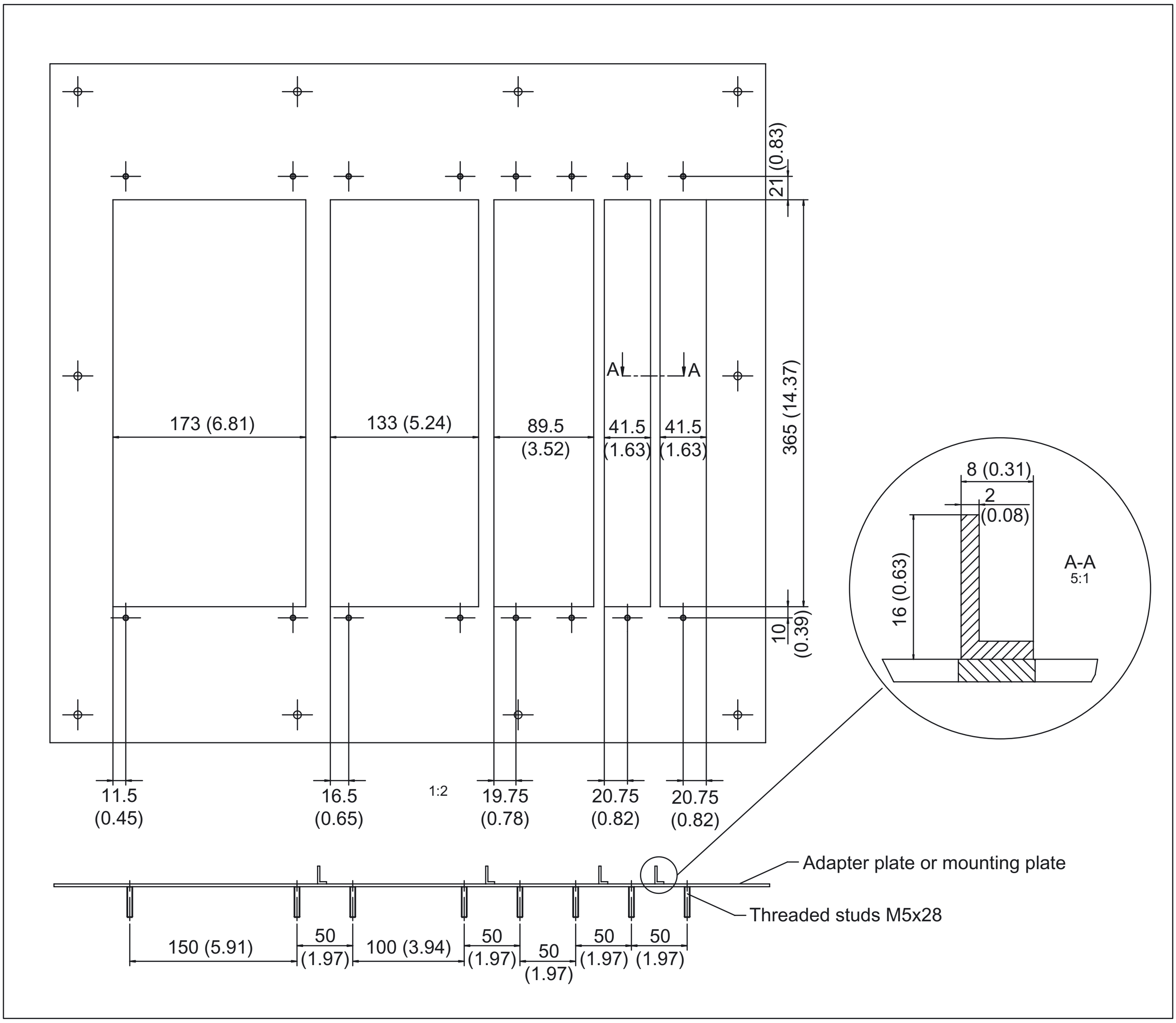


Figure 3-21 Example: mounting plate with a drive line-up

During installation it must be ensured that the component's seal is tight throughout.

Note

A set of seals consisting of spare seals for 50 mm, 100 mm, 150 mm, 200 mm and 300 mm wide components can be ordered with order number: 6SL3162-5BU00-0AA0.

The cross-pieces must have the appropriate stability. If required, we recommend that you reinforce the cross-pieces for the recesses. In our example, the cross-pieces have been reinforced using brackets to EN 755-9. Any means necessary can be used to secure the bracket to the insert plate.

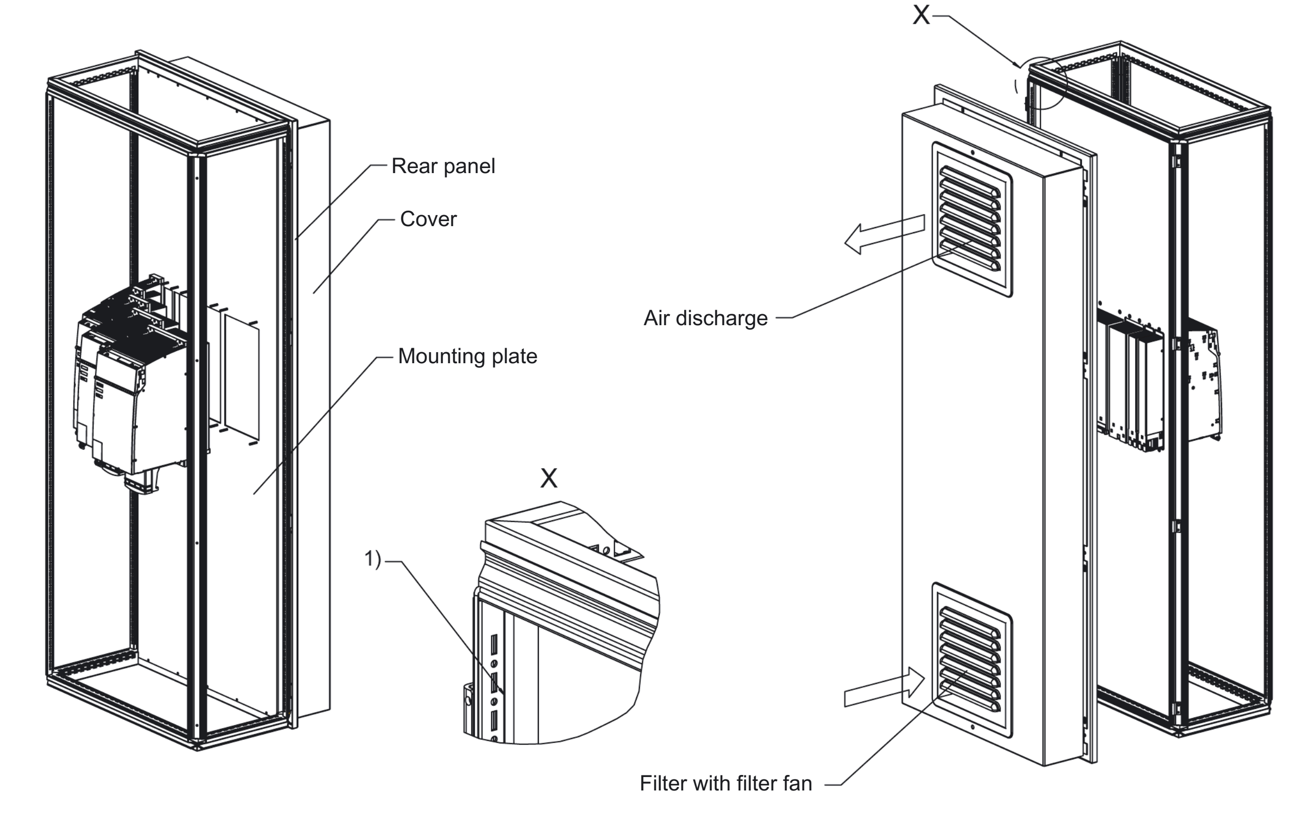


Figure 3-22 Example 1: installation in cabinet with mounting plate

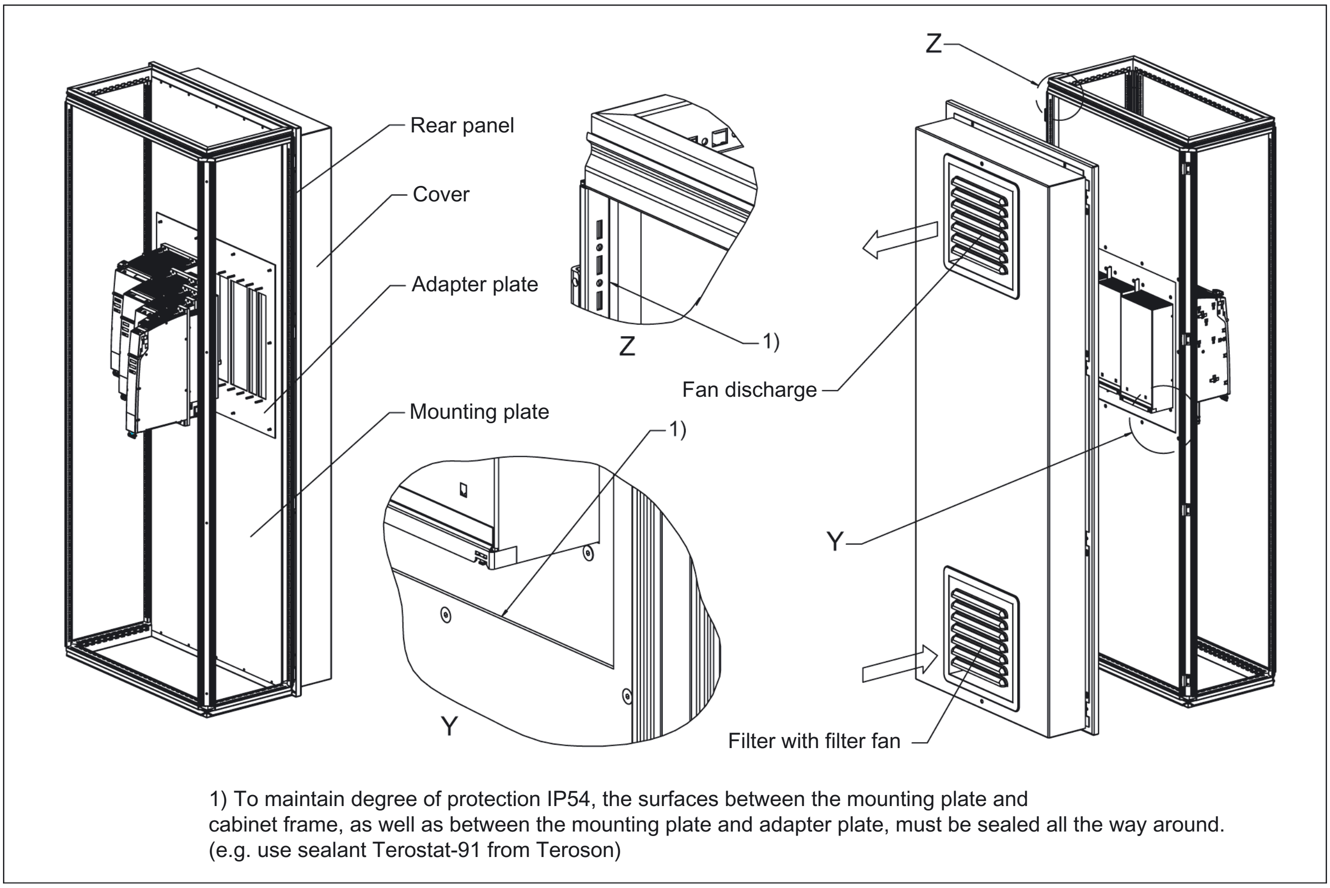


Figure 3-23 Example 2: installation in cabinet with mounting plate

We recommend that you attach a cover and filtered 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. This can be determined by establishing the total cooling air required by the individual components. This information is available in the 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 a filtered fan must be regularly checked for dirt and cleaned if necessary.

3.2.6 Technical data

Table 3- 21 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) Infeed power (S6-40%) 1) Peak infeed power 1)	 kW (Pn) kW (Ps6) kW (Pmax)	 16 21 35	 36 47 70	 55 71 91	 55 71 110
Regenerative feedback Continuous regenerative power Peak regenerative power	 kW kW	 16 35	 36 70	 55 91	 55 110
Supply voltages Rated voltage Line frequency Electronics power supply	 V_{ACrms} Hz V_{DC}	 3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10% 47 to 63 Hz 24 (20.4 - 28.8)			
DC link voltage Overvoltage trip Undervoltage trip 2)	V_{DC} V_{DC} V_{DC}	510 - 720 820 ± 2 % 360 ± 2 %			
Input currents Rated input current at 400 V_{AC}: Input current at 380 V_{AC} / 480 V_{AC} at 400 V_{AC}; S6-40% at 400 V_{AC}; peak current	 A_{AC} A_{AC} A_{AC} A_{AC}	 25 26 / 21 32 54	 55 58 /46 71 107	 84 88 / 70 108 139	 84 88 /70 108 168
DC link currents Rated DC link current at 600 V: DC link current: at 600 V_{DC}; at S6-40% at 600 V_{DC}; peak current	 A_{DC} A_{DC} A_{DC}	 27 35 59	 60 79 117	 92 121 152	 92 121 176
Current carrying capacity DC link busbar Reinforced DC link busbars: 24 V busbar:	 A_{DC} A_{DC} A_{DC}	 100 150 20	 100 / 200 3) -- 20	 200 -- 20	 200 -- 20
Electronics current consumption at 24 V DC	A_{DC}	0.95	1.5	1.9	1.9
Total power loss (including electronics losses) 4)	W	282.8	666	945.6	945.6
Max. ambient temperature Without derating With derating	 °C °C	 40 55	 40 55	 40 55	 40 55
DC link capacitance Active Line Module Drive line-up, max.	 µF µF	 705 20 000	 1 410 20 000	 1 880 20 000	 1 880 20 000
Power factor	cosϕ	1	1	1	1

External air cooling	6SL3131–	7TE21–6AAx	7TE23–6AAx	7TE25–5AAx	7TE25–5AA3 + Active Interface Module
Rated power	**kW**	**16**	**36**	**55**	**55**
Circuit breaker (UL) Type designation Rated current: Resulting rated short-circuit current [6)] SCCR at 480 V_{AC}:	 A kA	 3VL1135- 2KM30 35 65	 3VL2108- 2KN30 80 65	 3VL2112- 2KN30 125 65	 3VL2112- 2KN30 125 65
Safety fuse (UL) Type AJT Class J [5)] Rated current Resulting rated short-circuit current [6)] SCCR at 480 V_{AC}:	 A kA	 AJT35 35 65	 AJT80 80 65	 AJT125 125 65	 AJT125 125 65
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	8.78	13.77	18.5	18.5

1) The powers specified apply to the rated voltage range from 380 V to 480 V.
2) Default for 400 V supply systems; undervoltage trip threshold is adjusted to the parameterized rated voltage.
3) For components where the final digit in the order number is ≥ 3.
4) For an overview, see the power loss tables in chapter Control cabinet installation
5) Source of supply: Ferraz Shawmut, http://de.ferrazshawmut.com
6) 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 3- 22 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)] Infeed power (S6-40%) [1)] Peak infeed power [1)]	 kW (Pn) kW (Ps6) kW (Pmax)	 80 106 131	 120 145 175
Regenerative feedback Continuous regenerative power Peak regenerative power	 kW kW	 80 131	 120 175
Supply voltages Rated voltage Line frequency Electronics power supply	 V_{ACrms} Hz V_{DC}	 3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10% 47 to 63 Hz 24 (20.4 - 28.8)	
DC link voltage Overvoltage trip Undervoltage trip [2)]	V_{DC} V_{DC} V_{DC}	510 - 720 820 ± 2 % 360 ± 2 %	

External air cooling	6SL3131–	7TE28–0AAx	7TE31-2AAx
Rated power	kW	80	120
Input currents Rated input current at 400 V_{AC}: Input current at 380 V_{AC} / 480 V_{AC} at 400 V_{AC}; S6-40% at 400 V_{AC}; peak current	 A_{AC} A_{AC} A_{AC} A_{AC}	 122 128 / 102 161 200	 182 192 / 152 220 267
DC link currents Rated DC link current at 600 V: DC link current: at 600 V_{DC}; at S6-40% at 600 V_{DC}; peak current	 A_{DC} A_{DC} A_{DC}	 134 176 218	 200 244 292
Current carrying capacity DC link busbar: 24 V busbar:	 A_{DC} A_{DC}	 200 20	 200 20
Electronics current consumption at 24 V DC	A_{DC}	1.4	1.8
Total power loss (including electronics losses) [3]	W	1383.6	2243.2
Max. ambient temperature Without derating With derating	 °C °C	 40 55	 40 55
DC link capacitance Active Line Module Drive line-up, max.	 µF µF	 2 820 20 000	 3 995 20 000
Power factor	cosϕ	1	1
Circuit breaker (UL) Type designation Rated current: Resulting rated short-circuit current [5] SCCR at 480 V_{AC}:	 A kA	 3VL3117-2KN30 175 65	 3VL3125-2KN30 250 65
Safety fuse (UL) Type AJT Class J [4] Rated current Resulting rated short-circuit current [5] SCCR at 480 V_{AC}:	 A kA	 AJT175 175 65	 AJT250 250 65
Sound pressure level	dB(A)	<73	<73
Cooling air requirement	m^3/h	520	520
Rated voltage for rated data 3 AC 380 V			
Weight	kg	27.66	30.74

1) The powers specified apply to the rated voltage range from 380 V to 480 V.
2) Default for 400 V supply systems; undervoltage trip threshold is adjusted to the parameterized rated voltage.
3) For an overview, see the power loss tables in chapter Control cabinet installation
4) Source of supply: Ferraz Shawmut, http://de.ferrazshawmut.com
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.

3.2.6.1 Characteristics

Rated duty cycles of Active Line Modules

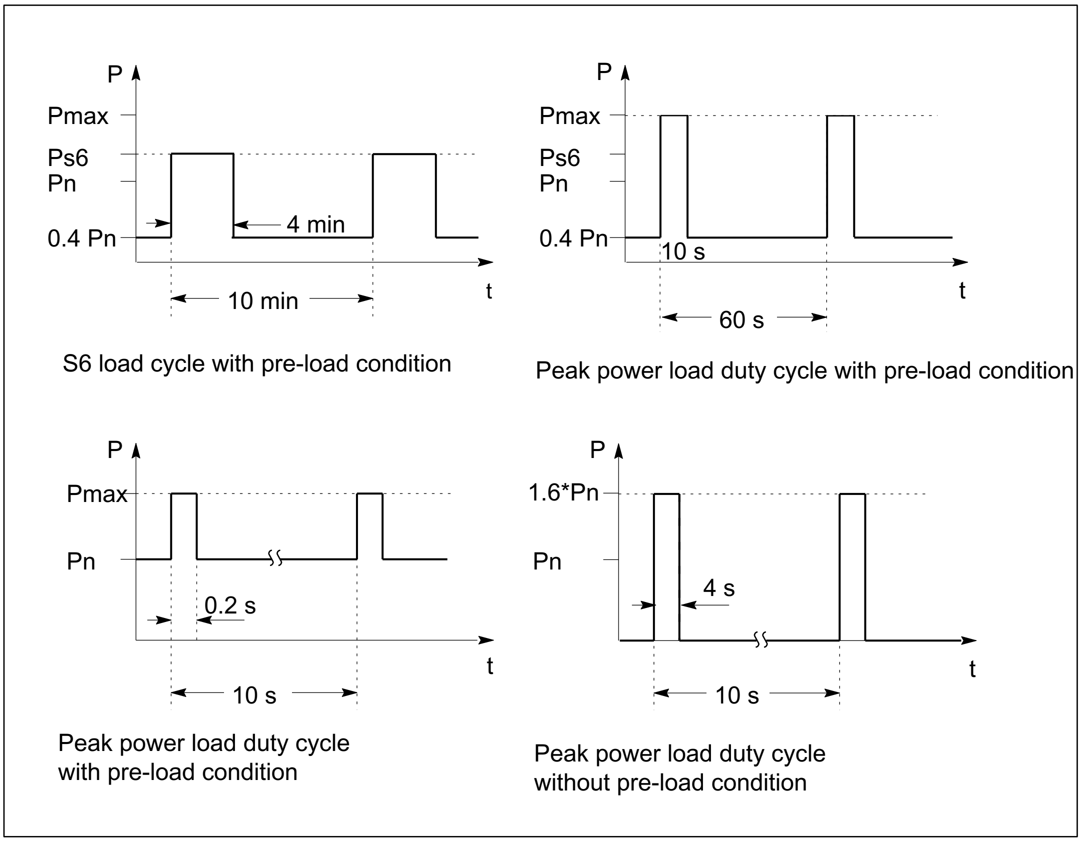


Figure 3-24 Rated duty cycles of Active Line Modules (**exception**: not applicable for 55 kW Active Line Module with Active Interface Module)

Rated duty cycles of Active Line Modules with Active Interface Modules

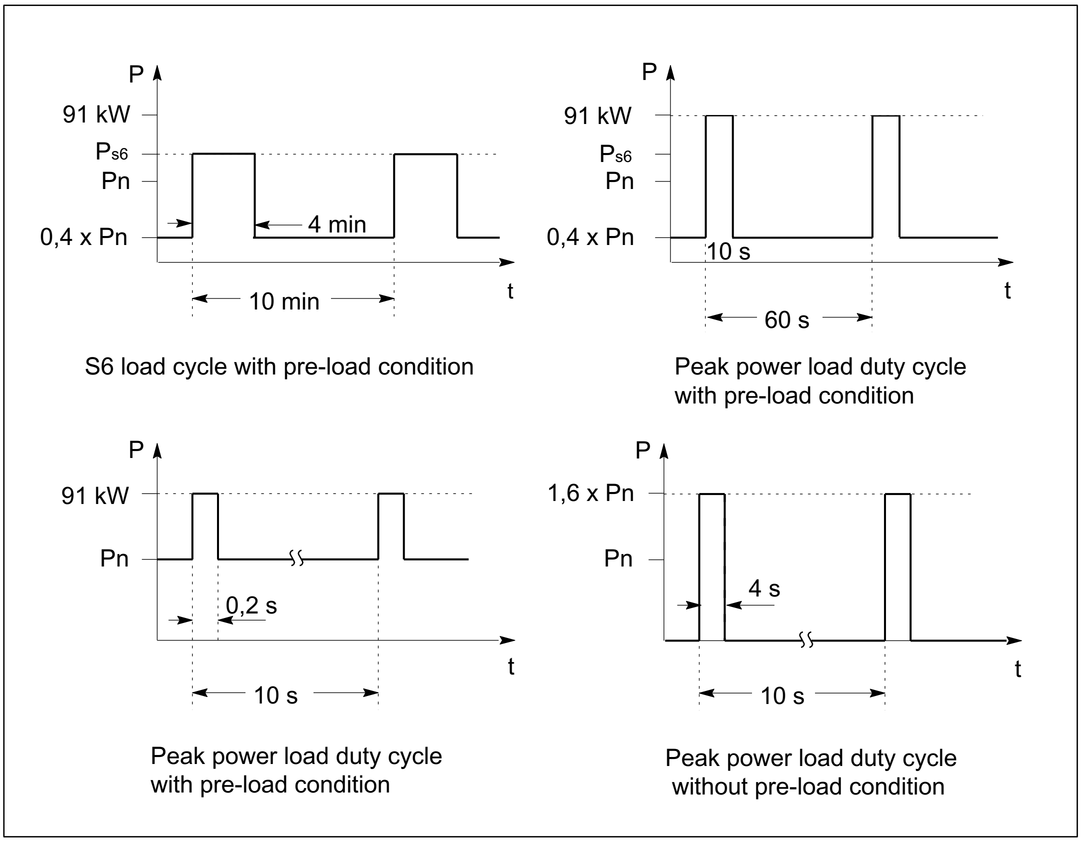


Figure 3-25 Rated duty cycles of 55 kW Active Line Modules with Active Interface Module

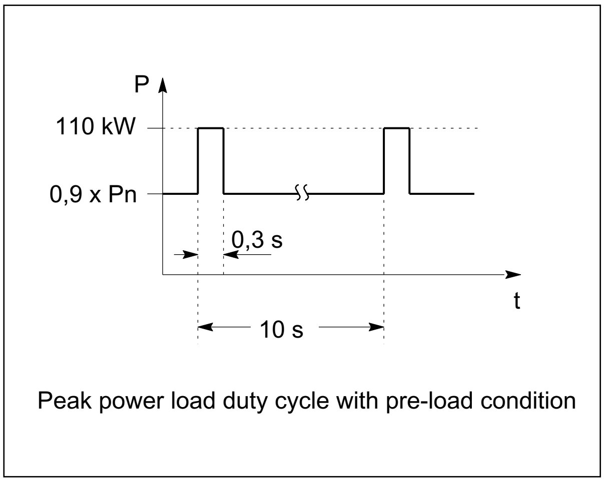


Figure 3-26 Rated duty cycle of 55 kW Active Line Modules with Active Interface Module

Derating characteristics

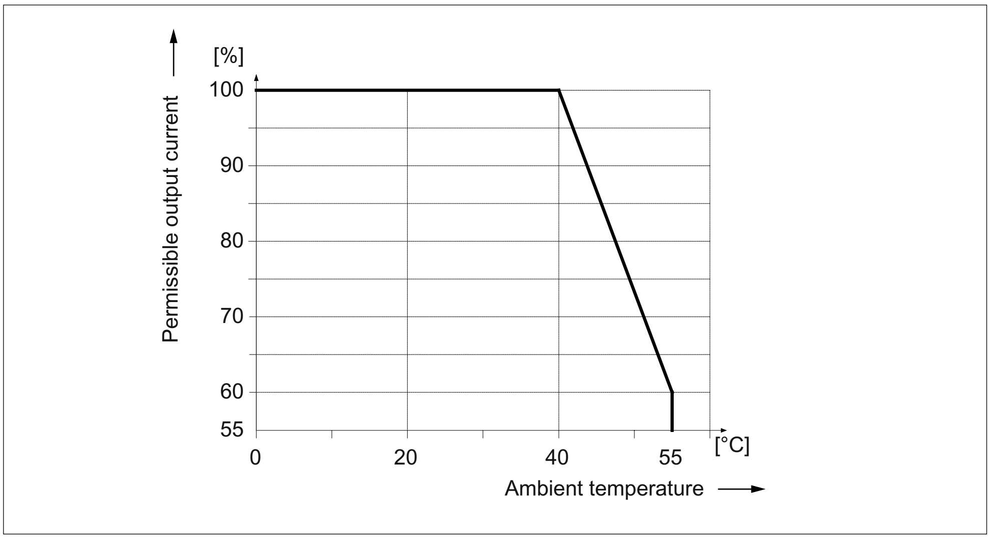


Figure 3-27 Output current as a function of the ambient temperature

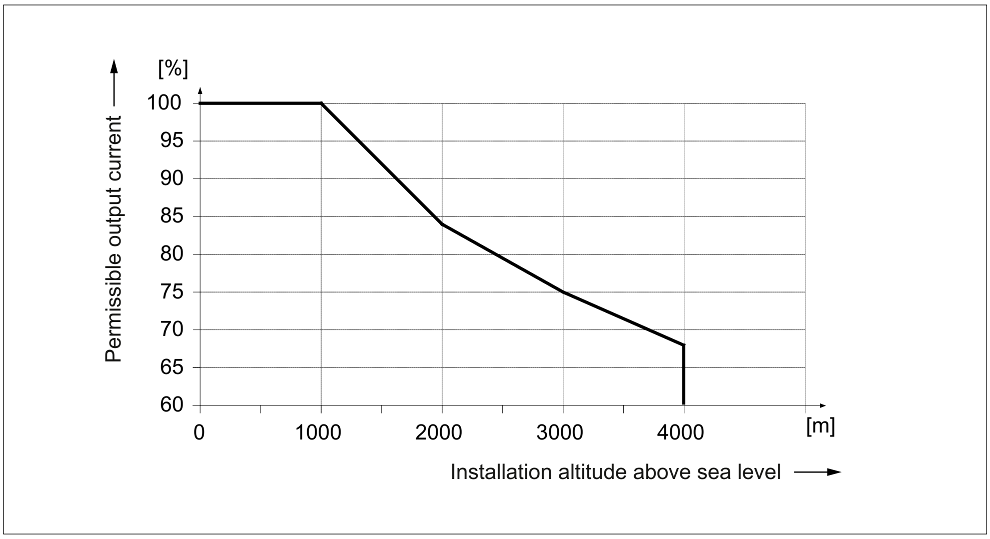


Figure 3-28 Output current as a function of the installation altitude

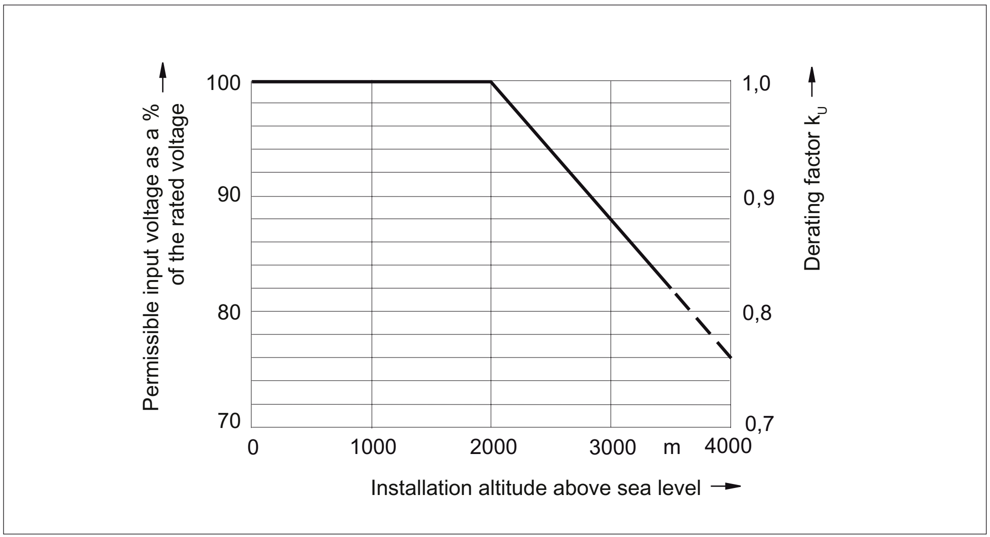


Figure 3-29 Voltage derating as a function of the installation altitude

3.3 Active Line Modules with cold plate

3.3.1 Description

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

This ensures that they are not influenced by network fluctuations.

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

The DC link starts precharging as soon as the supply voltage is applied and is independent of its phase sequence direction. Load can be applied to the DC link after the modules have been enabled. An optional main contactor is required for disconnecting the voltage.

Active Line Modules can be directly connected to TN and TT line supplies - both with grounded neutral point and also with grounded protective conductor; they can also be connected to IT line supplies. The Line Modules have an integrated overvoltage protection function.

3.3.2 Safety information

⚠ DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

⚠ DANGER

DC-link discharge time

A DC-link discharge time danger notice in the relevant national language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 70 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC-link adapter and DC-link rectifier adapter).

DANGER

If the Line Module is not disconnected from the supply system (e.g. via the line contactor or main switch), the DC link remains charged.

CAUTION

The cooling clearances of 80 mm above and below the components must be observed.

CAUTION

The tightening torque of the DC-link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

For lines without regenerative feedback capability (e.g. a diesel generator), the regenerative feedback capability of the Active Line Module must be deactivated by means of parameters (see Description of functions). The braking energy must then be dissipated via an additional Braking Module with braking resistor provided in the drive line-up.

CAUTION
The overall length of the power cables (motor supply cables and DC-link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION
Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION
DC-link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

3.3.3 Interface description

3.3.3.1 Overview

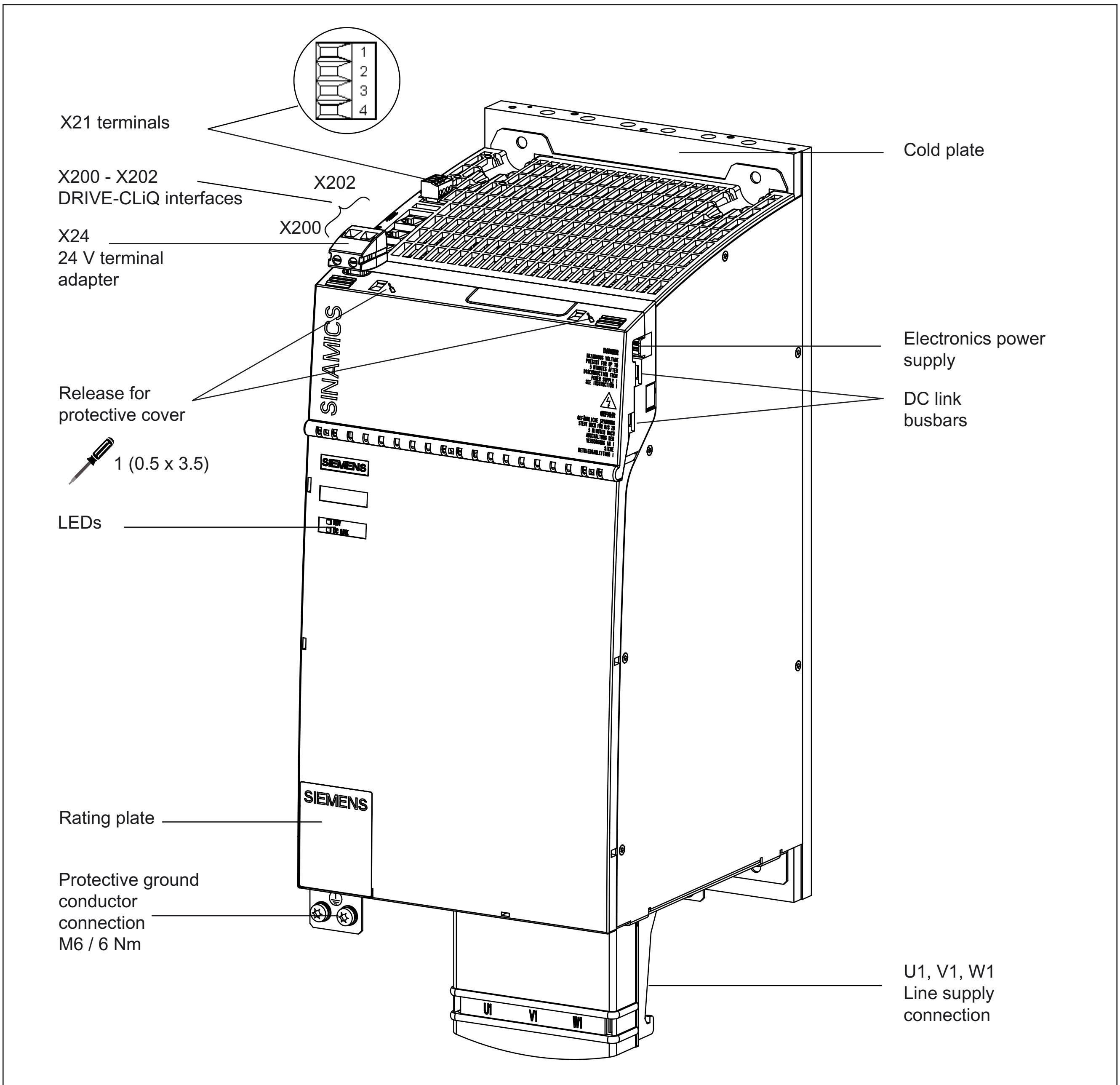
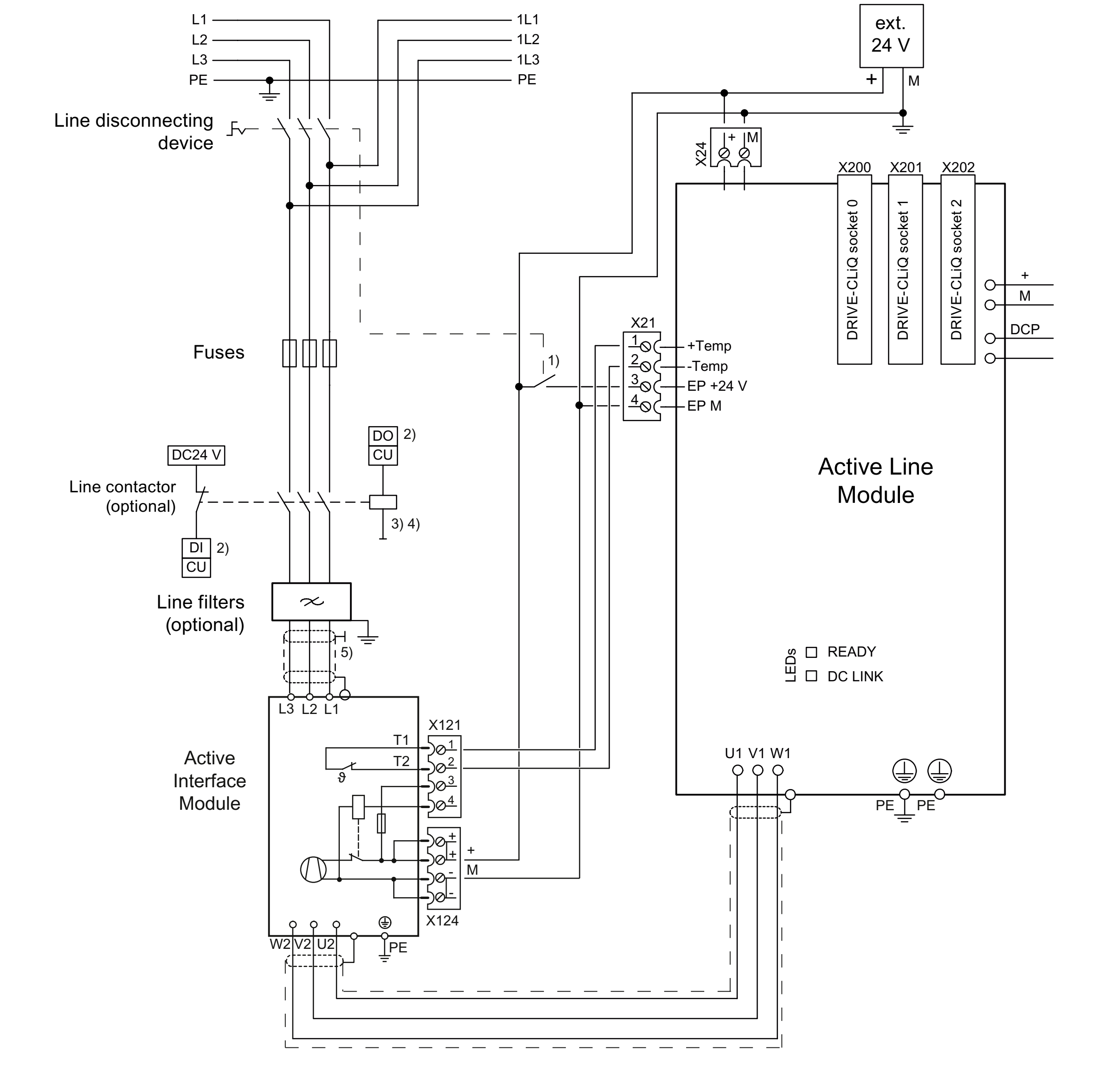


Figure 3-30 Active Line Module with cold plate (example: 55 kW)

3.3.3.2 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 coupling device must be used if required.
5) Contact through installation backplane or shield buses in accordance with EMC directive.

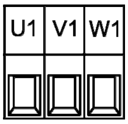
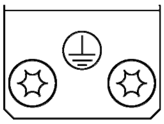
Figure 3-31 Connection example: Active Line Module with cold plate

Note

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

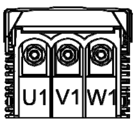
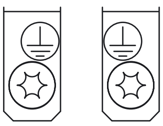
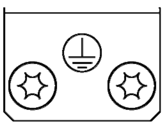
3.3.3.3 X1 line connection

Table 3- 23 Terminal block X1 Active Line Module 16 kW

	Terminal	Technical specifications
	U1 V1 W1	Max. connectable cross-section: 10 mm² Type: Screw terminal 6 (see chapter Connection methods) Tightening torque: 1.5 - 1.8 Nm
	PE connection	Threaded hole M5/3 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

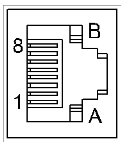
Table 3- 24 Terminal block for the Active Line Module (36 kW to 120 kW)

	Terminals	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50 / 60 Hz **36 kW:** Threaded bolt M6/6 Nm [1)] (see chapter Connection methods) **55 kW, 80 kW and 120 kW** Threaded bolt M8/13 Nm [1)]
	PE connection	**36 kW:** Threaded hole M6/6 Nm [1)]
		**55 kW:** Threaded hole M6/6 Nm [1)] **80 kW and 120 kW:** Threaded hole M8/13 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

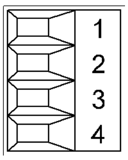
3.3.3.4 X200-X202 DRIVE-CLiQ interfaces

Table 3- 25 DRIVE-CLiQ interface X200-X202 for 16 kW and 36 kW Smart Line Modules

	PIN	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 V power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces included in the scope of delivery; blanking plate (50 pieces) Order number: 6SL3066-4CA00-0AA0			

3.3.3.5 X21 EP terminals

Table 3- 26 Terminal strip X21

	Terminal	Designation	Technical specifications
	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	
	2	EP +24 V Enable Pulses	Voltage 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M Enable Pulses	
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see Appendix A)			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual LH1).

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

Note

For operation, 24 VDC must be connected to terminal 3 and ground to terminal 4. When removed, pulse suppression is activated (if the relevant parameters have been assigned).

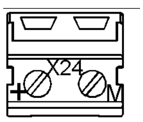
If the Line Module is not disconnected from the network (e.g. with a line contactor), the DC link remains charged.

NOTICE
Before the drive line-up is switched off by means of the disconnector unit, the voltage at terminals 3 (EP +24 V) and 4 (EP M) must be interrupted. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

⚠ DANGER
Risk of electric shock! Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), a Sensor Module External (SME120 or SME125) or Terminal Module TM120 must be used. If these instructions are not complied with, there is a risk of electric shock!

3.3.3.6 X24 24 V terminal adapter

Table 3- 27 Terminal strip X24

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 VDC supply voltage
	M	Ground	Electronics ground
The 24 V terminal adapter is supplied as standard. Max. connectable cross-section: 6 mm² Type: Screw terminal 5 (see chapter Connection methods)			

3.3.3.7 Meaning of the LEDs on the Active Line Module

Table 3- 28 Active Line Module - description of the LEDs

Status		Description, cause	Remedy
Ready (H200)	DC link (H201)		
off	off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	off	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.	Check line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/ red (0.5 Hz)	-	Firmware is being downloaded.	–
Green/red (2 Hz)	-	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	–	Component detection via LED is activated (p0124). **Note:** Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC link" LED.
The warning information on the components must be carefully observed!

3.3.4 Dimension drawings

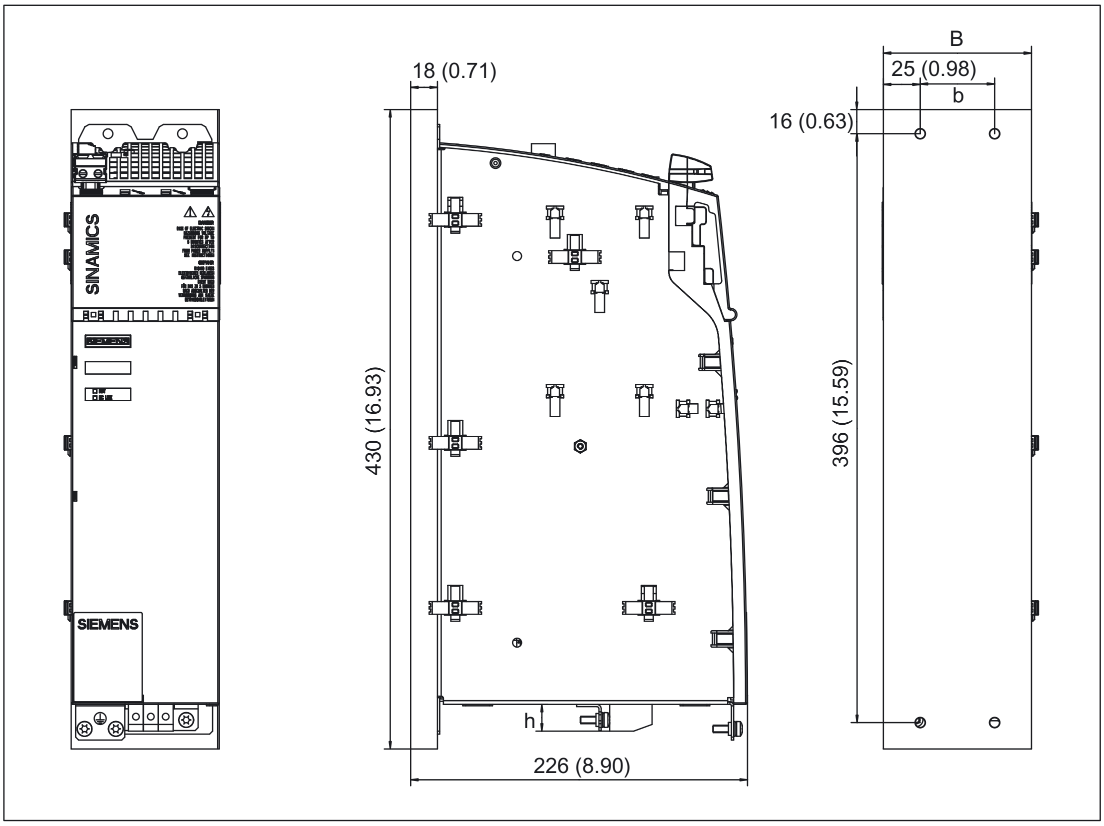


Figure 3-32 Dimension drawing of Active Line Module with cold plate (16 kW), all dimensions in mm and (inches)

Table 3- 29 Dimensions of Active Line Module with cold plate (16 kW)

Line module type	Order number	W [mm] (inches)	b [mm] (inches)	h [mm] (inches)
16 kW	6SL3136-7TE21-6AAx	100 (3.94)	50 (1.97)	18 (0.71)

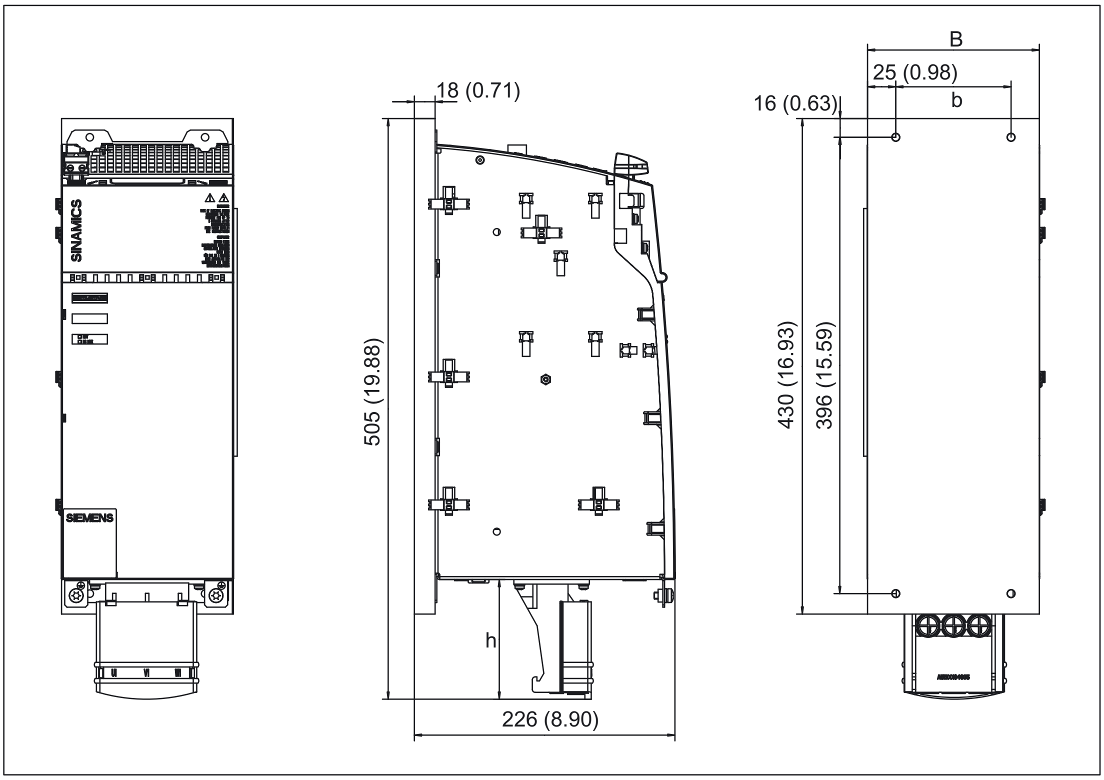


Figure 3-33 Dimension drawing of Active Line Module with cold plate (36 kW, 55 kW, 80 kW, and 120 kW), all dimensions in mm and (inches)

Table 3- 30 Dimensions, Active Line Modules with cold plate (36 kW, 55 kW, 80 kW, and 120 kW)

Line module type	Order number	W [mm] (inches)	b [mm] (inches)	h [mm] (inches)
36 kW	6SL3136-7TE23-6AAx	150 (5.91)	100 (3.94)	78 (3.07)
55 kW	6SL3136-7TE25-5AAx	200 (7.87)	150 (5.91)	78 (3.07)
80 kW	6SL3136-7TE28-0AAx	300 (11.81)	250 (9.84)	78 (3.07)
120 kW	6SL3136-7TE31-2AAx	300 (11.81)	250 (9.84)	78 (3.07)

3.3.5 Installation

Installation of the cold plate component on customer-specific heat sinks

Note the following before installation:

- Before the installation, check the surface of the heat sink to ensure that it is not damaged.
- To facilitate installation, M6 screw bolts and hexagon nuts/grub screws (ISO 7436-M6x40-14 H, property class 8.8) are recommended.
- 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 installation position of the heat-conducting foil (see diagram below).

Note

When a component is replaced, the heat-conducting foil must also be replaced.
Only heat-conducting foil approved or supplied by Siemens can be used.

	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

Installation

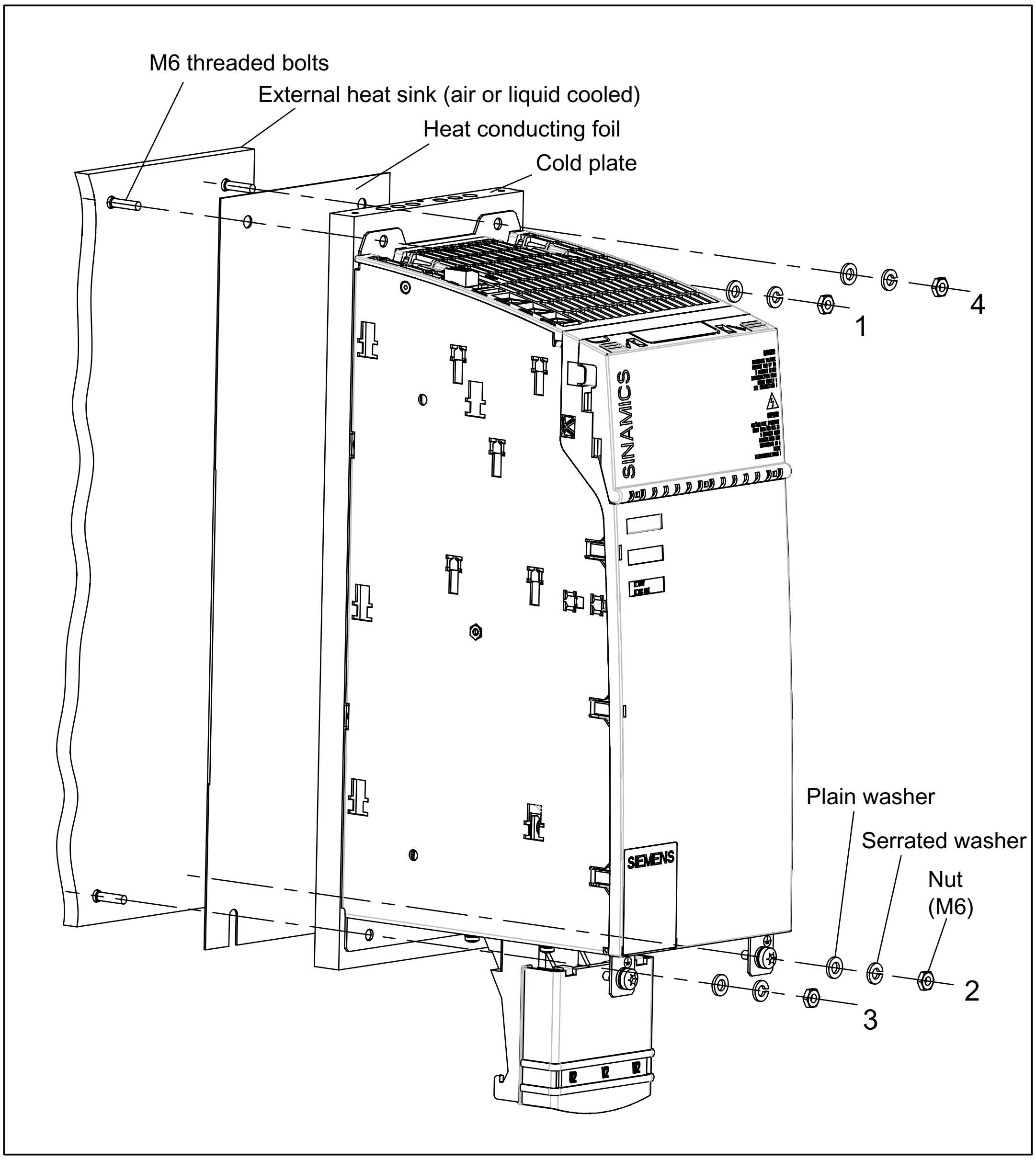


Figure 3-34 Installation of a cold plate power unit with an external heat sink and heat-conducting foil

To begin, tighten the screws by hand (approx. 0.5 Nm) in the sequence shown (steps 1 to 4) and then secure them (10 Nm).

Help with the mechanical control cabinet installation is available from:

Siemens AG
Industry Sector, IA SE WKC
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

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

The machine manufacturer can adapt the heat sink version to his 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
During the installation, you must ensure that the threaded bolts do not damage the cold plate.

3.3.6 Technical data

Table 3- 31 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] Infeed power (S6-40%) [2] Peak infeed power[2]	 kW (Pn) kW (Ps6) kW (Pmax)	 16 21 35	 36 47 70	 55 71 91	 55 71 110	 80 106 131	 120 145 175
Regenerative feedback Continuous regenerative power Peak regenerative power	 kW kW	 16 35	 36 70	 55 91	 55 110	 80 131	 120 175
Supply voltages Rated voltage Line frequency Electronics power supply	 V_{ACrms} Hz V_{DC}	 3 AC 380 10 % (-15 % < 1 min) to 3 AC 480 10 % 47 to 63 24 (20.4 - 28.8)					
DC link voltage Overvoltage trip Undervoltage trip [3]	V_{DC} V_{DC} V_{DC}	510 – 720 820 ± 2 % 360 ± 2 %					
Input currents Rated input current at 400 V_{AC}: Input current at 380 V_{AC} / 480 V_{AC} at 400 V_{AC}; S6-40% at 400 V_{AC}; peak current	 A_{AC} A_{AC} A_{AC} A_{AC}	 25 26 / 21 32 54	 55 58 /46 71 107	 84 88 / 70 108 139	 84 88 /70 108 168	 122 128 / 102 161 200	 182 192 / 152 220 267
DC link currents Rated DC link current at 600 V: DC link current: at 600 V_{DC}; at S6-40% at 600 V_{DC}; peak current	 A_{DC} A_{DC} A_{DC}	 27 35 59	 60 79 117	 92 121 152	 92 121 176	 134 176 195	 200 244 292
Current carrying capacity DC link busbar Reinforced DC link busbars: 24 V busbar:	 A_{ACrms} A_{ACrms} A_{ACrms}	 100 150 20	 100/200 [4] -- 20	 200 -- 20	 200 -- 20	 200 -- 20	 200 20
Electronics current consumption at 24 V DC	A_{DC}	0.85	1.05	1.15	1.15	1.4	1.8
Total power loss [7](including electronics losses)	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 20 000	 1410 20 000	 1880 20 000	 1880 20 000	 2820 20 000	 3760 20 000
Power factor	cosφ	1	1	1	1	1	1
Circuit breaker (UL) Type designation Rated current: Resulting rated short-circuit current [6] SCCR at 480 V_{AC}:	 A kA	 3VL1135- 2KM30 35 65	 3VL2108- 2KN30 80 65	 3VL2112- 2KN30 125 65	 3VL2112- 2KN30 125 65	 3VL3117- 2KN30 175 65	 3VL3125- 2KN30 250 65
Safety fuse (UL) Type AJT Class J [5] Rated current Resulting rated short-circuit [6] current SCCR at 480 V^{AC}	 A kA	 AJT35 35 65	 AJT80 80 65	 AJT125 125 65	 AJT125 125 65	 AJT175 175 65	 AJT250 250 65
Max. permissible heat-sink temperature	°C	70	70	78	78	70	75
Max. ambient temperature Without derating With derating	 °C °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 powers specified apply to the rated voltage range from 380 V to 480 V.
3) Default for 400 V supply systems; undervoltage trip threshold is adjusted to the parameterized rated voltage.
4) For components where the final digit in the order number is ≥ 3.
5) Source of supply: Ferraz Shawmut, http://de.ferrazshawmut.com
6) 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.
7) For an overview, see the power loss tables in chapter Control cabinet installation

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.

3.3.6.1 Characteristics

Rated duty cycles of Active Line Modules

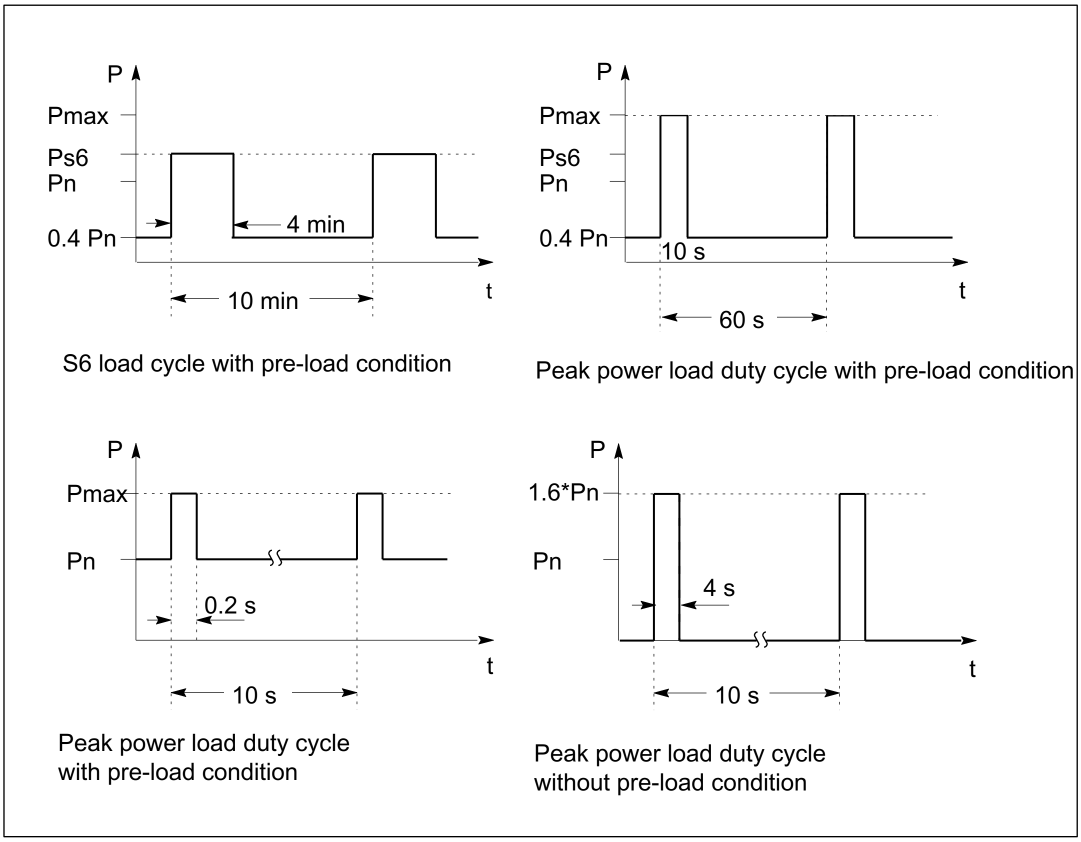


Figure 3-35 Rated duty cycles of Active Line Modules (exception: not applicable for 55 kW Active Line Module with Active Interface Module)

Rated duty cycles of Active Line Modules with Active Interface Modules

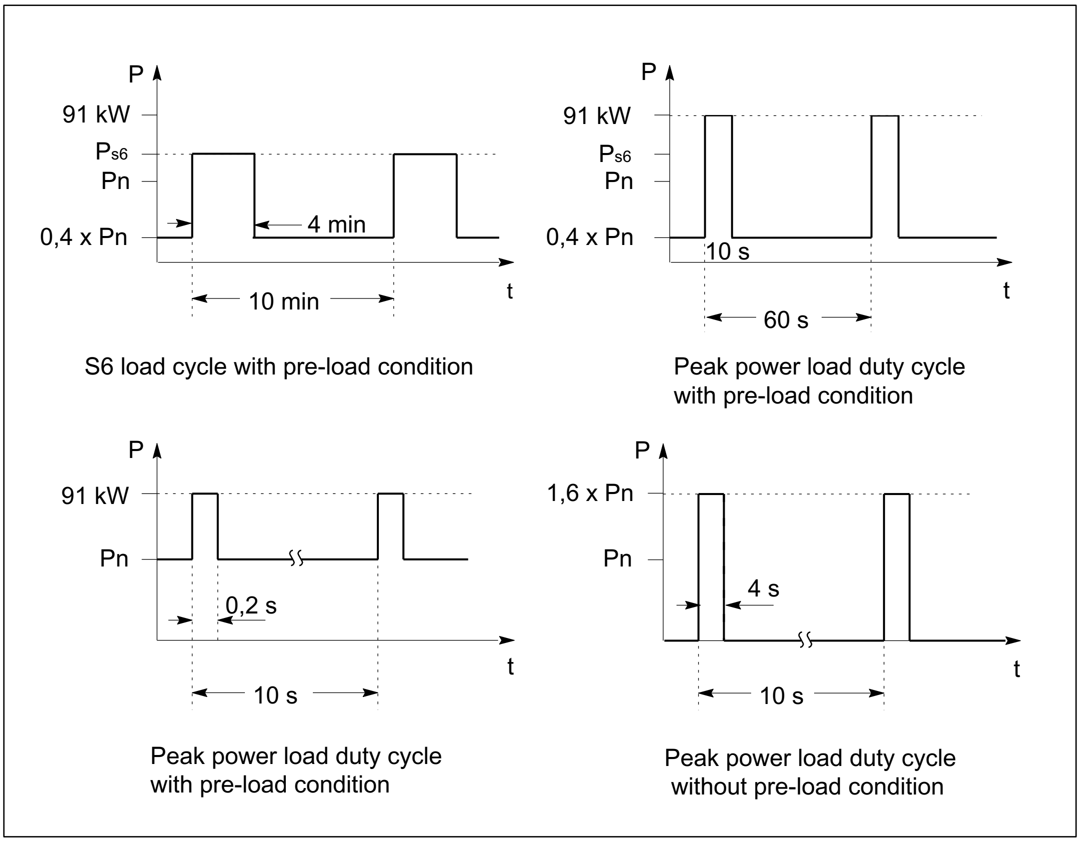


Figure 3-36 Rated duty cycles of 55 kW Active Line Modules with Active Interface Module

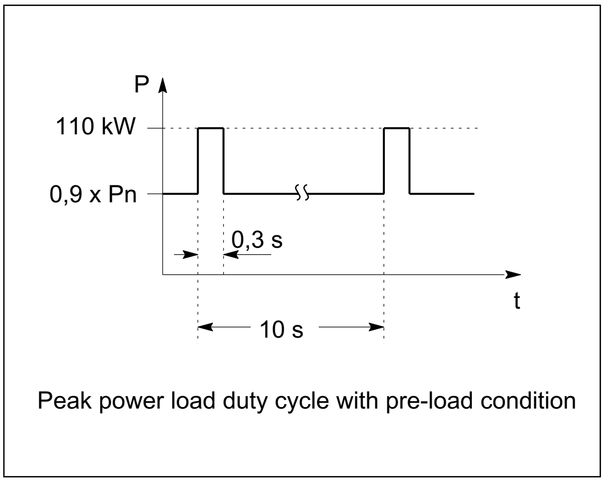


Figure 3-37 Rated duty cycle of 55 kW Active Line Modules with Active Interface Module

Derating characteristics

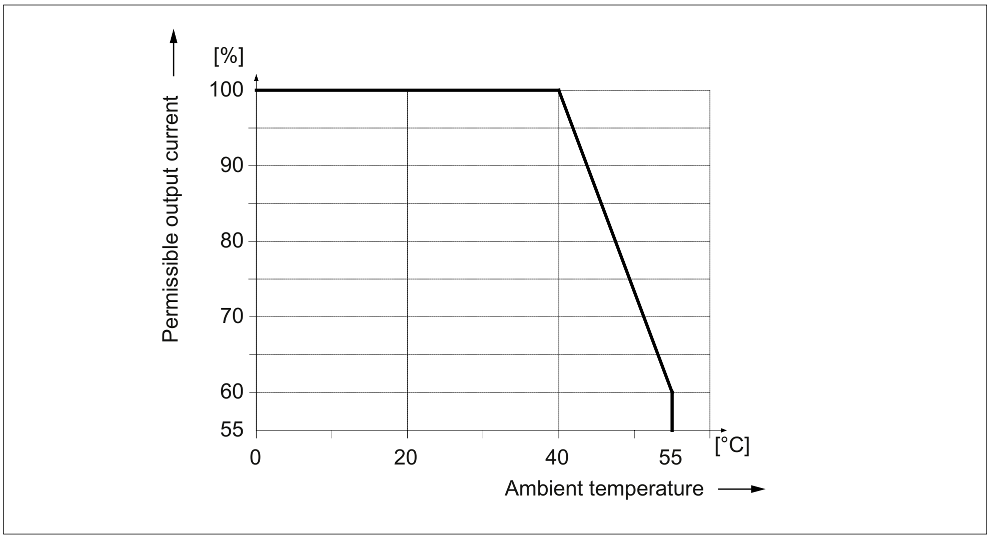


Figure 3-38 Output current as a function of the ambient temperature

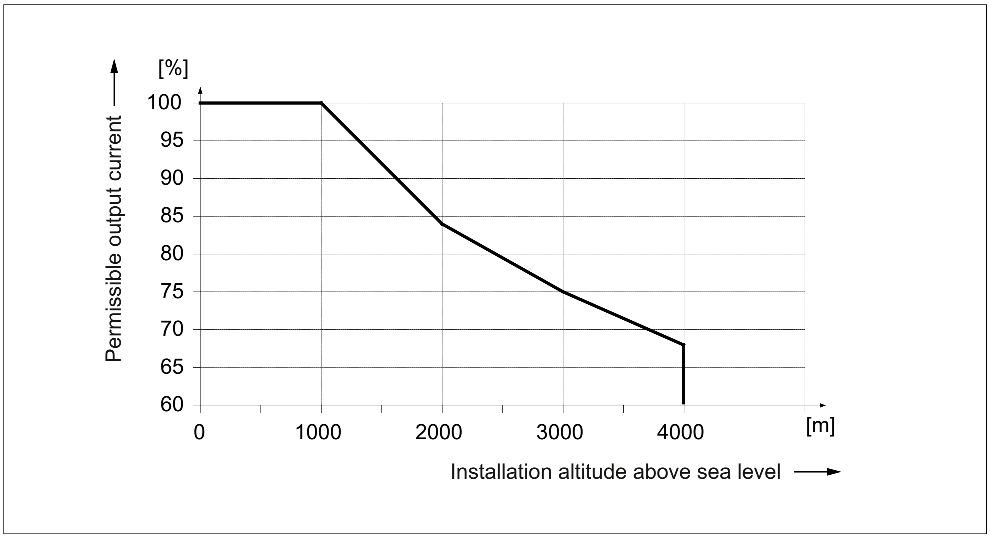


Figure 3-39 Output current as a function of the installation altitude

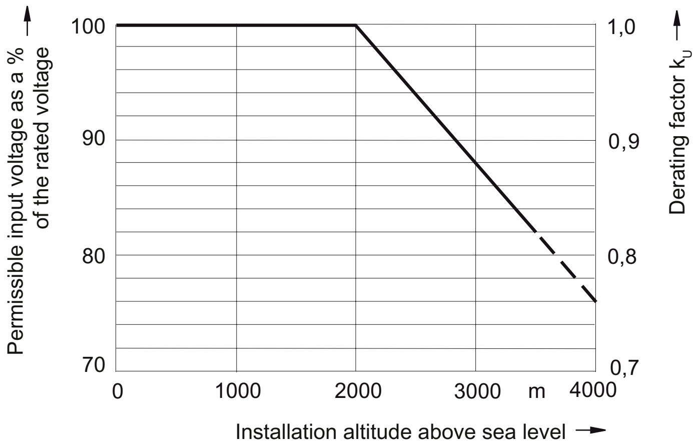


Figure 3-40 Voltage derating as a function of the installation altitude

3.4 Active Line Modules Liquid Cooled

3.4.1 Description

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

This ensures that they are not influenced by network fluctuations.

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

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 line contactor is required for disconnecting the voltage.

Active Line Modules can be directly connected to TN and TT systems - both with grounded neutral point and also with grounded line conductor; they can also be connected to IT systems. The Line Modules have an integrated overvoltage protection function.

3.4.2 Safety information

DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

DANGER

DC-link discharge time

A DC-link discharge time danger notice in the relevant national language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 70 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC-link adapter and DC-link rectifier adapter).

DANGER

If the Line Module is not disconnected from the supply system (e.g. via the line contactor or main switch), the DC link remains charged.

CAUTION

The cooling clearances of 80 mm above and below the components must be observed.

CAUTION

The tightening torque of the DC-link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

For lines without regenerative feedback capability (e.g. a diesel generator), the regenerative feedback capability of the Active Line Module must be deactivated by means of parameters (see Description of functions). The braking energy must then be dissipated via an additional Braking Module with braking resistor provided in the drive line-up.

CAUTION
The overall length of the power cables (motor supply cables and DC-link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION
Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION
DC-link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

3.4.3 Interface description

3.4.3.1 Overview

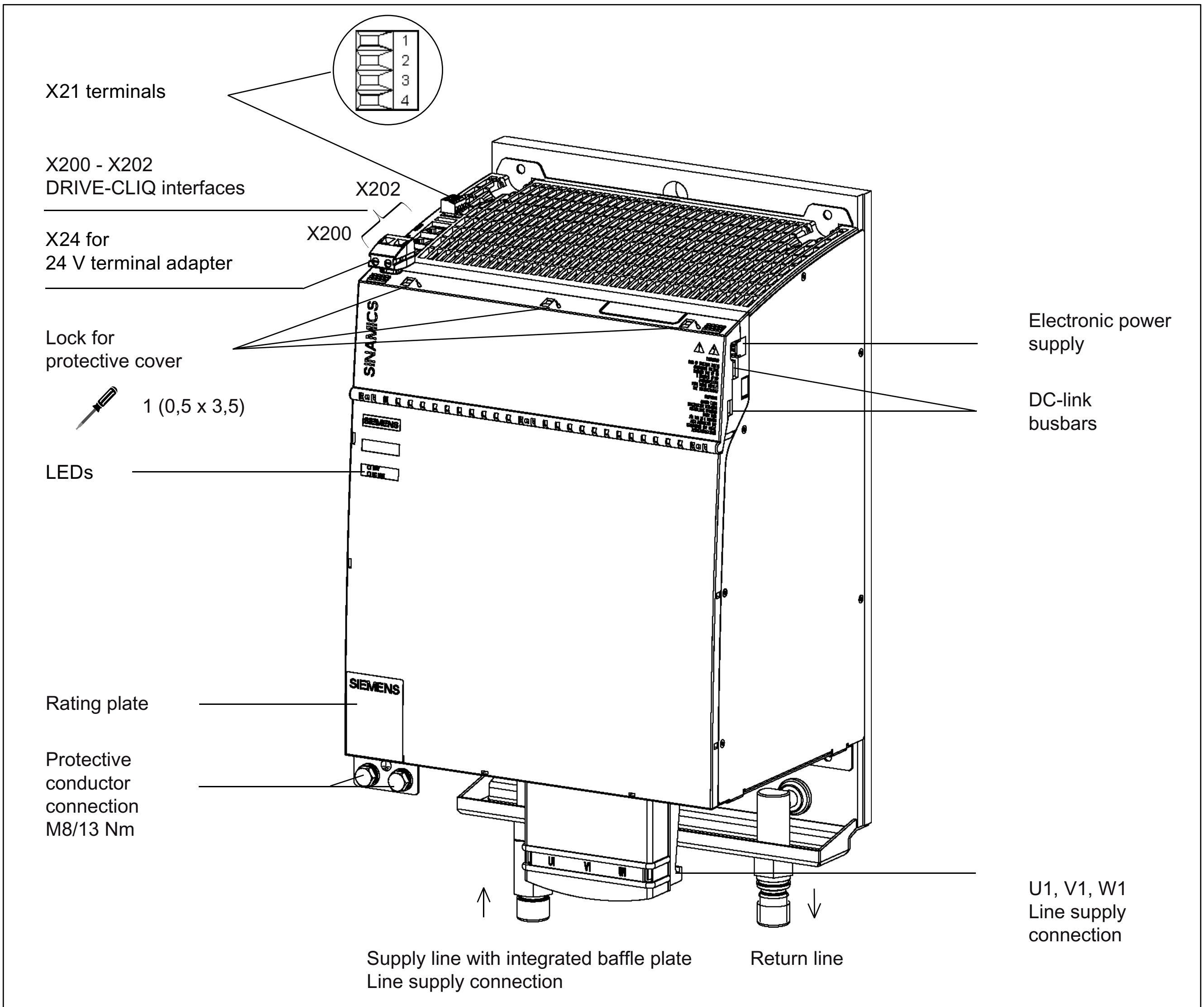
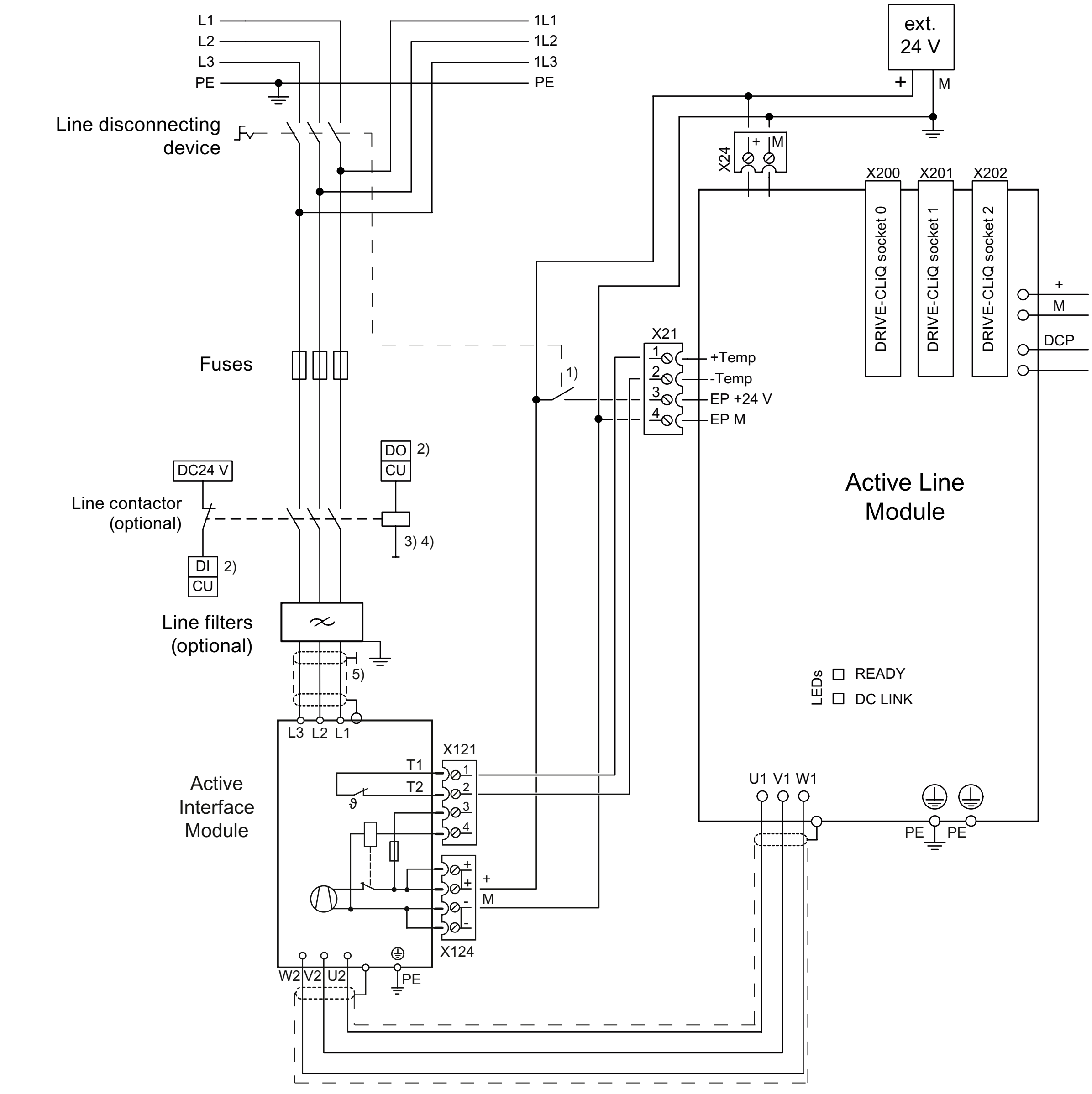


Figure 3-41 Active Line Module Liquid Cooled (120 kW)

3.4.3.2 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 coupling device must be used if required.
5) Contact through installation backplane or shield buses in accordance with EMC directive.

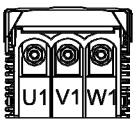
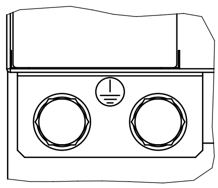
Figure 3-42 Example connection of Active Line Module

Note

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

3.4.3.3 X1 line connection

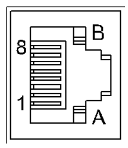
Table 3- 32 Active Line Module 120 kW terminal strip

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

1) For ring cable lugs in accordance with DIN 46234

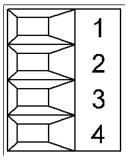
3.4.3.4 X200-X202 DRIVE-CLiQ interfaces

Table 3- 33 DRIVE-CLiQ interface X200-X202 for 16 kW and 36 kW Smart Line Modules

	PIN	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 V power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces included in the scope of delivery; blanking plate (50 pieces) Order number: 6SL3066-4CA00-0AA0			

3.4.3.5 X21 EP terminals

Table 3- 34 Terminal strip X21

	Terminal	Designation	Technical specifications
	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 (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm² Type: Screw terminal 1 (see Appendix)			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual LH1).

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

CAUTION

If an Active Interface Module is connected, the temperature output of the Active Interface Module must be connected to terminals 1 and 2.

WARNING

For operation, 24 VDC must be connected to terminal 3 and ground to terminal 4. Upon removal, pulse suppression is activated. Feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

NOTICE

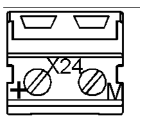
If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals 3 (EP +24 V) and 4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

This protects external loads located parallel to the drive on the same switching component.

> **⚠ DANGER**
>
> **Risk of electric shock!**
>
> Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), a Sensor Module External (SME120 or SME125) or Terminal Module TM120 must be used.
>
> If these instructions are not complied with, there is a risk of electric shock!

3.4.3.6 X24 24 V terminal adapter

Table 3- 35 Terminal strip X24

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 VDC supply voltage
	M	Ground	Electronics ground
The 24 V terminal adapter is supplied as standard. Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see chapter Connection methods)			

3.4.3.7 Description of the LEDs on the Active Line Module

Table 3- 36 Active Line Module - description of the LEDs

Status		Description, cause	Remedy
Ready (H200)	DC link (H201)		
off	off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	off	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.	Check line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/ red (0.5 Hz)	-	Firmware is being downloaded.	–
Green/red (2 Hz)	-	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	–	Component detection via LED is activated (p0124). **Note:** Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC link" LED.
The warning information on the components must be carefully observed!

3.4.4 Dimension drawing

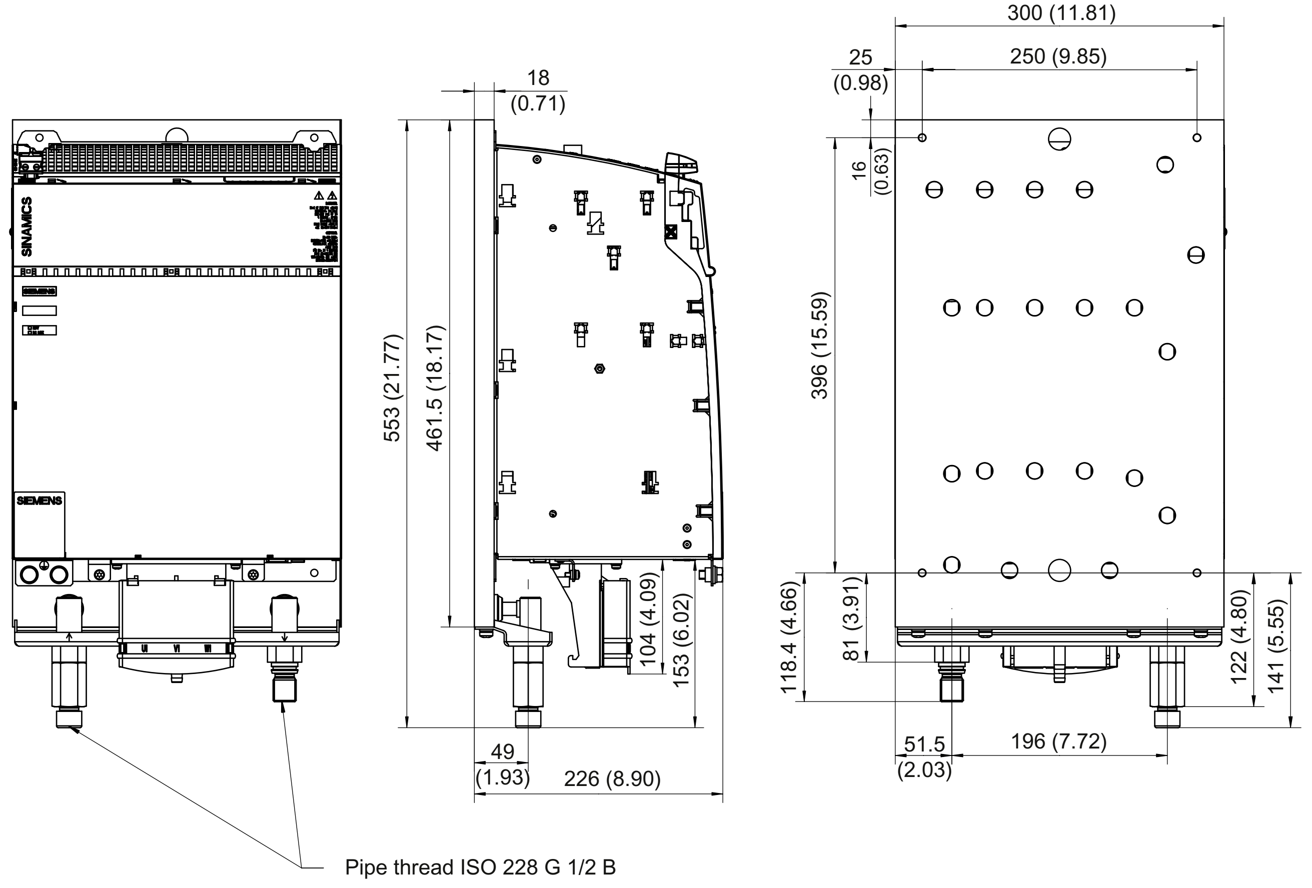


Figure 3-43 Dimension drawing of Active Line Module Liquid Cooled 120 kW, all dimensions in mm and (inches)

3.4.5 Installation

M6 screw bolts and hexagon nuts/grub screws (ISO 7436-M6x40-14 H, property class 8.8) are recommended for the installation of the power units.

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.

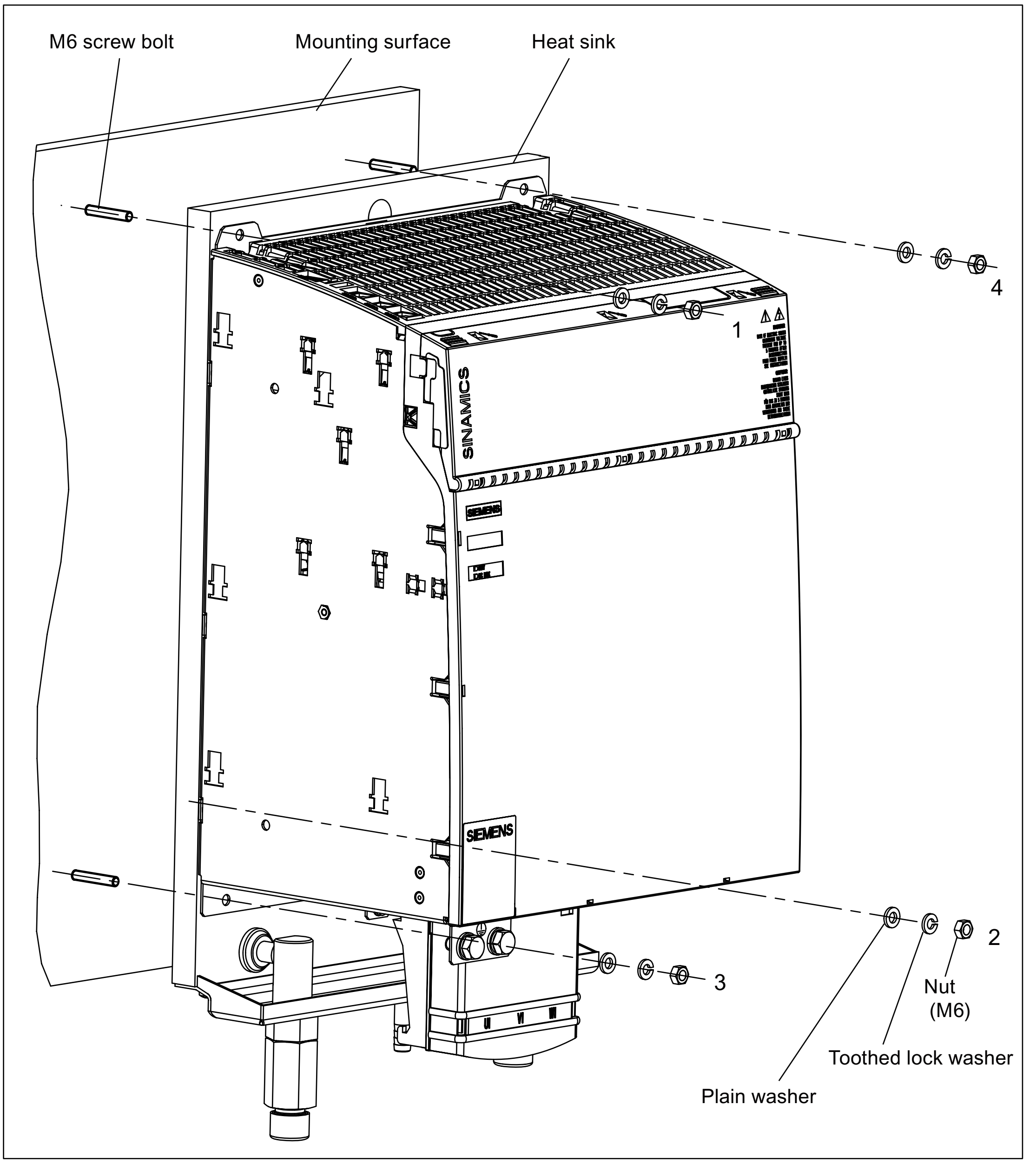


Figure 3-44 Installation of liquid-cooled power unit

To begin, tighten the screws by hand (approx. 0.5 Nm) in the sequence shown (steps 1 to 4) and then secure them (10 Nm).

3.4.6 Technical data

Table 3- 37 Technical data for an Active Line Module Liquid Cooled

Liquid Cooled		6SL3135-7TE31-2AA3
Rated power	**kW**	**120**
Infeed Rated power (S1)[1)] Infeed power (S6-40%)[1)] Peak infeed power[1)]	 kW (Pn) kW (Ps6) kW (Pmax)	 120 145 175
Regenerative feedback Continuous regenerative power Peak regenerative power	 kW kW	 120 175
Supply voltages Rated voltage Line frequency Electronics power supply	 V_{ACrms} Hz V_{DC}	 3 AC 380 10 % (-15 % < 1 min) to 3 AC 480 10 % 47 to 63 24 (20.4 - 28.8)
DC link voltage Overvoltage trip Undervoltage trip [2)]	V_{DC} V_{DC} V_{DC}	510 – 720 820 ± 2 % 360 ± 2 %
Input currents Rated input current at 400 V_{AC}: Input current at 380 V_{AC} / 480 V_{AC} at 400 V_{AC}; S6-40% at 400 V_{AC}; peak current	 A_{AC} A_{AC} A_{AC} A_{AC}	 182 192 / 152 220 267
DC link currents Rated DC link current at 600 V: DC link current: at 600 V_{DC}; at S6-40% at 600 V_{DC}; peak current	 A_{DC} A_{DC} A_{DC}	 200 244 292
Current carrying capacity DC link busbar: 24 V busbar:	 A_{DC} A_{DC}	 200 20
Electronics current consumptionat 24 V DC	A_{DC}	1.8
Total power loss (including electronics losses) [3)]	W	2243.2
Max. ambient temperature Without derating With derating	 °C °C	 40 55
DC link capacitance: Active Line Module Drive line-up, max.	 µF µF	 3995 20 000
Power factor	cosϕ	1
Circuit breaker (UL) Type designation Rated current: Resulting rated short-circuit current [6)] SCCR at 480 V_{AC}:	 A kA	 3VL3125-2KN30 250 65

Liquid Cooled		6SL3135-7TE31-2AA3
Rated power	kW	120
Safety fuse (UL) Type AJT Class J [4] Rated current Resulting rated short-circuit current [6] SCCR at 480 V_{AC}:	 A kA	 AJT250 250 65
Rated volumetric flow for water at 70 kPa pressure drop [5]	l/min	8
Volume of liquid internal	ml	100
Max. coolant temperature Without derating With derating	 °C °C	 45 50
Weight	kg	23

1) The powers specified apply to the rated voltage range from 380 V to 480 V.
2) Default for 400 V supply systems; undervoltage trip threshold is adjusted to the parameterized rated voltage.
3) For an overview, see the power loss tables in chapter Control cabinet installation
4) Source of supply: Ferraz Shawmut, http://de.ferrazshawmut.com
5) This value applies to the water coolant option; for other coolant types, see chapter "Cooling circuit and coolant properties".
6) 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.

3.4.6.1 Characteristics

Rated duty cycles of Active Line Modules Liquid Cooled

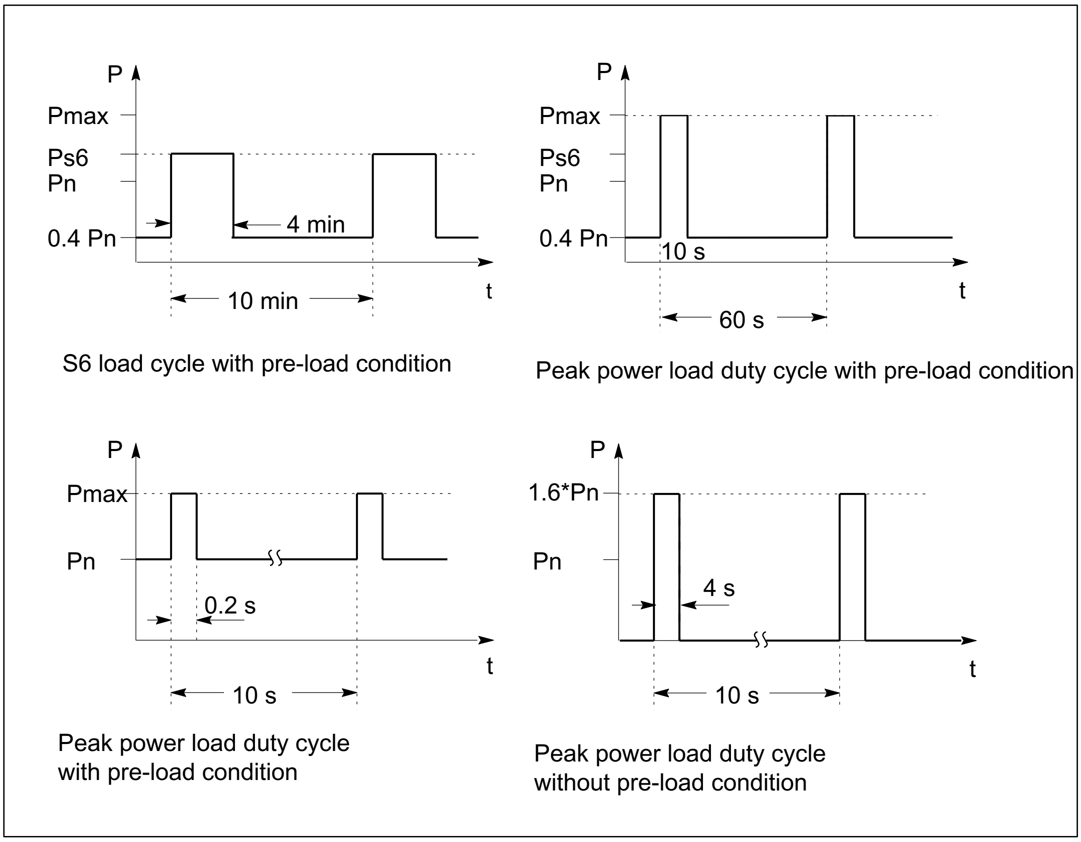


Figure 3-45 Rated duty cycles of Active Line Modules

Derating characteristics

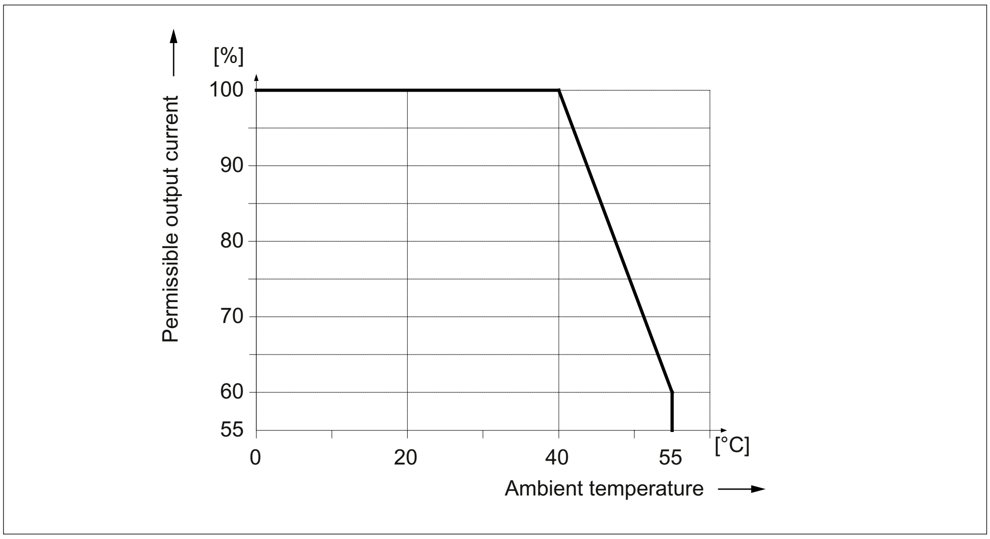


Figure 3-46 Output current as a function of the ambient temperature

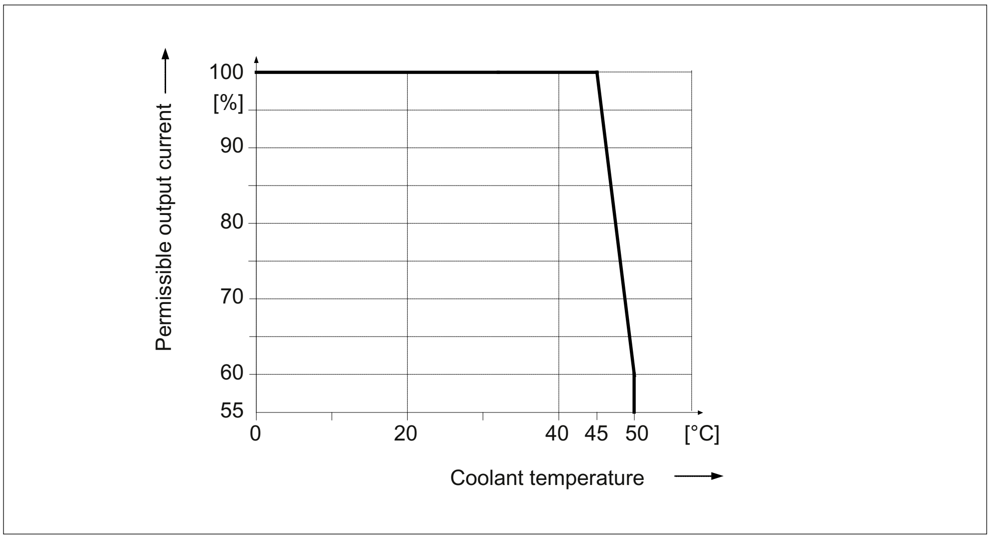


Figure 3-47 Output current as a function of the coolant temperature

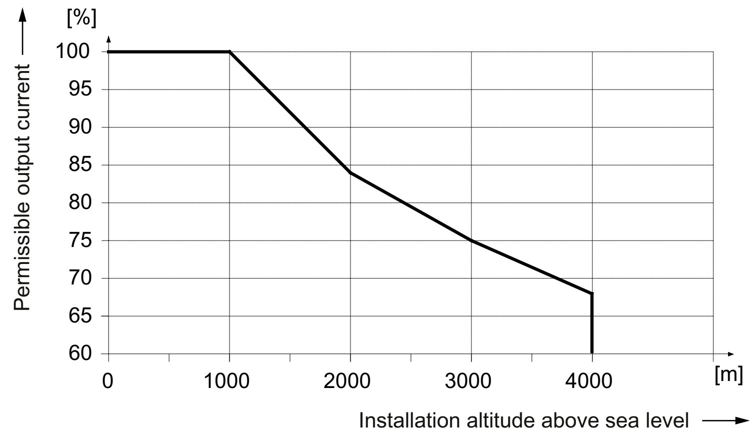


Figure 3-48 Output current as a function of the installation altitude

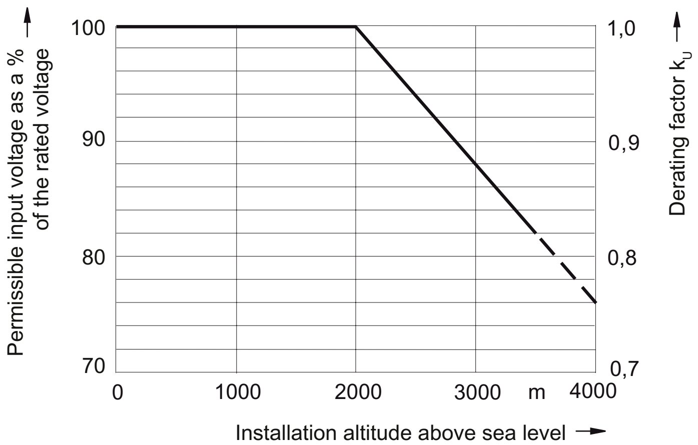


Figure 3-49 Voltage derating as a function of the installation altitude

3.5 Basic Line Modules with internal air cooling

3.5.1 Description

The Basic Line Modules provide a non-regulated DC link voltage that matches the rectified line input voltage.

One or more Motor Modules can be connected to the power supply network via the Basic Line Module. The Basic Line Module provides the DC link voltage for the Motor Modules.

To reduce the energy (e.g. for emergency retraction), a controller for an external braking resistor has been integrated in the 20 kW and 40 kW Basic Line Modules. An external Braking Module must be used for 100 kW Basic Line Modules.

The Basic Line Module is suitable for direct operation on TN, IT, and TT systems.

The 100 kW Basic Line Module includes a basic interference suppression, but the 20 kW and 40 kW Basic Line Modules do not include it.

The ratio of line short-circuit power to rated power must be ≥ 30.

The maximum total signal 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
  - 1000 m shielded with Voltage Clamping Module

3.5.2 Safety information

DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

DANGER

DC-link discharge time

The DC-link discharge time warning in the relevant national language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 30 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm² Cu or ≥ 16 mm² Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC-link adapter and DC-link rectifier adapter).

CAUTION

The cooling clearances of 80 mm above and below the components must be observed.

CAUTION

The tightening torque of the DC-link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning with the complete system in a no-voltage condition (powered-down) and with the DC link discharged. After transportation, the screws must be tightened.

CAUTION

The overall length of the power cables (motor supply cables and DC-link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION

Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION

DC-link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

3.5.3 Interface description

3.5.3.1 Overview

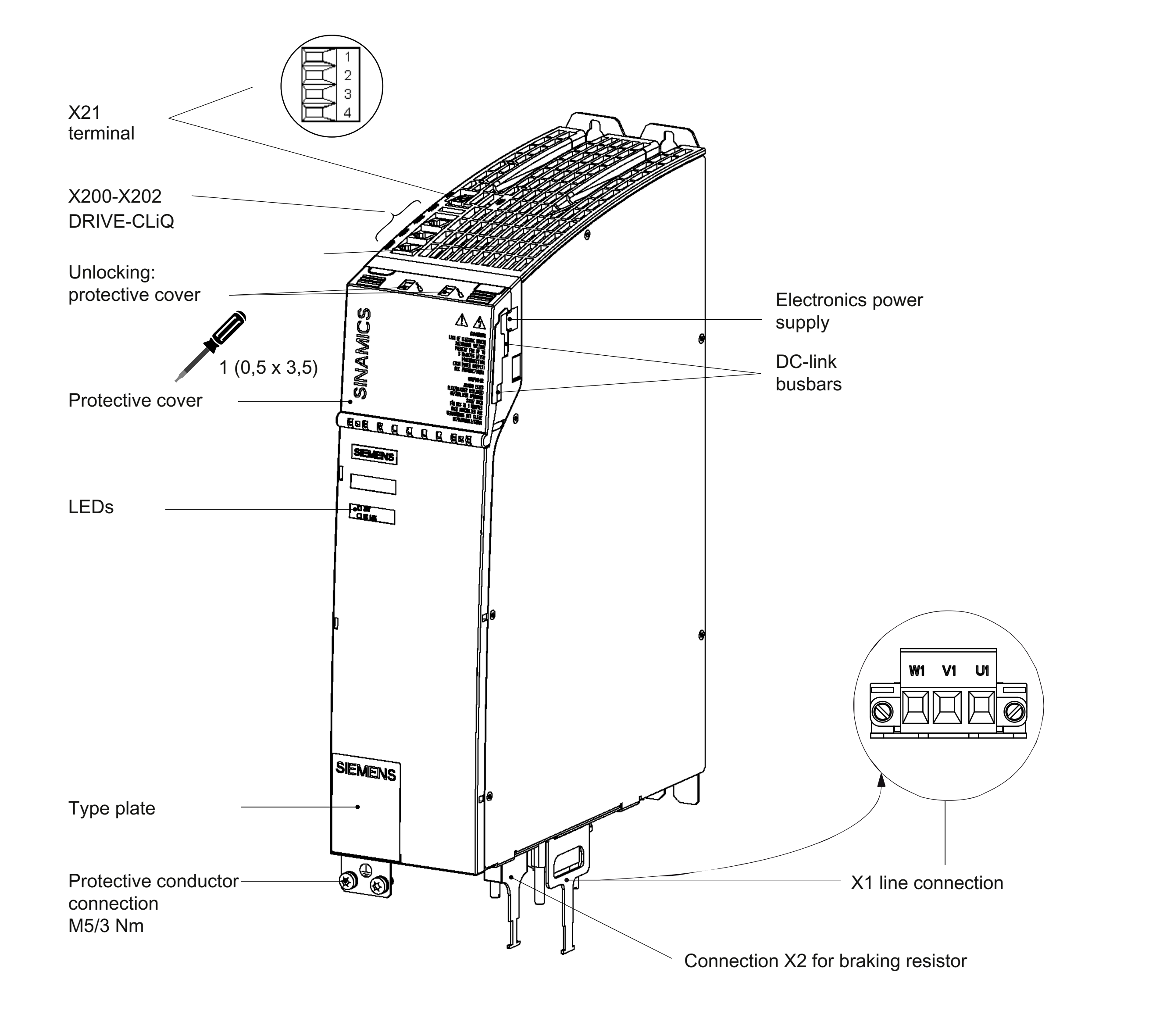


Figure 3-50 Basic Line Module with internal air cooling (20 kW)

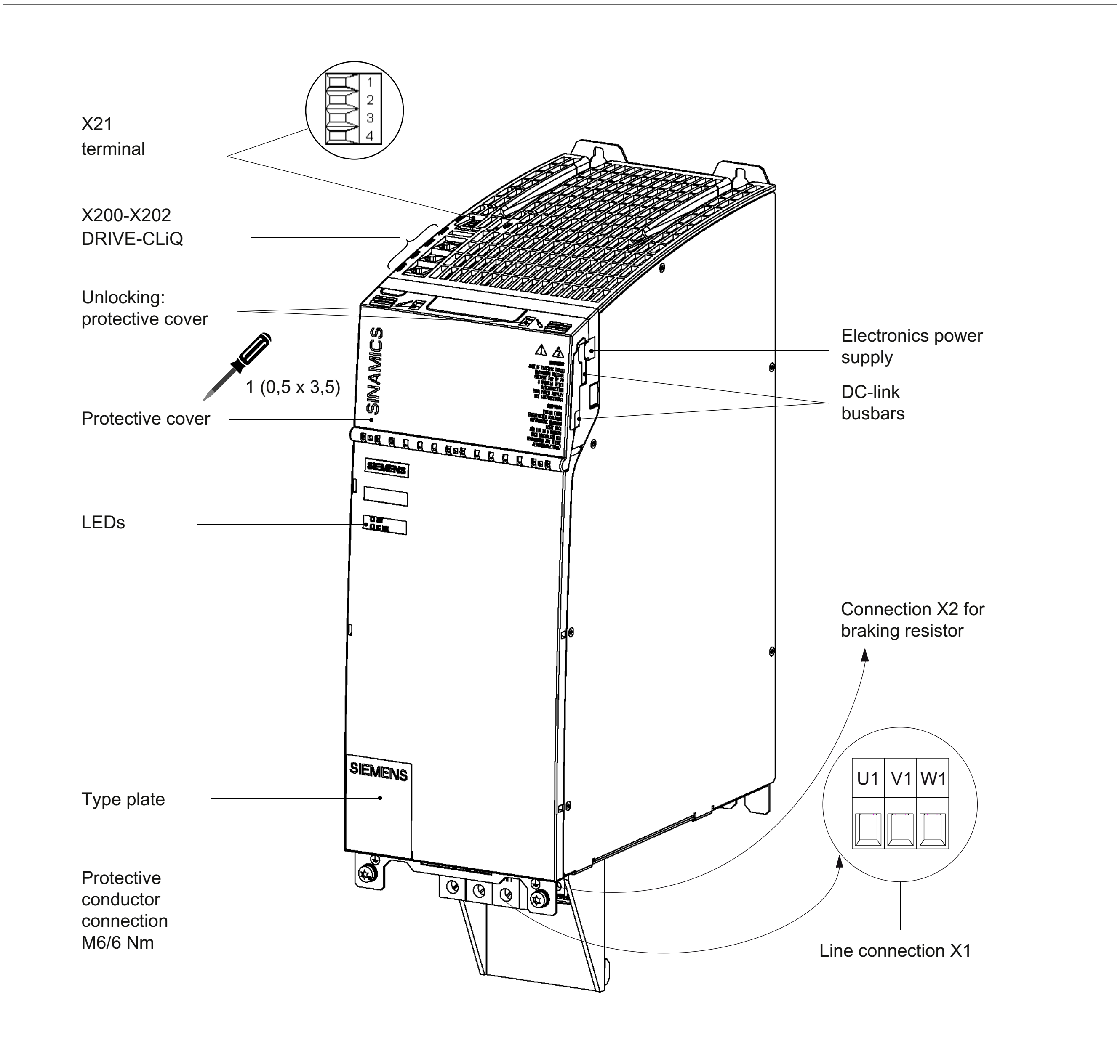


Figure 3-51 Basic Line Module with internal air cooling (40 kW)

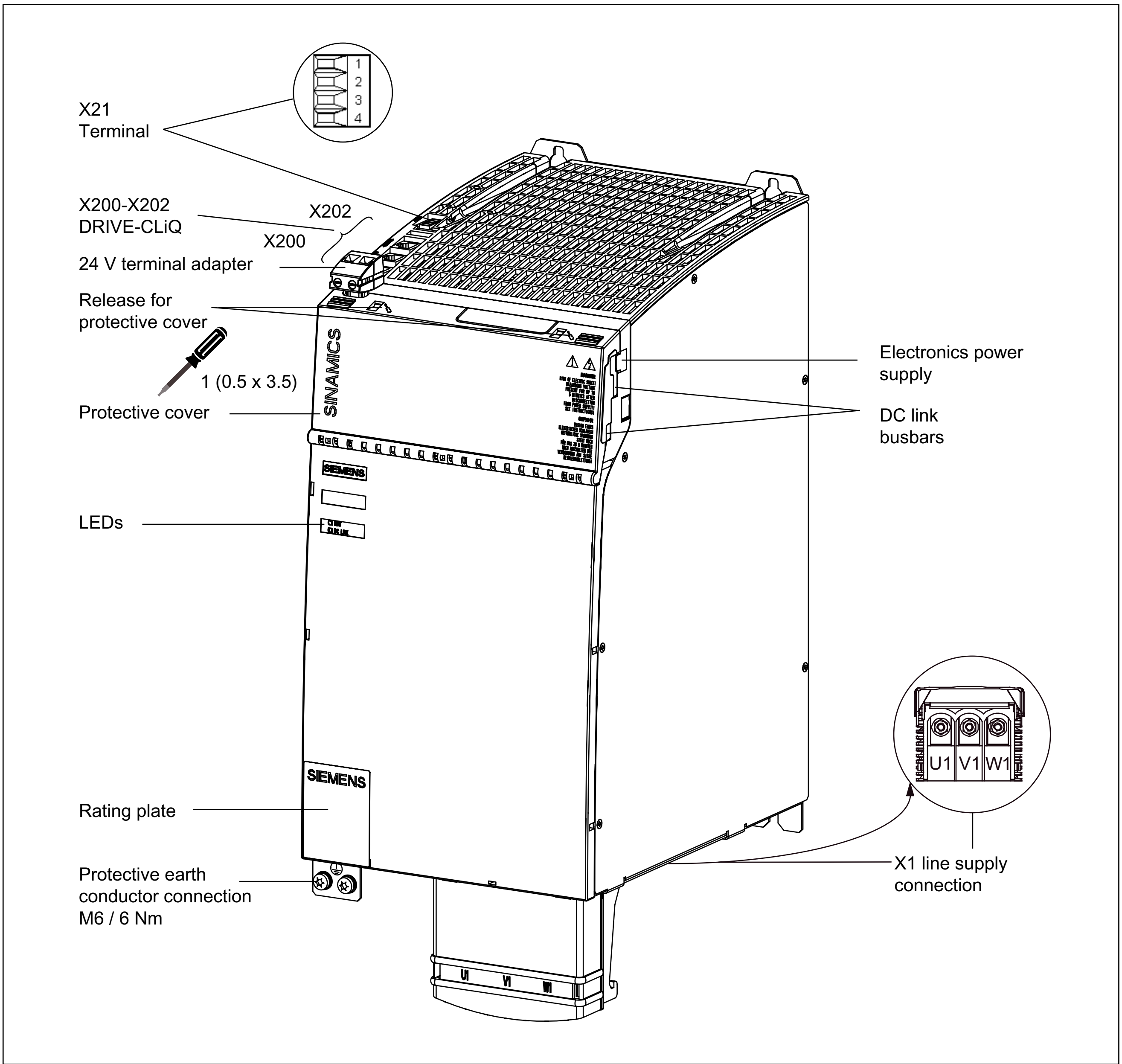
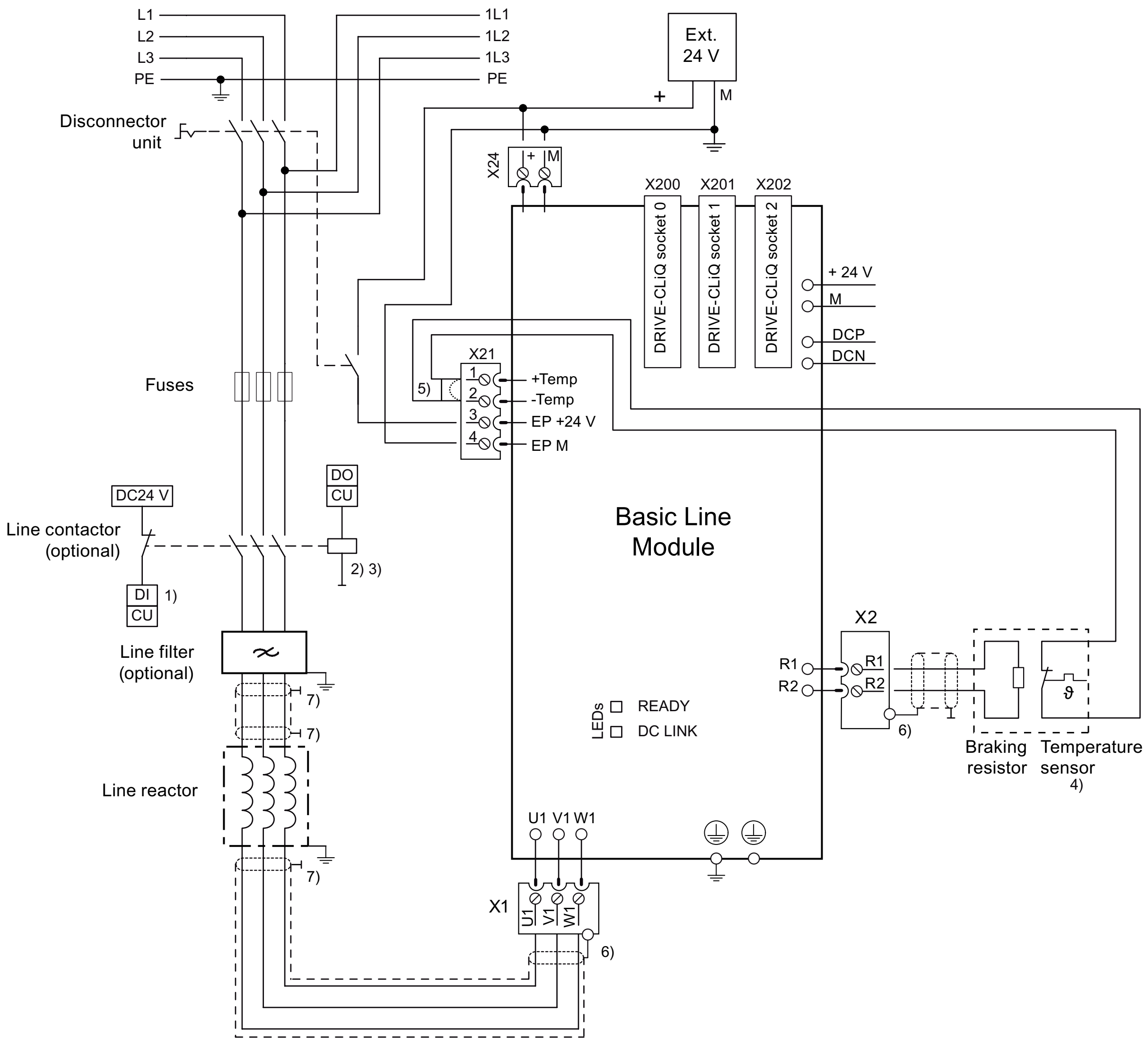


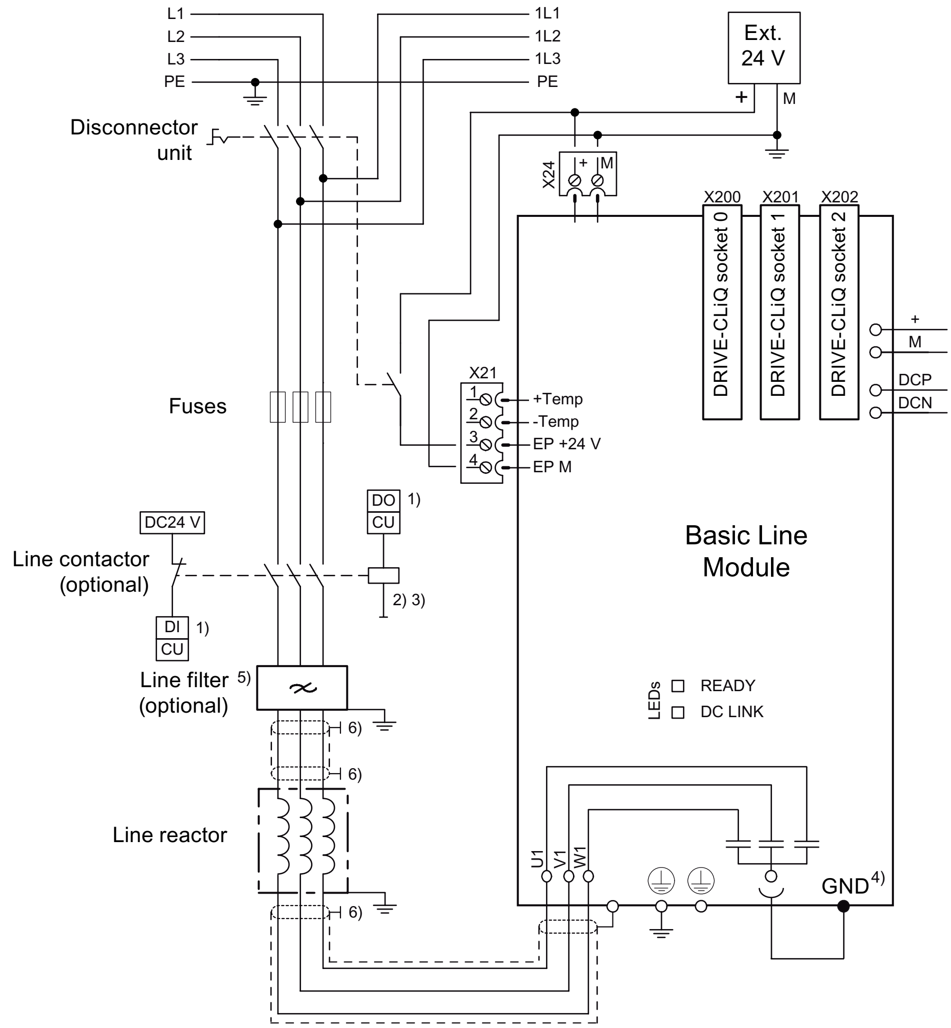
Figure 3-52 Basic Line Module with internal air cooling (100 kW)

3.5.3.2 Connection example



1) DI/DO, controlled by the Control Unit
2) No additional load permitted downstream of 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 and wiring must not exceed a resistance value of 100 ohms.
5) Jumper for switching off the temperature monitoring function for the braking resistor
6) Contact through connector (20 kW) or shield plate (40 kW)
7) Contact through the rear of the mounting surface or shielding buses in accordance with the EMC Directive

Figure 3-53 Connection example: Basic Line Module (20 kW and 40 kW)

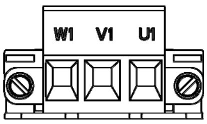
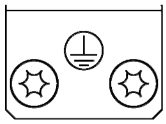


1) DI/DO, controlled by the Control Unit
2) No additional load permitted downstream of line contactor
3) The current carrying capacity of the DO must be observed; an output coupling device must be used if required.
4) When operating the component on an IT system, the connection bracket must be removed.
5) Line filter is required in order to comply with Category C2 radio-interference voltage values.
6) Contact through the rear of the mounting surface or shielding buses in accordance with the EMC Directive

Figure 3-54 Connection example: Basic Line Module (100 kW)

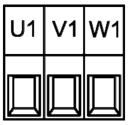
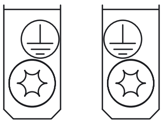
3.5.3.3 X1 line connection

Table 3- 38 Terminal block X1 Basic Line Module 20 kW

	Terminal	Technical specifications
	U1	Connection voltage: 380 V - 480 V 3 AC, 50 / 60 Hz max. connectable cross-section: 16 mm² Type: Screw terminal 7 (see chapter Connection methods) Tightening torque: 1.5 - 1.7 Nm
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm [1]

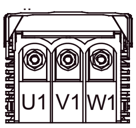
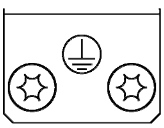
1) For ring cable lugs in accordance with DIN 46234

Table 3- 39 Terminal block X1 Basic Line Module 40 kW

	Terminal	Technical specifications
	U1	Connection voltage: 380 V - 480 V 3 AC, 50 / 60 Hz Terminal type HDFK 50, cross-section 50 mm², ferrules (see chapter Connection methods) Tightening torque min. 6 Nm
	V1	
	W1	
	PE connection	Threaded hole M6/6 Nm [1)]

1) For ring cable lugs in accordance with DIN 46234

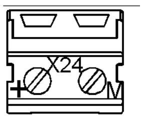
Table 3- 40 Terminal block X1 Basic Line Module 100 kW

	Terminal	Technical specifications
	U1	Connection voltage: 380 V - 480 V 3 AC, 50 / 60 Hz max. connectable cross-section: 120 mm² Type: Threaded bolt M8 [1)] (see chapter Connection methods) Tightening torque: 13 Nm
	V1	
	W1	
	PE connection	Threaded hole M6/6 Nm [1)]

1) For ring cable lugs in accordance with DIN 46234

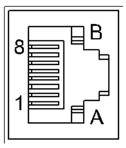
3.5.3.4 X24 24 V terminal adapter

Table 3- 41 Terminal block X24

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronic ground
The 24 V terminal adapter is supplied as standard Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see Connection Methods)			

3.5.3.5 X200-X202 DRIVE-CLiQ interfaces

Table 3- 42 DRIVE-CLiQ interface X200-X202 for 16 kW and 36 kW Smart Line Modules

	PIN	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 V power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces included in the scope of delivery; blanking plate (50 pieces) Order number: 6SL3066-4CA00-0AA0			

3.5.3.6 X2 braking resistor connection

Table 3- 43 Terminal block X2 on Basic Line Module (20 kW)

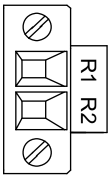
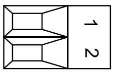
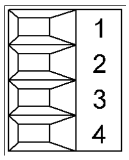
	Terminal	Designation	Technical specifications
	1	Braking resistor connection R	Max. connectable cross-section: 4 mm² Type: Screw terminal 4 (see chapter Connection methods) Tightening torque: 0.5 - 0.6 Nm
	2		

Table 3- 44 Terminal block X2 on Basic Line Module (40 kW)

	Terminal	Designation	Technical specifications
	1	Braking resistor connection R	Max. connectable cross-section: 10 mm² Type: Screw terminal 6 (see chapter Connection methods) Tightening torque: min 1.5 - 1.8 Nm
	2		

3.5.3.7 X21 EP terminals

Table 3- 45 Terminal strip X21

	Terminal	Designation	Technical specifications
	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 (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see chapter Connection methods)			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual LH1).

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

WARNING

For operation, 24 VDC must be connected to terminal 3 and ground to terminal 4. When removed, the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

DANGER

If the temperature switch is not connected, this can cause the resistor to overheat.

DANGER

Risk of electric shock!

Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), a Sensor Module External (SME120 or SME125) or Terminal Module TM120 must be used.

If these instructions are not complied with, there is a risk of electric shock!

3.5.3.8 Meaning of the LEDs on the Basic Line Module

Table 3- 46 Basic Line Module - description of the LEDs

Status		Description, cause	Remedy
Ready (H200)	DC link (H201)		
off	off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	off	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.	Check the line voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault.
Green/ red (0.5 Hz)	–	Firmware is being downloaded.	–
Green/red (2 Hz)	-	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	–	Component detection via LED is activated (p0124). **Note:** Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC link" LED.
The warning information on the components must be carefully observed!

3.5.4 Dimension drawings

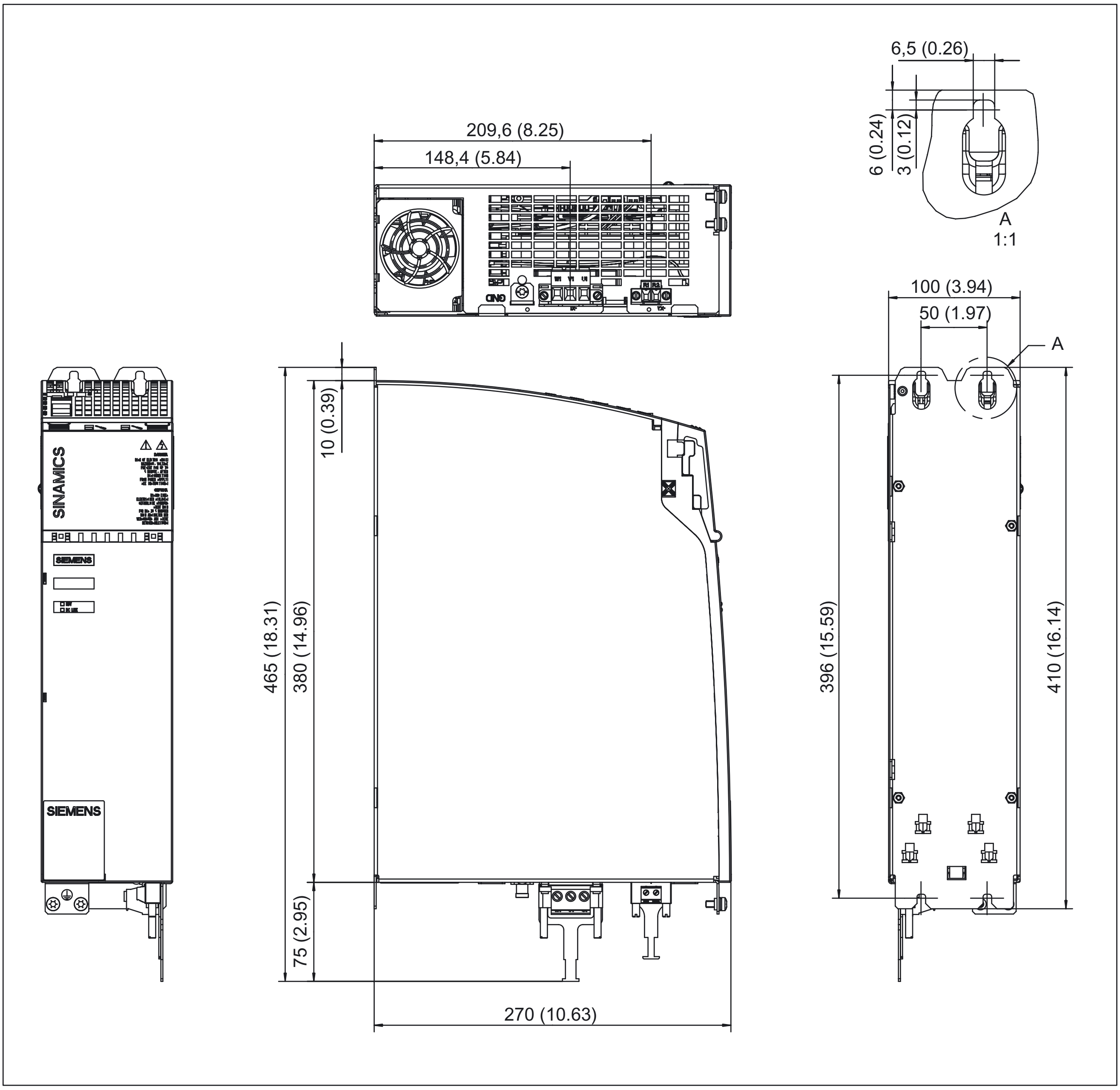


Figure 3-55 Dimension drawing of Basic Line Module 20 kW with internal air cooling, all dimensions in mm and (inches)

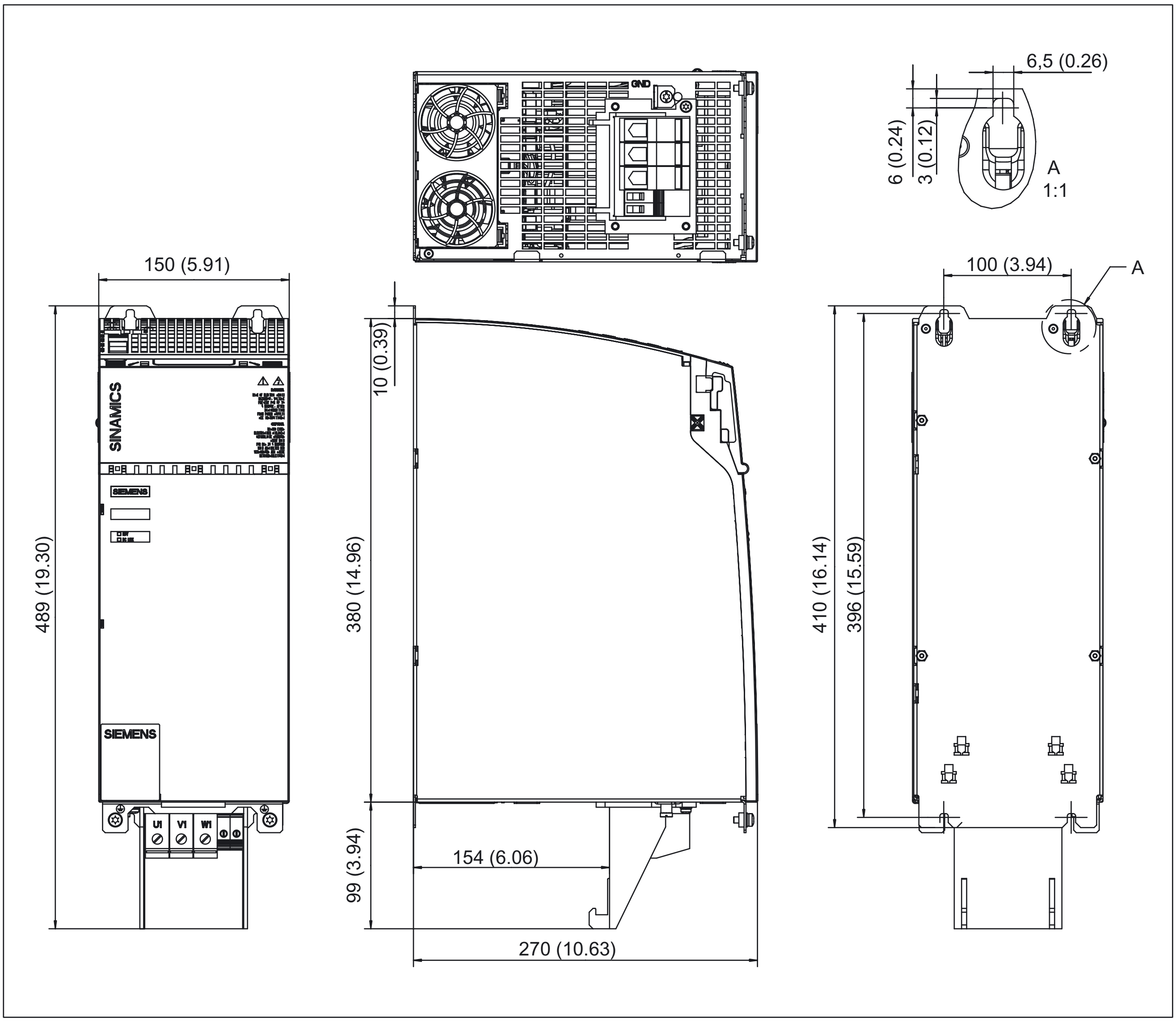


Figure 3-56 Dimension drawing of Basic Line Module 40 kW with internal air cooling, all dimensions in mm and (inches)

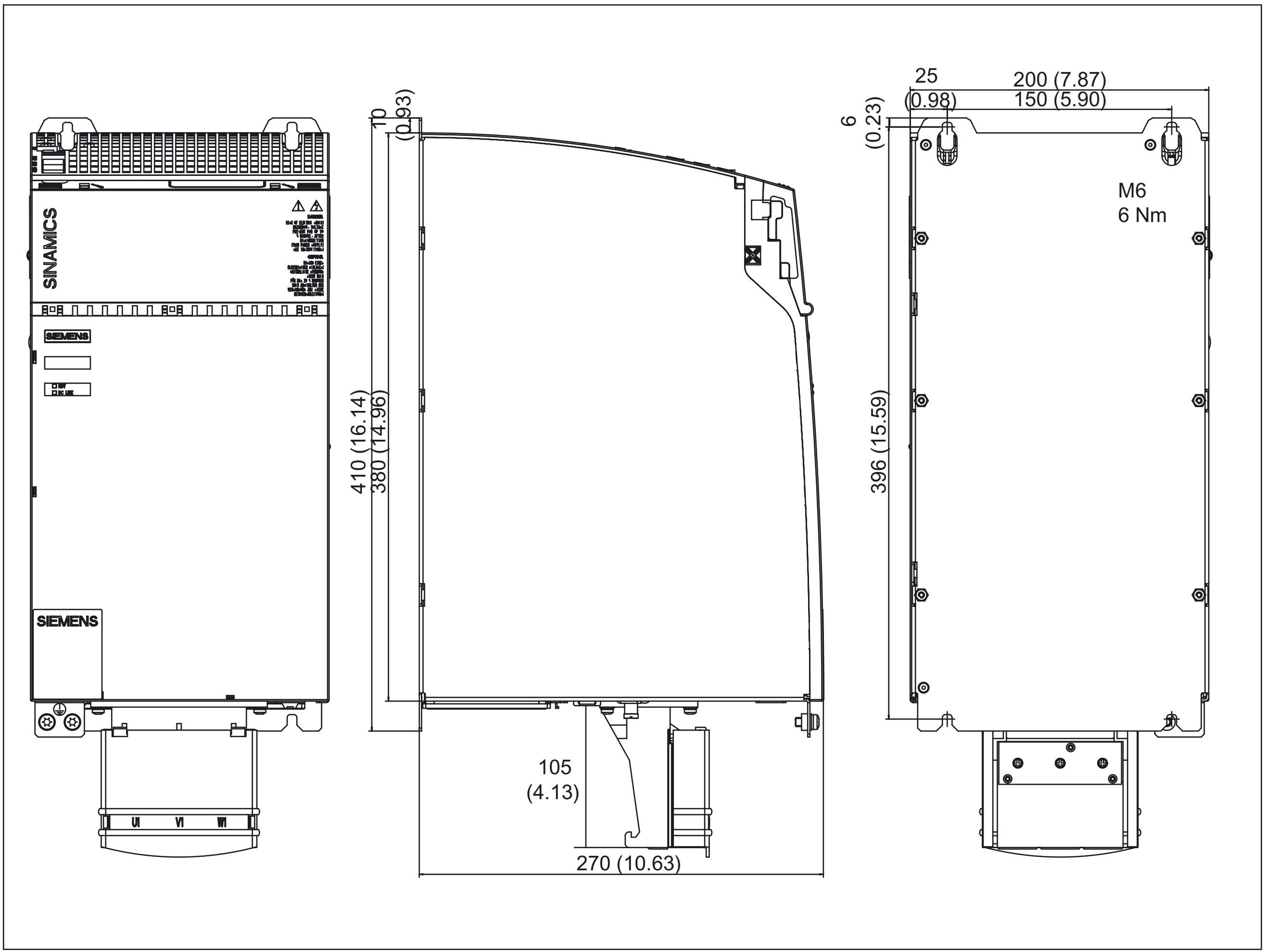


Figure 3-57 Dimension drawing of Basic Line Module 100 kW with internal air cooling, all dimensions in mm and (inches)

3.5.5 Installation

Basic Line Modules are installed in the same way as Active Line Modules and Booksize Motor Modules.

The Basic Line Modules are designed for installation in the control cabinet. The components are secured onto the control cabinet installation panel using M6 screws.

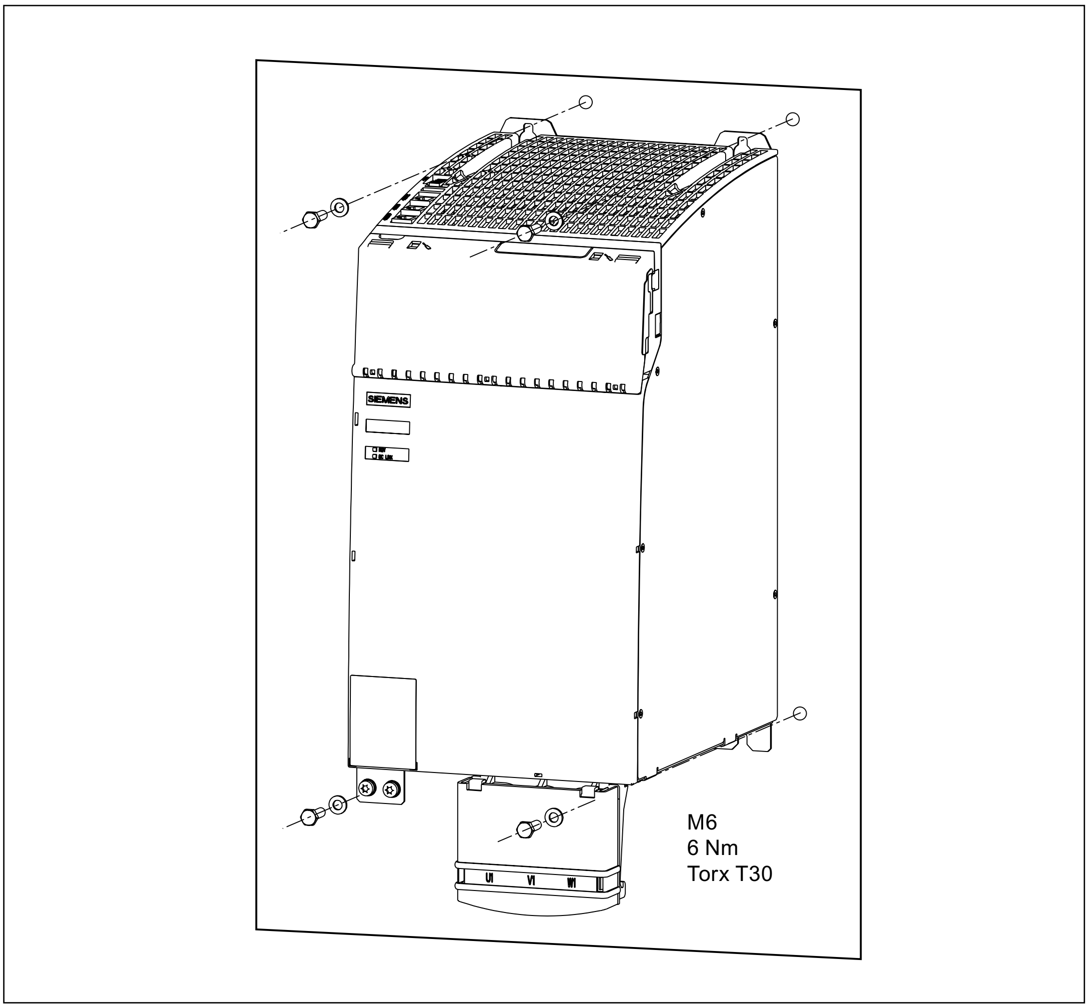


Figure 3-58 Installation: Basic Line Module 100 kW

Operating a 100 kW Basic Line Module from an insulated network (IT system)

When a 100 kW Basic Line Module is operated from an insulated network (IT system), the connection bracket for the interference-suppression capacitor must be removed. The connection bracket for the interference-suppression capacitor is located on the lower side of the component.

CAUTION
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 for the interference-suppression capacitor with a Tx25 screwdriver.	Remove the connection bracket	Connection bracket for the interference-suppression capacitor

Note

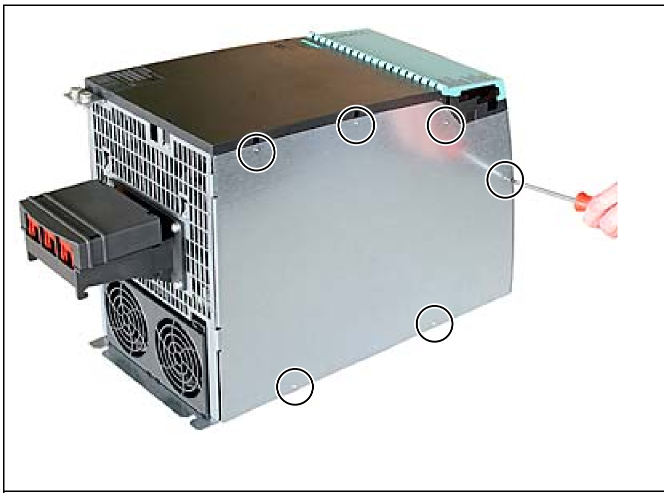
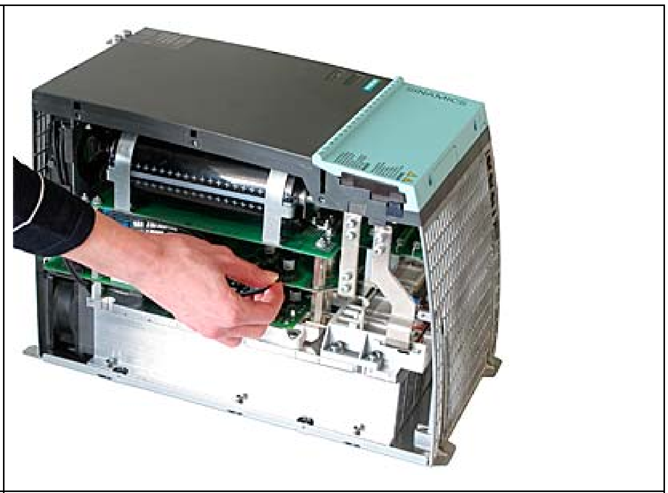
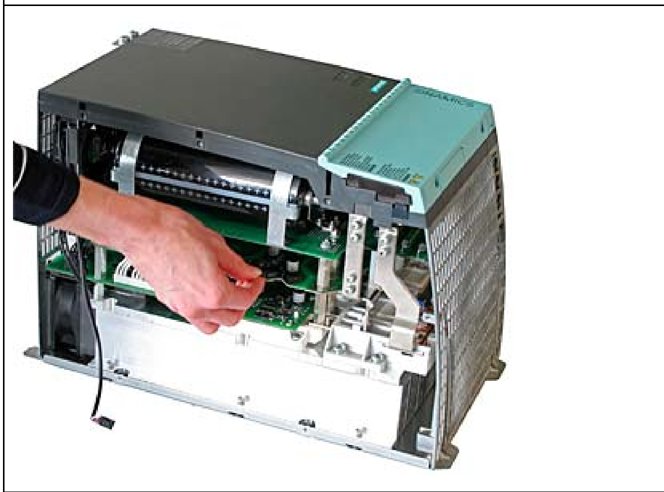
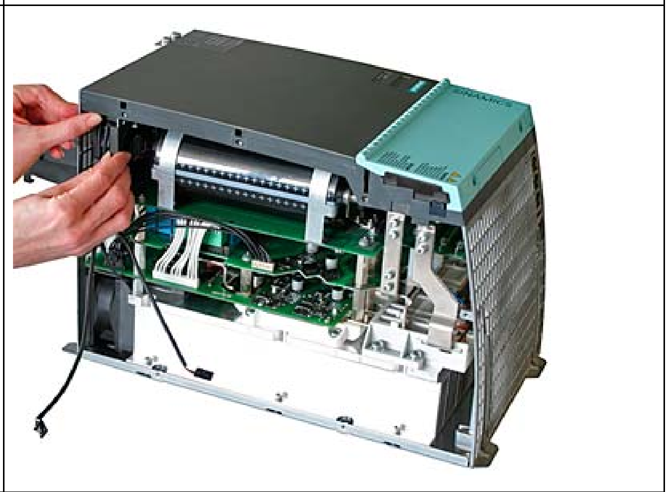
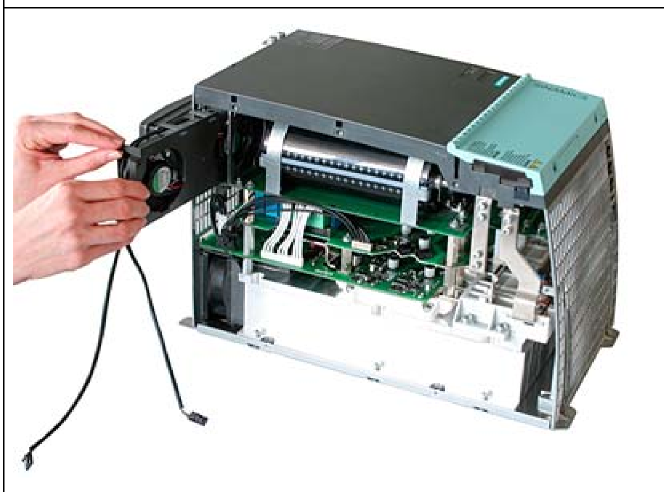
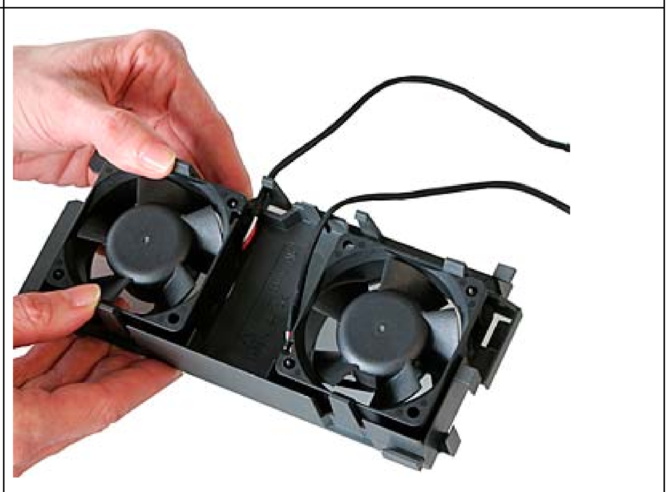
Installing the connection bracket for the interference-suppression capacitor

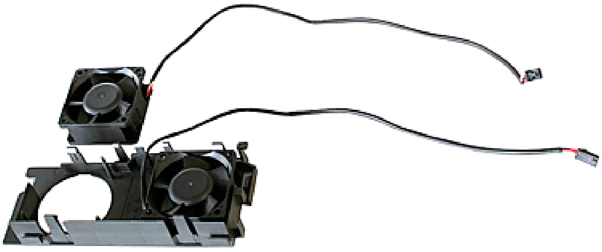
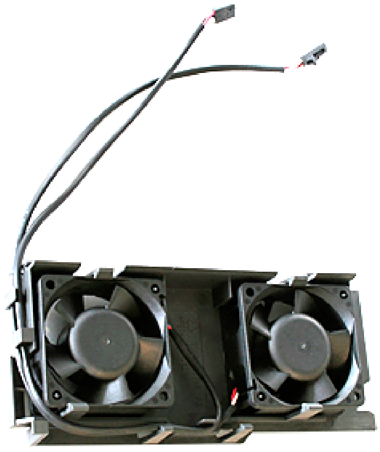
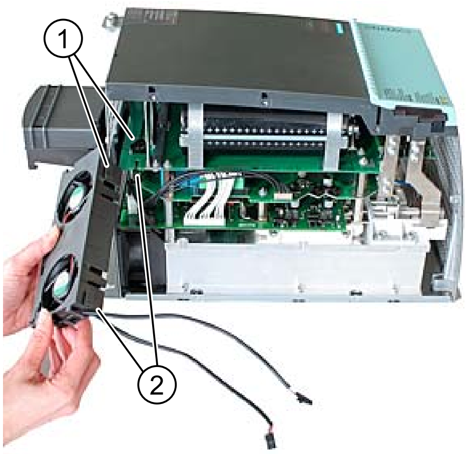
For operation in other systems, the connection bracket must be reinstalled and fixed with a tightening torque of 1.8 Nm.

Replacing the fan for capacitor cooling of a 100 kW Basic Line Module

⚠ DANGER
Before replacing the fan, you must switch off the power supplies (24 V DC and 400 V AC). Risk of electric shock. Dangerous voltages are still present for up to 5 minutes after the power supply has been switched off. The device cover must not be opened until this time has elapsed.

NOTICE
When replacing the fan, you must observe the ESD regulations. Parts must only be replaced by trained personnel (danger of damage to sensitive components due to static electricity)!

	
Open the right device cover by loosening the six marked screws	Pull the first fan cable by pressing it slightly
	
Pull the second fan cable	Unlatch the fan module
	
Completely pull out the fan module	Slightly push the fan holder apart and pull out the fan

	
Observe the air flow direction markings when inserting the new fan	Observe the cable guide
	
Push in the fan in guide rails 1 and 2. Connect the two fan cables. Close the device cover and tighten the six screws with 0.8 Nm	

3.5.6 Technical data

Table 3- 47 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)] Infeed power (S6-40%) [1)] Peak infeed power [1)]	 kW (Pn) kW (Ps6) kW (Pmax)	 20 26 60	 40 52 120	 100 130 175
Braking power Continuous power Peak power	 kW (Pn) kW (Pmax)	 5 40	 10 80	 - -
Supply voltages Rated voltage Line frequency Electronics power supply	 V_{ACrms} Hz V_{DC}	 3 AC 380 – 10% (-15% < 1 min) to 3 AC 480 + 10% [2)] 47 to 63 24 (20.4 – 28.8)		
DC link voltage Overvoltage trip Undervoltage trip [3)]	V_{DC} V_{DC} V_{DC}	480 – 720 820 ± 2 % 360 ± 2 %		
Input currents Rated input current at 400 V_{AC}: Input current at 380 V_{AC} / 480 V_{AC} at 400 V_{AC}; S6-40% at 400 V_{AC}; peak current	 A_{AC} A_{AC} A_{AC} A_{AC}	 33 35 / 28 43 100	 66 70 / 55 86 199	 166 172 / 138 216 290
DC link currents Rated DC link current at 600 V: DC link current at 540 V: at 600 V_{DC}; S6-40% at 600 V_{DC}; peak current	 A_{DC} A_{DC} A_{DC} A_{DC}	 33.5 37 43 100	 67 48 87 200	 167 185 217 292
Current carrying capacity DC link busbar Reinforced DC link busbars: 24 V busbar:	 A_{DC} A_{DC} A_{DC}	 100 150 20	 100 / 200 [6)] -- 20	 200 -- 20
Electronics current consumptionat 24 V DC	A_{DC}	1	1.4	2.0
Total power loss (including electronics losses) [4)]	W	144	283.6	628
Max. ambient temperature Without derating With derating	 °C °C	 40 55	 40 55	 40 55
DC link capacitance Basic Line Module Drive line-up, max.	 µF µF	 940 20 000	 1880 20 000	 4100 50 000
Power factor [5)]	cosϕ	0.98	0.98	0.98

Internal air cooling	6SL3130-	1TE22-0AA0	1TE24-0AA0	1TE31-0AA0
Circuit breaker (UL) Type designation Rated current: Resulting rated short-circuit current [8)] SCCR at 480 V_{AC}:	 A kA	 3VL2106-2KN30 60 65	 3VL2110-2KN30 100 65	 3VL3125-2KN30 250 65
Safety fuse (UL) Type AJT Class J [7)] Rated current Resulting rated short-circuit current [8)] SCCR at 480 V_{AC}:	 A kA	 AJT60 60 65	 AJT100 100 65	 AJT250 250 65
Cooling method (internal air cooling)		Internal fan	Internal fan	Internal fan
Sound pressure level	dB(A)	<60 dB	<65 dB	<65 dB
Cooling air requirement	m^3/h	56	112	180
Rated voltage for rated data 3 AC 380 V				
Weight	kg	6.8	11.3	15.8

1) The powers specified apply to the rated voltage range from 380 V to 480 V.
2) Can also be operated on supply systems with 200 to 240 V 3 AC ±10% with appropriate parameter assignment and reduced output.
3) Default for 400 V supply systems; undervoltage trip threshold is adjusted to the parameterized rated voltage.
4) For an overview, see the power loss tables in chapter Control cabinet installation
5) Fundamental component only
6) For components where the final digit in the order number is ≥ 3.
7) Source of supply: Ferraz Shawmut, http://de.ferrazshawmut.com
8) 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.

