

# SINAMICS S120

**Booksize Power Units**

Manual · 01/2013

SINAMICS

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## SINAMICS

### S120 Booksize Power Units




#### Manual

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## Legal information

### Warning notice system

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

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


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

### Qualified Personnel

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

### Proper use of Siemens products

Note the following:

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

### Trademarks

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

### Disclaimer of Liability

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

# Preface

## SINAMICS documentation

The SINAMICS documentation is organized in the following categories:

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

## More information

Using the following link, you can find information on the topics:

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

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

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

## My Documentation Manager

Using the following link, you can find information on how to create your own individual documentation based on Siemens content, and adapt it for your own machine documentation:

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

## Training

Using the following link, you can find information on SITRAIN - training from Siemens for products, systems and automation engineering solutions:

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

## FAQs

You can find Frequently Asked Questions in the Service&Support pages under **Product Support**:

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

## SINAMICS

You can find information on SINAMICS under:  
<http://www.siemens.com/sinamics>

### Usage phases and the available tools/documents

Table 1 Usage phases and the available tools/documents

Usage phase	Tools
Orientation	SINAMICS S sales documentation
Planning/engineering	<ul style="list-style-type: none"> <li>• SIZER configuration tool</li> <li>• Configuration manuals, motors</li> </ul>
Decision making/ordering	SINAMICS S Catalogs <ul style="list-style-type: none"> <li>• SIMOTION, SINAMICS S120 and Motors for Production Machines (Catalog PM 21)</li> <li>• SINAMICS and motors for single-axis drives (catalog D 31)</li> <li>• SINUMERIK &amp; SINAMICS Equipment for Machine Tools (Catalog NC 61)</li> <li>• SINUMERIK 840D sl Type 1B Equipment for Machine Tools (Catalog NC 62)</li> </ul>
Configuring/installation	<ul style="list-style-type: none"> <li>• SINAMICS S120 Equipment Manual for Control Units and Additional System Components</li> <li>• SINAMICS S120 Equipment Manual for Booksize Power Units</li> <li>• SINAMICS S120 Equipment Manual for Chassis Power Units</li> <li>• SINAMICS S120 Manual Liquid Cooled Chassis Power Units</li> <li>• SINAMICS S120 Equipment Manual for AC Drives</li> <li>• SINAMICS S120M Equipment Manual Distributed Drive Technology</li> <li>• MOTION CONTROL Configuration Manual EMC installation guidelines / basic system requirements</li> </ul>
Commissioning	<ul style="list-style-type: none"> <li>• STARTER commissioning tool</li> <li>• SINAMICS S120 Getting Started</li> <li>• SINAMICS S120 Commissioning Manual</li> <li>• SINAMICS S120 CANopen Commissioning Manual</li> <li>• SINAMICS S120 Function Manual</li> <li>• SINAMICS S120 Safety Integrated Function Manual</li> <li>• SINAMICS S120/S150 List Manual</li> </ul>
Using/operating	<ul style="list-style-type: none"> <li>• SINAMICS S120 Commissioning Manual</li> <li>• SINAMICS S120/S150 List Manual</li> </ul>
Maintenance/Service	<ul style="list-style-type: none"> <li>• SINAMICS S120 Commissioning Manual</li> <li>• SINAMICS S120/S150 List Manual</li> </ul>
List of references	<ul style="list-style-type: none"> <li>• SINAMICS S120/S150 List Manual</li> </ul>

## Target group

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

## Benefits

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

## Standard scope

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

- Other functions that are not explained in this documentation may be able to be executed in the drive system. However, no claim can be made regarding the availability of these functions when the equipment is first supplied or in the event of servicing.
- The documentation can also contain descriptions of functions that are not available in a particular product version of the drive system. The functionalities of the supplied drive system should only be taken from the ordering documentation.
- Extensions or changes made by the machine manufacturer must be documented by the machine manufacturer.

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

## Technical Support

Country-specific telephone numbers for technical support are provided in the Internet under **Contact:**

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

## EC Declarations of Conformity

The EC Declaration of Conformity for the EMC Directive can be found on the Internet at:

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

There – as a search term – enter the number **15257461** or contact your local Siemens office.

The EC Declaration of Conformity for the Low Voltage Directive can be found on the Internet at:

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

There – as a search term – enter the number **22383669** .

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**Note**

**Fulfilling the Low-Voltage Directive**

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

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**Note**

**Fulfilling the EMC Directive**

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

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**Note**

**Ensuring reliable operation**

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

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## EMC limit values in South Korea

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

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

The measures for EMC-compliant design of the system are described in detail in this manual respectively in the Configuration Manual EMC Installation Guideline.

Please note that the final statement regarding compliance with the standard is given by the respective label attached to the individual unit.

## Spare parts

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




## Test certificates

Test certificates for functional safety functions ("Safety Integrated") can be found at:  
<http://support.automation.siemens.com>

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

## Grounding symbols

Table 2 Symbols

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





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# Fundamental safety instructions

## 1.1 General safety instructions



### DANGER

#### **Danger to life when live parts are touched**

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

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

Generally, six steps apply when establishing safety:

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

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



### WARNING

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

Death or serious injury can result when live parts are touched in the event of a fault.

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



 **WARNING**

**Danger to life when live parts are touched on damaged devices**

Improper handling of devices can cause damage.

Hazardous voltages can be present at the housing or exposed components on damaged devices.

- Ensure compliance with the limit values specified in the technical data during transport, storage and operation.
- Do not use any damaged devices.
- Protect the components against conductive pollution, e.g. by installing them in a cabinet with IP54 degree of protection according to EN 60529. Provided conductive pollution can be prevented at the installation site, the degree of protection for the cabinet can be decreased accordingly.

 **WARNING**

**Danger of fire spreading due to inadequate housing**

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

- Install devices without a protective housing in a metal control cabinet (or protect the device by another equivalent measure) in such a way that contact with fire inside and outside the device is prevented.

 **WARNING**

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

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

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

 **WARNING**

**Fire hazard for the motor due to overload of the insulation**

There is a greater load on the motor insulation through a ground fault in an IT system. A possible result is the failure of the insulation with a risk for personnel through smoke development and fire.

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



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

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

- Ensure compliance with the specified minimum clearance as ventilation clearance for the respective component. They can be found in the dimension drawings or in the "Product-specific safety instructions" at the start of the respective section.

 **WARNING****Danger to life through electric shock due to unconnected cable shields**

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

- Connect cable shields and unused conductors of power cables (e.g. brake conductors) at least on one side to the grounded housing potential.

## 1.2 Safety instructions for electromagnetic fields (EMF)

 **WARNING****Danger to life from electromagnetic fields**

Electromagnetic fields (EMF) are generated by the operation of electrical power equipment such as transformers, converters or motors.

People with pacemakers or implants are at a special risk in the immediate vicinity of these devices/systems.

- Keep a distance of at least 2 m.

### 1.3 Handling electrostatic sensitive devices (ESD)

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



<b>NOTICE</b>
<b>Damage through electric fields or electrostatic discharge</b>
Electric fields or electrostatic discharge can cause malfunctions through damaged individual components, integrated circuits, modules or devices.
<ul style="list-style-type: none"><li>• Only pack, store, transport and send electronic components, modules or devices in their original packaging or in other suitable materials, e.g. conductive foam rubber or aluminum foil.</li><li>• Only touch components, modules and devices when you are grounded by one of the following methods:<ul style="list-style-type: none"><li>– Wearing an ESD wrist strap</li><li>– Wearing ESD shoes or ESD grounding straps in ESD areas with conductive flooring</li></ul></li><li>• Only place electronic components, modules or devices on conductive surfaces (table with ESD surface, conductive ESD foam, ESD packaging, ESD transport container).</li></ul>

## 1.4 Residual risks of power drive systems

### Residual risks of power drive systems

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

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

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

When assessing the machine's risk in accordance with the EC Machinery Directive, the machine manufacturer must take into account the following residual risks emanating from the control and drive components of a drive system:

1. Unintentional movements of driven machine components during commissioning, operation, maintenance, and repairs caused by, for example:
  - Hardware defects and/or software errors in the sensors, controllers, actuators, and connection technology
  - Response times of the controller and drive
  - Operating and/or ambient conditions outside of the specification
  - Condensation / conductive contamination
  - Parameterization, programming, cabling, and installation errors
  - Use of radio devices / cellular phones in the immediate vicinity of the controller
  - External influences / damage
2. In the event of a fault, exceptionally high temperatures, including an open fire, as well as emissions of light, noise, particles, gases, etc. can occur inside and outside the inverter, e.g.:
  - Component malfunctions
  - Software errors
  - Operating and/or ambient conditions outside of the specification
  - External influences / damage

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

3. Hazardous shock voltages caused by, for example:
  - Component malfunctions
  - Influence of electrostatic charging
  - Induction of voltages in moving motors
  - Operating and/or ambient conditions outside of the specification
  - Condensation / conductive contamination
  - External influences / damage
4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc. if they are too close.
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly.

---

**Note**

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

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

---

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

## System overview

### 2.1 Field of application

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

- Simple pump and fan applications in the process industry.
- Complex 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.
- High-precision servo drives in the manufacture of wind turbines
- Highly dynamic servo drives for machine tools, as well as packaging and printing machines.

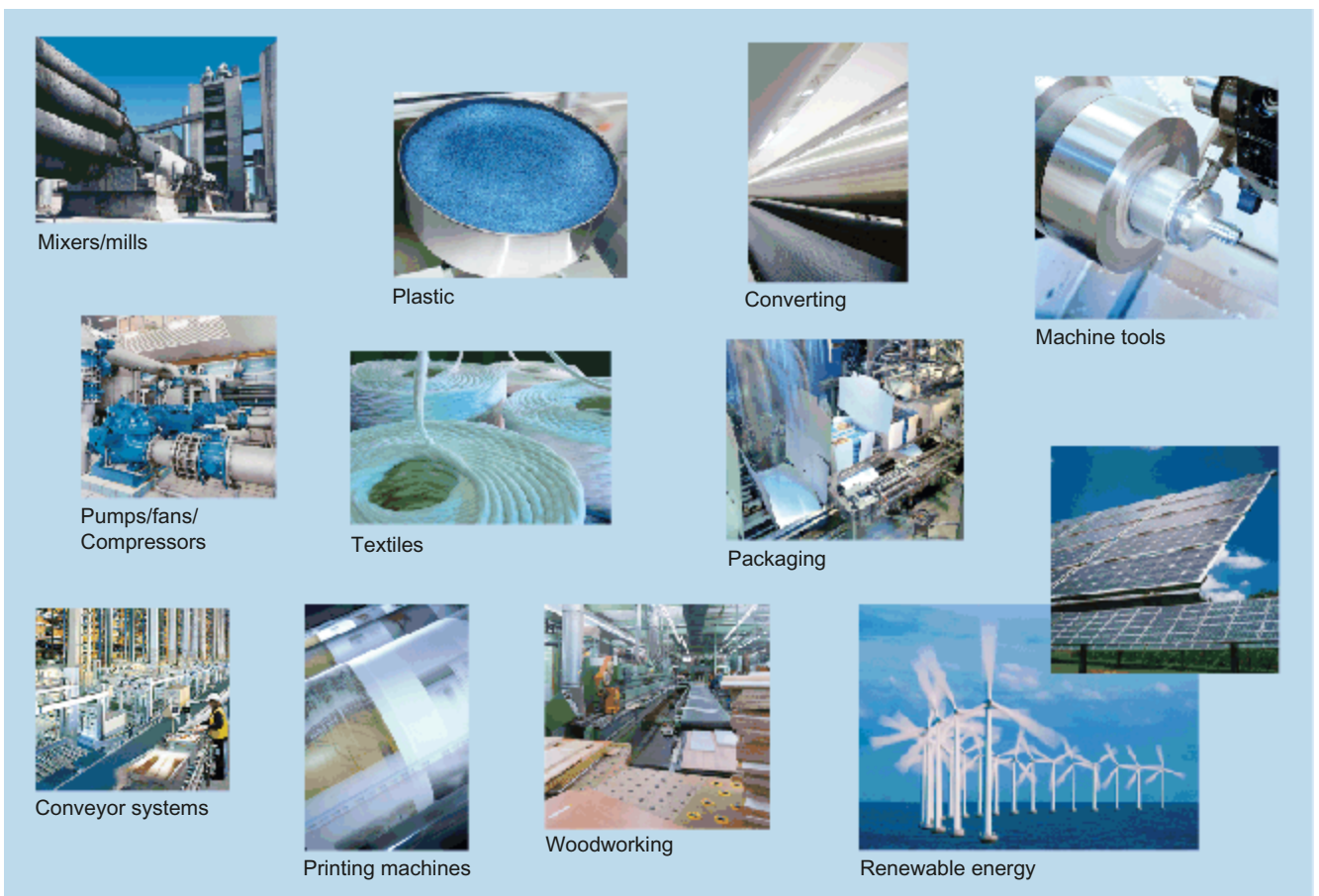


Figure 2-1 SINAMICS applications

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

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

## 2.2 Platform Concept and Totally Integrated Automation

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

### Totally Integrated Automation (TIA) with SINAMICS S120

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

PROFIBUS DP, the standard fieldbus of the TIA system, is supported by all SINAMICS S120 variants. It provides a high-performance, system-wide communication network which links all automation components: HMI, controls, drives and I/O devices.

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



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

## 2.3 Introduction

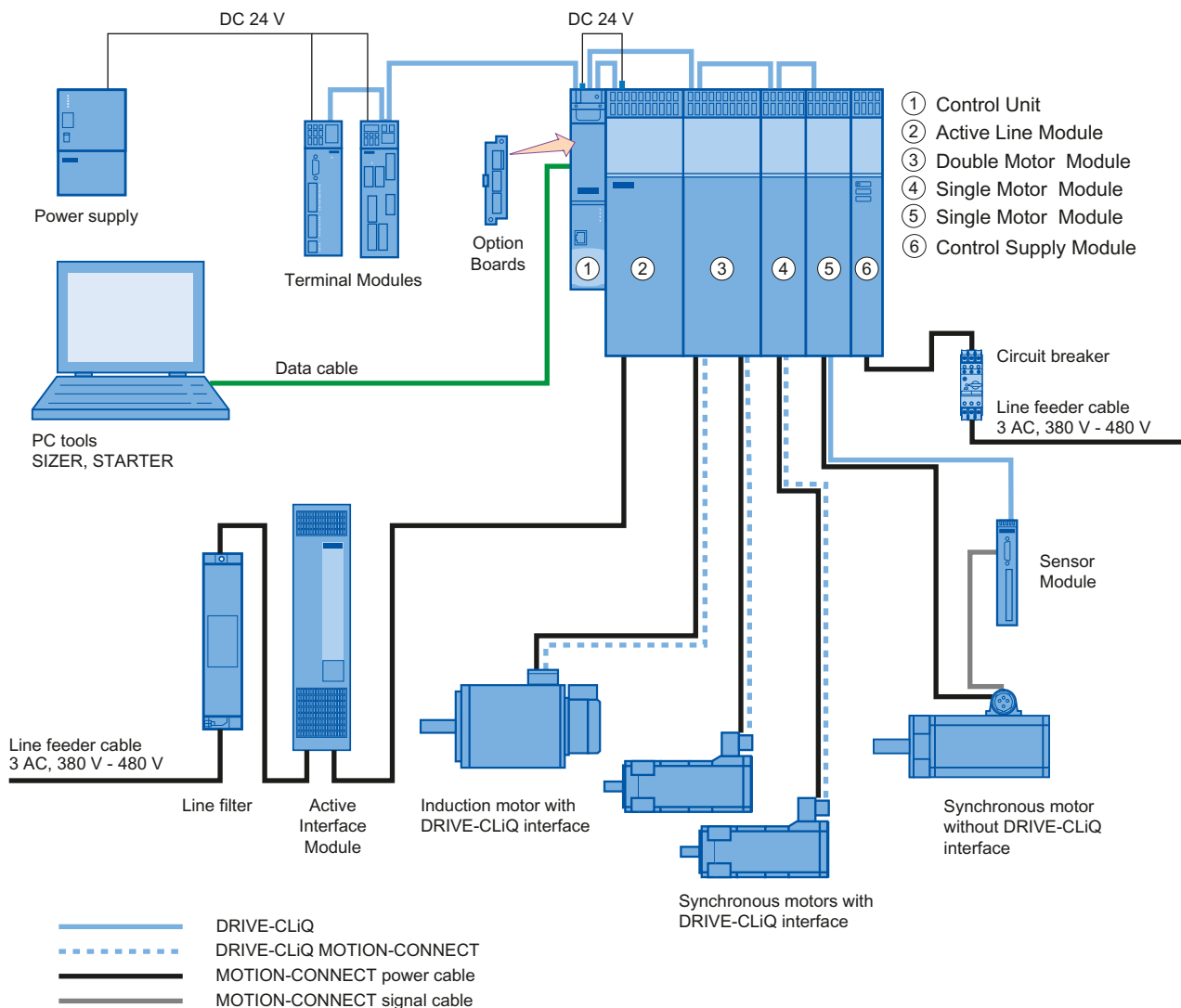


Figure 2-3 SINAMICS S120 system overview

### Modular system for sophisticated drive tasks

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

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



### **System architecture with a central Control Unit**

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

### **Functions for higher efficiency**

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

### **DRIVE-CLiQ – the digital interface between SINAMICS components**

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

### **Electronic rating plates in all components**

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

The rating plate contains all the relevant technical data about that particular component. In the motors, for example, this data includes the parameters of the electric equivalent circuit diagram and characteristic values for the built-in motor encoder.

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

## 2.4 SINAMICS S120 components

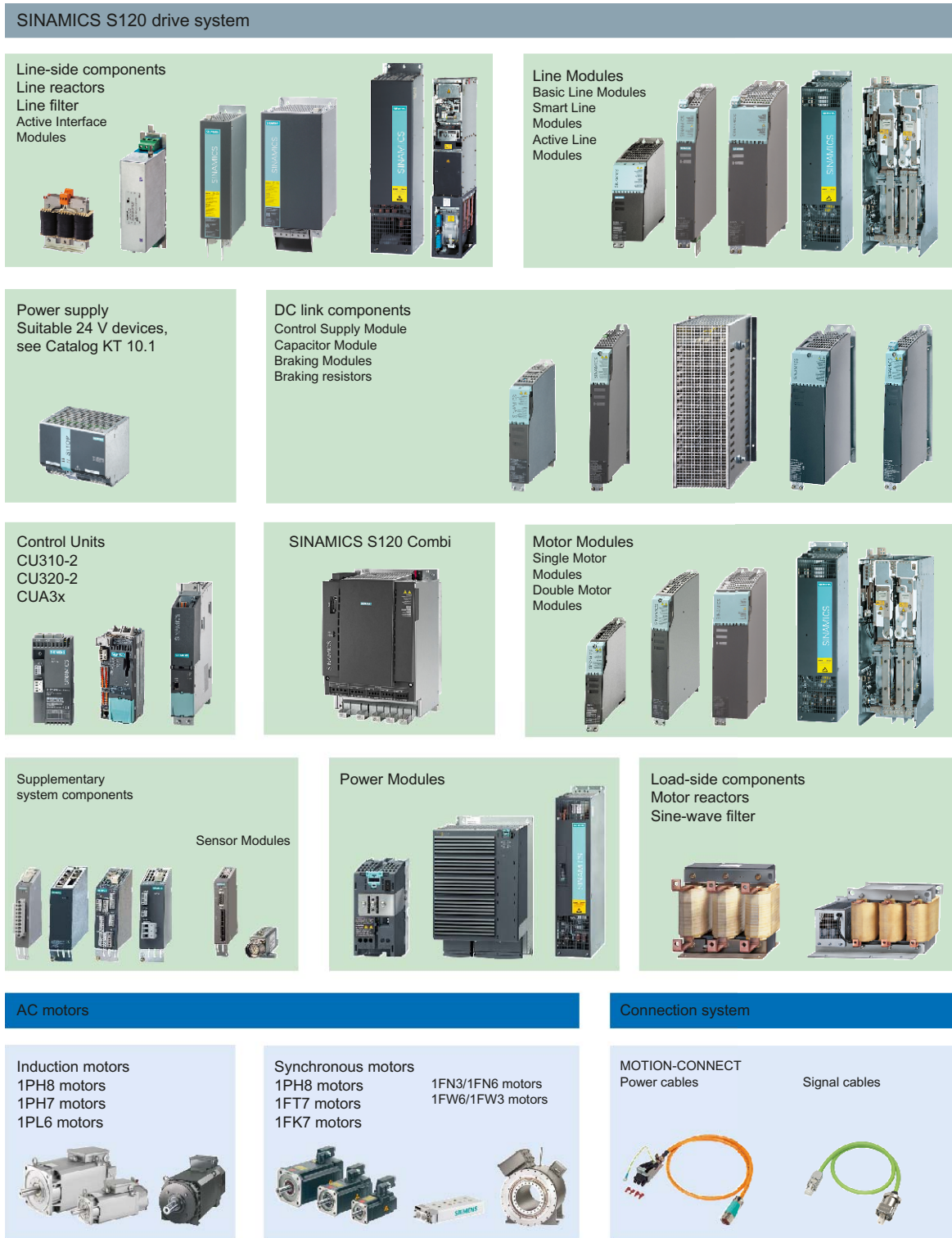


Figure 2-4 Overview of SINAMICS S120 components

### **System components**

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

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

- Control Units that processes the 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 are intended for installation in cabinets. They have the following features and characteristics:

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

---

### **Note**

#### **Installation location in the cabinet**

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

---

### **Booksize format**

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

The booksize format offers various cooling options:

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

### **Booksize compact format**

The booksize compact format combines all benefits of the booksize format and provides the same performance with an even smaller overall height 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

### 2.4.1 Overview of Line Modules

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

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

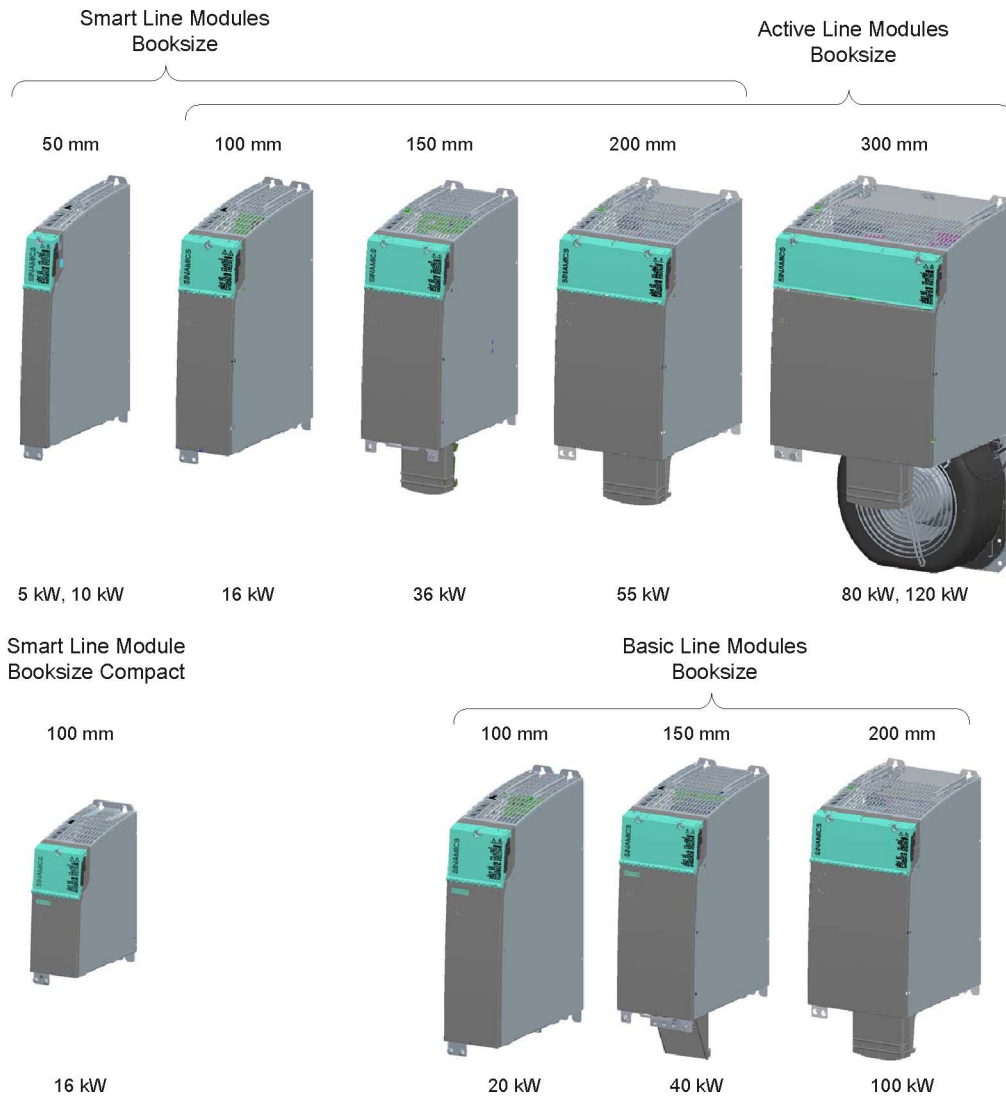


Figure 2-5 Overview of Line Modules

### **General characteristics of the Line Modules**

- Supply voltage, 3 AC 380 V to 480 V  $\pm 10\%$  (-15 % <1 min), 47 to 63 Hz
- Suitable for TN, TT, and IT supply systems
- Internal/external air cooling
- Liquid cooling and cold plate cooling
- Short-circuit/ground-fault-proof during the precharge phase
- Integrated DC link and electronics current busbar connection
- LEDs for indicating statuses and for diagnostics

### **Characteristics of the Active Line Modules**

- Regulated DC link voltage
- Regenerative feedback capability
- Sinusoidal line currents
- Electronic rating plate
- DRIVE-CLiQ interface for communicating with the Control Unit and/or other components in the drive line-up.
  - Integration in system diagnostics
- For all Active Line Modules with order numbers ending in 3 ((6SL...-...3)), outgoing circuit for DC link busbar possible on both sides.

### **Characteristics of the Smart Line Modules**

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

### **Characteristics of the Basic Line Modules**

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

### Frequency with which the DC link is precharged

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

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

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

## 2.4.2 Overview of Motor Modules

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

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

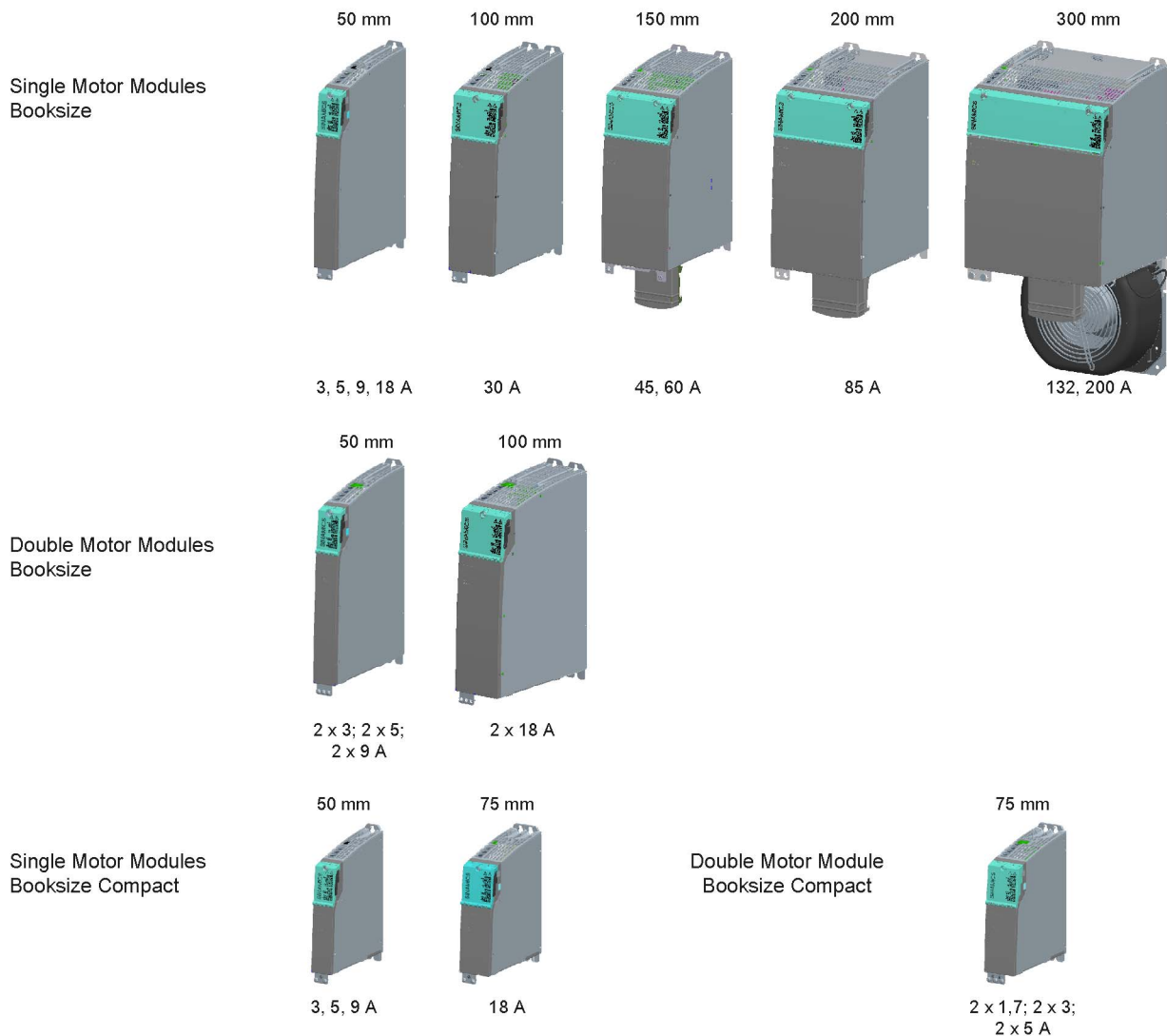


Figure 2-6 Overview of Motor Modules

**Characteristics of the Motor Modules:**

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



## 2.5 System data

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

Table 2- 1 Electrical data

Line connection voltage	3 AC 380 V to 480 V $\pm 10\%$ ( $-15\% < 1$ min)
Line frequency	47 Hz to 63 Hz
Electronics power supply	24 V DC $-15/+20\%$ <sup>1)</sup> , safety extra-low voltage DVC A
Short-circuit current rating SCCR according to UL508C (up to 600 V)	<ul style="list-style-type: none"> <li>• 1.1 kW – 447 kW: 65 kA</li> <li>• 448 kW – 671 kW: 84 kA</li> <li>• 672 kW – 1193 kW: 170 kA</li> <li>• <math>\geq 1194</math> kW: 200 kA</li> </ul>
Radio interference suppression acc. to EN 61800-3	Category C2 (optional) for system versions conformant with documentation
Overvoltage category	III according to EN 61800-5-1
Degree of contamination	2 according to EN 61800-5-1

1) If a motor holding brake is used, restricted voltage tolerances ( $24\text{ V} \pm 10\%$ ) may have to be taken into account.

Table 2- 2 Modules

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

Table 2- 3 Environmental conditions

Degree of protection	IP20 or IPXXB according to EN 60529, open type according to UL508
Protection class for line current circuits Protection class for electronic circuits	I (with protective conductor connection) and III (protective extra-low voltage DVC A) according 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.

2.5 System data

<b>Chemically active substances</b>	
Long-term storage in the transport packaging	Class 1C2 according to EN 60721-3-1
Transport in the transport packaging	Class 2C2 according to EN 60721-3-2
Operation	Class 3C2 according to EN 60721-3-3
<b>Biological environmental conditions</b>	
Long-term storage in the transport packaging	Class 1B1 according to EN 60721-3-1
Transport in the transport packaging	Class 2B1 according to EN 60721-3-2
Operation	Class 3B1 according to EN 60721-3-3
<b>Vibratory load</b>	
Long-term storage in the transport packaging	Class 1M2 according to EN 60721-3-1
Transport in the transport packaging	Class 2M3 according to EN 60721-3-2
Operation	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
<b>Shock stressing</b>	
Long-term storage in the transport packaging	Class 1M2 according to EN 60721-3-1
Transport in the transport packaging	Class 2M3 according to EN 60721-3-2
Operation Booksize format, Booksize Compact	Test values: 15 g / 11 ms
<b>Climatic environmental conditions</b>	
Long-term storage in the transport packaging	Class 1K4 according to EN 60721-3-1 Temperature: -25° C to + 55° C
Transport in the transport packaging	Class 2K4 according to EN 60721-3-2 Temperature: -40° C to +70° C
Operation	Class 3K3 according to EN 60721-3-3 Temperature +0° C to +40° C Relative humidity: 5% to 90% Oil mist, salt mist, ice formation, condensation, dripping water, spray, splash water, water jets are not permitted

Table 2- 4 Certificates

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

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

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

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

Table 2- 5 Air pressure for various installation altitudes

Installation altitude above sea level in [m]	0	2000	3000	4000	5000
Air pressure in mbar [kPa]	100	80	70	62	54

The output current must be reduced if the modules are operated at ambient temperatures above 40 °C (see derating characteristics for the individual modules). Ambient temperatures above 55 °C are not permissible.

The air gaps inside the devices can insulate surge voltages of surge voltage category III in accordance with EN 60664-1 up to an installation altitude of 2000 m. At installation altitudes above 2000 m, the Line Modules must be connected via an isolating transformer. The isolating transformer reduces surge voltages of surge voltage category III in power supplies to surge voltages of surge category II at the power terminals of the Power Modules and thereby conforms to the permissible voltage values for air gaps inside the unit. The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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

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

## Line connection and line-side power components

### 3.1 Introduction

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

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

The following line filter and line reactor variants are available:

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

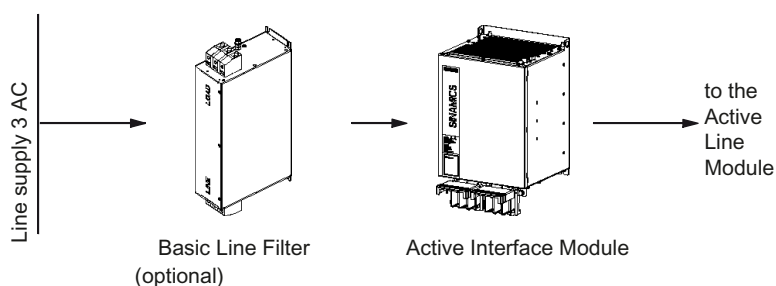


Figure 3-1 Overview diagram, line connection with Active Interface Module

3.2 Information on the disconnecter unit

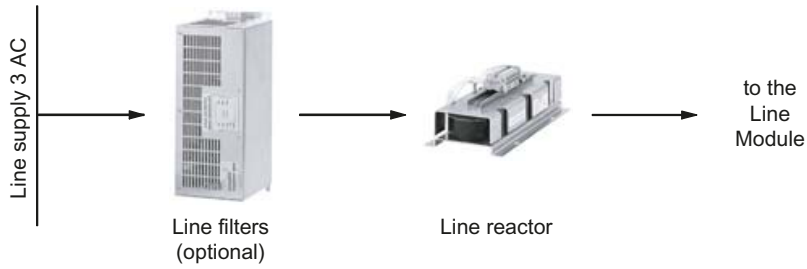


Figure 3-2 Overview diagram, line connection with line filter and line reactor

### 3.2 Information on the disconnecter unit

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

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

**NOTICE**

**Using a line disconnecter unit**

If an active drive line-up is switched off by means of the disconnecter unit, on Line Modules with regenerative feedback capability, the voltage at terminal X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be realized using a leading breaking auxiliary contact ( $\geq 10$  ms), for example.

This protects external loads located parallel to the drive at 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 disconnecter unit must be selected from the manufacturer catalogs. Refer also to catalogs PM21 and NC61.

### 3.3 Overcurrent protection by means of line fuses and circuit breakers

Line fuses or, preferably, circuit breakers must be used for line/overcurrent protection in order to limit the damage to a Line Module if a fault occurs. NH, D, and DO type fuses with a gL characteristic or suitable circuit breakers according to IEC 60947 can be used for this purpose.

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

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

1) Type AJT class J, source of supply: The Ferraz Shawmut company

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

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

1) Type AJT class J, source of supply: The Ferraz Shawmut company

3.3 Overcurrent protection by means of line fuses and circuit breakers

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


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

1) Type AJT class J, source of supply: The Ferraz Shawmut company

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

 <b>DANGER</b>
<p><b>Fire hazard and danger through electric shock because of unsuitable overcurrent protective devices</b></p> <p>In order to avoid the risk of fire or electric shock, overcurrent protection devices should be dimensioned so that, when a fault occurs, the equipment is switched off sufficiently quickly.</p> <p>Measurements must be taken at the installation site to determine whether the short-circuit current is sufficient to trip the protective devices quickly enough. Not only must the loop impedance be measured and the expected short-circuit current calculated, but the time-current characteristics of the overcurrent protection devices must also be compared, using measuring instruments according to EN 61557-3.</p> <p>If the necessary break time is not maintained, then the next-smallest overcurrent protection device must be used. Under no circumstances may fuses be used with rated currents higher than the specified <math>I_n</math>.</p>

**Note**

The devices can be connected to supply systems up to 480 V<sub>AC</sub>, which can supply a maximum of 65 kA symmetrical ("prospective current" according to EN 60269-1).



### Information on the tripping time of line fuses

In order that the line fuses trip in a timely manner, 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).

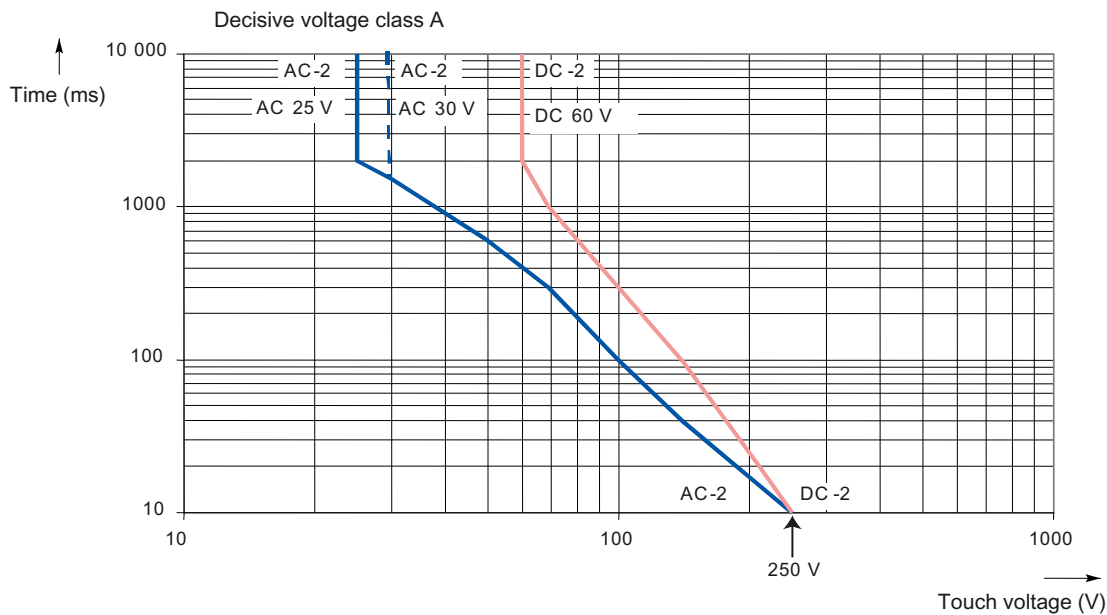


Figure 3-3 Permissible tripping time of fuses


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.

### 3.4 Line supply connection via residual-current devices


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

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

 <b>DANGER</b>
<b>Danger through electric shock during operation on TT systems without residual-current operated circuit breakers and residual current monitoring devices</b>
As a general rule, TT systems are not suitable for tripping the installed overcurrent protection devices within the specified period should an insulation fault occur. Therefore, residual current devices must always be installed for this purpose. Residual current devices (RCD) should be preferably used.
For infeed powers exceeding 55 kW and with systems that extend across large areas, for operation on TT systems, residual current monitors (RCM) must be installed in addition to suitable circuit breakers.

#### 3.4.1 Residual-current operated circuit breakers (RCD)

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

 <b>WARNING</b>
<b>Danger to life through electric shock due to unsuitable overcurrent protective devices</b>
Residual-current operated circuit breakers alone are not permissible to provide protection against direct and indirect contact. Always install residual-current protective device in addition to suitable overcurrent protective devices.

**Note**

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

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

- Only use a delayed tripping, selective AC/DC-sensitive residual-current operated circuit breaker, type B.
- Ensure compliance with the max. permissible ground resistance of the "selective protective device" (83 Ω max. for residual-current devices with 0.3 A rated differential current).
- Connect parts of the drive system and the machine that can be touched to the system's protective conductor.
- Check the total length of the shielded power cables (motor cables incl. line supply conductors from line filters to the connecting terminals of the Line Module) in the drive line-up. The total length must be less than 350 m.
- Only operate the system with the recommended line filters.
- Only connect **one** residual-current operated circuit breaker in series. Cascading is not permissible.
- Ensure that the switching elements (disconnecter unit, contactors) for connecting and disconnecting the drive system have max. 35 ms delay time between the closing/opening of the individual main contacts.

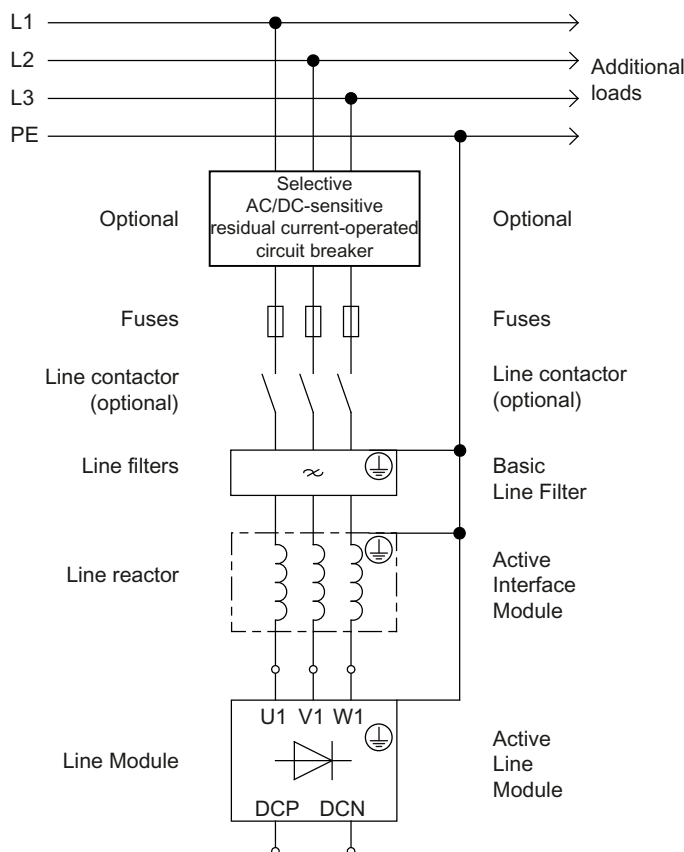


Figure 3-4 Connecting a residual-current operated circuit breaker

### Recommendation

SIEMENS selectively switching AC/DC-sensitive residual-current circuit-breakers according to EN 61009-1 of the 5SM series (e.g. 5SM3646-4 or 5SM3646-4+5SW3300 with an auxiliary disconnecter (1 NC contact / 1 NO contact) for a rated current of 63 A and rated fault current of 0.3 A (see Catalog "BETA Modular Installation Devices - ET B1").

---

#### Note

AC or pulse-sensitive RCCBs are not suitable.

---

### 3.4.2 Residual-current monitors (RCM)

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

 <b>WARNING</b>
---

<b>Fire hazard and danger of a plant standstill when residual currents occur</b>
--

Residual currents in the power supply that are not detected can cause fires and failures in the entire system.
--

- |   |
|---|
| <ul style="list-style-type: none"><li>• Always install residual-current monitors in conjunction with suitable circuit breakers.</li></ul> |
|---|

#### Note the points below when using residual-current monitors:

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

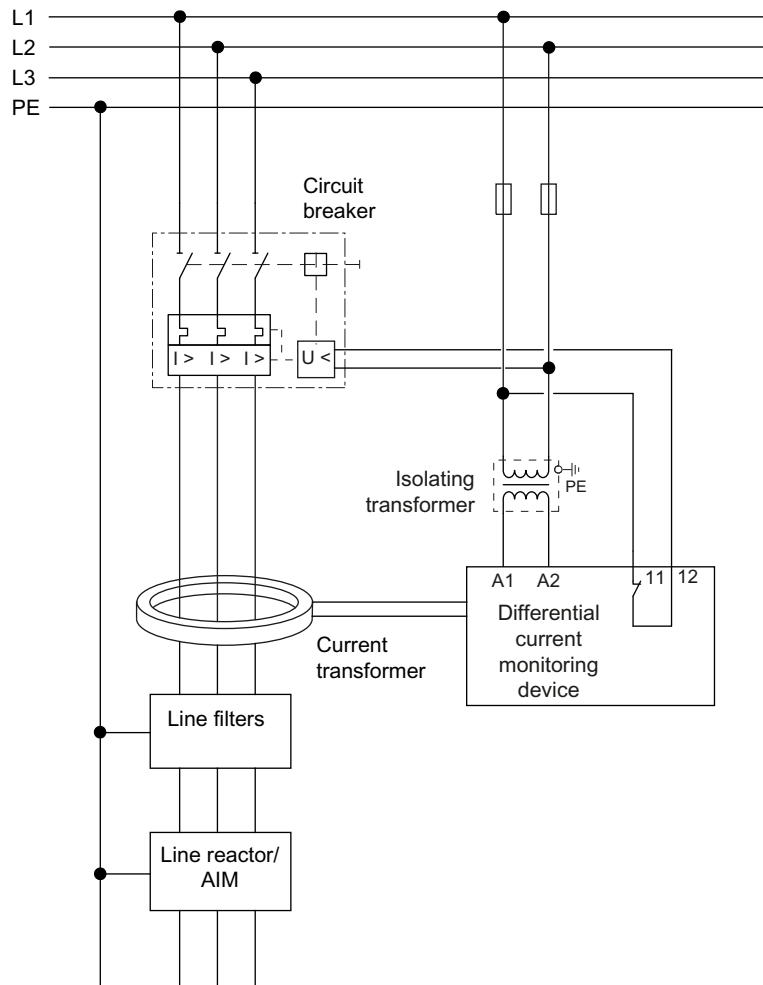


Figure 3-5 Connecting a residual-current monitor

### 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

### 3.5 Overvoltage protection

To protect the units against line-side surge voltages, you are advised to install an overvoltage protection device directly at the infeed point (upstream of the main switch). To fulfill the requirements of CSA C22.2 no. 14-05, surge protection is essential. The Raycap company has suitable surge arresters.

### 3.6 Line contactors

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

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.

<b>NOTICE</b>
<b>Using a line disconnecter unit</b>
If an active drive line-up is switched off by means of the disconnecter unit, on Line Modules with regenerative feedback capability, the voltage at terminal X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be realized using a leading breaking auxiliary contact ( $\geq 10$ ms), for example.
This protects external loads located parallel to the drive at the same switching component.

---

**Note**

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

---

**Note**

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

---

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

## 3.7 Line filters

### 3.7.1 Safety instructions for line filters

#### Note

When using a line filter, also observe the safety instructions in Section 1.

#### CAUTION

##### Risk of burns due to high surface temperatures

The line filter can become very hot. You can get seriously burnt when touching the surface.

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

#### NOTICE

##### Line filter damage by connecting to impermissible line supplies

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

#### NOTICE

##### Line filter damage due to interchanged connections

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

- Incoming line cable to LINE L1, L2, L3, and
- Outgoing line to line reactor at LOAD L1', L2', L3' (U, V, W).

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

#### WARNING

##### Fire hazard due to overheating because of inadequate ventilation clearances

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

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

#### NOTICE

##### Using an incorrect line filter

Line filters may only be used in combination with the components listed in Section "Possible line reactor and line filter combinations".

3.7 Line filters

<b>NOTICE</b>
<b>Damage or destruction of additional loads as a result of undesirable line harmonics</b> 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 fed from the line supply.

<b>NOTICE</b>
<b>Damage or destruction of additional loads by connecting after the line filter</b> 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.

**Note**

**Disconnect the line filter for a high-voltage test**

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

**3.7.2 Overview of line filters**

In conjunction with line reactors and a consistent EMC-compliant system configuration, line filters limit the conducted electromagnetic emissions generated by the Line Modules to the limit values according to EN 61800-3. A separate line filter must be used for the SINAMICS S120 drive line-up according to the following table.

<b>NOTICE</b>
<b>Several loads connected to the same line infeed point</b> 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.

<b>NOTICE</b>
<b>Use of filters of other makes</b> 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.

Table 3- 4 Overview of line filters

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

### 3.7.3 Basic Line Filters for Active Line Modules

#### 3.7.3.1 Description

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

Basic Line Filters can be used in conjunction with a line reactor for 16 kW, 36 kW, and 55 kW Active Line Modules or with an Active Interface Module for 16 kW, 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules. Assuming that an EMC-compatible design is used, the interference voltage categories listed below will be achieved (see also Section "Possible line reactor and line filter combinations").

##### **Basic Line Filter for Active Line Modules and line reactor**

- EN 61800-3 category C2 up to a total cable length <sup>1)</sup> of 150 m (shielded) for 16 kW, 36 kW and 55 kW components
- EN 61800-3 category C3 up to a total cable length <sup>1)</sup> of 150 m (shielded) for 16 kW, 36 kW and 55 kW components

##### **Basic Line Filters for Active Line Modules and Active Interface Module**

- EN 61800-3 category C2 up to a total cable length <sup>1)</sup> 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 <sup>1)</sup> of
  - 630 m (shielded) for 16 kW and 36 kW components
  - 1000 m (shielded) for 55 kW, 80 kW and 120 kW components.

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 power systems
- Only connect the Basic Line Filters to TN systems; otherwise an isolating transformer will be required
- Number of axes  $\leq 12$  when using a Basic Line Filter with an Active Line Module and a line reactor

---

#### **Note**

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

<sup>1)</sup> Maximum total cable length =  $\Sigma$  motor cables, mains supply conductor from line filter to Line Module

### 3.7.3.2 Interface description

#### Overview

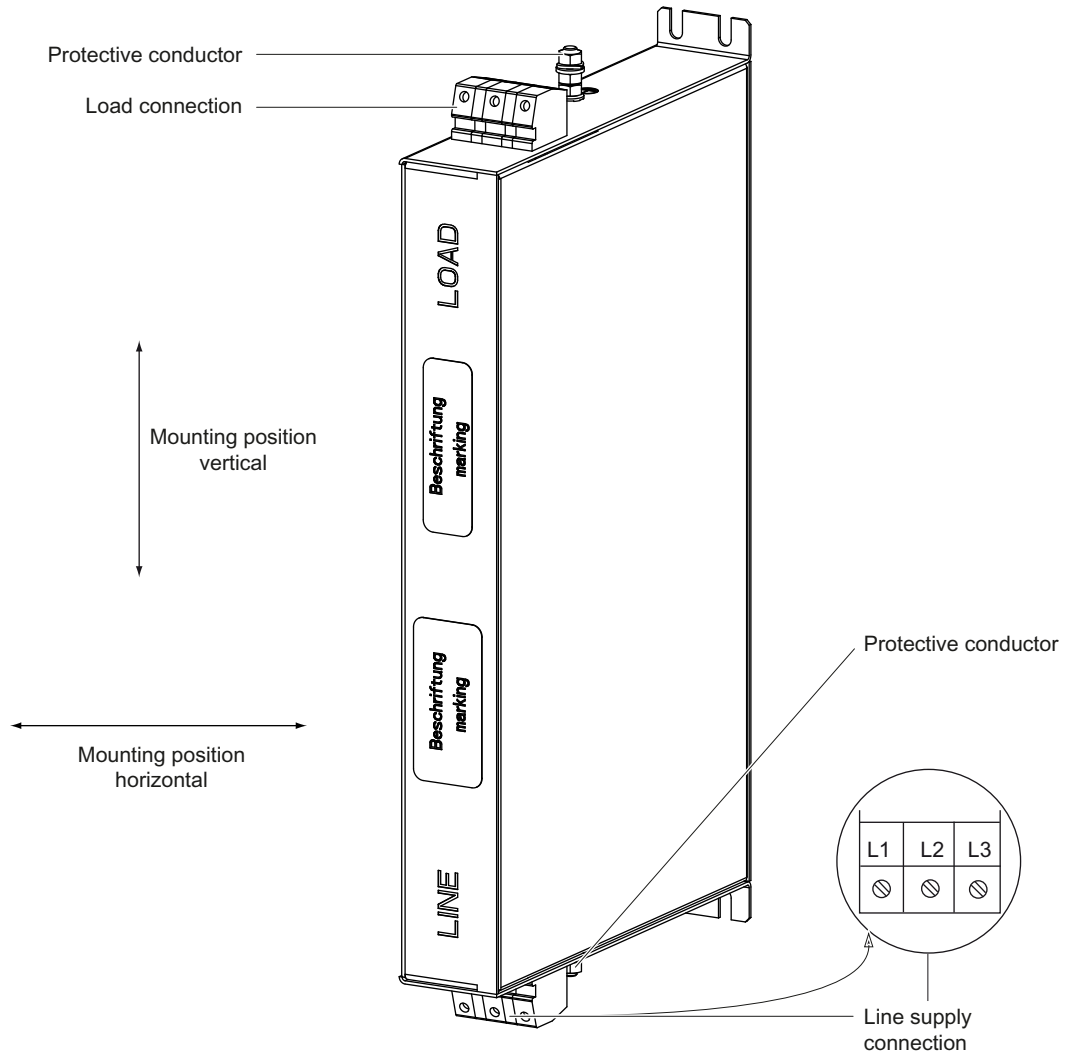


Figure 3-6 Interface overview, Basic Line Filter for Active Line Modules (example: 16 kW)

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

3.7 Line filters

Line/load connection

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

	6SL3000-0BE21-6DAx	6SL3000-0BE23-6DA1	6SL3000-0BE25-5DAx	6SL3000-0BE28-0DAx	6SL3000-0BE31-2DAx
Rated power [kW]	16	36	55	80	120
Line supply connection L1, L2, L3	Screw terminals: 10 mm <sup>2</sup> 3 pole 1.5 - 1.8 Nm	Screw terminals: 35 mm <sup>2</sup> 3 pole 3.2 - 3,7 Nm	Screw terminals: 50 mm <sup>2</sup> 3 pole 6 - 8 Nm	Screw terminals: 95 mm <sup>2</sup> , 3-pole 15 - 20 Nm	
Load connection L1', L2', L3',					
PE connection <sup>1)</sup>	Terminal studs M6 / 6 Nm	Terminal studs M6 / 6 Nm	Terminal studs M8 / 8 Nm	Terminal studs M10 / 10 Nm	

1) For ring cable lugs in accordance with DIN 46234

3.7.3.3 Dimension drawings

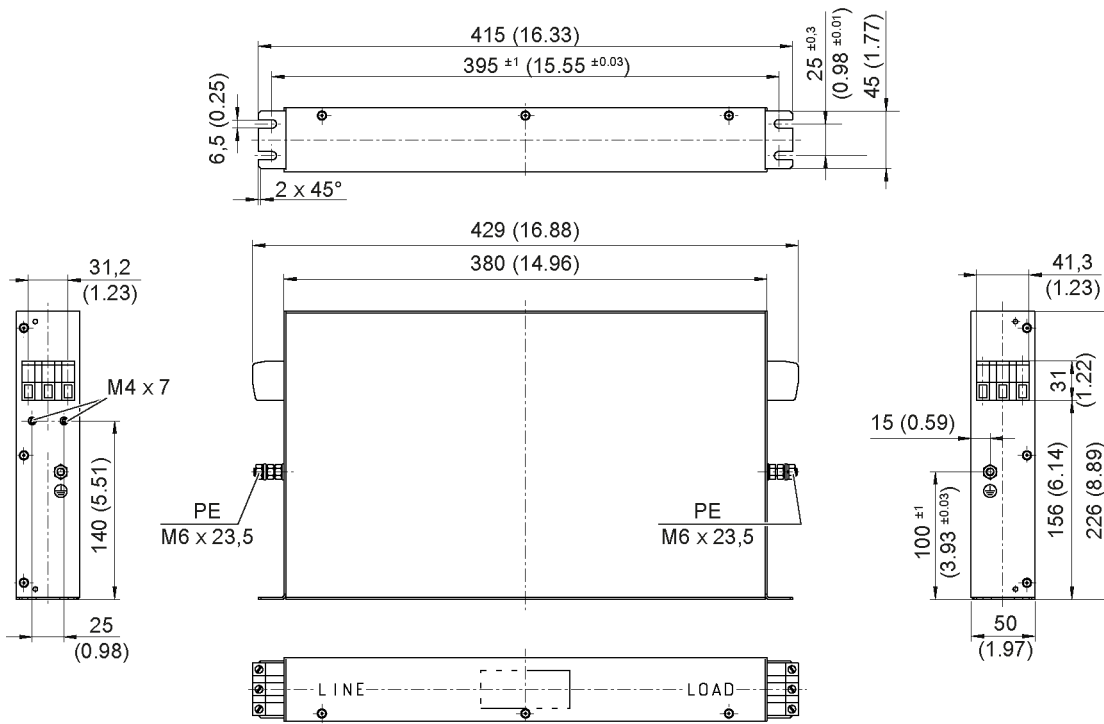


Figure 3-7 Dimension drawing of the Basic Line Filter for Active Line Modules 16 kW, all data in mm and (inches)

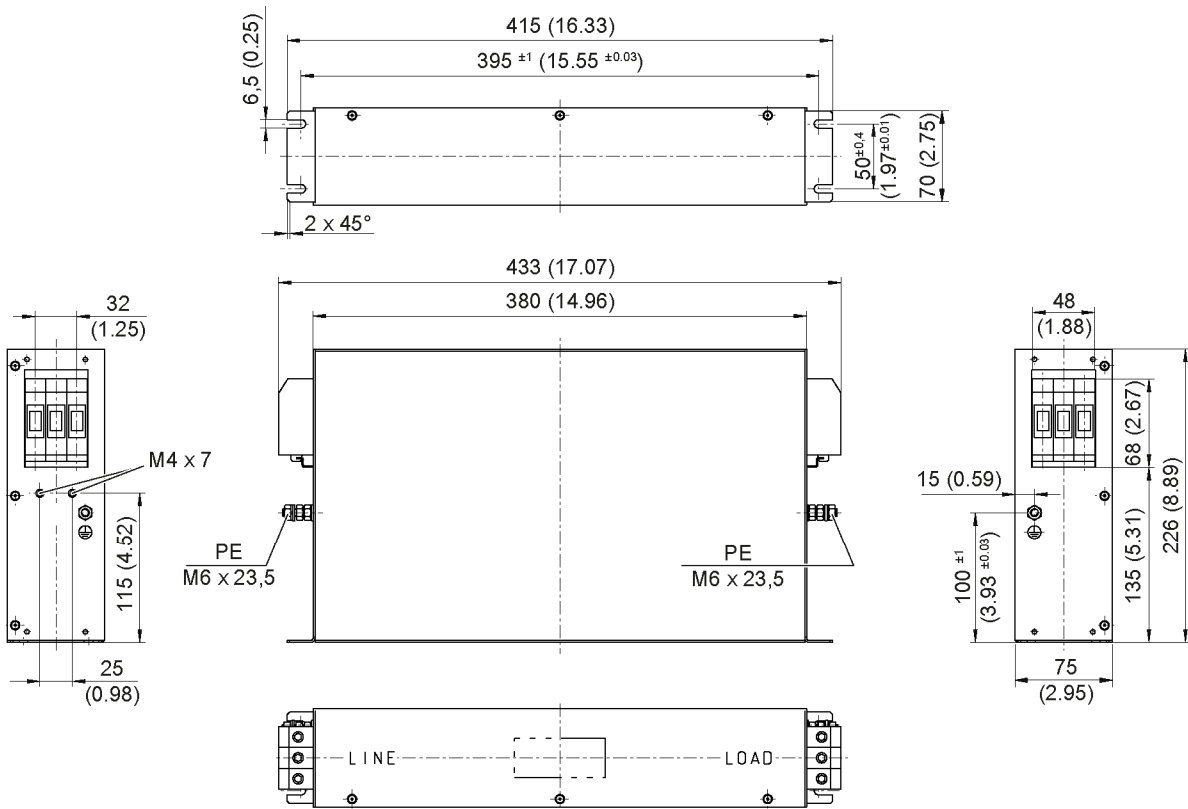


Figure 3-8 Dimension drawing of Basic Line Filter for Active Line Modules 36 kW, all data in mm and (inches)

3.7 Line filters

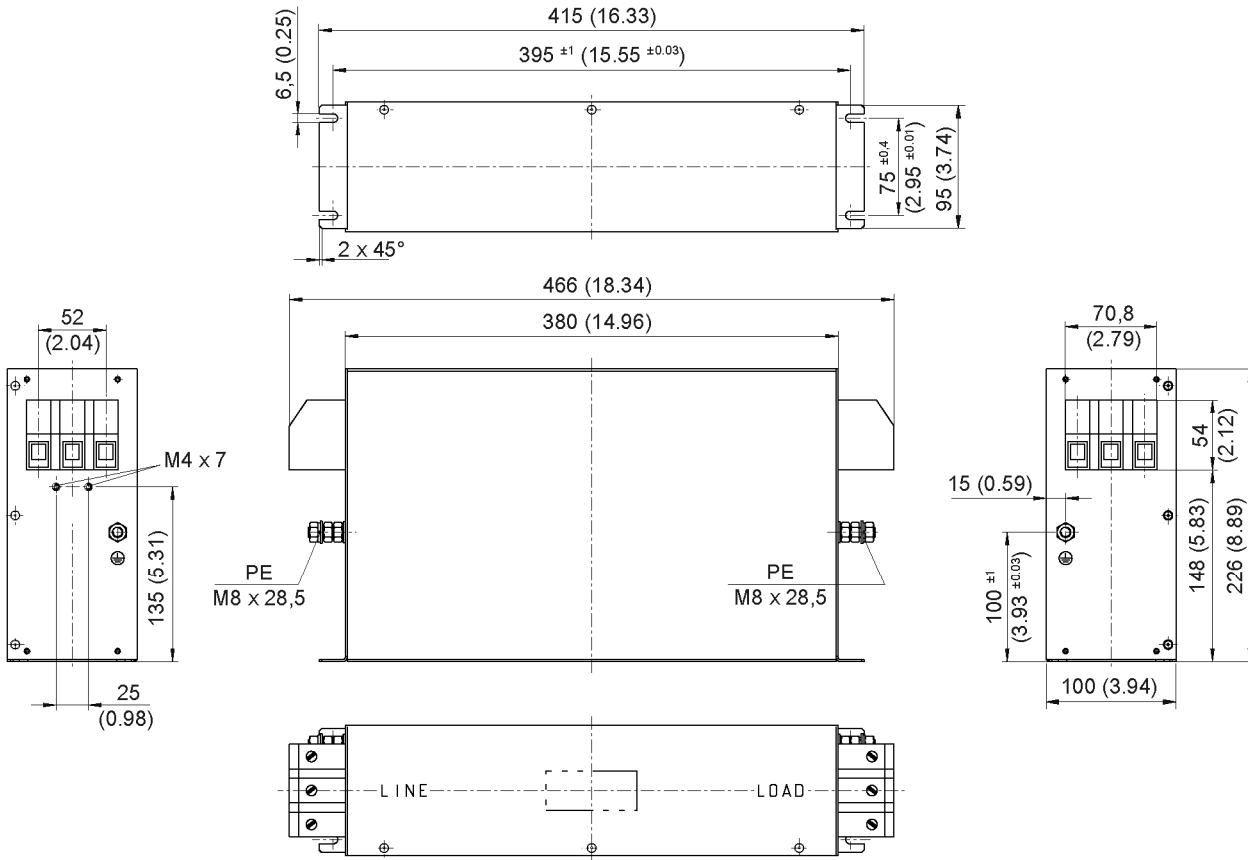


Figure 3-9 Dimension drawing of Basic Line Filter for Active Line Modules 55 kW, all data in mm and (inches)

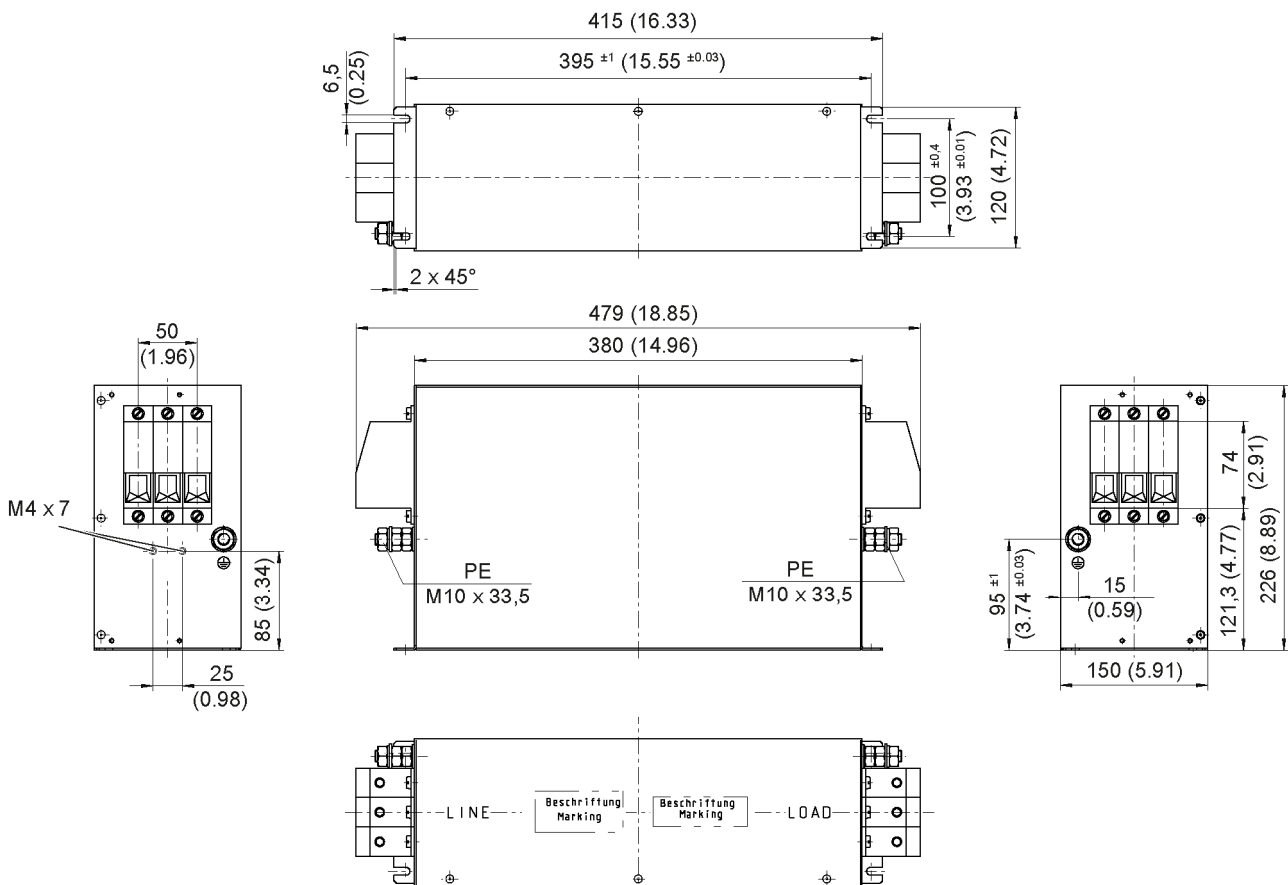


Figure 3-10 Dimension drawing of Basic Line Filter for Active Line Modules 80 kW and 120 kW, all dimensions in mm and (inches)

### 3.7.3.4 Technical data

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

	6SL3000-	0BE21-6DAx	0BE23-6DA1	0BE25-5DAx	0BE28-0DAx	0BE31-2DAx
Rated power	kW	16	36	55	80	120
Connection voltage: Supply voltage Line frequency	V <sub>AC</sub> Hz	3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10% 47 to 63 Hz				
Rated current	A <sub>AC</sub>	36	74	105	132	192
Power loss <sup>1)</sup>	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

## 3.7.4 Wideband Line Filter for Active Line Modules

### 3.7.4.1 Description

Wideband Line Filters for Active Line Modules are mainly effective in the frequency range from 150 kHz to 30 MHz; this is the range relevant to ensure compliance with the appropriate standard. Wideband Line Filters can also effectively limit low-frequency line harmonics of 2 kHz and above; this protects additional loads connected to the same supply system against disturbances and damage. As a result, these line filters have an extended function 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 a line reactor for Active Line Modules and not with an Active Interface Module.

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

- EN 61800-3 category C3 up to a total cable length <sup>1)</sup> of 350 m (shielded) for 16 kW, 36 kW, 55 kW, 80 kW, and 120 kW components
- EN 61800-3 category C2 up to a total cable length <sup>1)</sup> of 350 m (shielded) for 16 kW, 36 kW, 55 kW, 80 kW, and 120 kW components

<sup>1)</sup> Maximum total cable length =  $\Sigma$  motor cables, mains supply conductor from line filter to Line Module



## 3.7.4.2 Interface description

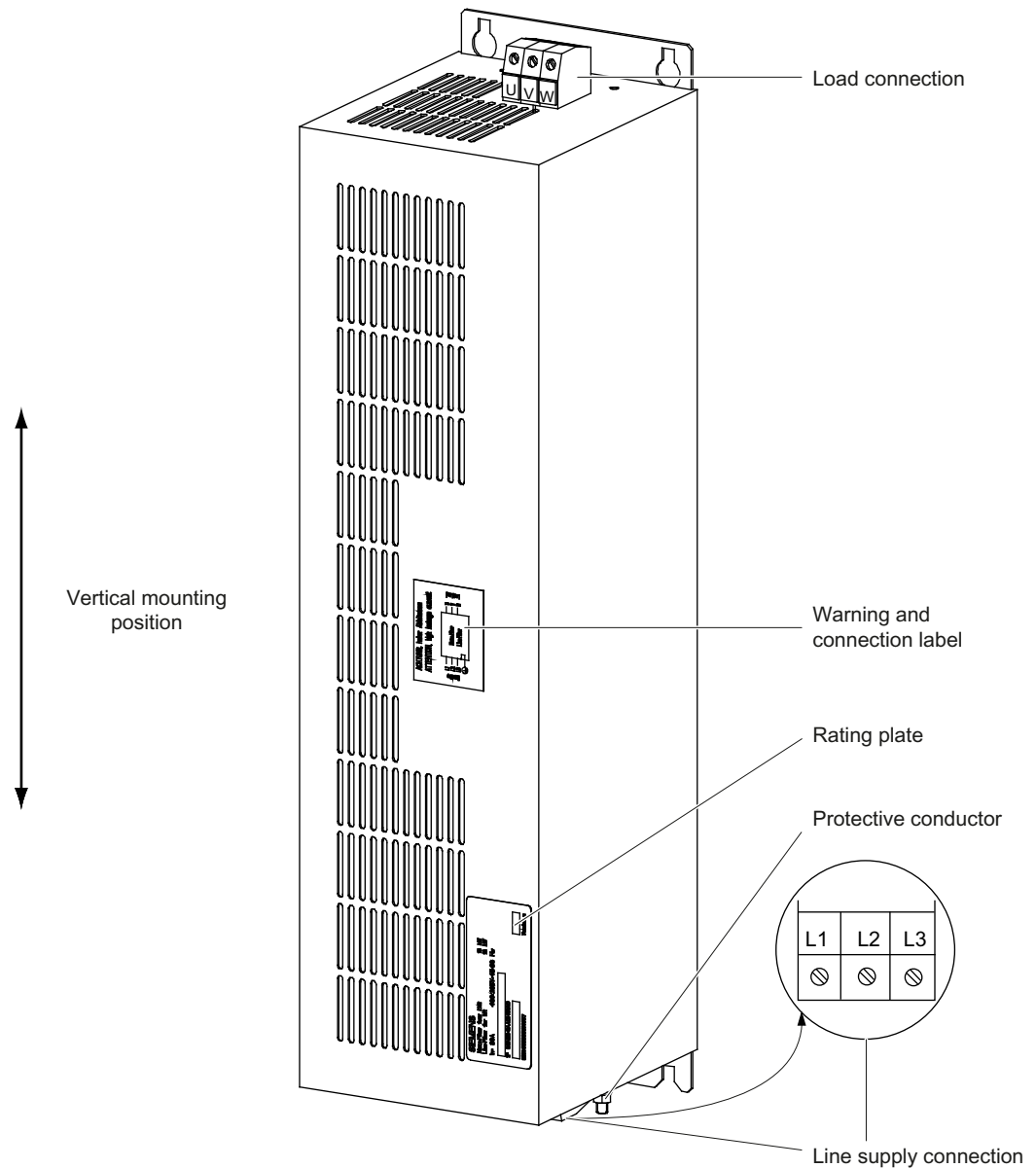


Figure 3-11 Interface overview, Wideband Line Filter for Active Line Modules (example: 16 kW)

**NOTICE****Operation in an impermissible mounting position**

The component must only be operated when mounted in a vertical position with the power supply terminals at the bottom.

3.7 Line filters

Line/load connection

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

	6SL3000-0BE21-6AAx	6SL3000-0BE23-6AAx	6SL3000-0BE25-5AAx	6SL3000-0BE28-0AAx	6SL3000-0BE31-2AAx
Rated power [kW]	16	36	55	80	120
Line supply connection L1, L2, L3	Screw terminals: 10 mm <sup>2</sup> 3 pole M4 / 1.5 - 1.8 Nm	Screw terminals 50 mm <sup>2</sup> 3-pole M6 / 6 - 8 Nm		Screw terminals 95 mm <sup>2</sup> 3-pole M8 / 15 -20 Nm	Connecting lugs d = 11 mm M10 / 25 Nm <b>Note: No touch protection (IP00B acc. to EN 60529)</b>
Load connection U, V, W					
PE connection <sup>1)</sup>	Terminal studs M5 / 3 Nm	Terminal studs M8 / 13 Nm	Terminal studs M8 / 13 Nm	Terminal studs M8 / 13 Nm	Terminal studs M10 / 25 Nm

1) For ring cable lugs in accordance with DIN 46234

3.7.4.3 Dimension drawings

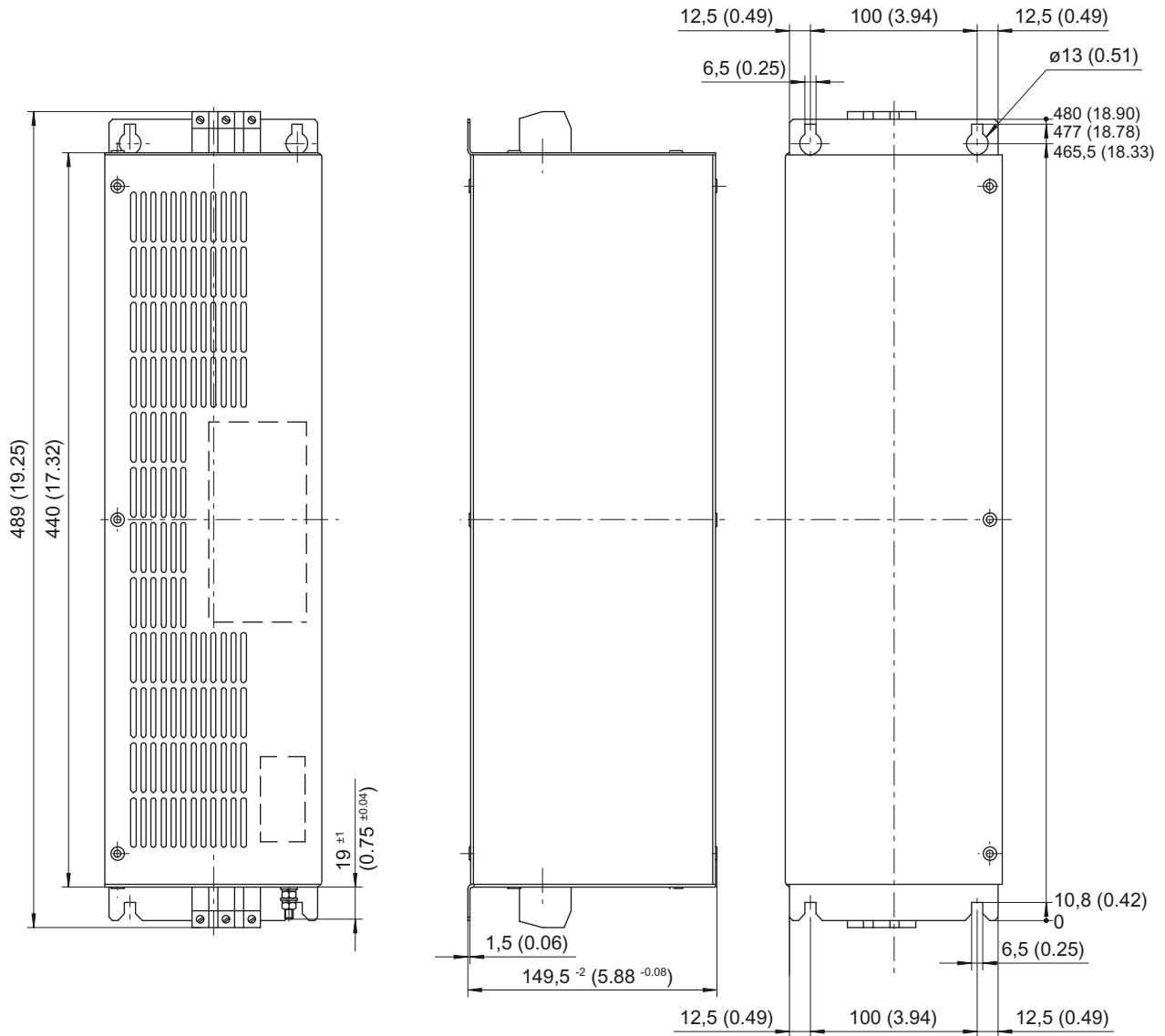


Figure 3-12 Dimension drawing of Wideband Line Filter 16 kW for Active Lines Modules, all dimensions in mm and (inches)

3.7 Line filters

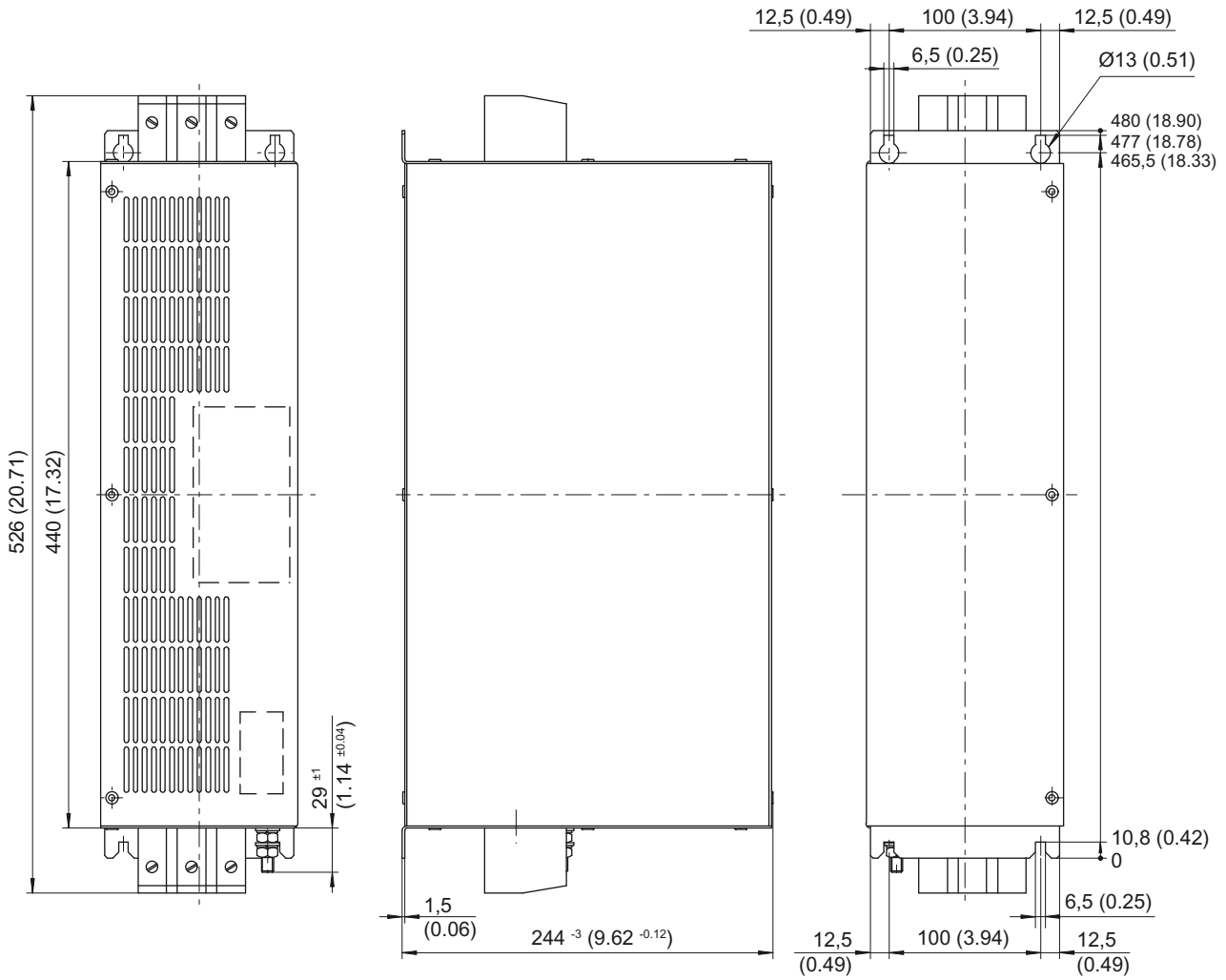


Figure 3-13 Dimension drawing of Wideband Line Filter 36 kW for Active Lines Modules, all dimensions in mm and (inches)

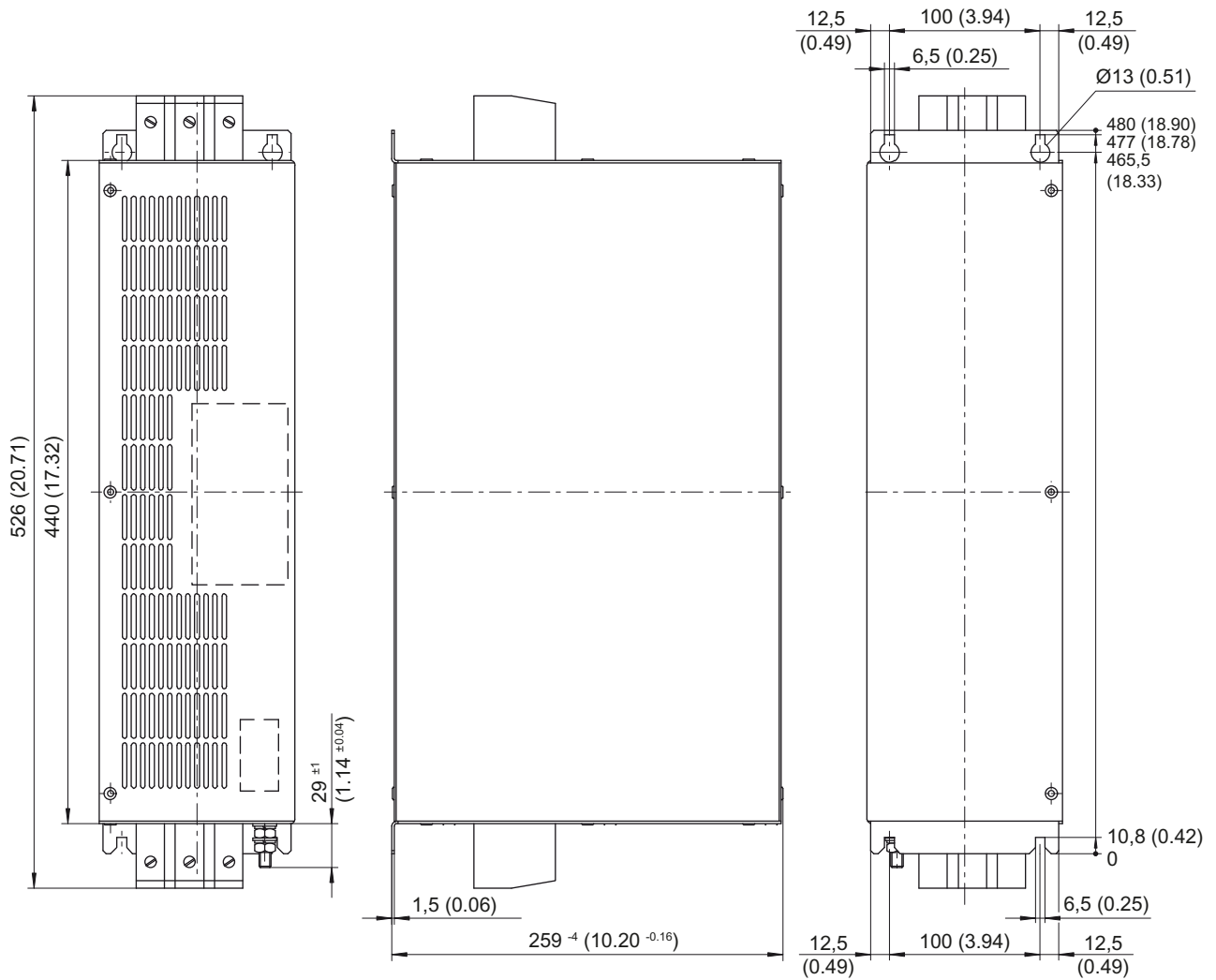


Figure 3-14 Dimension drawing of Wideband Line Filter 55 kW for Active Lines Modules, all dimensions in mm and (inches)

3.7 Line filters

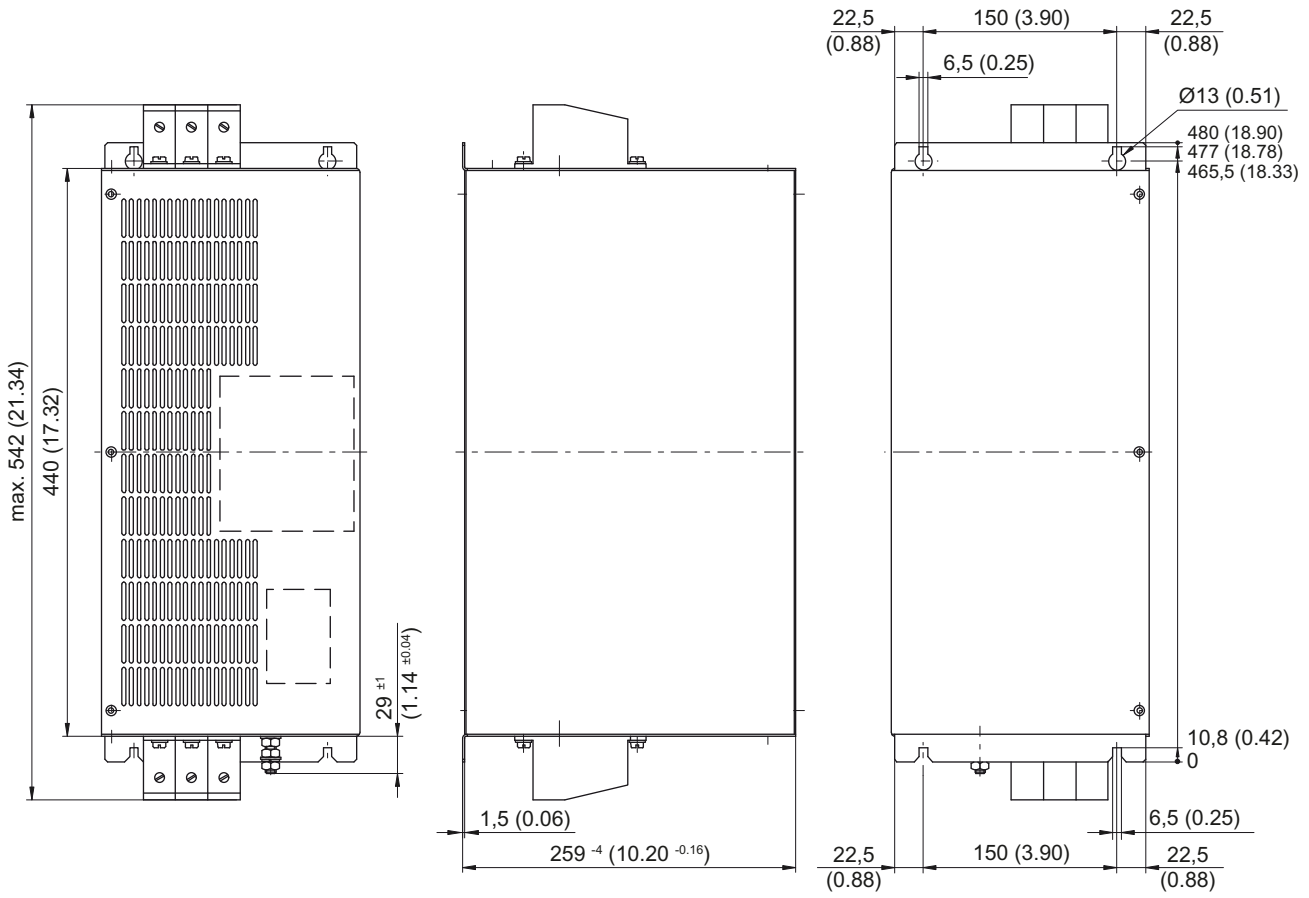


Figure 3-15 Dimension drawing of Wideband Line Filter 80 kW for Active Lines Modules, all dimensions in mm and (inches)

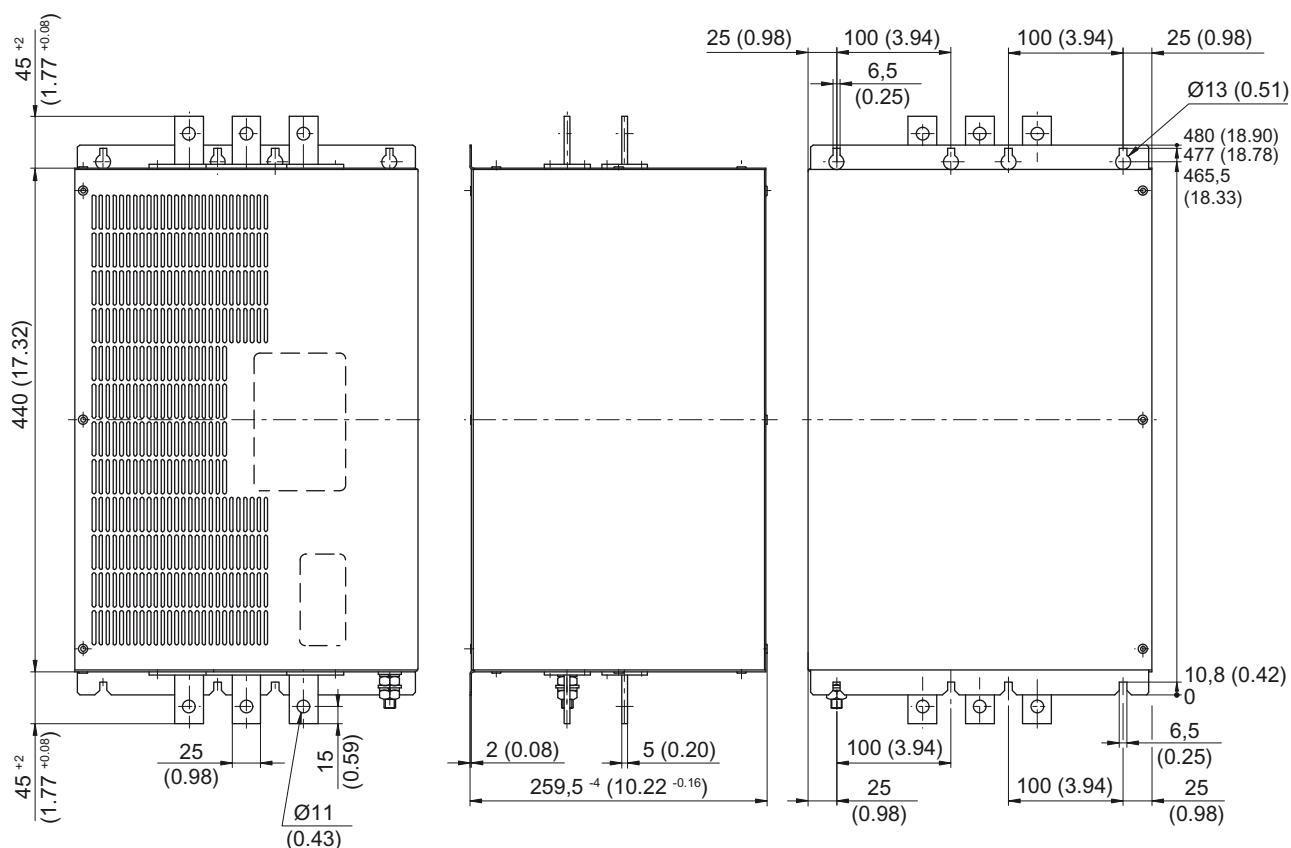


Figure 3-16 Dimension drawing of Wideband Line Filter 120 kW for Active Lines Modules, all dimensions in mm and (inches)

### 3.7.4.4 Technical data

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

	6SL3000 unit	0BE21- 6AAx	0BE23- 6AAx	0BE25- 5AAx	0BE28- 0AAx	0BE31- 2AAx
Rated power	kW	16	36	55	80	120
Connection voltages: Supply voltage Line frequency	V <sub>AC</sub> Hz	380 3 AC -10% (-15% < 1 min) to 480 3 AC +10% 47 to 63 Hz				
Rated current	A <sub>AC</sub>	30	67	103	150	225
Power loss <sup>1</sup>	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

### 3.7.5 Basic Line Filter for Basic Line Modules

#### 3.7.5.1 Description

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

The machine manufacturer must certify that the machine to be launched on the market is in accordance with the EC EMC Directive.

Basic Line Filters for Basic Line Modules can achieve the interference voltage categories listed below, when used in conjunction with the associated line reactors and an EMC-compliant design (see also Section "Possible line reactor and line filter combinations").

- EN 61800-3 category C2 up to a total cable length <sup>1)</sup> of 350 m (shielded) for 20 kW, 40 kW and 100 kW components
- EN 61800-3 category C3 up to a total cable length <sup>1)</sup> of 630 m (shielded) for 20 kW, 40 kW and 100 kW components

Basic Line Filters are only suitable for direct use on TN systems. An isolating transformer is required for other power systems.

<sup>1)</sup> Maximum total cable length =  $\Sigma$  motor cables, mains supply conductor from line filter to Line Module



## 3.7.5.2 Interface description

## Overview

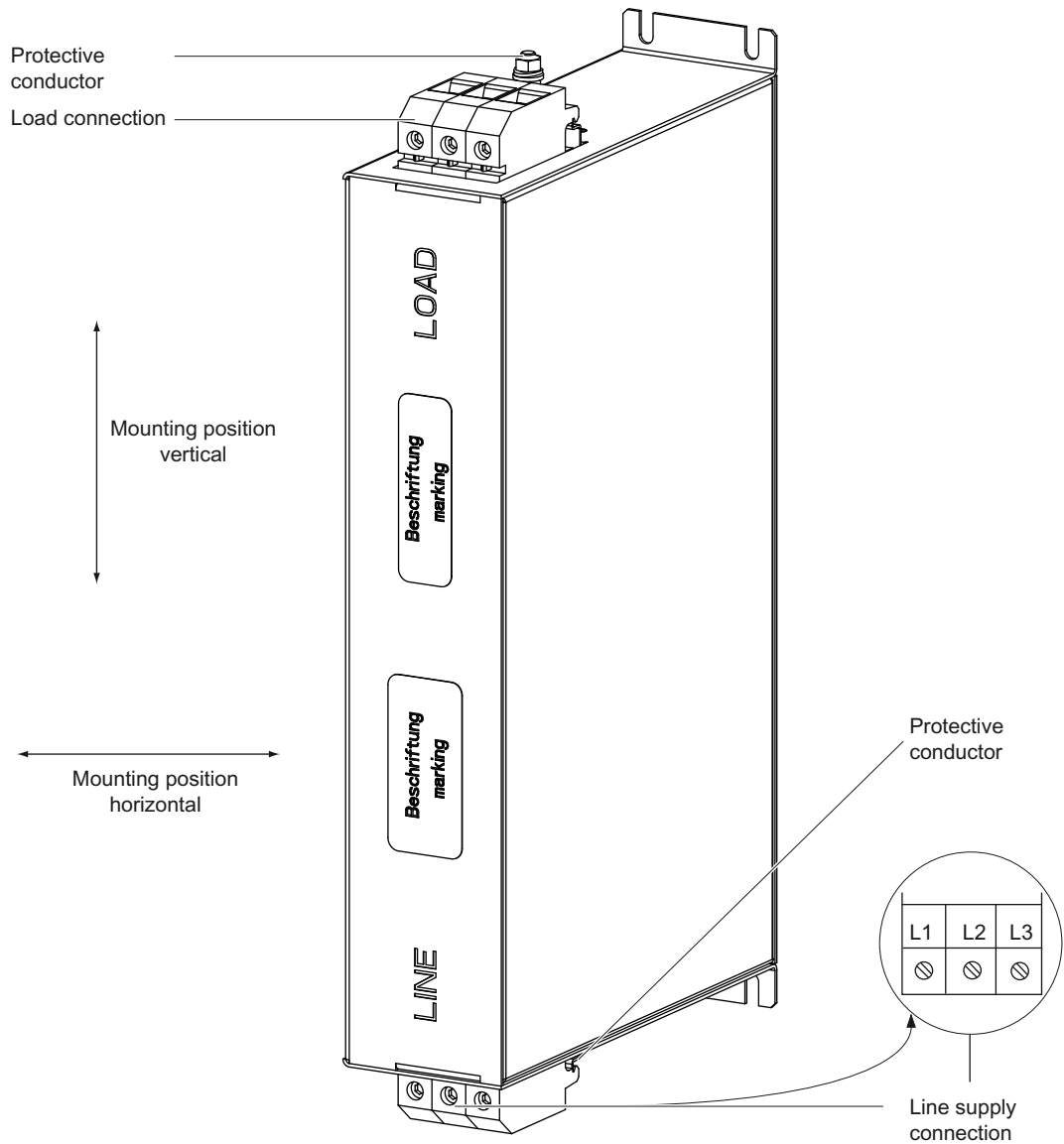


Figure 3-17 Interface overview, Basic Line Filter for Basic Line Modules (example: 40 kW)

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

3.7 Line filters

Line/load connection

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

	6SL3000-0BE21-6DAx	6SL3000-0BE23-6DA1	6SL3000-0BE31-2DAx
Rated power [kW]	20	40	100
Line supply connection L1, L2, L3	Screw terminals 10 mm <sup>2</sup> 3-pole 1.5 - 1,8 Nm	Screw terminals 35 mm <sup>2</sup> 3-pole 3.2 - 3,7 Nm	Screw terminals 95 mm <sup>2</sup> , 3-pole 15 - 20 Nm
Load connection L1', L2', L3'			
PE connection <sup>1)</sup>	Terminal studs M6 / 6 Nm	Terminal studs M6 / 6 Nm	Terminal studs M10 / 10 Nm

1) For ring cable lugs in accordance with DIN 46234

3.7.5.3 Dimension drawings

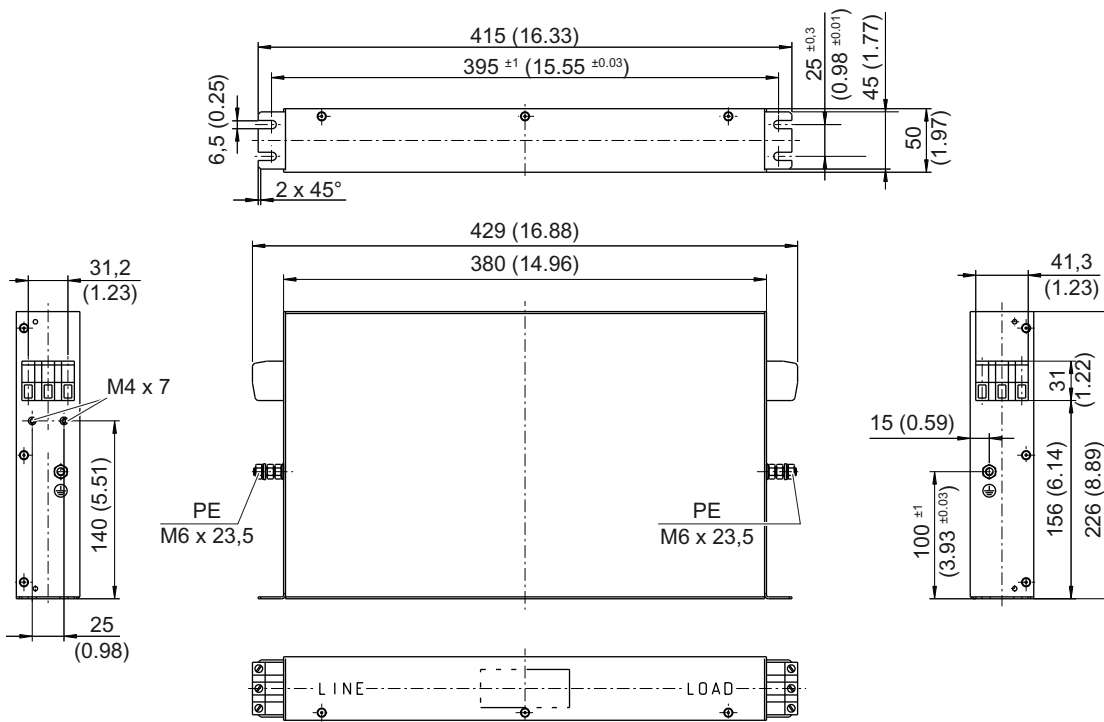


Figure 3-18 Dimension drawing of Basic Line Filter for Basic Line Modules 20 kW, all data in mm and (inches)

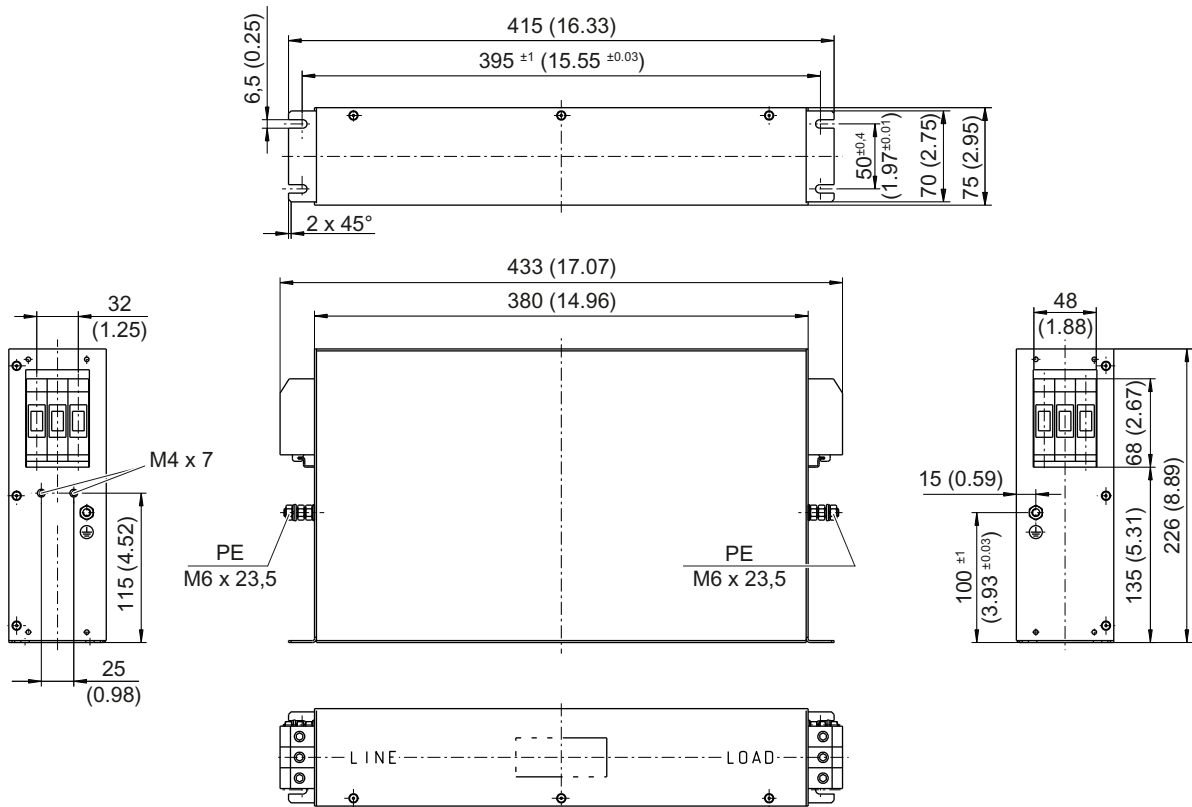


Figure 3-19 Dimension drawing of Basic Line Filter for Basic Line Modules 40 kW, all data in mm and (inches)

3.7 Line filters

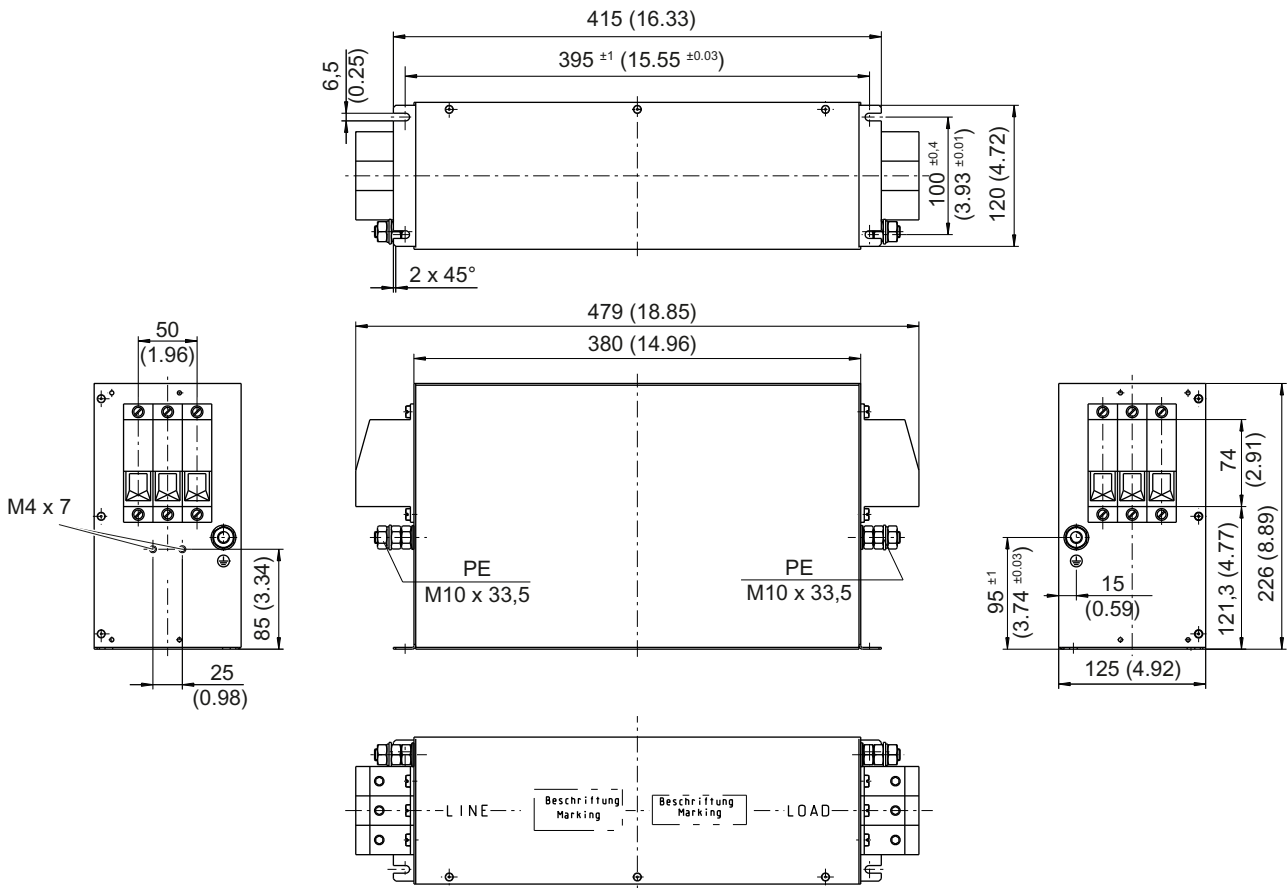


Figure 3-20 Dimension drawing of Basic Line Filter for Basic Line Modules 100 kW, all data in mm and (inches)

3.7.5.4 Technical specifications

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

	6SL3000-	0BE21-6DAx	0BE23-6DA1	0BE31-2DAx
Rated power	kW	20	40	100
Connection voltage: Supply voltage Line frequency	V <sub>AC</sub> Hz	3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10% 47 to 63 Hz		
Rated current	A <sub>AC</sub>	36	74	192
Power loss <sup>1)</sup>	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

## 3.7.6 Basic Line Filter for Smart Line Modules

### 3.7.6.1 Description

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

Basic Line Filters for Smart Line Modules can achieve the interference voltage categories listed below, when used in conjunction with the associated line reactors and an EMC-compliant design (see also Section "Possible line reactor and line filter combinations").

- EN 61800-3 category C2 up to a total cable length <sup>1)</sup> of 350 m (shielded) for 5 kW to 55 kW components
- EN 61800-3 category C3 up to a total cable length <sup>1)</sup> of 350 m (shielded) for 5 kW to 55 kW components

Basic Line Filters are only suitable for direct connection to TN systems. An isolating transformer is required for other power systems.

<sup>1)</sup> Maximum total cable length =  $\Sigma$  motor cables, mains supply conductor from line filter to Line Module

### 3.7.6.2 Interface description

#### Overview

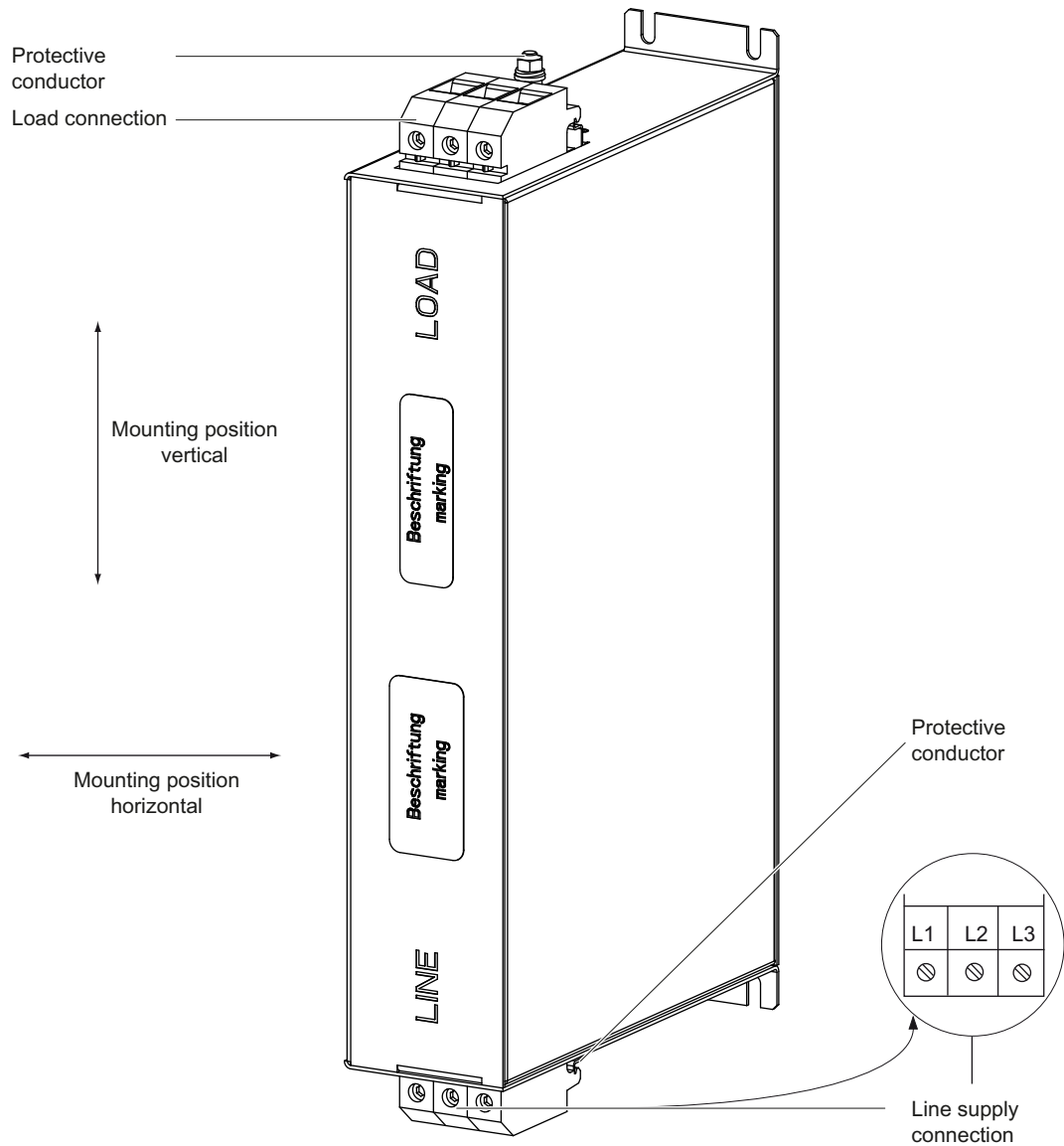


Figure 3-21 Interface overview, Basic Line Filter for Smart Line Modules (example: 36 kW)

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

## Line/load connection

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

	6SL3000-0HE15-0AAx	6SL3000-0HE21-0AAx	6SL3000-0BE21-6DAx	6SL3000-0BE23-6DA1	6SL3000-0BE25-5DAx
Rated power [kW]	5	10	16	36	55
Line supply connection L1, L2, L3	Screw terminals 10 mm <sup>2</sup> 3-pole 1.2 - 1,5 Nm			Screw terminals 35 mm <sup>2</sup> 3-pole 3.2 - 3,7 Nm	Screw terminals 50 mm <sup>2</sup> 3-pole 6 - 8 Nm
Load connection L1', L2', L3'					
PE connection <sup>1)</sup>	Terminal studs M6 / 6 Nm			Terminal studs M6 / 6 Nm	Terminal studs M8 / 8 Nm

1) For ring cable lugs in accordance with DIN 46234

## 3.7.6.3 Dimension drawings

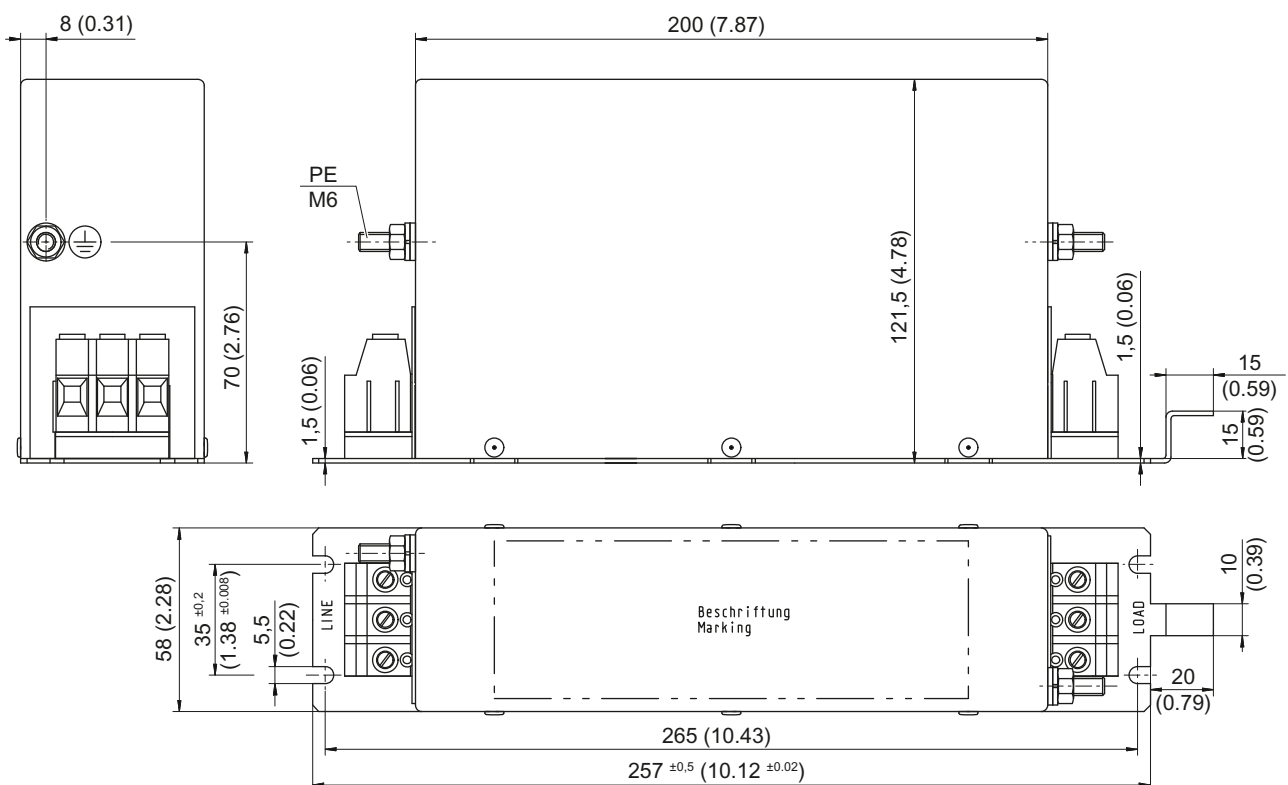


Figure 3-22 Dimension drawing of Basic Line Filter for 5 kW and 10 kW Smart Line Modules, all dimensions in mm and (inches)

3.7 Line filters

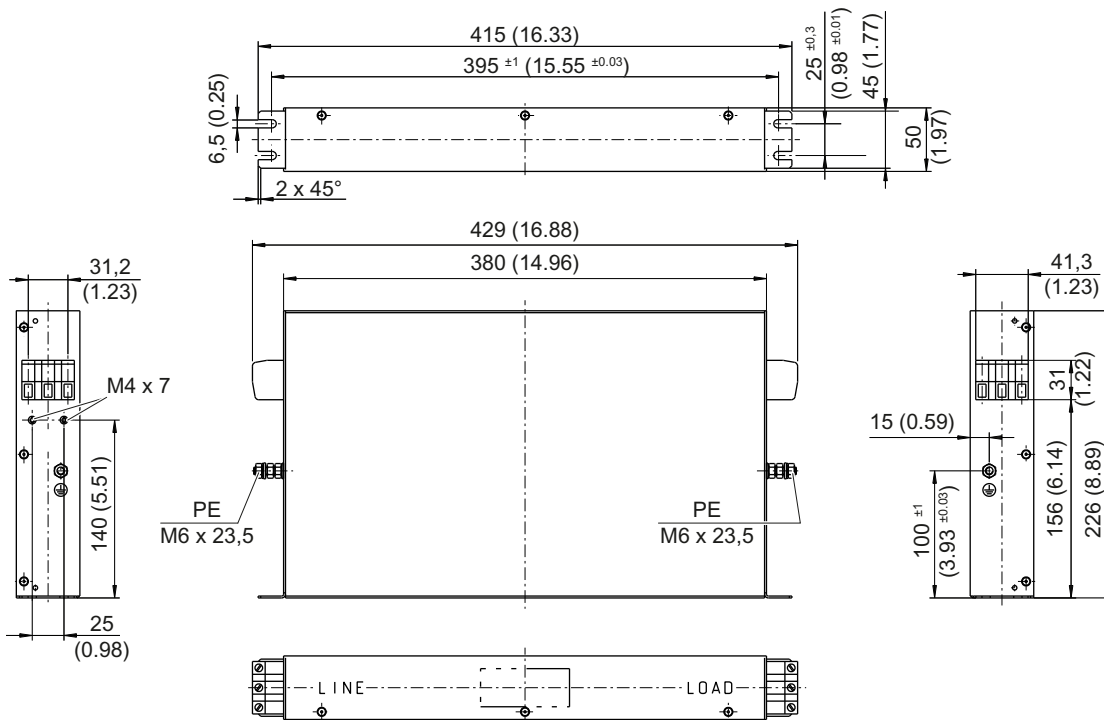


Figure 3-23 Dimension drawing of Basic Line Filter for Smart Line Modules 16 kW, all data in mm and (inches)



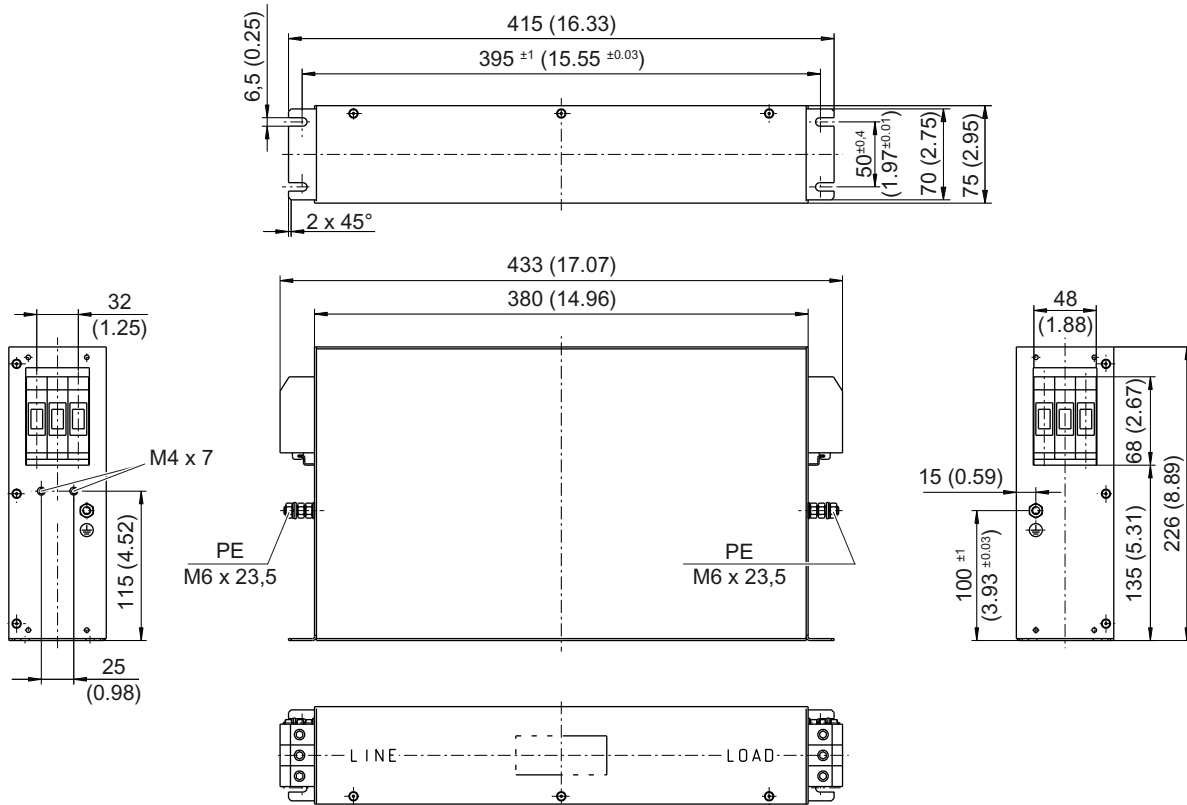


Figure 3-24 Dimension drawing of Basic Line Filter for Smart Line Modules 36 kW, all data in mm and (inches)

3.7 Line filters

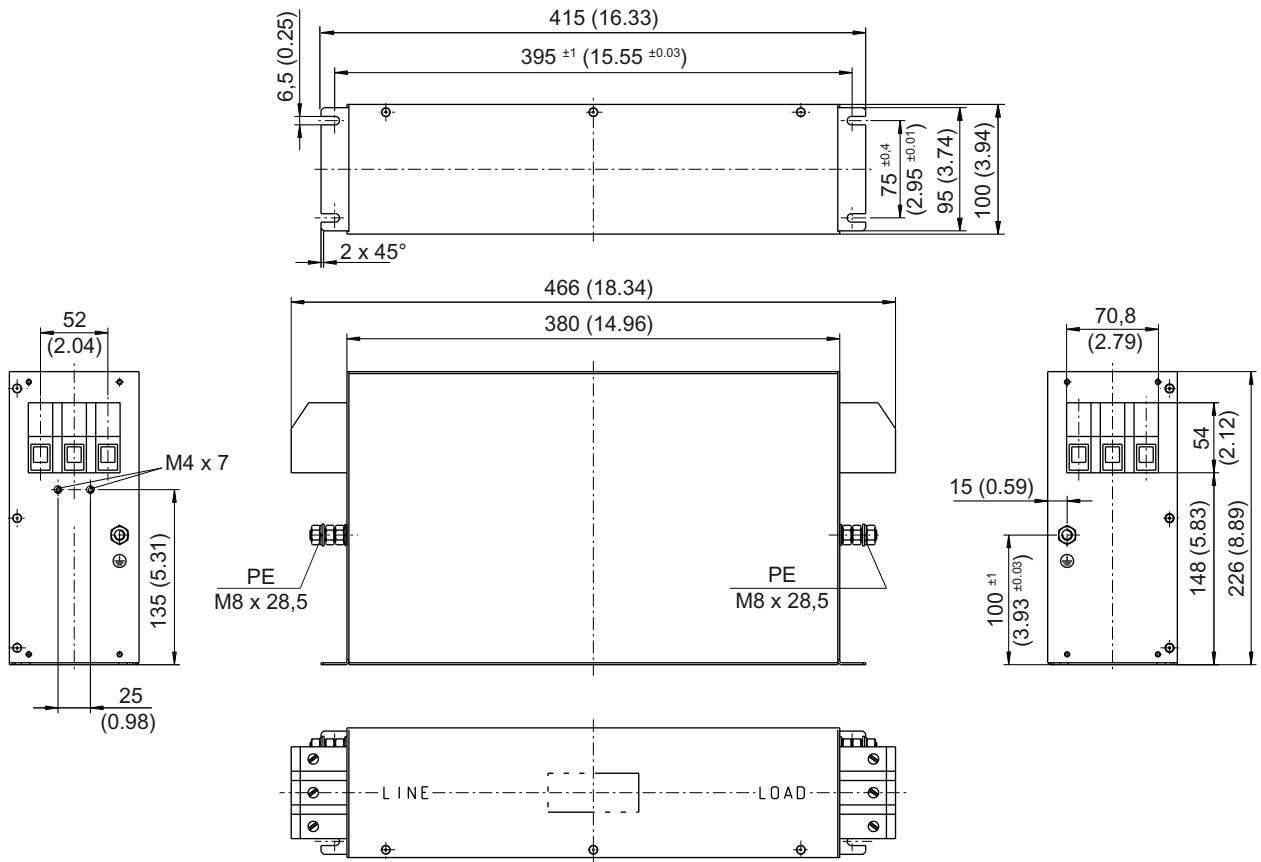


Figure 3-25 Dimension drawing of Basic Line Filter for Smart Line Modules 55 kW, all data in mm and (inches)

3.7.6.4 Technical Specifications

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

	6SL3000-	0HE15-0AAx	0HE21-0AAx	0BE21-6DAx	0BE23-6DA1	0BE25-5DAx
Rated power	kW	5	10	16	36	55
Connection voltage: Supply voltage Line frequency	V <sub>AC</sub> Hz	3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10% 47 to 63 Hz				
Rated current	A <sub>AC</sub>	12	25	36	74	105
Power loss <sup>1)</sup>	W	20	20	16	26	43
Weight	kg	2.1	2.3	5	7.5	11.5

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

## 3.8 Line reactors

### 3.8.1 Safety instructions for line reactors

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#### Note

When using a line reactor, also observe the safety instructions in Section 1.

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#### WARNING

##### **Danger to life due to high voltages on the additional winding of the HFD line reactor**

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

- Connect a damping resistor to the HFD line reactor.

#### CAUTION

##### **Risk of burns due to high surface temperatures**

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

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

#### NOTICE

##### **Damage or destruction of components**

Unsuitable line reactors can cause damage/faults on Line Modules. Line harmonics can also occur that damage/disturb loads connected to the same line supply.

- Only use line reactors or Active Interface Modules described in this manual.

---

#### Note

##### **Malfunctions through magnetic fields**

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

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

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**Note**

**Keep the connection cables as short as possible**

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

You must use shielded connection cables, whose cable shields are attached at both ends.

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

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

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

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### 3.8.2 Overview of the line reactors

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

They must be used in conjunction with Active Line Modules as an energy storage feature for the step-up converter function.

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

---

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

Table 3- 13 Overview of line reactors

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

### 3.8.3 Line reactors for Active Line Modules

#### 3.8.3.1 Interface description

##### Overview

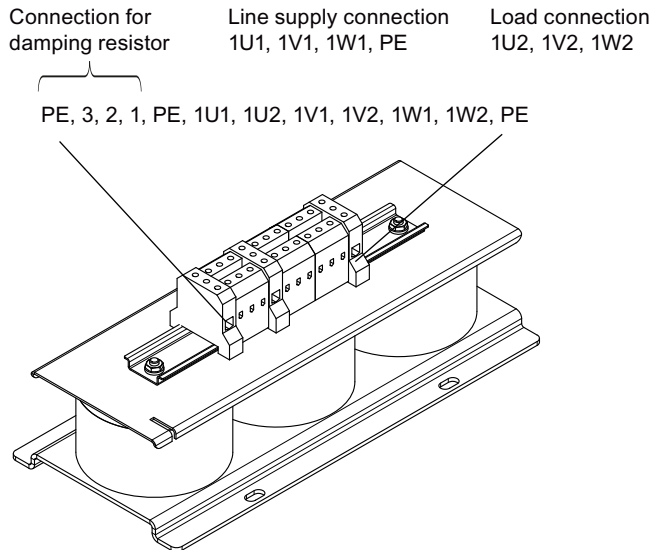


Figure 3-26 Interface overview, HFD line reactor 16 kW

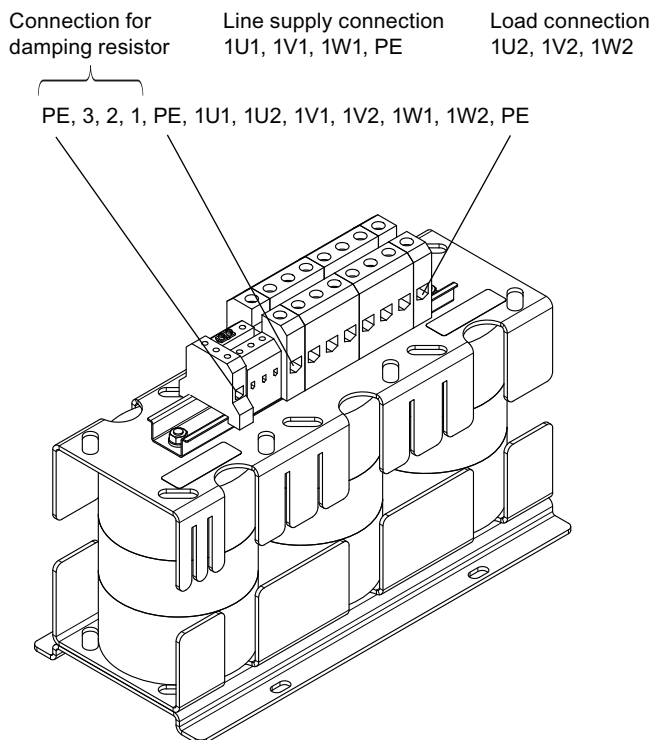


Figure 3-27 Interface overview, HFD line reactor 36 kW

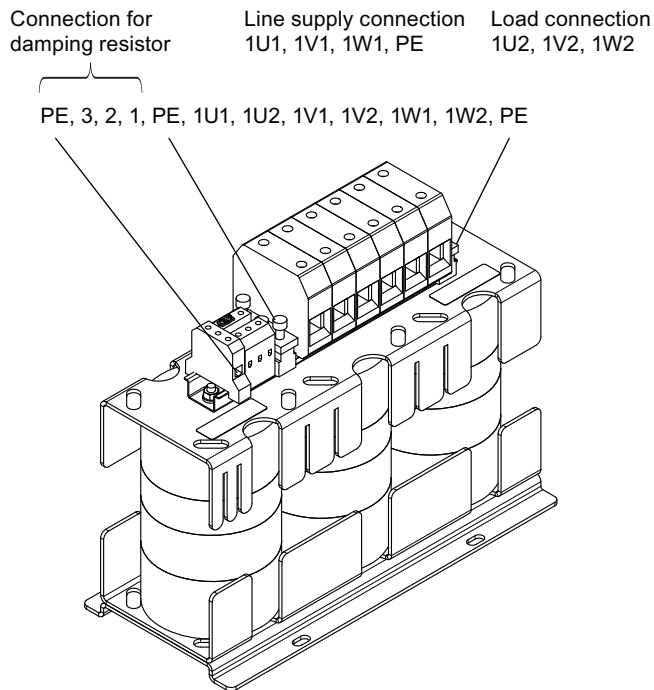


Figure 3-28 Interface overview, HFD line reactor 55 kW

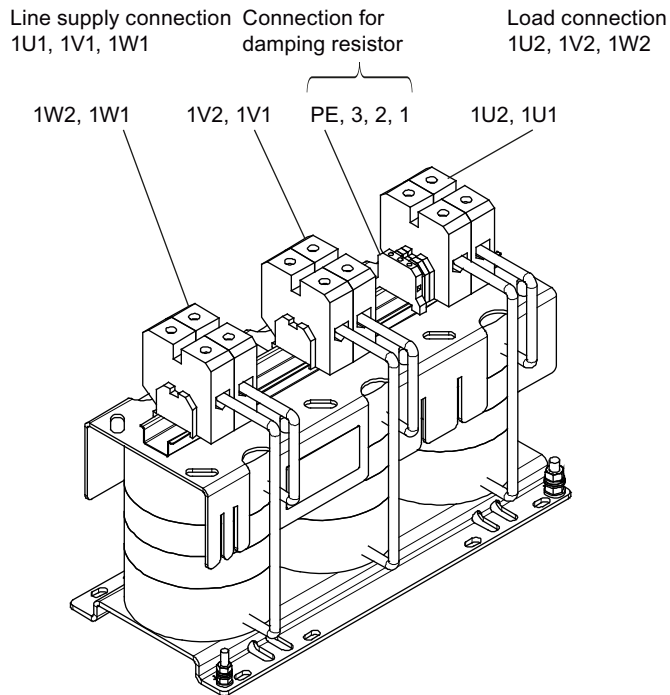


Figure 3-29 Interface overview, HFD line reactor 80 kW

3.8 Line reactors

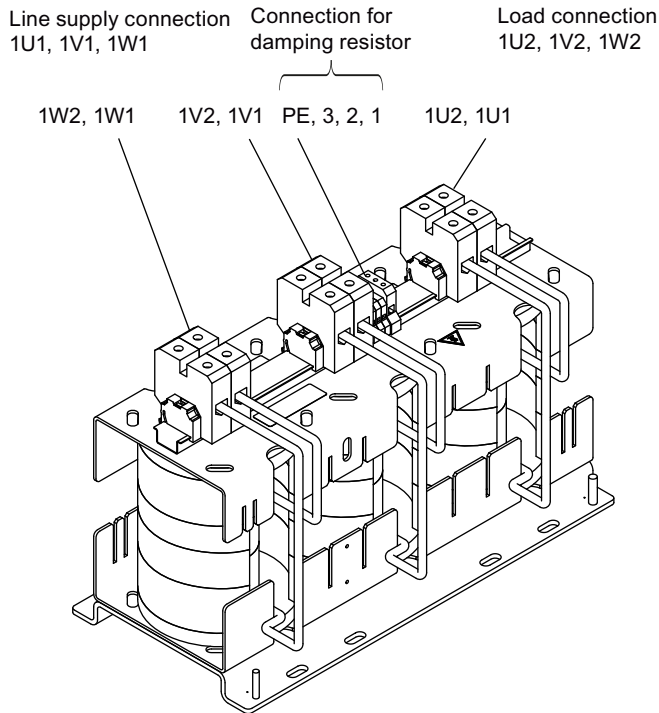


Figure 3-30 Interface overview, HFD line reactor 120 kW

Line/load connection

Table 3- 14 Connection of HFD line reactors

Order number	6SL3000-0DE21-6AAx	6SL3000-0DE23-6AAx	6SL3000-0DE25-5AAx	6SL3000-0DE28-0AAx	6SL3000-0DE31-2AAx
Power [kW]	16	36	55	80	120
Line supply connection 1U1, 1V1, 1W1	Screw terminal 16 mm <sup>2</sup> / 1.2 Nm	Screw terminal 35 mm <sup>2</sup> / 2.5 Nm	Screw terminal 70 mm <sup>2</sup> / 7 Nm	POWER CAGE CLAMPS 95 mm <sup>2</sup> /self-locking <sup>1)</sup>	
Load connection 1U2, 1V2, 1W2				POWER CAGE CLAMPS 95 mm <sup>2</sup> /self-locking <sup>1)</sup>	
PE connection	Screw terminal 16 mm <sup>2</sup> / 1.2 Nm	Screw terminal 35 mm <sup>2</sup> / 2.5 Nm	Screw terminal 70 mm <sup>2</sup> / 3.5 Nm	PE connecting lug M10/25 Nm for ring cable lugs according to DIN 46234	
Damping-resistor connection 1, 2, 3 PE	Screw terminal max. 1.5 mm <sup>2</sup> /1.2 Nm				

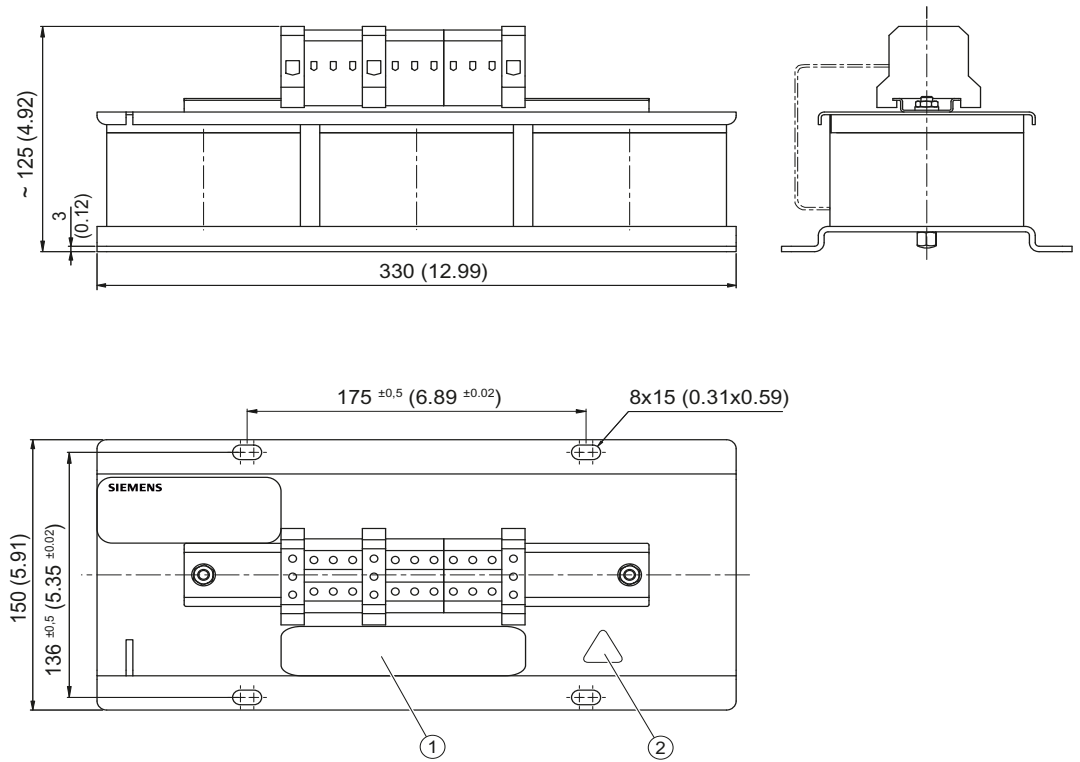
1) See Section "Spring-loaded terminals"

**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.



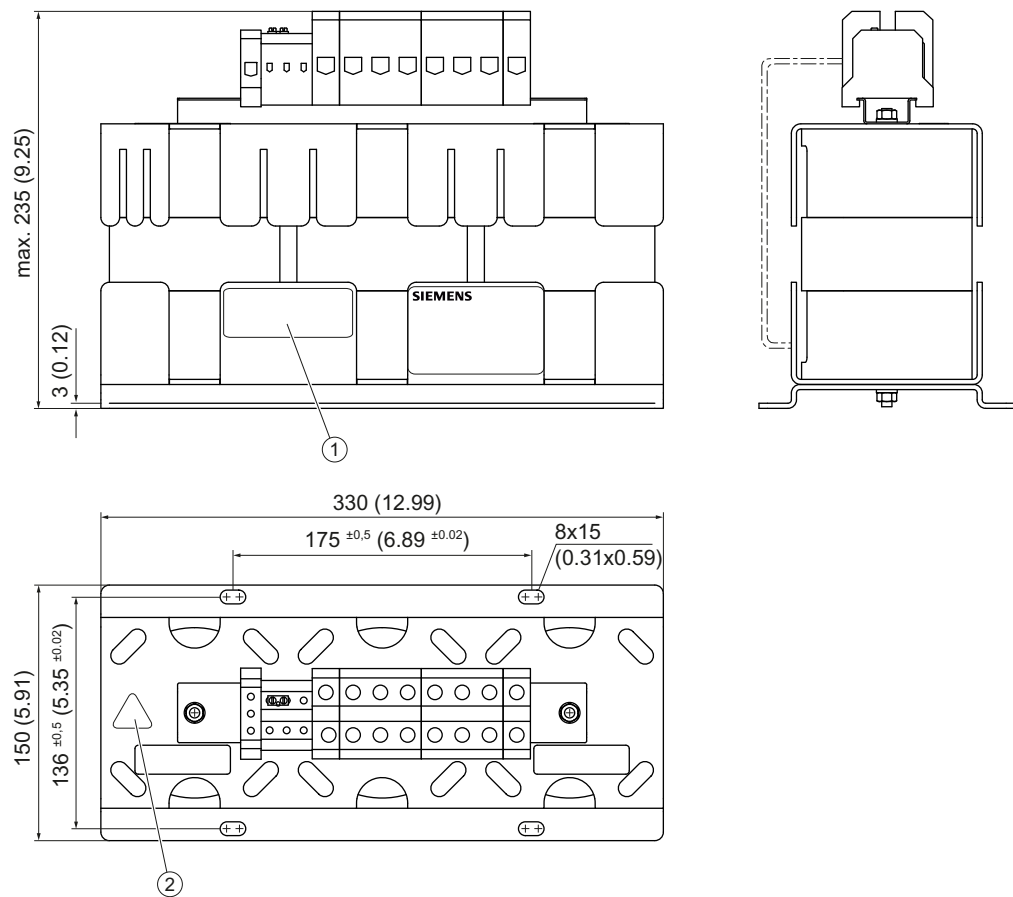
3.8.3.2 Dimension drawings



- ① Terminal arrangement
- ② Warning label

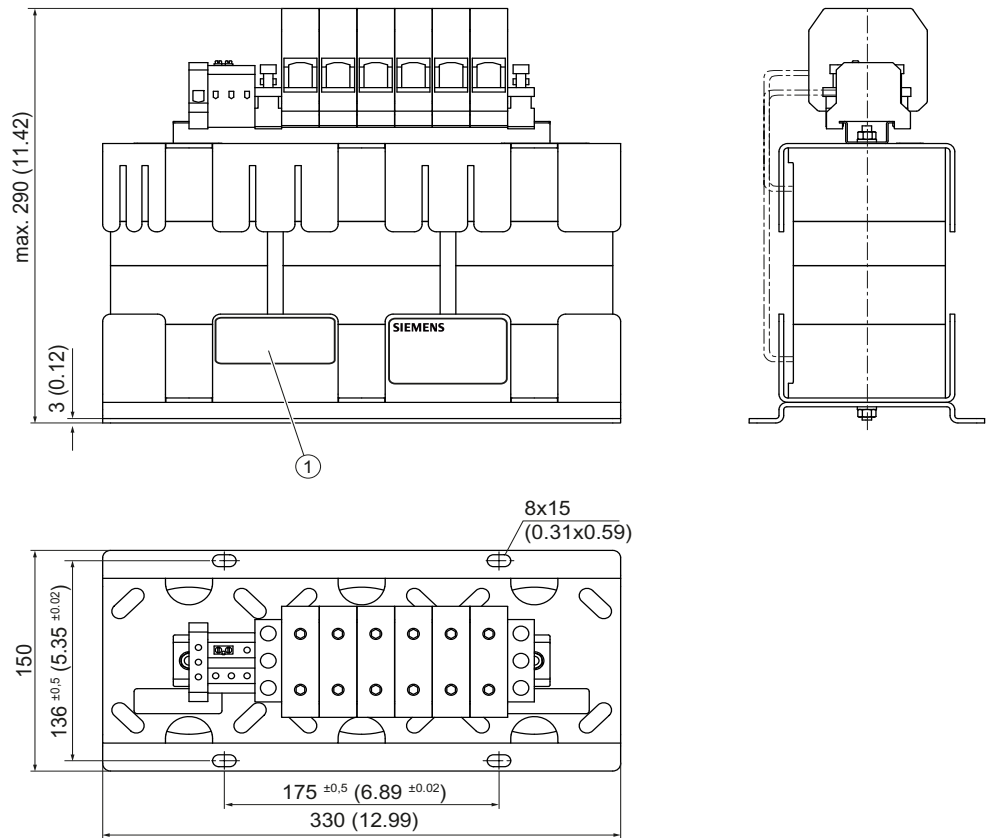
Figure 3-31 Dimension drawing of HFD line reactor 16 kW, all dimensions in mm and (inches)

3.8 Line reactors



- ① Terminal arrangement
- ② Warning label

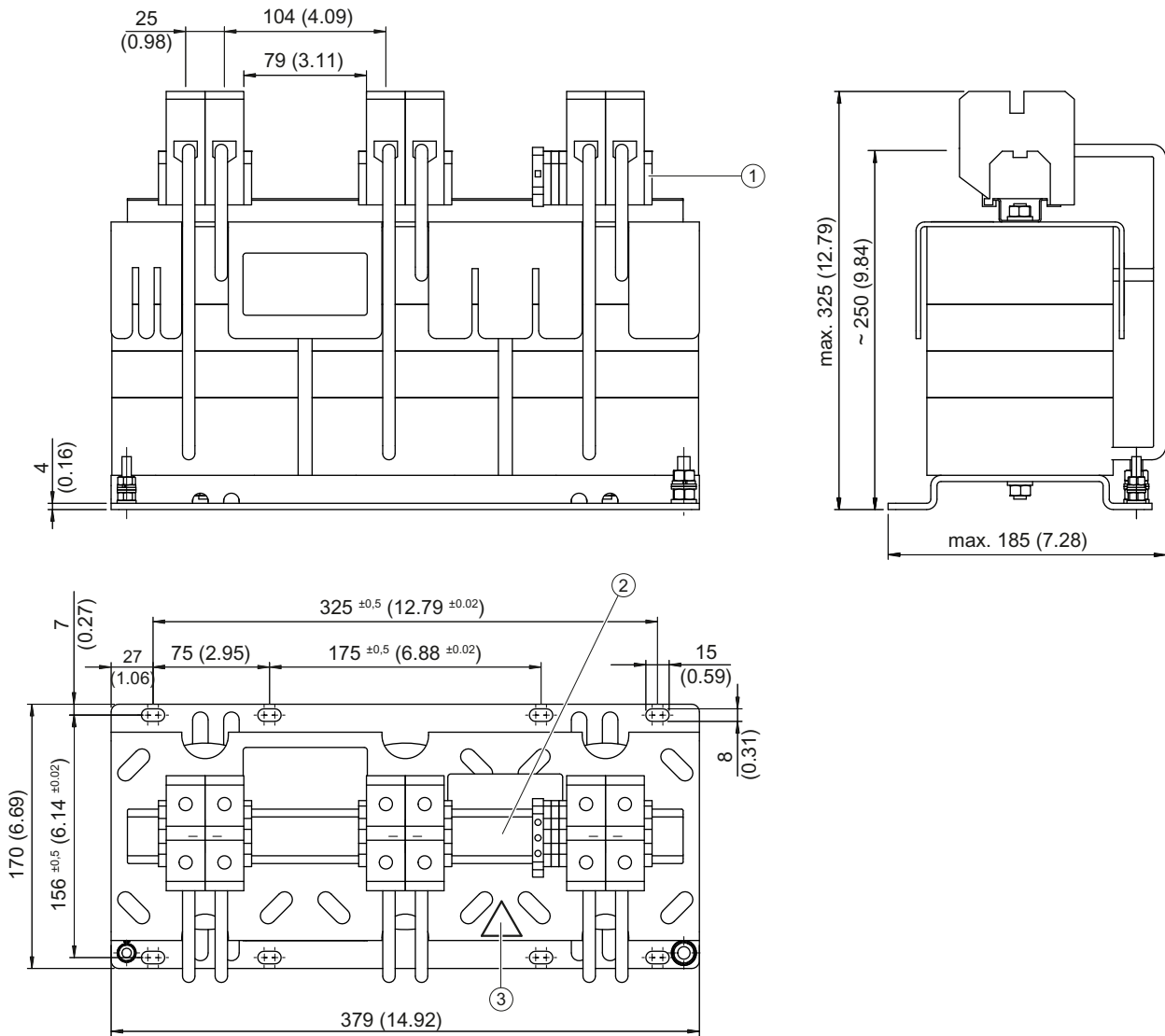
Figure 3-32 Dimension drawing of HFD line reactor 36 kW, all dimensions in mm and (inches)



① Terminal arrangement

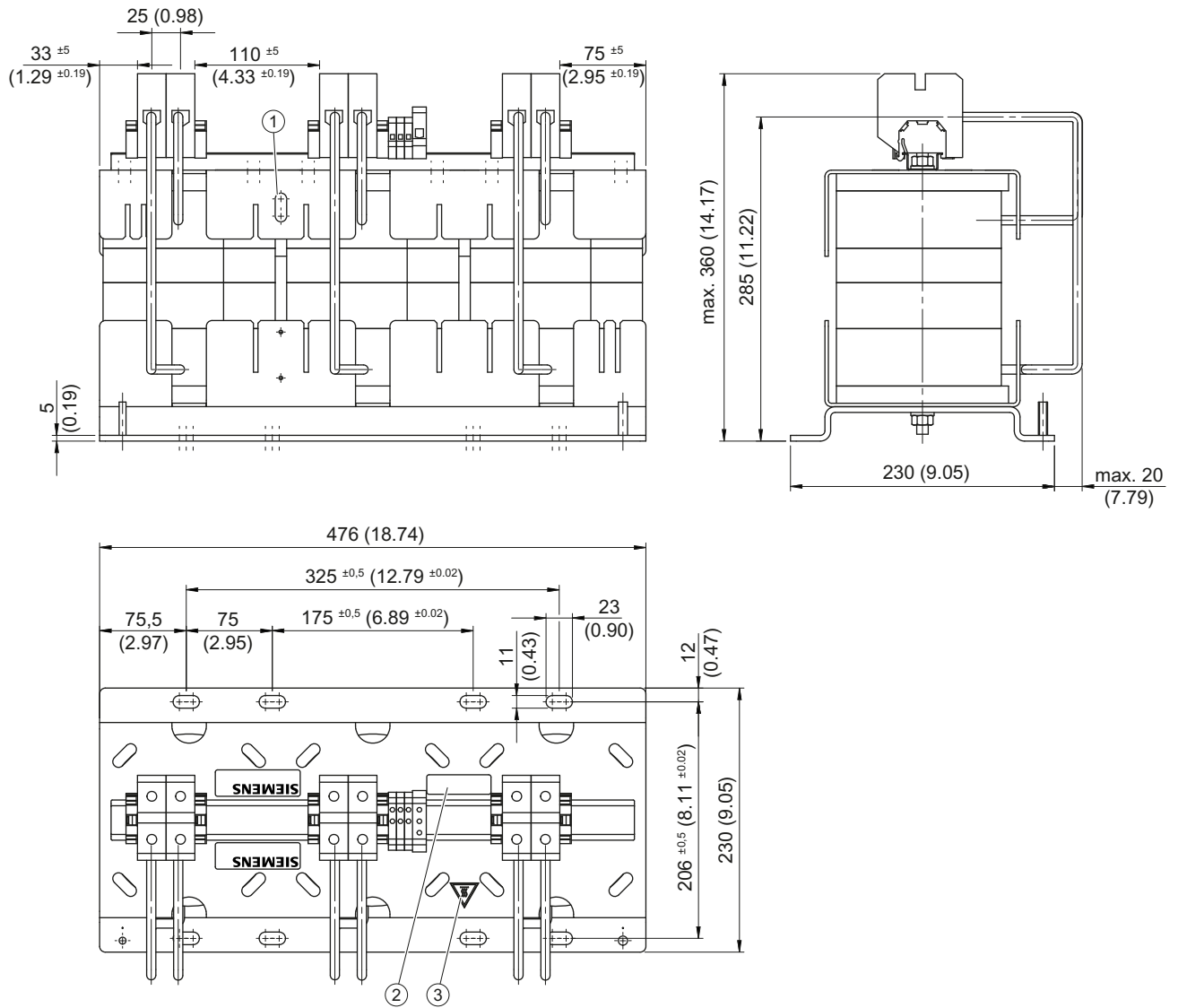
Figure 3-33 Dimension drawing of HFD line reactor 55 kW, all dimensions in mm and (inches)

3.8 Line reactors



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

Figure 3-34 Dimension drawing of HFD line reactor 80 kW, all dimensions in mm and (inches)



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

Figure 3-35 Dimension drawing of HFD line reactor 120 kW, all dimensions in mm and (inches)

3.8 Line reactors

3.8.3.3 Technical data

Table 3- 15 Technical data for HFD line reactors

	Unit	6SL3000-0DE21-6AAx	6SL3000-0DE23-6AAx	6SL3000-0DE25-5AAx	6SL3000-0DE28-0AAx	6SL3000-0DE31-2AAx
Power	kW	16	36	55	80	120
Rated current	A <sub>rms</sub>	30	67	103	150	225
Power loss <sup>1)</sup>	W	170	250	350	450	590
Weight	kg	9	21	27	37	67
Degree of protection according to EN 60529		IP20	IP00B (no touch protection)		IP00B (no touch protection)	
Mounting position		Any				

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

3.8.4 Damping resistor for HFD line reactors

3.8.4.1 Description

Using a damping resistor

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

**Note**

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

### 3.8.4.2 Safety instructions for damping resistors for HFD reactors

#### ⚠ CAUTION

##### Risk of burns due to high surface temperatures

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

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

#### Note

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

### 3.8.4.3 Dimension drawings

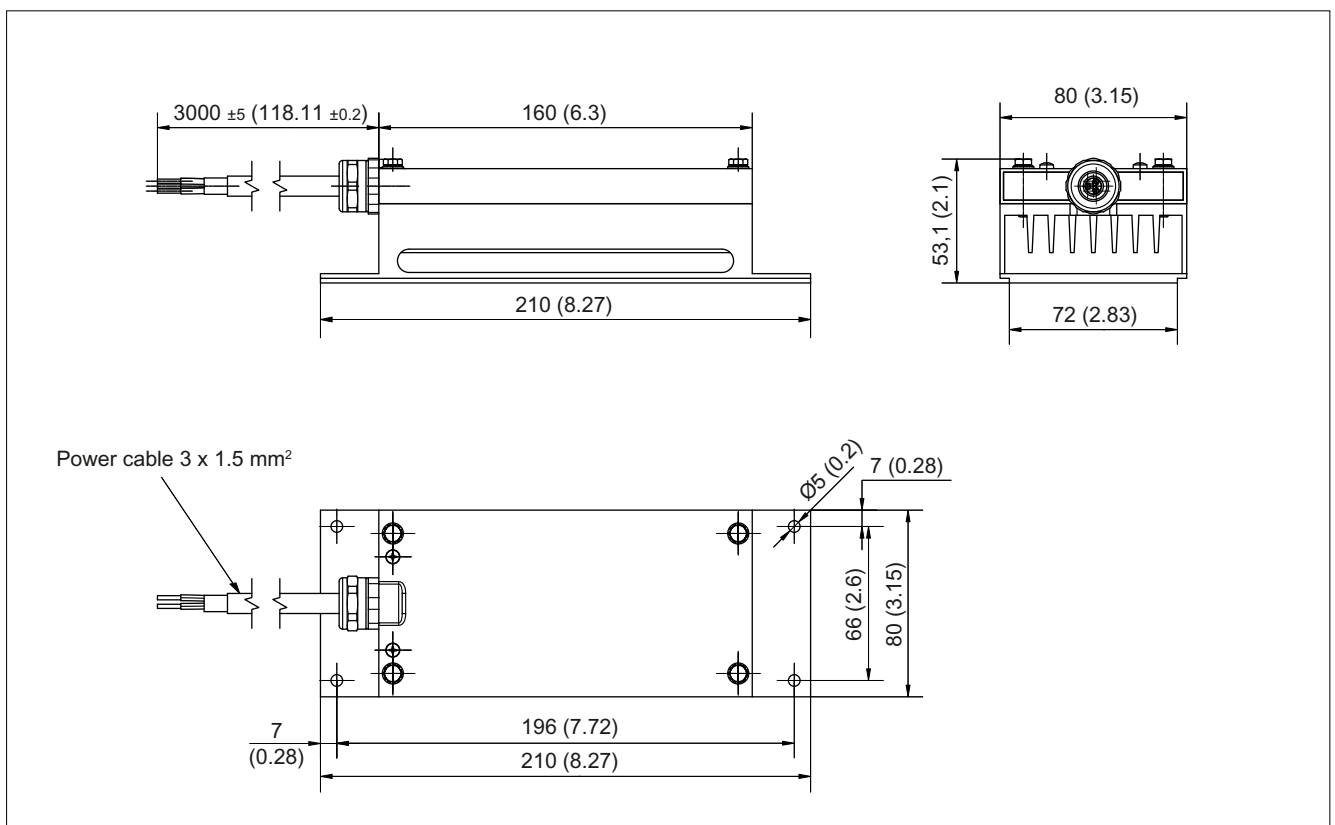


Figure 3-36 300 W damping resistor for HFD line reactors, all dimensions in mm and (inches)

3.8 Line reactors

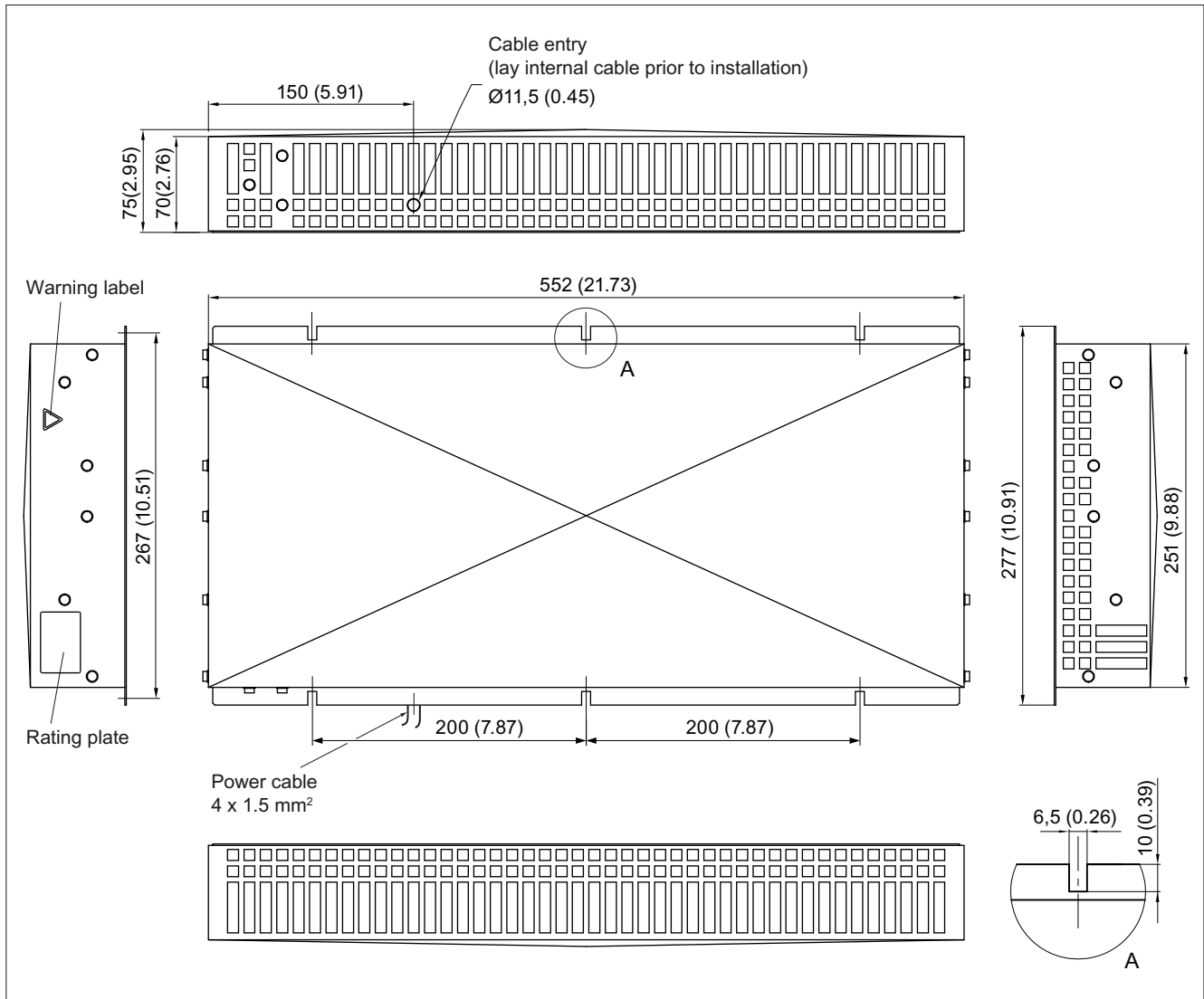


Figure 3-37 800 W damping resistor for HFD line reactors, all dimensions in mm and (inches)



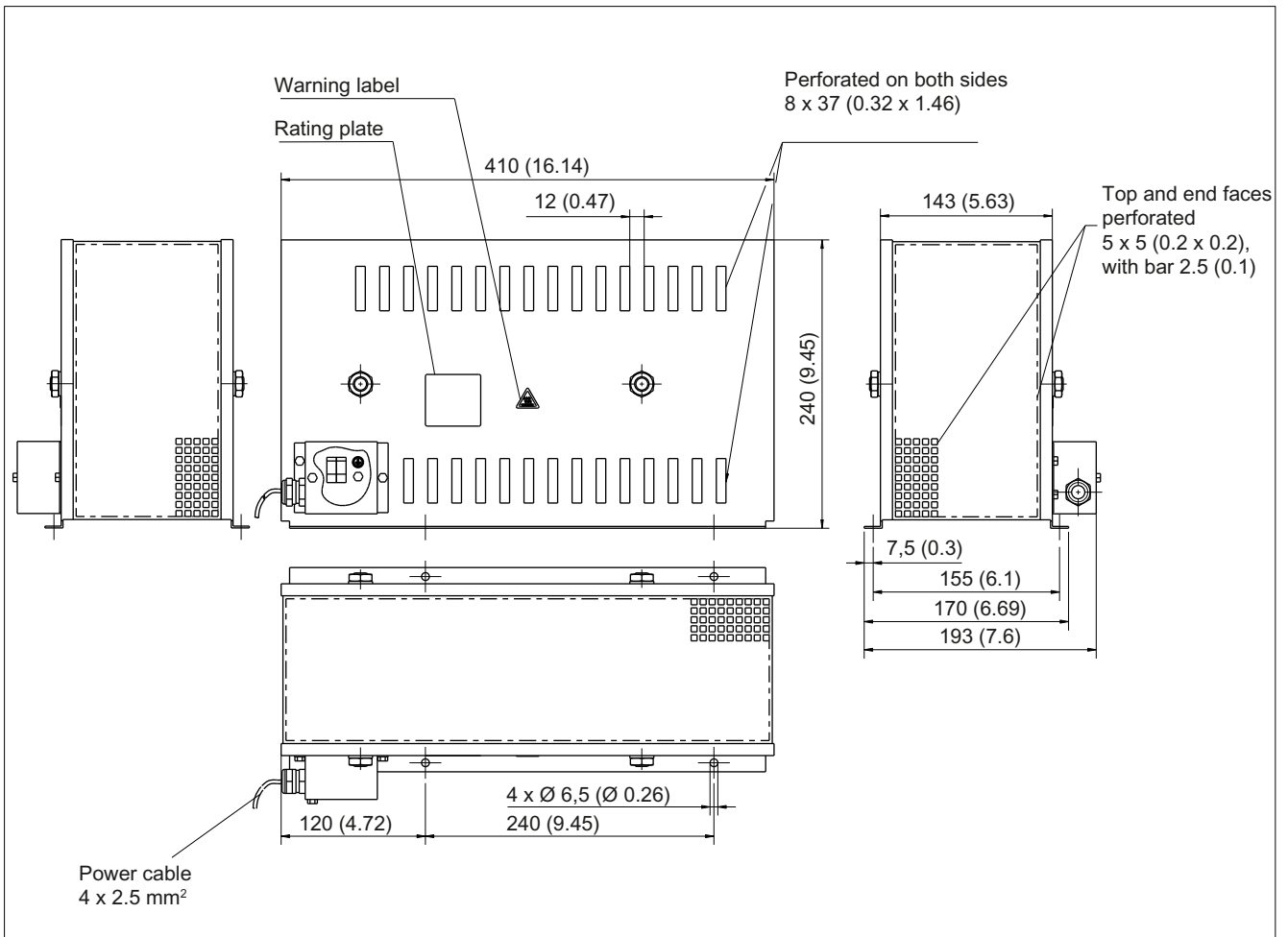


Figure 3-38 1500 W damping resistor for HFD line reactors, all dimensions in mm and (inches)

### 3.8.4.4 Technical data

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

Table 3- 16 Technical data for HFD damping resistors

Order number	6SN1113-1AA00-0DAx <sup>1)</sup>	6SL3100-1BE21-3AAx <sup>2)</sup>	6SL3100-1BE22-5AAx <sup>3)</sup>
Rated power [W]	300	800	1500
Connection cable [m], included in scope of delivery	3	5	5
Connection	3 x 1.5 mm <sup>2</sup>	4 x 1.5 mm <sup>2</sup>	4 x 1.5 mm <sup>2</sup>
Weight [kg]	1.45	5.5	5.6
Degree of protection according to EN 60529	IP54	IP51	IP20
UL file	E-228809	E-212934	E-192450
Ambient temperature [°C]	0...55		
Dimensions (W x H x D) [mm]	80 x 210 x 53	277 x 552 x 75	193 x 410 x 240

1) The 300 W damping resistor can be used for HFD applications if the following is true after a warm-up run when all axes are shut down in a regulated way:

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

2) Preferred type

3) Alternative possible

---

**Note**

Use of the 800 W damping resistor is preferable.