3.5.6.1 Characteristics

Rated duty cycles for Basic Line Modules

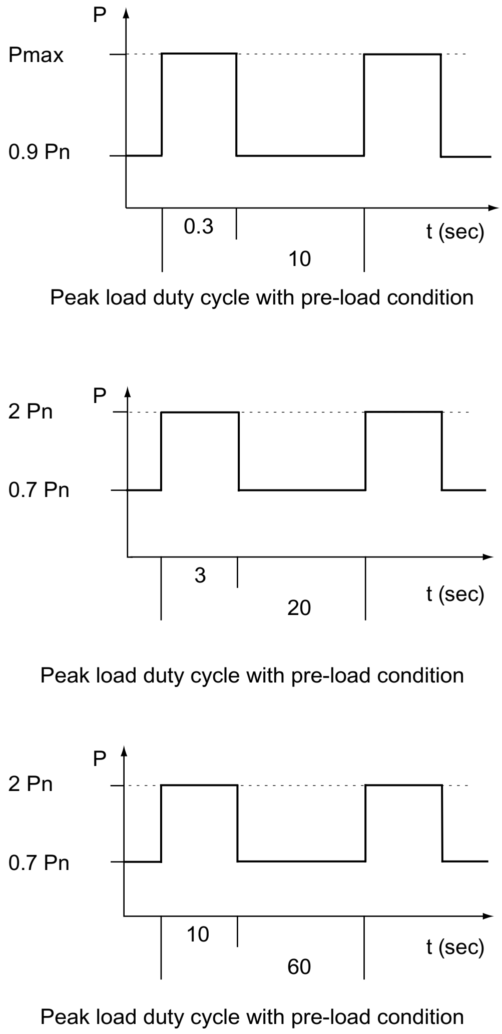


Figure 3-59 Rated duty cycles of 20 kW and 40 kW Basic Line Modules

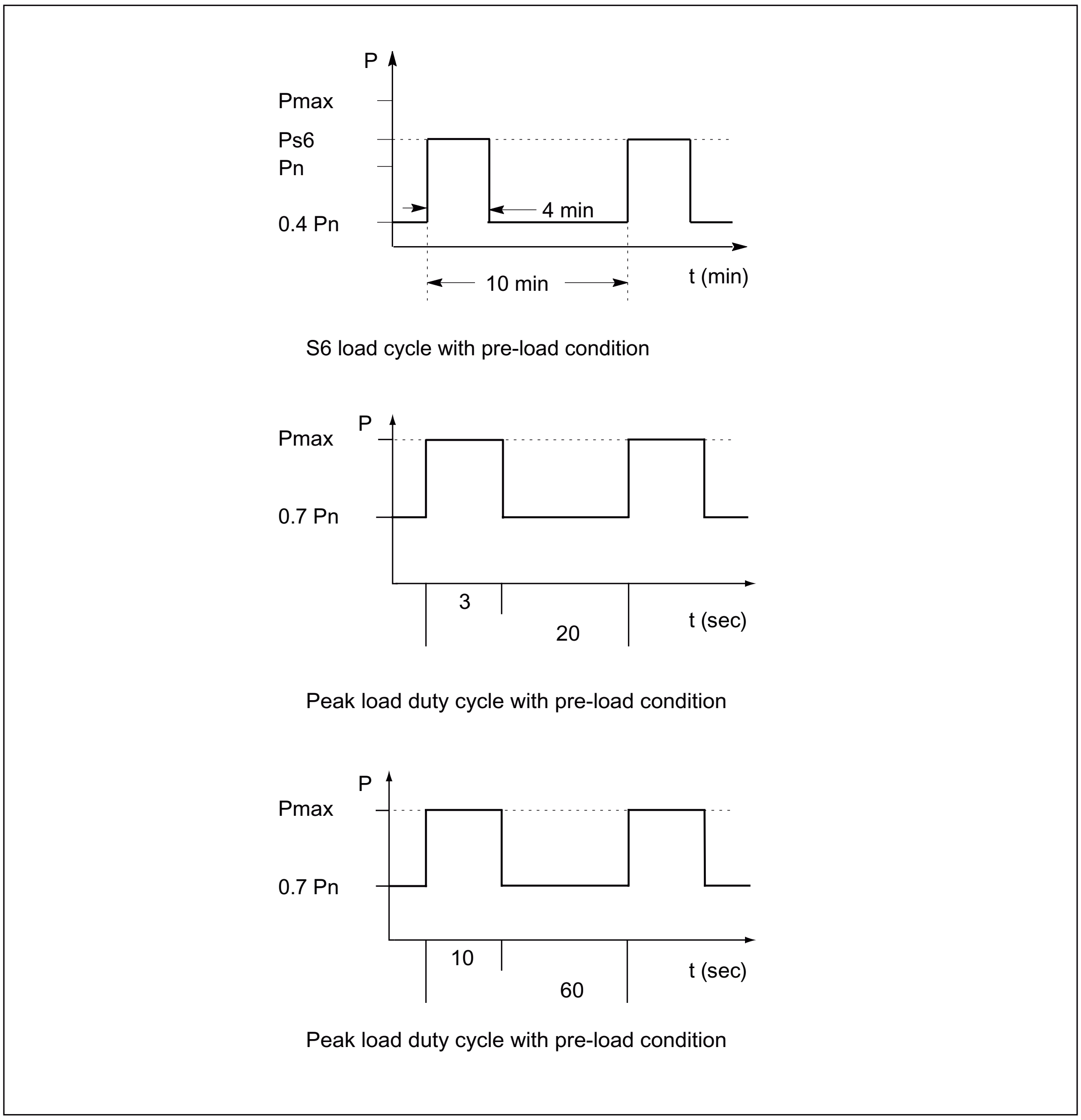


Figure 3-60 Rated duty cycles of 100 kW Basic Line Module

Braking duty cycle for Basic Line Modules

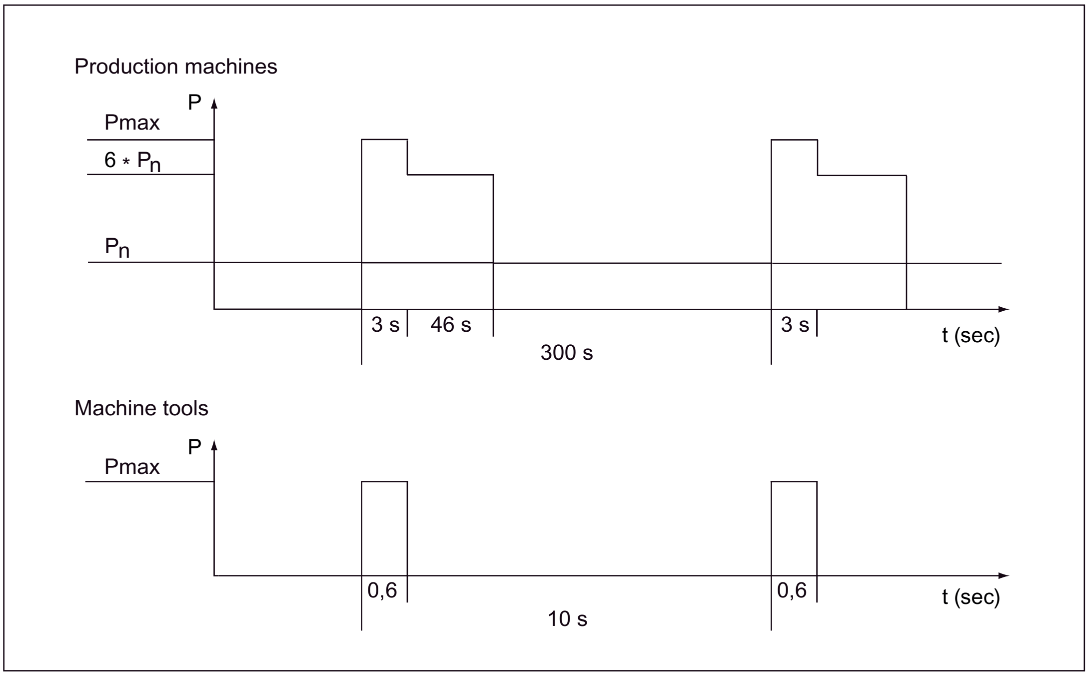


Figure 3-61 Braking duty cycle for Basic Line Modules

Derating characteristics

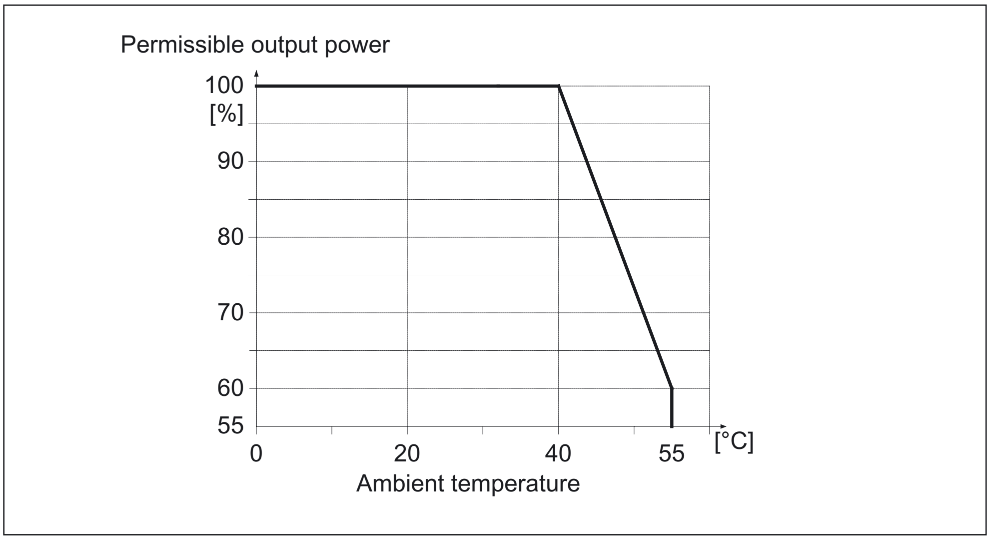


Figure 3-62 Output power as a function of the ambient temperature

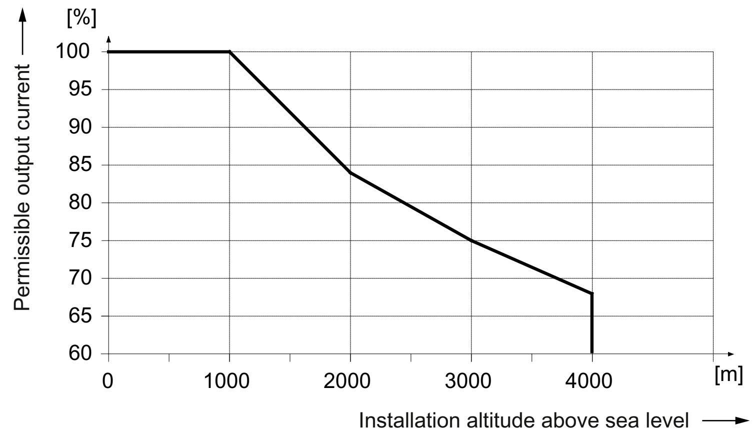


Figure 3-63 Output current as a function of the installation altitude

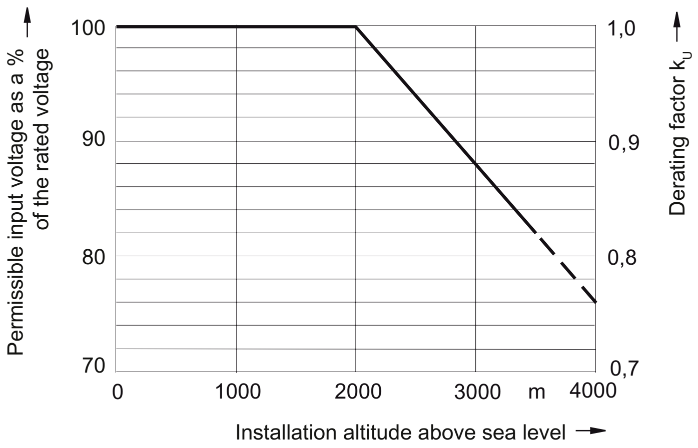


Figure 3-64 Voltage derating as a function of the installation altitude

3.5.7 Braking resistors for Basic Line Modules

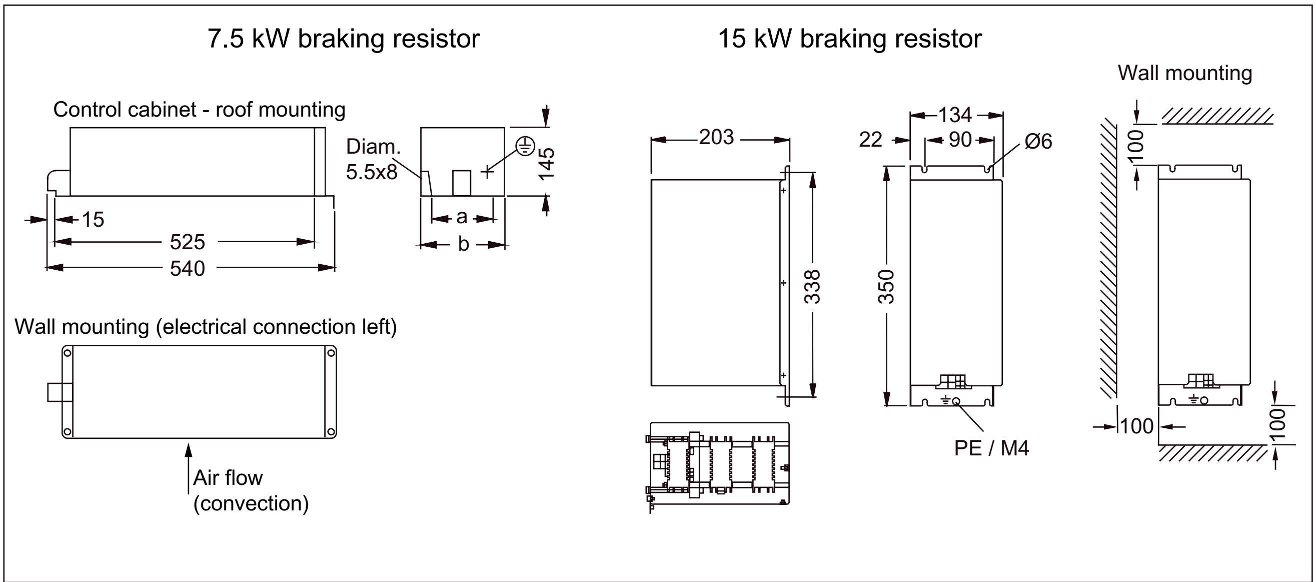


Figure 3-65 Dimension and installation drawing for braking resistor 7.5 kW and 15 kW, all dimensions in mm

Table 3- 48 Dimensions of braking resistor 7.5 kW and 15 kW

Rated power	Order number	a [mm (inches)]	b [mm (inches)]
7.5 kW	6SE7018-0ES87-2DC0	150 (5.90)	180 (7.08)
15 kW	6SE7021-6ES87-2DC0	330 (12.99)	360 (14.17)

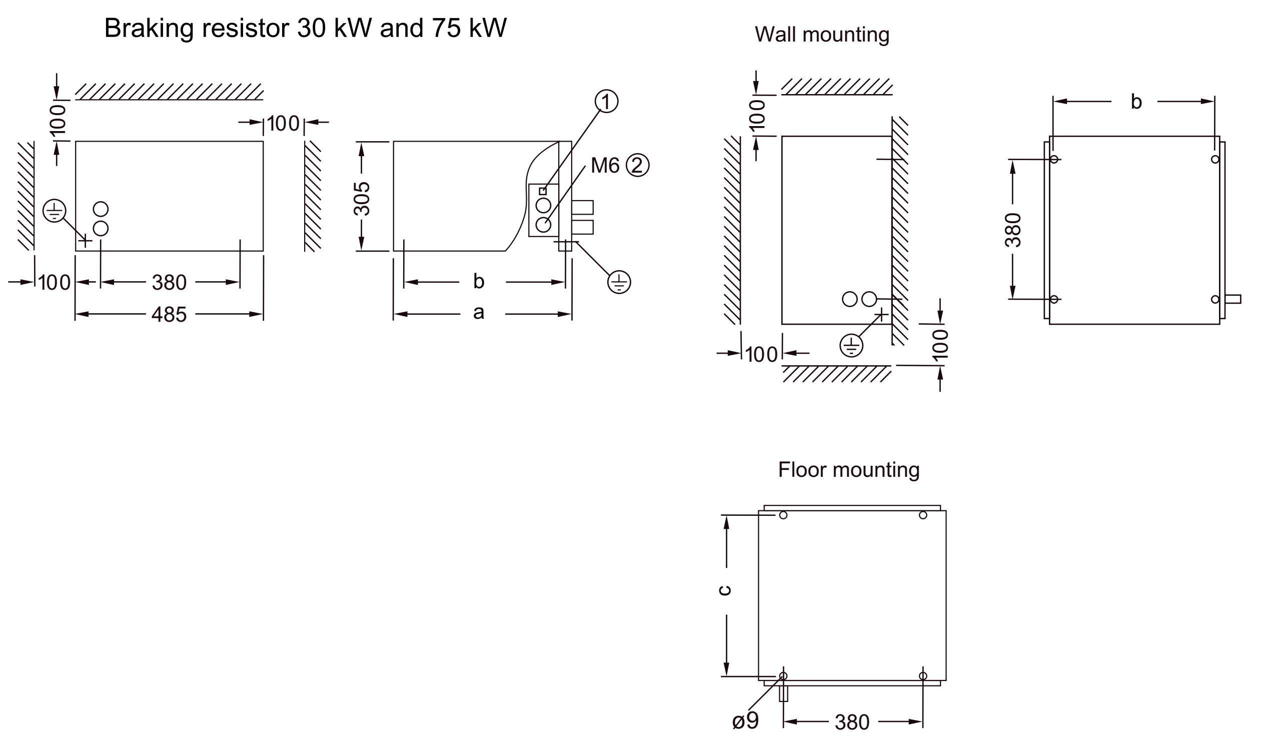


Figure 3-66 Dimension and installation drawing for braking resistor 30 kW and 75 kW, all dimensions in mm

① T1 / T2 tunnel terminals
② Stud terminals

Table 3- 49 Dimensions of braking resistor 30 kW and 75 kW

Rated power	Order number	a [mm (inches)]	b [mm (inches)]	c [mm (inches)]
30 kW	6SE7023-2ES87-2DC0	430 (16.92)	400 (15.74)	400 (15.74)
75 kW	6SE7028-0ES87-2DC0	740 (29.13)	710 (27.95)	710 (27.95)

CAUTION

The surface temperature of the braking resistors may exceed 80 °C.

Table 3- 50 Technical data of braking resistors for the Basic Line Modules

Braking resistor	Unit	6SE7018-0ES87-2DC0	6SE7021-6ES87-2DC0	6SE7023-2ES87-2DC0	6SE7028-0ES87-2DC0
	Ω	80	40	20	8
Peak power[1)] (P_{max})	kW	7.5	15	30	75
Rated power[1)] (P_n)	kW	1.25	2.5	5	12.5
Power connections		Screw-type terminals 4 mm²	Screw-type terminals 4 mm²	Screw studs for M6 ring terminal ends	Screw studs for M6 ring terminal ends
PE connection		M5 stud	M5 stud	M6 bolt	M8 bolts
Thermostatic switch (NC contact) Connection cross-section	 mm²	Screw terminals 4	Screw terminals 4	Screw terminals 2.5	Screw terminals 2.5
Can be used for Basic Line Modules 20 kW		Yes	Yes	Yes	--
Can be used for Basic Line Modules 40 kW		Yes	Yes	Yes	Yes
Weight	kg	6	11.5	17	27

1) Applies to a DC-link voltage of 760 V

Braking duty cycles for braking resistors

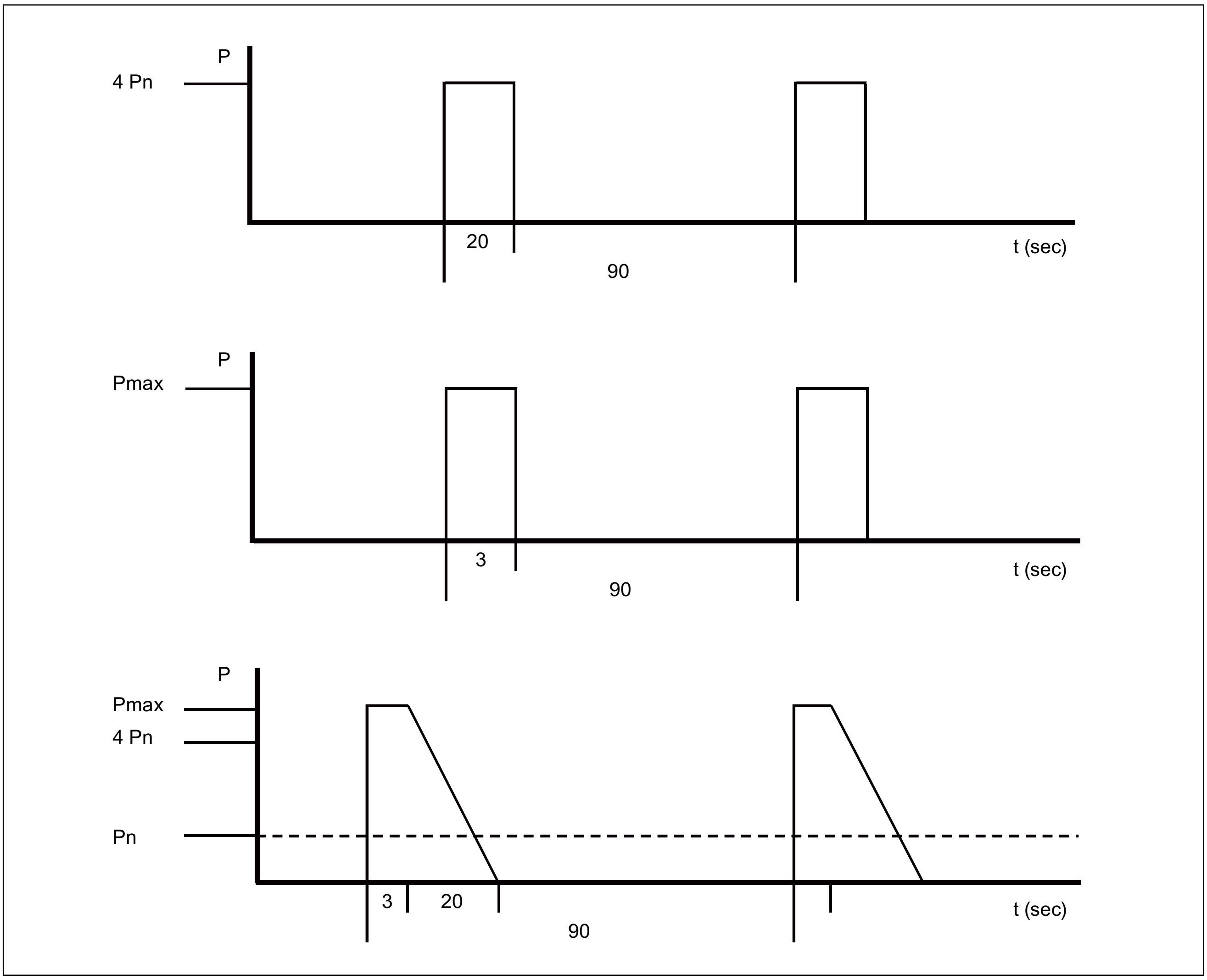


Figure 3-67 Braking duty cycles for braking resistors

3.5.8 Basic Line Modules 100 kW in combination with MASTERDRIVES braking module

3.5.8.1 Description

The braking unit (and an external braking resistor) is required to bring drives to a controlled standstill in the event of a power failure (e.g. emergency retraction or EMERGENCY OFF category 1) or limit the DC link voltage if the generator is operated for a short period of time, because a Basic Line Module cannot feed the energy back into the network.

The braking unit includes the necessary power electronics and control. when the braking unit is in operation, the regenerative energy is dissipated as thermal energy in an external braking resistor.

To connect the MASTERDRIVES braking unit to a SINAMICS S120 booksize line-up, you require either the DC link rectifier adapter, order number 6SL3162-2BM00-0AA0, or the DC link adapter, order number 6SL3162-2BM01-0AA0. The connection leads used to connect the braking unit to the DC link rectifier adapter or DC link adapter should be as short as possible.
Please observe the instructions in Chapter "DC link rectifier adapter" and "DC link adapter". Information on MASTERDRIVES braking units can be found in the "MASTERDRIVES Braking Unit" operating instructions, order number: 6SL3097-2AC00-OAP5.

Only MASTERDRIVE braking units order numbers 6SE7031-6EB87-2DA1 and 6SE7032-7EB87-2DA1 are approved for operation of Basic Line Module 100 kW.

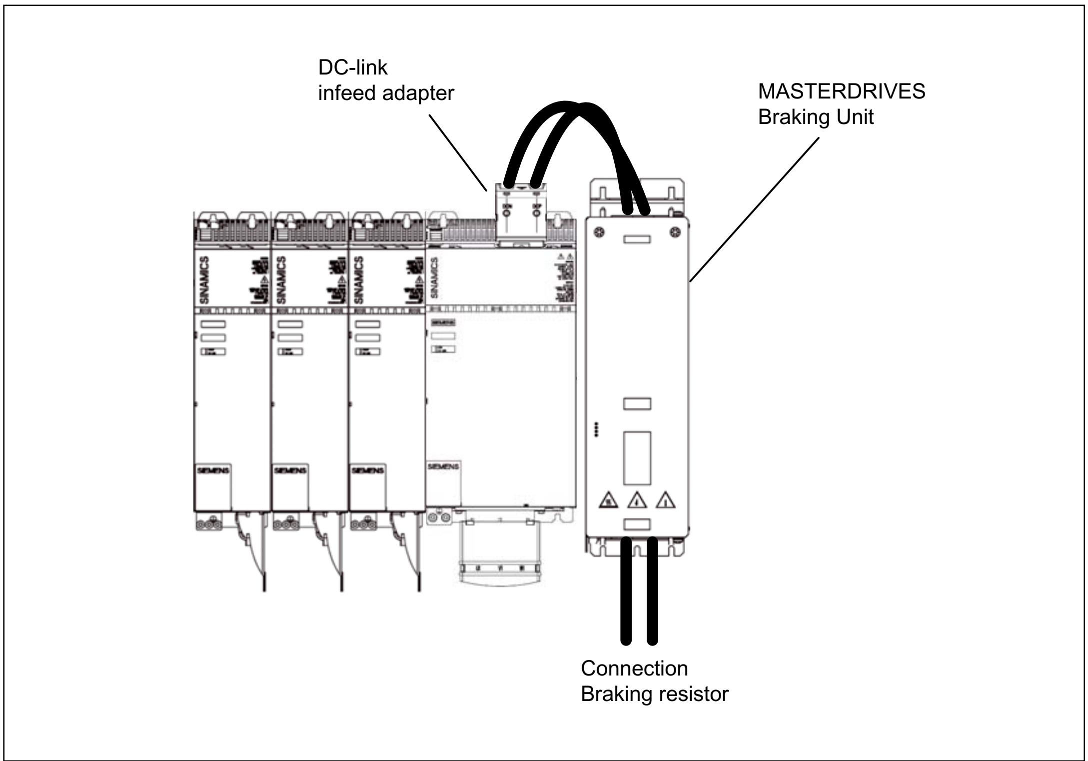


Figure 3-68 Connection of the MASTERDRIVES braking unit

Connection

Connect connection C/L+ of the braking unit with terminal DCP and connection D/L of the braking unit with terminal DCN of the DC link rectifier adapter or DC link adapter. The connection must be made with a cross-section of 95 mm^2 acc. to EN 60439-1 (short-circuit-proof installation). The electric strength of the cable must be rated for the line voltage. Establish protective conductor connection between S120 drive line-up and braking unit (cross-section of protective conductor connection min. 50 mm^2).

Length of connecting cables to DC link max. 3 m.

⚠ WARNING
The drive equipment or braking unit may be damaged if the DC link terminals are reversed or short-circuited. The exhaust air from the braking units can reach a temperature of > 80 °C. The temperature of the housing can reach > 65 °C.

The cable between the braking unit and the braking resistor is limited to 15 m.

In the MASTERDRIVES braking unit, switch S1 should be used for resetting the response threshhold in connection with a SINAMICS S120 booksize format drive line-up in the "high" setting (factory setting). This places the switch-on threshhold at 757 V_{DC}.

3.5.8.2 Safety information

⚠ DANGER
Risk of electric shock. A hazardous voltage is present for up to 5 minutes after the power supply has been switched off. It is only permissible to open the protective cover after this time has expired.

⚠ WARNING
When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver) must be used for this purpose. The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

⚠ DANGER
The DC link discharge voltage hazard warning in the local language must be attached to all of the components. A set of labels in 16 languages is supplied with the component. With a connected braking resistor, the braking unit is ground-fault proof.

WARNING

The cooling clearances of 80 mm above and below the components must be observed.

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

CAUTION

The connection to the braking resistors must be made using a shielded cable.

The tightening torque of the DC link busbar screws (1.8 Nm, tolerance +30 %) must be checked before commissioning. After transportation, the screws must be tightened.

NOTICE

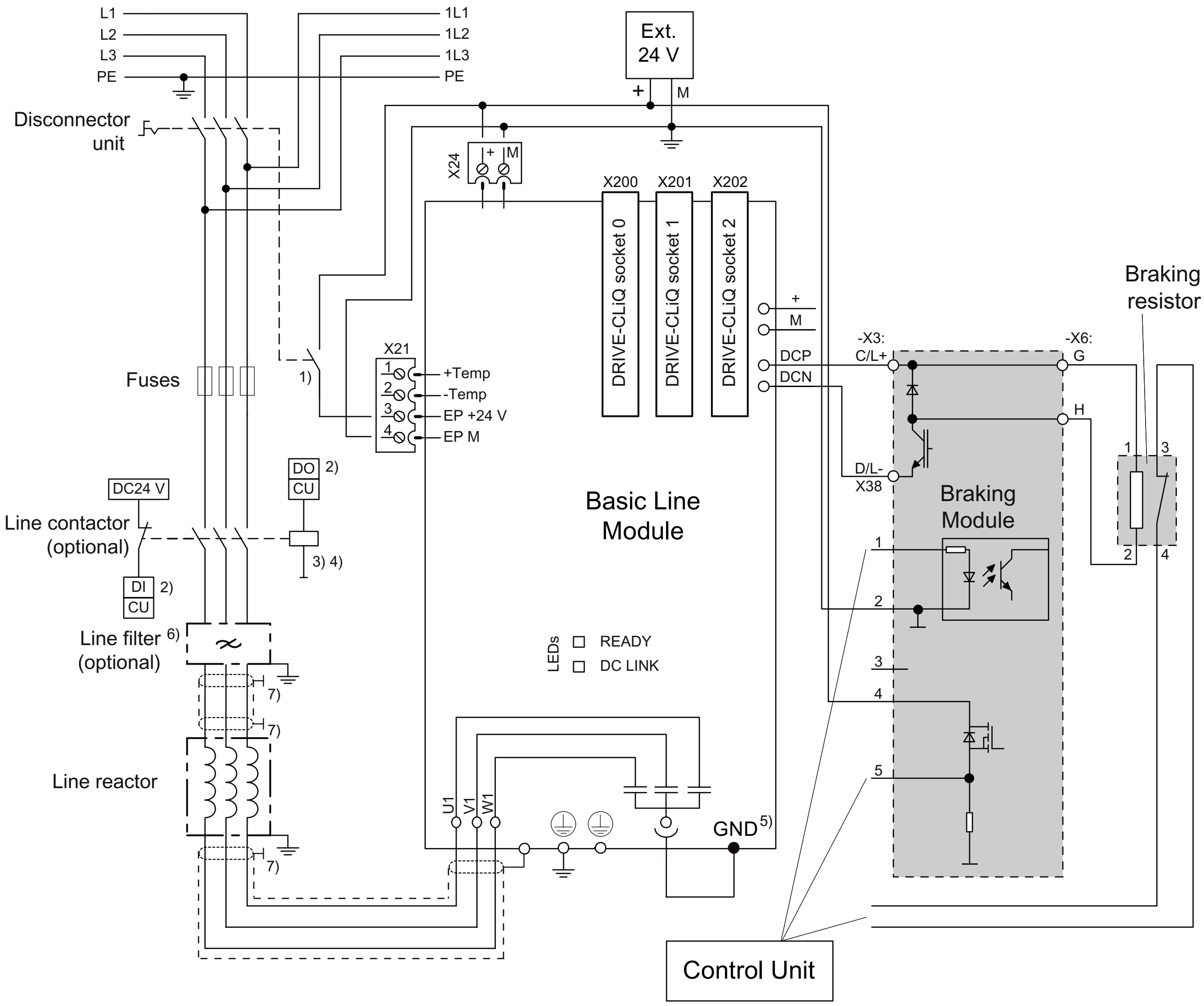
The electronics of the braking unit is powered from the DC link. That means, as long as there is no DC link voltage (< 360 V ± 2 %), the electronics are not active and an external control or the CU320 receives the signal "fault" from the fault output. So more than the 2 seconds are required that the electronics requires to start up as soon as the DC link voltage is present.

Note

If braking resistors other than those listed in the operating instructions, order number 6SE7087-6CX87-2DA1, are used, they may be damaged.

3.5.8.3 Interface description

Connection example



1) Operation requires 24 VDC and ground connections.
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) If components are being operated on the IT system, the connection bracket must be removed.
6) A line filter is required to ensure the radio interference voltage complies with Category C2 requirements.
7) Contacting via rear mounting panel or shielding buses in accordance with EMC installation guideline

Figure 3-69 Connection example MASTERDRIVES braking module

DC link connection and braking resistor connection

100 – 200 kW braking units

Note

After the the DC link voltage has been 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 switching on the system.

Table 3- 51 Power terminals of braking units 100 - 200 kW

DC link connection (via busbars, 100 - 200 kW)		
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
Braking resistor connection (via busbars, 100 - 200 kW)		
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	Crimping cable lug to DIN 46234 With shrinkdown plastic tubing pulled over it Cables connected with supplied M8 x 25 screws	
AWG	max 2/ 0	

WARNING

The connections between the power unit and braking unit must be short-circuit and ground-fault resistant. The electric strength of the cable must be rated to the line voltage.

3.5.8.4 Dimension drawing

Dimension drawing of braking modules 100 - 200 kW

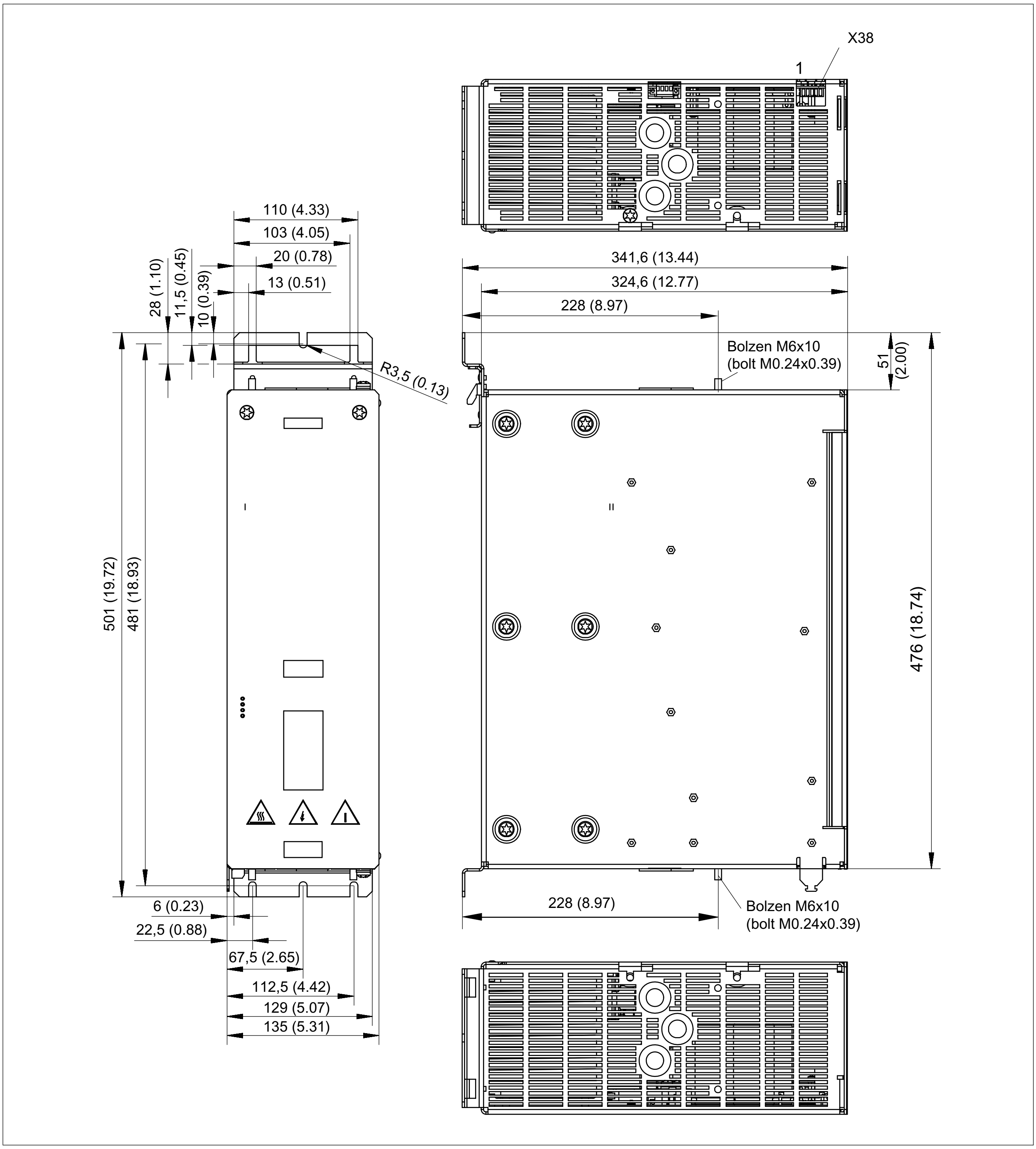


Figure 3-70 Dimension diagram of MASTERDRIVES braking unit, all data in mm and (inches)

3.6 Basic Line Modules with cold plate

3.6.1 Description

The Basic Line Modules provide a non-regulated DC link voltage that matches the rectified line input voltage.

One or more Motor Modules can be connected to the power supply network via the Basic Line Module. The Basic Line Module provides the DC link voltage for the Motor Modules.

To reduce the energy (e.g. for emergency retraction), a controller for an external braking resistor has been integrated in the 20 kW and 40 kW Basic Line Modules. An external Braking Module must be used for 100 kW Basic Line Modules.

The Basic Line Module is suitable for direct operation on TN, IT, and TT systems.

The 100 kW Basic Line Module includes a basic interference suppression, but the 20 kW and 40 kW Basic Line Modules do not include it.

The ratio of line short-circuit power to rated power must be ≥ 30.

The maximum total signal 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
  – 1000 m shielded with Voltage Clamping Module

3.6.2 Safety information

DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

DANGER

DC-link discharge time

The DC-link discharge time warning in the relevant national language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 30 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm² Cu or ≥ 16 mm² Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC-link adapter and DC-link rectifier adapter).

CAUTION

The cooling clearances of 80 mm above and below the components must be observed.

CAUTION

The tightening torque of the DC-link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning with the complete system in a no-voltage condition (powered-down) and with the DC link discharged. After transportation, the screws must be tightened.

CAUTION

The overall length of the power cables (motor supply cables and DC-link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION

Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION

DC-link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

3.6.3 Interface description

3.6.3.1 Overview

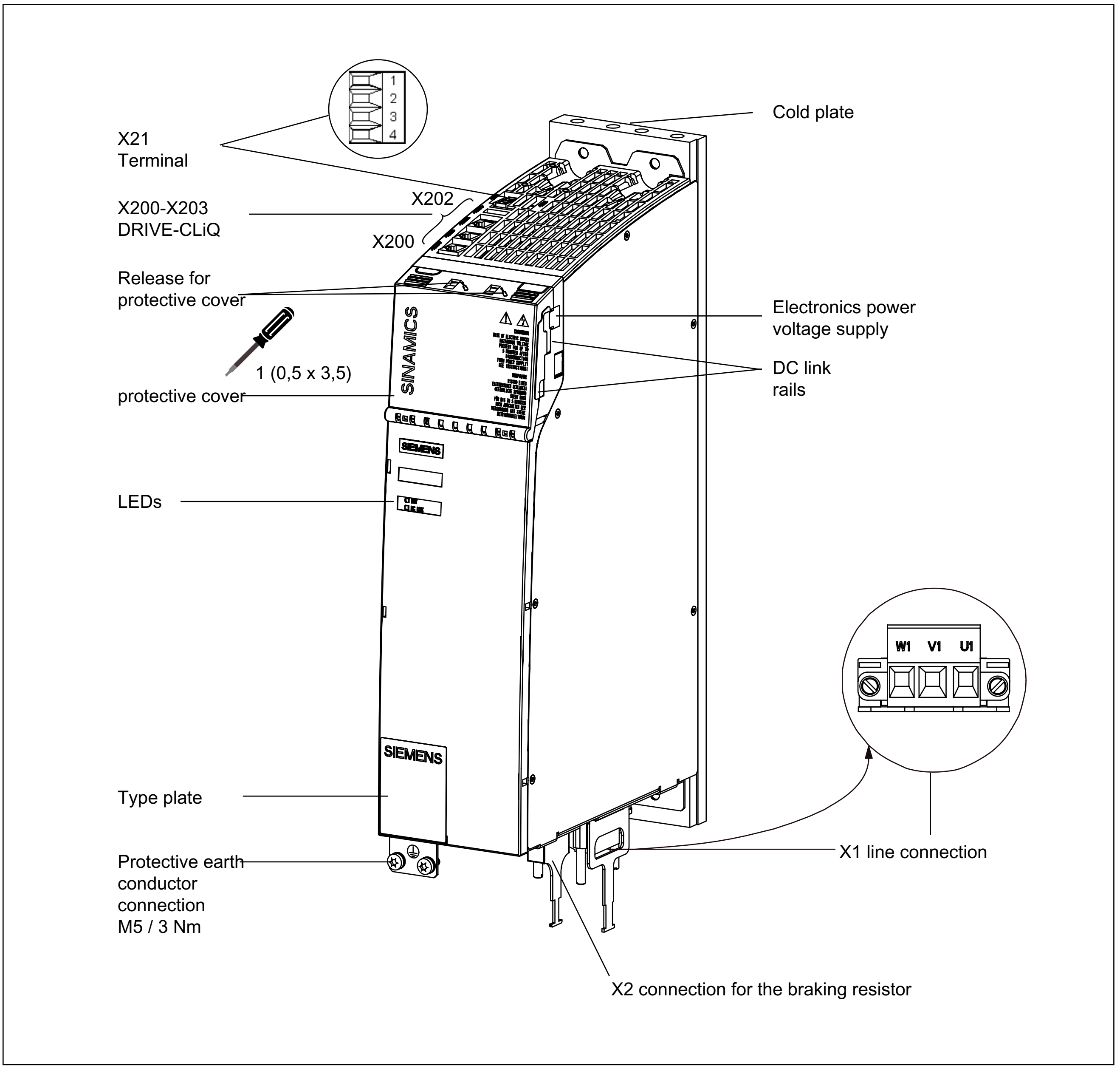


Figure 3-71 Basic Line Module with cold plate (20 kW)

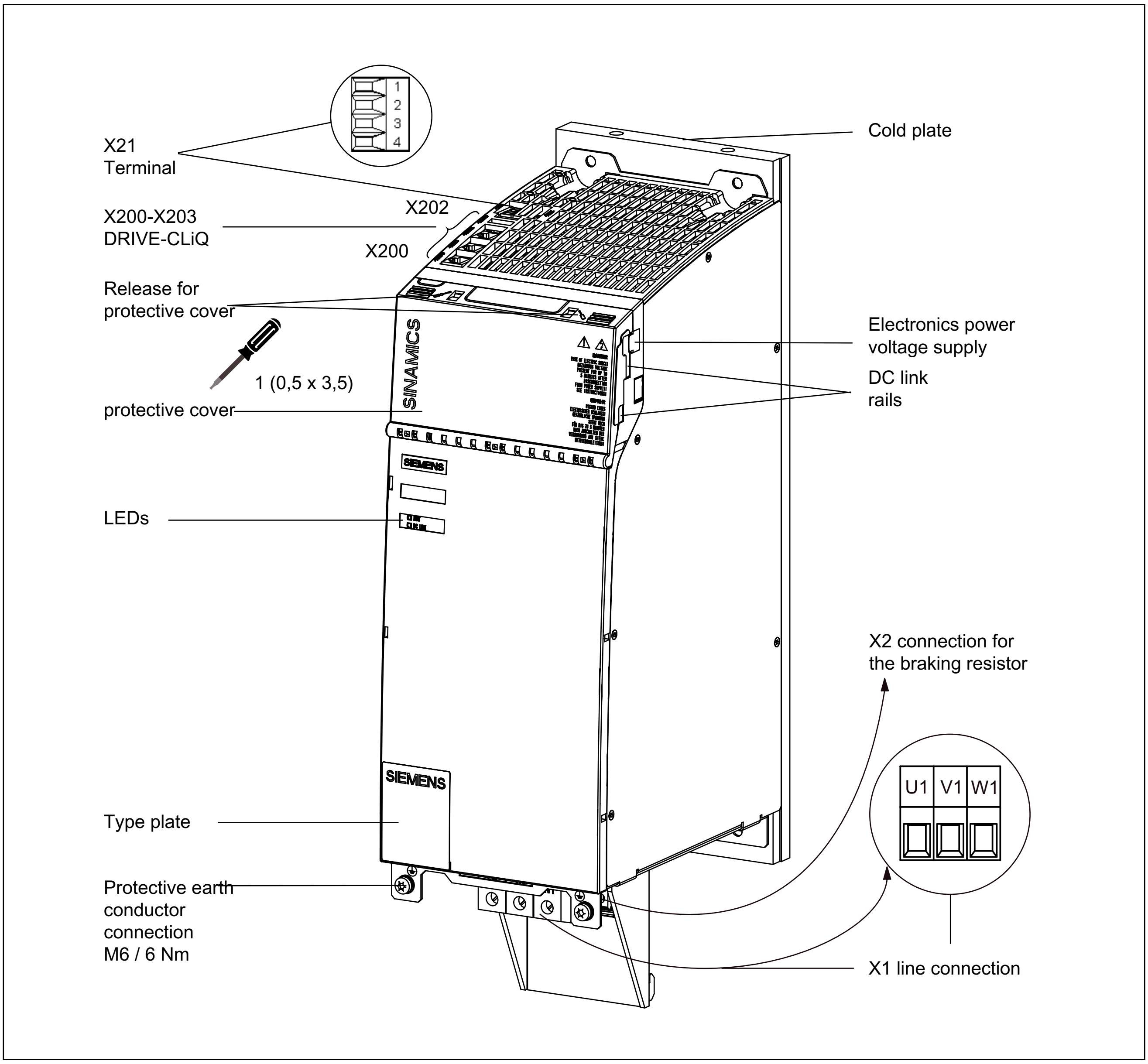


Figure 3-72 Basic Line Module with cold plate (40 kW)

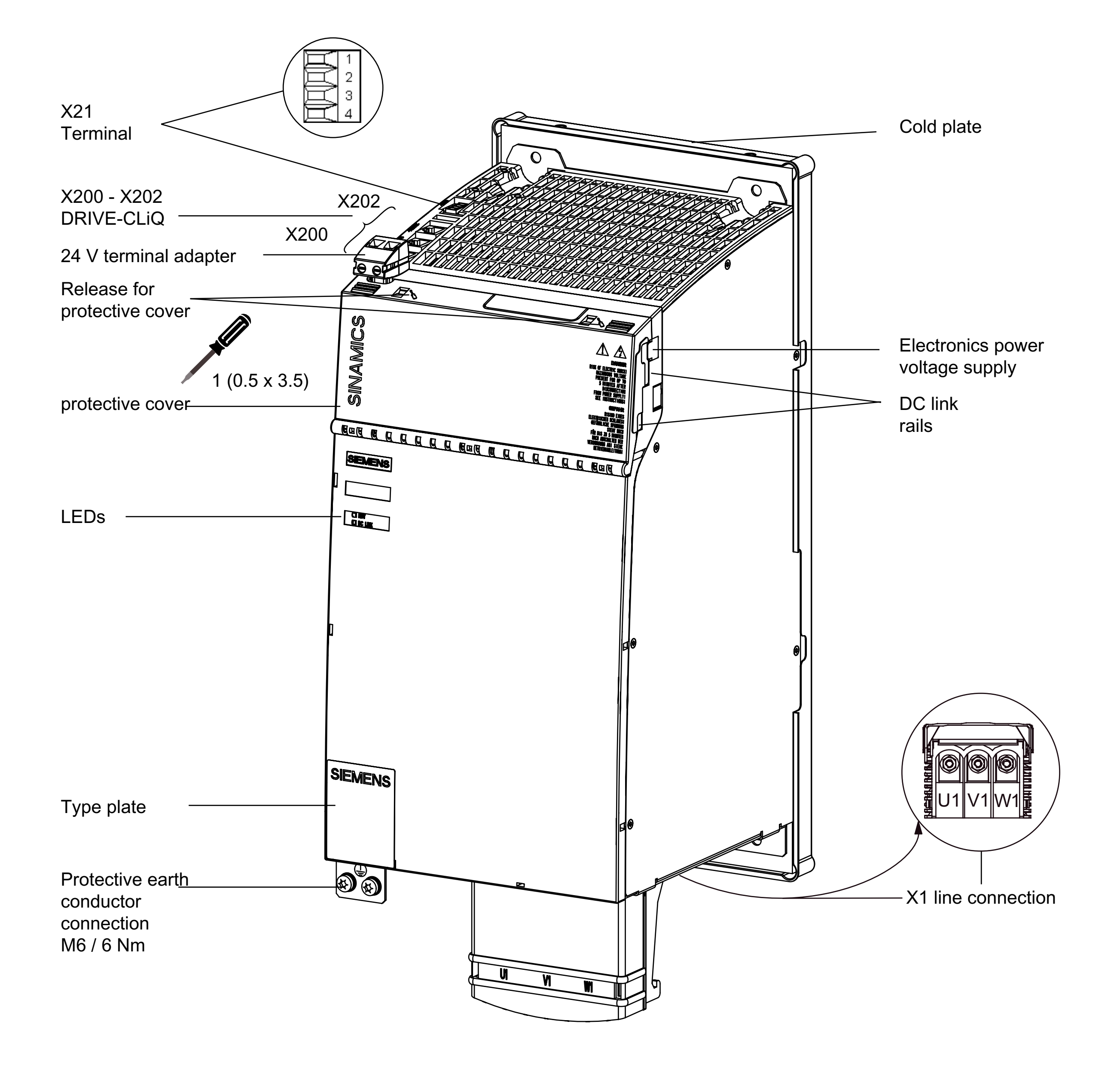
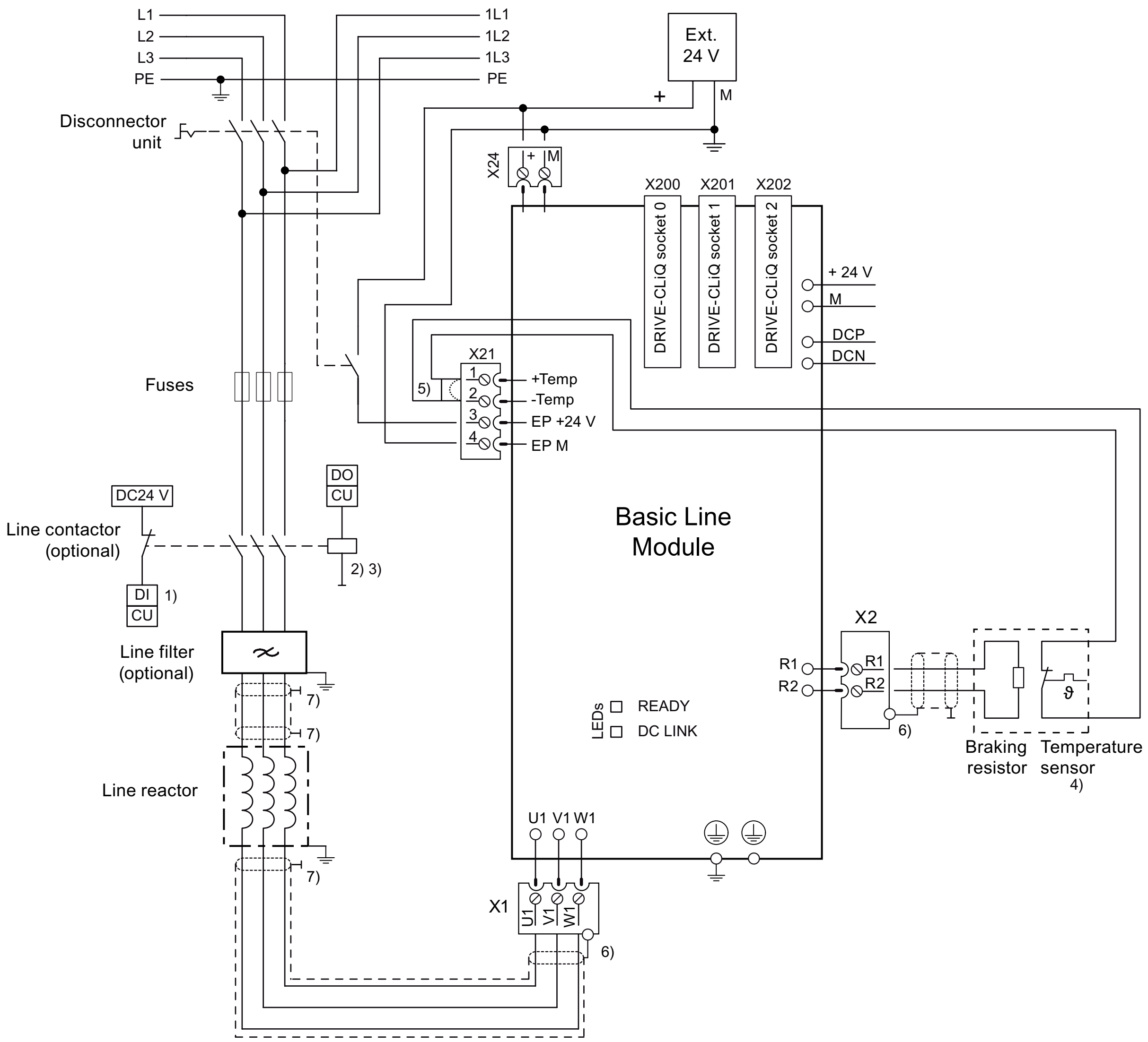


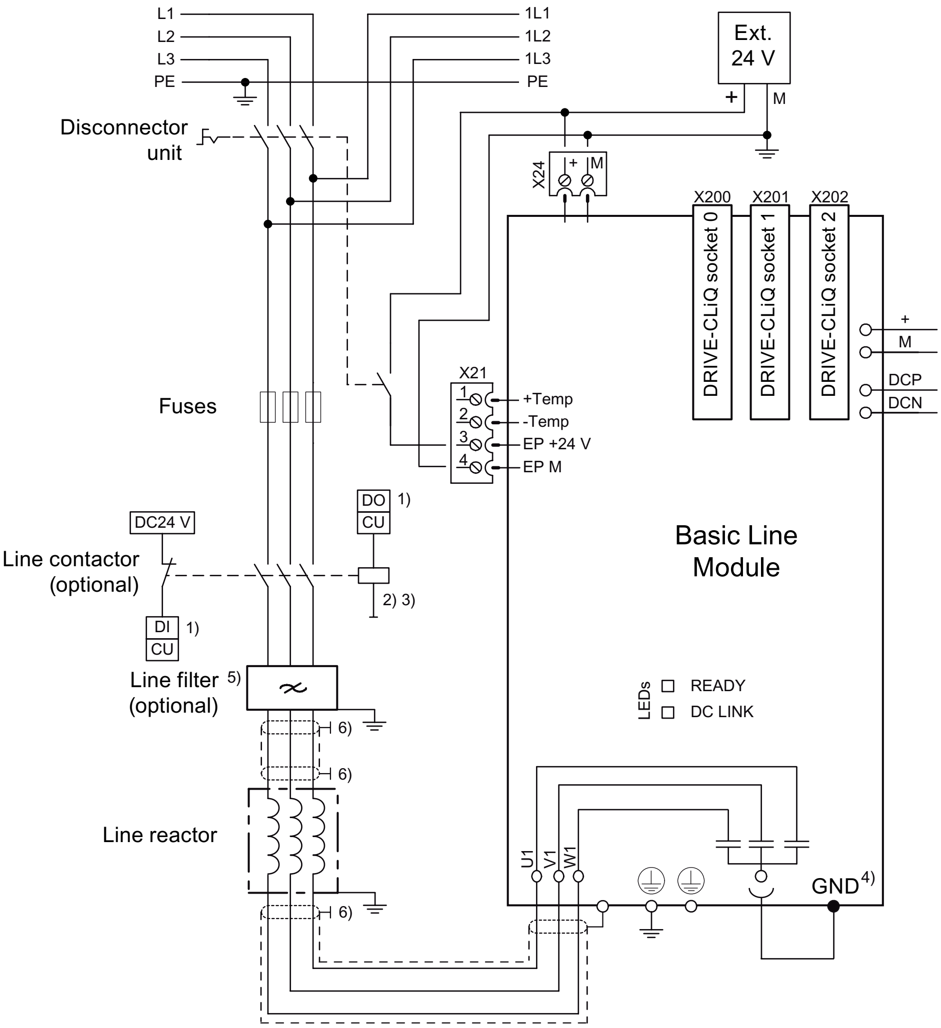
Figure 3-73 Basic Line Module with cold plate (100 kW)

3.6.3.2 Connection example



1) DI/DO, controlled by the Control Unit
2) No additional load permitted downstream of 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 and wiring must not exceed a resistance value of 100 ohms.
5) Jumper for switching off the temperature monitoring function for the braking resistor
6) Contact through connector (20 kW) or shield plate (40 kW)
7) Contact through the rear of the mounting surface or shielding buses in accordance with the EMC Directive

Figure 3-74 Connection example: Basic Line Module (20 kW and 40 kW)

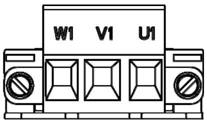
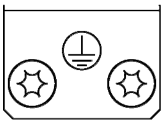


1) DI/DO, controlled by the Control Unit
2) No additional load permitted downstream of line contactor
3) The current carrying capacity of the DO must be observed; an output coupling device must be used if required.
4) When operating the component on an IT system, the connection bracket must be removed.
5) Line filter is required in order to comply with Category C2 radio-interference voltage values.
6) Contact through the rear of the mounting surface or shielding buses in accordance with the EMC Directive

Figure 3-75 Connection example: Basic Line Module (100 kW)

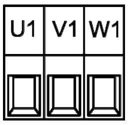
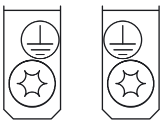
3.6.3.3 X1 line connection

Table 3- 52 Terminal block X1 Basic Line Module 20 kW

	Terminal	Technical specifications
	U1	Connection voltage: 380 V - 480 V 3 AC, 50 / 60 Hz max. connectable cross-section: 16 mm² Type: Screw terminal 7 (see chapter Connection methods) Tightening torque: 1.5 - 1.7 Nm
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm [1]

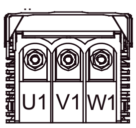
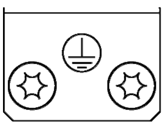
1) For ring cable lugs in accordance with DIN 46234

Table 3- 53 Terminal block X1 Basic Line Module 40 kW

	Terminal	Technical specifications
	U1	Connection voltage: 380 V - 480 V 3 AC, 50 / 60 Hz Terminal type HDFK 50, cross-section 50 mm², ferrules (see chapter Connection methods) Tightening torque min. 6 Nm
	V1	
	W1	
	PE connection	Threaded hole M6/6 Nm [1)]

1) For ring cable lugs in accordance with DIN 46234

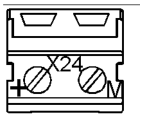
Table 3- 54 Terminal block X1 Basic Line Module 100 kW

	Terminal	Technical specifications
	U1	Connection voltage: 380 V - 480 V 3 AC, 50 / 60 Hz max. connectable cross-section: 120 mm² Type: Threaded bolt M8 [1)] (see chapter Connection methods) Tightening torque: 13 Nm
	V1	
	W1	
	PE connection	Threaded hole M6/6 Nm [1)]

1) For ring cable lugs in accordance with DIN 46234

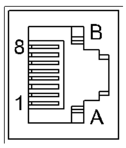
3.6.3.4 X24 24 V terminal adapter

Table 3- 55 Terminal block X24

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronic ground
The 24 V terminal adapter is supplied as standard Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see Connection Methods)			

3.6.3.5 X200-X202 DRIVE-CLiQ interfaces

Table 3- 56 DRIVE-CLiQ interface X200-X202 for 16 kW and 36 kW Smart Line Modules

	PIN	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 V power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces included in the scope of delivery; blanking plate (50 pieces) Order number: 6SL3066-4CA00-0AA0			

3.6.3.6 X2 braking resistor connection

Table 3- 57 Terminal block X2 on Basic Line Module (20 kW)

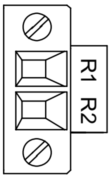
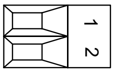
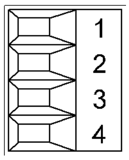
	Terminal	Designation	Technical specifications
	1	Braking resistor connection R	Max. connectable cross-section: 4 mm² Type: Screw terminal 4 (see chapter Connection methods) Tightening torque: 0.5 - 0.6 Nm
	2		

Table 3- 58 Terminal block X2 on Basic Line Module (40 kW)

	Terminal	Designation	Technical specifications
	1	Braking resistor connection R	Max. connectable cross-section: 10 mm² Type: Screw terminal 6 (see chapter Connection methods) Tightening torque: min 1.5 - 1.8 Nm
	2		

3.6.3.7 X21 EP terminals

Table 3- 59 Terminal strip X21

	Terminal	Designation	Technical specifications
	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 (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see chapter Connection methods)			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual LH1).

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

⚠ WARNING

For operation, 24 VDC must be connected to terminal 3 and ground to terminal 4. When removed, the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

⚠ DANGER

If the temperature switch is not connected, this can cause the resistor to overheat.

⚠ DANGER

Risk of electric shock!

Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), a Sensor Module External (SME120 or SME125) or Terminal Module TM120 must be used.

If these instructions are not complied with, there is a risk of electric shock!

3.6.3.8 Meaning of the LEDs on the Basic Line Module

Table 3- 60 Basic Line Module - description of the LEDs

Status		Description, cause	Remedy
Ready (H200)	DC link (H201)		
off	off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	off	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.	Check the line voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. Note: The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault.
Green/ red (0.5 Hz)	–	Firmware is being downloaded.	–
Green/red (2 Hz)	-	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	–	Component detection via LED is activated (p0124). Note: Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

⚠ DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC link" LED.
The warning information on the components must be carefully observed!

3.6.4 Dimension drawings

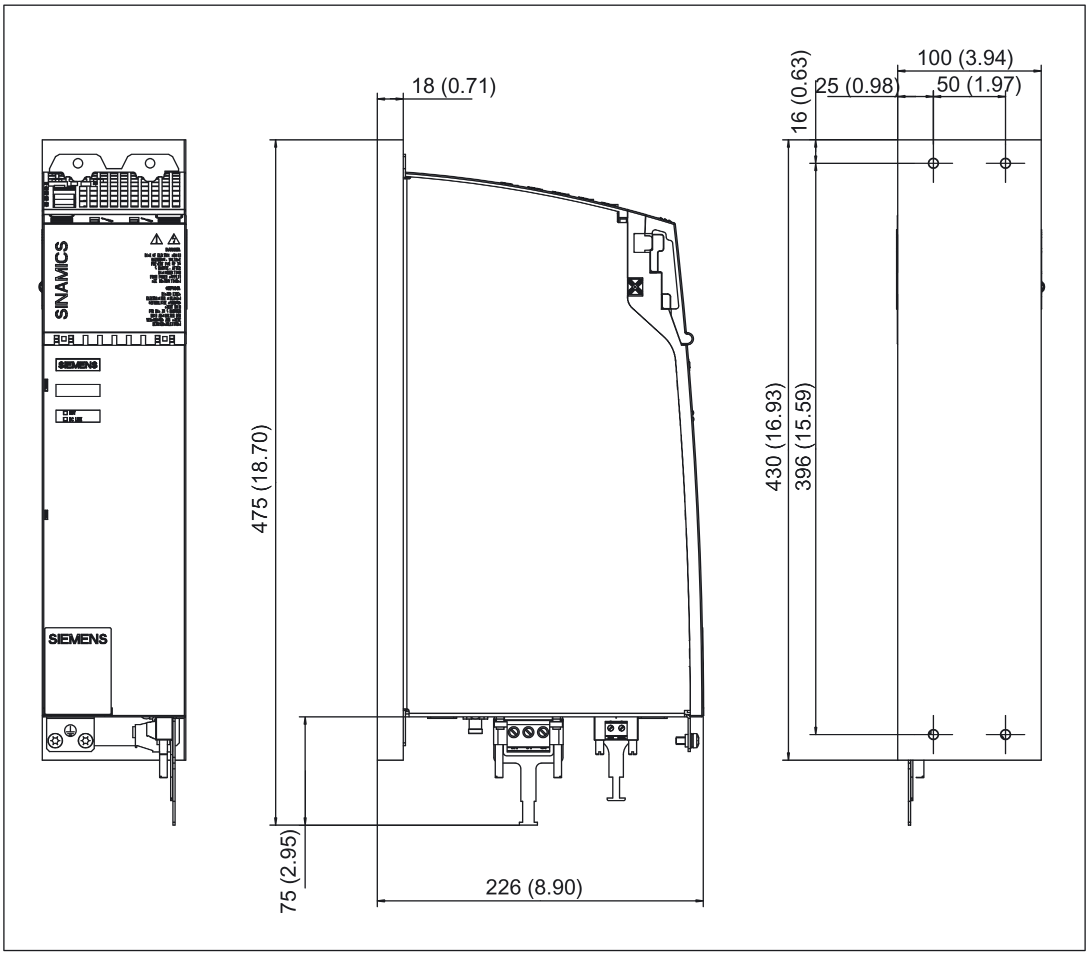


Figure 3-76 Dimension drawing of Basic Line Module with cold plate (20 kW), all dimensions in mm and (inches)

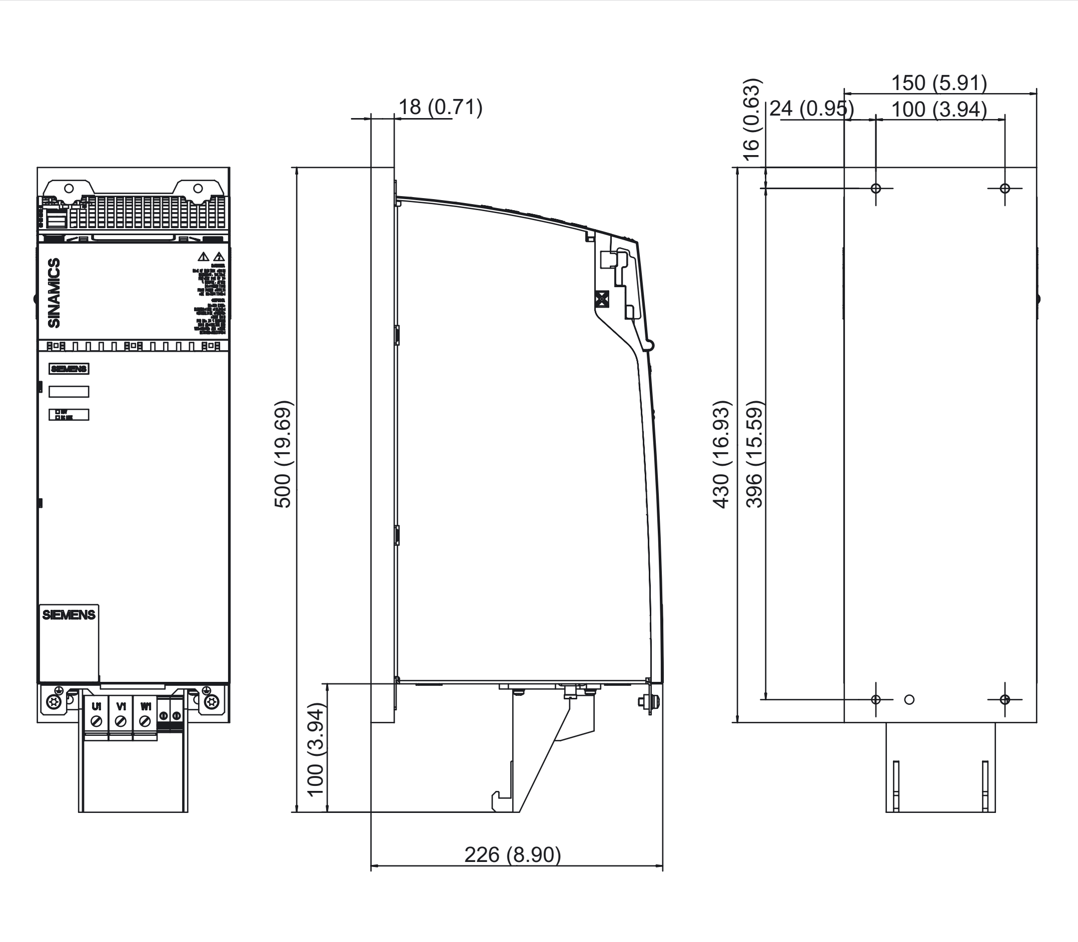


Figure 3-77 Dimension drawing of Basic Line Module with cold plate (40 kW), all dimensions in mm and (inches)

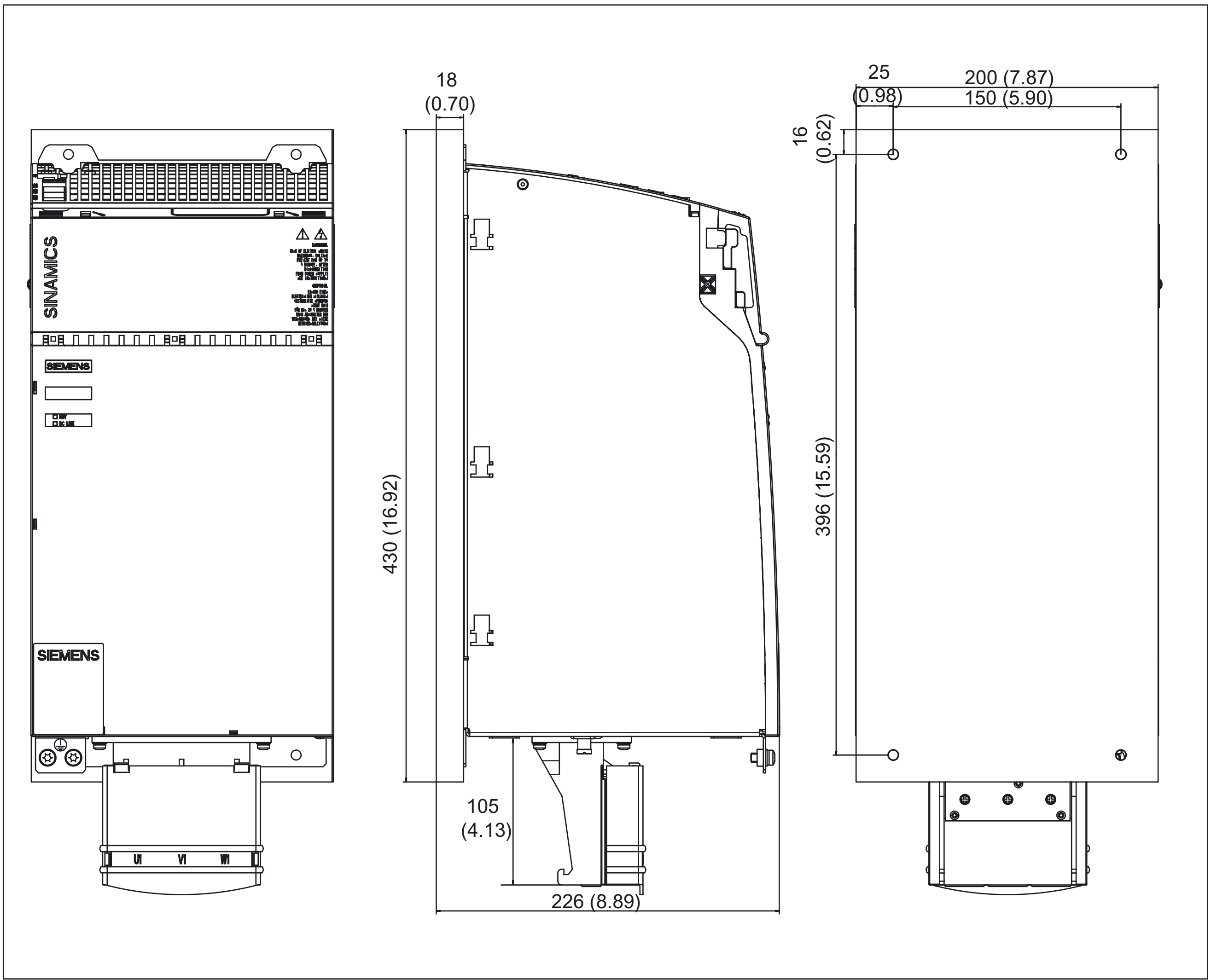


Figure 3-78 Dimension drawing of Basic Line Module with cold plate (100 kW), all dimensions in mm and (inches)

3.6.5 Installation

Mounting the cold plate component on customer-specific heat sinks

Note the following before installation:

- Before mounting, check the surface of the heat sink to ensure that it is not damaged.
- To facilitate installation, M6 screw bolts and hexagon nuts/threaded pins (ISO 7436-M6x40-14 H, strength class 8.8) are recommended.
- To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting film must be used for this purpose. Every cold plate power unit is supplied with heat-conducting film cut to the right size. Note the installation position of the heat-conducting film (see diagrams below).

Note

When a component is replaced, the heat-conducting film must also be replaced! Only heat-conducting film approved or supplied by Siemens may be used.

	Order No.
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

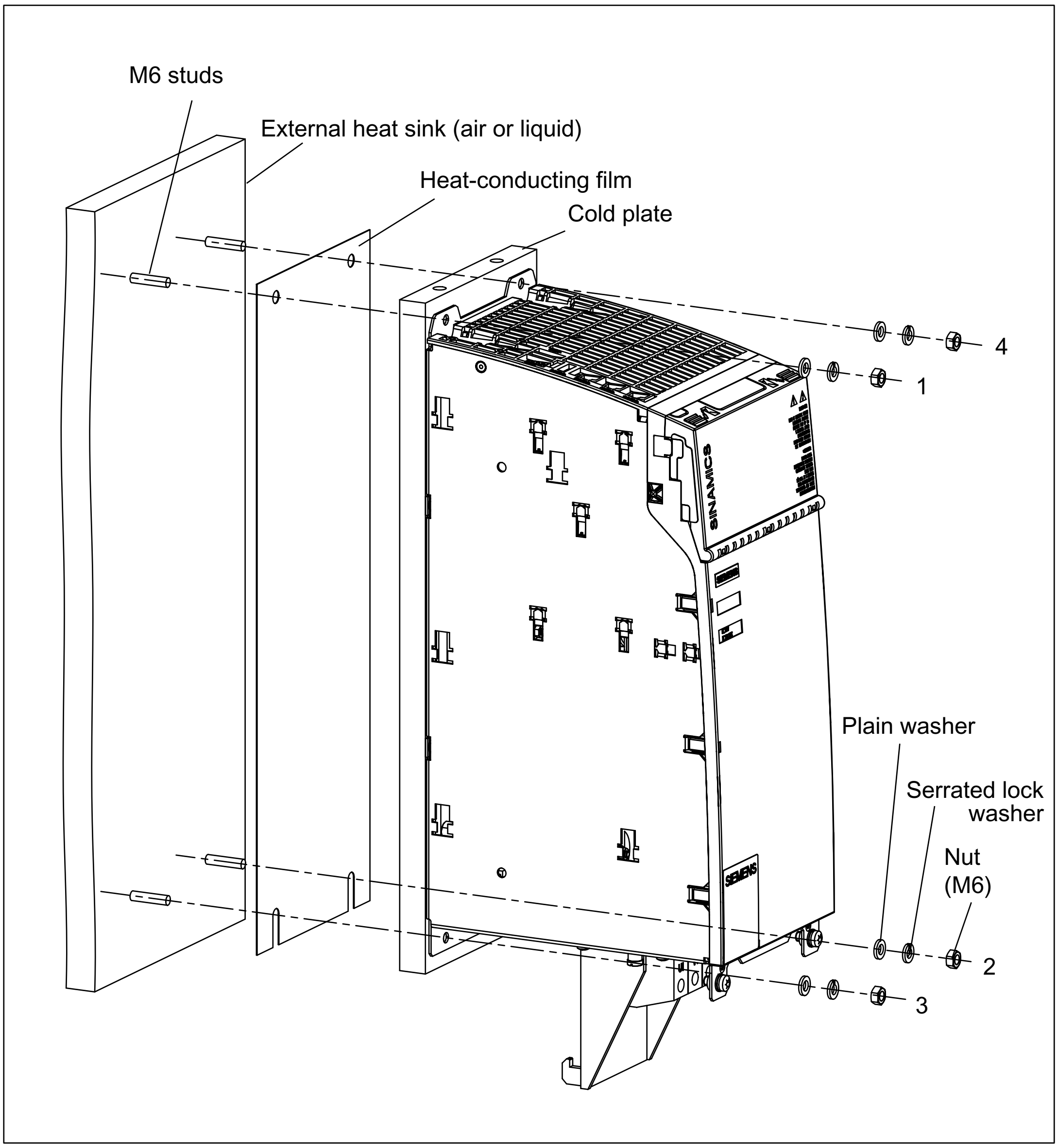


Figure 3-79 Installation of Basic Line Module 40 kW with external heat sink and heat-conducting film

To begin, tighten the screws by hand (approx. 0.5 Nm) in the sequence shown (steps 1 to 4) and then secure them (10 Nm).

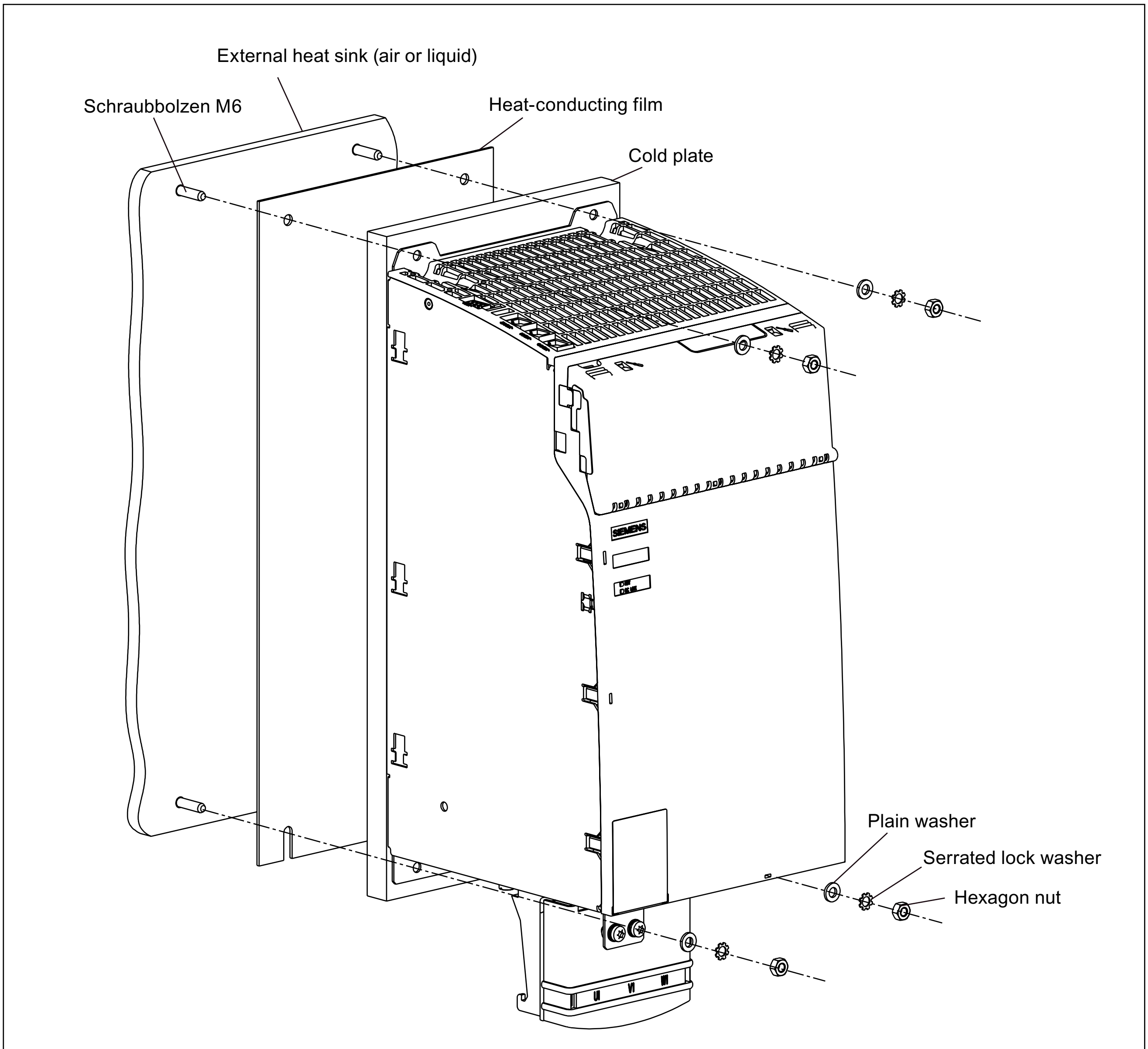


Figure 3-80 Installation of Basic Line Module 100 kW with external heat sink and heat-conducting film

Help with the mechanical cabinet design is available from:

Siemens AG
Industry Sector, IA SE WKC
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

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

The machine manufacturer can adapt the heat sink version to his 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.

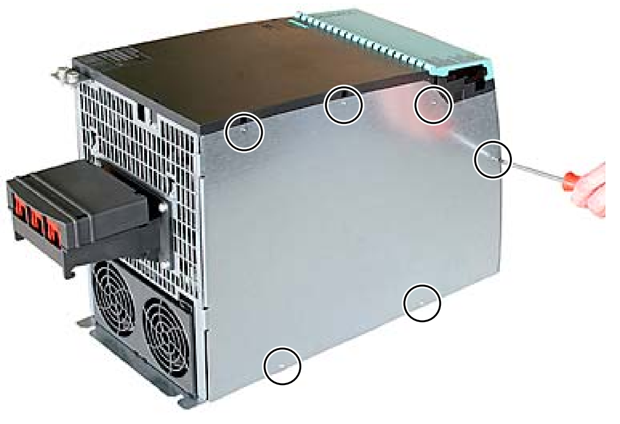
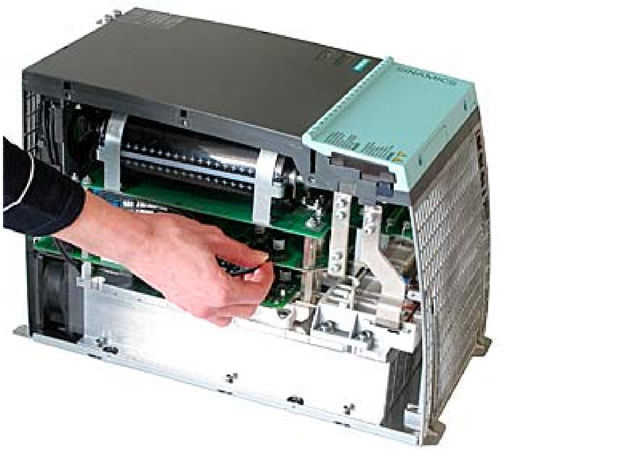
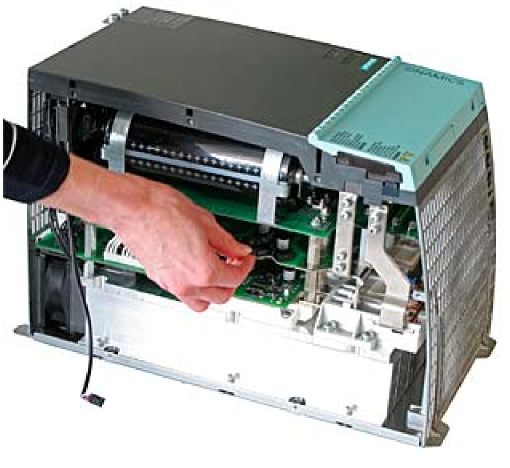
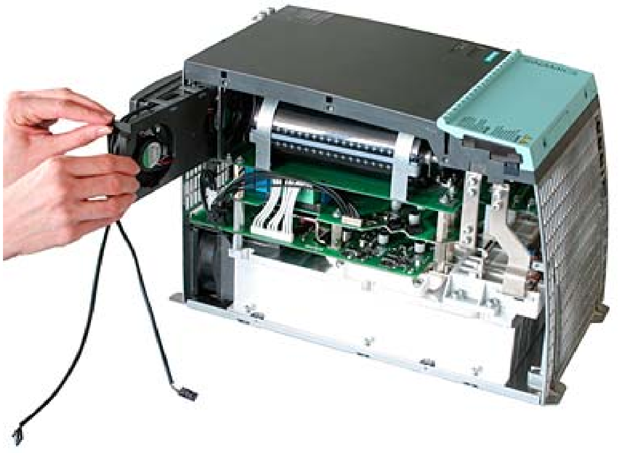
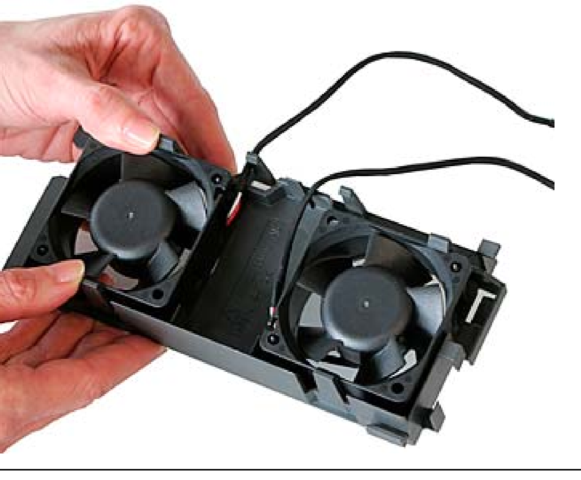
NOTICE
When mounting, you must ensure that the threaded bolts do not damage the cold plate.

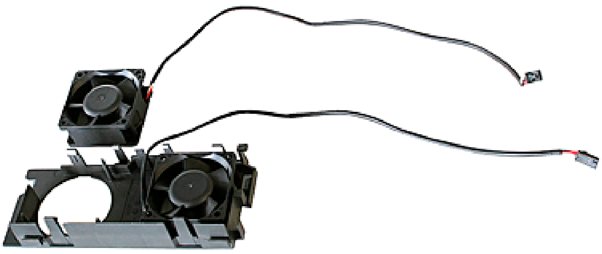
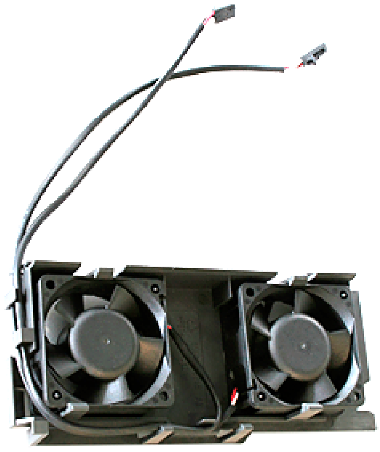
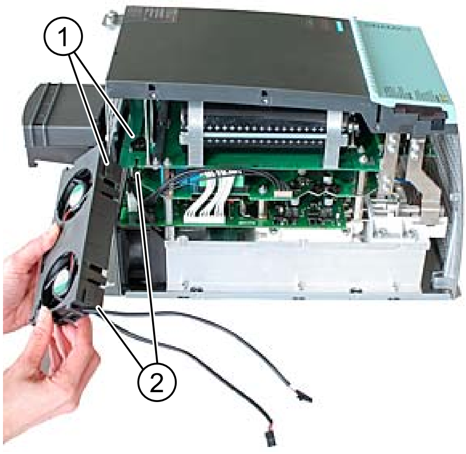
3.6.6 Replacing the fan for capacitor cooling

Replacing the fan for capacitor cooling of a 100 kW Basic Line Module

⚠ DANGER
Before replacing the fan, you must switch off the power supplies (24 V DC and 400 V AC). Risk of electric shock. Dangerous voltages are still present for up to 5 minutes after the power supply has been switched off. The device cover must not be opened until this time has elapsed.

NOTICE
When replacing the fan, you must observe the ESD regulations. Parts must only be replaced by trained personnel (danger of damage to sensitive components due to static electricity)!

	
Open the right device cover by loosening the six marked screws	Pull the first fan cable by pressing it slightly
	
Pull the second fan cable	Unlatch the fan module
	
Completely pull out the fan module	Slightly push the fan holder apart and pull out the fan

	
Observe the air flow direction markings when inserting the new fan	Observe the cable guide
	
Push in the fan in guide rails 1 and 2. Connect the two fan cables. Close the device cover and tighten the six screws with 0.8 Nm	

Operating a 100 kW Basic Line Module from an insulated network (IT system)

When a 100 kW Basic Line Module is operated from an insulated network (IT system), the connection bracket for the interference-suppression capacitor must be removed. The connection bracket for the interference-suppression capacitor is located on the lower side of the component.

CAUTION
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 for the interference-suppression capacitor with a Tx25 screwdriver.	Remove the connection bracket	Connection bracket for the interference-suppression capacitor

---

Note

Installing the connection bracket for the interference-suppression capacitor

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

3.6.7 Technical data

Table 3- 61 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) Infeed power (S6-40%) 1) Peak infeed power 1)	 kW (Pn) kW (Ps6) kW (Pmax)	 20 26 60	 40 52 120	 100 130 175
Braking power Continuous power Peak power	 kW kW	 5 40	 10 80	 - -
Supply voltages Rated voltage Line frequency Electronics power supply	 V_{ACrms} Hz V_{DC}	 3 AC 380 10 % (-15 % < 1 min) to 3 AC 480 10 % 47 to 63 24 (20.4 - 28.8)		
DC link voltage Overvoltage trip Undervoltage trip 2)	V_{DC} V_{DC} V_{DC}	510 – 720 820 ± 2 % 360 ± 2 %		
Rated input currents at 380 V_{AC} at 480 V_{AC}/528 V_{AC} at 480 V; S6-40% **Peak current** (at 400 V_{AC}/480 V_{AC})	 A_{AC} A_{AC} A_{AC} A_{AC}	 34.5 31 / 29 38 113 / 91	 69 62 / 58 78 208 / 172	 172 154 / 145 193 265 / 252
DC link currents Rated DC link current at 600 V: DC link current at 540 V: at 600 V_{DC}; at S6-40% at 600 V_{DC}; peak current	 A_{DC} A_{DC} A_{DC} A_{DC}	 33.5 37 43 100	 67 48 87 200	 167 185 217 292
Current carrying capacity DC link busbar Reinforced DC link busbars: 24 V busbar:	 A_{ACrms} A_{ACrms} A_{ACrms}	 100 150 20	 100 / 200 3) -- 20	 200 -- 20
Electronics current consumptionat 24 V DC	A_{DC}	0.9	1.1	1.6
Total power loss (incl. losses of the electronics) 7)	W	141.6	276.4	618.4
DC link capacitance Basic Line Module Drive line-up, max.	 µF µF	 940 20 000	 1880 20 000	 4100 20 000
Power factor 4)	cosφ	approx. 0.98	approx. 0.98	approx. 0.98
Circuit breaker (UL) Type designation Rated current: Resulting rated short-circuit current 6) SCCR at 480 V_{AC}:	 A kA	 3VL2106-2KN30 60 65	 3VL2110-2KN30 100 65	 3VL3125-2KN30 250 65

	6SL3136-	1TE22-0AA0	1TE24-0AA0	1TE31-0AA0
Safety fuse (UL) Type AJT Class J [5)] Rated current Resulting rated short-circuit current [6)] SCCR at 480 V_{AC}:	 A kA	 AJT60 60 65	 AJT100 100 65	 AJT250 250 65
Max. permissible heat-sink temperature	°C	65	70	70
Max. ambient temperature Without derating With derating	 °C °C	 40 55	 40 55	 40 55
Weight	kg	6.4	10.9	16.4

1) The powers specified apply to the rated voltage range from 380 V to 480 V.
2) Default for 400 V supply systems; undervoltage trip threshold is adjusted to the parameterized rated voltage.
3) For components where the final digit in the order number is ≥ 3.
4) Fundamental component only
5) Source of supply: Ferraz Shawmut, http://de.ferrazshawmut.com
6) 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.
7) For an overview, see the power loss tables in chapter Control cabinet installation

3.6.7.1 Characteristics

Rated duty cycles for Basic Line Modules

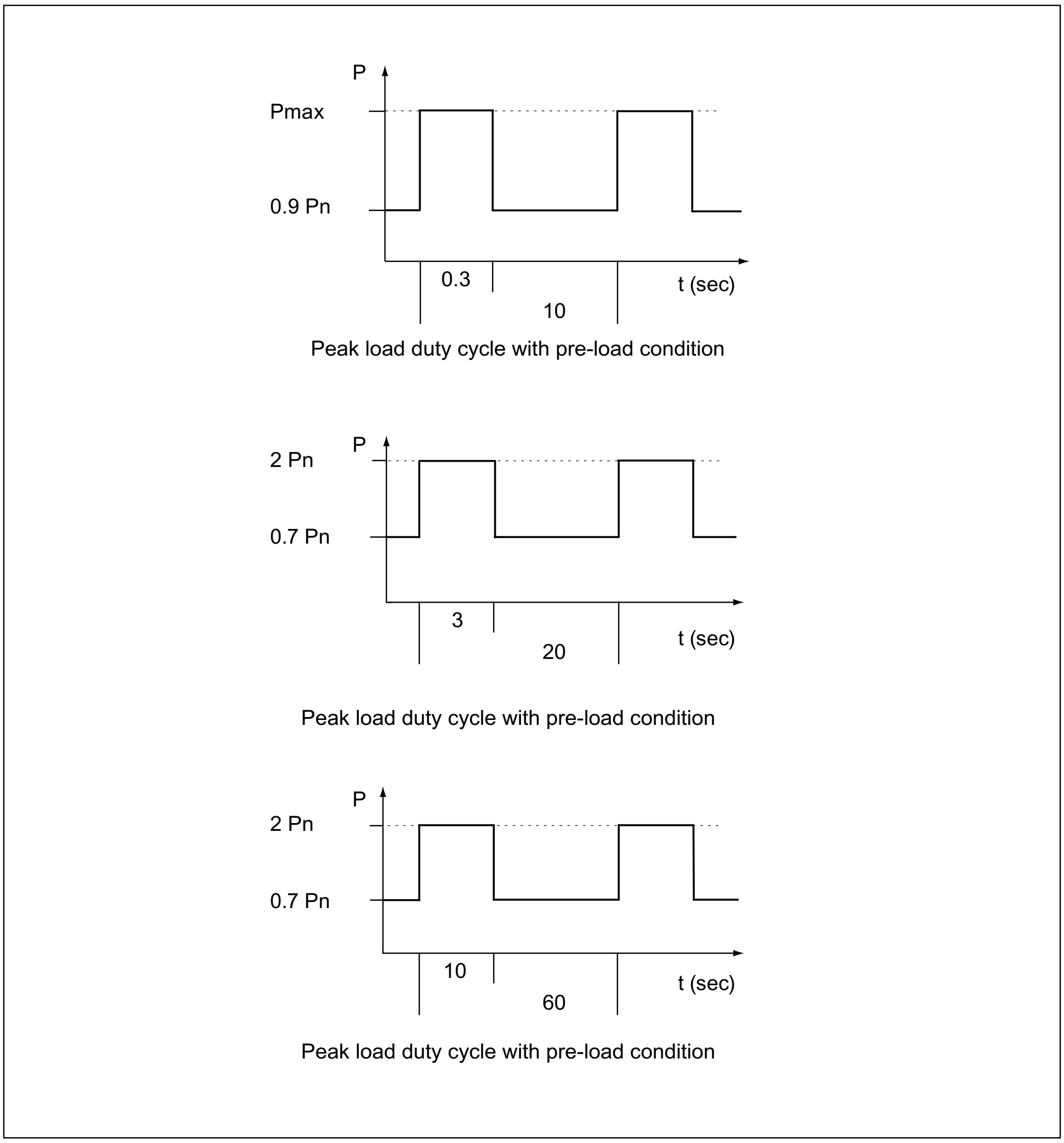


Figure 3-81 Rated duty cycles of 20 kW and 40 kW Basic Line Modules

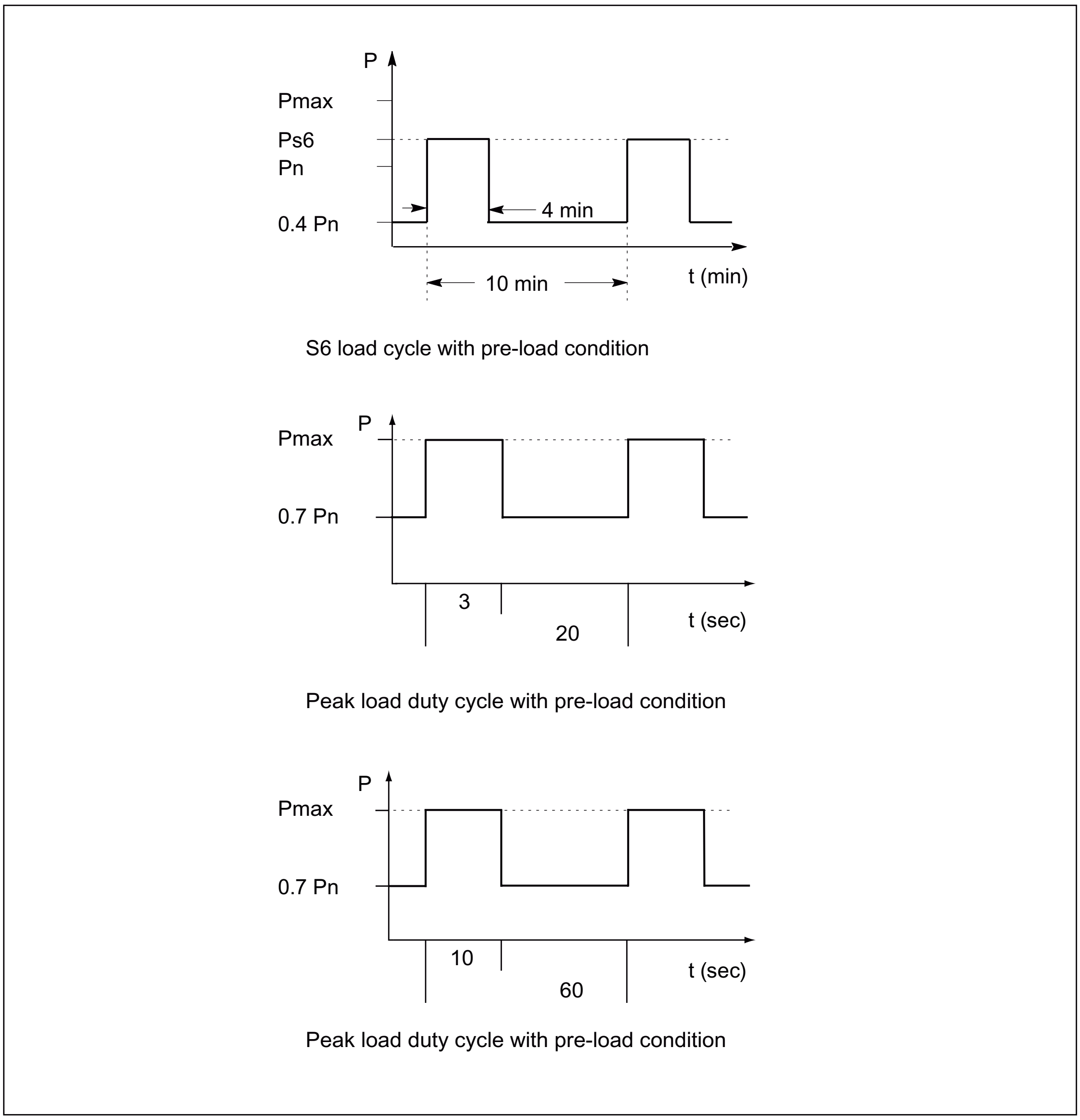


Figure 3-82 Rated duty cycles of 100 kW Basic Line Module

Braking duty cycle for Basic Line Modules

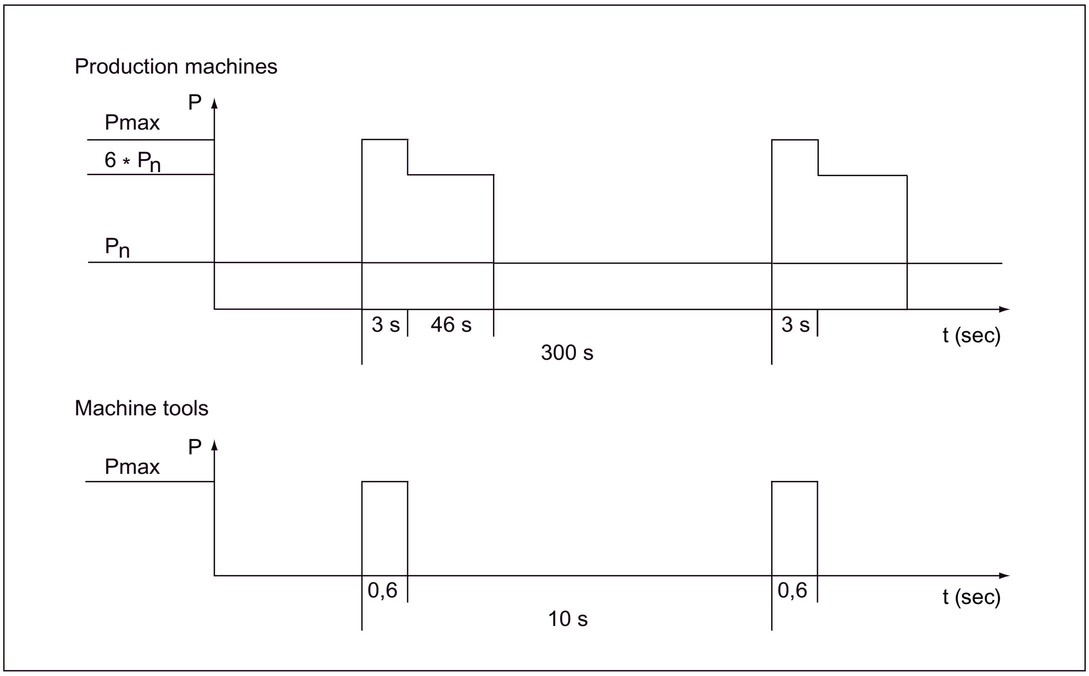


Figure 3-83 Braking duty cycle for Basic Line Modules

Derating characteristics

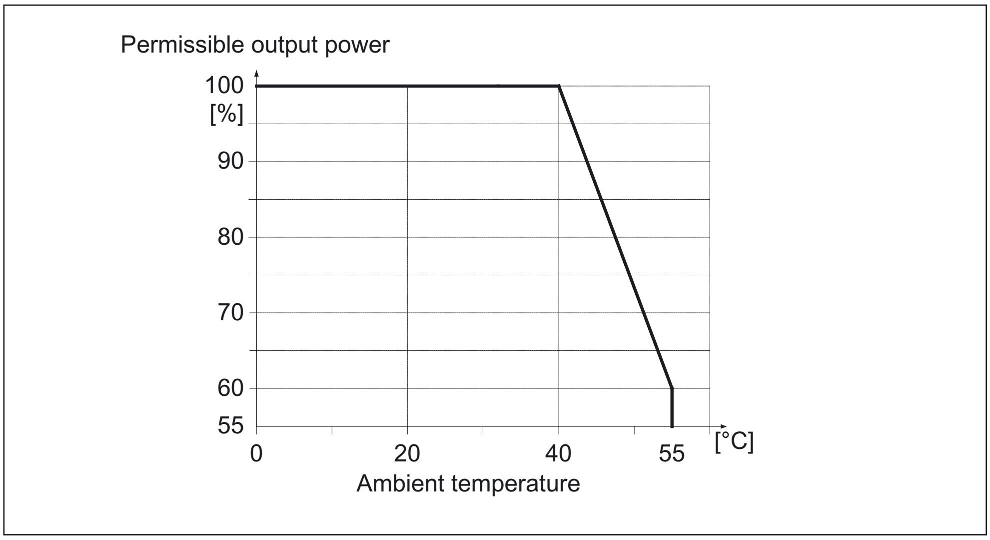


Figure 3-84 Output power as a function of the ambient temperature

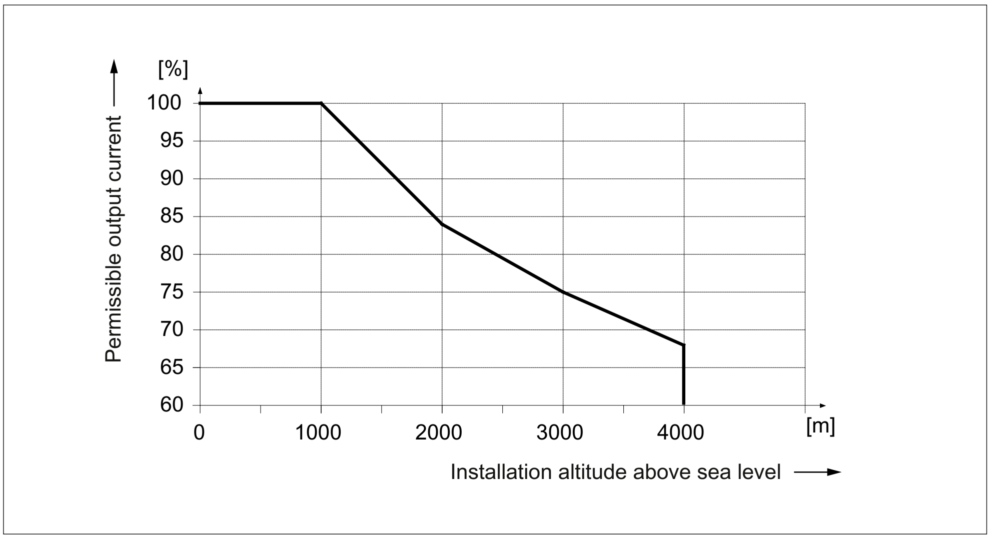


Figure 3-85 Output current as a function of the installation altitude

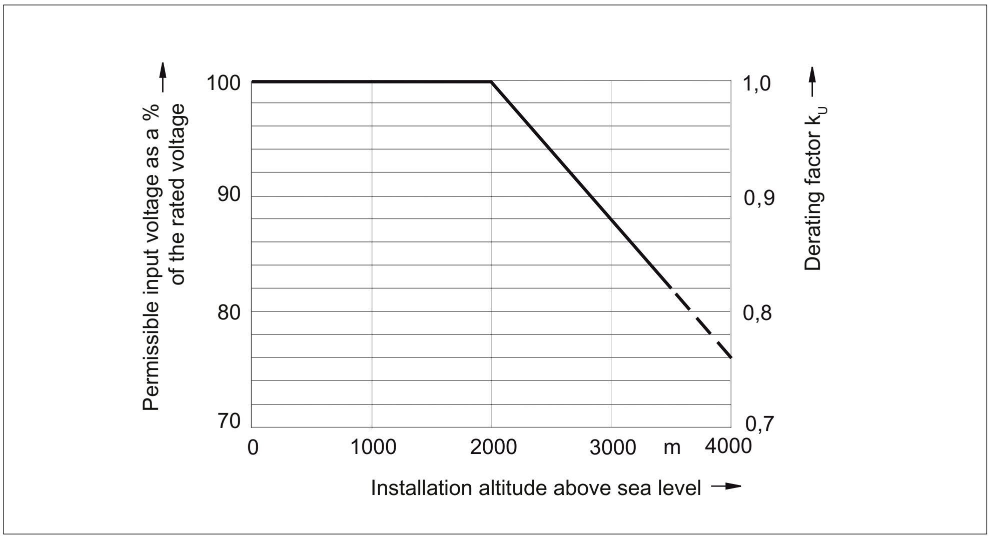


Figure 3-86 Voltage derating as a function of the installation altitude

3.6.8 Braking resistors for Basic Line Modules

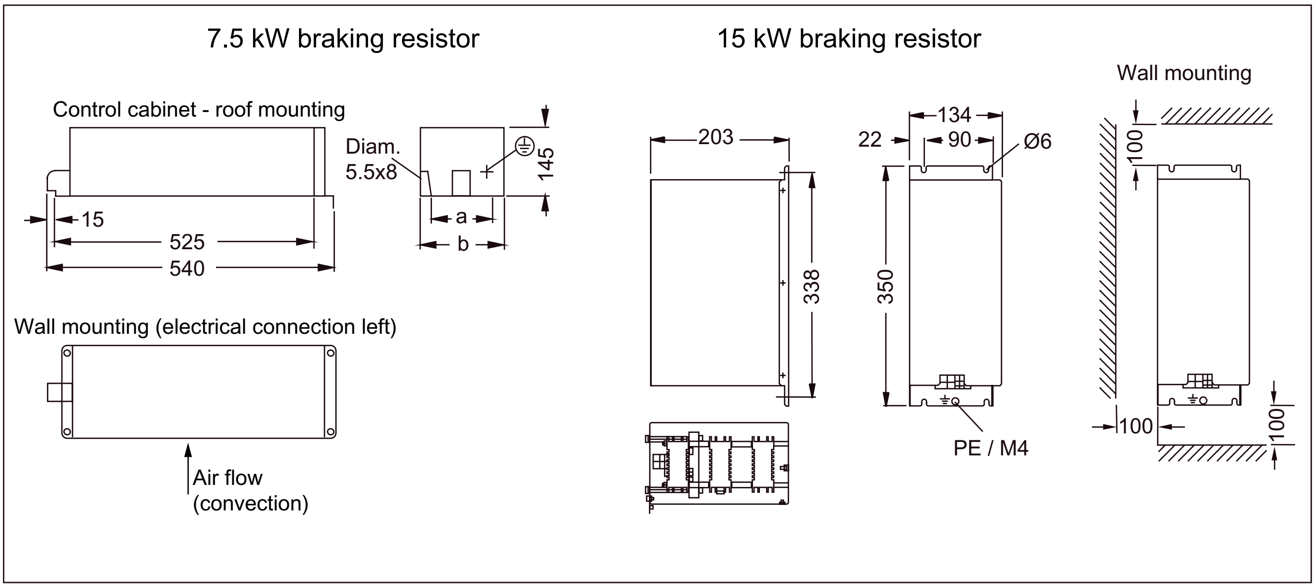


Figure 3-87 Dimension and installation drawing for braking resistor 7.5 kW and 15 kW, all dimensions in mm

Table 3- 62 Dimensions of braking resistor 7.5 kW and 15 kW

Rated power	Order number	a [mm (inches)]	b [mm (inches)]
7.5 kW	6SE7018-0ES87-2DC0	150 (5.90)	180 (7.08)
15 kW	6SE7021-6ES87-2DC0	330 (12.99)	360 (14.17)

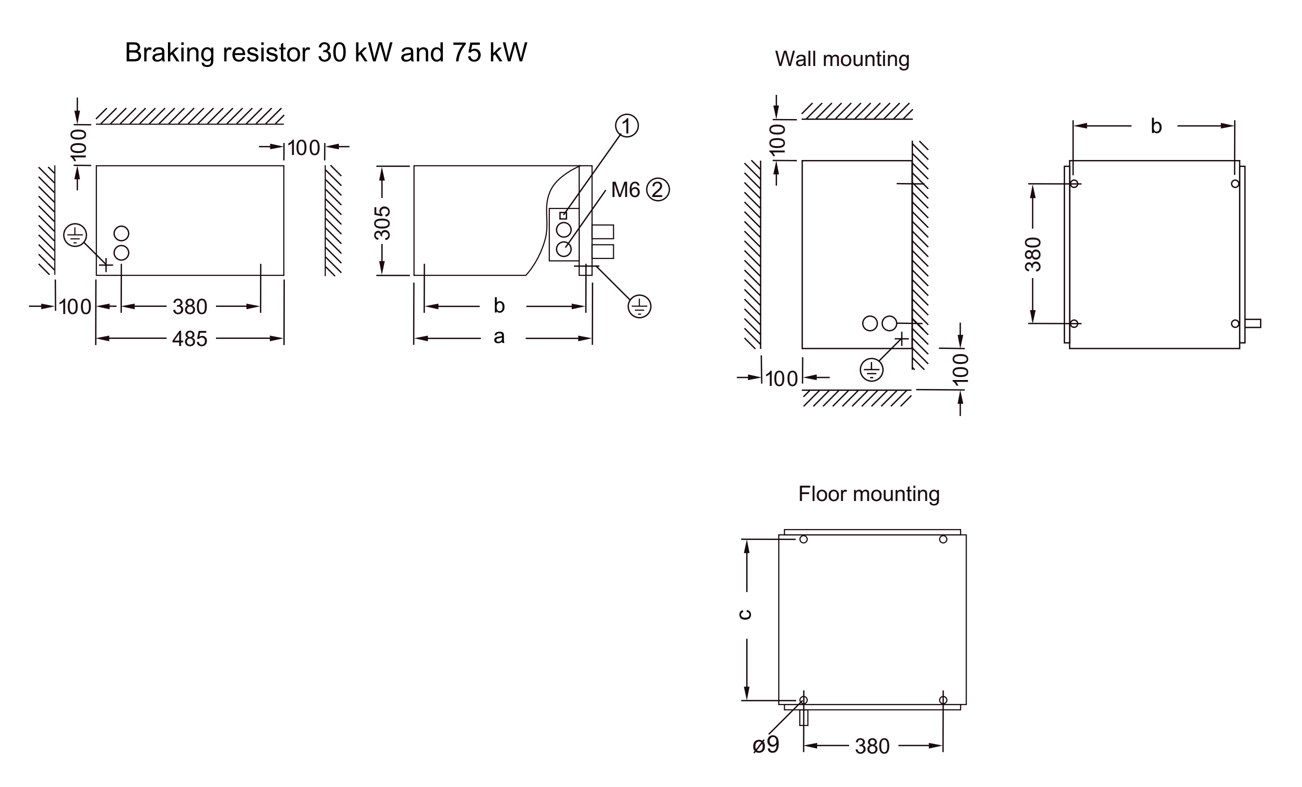


Figure 3-88 Dimension and installation drawing for braking resistor 30 kW and 75 kW, all dimensions in mm

① T1 / T2 tunnel terminals
② Stud terminals

Table 3- 63 Dimensions of braking resistor 30 kW and 75 kW

Rated power	Order number	a [mm (inches)]	b [mm (inches)]	c [mm (inches)]
30 kW	6SE7023-2ES87-2DC0	430 (16.92)	400 (15.74)	400 (15.74)
75 kW	6SE7028-0ES87-2DC0	740 (29.13)	710 (27.95)	710 (27.95)

CAUTION

The surface temperature of the braking resistors may exceed 80 °C.

Table 3- 64 Technical data of braking resistors for the Basic Line Modules

Braking resistor	Unit	6SE7018-0ES87-2DC0	6SE7021-6ES87-2DC0	6SE7023-2ES87-2DC0	6SE7028-0ES87-2DC0
	Ω	80	40	20	8
Peak power[1)] (P_{max})	kW	7.5	15	30	75
Rated power[1)] (P_n)	kW	1.25	2.5	5	12.5
Power connections		Screw-type terminals 4 mm²	Screw-type terminals 4 mm²	Screw studs for M6 ring terminal ends	Screw studs for M6 ring terminal ends
PE connection		M5 stud	M5 stud	M6 bolt	M8 bolts
Thermostatic switch (NC contact) Connection cross-section	 mm²	Screw terminals 4	Screw terminals 4	Screw terminals 2.5	Screw terminals 2.5
Can be used for Basic Line Modules 20 kW		Yes	Yes	Yes	--
Can be used for Basic Line Modules 40 kW		Yes	Yes	Yes	Yes
Weight	kg	6	11.5	17	27

1) Applies to a DC-link voltage of 760 V

Braking duty cycles for braking resistors

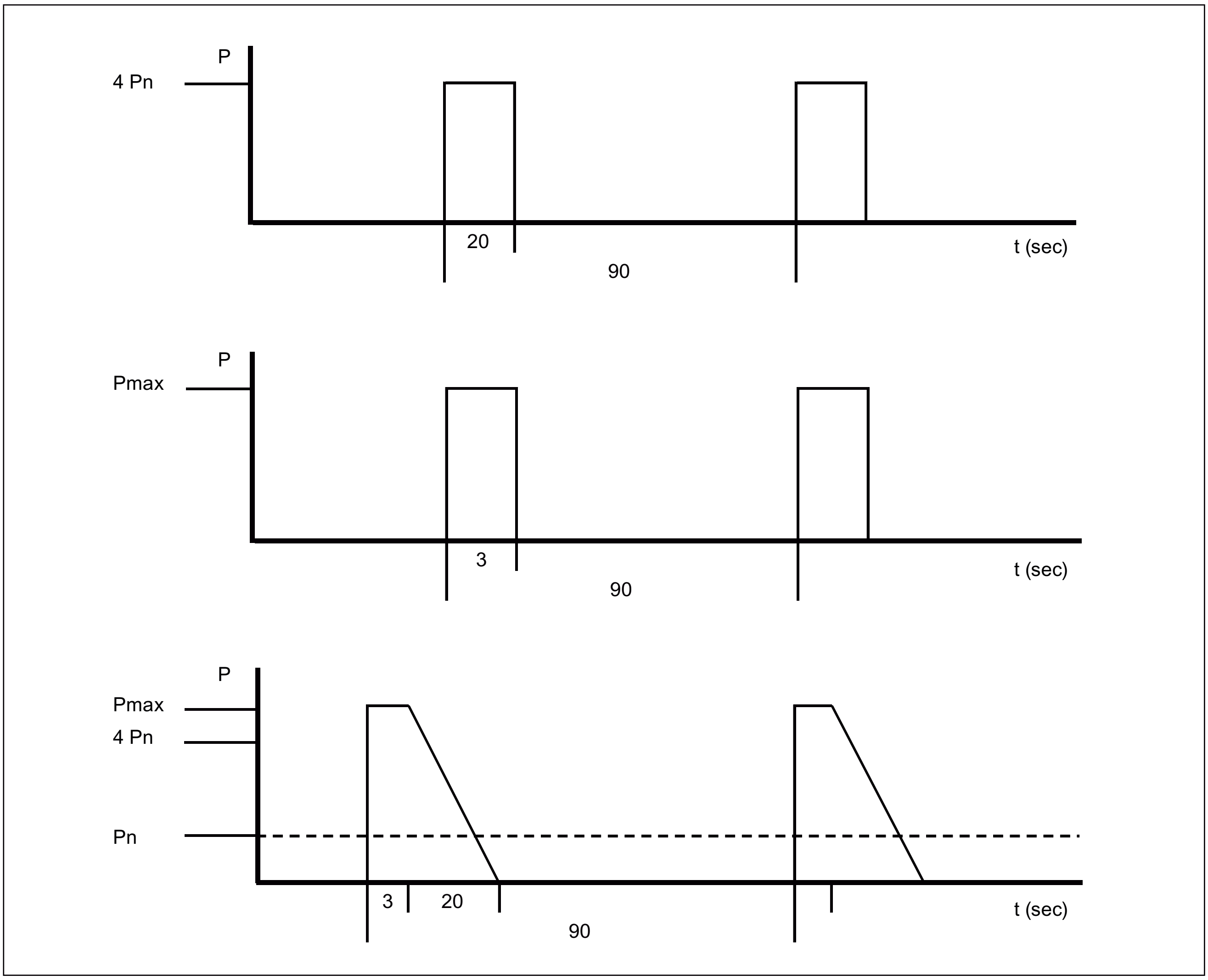


Figure 3-89 Braking duty cycles for braking resistors

3.7 Smart Line Modules with internal air cooling

3.7.1 Description

The Smart Line Module is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module(s) 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 Lines Modules are not equipped with a DRIVE-CLiQ connection.

The DC link starts precharging as soon as the supply voltage is applied and is independent of its phase sequence direction. Load can be applied to the DC link after the modules have been enabled. An optional main contactor is required for disconnecting the voltage.

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

3.7.2 Safety information

DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must no longer be used to avoid secondary damage or accidents.

DANGER

DC-link discharge time

A DC-link discharge time danger notice in the relevant national language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 70 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

DANGER

If the Line Module is not disconnected from the supply system (e.g. via the line contactor or main switch), the DC link remains charged.

CAUTION

The 80 mm clearances above and below the components must be observed.

CAUTION

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. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21, pin 1.

Switch on:

- 24 VDC power supply X24 ON
- Line contactor ON
- EP signal X21 pins 3 and 4 ON
- Wait until precharging is complete
- "Ready" signal at terminal X21 pin 1 set 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 pins 3 and 4 OFF
- Line contactor OFF
- 24 VDC power supply X24 OFF

Overload:

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

CAUTION

The tightening torque of the DC-link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning with the complete system in a no-voltage condition (powered-down) and with the DC link discharged. After transportation, the screws must be tightened.

For lines without regenerative feedback capability (e.g. a diesel generator), the regenerative feedback capability of the Smart Line Module must be deactivated by means of a jumper between terminals X22.1 and X22.2. The braking energy must then be dissipated via an additional Braking Module with braking resistor provided in the drive line-up.

CAUTION

The overall length of the power cables (motor supply cables and DC-link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION
DC-link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

NOTICE
Operation without the line reactor is not permissible.

Note

Fan operation

With 5 kW and 10 kW Smart Line Modules, the fan runs permanently.

The fans for the 16 kW and 36 kW Smart Line Modules are switched on and off in accordance with the heat-sink temperature.

The fans start up at the heat-sink temperature specified in the power stack data (normally 56 °C) and are switched off with a slight hysteresis when the heat-sink temperature decreases again. The length of time it takes for the fans to stop once they have been switched off depends on a number of factors (ambient temperature, output current, duty cycle, etc.) and, therefore, cannot be determined directly.

The fans are not equipped with temperature-dependent speed control; only the states "on" or "off" exist.

3.7.3 Interface description

3.7.3.1 Overview

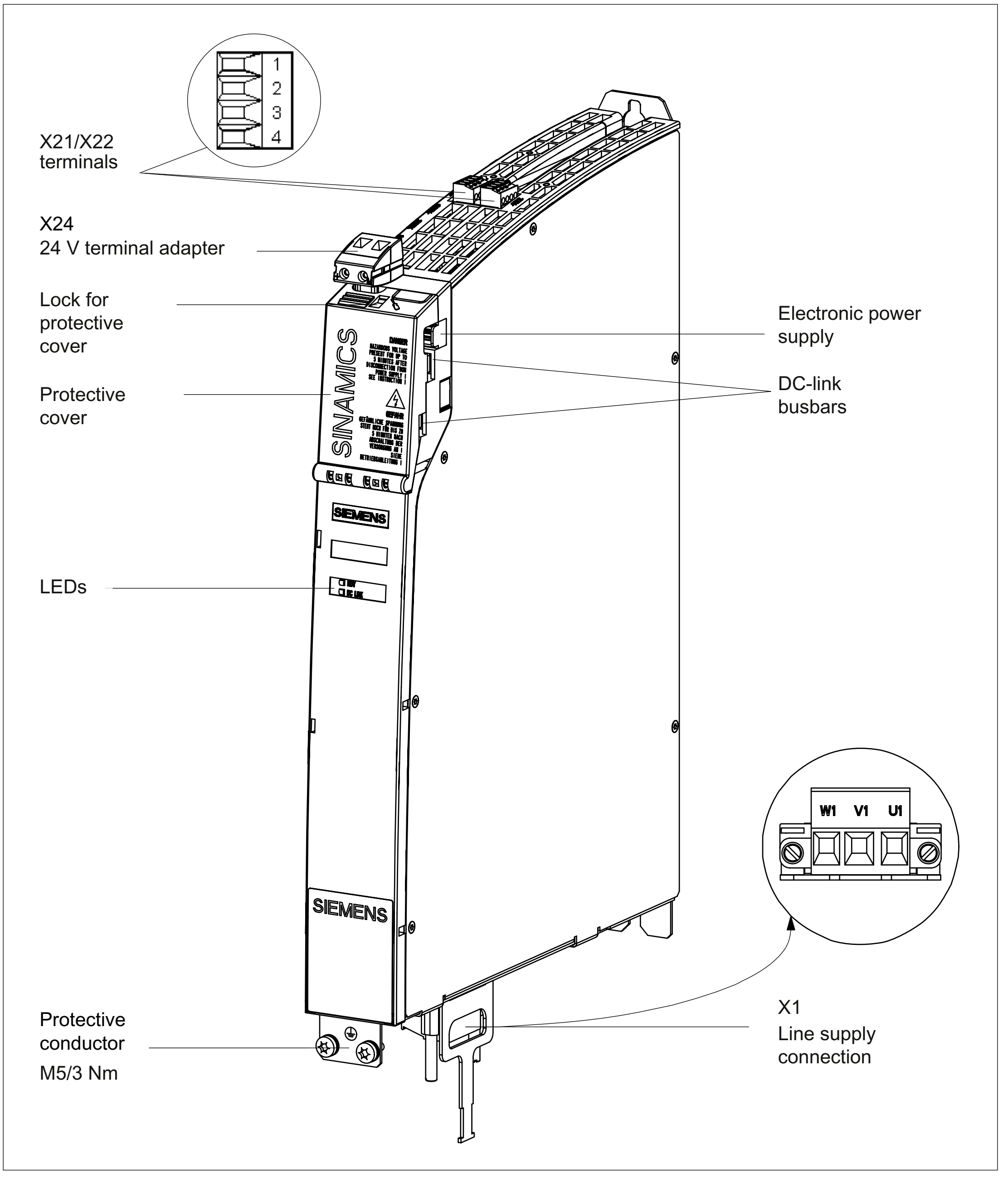


Figure 3-90 Smart Line Modules 5 kW and 10 kW with internal air cooling (example 5 kW)

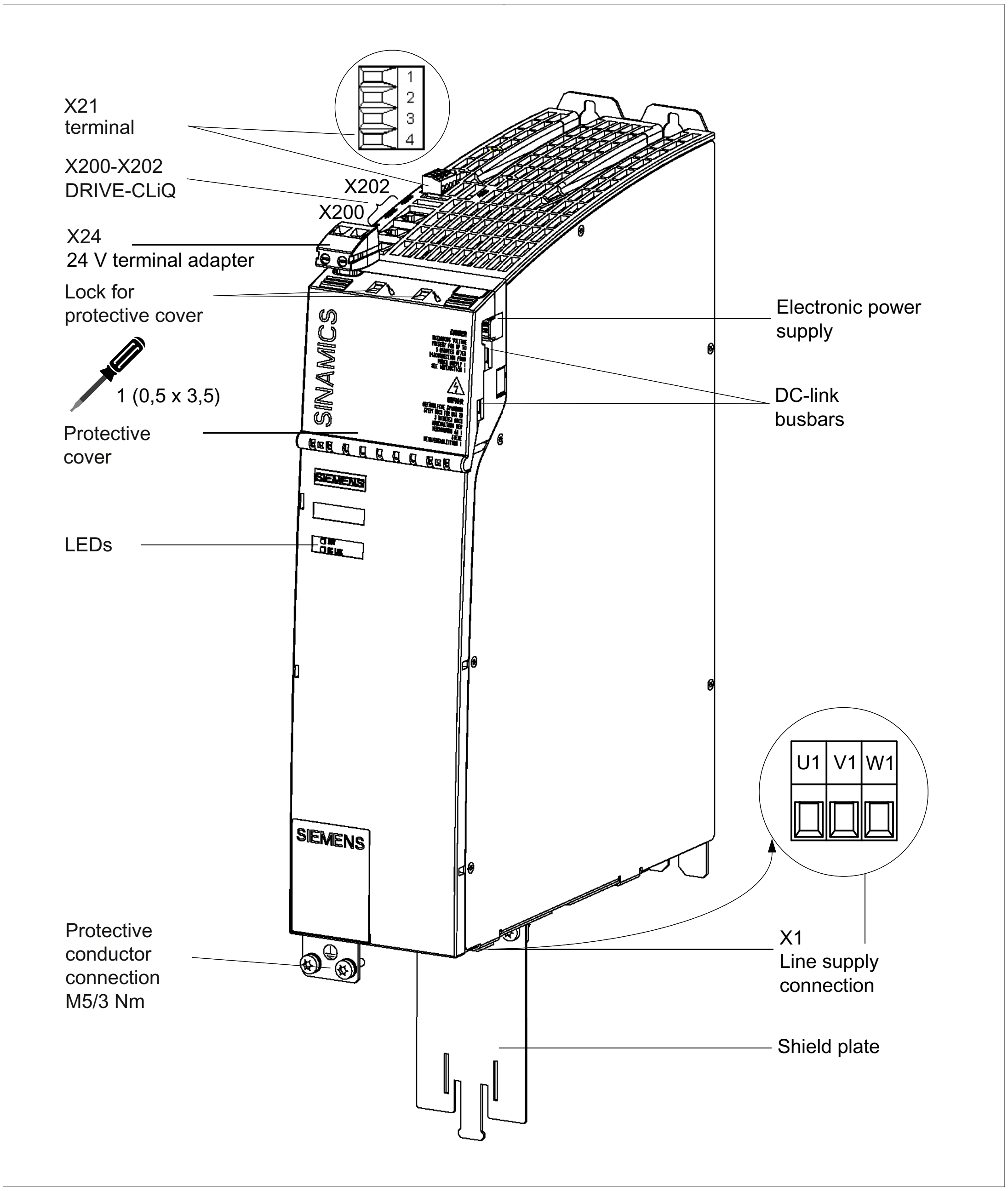


Figure 3-91 Smart Line Module with internal air cooling (16 kW)

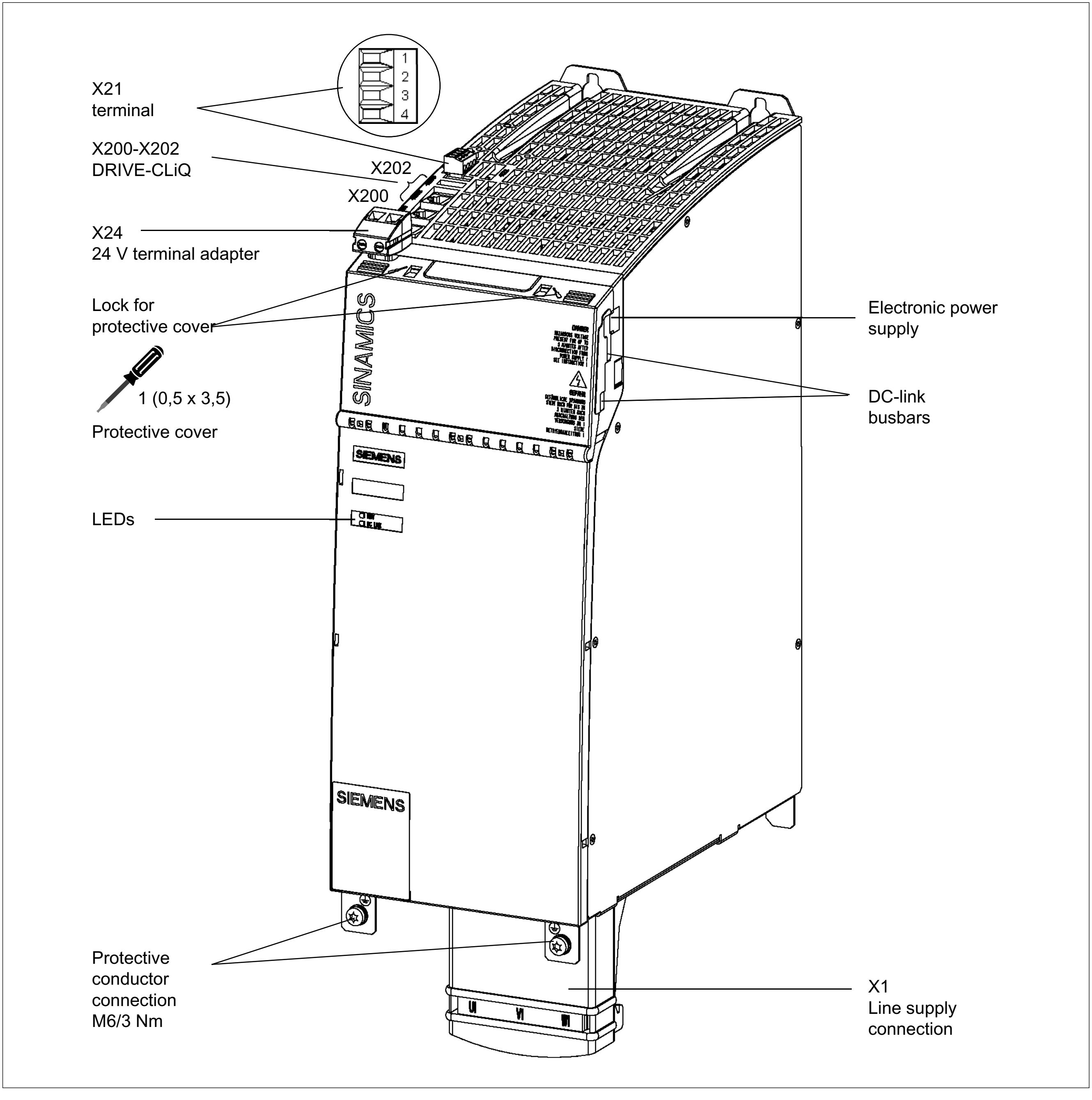
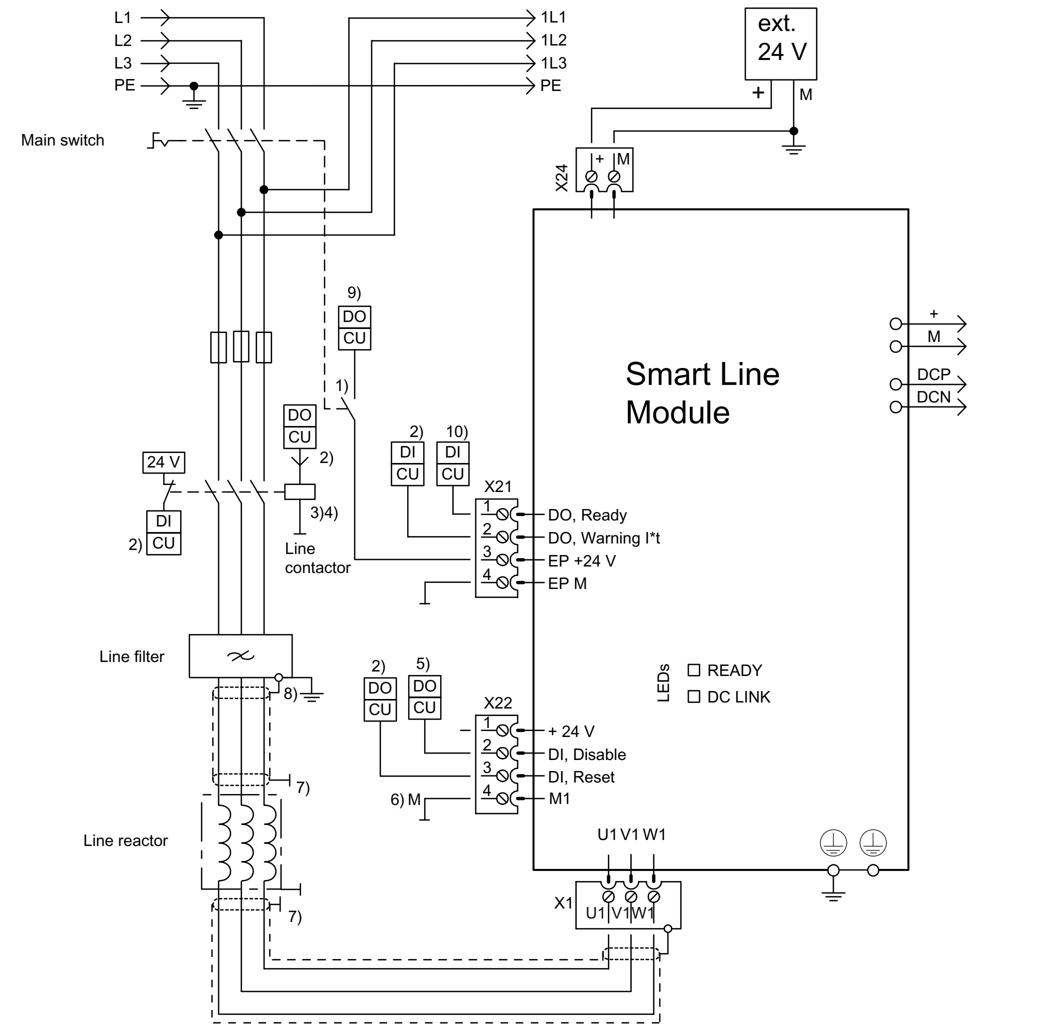


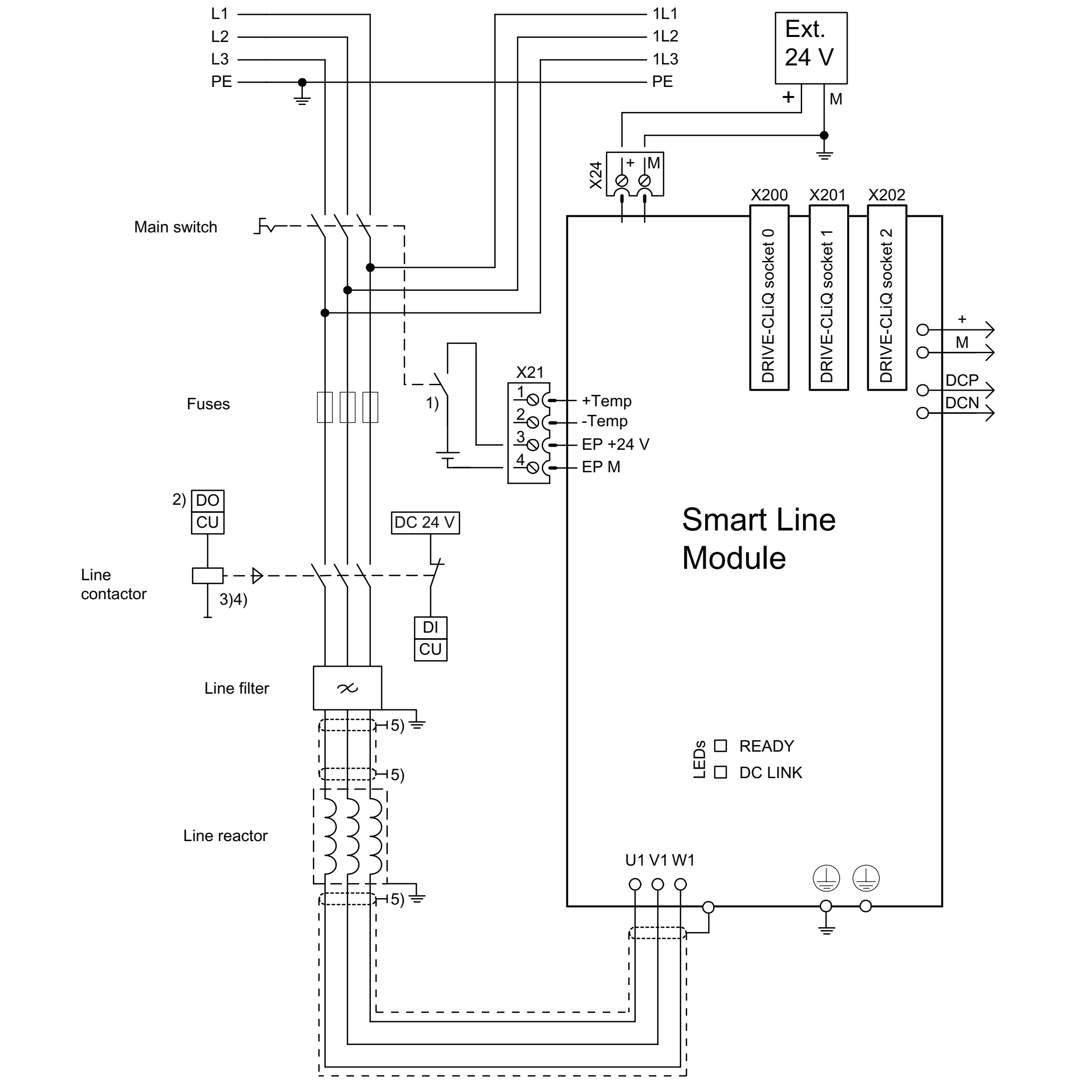
Figure 3-92 Smart Line Module with internal air cooling (36 kW)

3.7.3.2 Connection examples



1) Leading opening contact t >10 ms; 24 VDC and ground must be connected for operation.
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) DO high, feedback deactivated (for permanent deactivation, a jumper can be installed between X22 pins 1 and 2)
6) X22 pin 4 must be connected to ground (ext. 24 V).
7) Contact through the rear of the mounting surface or shielding buses in accordance with the EMC Directive
8) 5 kW and 10 kW line filter via shield connection
9) Signal output of the control system to prevent a disturbance at the EP terminal in terms of the 24 VDC supply
10) Connected via BICO technology to parameter p0864

Figure 3-93 Connection example for 5 kW and 10 kW Smart Line Modules



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 coupling device must be used if required.
5) Contact through the rear of the mounting surface or shielding buses in accordance with the EMC Directive

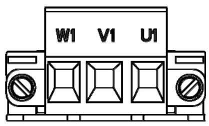
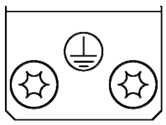
Figure 3-94 Connection example for 16 kW and 36 kW Smart Line Modules

Note

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

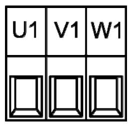
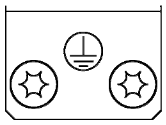
3.7.3.3 X1 line connection

Table 3- 65 Terminal strip X1 of Smart Line Modules 5 kW and 10 kW

	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see chapter Connection methods) Tightening torque: 1.2 - 1.5 Nm
	PE connection	Threaded hole M5/3 Nm [1]

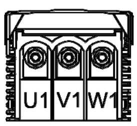
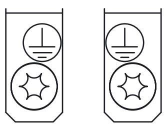
1) For ring cable lugs in accordance with DIN 46234

Table 3- 66 Terminal strip X1 Smart Line Module 16 kW

	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 10 mm^2 Type: Screw terminal 6 (see chapter Connection methods) Tightening torque: 1.5 - 1.8 Nm
	PE connection	Threaded hole M5/3 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

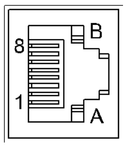
Table 3- 67 Terminal strip Smart Line Module 36 kW

	Terminals	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Threaded bolt M6/6 Nm [1)] (see chapter Connection system)
	PE connection	Threaded hole M6/6 Nm [1)]

1) For ring cable lugs in accordance with DIN 46234

3.7.3.4 X200-X202 DRIVE-CLiQ interfaces

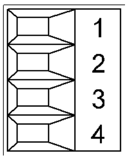
Table 3- 68 DRIVE-CLiQ interface X200-X202 for 16 kW and 36 kW Smart Line Modules

	PIN	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 V power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces included in the scope of delivery; blanking plate (50 pieces) Order number: 6SL3066-4CA00-0AA0			

3.7.3.5 X21 EP terminals

Smart Line Modules 5 kW and 10 kW

Table 3- 69 Terminal strip X21 for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation	Technical specifications
	1	DO: Ready	Checkback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: • 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 • 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 (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see chapter Connection methods)			

WARNING

For operation, 24 VDC must be connected to terminal 3 and ground to terminal 4. Upon removal, pulse suppression is activated. Feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

CAUTION

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. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21, pin 1. (see the "Safety information" chapter).

NOTICE

Output terminal X21, pin 1 must be wired to a digital input on the CU. The drives supplied with power by the Smart Line Module have to use this signal as a "Ready" message (BI: p0864 = digital input). 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. The control system cannot set the drives to ready until the infeed "Ready" signal is present.

NOTICE

The "Prewarning" signal at output terminal X21, pin 2 of Smart Line Modules 5 kW and 10 kW 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 changes to "low", the drive pulses must be suppressed within 4 ms.

NOTICE

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals 3 (EP +24 V) and 4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

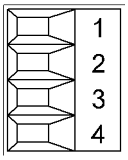
This protects external loads located parallel to the drive on the same switching component.

Note

The Smart Line Module signals that it is ready, even if one of the line conductors is not available. In this case, the feedback is deactivated and an alarm is output at X21/2 (DO, Warning I*t). If the feedback was deactivated by applying a "high" signal to terminal X22/2 (DI, Disable), no alarm will be output at X21/2 (DO, Warning I*t).

Smart Line Modules 16 kW and 36 kW

Table 3- 70 Terminal strip X21 (EP terminals) for Smart Line Modules 16 kW and 36 kW

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors[1]: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Voltage: 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs
	4	EP M (Enable Pulses)	
Max. connectable cross-section 1.5 mm^2 Type: Screw terminal 1 (see chapter Connection methods)			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual LH1).
Temperatures are detected but not evaluated in the Smart Line Module.

WARNING

For operation, 24 VDC must be connected to terminal 3 and ground to terminal 4. Upon removal, pulse suppression is activated. Feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

NOTICE

The KTY temperature sensor must be connected with the correct polarity.

NOTICE

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals 3 (EP +24 V) and 4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

This protects external loads located parallel to the drive on the same switching component.

DANGER

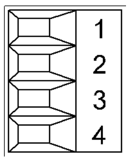
Risk of electric shock!

Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), a Sensor Module External (SME120 or SME125) or Terminal Module TM120 must be used.

If these instructions are not complied with, there is a risk of electric shock!

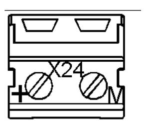
3.7.3.6 X22 terminals

Table 3- 71 Terminal strip X22 for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation	Technical specifications
	1	24 V power supply	Electronics power supply for controlling digital inputs X22.2 and 3.
	2	DI: Disable Regeneration	Deactivate 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
Max. connectable cross-section: 1.5 mm² Type: Screw terminal 1 (see chapter Connection methods)			

3.7.3.7 X24 24 V terminal adapter

Table 3- 72 Terminal block X24

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronic ground
The 24 V terminal adapter is supplied as standard Max. connectable cross-section: 6 mm² Type: Screw terminal 5 (see Connection Methods)			

3.7.3.8 Description of the LEDs on the Smart Line Module

Smart Line Modules 5 kW and 10 kW

Table 3- 73 5 kW and 10 kW Smart Line Modules – description of the LEDs

LED	Color	State	Description, cause	Remedy
READY	–	OFF	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Continuous	Component is ready to operate.	–
	Yellow	Continuous	Pre-charging not yet complete. bypass relay dropped out EP terminals not supplied with 24 VDC.	–
	Red	Continuous	Overtemperature Overcurrent switch-off	Diagnostics fault (via output terminals) and acknowledge it (via input terminal)
DC LINK	–	OFF	Electronics power supply is missing or outside permissible tolerance range.	–
	Yellow	Continuous	DC-link voltage within permissible tolerance range.	–
	Red	Continuous	DC-link voltage outside permissible tolerance range. Line supply fault.	Check the line voltage.

DANGER

Hazardous DC-link voltages may be present at any time regardless of the state of the "DC link" LED.
The warning information on the components must be carefully observed!

Smart Line Modules 16 kW and 36 kW

Table 3- 74 Smart Line Module ≥ 16 kW - description of the LEDs

State		Description, cause	Remedy
Ready (H200)	DC link (H201)		
OFF	OFF	Electronics power supply is missing or outside permissible tolerance range.	–
Green	OFF	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC-link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC-link voltage is too high.	Check the line voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/Red (0.5 Hz)	–	Firmware is being downloaded.	–
Green/Red (2 Hz)	-	Firmware download is complete. Waiting for POWER ON.	Carry out a POWER ON
Green/Orange or Red/Orange	–	Component detection via LED is activated (p0124). **Note:** Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

DANGER

Hazardous DC-link voltages may be present at any time regardless of the state of the "DC link" LED.
The warning information on the components must be carefully observed!

3.7.4 Dimension drawings

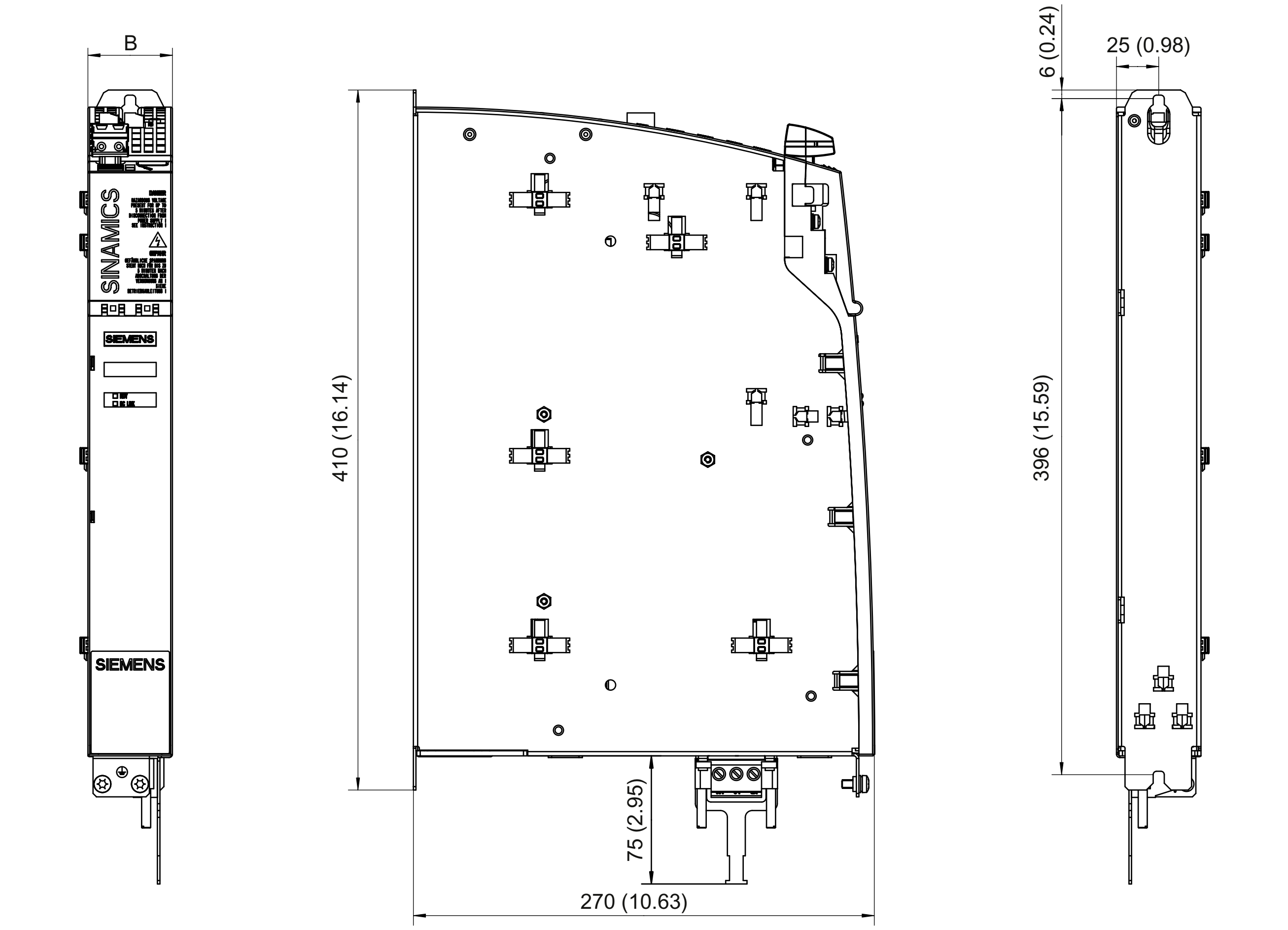


Figure 3-95 Dimension drawing of Smart Line Module with internal air cooling (5 kW and 10 kW), all dimensions in mm and (inches)

Table 3- 75 Dimensions of 5 kW and 10 kW Smart Line Modules with internal air cooling

Line module type	Order number	W [mm] (inches)
5 kW	6SL3130-6AE15-0AAx	50 (1.97)
10 kW	6SL3130-6AE21-0AAx	50 (1.97)

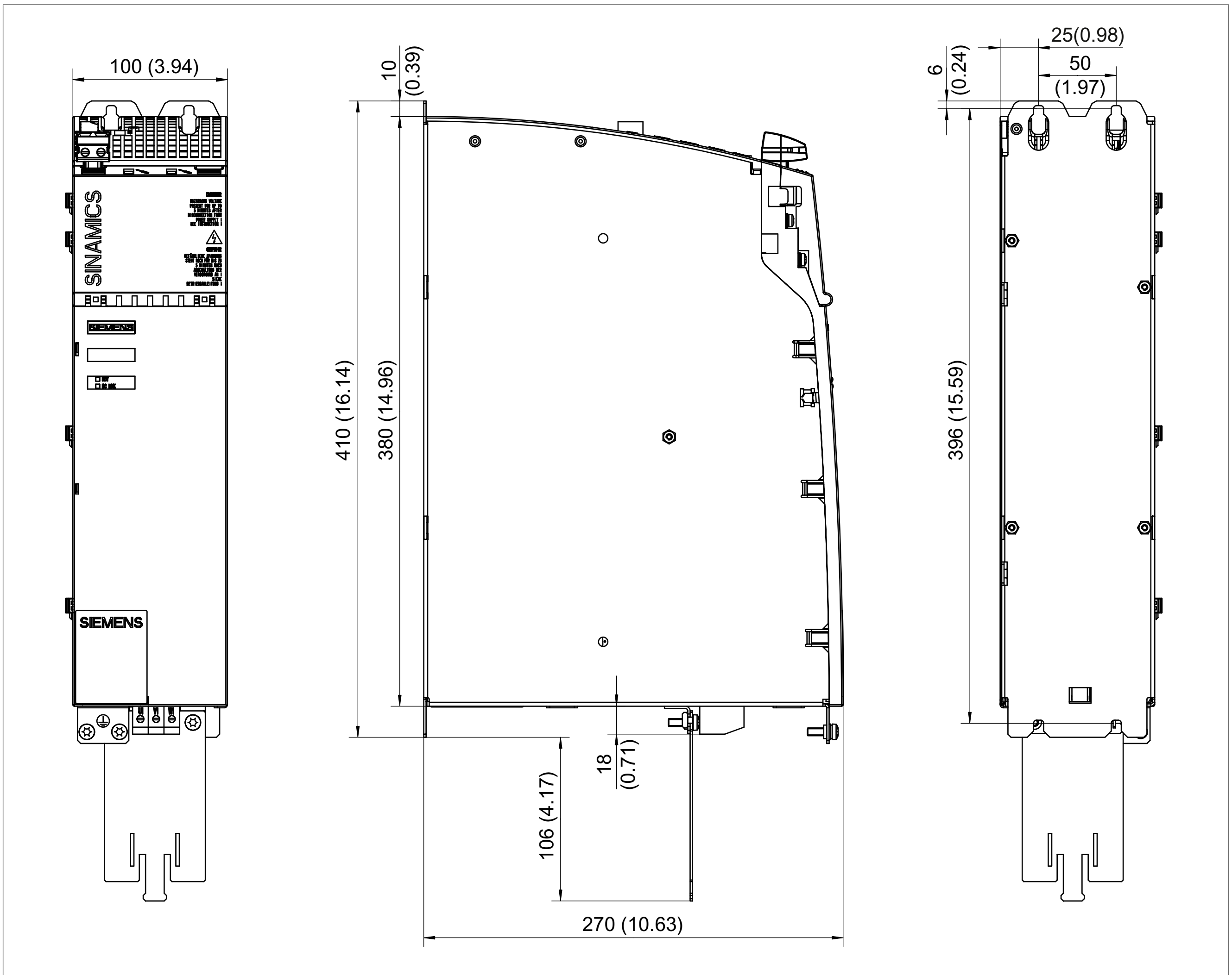


Figure 3-96 Dimension drawing of Smart Line Module with internal air cooling (16 kW), all dimensions in mm and (inches)

Note

The shield connecting plate is included in the scope of delivery of the 50 mm and 100 mm Smart Line Modules.

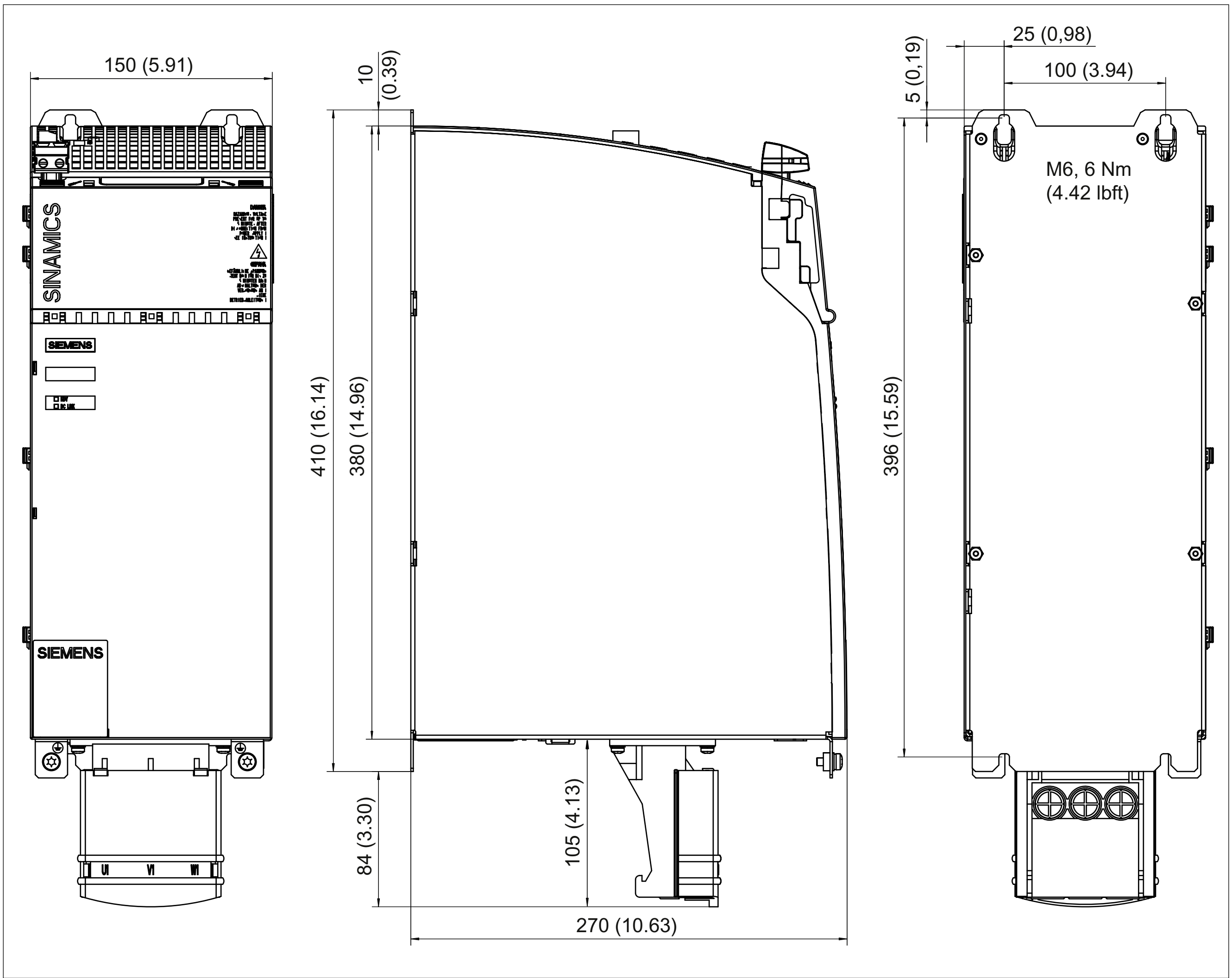


Figure 3-97 Dimension drawing of Smart Line Module with internal air cooling (36 kW), all dimensions in mm and (inches)

3.7.5 Technical data

Table 3- 76 Technical data for Smart Line Modules with internal air cooling

Internal air cooling	6SL3130–	6AE15–0ABx	6AE21–0ABx	6TE21-6Axx	6TE23-6Axx
Rated power	kW	5	10	16	36
Infeed Rated power (S1) 1) Infeed power (S6-40%)1) Peak infeed power 1)	 kW (Pn) kW (Ps6) kW (Pmax)	 5 6.5 10	 10 13 20	 16 21 35	 36 47 70
Regenerative feedback Continuous regenerative power Peak regenerative power	 kW kW	 5 10	 10 20	 16 35	 36 70
Supply voltages Rated voltage Line frequency Electronics power supply	 V_{AC} Hz V_{DC}	 3 AC 380 -10 % (-15 % < 1 min) to 3 AC 480 +10 % 47 to 63 24 (20.4 - 28.8)			
DC link voltage Overvoltage trip Undervoltage trip 2)	V_{DC} V_{DC} V_{DC}	510 – 720 820 ± 2 % 360 ± 2 %			
Input currents Rated input current at 400 V_{AC}: Input current at 380 V_{AC} / 480 V_{AC} at 400 V_{AC}; S6-40% at 400 V_{AC}; peak current	 A_{AC} A_{AC} A_{AC} A_{AC}	 8.1 8.6 / 6.7 10.6 15.7	 16.2 17 / 12.8 21.1 31.2	 27.5 29 / 24.5 35 57.5	 59 62 / 51 76 112
DC link currents Rated DC link current at 600 V: DC link current at 540 V: at 600 V_{DC}; S6-40% at 600 V_{DC}; peak current	 A_{DC} A_{DC} A_{DC} A_{DC}	 8.3 9.3 11 16.6	 16.6 18.5 22 33.2	 27 30 35 59	 60 67 79 118
Current carrying capacity DC link busbar Reinforced DC link busbars: 24 V busbar:	 A_{DC} A_{DC} A_{DC}	 100 150 20	 100 150 20	 100 150 20	 100 / 200 5) -- 20
Electronics current consumption at 24 V DC	A_{DC}	0.8	0.9	0.95	1.5
Total power loss (including electronics losses) 3)	W	79.2	141.6	187.8	406
Max. ambient temperature Without derating With derating	 °C °C	 40 55			
DC link capacitance Smart Line Module Drive line-up, max.	 µF µF	 220 6000	 330 6000	 705 20 000	 1410 20 000
Power factor	cos ϕ	0.98			

Internal air cooling	6SL3130–	6AE15–0ABx	6AE21–0ABx	6TE21-6Axx	6TE23-6Axx
Rated power	kW	5	10	16	36
Circuit breaker (UL) Type designation Rated current: Resulting rated short-circuit current [6] SCCR at 480 V_{AC}:	 A kA	 3VL1102-2KM30 20 65	 3VL1135-2KM30 35 65	 3VL1135-2KM30 35 65	 3VL2108-2KN30 80 65
Safety fuse (UL) Type AJT Class J [4] Rated current Resulting rated short-circuit [6] current SCCR at 480 V_{AC}:	 A kA	 AJT17-1/2 17.5 65	 AJT35 35 65	 AJT35 35 65	 AJT80 80 65
Cooling method (internal air cooling)		Internal fan			
Sound pressure level	dB(A)	<60	<60	<60	<65
Cooling air requirement	m^3/h	29.6	29.6	56	112
Rated voltage for rated data 3 AC 380 V					
Weight	kg	4.7	4.8	7	10

1) The powers specified apply to the rated voltage range from 380 V to 480 V.
2) For 16 kW and 36 kW Smart Line Modules: Default for 400 V supply systems; undervoltage trip threshold is adjusted to the parameterized rated voltage.
3) For an overview, see the power loss tables in chapter Control cabinet installation
4) Source of supply: Ferraz Shawmut, http://de.ferrazshawmut.com
5) For components where the final digit in the order number is ≥ 3.
6) 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.

3.7.5.1 Characteristics

Rated duty cycles of Smart Line Modules

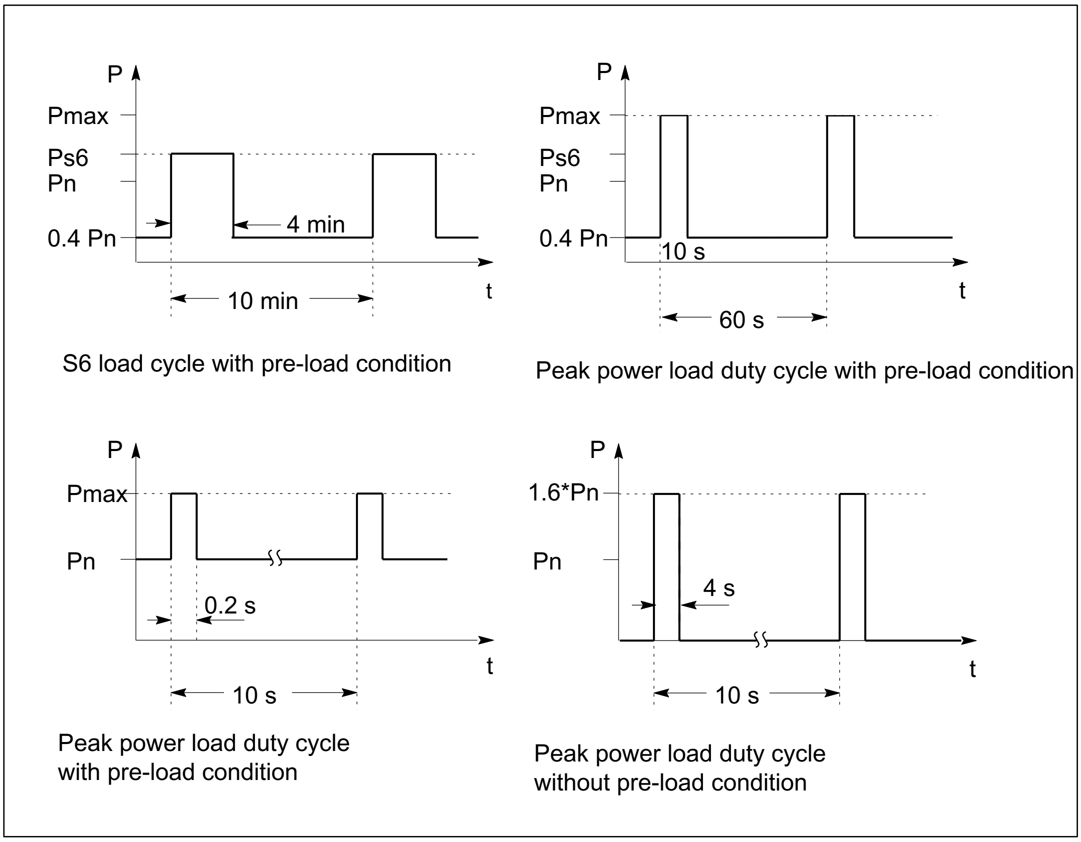


Figure 3-98 Rated duty cycles of Smart Line Modules

Derating characteristics

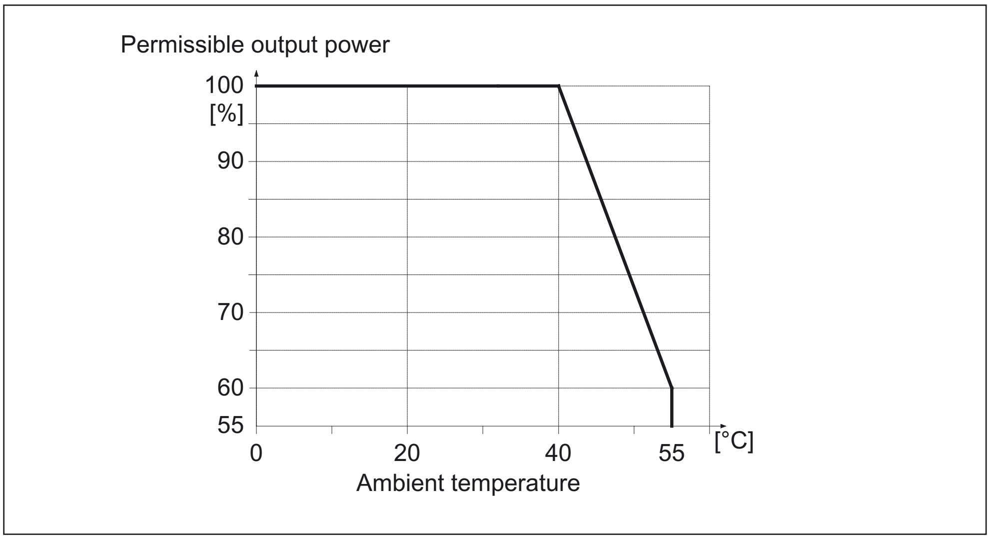


Figure 3-99 Output power as a function of the ambient temperature

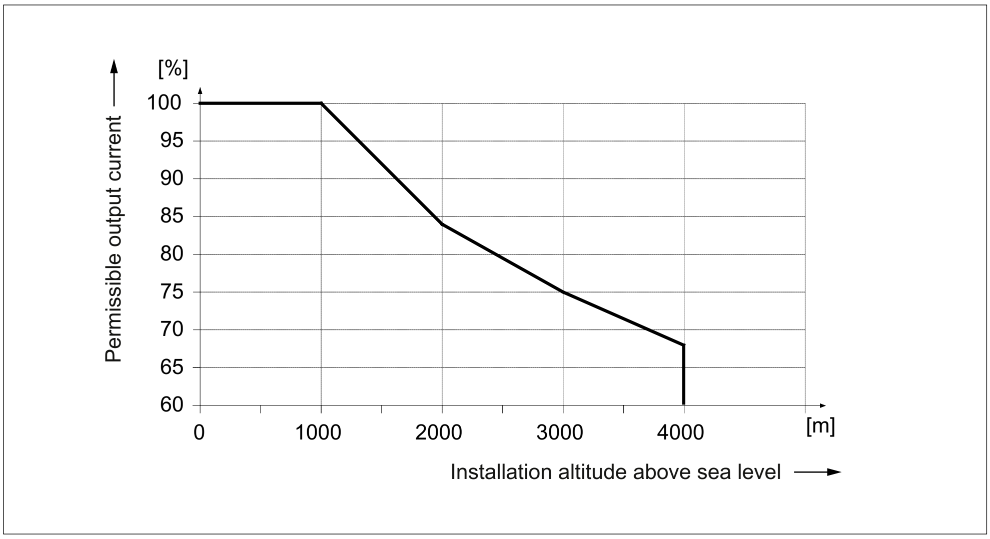


Figure 3-100 Output current as a function of the installation altitude

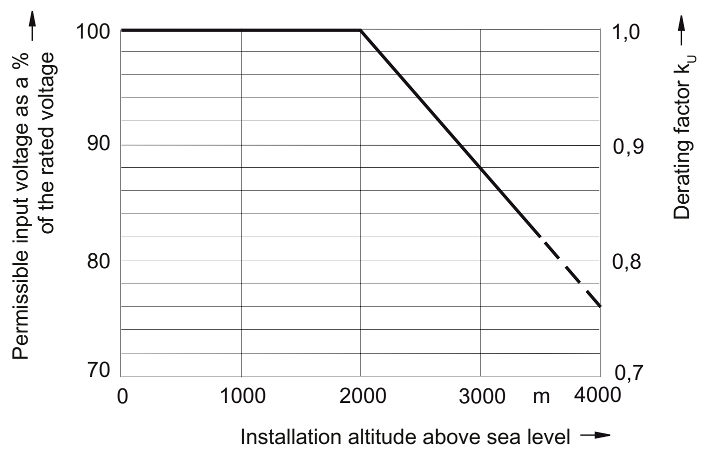


Figure 3-101 Voltage derating as a function of the installation altitude

3.8 Smart Line Modules with external air cooling

3.8.1 Description

The Smart Line Module is an unregulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module(s) with an unregulated 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 supply voltage is applied and is independent of its phase sequence direction. Load can be applied to the DC link after the modules have been enabled. An optional main contactor is required for disconnecting the voltage.

Smart Line Modules are suitable for direct operation in 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 for SINAMICS power units that is only available for booksize devices. 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.

3.8.2 Safety information

DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must no longer be used to avoid secondary damage or accidents.

DANGER

DC-link discharge time

A DC-link discharge time danger notice in the relevant national language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 70 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

DANGER

If the Line Module is not disconnected from the supply system (e.g. via the line contactor or main switch), the DC link remains charged.

CAUTION

The 80 mm clearances above and below the components must be observed.

CAUTION
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. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21, pin 1. Switch on: • 24 VDC power supply X24 ON • Line contactor ON • EP signal X21 pins 3 and 4 ON • Wait until precharging is complete • "Ready" signal at terminal X21 pin 1 set 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 pins 3 and 4 OFF • Line contactor OFF • 24 VDC power supply X24 OFF Overload: • "Prewarning" signal at terminal X21 pin 2 set to "low" • Shut drives down via the control system • "Ready" signal at terminal X21 pin 1 set to "low" • Pulse inhibit for all the drives supplied by this infeed within 4 ms

CAUTION
The tightening torque of the DC-link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning with the complete system in a no-voltage condition (powered-down) and with the DC link discharged. After transportation, the screws must be tightened. For lines without regenerative feedback capability (e.g. a diesel generator), the regenerative feedback capability of the Smart Line Module must be deactivated by means of a jumper between terminals X22.1 and X22.2. The braking energy must then be dissipated via an additional Braking Module with braking resistor provided in the drive line-up.

CAUTION
The overall length of the power cables (motor supply cables and DC-link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION
DC-link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

NOTICE
Operation without the line reactor is not permissible.

NOTICE
The external air cooling can cause the fans and the heat sink to become heavily contaminated, which may trigger the temperature monitor in the power unit. The fans and heat sink must be checked for contamination at regular intervals and, if necessary, cleaned.

Note

Fan operation

With 5 kW and 10 kW Smart Line Modules, the fan runs permanently.

The fans for the 16 kW and 36 kW Smart Line Modules are switched on and off in accordance with the heat-sink temperature.

The fans start up at the heat-sink temperature specified in the power stack data (normally 56 °C) and are switched off with a slight hysteresis when the heat-sink temperature decreases again. The length of time it takes for the fans to stop once they have been switched off depends on a number of factors (ambient temperature, output current, duty cycle, etc.) and, therefore, cannot be determined directly.

The fans are not equipped with temperature-dependent speed control; only the states "on" or "off" exist.

Note

After installation, the seal on the rear of the device must be checked to ensure that it is tight. Additional sealing can be used, if necessary.

Note

The mounting frames can only be used if the cabinet has an unpainted metal surface.

Note

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, authorization is required in advance from the local power supply company (utility company) if

- the rated current of the machine ≤ 16 A per conductor, and
- the rated machine current does not comply with the requirements specified in EN 61000-3-2 regarding current harmonics.

3.8.3 Interface description

3.8.3.1 Overview

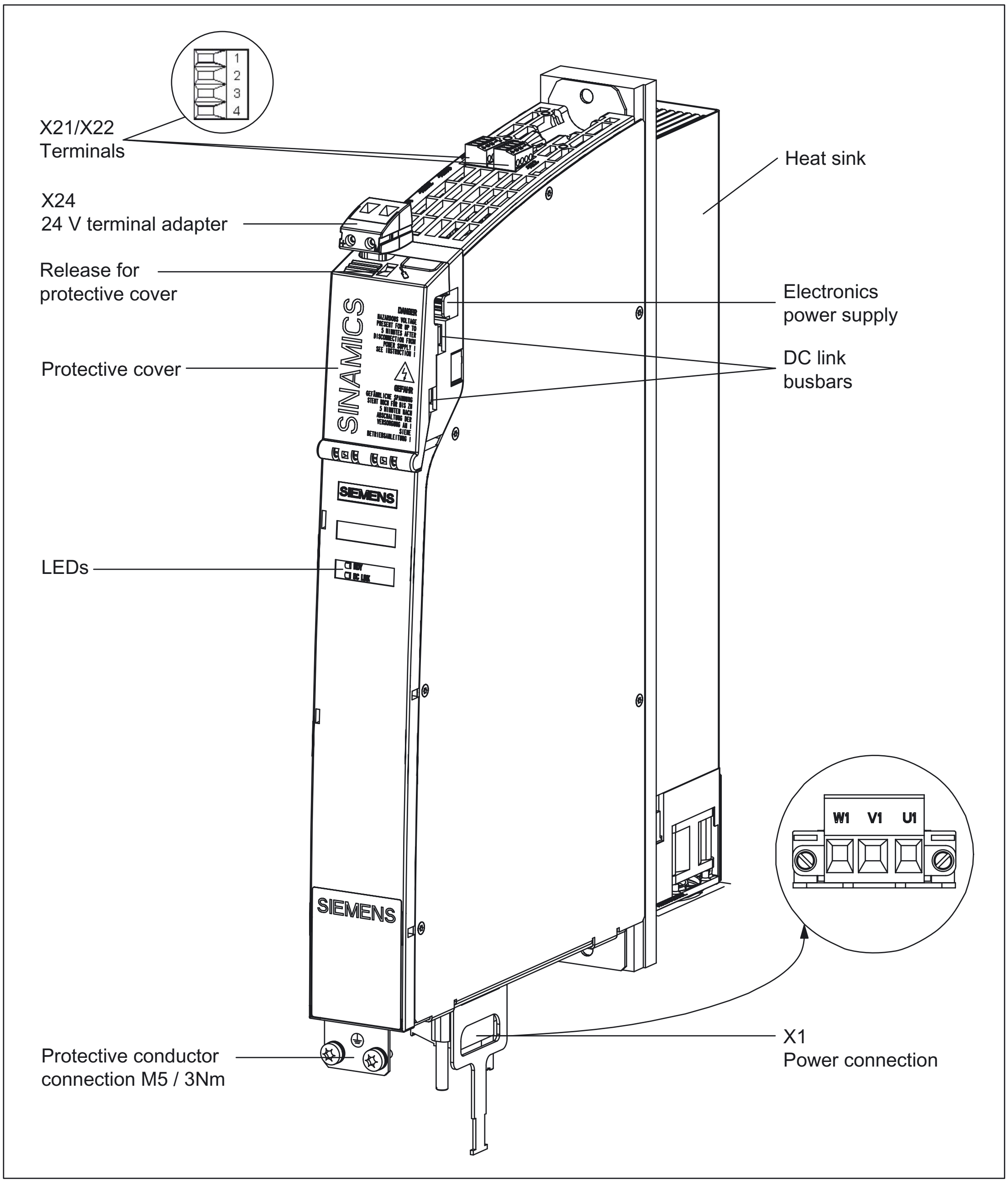
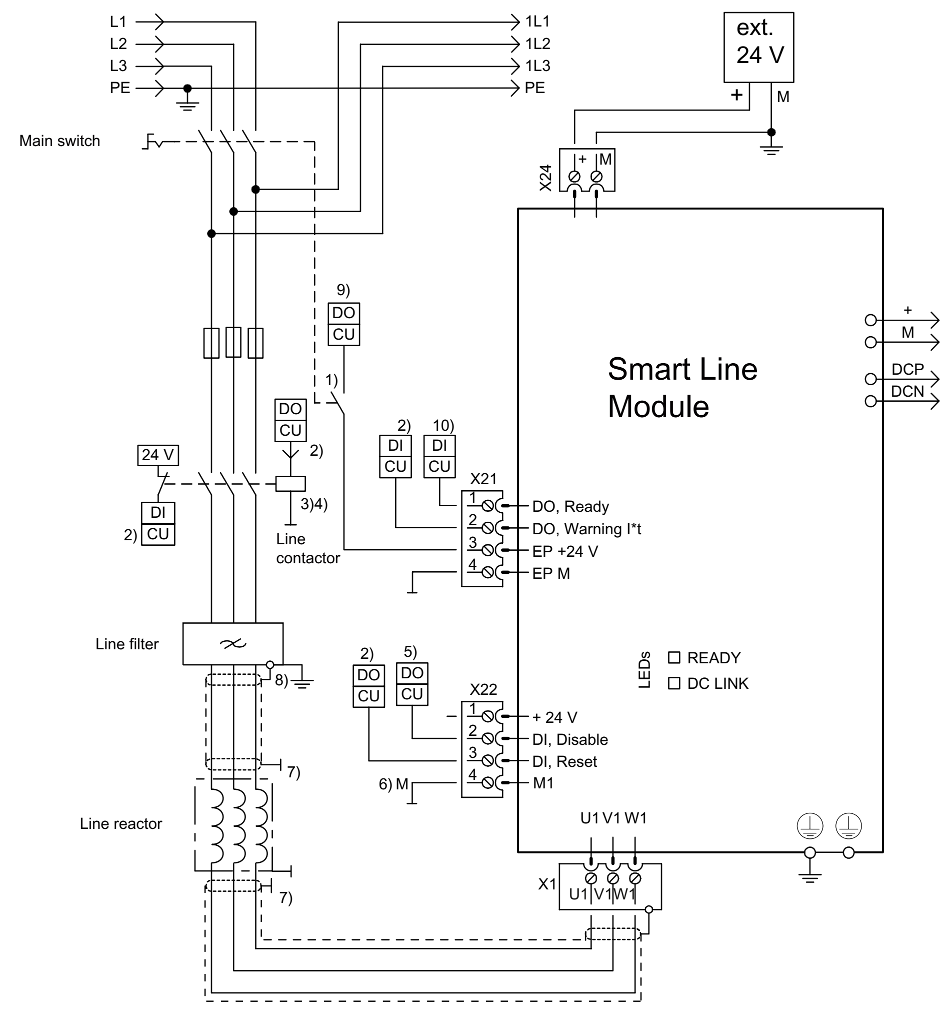


Figure 3-102 Smart Line Module with external air cooling (example 5 kW)

3.8.3.2 Connection example



1) Leading opening contact t >10 ms; 24 VDC and ground must be connected for operation.
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) DO high, feedback deactivated (for permanent deactivation, a jumper can be installed between X22 pins 1 and 2)
6) X22 pin 4 must be connected to ground (ext. 24 V).
7) Contact through the rear of the mounting surface or shielding buses in accordance with the EMC Directive
8) 5 kW and 10 kW line filter via shield connection
9) Signal output of the control system to prevent a disturbance at the EP terminal in terms of the 24 VDC supply
10) Connected via BICO technology to parameter p0864

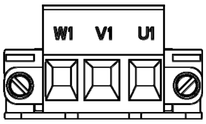
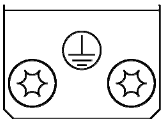
Figure 3-103 Connection example for 5 kW and 10 kW Smart Line Modules

Note

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

3.8.3.3 X1 line connection

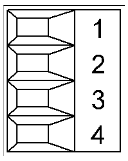
Table 3- 77 Terminal strip X1 of Smart Line Modules 5 kW and 10 kW

	Terminal	Technical specifications
	U1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 6 mm² Type: Screw terminal 5 (see chapter Connection methods) Tightening torque: 1.2 - 1.5 Nm
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

3.8.3.4 X21 terminals

Table 3- 78 Terminal strip X21

	Terminal	Designation	Technical specifications
	1	DO: Ready	Checkback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: • 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 • 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 (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm² Type: Screw terminal 1 (see chapter Connection methods)			

CAUTION
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. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21, pin 1. (see the "Safety information" chapter).

NOTICE
Output terminal X21, pin 1 must be wired to a digital input on the CU. The drives supplied with power by the Smart Line Module have to use this signal as a "Ready" message (BI: p0864 = digital input). 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. The control system cannot set the drives to ready until the infeed "Ready" signal is present.

Note

The "Prewarning" signal at output terminal X21, pin 2 of Smart Line Modules 5 kW and 10 kW 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 changes to "low", the drive pulses must be suppressed within 4 ms.

Note

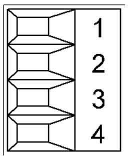
The Smart Line Module signals that it is ready, even if one of the line conductors is not available. In this case, the feedback is deactivated and an alarm is output at X21/2 (DO, Warning I*t). If the feedback was deactivated by applying a "high" signal to terminal X22/2 (DI, Disable), no alarm will be output at X21/2 (DO, Warning I*t).

WARNING
For operation, 24 VDC must be connected to terminal 3 and ground to terminal 4. Upon removal, pulse suppression is activated. Feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

NOTICE
If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals 3 (EP +24 V) and 4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example. This protects external loads located parallel to the drive on the same switching component.

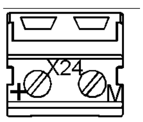
3.8.3.5 X22 terminals

Table 3- 79 Terminal strip X22 for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation	Technical specifications
	1	24 V power supply	Electronics power supply for controlling digital inputs X22.2 and 3.
	2	DI: Disable Regeneration	Deactivate 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
Max. connectable cross-section: 1.5 mm² Type: Screw terminal 1 (see chapter Connection methods)			

3.8.3.6 X24 24 V terminal adapter

Table 3- 80 Terminal block X24

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronic ground
The 24 V terminal adapter is supplied as standard Max. connectable cross-section: 6 mm² Type: Screw terminal 5 (see Connection Methods)			

3.8.3.7 Description of the LEDs on the Smart Line Module

Table 3- 81 5 kW and 10 kW Smart Line Modules – description of the LEDs

LED	Color	State	Description, cause	Remedy
READY	–	OFF	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Continuous	Component is ready to operate.	–
	Yellow	Continuous	Pre-charging not yet complete. bypass relay dropped out EP terminals not supplied with 24 VDC.	–
	Red	Continuous	Overtemperature Overcurrent switch-off	Diagnostics fault (via output terminals) and acknowledge it (via input terminal)
DC LINK	–	OFF	Electronics power supply is missing or outside permissible tolerance range.	–
	Yellow	Continuous	DC-link voltage within permissible tolerance range.	–
	Red	Continuous	DC-link voltage outside permissible tolerance range. Line supply fault.	Check the line voltage.

DANGER

Hazardous DC-link voltages may be present at any time regardless of the state of the "DC link" LED.
The warning information on the components must be carefully observed!

3.8.4 Dimension drawing

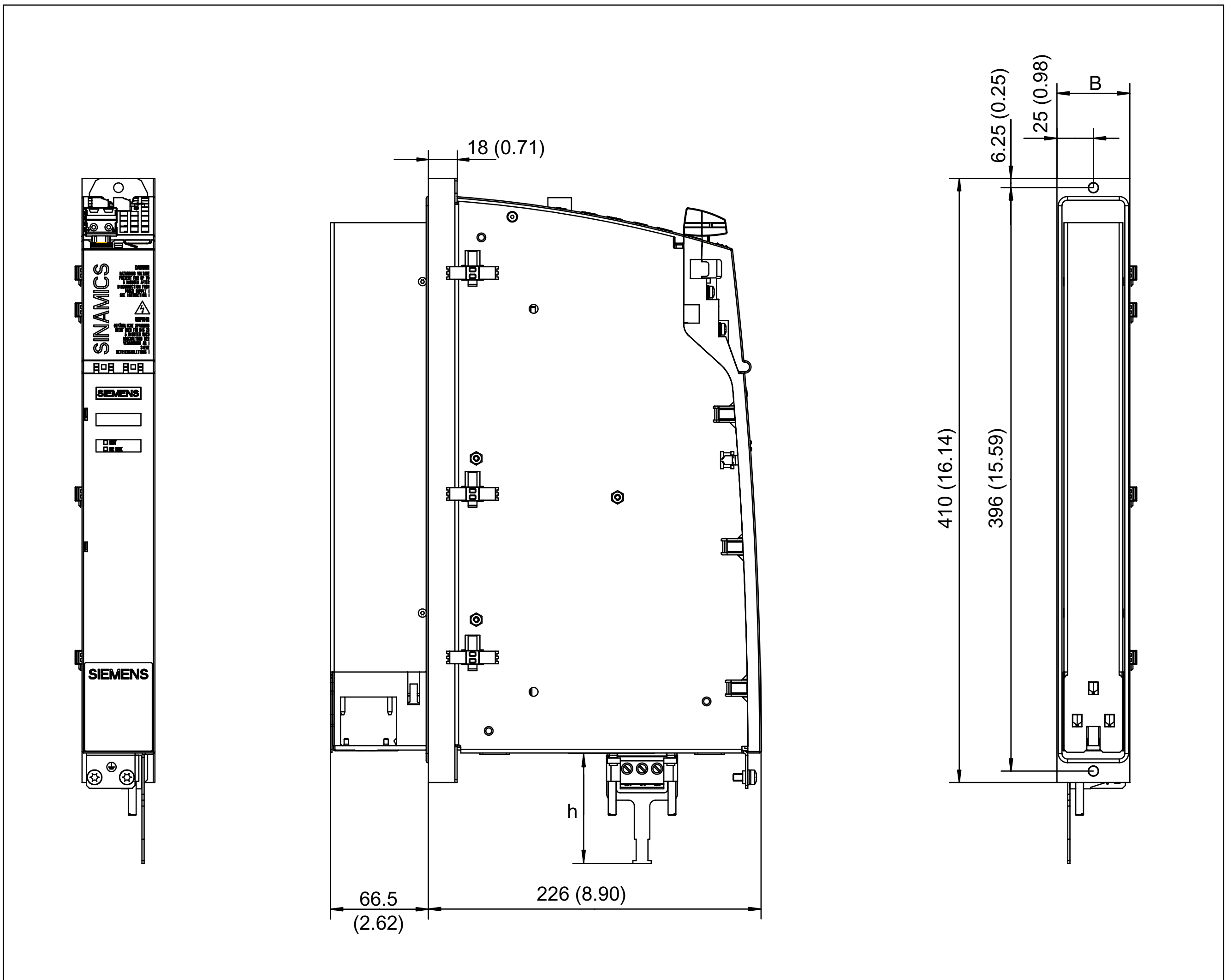


Figure 3-104 Dimension drawing of Smart Line Modules 5 kW and 10 kW with external air cooling, all data in mm and (inches)

Table 3- 82 Dimensions of Smart Line Module (5 kW and 10 kW) with external air cooling

Line module type	Order number	W [mm] (inches)	h [mm] (inches)
5 kW	6SL3131-6AE15-0AAx	50 (1.97)	75 (2.95)
10 kW	6SL3131-6AE21-0AAx	50 (1.97)	75 (2.95)

Note

The shield connecting plate is part of the scope of supply of the 50 mm Smart Line Module.

3.8.5 Installation

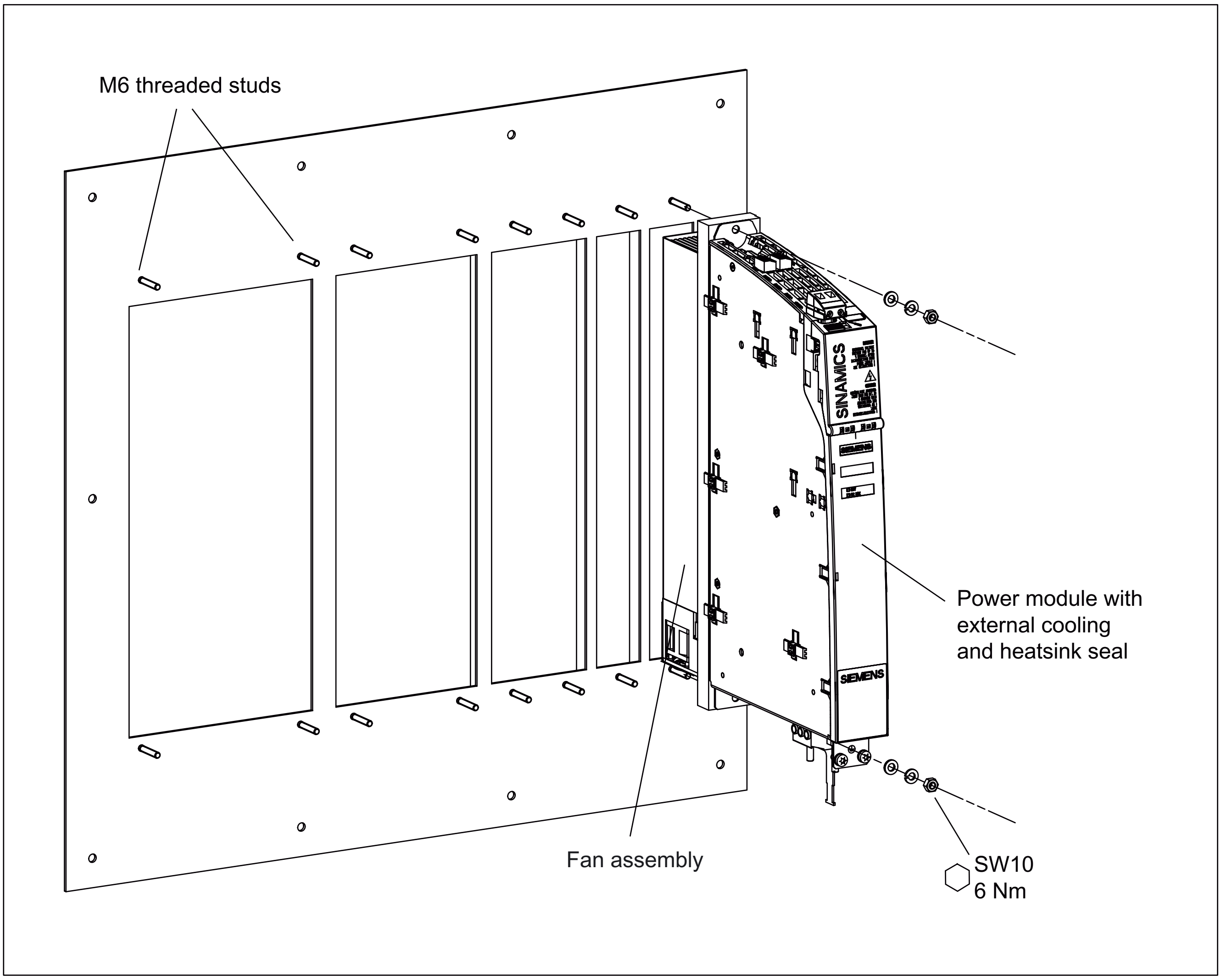


Figure 3-105 Example: Installation of the Power Module with external air cooling

Help with the mechanical control cabinet installation is available from:

Siemens AG
Industry Sector, IA SE WKC
TCCCC (Technical Competence Center Cabinets Chemnitz)
P.O. Box 1124
09070 Chemnitz, Germany

E-mail: cc.cabinetcooling.aud@siemens.com

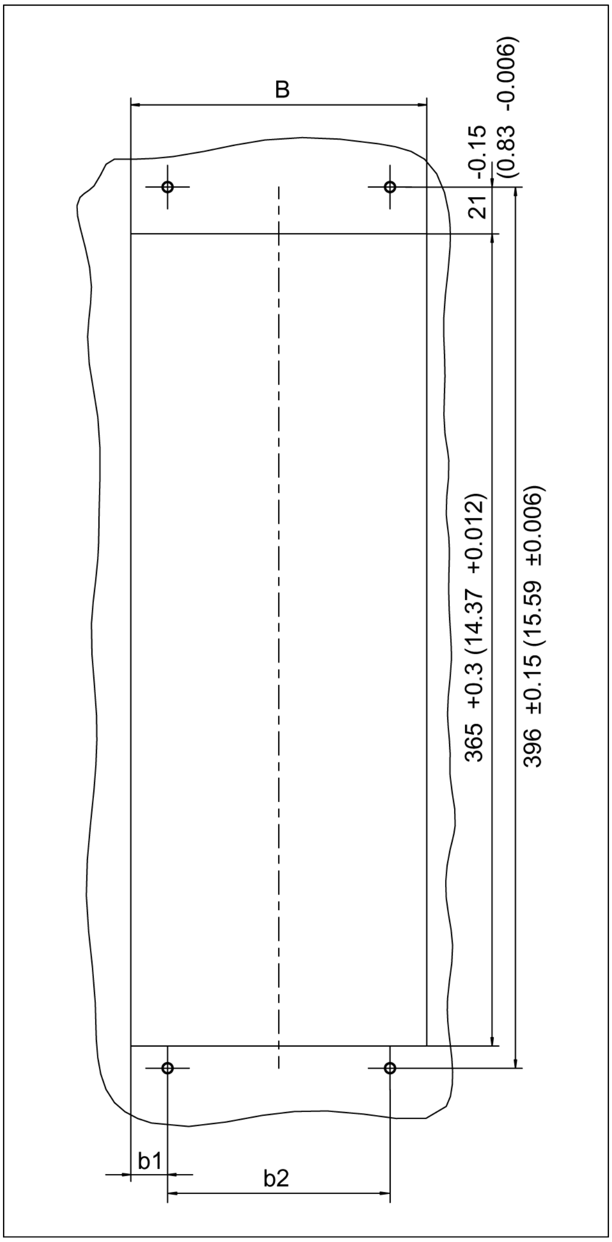


Figure 3-106 Installation openings for the Power Module with external air cooling (50 mm to 200 mm)

Table 3- 83 Dimensions of the installation openings for the Power Module with external air cooling

Module width	W [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)

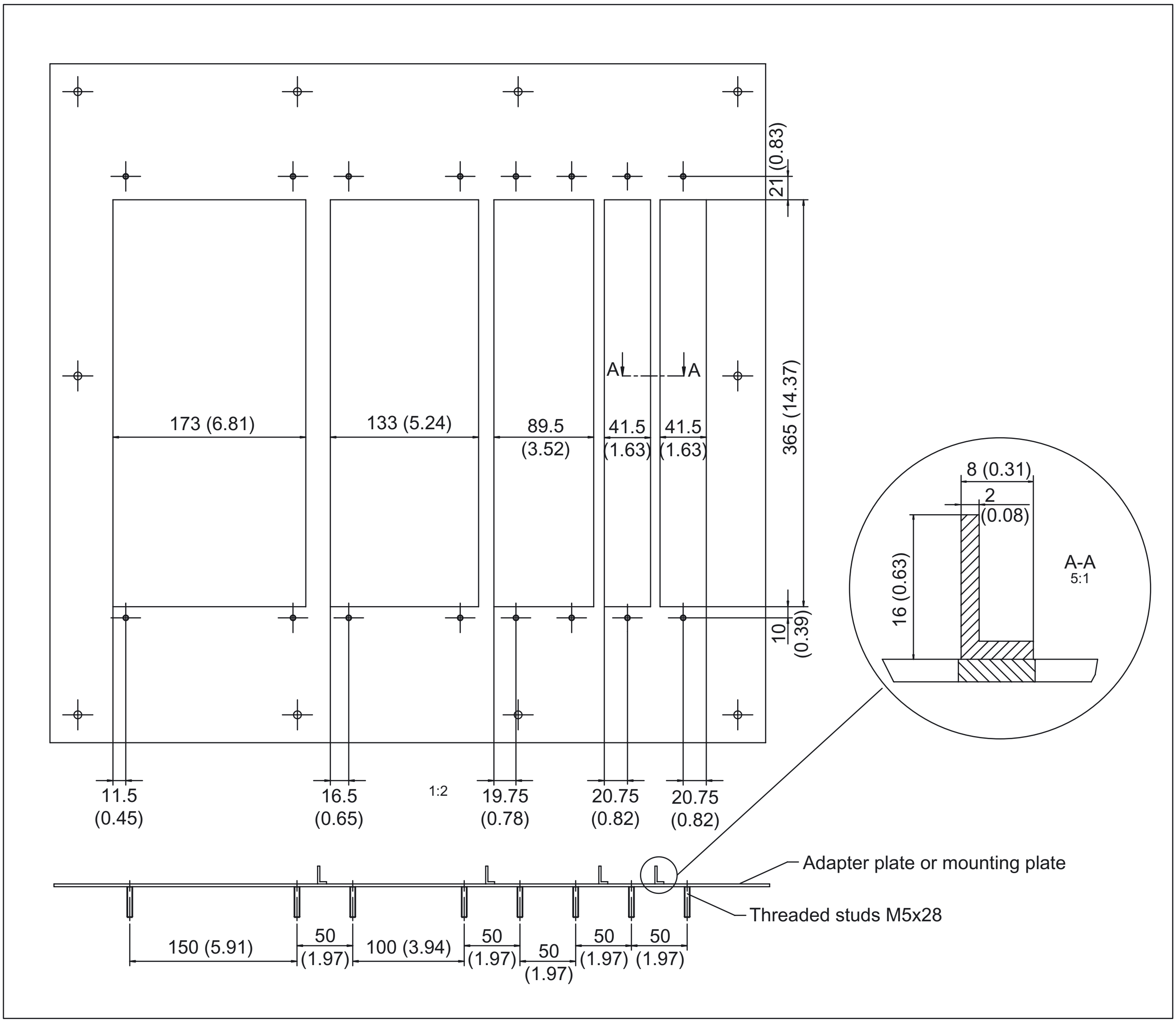


Figure 3-107 Example: mounting plate with a drive line-up

During installation it must be ensured that the component's seal is tight throughout.

Note

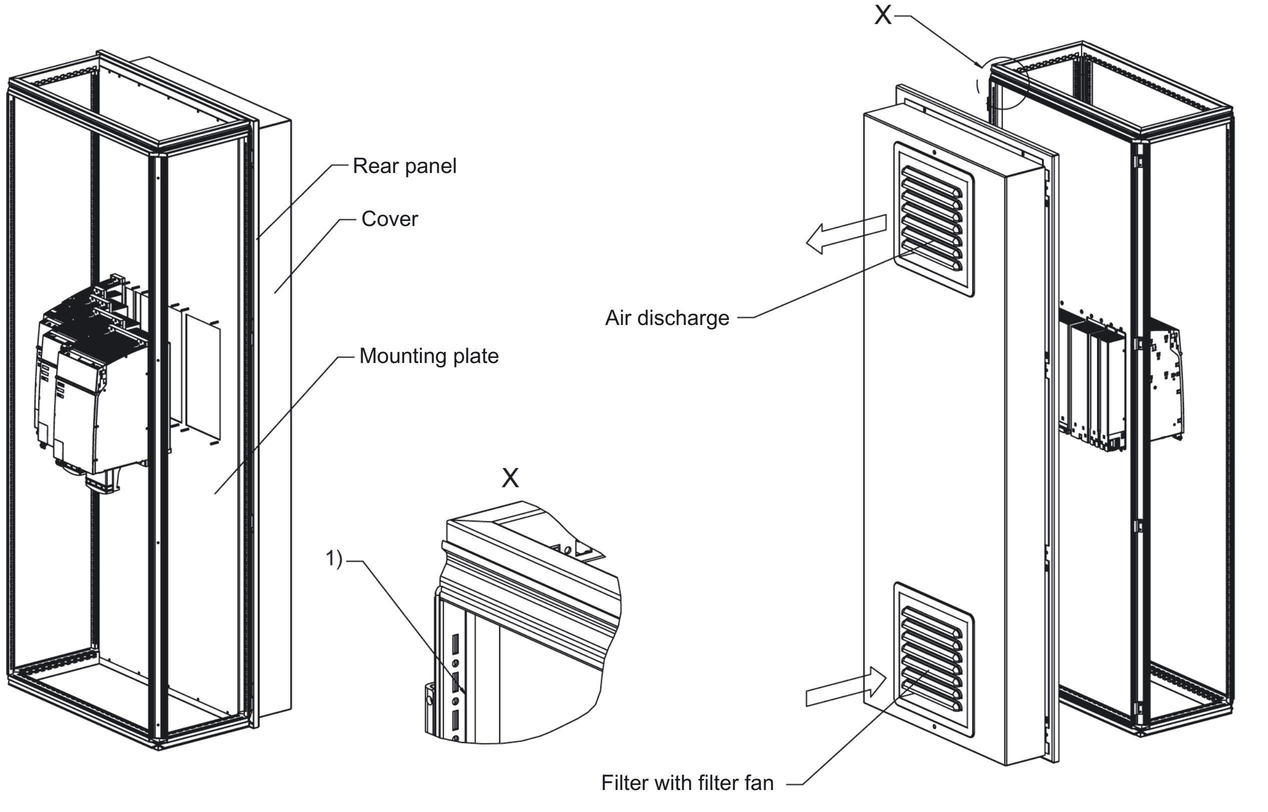
A set of seals consisting of spare seals for 50 mm, 100 mm, 150 mm, 200 mm and 300 mm wide components can be ordered with order number: 6SL3162-5BU00-0AA0.

The cross-pieces must have the appropriate stability.

If required, we recommend that you reinforce the cross-pieces for the recesses.

In our example, the cross-pieces have been reinforced using brackets to EN 755-9.

Any means necessary can be used to secure the bracket to the insert plate.



1) To maintain degree of protection IP54, the surfaces between the mounting plante and cabinet frame must be sealed all the way around. (e.g. use sealant Terostat-91 from Teroson)

Figure 3-108 Example 1: installation in cabinet with mounting plate

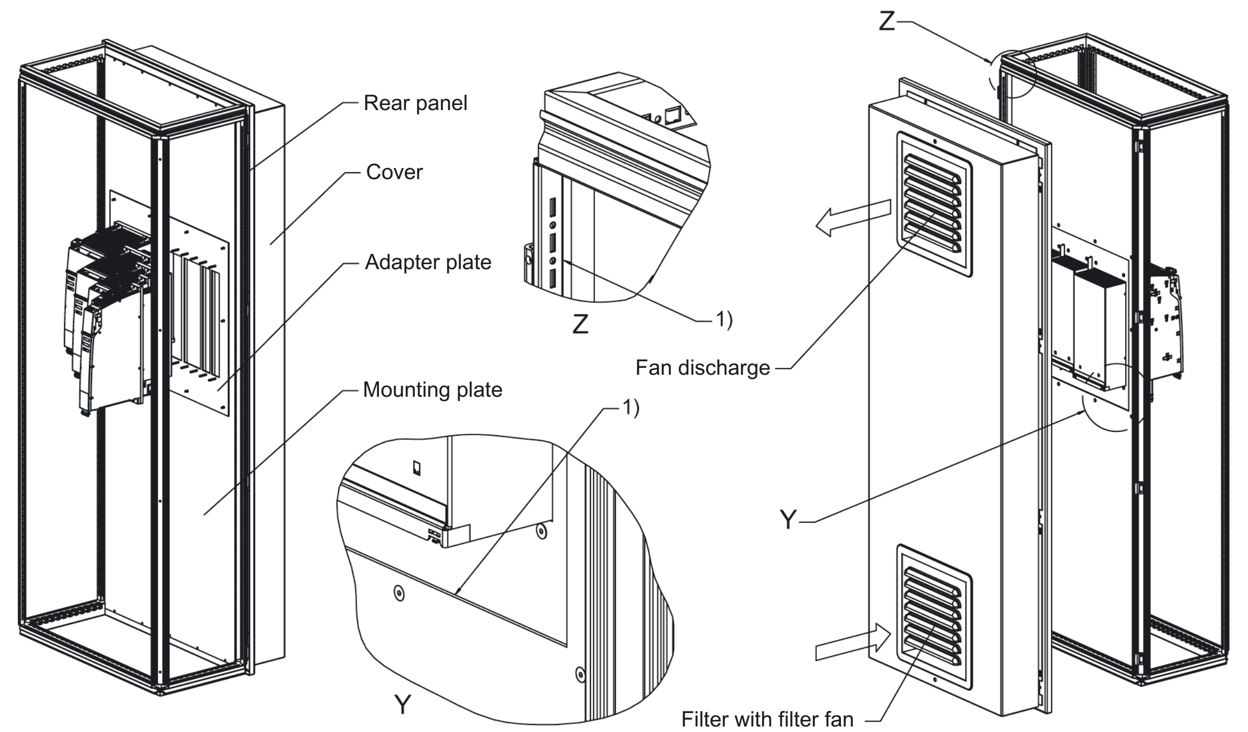


Figure 3-109 Example 2: installation in cabinet with mounting plate

We recommend that you attach a cover and filtered 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. This can be determined by establishing the total cooling air required by the individual components. This information is available in the 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 a filtered fan must be regularly checked for dirt and cleaned if necessary.

3.8.6 Technical data

Table 3- 84 Technical data Smart Line Modules Booksize external air cooling

Internal air cooling	6SL3131–	6AE15–0AAx	6AE21–0AAx
Rated power	**kW**	**5**	**10**
Infeed			
Rated power (S1) 1)	kW (Pn)	5	10
S6 power			
Infeed power (S6-40%) 1)	kW (Ps6)	6.5	13
Peak infeed power 1)	kW (Pmax)	10	20
Regenerative feedback			
Continuous regenerative power	kW	5	10
Peak regenerative power	kW	10	20
Supply voltages			
Rated voltage	V_{AC}	3 AC 380 -10 % (-15 % < 1 min) to 3 AC 480 +10 %	
Line frequency	Hz	47 to 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 %	
Input currents			
Rated input current			
at 400 V_{AC}:	A_{AC}	8.1	16.2
Input current			
at 380 V_{AC} / 480 V_{AC}	A_{AC}	8.6 / 6.7	17 / 12.8
at 400 V_{AC}; S6-40%	A_{AC}	10.6	21.1
at 400 V_{AC}; 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 600 V_{DC}; S6-40%	A_{DC}	11	22
at 600 V_{DC}; peak current	A_{DC}	16.6	33.2
Current carrying capacity			
DC link busbar	A_{DC}	100	100
Reinforced DC link busbars:	A_{DC}	150	150
24 V busbar:	A_{DC}	20	20
Electronics current consumptionat 24 V DC	A_{DC}	0.8	0.9
Total power loss (including electronics losses) 2)	W	79.2	141.6
Max. ambient temperature			
Without derating	°C	40	40
With derating	°C	55	55
DC link capacitance			
Smart Line Module	µF	220	330
Drive line-up, max.	µF	6000	6000
Power factor	cos ϕ	0.98	0.98
Circuit breaker (UL)			
Type designation		3VL1102-2KM30	3VL1135-2KM30
Rated current:	A	20	35
Resulting rated short-circuit current 4) SCCR at 480 V_{AC}:	kA	65	65

Internal air cooling	6SL3131–	6AE15–0AAx	6AE21–0AAx
Rated power	kW	5	10
Safety fuse (UL) Type AJT Class J [3)] Rated current Resulting rated short-circuit current [4)] SCCR at 480 V_{AC}:	 A kA	 AJT17-1/2 17.5 65	 AJT35 35 65
Sound pressure level	dB(A)	< 60	< 60
Cooling air requirement	m^3/h	29.6	29.6
Rated voltage for rated data 3 AC 380 V			
Weight	kg	5.3	5.4

1) The powers specified apply to the rated voltage range from 380 V to 480 V.
2) For an overview, see the power loss tables in chapter Control cabinet installation
3) Source of supply: Ferraz Shawmut, http://de.ferrazshawmut.com
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.

3.8.6.1 Characteristics

Rated duty cycles of Smart Line Modules

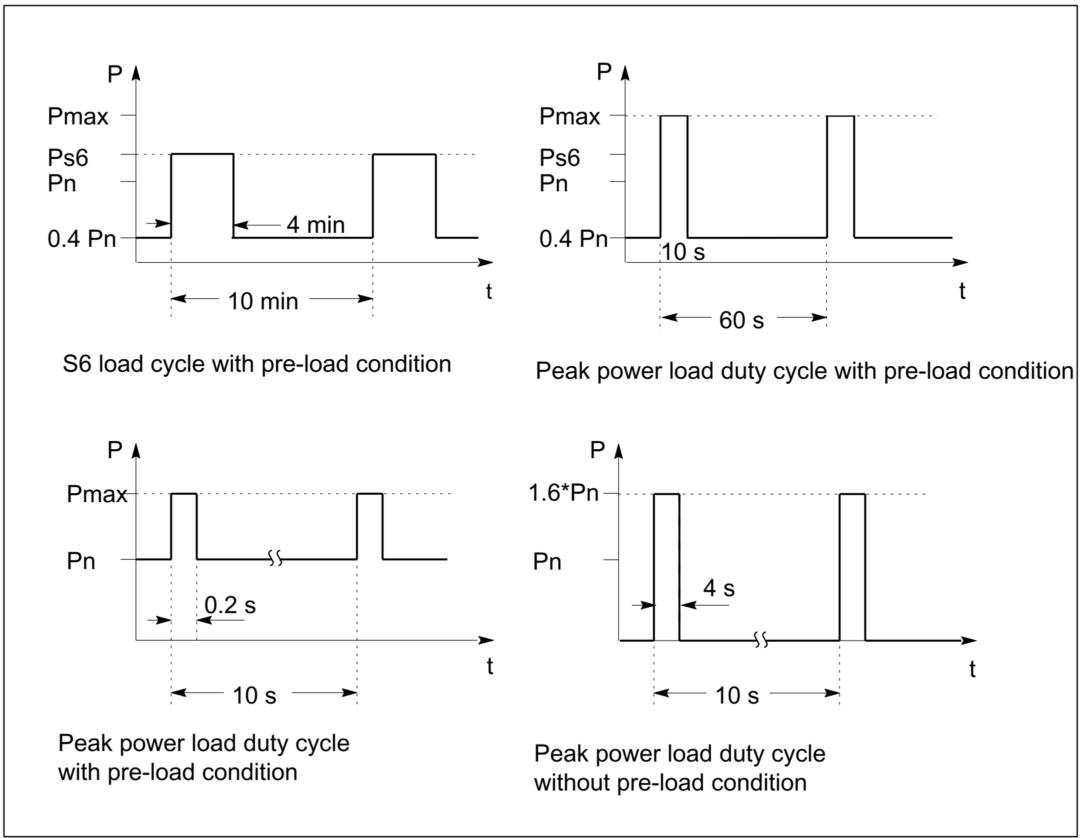


Figure 3-110 Rated duty cycles of Smart Line Modules

Derating characteristics

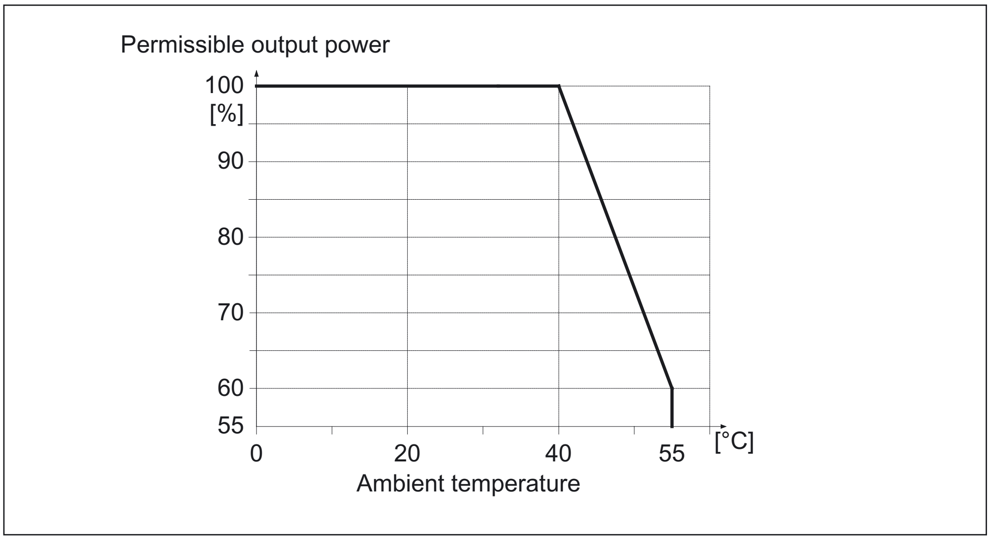


Figure 3-111 Output power as a function of the ambient temperature

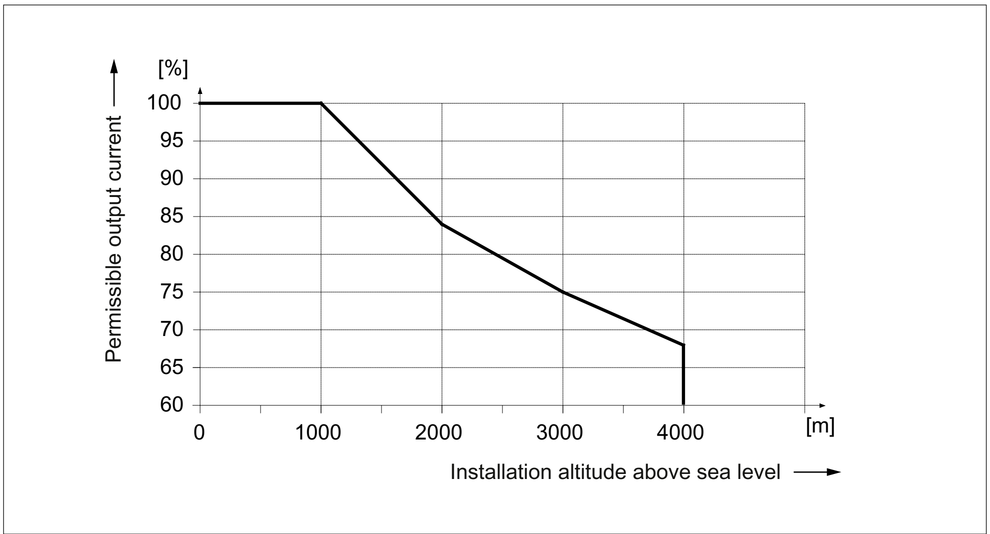


Figure 3-112 Output current as a function of the installation altitude

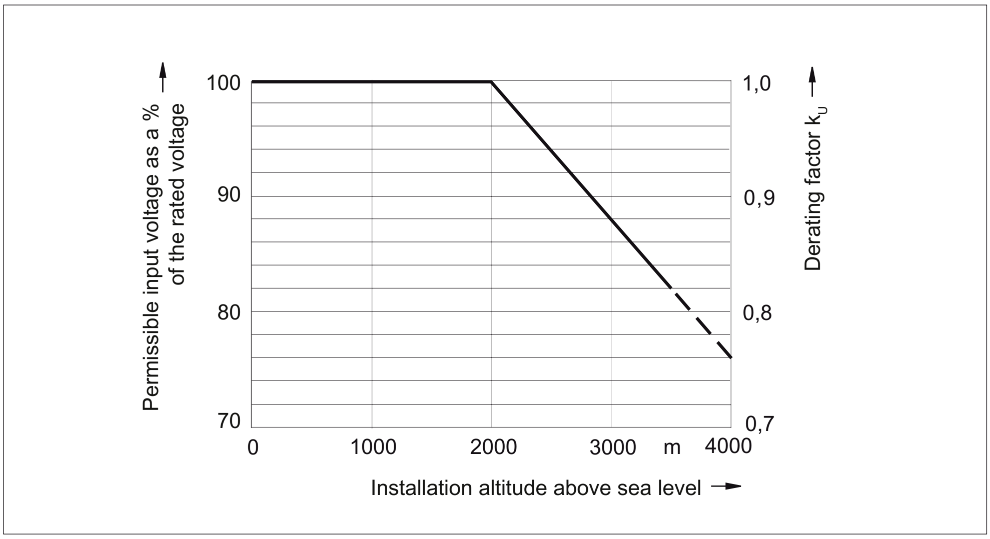


Figure 3-113 Voltage derating as a function of the installation altitude

3.9 Smart Line Modules with cold plate

3.9.1 Description

The Smart Line Module is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module(s) 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 Lines Modules are not equipped with a DRIVE-CLiQ connection.

The DC link starts precharging as soon as the supply voltage is applied and is independent of its phase sequence direction. Load can be applied to the DC link after the modules have been enabled. An optional main contactor is required for disconnecting the voltage.

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

3.9.2 Safety information

> **DANGER**
>
> **Risk of electric shock**
>
> A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
> The protective cover may only be opened after this time has expired.
>
> When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.
>
> The components must only be operated when the protective cover of the DC link is closed. Damaged components must no longer be used to avoid secondary damage or accidents.

> **DANGER**
>
> **DC-link discharge time**
>
> A DC-link discharge time danger notice in the relevant national language must be attached to all of the components.
> A set of labels in 16 languages is supplied with the component.

DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 70 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

DANGER

If the Line Module is not disconnected from the supply system (e.g. via the line contactor or main switch), the DC link remains charged.

CAUTION

The 80 mm clearances above and below the components must be observed.

CAUTION

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. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21, pin 1.

Switch on:

- 24 VDC power supply X24 ON
- Line contactor ON
- EP signal X21 pins 3 and 4 ON
- Wait until precharging is complete
- "Ready" signal at terminal X21 pin 1 set 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 pins 3 and 4 OFF
- Line contactor OFF
- 24 VDC power supply X24 OFF

Overload:

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

CAUTION

The tightening torque of the DC-link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning with the complete system in a no-voltage condition (powered-down) and with the DC link discharged. After transportation, the screws must be tightened.

For lines without regenerative feedback capability (e.g. a diesel generator), the regenerative feedback capability of the Smart Line Module must be deactivated by means of a jumper between terminals X22.1 and X22.2. The braking energy must then be dissipated via an additional Braking Module with braking resistor provided in the drive line-up.

CAUTION

The overall length of the power cables (motor supply cables and DC-link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION
DC-link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

NOTICE
Operation without the line reactor is not permissible.

Note

Fan operation

With 5 kW and 10 kW Smart Line Modules, the fan runs permanently.

The fans for the 16 kW and 36 kW Smart Line Modules are switched on and off in accordance with the heat-sink temperature.

The fans start up at the heat-sink temperature specified in the power stack data (normally 56 °C) and are switched off with a slight hysteresis when the heat-sink temperature decreases again. The length of time it takes for the fans to stop once they have been switched off depends on a number of factors (ambient temperature, output current, duty cycle, etc.) and, therefore, cannot be determined directly.

The fans are not equipped with temperature-dependent speed control; only the states "on" or "off" exist.

3.9.3 Interface description

3.9.3.1 Overview

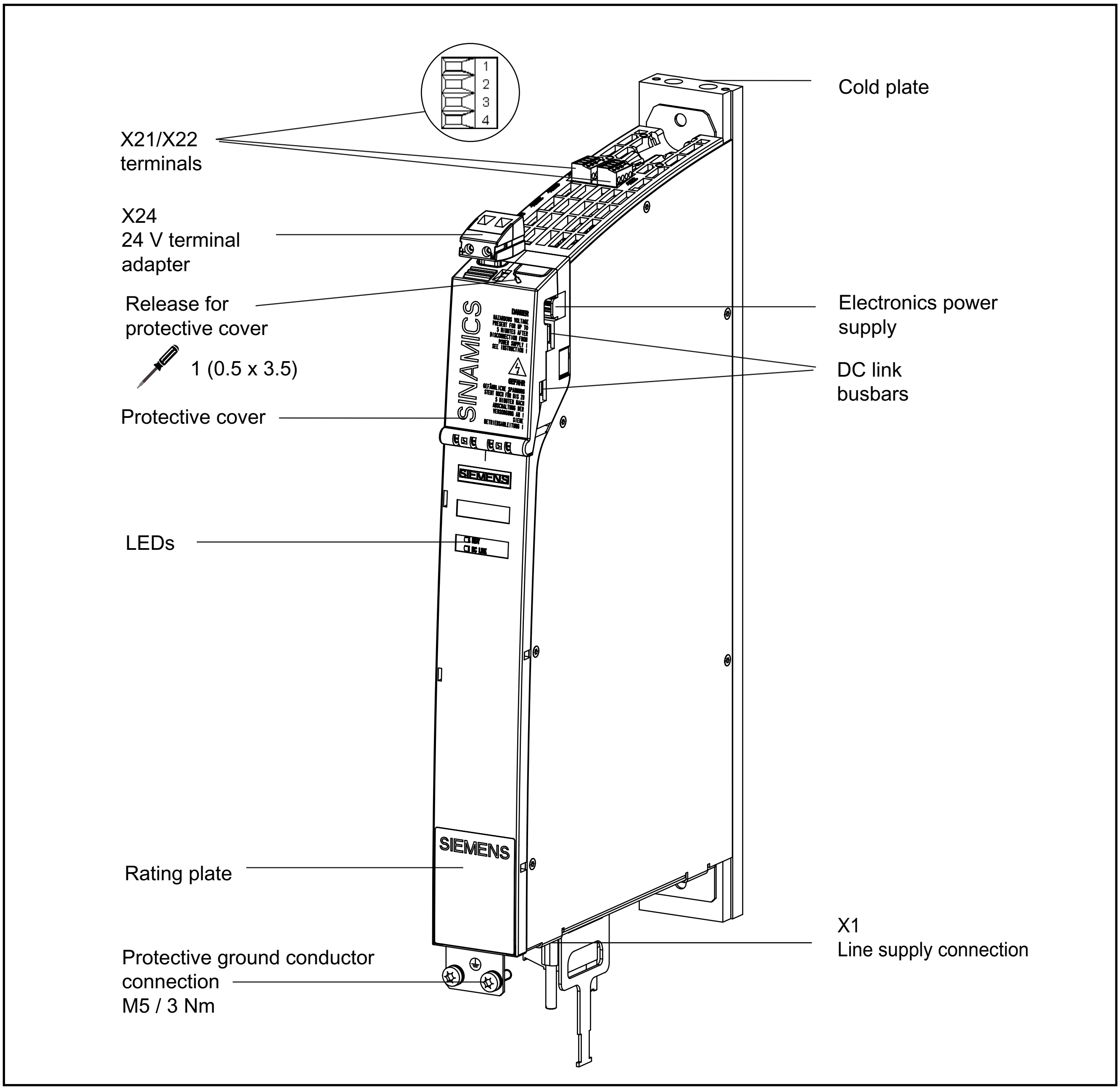
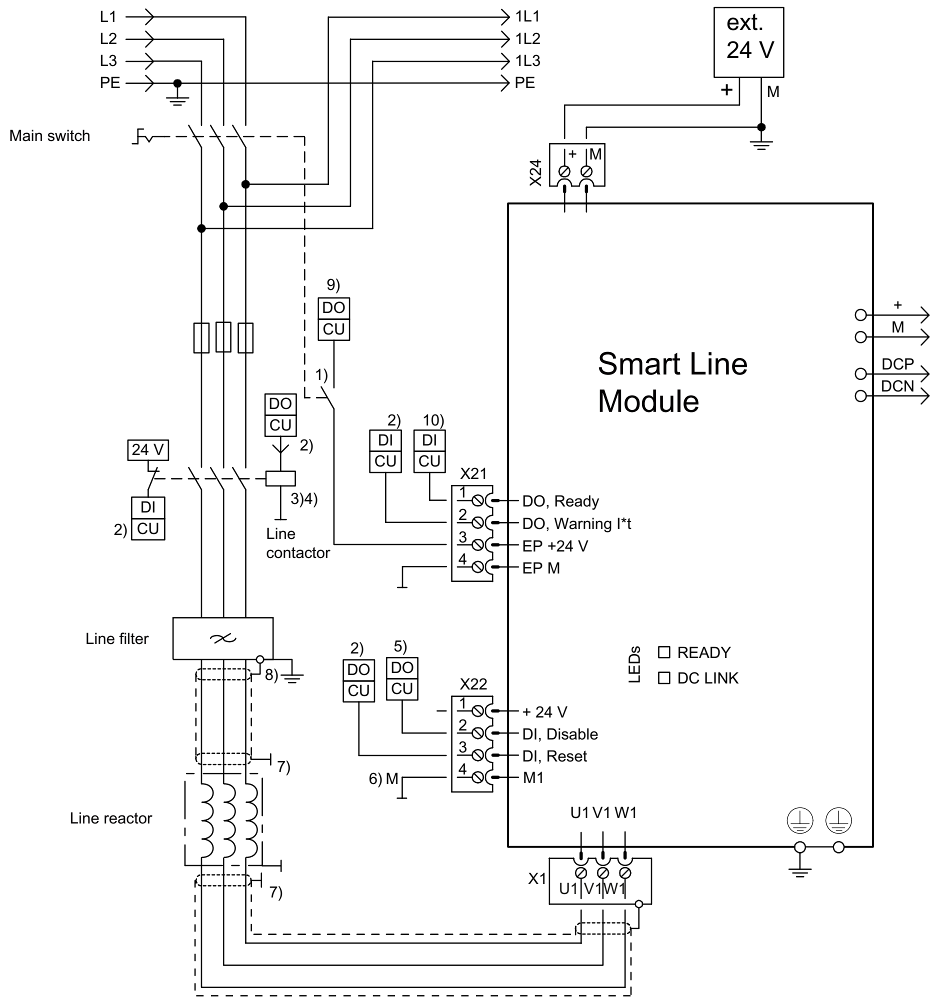


Figure 3-114 Smart line module with cold plate (10 kW)

3.9.3.2 Connection example



1) Leading opening contact t >10 ms; 24 VDC and ground must be connected for operation.
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) DO high, feedback deactivated (for permanent deactivation, a jumper can be installed between X22 pins 1 and 2)
6) X22 pin 4 must be connected to ground (ext. 24 V).
7) Contact through the rear of the mounting surface or shielding buses in accordance with the EMC Directive
8) 5 kW and 10 kW line filter via shield connection
9) Signal output of the control system to prevent a disturbance at the EP terminal in terms of the 24 VDC supply
10) Connected via BICO technology to parameter p0864

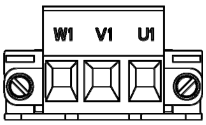
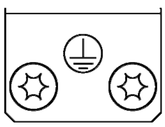
Figure 3-115 Connection example for 5 kW and 10 kW Smart Line Modules

Note

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

3.9.3.3 X1 line connection

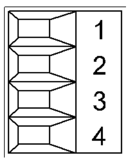
Table 3- 85 Terminal strip X1 of Smart Line Modules 5 kW and 10 kW

	Terminal	Technical specifications
	U1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 6 mm² Type: Screw terminal 5 (see chapter Connection methods) Tightening torque: 1.2 - 1.5 Nm
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

3.9.3.4 X21 terminals

Table 3- 86 Terminal strip X21

	Terminal	Designation	Technical specifications
	1	DO: Ready	Checkback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: • 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 • 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 (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm² Type: Screw terminal 1 (see chapter Connection methods)			

CAUTION

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. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21, pin 1. (see the "Safety information" chapter).

NOTICE

Output terminal X21, pin 1 must be wired to a digital input on the CU. The drives supplied with power by the Smart Line Module have to use this signal as a "Ready" message (BI: p0864 = digital input). 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. The control system cannot set the drives to ready until the infeed "Ready" signal is present.

Note

The "Prewarning" signal at output terminal X21, pin 2 of Smart Line Modules 5 kW and 10 kW 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 changes 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, the feedback is deactivated and an alarm is output at X21/2 (DO, Warning I*t). If the feedback was deactivated by applying a "high" signal to terminal X22/2 (DI, Disable), no alarm will be output at X21/2 (DO, Warning I*t).

WARNING

For operation, 24 VDC must be connected to terminal 3 and ground to terminal 4. Upon removal, pulse suppression is activated. Feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

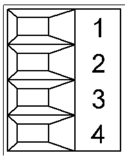
NOTICE

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals 3 (EP +24 V) and 4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

This protects external loads located parallel to the drive on the same switching component.

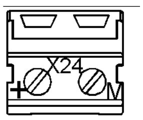
3.9.3.5 X22 terminals

Table 3- 87 Terminal strip X22 for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation	Technical specifications
	1	24 V power supply	Electronics power supply for controlling digital inputs X22.2 and 3.
	2	DI: Disable Regeneration	Deactivate 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
Max. connectable cross-section: 1.5 mm² Type: Screw terminal 1 (see chapter Connection methods)			

3.9.3.6 X24 24 V terminal adapter

Table 3- 88 Terminal block X24

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
The 24 V terminal adapter is supplied as standard Max. connectable cross-section: 6 mm²			

3.9.3.7 Description of the LEDs on the Smart Line Module

Table 3- 89 5 kW and 10 kW Smart Line Modules – description of the LEDs

LED	Color	State	Description, cause	Remedy
READY	–	OFF	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Continuous	Component is ready to operate.	–
	Yellow	Continuous	Pre-charging not yet complete. bypass relay dropped out EP terminals not supplied with 24 VDC.	–
	Red	Continuous	Overtemperature Overcurrent switch-off	Diagnostics fault (via output terminals) and acknowledge it (via input terminal)
DC LINK	–	OFF	Electronics power supply is missing or outside permissible tolerance range.	–
	Yellow	Continuous	DC-link voltage within permissible tolerance range.	–
	Red	Continuous	DC-link voltage outside permissible tolerance range. Line supply fault.	Check the line voltage.

DANGER

Hazardous DC-link voltages may be present at any time regardless of the state of the "DC link" LED.
The warning information on the components must be carefully observed!

3.9.4 Dimension drawing

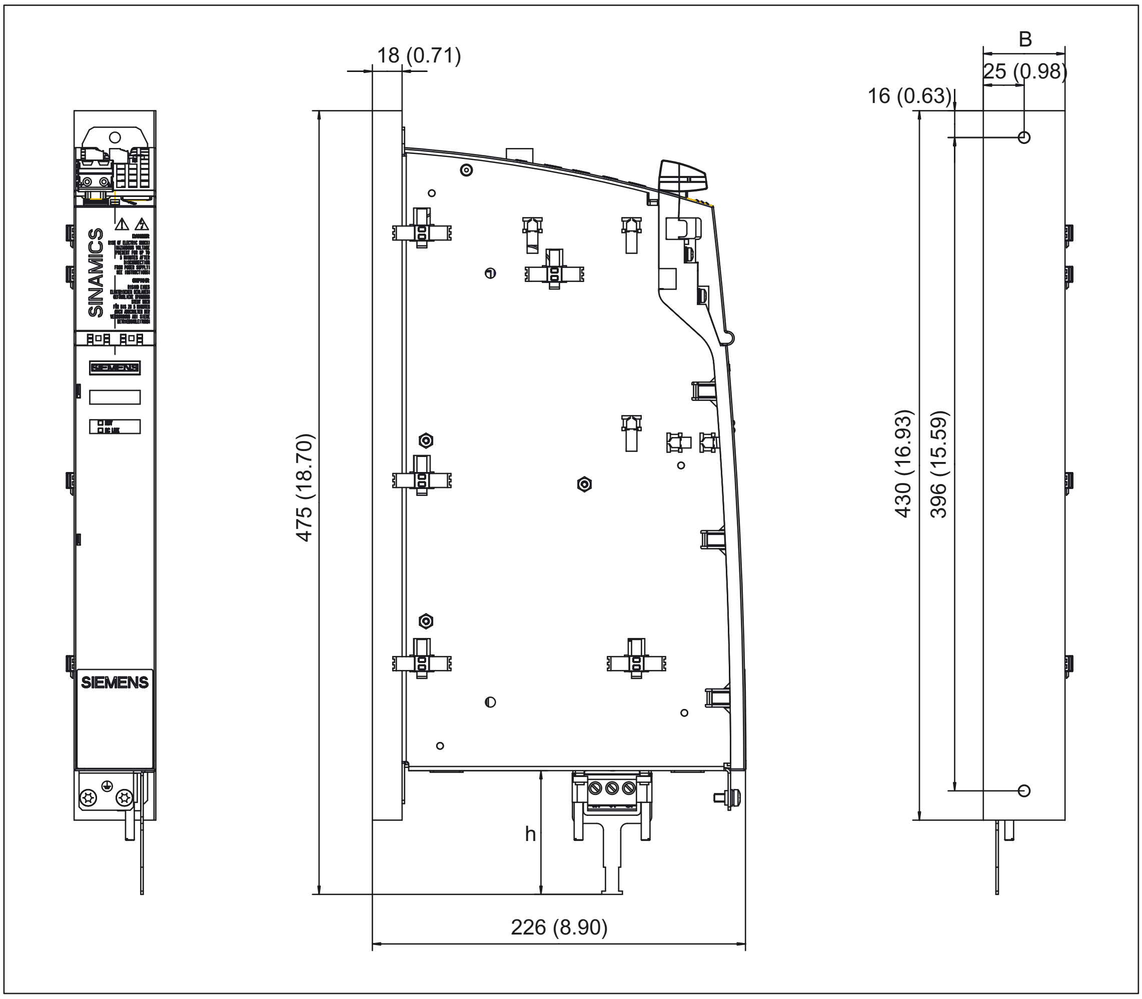


Figure 3-116 Dimension drawing of Smart Line Module with cold plate (5 kW and 10 kW), all dimensions in mm and (inches)

Table 3- 90 Dimension, Smart Line Module with cold plate (5 kW and 10 kW)

Line module type	Order number	W [mm] (inches)	H [mm] (inches)
5 kW	6SL3136-6AE15-0AAx	50 (1.97)	75 (2.95)
10 kW	6SL3136-6AE21-0AAx	50 (1.97)	75 (2.95)

3.9.5 Installation

Installation of the cold plate component on customer-specific heat sinks

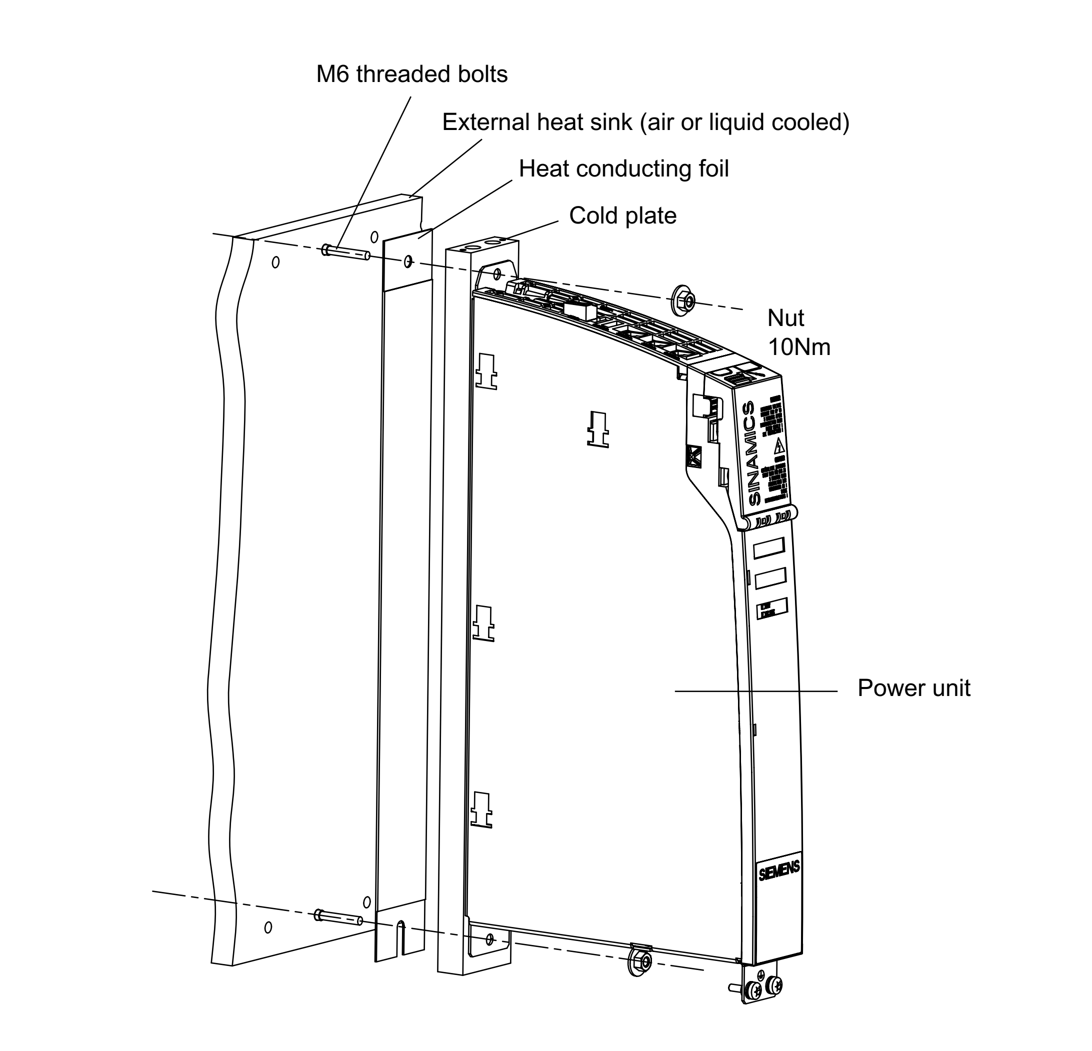


Figure 3-117 Installation of a cold-plate power unit with an external heat sink

Help with the mechanical control cabinet installation is available from:

Siemens AG
Industry Sector, IA SE WKC
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

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.

Note

The machine manufacturer can adapt the heat sink version to his 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

During the installation, you must ensure that the threaded bolts do not damage the cold plate.

Installation instructions

1. Before the installation, check the surface of the heat sink to ensure that it is not damaged.
2. For installation, M6 screw bolts and hexagon nuts/grub screws (ISO 7436-M6x40-14 H) are recommended.
3. 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 installation position of the heat-conducting foil (see diagram above). To make it easier to attach the heat-conducting foil, the screw bolts/grub screws should already be inserted in the holes provided on the heat sink.
4. The component is then mounted onto the external heat sink.
5. The tightening torque for the screw connection is 10 Nm.

   Note

   When a component is replaced, the heat-conducting foil must also be replaced.
   Only heat-conducting foil approved or supplied by Siemens can be used.

	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

3.9.6 Technical data

Table 3- 91 Technical data for Smart Line Modules with cold plate cooling

	6SL3136-6AE	15-0AAx	21-0AAx
Rated power	**kW**	**5**	**10**
Infeed Rated power (S1) 1) Infeed power (S6-40%) 1) Peak infeed power 1)	 kW (Pn) kW (Ps6) kW (Pmax)	 5 10	 10 20
Regenerative feedback Continuous regenerative power Peak regenerative power	 kW kW	 5 10	 10 20
Supply voltages Rated voltage Line frequency Electronics power supply	 V_{AC} Hz V_{DC}	 3 AC 380 10 % (-15 % < 1 min) to 3 AC 480 10 % 47 to 63 24 (20.4 - 28.8)	
DC link voltage Overvoltage trip Undervoltage trip	V_{DC} V_{DC} V_{DC}	510 – 720 820 ± 2 % 360 ± 2 %	
Input currents Rated input current at 400 V_{AC}: Input current at 380 V_{AC} / 480 V_{AC} at 400 V_{AC}; S6-40% at 400 V_{AC}; peak current	 A_{AC} A_{AC} A_{AC} A_{AC}	 8.1 8.6 / 6.7 10.6 15.7	 16.2 17 / 12.8 21.1 31.2
DC link currents Rated DC link current at 600 V: DC link current at 540 V: at 600 V_{DC}; at S6-40% at 600 V_{DC}; peak current	 A_{DC} A_{DC} A_{DC} A_{DC}	 8.3 9.3 11 16.6	 16.6 18.5 22 33.2
Current carrying capacity DC link busbar Reinforced DC link busbars: 24 V busbar:	 A_{DC} A_{DC} A_{DC}	 100 150 20	 100 150 20
Electronics current consumptionat 24 V DC	A_{DC}	0.6	0.7
Power loss distribution (incl. electronics losses) 4) internal external	 W W	 34.4 40	 56.8 80
DC link capacitance Smart Line Module Drive line-up, max.	 µF µF	 220 6000	 330 6000
Power factor	cosϕ	1	1
Circuit breaker (UL) Type designation Rated current: Resulting rated short-circuit current 3) SCCR at 480 V_{AC}:	 A kA	 3VL1102-2KM30 20 65	 3VL1135-2KM30 35 65

	6SL3136-6AE	15-0AAx	21-0AAx
Safety fuse (UL) Type AJT Class J 2) Rated current Resulting rated short-circuit current 3) SCCR at 480 V_{AC}:	 A kA	 AJT17-1/2 17.5 65	 AJT35 35 65
Max. permissible heat-sink temperature	°C	60	65
Max. ambient temperature Without derating With derating	 °C °C	 40 55	 40 55
Weight	kg	4.0	4.0

1) The powers specified apply to the rated voltage range from 380 V to 480 V.
2) Source of supply: Ferraz Shawmut, http://de.ferrazshawmut.com
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) For an overview, see the power loss tables in chapter Control cabinet installation

3.9.6.1 Characteristics

Rated duty cycles of Smart Line Modules

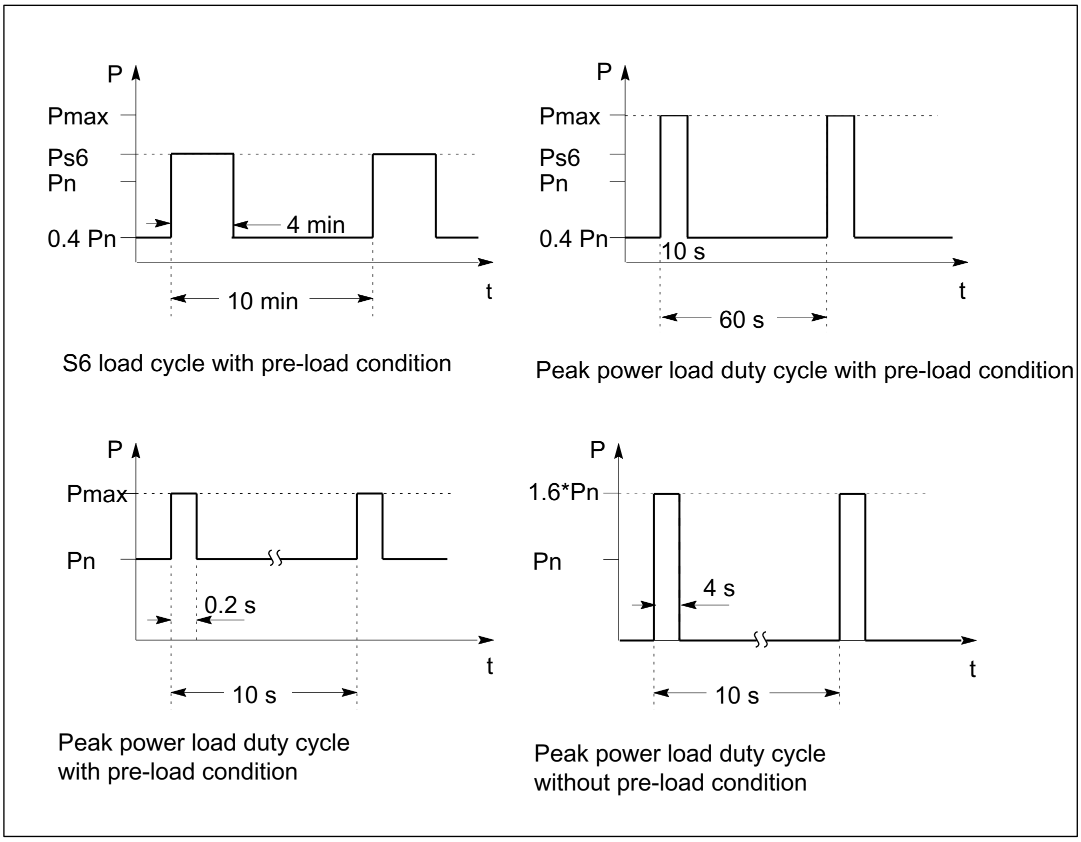


Figure 3-118 Rated duty cycles of Smart Line Modules

Derating characteristics

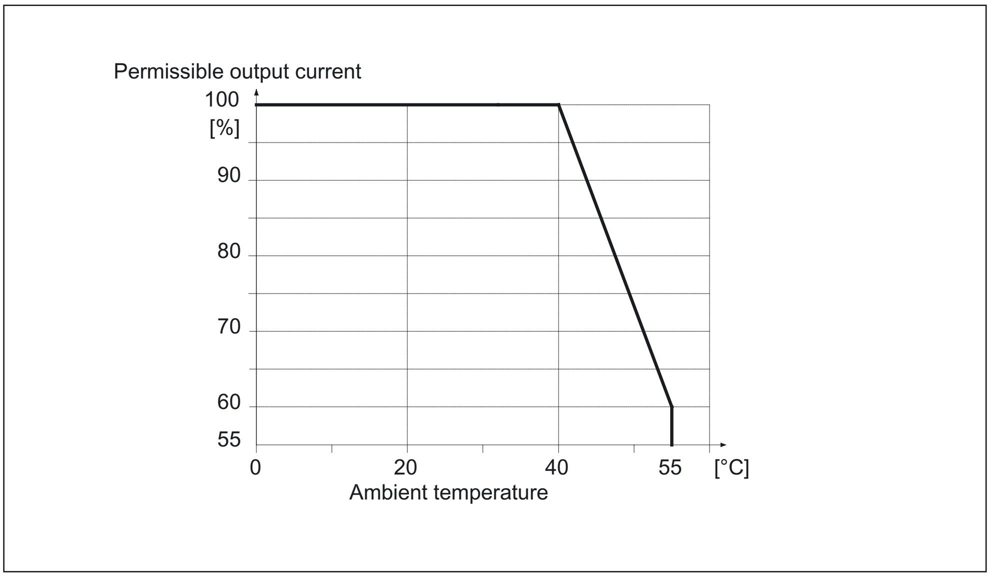


Figure 3-119 Output current as a function of the ambient temperature

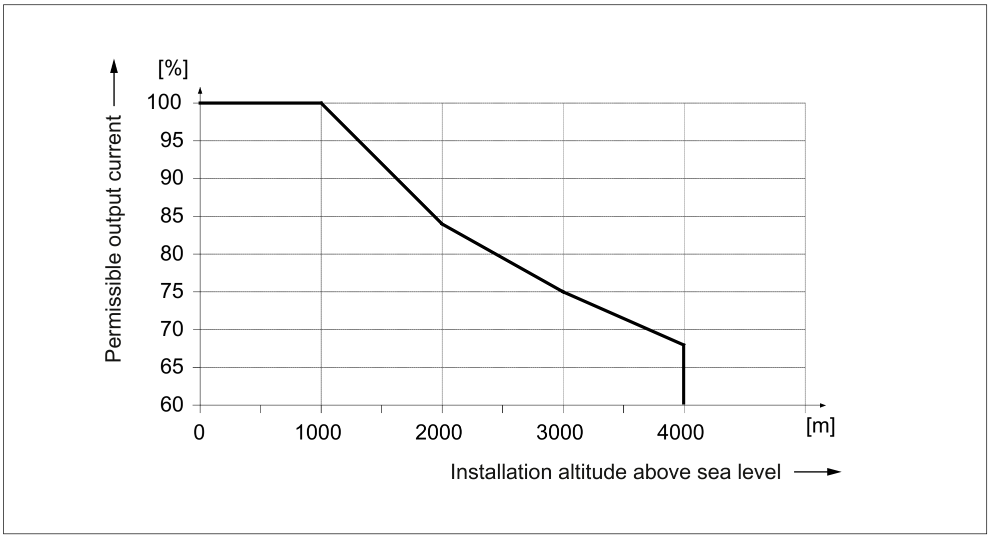


Figure 3-120 Output current as a function of the installation altitude

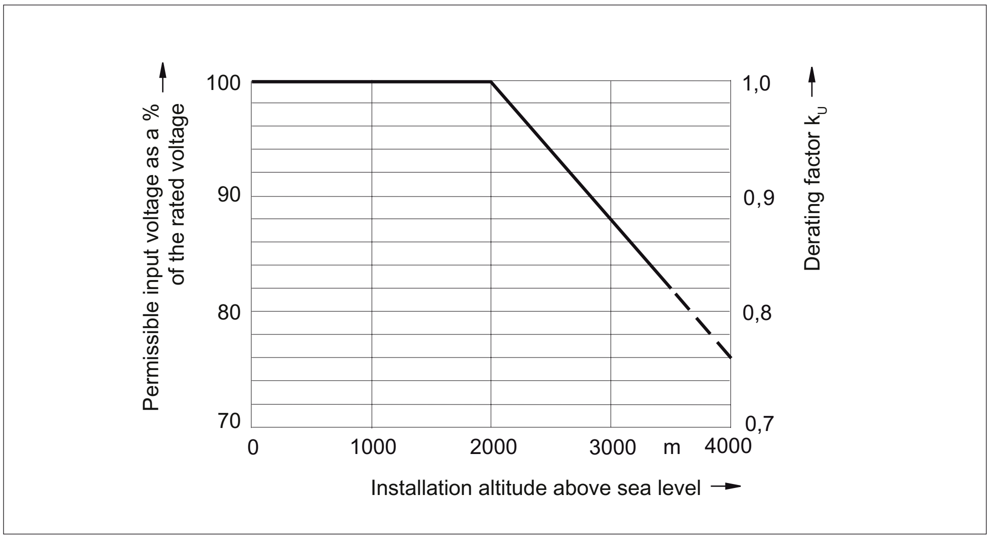


Figure 3-121 Voltage derating as a function of the installation altitude

Measuring range for maximum permissible heat-sink temperature

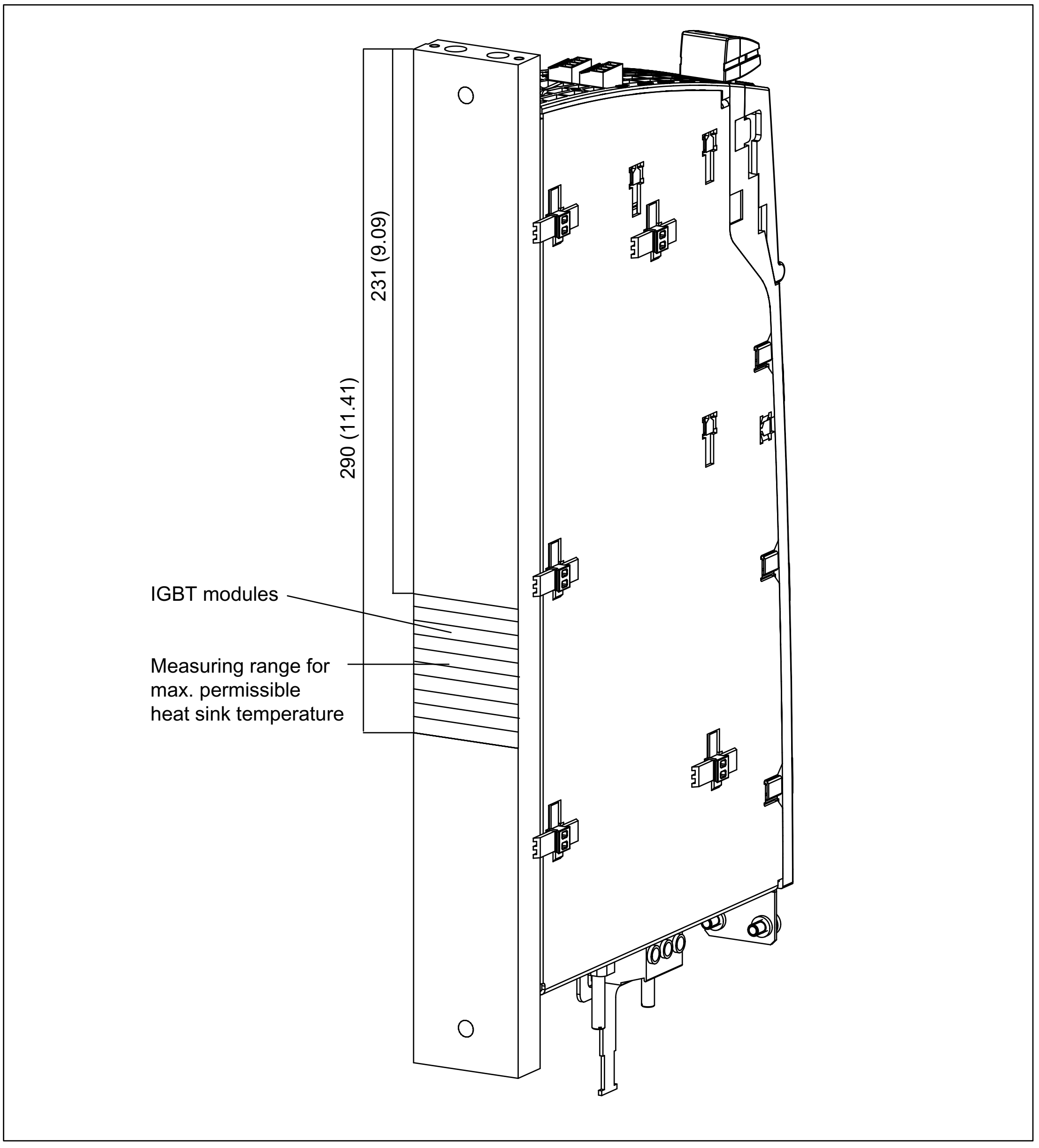


Figure 3-122 Measuring range for max. permissible heat-sink temperature for a Smart Line Module

Line Modules Booksize Compact

4

4.1 Smart Line Modules Booksize Compact

4.1.1 Description

The Smart Line Module booksize compact is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module(s) 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.

If the system requires metallic isolation from the network for safety isolation, a main contactor can be series-connected on the line side.

The Smart Line Module in bookzse compact format can be used with cooling types "internal air cooling" or "cold plate". The cooling type is selected via parameter p249 "Power unit cooling type".

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

4.1.2 Safety information

DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

DANGER

DC-link discharge time

A DC-link discharge time danger notice in the relevant national language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 70 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC-link adapter and DC-link rectifier adapter).

DANGER

If the Line Module is not disconnected from the supply system (e.g. via the line contactor or main switch), the DC link remains charged.

CAUTION

The 80 mm clearances above and below the components must be observed.

CAUTION

The correct tightening torque of the DC-link busbar screws (1.8 Nm, tolerance +30 %) must be checked before commissioning and with the complete system in a no-voltage condition (powered-down) and with the DC link discharged. After transportation, the screws must be tightened.

For line supplies without regenerative feedback capability (e.g. diesel generator), the regenerative feedback capability of the Smart Line Modules must be deactivated by means of parameters. The braking energy must then be dissipated via an additional Braking Module with braking resistor provided in the drive line-up.

CAUTION
The overall length of the power cables (motor supply cables and DC-link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION
DC-link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

NOTICE
Operation without the line reactor is not permissible.

Note

Activation of the fan is dependent on heat sink temperature and pulse enable.

4.1.3 Interface description

4.1.3.1 Overview

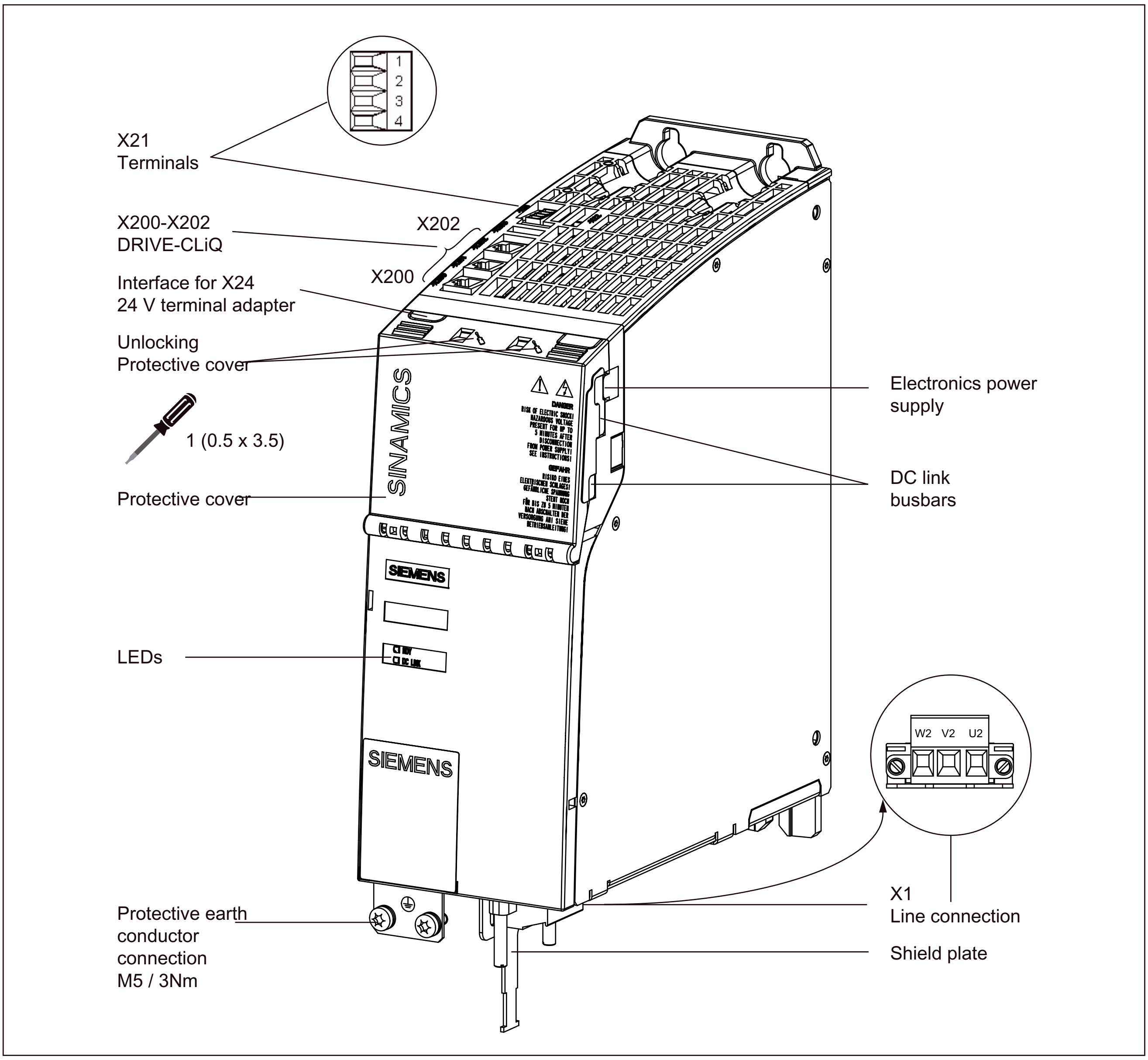
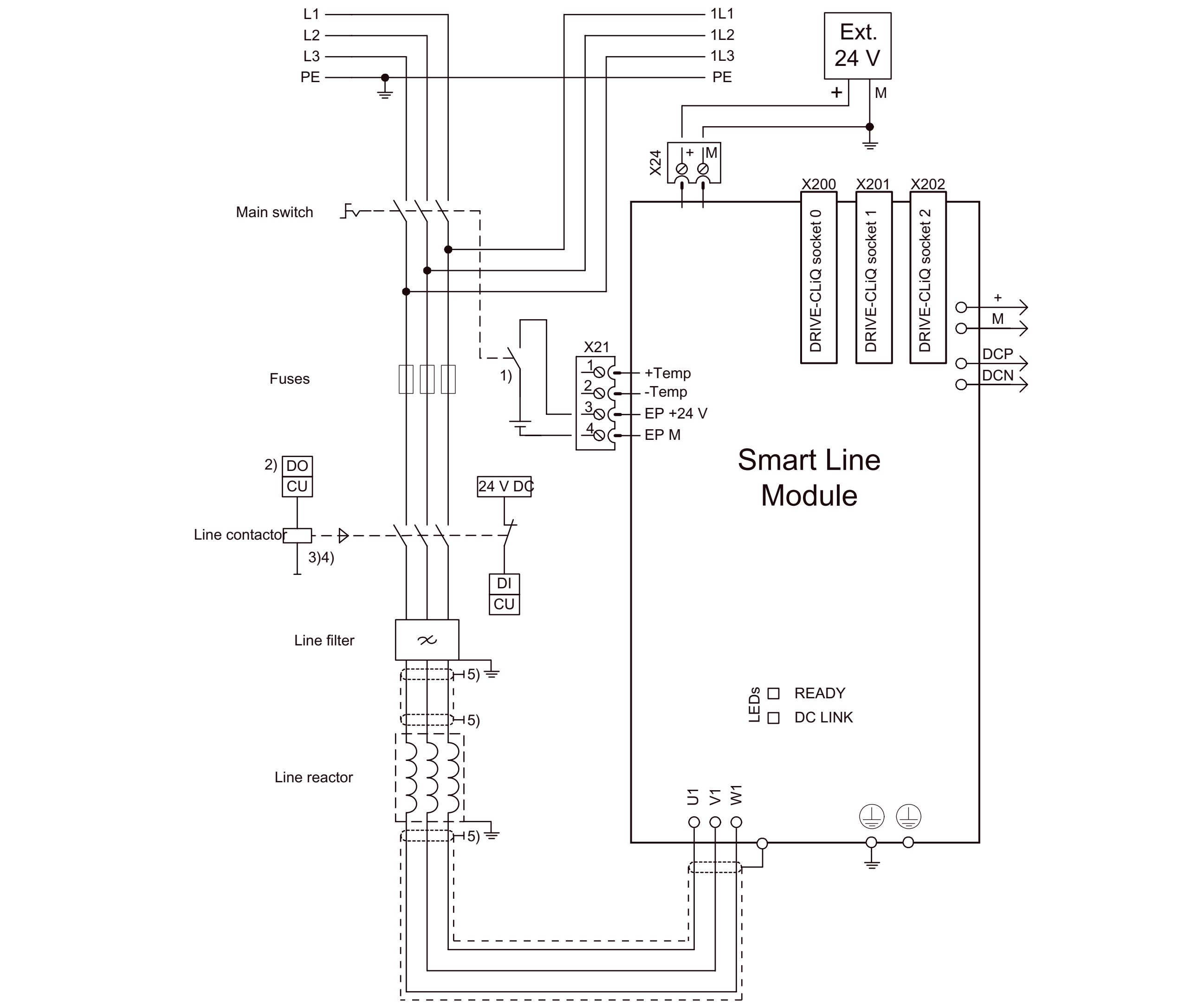


Figure 4-1 Smart Line Module in Booksize Compact format (16 kW)

4.1.3.2 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 taken into account,
an output interface must be used if required.
5) Contact through installation backplane or shield buses in accordance with EMC installation guideline

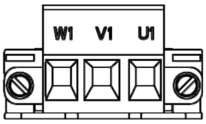
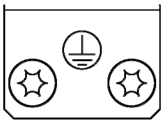
Figure 4-2 Connection example: Smart Line Module Booksize Compact 16 kW

Note

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

4.1.3.3 X1 line connection

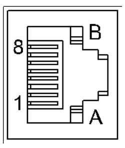
Table 4- 1 Terminal block X1 Smart Line Module 16 kW

	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50 / 60 Hz Max. connectable cross-section: 16 mm² Type: Screw terminal 7 (see Connection System) Tightening torque: 1.5 - 1.8 Nm
	PE connection	Threaded hole M5/3 Nm [1]

[1] for ring cable lugs to DIN 46234

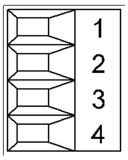
4.1.3.4 X200-X202 DRIVE-CLiQ interfaces

Table 4- 2 DRIVE-CLiQ interface X200-X202

	PIN	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 V power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces included in the scope of delivery; blanking plate (50 pieces) Order number: 6SL3066-4CA00-0AA0			

4.1.3.5 X21 EP terminals

Table 4- 3 Terminal strip X21

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors: KTY 84–1C130[1]/PTC[1]/bimetallic switch with NC contact The temperature sensor type can be selected via parameter p0601 and the temperature display via r35.[2]
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Voltage: 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs
	4	EP M (Enable Pulses)	
Max. connectable cross-section 1.5 mm^2 Type: Screw terminal 1 (see chapter Connection methods)			

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

2) For further information see SINAMICS S120, Commissioning Manual

NOTICE

The KTY temperature sensor must be connected with the correct polarity.

WARNING

For operation, 24 VDC must be connected to terminal 3 and ground to terminal 4. Upon removal, pulse suppression is activated. Feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

NOTICE

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals 3 (EP +24 V) and 4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

This protects external loads located parallel to the drive on the same switching component.

DANGER

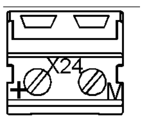
Risk of electric shock!

Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), a Sensor Module External (SME120 or SME125) or Terminal Module TM120 must be used.

If these instructions are not complied with, there is a risk of electric shock!

4.1.3.6 X24 24 V terminal adapter

Table 4- 4 Terminal block X24

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronic ground
The 24 V terminal adapter is supplied as standard Max. connectable cross-section: 6 mm² Type: Screw terminal 5 (see Connection Methods)			

4.1.3.7 Description of the LEDs on the Smart Line Module

Table 4- 5 Smart Line Module 16 kW - Description of the LEDs

State		Description, cause	Remedy
Ready (H200)	DC link (H201)		
OFF	OFF	Electronics power supply is missing or outside permissible tolerance range.	–
Green	OFF	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC-link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC-link voltage is too high.	Check the line voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/Red (0.5 Hz)	–	Firmware is being downloaded.	–
Green/Red (2 Hz)	-	Firmware download is complete. Waiting for POWER ON.	Carry out a POWER ON
Green/Orange or Red/Orange	–	Component detection via LED is activated (p0124). **Note:** Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

DANGER

Hazardous DC-link voltages may be present at any time regardless of the state of the "DC link" LED.
The warning information on the components must be carefully observed!

4.1.4 Dimension drawing

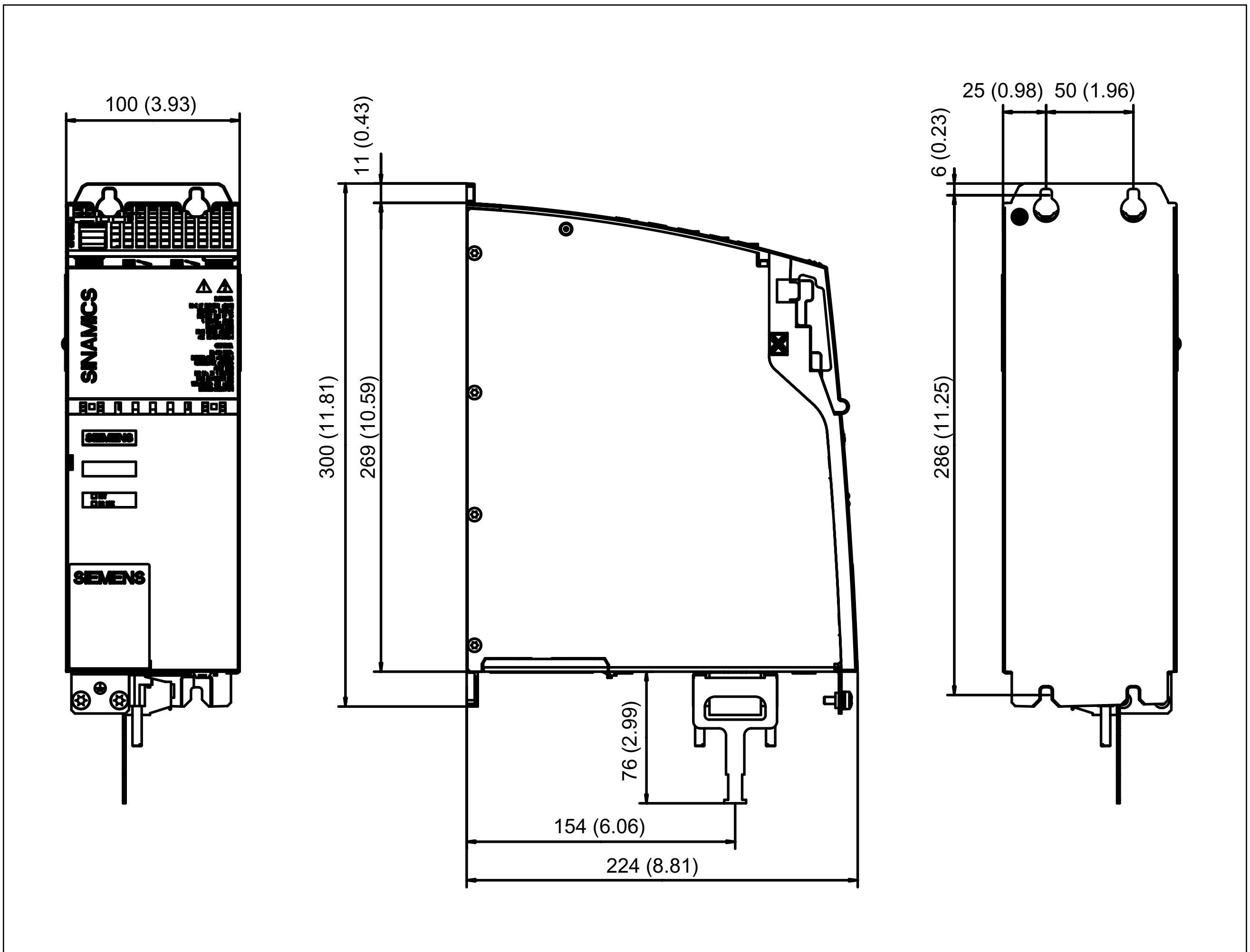


Figure 4-3 Dimension drawing Smart Line Module Booksize Compact format (16 kW), all dimensions in mm and (inches)

Table 4- 6 Smart Line Module Booksize Compact 16 kW

Line Module	Order number
16 kW	6SL3430-6TE21-6AAx

4.1.5 Installation

Installation of a Smart Line Module Booksize Compact

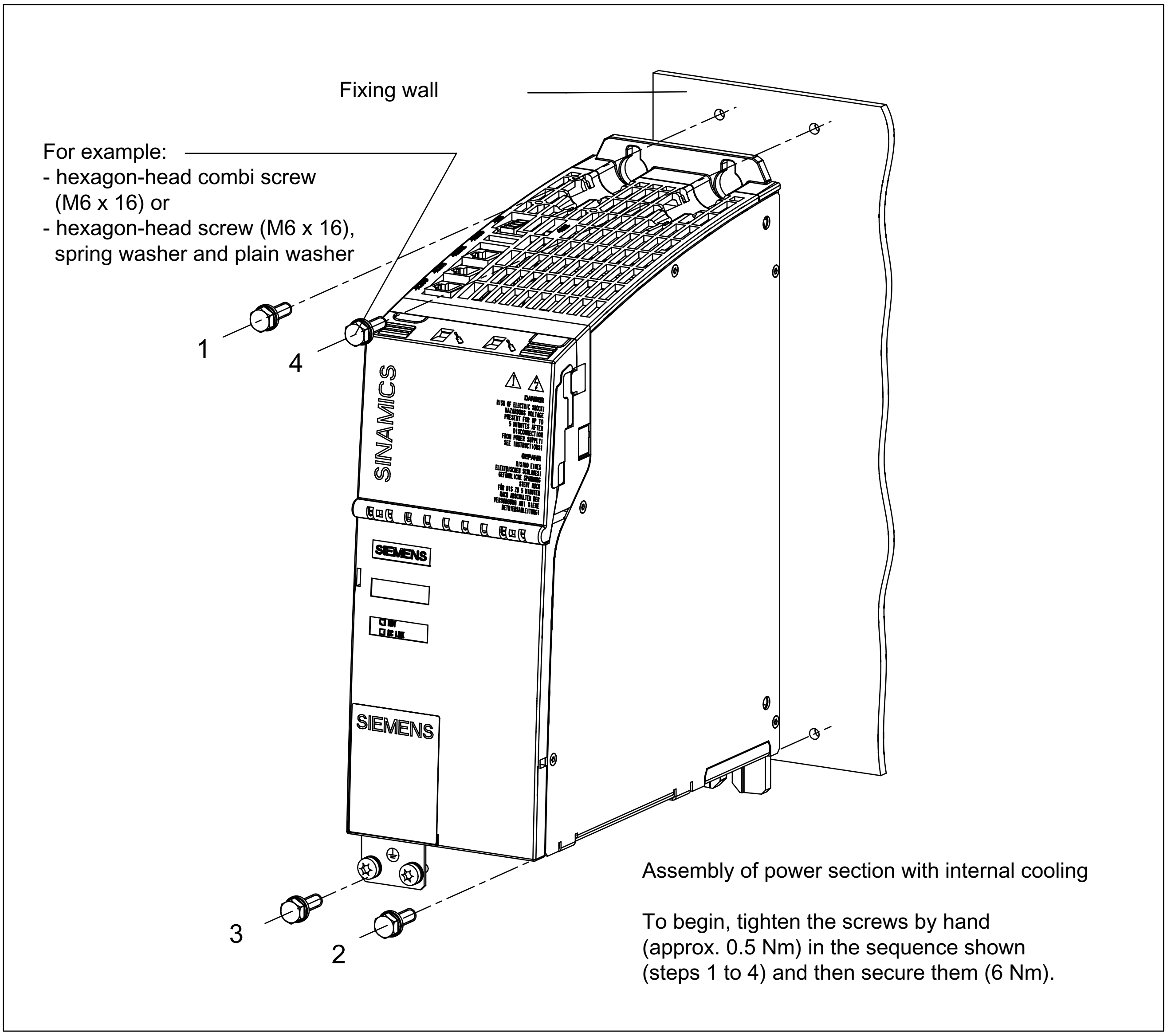


Figure 4-4 Installation: Smart Line Module Booksize Compact 16 kW with internal cooling

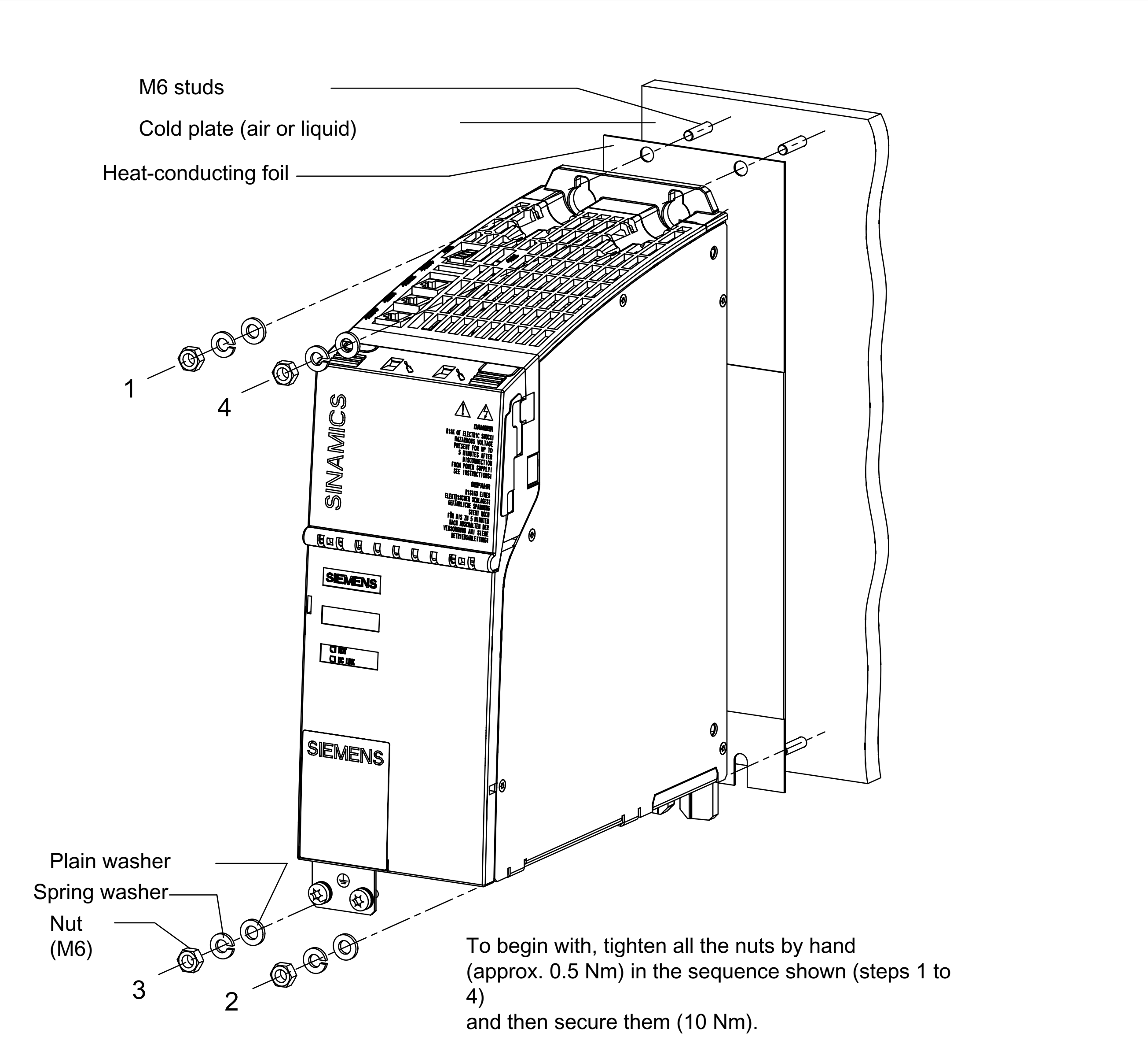


Figure 4-5 Installation: Smart Line Module Booksize Compact onto a cold plate

Special points to note in relation to installation onto 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. The installation position of the thermally conductive foil must be taken into account.

Note

When a component is replaced, the heat-conducting foil must also be replaced! Only heat-conducting foil approved or supplied by Siemens may be used.

	Order number
Heat-conducting foil, 100 mm	6SL3162-6FD01-0AA0

4.1.6 Technical data

Table 4- 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) Infeed power (S6-40%) 1) Peak infeed power 1)	 kW (Pn) kW (Ps6) kW (Pmax)	 16 21 35
Regenerative feedback Continuous regenerative power Peak regenerative power	 kW kW	 16 35
Supply voltages Rated voltage Line frequency Electronics power supply	 V_{AC} Hz V_{DC}	 3 AC 380 -10 % (-15 % < 1 min) to 3 AC 480 +10 % 47 to 63 24 (20.4 - 28.8)
DC link voltage Overvoltage trip Undervoltage trip 2)	V_{DC} V_{DC} V_{DC}	510 – 720 820 ± 2 % 360 ± 2 %
Input currents Rated input current at 400 V_{AC}: Input current at 380 V_{AC} / 480 V_{AC} at 400 V_{AC}; S6-40% at 400 V_{AC}; peak current	 A_{AC} A_{AC} A_{AC} A_{AC}	 27.5 29 / 24.5 35 57.5
DC link currents Rated DC link current at 600 V: DC link current at 540 V: at 600 V_{DC}; S6-40% at 600 V_{DC}; peak current	 A_{DC} A_{DC} A_{DC} A_{DC}	 27 30 35 59

Smart Line Module Booksize Compact	6SL3430–	6TE21-6AAx
Rated power	kW	16
Current carrying capacity DC link busbar Reinforced DC link busbar: 24 V busbar:	 A_{DC} A_{DC} A_{DC}	 100 150 20
Electronics current consumption at 24 V DC for internal air cooling for cold plate cooling	 A_{DC} A_{DC}	 0.95 0.85
Total power loss for internal air cooling (including electronics losses) 3)	W	187.8
Power loss distribution for cold plate (including electronics losses) 3) Internal External	W	 56.6 130
Max. ambient temperature Without derating With derating	 °C °C	 40 55
DC link capacitance Smart Line Module Drive line-up, max.	 µF µF	 705 6000
Power factor	cos ϕ	0.98
Circuit breaker (UL) Type designation Rated current: Resulting rated short-circuit current 5) SCCR at 480 V_{AC}:	 A kA	 3VL1135-2KM30 35 65
Safety fuse (UL) Type AJT Class J 4) Rated current Resulting rated short-circuit 5) current SCCR at 480 V_{AC}:	 A kA	 AJT35 35 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	70
Sound pressure level	dB(A)	<60
Weight	kg	5.3

1) The powers specified apply to the rated voltage range from 380 V to 480 V.
2) Default for 400 V supply systems; undervoltage trip threshold is adjusted to the parameterized rated voltage.
3) For an overview, see the power loss tables in chapter Control cabinet installation
4) Source of supply: Ferraz Shawmut, http://de.ferrazshawmut.com
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.

4.1.6.1 Characteristics

Rated duty cycles of Smart Line Modules

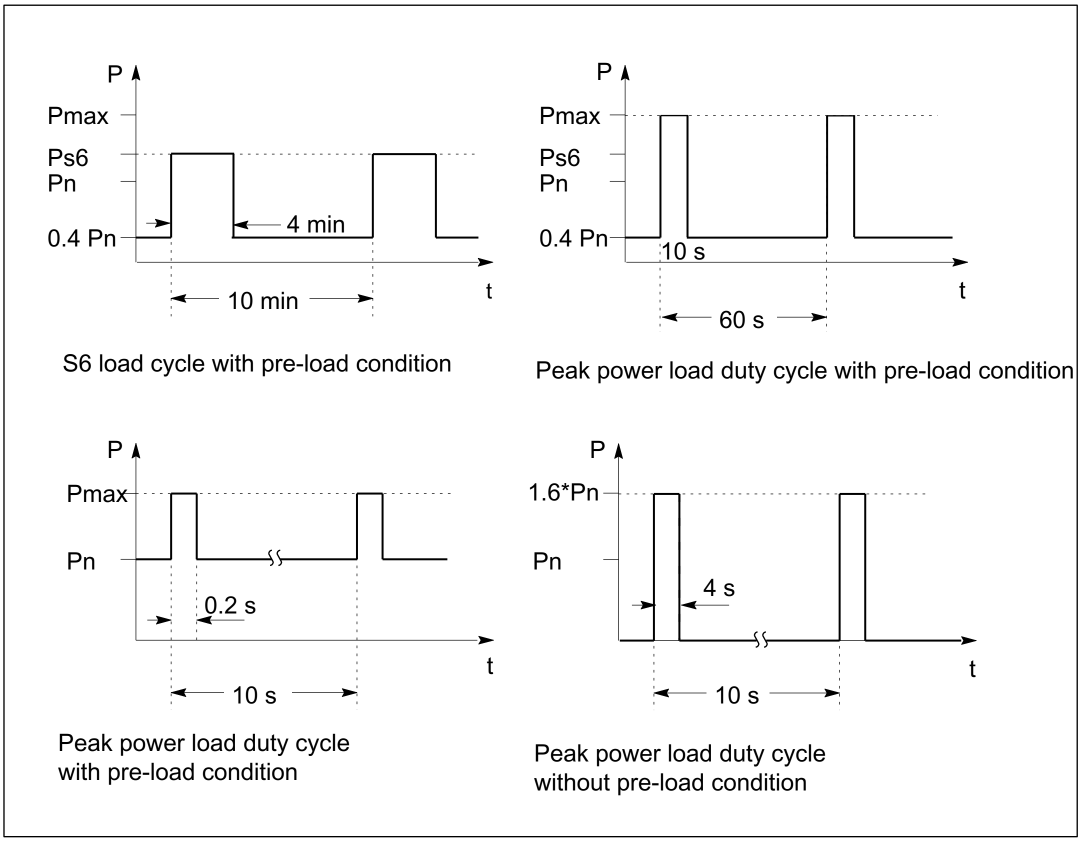


Figure 4-6 Rated duty cycles of Smart Line Modules

Derating characteristics

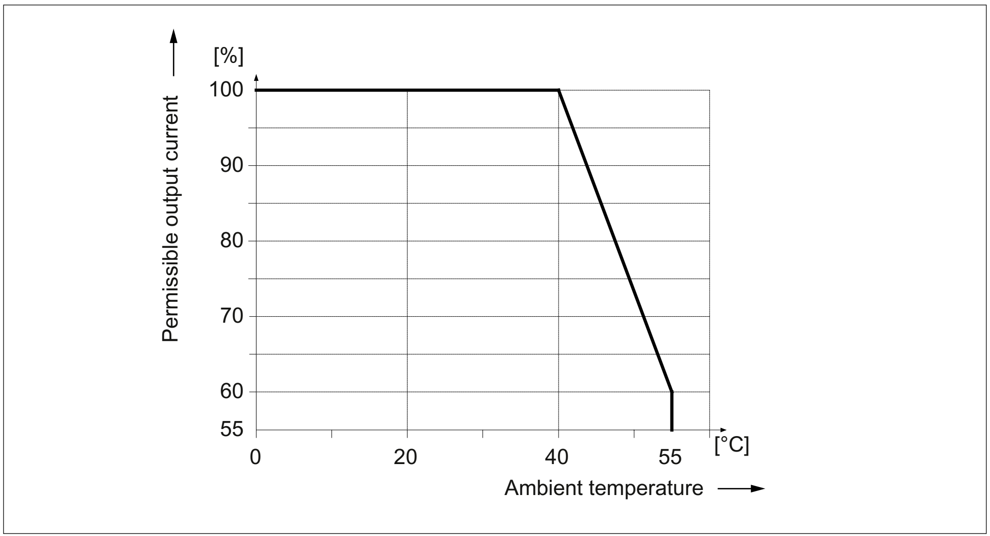


Figure 4-7 Output current as a function of the ambient temperature

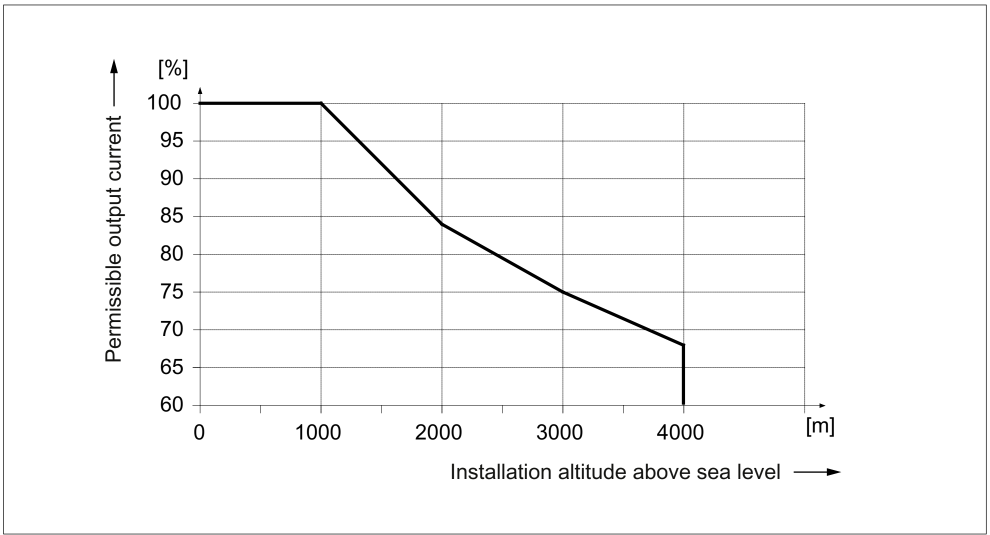


Figure 4-8 Output current as a function of the installation altitude

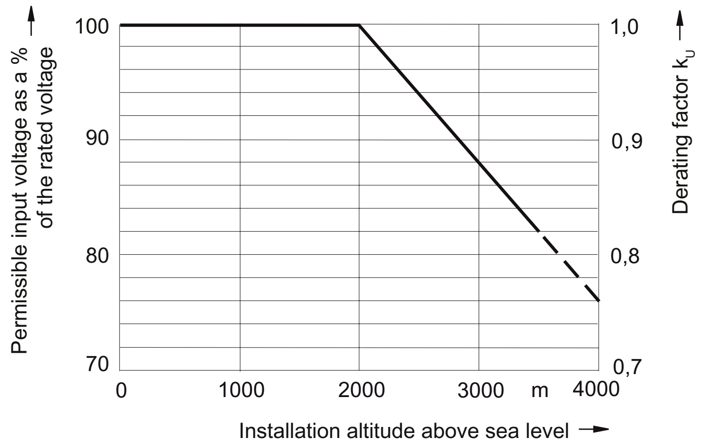


Figure 4-9 Voltage derating as a function of the installation altitude

Motor Modules Booksize 5

5.1 Motor Modules with internal air cooling

5.1.1 Description

A Motor Module is a power unit (inverter) that provides the power supply for the connected motor(s). Power is supplied by means of 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 two motors can be connected to Double Motor Modules.

5.1.2 Safety information

> **⚠ DANGER**
>
> **Risk of electric shock**
>
> A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
> The protective cover may only be opened after this time has expired.
>
> When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.
>
> The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

> **⚠ DANGER**
>
> **DC-link discharge voltage**
>
> A DC-link discharge voltage danger notice in the relevant national language must be attached to all of the components.
> A set of labels in 16 languages is supplied with the component.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC-link adapter and DC-link rectifier adapter).

DANGER

If a 50 mm wide Motor Module or a DC-link component with a similar width (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC-link bridge, including all of the screws, must be removed. It is not permissible to insert the screws without a DC-link bridge.

For all other power units and DC-link components (e. g. Capacitor Module) that are wider than 50 mm, it is neither permissible to move the DC-link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

DANGER

It is essential to apply the shield for the motor holding brake. Furthermore, only Motion-Connect cables must be used for integrated motor holding brakes, as otherwise insulation of the cores is not guaranteed. Risk of electric shock.

WARNING

Cable shields and unused power-cable cores (e.g. brake cores) must be connected to PE potential to dissipate capacitive cross-talk charges.

If this is not carefully observed, lethal shock voltages could result.

CAUTION

The cooling clearances of 80 mm above and below the components must be observed.

For the 132 A and 200 A Motor Modules, a cooling clearance of 50 mm must be observed in front of the fan.

CAUTION
The tightening torque of the DC-link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

CAUTION
Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION
Connecting cables to temperature sensors must always be installed with shielding. The cable shield must be connected to the chassis potential at both ends over a large surface area. Temperature-sensor cables that are routed together with the motor cable must be twisted in pairs and shielded separately.

CAUTION
DC-link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

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 V ± 10%) and the voltage drops of the connection cables must be taken into account.

The DC power supply should be set to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:

- Use of Siemens three-phase motors
- Use of Siemens MOTION-CONNECT power cables
- Motor cable lengths: max. 100 m

5.1.3 Interface description

5.1.3.1 Overview

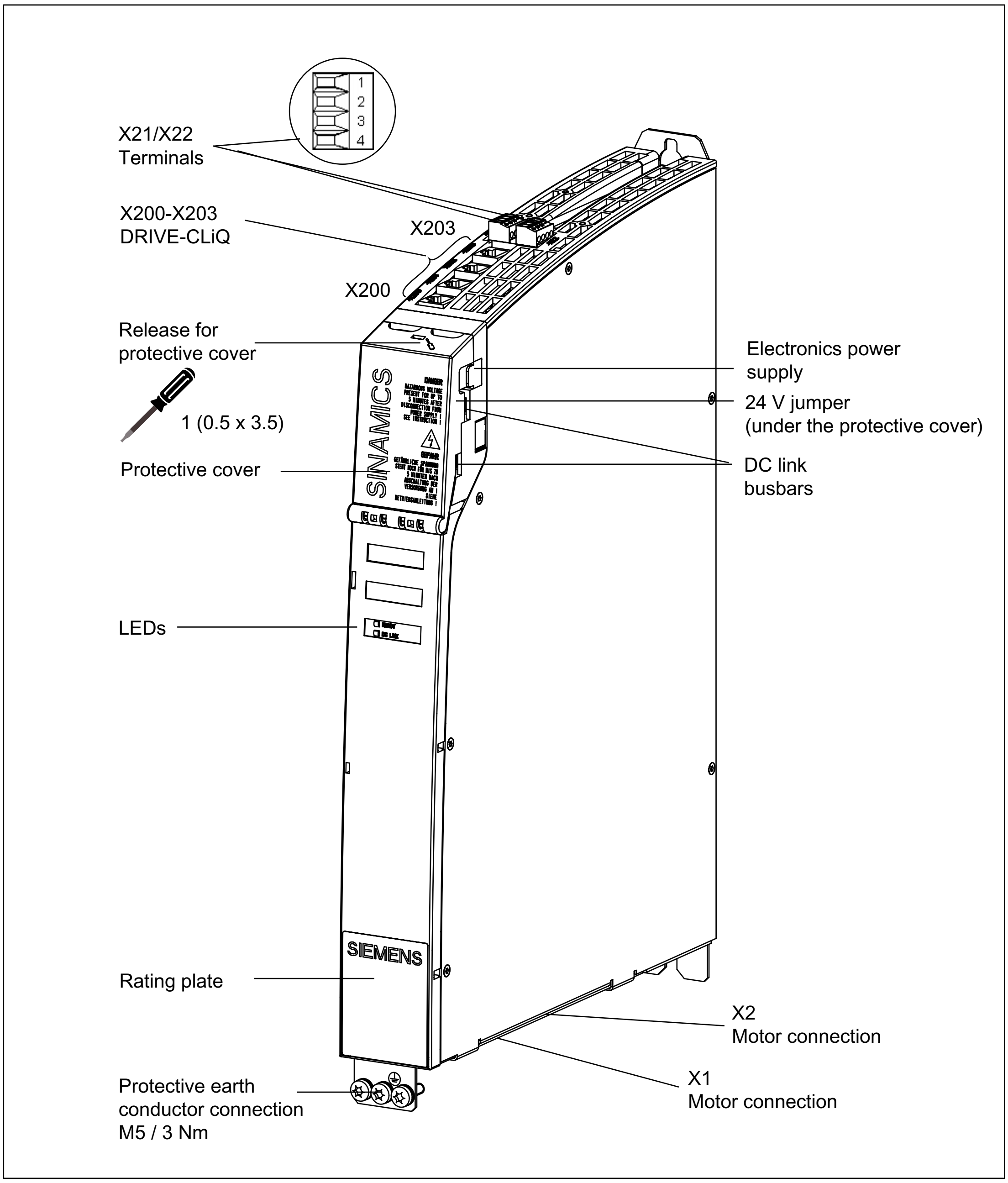


Figure 5-1 Example: Double Motor Module Booksize format with internal air cooling (2 x 3 A)

5.1.3.2 Connection examples

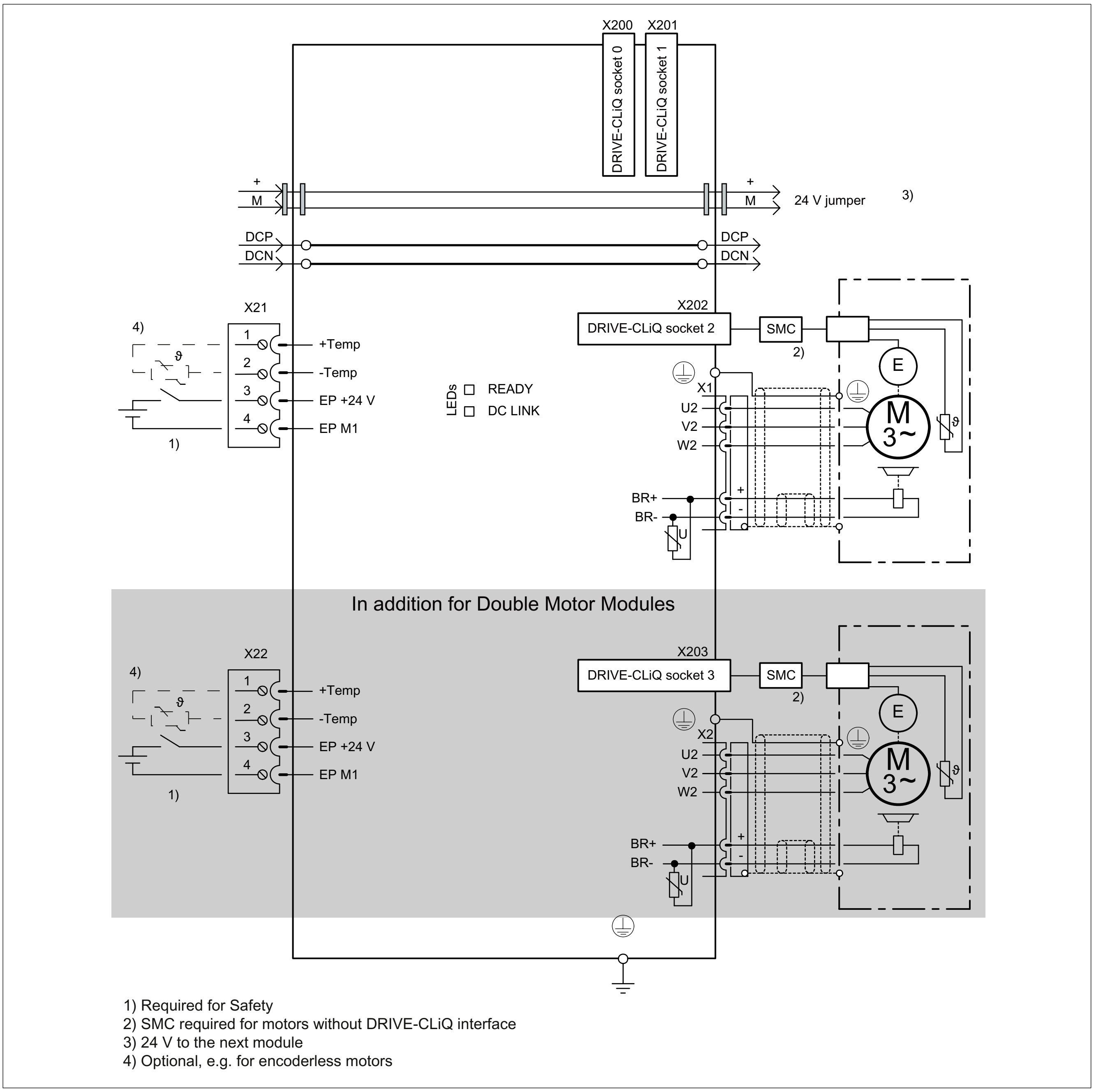
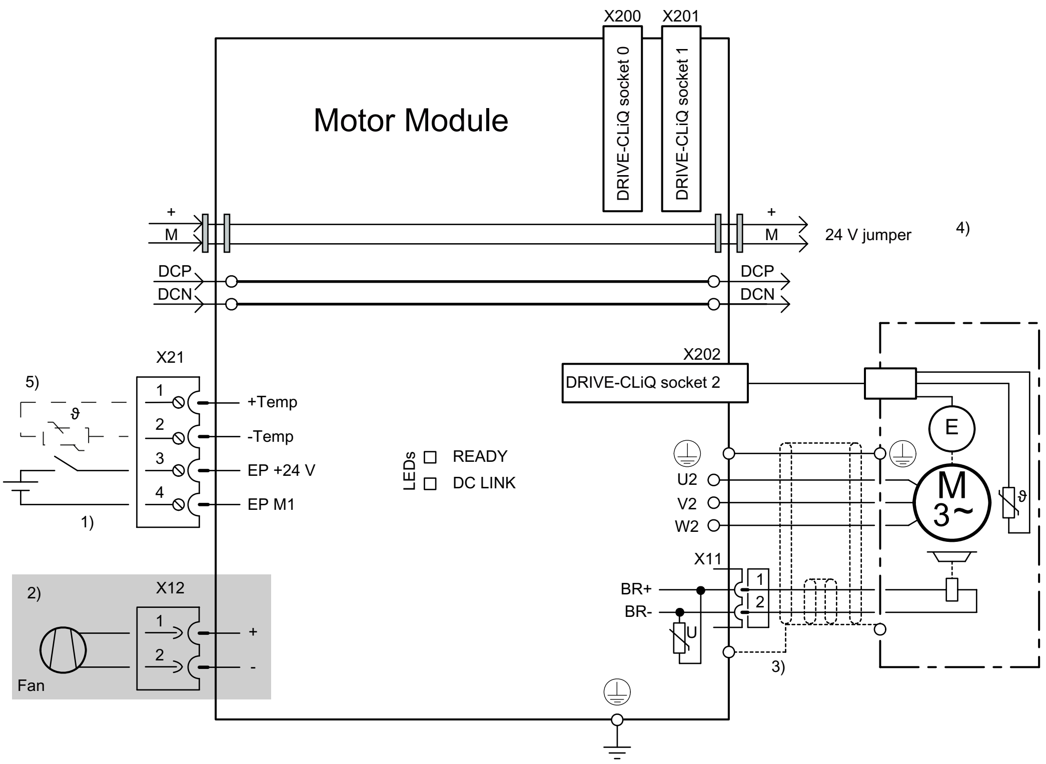


Figure 5-2 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

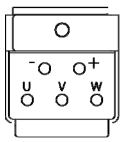
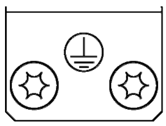


1) Required for Safety
2) In addition for Motor Modules 132 A to 200 A
3) Contact through the shield plate
4) 24 V to the next module
5) Optional, e.g. for encoderless motors

Figure 5-3 Example connection of Single Motor Modules 45 A to 200 A

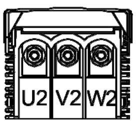
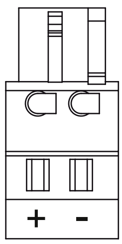
5.1.3.3 Motor/brake connection

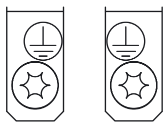
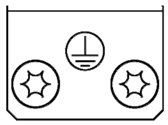
Table 5- 1 Terminal strip X1/X2 Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

	Terminal	Technical specifications
	U (U2)	Motor connection
	V (V2)	
	W (W2)	
	+ (BR+)	Brake connection max. load current 2 A min. load current 0.1 A
	- (BR-)	
	PE connection	Threaded hole M5/3 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

Table 5- 2 Terminal strip Single Motor Module 45 A to 200 A

	Terminals	Technical specifications
	U2	**45 A to 60 A:** Threaded bolt M6/6 Nm [1)] **85 A:** Threaded bolt M8/13 Nm [1)] **132 A to 200 A:** Threaded bolt M8/13 Nm [1)] (see chapter Connection methods)
	V2	
	W2	
	+ (BR+)	X11 brake connector [2)]: 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 (see chapter Connection methods) The brake connector is part of the pre-assembled cable
	- (BR-)	

	Terminals	Technical specifications
	PE connection	**Single Motor Module with a rated output current of 45 A to 60:** Threaded bolt for motor cables: M6/6 Nm 1) Threaded hole for PE: M6/6 Nm 1)
		**Single Motor Module with a rated output current of 85 A** Threaded bolt for motor cables: M8/13 Nm 1) Threaded hole for PE: M6/6 Nm 1) **Single Motor Module with a rated output current of 132 A to 200 A** Threaded bolt for motor cables: M8/13 Nm 1) Threaded hole for PE: M8/13 Nm 1)

1) For ring cable lugs in accordance with DIN 46234
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.

Note

The overall length of the power cables (motor supply cables and DC-link cables) must not exceed the values given in chapter "Possible line reactor and line filter combinations".

Note

The motor brake must be connected via connector X11. The BR- cable must not be connected directly to electronic ground (M).

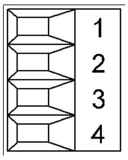
WARNING

Only protective extra-low voltages (DVC A) that comply with EN 60204-1 must be connected to all connections and terminals between 0 and 48 VDC.

The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.

5.1.3.4 X21/X22 EP terminals / temperature sensor Motor Module

Table 5- 3 Terminal strip X21/X22

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V - 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)	
Max. connectable cross-section 1.5 mm² Type: Screw terminal 1 (see chapter Connection methods)			

NOTICE

The KTY temperature sensor must be connected with the correct polarity.

NOTICE

The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

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).

DANGER

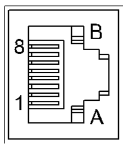
Risk of electric shock!

Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), a Sensor Module External (SME120 or SME125) or Terminal Module TM120 must be used.

If these instructions are not complied with, there is a risk of electric shock!

5.1.3.5 X200-X203 DRIVE-CLiQ interface

Table 5- 4 DRIVE-CLiQ interface X200-X202: Single Motor Module
DRIVE-CLiQ interface X200-X203: Double Motor Module

	Pin	Name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces included in the scope of delivery; blanking plate (50 pieces) Order number: 6SL3066-4CA00-0AA0			

5.1.3.6 Meaning of the LEDs on the Motor Module

Table 5- 5 Single Motor Module / Double Motor Module / Power Module - description of the LEDs

Status		Description, cause	Remedy
Ready (H200)	DC link (H201)		
OFF	OFF	Electronics power supply is missing or outside permissible tolerance range.	–
Green	OFF	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.	Check supply voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/red (0.5 Hz)	–	Firmware is being downloaded.	–
Green/red (2 Hz)	-	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	–	Component detection via LED is activated (p0124). **Note:** Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC link" LED.
The warning information on the components must be carefully observed!

5.1.4 Dimension drawings

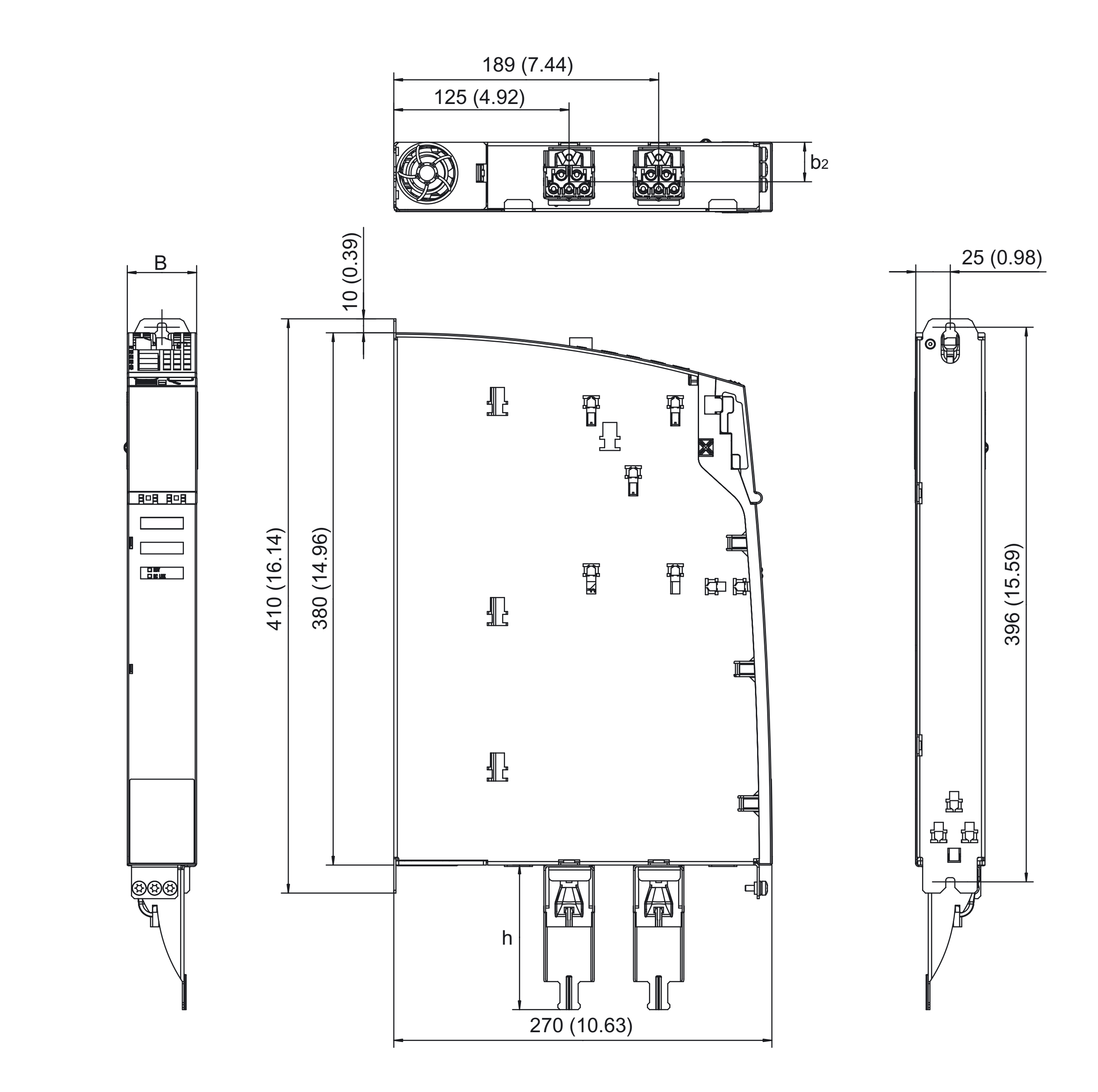


Figure 5-4 Dimension drawing of Motor Module in booksize format with internal air cooling 3 A to 18 A and 2 x 3 A to 2 x 9 A, all dimensions in mm and (inches)

Table 5- 6 Dimensions of Motor Module in booksize format with internal air cooling 3 A to 18 A and 2 x 3 A to 2 x 9 A

Motor Module type	Order number	W [mm] (inches)	w_2 [mm] (inches)	h [mm] (inches)
Single Motor Module 3 A	6SL3120-1TE13-0AAx	50 (1.97)	28 (1.10)	89 (3.50)
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			

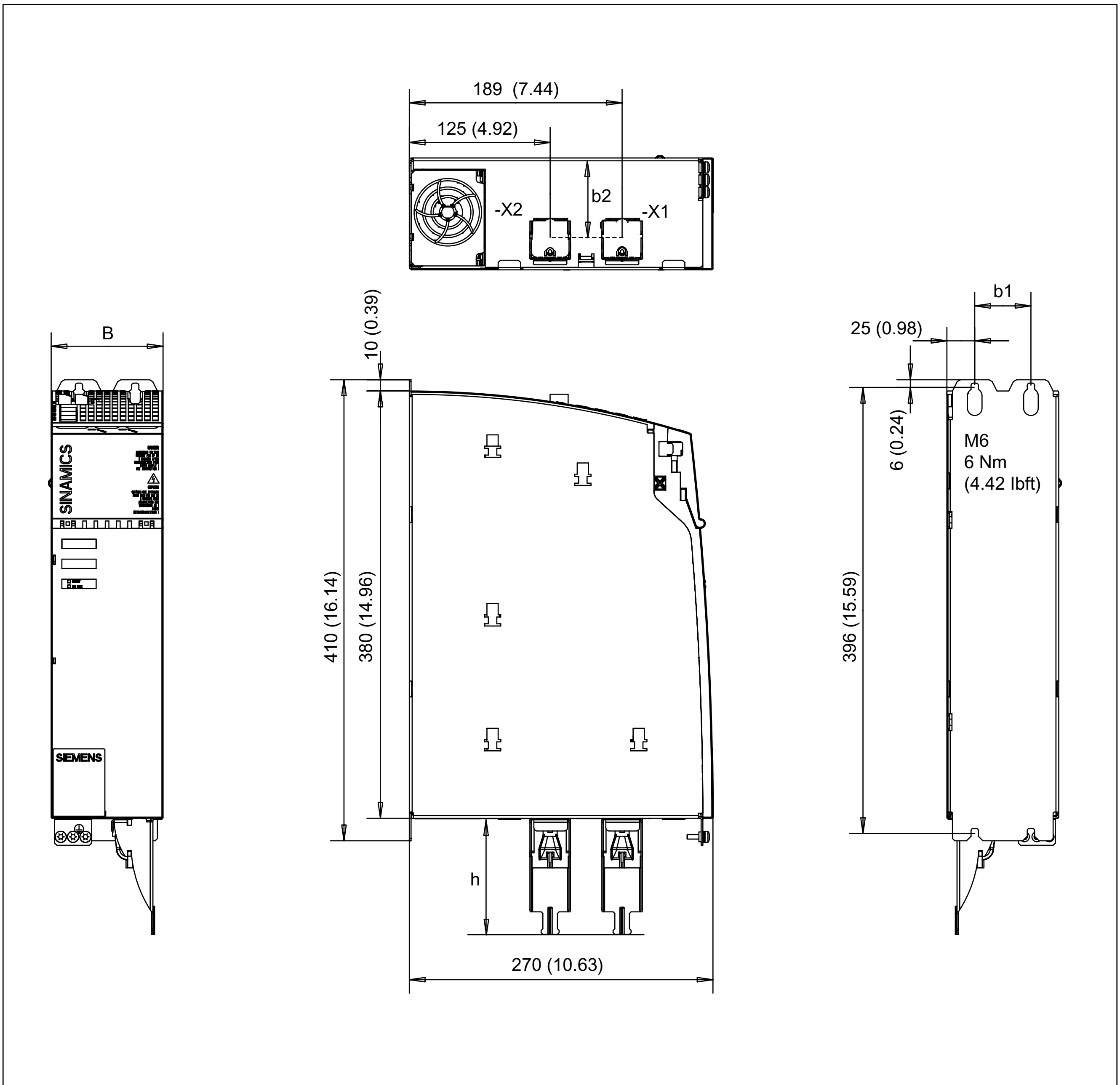


Figure 5-5 Dimension drawing of Motor Module in booksize format with internal air cooling 30 A and 2 x 18 A, all dimensions in mm and (inches)

Table 5- 7 Dimensions of Motor Module in booksize format with internal air cooling 30 A and 2 x 18 A

Motor Module type	Order number	W [mm] (inches)	w_1 [mm] (inches)	w_2 [mm] (inches)	h [mm] (inches)
Single Motor Module 30 A	6SL3120-1TE23-0AAx	100 (3.94)	50 (1.97)	78 (3.07)	89 (3.50)
Double Motor Module 18 A	6SL3120-2TE21-8AAx				

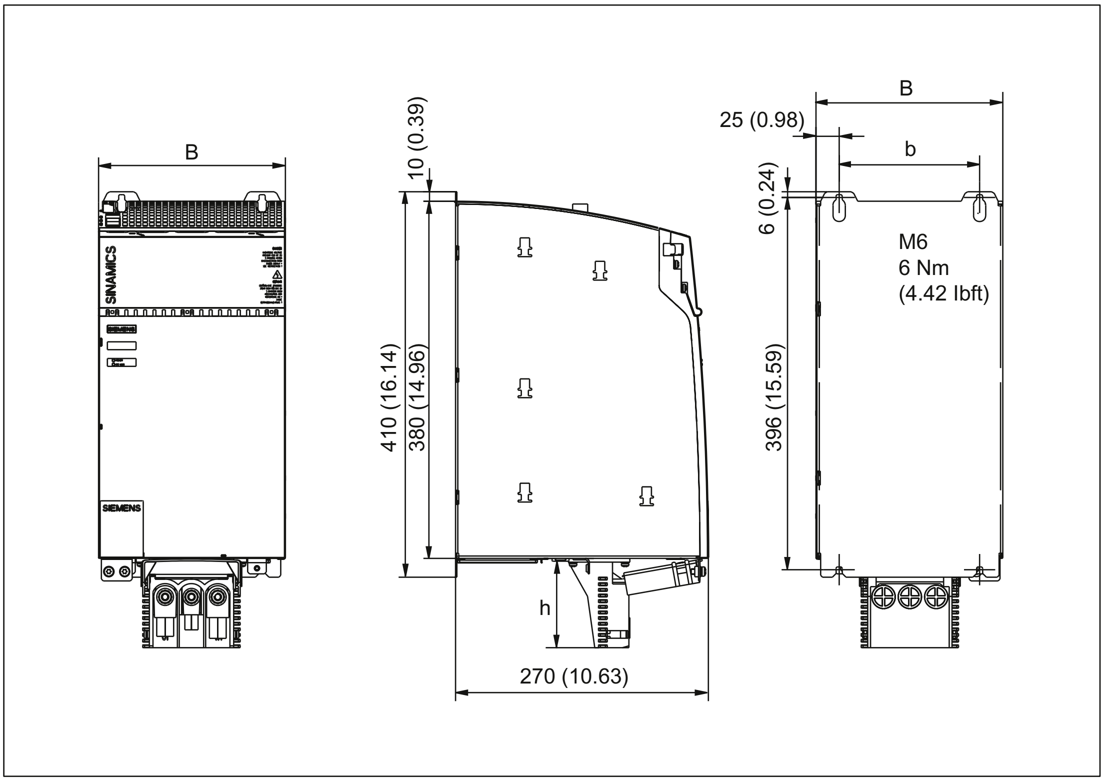


Figure 5-6 Dimension drawing of Motor Module in booksize format with internal air cooling 45 A to 85 A, all dimensions in mm and (inches)

Table 5- 8 Dimensions of Motor Module in booksize format with internal air cooling 45 A to 85 A

Motor Module type	Order number	W [mm] (inches)	b [mm] (inches)	h [mm] (inches)
Single Motor Module 45 A	6SL3120-1TE24-5AAx	150 (5.91)	100 (3.94)	105 (4.13)
Single Motor Module 60 A	6SL3120-1TE26-0AAx			
Single Motor Module 85 A	6SL3120-1TE28-5AAx	200 (7.87)	150 (5.91)	105 (4.13)

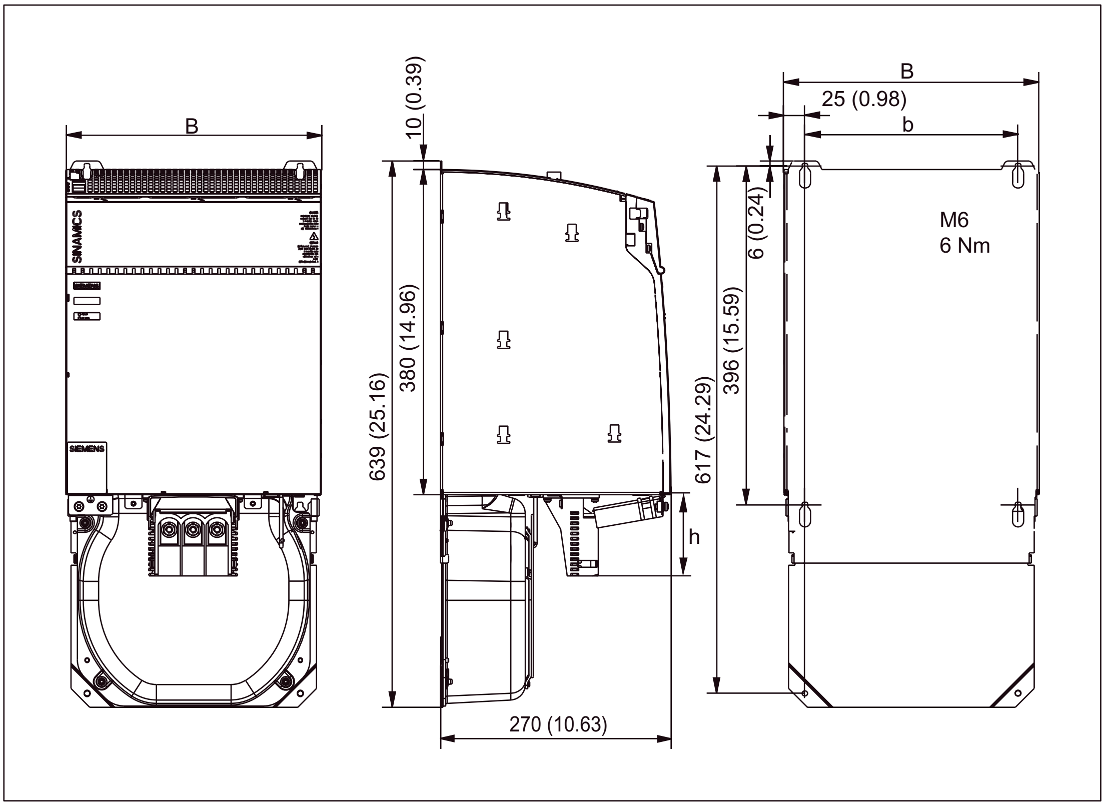


Figure 5-7 Dimension drawing of Motor Module in booksize format with internal air cooling 132 A and 200 A, all dimensions in mm and (inches)

Table 5- 9 Dimensions of Motor Module in booksize format with internal air cooling 132 A and 200 A

Motor Module type	Order number	W [mm] (inches)	b [mm] (inches)	h [mm] (inches)
Single Motor Module 132 A	6SL3120-1TE31-3AAx	300 (11.81)	250 (9.84)	105 (4.13)
Single Motor Module 200 A	6SL3120-1TE32-0AAx			

5.1.5 Installation

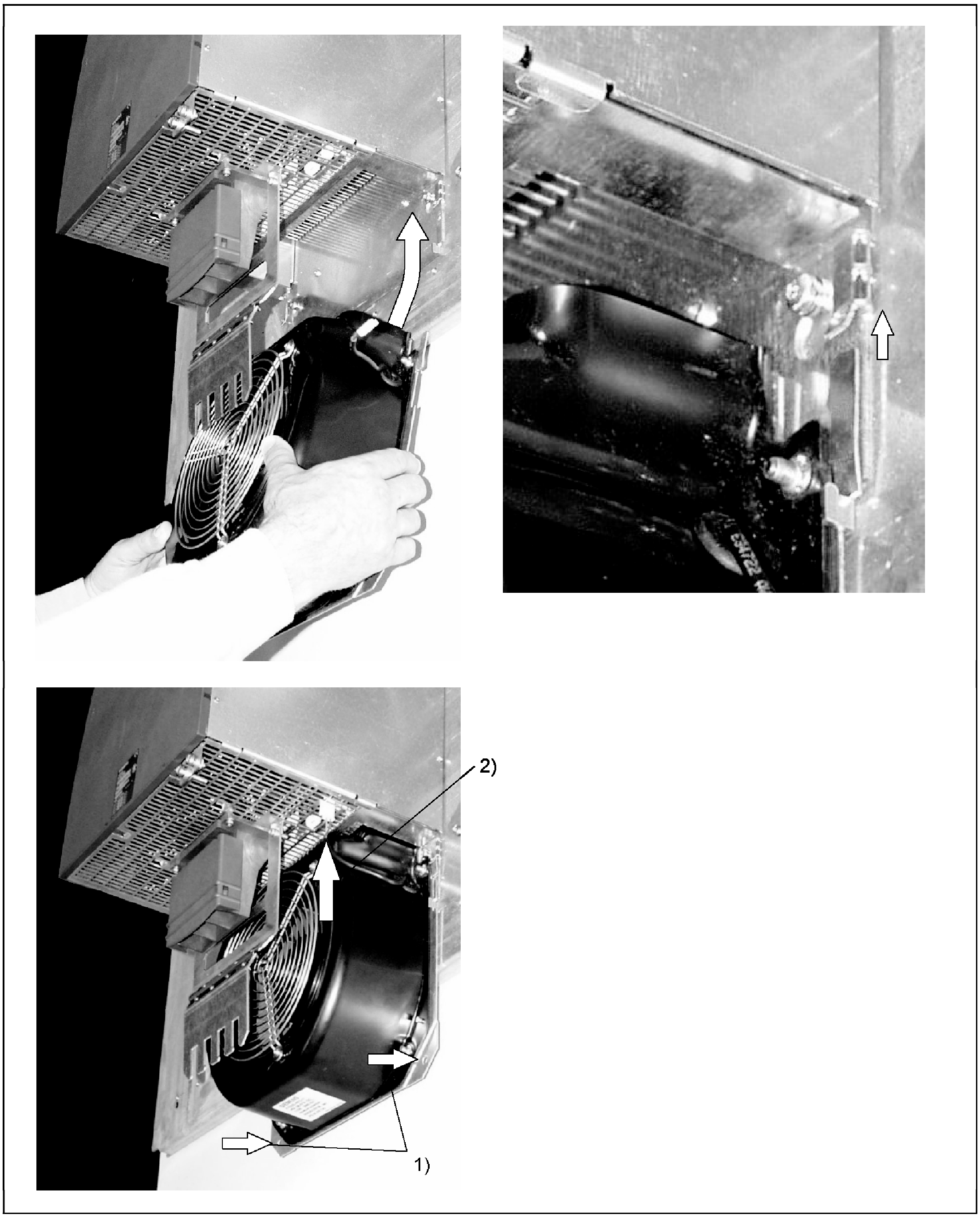


Figure 5-8 Installing the fan for 300 mm modules

1) Secure with M6 / 6 Nm screws

2) Connect the power supply for the fan

Note

The fans are power-up and power-down as a function of the heatsink temperature.