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3.8.4.5 Wiring with the HFD line reactor

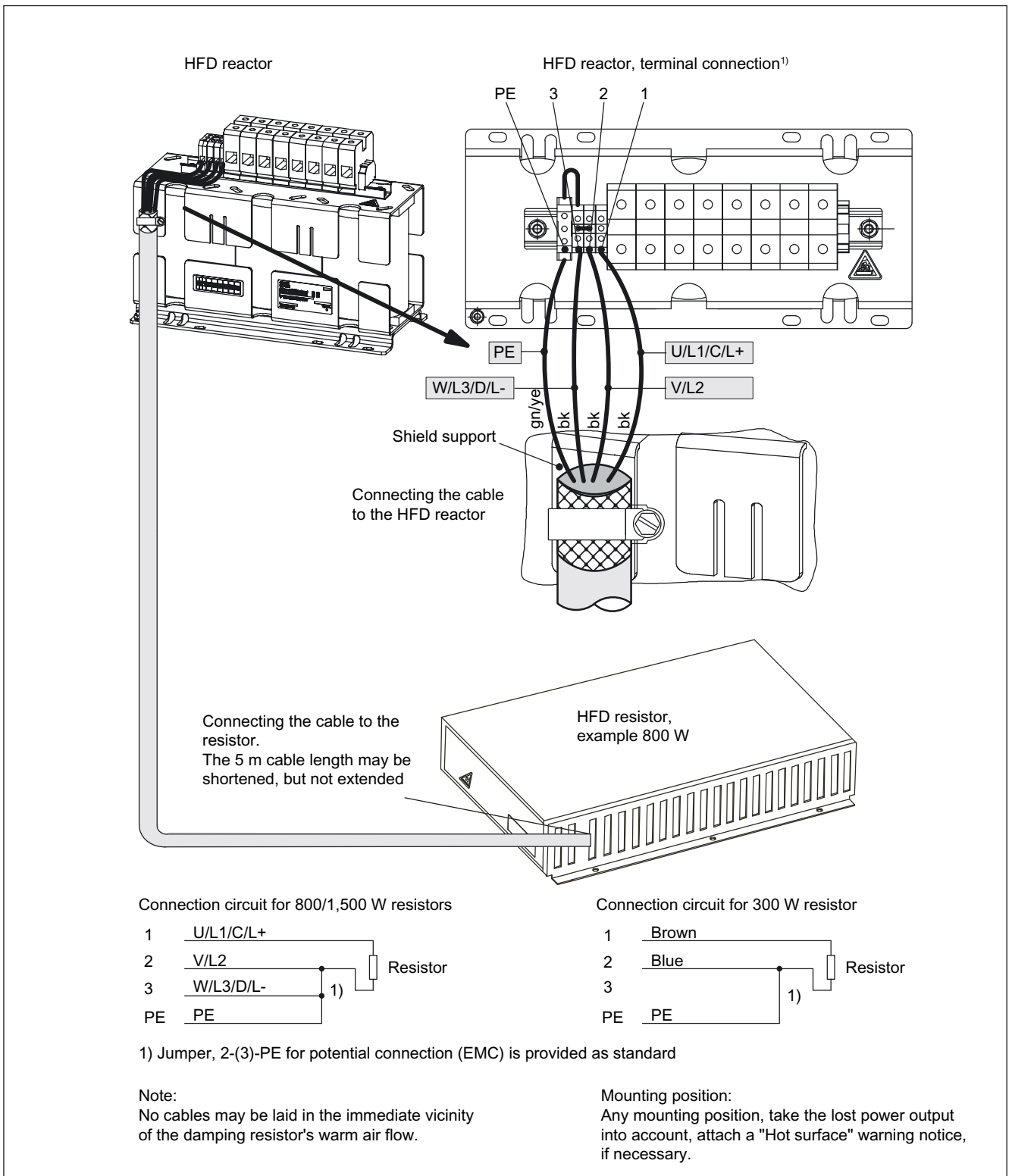


Figure 3-39 Wiring the HFD line reactor with a damping resistor

### 3.8.5 Line reactors for Basic Line Modules

#### 3.8.5.1 Interface description

##### Overview

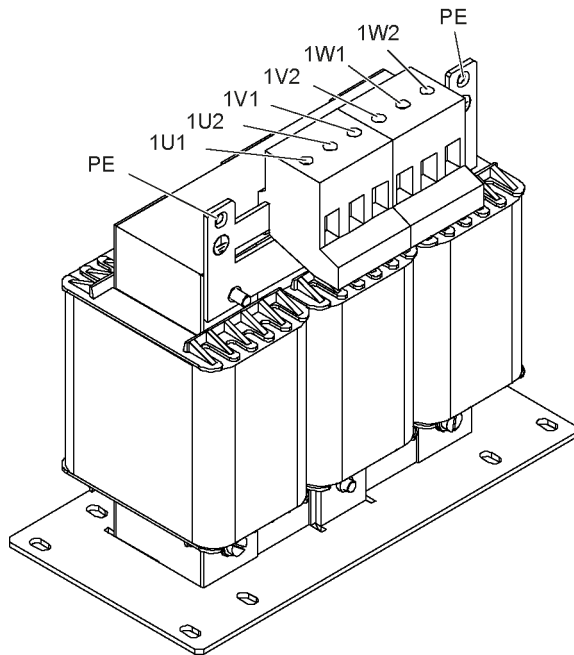


Figure 3-40 Interface overview, line reactor for Basic Line Modules (20 kW)

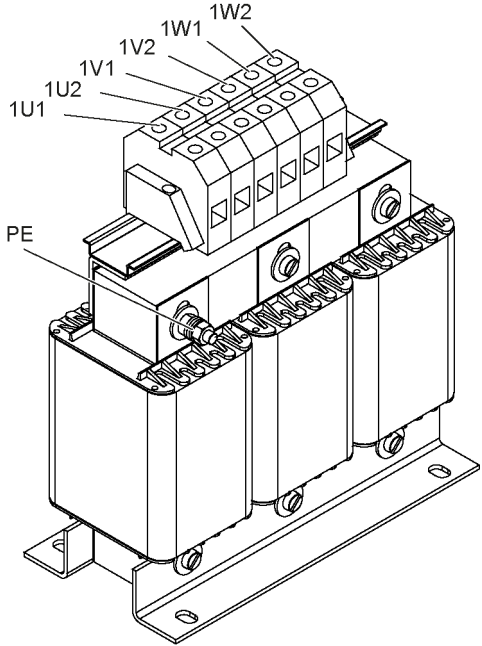


Figure 3-41 Interface overview, line reactor for Basic Line Modules (40 kW)

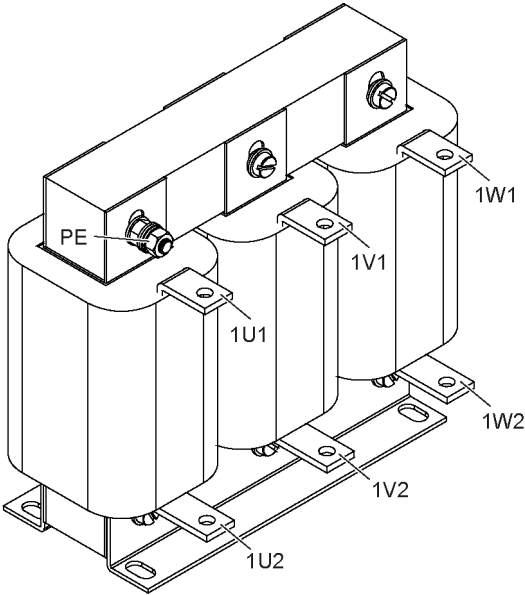


Figure 3-42 Interface overview, line reactor for Basic Line Modules (100 kW)

3.8 Line reactors

**Line/load connection**

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

	<b>6SL3000-0CE22-0AAx</b>	<b>6SL3000-0CE24-0AAx</b>	<b>6SL3000-0CE31-0AAx</b>
Power	20 kW	40 kW	100 kW
Line supply connection 1U1, 1V1, 1W1	Screw terminals 16 mm <sup>2</sup> ; 0.6 - 0.8 Nm	Screw terminals 35 mm <sup>2</sup> ; 2.5 - 5.0 Nm	Copper rails with 8.5 mm holes
Load connection 1U2, 1V2, 1W2			
PE connection	Screw M4 1.8 Nm	Terminal studs M6 6 Nm	Terminal studs M8 8 Nm

3.8.5.2 Dimension drawings

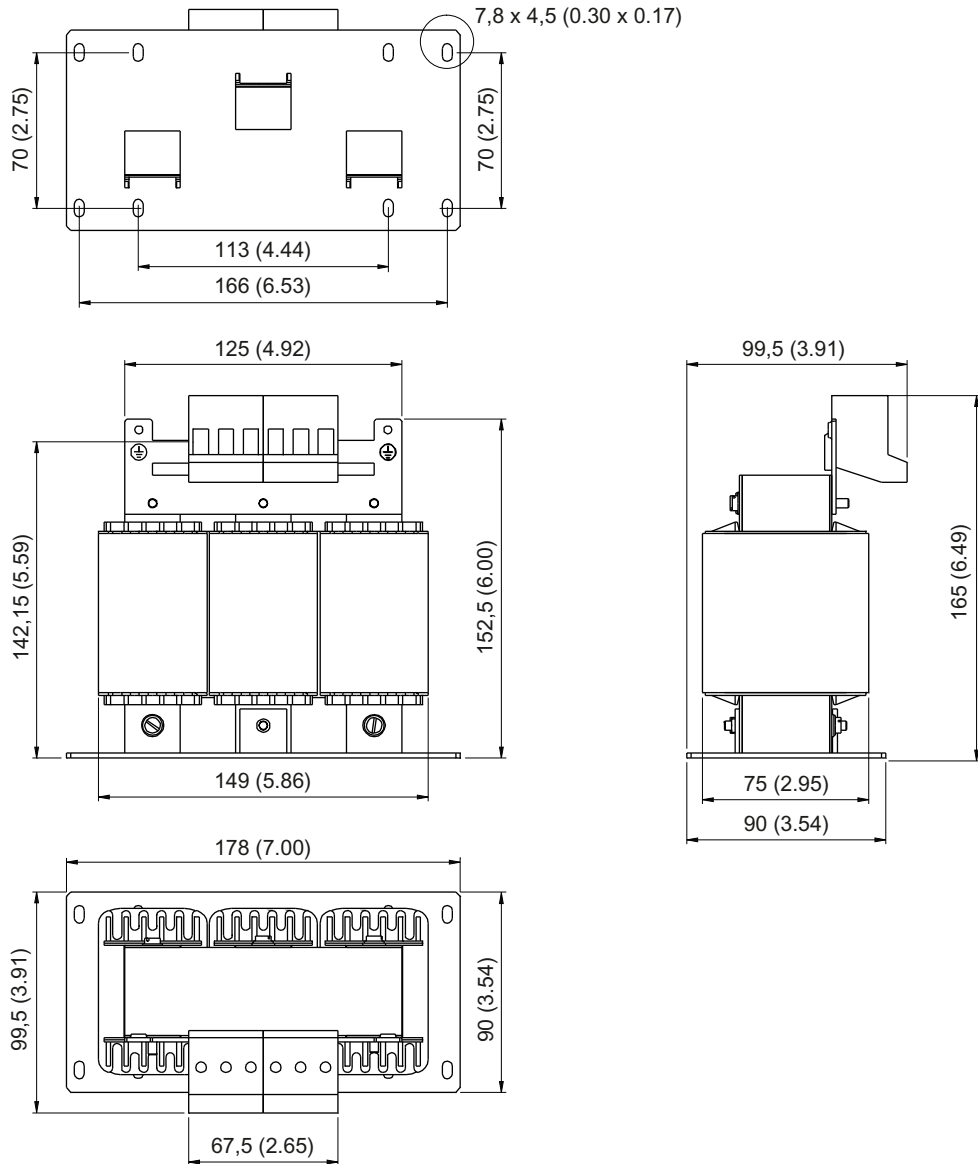


Figure 3-43 Dimension drawing of line reactor for Basic Line Module 20 kW, all dimensions in mm and (inches)

3.8 Line reactors

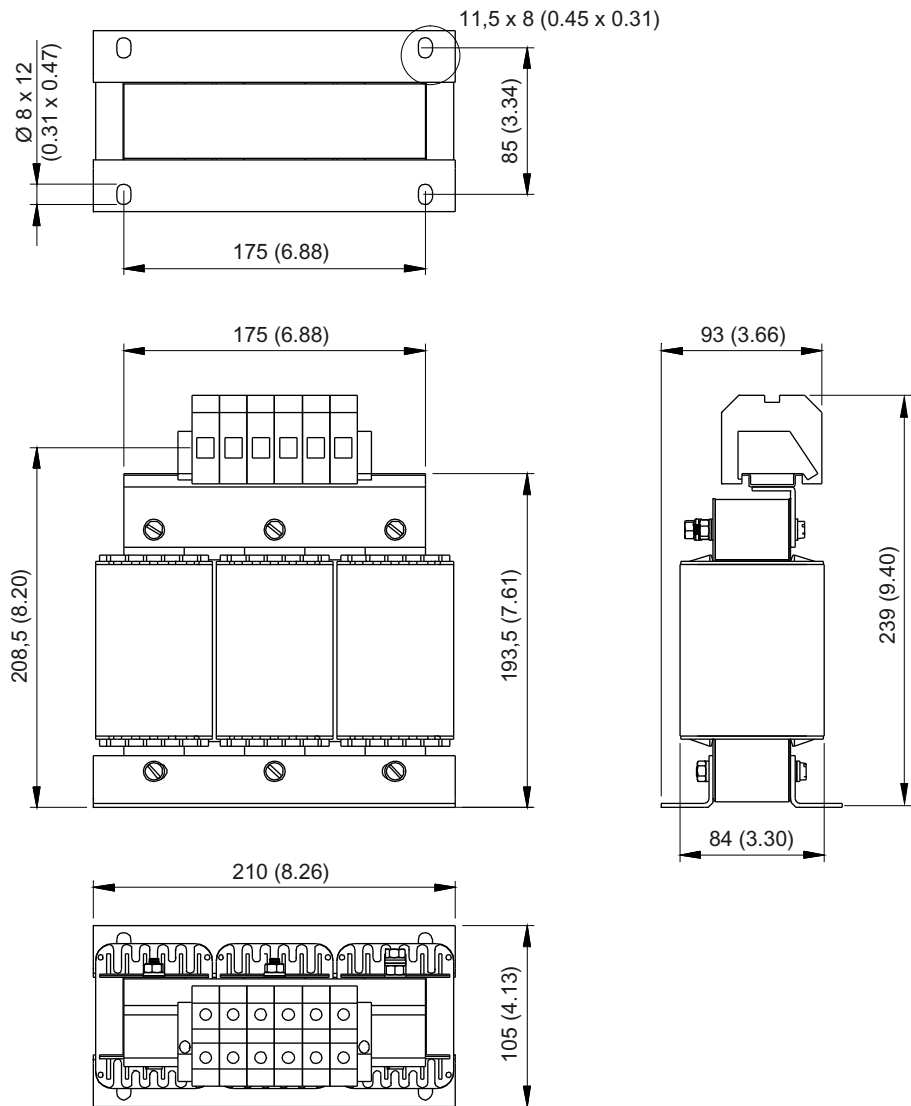


Figure 3-44 Dimension drawing of line reactor for Basic Line Module 40 kW, all dimensions in mm and (inches)



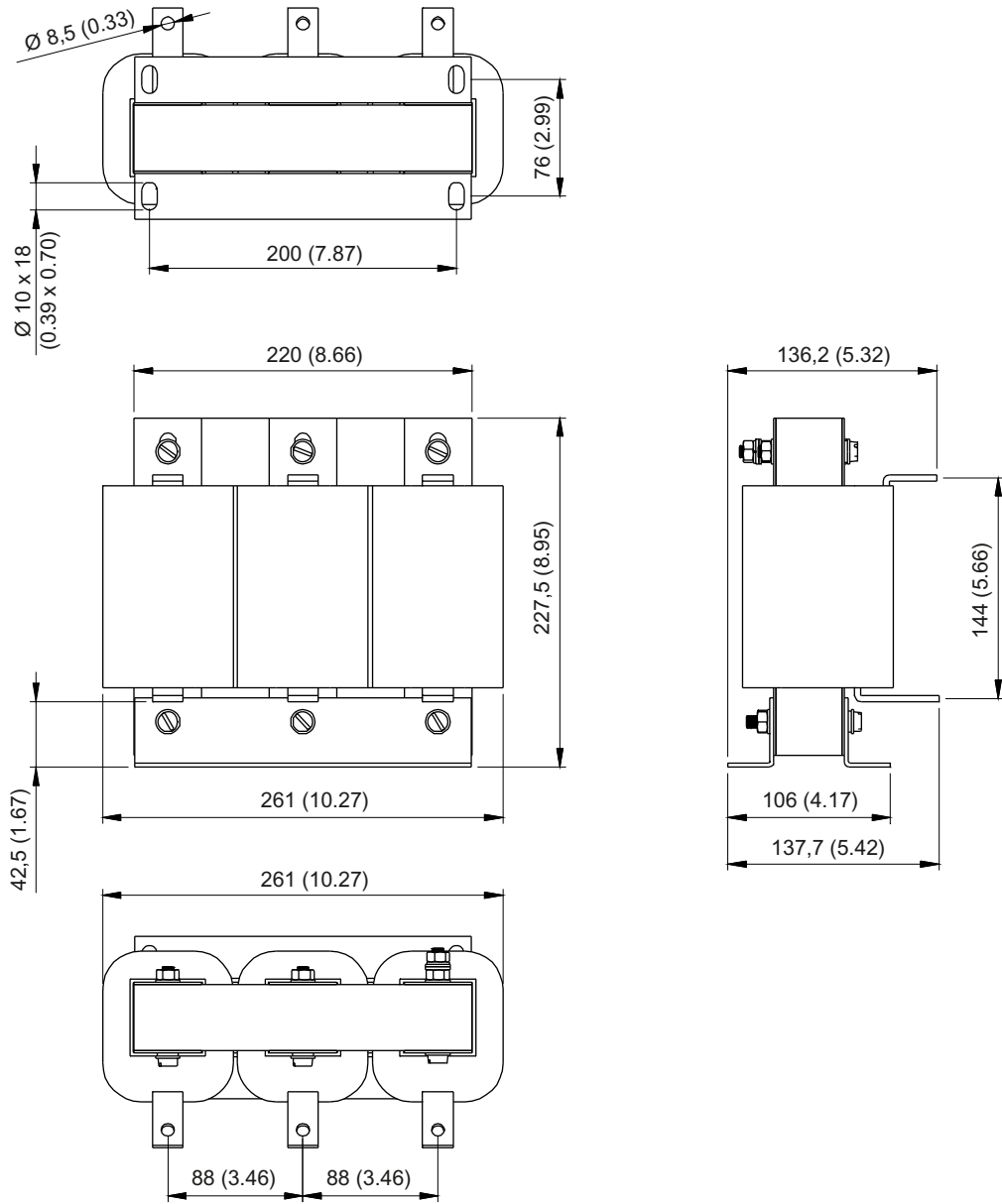


Figure 3-45 Dimension drawing of line reactor for Basic Line Module 100 kW, all dimensions in mm and (inches)

3.8 Line reactors

3.8.5.3 Technical data

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

	Unit	6SL3000-0CE22-0AAx	6SL3000-0CE24-0AAx	6SL3000-0CE31-0AAx
Power	kW	20	40	100
Rated current	A <sub>rms</sub>	37	74	185
Power loss <sup>1)</sup>	W	130	270	480
Weight	kg	5.2	11.2	21.7

1) For an overview, see the power loss tables in Section "Control cabinet installation and EMC"

3.8.6 Line reactors for Smart Line Modules

3.8.6.1 Interface description

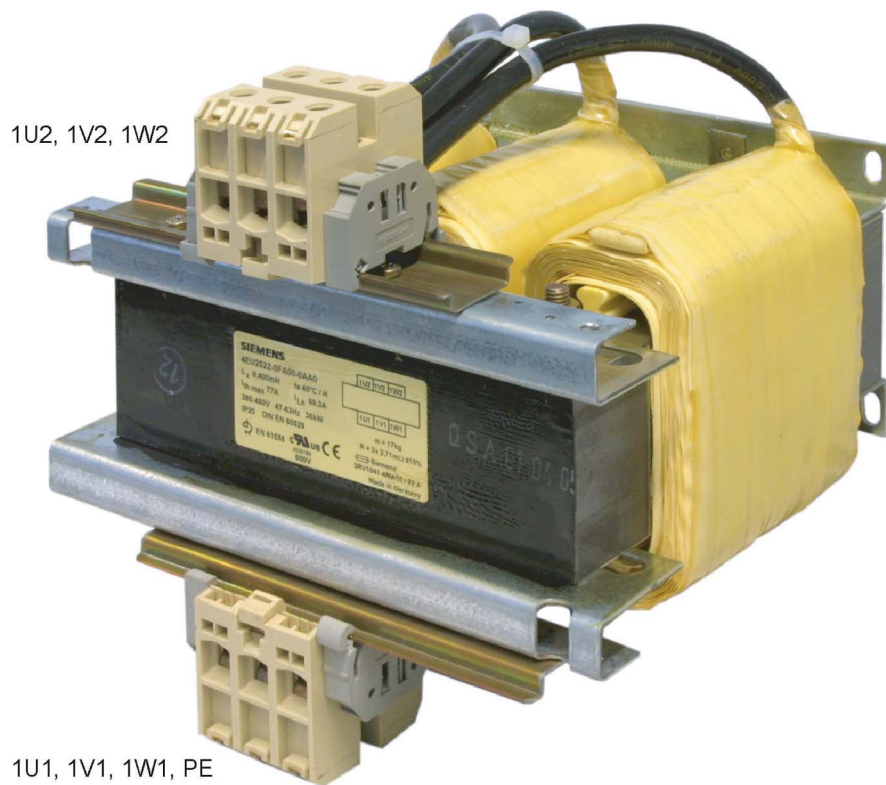


Figure 3-46 Interface overview, line reactors for Smart Line Modules (example: 36 kW)

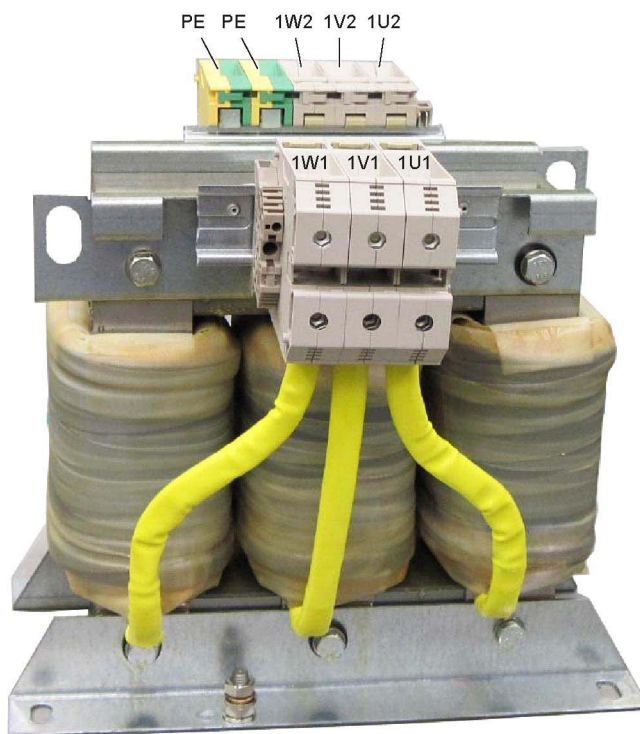


Figure 3-47 Interface overview, line reactors for Smart Line Modules (example: 55 kW)

## Line/load connection

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

	6SL3000-0CE15-0AAx	6SL3000-0CE21-0AAx	6SL3000-0CE21-6AAx	6SL3000-0CE23-6AAx	6SL3100-0CE25-5DAx
Power	5 kW	10 kW	16 kW	36 kW	55 kW
Line supply connection 1U1, 1V1, 1W1	Screw terminals 4 mm <sup>2</sup> 0.5 - 0.6 Nm	Screw terminals 10 mm <sup>2</sup> 1.2 - 1.5 Nm	Screw terminals 10 mm <sup>2</sup> 1.2 - 1.5 Nm	Screw terminals 16 mm <sup>2</sup> 1.5 - 1.8 Nm	Screw terminals 70 mm <sup>2</sup> 8-12 Nm
Load connection 1U2, 1V2, 1W2					
PE connection			Terminal studs M5 1)	Terminal studs M6 1)	Terminal studs M8 1)

1) For ring cable lug in accordance with DIN 46234

3.8.6.2 Dimension drawings

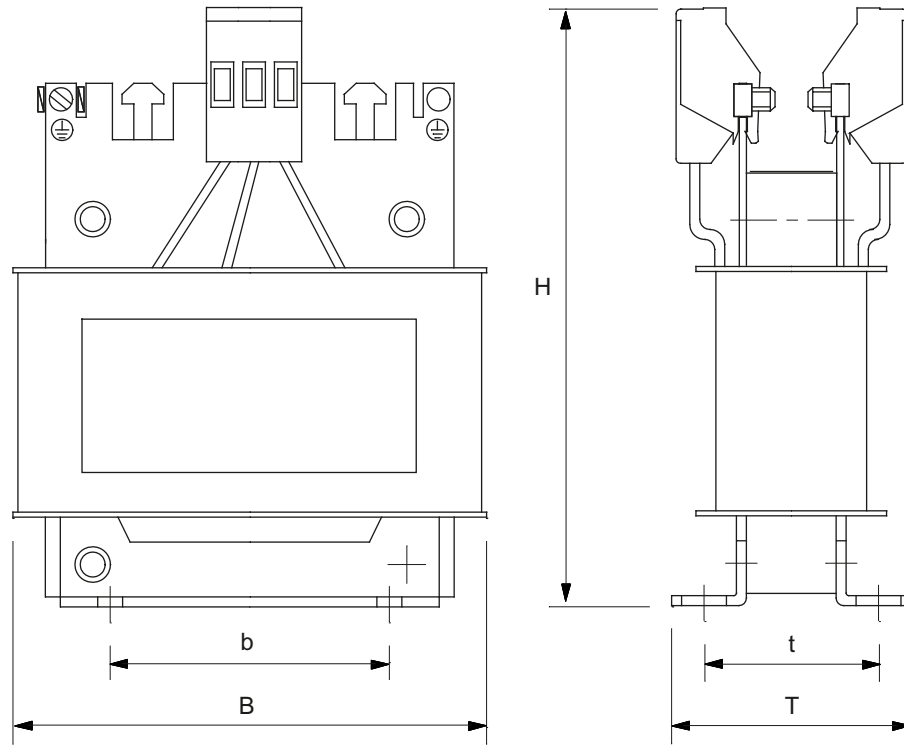


Figure 3-48 Dimension drawing of line reactor for Smart Line Modules (5 kW and 10 kW)

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

	Order number 6SL3000-	B [mm] (inches)	b [mm] <sup>1)</sup> (inches)	H [mm] (inches)	D [mm] (inches)	t [mm] <sup>1)</sup> (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

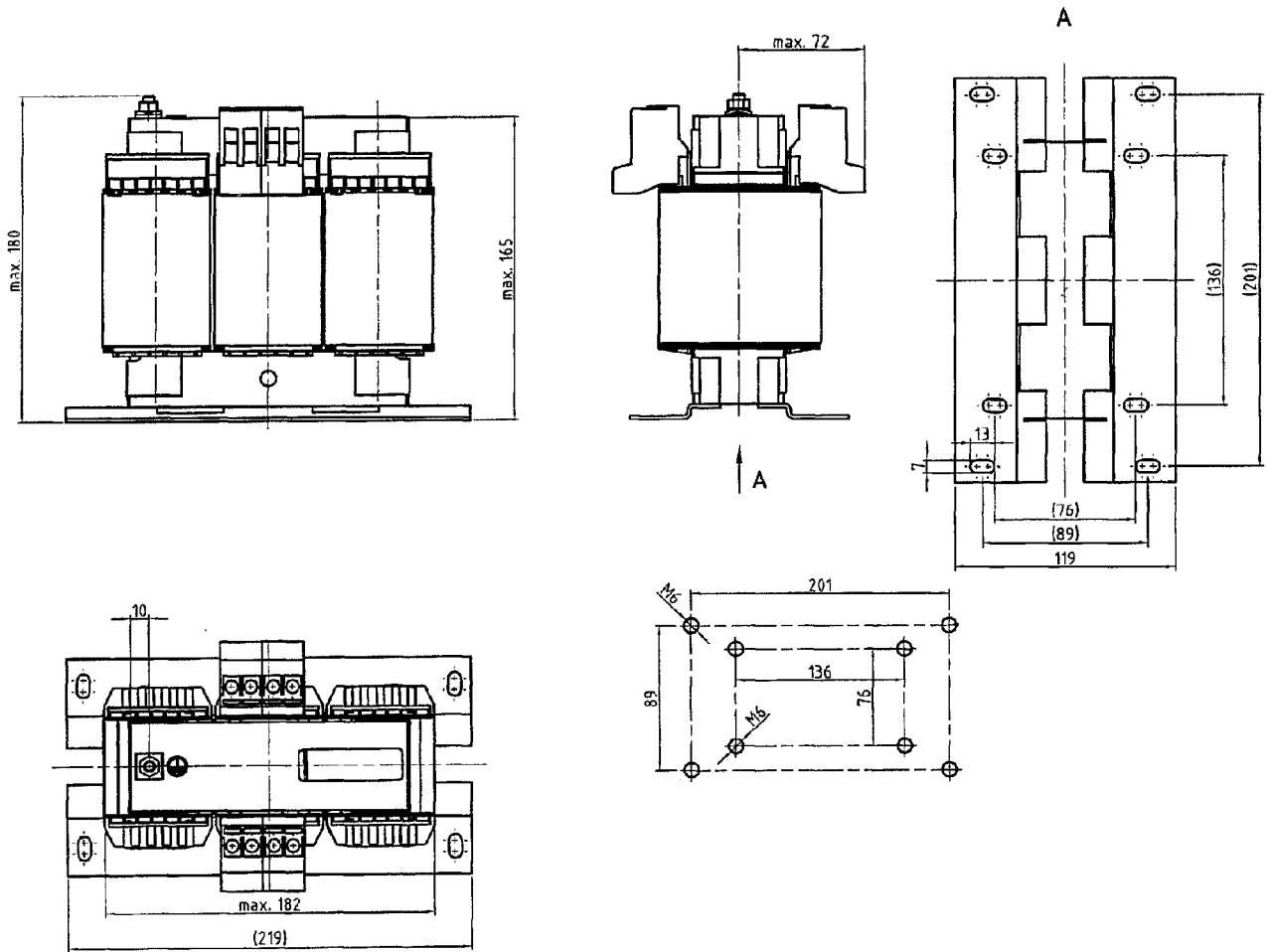


Figure 3-49 Dimension drawing of line reactor for Smart Line Module 16 kW

3.8 Line reactors

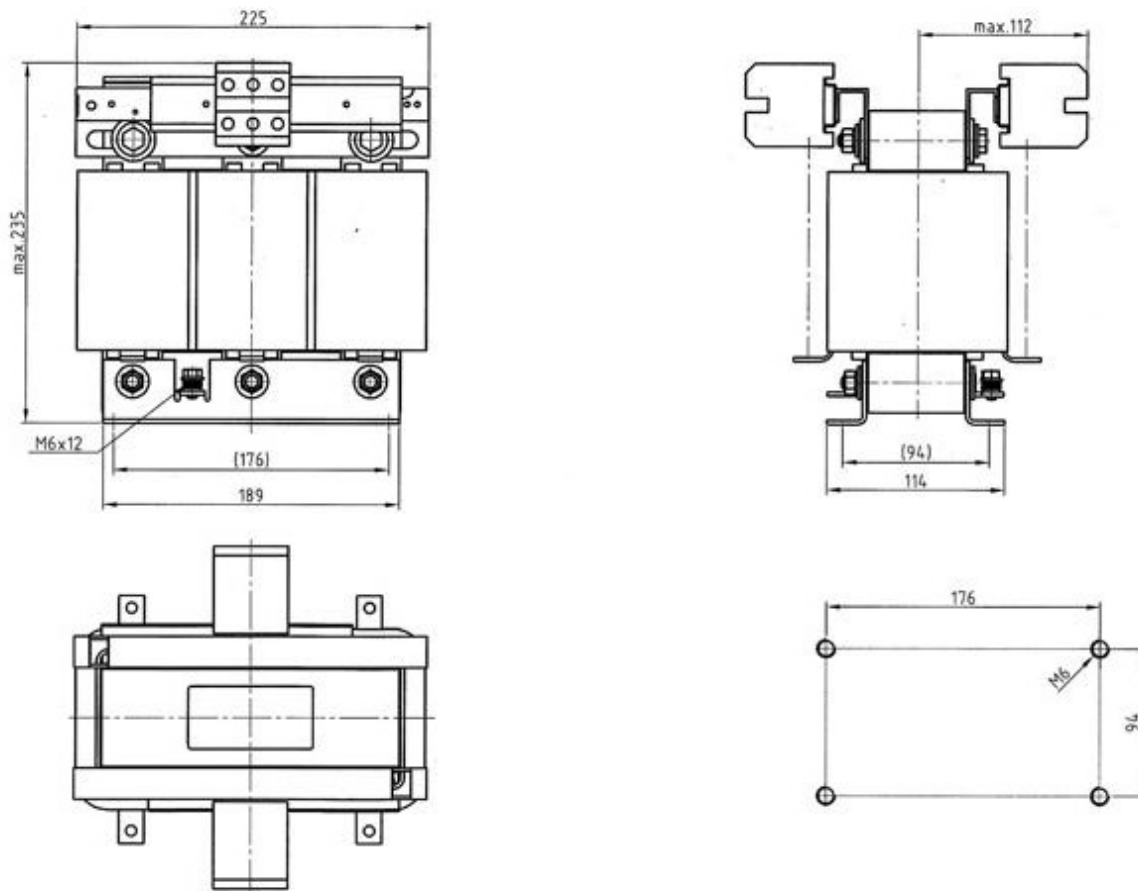


Figure 3-50 Dimension drawing of line reactor for Smart Line Module 36 kW

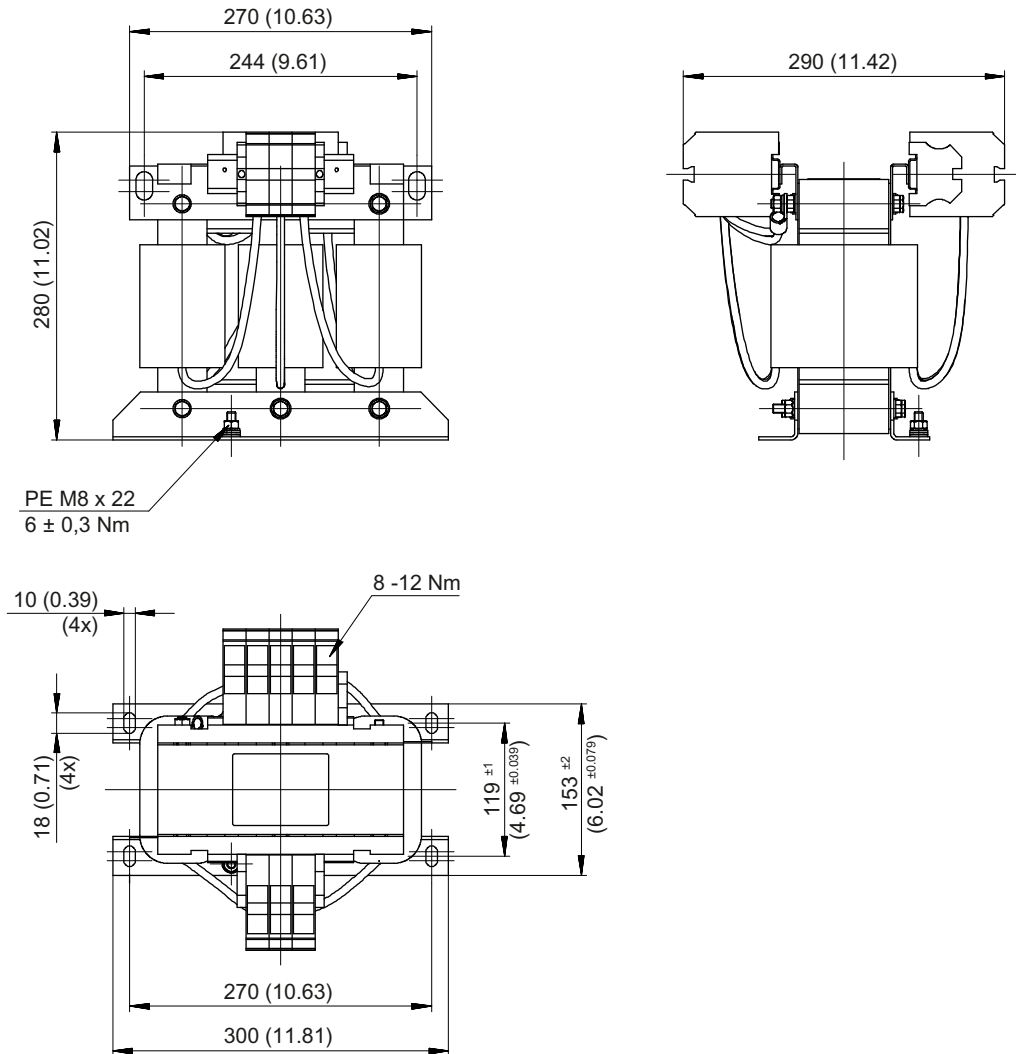


Figure 3-51 Dimension drawing of line reactor for Smart Line Module 55 kW, all dimensions in mm and (inches)

### 3.8.6.3 Technical data

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

		6SL3000-0CE15-0AAx	6SL3000-0CE21-0AAx	6SL3000-0CE21-6AAx	6SL3000-0CE23-6AAx	6SL3100-0CE25-5AAx
Power	kW	5	10	16	36	55
Rated current	A <sub>rms</sub>	14	28	35	69	103
Power loss <sup>1)</sup>	W	62	116	110	170	190
Weight	kg	3.7	7.5	9.5	17	37

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

## 3.9 Active Interface Modules internal air cooling

### 3.9.1 Safety instructions for Active Interface Modules

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**Note**

When using an Active Interface Module, also observe the safety instructions in Section 1.

---

**NOTICE****Destruction of the Active Interface Module through incorrect settings made during commissioning**

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

Operate Active Interface Modules only with the following settings in the commissioning wizard:

- Set the "Line filter available" option for the Active Line Module.
- Select line filter "AIM 400 V xxkW (6SL3100-0BE\*\*-\*AB\*)"

In conjunction with SINAMICS V2.6, the appropriate Active Interface Module is already preset by running the wizard in STARTER.

With firmware version SINAMICS V2.5, the default setting in STARTER/SCOUT is "Wideband Line Filter". Parameter p0220 must be changed to "AIM".

Operation with a SINAMICS firmware less than V2.5 is not permitted.

**NOTICE****Destruction of the Active Interface Module through incorrect/missing wiring**

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

- Before commissioning the Active Interface Module, it is essential to connect the 24 V DC at connector X124 to supply the fans. Current required  $\leq 1.2$  A.
- Connect the temperature signaling contact of the Active Interface Module to the temperature input of the associated Active Line Module.

**CAUTION****Risk of burns due to high surface temperatures**

The Active Interface Module can become very hot. You can get seriously burnt when touching the surface.

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



 **WARNING**

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

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

- Maintain the 80 mm clearances above and below the Active Interface Module.

**NOTICE**

**Permitted mounting position**

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

**NOTICE**

**Connection cables**

The connection cables between the Active Interface Module and the Active Line Module, as well as between the Active Interface Module and the Basic Line Filter, must be kept as short as possible (max. 10 m in total).

Shielded connection cables must be used in order to achieve interference voltage category C2. The cable shields must be connected on both sides.

### **3.9.2 Description**

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

They contain the following functional units:

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

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

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

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

### 3.9.3 Interface description

#### 3.9.3.1 Overview

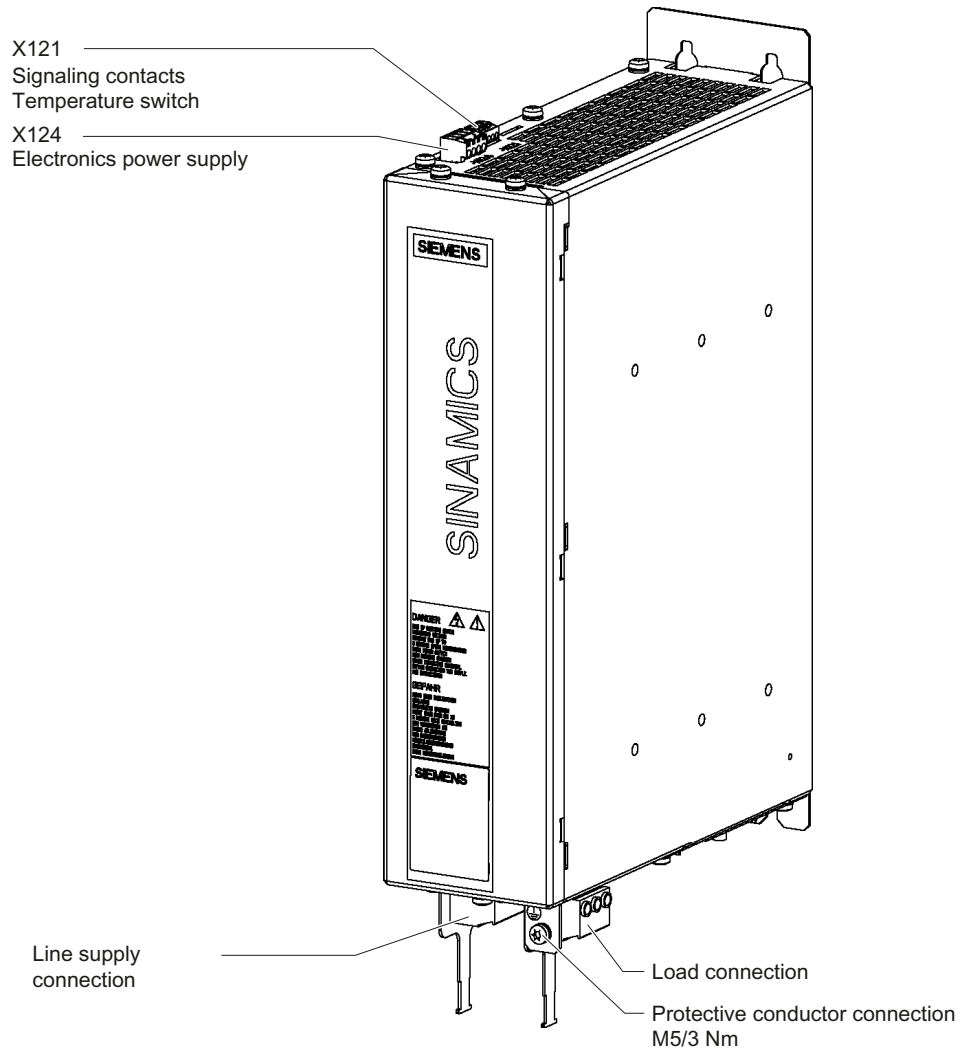


Figure 3-52 Interface overview, Active Interface Module 16 kW

3.9 Active Interface Modules internal air cooling

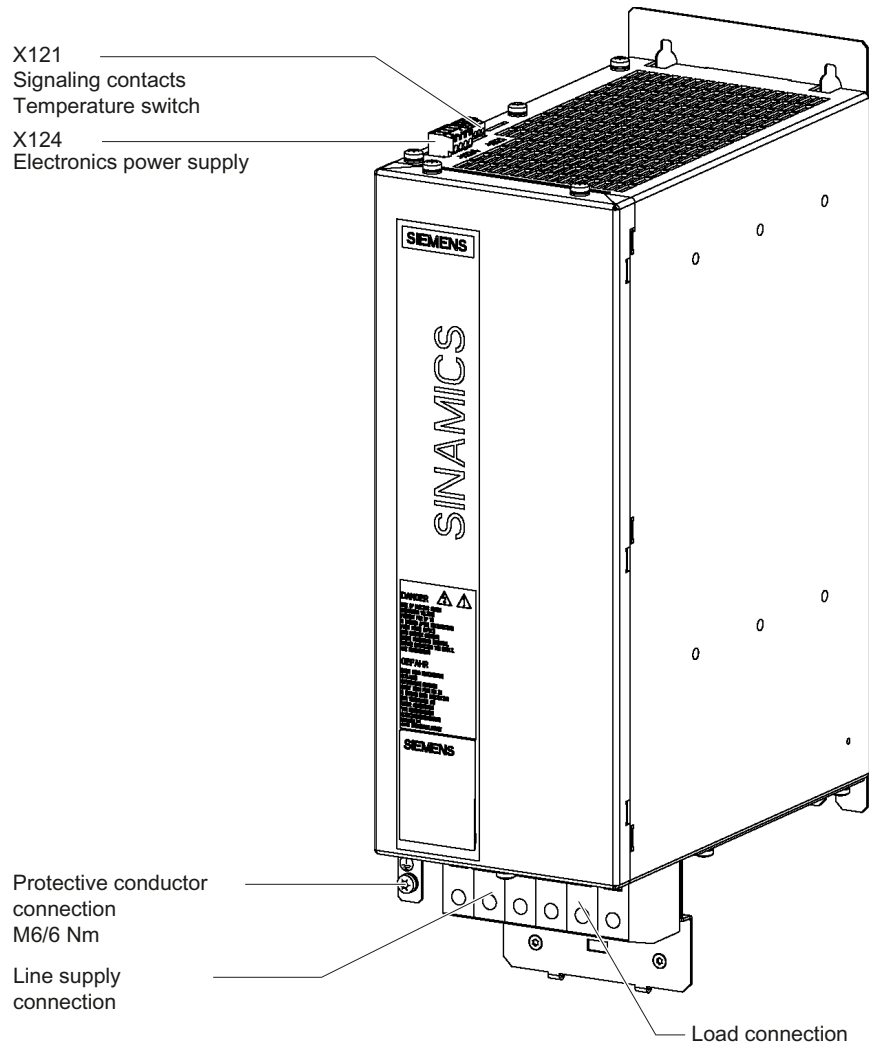


Figure 3-53 Interface overview, Active Interface Module 36 kW

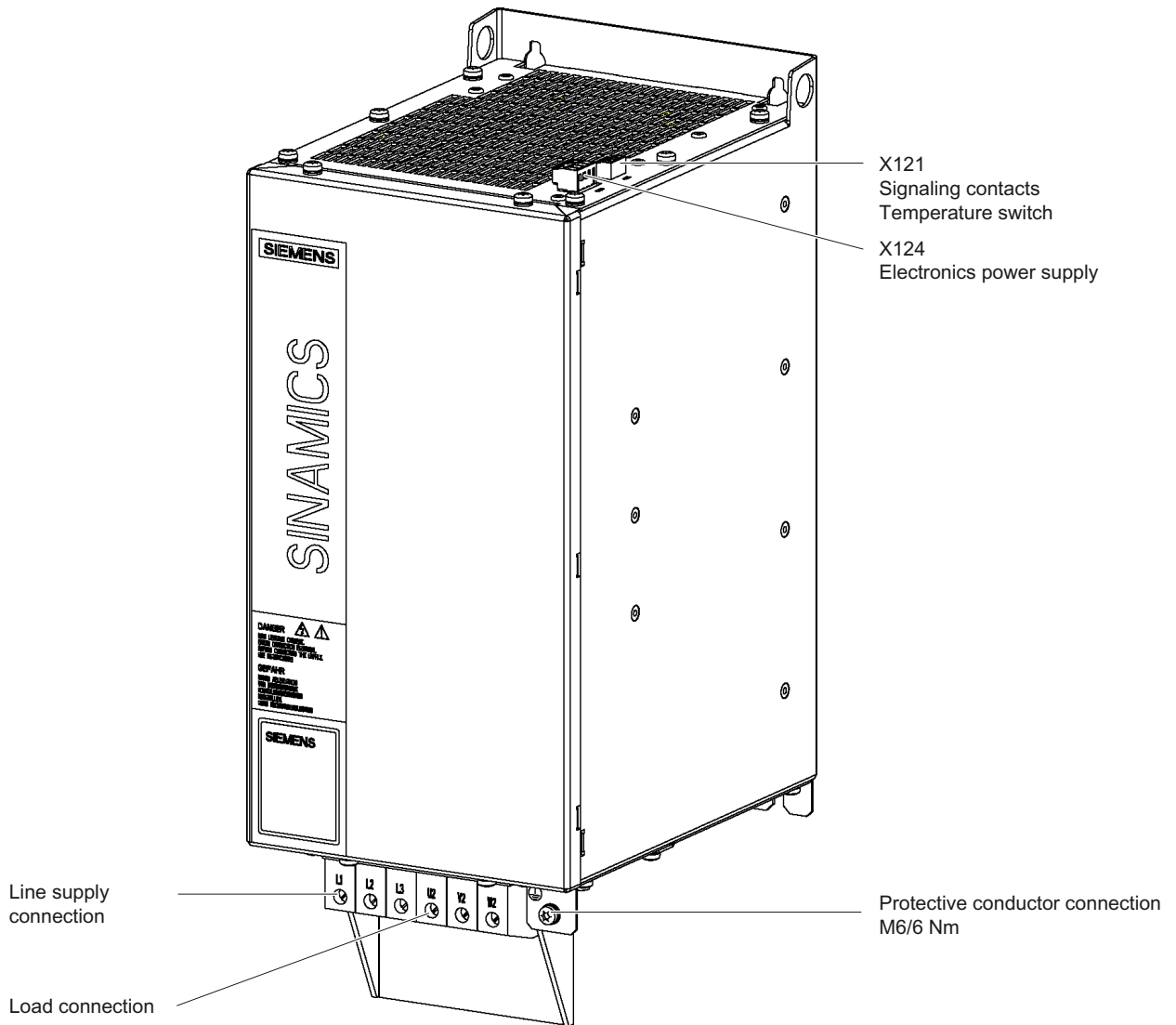


Figure 3-54 Interface overview, Active Interface Module 55 kW

3.9 Active Interface Modules internal air cooling

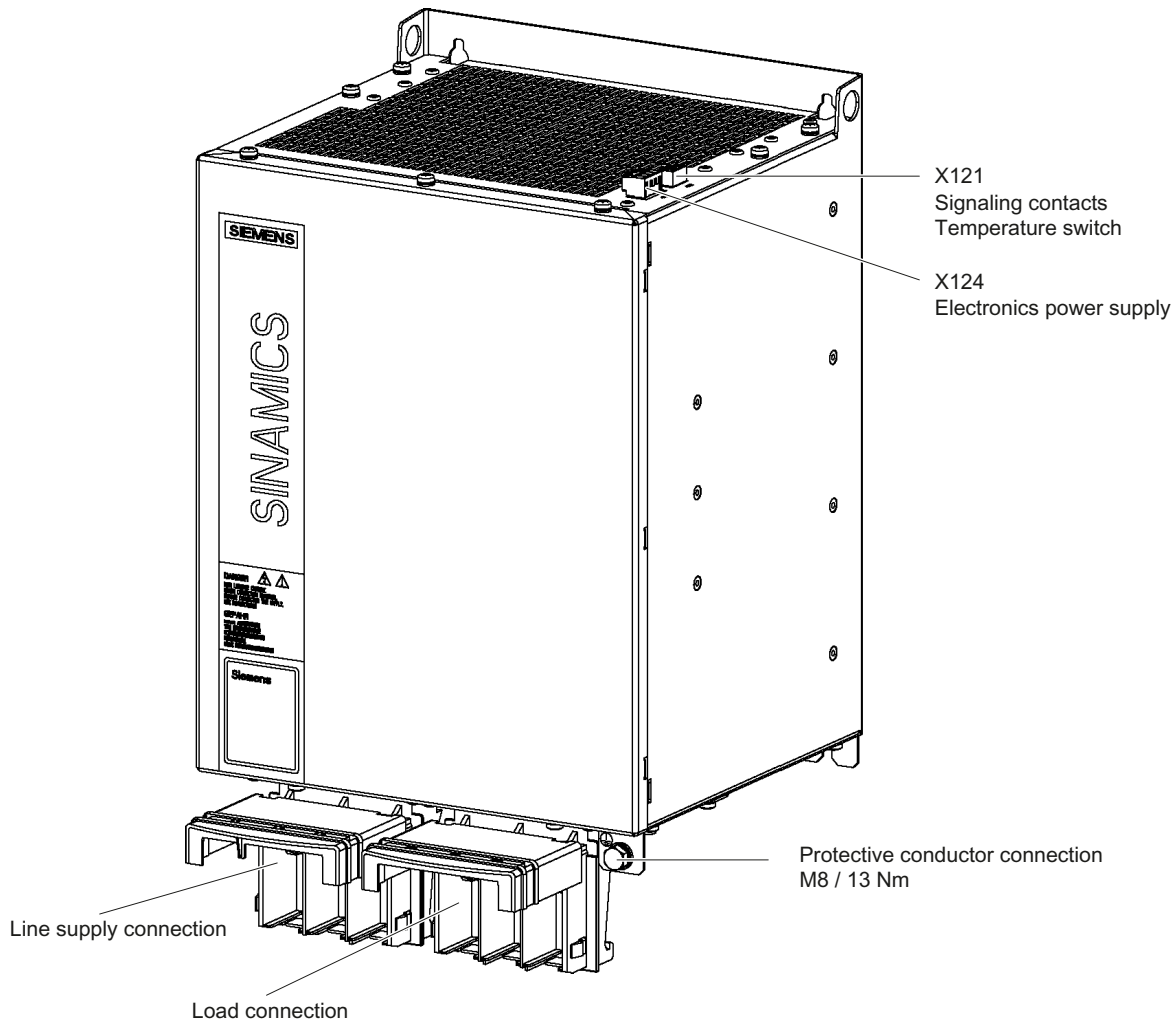


Figure 3-55 Interface overview, Active Interface Module 80 kW and 120 kW

3.9.3.2 Line/load connection

Table 3- 22 Line and load connection Active Interface Module

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

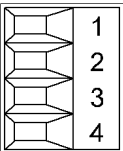
1) For ring cable lugs in accordance with DIN 46234

**Note**

The connection terminals of the 36 kW and 55 kW Active Interface Modules are only certain to be safe from touch protection according to EN 60529 if cables with a minimum cross-section of 25 mm<sup>2</sup> and insulated end sleeve are used.

**3.9.3.3 X121 temperature sensor and fan control**

Table 3- 23 Plug-in screw terminal X121

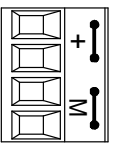
	Terminal	Designation	Technical specifications
	1	+Temp	Output Temperature switch must be connected to X21 of the Active Line Module.
	2	-Temp	Temperature switch output
	3	+24 V power supply for digital inputs	Current carrying capacity: 500 mA
	4	Disable Fan	<b>The fan can be disabled. The fan may only be switched off while the Active Line Module is disabled.</b>
Max. connectable cross-section: 1.5 mm <sup>2</sup>			

**Note**

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

**3.9.3.4 X124 Electronics power supply**

Table 3- 24 X124 Electronics power supply

	Terminal	Function	Technical 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	Electronics ground	
	M	Electronics ground	
Max. connectable cross-section: 2.5 mm <sup>2</sup>			

**Note**

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

### 3.9.4 Connection example

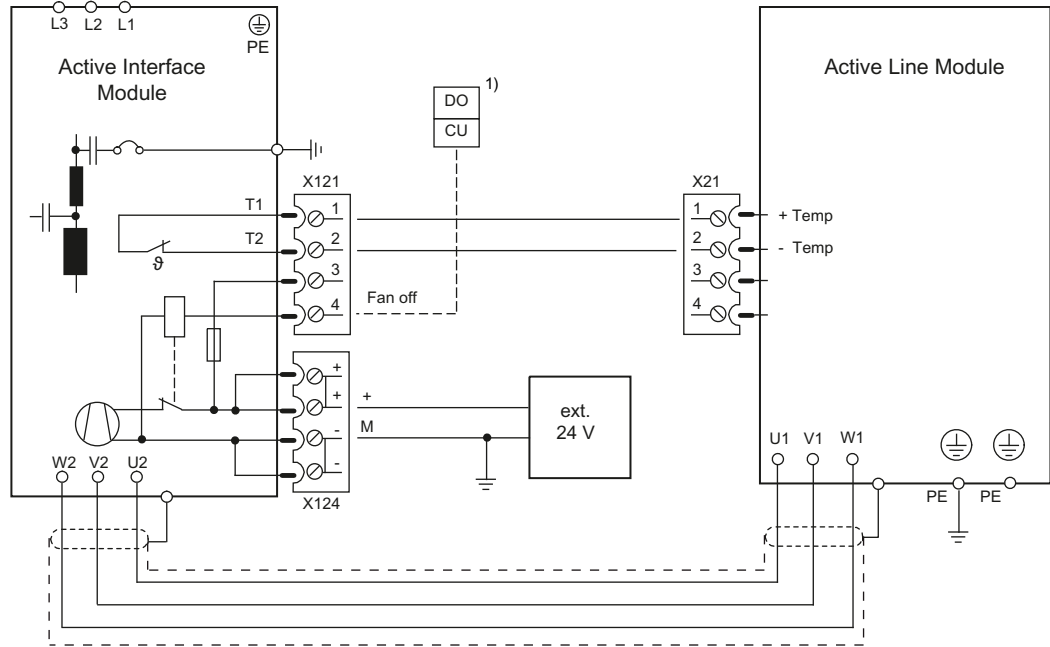


Figure 3-56 Connection example: Active Interface Module

1) Digital output (DO) controlled from the Control Unit



### 3.9.5 Dimension drawings

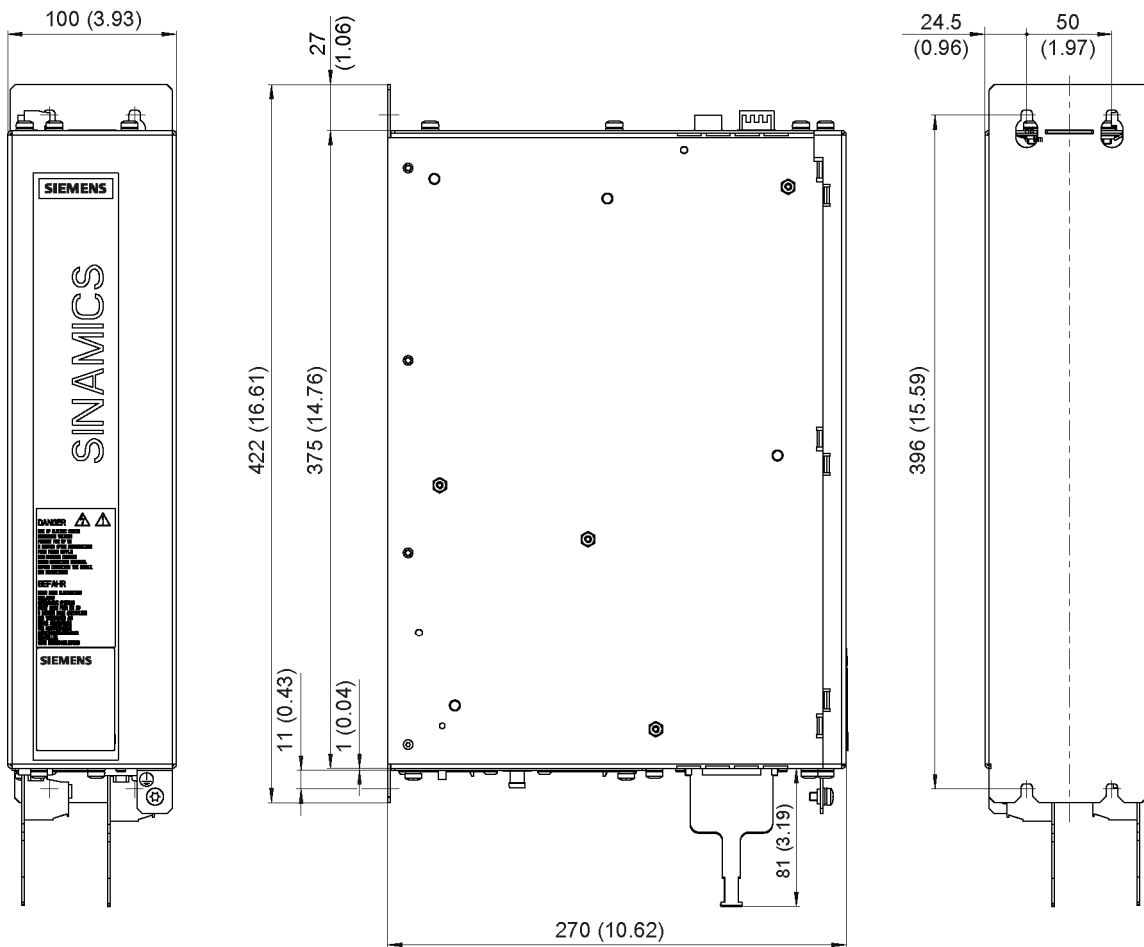


Figure 3-57 Dimension drawing of Active Interface Module 16 kW, all dimensions in mm and (inches)

3.9 Active Interface Modules internal air cooling

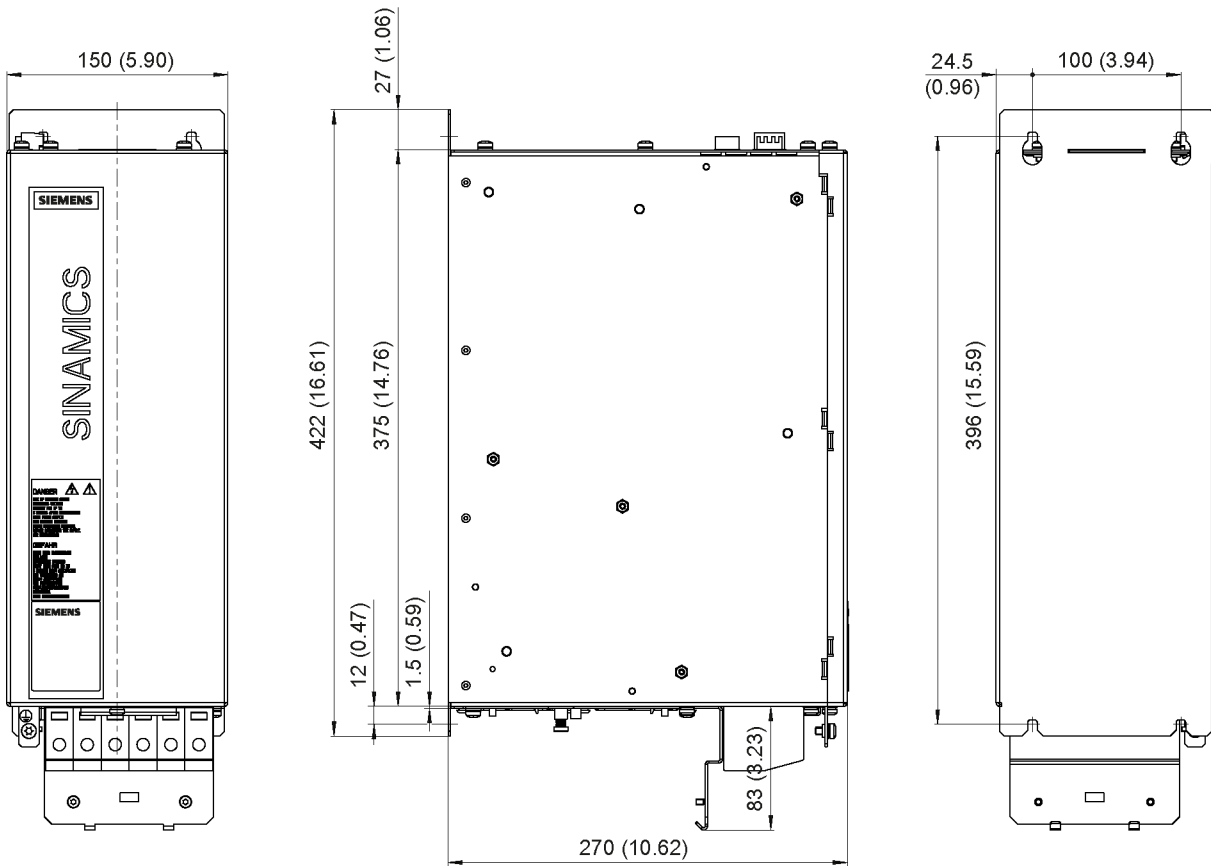


Figure 3-58 Dimension drawing of Active Interface Module 36 kW, all dimensions in mm and (inches)

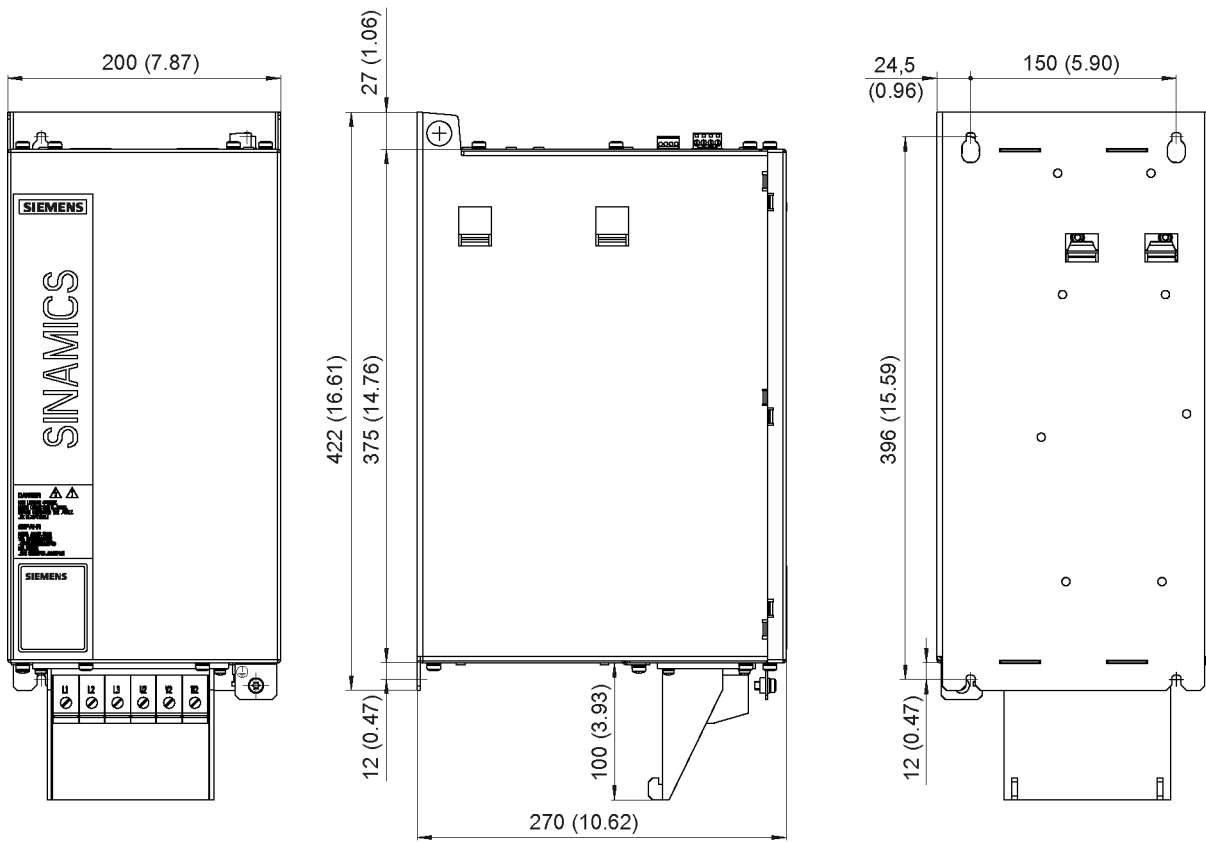


Figure 3-59 Dimension drawing of Active Interface Module 55 kW, all dimensions in mm and (inches)

3.9 Active Interface Modules internal air cooling

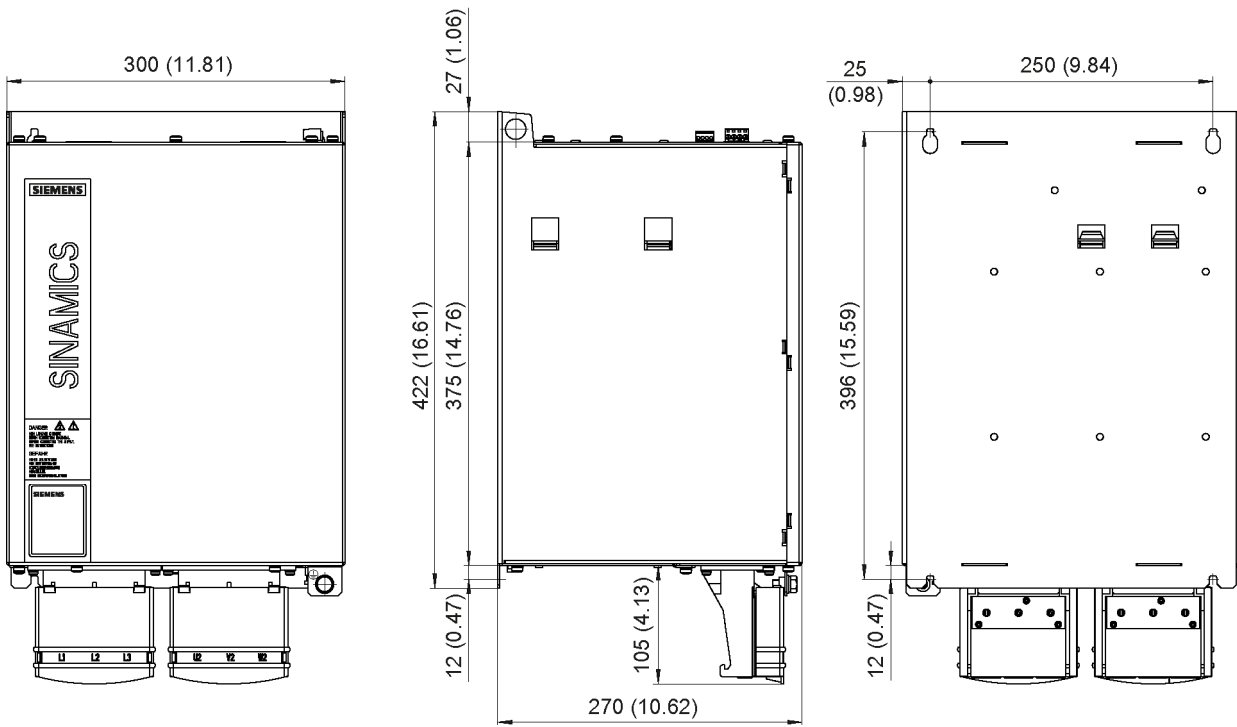
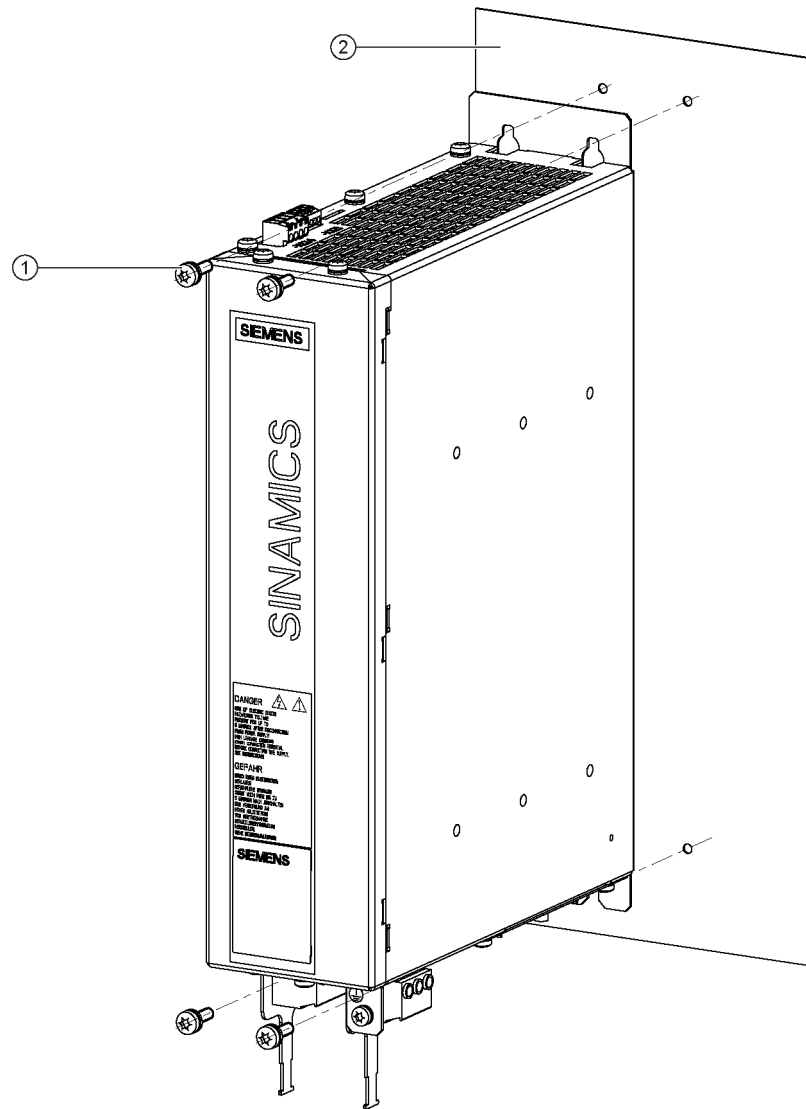


Figure 3-60 Dimension drawing of Active Interface Module 80 kW and 120 kW, all dimensions in mm and (inches)

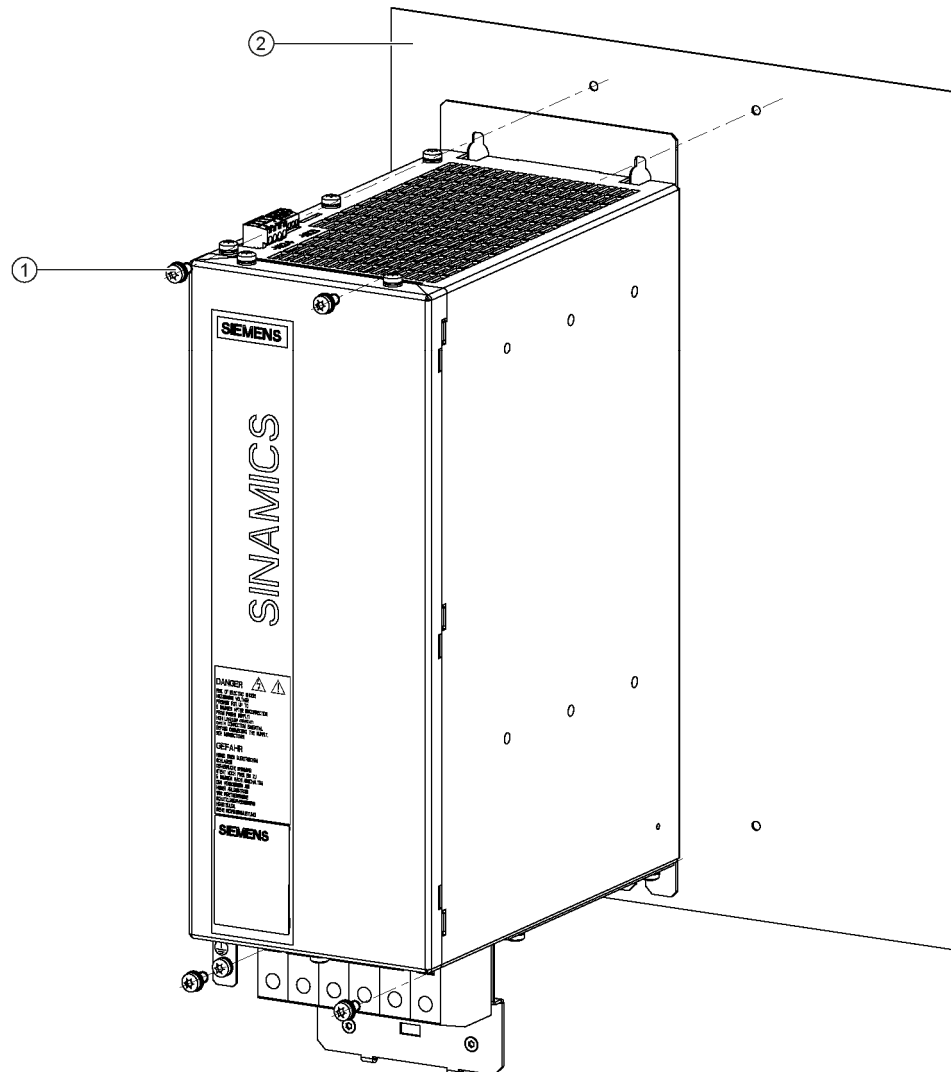
### 3.9.6 Installation

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



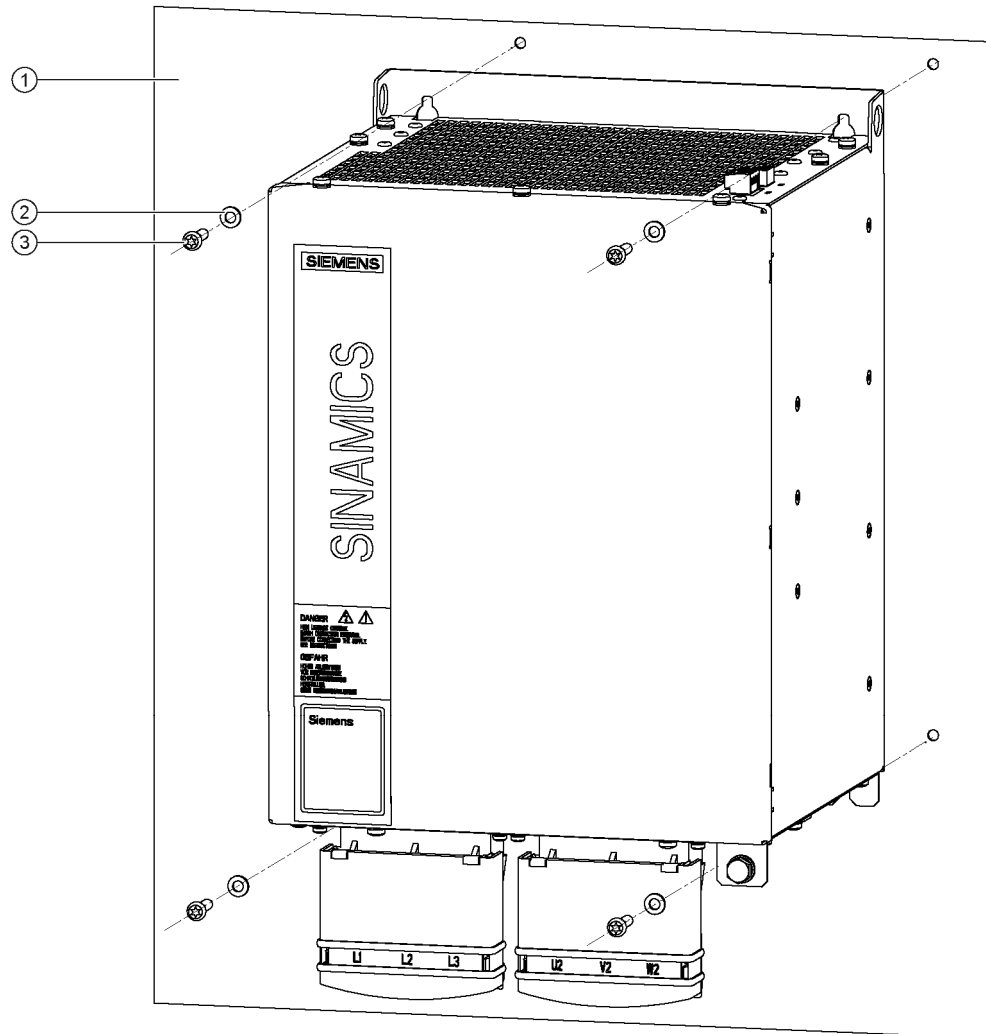
- ① Mounting panel
- ② M6 screws, Torx T30 (not hexagon-head screws)

Figure 3-61 Installation of 16 kW Active Interface Module



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

Figure 3-62 Installation of 36 kW Active Interface Module



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

Figure 3-63 Installation of 55 kW Active Interface Module

**Tightening torque for all screws: 6 Nm**

Table 3- 25 Protective conductor connection

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

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

#### IT system

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

Only Line Modules without line filters are to be operated on this system type. The emitted interference can exceed the limit values of category C3. The Active Interface Module must be set for operation on an IT system.

#### Operating an Active Interface Module on an isolated-neutral 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.



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.



		
<p>Remove the connection bracket for the interference-suppression capacitor with a Tx25 screwdriver.</p>	<p>Remove the connection bracket</p>	<p>Connection bracket for the interference-suppression capacitor</p>

**Note**

**Installing the connection bracket for the interference-suppression capacitor**

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



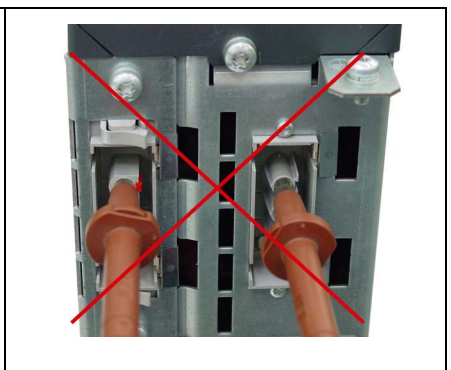
**3.9.8 Electrical tests**

**Tests on the 16 kW Active Interface Module**

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

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

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

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

### 3.9.9 Technical data

Table 3- 27 Technical data

Active Interface Module	6SL3100-	0BE21-6ABx	0BE23-6ABx	0BE25-5ABx	0BE28-0ABx	0BE31-2ABx
		<b>16 kW</b>	<b>36 kW</b>	<b>55 kW</b>	<b>80 kW</b>	<b>120 kW</b>
P <sub>max</sub>	kW	35	70	110	131	175
I <sub>rated</sub>	A	27	60	88	132	200
I <sub>max</sub>	A	59	117	176	218	292
Current requirements of the 24 V DC electronics 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	m <sup>3</sup> /h	112	160	300	600	600
Power loss <sup>1)</sup>	W	270	340	380	490	585
Weight	kg	10,7	18,5	21	29	35,5
Connection cross-section	mm <sup>2</sup>	10	35	50	120	120
PE connecting studs		M5	M5	M6	M8	M8

1) Based V<sub>DC link</sub> 600 V, for an overview, see the power loss tables in Section "Control cabinet installation"

### 3.10 Combining line reactors and line filters

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

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

**Note**

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

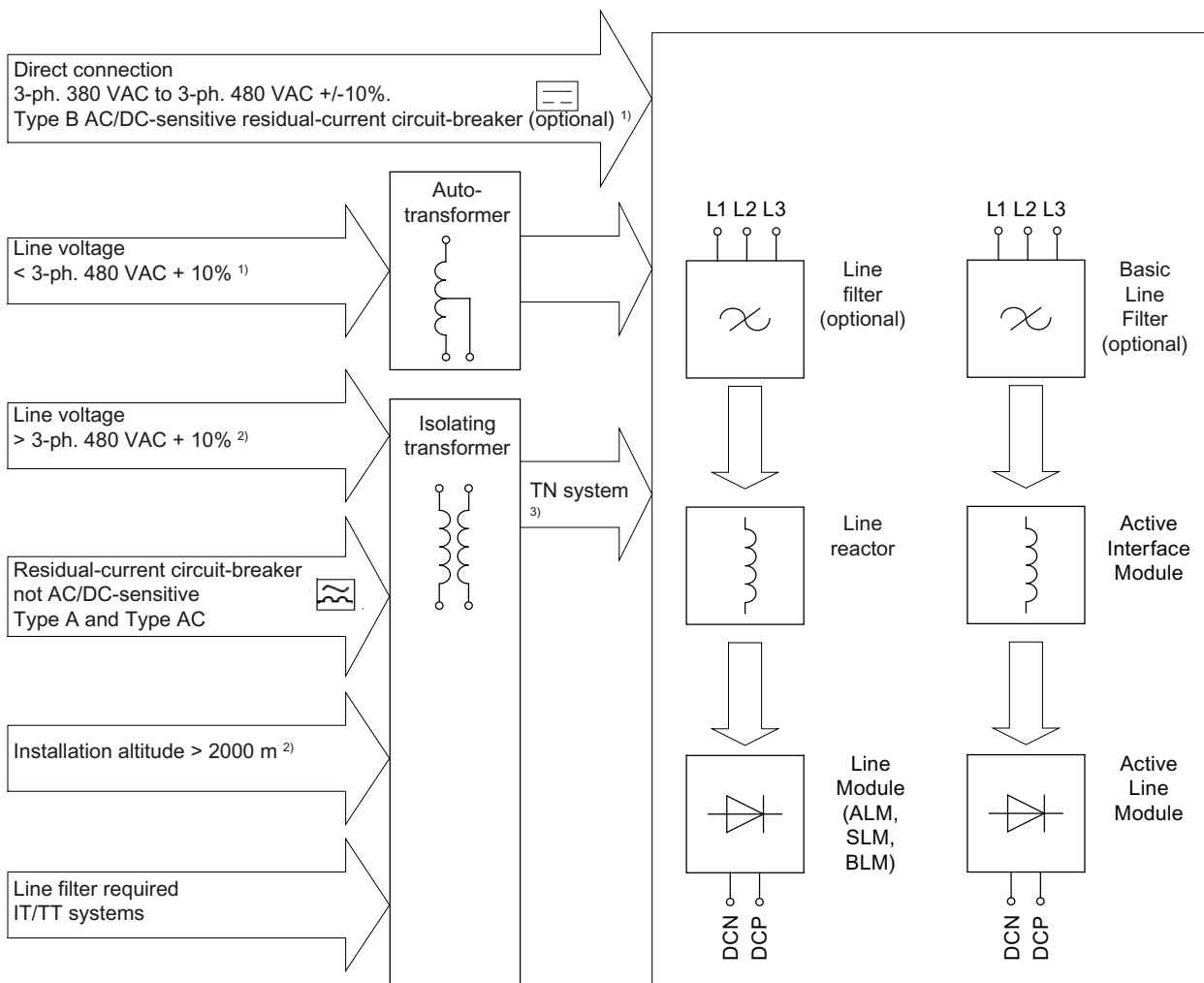
Figure 3-64 Combining line reactors and line filters

### 3.11 Line connection variants

#### 3.11.1 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



1) TN or TT systems with grounded neutral point or IT systems with monitoring  
 2) Any line system  
 3) With grounded neutral point

Figure 3-65 Overview of line connection versions

**! WARNING**

**Damage to the motors through errors when connecting to different power supplies**

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

When operated on IT systems, the occurrence of a first fault between an active part and ground must be signaled by a monitoring device. According to 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.

Motors should be connected-up corresponding to the circuit diagram supplied with the motor (refer to the connection examples, Motor Modules). It is not permissible that they are directly connected to the three-phase supply because this will damage them.

### 3.11.2 Operating line connection components on the line supply

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

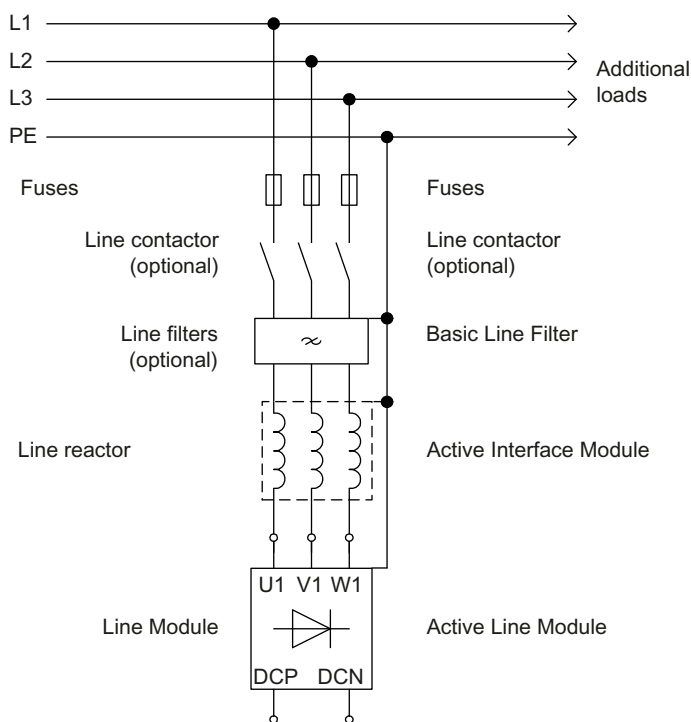


Figure 3-66 Direct operation on the line supply

### 3.11.3 Operation of the line connection components via a transformer

#### 3.11.3.1 Safety instructions for line connection components

<p><b>NOTICE</b></p> <p><b>Damage or destruction of additional loads as a result of undesirable line harmonics</b></p> <p>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.</p> <p>It is not permissible to connect other loads after the line filter.</p>
--

<p><b>NOTICE</b></p> <p><b>Faults at the Line Module as a result of an excessively low system fault power</b></p> <p>If the system fault power is too low, this can result in faults at the SINAMICS Line Modules. It can also result in faults and damage to other devices that are connected at the same point of the line supply as the Line Module.</p>
---

**Note**

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

#### 3.11.3.2 Line supply connection conditions for Line Modules

Table 3- 28 Line supply connection conditions for Line Modules

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

1)  $S_{Kline}$  = short-circuit power of the line supply;  $P_n$  = rated power of the Line Module

2) Applies only for operation in the Active Mode. For line supplies 3-ph 480 VAC  $\pm 10\%$ , it must be checked as to whether the motor systems are suitable for this mode.

If a TN system is required on the secondary side, for example, when using a Wideband Line Filter, a transformer with grounded neutral point must be used. However, the loop resistance must be small enough to trigger the fuses as fast as required. Also see Section "Overcurrent protection using line fuses and circuit breakers (Page 47)".

---

**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.

---

**Vector group**

Suggestion: Dyn5 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.

3.11 Line connection variants

3.11.3.3 Dimensioning an isolating transformer / autotransformer for several loads

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

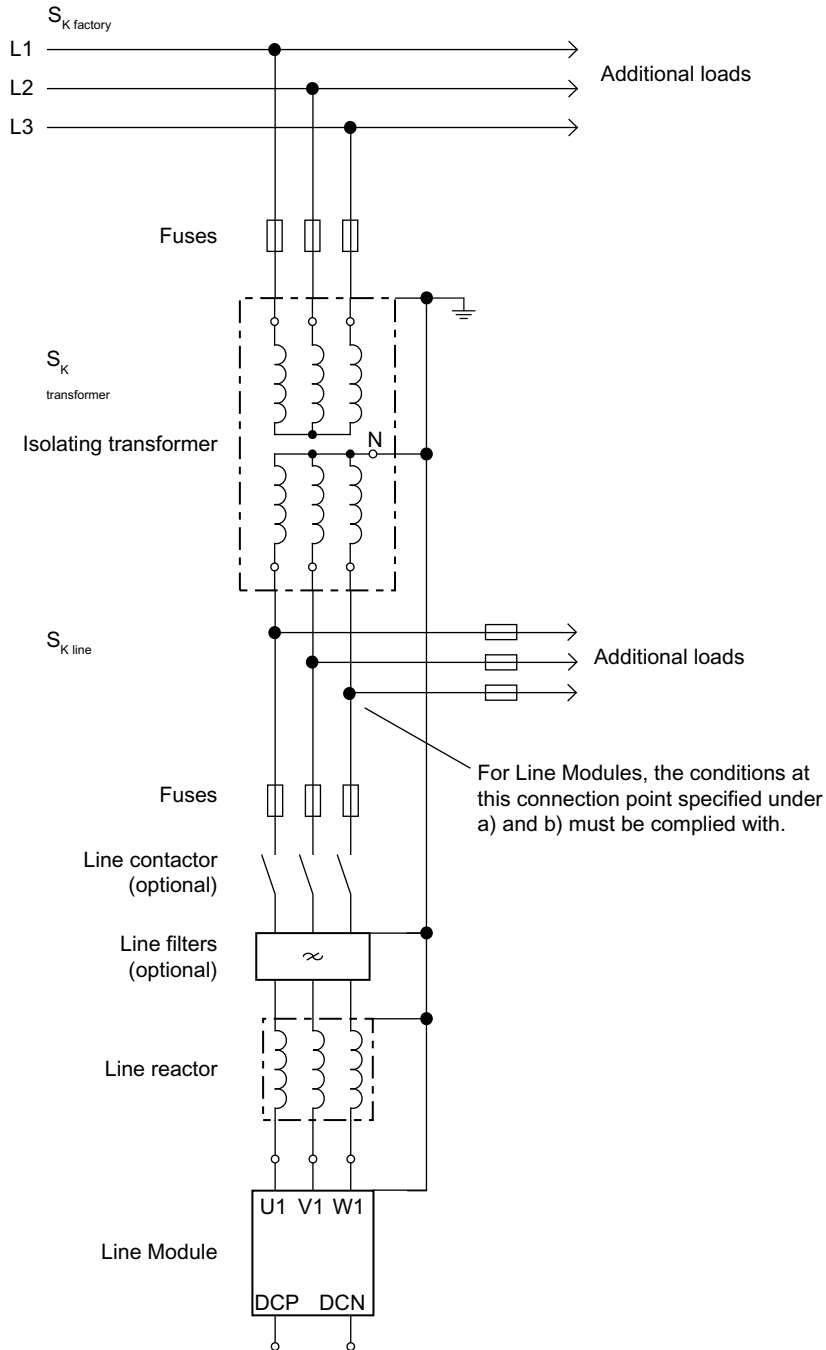


Figure 3-67 Operation of a Line Module and additional loads via an isolating transformer



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

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

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

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

$S_k$  = short-circuit power.

 **WARNING**

**Fire hazard through insufficient short-circuit power of the transformers**

A sufficiently high short-circuit power is required to ensure that when a fault does occur, the fuses rupture in the specified time. An insufficient short-circuit power increases the time to trip beyond permissible levels (e.g. a fire is possible).

Supplementary condition

Limitation a)

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

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

Example:

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

Limitations b)

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

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

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

Special case:

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

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

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

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

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

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

Note:

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

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

Table 3- 29 Transformer configuration instructions

Rated power of the used Active Line Module $P_n$	Required rated power of the isolating transformer / autotransformer $S_n (1.27 \cdot P_n)$	Required short-circuit voltage $u_k$	Minimum required system fault power $S_{Kline} (70 \cdot P_n)$
16 kW	$\geq 21$ kVA	$\leq 3\%$	$\geq 1.12$ MVA
36 kW	$\geq 46$ kVA	$\leq 3\%$	$\geq 2.52$ MVA
55 kW	$\geq 70$ kVA	$\leq 3\%$	$\geq 3.85$ MVA
80 kW	$\geq 102$ kVA	$\leq 3\%$	$\geq 5.6$ MVA
120 kW	$\geq 153$ kVA	$\leq 3\%$	$\geq 8.4$ MVA
Rated power of the used Smart Line Module $P_n$	Required rated power of the isolating transformer / autotransformer $S_n (1.27 \cdot P_n)$	Required short-circuit voltage $u_k$	Minimum required system fault power $S_{Kline} (70 \cdot P_n)$
5 kW	$\geq 6.4$ kVA	$\leq 3\%$	$\geq 0.35$ MVA
10 kW	$\geq 13$ kVA	$\leq 3\%$	$\geq 0.7$ MVA
16 kW	$\geq 21$ kVA	$\leq 3\%$	$\geq 1.12$ MVA
36 kW	$\geq 46$ kVA	$\leq 3\%$	$\geq 2.52$ MVA
55 kW	$\geq 70$ kVA	$\leq 3\%$	$\geq 3.85$ MVA
Rated power of the used Basic Line Module $P_n$	Required rated power of the isolating transformer / autotransformer $S_n (1.27 \cdot P_n)$	Required short-circuit voltage $u_k$	Minimum required system fault power $S_{Kline} (30 \cdot P_n)$
20 kW	$\geq 26$ kVA	$\leq 10\%$	$\geq 0.6$ MVA
40 kW	$\geq 51$ kVA	$\leq 10\%$	$\geq 1.2$ MVA
100 kW	$\geq 127$ kVA	$\leq 10\%$	$\geq 3.0$ MVA

**Note**

Ask your local power utility company for the short-circuit power at the plant connection  $S_k$  plant.

**Example 1**

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

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

According to b)

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

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

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

**Example 2:**

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

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

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 for a short-circuit voltage  $u_k$  of 1%.

**Example 3:**

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

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

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

According to b)

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

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

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

**Example 4:**

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

$u_k$  matching transformer = 1%,

$S_{K \text{ plant}} = 3,000 \text{ kVA}$

$S_{K \text{ line}} = 16 \text{ kW} \cdot 70 \cdot 0.73 = 820 \text{ kVA}$

According to a)

$S_{n1} = 1.27 \cdot 16 \text{ kW} = 21 \text{ kVA}$

According to b)

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

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

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

**Note**

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

**3.11.3.4 Operating line connection components via an autotransformer**

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

 **DANGER**

**Danger to life through electric shock**

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

Applications:

- The motor insulation must be protected from excessive voltages.
- The Active Line Module must supply a regulated DC link voltage. This is possible with a rated voltage of 380 V to 415 V.  
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.

3.11 Line connection variants

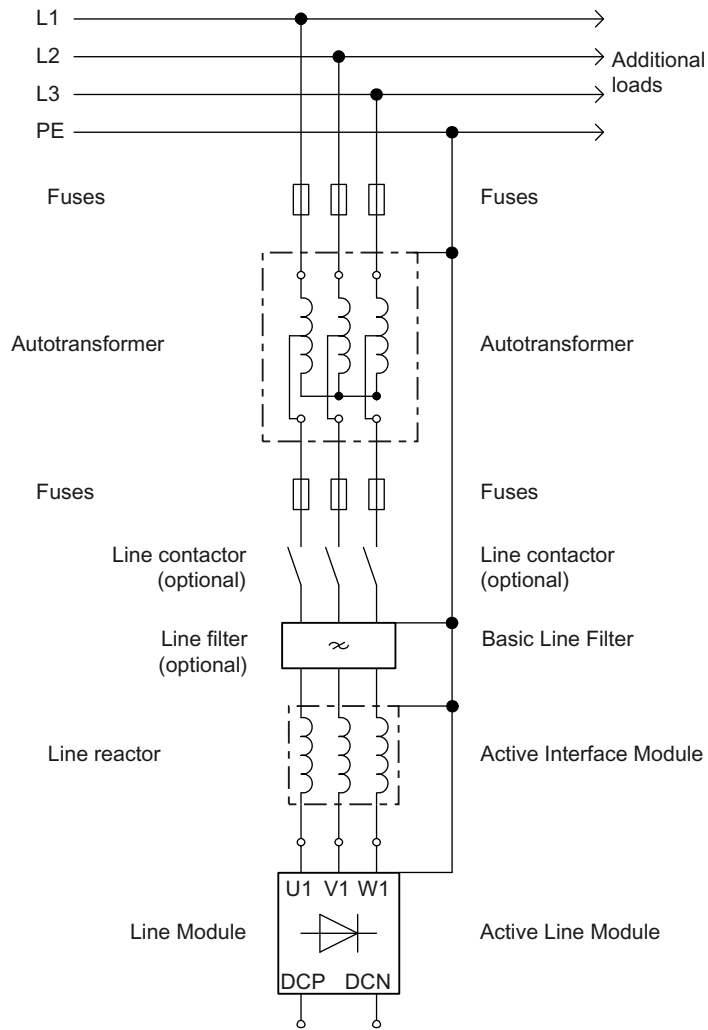



Figure 3-68 Operation of a Line Module via an autotransformer

### 3.11.3.5 Operating line connection components via an isolating transformer

An isolating transformer converts the line supply type of the plant or system (e.g. IT/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 greater than 2000 m above sea level.
- A line filter should be used in a line supply system that is not a TN line supply system with grounded neutral conductor.

 <b>DANGER</b>
<p><b>Danger to life through electric shock</b></p> <p>If the line supply voltage is greater than 480 V +10%, it is not permissible to use an autotransformer.</p> <p>An isolating transformer must be used to ensure protective separation.</p>

An isolating transformer must have the following properties:

- The transformer secondary must be in the star connection (a delta connection is not permissible).
- The neutral conductor must be brought out. It must be connected to the PE of the line filter, line reactor or AIM and Line Module (infeed).  
**Caution:** If the neutral conductor is not brought out and/or not connected, then all of the restrictions of an IT system apply.
- If the line supply is available in a star connection on the primary side, then the vector group that is required is: Yyn0
- If the line supply is available in a delta connection on the primary side, then the vector group that is required is: Dyn5

3.11 Line connection variants

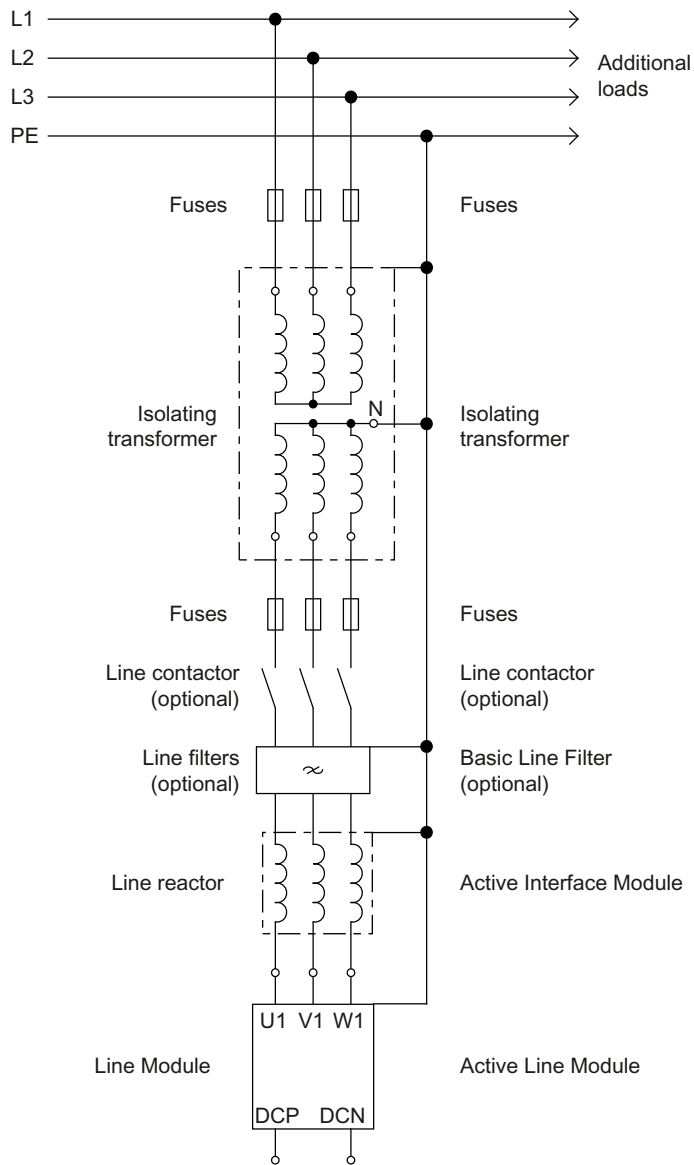


Figure 3-69 Operation of a Line Module via an isolating transformer



## 4.1 Safety instructions for Line Modules Booksize

### Note

When using a Line Module Booksize, it is imperative that you observe the safety instructions in Section 1.



### DANGER

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

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

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



### DANGER

#### **Danger to life through electric shock due to a high DC link voltage**

As long as the Line Module is connected to the line supply, the DC link is charged with a high voltage. Contact with components can result in death or serious injury.

- Isolate the Line Module from the line supply during installation or maintenance work, e.g. via the line contactor or main switch.



### DANGER

#### **Danger to life through electric shock due to the residual charge of the DC link capacitors**


Because of the DC link capacitors, a hazardous voltage is present for up to five minutes after the power supply has been switched off.

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


- Do not open the protective cover of the DC link until five minutes have elapsed.
- Measure the voltage before starting work on the DCP and DCN DC link terminals.

4.1 Safety instructions for Line Modules Booksize




 <b>DANGER</b>
<p><b>Danger to life through electric shock when the protective cover of the DC link is open</b></p> <p>Contact with live parts can result in death or serious injury.</p> <ul style="list-style-type: none"> <li>• Only operate the components with closed protective cover.</li> </ul>




 <b>WARNING</b>
<p><b>Danger to life through interruption of the external protective conductor due to high leakage currents</b></p> <p>The drive components conduct a high leakage current via the protective conductor. Touching conductive parts when the protective conductor is interrupted can result in death or serious injury.</p> <ul style="list-style-type: none"> <li>• Ensure that the external protective conductor satisfies at least one of the following conditions: <ul style="list-style-type: none"> <li>– It has been laid so that it is protected against mechanical damage. <sup>1)</sup></li> <li>– If it is a single cable, it has a cross-section of at least 10 mm<sup>2</sup> Cu.</li> <li>– If it is a conductor of a multi-conductor cable, it has a cross-section of at least 2.5 mm<sup>2</sup> Cu.</li> <li>– It has a second protective conductor in parallel with the same cross-section.</li> <li>– It complies with the local regulations for equipment with increased leakage current.</li> </ul> </li> </ul> <p><sup>1)</sup> Cables laid within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.</p>



 <b>WARNING</b>
<p><b>Danger to life through electric shock due to incorrect connection to the DC link</b></p> <p>Incorrect connections can lead to overheating and therefore a risk of fire. There is also a risk of an electric shock. This can result in serious injury or death.</p> <ul style="list-style-type: none"> <li>• Only use adapters (DC link adapters and DC link rectifier adapters) released by Siemens for the connection to the DC link.</li> </ul>



 <b>WARNING</b>
<p><b>Danger to life through electric shock due to incorrectly installed DC link bridges</b></p> <p>Incorrectly installed DC link bridges <b>at the left-hand end of the drive line-up</b> can cause an electric shock.</p> <ul style="list-style-type: none"> <li>• For all 50 mm wide modules (exception: Smart Line Modules), remove the DC link bridge, including the screws. Do not tighten the screws without the DC link bridges.</li> <li>• For all components that are 75 mm wide or wider, the DC link bridges must not be moved to the left or removed.</li> </ul>



**! WARNING**

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

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

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

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

**! WARNING**

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

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

- Attach the component warning labels in the national language.

**! WARNING**

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

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

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

**! CAUTION**

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

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

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

**NOTICE**

**Material damage due to loose power connections**

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

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

**NOTICE**

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

As part of routine tests, SINAMICS S components undergo a voltage test according to EN 61800-5-1. Connected devices can be damaged.

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

**NOTICE**

**Damage to the equipment due to excess energy not being fed back to non-regenerative supply systems**

Excess energy that is not fed back can damage equipment.

- For line supplies without regenerative feedback capability (e.g. diesel generator), deactivate the regenerative feedback capability of the Active Line Modules and Smart Line Modules via parameter p3533.
- The braking energy must then be dissipated via an additional Braking Module with braking resistor in the drive line-up.

**Exception:** For 5 kW and 10 kW Smart Line Modules, the regenerative feedback capability must be deactivated as follows:

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

**NOTICE**

**Damage to external loads when using a disconnecter unit without prior voltage interruption**

For Line Modules with regenerative feedback capability, switching off a running drive line-up with a disconnecter unit can destroy external loads that remain on the same switching component parallel to the drive.

- Therefore, interrupt the voltage first at terminals X21.3 (EP +24 V) and X21.4 (EP M). This can be achieved using a leading breaking auxiliary contact ( $\geq 10$  ms), for example.

**NOTICE**

**Damage through use of incorrect DRIVE-CLiQ cables**

Damage or malfunctions can occur on the devices or system when incorrect or unreleased DRIVE-CLiQ cables are used.

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

**Note**

**Malfunctions due to polluted DRIVE-CLiQ interfaces**

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

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

### Special features for Line Modules with external air cooling

<b>NOTICE</b>
<b>Component failure due to the pollution of external heat sinks</b> For components with external air cooling, the fan and the heat sinks can accumulate a lot of pollution. If the cooling air requirement is not provided by the filtered fan, the components cannot output their specified power. This can cause the temperature monitoring function in the components to respond. <ul style="list-style-type: none"><li>• Check the fans and heat sinks for pollution at regular intervals and clean them when necessary.</li></ul>

---

**Note****Checking the seal**

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

---

**Note****Using an installation frame**

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

### See also

Combining line reactors and line filters (Page 131)

## 4.2 Active Line Modules with internal air cooling

### 4.2.1 Description

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

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

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

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#### Note

When handling/using a Line Module, it is imperative that you observe the safety instructions in Chapter 1.

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## 4.2.2 Interface description

### 4.2.2.1 Overview

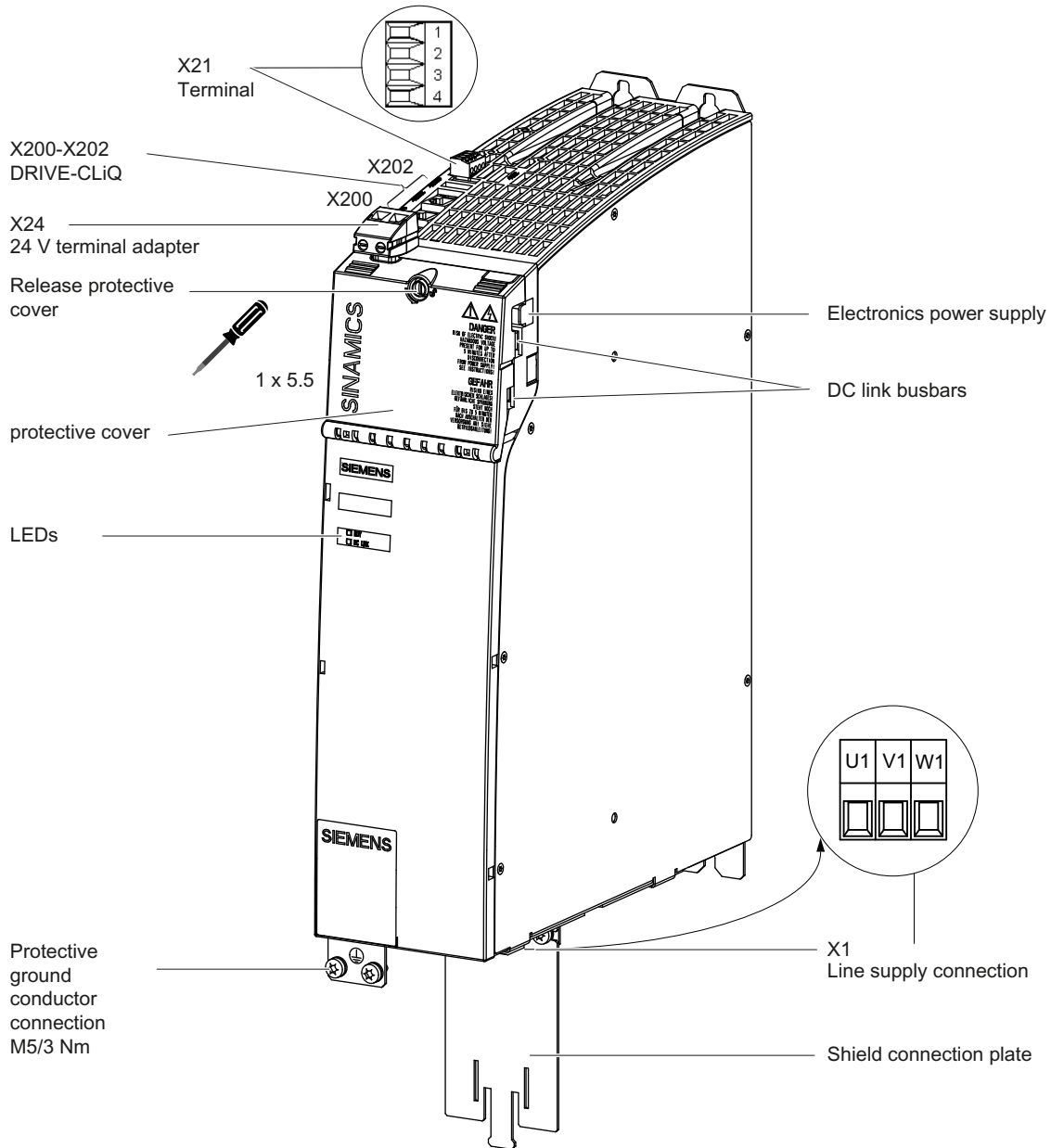
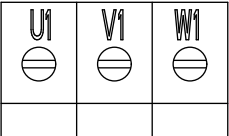
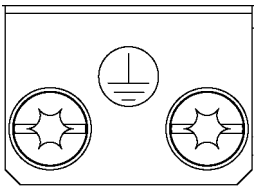


Figure 4-1 Interface overview, Active Line Module with internal air cooling (example: 16 kW)

4.2 Active Line Modules with internal air cooling

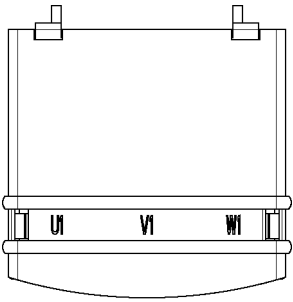
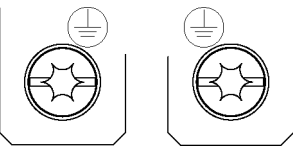
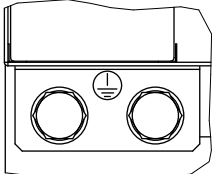
4.2.2.2 X1 line connection

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

	Terminal	Technical data
	U1	Max. connectable cross-section: 10 mm <sup>2</sup> Type: Screw terminal 6 Tightening torque: 1.5 - 1.8 Nm (see Section "Control cabinet installation/connection system")
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm <sup>1)</sup>

1) For ring cable lugs in accordance with DIN 46234

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

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

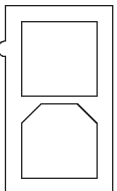
1) For ring cable lugs in accordance with DIN 46234



### 4.2.2.3 X12 fan connection

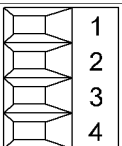
Active Line Modules 80 kW and 120 kW are equipped with an interface for connecting the sub-chassis fan. The interface is located on the underside of the Line Module.

Table 4- 3 X12 fan connection

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

### 4.2.2.4 X21 EP terminals

Table 4- 4 X21 EP terminal / temperature sensor

	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors <sup>1)</sup> : KTY 84–1C130 <sup>2)</sup> /PTC <sup>2)</sup> /bimetallic switch with NC contact If an Active Interface Module is used, the temperature input must be connected to the Active Interface Module sensor (bimetallic switch with NC contact).
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage 24 V DC
	4	EP M (Enable Pulses)	Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs
Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Section "Control cabinet installation and EMC / connection system")			

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.

4.2 Active Line Modules with internal air cooling


**Terminals X21.1 and X21.2**

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

**Terminals X21.3 and X21.4**

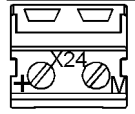
 <b>WARNING</b>
<b>Connecting terminals X21.3 and X21.4</b> For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. Pulse suppression is activated when removed. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example because a line contactor is not installed, then the DC link remains charged.

<b>NOTICE</b>
<b>Using a line disconnecter unit</b> If an active drive line-up is switched off using the disconnecter unit, the voltage at X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be realized using a leading breaking auxiliary contact ( $\geq 10$ ms), for example. This protects external loads located parallel to the drive at the same switching component.  If you are using a VSM10 Voltage Sensing Module, the leading opening contact can be omitted.

 <b>DANGER</b>
<b>Danger to life through electric shock</b> Only temperature sensors that meet the safety isolation specifications stipulated 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 danger to life!

### 4.2.2.5 X24 24 V terminal adapter

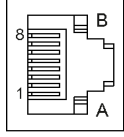
Table 4- 5 X24: 24 V terminal adapter

	Terminal	Designation	Technical data
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 (see Section "Control cabinet installation and EMC / connection system")			

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

### 4.2.2.6 X200-X202 DRIVE-CLiQ interfaces

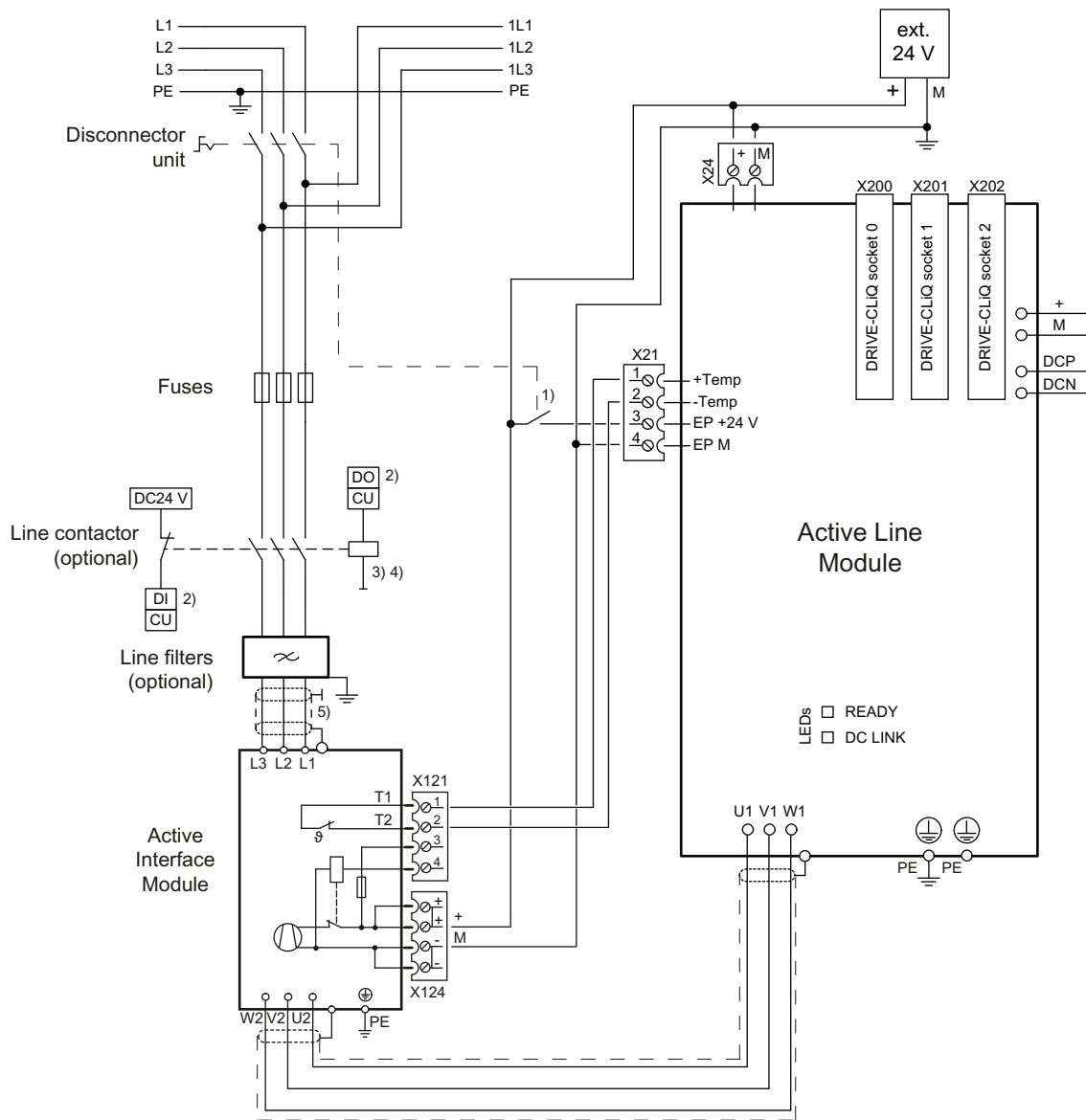
Table 4- 6 X200-X202: DRIVE-CLiQ interfaces

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

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

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

### 4.2.3 Connection example



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

Figure 4-2 Example connection of Active Line Module

**Note**

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

## 4.2.4 Meaning of LEDs

Table 4- 7 Meaning of the LEDs on the Active Line Module

Status		Description, cause	Remedy
RDY	DC LINK		
off	off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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. <b>Note:</b> 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	--	Detection of the components via LED is activated (p0124). <b>Note:</b> Both options depend on the LED status when module 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!

### 4.2.5 Dimension drawings

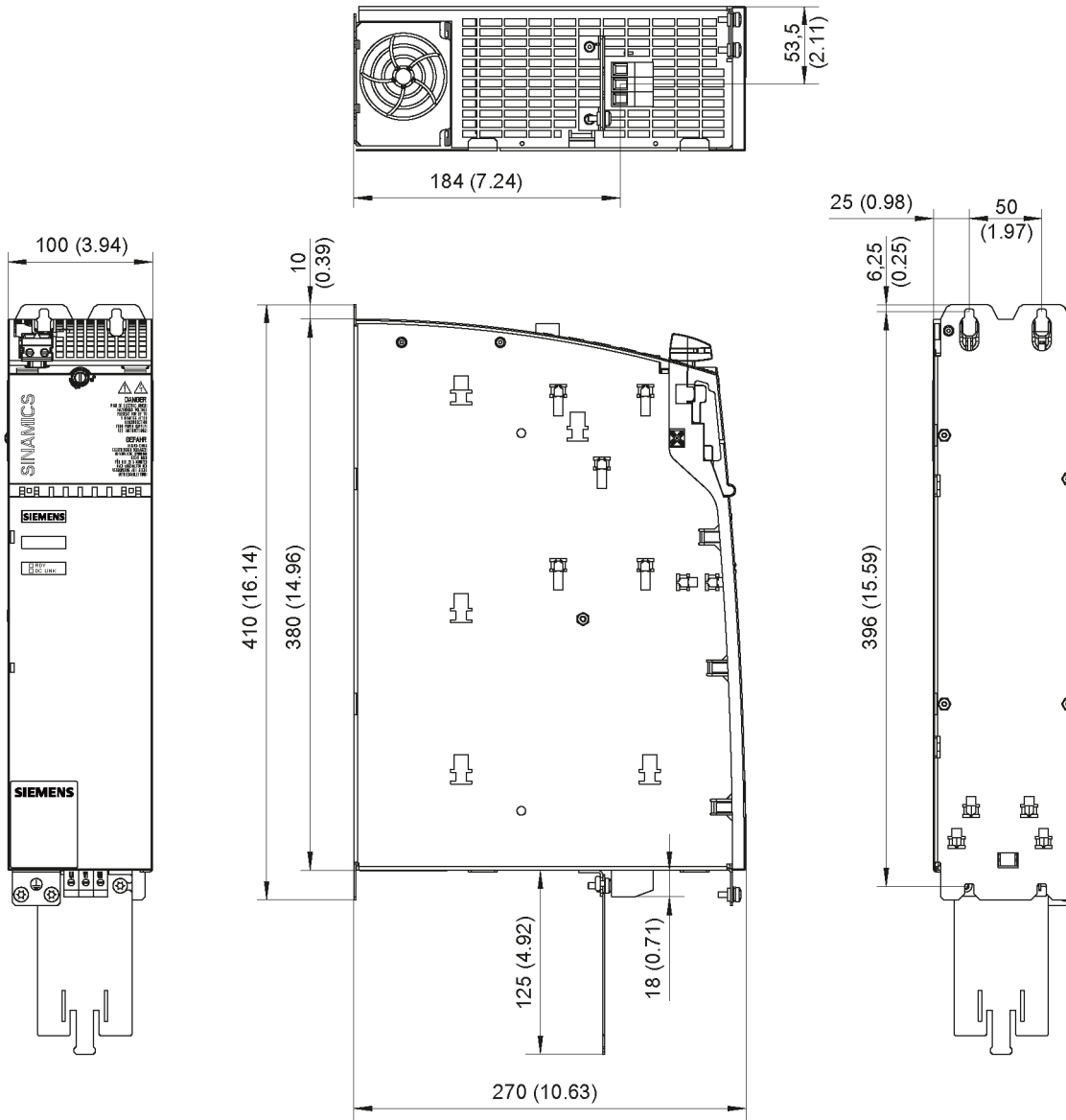


Figure 4-3 Dimension drawing of 16 kW Active Line Module with internal air cooling, all dimensions in mm and (inches)

#### Note

The shield connecting plate is supplied as standard with a 100 mm Line Module. For more information, see the chapter titled "Accessories".

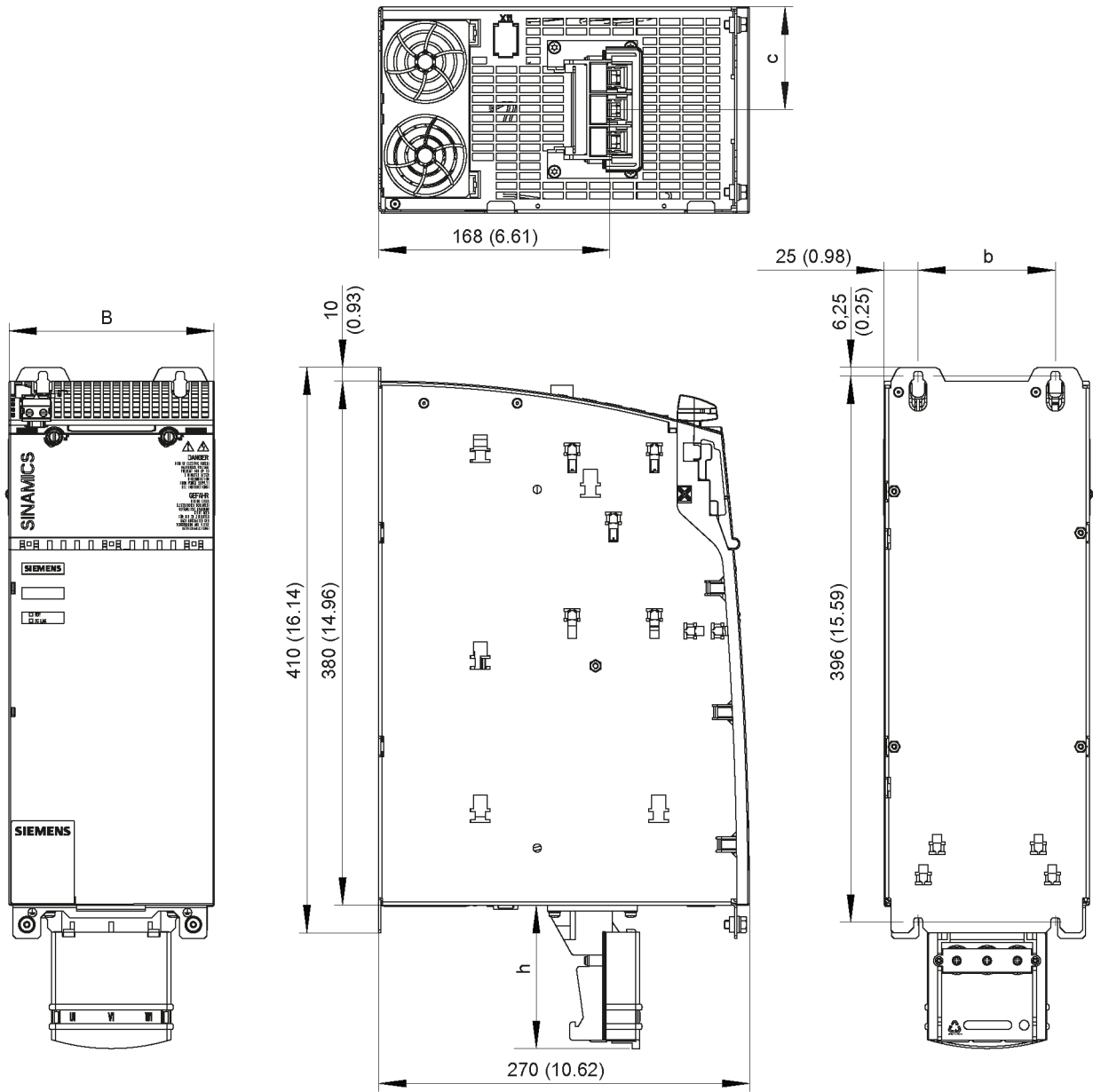


Figure 4-4 Dimension drawing of 36 kW and 55 kW Active Line Modules with internal air cooling (example, 36 kW), all dimensions in mm and (inches)

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

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

4.2 Active Line Modules with internal air cooling

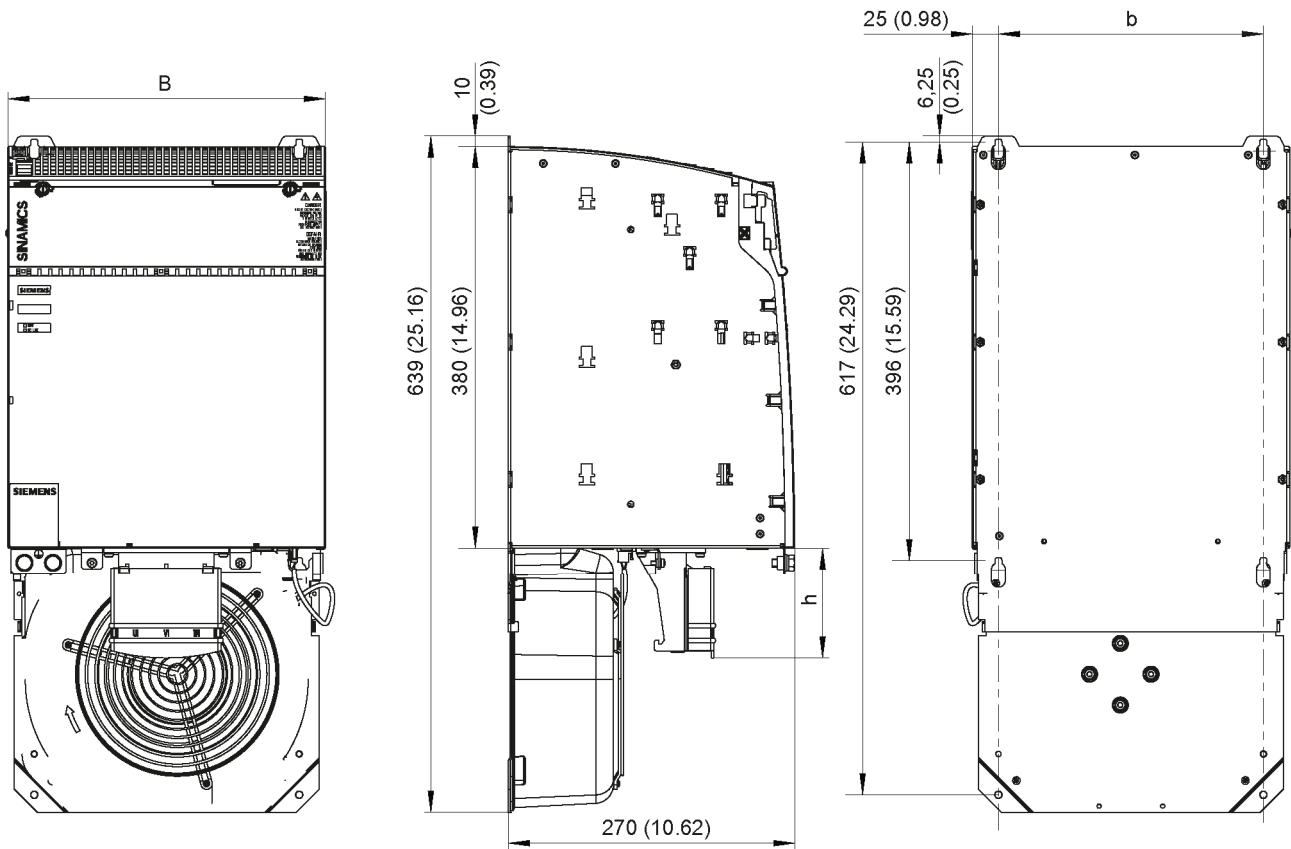


Figure 4-5 Dimension drawing of 80 kW and 120 kW Active Line Modules with internal air cooling, all dimensions in mm and (inches)

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

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



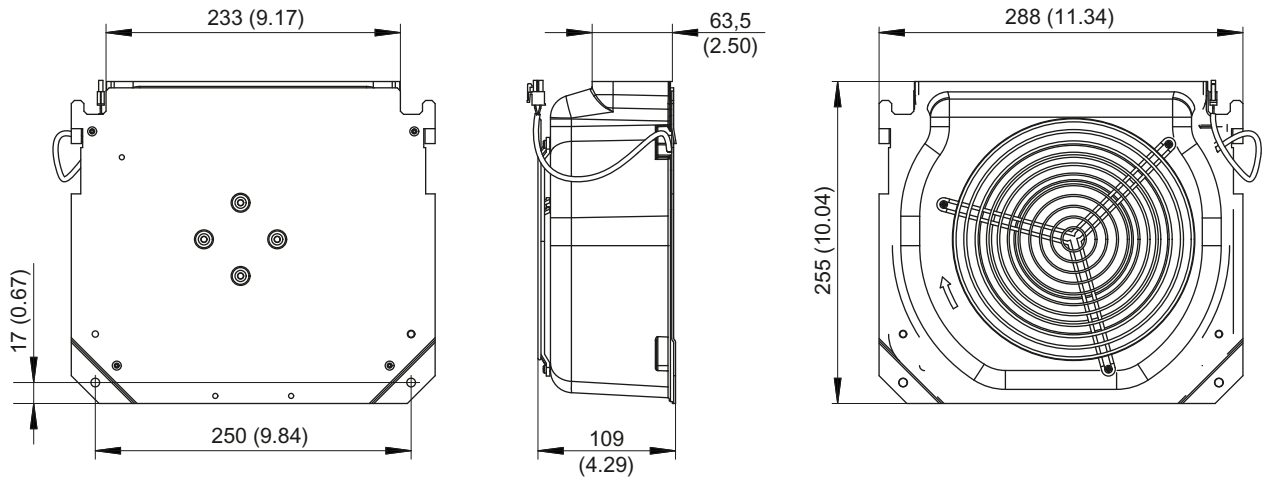


Figure 4-6 Dimension drawing of fan for 80 kW and 120 kW Active Line Modules with internal air cooling, all dimensions in mm and (inches)

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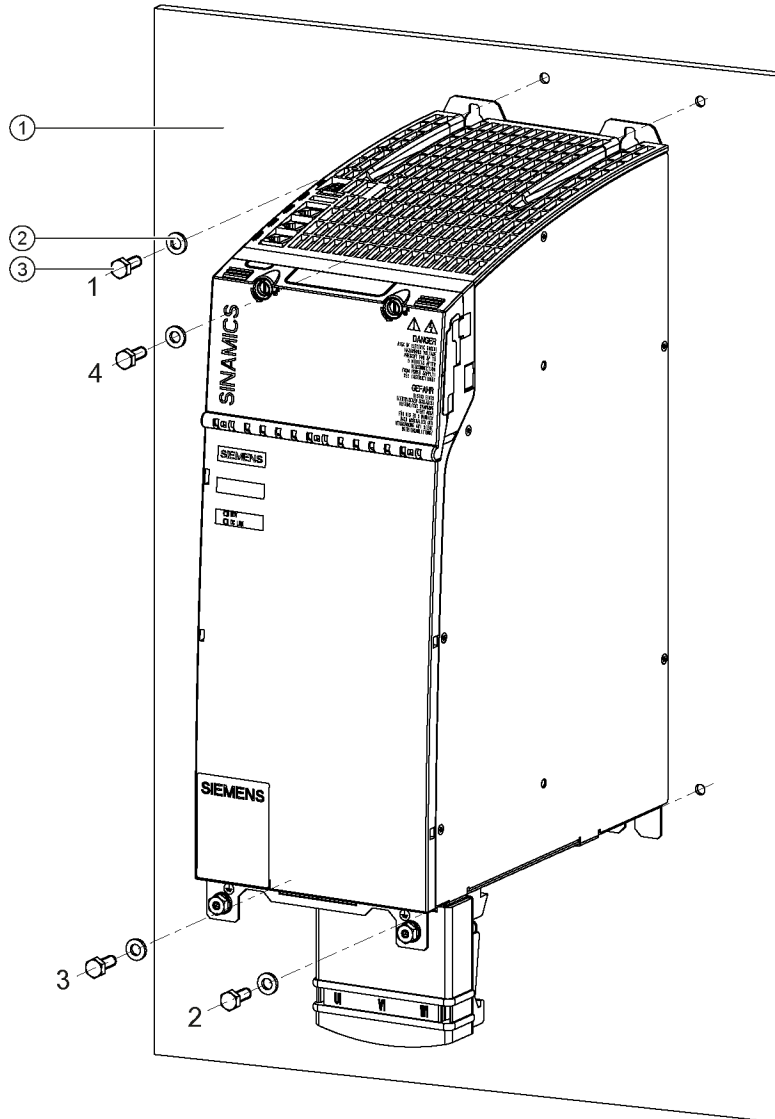
**Note**

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

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### 4.2.6 Installation

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



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

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

#### Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 6 Nm (in the specific sequence 1 to 4)

### Installing the sub-chassis fan

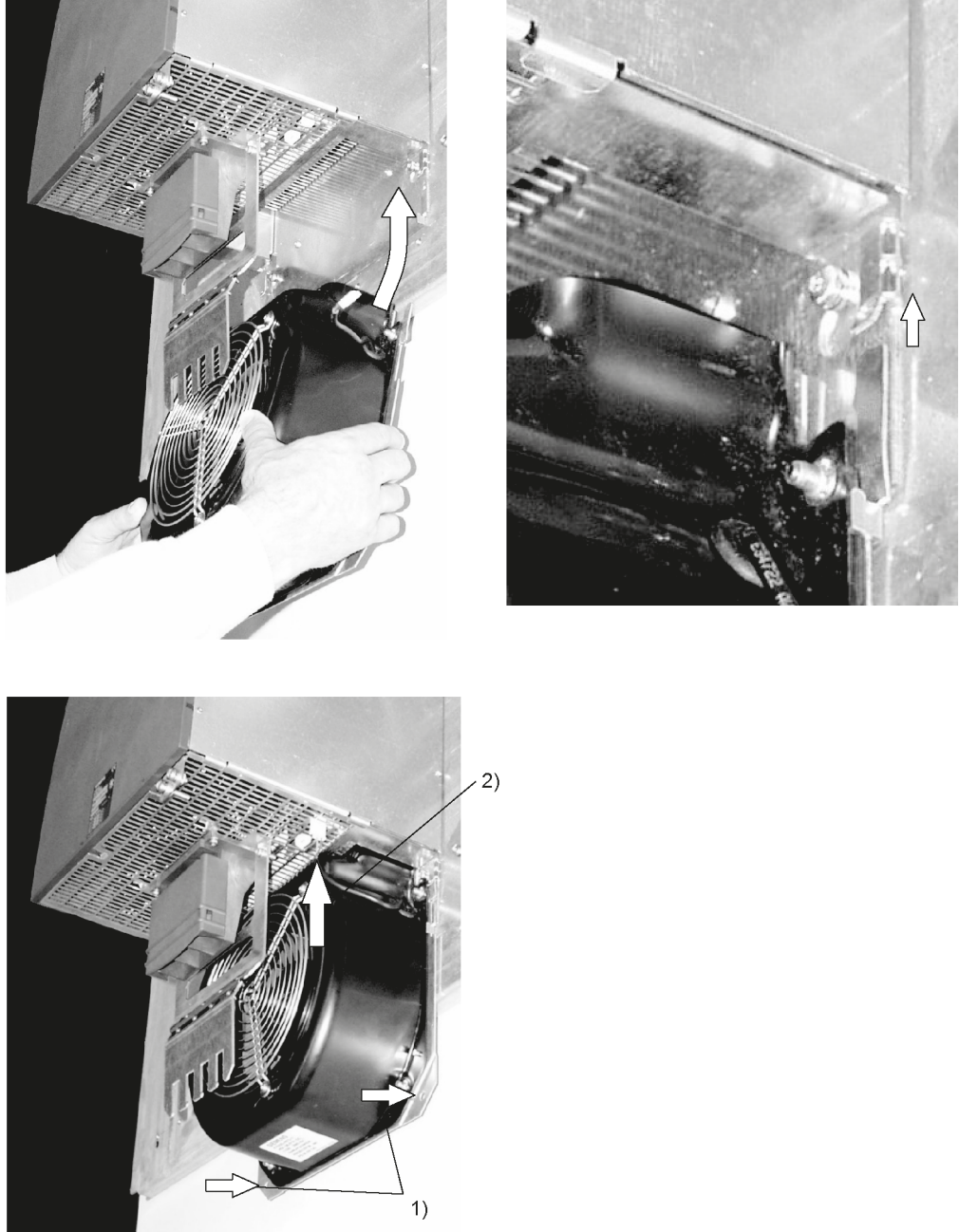


Figure 4-8 Mounting the fan for Active Line Modules 80 kW and 120 kW

1. Attach the fan with M6 / 6 Nm screws
2. Connect the power supply for the fan

## 4.2.7 Technical data

Table 4- 10 Technical data of Active Line Modules

Internal air cooling	6SL3130-	7TE21-6AAx	7TE23-6AAx	7TE25-5AAx	7TE25-5AA3 + Active Interface Module
<b>Rated power</b>	<b>kW</b>	<b>16</b>	<b>36</b>	<b>55</b>	<b>55</b>
<b>Infeed</b>					
Rated power (S1) <sup>1)</sup>	kW (P <sub>n</sub> )	16	36	55	55
Infeed power (S6-40%) <sup>1)</sup>	kW (P <sub>s6</sub> )	21	47	71	71
Peak infeed power <sup>1)</sup>	kW (P <sub>max</sub> )	35	70	91	110
<b>Regenerative feedback</b>					
Continuous regenerative power	kW	16	36	55	55
Peak regenerative power	kW	35	70	91	110
<b>Supply voltages</b>					
Line voltage	V <sub>ACrms</sub>	3 AC 380 to 480 ±10% (-15% < 1 min)			
Line frequency	Hz	47 to 63			
Electronics power supply	V <sub>DC</sub>	24 (20.4 - 28.8)			
DC link voltage	V <sub>DC</sub>	510 - 720			
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %			
Undervoltage trip <sup>2)</sup>	V <sub>DC</sub>	360 ± 2 %			
<b>Input currents</b>					
Rated input current: at 400 V <sub>AC</sub>	A <sub>AC</sub>	25	55	84	84
Input current at 380 V <sub>AC</sub> /480 V <sub>AC</sub>	A <sub>AC</sub>	26 / 21	58 / 46	88 / 70	88 / 70
at 400 V <sub>AC</sub> ; S6-40%	A <sub>AC</sub>	32	71	108	108
at 400 V <sub>AC</sub> ; peak current	A <sub>AC</sub>	54	107	139	168
<b>DC link currents</b>					
Rated DC link current at 600 V	A <sub>DC</sub>	27	60	92	92
DC link current at 600 V <sub>DC</sub> ; at S6-40%	A <sub>DC</sub>	35	79	121	121
at 600 V <sub>DC</sub> ; peak current	A <sub>DC</sub>	59	117	152	176
<b>Current carrying capacity</b>					
DC link busbars	A <sub>DC</sub>	100	200	200	200
Reinforced DC link busbars	A <sub>DC</sub>	150	--	--	--
24 V DC busbars	A <sub>DC</sub>	20	20	20	20
<b>Electronics current consumption at 24 V DC</b>	A <sub>DC</sub>	0.95	1.5	1.9	1.9
<b>Total power loss (including electronics losses) <sup>3)</sup></b>	W	282,8	666	945,6	945,6
<b>Max. ambient temperature</b>					
without derating	° C	40	40	40	40
with derating	° C	55	55	55	55
<b>DC link capacitance</b>					
Active Line Module	µF	705	1410	1880	1880
Drive line-up, max.	µF	20000	20000	20000	20000
<b>Power factor</b>	cosφ	1	1	1	1

## 4.2 Active Line Modules with internal air cooling

Internal air cooling	6SL3130–	7TE21–6AAx	7TE23–6AAx	7TE25–5AAx	7TE25–5AA3 + Active Interface Module
<b>Rated power</b>	<b>kW</b>	<b>16</b>	<b>36</b>	<b>55</b>	<b>55</b>
<b>Circuit breaker</b> (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 47)			
<b>Rated short-circuit current</b> SCCR <sup>4)</sup> :	kA	65	65	65	65
<b>Cooling method</b> (internal air cooling)		Internal fan	Internal fan	Internal fan	Internal fan
<b>Max. permissible heat sink temperature</b>	° C	85	90	83	83
<b>Sound pressure level</b>	dB(A)	<60	<65	<60	<60
<b>Cooling air requirement</b>	m <sup>3</sup> /h	56	112	160	160
Rated voltage for rated data 3 AC 380 V					
<b>Weight</b>	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 line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.
- 3) For an overview, see the power loss tables in Section "Control cabinet installation".
- 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.

Table 4- 11 Technical data of Active Line Modules

Internal air cooling	6SL3130–	7TE28–0AAx	7TE31–2AAx
<b>Rated power</b>	<b>kW</b>	<b>80</b>	<b>120</b>
<b>Infeed</b>			
Rated power (S1) <sup>1)</sup>	kW (P <sub>n</sub> )	80	120
Infeed power (S6-40%) <sup>1)</sup>	kW (P <sub>S6</sub> )	106	145
Peak infeed power <sup>1)</sup>	kW (P <sub>max</sub> )	131	175
<b>Regenerative feedback</b>			
Continuous regenerative power	kW	80	120
Peak regenerative power	kW	131	175
<b>Supply voltages</b>			
Line voltage	V <sub>ACrms</sub>	3 AC 380 to 480 ±10% (-15% < 1 min)	
Line frequency	Hz	47 to 63	
Electronics power supply	V <sub>DC</sub>	24 (20.4 - 28.8)	
DC link voltage	V <sub>DC</sub>	510 - 720	
Overvoltage trip	V <sub>DC</sub>	820 ± 2%	
Undervoltage trip <sup>2)</sup>	V <sub>DC</sub>	360 ± 2%	
<b>Input currents</b>			
Rated input current at 400 V <sub>AC</sub> :	A <sub>AC</sub>	122	182
Input current at 380 V <sub>AC</sub> / 480 V <sub>AC</sub>	A <sub>AC</sub>	128 / 102	192 / 152
at 400 V <sub>AC</sub> ; S6-40%	A <sub>AC</sub>	161	220
at 400 V <sub>AC</sub> ; peak current	A <sub>AC</sub>	200	267

## 4.2 Active Line Modules with internal air cooling

Internal air cooling	6SL3130-	7TE28-0AAx	7TE31-2AAx
<b>Rated power</b>	<b>kW</b>	<b>80</b>	<b>120</b>
<b>DC link currents</b>			
Rated DC link current at 600 V	A <sub>DC</sub>	134	200
DC link current at 600 V <sub>DC</sub> ; at S6-40%	A <sub>DC</sub>	176	244
at 600 V <sub>DC</sub> ; peak current	A <sub>DC</sub>	218	292
<b>Current carrying capacity</b>			
DC link busbar:	A <sub>DC</sub>	200	200
24 V busbar:	A <sub>DC</sub>	20	20
<b>Electronics current consumption at 24 V DC</b>	A <sub>DC</sub>	1,4	1,8
<b>Total power loss (including electronics losses) <sup>3)</sup></b>	W	1383,6	2243,2
<b>Max. ambient temperature</b>			
without derating	° C	40	40
with derating	° C	55	55
<b>DC link capacitance</b>			
Active Line Module	µF	2820	3995
Drive line-up, max.	µF	20000	20000
<b>Power factor</b>	cosφ	1	1
<b>Circuit breaker (IEC 60947 and UL)</b>		See Section Overcurrent protection using line fuses and circuit breakers (Page 47)	
<b>Rated short-circuit current SCCR <sup>4)</sup>:</b>	kA	65	65
<b>Cooling method (internal air cooling)</b>		Mounted fan	Mounted fan
<b>Sound pressure level</b>	dB(A)	<73	<73
<b>Cooling air requirement</b>	m <sup>3</sup> /h	520	520
<b>Max. permissible heat sink temperature</b>	° C	70	75
Rated voltage for rated data 3 AC 380 V			
<b>Weight</b>	kg	23	23

- 1) The powers specified apply to the rated voltage range from 380 V to 480 V.
- 2) Default for 400 V line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.
- 3) For an overview, see the power loss tables in Section "Control cabinet installation".
- 4) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker, and the Line Module in the drive system.

4.2.7.1 Characteristics

Rated duty cycles for Active Line Modules

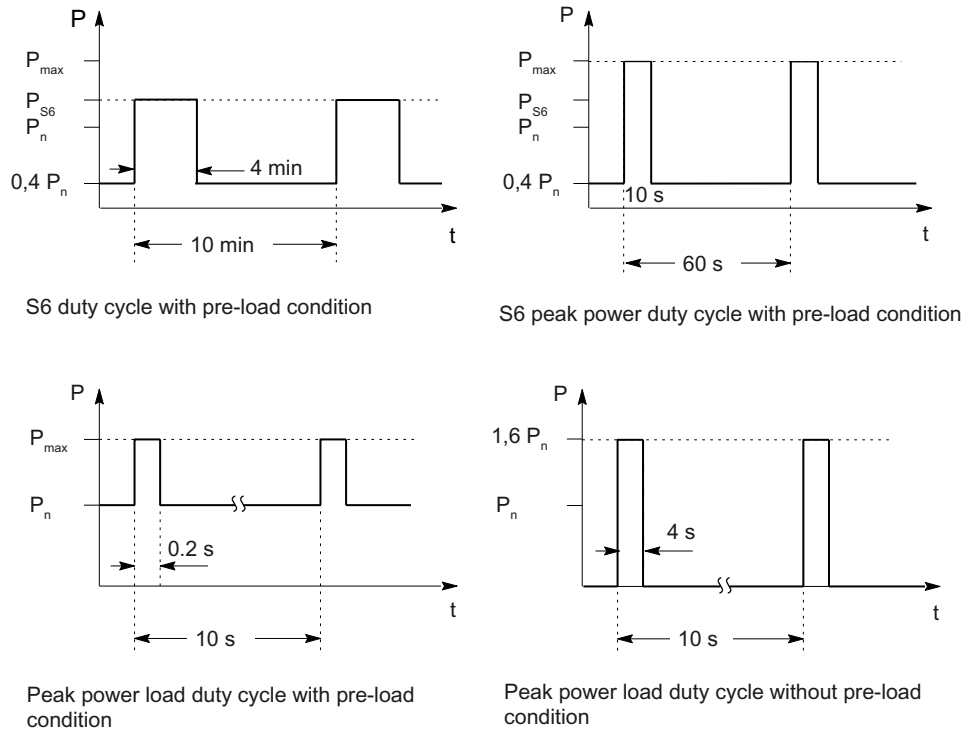
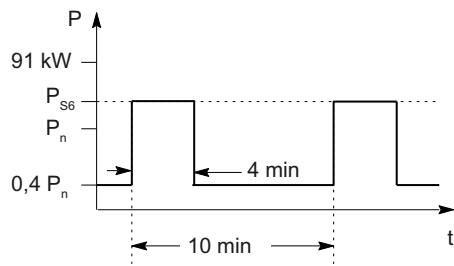
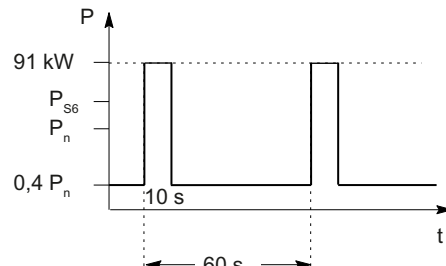


Figure 4-9 Rated duty cycles for Active Line Modules (**exception:** not applicable for 55 kW Active Line Module with Active Interface Module)

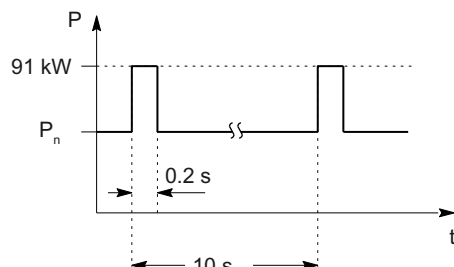
Rated duty cycles for Active Line Modules with Active Interface Modules



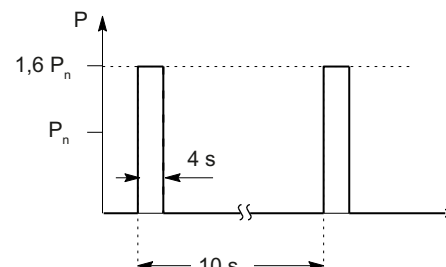
S6 duty cycle with pre-load condition



S6 peak power duty cycle with pre-load condition



Peak power load duty cycle with pre-load condition



Peak power load duty cycle without pre-load condition

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

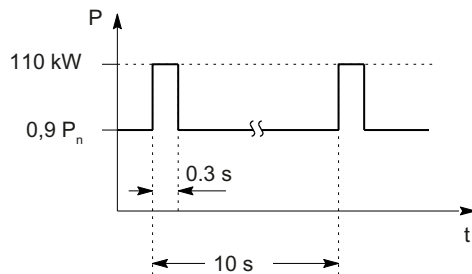


Figure 4-11 Peak load cycle with initial load for 55 kW Active Line Modules with Active Interface Module



## Derating characteristics

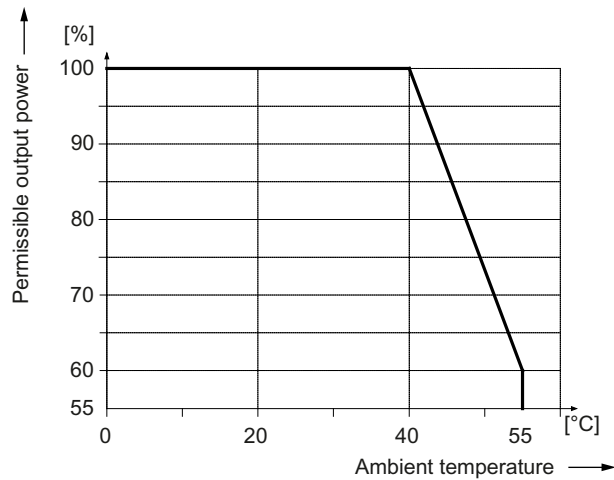


Figure 4-12 Output power as a function of the ambient temperature

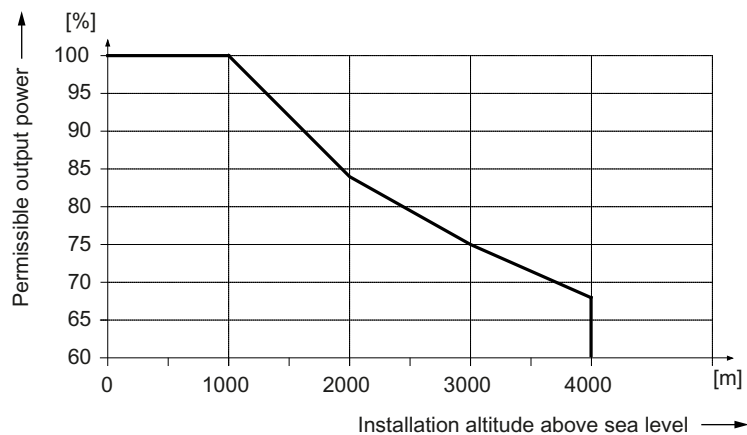


Figure 4-13 Output power as a function of the installation altitude

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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

## 4.3 Active Line Modules with external air cooling

### 4.3.1 Description

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

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

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

---

#### Note

When handling/using a Line Module, it is imperative that you observe the safety instructions in Chapter 1.

---

### 4.3.2 Interface description

#### 4.3.2.1 Overview

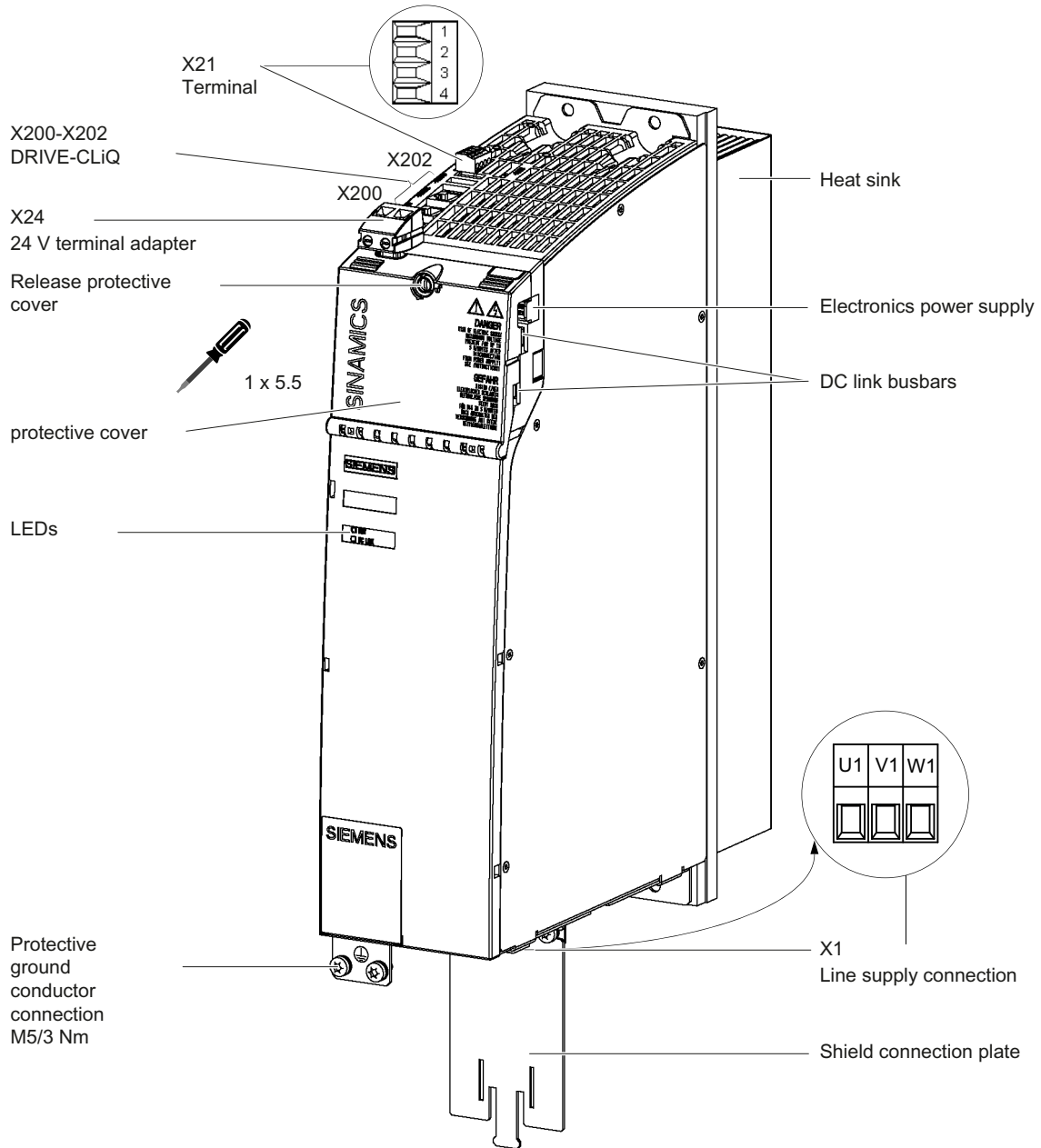
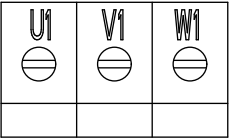
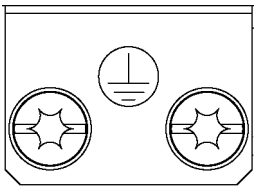


Figure 4-14 Interface overview, Active Line Module with external air cooling (example: 16 kW)

4.3 Active Line Modules with external air cooling

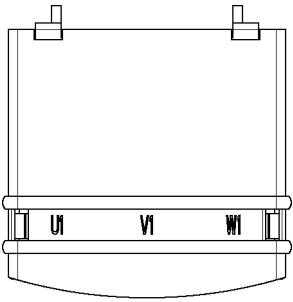
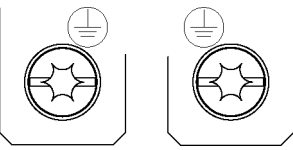
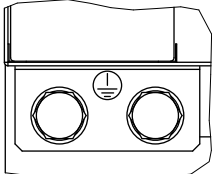
4.3.2.2 X1 line connection

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

	Terminal	Technical data
	U1	Max. connectable cross-section: 10 mm <sup>2</sup> Type: Screw terminal 6 Tightening torque: 1.5 - 1.8 Nm (see Section "Control cabinet installation/connection system")
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm <sup>1)</sup>

1) For ring cable lugs in accordance with DIN 46234

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

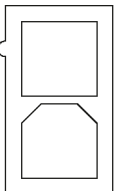
	Terminal	Technical data
	U1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz <b>36 kW:</b> Threaded bolts M6 / 6 Nm <sup>1)</sup> <b>55 kW, 80 kW and 120 kW:</b> Threaded bolts M8 / 13 Nm <sup>1)</sup>
	V1	
	W1	
	PE connection	<b>36 kW and 55 kW:</b> Threaded hole M6 / 6 Nm <sup>1)</sup>
		<b>80 kW and 120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

1) For ring cable lugs in accordance with DIN 46234

### 4.3.2.3 X12 fan connection

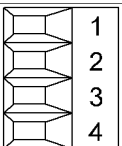
Active Line Modules 80 kW and 120 kW are equipped with an interface for connecting the sub-chassis fan. The interface is located on the underside of the Line Module.

Table 4- 14 X12 fan connection

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

### 4.3.2.4 X21 EP terminals

Table 4- 15 X21 EP terminal / temperature sensor

	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors <sup>1)</sup> : KTY 84–1C130 <sup>2)</sup> /PTC <sup>2)</sup> /bimetallic switch with NC contact If an Active Interface Module is used, the temperature input must be connected to the Active Interface Module sensor (bimetallic switch with NC contact).
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage 24 V DC
	4	EP M (Enable Pulses)	Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs
Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Section "Control cabinet installation and EMC / connection system")			

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.

4.3 Active Line Modules with external air cooling

**Terminals X21.1 and X21.2**

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

**Terminals X21.3 and X21.4**

 **WARNING**

**Connecting terminals X21.3 and X21.4**

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. Pulse suppression is activated when removed. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example because a line contactor is not installed, then the DC link remains charged.

**NOTICE**

**Using a line disconnecter unit**

If an active drive line-up is switched off using the disconnecter unit, the voltage at X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be realized using a leading breaking auxiliary contact ( $\geq 10$  ms), for example. This protects external loads located parallel to the drive at the same switching component.

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

 **DANGER**

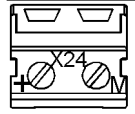
**Danger to life through electric shock**

Only temperature sensors that meet the safety isolation specifications stipulated 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 danger to life!

### 4.3.2.5 X24 24 V terminal adapter

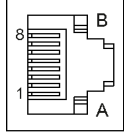
Table 4- 16 X24: 24 V terminal adapter

	Terminal	Designation	Technical data
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 (see Section "Control cabinet installation and EMC / connection system")			

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

### 4.3.2.6 X200-X202 DRIVE-CLiQ interfaces

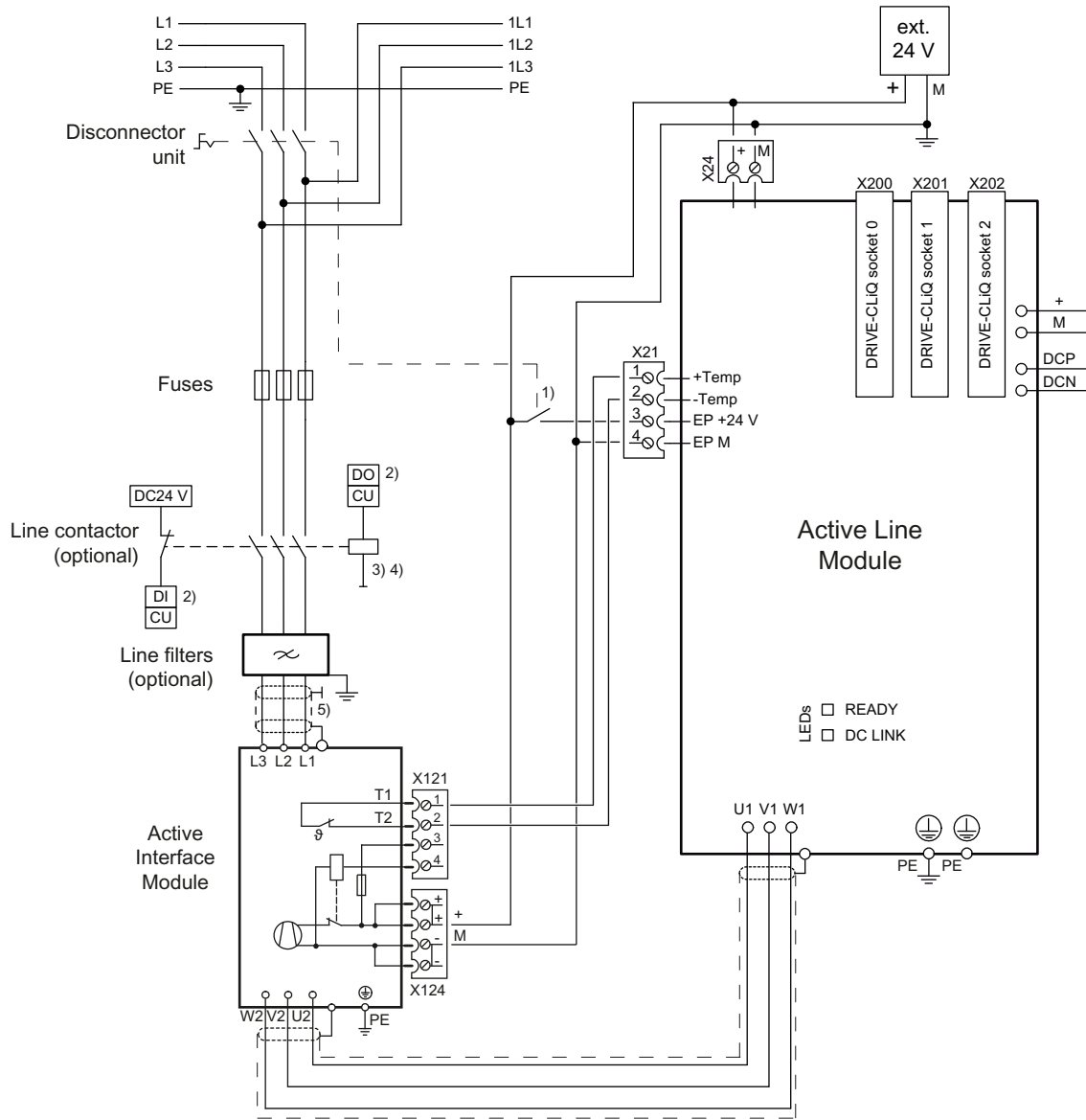
Table 4- 17 X200-X202: DRIVE-CLiQ interfaces

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

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

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

### 4.3.3 Connection example



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

Figure 4-15 Example connection of Active Line Module

**Note**

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



### 4.3.4 Meaning of LEDs

Table 4- 18 Meaning of the LEDs on the Active Line Module

Status		Description, cause	Remedy
RDY	DC LINK		
off	off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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. <b>Note:</b> 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	--	Detection of the components via LED is activated (p0124). <b>Note:</b> Both options depend on the LED status when module 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!

4.3.5 Dimension drawings

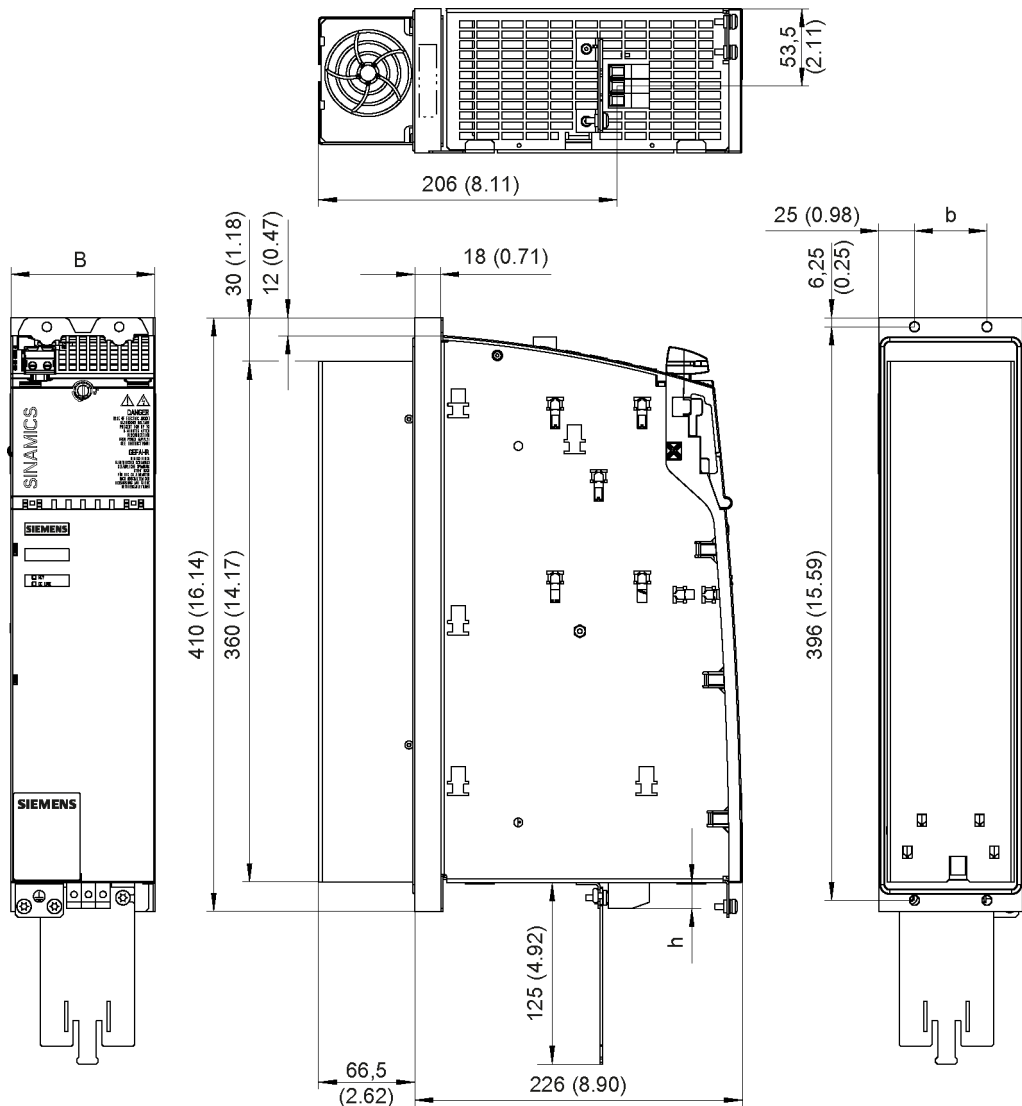


Figure 4-16 Dimension drawing of 16 kW Active Line Module with external air cooling, all dimensions in mm and (inches)

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

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

**Note**

The shield connecting plate is supplied as standard with a 100 mm Line Module. For more information, see the chapter titled "Accessories".

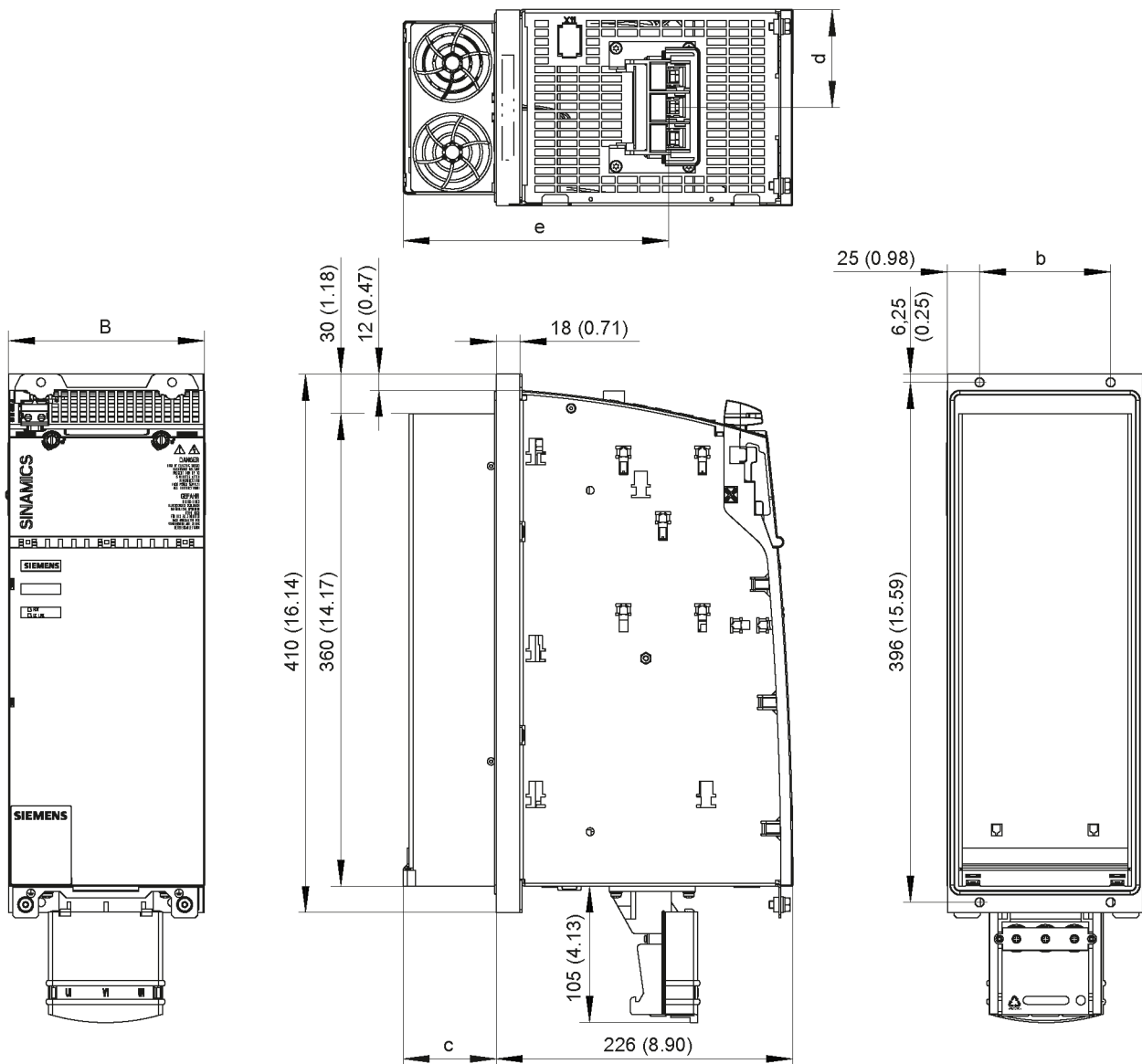


Figure 4-17 Dimension drawing of 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules with external air cooling (example 36 kW), all dimensions in mm and (inches)

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

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

4.3 Active Line Modules with external air cooling

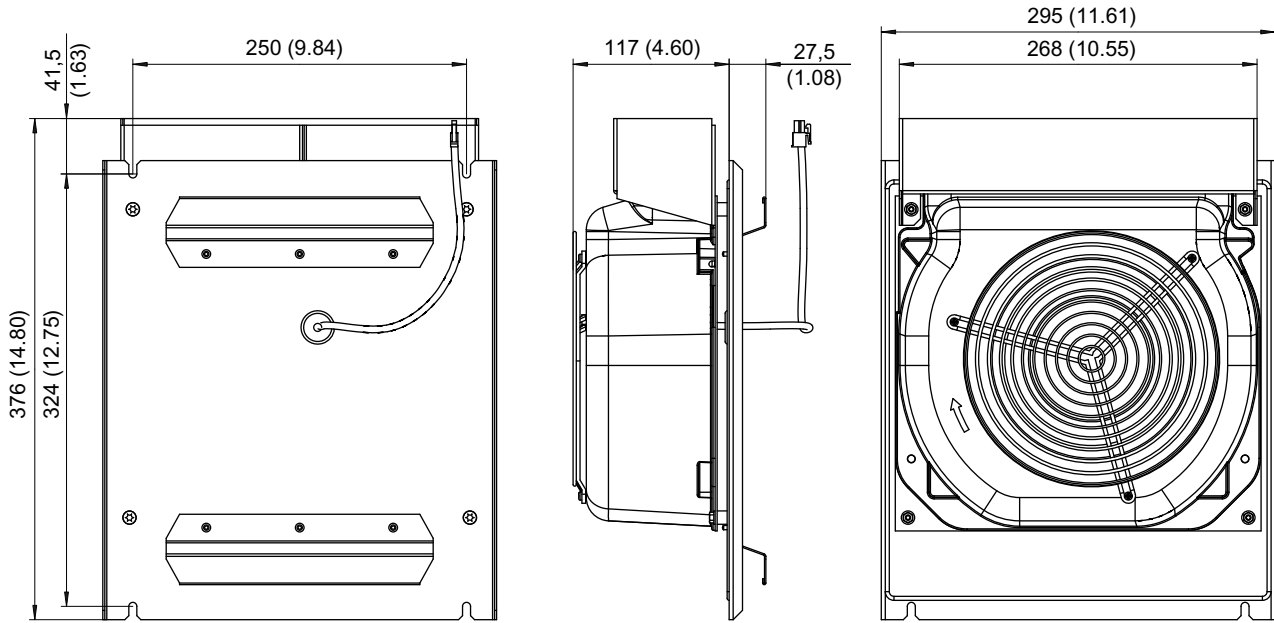
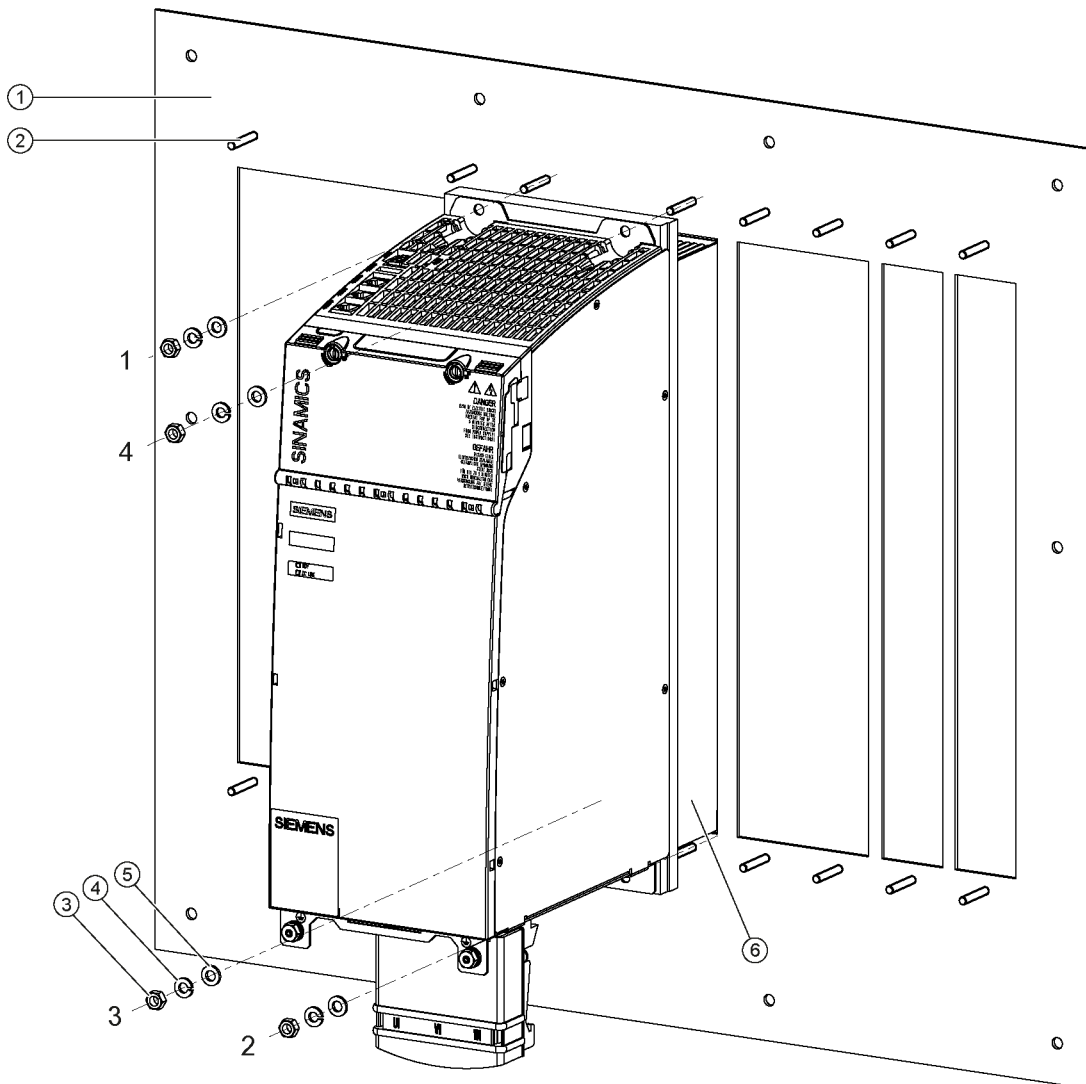


Figure 4-18 Dimension drawing of fan for 80 kW and 120 kW Active Line Modules with external air cooling, all dimensions in mm and (inches)

## 4.3.6 Mounting



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

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

**Tightening torques:**

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 6 Nm (in the specific sequence 1 to 4)

4.3 Active Line Modules with external air cooling

Help with the mechanical control cabinet design is available from:

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

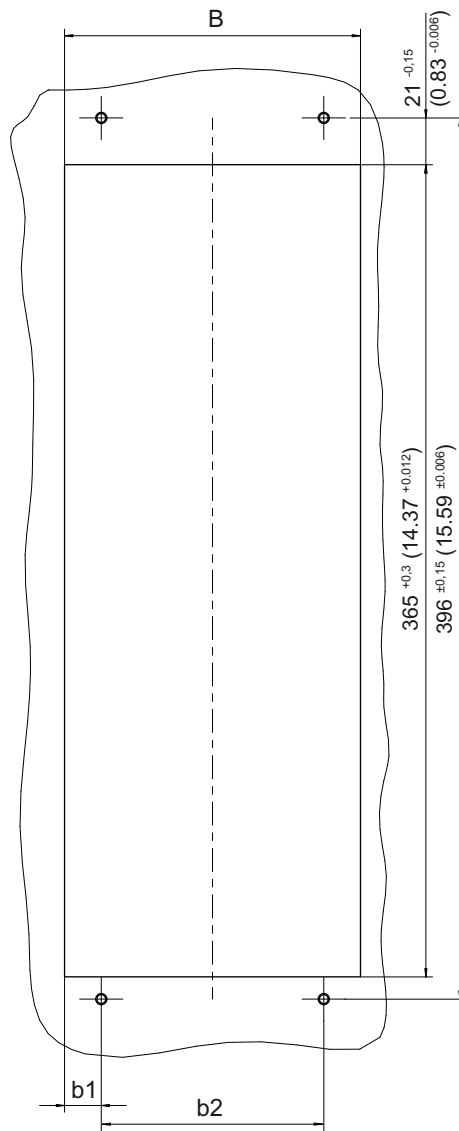
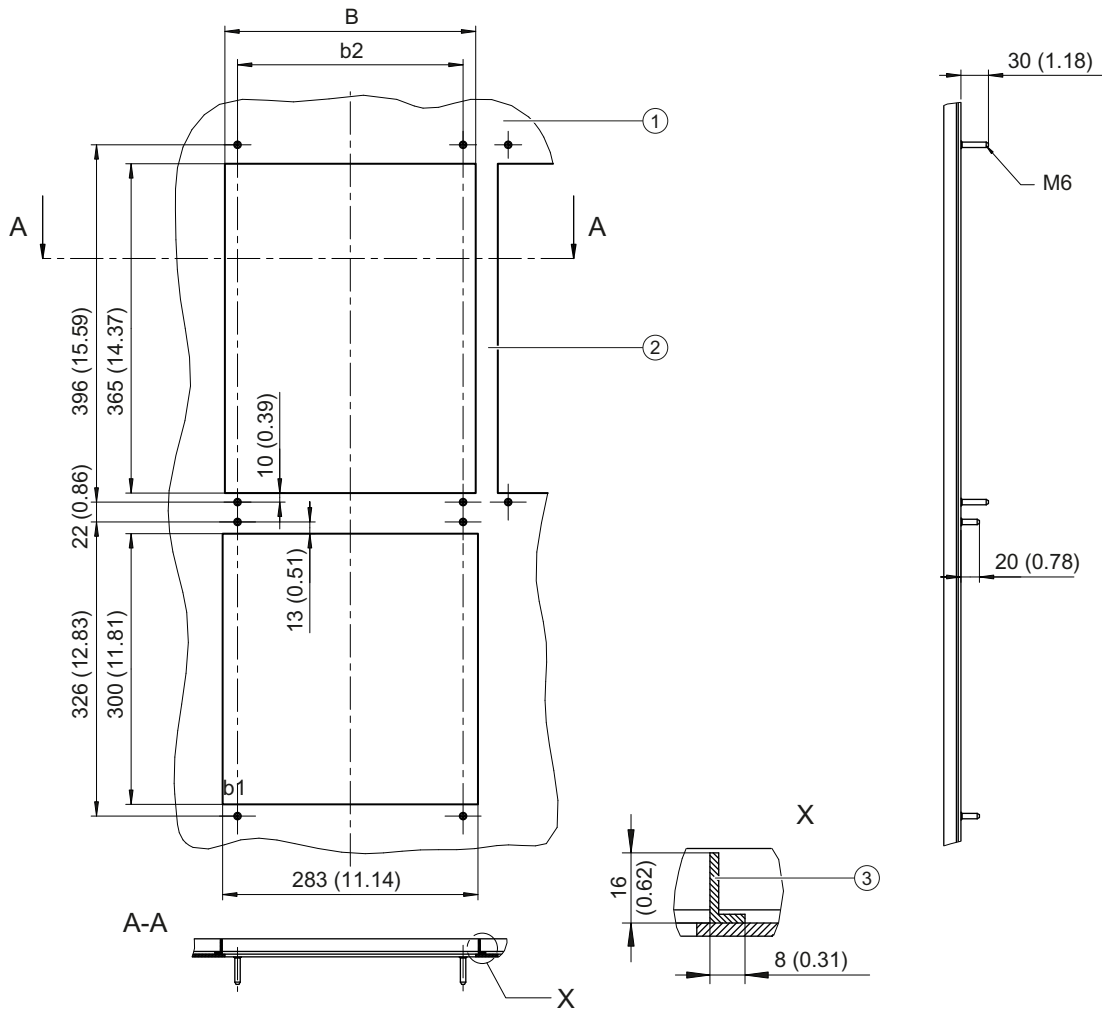


Figure 4-20 Openings to mount Active Line Modules 50 mm to 200 mm with external air cooling, all data in mm and (inches)



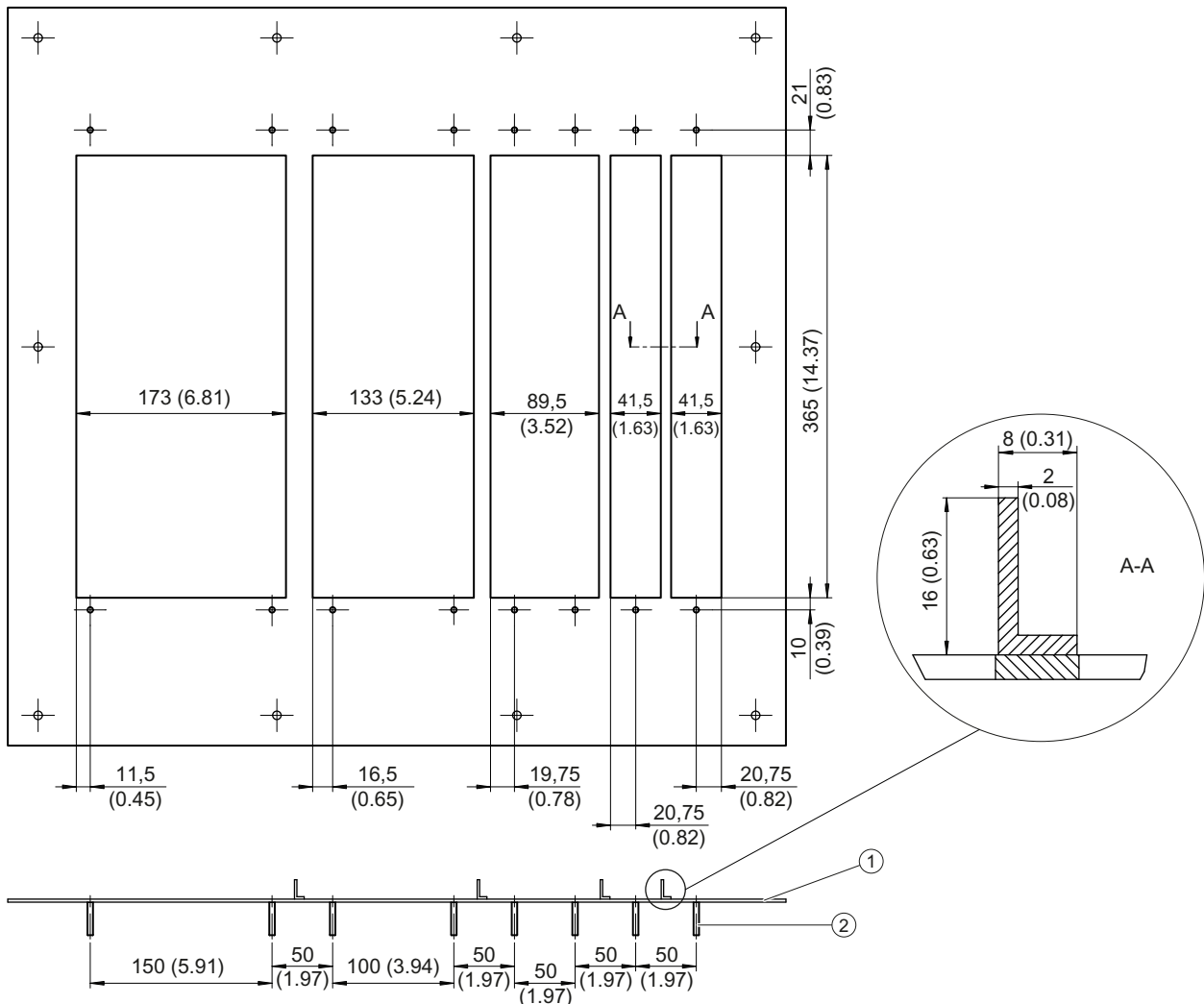
- ① Insert plate or mounting plate
- ② Cross-piece
- ③ Reinforcing bracket

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

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

Component width	B [mm] (inches)	w1 [mm] (inches)	w2 [mm] (inches)
50 mm	41.5 <sup>+0.3</sup> (1.63 <sup>+0.012</sup> )	20.75 <sup>+0.15</sup> (0.82 <sup>+0.006</sup> )	0
100 mm	89,5 <sup>+0.3</sup> (3.52 <sup>+0.012</sup> )	19,75 <sup>+0.15</sup> (0.78 <sup>+0.006</sup> )	50 <sup>±0.15</sup> (1.97 <sup>±0.006</sup> )
150 mm	133 <sup>+0.3</sup> (5.24 <sup>+0.012</sup> )	16,5 <sup>+0.15</sup> (0.65 <sup>+0.006</sup> )	100 <sup>±0.15</sup> (3.94 <sup>±0.006</sup> )
200 mm	173 <sup>+0.3</sup> (6.81 <sup>+0.012</sup> )	11,5 <sup>+0.15</sup> (0.45 <sup>+0.006</sup> )	150 <sup>±0.15</sup> (5.91 <sup>±0.006</sup> )
300 mm	278 <sup>+0.3</sup> (10.94 <sup>+0.012</sup> )	14,0 <sup>±0.15</sup> (0.55 <sup>±0.006</sup> )	250 <sup>+0.15</sup> (9.84 <sup>+0.006</sup> )

4.3 Active Line Modules with external air cooling



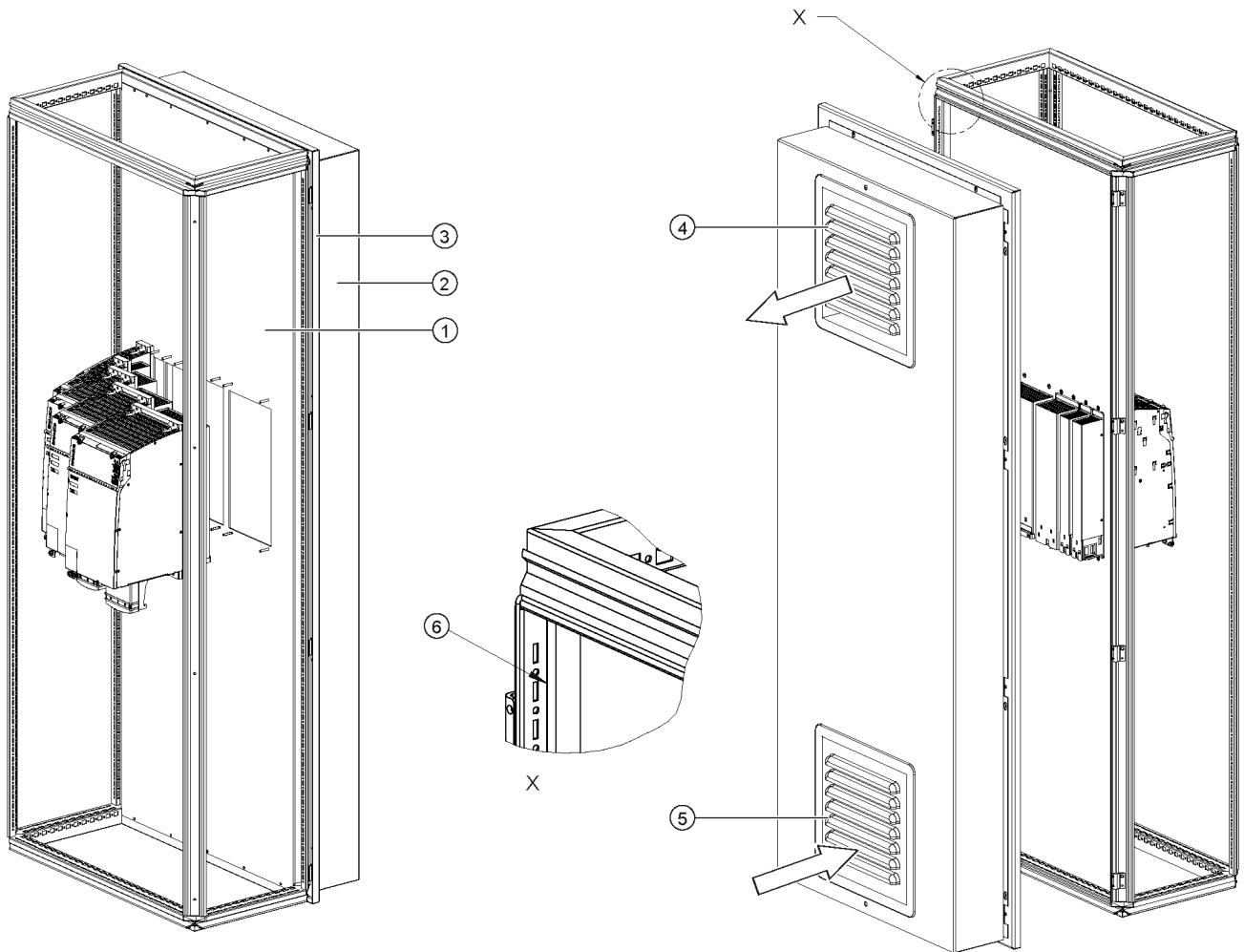
- ① Insert plate or mounting plate
- ② Threaded bolts M5 x 28

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

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

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

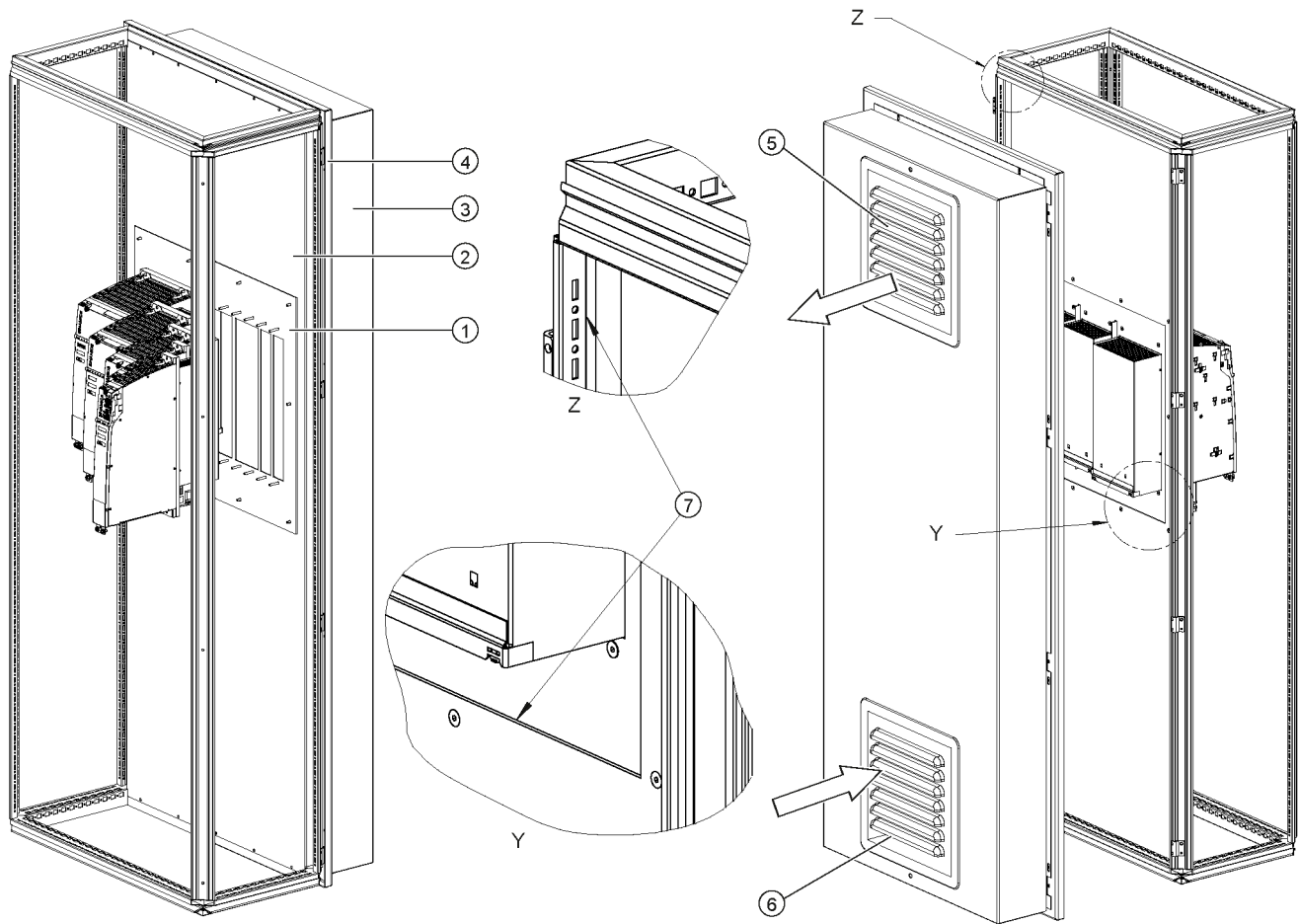




- ① Mounting plate
- ② Cover
- ③ Rear panel
- ④ Air discharge
- ⑤ Air inlet - filter with filter fan
- ⑥ To comply with degree of protection IP54, the surfaces ⑥ between the mounting plate and the cabinet strip must be sealed all round. (for example, sealant Terostat-91 from the Teroson company)

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

4.3 Active Line Modules with external air cooling



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

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

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

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

**Note**

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

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

**4.3.7 Technical data**

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

External air cooling	6SL3131-	7TE21-6AAx	7TE23-6AAx	7TE25-5AAx	7TE25-5AA3 + Active Interface Module
<b>Rated power</b>	<b>kW</b>	<b>16</b>	<b>36</b>	<b>55</b>	<b>55</b>
<b>Infeed</b>					
Rated power (S1) <sup>1)</sup>	kW (P <sub>n</sub> )	16	36	55	55
Infeed power (S6-40%) <sup>1)</sup>	kW (P <sub>s6</sub> )	21	47	71	71
Peak infeed power <sup>1)</sup>	kW (P <sub>max</sub> )	35	70	91	110
<b>Regenerative feedback</b>					
Continuous regenerative power	kW	16	36	55	55
Peak regenerative power	kW	35	70	91	110
<b>Supply voltages</b>					
Line voltage	V <sub>ACrms</sub>	3 AC 380 to 480 ±10% (-15% < 1 min)			
Line frequency	Hz	47 to 63 Hz			
Electronics power supply	V <sub>DC</sub>	24 (20.4 - 28.8)			
DC link voltage	V <sub>DC</sub>	510 - 720			
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %			
Undervoltage trip <sup>2)</sup>	V <sub>DC</sub>	360 ± 2 %			
<b>Input currents</b>					
Rated input current: at 400 V <sub>AC</sub>	A <sub>AC</sub>	25	55	84	84
Input current at 380 V <sub>AC</sub> /480 V <sub>AC</sub>	A <sub>AC</sub>	26 / 21	58 / 46	88 / 70	88 / 70
at 400 V <sub>AC</sub> ; S6-40%	A <sub>AC</sub>	32	71	108	108
at 400 V <sub>AC</sub> ; peak current	A <sub>AC</sub>	54	107	139	168
<b>DC link currents</b>					
Rated DC link current at 600 V	A <sub>DC</sub>	27	60	92	92
DC link current at 600 V <sub>DC</sub> ; at S6-40%	A <sub>DC</sub>	35	79	121	121
at 600 V <sub>DC</sub> ; peak current	A <sub>DC</sub>	59	117	152	176
<b>Current carrying capacity</b>					
DC link busbars	A <sub>DC</sub>	100	200	200	200
Reinforced DC link busbars	A <sub>DC</sub>	150	--	--	--
24 V DC busbars	A <sub>DC</sub>	20	20	20	20

4.3 Active Line Modules with external air cooling

External air cooling	6SL3131-	7TE21-6AAx	7TE23-6AAx	7TE25-5AAx	7TE25-5AA3 + Active Interface Module
<b>Rated power</b>	<b>kW</b>	<b>16</b>	<b>36</b>	<b>55</b>	<b>55</b>
<b>Electronics current consumption</b> at 24 V DC	A <sub>bc</sub>	0.95	1.5	1.9	1.9
<b>Total power loss</b> (including electronics losses) <sup>3)</sup>	W	282,8	666	945,6	945,6
<b>Max. ambient temperature</b> without derating	° C	40	40	40	40
with derating	° C	55	55	55	55
<b>DC link capacitance</b> Active Line Module	µF	705	1410	1880	1880
Drive line-up, max.	µF	20000	20000	20000	20000
<b>Power factor</b>	cosφ	1	1	1	1
<b>Circuit breaker</b> (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 47)			
<b>Rated short-circuit current</b> SCCR <sup>4)</sup>	kA	65	65	65	65
<b>Sound pressure level</b>	dB(A)	<60	<65	<60	<60
<b>Cooling air requirement</b>	m <sup>3</sup> /h	56	112	160	160
<b>Max. permissible heat sink temperature</b>	° C	85	90	88	88
Rated voltage for rated data 3 AC 380 V					
<b>Weight</b>	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 line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.
- 3) For an overview, see the power loss tables in Section "Control cabinet installation".
- 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.

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

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

External air cooling	6SL3131-	7TE28-0AAx	7TE31-2AAx
<b>Rated power</b>	<b>kW</b>	<b>80</b>	<b>120</b>
DC link voltage	V <sub>DC</sub>	510 - 720	
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %	
Undervoltage trip <sup>2)</sup>	V <sub>DC</sub>	360 ± 2 %	
<b>Input currents</b>			
Rated input current at 400 V <sub>AC</sub> :	A <sub>AC</sub>	122	182
Input current at 380 V <sub>AC</sub> / 480 V <sub>AC</sub>	A <sub>AC</sub>	128 / 102	192 / 152
at 400 V <sub>AC</sub> ; S6-40%	A <sub>AC</sub>	161	220
at 400 V <sub>AC</sub> ; peak current	A <sub>AC</sub>	200	267
<b>DC link currents</b>			
Rated DC link current at 600 V	A <sub>DC</sub>	134	200
DC link current at 600 V <sub>DC</sub> ; at S6-40%	A <sub>DC</sub>	176	244
at 600 V <sub>DC</sub> ; peak current	A <sub>DC</sub>	218	292
<b>Current carrying capacity</b>			
DC link busbar:	A <sub>DC</sub>	200	200
24 V busbar:	A <sub>DC</sub>	20	20
<b>Electronics current consumption</b> at 24 V DC	A <sub>DC</sub>	1,4	1.8
<b>Total power loss</b> (including electronics losses) <sup>3)</sup>	W	1383,6	2243,2
<b>Max. ambient temperature</b>			
without derating	° C	40	40
with derating	° C	55	55
<b>DC link capacitance</b>			
Active Line Module	µF	2820	3995
Drive line-up, max.	µF	20000	20000
<b>Power factor</b>	cosφ	1	1
<b>Circuit breaker</b> (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 47)	
<b>Rated short-circuit current</b> SCCR <sup>4)</sup>	kA	65	65
<b>Sound pressure level</b>	dB(A)	<73	<73
<b>Cooling air requirement</b>	m <sup>3</sup> /h	520	520
<b>Max. permissible heat sink temperature</b>		73	83
Rated voltage for rated data 3 AC 380 V			
<b>Weight</b>	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 line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.

3) For an overview, see the power loss tables in Section "Control cabinet installation".

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

4.3.7.1 Characteristics

Rated duty cycles for Active Line Modules

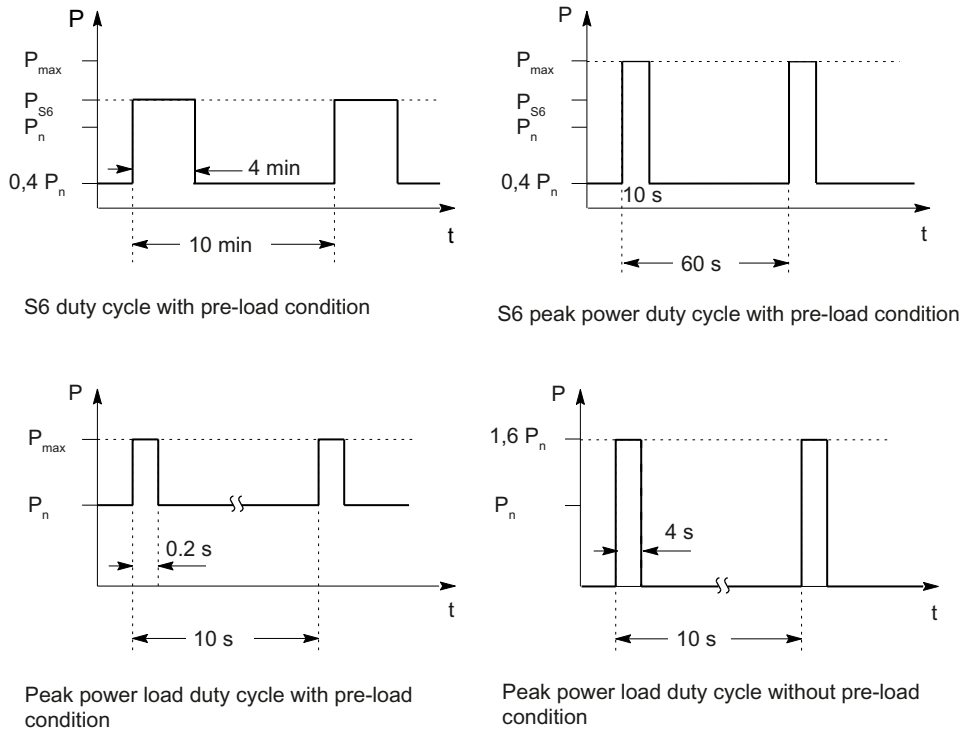
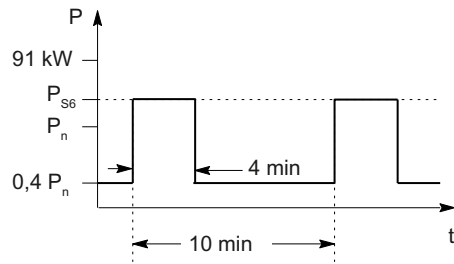
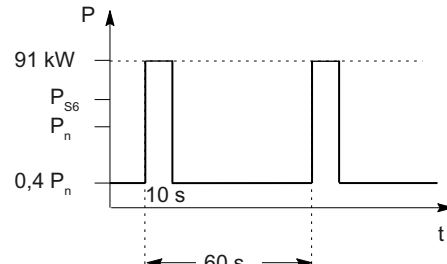


Figure 4-25 Rated duty cycles for Active Line Modules (exception: not applicable for 55 kW Active Line Module with Active Interface Module)

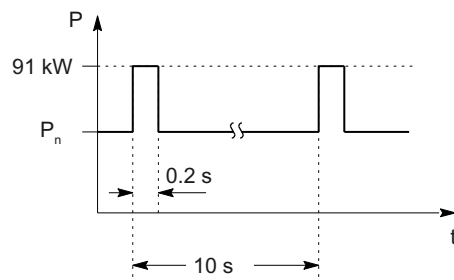
Rated duty cycles for Active Line Modules with Active Interface Modules



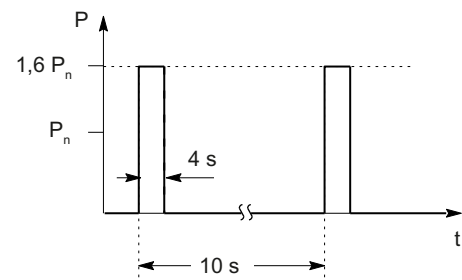
S6 duty cycle with pre-load condition



S6 peak power duty cycle with pre-load condition



Peak power load duty cycle with pre-load condition



Peak power load duty cycle without pre-load condition

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

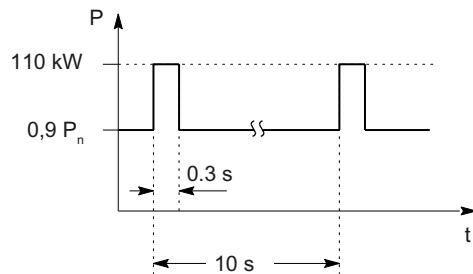


Figure 4-27 Peak load cycle with initial load for 55 kW Active Line Modules with Active Interface Module

### Derating characteristics

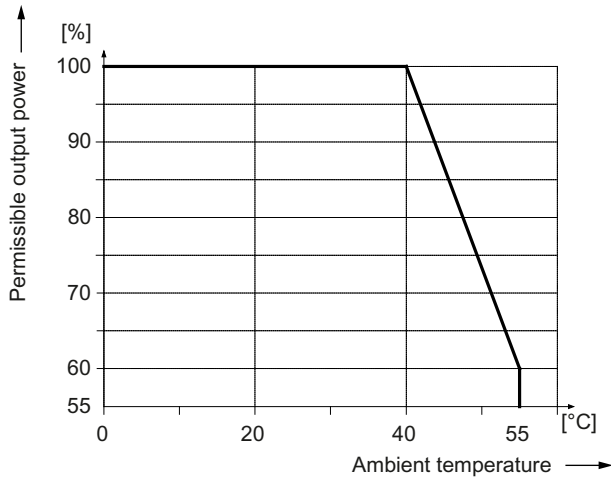


Figure 4-28 Output power as a function of the ambient temperature

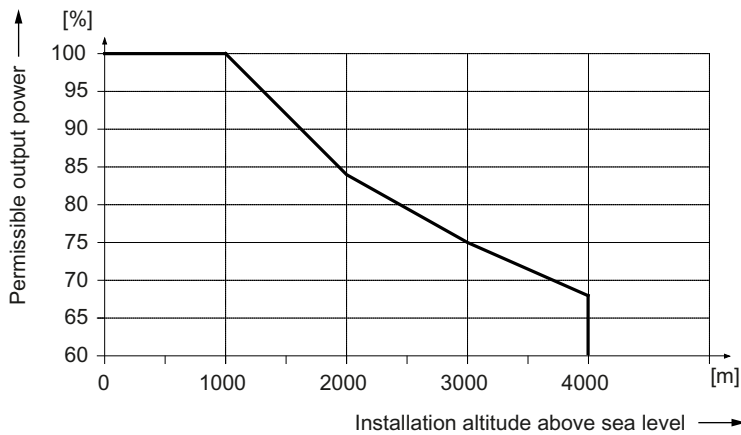


Figure 4-29 Output power as a function of the installation altitude

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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



## 4.4 Active Line Modules with cold plate

### 4.4.1 Description

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

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

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

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#### **Note**

When handling/using a Line Module, it is imperative that you observe the safety instructions in Chapter 1.

---

### 4.4.2 Interface description

#### 4.4.2.1 Overview

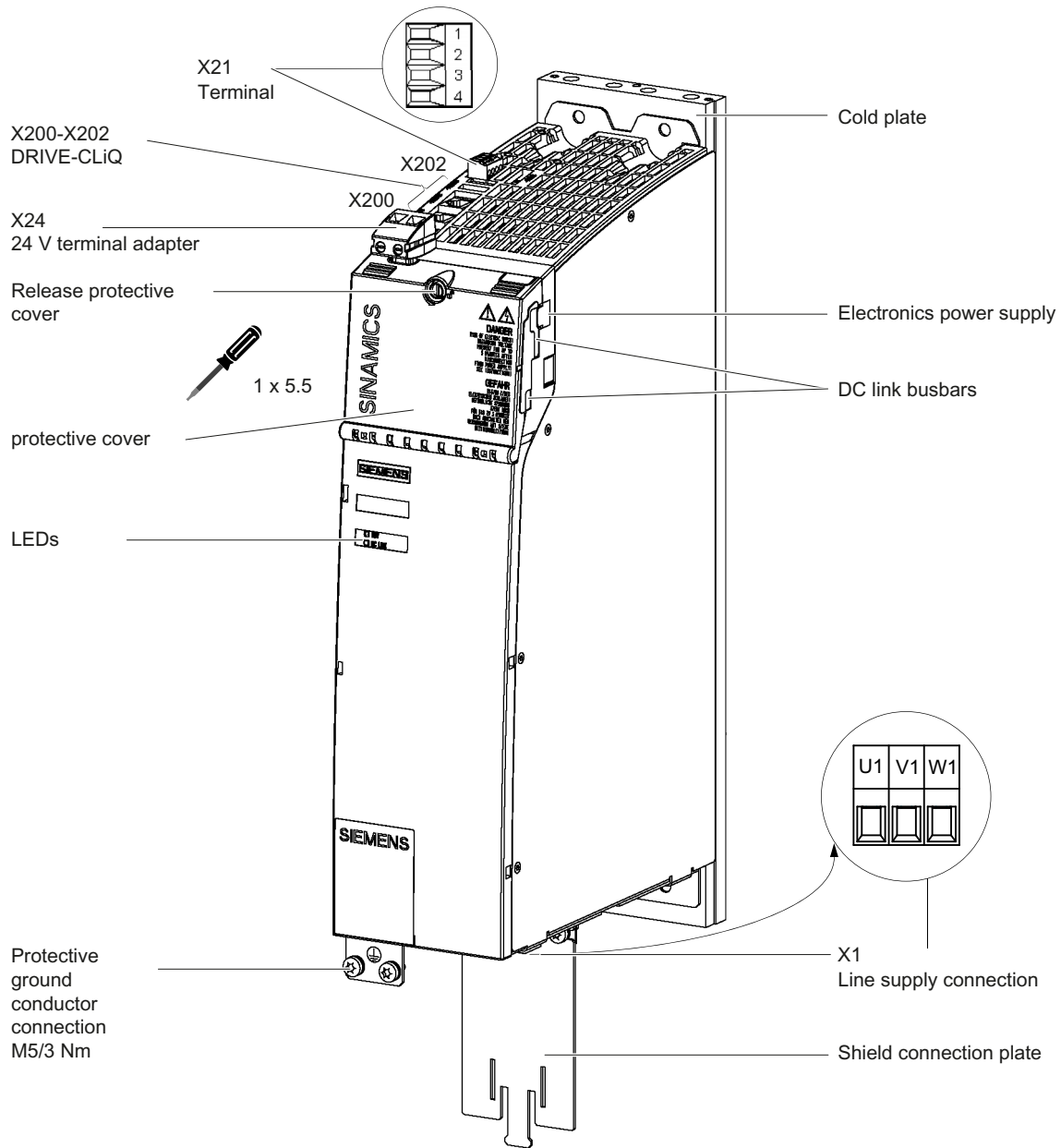
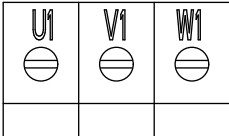
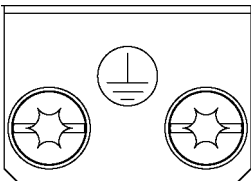


Figure 4-30 Interface overview, Active Line Module with cold plate (example: 16 kW)

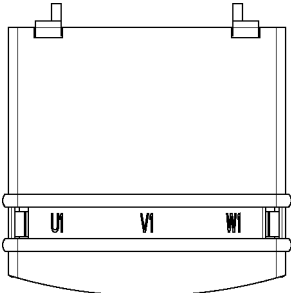
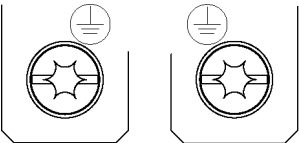
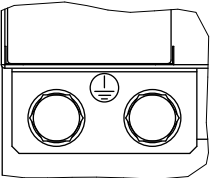
## 4.4.2.2 X1 line connection

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

	Terminal	Technical data
	U1	Max. connectable cross-section: 10 mm <sup>2</sup>
	V1	Type: Screw terminal 6
	W1	Tightening torque: 1.5 - 1.8 Nm (see Section "Control cabinet installation/connection system")
	PE connection	Threaded hole M5/3 Nm <sup>1)</sup>

1) For ring cable lugs in accordance with DIN 46234

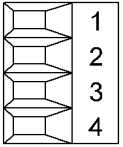
Table 4- 25 X1: Line supply connection for Active Line Modules 36 kW to 120 kW

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

1) For ring cable lugs in accordance with DIN 46234

4.4.2.3 X21 EP terminals

Table 4- 26 X21 EP terminal / temperature sensor


	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors <sup>1)</sup> : KTY 84–1C130 <sup>2)</sup> /PTC <sup>2)</sup> /bimetallic switch with NC contact If an Active Interface Module is used, the temperature input must be connected to the Active Interface Module sensor (bimetallic switch with NC contact).
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage 24 V DC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Section "Control cabinet installation and EMC / connection system")			

- 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.


**Terminals X21.1 and X21.2**

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

**Terminals X21.3 and X21.4**

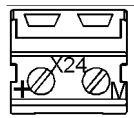
 <b>WARNING</b>
<p><b>Connecting terminals X21.3 and X21.4</b></p> <p>For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. Pulse suppression is activated when removed. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example because a line contactor is not installed, then the DC link remains charged.</p>

<b>NOTICE</b>
<p><b>Using a line disconnecter unit</b></p> <p>If an active drive line-up is switched off using the disconnecter unit, the voltage at X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be realized using a leading breaking auxiliary contact (≥ 10 ms), for example. This protects external loads located parallel to the drive at the same switching component.</p> <p>If you are using a VSM10 Voltage Sensing Module, the leading opening contact can be omitted.</p>

 <b>DANGER</b>
<b>Danger to life through electric shock</b>
Only temperature sensors that meet the safety isolation specifications stipulated 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 danger to life!

#### 4.4.2.4 X24 24 V terminal adapter

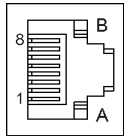
Table 4- 27 X24: 24 V terminal adapter

	Terminal	Designation	Technical data
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 (see Section "Control cabinet installation and EMC / connection system")			

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

#### 4.4.2.5 X200-X202 DRIVE-CLiQ interfaces

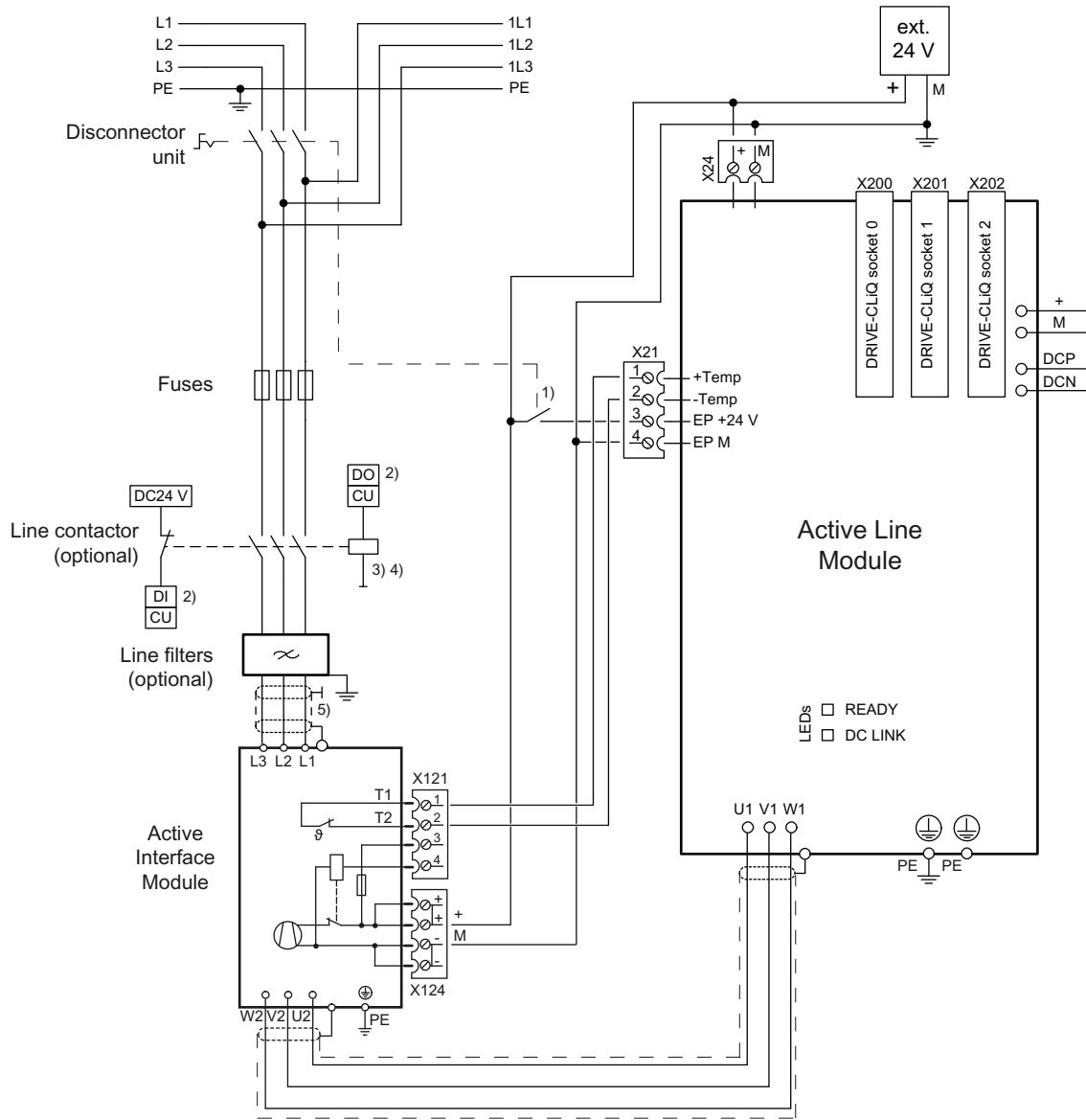
Table 4- 28 X200-X202: DRIVE-CLiQ interfaces

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

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

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

### 4.4.3 Connection example



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

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

**Note**

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

#### 4.4.4 Meaning of LEDs

Table 4- 29 Meaning of the LEDs on the Active Line Module

Status		Description, cause	Remedy
RDY	DC LINK		
off	off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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. <b>Note:</b> 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	--	Detection of the components via LED is activated (p0124). <b>Note:</b> Both options depend on the LED status when module 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!

4.4.5 Dimension drawings

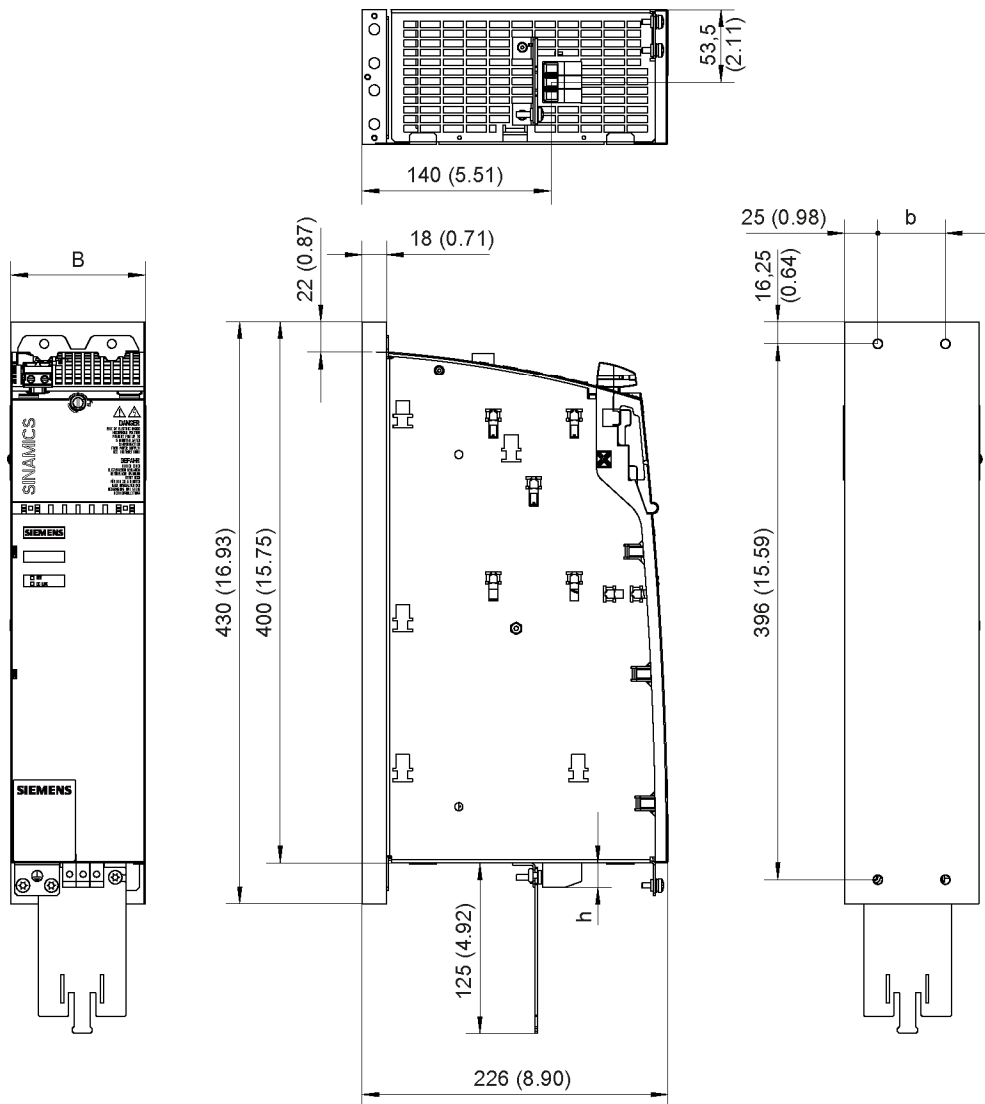


Figure 4-32 Dimension drawing of 16 kW Active Line Module with cold plate, all dimensions in mm and (inches)

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

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



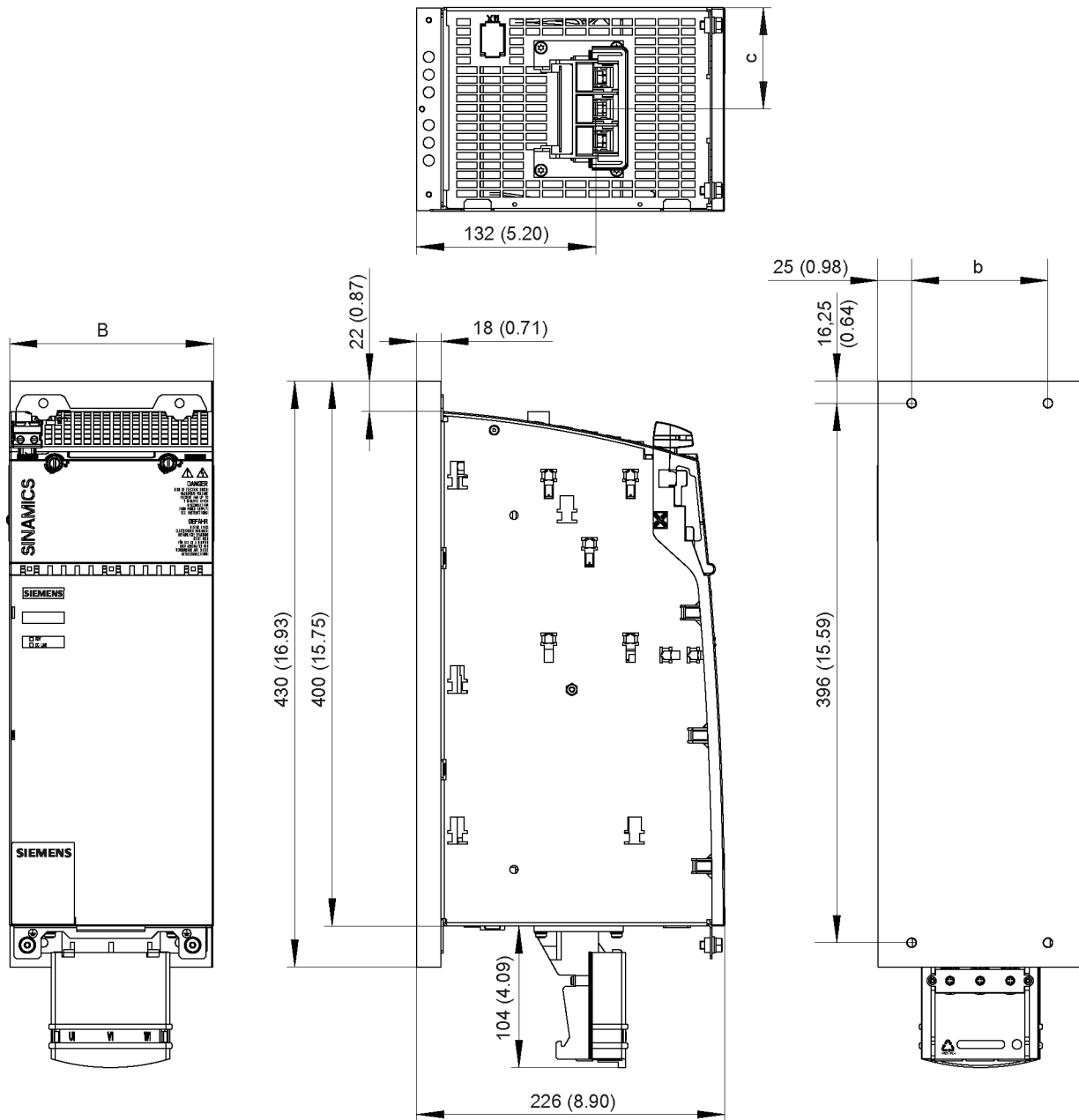


Figure 4-33 Dimension drawing of 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules with cold plate, all dimensions in mm and (inches)

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

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

### 4.4.6 Mounting

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

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

---

#### Note

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

Table 4- 32 Overview of heat-conducting foils

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

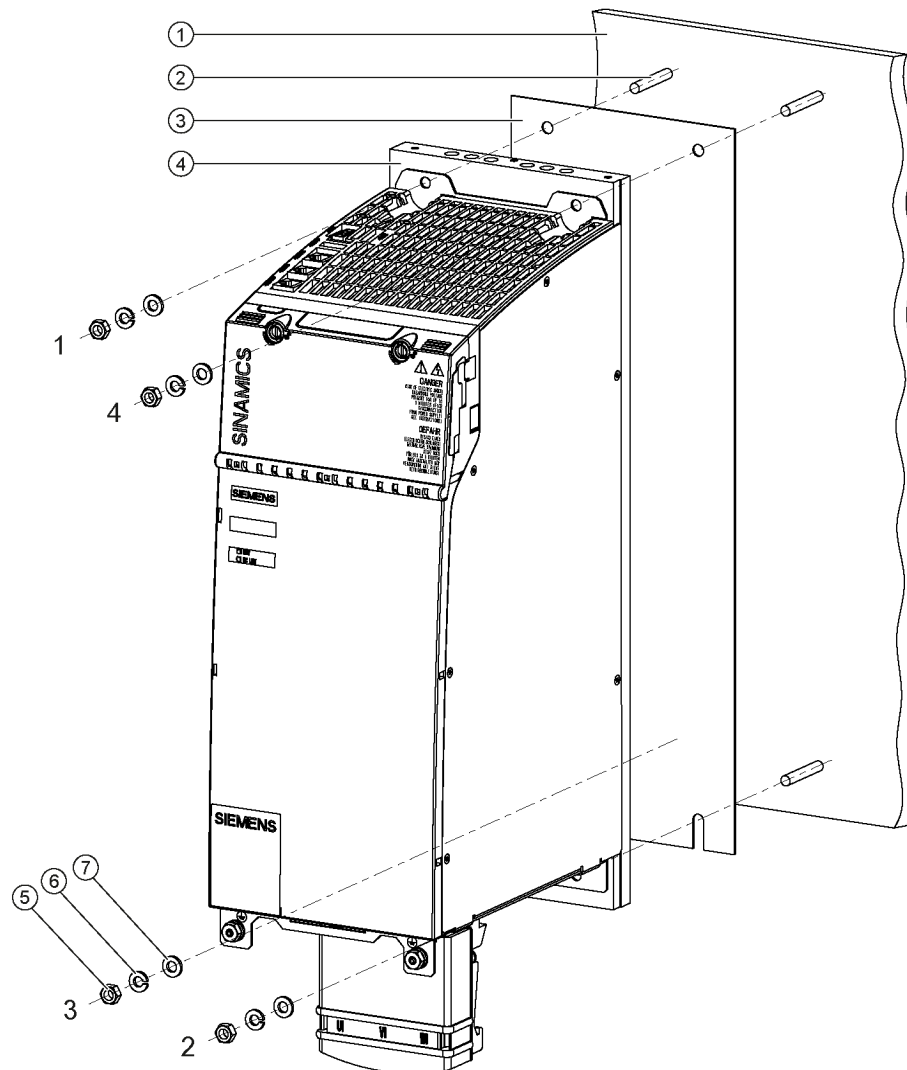
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#### Note

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

---

## Mounting



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

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

## Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm (in the specific sequence 1 to 4)

4.4 Active Line Modules with cold plate

Help with the mechanical control cabinet design is available from:

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

**Properties of the heat sink**

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

---

**Note**

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

---

<b>NOTICE</b>
---------------

<b>Ensure that the threaded bolts do not damage the cold plate</b>
--

- |   |
|---|
| <ul style="list-style-type: none"><li>• When mounting, ensure that the threaded bolts do not damage the cold plate.</li></ul> |
|---|

## 4.4.7 Technical data

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

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

4.4 Active Line Modules with cold plate

Cold plate	6SL3136-7TE	21-6AAx	23-6AAx	25-5AAx	25-5AA3 + Active Interface Module	28-0AAx	31-2AAx
<b>Total power loss</b> <sup>5)</sup> (including electronics losses)	W	280,4	655,2	927,6	927,6	1383,6	2243,2
<b>DC link capacitance</b> Active Line Module	μF	710	1410	1880	1880	2820	3760
Drive line-up, max.	μF	20000	20000	20000	20000	20000	20000
<b>Power factor</b>	cosφ	1	1	1	1	1	1
<b>Circuit breaker</b> (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 47)					
<b>Rated short-circuit-current</b> SCCR <sup>4)</sup>	kA	65	65	65	65	65	65
<b>Max. permissible heat sink temperature</b>	° C	70	73	83	83	75	80
<b>Max. ambient temperature</b> without derating	° C	40	40	40	40	40	40
	° C	55	55	55	55	55	55
<b>Weight</b>	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 line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.
- 4) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker, and the Line Module in the drive system.
- 5) For an overview, see the power loss tables in Section "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.

4.4.7.1 Characteristics

Rated duty cycles for Active Line Modules

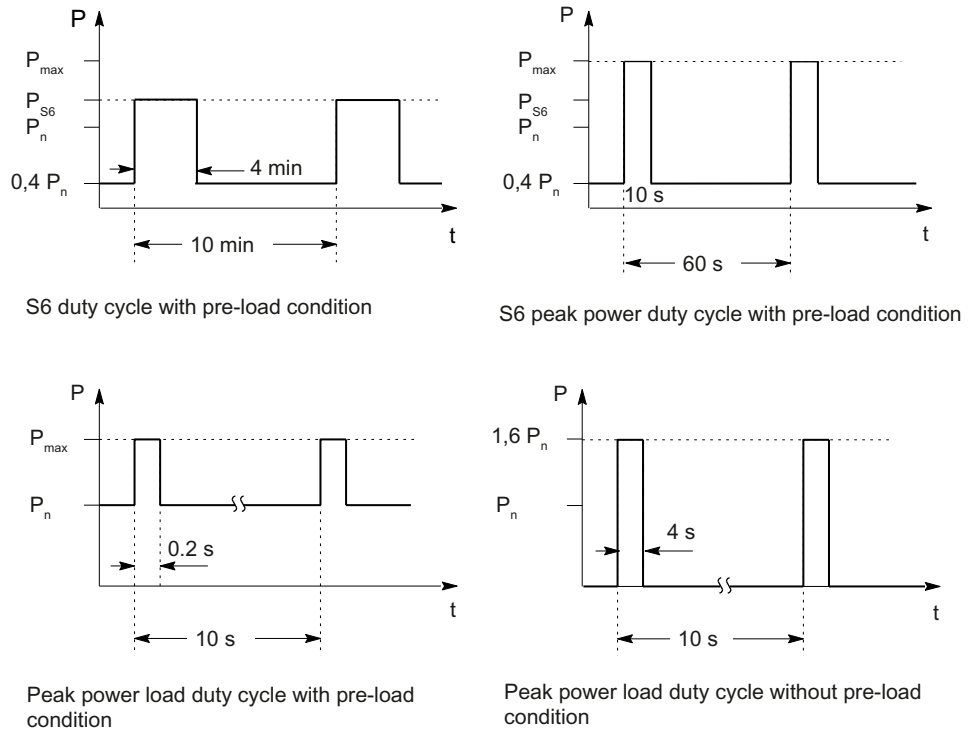
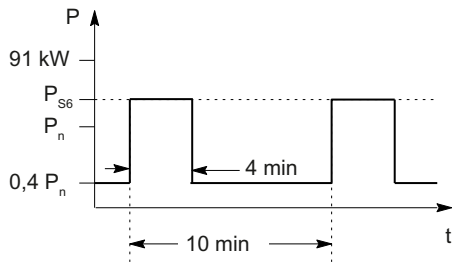
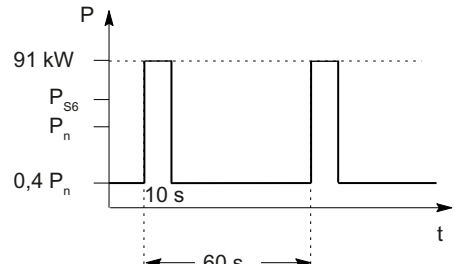


Figure 4-35 Rated duty cycles for Active Line Modules (**exception:** not applicable for 55 kW Active Line Module with Active Interface Module)

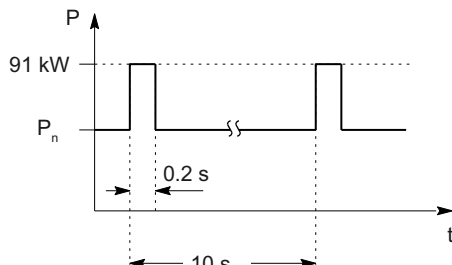
Rated duty cycles for Active Line Modules with Active Interface Modules



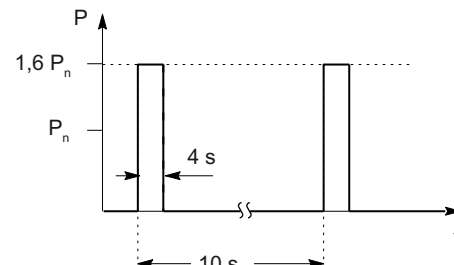
S6 duty cycle with pre-load condition



S6 peak power duty cycle with pre-load condition



Peak power load duty cycle with pre-load condition



Peak power load duty cycle without pre-load condition

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

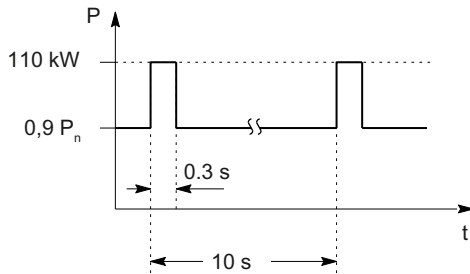


Figure 4-37 Peak load cycle with initial load for 55 kW Active Line Modules with Active Interface Module



## Derating characteristics

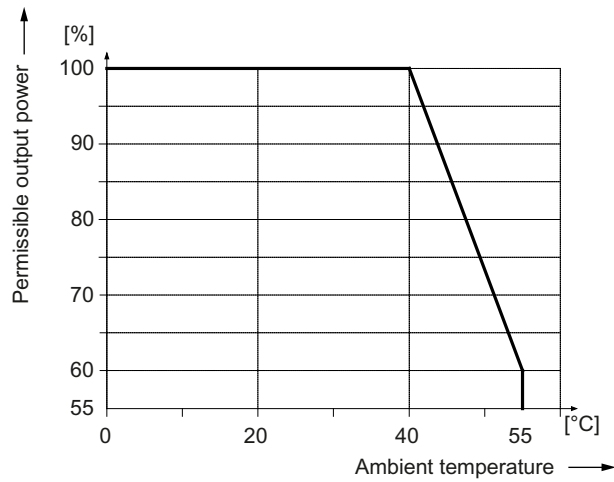


Figure 4-38 Output power as a function of the ambient temperature

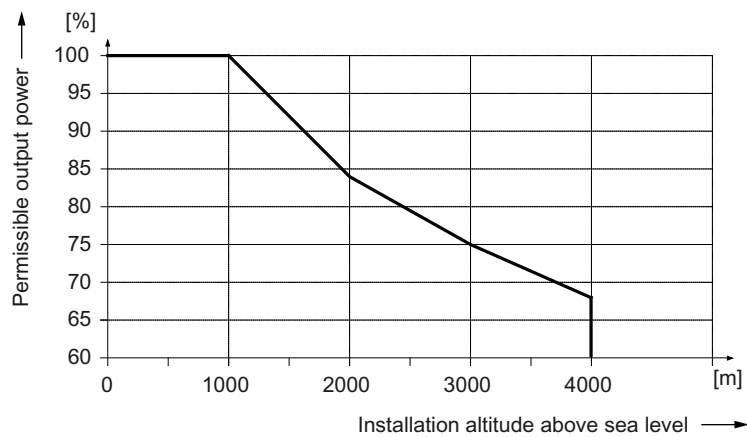


Figure 4-39 Output power as a function of the installation altitude

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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

## 4.5 Active Line Modules Liquid Cooled

### 4.5.1 Description

Active Line Modules generate a constant, regulated DC voltage in the DC link from the three-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 parameterization.

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

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#### Note

When handling/using a Line Module, it is imperative that you observe the safety instructions in Chapter 1.

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## 4.5.2 Interface description

### 4.5.2.1 Overview

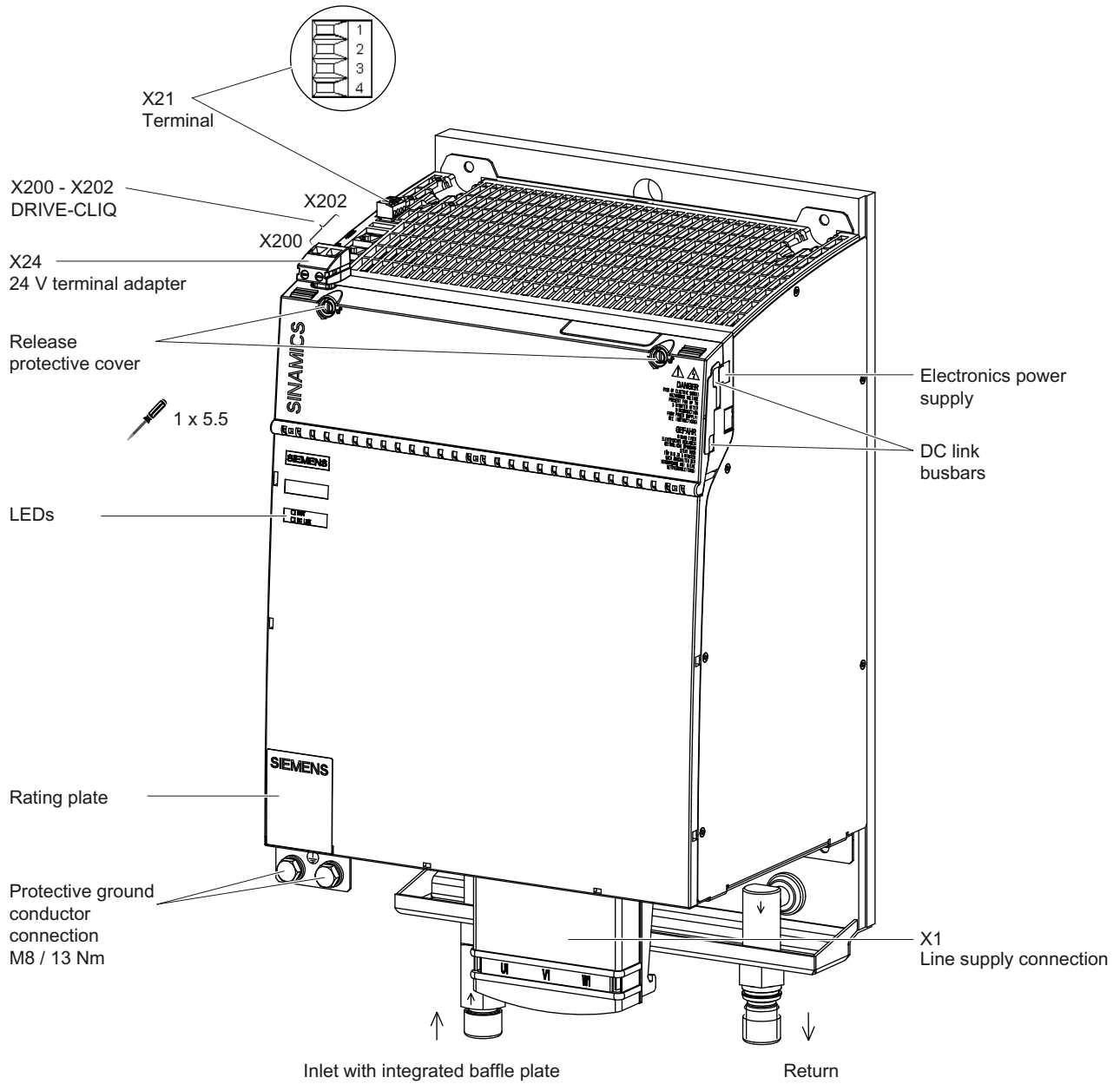
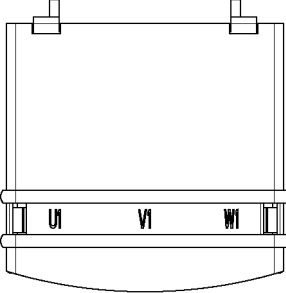
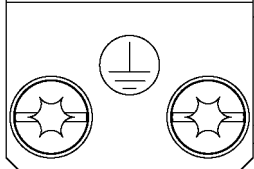


Figure 4-40 Interface overview, Active Line Module Liquid Cooled (120 kW)

4.5.2.2 X1 line connection

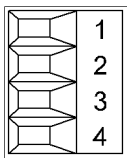
Table 4- 34 X1 line connection

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

1) For ring cable lugs in accordance with DIN 46234

4.5.2.3 X21 EP terminals

Table 4- 35 X21 EP terminal / temperature sensor

	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors <sup>1)</sup> : KTY 84– 1C130 <sup>2)</sup> /PTC <sup>2)</sup> /bimetallic switch with NC contact If an Active Interface Module is used, the temperature input must be connected to the Active Interface Module sensor (bimetallic switch with NC contact).
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage 24 V DC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Section "Control cabinet installation and EMC / connection system")			

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.

**Terminals X21.1 and X21.2**

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

**Terminals X21.3 and X21.4** **WARNING****Connecting terminals X21.3 and X21.4**

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. Pulse suppression is activated when removed. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example because a line contactor is not installed, then the DC link remains charged.

**NOTICE****Using a line disconnecter unit**

If an active drive line-up is switched off using the disconnecter unit, the voltage at X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be realized using a leading breaking auxiliary contact ( $\geq 10$  ms), for example. This protects external loads located parallel to the drive at the same switching component.

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

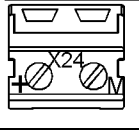
 **DANGER****Danger to life through electric shock**

Only temperature sensors that meet the safety isolation specifications stipulated 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 danger to life!

4.5.2.4 X24 24 V terminal adapter

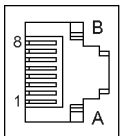
Table 4- 36 X24: 24 V terminal adapter

	Terminal	Designation	Technical data
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 (see Section "Control cabinet installation and EMC / connection system")			

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

4.5.2.5 X200-X202 DRIVE-CLiQ interfaces

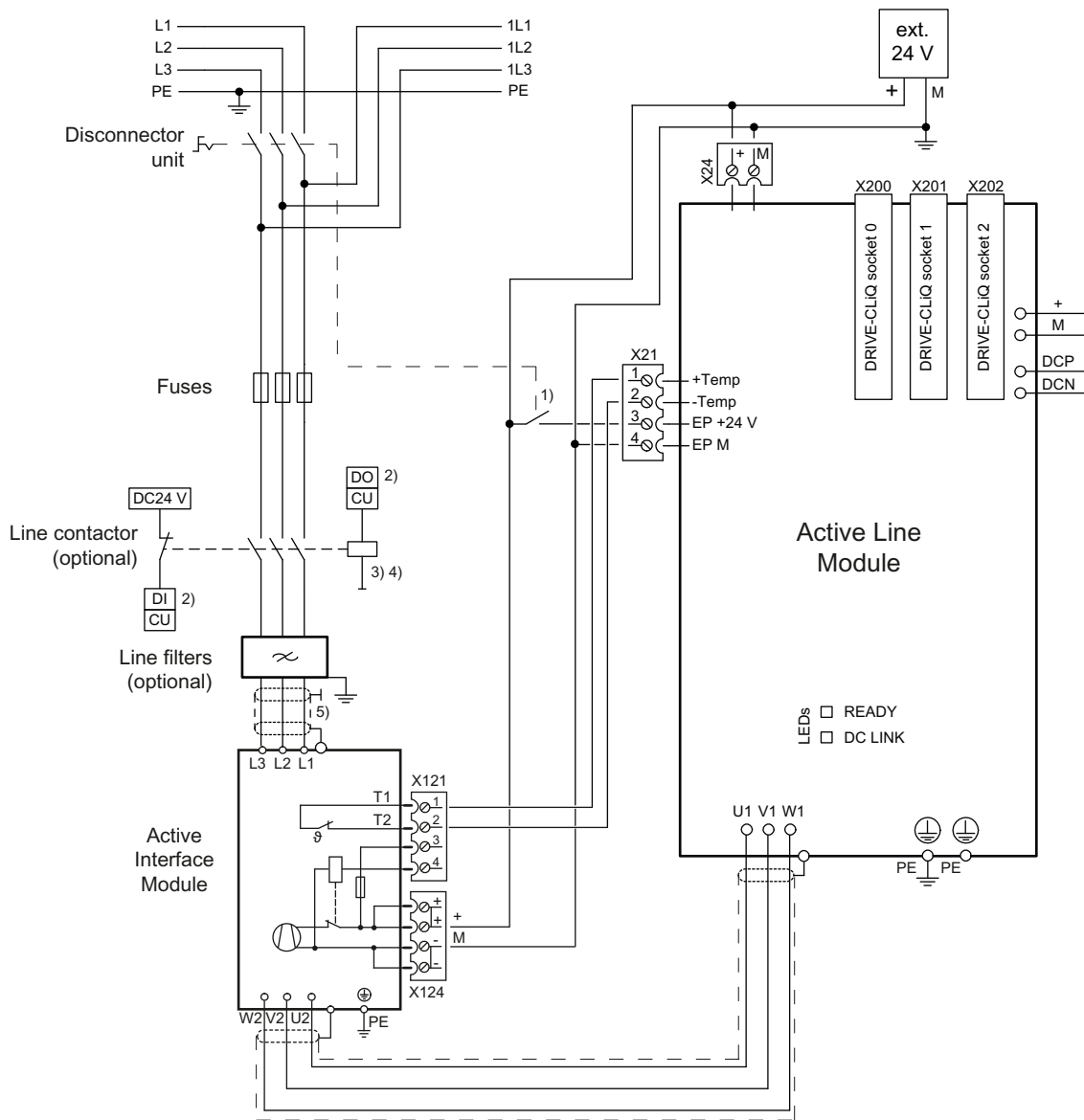
Table 4- 37 X200-X202: DRIVE-CLiQ interfaces

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

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

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

## 4.5.3 Connection example



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

Figure 4-41 Example connection of Active Line Module

**Note**

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

#### 4.5.4 Meaning of LEDs

Table 4- 38 Meaning of the LEDs on the Active Line Module

Status		Description, cause	Remedy
RDY	DC LINK		
off	off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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. <b>Note:</b> 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	--	Detection of the components via LED is activated (p0124). <b>Note:</b> Both options depend on the LED status when module recognition is activated via p0124 = 1.	–



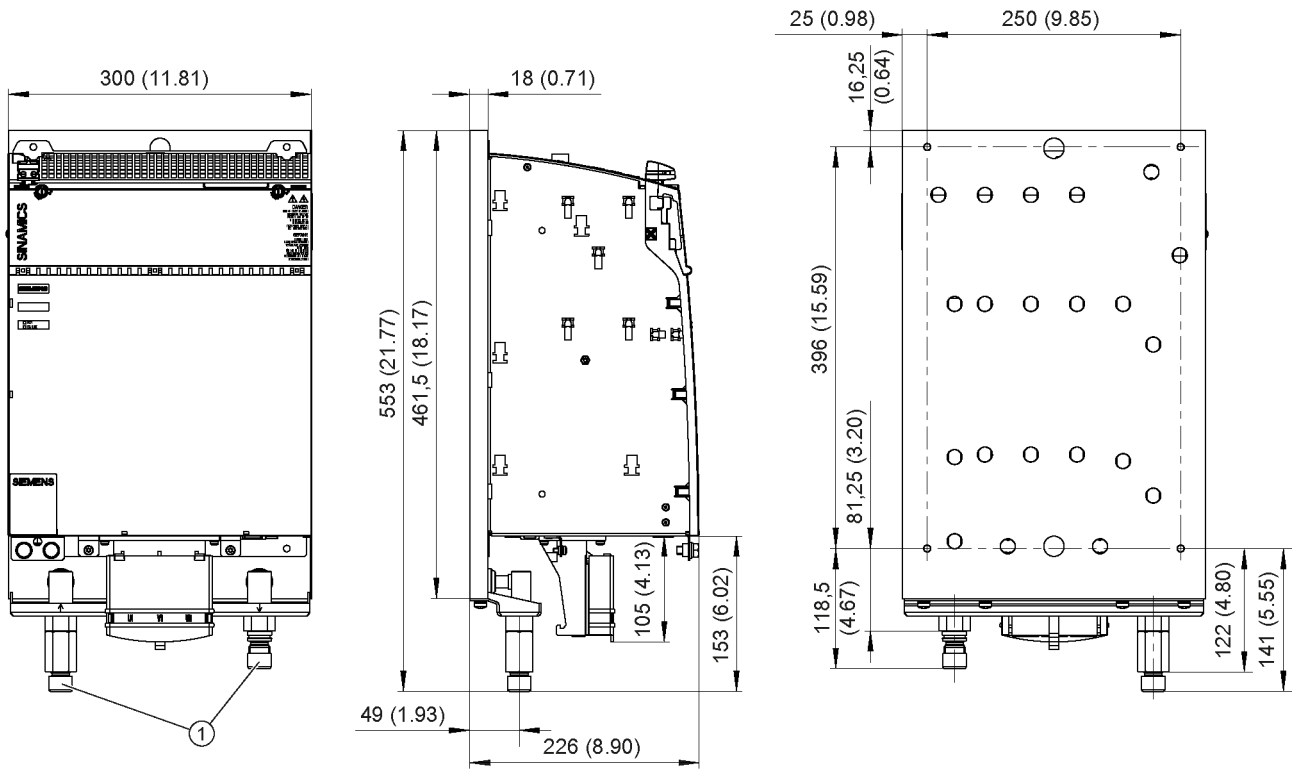
#### DANGER

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!



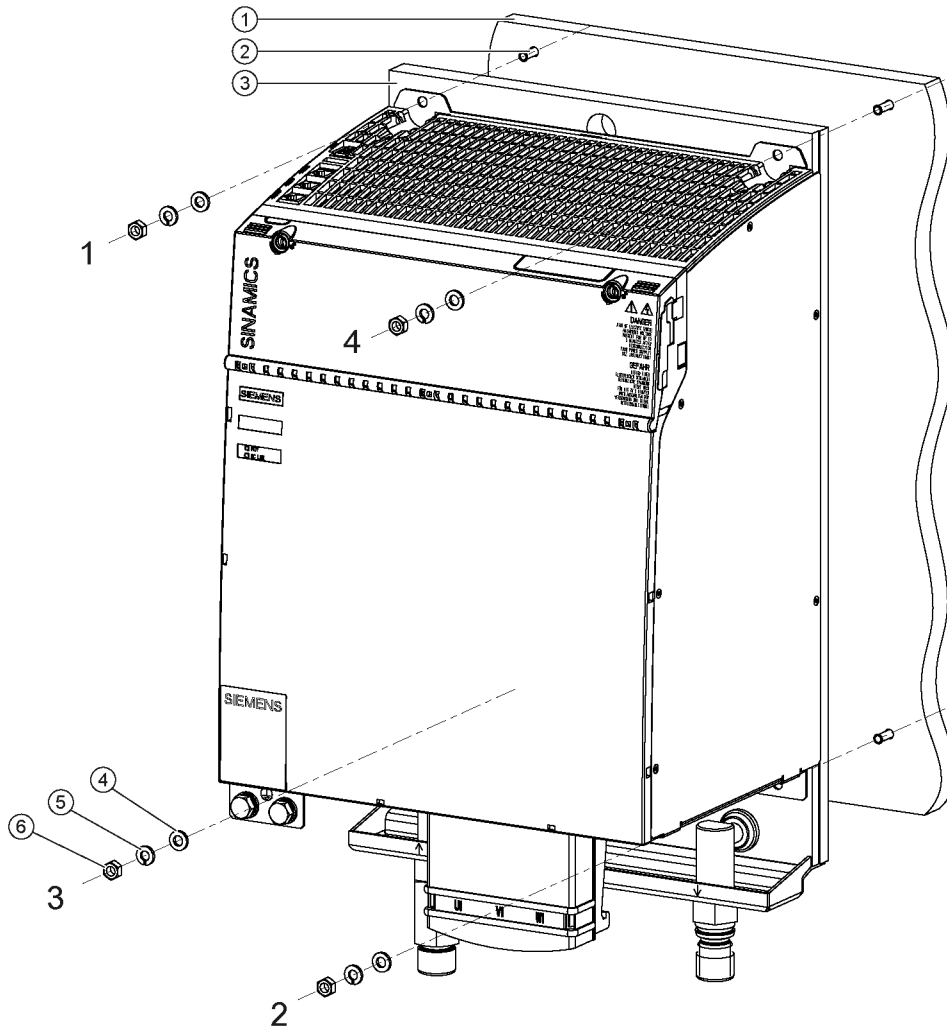
4.5.5 Dimension drawing



① Pipe thread ISO 228 G ½ B.

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

### 4.5.6 Installation



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

Figure 4-43 Mounting an Active Line Module Liquid Cooled

**Tightening torques:**

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm (in the specific sequence 1 to 4)

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

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

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

## 4.5.7 Technical data

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

Liquid Cooled		6SL3135-7TE31-2AA3
<b>Rated power</b>	<b>kW</b>	<b>120</b>
<b>Infeed</b>		
Rated power (S1) <sup>1)</sup>	kW (P <sub>n</sub> )	120
Infeed power (S6-40%) <sup>1)</sup>	kW (P <sub>S6</sub> )	145
Peak infeed power <sup>1)</sup>	kW (P <sub>max</sub> )	175
<b>Regenerative feedback</b>		
Continuous regenerative power	kW	120
Peak regenerative power	kW	175
<b>Supply voltages</b>		
Line voltage	V <sub>ACrms</sub>	3 AC 380 to 480 ±10% (-15% < 1 min)
Line frequency	Hz	47 to 63
Electronics power supply	V <sub>DC</sub>	24 (20.4 – 28.8)
DC link voltage	V <sub>DC</sub>	510 – 720
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %
Undervoltage trip <sup>2)</sup>	V <sub>DC</sub>	360 ± 2 %
<b>Input currents</b>		
Rated input current at 400 V <sub>AC</sub> :	A <sub>AC</sub>	182
Input current		
at 380 V <sub>AC</sub> / 480 V <sub>AC</sub>	A <sub>AC</sub>	192 / 152
at 400 V <sub>AC</sub> ; S6-40%	A <sub>AC</sub>	220
at 400 V <sub>AC</sub> ; peak current	A <sub>AC</sub>	267
<b>DC link currents</b>		
Rated DC link current at 600 V	A <sub>DC</sub>	200
DC link current		
at 600 V <sub>DC</sub> ; at S6-40%	A <sub>DC</sub>	244
at 600 V <sub>DC</sub> ; peak current	A <sub>DC</sub>	292
<b>Current carrying capacity</b>		
DC link busbars	A <sub>DC</sub>	200
24 V DC busbars	A <sub>DC</sub>	20
<b>Electronics current consumption</b> at 24 V DC	A <sub>DC</sub>	1.8
<b>Total power loss</b> (including electronics losses) <sup>3)</sup>	W	2243,2

<b>Liquid Cooled</b>		<b>6SL3135-7TE31-2AA3</b>
<b>Rated power</b>	<b>kW</b>	<b>120</b>
<b>Max. ambient temperature</b> without derating	° C	40
with derating	° C	55
<b>DC link capacitance:</b> Active Line Module	µF	3995
Drive line-up, max.	µF	20000
<b>Power factor</b>	cosφ	1
<b>Circuit breaker</b> (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 47)
<b>Rated short-circuit current</b> SCCR <sup>5)</sup>	kA	65
<b>Rated volumetric flow</b> for water at 70 kPa pressure drop <sup>4)</sup>	l/min	8
<b>Volume of liquid</b> internal	ml	100
<b>Max. coolant temperature</b> without derating	° C	45
with derating	° C	50
<b>Max. permissible heat sink temperature</b>	° C	80
<b>Weight</b>	kg	23

- 1) The powers specified apply to the rated voltage range from 380 V to 480 V.
- 2) Default for 400 V line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.
- 3) For an overview, see the power loss tables in Section "Control cabinet installation".
- 4) This value applies to the water coolant option; for other coolant types, see Section "Cooling circuit and coolant properties".
- 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.

4.5.7.1 Characteristics

Rated duty cycles of Active Line Modules Liquid Cooled

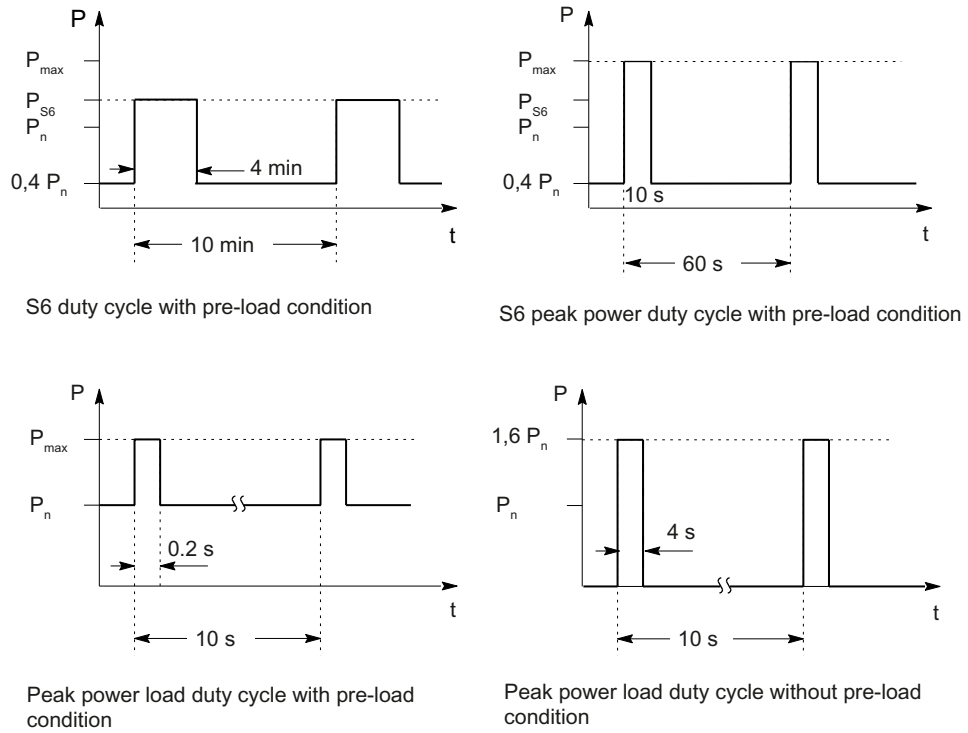


Figure 4-44 Rated duty cycles of Active Line Modules

Derating characteristics

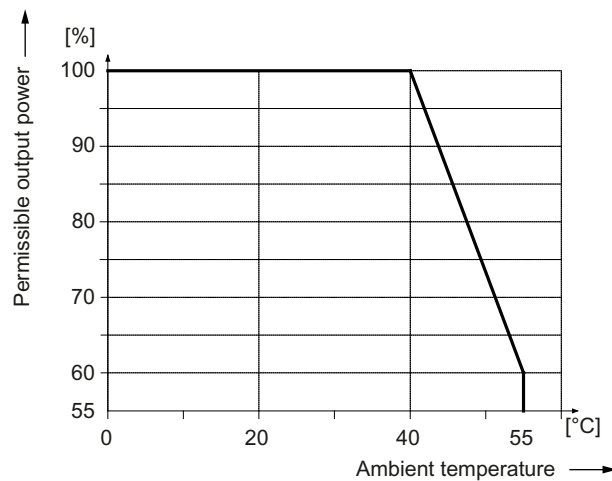


Figure 4-45 Output power as a function of the ambient temperature

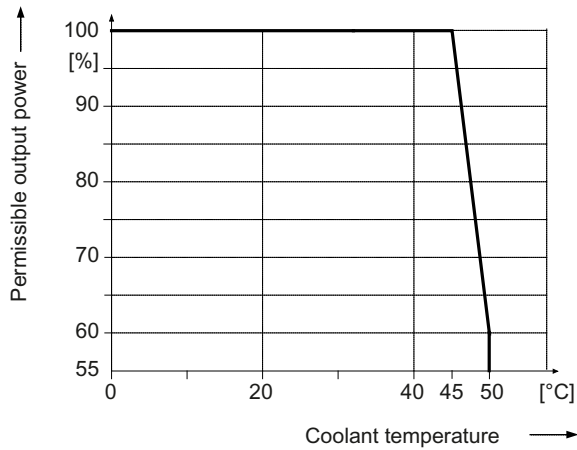


Figure 4-46 Output power as a function of the coolant temperature

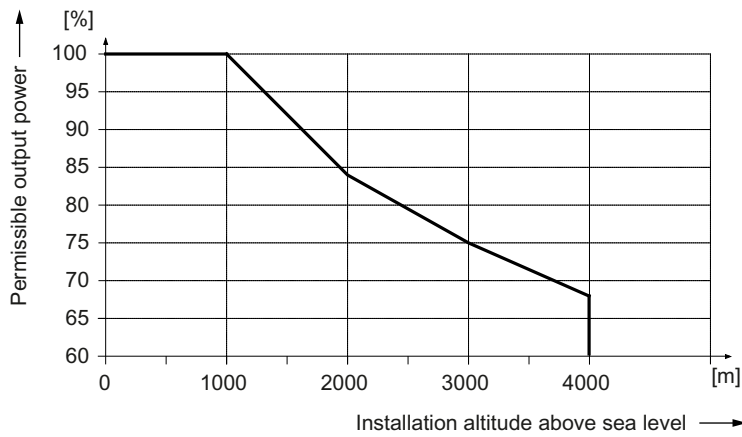


Figure 4-47 Output power as a function of the installation altitude

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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

## 4.6 Basic Line Modules with internal air cooling

### 4.6.1 Description

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

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

For 100 kW Basic Line Modules, an external braking unit is required for degradation of energy. Either Braking Modules Booksize Compact (also in parallel circuit) or a MASTERDRIVES braking unit (see Section "Braking units for 100 kW Basic Line Modules (Page 526)") can be used.

Basic Line Modules are suitable for direct operation on TN, TT, and IT systems.

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

The ratio of line short-circuit power to rated power must be  $\geq 30$ .

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

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#### Note

When handling/using a Line Module, it is imperative that you observe the safety instructions in Chapter 1.

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### 4.6.2 Interface description

#### 4.6.2.1 Overview

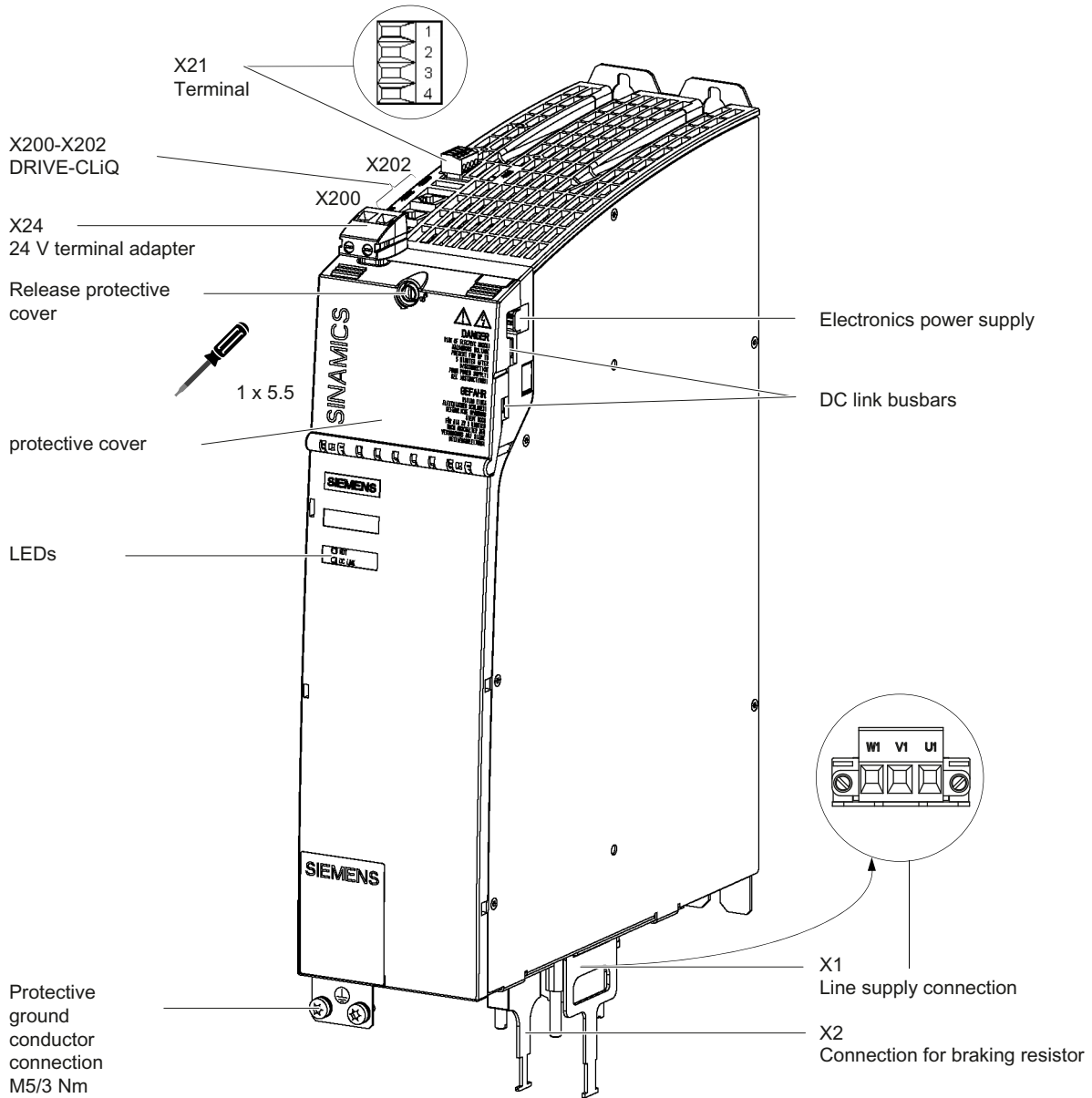
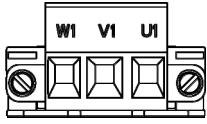
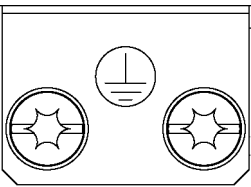


Figure 4-48 Interface overview, Basic Line Module with internal air cooling (example: 20 kW)



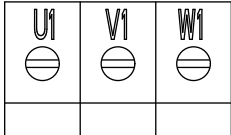
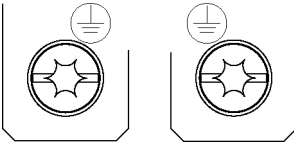
## 4.6.2.2 X1 line connection

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

	Terminal	Technical data
	U1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 16 mm <sup>2</sup> Type: Screw terminal 7 Tightening torque: 1.5 - 1.7 Nm (see Section "Control cabinet installation / connection system")
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm <sup>1)</sup>

1) For ring cable lugs in accordance with DIN 46234

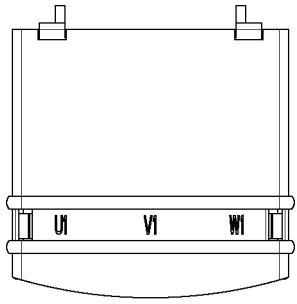
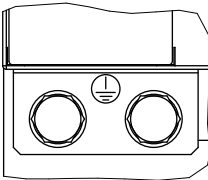
Table 4- 41 X1: Line supply connection for Basic Line Modules 40 kW

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

1) For ring cable lugs in accordance with DIN 46234

4.6 Basic Line Modules with internal air cooling

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

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

1) For ring cable lugs in accordance with DIN 46234

4.6.2.3 X2 braking resistor connection

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

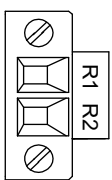
	Terminal	Designation	Technical specifications
	1	Braking resistor connection R1	Max. connectable cross-section: 4 mm <sup>2</sup> Type: Screw terminal 4 (see the chapter titled "Control cabinet installation/Connection system") Tightening torque: 0.5 - 0.6 Nm
	2	Braking resistor connection R2	

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

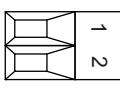
	Terminal	Designation	Technical specifications
	1	Braking resistor connection R1	Max. connectable cross-section: 10 mm <sup>2</sup> Type: Screw terminal 6 (see the chapter titled "Control cabinet installation/Connection system") Tightening torque: min 1.5 - 1.8 Nm
	2	Braking resistor connection R2	

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

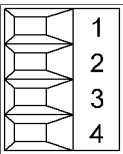
Braking resistor	R in $\Omega$	P <sub>N</sub> in kW	4 x P <sub>N</sub> in kW	P <sub>max</sub> in kW
6SE7018-0ES87-2DC0	80	1.25	5	7.5
6SE7021-6ES87-2DC0	40	2.5	10	15
6SE7023-2ES87-2DC0	20	5	20	30
6SE7028-0ES87-2DC0 <sup>1)</sup>	8	12.5	50	75

1) Not suitable for 20 kW Basic Line Module

For detailed technical information on the braking resistors, see the chapter titled "Braking resistors".

#### 4.6.2.4 X21 EP terminals

Table 4- 46 X21 EP terminal/temperature sensor

	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors <sup>1)</sup> : KTY84-1C130 <sup>2)</sup> /PTC <sup>2)</sup> /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. <b>Response thresholds</b> 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 <b>Fault reactions:</b> An alarm is output and the Basic Line Module is deactivated with a fault after one minute, if overtemperature is still present at the braking resistor. If there is no braking resistor, terminals 1 and 2 must be jumpered to deactivate the overtemperature.
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage 24 V DC
	4	EP M (Enable Pulses)	Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs
Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Section "Control cabinet installation and EMC / connection system")			

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.


4.6 Basic Line Modules with internal air cooling

Terminals X21.1 and X21.2

<b>NOTICE</b>
<b>Overheating of the resistor</b>
If the temperature switch is not connected, this can cause the resistor to overheat.

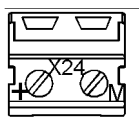
Terminals X21.3 and X21.4

 <b>WARNING</b>
<b>Connecting terminals X21.3 and X21.4</b>
For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. When removed, the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example because a line contactor is not installed, then the DC link remains charged.

 <b>DANGER</b>
<b>Danger to life through electric shock</b>
Only temperature sensors that meet the safety isolation specifications stipulated 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 danger to life!

4.6.2.5 X24 24 V terminal adapter

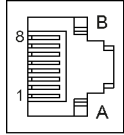
Table 4- 47 X24: 24 V terminal adapter

	Terminal	Designation	Technical data
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 (see Section "Control cabinet installation and EMC / connection system")			

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

## 4.6.2.6 X200-X202 DRIVE-CLiQ interfaces

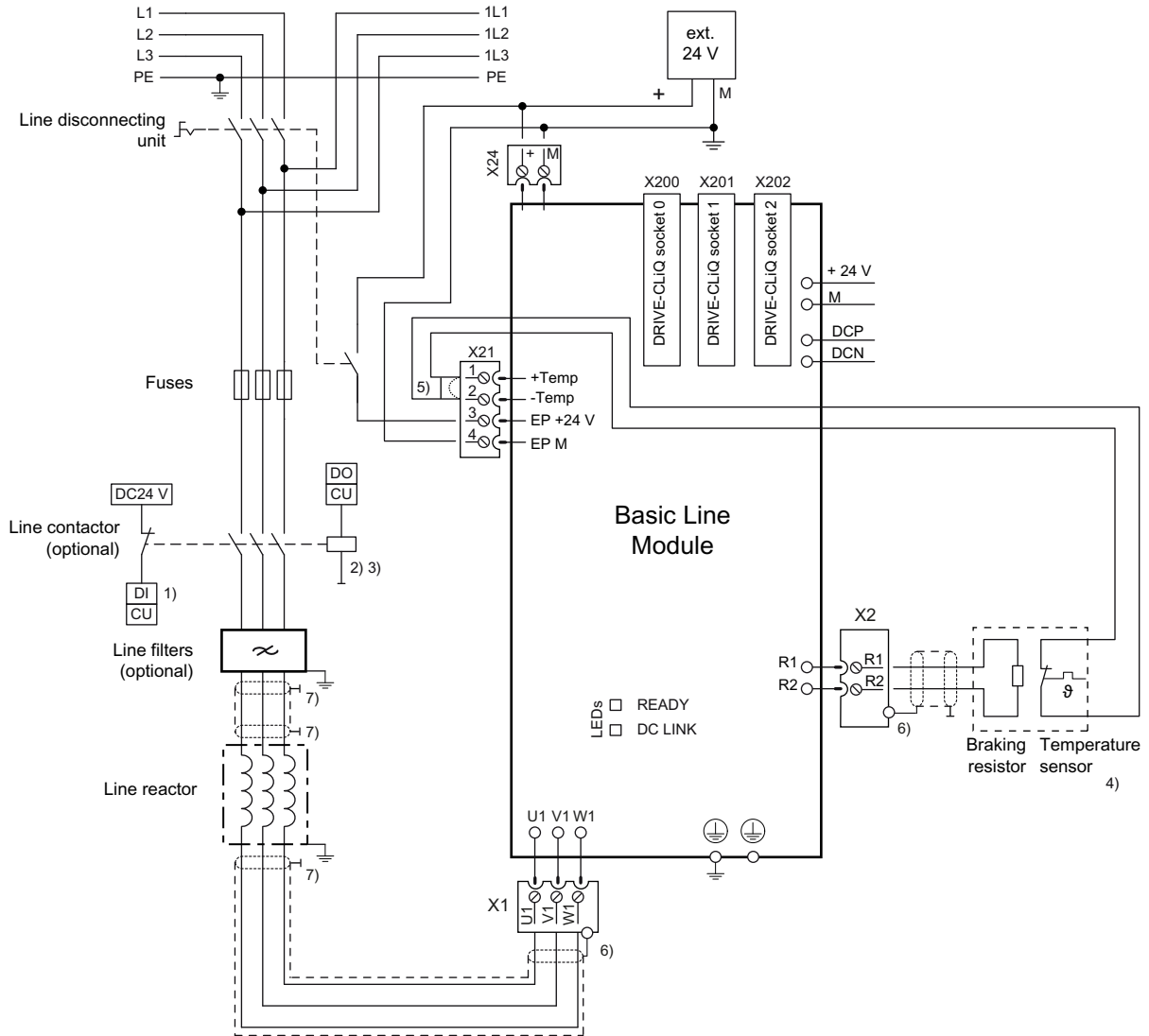
Table 4- 48 X200-X202: DRIVE-CLiQ interfaces

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

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

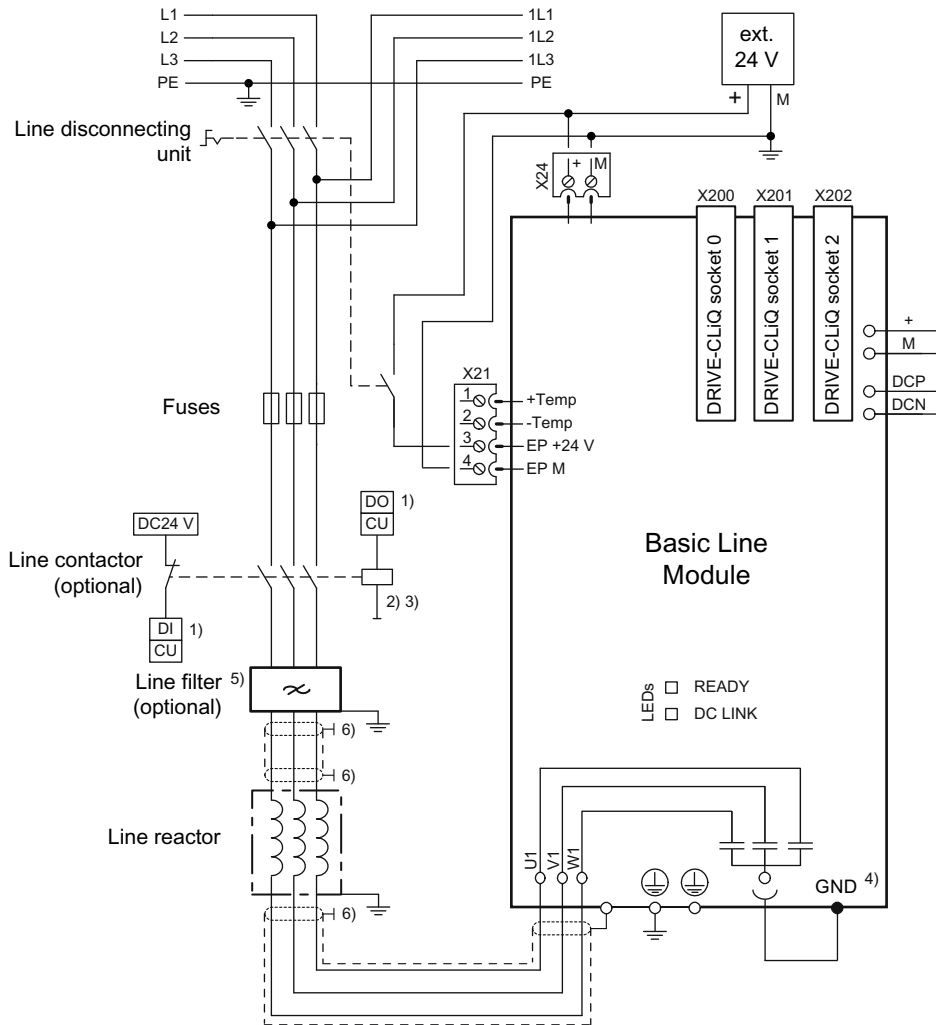
Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

### 4.6.3 Connection examples



- 1) DI/DO, controlled from the Control Unit
- 2) No additional load permitted downstream of line contactor!
- 3) The current carrying capacity of the digital output (DO) must be observed; an output interface must be used if required.
- 4) The bimetallic switch with wiring must not exceed a resistance value of 100 ohms in the closed state.
- 5) Jumper for switching off the temperature monitoring for the braking resistor.
- 6) Contact via connector (20 kW) or shield plate (40 kW).
- 7) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline.

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



- 1) DI/DO, controlled from 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 interface must be used if required.
- 4) When operating the component on an IT system, the connecting bar must be removed.
- 5) Line filter is required in order to maintain radio interference voltage according to category C2.
- 6) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline.

Figure 4-50 Connection example: Basic Line Module (100 kW)

## 4.6.4 Meaning of LEDs

Table 4- 49 Meaning of the LEDs on the Basic Line Module

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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. <b>Note:</b> 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). <b>Note:</b> 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!



4.6.5 Dimension drawings

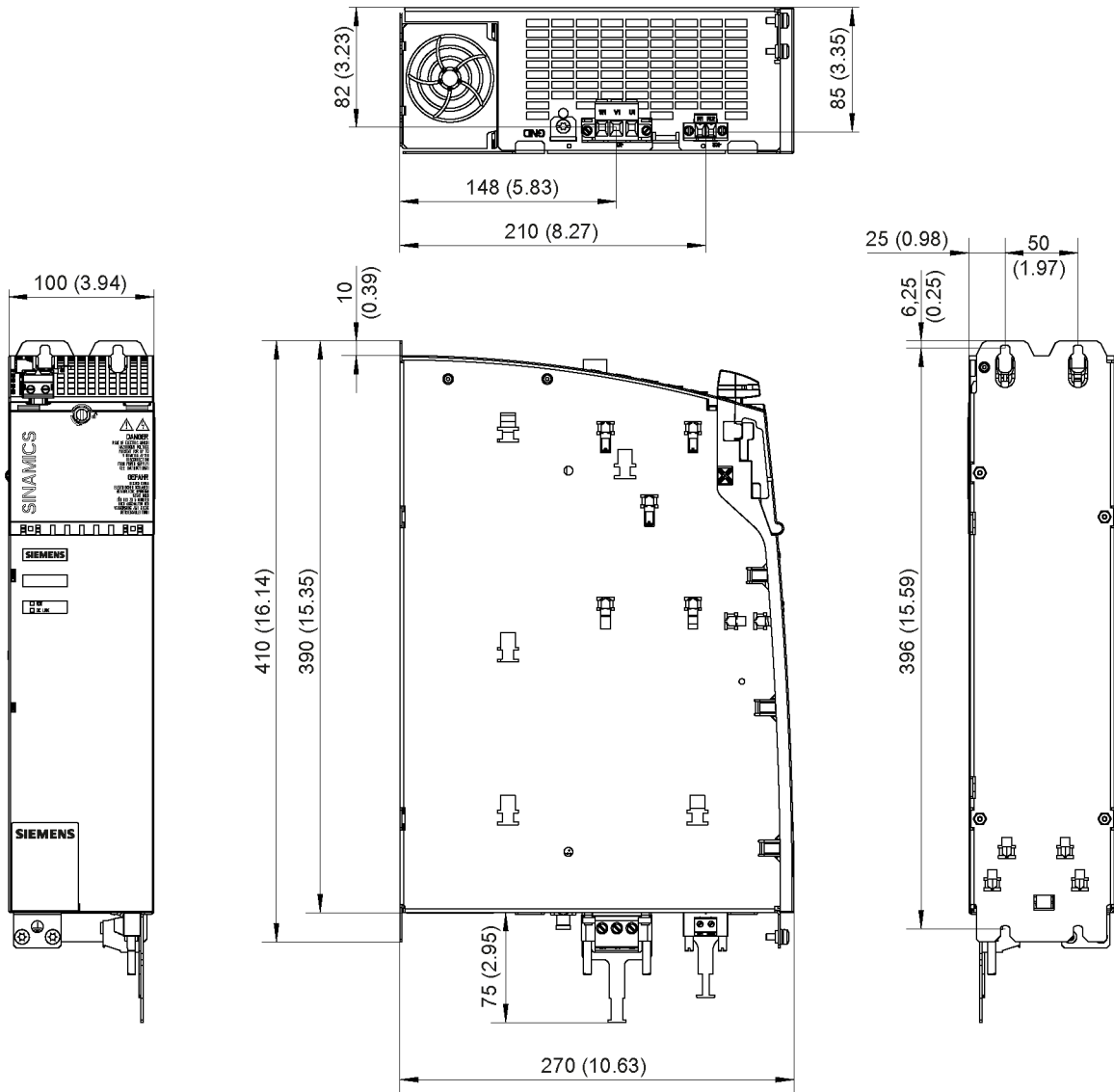


Figure 4-51 Dimension drawing of 20 kW Basic Line Module with internal air cooling, all dimensions in mm and (inches)

4.6 Basic Line Modules with internal air cooling

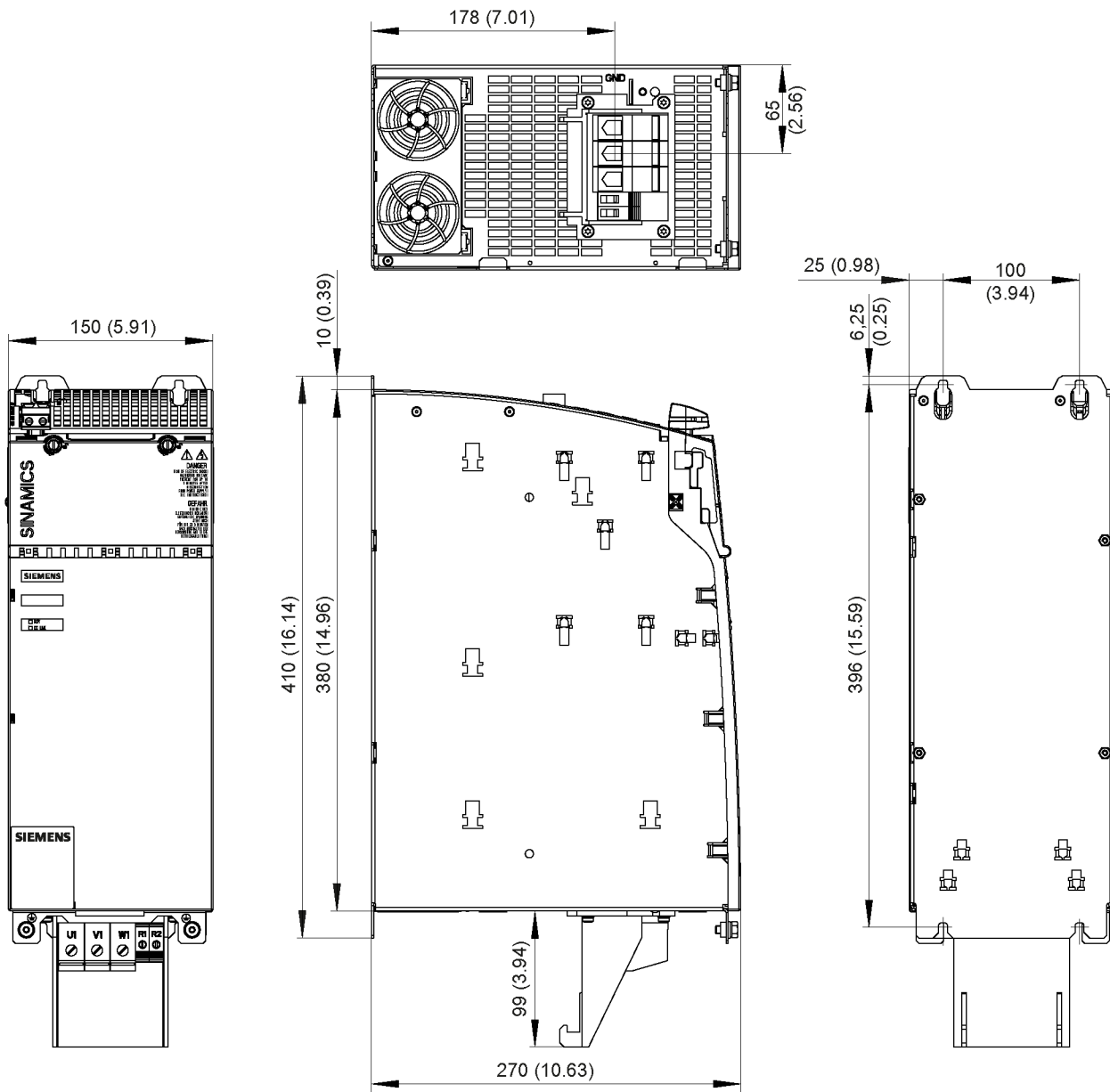


Figure 4-52 Dimension drawing of 40 kW Basic Line Module with internal air cooling, all dimensions in mm and (inches)

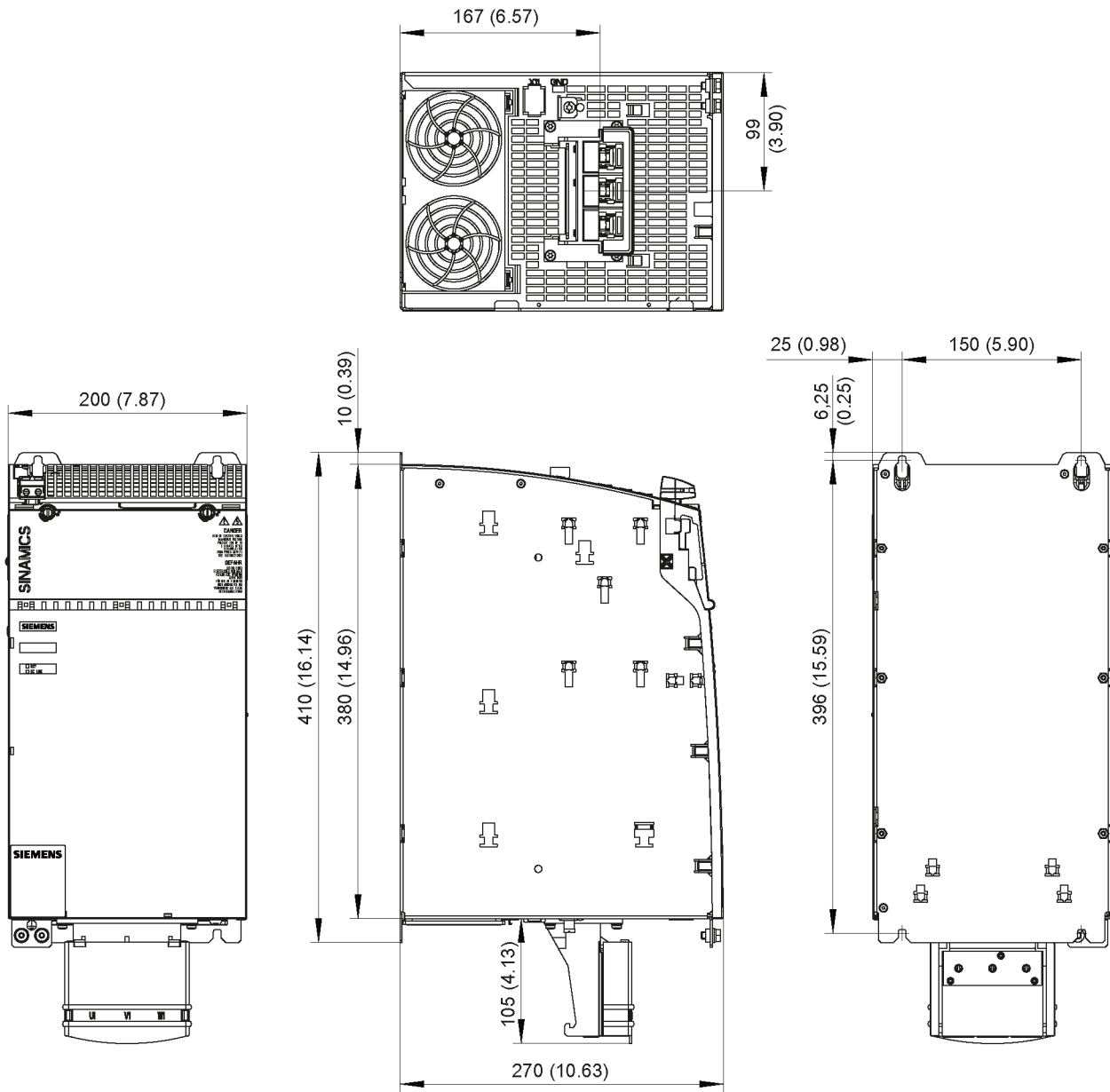
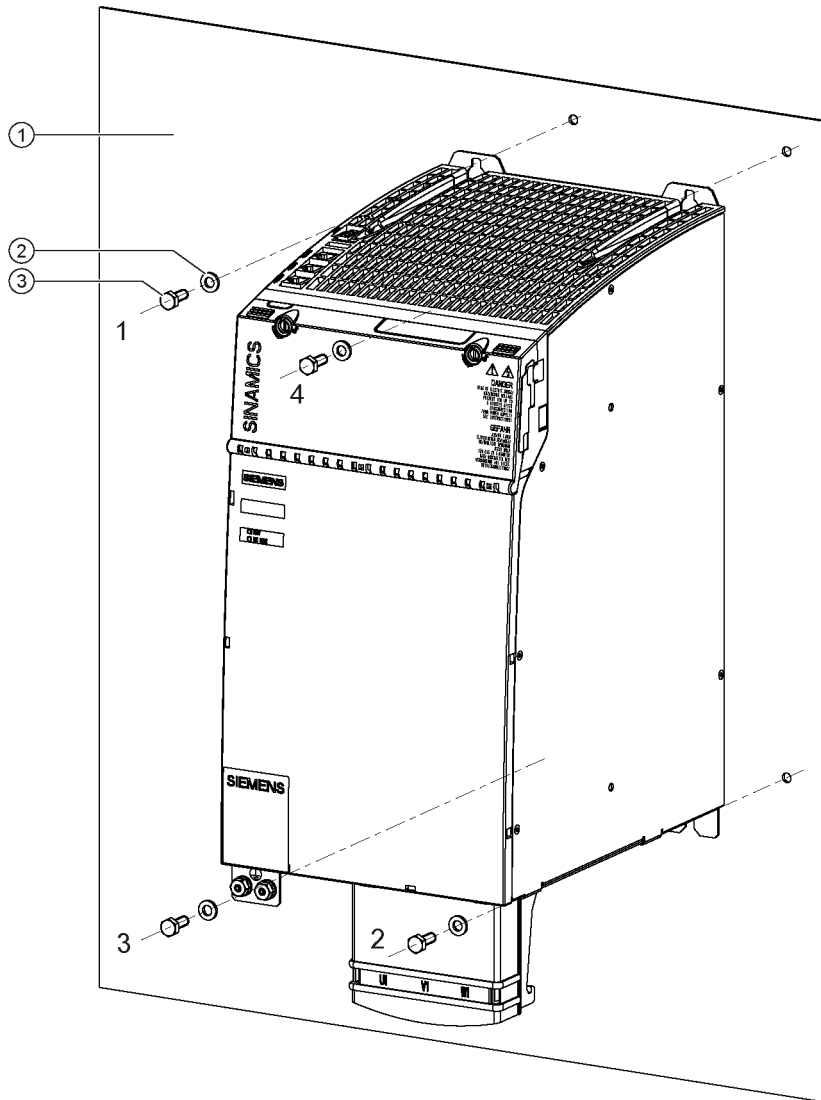


Figure 4-53 Dimension drawing of 100 kW Basic Line Module with internal air cooling, all dimensions in mm and (inches)

### 4.6.6 Installation

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



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

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

#### Tightening torques:


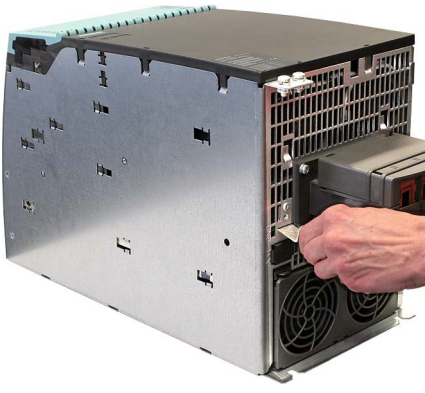

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 6 Nm (in the specific sequence 1 to 4)

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

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

##### NOTICE

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.

## 4.6.8 Technical data

Table 4- 50 Technical data: Basic Line Modules

Internal air cooling	6SL3130-	1TE22-0AA0	1TE24-0AA0	1TE31-0AA0
<b>Rated power</b>	kW	20	40	100
<b>Infeed</b>				
Rated power (S1) <sup>1)</sup>	kW (P <sub>n</sub> )	20	40	100
Infeed power (S6-40%) <sup>1)</sup>	kW (P <sub>S6</sub> )	26	52	130
Peak infeed power <sup>1)</sup>	kW (P <sub>max</sub> )	60	120	175
<b>Braking power</b>				
Continuous power	kW (P <sub>n</sub> )	5	10	-
Peak power	kW (P <sub>max</sub> )	40	80	-
<b>Supply voltages</b>				
Line voltage	V <sub>ACrms</sub>	3 AC 380 to 480 ±10% (-15% < 1 min) <sup>2)</sup>		
Line frequency	Hz	47 to 63		
Electronics power supply	V <sub>DC</sub>	24 (20.4 – 28.8)		
DC link voltage	V <sub>DC</sub>	480 – 720		
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %		
Undervoltage trip <sup>3)</sup>	V <sub>DC</sub>	360 ± 2 %		
<b>Input currents</b>				
Rated input current: at 400 V <sub>AC</sub>	A <sub>AC</sub>	33	66	166
Input current at 380 V <sub>AC</sub> /480 V <sub>AC</sub>	A <sub>AC</sub>	35 / 28	70 / 55	172 / 138
at 400 V <sub>AC</sub> ; S6-40%	A <sub>AC</sub>	43	86	216
at 400 V <sub>AC</sub> ; peak current	A <sub>AC</sub>	100	199	290
<b>DC link currents</b>				
Rated DC link current at 600 V:	A <sub>DC</sub>	33.5	67	167
DC link current at 540 V:	A <sub>DC</sub>	37	48	185
at 600 V <sub>DC</sub> ; S6-40%	A <sub>DC</sub>	43	87	217
at 600 V <sub>DC</sub> ; peak current	A <sub>DC</sub>	100	200	292
<b>Current carrying capacity</b>				
DC link busbars	A <sub>DC</sub>	100	200	200
Reinforced DC link busbars	A <sub>DC</sub>	150	--	--
24 V DC busbars	A <sub>DC</sub>	20	20	20
<b>Electronics current consumption</b> at 24 V DC	A <sub>DC</sub>	1	1,4	2,0
<b>Total power loss</b> (including electronics losses) <sup>4)</sup>	W	144	283,6	628
<b>Max. ambient temperature</b>				
without derating	° C	40	40	40
with derating	° C	55	55	55
<b>DC link capacitance</b>				
Basic Line Module	µF	940	1880	4100
Drive line-up, max.	µF	20000	20000	50000
<b>Power factor</b> <sup>5)</sup>	cosφ	0,98	0,98	0,98
<b>Circuit breaker</b> (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 47)		

Internal air cooling	6SL3130-	1TE22-0AA0	1TE24-0AA0	1TE31-0AA0
Rated short-circuit current SCCR <sup>6)</sup>	kA	65	65	65
Cooling method (internal air cooling)		Internal fan		
Sound pressure level	dB(A)	<60 dB	<65 dB	<65 dB
Cooling air requirement	m <sup>3</sup> /h	56	112	180
Max. permissible heat sink temperature	° C	65	70	70
Rated voltage for rated data 3 AC 380 V				
Weight	kg	6,8	11,3	15,8

- 1) The 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  $\pm 10\%$  with appropriate parameter assignment and reduced output.
- 3) Default for 400 V line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.
- 4) For an overview, see the power loss tables in Section "Control cabinet installation".
- 5) Fundamental component only.
- 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.

#### 4.6.8.1 Characteristics

##### Rated duty cycles for Basic Line Modules

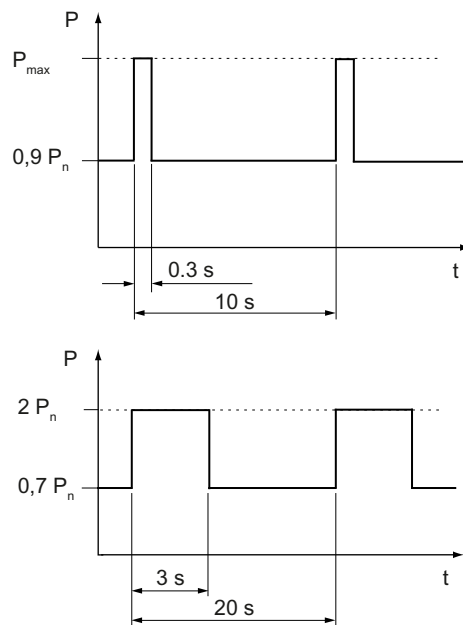


Figure 4-55 Duty cycles with initial load

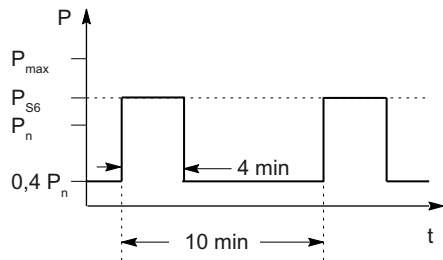


Figure 4-56 S6 duty cycle with pre-load condition

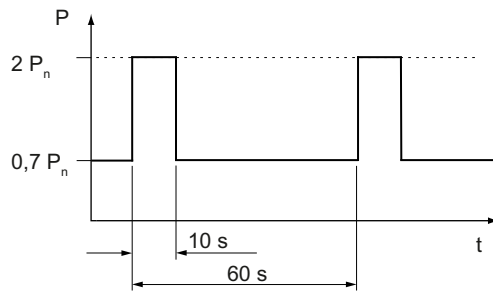
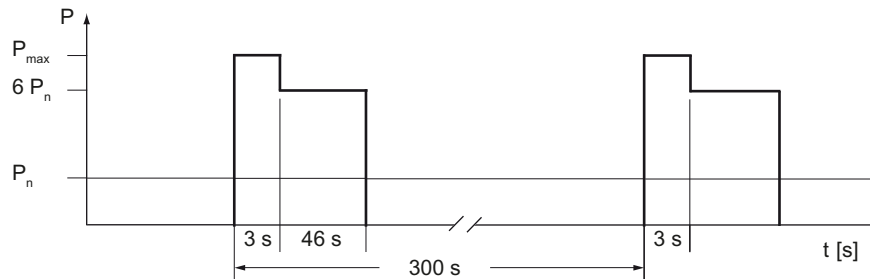


Figure 4-57 Duty cycle with pre-load condition for 20 kW and 40 kW Basic Line Modules

### Braking duty cycle for Basic Line Modules

Production machines



Machine tools

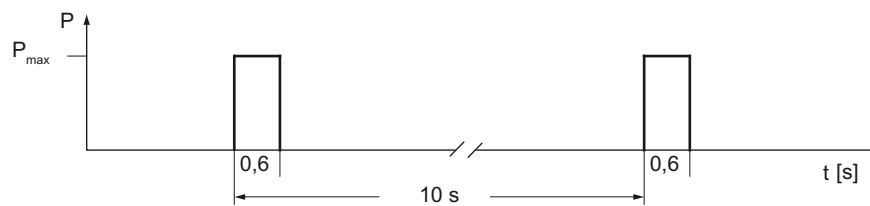


Figure 4-58 Braking duty cycle for Basic Line Modules



## Derating characteristics

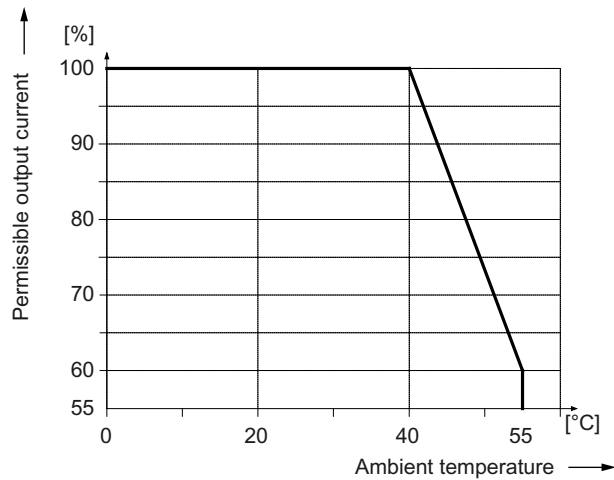


Figure 4-59 Output current as a function of the ambient temperature

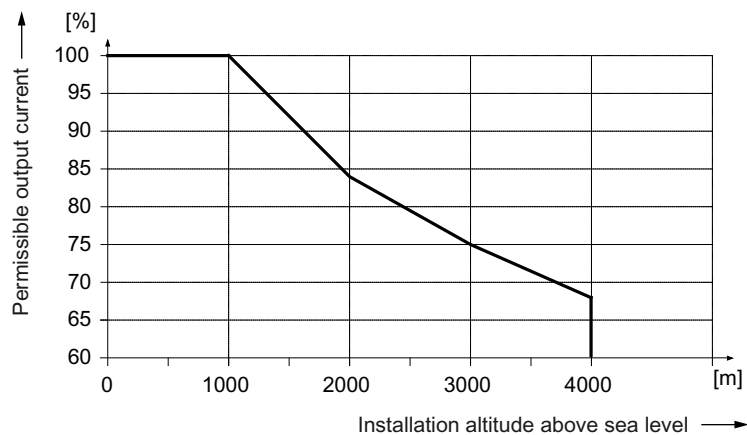


Figure 4-60 Output current as a function of the installation altitude

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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

## 4.7 Basic Line Modules with cold plate

### 4.7.1 Description

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

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

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

Basic Line Modules are suitable for direct operation on TN, TT, and IT systems.

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

The ratio of line short-circuit power to rated power must be  $\geq 30$ .

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

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#### Note

When handling/using a Line Module, it is imperative that you observe the safety instructions in Chapter 1.

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## 4.7.2 Interface description

### 4.7.2.1 Overview

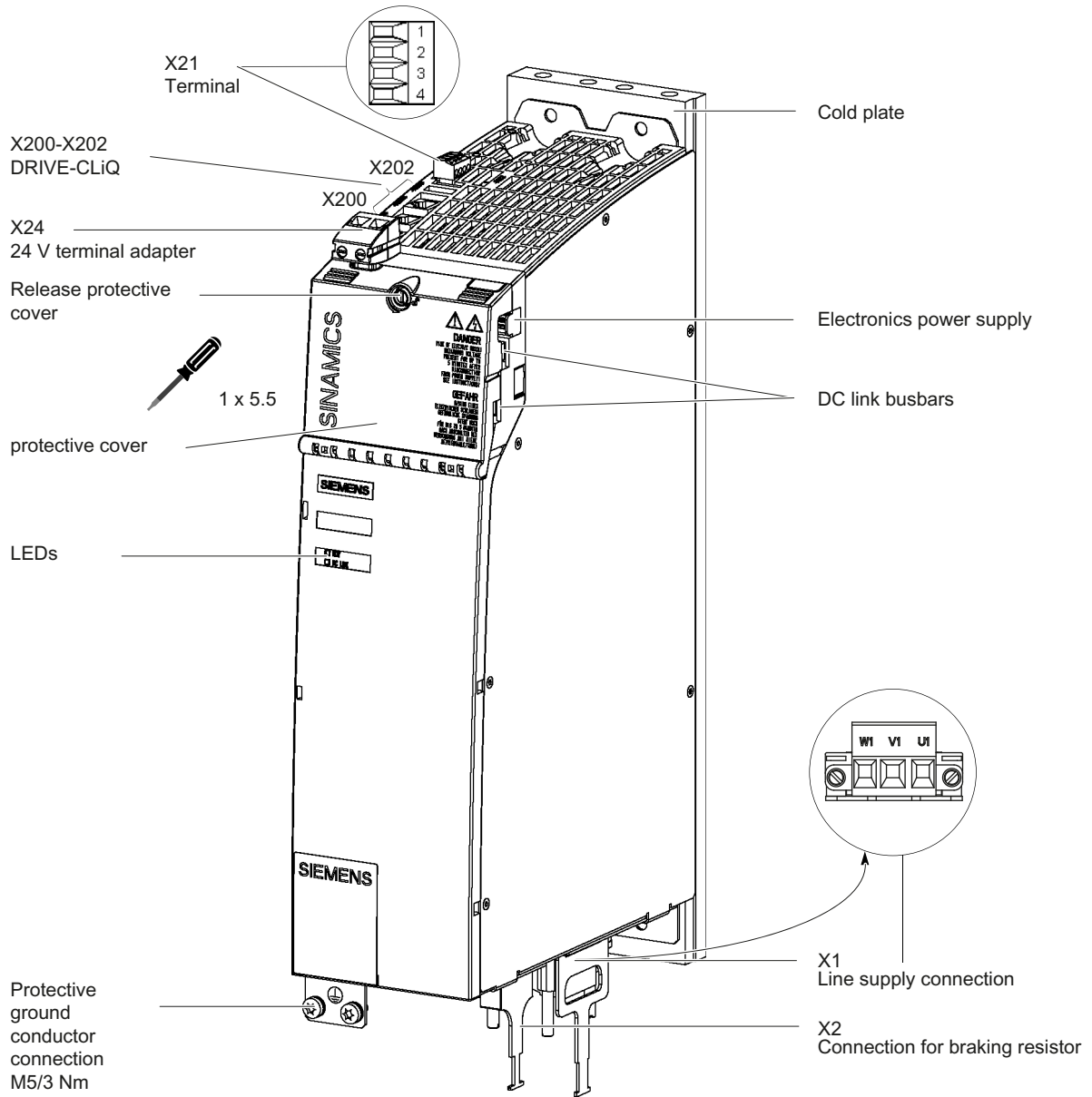
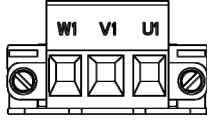
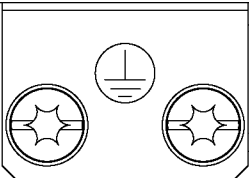


Figure 4-61 Interface overview, Basic Line Module with cold plate (example: 20 kW)

4.7 Basic Line Modules with cold plate

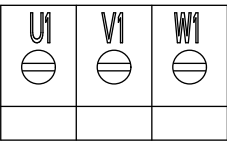
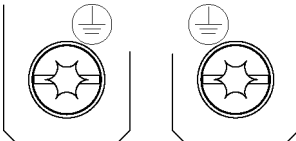
4.7.2.2 X1 line connection

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

	Terminal	Technical data
	U1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 16 mm <sup>2</sup> Type: Screw terminal 7 Tightening torque: 1.5 - 1.7 Nm (see Section "Control cabinet installation / connection system")
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm <sup>1)</sup>

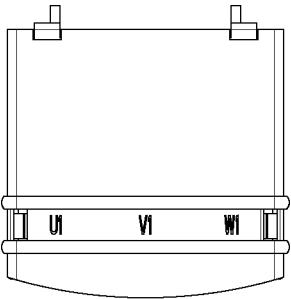
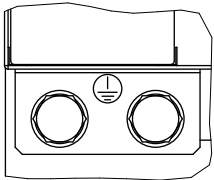
1) For ring cable lugs in accordance with DIN 46234

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

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

1) For ring cable lugs in accordance with DIN 46234

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

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

1) For ring cable lugs in accordance with DIN 46234

#### 4.7.2.3 X2 braking resistor connection

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

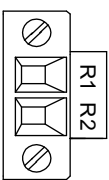
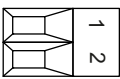
	Terminal	Designation	Technical specifications
	1	Braking resistor connection R1	Max. connectable cross-section: 4 mm <sup>2</sup> Type: Screw terminal 4 (see the chapter titled "Control cabinet installation/Connection system") Tightening torque: 0.5 - 0.6 Nm
	2	Braking resistor connection R2	

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

	Terminal	Designation	Technical specifications
	1	Braking resistor connection R1	Max. connectable cross-section: 10 mm <sup>2</sup> Type: Screw terminal 6 (see the chapter titled "Control cabinet installation/Connection system") Tightening torque: min 1.5 - 1.8 Nm
	2	Braking resistor connection R2	

4.7 Basic Line Modules with cold plate

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

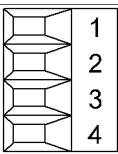
Braking resistor	R in Ω	P <sub>N</sub> in kW	4 x P <sub>N</sub> in kW	P <sub>max</sub> in kW
6SE7018-0ES87-2DC0	80	1.25	5	7.5
6SE7021-6ES87-2DC0	40	2.5	10	15
6SE7023-2ES87-2DC0	20	5	20	30
6SE7028-0ES87-2DC0 <sup>1)</sup>	8	12.5	50	75

1) Not suitable for 20 kW Basic Line Module

For detailed technical information on the braking resistors, see the chapter titled "Braking resistors".

4.7.2.4 X21 EP terminals

Table 4- 57 X21 EP terminal/temperature sensor

	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors <sup>1)</sup> : KTY84-1C130 <sup>2)</sup> /PTC <sup>2)</sup> /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. <b>Response thresholds</b> 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 <b>Fault reactions:</b> An alarm is output and the Basic Line Module is deactivated with a fault after one minute, if overtemperature is still present at the braking resistor. If there is no braking resistor, terminals 1 and 2 must be jumpered to deactivate the overtemperature.
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage 24 V DC
	4	EP M (Enable Pulses)	Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs
Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Section "Control cabinet installation and EMC / connection system")			

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.

**Terminals X21.1 and X21.2****NOTICE****Overheating of the resistor**

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

**Terminals X21.3 and X21.4****⚠ WARNING****Connecting terminals X21.3 and X21.4**

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. When removed, the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example because a line contactor is not installed, then the DC link remains charged.

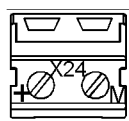
**⚠ DANGER****Danger to life through electric shock**

Only temperature sensors that meet the safety isolation specifications stipulated 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 danger to life!

**4.7.2.5 X24 24 V terminal adapter**

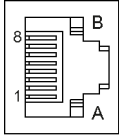
Table 4- 58 X24: 24 V terminal adapter

	Terminal	Designation	Technical data
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 (see Section "Control cabinet installation and EMC / connection system")			

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

4.7.2.6 X200-X202 DRIVE-CLiQ interfaces

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

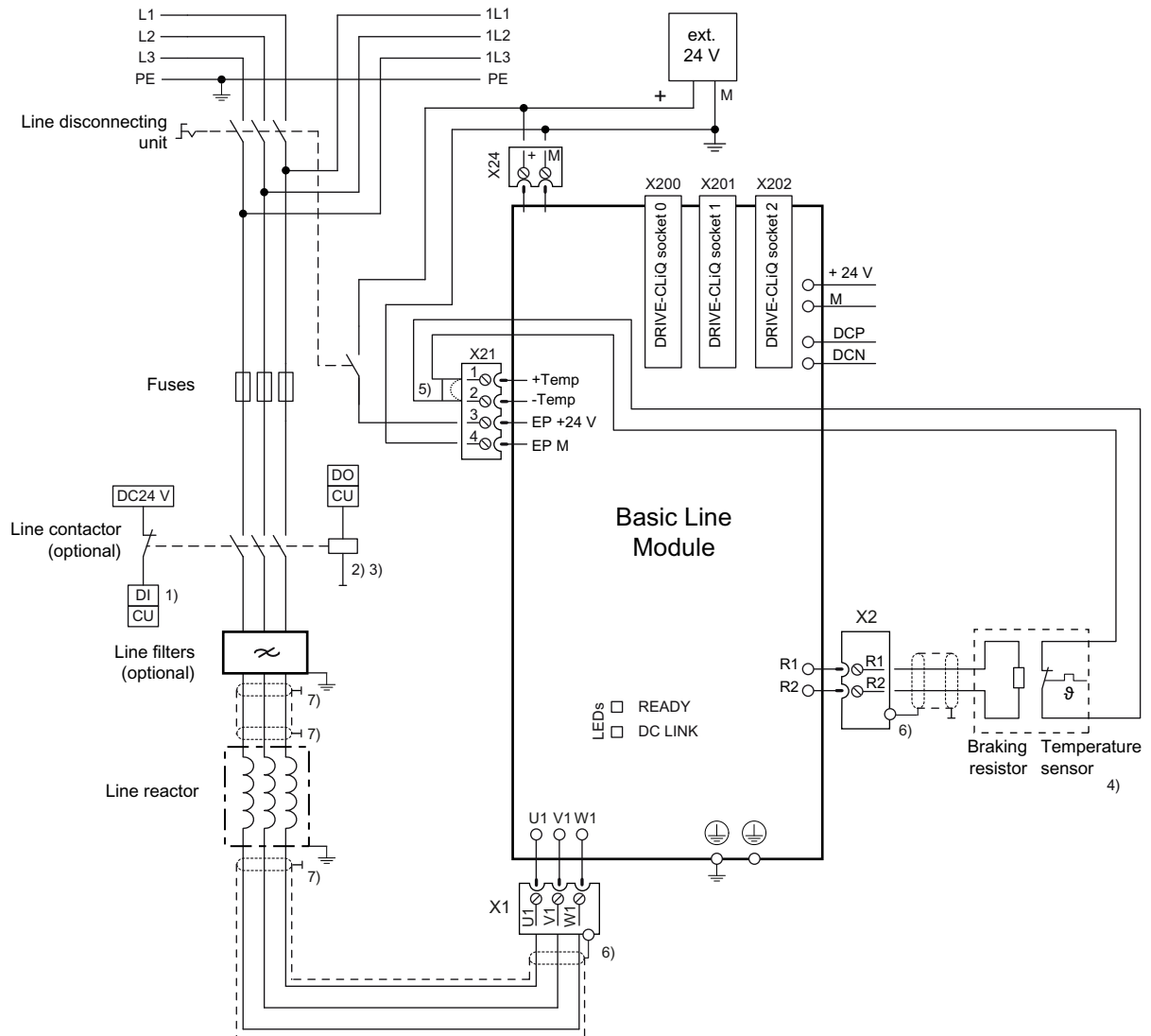
	PIN	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+(24 V)	24 V power supply
	B	M (0 V)	Electronics ground

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

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



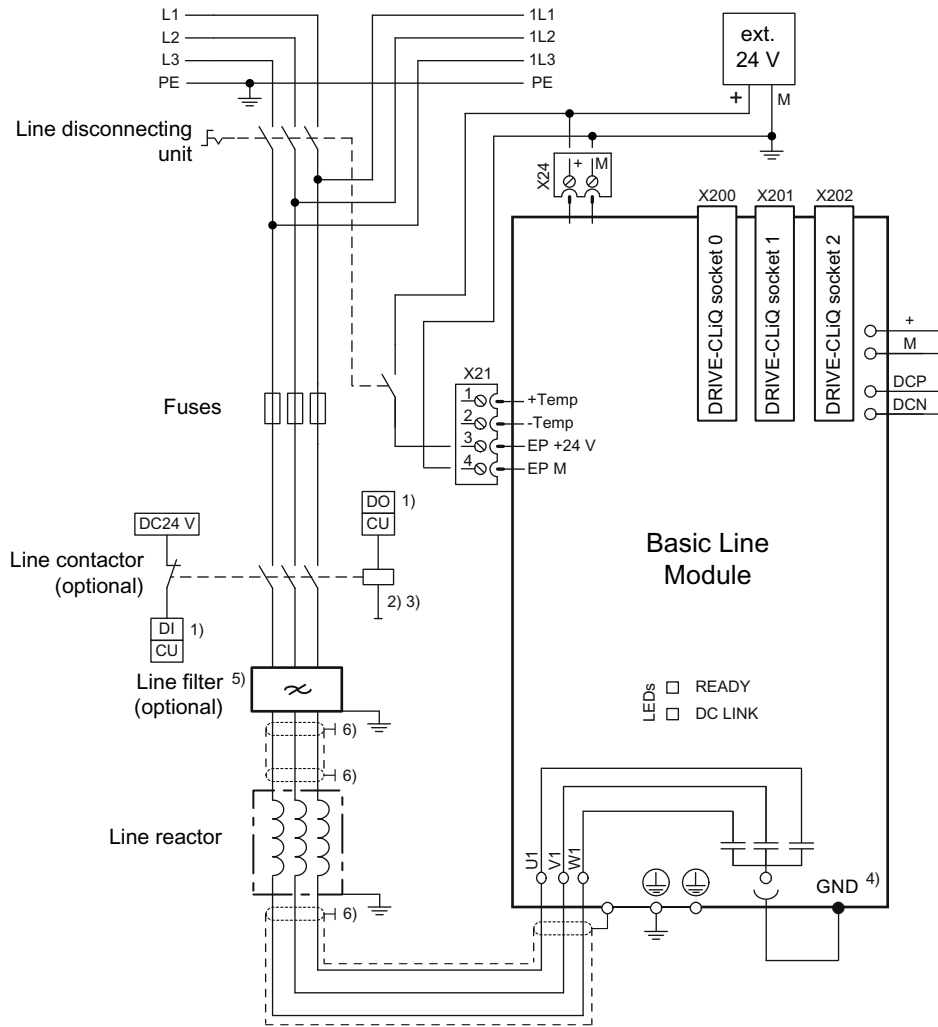
## 4.7.3 Connection examples



- 1) DI/DO, controlled from the Control Unit
- 2) No additional load permitted downstream of line contactor!
- 3) The current carrying capacity of the digital output (DO) must be observed; an output interface must be used if required.
- 4) The bimetallic switch with wiring must not exceed a resistance value of 100 ohms in the closed state.
- 5) Jumper for switching off the temperature monitoring for the braking resistor.
- 6) Contact via connector (20 kW) or shield plate (40 kW).
- 7) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline.

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

4.7 Basic Line Modules with cold plate



- 1) DI/DO, controlled from 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 interface must be used if required.
- 4) When operating the component on an IT system, the connecting bar must be removed.
- 5) Line filter is required in order to maintain radio interference voltage according to category C2.
- 6) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline.

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

## 4.7.4 Meaning of LEDs

Table 4- 60 Meaning of the LEDs on the Basic Line Module

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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. <b>Note:</b> 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). <b>Note:</b> 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!

### 4.7.5 Dimension drawings

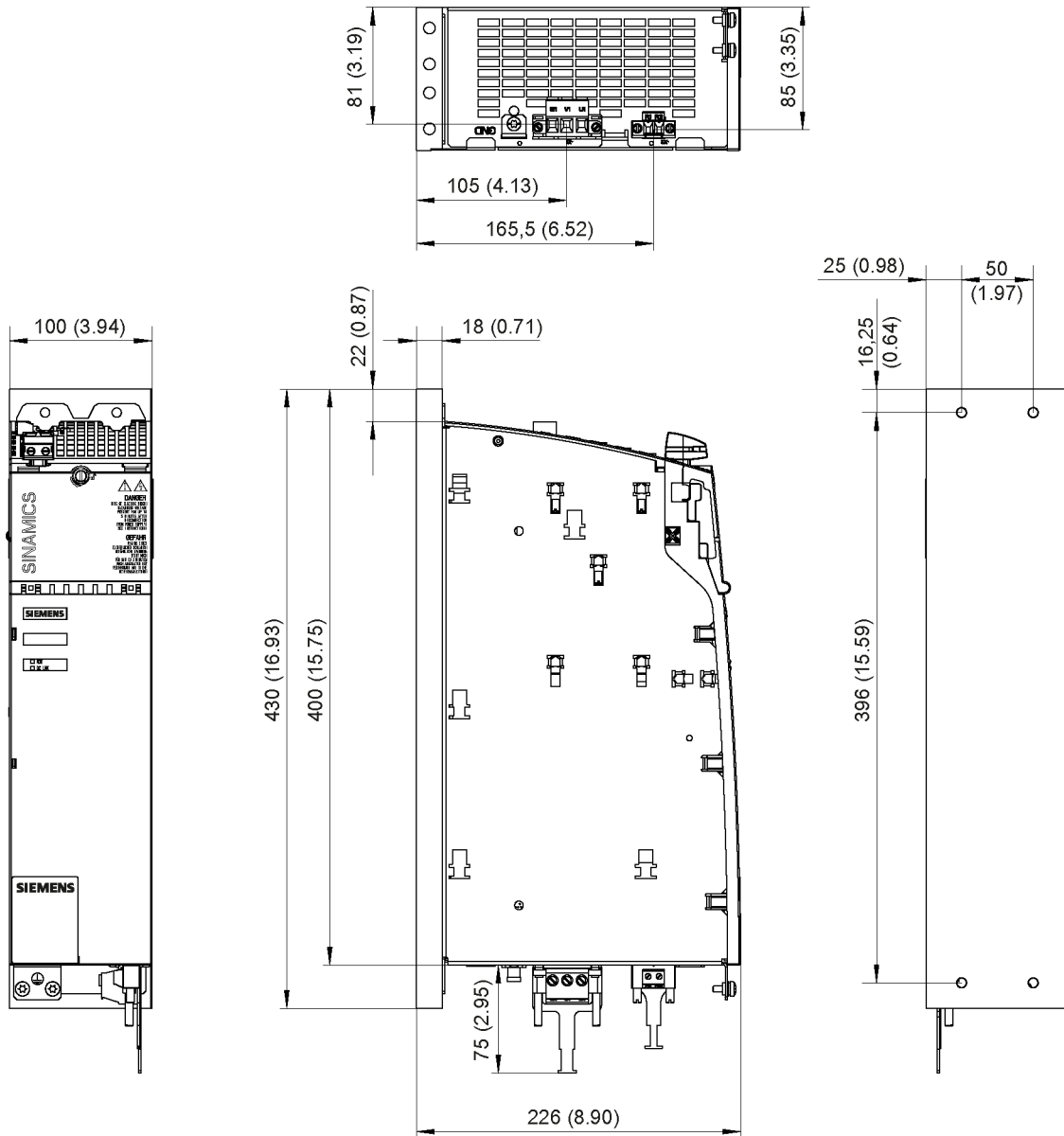


Figure 4-64 Dimension drawing of 20 kW Basic Line Module with cold plate, all dimensions in mm and (inches)

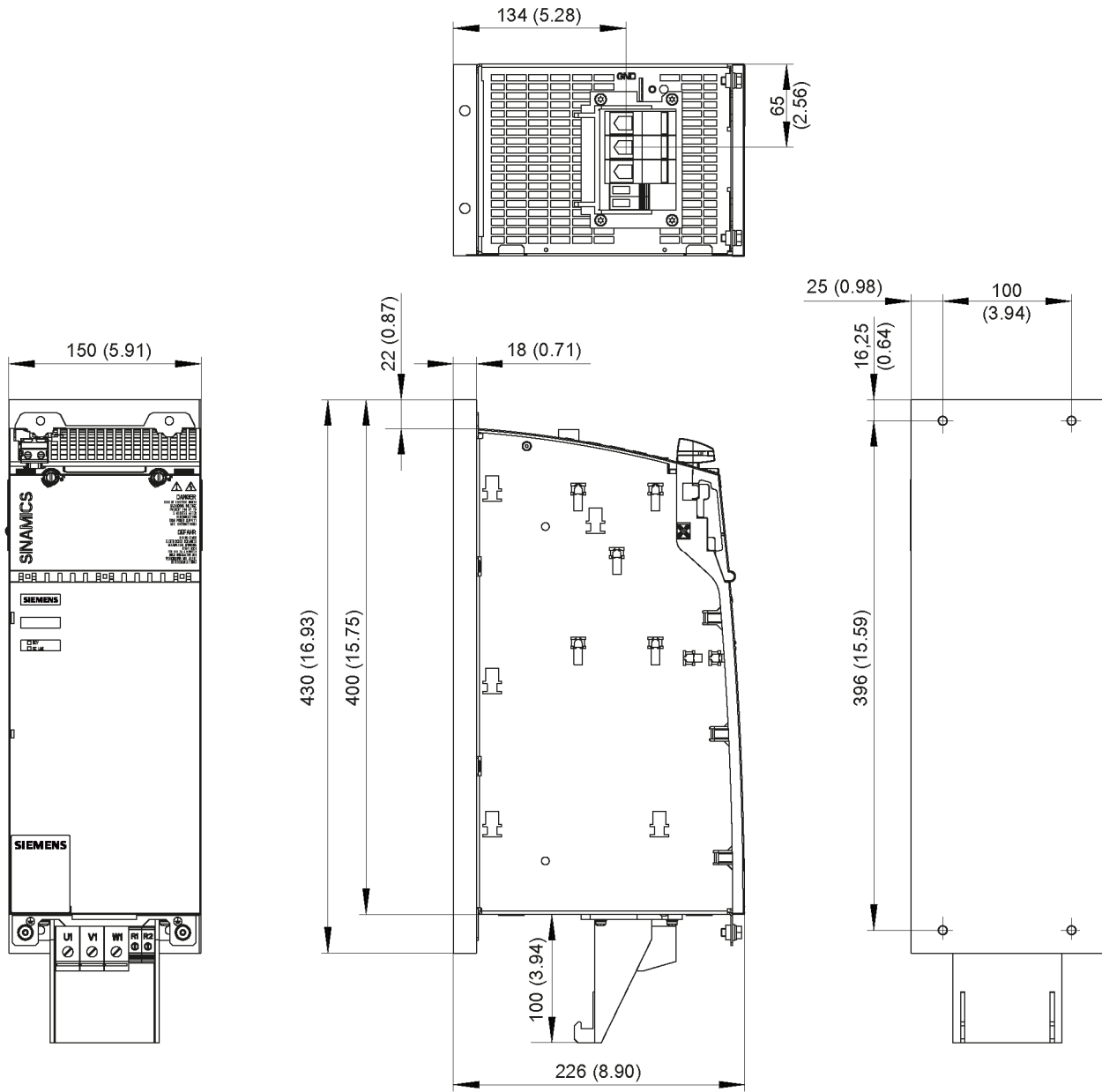


Figure 4-65 Dimension drawing of 40 kW Basic Line Module with cold plate, all dimensions in mm and (inches)

4.7 Basic Line Modules with cold plate

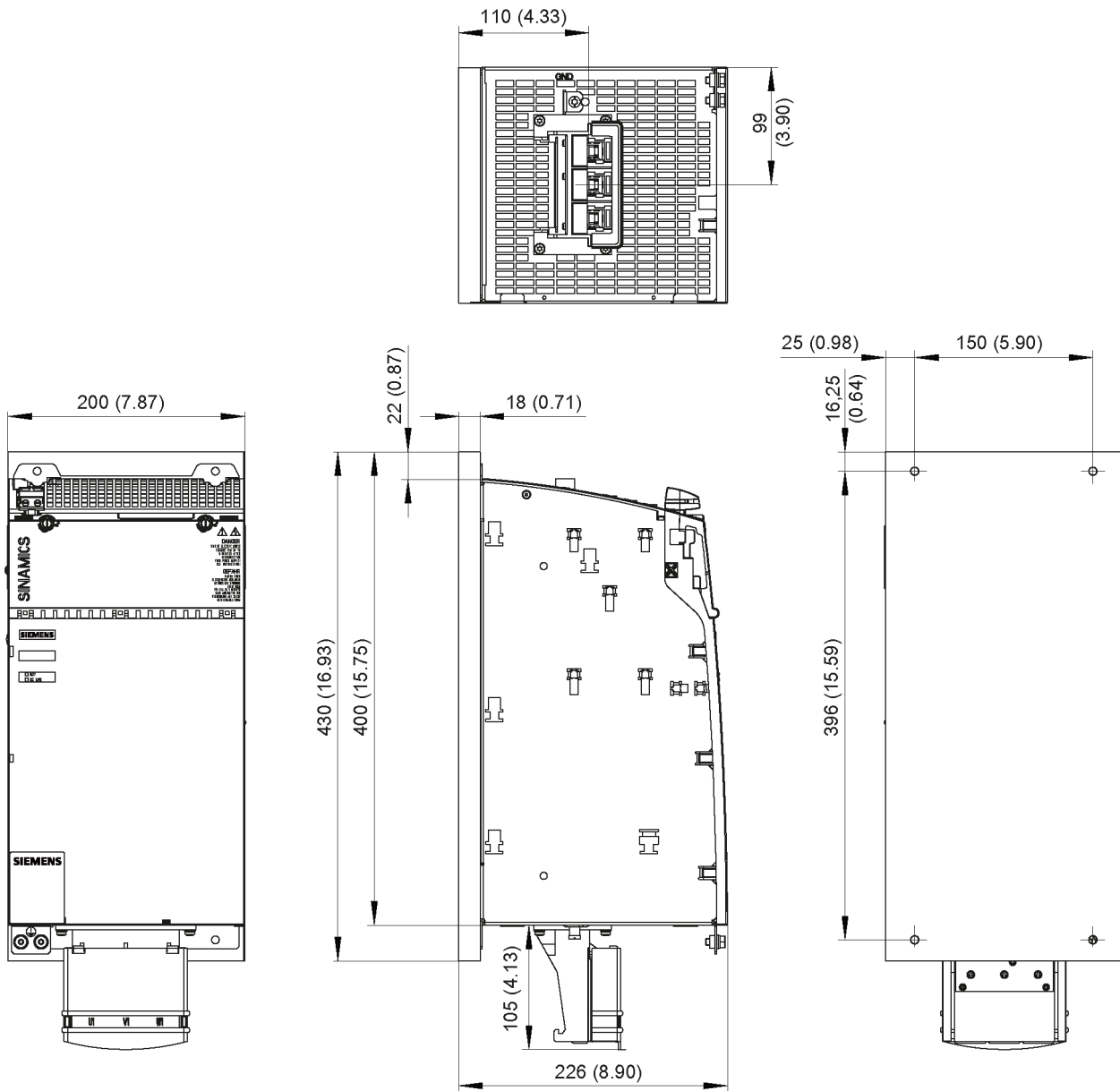


Figure 4-66 Dimension drawing of 100 kW Basic Line Module with cold plate, all dimensions in mm and (inches)

## 4.7.6 Mounting

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

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

---

### Note

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

Table 4- 61 Overview of heat-conducting foils

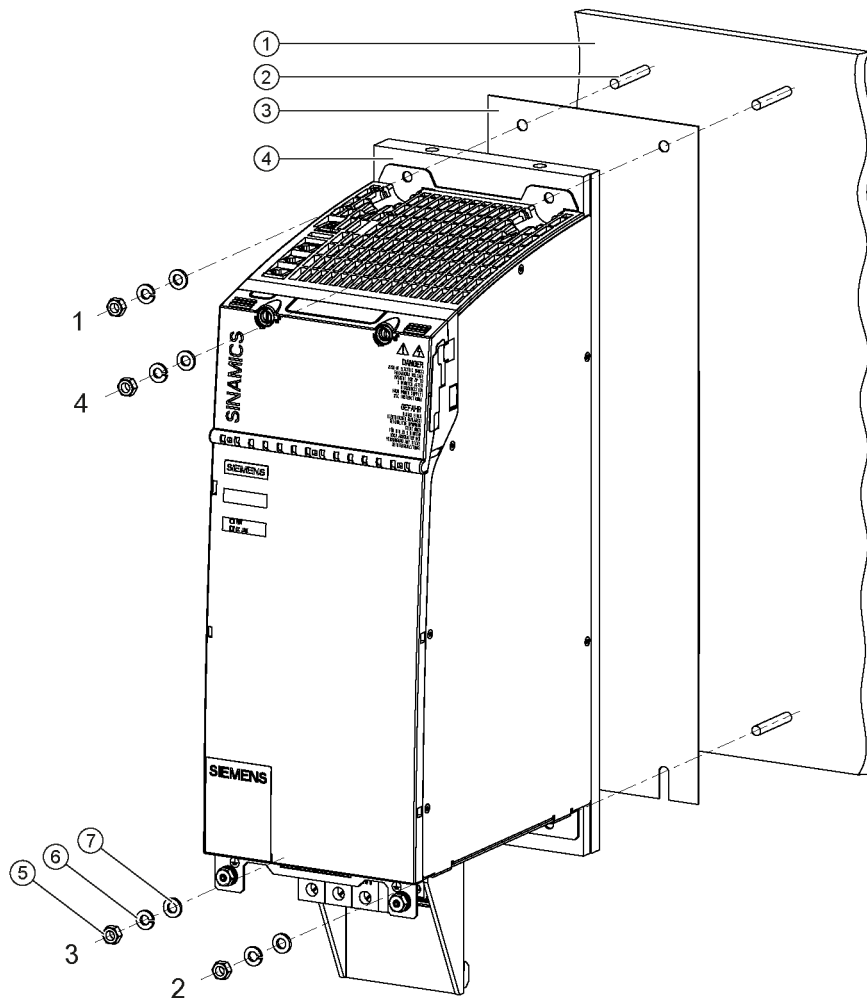
	Order number
Heat-conducting foil, 100 mm	6SL3162-6FD00-0AA0
Heat-conducting foil, 150 mm	6SL3162-6FF00-0AA0
Heat-conducting foil, 200 mm	6SL3162-6FH00-0AA0

---

### Note

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

---



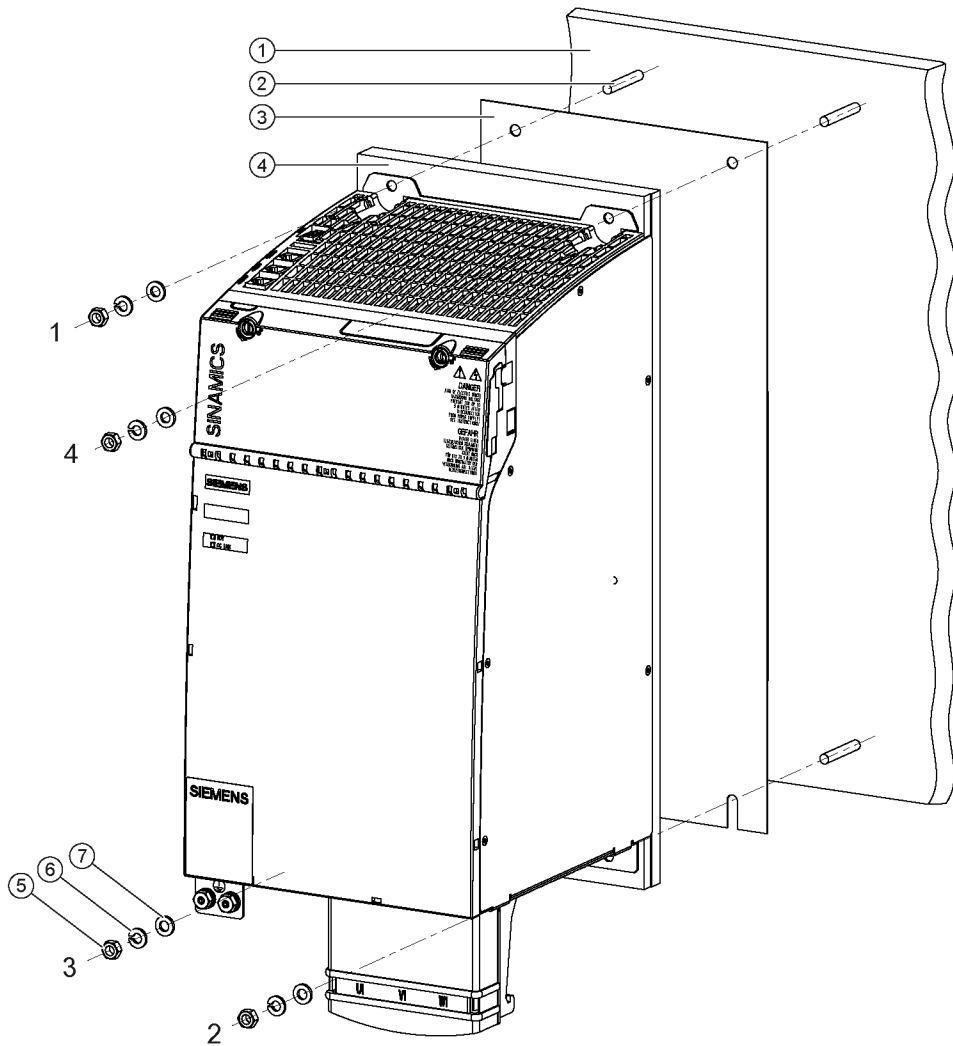
- ① External heat sink
- ② M6 studs
- ③ Heat-conducting foil
- ④ Cold plate
- ⑤ M6 nut
- ⑥ Spring washer
- ⑦ Washer

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

**Tightening torques:**

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm (in the specific sequence 1 to 4)





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

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

#### Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm (in the specific sequence 1 to 4)

Help with the mechanical control cabinet design is available from:

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

### Properties of the heat sink

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

---

#### Note

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

---

<b>NOTICE</b>
---------------

<b>Ensure that the threaded bolts do not damage the cold plate</b>
--




- |   |
|---|
| <ul style="list-style-type: none"><li>• When mounting, ensure that the threaded bolts do not damage the cold plate.</li></ul> |
|---|

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

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

<b>NOTICE</b>
---------------

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.