The fans start up at the heat-sink temperature specified in the power stack data (normally 56°C) and are switched off with a slight hysteresis when the heat-sink temperature decreases again. The length of time it takes for the fans to stop once they have been switched off depends on a number of factors (ambient temperature, output current, duty cycle, etc.) and, therefore, cannot be determined directly.

The fans are not equipped with temperature-dependent speed control; Only the states on or off exist.

5.1.6 Technical data

Table 5- 10 Technical data Single Motor Modules Booksize (3 to 30 A)

Internal air cooling	6SL3120–	1TE13-0AAx	1TE15-0AAx	1TE21–0AAx	1TE21–8AAx	1TE23-0AAx
Rated current	A	3	5	9	18	30
Voltage						
Infeed DC link voltage Electronics power supply	 V_{DC} V_{DC}	 510 – 720 24 (20.4 – 28.8)				
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage				
Overvoltage trip Undervoltage trip [1]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %				
Current						
Electronics current consumption at 24 V DC	A_{DC}	0.85	0.85	0.85	0.85	0.8
Rated output current (I_n)	A_{ACrms}	3	5	9	18	30
Base-load current (I_{base})	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
Current carrying capacity DC link busbar Reinforced DC link busbars 24 V busbar	 A_{DC} A_{DC} A_{DC}	 100 150 20				
Power						
Rated power (with DC link voltage of 600 V_{DC} and pulse frequency of 4 kHz)	kW	1.6	2.7	4.8	9.7	16
Total power loss (including electronics losses) [2]	W	50.4	75.4	100.4	185.4	311.6
Max. pulse frequency Without derating With derating	 kHz kHz	 4 16				
Max. ambient temperature Without derating With derating	 °C °C	 40 55				
DC link capacitance	µF	110	110	110	220	705
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
Weight	kg	5	5	5	5	6.9

1) Default for 400 V supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized rated voltage

2) For an overview, see the power loss tables in chapter Control cabinet installation

Table 5- 11 Technical data Single Motor Modules Booksize (45 to 200 A)

Internal air cooling	6SL3120–	1TE24-5AAx	1TE26-0AAx	1TE28-5AAx	1TE31-3AAx	1TE32-0AAx
Rated current	**A**	**45**	**60**	**85**	**132**	**200**
Voltage						
Infeed DC link voltage Electronics power supply	 V_{DC} V_{DC}	 510 – 720 24 (20.4 – 28.8)				
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage				
Overvoltage trip Undervoltage trip [1]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %				
Current						
Electronics current consumption at 24 V DC	A_{DC}	1.05	1.05	1.5	0.85	0.85
Rated output current (I_n)	A_{ACrms}	45	60	85	132	200
Base-load current (I_{base})	A	38	51	68	105	141
Intermittent duty current (I_{s6}) 40%	A_{ACrms}	60	80	110	150	230
Peak current (I_{max})	A_{ACrms}	85	113	141	210	282
Current carrying capacity DC link busbar 24 V busbar	 A_{DC} A_{DC}	 100 / 200 [2] 20	 100 / 200 [2] 20	 200 20	 200 20	 200 20
Power						
Rated power (with DC link voltage of 600 V_{DC} and clock frequency of 4 kHz)	kW	24	32	46	71	107
Total power loss (including electronics losses) [3]	W	458.8	618.8	786	1286	2086
Max. pulse frequency Without derating With derating	 kHz kHz	 4 16				
Max. ambient temperature Without derating With derating	 °C °C	 40 55				
DC link capacitance	µF	1175	1410	1880	2820	3995
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
Weight	kg	9	9	15	21	21

1) Default for 400 V supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V (exception: 132 A and 200 A Motor Modules) and is adjusted to the parameterized rated voltage
2) For components where the final digit in the order number is ≥ 3.
3) For an overview, see the power loss tables in chapter Control cabinet installation

Table 5- 12 Technical data Double Motor Modules Booksize (3 to 18A)

Internal air cooling	6SL3120-	2TE13-0AAx	2TE15-0AAx	2TE21-0AAx	2TE21-8AAx
Rated current	A	2x3	2x5	2x9	2x18
Voltage					
Infeed DC link voltage Electronics power supply	 V_{DC} V_{DC}	 510 – 720 24 (20.4 – 28.8)			
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage			
Overvoltage trip Undervoltage trip [1]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %			
Current					
Electronics current consumption at 24 V DC	A_{DC}	1.15	1.15	1.15	1.3
Rated output current (I_n)	A	2x3	2x5	2x9	2x18
Base-load current (I_{base})	A	2x2.6	2x4.3	2x7.7	2x15.3
Intermittent duty current (I_{S6}) 40%	A_{ACrms}	2x3.5	2x6	2x10	2x24
Peak current (I_{max})	A_{ACrms}	2x6	2x10	2x18	2x36
Current carrying capacity DC link busbar Reinforced DC link busbars 24 V busbar	 A_{DC} A_{DC} A	 100 150 20			
Power					
Rated power (600 V, 4 kHz)	kW	1.6	2.7	4.8	9.7
Total power loss (including electronics losses) [2]	W	94	129	184	344
Max. pulse frequency Without derating With derating	 kHz kHz	 4 16			
Max. ambient temperature Without derating With derating	 °C °C	 40 55			
DC link capacitance	µF	110	220	220	705
Sound pressure level	dBA	<60	<60	<60	<60
Cooling method		Internal fan			
Cooling air requirement	m^3/h	29.6	29.6	29.6	56
Weight	kg	5.3	5.3	5.5	6.8

1) Default for 400 V supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized rated voltage

2) For an overview, see the power loss tables in chapter Control cabinet installation

5.1.6.1 Characteristics

Rated duty cycles Motor Modules Booksize

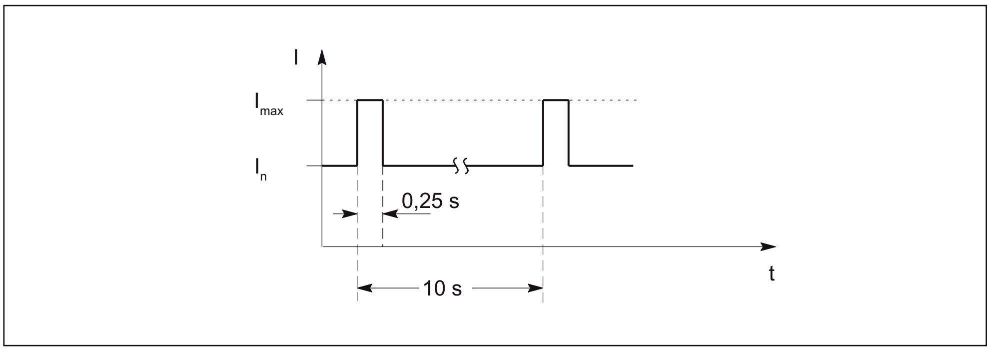


Figure 5-9 Duty cycle with initial load (for servo drives)

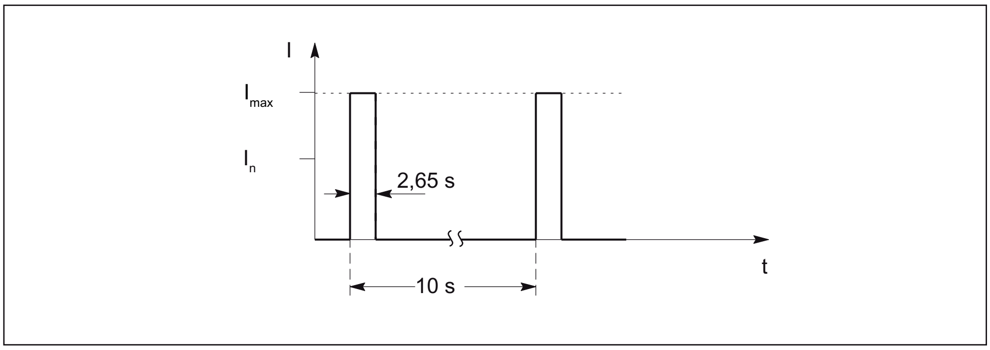


Figure 5-10 Duty cycle without initial load (for servo drives)

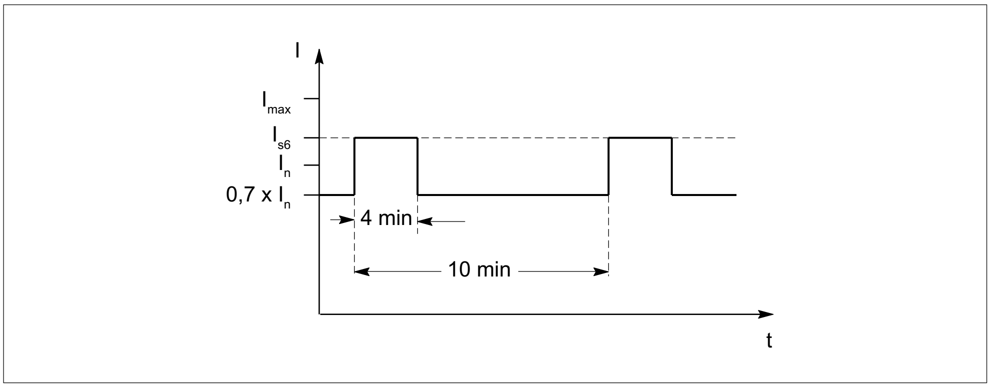


Figure 5-11 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

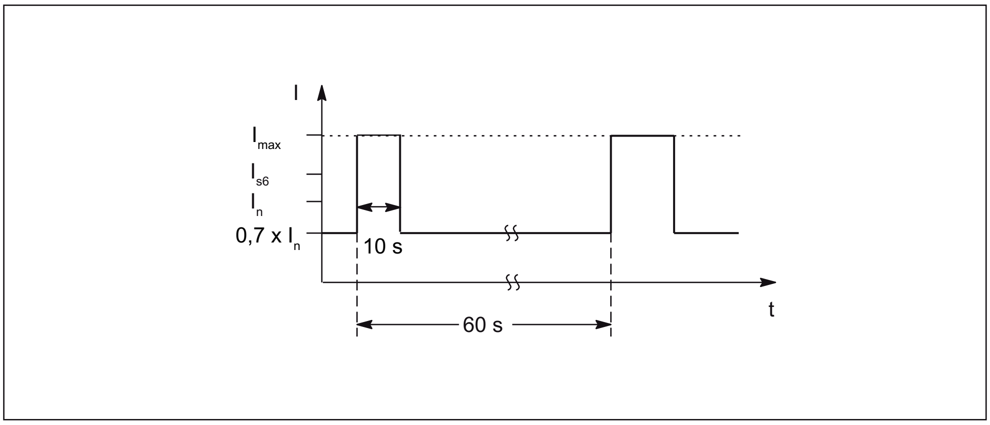


Figure 5-12 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

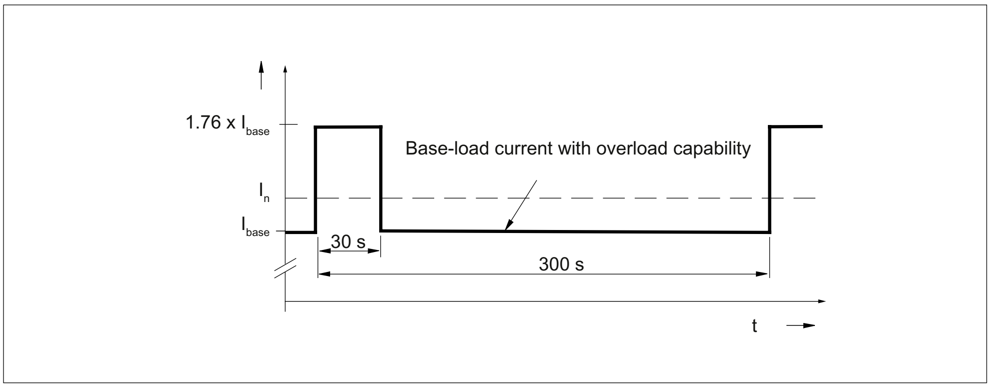


Figure 5-13 Duty cycle with 30 s overload with a duty cycle duration of 300 s

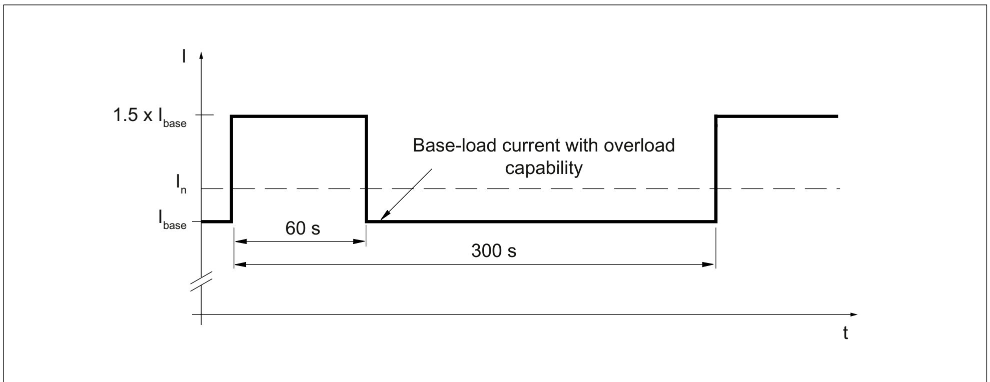


Figure 5-14 Duty cycle with 60 s overload with a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize

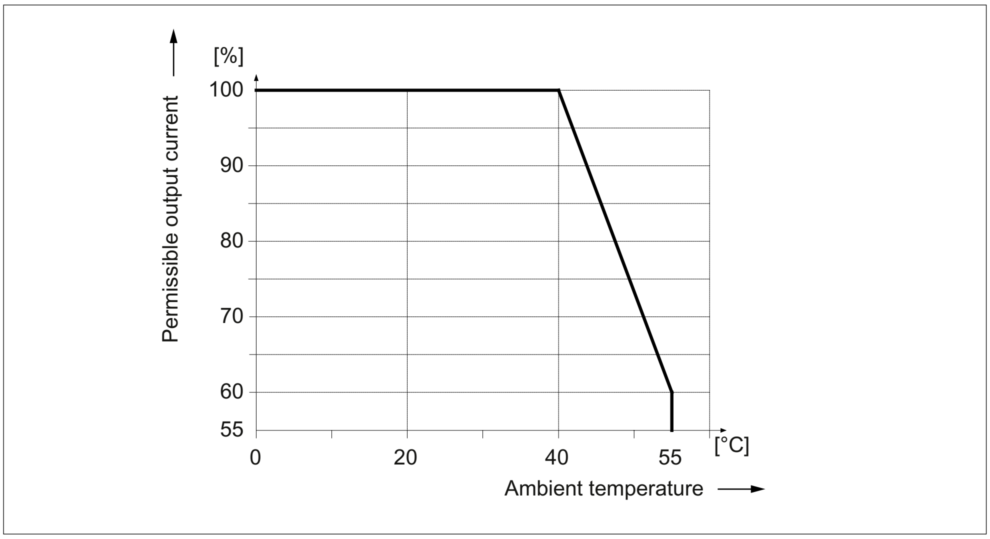


Figure 5-15 Output current as a function of the ambient temperature

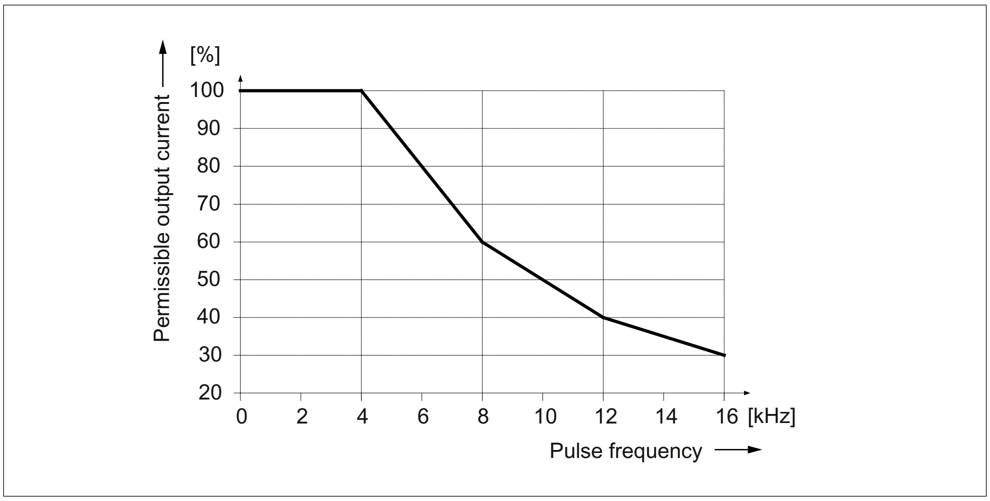


Figure 5-16 Output current as a function of the pulse frequency

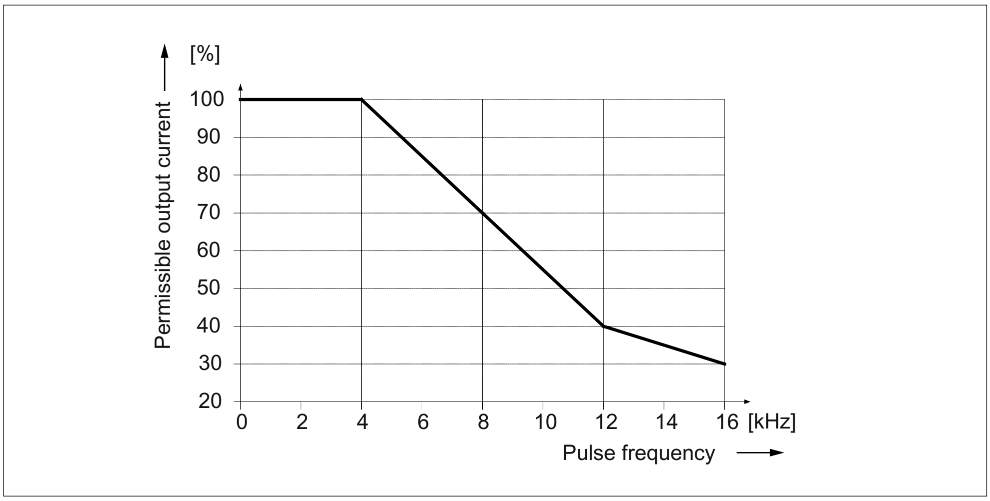


Figure 5-17 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

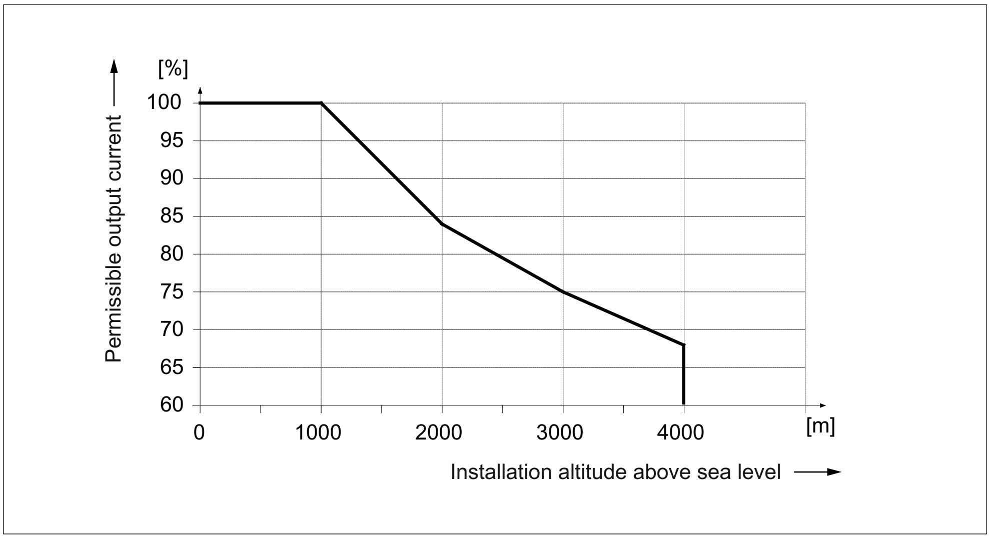


Figure 5-18 Output current as a function of the installation altitude

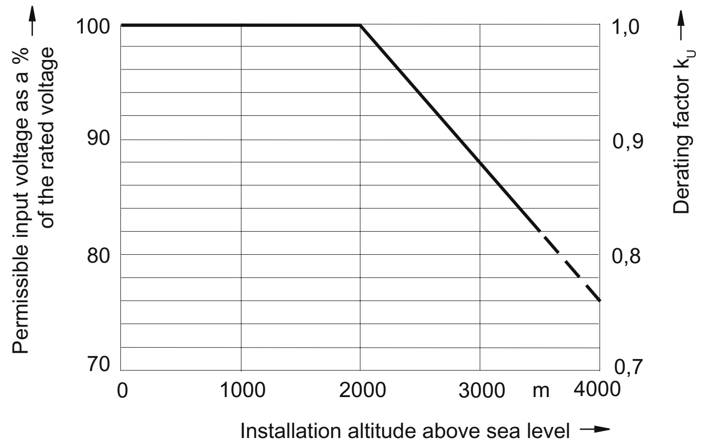


Figure 5-19 Voltage derating as a function of the installation altitude

5.2 Motor Module with external air cooling

5.2.1 Description

A Motor Module with external air cooling is a power unit (inverter) that provides the power supply for the connected motor(s). Power is supplied by means of 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 two motors can be connected to Double Motor Modules.

External air cooling uses the "through-hole" method. This is a cooling method for SINAMICS power units that is only available for booksize devices. 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 supply) project beyond the rear of the control cabinet and the heat is dissipated outside the control cabinet or in a separate air duct.

5.2.2 Safety information

DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

DANGER

DC-link discharge voltage

A DC-link discharge voltage danger notice in the relevant national language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC-link adapter and DC-link rectifier adapter).

DANGER

If a 50 mm wide Motor Module or a DC-link component with a similar width (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC-link bridge, including all of the screws, must be removed. It is not permissible to insert the screws without a DC-link bridge.

For all other power units and DC-link components (e. g. Capacitor Module) that are wider than 50 mm, it is neither permissible to move the DC-link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

DANGER

It is essential to apply the shield for the motor holding brake. Furthermore, only Motion-Connect cables must be used for integrated motor holding brakes, as otherwise insulation of the cores is not guaranteed. Risk of electric shock.

WARNING

Cable shields and unused power-cable cores (e.g. brake cores) must be connected to PE potential to dissipate capacitive cross-talk charges.

If this is not carefully observed, lethal shock voltages could result.

CAUTION

The cooling clearances of 80 mm above and below the components must be observed.

CAUTION

The tightening torque of the DC-link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

CAUTION

Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION

Connecting cables to temperature sensors must always be installed with shielding. The cable shield must be connected to the chassis potential at both ends over a large surface area. Temperature-sensor cables that are routed together with the motor cable must be twisted in pairs and shielded separately.

CAUTION

DC-link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

NOTICE

The external air cooling can cause the fans and the heat sink to become heavily contaminated, which may trigger the temperature monitor in the power unit. The fans and heat sink must be checked for contamination at regular intervals and, if necessary, cleaned.

Note

After installation, the seal on the rear of the device must be checked to ensure that it is tight. Additional sealing can be used, if necessary.

Note

The mounting frames can only be used if the cabinet has an unpainted metal surface.

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 V ± 10%) and the voltage drops of the connection cables must be taken into account.

The DC power supply should be set to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:

- Use of Siemens three-phase motors
- Use of Siemens MOTION-CONNECT power cables
- Motor cable lengths: max. 100 m

5.2.3 Interface description

5.2.3.1 Overview

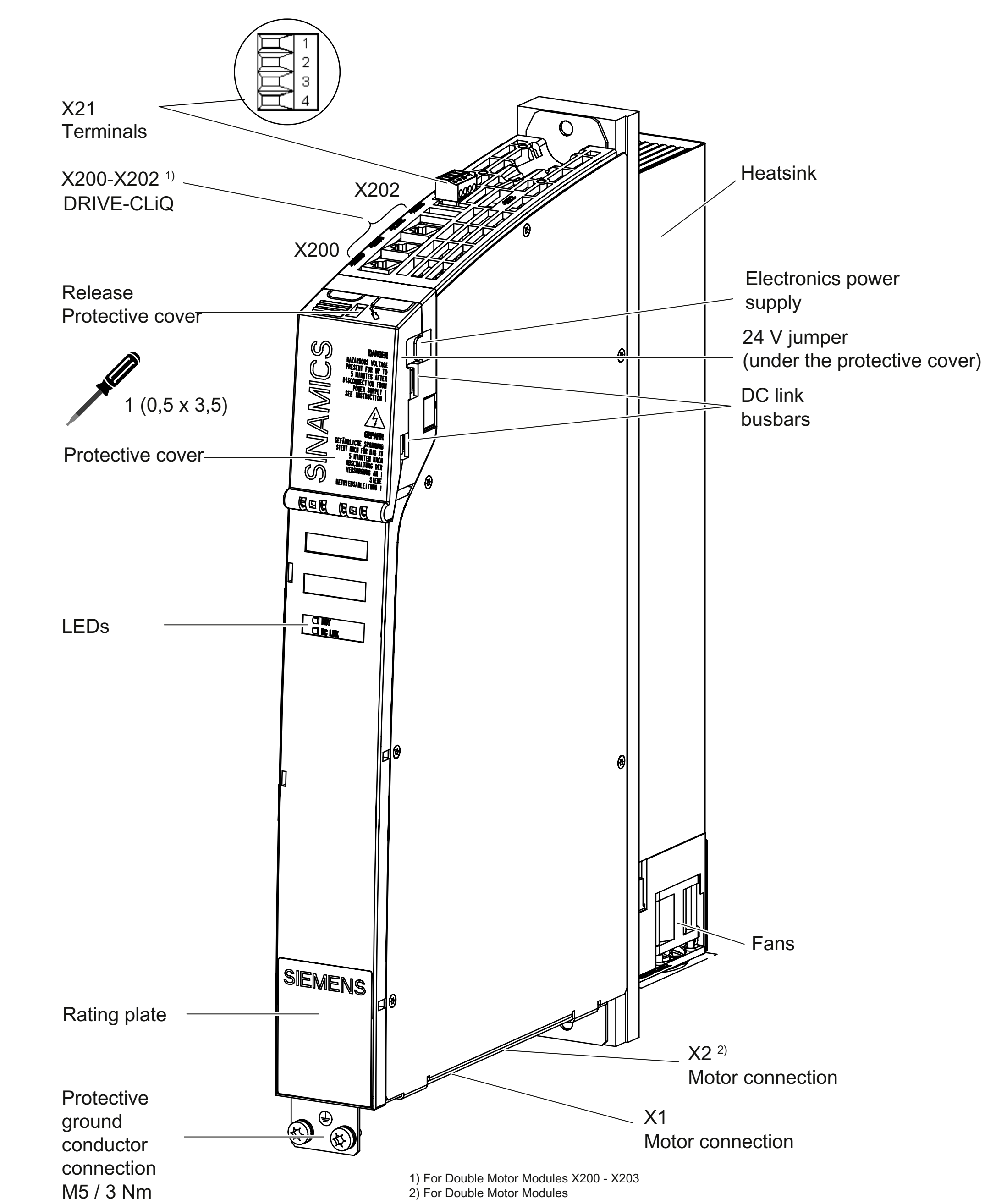
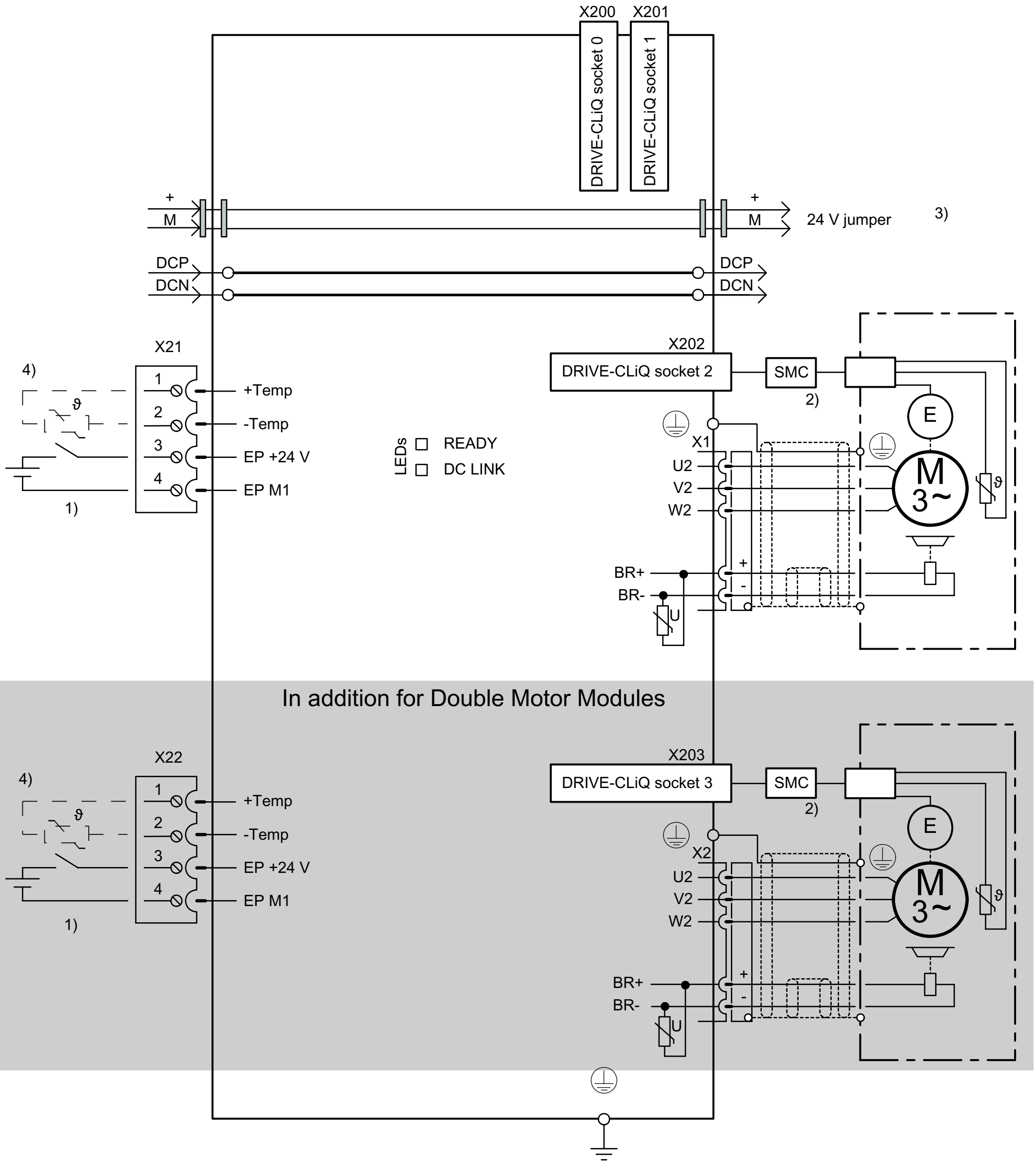


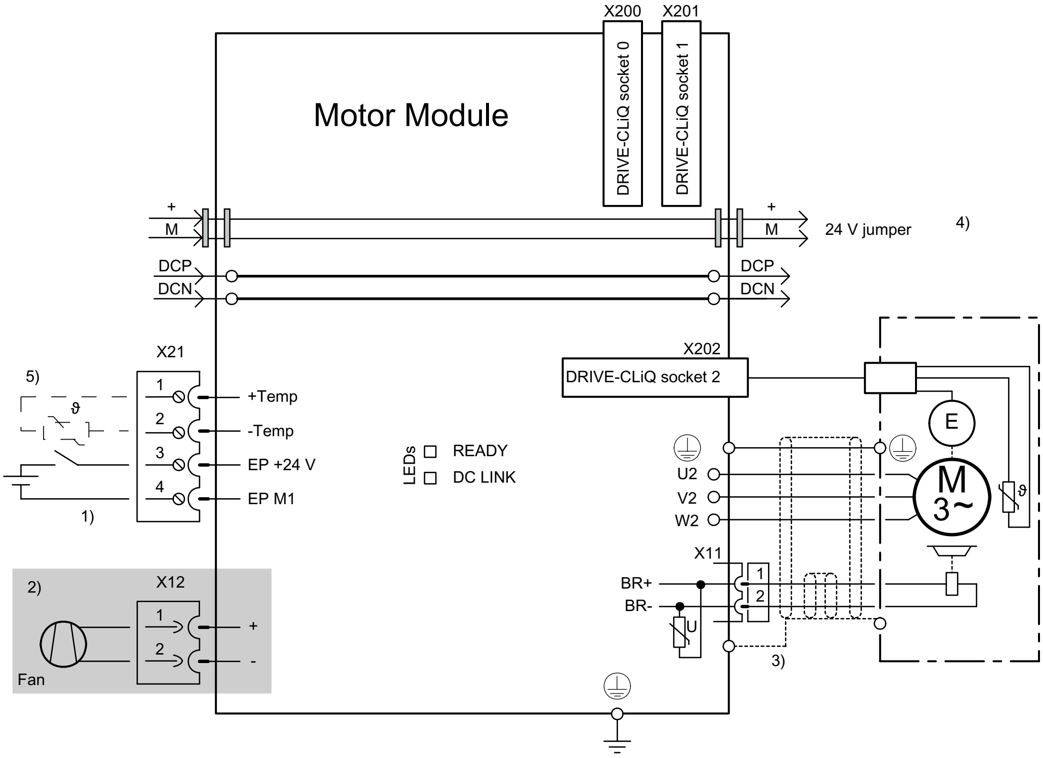
Figure 5-20 Example: Single Motor Module with external air cooling (5 A)

5.2.3.2 Connection examples



1) Required for Safety
2) SMC required for motors without DRIVE-CLiQ interface
3) 24 V to the next module
4) Optional, e.g. for encoderless motors

Figure 5-21 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

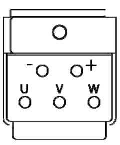
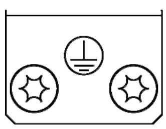


1) Required for Safety
2) In addition for Motor Modules 132 A to 200 A
3) Contact through the shield plate
4) 24 V to the next module
5) Optional, e.g. for encoderless motors

Figure 5-22 Example connection of Single Motor Modules 45 A to 200 A

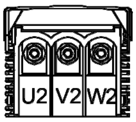
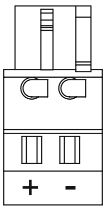
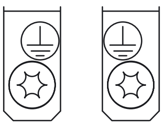
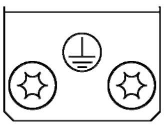
5.2.3.3 Motor/brake connection

Table 5- 13 Terminal strip X1/X2 Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

	Terminal	Technical specifications
	U (U2)	Motor connection
	V (V2)	
	W (W2)	
	+ (BR+)	Brake connection max. load current 2 A min. load current 0.1 A
	- (BR-)	
	PE connection	Threaded hole M5/3 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

Table 5- 14 Terminal strip Single Motor Module 45 A to 200 A

	Terminals	Technical specifications
	U2 V2 W2	**45 A to 60 A:** Threaded bolt M6/6 Nm 1) **85 A:** Threaded bolt M8/13 Nm 1) **132 A to 200 A:** Threaded bolt M8/13 Nm 1) (see chapter Connection methods)
	+ (BR+) - (BR-)	X11 brake connector 2): 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 (see chapter Connection methods) The brake connector is part of the pre-assembled cable
	PE connection	**Single Motor Module with a rated output current of 45 A to 60:** Threaded bolt for motor cables: M6/6 Nm 1) Threaded hole for PE: M6/6 Nm 1)
		**Single Motor Module with a rated output current of 85 A** Threaded bolt for motor cables: M8/13 Nm 1) Threaded hole for PE: M6/6 Nm 1) **Single Motor Module with a rated output current of 132 A to 200 A** Threaded bolt for motor cables: M8/13 Nm 1) Threaded hole for PE: M8/13 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

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.

Note

The overall length of the power cables (motor supply cables and DC-link cables) must not exceed the values given in chapter "Possible line reactor and line filter combinations".

Note

The motor brake must be connected via connector X11. The BR- cable must not be connected directly to electronic ground (M).

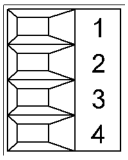
WARNING

Only protective extra-low voltages (DVC A) that comply with EN 60204-1 must be connected to all connections and terminals between 0 and 48 VDC.

The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.

5.2.3.4 X21/X22 EP terminals / temperature sensor Motor Module

Table 5- 15 Terminal strip X21/X22

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V - 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)	
Max. connectable cross-section 1.5 mm^2 Type: Screw terminal 1 (see chapter Connection methods)			

NOTICE

The KTY temperature sensor must be connected with the correct polarity.

NOTICE

The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

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).

DANGER

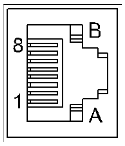
Risk of electric shock!

Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), a Sensor Module External (SME120 or SME125) or Terminal Module TM120 must be used.

If these instructions are not complied with, there is a risk of electric shock!

5.2.3.5 X200-X203 DRIVE-CLiQ interface

Table 5- 16 DRIVE-CLiQ interface X200-X202: Single Motor Module
DRIVE-CLiQ interface X200-X203: Double Motor Module

	Pin	Name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces included in the scope of delivery; blanking plate (50 pieces) Order number: 6SL3066-4CA00-0AA0			

5.2.3.6 Meaning of the LEDs on the Motor Module

Table 5- 17 Single Motor Module / Double Motor Module / Power Module - description of the LEDs

Status		Description, cause	Remedy
Ready (H200)	DC link (H201)		
OFF	OFF	Electronics power supply is missing or outside permissible tolerance range.	–
Green	OFF	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.	Check supply voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. Note: The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/red (0.5 Hz)	–	Firmware is being downloaded.	–
Green/red (2 Hz)	-	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	–	Component detection via LED is activated (p0124). Note: Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC link" LED.
The warning information on the components must be carefully observed!

5.2.4 Dimension drawings

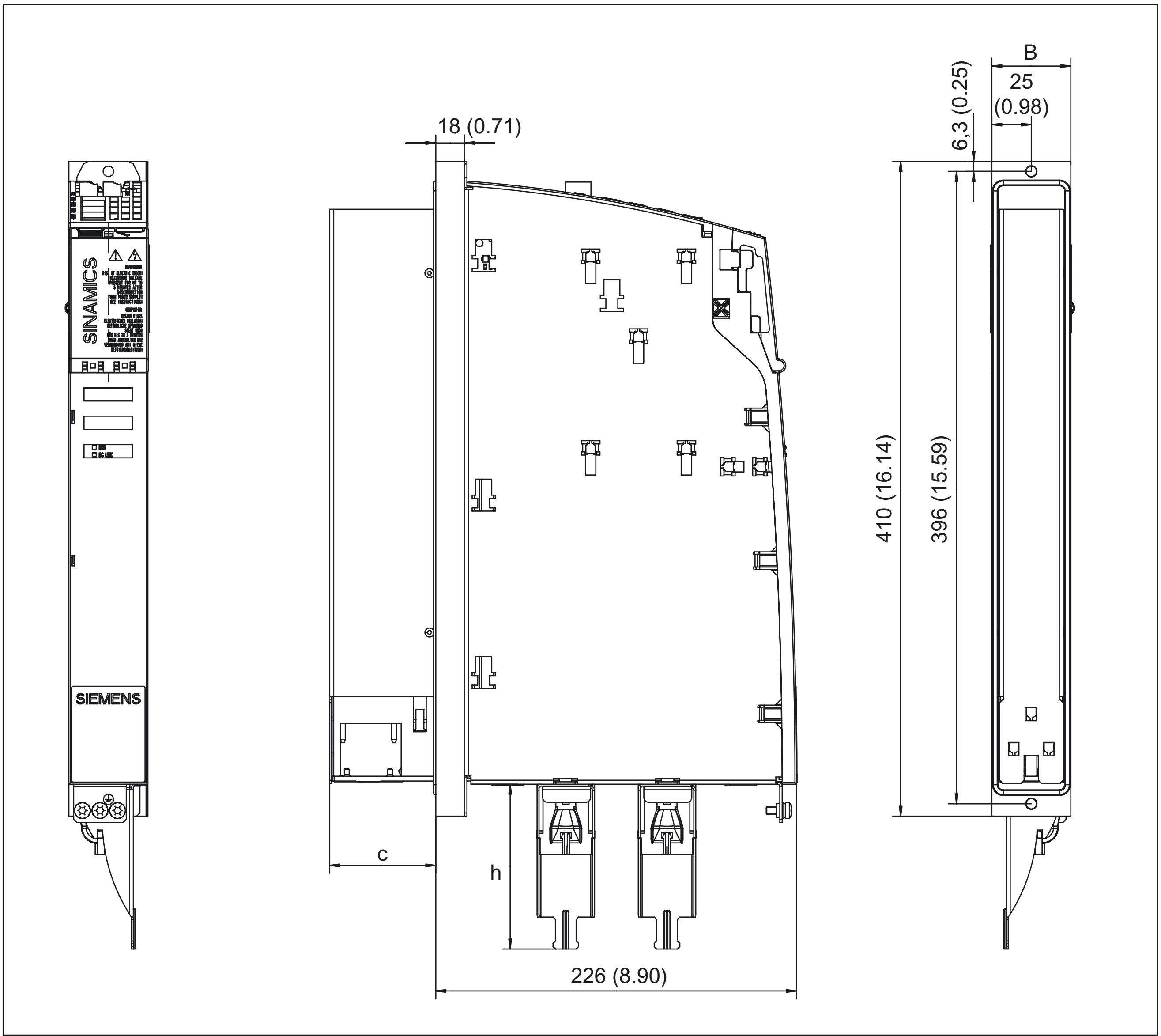


Figure 5-23 Dimension drawing of Motor Modules with external air cooling 3 A to 18 A and 2 x 3 A to 2 x 9 A, all dimensions in mm and (inches)

Table 5- 18 Dimensions of Motor Module with external air cooling 3 A to 18 A and 2 x 3 A to 2 x 9 A

Motor Module type	Order number	W [mm] (inches)	c [mm] (inches)	h [mm] (inches)
Single Motor Module 3 A	6SL3121-1TE13-0AAx	50 (1.97)	66.5 (2.62)	105 (4.13)
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			

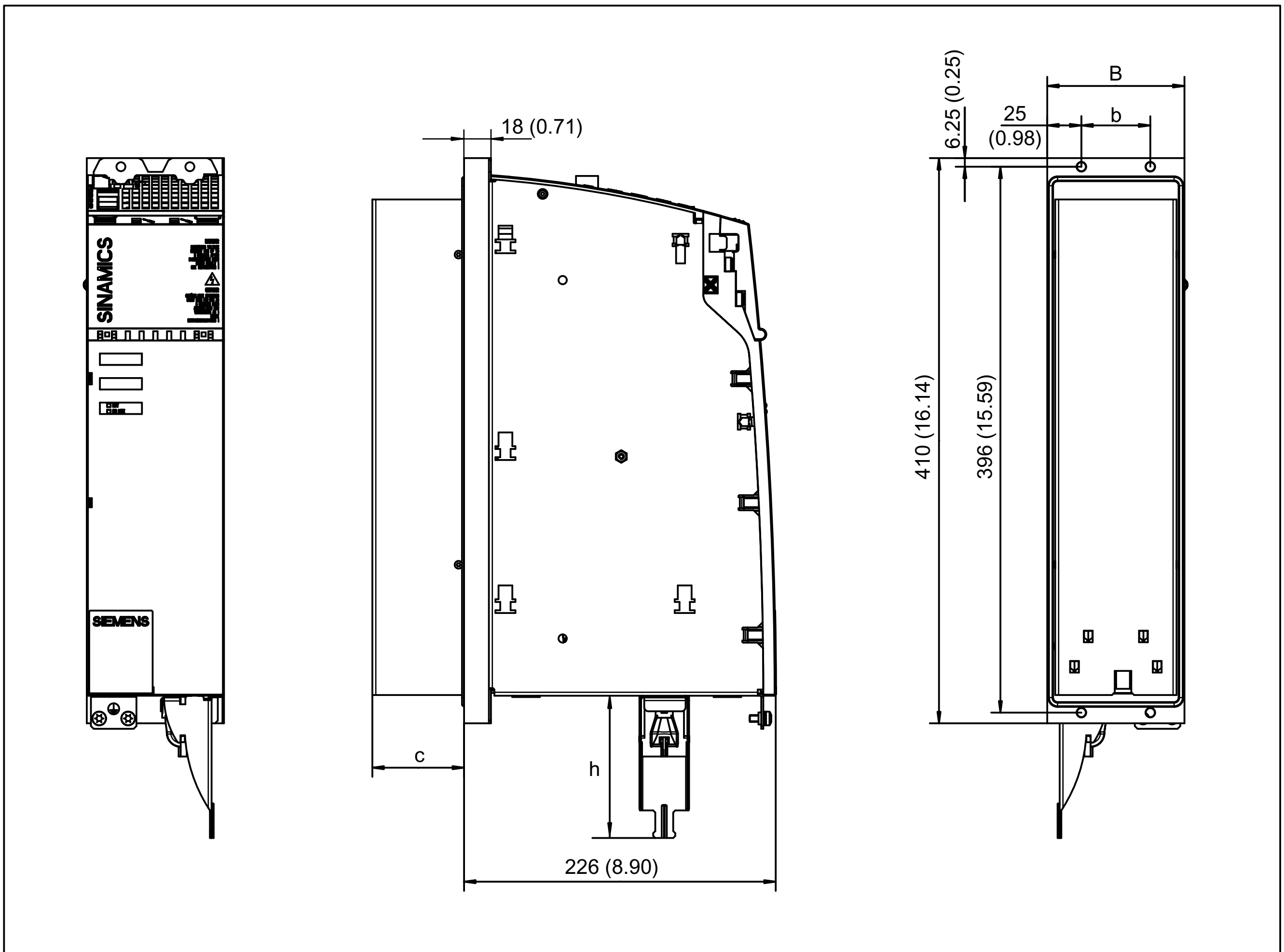


Figure 5-24 Dimension drawing of Motor Modules with external air cooling 30 A and 2 x 18 A, all dimensions in mm and (inches)

Table 5- 19 Dimensions of Motor Module with external air cooling 30 A and 2 x 18 A

Motor Module type	Order number	W [mm] (inches)	b [mm] (inches)	c [mm] (inches)	h [mm] (inches)
Single Motor Module 30 A	6SL3121-1TE23-0AAx	100 (3.94)	50 (1.97)	66.5 (2.62)	105 (4.13)
Double Motor Module 18 A	6SL3121-2TE21-8AAx				

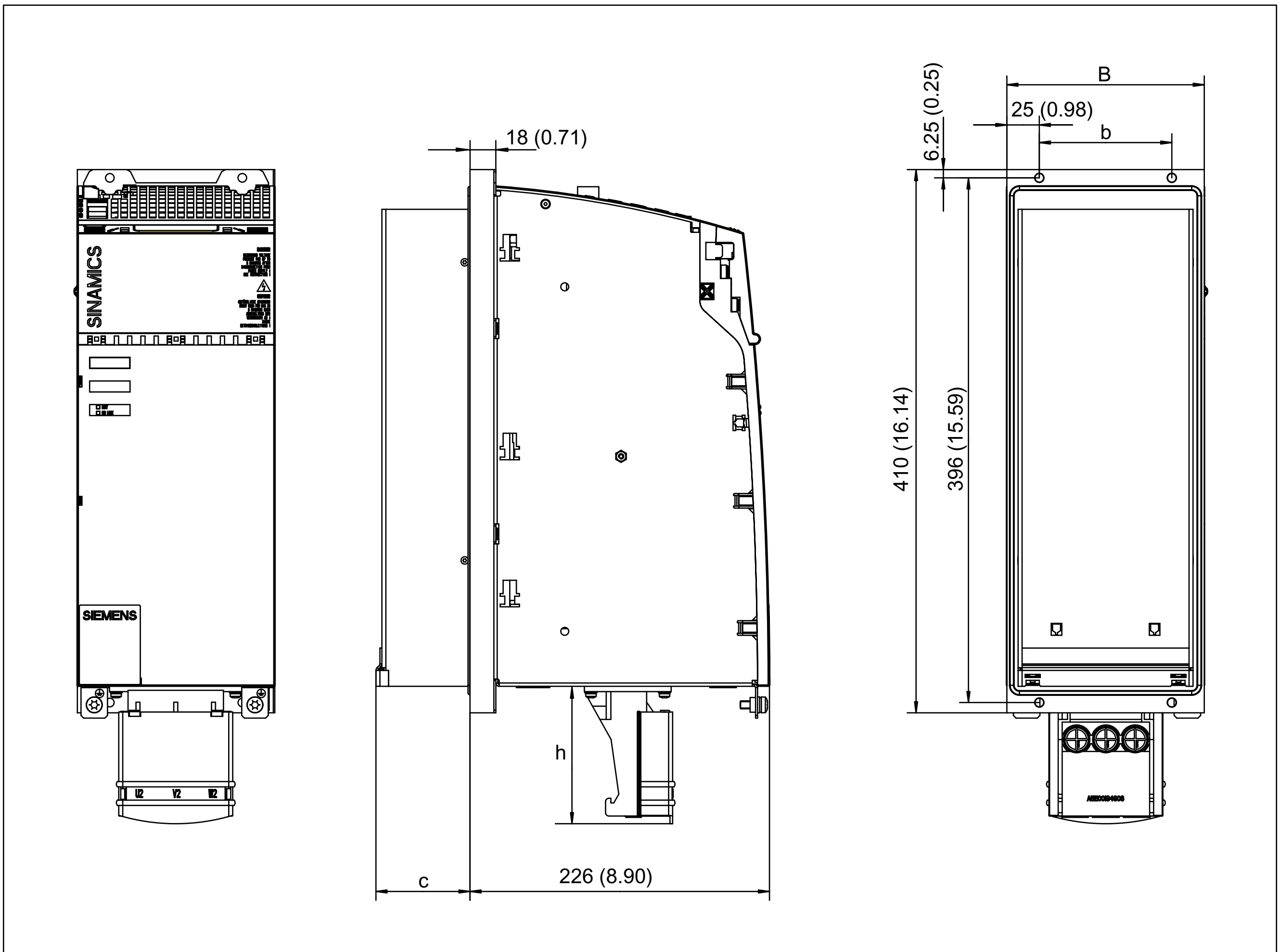


Figure 5-25 Dimension drawing of Motor Modules with external air cooling 45 A, 60 x 85 A, all dimensions in mm and (inches)

Table 5- 20 Dimensions of Motor Module with external air cooling (45 A, 60 A, and 85 A)

Motor Module type	Order number	W [mm] (inches)	b [mm] (inches)	c [mm] (inches)	h [mm] (inches)
Motor Module with External Air Cooling					
Single Motor Module 45 A	6SL3121-1TE24-5AAx	150 (5.91)	100 (3.94)	71 (2.80)	105 (4.13)
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)	105 (4.13)

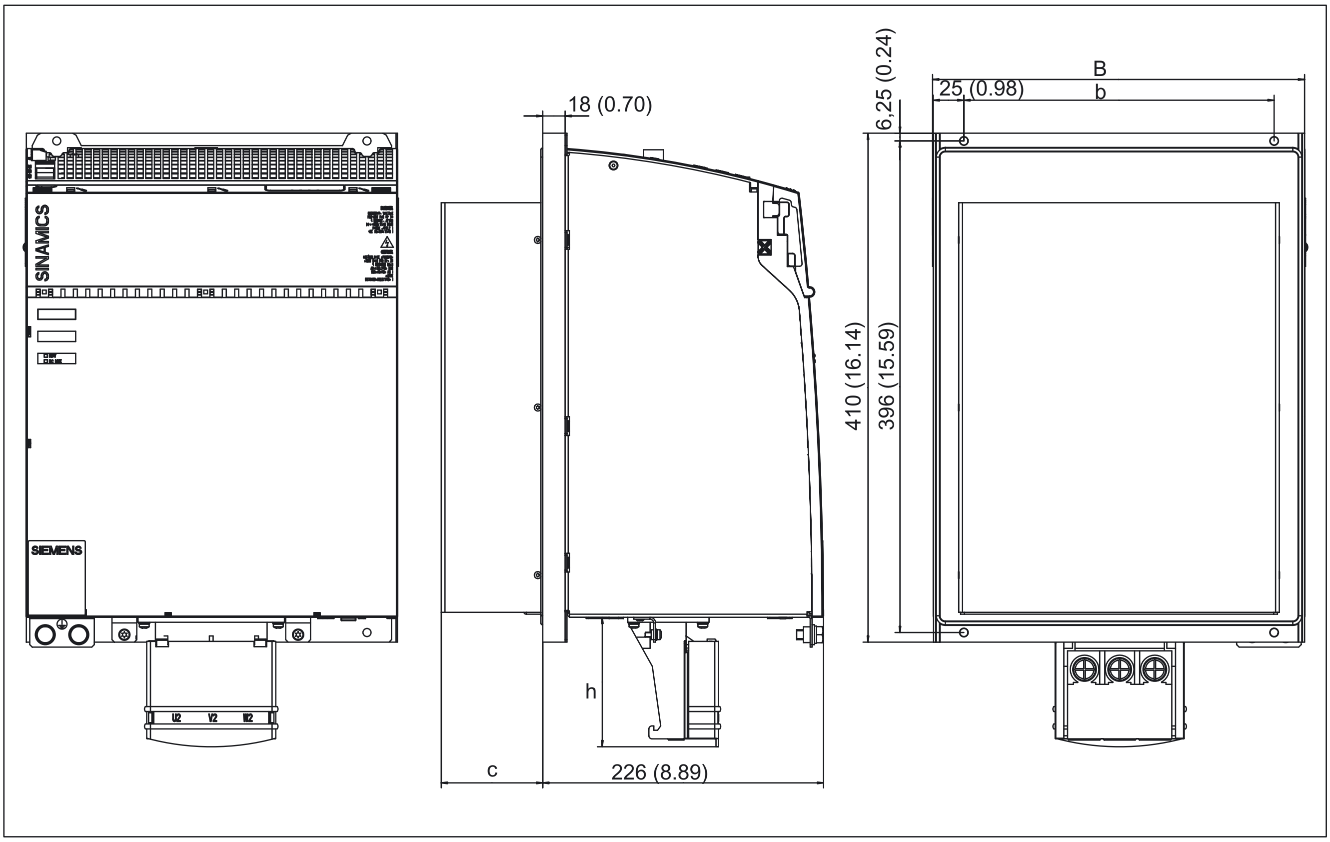


Figure 5-26 Dimension drawing of Motor Modules with external air cooling 132 A and 200 A, all dimensions in mm and (inches)

Table 5- 21 Dimensions of Motor Module with external air cooling (132 A and 200 A)

Motor Module type	Order number	W [mm] (inches)	b [mm] (inches)	c [mm] (inches)	h [mm] (inches)
Motor Module with External Air Cooling					
Single Motor Module 132 A	6SL3121-1TE31-3AAx	300 (11.81)	250 (9.84)	82 (3.23)	105 (4.13)
Single Motor Module 200 A	6SL3121-1TE32-0AAx				

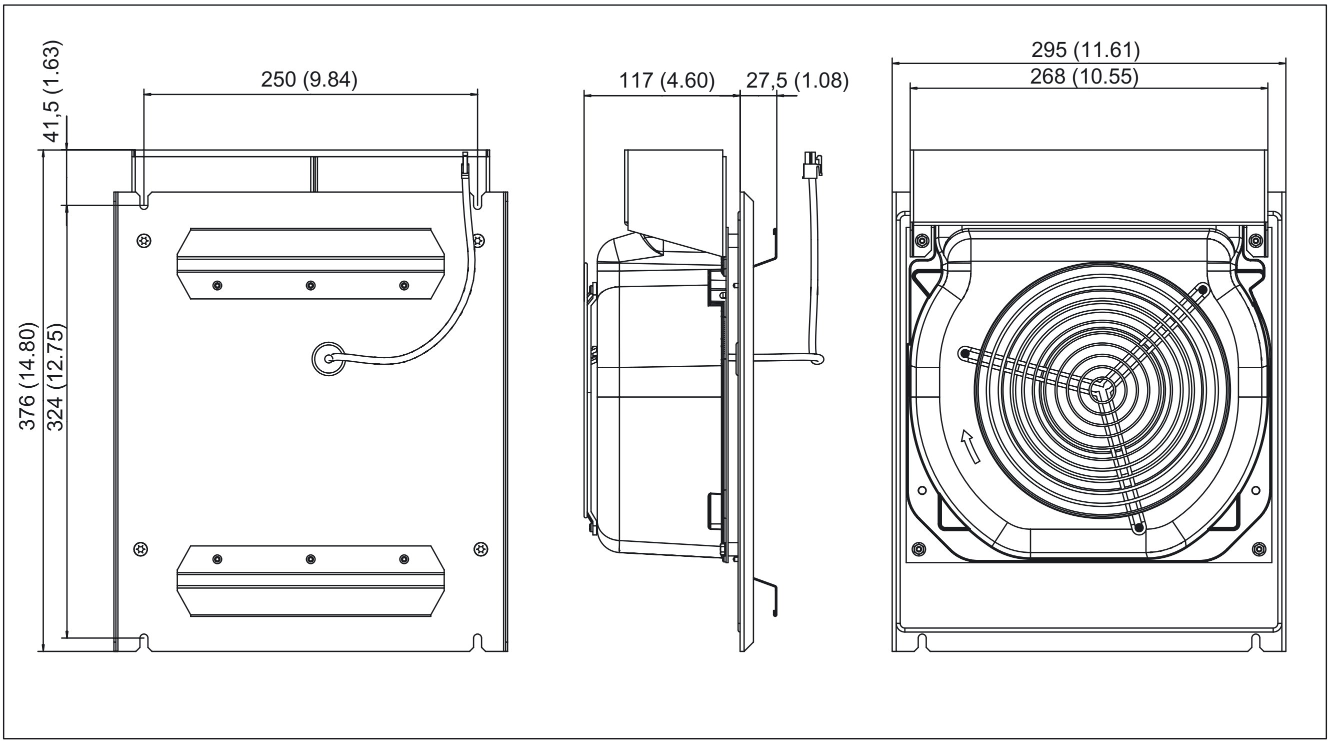


Figure 5-27 Dimension drawing of Fans for Motor Modules with external air cooling 132 A and 200 A, all dimensions in mm and (inches)

5.2.5 Installation

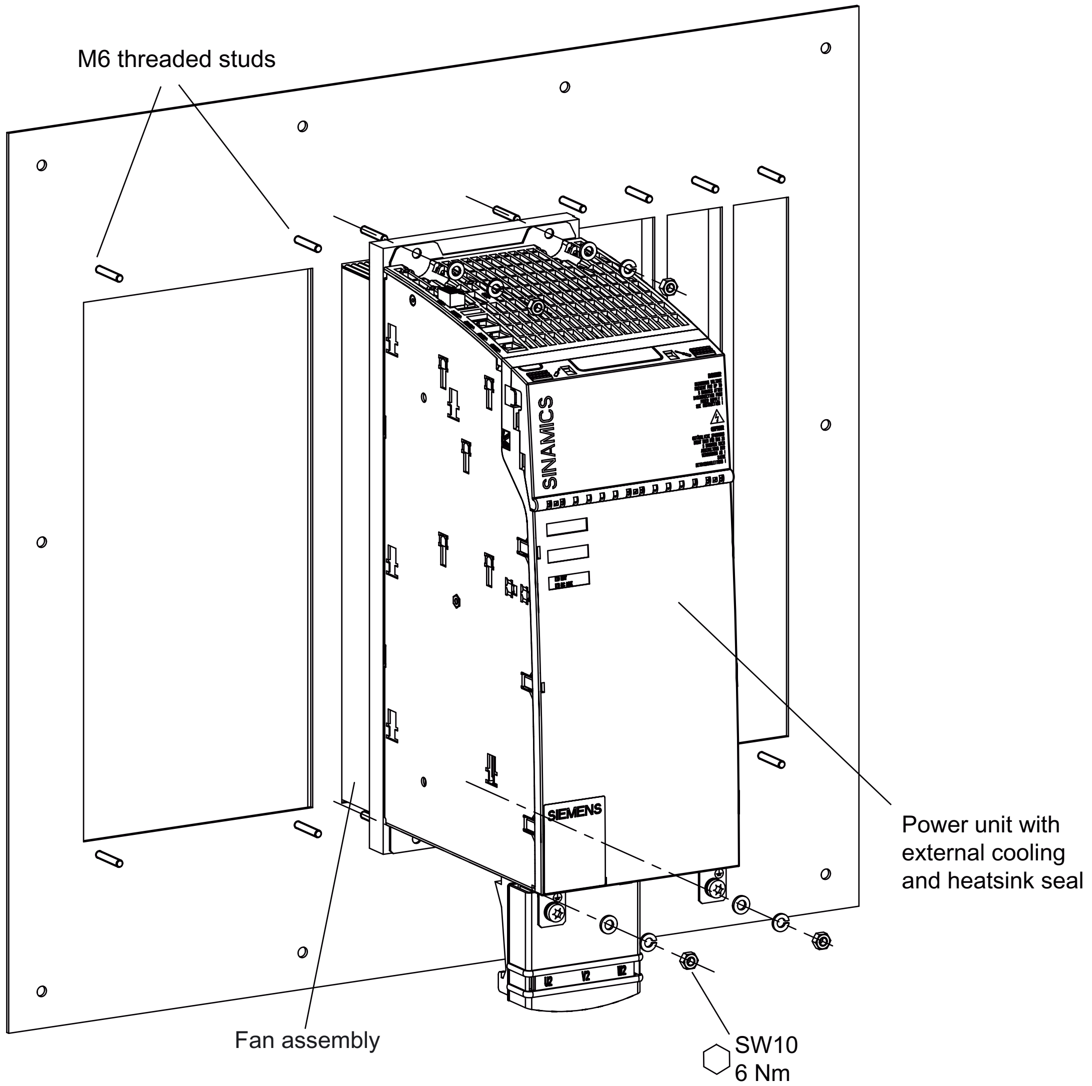


Figure 5-28 Example: Installation of the power unit with external air cooling

Help with the mechanical control cabinet installation is available from:

Siemens AG
Industry Sector, IA SE WKC
TCCCC (Technical Competence Center Cabinets Chemnitz)
P.O. Box 1124
09070 Chemnitz, Germany

E-mail: cc.cabinetcooling.aud@siemens.com

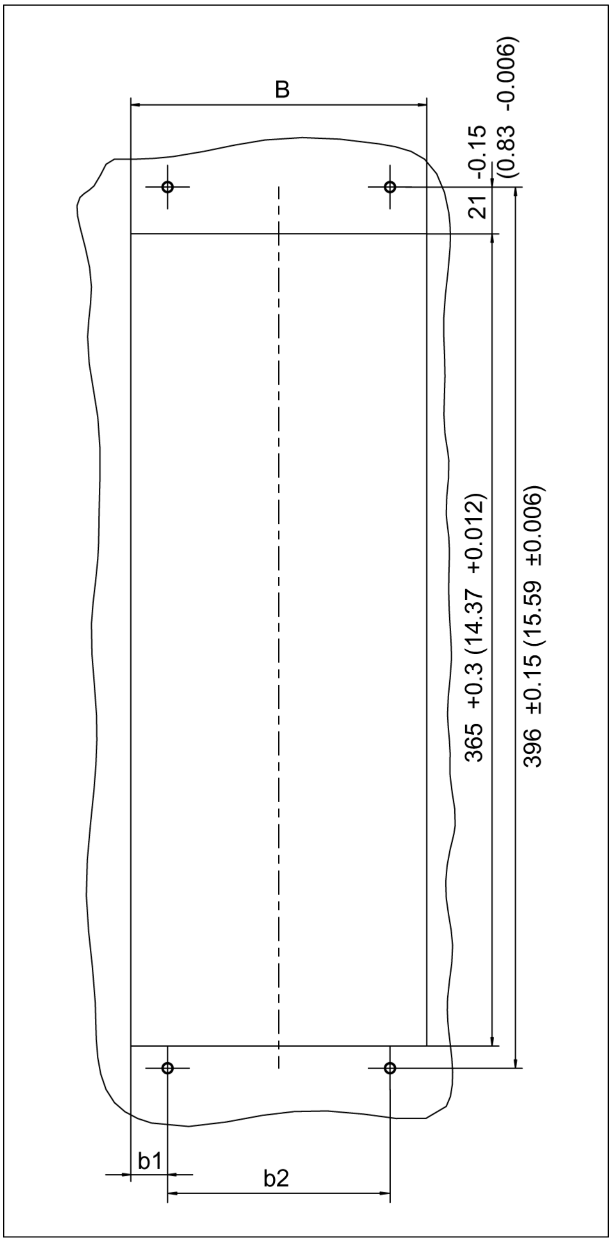


Figure 5-29 Installation openings for the power unit with external air cooling, 50 mm to 200 mm

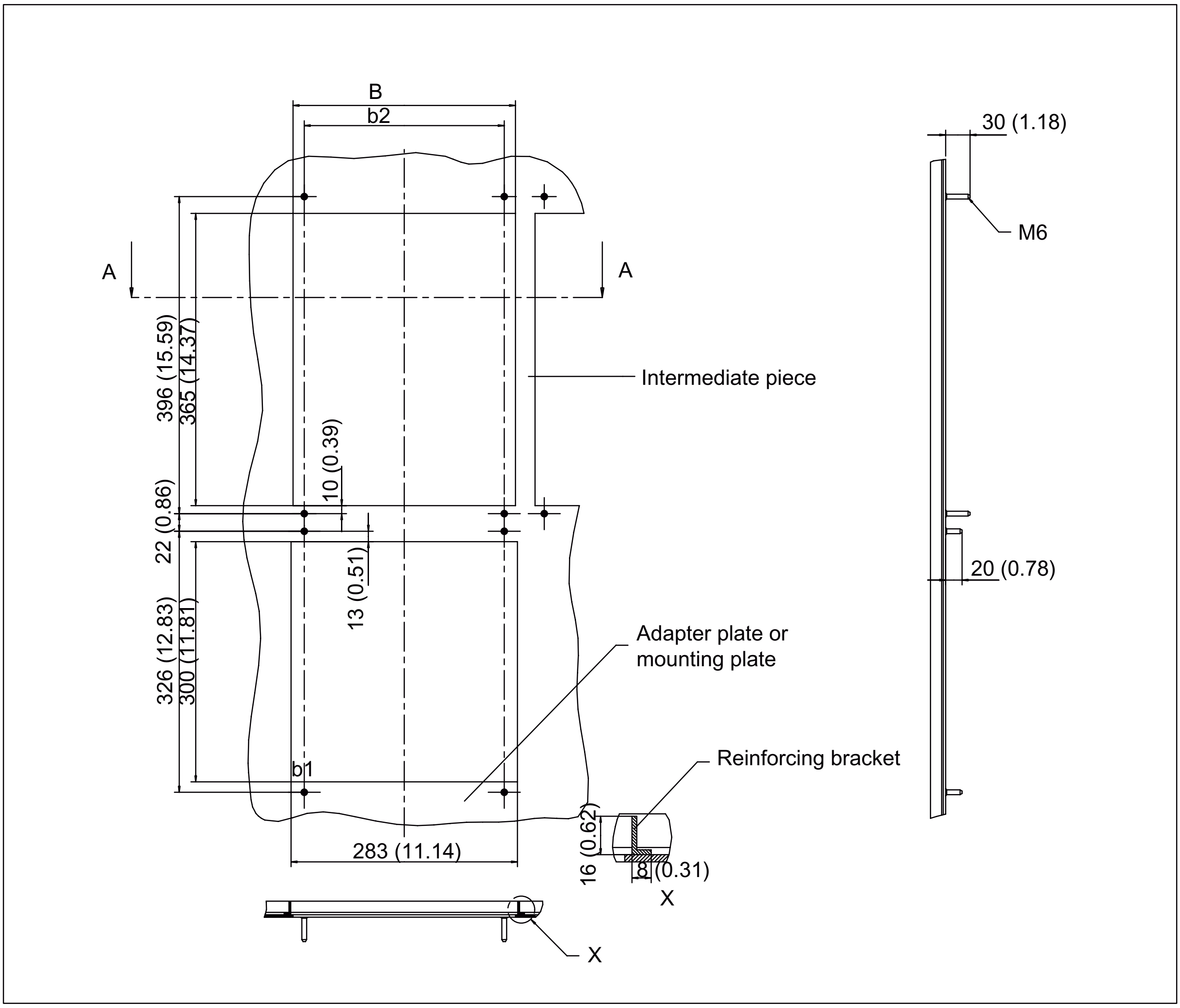


Figure 5-30 Installation openings for the power unit with external air cooling, 300 mm

Table 5- 22 Dimensions of the installation openings for the power unit with external air cooling

Component width	W [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)

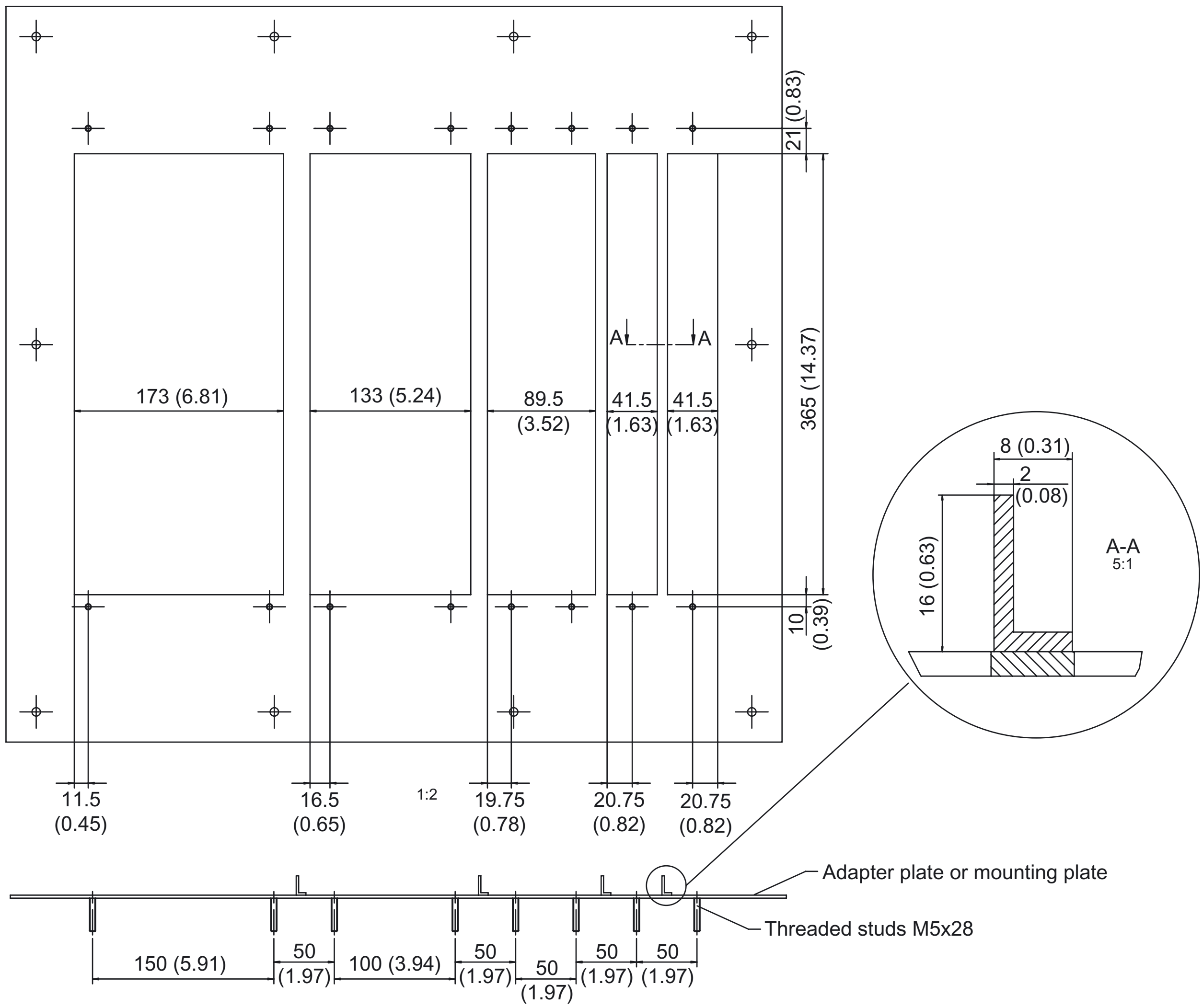


Figure 5-31 Example: mounting plate with a drive line-up

During installation it must be ensured that the component's seal is tight throughout.

Note

A set of seals consisting of spare seals for 50 mm, 100 mm, 150 mm, 200 mm and 300 mm wide components can be ordered with order number: 6SL3162-5BU00-0AA0.

The cross-pieces must have the appropriate stability. If required, we recommend that you reinforce the cross-pieces for the recesses. In our example, the cross-pieces have been reinforced using brackets to EN 755-9. Any means necessary can be used to secure the bracket to the insert plate.

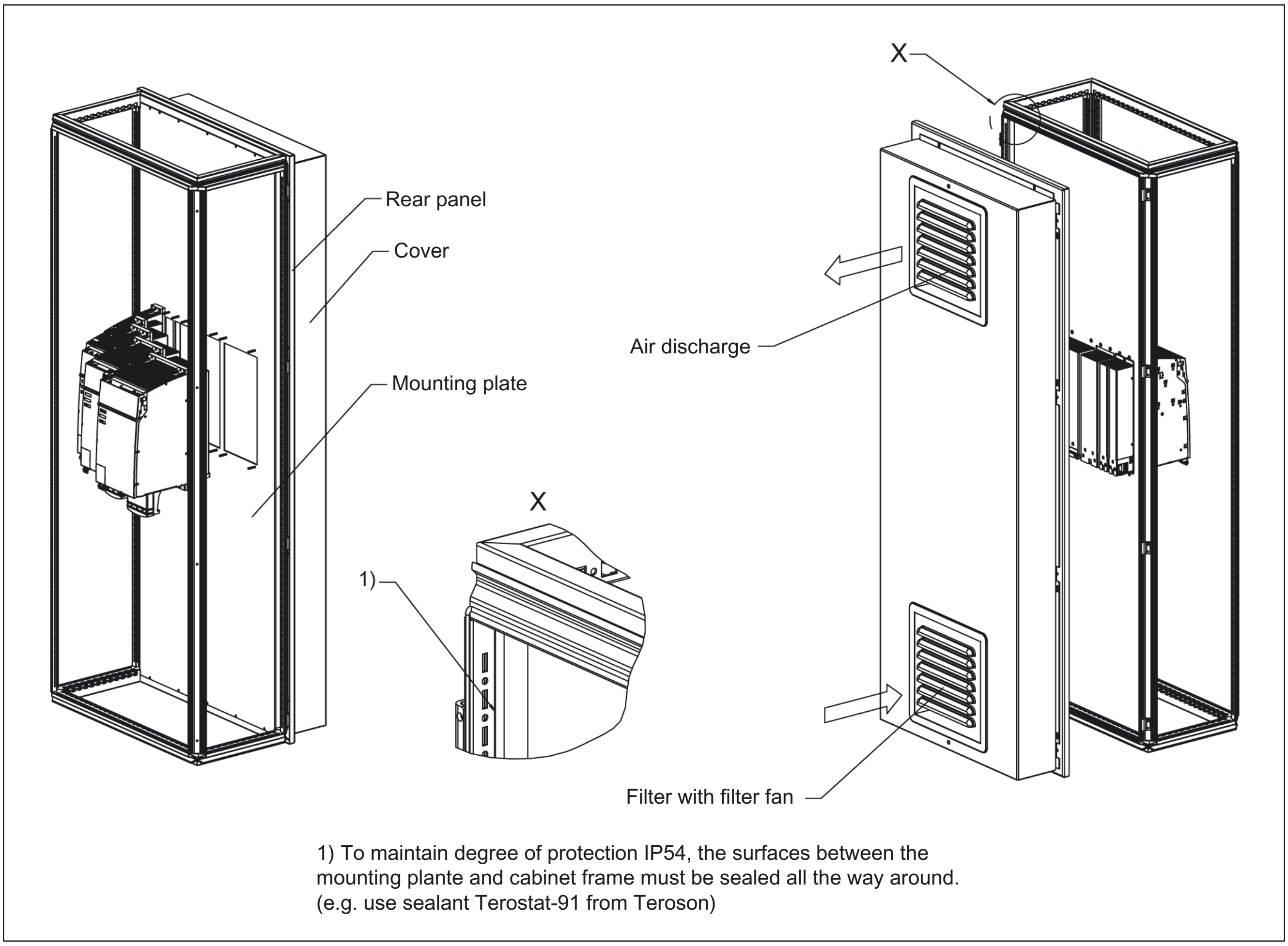


Figure 5-32 Example 1: installation in cabinet with mounting plate

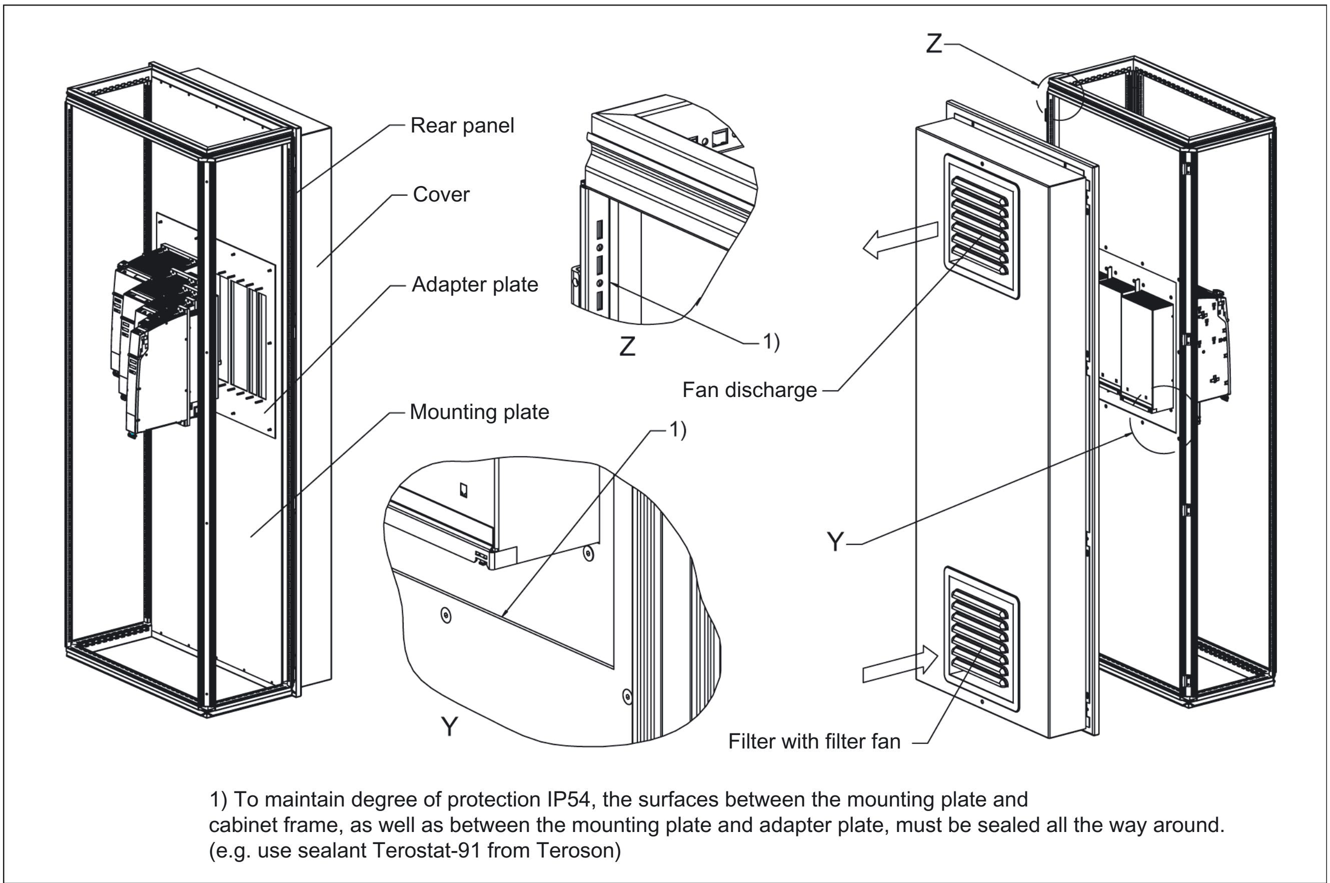


Figure 5-33 Example 2: installation in cabinet with mounting plate

We recommend that you attach a cover and filtered 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. This can be determined by establishing the total cooling air required by the individual components. This information is available in the 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 a filtered fan must be regularly checked for dirt and cleaned if necessary.

5.2.6 Technical data

Table 5- 23 Technical data Single Motor Modules Booksize (3 to 30 A)

External air cooling	**6SL3121–**	**1TE13-0AAx**	**1TE15-0AAx**	**1TE21–0AAx**	**1TE21–8AAx**	**1TE23-0AAx**
Rated current	**A**	**3**	**5**	**9**	**18**	**30**
Voltage						
Infeed DC link voltage Electronics power supply	 V_{DC} V_{DC}	 510 – 720 24 (20.4 – 28.8)				
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage				
Overvoltage trip Undervoltage trip [1)]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %				
Current						
Electronics current consumption at 24 V DC	A_{DC}	0.85	0.85	0.85	0.85	0.8
Rated output current (I_n)	A_{ACrms}	3	5	9	18	30
Base-load current (I_{base})	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
Current carrying capacity DC link busbar Reinforced DC link busbars 24 V busbar	 A_{DC} A_{DC} A_{DC}	 100 150 20	 100 150 20	 100 150 20	 100 150 20	 100 150 20
Power						
Rated power (with DC link voltage of 600 V_{DC} and pulse frequency of 4 kHz)	kW	1.6	2.7	4.8	9.7	16
Total power loss (including electronics losses) [2)]	W	50.4	75.4	100.4	185.4	311.6
Max. pulse frequency Without derating With derating	 kHz kHz	 4 16				
Max. ambient temperature Without derating With derating	 °C °C	 40 55				
DC link capacitance	μF	110	110	110	220	705
Sound pressure level	dB(A)	<60	<60	<60	<60	<60

External air cooling	6SL3121–	1TE13-0AAx	1TE15-0AAx	1TE21–0AAx	1TE21–8AAx	1TE23-0AAx
Rated current	A	3	5	9	18	30
Cooling air requirement	m^3/h	29.6	29.6	29.6	29.6	56
Weight	kg	5.7	5.7	5.7	5.7	8.4

1) Default for 400 V supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized rated voltage

2) For an overview, see the power loss tables in chapter Control cabinet installation

Table 5- 24 Technical data Single Motor Modules Booksize (45 to 200 A)

External air cooling	**6SL3121–**	**1TE24-5AAx**	**1TE26-0AAx**	**1TE28-5AAx**	**1TE31-3AAx**	**1TE32-0AAx**
Rated current	**A**	**45**	**60**	**85**	**132**	**200**
Voltage						
Infeed DC link voltage Electronics power supply	 V_{DC} V_{DC}	 510 – 720 24 (20.4 – 28.8)				
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage				
Overvoltage trip Undervoltage trip [1]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %				
Current						
Electronics current consumption at 24 V DC	A_{DC}	1.05	1.05	1.5	0.85	0.85
Rated output current (I_n)	A_{ACrms}	45	60	85	132	200
Base-load current (I_{base})	A	38	51	68	105	141
Intermittent duty current (I_{s6}) 40%	A_{ACrms}	60	80	110	150	230
Peak current (I_{max})	A_{ACrms}	85	113	141	210	282
Current carrying capacity DC link busbar 24 V busbar	 A_{DC} A_{DC}	 100 / 200 [2] 20	 100 / 200 [2] 20	 200 20	 200 20	 200 20
Power						
Rated power (with DC link voltage of 600 V_{DC} and clock frequency of 4 kHz)	kW	24	32	46	71	107
Total power loss (including electronics losses) [3]	W	458.8	618.8	786	1286	2086
Max. pulse frequency Without derating With derating	 kHz kHz	 4 16				
Max. ambient temperature Without derating With derating	 °C °C	 40 55				
DC link capacitance	µF	1175	1410	1880	2820	3995
Sound pressure level	dB(A)	< 65	< 65	< 60	< 73	< 73
Cooling air requirement	m^3/h	112	112	160	520	520
Weight	kg	13.2	13.3	17.2	27.1	28

1) Default for 400 V supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V (exception: 132 A and 200 A Motor Modules) and is adjusted to the parameterized rated voltage
2) For components where the final digit in the order number is ≥ 3.
3) For an overview, see the power loss tables in chapter Control cabinet installation

Table 5- 25 Technical data Double Motor Modules Booksize (3 to 18 A)

External air cooling	6SL3121-	2TE13-0AAx	2TE15-0AAx	2TE21-0AAx	2TE21-8AAx
Rated current	A	2x3	2x5	2x9	2x18
Voltage					
Infeed DC link voltage Electronics power supply	 V_{DC} V_{DC}	 510 – 720 24 (20.4 – 28.8)			
Output voltage	V_{ACrms}	0 -480			
Overvoltage trip Undervoltage trip 1)	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %			
Current					
Electronics current consumption at 24 V DC	A_{DC}	1.15	1.15	1.15	1.3
Rated output current (I_n)	A	2x3	2x5	2x9	2x18
Base-load current (I_{base})	A	2x2.6	2x4.3	2x7.7	2x15.3
Intermittent duty current (I_{S6}) 40%	A_{ACrms}	2x3.5	2x6	2x10	2x24
Peak current (I_{max})	A_{ACrms}	2x6	2x10	2x18	2x36
Current carrying capacity DC link busbar Reinforced DC link busbars 24 V busbar	 A_{DC} A_{DC} A	 100 150 20	 100 150 20	 100 150 20	 100 150 20
Power					
Rated power (600 V, 4 kHz)	kW	1.6	2.7	4.8	9.7
Total power loss (including electronics losses) 2)	W	95	129	184	344
Max. pulse frequency Without derating With derating	 kHz kHz	 4 16			
Max. ambient temperature Without derating With derating	 °C °C	 40 55			
DC link capacitance	µF	110	220	220	705
Sound pressure level	dBA	<60	<60	<60	<60
Cooling air requirement	m^3/h	29.6	29.6	29.6	56
Weight	kg	58	5.8	5.7	8.6

1) Default for 400 V supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized rated voltage

2) For an overview, see the power loss tables in chapter Control cabinet installation

5.2.6.1 Characteristics

Rated duty cycles Motor Modules Booksize

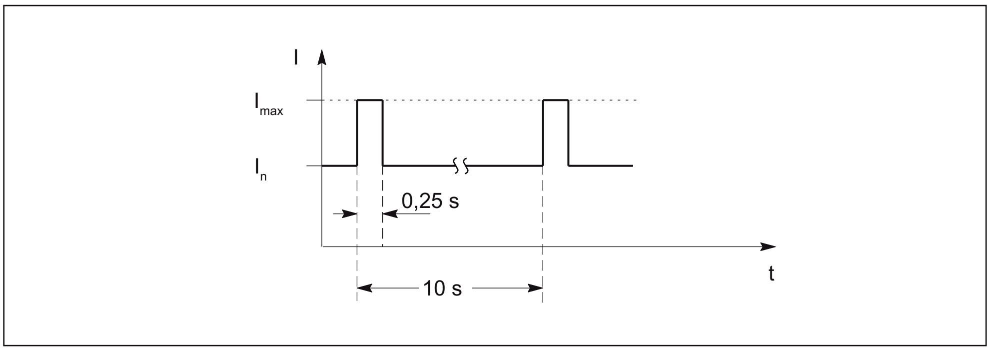


Figure 5-34 Duty cycle with initial load (for servo drives)

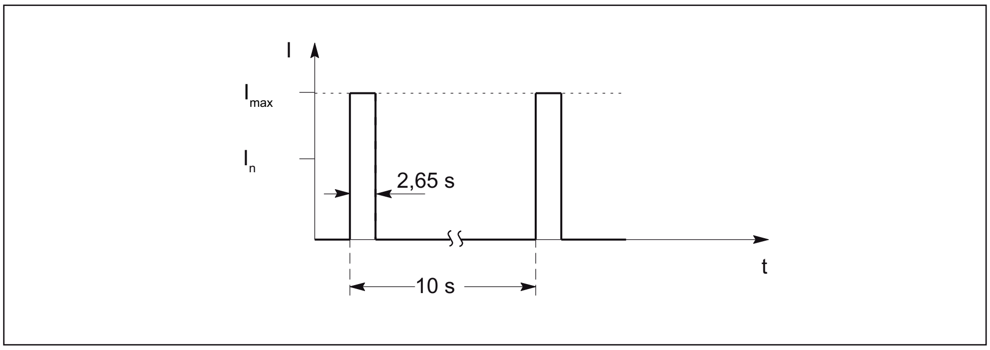


Figure 5-35 Duty cycle without initial load (for servo drives)

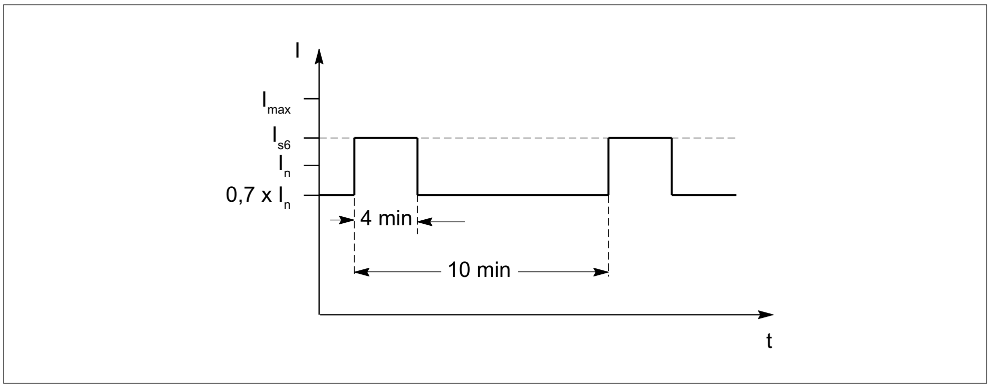


Figure 5-36 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

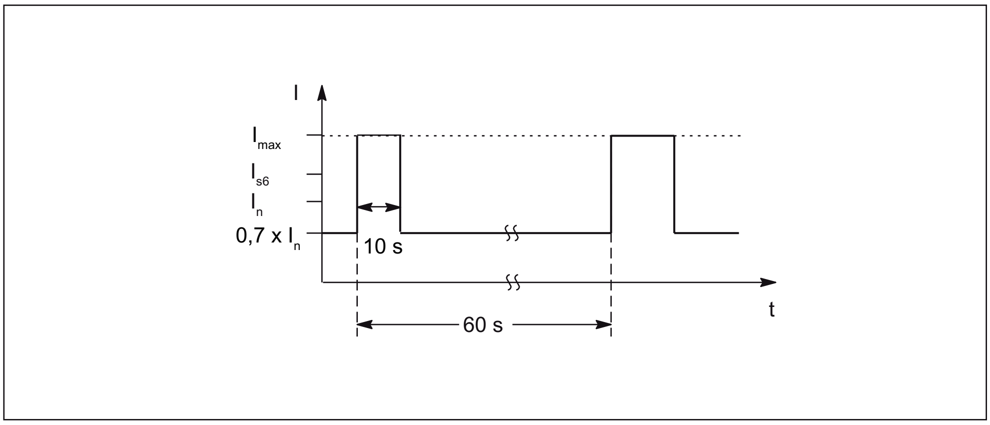


Figure 5-37 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

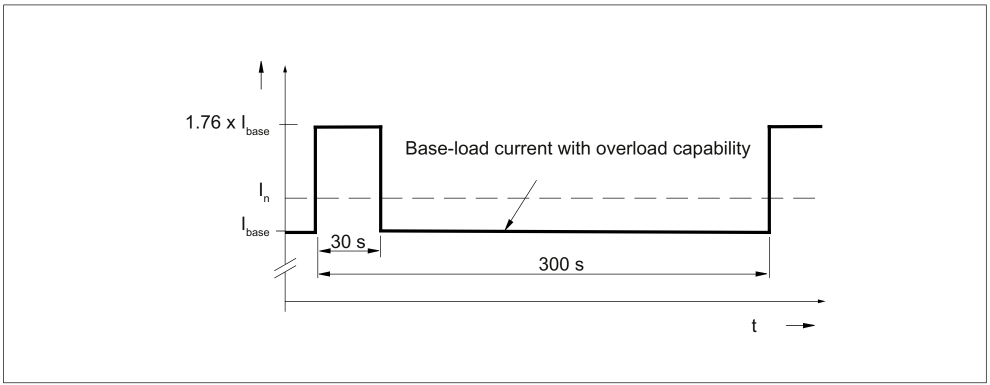


Figure 5-38 Duty cycle with 30 s overload with a duty cycle duration of 300 s

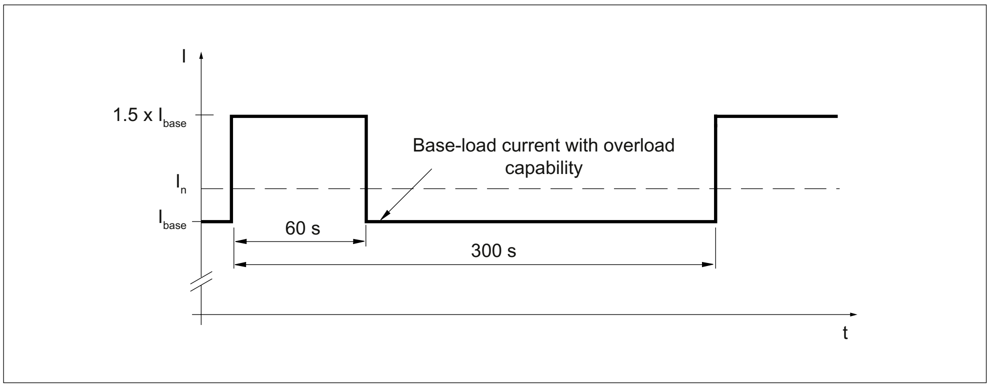


Figure 5-39 Duty cycle with 60 s overload with a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize

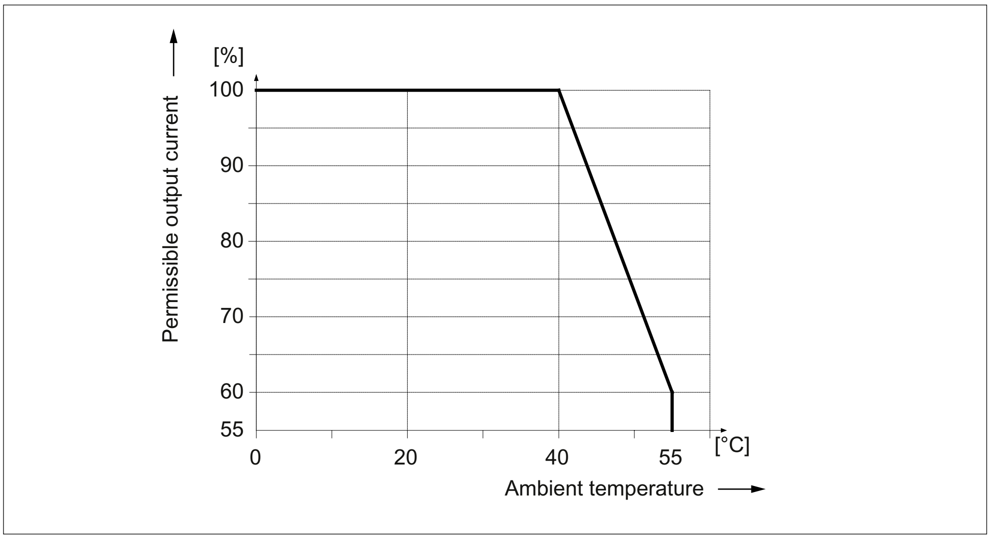


Figure 5-40 Output current as a function of the ambient temperature

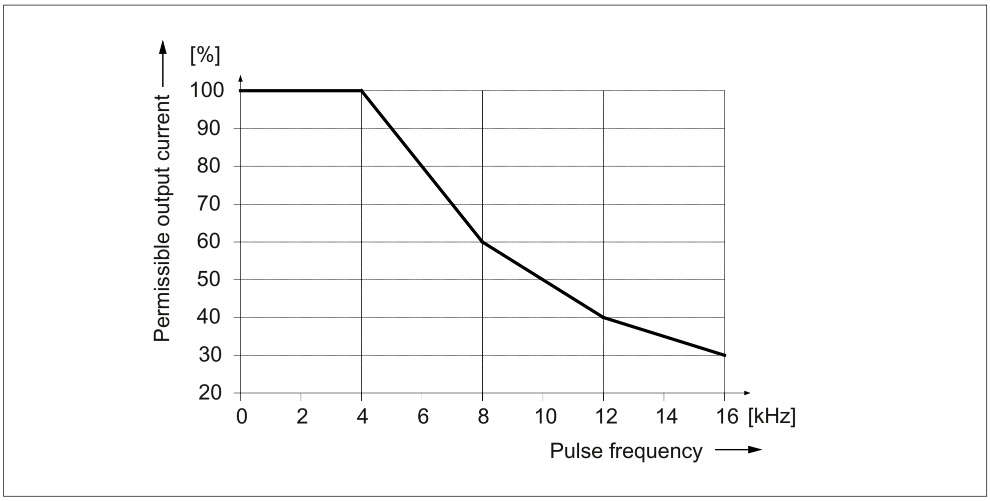


Figure 5-41 Output current as a function of the pulse frequency

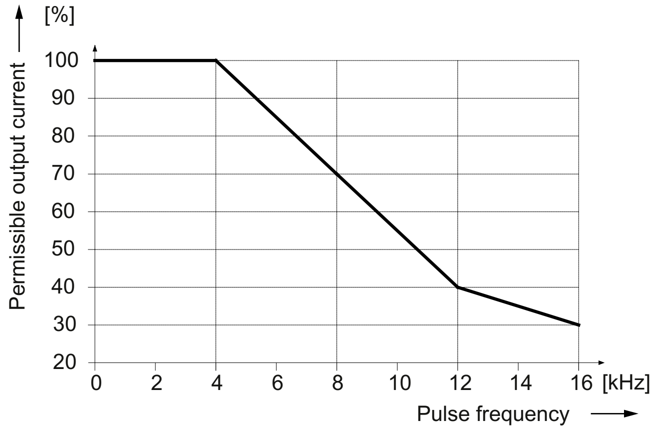


Figure 5-42 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

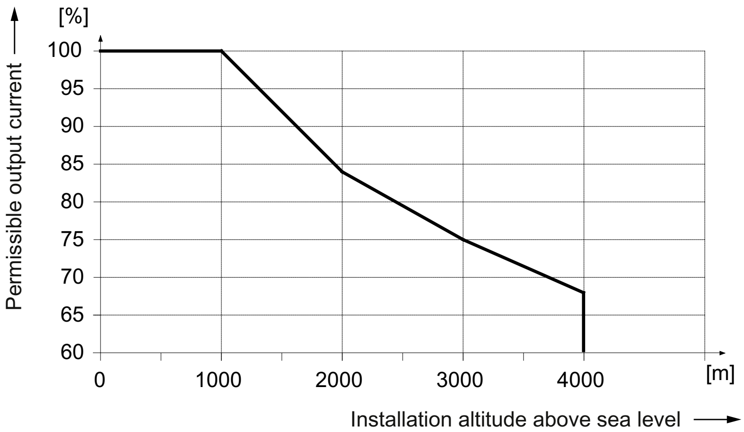


Figure 5-43 Output current as a function of the installation altitude

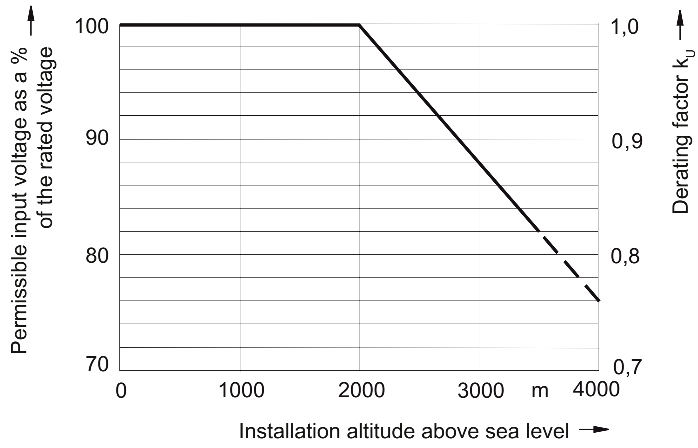


Figure 5-44 Voltage derating as a function of the installation altitude

5.3 Motor Modules with cold plate

5.3.1 Description

A Motor Module is a power unit (inverter) that provides the power supply for the connected motor(s). Power is supplied by means of 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 two motors can be connected to Double Motor Modules.

5.3.2 Safety information

DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

DANGER

DC-link discharge voltage

A DC-link discharge voltage danger notice in the relevant national language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

DANGER

Only motors with a safe electrically isolated holding brake may be connected. The brake conductors must also be safely electrically isolated.

If the motor power cable is connected to intermediate terminals, the power cables and brake cables must be routed apart (≥ 300 mm).

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC-link adapter and DC-link rectifier adapter).

DANGER

If a 50 mm wide Motor Module or a DC-link component with a similar width (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC-link bridge, including all of the screws, must be removed. It is not permissible to insert the screws without a DC-link bridge.

For all other power units and DC-link components (e. g. Capacitor Module) that are wider than 50 mm, it is neither permissible to move the DC-link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

DANGER

It is essential to apply the shield for the motor holding brake. Furthermore, only Motion-Connect cables must be used for integrated motor holding brakes, as otherwise insulation of the cores is not guaranteed. Risk of electric shock.

WARNING

Cable shields and unused power-cable cores (e.g. brake cores) must be connected to PE potential to dissipate capacitive cross-talk charges. If this is not carefully observed, lethal shock voltages could result.

CAUTION

The cooling clearances of 80 mm above and below the components must be observed.

CAUTION

The tightening torque of the DC-link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

CAUTION

Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION
Connecting cables to temperature sensors must always be installed with shielding. The cable shield must be connected to the chassis potential at both ends over a large surface area. Temperature-sensor cables that are routed together with the motor cable must be twisted in pairs and shielded separately.

CAUTION
DC-link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

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 V ± 10%) and the voltage drops of the connection cables must be taken into account.

The DC power supply should be set to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:

- Use of Siemens three-phase motors
- Use of Siemens MOTION-CONNECT power cables
- Motor cable lengths: max. 100 m

5.3.3 Interface description

5.3.3.1 Overview

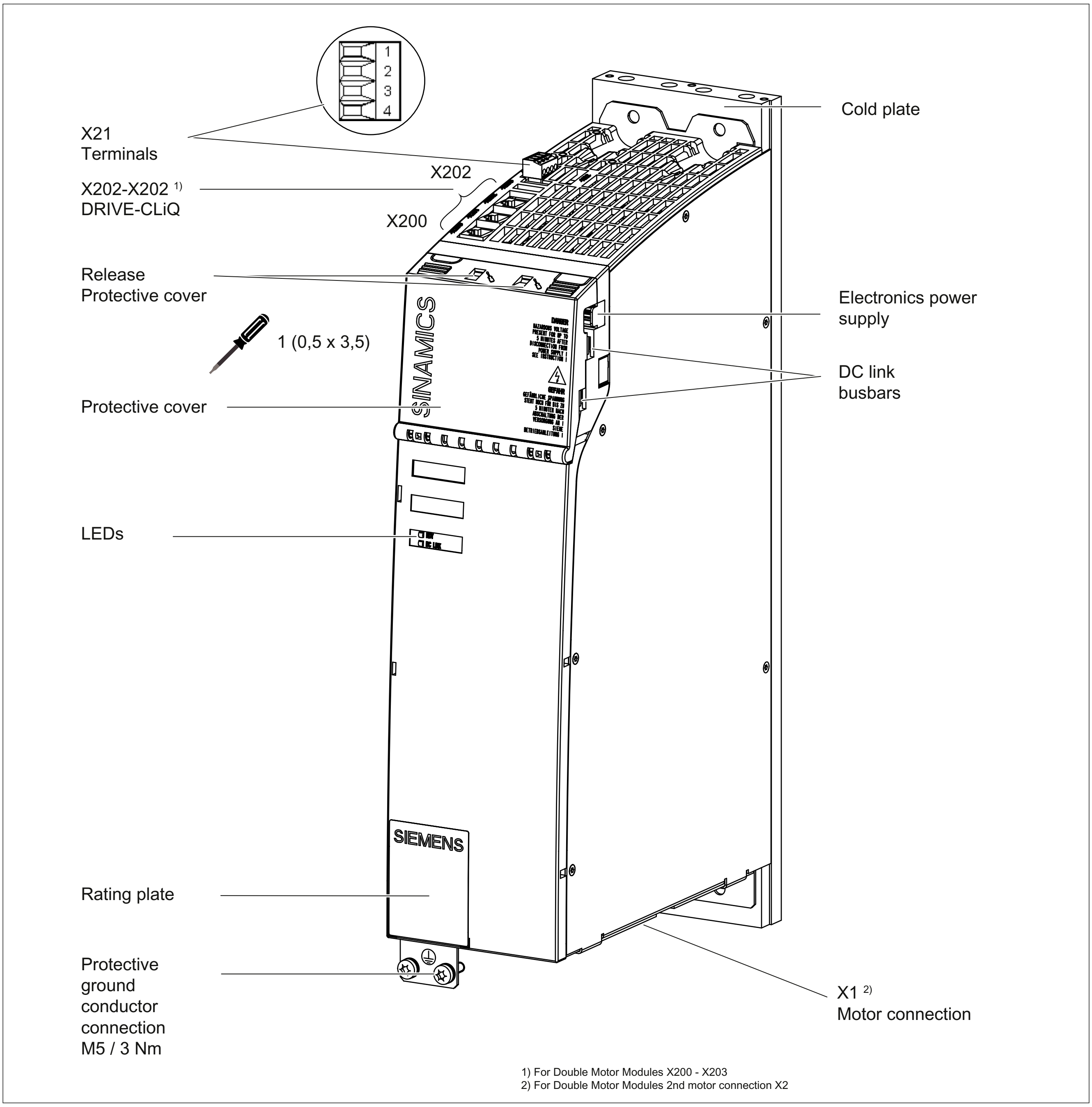


Figure 5-45 Single motor module with cold plate (example 30 A)

5.3.3.2 Connection examples

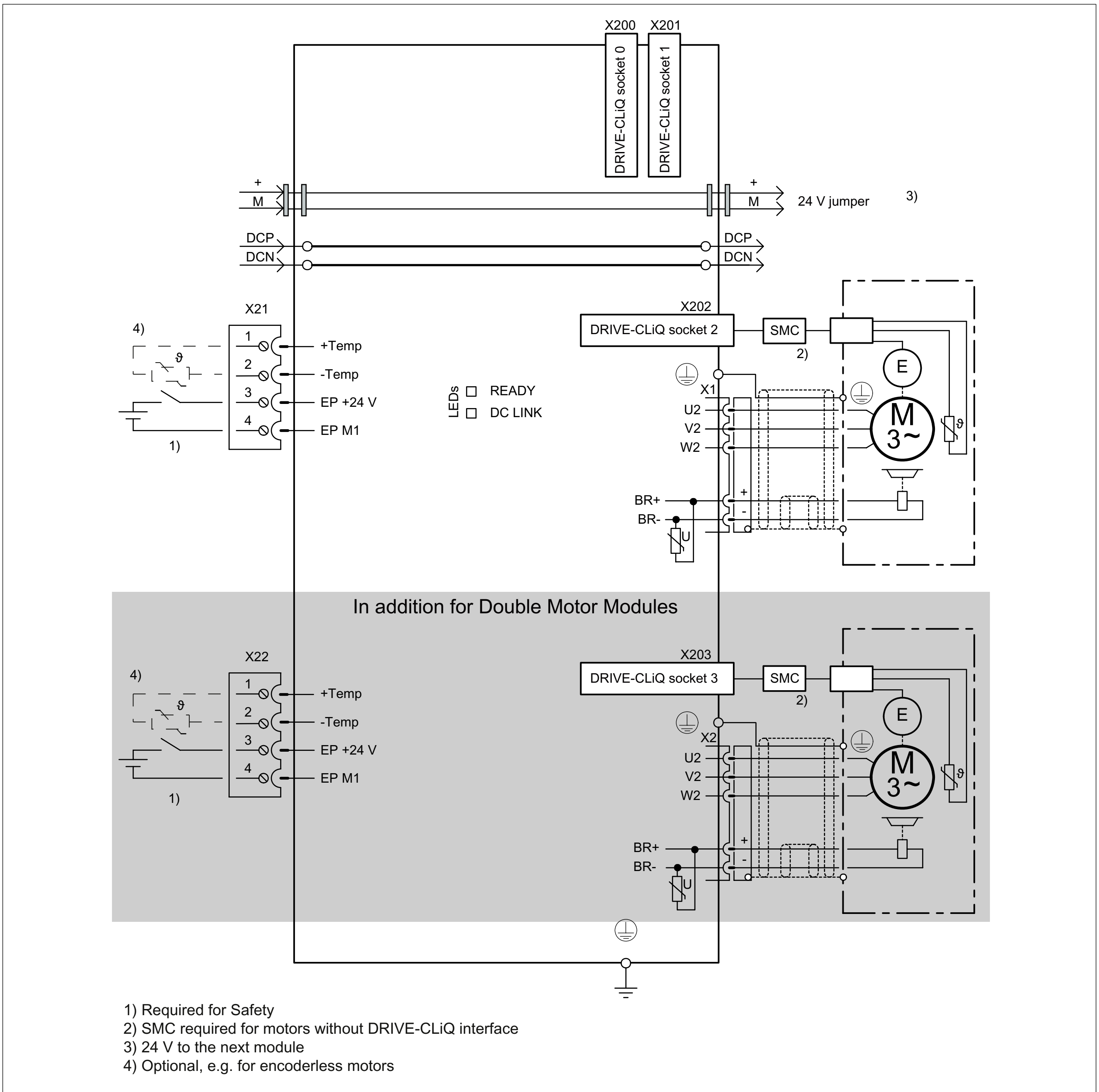
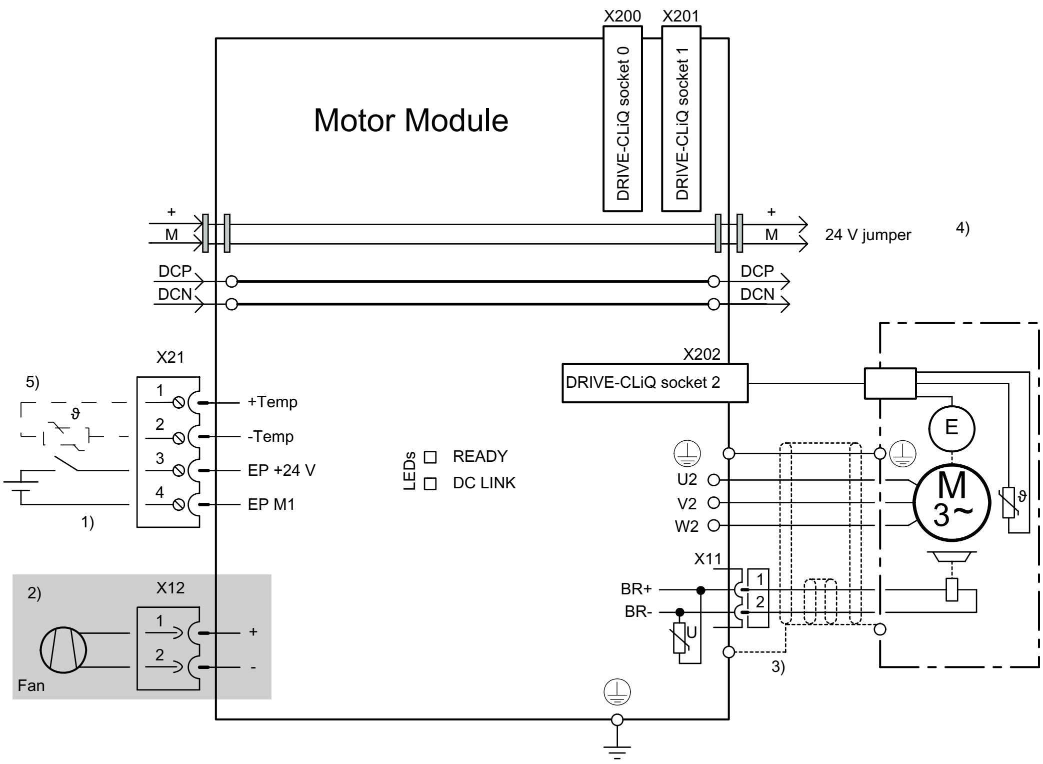


Figure 5-46 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

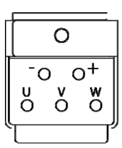
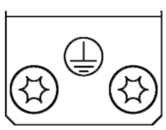


1) Required for Safety
2) In addition for Motor Modules 132 A to 200 A
3) Contact through the shield plate
4) 24 V to the next module
5) Optional, e.g. for encoderless motors

Figure 5-47 Example connection of Single Motor Modules 45 A to 200 A

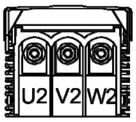
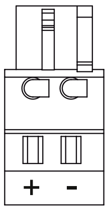
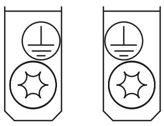
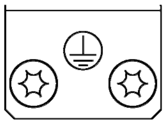
5.3.3.3 Motor/brake connection

Table 5- 26 Terminal strip X1/X2 Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

	Terminal	Technical specifications
	U (U2)	Motor connection
	V (V2)	
	W (W2)	
	+ (BR+)	Brake connection max. load current 2 A min. load current 0.1 A
	- (BR-)	
	PE connection	Threaded hole M5/3 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

Table 5- 27 Terminal strip Single Motor Module 45 A to 200 A

	Terminals	Technical specifications
	U2 V2 W2	**45 A to 60 A:** Threaded bolt M6/6 Nm [1)] **85 A:** Threaded bolt M8/13 Nm [1)] **132 A to 200 A:** Threaded bolt M8/13 Nm [1)] (see chapter Connection methods)
	+ (BR+) - (BR-)	X11 brake connector [2)]: 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 (see chapter Connection methods) The brake connector is part of the pre-assembled cable
	PE connection	**Single Motor Module with a rated output current of 45 A to 60:** Threaded bolt for motor cables: M6/6 Nm [1)] Threaded hole for PE: M6/6 Nm [1)]
		**Single Motor Module with a rated output current of 85 A** Threaded bolt for motor cables: M8/13 Nm [1)] Threaded hole for PE: M6/6 Nm [1)] **Single Motor Module with a rated output current of 132 A to 200 A** Threaded bolt for motor cables: M8/13 Nm [1)] Threaded hole for PE: M8/13 Nm [1)]

1) For ring cable lugs in accordance with DIN 46234
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.

Note

The overall length of the power cables (motor supply cables and DC-link cables) must not exceed the values given in chapter "Possible line reactor and line filter combinations".

Note

The motor brake must be connected via connector X11. The BR- cable must not be connected directly to electronic ground (M).

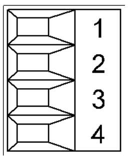
WARNING

Only protective extra-low voltages (DVC A) that comply with EN 60204-1 must be connected to all connections and terminals between 0 and 48 VDC.

The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.

5.3.3.4 X21/X22 EP terminals / temperature sensor Motor Module with cold plate

Table 5- 28 Terminal strip X21/X22

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V - 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)	
Max. connectable cross-section 1.5 mm² Type: Screw terminal 1 (see Appendix A)			

NOTICE

The KTY temperature sensor must be connected with the correct polarity.

NOTICE

The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

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).

DANGER

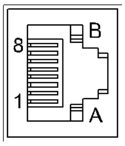
Risk of electric shock!

Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), a Sensor Module External (SME120 or SME125) or Terminal Module TM120 must be used.

If these instructions are not complied with, there is a risk of electric shock!

5.3.3.5 X200-X203 DRIVE-CLiQ interface

Table 5- 29 DRIVE-CLiQ interface X200-X202: Single Motor Module
DRIVE-CLiQ interface X200-X203: Double Motor Module

	Pin	Name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces included in the scope of delivery; blanking plate (50 pieces) Order number: 6SL3066-4CA00-0AA0			

5.3.3.6 Meaning of the LEDs on the Motor Module

Table 5- 30 Single Motor Module / Double Motor Module / Power Module - description of the LEDs

Status		Description, cause	Remedy
Ready (H200)	DC link (H201)		
OFF	OFF	Electronics power supply is missing or outside permissible tolerance range.	–
Green	OFF	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.	Check supply voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. Note: The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/red (0.5 Hz)	–	Firmware is being downloaded.	–
Green/red (2 Hz)	-	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	–	Component detection via LED is activated (p0124). Note: Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC link" LED.
The warning information on the components must be carefully observed!

5.3.4 Dimension drawings

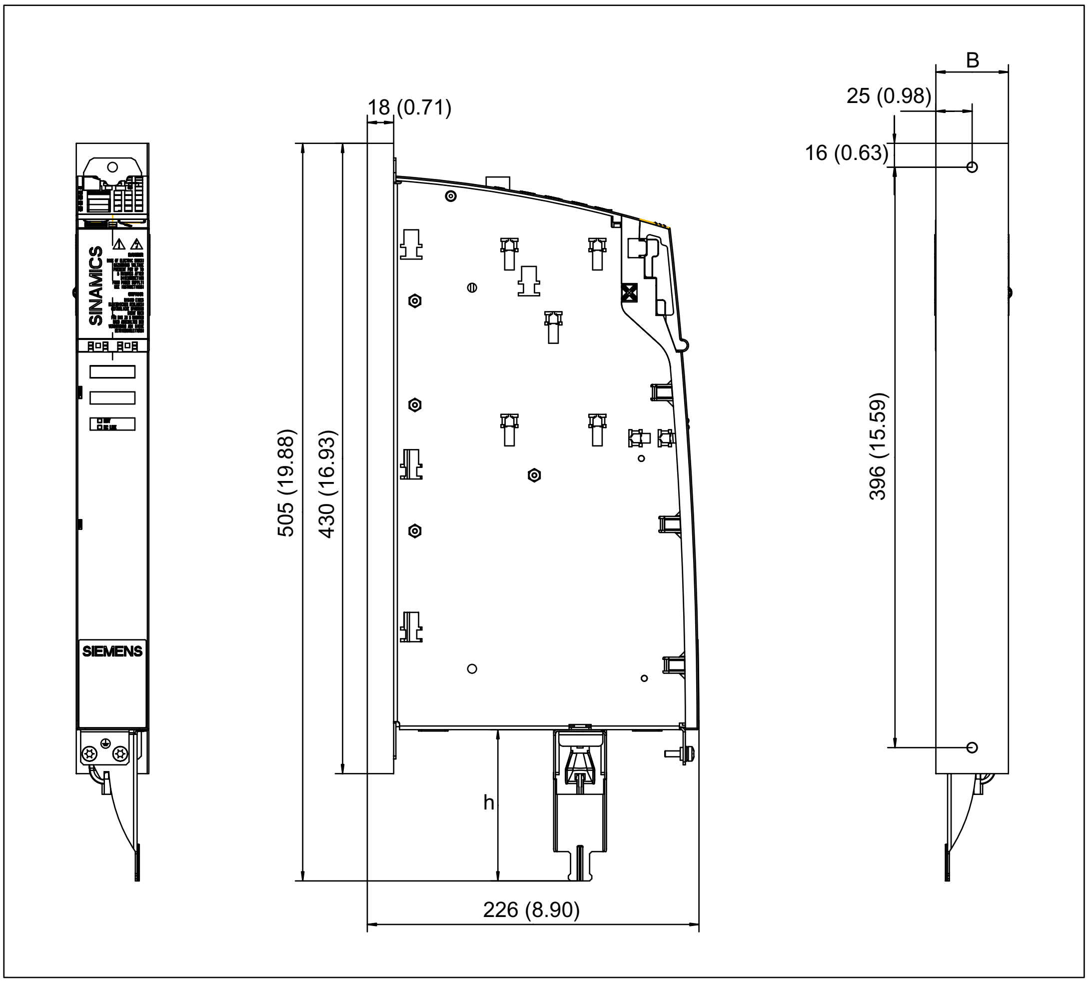


Figure 5-48 Dimension drawing of Motor Module with cold plate 3 A to 18 A and 2 x 3 A to 2 x 9 A, all dimensions in mm and (inches)

Table 5- 31 Dimensions of Motor Module with cold plate 3 A to 18 A and 2 x 3 A to 2 x 9 A

Motor Module type	Order number	W [mm] (inches)	h [mm] (inches)
Single Motor Module 3 A	6SL3126-1TE13-0AAx	50 (1.97)	89 (3.50)
Single Motor Module 5 A	6SL3126-1TE15-0AAx		
Single Motor Module 9 A	6SL3126-1TE21-0AAx		
Single Motor Module 18 A	6SL3126-1TE21-8AAx		
Double Motor Module 3 A	6SL3126-2TE13-0AAx		
Double Motor Module 5 A	6SL3126-2TE15-0AAx		
Double Motor Module 9 A	6SL3126-2TE21-0AAx		

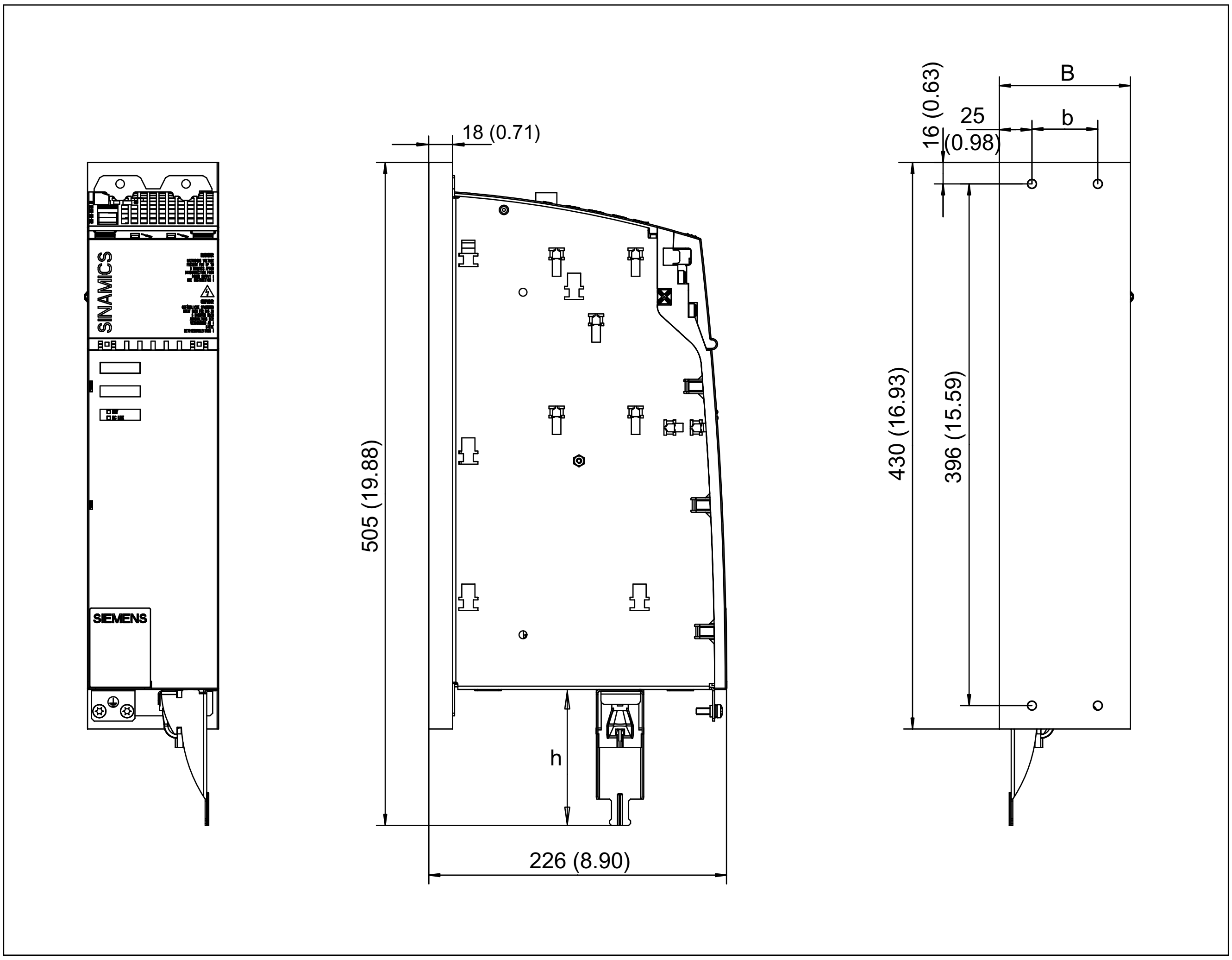


Figure 5-49 Dimension drawing of Motor Module with cold plate 30 A and 2 x 18 A, all dimensions in mm and (inches)

Table 5- 32 Dimensions of Motor Module with cold plate 30 A and 2 x 18 A

Motor Module type	Order number	W [mm] (inches)	b [mm] (inches)	h [mm] (inches)
Single Motor Module 30 A	6SL3126-1TE23-0AAx	100 (3.94)	50 (1.97)	89 (3.50)
Double Motor Module 18 A	6SL3126-2TE21-8AAx			

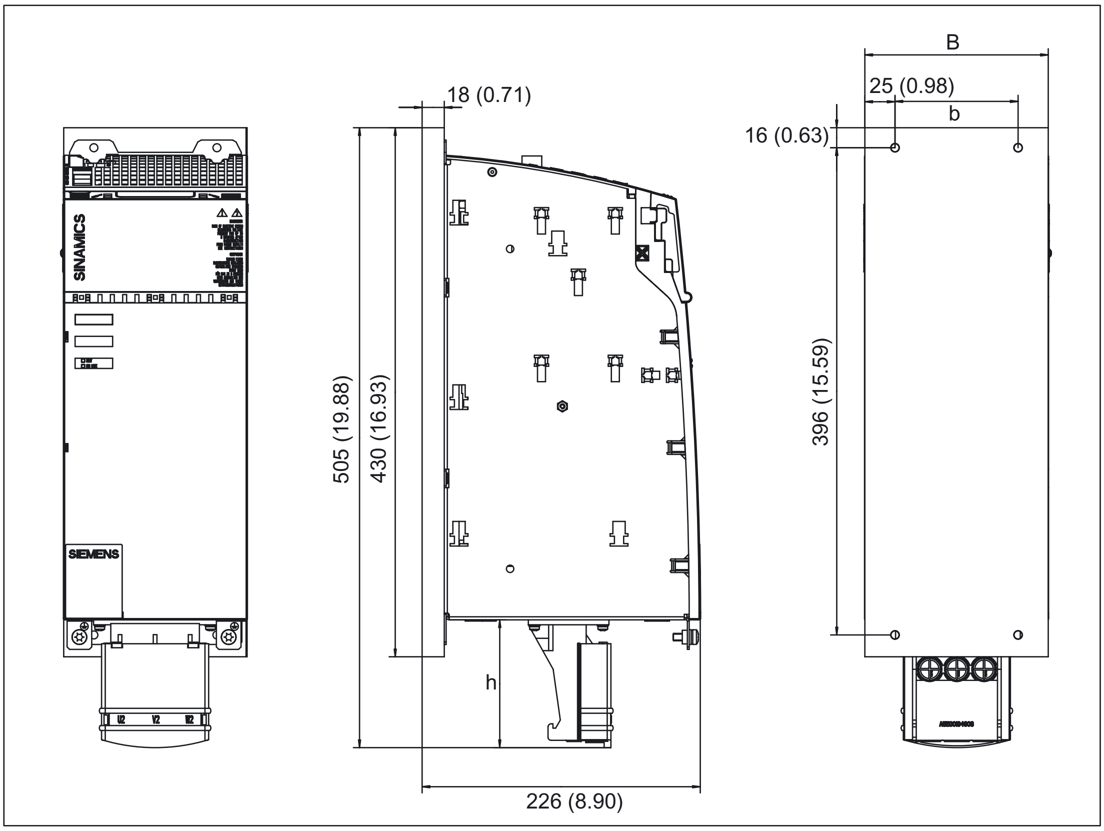


Figure 5-50 Dimension drawing of Motor Module with cold plate 45 A, 60 A, and 85 A, all dimensions in mm and (inches)

Table 5- 33 Dimensions, Motor Module with cold plate 45 A, 60 A and 85 A

<table>
<tr><th>Motor Module type</th><th>Order number</th><th>W [mm]
(inches)</th><th>b [mm]
(inches)</th><th>h [mm]
(inches)</th></tr>
<tr><td>Single Motor Module 45 A</td><td>6SL3126-1TE24-5AAx</td><td rowspan="2">150 (5.91)</td><td rowspan="2">100 (3.94)</td><td rowspan="3">105 (4.13)</td></tr>
<tr><td>Single Motor Module 60 A</td><td>6SL3126-1TE26-0AAx</td></tr>
<tr><td>Single Motor Module 85 A</td><td>6SL3126-1TE28-5AAx</td><td>200 (7.87)</td><td>150 (5.91)</td></tr>
</table>

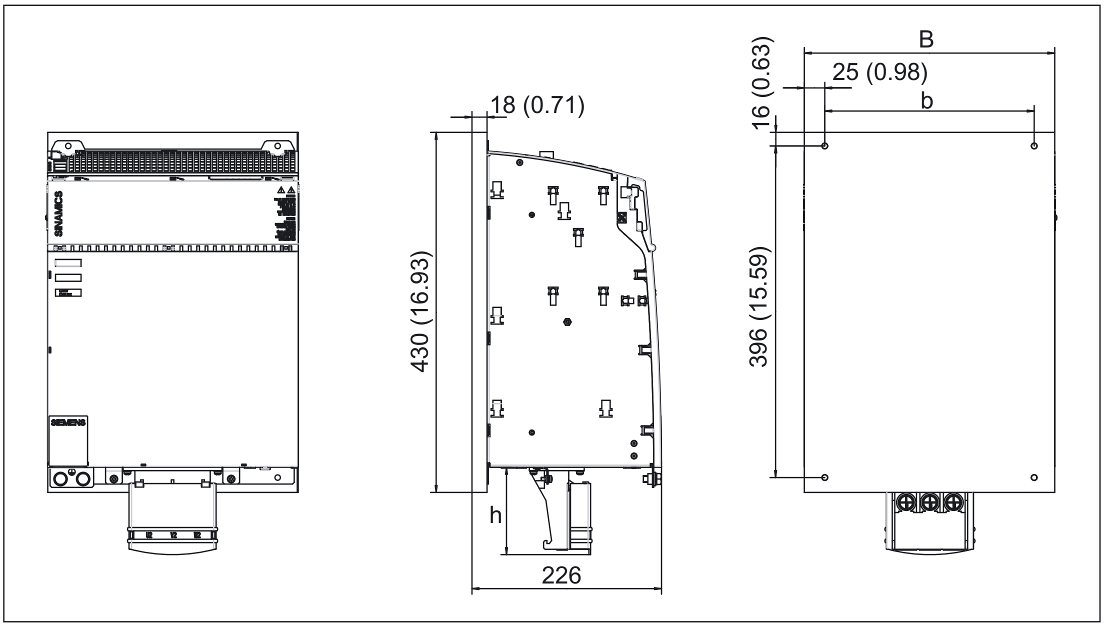


Figure 5-51 Dimension drawing of Motor Module with cold plate 132 A and 200 A, all dimensions in mm and (inches)

Table 5- 34 Dimensions of Motor Module with cold plate (132 A and 200 A)

Motor Module type	Order number	W [mm] (inches)	b [mm] (inches)	h [mm] (inches)
Single Motor Module 132 A	6SL3126-1TE31-3AAx	299 (11.77)	250 (9.84)	105 (4.13)
Single Motor Module 200 A	6SL3126-1TE32-0AAx			

5.3.5 Installation

Installation of the cold plate component on customer-specific heat sinks

Note the following before installation:

- Before the installation, check the surface of the heat sink to ensure that it is not damaged.
- To facilitate installation, M6 screw bolts and hexagon nuts/grub screws (ISO 7436-M6x40-14 H, property class 8.8) are recommended.
- 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 installation position of the heat-conducting foil (see diagram below).

Note

When a component is replaced, the heat-conducting foil must also be replaced.
Only heat-conducting foil approved or supplied by Siemens can be used.

	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

Installation

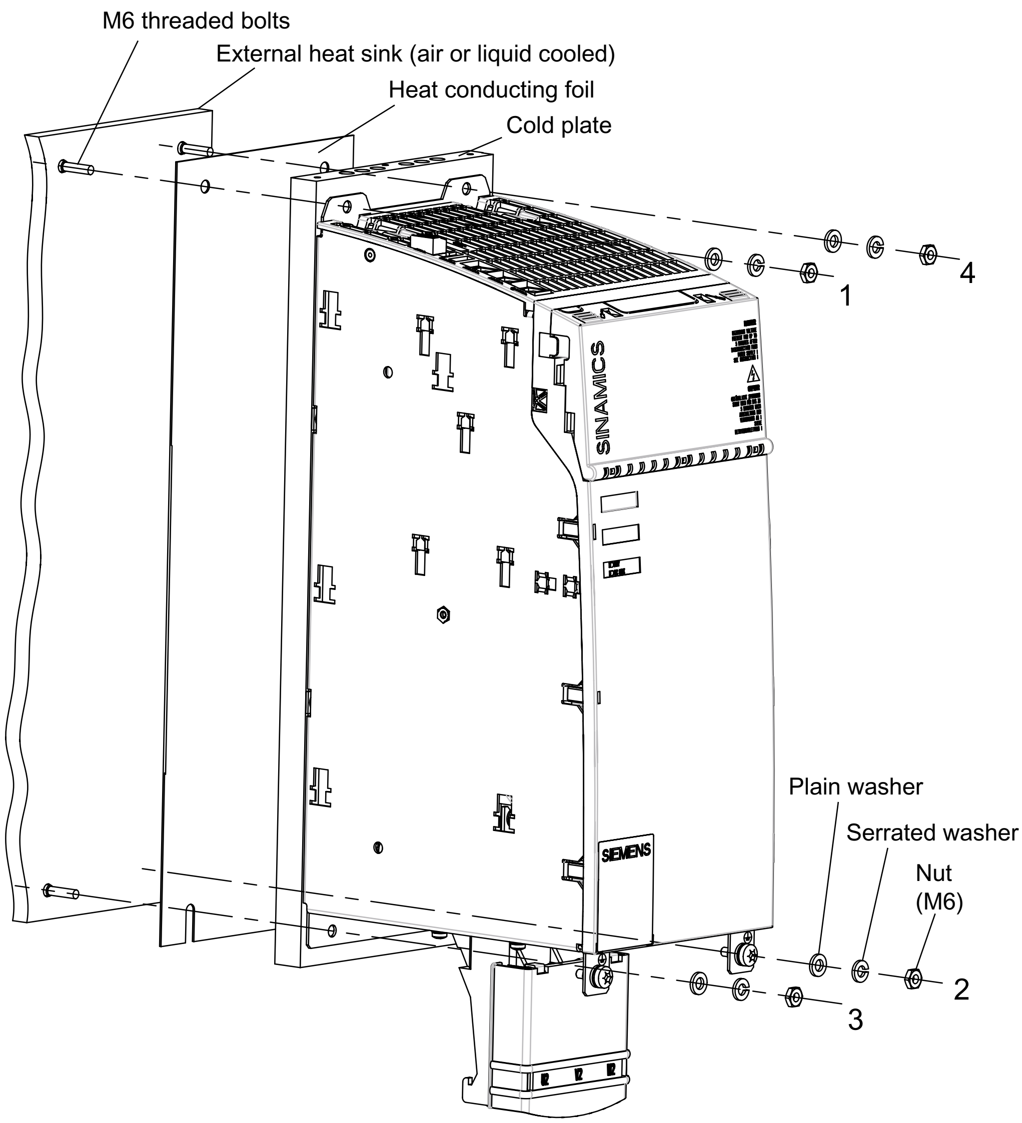


Figure 5-52 Installation of a cold plate power unit with an external heat sink and heat-conducting foil

To begin, tighten the screws by hand (approx. 0.5 Nm) in the sequence shown (steps 1 to 4) and then secure them (10 Nm).

Help with the mechanical control cabinet installation is available from:

Siemens AG
Industry Sector, IA SE WKC
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

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

The machine manufacturer can adapt the heat sink version to his 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
During the installation, you must ensure that the threaded bolts do not damage the cold plate.

5.3.6 Technical data

Table 5- 35 Technical data for Single Motor Modules with cold plate cooling (3 A - 30 A)

Cold plate	6SL3126-1TE	13-0AAx	15-0AAx	21-0AAx	21-8AAx	23-0AAx
Rated current	**A**	**3**	**5**	**9**	**18**	**30**
Voltage						
Infeed DC link voltage Electronics power supply	 V_{DC} V_{DC}	 510 –720 24 (20.4 – 28.8)				
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage				
Overvoltage trip Undervoltage trip [1]	V_{DC} V_{DC}	820 ± 2 % 380				
Current						
Electronics current consumption at 24 V DC	A_{DC}	0.65				
Rated output current	$A_{ACrms(In)}$	3	5	9	18	30
Base-load current I_{base}	A	2.6	4.3	7.7	15.3	25.5
Intermittent duty current I_{S6} 40%	$A_{ACrms(Is6)}$	3.5	6	10	24	40
Peak current	$A_{ACrms(Imax)}$	6	10	18	36	56
Current carrying capacity DC link busbar Reinforced DC link busbars 24 V busbar	 A_{DC} A_{DC} A_{DC}	 100 150 20	 100 150 20	 100 150 20	 100 150 20	 100 150 20
Power						
Rated power (with DC link voltage of 600 V_{DC} and clock frequency of 4 kHz)	kW	1.6	2.7	4.8	9.7	16
Max. pulse frequency Without derating With derating	 kHz kHz	 4 16				
Max. ambient temperature Without derating With derating	 °C °C	 40 55				
Max. permissible heat-sink temperature	°C	70	70	70	75	70
DC link capacitance	µF	110	110	110	220	710
Weight	kg	4.2	4.2	4.5	4.5	6.1

1) Default for 400 V supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized rated voltage

Table 5- 36 Technical data for Single Motor Modules with cold plate cooling (45 A - 200 A)

	6SL3126-1TE	24-5AAx	26-0AAx	28-5AAx	31-3AAx	32-0AAx
Rated current	A	45	60	85	132 (105) 1)	200 (140) 1)
Voltage						
Infeed DC link voltage Electronics power supply	 V_{DC} V_{DC}	 510 –720 24 (20.4 – 28.8)				
Output voltage	V_{ACrms}	0 - 480				
Overvoltage trip Undervoltage trip 2)	V_{DC} V_{DC}	820 ± 2 % 380				
Current						
Electronics current consumption at 24 V DC	A_{DC}	0.75	0.75	0.8	0.85	0.85
Rated output current	$A_{ACrms(In)}$	45	60	85	132	200
Base-load current I_{base}	A	38	51	68	105	141
Intermittent duty current I_{S6} 40%	$A_{ACrms(Is6)}$	60	80	110	150	250
Peak current	$A_{ACrms(Imax)}$	85	113	141	210	282
Current carrying capacity DC link busbar 24 V busbar	 A_{DC} A_{DC}	 100/200 3) 20	 100/200 3) 20	 200 20	 200 20	 200 20
Power						
Rated power (with DC link voltage of 600 V_{DC} and clock frequency of 4 kHz)	kW	24	32	46	71	107
Max. pulse frequency Without derating With derating	 kHz kHz	 4 16				
Max. ambient temperature Without derating With derating	 °C °C	 40 55				
Max. permissible heat-sink temperature	°C	75	70	78	70	75
DC link capacitance	µF	1175	1410	1880	2820	3995
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 supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V (exception: 132 A and 200 A Motor Modules) and is adjusted to the parameterized rated voltage

3) For components where the final digit in the order number is ≥ 3.

Note

New systems with 132 A and 200 A Motor Modules should ideally be designed with 200 A Motor Modules Liquid Cooled in order to avoid current derating.

Table 5- 37 Technical data of Double Motor Modules with cold plate cooling (2 x 3 to 2 x18 A)

	6SL3126-2TE	13-0AAx	15-0AAx	21-0AAx	21-8AAx
Rated current	A	2 x 3	2 x 5	2 x 9	2 x 18
Voltage					
Infeed DC link voltage Electronics power supply	 V_{DC} V_{DC}	 510 –720 24 (20.4 – 28.8)			
Output voltage	V_{ACrms}	0 - 480			
Overvoltage trip Undervoltage trip [1]	V_{DC} V_{DC}	820 ± 2% 380			
Current					
Electronics current consumption at 24 V DC	A_{DC}	0.9	0.9	0.9	1.05
Rated output current	$A_{ACrms(In)}$	2x3	2x5	2x9	2x18
Base-load current I_{base}	A	2x2.6	2x4.3	2x7.7	2x15.3
Intermittent duty current I_{S6} 40%	$A_{ACrms(Is6)}$	2x3.5	2x6	2x10	2x24
Peak current	$A_{ACrms(Imax)}$	2x6	2x10	2x18	2x36
Current carrying capacity DC link busbar Reinforced DC link busbars 24 V busbar	 A_{DC} A_{DC} A_{DC}	 100 150 20	 100 150 20	 100 150 20	 100 150 20
Power					
Rated power (with DC link voltage of 600 V_{DC} and clock frequency of 4 kHz)	kW	1.6	2.7	4.8	9.7
Max. pulse frequency Without derating With derating	 kHz kHz	 4 16			
Max. ambient temperature Without derating With derating	 °C °C	 40 55			
Max. permissible heat-sink temperature	°C	75	75	85	80
DC link capacitance	µF	110	220	220	705
Weight	kg	4.5	4.5	4.5	5.9

1) Default for 400 V supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized rated voltage

5.3.6.1 Characteristics

Rated duty cycles Motor Modules Booksize

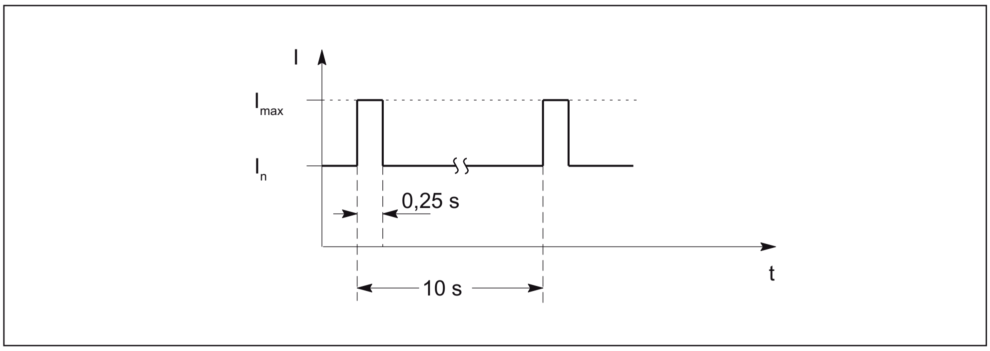


Figure 5-53 Duty cycle with initial load (for servo drives)

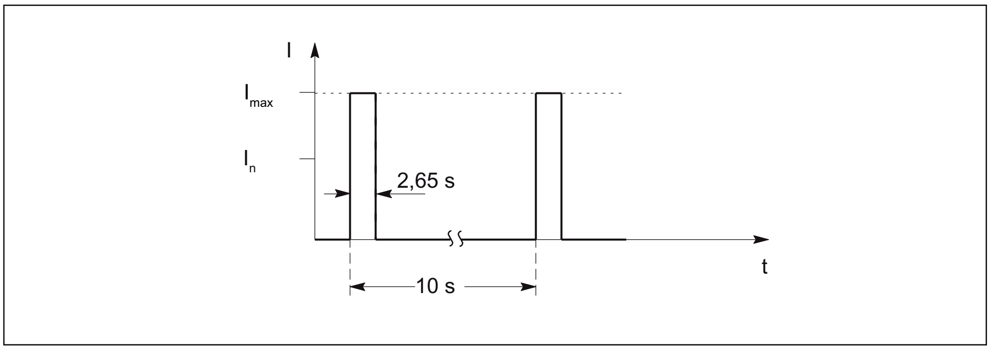


Figure 5-54 Duty cycle without initial load (for servo drives)

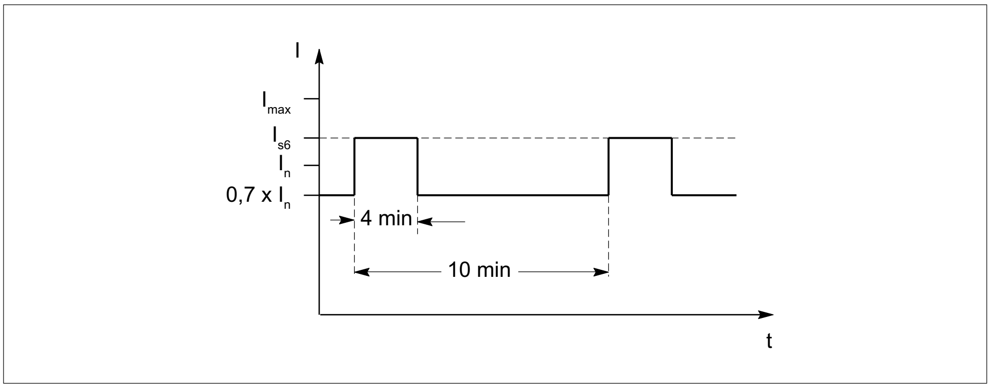


Figure 5-55 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

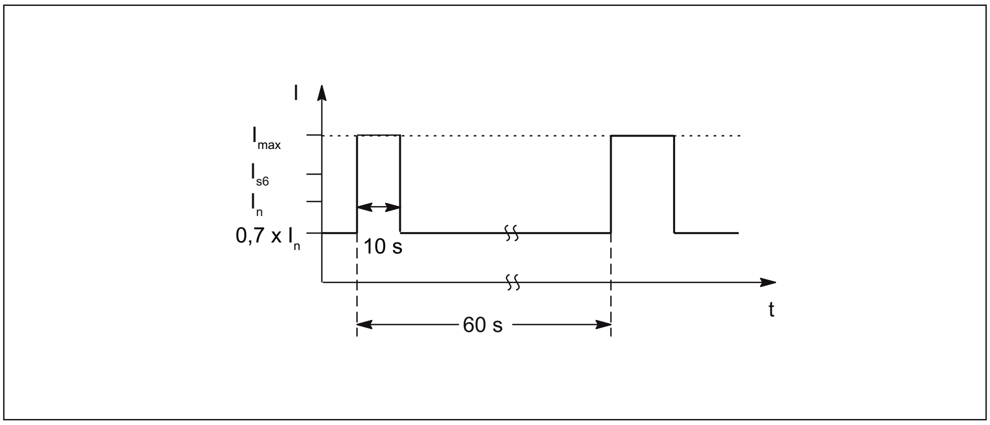


Figure 5-56 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

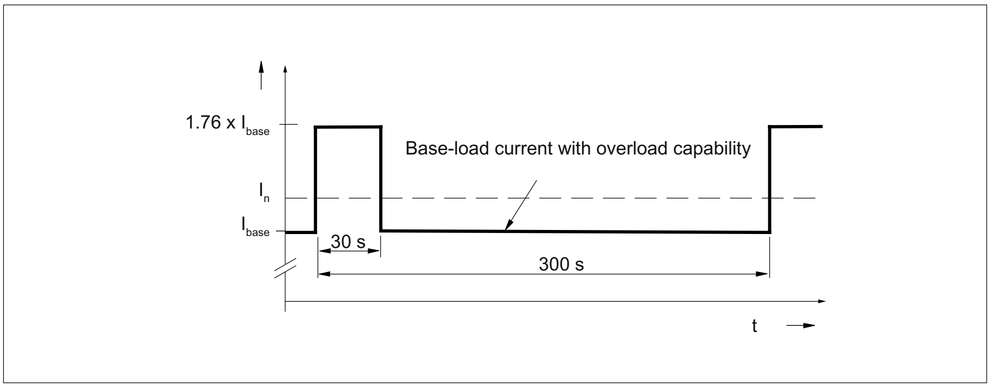


Figure 5-57 Duty cycle with 30 s overload with a duty cycle duration of 300 s

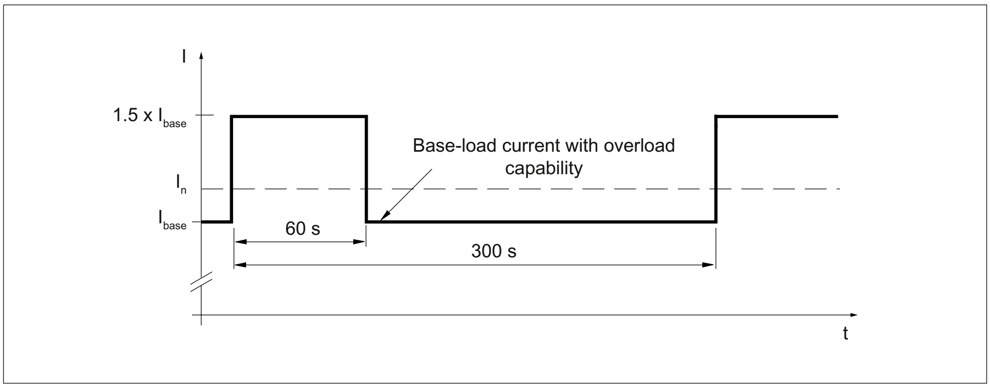


Figure 5-58 Duty cycle with 60 s overload with a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize

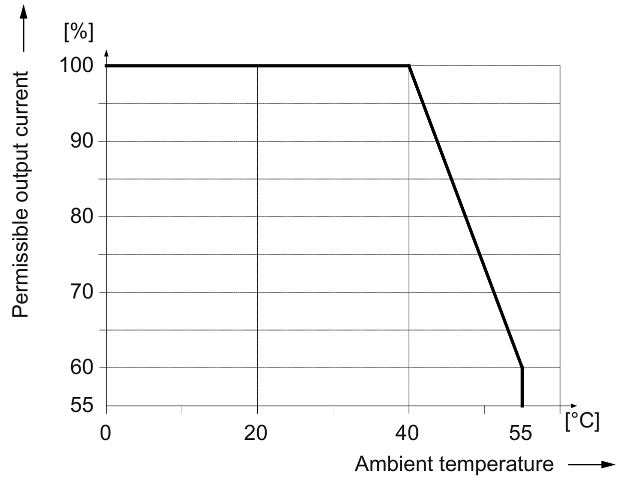


Figure 5-59 Output current as a function of the ambient temperature

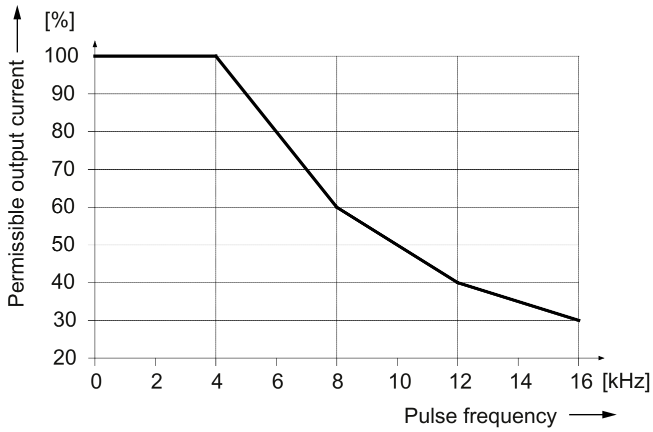


Figure 5-60 Output current as a function of the pulse frequency

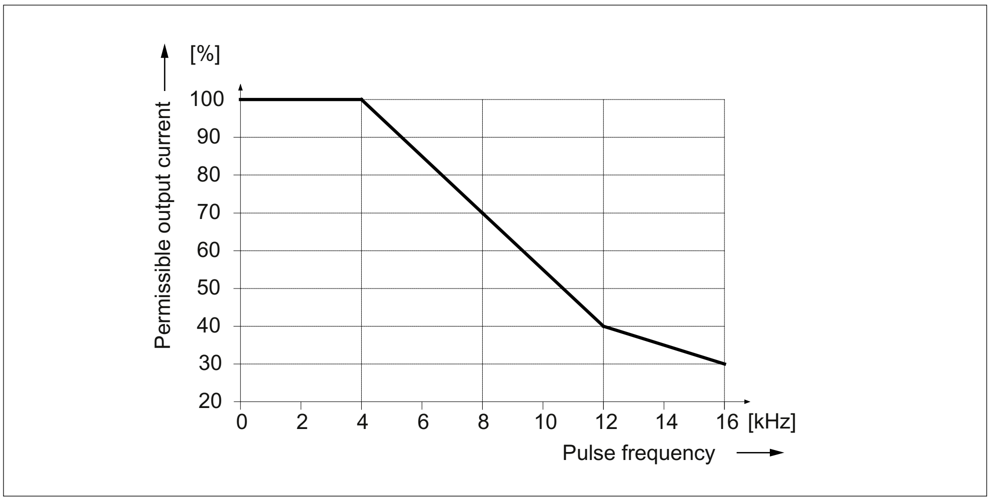


Figure 5-61 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

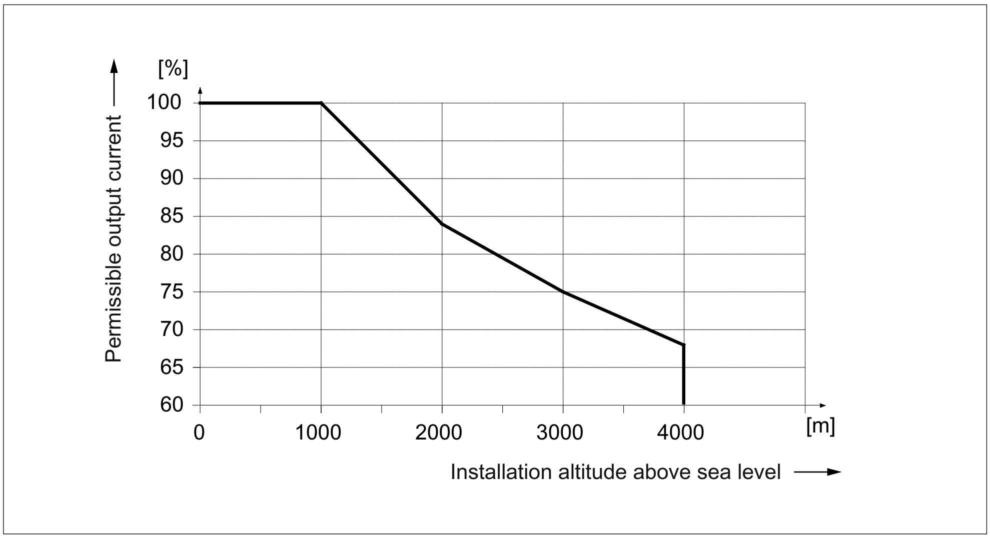


Figure 5-62 Output current as a function of the installation altitude

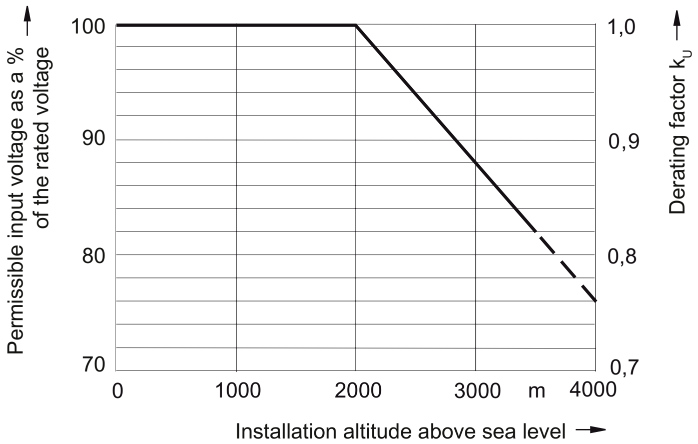


Figure 5-63 Voltage derating as a function of the installation altitude

5.4 Motor Modules Liquid Cooled

5.4.1 Description

A Motor Module is a power unit (inverter) that provides the power supply for the connected motor(s). Power is supplied by means of 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.

5.4.2 Safety information

DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

DANGER

DC-link discharge voltage

A DC-link discharge voltage danger notice in the relevant national language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC-link adapter and DC-link rectifier adapter).

DANGER

If a 50 mm wide Motor Module or a DC-link component with a similar width (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC-link bridge, including all of the screws, must be removed. It is not permissible to insert the screws without a DC-link bridge.

For all other power units and DC-link components (e. g. Capacitor Module) that are wider than 50 mm, it is neither permissible to move the DC-link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

DANGER

It is essential to apply the shield for the motor holding brake. Furthermore, only Motion-Connect cables must be used for integrated motor holding brakes, as otherwise insulation of the cores is not guaranteed. Risk of electric shock.

WARNING

Cable shields and unused power-cable cores (e.g. brake cores) must be connected to PE potential to dissipate capacitive cross-talk charges.

If this is not carefully observed, lethal shock voltages could result.

CAUTION

The cooling clearances of 80 mm above and below the components must be observed.