**4.7.8 Technical data**

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

	6SL3136-	1TE22-0AA0	1TE24-0AA0	1TE31-0AA0
<b>Rated power</b>	<b>kW</b>	<b>20</b>	<b>40</b>	<b>100</b>
<b>Infeed</b>				
Rated power (S1) <sup>1)</sup>	kW (P <sub>n</sub> )	20	40	100
Infeed power (S6-40%) <sup>1)</sup>	kW (P <sub>S6</sub> )	26	52	130
Peak infeed power <sup>1)</sup>	kW (P <sub>max</sub> )	60	120	175
<b>Braking power</b>				
Continuous power	kW (P <sub>n</sub> )	5	10	-
Peak power	kW (P <sub>max</sub> )	40	80	-
<b>Supply voltages</b>				
Line voltage	V <sub>ACrms</sub>	3 AC 380 to 480 ±10% (-15% < 1 min)		
Line frequency	Hz	47 to 63		
Electronics power supply	V <sub>DC</sub>	24 (20.4 – 28.8)		
DC link voltage	V <sub>DC</sub>	510 – 720		
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %		
Undervoltage trip <sup>2)</sup>	V <sub>DC</sub>	360 ± 2 %		

## 4.7 Basic Line Modules with cold plate

	6SL3136-	1TE22-0AA0	1TE24-0AA0	1TE31-0AA0
<b>Rated input currents</b> at 380 V <sub>AC</sub> at 480 V <sub>AC</sub> /528 V <sub>AC</sub> at 480 V; S6-40% <b>Peak current</b> (at 400 V <sub>AC</sub> /480 V <sub>AC</sub> )	A <sub>AC</sub> A <sub>AC</sub> A <sub>AC</sub> A <sub>AC</sub>	34.5 31 / 29 38 113 / 91	69 62 / 58 78 208 / 172	172 154 / 145 193 265 / 252
<b>DC link currents</b> Rated DC link current at 600 V: DC link current at 540 V: at 600 V <sub>DC</sub> ; S6-40% at 600 V <sub>DC</sub> ; peak current	A <sub>DC</sub> A <sub>DC</sub> A <sub>DC</sub> A <sub>DC</sub>	33.5 37 43 100	67 48 87 200	167 185 217 292
<b>Current carrying capacity</b> DC link busbars Reinforced DC link busbars 24 V DC busbars	A <sub>ACrms</sub> A <sub>ACrms</sub> A <sub>ACrms</sub>	100 150 20	200 -- 20	200 -- 20
<b>Electronics current consumption</b> at 24 V DC	A <sub>DC</sub>	0,9	1,1	1,6
<b>Total power loss</b> (incl. electronics losses) <sup>5)</sup>	W	141,6	276,4	618,4
<b>DC link capacitance</b> Basic Line Module Drive line-up, max.	μF μF	940 20000	1880 20000	4100 20000
<b>Power factor</b> <sup>3)</sup>	cosφ	approx. 0.98		
<b>Circuit breaker</b> (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 47)		
<b>Rated short-circuit current</b> SCCR <sup>4)</sup>	kA	65	65	65
<b>Max. ambient temperature</b> without derating with derating	° C ° C	40 55	40 55	40 55
<b>Max. permissible heat sink temperature</b>	° C	70	70	70
<b>Weight</b>	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 line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.

3) Fundamental component only.

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.

5) For an overview, see the power loss tables in Section "Control cabinet installation".

4.7.8.1 Characteristics

Rated duty cycles for Basic Line Modules

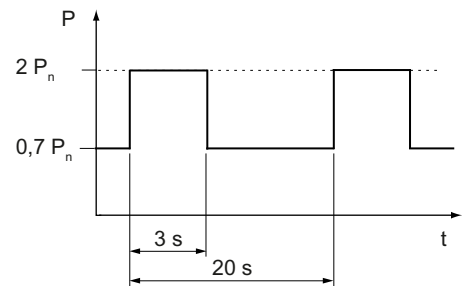
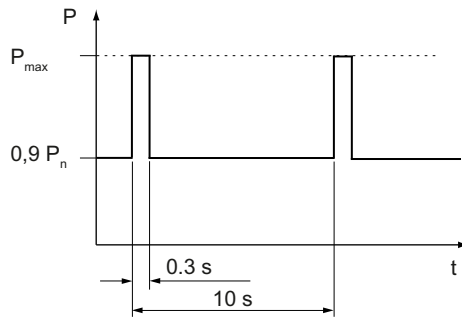


Figure 4-69 Duty cycles with initial load

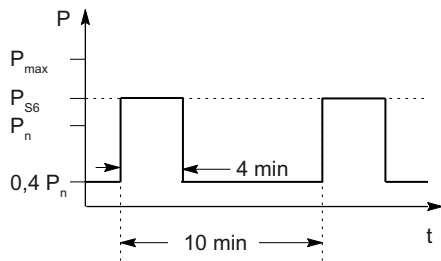


Figure 4-70 S6 duty cycle with pre-load condition

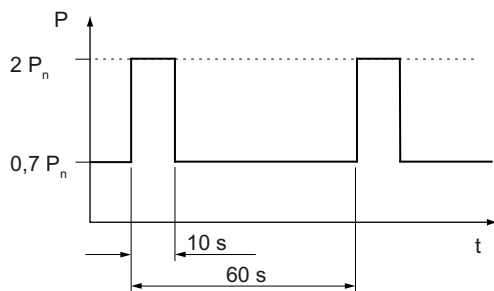


Figure 4-71 Duty cycle with pre-load condition for 20 kW and 40 kW Basic Line Modules

### Braking duty cycle for Basic Line Modules

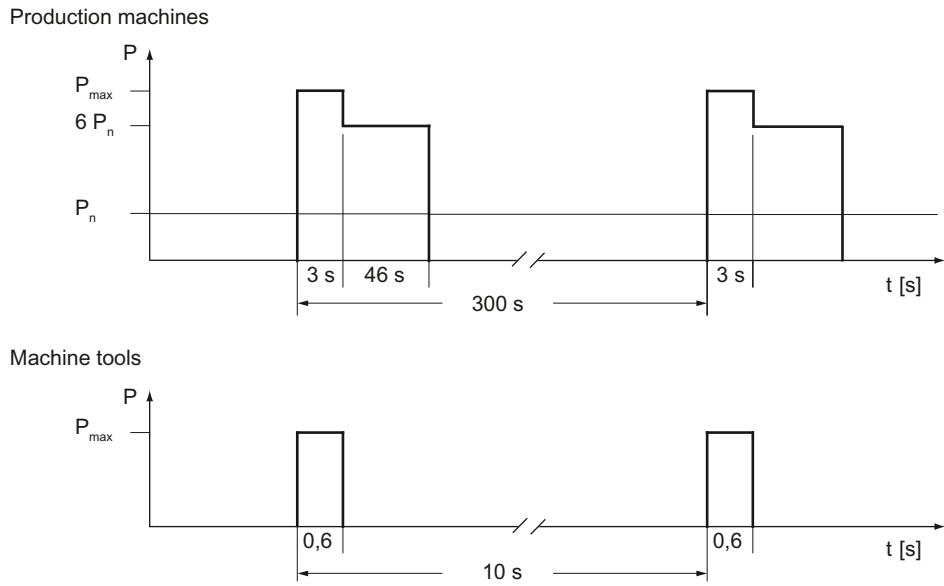


Figure 4-72 Braking duty cycle for Basic Line Modules

### Derating characteristics

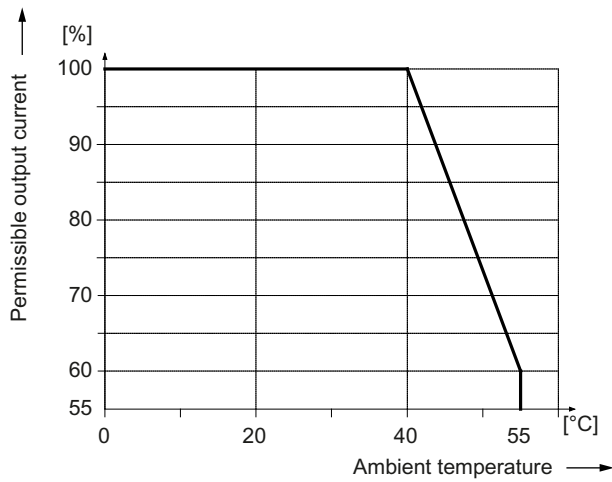


Figure 4-73 Output current as a function of the ambient temperature

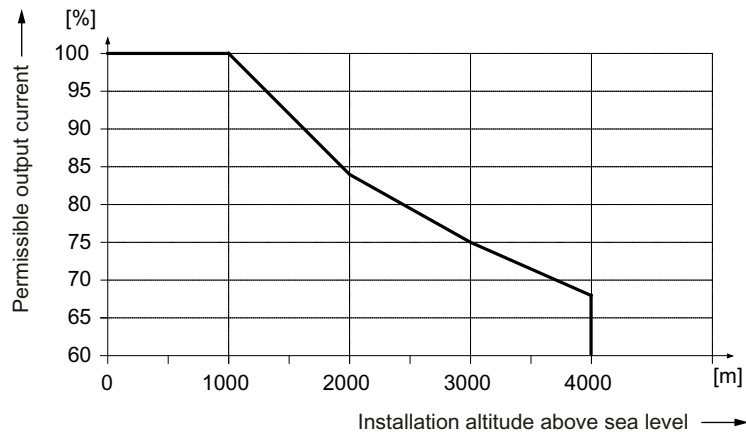


Figure 4-74 Output current as a function of the installation altitude

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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

## 4.8 Smart Line Modules with internal air cooling

### 4.8.1 Description

The Smart Line Module is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module(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. Regenerative feedback can be deactivated if required. On 5 kW and 10 kW Smart Line Modules, this is done via a terminal, since these modules do not feature a DRIVE-CLiQ connection. On 16 kW to 55 kW Smart Line Modules, regenerative feedback can be deactivated via parameters, as, just like Active Line Modules, these modules are equipped with a DRIVE-CLiQ connection.

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

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

## 4.8.2 Safety instructions for Smart Line Modules Booksize

### Note

When using a Smart Line Module, you should also strictly observe the product-specific safety instructions for Line Modules as well as the safety instructions in Section 1.

### NOTICE

#### Please note the switch-on and switch-off sequence

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21.1

#### Switch on:

- 24 V DC power supply X24 ON
- Line contactor ON
- EP signal X21.3 and X21.4 ON
- Wait until precharging is complete
- "Ready" signal at terminal X21.1 switched to high
- Infeed is ready, pulse enable possible for motors

#### Switch off:

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

#### Overload:

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



**Note**

**Connected to the public low-voltage network**

Smart Line Modules have been designed for use in the industrial environment and generate current harmonics on the line side as a result of the rectifier circuit.

When connecting a machine with integrated Smart Line Modules to the public low-voltage network, authorization is required in advance from the local power supply company (utility company) if

- the rated current of the machine  $\leq 16$  A per conductor, and
  - the rated machine current does not comply with the requirements specified in EN 61000-3-2 regarding current harmonics.
-

### 4.8.3 Interface description

#### 4.8.3.1 Overview

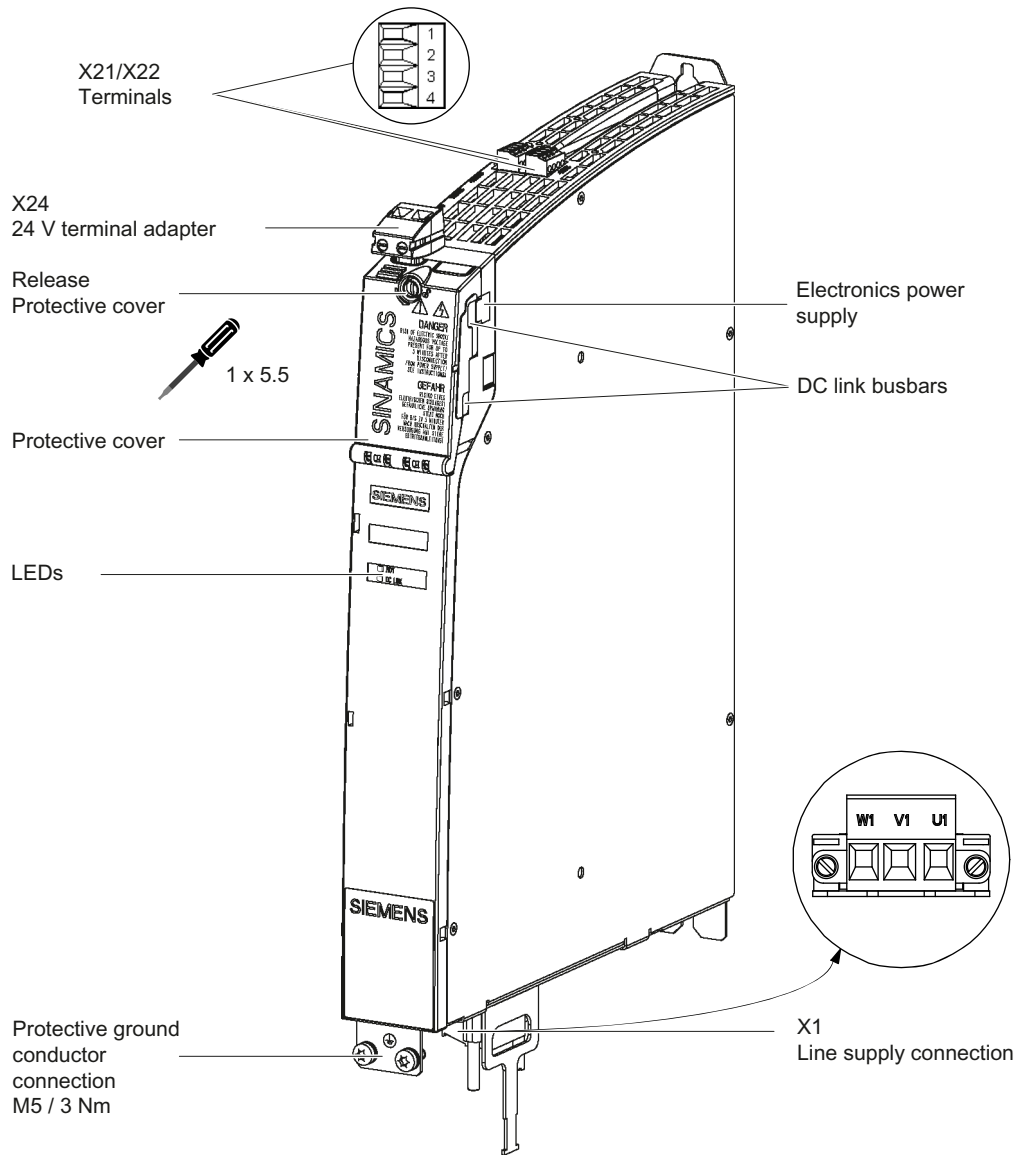


Figure 4-75 Interface overview, 5 kW and 10 kW Smart Line Modules with internal air cooling (example: 5 kW)

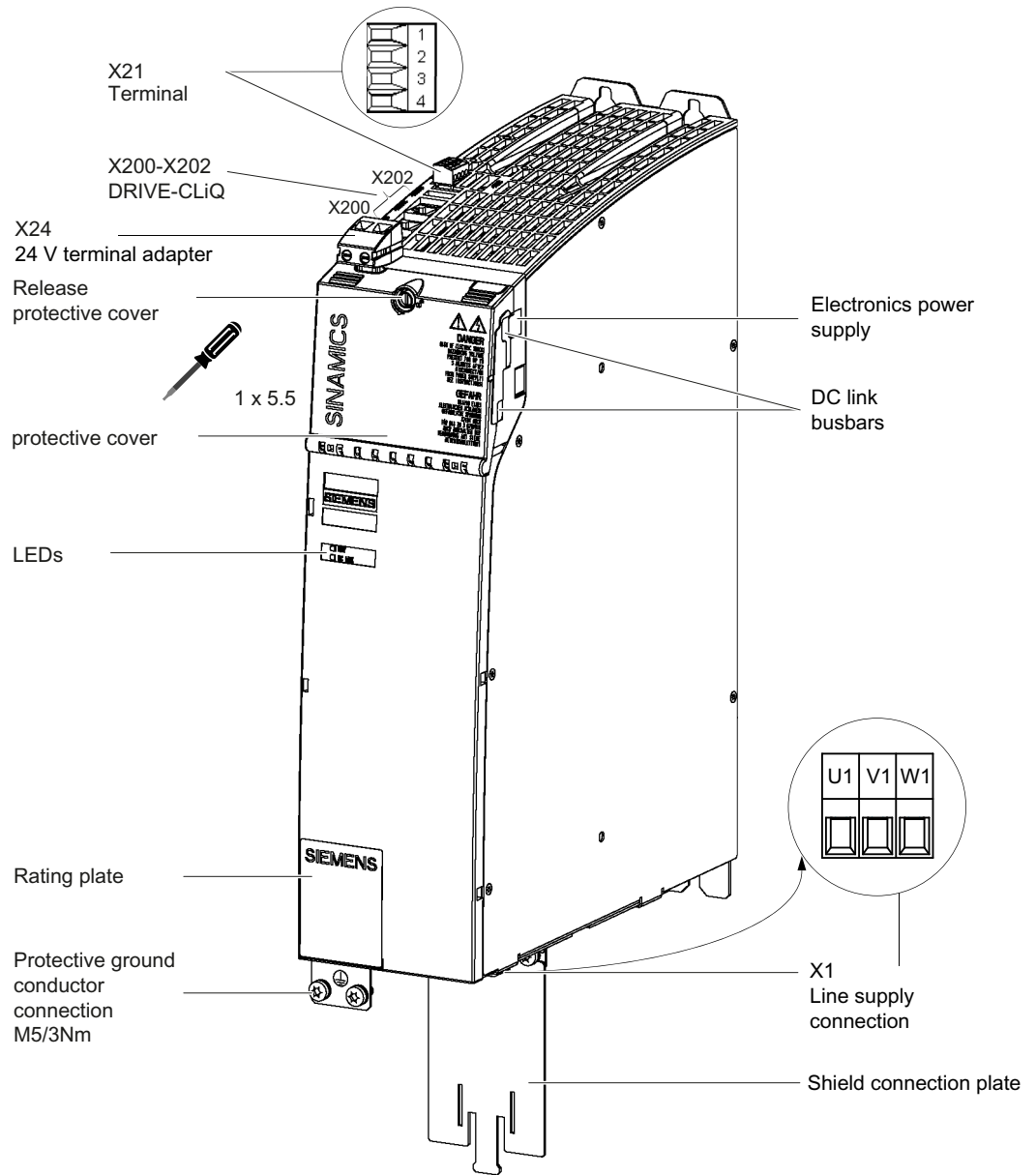


Figure 4-76 Interface overview, 16 kW Smart Line Module with internal air cooling

4.8 Smart Line Modules with internal air cooling

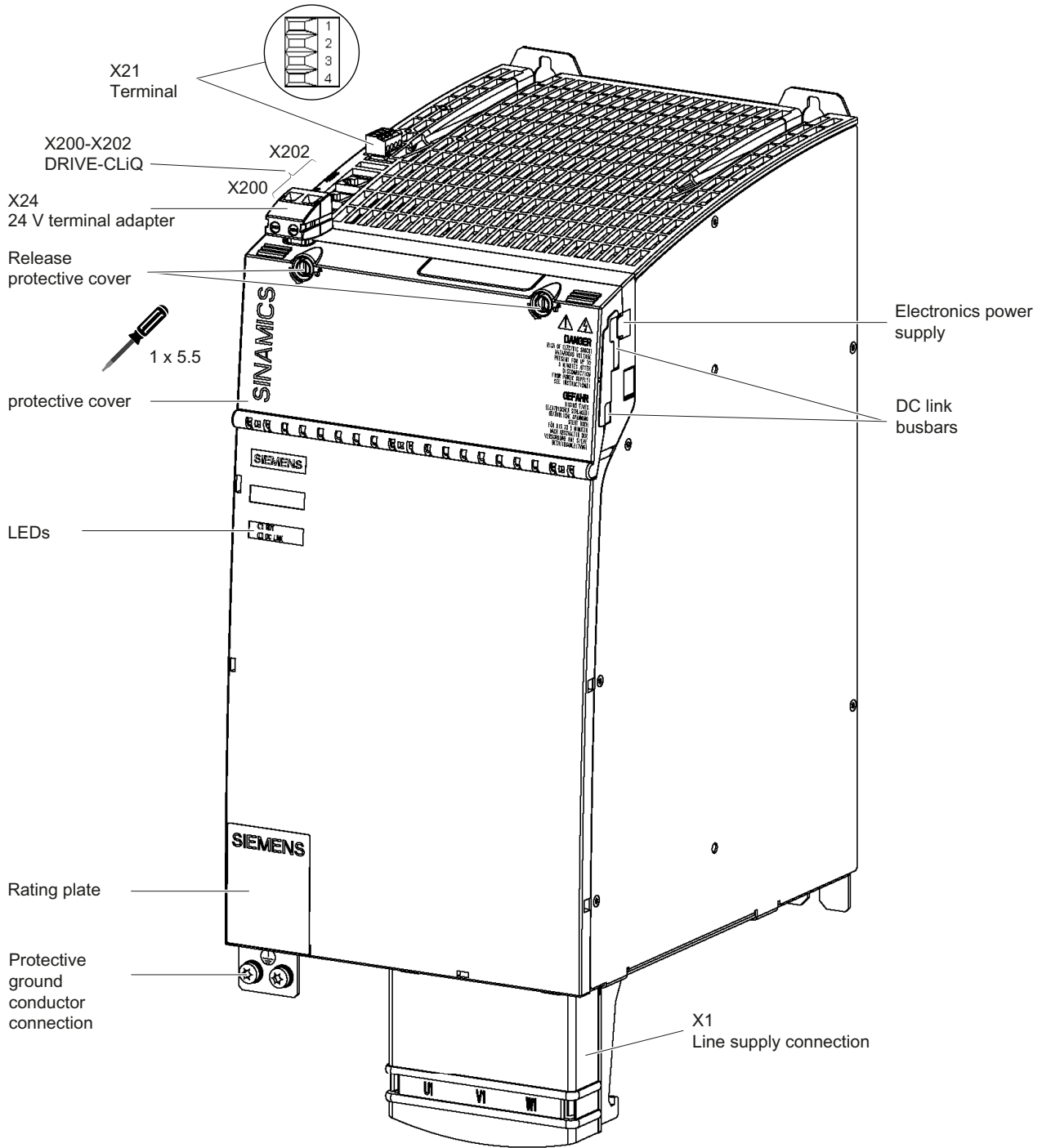
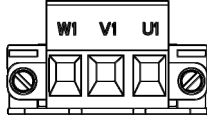
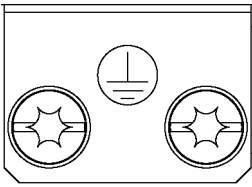


Figure 4-77 Interface overview, 36 kW and 55 kW Smart Line Modules with internal air cooling (example: 55 kW)

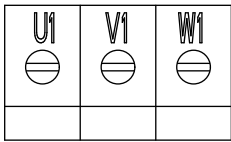
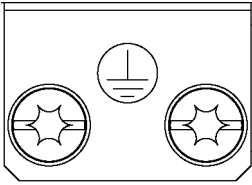
## 4.8.3.2 X1 line connection

Table 4- 63 X1: Line connection for Smart Line Modules 5 kW and 10 kW

	Terminal	Technical data
	U1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 Tightening torque: 1.2 - 1.5 Nm (see Section "Control cabinet installation / connection system")
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm <sup>1)</sup>

1) For ring cable lugs in accordance with DIN 46234

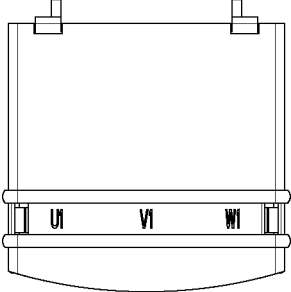
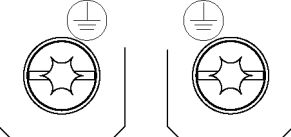
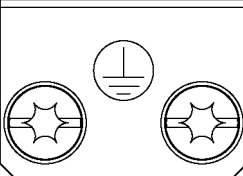
Table 4- 64 X1: Line supply connection for Smart Line Modules 16 kW

	Terminal	Technical data
	U1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 10 mm <sup>2</sup> Type: Screw terminal 6 Tightening torque: 1.5 - 1.8 Nm (see Section "Control cabinet installation / connection system")
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm <sup>1)</sup>

1) For ring cable lugs in accordance with DIN 46234

4.8 Smart Line Modules with internal air cooling

Table 4- 65 X1: Line connection for Smart Line Modules 36 kW and 55 kW

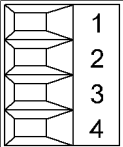
	Terminal	Technical data
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz <b>36 kW:</b> Threaded bolt M6 / 6 Nm <sup>1)</sup> <b>55 kW:</b> Threaded bolts M8/13 Nm <sup>1)</sup>
	PE connection	<b>36 kW:</b> Threaded hole M6 / 6 Nm <sup>1)</sup>
		<b>55 kW:</b> Threaded hole M6 / 6 Nm <sup>1)</sup>

1) For ring cable lugs in accordance with DIN 46234

## 4.8.3.3 X21 EP terminals

## Smart Line Modules 5 kW and 10 kW

Table 4- 66 X21 EP terminal for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation	Technical data
	1	DO: Ready	Checkback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: <ul style="list-style-type: none"> <li>• Electronics power supply (X24) OK</li> <li>• DC link is precharged</li> <li>• Pulses enabled (X21.3/4)</li> <li>• No overtemperature</li> <li>• No overcurrent</li> </ul>
	2	DO: Prewarning	DO: Prewarning High = no prewarning Low = prewarning <ul style="list-style-type: none"> <li>• Overtemperature warning threshold/<math>I^2t</math>                5 kW                prewarning: 64° C, overtemperature threshold: 69° C                10 kW                prewarning: 68° C, overtemperature threshold: 73° C</li> <li>• No regenerative feedback capability due to a line fault [only monitored when feedback is activated (see terminal X22.2)]</li> </ul>
	3	EP +24 V (pulse enable)	Voltage 24 V DC
	4	EP M (Enable Pulses)	Current consumption: 10 mA Isolated input
Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Section "Control cabinet installation and EMC / connection system")			

## Terminals X21.1 and X21.2

**NOTICE****Please note the switch-on and switch-off sequence**

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21.1 (see Section "Safety instructions for Smart Line Modules Booksize (Page 264)").


<b>NOTICE</b>
<b>Wiring to a digital input of the Control Unit</b>
Output terminal X21.1 must be wired to a digital input on the CU. The drives supplied with power from the Smart Line Module have to use this signal as a "Ready" signal (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. It is not permissible that the control system sets the drives to ready until the infeed "Ready" signal is present.

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

**Note**

The Smart Line Module signals that it is ready, even if one of the line conductors is not available. In this case, regenerative feedback is deactivated and an alarm is output at X21.2 (DO, Warning I<sup>2t</sup>). If regenerative feedback was deactivated by applying a "high" signal to terminal X22.2 (DI, Disable), no alarm will be output at X21.2 (DO, Warning I<sup>2t</sup>).

**Terminals X21.3 and X21.4**

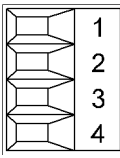
 <b>WARNING</b>
<b>Connecting terminals X21.3 and X21.4</b>
For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. Pulse suppression is activated when removed. The regenerative feedback is deactivated. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example because a line contactor is not installed, then the DC link remains charged.

<b>NOTICE</b>
<b>Using a line disconnecter unit</b>
If an active drive line-up is switched off using the disconnecter unit, the voltage at X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be realized using a leading breaking auxiliary contact ( $\geq 10$ ms), for example. This protects external loads located parallel to the drive at the same switching component.



## 16 kW to 55 kW Smart Line Modules

Table 4- 67 X21 EP terminal / temperature sensor for 16 kW to 55 kW Smart Line Modules

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors <sup>1)</sup> : KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage: 24 V DC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Max. connectable cross-section 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Section "Control cabinet installation and EMC / connection system")			

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

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

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

 **DANGER**
**Danger to life through electric shock**

Only temperature sensors that meet the safety isolation specifications stipulated 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 danger to life!

**NOTICE****Risk of the motor overheating due to an incorrectly connected KTY temperature sensor**

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY sensor with the correct polarity.

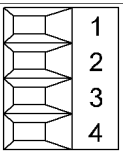
**Terminals X21.3 and X21.4**

 <b>WARNING</b>
<p><b>Connecting terminals X21.3 and X21.4</b></p> <p>For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. Pulse suppression is activated when removed. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example because a line contactor is not installed, then the DC link remains charged.</p>

<p><b>NOTICE</b></p>
<p><b>Using a line disconnecter unit</b></p> <p>If an active drive line-up is switched off using the disconnecter unit, the voltage at X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be realized using a leading breaking auxiliary contact (<math>\geq 10</math> ms), for example. This protects external loads located parallel to the drive at the same switching component.</p> <p>If you are using a VSM10 Voltage Sensing Module, the leading opening contact can be omitted.</p>

**4.8.3.4 X22 digital inputs**

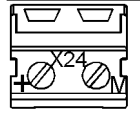
Table 4- 68 X22 digital inputs for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation <sup>1)</sup>	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 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) DI: Digital input

### 4.8.3.5 X24 24 V terminal adapter

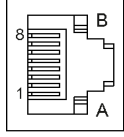
Table 4- 69 X24: 24 V terminal adapter

	Terminal	Designation	Technical data
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 (see Section "Control cabinet installation and EMC / connection system")			

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

### 4.8.3.6 X200-X202 DRIVE-CLiQ interfaces

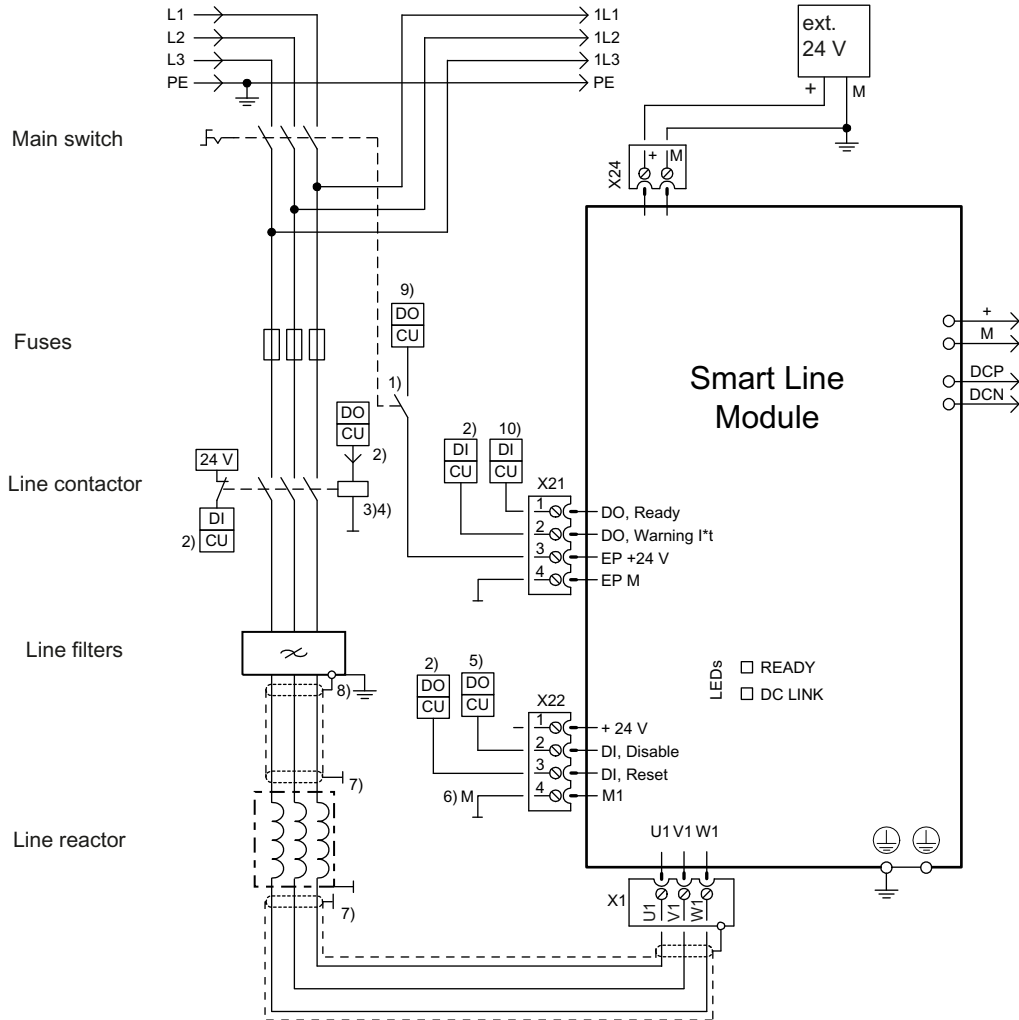
Table 4- 70 X200-X202: DRIVE-CLiQ interfaces

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

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

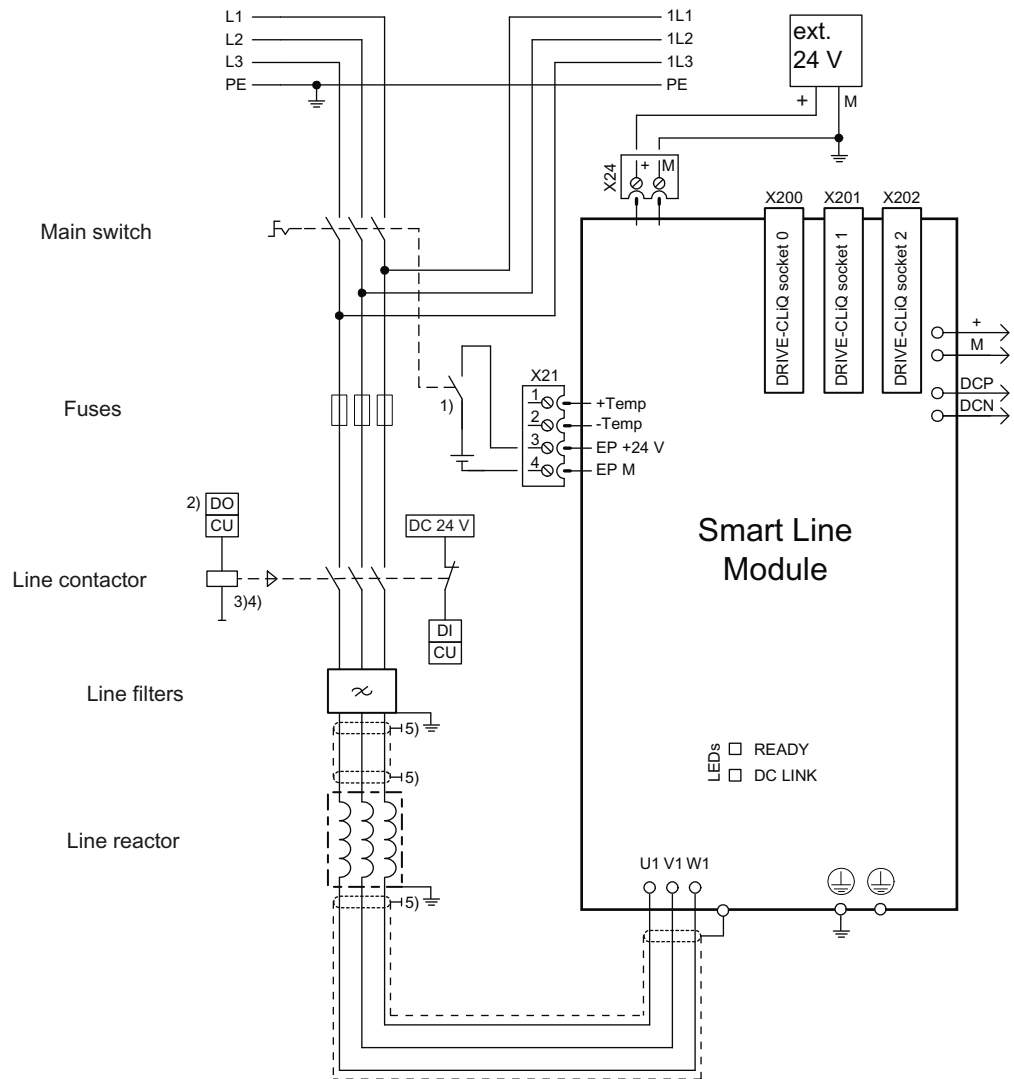
Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

4.8.4 Connection examples



- 1) Leading opening contact  $t > 10\text{ms}$ , 24 V DC and ground must be connected for operation.
- 2) DI/DO controlled by the Control Unit
- 3) No additional load permitted downstream of line contactor
- 4) The current carrying capacity of the DO must be observed; an output interface must be used if required.
- 5) DO high, regenerative feedback deactivated (for permanent deactivation, a jumper can be installed between X22 pin 1 and 2)
- 6) X22 pin 4 must be connected to ground (external 24 V)
- 7) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline
- 8) 5 kW and 10 kW line filters via shield connection
- 9) Signal output of the control to avoid reaction of the 24 V supply on the EP terminal
- 10) Connect to parameter p0864 via BICO

Figure 4-78 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 interface must be used if required.
- 5) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline

Figure 4-79 Connection example for 16 kW to 55 kW Smart Line Modules

### Note


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

### 4.8.5 Meaning of LEDs

#### 4.8.5.1 Smart Line Modules 5 kW and 10 kW

Table 4- 71 Meaning of the LEDs on 5 kW and 10 kW Smart Line Modules

LED	Color	Status	Description, cause	Remedy
RDY	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	Component is ready to operate.	–
	Yellow	Continuous light	Pre-charging not yet complete. bypass relay dropped out EP terminals not supplied with 24 VDC.	–
	Red	Continuous light	Overtemperature, overcurrent	Diagnose 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 light	DC link voltage within permissible tolerance range.	–
	Red	Continuous light	DC link voltage outside permissible tolerance range. Line supply fault.	Check the line voltage.

 <b>DANGER</b>
<p>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!</p>

## 4.8.5.2 16 kW to 55 kW Smart Line Modules

Table 4- 72 Meaning of the LEDs on Smart Line Modules  $\geq$  16 kW

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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. <b>Note:</b> 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). <b>Note:</b> 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!

### 4.8.6 Dimension drawings

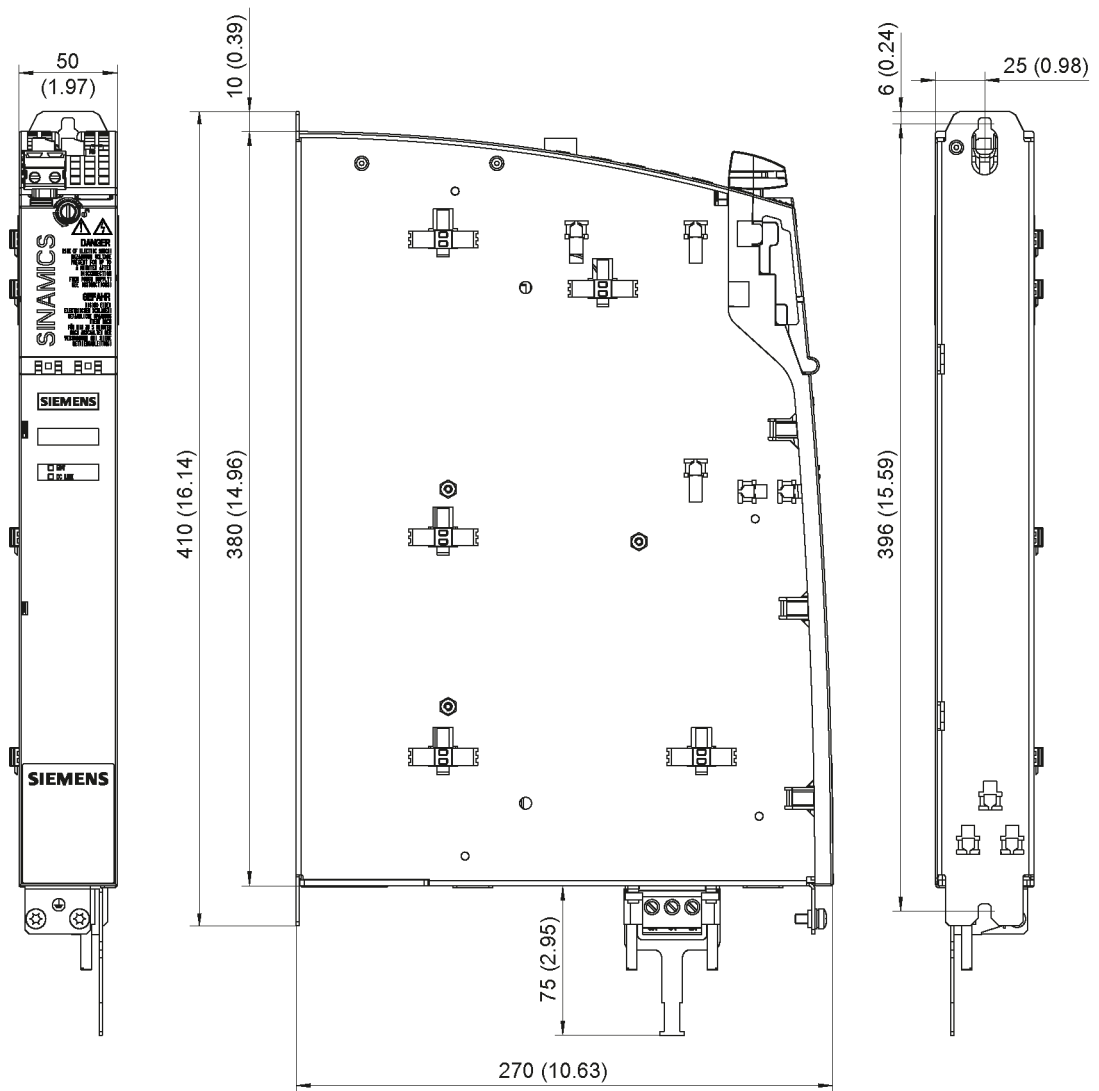


Figure 4-80 Dimension drawing of 5 kW and 10 kW Smart Line Modules with internal air cooling, all dimensions in mm and (inches)

#### Note

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



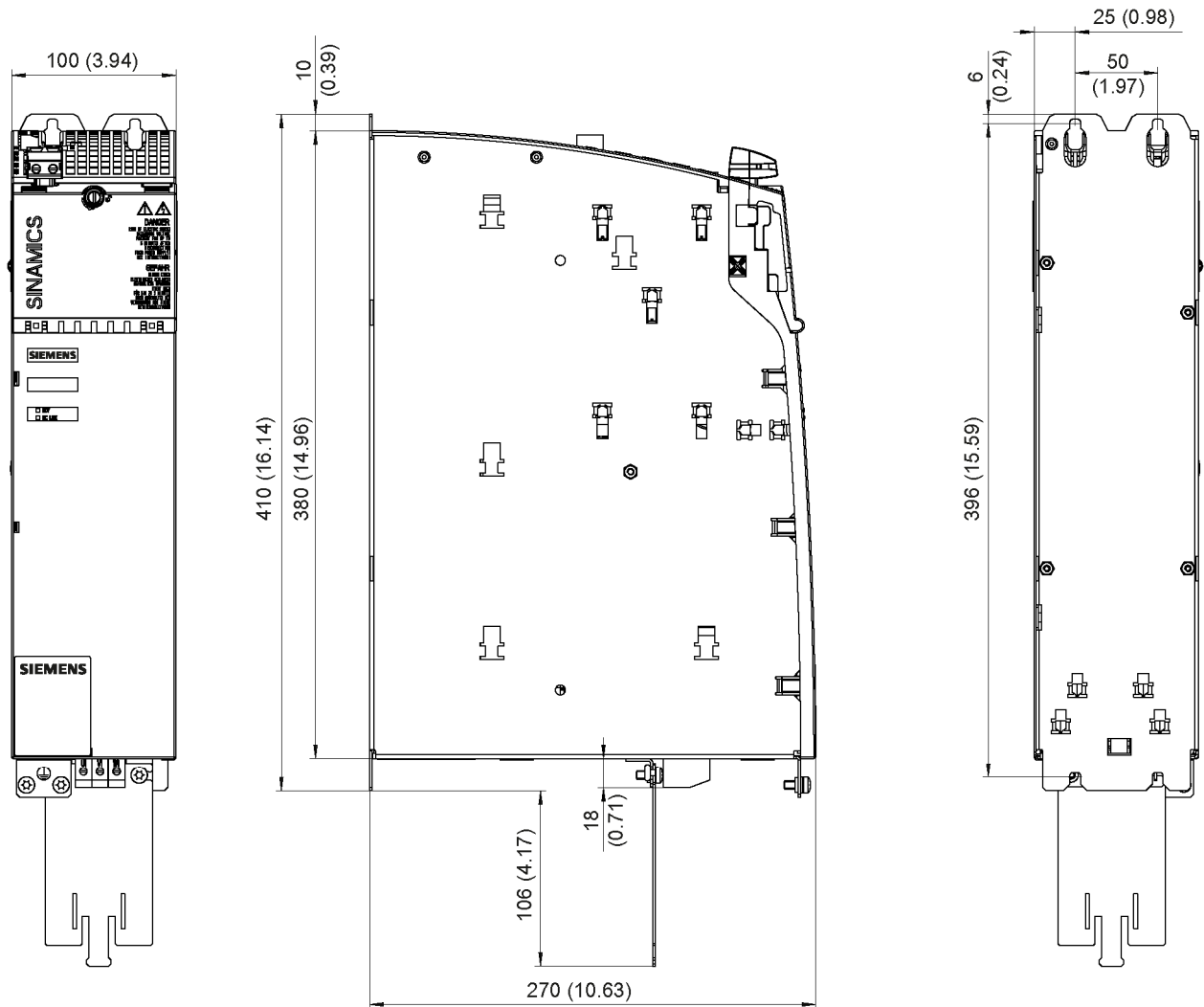


Figure 4-81 Dimension drawing of 16 kW Smart Line Module with internal air cooling, all dimensions in mm and (inches)

#### Note

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

4.8 Smart Line Modules with internal air cooling

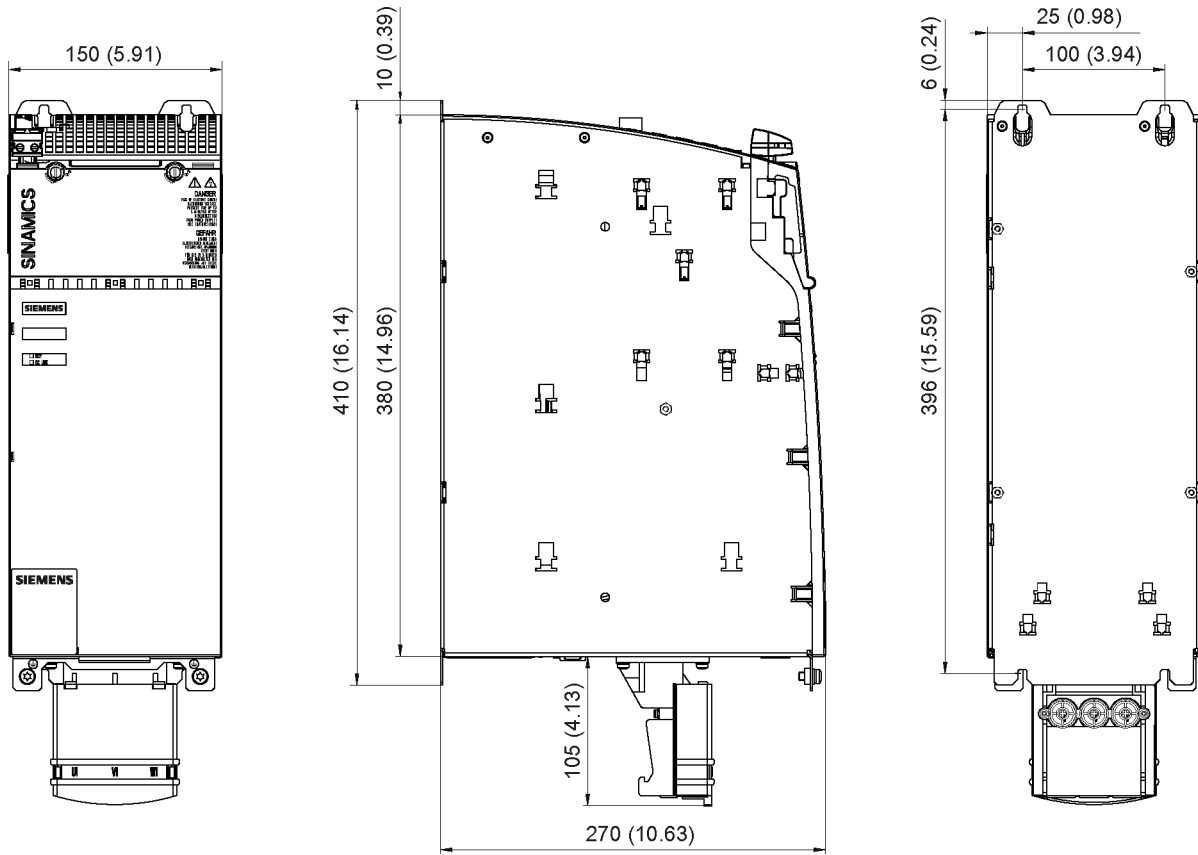


Figure 4-82 Dimension drawing of 36 kW Smart Line Module with internal air cooling, all dimensions in mm and (inches)

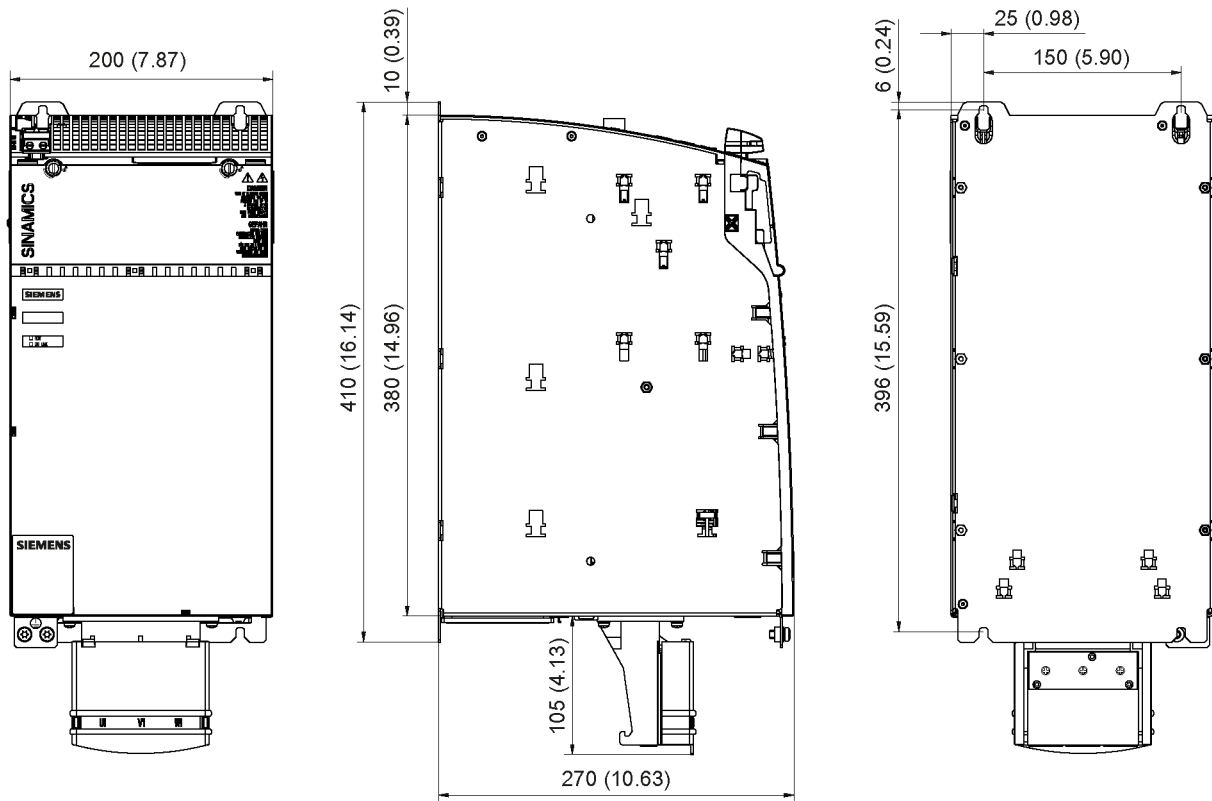
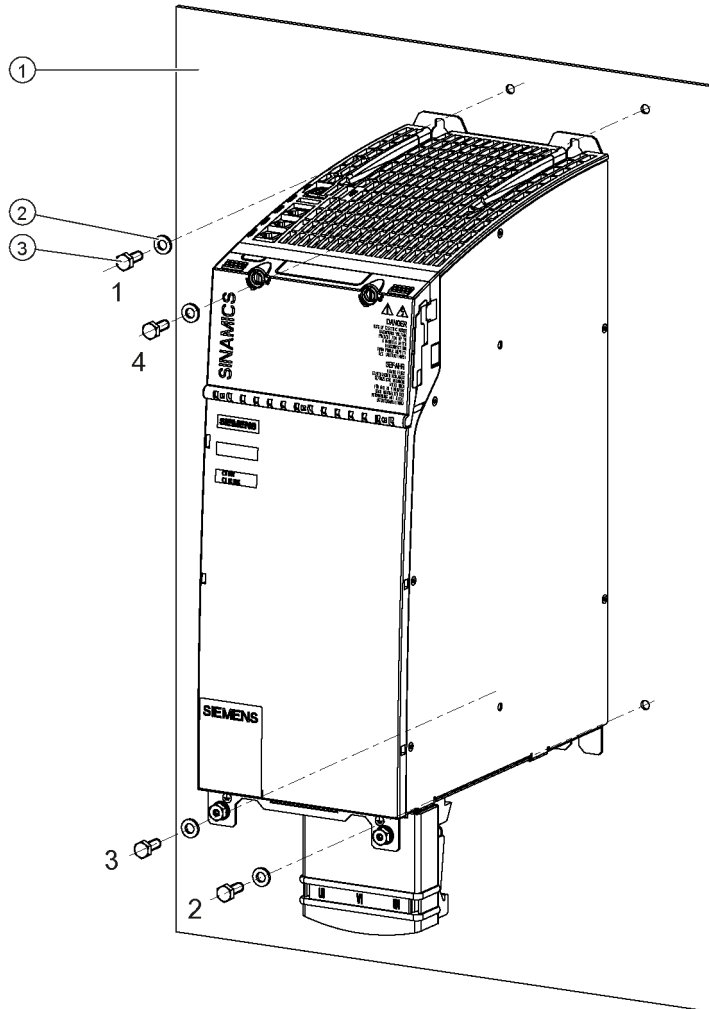


Figure 4-83 Dimension drawing of 55 kW Smart Line Module with internal air cooling, all dimensions in mm and (inches)

### 4.8.7 Installation

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



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

Figure 4-84 Mounting a Smart Line Module with internal air cooling (example: 36 kW)

**Tightening torques:**

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 6 Nm (in the specific sequence 1 to 4)

## 4.8.8 Technical data

Table 4- 73 Technical data for Smart Line Modules in booksize format with internal air cooling

Internal air cooling	6SL3130–	6AE15–0Axx	6AE21–0Axx	6TE21-6Axx	6TE23-6Axx	6TE25-5Axx
<b>Rated power</b>	<b>kW</b>	<b>5</b>	<b>10</b>	<b>16</b>	<b>36</b>	<b>55</b>
<b>Infeed</b>						
Rated power (S1) <sup>1)</sup>	kW (P <sub>n</sub> )	5	10	16	36	55
S6 operation (40%) <sup>1)</sup>	kW (P <sub>S6</sub> )	6.5	13	21	47	71
Peak infeed power <sup>1)</sup>	kW (P <sub>max</sub> )	10	20	35	70	91
<b>Regenerative feedback</b>						
Continuous regenerative power	kW	5	10	16	36	55
Peak regenerative power	kW	10	20	35	70	91
<b>Supply voltages</b>						
Line voltage	V <sub>AC</sub>	3 AC 380 to 480 ±10% (-15% < 1 min)				
Line frequency	Hz	47 to 63				
Electronics power supply	V <sub>DC</sub>	24 (20.4 - 28.8)				
DC link voltage	V <sub>DC</sub>	510 – 720				
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %				
Undervoltage trip <sup>2)</sup>	V <sub>DC</sub>	360 ± 2 %				
<b>Input currents</b>						
Rated input current						
at 400 V <sub>AC</sub>	A <sub>AC</sub>	8,1	16,2	27,5	59	90
at 380 V <sub>AC</sub> /480 V <sub>AC</sub>	A <sub>AC</sub>	8,6 / 6,7	17 / 12,8	29 / 24,5	62 / 51	94 / 77
S6 (40%) at 400 V <sub>AC</sub>	A <sub>AC</sub>	10,6	21,1	35	76	106
Peak current at 400 V <sub>AC</sub>	A <sub>AC</sub>	15,7	31,2	57,5	112	130
<b>DC link currents</b>						
DC link output current						
at 600 V	A <sub>DC</sub>	8,3	16,6	27	60	92
at 540 V	A <sub>DC</sub>	9,3	18,5	30	67	105
S6 (40%) at 600 V <sub>DC</sub>	A <sub>DC</sub>	11	22	35	79	138
Peak current at 600 V <sub>C</sub>	A <sub>DC</sub>	16,6	33,2	59	118	178
<b>Current carrying capacity</b>						
DC link busbars	A <sub>DC</sub>	100	100	100	200	200
Reinforced DC link busbars						
24 V DC busbars	A <sub>DC</sub>	150	150	150	--	--
	A <sub>DC</sub>	20	20	20	20	20
<b>Electronics current consumption</b>						
at 24 V DC	A <sub>DC</sub>	0,8	0,9	0,95	1,5	1,9
<b>Total power loss</b> (including electronics losses) <sup>3)</sup>	W	79,2	141,6	187,8	406	665,6
<b>Max. ambient temperature</b>						
without derating	° C	40				
with derating	° C	55				
<b>DC link capacitance</b>						
Smart Line Module	µF	220	330	705	1410	1880
Drive line-up, max.	µF	6000	6000	20000	20000	20000
<b>Power factor</b>	cos φ	0,98				
<b>Circuit breaker</b> (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 47)				

4.8 Smart Line Modules with internal air cooling

<b>Internal air cooling</b>	<b>6SL3130-</b>	<b>6AE15-0Axx</b>	<b>6AE21-0Axx</b>	<b>6TE21-6Axx</b>	<b>6TE23-6Axx</b>	<b>6TE25-5AAx</b>
<b>Rated power</b>	<b>kW</b>	<b>5</b>	<b>10</b>	<b>16</b>	<b>36</b>	<b>55</b>
<b>Rated short-circuit current SCCR <sup>4)</sup></b>	<b>kA</b>	<b>65</b>	<b>65</b>	<b>65</b>	<b>65</b>	<b>65</b>
<b>Cooling method (internal air cooling)</b>		<b>Internal fan</b>				
<b>Sound pressure level</b>	<b>dB(A)</b>	<b>&lt;60</b>	<b>&lt;60</b>	<b>&lt;60</b>	<b>&lt;65</b>	<b>&lt;60</b>
<b>Cooling air requirement</b>	<b>m<sup>3</sup>/h</b>	<b>29,6</b>	<b>29,6</b>	<b>56</b>	<b>112</b>	<b>160</b>
<b>Max. permissible heat sink temperature</b>	<b>° C</b>	<b>69 <sup>5)</sup></b>	<b>73 <sup>5)</sup></b>	<b>77</b>	<b>80</b>	<b>75</b>
Rated voltage for rated data 3 AC 380 V						
<b>Weight</b>	<b>kg</b>	<b>4,7</b>	<b>4,8</b>	<b>7</b>	<b>10</b>	<b>17</b>

- 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 line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.
- 3) For an overview, see the power loss tables in Section "Control cabinet installation".
- 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.
- 5) Values cannot be read out via the system (STARTER).

4.8.8.1 Characteristics

Rated duty cycles of Smart Line Modules

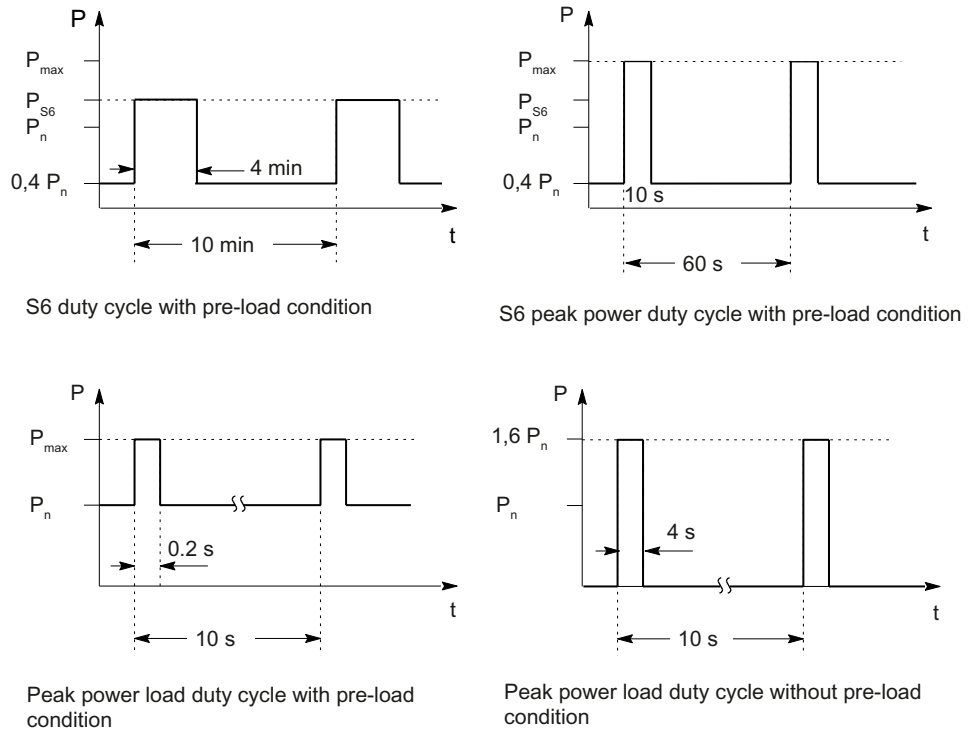


Figure 4-85 Rated duty cycles of Smart Line Modules

Derating characteristics

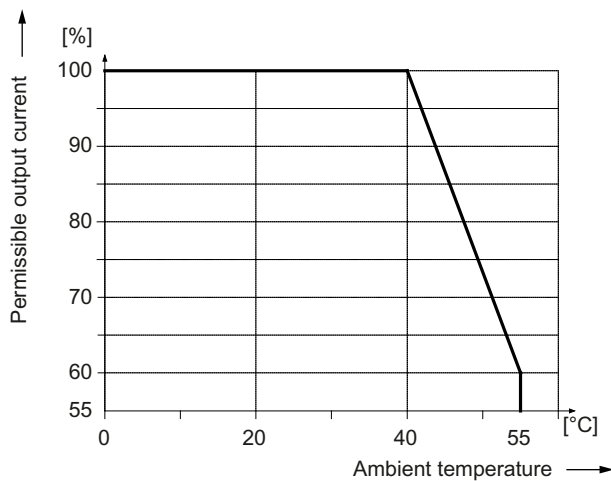


Figure 4-86 Output current as a function of the ambient temperature

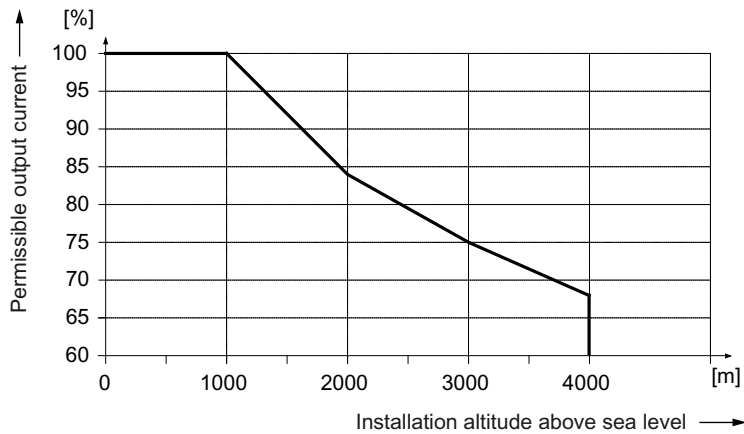


Figure 4-87 Output current as a function of the installation altitude

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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



## 4.9 Smart Line Modules with external air cooling

### 4.9.1 Description

The Smart Line Module is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module(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. Regenerative feedback can be deactivated if required. On 5 kW and 10 kW Smart Line Modules, this is done via a terminal, since these modules do not feature a DRIVE-CLiQ connection. On 16 kW to 55 kW Smart Line Modules, regenerative feedback can be deactivated via parameters, as, just like Active Line Modules, these modules are equipped with a DRIVE-CLiQ connection.

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

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

External air cooling uses the "through-hole" method. This is a cooling method that is only available for SINAMICS booksize units. The Smart Line Module and its heat sink can be inserted in a rectangular knockout at the rear of the control cabinet and mounted with a seal. The heat sink and the fan (included in the scope of supply) project beyond the rear of the control cabinet and the heat is dissipated outside the control cabinet or in a separate air duct.

### 4.9.2 Safety instructions for Smart Line Modules Booksize

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**Note**

When using a Smart Line Module, you should also strictly observe the product-specific safety instructions for Line Modules as well as the safety instructions in Section 1.

---

**NOTICE**

**Please note the switch-on and switch-off sequence**

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21.1

**Switch on:**

- 24 V DC power supply X24 ON
- Line contactor ON
- EP signal X21.3 and X21.4 ON
- Wait until precharging is complete
- "Ready" signal at terminal X21.1 switched to high
- Infeed is ready, pulse enable possible for motors

**Switch off:**

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

**Overload:**

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

**Note**

**Connected to the public low-voltage network**

Smart Line Modules have been designed for use in the industrial environment and generate current harmonics on the line side as a result of the rectifier circuit.

When connecting a machine with integrated Smart Line Modules to the public low-voltage network, authorization is required in advance from the local power supply company (utility company) if

- the rated current of the machine  $\leq 16$  A per conductor, and
- the rated machine current does not comply with the requirements specified in EN 61000-3-2 regarding current harmonics.

### 4.9.3 Interface description

#### 4.9.3.1 Overview

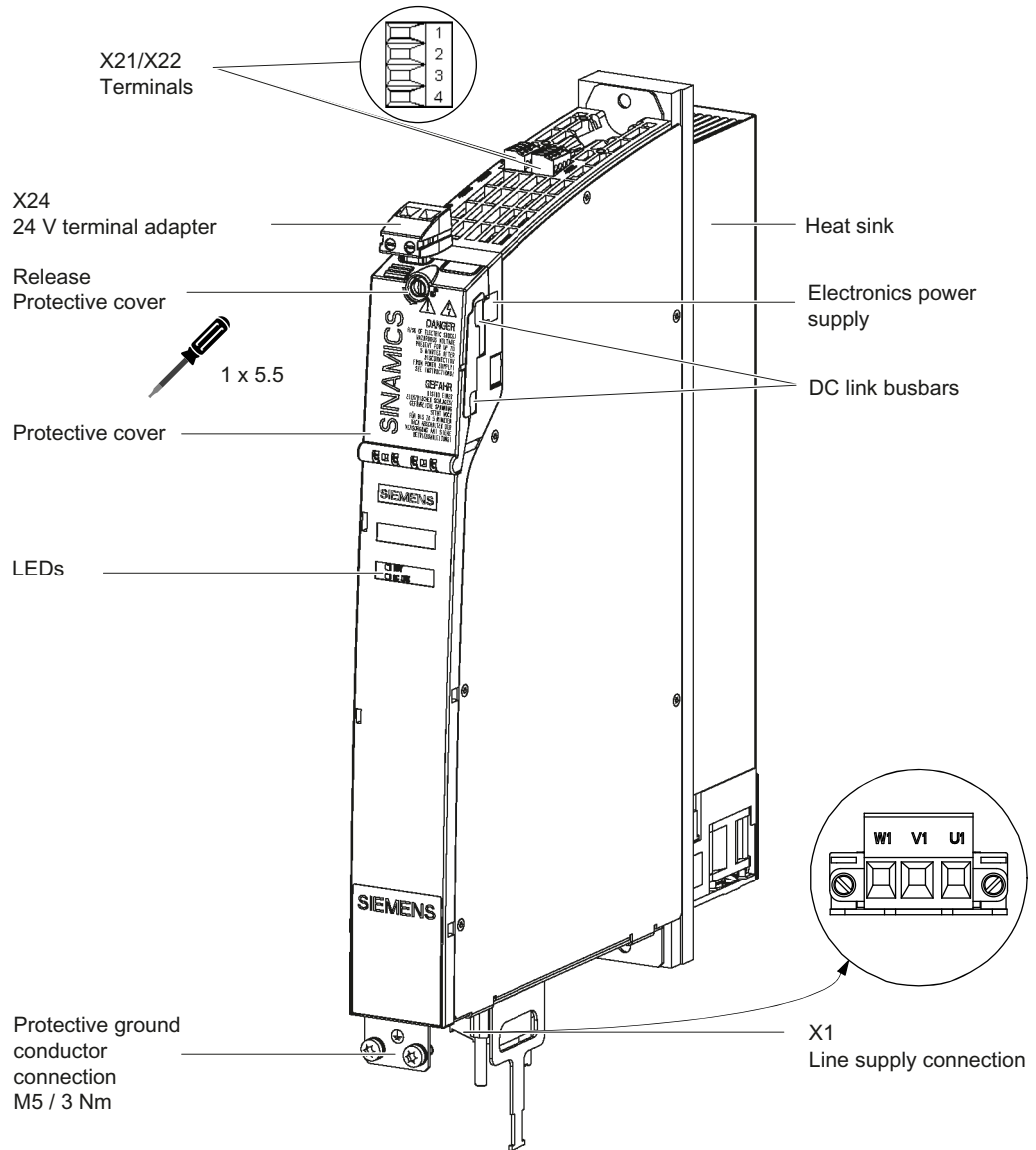


Figure 4-88 Interface overview, 5 kW and 10 kW Smart Line Modules with external air cooling (example: 5 kW)

4.9 Smart Line Modules with external air cooling

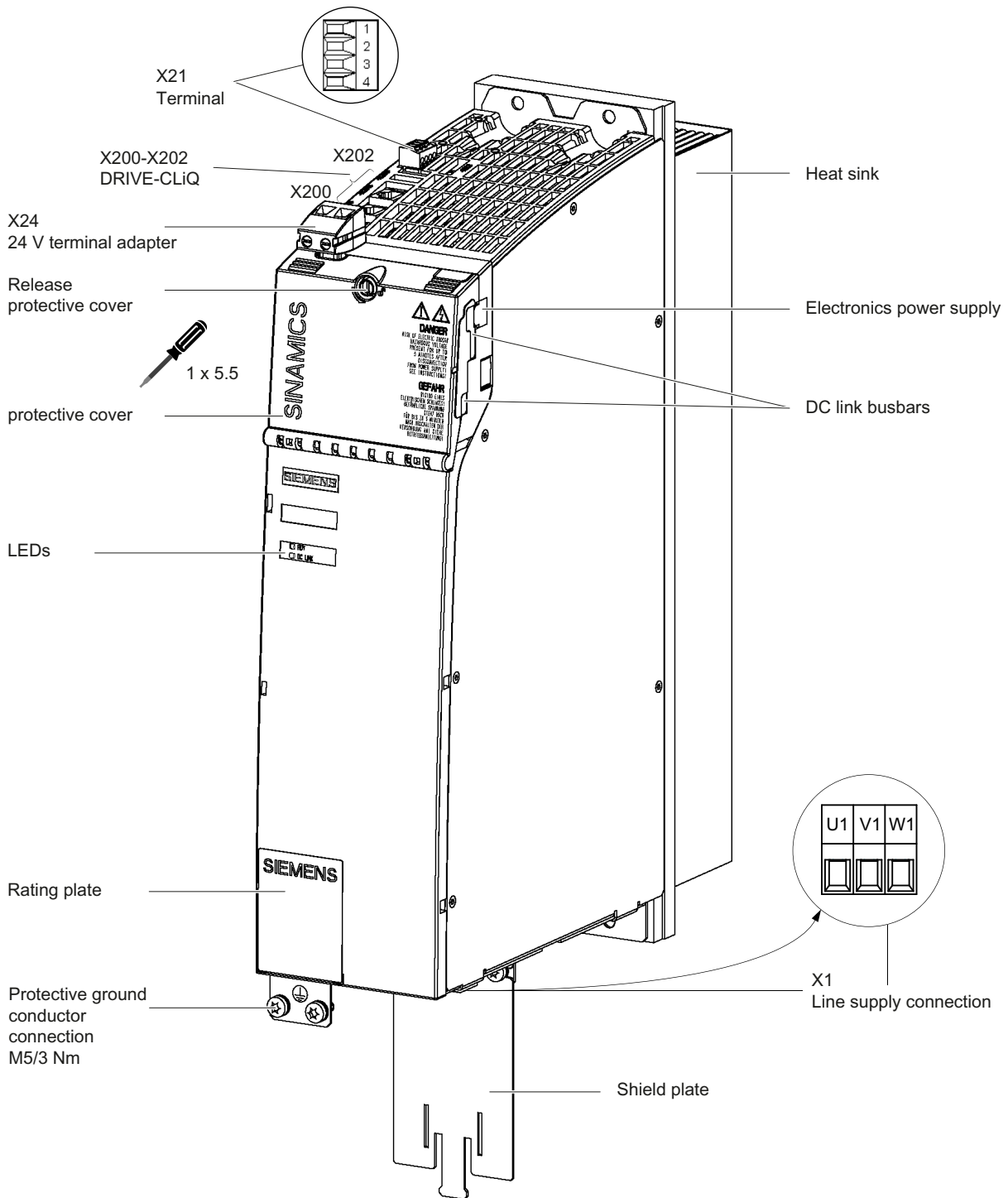


Figure 4-89 Interface overview, 16 kW Smart Line Module with external air cooling

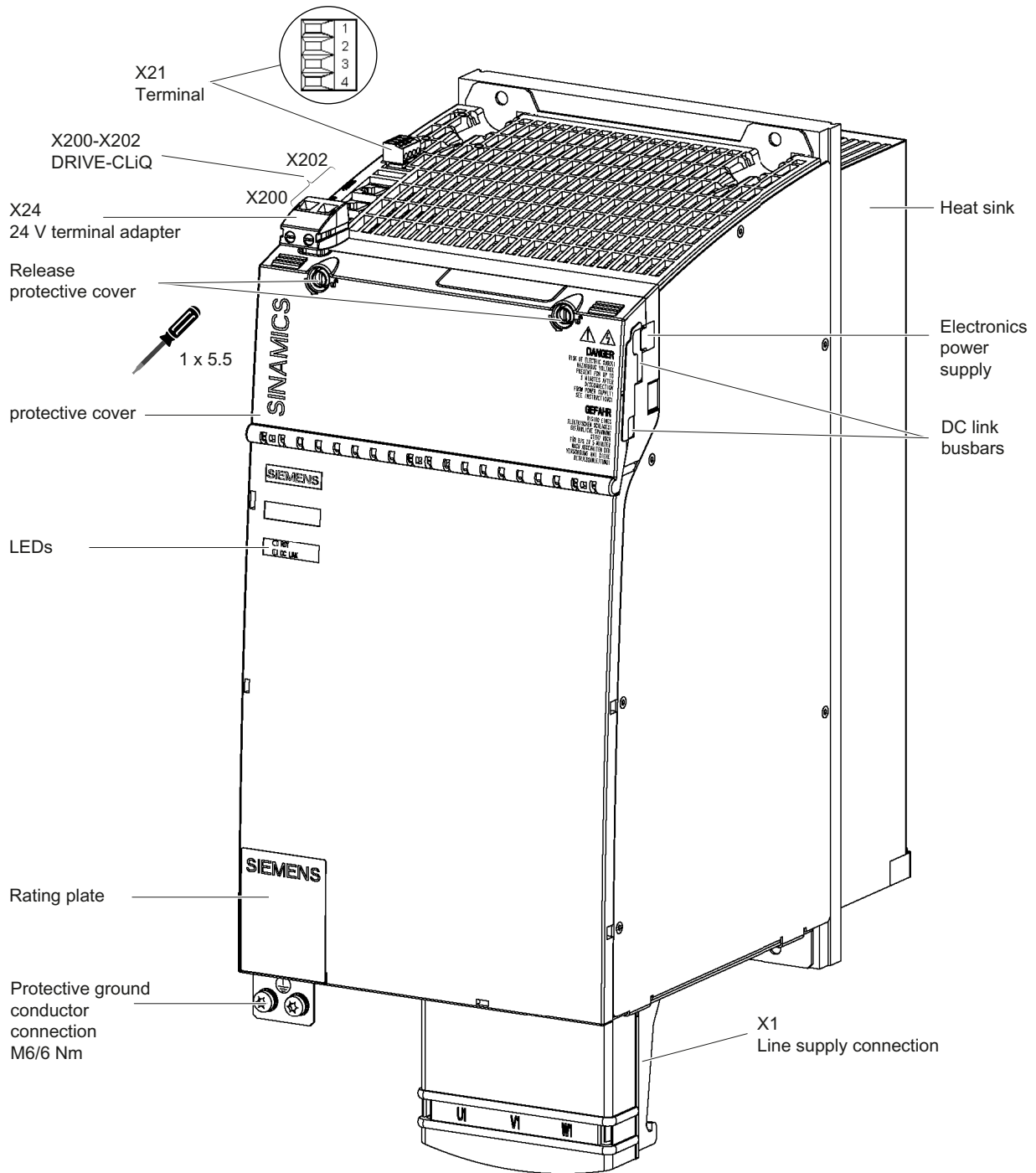
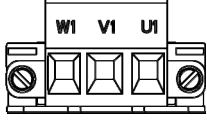
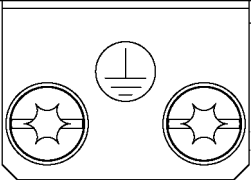


Figure 4-90 Interface overview, 36 kW and 55 kW Smart Line Modules with external air cooling (example: 55 kW)

4.9 Smart Line Modules with external air cooling

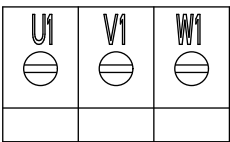
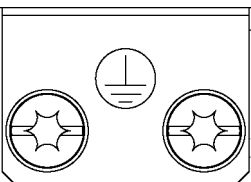
4.9.3.2 X1 line connection

Table 4- 74 X1: Line connection for Smart Line Modules 5 kW and 10 kW

	Terminal	Technical data
	U1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 Tightening torque: 1.2 - 1.5 Nm (see Section "Control cabinet installation / connection system")
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm <sup>1)</sup>

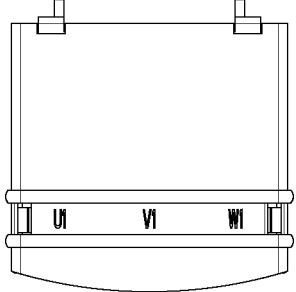
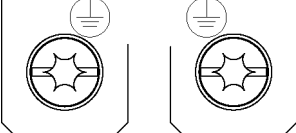
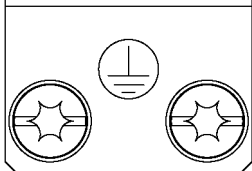
1) For ring cable lugs in accordance with DIN 46234

Table 4- 75 X1: Line supply connection for Smart Line Modules 16 kW

	Terminal	Technical data
	U1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 10 mm <sup>2</sup> Type: Screw terminal 6 Tightening torque: 1.5 - 1.8 Nm (see Section "Control cabinet installation / connection system")
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm <sup>1)</sup>

1) For ring cable lugs in accordance with DIN 46234

Table 4- 76 X1: Line connection for Smart Line Modules 36 kW and 55 kW

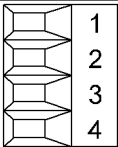
	Terminal	Technical data
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz <b>36 kW:</b> Threaded bolt M6 / 6 Nm <sup>1)</sup> <b>55 kW:</b> Threaded bolts M8/13 Nm <sup>1)</sup>
	PE connection	<b>36 kW:</b> Threaded hole M6 / 6 Nm <sup>1)</sup>
		<b>55 kW:</b> Threaded hole M6 / 6 Nm <sup>1)</sup>

1) For ring cable lugs in accordance with DIN 46234

4.9.3.3 X21 EP terminals

Smart Line Modules 5 kW and 10 kW

Table 4- 77 X21 EP terminal for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation	Technical data
	1	DO: Ready	Checkback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: <ul style="list-style-type: none"> <li>• Electronics power supply (X24) OK</li> <li>• DC link is precharged</li> <li>• Pulses enabled (X21.3/4)</li> <li>• No overtemperature</li> <li>• No overcurrent</li> </ul>
	2	DO: Prewarning	DO: Prewarning High = no prewarning Low = prewarning <ul style="list-style-type: none"> <li>• Overtemperature warning threshold/I<sup>2</sup>t                          5 kW                          prewarning: 64° C, overtemperature threshold: 69° C                          10 kW                          prewarning: 68° C, overtemperature threshold: 73°C</li> <li>• No regenerative feedback capability due to a line fault [only monitored when feedback is activated (see terminal X22.2)]</li> </ul>
	3	EP +24 V (pulse enable)	Voltage 24 V DC
	4	EP M (Enable Pulses)	Current consumption: 10 mA Isolated input
Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Section "Control cabinet installation and EMC / connection system")			

Terminals X21.1 and X21.2

<p><b>NOTICE</b></p> <p><b>Please note the switch-on and switch-off sequence</b></p> <p>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 X21.1 (see Section "Safety instructions for Smart Line Modules Booksize (Page 289)").</p>
--



**NOTICE****Wiring to a digital input of the Control Unit**

Output terminal X21.1 must be wired to a digital input on the CU. The drives supplied with power from the Smart Line Module have to use this signal as a "Ready" signal (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. It is not permissible that the control system sets the drives to ready until the infeed "Ready" signal is present.

**NOTICE****Evaluating the "Prewarning" signal**

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

**Note**

The Smart Line Module signals that it is ready, even if one of the line conductors is not available. In this case, regenerative feedback is deactivated and an alarm is output at X21.2 (DO, Warning I<sup>2t</sup>). If regenerative feedback was deactivated by applying a "high" signal to terminal X22.2 (DI, Disable), no alarm will be output at X21.2 (DO, Warning I<sup>2t</sup>).

**Terminals X21.3 and X21.4** **WARNING****Connecting terminals X21.3 and X21.4**

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. Pulse suppression is activated when removed. The regenerative feedback is deactivated. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example because a line contactor is not installed, then the DC link remains charged.

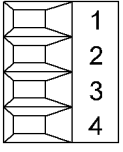
**NOTICE****Using a line disconnecter unit**

If an active drive line-up is switched off using the disconnecter unit, the voltage at X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be realized using a leading breaking auxiliary contact ( $\geq 10$  ms), for example.

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


16 kW to 55 kW Smart Line Modules

Table 4- 78 X21 EP terminal / temperature sensor for 16 kW to 55 kW Smart Line Modules

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors <sup>1)</sup> : KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage: 24 V DC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs
	4	EP M (Enable Pulses)	
Max. connectable cross-section 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Section "Control cabinet installation and EMC / connection system")			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual).  
 Temperatures are detected but not evaluated in the Smart Line Module.

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

 <b>DANGER</b>
<p><b>Danger to life through electric shock</b></p> <p>Only temperature sensors that meet the safety isolation specifications stipulated 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.</p> <p>If these instructions are not complied with, there is danger to life!</p>
<b>NOTICE</b>
<p><b>Risk of the motor overheating due to an incorrectly connected KTY temperature sensor</b></p> <p>A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.</p> <ul style="list-style-type: none"> <li>• Always connect the KTY sensor with the correct polarity.</li> </ul>

## Terminals X21.3 and X21.4

 **WARNING****Connecting terminals X21.3 and X21.4**

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. Pulse suppression is activated when removed. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example because a line contactor is not installed, then the DC link remains charged.

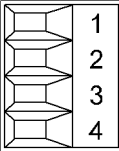
**NOTICE****Using a line disconnecter unit**

If an active drive line-up is switched off using the disconnecter unit, the voltage at X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be realized using a leading breaking auxiliary contact ( $\geq 10$  ms), for example. This protects external loads located parallel to the drive at the same switching component.

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

## 4.9.3.4 X22 digital inputs

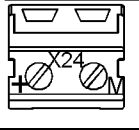
Table 4- 79 X22 digital inputs for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation <sup>1)</sup>	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 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) DI: Digital input

4.9.3.5 X24 24 V terminal adapter

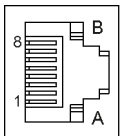
Table 4- 80 X24: 24 V terminal adapter

	Terminal	Designation	Technical data
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 (see Section "Control cabinet installation and EMC / connection system")			

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

4.9.3.6 X200-X202 DRIVE-CLiQ interfaces

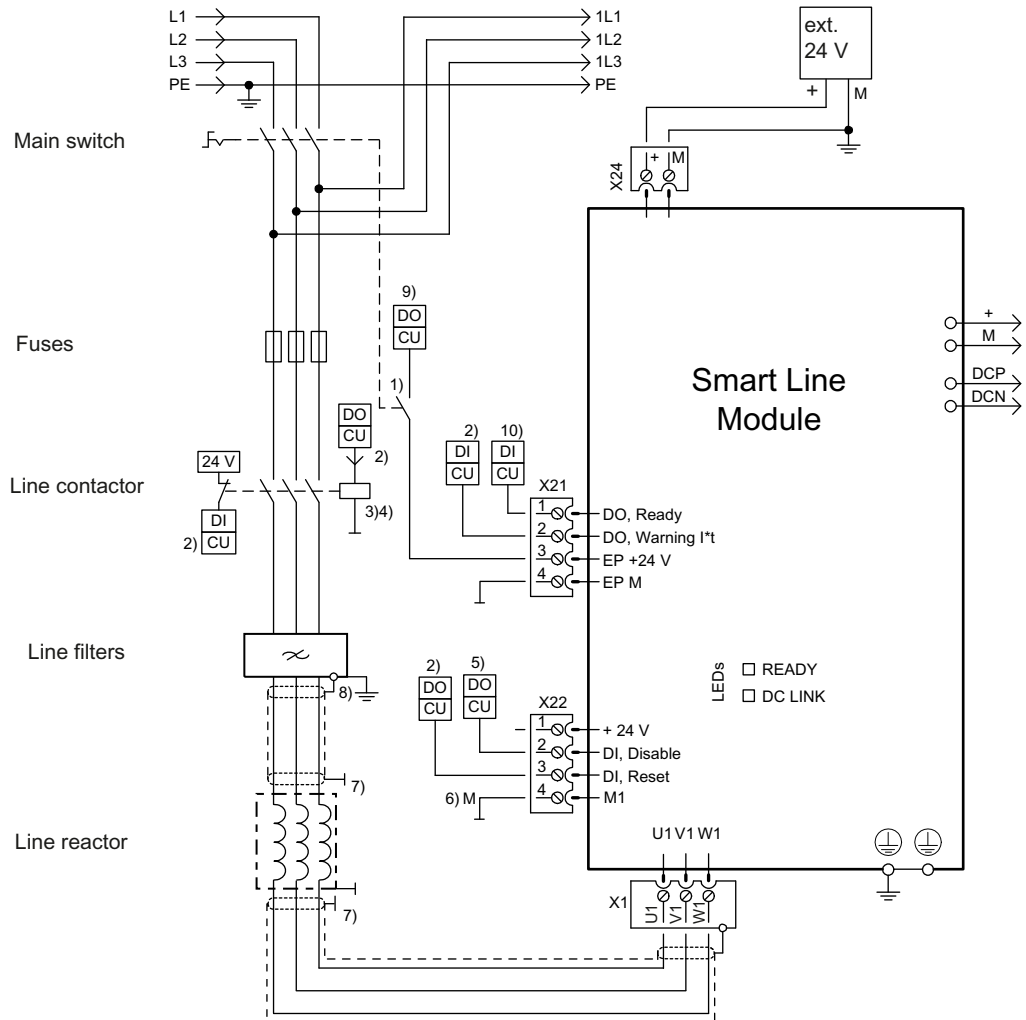
Table 4- 81 X200-X202: DRIVE-CLiQ interfaces

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

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

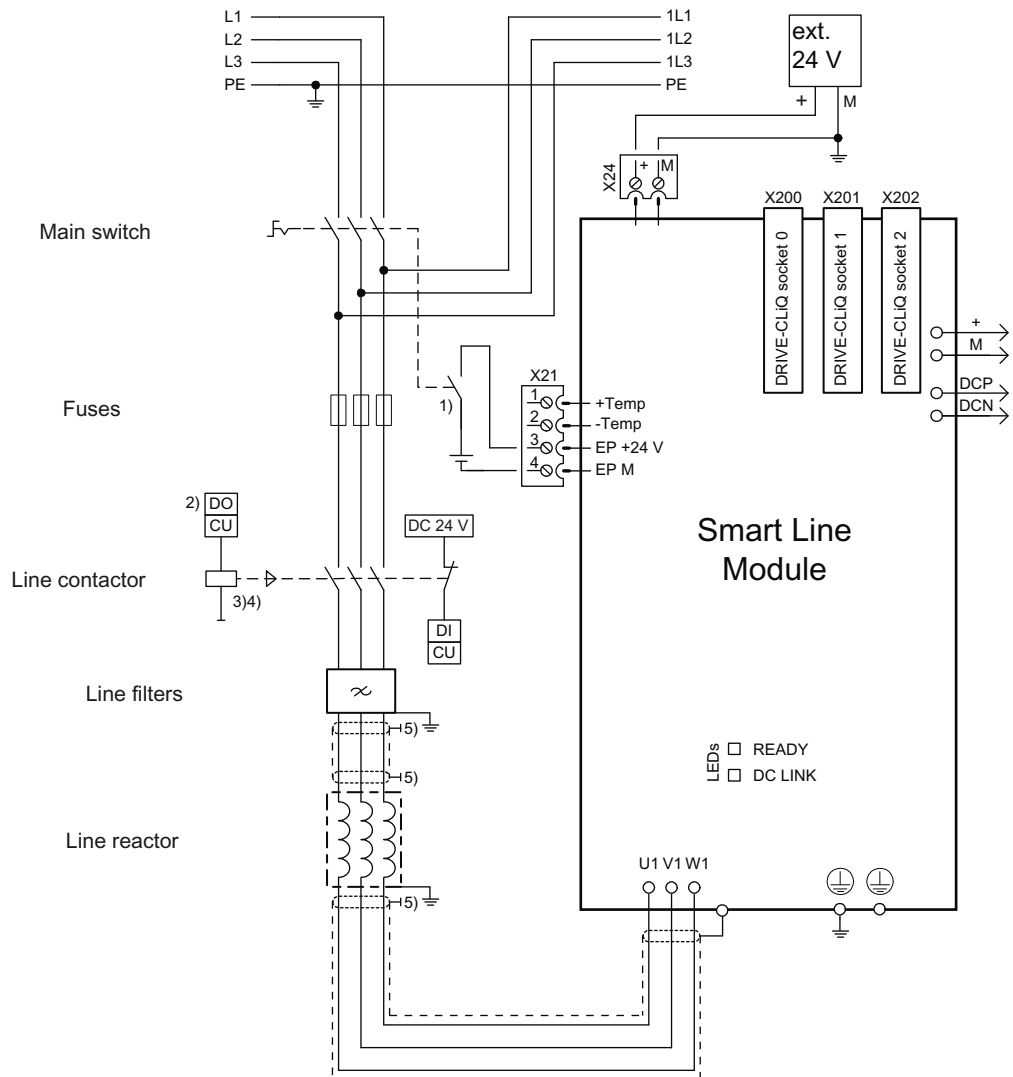
Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

## 4.9.4 Connection examples



- 1) Leading opening contact  $t > 10\text{ms}$ , 24 V DC and ground must be connected for operation.
- 2) DI/DO controlled by the Control Unit
- 3) No additional load permitted downstream of line contactor
- 4) The current carrying capacity of the DO must be observed; an output interface must be used if required.
- 5) DO high, regenerative feedback deactivated (for permanent deactivation, a jumper can be installed between X22 pin 1 and 2)
- 6) X22 pin 4 must be connected to ground (external 24 V)
- 7) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline
- 8) 5 kW and 10 kW line filters via shield connection
- 9) Signal output of the control to avoid reaction of the 24 V supply on the EP terminal
- 10) Connect to parameter p0864 via BICO

Figure 4-91 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 interface must be used if required.
- 5) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline

Figure 4-92 Connection example for 16 kW to 55 kW Smart Line Modules

**Note**

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

## 4.9.5 Meaning of LEDs

### 4.9.5.1 Smart Line Modules 5 kW and 10 kW

Table 4- 82 Meaning of the LEDs on 5 kW and 10 kW Smart Line Modules

LED	Color	Status	Description, cause	Remedy
RDY	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	Component is ready to operate.	–
	Yellow	Continuous light	Pre-charging not yet complete. bypass relay dropped out EP terminals not supplied with 24 VDC.	–
	Red	Continuous light	Overtemperature, overcurrent	Diagnose 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 light	DC link voltage within permissible tolerance range.	–
	Red	Continuous light	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 status of the "DC LINK" LED.

The warning information on the components must be carefully observed!

4.9.5.2 16 kW to 55 kW Smart Line Modules

Table 4- 83 Meaning of the LEDs on Smart Line Modules ≥ 16 kW

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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. <b>Note:</b> 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). <b>Note:</b> Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

 <b>DANGER</b>
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!



## 4.9.6 Dimension drawings

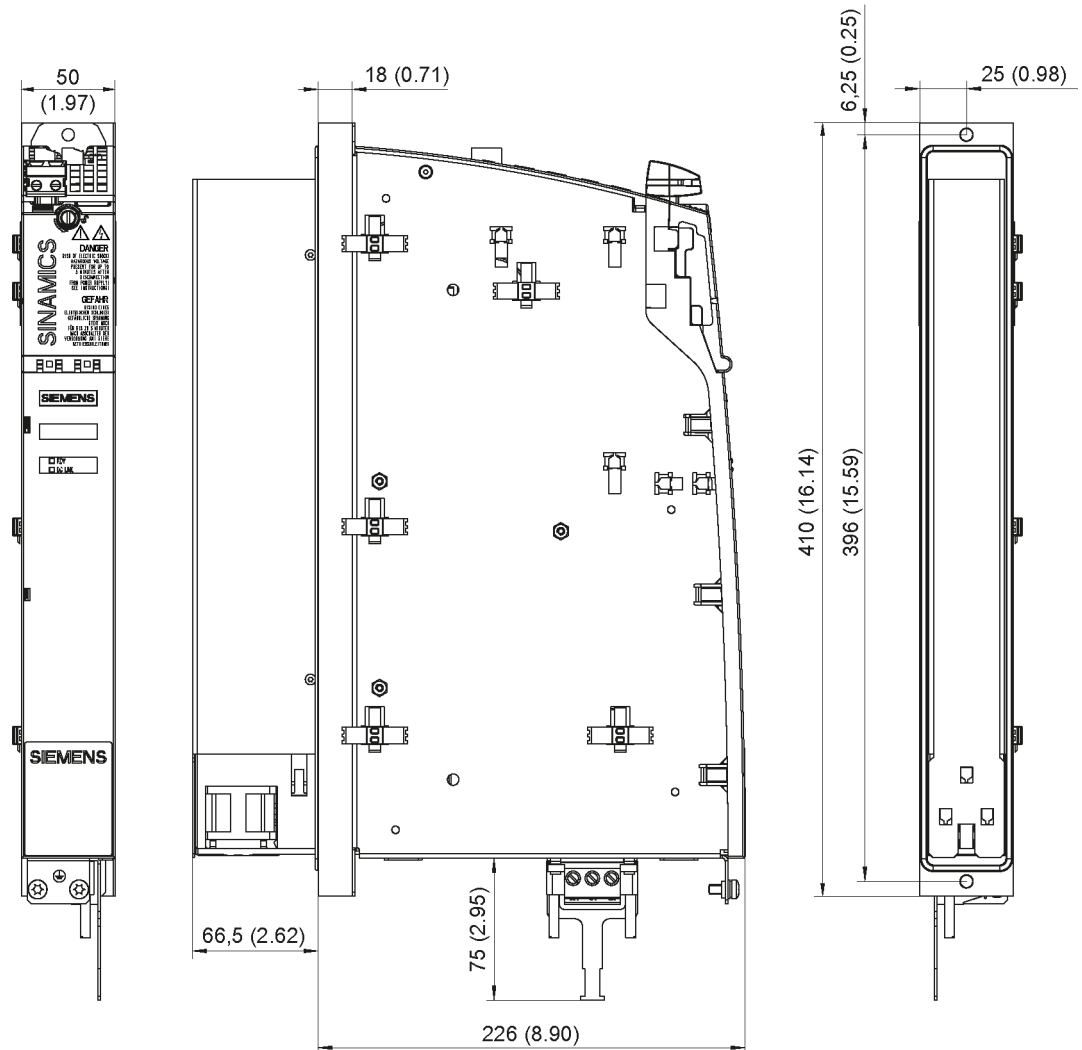


Figure 4-93 Dimension drawing of 5 kW and 10 kW Smart Line Modules with external air cooling, all dimensions in mm and (inches)

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**Note**

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

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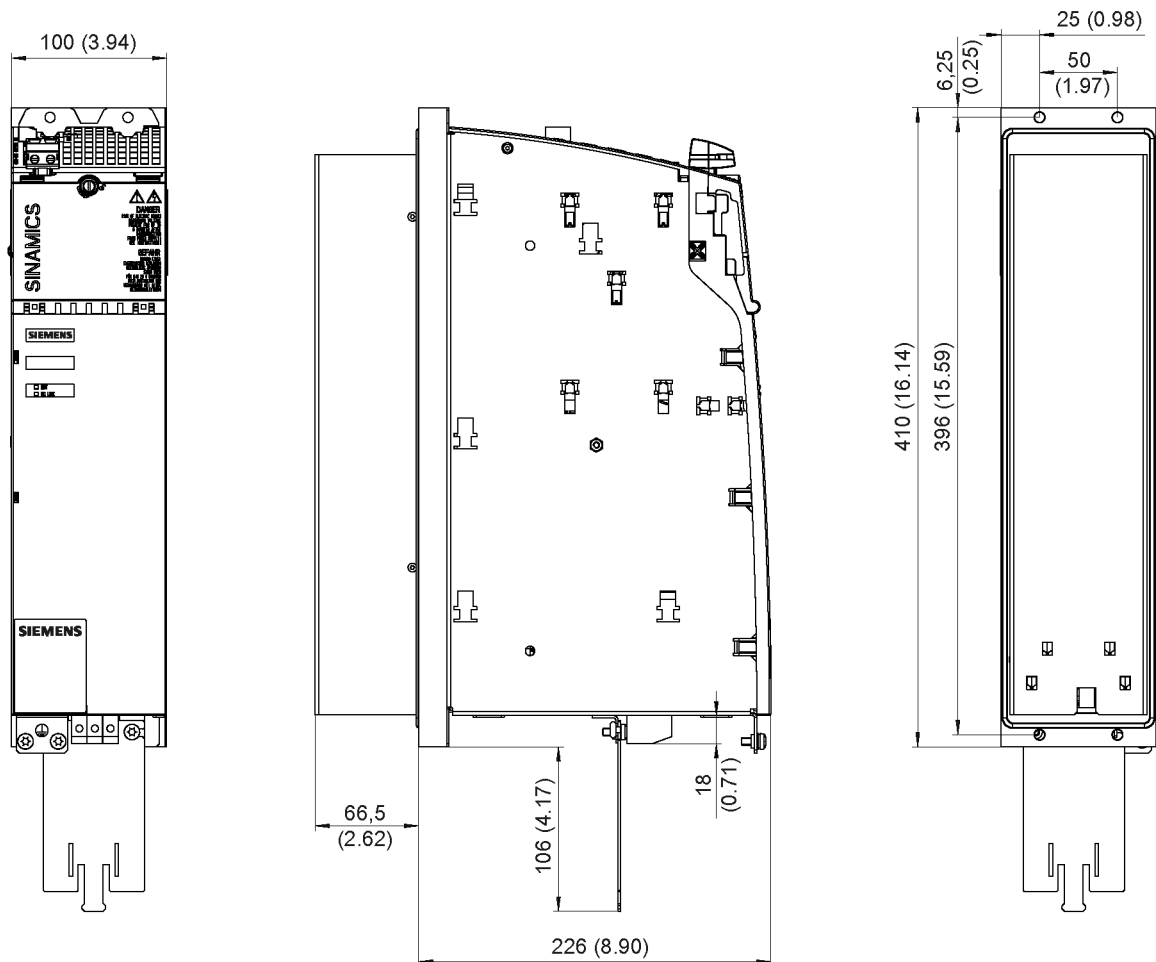


Figure 4-94 Dimension drawing of 16 kW Smart Line Module with external air cooling, all dimensions in mm and (inches)

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**Note**

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

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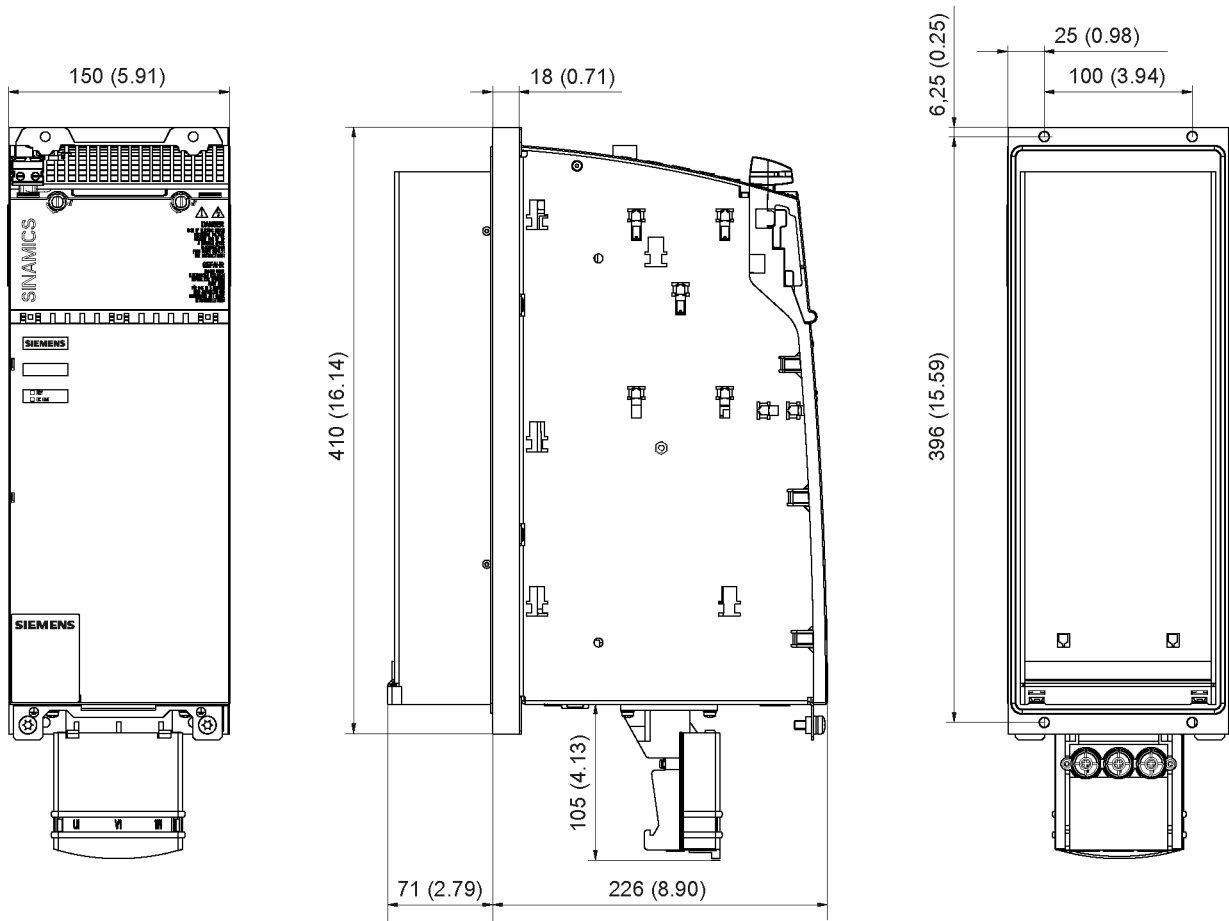


Figure 4-95 Dimension drawing of 36 kW Smart Line Module with external air cooling, all dimensions in mm and (inches)

4.9 Smart Line Modules with external air cooling

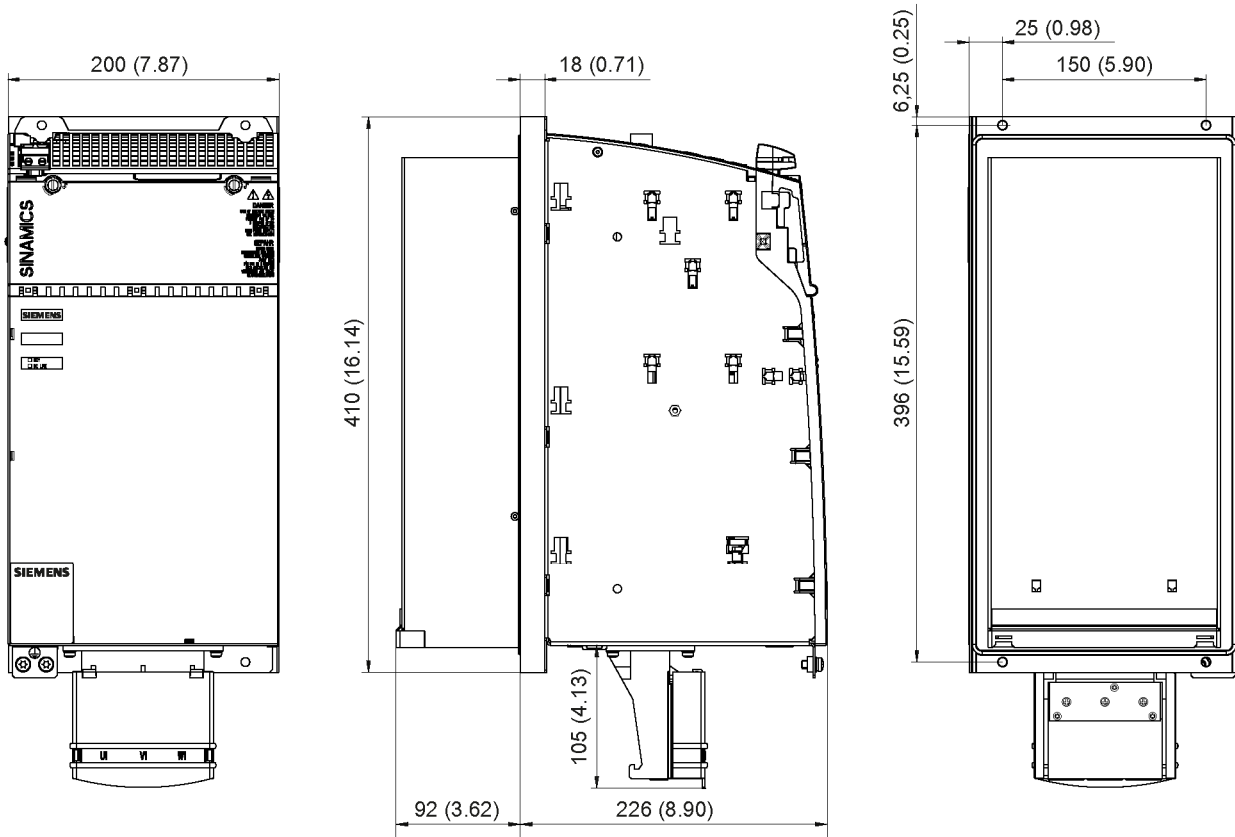
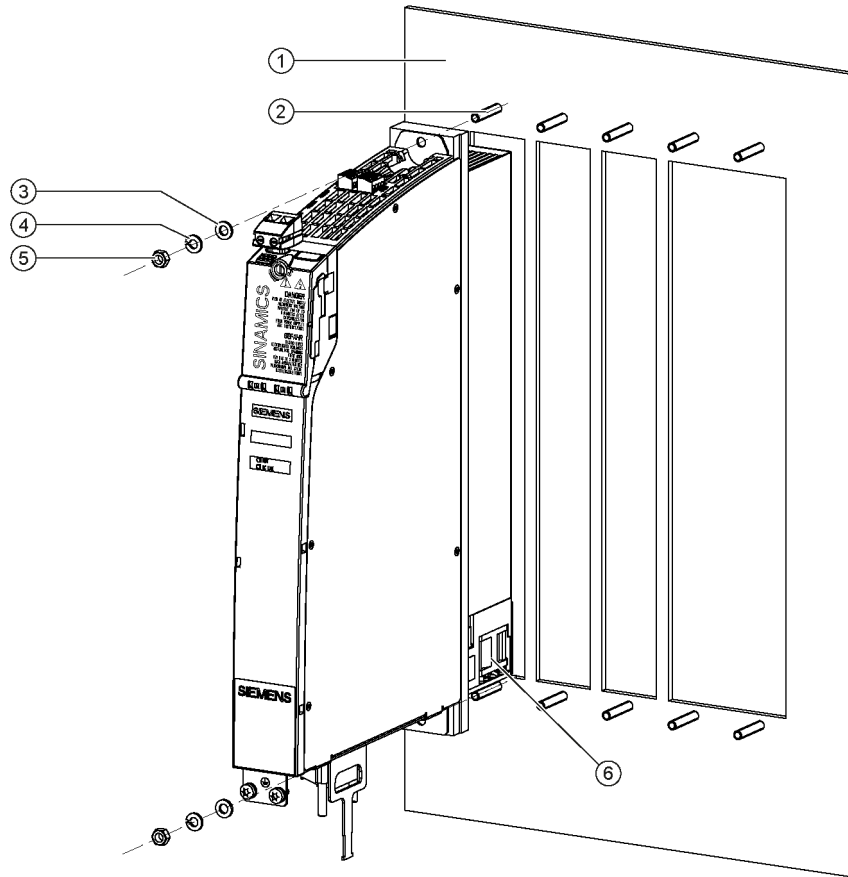


Figure 4-96 Dimension drawing of 55 kW Smart Line Module with external air cooling, all dimensions in mm and (inches)

## 4.9.7 Mounting



- ① Mounting plate with openings
- ② M6 studs
- ③ Washer
- ④ Spring washer
- ⑤ M6 nut, width A/F 10 (hexagon head)
- ⑥ Fan assembly

Figure 4-97 Mounting a Smart Line Module with external air cooling on a mounting plate, using a 5 kW Smart Line Module as an example

### Tightening torques:

- Initially, tighten by hand (0.5 Nm)
- Then tighten with 6 Nm

4.9 Smart Line Modules with external air cooling

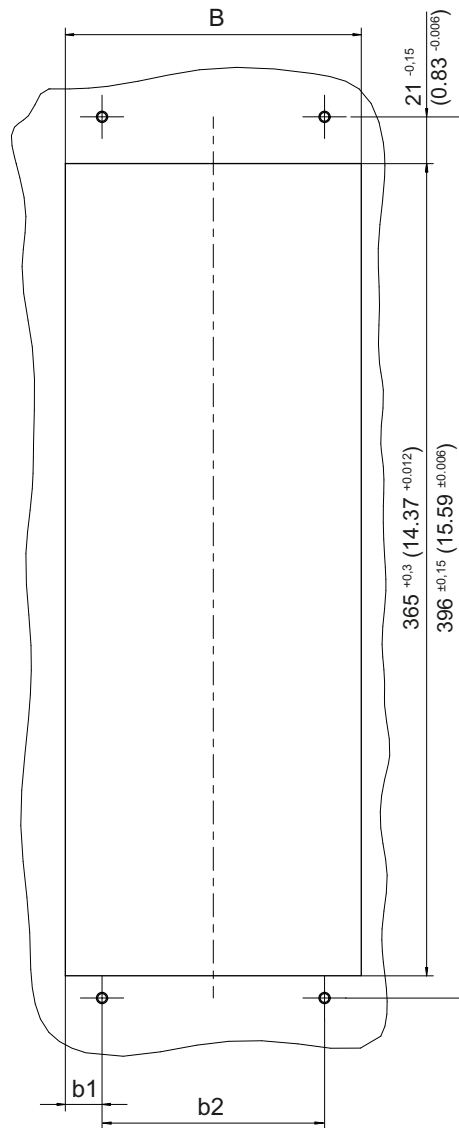
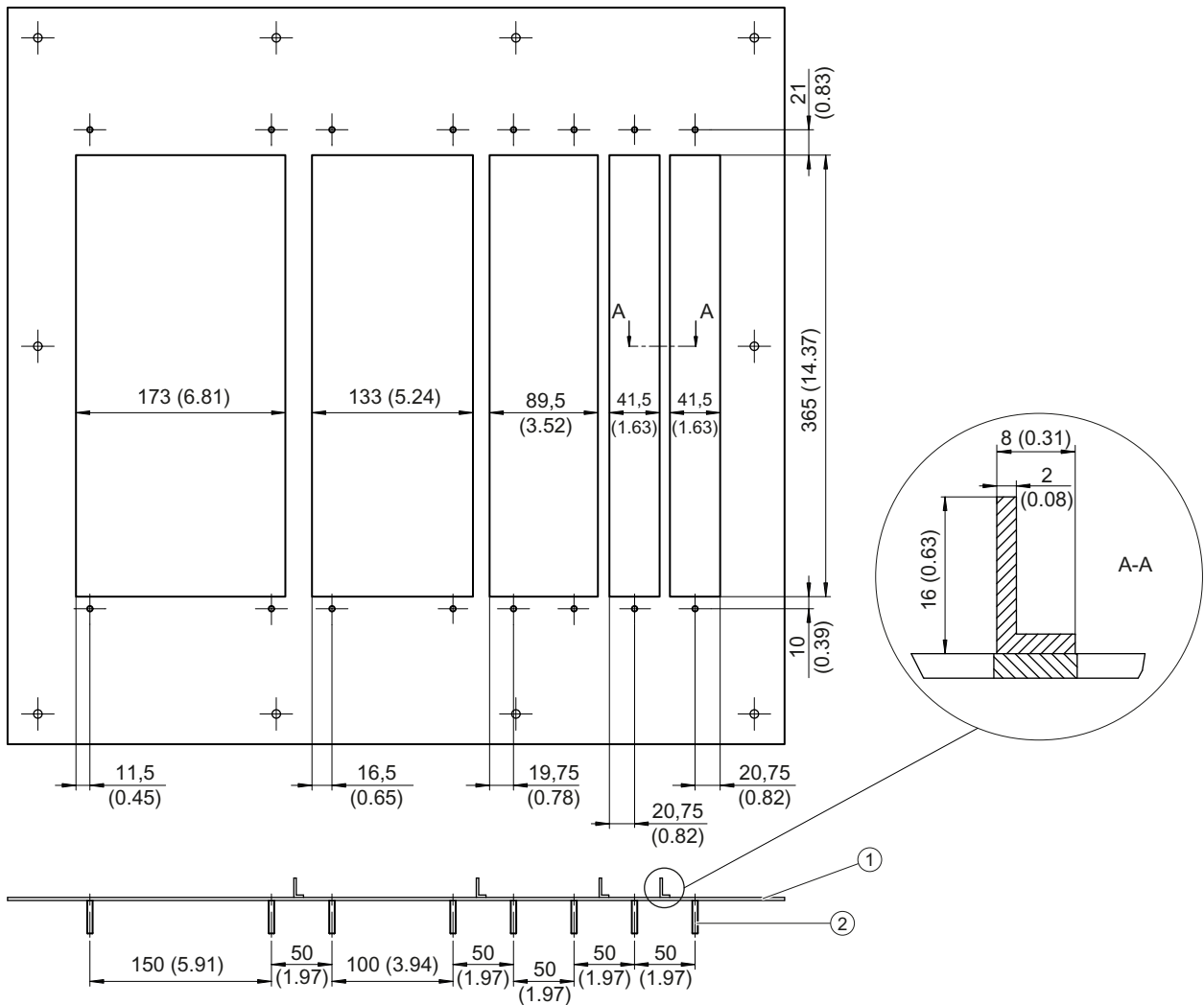


Figure 4-98 Opening to mount Smart Line Modules 50 mm to 200 mm with external air cooling, all data in mm and (inches)

Table 4- 84 Dimensions of openings to mount Smart Line Modules with external air cooling

Module width	W in mm (inches)	w1 in mm (inches)	w2 in mm (inches)
50 mm	41.5 <sup>+0.3</sup> (1.63 <sup>+0.012</sup> )	20.75 <sup>+0.15</sup> (0.82 <sup>+0.006</sup> )	--
100 mm	89,5 <sup>+0.3</sup> (3.52 <sup>+0.012</sup> )	19,75 <sup>+0.15</sup> (0.78 <sup>+0.006</sup> )	50 ±0,15 (1.97 ±0.006)
150 mm	133 <sup>+0.3</sup> (5.24 <sup>+0.012</sup> )	16,5 <sup>+0.15</sup> (0.65 <sup>+0.006</sup> )	100 ±0,15 (3.94 ±0.006)
200 mm	173 <sup>+0.3</sup> (6.81 <sup>+0.012</sup> )	11,5 <sup>+0.15</sup> (0.45 <sup>+0.006</sup> )	150 ±0,15 (5.91 ±0.006)

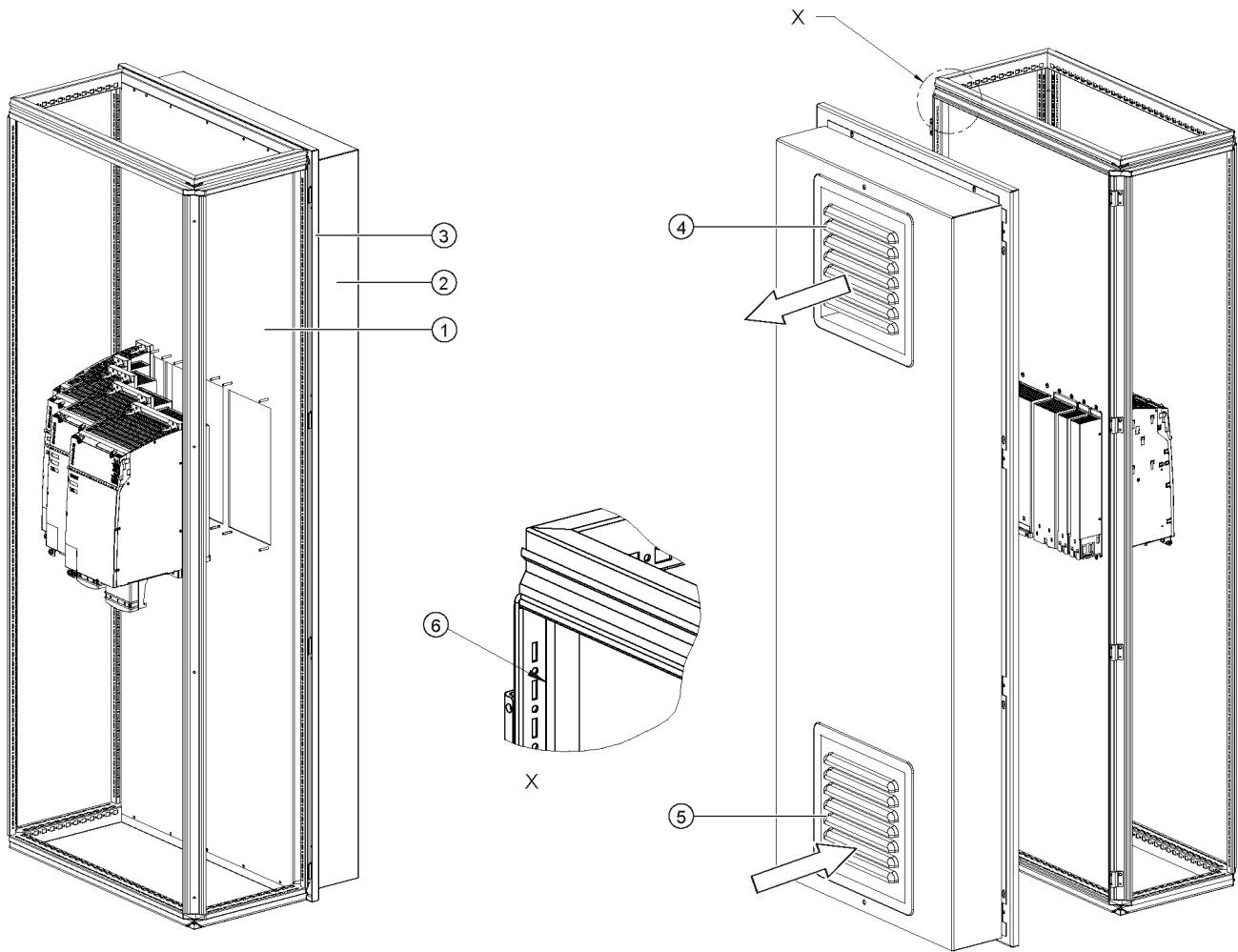


- ① Insert plate or mounting plate
- ② Threaded bolts M5 x 28

Figure 4-99 Example of a mounting plate for a drive line-up with external air cooling

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

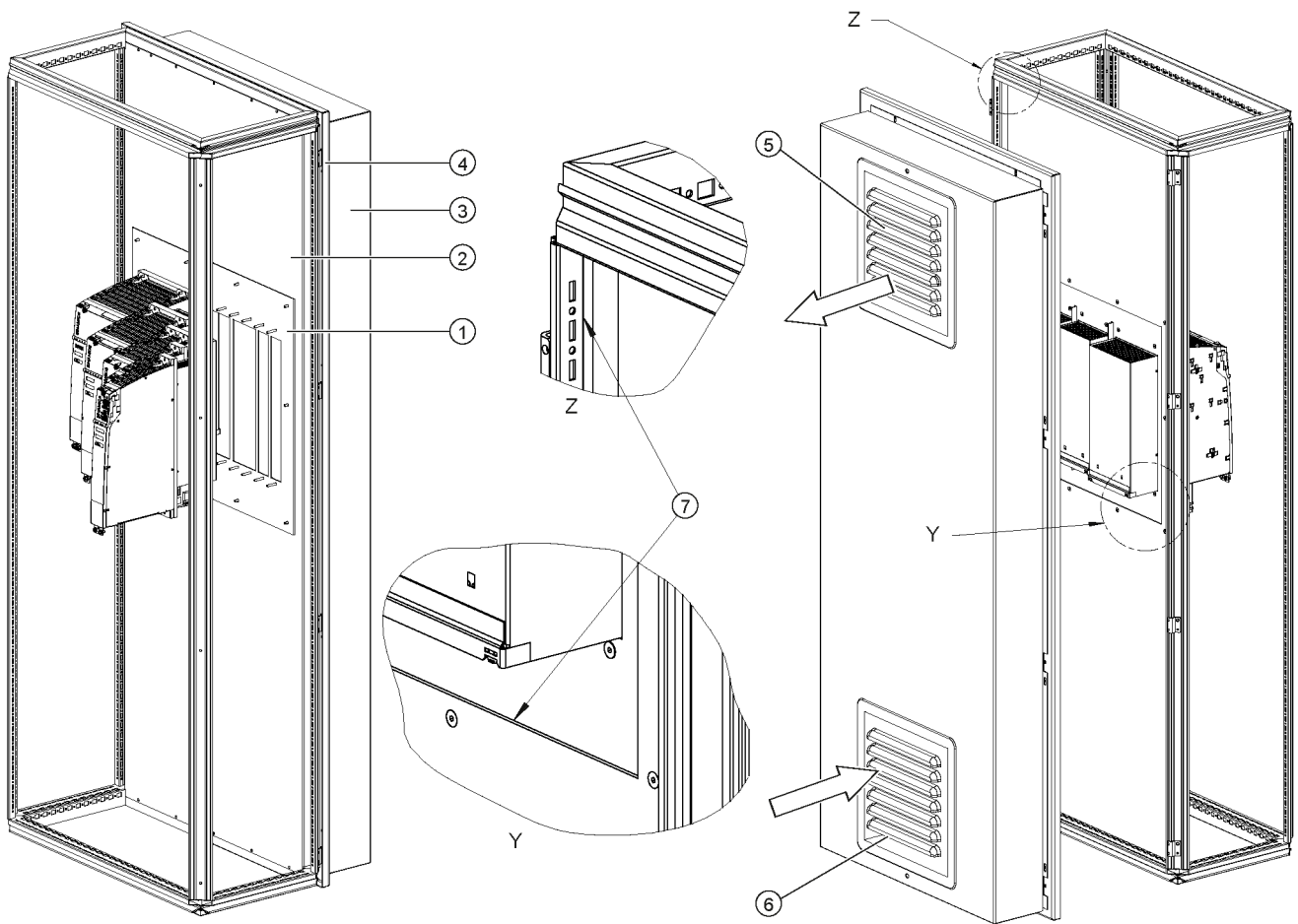
In our example, the cross-pieces have been reinforced using brackets according to EN 755-9. You are free to select the way that the bracket is attached to the insert.



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

Figure 4-100 Example 1: mounting in the cabinet with mounting plate





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

Figure 4-101 Example 2: mounting in the cabinet with mounting plate

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

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

**Note**

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

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

**Help with the mechanical control cabinet design is available from:**

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

**4.9.8 Technical data**

Table 4- 85 Technical data Smart Line Modules Booksize external air cooling

Internal air cooling	6SL3131-	6AE15-0AAx	6AE21-0AAx	6TE21-6AAx	6TE23-6AAx	6TE25-5AAx
<b>Rated power</b>	<b>kW</b>	<b>5</b>	<b>10</b>	<b>16</b>	<b>36</b>	<b>55</b>
<b>Infeed</b>						
Rated power (S1) <sup>1)</sup>	kW (P <sub>n</sub> )	5	10	16	36	55
S6 operation (40%) <sup>1)</sup>	kW (P <sub>s6</sub> )	6.5	13	21	47	71
Peak infeed power <sup>1)</sup>	kW (P <sub>max</sub> )	10	20	35	70	91
<b>Regenerative feedback</b>						
Continuous regenerative power	kW	5	10	16	36	55
Peak regenerative power	kW	10	20	35	70	91
<b>Supply voltages</b>						
Line voltage	V <sub>AC</sub>	3 AC 380 to 480 ±10% (-15% < 1 min)				
Line frequency	Hz	47 to 63				
Electronics power supply	V <sub>DC</sub>	24 (20.4 - 28.8)				
DC link voltage	V <sub>DC</sub>	510 – 720				
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %				
Undervoltage trip <sup>2)</sup>	V <sub>DC</sub>	360 ± 2 %				
<b>Input currents</b>						
Rated input current at 400 V <sub>AC</sub>	A <sub>AC</sub>	8,1	16,2	27,5	59	90
at 380 V <sub>AC</sub> /480 V <sub>AC</sub>	A <sub>AC</sub>	8,6 / 6,7	17 / 12,8	29 / 24,5	62 / 51	94 / 77
S6 (40%) at 400 V <sub>AC</sub>	A <sub>AC</sub>	10,6	21,1	35	76	106
Peak current at 400 V <sub>AC</sub>	A <sub>AC</sub>	15,7	31,2	57,5	112	130

Internal air cooling	6SL3131-	6AE15-0AAx	6AE21-0AAx	6TE21-6AAx	6TE23-6AAx	6TE25-5AAx
<b>Rated power</b>	<b>kW</b>	<b>5</b>	<b>10</b>	<b>16</b>	<b>36</b>	<b>55</b>
<b>DC link currents</b>						
DC link output current at 600 V <sub>DC</sub>	A <sub>DC</sub>	8,3	16,6	27	60	92
at 540 V <sub>DC</sub>	A <sub>DC</sub>	9,3	18,5	30	67	105
S6 (40%) at 600 V <sub>DC</sub>	A <sub>DC</sub>	11	22	35	79	138
Peak current at 600 V <sub>DC</sub>	A <sub>DC</sub>	16,6	33,2	59	118	178
<b>Current carrying capacity</b>						
DC link busbars	A <sub>DC</sub>	100	100	100	200	200
Reinforced DC link busbars	A <sub>DC</sub>	150	150	150	--	--
24 V DC busbars	A <sub>DC</sub>	20	20	20	20	20
<b>Electronics current consumption</b> at 24 V DC	A <sub>DC</sub>	0,8	0,9	0,95	1,5	1,9
<b>Total power loss</b> (incl. electronics losses) <sup>3)</sup>	W	79,2	141,6	187,8	406	665,6
Internal	W	41,2	66,6	64,8	116	185,6
External	W	38	75	123	290	480
<b>Max. ambient temperature</b> without derating	° C	40				
with derating	° C	55				
<b>DC link capacitance</b>						
Smart Line Module	µF	220	330	705	1410	1880
Drive line-up, max.	µF	6000	6000	20000	20000	20000
<b>Power factor</b>	cos φ	0,98	0,98	0,98	0,98	0,98
<b>Circuit breaker</b> (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 47)				
<b>Rated short-circuit current</b> SCCR <sup>4)</sup>	kA	65	65	65	65	65
<b>Sound pressure level</b>	dB(A)	< 60	< 60	< 60	<65	< 60
<b>Cooling air requirement</b>	m <sup>3</sup> /h	29,6	29,6	56	112	160
<b>Max. permissible heat sink temperature</b>	° C	69 <sup>5)</sup>	73 <sup>5)</sup>	77	80	75
Rated voltage for rated data 3 AC 380 V						
<b>Weight</b>	kg	5,3	5,4	8,8	13,8	18,5

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 line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.

3) For an overview, see the power loss tables in Section "Control cabinet installation".

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.

5) Values cannot be read out via the system (STARTER).

4.9.8.1 Characteristics

Rated duty cycles of Smart Line Modules

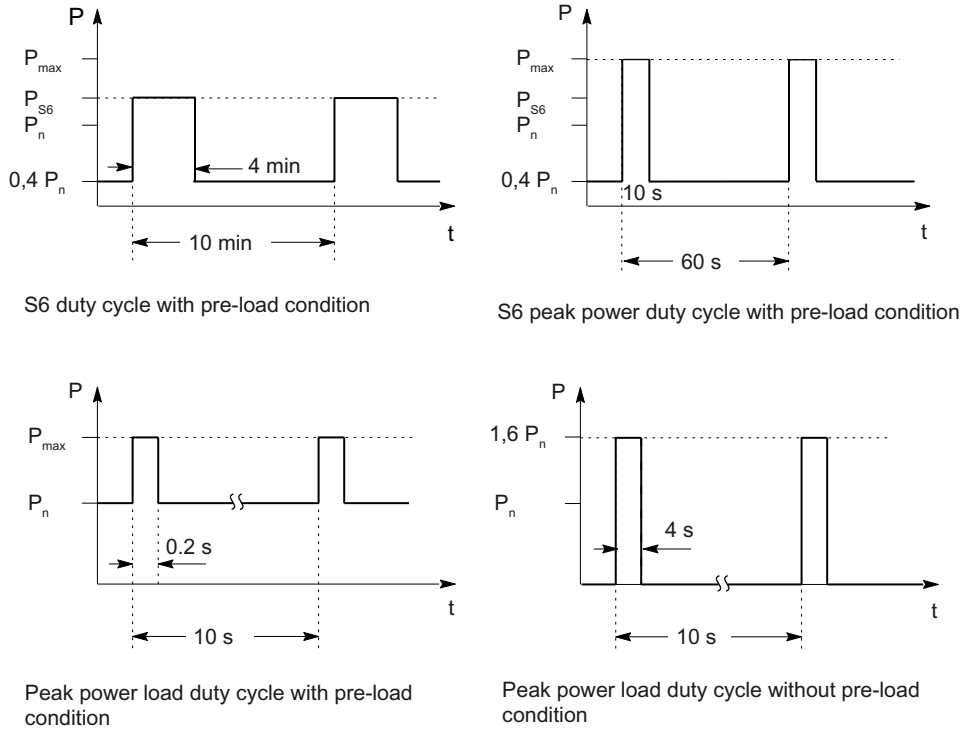


Figure 4-102 Rated duty cycles of Smart Line Modules

Derating characteristics

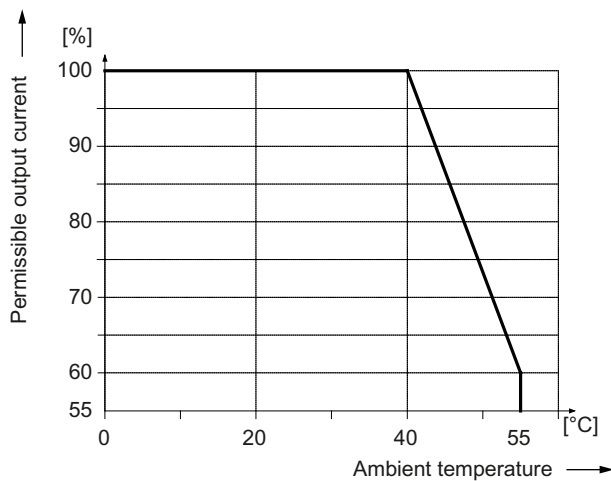


Figure 4-103 Output current as a function of the ambient temperature

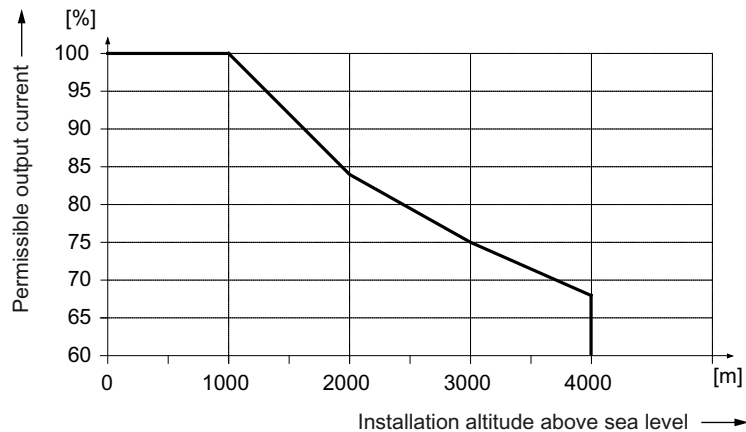


Figure 4-104 Output current as a function of the installation altitude

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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

## 4.10 Smart Line Modules with cold plate

### 4.10.1 Description

The Smart Line Module is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module(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 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 module has been enabled. An optional main contactor is required for disconnecting the voltage.

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

### 4.10.2 Safety instructions for Smart Line Modules Booksize

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**Note**

When using a Smart Line Module, you should also strictly observe the product-specific safety instructions for Line Modules as well as the safety instructions in Section 1.

---

**NOTICE**

**Please note the switch-on and switch-off sequence**

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21.1

**Switch on:**

- 24 V DC power supply X24 ON
- Line contactor ON
- EP signal X21.3 and X21.4 ON
- Wait until precharging is complete
- "Ready" signal at terminal X21.1 switched to high
- Infeed is ready, pulse enable possible for motors

**Switch off:**

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

**Overload:**

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

**Note**

**Connected to the public low-voltage network**

Smart Line Modules have been designed for use in the industrial environment and generate current harmonics on the line side as a result of the rectifier circuit.

When connecting a machine with integrated Smart Line Modules to the public low-voltage network, authorization is required in advance from the local power supply company (utility company) if

- the rated current of the machine  $\leq 16$  A per conductor, and
  - the rated machine current does not comply with the requirements specified in EN 61000-3-2 regarding current harmonics.
-

### 4.10.3 Interface description

#### 4.10.3.1 Overview

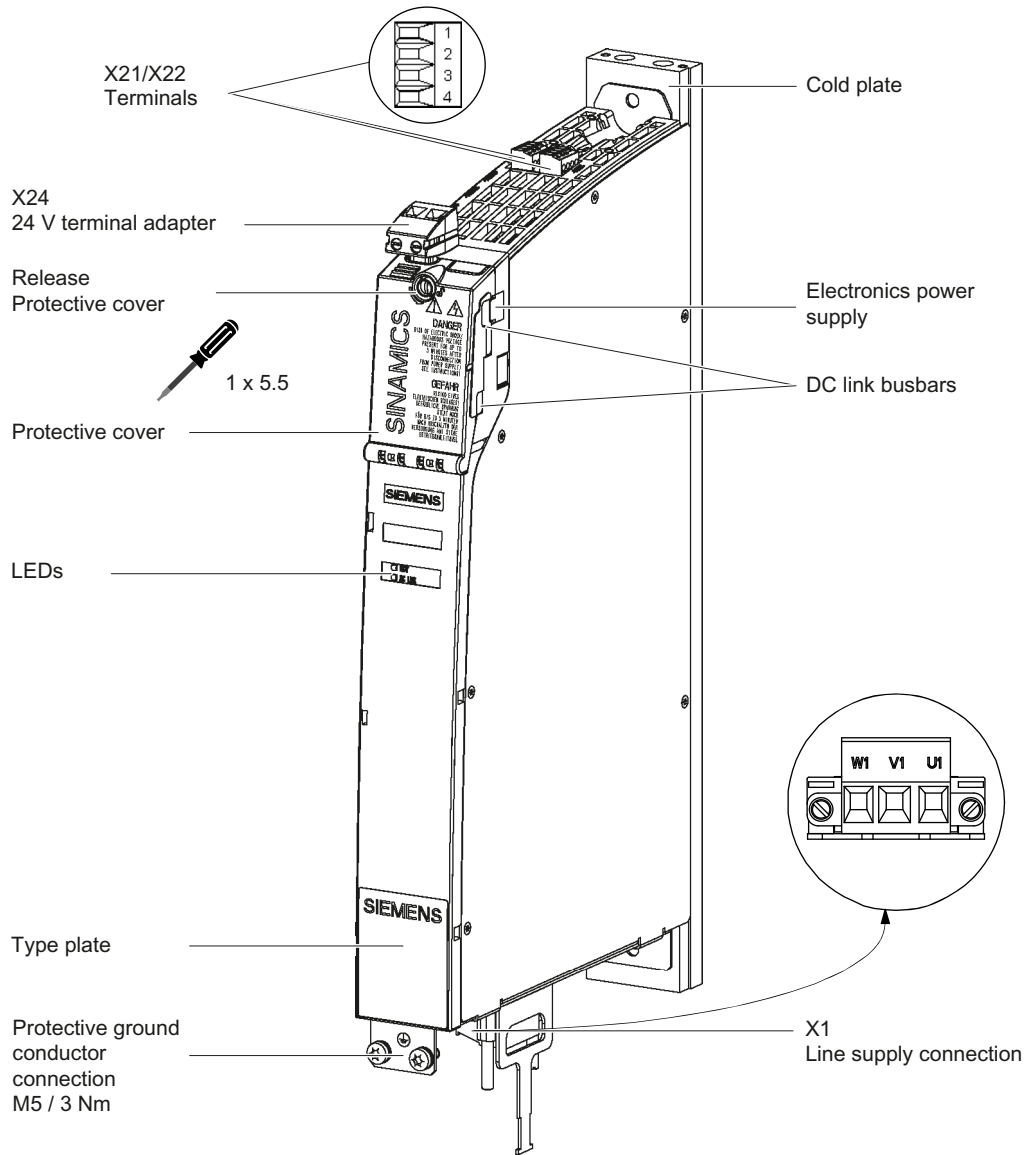
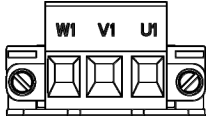
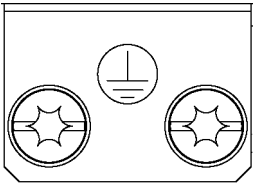


Figure 4-105 Interface overview, Smart Line Module with cold plate (example: 5 kW)



### 4.10.3.2 X1 line connection

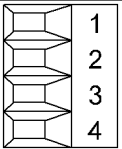
Table 4- 86 X1 line connection

	Terminal	Technical specifications
	U1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 Tightening torque: 1.2 - 1.5 Nm (see Chapter, "Control cabinet installation/connection system")
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm <sup>1)</sup>

1) For ring cable lugs in accordance with DIN 46234

### 4.10.3.3 X21 EP terminals

Table 4- 87 X21 EP terminals

	Terminal	Designation	Technical data
	1	DO: Ready	Checkback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: <ul style="list-style-type: none"> <li>• Electronics power supply (X24) OK</li> <li>• DC link is precharged</li> <li>• Pulses enabled (X21.3/.4)</li> <li>• No overtemperature</li> <li>• No overcurrent switch-off</li> </ul>
	2	DO: Prewarning	DO: Prewarning High = no prewarning Low = prewarning <ul style="list-style-type: none"> <li>• Overtemperature warning threshold / I*t                5 kW prewarning: 64° C, disconnection: 69° C                10 kW prewarning: 68° C, disconnection: 73° C</li> <li>• No regenerative feedback capability due to a line fault                [only monitored when feedback is activated (see terminal X22.2)]</li> </ul>
	3	EP +24 V (pulse enable)	Voltage 24 V DC
	4	EP M (Enable Pulses)	Current consumption: 10 mA Isolated input
Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Section "Control cabinet installation and EMC / connection system")			

**Terminals X21.1 and X21.2**

**NOTICE**

**Please note the switch-on and switch-off sequence**

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21.1 (see Section "Safety instructions for Smart Line Modules Booksize (Page 318)")

**NOTICE**

**Wiring to a digital input of the Control Unit**

Output terminal X21.1 must be wired to a digital input on the CU. The drives supplied with power from the Smart Line Module have to use this signal as a "Ready" signal (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. It is not permissible that the control system sets the drives to ready until the infeed "Ready" signal is present.

**NOTICE**


**Evaluating the "Prewarning" signal**

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

**Note**

The Smart Line Module signals that it is ready, even if one of the line conductors is not available. In this case, regenerative feedback is deactivated and an alarm is output at X21.2 (DO, Warning I<sup>2</sup>t). If regenerative feedback was deactivated by applying a "high" signal to terminal X22.2 (DI, Disable), no alarm will be output at X21.2 (DO, Warning I<sup>2</sup>t).

**Terminals X21.3 and X21.4**

 **WARNING**

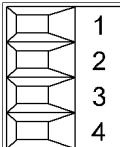
**Connecting terminals X21.3 and X21.4**

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. Pulse suppression is activated when removed. The regenerative feedback is deactivated. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example because a line contactor is not installed, then the DC link remains charged.

NOTICE
<p><b>Using a line disconnecter unit</b></p> <p>If an active drive line-up is switched off using the disconnecter unit, the voltage at X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be realized using a leading breaking auxiliary contact (<math>\geq 10</math> ms), for example.</p> <p>This protects external loads located parallel to the drive at the same switching component.</p>

#### 4.10.3.4 X22 digital inputs

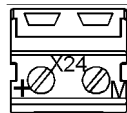
Table 4- 88 X22 digital inputs for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation <sup>1)</sup>	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 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) DI: Digital input

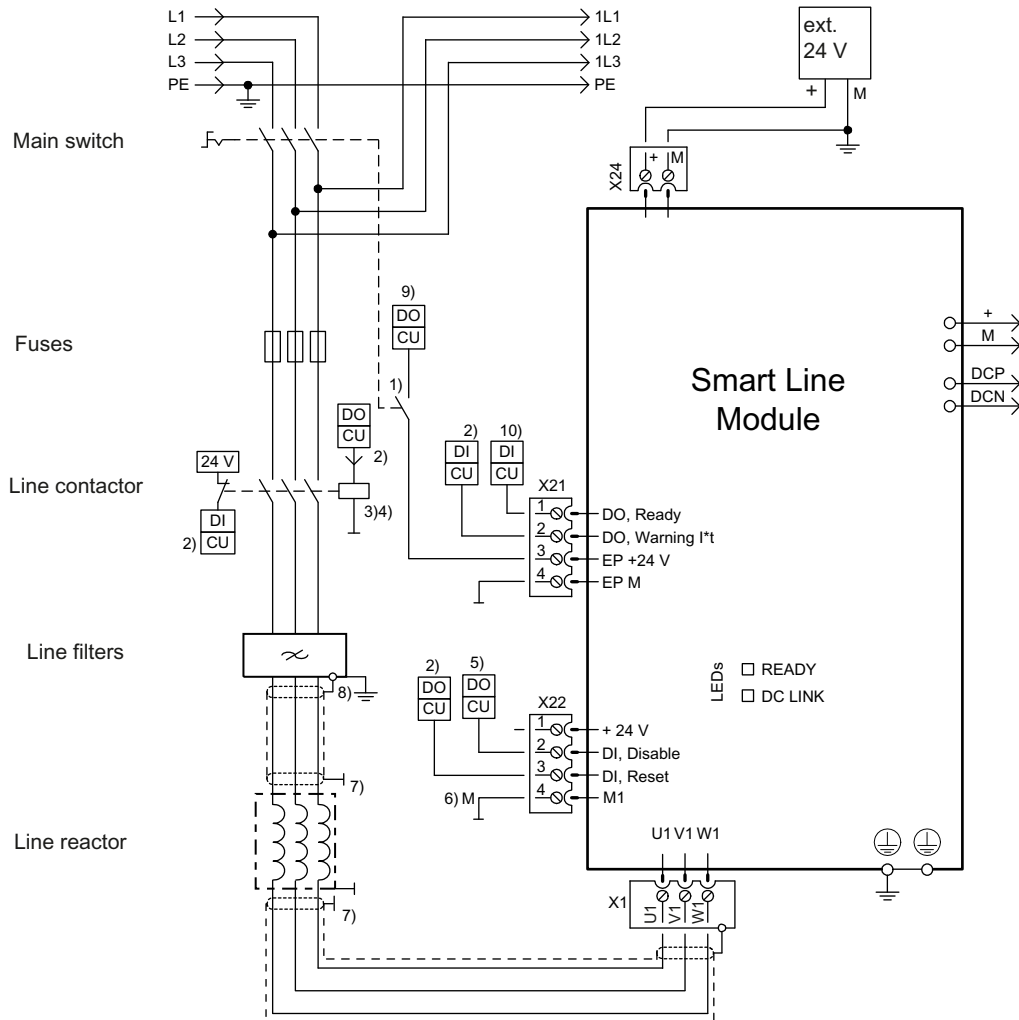
#### 4.10.3.5 X24 24 V terminal adapter

Table 4- 89 X24: 24 V terminal adapter

	Terminal	Designation	Technical data
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 (see Section "Control cabinet installation and EMC / connection system")			

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

4.10.4 Connection example



- 1) Leading opening contact  $t > 10\text{ms}$ , 24 V DC and ground must be connected for operation.
- 2) DI/DO controlled by the Control Unit
- 3) No additional load permitted downstream of line contactor
- 4) The current carrying capacity of the DO must be observed; an output interface must be used if required.
- 5) DO high, regenerative feedback deactivated (for permanent deactivation, a jumper can be installed between X22 pin 1 and 2)
- 6) X22 pin 4 must be connected to ground (external 24 V)
- 7) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline
- 8) 5 kW and 10 kW line filters via shield connection
- 9) Signal output of the control to avoid reaction of the 24 V supply on the EP terminal
- 10) Connect to parameter p0864 via BICO

Figure 4-106 Connection example for 5 kW and 10 kW Smart Line Modules

**Note**

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

### 4.10.5 Meaning of LEDs

Table 4- 90 Meaning of the LEDs on 5 kW and 10 kW Smart Line Modules

LED	Color	Status	Description, cause	Remedy
RDY	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	Component is ready to operate.	–
	Yellow	Continuous light	Pre-charging not yet complete. bypass relay dropped out EP terminals not supplied with 24 VDC.	–
	Red	Continuous light	Overtemperature, overcurrent	Diagnose 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 light	DC link voltage within permissible tolerance range.	–
	Red	Continuous light	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 status of the "DC LINK" LED.

The warning information on the components must be carefully observed!

### 4.10.6 Dimension drawings

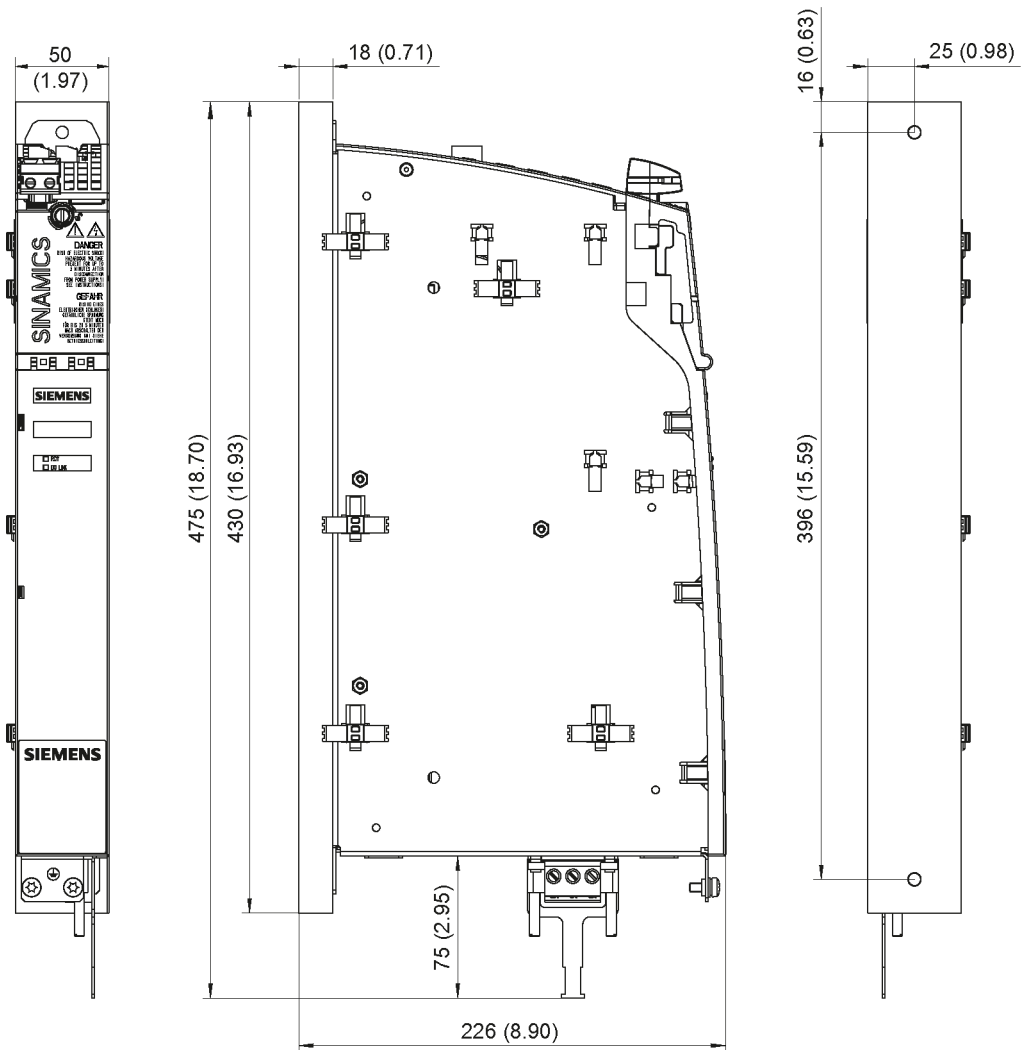


Figure 4-107 Dimension drawing of Smart Line Module with cold plate (5 kW and 10 kW), all dimensions in mm and (inches)

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#### Note

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

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### 4.10.7 Mounting

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

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

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#### Note

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

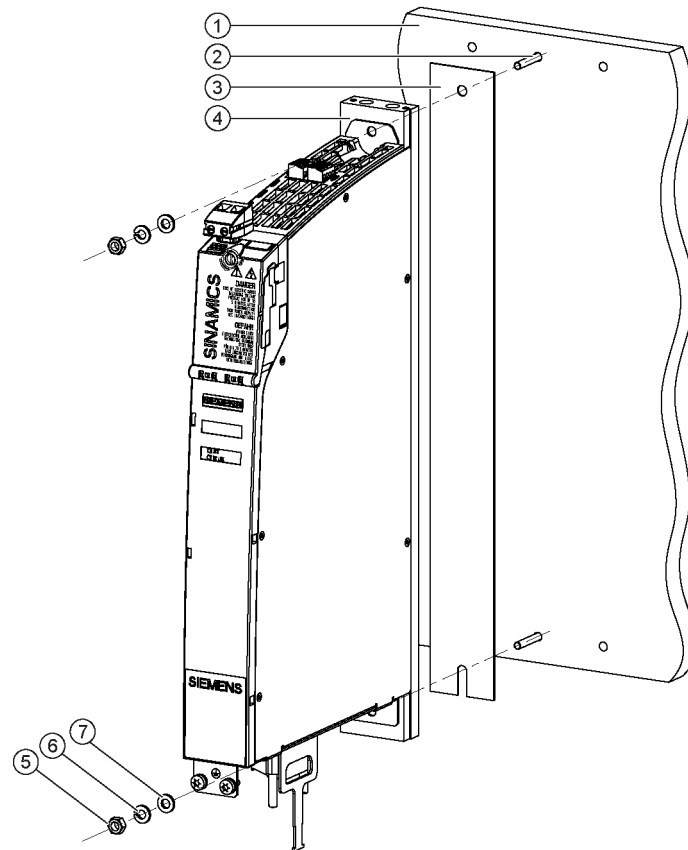
	Order number
Heat-conducting foil, 50 mm	6SL3162-6FB00-0AA0

---

#### Note

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

---



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

Figure 4-108 Mounting a Smart Line Module with cold plate on an external heat sink, using a 5 kW Smart Line Module as an example

**Tightening torques:**

- Initially, only tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm

**Help with the mechanical control cabinet design is available from:**

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



**Properties of the heat sink**

We recommend using AlMgSi 0.5 as the heat sink material.

The roughness of the external heat sink surface should be at least Rz 16 and the contact surface between the heat sink and cold plate should have an evenness of 0.2 mm.

**Note**

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

**NOTICE****Ensure that the threaded bolts do not damage the cold plate**

- When mounting, ensure that the threaded bolts do not damage the cold plate.

**4.10.8 Technical data**

Table 4- 91 Technical data for Smart Line Modules with cold plate cooling

	6SL3136-	6AE15-0AAx	6AE21-0AAx
<b>Rated power</b>	<b>kW</b>	<b>5</b>	<b>10</b>
<b>Infeed</b>			
Rated power (S1) <sup>1)</sup>	kW (P <sub>n</sub> )	5	10
Infeed power (S6-40%) <sup>1)</sup>	kW (P <sub>S6</sub> )		
Peak infeed power <sup>1)</sup>	kW (P <sub>max</sub> )	10	20
<b>Regenerative feedback</b>			
Continuous regenerative power	kW	5	10
Peak regenerative power	kW	10	20
<b>Supply voltages</b>			
Line voltage	V <sub>AC</sub>	3 AC 380 to 480 ±10% (-15% < 1 min)	
Line frequency	Hz	47 to 63	
Electronics power supply	V <sub>DC</sub>	24 (20.4 – 28.8)	
DC link voltage	V <sub>DC</sub>	510 – 720	
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %	
Undervoltage trip	V <sub>DC</sub>	360 ± 2 %	
<b>Input currents</b>			
Rated input current			
at 400 V <sub>AC</sub> :	A <sub>AC</sub>	8.1	16.2
Input current			
at 380 V <sub>AC</sub> / 480 V <sub>AC</sub>	A <sub>AC</sub>	8.6 / 6.7	17 / 12.8
at 400 V <sub>AC</sub> ; S6-40%	A <sub>AC</sub>	10.6	21.1
at 400 V <sub>AC</sub> ; peak current	A <sub>AC</sub>	15.7	31.2

## 4.10 Smart Line Modules with cold plate

	6SL3136-	6AE15-0AAx	6AE21-0AAx
<b>DC link currents</b>			
Rated DC link current at 600 V	A <sub>DC</sub>	8,3	16,6
DC link current at 540 V at 600 V <sub>DC</sub> ; S6-40%	A <sub>DC</sub>	9,3	18,5
DC link current at 600 V <sub>DC</sub> ; peak current	A <sub>DC</sub>	11	22
	A <sub>DC</sub>	16,6	33,2
<b>Current carrying capacity</b>			
DC link busbars	A <sub>DC</sub>	100	100
Reinforced DC link busbars	A <sub>DC</sub>	150	150
24 V DC busbars	A <sub>DC</sub>	20	20
<b>Electronics current consumption at 24 V DC</b>	A <sub>DC</sub>	0,6	0,7
<b>Power loss distribution</b> (incl. electronics losses) <sup>3)</sup>			
internal	W	34,4	56,8
external	W	40	80
<b>DC link capacitance</b>			
Smart Line Module	μF	220	330
Drive line-up, max.	μF	6000	6000
<b>Power factor</b>	cosφ	1	1
<b>Circuit breaker</b> (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 47)	
<b>Rated short-circuit current</b> SCCR <sup>2)</sup>	kA	65	65
<b>Max. permissible heat-sink temperature</b>	° C	60	65
<b>Max. ambient temperature</b>			
without derating	° C	40	40
with derating	° C	55	55
<b>Weight</b>	kg	4,0	4,0

1) The powers specified apply to the rated voltage range from 380 V to 480 V.

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

3) For an overview, see the power loss tables in Section "Control cabinet installation".

4.10.8.1 Characteristics

Rated duty cycles of Smart Line Modules

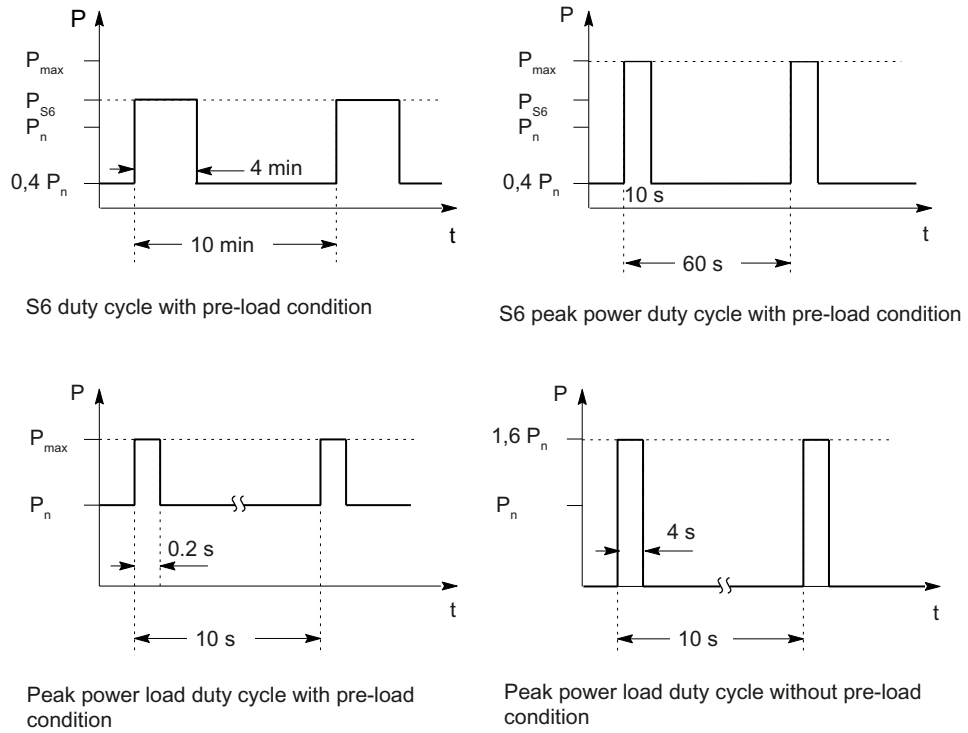


Figure 4-109 Rated duty cycles of Smart Line Modules

Derating characteristics

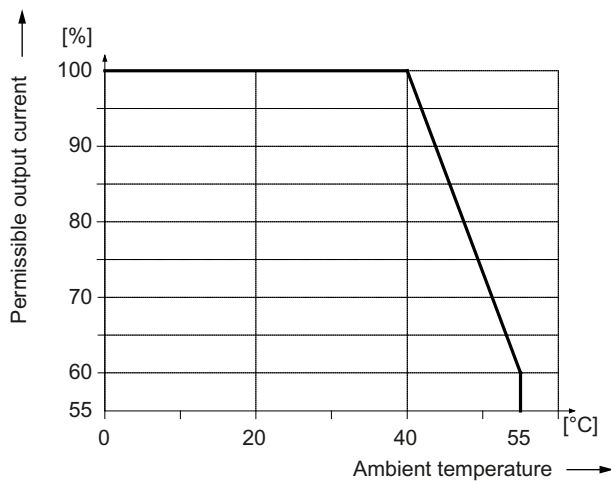


Figure 4-110 Output current as a function of the ambient temperature

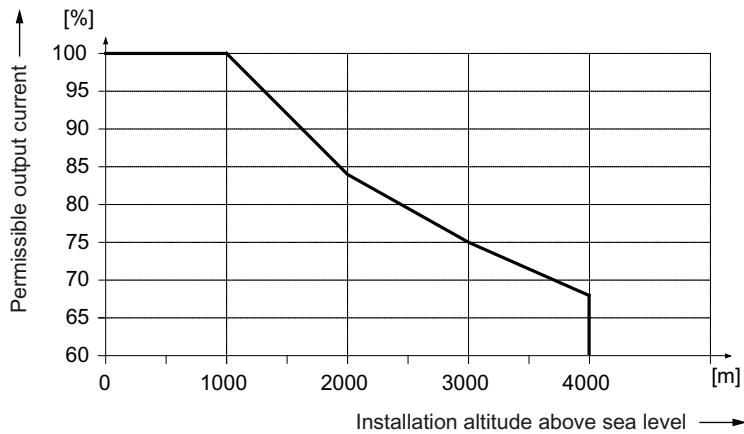


Figure 4-111 Output current as a function of the installation altitude

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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

### 4.10.8.2 Measuring the heat sink temperature

The maximum permissible heat sink temperature is calculated at the cold plate in the measuring range shown below.

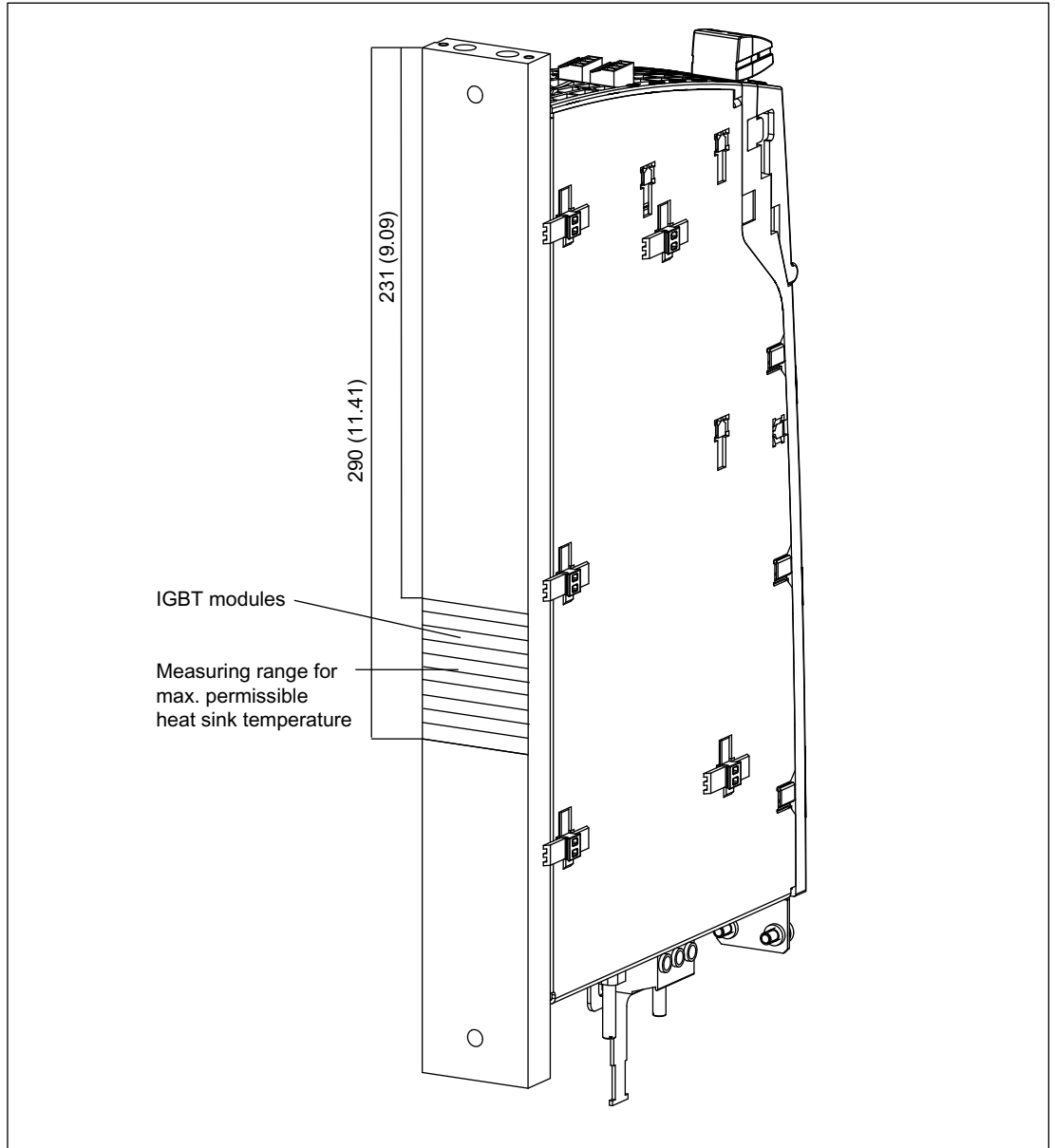


Figure 4-112 Measuring range for max. permissible heat-sink temperature for a Smart Line Module with cold plate



## Line Modules Booksize Compact

### 5.1 Smart Line Modules Booksize Compact

#### 5.1.1 Description

The Smart Line Module booksize compact is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module(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.

#### 5.1.2 Safety instructions for Smart Line Modules Booksize Compact

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##### Note

When using a Line Module Booksize Compact, also observe the safety instructions in Section 1.

---



##### WARNING

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

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

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



**! DANGER**

**Danger to life through electric shock due to a high DC link voltage**

As long as the Line Module is connected to the line supply, the DC link is charged with a high voltage. Contact with components can result in death or serious injury.

- Isolate the Line Module from the line supply during installation or maintenance work, e.g. via the line contactor or main switch.



**! DANGER**

**Danger to life through electric shock due to the residual charge of the DC link capacitors**

Because of the DC link capacitors, a hazardous voltage is present for up to five minutes after the power supply has been switched off.

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

- Do not open the protective cover of the DC link until five minutes have elapsed.
- Measure the voltage before starting work on the DCP and DCN DC link terminals.



**! DANGER**

**Danger to life through electric shock when the protective cover of the DC link is open**

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

- Only operate the components with closed protective cover.



**! WARNING**

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

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

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



**! WARNING**

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

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

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

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





 **WARNING**

**Danger to life through interruption of the external protective conductor due to high leakage currents**

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

- Ensure that the external protective conductor satisfies at least one of the following conditions:
  - It has been laid so that it is protected against mechanical damage.<sup>1)</sup>
  - If it is a single cable, it has a cross-section of at least 10 mm<sup>2</sup> Cu.
  - If it is a conductor of a multi-conductor cable, it has a cross-section of at least 2.5 mm<sup>2</sup> Cu.
  - It has a second protective conductor in parallel with the same cross-section.
  - It complies with the local regulations for equipment with increased leakage current.

<sup>1)</sup> Cables laid within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.

 **WARNING**

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

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

- Attach the component warning labels in the national language.

 **WARNING**

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

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

- Maintain the 80 mm clearances above and below the Line Modules.

 **CAUTION**

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

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

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

<b>NOTICE</b>
<b>Damage to the equipment due to excess energy not being fed back to non-regenerative supply systems</b>
Excess energy that is not fed back can damage equipment.
<ul style="list-style-type: none"><li>• For line supplies without regenerative feedback capability (e.g. diesel generator), deactivate the regenerative feedback capability of the Line Modules via parameter p3533.</li><li>• The braking energy must then be dissipated via an additional Braking Module with braking resistor in the drive line-up.</li></ul>

<b>NOTICE</b>
<b>Damage to external loads when using a disconnecter unit without prior voltage interruption</b>
For Line Modules with regenerative feedback capability, switching off a running drive line-up with a disconnecter unit can destroy external loads that remain on the same switching component parallel to the drive.
<ul style="list-style-type: none"><li>• Therefore, interrupt the voltage first at terminals X21.3 (EP +24 V) and X21.4 (EP M). This can be achieved using a leading breaking auxiliary contact (<math>\geq 10</math> ms), for example.</li></ul>

<b>NOTICE</b>
<b>Damage through use of incorrect DRIVE-CLiQ cables</b>
Damage or malfunctions can occur on the devices or system when incorrect or unreleased DRIVE-CLiQ cables are used.
<ul style="list-style-type: none"><li>• Only use suitable DRIVE-CLiQ cables that have been released by Siemens for the respective application.</li></ul>

---

**Note**

**Malfunctions due to polluted DRIVE-CLiQ interfaces**

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

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

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**Note**

**Fan operation**

Activation of the fan is dependent on heat sink temperature and pulse enable.

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### 5.1.3 Interface description

#### 5.1.3.1 Overview

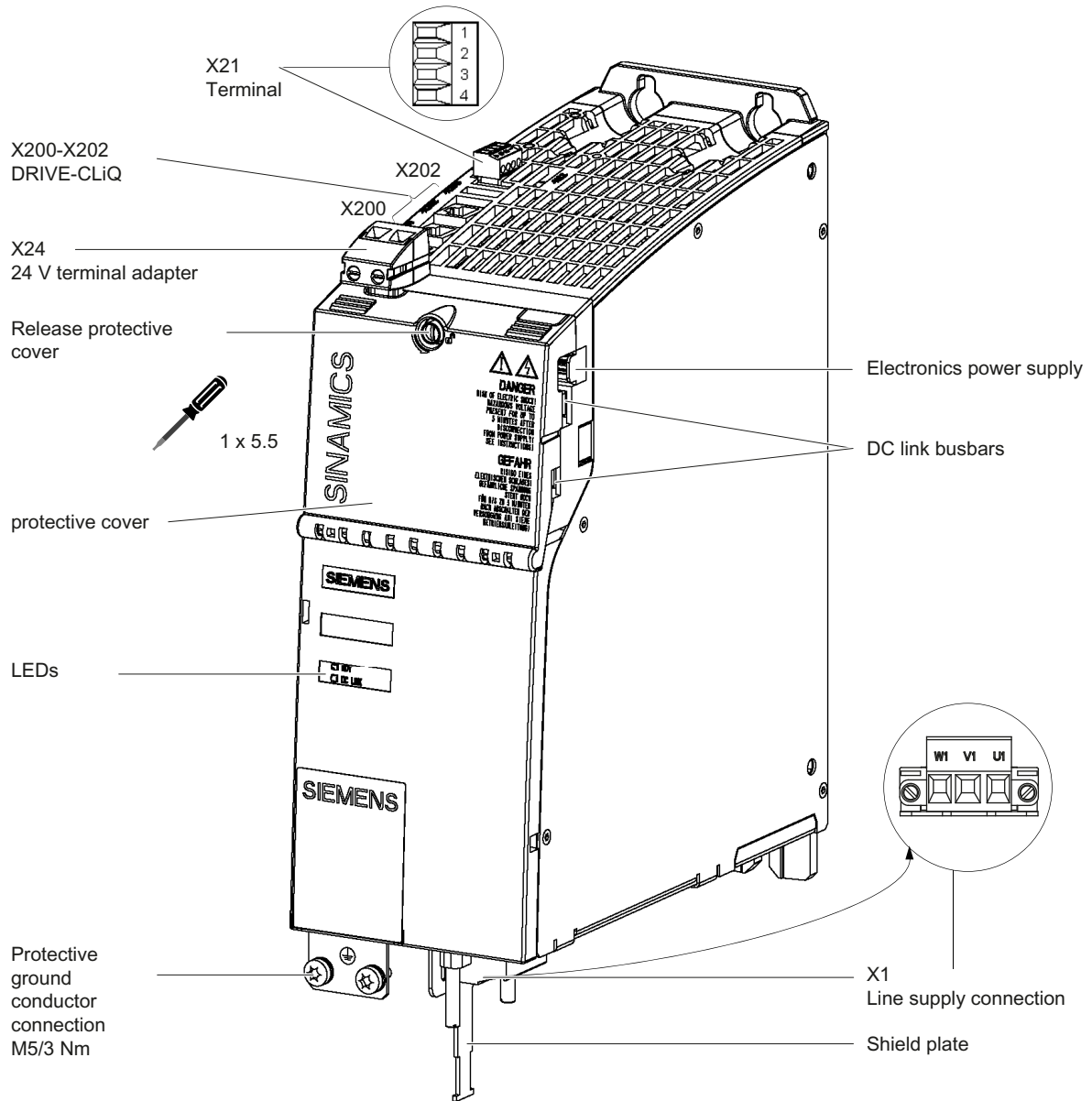
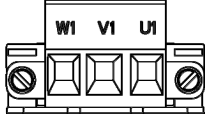
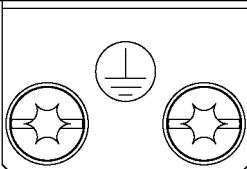


Figure 5-1 Interface overview, Smart Line Module in Booksize Compact format (16 kW)

5.1.3.2 X1 line connection

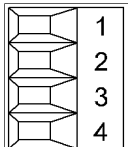
Table 5- 1 X1 line connection

	Terminal	Technical specifications
	U1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 16 mm <sup>2</sup> Type: Screw terminal 7 Tightening torque: 1.5 - 1.8 Nm (see Chapter, "Control cabinet installation/connection system")
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm <sup>1)</sup>

1) For ring cable lugs in accordance with DIN 46234

5.1.3.3 X21 EP terminals

Table 5- 2 X21 EP terminal / temperature sensor

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors: KTY 84–1C130 <sup>1)</sup> /PTC <sup>1)</sup> /bimetallic switch with NC contact The temperature sensor type can be selected via parameter p0601 and the temperature display via r35. <sup>2)</sup>
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage: 24 V DC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs
	4	EP M (Enable Pulses)	
Max. connectable cross-section 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Section "Control cabinet installation and EMC / connection system")			

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

2) For further information see SINAMICS S120, Commissioning Manual.

**Terminals X21.1 and X21.2 - temperature sensor connection** **DANGER****Danger to life through electric shock**

Only temperature sensors that meet the safety isolation specifications stipulated 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 danger to life!

**NOTICE****Risk of the motor overheating due to an incorrectly connected KTY temperature sensor**

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY sensor with the correct polarity.

**Terminals X21.3 and X21.4** **WARNING****Connecting terminals X21.3 and X21.4**

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. Pulse suppression is activated when removed. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example because a line contactor is not installed, then the DC link remains charged.

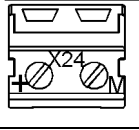
**NOTICE****Using a line disconnecter unit**

If an active drive line-up is switched off using the disconnecter unit, the voltage at X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be realized using a leading breaking auxiliary contact ( $\geq 10$  ms), for example. This protects external loads located parallel to the drive at the same switching component.

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

5.1.3.4 X24 24 V terminal adapter

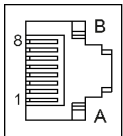
Table 5-3 X24: 24 V terminal adapter

	Terminal	Designation	Technical data
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 (see Section "Control cabinet installation and EMC / connection system")			

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

5.1.3.5 X200-X202 DRIVE-CLiQ interfaces

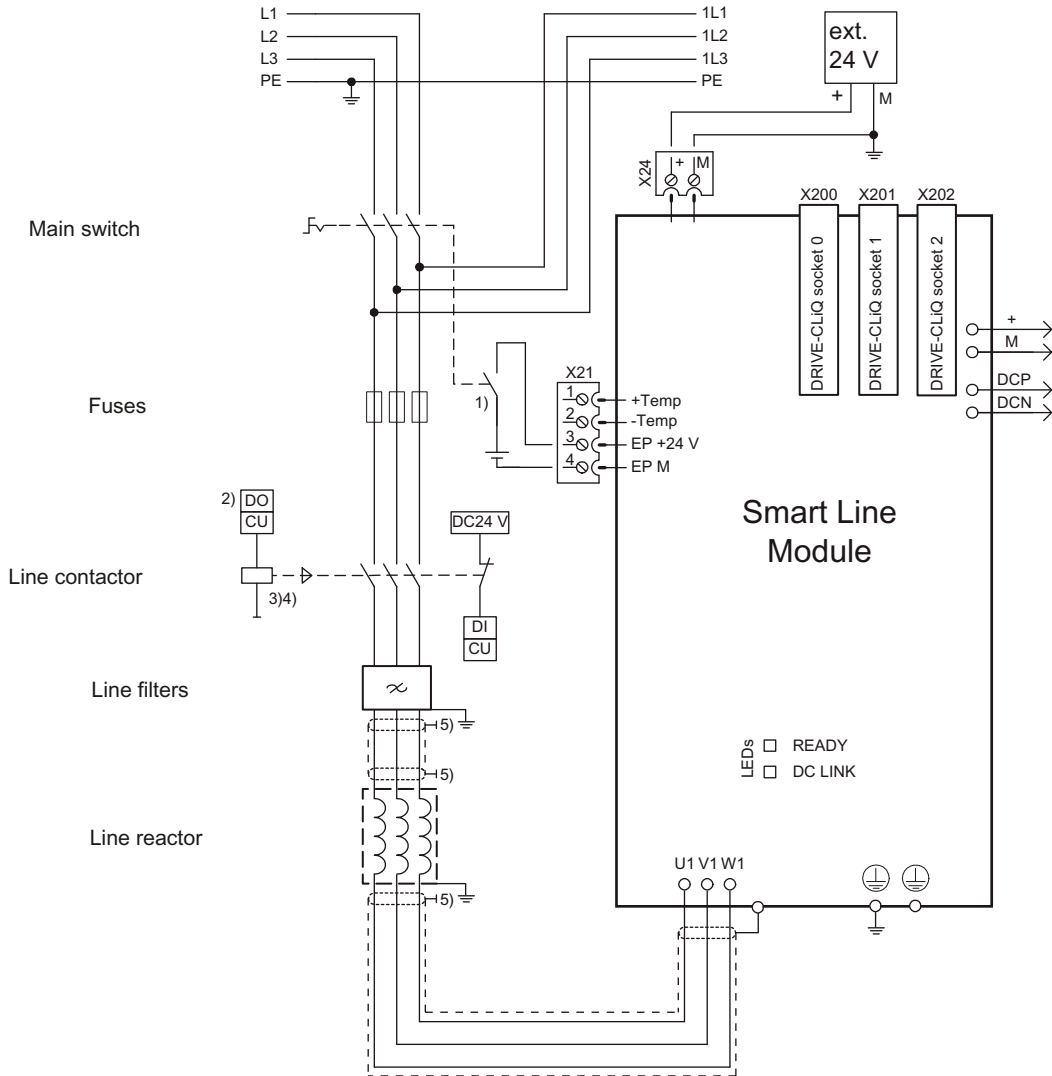
Table 5-4 X200-X202: DRIVE-CLiQ interfaces

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

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

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

### 5.1.4 Connection example



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

Figure 5-2 Connection example, Smart Line Module Booksize Compact 16 kW


#### Note

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

### 5.1.5 Meaning of the LEDs

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

State		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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. <b>Note:</b> 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	--	Detection of the components via LED is activated (p0124). <b>Note:</b> Both options depend on the LED state when module recognition is activated via p0124 = 1.	–

 <b>DANGER</b>
<p><b>Danger to life when live parts are touched</b></p> <p>Hazardous DC link voltages may be present at any time regardless of the state of the LED "DC LINK".</p> <p>Note the warning information on the component!</p>



### 5.1.6 Dimension drawing

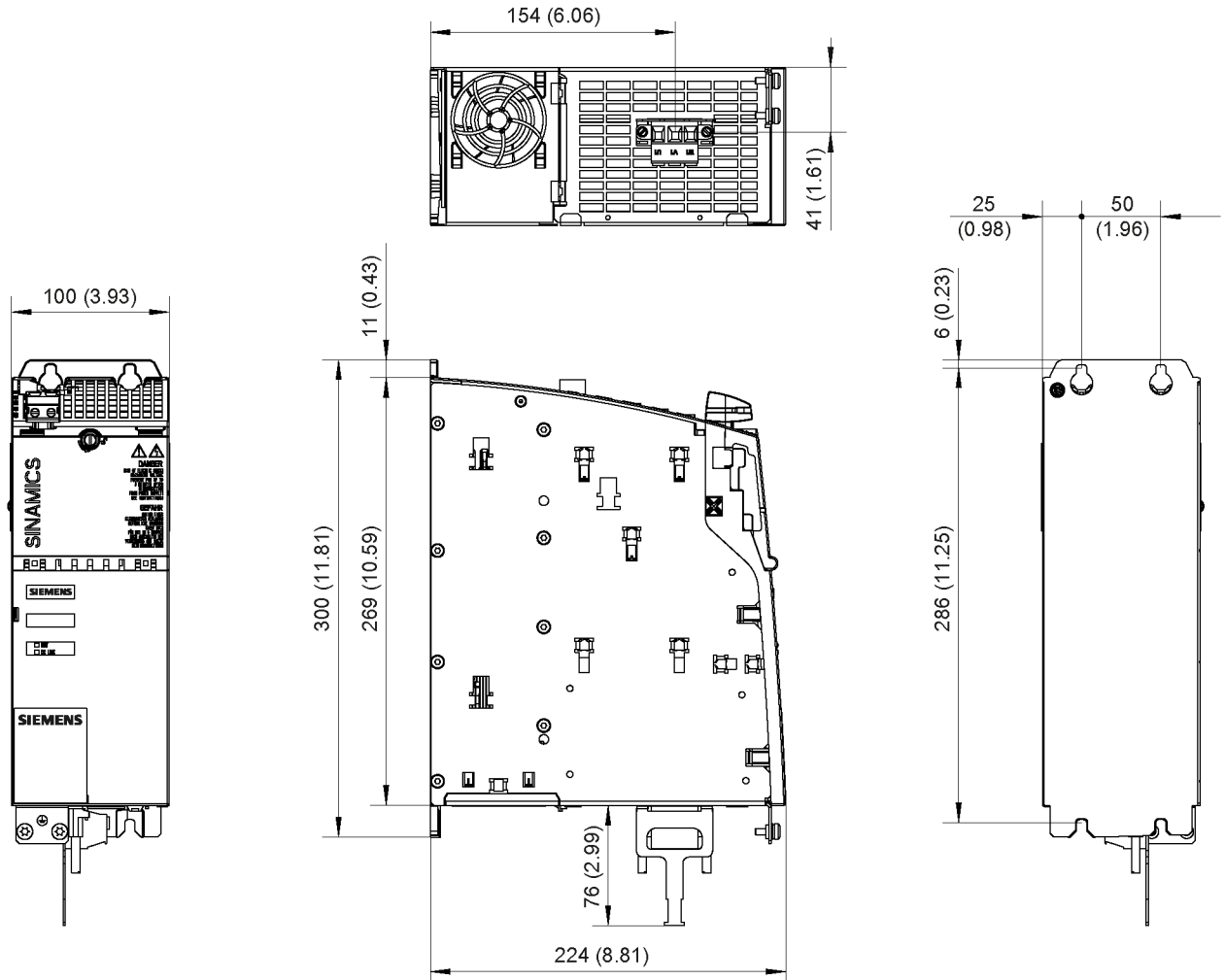


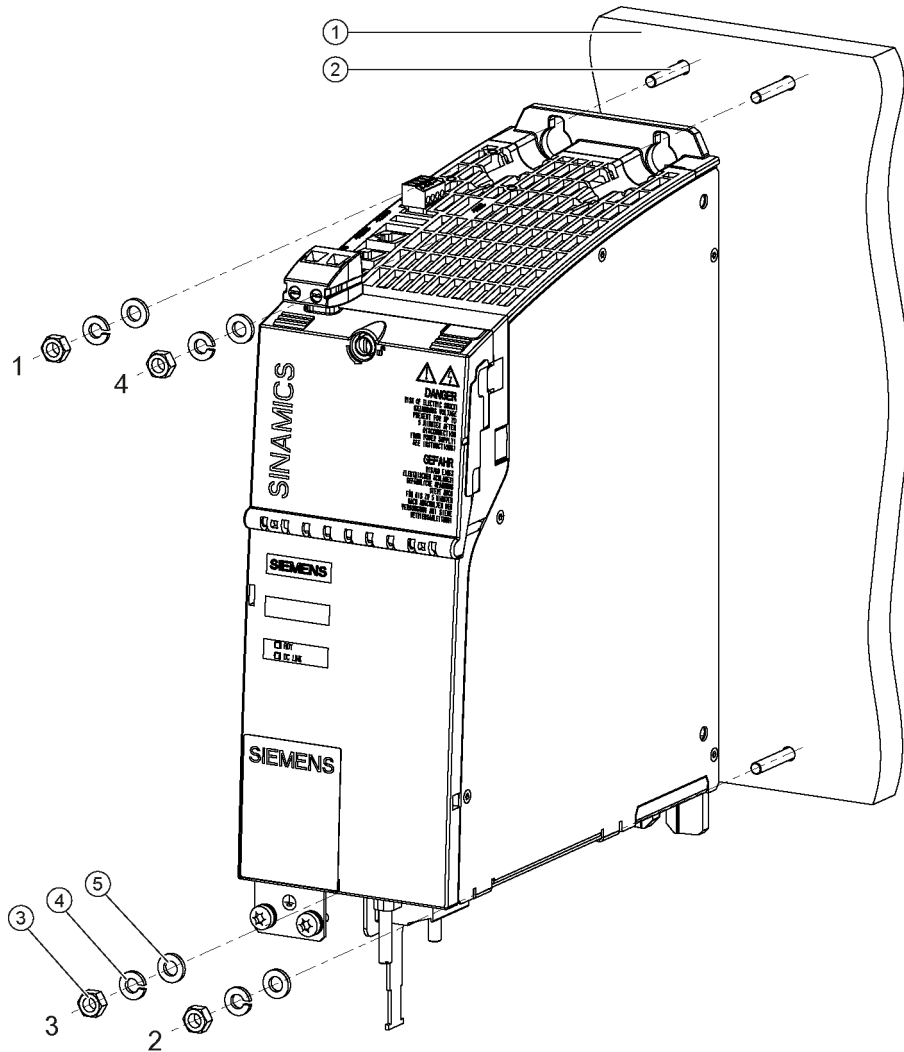
Figure 5-3 Dimension drawing Smart Line Module Booksize Compact format (16 kW), all dimensions in mm and (inches)

#### Note

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

### 5.1.7 Mounting

#### Mounting a Smart Line Module Booksize Compact with internal air cooling



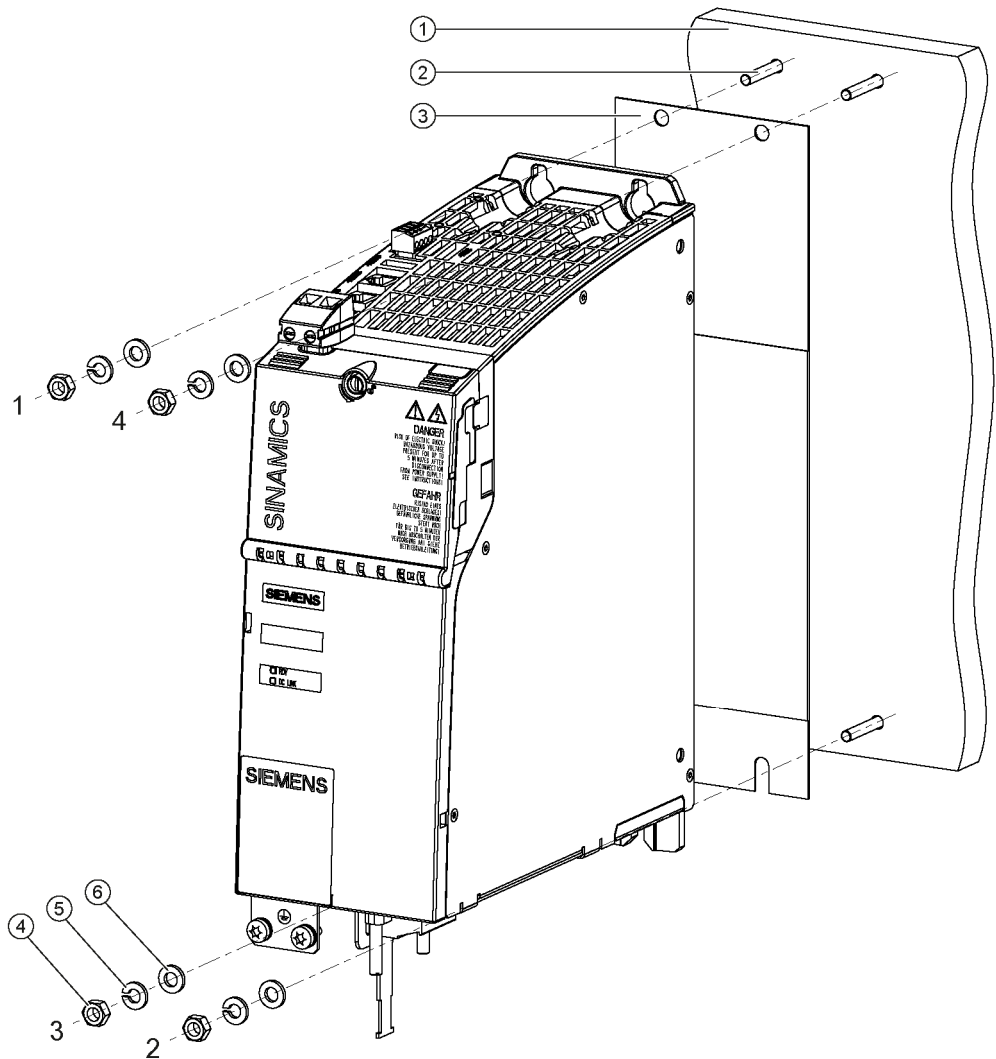
- ① Mounting wall
- ② M6 studs
- ③ M6 nut
- ④ Spring washer
- ⑤ Washer

Figure 5-4 Mounting a Smart Line Module Booksize Compact with internal cooling

#### Tightening torques:

- Initially, only tighten the nuts by hand (0.5 Nm)
- Then tighten with 6 Nm (in the specific sequence 1 to 4)

### Mounting a Smart Line Module Booksize Compact on a cold plate



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

Figure 5-5 Mounting a Smart Line Module Booksize Compact on a cold plate

#### Tightening torques:

- Initially, only tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm (in the specific sequence 1 to 4)

**Special points to note in relation to mounting on a cold plate**

To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every Smart Line Module Booksize Compact is supplied with heat-conducting foil cut to the right size. Note the mounting position of the heat-conducting foil.

**Note**

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

Table 5- 6 Heat-conducting foil

	Order number
Heat-conducting foil, 100 mm	6SL3162-6FD01-0AA0

**5.1.8 Technical data**

Table 5- 7 Technical data Smart Line Modules Booksize Compact

Smart Line Module Booksize Compact	6SL3430-	6TE21-6AAx
<b>Rated power</b>	<b>kW</b>	<b>16</b>
<b>Infeed</b>		
Rated power (S1) <sup>1)</sup>	kW (P <sub>n</sub> )	16
Infeed power (S6-40 %) <sup>1)</sup>	kW (P <sub>S6</sub> )	21
Peak infeed power <sup>1)</sup>	kW (P <sub>max</sub> )	35
<b>Regenerative feedback</b>		
Continuous regenerative power	kW	16
Peak regenerative power	kW	35
<b>Supply voltages</b>		
Line voltage	V <sub>AC</sub>	3 AC 380 to 480 ±10 % (-15 % < 1 min)
Line frequency	Hz	47 to 63
Electronics power supply	V <sub>DC</sub>	24 (20.4 - 28.8)
DC link voltage	V <sub>DC</sub>	510 – 720
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %
Undervoltage trip <sup>2)</sup>	V <sub>DC</sub>	360 ± 2 %
<b>Input currents</b>		
Rated input current at 400 V <sub>AC</sub> :	A <sub>AC</sub>	27.5
Input current		
at 380 V <sub>AC</sub> / 480 V <sub>AC</sub>	A <sub>AC</sub>	29 / 24.5
at 400 V <sub>AC</sub> ; S6-40%	A <sub>AC</sub>	35
at 400 V <sub>AC</sub> ; peak current	A <sub>AC</sub>	57.5
<b>DC link currents</b>		
Rated DC link current at 600 V:	A <sub>DC</sub>	27
DC link current at 540 V:	A <sub>DC</sub>	30
at 600 V <sub>DC</sub> ; S6-40%	A <sub>DC</sub>	35
at 600 V <sub>DC</sub> ; peak current	A <sub>DC</sub>	59

Smart Line Module Booksize Compact	6SL3430–	6TE21-6AAx
<b>Rated power</b>	<b>kW</b>	<b>16</b>
<b>Current carrying capacity</b> DC link busbar Reinforced DC link busbar: 24 V busbar:	$A_{DC}$ $A_{DC}$ $A_{DC}$	100 150 20
<b>Electronics current consumption at 24 V DC</b> For internal air cooling For cold plate cooling	$A_{DC}$ $A_{DC}$	0,95 0,85
<b>Total power loss for internal air cooling</b> (including electronics losses) <sup>3)</sup>	W	187,8
<b>Power loss distribution for cold plate</b> (including electronics losses) <sup>3)</sup> Internal External	W	56,6 130
<b>Max. ambient temperature</b> without derating with derating	°C °C	40 55
<b>DC link capacitance</b> Smart Line Module Drive line-up, max.	$\mu F$ $\mu F$	705 6000
<b>Power factor</b>	$\cos \phi$	0,98
<b>Circuit breaker</b> (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 47)
<b>Rated short-circuit current SCCR</b> <sup>4)</sup>	kA	65
<b>Cooling methods</b>		Internal air cooling Cold plate cooling
<b>Cooling air requirement</b> with internal air cooling	m <sup>3</sup> /h	56
<b>Max. permissible heat-sink temperature</b> cold plate	°C	71
<b>Sound pressure level</b>	dB(A)	<60
<b>Weight</b>	kg	5,3

1) The powers specified apply to the rated voltage range from 380 V to 480 V.

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

3) For an overview, see the power loss tables in Section "Control cabinet installation"

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.

5.1.8.1 Characteristics

Rated duty cycles of Smart Line Modules

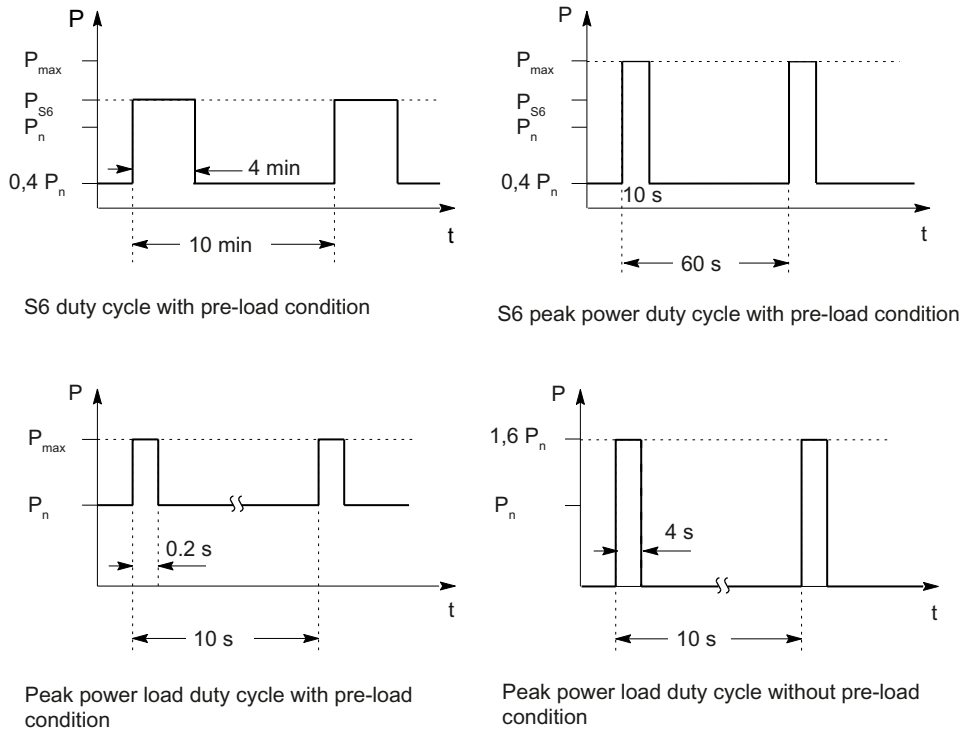


Figure 5-6 Rated duty cycles of Smart Line Modules

Derating characteristics

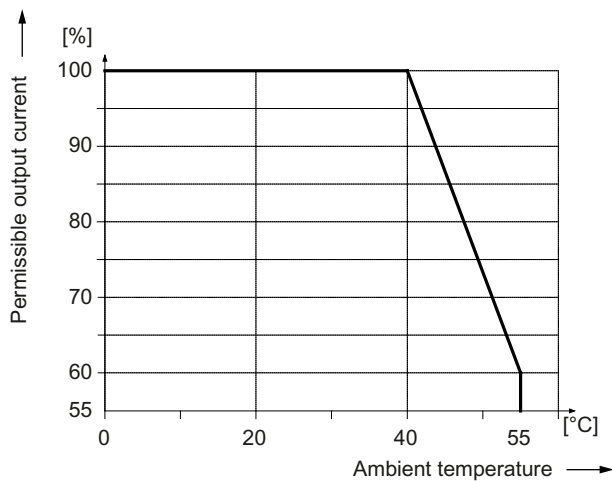


Figure 5-7 Output current as a function of the ambient temperature

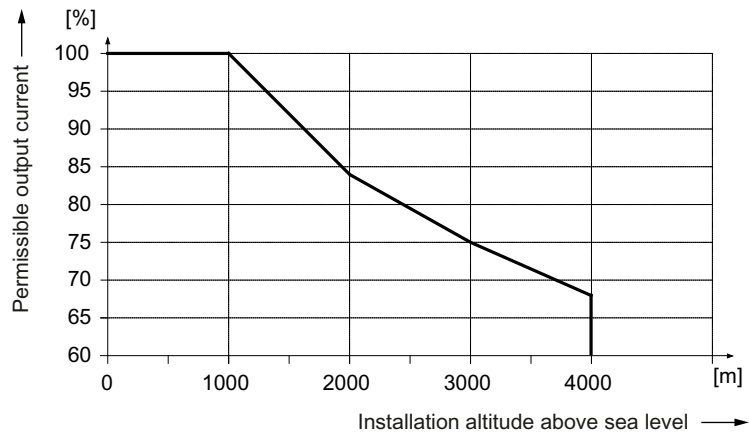


Figure 5-8 Output current as a function of the installation altitude

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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





## Motor Modules Booksize

### 6.1 Safety instructions for Motor Modules Booksize

#### Note

When using a Motor Module Booksize, also observe the safety instructions in Section 1.



#### DANGER

##### **Danger to life through electric shock due to the residual charge of the DC link capacitors**

Because of the DC link capacitors, a hazardous voltage is present for up to five minutes after the power supply has been switched off.

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

- Do not open the protective cover of the DC link until five minutes have elapsed.
- Measure the voltage before starting work on the DCP and DCN DC link terminals.



#### DANGER

##### **Danger to life through electric shock when the protective cover of the DC link is open**

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

- Only operate the components with closed protective cover.



#### WARNING

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

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

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



#### WARNING

##### **Danger to life through electric shock due to incorrectly installed DC link bridges**

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

- For all 50 mm wide modules (exception: Smart Line Module), remove the DC link bridge, including the screws. Do not tighten the screws without the DC link bridges.
- For all components that are 75 mm wide or wider, the DC link bridges must not be moved to the left or removed.



**! WARNING**

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

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

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

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



**! WARNING**

**Danger to life through interruption of the external protective conductor due to high leakage currents**

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

- Ensure that the external protective conductor satisfies at least one of the following conditions:
  - It has been laid so that it is protected against mechanical damage.<sup>1)</sup>
  - If it is a single cable, it has a cross-section of at least 10 mm<sup>2</sup> Cu.
  - If it is a conductor of a multi-conductor cable, it has a cross-section of at least 2.5 mm<sup>2</sup> Cu.
  - It has a second protective conductor in parallel with the same cross-section.
  - It complies with the local regulations for equipment with increased leakage current.

<sup>1)</sup> Cables laid within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.



**! WARNING**

**Danger to life through electric shock due to incorrectly laid brake cables**

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

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

**! WARNING**

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

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

- Attach the component warning labels in the national language.

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

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

- Maintain the 80 mm clearances above and below the Motor Modules.
- For the 132 A and 200 A Motor Modules, a ventilation clearance of 50 mm must also be maintained in front of the fan.

**NOTICE****Material damage due to loose power connections**

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

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

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

As part of routine tests, SINAMICS S components undergo a voltage test according to EN 61800-5-1. Connected devices can be damaged.

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

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

With unshielded or incorrectly laid cables, it can be expected that interference will be coupled into the signal processing electronics from the power side. This can result in significant disturbances (fault messages) up to failure of individual components (destruction of the devices).

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

<b>NOTICE</b>
<b>Destruction of the motor/brake due to incorrect power supply</b>
With an incorrect power supply, the brake can malfunction, i.e. the brake does not open reliably. If the motor constantly runs against the closed brake, the brake and/or the motor will be destroyed.
<ul style="list-style-type: none"><li>• Always use a regulated DC power supply to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars.</li><li>• Take note of the motor holding brake voltage tolerances (24 V ± 10%) and the connecting cable voltage drop.</li><li>• Set the DC power supply to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:<ul style="list-style-type: none"><li>– Use of Siemens three-phase motors</li><li>– Use of Siemens MOTION-CONNECT power cables</li><li>– Motor cable lengths, max. 100 m</li></ul></li></ul>

<b>NOTICE</b>
<b>Damage through use of incorrect DRIVE-CLiQ cables</b>
Damage or malfunctions can occur on the devices or system when incorrect or unreleased DRIVE-CLiQ cables are used.
<ul style="list-style-type: none"><li>• Only use suitable DRIVE-CLiQ cables that have been released by Siemens for the respective application.</li></ul>

**Note**

**Malfunctions due to polluted DRIVE-CLiQ interfaces**

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

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

**Special features for Motor Modules with external air cooling**

**Note**

**Insufficient cooling power when the external heat sinks are polluted**

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

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

---

**Note**

**Checking the seal**

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

**Note**

**Using an installation frame**

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

## 6.2 Motor Modules with internal air cooling

### 6.2.1 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.

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**Note**

When handling/using a Motor Module it is imperative that you observe the safety instructions in Chapter 1.

---

### 6.2.2 Interface description

#### 6.2.2.1 Overview

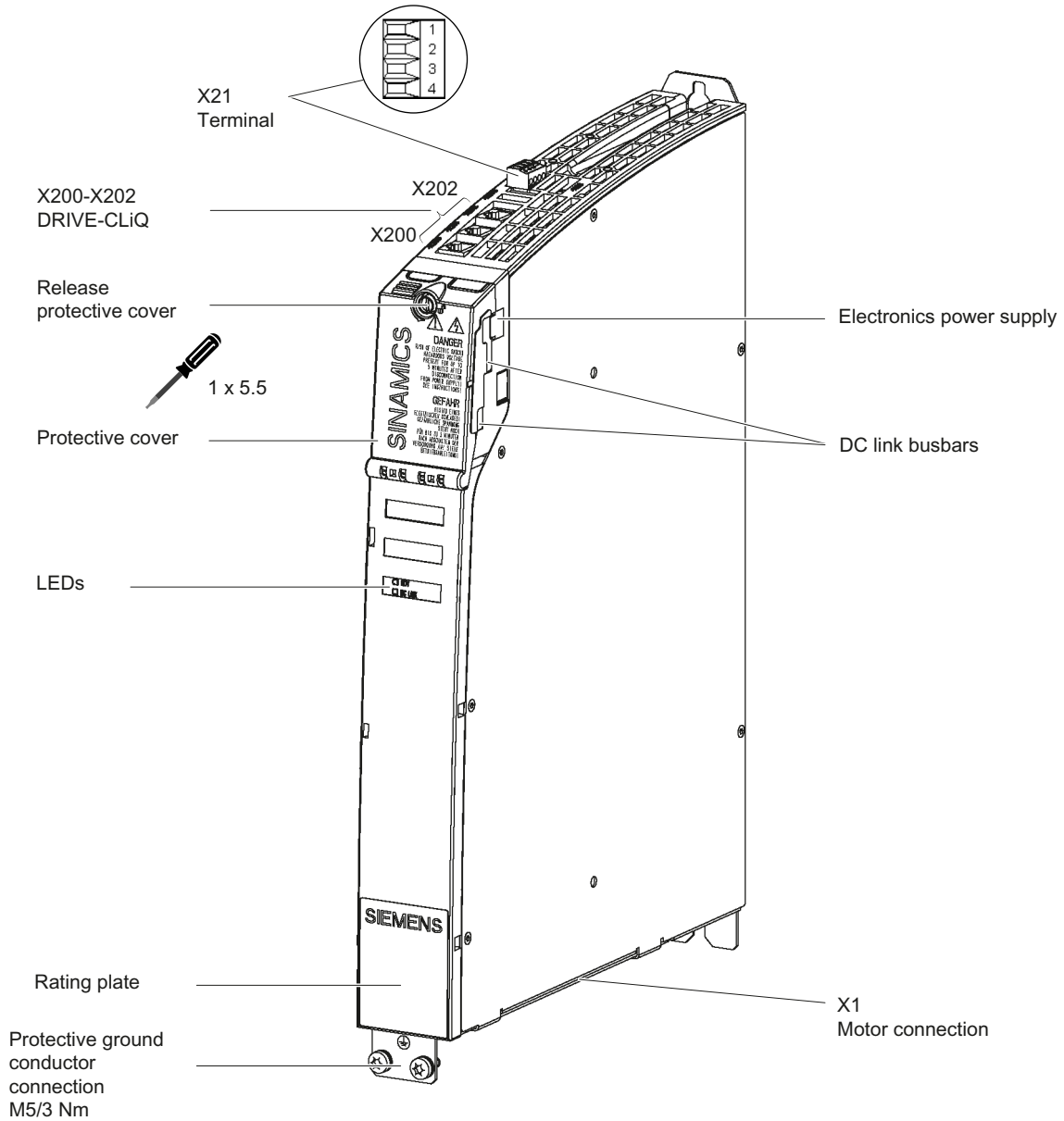


Figure 6-1 Interface overview, Single Motor Module Booksize with internal air cooling (example: 5 A)

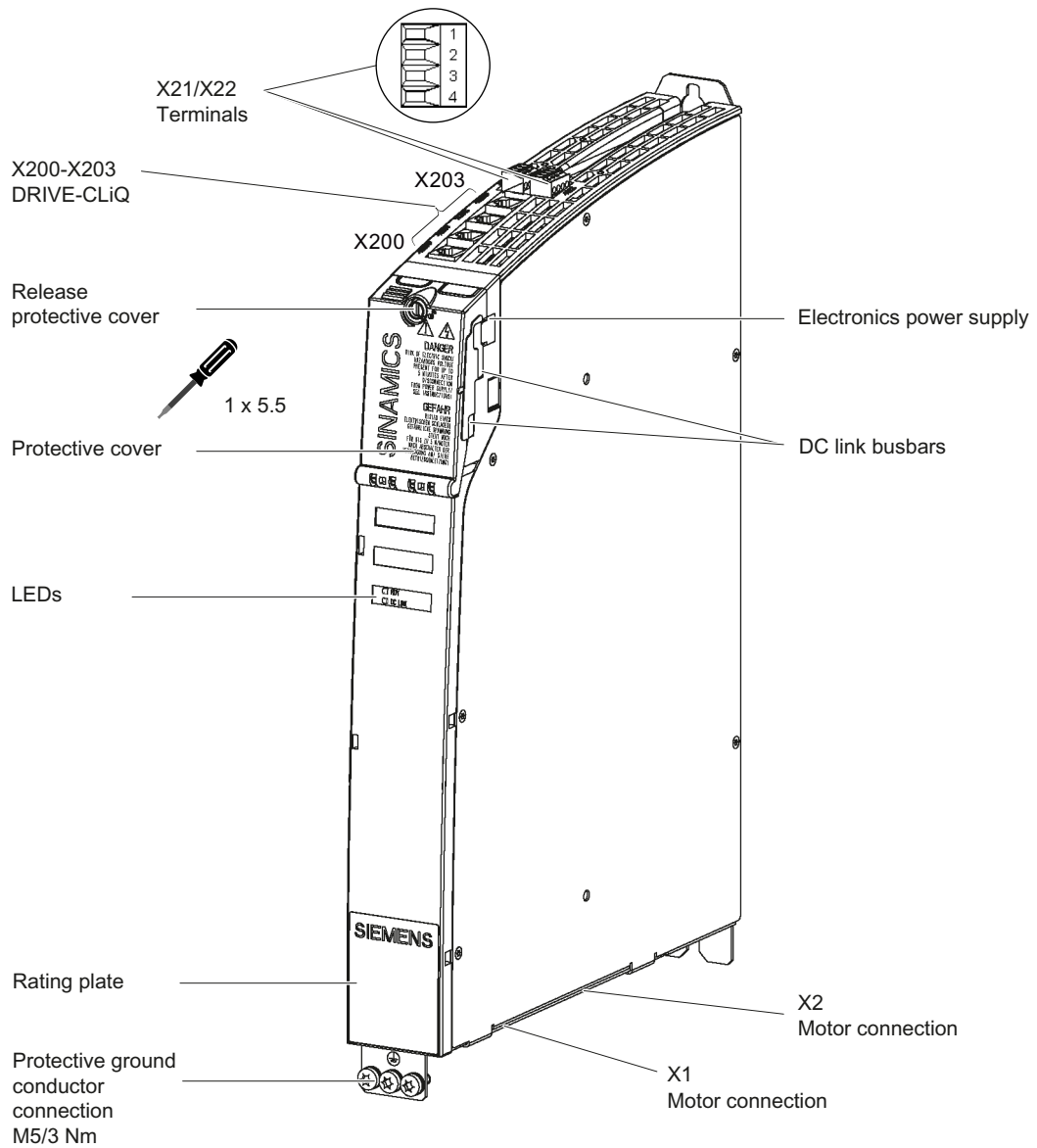
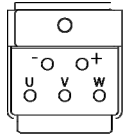
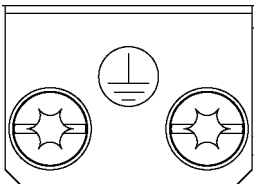
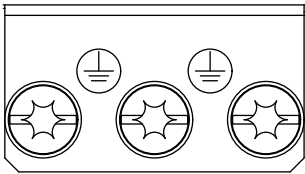


Figure 6-2 Interface overview, Double Motor Module Booksize with internal air cooling (example: 2 x 5 A)

6.2.2.2 Motor and brake connection

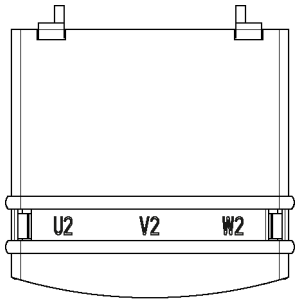
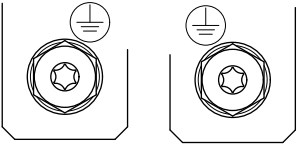
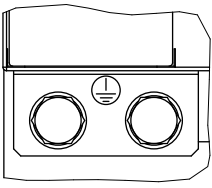
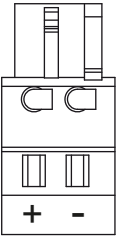
Table 6- 1 X1/X2 motor and brake connection for Single Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

	Terminal	Technical data
	U (U2)	Motor connection
	V (V2)	
	W (W2)	
	+ (BR+)	Brake connection max. load current 2 A min. load current 0.1 A
	- (BR-)	
	PE connection	<b>Single Motor Modules 3 A to 30 A:</b> Threaded hole M5 / 3 Nm <sup>1)</sup>
		

1) For ring cable lugs in accordance with DIN 46234




Table 6-2 X1 motor connection and X11 brake connection for Single Motor Modules 45 A to 200 A

	Terminal	Technical data
	U2	<b>45 A to 60 A:</b> Threaded bolts M6 / 6 Nm <sup>1)</sup>  <b>85 A:</b> Threaded bolts M8 / 13 Nm <sup>1)</sup>  <b>132 A to 200 A:</b> Threaded bolts M8 / 13 Nm <sup>1)</sup>
	V2	
	W2	
	PE connection	<b>45 A to 60 A:</b> Threaded bolts for motor cables: M6 / 6 Nm <sup>1)</sup> Threaded hole for PE: M6 / 6 Nm <sup>1)</sup>
		
	+ (BR+)	<b>X11 brake connector <sup>2)</sup>:</b> Voltage 24 V DC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm <sup>2</sup> Type: Spring-loaded terminal 2 (see Section "Control cabinet installation and EMC / connection system")  The brake connector is part of the prefabricated cable
	- (BR-)	

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.

 <b>CAUTION</b>
<b>Protective extra-low voltages according to EN 60204-1</b>  Only protective extra-low voltages (DVC A) according to EN 60204-1 must be connected to all connections and terminals between 0 and 48 V DC.  These voltages must be safely isolated from all hazardous voltages.

<b>NOTICE</b>
<b>Voltage tolerances of the motor holding brakes</b>
The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.

**Note**

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

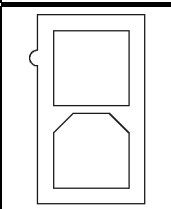
**Note**

The motor brake must be connected via connector X11. It is not permitted to directly connect the cable BR – to the electronics ground M.

**6.2.2.3 X12 fan connection**

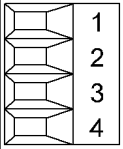
The Motor Modules 132 A and 200 A are equipped with an interface to connect a sub-chassis fan. The interface is located on the underside of the Motor Module.

Table 6- 3 X12 fan connection

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

### 6.2.2.4 X21/X22 EP terminals/temperature sensor

Table 6- 4 X21/X22 EP terminals / temperature sensor

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (pulse enable)	Supply voltage: 24 V DC (20.4 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 <sup>2</sup> Type: Screw terminal 1 (see Section "Control cabinet installation / connection system")			

#### EP terminals

Parameters p9651 and p9851 are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4. Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Section "Controlling the safety functions".

#### Note

##### Function of the EP terminals

The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

#### Temperature sensor connection

##### NOTICE


##### Risk of the motor overheating due to an incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY sensor with the correct polarity.

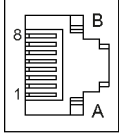
#### Note

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

 <b>DANGER</b>
<p><b>Danger to life through electric shock</b></p> <p>Only temperature sensors that meet the safety isolation specifications stipulated 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.</p> <p>If these instructions are not complied with, there is danger to life!</p>

**6.2.2.5 X200-X203 DRIVE-CLiQ interface**

Table 6- 5 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules  
 X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

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

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

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

6.2.3 Connection examples

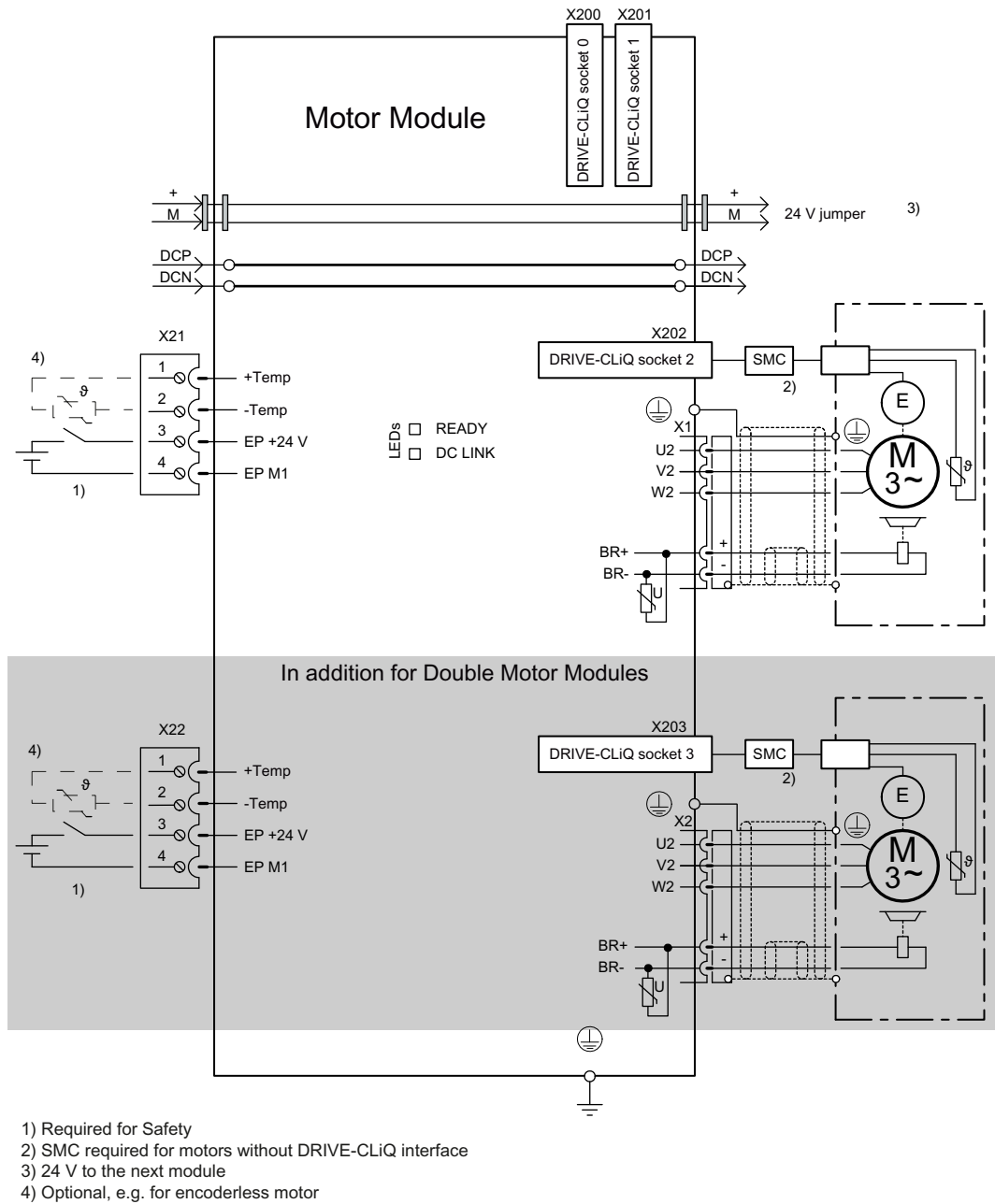
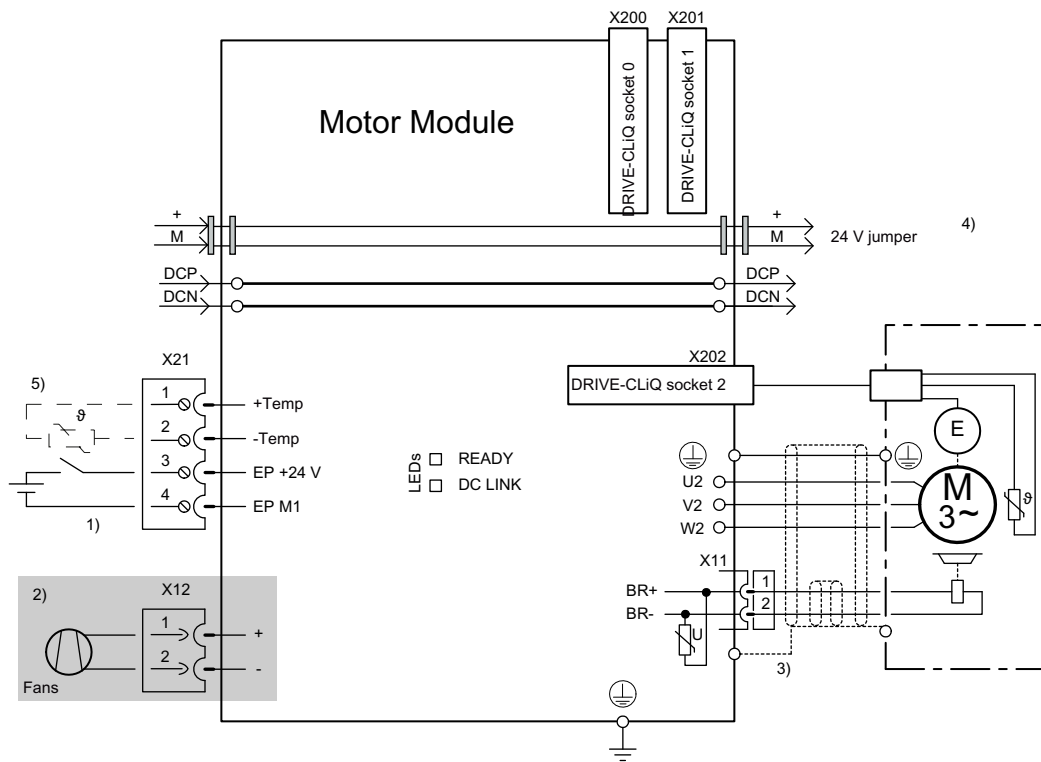


Figure 6-3 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A



- 1) Required for Safety
- 2) In addition for Motor Modules 132 A to 200 A
- 3) Contact through the shield connection plate
- 4) 24 V to the next module
- 5) Optional, e.g. for encoderless motor

Figure 6-4 Example connection of Single Motor Modules 45 A to 200 A

## 6.2.4 Meaning of LEDs

Table 6- 6 Meaning of the LEDs on the Motor Module

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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. <b>Note:</b> The LED is driven irrespective of the corresponding messages being 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	--	Detection of the components via LED is activated (p0124). <b>Note:</b> Both options depend on the LED status when module 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!

### 6.2.5 Dimension drawings

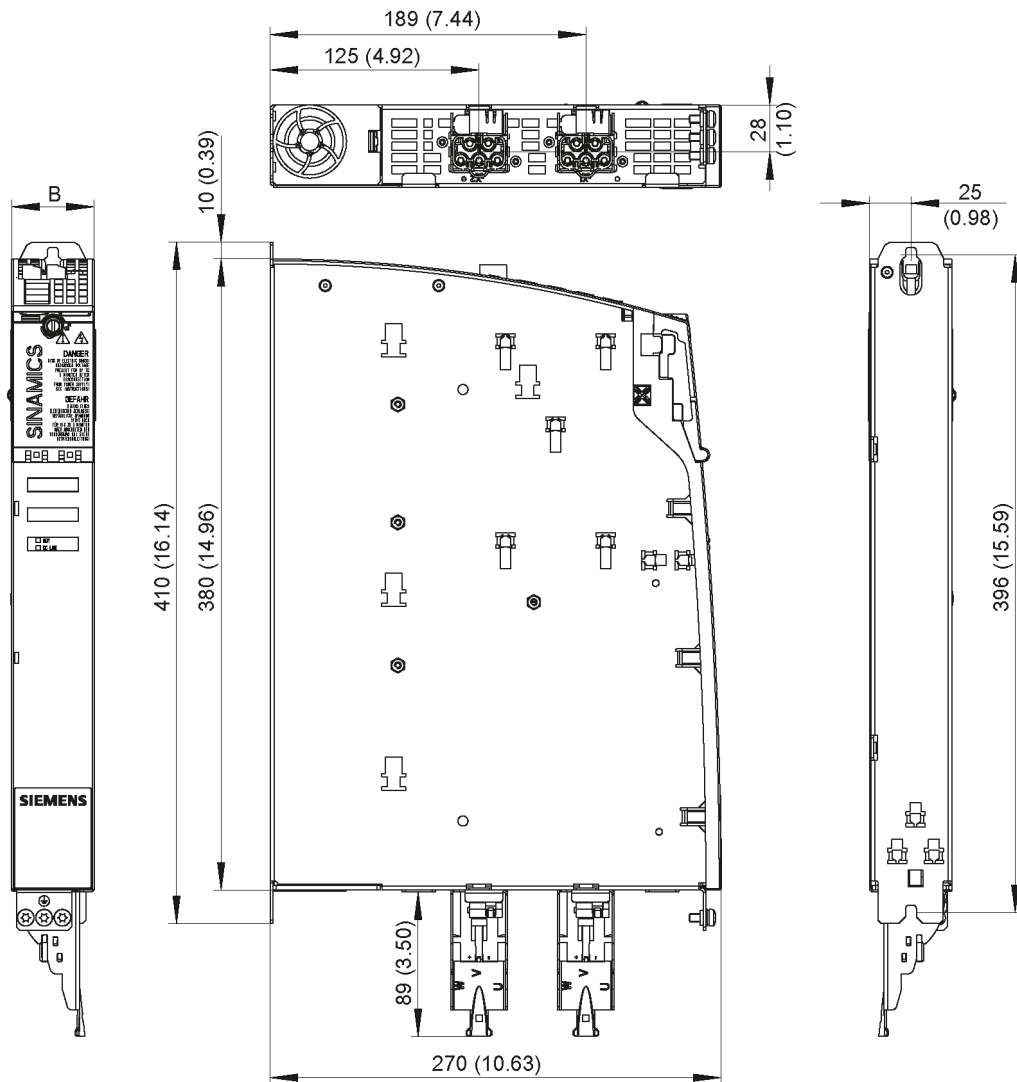


Figure 6-5 Dimension drawing of Motor Modules Booksize with internal air cooling 3 A to 18 A and 2 x 3 A to 2 x 9 A, all dimensions in mm and (inches); example: Double Motor Module 2 x 5 A



Table 6- 7 Dimensions of Motor Modules Booksize with internal air cooling 3 A to 18 A and 2 x 3 A to 2 x 9 A

Motor Module	Order number	B [mm] (inches)
Single Motor Module 3 A	6SL3120-1TE13-0AAx	50 (1.97)
Single Motor Module 5 A	6SL3120-1TE15-0AAx	
Single Motor Module 9 A	6SL3120-1TE21-0AAx	
Single Motor Module 18 A	6SL3120-1TE21-8AAx	
Double Motor Module 3 A	6SL3120-2TE13-0AAx	
Double Motor Module 5 A	6SL3120-2TE15-0AAx	
Double Motor Module 9 A	6SL3120-2TE21-0AAx	

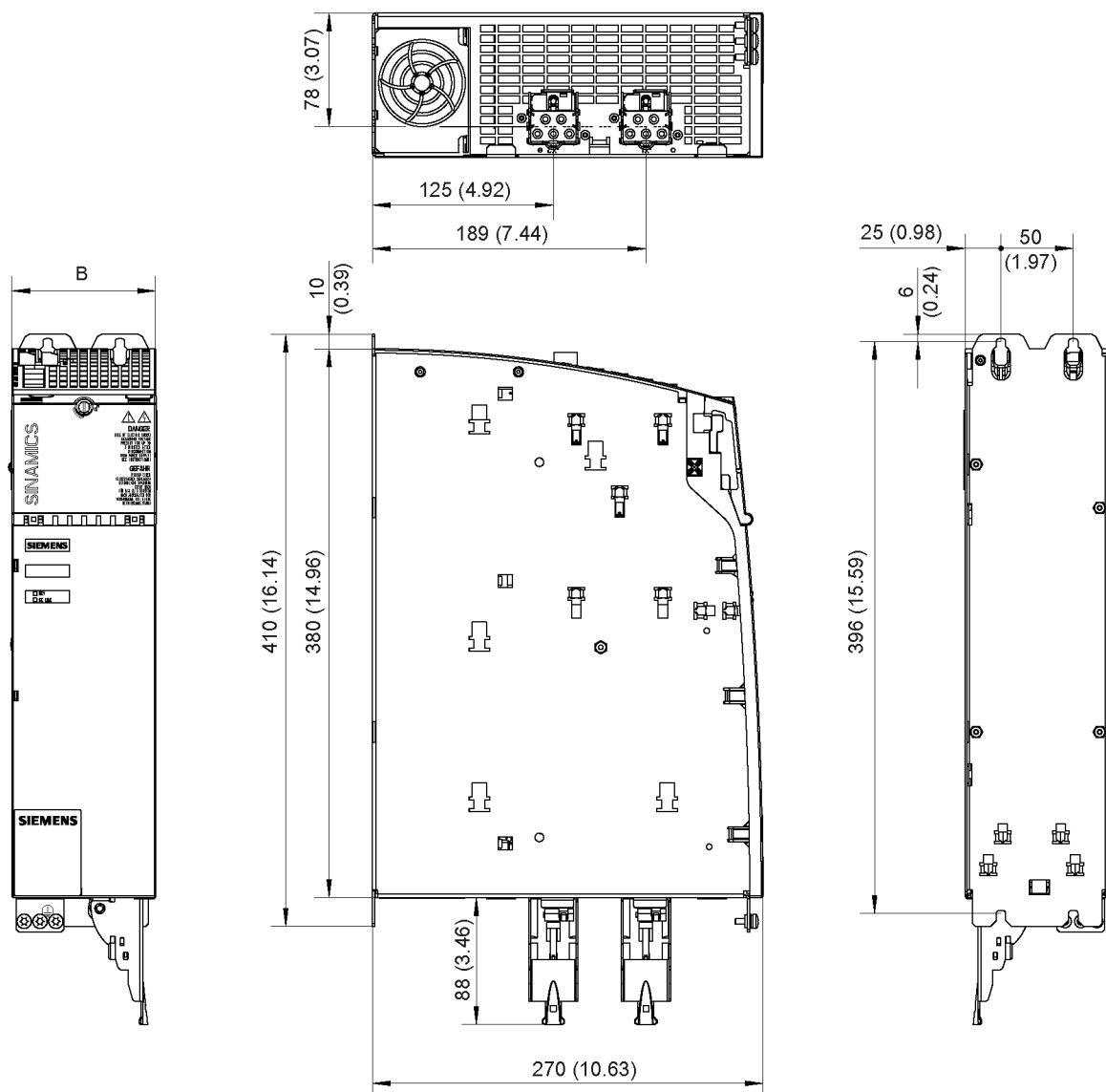


Figure 6-6 Dimension drawing of Motor Modules Booksize with internal air cooling 30 A and 2 x 18 A, all dimensions in mm and (inches); example: Double Motor Module 2 x 18 A

6.2 Motor Modules with internal air cooling

Table 6- 8 Dimensions of Motor Modules Booksize with internal air cooling 30 A and 2 x 18 A

Motor Module	Order number	B [mm] (inches)
Single Motor Module 30 A	6SL3120-1TE23-0AAx	100 (3.94)
Double Motor Module 18 A	6SL3120-2TE21-8AAx	

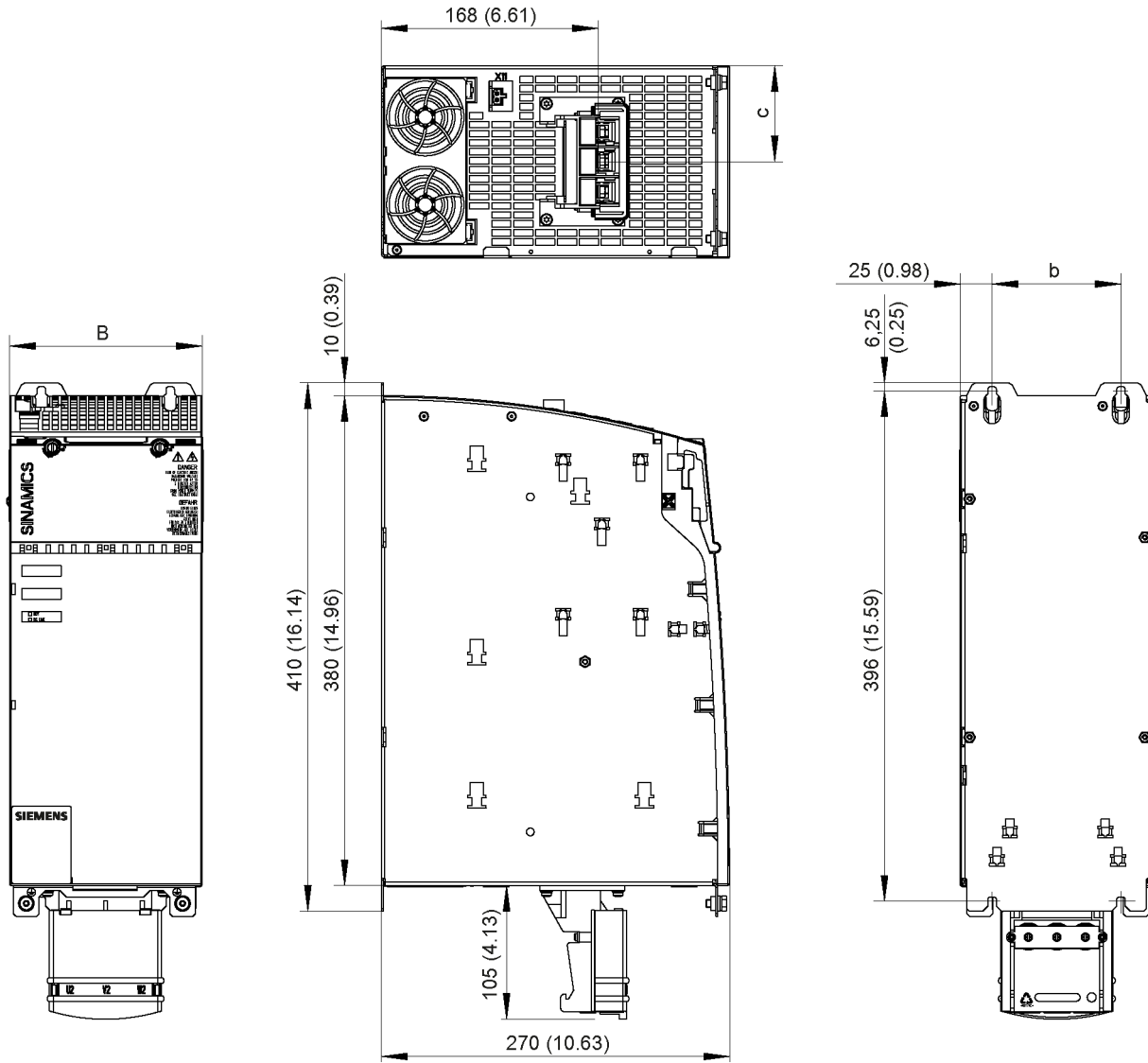


Figure 6-7 Dimension drawing of Motor Modules Booksize with internal air cooling 45 A to 85 A, all dimensions in mm and (inches); example 45 A

Table 6- 9 Dimensions of Motor Modules Booksize with internal air cooling 45 A to 85 A

Motor Module	Order number	B [mm] (inches)	b [mm] (inches)	c [mm] (inches)
Single Motor Module 45 A	6SL3120-1TE24-5AAx	150 (5.91)	100 (3.94)	75 (2.95)
Single Motor Module 60 A	6SL3120-1TE26-0AAx			
Single Motor Module 85 A	6SL3120-1TE28-5AAx	200 (7.87)	150 (5.91)	100 (3.94)

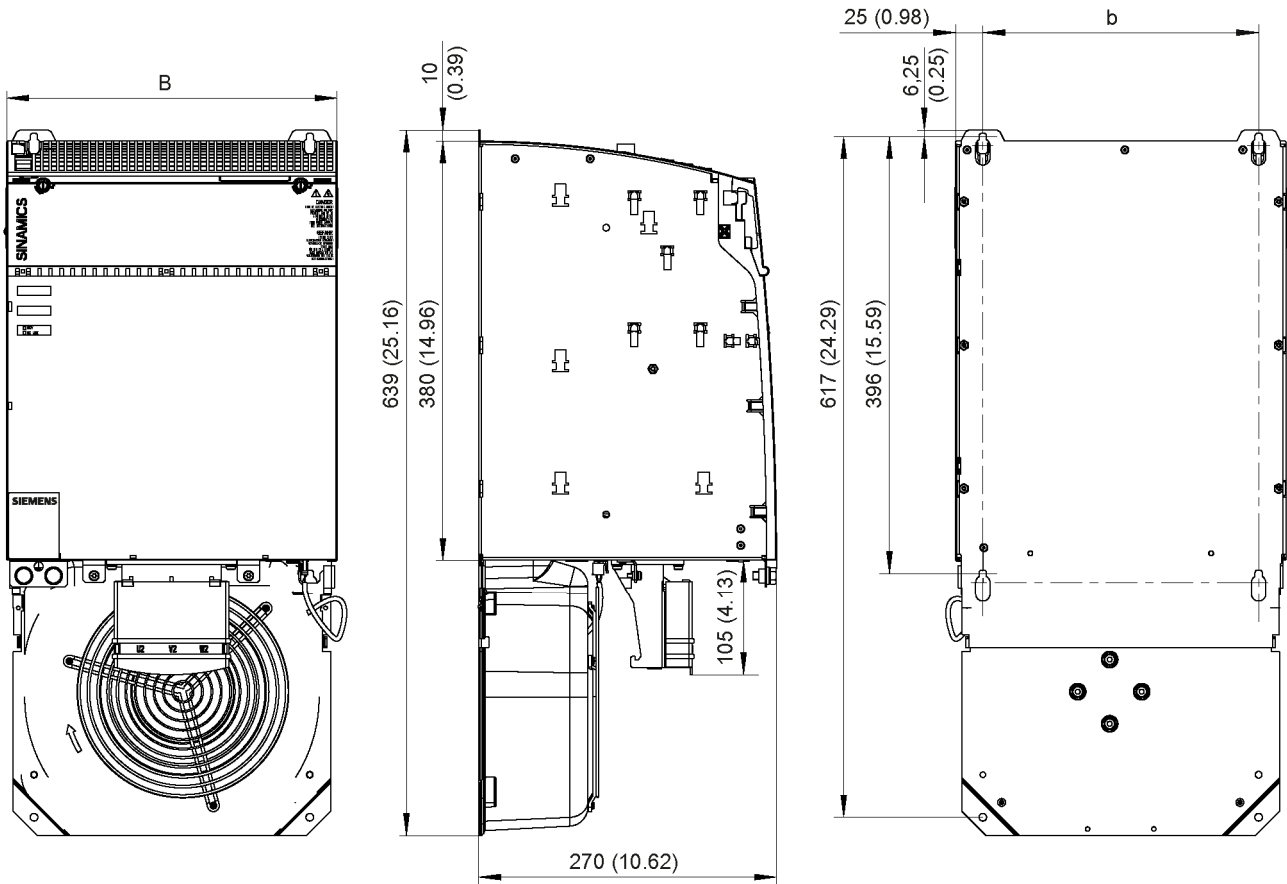


Figure 6-8 Dimension drawing of Motor Modules Booksize with internal air cooling 132 A and 200 A, all dimensions in mm and (inches)

Table 6- 10 Dimensions of Motor Modules Booksize with internal air cooling 132 A and 200 A

Motor Module	Order number	B [mm] (inches)	b [mm] (inches)
Single Motor Module 132 A	6SL3120-1TE31-3AAx	300 (11.81)	250 (9.84)
Single Motor Module 200 A	6SL3120-1TE32-0AAx		

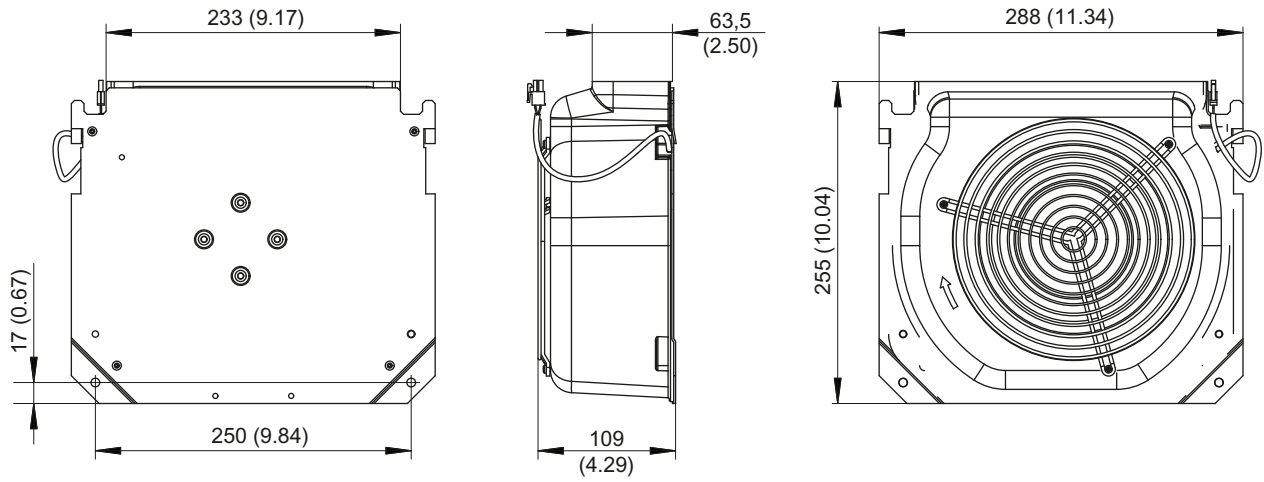


Figure 6-9 Dimension drawing of fans for Motor Modules 132 A and 200 A with internal air cooling, all dimensions in mm and (inches)

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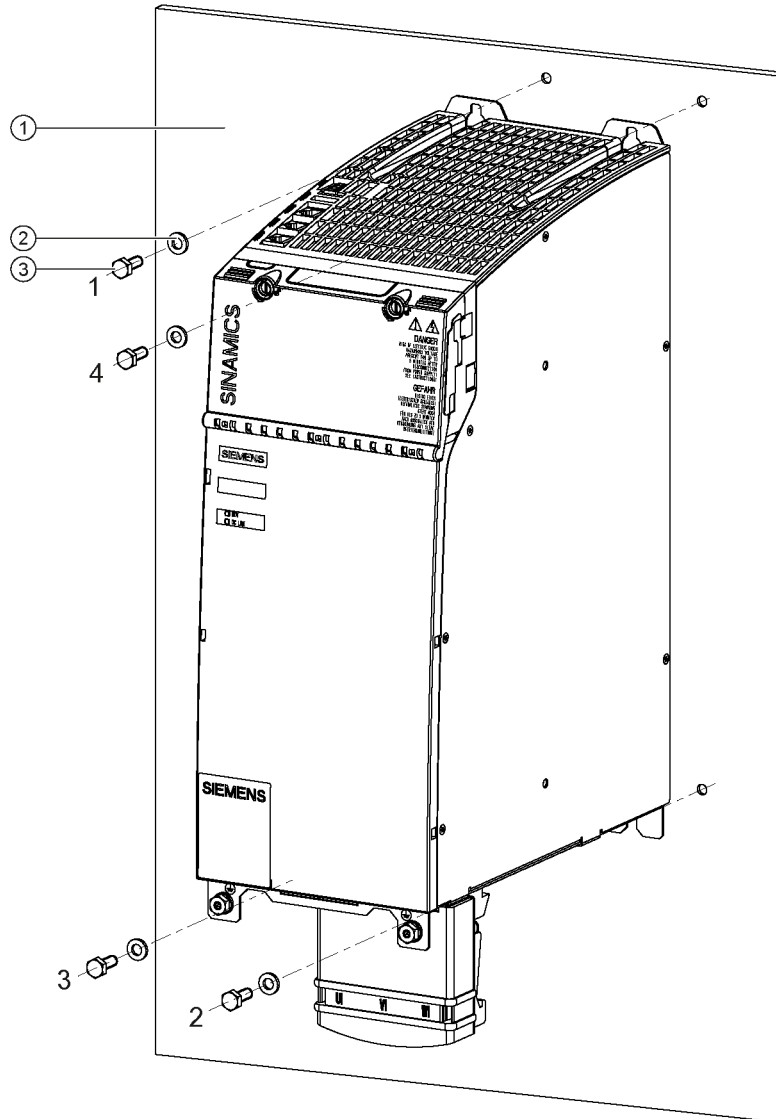
**Note**

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

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## 6.2.6 Installation

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



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

Figure 6-10 Installation of a Motor Module with internal air cooling (example 45 A)

### Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 6 Nm (in the specific sequence 1 to 4)

### Installing the sub-chassis fan

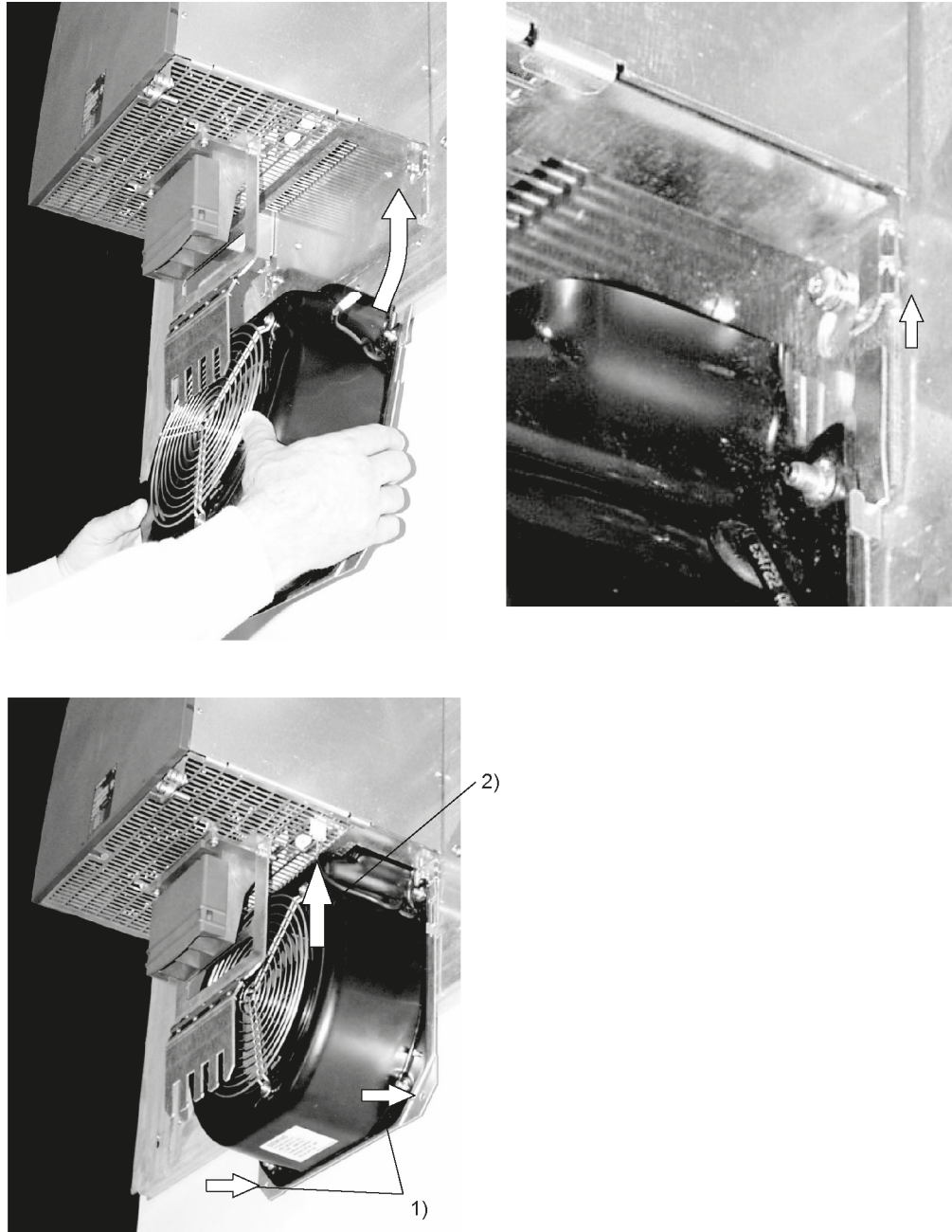


Figure 6-11 Installing the fan for Motor Modules 132 A and 200 A

1. Attach the fan with M6 / 6 Nm screws
2. Connect the power supply for the fan

## 6.2.7 Technical data

### 6.2.7.1 Single Motor Modules

Table 6- 11 Technical data Single Motor Modules Booksize (3 to 30 A)

Internal air cooling	6SL3120-	1TE13-0AAx <sup>1)</sup>	1TE15-0AAx <sup>1)</sup>	1TE21-0AAx <sup>1)</sup>	1TE21-8AAx <sup>1)</sup>	1TE23-0AAx
<b>Output current</b>						
Rated current (I <sub>N</sub> )	A <sub>ACrms</sub>	3	5	9	18	30
Base-load current (I <sub>H</sub> )	A	2.6	4.3	7.7	15.3	25.5
Intermittent duty current (I <sub>SB</sub> ) 40%	A <sub>ACrms</sub>	3.5	6	10	24	40
Peak current (I <sub>max</sub> )	A <sub>ACrms</sub>	6	10	18	36	56
<b>Output voltage</b>	V <sub>ACrms</sub>	0 - 0.717 x DC link voltage				
<b>DC link current I<sub>d</sub></b>	A <sub>DC</sub>	3,6	6	11	22	36
<b>DC link voltage</b> (up to 2000 m above sea level)	V <sub>DC</sub>	510 – 720				
<b>DC link capacitance</b>	μF	110	110	110	220	705
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %				
Undervoltage trip <sup>2)</sup>	V <sub>DC</sub>	380 ± 2 %				
<b>Electronics power supply</b>	V <sub>DC</sub>	24 (20,4 - 28,8)				
<b>Electronics current consumption</b> at 24 V DC	A <sub>DC</sub>	0,85	0,85	0,85	0,85	0,8
<b>Current carrying capacity</b>						
DC link busbars	A <sub>DC</sub>	100				
Reinforced DC link busbars	A <sub>DC</sub>	150				
24 V DC busbars	A <sub>DC</sub>	20				
<b>Unit rating</b>						
Based on I <sub>N</sub> (600 V <sub>DC</sub> ; 4 kHz)	kW	1,6	2,7	4,8	9,7	16
Based on I <sub>H</sub>	kW	1,4	2,3	4,1	8,2	13,7
<b>Total power loss</b> (including electronics losses) <sup>3)</sup>	W	50,4	73,4	100,4	185,4	309,2
<b>Max. pulse frequency</b> without derating	kHz	4				
with derating	kHz	16				
<b>Max. ambient temperature</b> without derating	° C	40				
with derating	° C	55				
<b>Sound pressure level</b>	dB(A)	<60	<60	<60	<60	<60
<b>Cooling method</b>		Internal fan				
<b>Cooling air requirement</b>	m <sup>3</sup> /h	29,6	29,6	29,6	29,6	56
<b>Max. permissible heat sink temperature</b>	° C	75	75	79	82	85
<b>Weight</b>	kg	5	5	5	5	6,9

1) Applies only to order numbers with x = 0...3

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

3) For an overview, see the power loss tables in Section "Control cabinet installation".

Table 6- 12 Technical data Single Motor Modules Booksize (45 to 200 A)

Internal air cooling	6SL3120	1TE24-5AAx	1TE26-0AAx	1TE28-5AAx	1TE31-3AAx	1TE32-0AAx
	–					
<b>Output current</b>						
Rated current (I <sub>n</sub> )	A <sub>ACrms</sub>	<b>45</b>	<b>60</b>	<b>85</b>	<b>132</b>	<b>200</b>
Base-load current (I <sub>H</sub> )	A	38	51	68	105	141
Intermittent duty current (I <sub>s6</sub> )	A <sub>ACrms</sub>	60	80	110	150	230
40%	A <sub>ACrms</sub>	85	113	141	210	282
Peak current (I <sub>max</sub> )						
<b>Output voltage</b>	V <sub>ACrms</sub>	0 - 0.717 x DC link voltage				
<b>DC link current I<sub>d</sub></b>	A <sub>DC</sub>	54	72	102	158	200
<b>DC link voltage</b> (up to 2000 m above sea level)	V <sub>DC</sub>	510 – 720				
<b>DC link capacitance</b>	µF	1175	1410	1880	2820	3995
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %				
Undervoltage trip <sup>1)</sup>	V <sub>DC</sub>	380 ± 2 %				
<b>Electronics power supply</b>	V <sub>DC</sub>	24 (20,4 - 28,8)				
<b>Electronics current consumption</b> at 24 V DC	A <sub>DC</sub>	1,05	1,05	1,5	0,85	0,85
<b>Current carrying capacity</b>						
DC link busbars	A <sub>DC</sub>	200	200	200	200	200
24 V DC busbars	A <sub>DC</sub>	20	20	20	20	20
<b>Unit rating</b>						
Based on I <sub>n</sub> (600 V <sub>DC</sub> ; 4 kHz)	kW	24	32	46	71	107
Based on I <sub>H</sub>	kW	21	28	37	57	76
<b>Total power loss</b> (incl. electronics losses) <sup>2)</sup>	W	455,2	615,2	786	1270,4	2070,4
<b>Max. pulse frequency</b> without derating	kHz	4				
with derating	kHz	16				
<b>Max. ambient temperature</b> without derating	° C	40				
with derating	° C	55				
<b>Sound pressure level</b>	dB(A)	<65	<65	<60	<73	<73
<b>Cooling method (with fan)</b>		Internal fan			Mounted fan	
<b>Cooling air requirement</b>	m <sup>3</sup> /h	112	112	160	520	520
<b>Max. permissible heat sink temperature</b>	° C	85	90	83	70	80 (70% derating)
<b>Weight</b>	kg	9	9	15	21	21

1) Default for 400 V line supplies; 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 an overview, see the power loss tables in Section "Control cabinet installation".



## 6.2.7.2 Double Motor Modules

Table 6- 13 Technical data Double Motor Modules Booksize (3 to 18A)

Internal air cooling	6SL3120-	2TE13- 0AAx <sup>1)</sup>	2TE15- 0AAx <sup>1)</sup>	2TE21- 0AAx <sup>1)</sup>	2TE21- 8AAx
<b>Output current</b>					
Rated current ( $I_n$ )	$A_{ACrms}$	2 x 3	2 x 5	2 x 9	2 x 18
Base-load current ( $I_H$ )	A	2 x 2.6	2 x 4.3	2 x 7.7	2 x 15.3
Intermittent duty current ( $I_{s6}$ ) 40%	$A_{ACrms}$	2 x 3.5	2 x 6	2 x 10	2 x 24
Peak current ( $I_{max}$ )	$A_{ACrms}$	2 x 6	2 x 10	2 x 18	2 x 36
<b>Output voltage</b>	$V_{ACrms}$	0 - 0.717 x DC link voltage			
<b>DC link current <math>I_d</math></b>	$A_{DC}$	7.2	12	22	43
<b>DC link voltage</b>	$V_{DC}$	510 – 720			
<b>DC link capacitance</b>	$\mu F$	220	220	220	705
Overvoltage trip	$V_{DC}$	820 $\pm$ 2 %			
Undervoltage trip <sup>2)</sup>	$V_{DC}$	380 $\pm$ 2 %			
<b>Electronics power supply</b>	$V_{DC}$	24 (20,4 - 28,8)			
<b>Electronics current consumption at 24 V DC</b>	$A_{DC}$	1,15	1,15	1,15	1,3
<b>Current carrying capacity</b>					
DC link busbars	$A_{DC}$	100			
Reinforced DC link busbars	$A_{DC}$	150			
24 V DC busbars	A	20			
<b>Unit rating</b>					
Based on $I_n$ (600 $V_{DC}$ , 4 kHz)	kW	2 x 1.6	2 x 2.7	2 x 4.8	2 x 9.7
Based on $I_H$	kW	2 x 1.4	2 x 2.3	2 x 4.1	2 x 8.2
<b>Total power loss</b> (including electronics losses) <sup>3)</sup>	W	97,6	132,6	187,6	351,2
<b>Max. pulse frequency</b>					
without derating	kHz	4			
with derating	kHz	16			
<b>Max. ambient temperature</b>					
without derating	$^{\circ} C$	40			
with derating	$^{\circ} C$	55			
<b>Sound pressure level</b>	dBA	<60	<60	<60	<60
<b>Cooling method</b>		Internal fan			
<b>Cooling air requirement</b>	$m^3/h$	29,6	29,6	29,6	56
<b>Max. permissible heat sink temperature</b>	$^{\circ} C$	85	90	89	90
<b>Weight</b>	kg	5,3	5,3	5,5	6,8

1) Applies only to order numbers with x = 0...3

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

3) For an overview, see the power loss tables in Section "Control cabinet installation"

6.2.7.3 Characteristics

Rated duty cycles Motor Modules Booksize

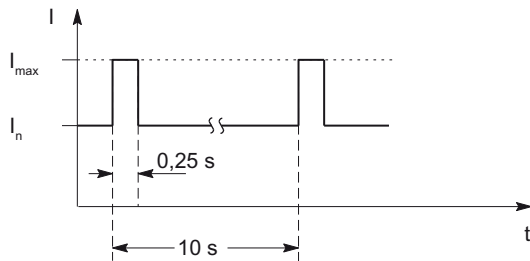


Figure 6-12 Duty cycle with initial load (for servo drives)

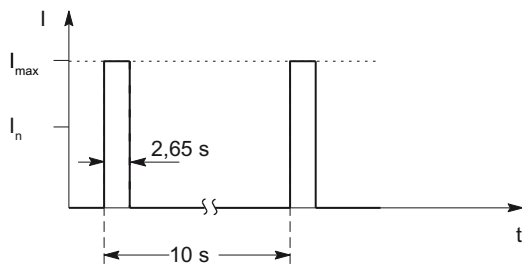


Figure 6-13 Duty cycle without initial load (for servo drives)

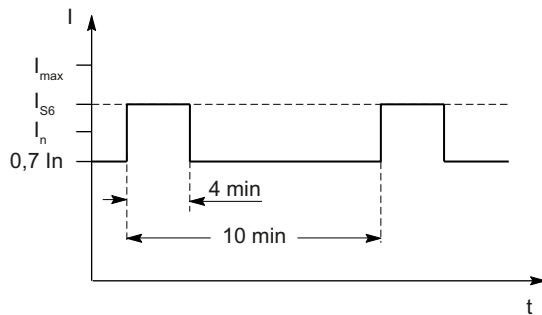


Figure 6-14 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

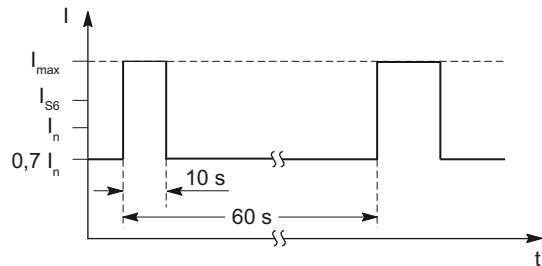


Figure 6-15 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

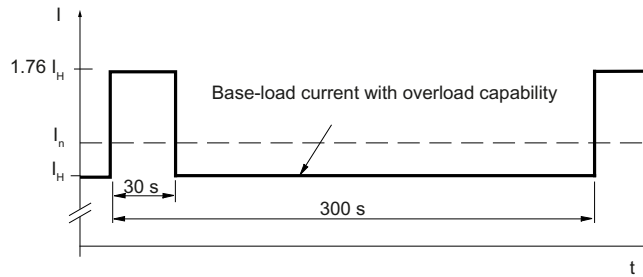


Figure 6-16 Duty cycle with 30 s overload for a duty cycle duration of 300 s

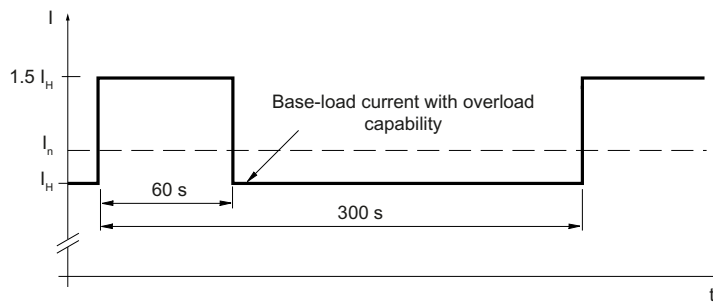


Figure 6-17 Duty cycle with 60 s overload for a duty cycle duration of 300 s

**Derating characteristics for Motor Modules Booksize**

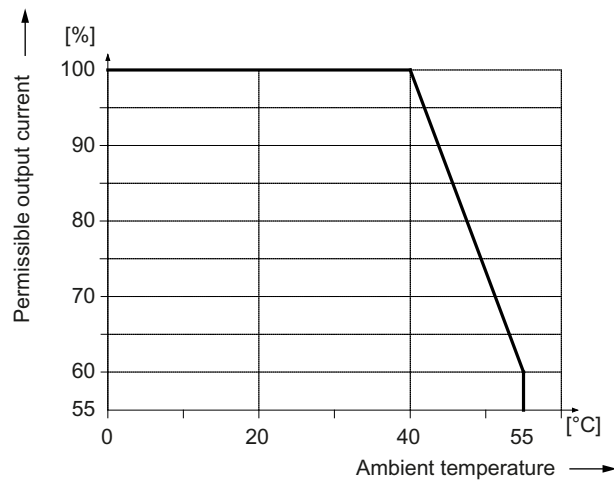


Figure 6-18 Output current as a function of the ambient temperature

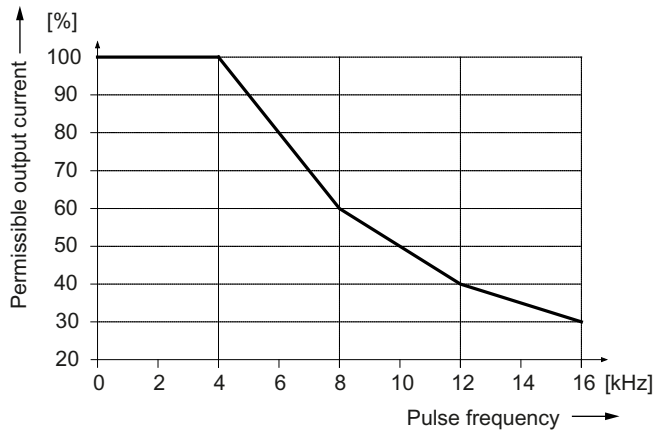


Figure 6-19 Output current as a function of the pulse frequency

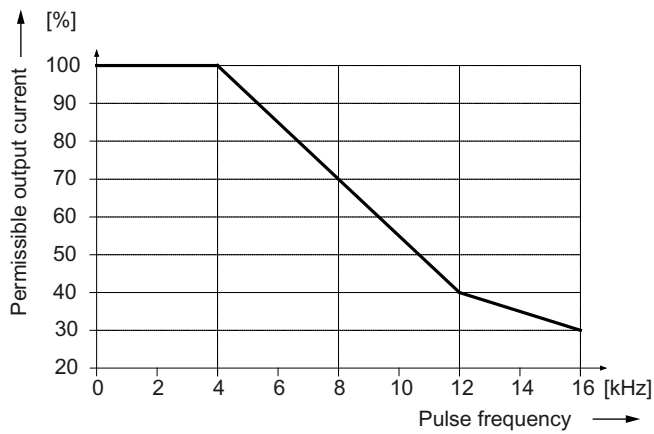


Figure 6-20 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

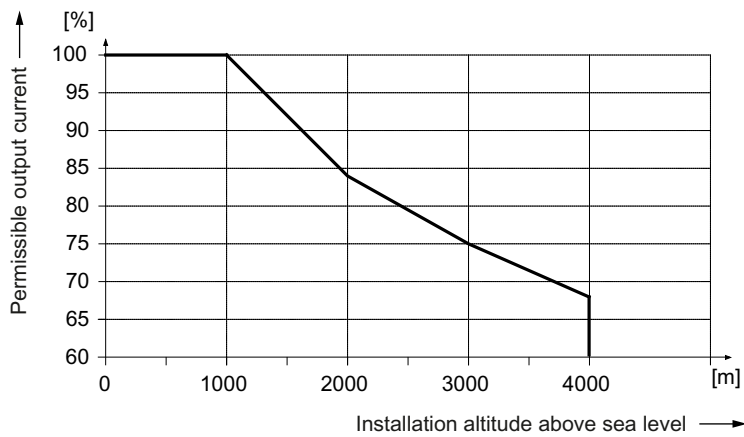


Figure 6-21 Output current as a function of the installation altitude

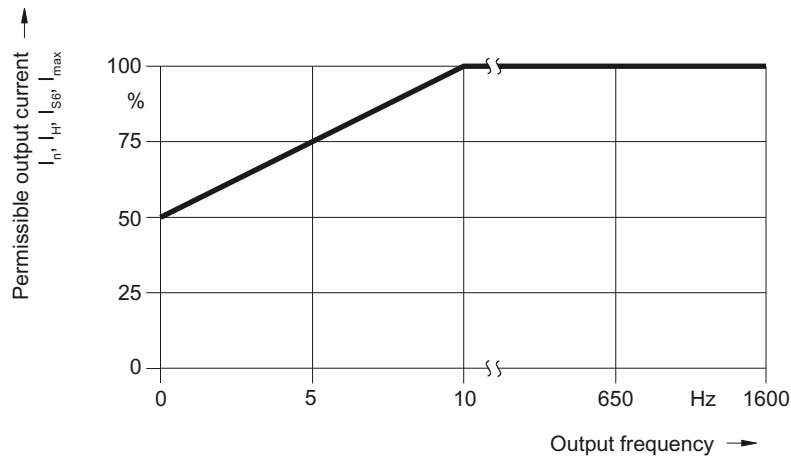


Figure 6-22 Output current as a function of the output frequency

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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

## 6.2.8 Technical data for Motor Modules Booksize with 300% overload

### 6.2.8.1 Single Motor Modules (300% overload)

Table 6- 14 Technical data Single Motor Modules Booksize (3 to 18 A) with 300% overload

Internal air cooling	6SL3120-	1TE13-0AA4	1TE15-0AA4	1TE21-0AA4	1TE21-8AA4
<b>Output current</b>					
Rated current ( $I_n$ )	$A_{ACrms}$	3	5	9	18
Base-load current ( $I_H$ )	A	2.6	4.3	7.7	15.3
Intermittent duty current ( $I_{S6}$ ) 40%	$A_{ACrms}$	3.5	6	10	24
Peak current ( $I_{max}$ )	$A_{ACrms}$	9	15	27	54
<b>Output voltage</b>	$V_{ACrms}$	0 - 0.717 x DC link voltage			
<b>DC link current <math>I_d</math></b>	$A_{DC}$	3,6	6	11	22
<b>DC link voltage</b> (up to 2000 m above sea level)	$V_{DC}$	510 – 720			
<b>DC link capacitance</b>	$\mu F$	110	110	110	220
Overvoltage trip	$V_{DC}$	820 ± 2 %			
Undervoltage trip <sup>1)</sup>	$V_{DC}$	380 ± 2 %			
<b>Electronics power supply</b>	$V_{DC}$	24 (20,4 - 28,8)			

Internal air cooling	6SL3120–	1TE13-0AA4	1TE15-0AA4	1TE21–0AA4	1TE21–8AA4
<b>Electronics current consumption</b> at 24 V DC	A <sub>DC</sub>	0,85	0,85	0,85	0,85
<b>Current carrying capacity</b> DC link busbars	A <sub>DC</sub>	100			
Reinforced DC link busbars	A <sub>DC</sub>	150			
24 V DC busbars	A <sub>DC</sub>	20			
<b>Unit rating</b> Based on I <sub>n</sub> (600 V <sub>DC</sub> ; 4 kHz)	kW	1,6	2,7	4,8	9,7
Based on I <sub>H</sub>	kW	1,4	2,3	4,1	8,2
<b>Total power loss</b> (including electronics losses) <sup>2)</sup>	W	50,4	73,4	100,4	185,4
<b>Max. pulse frequency</b> without derating	kHz	4			
with derating	kHz	16			
<b>Max. ambient temperature</b> without derating	° C	40			
with derating	° C	55			
<b>Sound pressure level</b>	dB(A)	<60			
<b>Cooling method</b>		Internal fan			
<b>Cooling air requirement</b>	m <sup>3</sup> /h	29,6			
<b>Max. permissible heat sink temperature</b>	° C	74	74	75	90
<b>Weight</b>	kg	5	5	5	5

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

2) For an overview, see the power loss tables in Section "Control cabinet installation".

<p><b>NOTICE</b></p> <p><b>Disturbance of the 18 A Single Motor Module with 300% overload during operation on a 16 kW Line Module</b></p> <p>The maximum output of a 16 kW Line Module is not sufficient for the operation of an 18 A Single Motor Module with 300% overload.</p> <ul style="list-style-type: none"> <li>Do NOT operate the 18 A Single Motor Module with 300% overload on a 16 kW Line Module.</li> <li>Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.</li> <li>Only operate an 18 A Single Motor Module on a 16 kW Line Module when the maximum current is limited to 2 x I<sub>rated</sub>.</li> </ul>
---

## 6.2.8.2 Double Motor Modules (300% overload)

Table 6- 15 Technical data Double Motor Modules Booksize (2 x 3 to 2 x 9 A) with 300% overload

Internal air cooling	6SL3120-	2TE13-0AA4	2TE15-0AA4	2TE21-0AA4
<b>Output current</b>				
Rated current ( $I_n$ )	$A_{ACrms}$	<b>2 x 3</b>	<b>2 x 5</b>	<b>2 x 9</b>
Base-load current ( $I_H$ )	A	2 x 2.6	2 x 4.3	2 x 7.7
Intermittent duty current ( $I_{S6}$ ) 40%	$A_{ACrms}$	2 x 3.5	2 x 6	2 x 10
Peak current ( $I_{max}$ )	$A_{ACrms}$	2 x 9	2 x 15	2 x 27
<b>Output voltage</b>	$V_{ACrms}$	0 - 0.717 x DC link voltage		
<b>DC link current <math>I_d</math></b>	$A_{DC}$	7.2	12	22
<b>DC link voltage</b> (up to 2000 m above sea level)	$V_{DC}$	510 – 720		
<b>DC link capacitance</b>	$\mu F$	220		
Overvoltage trip	$V_{DC}$	820 $\pm$ 2 %		
Undervoltage trip <sup>1)</sup>	$V_{DC}$	380 $\pm$ 2 %		
<b>Electronics power supply</b>	$V_{DC}$	24 (20,4 - 28,8)		
<b>Electronics current consumption at 24 V DC</b>	$A_{DC}$	1,15		
<b>Current carrying capacity</b>				
DC link busbars	$A_{DC}$	100		
Reinforced DC link busbars	$A_{DC}$	150		
24 V DC busbars	A	20		
<b>Unit rating</b>				
Based on $I_n$ (600 $V_{DC}$ , 4 kHz)	kW	2 x 1.6	2 x 2.7	2 x 4.8
Based on $I_H$	kW	2 x 1.4	2 x 2.3	2 x 4.1
<b>Total power loss</b> (including electronics losses) <sup>2)</sup>	W	97,6	132,6	187,6
<b>Max. pulse frequency</b>				
without derating	kHz	4		
with derating	kHz	16		
<b>Max. ambient temperature</b>				
without derating	$^{\circ} C$	40		
with derating	$^{\circ} C$	55		
<b>Sound pressure level</b>	dBA	<60		
<b>Cooling method</b>		Internal fan		
<b>Cooling air requirement</b>	$m^3/h$	29,6		
<b>Max. permissible heat sink temperature</b>	$^{\circ} C$	84	78	92
<b>Weight</b>	kg	5,3	5,3	5,5

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

2) For an overview, see the power loss tables in Section "Control cabinet installation"

**NOTICE**

**Disturbance of the 2 x 9 A Double Motor Module with 300% overload during operation on a 16 kW Line Module**

The maximum output of a 16 kW Line Module is not sufficient for the operation of a 2 x 9 A Double Motor Module with 300% overload.

- Do NOT operate the 2 x 9 A Double Motor Module with 300% overload on a 16 kW Line Module.
- Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.
- Only operate a 2 x 9 A Double Motor Module on a 16 kW Line Module when the maximum current is limited to  $2 \times I_{rated}$ .

6.2.8.3 Characteristics for Motor Modules Booksize with 300% overload

Rated duty cycles Motor Modules Booksize with 300% overload

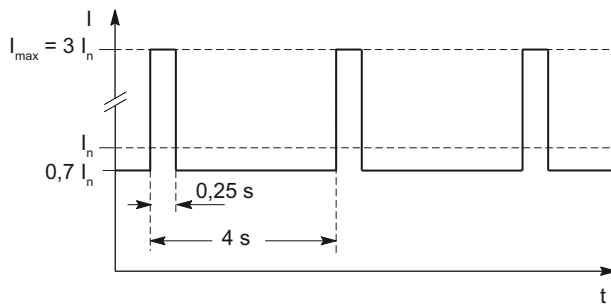


Figure 6-23 Peak current duty cycle with initial load (300% overload)

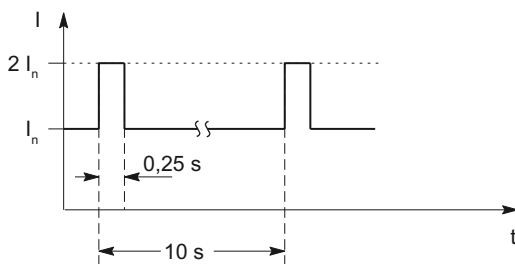


Figure 6-24 Duty cycle with initial load



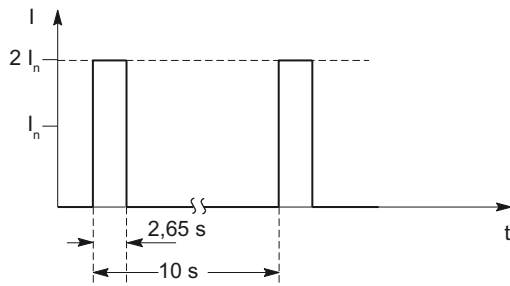


Figure 6-25 Duty cycle without initial load

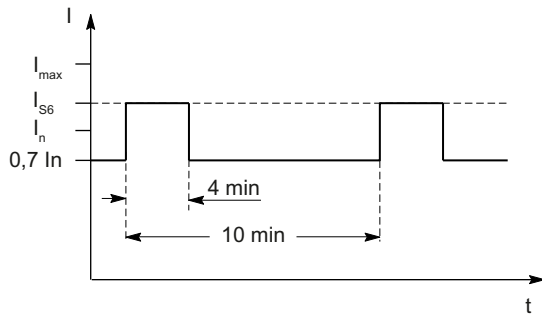


Figure 6-26 S6 duty cycle with initial load for a duty cycle duration of 600 s

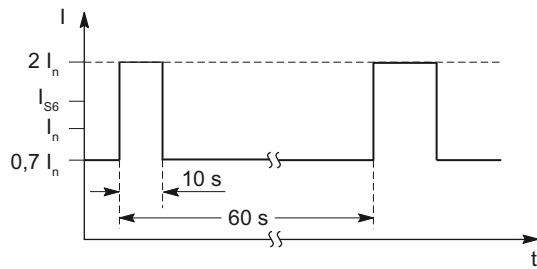


Figure 6-27 S6 duty cycle with initial load for a duty cycle duration of 60 s

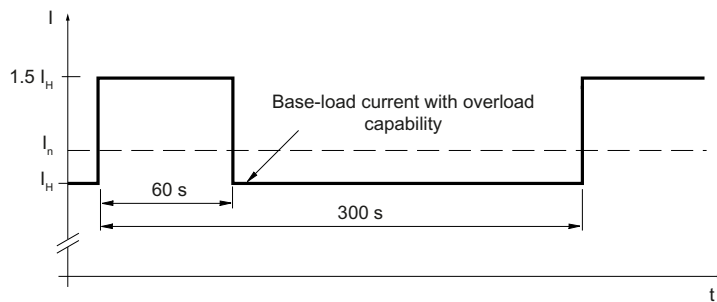


Figure 6-28 Duty cycle with 60 s overload for a duty cycle duration of 300 s

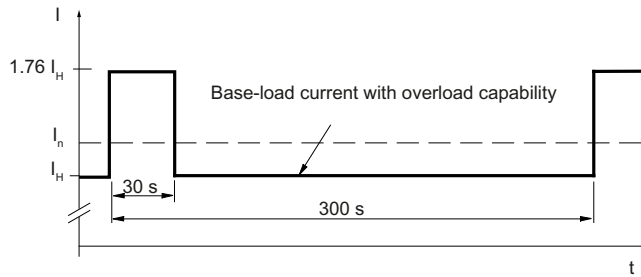


Figure 6-29 Duty cycle with 30 s overload for a duty cycle duration of 300 s

**Derating characteristics for Motor Modules Booksize with 300% overload**

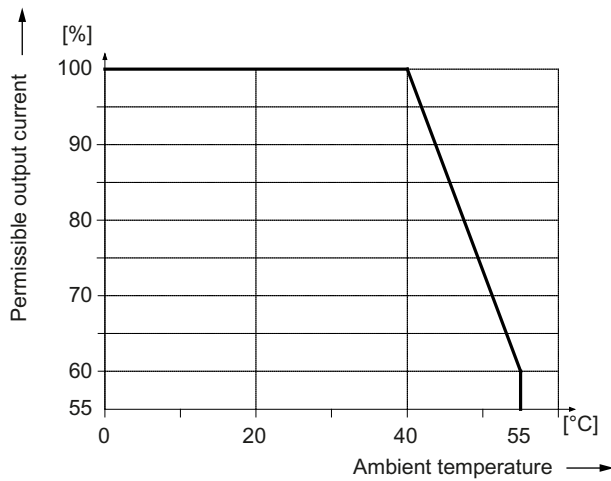


Figure 6-30 Output current as a function of the ambient temperature

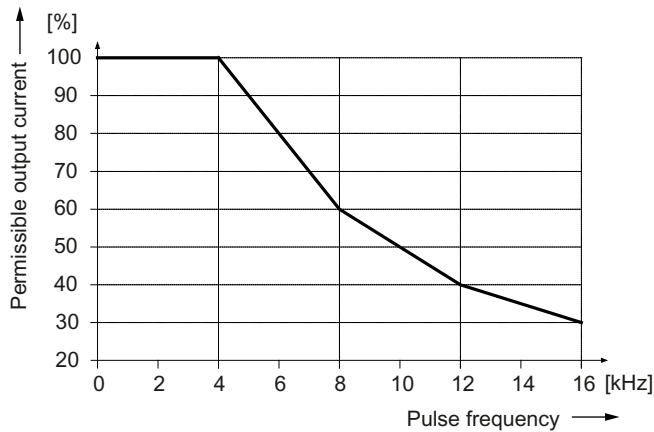


Figure 6-31 Output current as a function of the pulse frequency

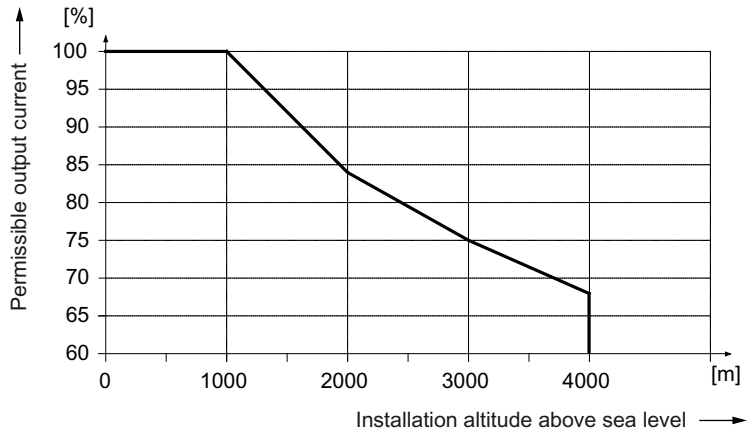


Figure 6-32 Output current as a function of the installation altitude

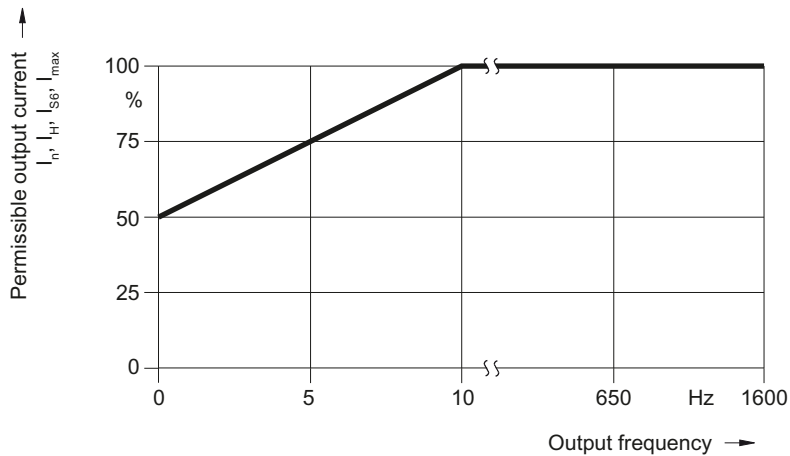


Figure 6-33 Output current as a function of the output frequency

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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

## 6.3 Motor Module with external air cooling

### 6.3.1 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. The power unit and its heat sink can be inserted in a rectangular knockout at the rear of the control cabinet and mounted with a seal. The heat sink fins and the fan (included in the scope of delivery) project beyond the rear of the control cabinet and the heat is dissipated outside the control cabinet or in a separate air duct.

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#### Note

When handling/using a Motor Module it is imperative that you observe the safety instructions in Chapter 1.

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## 6.3.2 Interface description

### 6.3.2.1 Overview

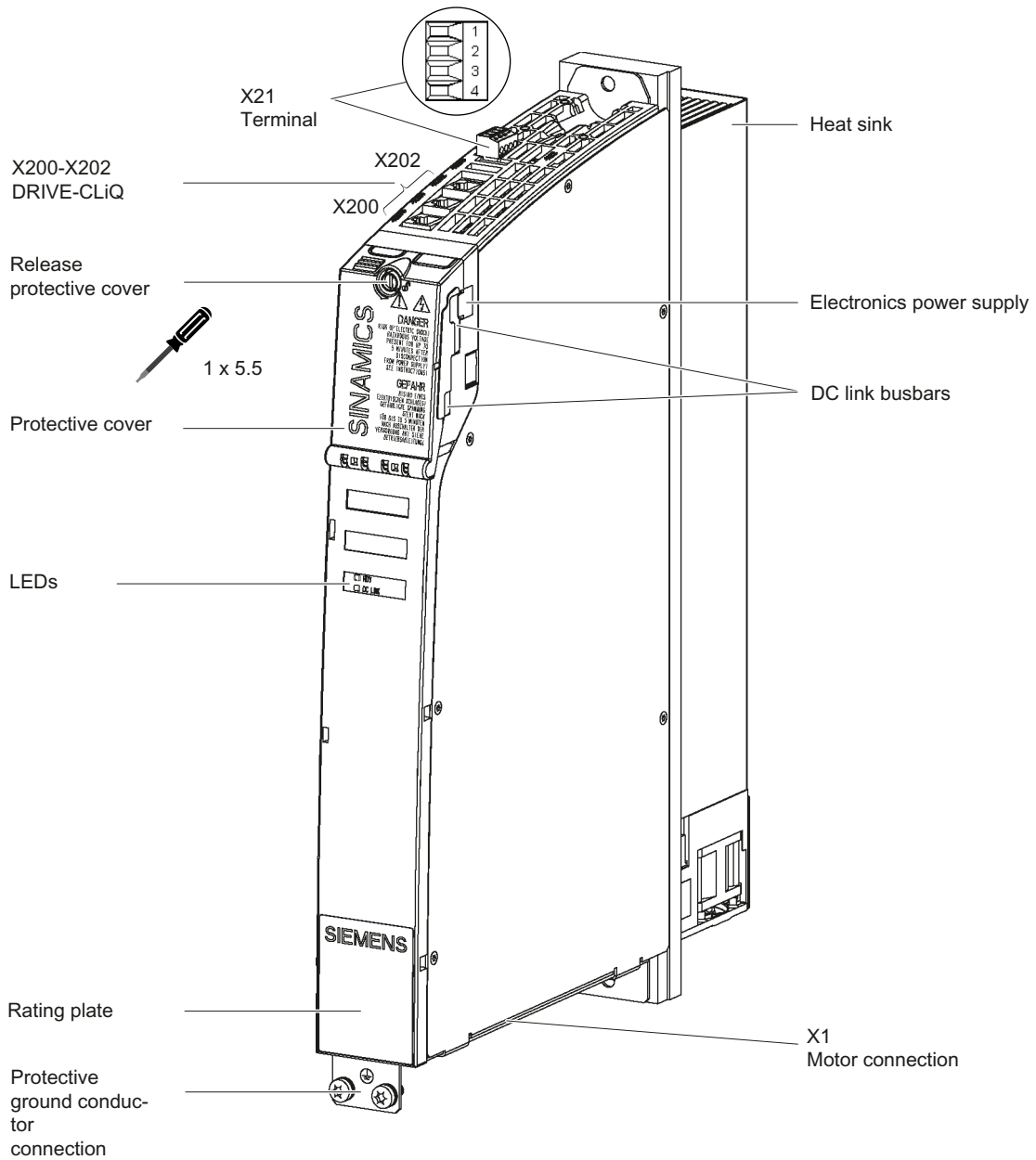


Figure 6-34 Interface overview, Single Motor Module Booksize with external air cooling (example: 5 A)

6.3 Motor Module with external air cooling

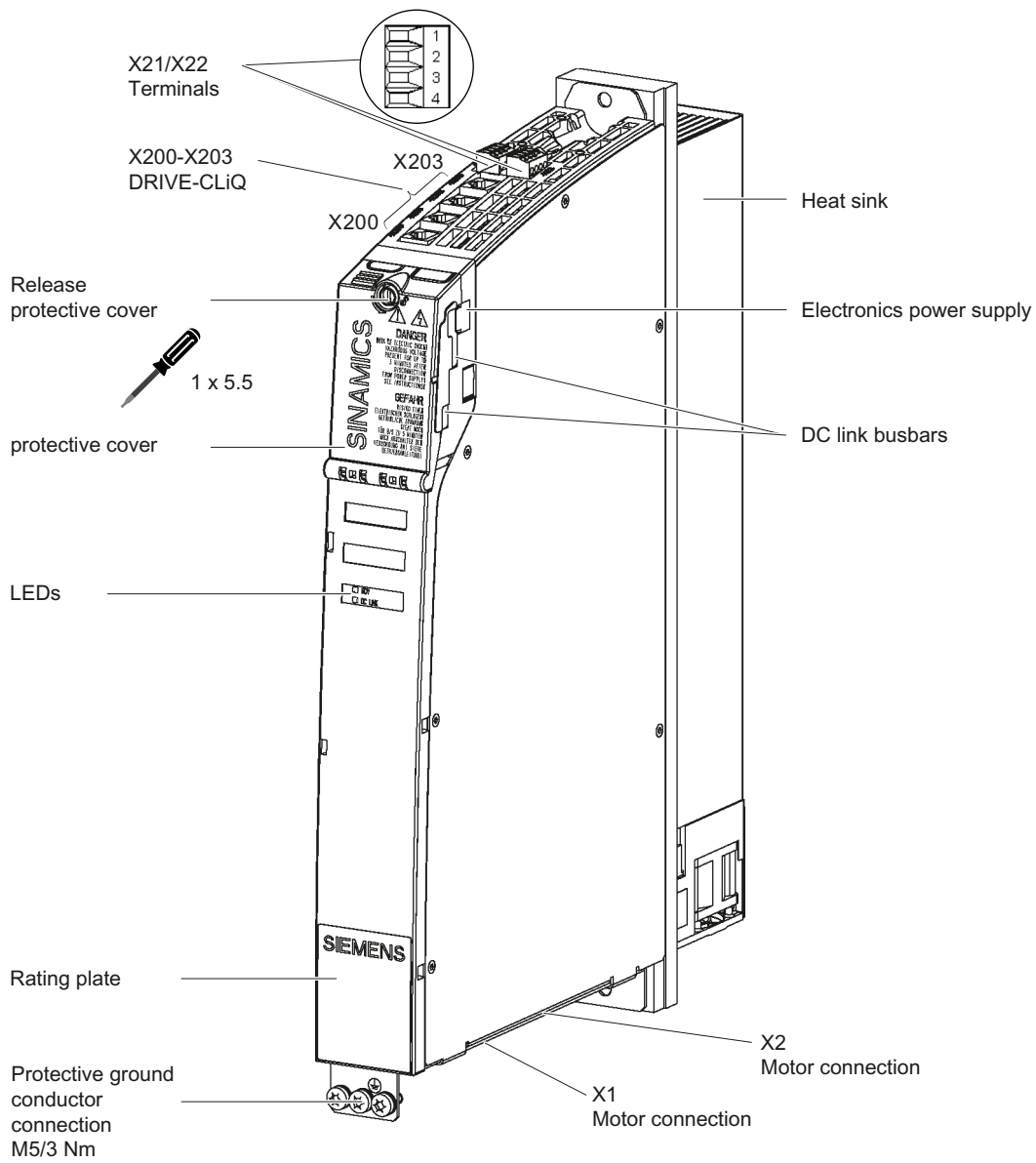
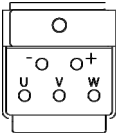
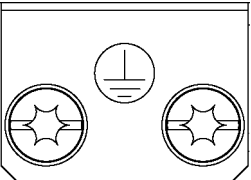
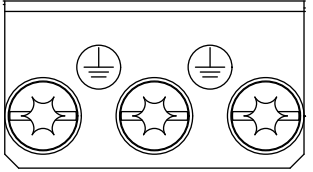


Figure 6-35 Interface overview, Double Motor Module Booksize with external air cooling (example: 2 x 5 A)

6.3.2.2 Motor and brake connection

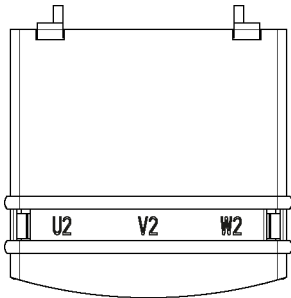
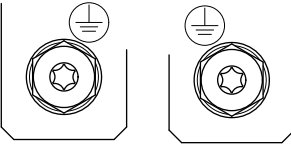
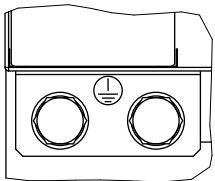
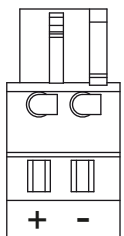
Table 6- 16 X1/X2 motor and brake connection for Single Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

	Terminal	Technical data
	U (U2)	Motor connection
	V (V2)	
	W (W2)	
	+ (BR+)	Brake connection max. load current 2 A min. load current 0.1 A
	- (BR-)	
 	PE connection	<b>Single Motor Modules 3 A to 30 A:</b> Threaded hole M5 / 3 Nm <sup>1)</sup>
		<b>Double Motor Modules 3 A to 18 A:</b> Threaded hole M5 / 3 Nm <sup>1)</sup>

1) For ring cable lugs in accordance with DIN 46234


6.3 Motor Module with external air cooling

Table 6- 17 X1 motor connection and X11 brake connection for Single Motor Modules 45 A to 200 A

	Terminal	Technical data
	U2	<b>45 A to 60 A:</b> Threaded bolts M6 / 6 Nm <sup>1)</sup> <b>85 A:</b> Threaded bolts M8 / 13 Nm <sup>1)</sup> <b>132 A to 200 A:</b> Threaded bolts M8 / 13 Nm <sup>1)</sup>
	V2	
	W2	
	PE connection	<b>45 A to 60 A:</b> Threaded bolts for motor cables: M6 / 6 Nm <sup>1)</sup> Threaded hole for PE: M6 / 6 Nm <sup>1)</sup>
		
	+ (BR+)	<b>X11 brake connector <sup>2)</sup>:</b> Voltage 24 V DC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm <sup>2</sup> Type: Spring-loaded terminal 2 (see Section "Control cabinet installation and EMC / connection system") The brake connector is part of the prefabricated cable
	- (BR-)	

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.

 <b>CAUTION</b>
<b>Protective extra-low voltages according to EN 60204-1</b> Only protective extra-low voltages (DVC A) according to EN 60204-1 must be connected to all connections and terminals between 0 and 48 V DC. These voltages must be safely isolated from all hazardous voltages.



<b>NOTICE</b>
<p><b>Voltage tolerances of the motor holding brakes</b></p> <p>The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.</p>

**Note**

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

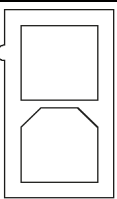
**Note**

The motor brake must be connected via connector X11. It is not permitted to directly connect the cable BR – to the electronics ground M.

**6.3.2.3 X12 fan connection**

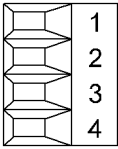
The Motor Modules 132 A and 200 A are equipped with an interface to connect a sub-chassis fan. The interface is located on the underside of the Motor Module.

Table 6- 18 X12 fan connection

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

6.3.2.4 X21/X22 EP terminals/temperature sensor

Table 6- 19 X21/X22 EP terminals / temperature sensor

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (pulse enable)	Supply voltage: 24 V DC (20.4 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 <sup>2</sup> Type: Screw terminal 1 (see Section "Control cabinet installation / connection system")			

**EP terminals**

Parameters p9651 and p9851 are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4. Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Section "Controlling the safety functions".

**Note**

**Function of the EP terminals**


The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

**Temperature sensor connection**

<p><b>NOTICE</b></p> <p><b>Risk of the motor overheating due to an incorrectly connected KTY temperature sensor</b></p> <p>A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.</p> <ul style="list-style-type: none"> <li>Always connect the KTY sensor with the correct polarity.</li> </ul>
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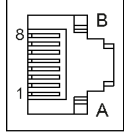
**Note**

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).

 <b>DANGER</b>
<p><b>Danger to life through electric shock</b></p> <p>Only temperature sensors that meet the safety isolation specifications stipulated 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.</p> <p>If these instructions are not complied with, there is danger to life!</p>

### 6.3.2.5 X200-X203 DRIVE-CLiQ interface

Table 6- 20 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules  
X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

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

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

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

6.3.3 Connection examples

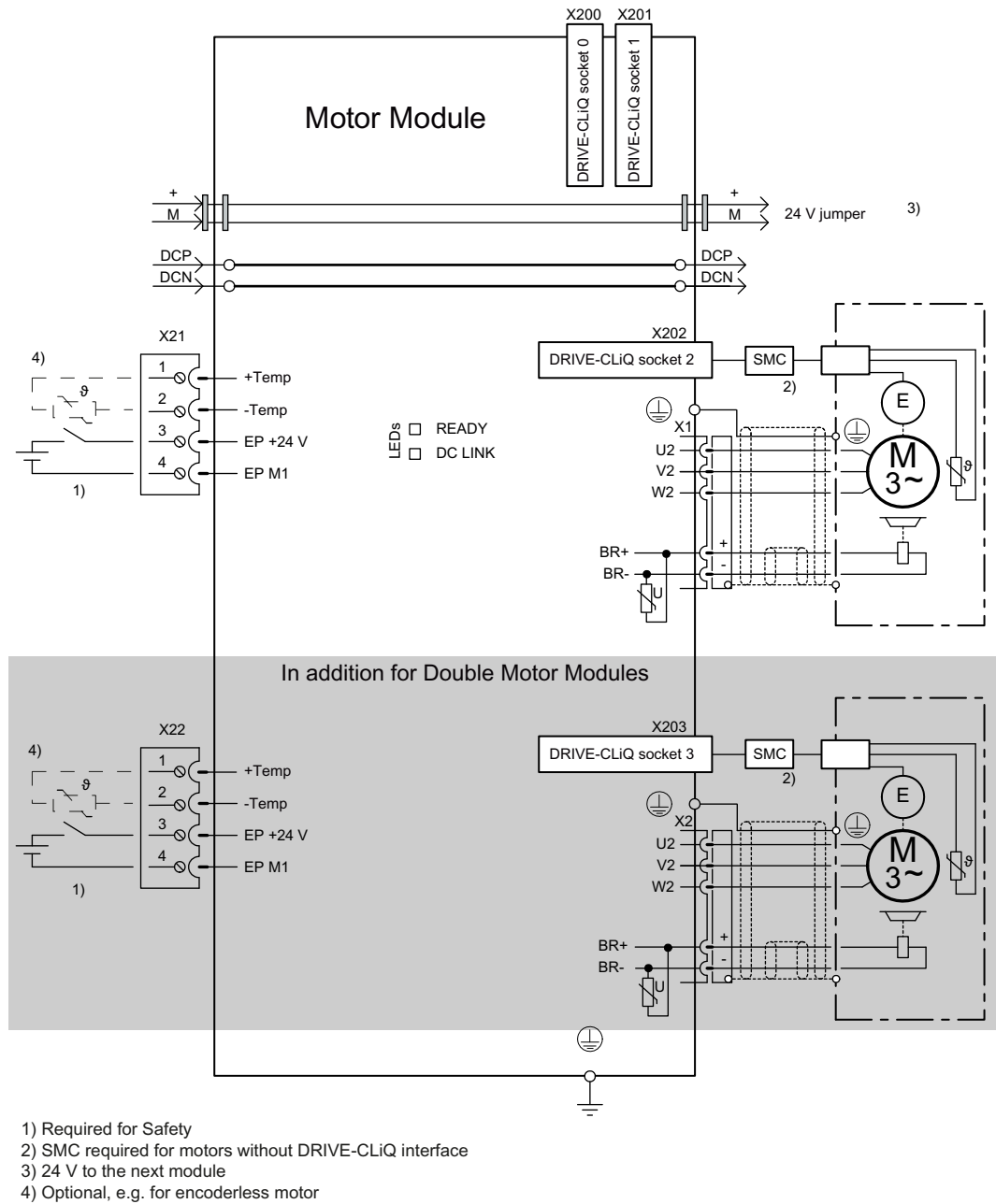
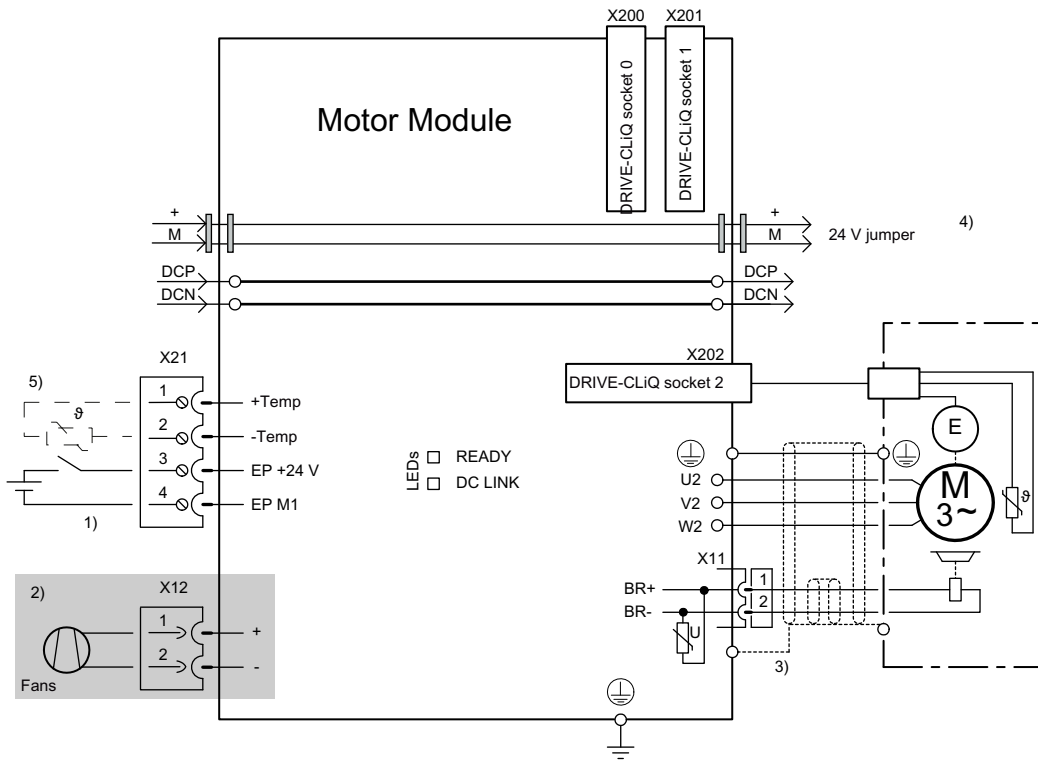


Figure 6-36 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A




- 1) Required for Safety
- 2) In addition for Motor Modules 132 A to 200 A
- 3) Contact through the shield connection plate
- 4) 24 V to the next module
- 5) Optional, e.g. for encoderless motor

Figure 6-37 Example connection of Single Motor Modules 45 A to 200 A

### 6.3.4 Meaning of LEDs

Table 6- 21 Meaning of the LEDs on the Motor Module

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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. <b>Note:</b> The LED is driven irrespective of the corresponding messages being 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	--	Detection of the components via LED is activated (p0124). <b>Note:</b> Both options depend on the LED status when module recognition is activated via p0124 = 1.	–

 <b>DANGER</b>
<p>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!</p>

6.3.5 Dimension drawings

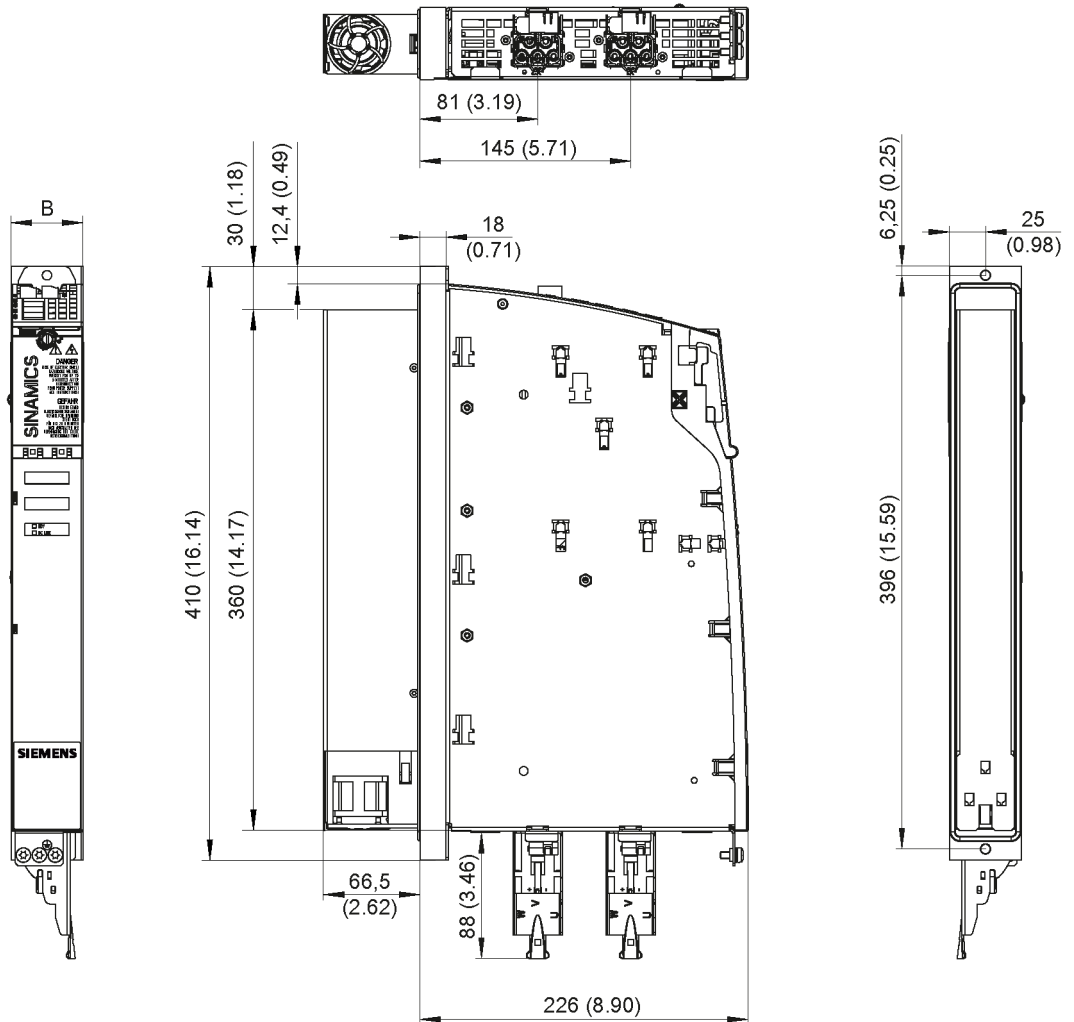


Figure 6-38 Dimension drawing of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches); example: 2 x 5 A Double Motor Module

Table 6- 22 Dimensions of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with external air cooling

Motor Module	Order number	B [mm] (inches)
3 A Single Motor Module	6SL3121-1TE13-0AAx	50 (1.97)
5 A Single Motor Module	6SL3121-1TE15-0AAx	
9 A Single Motor Module	6SL3121-1TE19-0AAx	
18 A Single Motor Module	6SL3121-1TE21-8AAx	
3 A Double Motor Module	6SL3121-2TE13-0AAx	
5 A Double Motor Module	6SL3121-2TE15-0AAx	
9 A Double Motor Module	6SL3121-2TE21-0AAx	

6.3 Motor Module with external air cooling

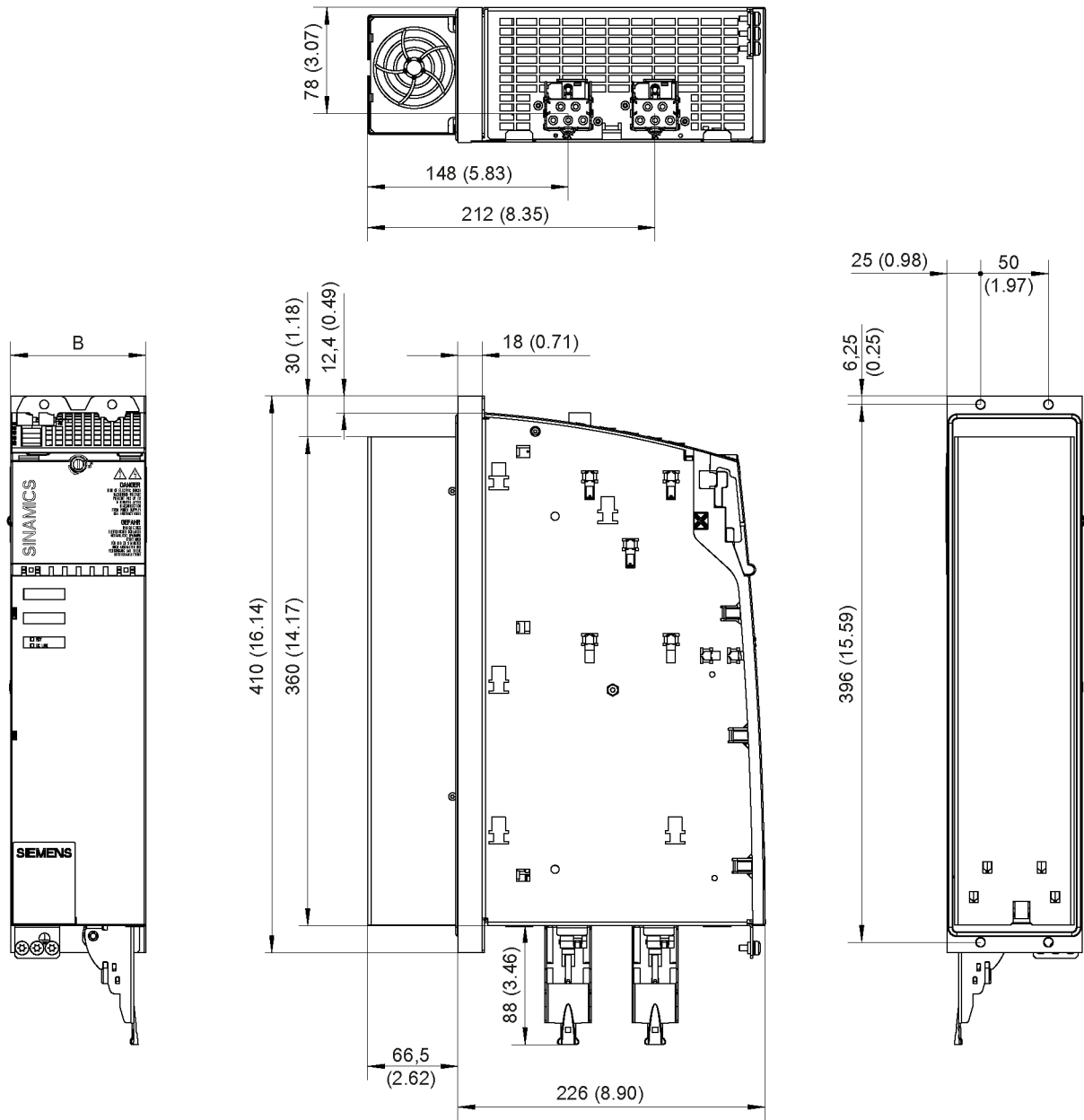


Figure 6-39 Dimension drawing of 30 A and 2 x 18 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches); example: 2 x 18 A Double Motor Module

Table 6- 23 Dimensions of 30 A and 2 x 18 A Motor Modules Booksize with external air cooling

Motor Module	Order number	B [mm] (inches)
30 A Single Motor Module	6SL3121-1TE23-0AAx	100 (3.94)
18 A Double Motor Module	6SL3121-2TE21-8AAx	



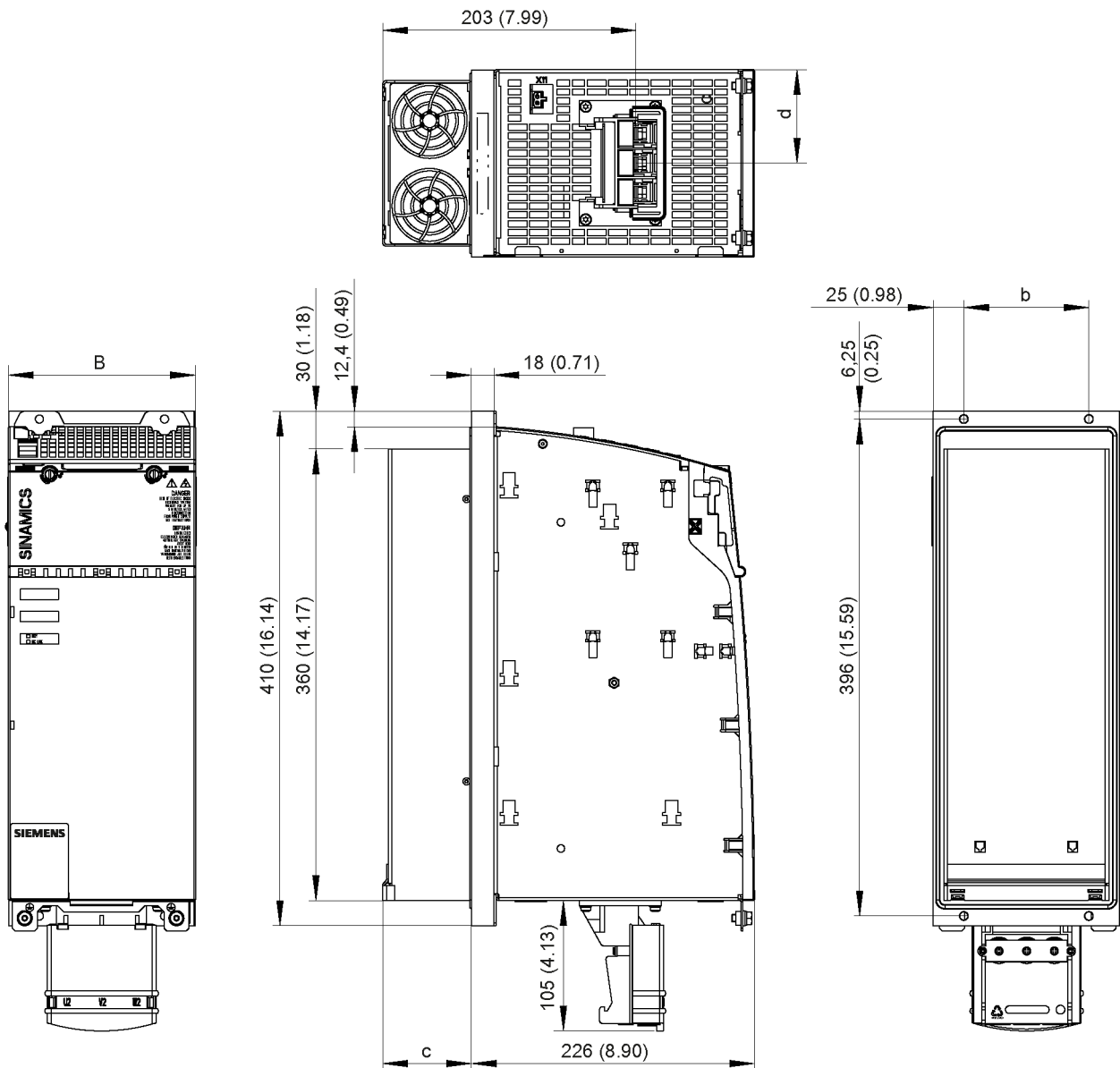


Figure 6-40 Dimension drawing of 45 A, 60 A, and 85 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches); example 45 A

Table 6- 24 Dimensions of 45 A, 60 A, and 85 A Motor Modules Booksize with external air cooling

Motor Module	Order number	B [mm] (inches)	b [mm] (inches)	c [mm] (inches)	d [mm] (inches)
Single Motor Module 45 A	6SL3121-1TE24-5AAx	150 (5.91)	100 (3.94)	71 (2.80)	75 (2.95)
Single Motor Module 60 A	6SL3121-1TE26-0AAx				
Single Motor Module 85 A	6SL3121-1TE28-5AAx	200 (7.87)	150 (5.91)	92 (3.62)	100 (3.94)

6.3 Motor Module with external air cooling

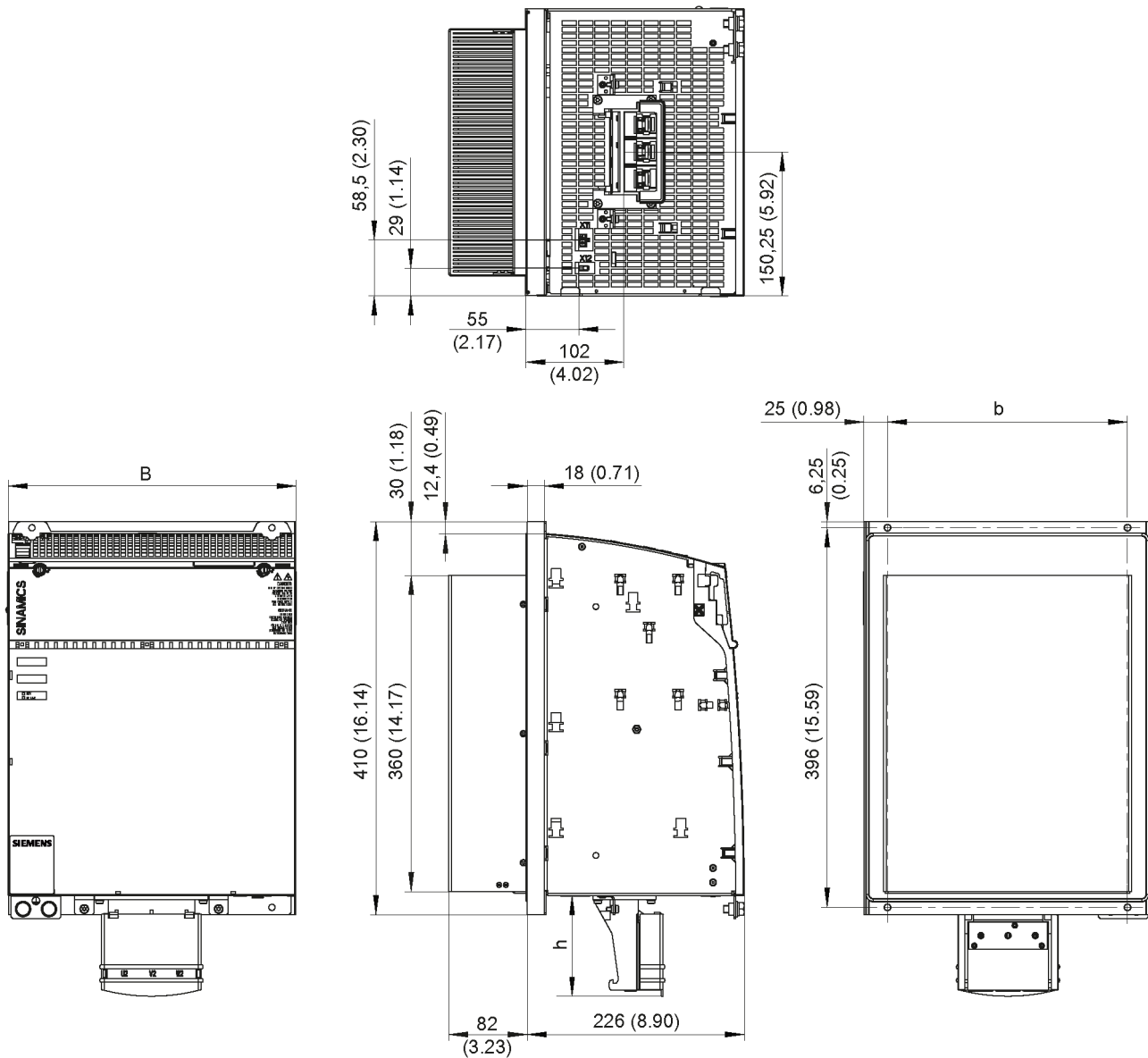


Figure 6-41 Dimension drawing of 132 A and 200 A Motor Modules Booksize, all dimensions in mm and (inches); example: 200 A Single Motor Module

Table 6- 25 Dimensions of 132 A and 200 A Motor Modules Booksize with external air cooling

Motor Module	Order number	B [mm] (inches)	b [mm] (inches)	h [mm] (inches)
Single Motor Module 132 A	6SL3121-1TE31-3AAx	300 (11.81)	250 (9.84)	105 (4.13)
Single Motor Module 200 A	6SL3121-1TE32-0AAx			

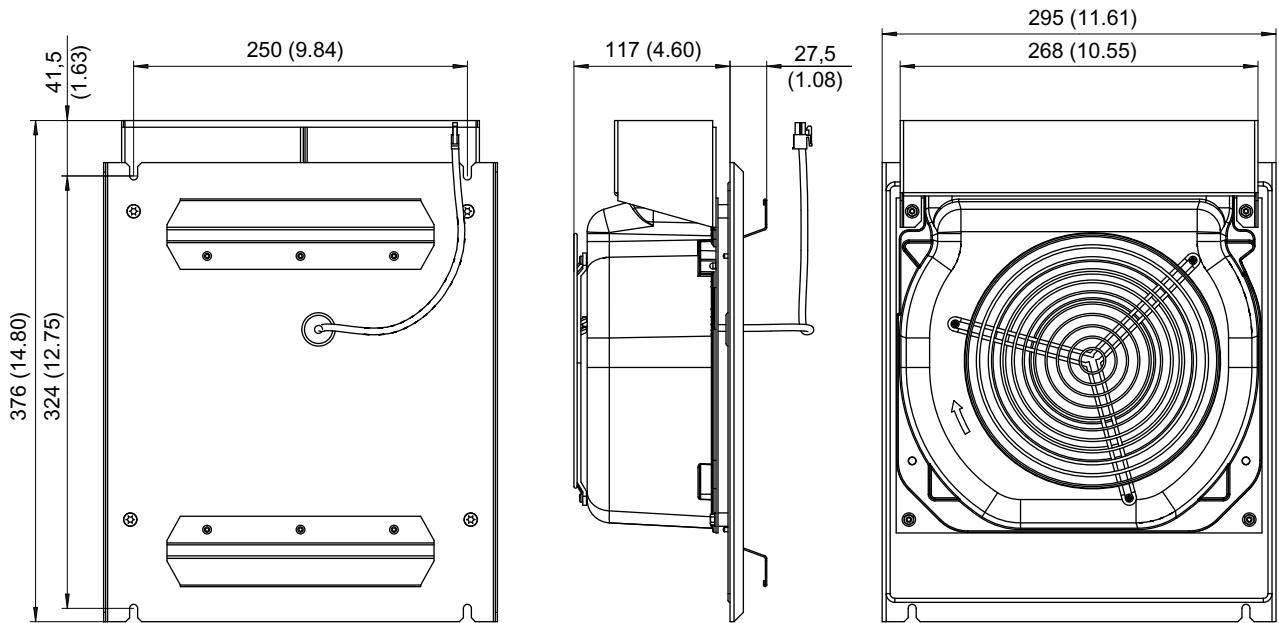
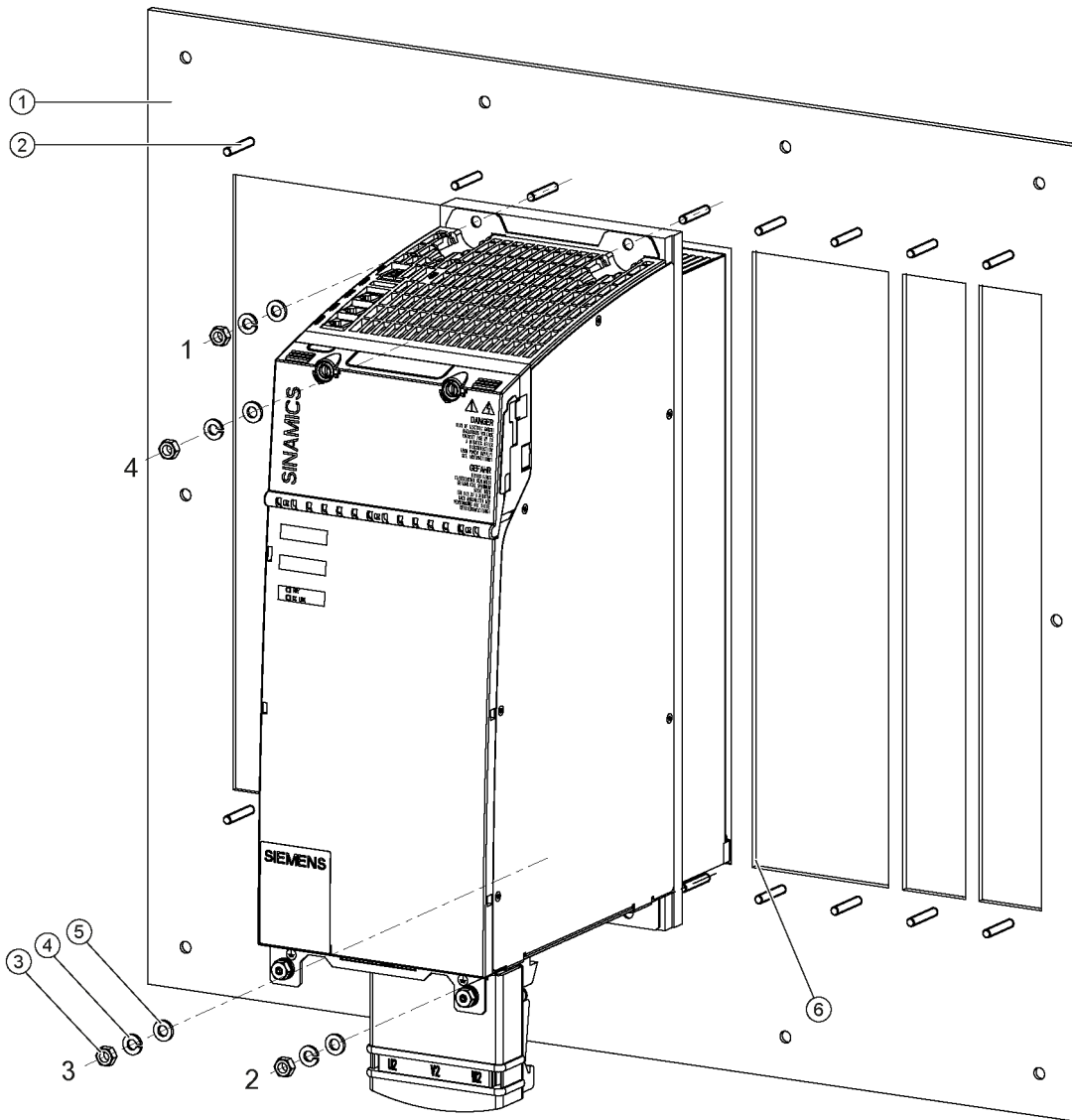


Figure 6-42 Dimension drawing of fan for 132 A and 200 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches)

### 6.3.6 Mounting



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

Figure 6-43 Mounting a Motor Module with external air cooling

#### Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 6 Nm (in the specific sequence 1 to 4)

Help with the mechanical control cabinet design is available from:

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

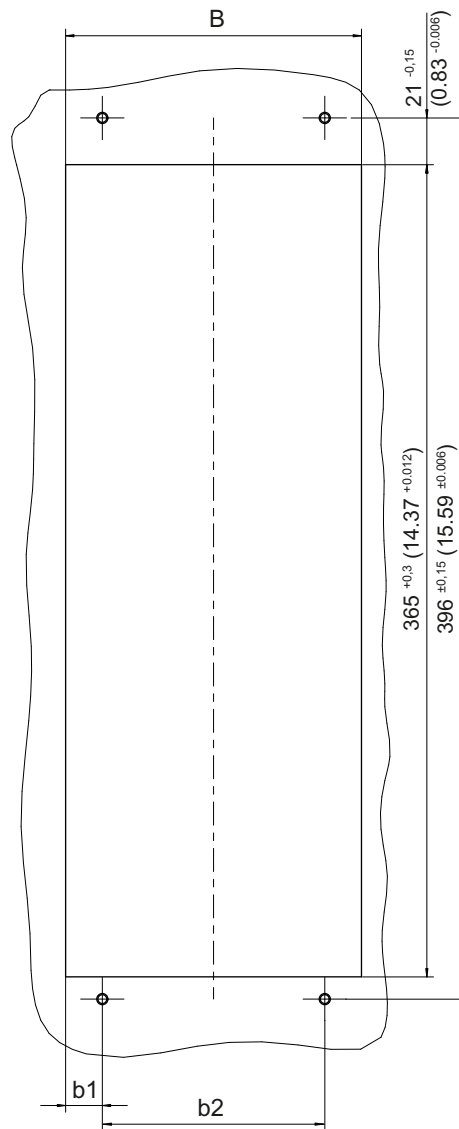
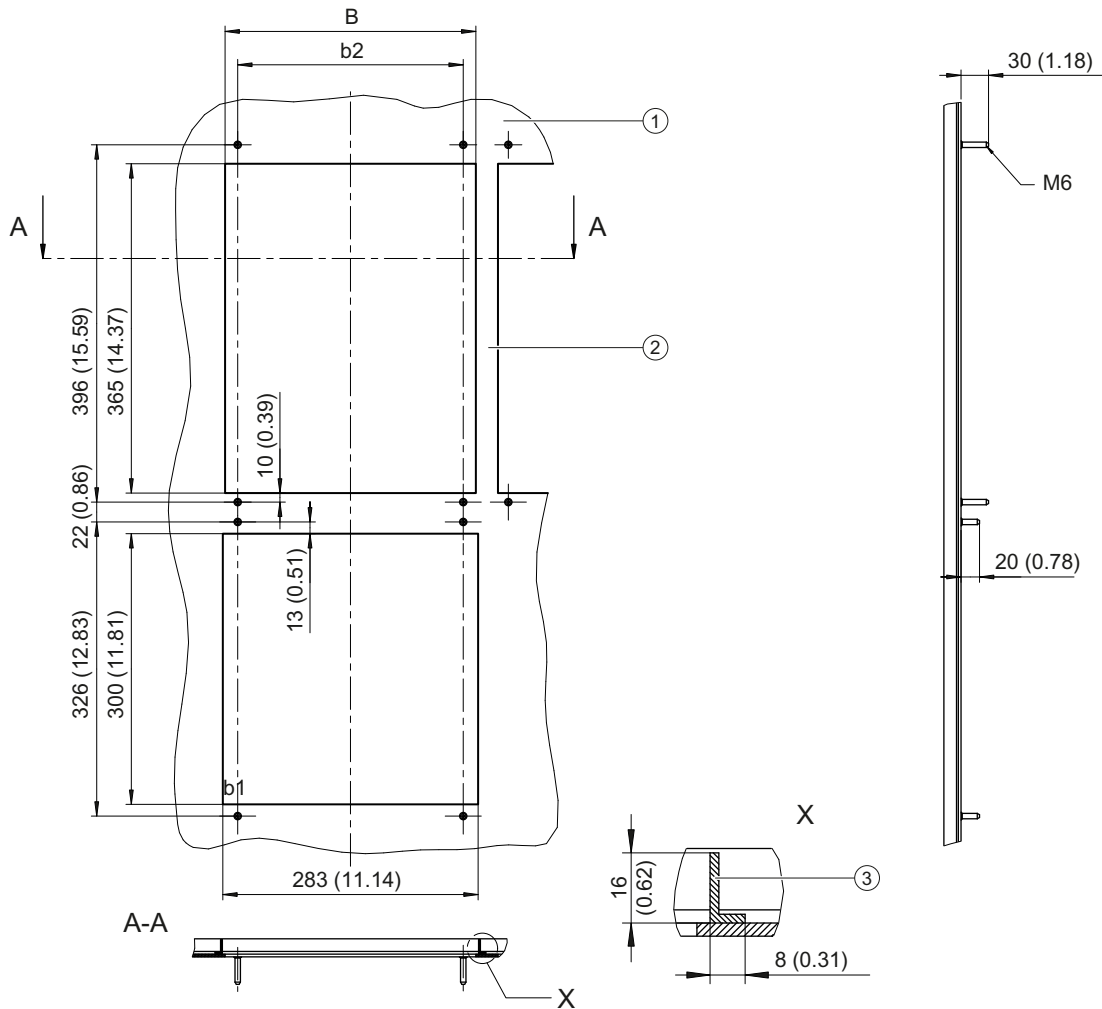


Figure 6-44 Opening to mount Motor Modules 50 mm to 200 mm with external air cooling, all data in mm and (inches)

6.3 Motor Module with external air cooling

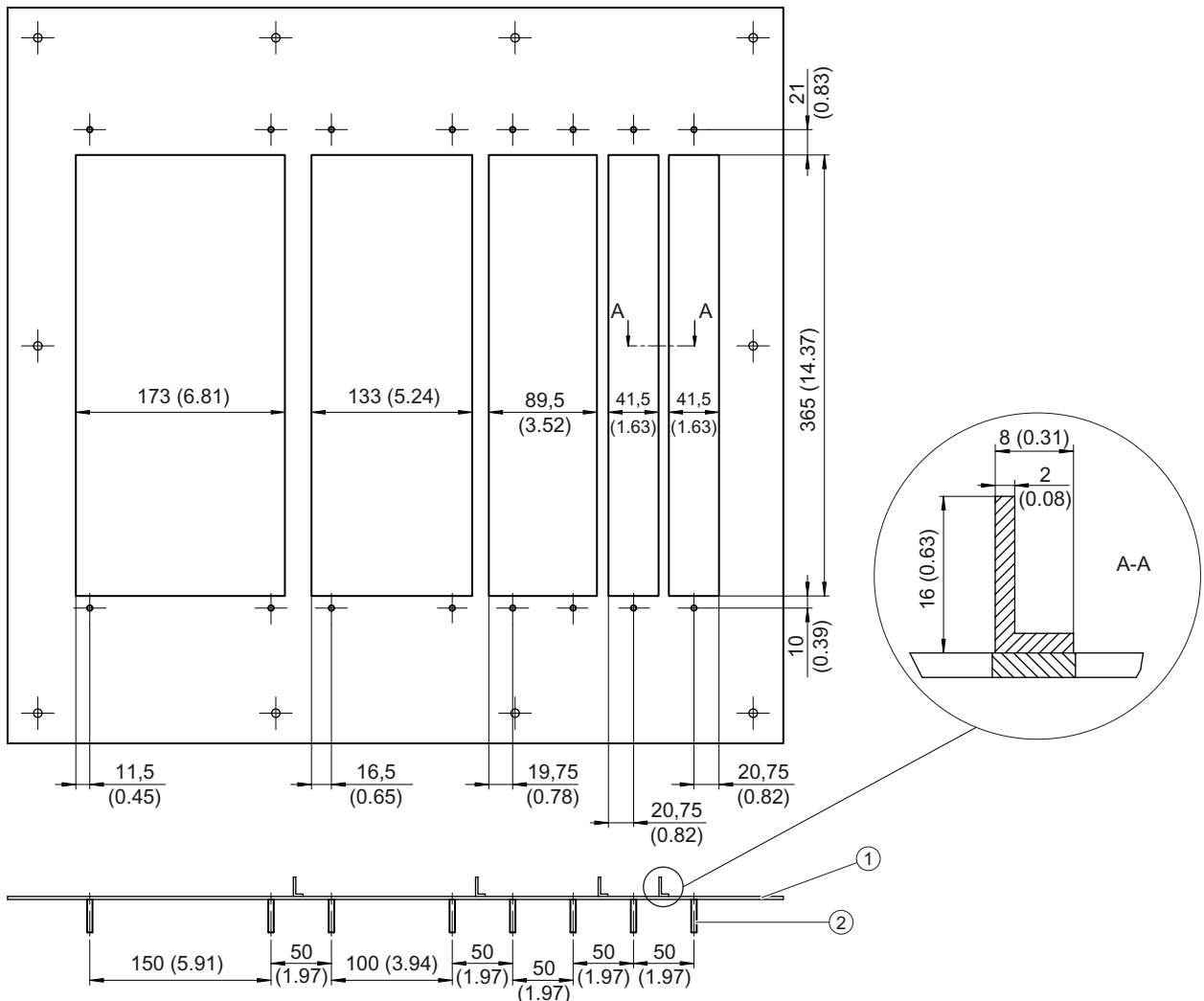


- ① Insert plate or mounting plate
- ② Cross-piece
- ③ Reinforcing bracket

Figure 6-45 Openings to mount a Motor Module 300 mm with external air cooling, all data in mm and (inches)

Table 6- 26 Dimensions of openings to mount Motor Modules with external air cooling

Component width	W [mm] (inches)	b1 [mm] (inch)	b2 [mm] (inch)
50 mm	41.5 <sup>+0.3</sup> (1.63 <sup>+0.012</sup> )	20.75 <sup>+0.15</sup> (0.82 <sup>+0.006</sup> )	0
100 mm	89,5 <sup>+0,3</sup> (3.52 <sup>+0.012</sup> )	19,75 <sup>+0,15</sup> (0.78 <sup>+0.006</sup> )	50 <sup>±0,15</sup> (1.97 <sup>±0.006</sup> )
150 mm	133 <sup>+0,3</sup> (5.24 <sup>+0.012</sup> )	16,5 <sup>+0,15</sup> (0.65 <sup>+0.006</sup> )	100 <sup>±0,15</sup> (3.94 <sup>±0.006</sup> )
200 mm	173 <sup>+0,3</sup> (6.81 <sup>+0.012</sup> )	11,5 <sup>+0,15</sup> (0.45 <sup>+0.006</sup> )	150 <sup>±0,15</sup> (5.91 <sup>±0.006</sup> )
300 mm	278 <sup>+0,3</sup> (10.94 <sup>+0.012</sup> )	14,0 <sup>±0,15</sup> (0.55 <sup>±0.006</sup> )	250 <sup>+0,15</sup> (9.84 <sup>+0.006</sup> )

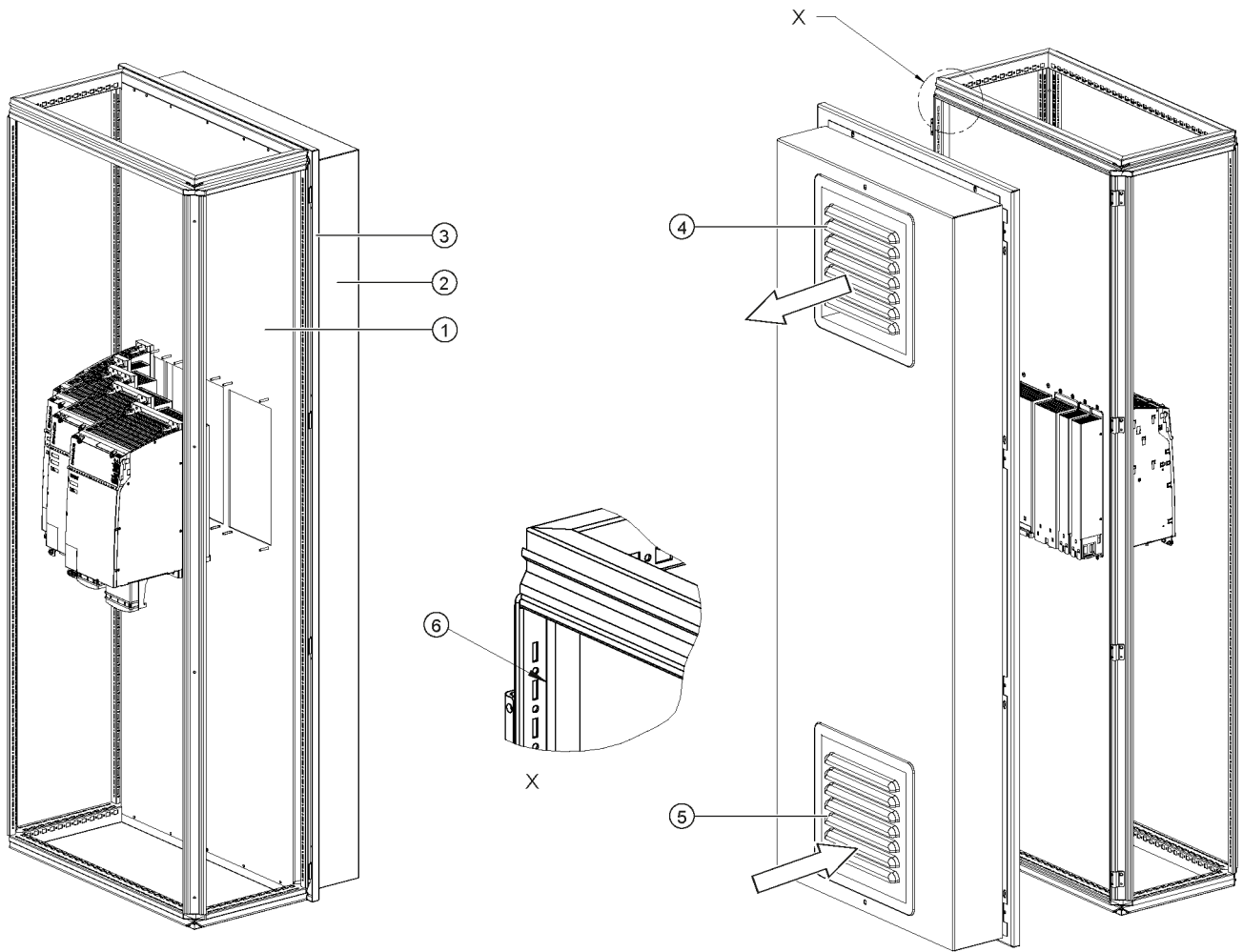


- ① Insert plate or mounting plate
- ② Threaded bolts M5 x 28

Figure 6-46 Example of a mounting plate for a drive line-up with external air cooling

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

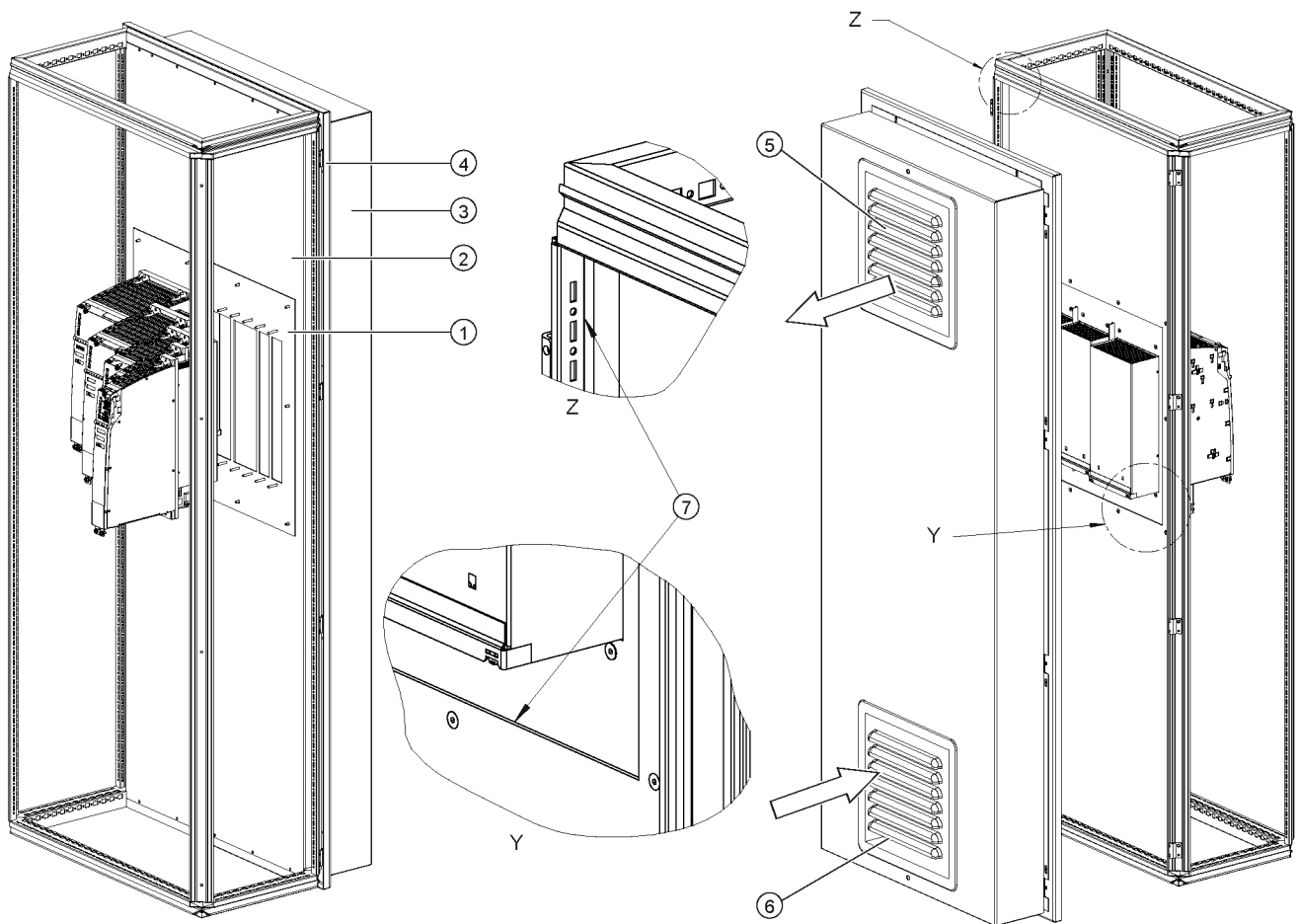
In our example, the cross-pieces have been reinforced using brackets according to EN 755-9. You are free to select the way that the bracket is attached to the insert.