CAUTION

The tightening torque of the DC-link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

CAUTION

Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION

Connecting cables to temperature sensors must always be installed with shielding. The cable shield must be connected to the chassis potential at both ends over a large surface area. Temperature-sensor cables that are routed together with the motor cable must be twisted in pairs and shielded separately.

CAUTION
DC-link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

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 V ± 10%) and the voltage drops of the connection cables must be taken into account.

The DC power supply should be set to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:

- Use of Siemens three-phase motors
- Use of Siemens MOTION-CONNECT power cables
- Motor cable lengths: max. 100 m

5.4.3 Interface description

5.4.3.1 Overview

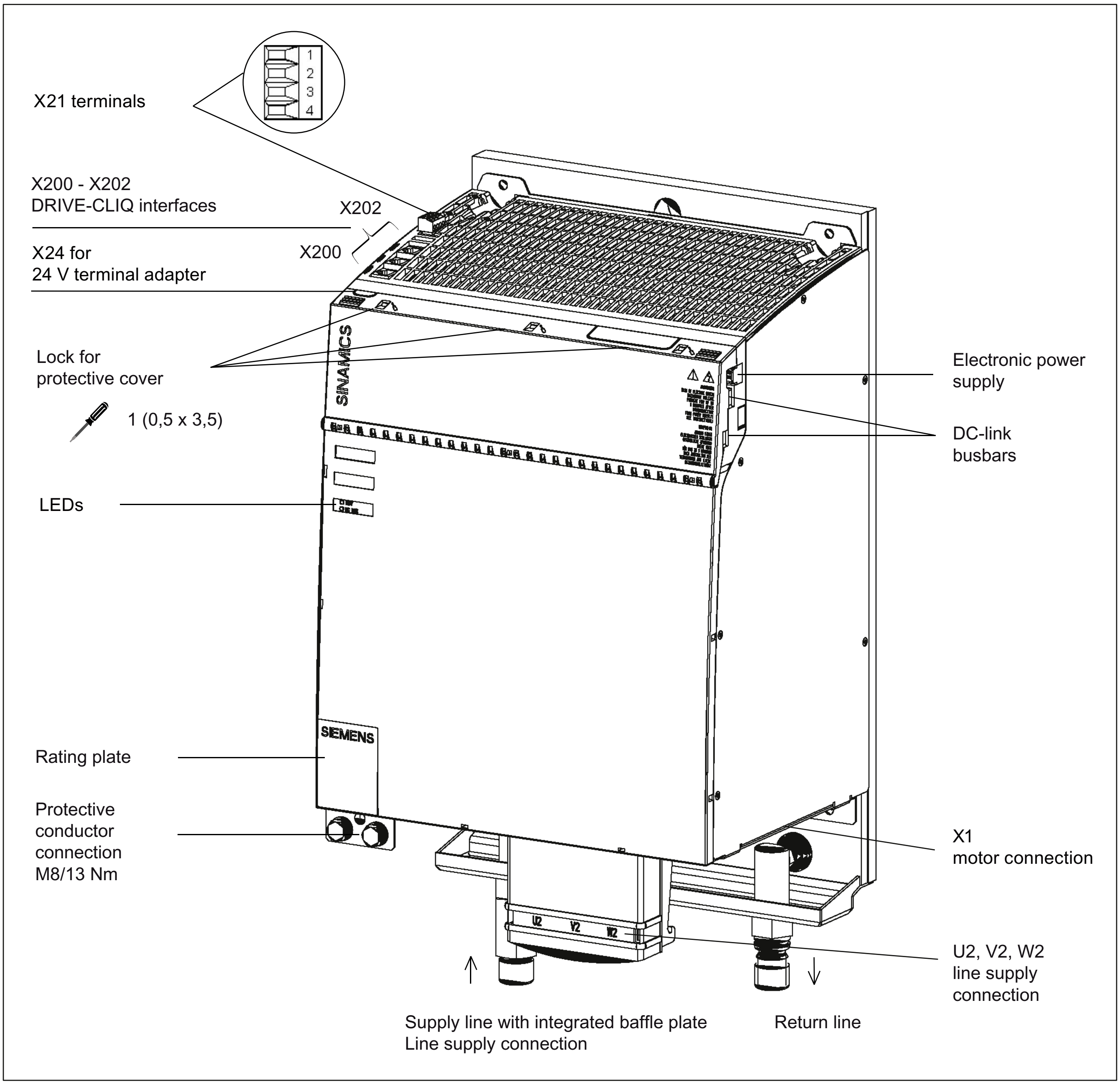


Figure 5-64 Motor Module Liquid Cooled (200 A)

5.4.3.2 Connection example

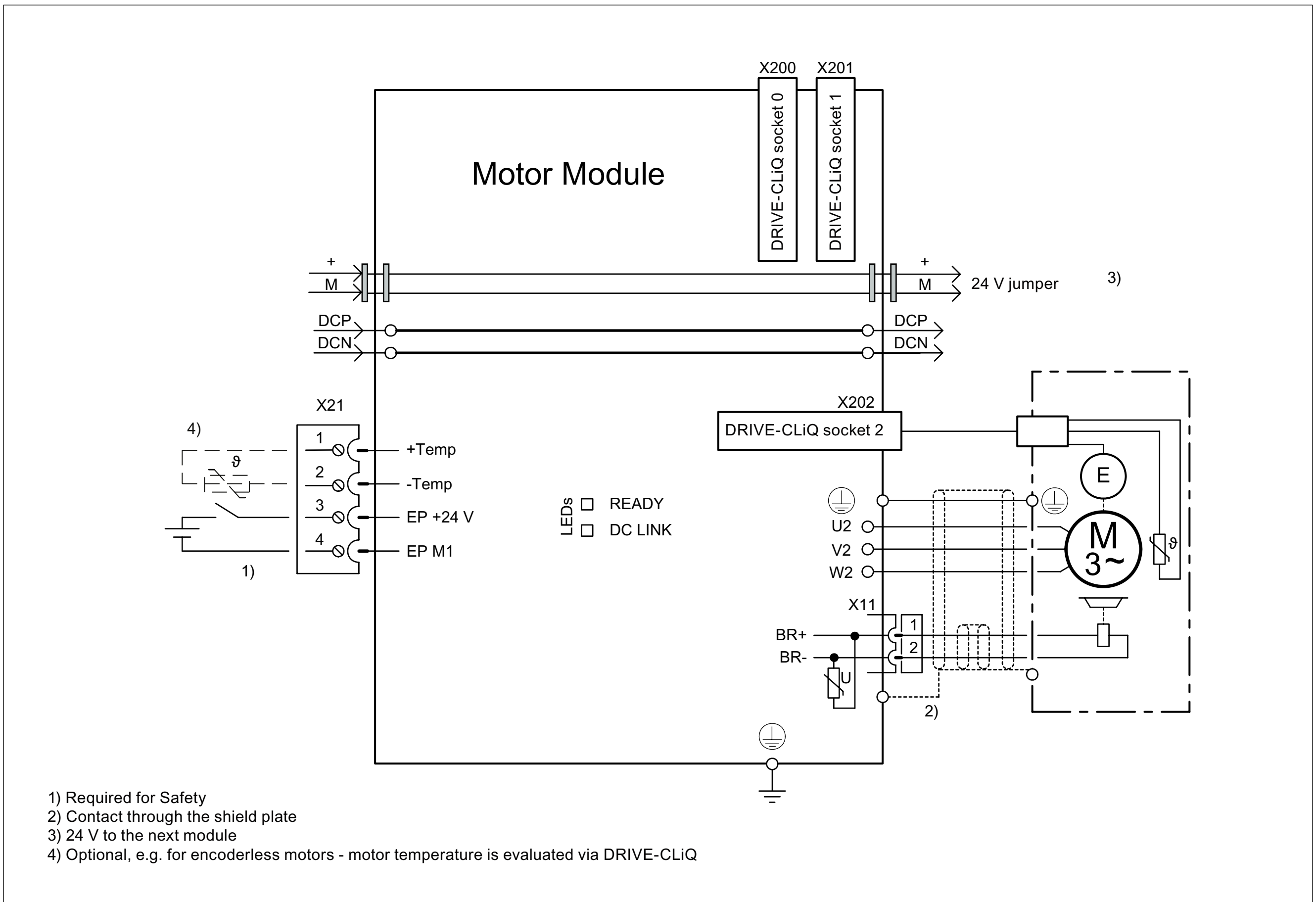
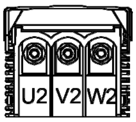
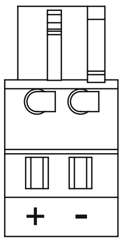
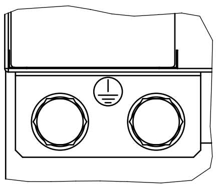


Figure 5-65 Connection example for Motor Module Liquid Cooled (200 A)

5.4.3.3 Motor/brake connection

Table 5- 38 Terminal strip Single Motor Module 200 A

	Terminals	Technical specifications
	U2	Threaded bolt M8/13 Nm 1) (see chapter Connection methods)
	V2	
	W2	
	+ (BR+)	X11 brake connector 2):
	- (BR-)	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 (see chapter Connection methods) The brake connector is part of the pre-assembled cable
	PE connection	Threaded hole M8/13 Nm 1

1) For ring cable lugs in accordance with DIN 46234
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.

Note

The overall length of the power cables (motor supply cables and DC-link cables) must not exceed the values given in chapter "Possible line reactor and line filter combinations".

Note

The motor brake must be connected via connector X11. The BR- cable must not be connected directly to electronic ground (M).

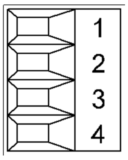
WARNING

Only protective extra-low voltages (DVC A) that comply with EN 60204-1 must be connected to all connections and terminals between 0 and 48 VDC.

The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.

5.4.3.4 X21/X22 EP terminals/Temperature sensor Motor Module Liquid Cooled

Table 5- 39 Terminal strip X21/X22

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V - 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)	
Max. connectable cross-section 1.5 mm² Type: Screw terminal 1 (see Appendix A)			

NOTICE

The temperature sensor must be connected with the correct polarity.

NOTICE

The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

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).

DANGER

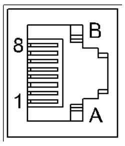
Risk of electric shock!

Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), a Sensor Module External (SME120 or SME125) or Terminal Module TM120 must be used.

If these instructions are not complied with, there is a risk of electric shock!

5.4.3.5 X200-X202 DRIVE-CLiQ interface

Table 5- 40 DRIVE-CLiQ interface X200-X202: Single Motor Module

	Pin	Name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces included in the scope of delivery; blanking plate (50 pieces) Order number: 6SL3066-4CA00-0AA0			

5.4.3.6 Meaning of the LEDs on the Motor Module

Table 5- 41 Description of the LEDs

State		Description, cause	Remedy
Ready (H200)	DC link (H201)		
OFF	OFF	Electronics power supply is missing or outside permissible tolerance range.	–
Green	OFF	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC-link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC-link voltage is too high.	Check the line voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/Red (0.5 Hz)	–	Firmware is being downloaded.	–
Green/Red (2 Hz)	-	Firmware download is complete. Waiting for POWER ON.	Carry out a POWER ON
Green/Orange or Red/Orange	–	Component detection via LED is activated (p0124). **Note:** Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

DANGER

Hazardous DC-link voltages may be present at any time regardless of the state of the "DC link" LED.
The warning information on the components must be carefully observed!

5.4.4 Dimension drawing

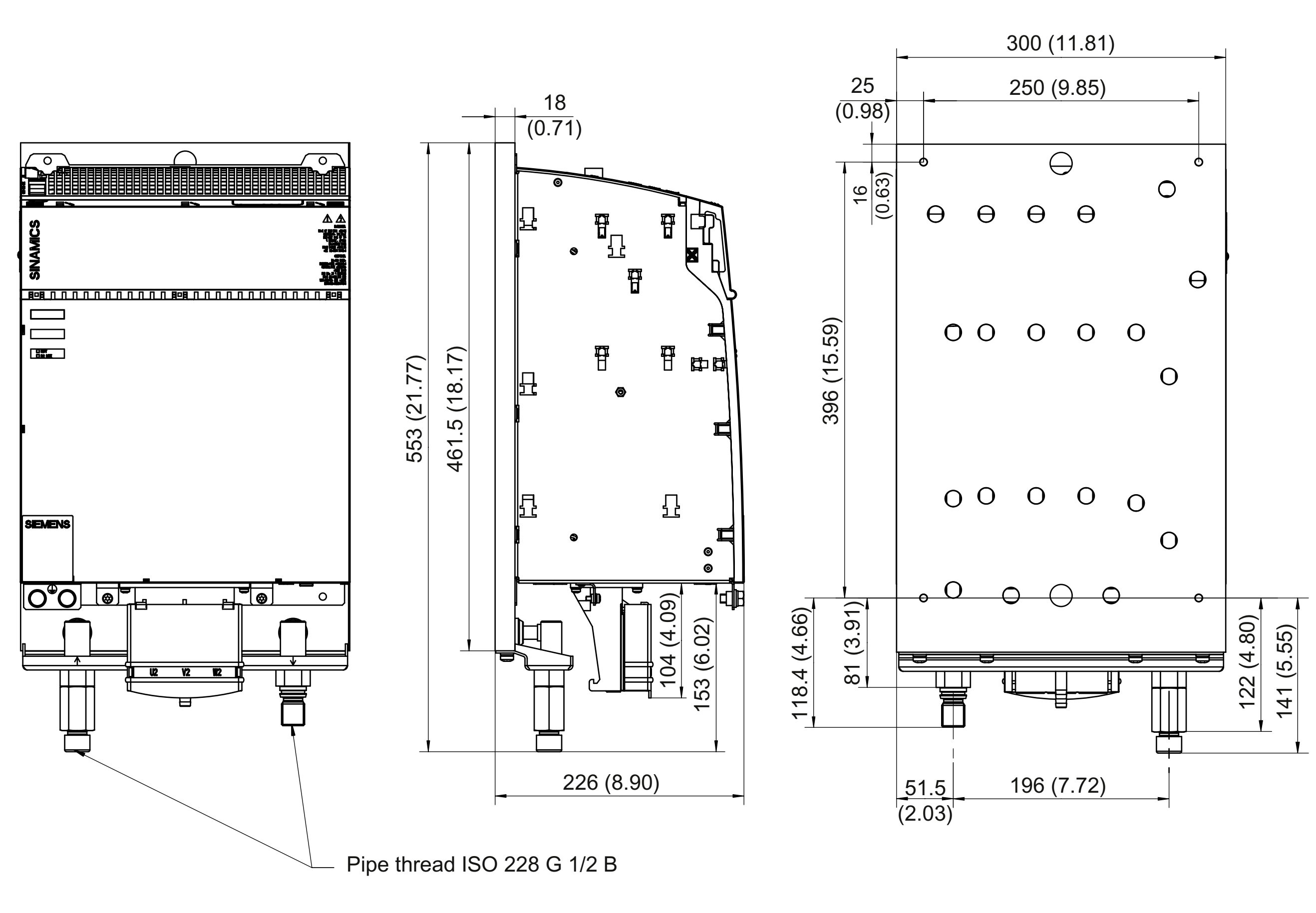


Figure 5-66 Dimension drawing of Motor Module Liquid Cooled (200 A), all dimensions in mm and (inches)

5.4.5 Installation

M6 screw bolts and hexagon nuts/grub screws (ISO 7436-M6x40-14 H, property class 8.8) are recommended for the installation of the power units.

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.

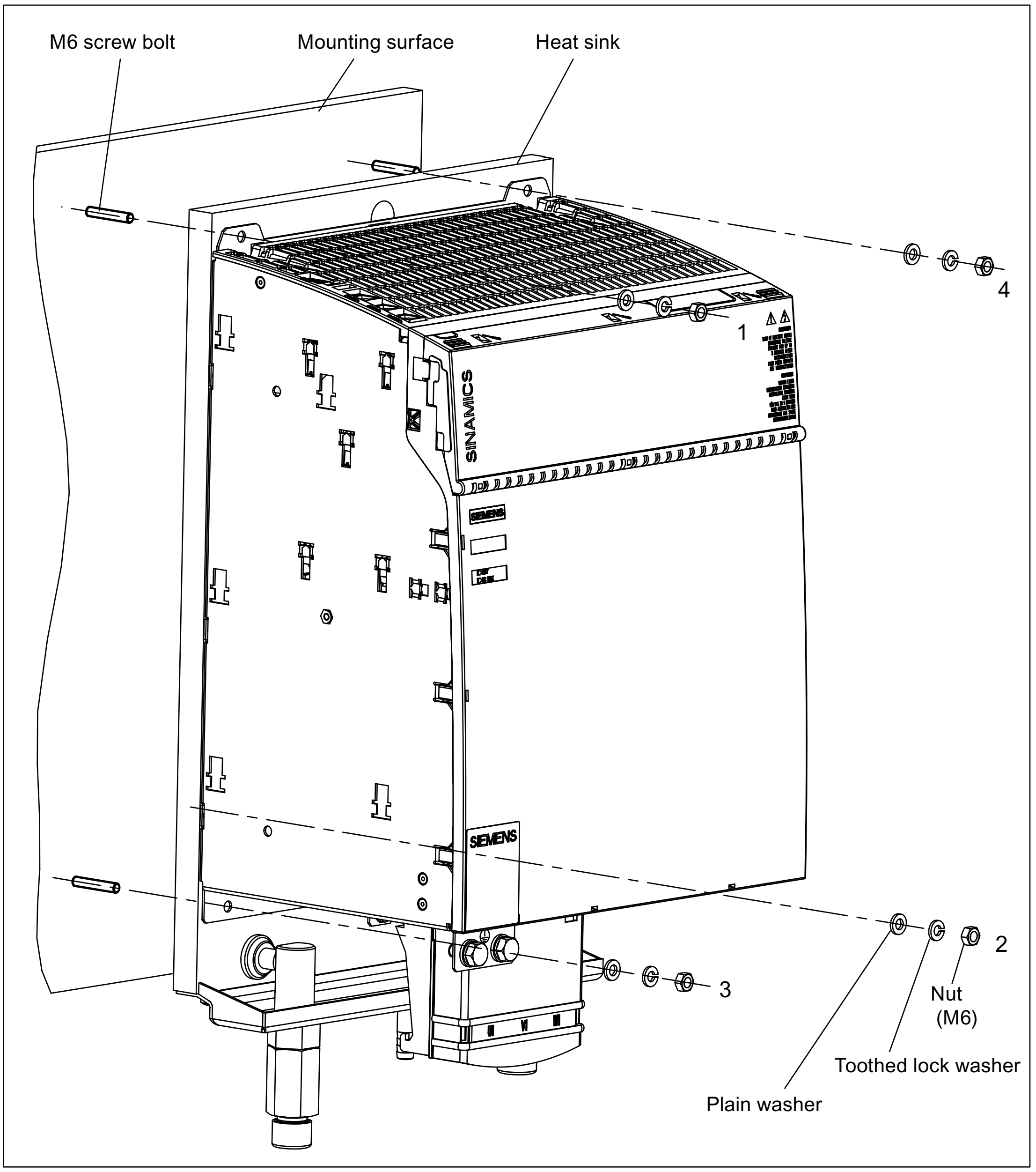


Figure 5-67 Installation of liquid-cooled power unit

To begin, tighten the screws by hand (approx. 0.5 Nm) in the sequence shown (steps 1 to 4) and then secure them (10 Nm).

5.4.6 Technical data

Table 5- 42 Technical data for Motor Module Liquid Cooled 200 A

Liquid Cooled		6SL3125-1TE32-0AA3
Rated current	A	200
Voltage		
Infeed DC link voltage Electronics power supply	 V_{DC} V_{DC}	 510 –720 24 (20.4 – 28.8)
Output voltage	V_{ACrms}	0 - 480
Overvoltage trip Undervoltage trip [1]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %
Current		
Electronics current consumption at 24 V DC	A_{DC}	0.85
Rated output current	$A_{ACrms(In)}$	200
Base-load current I_{base}	A	141
Intermittent duty current I_{S6} 40%	$A_{ACrms(Is6)}$	230
Peak current	$A_{ACrms(Imax)}$	282
Current carrying capacity DC link busbar 24 V busbar	 A_{DC} A_{DC}	 200 20
Power		
Rated power (with DC link voltage of 600 V_{DC} and clock frequency of 4 kHz)	kW	107
Total power loss (including electronics losses) [2]	W	2086
Max. pulse frequency Without derating With derating	 kHz kHz	 4 16
Max. ambient temperature Without derating With derating	 °C °C	 40 55
Max. coolant temperature Without derating With derating	 °C °C	 45 50
Rated volumetric flow for water at 70 kPa pressure drop [3]	l/min	8
Volume of liquid internal	ml	100
DC link capacitance	µF	3995
Sound pressure level	dB(A)	<73
Weight	kg	21

1) Default for 400 V supply systems; undervoltage trip threshold is adjusted to the parameterized line voltage.
2) For an overview, see the power loss tables in chapter Control cabinet installation
3) This value applies to the water coolant option; for other coolant types, see chapter "Cooling circuit and coolant properties".

5.4.6.1 Characteristics

Rated duty cycles Motor Modules Booksize

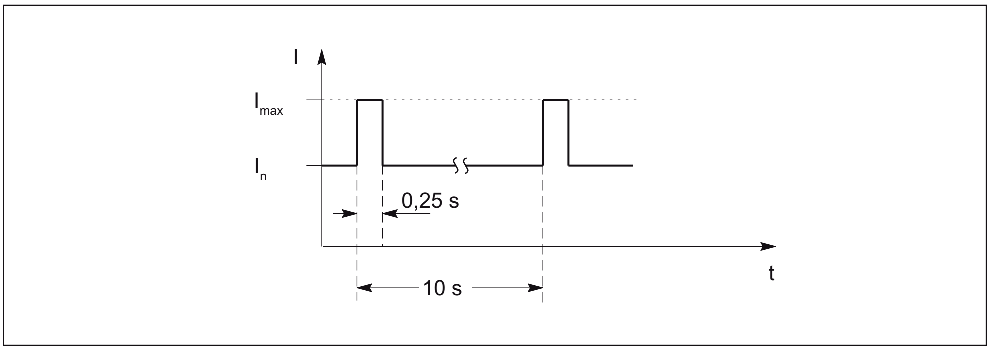


Figure 5-68 Duty cycle with initial load (for servo drives)

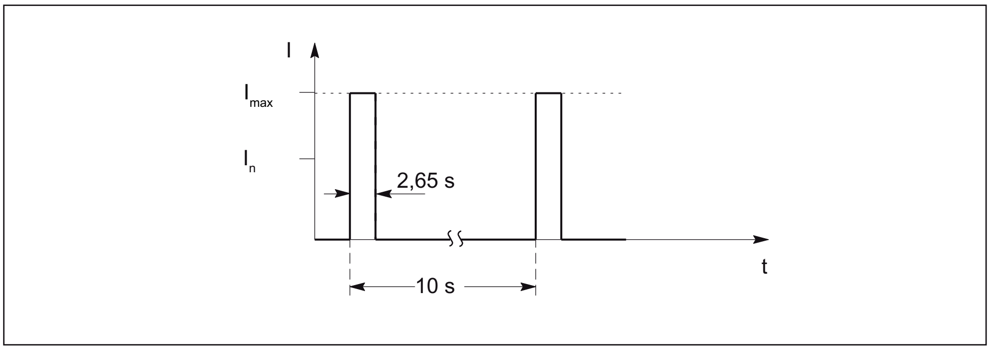


Figure 5-69 Duty cycle without initial load (for servo drives)

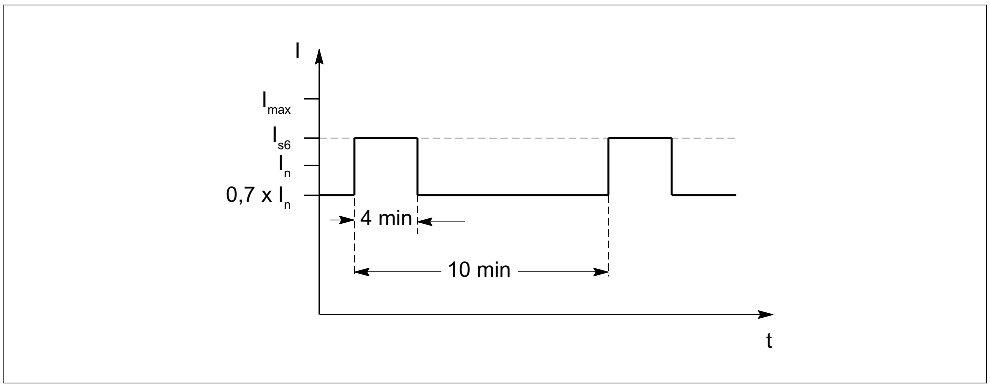


Figure 5-70 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

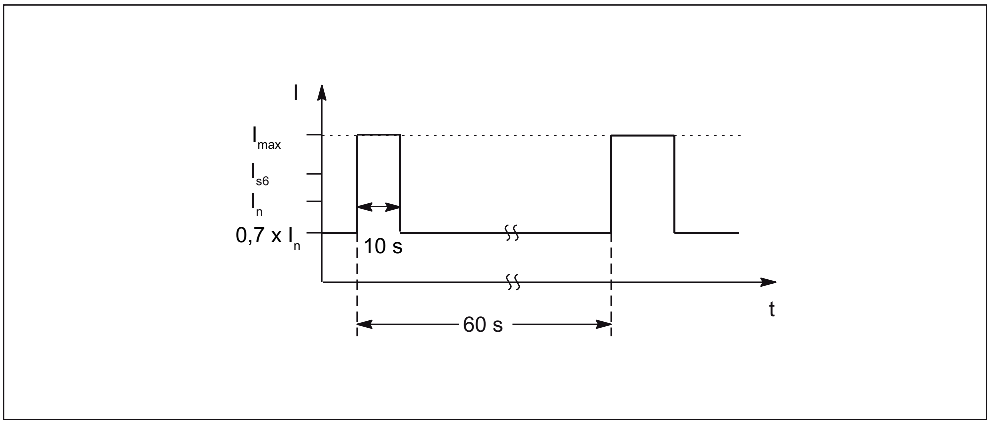


Figure 5-71 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

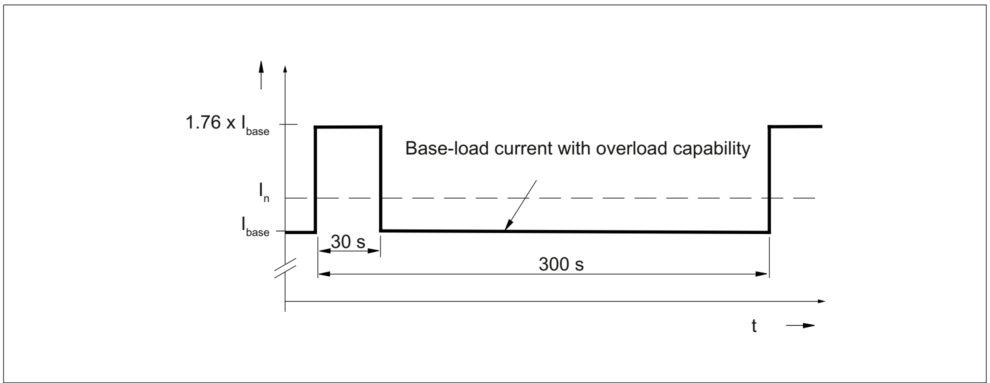


Figure 5-72 Duty cycle with 30 s overload with a duty cycle duration of 300 s

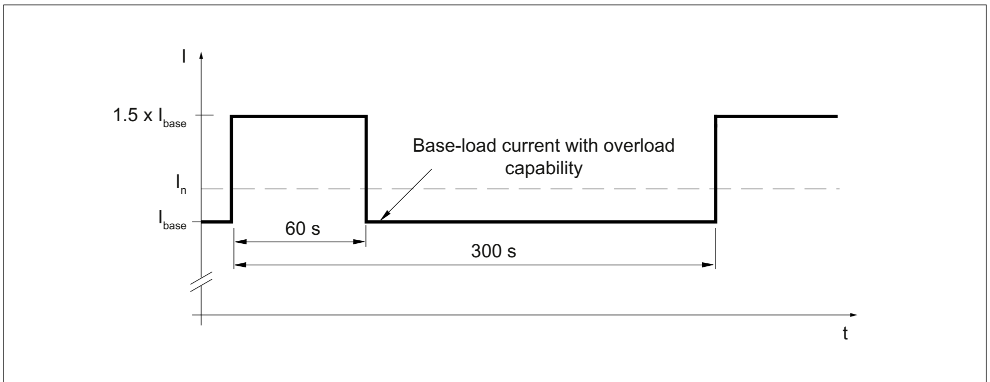


Figure 5-73 Duty cycle with 60 s overload with a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize Liquid Cooled

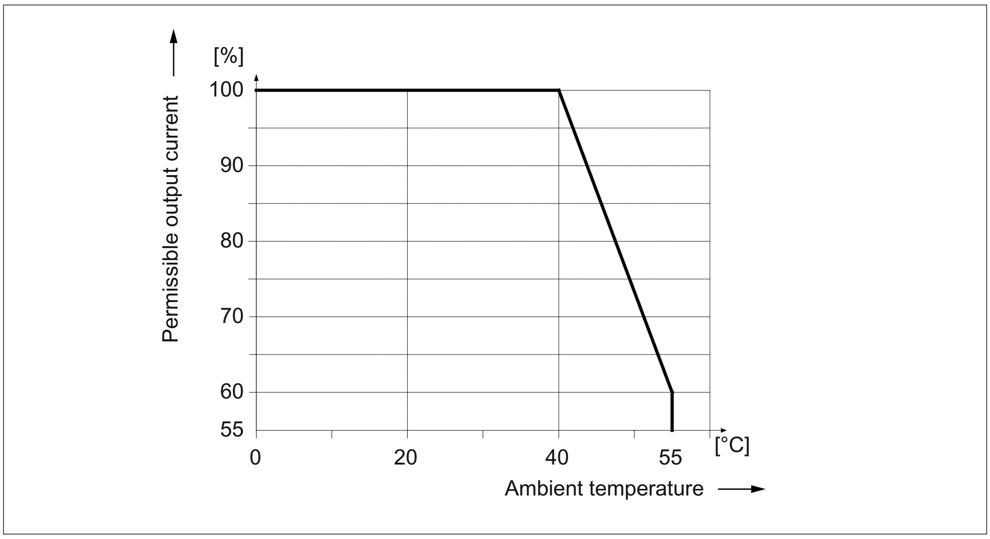


Figure 5-74 Output current as a function of the ambient temperature

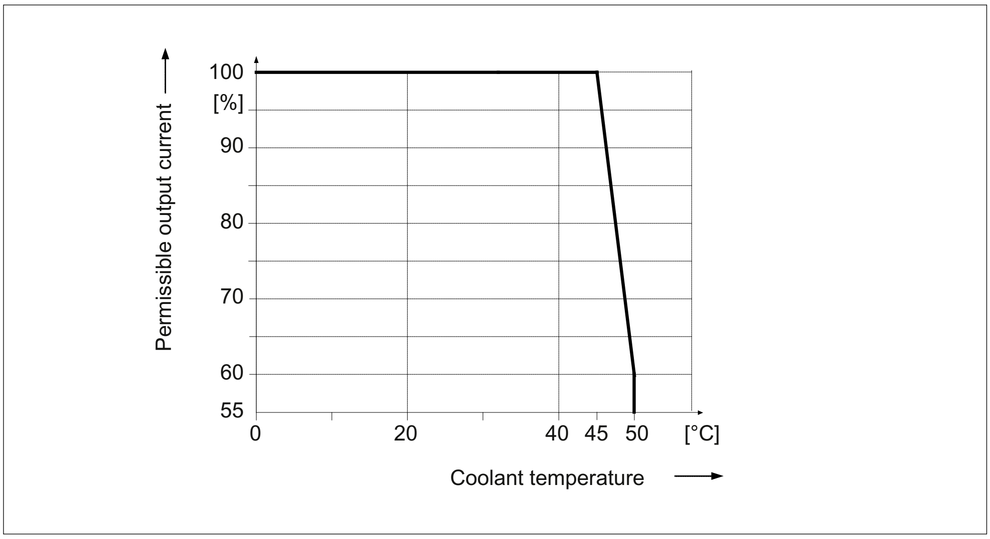


Figure 5-75 Output current as a function of the coolant temperature

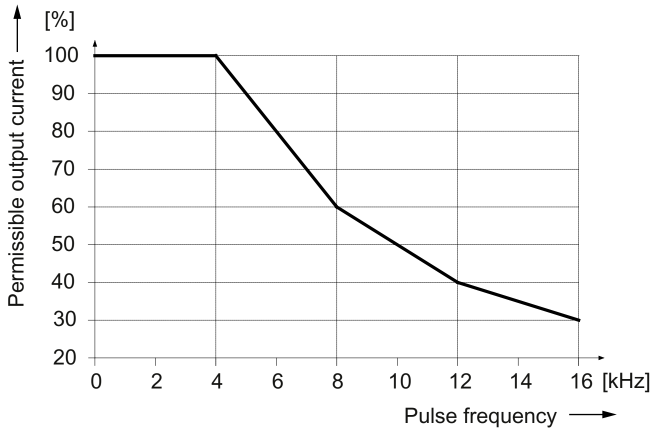


Figure 5-76 Output current as a function of the pulse frequency

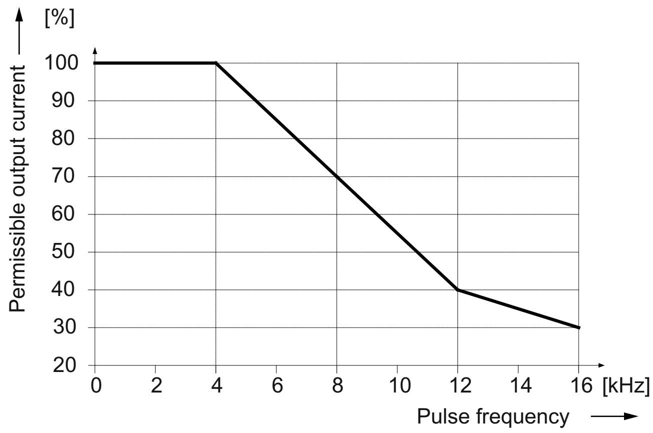


Figure 5-77 Output current as a function of the pulse frequency
(applies from order number 6SL312x-1TE32-0AA4)

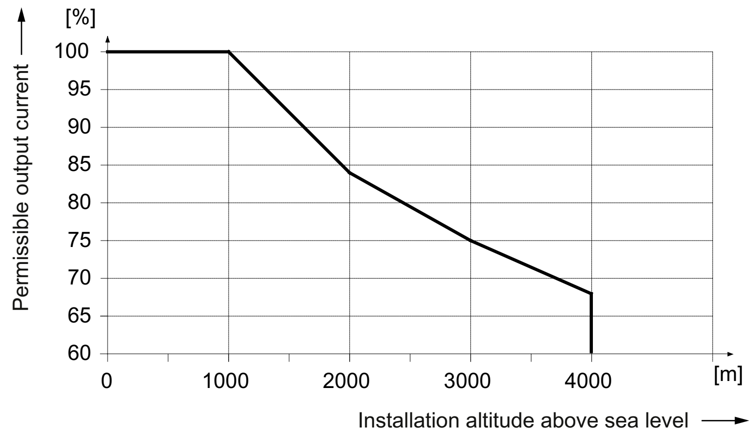


Figure 5-78 Output current as a function of the installation altitude

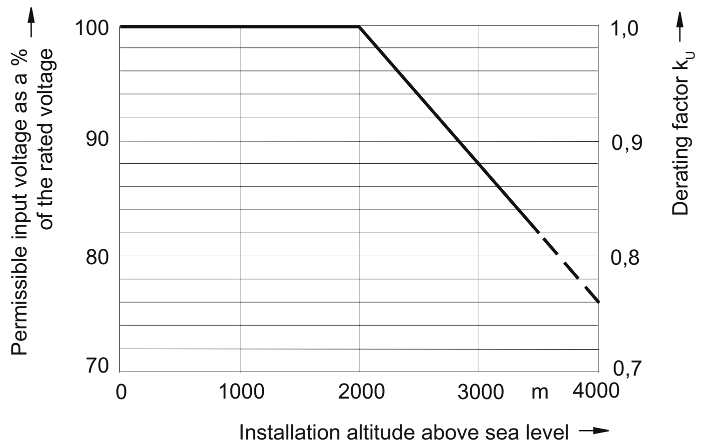


Figure 5-79 Voltage derating as a function of the installation altitude

Motor Modules Booksize Compact 6

6.1 Description

A Motor Module Booksize Compact is a power unit (inverter) that provides the power supply for the connected motor(s). Power is supplied by means of 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 two 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 via parameter p249 "Power section cooling type".

6.2 Safety information

DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

DANGER

DC-link discharge voltage

A DC-link discharge voltage danger notice in the relevant national language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC-link adapter and DC-link rectifier adapter).

DANGER

If a 50 mm wide Motor Module or a DC-link component with a similar width (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC-link bridge, including all of the screws, must be removed. It is not permissible to insert the screws without a DC-link bridge.

For all other power units and DC-link components (e. g. Capacitor Module) that are wider than 50 mm, it is neither permissible to move the DC-link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

DANGER

It is essential to apply the shield for the motor holding brake. Furthermore, only Motion-Connect cables must be used for integrated motor holding brakes, as otherwise insulation of the cores is not guaranteed. Risk of electric shock.

WARNING

Cable shields and unused power cable conductors (e.g. brake conductors) must be connected to PE potential to prevent capacitive cross-talk charges.

If this is not carefully observed, lethal shock voltages could result.

CAUTION

The cooling clearances of 80 mm above and below the components must be observed.

CAUTION

The tightening torque of the DC-link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

CAUTION

Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION

Connecting cables to temperature sensors must always be installed with shielding. The cable shield must be connected to the chassis potential at both ends over a large surface area. Temperature-sensor cables that are routed together with the motor cable must be twisted in pairs and shielded separately.

CAUTION

DC-link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

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 V ± 10%) and the voltage drops of the connection cables must be taken into account.

The DC power supply should be set to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:

- Use of Siemens three-phase motors
- Use of Siemens MOTION-CONNECT power cables
- Motor cable lengths: max. 100 m

6.3 Interface description

6.3.1 Overview

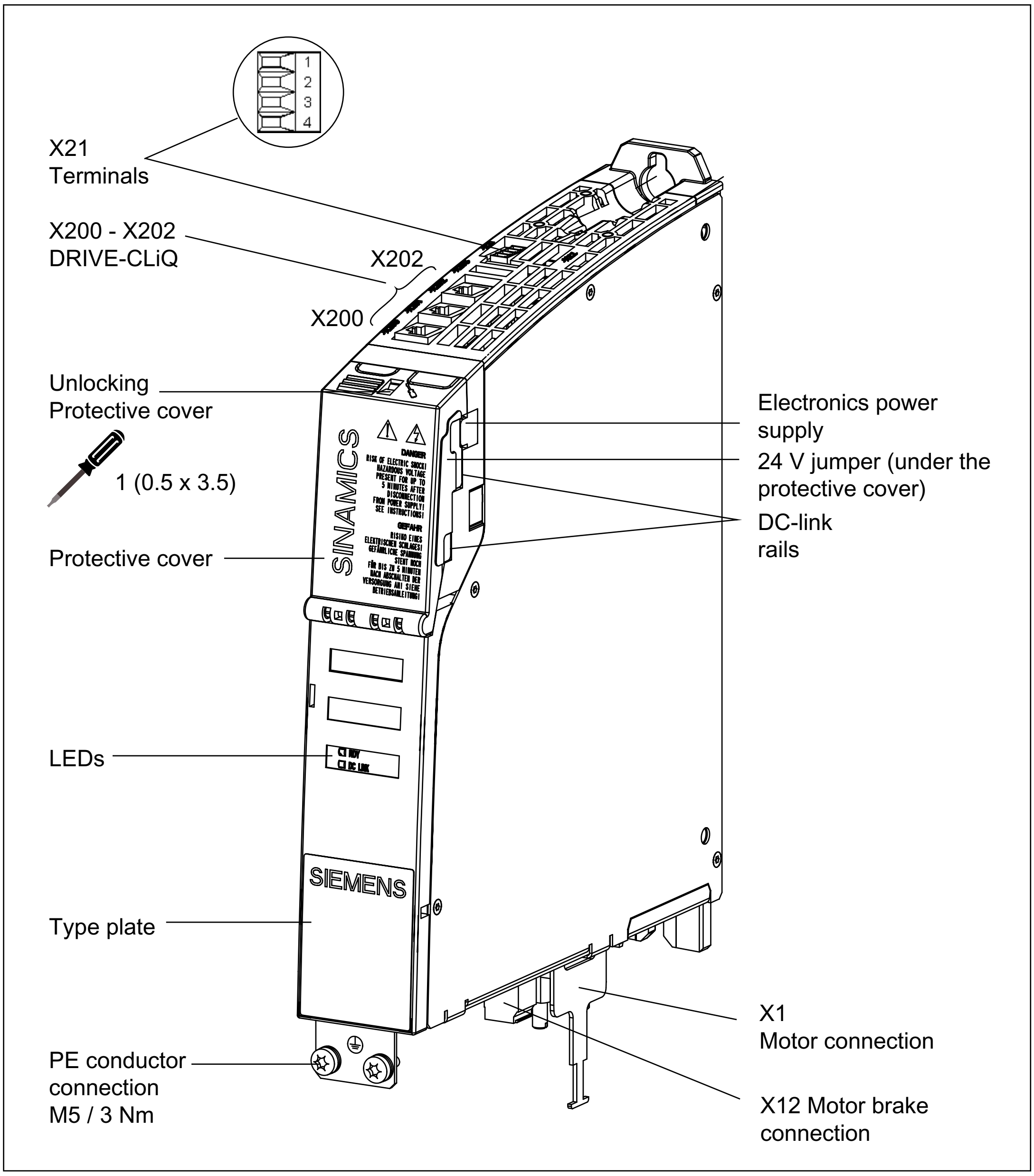


Figure 6-1 Example: Motor Module Booksize Compact format 3 A, 5 A, and 9 A

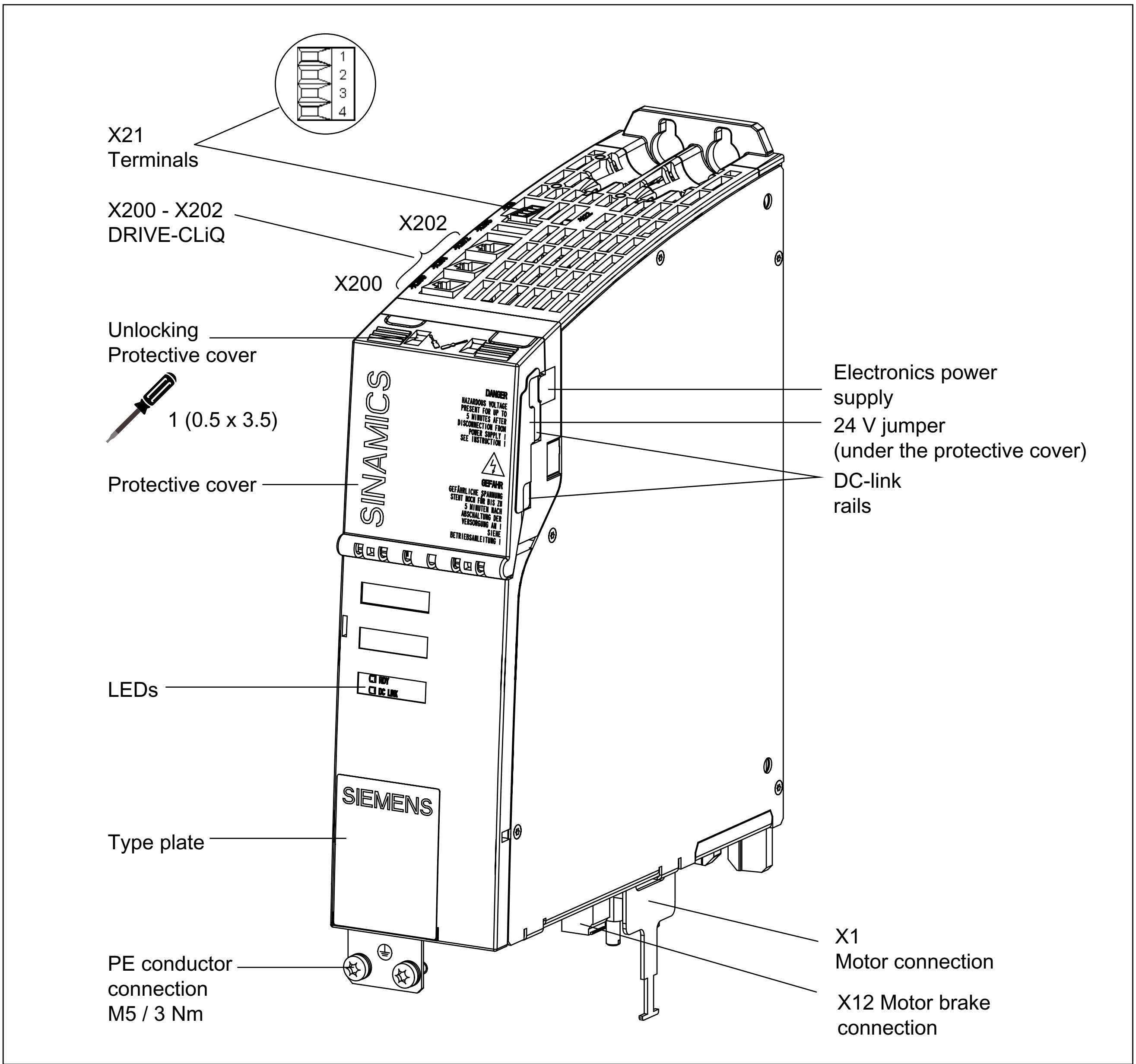


Figure 6-2 Example: Motor Module Booksize Compact format 18 A

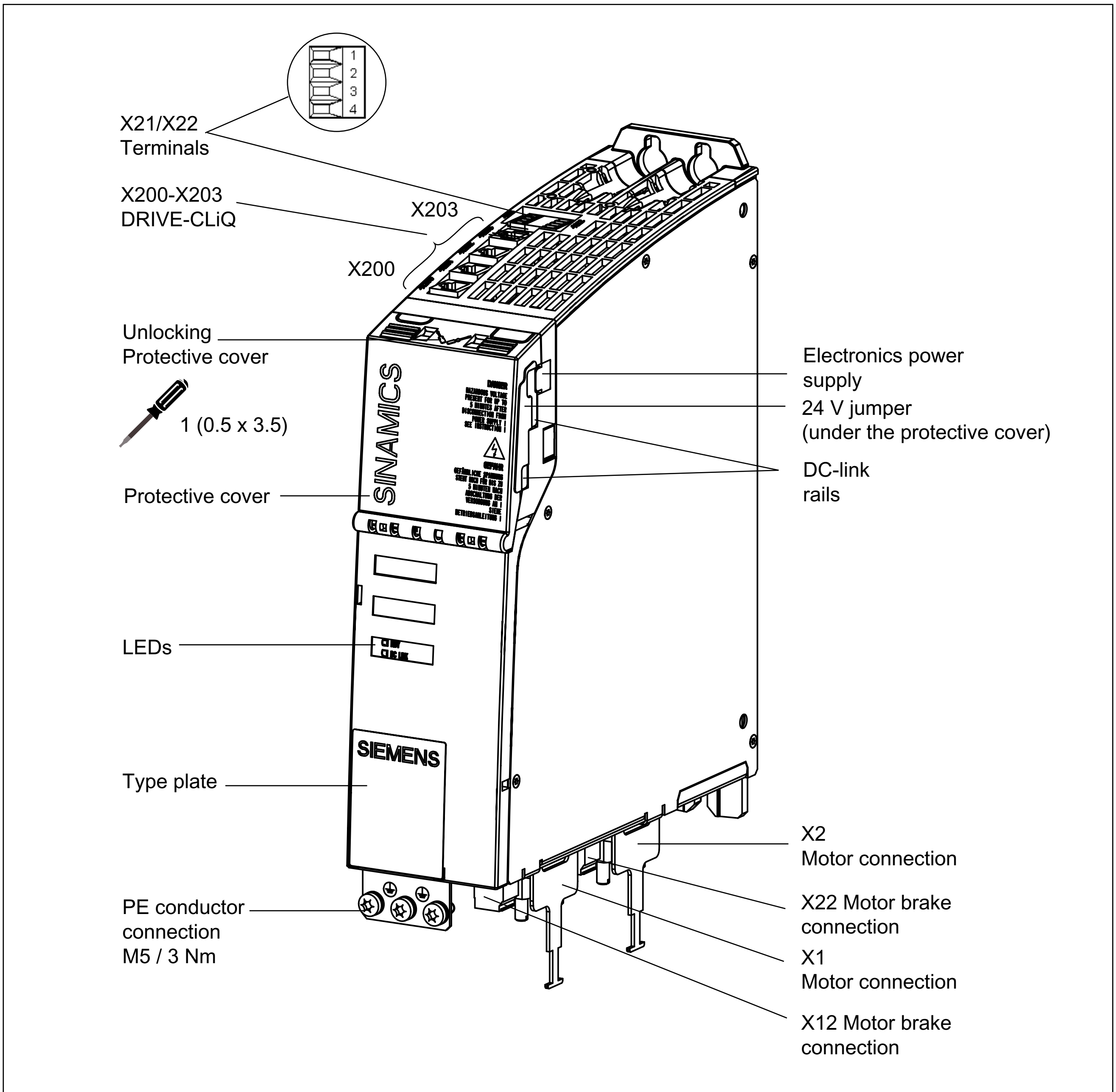
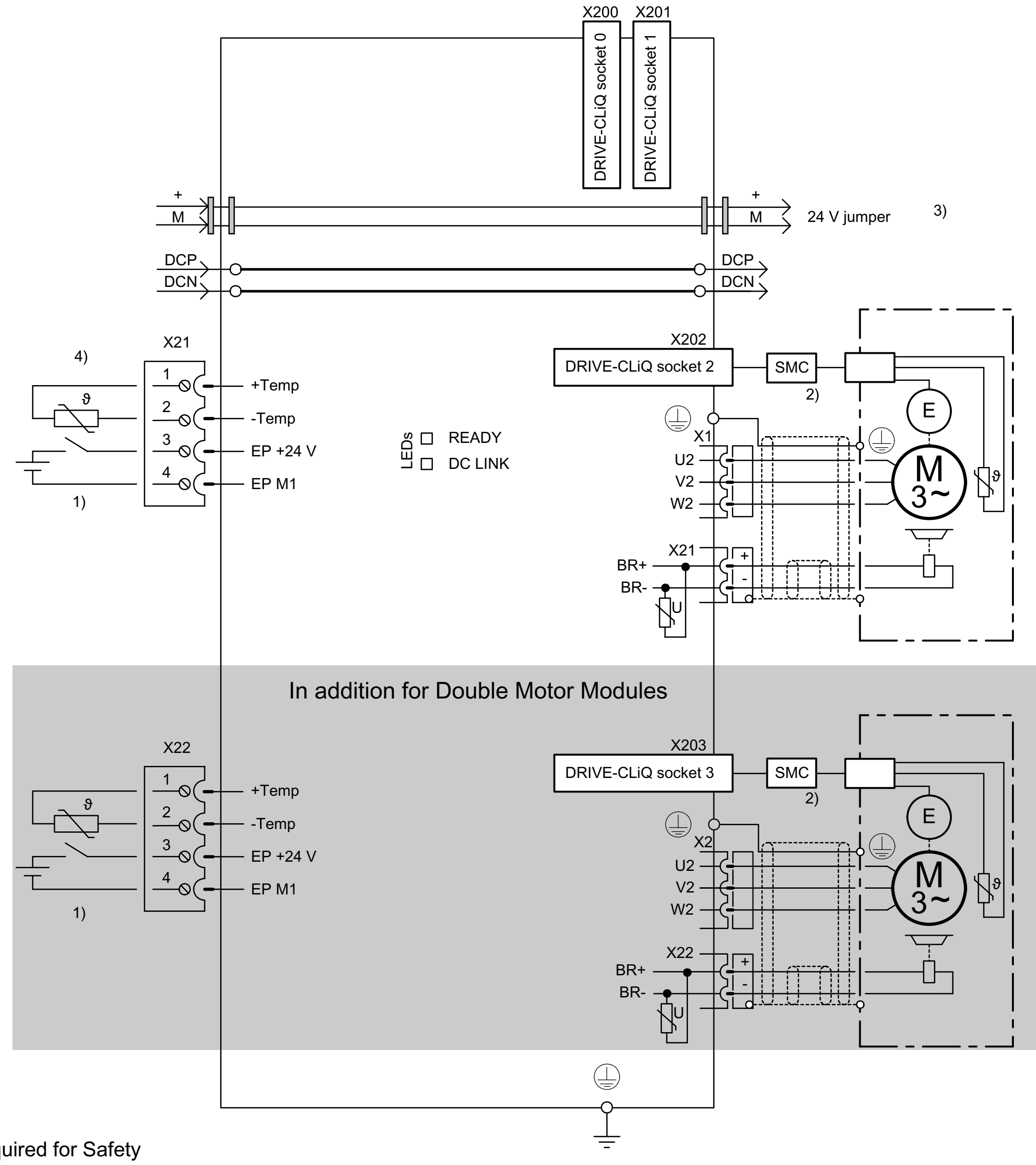


Figure 6-3 Example: Double Motor Module Booksize Compact format 2 x 1.7 A, 2 x 3 A, 2 x 5 A

6.3.2 Connection example

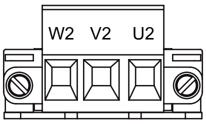
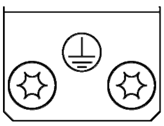
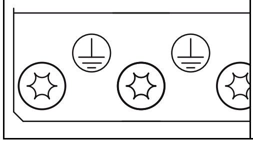


1) Required for Safety
2) SMC required for motors without DRIVE-CLiQ interface
3) 24 V to the next module
4) Alternative option for motor temperature evaluation

Figure 6-4 Connection example: Single Motor Module Booksize Compact 3 A to 18 A and Double Motor Module Booksize Compact 1.7 A to 5 A

6.3.3 X1 Motor connection

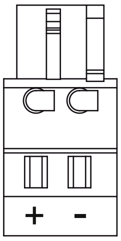
Table 6- 1 Terminal strip X1 Motor Module Booksize Compact

	Terminal	Technical specifications
	U2 V2 W2	Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see chapter Connection methods) Tightening torque: 1.2 - 1.5 Nm
	PE connection	**Single Motor Module with a rated output current of 3 A to 18 A** Threaded hole M5/3 Nm [1]
		**Double Motor Module with a rated output current of 1.7 A to 5 A** Threaded hole M5/3 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

6.3.4 Motor brake connection

Table 6- 2 Terminal strip X12

	Terminals	Technical specifications
	+ (BR+)	X12 brake connector [1]:
	- (BR-)	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 (see chapter Connection methods) Manufacturer: Wago; order number: 721-102/026-000/56-000 The brake connector is part of the scope of delivery

1) The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.

Note

The overall length of the power cables (motor supply cables and DC-link cables) must not exceed the values given in chapter "Possible line reactor and line filter combinations".

Note

The motor brake must be connected via connector X12 and X22 on Double Motor Modules. The BR- cable must not be connected directly to electronic ground (M).

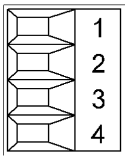
WARNING

Only protective extra-low voltages (DVC A) that comply with EN 60204-1 must be connected to all connections and terminals between 0 and 48 VDC.

The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.

6.3.5 X21/X22 EP terminals / temperature sensor Motor Module

Table 6- 3 Terminal strip X21/X22

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V - 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)	
Max. connectable cross-section 1.5 mm^2 Type: Screw terminal 1 (see chapter Connection methods)			

NOTICE

The KTY temperature sensor must be connected with the correct polarity.

NOTICE

The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

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).

DANGER

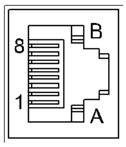
Risk of electric shock!

Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), a Sensor Module External (SME120 or SME125) or Terminal Module TM120 must be used.

If these instructions are not complied with, there is a risk of electric shock!

6.3.6 X200-X203 DRIVE-CLiQ interface

Table 6- 4 DRIVE-CLiQ interface X200-X202: Single Motor Module
DRIVE-CLiQ interface X200-X203: Double Motor Module

	Pin	Name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces included in the scope of delivery; blanking plate (50 pieces) Order number: 6SL3066-4CA00-0AA0			

6.3.7 Meaning of the LEDs on the Motor Module

Table 6- 5 Single Motor Module / Double Motor Module / Power Module - description of the LEDs

Status		Description, cause	Remedy
Ready (H200)	DC link (H201)		
OFF	OFF	Electronics power supply is missing or outside permissible tolerance range.	–
Green	OFF	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.	Check supply voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. Note: The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/red (0.5 Hz)	–	Firmware is being downloaded.	–
Green/red (2 Hz)	-	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	–	Component detection via LED is activated (p0124). Note: Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC link" LED.
The warning information on the components must be carefully observed!

6.4 Dimension drawings

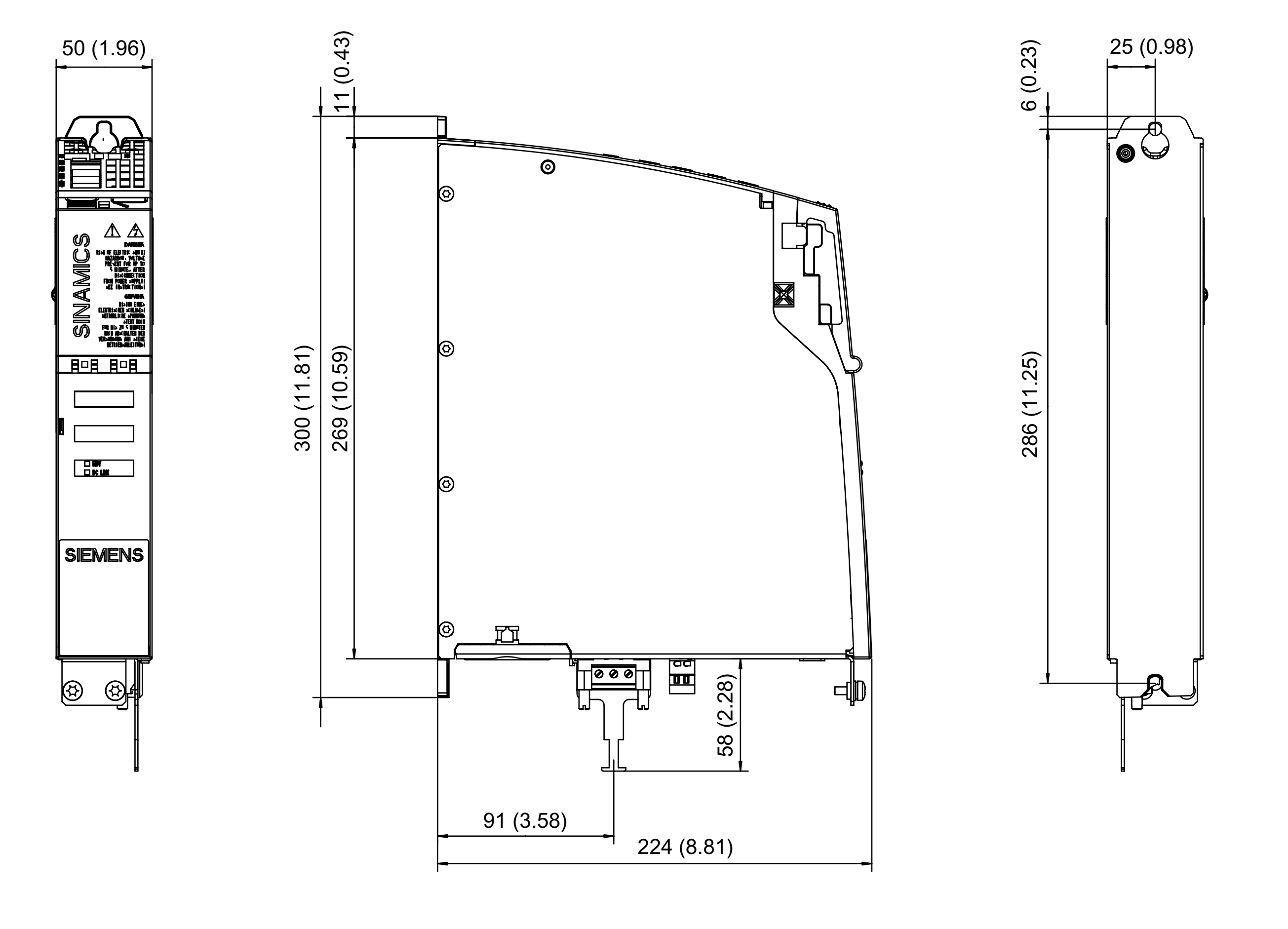


Figure 6-5 Dimension drawing of Motor Module in booksize compact format 3 A, 5 A, and 9 A, all dimensions in mm and (inches)

Table 6- 6 Motor Modules Booksize Compact 3 A, 5 A, and 9 A

Motor Module type	Order number
3 A	6SL3420-1TE13-0AAx
5 A	6SL3420-1TE15-0AAx
9 A	6SL3420-1TE21-0AAx

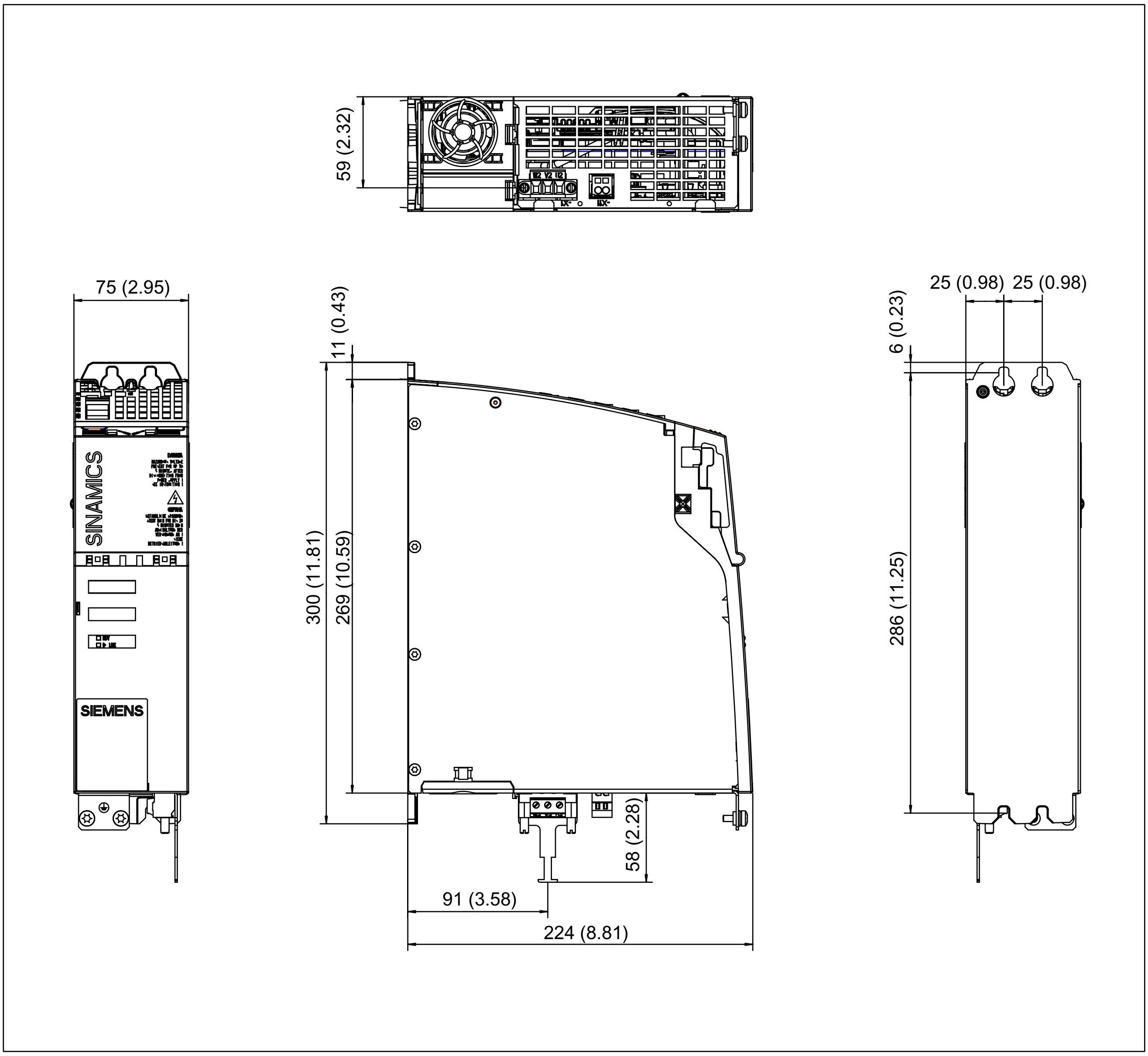


Figure 6-6 Dimension drawing of Motor Module in booksize compact format 18 A, all dimensions in mm and (inches)

Table 6- 7 Motor Module Booksize Compact 18 A

Motor Module type	Order number
18 A	6SL3420-1TE21-8AAx

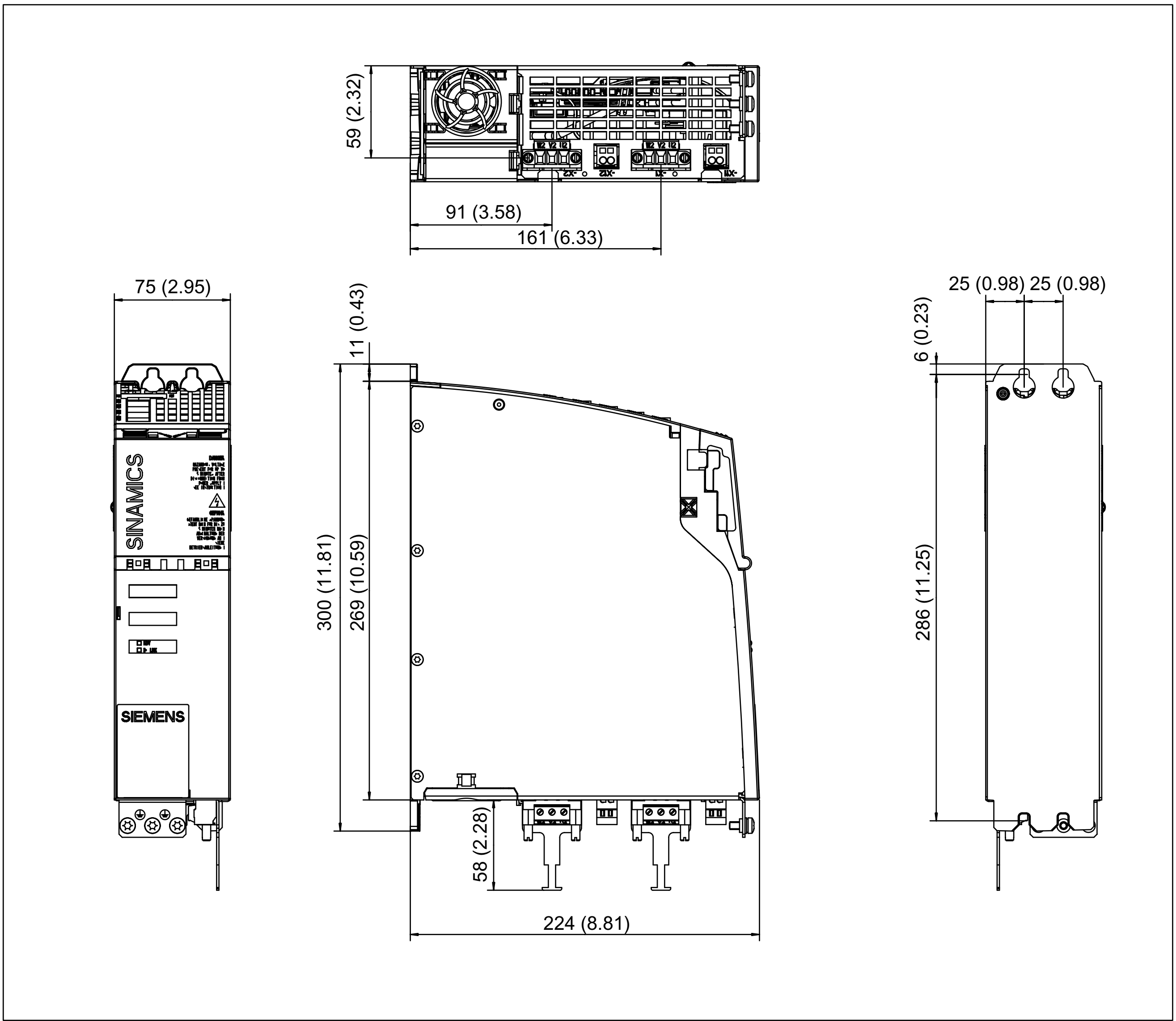


Figure 6-7 Dimension drawing of Double Motor Module in compact format 2 x 1.7 A, 2 x 3 A, and 2 x 5 A, all dimensions in mm and (inches)

Table 6- 8 Double Motor Modules Booksize Compact 2 x 1.7 A, 2 x 3 A, and 2 x 5 A

Double Motor Module type	Order number
2 x 1.7 A	6SL3420-2TE11-0AAx
2 x 3 A	6SL3420-2TE13-0AAx
2 x 5 A	6SL3420-2TE15-0AAx

6.5 Installation

Installation of a Motor Module with internal air cooling

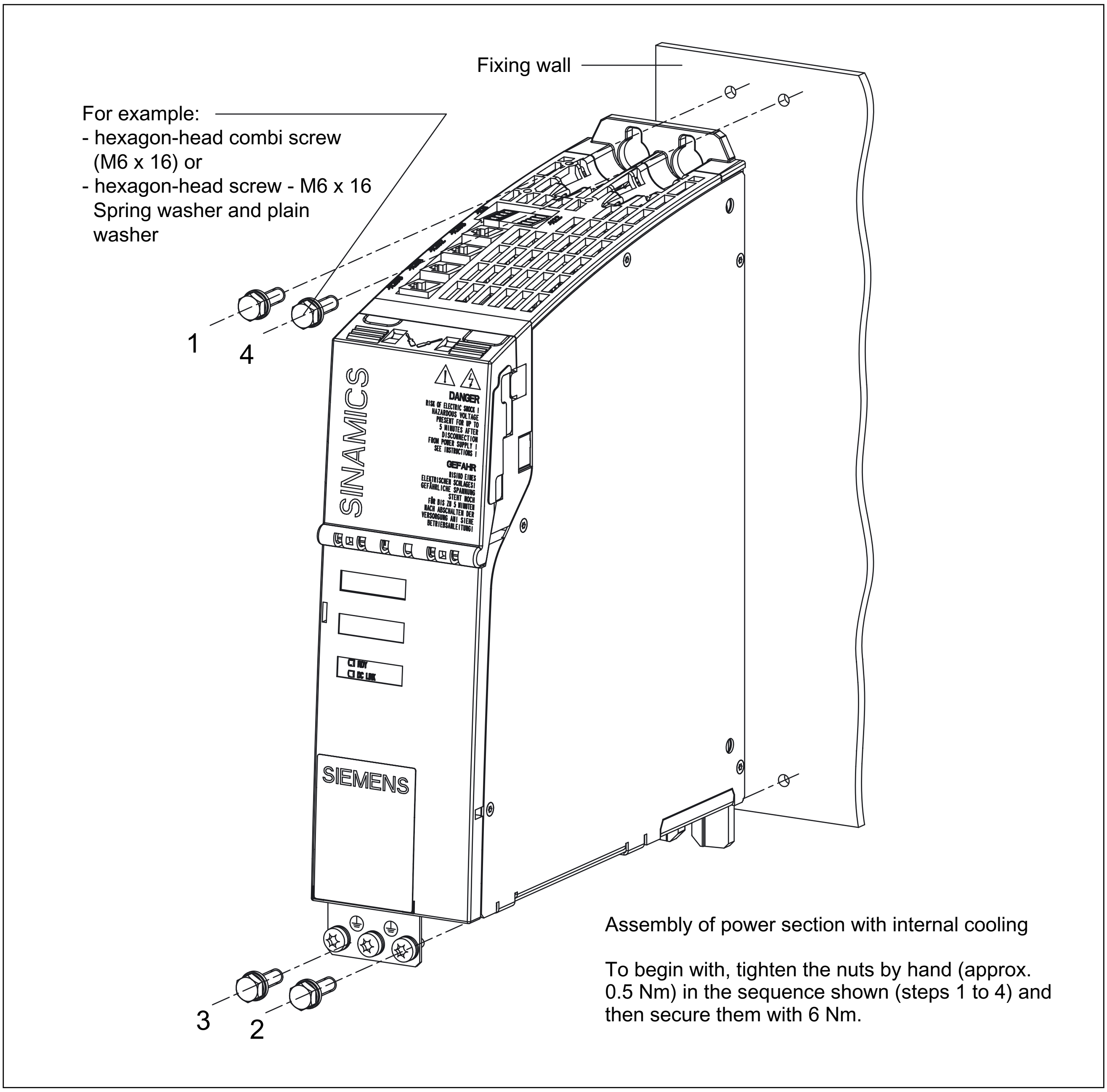


Figure 6-8 Installation: Motor Module Booksize Compact with internal air cooling

Installation of a Motor Module with cold plate

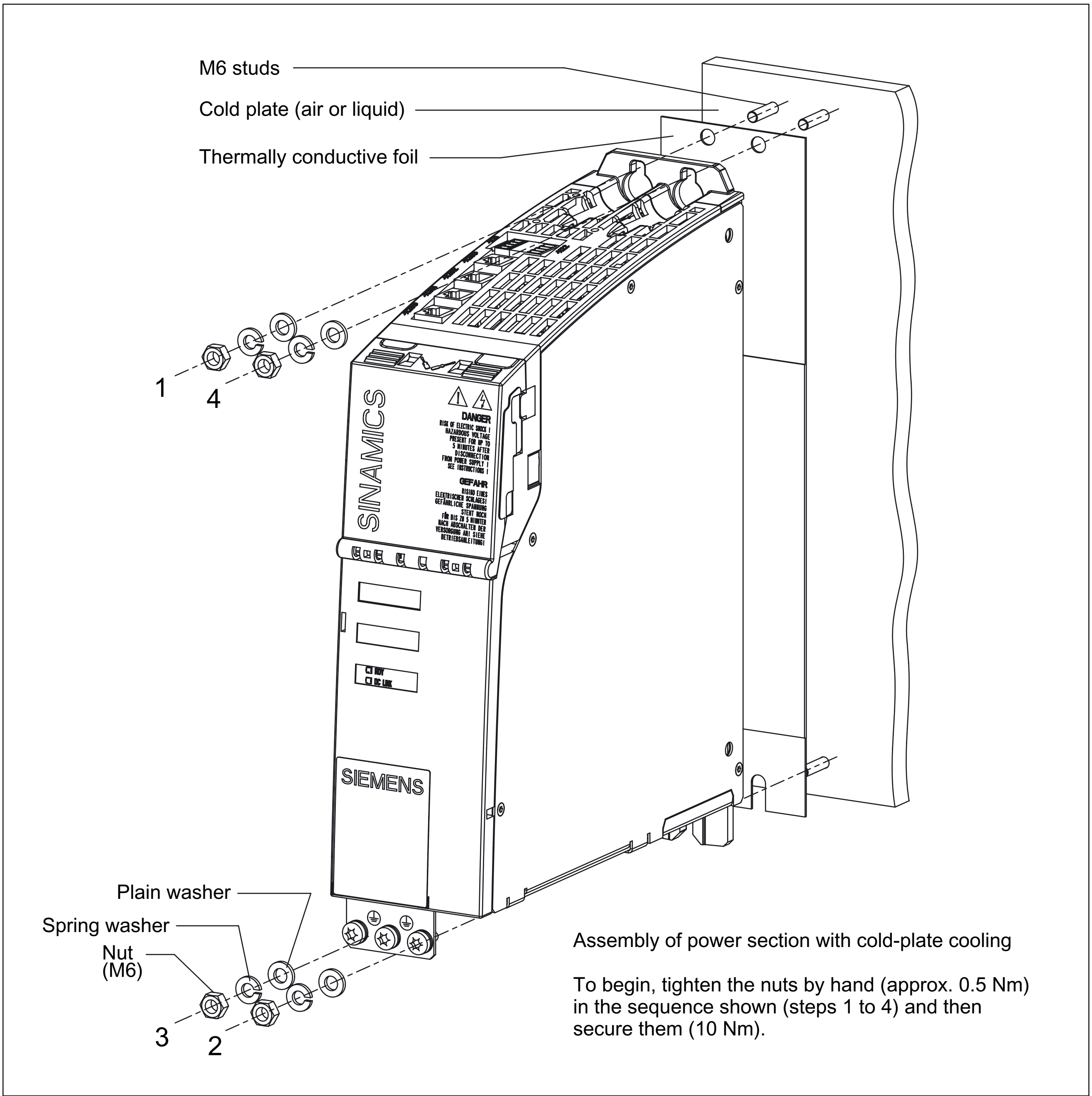


Figure 6-9 Installation: Motor Module Booksize Compact with cold plate

To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every cold plate power unit is supplied with heat-conducting foil cut to the right size. The installation position of the thermally conductive foil must be taken into account.

Note

When a component is replaced, the heat-conducting foil must also be replaced! Only heat-conducting foil approved or supplied by Siemens may be used.

	Order number
Heat-conducting foil, 50 mm	6SL3162-6FB01-0AA0
Heat-conducting foil, 75 mm	6SL3162-6FC01-0AA0

6.6 Technical data

Table 6- 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
Rated current	A	3	5	9	18
Voltage					
Infeed DC link voltage Electronics power supply	 V_{DC} V_{DC}	 510 – 720 24 (20.4 – 28.8)			
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage			
Overvoltage trip Undervoltage trip [1]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %			
Current					
Electronics current consumption at 24 V DC For internal air cooling For cold plate cooling	 A_{DC} A_{DC}	 0.85 0.65	 0.85 0.65	 0.85 0.65	 0.85 0.65
Rated output current (I_n)	A_{ACrms}	3	5	9	18
Base-load current (I_{base})	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
Current carrying capacity DC link busbar Reinforced DC link busbars 24 V busbar	 A_{DC} A_{DC} A_{DC}	 100 150 20	 100 150 20	 100 150 20	 100 150 20
Max. current motor brake	A	2	2	2	2
Power					
Rated power (with DC link voltage of 600 V_{DC} and pulse frequency of 4 kHz)	kW	1.6	2.7	4.8	9.7
Total power loss for internal air cooling (including electronics losses) [2]	W	68 at 8 kHz	98 at 8 kHz	100.4 at 4 kHz	185.4 at 4 kHz
Power loss distribution for cold plate (including electronics losses) [2] Internal External	W	 25.6 40	 30.6 65	 45.6 50	 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			
DC link capacitance	μF	110	110	110	235
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

Motor Modules Booksize Compact	6SL3420–	1TE13-0AAx	1TE15-0AAx	1TE21–0AAx	1TE21–8AAx
Rated current	A	3	5	9	18
Max. permissible heat-sink temperature cold plate	°C	70	70	70	70
Weight	kg	2.7	2.7	2.7	3.4

1) Default for 400 V supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized line voltage.

2) For an overview, see the power loss tables in chapter Control cabinet installation

Table 6- 10 Technical data Double Motor Modules in booksize compact format (2 x 1.7 A to 2 x 5 A)

Double Motor Modules Booksize Compact	6SL3420-	2TE11-0AAx	2TE13-0AAx	2TE15-0AAx
Rated current	A	2 x 1.7	2 x 3	2 x 5
Voltage				
Infeed DC link voltage Electronics power supply	 V_{DC} V_{DC}	 510 – 720 24 (20.4 – 28.8)		
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage		
Overvoltage trip Undervoltage trip [1]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %		
Current				
Electronics current consumption at 24 V DC For internal air cooling For cold plate cooling	 A_{DC} A_{DC}	 1.15 0.9	 1.15 0.9	 1.15 0.9
Rated current (I_n)	A	2 x 1.7	2 x 3	2 x 5
Base-load current (I_{base})	A	2 x 1.5	2 x 2.6	2 x 4.3
Intermittent duty current (I_{S6}) 40%	A_{ACrms}	2 x 2	2 x 3.5	2 x 6
Peak current (I_{max})	A_{ACrms}	2 x 5.1	2 x 9	2 x 15
Current carrying capacity DC link busbar Reinforced DC link busbars 24 V busbar	 A A A	 100 150 20	 100 150 20	 100 150 20
Max. current motor brake	A	2 x 2	2 x 2	2 x 2
Power				
Rated power (600 V, 8 kHz)	kW	2 x 1	2 x 1.6	2 x 2.7
Total power loss for internal air cooling (including electronics losses) [2] at 8 kHz	W	114	134	194
Power loss distribution for cold plate (including electronics losses) [2] Internal External	W	 42 72	 44 90	 59 135
Max. pulse frequency Without derating With derating	 kHz kHz	 8 16	 8 16	 8 16
Max. ambient temperature Without derating With derating	 °C °C	 40 55		
DC link capacitance	µF	165	165	165
Sound pressure level	dBA	<60	<60	<60
Cooling methods		Internal air cooling with installed fan cold plate cooling		
Cooling air requirement	m³/h	29.6	29.6	29.6
Max. permissible heat-sink temperature cold plate	°C	65	70	70
Weight	kg	3.4	3.4	3.4

1) Default for 400 V supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized line voltage.

2) For an overview, see the power loss tables in chapter Control cabinet installation

6.6.1 Characteristics

Rated duty cycles Motor Modules Booksize Compact

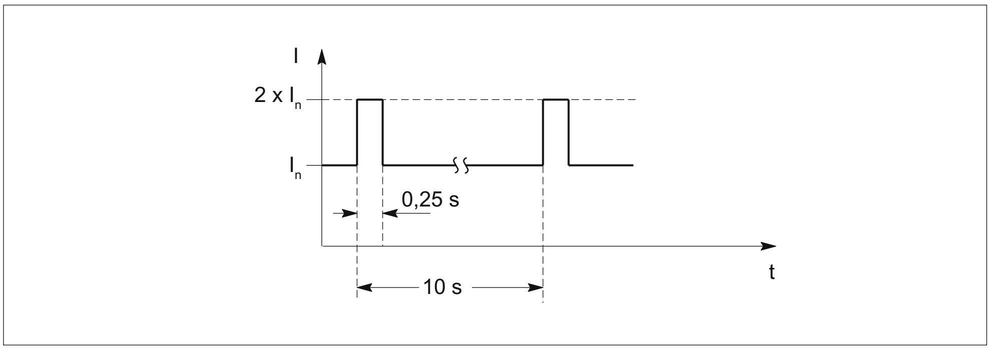


Figure 6-10 Duty cycle with initial load

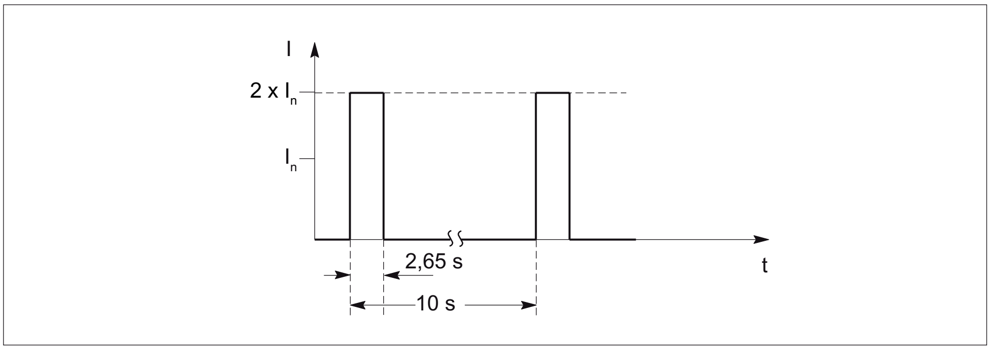


Figure 6-11 Duty cycle without initial load

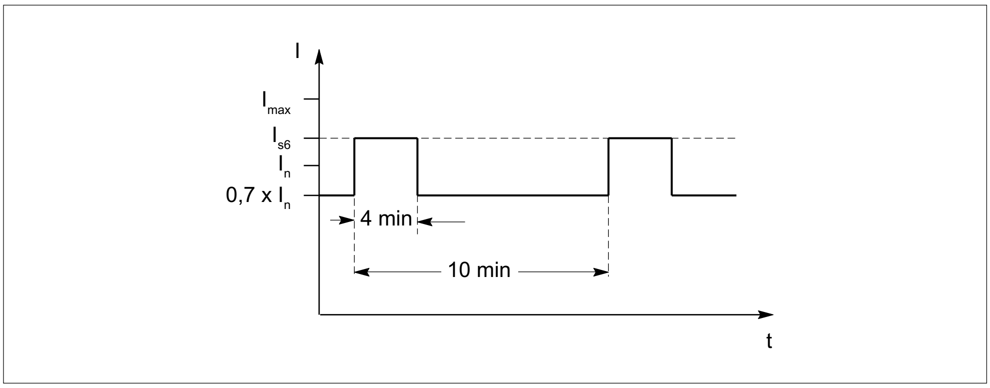


Figure 6-12 S6 duty cycle with initial load with a duty cycle duration of 600 s

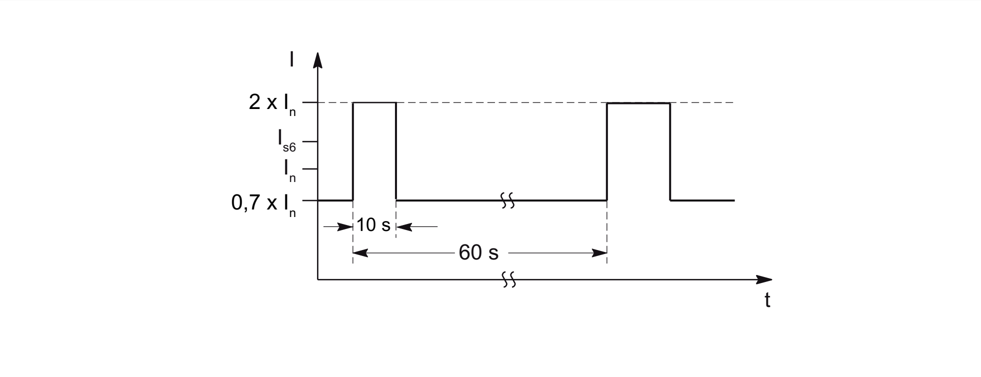


Figure 6-13 S6 duty cycle with initial load with a duty cycle duration of 60 s

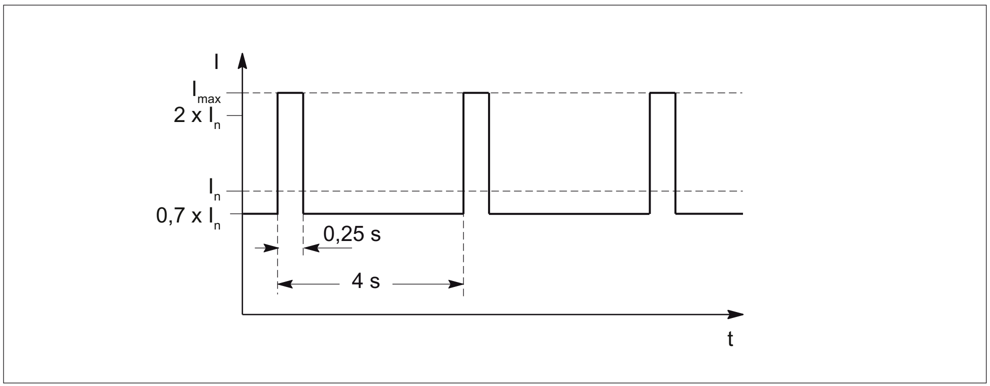


Figure 6-14 Peak current duty cycle with initial load

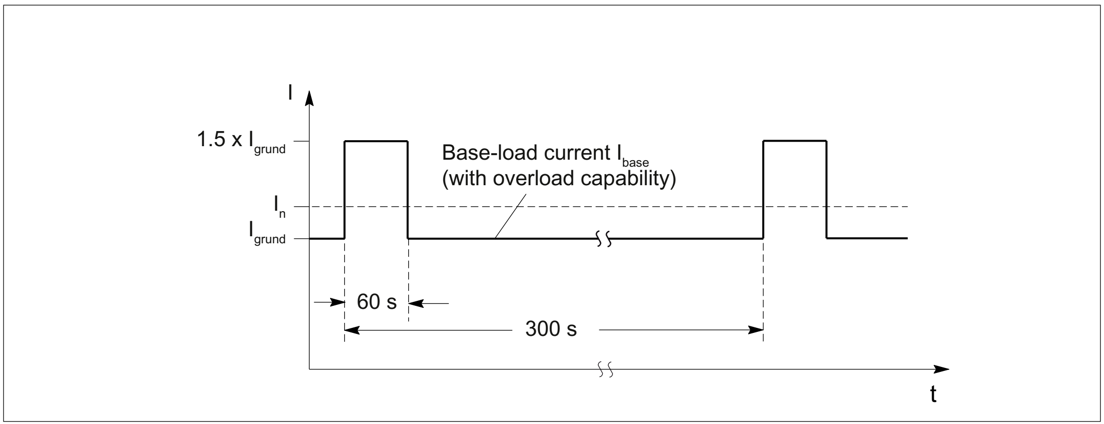


Figure 6-15 Duty cycle with 60 s overload with a duty cycle duration of 300 s

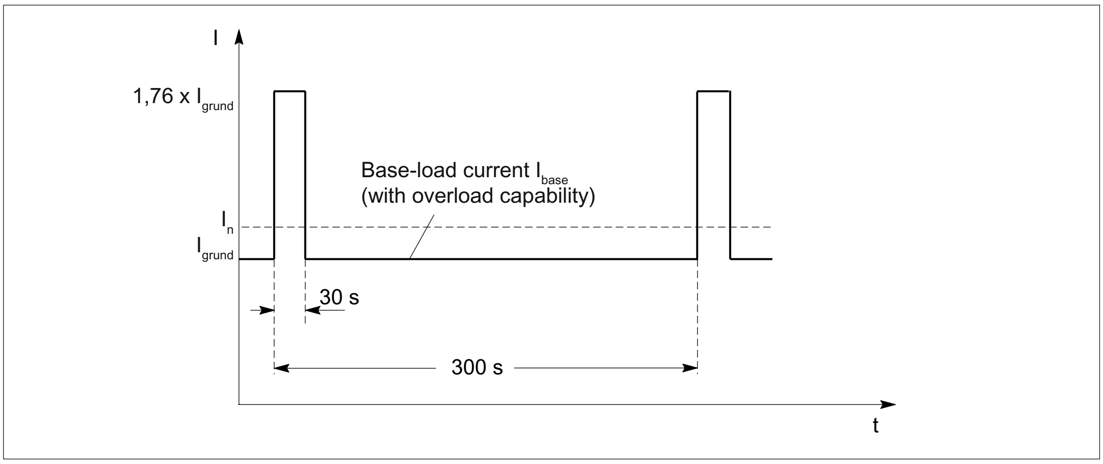


Figure 6-16 Duty cycle with 30 s overload with a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize Compact

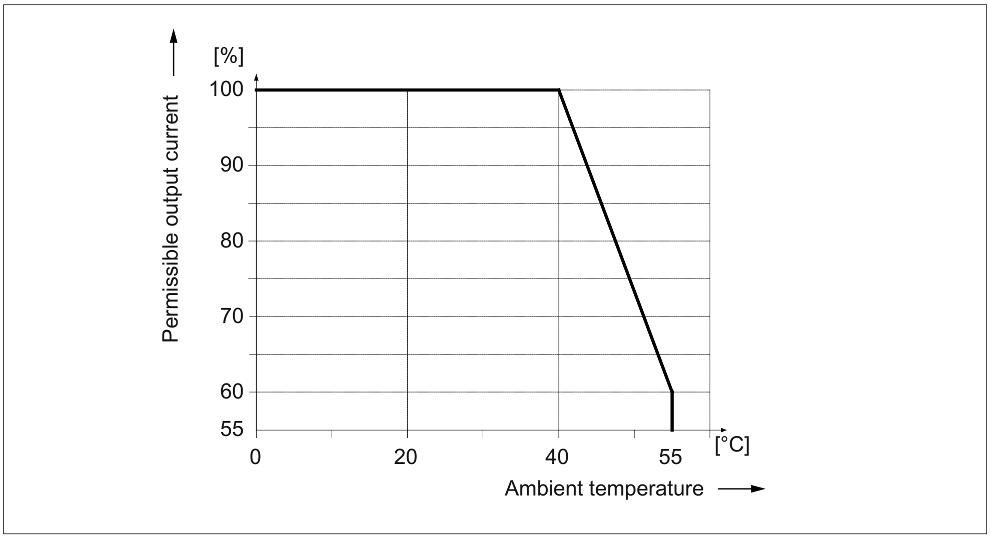


Figure 6-17 Output current as a function of the ambient temperature

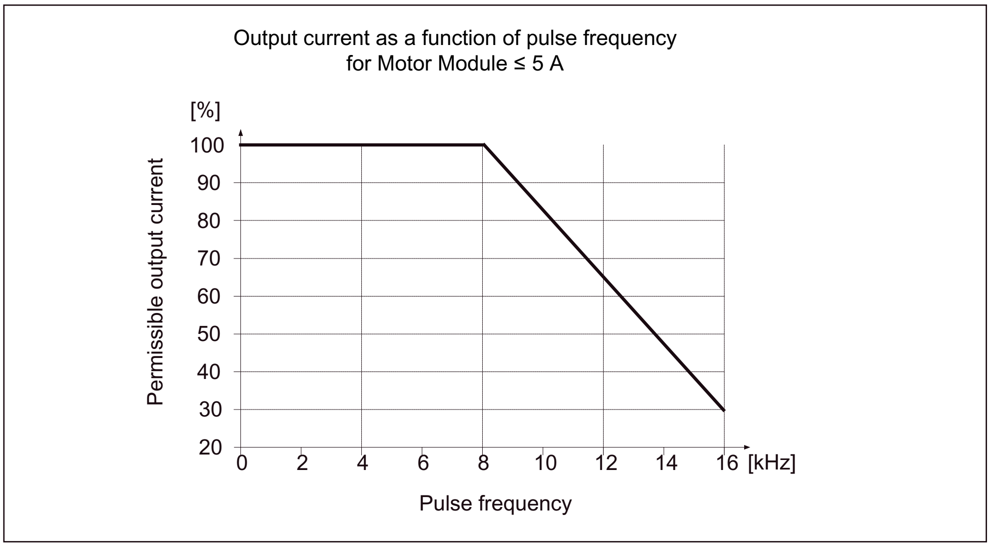


Figure 6-18 Output current as a function of the pulse frequency for the Motor Module ≤ 5 A

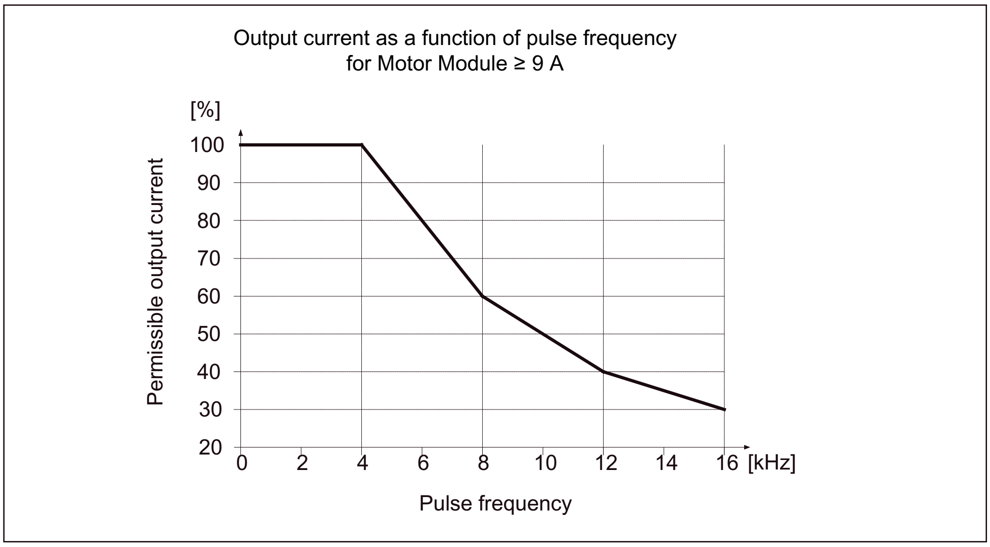


Figure 6-19 Output current as a function of the pulse frequency for the Motor Module ≥ 9 A

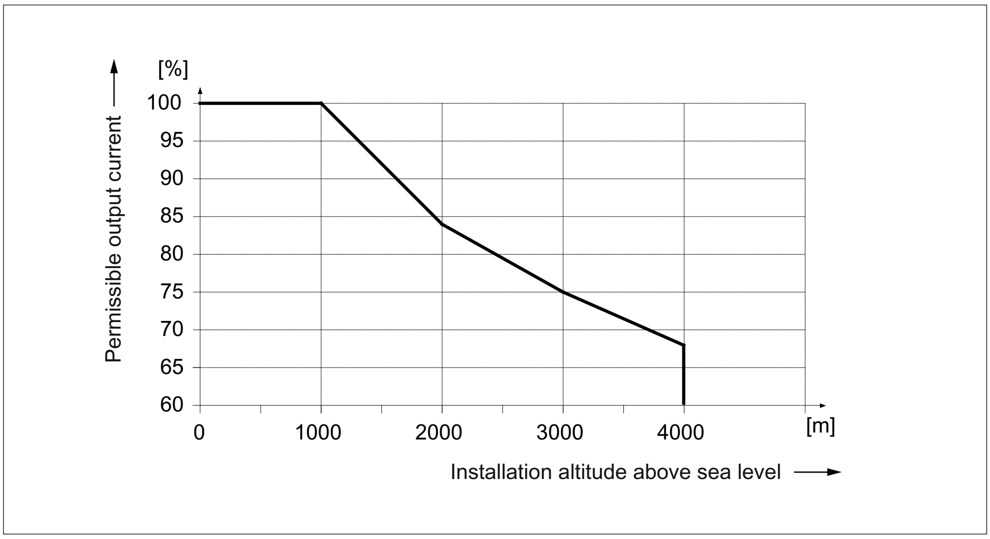


Figure 6-20 Output current as a function of the installation altitude

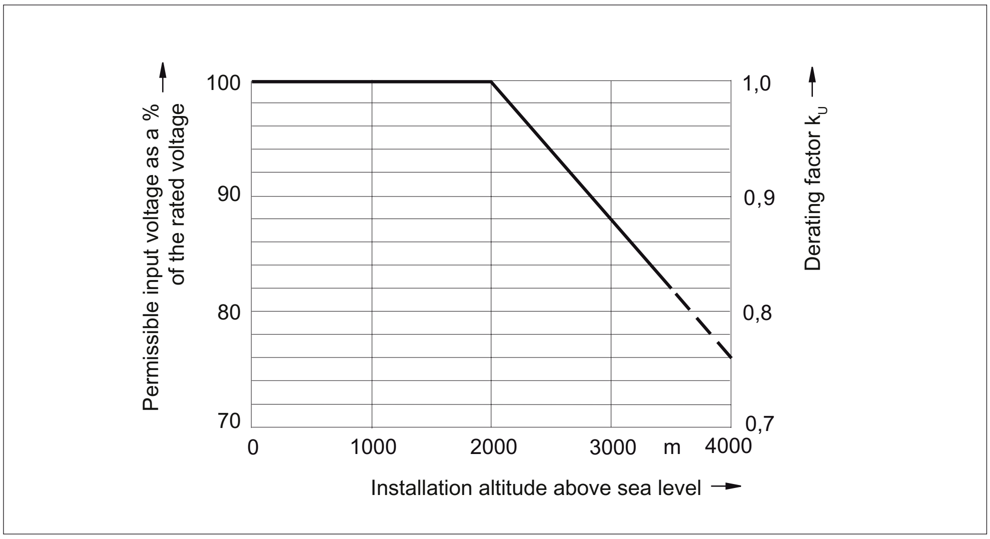


Figure 6-21 Voltage derating as a function of the installation altitude

Electrical connection for Line Modules and Motor Modules

7

7.1 Connection of DC-link busbars and 24 V busbars

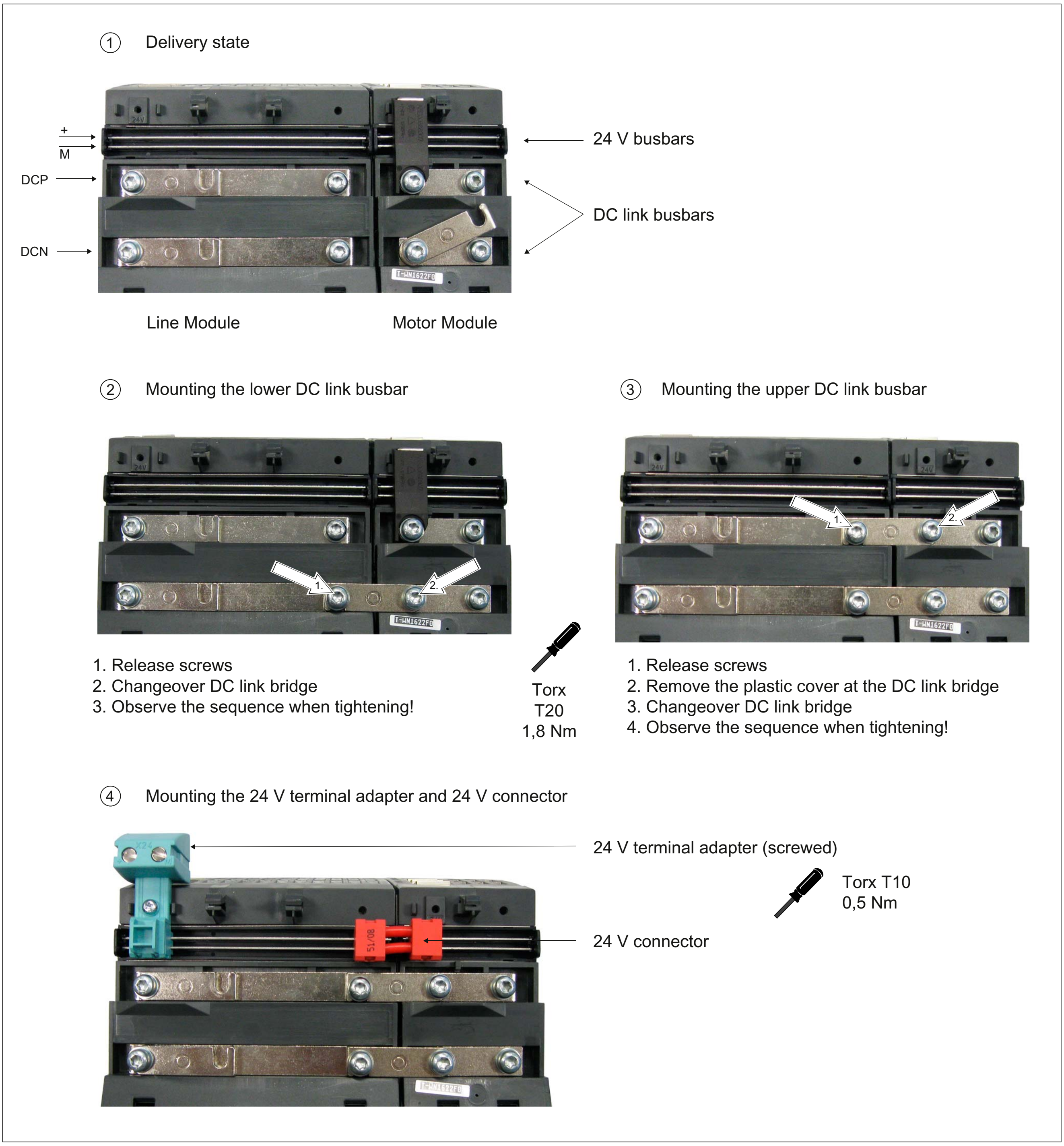


Figure 7-1 Connection of DC-link busbars and 24 V busbars

7.2 Installation of the 24 V terminal adapter

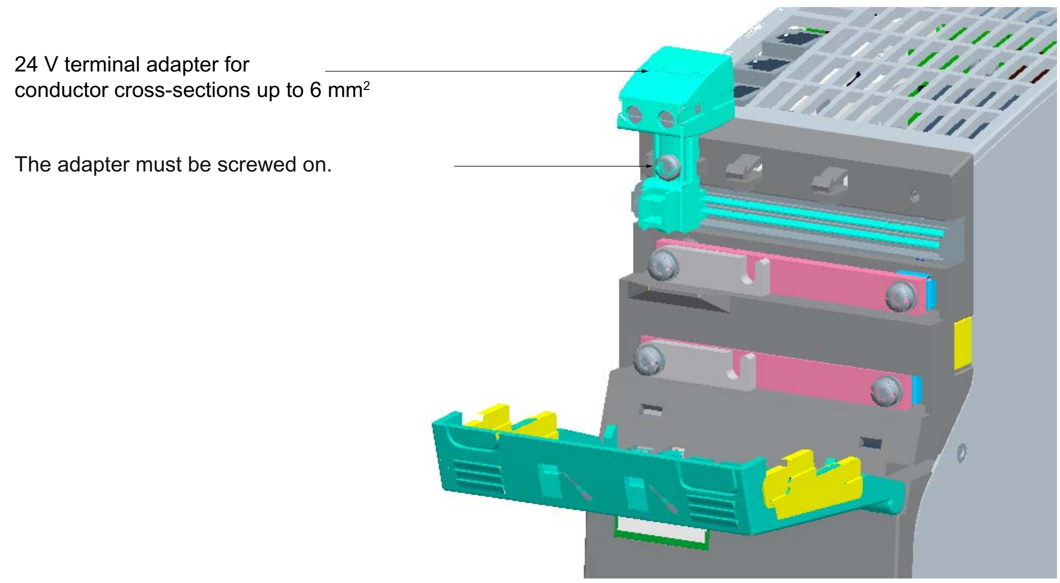


Figure 7-2 24 V terminal adapter

The terminal adapter can be fitted to any power unit. A recess must be provided for this purpose on the protective cover of the DC link using suitable pliers. The terminal adapter is snapped on and is retained using the screw provided (tightening torque, 0.5 Nm).

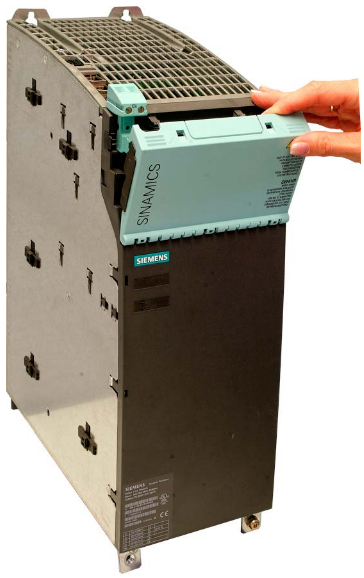
Screw: SHR, PT-TORX K30-3, 0X16-ST-A2F WN1452 / EJOT company (http://www.ejot.de/)

The 24 V terminal adapter is suitable for connecting conductor cross-sections of 0.5 mm^2 to 6 mm^2. The terminal adapter and associated screw are included in the scope of delivery of the Line Modules and Control Supply Modules.

DANGER
The 24 V terminal adapter must not be removed or plugged in with 24 V applied. The 24 V terminal adapter may only be withdrawn vertically to the front plate (i.e. not at an angle).

NOTICE
Once attached, the 24 V terminal adapter must be screwed tight using the screw supplied.

Table 7- 1 Installing the 24 V terminal adapter using an Active Line Module (36 kW) as example

	
Release and open the protective cover using the release tool	Break out the recess using suitable pliers
	
Attach and tighten the screw fittings of the 24 V terminal adapter	Close the protective cover (the protective cover must audibly click into place)

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 positioned on the right for 50 mm and 100 mm modules.

Note

If the 24 V terminal adapter is removed, the protective cover whose cutout has been broken out must be replaced by a new one for safety reasons.

7.3 Shield connection for terminals X21/X22 on the Motor Module

The image below shows a typical shield connection terminal for shielding the cables to terminal X21.

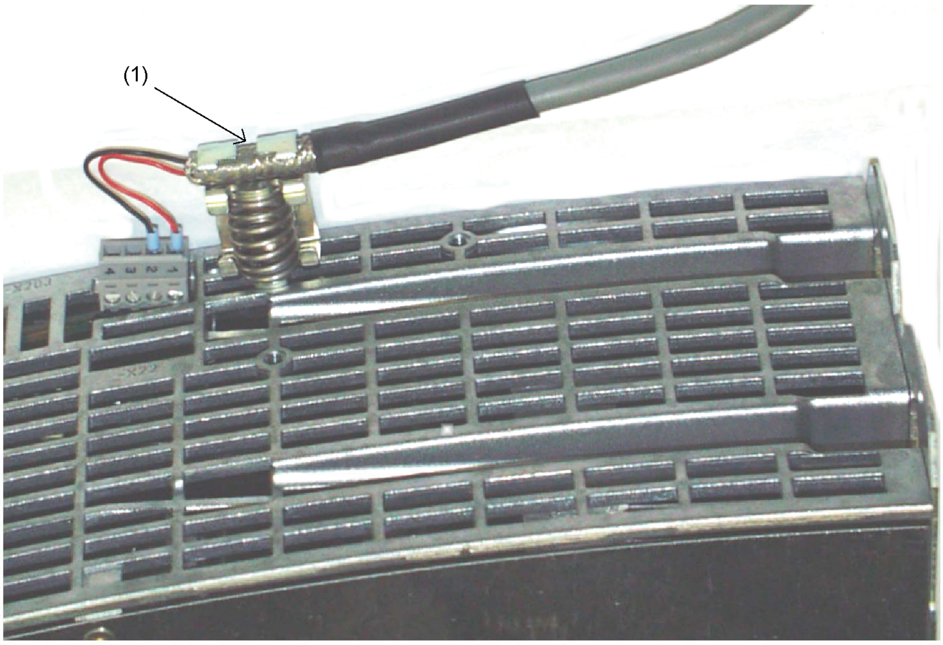


Figure 7-3 Shield connection terminals for shield support

(1) Shield connection terminals: Weidmüller, type KLBÜ 3-8 SC

Internet address for Weidmüller: http://www.weidmueller.com

NOTICE
Only use screws with a permissible mounting depth of 4 - 6 mm.

Booksize DC Link Components 8

8.1 Braking Module

8.1.1 Description

A Braking Module (and an external braking resistor) are required for a controlled shutdown of drives during power failure (e.g. emergency retraction or EMERGENCY STOP Category 1) or to limit the DC link voltage during temporary regenerative operation when, for example, the regenerative capability of the Line Module is deactivated or not appropriately dimensioned.
The Braking Module includes the necessary power electronics together with its control. The Braking Module is operational, the regenerative energy is dissipated as thermal energy in an external braking resistor.

Further, the Braking Module can also 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 rectifier unit has been switched off and the line-up has been disconnected from the power supply (e.g. main circuit-breaker, line contactor). The function can be activated via a digital input on the braking module.

To operate the Braking Modules, a minimum capacitance is required in the DC link. The DC link capacitance for the 25 kW and 100 kW braking resistors is 440 µF.
The capacitance of the Braking Modules of 110 µF is included in the total capacitance.
When the Braking Modules are connected in parallel, the above-mentioned minimum DC link capacitance must be available for each Braking Module.

Note

Only the components that are connected to each other via the DC link busbar can be included in the total capacitance.

Note

The fast discharge function is used for discharging the capacitors in the DC link after interruption of the mains supply. This makes sense, for example, when maintenance tasks are to be performed at the Motor Module and/or motor installation (reduction of the discharge time). For this purpose, the drive system must be completely disconnected from the supply and the motors must be in standstill position.

The cable between the braking module and the braking resistor is limited to 10 m.

8.1.2 Safety information

DANGER

Risk of electric shock. A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

DANGER

A DC-link discharge voltage danger notice in the relevant national language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

With a connected braking resistor, the Braking Module is ground-fault proof.

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC-link adapter and DC-link rectifier adapter).

CAUTION

The connection to the braking resistors must be made using a shielded cable.

The tightening torque of the DC-link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

CAUTION

The DC-link side covers are supplied as standard with the components; they can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

WARNING

The cooling clearances of 80 mm above and below the components must be observed.

Note

If braking resistors that are not listed in catalog PM21 or NC61 are used, they may be damaged beyond repair.

8.1.3 Interface description

8.1.3.1 Overview

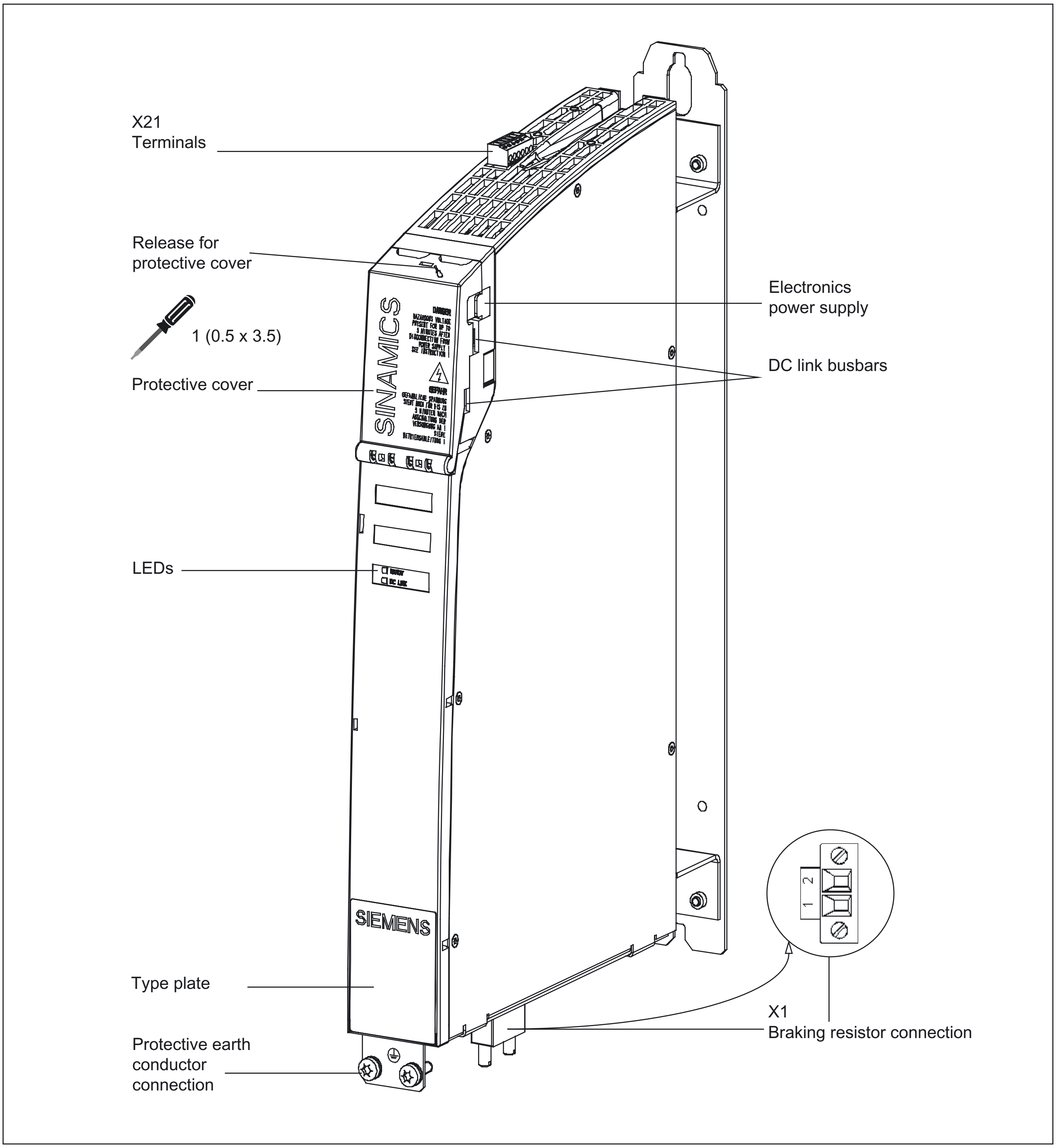


Figure 8-1 Interface description of Braking Module

8.1.3.2 Connection example

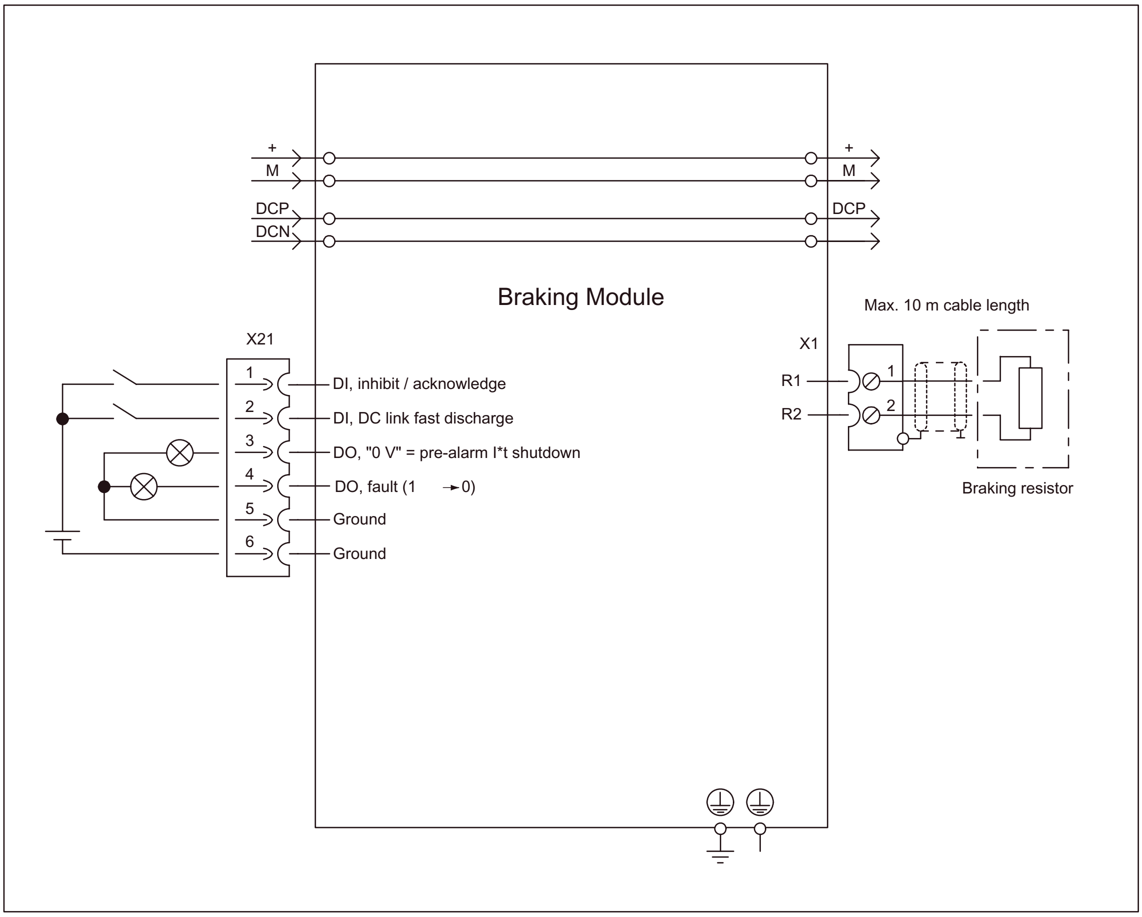
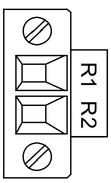


Figure 8-2 Example connection of Braking Module

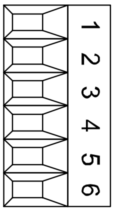
8.1.3.3 Braking resistor connection X1

Table 8- 1 Terminal block X1

	Terminal	Designation	Technical specifications
	1	Braking resistor connection R1	Continued-short-circuit-proof
	2	Braking resistor connection R2	
Max. connectable cross-section: 4 mm² Type: Screw terminal 4 (see Connection Methods)			

8.1.3.4 X21 digital inputs/outputs

Table 8- 2 Terminal block X21

	Terminal	Designation 1)	Technical specifications
	1	DI low: enable Braking Module DI high: inhibit / acknowledge Edge change high -> low: fault acknowledgement	Voltage: -3 V to 30 V Typical current consumption: 10 mA at 24 V DC Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V
	2	DI low: braking resistor not activated manually DI high: braking resistor activated manually (fast discharge) 2) Safety functions remain active, I*t protection remains active	
		If X21.1 and 2 are activated simultaneously, the Braking Module inhibit has priority.	
	3	DO high: no pre-warning for I*t shutdown DO low: pre-warning for I*t shutdown (80% of max. ON time reached)	Max. load current per output: 100 mA Continued-short-circuit-proof Voltage: 24 V DC
	4	DO high: ready for operation, no fault DO low: Fault (1→0)	
	5	Ground	
	6		
Max. connectable cross-section 1.5 mm^2 Type: Screw terminal 1 (see Connection Methods)			

1) DI: digital input; DO: digital output; M: Electronic ground

2) The fast discharge function is used for discharging the capacitors in the DC link after interruption of the mains supply. This functions may be used 1 to 2 times per week at the most. This makes sense, for example, when maintenance tasks are to be performed at the Motor Module and/or motor installation (reduction of the discharge time). For this purpose, the drive system must be completely disconnected from the supply and the motors must be in standstill position.

⚠ DANGER

Prior to performing maintenance task at the drive system, the following tasks must be performed:

1. Disconnect the system.
2. Protect against reconnection.
3. Make sure that the equipment is de-energized.
4. Ground and short-circuit.
5. Cover or enclose adjacent components that are still live

These tasks must be performed in the above mentioned order prior to maintenance. After maintenance proceed in the reverse order.

Note

Applying a high signal to terminal X21.1 inhibits the Braking Module. On a falling edge, pending error signals are acknowledged.

The pre-warning for I*t monitoring is output as a high level on reaching 80% of the maximum braking resistor ON time.
Only braking resistors approved by Siemens for this component are identified automatically.

8.1.3.5 Meaning of the LEDs on the Braking Module

Table 8- 3 Braking Module Booksize – description of the LEDs

LED	Color	Status	Description, cause	Remedy
READY	-	off	Electronics power supply is missing or outside permissible tolerance range. Component deactivated via terminal.	–
	Green	Continuous	Component is ready to operate.	–
	Red	Continuous	Overtemperature Overcurrent switch-off I^2t monitoring activated.. Ground fault/short-circuit. **Note:** In the event of an overtemperature, the error cannot be acknowledged until a cooling time has elapsed.	Diagnose fault (via output terminals) and acknowledge it (via input terminal)
DC LINK	-	off	Electronics power supply is missing or outside permissible tolerance range. Component not active.	–
	Green	Flashing	Component active (DC link discharge via braking resistor in progress).	–

8.1.4 Dimension drawing

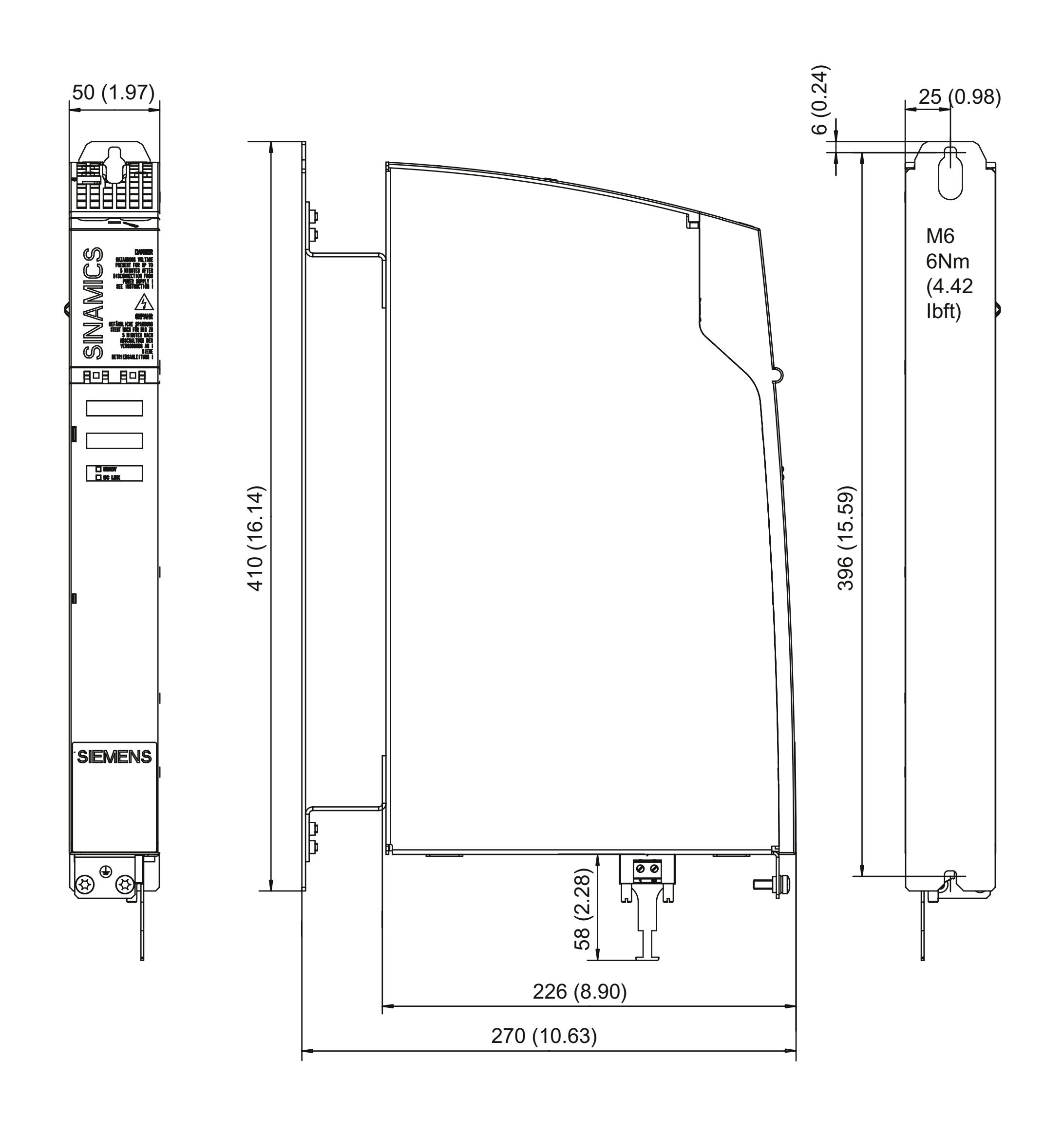


Figure 8-3 Dimension drawing of Braking Module, all dimensions in mm and (inches)

8.1.5 Mounting

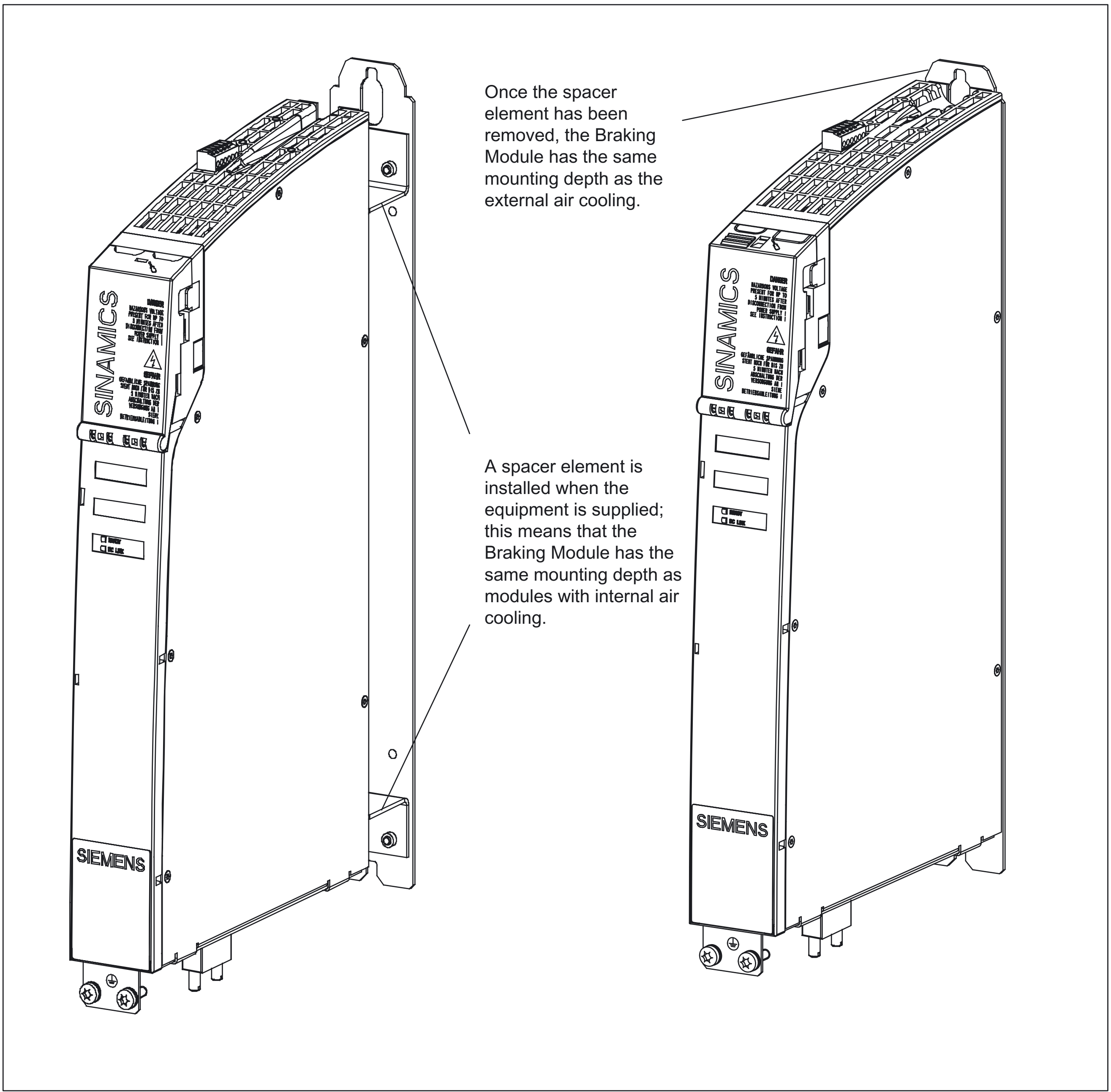


Figure 8-4 Methods of installing Braking Modules with/without spacer elements

8.1.6 Technical data

Table 8- 4 Technical data

Braking Module Booksize		
Voltages		
Infeed: DC link voltage	V_{DC}	510 - 720
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 busbar	A_{DC}	100
Current carrying capacity 24 V busbar	A_{DC}	20
Max. braking power	kW	100
Continuous braking power	kW	1.5
Power loss[1]	W	20
Cooling method		Natural convection
Weight	kg	4.1

1) For an overview, see the power loss tables in chapter Control cabinet installation

8.1.7 Braking resistors for Braking Modules

8.1.7.1 Installation of the braking resistors

Ideally, external braking resistors should be installed outside of the control cabinet to prevent the heat lost by the resistors from subjecting the cabinet to thermal stress.

The resistor may be installed inside the control cabinet either standing on the cabinet floor or suspended (horizontally or vertically) from the cabinet wall. You must ensure that the braking resistors do not obstruct the flow of cooling air to the drive line-up.

CAUTION

The braking resistor can become very hot. Consequently, it must be installed so that it cannot be touched or, if this is not possible, an appropriate warning notice must be attached to it.

Note

The cooling clearances of 100 mm above and below the components must be observed.

Connection cables

A shielded connection cable (3 m long; 3 x 1.5 mm^2) is supplied with braking resistor 6SN1113-1AA00-0DA0.

Braking resistor 6SL3100-1BE31-0AA0 is supplied without a connection cable (4 mm^2).

The maximum cable length for both braking resistors is 10 m.

8.1.7.2 Dimension drawings

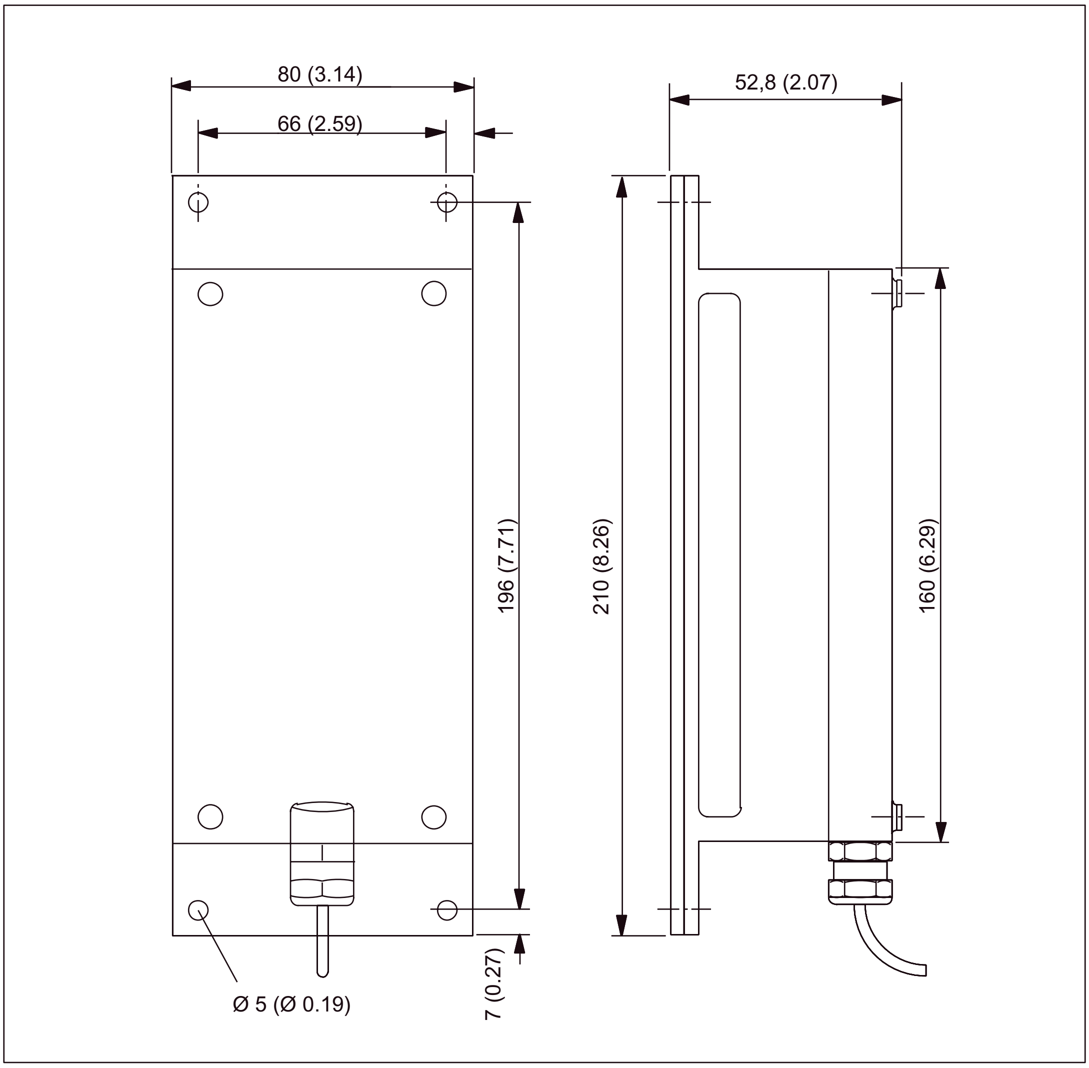


Figure 8-5 Dimension drawing of braking resistor 0.3 kW/25 kW, all dimensions in mm and (inches)

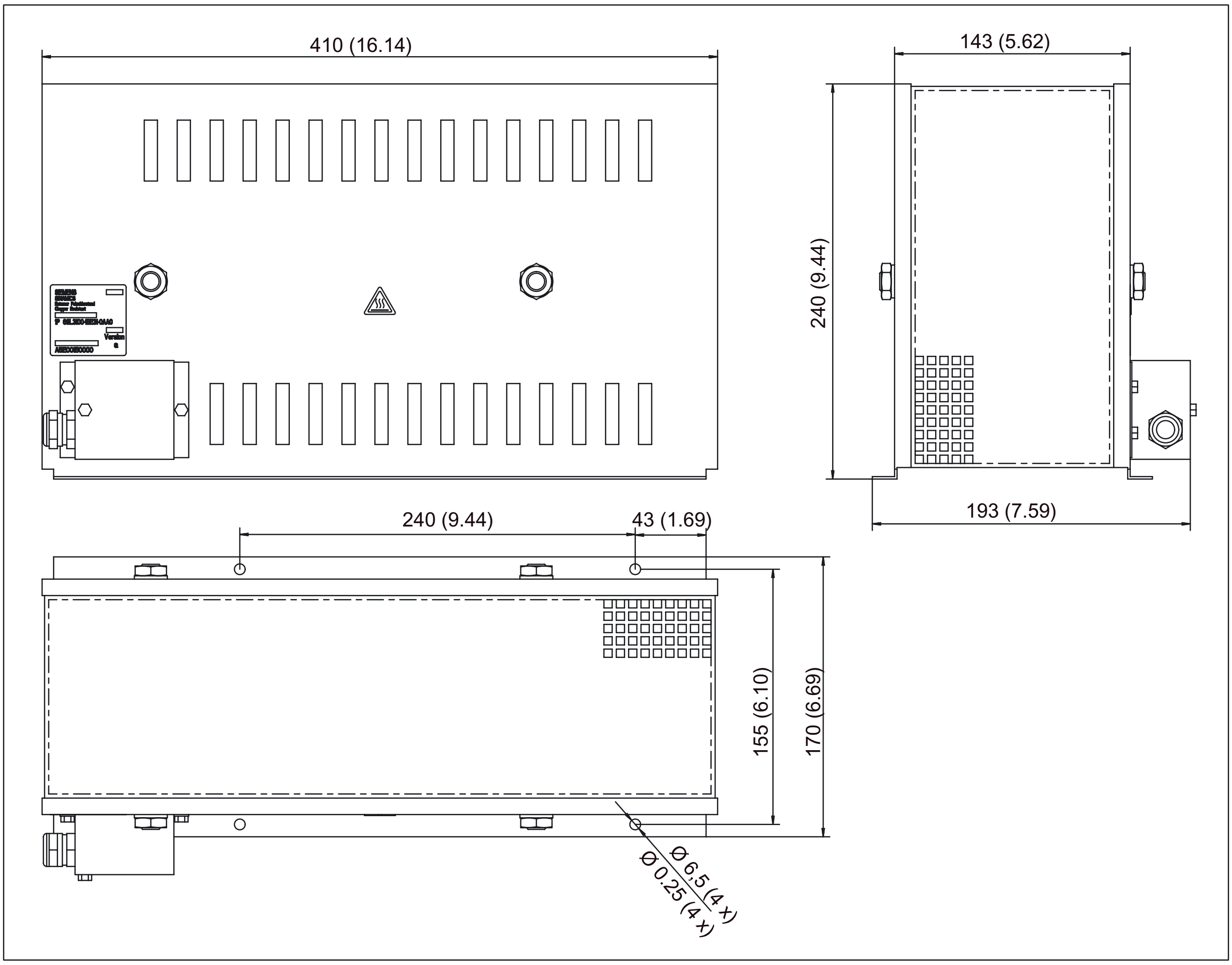


Figure 8-6 Dimension drawing of braking resistor 1.5 kW/100 kW, all dimensions in mm and (inches)

8.1.7.3 Technical data

Table 8- 5 Technical data

	Unit	Braking resistor 6SN1113–1AA00–0DA0	Braking resistor 6SL3100–1BE31–0AAx
Rated power P_n	kW	0.3	1.5
Peak power P_{max}	kW	25	100
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		IP54B acc. to EN 60529	IP20 to EN 60529

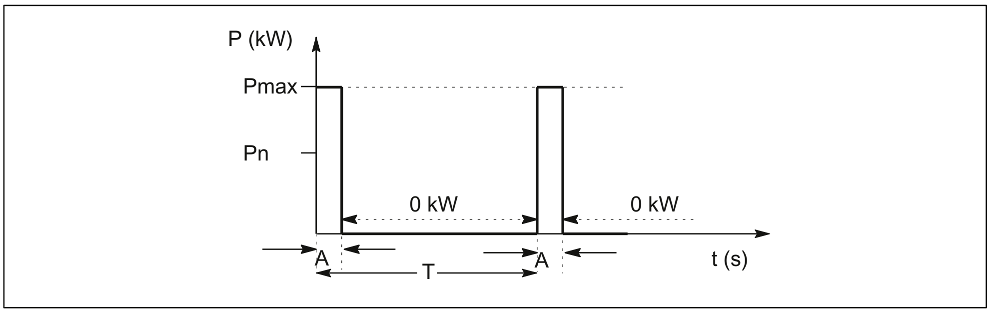


Figure 8-7 Duty cycle for braking resistors

T [s] period duration of braking duty cycle

A [s] load duration

P_n [W] continuous braking power of braking resistor

P_{max} [W] peak braking power of braking resistor

Table 8- 6 Example of duty cycles

	Unit	R 25 kW		R 100 kW	
		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

8.2 Capacitor Module

8.2.1 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.

8.2.2 Safety Information

DANGER

Risk of electric shock. A hazardous voltage is present for up to 5 minutes after the power supply has been switched off.
It is only permissible to open the protective cover after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking device) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

DANGER

The DC link discharge voltage hazard warning in the local language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

WARNING

The cooling clearances of 80 mm above and below the components must be observed.

NOTICE

The Capacitor Module is precharged by the Line Module. The applicable maximum permissible DC link capacitances of the Line Modules must be taken into account.

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

CAUTION
The DC link side covers are supplied as standard with the components; they can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

8.2.3 Interface description

8.2.3.1 Overview

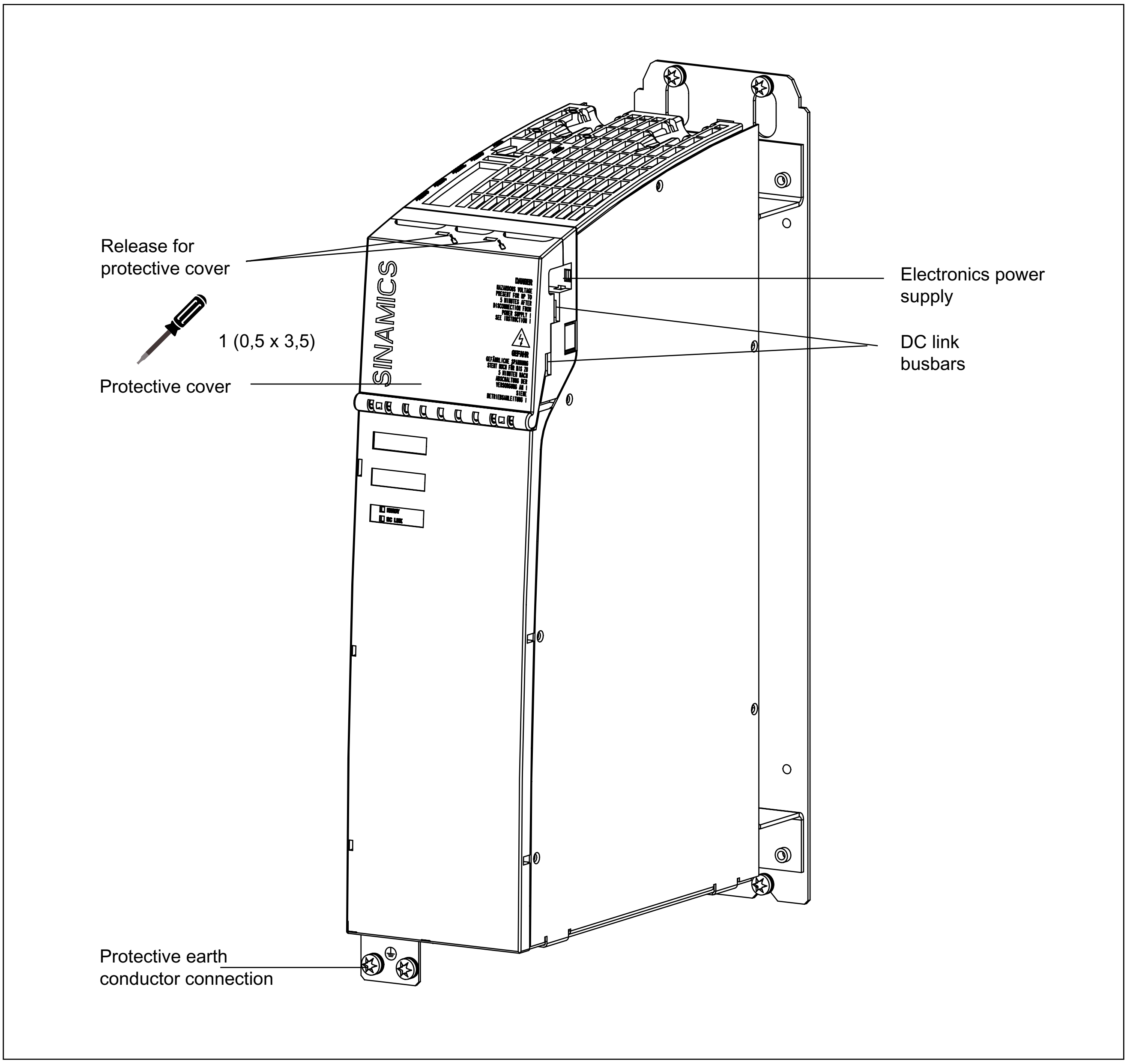


Figure 8-8 Interface description of the capacitor module

8.2.4 Dimension Drawing

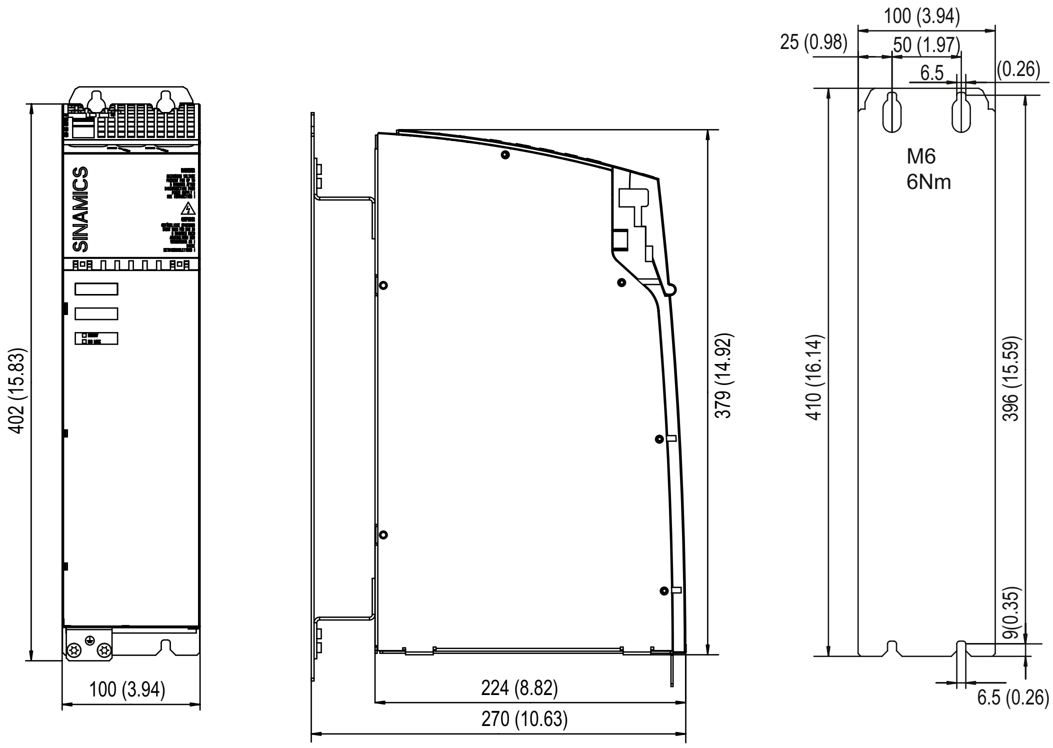


Figure 8-9 Dimension drawing of Capacitor Module, all dimensions in mm and (inches)

8.2.5 Installation

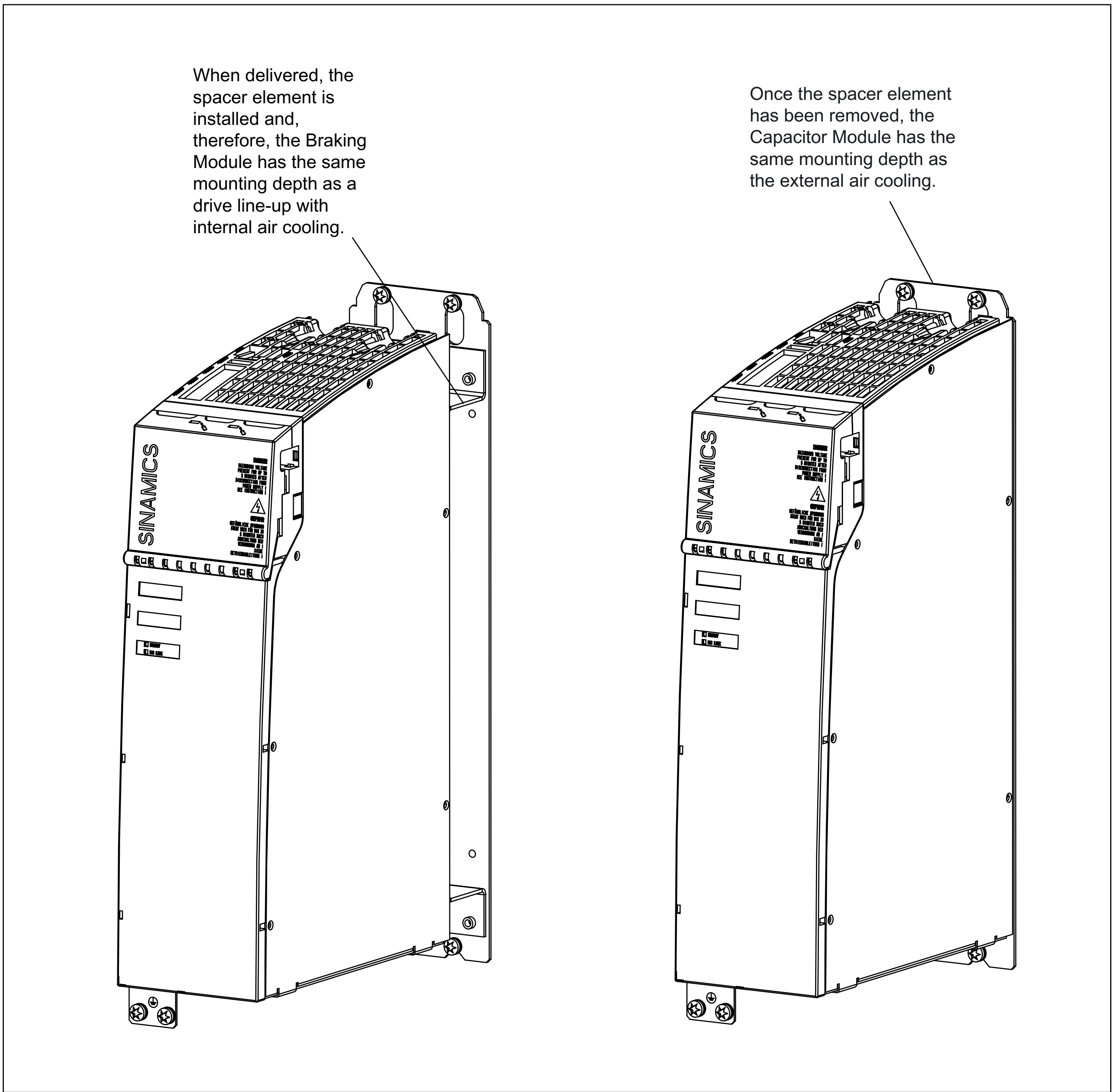


Figure 8-10 Installing a Capacitor Module with/without spacer elements

The Capacitor Module can be attached to the cabinet panel with or without spacer elements.

8.2.6 Technical data

Table 8- 7 Technical data

Capacitor Module		
Electronics power supply	V_{DC}	24 (20.4 – 28.8)
DC link voltage	V_{DC}	510 - 720
Capacitance	µF	4000
24 V DC busbar current carrying capacity	A	20
DC link busbar current carrying capacity	A	100
Power loss[1]	W	25
Weight	kg	7.2

1) For an overview, see the power loss tables in chapter Control cabinet installation

8.3 Control Supply Module CSM

8.3.1 Description

The Control Supply Module in booksize format provides a 24 VDC power supply. In normal operation the component obtains its supply from the line voltage. In the event of a power failure, the component automatically changes over to supply from the DC link. This makes it possible, for example, to make retraction movements in the event of the failure of the line supply.

The Control Supply Module has safe electrical separation between the line potential and the DC-link potential. This means that there is no danger that the DC link will be charged unintentionally. The Control Supply Module can therefore remain connected to the supply if the Line Module is metallically separated from the supply, for example via a line contactor.

The 24 V ground of the Control Supply Module is internally grounded.

8.3.2 Safety Information

DANGER

This component is equipped with two supply circuits!
Risk of electric shock. A hazardous voltage is present for up to 5 minutes after the power supply has been switched off.
It is only permissible to open the protective cover after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking device) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components (e.g. with a defective lock on the protective cover) must not be operated further.

DANGER

The DC link discharge voltage hazard warning in the local language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

WARNING

The cooling clearances of 80 mm above and below the components must be observed.

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

CAUTION
The tightening torque of the DC link busbar screws (1.8 Nm, tolerance +30 %) must be checked before commissioning. After transportation, the screws must be tightened.

CAUTION
The DC link side covers are supplied as standard with the components; they can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

CAUTION
If used, the 24 V terminal adapter must be screwed into place. The following screw must be used: EJOT-PT screw K30 x 16. Tightening torque 0.5 Nm.

8.3.3 Interface description

8.3.3.1 Overview

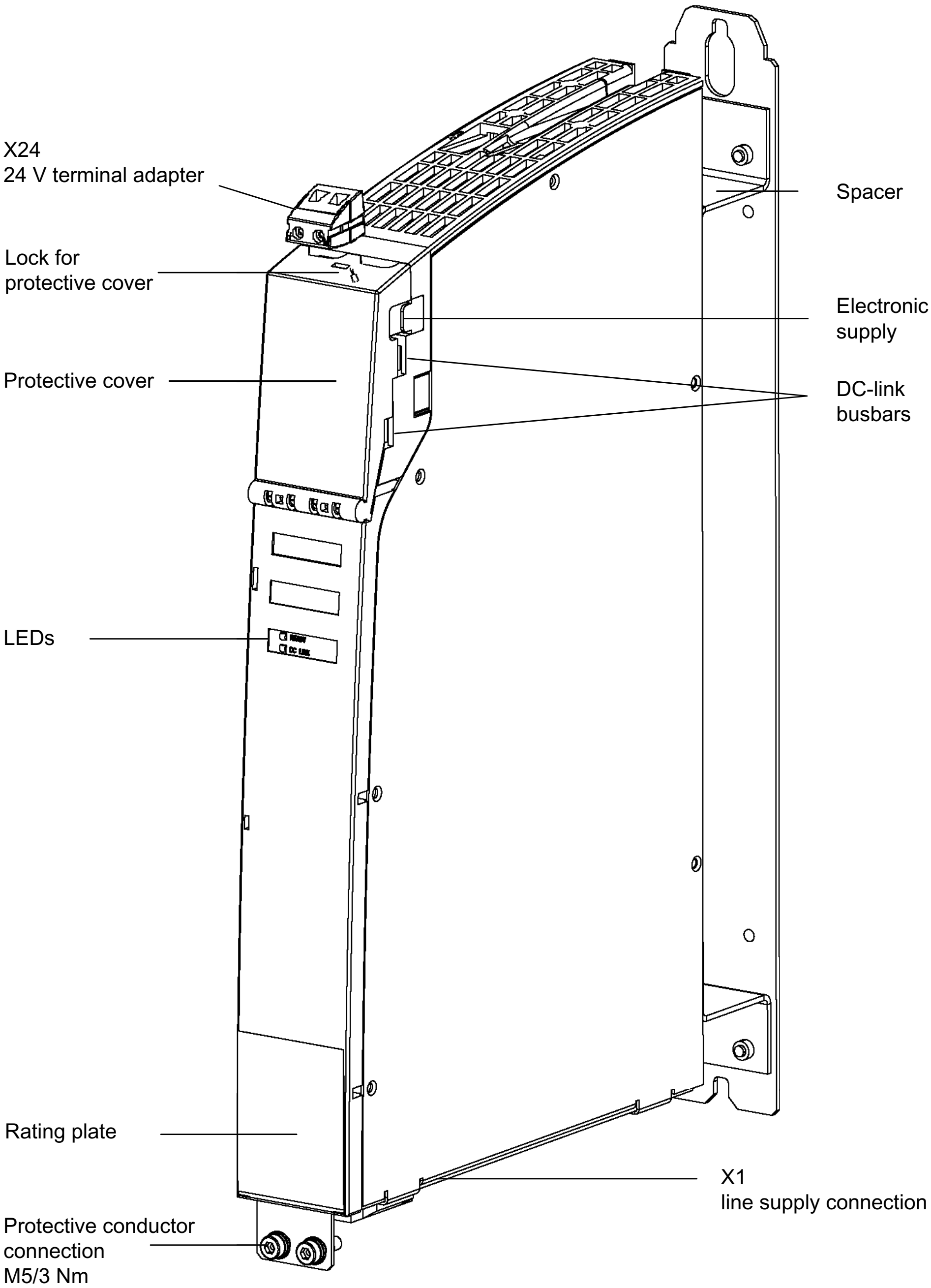
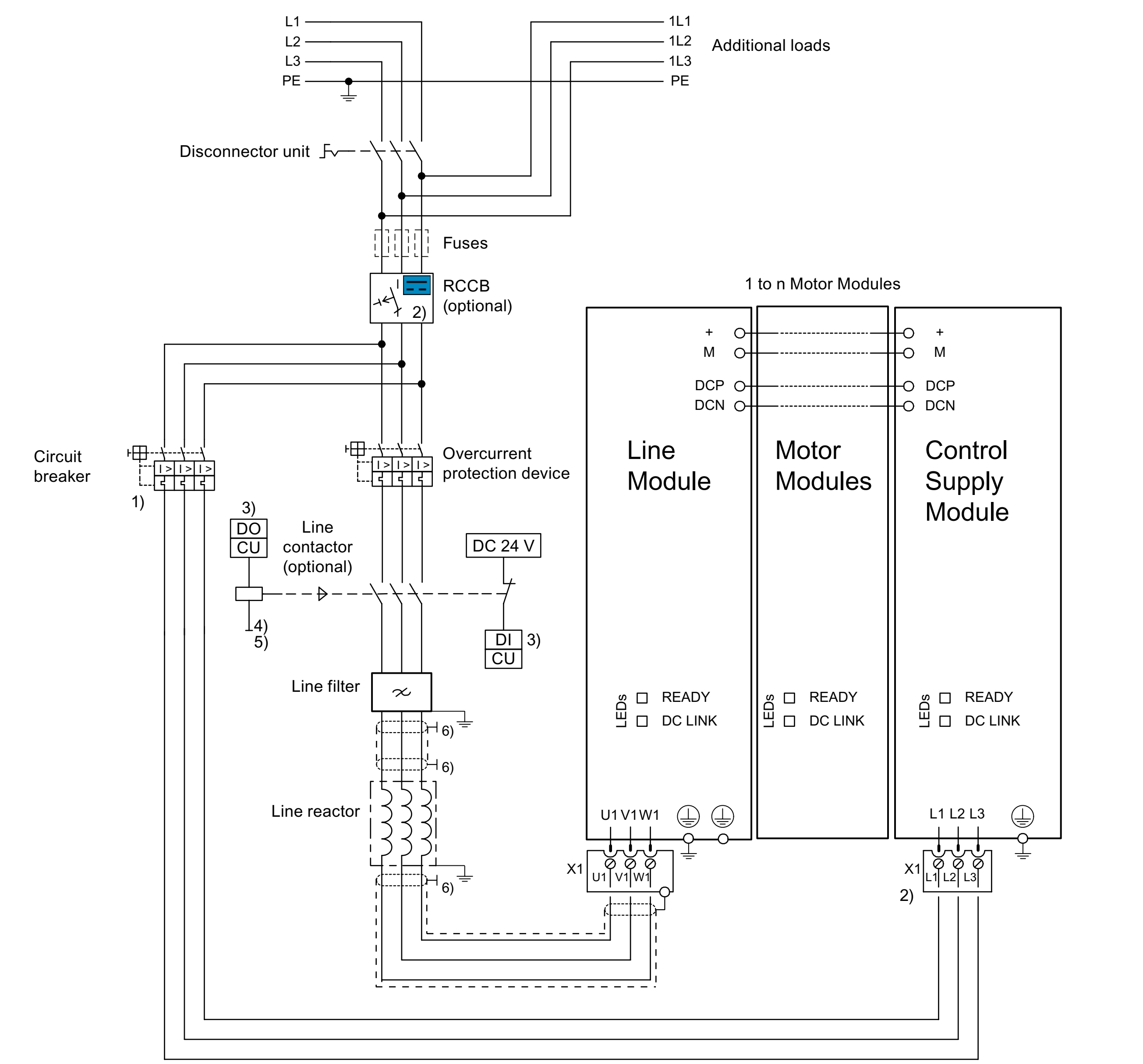


Figure 8-11 Interface description: control supply module

8.3.3.2 Connection example



1) Permissible types:
   a) SIRIUS circuit breaker, 3RV 1021 1DA10, set to 3A
   b) KTS-R-6 branch circuit fuse (class RK1)
2) The line supply connection must be established at all times.
3) DI/DO, controlled by the Control Unit
4) No additional load permitted downstream of line contactor
5) The current carrying capacity of the DO must be observed; an output coupling device must be used if required.
6) Contact through the rear of the mounting surface or shielding buses in accordance with the EMC Directive

Figure 8-12 Example connection of Control Supply Module

The Control Supply Module (CSM) is connected to the line supply (380 V 3 AC –10 % up to 480 V +10 %) via the appropriate screw terminals (0.2 to 4 mm^2). This connection should preferably be made without using an isolating device (e.g. contactor).