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

Figure 6-47 Example 1: mounting in the cabinet with mounting plate





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

Figure 6-48 Example 2: mounting in the cabinet with mounting plate

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

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

---

**Note**

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

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

---

## 6.3.7 Technical data

### 6.3.7.1 Single Motor Modules

Table 6- 27 Technical data Single Motor Modules Booksize (3 to 30 A)

External air cooling	6SL3121-	1TE13-0AAx 1)	1TE15-0AAx 1)	1TE21-0AAx 1)	1TE21-8AAx 1)	1TE23-0AAx
<b>Output current</b>						
Rated current ( $I_n$ )	$A_{ACrms}$	<b>3</b>	<b>5</b>	<b>9</b>	<b>18</b>	<b>30</b>
Base-load current ( $I_H$ )	A	2.6	4.3	7.7	15.3	25.5
Intermittent duty current ( $I_{s6}$ )	$A_{ACrms}$	3.5	6	10	24	40
40%	$A_{ACrms}$	6	10	18	36	56
Peak current ( $I_{max}$ )						
<b>Output voltage</b>	$V_{ACrms}$	0 - 0.717 x DC link voltage				
<b>DC link current <math>I_d</math></b>	$A_{DC}$	3,6	6	11	22	36
<b>DC link voltage</b>	$V_{DC}$	510 – 720				
<b>DC link capacitance</b>	$\mu F$	110	110	110	220	705
Overvoltage trip	$V_{DC}$	820 $\pm$ 2 %				
Undervoltage trip <sup>2)</sup>	$V_{DC}$	380 $\pm$ 2 %				
<b>Electronics power supply</b>	$V_{DC}$	24 (20,4 - 28,8)				
<b>Electronics current consumption at 24 V DC</b>	$A_{DC}$	0,85	0,85	0,85	0,85	0,8
<b>Current carrying capacity</b>						
DC link busbars	$A_{DC}$	100	100	100	100	100
Reinforced DC link busbars	$A_{DC}$	150	150	150	150	150
24 V DC busbars	$A_{DC}$	20	20	20	20	20
<b>Unit rating</b>						
Based on $I_n$ (600 $V_{DC}$ ; 4 kHz)	kW	1,6	2,7	4,8	9,7	16
Based on $I_H$	kW	1,4	2,3	4,1	8,2	13,7
<b>Total power loss (incl. electronics losses) <sup>3)</sup></b>	W	50,4	73,4	100,4	185,4	309,2
<b>Max. pulse frequency</b>						
without derating	kHz	4				
with derating	kHz	16				
<b>Max. ambient temperature</b>						
without derating	$^{\circ}C$	40				
with derating	$^{\circ}C$	55				
<b>Sound pressure level</b>	dB(A)	<60	<60	<60	<60	<60
<b>Cooling air requirement</b>	m <sup>3</sup> /h	29,6	29,6	29,6	29,6	56
<b>Max. permissible heat sink temperature</b>	$^{\circ}C$	70	70	73	82	85
<b>Weight</b>	kg	5,7	5,7	5,7	5,7	8,4

1) Applies only to order numbers with x = 0...3

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

3) For an overview, see the power loss tables in Section "Control cabinet installation".

6.3 Motor Module with external air cooling

Table 6- 28 Technical data Single Motor Modules Booksize (45 to 200 A)

External air cooling	6SL3121-	1TE24-5AAx	1TE26-0AAx	1TE28-5AAx	1TE31-3AAx	1TE32-0AAx
<b>Output current</b>						
Rated current (I <sub>n</sub> )	A <sub>ACrms</sub>	45	60	85	132	200
Base-load current (I <sub>H</sub> )	A	38	51	68	105	141
Intermittent duty current (I <sub>s6</sub> )	A <sub>ACrms</sub>	60	80	110	150	230
40%	A <sub>ACrms</sub>	85	113	141	210	282
Peak current (I <sub>max</sub> )						
<b>Output voltage</b>	V <sub>ACrms</sub>	0 - 0.717 x DC link voltage				
<b>DC link current I<sub>d</sub></b>	A <sub>DC</sub>	54	72	102	158	200
<b>DC link voltage</b>	V <sub>DC</sub>	510 – 720				
<b>DC link capacitance</b>	µF	1175	1410	1880	2820	3995
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %				
Undervoltage trip <sup>1)</sup>	V <sub>DC</sub>	380 ± 2 %				
<b>Electronics power supply</b>	V <sub>DC</sub>	24 (20,4 - 28,8)				
<b>Electronics current consumption at 24 V DC</b>	A <sub>DC</sub>	1,05	1,05	1,5	0,85	0,85
<b>Current carrying capacity</b>						
DC link busbars	A <sub>DC</sub>	200	200	200	200	200
24 V DC busbars	A <sub>DC</sub>	20	20	20	20	20
<b>Unit rating</b>						
Based on I <sub>n</sub> (600 V <sub>DC</sub> ; 4 kHz)	kW	24	32	46	71	107
Based on I <sub>H</sub>	kW	21	28	37	57	76
<b>Total power loss (incl. electronics losses) <sup>2)</sup></b>	W	455,2	615,2	786	1270,4	2070,4
<b>Max. pulse frequency without derating</b>	kHz	4				
<b>with derating</b>	kHz	16				
<b>Max. ambient temperature without derating</b>	° C	40				
<b>with derating</b>	° C	55				
<b>Sound pressure level</b>	dB(A)	< 65	< 65	< 60	< 73	< 73
<b>Cooling air requirement</b>	m <sup>3</sup> /h	112	112	160	520	520
<b>Max. permissible heat sink temperature</b>	° C	85	90	88	73	80 (70% derating)
<b>Weight</b>	kg	13,2	13,3	17,2	27,1	28

1) Default for 400 V line supplies; 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 an overview, see the power loss tables in Section "Control cabinet installation".

## 6.3.7.2 Double Motor Modules

Table 6- 29 Technical data Double Motor Modules Booksize (3 to 18 A)

External air cooling	6SL3121-	2TE13-0AAx 1)	2TE15-0AAx 1)	2TE21-0AAx 1)	2TE21-8AAx
<b>Output current</b>					
Rated current ( $I_n$ )	$A_{ACrms}$	2 x 3	2 x 5	2 x 9	2 x 18
Base-load current ( $I_H$ )	A	2 x 2.6	2 x 4.3	2 x 7.7	2 x 15.3
Intermittent duty current ( $I_{s6}$ ) 40%	$A_{ACrms}$	2 x 3.5	2 x 6	2 x 10	2 x 24
Peak current ( $I_{max}$ )	$A_{ACrms}$	2 x 6	2 x 10	2 x 18	2 x 36
<b>Output voltage</b>	$V_{ACrms}$	0 -480			
<b>DC link current <math>I_d</math></b>	$A_{DC}$	7.2	12	22	43
<b>DC link voltage</b>	$V_{DC}$	510 – 720			
<b>DC link capacitance</b>	$\mu F$	110	220	220	705
Overvoltage trip	$V_{DC}$	820 $\pm$ 2 %			
Undervoltage trip <sup>1)</sup>	$V_{DC}$	380 $\pm$ 2 %			
<b>Electronics power supply</b>	$V_{DC}$	24 (20,4 - 28,8)			
<b>Electronics current consumption at 24 V DC</b>	$A_{DC}$	1,15	1,15	1,15	1,3
<b>Current carrying capacity</b>					
DC link busbars	$A_{DC}$	100	100	100	100
Reinforced DC link busbars	$A_{DC}$	150	150	150	150
24 V DC busbars	A	20	20	20	20
<b>Unit rating</b>					
Based on $I_n$ (600 $V_{DC}$ ; 4 kHz)	kW	2 x 1.6	2 x 2.7	2 x 4.8	2 x 9.7
Based on $I_H$	kW	2 x 1.4	2 x 2.3	2 x 4.4	2 x 8.2
<b>Total power loss</b> (including electronics losses) <sup>2)</sup>	W	97,6	132,6	187,6	351,2
<b>Max. pulse frequency</b>					
without derating	kHz	4			
with derating	kHz	16			
<b>Max. ambient temperature</b>					
without derating	$^{\circ}C$	40			
with derating	$^{\circ}C$	55			
<b>Sound pressure level</b>	dB(A)	<60	<60	<60	<60
<b>Cooling air requirement</b>	m <sup>3</sup> /h	29,6	29,6	29,6	56
<b>Max. permissible heat sink temperature</b>	$^{\circ}C$	80	85	89	90
<b>Weight</b>	kg	5,8	5,8	5,7	8,6

1) Applies only to order numbers with x = 0...3

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

3) For an overview, see the power loss tables in Section "Control cabinet installation"

6.3.7.3 Characteristics

Rated duty cycles Motor Modules Booksize

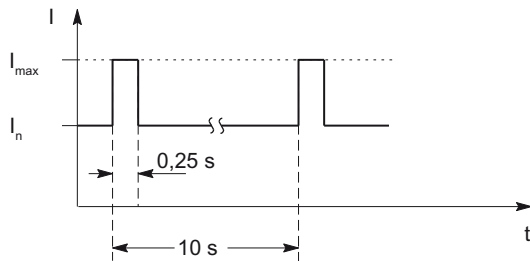


Figure 6-49 Duty cycle with initial load (for servo drives)

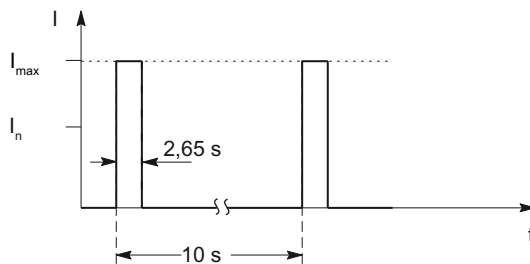


Figure 6-50 Duty cycle without initial load (for servo drives)

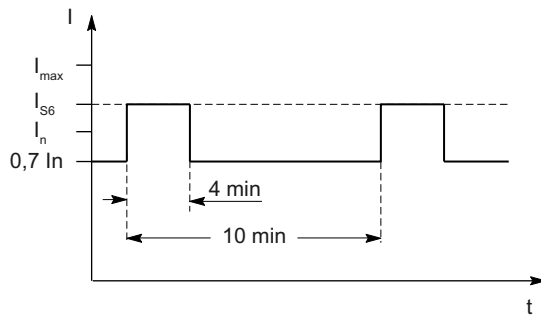


Figure 6-51 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

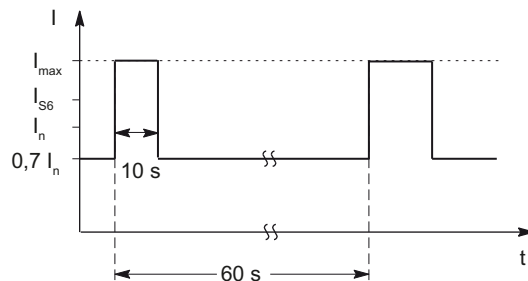


Figure 6-52 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

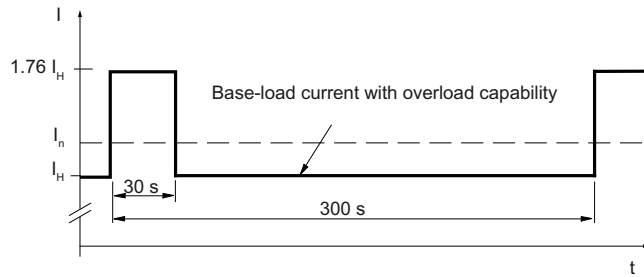


Figure 6-53 Duty cycle with 30 s overload with a duty cycle duration of 300 s

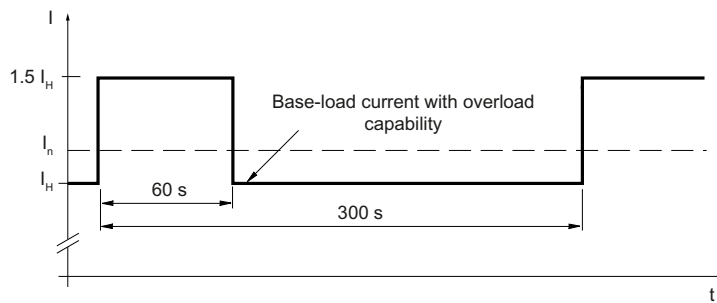


Figure 6-54 Duty cycle with 60 s overload with a duty cycle duration of 300 s

**Derating characteristics for Motor Modules Booksize**

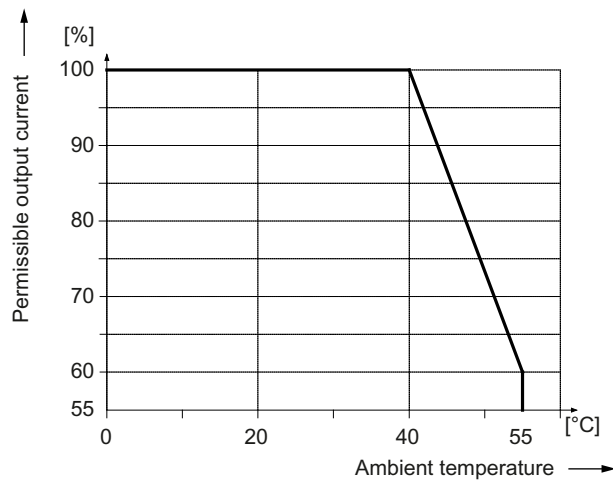


Figure 6-55 Output current as a function of the ambient temperature

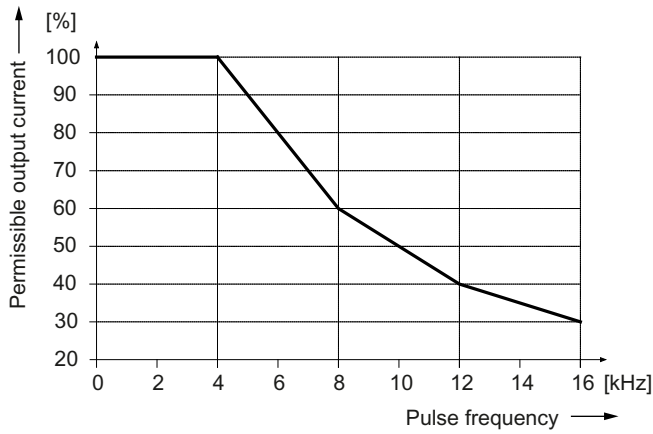


Figure 6-56 Output current as a function of the pulse frequency

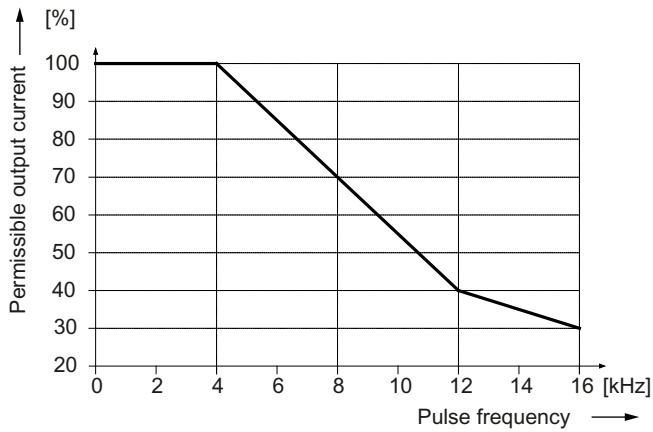


Figure 6-57 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

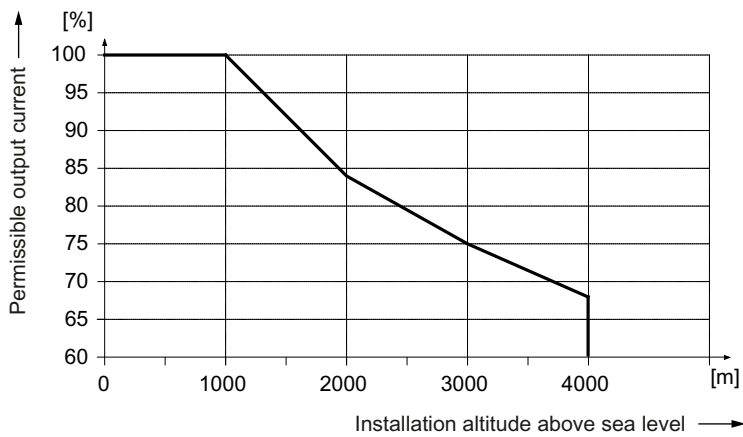


Figure 6-58 Output current as a function of the installation altitude



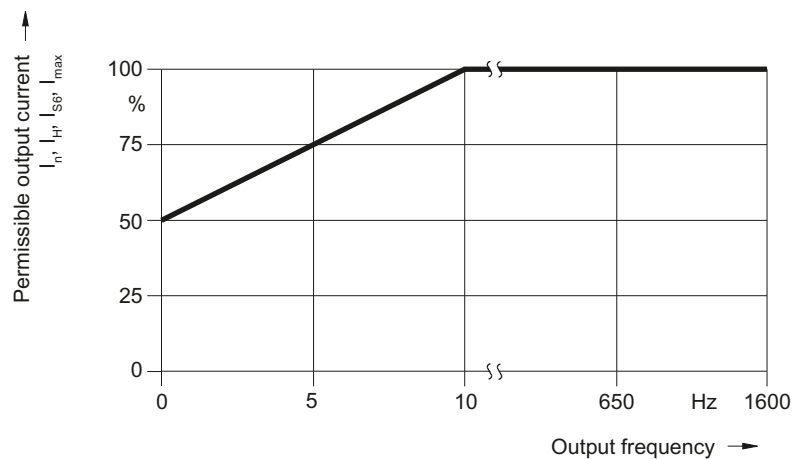


Figure 6-59 Output current as a function of the output frequency

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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

6.3.8 Technical data for Motor Modules Booksize with 300% overload

6.3.8.1 Single Motor Modules (300% overload)

Table 6- 30 Technical data Single Motor Modules Booksize (3 to 18 A) with 300% overload

External air cooling		6SL3121-	1TE13-0AA4	1TE15-0AA4	1TE21-0AA4	1TE21-8AA4
<b>Output current</b>						
Rated current (I <sub>n</sub> )	A <sub>ACrms</sub>	3	5	9	18	
Base-load current (I <sub>H</sub> )	A	2.6	4.3	7.7	15.3	
Intermittent duty current (I <sub>s6</sub> ) 40%	A <sub>ACrms</sub>	3.5	6	10	24	
Peak current (I <sub>max</sub> )	A <sub>ACrms</sub>	9	15	27	54	
<b>Output voltage</b>	V <sub>ACrms</sub>	0 - 0.717 x DC link voltage				
<b>DC link current I<sub>d</sub></b>	A <sub>DC</sub>	3,6	6	11	22	
<b>DC link voltage</b>	V <sub>DC</sub>	510 – 720				
<b>DC link capacitance</b>	µF	110	110	110	220	
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %				
Undervoltage trip <sup>1)</sup>	V <sub>DC</sub>	380 ± 2 %				
<b>Electronics power supply</b>	V <sub>DC</sub>	24 (20,4 - 28,8)				
<b>Electronics current consumption at 24 V DC</b>	A <sub>DC</sub>	0,85				
<b>Current carrying capacity</b>						
DC link busbars	A <sub>DC</sub>	100				
Reinforced DC link busbars	A <sub>DC</sub>	150				
24 V DC busbars	A <sub>DC</sub>	20				
<b>Unit rating</b>						
Based on I <sub>n</sub> (600 V <sub>DC</sub> ; 4 kHz)	kW	1,6	2,7	4,8	9,7	
Based on I <sub>H</sub>	kW	1,4	2,3	4,1	8,2	
<b>Total power loss (incl. electronics losses) <sup>2)</sup></b>	W	50,4	73,4	100,4	185,4	
<b>Max. pulse frequency</b>						
without derating	kHz	4				
with derating	kHz	16				
<b>Max. ambient temperature</b>						
without derating	° C	40				
with derating	° C	55				
<b>Sound pressure level</b>	dB(A)	<60				
<b>Cooling air requirement</b>	m <sup>3</sup> /h	29,6				
<b>Max. permissible heat sink temperature</b>	° C	70	70	70	90	
<b>Weight</b>	kg	5,7	5,7	5,7	5,7	

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

2) For an overview, see the power loss tables in Section "Control cabinet installation".

**NOTICE**

**Disturbance of the 18 A Single Motor Module with 300% overload during operation on a 16 kW Line Module**

The maximum output of a 16 kW Line Module is not sufficient for the operation of an 18 A Single Motor Module with 300% overload.

- Do NOT operate the 18 A Single Motor Module with 300% overload on a 16 kW Line Module.
- Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.
- Only operate an 18 A Single Motor Module on a 16 kW Line Module when the maximum current is limited to  $2 \times I_{rated}$ .

6.3 Motor Module with external air cooling

Table 6- 31 Technical data Double Motor Modules Booksize (2 x 3 to 2 x 9 A) with 300% overload

External air cooling	6SL3121-	2TE13-0AA4	2TE15-0AA4	2TE21-0AA4
<b>Output current</b>				
Rated current (I <sub>n</sub> )	A <sub>ACrms</sub>	<b>2 x 3</b>	<b>2 x 5</b>	<b>2 x 9</b>
Base-load current (I <sub>H</sub> )	A	2 x 2.6	2 x 4.3	2 x 7.7
Intermittent duty current (I <sub>s6</sub> ) 40%	A <sub>ACrms</sub>	2 x 3.5	2 x 6	2 x 10
Peak current (I <sub>max</sub> )	A <sub>ACrms</sub>	2 x 9	2 x 15	2 x 27
<b>Output voltage</b>	V <sub>ACrms</sub>	0 -480		
<b>DC link current I<sub>d</sub></b>	A <sub>DC</sub>	7.2	12	22
<b>DC link voltage</b>	V <sub>DC</sub>	510 – 720		
<b>DC link capacitance</b>	µF	110	220	220
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %		
Undervoltage trip <sup>1)</sup>	V <sub>DC</sub>	380 ± 2 %		
<b>Electronics power supply</b>	V <sub>DC</sub>	24 (20,4 - 28,8)		
<b>Electronics current consumption at 24 V DC</b>	A <sub>DC</sub>	1,15		
<b>Current carrying capacity</b>				
DC link busbars	A <sub>DC</sub>	100		
Reinforced DC link busbars	A <sub>DC</sub>	150		
24 V DC busbars	A	20		
<b>Unit rating</b>				
Based on I <sub>n</sub> (600 V <sub>DC</sub> ; 4 kHz)	kW	2 x 1.6	2 x 2.7	2 x 4.8
Based on I <sub>H</sub>	kW	2 x 1.4	2 x 2.3	2 x 4.4
<b>Total power loss</b> (including electronics losses) <sup>2)</sup>	W	97,6	132,6	187,6
<b>Max. pulse frequency</b>				
without derating	kHz	4		
with derating	kHz	16		
<b>Max. ambient temperature</b>				
without derating	° C	40		
with derating	° C	55		
<b>Sound pressure level</b>	dBA	<60		
<b>Cooling air requirement</b>	m <sup>3</sup> /h	29,6		
<b>Max. permissible heat sink temperature</b>	° C	78	78	78
<b>Weight</b>	kg	5,8	5,8	5,7

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

2) For an overview, see the power loss tables in Section "Control cabinet installation"

**NOTICE**

**Disturbance of the 2 x 9 A Double Motor Module with 300% overload during operation on a 16 kW Line Module**

The maximum output of a 16 kW Line Module is not sufficient for the operation of a 2 x 9 A Double Motor Module with 300% overload.

- Do NOT operate the 2 x 9 A Double Motor Module with 300% overload on a 16 kW Line Module.
- Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.
- Only operate a 2 x 9 A Double Motor Module on a 16 kW Line Module when the maximum current is limited to  $2 \times I_{rated}$ .

**6.3.8.2 Characteristics for Motor Modules Booksize with 300% overload**

**Rated duty cycles Motor Modules Booksize with 300% overload**

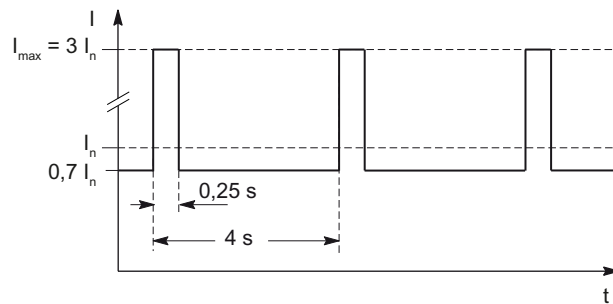


Figure 6-60 Peak current duty cycle with initial load (300% overload)

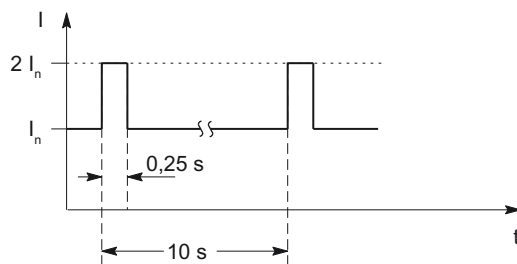


Figure 6-61 Duty cycle with initial load

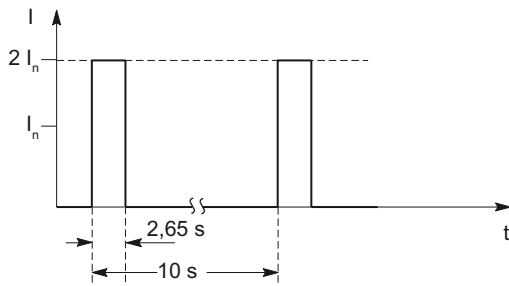


Figure 6-62 Duty cycle without initial load

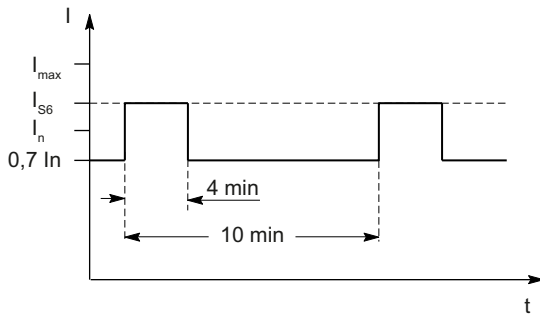


Figure 6-63 S6 duty cycle with initial load for a duty cycle duration of 600 s

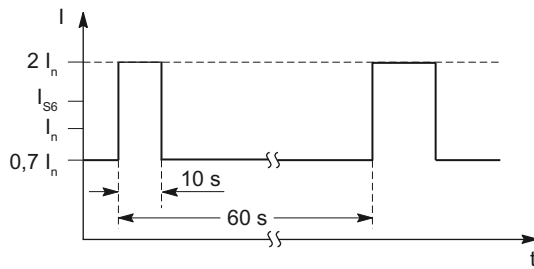


Figure 6-64 S6 duty cycle with initial load for a duty cycle duration of 60 s

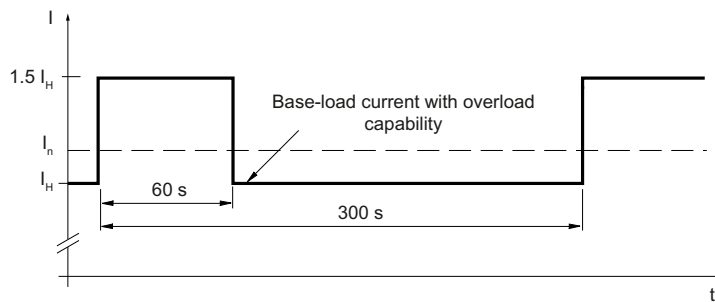


Figure 6-65 Duty cycle with 60 s overload for a duty cycle duration of 300 s

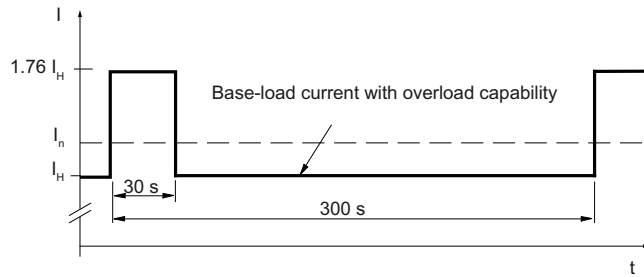


Figure 6-66 Duty cycle with 30 s overload for a duty cycle duration of 300 s

### Derating characteristics for Motor Modules Booksize with 300% overload

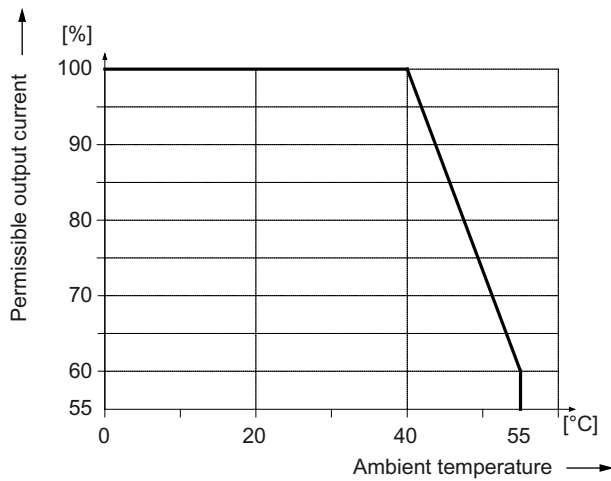


Figure 6-67 Output current as a function of the ambient temperature

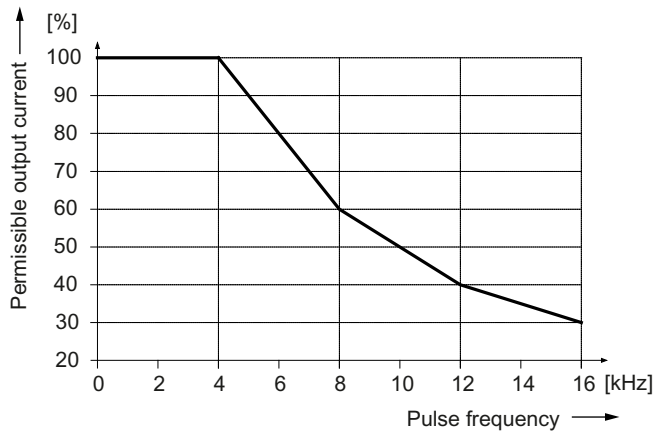


Figure 6-68 Output current as a function of the pulse frequency

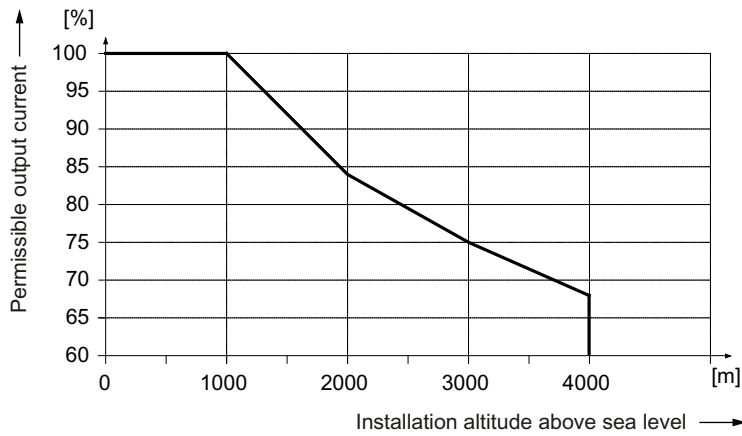


Figure 6-69 Output current as a function of the installation altitude

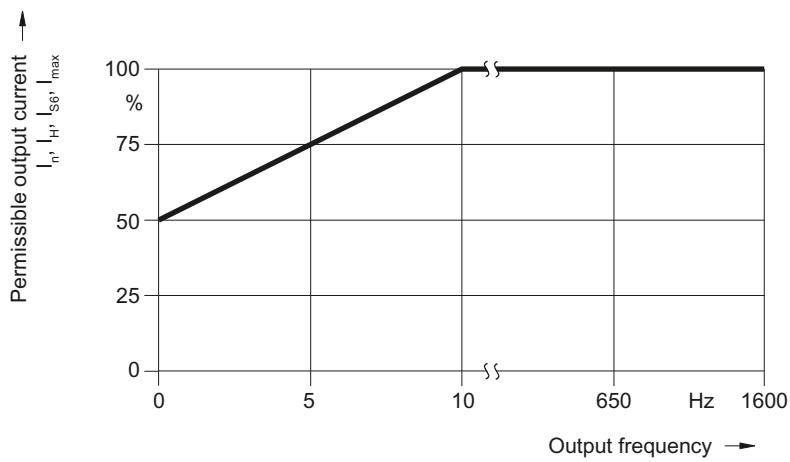


Figure 6-70 Output current as a function of the output frequency

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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



## **6.4 Motor Modules with cold plate**

### **6.4.1 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.

One motor can be connected to Single Motor Modules and two motors can be connected to Double Motor Modules.

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#### **Note**

When handling/using a Motor Module it is imperative that you observe the safety instructions in Chapter 1.

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### 6.4.2 Interface description

#### 6.4.2.1 Overview

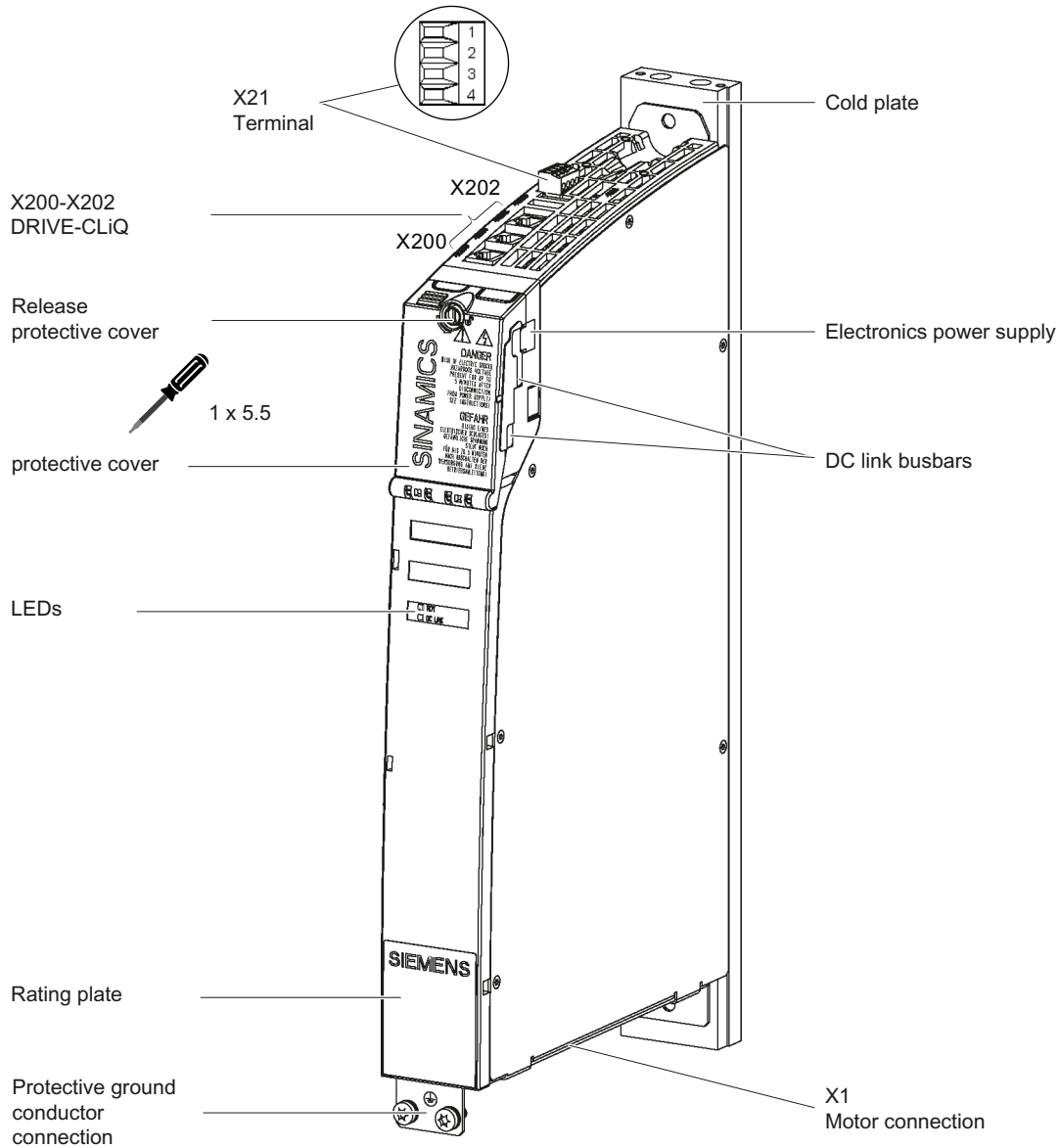


Figure 6-71 Interface overview, Single Motor Module Booksize with cold plate (example: 5 A)

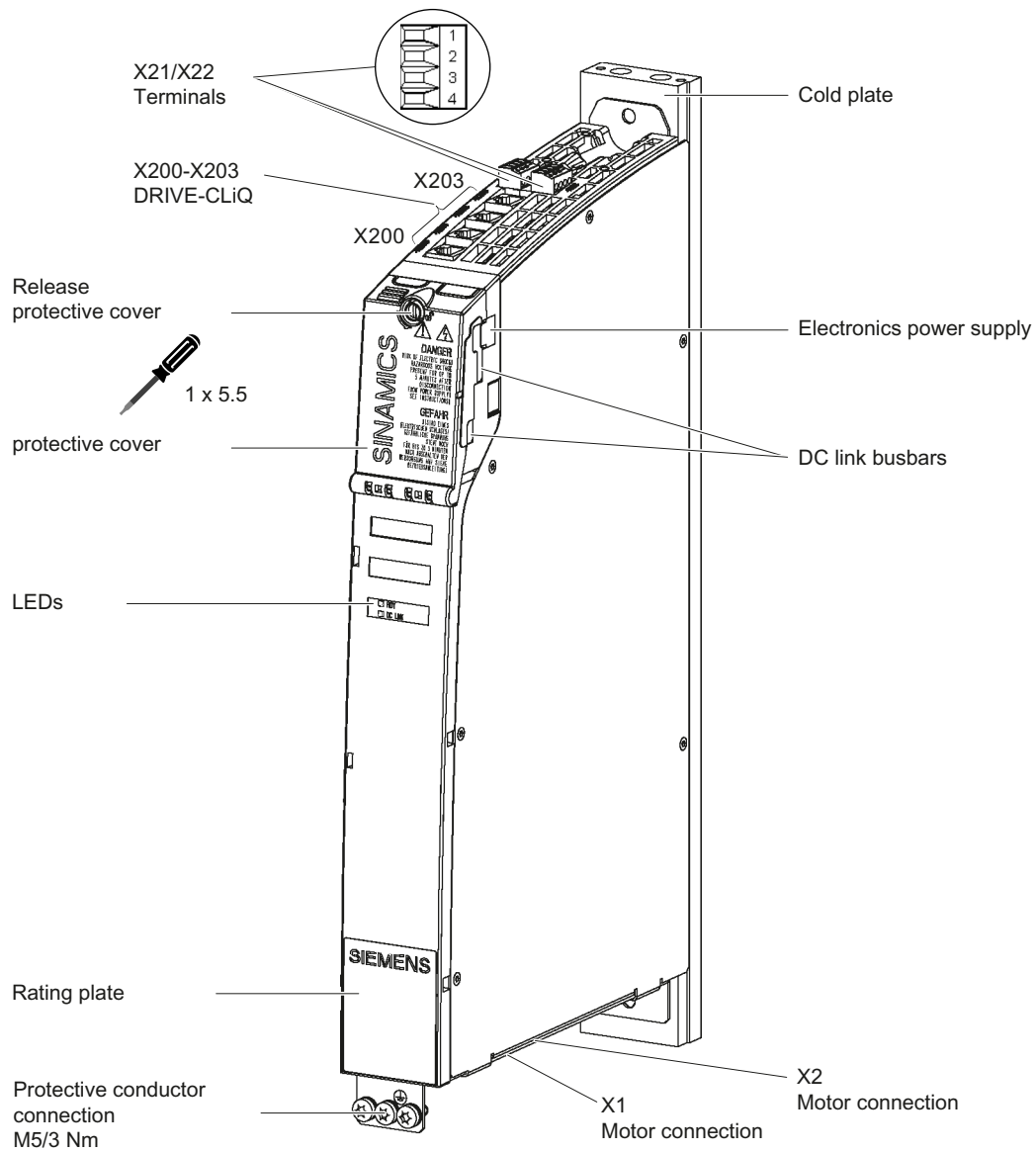
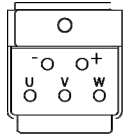
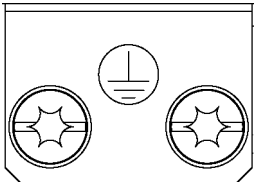
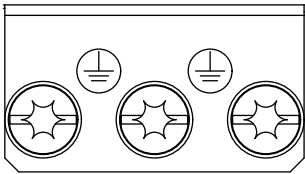


Figure 6-72 Interface overview, Double Motor Module Booksize with cold plate (example: 2 x 5 A)

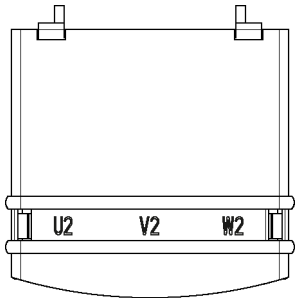
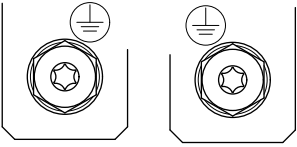
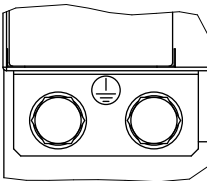
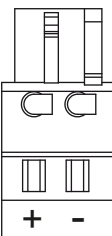
6.4.2.2 Motor and brake connection

Table 6- 32 X1/X2 motor and brake connection for Single Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

	Terminal	Technical data
	U (U2)	Motor connection
	V (V2)	
	W (W2)	
	+ (BR+)	Brake connection max. load current 2 A min. load current 0.1 A
	- (BR-)	
	PE connection	<b>Single Motor Modules 3 A to 30 A:</b> Threaded hole M5 / 3 Nm <sup>1)</sup>
		<b>Double Motor Modules 3 A to 18 A:</b> Threaded hole M5 / 3 Nm <sup>1)</sup>


1) For ring cable lugs in accordance with DIN 46234

Table 6- 33 X1 motor connection and X11 brake connection for Single Motor Modules 45 A to 200 A

	Terminal	Technical data
	U2	<b>45 A to 60 A:</b> Threaded bolts M6 / 6 Nm <sup>1)</sup>  <b>85 A:</b> Threaded bolts M8 / 13 Nm <sup>1)</sup>  <b>132 A to 200 A:</b> Threaded bolts M8 / 13 Nm <sup>1)</sup>
	V2	
	W2	
	PE connection	<b>45 A to 60 A:</b> Threaded bolts for motor cables: M6 / 6 Nm <sup>1)</sup> Threaded hole for PE: M6 / 6 Nm <sup>1)</sup>
		
	+ (BR+)	<b>X11 brake connector <sup>2)</sup>:</b> Voltage 24 V DC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm <sup>2</sup> Type: Spring-loaded terminal 2 (see Section "Control cabinet installation and EMC / connection system")  The brake connector is part of the prefabricated cable
	- (BR-)	

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.

 <b>CAUTION</b>
<b>Protective extra-low voltages according to EN 60204-1</b>  Only protective extra-low voltages (DVC A) according to EN 60204-1 must be connected to all connections and terminals between 0 and 48 V DC.  These voltages must be safely isolated from all hazardous voltages.

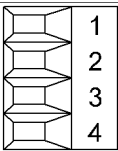
<b>NOTICE</b>
<b>Voltage tolerances of the motor holding brakes</b>
The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.

**Note**  
 The overall length of the power cables (motor supply cables and DC link cables) must not exceed the values listed in Section "Possible line reactor and line filter combinations".

**Note**  
 The motor brake must be connected via connector X11. It is not permitted to directly connect the cable BR – to the electronics ground M.

**6.4.2.3 X21/X22 EP terminals/temperature sensor**

Table 6- 34 X21/X22 EP terminals / temperature sensor

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (pulse enable)	Supply voltage: 24 V DC (20.4 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 <sup>2</sup> Type: Screw terminal 1 (see Section "Control cabinet installation / connection system")			

**EP terminals**

Parameters p9651 and p9851 are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4. Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Section "Controlling the safety functions".

**Note**  
**Function of the EP terminals**  
 The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

### Temperature sensor connection

#### NOTICE

#### Risk of the motor overheating due to an incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY sensor with the correct polarity.

#### Note

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

#### DANGER

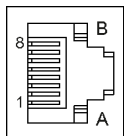
#### Danger to life through electric shock

Only temperature sensors that meet the safety isolation specifications stipulated 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 danger to life!

### 6.4.2.4 X200-X203 DRIVE-CLiQ interface

Table 6- 35 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules  
X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

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

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

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

### 6.4.3 Connection examples

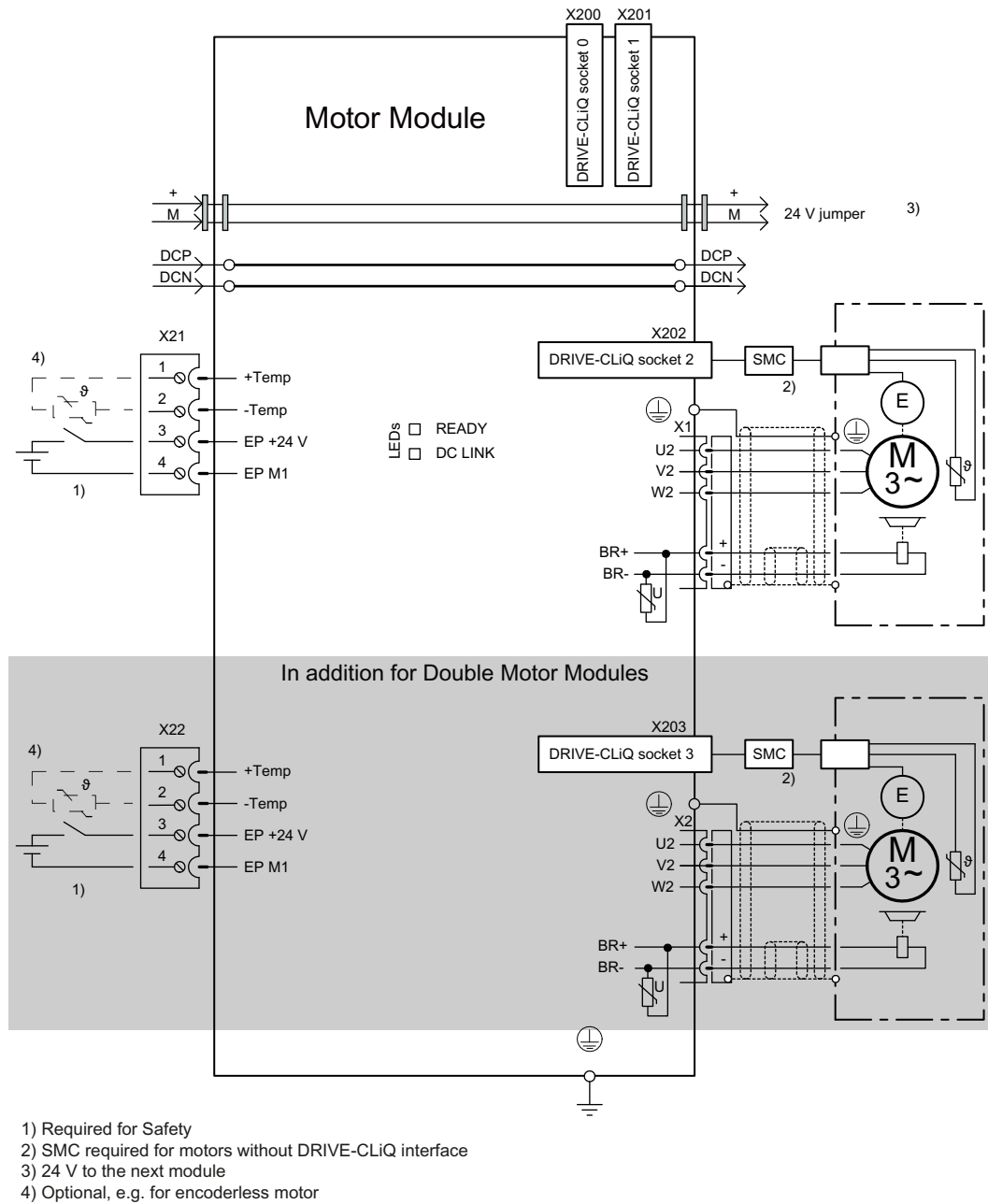
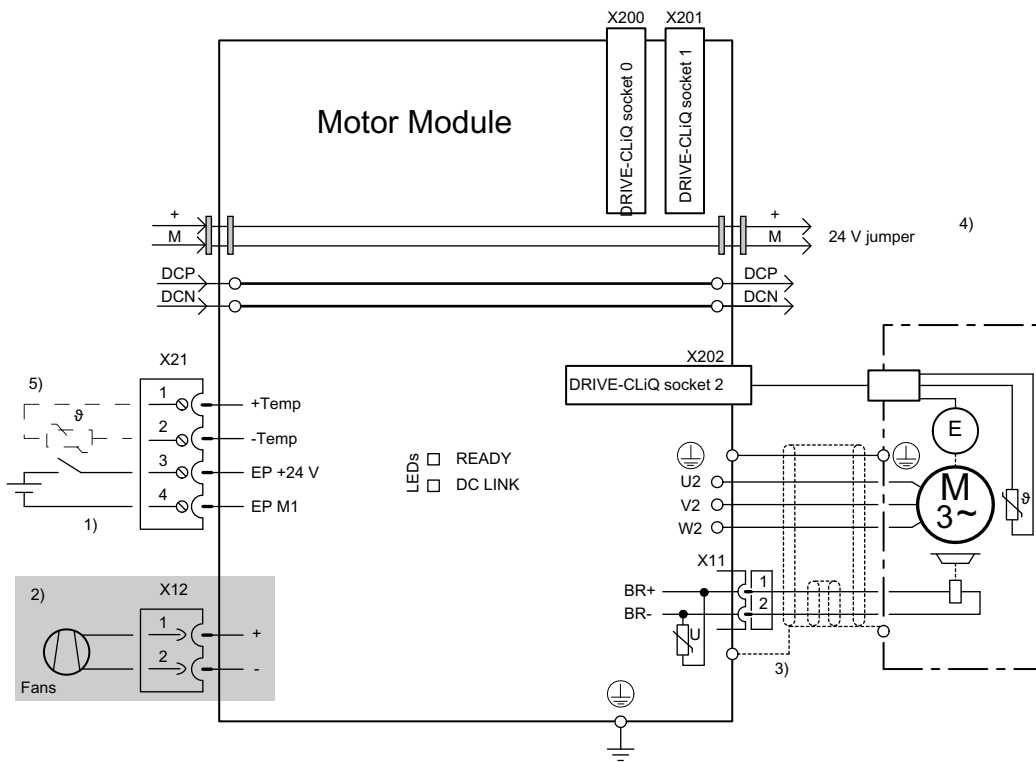


Figure 6-73 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A






- 1) Required for Safety
- 2) In addition for Motor Modules 132 A to 200 A
- 3) Contact through the shield connection plate
- 4) 24 V to the next module
- 5) Optional, e.g. for encoderless motor

Figure 6-74 Example connection of Single Motor Modules 45 A to 200 A

### 6.4.4 Meaning of LEDs

Table 6- 36 Meaning of the LEDs on the Motor Module

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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. <b>Note:</b> The LED is driven irrespective of the corresponding messages being 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	--	Detection of the components via LED is activated (p0124). <b>Note:</b> Both options depend on the LED status when module recognition is activated via p0124 = 1.	–

 <b>DANGER</b>
<p>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!</p>

### 6.4.5 Dimension drawings

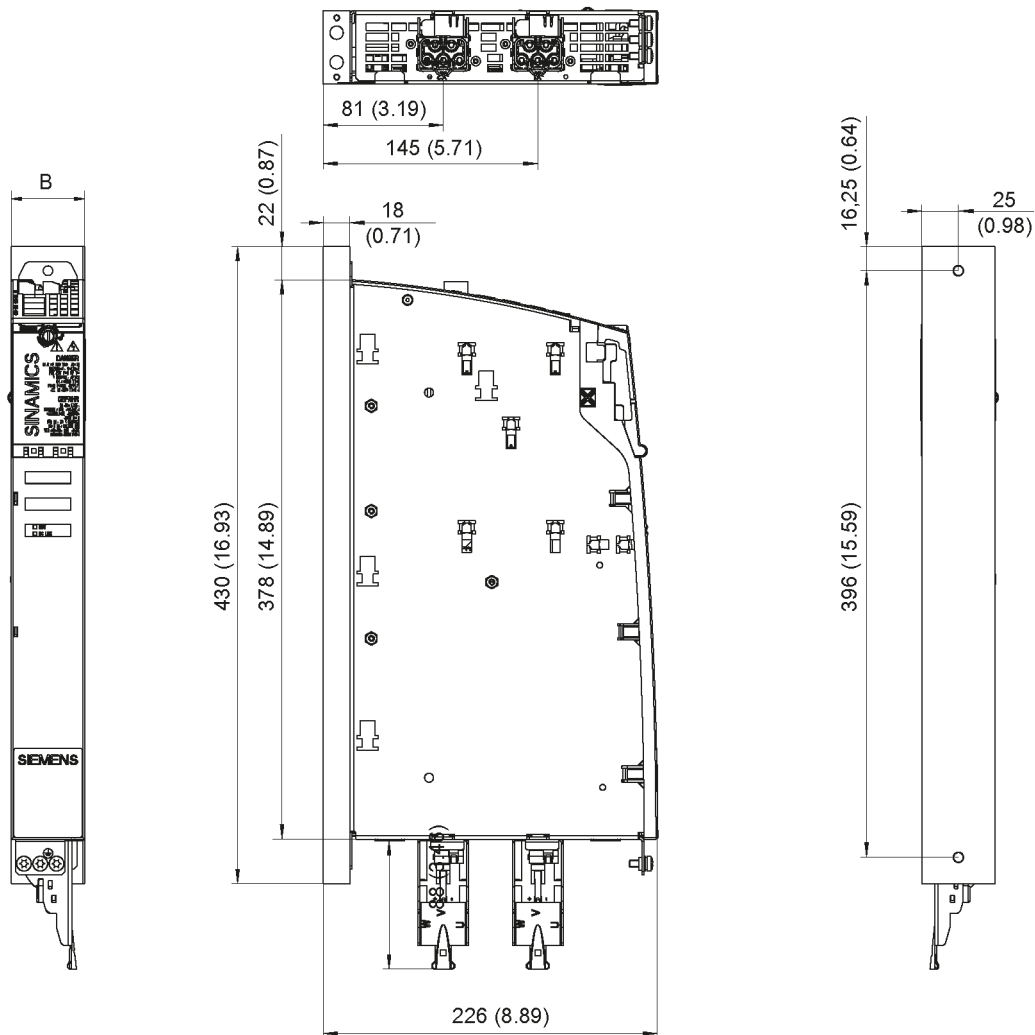


Figure 6-75 Dimension drawing of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with cold plate, all dimensions in mm and (inches); example: 2 x 5 A Double Motor Module

Table 6- 37 Dimensions of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with cold plate

Motor Module	Order number	B [mm] (inches)
3 A Single Motor Module	6SL3126-1TE13-0AAx	50 (1.97)
5 A Single Motor Module	6SL3126-1TE15-0AAx	
9 A Single Motor Module	6SL3126-1TE21-0AAx	
18 A Single Motor Module	6SL3126-1TE21-8AAx	
3 A Double Motor Module	6SL3126-2TE13-0AAx	
5 A Double Motor Module	6SL3126-2TE15-0AAx	
9 A Double Motor Module	6SL3126-2TE21-0AAx	

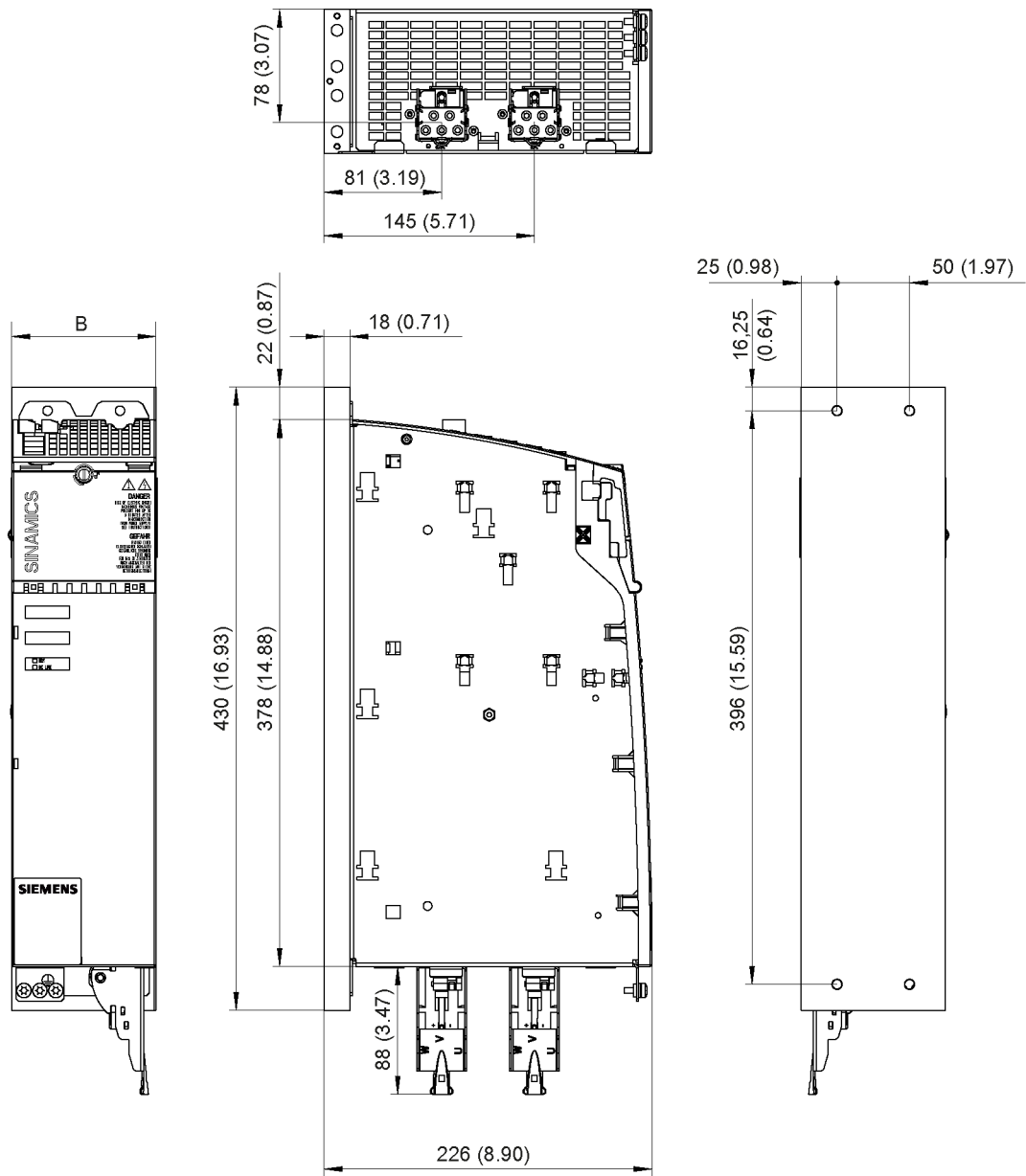


Figure 6-76 Dimension drawing of 30 A and 2 x 18 A Motor Modules Booksize with cold plate, all dimensions in mm and (inches)

Table 6- 38 Dimensions of 30 A and 2 x 18 A Motor Modules Booksize with cold plate

Motor Module	Order number	B [mm] (inches)
30 A Single Motor Module	6SL3126-1TE23-0AAx	100 (3.94)
18 A Double Motor Module	6SL3126-2TE21-8AAx	

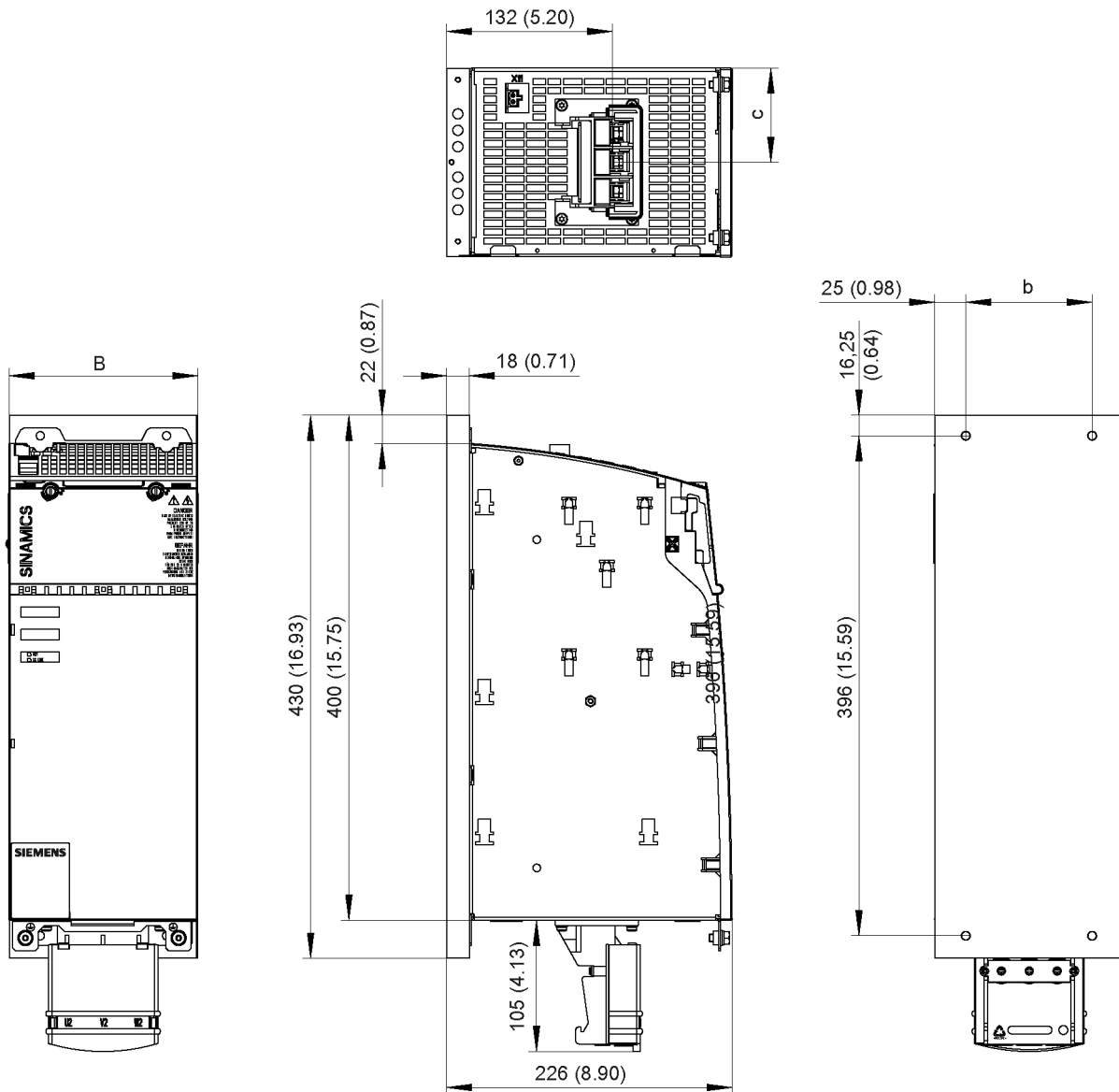


Figure 6-77 Dimension drawing of Motor Modules Booksize 45 A, 60 A, and 85 A with cold plate, all dimensions in mm and (inches); example for Motor Module 45 A

Table 6- 39 Dimensions of 45 A, 60 A, and 85 A Motor Modules Booksize with cold plate

Motor Modules	Order number	B [mm] (inches)	b [mm] (inches)	c [mm] (inches)
Single Motor Module 45 A	6SL3126-1TE24-5AAx	150 (5.91)	100 (3.94)	75 (2.95)
Single Motor Module 60 A	6SL3126-1TE26-0AAx			
Single Motor Module 85 A	6SL3126-1TE28-5AAx	200 (7.87)	150 (5.91)	100 (3.94)

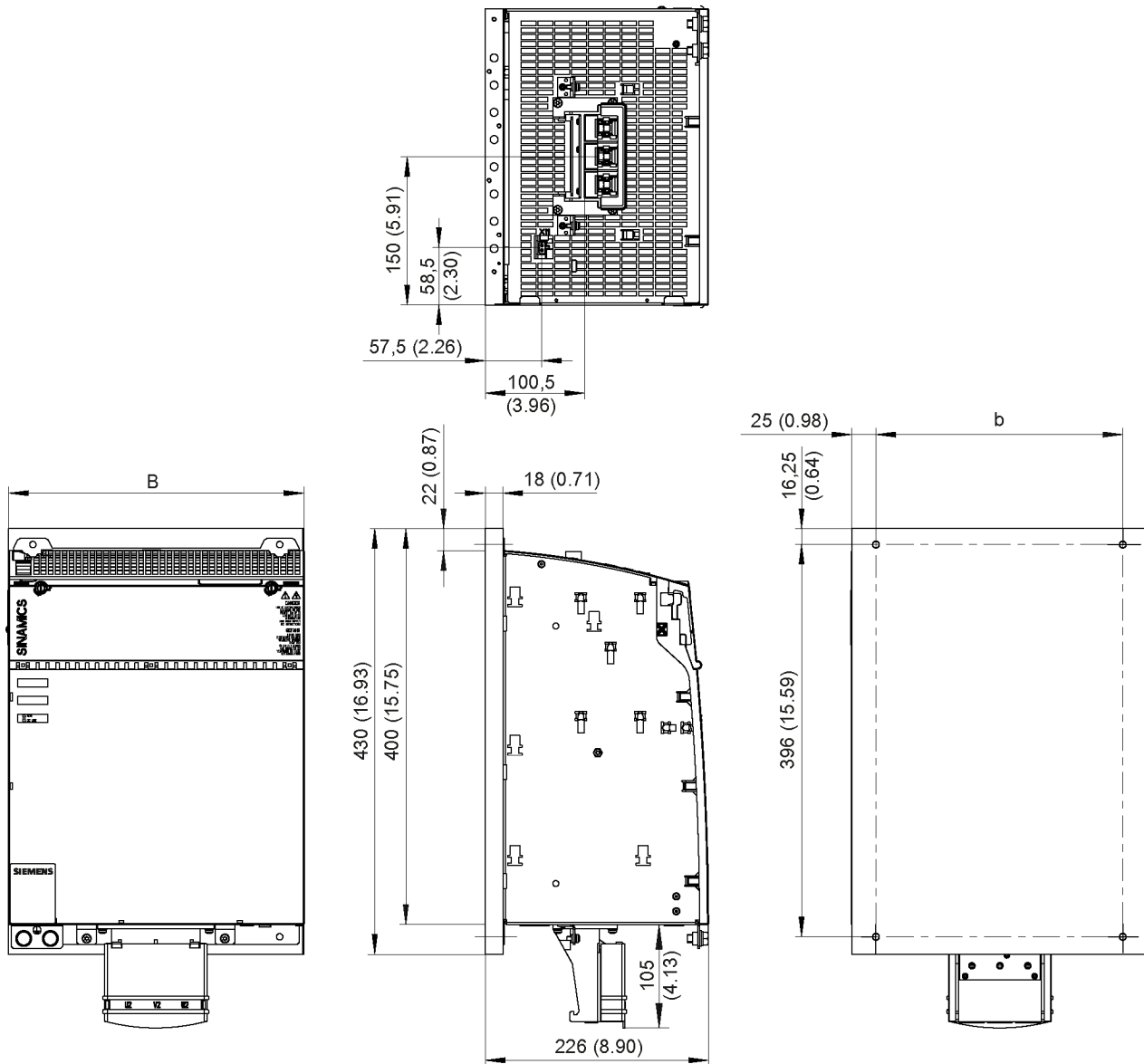


Figure 6-78 Dimension drawing of Motor Modules Booksize 132 A and 200 A with cold plate, all dimensions in mm and (inches); example for Motor Module 200 A

Table 6- 40 Dimensions of 132 A and 200 A Motor Modules Booksize with cold plate

Motor Module	Order number	B [mm] (inches)	b [mm] (inches)
Single Motor Module 132 A	6SL3126-1TE31-3AAx	300 (11.81)	250 (9.84)
Single Motor Module 200 A	6SL3126-1TE32-0AAx		

## 6.4.6 Mounting

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

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

---

### Note

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

Table 6- 41 Overview of heat-conducting foils

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

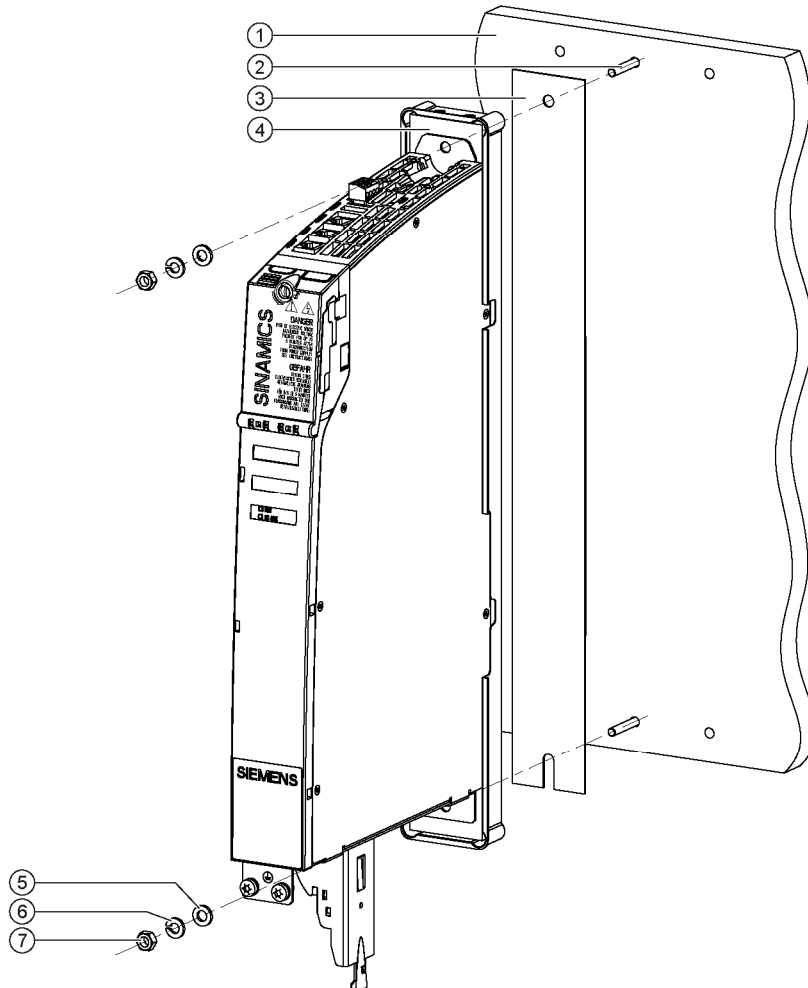
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### Note

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

---

### Mounting



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

Figure 6-79 Mounting a Motor Module with cold plate on an external heat sink (example: 3 A Motor Module)

#### Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm.



---

**Note**

- Where components have four fixing points, the nuts must be tightened evenly by alternating diagonally between them.
- 

Help with the mechanical control cabinet design is available from:

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

**Properties of the heat sink**

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

---

**Note**

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

---

<b>NOTICE</b>
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<b>Ensure that the threaded bolts do not damage the cold plate</b>
--

- |   |
|---|
| <ul style="list-style-type: none"><li>• When mounting, ensure that the threaded bolts do not damage the cold plate.</li></ul> |
|---|

6.4.7 Technical data

6.4.7.1 Single Motor Modules

Table 6- 42 Technical data Single Motor Modules Booksize (3 to 30 A)

Cold plate	6SL3126-	1TE13-0AAx <sup>1)</sup>	1TE15-0AAx <sup>1)</sup>	1TE21-0AAx <sup>1)</sup>	1TE21-8AAx <sup>1)</sup>	1TE23-0AAx
<b>Output current</b>						
Rated current (I <sub>n</sub> )	A <sub>ACrms</sub>	3	5	9	18	30
Base-load current (I <sub>H</sub> )	A	2.6	4.3	7.7	15.3	25.5
Intermittent duty current (I <sub>s6</sub> )	A <sub>ACrms</sub>	3.5	6	10	24	40
40%	A <sub>ACrms</sub>	6	10	18	36	56
Peak current (I <sub>max</sub> )						
<b>Output voltage</b>	V <sub>ACrms</sub>	0 - 0.717 x DC link voltage				
<b>DC link current I<sub>d</sub></b>	A <sub>DC</sub>	3,6	6	11	22	36
<b>DC link voltage</b> (up to 2000 m above sea level)	V <sub>DC</sub>	510 –720				
<b>DC link capacitance</b>	µF	110	110	110	220	710
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %				
Undervoltage trip <sup>2)</sup>	V <sub>DC</sub>	380				
<b>Electronics power supply</b>	V <sub>DC</sub>	24 (20,4 – 28,8)				
<b>Electronics current consumption at 24 V DC</b>	A <sub>DC</sub>	0,65				
<b>Current carrying capacity</b>						
DC link busbars	A <sub>DC</sub>	100				
Reinforced DC link busbars	A <sub>DC</sub>	150				
24 V DC busbars	A <sub>DC</sub>	20				
<b>Unit rating</b>						
Based on I <sub>n</sub> (600 V <sub>DC</sub> ; 4 kHz)	kW	1,6	2,7	4,8	9,7	16
Based on I <sub>H</sub>	kW	1,1	2,3	4,1	8,2	13,7
<b>Total power loss</b> (incl. electronics losses) <sup>3)</sup>	W	45,5	70,6	95,6	180,6	305,6
<b>Max. pulse frequency</b>						
without derating	kHz	4				
with derating	kHz	16				
<b>Max. ambient temperature</b>						
without derating	° C	40				
with derating	° C	55				
<b>Max. permissible heat sink temperature</b>	° C	80	80	80	80	70
<b>Weight</b>	kg	4,2	4,2	4,5	4,5	6,1

1) Applies only to order numbers with x = 0...3

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

3) For an overview, see the power loss tables in Section "Control cabinet installation".

Table 6- 43 Technical data Single Motor Modules (45A to 200A)

Cold plate	6SL3126-	1TE24-5AAx	1TE26-0AAx	1TE28-5AAx	1TE31-3AAx	1TE32-0AAx
<b>Output current</b>						
Rated current ( $I_n$ )	$A_{ACrms}$	<b>45</b>	<b>60</b>	<b>85</b>	<b>132</b> (105) <sup>1)</sup>	<b>200</b> (140) <sup>1)</sup>
Base-load current ( $I_H$ )	A	38	51	68	105 (84) <sup>1)</sup>	141 (99) <sup>1)</sup>
Intermittent duty current ( $I_{S6}$ )	$A_{ACrms}$	60	80	110	150 (120) <sup>1)</sup>	230 (161) <sup>1)</sup>
40%	$A_{ACrms}$	85	113	141	210	282
Peak current ( $I_{max}$ )						
<b>Output voltage</b>	$V_{ACrms}$	0 - 480				
<b>DC link current <math>I_d</math></b>	$A_{DC}$	54	72	102	158	200
<b>DC link voltage</b> (up to 2000 m above sea level)	$V_{DC}$	510 –720				
<b>DC link capacitance</b>	$\mu F$	1175	1410	1880	2820	3995
Overvoltage trip Undervoltage trip <sup>2)</sup>	$V_{DC}$ $V_{DC}$	820 $\pm$ 2 % 380				
<b>Electronics power supply</b>	$V_{DC}$	24 (20,4 – 28,8)				
<b>Electronics current consumption</b> at 24 V DC	$A_{DC}$	0,75	0,75	0,8	0,85	0,85
<b>Current carrying capacity</b>						
DC link busbars	$A_{DC}$	200				
24 V DC busbars	$A_{DC}$	20				
<b>Unit rating</b>						
Based on $I_n$ (600 V <sub>DC</sub> ; 4 kHz)	kW	24	32	46	71 (57) <sup>1)</sup>	107 (75) <sup>1)</sup>
Based on $I_H$	kW	21	28	37	57 (46) <sup>1)</sup>	76 (53) <sup>1)</sup>
<b>Total power loss</b> (incl. electronics losses) <sup>3)</sup>	W	448	608	769,2	1270,4	2070,4
<b>Max. pulse frequency</b>						
without derating	kHz	4				
with derating	kHz	16				
<b>Max. ambient temperature</b>						
without derating	° C	40				
with derating	° C	55				
<b>Max. permissible heat sink temperature</b>	° C	80	73	83	75	79 (70% derating)
<b>Weight</b>	kg	9,1	9,1	12,5	18,0	18,0

- 1) Derating must be applied due to the transfer of heat to the external heat sink. At a temperature of 40° C at the interface to the power unit, 80% derating occurs for 6SL3126-1TE31-3AAx and 70% for 6SL3126-1TE32-0AAx.
- 2) Default for 400 V line supplies; 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 an overview, see the power loss tables in Section "Control cabinet installation".

### Note

New systems with 132 A and 200 A Motor Modules should ideally be designed with 200 A liquid-cooled Motor Modules in order to avoid current derating.

6.4.7.2 Double Motor Modules

Table 6- 44 Technical data Double Motor Modules (2 x 3 to 2 x18 A)

Cold plate	6SL3126-	2TE13-0AAx <sup>1)</sup>	2TE15-0AAx <sup>1)</sup>	2TE21-0AAx <sup>1)</sup>	2TE21-8AAx
<b>Output current</b>					
Rated current (I <sub>n</sub> )	A <sub>ACrms</sub>	2 x 3	2 x 5	2 x 9	2 x 18
Base-load current (I <sub>H</sub> )	A	2 x 2.6	2 x 4.3	2 x 7.7	2 x 15.3
Intermittent duty current (I <sub>SB</sub> ) 40 %	A <sub>ACrms</sub>	2 x 3.5	2 x 6	2 x 10	2 x 24
Peak current (I <sub>max</sub> )	A <sub>ACrms</sub>	2 x 6	2 x 10	2 x 18	2 x 36
<b>Output voltage</b>	V <sub>ACrms</sub>	0 - 480			
<b>DC link current I<sub>d</sub></b>	A <sub>DC</sub>	7.2	12	22	43
<b>DC link voltage</b>	V <sub>DC</sub>	510 - 720			
<b>DC link capacitance</b>	μF	110	220	220	705
Overvoltage trip	V <sub>DC</sub>	820 ± 2%			
Undervoltage trip <sup>2)</sup>	V <sub>DC</sub>	380			
<b>Electronics power supply</b>	V <sub>DC</sub>	24 (20,4 - 28,8)			
<b>Electronics current consumption at 24 V DC</b>	A <sub>DC</sub>	0,9	0,9	0,9	1,05
<b>Current carrying capacity</b>					
DC link busbars	A <sub>DC</sub>	100	100	100	100
Reinforced DC link busbars	A <sub>DC</sub>	150	150	150	150
24 V DC busbars	A <sub>DC</sub>	20	20	20	20
<b>Unit rating</b>					
Based on I <sub>n</sub> (600 V <sub>DC</sub> ; 4 kHz)	kW	2 x 1.6	2 x 2.7	2 x 4.8	2 x 9.7
Based on I <sub>H</sub>	kW	2 x 1.4	2 x 2.3	2 x 4.1	2 x 8.2
<b>Total power loss</b> (incl. electronics losses) <sup>3)</sup>	W	91,6	126,6	181,6	345,2
<b>Max. pulse frequency</b>					
without derating	kHz	4			
with derating	kHz	16			
<b>Max. ambient temperature</b>					
without derating	° C	40			
with derating	° C	55			
<b>Max. permissible heat sink temperature</b>	° C	80	80	90	90
<b>Weight</b>	kg	4,5	4,5	4,5	5,9

1) Applies only to order numbers with x = 0...3

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

3) For an overview, see the power loss tables in Section "Control cabinet installation"

### 6.4.7.3 Characteristics

#### Rated duty cycles Motor Modules Booksize

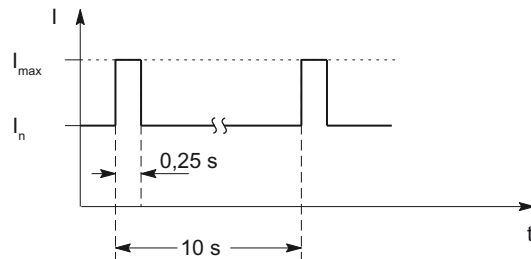


Figure 6-80 Duty cycle with initial load (for servo drives)

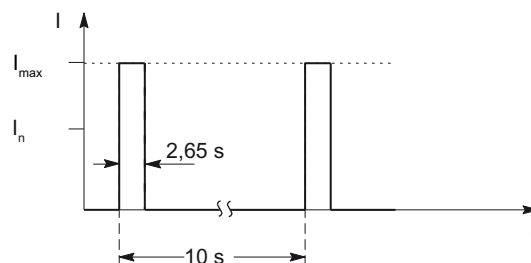


Figure 6-81 Duty cycle without initial load (for servo drives)

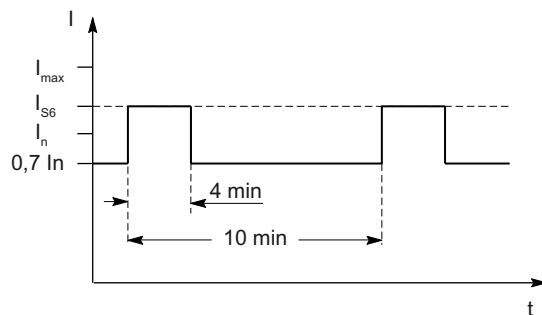


Figure 6-82 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

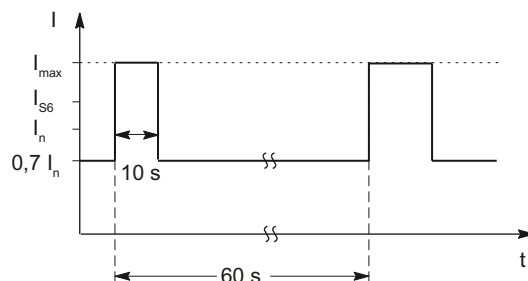


Figure 6-83 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

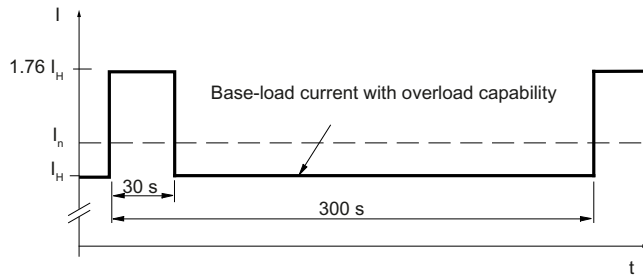


Figure 6-84 Duty cycle with 30 s overload with a duty cycle duration of 300 s

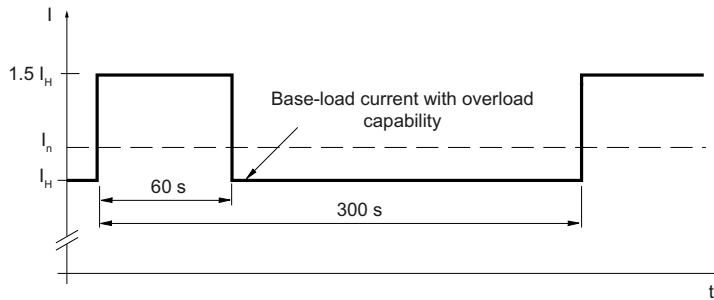


Figure 6-85 Duty cycle with 60 s overload with a duty cycle duration of 300 s

**Derating characteristics for Motor Modules Booksize**

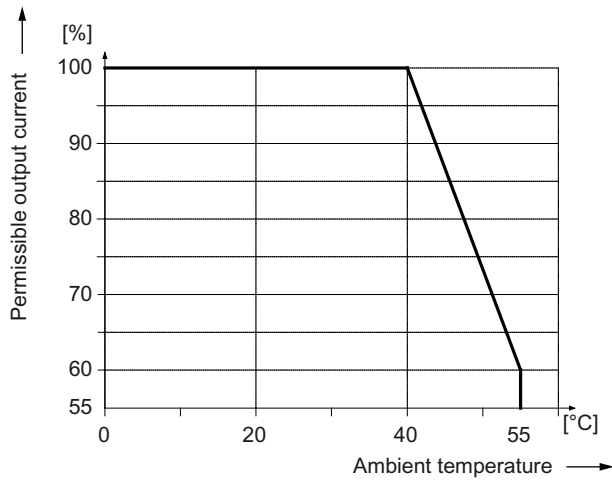


Figure 6-86 Output current as a function of the ambient temperature

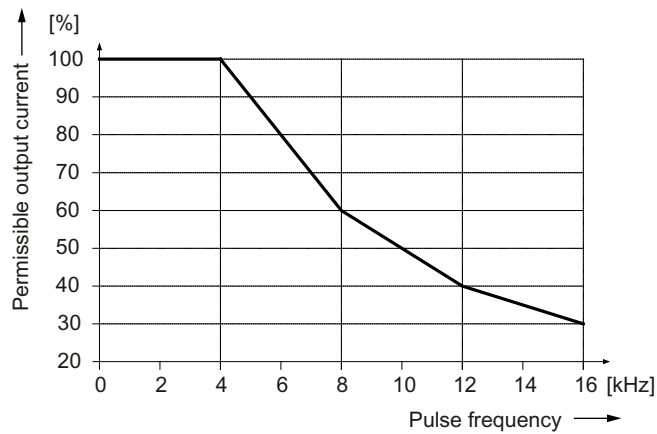


Figure 6-87 Output current as a function of the pulse frequency

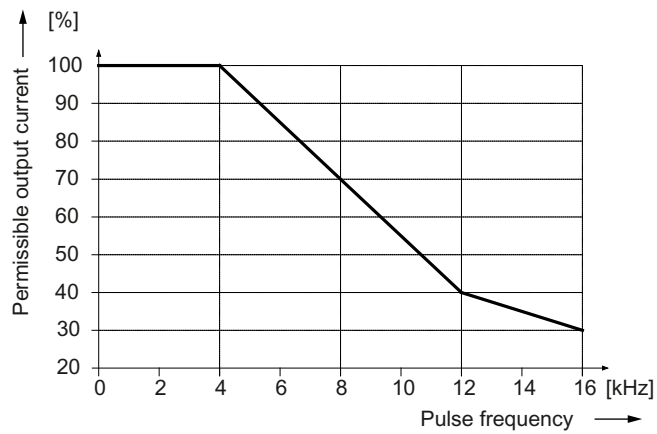


Figure 6-88 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

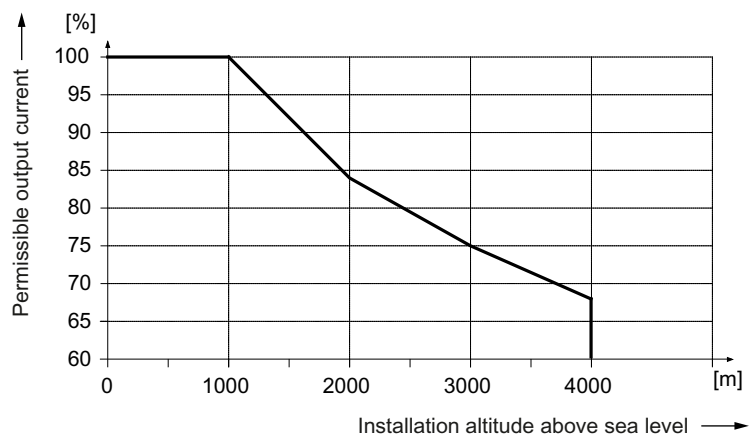


Figure 6-89 Output current as a function of the installation altitude

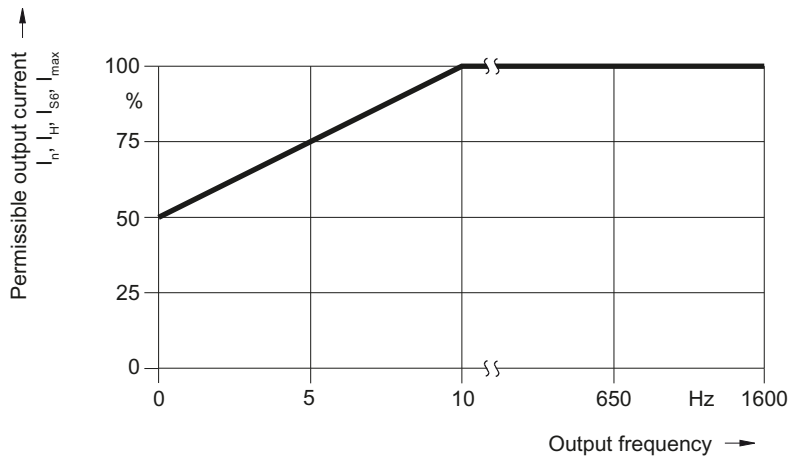


Figure 6-90 Output current as a function of the output frequency

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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



## 6.4.8 Technical data for Motor Modules Booksize with 300% overload

### 6.4.8.1 Single Motor Modules (300% overload)

Table 6- 45 Technical data Single Motor Modules (3 to 18 A) with 300% overload

Cold plate	6SL3126-	1TE13-0AA4	1TE15-0AA4	1TE21-0AA4	1TE21-8AA4
<b>Output current</b>					
Rated current ( $I_N$ )	$A_{ACrms}$	<b>3</b>	<b>5</b>	<b>9</b>	<b>18</b>
Base-load current ( $I_H$ )	A	2.6	4.3	7.7	15.3
Intermittent duty current ( $I_{S6}$ ) 40%	$A_{ACrms}$	3.5	6	10	24
Peak current ( $I_{max}$ )	$A_{ACrms}$	9	15	27	54
<b>Output voltage</b>	$V_{ACrms}$	0 - 0.717 x DC link voltage			
<b>DC link current <math>I_d</math></b>	$A_{DC}$	3,6	6	11	22
<b>DC link voltage</b> (up to 2000 m above sea level)	$V_{DC}$	510 –720			
<b>DC link capacitance</b>	$\mu F$	110	110	110	220
Overvoltage trip	$V_{DC}$	820 $\pm$ 2 %			
Undervoltage trip <sup>1)</sup>	$V_{DC}$	380			
<b>Electronics power supply</b>	$V_{DC}$	24 (20,4 – 28,8)			
<b>Electronics current consumption at 24 V DC</b>	$A_{DC}$	0,65			
<b>Current carrying capacity</b>					
DC link busbars	$A_{DC}$	100			
Reinforced DC link busbars	$A_{DC}$	150			
24 V DC busbars	$A_{DC}$	20			
<b>Unit rating</b>					
Based on $I_N$ (600 $V_{DC}$ ; 4 kHz)	kW	1,6	2,7	4,8	9,7
Based on $I_H$	kW	1,1	2,3	4,1	8,2
<b>Total power loss</b> (incl. electronics losses) <sup>2)</sup>	W	45,5	70,6	95,6	180,6
<b>Max. pulse frequency</b>					
without derating	kHz	4			
with derating	kHz	16			
<b>Max. ambient temperature</b>					
without derating	$^{\circ} C$	40			
with derating	$^{\circ} C$	55			
<b>Max. permissible heat sink temperature</b>	$^{\circ} C$	70	70	70	70
<b>Weight</b>	kg	4,2	4,2	4,5	4,5

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

2) For an overview, see the power loss tables in Section "Control cabinet installation"

**NOTICE**

**Disturbance of the 18 A Single Motor Module with 300% overload during operation on a 16 kW Line Module**

The maximum output of a 16 kW Line Module is not sufficient for the operation of an 18 A Single Motor Module with 300% overload.

- Do NOT operate the 18 A Single Motor Module with 300% overload on a 16 kW Line Module.
- Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.
- Only operate an 18 A Single Motor Module on a 16 kW Line Module when the maximum current is limited to  $2 \times I_{\text{rated}}$ .

### 6.4.8.2 Double Motor Modules (300% overload)

Table 6- 46 Technical data Double Motor Modules (2 x 3 to 2 x 9 A) with 300% overload

Cold plate	6SL3126-	2TE13-0AA4	2TE15-0AA4	2TE21-0AA4
<b>Output current</b>				
Rated current ( $I_n$ )	$A_{ACrms}$	2 x 3	2 x 5	2 x 9
Base-load current ( $I_H$ )	A	2 x 2.6	2 x 4.3	2 x 7.7
Intermittent duty current ( $I_{S6}$ ) 40 %	$A_{ACrms}$	2 x 3.5	2 x 6	2 x 10
Peak current ( $I_{max}$ )	$A_{ACrms}$	2 x 9	2 x 15	2 x 27
<b>Output voltage</b>	$V_{ACrms}$	0 - 480		
<b>DC link current <math>I_d</math></b>	$A_{DC}$	7.2	12	22
<b>DC link voltage</b> (up to 2000 m above sea level)	$V_{DC}$	510 –720		
<b>DC link capacitance</b>	$\mu F$	110	220	220
Overvoltage trip	$V_{DC}$	820 $\pm$ 2%		
Undervoltage trip <sup>1)</sup>	$V_{DC}$	380		
<b>Electronics power supply</b>	$V_{DC}$	24 (20,4 – 28,8)		
<b>Electronics current consumption</b> at 24 V DC	$A_{DC}$	0,9	0,9	0,9
<b>Current carrying capacity</b>				
DC link busbar	$A_{DC}$	100	100	100
Reinforced DC link busbars	$A_{DC}$	150	150	150
24 V busbar	$A_{DC}$	20	20	20
<b>Unit rating</b>				
Based on $I_n$ (600 $V_{DC}$ ; 4 kHz)	kW	2 x 1.6	2 x 2.7	2 x 4.8
Based on $I_H$	kW	2 x 1.4	2 x 2.3	2 x 4.1
<b>Total power loss</b> (incl. electronics losses) <sup>2)</sup>	W	91,6	126,6	181,6
<b>Max. pulse frequency</b>				
without derating	kHz	4		
with derating	kHz	16		
<b>Max. ambient temperature</b>				
without derating	$^{\circ} C$	40		
with derating	$^{\circ} C$	55		
<b>Max. permissible heat sink temperature</b>	$^{\circ} C$	77	77	77
<b>Weight</b>	kg	4,5	4,5	4,5

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

2) For an overview, see the power loss tables in Section "Control cabinet installation"

**NOTICE**

**Disturbance of the 2 x 9 A Double Motor Module with 300% overload during operation on a 16 kW Line Module**

The maximum output of a 16 kW Line Module is not sufficient for the operation of a 2 x 9 A Double Motor Module with 300% overload.

- Do NOT operate the 2 x 9 A Double Motor Module with 300% overload on a 16 kW Line Module.
- Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.
- Only operate a 2 x 9 A Double Motor Module on a 16 kW Line Module when the maximum current is limited to  $2 \times I_{rated}$ .

6.4.8.3 Characteristics for Motor Modules Booksize with 300% overload

Rated duty cycles Motor Modules Booksize with 300% overload

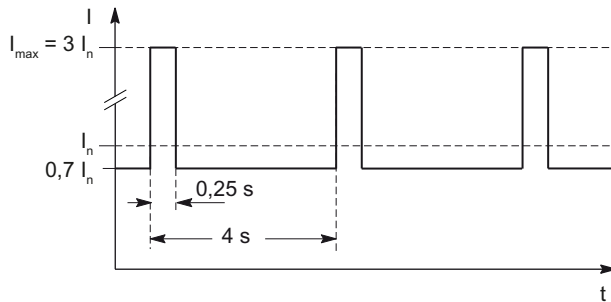


Figure 6-91 Peak current duty cycle with initial load (300% overload)

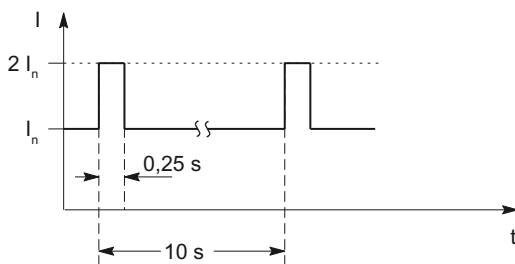


Figure 6-92 Duty cycle with initial load

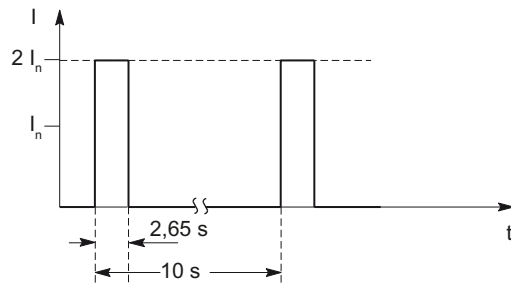


Figure 6-93 Duty cycle without initial load

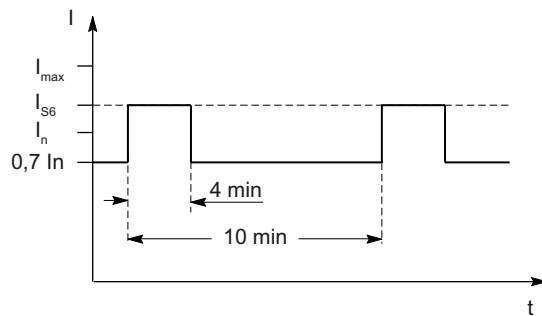


Figure 6-94 S6 duty cycle with initial load for a duty cycle duration of 600 s

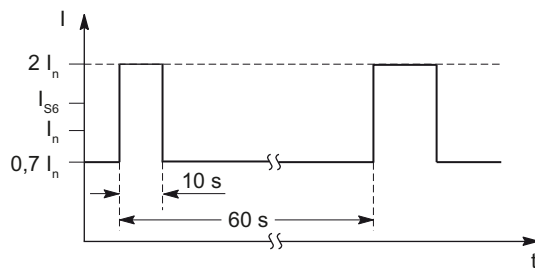


Figure 6-95 S6 duty cycle with initial load for a duty cycle duration of 60 s

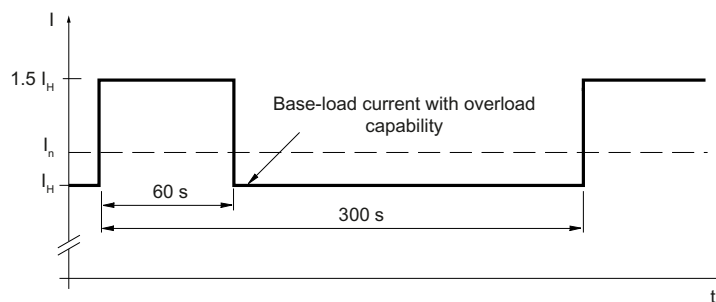


Figure 6-96 Duty cycle with 60 s overload for a duty cycle duration of 300 s

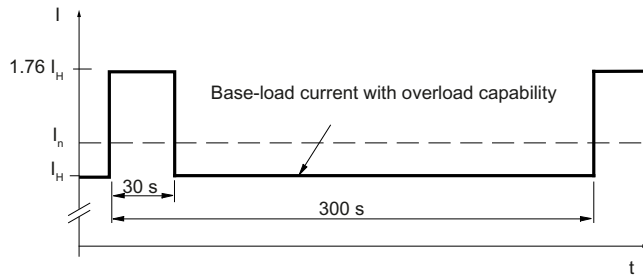


Figure 6-97 Duty cycle with 30 s overload for a duty cycle duration of 300 s

**Derating characteristics for Motor Modules Booksize with 300% overload**

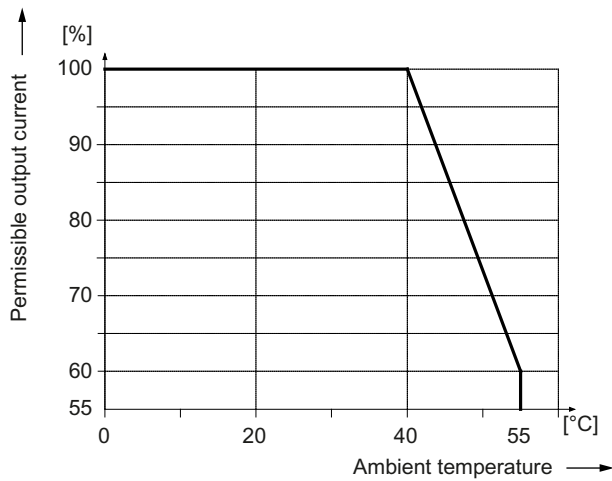


Figure 6-98 Output current as a function of the ambient temperature

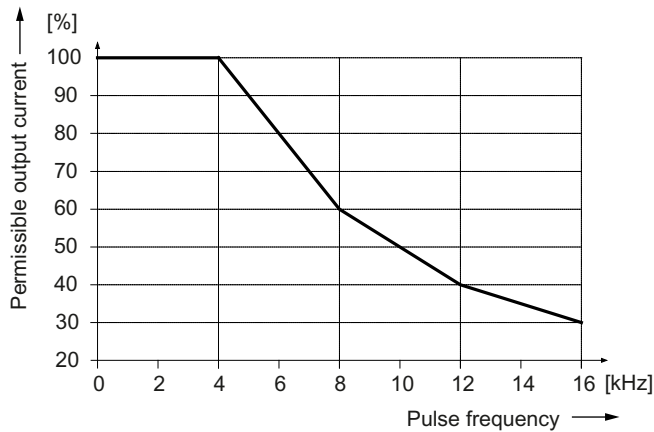


Figure 6-99 Output current as a function of the pulse frequency

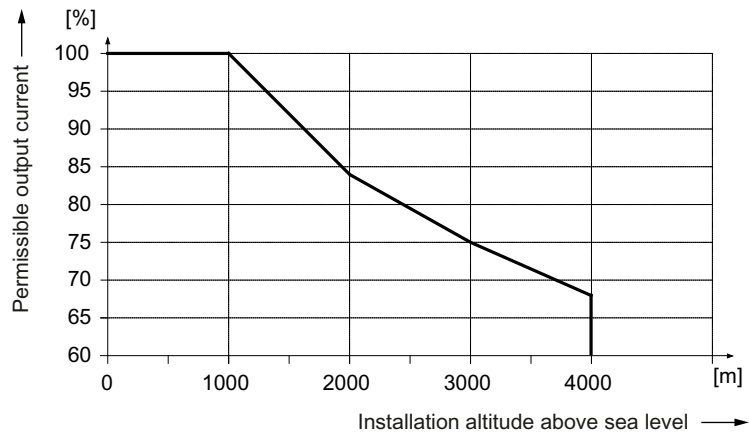


Figure 6-100 Output current as a function of the installation altitude

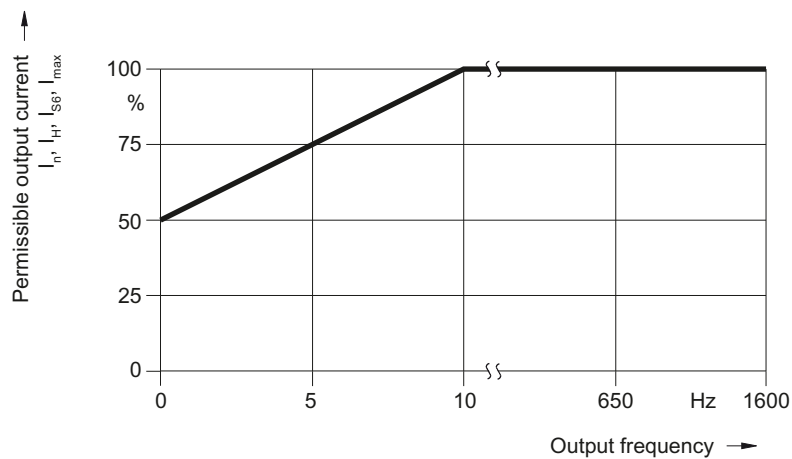


Figure 6-101 Output current as a function of the output frequency

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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

## 6.5 Motor Modules Liquid Cooled

### 6.5.1 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.

---

#### Note

When handling/using a Motor Module it is imperative that you observe the safety instructions in Chapter 1.

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## 6.5.2 Interface description

### 6.5.2.1 Overview

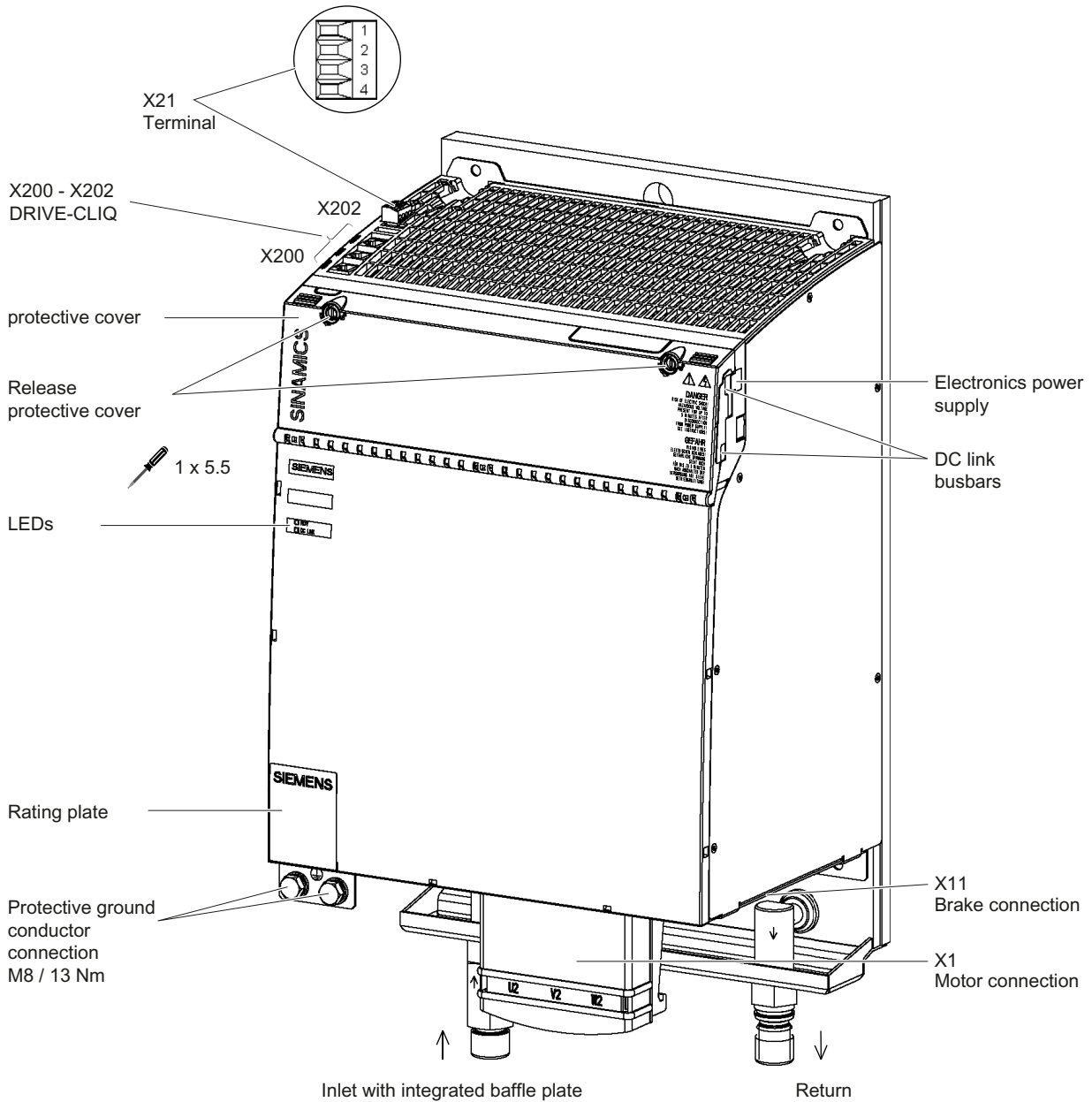
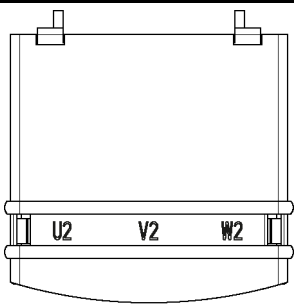
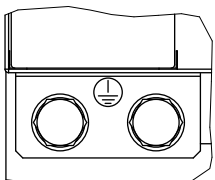


Figure 6-102 Interface overview, Motor Module Liquid Cooled (200 A)

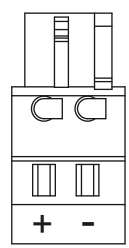
6.5.2.2 Motor and brake connection

Table 6- 47 X1 Motor connection


	Terminal	Technical data
	U2	Threaded bolts M8 / 13 Nm <sup>1)</sup> (see Section "Control cabinet installation and EMC / connection system")
	V2	
	W2	
	- (BR-)	
	PE connection	Threaded hole M8 / 13 Nm <sup>1)</sup>

1) For ring cable lugs in accordance with DIN 46234

Table 6- 48 X11 brake connector

	Terminal	Technical data
	+ (BR+)	Voltage 24 V DC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm <sup>2</sup> Type: Spring-loaded terminal 2 (see Section "Control cabinet installation and EMC / connection system") The brake connector is part of the prefabricated cable
	- (BR-)	

The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.

 <b>CAUTION</b>
<b>Protective extra-low voltages according to EN 60204-1</b> Only protective extra-low voltages (DVC A) according to EN 60204-1 must be connected to all connections and terminals between 0 and 48 V DC. These voltages must be safely isolated from all hazardous voltages.

<b>NOTICE</b>
<b>Voltage tolerances of the motor holding brakes</b>
The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.

**Note**

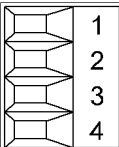
The motor brake must be connected via connector X11. It is not permitted to directly connect the cable BR – to the electronics ground M.

**Note**

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

### 6.5.2.3 X21 EP terminal/temperature sensor

Table 6- 49 X21 EP terminal / temperature sensor

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (pulse enable)	Supply voltage: 24 V DC (20.4 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 <sup>2</sup> Type: Screw terminal 1 (see Section "Control cabinet installation / connection system")			

**EP terminals**

The filter times to debounce terminals X21.3 and X21.4 are set using parameter p9651. Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Section "Controlling the safety functions".

**Note**

**Function of the EP terminals**


The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

Temperature sensor connection

<b>NOTICE</b>
<b>Risk of the motor overheating due to an incorrectly connected KTY temperature sensor</b>
A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.
<ul style="list-style-type: none"> <li>Always connect the KTY sensor with the correct polarity.</li> </ul>

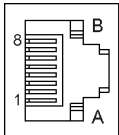
**Note**

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).

 <b>DANGER</b>
<b>Danger to life through electric shock</b>
Only temperature sensors that meet the safety isolation specifications stipulated 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 danger to life!

6.5.2.4 X200-X202 DRIVE-CLiQ interface

Table 6- 50 X200-X202: DRIVE-CLiQ interfaces

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

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

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

### 6.5.3 Connection example

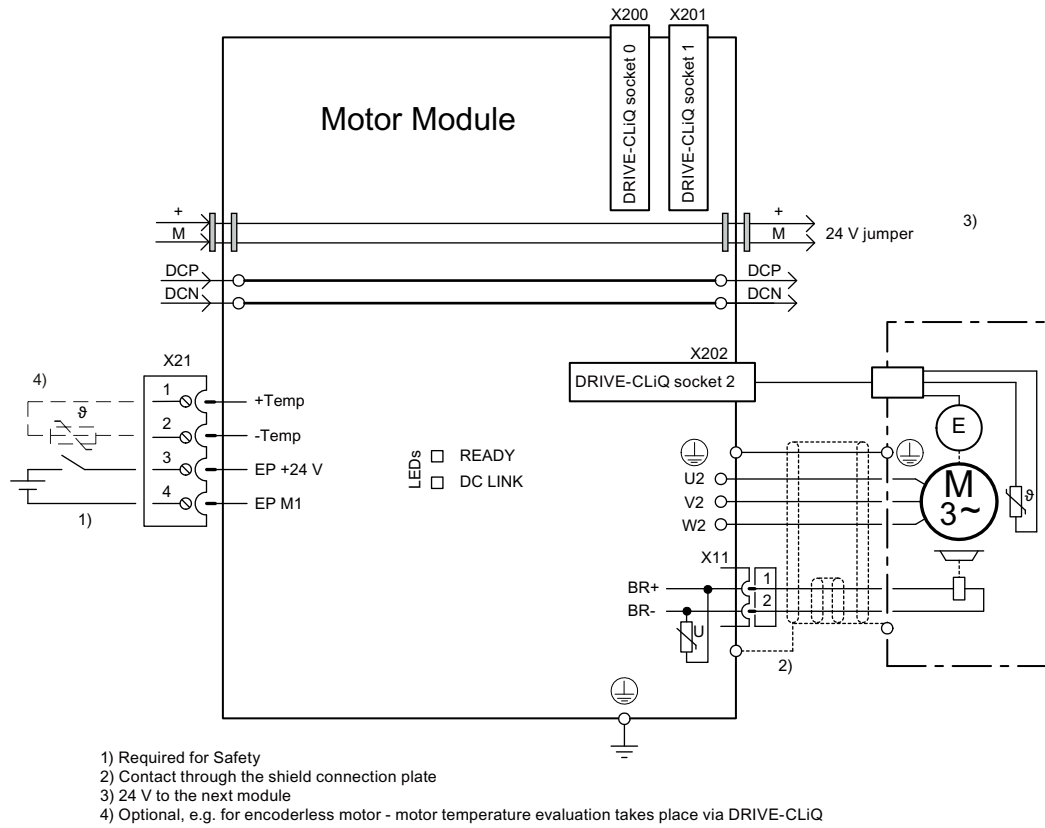



Figure 6-103 Connection example for Motor Module Liquid Cooled (200 A)

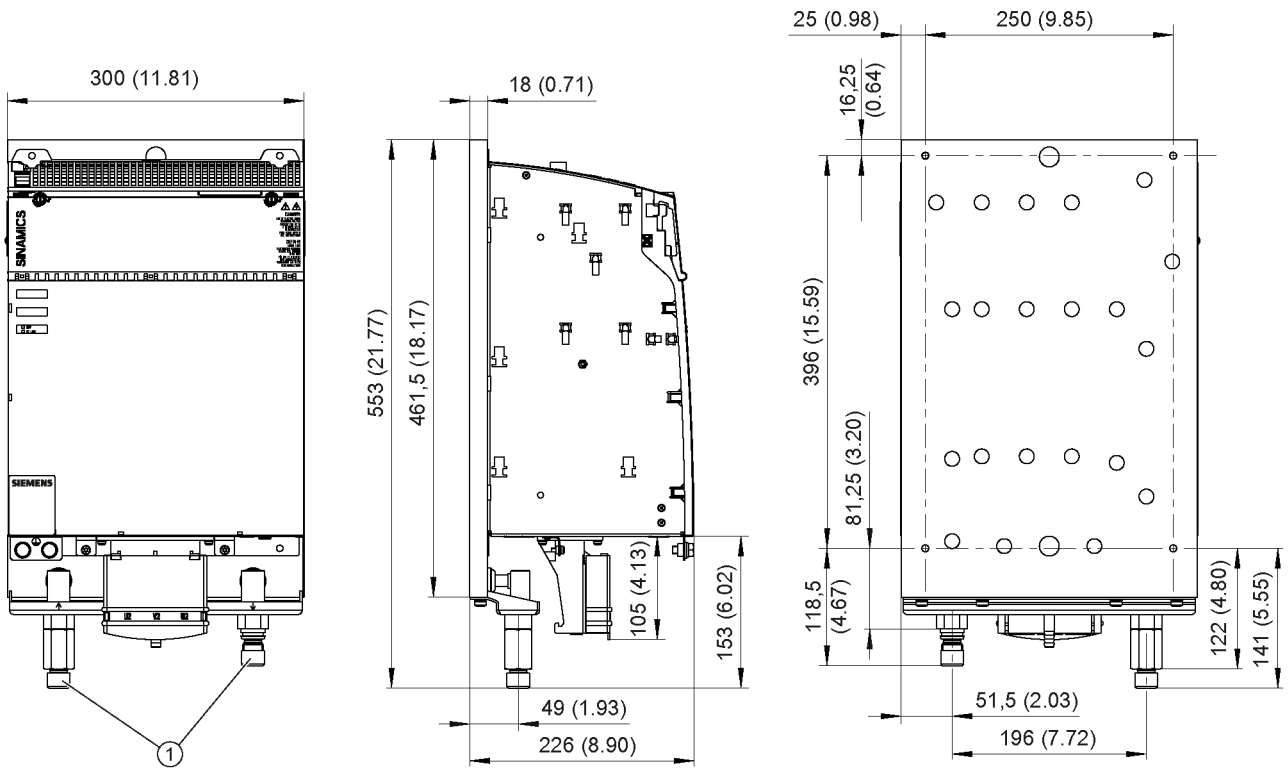
### 6.5.4 Meaning of LEDs

Table 6- 51 Meaning of LEDs

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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. <b>Note:</b> The LED is driven irrespective of the corresponding messages being 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	--	Detection of the components via LED is activated (p0124). <b>Note:</b> Both options depend on the LED status when module recognition is activated via p0124 = 1.	–

 <b>DANGER</b>
<p>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!</p>

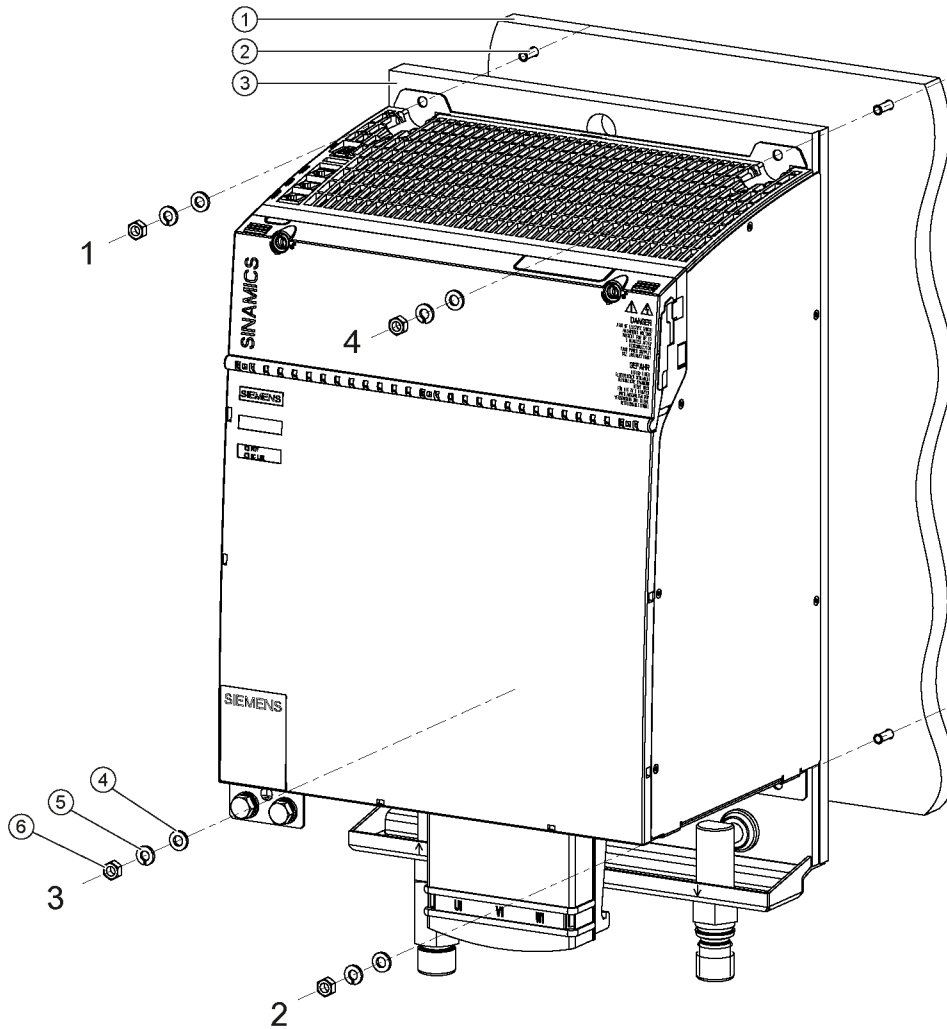
6.5.5 Dimension drawing



① Pipe thread ISO 228 G ½ B.

Figure 6-104 Dimension drawing of Motor Module Liquid Cooled (200 A), all dimensions in mm and (inches)

### 6.5.6 Installation



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

Figure 6-105 Installing a Motor Module Liquid Cooled

#### Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm (in the specific sequence 1 to 4)



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

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

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

6.5.7 Technical data

Table 6- 52 Technical data for Motor Module Liquid Cooled 200 A

Liquid Cooled		6SL3125-1TE32-0AAx
<b>Output current</b>		
Rated current (I <sub>n</sub> )	A <sub>ACrms</sub>	200
Base-load current (I <sub>H</sub> )	A	141
Intermittent duty current (I <sub>s6</sub> ) 40%	A <sub>ACrms(I<sub>s6</sub>)</sub>	230
Peak current (I <sub>max</sub> )	A <sub>ACrms(I<sub>max</sub>)</sub>	282
<b>Output voltage</b>	V <sub>ACrms</sub>	0 - 480
<b>DC link current I<sub>d</sub></b>	A <sub>DC</sub>	200
<b>DC link voltage</b> (up to 2000 m above sea level)	V <sub>DC</sub>	510 –720
<b>DC link capacitance</b>	μF	3995
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %
Undervoltage trip <sup>1)</sup>	V <sub>DC</sub>	380 ± 2 %
<b>Electronics power supply</b>	V <sub>DC</sub>	24 (20,4 – 28,8)
<b>Electronics current consumption</b> at 24 V DC	A <sub>DC</sub>	0.85
<b>Current carrying capacity</b>		
DC link busbars	A <sub>DC</sub>	200
24 V DC busbars	A <sub>DC</sub>	20
<b>Unit rating</b>		
Based on I <sub>n</sub> (600 V <sub>DC</sub> ; 4 kHz)	kW	107
Based on I <sub>H</sub>	kW	76
<b>Total power loss</b> (including electronics losses) <sup>2)</sup>	W	2070,4
<b>Max. pulse frequency</b>		
without derating	kHz	4
with derating	kHz	16
<b>Max. ambient temperature</b>		
without derating	° C	40
with derating	° C	55
<b>Max. coolant temperature</b>		
without derating	° C	45
with derating	° C	50
<b>Max. permissible heat sink temperature</b>	° C	79 (70% derating)
<b>Rated volumetric flow</b>		
for water at 70 kPa pressure drop <sup>3)</sup>	l/min	8
<b>Volume of liquid</b> internal	ml	100
<b>Weight</b>	kg	21

1) Default for 400 V line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.

2) For an overview, see the power loss tables in Section "Control cabinet installation".

3) This value applies to the water coolant option; for other coolant types, see Section "Cooling circuit and coolant properties".

### 6.5.7.1 Characteristics

#### Motor Modules Booksize Liquid Cooled

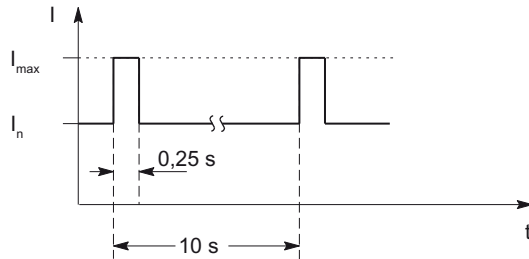


Figure 6-106 Duty cycle with initial load (for servo drives)

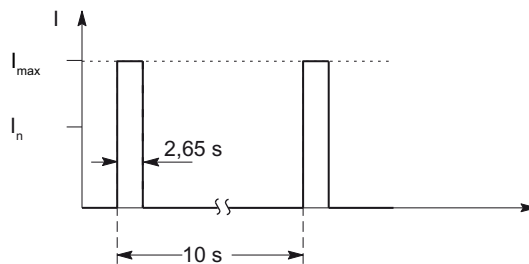


Figure 6-107 Duty cycle without initial load (for servo drives)

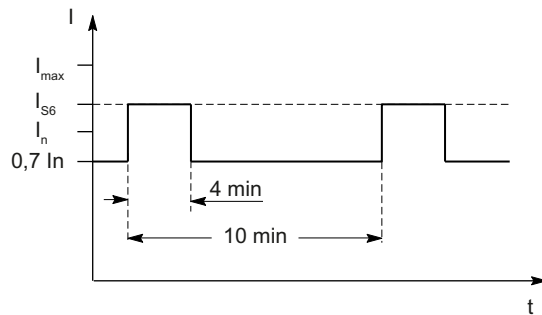


Figure 6-108 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

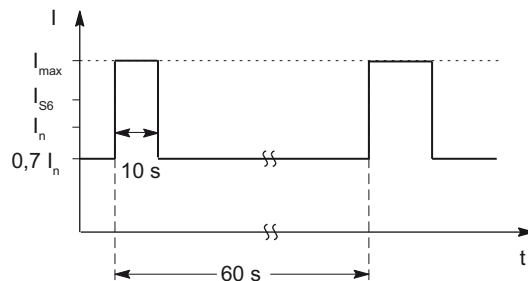


Figure 6-109 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

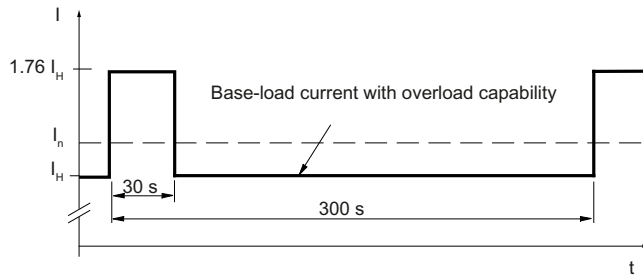


Figure 6-110 Duty cycle with 30 s overload with a duty cycle duration of 300 s

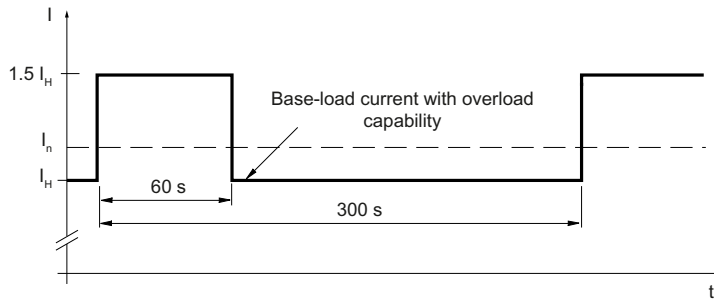


Figure 6-111 Duty cycle with 60 s overload with a duty cycle duration of 300 s

**Derating characteristics for Motor Modules Booksize Liquid Cooled**

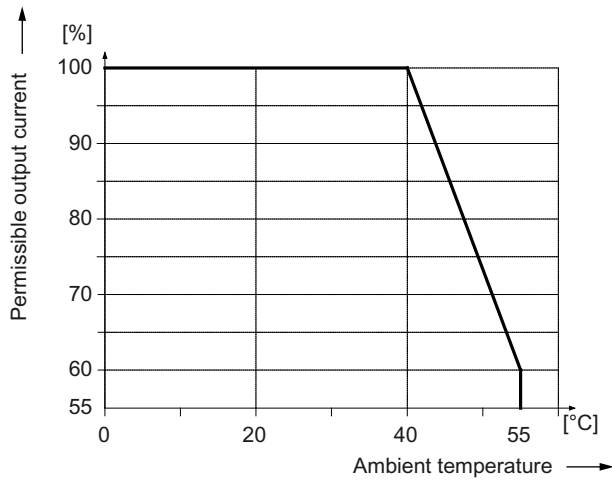


Figure 6-112 Output current as a function of the ambient temperature

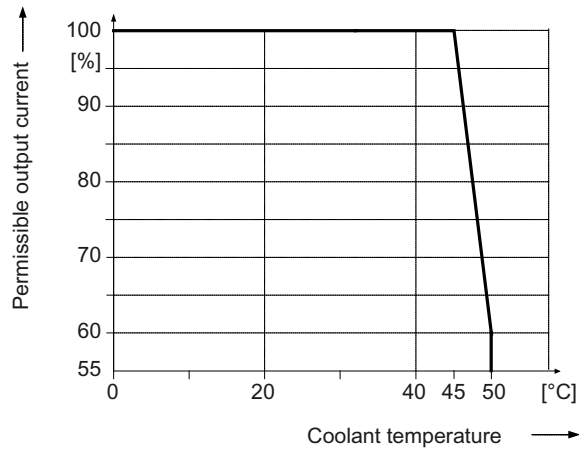


Figure 6-113 Output current as a function of the coolant temperature

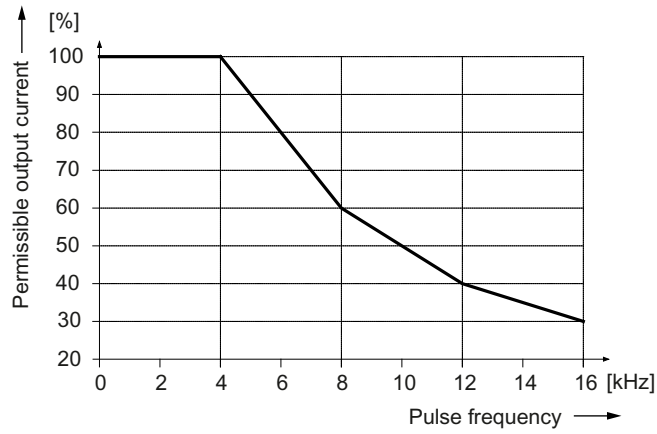


Figure 6-114 Output current as a function of the pulse frequency

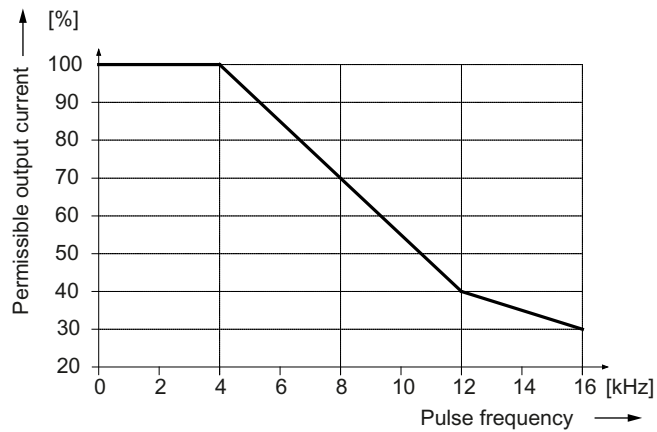


Figure 6-115 Output current as a function of the pulse frequency  
(applies from order number 6SL312x-1TE32-0AA4)

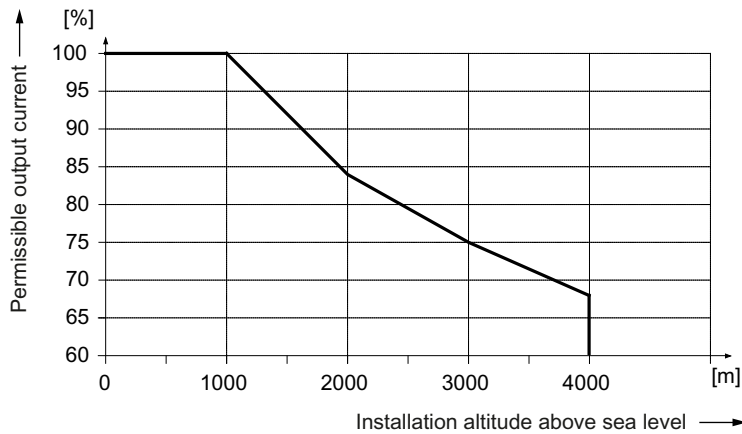


Figure 6-116 Output current as a function of the installation altitude

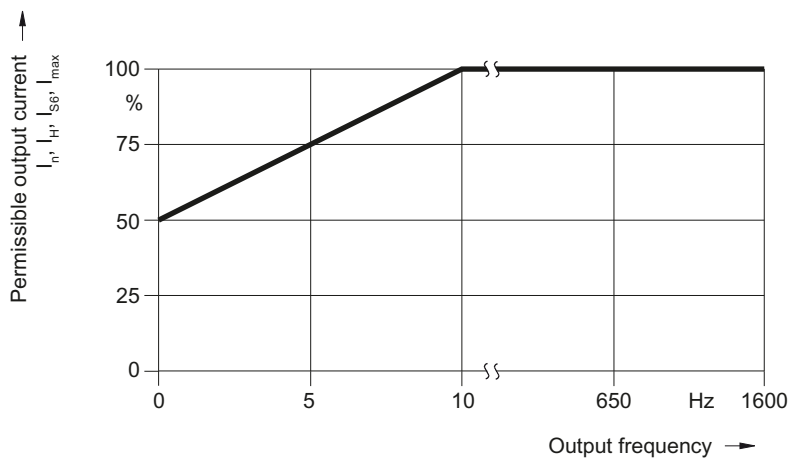


Figure 6-117 Current derating as a function of the output frequency

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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

## Motor Modules Booksize Compact

### 7.1 Safety instructions for Motor Modules Booksize Compact

#### Note

When using a Motor Module Booksize Compact, also observe the safety instructions in Section 1.



#### DANGER

##### **Danger to life through electric shock due to the residual charge of the DC link capacitors**

Because of the DC link capacitors, a hazardous voltage is present for up to five minutes after the power supply has been switched off.

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

- Do not open the protective cover of the DC link until five minutes have elapsed.
- Measure the voltage before starting work on the DCP and DCN DC link terminals.



#### DANGER

##### **Danger to life through electric shock when the protective cover of the DC link is open**

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

- Only operate the components with closed protective cover.



#### WARNING

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

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

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



#### WARNING

##### **Danger to life through electric shock due to incorrectly installed DC link bridges**

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

- For all 50 mm wide modules (exception: Smart Line Module), remove the DC link bridge, including the screws. Do not tighten the screws without the DC link bridges.
- For all components that are 75 mm wide or wider, the DC link bridges must not be moved to the left or removed.



**! WARNING**

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

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

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

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



**! WARNING**

**Danger to life through interruption of the external protective conductor due to high leakage currents**

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

- Ensure that the external protective conductor satisfies at least one of the following conditions:
  - It has been laid so that it is protected against mechanical damage. <sup>1)</sup>
  - If it is a single cable, it has a cross-section of at least 10 mm<sup>2</sup> Cu.
  - If it is a conductor of a multi-conductor cable, it has a cross-section of at least 2.5 mm<sup>2</sup> Cu.
  - It has a second protective conductor in parallel with the same cross-section.
  - It complies with the local regulations for equipment with increased leakage current.

<sup>1)</sup> Cables laid within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.



**! WARNING**

**Danger to life through electric shock due to incorrectly laid brake cables**

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

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

**! WARNING**

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

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

- Attach the component warning labels in the national language.



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

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

- Maintain the 80 mm clearances above and below the Motor Modules.

**NOTICE****Material damage due to loose power connections**

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

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

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

As part of routine tests, SINAMICS S components undergo a voltage test according to EN 61800-5-1. Connected devices can be damaged.

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

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

With unshielded or incorrectly laid cables, it can be expected that interference will be coupled into the signal processing electronics from the power side. This can result in significant disturbances (fault messages) up to failure of individual components (destruction of the devices).

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

---

**Note**

**Operating motors with a built-in holding brake**

A regulated DC power supply is required to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars.

- Take note of the motor holding brake voltage tolerances ( $24\text{ V} \pm 10\%$ ) and the connecting cable voltage drop.
  - Set the DC power supply to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:
    - Use of Siemens three-phase motors
    - Use of Siemens MOTION-CONNECT power cables
    - Motor cable lengths, max. 100 m
- 

**NOTICE**

**Damage through use of incorrect DRIVE-CLiQ cables**

Damage or malfunctions can occur on the devices or system when incorrect or unreleased DRIVE-CLiQ cables are used.

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

**Note**

**Malfunctions due to polluted DRIVE-CLiQ interfaces**

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

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

## 7.2 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".

## 7.3 Interface description

### 7.3.1 Overview

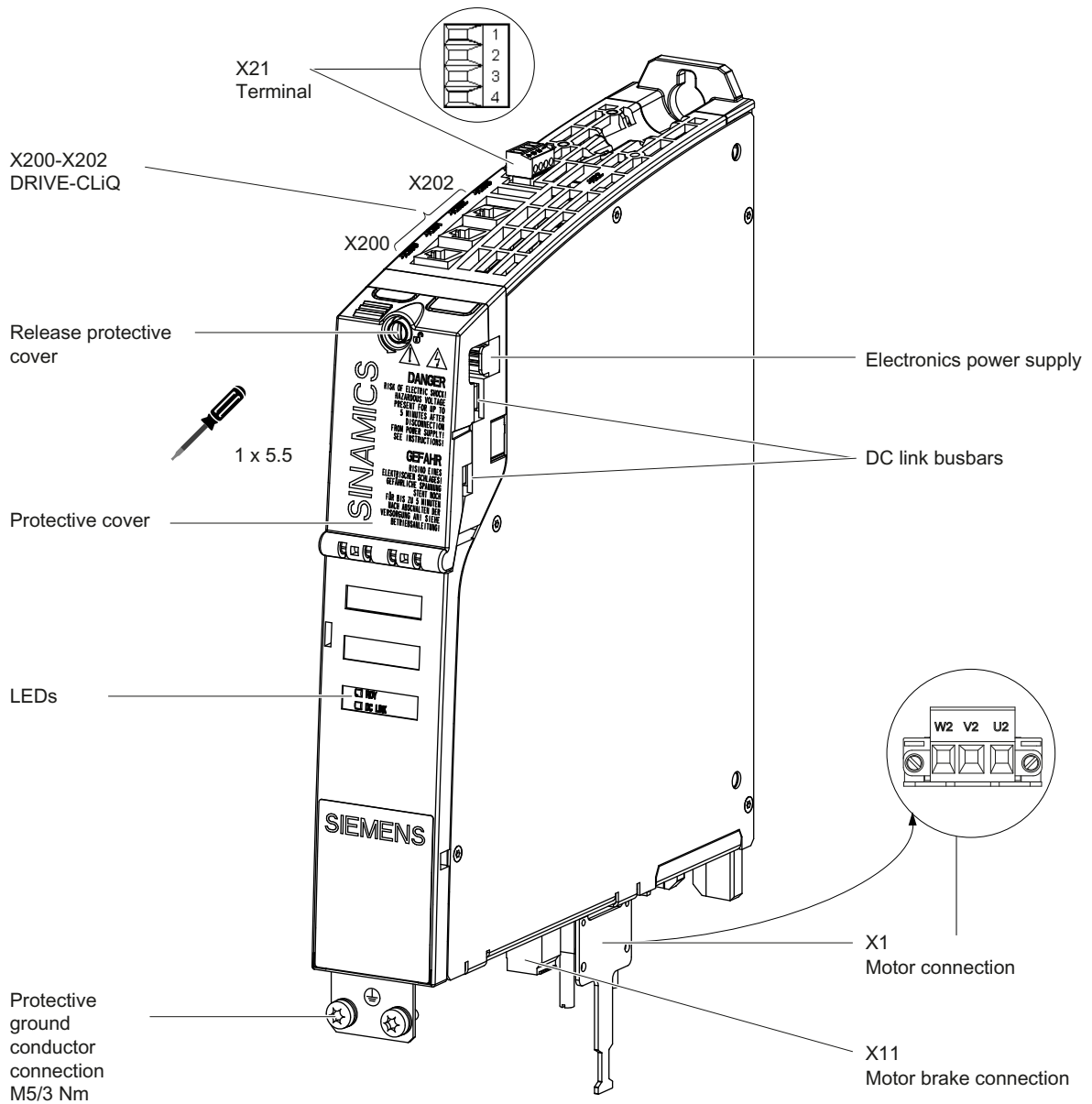


Figure 7-1 Interface overview, Single Motor Module Booksize Compact (example: 5 A)

7.3 Interface description

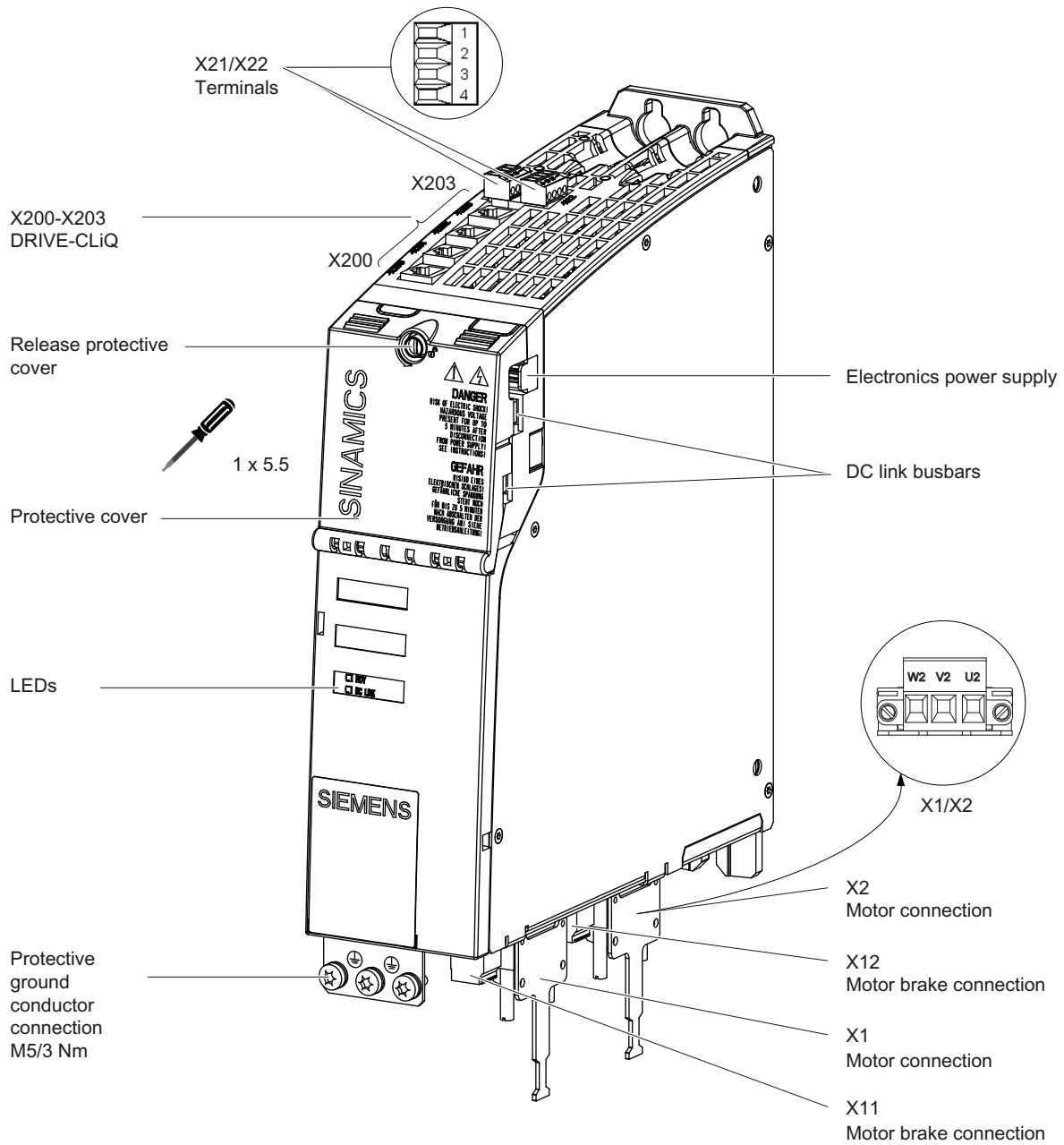
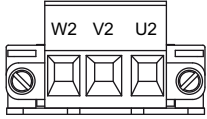
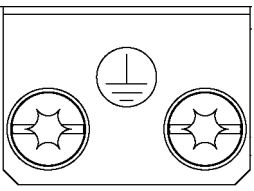
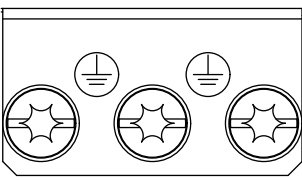


Figure 7-2 Interface overview, Double Motor Module Booksize Compact (example: 2 x 5 A)

### 7.3.2 X1/X2 motor connection

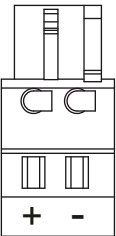
Table 7- 1 X1/X2 motor connection

	Terminal	Technical specifications
	U2	Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 (see Chapter "Control cabinet installation and EMC / connection system") Tightening torque: 1.2 - 1.5 Nm
	V2	
	W2	
	PE connection	<b>Single Motor Modules 3 A to 18 A</b> Threaded hole M5/3 Nm <sup>1</sup>
		<b>Double Motor Modules 1.7 A to 5 A</b> Threaded hole M5/3 Nm <sup>1</sup>

1) For ring cable lugs in accordance with DIN 46234

### 7.3.3 X11/X12 motor brake connection

Table 7- 2 X11/X12 motor brake connection

	Terminals	Technical specifications
	+ (BR+)	Brake connector <sup>1)</sup> : Voltage 24 V DC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm <sup>2</sup> Type: Spring-loaded terminal 2 (see the chapter titled "Control cabinet installation and EMC/Connection system") Manufacturer: Wago; order number: 721-102/026-000/56-000 The brake connector is part of the scope of delivery
	- (BR-)	

1) The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.


7.3 Interface description

**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".

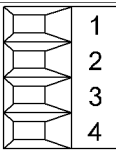
**Note**

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

 <b>WARNING</b>
<p>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 V DC.</p> <p>The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.</p>

**7.3.4 X21/X22 EP terminals/temperature sensor**

Table 7- 3 X21/X22 EP terminals / temperature sensor

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (pulse enable)	Supply voltage: 24 V DC (20.4 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 <sup>2</sup> Type: Screw terminal 1 (see Section "Control cabinet installation / connection system")			

### EP terminals

Parameters p9651 and p9851 are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4. Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Section "Controlling the safety functions".

---

#### Note

##### Function of the EP terminals

The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

---

### Temperature sensor connection

<b>NOTICE</b>
<b>Risk of the motor overheating due to an incorrectly connected KTY temperature sensor</b> A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats. <ul style="list-style-type: none"><li>• Always connect the KTY sensor with the correct polarity.</li></ul>



---

#### Note

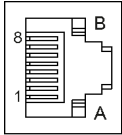
The temperature sensor input is not needed if the motors feature an integrated DRIVE-CLiQ interface or if temperature values are detected by means of a different module (SMC, SME, TM).

---

 <b>DANGER</b>
<b>Danger to life through electric shock</b> Only temperature sensors that meet the safety isolation specifications stipulated 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 danger to life!

7.3.5 X200-X203 DRIVE-CLiQ interface

Table 7- 4 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules  
X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

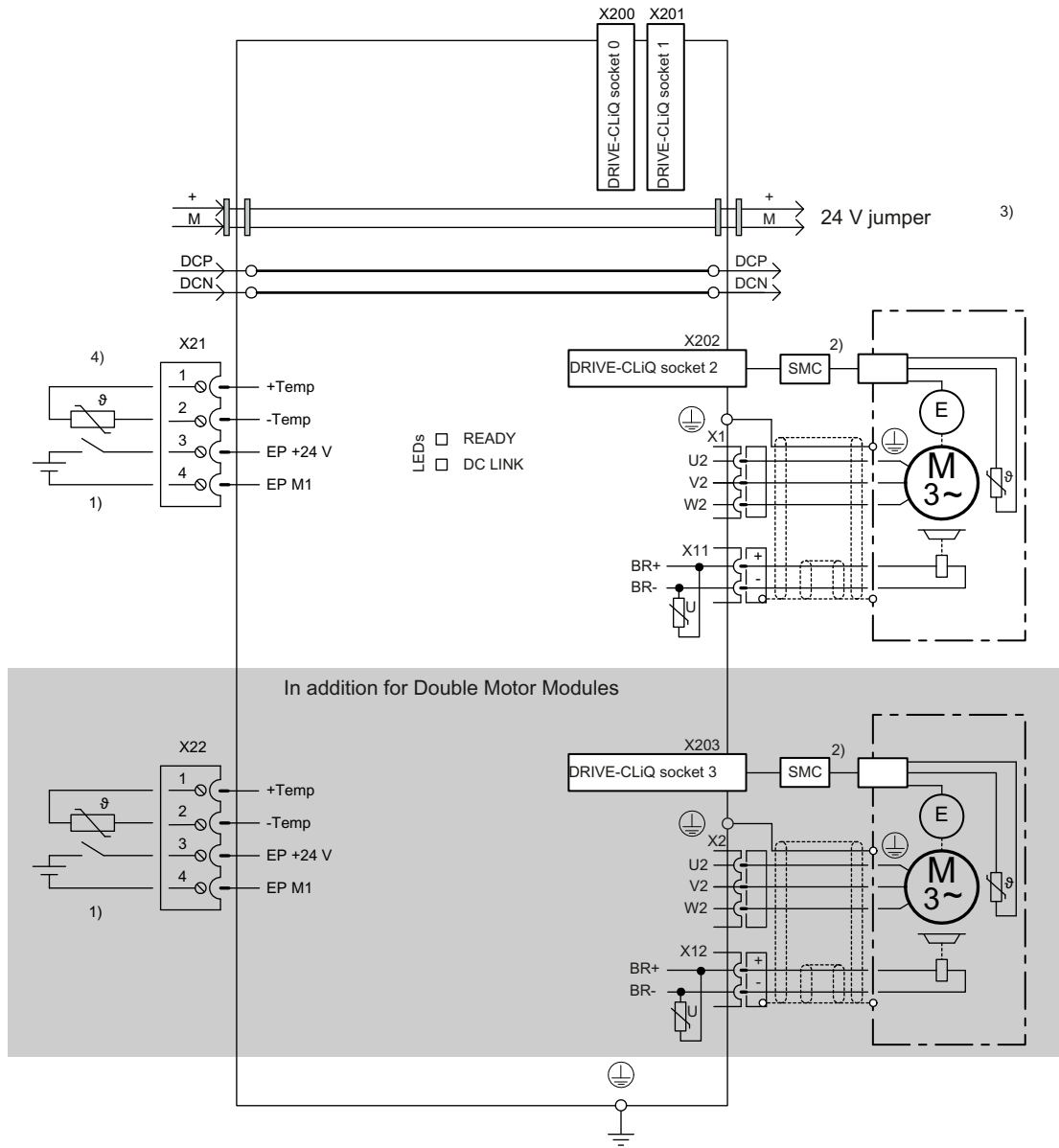
	Pin	Name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground

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

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



## 7.4 Connection example




- 1) Required for Safety
- 2) SMC required for motors without DRIVE-CLiQ interface
- 3) 24 V to the next module
- 4) An alternative possibility of the motor temperature evaluation

Figure 7-3 Connection example, Single Motor Modules Booksize Compact 3 A to 18 A and Double Motor Modules Booksize Compact 1.7 A to 5 A

## 7.5 Meaning of LEDs

Table 7- 5 Meaning of the LEDs on the Motor Module booksize compact

State		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronic power supply is missing or outside permissible tolerance range.	–
Green	--	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	--	This component has at least one fault. <b>Note:</b> 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	--	Detection of the components via LED is activated (p0124). <b>Note:</b> Both options depend on the LED state when activated via p0124 = 1.	–

 <b>DANGER</b>
<p>Hazardous DC link voltages may be present at any time regardless of the state of the "DC LINK" LED. The warning information on the component must be carefully observed!</p>

## 7.6 Dimension drawings

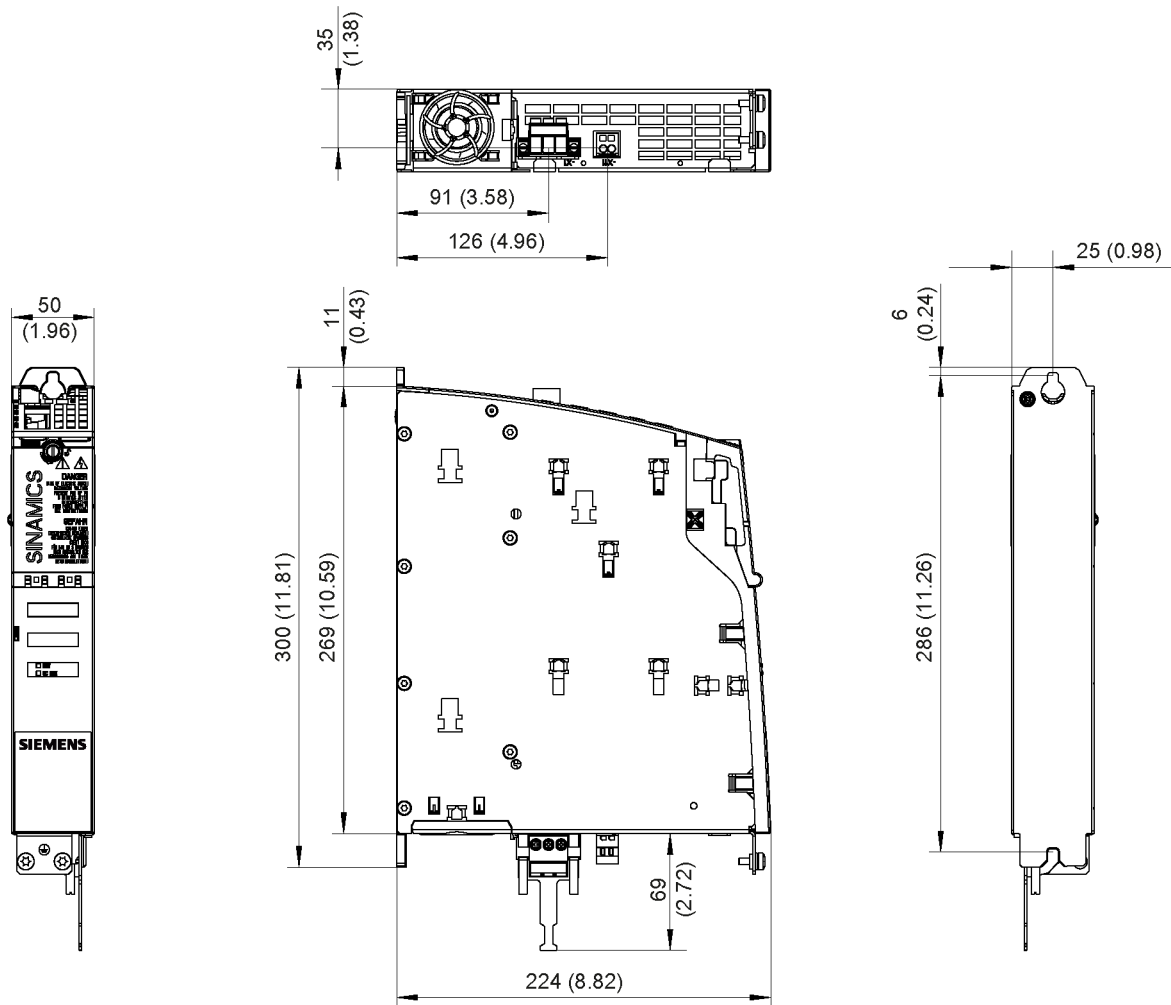


Figure 7-4 Dimension drawing of 3 A, 5 A, and 9 A Motor Modules Booksize Compact, all dimensions in mm and (inches); example: 5 A Single Motor Module

Table 7- 6 Motor Modules Booksize Compact 3 A, 5 A, and 9 A

Motor Module	Order number
Single Motor Module 3 A	6SL3420-1TE13-0AAx
Single Motor Module 5 A	6SL3420-1TE15-0AAx
Single Motor Module 9 A	6SL3420-1TE21-0AAx

7.6 Dimension drawings

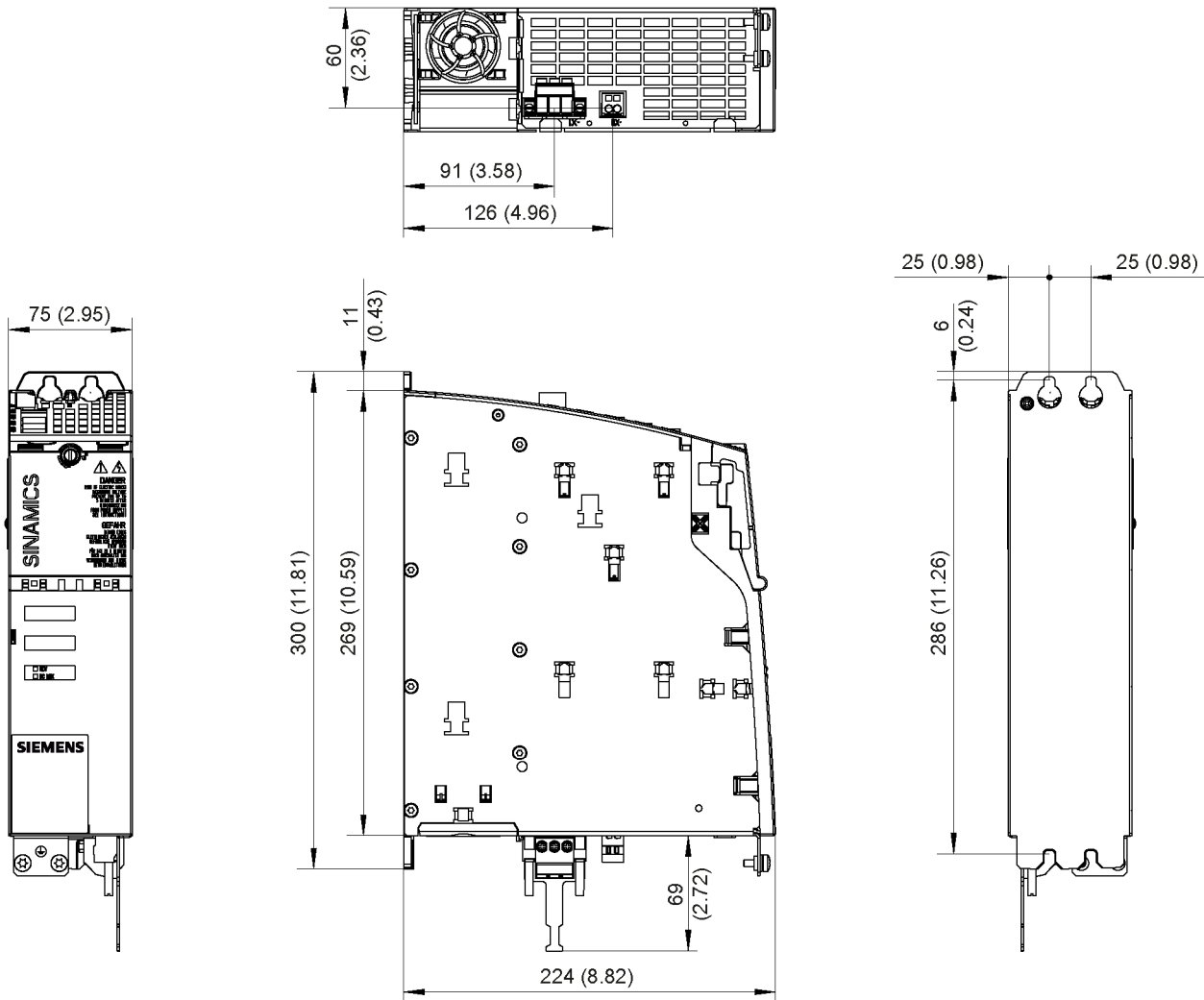


Figure 7-5 Dimension drawing of 18 A Motor Module Booksize Compact, all dimensions in mm and (inches)

Table 7-7 Motor Module Booksize Compact 18 A

Motor Module	Order number
Single Motor Module 18 A	6SL3420-1TE21-8AAx

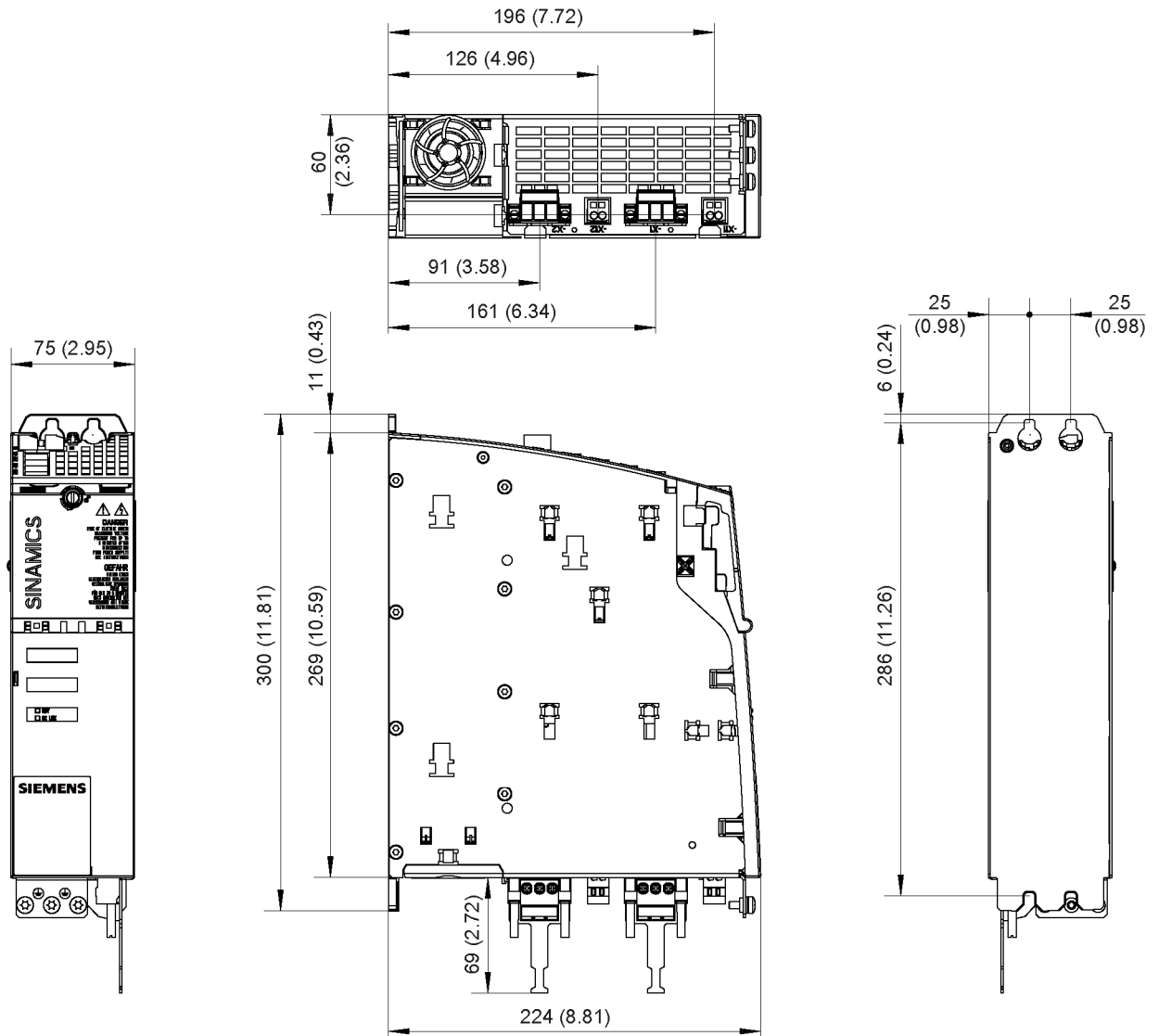


Figure 7-6 Dimension drawing of 2 x 1.7 A, 2 x 3 A, and 2 x 5 A Double Motor Modules Compact, all dimensions in mm and (inches); example: 2 x 5 A Double Motor Module

Table 7- 8 2 x 1.7 A, 2 x 3 A, and 2 x 5 A Double Motor Modules Booksize Compact

Double Motor Module	Order number
2 x 1.7 A Double Motor Module	6SL3420-2TE11-7AAx
2 x 3 A Double Motor Module	6SL3420-2TE13-0AAx
2 x 5 A Double Motor Module	6SL3420-2TE15-0AAx

## 7.7 Mounting

### Mounting a Motor Module Booksize Compact with internal air cooling

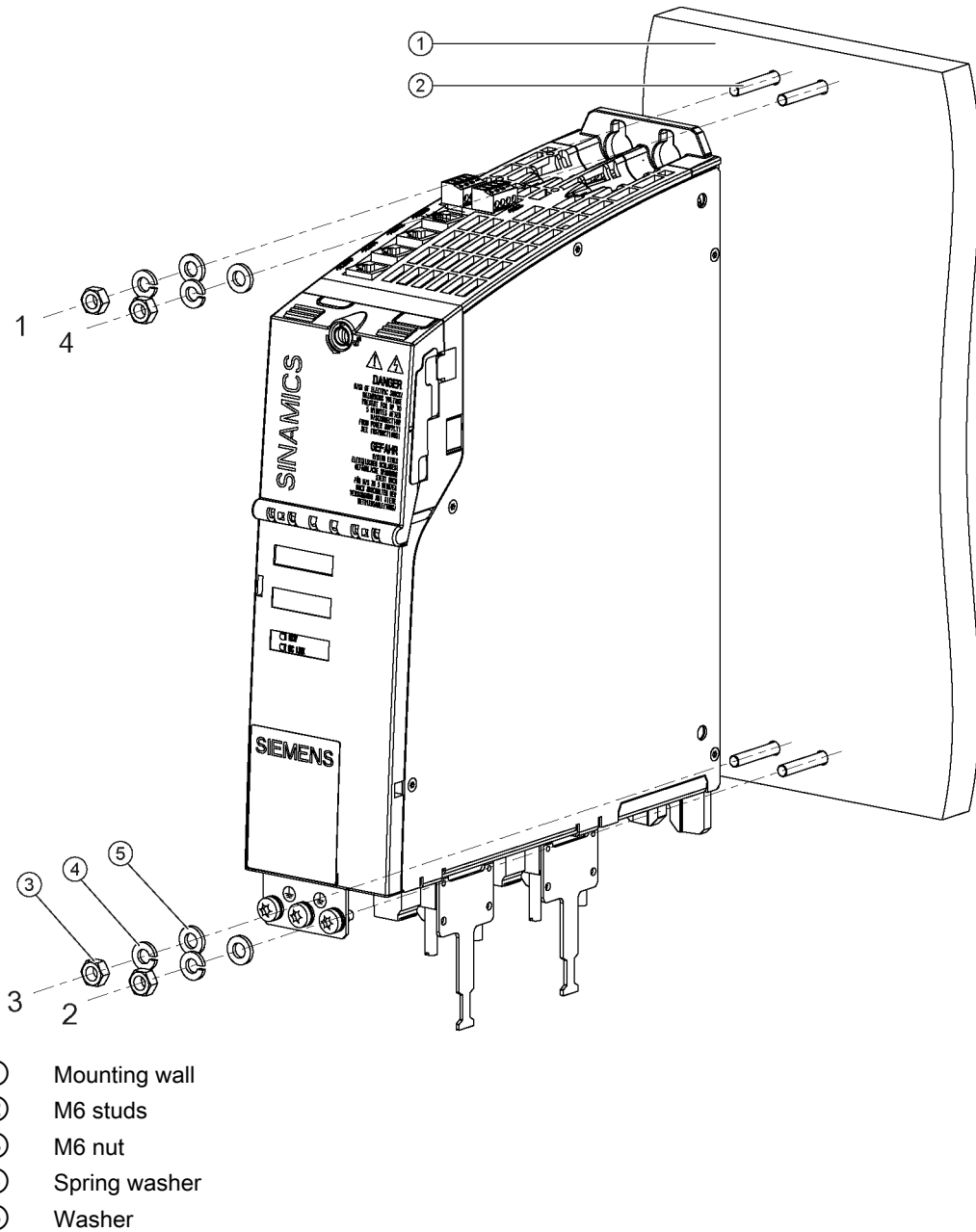
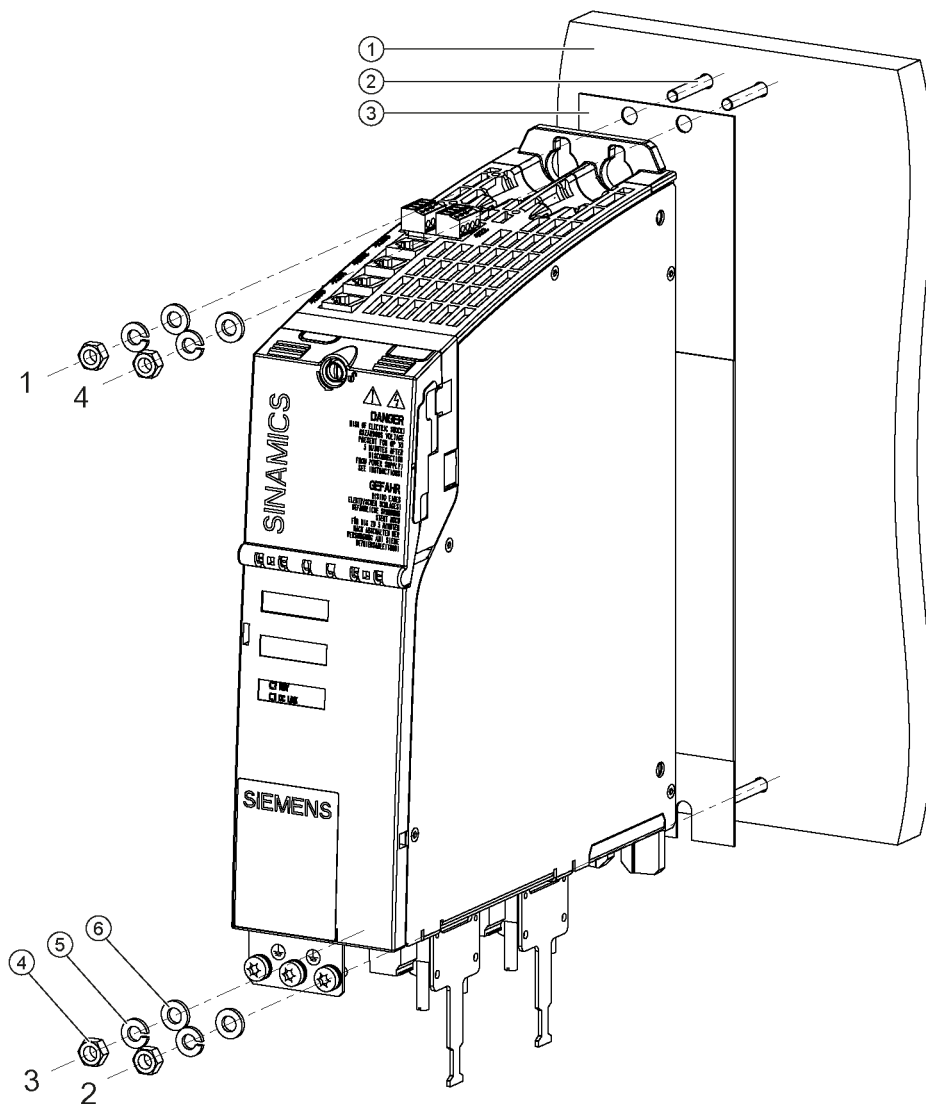


Figure 7-7 Mounting a Motor Module Booksize Compact with internal air cooling

#### Tightening torques:

- Initially, tighten by hand (0.5 Nm)
- Then tighten with 6 Nm (in the specific sequence 1 to 4)

Mounting a Motor Module Booksize Compact on a cold plate



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

Figure 7-8 Mounting a Motor Module Booksize Compact on a cold plate

**Tightening torques:**

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm (in the specific sequence 1 to 4)

**Special points to note in relation to mounting on a cold plate**

To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every Motor Module Booksize Compact is supplied with heat-conducting foil cut to the right size. Note the mounting position of the heat-conducting foil.