The CSM has an internal line filter (Class A for TN line supplies), and the pre-charging circuit for the DC link inside the unit is electrically isolated from the 24 V supply.

The CSM also features a current limitation function. If cables with a cross-section of 2.5 mm^2 are used and a maximum operating temperature of 40 °C is observed, there is no need for additional fuse protection on the 24 V side, nor do the cables on that side have to be laid in a way that makes them short-circuit proof.
If it is necessary to create multiple branches, we recommend using a SITOP select diagnostics module as a form of overcurrent protection. You can find more information on fuse protection in the chapter titled "Control cabinet installation and EMC".

Note

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.

Note

Connecting to the line

When engineering the line supply of the CSM, it should be noted that the CSM may not be connected to the line supply after the Line Module is connected to the line supply. When charging, this prevents the DC link from being immediately loaded by the CSM.

Note

Using several Control Supply Modules

It is possible to use several CSMs in one DC link, but they must not be connected in parallel. An individual line, complete with 20 A fuse protection, must be created for each CSM.

Note

Installation of the 24 V terminal adapter

If necessary, the 24 V terminal adapter can be installed on the right-hand side of the CSM. The adapter must be screwed tight using the screw supplied.

8.3.3.3 Meaning of the LEDs on the Control Supply Module

Table 8- 8 Control Supply Module – description of the LEDs

LED	Color	Status	Description, cause	Remedy
READY	-	off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Continuous	Component is ready to operate.	–
DC LINK	-	off	Electronics power supply is missing or outside permissible tolerance range.	–
	Orange	Continuous	DC link voltage within permissible tolerance range.	–
	Red	Continuous	DC link voltage outside permissible tolerance range.	–

8.3.4 Dimension Drawing

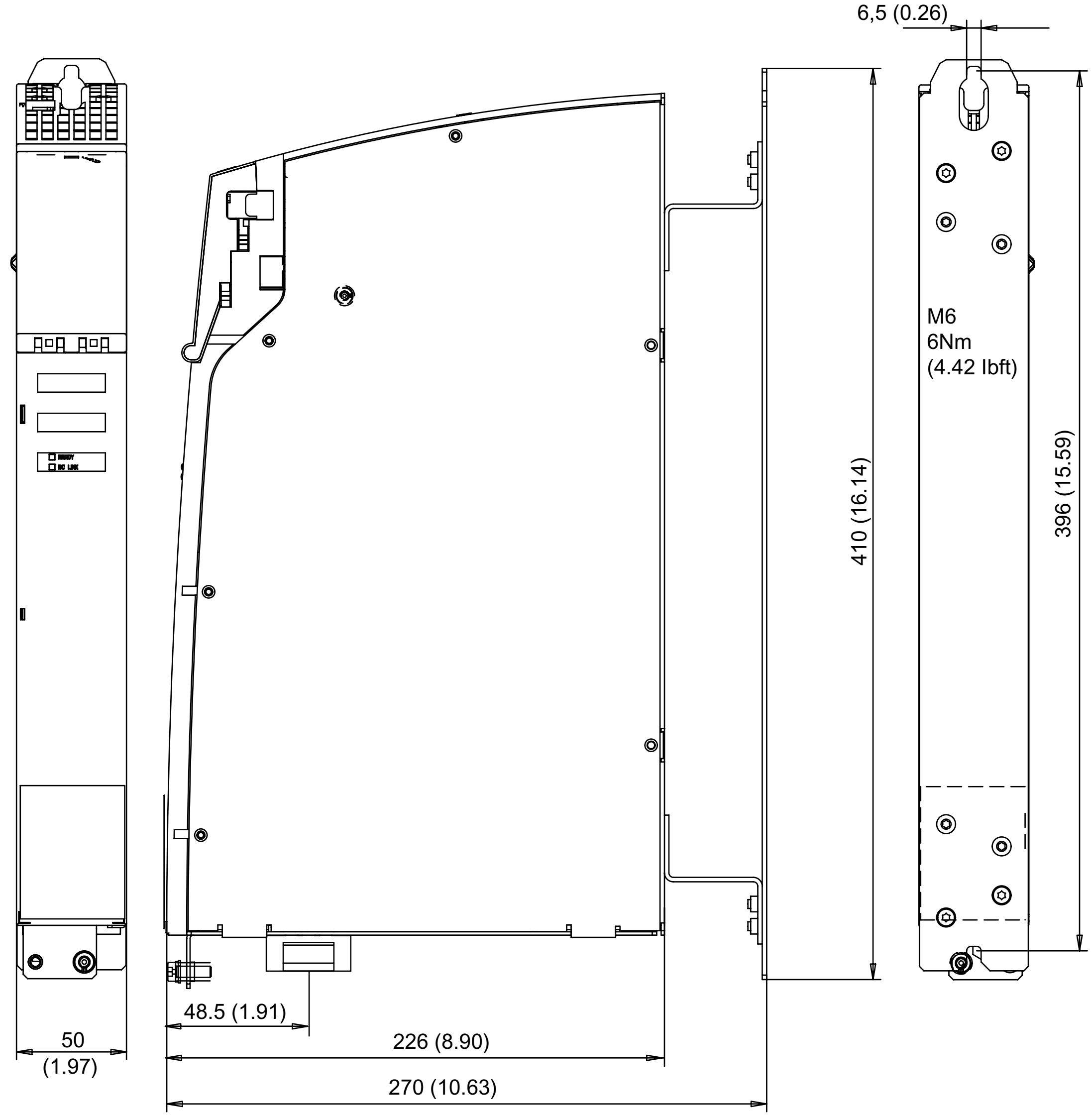


Figure 8-13 Dimension Control Supply Module, all dimensions in mm and (inches)

8.3.5 Replacing the fan

Replacement fan (Order. No. 6SL3160-0AB00-0AA0)

NOTICE
When replacing the fan, you must observe the ESD regulations. (Danger of damage to sensitive components due to static electricity).

DANGER
Spare parts must always be replaced by properly trained personnel. Risk of electric shock. Dangerous voltages are still present for up to 5 minutes after the power supply has been switched off. More than one supply circuit!

Removing the fan:

1. Switch off the power supplies (400 V 3 AC for Control Supply Module **and** Line Modules)

Allow time (min. 5 minutes) for the DC link energy to discharge!

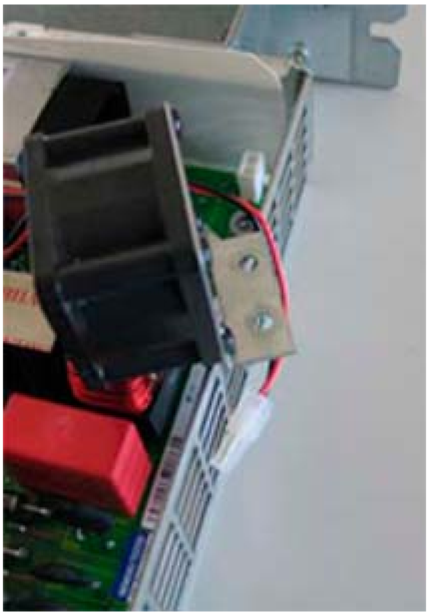
2. Remove the component from the drive line-up.

3. Open the device cover (6 TX10 screws)

4. Unlatch and pull out the plug connector

5. Release the 2 screws (TX20)

6. Take out the fan



Installing the fan:

1. Before installing the fan, check the air flow direction (the arrow on the fan must point towards the cooling ribs).
2. Insert the connector until it fully engages.
3. Screw in the 2 screws (TX20); torque 1.2 Nm
4. Close the device cover (TX10); torque 0.8 Nm

8.3.6 Technical data

Table 8- 9 Technical data

Control Supply Module	Unit	Value
Input data		
Line voltage Line frequency	V_{AC} Hz	380 - 480 $V_{3\ AC}$ ± 15 % 47 to 63
Rated input current Rated value (at U_{eRated})	 A_{AC}	 approx. 2
Starting current inrush	A_{AC}	Max. 80
Power loss ride-through (at 400 V_{AC})	ms	5
DC link voltage	V_{DC}	430 to 882 (300 to 430 < 1 min)
Supply current (at 600 V)	A_{DC}	1.1
Output data		
Output voltage	V_{DC}	26 +/- 2 %
Rated output current	A_{DC}	20
Run up to short-circuit Short-circuit in operation	A_{DC} A_{DC}	≤ 24 normally 23 (continuous)
24 V DC busbar current carrying capacity	 A_{DC}	 20
Residual ripple (clock frequency approx. 50 kHz)	mV_{pp}	< 100
Cycle peaks (bandwidth 20 MHz)	mV_{pp}	< 200
Power loss (line) [1)] Power loss (DC link)	W	70 65
Efficiency	%	88
Weight	kg	4.8

1) For an overview, see the power loss tables in chapter Control cabinet installation

8.4 Voltage Clamping Module VCM

8.4.1 Description

Under certain unfavorable conditions, voltage rises can occur in extended drive line-ups due to the stimulation of the system resonance frequency. This can be particularly damaging for the insulation systems of the connected motors since partial discharges can occur.

The Voltage Clamping Module ensures that the motor voltages are limited to permissible values even when resonance occurs. In conjunction with an Active Line Module with an HF line reactor the Voltage Clamping Module must always be used if the total lengths of all the motor and DC link cables exceed the following value:

- 350 m for shielded cables.
- 560 m for unshielded cables.

In conjunction with the Voltage Clamping Module, the following total cable lengths are permitted:

- 630 m for shielded cables
- 850 m for unshielded cables

Limitations/secondary conditions

The following secondary conditions must be observed:

- Power derating for Line Modules to 80% for cable lengths > 350m.
- Max. step-up factor 1.4 to 1.6 (rectification factor V_{dc}/V_{line}) with regulated infeed.
- No built-in motors must be connected (torque motors, linear motors).
- Can only be connected to TN line supply systems with grounded neutral point.
- The EMC limit values (radio interference voltage) are no longer observed, which means that special measures have to be taken to ensure CE conformity (on-site measurement (subject to charge) and adjusted filter). Contact: EPCOS, e-mail: emv.labor@epcos.com

Compatibility

The Voltage Clamping Module can be integrated in the drive line-up with:

- Internal air cooling with mounting brackets (included in the scope of delivery)
- External air cooling
- Cold plate cooling
- Liquid cooling

8.4.2 Safety information

DANGER

Risk of electric shock. A hazardous voltage is present for up to 5 minutes after the power supply has been switched off.
It is only permissible to open the protective cover after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking device) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

DANGER

The DC link discharge voltage hazard warning in the local language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection on the cabinet or machine must be implemented in accordance with one of the following measures:

- stationary connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- stationary connection and automatic shutdown of the power supply if the protective conductor is interrupted

NOTICE

It is not permissible to use a green/yellow cable for the functional ground of the Voltage Clamping Module.

The Voltage Clamping Module includes capacitors that are connected with respect to the functional ground. This is the reason that when carrying-out a high-voltage test in the system, the components must be disconnected from the functional ground.

WARNING

The cooling clearances of 80 mm above and below the components must be observed.

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

CAUTION

After transportation, the screws must be tightened. The tightening torque of the DC link busbar screws (1.8 Nm, tolerance +30 %) must be checked before commissioning.

CAUTION

The DC link side covers are supplied as standard with the components; they can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

8.4.3 Interface description

8.4.3.1 Overview

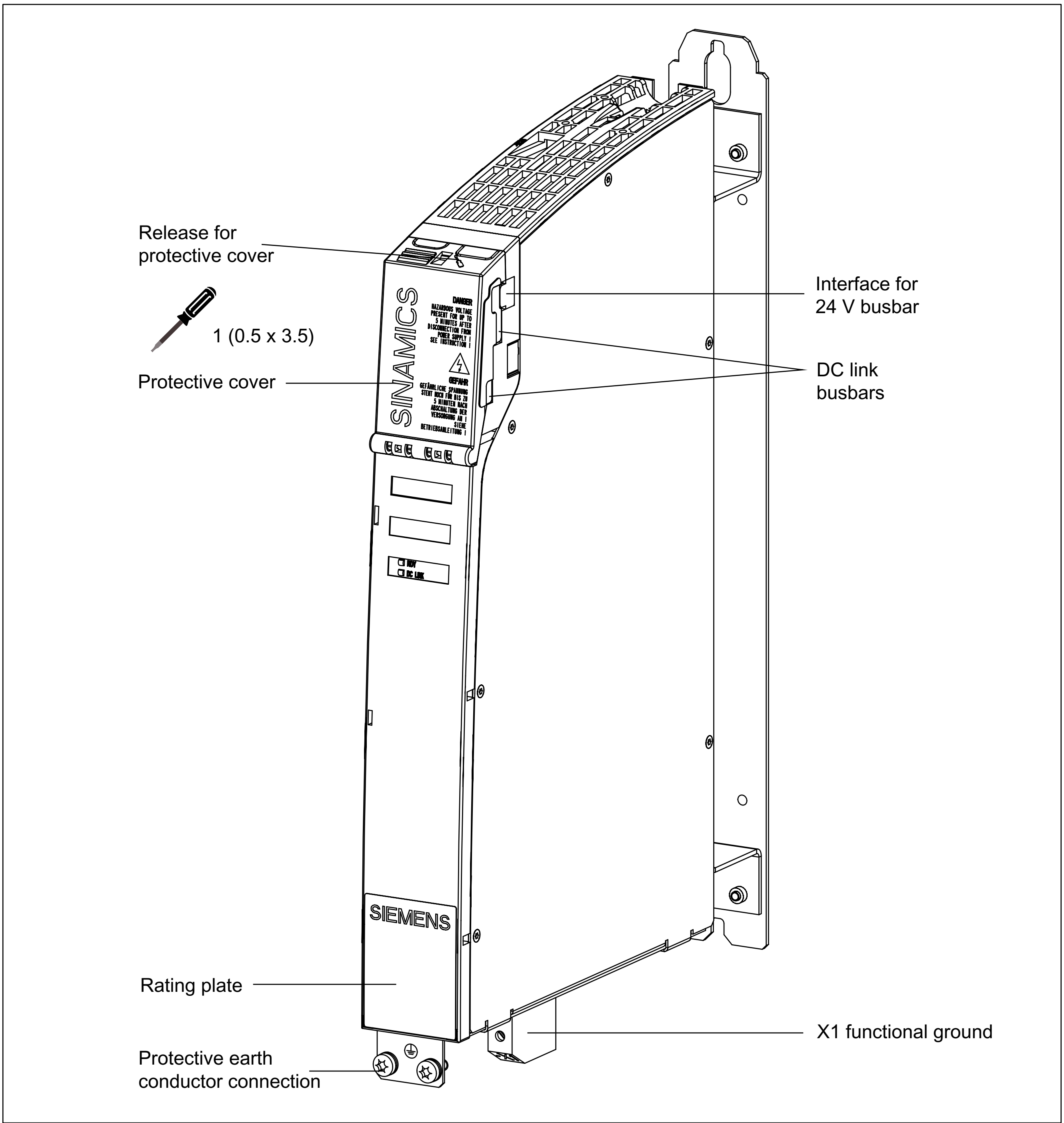


Figure 8-14 Interface description: Voltage Clamping Module

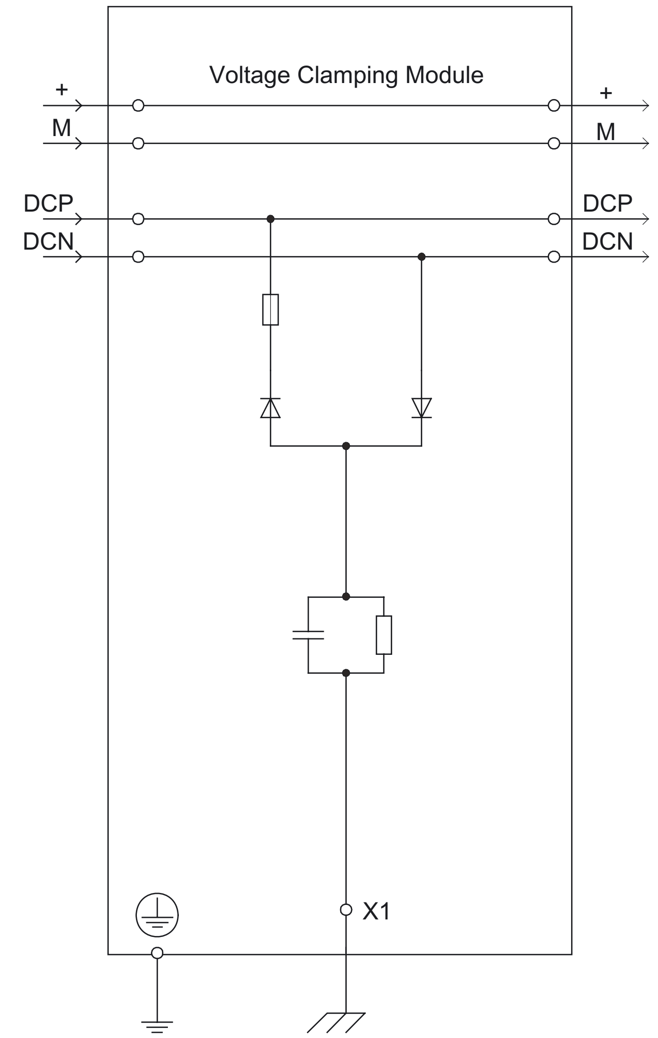


Figure 8-15 Circuit diagram: Voltage Clamping Module

8.4.3.2 X1 functional ground

X1 functional ground

To ensure that the Voltage Clamping Module functions properly, a functional ground must be connected to X1. Please note:

- The cables must be routed via the shortest possible path
- Cross-section: 4 mm² to 16 mm²
- When a line filter is used, the functional ground should be located on the metallic installation panel in the immediate vicinity of the line filter.
- In systems without a line filter, it should be connected on the PE busbar.

8.4.4 Dimension drawing

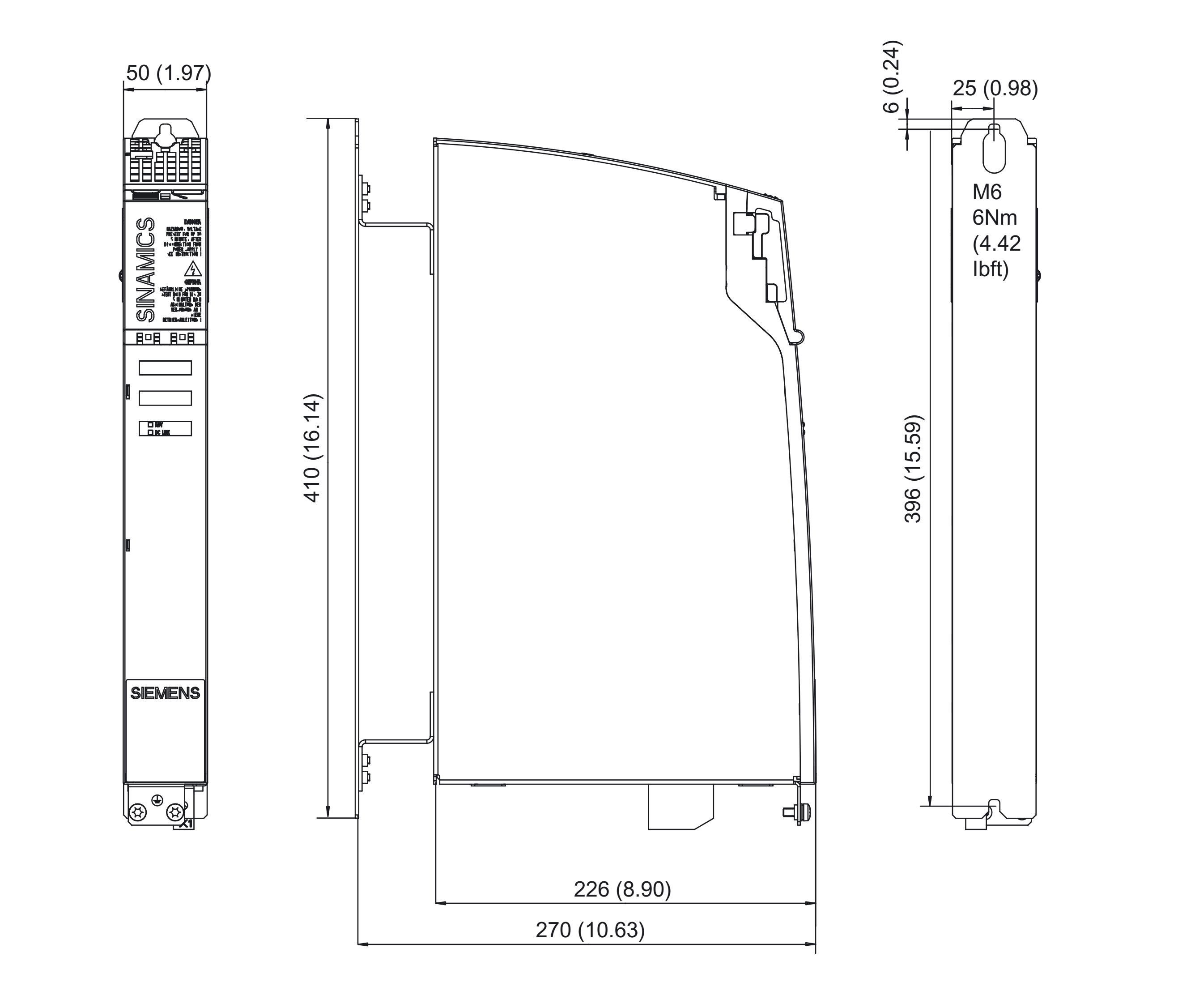


Figure 8-16 Dimension drawing of Voltage Clamping Module, all dimensions in mm and (inches)

8.4.5 Installation

See the instructions for installing other DC link components (e.g. Braking Module, Capacitor Module).

Arrangement of the Voltage Clamping Module:

The Voltage Clamping Module should ideally be placed directly next to the Line Module.

- The current-carrying capacity of the DC link must be taken into account (100 A for the Voltage Clamping Module)
- The Voltage Clamping Module should ideally be placed to the left next to the Line Module.
- If the Voltage Clamping Module is to be installed in an existing drive line-up, it can also be placed at the end.

8.4.6 Technical data

Table 8- 10 Technical data

Voltage Clamping Module		
Electronics power supply	V_{DC}	24 (20.4 – 28.8)
DC link voltage	V_{DC}	510 - 720
DC link busbar current carrying capacity	A	100
24 V busbar current carrying capacity	A	20
Power loss[1]	W	50
Weight	kg	3.1

1) For an overview, see the power loss tables in chapter Control cabinet installation

Derating characteristic

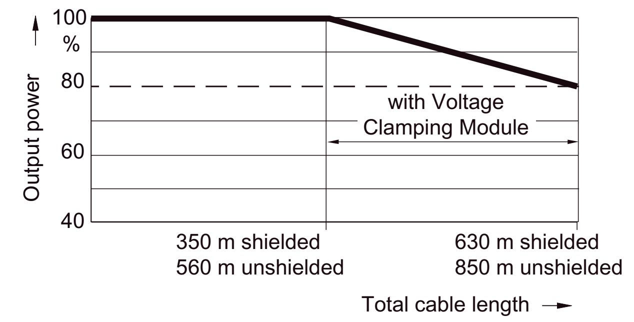


Figure 8-17 Output power as a function of the total cable length

Motor-side power components 9

9.1 Motor reactors

9.1.1 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 re-charging currents that additionally load the output of the Power Module when longer motor cables are used are simultaneously reduced.

Prerequisites

- Ambient temperature 40 °C.
- Pulse frequency f_{max}=4 kHz.
- Output frequency f_{max}=120 kHz.
- Only valid for vector operating mode.
- Supported in Starter from Version 2.4 up to 1 motor reactor.
- Supported in Starter from Version 2.5 up to 3 motor reactors.

9.1.2 Safety information

⚠ WARNING
A ventilation clearance of 100 mm above and below the components must be observed.

Note

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

CAUTION
When using motor reactors that SIEMENS has not approved for SINAMICS, then these can thermally damage the reactor.

⚠ CAUTION
The surface temperature of the motor reactors can exceed 80 °C.

CAUTION
The maximum permissible output frequency when motor reactors are used is 120 Hz.

9.1.3 Dimension drawings

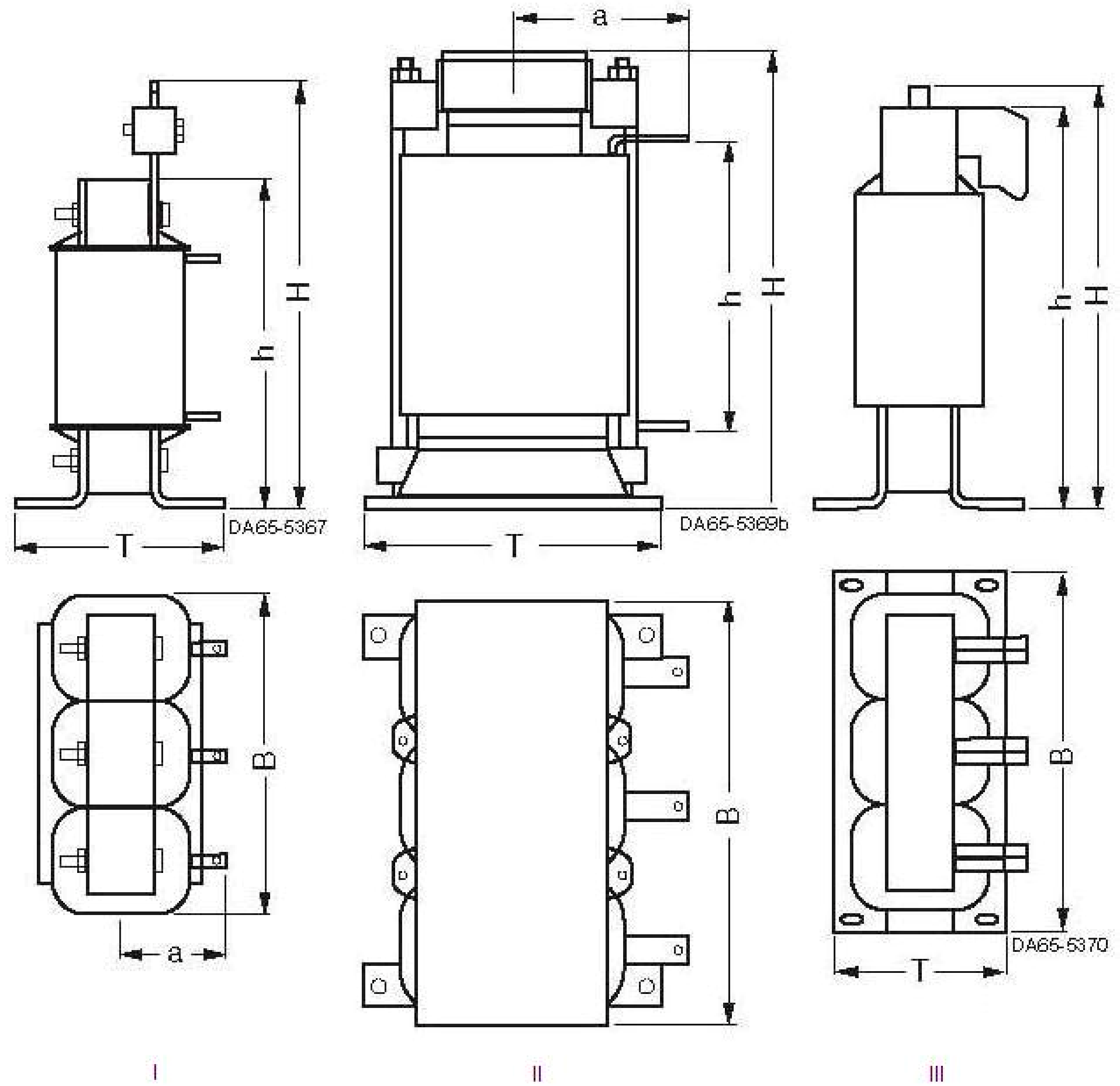


Figure 9-1 Dimension drawings of motor reactors

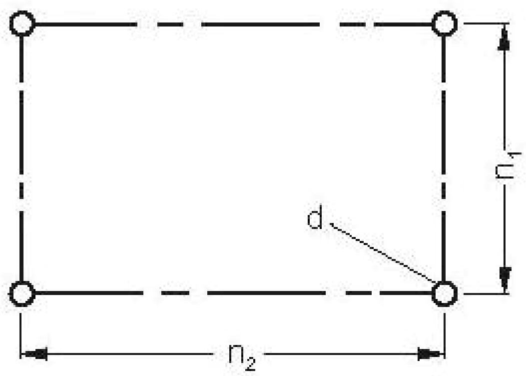


Figure 9-2 Mounting hole

Table 9- 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 9- 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			

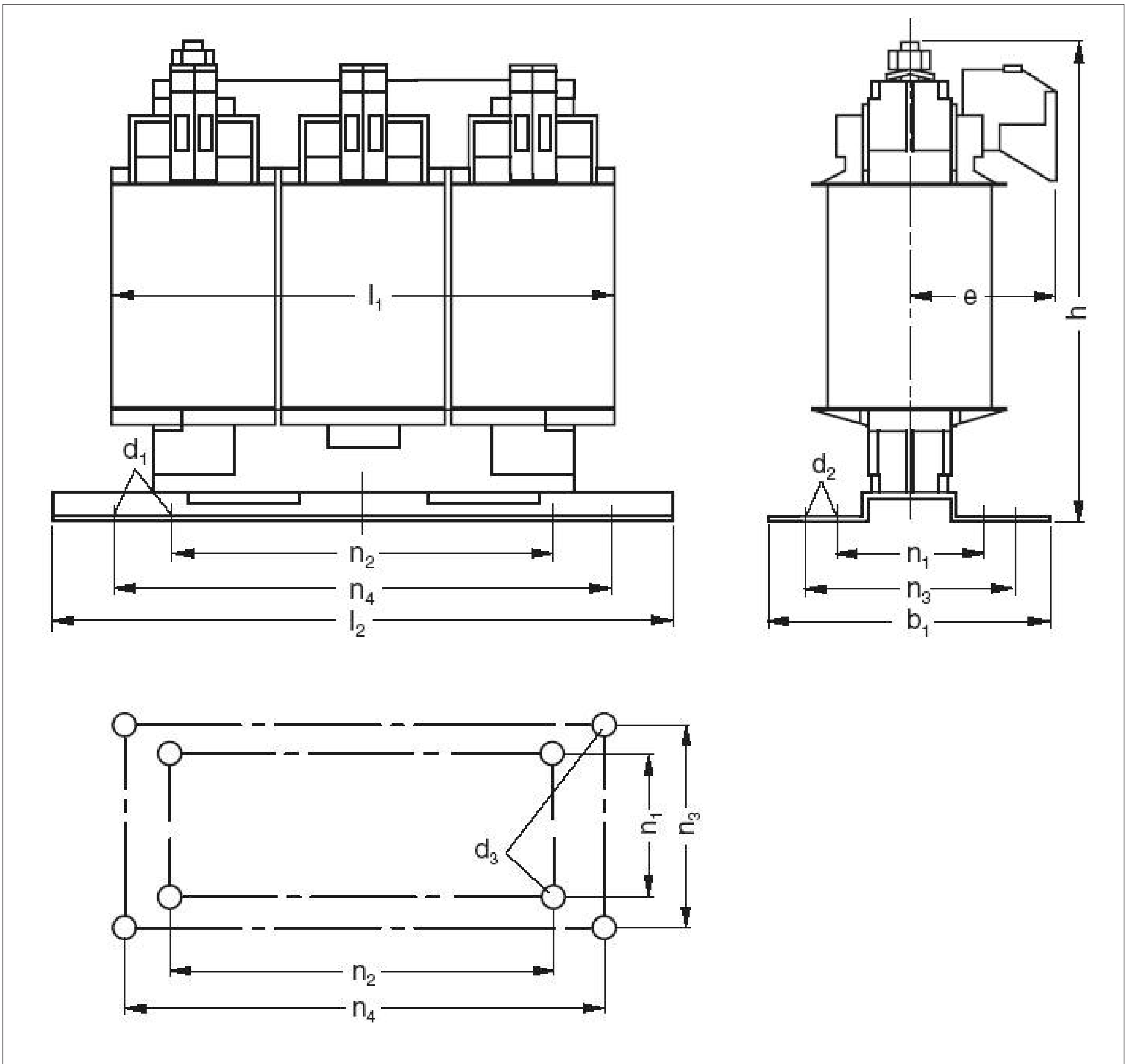


Figure 9-3 Dimension drawing and mounting hole of motor reactor 9 A (6SL3000-2BE21-0AA0)

Table 9- 3 Dimensions of motor reactor 9 A, all dimensions in mm and (inches)

6SL3000-2BE21-0AA0	
l_1	150 (5.90)
l_2	178 (7.00)
b_1	88 (3.46)
b_{max}	111 (4.37)
e	67 (2.63)
h	159 (6.25)
n_1	64 (2.51)
n_2	113 (4.44)
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	

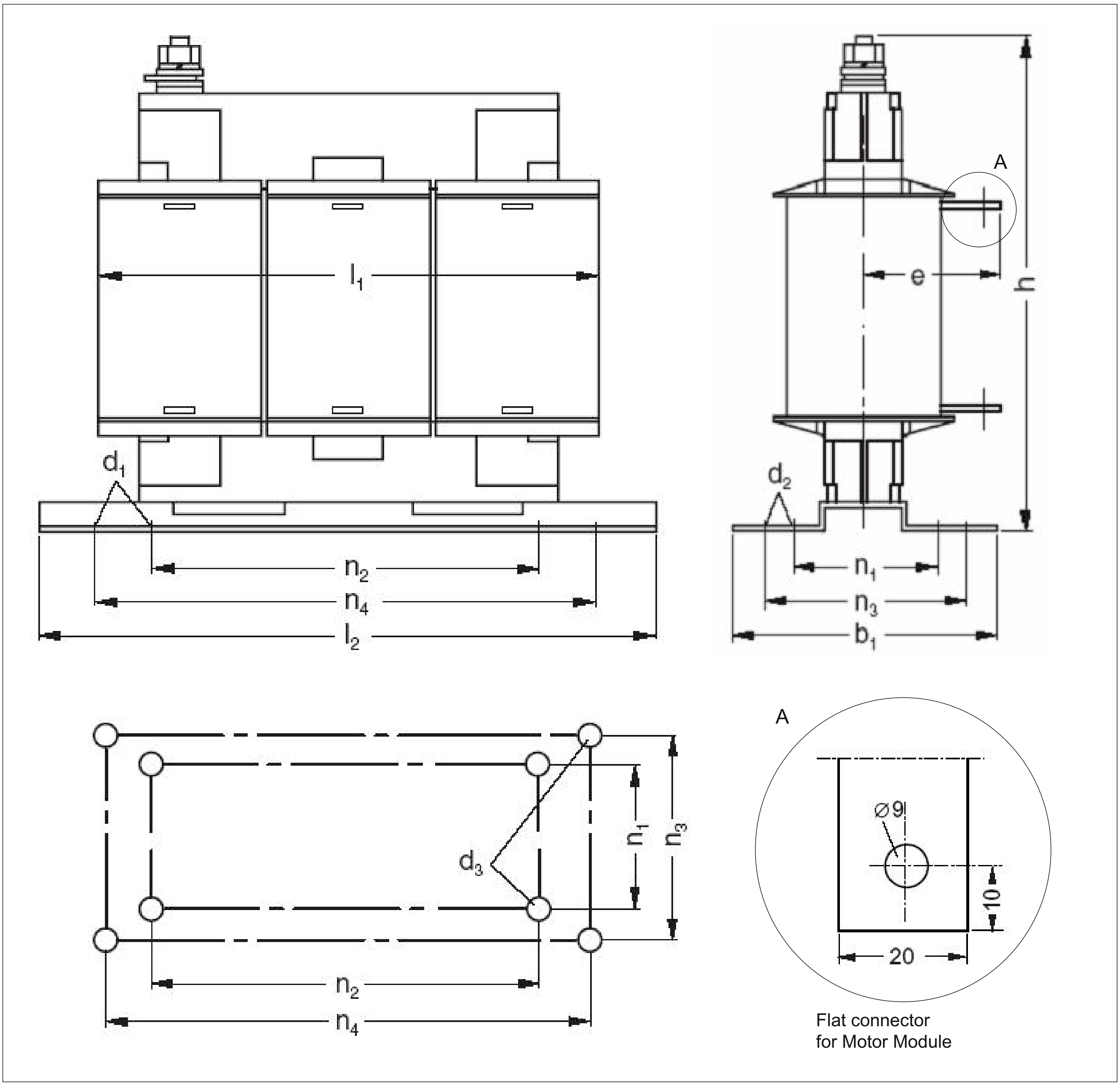


Figure 9-4 Dimension drawing and mounting hole of motor reactor 60 A (6SL3000-2BE26-0AA0)

Table 9- 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	

9.1.4 Technical data

Table 9- 5 Technical data, motor reactors, part 1

Order No.		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	6SL312x-1TE21-0AAx 6SL312x-2TE21-0AAx	6SL312x-1TE21-8AAx 6SL312x-2TE21-8AAx	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	130
Connections - to the Motor Module - to the load - PE		 4 mm^2 4 mm^2 M6	 10 mm^2 10 mm^2 M6	 10 mm^2 10 mm^2 M6	 M8 M8 M6	 M8 M8 M6
Degree of protection		IP00	IP00	IP00	IP00	IP00
Weight	kg	5.5	4.83	9.2	20	11

Table 9- 6 Technical data, motor reactors, part 2

Order No.		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	59	29	23	16
Power loss	W	105	220	300	300
Connections - to the Motor Module - to the load - PE		 M8 M8 M6	 M8 M8 M6	 M10 M10 M6	 M10 M10 M6
Degree of protection		IP00	IP00	IP00	IP00
Weight	kg	10.5	25	30	30

Table 9- 7 Cable lengths, Part 1

Order No.	6SE7021-0ES87-1FE0	6SL3000-2BE21-0AA0	6SE7022-6ES87-1FE0	6SE7024-7ES87-1FE0	6SE7027-2ES87-1FE0
Rated current [A]	5	9	18	30	45
Shielded cables					
Maximum motor cable length, 1 reactor	100	135	160	190	200
Maximum motor cable length, 2 reactors	-	-	320	375	400
Maximum motor cable length, 3 reactors	-	-	-	-	600
Unshielded cables					
Maximum motor cable length, 1 reactor	150	200	240	280	300
Maximum motor cable length, 2 reactors	-	-	480	560	600
Maximum motor cable length, 3 reactors	-	-	-	-	900

Table 9- 8 Cable lengths, Part 2

Order No.	6SL3000-2BE26-0AA0	6SE7031-5ES87-1FE0	6SE7031-8ES87-1FE0	6SE7032-6ES87-1FE0
Rated current [A]	60	85	132	200
Shielded cables				
Maximum motor cable length, 1 reactor	200	200	200	200
Maximum motor cable length, 2 reactors	400	400	400	400
Maximum motor cable length, 3 reactors	600	600	600	600
Unshielded cables				
Maximum motor cable length, 1 reactor	300	300	300	300
Maximum motor cable length, 2 reactors	600	600	600	600
Maximum motor cable length, 3 reactors	900	900	900	900

9.2 Voltage Protection Module VPM

9.2.1 Description

The Voltage Protection Module (VPM) is a component for limiting voltage. It is used for both 1FE 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 DC-link voltage is too high (> 800 V) and uses an electronic switch to short 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 9- 9 Overview of the Voltage Protection Modules available

Designation	Rated current
VPM120	120 A
VPM200	200 A
VPM200 Dynamik	200 A

The VPM 200 Dynamik is to be used with third-party synchronous motors (which generally have higher inductances than 1FE motors), when combining a third-party synchronous motor with a motor reactor, and when combining a 1FE motor with a motor reactor. This is because of the higher operating inductances and resulting higher voltage rates-of-rise, which can affect the Voltage Protection Module.

Table 9- 10 Interface overview for Voltage Protection Modules

Type	Number VPM120/VPM200	Number VPM200 Dynamik
Signaling interface	1	1
PE connection	2	4
Load connecting bolt, input	3	5
Load connecting bolt, output	3	5

9.2.2 Safety information

NOTICE

The unit is a safety-relevant piece of equipment and may only be used as specified. Other applications, e.g. armature short-circuits in operation, etc., are not permissible.

The warning information on the unit must be carefully observed!

The Voltage Protection Module can only be operated effectively in combination with SINAMICS Booksize and 1FE1/2SP1 motors. Shielded MOTION-CONNECT 800 motor cables (type 6FX8) must be used with the VPM.

WARNING

Motors whose EMF can reach a DC-link voltage > 2 kV (EMF = 1.4 kV_{rms}) at maximum speed must not be connected to a Motor Module. The insulation voltage could be exceeded, resulting in personal injury due to electric shocks.

Under fault conditions, voltages up to 2 kV can occur at cables that are cut or damaged.

Depending on the speed of the motors, the motor terminal voltage of the 1FE1 motors can attain values as high as 2 kV.

DANGER

Only short-circuit proof motors may be used in conjunction with a Voltage Protection Module.

DANGER

Risk of electric shock

Dangerous voltages are still present for up to 30 minutes after the power supply has been switched off.

WARNING

Measures must be adopted to prevent the drive from starting automatically.

WARNING

The cooling clearances of 200 mm above and below the components must be observed.

DANGER

Only qualified personnel should work on or around the equipment. They must be thoroughly familiar with all the warnings and maintenance procedures described in the relevant operating instructions.

DANGER

The motor may only be operated below the field weakening speed while the Voltage Protection Module is ramping up (see the technical data).

9.2.3 Interface description

9.2.3.1 Overview

The drawings below give a general idea of where the interfaces and housing outlets on the Voltage Protection Modules VPM 120, VPM 200, and VPM 200 Dynamik are located.

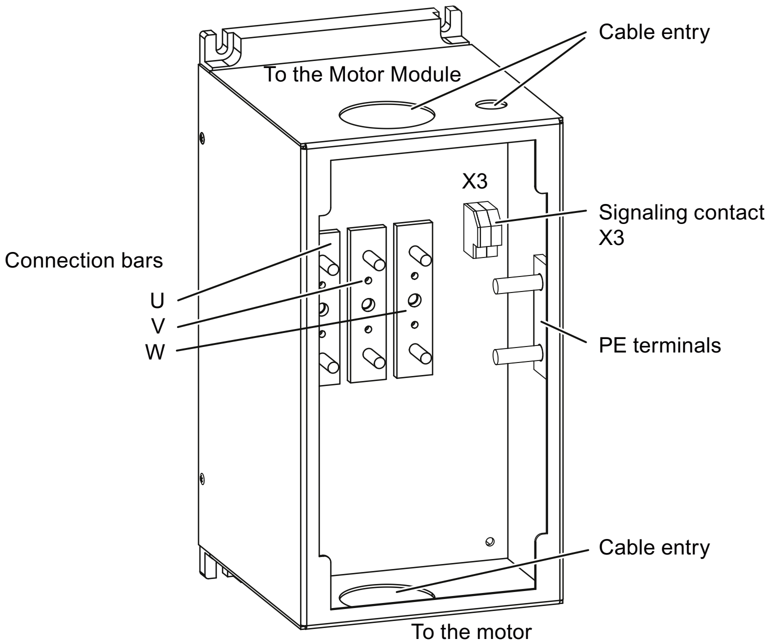


Figure 9-5 Voltage Protection Modules VPM 120 (without cover)

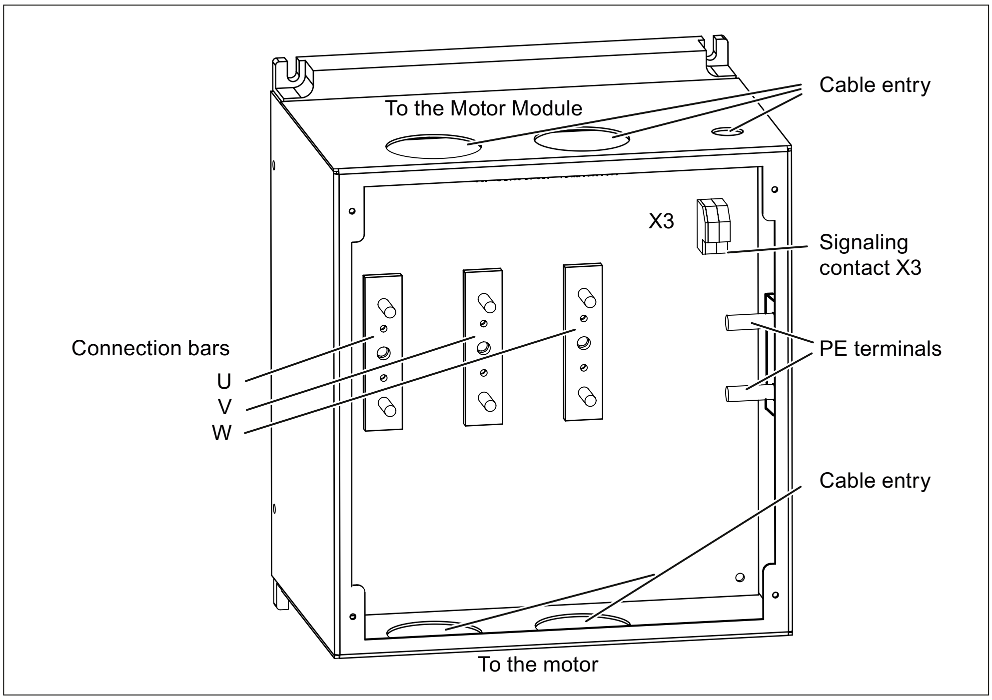


Figure 9-6 Voltage Protection Modules VPM 200 (without cover)

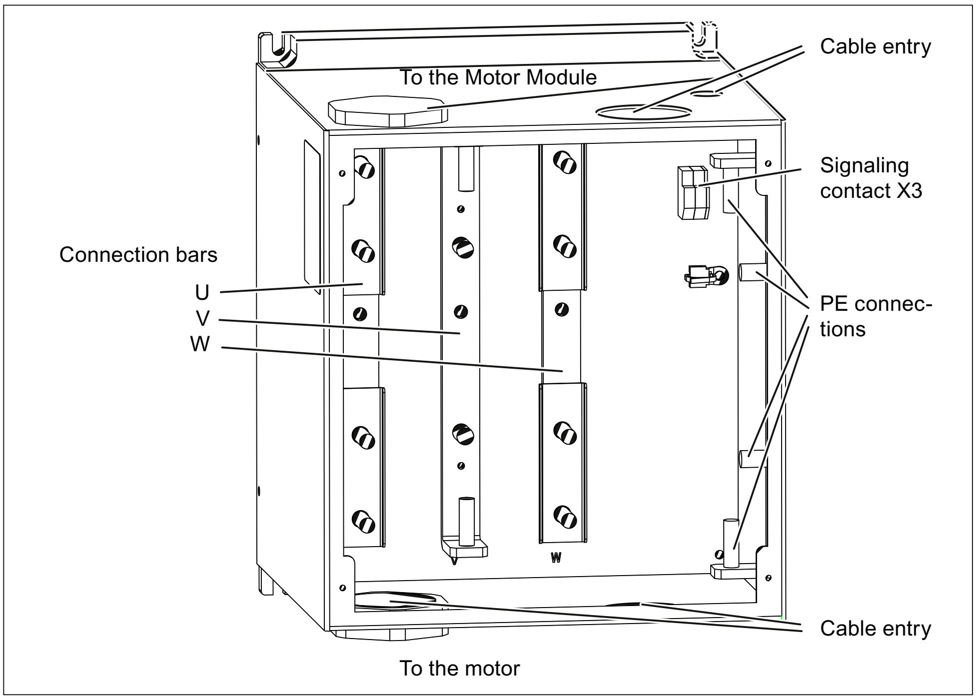
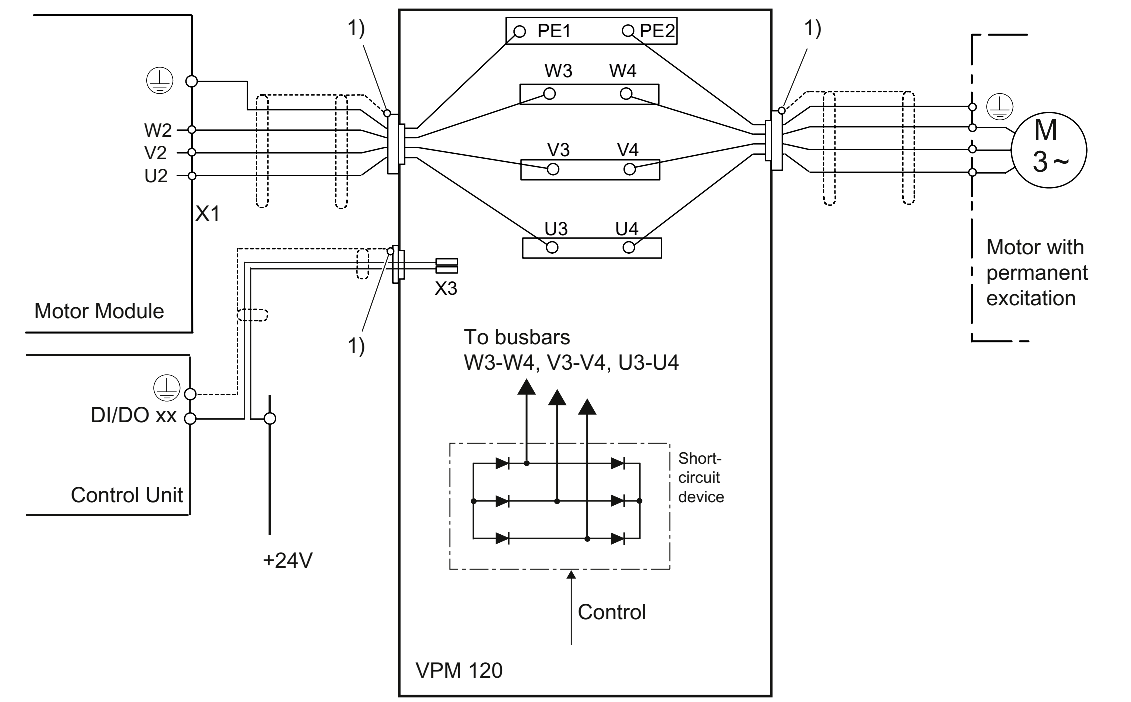


Figure 9-7 Voltage Protection Modules VPM 200 Dynamik (without cover)

The housing is closed during operation to ensure the electrical terminals are covered.

9.2.3.2 Connection examples



1) A conductive connection is established between the cable shield and cable entry.

Figure 9-8 Connection example for Voltage Protection Module VPM 120

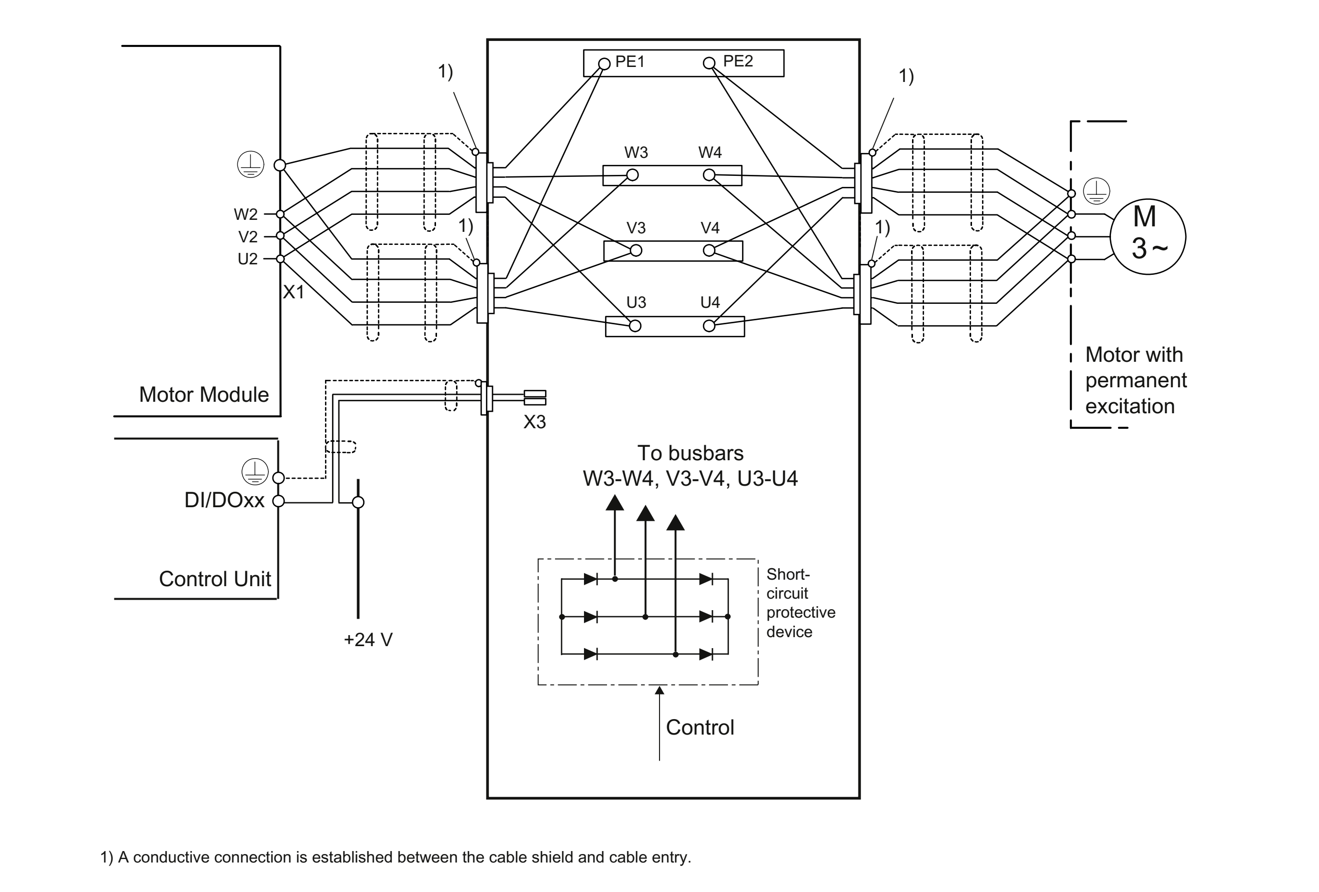


Figure 9-9 Connection example for Voltage Protection Module VPM 200

Cable lengths

The maximum cable length between a Motor Module and Voltage Protection Module is 1.5 m and must not include any switching elements.
The cable between the Voltage Protection Module and motor must not exceed a length of 50 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, pulse inhibiting must continue to be applied to the affected axis. To ensure this happens, the connected digital input is interconnected to control bit OFF2 (pulse inhibit) via p0845 = r0722.xx. The signaling interface requires a +24 V supply.

9.2.3.3 Signaling interface X3

The signaling interface has the following assignments:

Table 9- 11 Signaling interface X3

Terminal	Designation	Technical specifications
1	Operating message for Control Unit	• The cable shield is connected to the VPM housing via the cable entry. • Floating contact, load rating: 30 VDC at 0.1 A
2	Operating voltage +24 V (from external source)	
Terminal type: WAGO spring-loaded terminal, type 226-111, max. conductor cross-section: 1.5 mm², shielded lead		
Cable entry: Max. 9 mm ∅ Types VPM 120, VPM 200, and VPM 200 Dynamik • 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.

When the temperature error no longer applies, signaling contact X3 closes after time t > 2 min.

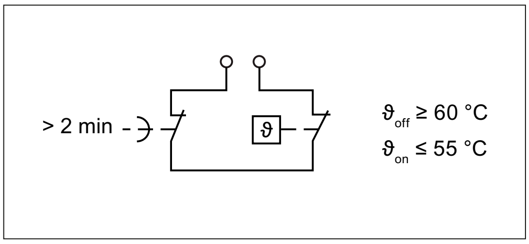


Figure 9-10 Signaling contact X3 of the Voltage Protection Module

DANGER

Measures must be taken to prevent the drive starting automatically, since signaling contact X3 restores the pulse enable after t > 2 min.

9.2.3.4 Connection bars U, V, W, PE

As far as the power connections to the Motor Module and motor are concerned, cables are routed through the cable entry of the Voltage Protection Module and attached to the connection bars inside the unit.

Table 9- 12 Connections U, V, W, and PE

	VPM 120	VPM 200	VPM 200 Dyn
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° angle
Conductor cross section	≤ 50 mm²	≤ 50 mm²	≤ 50 mm²
Tightening torque	10 Nm	25 Nm	25 Nm
Cable entry	For cables with max. 40 mm ∅		
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 terminals for each phase and for PE.

2) There is a set of 4 terminals for each of the phases U, W, and PE and 2 terminals 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 2 cables connected in parallel.

9.2.4 Dimension drawings

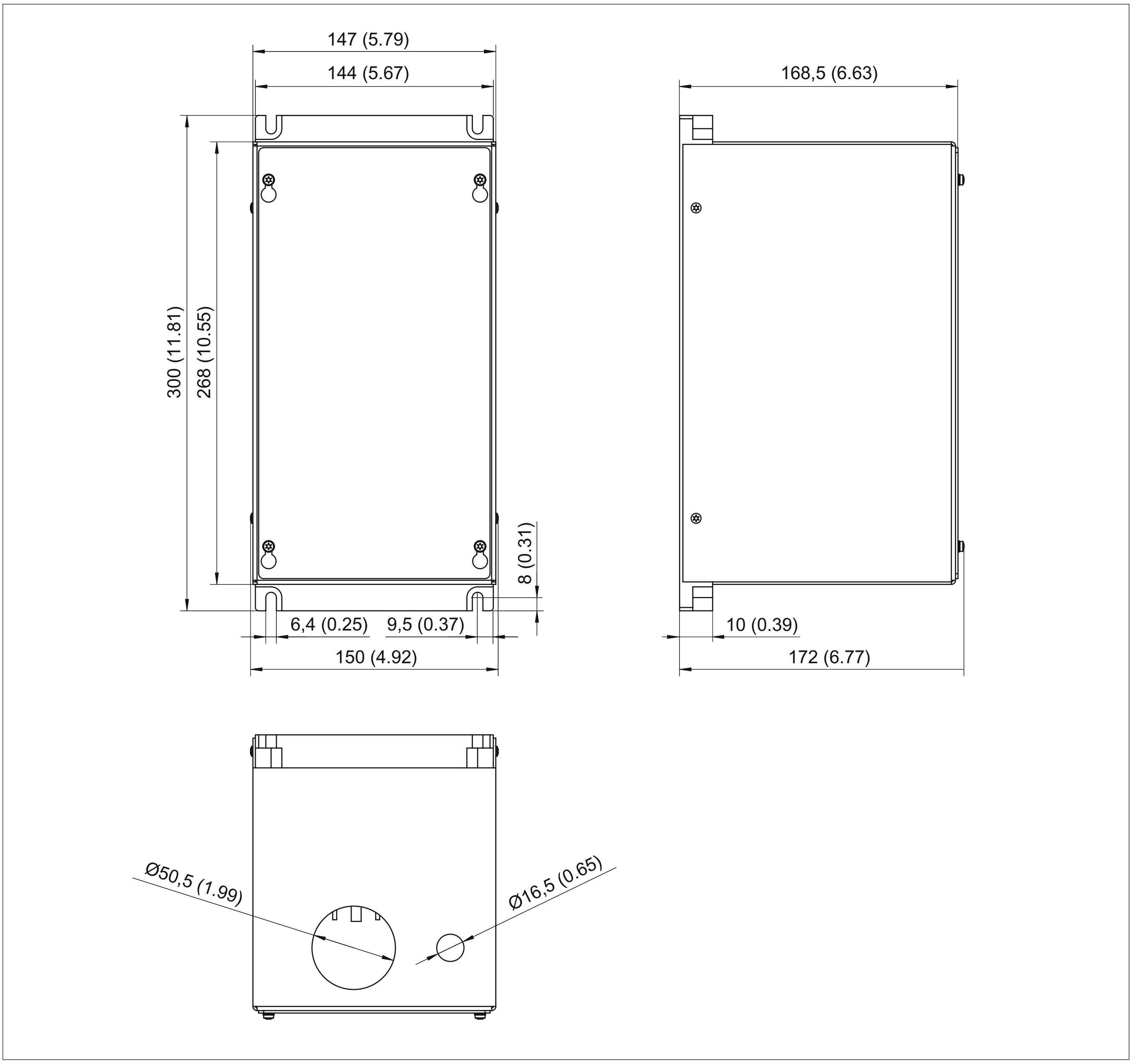


Figure 9-11 Dimension drawing of the Voltage Protection Module VPM120, all data in mm and (inches)

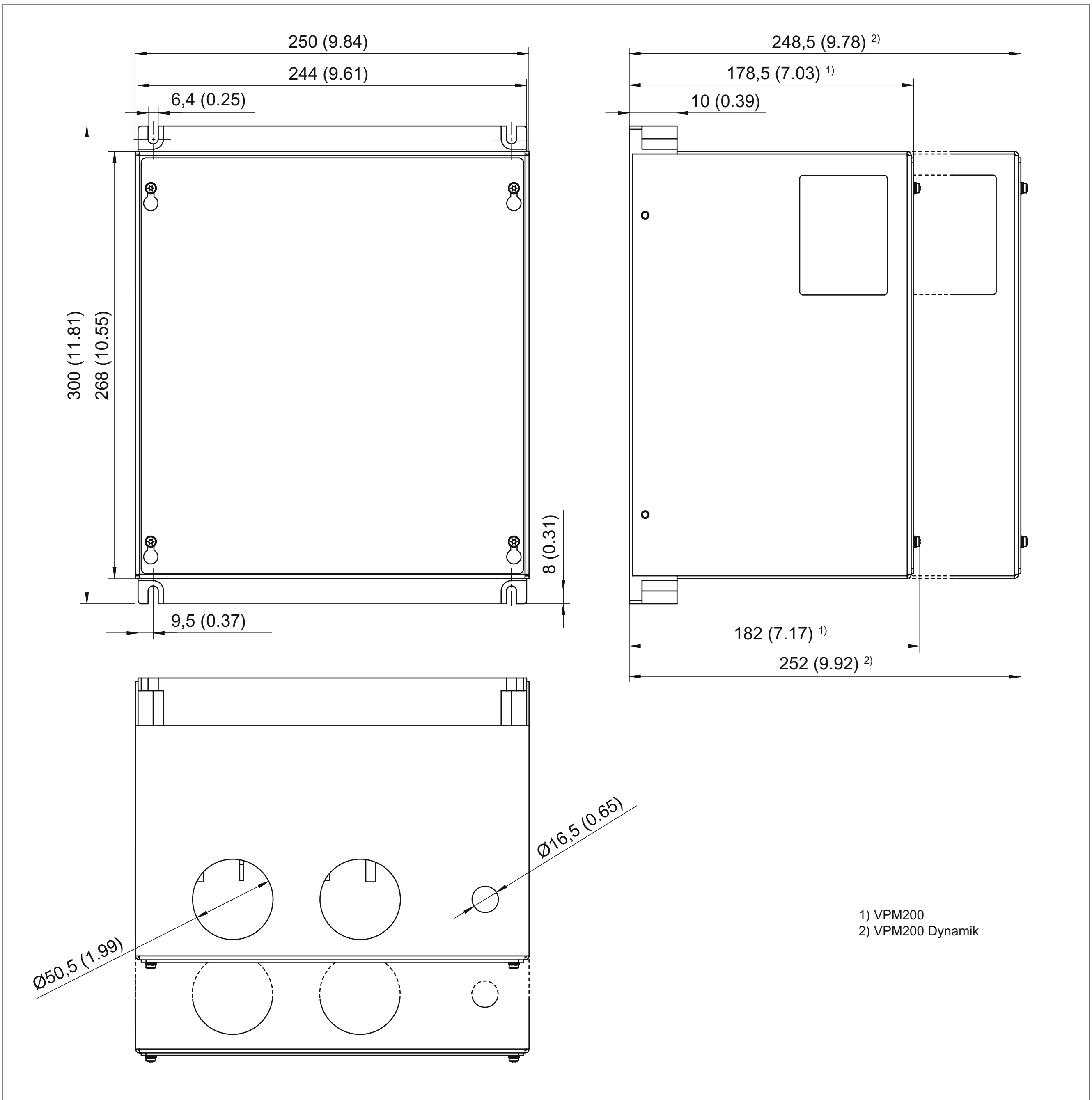


Figure 9-12 Dimension drawing of the Voltage Protection Module VPM200 and VPM200 Dynamic, all data in mm and (inches)

9.2.5 Installation

The Voltage Protection Module is installed in the control cabinet close to the drive.

DANGER

Motor reactors may only be connected between the Voltage Protection Module and motor.

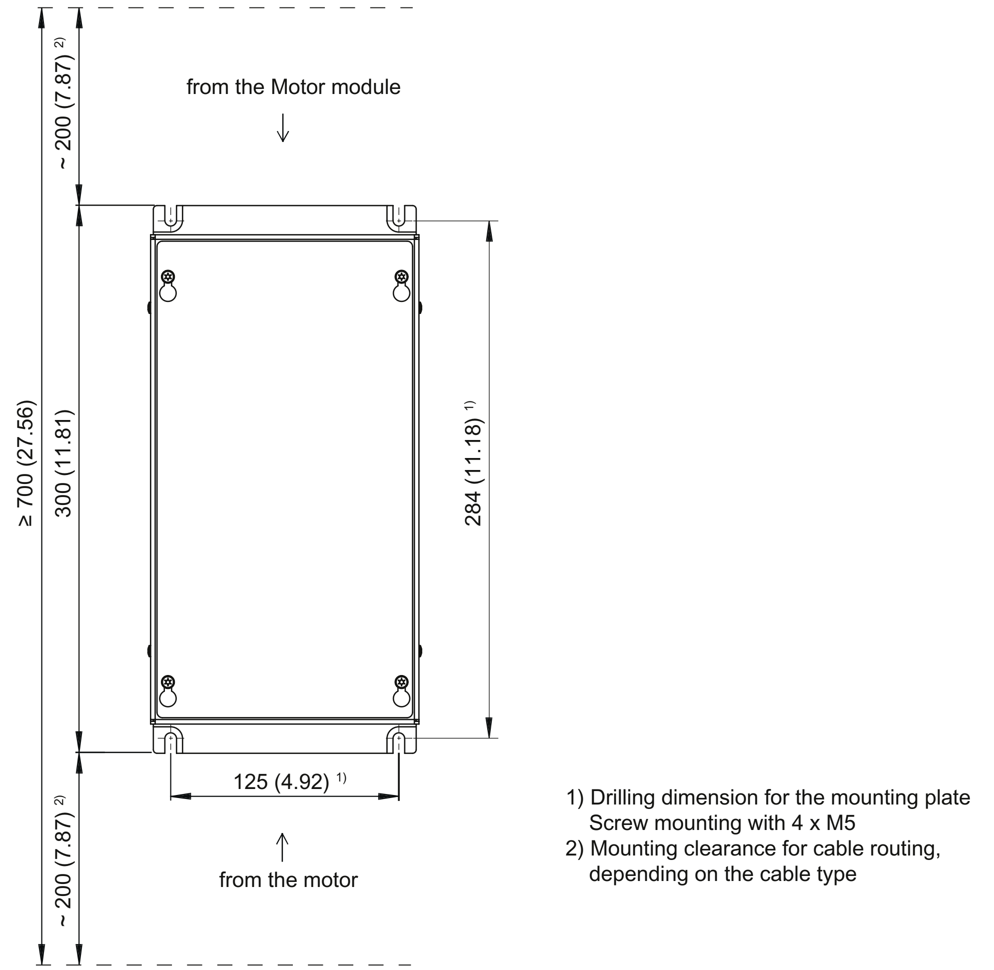


Figure 9-13 Mounting dimension for a Voltage Protection Module VPM120

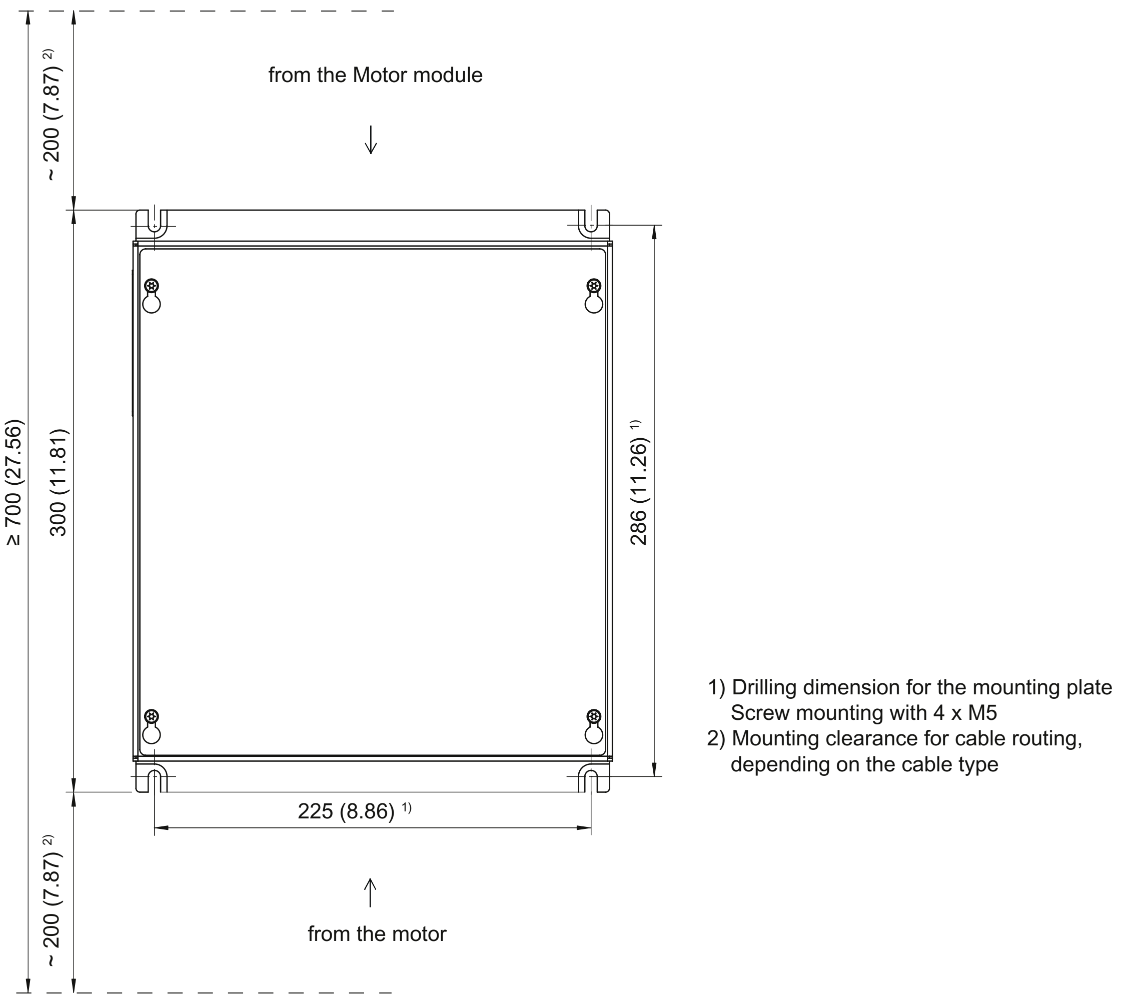


Figure 9-14 Mounting dimensions for a Voltage Protection Module VPM200

9.2.6 Electrical connection

Note

Only the enclosure cover may be opened for electrical connection of 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's feeding branch. All connections must be set up inside the VPM housing. Cable cross-sections are determined by the rated motor power and may be as much as 2 x 50 mm^2 for each conductor. An installation sequence for individual conductors is outlined below. It is particularly relevant for larger cross-sections.

DANGER

Before installation or maintenance work can begin, the system's main switch must be switched off and measures taken to prevent it being switched on again.

Preparation

The following preparations must be made before setting up connections:

- Loosen 4 screws on the enclosure cover so it can be moved into the cutouts.
- Move the enclosure cover to the point where the cutout widens out so it can be lifted over the screw heads.
- Fix the screwed joints for the signaling cable and power cables (x 2 for the VPM120, x 4 for the VPM200) at the entries in the Voltage Protection Module's housing.
- Strip back 300 mm of sheath from the power cables and expose their shield supports. Make sure they fit the screwed joints of the housing.
- Strip the ends of the individual wires and push the cable lugs on.
- Connect the signaling cable to X3 and use cable ties to secure it inside the Voltage Protection Module.

9.2.6.1 Connecting signaling contact X3

Signaling contact X3 must be wired before the power cables are connected.

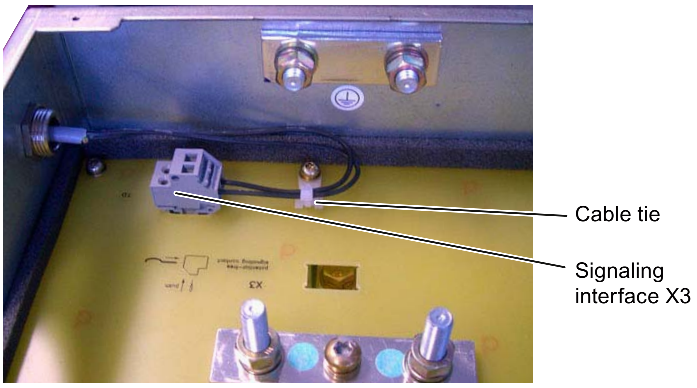


Figure 9-15 Connecting terminal X3 on the Voltage Protection Module (using the VPM 200 as an example)

Note

Signaling contact X3 on the Voltage Protection Module 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.

CAUTION

When a Voltage Protection Module is tripped, the short-circuit thyristor must be safely cleared before the connected inverter can be switched on again. This is only possible if the motor has first come to a standstill. The fact that signaling contact X3 has closed again **does not prove this conclusively!** It is particularly important to bear this in mind when performing servicing and commissioning tasks.

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:

/../ Voltage Protection Module VPM 120, Operating Instructions order no.: A5E00302281B

/../ Voltage Protection Module VPM 200, Operating Instructions order no.: A5E00777655A

/../ Voltage Protection Module VPM 200 Dynamik, Operating Instructions order no.: A5E00302261B

9.2.6.2 Connecting power cables (using the VPM 200 Dynamik as an example)

Terminals

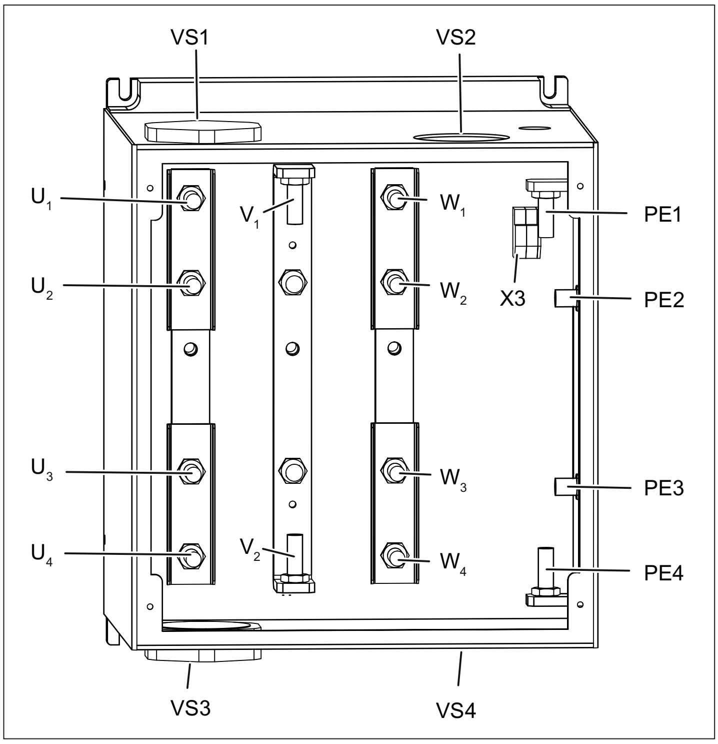


Figure 9-16 Terminals for Voltage Protection Module VPM 200 Dynamik

Table 9- 13 Short designations

Short designation	Explanation	Range of validity
VS1, VS2	Cable screwed joint 1 or 2 in the housing entry of the VPM, towards Motor Module	VPM 200 Dyn
VS3, VS4	Cable screwed joint 3 or 4 in the housing entry of the VPM, towards motor	VPM 200 Dyn
K1, K2	Cable 1 or 2 to the Motor Module	VPM 200 Dyn
K3, K4	Cable 3 or 4 to the motor	VPM 200 Dyn
U_1, U_2	Connection bolts on busbar U	VPM 200 Dyn
U_3, U_4	Connection bolts on busbar U	VPM 200 Dyn
V_1, V_2	Connection bolts on busbar V	VPM 200 Dyn
W_1, W_2	Connection bolts on busbar W	VPM 200 Dyn
W_3, W_4	Connection bolts on busbar W	VPM 200 Dyn
PE_1, PE_2, PE_3, PE_4	Connection bolts on busbar PE	VPM 200 Dyn
U	Busbar U in the VPM	VPM
V	Busbar V in the VPM	VPM
W	Busbar W in the VPM	VPM

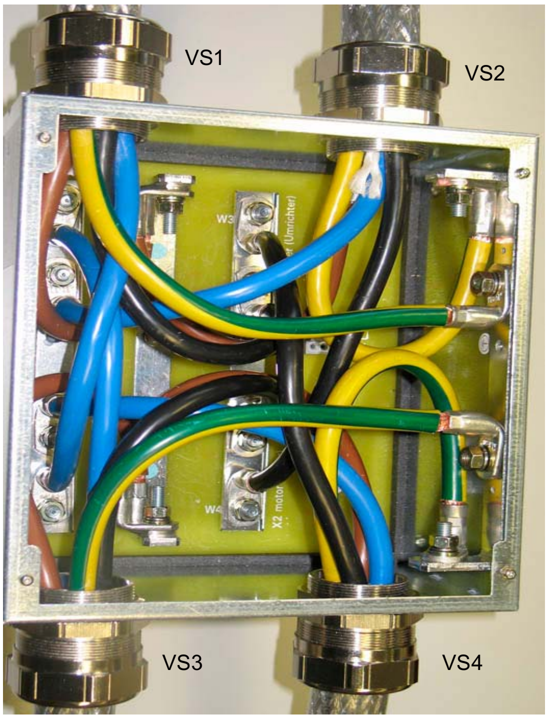


Figure 9-17 Wired Voltage Protection Module VPM 200 Dynamik with short designations

Table 9- 14 Installation steps

Screwed cable joint	Cable	Conductor/Phase	Action
VS1	K1	L_1, L_2, L_3, PE	Introduce the cable with all the conductors and shield, tighten the screwed joint, 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 screwed joint, lay conductors L_1 (black) and PE (green/yellow) on top of the other conductors.
	K1	L_2 (blue)	Attach to V1 and screw in place.
	K2	L_2 (blue)	Attach to V1 and screw in place.
	K2	PE (green/yellow)	Attach to PE1 and screw in place.
	K1	L_3 (brown)	Attach to W2 and screw in place.
	K2	L_1 (black)	Attach to U2 and screw in place.
	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 screwed joint, laying conductors L_1 (black) and PE (green/yellow) on top of the other conductors.
VS4	K4	L_1, L_2, L_3, PE	Introduce the cable with all the conductors and shield, tighten the screwed joint, laying conductors L_1 (black) and PE (green/yellow) on top of the other conductors.
	K3	L_2 (blue)	Attach to V2 and screw in place.
	K4	L_2 (blue)	Attach to V2 and screw in place.
	K3	L_3 (brown)	Attach to W3 and screw in place.
	K4	PE (green/yellow)	Attach to PE4 and screw in place.
	K4	L_1 (black)	Attach to U3 and screw in place.
	K1	L_1 (black)	Attach to U4 and screw in place.
	K3	L_1 (black)	Attach to U1 and screw in place.
	K2	L_3 (brown)	Attach to W4 and screw in place.
	K4	L_3 (brown)	Attach to W1 and screw in place.
	K3	PE (green/yellow)	Attach to PE3 and screw in place.
	K1	PE (green/yellow)	Attach to PE2 and screw in place.

9.2.7 Technical data

Table 9- 15 Technical data

	VPM 120	VPM 200	VPM 200 Dynamik
Order number	6SN1113–1AA00–1JAx	6SN1113–1AA00–1KAx	6SN1113–1AA00–1KOx
Type of voltage	3-phase pulsed AC voltage, EMF motor		
Ramp-up time for VPM	1 s (from pulse enable)		
Normal range of DC-link voltage: - Lower limit - Upper limit	 490 VDC 795 VDC		
Operating range for VPM	from 830 V to 2,000 V (peak value)		
Clock frequency	3.2 to 8 kHz		
Rated current	120 A_{rms}	200 A_{rms}	
Time range	Maximum permissible short-circuit current		
0 to 10 ms 10 to 500 ms 500 ms to 2 min > 2 min	1,500 A 255 A 90 A 0 A	2,000 A 600 A 200 A 0 A	
Max. permissible short-circuit duration	120 s		
Protection class in accordance with EN 61140	I		
Safe electrical separation	Between the signaling contact and motor cables U, V, W in accordance with EN 61800-5-1, UL 508 C		
Degree of protection to EN 60529	IP20		
Permitted humidity Humidity classification according to EN 60721-3-3	< 90 % 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
External lateral clearance required for cable entries	200 mm		

Accessories 10

10.1 Shield connecting plates for power supply and motor cables

10.1.1 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.

10.1.2 Shield connecting plates

Table 10- 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	Clamp
Motor Module	3 A to 18 A 2 x 3 A to 2 x 9 A	50 mm	Integrated in the connector	
	18 A (Compact) 2 x 1.7 A to 2 x 5 A	75 mm	Integrated in the 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
Active Interface Module	16 kW	100 mm	Integrated in the 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 10- 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 A to 18 A 2 x 3 A to 2 x 9 A	50 mm	Integrated in the 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

Table 10- 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	
	16 kW	100 mm		KLBÜ CO4 1)
	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 A to 18 A 2 x 3 A to 2 x 9 A	50 mm	Integrated in the connector	
	18 A (Compact) 2 x 1.7 A to 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 10- 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

10.1.3 Overview examples

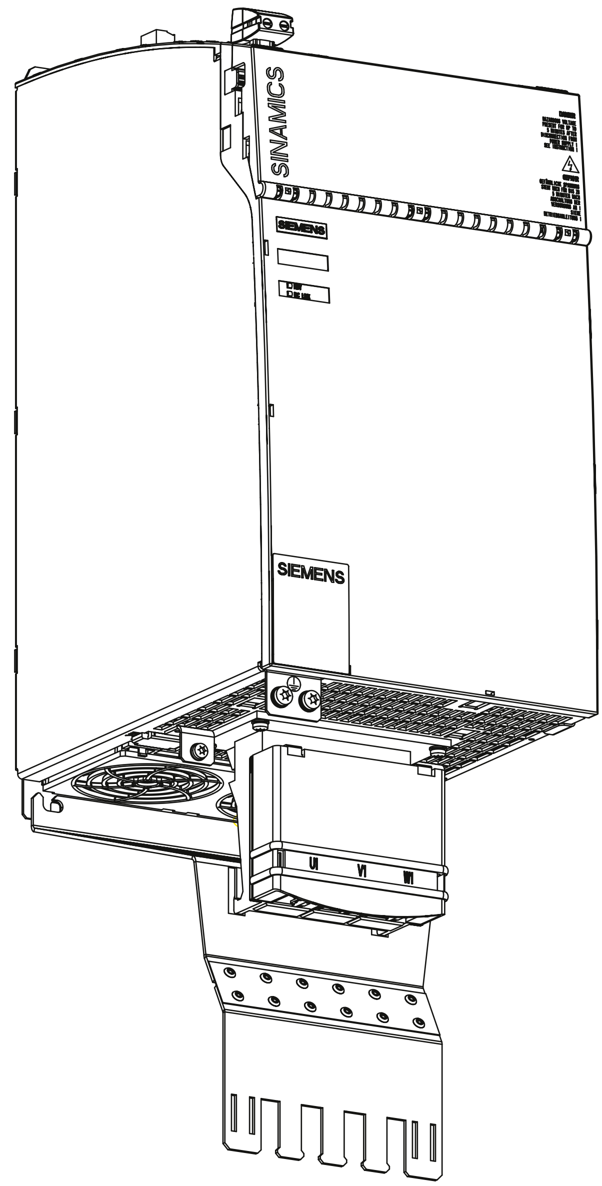


Figure 10-1 Shield connecting plate for a 200 mm module with internal air cooling

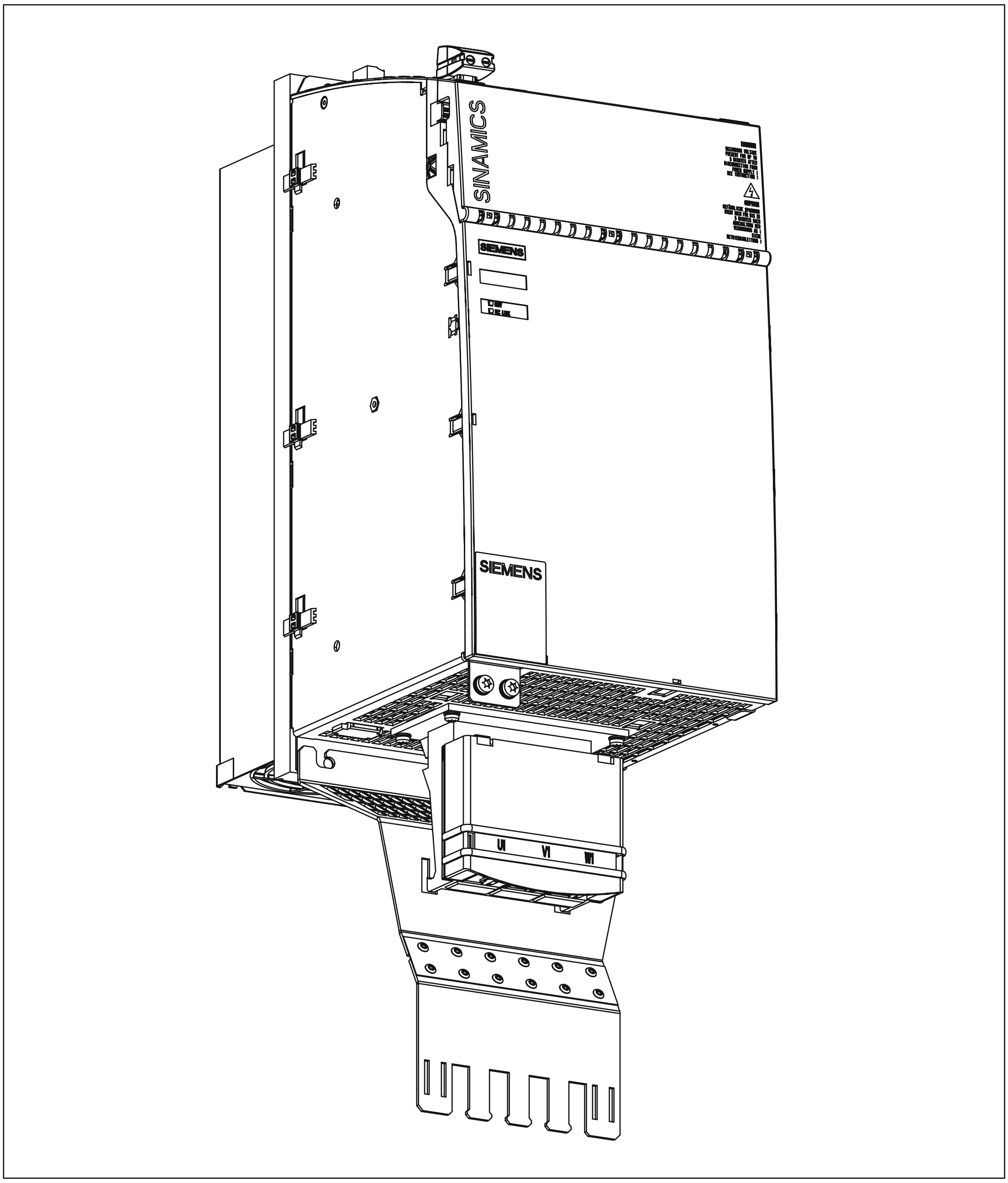


Figure 10-2 Shield connecting plate for a 200 mm module with external air cooling

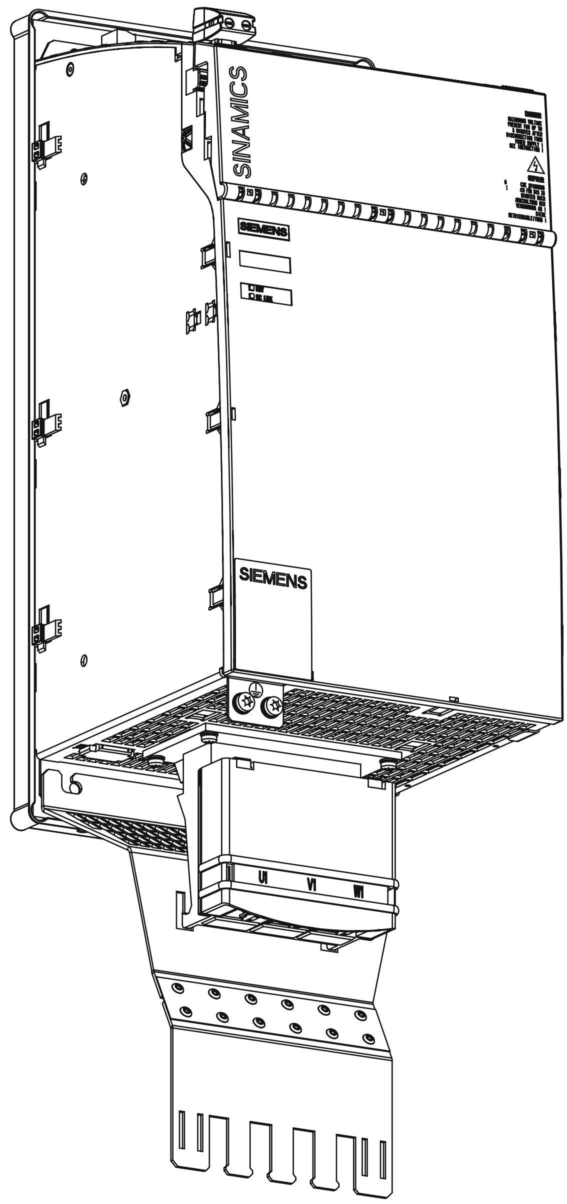


Figure 10-3 Shield connecting plate for a 200 mm module with with a cold plate

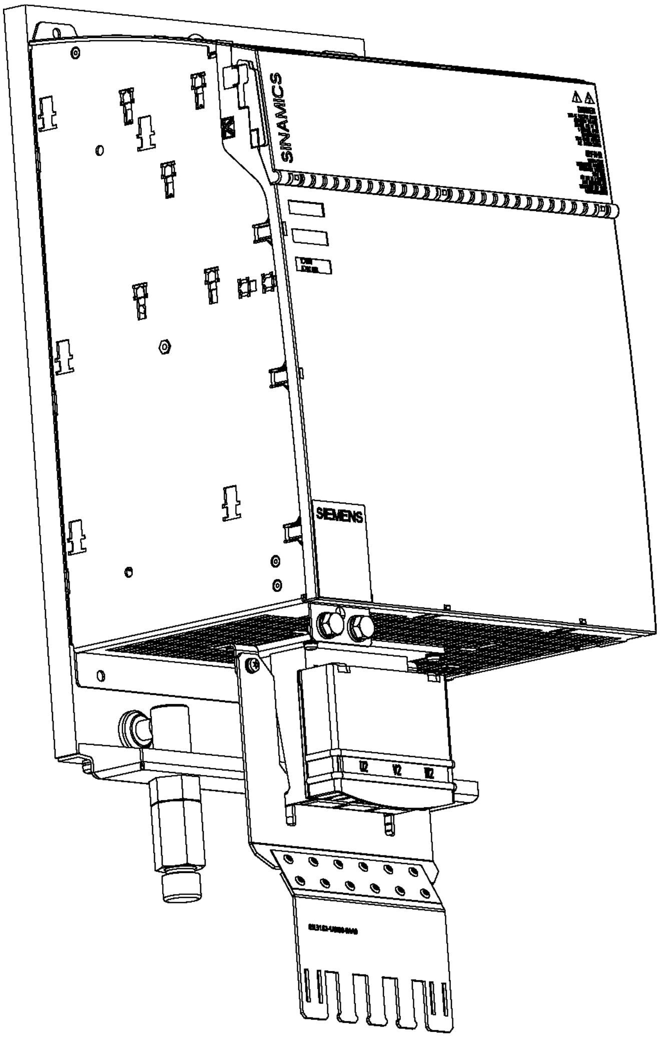


Figure 10-4 Shield connecting plate on a 300 mm Liquid Cooled module

10.1.4 Dimension drawings

10.1.4.1 Line Modules and Motor Modules with internal air cooling

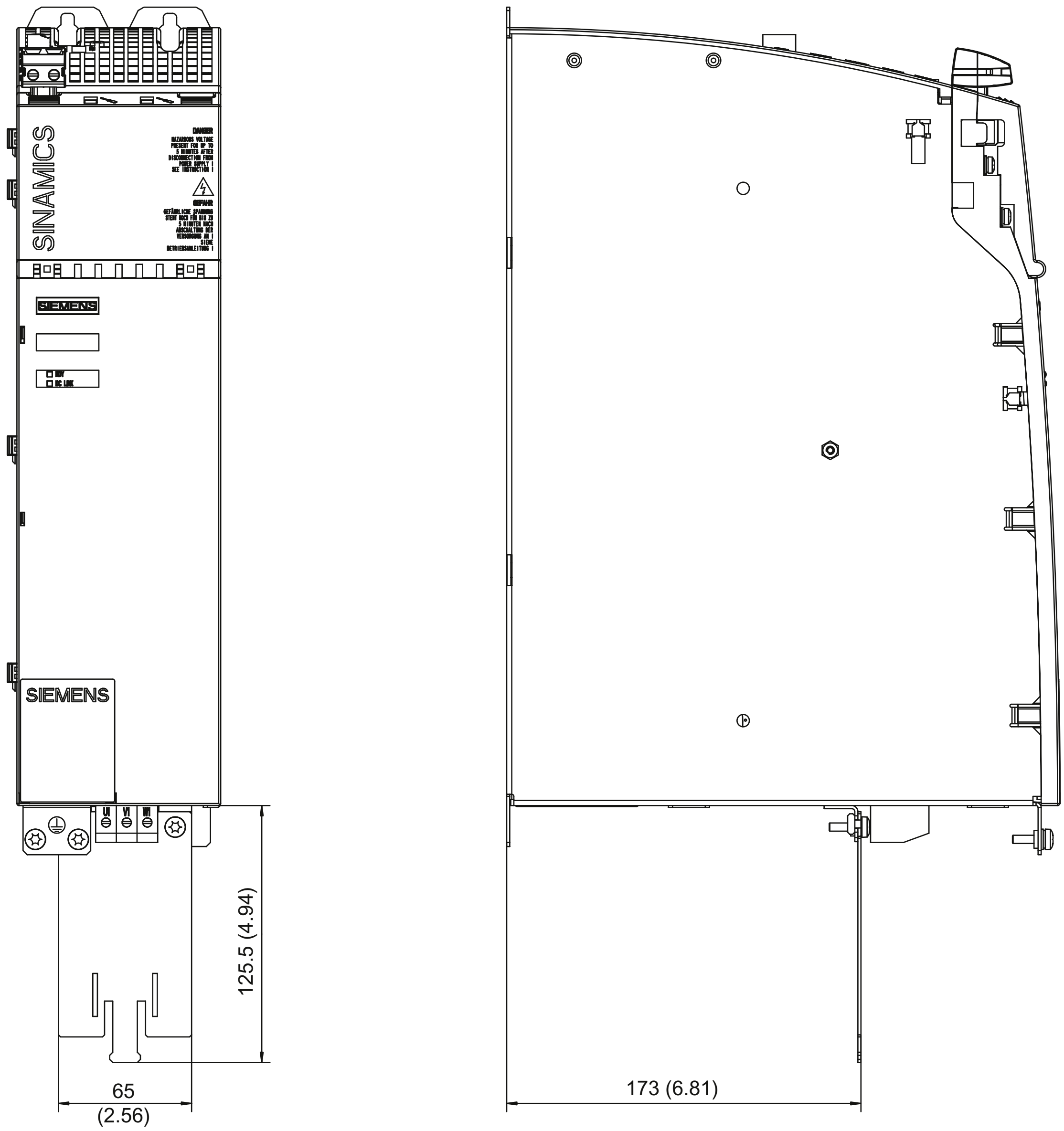


Figure 10-5 Dimension drawing of shield connecting plate on a 100 mm component with internal air cooling, all dimensions in mm and (inches)

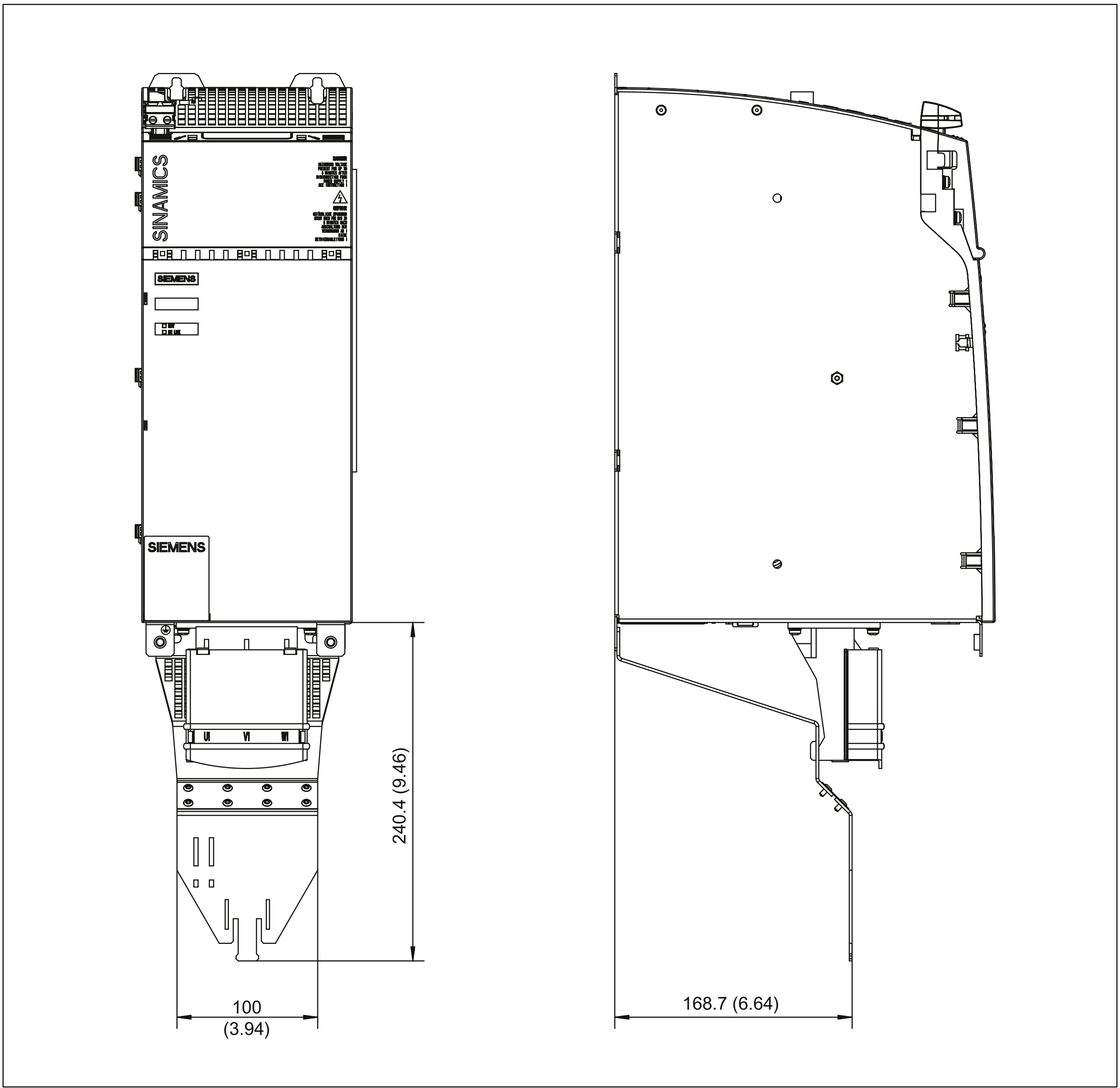


Figure 10-6 Dimension drawing of shield connecting plate on a 150 mm component with internal air cooling, all dimensions in mm and (inches)

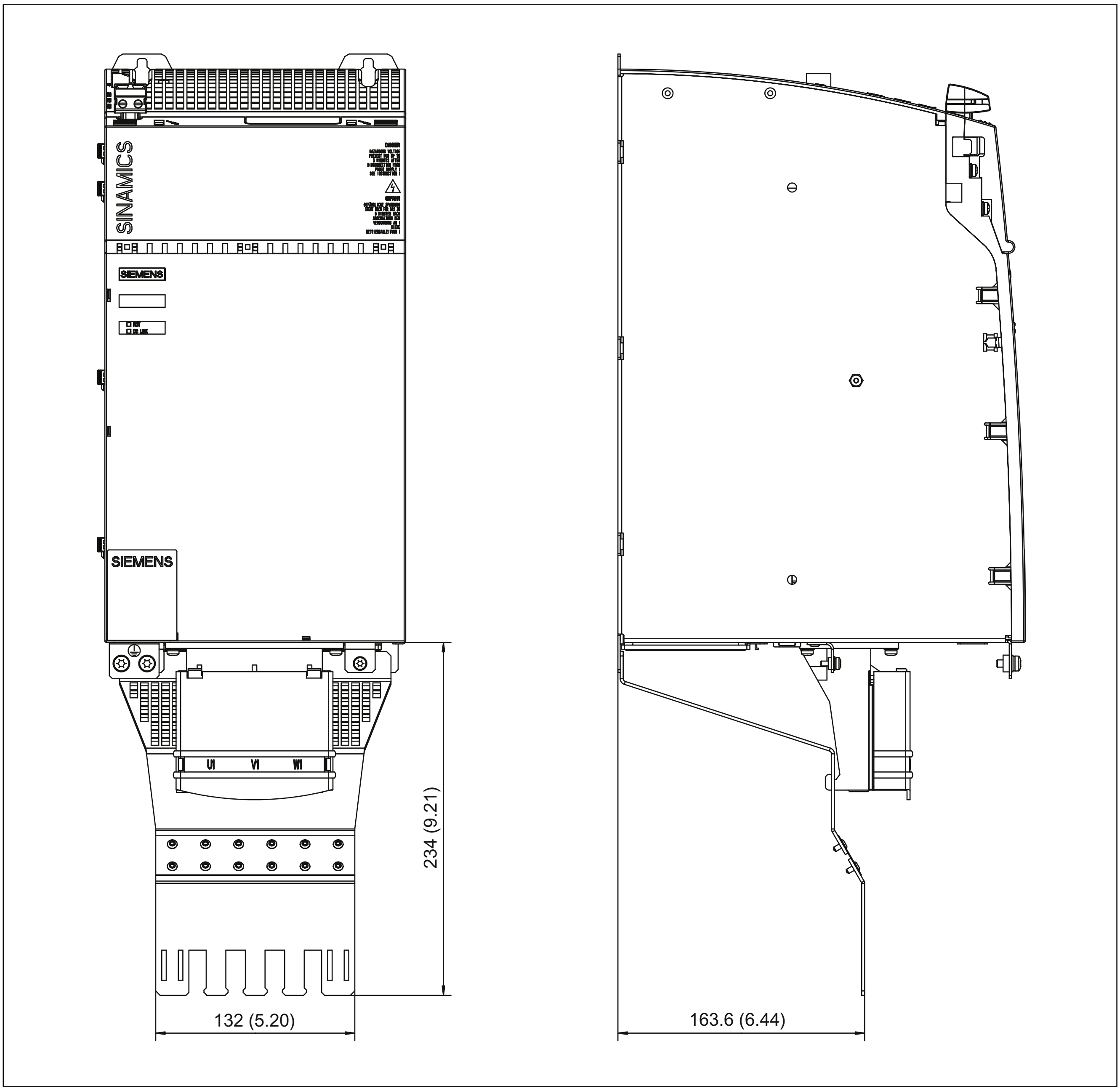


Figure 10-7 Dimension drawing of shield connecting plate on a 200 mm component with internal air cooling, all dimensions in mm and (inches)

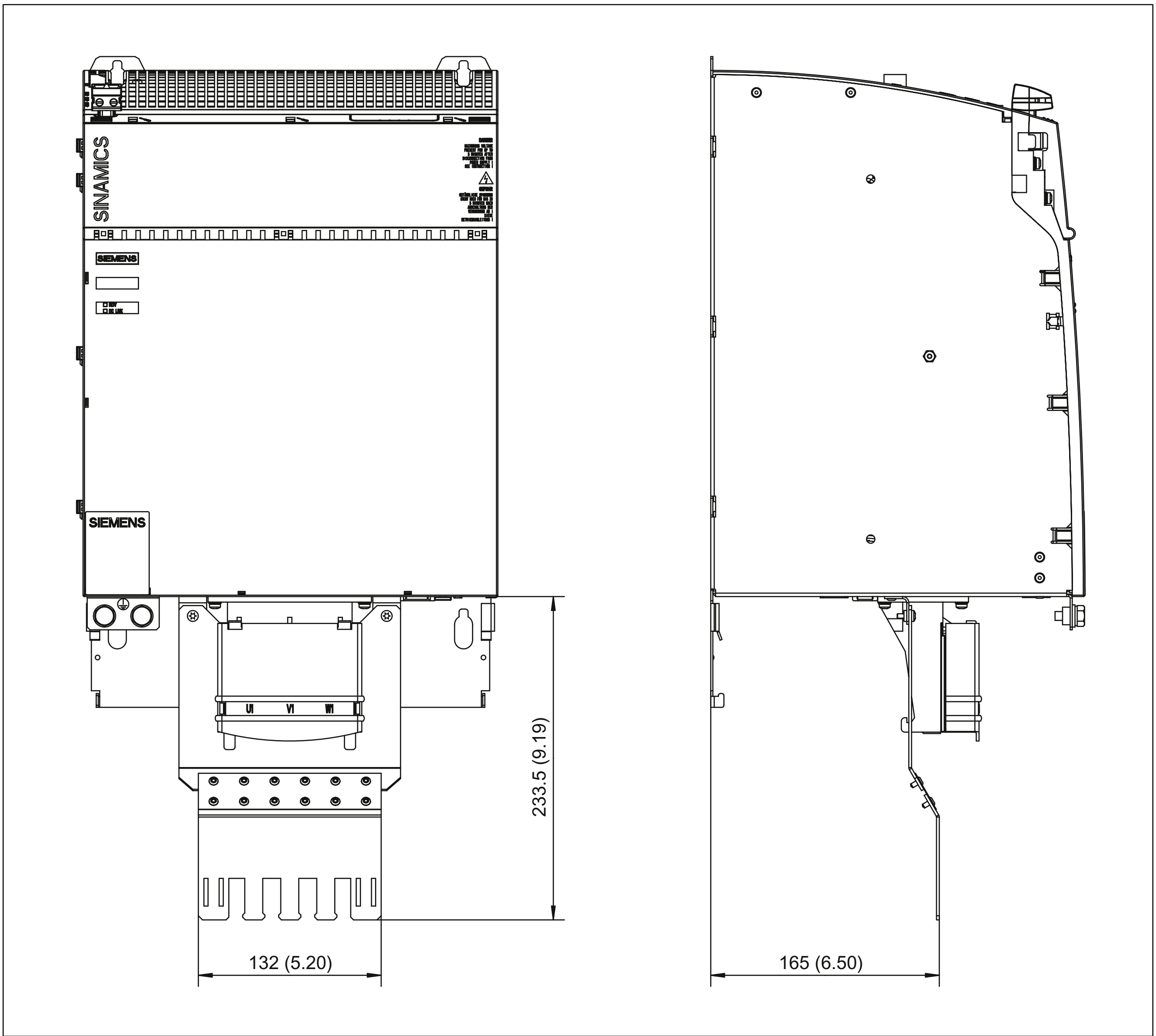


Figure 10-8 Dimension drawing of shield connecting plate on a 300 mm component with internal air cooling, all dimensions in mm and (inches)

10.1.4.2 Line Modules and Motor Modules with external air cooling

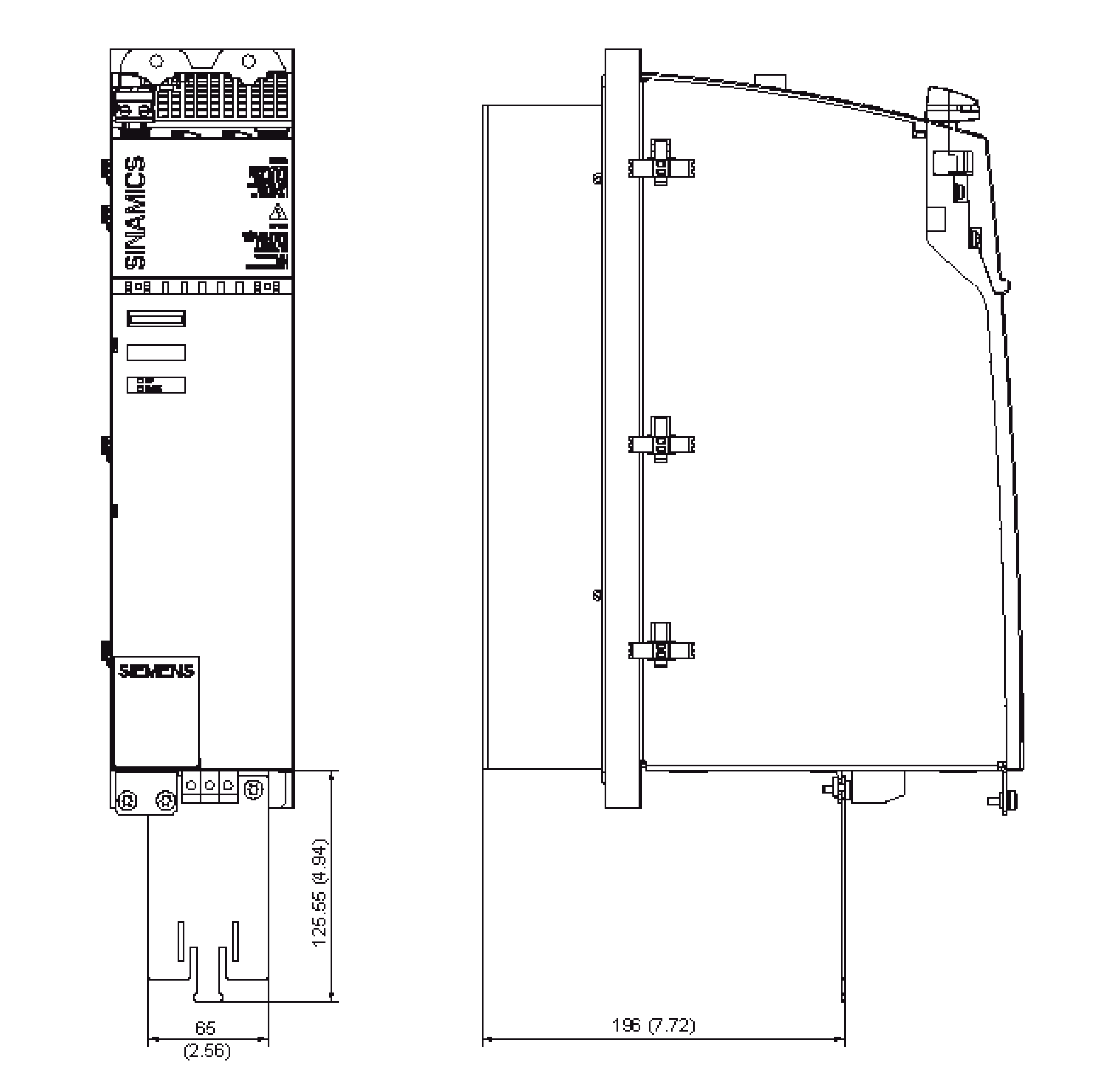


Figure 10-9 Dimension drawing of shield connecting plate on a 100 mm component with external air cooling, all dimensions in mm and (inches)

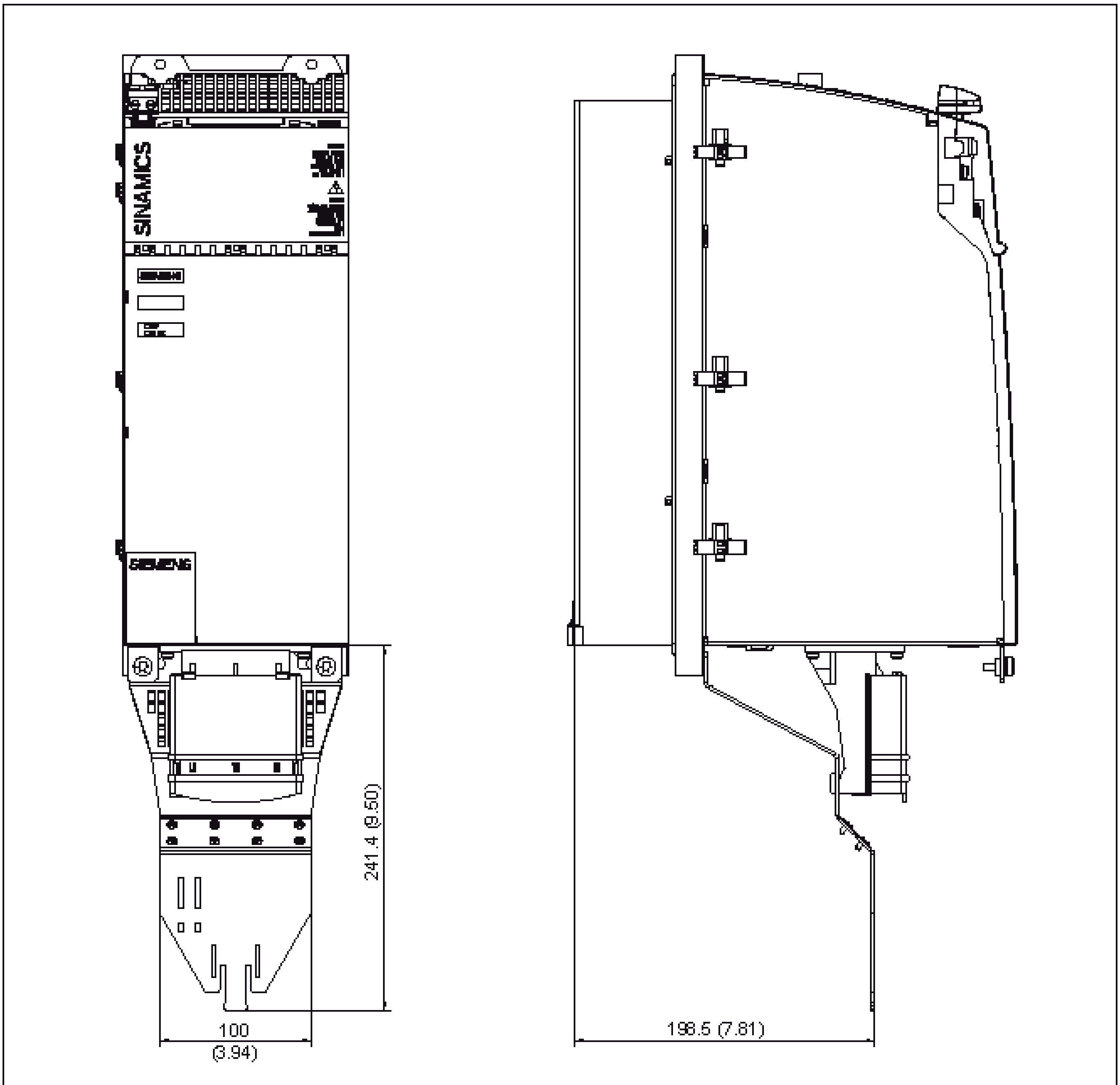


Figure 10-10 Dimension drawing of shield connecting plate on a 150 mm component with external air cooling, all dimensions in mm and (inches)

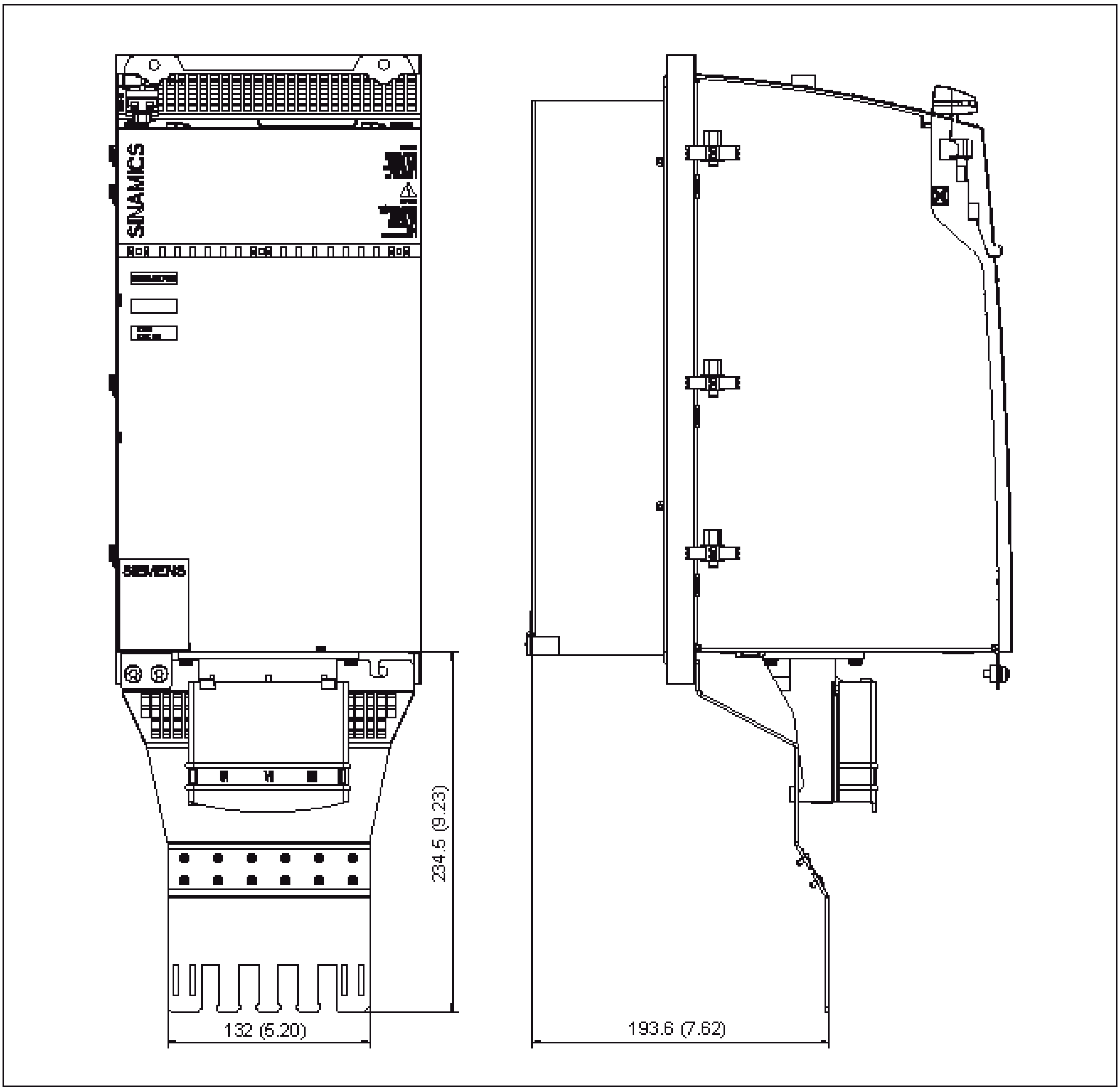


Figure 10-11 Dimension drawing of shield connecting plate on a 200 mm component with external air cooling, all dimensions in mm and (inches)

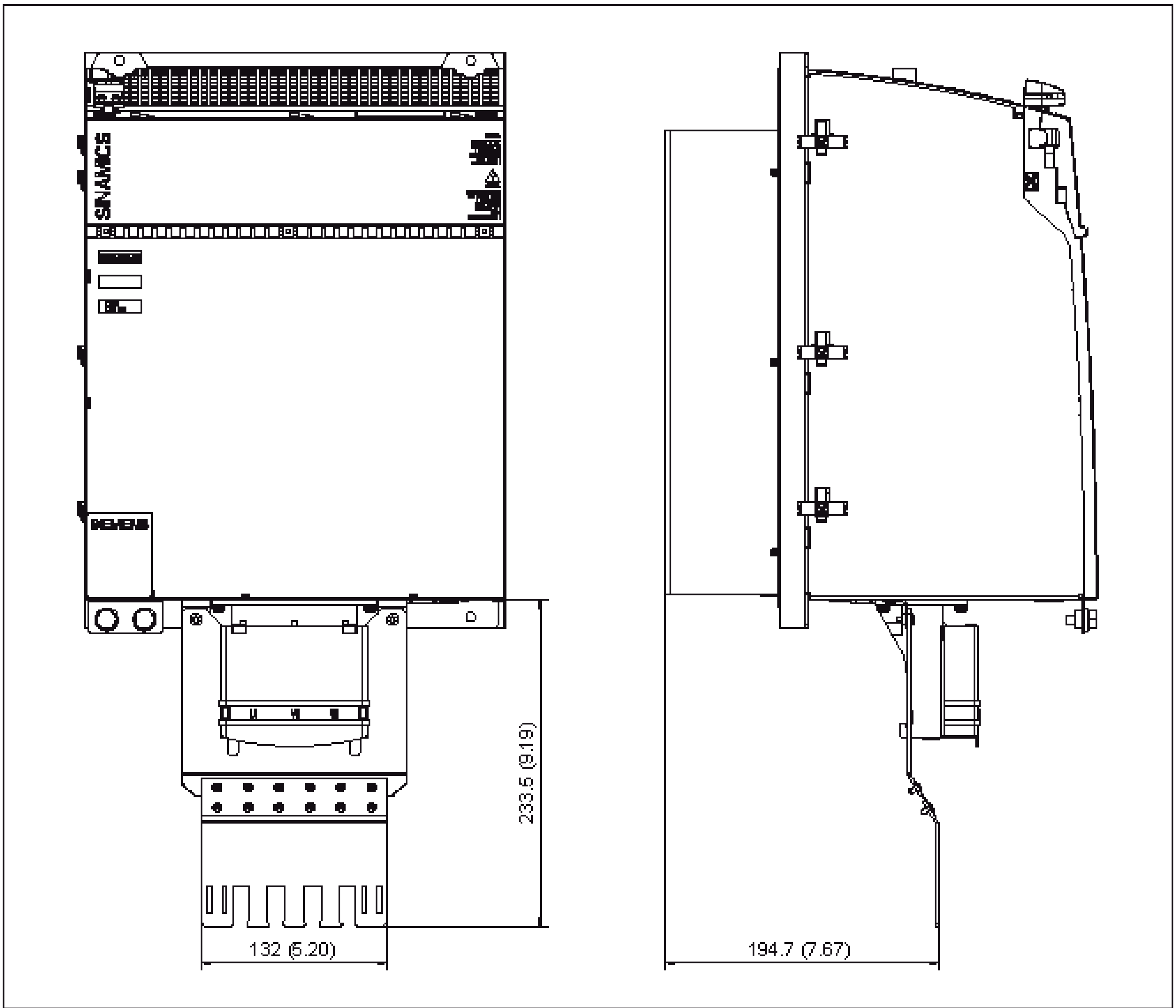


Figure 10-12 Dimension drawing of shield connecting plate on a 300 mm component with external air cooling, all dimensions in mm and (inches)

10.1.4.3 Line Modules and Motor Modules with cold plate

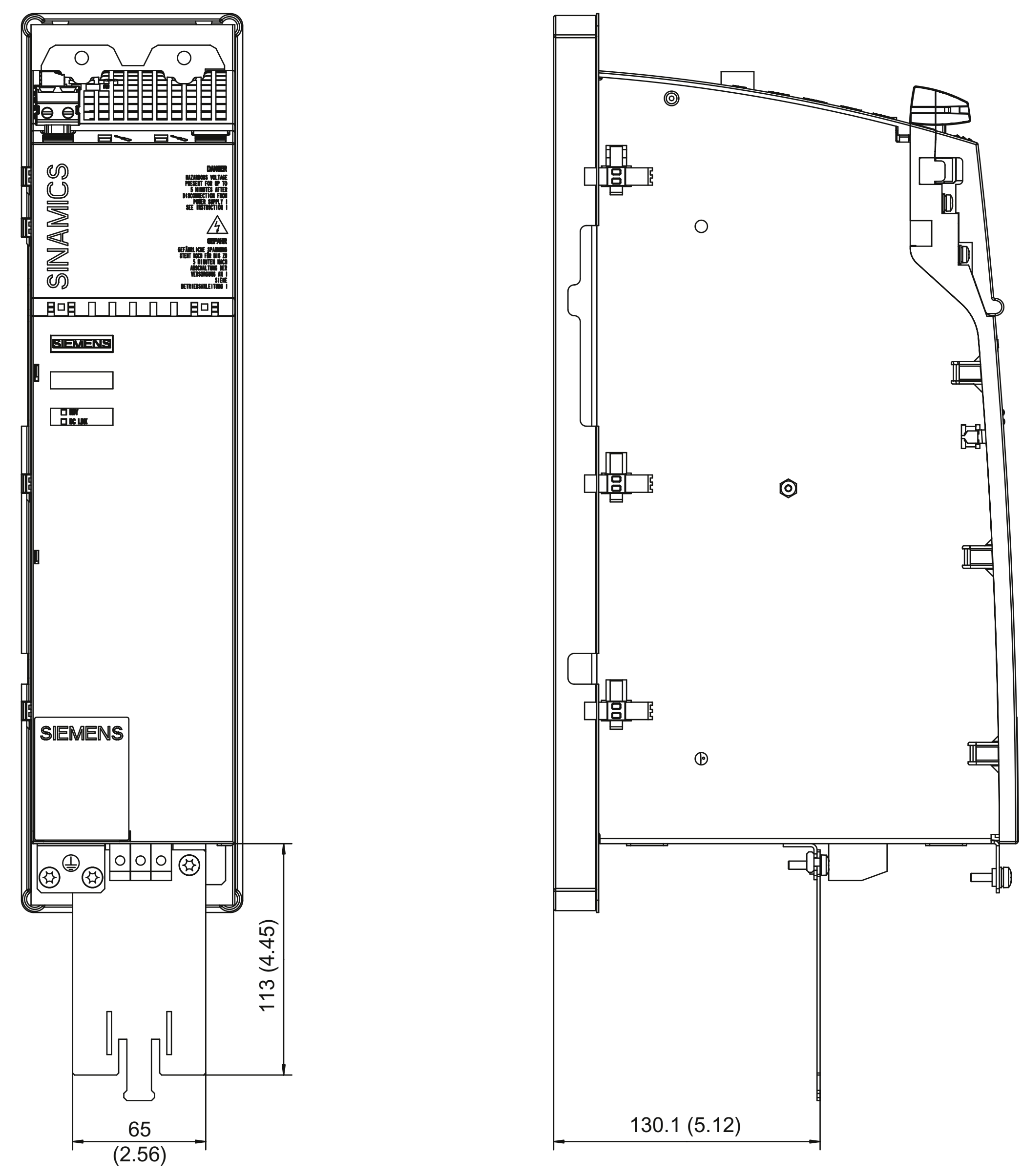


Figure 10-13 Dimension drawing of shield connecting plate on a 100 mm component with cold plate, all dimensions in mm and (inches)

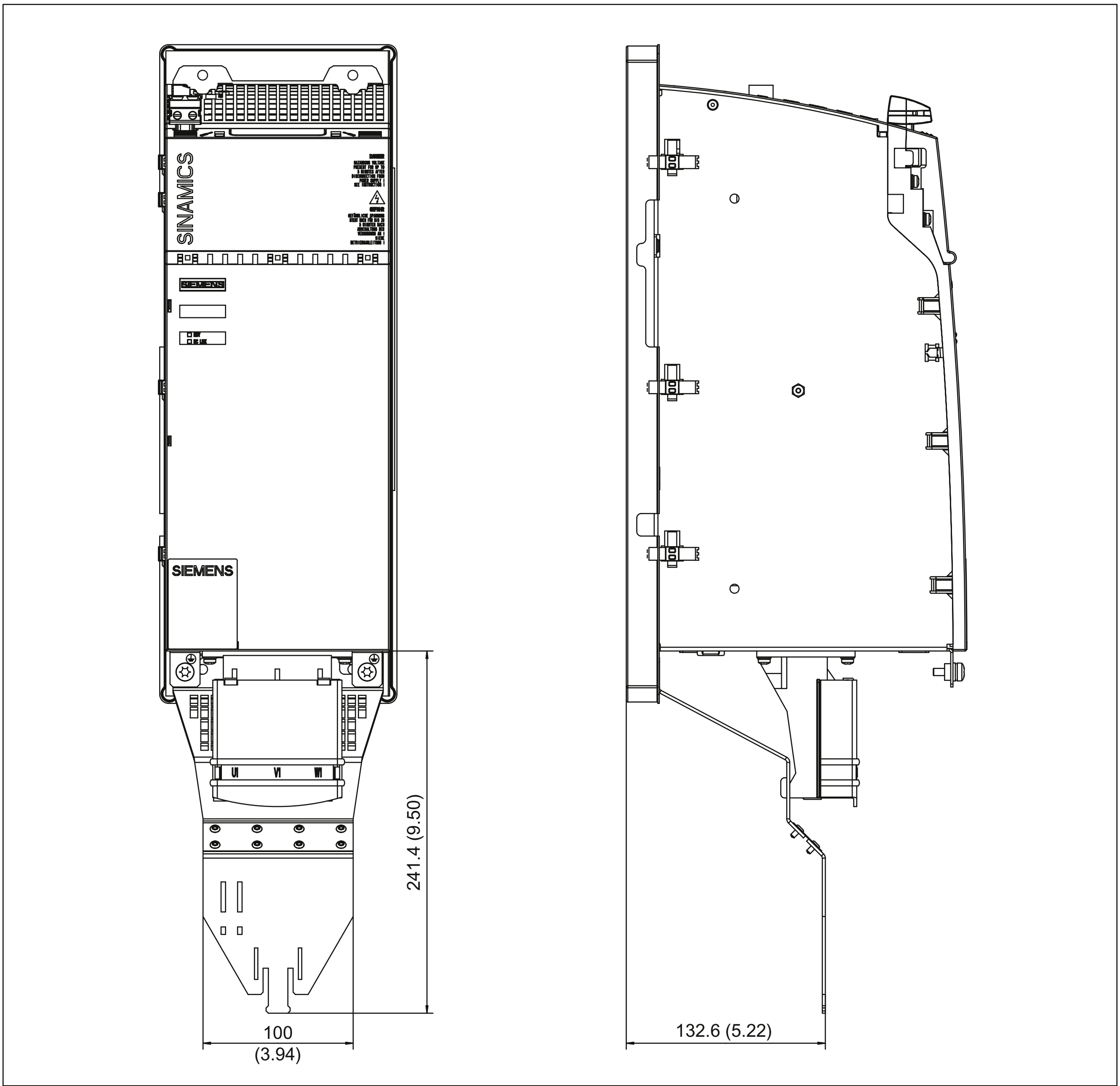


Figure 10-14 Dimension drawing of shield connecting plate on a 150 mm component with cold plate, all dimensions in mm and (inches)

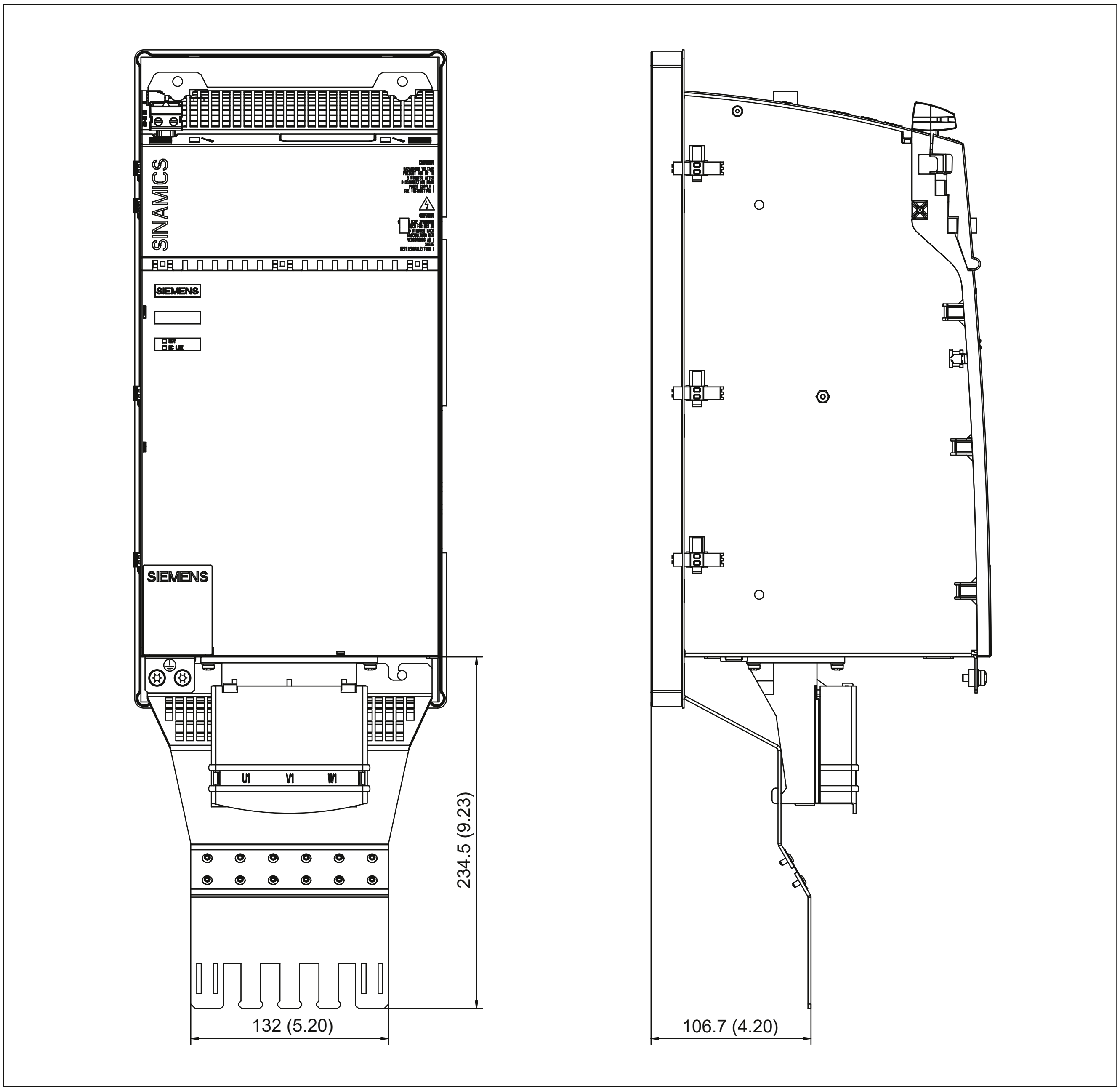
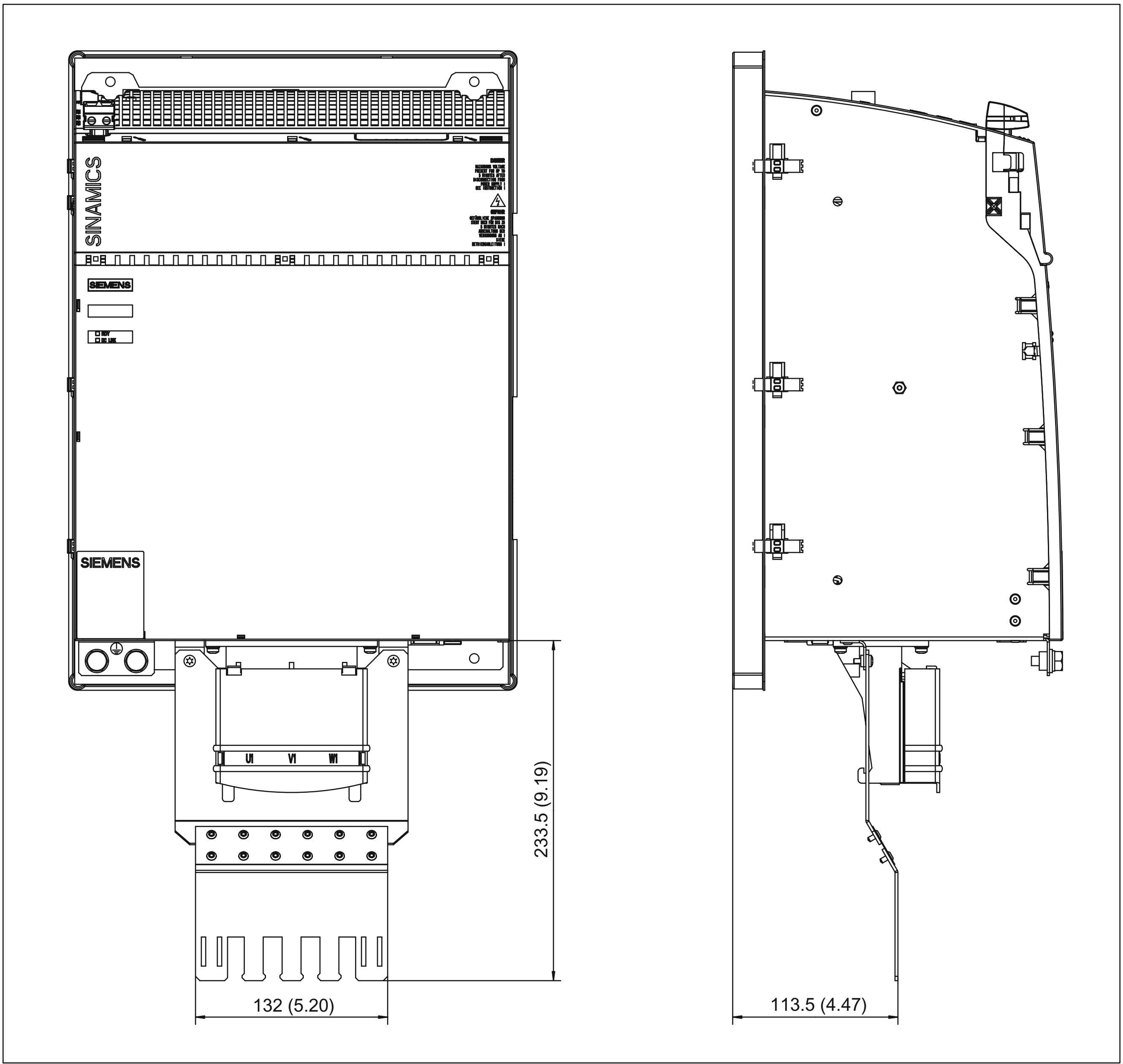


Figure 10-15 Dimension drawing of shield connecting plate on a 200 mm component with cold plate, all dimensions in mm and (inches)



Dimension drawing of shield connecting plate on a 300 mm component with cold plate, all dimensions in mm and (inches)

10.1.4.4 Line Modules and Motor Modules, Liquid Cooled

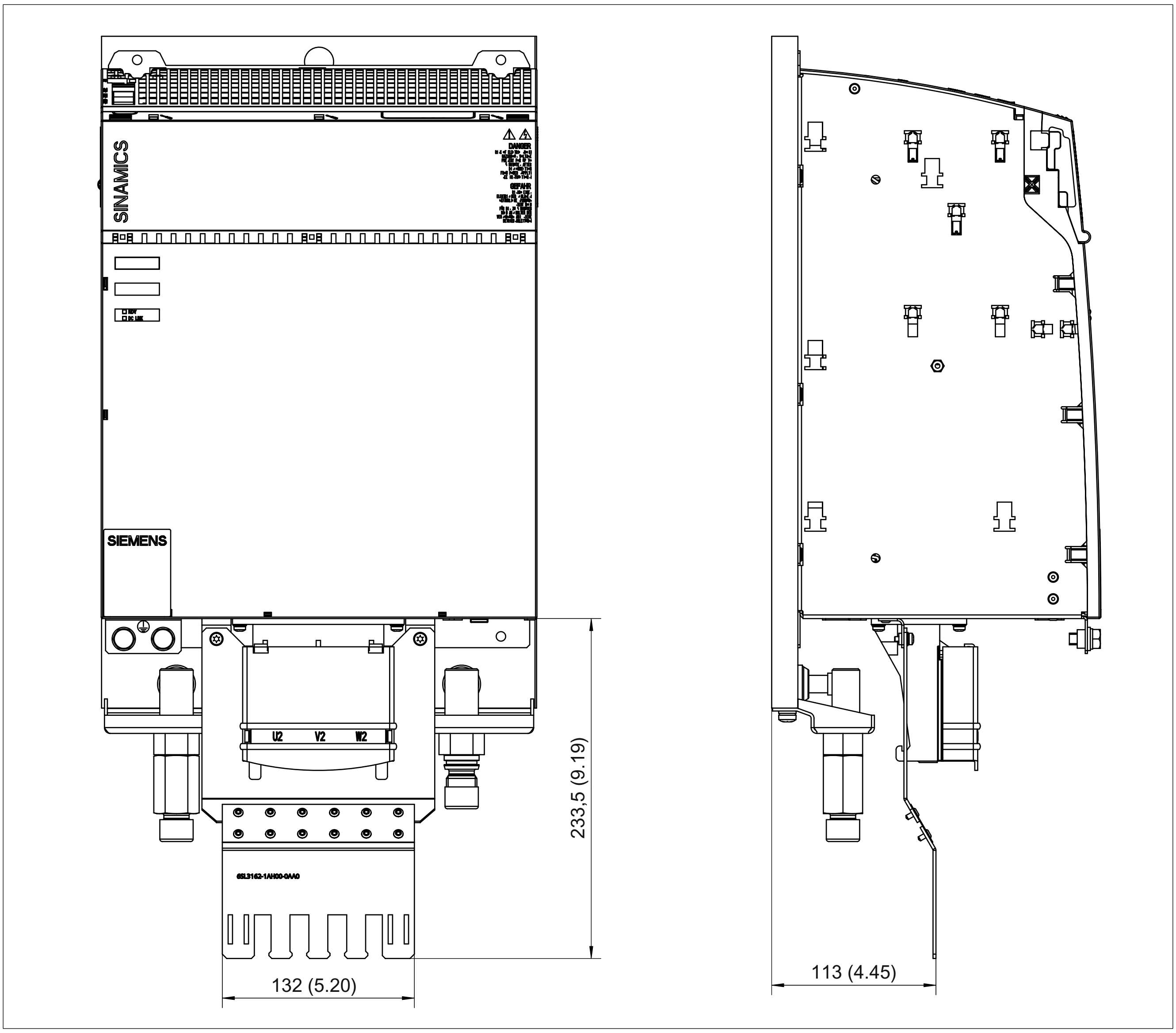


Figure 10-16 Dimension drawing of shield connecting plate on a 300 mm Liquid Cooled component, all dimensions in mm and (inches)

10.1.4.5 Active Interface Modules

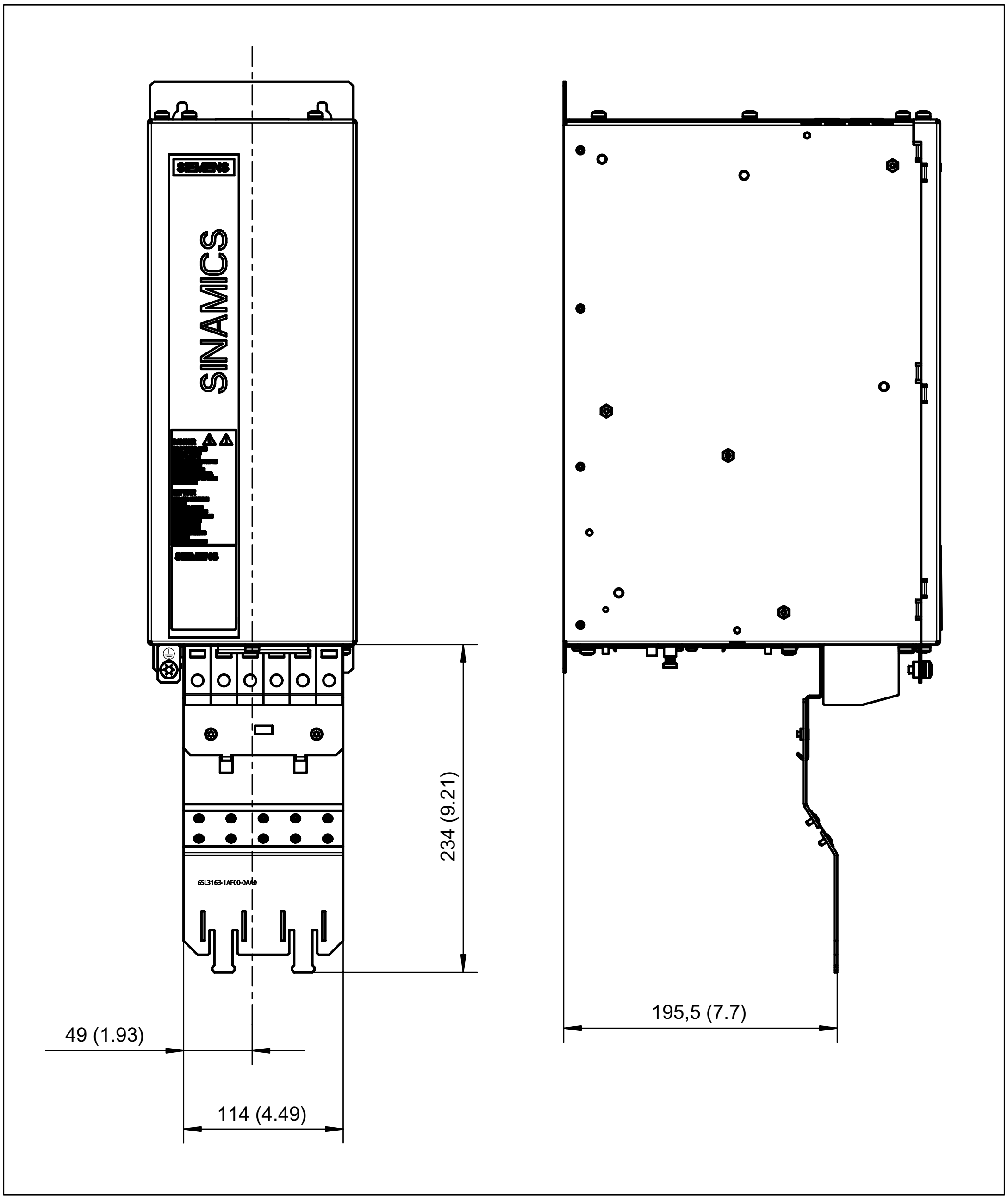


Figure 10-17 Dimension drawing of shield connecting plate on the 36 kW Active Interface Module, all dimensions in mm and (inches)

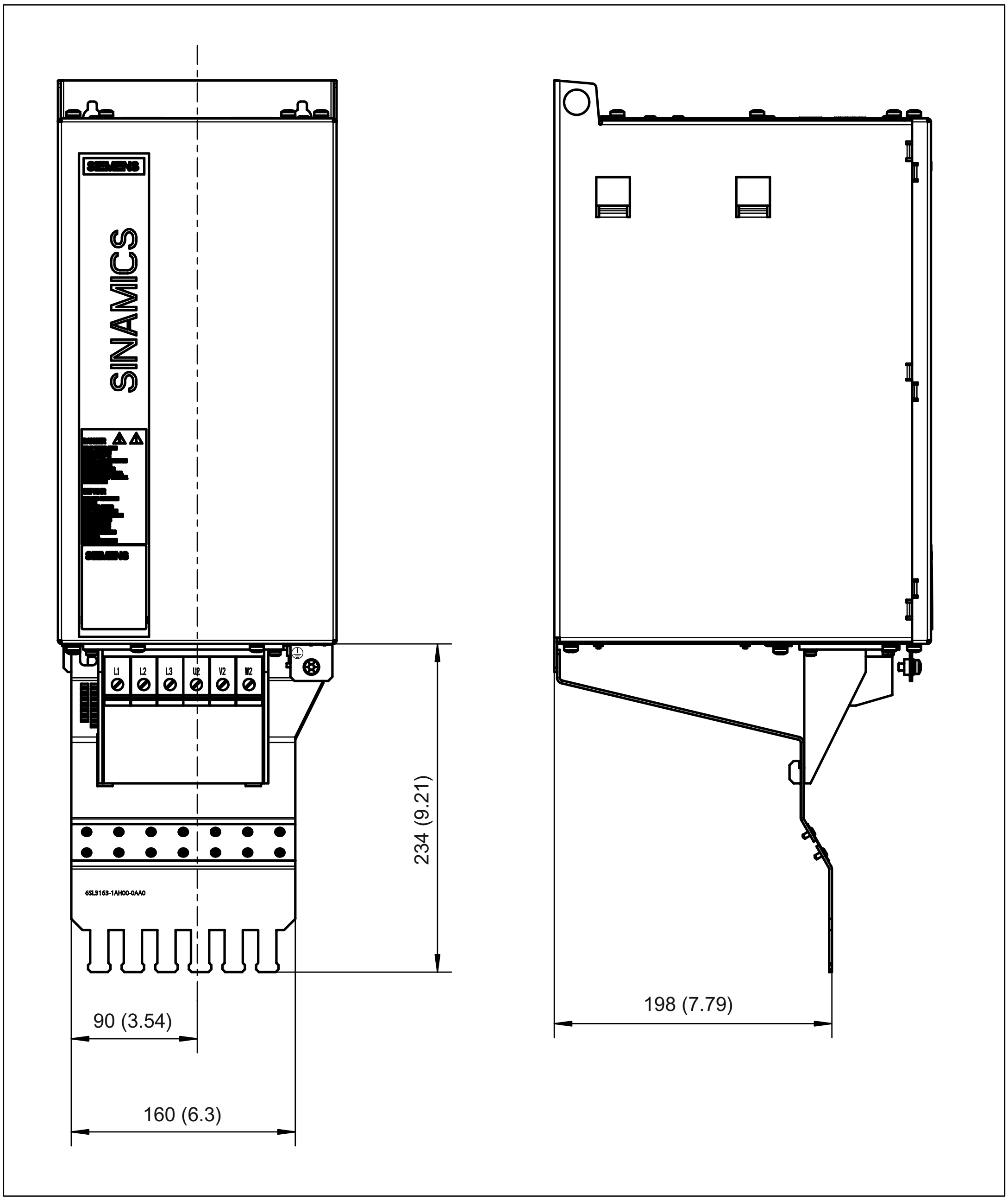


Figure 10-18 Dimension drawing of shield connecting plate on the 55 kW Active Interface Module, all dimensions in mm and (inches)

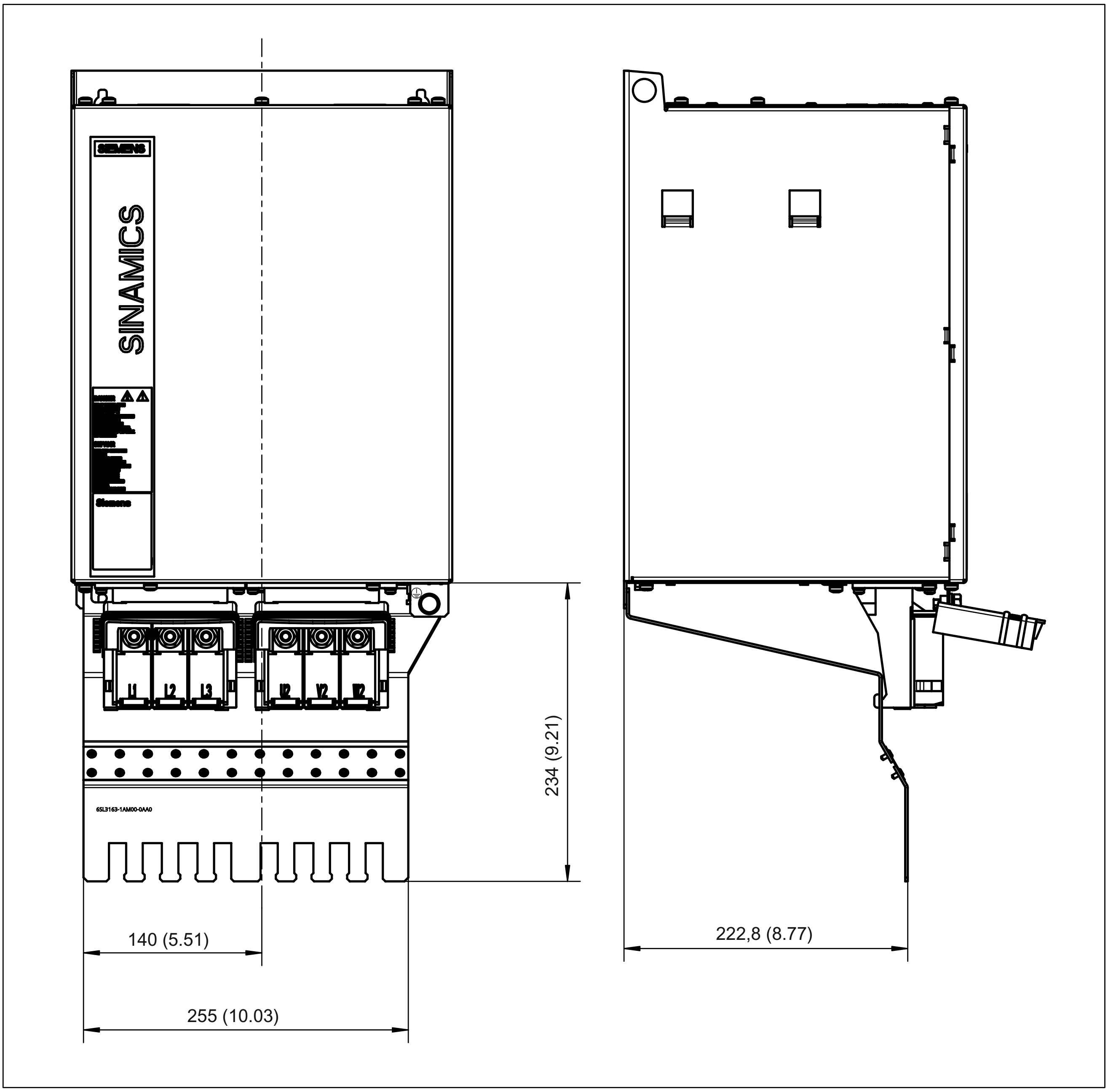


Figure 10-19 Dimension drawing of shield connecting plate on the 80 and 120 kW Active Interface Module, all dimensions in mm and (inches)

10.1.5 Installation

Table 10- 5 Installing the shield connecting plate to a 100 mm component using as an example, internal air cooling

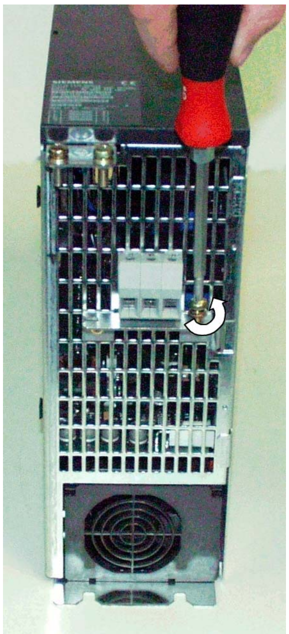
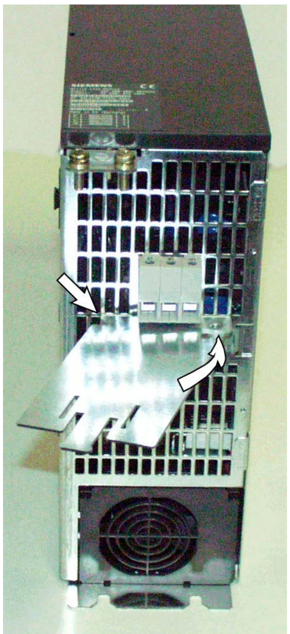
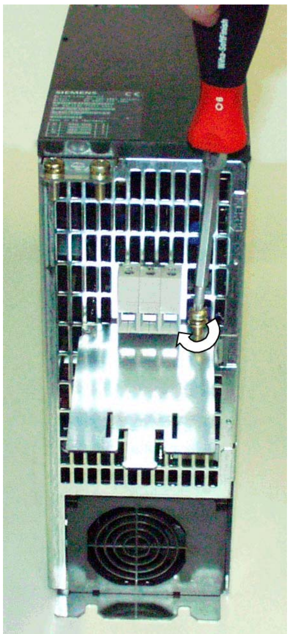
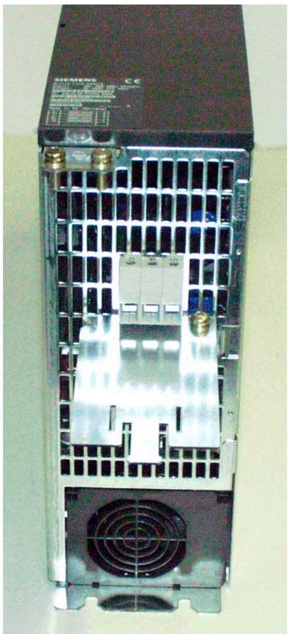
			
Remove the screw with screwdriver T25	Hook in the shielded plate.	Secure the shield connecting plate with screwdriver T25/3 Nm.	Installed shield connecting plate

Table 10- 6 Installing the shield connecting plate to a 200 mm component using as an example, internal air cooling

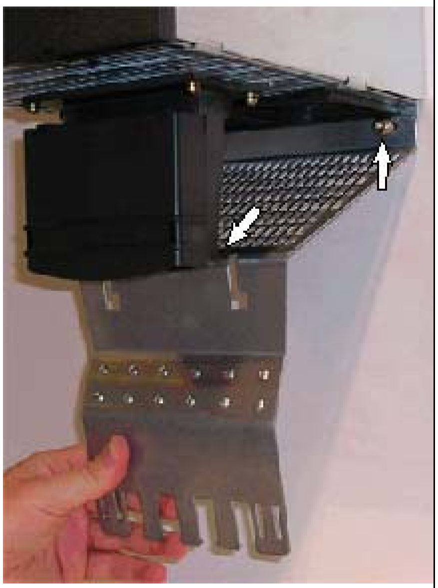
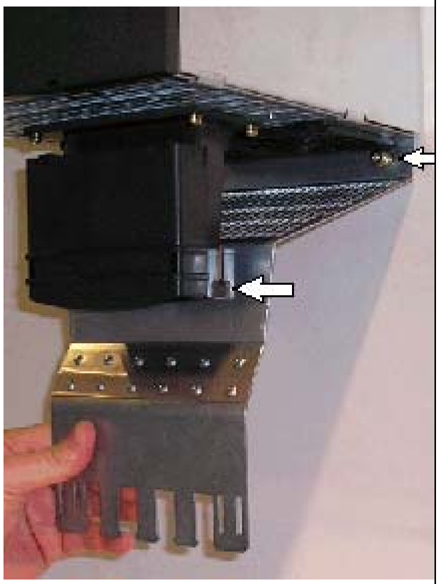
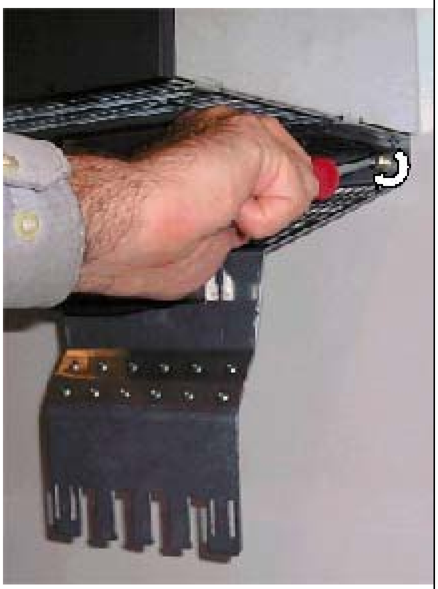
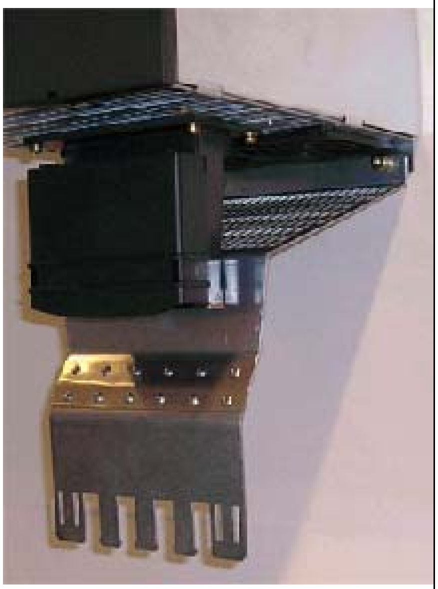
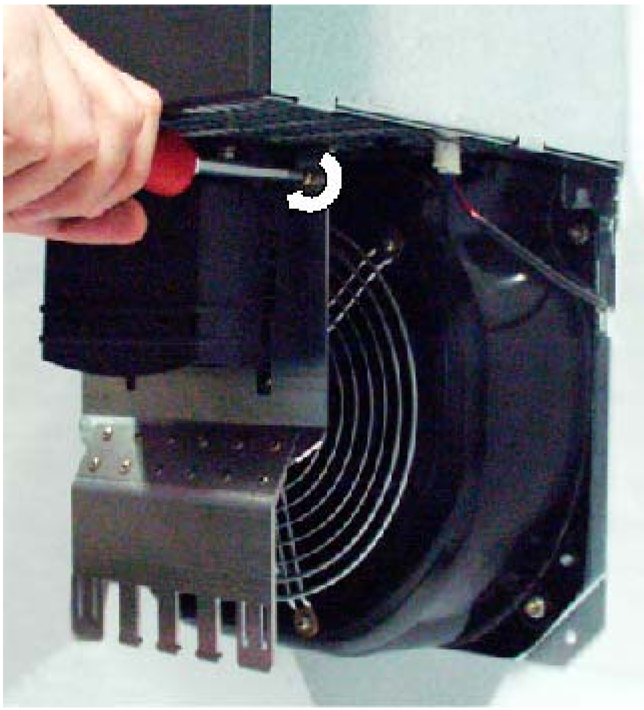
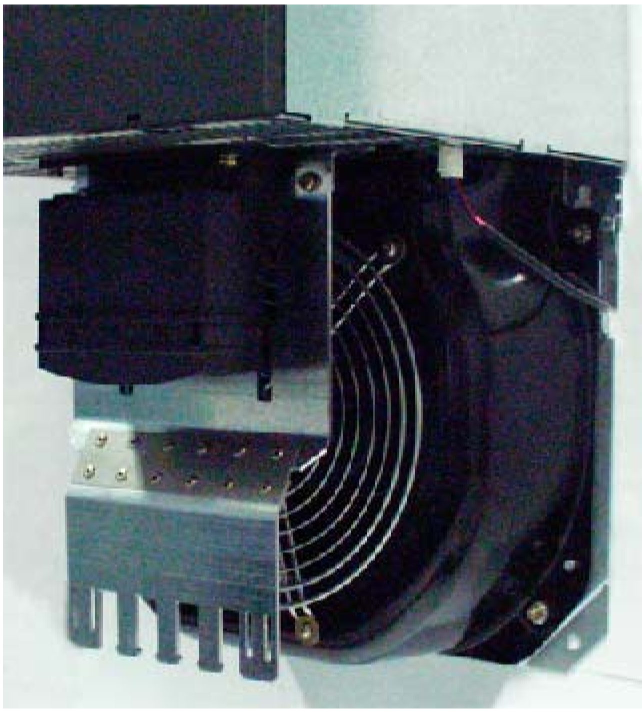
		
Loosen the lower mounting screws using a screwdriver	Hook the shield connecting plate into the screws and on the line/motor connection	Secure the shield connecting plate by shifting it to the left
		
Secure the shield connecting plate with screwdriver 6 Nm	Installed shield connecting plate	

Table 10- 7 Installing the shield connecting plate to a 300 mm component using as an example, internal air cooling

	
Remove the screw with screwdriver T25	Hook the shield connecting plate into the line/motor connection
	
Secure the shield connecting plate with screwdriver T25/3 Nm	Installed shield connecting plate

10.1.6 Connecting the power cables

Table 10- 8 Connecting power cables for a 100 mm component using internal air cooling as an example

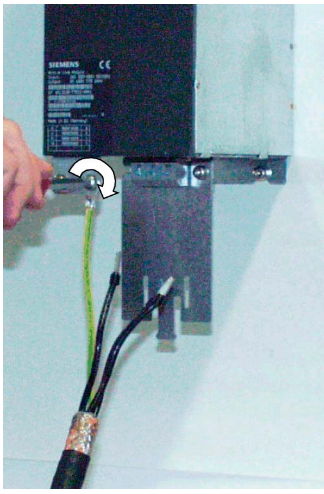
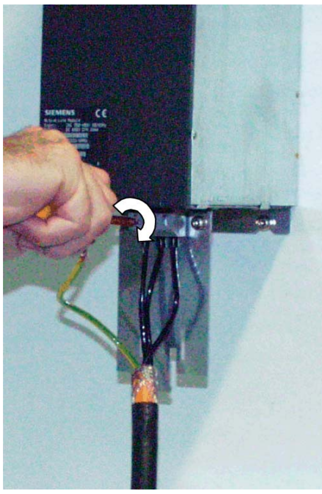
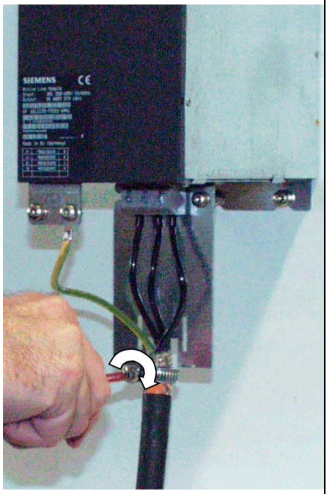
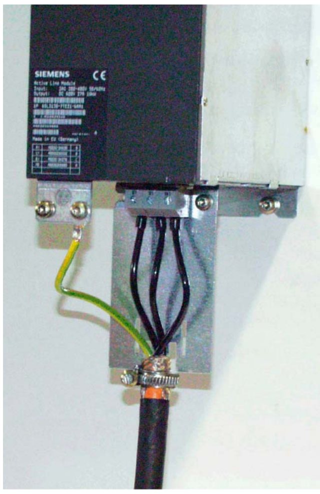
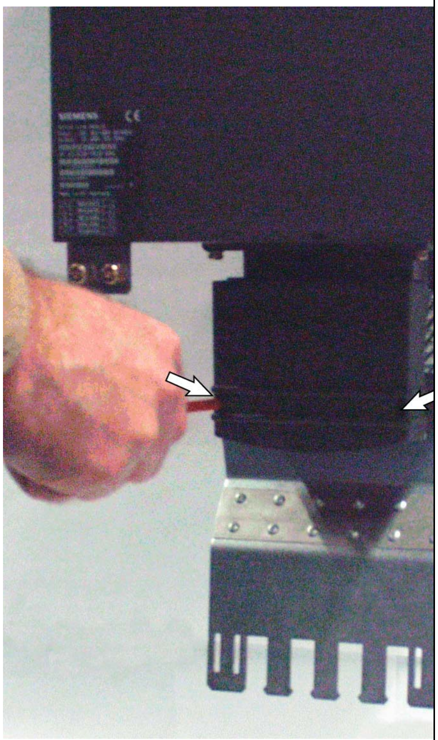
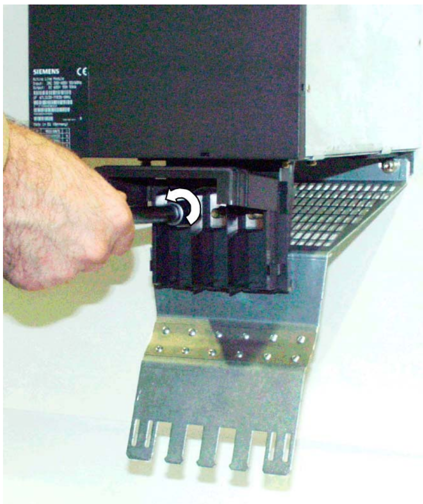
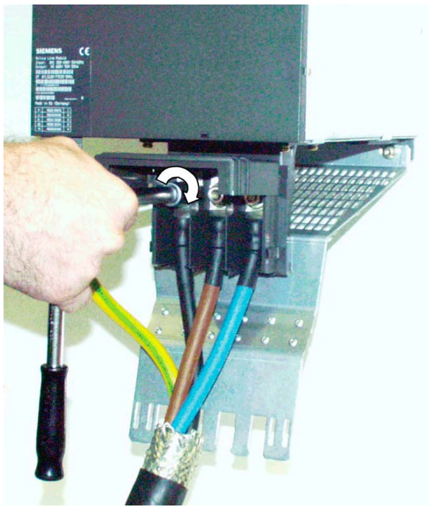
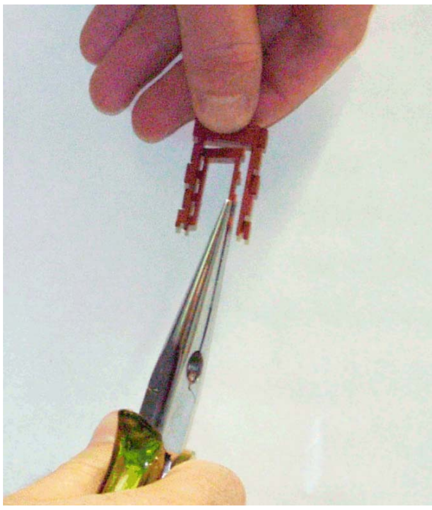
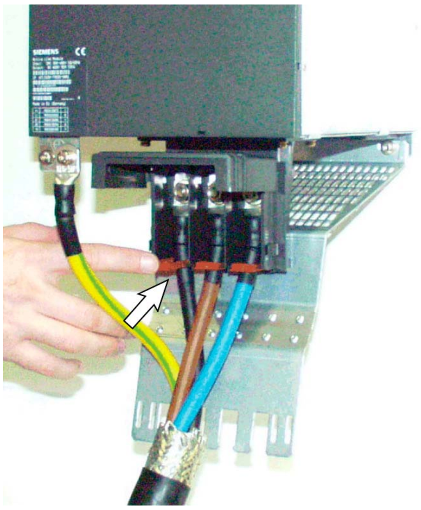
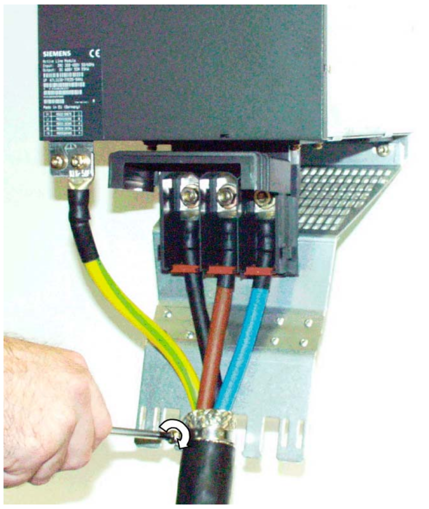
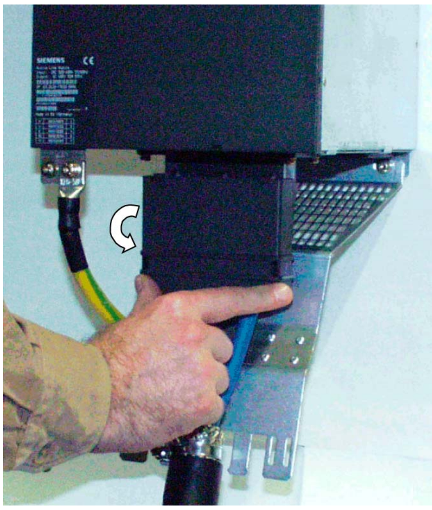
			
Attach the protective conductor (PE) using a screwdriver T25/3 Nm	Secure the power cable with flat-bladed screwdriver 4/1.8 Nm	Tighten the clamp at the shield connection plate using a suitable tool	The power cable is connected.