**Note**

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

	Order number
Heat-conducting foil, 50 mm	6SL3162-6FB01-0AA0
Heat-conducting foil, 75 mm	6SL3162-6FC01-0AA0

**7.8 Technical data**

**7.8.1 Single Motor Modules**

Table 7-9 Technical data Single Motor Modules Booksize Compact (3 A to 18 A)

Motor Modules Booksize Compact	6SL3420-	1TE13-0AAx	1TE15-0AAx	1TE21-0AAx	1TE21-8AAx
<b>Output current</b>					
Rated current (I <sub>n</sub> )	A <sub>ACrms</sub>	3	5	9	18
Base-load current (I <sub>H</sub> )	A	2.6	4.3	7.7	15.3
Intermittent duty current (I <sub>s6</sub> ) 40%	A <sub>ACrms</sub>	3.5	6	10	24
Peak current (I <sub>max</sub> )	A <sub>ACrms</sub>	9	15	27	54
<b>Output voltage</b>	V <sub>ACrms</sub>	0 - 0.717 x DC link voltage			
<b>DC link current I<sub>d</sub></b>	A <sub>DC</sub>	3,6	6	11	22
<b>DC link voltage</b> (up to 2000 m above sea level)	V <sub>DC</sub>	510 – 720			
<b>DC link capacitance</b>	µF	110	110	110	235
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %			
Undervoltage trip <sup>1)</sup>	V <sub>DC</sub>	380 ± 2 %			
<b>Electronics power supply</b>	V <sub>DC</sub>	24 (20,4 - 28,8)			
<b>Electronics current consumption at 24 V DC</b>					
For internal air cooling	A <sub>DC</sub>	0,85	0,85	0,85	0,85
For cold plate cooling	A <sub>DC</sub>	0,65	0,65	0,65	0,65
<b>Current carrying capacity</b>					
DC link busbars	A <sub>DC</sub>	100	100	100	100
Reinforced DC link busbars	A <sub>DC</sub>	150	150	150	150
24 V DC busbars	A <sub>DC</sub>	20	20	20	20
Max. current motor brake	A	2	2	2	2



Motor Modules Booksize Compact	6SL3420-	1TE13-0AAx	1TE15-0AAx	1TE21-0AAx	1TE21-8AAx
<b>Unit rating</b> Based on $I_n$ (600 V <sub>DC</sub> ; 4 kHz) Based on $I_H$	kW kW	1,6 1,4	2,7 2,3	4,8 4,1	9,7 8,2
<b>Total power loss</b> (incl. electronics losses) <sup>2)</sup> Internal air cooling Cold plate int./ext.	W W	68 (8 kHz) 25.6/40	98 (8 kHz) 30.6/65	100.4 (4 kHz) 45.6/50	185.4 (4 kHz) 80.6/100
<b>Max. pulse frequency</b> without derating with derating	kHz kHz	8 16	8 16	4 16	4 16
<b>Max. ambient temperature</b> without derating with derating	° C ° C	40 55			
<b>Sound pressure level</b> with internal air cooling	dB(A)	<60	<60	<60	<60
<b>Cooling methods</b>		Internal air cooling Cold plate cooling			
<b>Cooling air requirement</b> with internal air cooling	m <sup>3</sup> /h	29,6	29,6	29,6	29,6
<b>Max. permissible heat sink temperature</b> For internal air cooling For cold plate cooling	° C ° C	73 71	82 75	85 75	90 77
<b>Weight</b>	kg	2,7	2,7	2,7	3,4

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

2) For an overview, see the power loss tables in Section "Control cabinet installation".

## 7.8.2 Double Motor Modules

Table 7- 10 Technical data Double Motor Modules Booksize Compact (2 x 1.7 A to 2 x 5 A)

Double Motor Modules Booksize Compact	6SL3420-	2TE11-7AAx	2TE13-0AAx	2TE15-0AAx
<b>Output current</b> Rated current ( $I_n$ ) Base-load current ( $I_H$ ) Intermittent duty current ( $I_{S6}$ ) 40 % Peak current ( $I_{max}$ )	A <sub>ACrms</sub> A A <sub>ACrms</sub> A <sub>ACrms</sub>	<b>2 x 1.7</b> 2 x 1.5 2 x 2 2 x 5.1	<b>2 x 3</b> 2 x 2.6 2 x 3.5 2 x 9	<b>2 x 5</b> 2 x 4.3 2 x 6 2 x 15
<b>Output voltage</b>	V <sub>ACrms</sub>	0 - 0.717 x DC link voltage		
<b>DC link current</b> $I_d$	A <sub>DC</sub>	4.1	7.2	12
<b>DC link voltage</b> (up to 2000 m above sea level)	V <sub>DC</sub>	510 – 720		
<b>DC link capacitance</b>	μF	165	165	165
Overvoltage trip Undervoltage trip <sup>1)</sup>	V <sub>DC</sub> V <sub>DC</sub>	820 ± 2 % 380 ± 2 %		
<b>Electronics power supply</b>	V <sub>DC</sub>	24 (20,4 - 28,8)		

7.8 Technical data

Double Motor Modules Booksize Compact	6SL3420-	2TE11-7AAx	2TE13-0AAx	2TE15-0AAx
<b>Electronics current consumption at 24 V DC</b>				
For internal air cooling	A <sub>DC</sub>	1,15	1,15	1,15
For cold plate cooling	A <sub>DC</sub>	0,9	0,9	0,9
<b>Current carrying capacity</b>				
DC link busbars	A	100	100	100
Reinforced DC link busbars	A	150	150	150
24 V DC busbars	A	20	20	20
<b>Max. current motor brake</b>	A	2 x 2	2 x 2	2 x 2
<b>Unit rating</b>				
Based on I <sub>n</sub> (600 V, 8 kHz)	kW	2 x 0.9	2 x 1.6	2 x 2.7
Based on I <sub>H</sub>	kW	2 x 0.8	2 x 1.4	2 x 2.3
<b>Total power loss</b> (incl. electronics losses) <sup>2)</sup>				
Internal air cooling	W	114 (8 kHz)	134 (8 kHz)	194 (8 kHz)
Cold plate int./ext.	W	42/72	44/90	59/135
<b>Max. pulse frequency</b>				
without derating	kHz	8	8	8
with derating	kHz	16	16	16
<b>Max. ambient temperature</b>				
without derating	° C	40		
with derating	° C	55		
<b>Sound pressure level with internal air cooling</b>	dBA	<60	<60	<60
<b>Cooling methods</b>		Internal air cooling with mounted fan Cold plate cooling		
<b>Cooling air requirement with internal air cooling</b>	m <sup>3</sup> /h	29,6	29,6	29,6
<b>Max. permissible heat sink temperature</b>				
For internal air cooling	° C	84	88	93
For cold plate cooling	° C	71	75	75
<b>Weight</b>	kg	3,4	3,4	3,4

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

2) For an overview, see the power loss tables in Section "Control cabinet installation"

### 7.8.3 Characteristics

#### Rated duty cycles Motor Modules Booksize Compact

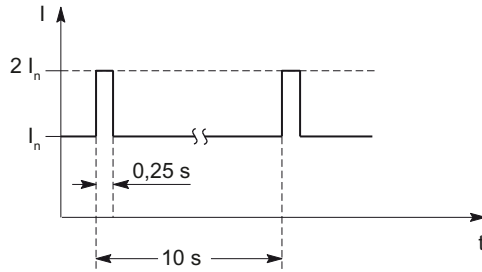


Figure 7-9 Duty cycle with initial load

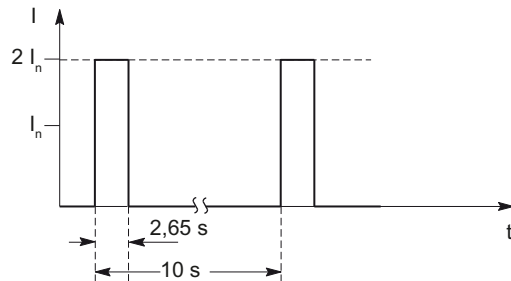


Figure 7-10 Duty cycle without initial load

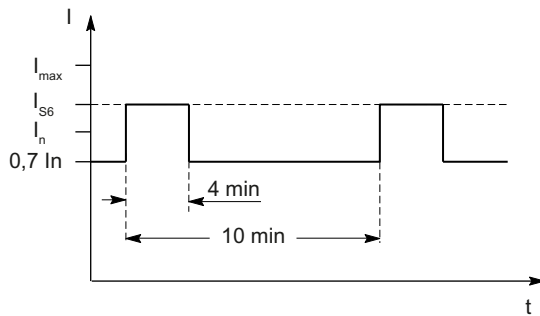


Figure 7-11 S6 duty cycle with initial load for a duty cycle duration of 600 s

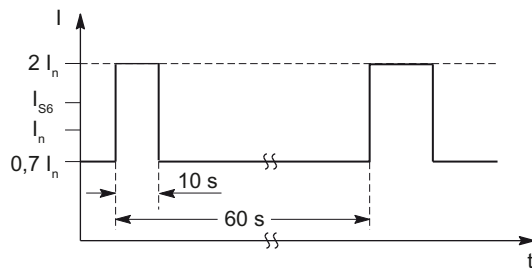


Figure 7-12 S6 duty cycle with initial load for a duty cycle duration of 60 s

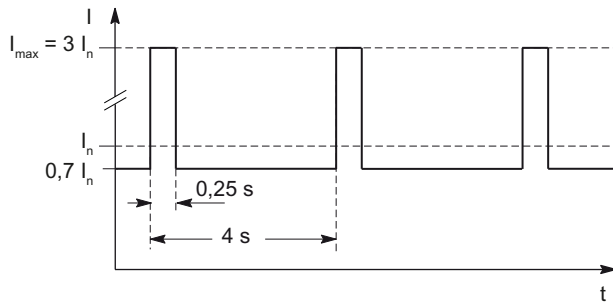


Figure 7-13 Peak current duty cycle with initial load

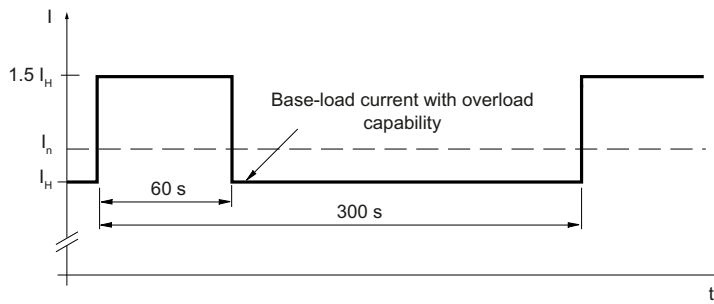


Figure 7-14 Duty cycle with 60 s overload for a duty cycle duration of 300 s

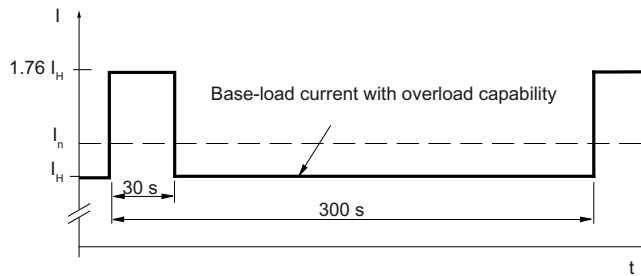


Figure 7-15 Duty cycle with 30 s overload for a duty cycle duration of 300 s

### Derating characteristics for Motor Modules Booksize Compact

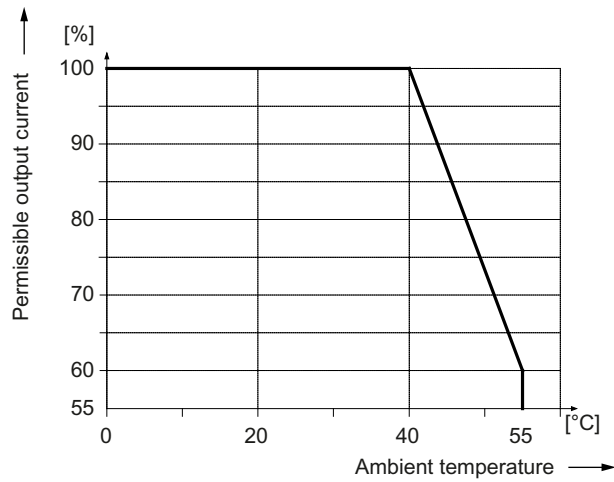


Figure 7-16 Output current as a function of the ambient temperature

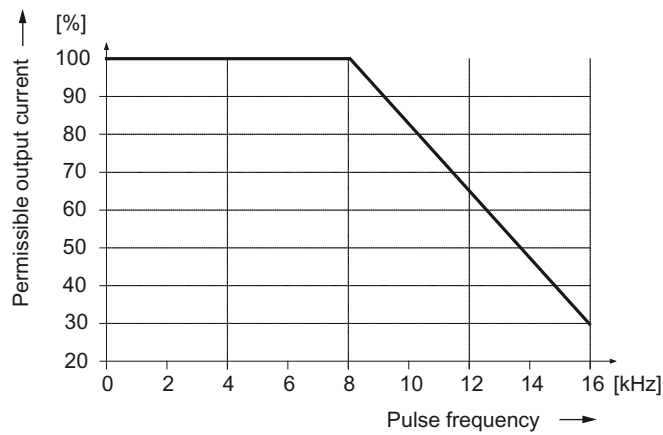


Figure 7-17 Output current as a function of the pulse frequency for the Motor Module  $\leq 5$  A

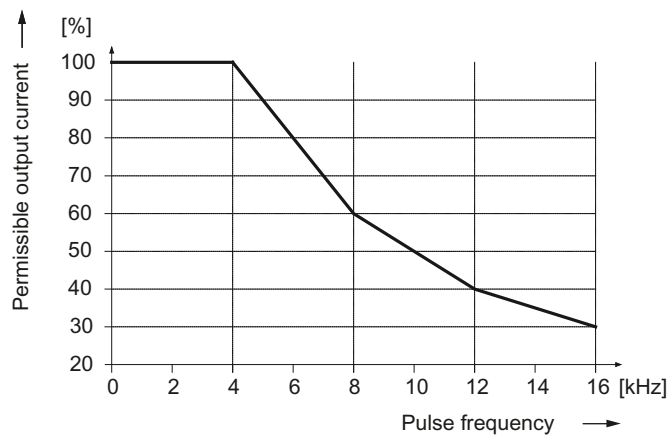


Figure 7-18 Output current as a function of the pulse frequency for the Motor Module  $\geq 9$  A

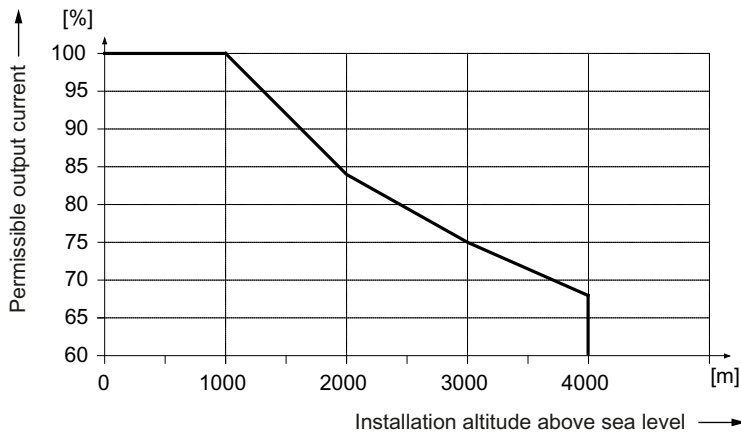


Figure 7-19 Output current as a function of the installation altitude

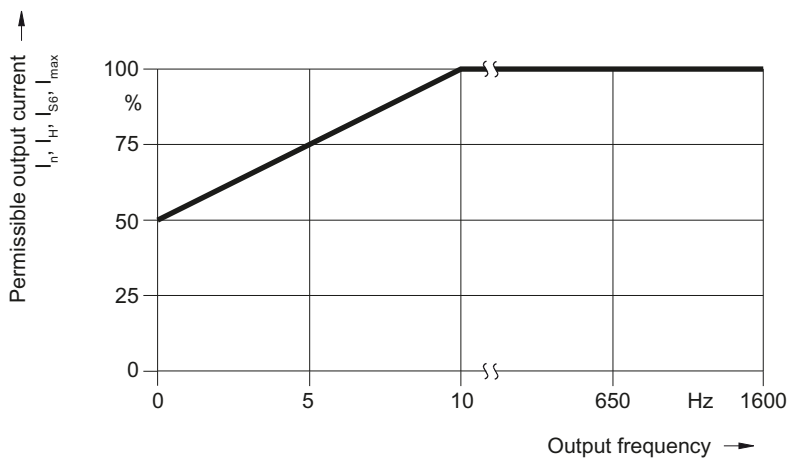


Figure 7-20 Current derating as a function of the output frequency

At installation altitudes >2000 m, an insulating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

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

## DC link components

### 8.1 Safety instructions for DC link components

#### Note

When using DC link components, also observe the safety instructions in Section 1.



#### DANGER

##### **Danger to life through electric shock due to the residual charge of the DC link capacitors**

Because of the DC link capacitors, a hazardous voltage is present for up to five minutes after the power supply has been switched off.

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

- Do not open the protective cover of the DC link until five minutes have elapsed.
- Measure the voltage before starting work on the DCP and DCN DC link terminals.



#### DANGER

##### **Danger to life through electric shock when the protective cover of the DC link is open**

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

- Only operate the components with closed protective cover.



#### WARNING

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

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

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



#### WARNING

##### **Danger to life through electric shock due to incorrectly installed DC link bridges**

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

- For all 50 mm wide modules (exception: Smart Line Module), remove the DC link bridge, including the screws. Do not tighten the screws without the DC link bridges.
- For all components that are 75 mm wide or wider, the DC link bridges must not be moved to the left or removed.



**! WARNING**

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

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

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

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



**! WARNING**

**Danger to life through interruption of the external protective conductor due to high leakage currents**

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

- Ensure that the external protective conductor satisfies at least one of the following conditions:
  - It has been laid so that it is protected against mechanical damage.<sup>1)</sup>
  - If it is a single cable, it has a cross-section of at least 10 mm<sup>2</sup> Cu.
  - If it is a conductor of a multi-conductor cable, it has a cross-section of at least 2.5 mm<sup>2</sup> Cu.
  - It has a second protective conductor in parallel with the same cross-section.
  - It complies with the local regulations for equipment with increased leakage current.

<sup>1)</sup> Cables laid within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.

**! WARNING**

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

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

- Attach the component warning labels in the national language.

**NOTICE**

**Material damage due to loose power connections**

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

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



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

As part of routine tests, SINAMICS S components undergo a voltage test according to EN 61800-5-1. Connected devices can be damaged.

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

**NOTICE****Damage through use of incorrect DRIVE-CLiQ cables**

Damage or malfunctions can occur on the devices or system when incorrect or unreleased DRIVE-CLiQ cables are used.

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

**Note****Malfunctions due to polluted DRIVE-CLiQ interfaces**

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

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

## 8.2 Braking Module Booksize

### 8.2.1 Description

The Braking Module Booksize is always used together with an external braking resistor. It has the following tasks:

- Specific stop of the drives in the event of a line failure (e.g. emergency retraction or EMERGENCY OFF category 1).
- Limit the DC link voltage for brief periods of generator operation (e.g. if the regenerative feedback capability of the Line Module is deactivated or is not adequately dimensioned).

The Braking Module includes the necessary power electronics and control. When the Braking Module is in operation, the power which is fed back into the DC link is dissipated via an external braking resistor.

#### External braking resistors

Braking resistors without thermostatic switch 6SN1113-1AA00-0DA0 ( $P_N = 0.3 \text{ kW}$ ) and 6SL3100-1BE31-0AA0 ( $P_N = 1.5 \text{ kW}$ ) can be operated at the Braking Module Booksize. The cable lengths between the Braking Module and braking resistor is limited to a maximum of 10 m.

The scope of delivery of the braking resistor 6SN1113-1AA00-0DA0 includes a shielded connection cable (3 m, 3 x 1.5 mm<sup>2</sup>).

#### Rapid discharge

Furthermore, the Braking Module Booksize can be used with a braking resistor to quickly discharge the DC link capacitors. The DC link is discharged in a controlled manner via the braking resistor once the infeed unit has been switched off and the line-up has been disconnected from the line supply (e.g. via the main switch or line contactor). The function can be activated via a digital input on the Braking Module. A quick discharge makes sense, for example, when maintenance tasks are to be performed at the Motor Module and/or motor installation (reduction of the discharge time).

<b>NOTICE</b>
<b>Damage to the Motor Module or connected motors</b>
The drive system must be completely disconnected from the line supply in order for rapid discharge to take place. The motors must be at a standstill.

## Monitoring functions

- Automatic detection of braking resistors and braking power monitoring
- I<sup>2</sup>t monitoring of the braking resistors.
- Temperature monitoring of the Braking Module
- Short circuit and overload detection
- Ground fault detection

## 8.2.2 Safety instructions for Braking Modules Booksize

---

### Note

When using a Braking Module, it is imperative that you observe the safety instructions in Section 1.

---

 <b>WARNING</b>
--

<b>Fire hazard due to overheating because of inadequate ventilation clearances</b>
--

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

- |   |
|---|
| <ul style="list-style-type: none"><li>• Maintain the 80 mm clearances above and below the components.</li></ul> |
|---|

<b>NOTICE</b>
---------------

<b>Type of connecting cables to braking resistors</b>
---

- |   |
|---|
| <ul style="list-style-type: none"><li>• The connection to the braking resistors must be made using shielded cables.</li></ul> |
|---|

<b>NOTICE</b>
---------------

<b>Device damage when using non-approved braking resistors</b>
--

If braking resistors that are not listed in this manual are used, they can be destroyed.
--

- |   |
|---|
| <ul style="list-style-type: none"><li>• Only use braking resistors released by Siemens.</li></ul> |
|---|

### 8.2.3 Interface description

#### 8.2.3.1 Overview

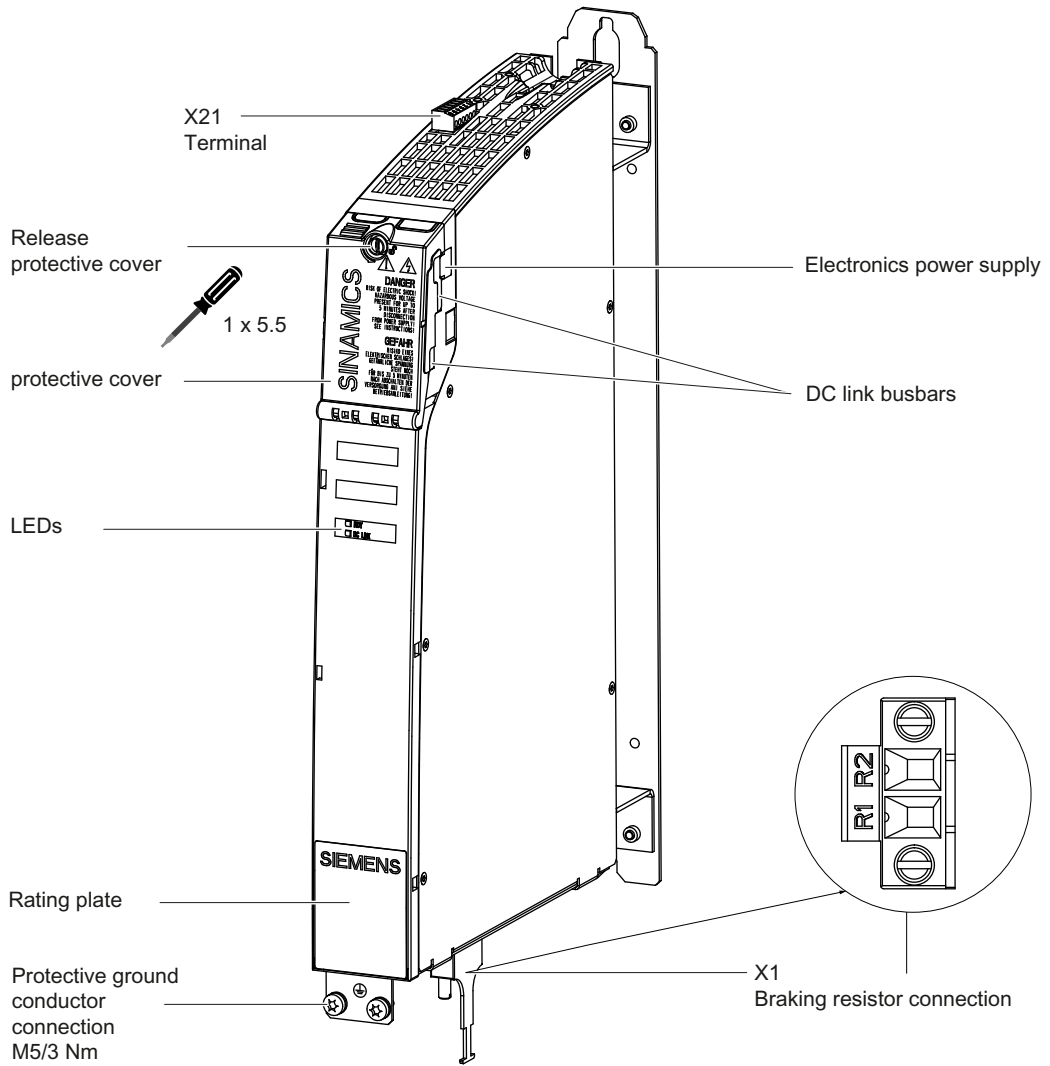


Figure 8-1 Interface overview, Braking Module Booksize

### 8.2.3.2 X1 braking resistor connection

Table 8- 1 X1 braking resistor connection

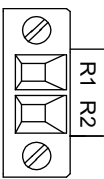
	Terminal	Designation	Technical specifications
	1	Braking resistor connection R1	Continued-short-circuit-proof
	2	Braking resistor connection R2	
Max. connectable cross-section: 4 mm <sup>2</sup> Type: Screw terminal 4 (see Chapter "Control cabinet installation/Connection system")			

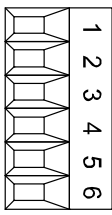
Table 8- 2 Braking resistors without a thermostatic switch for Braking Modules

Braking resistor	R in $\Omega$	P <sub>N</sub> in kW	P <sub>max</sub> in kW
6SN1113-1AA00-0DA0	17	0.3	25
6SL3100-1BE31-0AA0	5.7	1.5	100

For detailed technical information on the braking resistors, see the chapter titled "Braking resistors".

8.2.3.3 X21 digital inputs/outputs

Table 8- 3 X21 digital inputs/outputs

	Terminal	Designation <sup>1)</sup>	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 controlled manually (quick discharge) <sup>2)</sup>  If X21.1 and 2 are activated simultaneously, the Braking Module inhibit has priority.	
	3	DO high: no prewarning DO low: Prewarning, disconnection imminent	Max. load current per output: 100 mA Continued-short-circuit-proof Voltage: 24 V DC
	4	DO high: ready for operation, no fault DO low: Fault	
	5	Ground	
	6		
Max. connectable cross-section 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) DI: digital input; DO: digital output; M: Electronics ground

2) The "fast discharge function" is used for discharging the capacitors in the DC link after interruption of the mains supply. This functions may be used 1 to 2 times per week at the most.

**Terminal X21.1 - inhibit/acknowledge**

Applying a high signal to terminal X21.1 inhibits the Braking Module. Fault messages that are available are acknowledged with a falling edge.

**Terminal X21.3 - prewarning**

When a prewarning is sent, disconnection of the braking module is imminent. This may be due to the following causes:

- The temperature of the Braking Module is 80% of the maximum value.
- 80% of the maximum on-load factor of the braking resistor has been reached (I<sup>2</sup>t monitoring).
- 80% of the maximum braking energy of the braking resistor has been reached.
- An incorrect braking resistor is connected (only braking resistors approved by Siemens for this component are identified automatically).

### Terminal X21.4 - fault

The fault can have the following causes:

- Electronics power supply is missing or outside permissible tolerance range
- Enable missing (input terminal).
- Overtemperature
- Overcurrent trip
- I<sup>2</sup>t monitoring has responded.
- Ground fault/short circuit

In the event of an overtemperature, the fault can only be acknowledged with X21.1= high after a cooling-down time.

## 8.2.4 Connection example

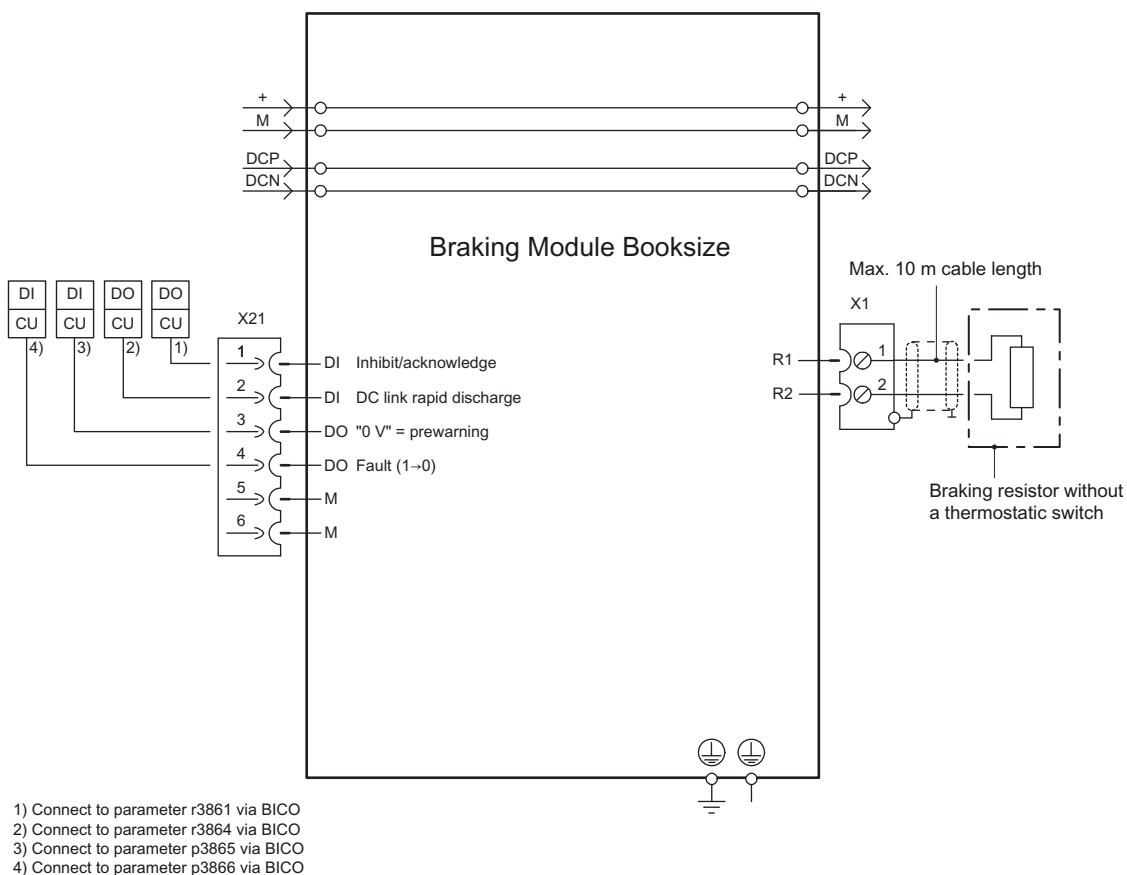


Figure 8-2 Connection example of a Braking Module Booksize

## 8.2.5 Meaning of LEDs

Table 8- 4 Meaning of the LEDs on the Braking Module Booksize

LED	Color	Status	Description, cause	Remedy
READY	-	Off	Electronics power supply is missing or outside permissible tolerance range. Component deactivated via terminal.	-
	Green	Continuous light	Component is ready to operate.	-
	Red	Continuous light	Enable missing (input terminal) Overtemperature Overcurrent trip I <sup>2</sup> t monitoring activated Ground fault/short circuit <b>Note:</b> 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	Only braking resistors approved by Siemens for this component are identified automatically. Component not active.	-
	Green	Flashing light	Component active (DC link discharge via braking resistor in progress).	-



8.2.6 Dimension drawing

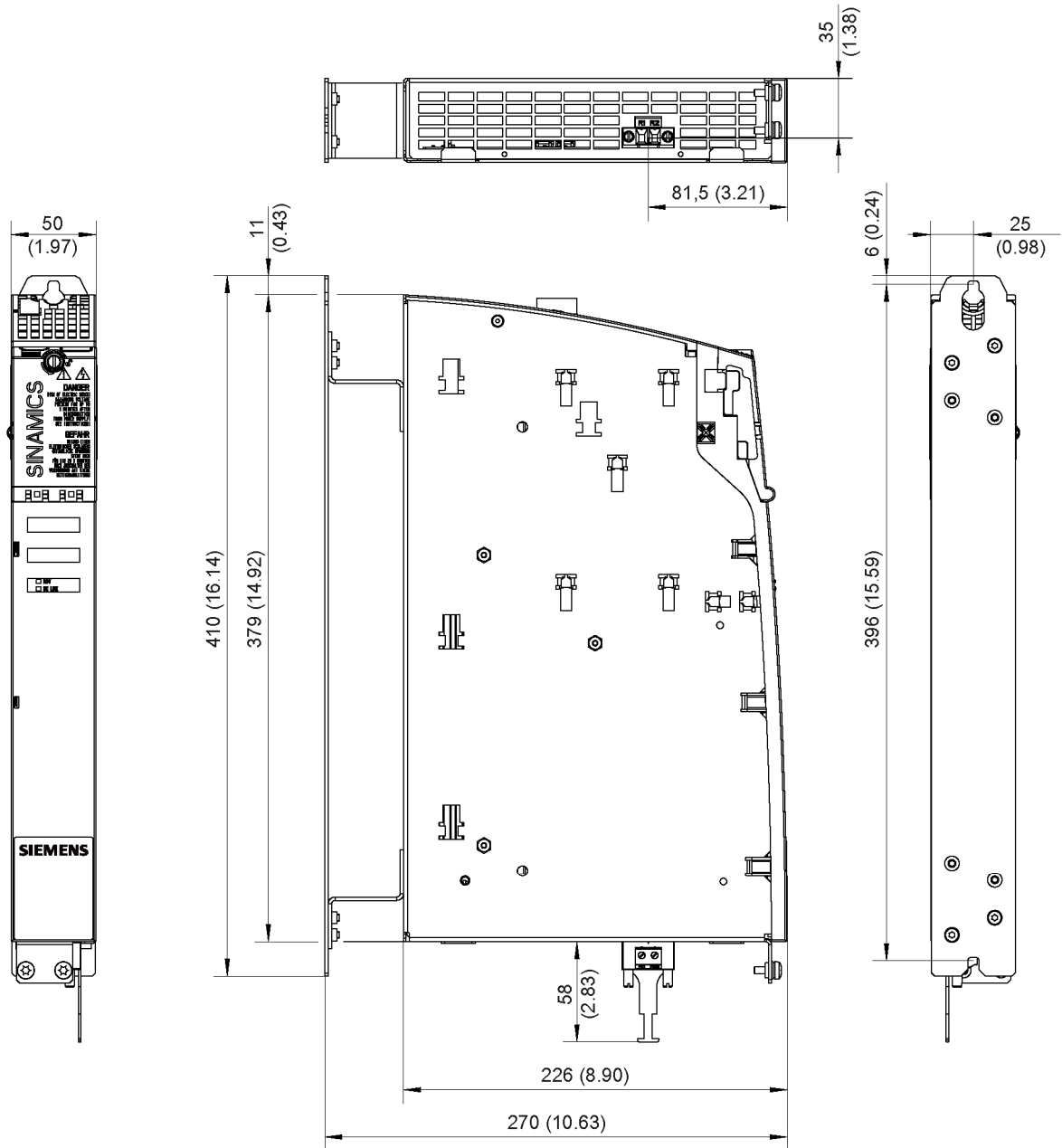
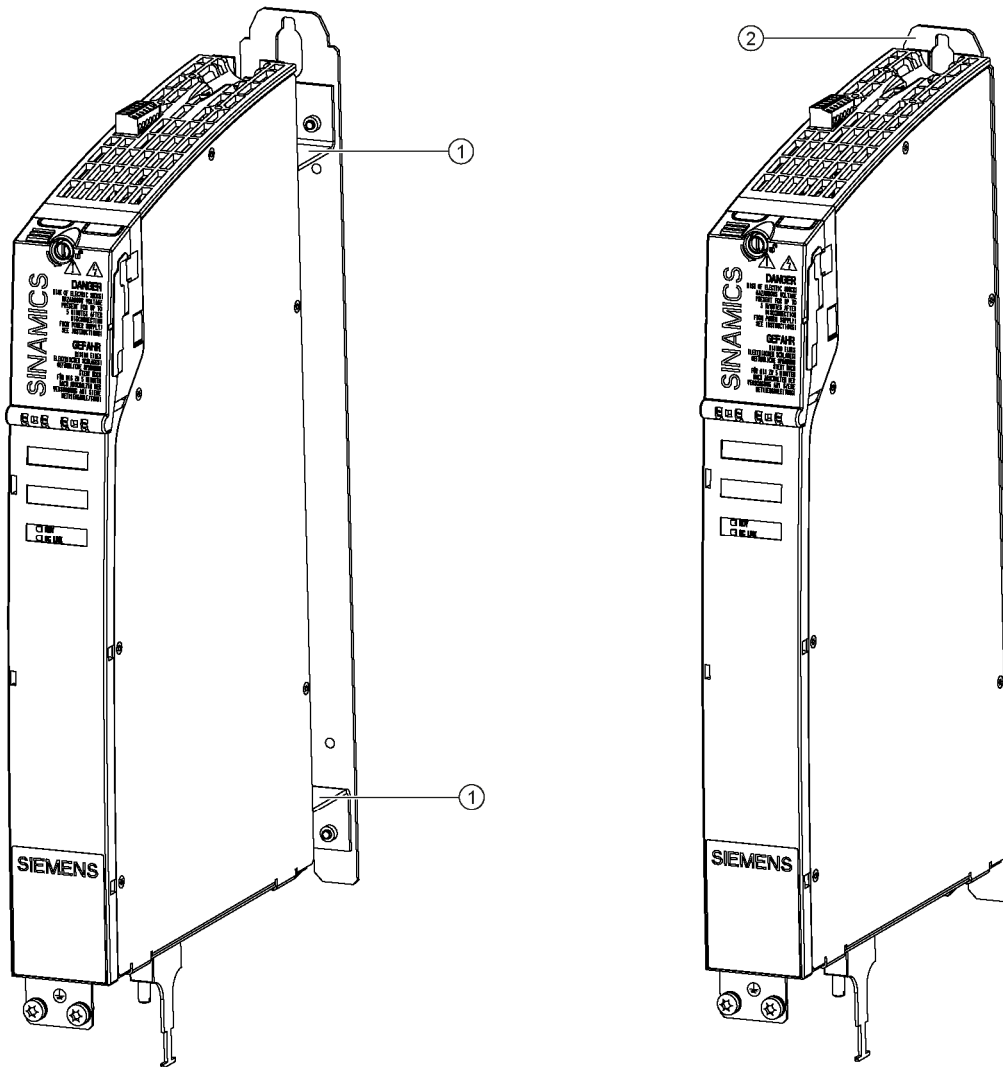


Figure 8-3 Dimension drawing of Braking Module, all dimensions in mm and (inches)

### 8.2.7 Installation



- ① Delivery condition with spacer - mounting depth for drive line-up in booksize format with internal air cooling
- ② Spacer removed - mounting depth for drive line-up in booksize format with external air cooling

Figure 8-4 Methods of installing Braking Modules with/without spacer elements

## 8.2.8 Technical data

Table 8- 5 Technical data

<b>6SL3100-1AE31-0ABx</b>		
DC link voltage	$V_{DC}$	510 - 720
DC link capacitance	$\mu F$	110
ON threshold	V	770
Electronics power supply	$V_{DC}$	24 (20,4 - 28,8)
Electronics current consumption (at 24 V DC)	$A_{DC}$	0.5
<b>Current carrying capacity</b>		
DC link busbars	$A_{DC}$	100
24 V busbars	$A_{DC}$	20
<b>Braking power</b>		
Max.	kW	100
Continuous braking power	kW	1,5
Power loss <sup>1)</sup>	W	20
Cooling method		Natural convection
Weight	kg	4,1

1) For an overview, see the power loss tables in Section "Control cabinet installation".

### 8.2.8.1 Characteristic curves

#### Duty cycle for braking resistors without a thermostatic switch

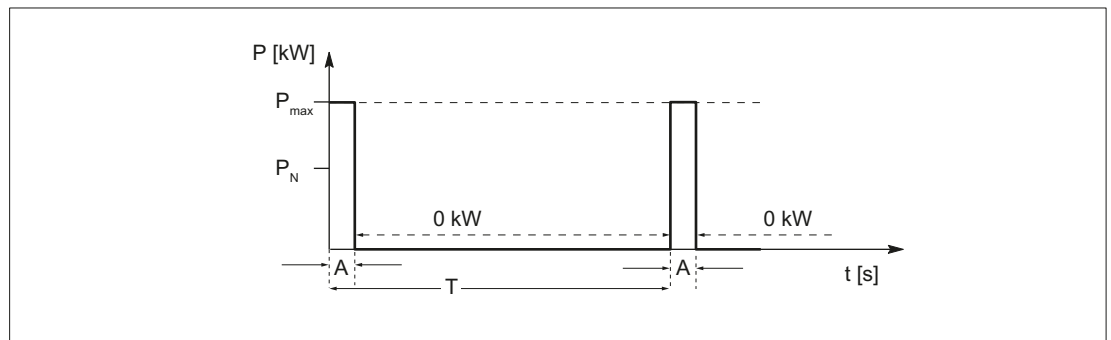


Figure 8-5 Duty cycle for braking resistors without a thermostatic switch

$T$  [s] time period of braking duty cycle

$A$  [s] load duration

$P_N$  [W] rated power (continuous power) of braking resistor

$P_{max}$  [W] peak power of braking resistor ( $6 \times P_N$ )

Table 8- 6 Duty cycles

	6SN1113-1AA00-0DA0		6SL3100-1BE31-0AAx	
	Short duty cycle	Long duty cycle	Short duty cycle	Long duty cycle
A [s]	0.1	0.4	1	2
T [s]	11.5	210	68	460

The following applies when connecting Braking Modules in parallel:

$$P_{N \text{ total}} = 0.9 \times \text{total } P_N \text{ of single devices}$$

$$P_{\text{max total}} = \text{total } P_{\text{max}} \text{ of single devices}$$

## 8.2.9 Configuration instructions

### DC link capacitance

To operate the Braking Modules, a minimum capacitance is required in the DC link. The DC link voltage of braking resistors is 440 µF each.

The capacitance of the Braking Module of 110 µF is included in the total capacitance value.

---

#### Note

Only the components that are connected to each other via the DC link busbar can be included in the total capacitance.

---

### DC link cable

In a two-row or distributed drive line-up, the DC links are connected to each other via a DC link cable. When using a Braking Module in the drive line-up, this cable must not be longer than 10 m. In all cases, the DC link cable must have low impedance and a cross-section of at least 10 mm<sup>2</sup>.

### Parallel connection

The Braking Module Booksize Compact 6SL3400-1AE31-0AAx is recommended for the parallel connection of Braking Modules.

Parallel connection of the Braking Module 6SL3100-1AE31-0AAx is not recommended because a power distribution between the modules is not guaranteed.

---

#### Note

When Braking Modules are connected in parallel, the DC link capacitance specified above must be available for each Braking Module.

---

## 8.3 Braking Module Booksize Compact

### 8.3.1 Description

The Braking Module Booksize Compact is always used together with a braking resistor. It has the following tasks:

- Specific stop of the drives in the event of a line failure (e.g. emergency retraction or EMERGENCY OFF category 1).
- Limit the DC link voltage for brief periods of generator operation (e.g. if the regenerative feedback capability of the Line Module is deactivated or is not adequately dimensioned).

The Braking Module includes the necessary power electronics and control. When the module is in operation, the power which is fed back into the DC link is dissipated via an external braking resistor.

The Braking Module can be operated on 200 V or 400 V supply systems; the 4-pin DIP switch on the top of the module is used to select which one applies in each case. The factory setting is 400 V.

When spacers (6SL3462-1CC00-0AA0) are used, the Braking Module Booksize Compact can be integrated into a drive line-up in booksize format with internal air cooling.

### External braking resistors

Braking resistors with or without a thermostatic switch can be used on the Braking Module Booksize Compact (for a list of braking resistors, see the chapter titled "X1 braking resistor connection"). The DIP switch sets the type of braking resistor being used in each case. The factory setting is "braking resistor with a thermostatic switch".

The cable length between the Braking Module and the braking resistor is limited to 10 m.

### Rapid discharge

Furthermore, the Braking Module Booksize Compact can be used with a braking resistor to quickly discharge the DC link. The DC link is discharged in a controlled manner via the braking resistor once the infeed unit has been switched off and the line-up has been disconnected from the line supply (e.g. via the main switch or line contactor). The function can be activated via a digital input on the Braking Module. A quick discharge makes sense, for example, when maintenance tasks are to be performed at the Motor Module and/or motor installation (reduction of the discharge time).

**NOTICE**

**Safety in the case of quick discharge**

The drive system must be completely disconnected from the line supply in order for rapid discharge to take place. The motors must be at a standstill.

On completion of quick discharge, a voltage of 30 V is still present at the DC link. If quick discharge is aborted before it has been completed, this voltage can still be >60 V. The DC link voltage must be checked prior to commencing work in all cases!

**Cooling methods**

The Braking Module Booksize Compact can be operated with the following cooling methods:

- Internal air cooling
- Cold plate cooling

The required cooling method is set using the DIP switch. The factory setting is "internal air cooling".

**Internal fan**

When the Braking Module is being used with internal air cooling, the internal fan starts up immediately and is subsequently controlled by the temperature.

If the DIP switch is set to cold plate cooling by mistake, the fan will still start up when a certain temperature threshold is reached, in order to prevent the Braking Module shutting down due to overtemperature. If this threshold is exceeded, an alarm is issued via the digital output "Prewarning". This ensures that an emergency stop can be performed if necessary.

**Monitoring functions**

- Automatic detection of braking resistors without thermostatic switch and corresponding braking power monitoring (only if the "Braking resistor without thermostatic switch" setting is used)
- I<sup>2</sup>t monitoring of the Braking Module
- Temperature monitoring of the Braking Module
- Temperature monitoring of the connected braking resistor with thermostatic switch (only for setting "Braking resistor with thermostatic switch")
- Short-circuit and overload detection (for all braking resistors)
- Ground fault detection (for all braking resistors)

## Parallel operation

Several Braking Modules Booksize Compact can be connected in parallel to increase the braking power. In this case, the braking energy is divided between the modules. Formulae for calculating the parallel connection are given in the section "Notes on planning/configuration"

A parallel connection of the Braking Module Booksize Compact to SINAMICS S120 Basic Line Modules 20 kW and 40 kW is also possible.

## 8.3.2 Safety instructions for Braking Modules Booksize Compact

### Note

When using a Braking Module Booksize Compact, it is imperative that you observe the safety instructions in Section 1.

### WARNING

#### Fire hazard due to overheating because of inadequate ventilation clearances

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

- Maintain the 80 mm clearances above and below the components.

### NOTICE

#### Type of connecting cables to braking resistors

- The connection to the braking resistors must be made using shielded cables.

### NOTICE

#### Device damage when using non-approved braking resistors

If braking resistors that are not listed in this manual are used, they can be destroyed.

- Only use braking resistors released by Siemens.

### 8.3.3 Interface description

#### 8.3.3.1 Overview

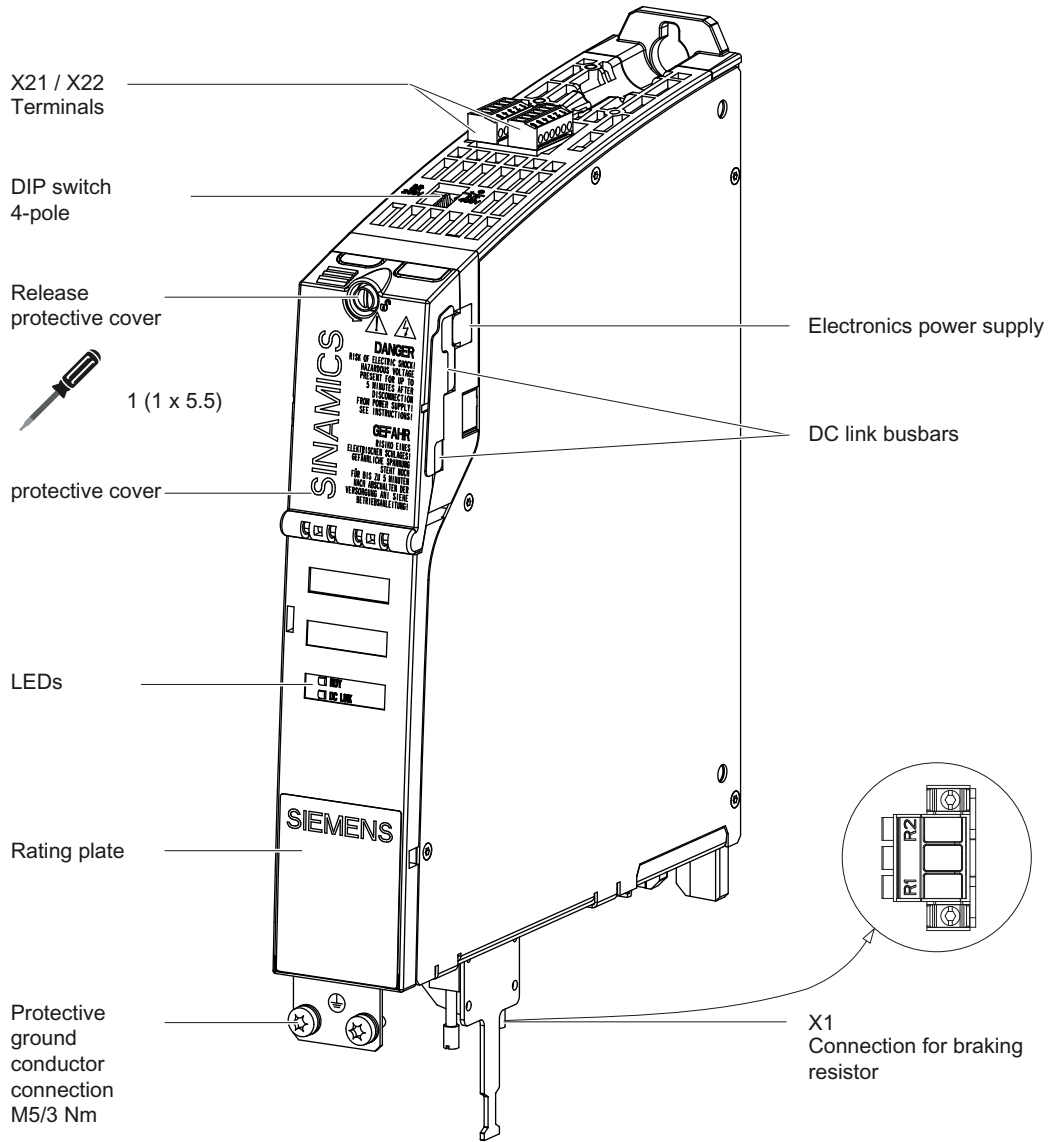
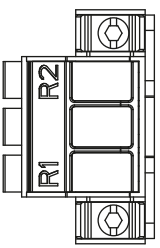


Figure 8-6 Interface overview, Braking Module Booksize Compact



### 8.3.3.2 X1 braking resistor connection

Table 8- 7 X1 braking resistor connection

	Terminal	Designation	Technical specifications
	1	Braking resistor connection R1	Continued-short-circuit-proof
	2	Not assigned	
	3	Braking resistor connection R2	
Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 (see Chapter "Control cabinet installation/Connection system")			

#### Braking resistors without a thermostatic switch

The Braking Module Booksize Compact is only designed for operation with the braking resistors listed below.

Table 8- 8 Braking resistors without a thermostatic switch

Braking resistor	R in $\Omega$	P <sub>N</sub> in kW	P <sub>max</sub> in kW
6SN1113-1AA00-0DA0	17	0.3	25
6SL3100-1BE31-0AA0	5.7	1.5	100

#### Braking resistors with a thermostatic switch

The Braking Module Booksize Compact is only designed for operation with the braking resistors listed below.

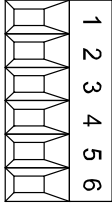
Table 8- 9 Braking resistors with a thermostatic switch

Braking resistor	R in $\Omega$	P <sub>N</sub> in kW	P <sub>20</sub> in kW	P <sub>max</sub> in kW
6SE7018-0ES87-2DC0	80	1.25	5	7.5
6SE7021-6ES87-2DC0	40	2.5	10	15
6SE7023-2ES87-2DC0	20	5	20	30

For detailed technical information on the braking resistors, see the chapter titled "Braking resistors".

8.3.3.3 X21 digital inputs/outputs

Table 8- 10 X21 digital inputs/outputs

	Terminal	Designation <sup>1)</sup>	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 VDC
	2	DI low: braking resistor not activated manually DI high: Braking resistor controlled manually (quick discharge) <sup>2)</sup>  If X21.1 and X21.2 are activated simultaneously, the Braking Module inhibit has priority.	Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V
	3	DO high: no prewarning DO low: Prewarning:	Max. load current per output: 100 mA Continued-short-circuit-proof
	4	DO high: ready for operation, no fault DO low: Fault	Voltage: 24 V DC
	5	Ground	
	6		
Max. connectable cross-section 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) DI: digital input; DO: digital output; M: Electronics ground

2) The "fast discharge function" is used for discharging the capacitors in the DC link after interruption of the mains supply.

**Terminal X21.1 - inhibit/acknowledge**

Applying a high signal to terminal X21.1 inhibits the Braking Module. Fault messages that are available are acknowledged with a falling edge.

**Terminal X21.3 - prewarning**

When a prewarning is sent, disconnection of the braking module is imminent. This may be due to the following causes:

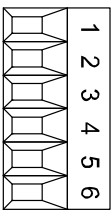
- The temperature switch braking resistor has triggered (only if the "Braking resistor with thermostatic switch" setting is used)
- The temperature of the Braking Module is 80% of the maximum value.
- The I<sup>2</sup>t counter of the Braking Module has reached 80% of the maximum value.
- The braking resistor has reached 80% of the maximum permissible braking energy (only for setting "Braking resistor without thermostatic switch")
- An incorrect braking resistor is connected (only if the "braking resistor without a thermostatic switch" setting is used)

**Terminal X21.4 - fault**

In the event of an overtemperature fault, I<sup>2</sup>t monitoring, or braking power monitoring, the fault will be acknowledged automatically after a cooling phase. Manual acknowledgment is not necessary!

### 8.3.3.4 X22 digital output/temperature switch

Table 8- 11 X22 digital output/temperature switch, braking resistor

	Terminal	Designation <sup>1)</sup>	Technical specifications
	1	+ Temp	Temperature switch of the braking resistor
	2	- Temp	
	3	Reserved	Please do not assign
	4	Reserved	
	5	DO high: 200 V supply system is selected DO low: 400 V supply system is selected	
	6	Reserved	Please do not assign

Max. connectable cross-section 1.5 mm<sup>2</sup>  
Type: Screw terminal 1 (see Chapter, "Control cabinet installation/Connection system")

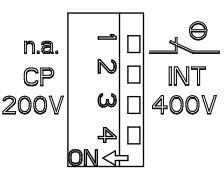
1) DO: digital output

### 8.3.3.5 DIP switch

The 4-pin DIP switch is located at the top of the Braking Module and sets the braking resistor being used, the cooling method, and the line voltage.

Make the required settings before the Braking Module is mounted in the control cabinet; once the module is mounted, the DIP switch can no longer be accessed from the front.

Table 8- 12 DIP switch for Braking Module Booksize Compact

	Switch	Switch position	Function	Factory setting
	1	ON	Braking resistor without a thermostatic switch	OFF
		OFF	Braking resistor with a thermostatic switch	
	2	ON	Cold plate cooling	OFF
		OFF	Internal air cooling	
	3	ON	200 V line voltage	OFF
		OFF	400 V line voltage	
	4	ON	Reserved	OFF
		OFF		

#### NOTICE

##### Terminal assignment for "Braking resistor without a thermostatic switch" mode

For "braking resistor without a thermostatic switch" mode (switch 1 = ON) , terminals X22.1 and X22.2 must not be assigned for the Braking Module to work.

### 8.3.4 Connection examples

#### Connection of a braking resistor without thermostatic switch to a Braking Module Booksize Compact

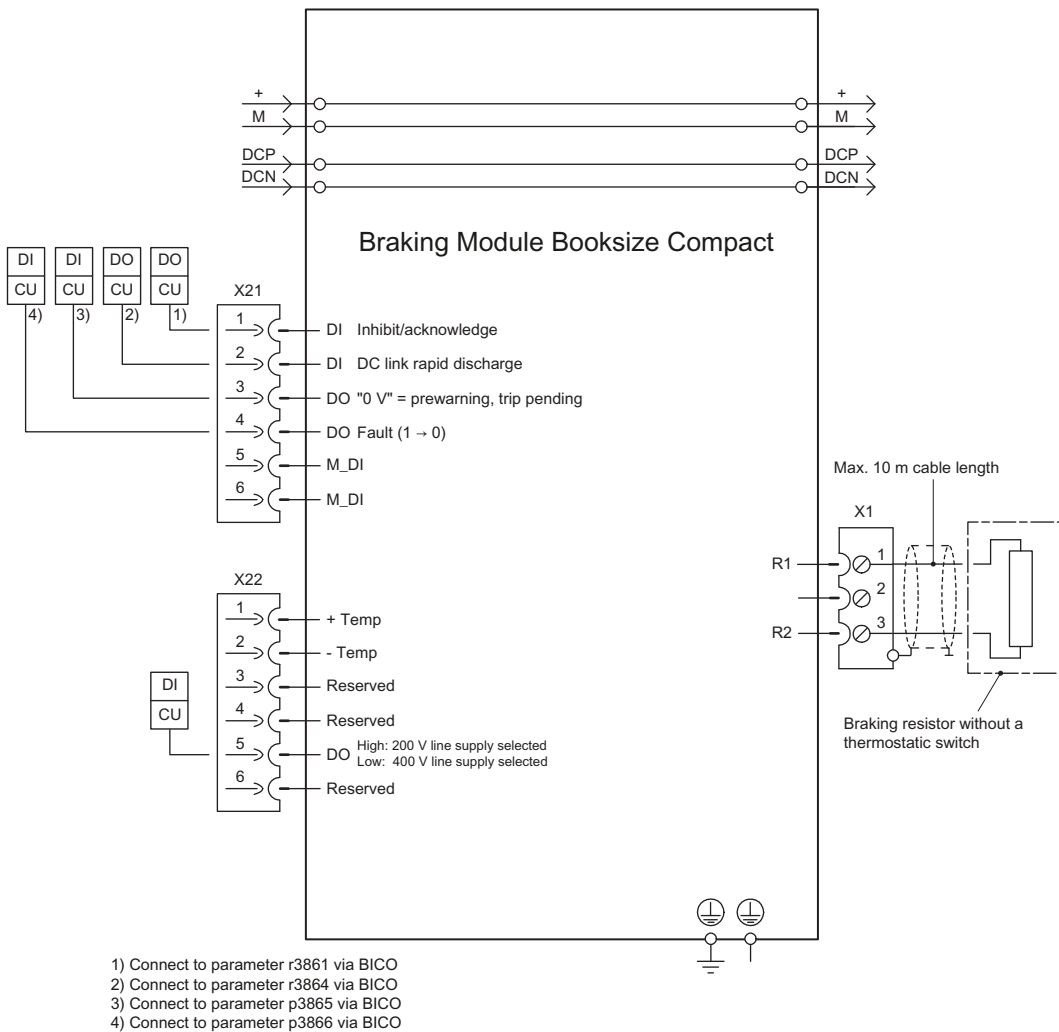


Figure 8-7 Connection example for Braking Module Booksize Compact and braking resistor without a thermostatic switch

#### Note

The digital inputs DI are isolated and refer to M\_DI (X21.5 and X21.6).  
The reference point of the digital outputs DO is the ground GND of the 24 V supply.

The connections for the temperature switches (X22.1 and X22.2) must not be assigned for "braking resistor without a thermostatic switch" mode for the Braking Module to work.

### Connection of a braking resistor with thermostatic switch to a Braking Module Booksize Compact

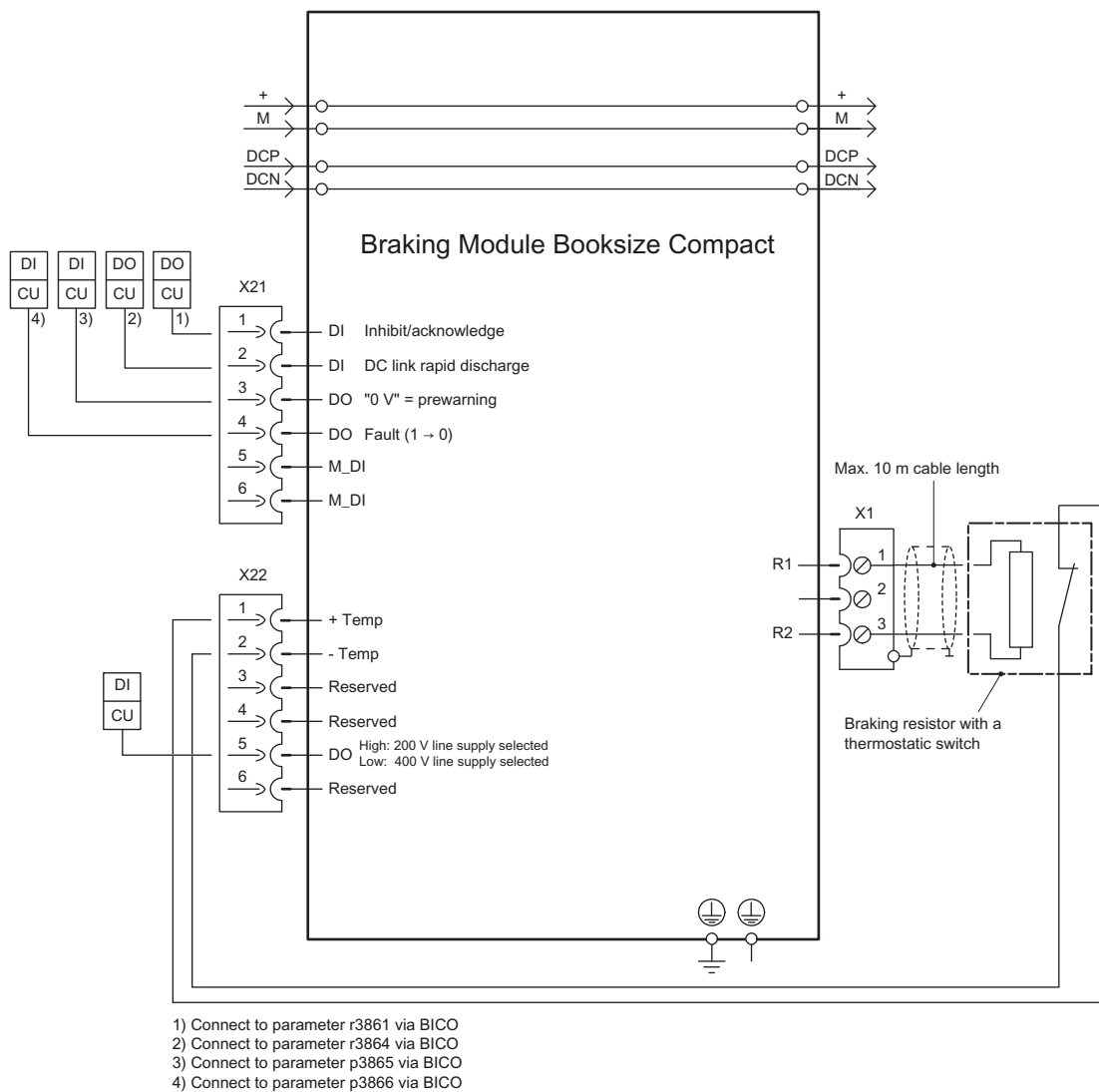


Figure 8-8 Connection example for Braking Module Booksize Compact and braking resistor with a thermostatic switch

#### Note

The digital inputs DI are isolated and refer to M\_DI (X21.5 and X21.6).  
 The reference point of the digital outputs DO is the ground GND of the 24 V supply.

### 8.3.5 Meaning of LEDs

Table 8- 13 Meaning of LEDs on the Braking Module Booksize Compact

LED	Color	Status	Description	Remedy
READY	-	Off	Electronics power supply is missing or outside permissible tolerance range.	Check electronics power supply
	Green	Continuous light	The component is ready for operation.	-
	Red	Continuous light	Enable missing (input terminal) Overtemperature of IGBT/braking resistor Overcurrent trip I <sup>2</sup> t monitoring activated Braking power monitoring triggered Ground fault/short circuit  Note: In the event of overtemperature, I <sup>2</sup> t monitoring, or braking power monitoring, the fault will be acknowledged automatically after a cooling phase. Manual acknowledgment is not possible.	Diagnose the fault (using the output terminals) and acknowledge (using the input terminal)
DC LINK	-	Off	Only braking resistors approved by Siemens for this component are identified automatically. The component is not active.	
	Orange	Continuous light	The DC link voltage is present.	-
	Orange	Flashing light	Component active (DC link discharge via braking resistor in progress)	-

8.3.6 Dimension drawing

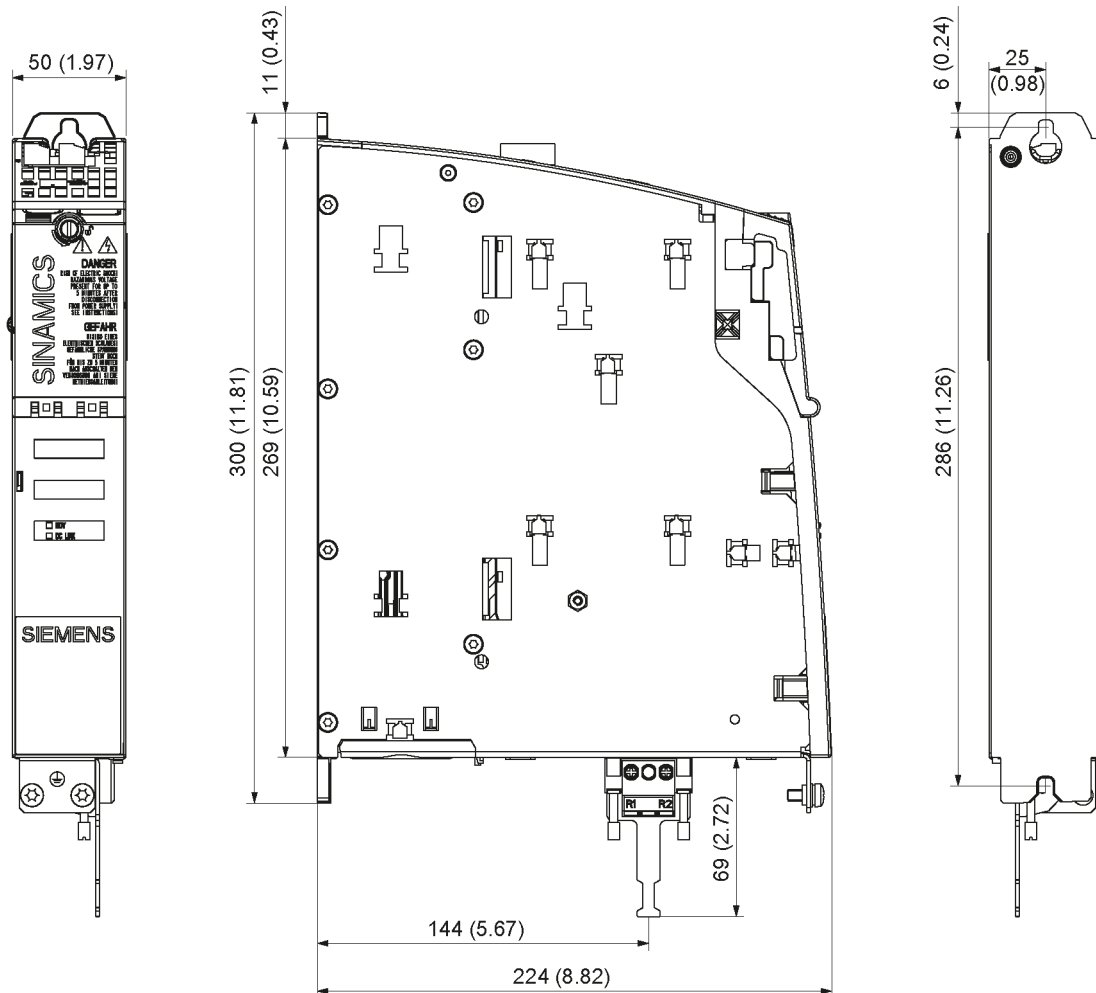
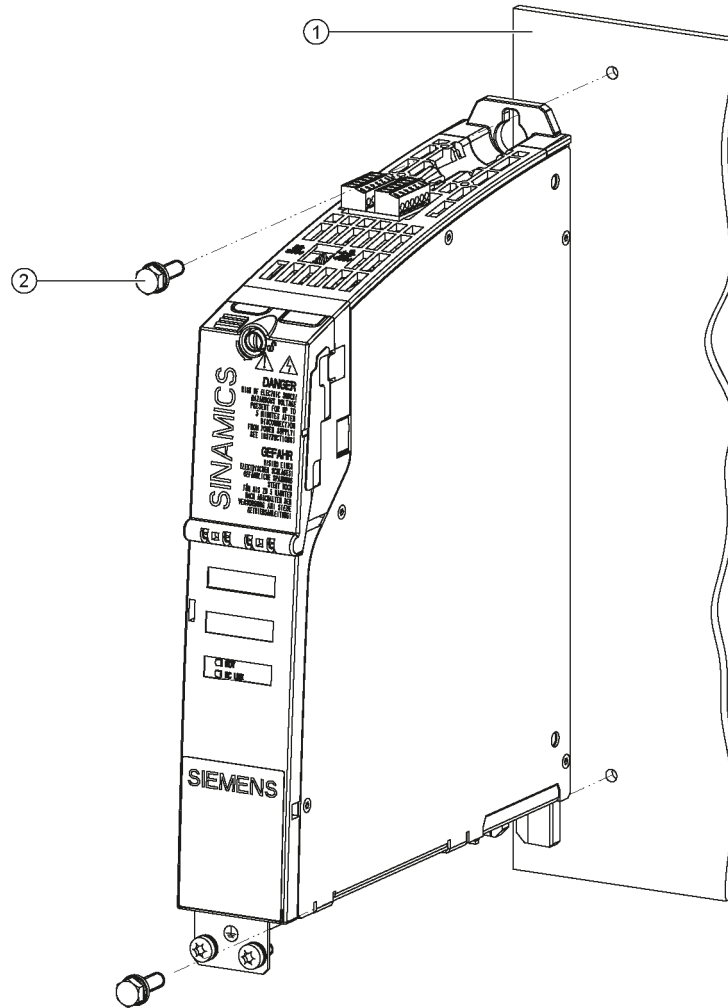


Figure 8-9 Dimension drawing of Braking Module Booksize Compact, all dimensions in mm and (inches)

### 8.3.7 Mounting

#### Mounting a Braking Module Booksize Compact with internal air cooling



- ① Mounting wall
- ② M6 x 16 screw  
Hex combination screw or hex screw with spring washer and plain washer

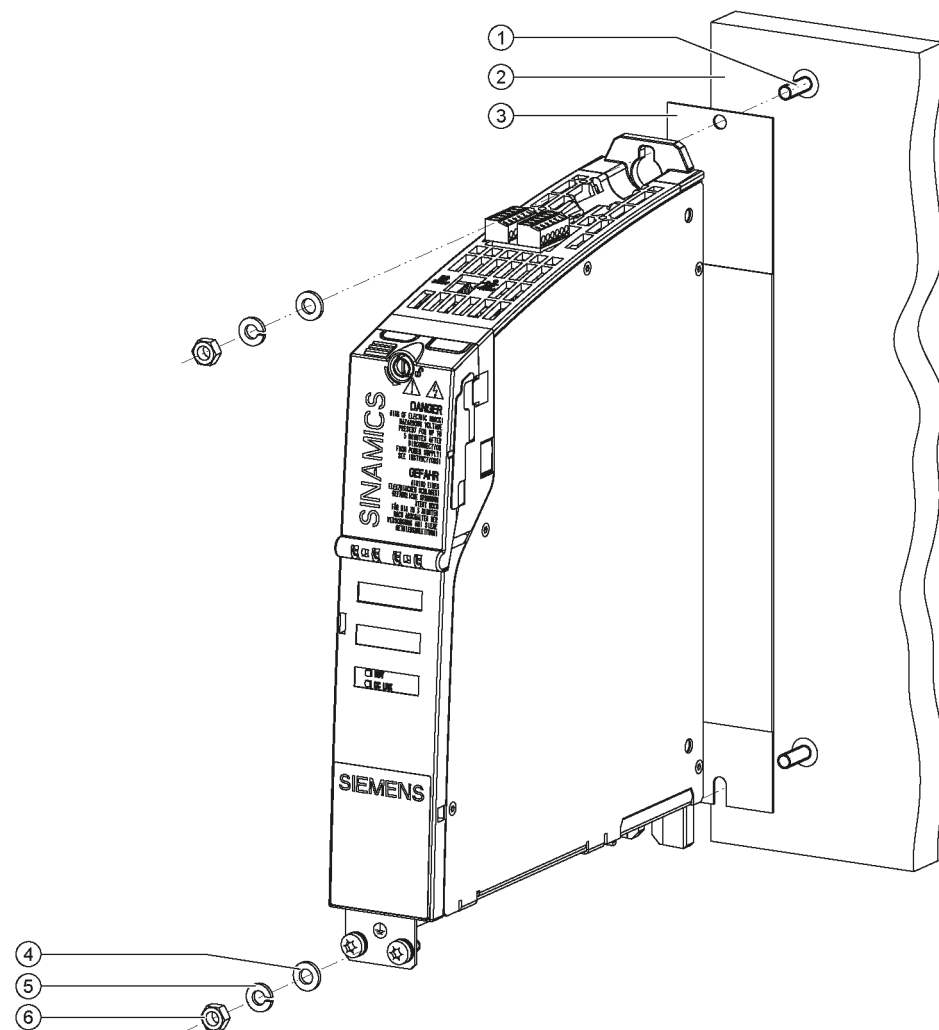
Figure 8-10 Mounting a Braking Module Booksize Compact with internal air cooling

#### Tightening torques:

- Initially, tighten by hand (0.5 Nm)
- Then tighten with 6 Nm



## Mounting a Braking Module Booksize Compact with cold plate



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

Figure 8-11 Mounting a Braking Module Booksize Compact with cold plate

**Tightening torques:**

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm

**Special points to note in relation to mounting on a cold plate**

To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every Braking Module Booksize Compact is supplied with heat-conducting foil cut to the right size. Note the mounting position of the heat-conducting foil.

**Note**

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

	Order number
Heat-conducting foil, 50 mm	6SL3162-6FB01-0AA0

**8.3.8 Technical specifications**

Table 8- 14 Technical data

<b>6SL3400-1AE31-0AAx</b>			
Line supply		200 V	400 V
DC link voltage	V <sub>DC</sub>	250 - 360	510 - 720
ON threshold	V <sub>DC</sub>	400	760
<b>Braking power</b> maximum <sup>1)</sup>	kW	50	100
continuous braking power	kW	2.5	5
Electronics power supply	V <sub>DC</sub>	24 (20,4 - 28,8)	
Electronics current consumption (at DC 24 V)	A <sub>DC</sub>	0.2	
Standby mode		0.4	
<b>Current carrying capacity:</b> 24 V busbars	A <sub>DC</sub>	100	
current carrying capacity	A <sub>DC</sub>	20	
Power loss <sup>2)</sup>			
Standby mode	W	5	
	W	25	
Switching frequency	Hz	2000	
Cooling methods		Internal air cooling Cold plate cooling	
Max. ambient temperature	°C	55	
Weight	kg	2.7	

1) At upper switch-on threshold

2) For an overview, see the power loss tables in Chapter, Control cabinet installation

## 8.3.8.1 Characteristic curves

## Duty cycle for braking resistors without a thermostatic switch

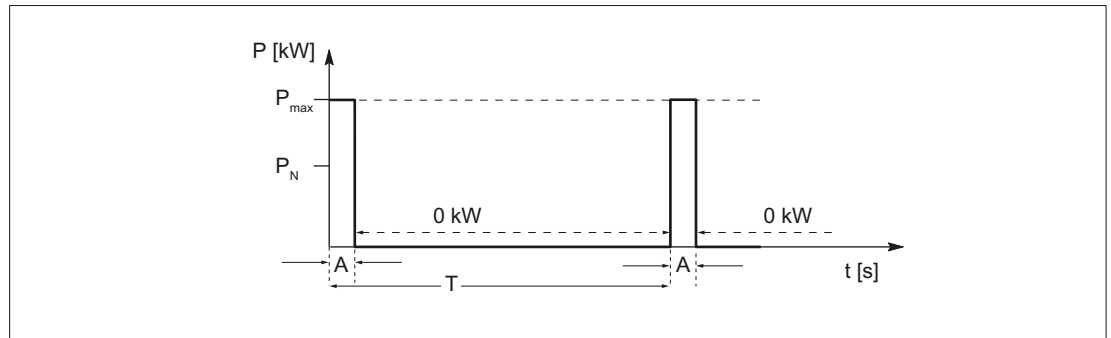


Figure 8-12 Duty cycle for braking resistors without a thermostatic switch

$T$  [s] time period of braking duty cycle

$A$  [s] load duration

$P_N$  [W] rated power (continuous power) of braking resistor

$P_{max}$  [W] peak power of braking resistor ( $6 \times P_N$ )

Table 8- 15 Duty cycles

	6SN1113-1AA00-0DA0		6SL3100-1BE31-0AAx	
	Short duty cycle	Long duty cycle	Short duty cycle	Long duty cycle
A [s]	0.1	0.4	1	2
T [s]	11.5	46	68	136

Duty cycles for braking resistors with a thermostatic switch

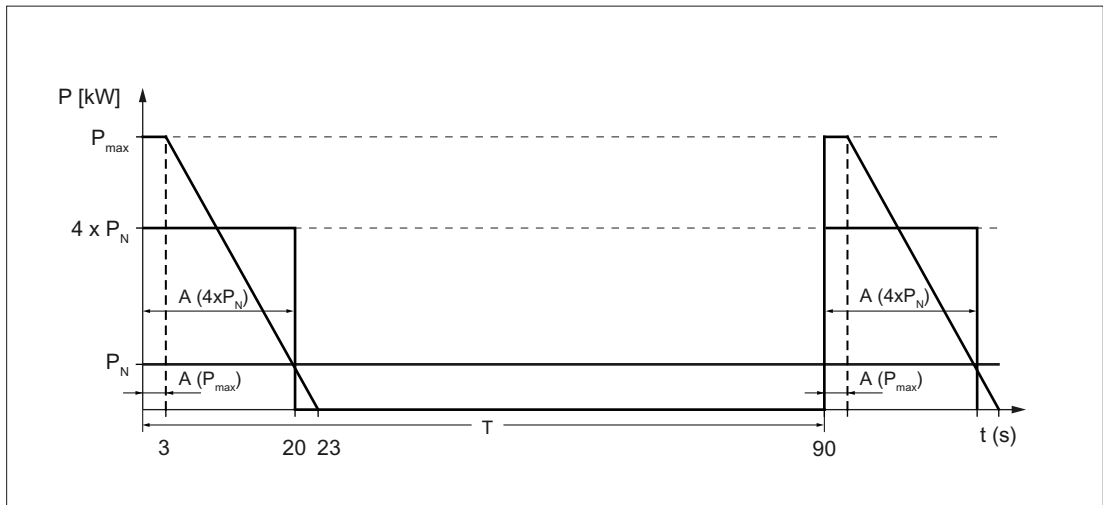


Figure 8-13 Duty cycles for braking resistors with a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

$P_N$  [W] rated power (continuous power) of braking resistor

$P_{max}$  [W] peak power of braking resistor ( $6 \times P_N$ )

$4 \times P_N$  [W] = power permitted every 90 s for 20 s

Table 8- 16 Duty cycles

	6SE7018-0ES87-2DC0		6SE7021-6ES87-2DC0		6SE7023-2ES87-2DC0	
	Duty cycle $P_{max}$	Duty cycle $4 \times P_N$	Duty cycle $P_{max}$	Duty cycle $4 \times P_N$	Duty cycle $P_{max}$	Duty cycle $4 \times P_N$
A [s]	3	20	3	20	3	20
T [s]	90	90	90	90	90	90

## 8.3.9 Configuration instructions

### DC link capacitance

When configuring the drive line-up, please note that only one Braking Module Booksize Compact may be used per complete 500  $\mu\text{F}$  DC link capacitance.

Table 8- 17 Configuration examples

DC link capacitance in $\mu\text{F}$	Max. number of Braking Modules
900	1
2400	4
9800	19

### DC link cable

In a two-row or distributed drive line-up, the DC links are connected to each other via a DC link cable. When using a Braking Module Booksize Compact in the drive line-up, this cable must not be longer than 10 m. In all cases, the DC link cable must have low impedance and a cross-section of at least 10  $\text{mm}^2$ .

### Parallel operation

During configuration of parallel operation for Braking Modules Booksize Compact, dimensioning can only take 90% of the specified braking power into account. Only the peak powers may be added without derating.

The following applies when connecting Braking Modules in parallel:

$$P_{N \text{ total}} = 0.9 \times \text{total } P_N \text{ of single devices}$$

$$4 \times P_{N \text{ total}} = 0.9 \times \text{sum } (4 \times P_N) \text{ of single devices}$$

$$P_{\text{max total}} = \text{total } P_{\text{max}} \text{ of single devices}$$

## 8.4 Braking units for 100 kW Basic Line Modules

### 8.4.1 Description

Since Basic Line Modules 100 kW cannot feed power back into the supply system, an external braking unit is required, together with a braking resistor, in order to

- enable a controlled shut down of the drives if a power failure occurs (e.g. emergency retraction or EMERGENCY OFF Category 1)
- Limit the DC link voltage during temporary generator operation.

The MASTERDRIVES braking unit includes the necessary power electronics and control. When the braking unit is in operation, the power which is fed back into the DC link is dissipated via an external braking resistor.

For the operation of a Basic Line Module 100 kW, only MASTERDRIVES braking units with the following rated braking powers are permitted:

- $4 \times P_N = 100 \text{ kW}$  (order number 6SE7031-6EB87-2DA1)
- $4 \times P_N = 170 \text{ kW}$  (order number 6SE7032-7EB87-2DA1)

For detailed information about the MASTERDRIVES braking unit, please see the operating instructions titled "MASTERDRIVES braking unit", order number 6SE7087-6CX87-2DA0.

### 8.4.2 Safety instructions for Braking Modules for the 100 kW Basic Line Module

---

#### Note

When using a MASTERDRIVES Braking Module, it is imperative that you observe the safety instructions in Section 1.

---

 <b>WARNING</b>
--

<b>Fire hazard due to overheating because of inadequate ventilation clearances</b>
--

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

- |   |
|---|
| <ul style="list-style-type: none"><li>• Maintain the 80 mm clearances above and below the components.</li></ul> |
|---|

<b>NOTICE</b>
---------------

<b>Type of connecting cables to braking resistors</b>
---

With a connected braking resistor, the Braking Module is ground-fault proof.
--



- |   |
|---|
| <ul style="list-style-type: none"><li>• The connection to the braking resistors must be made using shielded cables.</li></ul> |
|---|

<b>NOTICE</b>
<p><b>Note the starting time for the electronics</b></p> <p>The electronics of the Braking Module is supplied from the DC link. As long as no DC link voltage is present (<math>&lt; 360 \text{ V} \pm 2\%</math>), the electronics are not active and an external control or the Control Unit receives the "fault" signal from the fault output. The electronics requires more than the two seconds to start up as soon as the DC link voltage is present.</p>
<b>NOTICE</b>
<p><b>Device damage when using non-approved braking resistors</b></p> <p>If braking resistors other than those listed in the operating instructions (order number 6SE7087-6CX87-2DA0) are used, they may be damaged.</p> <ul style="list-style-type: none"> <li>• Only use the specified braking resistors.</li> </ul>

### 8.4.3 Interface description

#### 8.4.3.1 X3 DC link connection

Table 8- 18 X3: Connection for the DC link



Connection/Meaning	Remarks	Tightening torque [Nm]
C/L+ input (plus DC link)	Busbar C/L+	16
D/L- input (minus DC link)	Busbar D/L	16
 Protective conductor	 Busbar PE	16
Shield connection	M6 bolts at top of housing	8
<b>NOTE</b>		
Connection via	Crimping cable lug to DIN 46234 With shrink-on sleeve pulled over it Cables connected with supplied M8 x 25 screws	
AWG	max 2/ 0	

#### Note

After the DC link voltage is applied, fault output -X38/5 is "low" for approx. 2 seconds (self-test), i.e. in the "fault" state. The Control Unit must suppress this state when the system is switched on.

**8.4.3.2 X6 braking resistor connection**

Table 8- 19 X6: Connection for the braking resistor

Connection/Meaning	Remarks	Tightening torque [Nm]
G/R+ external braking resistor	Busbar G/R+	16
H/R external braking resistor	Busbar H/R	16
 Protective conductor	Busbar PE 	16
Shield connection	M6 bolts at bottom of housing	8
<b>NOTE</b>		
Connection via	Crimping cable lug to DIN 46234 With shrink-on sleeve pulled over it Cables connected with supplied M8 x 25 screws	
AWG	max 2/ 0	

**Note**

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

The following braking resistors are suitable for connecting to the MASTERDRIVES braking unit:

Table 8- 20 Braking resistors for MASTERDRIVES braking unit

Braking resistor	P <sub>N</sub> in kW	P <sub>20</sub> in kW	P <sub>max</sub> in kW	R in Ω
6SE7031-6ES87-2DC0	25	100	150	4
6SE7032-7ES87-2DC0	42.5	170	255	2.35

**8.4.3.3 Switch S1**

Switch S1 on the MASTERDRIVES braking unit is used to set the switch-on threshold. It is located behind the front panel.

Switch S1 should be set to "high" (factory setting) in order to operate the braking unit on a SINAMICS S120 drive line-up in booksize format. This equates to a switch-on threshold of 757 V<sub>DC</sub>.

For more information, please see the operating instructions for the MASTERDRIVES braking unit.



## 8.4.4 Connection example

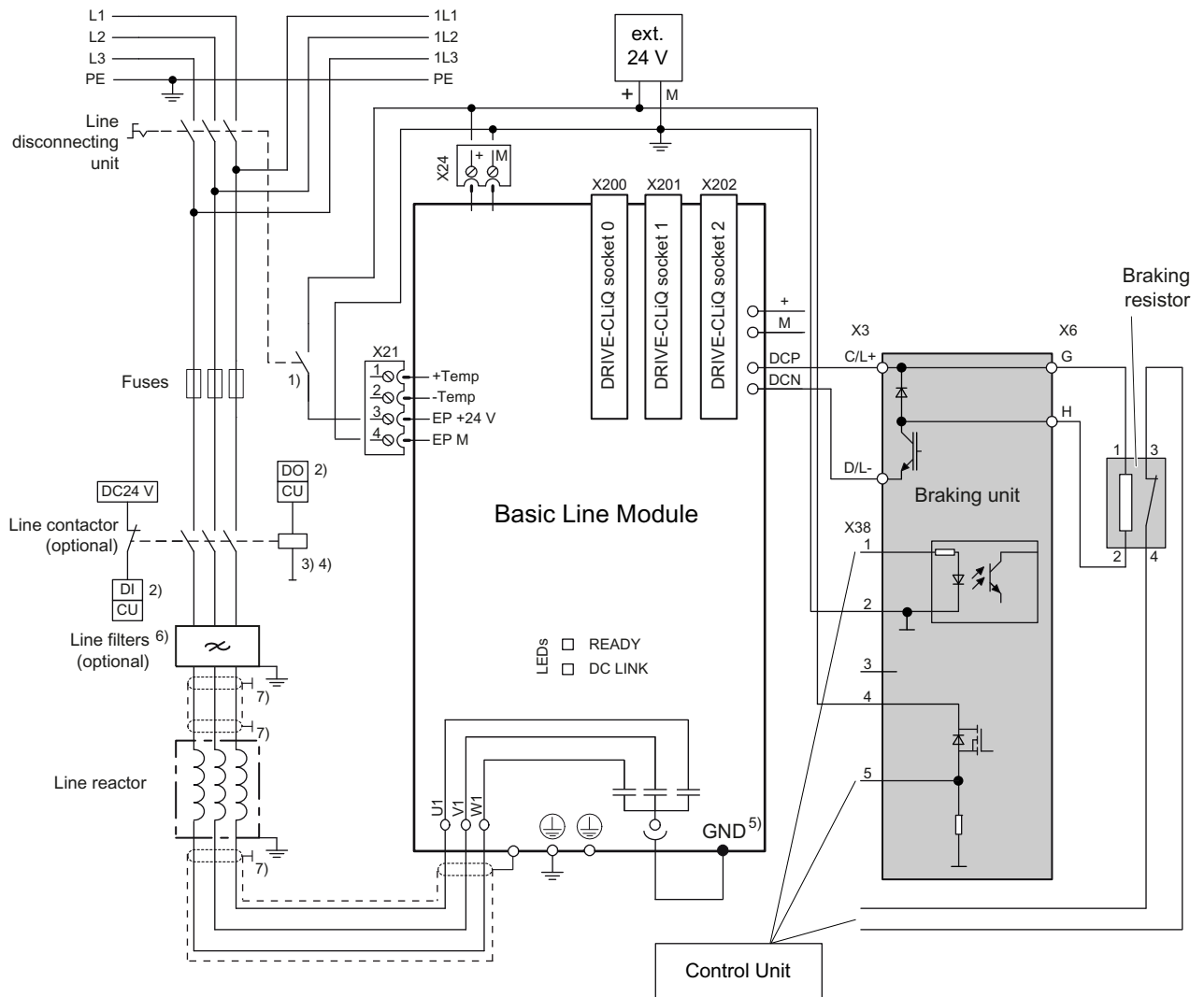


Figure 8-14 Connection example for MASTERDRIVES braking unit

8.4.5 Dimension drawing

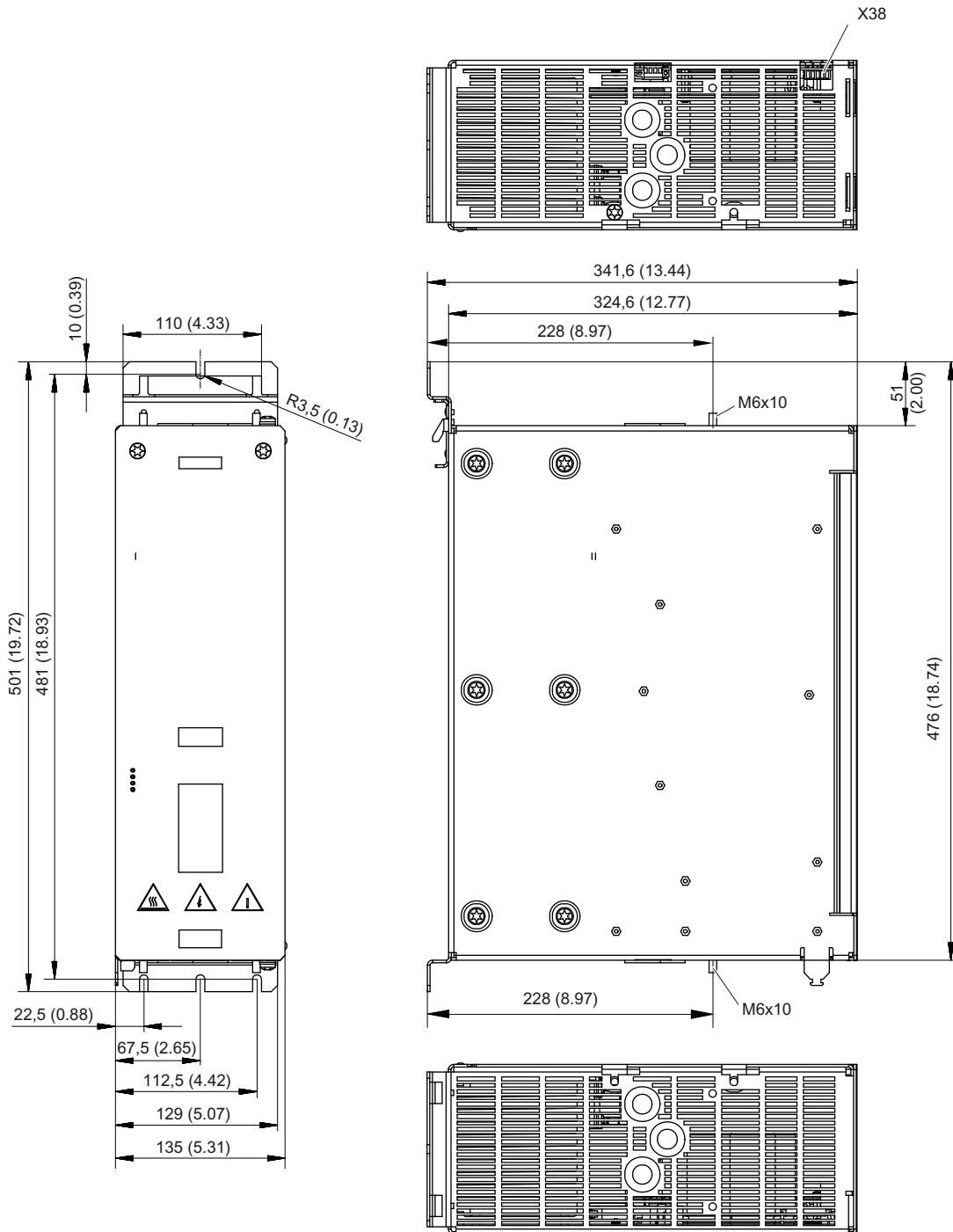


Figure 8-15 Dimension drawing of 100 kW and 170 kW MASTERDRIVES braking unit, all dimensions in mm and (inches)

## 8.4.6 Connection to the Basic Line Module 100 kW

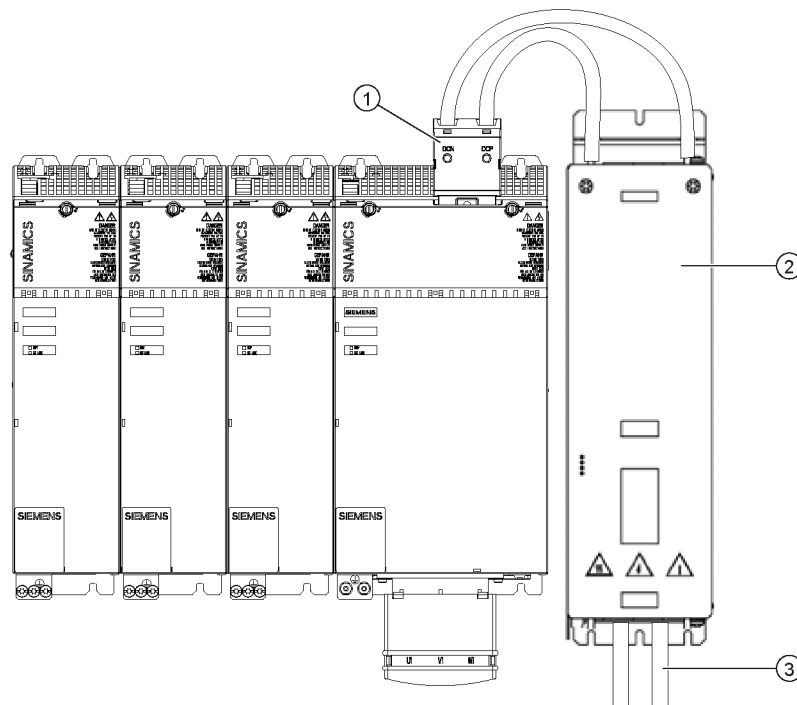
### Connecting the braking unit to the DC link

The following adapters can be used to connect the MASTERDRIVES braking unit to a SINAMICS S120 line-up in booksize format:

- DC link rectifier adapter, order number 6SL3162-2BM00-0AA0
- DC link adapter, order number 6SL3162-2BM01-0AA0

The connecting cables used to connect the braking unit to the DC link rectifier adapter or DC link adapter must be kept as short as possible.

Please observe the instructions contained in the chapters titled "Accessories/DC link rectifier adapter" and "Accessories/DC link adapter".



- ① DC link rectifier adapter
- ② MASTERDRIVES braking unit
- ③ Cable routing to the braking resistor

Figure 8-16 Connecting a MASTERDRIVES braking unit via a DC link rectifier adapter

### Connecting the braking unit to the DC link adapter or DC link rectifier adapter

1. Connect the C/L+ connection on the braking unit to the DCP terminal on the DC link rectifier adapter or DC link adapter.
2. Connect the D/L- connection on the braking unit to the DCN terminal on the DC link rectifier adapter or DC link adapter.
3. Connect the protective conductor between the S120 drive line-up and the braking unit. The cross-section of the protective conductor connection must be at least 50 mm<sup>2</sup>.

The connecting cable between the braking unit and the DC link rectifier adapter or DC link adapter must be dimensioned with a cross-section of 95 mm<sup>2</sup> in accordance with EN 60439-1 (short-circuit-proof cable installation). The electric strength of the cable must be rated to the line voltage. The maximum permissible length of the connecting cables to the DC link is 3 m.

 **WARNING**

The drive equipment or braking unit may be damaged if the DC link terminals are reversed or short-circuited.

 **CAUTION**

The exhaust air from the braking units can reach temperatures of > 80 °C. The temperature of the housing can reach > 65 °C.

## 8.5 Capacitor Module

### 8.5.1 Description

Capacitor modules are used to increase the DC link capacitance to bridge momentary power losses.

Capacitor modules are connected to the DC link voltage via the integrated DC link busbars. Capacitor modules function autonomously.

Several capacitor modules can be operated in parallel.

### 8.5.2 Safety instructions for Capacitor Modules

---

#### Note

When using a Capacitor Module, it is imperative that you observe the safety instructions in Section 1.

---

 <b>WARNING</b>
--

<b>Fire hazard due to overheating because of inadequate ventilation clearances</b>
--

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

- |   |
|---|
| <ul style="list-style-type: none"><li>• Maintain the 80 mm clearances above and below the components.</li></ul> |
|---|

<b>NOTICE</b>
---------------

<b>Note the maximum permissible DC link capacitance</b>
---

The Capacitor Module is precharged by the Line Module.
--

- |  |
|--|
| <ul style="list-style-type: none"><li>• Observe the respective maximum permissible DC link capacitances of the Line Modules.</li></ul> |
|--|

### 8.5.3 Interface description

#### 8.5.3.1 Overview

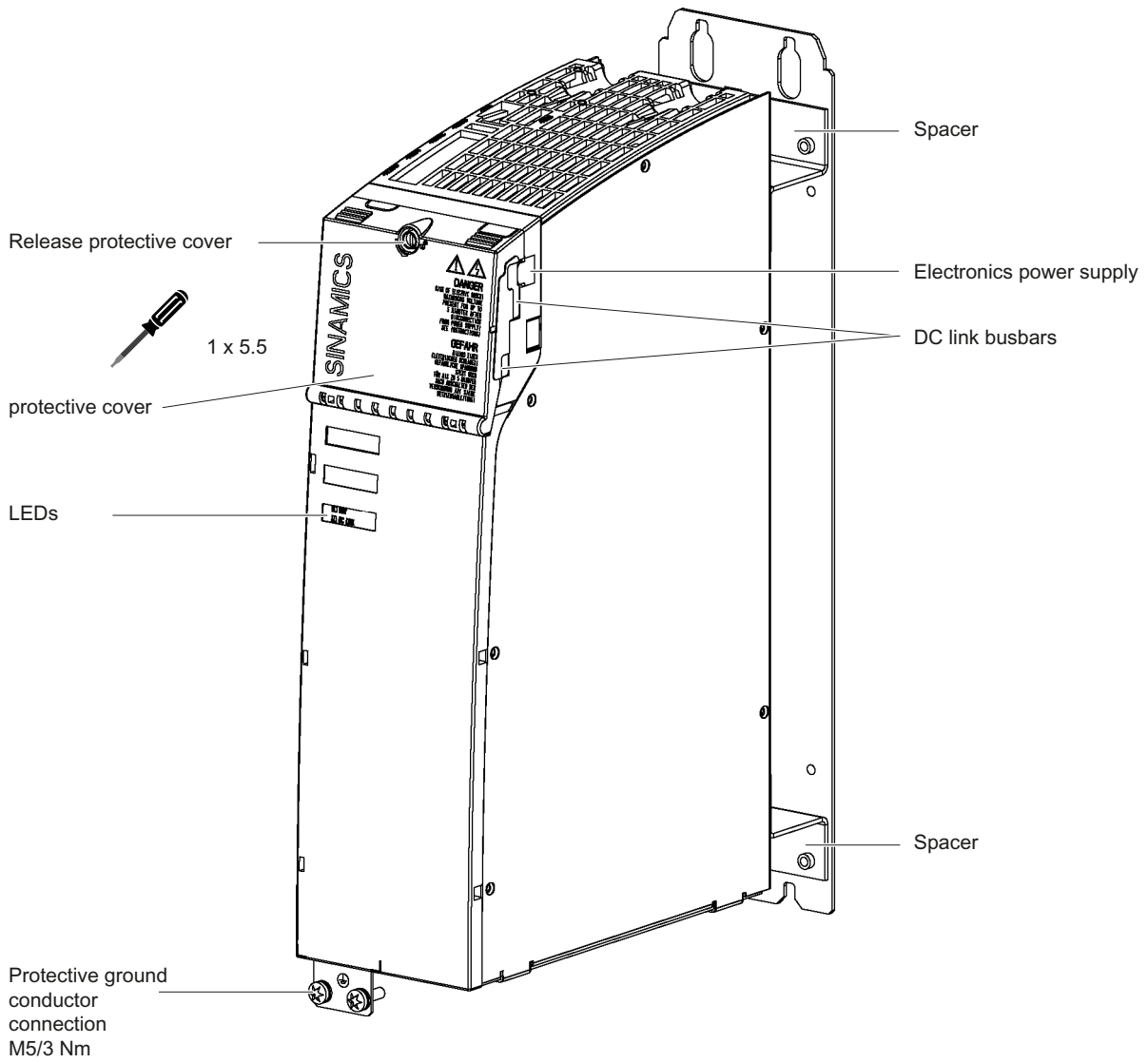


Figure 8-17 Interface overview, Capacitor Module

### 8.5.4 Dimension drawing

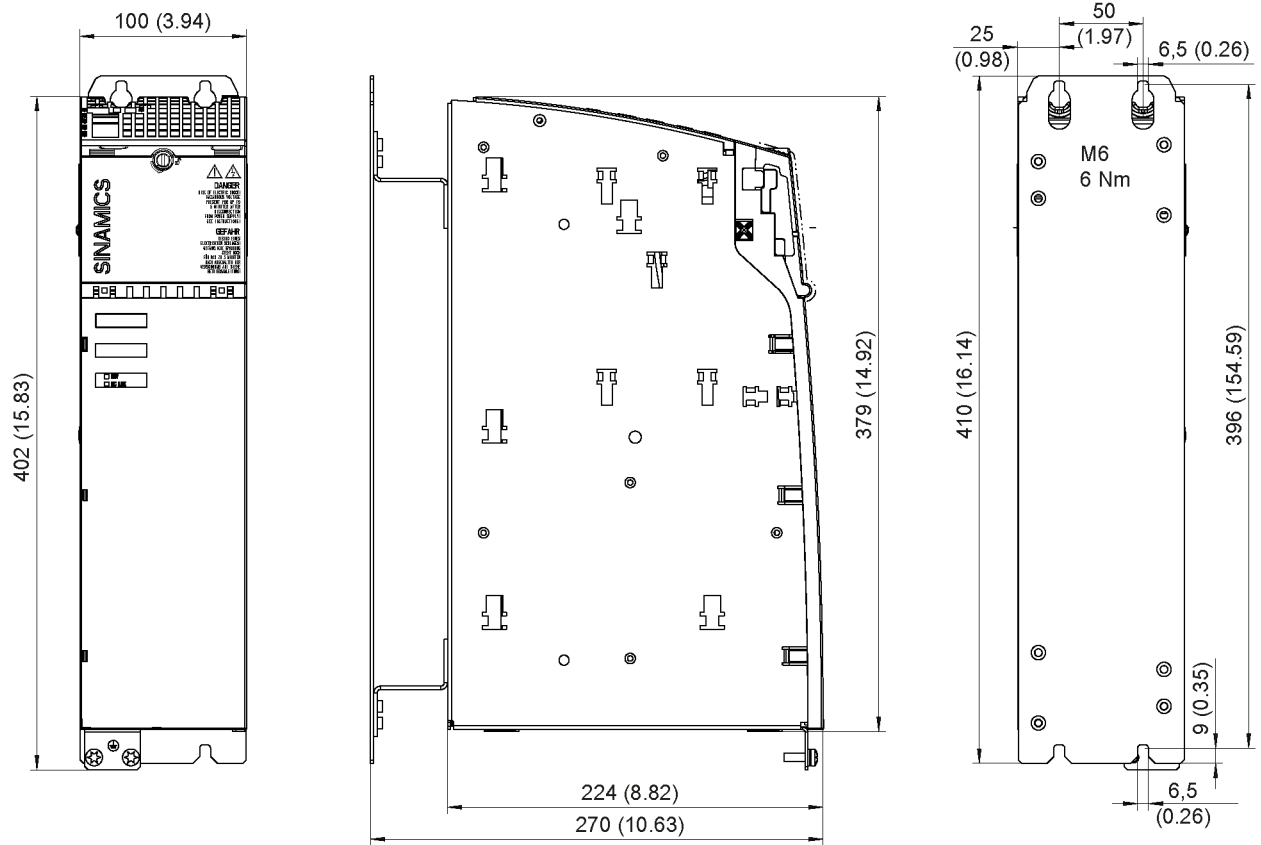
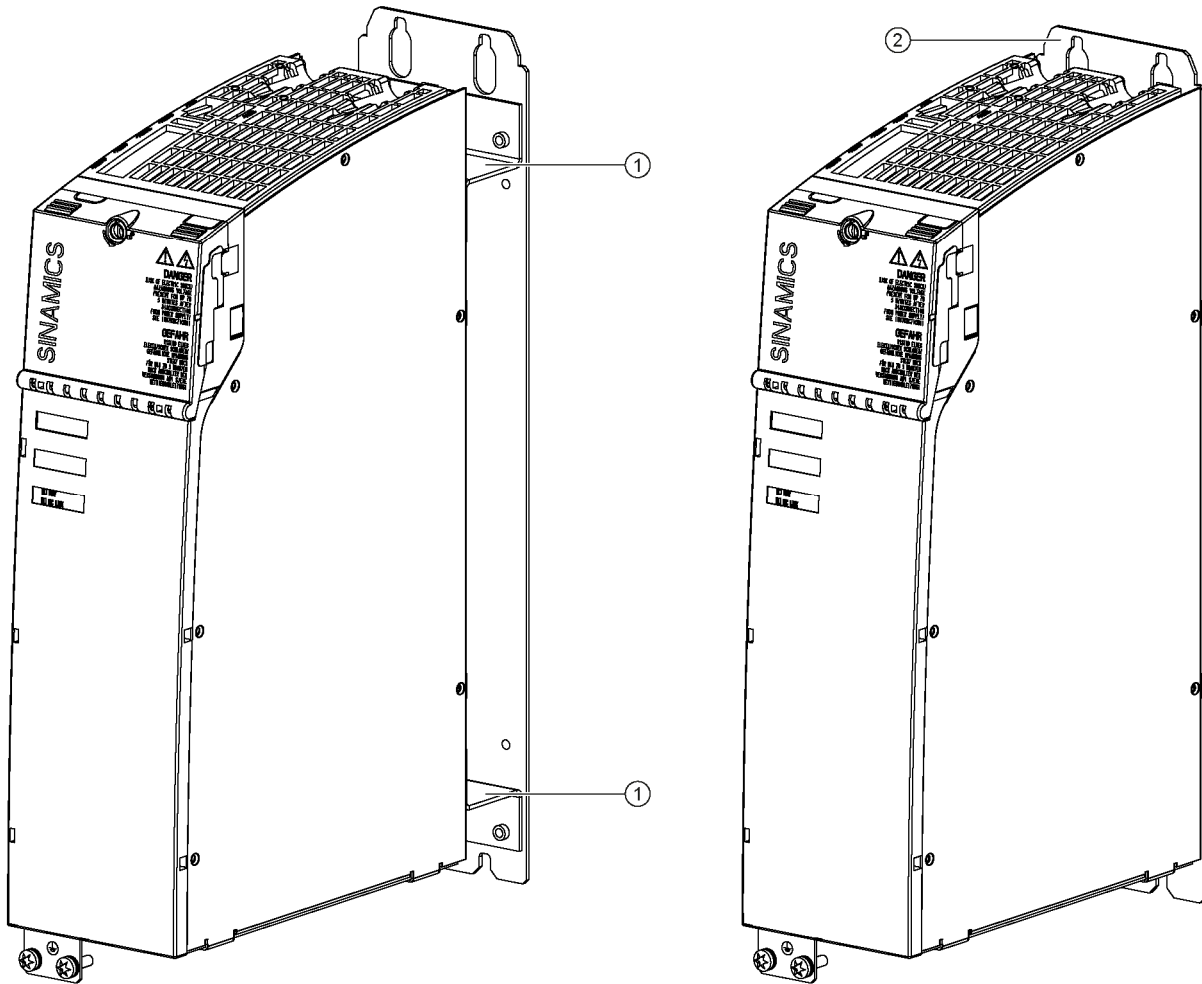


Figure 8-18 Dimension drawing of Capacitor Module, all dimensions in mm and (inches)

### 8.5.5 Mounting



- ① Delivery condition with spacer - mounting depth for drive line-up in booksize format with internal air cooling
- ② Spacer removed - mounting depth for drive line-up in booksize format with external air cooling

Figure 8-19 Mounting methods for Capacitor Module with and without spacer elements

The Capacitor Module can be attached to the cabinet panel with or without spacer elements.



## 8.5.6 Technical Specifications

Table 8- 21 Technical data

<b>6SL3100-1CE14-0AA0</b>		
DC link voltage	V <sub>DC</sub>	510 - 720
Electronics power supply	V <sub>DC</sub>	24 (20,4 - 28,8)
Capacitance	μF	4000
<b>Current carrying capacity</b>		
DC link busbar	A	100
24 V busbar	A	20
Power loss <sup>1)</sup>	W	25
Weight	kg	7.2

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

## 8.6 Control Supply Module CSM

### 8.6.1 Description

The Control Supply Module provides an output voltage of 24 V - 28.8 V DC. The output voltage can be adjusted using an integrated potentiometer.

In normal operation, the Control Supply Module is supplied from the line voltage. In the event of a power failure, the module 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 therefore ensures that the DC link is not unintentionally charged. The Control Supply Module can therefore remain connected to the supply if the Line Module is galvanically isolated from the supply, for example via a line contactor.

The 24 V ground of the Control Supply Module is internally grounded.  
The Control Supply Module is cooled using an internal fan.

Temperature and voltages are internally monitored.

#### **Temperature monitoring:**

In the event of an overtemperature in the Control Supply Module, a temperature advance warning is issued via a signaling contact. If the temperature falls below the limit value within the advance warning time, then the module remains operational and the signaling contact is de-energized. If the overtemperature condition persists, the module is switched off and restarted.

#### **Voltage monitoring:**

When the monitoring threshold (32 V) of the output voltage is exceeded for > 20 ms, the control supply module switches off and attempts a restart after 10 s. This is supplemented by a hardware-based overvoltage limiting. This prevents that more than 35 V can be output in the case of a fault.

The Control Supply Module can either be operated individually or in a parallel connection with a maximum of 10 devices. The switchover between single and parallel operation is realized in a no-current state using a DIP switch on the upper side of the module.

---

#### **Note**

##### **Compatibility**

The new Control Supply Module 6SL3100-1DE22-0AA1 with extended functions described here replaces Control Supply Module 6SL3100-1DE22-0AA0. The modules are downwards compatible (-0AA1 can be used as spare part for -0AA0).

---

## 8.6.2 Safety instructions for Control Supply Modules

### Note

When using a Control Supply Module, it is imperative that you observe the safety instructions in Section 1.



### WARNING

#### **Danger to life through electric shock**

The Control Supply Module has two supply circuits.

As a result of the DC link capacitors, a hazardous voltage is present for up to 5 minutes after the power supply has been switched off. This is the reason that it is only permissible to open the components after this time has expired.

To open the protective cover of the DC link, the release catch must be actuated with a suitable screwdriver.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further. If this is not observed, it can result in serious injury or death.

### WARNING

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

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

- Maintain the 80 mm clearances above and below the components.

### NOTICE

#### **Use of the 24 V terminal adapter**

When using the 24 V terminal adapter, it must be screwed onto the Control Supply Module. Use the enclosed EJOT-PT screw K30 x 16 (tightening torque, 0.5 Nm).

### 8.6.3 Interface description

#### 8.6.3.1 Overview

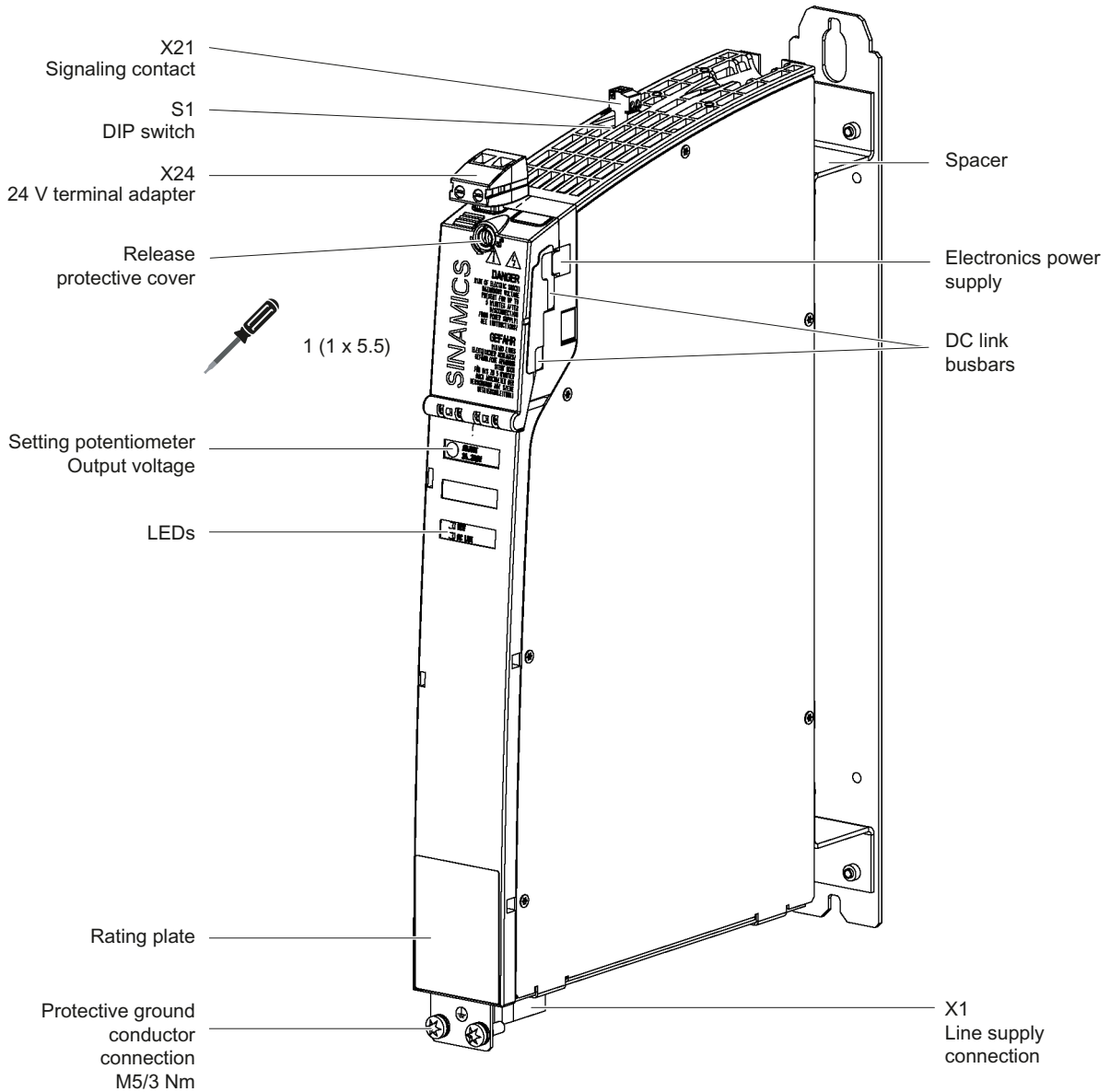
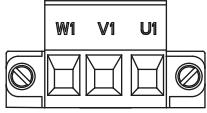
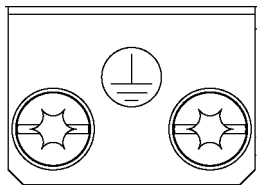


Figure 8-20 Interface overview, Control Supply Module

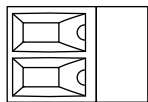
### 8.6.3.2 X1 line connection

Table 8- 22 X1 line connection

	Terminal	Technical specifications
	U1	Supply voltage: 380 V - 480 V 3 AC, 50 / 60 Hz Max. connectable cross-section: 4 mm <sup>2</sup> Type: Screw terminal 4 (see Chapter "Control cabinet installation and EMC / connection system") Tightening torque: 0.5 - 0.6 Nm
	V1	
	W1	
	PE connection	M5 screw / 3 Nm at the housing

### 8.6.3.3 X21 signaling contact

Table 8- 23 X21 signaling contact

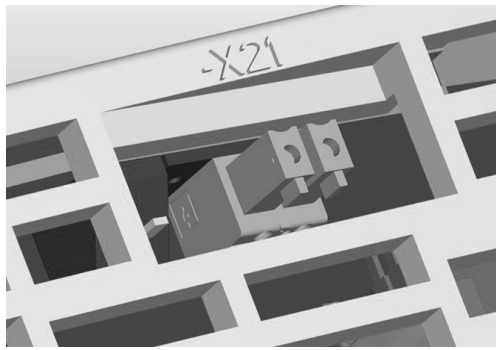
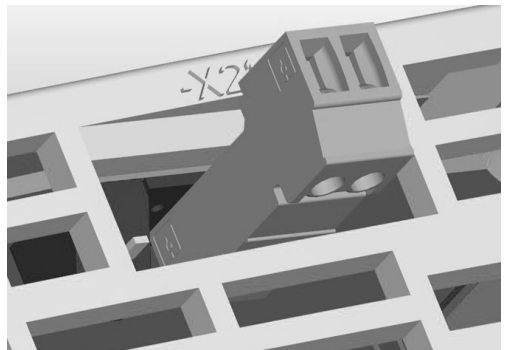
	Terminal	Technical specifications
	1	Voltage 24 V DC max. load current 0.5 A (ohmic load)
	2	
Max. connectable cross-section 1.5 mm <sup>2</sup> Type: Screw terminal 1_1 (see the chapter titled "Control cabinet installation and EMC/Connection system")		

The 2-pole terminal connector for the signaling contact is included in the Completion Kit provided.

The signaling contact can be connected with a digital input (DI) on the Control Unit or other digital interface (PLC, SCADA). In parallel or redundant operation the failure of a Control Supply Module is indicated in order to initiate a service call, for example.

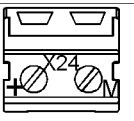
The signaling contact operates as an isolated NO contact. When the switch is closed, the Control Supply Module is "OK" and provides the output voltage. The switch opens in the event of a fault "Not OK" – when the overtemperature condition is still present, after a pre-warning, wire breakage, short-circuit etc. The Control Supply Module is correspondingly switched off.

Table 8- 24 Installing the signaling contact

	
<p>Signaling contact without terminal connector in the delivery condition</p>	<p>Signaling contact, complete with terminal connector</p>

### 8.6.3.4 X24 24 V terminal adapter

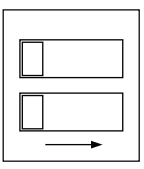
Table 8- 25 X24 24 V terminal adapter

	Terminal	Designation	Technical specifications
	+	24 V power supply	Supply voltage 24 - 28.8 V DC
	M	Ground	Electronics ground
<p>Max. connectable cross-section: 6 mm<sup>2</sup>                      Type: Screw terminal 5 (see Chapter "Control cabinet installation and EMC / connection system")</p>			

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

### 8.6.3.5 S1 DIP switch

Table 8- 26 DIP switch S1

	Terminal	Designation	Technical specifications
	1	Changeover switch, single operation / parallel operation	Left: Single operation Right: Parallel operation Changing over the output characteristic
	2	Dummy contact (not used)	

The changeover is only made in the no-voltage state.

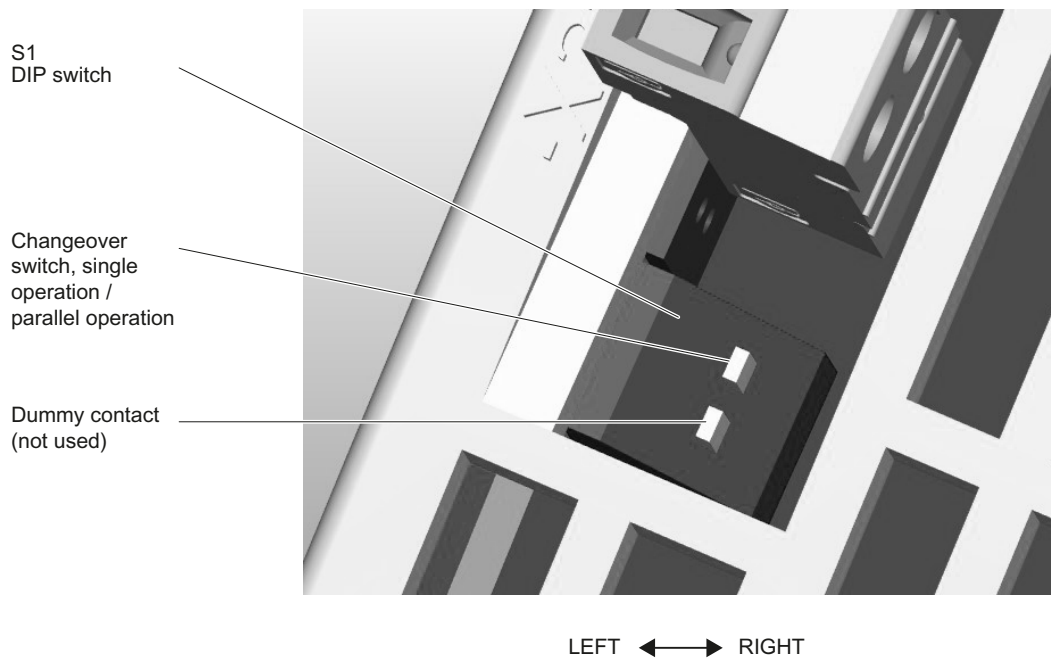


Figure 8-21 DIP switch on the upper side of the component

When delivered, "single operation" is set. Both switches are set to the left.

## 8.6.4 Connection examples

The Control Supply Module is connected to the line supply (3-ph. 380 VAC –10% to 480 VAC +10%) via interface X1 (screw terminals 0.2 to 4 mm<sup>2</sup>). This connection should preferably be made without using an isolating device (e.g. contactor).

The Control Supply Module has an internal line filter (Class A for TN systems), and the pre-charging circuit for the DC link inside the device is electrically isolated from the 24 V supply.

The Control Supply Module also features a current limitation function.

---

### Note

If you use cables with a cross-section of 2.5 mm<sup>2</sup>, no additional protection is required on the 24 V side for the following cable types:

- Cables of the XLPE type
- Cables of the EPR type
- Cable with a similar quality and with a thermal stability of up to 90° C

---

### Note

#### Observe the connection sequence

If a selectively tripping, AC/DC-sensitive RCCB is used for the drive line-up, the Control Supply Module must always be connected to the line supply downstream of this circuit breaker. Otherwise, the residual current operated circuit breaker will trip erroneously if the direct-current component is asymmetrically withdrawn in certain operating states.

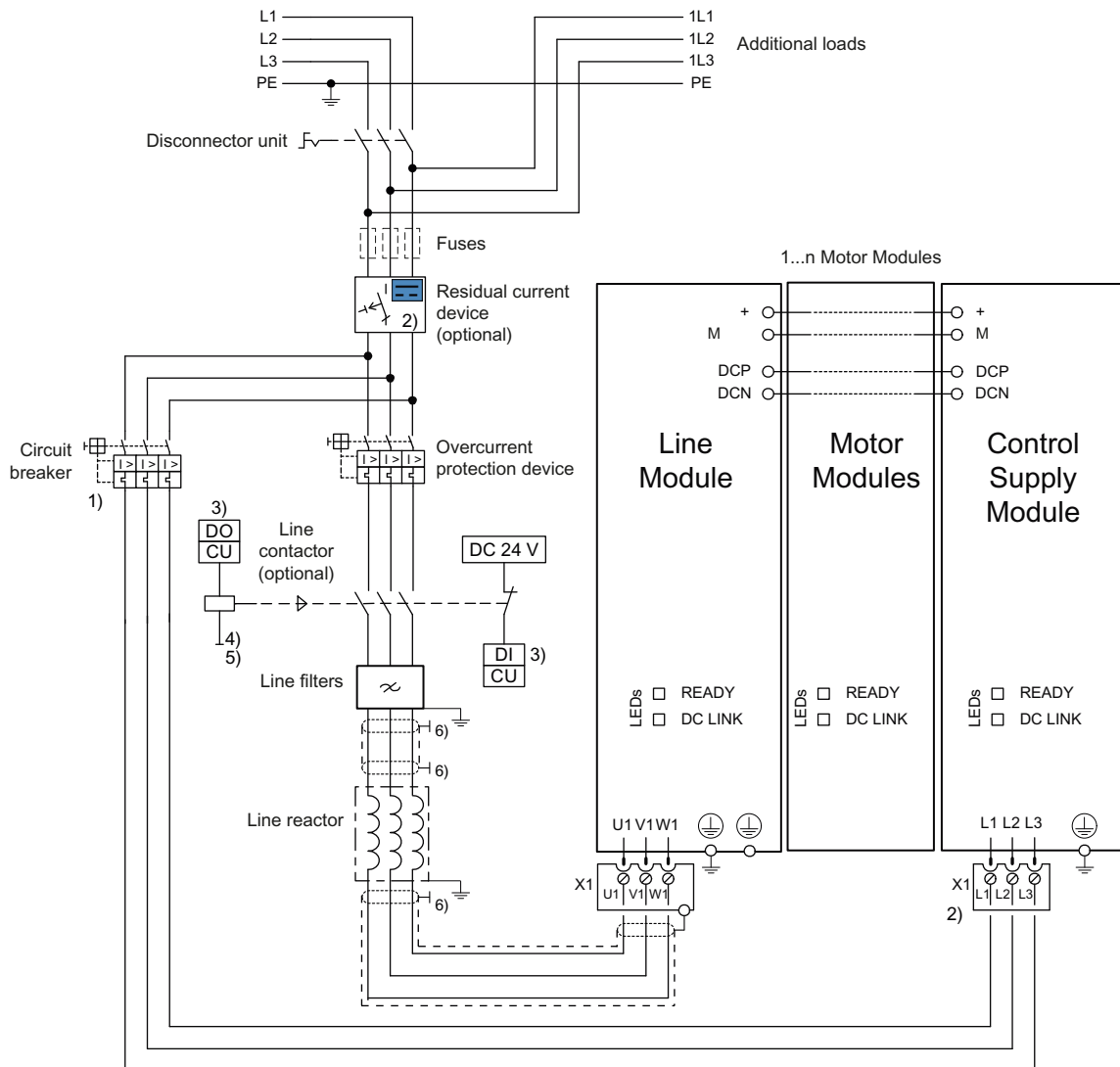
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### 8.6.4.1 Single operation

Within the drive line-up, the Control Supply Module must be connected to the drive line-up via the DC link busbars as well as the 24 V busbars. The red 24 V connector from the accessories pack provided must be inserted under all circumstances. The DIP switch on the Control supply Module must be set to "single mode" The connection can be established as shown below.

The supply for other 24 V loads outside the drive line-up using additional Control Supply Modules, whose outputs are not connected in parallel, must be realized using the 24 V terminal adapter (do not insert the red 24 V connector).





- 1) Permissible types:
  - a) Circuit breaker type SIRIUS, 3RV 1021 1DA10, set to 3A
  - b) Branch circuit fuse type KTS-R-6 (class RK1)
- 2) The mains connection must always be available
- 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) Contacting via rear mounting panel or shielding buses in accordance with EMC Directive

Figure 8-22 Connection example for Control Supply Module in single operation

### 8.6.4.2 Parallel operation

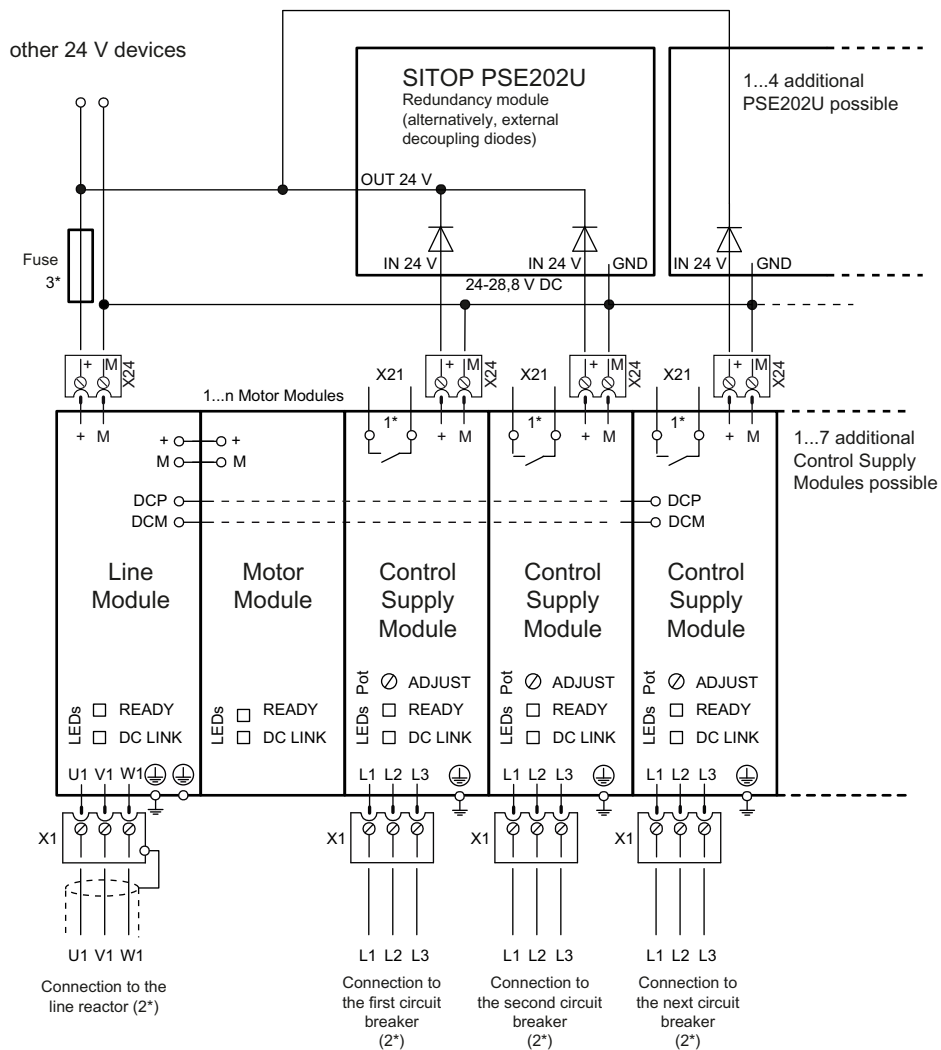
A maximum of 10 Control Supply Modules can be connected in parallel.

The DIP switch of the Control supply Module must be set to "parallel mode". The same output voltage must be set for all modules at the adjusting potentiometer.

In parallel mode, each Control Supply Module should supply the 24 V DC voltage via the 24 V terminal adapter. For this reason, the red 24 V connector must **not** be used (see connection examples).

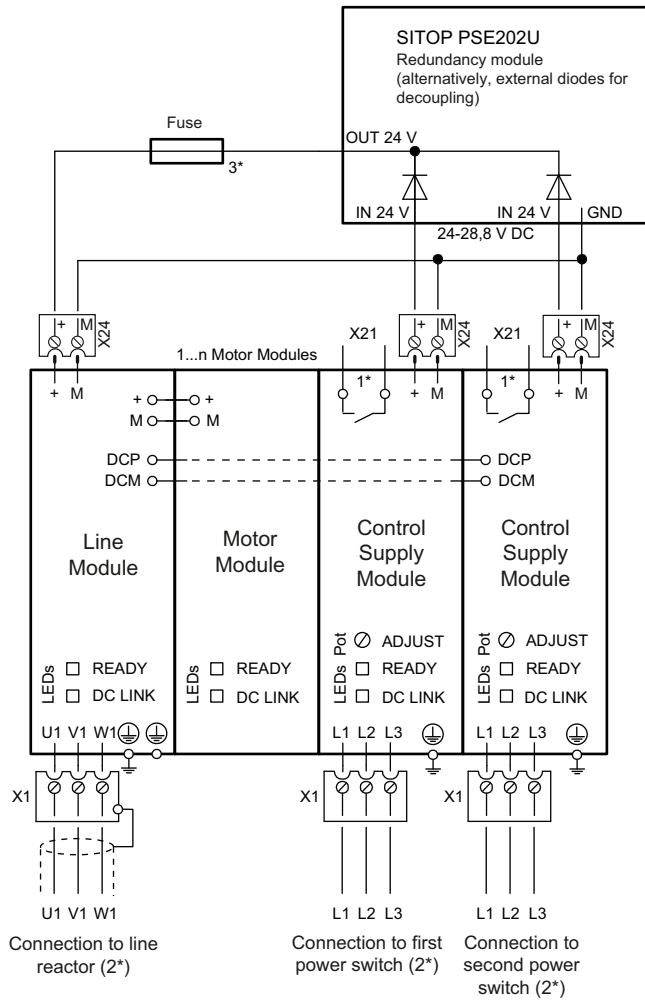
Use of a SITOP redundancy module (6EP1961-3BA20) is recommended for parallel connection. One SITOP redundancy module must be used for two Control Supply Modules in this case. Alternatively, a connection with external diodes to decouple the individual Control Supply Modules is possible. If a Control Supply Module fails, an alarm is generated and provided via the X21 signaling contact. The 24 V supply is maintained via the second module.

<b>NOTICE</b>
Only Control Supply Modules with order number 6SL3100-1DE22-0AA1 may be used for parallel connection.



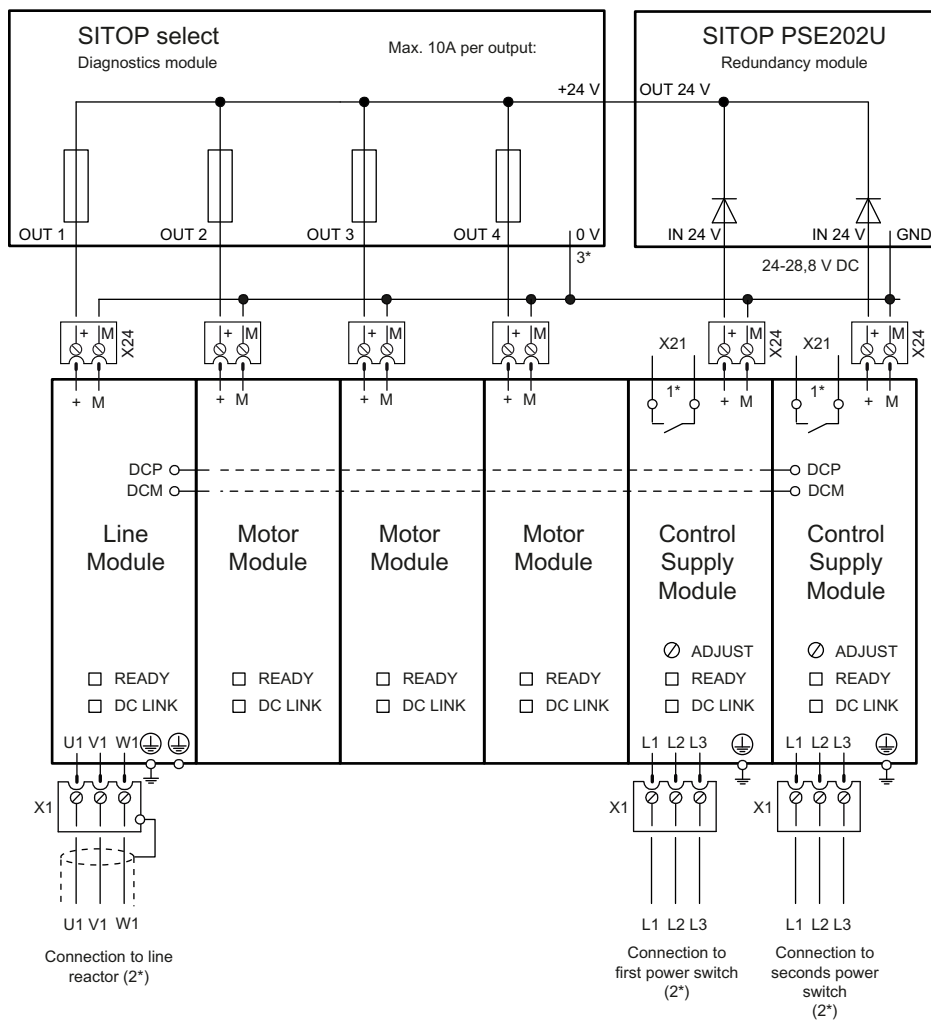
1\* connection to digital interface (SCADA or PLC); closed, means: 24 V OK  
 2\* continue as in "Connection example Control Supply Module in individual operation"  
 3\* max. permissible 20A continuous current (refer to the fuse characteristics)

Figure 8-23 Connection example for parallel connection of 2 to 10 Control Supply Modules via SITOP PSE202U redundancy module



1\* Connection to digital interface (SCADA or PLC); closed means: 24 V OK  
 2\* continue as for "connection example Control Supply Module in single mode"  
 3\* max. permissible 20A continuous current (see fuse characteristics)

Figure 8-24 Connection example for a redundancy circuit with two Control Supply Modules via SITOP PSE202U redundancy module



1\* Connection to digital interface (SCADA or PLC); closed means: 24 V OK  
 2\* continue as for "connection example Control Supply Module in single mode"  
 3\* Functional reference point (not load with high current)

Figure 8-25 Connection example for parallel connection of Control Supply Modules via SITOP PSE202U redundancy module and a SITOP select diagnostic module (6EP1961-2BA00)

8.6 Control Supply Module CSM

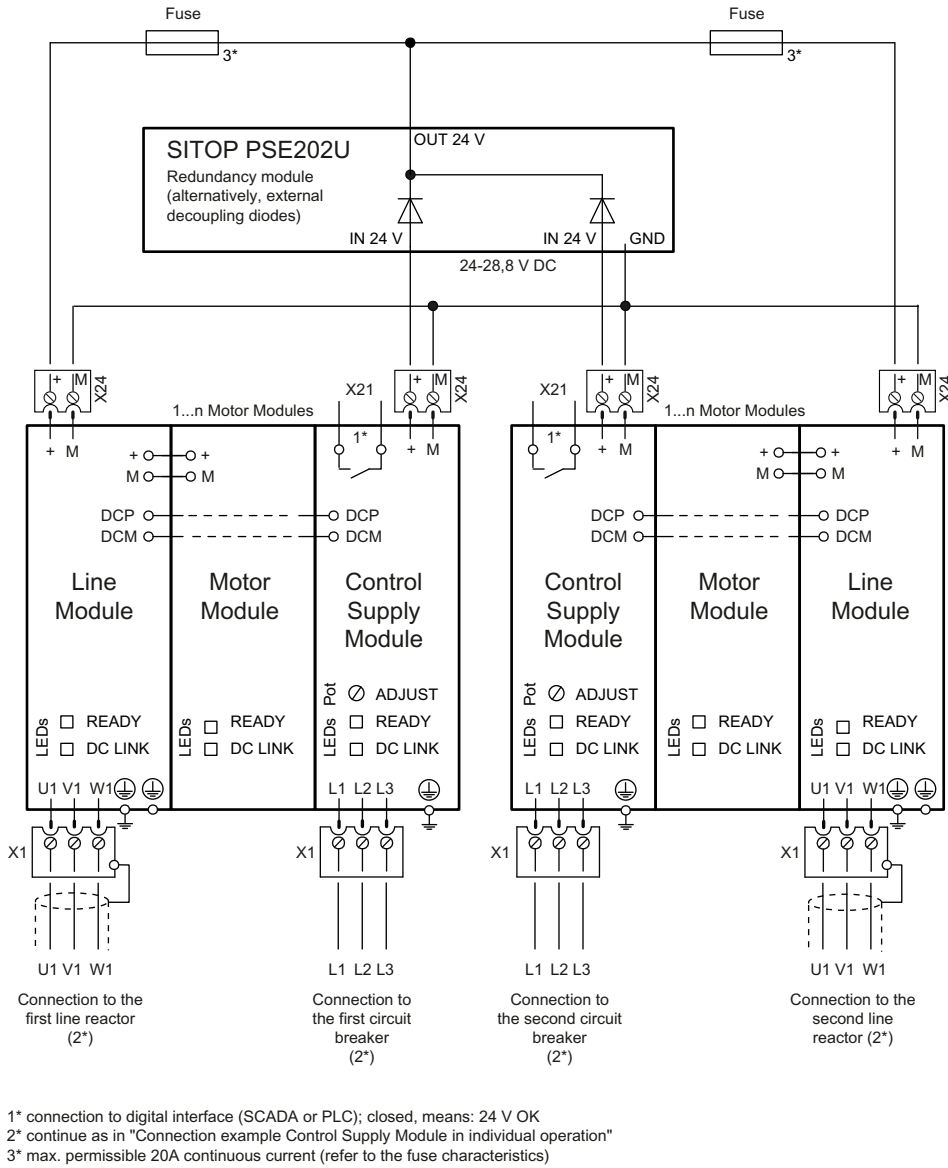


Figure 8-26 Connection example for operation of 2 units with Control Supply Modules via a SITOP PSE202U redundancy module

## 8.6.5 Meaning of LEDs

Table 8- 27 Meaning of the LEDs on the Control Supply Module

LED	Color	Status	Description
READY	-	Off	Electronics power supply outside the permissible tolerance range or temperature advance warning active
	Green	Continuous light	Ready for operation. Output voltage in the tolerance range and temperature advance warning inactive
DC LINK	-	Off	DC input voltage $V_{E\ DC} < 280...300\ V$ Buffer operation not possible
	Yellow	Continuous light	DC input voltage in the range $360...380 < V_{E\ DC} < 820\ V \pm 3\ \%$ Buffer operation possible
	Red	Continuous light	DC input voltage outside the tolerance range: $V_{E\ DC} < 360...380\ V$ or $V_{E\ DC} > 820\ V \pm 3\ \%$

### 8.6.6 Dimension drawing

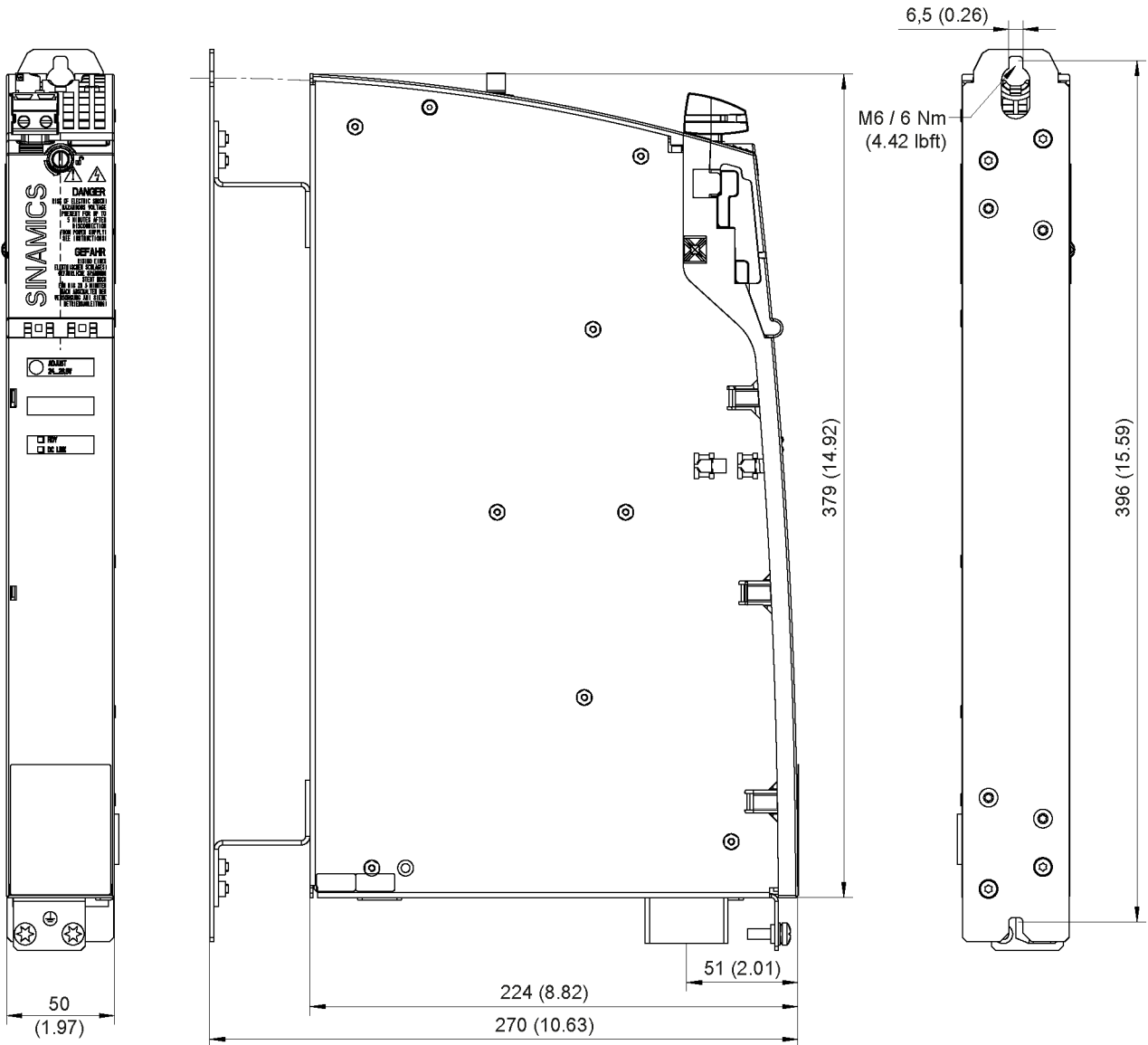
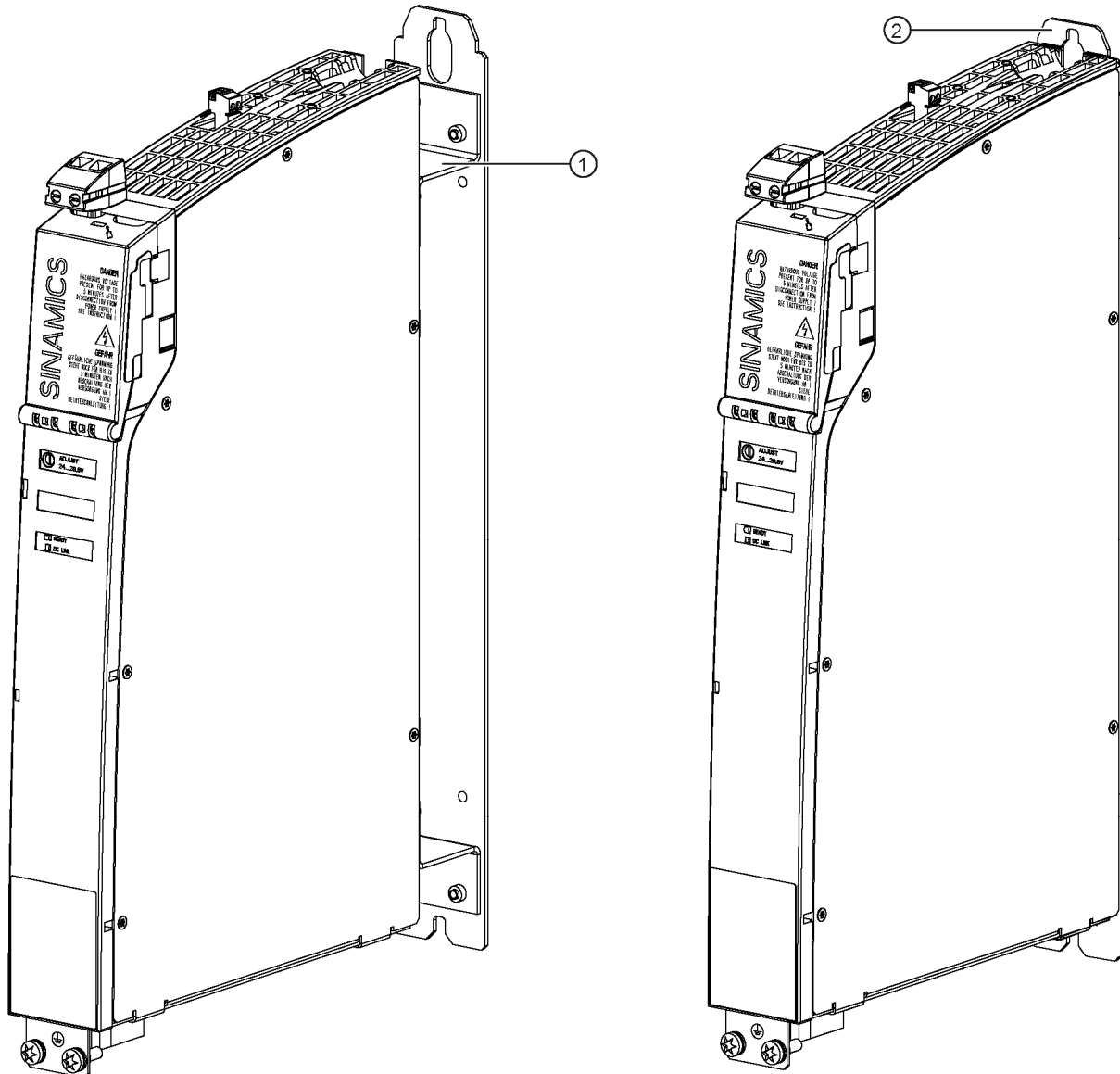


Figure 8-27 Dimension Control Supply Module, all dimensions in mm and (inches)



### 8.6.7 Installation



- ① Delivery condition with spacer - mounting depth for drive line-up in booksize format with internal air cooling
- ② Spacer removed - mounting depth for drive line-up in booksize format with external air cooling

Figure 8-28 Methods of installing the Control Supply Module with and without spacer

The Control Supply Module can be attached to the control cabinet panel with or without spacers.

## 8.6.8 Technical data

Table 8- 28 Technical data

6SL3100-1DE22-0AA1	Unit	Value
<b>Input data, AC input</b>		
Line voltage	V <sub>AC</sub>	3-ph. 380 - 480 V <sub>AC</sub> ± 15%
Line frequency	Hz	45 to 66
Rated input current		
Rated value (at V <sub>E rated</sub> )	A <sub>AC</sub>	≤ 2
Starting current inrush	A <sub>AC</sub>	≤ 28 at > 5 ms
<b>Input data, DC input</b>		
Rated input voltage	V <sub>DC</sub>	600
Input voltage range	V <sub>DC</sub>	300 - 882
DC link voltage (continuous input voltage)	V <sub>DC</sub>	430 to 800 300 - 430 < 1 min 800 - 853 < 1 min 853 - 882 < 10 s
Supply current (at 600 V)	A <sub>DC</sub>	1.1
Overtoltage trip	V <sub>DC</sub>	> 882
Undervoltage trip	V <sub>DC</sub>	280 ± 3 %
<b>Output data</b>		
Rated output voltage V <sub>A rated</sub> :	V <sub>DC</sub>	24 - 28.8 V
Rated output current I <sub>A rated</sub> <sup>1)</sup>	A <sub>DC</sub>	20
Rated output power P <sub>A rated</sub>	W	520
Overcurrent limitation for short-circuit	A <sub>DC</sub>	approx. 23
Surge suppression	V	< 35
Current carrying capacity of the 24 V busbar	A <sub>DC</sub>	20
Residual ripple (clock frequency approx. 50 kHz)	mV <sub>pp</sub>	< 100
Cycle peaks (bandwidth 20 MHz)	mV <sub>pp</sub>	< 200
Power loss ride-through (at 400 V <sub>AC</sub> )	ms	5
<b>Power loss</b> <sup>2)</sup>		
Line	W	70
DC link		65
<b>Efficiency</b>	%	>83
<b>Circuit breaker (UL)</b>		
Type designation:		3RV1021-1DA10
Rated current:	A	2.2 to 3.2 (setting value 3)
Resulting rated short-circuit current	kA	100
SCCR at 480 V <sub>AC</sub> :		
<b>Fuses (UL)</b>		
Class RK1, listed JDDZ		
Rated current:	A	6
resulting rated short-circuit current	kA	200
SCCR at 480 V <sub>AC</sub> :		
<b>Cooling method</b>		Internal air cooling

6SL3100-1DE22-0AA1	Unit	Value
Max. ambient temperature without derating	° C	≤40
with derating as of 26 V output voltage	° C	>40 to 55
Weight	kg	4,8

- 1) As of 40° C, a linear derating of the output current for 26 V output voltage and higher must be observed.
- 2) For an overview, see the power loss tables in Section "Control cabinet installation".

### 8.6.8.1 Characteristics

#### Derating characteristic

For ambient temperatures > 40°C, a linear derating for the output current must be observed as of 26 output voltage.

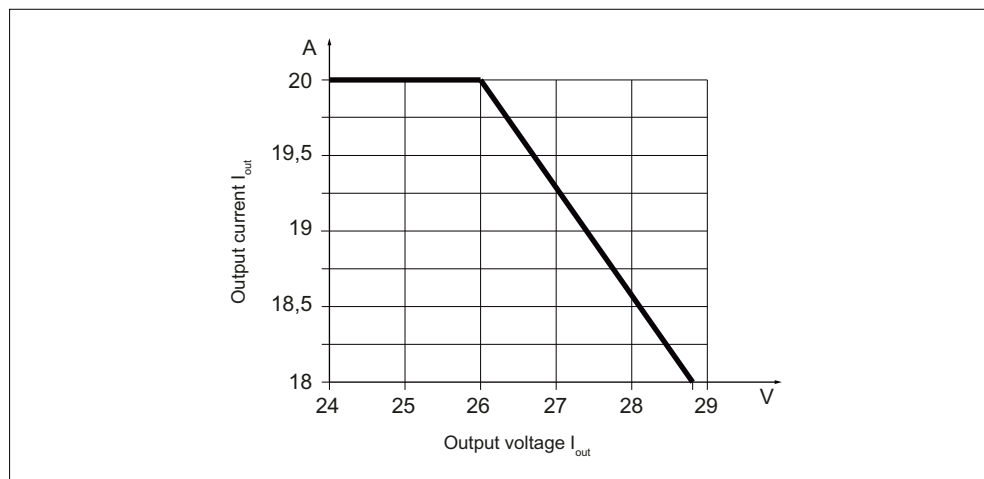


Figure 8-29 Current derating for ambient temperatures >40°C as a function of the output voltage

## 8.7 Voltage Clamping Module VCM

### 8.7.1 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](mailto: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

## 8.7.2 Safety instructions for Voltage Clamping Modules

### Note

When using a Voltage Clamping Modules, it is imperative that you observe the safety instructions in Section 1.

### WARNING

#### Fire hazard due to overheating because of inadequate ventilation clearances

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

- Maintain the 80 mm clearances above and below the components.

### NOTICE

#### Functional ground

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.
- Do **not** use a green/yellow cable for the functional ground of the Voltage Clamping Module.