Table 10- 9 Connecting power cables for a 200 mm component using internal air cooling as an example

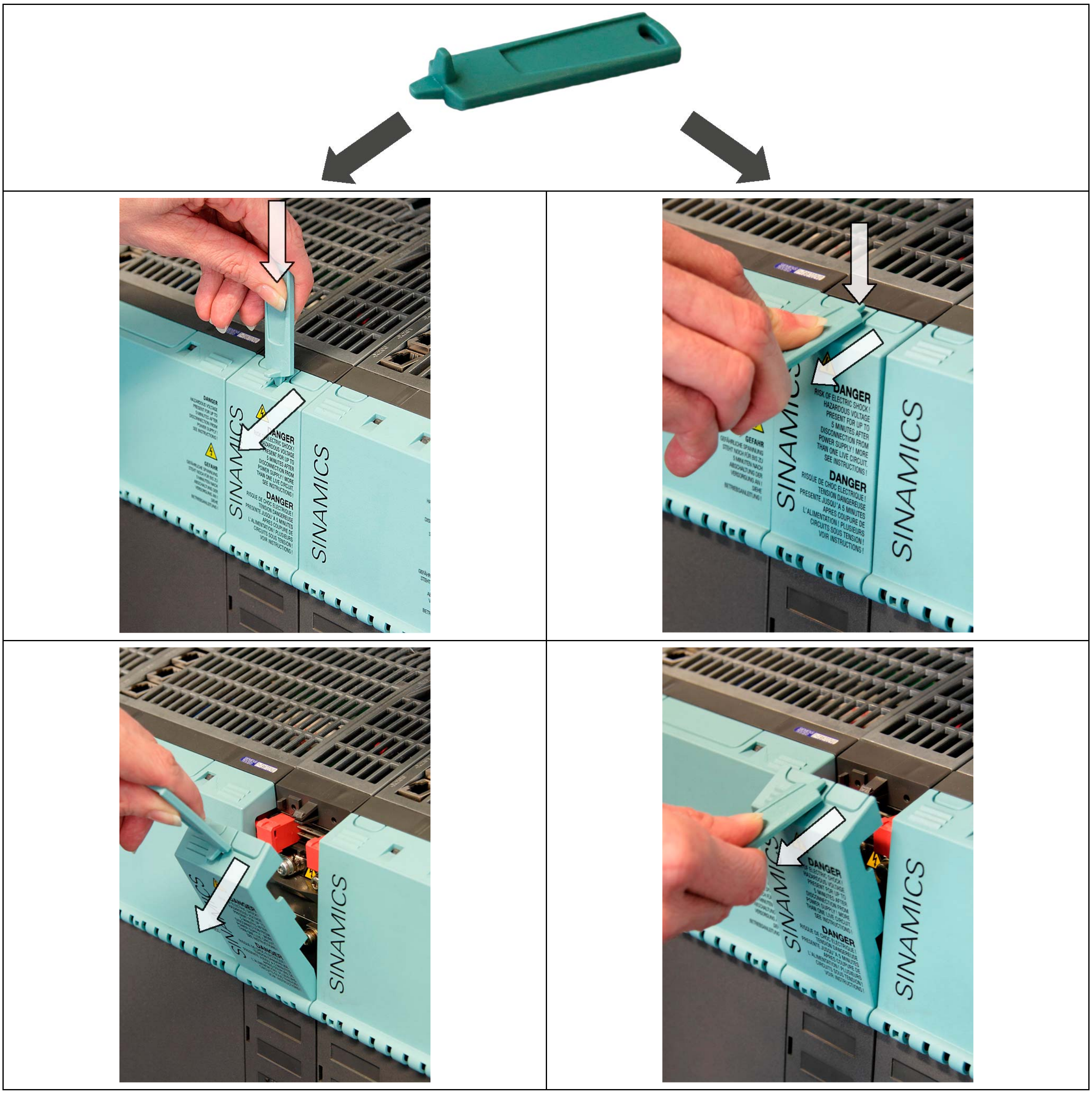
		
Unlock and remove the cover of the terminal strip.	Remove nuts M8 using a suitable tool.	Secure the earthing cable with screwdriver T25 and the power cable with torque spanner M8/13 Nm.
		
Adapt a restrictor collar for the purpose of touch protection using a suitable tool.	Attach the restrictor collar.	Tighten the clamp at the shield connection plate using a suitable tool

		
Close the cover of the terminal strip.		

10.2 Unlocking tool for DC-link cover flap

Opening the DC-link cover flaps

An unlocking tool is supplied with every power unit for the purpose of opening the DC-link cover flaps. The images below illustrate how the tool should be used.



10.3 DC link rectifier adapter for Booksize format

10.3.1 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 more than one component, it is important to remember it can only be installed on the component on the far right. The choice of connection cable diameter should be based on the required summation current for all the connected components.

The connection cables must be fused accordingly.

Note

When a DC link rectifier adapter and DC busbars are used, the limit values for radio interference suppression under Category C2 according to EN 61800-3 can no longer be observed.

Table 10- 10 Available DC link rectifier adapters

Order number	Screw terminals	Used for Line/Motor Modules with these sizes
6SL3162-2BD00-0AA0	0.5 to 10 mm²	50 mm; 100 mm
6SL3162-2BM00-0AA0	35 to 95 mm²	150 mm; 200 mm; 300 mm

10.3.2 Safety Information

⚠ DANGER

Risk of electric shock. A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
This time must elapse before any work may be carried-out on the adapter (e.g. mounting/installation).

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking device) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

DANGER

The DC link discharge voltage hazard warning in the local language must be attached to all of the components on which the adapter is mounted.
A set of labels in 16 languages is supplied with the component.

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

DANGER

Components for which the recesses for the DC link rectifier adapter have been removed must no longer be operated without them. If components need to be operated without the recess and without DC link rectifier adapter, the DC link cover must be replaced.

CAUTION

The screw tightening torque (1.8 Nm, tolerance +30 %) for securing components to the module-side DC link busbar must be checked before commissioning to ensure that it is correct. After transportation, the screws must be tightened.

DANGER

If a 50 mm wide module or if a DC link component with the appropriate width (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridge including all of the screws must be removed. It is not permissible to insert the screws without a DC link bridge.

For all other power units and DC link components (e.g. Capacitor Module) that are wider than 50 mm, it is not permissible to remove the DC link bridge.

If this is not carefully observed, this can result in damage and accidents.

CAUTION

To ensure safe electrical separation, the 24 V supply cables and those for the DC link connection cables must be physically separated (> 100 mm), or the 24 V cables must be doubly insulated (e.g. light plastic-sheathed cable).

WARNING

The DC link connection cables must be routed in such a way as to ensure that they are ground-fault and short-circuit proof in accordance with DIN/VDE 0100 or suitable fuse protection must be provided.

CAUTION

The total length of the DC link (including the connection cables) must not exceed 10 m.

10.3.3 Interface description

10.3.3.1 Overview

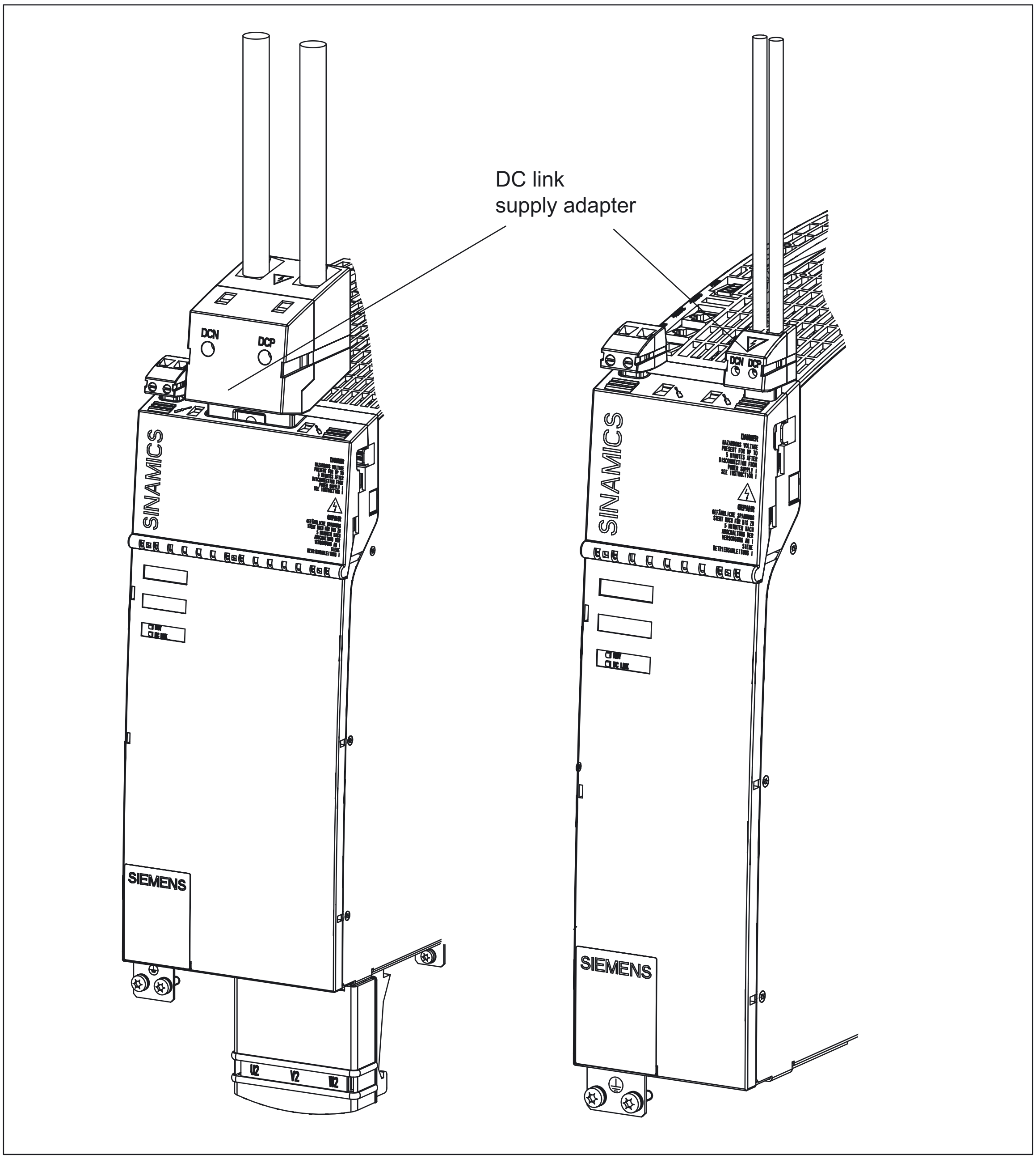


Figure 10-20 150 mm components with DC link rectifier adapter for 35 mm² to 95 mm² and 100 mm components with DC link rectifier adapter for 0.5 mm² to 10 mm²

10.3.3.2 DC link connection

Table 10- 11 DC link rectifier adapter – description of the terminals

Terminal	Function	Technical specifications
DCP	DC link positive	Supply voltage: 720 V-VDE/600 V-UL Direct supply 0.5 – 10 mm² Current carrying capacity: 43 A connection cross-section: 0.5 – 10 mm² Stripped length: 11 mm Direct supply 35 – 95 mm² Current carrying capacity: 200 A connection cross-section: 35 – 95 mm² Stripped length: 27 mm
DCN	DC link negative	

10.3.4 Dimension drawings

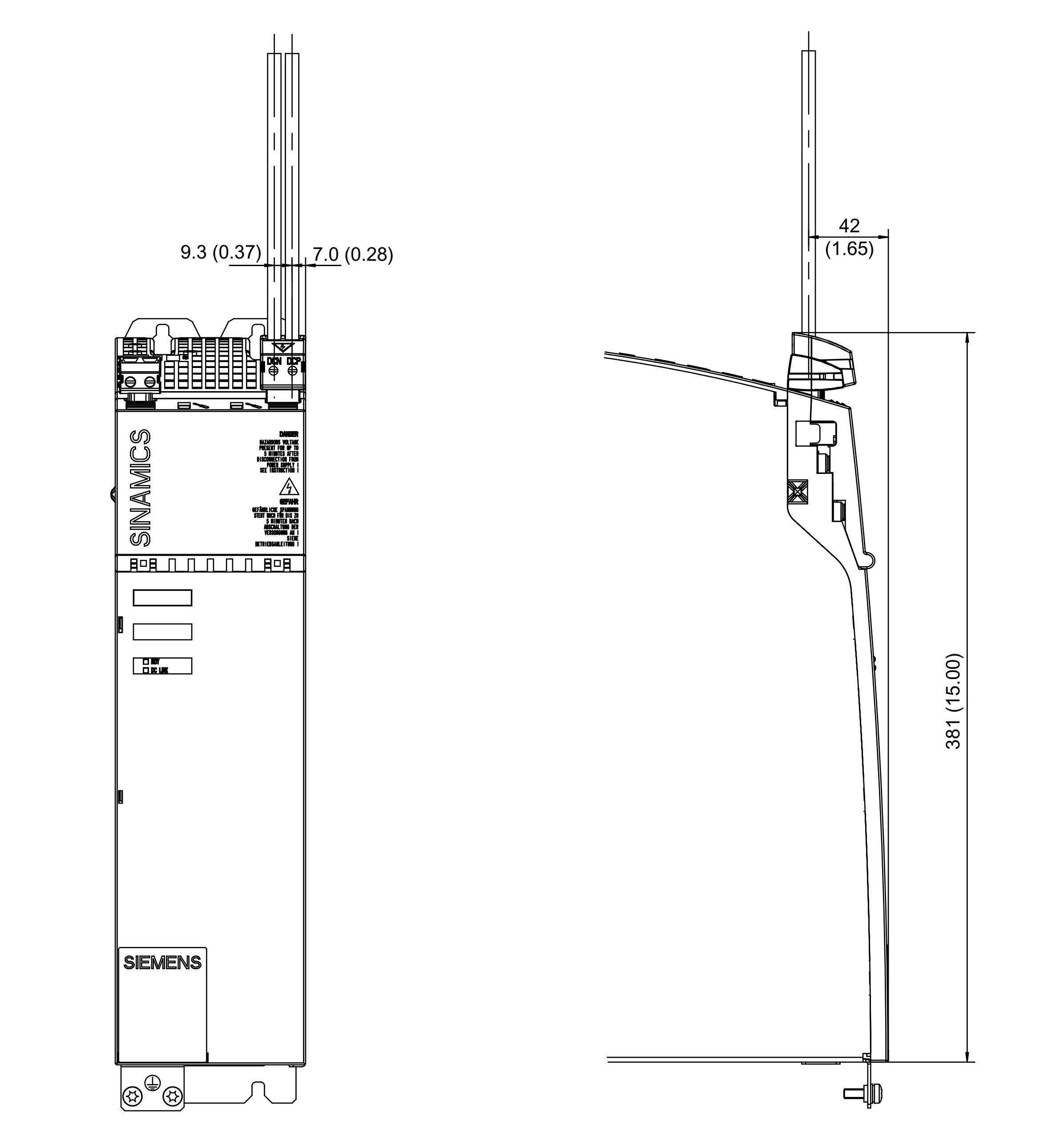


Figure 10-21 Dimension drawing of 100 mm component with DC link rectifier adapter for 0.5 mm² to 10 mm², all dimensions in mm and (inch)

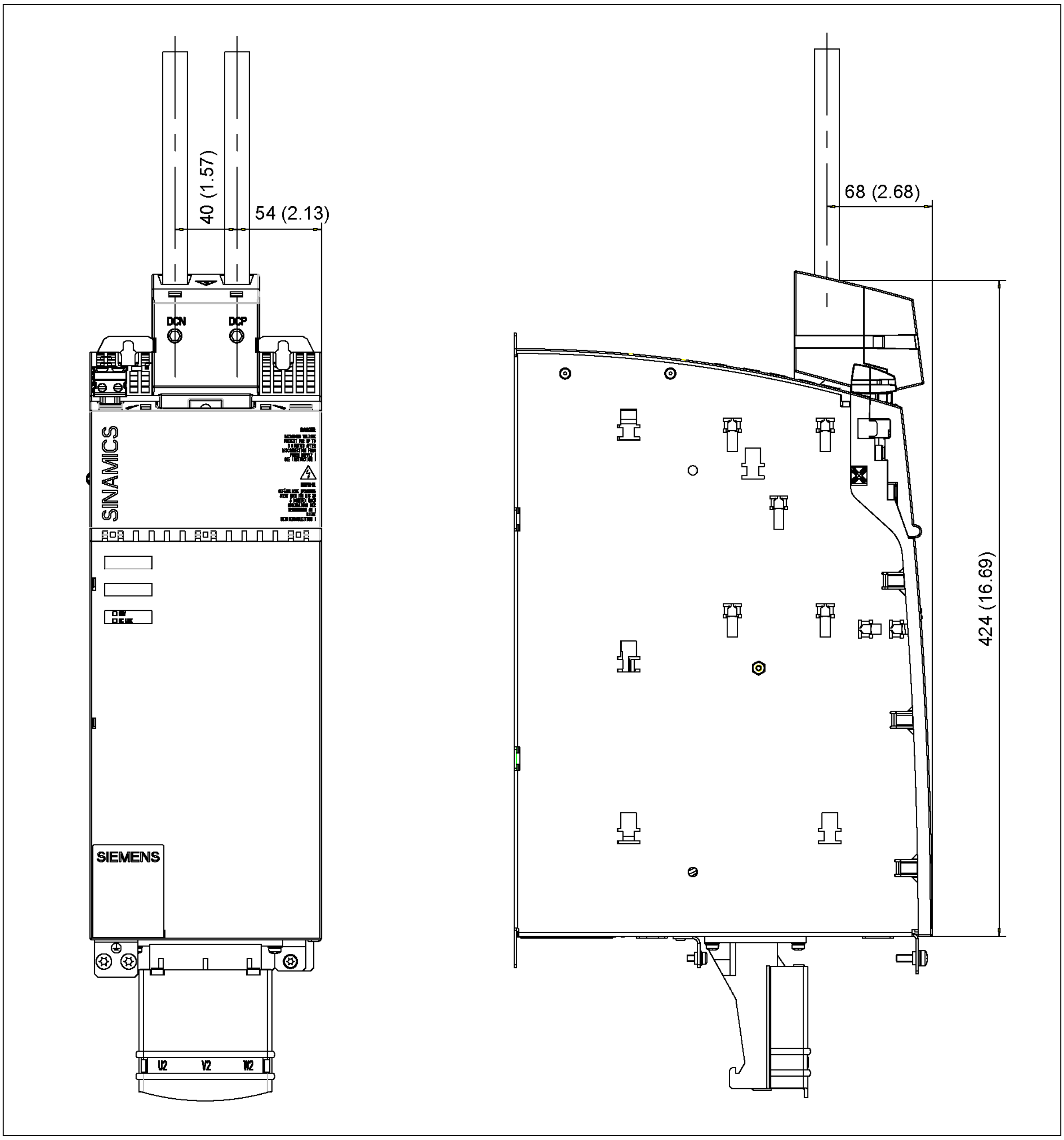


Figure 10-22 Dimension drawing of 150 mm component with DC link rectifier adapter for 35 mm² to 95 mm², all dimensions in mm and (inch)

10.3.5 Installation

⚠ DANGER

If a 50 mm wide component or if a DC link component with the appropriate width (e.g. Braking Module, CSM, VCM) is located on the left-hand side of the drive line-up, the DC link bridge including all of the screws must be removed. It is not permissible to insert the screws without a DC link bridge.

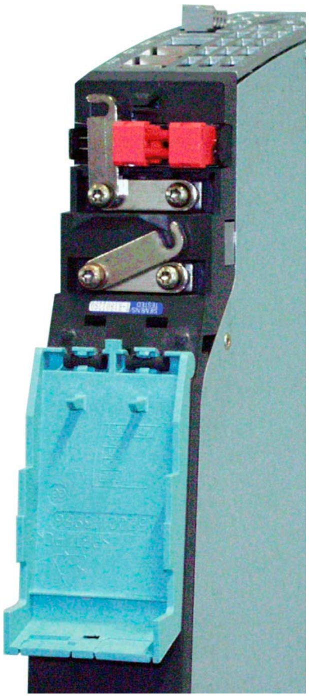
For all other power units and DC link components (e.g. Capacitor Module) that are wider than 50 mm, it is not permissible to remove the DC link bridge.

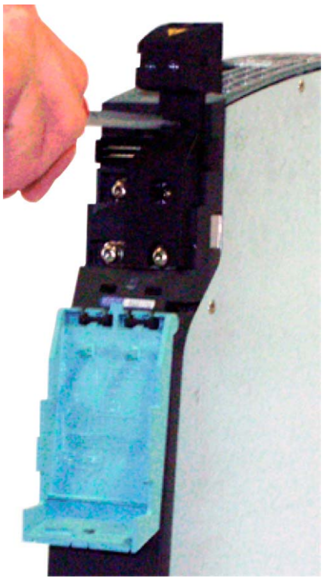
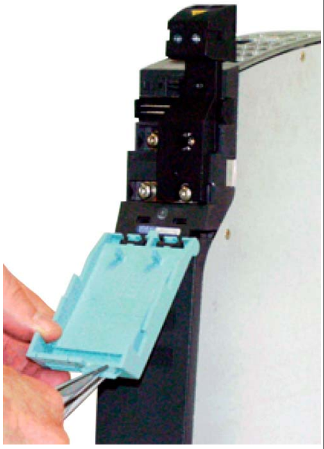
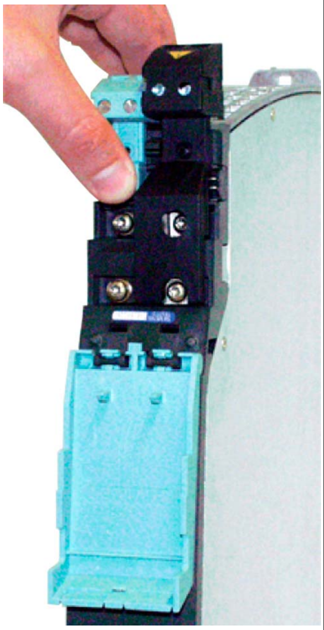
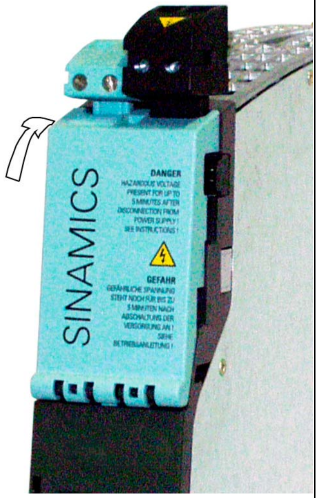
If this is not carefully observed, this can result in damage and accidents.

Required tools:

- Unlocking tool
- Torx screwdriver T10
- Torx screwdriver T20

Table 10- 12 Installation of the DC link rectifier adapter for 50 mm and 100 mm components

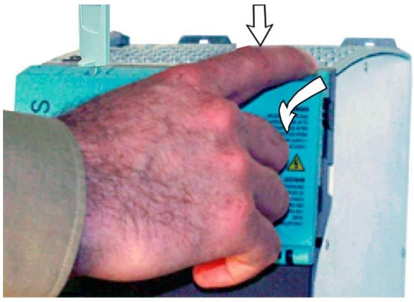
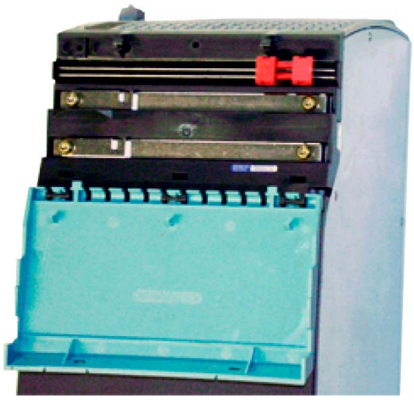
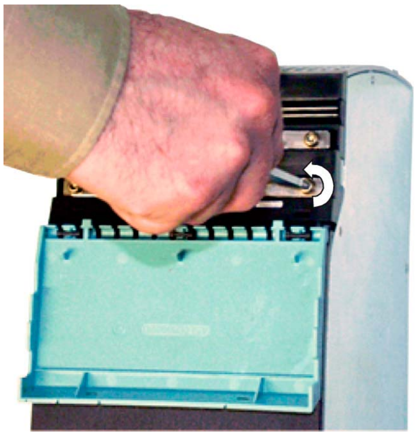
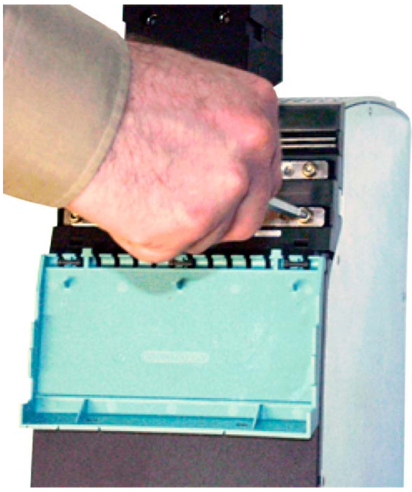
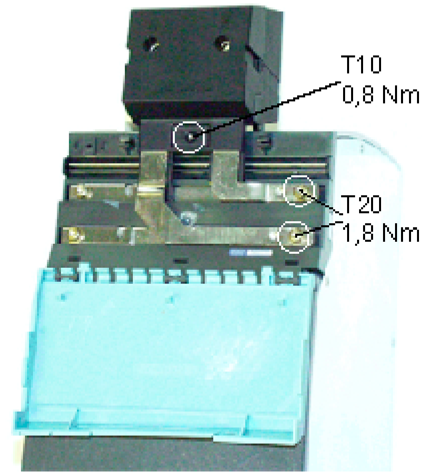
			
Release and open the protective cover using the release tool	Opened cover with 24 V jumper and DC link bridge	The DC link bridge and 24 V jumper have been removed.	Removed DC link bridge and screws

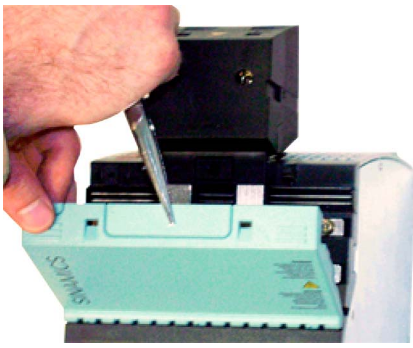
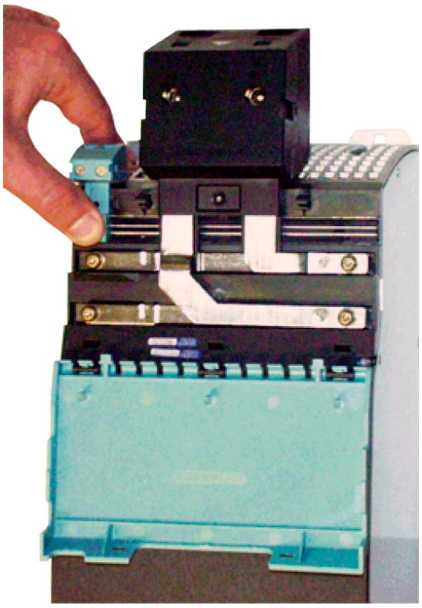
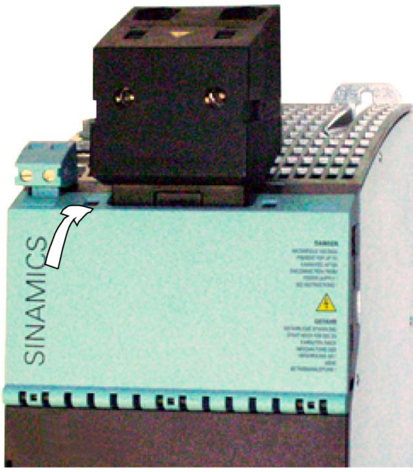
			
Secure the adapter	Break out the recess using suitable pliers	Attach and tighten the screw fittings of the 24 V terminal adapter	Close the protective cover

Note

If the 24 V terminal adapter and/or the DC link rectifier adapter is removed, the protective cover whose cutouts have been broken out must be replaced by a new one for safety reasons.

Table 10- 13 Installation of the DC link rectifier adapter for 150 mm, 200 mm, and 300 mm components

		
Release and open the protective cover using the release tool	Opened cover with 24 V jumper	Remove the 24 V jumper and unscrew the DC link screws.
		
Hook in the adapter.	Secure the adapter	The adapter has been screwed in.

		
Break out the recess using suitable pliers	Attach and tighten the screw fittings of the 24 V terminal adapter	Close the protective cover

Note

If the 24 V terminal adapter and/or the DC link rectifier adapter is removed, the protective cover whose cutouts have been broken out must be replaced by a new one for safety reasons.

10.3.6 Electrical connection

Table 10- 14 Connecting the DC link rectifier adapter for 50 mm and 100 mm components

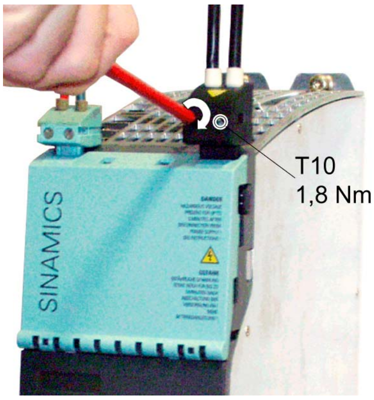
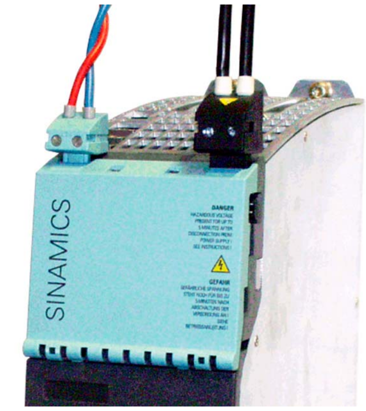
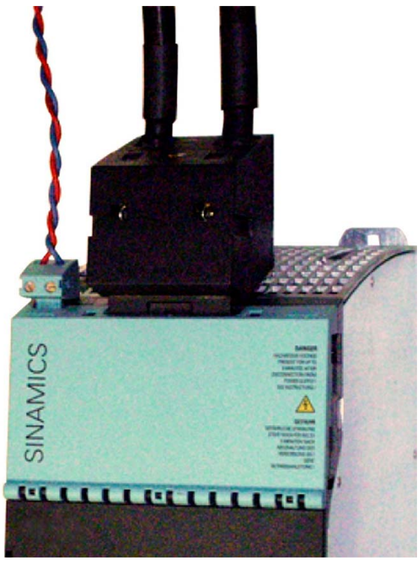
	
Install the cables at the DC link rectifier adapter	Connected DC link rectifier adapter

Table 10- 15 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

10.4 DC link adapter

10.4.1 Description

The DC link adapter is required when the drive line-up needs to be divided up (e.g. into two rows). The sub-line-ups are connected using cables (35 $mm^2$to 95 mm^2). Shielded individual cores are recommended.

The DC link adapter can be used for all line modules/motor modules in booksize format.

10.4.2 Safety Information

DANGER

Risk of electric shock. A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
This time must elapse before any work may be carried-out on the adapter (e.g. mounting/installation).

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, as this could result in secondary damage or accidents.

DANGER

The DC link discharge voltage hazard warning in the local language must be attached to all of the components on which the adapter is mounted.
A set of labels in 16 languages is supplied with the component.

DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

CAUTION

The screw tightening torque (1.8 Nm, tolerance +30 %) for securing components to the module-side DC link busbar must be checked before commissioning to ensure that it is correct. After transportation, the screws must be tightened.

DANGER

If a 50 mm wide module or if a DC link component with the appropriate width (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridge including all of the screws must be removed. It is not permissible to insert the screws without a DC link bridge.

For all other power units and DC link components (e.g. Capacitor Module) that are wider than 50 mm, it is not permissible to remove the DC link bridge.

If this is not carefully observed, this can result in damage and accidents.

DANGER

The DC link connection cables must be routed in such a way that they are ground-fault and short-circuit proof in accordance with EN 60204-1.

CAUTION

The total length of the DC link (including the connection cables) must not exceed 10 m.

10.4.3 Interface description

10.4.3.1 Overview

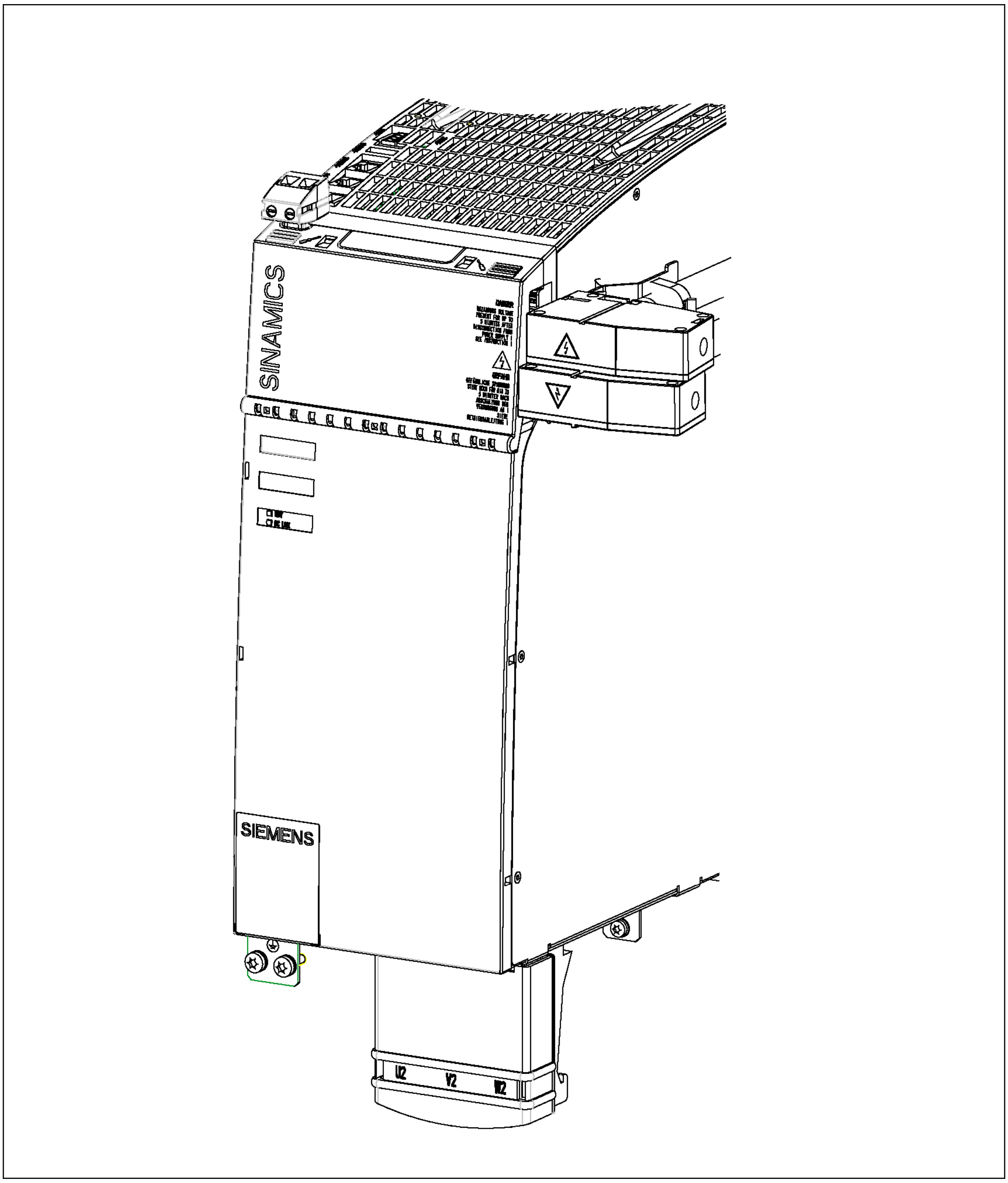


Figure 10-23 150 mm components with DC link adapter for two-row configuration 35 mm² to 95 mm²

10.4.3.2 DC link connection

Table 10- 16 DC link adapter – description of the terminals

Terminal	Function	Technical specifications
DCP	DC link positive	**Two-row configuration of adapter 35 – 95 mm²** Current carrying capacity: 200 A Voltage: 720 V-VDE/600 V AC Connection cross-section: 35 – 95 mm² Stripped length: 27 mm
DCN	DC link negative	

10.4.4 Dimension drawing

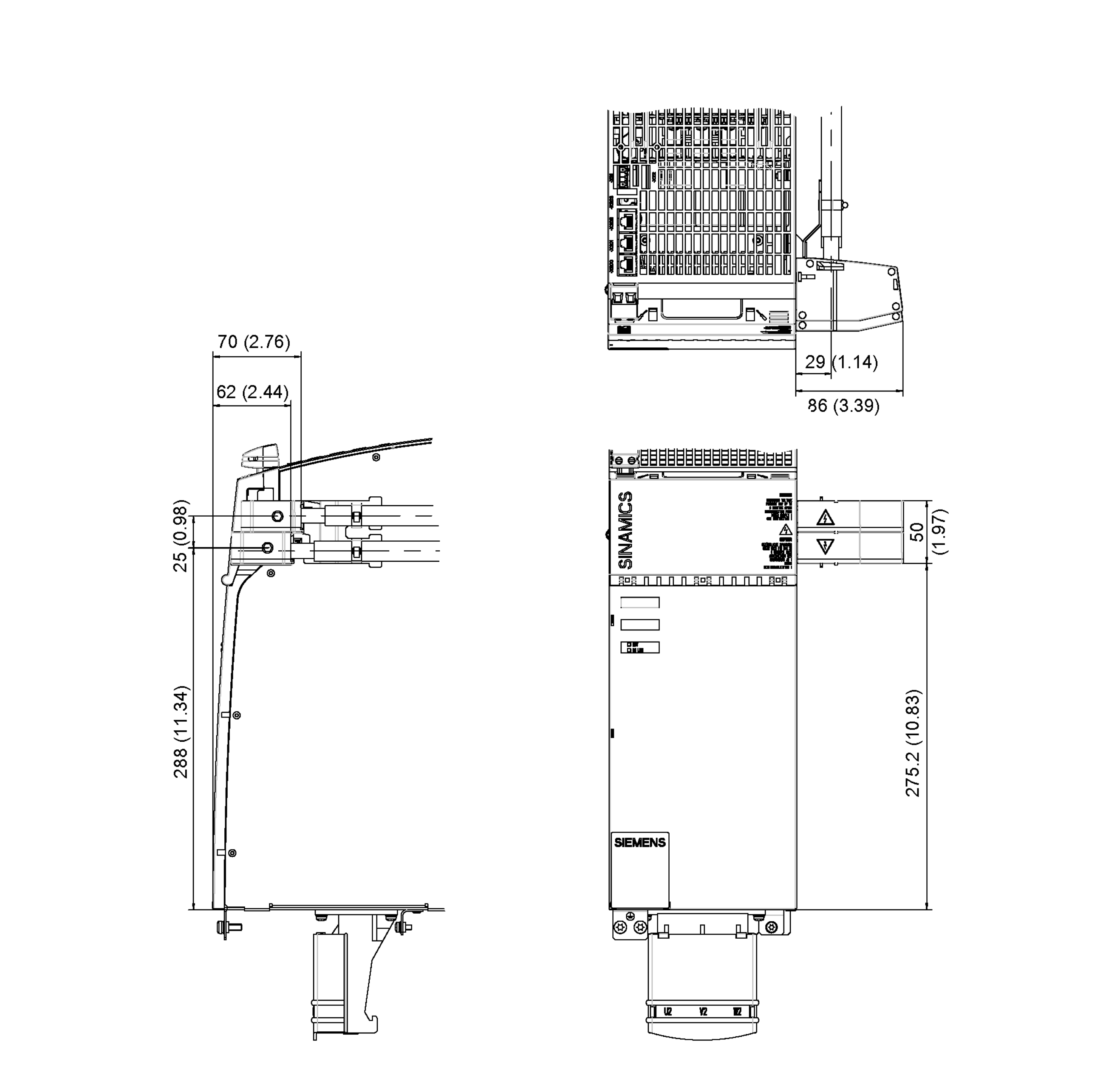


Figure 10-24 Dimension drawing of 150 mm component with DC link rectifier adapter for 35 mm² to 95 mm², all dimensions in mm and (inches)

10.4.5 Installation

DANGER

If a 50 mm wide module or if a DC link component with the appropriate width (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridge including all of the screws must be removed. It is not permissible to insert the screws without a DC link bridge.

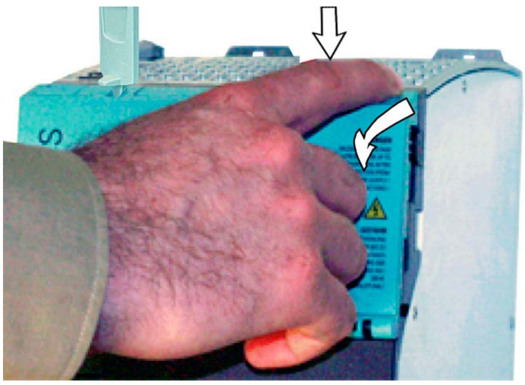
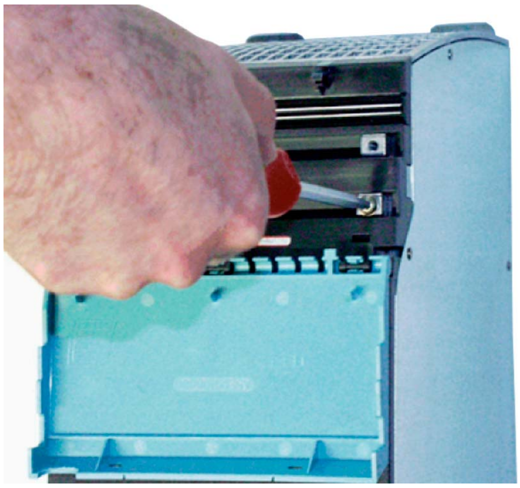
For all other power units and DC link components (e.g. Capacitor Module) that are wider than 50 mm, it is not permissible to remove the DC link bridge.

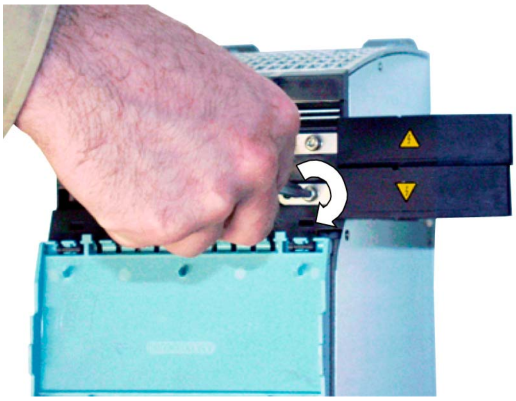
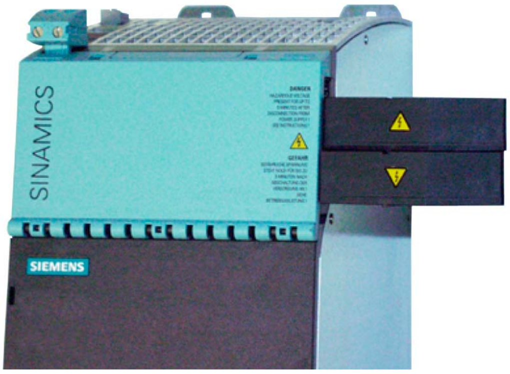
If this is not carefully observed, this can result in damage and accidents.

Required tools:

- Unlocking tool
- Torx screwdriver T20

Table 10- 17 Installation of the DC link adapter for a 150 mm component

	
Release and open the protective cover using the release tool	Unscrew the screws.

	
Tighten the DC link adapter screws (1.8 Nm)	Installed DC link adapter and 24 V terminal adapter with closed DC link cover

Note

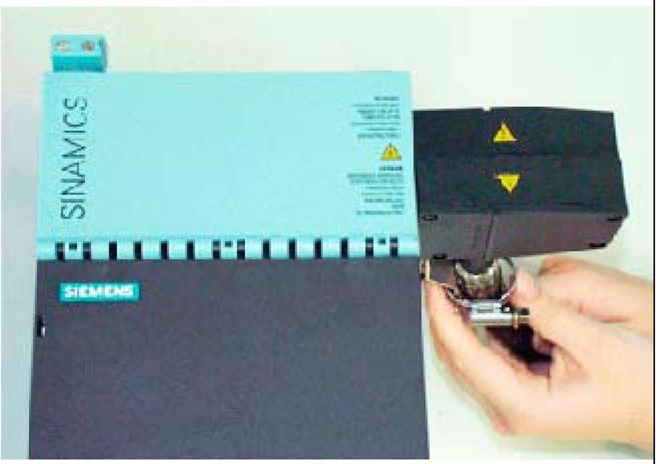
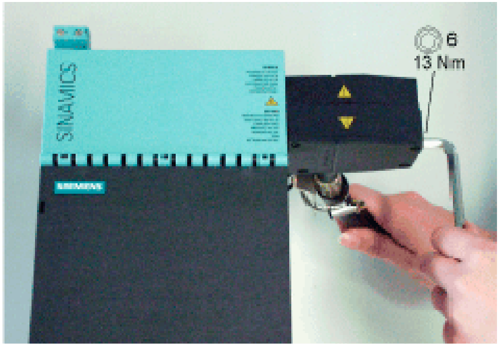
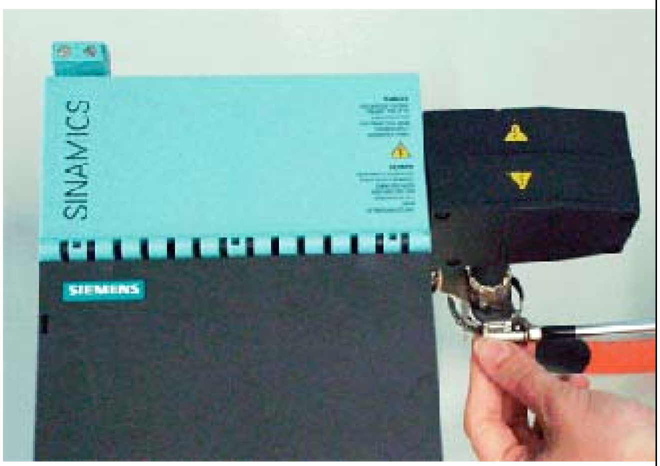
By moving the adapter housing, the DC link adapter can be fitted on either the left-hand or right-hand side of the component. This configuration is possible for all Active Line Modules.

10.4.6 Electrical connection

Required tools:

- Hexagon-socket spanner (size 6)
- Suitable tool for tube clips (e.g. flat-bladed screwdriver)

Table 10- 18 Electrical connection of the DC link adapter for a 150 mm component

	
Route the cable through the tube clip and insert it into the DC link adapter.	Secure the cable.
	
Secure the tube clip.	The cable is connected.

Always use shielded connection cables only.

The DC link adapter can be fitted on the right or left.

10.5 Reinforced DC-link busbars

10.5.1 Description

Reinforced DC link busbars (optional) are available for 50 mm and 100 mm wide components.

Reinforced DC link busbars	Order Number
Suitable for 50 mm components	6SL3162-2DB00-0AAx
Suitable for 100 mm components	6SL3162-2DD00-0AAx
DC link rectifier adapter (cable outlet on top)	
Suitable for 50 mm and 100 mm components	6SL3162-2BD00-0AAx
Suitable for 150 mm, 200 mm and 200 mm components	6SL3162-2BM00-0AAx
DC link adapter (cable outlet on side)	
Suitable for all components	6SL3162-2BM01-0AAx

The reinforced DC link busbars are required if the drive line-up is fed via a Line Module > 55 kW or a DC link adapter.

Using the reinforced DC link busbars has the effect of raising the current carrying capacity from 100 A to 150 A for all booksize and booksize compact components in widths of 50 mm and 100 mm.

10.5.2 Safety information

DANGER

Risk of electric shock. A hazardous voltage is present for up to 5 minutes after the power supply has been switched off.
It is only permissible to open the protective cover of the DC link after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking device) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

The protective cover for the DC link must be closed for all components before the voltage supply is switched on. The interlocks must audibly engage.

DANGER

If a 50 mm wide Motor Module or if a DC link component with the appropriate width (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridge including all of the screws must be removed. It is not permissible to insert the screws without a DC link bridge.

For all of the other power units and DC link components (e.g. Capacitor Module) that are wider than 50 mm, the DC link bridge must not be moved to the left or removed.

Failure to comply with this could result in secondary damage or accidents.

CAUTION

The left and right ends of the DC link busbar of a drive line-up must be closed using lateral covers (Order No.: 6SL3162-5AA00-0AA0).

CAUTION

The correct tightening torque of the DC link busbar screws (1.8 Nm +30%) must be checked after transportation and before commissioning when the system is disconnected from the power supply and the DC link is discharged.

NOTICE

The current carrying capacity of the DC link adapter (Order No.: 6SL3162-2BM00-0AAx) cannot be fully utilized.

10.5.3 Dimension drawings

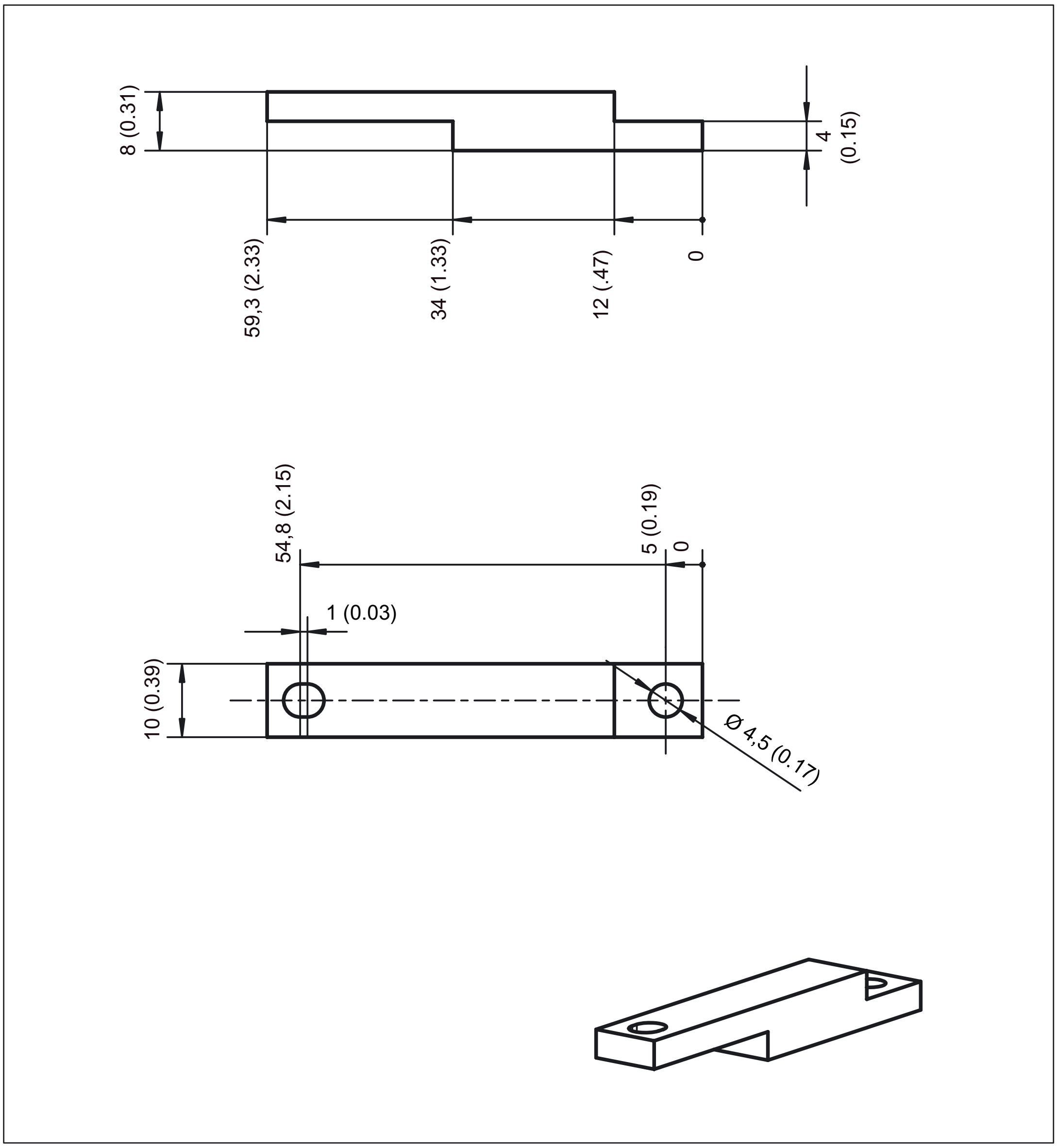


Figure 10-25 Dimension drawing of reinforced DC-link busbar 50 mm, all dimensions in mm and (inches)

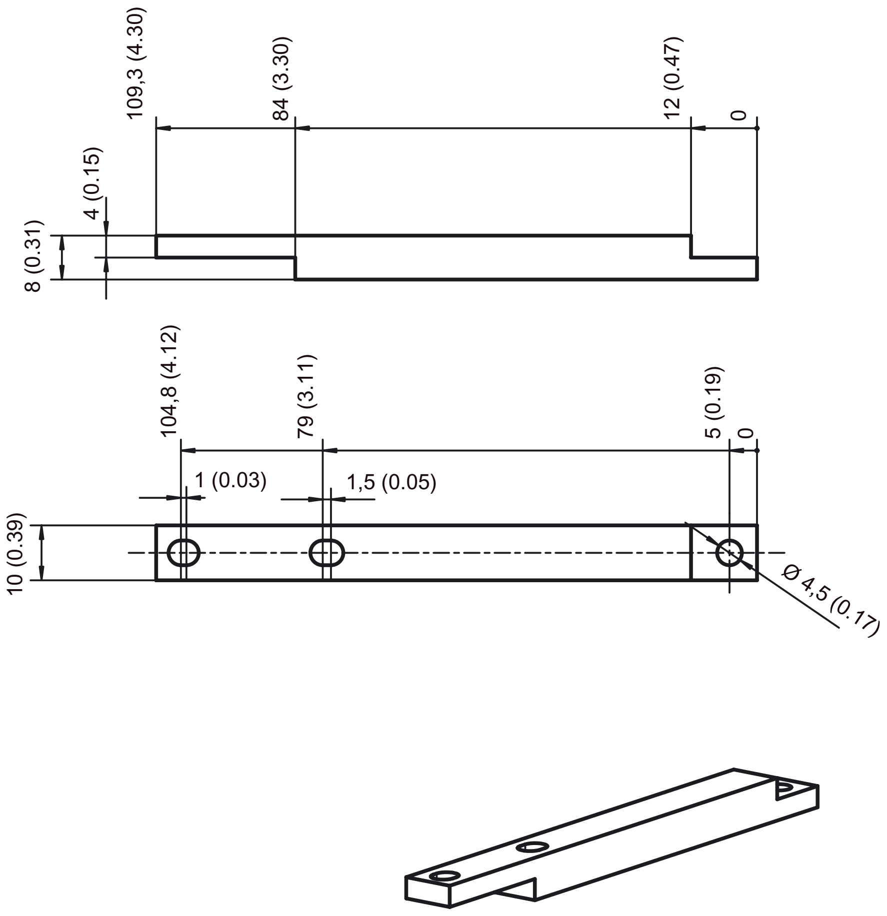
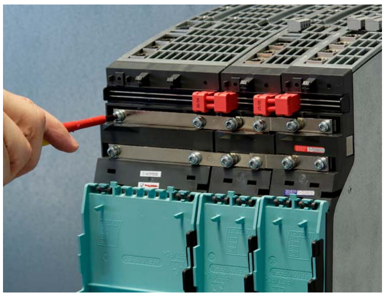
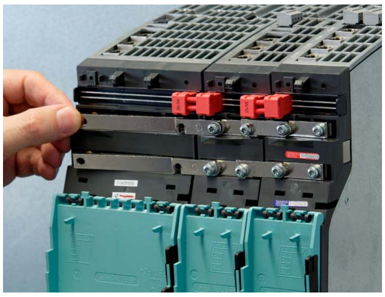
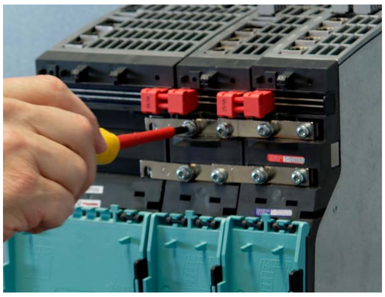
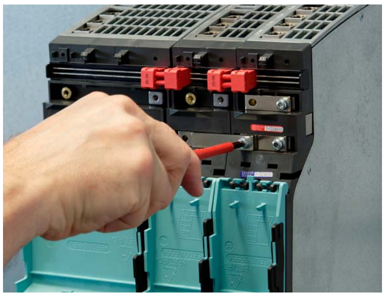
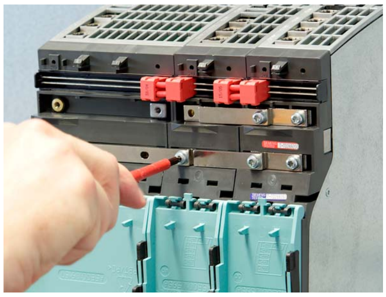
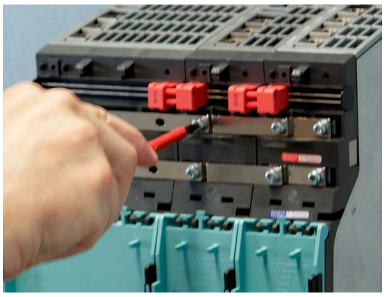


Figure 10-26 Dimension drawing of reinforced DC-link busbar 100 mm, all dimensions in mm and (inches)

10.5.4 Removing the DC link busbars

	
Unscrew the screws for the DC link busbar	Remove the DC link busbars
	
Remove the DC link busbars on the adjacent components too.	View once the DC link busbars have been removed

10.5.5 Installing the reinforced DC link busbars

	
Secure the reinforced DC link busbars Do not secure M4 screws tightly yet.	Secure the reinforced DC link busbars on the adjacent components too.
	
Tightly secure all the M4 screws, 1.8 Nm +30 %	With installed reinforced DC link busbars

The current carrying capacity of the reinforced DC link busbars is shown in the "Technical data" section for each component.

10.6 DRIVE-CLiQ cabinet bushing

10.6.1 Description

The DRIVE-CLiQ cabinet bushing is used to connect two DRIVE-CLiQ cables and can be installed in a control cabinet wall.

At the interface outside the control cabinet, a DRIVE-CLiQ connection is established with degree of protection IP67 according to EN 60529; however, inside the control cabinet, a connection is created with degree of protection IP20 or IPXXB according to EN 60529. The interface between the control cabinet wall and the DRIVE-CLiQ cabinet bushing requires degree of protection IP54 according to EN 60529.

In addition to the data lines, the power supply contacts of DRIVE-CLiQ are also routed via the coupling.

10.6.2 Safety Information

Note

Only cables from Siemens may be used for DRIVE-CLiQ connections.

10.6.3 Interface description

10.6.3.1 Overview

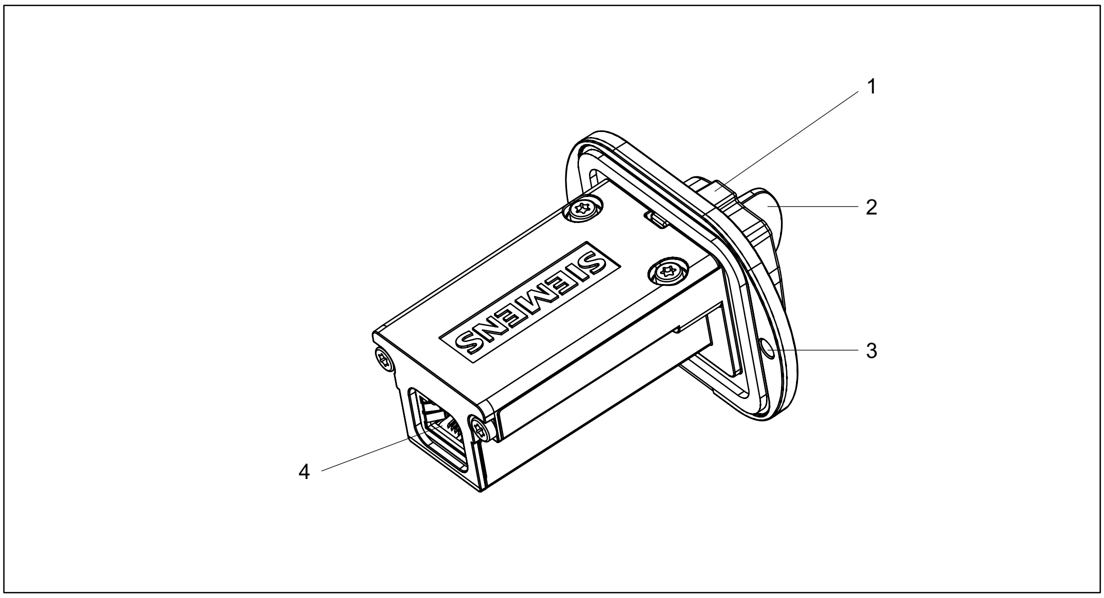


Figure 10-27 DRIVE-CLiQ cabinet bushing

1	Covering cap, Yamaichi, order number: Y-ConAS-24-S
2	IP67 interface according to EN 60529
3	Mounting holes
4	IP20 or IPXXB interface according to EN 60529

10.6.4 Dimension drawing

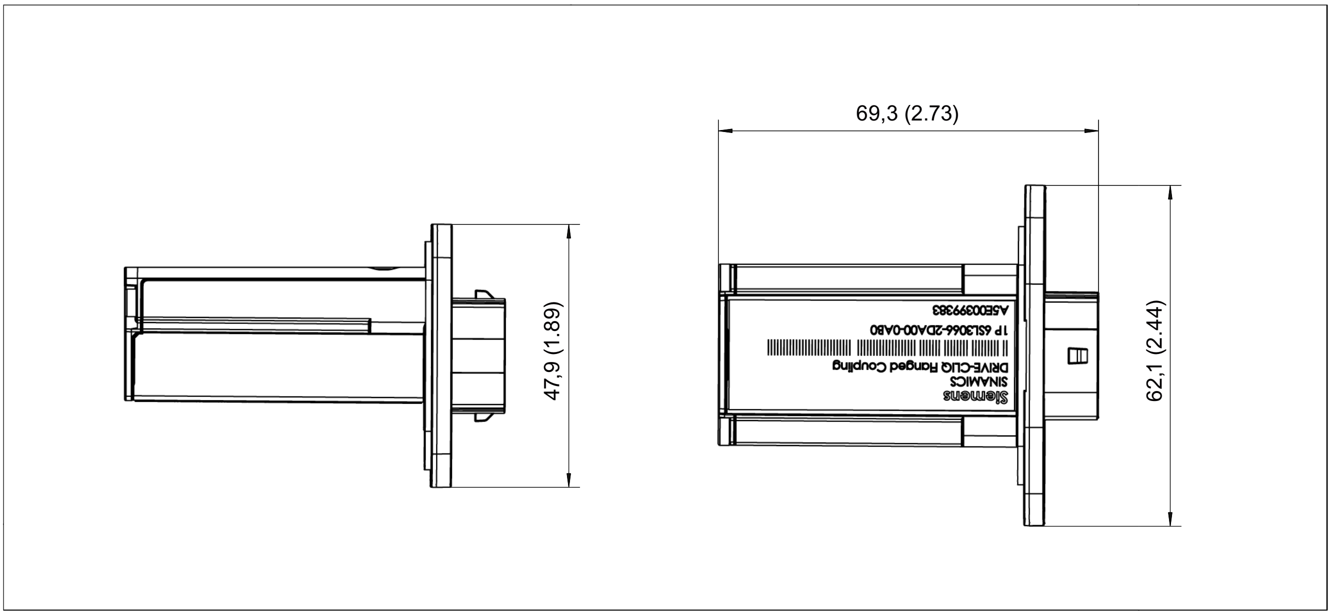


Figure 10-28 Dimension drawing of the DRIVE-CLiQ cabinet bushing, all dimensions in mm and (inches)

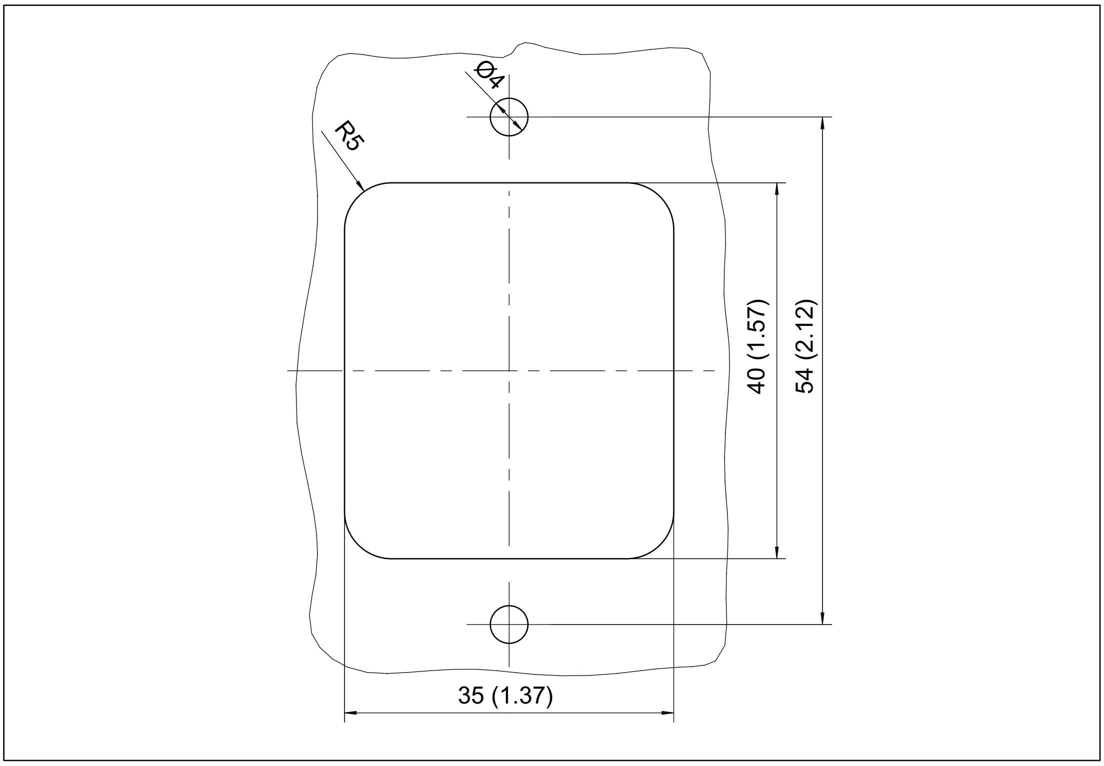


Figure 10-29 Cut-out for the cabinet

10.6.5 Installation

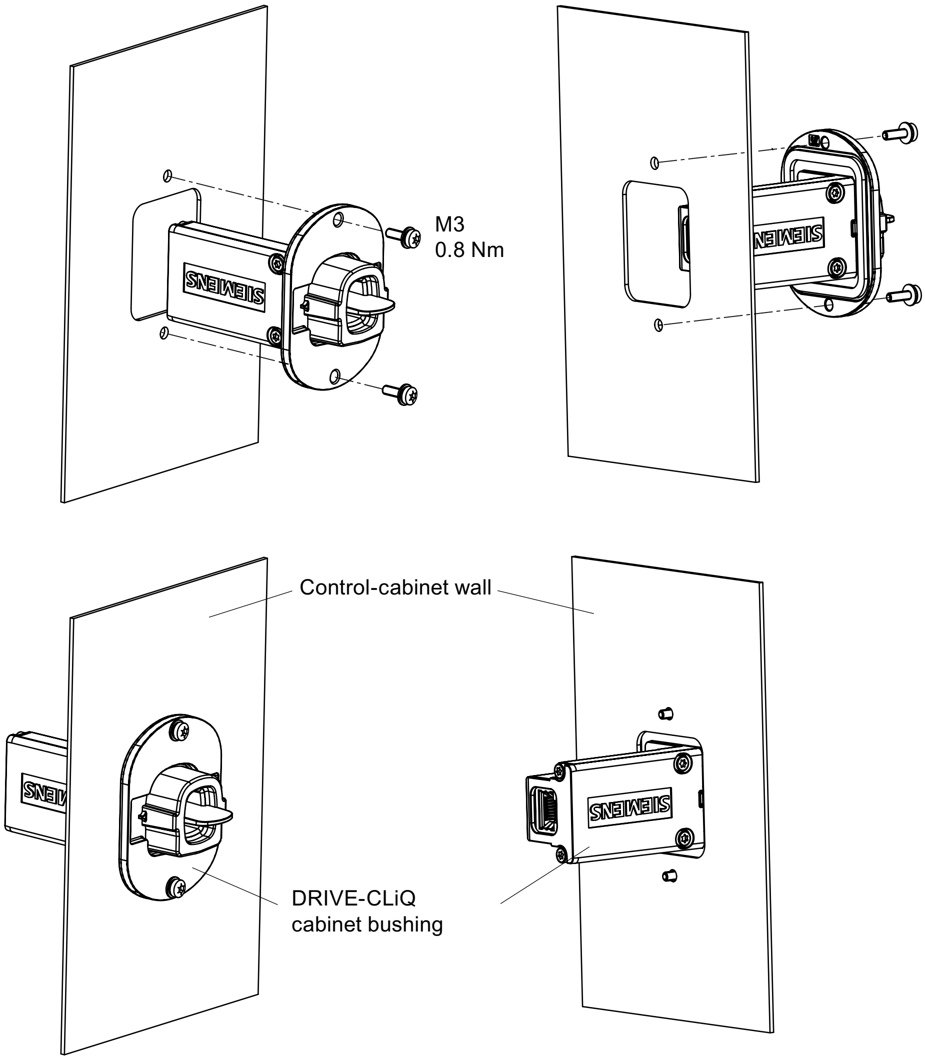


Figure 10-30 DRIVE-CLiQ cabinet bushing

Installation

1. Make a cutout in the control cabinet wall for the DRIVE-CLiQ cabinet bushing, as per the chapter titled "Dimension drawing".
2. Insert the components from the outer side of the cabinet through the opening in the cabinet.
3. Secure the DRIVE-CLiQ cabinet bushing to the outer control cabinet wall using two M3 screws and two nuts. In order to ensure good electromagnetic compatibility, a good electrical connection must be established between the DRIVE-CLiQ cabinet bushing and the cabinet wall over a large surface area.

10.6.6 Technical data

Table 10- 19 Technical data

DRIVE-CLiQ cabinet bushing 6SL3066-2DA00-0AA0	Unit	
Weight	kg	0.165
Degree of protection	IP20 or IPXXB acc. to EN 60529 in the electrical cabinet IP54 to EN 60529 outside the electrical cabinet	

10.7 DRIVE-CLiQ coupling

10.7.1 Description

The DRIVE-CLiQ coupling is used to connect two 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 the chapter "DRIVE-CLiQ cable".

10.7.2 Safety Information

Note

Only cables from Siemens may be used for DRIVE-CLiQ connections.

10.7.3 Interface description

10.7.3.1 Overview

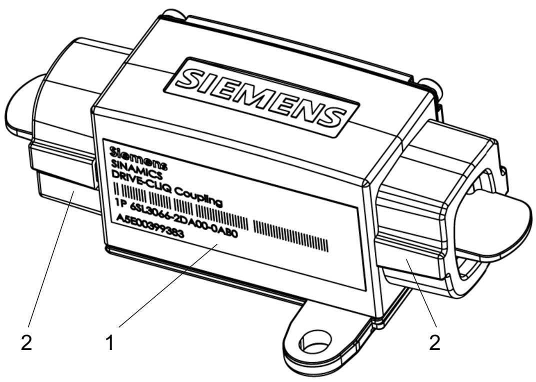


Figure 10-31 DRIVE-CLiQ coupling

1	Rating plate
2	Covering caps, Yamaichi, order number: Y-ConAS-24-S

10.7.4 Dimension drawing

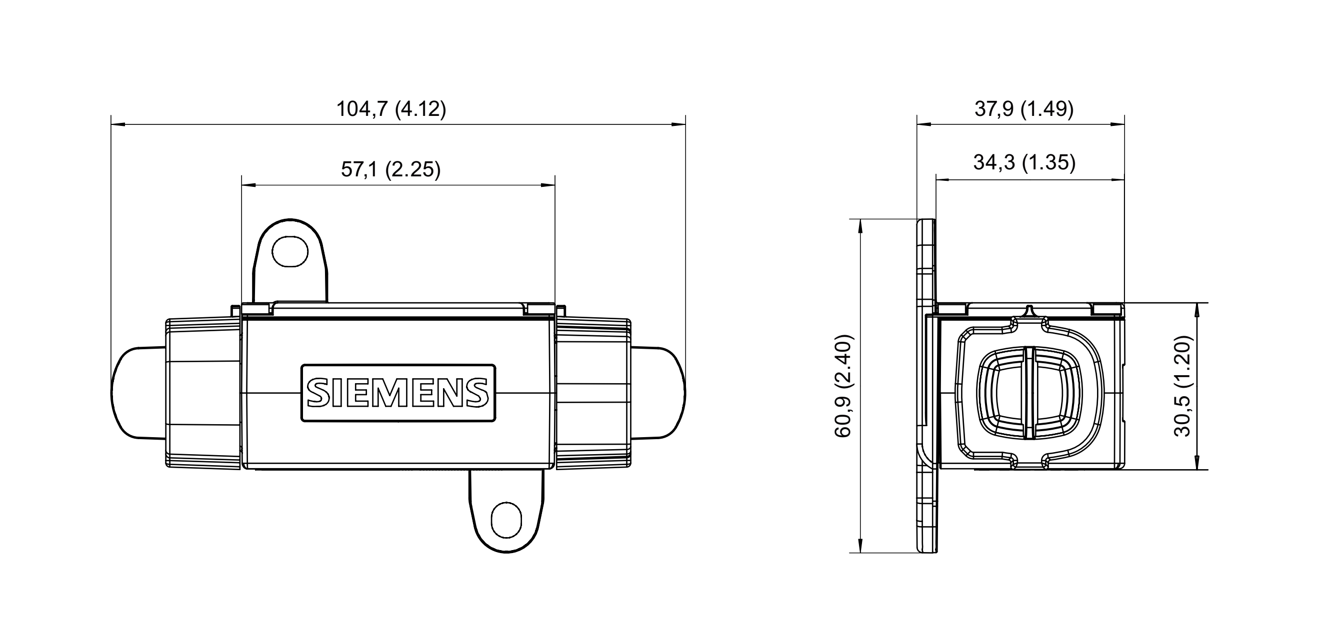


Figure 10-32 Dimension drawing of the DRIVE-CLiQ coupling, all dimensions in mm and (inches)

10.7.5 Installation

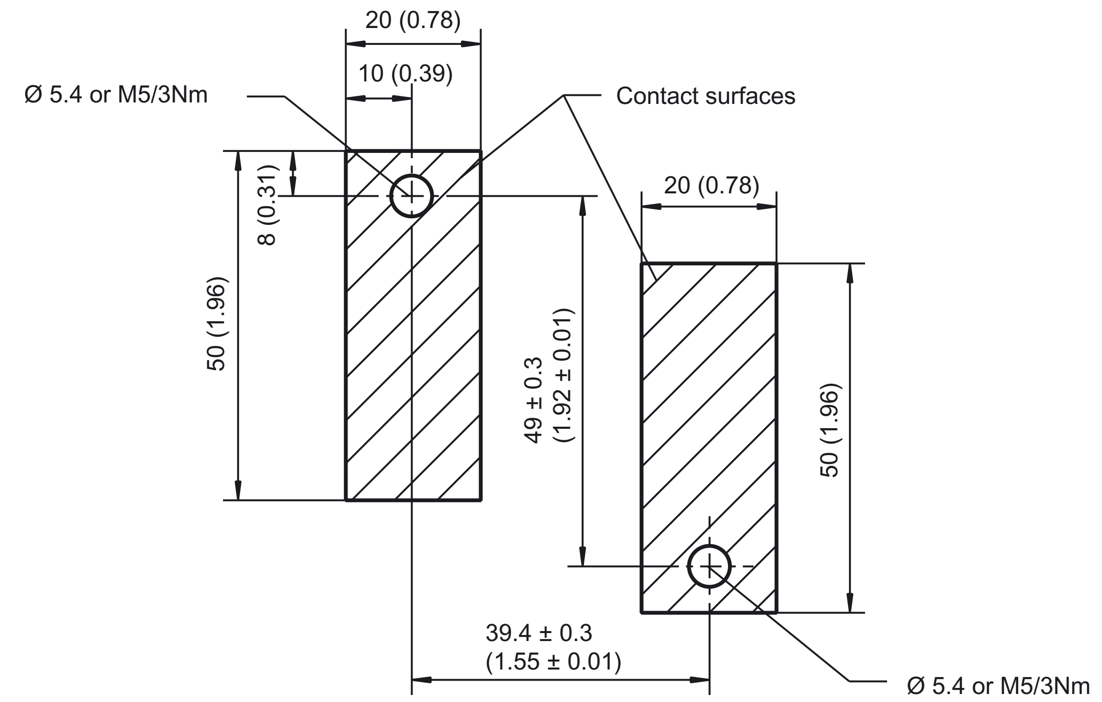


Figure 10-33 Hole drilling pattern for installation

1. Fit the DRIVE-CLiQ coupling to the mounting surface in accordance with the drilling pattern.
2. Remove the protective caps from the DRIVE-CLiQ coupling.
3. Insert the DRIVE-CLiQ plugs at both ends of the DRIVE-CLiQ coupling until they latch into place.

10.7.6 Technical data

Table 10- 20 Technical data

DRIVE-CLiQ coupling 6SL3066-2DA00-0AB0	**Unit**	
Weight	kg	0.272
Degree of protection	IP67 acc. to EN 60529	

10.8 Spacing bolt for booksize compact components

10.8.1 Installation

The spacing bolts (order number: 6SL3426-1CC00-0AAx) increase the mounting depth of the compact components to enable them to be combined directly with booksize format components with internal air cooling.

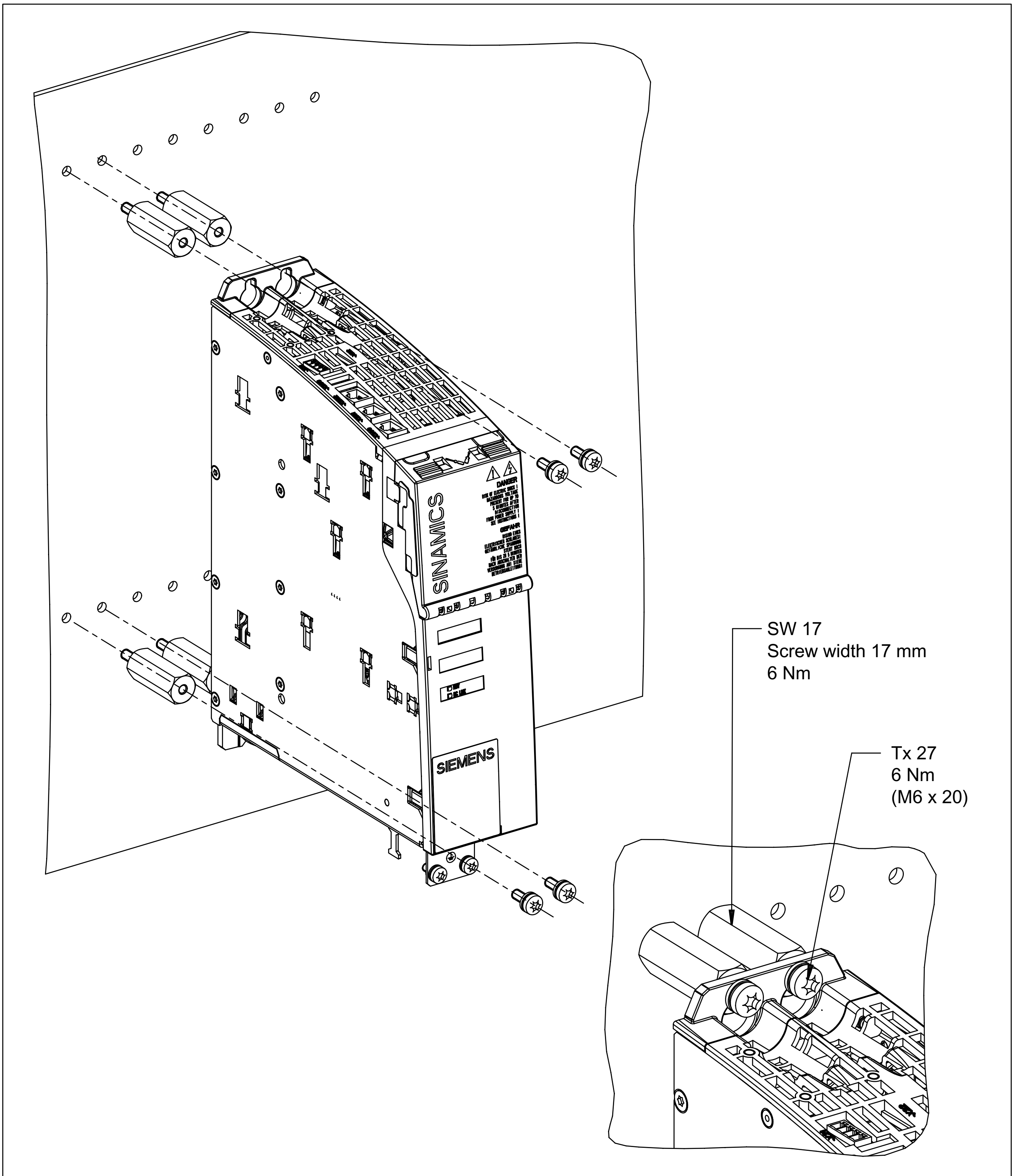


Figure 10-34 Installation of the spacing bolts on a booksize compact format component (example: Motor Module booksize compact, 18 A)

Cabinet design and EMC Booksize 11

11.1 Information

11.1.1 General information

SINAMICS S components fulfill the requirements according to degree of protection IP20 in compliance with EN 60529. This provides protection against electric shock for chassis units. As far as UL 50 is concerned, the components are classified and certified as open type. Protection against mechanical and climatic stressing must be ensured by installing the components in housings, cabinets or electrical rooms that can be closed and locked. Higher-level housings must, as a minimum, have degree of protection IP54 according to EN 60529 be classified as enclosure type 12 in compliance with UL 50.

Prefabricated MOTION-CONNECT cables are recommended.

Note

Functional safety of SINAMICS components

The components must be protected against conductive contamination (e.g. by installing them in a cabinet with degree of protection IP54B according to EN 60529).

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

Installation in a cabinet with degree of protection IP54B according to EN 60529 is advisable 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

- Connected to 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

11.1.2 Safety information

CAUTION

The voltage drop between the start of the consumer's installation and the consuming equipment being supplied should generally not exceed 4% in operation with rated values.

The relevant tables in Supplement 5 of the standard DIN VDE 0100 should be consulted. The following note must be included in the technical user documentation: "The machine builder must ensure that the voltage drop between the start of the consumer's installation and the PDS does not exceed 4% when operating with rated values."

(VDE 0100-520)

Checking the documented development stipulations regarding the above requirement, implementation in the production documentation and execution in the device.

DANGER

When installing the cabinet, you must cover the ventilation slots to prevent drill swarf, wire end ferrules, and so on from falling into the housing, which could result in short-circuits or damage the insulation.

Safety regulations governing shock protection must be observed. See also EN 60204-1.

DANGER

Only motors with a safe electrically isolated holding brake may be connected. The brake conductors must also be safely electrically isolated.

If the motor power cable is connected to intermediate terminals, the power cables and brake cables must be routed apart (≥ 300 mm).

WARNING

Cable shields and unused conductors of power cables (e.g. brake conductors) must be connected to PE potential.

If this is not carefully observed, lethal shock voltages could result.

WARNING

If static discharge occurs on surfaces or interfaces that cannot be easily accessed, this can cause malfunctions and/or defects.

CAUTION

The correct tightening torque of the DC-link busbar screws (1.8 Nm) must be checked before commissioning.

To ensure that the encoder system works properly, you are advised to use the original Siemens accessories from catalog PM21 or NC61.

DANGER

To protect against electric shock the components should only be operated in closed electrical operating areas or in cabinets. Furthermore, an internal protective conductor connection of the components is absolutely essential.

The components generate high leakage currents in the protective conductor. In order to ensure protection against electric shocks if the external protective conductor is interrupted, one of the following measures must be implemented for the external connection:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

11.1.3 Directives

The product satisfies the protection targets of the following EU Directives applicable within the European Economic Area (EEA):

Table 11- 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).

11.2 Selecting the line-side devices and components required to operate SINAMICS

11.2.1 General information

The following components are required to connected to the line supply:

- Disconnector 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 electrical isolation)
- Line filter (see chapter Line supply connection)
- Line reactor (see chapter Line supply connection)

For notes on overvoltage protection, refer to the section "Selecting the line-side devices and components required to operate SINAMICS" in the chapter "Overvoltage Protection".

11.2.2 Information on the disconnector unit

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

A disconnector unit is required for disconnecting the drive line-up from the supply system correctly. The disconnector unit of the machine's electrical equipment can be used for this purpose. The disconnector unit must be selected in compliance with the requirements of the internationally binding standard relating to the electrical equipment of machines EN 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

If an active drive line-up is switched off by means of the disconnector unit, on Line Modules with regenerative feedback capability the voltage at terminals 3 (EP +24 V) and 4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

This protects external loads located parallel to the drive on the same switching component.

Note

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

The accessories required for the disconnector unit must be selected from the manufacturer catalogs. Refer also to catalogs PM21 and NC61.

11.2.3 Overcurrent protection by means of line fuses and circuit breakers

Line fuses or preferably circuit breakers should be used for cable/overcurrent protection in order to limit the damage to the Line Module if a fault occurs. NH, D, and DO-type fuses with a gL characteristic or suitable circuit breakers can be used for this purpose.

DANGER

As a general rule, the higher loop impedance of TT systems means they are not suitable for tripping the installed overcurrent protection devices within the prescribed period should an insulation fault occur. If TT systems are used, residual-current-operated circuit breakers (see chapter "Residual-current-operated circuit breakers (RCD)") should ideally be used in addition to the overcurrent protection devices. At infeed powers above 55 kW and with systems that extend across a large area, residual-current monitors (see chapter "Residual-current monitors (RCM)") must be installed in addition to appropriate circuit breakers for operation on TT systems.

WARNING

It is not permissible to overdimension fuses as this can result in significant levels of danger and also faults.

WARNING

Fuses that can operate across the maximum cable length within a circuit must be rated in accordance with the requirements for:

1. Short circuit protection (IEC 60364-4-43 and -5-52, EN 60204-1, and EN 61800-5-1)
2. The maximum permissible break time for protection against electric shock in the event of indirect contact (IEC 60364-4-41 and -4–43, EN 61800-5-1 and EN 60204-1)
3. The maximum permissible voltage drop during operation

that may have an effect with a maximum cable length for the circuits.

The maximum cable length depends on the cable cross-section, material, and insulation, as well as the type and size of the upstream overcurrent protection device.

The minimum value, which is derived from the three requirements, must generally be observed. This means that the fuses must be designed in such a way that, if a fault occurs, the line fuses trip after 0.4 s with mobile equipment and after 5 s with stationary equipment.

Note

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

Recommendations for line fuses and circuit breakers

The tables below provide details of LV HRC line fuses with a gL characteristic and circuit breakers according to EN 60947, which are recommended for use with Active Line Modules, Smart Line Modules, and Basic Line Modules.

Table 11- 2 Recommended LV HRC line fuse (gL) and circuit breaker for Active Line Modules

	16 kW	36 kW	55 kW	80 kW	120 KW
I_{rated} fuse	35 A	80 A	125 A	160 A	250 A
Line fuse	3NA3 814	3NA3 824	3NA3 132	3NA3 136	3NA3 144
Circuit breaker	3RV1031-4FA10	3RV1041-4LA10	3VL2712-1DC33	3VL3720-1DC33	3VL3725-1DC36

Table 11- 3 Recommended LV HRC. line fuse (gL) and circuit breaker for Smart Line Modules

	5 kW	10 kW	16 kW	36 kW
I_{rated} fuse	16 A	35 A	35 A	80 A
Line fuse	3NA3 805	3NA3 814	3NA3 814	3NA3 824
Circuit breaker	3RV1031-4BA10	3RV1031-4FA10	3RV1031-4FA10	3RV1041-4LA10

Table 11- 4 Recommended LV HRC line fuse (gL) and circuit breaker for Basic Line Modules

	20 kW	40 kW	100 kW
I_{rated} fuse	63 A	100 A	250 A
Line fuse	3NA3 822	3NA3 830	3NA3 144
Circuit breaker	3RV1041-4JA10	3VL2710-1DC33	3VL3725-1DC36

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

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

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

Information on the tripping time of line fuses

For timely tripping of line fuses, the loop resistance as well as the vector group of the feeding line transformer must ensure that, if a fault occurs, the touch voltage of the devices is disconnected by the fuses provided within the permissible tripping time (see figure below, in accordance with EN 61800-5-1 Ed. 2).

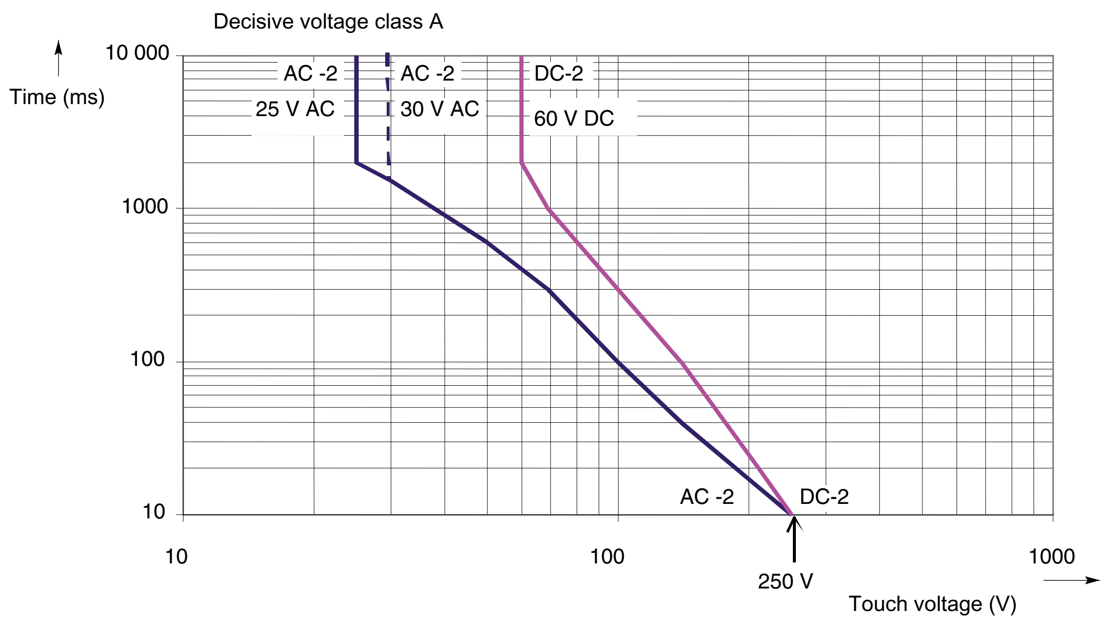


Figure 11-1 Permissible tripping time of fuses

The boundary conditions indicated above also serve to avoid a fire in case of a fault. If you do not comply with these boundary conditions, you must take additional measures, e.g., residual current transformer.

Fuse and plant conditions such as loop resistance and short-circuit power must be harmonized to one another so that the limit curve is not exceeded. This guarantees the shock-hazard protection.

11.2.4 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.

DANGER

It is not permissible to use residual-current devices as the sole means of protection.

NOTICE

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. Since TT systems do not generally meet this requirement, residual-current devices must always be installed for this type of system.

11.2.4.1 Residual-current operated circuit breakers (RCD)

Residual-current operated circuit breakers (RCD) can be used in addition to the overcurrent protection devices provided.

DANGER

Residual-current circuit-breakers alone are not permissible to provide protection against direct and indirect contact.

DANGER

As a general rule, the higher loop impedance of TT systems means they are not suitable for tripping the installed overcurrent protection devices within the prescribed period should an insulation fault occur. If TT systems are used, residual-current operated circuit breakers should ideally be used in addition to the overcurrent protection devices.

Note

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

Please note the following:

- It is only permissible to use a delayed tripping, selective AC/DC-sensitive residual-current operated circuit breaker, type B.
- The max. permitted grounding resistance of the "selective protective device" is observed (83 Ω max. for residual-current devices with 0.3 A rated differential current).
- Accessible parts of the Power Drive System and the machine are connected to the system's protective ground conductor.
- The total length of the shielded power cables in the drive line-up (motor cables incl. line supply conductors from line filters to the connecting terminals of the Line Module) must be less than 350 m.
- Only recommended line filters must be used during operation.
- Only one residual-current circuit-breaker may be connected in series (cascading is not possible).
- Switching elements (disconnector unit, contactors) for connecting and disconnecting the drive line-up have max. 35 ms delay time time between the closing/opening of the individual main contacts.

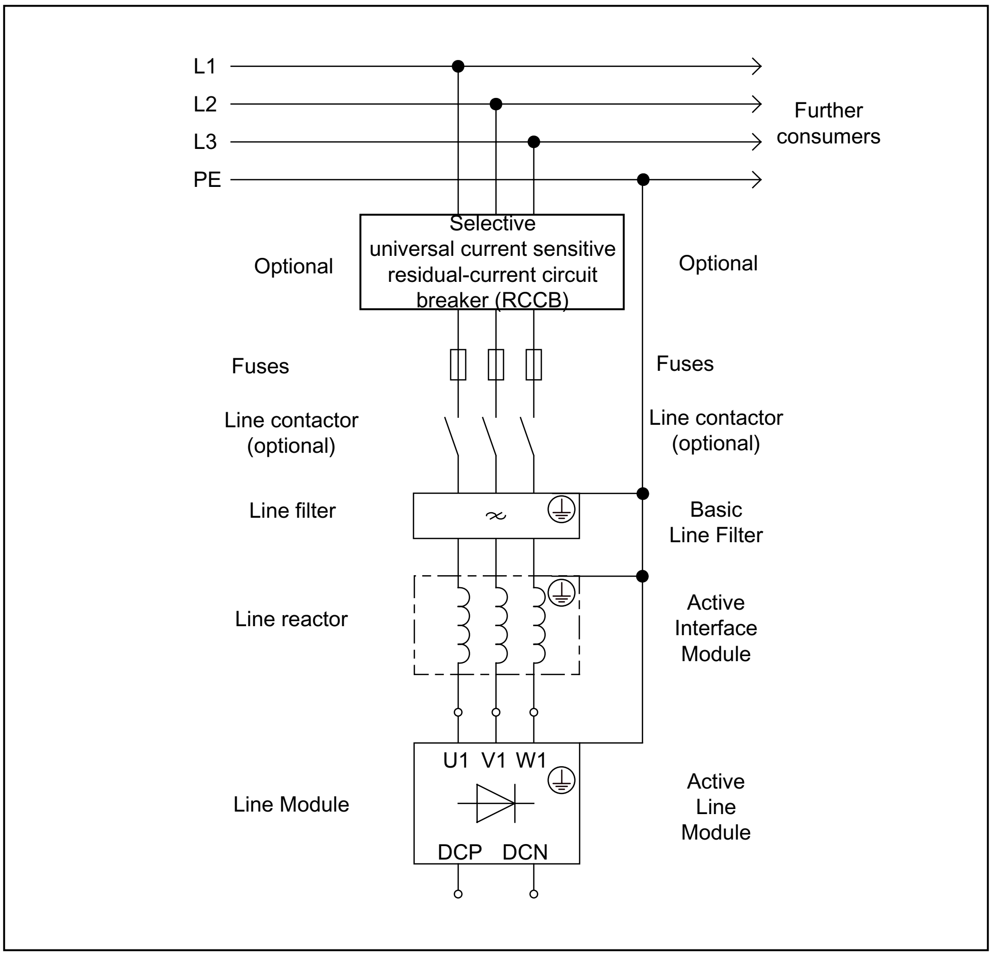


Figure 11-2 Connecting a residual-current operated circuit breaker

Recommendation

SIEMENS selectively switching AC/DC-sensitive residual-current circuit-breakers in accordance with EN 61009-1 of the 5SM series (e.g. 5SM3646-4 or 5SM3646-4+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")).

NOTICE
AC or pulse-sensitive RCCBs are not suitable.

11.2.4.2 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).

⚠ DANGER
Residual-current monitors must always be used in conjunction with appropriate circuit breakers.

⚠ DANGER
As a general rule, the higher loop impedance of TT systems means they are not suitable for tripping the installed overcurrent protection devices within the prescribed period should an insulation fault occur. When operating on TT systems at infeed powers above 55 kW and with systems that extend across a large area, residual-current monitors must be installed in addition to appropriate circuit breakers.

Please note the following:

- It is only permissible to use a delayed tripping, AC/DC-sensitive RCM type B, in order to ensure reliable tripping even with smooth residual currents.
- Accessible parts of the power drive system and the machine are connected to the system's protective conductor.
- The protective conductor must not be routed through the measuring current transformer, as this would negate its protection function.

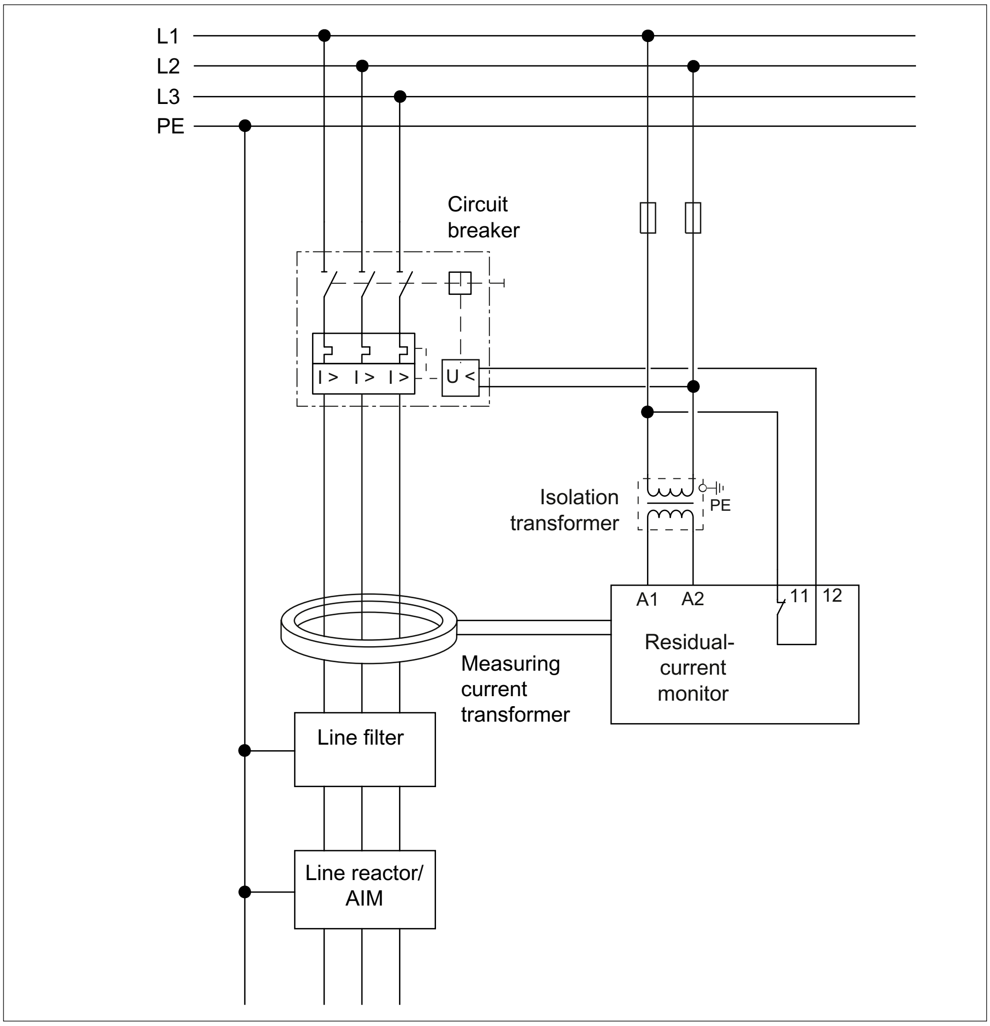


Figure 11-3 Connecting a residual-current monitor

Recommendation

- Bender AC/DC-sensitive residual-current monitor RCMA471LY, with measuring current transformer W120B (120 mm) or W210B (210 mm)
- Circuit breaker with thermal overload release, short-circuit release, and undervoltage release

11.2.5 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 fulfill the requirements of CSA C22.2 no. 14-05, surge protection is essential. For examples of suitable voltage surge arresters, see www.raycap.com (for example)

11.2.6 Line contactors

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

When selecting a line contactor, the characteristic values in the technical data apply. 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.

CAUTION
Line contactors must not be switched under load.

Note

To limit the switching overvoltage, the contactor coil must be connected to an overvoltage limiter (e.g. flywheel diode or varistor).

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

11.2.7 Line filter

A separate line filter (see catalog) must be used for the SINAMICS S120 drive line-up.

NOTICE
An additional line filter must be used to suppress interference in other loads. To prevent mutual interference, this line filter must not be equipped with line-side capacitors with respect to ground. Filter series B84144A*R120 (EPCOS) is recommended.

Note

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 for this purpose. The use of filters of other makes can lead to limit value violations, resonances, overvoltages, and irreparable damage to motors or other equipment. The machine manufacturer must provide verification that the machinery to be operated with the drive products and the installed suppression elements, e.g. line filters, are CE/EMC-compliant before the machines are approved for delivery.

For information on selecting and connecting the appropriate line filter, see chapter "Line Connection Booksize".

11.3 24 V DC supply voltage

11.3.1 General information

The 24 VDC voltage is required for the power supply of:

1. the electronics of the SINAMICS components using the integrated 24 V busbar
2. The electronics of the Control Units, Option Boards, Sensor Modules, and Terminal Modules, as well as the process voltage of their digital inputs
3. The load voltage of the digital outputs
4. The motor holding brakes

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

Note

The electronic power supply has to be supplied by the user as described in the System Data chapter of this documentation.

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

Note

The red 24 V connectors must be plugged in and are designed for a maximum of 5 withdrawal and insertion cycles.

NOTICE

If other consumers are connected to the power supply, connected inductance devices (contactors, relays) must be fitted with suitable overvoltage protection circuits.

DANGER

Only motors with a safe electrically isolated holding brake may be connected. The brake conductors must also be safely electrically isolated.

If the motor power cable is connected to intermediate terminals, the power cables and brake cables must be routed apart (≥ 300 mm).

DANGER

Only safety extra-low voltages (DVC A) that comply with EN61800-5-1 must be connected to the connections and terminals between 0 and 48 VDC.

The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.

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 V ± 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:

- Use of Siemens three-phase motors
- Use of Siemens MOTION-CONNECT power cables
- Motor cable lengths: max. 100 m

11.3.2 24 V power supply and connection of components

The Line Modules, Motor Modules, and DC-link components are connected to the 24 VDC power supply via the integrated 24 V busbars. The current carrying capacity of these busbars is 20 A.

The power can be supplied in two ways:

1. When a Current Supply Module is used, the 24 V supply can be directly established through 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.

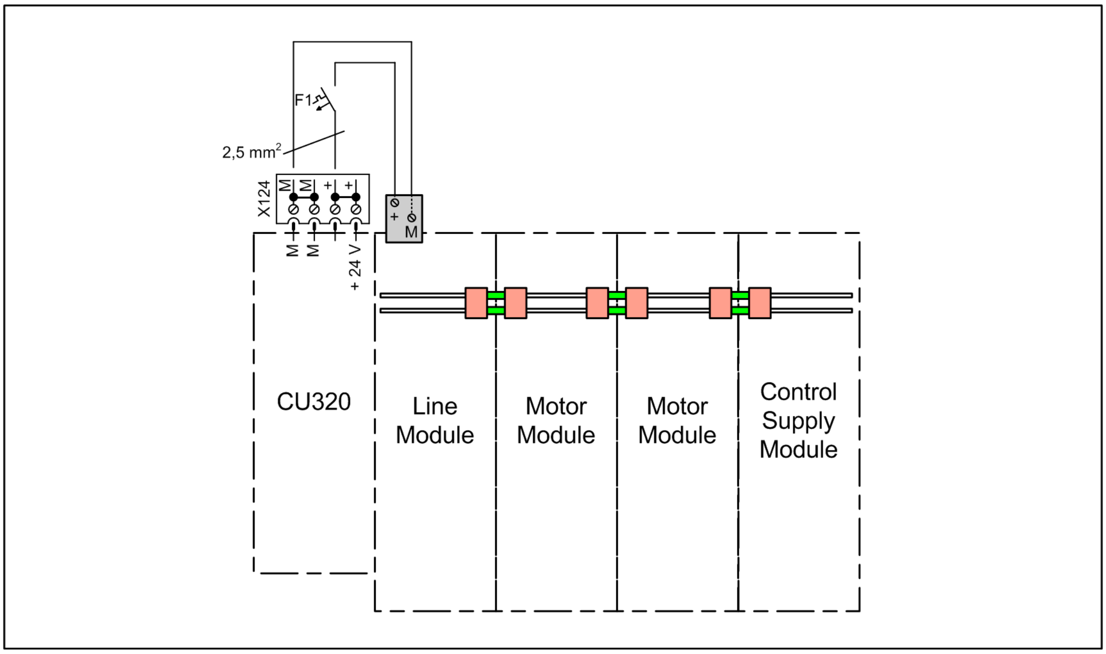


Figure 11-4 Example: 24 V supply with Control Supply Module

2. When using an external 24 V power supply, e.g. SITOP, the 24 V terminal adapter must be used. Miniature circuit breakers are recommended as overcurrent protection devices for cables and busbars. The ground potential M must be connected to the protective conductor system (DVC A).

24 V connector

- A 24 V connector must be plugged onto the 24 V busbar between each of the Line Module, Motor Module and DC-link component
- Insertion and withdrawal are only permissible in a de-energized state
- Only 5 withdrawal and insertion cycles are permissible

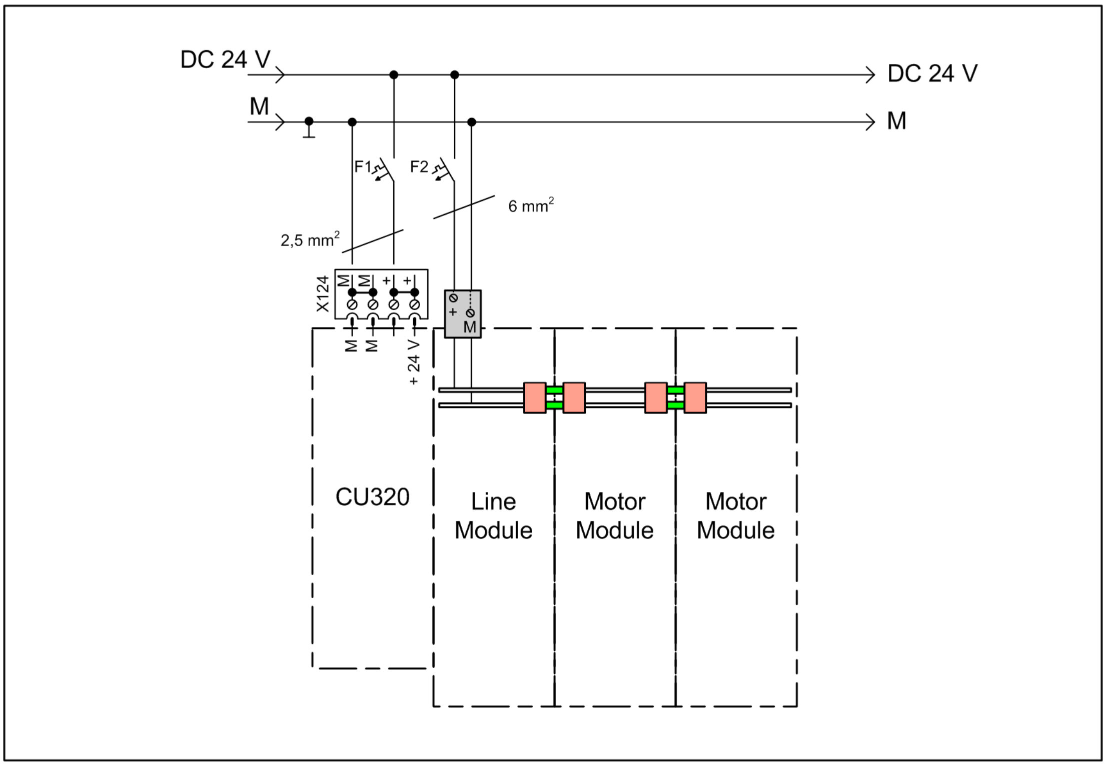


Figure 11-5 Example of 24 VDC fuse protection

Recommendation:
Miniature circuit breaker with tripping characteristic D

11.3.3 Protection against overcurrent and overvoltage in the 24 V solid-state circuit

11.3.3.1 Overcurrent protection

Cables on both the primary and the secondary side of the 24 V supply unit must be protected from overcurrent. Primary side protection must be implemented according to the manufacturer's instructions.

Secondary side protection must be rated to deal with the actual conditions. In particular:

- Loading due to loads, possibly the simultaneity factor in response to machine operation
- Current carrying capacity of the conductors used and cables in normal and short-circuit conditions
- Ambient temperature
- The bunching of the cables in a single duct
- Cable laying method to EN 60204-1

EN 60204-1, Section 14, can be used to determine the overcurrent protection devices.

Circuit breakers from the Siemens NSK catalog are recommended as overcurrent protection devices on the primary side, and miniature circuit breakers or SITOP select 6EP1961-2BA00 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 breakers, you must take into account the following standards:

EN 61800-5-1, EN 60204-1, IEC 60364-5-52, IEC 60287-1 to -3, EN 60228 and UL 508C.

The following conditions for the conductors/cables should be used as basis:

- Ambient temperature 55 °C
- Limit conductor temperature, ≤ 70 °C for operation with the rated load current
- Cable length max.:
  - 10 m for the supply cables
  - 30 m for signal lines

Further, the conductors/cables should be routed so that

- max. 1 conductor pair, bundled and
- the 24 V conductors should be separately routed away from other cables and conductors that could conduct the operating current.

Table 11- 5 MCBs by conductor cross-section and temperature

Conductor cross-section	Max. value up to 40 °C	Max. value up to 55°C
1.5 mm²	10 A	6 A
2.5 mm²	16 A	10 A
4 mm²	25 A	16 A
6 mm²	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.

11.3.3.2 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 11- 6 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
Weidmüller GmbH & Co. KG An der Talle 89 33102 Paderborn, Germany Phone +49 (0)5252 960 0 Fax +49 (0)5252 960 116 http://www.weidmueller.com	

The overvoltage protectors must always be positioned on the edge of the area to be protected, such as the entry point to the control cabinet.
The figure below shows how the overvoltage protectors are connected, using a CU320 as an example.

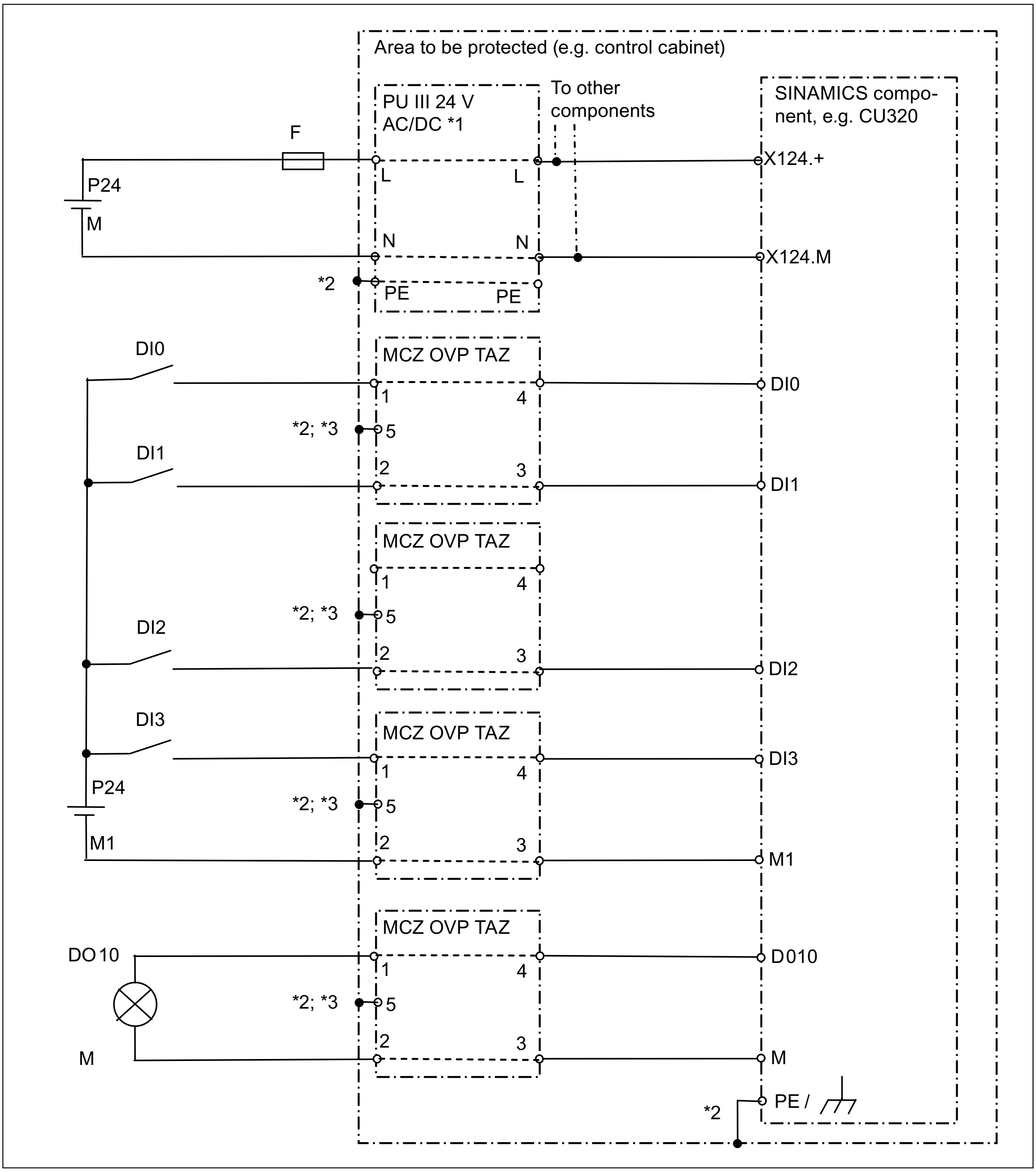


Figure 11-6 Connection example: Overvoltage protection components from Weidmüller to SINAMICS components

*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 protectors 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 make a good conductive interconnection 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 metallic mounting plate.

11.3.4 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 VDC power supply. The values for typical current consumption are used as a basis for configuration.

Table 11- 7 Overview of 24 VDC current consumption

Component	Typical current consumption [A_{DC}]
Control Units	
CU320 without load Per digital output PROFIBUS teleservice	0.8 0.1 Max. 0.15
CU320-2 DP without load Per digital output	1.0 0.1
Sensor Modules Cabinet	
SMC10 without/with encoder system	0.20 / 0.35
SMC20 without/with encoder system	0.20 / 0.355
SMC30 without/with encoder system	0.20 / 0.55
Sensor Modules External	
SME20 without/with encoder system	0.15 / 0.25
SME25 without/with encoder system	0.15 / 0.25
SME120 without/with encoder system	0.20 / 0.30
SME125 without/with encoder system	0.20 / 0.30
Terminal Modules	
TM15 (without digital outputs, without DRIVE-CLiQ) Per digital output/DRIVE-CLiQ	0.2 0.5
TM17 (without digital outputs, without DRIVE-CLiQ) Per digital output/DRIVE-CLiQ	0.2 0.5

Component	Typical current consumption [A_{DC}]
TM31 (without digital outputs, without DRIVE-CLiQ) Σ 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
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	0.2 0.5
CBC10	0.1
CBE20	
Active Interface Modules	
16 kW	0.25
36 kW	0.49
55 kW	1.2
80 kW	1.2
120 kW	1.2
Active Line Modules (internal/external air cooling)	
16 kW	1.1
36 kW	1.5
55 kW	1.9
80 kW	1.7
120 kW	2.1
Active Line Modules (cold plate cooling)	
16 kW	0.9
36 kW	1.0
55 kW	1.4
80 kW	1.7
120 kW	2.1
Smart Line Modules (internal/external air cooling)	
5 kW	1.0
10 kW	1.3
16 kW	1.1
36 kW	1.5
Smart Line Modules (cold plate cooling)	

Component	Typical current consumption [A_{DC}]
5 kW	0.7
10 kW	0.8
Smart Line Modules Booksize Compact	
16 kW (internal air cooling)	1.1
16 kW (cold plate cooling)	0.9
Basic Line Modules (internal/external air cooling)	
20 kW	1
40 kW	1.4
100 kW	2
Basic Line Modules (cold plate cooling)	
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)	0.9
45 A (+1 x DRIVE–CLiQ; +1 x brake)	1.2
60 A (+1 x DRIVE-CLiQ; +1 x brake)	1.2
85 A (+1 x DRIVE–CLiQ; +1 x brake)	1.5
132 A (+1 x DRIVE–CLiQ; +1 x brake)	1.2
200 A (+1 x DRIVE–CLiQ + 1 x brake)	1.2
Single Motor Modules (cold plate cooling)	
3 A (+1 x DRIVE–CLiQ; +1 x brake)	0.7
5 A (+1 x DRIVE–CLiQ; +1 x brake)	0.7
9 A (+1 x DRIVE–CLiQ; +1 x brake)	0.7
18 A (+1 x DRIVE–CLiQ; +1 x brake)	0.7
30 A (+1 x DRIVE–CLiQ; +1 x brake)	0.7
45 A (+1 x DRIVE–CLiQ; +1 x brake)	0.8
60 A (+1 x DRIVE–CLiQ; +1 x brake)	0.8
85 A (+1 x DRIVE–CLiQ; +1 x brake)	1.0
132 A (+1 x DRIVE–CLiQ; +1 x brake)	1.2
200 A (+1 x DRIVE–CLiQ; +1 x brake)	1.2
Single Motor Modules Booksize Compact (internal air cooling)	
3 A (+1 x DRIVE–CLiQ; +1 x brake)	0.75
5 A (+1 x DRIVE–CLiQ; +1 x brake)	0.75
9 A (+1 x DRIVE–CLiQ; +1 x brake)	0.75

Component	Typical current consumption [A_{DC}]
18 A (+1 x DRIVE–CLiQ; +1 x brake)	0.75
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	
2 x 1.7 A (+2 x DRIVE–CLiQ; +2 x brake)	1
2 x 3 A (+2 x DRIVE–CLiQ; +2 x brake)	1
2 x 5 A (+2 x DRIVE–CLiQ; +2 x brake)	1
Braking Module	0.5

If no other specifications are made to the contrary, the Line Modules and Motor Modules listed here are components in booksize format.

Example: calculating 24 VDC current requirements

Table 11- 8 Example of 24 VDC current requirements

Component	Number	Current consumption [A]	Total current consumption [A]
CU320 8 digital outputs	1 8	0.8 0.1	0.8 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	0.9	2.7
Encoders	5	0.25	1.25
Brake	5	1.1	5.5
Total:			14.25

11.3.5 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 11- 9 Recommended SITOP Power

Rated output current [A]	Phases	Rated input voltage [V] Working voltage range [V]	Short-circuit current [A]	Order number
5	1 / 2	120 - 230/230 - 500 85 - 264/176 - 550 AC	Approx. 5.5 (power up), typ. 15 for 25 ms (operation)	6EP1333-3BA00-8AC0
10	1 / 2	120 - 230/230 - 500 85 - 264/176 - 550 AC	Approx. 12 (power up), typ. 30 for 25 ms (operation)	6EP1334-3BA00-8AB0
20	1 / 2	120/230 85 - 132/176 - 264 AC	Approx. 23 (power up), typ. 60 for 25 ms (operation)	6EP1336-3BA00-8AA0
	3	230/400 to 288/500 320 - 550 3 AC		6EP1436-3BA00-8AA0
40	1 / 2	120/230 85 - 132/176 - 264 AC	Approx. 46 (power up), typ. 120 for 25 ms (operation)	6EP1337-3BA00-8AA0
	3	230/400 to 288/500 320 - 550 3 AC		6EP1437-3BA00-8AA0

Table 11- 10 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	6SL3100-1DE22-0AA0

Refer also to Catalog PM21 or NC61.

WARNING

When using external power supplies, e.g. SITOP, the following points must be observed:

- The ground potential M must be connected to the protective conductor terminal (DVC A).
- The power supply must be installed close to the drive line-up.

Ideally, they should be installed on a common mounting plate. If different mounting plates are used, their electrical interconnection must comply with the EMC installation guideline.

This installation guideline covers protection against electric shock, protection against fire, and best possible electromagnetic compatibility.

11.4 Arrangement of components and equipment

11.4.1 General information

The arrangement of the components and equipment takes account of

- Space requirements
- Cable routing
- Bending radii of the connection cables
  MOTION-CONNECT cables, refer to catalog PM21 or NC61
- Heat dissipation
- EMC

Components are usually located centrally in a cabinet.

The necessary mounting and installation clearances above an below the components can, under certain circumstances, exceed the minimum clearances specified in the product documentation.

11.4.2 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 depending on the width of the power units.

- For Motor Modules from 3 A to 30 A and with order number ...-0AA3 and above (width 50 mm and 100 mm) and for DC-link components (Braking, Capacitor and Control Supply Module), the DC-link busbar can be loaded with 100 A.
- For power units from 3 A to 30 A (width 50 mm and 100 mm) with reinforced DC-link busbars, the DC-link busbar can be loaded with 150 A.
- For power units from 45 A to 200 A (150 / 200 / 300 mm width) and for Motor Modules with order number ...-0AA3 and above, the DC-link busbar can be loaded with 200 A.

If the current carrying capacity of the DC-link busbar is exceeded, two solutions are possible: either the arranagement of the drive line-up with infeed from left and right (center infeed; see below) or the use of another Line Module.

Note

The following examples are based on the concurrent use and loading of the Motor Modules with the rated output current of the Motor Modules. The current values are taken from the Equipment Manual Booksize Power Units or the NC61 catalog.

Example 1:

Connection of several Motor Modules with different current carrying capacity of the DC-link busbar to a Line Module.

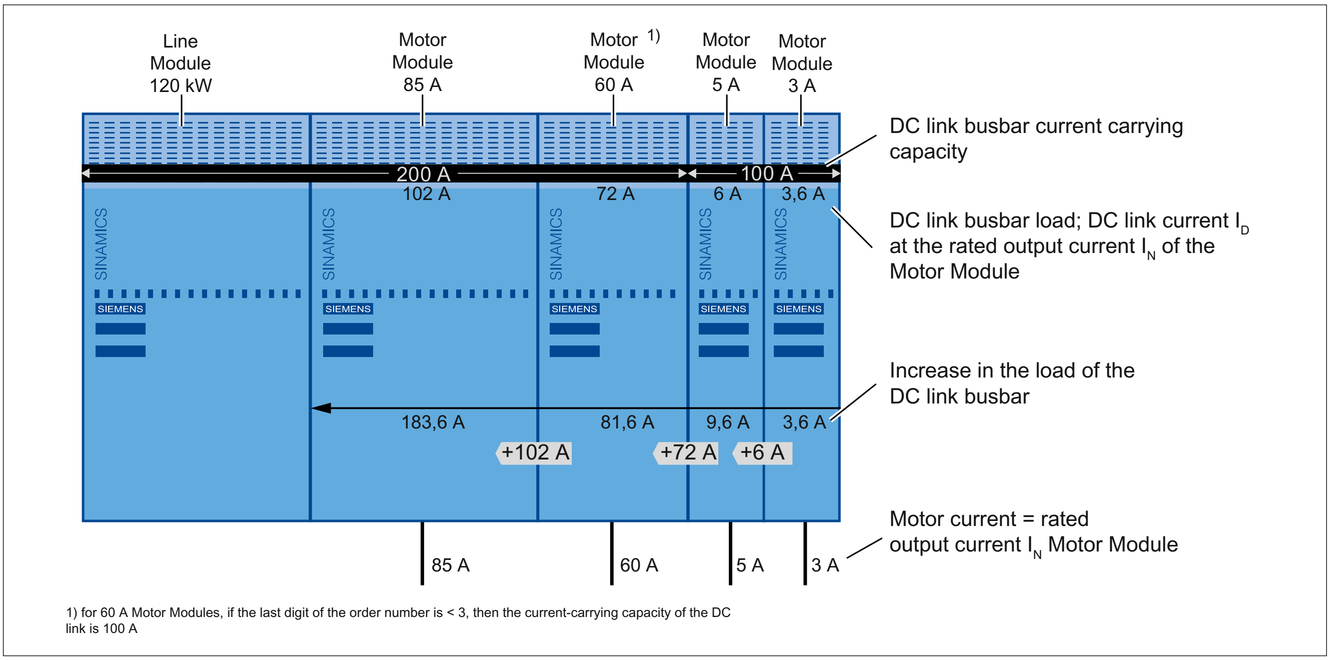


Figure 11-7 Regular arrangement; DC link busbar not overloaded

Example 2:

Connection of several Motor Modules with the same current carrying capacity of the DC-link busbar to a Line Module with center infeed.

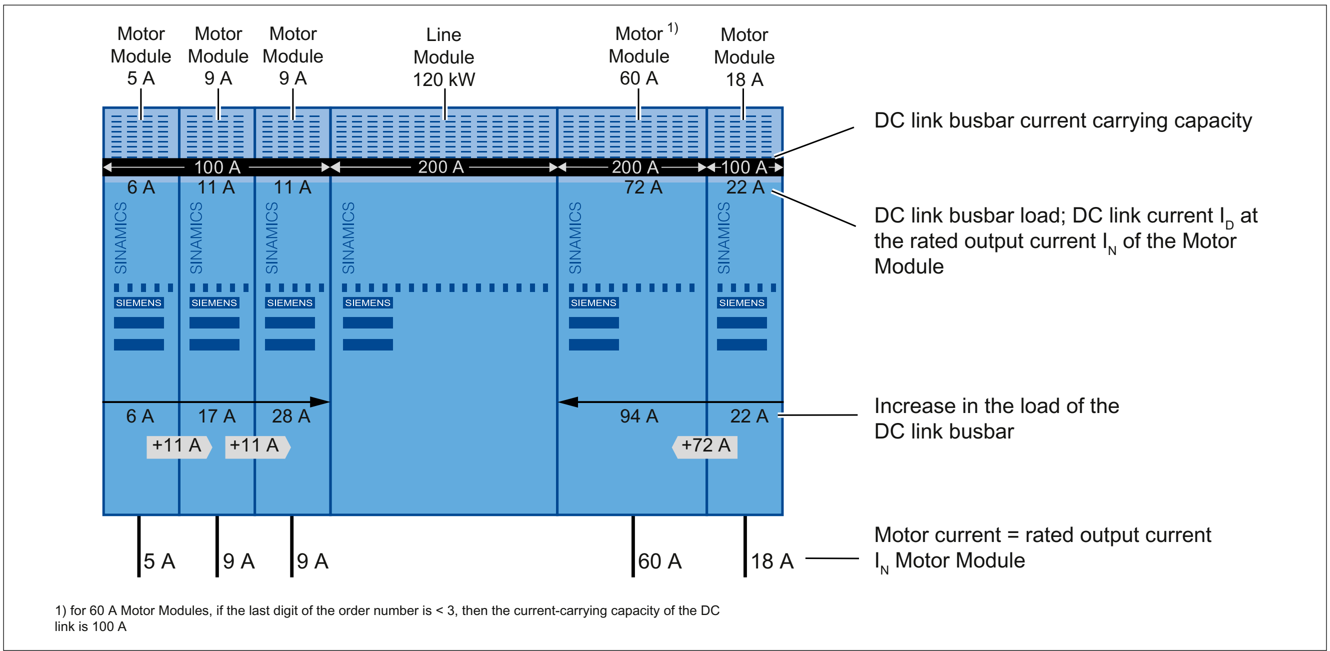


Figure 11-8 Infeed from left and right (center infeed)

A center infeed with Motor Modules to the right and left of the Line Module can be configured for all Line Modules.
Exception: Smart Line Modules 5 kW and 10 kW

11.4.3 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)

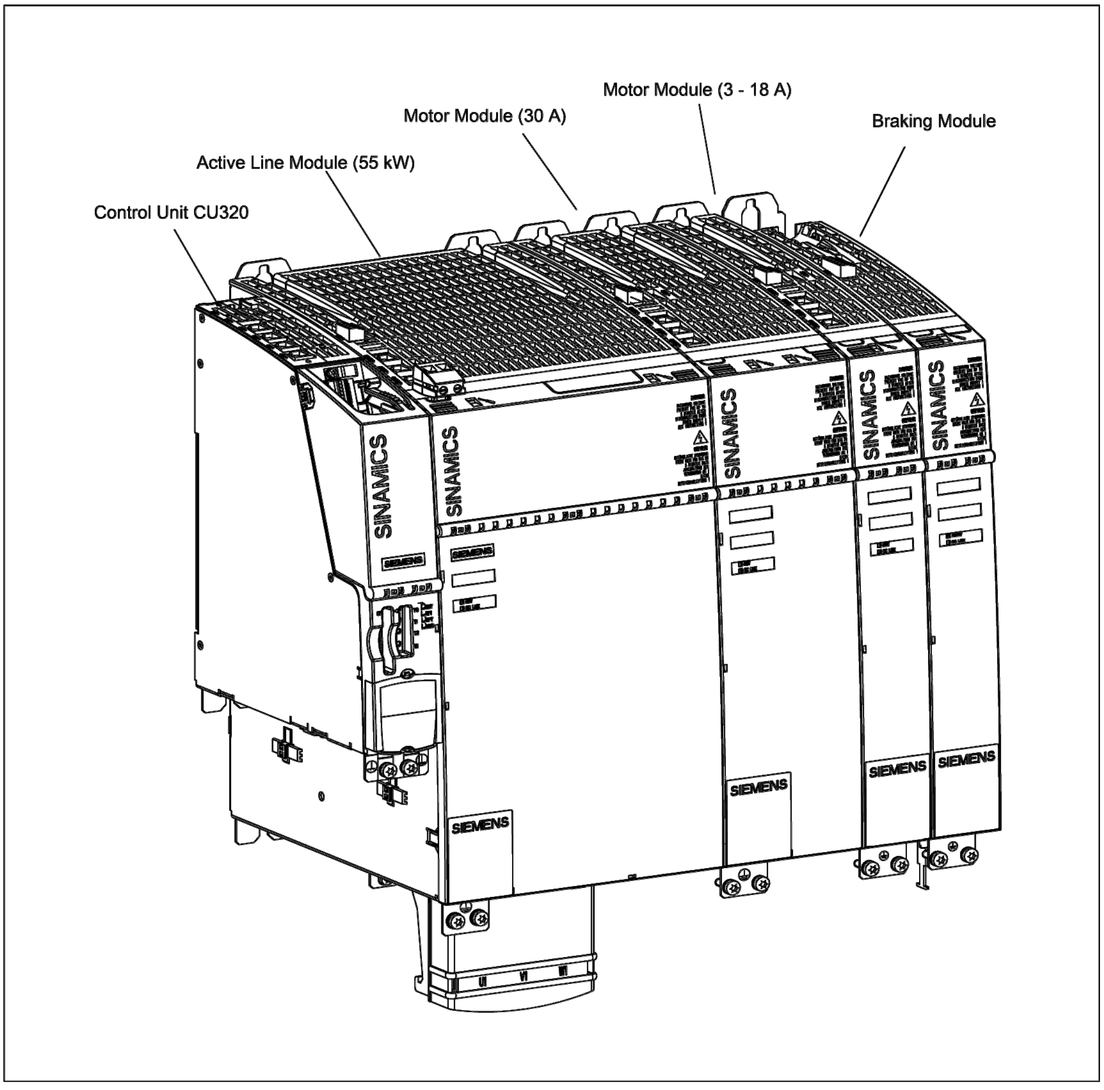


Figure 11-9 Example of a drive line-up

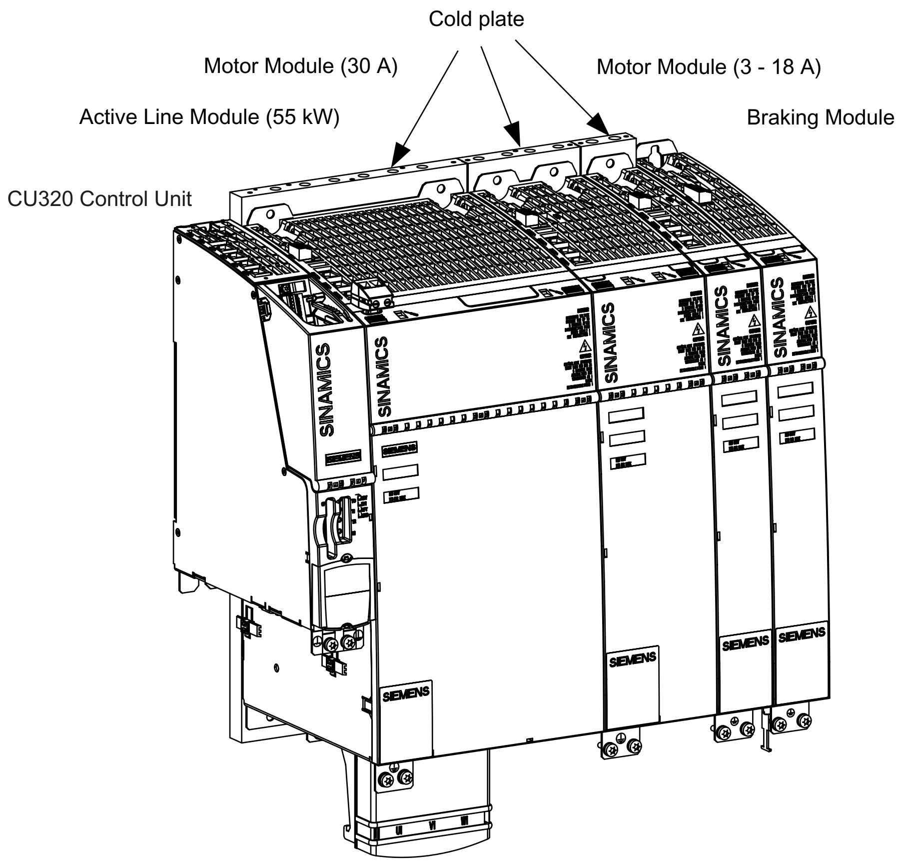


Figure 11-10 Example of a drive line-up with cold plate

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.

The components can be arranged in one or more tiers. In a multiple-tier arrangement, vertical installation or, in a cabinet row, side-by-side installation in different cabinet sections is possible.

To determine the cross-section, use the DC-link busbar current carrying capacity given in the relevant technical data.

A ventilation clearance of 100 mm must be maintained around the line reactor (not including the mounting surface).

Note concerning the use of components with a width of 50 mm

DANGER

If a 50 mm wide Motor Module or a DC-link component with a similar width (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC-link bridge, including all of the screws, must be removed. It is not permissible to insert the screws without a DC-link bridge.

For all other Line Modules and DC-link components (e.g. Capacitor Module) that are wider than 50 mm, it is not permissible to remove the DC-link bridge.

If this is not carefully observed, this can result in damage and accidents.

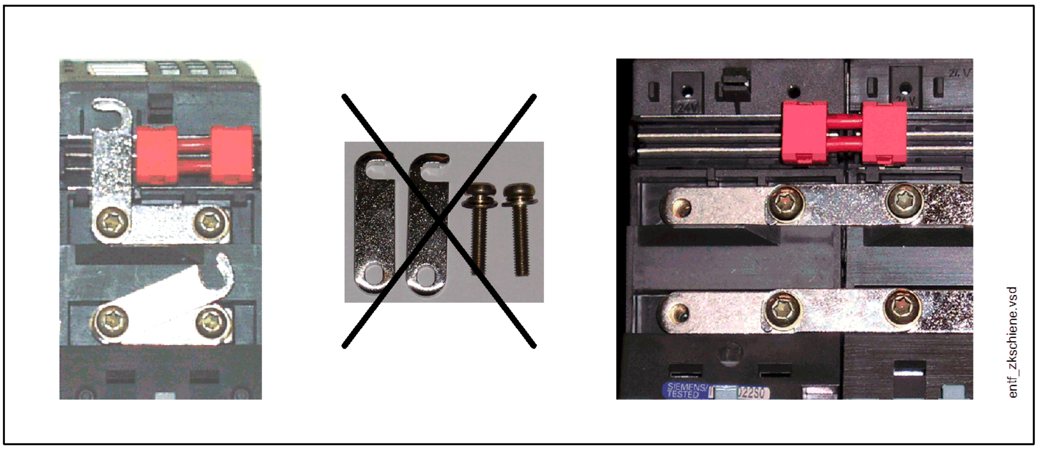


Figure 11-11 Removing the DC-link bridges

The DC-link bridges must be removed by unscrewing the M4 screws.

11.4.4 Multi-tier drive line-up

11.4.4.1 Arrangement rules

Design of a multi-tier drive line-up

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.
- Continuation of the DC link is achieved outside of the components with the DC-link adapter (for information on installation, refer to the chapter titled "Accessories") using single-core, finely-stranded, shielded cables that are laid so as to ensure they are inherently short-circuit and ground-fault proof.
- The distance between the rows 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.

CAUTION
Signal cables must not be routed parallel to power cables.

Note

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 the chapter titled "Single-tier drive line-up" apply in reverse.

This means that: The Motor Modules are arranged in order of power from the highest power to the lowest power, followed by the DC-link components, such as the Braking Module, at the end.

Wiring rules for DRIVE-CLiQ

Refer to the Commissioning Manual.

Selecting the DC-link adapter and DC-link rectifier adapter

Table 11- 11 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 mm²	43 A
6SL3162-2BM00-0AAx	150 mm, 200 mm, 300 mm	95 mm²	240 A
DC-link adapter (cable outlet on side)			
6SL3162-2BM01-0AAx	All	95 mm²	240 A

11.4.4.2 Examples of a multi-tier configuration

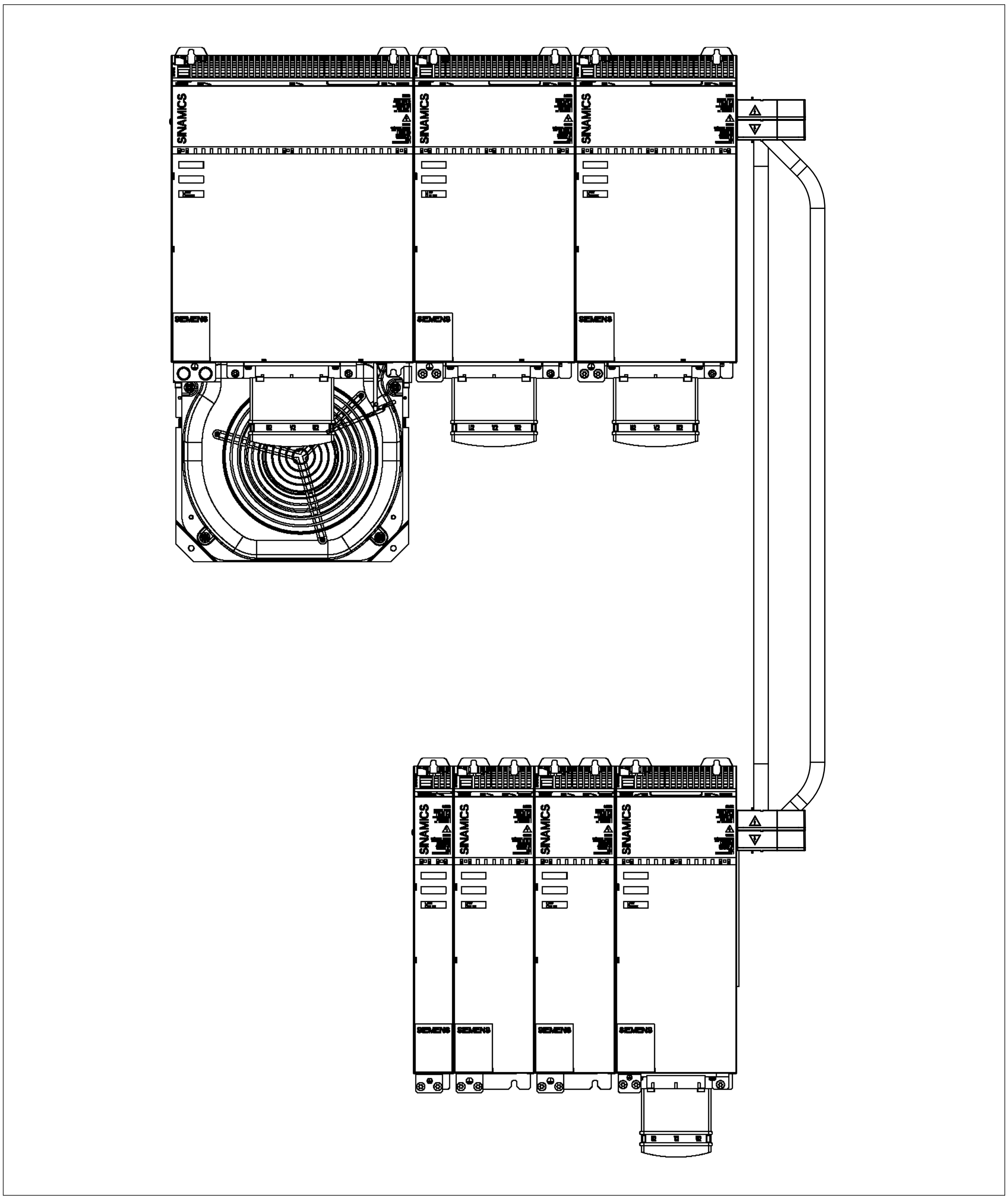


Figure 11-12 Example of a two-tier configuration with components between 150 and 300 mm wide

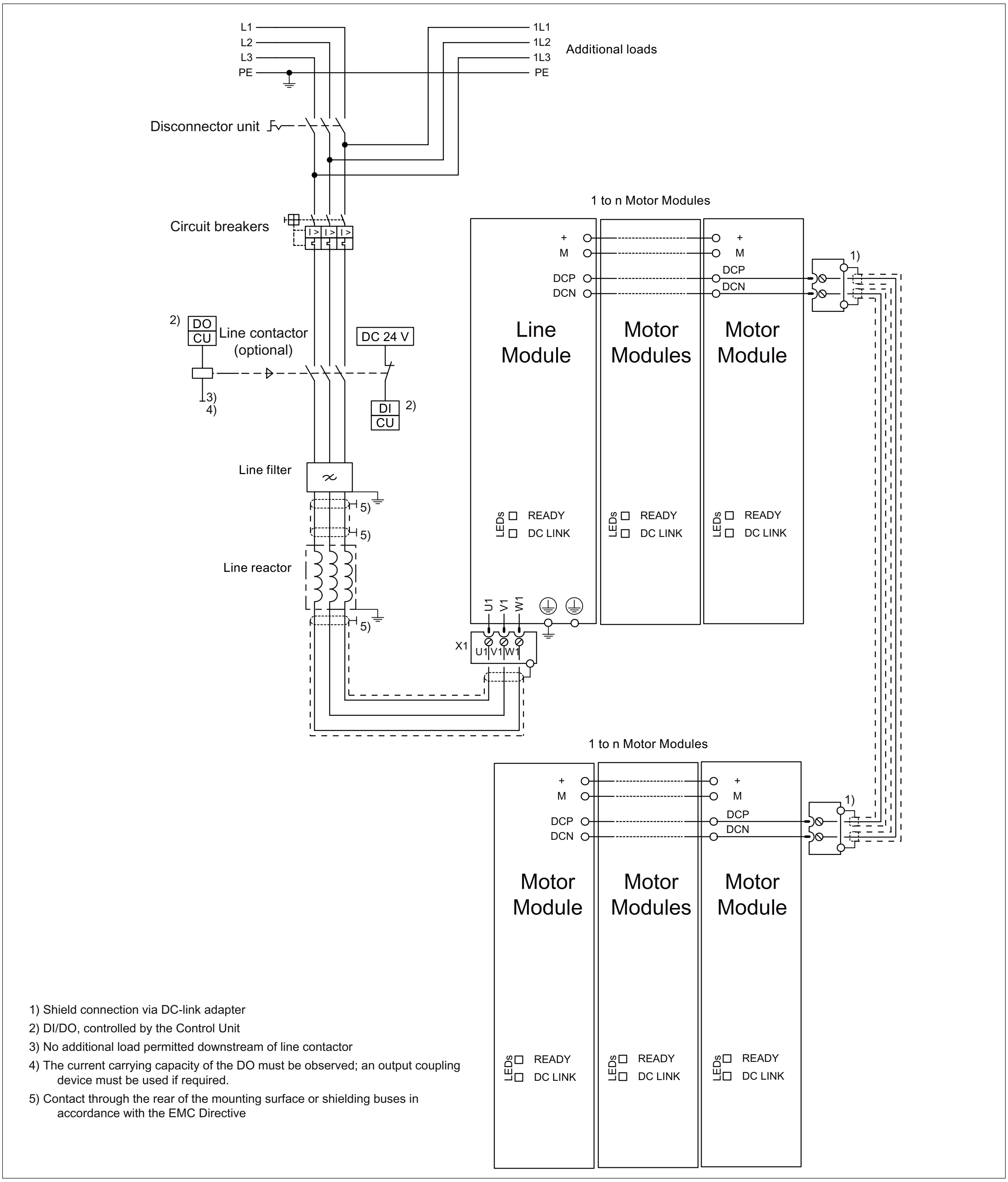


Figure 11-13 Connection example of a two-tier drive line-up

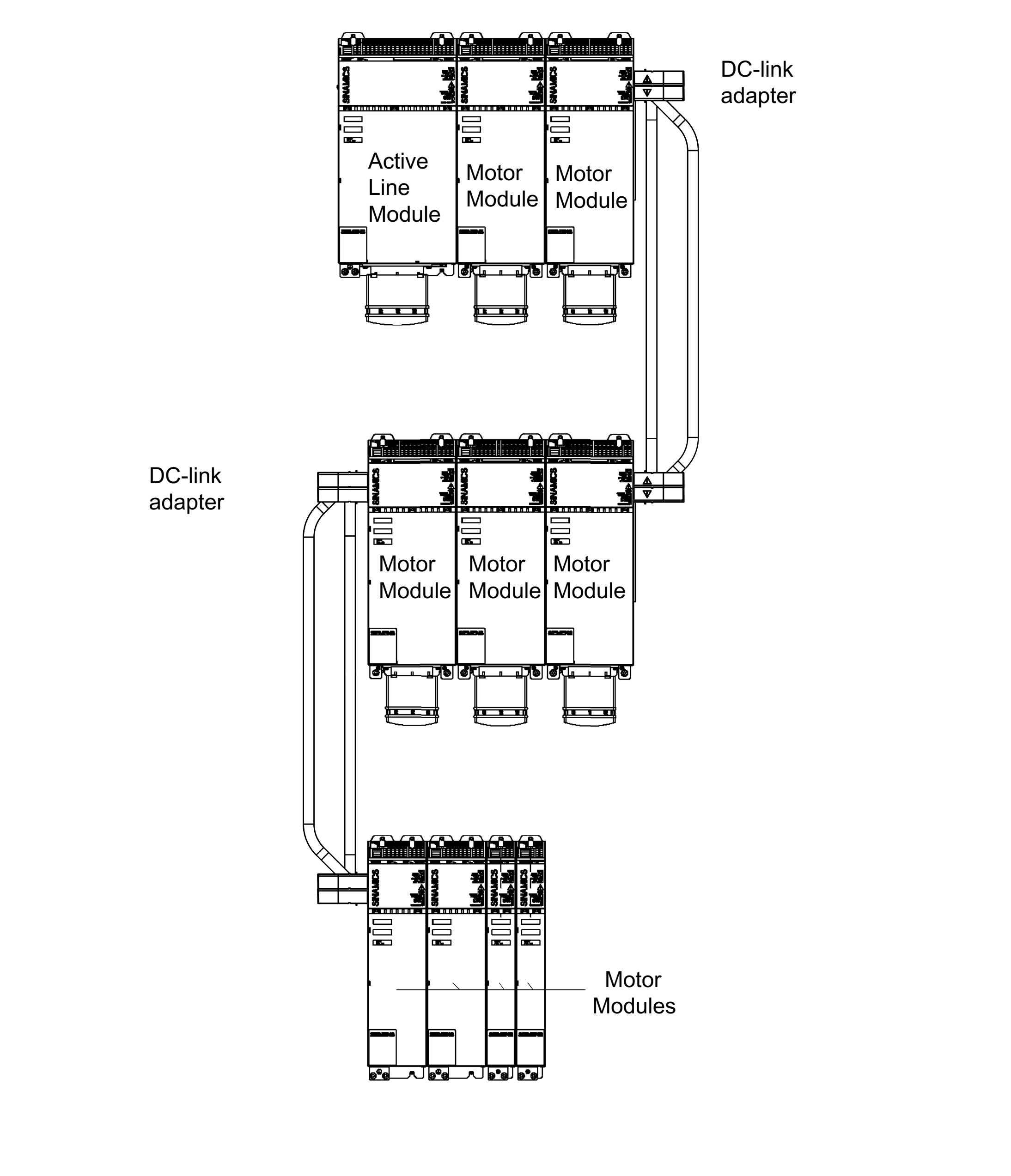


Figure 11-14 Example of a three-tier configuration with components between 50 and 200 mm wide

11.5 Information about electromagnetic compatibility (EMC) and cable routing

11.5.1 General information

Requirements to implement EMC are listed in EN 61000-6-2, EN 61000-6-4, EN 61800-3, EN 60204-1 and in the EMC Design Directives - Order number 6FC5297-0AD30-0*P2. German, *B: English). Conformance with the EMC Directive of the EC can be secured by following the measures described in the EMC Design Directives.
When mounting components in cabinets, in order to fulfill the EMC directive, the following conditions must be additionally observed:

- Connected to TN and TT supply systems with grounded neutral point and grounded line conductor as well as to IT supply systems.
- Observance of information about cable shielding and equipotential bonding.
- Only the recommended Siemens power and signal cables are used
- Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION
If couplings or cabinet glands are needed for the DRIVE-CLiQ connections, only the DRIVE-CLiQ coupling and DRIVE-CLiQ cabinet gland, described in the Chapter Accessories, may be used.

DANGER
If the shielding procedures described and the specified cable lengths are not observed, the machine may not operate properly.

11.5.2 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 full 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

DANGER

A suitable PE conductor must be connected to all devices in protection class I.

The protective conductor connection of the individual components must be at least 4 mm².

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.

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 Siemens power cables in which the shield is connected to the connector shell (see relevant catalog), this is a sufficiently good shield support.

With 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, these plates are part of the scope of delivery of the components, or they are integrated in the connector.

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.

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.

DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

11.5.3 Signal and 24 V supply cables

If you are using unshielded signal and 24 V supply cables (e.g. 24 V infeed with external supply), the following unshielded cable lengths are permissible:

- 24 V supply cables: max. length 10 m
- Signal cables: max. length 30 m without additional wiring

For longer lengths, the user must connect a suitable protective circuit up in order to provide overvoltage protection (refer to the chapter titled “Overvoltage protection” under "24 VDC supply")

NOTICE

The connected signal and power cables must be routed to the components in such a way that they do not cover the ventilation slots.

CAUTION

Unshielded signal cables must not be routed parallel to power cables.

11.5.4 Motor cable

Booksize format Motor Modules

Where a long motor cable is required, a higher rating of Motor Module must be selected or the permissible continuous output current $I_{continuous}$ must be reduced in relation to the rated output current I_{rated}. The configuring data for booksize format Motor Modules are given in the following table:

Table 11- 12 Permissible motor cable lengths

Motor Module	**Length of motor cable (shielded)**			
Rated output current I_N	**> 50 … 100 m**	**> 100 … 150 m**	**> 150 … 200 m**	**> 200 m**
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 $I_{max} \leq 1.5 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	Use 30 A Motor Module	Not permissible	Not permissible
30 A	Always permitted	$I_{max} \leq 1.35 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$	$I_{max} \leq 1.1 \times I_{rated}$ $I_{continuous} \leq 0.85 \times I_{rated}$	Not permissible
45 A/60 A	Always permitted	$I_{max} \leq 1.75 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$	$I_{max} \leq 1.5 \times I_{rated}$ $I_{continuous} \leq 0.85 \times I_{rated}$	Not permissible
85 A/132 A	Always permitted	$I_{max} \leq 1.35 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	$I_{max} \leq 1.1 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$	Not permissible
200 A	Always permitted	$I_{max} \leq 1.25 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	$I_{max} \leq 1.1 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$	Not permissible

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.

11.5.5 DRIVE-CLiQ cables

DRIVE-CLiQ signal cables without 24 V DC conductors

Table 11- 13 DRIVE-CLiQ cable lengths 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 longer are used to connect up other applications (e.g. connection to Sensor Modules Cabinet-Mounted, establish a 2nd line in the drive group, establish a star-type wiring configuration etc.)

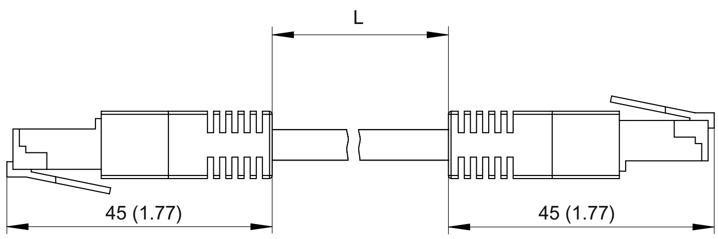


Figure 11-15 DRIVE-CLiQ signal cable without 24 V DC conductors

DRIVE-CLiQ signal cables with 24 V DC conductors

Note

Only MOTION-CONNECT DRIVE-CLiQ cables are permitted to be used for connection. The maximum cable length for Motion Connect 500 cables is 100 m and for Motion Connect 800 cables, 50 m.

Permissible cable length when using DRIVE-CLiQ data couplings

If DRIVE-CLiQ data couplings are used, the permissible cable length can be calculated as follows:

$\Sigma MC500 + 2 * \Sigma MC800 + n_c * 5\ m \leq 100\ m$

ΣMC500: Total length of all MC500 cable sections

ΣMC800: Total length of all MC800 cable sections

n_c: Number of DRIVE-CLiQ couplings (max. 0..3)

11.5.6 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 11- 14 Maximum cable lengths

Type	Maximum length [m]	Radio-interference-voltage category
24 VDC supply cables 1)	10	
24 V signal cables 1)	30	
DRIVE-CLiQ signal cables MC500	100	
DRIVE-CLiQ signal cables MC800	50	
DRIVE-CLiQ signal cables FIX	70	
DC link, including extensions	10	
Total cable length for Line Modules with line filter and line reactor 4)	350 (shielded) 3) 560 (unshielded) 3)	C2
Total cable length for Active Line Module with Active Interface Module 4)	350 (shielded) 3)	C3
Total cable length for Active Line Module (16 kW and 36 kW) with Active Interface Module and Basic Line Filter 4)	630 (shielded) 3)	C3
Total cable length for Active Line Module (55 kW to 120 kW) with Active Interface Module and Basic Line Filter 4)	1000 (shielded) 3)	C3
Total cable length for Active Line Module with Basic Line Filter and line reactor 4)	< 150 (shielded) 3)	C2
Total cable length with Voltage Clamping Module (for conditions, refer to the chapter titled "Voltage Clamping Module")	630 (shielded) 850 (unshielded)	
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 ≥ 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 up in order to provide overvoltage protection (refer to the chapter titled “Overvoltage protection” under "24 VDC supply")
2) To comply with EMC limit values, shielded cables (preferably Motion-Connect cables) must be used.
3) Refer to the chapter titled "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 cable(s), and the line supply conductor from the line filter output on.

11.5.7 Equipotential bonding

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

The machine OEM has to ensure that all conditions with regard to the assignment of ground cable connectors, protective conductor and equipotential bonding conductor connectors and terminals are indicated clearly in the Technical User Manual / Manufacturer Documentation (extremely important when several protective conductor/equipotential bonding conductor connections/terminals are available in the device). A special note must be made for connectors/terminals for equipotential bonding connections that are available in parallel with protective ground connection cables, indicating that they must not be used for looping through the protective ground connection.

If the drive line-up is arranged on a common unpainted metal-surfaced mounting plate, e.g. with a galvanized surface, no additional equipotential bonding is needed within the drive line-up as

- All parts of the switchgear assembly are connected to the protective conductor system.
- The mounting plate is connected with the external PE conductor by means of a finely-stranded copper conductor with a cross-section of 16 mm², including the outer conductor. From a cross-section of 25 mm² copper, the outer cross-section of the finely-stranded conductor is halved.

For other installation methods, equipotential bonding must be implemented using conductor cross-sections as stated in the second item in the list or at least equal to the conductance.

If components are mounted on DIN rails, the specifications listed in the second item applies to equipotential bonding. If only smaller connection cross-sections are permissible on components, the largest must be used (e.g. 6 mm² for TM31 and SMC). These requirements also apply to distributed components located outside the cabinet.

⚠ CAUTION
An equipotential bonding conductor with a cross-section of at least 25 mm² must be used between components in a system that are located at a distance from each other. If an equipotential bonding conductor is not used, leakage currents that could destroy the Control Unit or other PROFIBUS nodes can be conducted via the PROFIBUS cable.

Create a low-impedance ground connection for additional cabinets, system components, and distributed devices with the largest possible cross-section (at least 16 mm²). Other system and machine components must also be integrated in the equipotential bonding concept. The PE conductor for the motors used must be connected via a PE conductor within the motor cable.

NOTICE
If the above information about equipotential bonding is not taken into account, this can cause the field bus interfaces to malfunction or devices to malfunction.

Functional ground connection for PROFIBUS

Note

Functional ground

Ensure that grounding is carried out properly and is suitable for high frequencies to enable HF currents to flow to ground. The protective grounding provided should not be used as functional ground.

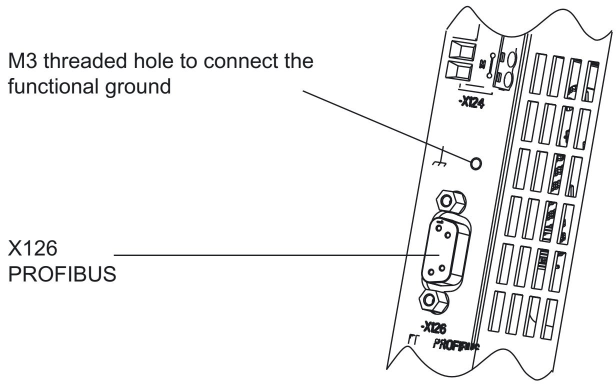


Figure 11-16 Functional ground connection for PROFIBUS

The following connectors are recommended:

- PROFIBUS connector without PG/PC connection (6ES7972-0BA41-0XA0)
- PROFIBUS connector with PG/PC connection (6ES7972-0BB41-0XA0)

11.6 Connection systems

11.6.1 Connectable conductor cross-sections for spring-loaded terminals

Table 11- 15 Spring-loaded terminals

Spring-loaded terminal type			
1	Connectable conductor cross-sections	Rigid Flexible Flexible with end sleeve without plastic sleeve AWG/kcmil	0.14 mm² to 0.5 mm² 0.14 mm² to 0.5 mm² 0.25 mm² to 0.5 mm² 26 to 20
	Stripped length	8 mm	
	Tool	Screwdriver 0.4 x 2.0 mm	
2	Connectable conductor cross-sections	Flexible	0.08 mm² to 2.5 mm²
	Stripped length	8 to 9 mm	
	Tool	Screwdriver 0.4 x 2.0 mm	
3	Connectable conductor cross-sections	Rigid Flexible Flexible with end sleeve without plastic sleeve Flexible with end sleeve with plastic sleeve AWG/kcmil	0.2 mm² to 1 mm² 0.2 mm² to 1.5 mm² 0.25 mm² to 1.5 mm² 0.25 mm² to 0.75 mm² 24 to 16
	Stripped length	8 mm	
	Tool	Screwdriver 0.4 x 2.0 mm	
4	Connectable conductor cross-sections	25 mm² to 95 mm² AWG 4 to 4/0	
	Stripped length	35 mm	
5	Connectable conductor cross-sections	Rigid Flexible Flexible with end sleeve without plastic sleeve Flexible with end sleeve with plastic sleeve AWG/kcmil	0.2 mm² to 10 mm² 0.2 mm² to 6 mm² 0.25 mm² to 6 mm² 0.25 mm² to 4 mm² 24 to 8
	Stripped length	15 mm	

11.6.2 Connectable conductor cross-sections for screw terminals

Table 11- 16 Screw terminals

Screw terminal type			
1	Connectable conductor cross-sections	Rigid, flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.08 mm² to 1.5 mm² 0.25 mm² to 1.5 mm² 0.25 mm² to 0.5 mm²
	Stripped length	7 mm	
	Tool	Screwdriver 0.4 x 2.0 mm	
	Tightening torque	0.22 to 0.25 Nm	
2	Connectable conductor cross-sections	Rigid, flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.08 mm² to 2.5 mm² 0.5 mm² to 2.5 mm² 0.5 mm² to 1.5 mm²
	Stripped length	7 mm	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 to 0.6 Nm	
3	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.2 mm² to 2.5 mm² 0.25 mm² to 1 mm² 0.25 mm² to 1 mm²
	Stripped length	9 mm	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 to 0.6 Nm	
4	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.2 mm² to 4 mm² 0.25 mm² to 4 mm² 0.25 mm² to 4 mm²
	Stripped length	7 mm	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 to 0.6 Nm	
5	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.5 mm² to 6 mm² 0.5 mm² to 6 mm² 0.5 mm² to 6 mm²
	Stripped length	12 mm	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.2 to 1.5 Nm	
6	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.5 mm² to 10 mm² 0.5 mm² to 10 mm² 0.5 mm² to 10 mm²
	Stripped length	11 mm	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.5 to 1.8 Nm	
7	Connectable conductor cross-sections	0.5 mm² to 16 mm²	
	Stripped length	14 mm	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.5 to 1.7 Nm	

11.6.3 Current-carrying capacity for power 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 with reference to an ambient air temperature of 40 °C. For other ambient temperatures, the values must be corrected by the factors from the table of derating factors.

Cross section	Current-carrying capacity rms; 50/60 Hz AC or DC for routing type			Standard
mm²	B1 A	B2 A	C A	
Electronics				EN 60204-1
0.20	–	4.3	4.4	
0.50	–	7.5	7.5	
0.75	–	9	9.5	
Power				EN 60204-1
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	
Power				IEC 60364-5-52
150	–	–	344	
185	–	–	392	
> 185	Values must be taken from the standard			

11.6.4 Derating factors for power and signal cables

Ambient air temperature °C	Derating factor In accordance with 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

11.6.5 Connectable conductor cross-sections for motor cables and line supply conductors

Table 11- 17 Connectable conductor cross-sections: Line supply conductor / motor cable, part 1

		Connection cross-section [mm²]						
Component	**Terminal type**	**0.5**	**1.5**	**2.5**	**4**	**6**	**10**	**16**
Motor Module Booksize format 3 A to 30 A 2 x 3 A to 2 x 18 A	Motor connection plug 30 A 3+2 pin		X	X	X	X	X	
Motor Module Booksize Compact format 1.7 A - 18 A	Screw terminal		X	X	X	X		
Motor Module 45 A to 60 A	Threaded bolt M6/6 Nm 1)					X	X	X
Motor Module 85 A	Threaded bolt M8/13 Nm							X
Smart Line Module Booksize format 5 kW to 10 kW	Screw terminal		X	X	X	X		
Smart Line Module Booksize Compact format 16 kW	Screw terminal					X	X	X
Active Line Module 16 kW Smart Line Module 16 kW	Screw terminal					X	X	
Active Line Module 36 kW Smart Line Module 36 kW	Threaded bolt M6/6 Nm							X
Active Interface Module 16 kW	Screw terminal					X	X	X
Active Interface Module 36 kW	Screw terminal							X

1) For ring cable lugs in accordance with DIN 46234
Terminal area for flexible cable with end sleeve
Terminal area for flexible cable with ring cable lug M6
Terminal area for flexible cable with ring cable lug M8
IP2xB to EN 60529 ensured; note: The restrictor collar installed as standard for the purpose of touch protection must be used or adapted as appropriate.

Table 11- 18 Connectable conductor cross-sections: Line supply conductor / motor cable, part 2

		Connection cross-section [mm²]					
Component	**Terminal type**	**25**	**35**	**50**	**70**	**95**	**120**
Motor Module 45 A to 60 A	Threaded bolt M6/6 Nm 1)	X	X	X			
Motor Module 85 A 2)	Threaded bolt M8/13 Nm	X	X	X	X	X	X
Motor Module 132 A to 200 A 2)	Threaded bolt M8/13 Nm	X	X	X	X	X	X
Active Line Module 36 kW Smart Line Module 36 kW	Threaded bolt M6/6 Nm	X	X	X			
Active Line Module 55 kW 2)	Threaded bolt M8/13 Nm		X	X	X	X	X
Active Line Module 80 kW to 120 kW 2)	Threaded bolt M8/13 Nm				X	X	X
Active Interface Module 36 kW	Screw terminal	X	X	X			
Active Interface Module 55 kW	Screw terminal		X	X			
Active Interface Module 80 kW to 120 kW 2)	Threaded bolt M8/13 Nm				X	X	X

1) For ring cable lugs in accordance with DIN 46234
Terminal area for flexible cable with end sleeve
Terminal area for flexible cable with ring cable lug M6
Terminal area for flexible cable with ring cable lug M8
IP2xB to EN 60529 ensured; note: The restrictor collar installed as standard for the purpose of touch protection must be used or adapted as appropriate.

2) Alternatively, two cable lugs in accordance with DIN 46234 can be connected to each threaded bolt to facilitate the parallel connection of two cables with a maximum cross-section of 50 mm². Both cable lugs should be installed "back to back".

Table 11- 19 Connectable conductor cross-sections: Line supply conductor / connection for braking resistor, part 3

		Connection cross-section [mm²]					
Component	**Terminal type**	**1.5**	**2.5**	**4**	**6**	**10**	**16**
Basic Line Module 20 kW line supply connection	Screw terminal				x	x	x
Basic Line Module 20 kW Connection for braking resistor	Screw terminal	x	x	x			
Basic Line Module 40 kW Connection for braking resistor	Screw terminal			x	x	x	

Table 11- 20 Connectable conductor cross-sections: Line supply conductor / connection for braking resistor, part 4

		Connection cross-section [mm²]					
Component	Terminal type	25	35	50	70	95	120
Basic Line Module 40 kW line supply connection	Screw terminal	x	x	x			
Basic Line Module 100 kW line supply connection 1)	Threaded bolt M8/13 Nm				x	x	x

1) Alternatively, two cable lugs in accordance with DIN 46234 can be connected to each threaded bolt to facilitate the parallel connection of two cables with a maximum cross-section of 50 mm². Both cable lugs should be installed "back to back".

Note

The 40 kW Basic Line Module provides the IP20 degree of protection only with insulated ferrule and a cross-section > 25 mm².

Note

The cross-section of the PE conductor must be selected in accordance with DIN EN 60204-1, DIN EN 61800-5-1, and VDE 0100-540 (IEC 60364-5-54). When doing so, note that certain components conduct a high leakage current, which means that the relevant guidelines must be observed (EN 61800-5-1).

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.

WARNING

The internal overload monitoring function of the power module only protects the cable if this is dimensioned/selected corresponding to the power module currents. If smaller cross-sections are selected, then the user must ensure the appropriate level of cable protection - e.g. by suitably setting the control parameters.

11.6.6 Handling restrictor collars for touch protection

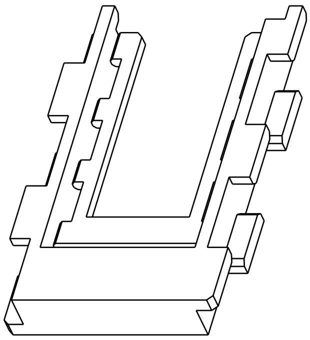
Handling restrictor collars for touch protection and when connecting cables

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. For information on adapting touch protection, refer also to "Electrical connection" in the chapter titled "Shield connecting plates".

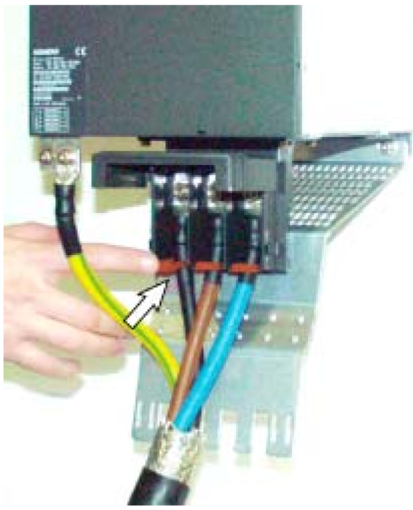
Exception: The cross-section of the connected cables is large enough to ensure that the threaded bolts and the ends of the cables cannot be touched when the cover is closed.

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

11.6.7 Motor connection plug

11.6.7.1 Installation of the motor connection plug with locking mechanism

Motor connection plugs 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 the motor connection plug is installed depends on the type of Motor Module used.

Note

With Double Motor Modules, the rear motor connection plug must be installed first and then locked.

Installation on Motor Modules without pre-assembled interlock bolt

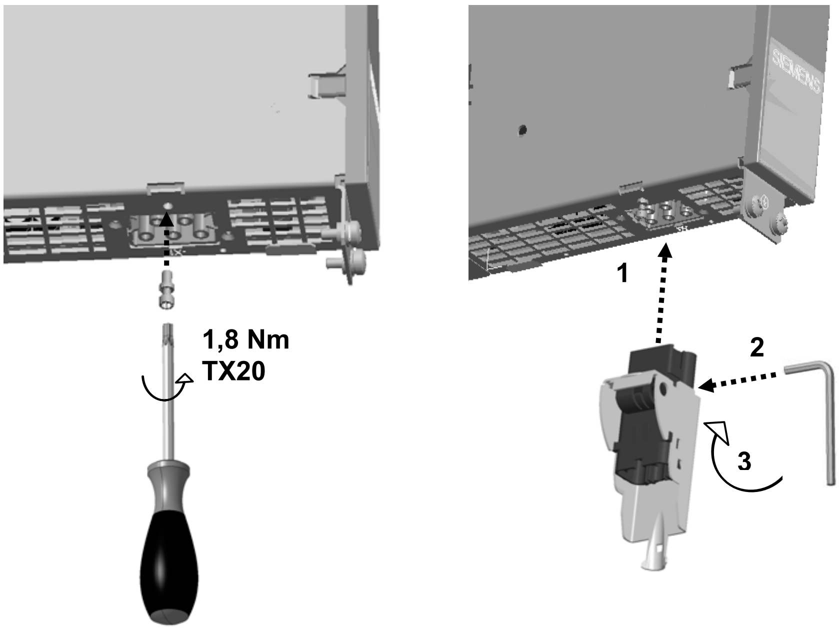


Figure 11-17 Installation example: Crimp plug

1. Screw the interlock bolt into the threaded socket provided in the enclosure.
2. Insert the plug, including the motor cable, and lock it in place by turning a screwdriver or size 4 hexagon socket-head screw clockwise by 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.

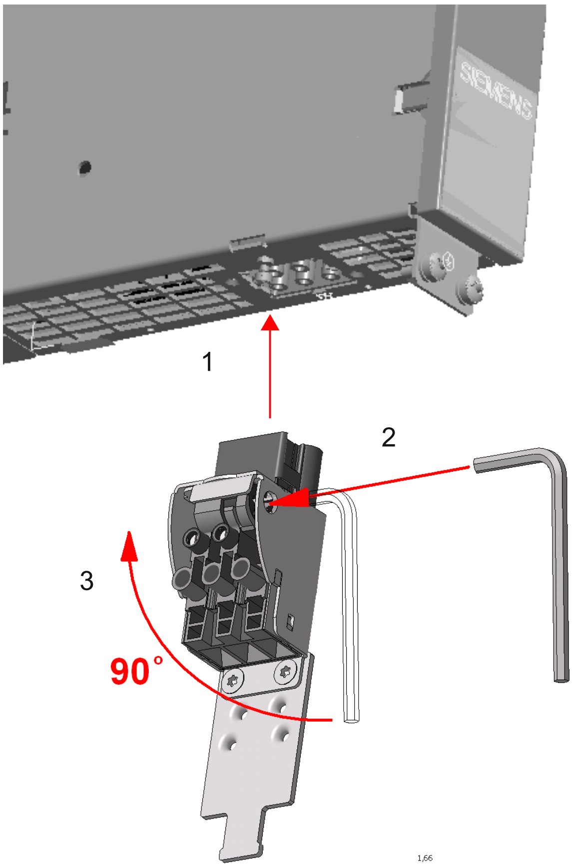


Figure 11-18 Installation example: Screw connector

Simply insert the connector, including the motor cable, and lock it in place by turning a screwdriver or size 4 hexagon socket-head screw clockwise by a ¼ turn (90°).

11.6.7.2 Installation of the motor connection plug with screwed joint

The way in which the motor connection plug with screwed joint is installed depends on the type of Motor Module used.

Note

With Double Motor Modules, the rear motor connection plug must be installed first and then locked.

Installation on Motor Modules with interlock bolt

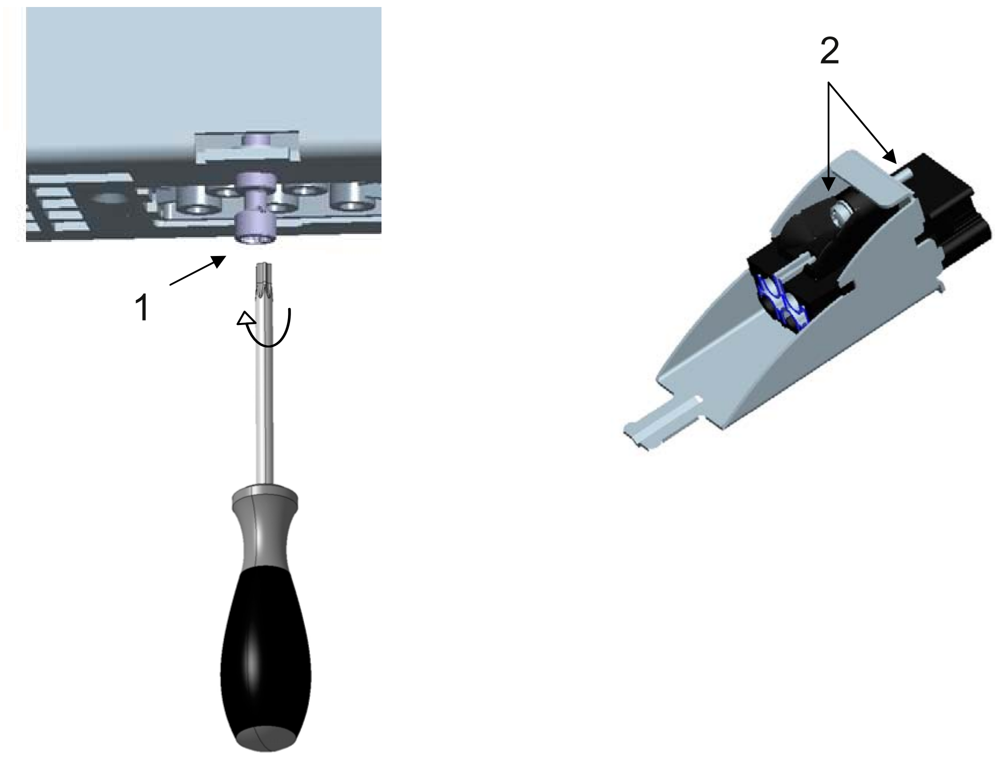


Figure 11-19 Installation of the motor connection plug with screwed joint

1. Use a TX20 screwdriver to remove the interlock bolt from the lower side of the enclosure.
2. Insert the plug, including the motor cable, and screw in with a TX20 screwdriver.

Installation on Motor Modules without interlock bolt

If the motor connection plug with screwed joint is being installed on a Motor Module without a pre-assembled interlock bolt, step 1 described above can be omitted.

Simply insert the plug, including the motor cable, and screw in with a TX20 screwdriver.

11.6.7.3 Removal and coding

Removing the motor connection plug

The motor connection plug of a pre-assembled motor cable might have to be removed if the cable needs to be routed through narrow cable glands, for example.

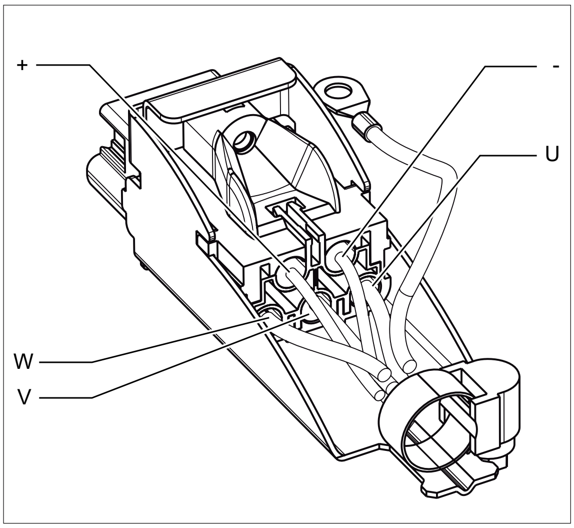


Figure 11-20 Motor connection plug with screwed joint

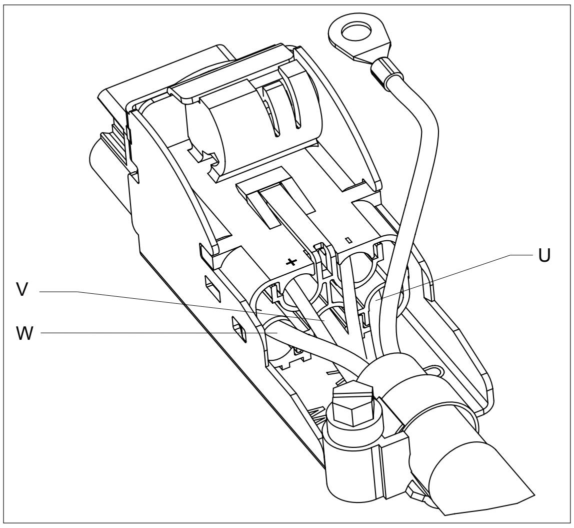


Figure 11-21 Crimp version motor connection plug with locking mechanism

In the case of motor connection plugs with a screwed joint, the pipe clamp first needs to be released. The interlock in the plug can then be raised using a pair of engineer's pliers, for example, and the cable can be removed.

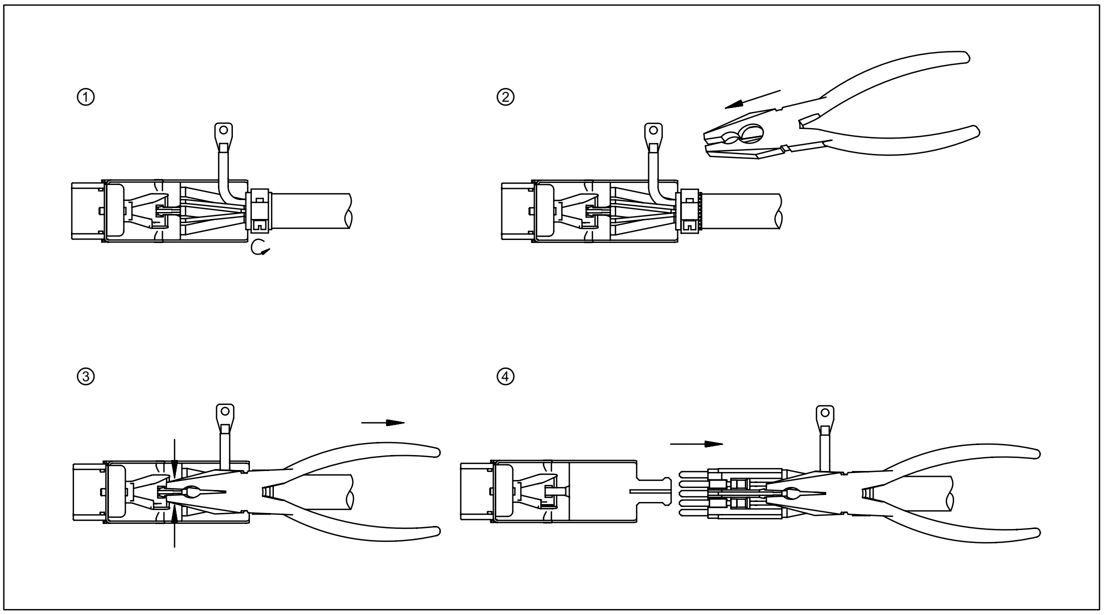


Figure 11-22 Removing the motor connection plug with screwed joint

In the case of motor connection plugs with a locking mechanism, the clamp first needs to be released. The interlock then has to be raised using a screwdriver, for example. After that, the insert can be removed, followed by the motor cable.

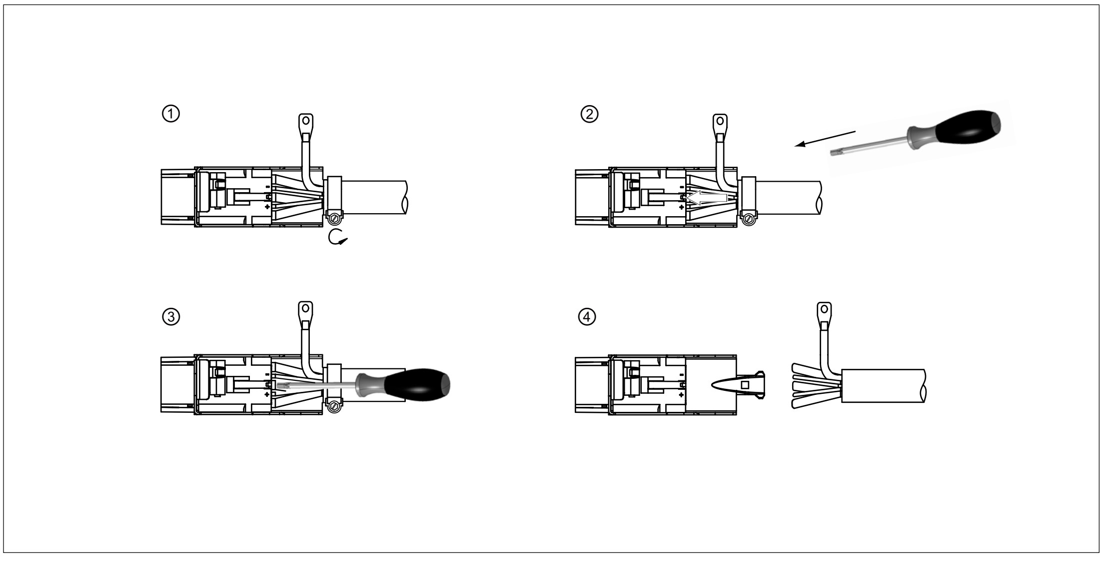


Figure 11-23 Removing the crimp plug with locking mechanism

Coding the motor connection plug

The coding of a motor connection plug is illustrated below, using the example of a plug with screwed joint. Coding can be used to prevent incorrect connections being made, particularly in the case of Double Motor Modules.

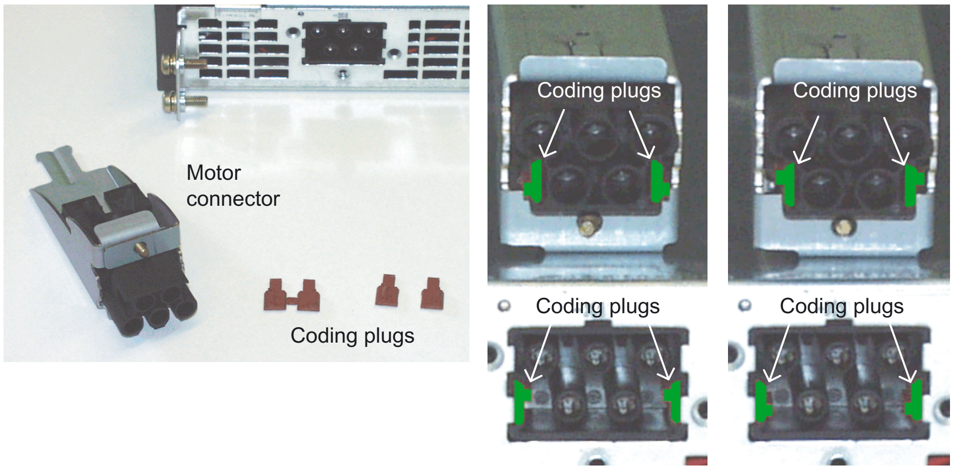


Figure 11-24 Coding the motor connection plug

The coding plugs are included in the scope of delivery of the motor cables and screw connectors (motor connection plug with locking mechanism and screwed joint).

11.6.8 Power connector (X1/X2)

Design and installation of the power connector with screw terminals

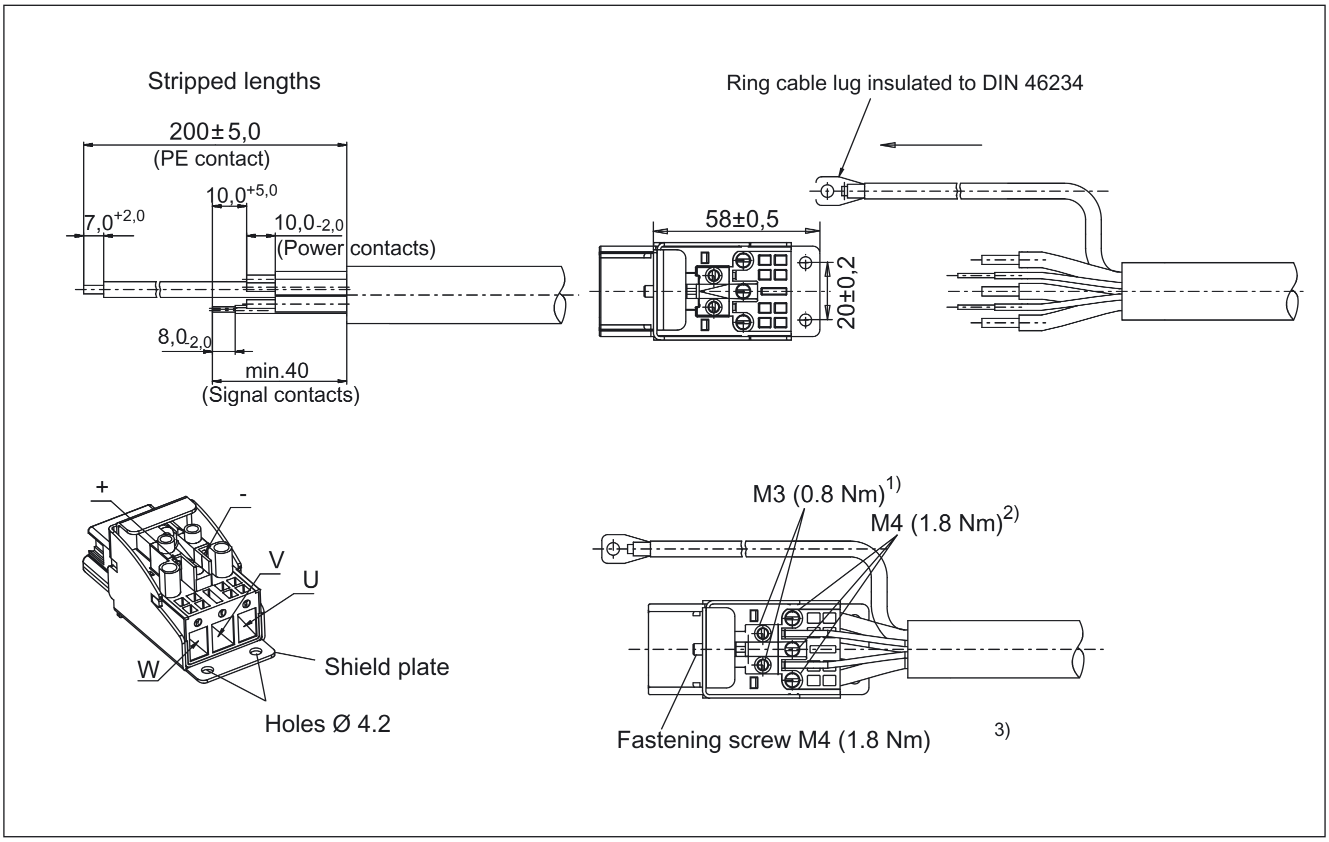


Figure 11-25 Design and installation of the power connector (X1/X2)

Screwdriver: 1) SZS 0.6 x 3.5; 2) SZS 1.0 x 4.0; 3) Torx TX20

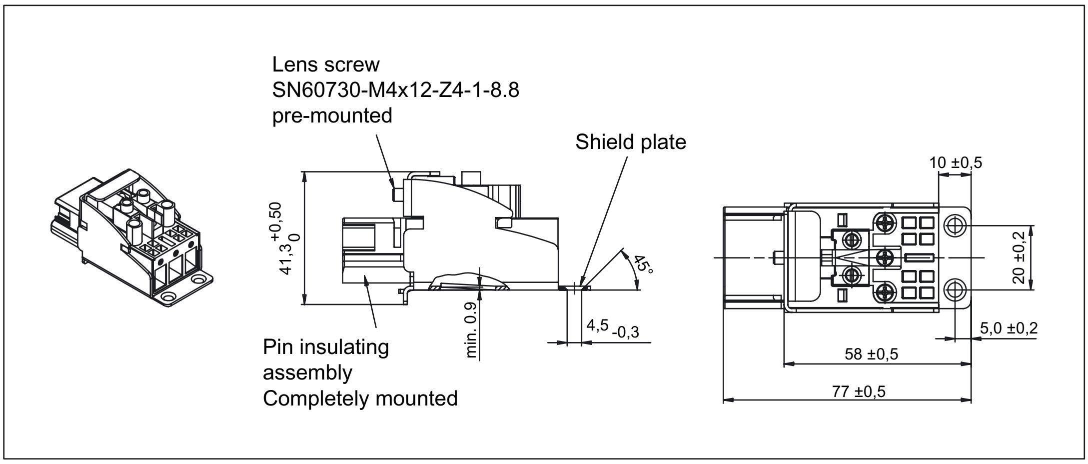


Figure 11-26 Dimensions: Power connector

Shield support options

The following options are available for cable shield support:

1. Shield support with shield plate supplied
2. Shield support on a toothed rail
3. Securing a shield support constructed by the customer on the shield plate

Shield support with shield plate supplied

Ideally, this type of shield support should be used.

Table 11- 21 Possible installations of the shield plate

	
Shield plate supplied for power connectors	Frontal alignment of the shield plate

	
Lateral alignment of the shield plate	Lateral alignment of the shield plate

The shield plate supplied can be installed at a number of angles using the two (M4) screws provided (tightening torque 1.8 Nm).

Shield support on a toothed rail

The toothed rail should be fitted at a distance of ≤ 150 mm below the drive line-up across the greatest possible surface area. 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 plug-in direction is 100 N.

With these versions, the shield for the brake connection wires must be laid together with the cable shield.

11.7 Information on cold plate cooling

11.7.1 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, which is located on the rear of the device, acts as a thermal interface in cold plate cooling.

There are two ways of configuring this type of cooling:

1. Cold plate 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 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.

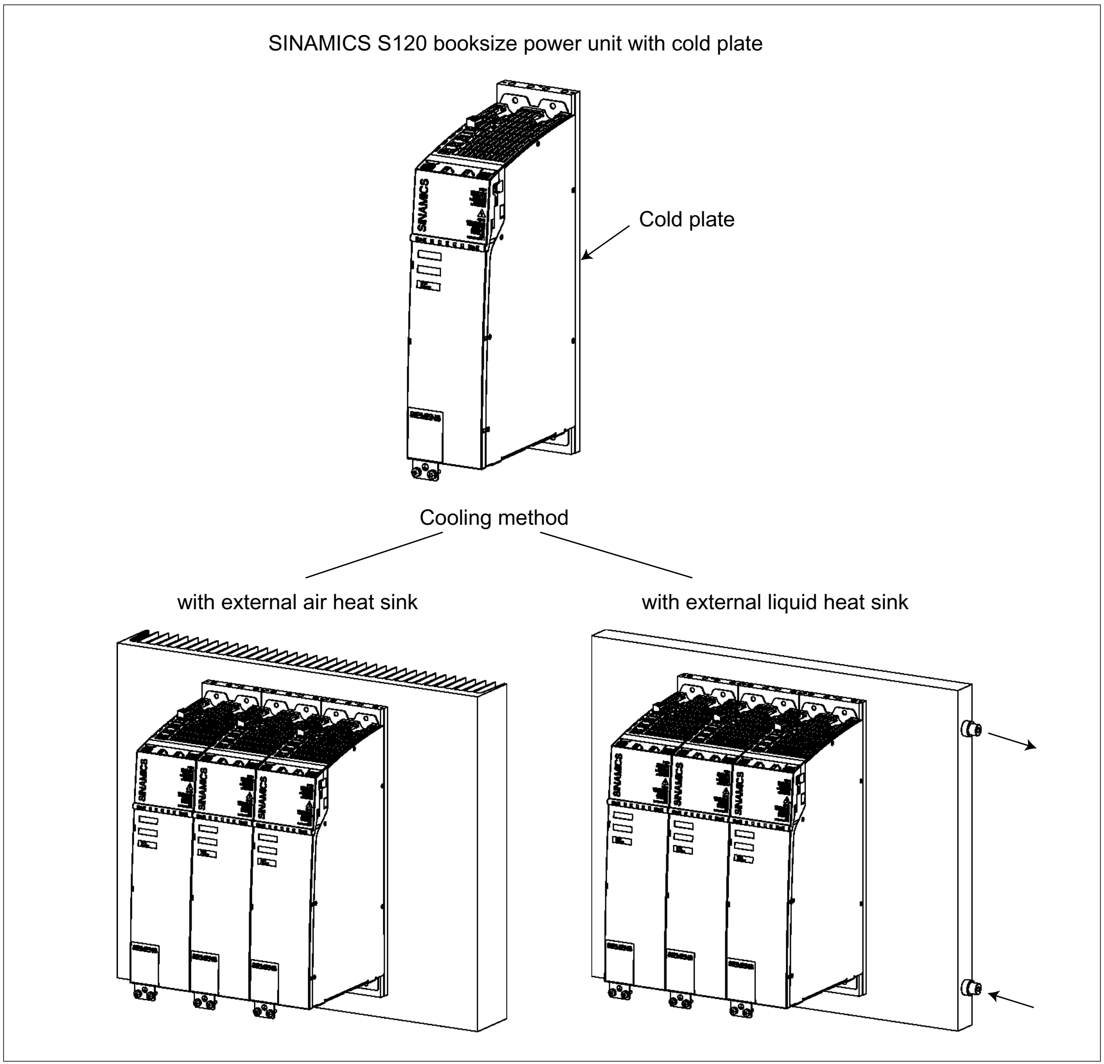


Figure 11-27 Overview of cold plate cooling methods

Benefits of cold plate cooling

1. Particularly suitable for machine configurations involving a high degree of contamination 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).
2. Particularly suitable for machine concepts in which liquid is already used for in-process cooling. This cooling method is also suitable for external cold plate cooling of the power components.

11.7.2 Cold plate with external air heat sink

11.7.2.1 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 r0037.
3. The customer must take measures to protect the devices against condensation (see also chapter "Anti-condensation measures" under "Cooling circuit and coolant properties").

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 Foreword).

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).

11.7.2.2 Sample setup: cold plate with external air heat sink

Front view of cabinet

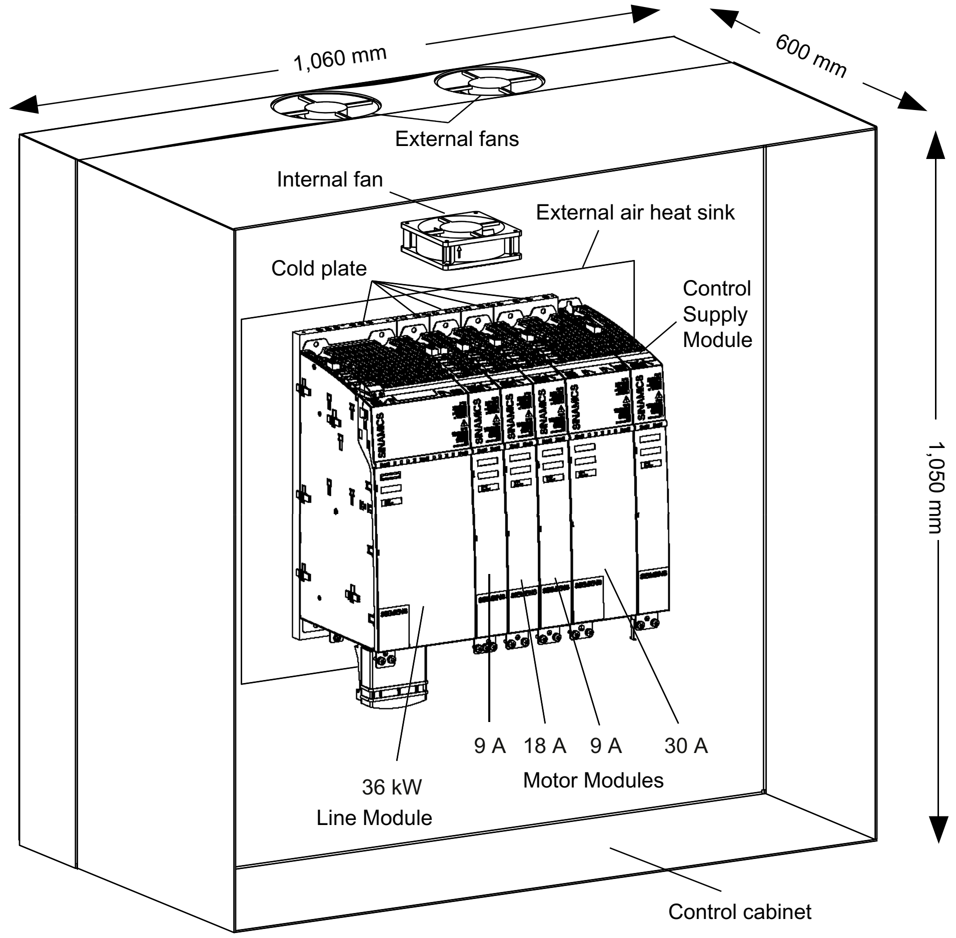


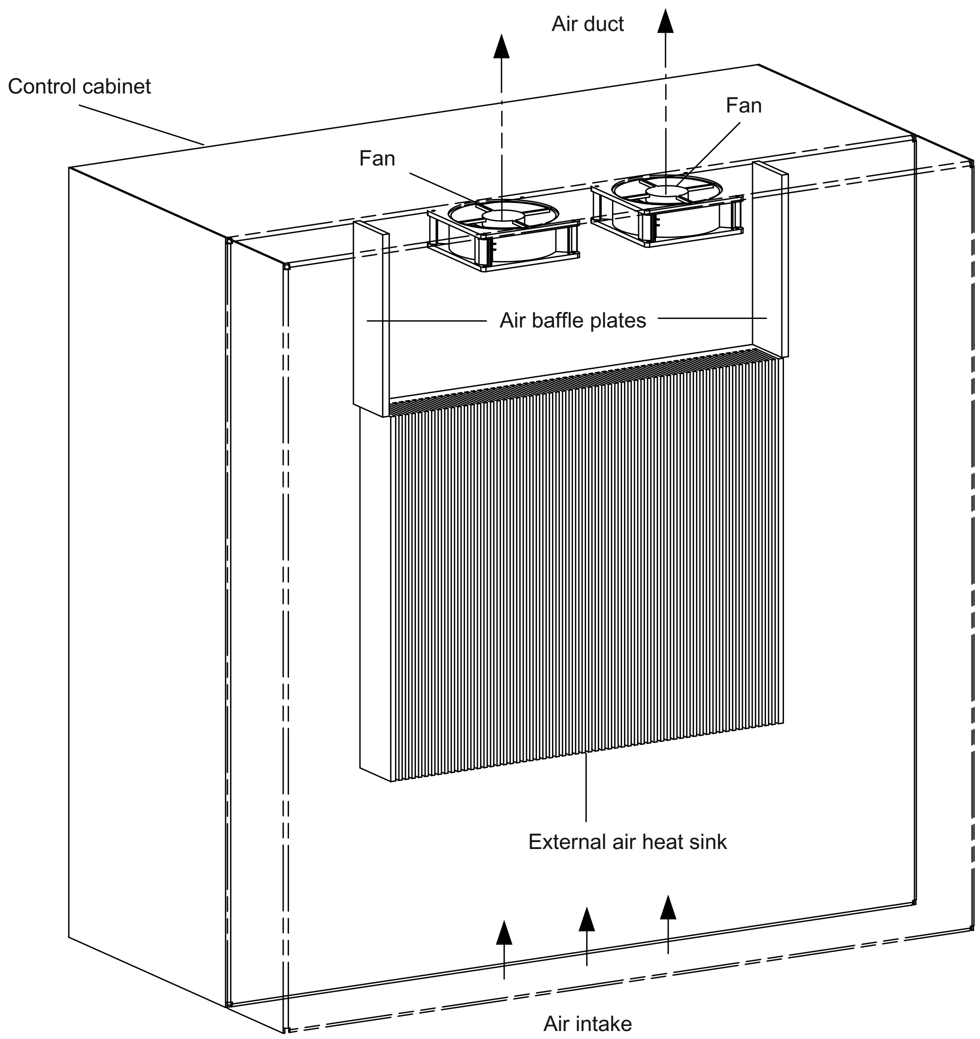
Figure 11-28 Example: cabinet setup with powers ections, cold plate, and external air heat sink

Setup:

- Infeed: Active Line Module 36 kW
- 4 Single Motor Modules
- Control Supply Module
- 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.

Rear view of cabinet

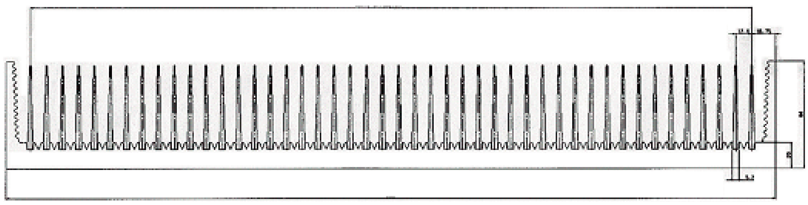


The external heat sink must be sealed vis-à-vis the control cabinet to IP65.

Figure 11-29 Rear view of cabinet

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 on the sides improve air guidance and significantly optimize the cooling process for the power sections.

Example: external air heat sink



Dimensions: 600 x 500 x 84 mm (W x H x D)
Fin length: 60 mm
Fin spacing: 12.5 mm

Figure 11-30 Example of an air heat sink

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, Singen: http://www.alcan.com

Sykatec, Erlangen: http://www.sykatec.de

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".

11.7.3 Cold plate with an external liquid heat sink

11.7.3.1 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 r0037.
3. The customer must take measures to protect the devices against condensation (see also chapter "Anti-condensation measures" under "Cooling circuit and coolant properties").

11.7.3.2 Sample setup: cold plate with external liquid heat sink

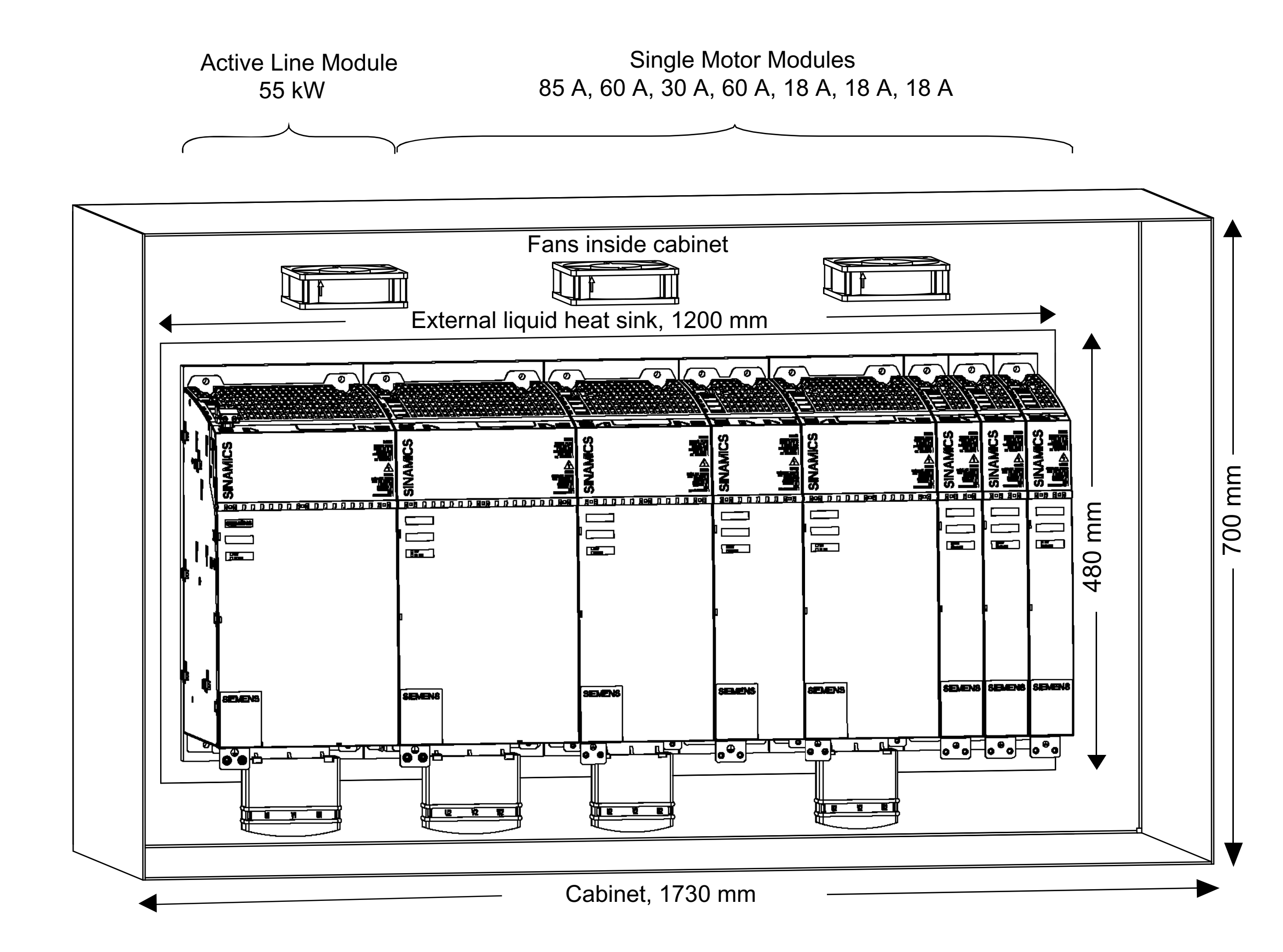


Figure 11-31 Example: cold plate drive line-up with external liquid cooling

Setup:

- Infeed: Active Line Module 55 kW
- 7 Single Motor Modules
- 3 internal fans at the top of the cabinet
- A joint external liquid heat sink (1200 mm x 480 mm)

The heat sinks and fans are not part of the scope of supply.
Recommended suppliers of liquid heat sinks include:
DAU Ges.m.b.H & CO.KG., Ligist: http://www.dau-at.com

Rittal: http://www.rittal.de/dcp

11.8 Notes on electrical cabinet cooling

11.8.1 General information

The cabinet can be cooled, among others, by using:

- Filter fans
- Heat exchangers
- Refrigerators
- Liquid cooling
- external air cooling
- external liquid cooling

The decision in favor of one of these methods will depend on the prevailing ambient conditions and the cooling power required.

The air routing inside the control cabinet and the cooling clearances specified here, must be carefully observed. No other components or cables must be located in these areas.

CAUTION
If you do not observe the guidelines for installing SINAMICS equipment in the cabinet, this can reduce the service life of the equipment and result in premature component failure.

Note

When the line reactor is being installed, it is best not to install it in the same cabinet (max. distance approx. 0.5 m). If necessary, it can be installed on the heat sink.

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

- Ventilation clearance
- Wiring and cabling
- Air guidance, air-conditioner

Table 11- 22 Ventilation clearances above and below the components

Component	Order number	Clearance [mm]
CU320/CU320-2 DP	6SL3040-0MA00-0AAx	80
SMCxx	6SL3055-0AA00-5xAx	50
TM15	6SL3055-0AA00-3FAx	50
TM31	6SL3055-0AA00-3AAx	50
TM41	6SL3055-0AA00-3PAx	50
Line filter for Line Module 5 kW - 120 kW	6SL3000-0BExx-xAAx	100

Component	Order number	Clearance [mm]
Active Interface Module 16 kW 36 kW 50 kW 80 kW 120 kW	 6SL3100-0BE21-6ABx 6SL3100-0BE23-6ABx 6SL3100-0BE25-5ABx 6SL3100-0BE28-0ABx 6SL3100-0BE31-2ABx	 80
Line reactor for Active Line Module 16 kW – 120 kW	 6SN1111-0AA00-xxAx	 100
Line reactor for Basic Line Module 20 kW – 100 kW	 6SL3000-0CExx-0AAx	 100
Line reactor for Smart Line Module 5 kW – 36 kW	 6SL3000-0CExx-0AAx	 100
Active Line Module 16 kW – 55 kW 80 kW – 120 kW	 6SL3130-7TExx-xAAx 6SL3130-7TExx-xAAx	 80 80 (additional 50 in front of fan)
Smart Line Module Booksize format 5 kW – 36 kW	 6SL3130-6AExx-0AAx	 80
Smart Line Module Booksize Compact format 16 kW	 6SL3430-6TE21-6AAx	 80
Basic Line Module 20 kW – 100 kW	6SL3130-1TExx-xAAx	80
Motor Module Booksize format < 132 A	6SL312x-1TExx-xAAx	80
Motor Module Booksize format 132 A a. 200 A	 6SL312x-1TE3x-xAAx	 80 (additional 50 in front of fan)
Motor Module Booksize Compact format 1.7 A - 18 A	 6SL3420-xTExx-xAAx	 80
Braking Module	6SL3100-1AE31-0AAx	80
Control Supply Module	6SL3100-1DE22-0AAx	80
Capacitor Module	6SL3100-1CE14-0AAx	80

The specifications regarding ventilation clearances for two-tier configurations are provided in Drive Line-Up.

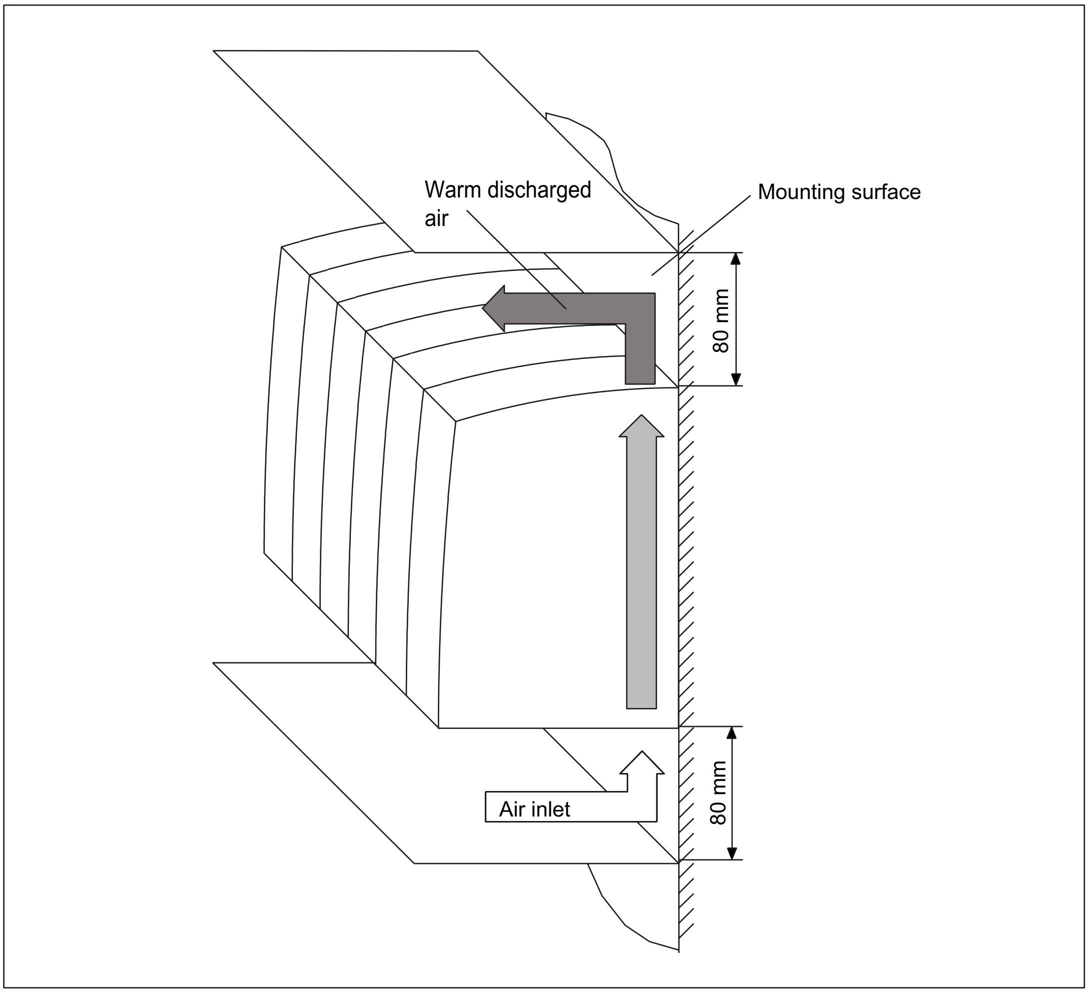


Figure 11-32 Clearances for booksize drive line-up with internal air cooling

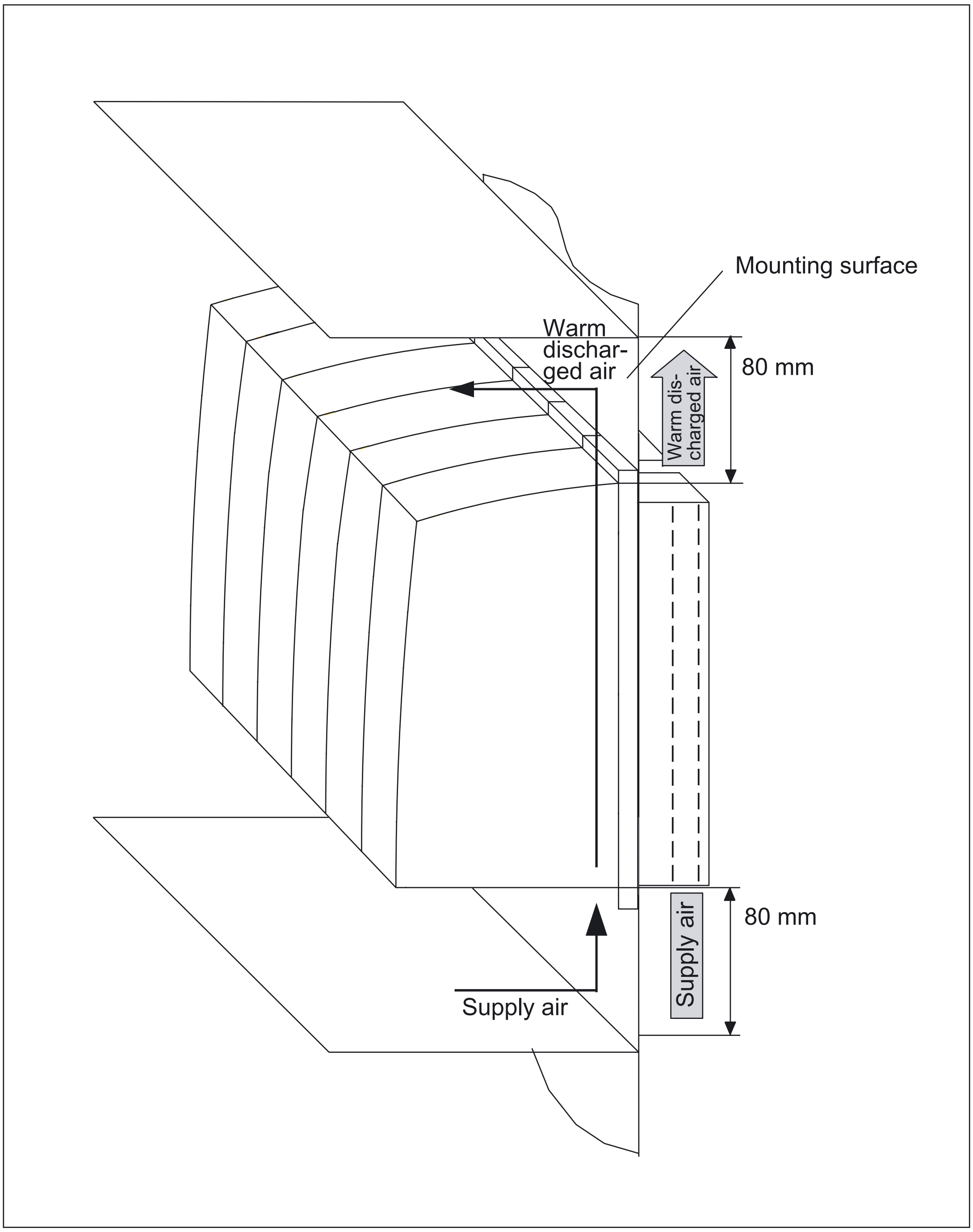


Figure 11-33 Clearances for booksize drive line-up with external air cooling

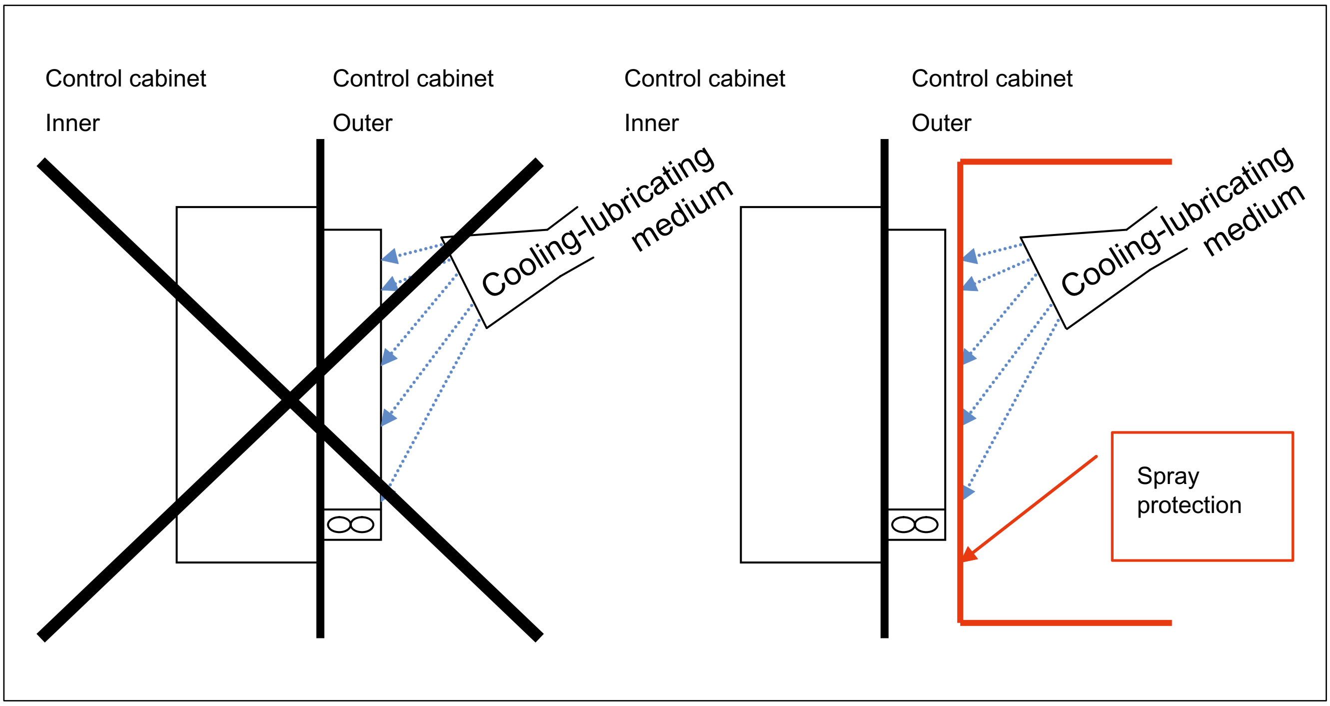


Figure 11-34 Spray protection for external cooling

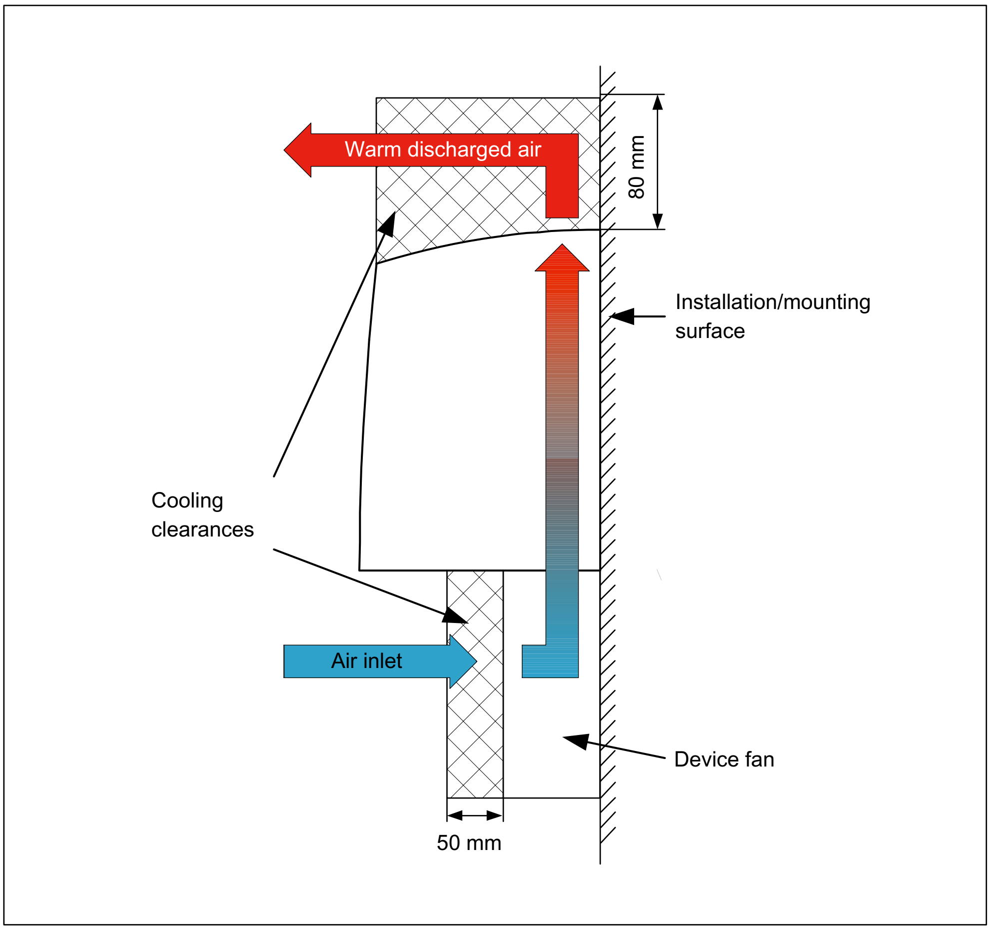


Figure 11-35 Cooling clearances for 300 mm components with mounted equipment fan

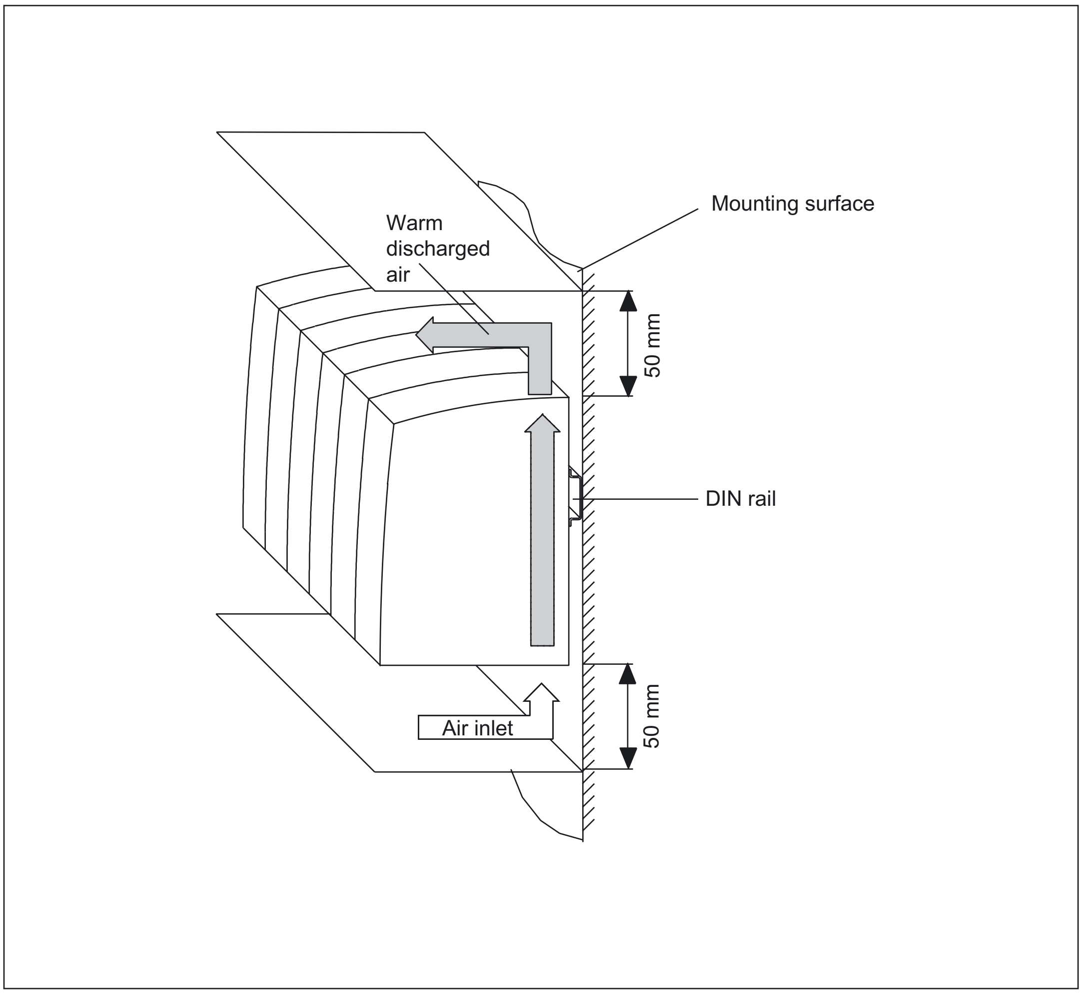


Figure 11-36 Cooling clearances, rail-mounted modules (e.g. VSM, SMC, TM, DMC)

11.8.2 Ventilation

The SINAMICS equipment is ventilated separately by means of integrated fans and is in some cases cooled by means of natural convection.

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

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

NOTICE
The connected signal and power cables must be routed to the components in such a way that they do not cover the ventilation slots. Cold air must not be allowed to blow directly onto electronic equipment.

Note

The distance between the blow-out aperture of the air conditioner and the electronic equipment must be at least 200 mm.

Note

If the components are installed in a sealed cabinet, an internal air cooling system must be installed to circulate the air and prevent hot spots. It is best to install the fan above the components to optimize the air flow (suction).

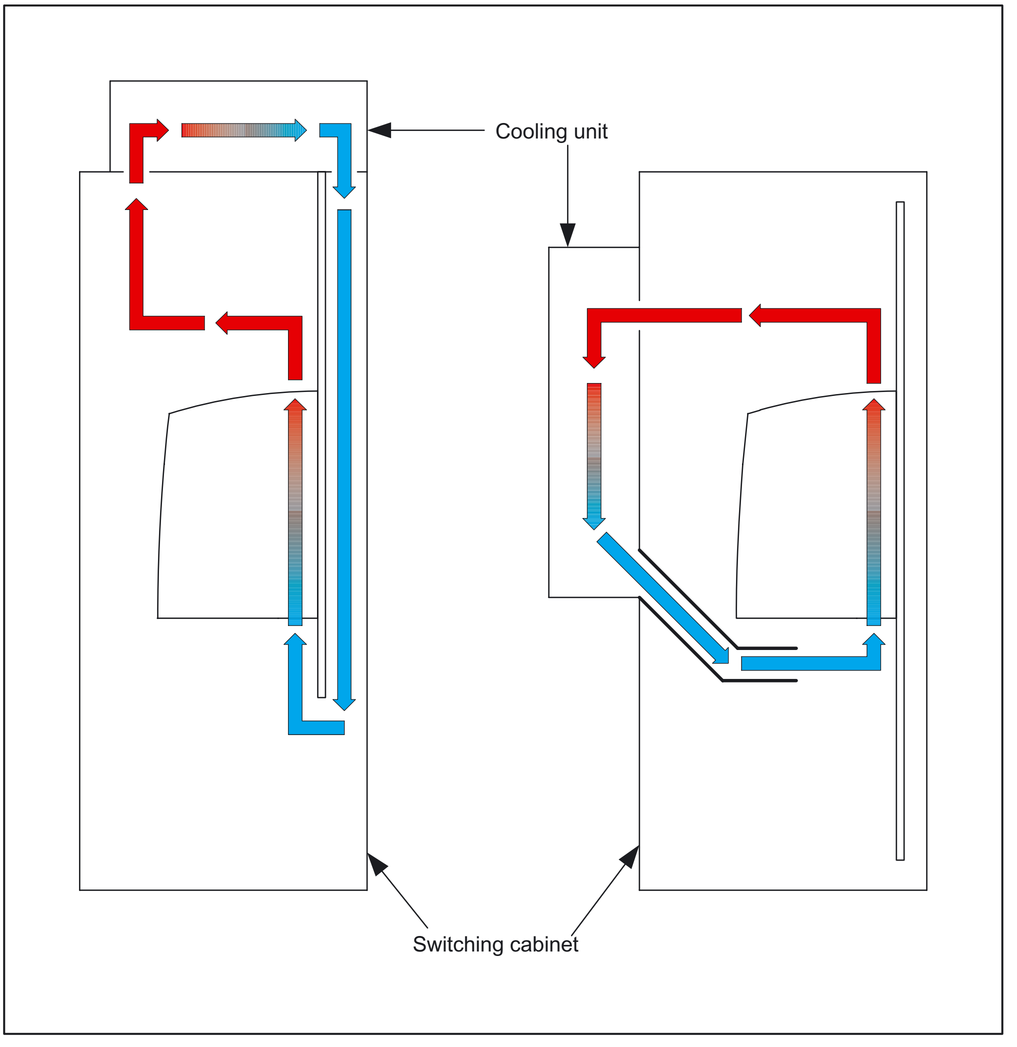


Figure 11-37 Examples of cabinet ventilation

CAUTION
The air guidance and arrangement of the cooling equipment must be chosen in such a way as to prevent condensation from forming. If necessary, cabinet enclosure heating may have to be installed.

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 equipment is over 80% for an extended period of time, the insulation in the equipment may fail to function properly due to electrochemical reactions (refer to System Overview). 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 equipment. This reduces the relative air humidity to uncritical values.

11.8.3 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 or by some other means.

When an external air heat sink is used, ventilation must also be provided outside the cabinet or by some other means.

Temperature measurement

The temperature of the power units can be read via parameter r0037.

Temperature limits

1. For the maximum heat sink temperature, see the "Technical data" for the power units.
2. For the maximum internal cabinet temperature, see the "Technical data" for the power units.

Measures for remaining within temperature limits

1. Install one or more fans.
2. If necessary, the drive line-up can be operated with derating.

11.8.4 Dimensioning Climate Control Equipment

Cabinet manufacturers provide calculation programs for selecting climate control equipment. It is always necessary to know the power loss of the components and equipment installed in the cabinet.

The physical relationship is shown in the following example.

$q = Q - k \times A \times \Delta T$

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 value, e.g. sheet-steel, painted 5.5 [W / (m^2 * K)]

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

Table 11- 23 Example, calculating the power loss of a drive configuration

Component	Number	Total power loss [W] (including electronic losses)	Total power loss [W]
CU320	1	20	20
Line filters	1	90	90
Line reactor	1	250	250
Active Line Module 36 kW	1	666	666
Motor Module 18 A	2	185.4	370.8
Motor Module 30 A	3	311.6	934.8
SMC	5	10	50
SITOP 20	1	53	53
Line contactor	1	12	12
Total:			2446.6

Assumption:

Free-standing cabinet surface area A = 5 m^2

Temperature difference between the room and cabinet interior ΔT = 10 K

q = 2446.6 W - 5.5 W / (m^2 K) * 5 m^2 * 10 K = 2171.6 W

11.8.5 Power loss of components during rated operation

11.8.5.1 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.

11.8.5.2 Power loss for Control Units, Sensor Modules, and other system components

Table 11- 24 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	W	20
CU320-2 DP	W	24
TB30	W	< 3
CBC10	W	< 3
CBE20	W	2.8
Sensor Modules		
SMC10	W	< 10
SMC20	W	< 10
SMC30	W	< 10
SME20	W	≤ 4
SME25	W	≤ 4
SME120	W	≤ 4.5
SME125	W	≤ 4.5
Terminal Modules		
TM15	W	< 3
TM31	W	< 10
TM41	W	10
TM54F	W	4.5
Additional system components		
VSM10	W	< 10
DC-link components		
Braking Module	W	20
Capacitor Module	W	25
Control Supply Module Line DC link	W	 70 65
Voltage Clamping Module	W	50

11.8.5.3 Power loss for line filters and line reactors

Table 11- 25 Overview of power loss during rated operation for line filters and line reactors

	Unit	Power loss
Basic Line Filter 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
Basic Line Filter for Basic Line Modules		
20 kW	W	16
40 kW	W	26
100 kW	W	73
Active Interface Modules		
16 kW	W	270 [1)]
36 kW	W	340 [1)]
55 kW	W	380 [1)]
80 kW	W	490 [1)]
120 kW	W	585 [1)]
Line reactors for Active Line Modules (HF/HFD line reactors)		
16 kW	W	170
36 kW	W	250
55 kW	W	350
80 kW	W	450
120 kW	W	590

	Unit	Power loss
Line reactors for Smart Line Modules		
5 kW	W	62
10 kW	W	116
16 kW	W	110
36 kW	W	170
Line reactors for Basic Line Modules		
20 kW	W	130
40 kW	W	270
100 kW	W	480

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

11.8.5.4 Power loss for power units with internal air cooling

Table 11- 26 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
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	75.4
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

	Unit	Power loss
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
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

11.8.5.5 Power loss for power units with external air cooling

Table 11- 27 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	108.2
10 kW	W	66.6 (45 + 21.6)	75	141.6
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
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

11.8.5.6 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 11- 28 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
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				

	Unit	Internal power loss 1)	External power loss	Total power loss
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.

11.8.5.7 Power loss for liquid-cooled power units

Table 11- 29 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

11.8.5.8 Electronics losses of power units

Table 11- 30 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
Smart Line Module Booksize Compact	16 kW	22.8

Table 11- 31 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 11- 32 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

11.8.5.9 Losses for power units in the partial load range

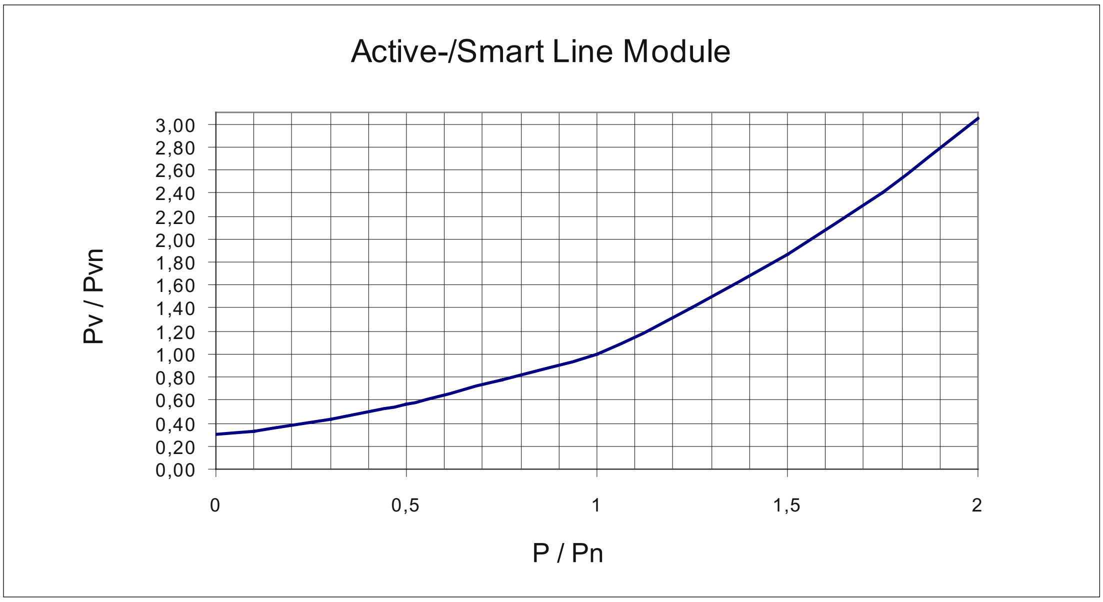


Figure 11-38 Losses in the partial load range for Active Line Modules and Smart Line Modules

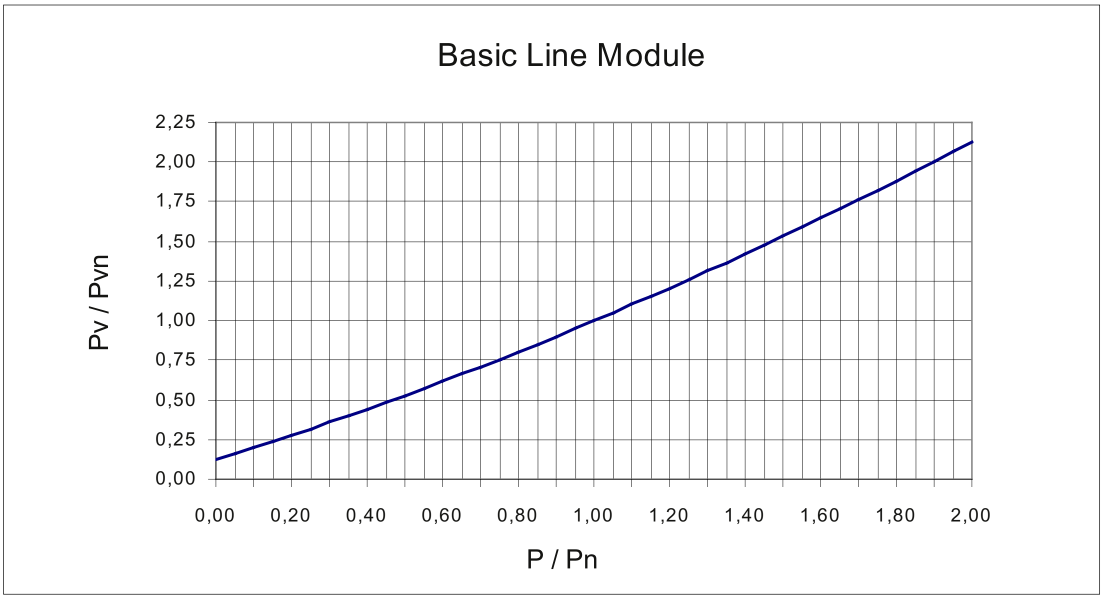


Figure 11-39 Losses in the partial load range for Basic Line Modules

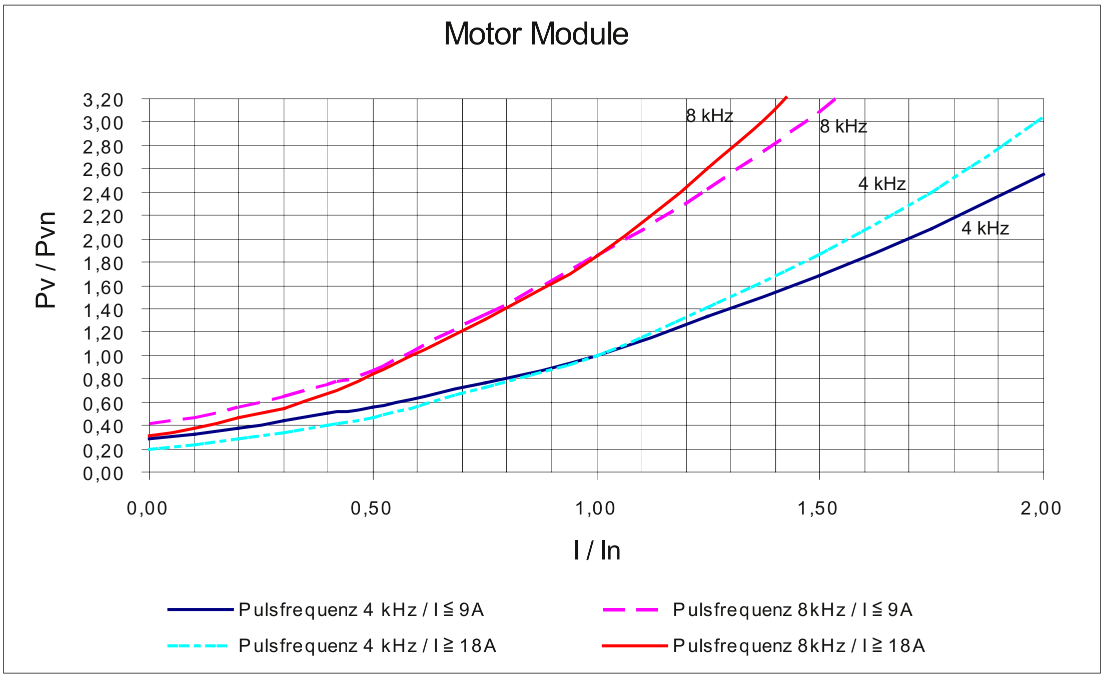


Figure 11-40 Losses in the partial load range for Motor Modules

11.9 Insulation test

Insulation test

In accordance with EN 60204-1, an insulation test must be performed on the machine/system.

This can be performed either by

- insulation resistance testing or
- voltage testing.

⚠ WARNING
Disconnect the machine/system from the power supply prior to testing.

Insulation resistance testing

Insulation resistance testing should be preferred. The insulation resistance for the test must not be lower than 1 MΩ Testing is carried out with 500 V DC between the main-circuit conductors [1)] and the protective conductor system. Testing may be carried out on individual sections of the system.

Exception: A lower resistance value is permissible for certain components of the electrical equipment; however, the value must not be lower than 50 kΩ.

SINAMICS components are covered by this exception. They must therefore be disconnected during testing and tested separately.

Voltage testing

> **WARNING**
>
> Test equipment to EN61180-2 should be used for voltage testing.

The rated frequency for the test voltage must be 50 Hz or 60 Hz.

The maximum test voltage must be either twice the rated voltage value for the equipment power supply or 1000 V. The larger of the two values should be used. The maximum test voltage must be applied between the conductors of the main circuits [1)] and the protective conductor system for approx. 1 s.

Components and devices that are not rated to withstand this test voltage must be disconnected prior to testing.

Components and devices that are voltage tested according to their product standard may be disconnected during testing.

The SINAMICS components are voltage-tested to EN 61800-5-1 and must be be disconnected during this test.
If they cannot be disconnected, the input and output terminals must be shorted and a bypass installed. In this case, a DC voltage that is 1.5 times the AC test voltage should be used for testing.

1) Main circuits are circuits that are electrically connected to the line voltage.

Cooling circuit and coolant properties 12

12.1 Cooling circuit requirements

12.1.1 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 the 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.

12.1.2 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 the chapter titled "Using heat exchangers").

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.

12.1.3 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.

A pump's pressure depends on the volumetric flow, so the pressure created will depend on the number of components which are connected. At the minimum differential pressure p1 (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 p2 (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, the pump may be damaged due to cavitation during operation. If necessary, note any differing minimum pressure values from the pump manufacturer. 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 Vn of the coolant at this operating point.

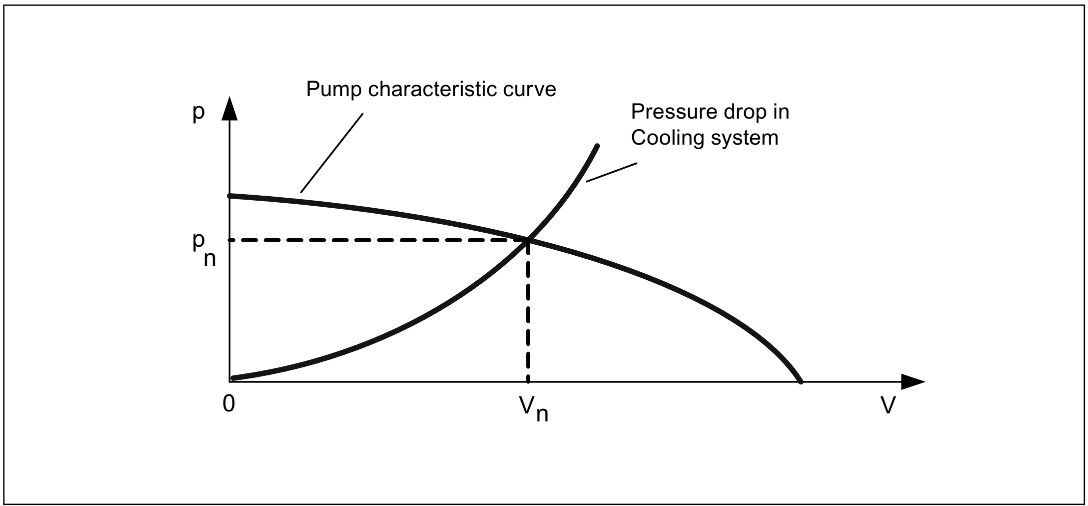


Figure 12-1 Pump characteristic curve

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 ≤ 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.

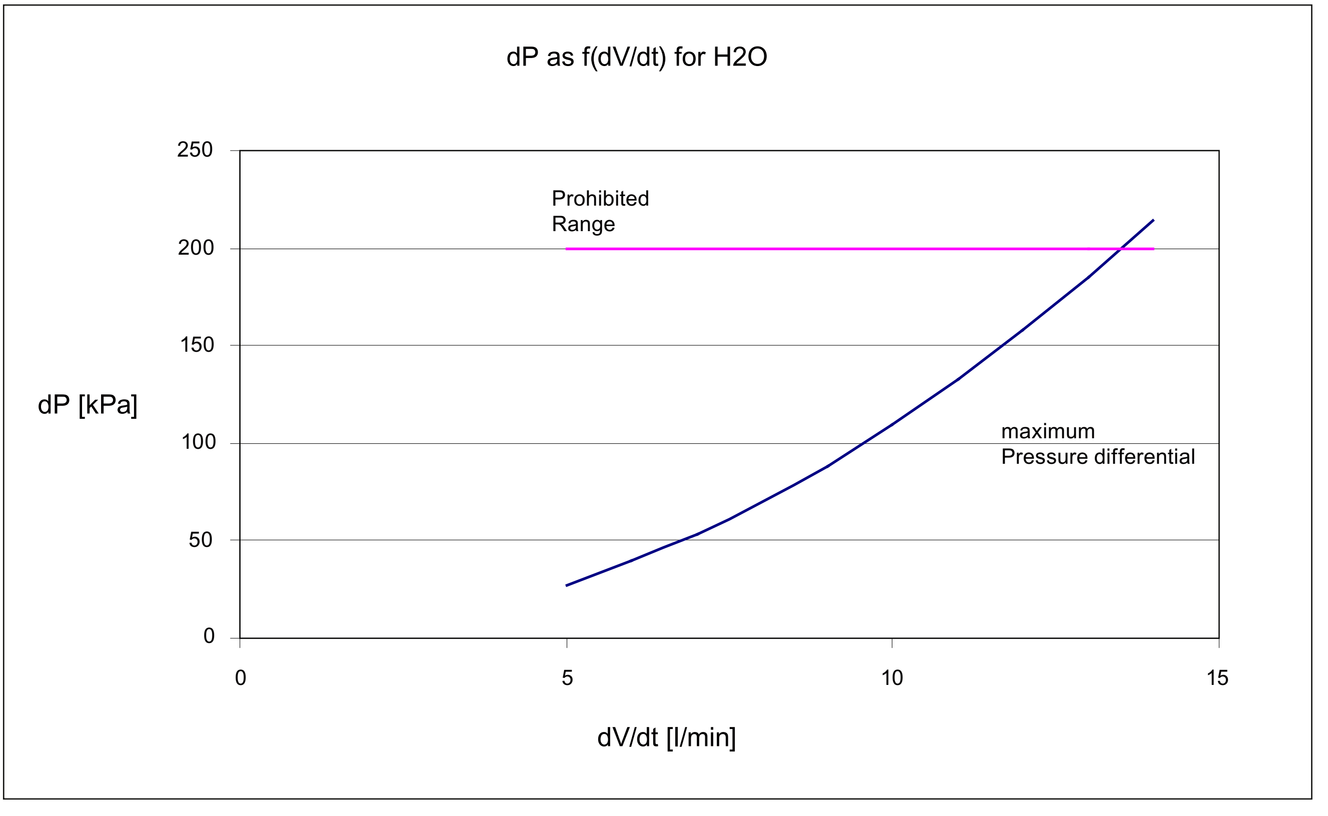


Figure 12-2 Pressure difference as a function of volumetric flow

Pressure difference and pressure drop when using coolant mixtures

If a mixture of Antifrogen N and H_2O 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 12- 1 Pressure drop at different coolant temperatures for Antifrogen N/H_2O: 45 %

dV/dt H_2O [l/min]	dP H_2O [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.

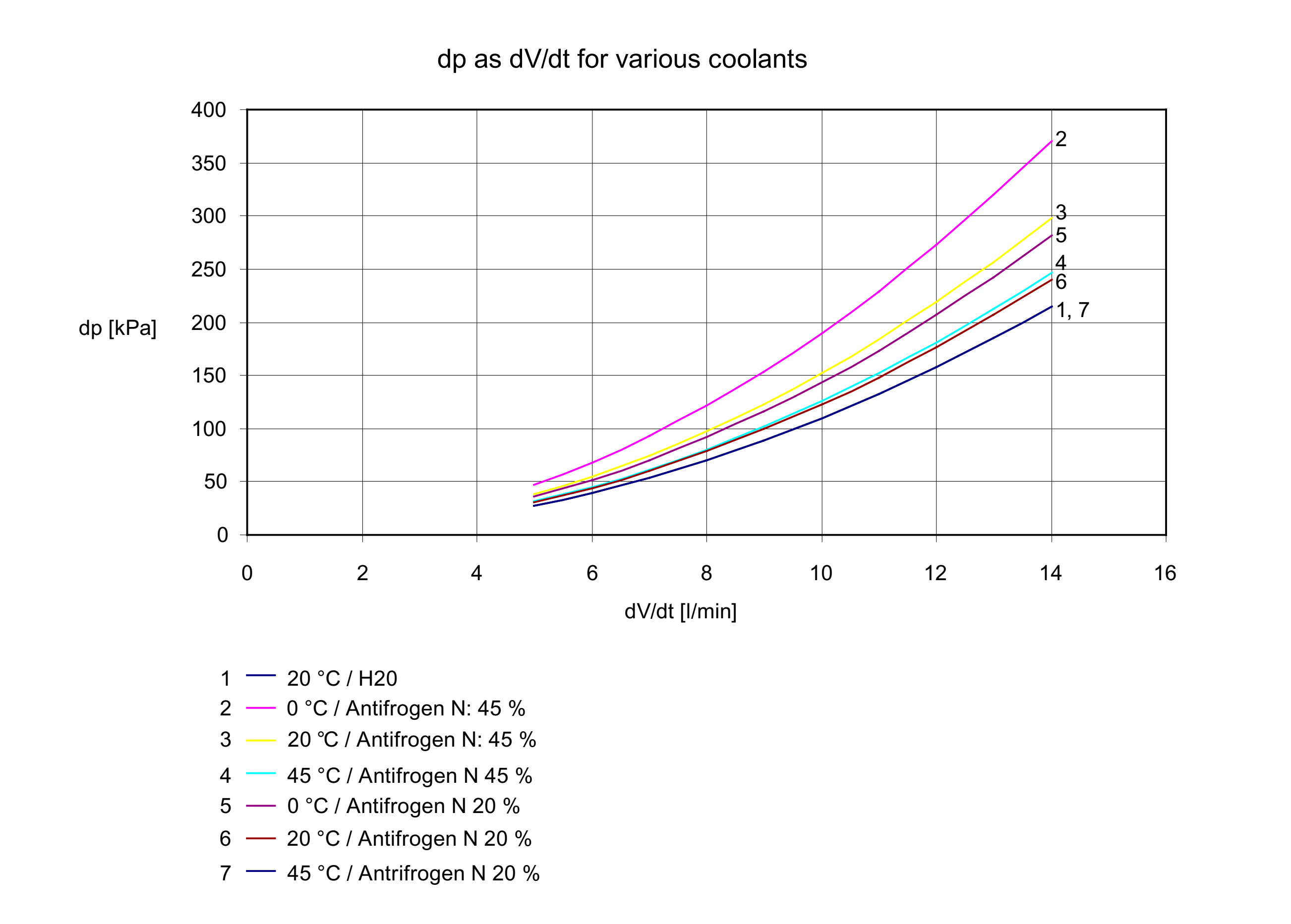


Figure 12-3 Pressure difference as a function of volumetric flow

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 H_2O) via a baffle plate.

Layout of the components

The components should be laid out in the system in such a way that the overall length of the supply and drain 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:

$\Sigma dPi < dP_{Syst} < \Sigma dPi + 30$ kPa

The individual pressure drops Pi 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 mm must always be maintained between pipes and live parts. The pipes must be securely mounted and checked for leaks.

12.1.4 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.

CAUTION
Coolant pipes must be routed with extreme care. The pipes must be securely mounted and checked for leaks. The pipes must never come into contact with electrically live components.

Materials and connections

Stainless-steel pipes are used to route the coolant through the cooling plates on the liquid-cooled power units. When it comes to power units with internal liquid cooling, 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. For this reason, mixed installations (i.e. a combination of different materials, such as copper, brass, iron, zinc, or halogenated plastic (PVC hoses and seals)) should not be used or should be limited to an absolute 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 by Semperit; http://www.semperit.at)
- DEMITEL® hoses made of PE/EPDM (Telle; http://www.telle.de)
- Secure with clips that comply with DIN2871, available from Telle, for example.

All control cabinets must be designed with a PE busbar and a good electrical connection must be established between them.

NOTICE
The sealing materials must be free of chlorides, graphite, and carbon (Viton® or EPDM).

Note

When non-conductive hoses are used, particular attention must be paid to the equipotential bonding of all components. (see chapter "Equipotential bonding")

Note

Teflon-based seals are not permitted.

Note

Once installed, the cooling system must be checked to ensure that it is properly sealed.

12.1.5 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 on 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 provided in the chapter titled "Configuring cooling circuits in accordance with the pressure" regarding series connection and maximum pressure must also be followed.

12.1.6 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.

CAUTION
Ventilation must only be performed when the system is at zero voltage.

12.2 Coolant requirements

12.2.1 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 12- 2 Cooling water specifications

		Liquid Cooled
Properties		Chemically neutral, clean, free of solids
Max. inlet temperature (during operation)	°C	45
Max. coolant temperature	°C	<50
Operating pressure	kPa	100 to 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 to 8
Max. particle size of any residue	mm	0.1
pH value		6.5 to 9
Chloride	ppm	< 200
Sulfate	ppm	< 240
Nitrate	ppm	< 50
Dissolved solids	ppm	< 340
Total hardness	ppm	< 170
Electrical conductivity	μS/cm	< 2000

NOTICE
Condensation must not be allowed to form on the SINAMICS S120 equipment as a result of supercooling. The temperature of the cooling water may have to be regulated.

NOTICE

The heat sink is made of non-seawater-proof material, which means that it must not be cooled directly with seawater.

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.

12.2.2 Corrosion Inhibitor Additive (Inhibiting)

Nalco 00GE056 (ONDEO Nalco; http://www.ondeonalco.com) is recommended as a corrosion inhibitor. The concentration of anti-corrosion agent in the cooling water must be at least 2500 ppm (250 ml/100 liters KW).
The water quality must meet the specifications contained in the chapter titled "Coolant properties" or the water used must be de-ionized.

NOTICE

Corrosion inhibitor does not need to be added if the anti-freeze Antifrogen N is used in the right concentration (refer to the chapter titled "Addition of antifreeze").

12.2.3 Anti-Freeze Additive

Antifrogen N (Clariant; http://www.clariant.com) is recommended as an antifreeze. The proportion of antifreeze must be between 20% and 30%. This ensures frost protection in temperatures down to -10 °C.

NOTICE

If the proportion of antifreeze added is greater than 30%, this can inhibit the transfer of heat and prevent the devices from functioning correctly.

Note

You must always bear in mind that the kinematic viscosity of the cooling water changes when anti-freeze is added, which means that the pump power must be adjusted accordingly.

NOTICE
Cooling water mixtures with Antifrogen N are highly conductive. In the event of leakage, the insulating systems must be cleaned.

NOTICE
When EPDM hoses are used, oily corrosion inhibitor additives must not be used because additives can corrode and destroy EPDM.

12.2.4 Biocide additives (only if required)

Closed cooling circuits with soft water (°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:

- Slime-forming bacteria
- Corrosive bacteria
- Iron-depositing bacteria

The type of bacteria determines the suitability of a biocide. At least one water analysis per year (to determine the number of bacterial colonies) is recommended. Suitable biocides are available, for example, from Nalco (Manufacturer: Nalco).

- We recommend adding partial doses of Nalco N 77352 (ONDEO Nalco; http://www.ondeonalco.com) twice a month, rather than adding an entire dose all at once (i.e. to introduce pauses in the dosing process).
  Dosage: 5 – 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 dosage and compatibility with any inhibitor used.

Biocides and Antifrogen N must not be mixed.

Antifrogen N has a biocidal effect even at the minimum required concentration of > 20%.

12.3 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 (≈ 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 ≥ the dew point temperature).

Table 12- 3 Dew point temperature as a function of the relative air humidity (Φ) and the room temperature at an installation altitude of between 0 m and 500 m

T room °C	Φ=20%	Φ=30%	Φ=40%	Φ=50%	Φ=60%	Φ=70%	Φ=80%	Φ=85%	Φ=90%	Φ=95%	Φ=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	24.9
30	4.7	10.5	14.9	18.4	21.3	23.8	26.1	27.1	28.1	29	29.9
35	8.7	14.8	19.3	22.9	26	28.6	30.9	32	33	34	34.9
38	11.1	17.4	22	25.7	28.8	31.5	33.8	34.9	36	36.9	37.9
40	12.8	19.1	23.7	27.5	30.6	33.4	35.8	36.9	37.9	38.9	39.9
45	16.8	23.3	28.2	32	35.3	38.1	40.6	41.8	42.9	43.9	44.9
50	20.8	27.5	32.6	36.6	40	42.9	45.5	46.6	47.8	48.9	49.9

The dew point also depends on the absolute pressure (i.e. the installation altitude).

The dew points for low atmospheric pressure are lower than those at an altitude of 0 m (i.e. it is always acceptable to calculate the coolant supply temperature for an altitude of 0 m).

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 in line with the room temperature. This is the preferred method with high room temperatures, low water temperatures, and high air humidity.
3. Physical dehumidification.
   This 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.

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.

12.4 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 conductivity) to prevent potential differences and, in turn, avoid the risk of electrochemical corrosion. For this reason, a PE bar must also be installed in all the cabinets, including the re-cooling system.

12.5 Using heat exchangers

12.5.1 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.

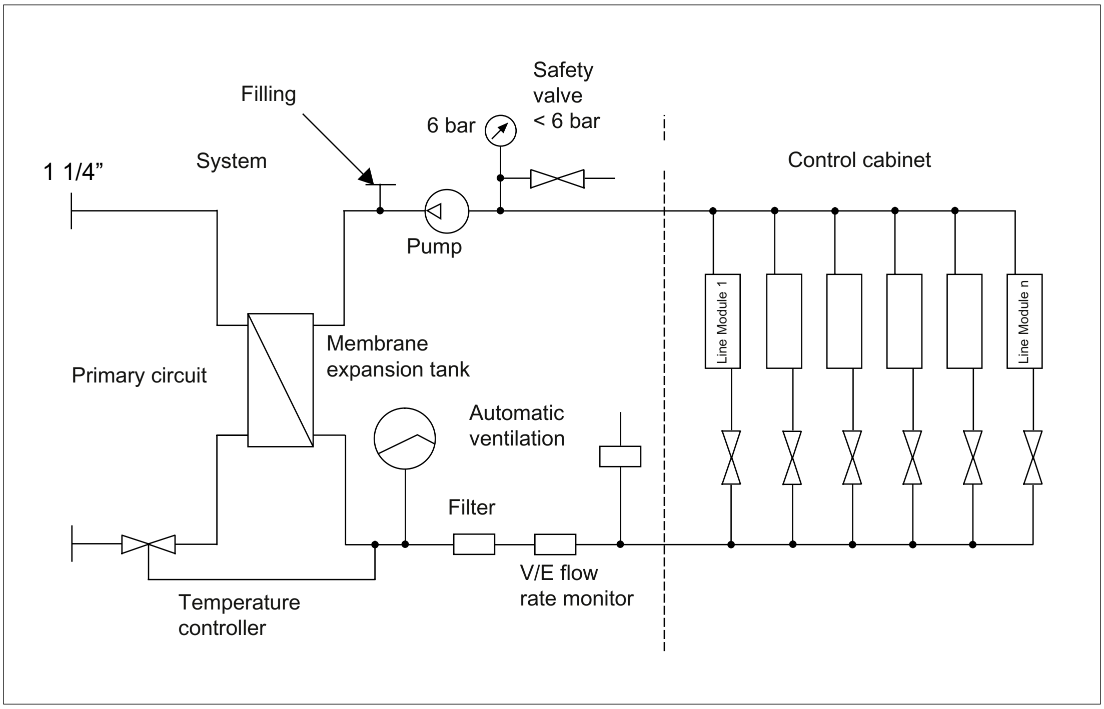


Figure 12-4 Water-to-water heat exchanger

12.5.2 Air-to-water heat exchanger

If no process-water network has been installed 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°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 supercooling must only be taken on the secondary side by means of temperature closed-loop control, a thermostat, or a solenoid valve.

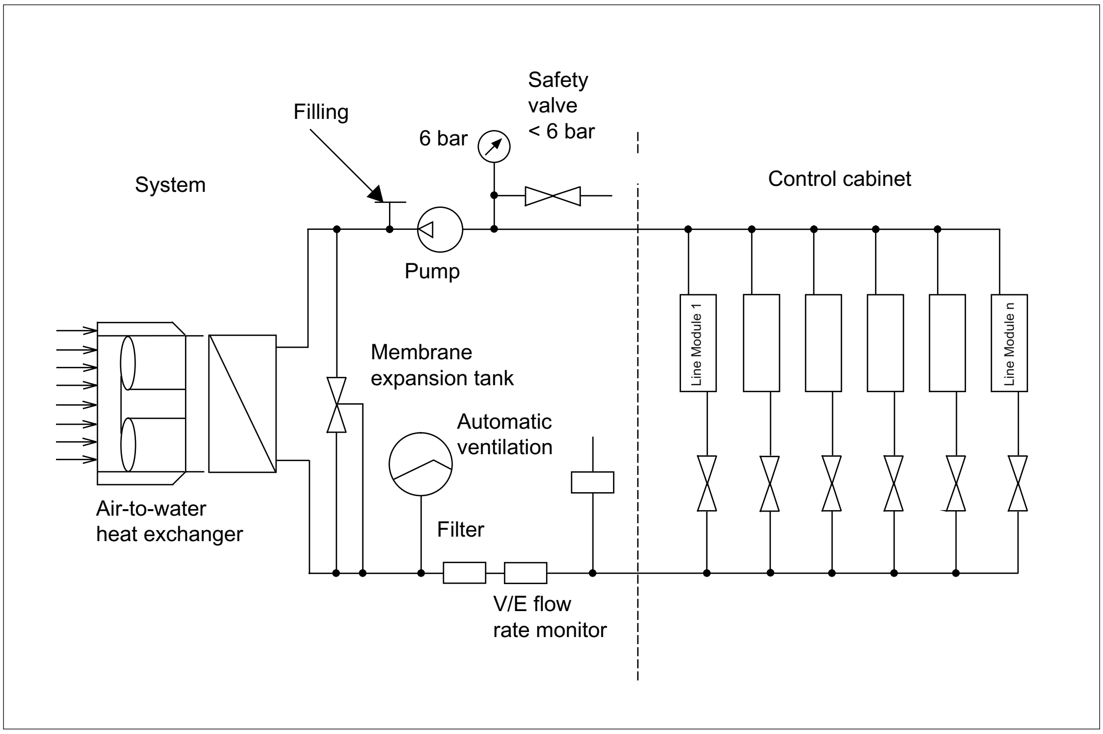


Figure 12-5 Air-to-water heat exchanger

12.5.3 Active cooling unit

If no process-water network has been installed and the ambient air is > 35 °C (35 °C < τ < 40 °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.

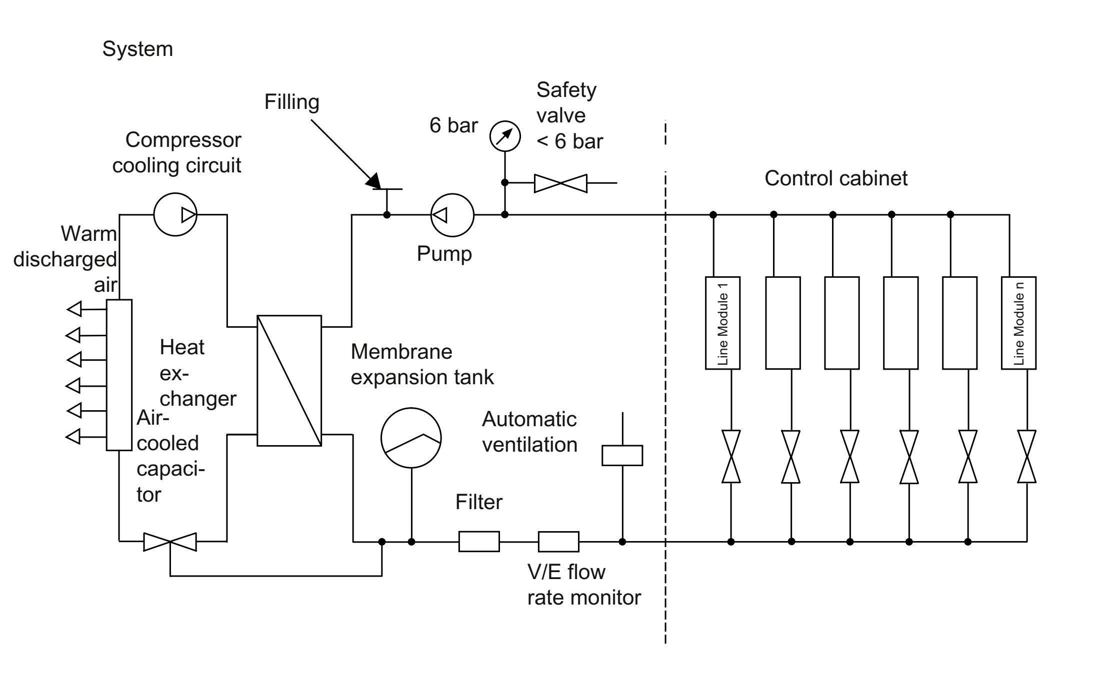


Figure 12-6 Active cooling unit

13 Service and Support Booksize

13.1 Technical Support

Technical support

If you have any further questions, please call our hotline:

Technical Support
Tel.: +49 (0) 180 5050 – 222
Fax: +49 (0) 180 5050 – 223
E-mail: adsupport@siemens.com

Please send any questions about the documentation (suggestions for improvement, corrections, and so on) to the following fax number or e-mail address:

Fax: +49 (0) 9131 98 – 2176
E-mail: docu.motioncontrol@siemens.com

Internet Address

Up-to-date information about our products can be found on the Internet at the following address:

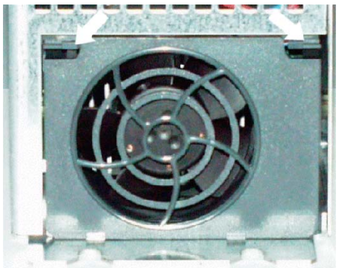
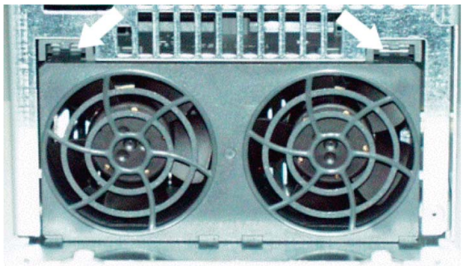
http://www.ad.siemens.de/mc

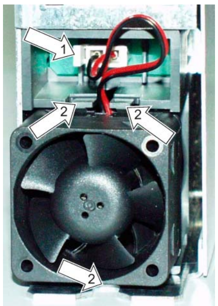
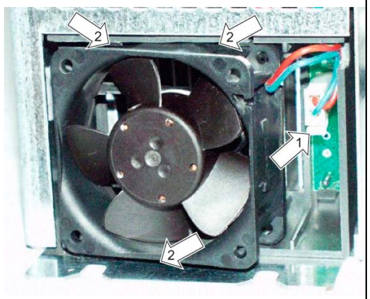
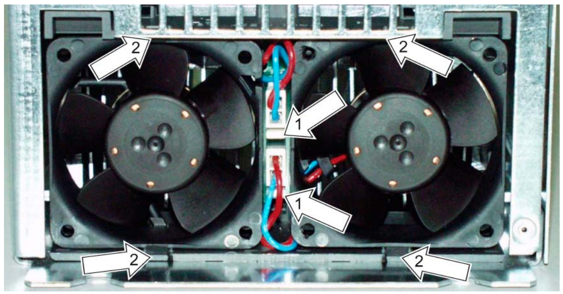
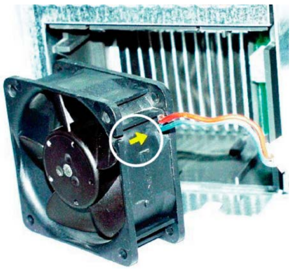
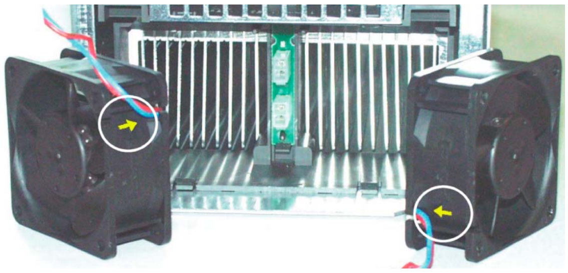
13.2 Replacing the fan

NOTICE
When replacing the fan, you must observe the ESD regulations. Only qualified personnel are permitted to install spare parts!

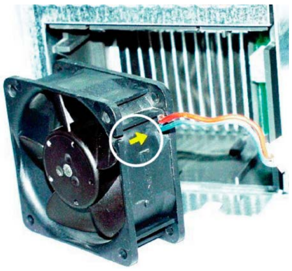
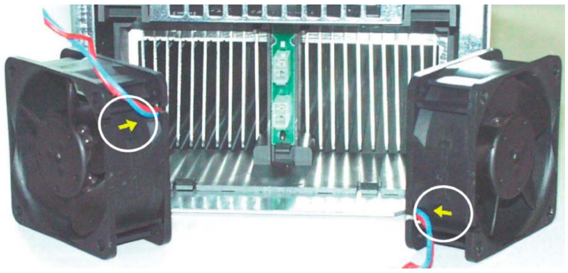
DANGER
Switch off the power supply (400 VAC) before replacing the fan. Risk of electric shock! Dangerous voltages are still present for up to 5 minutes after the power supply has been switched off. Make sure components are isolated from the supply before removing them.

Removing the fan:

Module width: 50 mm	Module width: 100 mm	Module width: 150 mm and 200 mm
1. Remove the component from the drive line-up. 2. Release the snap hooks to open the fan cover.		
		
1. Release and pull out the connection plugs (1). 2. Release the snap hooks (2) and remove the fan.		

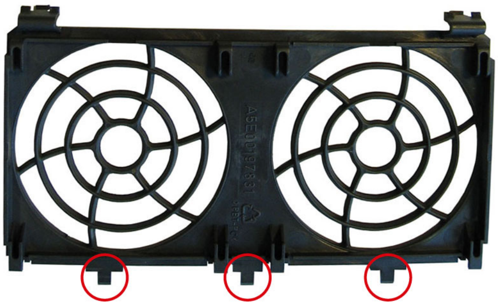
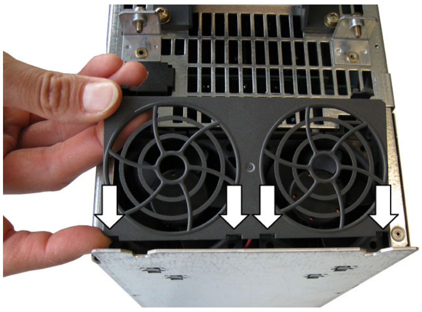
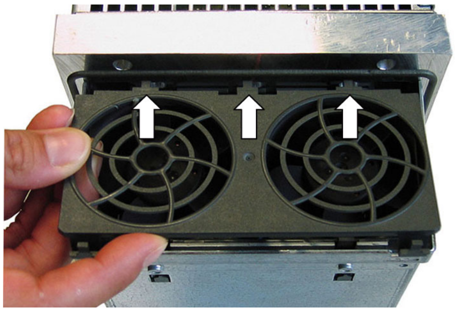
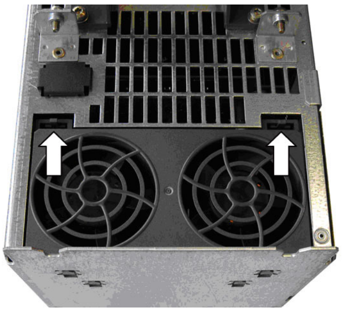
		
		

Installing the fan:

Module width: 50 mm	Module width: 100 mm	Module width: 150 mm and 200 mm
1. Before installing the fan, check the air flow direction (the arrow on the fan must point towards the cooling ribs).		
		
1. Keep moving the fan into position until it is fully engaged NOTICE! Do not crush the connection cables! 2. Insert the connection plug until it is fully engaged. 3. Insert the fan cover.		

NOTICE
The spare parts pack for module widths 150 mm and 200 mm contains two different fan covers. One is for a module with internal air cooling, the other for a module with external air cooling. Make sure you use the right fan cover!

Inserting fan covers for module widths 150 mm and 200 mm

Internal air cooling	External air cooling
 Fan cover for module with internal air cooling	 Fan cover with three installation lugs for module with external air cooling
 Insert the fan cover.	 Insert the fan cover (installation lugs first).
 Push the fan cover in until the snap hooks engage.	 Push the fan cover in until the snap hooks engage.

Note

Replacing a fan for a 300 mm wide component is described in the Chapter "Installation" under "Motor Modules with internal air cooling".

13.3 Forming the DC link capacitors

CAUTION

If the Active Line Modules, Basic Line Modules, Smart Line Modules and Motor Modules have not been used for more than two years, the DC link capacitors must be reformed. If this is not performed, the units could be damaged when they are switched on.

Note

It is important that the storage period is calculated from the date of manufacture and not from the date that the equipment was shipped.

Date of manufacture

The date of manufacture can be determined from the following assignment to the serial number (e.g. T-**S9**2067000015 for 2004, September):

Table 13- 1 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		

The serial number is found on the rating plate.

When DC link capacitors are formed, a defined voltage is connected to them and a defined current flows so that the appropriate capacitor characteristics are re-established for them to be re-used as DC link capacitors.

Forming circuit

The forming circuit can be established using incandescent lamps or alternatively, PTC resistors.

Components required (recommendation)

- 1 fuse switch 3-phase 400 V / 10 A
- Cable 1.5 mm^2
- 3 PTC resistors 350 R / 35 W
  (recommendation: PTC-35W PTC800620-350 Ohm, Michael Koch GmbH; www.koch-mk.de)
- 3 incandescent lamps 230 V / 100 W
- Various Small components, such as lamp socket, etc.

DANGER

Dangerously high voltage levels are still present in the cabinet up to 5 minutes after it has been disconnected due to the DC link capacitors. It is only permissible to work on the equipment or at the DC link terminals after this time has expired.

Note

Line Modules must be enabled from the connected Motor Module.

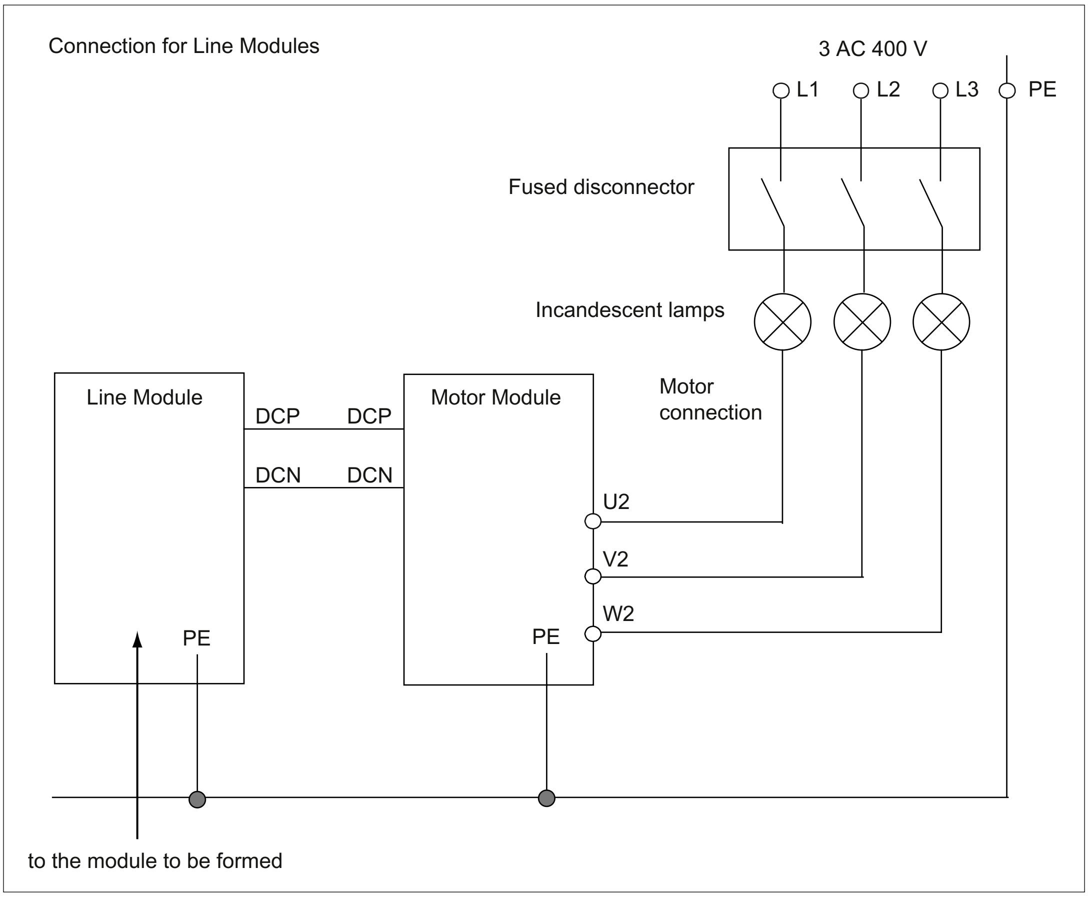


Figure 13-1 Forming circuit for Line Modules with incandescent lamps

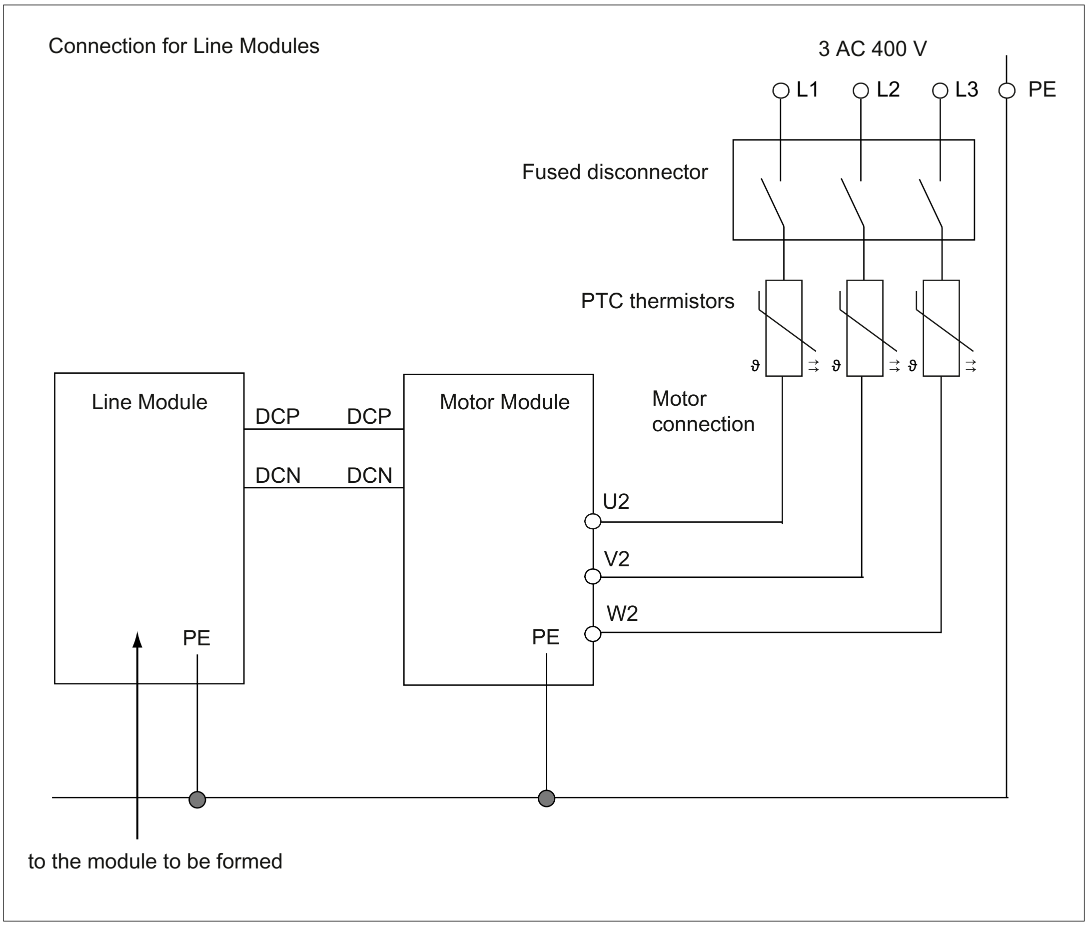


Figure 13-2 Forming circuit for Line Modules with PTC resistors

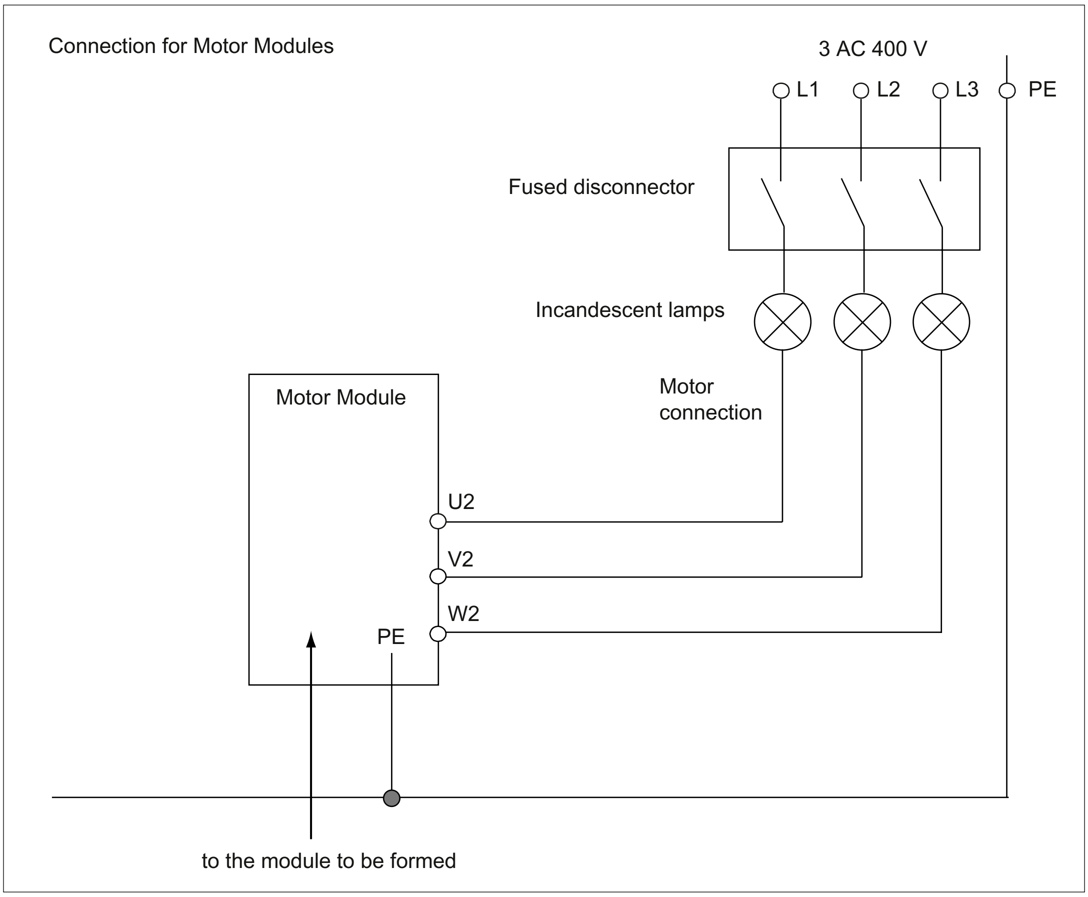


Figure 13-3 Forming circuit for Motor Modules with incandescent lamps

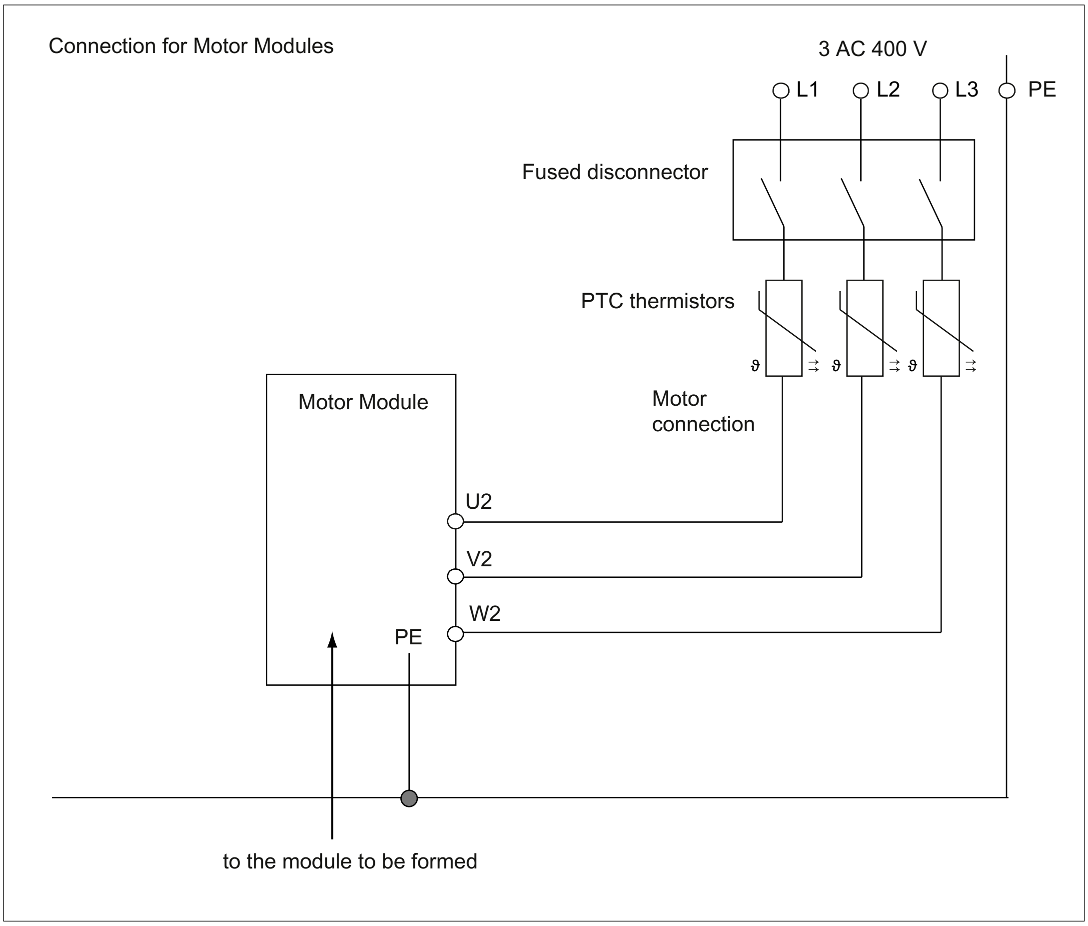


Figure 13-4 Forming circuit for Motor Modules with PTC resistors

Procedure

- Before forming the DC link capacitors, the DC link bridge must be removed.
- It is not permissible that the drive unit receives a power-on command (e.g. from the keyboard, BOP20 or terminal block).
- Connect the forming circuit.
- During the forming process, 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.
- To form 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).

13.4 Spare parts

Spare parts are available on the Internet at:

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

13.5 Disposal

The relevant national environmental regulations must be respected when disposing of devices!

Appendix A

A

A.1 List of abbreviations

Note:

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

Abbreviation	Source of 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
ASM	Induction motor	Induction motor
B		
OC	Operating Condition	Operating condition
BERO	-	Contactless proximity switch
BI	Binector Input	Binector input
BIA	Germany's Institute for Occupational Safety and Health	Germany's Institute for Occupational Safety and Health
BICO	Binector Connector Technology	Binector connector technology
BLM	Basic Line Module	Basic Line Module
BO	Binector Output	Binector output
BOP	Basic Operator Panel	Basic Operator Panel

Abbreviation	Source of abbreviation	Meaning
C		
C	Capacitance	Capacitance
C...	-	Safety message
CAN	Controller Area Network	Serial bus system
CBC	Communication Board CAN	Communication board CAN
CD	Compact Disc	Compact Disc
CDS	Command Data Set	Command data set
CF Card	CompactFlash Card	CompactFlash Card
CI	Connector Input	Connector input
CLC	Clearance Control	Clearance control
CNC	Computer Numerical Control	Computer numerical control
CO	Connector Output	Connector output
CO/BO	Connector Output/Binector Output	Connector/binector output
COB ID	CAN Object Identification	CAN Object identification
COM	Common contact of a changeover relay	Center contact of a changeover contact
COMM	Commissioning	Commissioning
CP	Communication Processor	Communication 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	DC current
DCB	Drive Control Block	Drive Control Block
DCC	Drive Control Chart	Drive Control Chart
DCC	Data Cross Check	Crosswise data comparison
DCN	Direct Current Negative	DC current negative
DCP	Direct Current Positive	DC current positive
DDS	Drive Data Set	Drive data set
DI	Digital Input	Digital input
DI/DO	Digital Input/Digital Output	Digital input/output bidirectional
DMC	DRIVE-CLiQ Hub Module Cabinet	DRIVE-CLiQ Hub Module Cabinet
DME	DRIVE-CLiQ Hub Module External	DRIVE-CLiQ Hub Module External
DO	Digital Output	Digital output
DO	Drive Object	Drive object
DP	Decentralized Peripherals	Distributed IOs
DPRAM	Dual Ported Random Access Memory	Memory with dual access ports

Abbreviation	Source of abbreviation	Meaning
DRAM	Dynamic Random Access Memory	Dynamic memory
DRIVE-CLiQ	Drive Component Link with IQ	Drive Component Link with IQ
DSC	Dynamic Servo Control	Dynamic Servo Control
E		
EASC	External Armature Short Circuit	External armature short circuit
EDS	Encoder Data Set	Encoder data set
ESD	Electrostatic Sensitive Devices	Electrostatic sensitive devices
ELCB	Earth Leakage Circuit Breaker	Earth leakage circuit breaker
ELP	Earth Leakage Protection	Earth leakage protection
EMC	Electromagnetic Compatibility	Electromagnetic compatibility
EMF	Electromagnetic Force	Electromagnetic force
EMF	Electromagnetic force	Electromagnetic force
EMC	Electromagnetic compatibility	Electromagnetic compatibility
EN	European standard	European standard
EnDat	Encoder Data Interface	Encoder interface
EP	Enable Pulses	Pulse enable
EPOS	Basic positioner	Basic positioner
ES	Engineering System	Engineering System
ESB	Equivalent circuit diagram	Equivalent circuit diagram
ESD	Electrostatic Sensitive Devices	Electrostatic sensitive devices
ESR	Extended Stop and Retract	Extended stop and retract
F		
F...	Fault	Fault
FAQs	Frequently Asked Questions	Frequently asked questions
FBL	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
FEM	Separately excited synchronous motor	Separately excited synchronous motor
FEPROM	Flash EPROM	Non volatile read and write memory
FG	Function Generator	Function generator
FI	-	Fault current
FOC	Fiber-Optic Cable	Fiber-optic cable
FP	Function diagram	Function diagram
FPGA	Field Programmable Gate Array	Field Programmable Gate Array
FW	Firmware	Firmware
G		
GB	Gigabyte	Gigabyte

Abbreviation	Source of abbreviation	Meaning
GC	Global Control	Global Control Telegram (Broadcast Telegramm)
GND	Ground	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as G)
GSD	Generic Station Description	Generic station description: Describes the characteristics 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	High-frequency reactor	High-frequency reactor
RFG	Ramp-Function Generator	Ramp-function generator
HMI	Human Machine Interface	Human machine interface
HTL	High-Threshold Logic	Logic with a high fault threshold
HW	Hardware	Hardware
I		
u.d.	under development	Under development: This feature is not currently 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	Commissioning	Commissioning
ID	Identifier	Identification
IE	Industrial Ethernet	Industrial Ethernet
IEC	International Electrotechnical Commission	International Electrotechnical Commission
IF	Interface	Interface
IGBT	Insulated Gate Bipolar Transistor	Insulated gate bipolar transistor
IGCT	Integrated Gate-Controlled Thyristor	Semiconductor power switch with integrated control electrode
IL	Pulse cancelation	Pulse cancelation
IP	Internet Protocol	Internet Protocol
IPO	Interpolator	Interpolator
IT	Isolé Terré	Non-grounded three-phase power supply
IVP	Internal Voltage Protection	Internal voltage protection
J		
JOG	Jogging	Jogging
K		
CDC	Crosswise data comparison	Crosswise data comparison
KIP	Kinetic buffering	Kinetic buffering
Kp	-	Proportional gain
KTY	-	Special temperature sensor

Abbreviation	Source of abbreviation	Meaning
L		
L	-	Formula symbol for inductance
LED	Light Emitting Diode	Light Emitting Diode
LIN	Linear motor	Linear motor
PC	Position Controller	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
FOC	Fiber-Optic Cable	Fiber-optic cable
M		
M	-	Formula symbol for torque
M	Ground	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
MDS	Motor Data Set	Motor data set
MLFB	Machine-Readable Product Code	Machine-Readable Product Code
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
MSR	Motor-side converter	Motor-side converter
MT	Probe	Probe
N		
N. C.	Not Connected	Not connected
N...	No Report	No message or internal message
NAMUR	Standardization association for measurement and control in the chemical industry	Standardization association for measurement and control in the chemical industry
NC	Normally Closed (contact)	NC contact
NC	Numerical Control	Numerical control
NEMA	National Electrical Manufacturers Association	Standardization body in the US
NM	Zero mark	Zero mark
NO	Normally Open (contact)	NO contact
NSR	Line-side converter	Line-side converter
NVRAM	Non-Volatile Random Access Memory	Non-volatile read/write memory

Abbreviation	Source of abbreviation	Meaning
O		
OA	Open Architecture	Open Architecture
OC	Operating Condition	Operating condition
OEM	Original Equipment Manufacturer	Original Equipment Manufacturer
OLP	Optical Link Plug	Fiber-optic bus connector
OMI	Option Module Interface	Option module interface
P		
p...	-	Adjustable parameters
PB	PROFIBUS	PROFIBUS
PcCtrl	PC Control	Control for master
PD	PROFIdrive	PROFIdrive
PDS	Power unit Data Set	Power unit data set
PE	Protective Earth	Protective earth
PELV	Protective Extra Low Voltage	Protective extra low voltage
PEM	Permanent-magnet synchronous motor	Permanent-magnet synchronous motor
PG	Programming device	Programming device
PI	Proportional Integral	Proportional integral
PID	Proportional Integral Differential	Proportional integral differential
PLC	Programmable Logic Controller	Programmable logic controller
PLL	Phase-Locked Loop	Phase-locked loop
PN	PROFINET	PROFINET
PNO	PROFIBUS user organization	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	Process data	Process data
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

Abbreviation	Source of abbreviation	Meaning
RKA	Cooling unit	Cooling unit
RO	Read Only	Read only
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 under 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 under EIA485)
RTC	Real Time Clock	Real time clock
RZA	Space vector approximation	Space vector approximation
S		
S1	-	Uninterrupted duty
S3	-	Intermittent duty
SBC	Safe Brake Control	Safe brake control
SBH	Safe operating stop	Safe operating stop
SBR	-	Safe acceleration monitoring
SCA	Safe Cam	Safe cam
SD Card	SecureDigital Card	Secure digital memory card
SE	Safe software limit switch	Safe software limit switch
SG	Safely reduced speed	Safely reduced speed
SGA	Safety-related output	Safety-related output
SGE	Safety-related input	Safety-related input
SH	Safe standstill	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
SM	Sensor Module	Sensor Module
SMC	Sensor Module Cabinet	Sensor Module Cabinet
SME	Sensor Module External	Sensor Module External
SN	Safe software cam	Safe software cam
SOS	Safe Operating Stop	Safe operating stop
SP	Service Pack	Service pack
SPC	Setpoint Channel	Setpoint channel
SPI	Serial Peripheral Interface	Serial interface for connecting peripherals
PLC	Programmable Logic Controller	Programmable logic control

Abbreviation	Source of abbreviation	Meaning
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 for speed monitoring (n < nx)
SSP	SINAMICS Support Package	SINAMICS support package
STO	Safe Torque Off	Safe torque off
STW	Control word	Control word
T		
TB	Terminal Board	Terminal Board
TIA	Totally Integrated Automation	Totally Integrated Automation
TM	Terminal Module	Terminal module
TN	Terre Neutre	Grounded three-phase supply network
Tn	-	Integral time
TPDO	Transmit Process Data Object	Transmit process data object
TT	Terre Terre	Grounded three-phase supply network
TTL	Transistor-Transistor Logic	Transistor-transistor logic
Tv	-	Rate time
U		
UL	Underwriters Laboratories Inc.	Underwriters Laboratories Inc.
UPS	Uninterruptible Power Supply	Uninterruptible power supply
UPS	Uninterruptible Power Supply	Uninterruptible power supply
UTC	Universal Time Coordinated	Universal time coordinated
V		
VC	Vector Control	Vector control
Vdc	-	DC link voltage
VdcN	-	Partial DC link voltage negative
VdcP	-	Partial DC link voltage positive
VDE	Verband Deutscher Elektrotechniker	Association of German electrical engineers
VDI	Verein Deutscher Ingenieure	Association of German Engineers
VPM	Voltage Protection Module	Voltage Protection Module
Vpp	Volt peak-to-peak	Volt peak-to-peak
VSM	Voltage Sensing Module	Voltage Sensing Module
W		
AR	Automatic restart	Automatic restart
MT	Machine Tool	Machine tool
X		
XML	Extensible Markup Language	Standard language for Web publishing and document management

Abbreviation	Source of abbreviation	Meaning
Z		
DC link	DC link	DC link
ZM	Zero Mark	Zero mark
ZSW	Status word	Status word

SINAMICS documentation overview

General documentation/catalogs

SINAMICS G110
D11.1
Inverter Chassis Units
0.12 kW to 3 kW

SINAMICS G130 G150
D11
Drive Converter Chassis Units
Drive Converter Cabinet Units

SIMOTION SINAMICS S120
PM21
SIMOTION, SINAMICS S120 and
Motors for Production Machines

SINAMICS S120 S150
D21.3
SINAMICS S120 Chassis Units
Chassis Format Units and Cabinet Modules
SINAMICS S150
Converter Cabinet Units

Manufacturer/service documentation

SINAMICS G110
Getting Started
Operating Instructions
List Manual

SINAMICS G120
Getting Started
Operating Instructions
Hardware Installation Manual
Function Manual Safety Integrated
List Manual

SINAMICS G130
Operating Instructions
List Manual

SINAMICS G150
Operating Instructions
List Manual

SINAMICS GM150 SM150 GL150 SL150
Operating Instructions
List Manual

Manufacturer/service documentation

SINAMICS S110
Equipment Manual
Getting Started
Function Manual
List Manual

SINAMICS S120
Getting Started
Commissioning Manual
Commissioning Manual for CANopen
Function Manual Drive Functions
Function Manual Safety Integrated
Function Manual DCC
List Manual

SINAMICS S120
Equipment Manual for Control Units and
Additional Components
Equipment Manual for Booksize Power Units
Equipment Manual for Chassis Power Units
Equipment Manual for Chassis Liquid
Cooled Power Units
Equipment Manual Cabinet Modules
Equipment Manual AC Drive

SINAMICS S150
Operating Instruc-
tions
List Manual

Manufacturer/service documentation

SINAMICS Motors
DOConCD

Engineering Manuals
Motors

EMC
Configuration
Guidelines

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Suggestions and/or corrections

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