### 8.7.3 Interface description

#### 8.7.3.1 Overview

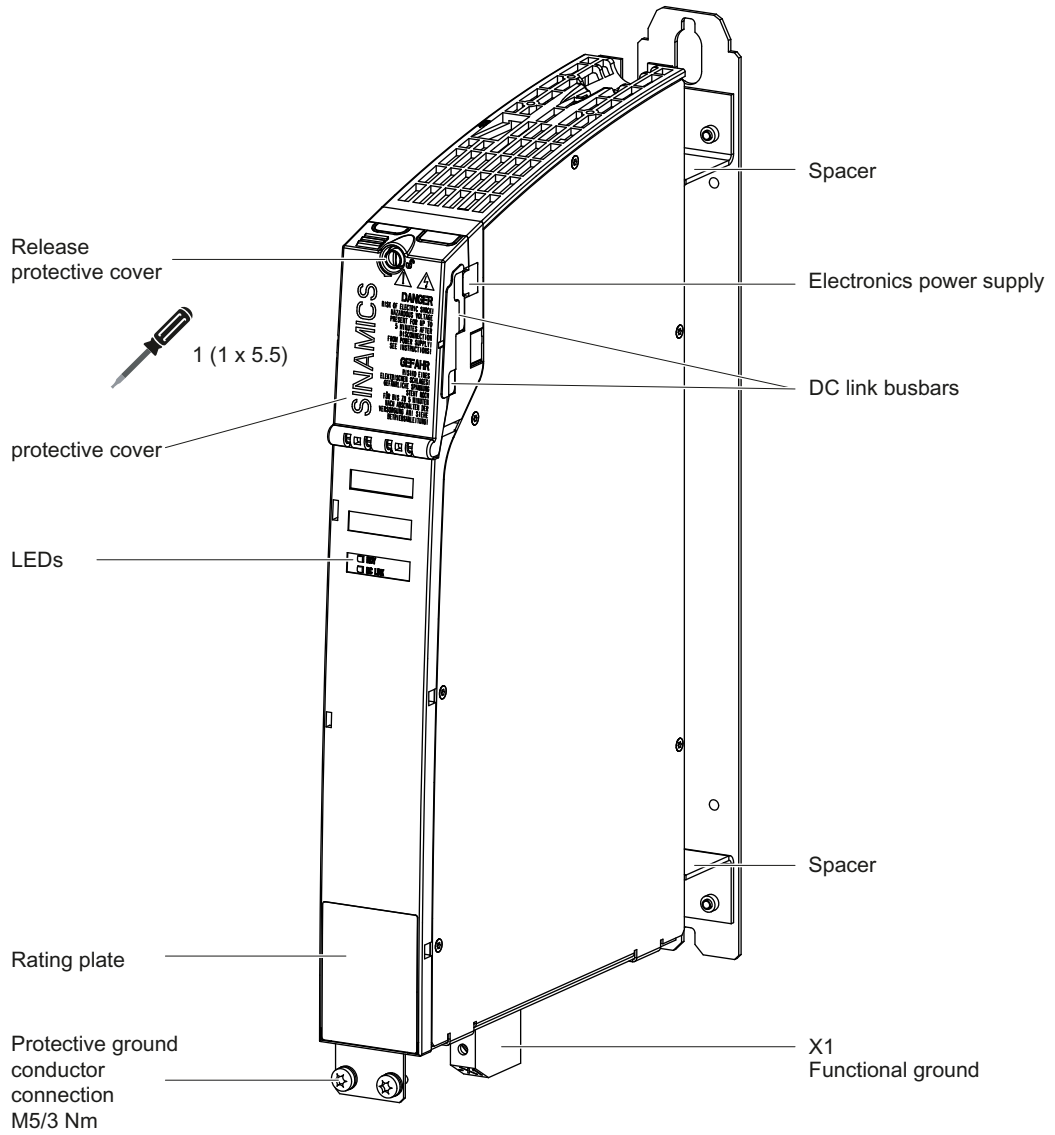


Figure 8-30 Interface overview, Voltage Clamping Module

### 8.7.3.2 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 mm<sup>2</sup> to 16 mm<sup>2</sup>
- 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.

### 8.7.4 Connection example

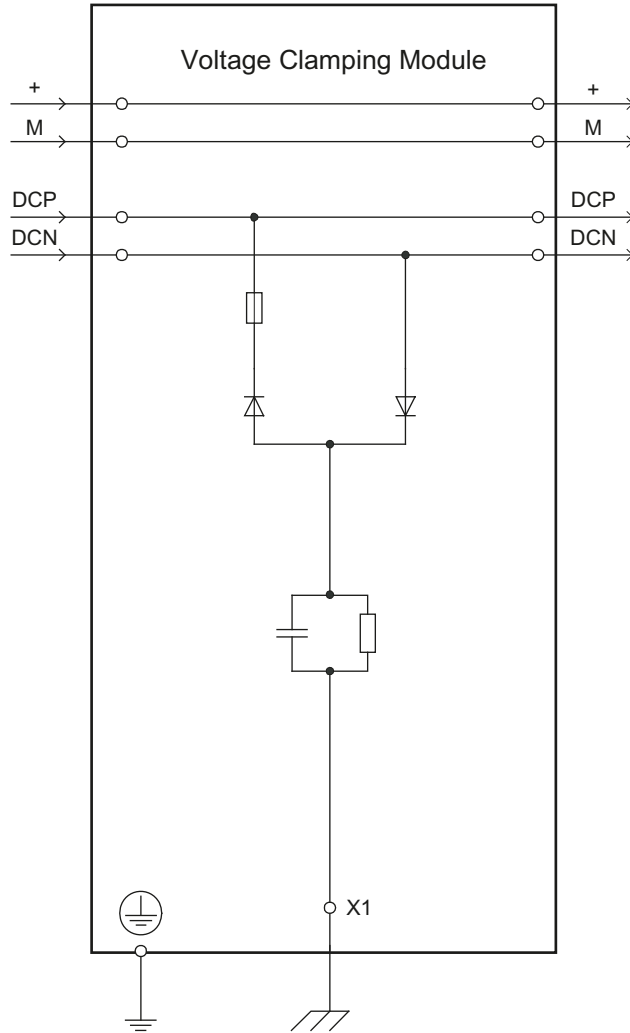


Figure 8-31 Connection example for the Voltage Clamping Module



8.7.5 Dimension drawing

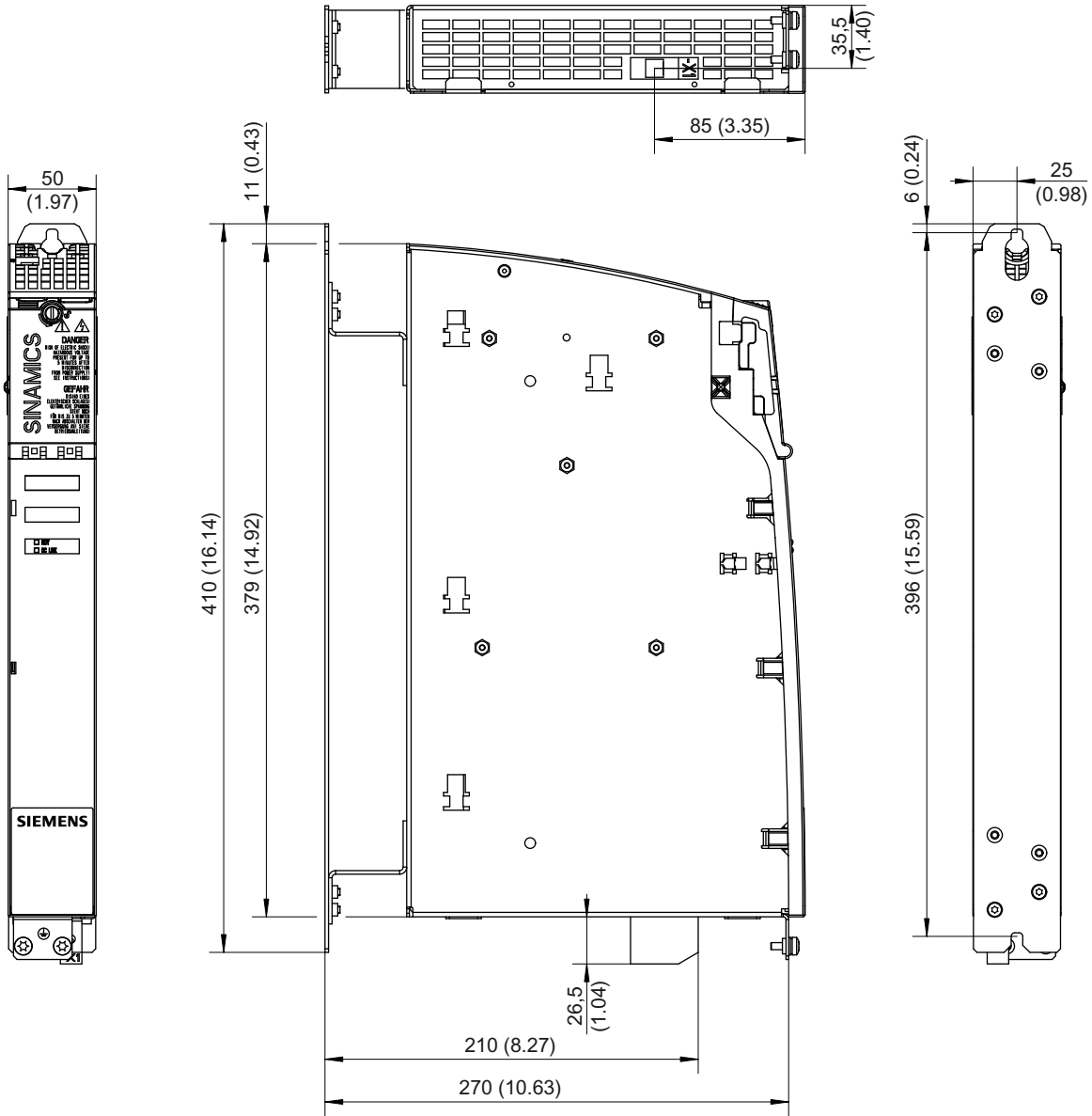


Figure 8-32 Dimension drawing of Voltage Clamping Module, all dimensions in mm and (inches)

### 8.7.6 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.

### 8.7.7 Technical specifications

Table 8- 29 Technical data

<b>6SL3100-1VE00-0AAx</b>		
DC link voltage	V <sub>DC</sub>	510 - 720
Electronics power supply	V <sub>DC</sub>	24 (20,4 - 28,8)
<b>Current carrying capacity</b>		
DC link busbar	A	100
24 V busbar	A	20
Power loss <sup>1)</sup>	W	50
Weight	kg	3.1

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

#### Derating characteristic

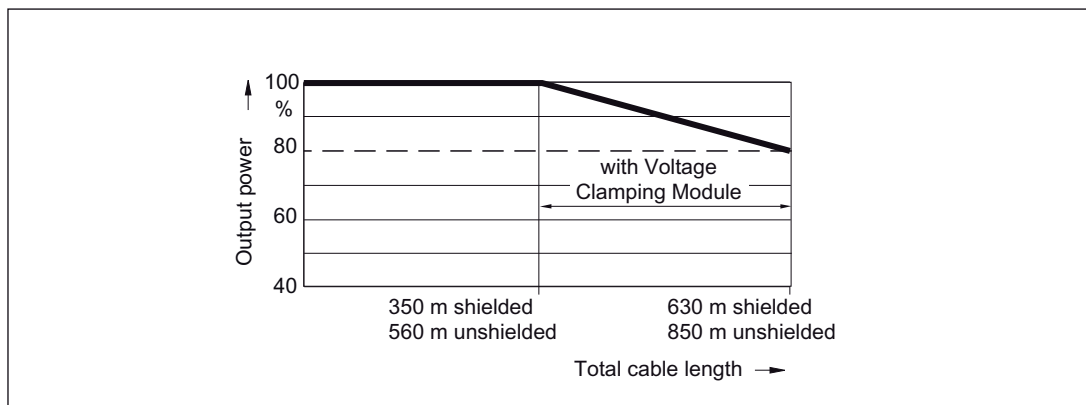


Figure 8-33 Output power as a function of the total cable length

## Braking resistors

### 9.1 Description

A braking resistor is used to dissipate the excess DC link energy in generator operation. The braking resistors can be connected to a Braking Module or directly to a 20 kW or 40 kW Basic Line Module.

Resistors with and without a thermostatic switch are available with various rated powers. The thermostatic switch monitors the braking resistors for overtemperature and issues a signal on a floating contact if the limit value is exceeded.

Table 9- 1 Assignment of braking resistors

Braking resistor	Braking Module Booksize	Braking Module Booksize Compact	Basic Line Module 20 kW	Basic Line Module 40 kW
<b>Braking resistors without a thermostatic switch</b>				
<b>6SN1113-1AA00-0DA0</b> Resistance: 17 $\Omega$ P <sub>N</sub> : 0.3 kW	X	X		
<b>6SL3100-1BE31-0AA0</b> Resistance: 5.7 $\Omega$ P <sub>N</sub> : 1.5 kW	X	X		
<b>Braking resistors with a thermostatic switch</b>				
<b>6SE7018-0ES87-2DC0</b> Resistance: 80 $\Omega$ P <sub>N</sub> : 1.25 kW		X	X	X
<b>6SE7021-6ES87-2DC0</b> Resistance: 40 $\Omega$ P <sub>N</sub> : 2.5 kW		X	X	X
<b>6SE7023-2ES87-2DC0</b> Resistance: 20 $\Omega$ P <sub>N</sub> : 5 kW		X	X	X
<b>6SE7028-0ES87-2DC0</b> Resistance: 8 $\Omega$ P <sub>N</sub> : 12.5 kW				X

### Installation

The braking resistors can be installed standing on the floor of the control cabinet or suspended. You must ensure that the braking resistors do not obstruct the flow of cooling air to the drive line-up.

Positioning the braking resistor outside the control cabinet or switchgear room enables the resulting thermal losses to be routed away. This reduces the level of air conditioning required.

### Connection cables

A shielded connection cable (3 m, 3 x 1.5 mm<sup>2</sup>) is supplied with braking resistor 6SN1113-1AA00-0DA0.

All other braking resistors are supplied without a connection cable. The maximum conductor cross-sections are listed in the technical data.

The maximum cable length for all braking resistors is 10 m.

## 9.2 Safety instructions for braking resistors

### Note

When using braking resistors, also observe the safety instructions in Section 1.

#### WARNING

##### Fire hazard and device damage through ground fault / short-circuit

The cables to the braking resistor must be laid so that a ground fault or short-circuit is impossible. A ground fault can cause a fire with smoke development.

- Use the local installation regulations to avoid this fault.
- Protect the cables against mechanical damage.

Also implement one of the following measures:

- Use cables with double insulation.
- Maintain adequate clearance, using spacers, for example
- Lay the cables in separate cable ducts or conduits.

#### CAUTION

##### Risk of burns due to high surface temperatures

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

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

## 9.3 Dimension drawings

### Braking resistors without a thermostatic switch

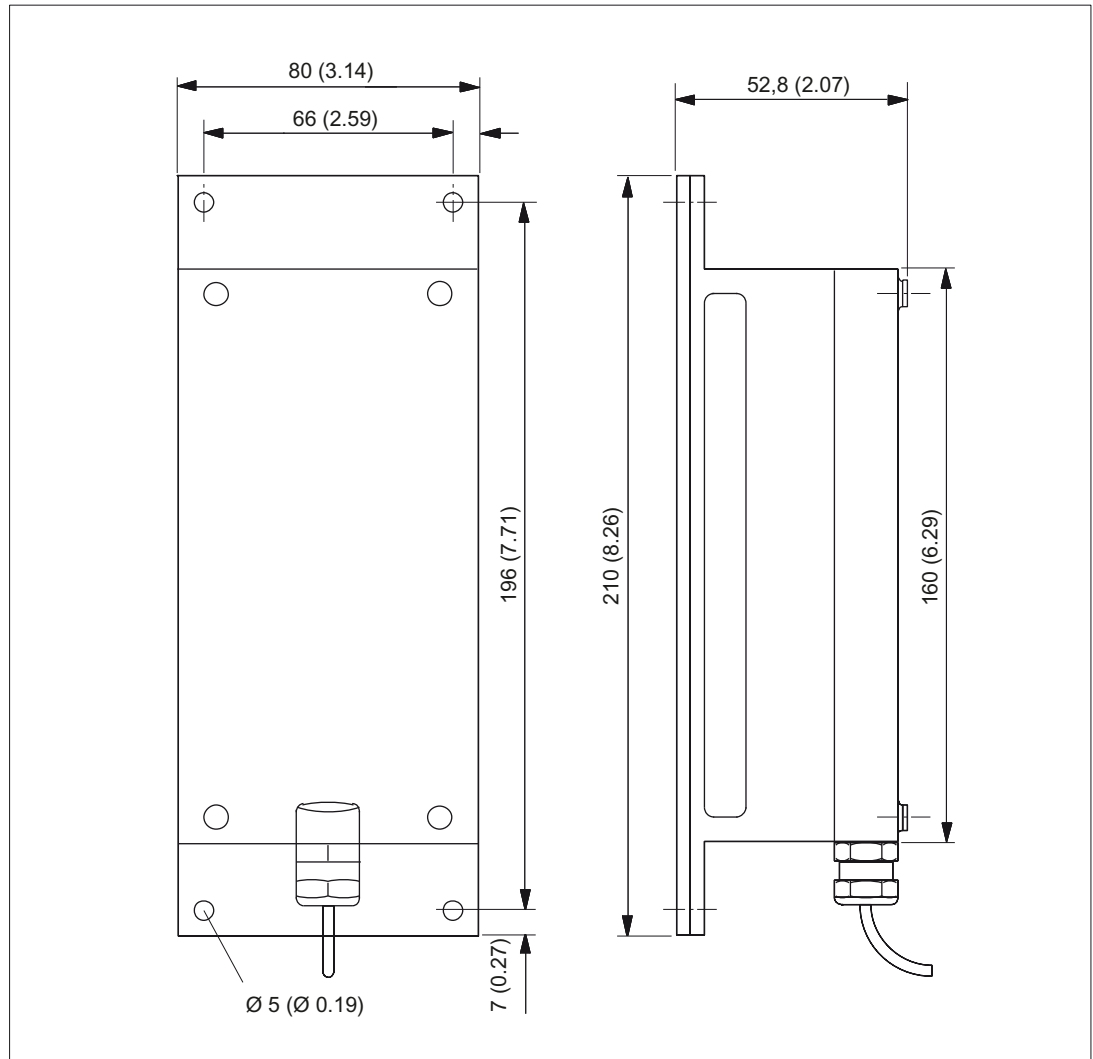


Figure 9-1 Dimension drawing of braking resistor 6SN1113-1AA00-0DA0 where  $P_n/P_{max} = 0.3 \text{ kW}/25 \text{ kW}$ , all dimensions in mm and (inches)

9.3 Dimension drawings

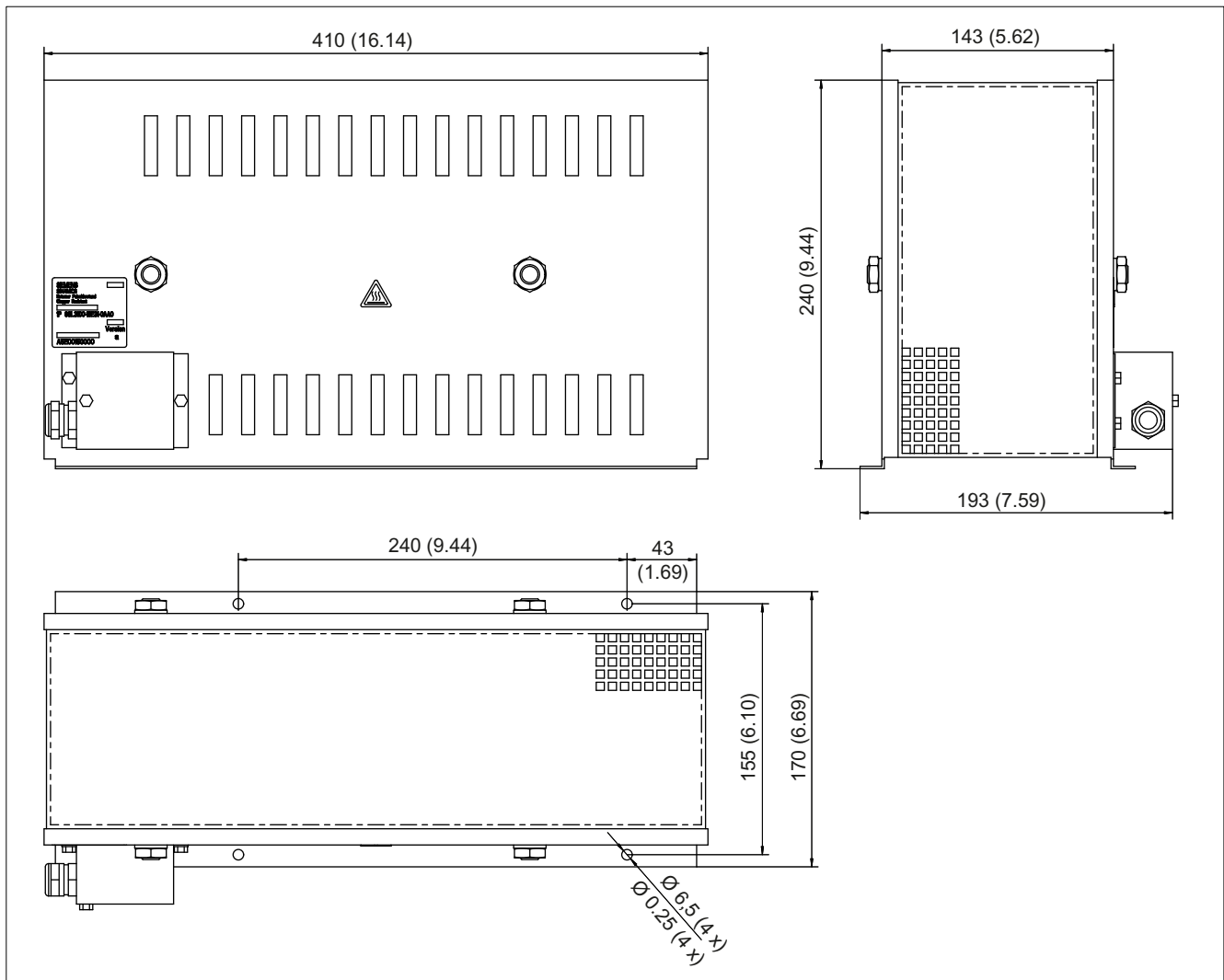


Figure 9-2 Dimension drawing of braking resistor 6SL3100-1BE31-0AA0 where  $P_n/P_{max} = 1.5 \text{ kW}/100 \text{ kW}$ , all dimensions in mm and (inches)

Braking resistors with a thermostatic switch

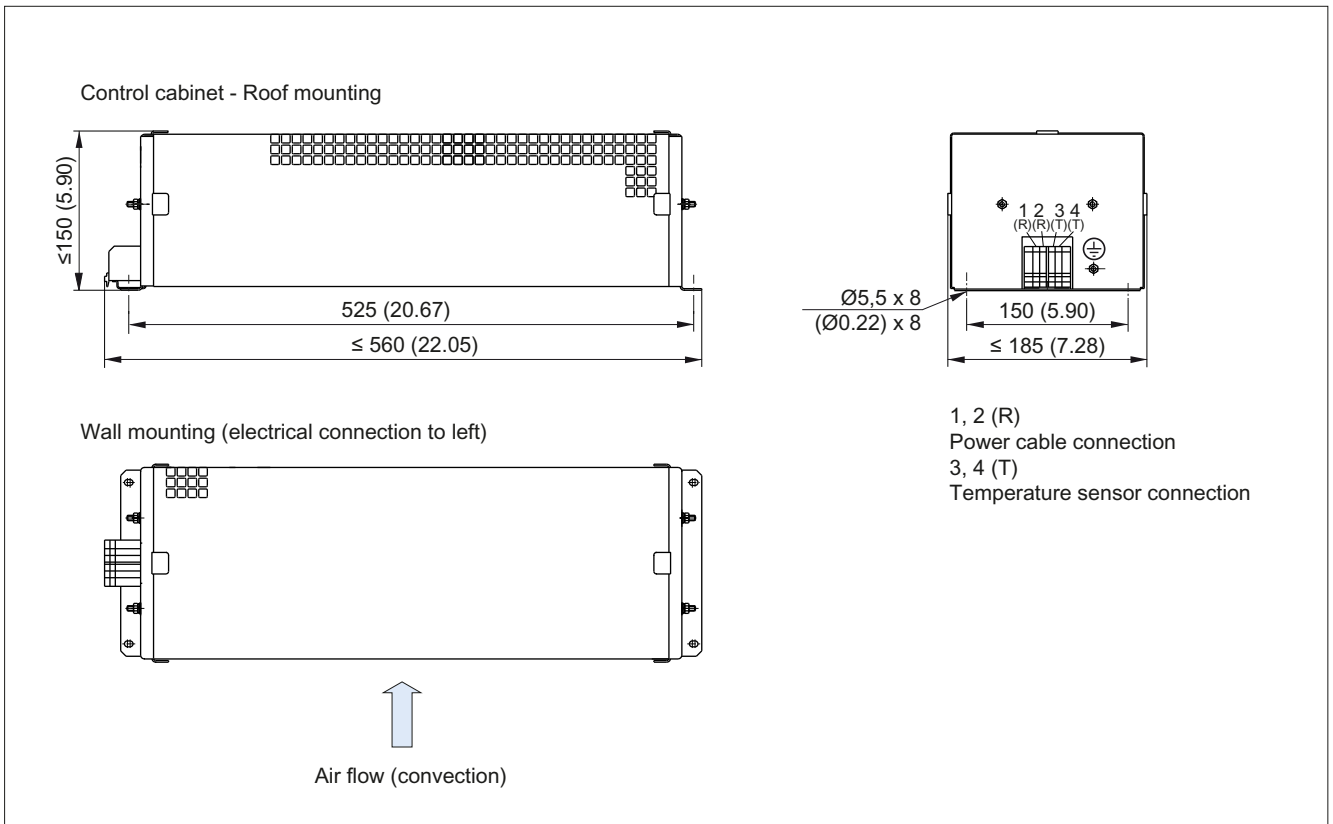


Figure 9-3 Dimension and installation drawing (roof and wall mounting) of braking resistor 6SE7018-0ES87-2DC0 where  $P_n/P_{max} = 1.25 \text{ kW}/7.5 \text{ kW}$ , all dimensions in mm and (inches)

9.3 Dimension drawings

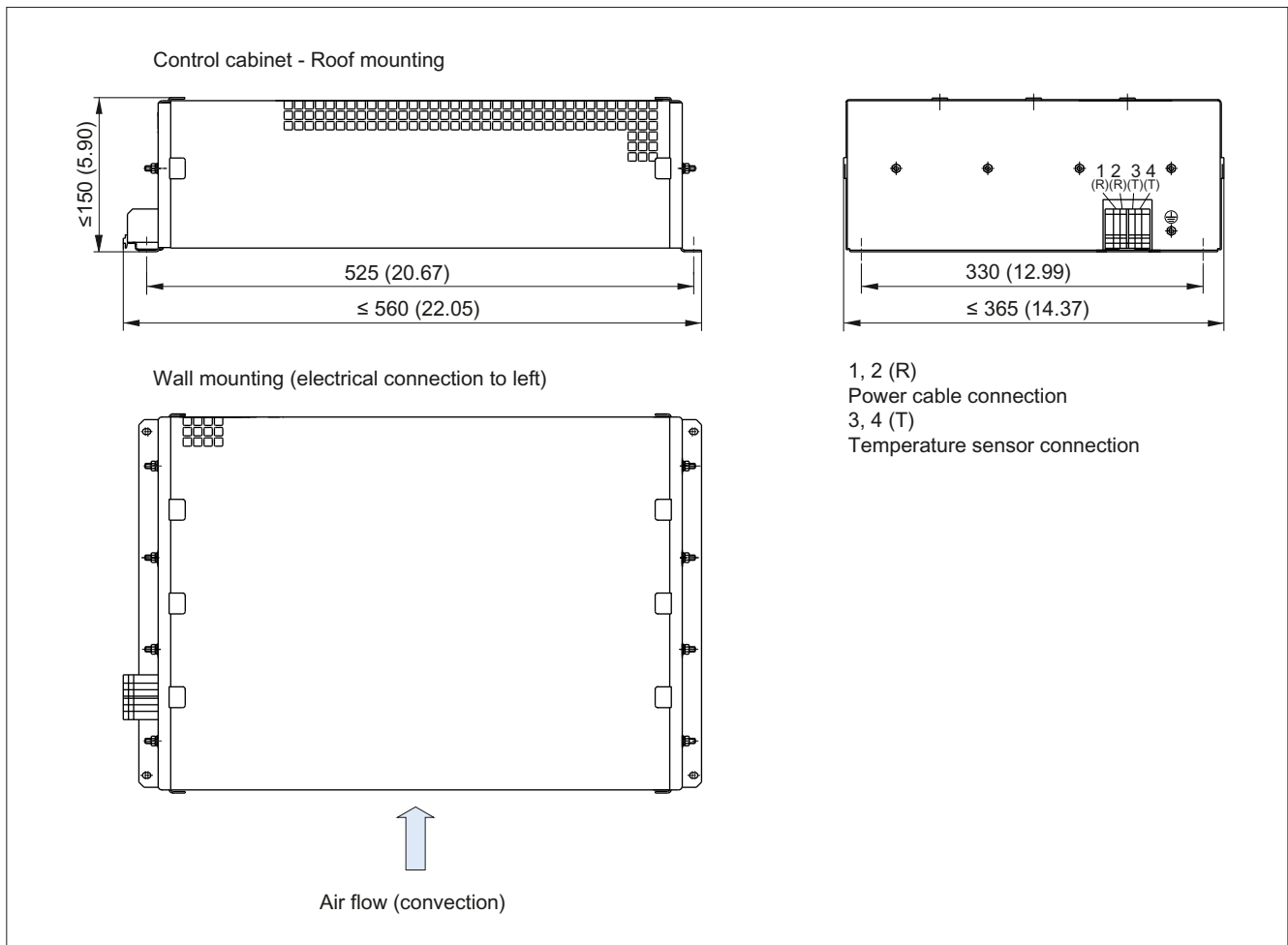


Figure 9-4 Dimension and installation drawing (roof and wall mounting) of braking resistor 6SE7021-6ES87-2DC0 where  $P_n/P_{max} = 2.5 \text{ kW}/15 \text{ kW}$ , all dimensions in mm and (inches)



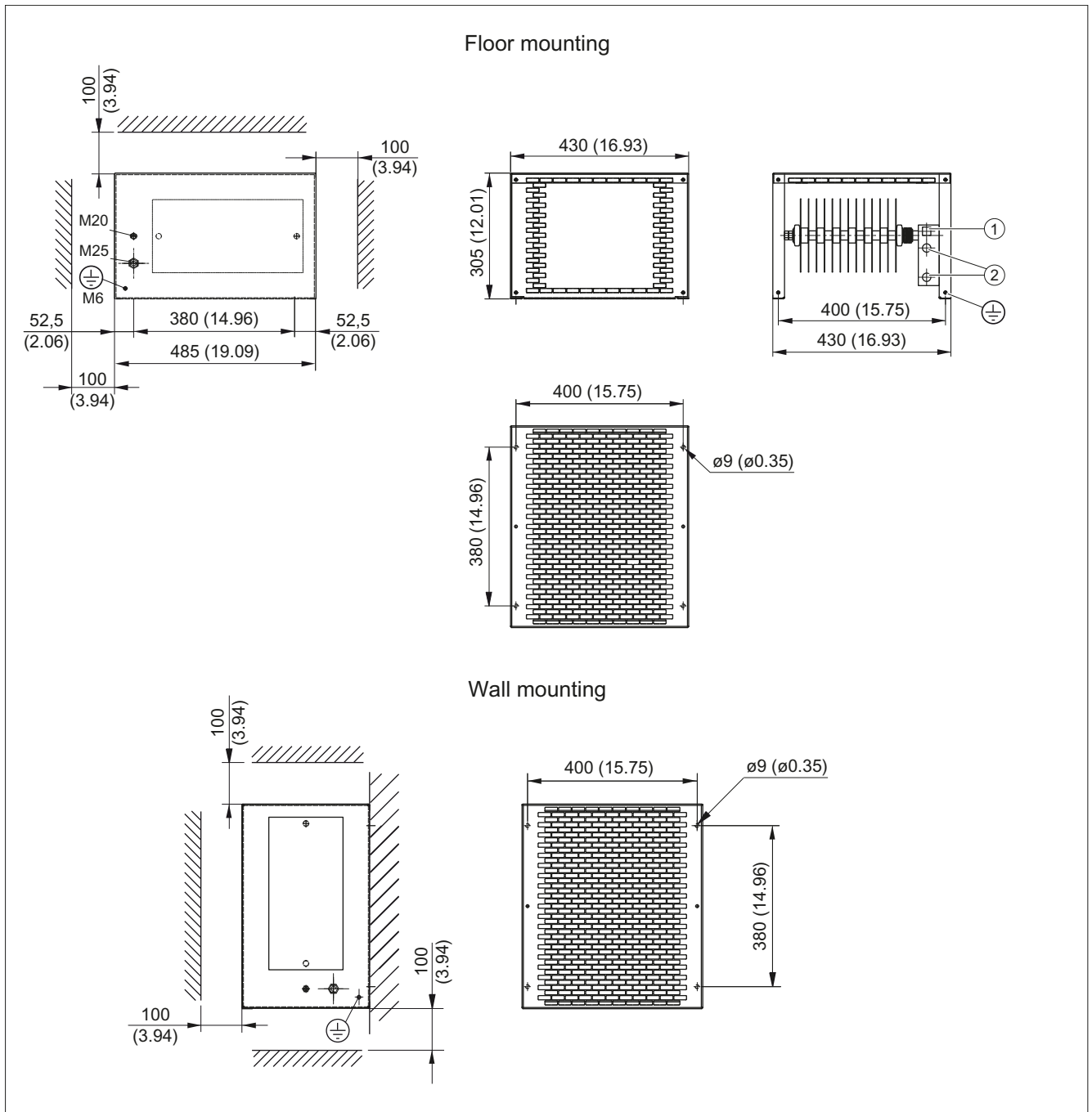
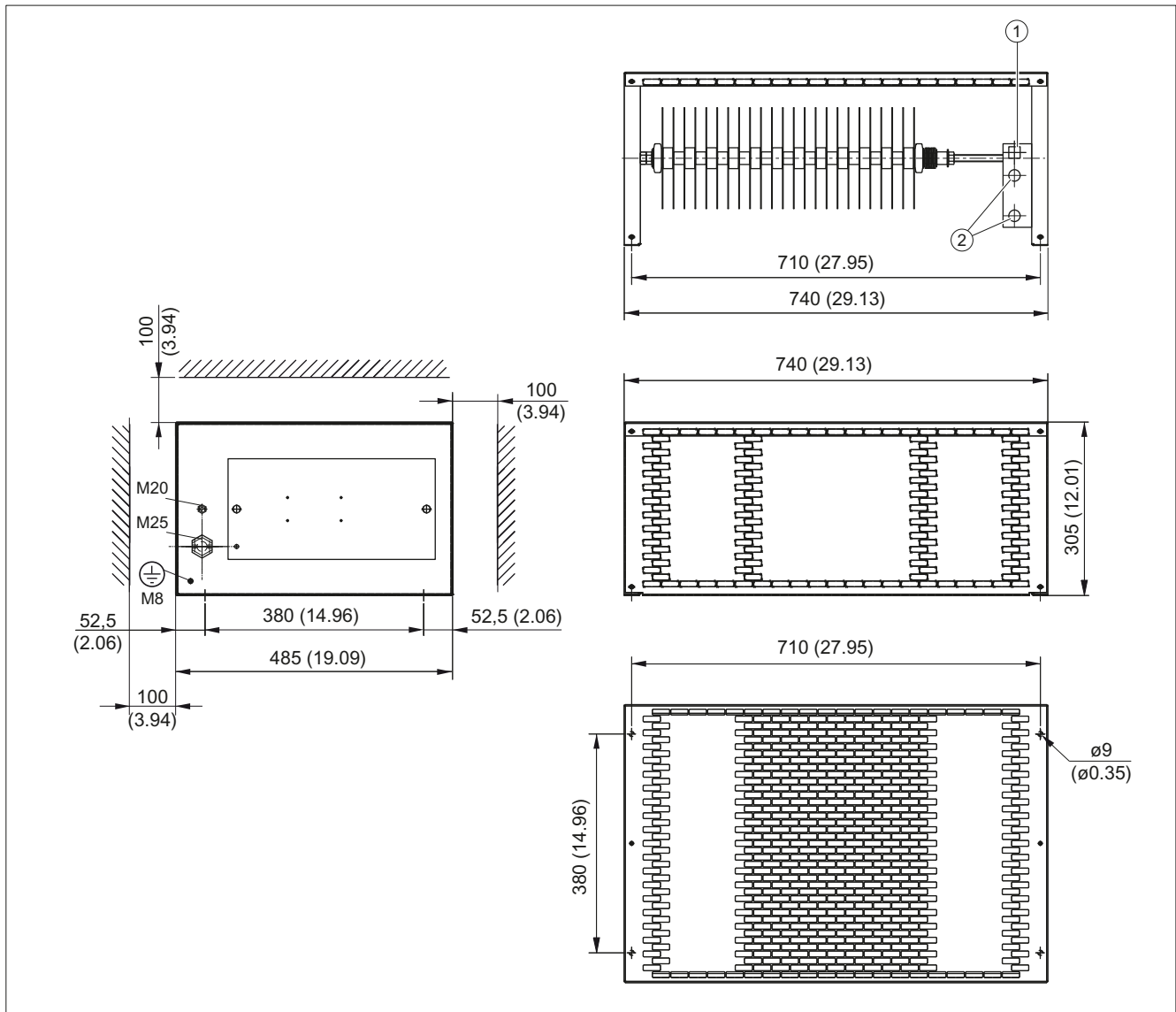


Figure 9-5 Dimension and installation drawing (floor and wall mounting) of braking resistor 6SE7023-2ES87-2DC0 where  $P_n/P_{max} = 5 \text{ kW}/30 \text{ kW}$ , all dimensions in mm and (inches)



1 Connection for thermostatic switch T1/T2 with conductor cross-section 2.5 mm<sup>2</sup>

2 Connection for power cable, 2 x M6 bolts

Figure 9-6 Dimension and installation drawing (floor mounting) of braking resistor 6SE7028-0ES87-2DC0 where  $P_n/P_{max} = 12.5 \text{ kW}/75 \text{ kW}$ , all dimensions in mm and (inches)

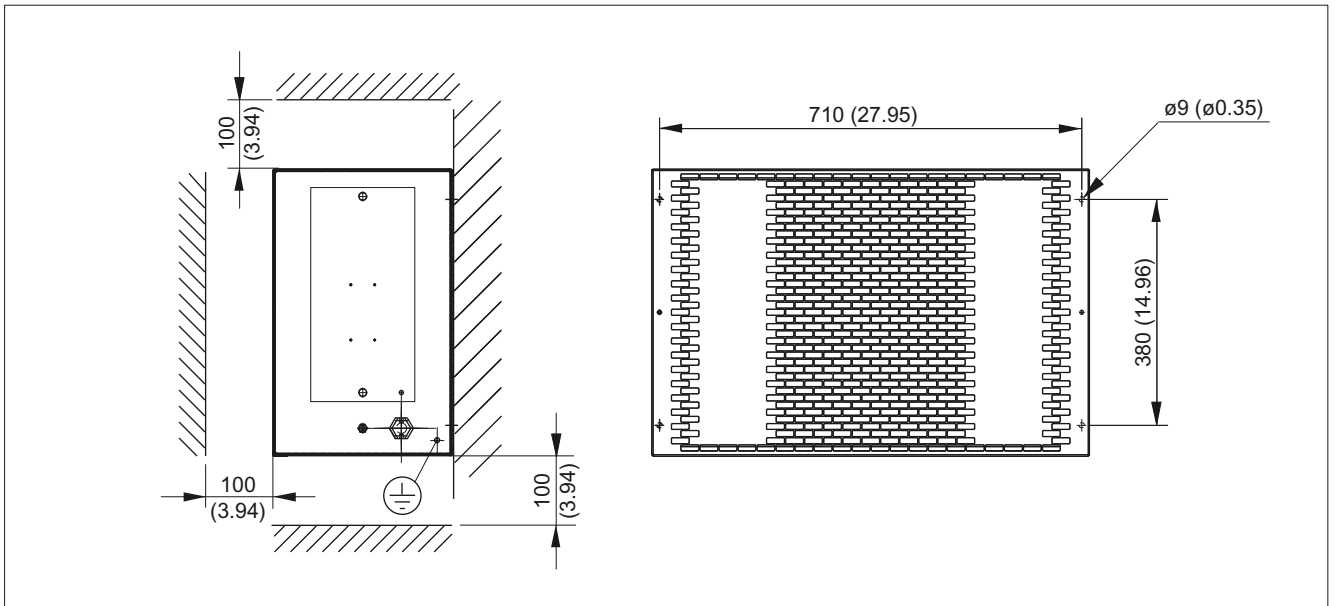


Figure 9-7 Installation drawing (wall mounting) of braking resistor 6SE7028-0ES87-2DC0 where  $P_n/P_{max} = 12.5 \text{ kW}/75 \text{ kW}$ , all dimensions in mm and (inches)

## 9.4 Technical data

Table 9- 2 Technical data for braking resistors without a thermostatic switch

	Unit	6SN1113-1AA00-0DA0	6SL3100-1BE31-0AAx
Resistance R	Ω	17	5.7
Rated power P <sub>N</sub>	kW	0,3	1,5
Peak power P <sub>max</sub>	kW	25	100
Max. energy consumption E <sub>max</sub>	kWs	7,5	200
Power cable connection		Included in delivery; length 3 m, 3 x 1.5 mm <sup>2</sup>	Screw terminal <sup>1)</sup> , 4 mm <sup>2</sup>
Weight	kg	3,4	5,6
Dimensions (W x H x D)	mm	80 x 210 x 53	193 x 410 x 240
Degree of protection according to EN 60529		IP54B	IP20

1) Recommended conductor cross-section: 4 mm<sup>2</sup>

Table 9- 3 Technical data for braking resistors with a thermostatic switch

	Unit	6SE7018-0ES87-2DC0	6SE7021-6ES87-2DC0	6SE7023-2ES87-2DC0	6SE7028-0ES87-2DC0
Resistance R	Ω	80	40	20	8
Rated power P <sub>N</sub>	kW	1,25	2,5	5	12,5
Braking power 4 x P <sub>N</sub>	kW	5	10	20	50
Peak power P <sub>max</sub> <sup>1)</sup>	kW	7,5	15	30	75
Max. energy consumption E <sub>max</sub> at P <sub>max</sub> at 4xP <sub>N</sub>	kWs kWs	22,5 100	45 200	90 400	225 1000
Thermostatic switch connection		Screw terminal <sup>2)</sup> , 4 mm <sup>2</sup>	Screw terminal <sup>2)</sup> , 4 mm <sup>2</sup>	Screw terminal, 2.5 mm <sup>2</sup>	Screw terminal, 2.5 mm <sup>2</sup>
Power cable connection		Screw terminal <sup>3)</sup> , 4 mm <sup>2</sup>	Screw terminal <sup>3)</sup> , 4 mm <sup>2</sup>	M6 screw bolt for ring cable lug <sup>4)</sup>	M8 screw bolt for ring cable lug <sup>5)</sup>
PE connection		M5 bolt	M5 bolt	M6 bolt	M8 bolt
Weight	kg	6	12	17	27
Dimensions (W x H x D)	mm	145 x 180 x 540	145 x 360 x 540	450 x 305 x 485	745 x 305 x 485
Degree of protection according to EN 60529		IP20	IP20	IP20	IP20

1) Applies to a DC link voltage of 760 V

2) Recommended conductor cross-section: 0.75 to 1.5 mm<sup>2</sup>

3) Recommended conductor cross-section: 2.5 mm<sup>2</sup>

4) Recommended conductor cross-section: 4 mm<sup>2</sup>

5) Recommended conductor cross-section: 16 mm<sup>2</sup>

### 9.4.1 Characteristic curves

#### Duty cycle for braking resistors without a thermostatic switch

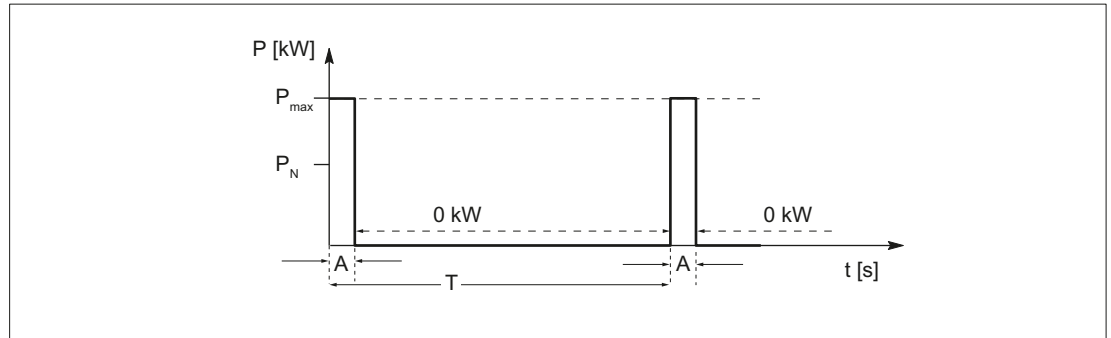


Figure 9-8 Duty cycle for braking resistors without a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

$P_N$  [W] rated power (continuous power) of braking resistor

$P_{max}$  [W] peak power of braking resistor ( $6 \times P_N$ )

Table 9- 4 Duty cycles for Braking Module Booksize

	6SN1113-1AA00-0DA0		6SL3100-1BE31-0AAX	
	Short duty cycle	Long duty cycle	Short duty cycle	Long duty cycle
A [s]	0.1	0.4	1	2
T [s]	11.5	210	68	460

Table 9- 5 Duty cycles for Braking Module Booksize Compact

	6SN1113-1AA00-0DA0		6SL3100-1BE31-0AAX	
	Short duty cycle	Long duty cycle	Short duty cycle	Long duty cycle
A [s]	0.1	0.4	1	2
T [s]	11.5	210	68	460

**The following applies when connecting Braking Modules in parallel:**

$P_{N\ total} = 0.9 \times \text{total } P_N \text{ of single devices}$

$P_{max\ total} = \text{total } P_{max} \text{ of single devices}$

Duty cycles for braking resistors with a thermostatic switch

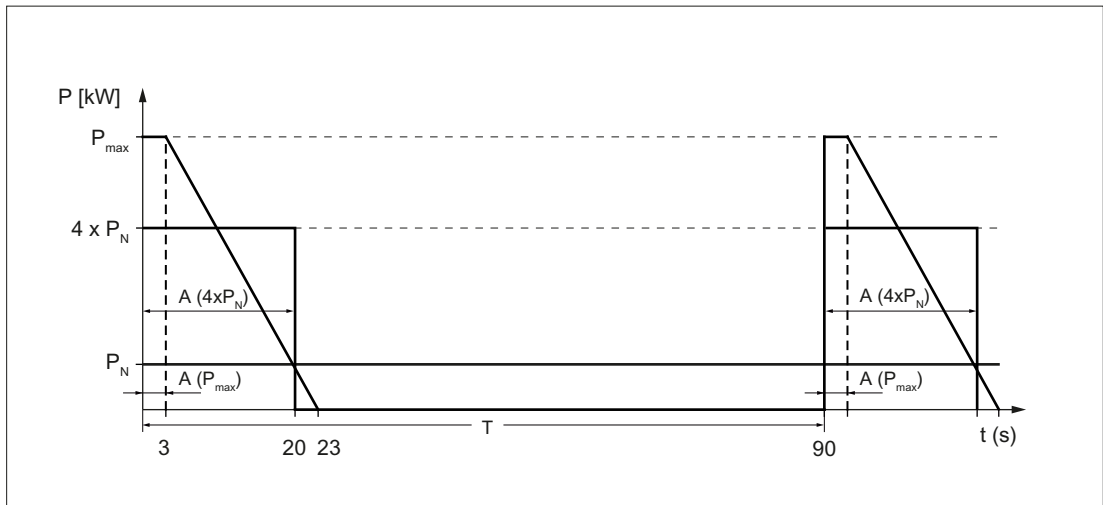


Figure 9-9 Duty cycles for braking resistors with a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

$P_N$  [W] rated power (continuous power) of braking resistor

$P_{max}$  [W] peak power of braking resistor ( $6 \times P_N$ )

$4 \times P_N$  [W] = power permitted every 90 s for 20 s

Table 9- 6 Duty cycles

	6SE7018-0ES87-2DC0		6SE7021-6ES87-2DC0		6SE7023-2ES87-2DC0		6SE7028-0ES87-2DC0	
	Duty cycle $P_{max}$	Duty cycle $4 \times P_N$	Duty cycle $P_{max}$	Duty cycle $4 \times P_N$	Duty cycle $P_{max}$	Duty cycle $4 \times P_{N0}$	Duty cycle $P_{max}$	Duty cycle $4 \times P_N$
A [s]	3	20	3	20	3	20	3	20
T [s]	90	90	90	90	90	90	90	90

The following applies when connecting Braking Modules in parallel:

$P_{N\ total} = 0.9 \times \text{total } P_N \text{ of single devices}$

$4 \times P_{N\ total} = 0.9 \times \text{sum } (4 \times P_N) \text{ of single devices}$

$P_{max\ total} = \text{total } P_{max} \text{ of single devices}$

## Motor-side power components

### 10.1 Motor reactors

#### 10.1.1 Description

Motor reactors reduce the voltage stress on the motor windings by reducing the voltage gradients at the motor terminals that occur when motors are fed from drive converters. At the same time, the capacitive charge/discharge currents that also occur on the output of the Motor Module when long motor cables are used are reduced.

Motor reactors can be operated in the VECTOR and SERVO control modes.

#### Prerequisites

- Ambient temperature 40 °C.
- Pulse frequency  $f_{\max}=4$  kHz.
- Output frequency  $f_{\max}=120$  kHz.
- Supported in STARTER from Version 2.4 up to 1 motor reactor.
- Supported in STARTER from Version 2.5 up to 3 motor reactors.

---

#### Note

In SERVO control mode, the maximum output frequency of the converter must not be higher than the maximum motor reactor frequency.

---

### 10.1.2 Safety instructions for motor reactors

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**Note**

When using motor reactors, also observe the safety instructions in Section 1.

---

 **WARNING**

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

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

- Maintain the 100 mm clearances above and below the components.

 **CAUTION**

**Risk of burns due to high surface temperatures**

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

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

**NOTICE**

**Maximum permissible output frequency**

The maximum permissible output frequency when motor reactors are used is 120 Hz.

**NOTICE**

**Thermal damage of the motor reactors**

When using motor reactors that Siemens has not approved for SINAMICS, then these can thermally damage the reactor.

- Only use motor reactors that have been released by Siemens for SINAMICS.

---

**Note**

**Maximum cable length of the connection cables**

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

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### 10.1.3 Dimension drawings

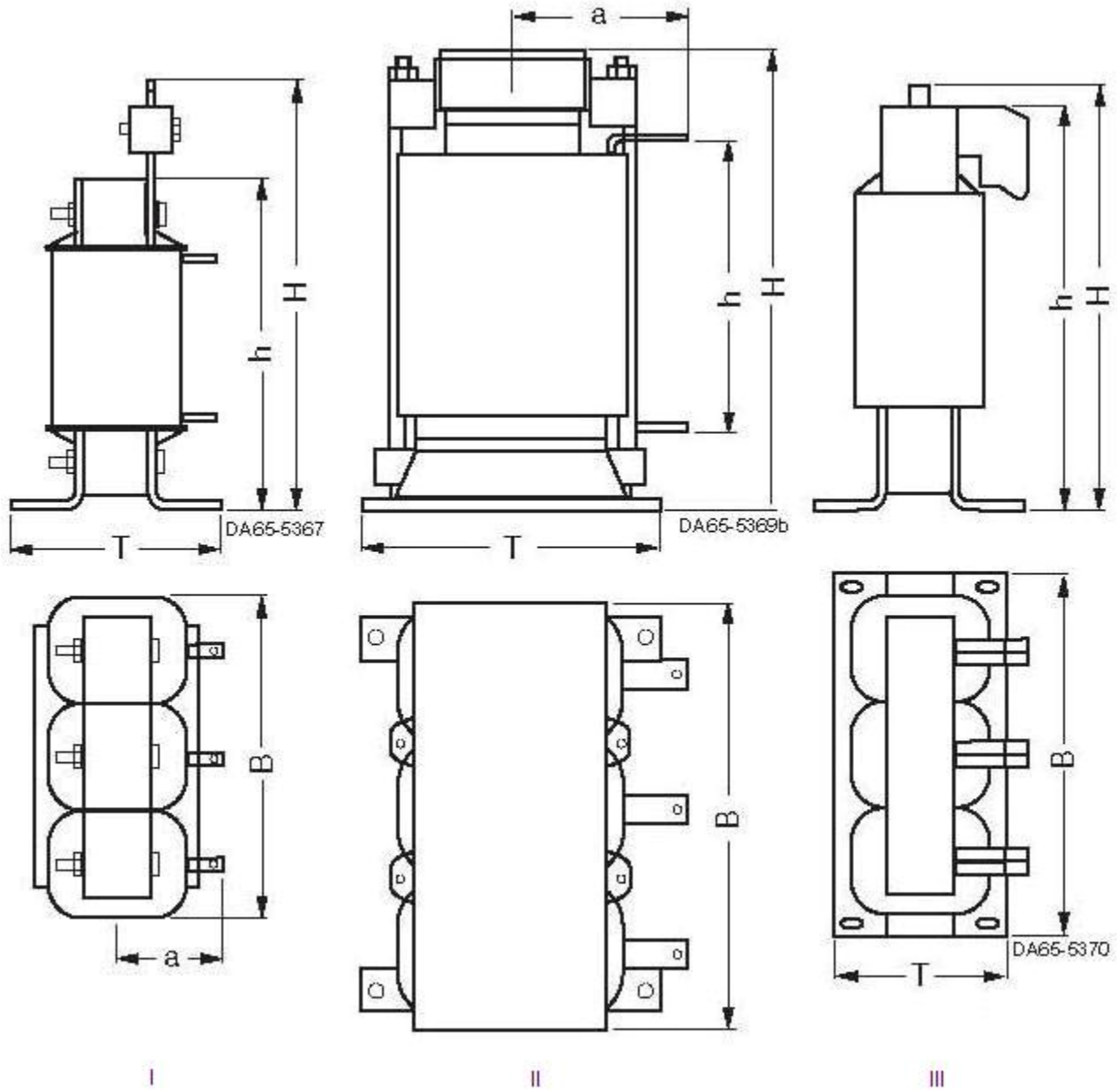


Figure 10-1 Dimension drawings of motor reactors

10.1 Motor reactors

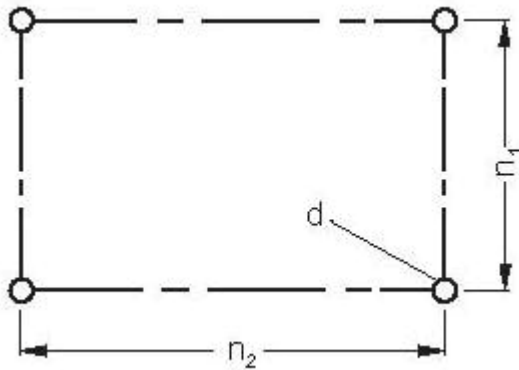


Figure 10-2 Mounting hole

Table 10- 1 Dimensions of motor reactors, all dimensions in mm and (inches)

	6SE7021-0ES87-1FE0	6SE7022-6ES87-1FE0	6SE7024-7ES87-1FE0	6SE7027-2ES87-1FE0
	Fig. III	Fig. III	Fig. II	Fig. I
B	178 (7.00)	219 (8.62)	197 (7.75)	267 (10.51)
H	153 (6.02)	180 (7.08)	220 (8.66)	221 (8.70)
T	88 (3.46)	119 (4.68)	104 (4.09)	107 (4.21)
a	-	-	69 (2.71)	77 (3.03)
h	146 (5.74)	181 (7.12)	103 (4.05)	206 (8.11)
n <sub>1</sub>	68 (2.67)	89 (3.50)	70 (2.75)	77 (3.03)
n <sub>2</sub>	166 (6.53)	201 (7.91)	176 (6.92)	249 (9.80)
d	M5	M6	M6	M6

Lengths n<sub>1</sub> and n<sub>2</sub> correspond to the distance between holes

Table 10- 2 Dimensions of motor reactors, all dimensions in mm and (inches)

	6SE7031-5ES87-1FE0	6SE7031-8ES87-1FE0	6SE7032-6ES87-1FE0
	Fig. II	Fig. II	Fig. II
B	197 (7.75)	281 (11.06)	281 (11.06)
H	220 (8.66)	250 (9.84)	250 (9.84)
T	128 (5.03)	146 (5.74)	146 (5.74)
a	81 (3.18)	98 (3.85)	111 (4.37)
h	100 (3.93)	119 (4.68)	121 (4.76)
n <sub>1</sub>	94 (3.70)	101 (3.97)	101 (3.97)
n <sub>2</sub>	176 (6.92)	200 (7.87)	200 (7.87)
d	M6	M8	M8

Lengths n<sub>1</sub> and n<sub>2</sub> correspond to the distance between holes

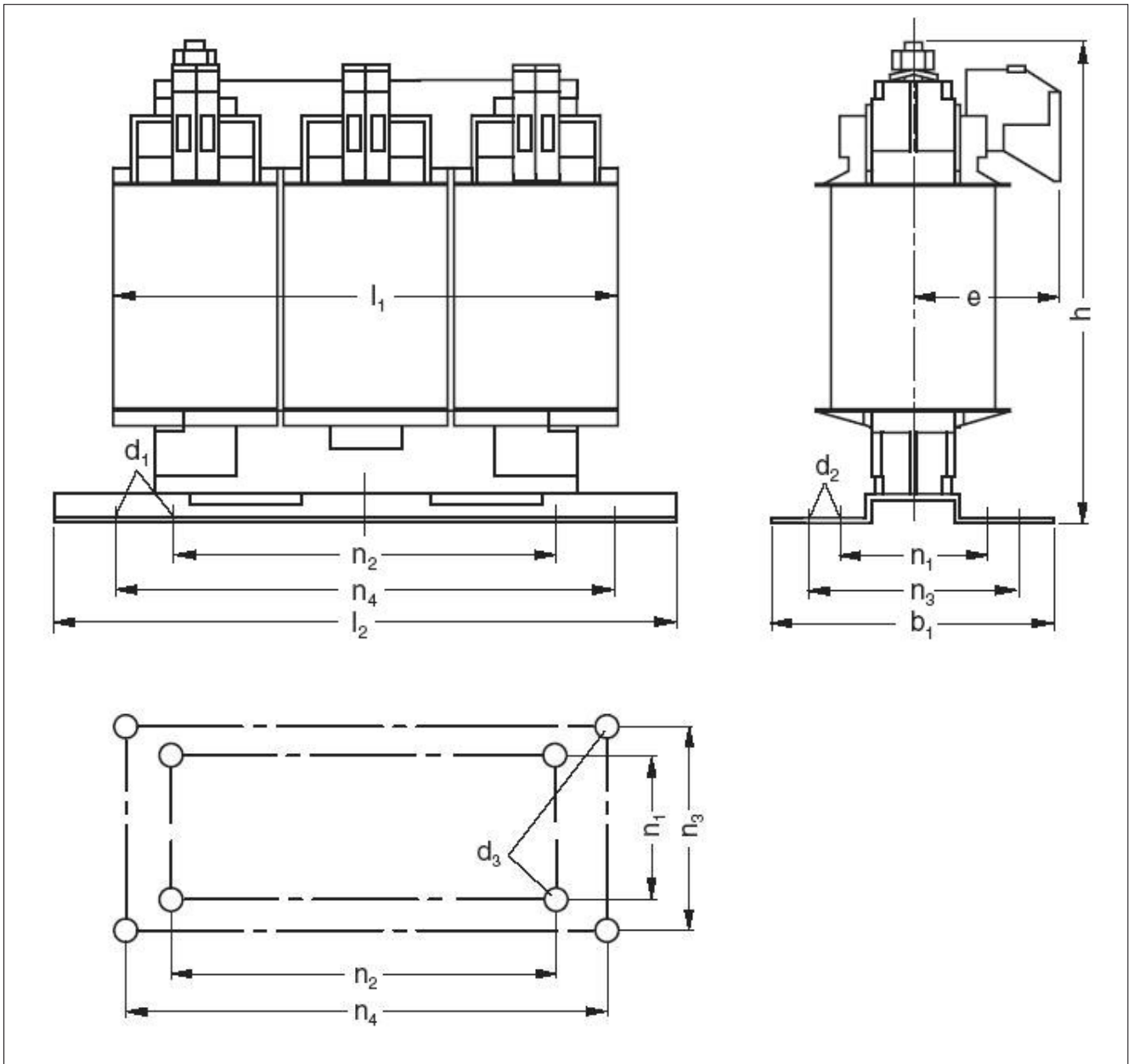


Figure 10-3 Dimension drawing and mounting hole of motor reactor 9 A (6SL3000-2BE21-0AA0)

Table 10- 3 Dimensions of motor reactor 9 A, all dimensions in mm and (inches)

<b>6SL3000-2BE21-0AA0</b>	
l <sub>1</sub>	150 (5.90)
l <sub>2</sub>	178 (7.00)
b <sub>1</sub>	88 (3.46)
b <sub>max</sub>	111 (4.37)
e	67 (2.63)
h	159 (6.25)
n <sub>1</sub>	64 (2.51)
n <sub>2</sub>	113 (4.44)
n <sub>3</sub>	68 (2.67)
n <sub>4</sub>	166 (6.53)
d <sub>1</sub>	5.8 (0.22)
d <sub>2</sub>	11 (0.43)
d <sub>3</sub>	M5
PE	M6
Lengths n <sub>1</sub> , n <sub>2</sub> , n <sub>3</sub> and n <sub>4</sub> corresponds to the distance between holes	

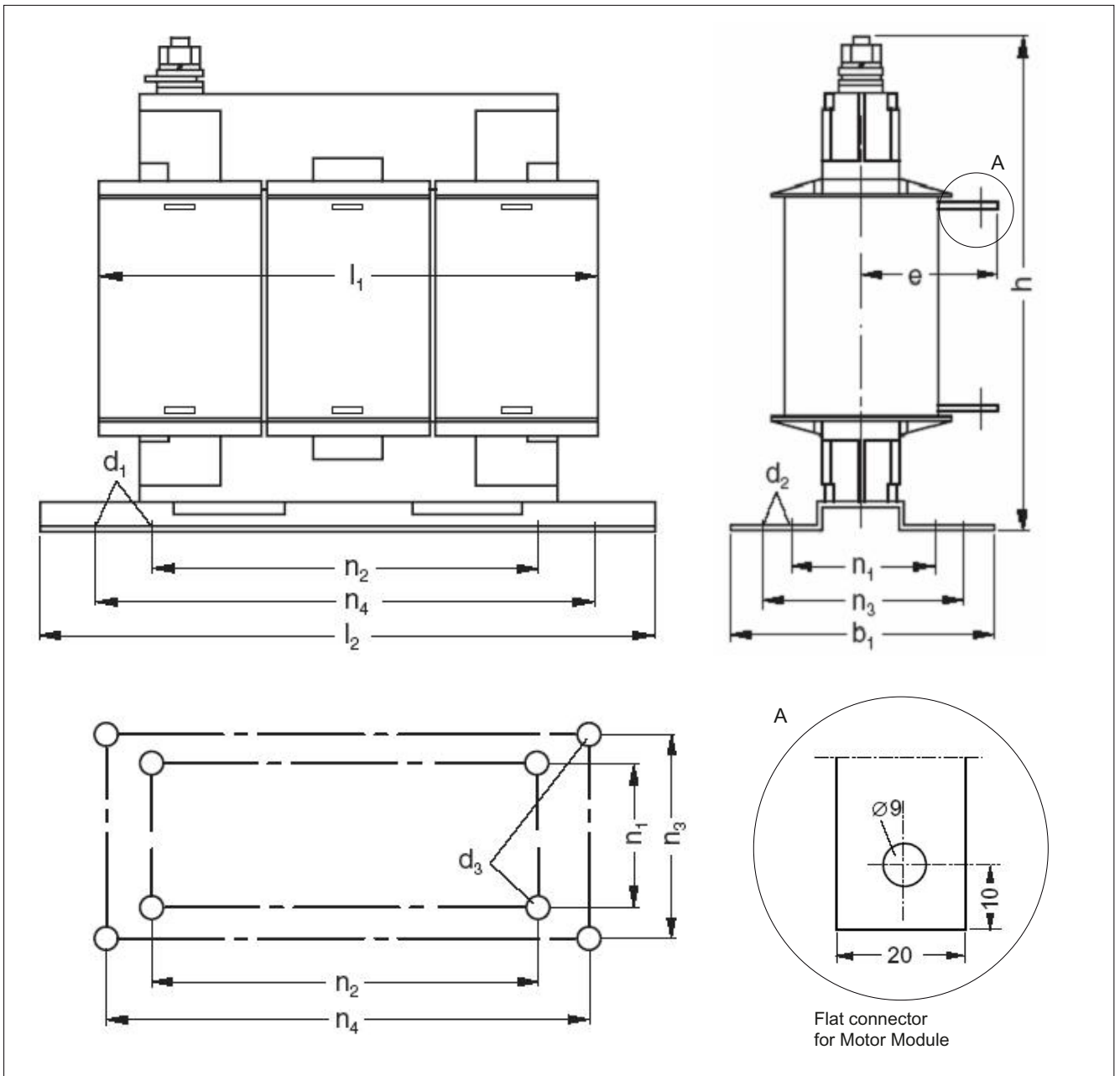


Figure 10-4 Dimension drawing and mounting hole of motor reactor 60 A (6SL3000-2BE26-0AA0)

Table 10- 4 Dimensions of motor reactor 60 A, all dimensions in mm and (inches)

<b>6SL3000-2BE26-0AA0</b>	
l <sub>1</sub>	max. 228 (8.97)
l <sub>2</sub>	267 (10.51)
b <sub>1</sub>	107 (4.21)
b <sub>max</sub>	125.5 (4.94)
e	72 (2.83)
h	220 (8.66)
h <sub>1</sub>	56 (2.20)
h <sub>2</sub>	100 (3.93)
n <sub>1</sub>	70 (2.75)
n <sub>2</sub>	176 (6.92)
n <sub>3</sub>	77 (3.03)
n <sub>4</sub>	249 (9.80)
d <sub>1</sub>	36 (1.41)
d <sub>2</sub>	3.5 (0.13)
d <sub>3</sub>	M6
PE	M6
Lengths n <sub>1</sub> , n <sub>2</sub> , n <sub>3</sub> and n <sub>4</sub> corresponds to the distance between holes	

### 10.1.4 Technical data

Table 10- 5 Technical data, motor reactors, part 1

Order number		6SE7021-0ES87-1FE0	6SL3000-2BE21-0AA0	6SE7022-6ES87-1FE0	6SE7024-7ES87-1FE0	6SE7027-2ES87-1FE0
Matching the Motor Module		6SL312x-1TE13-0AAx 6SL312x-2TE13-0AAx 6SL312x-1TE15-0AAx 6SL312x-2TE15-0AAx	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
Motor Module/motor connection		Screw-type terminals 4 mm <sup>2</sup>	Screw-type terminals 10 mm <sup>2</sup>	Screw-type terminals 10 mm <sup>2</sup>	Flat connector for M8 screw	
PE connection		M6 studs				
Degree of protection		IP00	IP00	IP00	IP00	IP00
Weight	kg	5.5	4.83	9.2	20	11

Table 10- 6 Technical data, motor reactors, part 2

Order number		6SL3000-2BE26-0AA0	6SE7031-5ES87-1FE0	6SE7031-8ES87-1FE0	6SE7032-6ES87-1FE0	
Matching the Motor Module		6SL312x-1TE26-0AAx	6SL312x-1TE28-5AAx	6SL312x-1TE31-3AAx	6SL312x-1TE32-0AAx	
Rated current	A	60	85	132	200	
Inductance	μH	59	29	23	16	
Power loss	W	105	220	300	300	
Motor Module/motor connection		Flat connector for M8 screw		Flat connector for M10 screw		
PE connection		M6 studs				
Degree of protection		IP00	IP00	IP00	IP00	
Weight	kg	10,5	25	30	30	

10.1 Motor reactors

Table 10- 7 Cable lengths, Part 1

Order number	6SE7021-0ES87-1FE0	6SL3000-2BE21-0AA0	6SE7022-6ES87-1FE0	6SE7024-7ES87-1FE0	6SE7027-2ES87-1FE0
Rated current [A]	5	9	18	30	45
Shielded cables					
Maximum motor cable length, 1 reactor	100	135	160	190	200
Maximum motor cable length, 2 reactors	-	-	320	375	400
Maximum motor cable length, 3 reactors	-	-	-	-	600
Unshielded cables					
Maximum motor cable length, 1 reactor	150	200	240	280	300
Maximum motor cable length, 2 reactors	-	-	480	560	600
Maximum motor cable length, 3 reactors	-	-	-	-	900

Table 10- 8 Cable lengths, Part 2

Order number	6SL3000-2BE26-0AA0	6SE7031-5ES87-1FE0	6SE7031-8ES87-1FE0	6SE7032-6ES87-1FE0
Rated current [A]	60	85	132	200
Shielded cables				
Maximum motor cable length, 1 reactor	200	200	200	200
Maximum motor cable length, 2 reactors	400	400	400	400
Maximum motor cable length, 3 reactors	600	600	600	600
Unshielded cables				
Maximum motor cable length, 1 reactor	300	300	300	300
Maximum motor cable length, 2 reactors	600	600	600	600
Maximum motor cable length, 3 reactors	900	900	900	900



## 10.2 Voltage Protection Module VPM

### 10.2.1 Description

The Voltage Protection Module (VPM) is a component for limiting voltage. It is used for both 1FE1 and 2SP1 motors and those with an electromagnetic force (EMF) of between 800 V and 2000 V to limit DC-link voltage if a fault occurs.

The Voltage Protection Module is installed within the motor cable between the Motor Module and motor. If the line voltage fails at the maximum motor speed or the pulses at the Motor Module are canceled as a result of the power failure, the motor regenerates at high voltage into the DC link. The Voltage Protection Module recognizes that the motor voltage is too high (> 800 V) and uses an electronic switch to short-circuit the three phases of the motor at its supply lines. The power remaining in the motor is converted to heat via the short circuit between the Voltage Protection Module and motor cables.

The Voltage Protection Module is available in 3 versions.

Table 10- 9 Overview of the Voltage Protection Modules available

Designation	Rated current
VPM120	120 A
VPM200	200 A
VPM200 Dynamic	200 A

The VPM200 Dynamic should be used in the following applications:

- When operating third-party synchronous motors (they generally have higher inductances than 1FE motors)
- When a third-party motor is combined with a motor reactor
- When a 1FE motor is combined 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 10- 10 Interface overview for Voltage Protection Modules

Type	Number VPM120/VPM200	Number VPM200 Dynamic
Signaling interface	1	1
PE connection	2	4
Load connecting bolt, input	3	5
Load connecting bolt, output	3	5

### 10.2.2 Safety instructions for Voltage Protection Modules

**Note**

When using a Voltage Protection Module, also observe the safety instructions in Section 1.



**! DANGER**

**Danger to life due to high voltages**

Because of the converter DC link capacitors, a hazardous voltage is present for up to 30 minutes after the power supply has been switched off.

- Avoid contact with the Voltage Protection Module as long as it is under voltage.



**! WARNING**

**Danger to life through electric shock due to high speed of the motor while the VPM is being ramped up**

If the motor is operated with a speed higher than the field weakening threshold speed while the Voltage Protection Module is ramping up (see the technical data), the protection function of the VPM is inactive during this phase. High voltages can then be fed into the DC link which can cause fatal accidents if there is contact.

- Only operate the motor below the field weakening threshold speed while the VPM is ramping up



**! WARNING**

**Danger to life through electric shock due to the insulation voltage being exceeded**

Motors whose electromotive force (EMF) can reach a DC link voltage  $> 2 \text{ kV}$  ( $\text{EMF} = 1.4 \text{ kV}_{\text{rms}}$ ) at maximum speed must not be connected to a Motor Module. The insulation voltage could be exceeded, resulting in fatal accidents due to electric shock.

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.

- Do not connect such motors to a Motor Module.

**! WARNING**

**Danger to life through automatic start of the drive**

An uncontrolled automatic start of the drive can result in fatal accidents.

- Take precautions against an automatic start of the drive.

**NOTICE**

**Damage when using motors that are not short-circuit proof**

Use of motors that are not short-circuit proof in conjunction with a Voltage Protection Module can result in their destruction.

- Only use motor that are short-circuit proof.



**WARNING**

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

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

- Maintain the 200 mm clearances above and below the components.

**NOTICE**

**Device damage when used for an unintended purpose**

The unit is a safety-relevant piece of equipment and may only be used as intended. The Voltage Protection Module can only be operated effectively in combination with SINAMICS Booksize and 1FE1/2SP1 motors. Other applications, e.g. armature short-circuit in operation, are not permissible as they cause damage in the connected components.

- Note the warning information on the device.
- Use only shielded MOTION-CONNECT 800PLUS motor cables (type 6FX8) in combination with the VPM.

### 10.2.3 Interface description

#### 10.2.3.1 Overview

The drawings below show the basic positions of interfaces and the housing openings of the Voltage Protection Modules VPM120, VPM200 and VPM200 Dynamic.

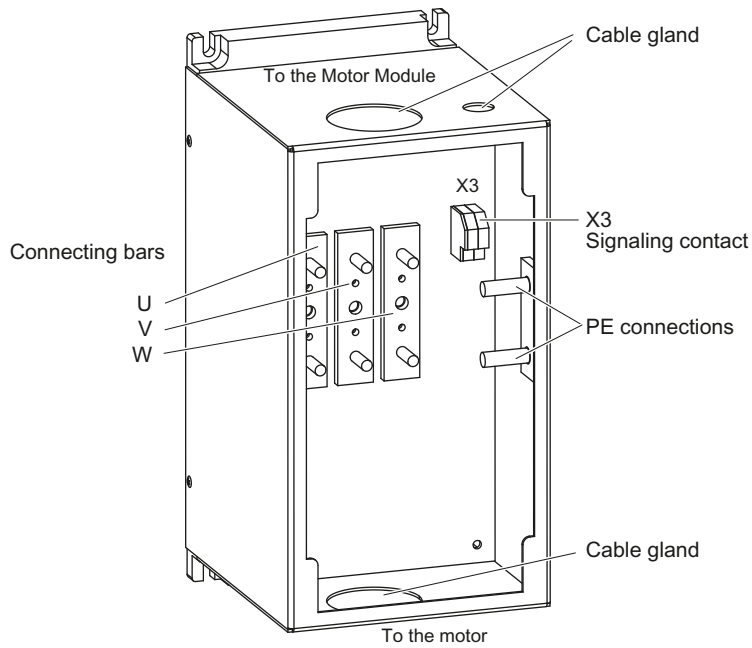


Figure 10-5 Interface overview, Voltage Protection Modules VPM120 (without cover)

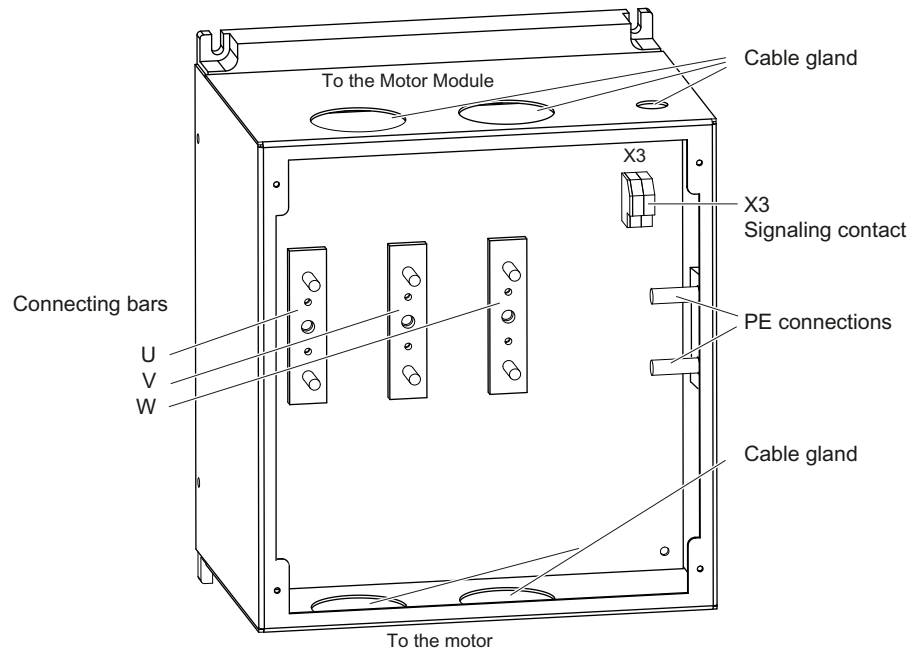


Figure 10-6 Interface overview, Voltage Protection Modules VPM200 (without cover)

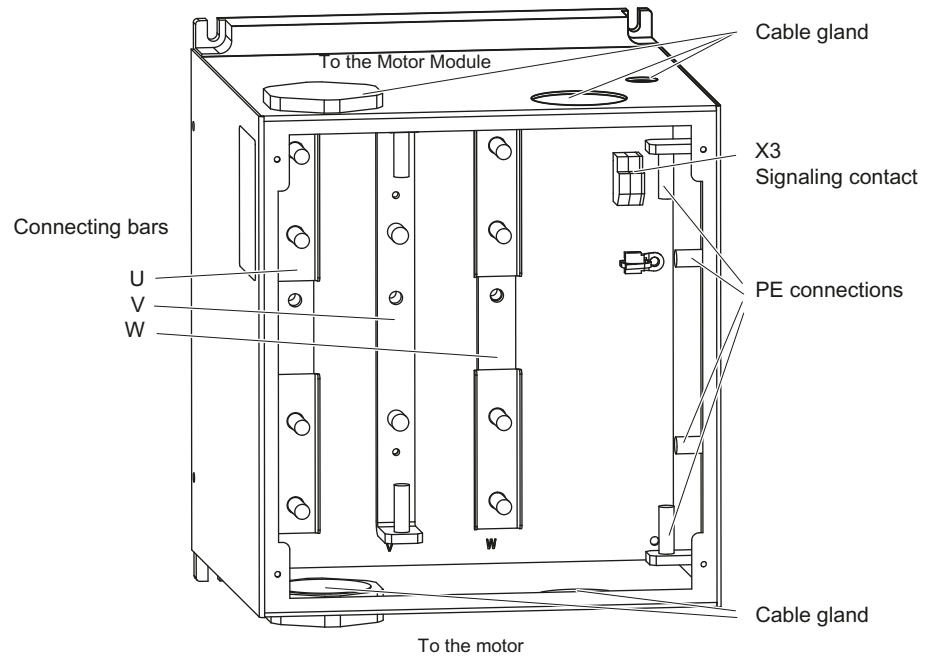


Figure 10-7 Interface overview, Voltage Protection Modules VPM200 Dynamic (without cover)

The housing is closed during operation to ensure the electrical terminals are covered.

### 10.2.3.2 Signaling interface X3

The signaling interface has the following assignments:

Table 10- 11 Signaling interface X3

Terminal	Designation	Technical specifications
1	Operating message for Control Unit	<ul style="list-style-type: none"> <li>The cable shield is connected to the VPM housing via the cable entry.</li> <li>Floating contact, load rating: 30 VDC at 0.1 A</li> </ul>
2	Operating voltage +24 V (from external source)	
Terminal type: WAGO spring-loaded terminal, type 226-111, max. conductor cross-section: 1.5 mm <sup>2</sup> , shielded lead		
Cable gland: Max. 9 mm Ø		
Types VPM120, VPM200 and VPM200 Dynamic		
<ul style="list-style-type: none"> <li>Screwed joint: 1 x M16, e.g. from Pflitsch, order designation: UNI DICHT EMV 2165211S05</li> <li>Locknut M16: GM216PA.</li> </ul>		

### 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  $t > 2 \text{ min}$ .

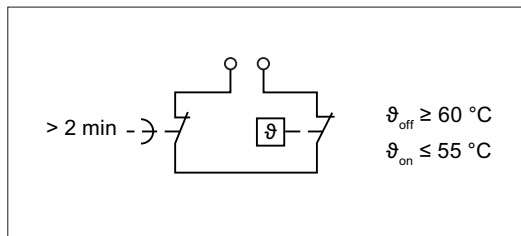


Figure 10-8 Signaling contact X3 of the Voltage Protection Module

<b>DANGER</b>
<p>Measures must be taken to prevent the drive starting automatically, since signaling contact X3 restores the pulse enable after <math>t &gt; 2 \text{ min}</math>.</p>

### 10.2.3.3 Connection bars U, V, W, PE

The cables to the Motor Module and motor are routed through the cable entry of the Voltage Protection Module and attached to the connection bars inside the unit.

Table 10- 12 Connections U, V, W, and PE

	VPM120	VPM200	VPM200 Dynamic
Connection bolt	8 x M6 <sup>1)</sup>	8 x M8 <sup>1)</sup>	14 x M8 <sup>2)</sup>
Cable lug	Crimp-type cable lug M6	Crimp-type cable lug M8	Tubular cable lug M8, 90° angle
Conductor cross section	≤ 50 mm <sup>2</sup>	≤ 50 mm <sup>2</sup>	≤ 50 mm <sup>2</sup>
Tightening torque	10 Nm	25 Nm	25 Nm
Cable gland	For cables with max. 40 mm Ø		
Gland <sup>3)</sup>	2 x M50 e.g. from Pflitsch, order designation: UNI DICHT EMV 250584117 Locknut M50: GM250PA	4 x M50 e.g. from Pflitsch, order designation: UNI DICHT EMV 250584117 Locknut M50: GM250PA	4 x M50 e.g. from Pflitsch, order designation: UNI DICHT EMV 250584117 Locknut M50: GM250PA

- 1) There are 2 connection points for each phase and for PE.
- 2) There are 4 connection points for each of the phases U, W, and PE, and 2 terminals for phase V.
- 3) The glands must be separately ordered.

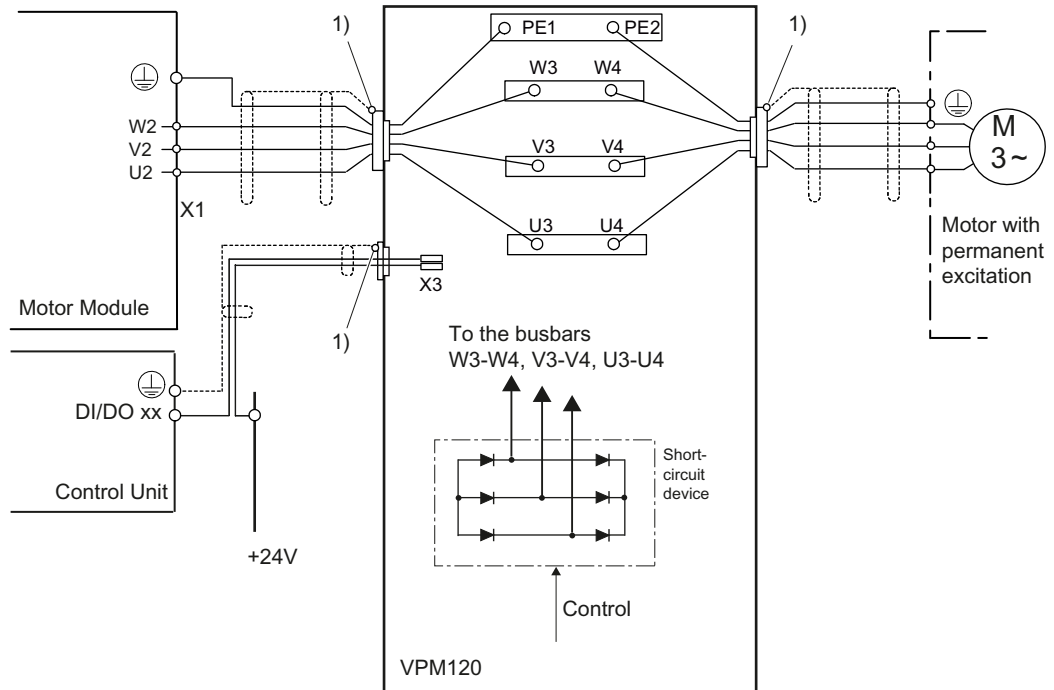
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#### Note

Cable lengths with cross-sections of > 50 mm<sup>2</sup> between the Motor Module and the Voltage Protection Module or between the Voltage Protection Module and the motor are implemented using two cables connected in parallel.

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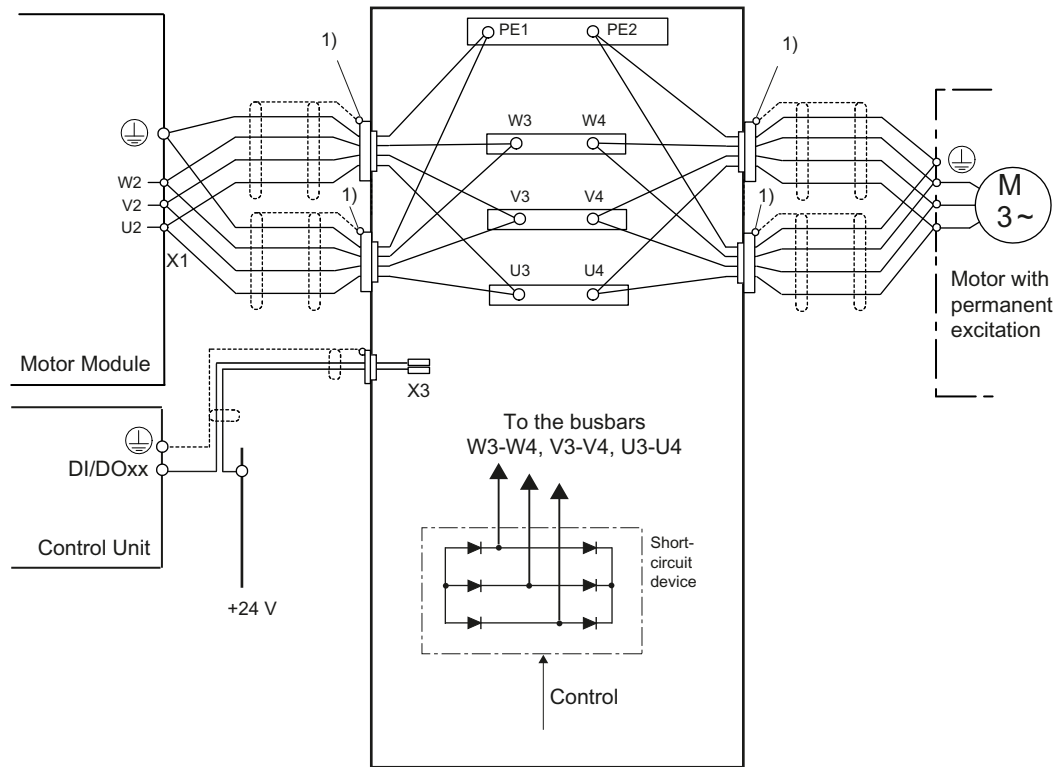
### 10.2.4 Connection examples



1) Cable shield is conductively connected to the cable gland

Figure 10-9 Connection example for Voltage Protection Module VPM120





1) Cable shield is conductively connected to the cable gland

Figure 10-10 Connection example for Voltage Protection Module VPM200

## Cable lengths

The maximum length of the power cable between the Motor Module and the Voltage Protection Module is 1.5 m and must not include any switching elements.

The power cable between the Voltage Protection Module and the motor must not exceed a length of 50 m.

The length of the signal cable must not exceed 10 m.

## Signaling contact

Signaling interface X3 on the Voltage Protection Module is wired to a digital input (DI) on the Control Unit, which controls this spindle. If more than one Voltage Protection Module is used, each X3 terminal is wired to the respective Control Unit. If an armature short-circuit occurs, the pulses of the axis involved must remain inhibited. To ensure this happens, the connected digital input is interconnected to control bit OFF2 (pulse inhibit) via p0845 = r0722.xx. The signaling interface is operated with +24 V.

### 10.2.5 Dimension drawings

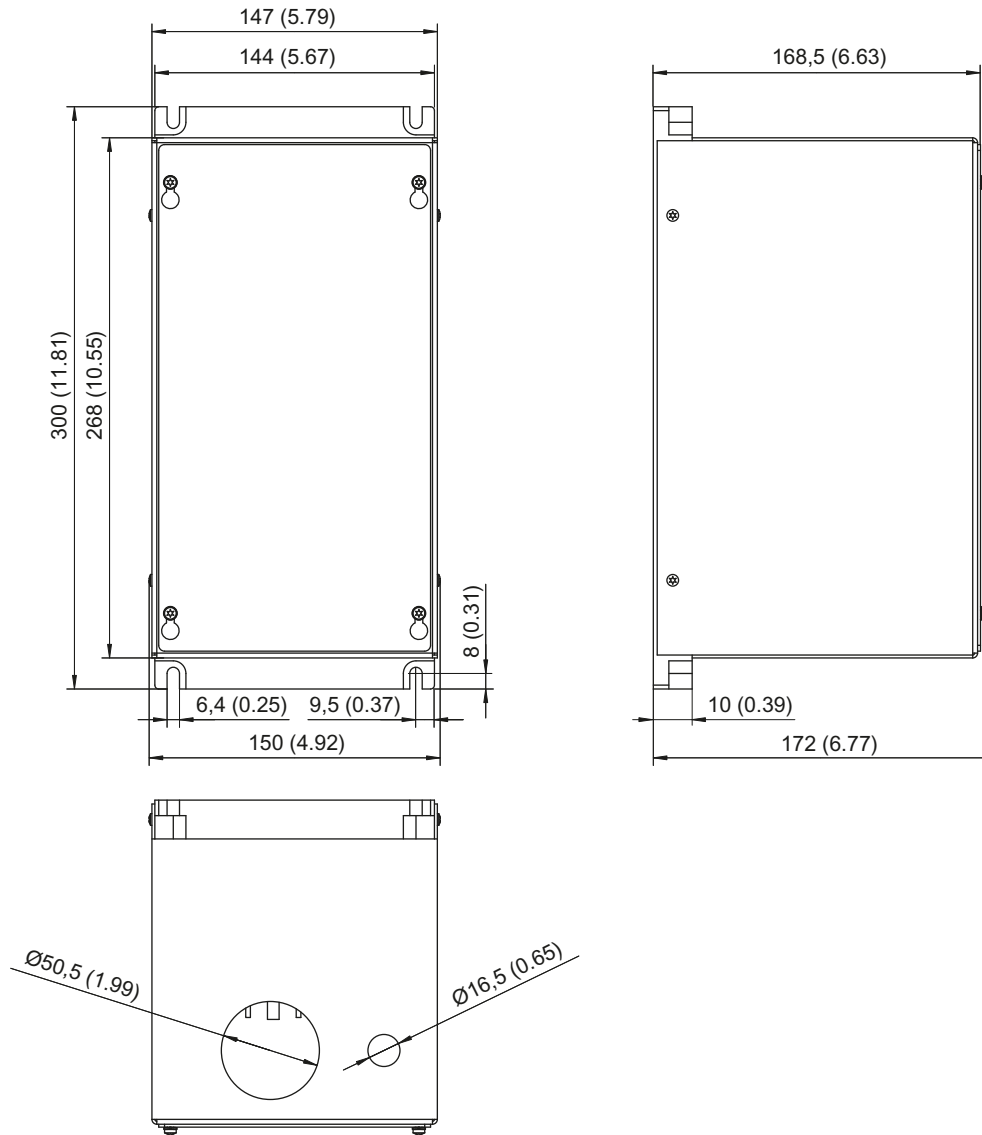


Figure 10-11 Dimension drawing of the Voltage Protection Module VPM120, all data in mm and (inches)

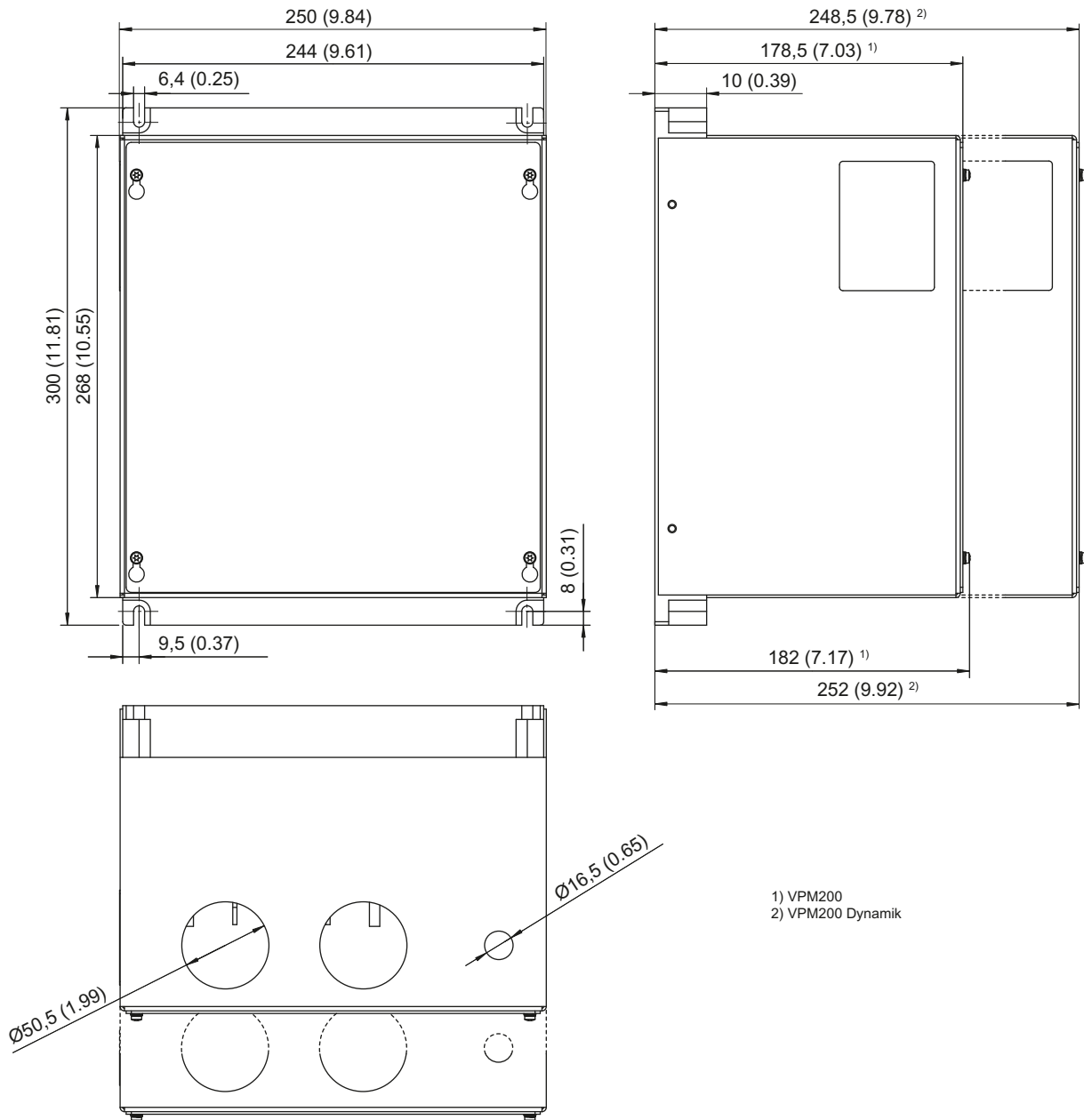



Figure 10-12 Dimension drawing of the Voltage Protection Module VPM200 and VPM200 Dynamic, all data in mm and (inches)

### 10.2.6 Installation

The Voltage Protection Module is installed in the control cabinet close to the drive.

 <b>DANGER</b>
Motor reactors may only be connected between the Voltage Protection Module and motor.

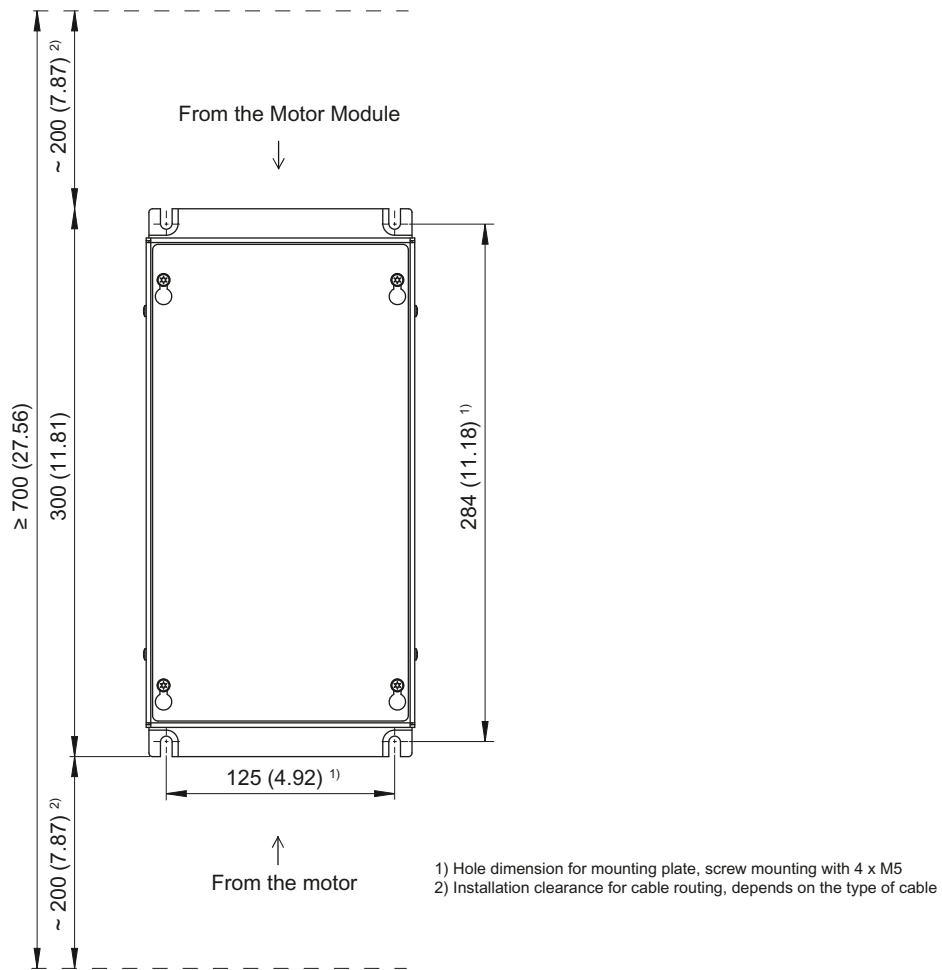


Figure 10-13 Mounting dimension for a Voltage Protection Module VPM120

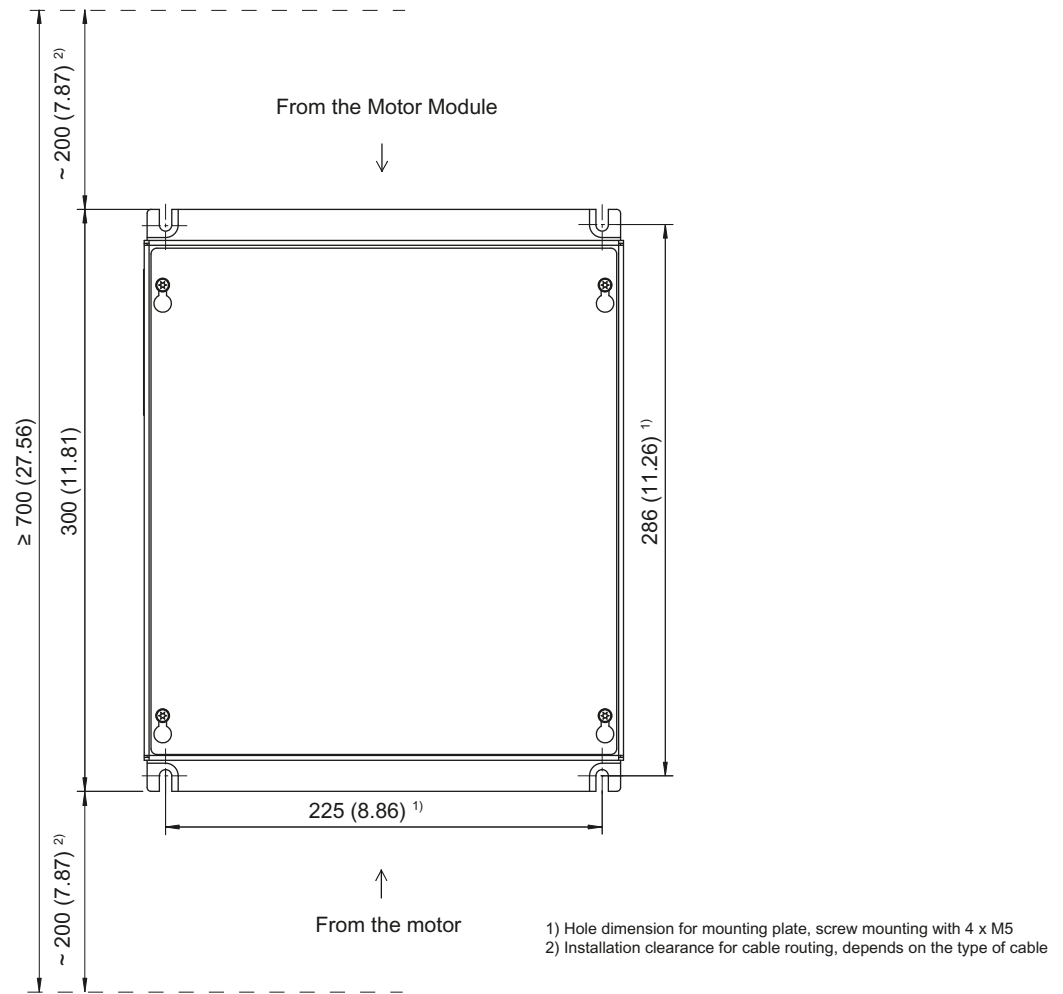


Figure 10-14 Mounting dimensions for a Voltage Protection Module VPM200

## 10.2.7 Electrical connection

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### Note

Only the enclosure cover may be opened for electrical connection of the Voltage Protection Module.

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### 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<sup>2</sup> for each conductor. An installation sequence for individual conductors is outlined below. It is particularly relevant for larger cross-sections.



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.

### 10.2.7.1 Connecting signaling contact X3

The signaling contact X3 must be wired before connecting the power cables.



Figure 10-15 Connection of the signaling contact using the VPM200 as an example

The X3 signaling contact is routed via a bistable relay. The relay may shift to the other switching state if subjected to excessive movement during transportation and installation. This may prevent the system from starting.

<p><b>CAUTION</b></p> <p>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 <b>does not prove this conclusively!</b> It is particularly important to bear this in mind when performing servicing and commissioning tasks.</p>
---

### Cause and rectification of faults

The "Installation" sections in the documents referred to below contain additional information on the causes of faults and how they can be rectified:

Operating Instructions for Voltage Protection Module VPM120, Order No.: A5E00302281B

Operating Instructions for Voltage Protection Module VPM200, Order No.: A5E00777655A

Operating Instructions for Voltage Protection Module VPM200 Dynamic, Order No.: A5E00302261B

10.2.7.2 Connecting power cables (using the VPM 200 Dynamik as an example)

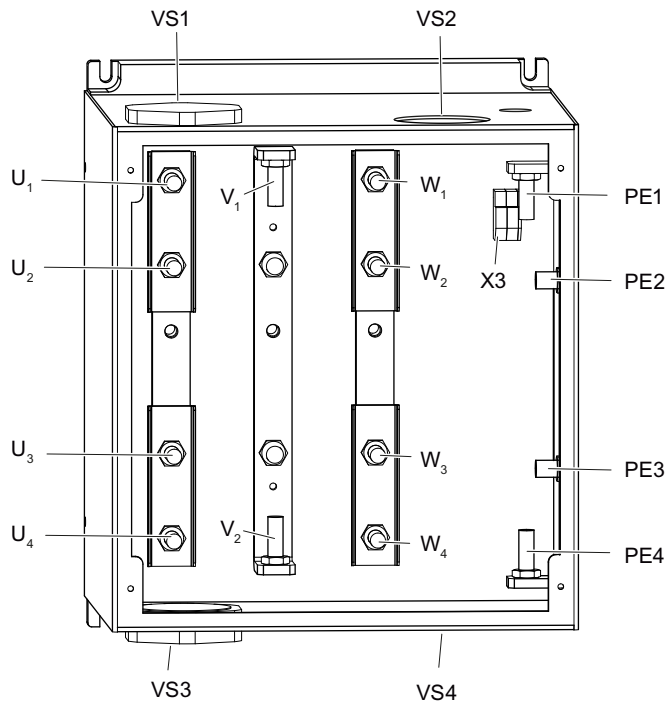


Figure 10-16 Connection points of the Voltage Protection Module VPM200 Dynamic

Table 10- 13 Short designations

Short designation	Explanation
VS1, VS2	Cable screwed joint 1 or 2 in the housing entry of the VPM, towards Motor Module
VS3, VS4	Cable screwed joint 3 or 4 in the housing entry of the VPM, towards motor
K1, K2	Cable 1 or 2 to the Motor Module
K3, K4	Cable 3 or 4 to the motor
U <sub>1</sub> , U <sub>2</sub>	Connection bolts on busbar U
U <sub>3</sub> , U <sub>4</sub>	Connection bolts on busbar U
V <sub>1</sub> , V <sub>2</sub>	Connection bolts on busbar V
W <sub>1</sub> , W <sub>2</sub>	Connection bolts on busbar W
W <sub>3</sub> , W <sub>4</sub>	Connection bolts on busbar W
PE <sub>1</sub> , PE <sub>2</sub> , PE <sub>3</sub> , PE <sub>4</sub>	Connection bolts on busbar PE
U	Busbar U in the VPM
V	Busbar V in the VPM
W	Busbar W in the VPM



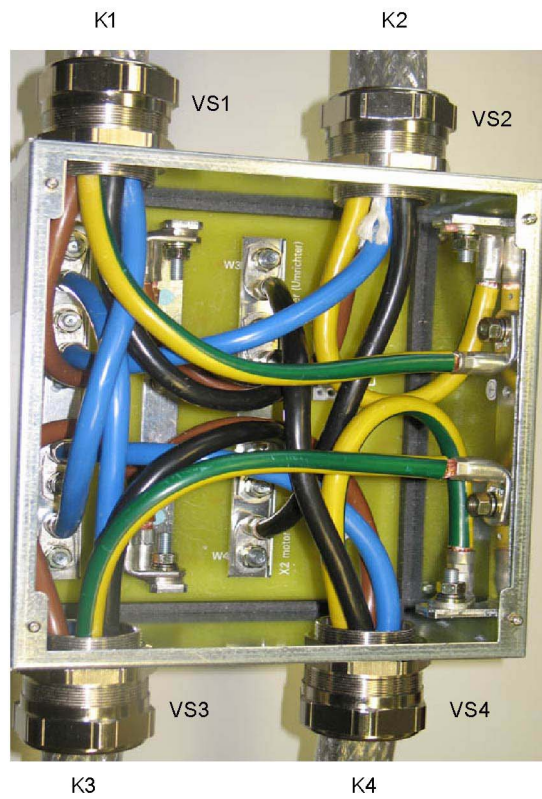


Figure 10-17 Wired Voltage Protection Module VPM200 Dynamic with short designations

10.2 Voltage Protection Module VPM

Table 10- 14 Installation steps

Screwed cable joint	Cable	Conductor/Phase	Installation step
VS1	K1	L <sub>1</sub> , L <sub>2</sub> , L <sub>3</sub> , PE	Introduce the cable with all the conductors and shield, tighten the screwed joint, lay conductors L <sub>1</sub> (black) and PE (green/yellow) on top of the other conductors.
VS2	K2	L <sub>1</sub> , L <sub>2</sub> , L <sub>3</sub> , PE	Introduce the cable with all the conductors and shield, tighten the screwed joint, lay conductors L <sub>1</sub> (black) and PE (green/yellow) on top of the other conductors.
	K1	L <sub>2</sub> (blue)	Attach to V1 and screw in place.
	K2	L <sub>2</sub> (blue)	Attach to V1 and screw in place.
	K2	PE (green/yellow)	Attach to PE1 and screw in place.
	K1	L <sub>3</sub> (brown)	Attach to W2 and screw in place.
	K2	L <sub>1</sub> (black)	Attach to U2 and screw in place.
3 separate cable ends for cables K1 and K2 are connected later.			
VS3	K3	L <sub>1</sub> , L <sub>2</sub> , L <sub>3</sub> , PE	Introduce the cable with all the conductors and shield, tighten the screwed joint, laying conductors L <sub>1</sub> (black) and PE (green/yellow) on top of the other conductors.
VS4	K4	L <sub>1</sub> , L <sub>2</sub> , L <sub>3</sub> , PE	Introduce the cable with all the conductors and shield, tighten the screwed joint, laying conductors L <sub>1</sub> (black) and PE (green/yellow) on top of the other conductors.
	K3	L <sub>2</sub> (blue)	Attach to V2 and screw in place.
	K4	L <sub>2</sub> (blue)	Attach to V2 and screw in place.
	K3	L <sub>3</sub> (brown)	Attach to W3 and screw in place.
	K4	PE (green/yellow)	Attach to PE4 and screw in place.
	K4	L <sub>1</sub> (black)	Attach to U3 and screw in place.
	K1	L <sub>1</sub> (black)	Attach to U4 and screw in place.
	K3	L <sub>1</sub> (black)	Attach to U1 and screw in place.
	K2	L <sub>3</sub> (brown)	Attach to W4 and screw in place.
	K4	L <sub>3</sub> (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.

## 10.2.8 Technical data

Table 10- 15 Technical data

	VPM 120	VPM 200	VPM 200 Dynamic
Order number	6SN1113-1AA00-1JAx	6SN1113-1AA00-1KAx	6SN1113-1AA00-1KCx
Type of voltage	3-phase pulsed AC voltage, EMF motor		
Ramp-up time for VPM	1 s (from pulse enable)		
Normal range of the DC link voltage: - lower limit - upper limit	490 V DC 795 V DC		
Operating range for VPM	from 830 V to 2,000 V (peak value)		
Clock frequency	3.2...8 kHz		
Rated current	120 A <sub>rms</sub>	200 A <sub>rms</sub>	
Time range	Maximum permissible short-circuit current		
0...10 ms 10...500 ms 500 ms...2 min > 2 min	1,500 A 255 A 90 A 0 A	2,000 A 600 A 200 A 0 A	
Max. perm. short-circuit time	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



## Accessories

### 11.1 Shield connecting plates for power supply and motor cables

#### 11.1.1 Description

Shield connection plates are available to connect the shields of line and motor power cables as well as brake cables for all Line Modules, Motor Modules, and Active Interface Modules.

A shield connection terminal and/or clamp is used to connect the cable shield to the shield connection plate. Shield supports must be properly arranged to ensure EMC compliance.

#### 11.1.2 Shield connecting plates

Table 11- 1 Shield connection for components with internal air cooling

Component	Power	Total width of component	Shield connection plate	Recommended shield connection
Line Module	5 kW/10 kW	50 mm	Included in the scope of delivery	
	16 kW	100 mm	Included in the scope of delivery	KLBÜ CO4 <sup>1)</sup>
	36 kW	150 mm	6SL3162-1AF00-0AA1	KLBÜ CO4 <sup>1)</sup>
	55 kW	200 mm	6SL3162-1AH01-0AA0	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 motor connector	
	18 A (Compact) 2 x 1.7 A to 2 x 5 A	75 mm	Integrated in the motor connector	
	30 A and 2 x 18 A	100 mm	Included in the scope of delivery	KLBÜ CO4 <sup>1)</sup>
	45 A and 60 A	150 mm	6SL3162-1AF00-0AA1	KLBÜ CO1 <sup>1)</sup> for the brake cable KLBÜ CO4 <sup>1)</sup> for the motor cable
	85 A	200 mm	6SL3162-1AH01-0AA0	KLBÜ CO1 <sup>1)</sup> for brake cable clamps for motor cable
	132 A and 200 A	300 mm	6SL3162-1AH00-0AA0	KLBÜ CO1 <sup>1)</sup> 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 <sup>1)</sup>
	55 kW	200 mm	6SL3163-1AH00-0AA0	Clamps
	80 kW / 120 kW	300 mm	6SL3163-1AM00-0AA0	Clamps

1) Shield connection terminal, Weidmüller Company

11.1 Shield connecting plates for power supply and motor cables

Table 11- 2 Shield connection for components with external air cooling

Component	Power	Total width of component	Shield connection plate	Recommended shield connection
Line Module	5 kW/10 kW	50 mm	Included in the scope of delivery	
	16 kW	100 mm		KLBÜ CO4 <sup>1)</sup>
	36 kW	150 mm	6SL3162-1AF00-0BA1	KLBÜ CO4 <sup>1)</sup>
	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 motor connector	
	30 A and 2 x 18 A	100 mm	Included in the scope of delivery	KLBÜ CO4 <sup>1)</sup>
	45 A and 60 A	150 mm	6SL3162-1AF00-0BA1	KLBÜ CO1 <sup>1)</sup> for the brake cable KLBÜ CO4 <sup>1)</sup> for the motor cable
	85 A	200 mm	6SL3162-1AH01-0BA0	KLBÜ CO1 <sup>1)</sup> for brake cable clamps for motor cable
	132 A and 200 A	300 mm	6SL3162-1AH00-0AA0	KLBÜ CO1 <sup>1)</sup> for brake cable clamps for motor cable

1) Shield connection terminal, Weidmüller Company

Table 11- 3 Shield connection for components with cold plate

Component	Power	Total width of component	Shield connection plate	Recommended shield connection
Line Module	5 kW/10 kW	50 mm	Included in the scope of delivery	
	16 kW	100 mm		KLBÜ CO4 <sup>1)</sup>
	36 kW	150 mm	6SL3162-1AF00-0BA1	KLBÜ CO1 <sup>1)</sup> and KLBÜ CO4 <sup>1)</sup>
	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 motor 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 <sup>1)</sup>
	45 A and 60 A	150 mm	6SL3162-1AF00-0BA1	KLBÜ CO1 <sup>1)</sup> for the brake cable KLBÜ CO4 <sup>1)</sup> for the motor cable
	85 A	200 mm	6SL3162-1AH01-0BA0	KLBÜ CO1 <sup>1)</sup> for brake cable clamps for motor cable
	132 A and 200 A	300 mm	6SL3162-1AH00-0AA0	KLBÜ CO1 <sup>1)</sup> for brake cable clamps for motor cable

1) Shield connection terminal, Weidmüller Company

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*11.1 Shield connecting plates for power supply and motor cables*

Table 11-4 Shield connection for liquid-cooled components

<b>Component</b>	<b>Power</b>	<b>Total width of component</b>	<b>Shield connection plate</b>	<b>Recommended shield connection</b>
Line Module	120 kW	300 mm	6SL3162-1AH00-0AA0	Clamps
Motor Module	200 A	300 mm	6SL3162-1AH00-0AA0	KLBÜ CO1 <sup>1)</sup> for brake cable clamps for motor cable

1) Shield connection terminal, Weidmüller Company

11.1.3 Overview examples

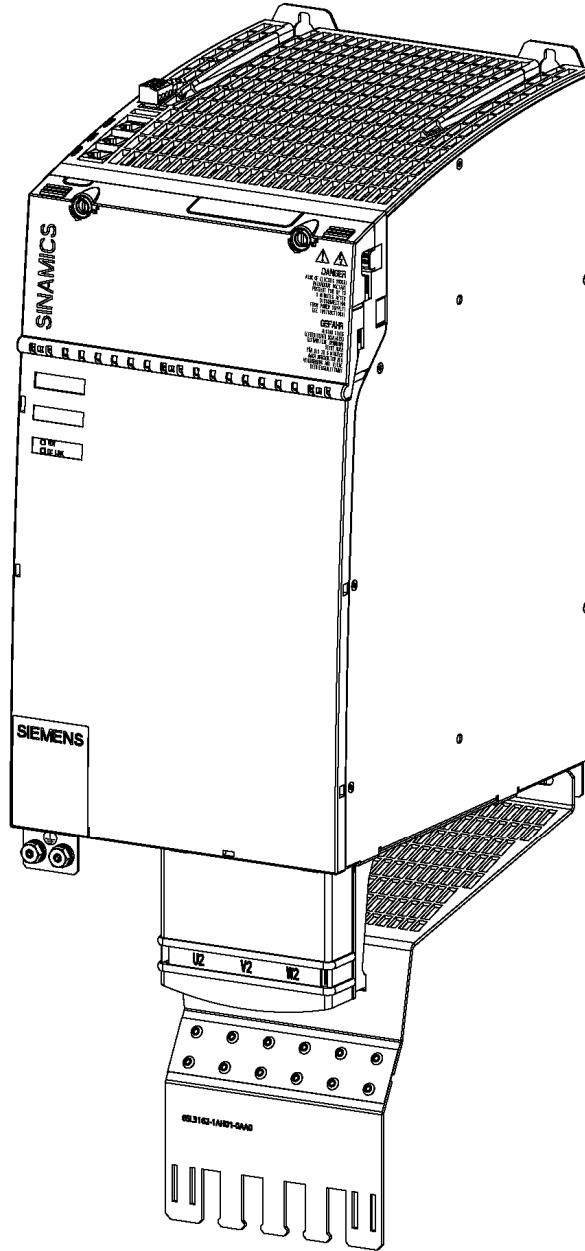


Figure 11-1 Shield connecting plate for a 200 mm module with internal air cooling



11.1 Shield connecting plates for power supply and motor cables

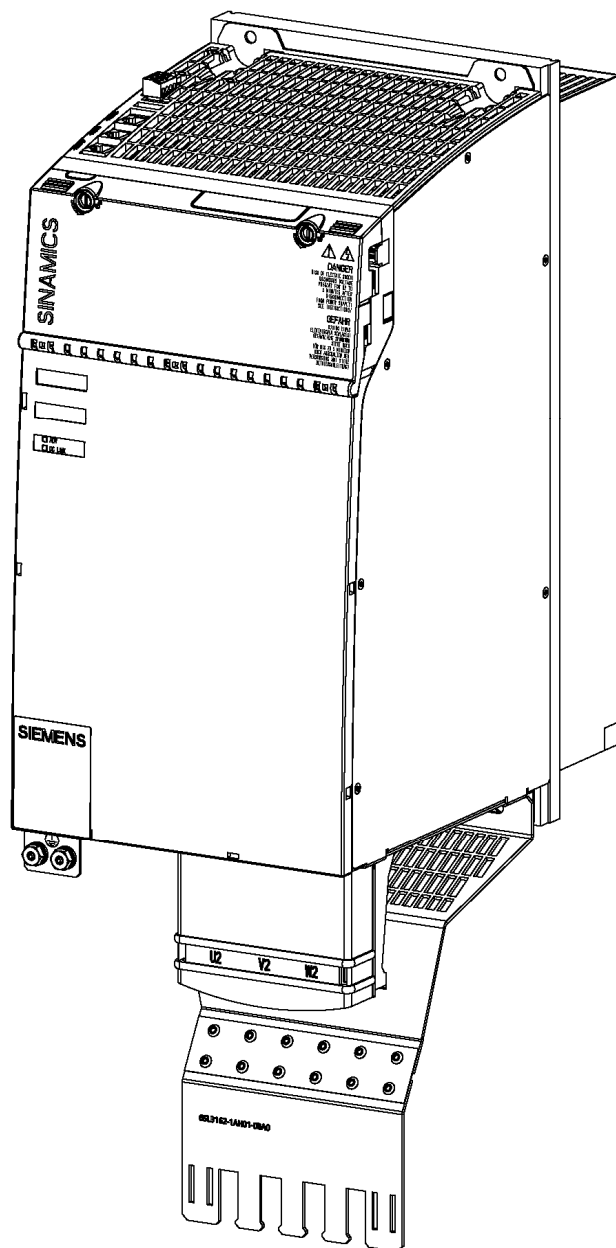


Figure 11-2 Shield connecting plate for a 200 mm module with external air cooling

11.1 Shield connecting plates for power supply and motor cables

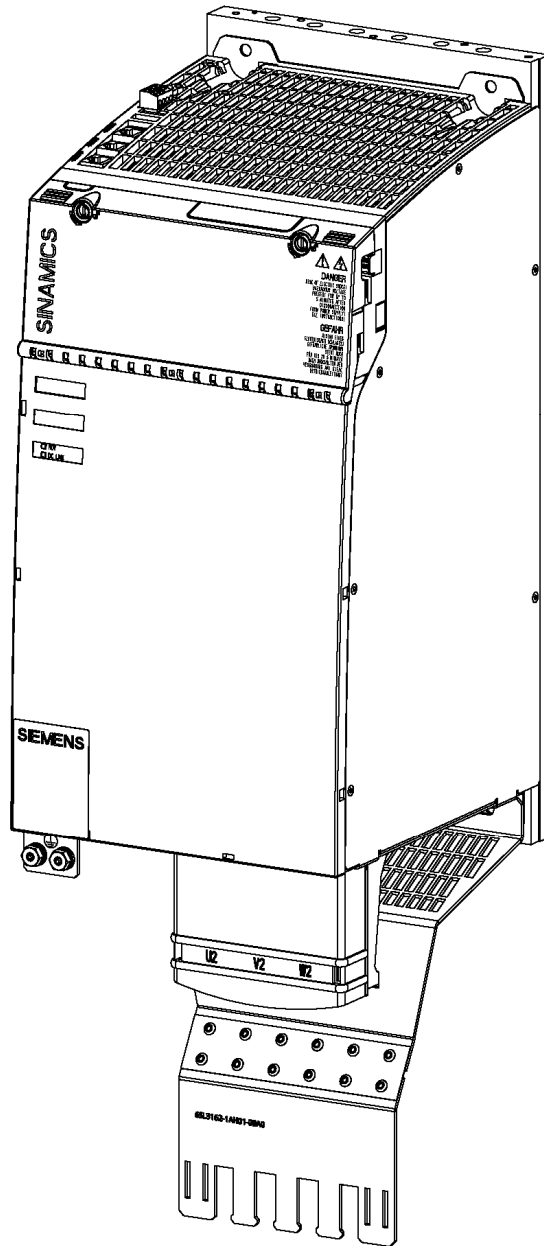


Figure 11-3 Shield connecting plate for a 200 mm module with a cold plate

## 11.1 Shield connecting plates for power supply and motor cables

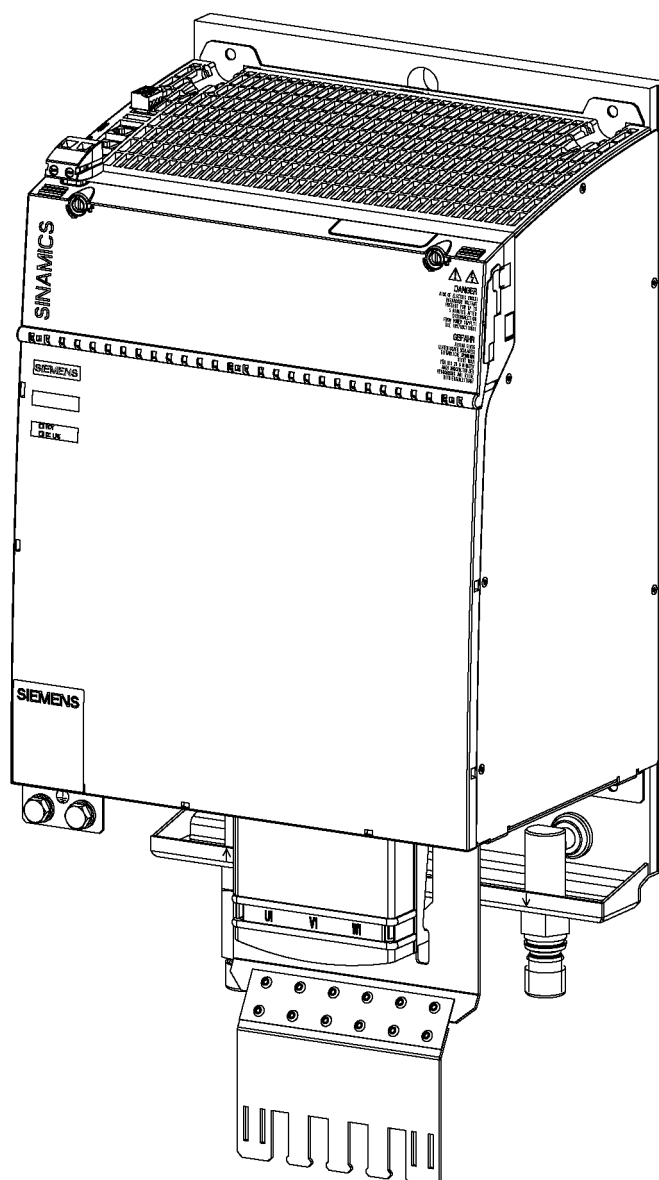


Figure 11-4 Shield connecting plate on a 300 mm module Liquid Cooled

11.1 Shield connecting plates for power supply and motor cables

11.1.4 Dimension drawings

11.1.4.1 Line Modules and Motor Modules with internal air cooling

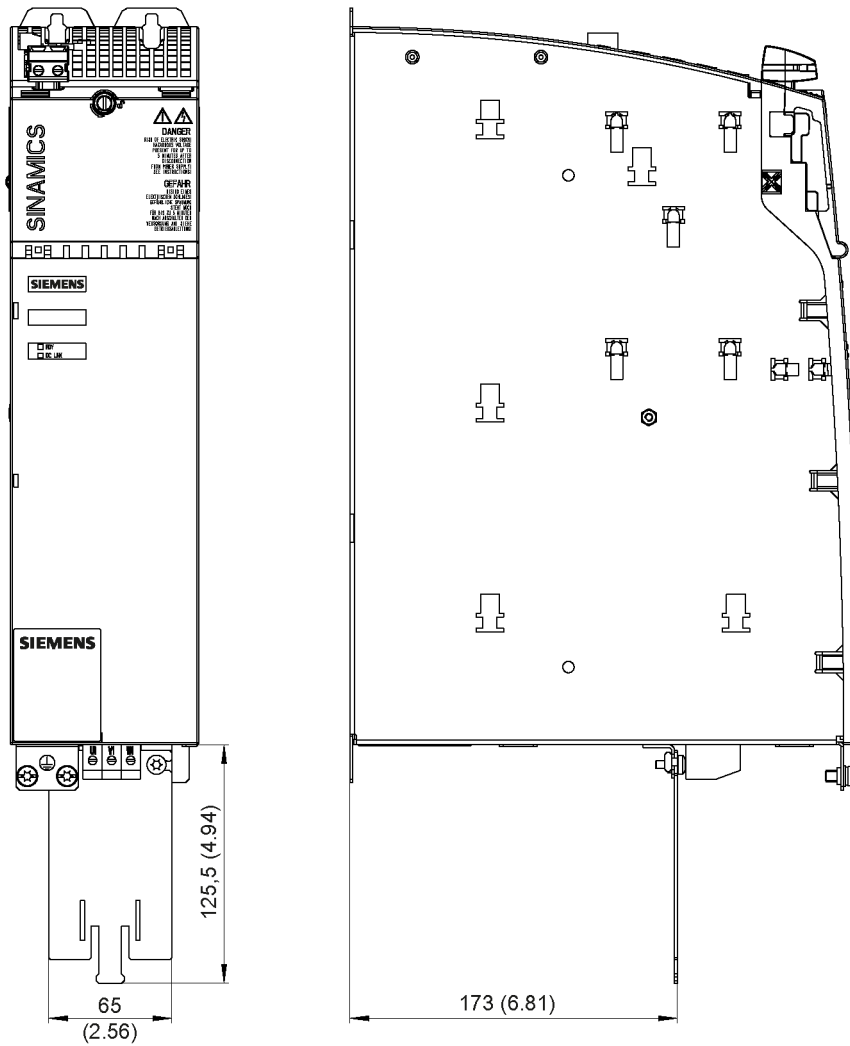


Figure 11-5 Dimension drawing of shield connecting plate on a 100 mm component with internal air cooling, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

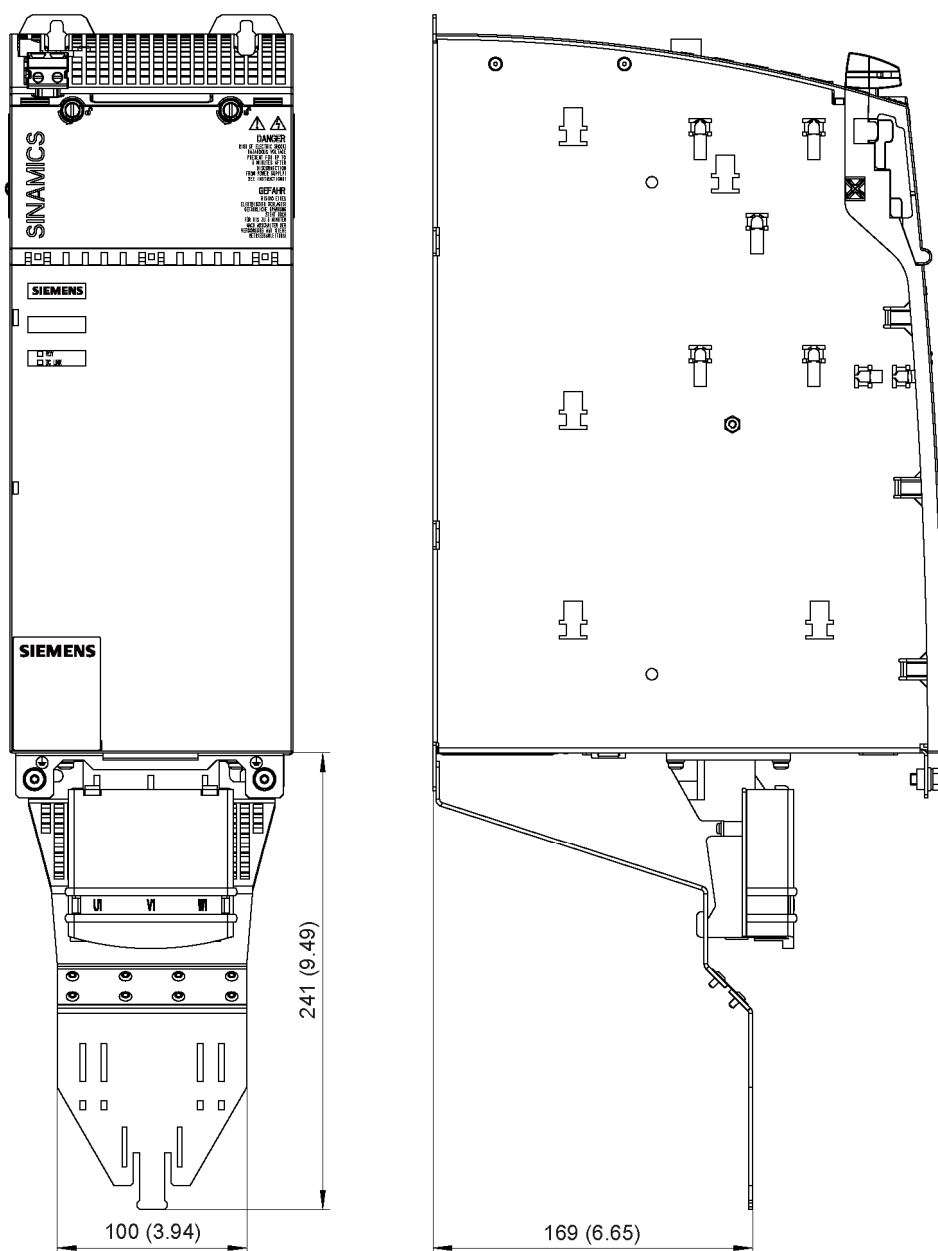


Figure 11-6 Dimension drawing of shield connecting plate on a 150 mm component with internal air cooling, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

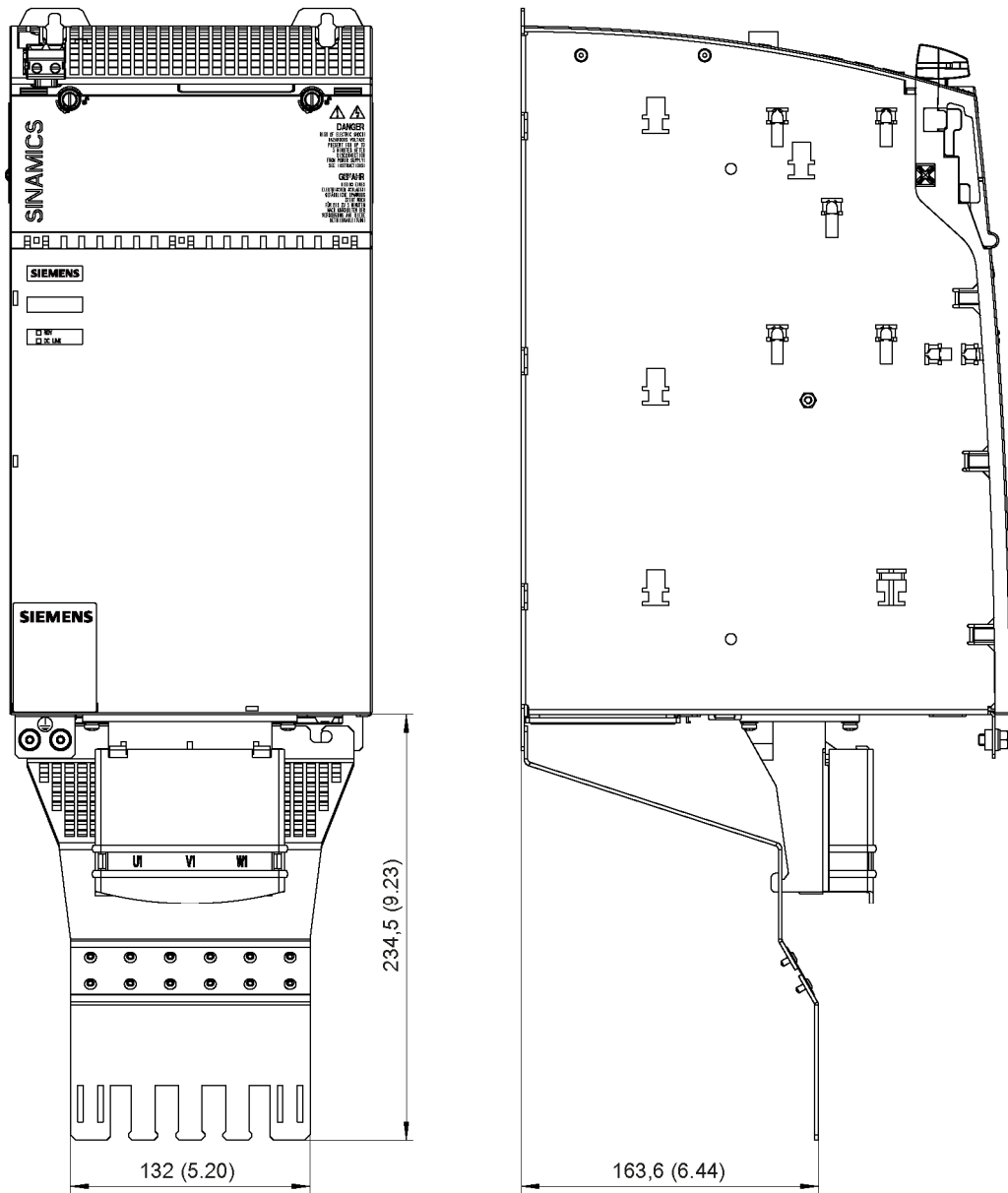


Figure 11-7 Dimension drawing of shield connecting plate on a 200 mm component with internal air cooling, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

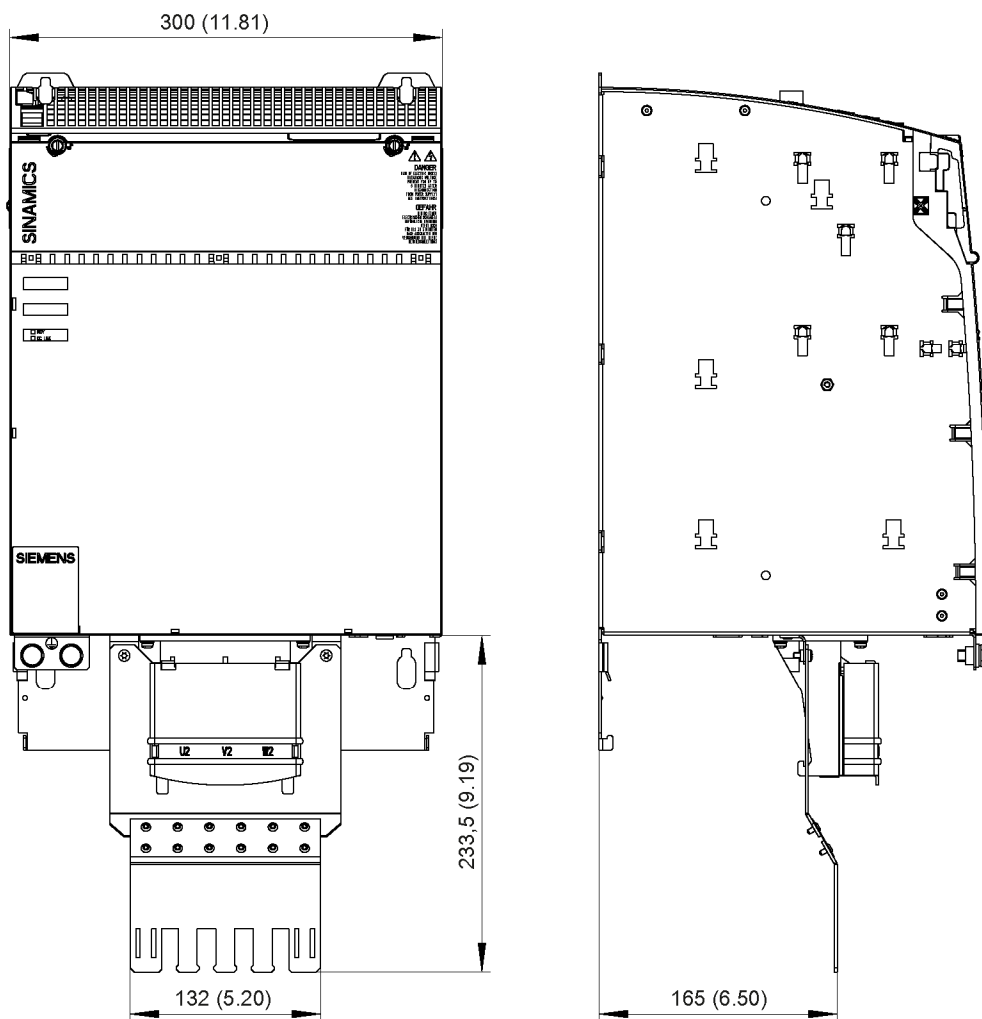


Figure 11-8 Dimension drawing of shield connecting plate on a 300 mm component with internal air cooling, all dimensions in mm and (inches)

11.1.4.2 Line Modules and Motor Modules with external air cooling

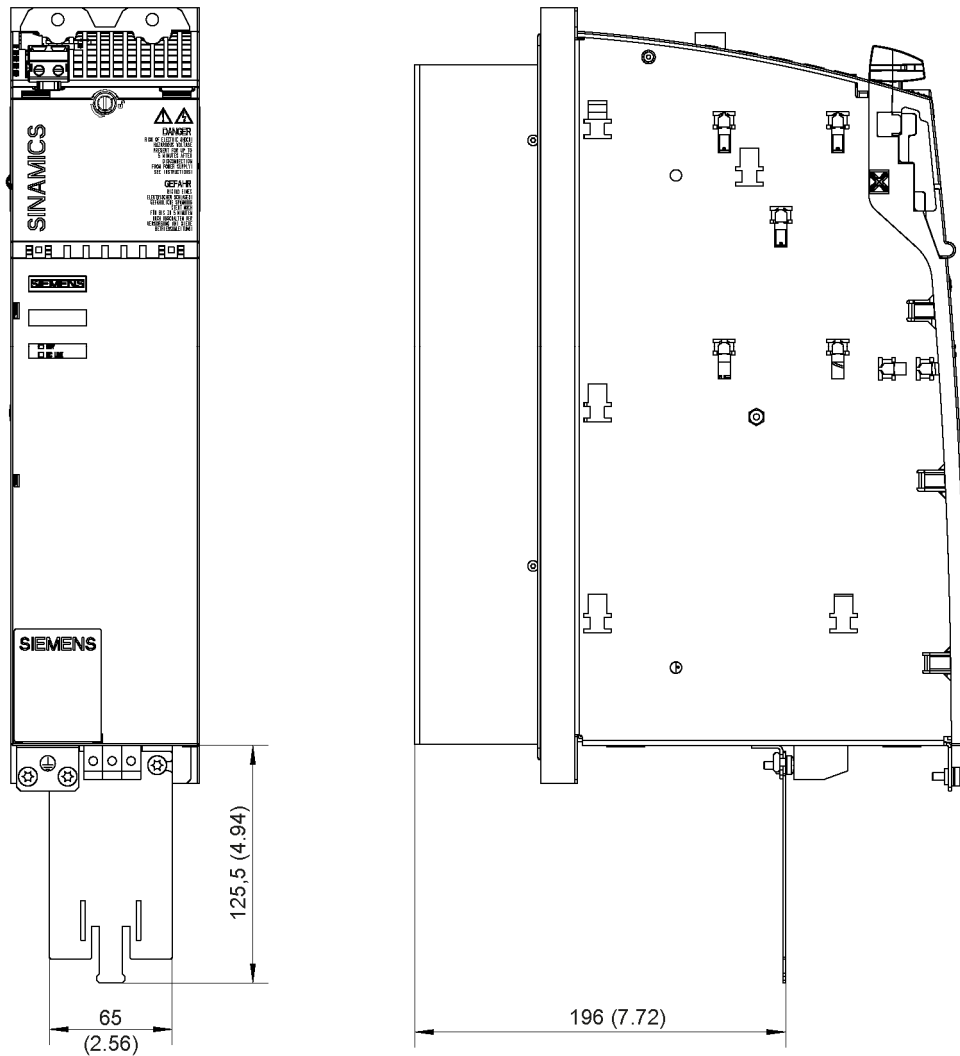


Figure 11-9 Dimension drawing of shield connecting plate on a 100 mm component with external air cooling, all dimensions in mm and (inches)



11.1 Shield connecting plates for power supply and motor cables

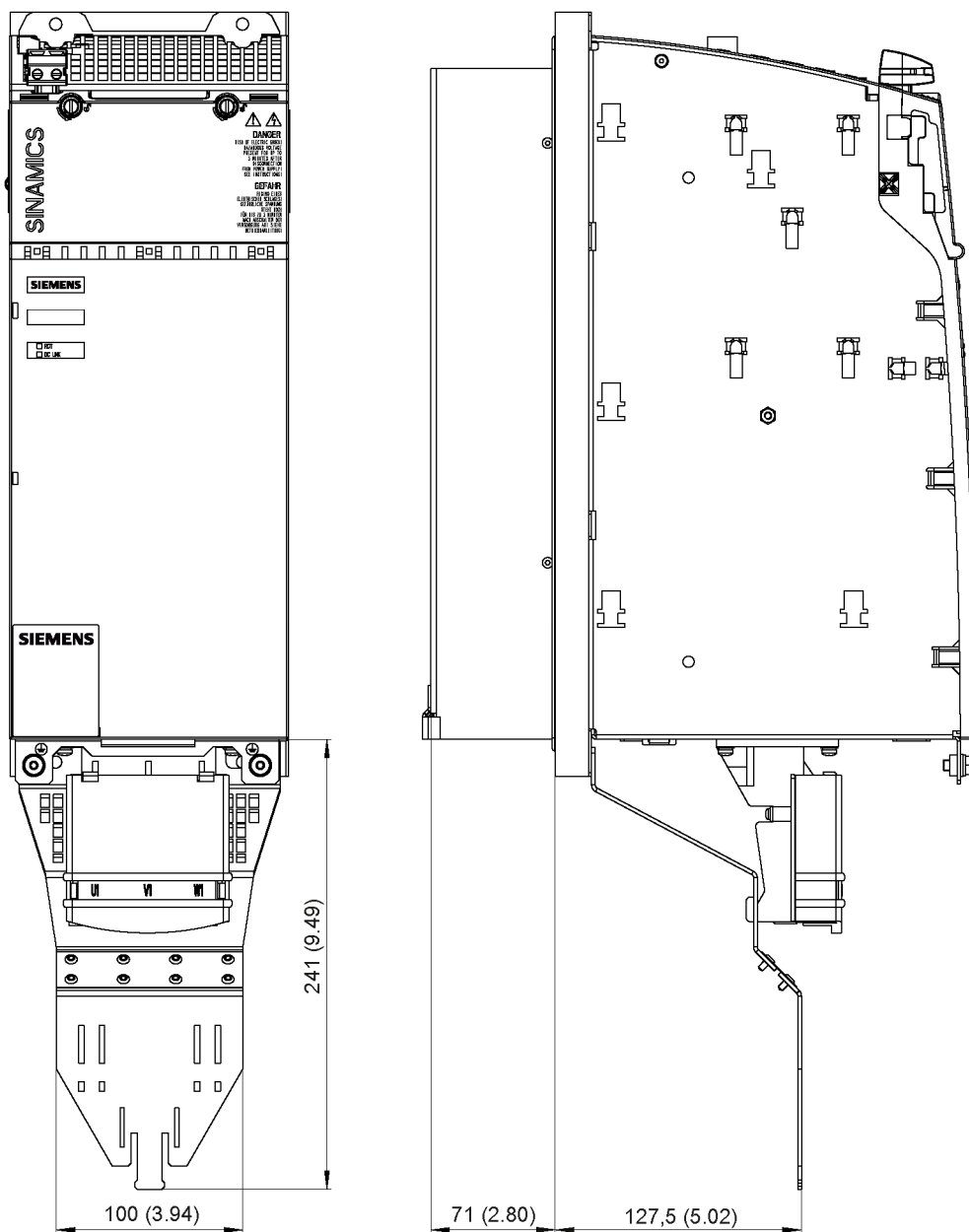


Figure 11-10 Dimension drawing of shield connecting plate on a 150 mm component with external air cooling, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

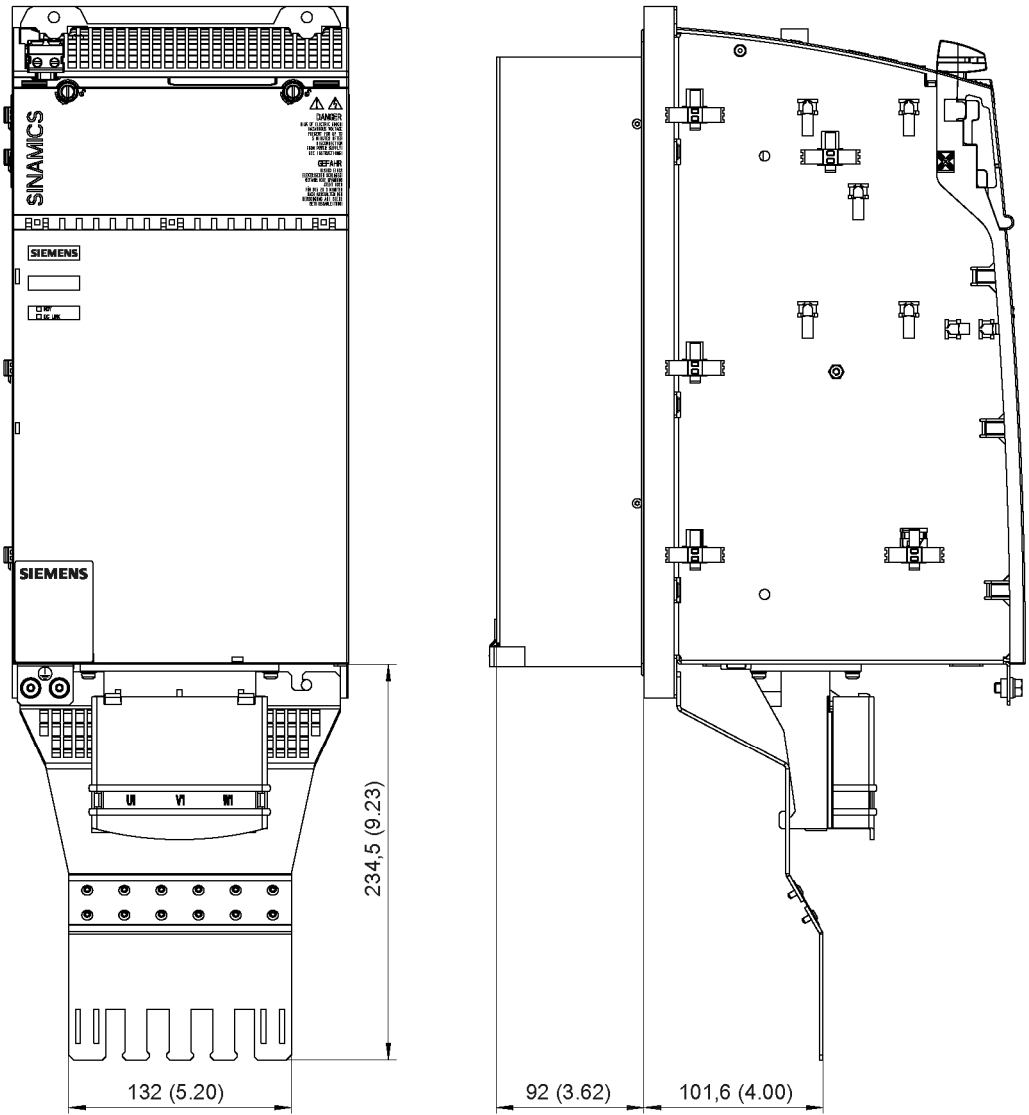


Figure 11-11 Dimension drawing of shield connecting plate on a 200 mm component with external air cooling, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

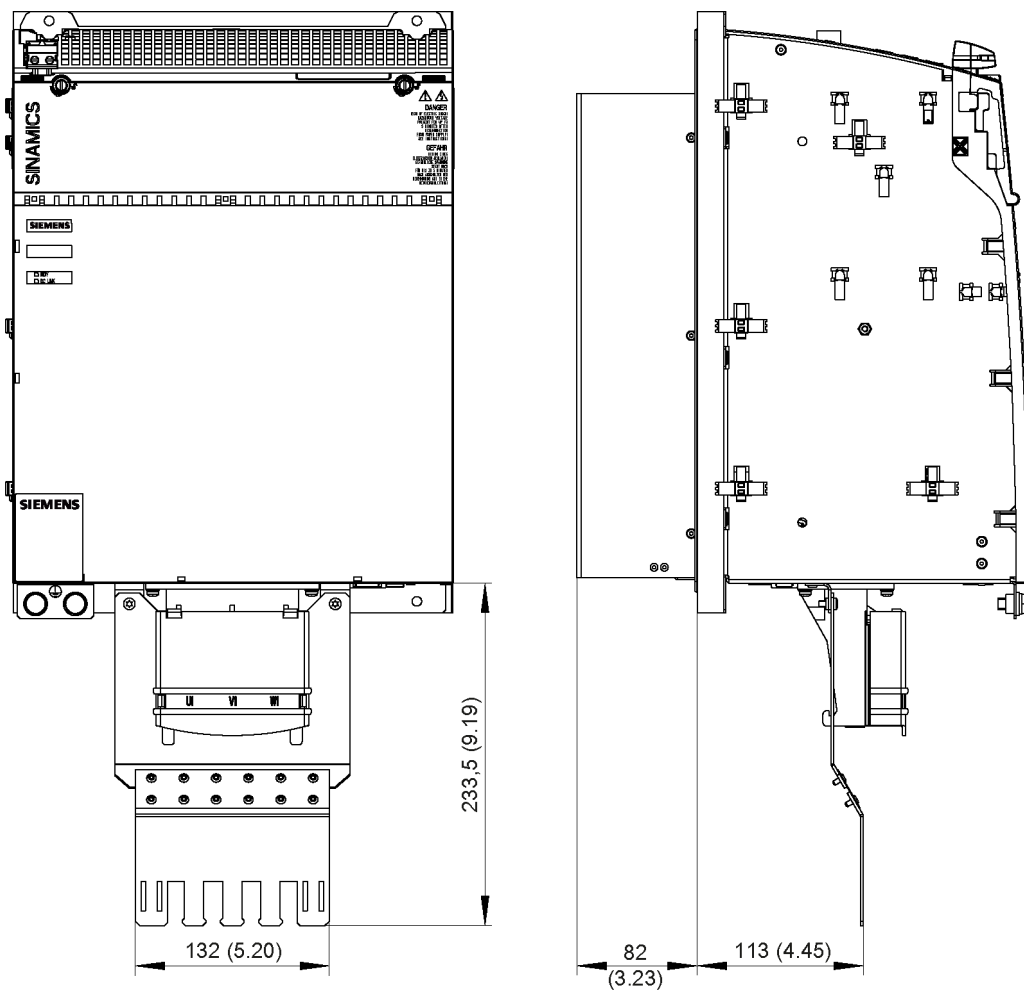


Figure 11-12 Dimension drawing of shield connecting plate on a 300 mm component with external air cooling, all dimensions in mm and (inches)

11.1.4.3 Line Modules and Motor Modules with cold plate

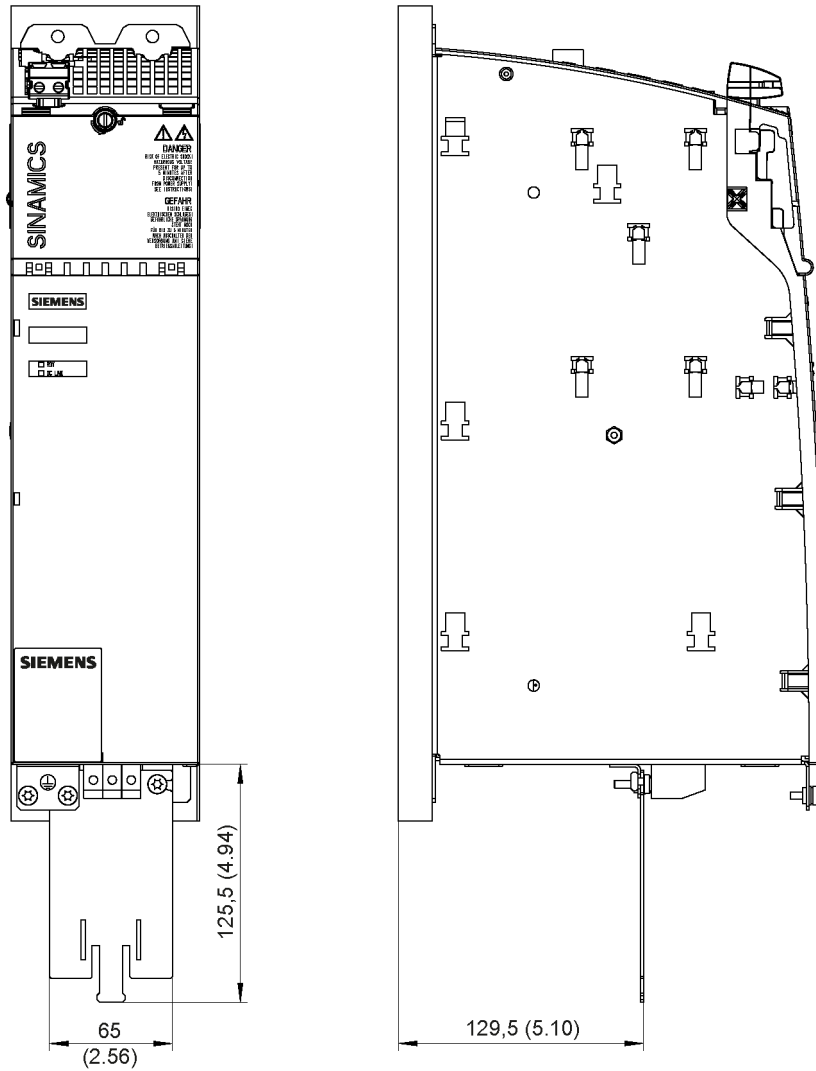


Figure 11-13 Dimension drawing of shield connecting plate on a 100 mm component with cold plate, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

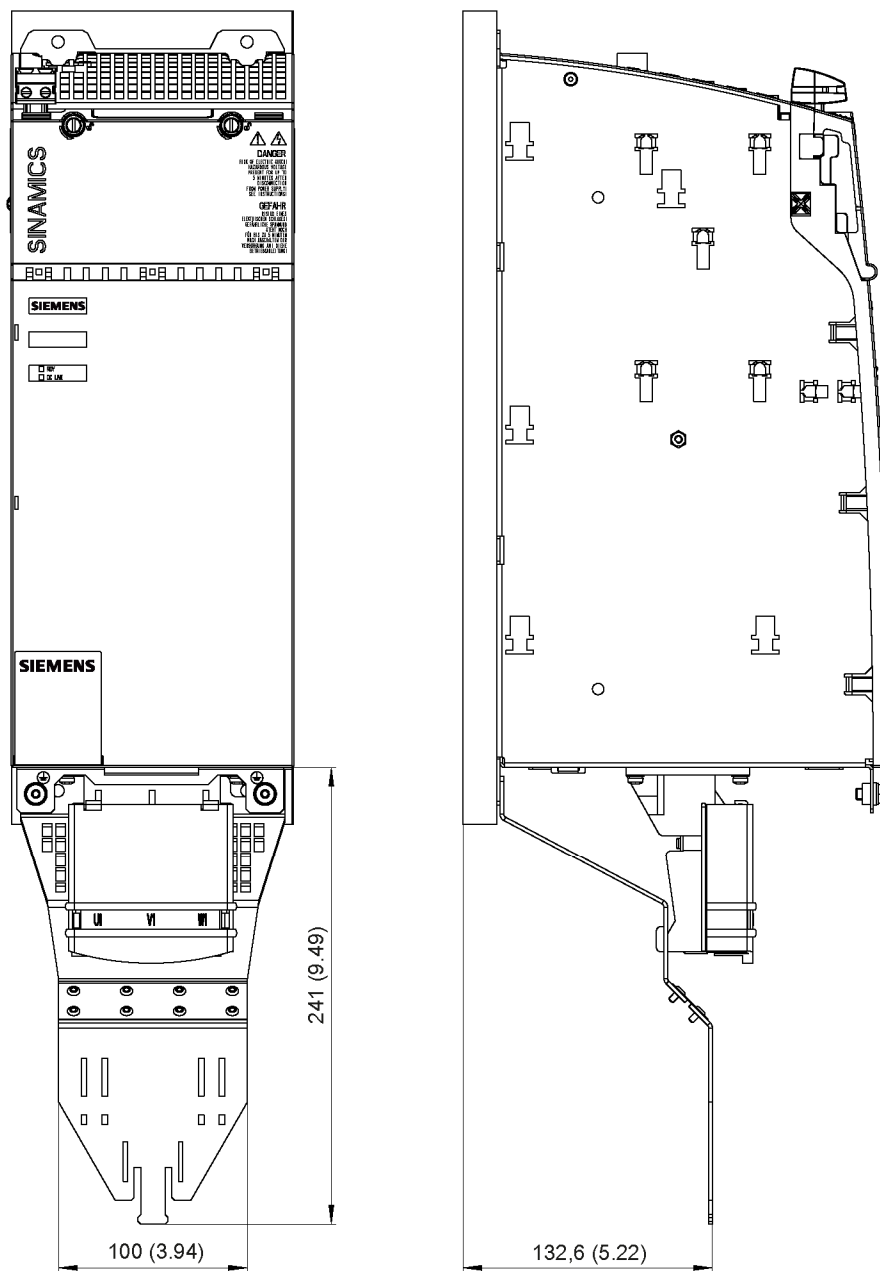


Figure 11-14 Dimension drawing of shield connecting plate on a 150 mm component with cold plate, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

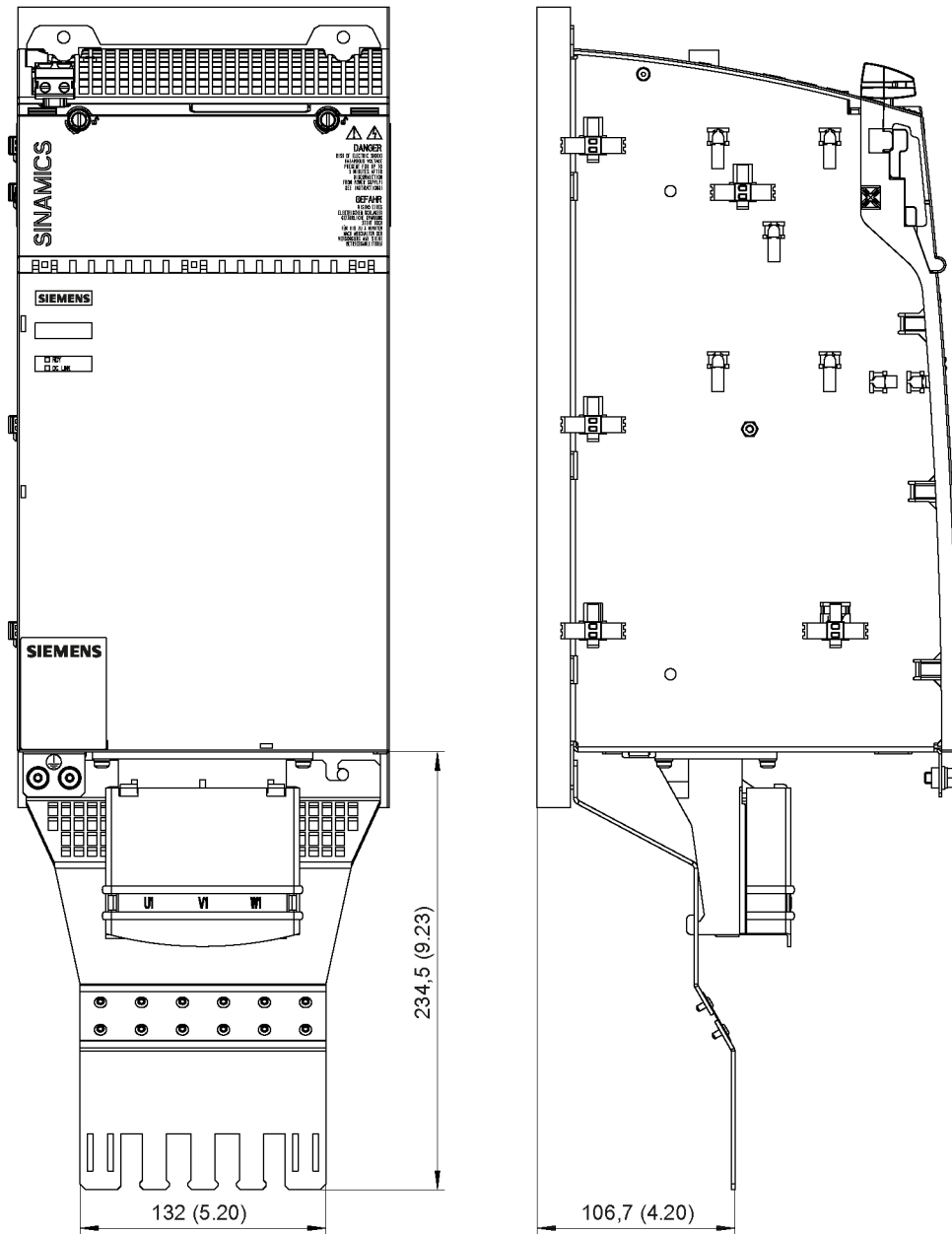


Figure 11-15 Dimension drawing of shield connecting plate on a 200 mm component with cold plate, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

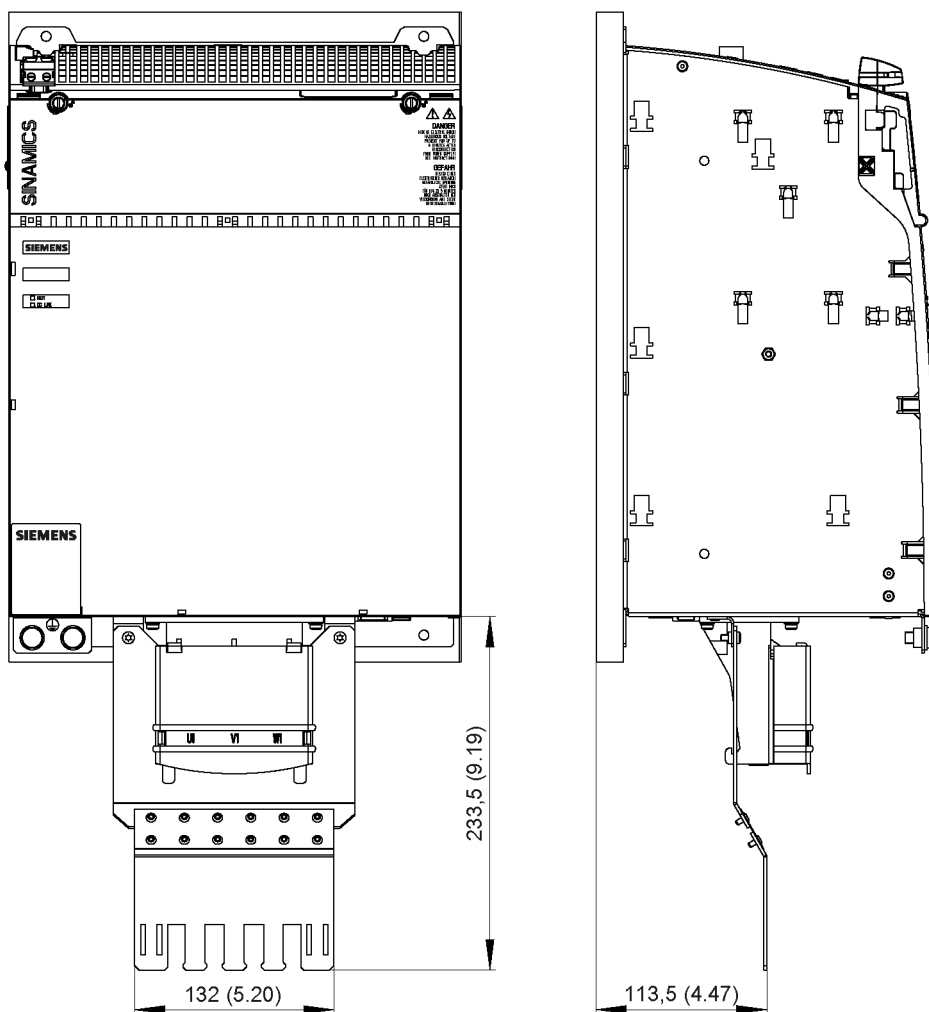


Figure 11-16 Dimension drawing of shield connecting plate on a 300 mm component with cold plate, all dimensions in mm and (inches)

11.1.4.4 Line Modules and Motor Modules, Liquid Cooled

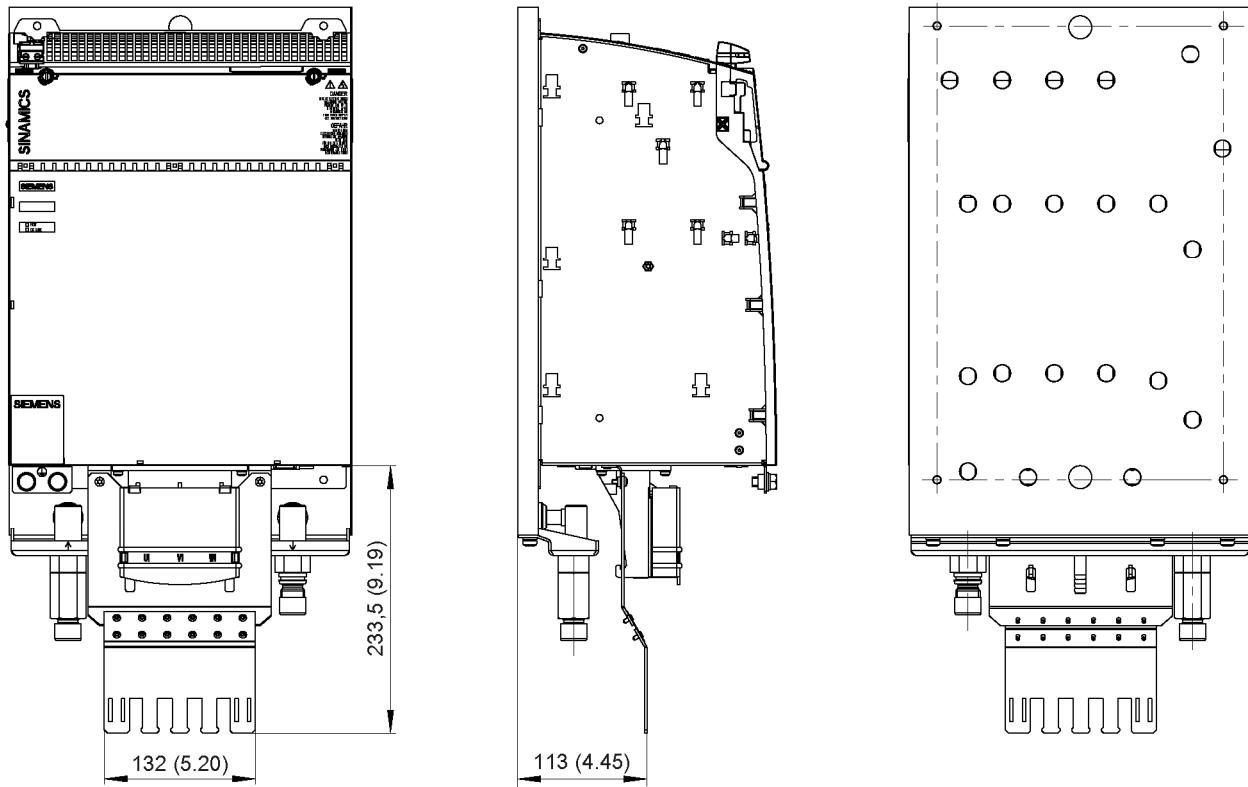


Figure 11-17 Dimension drawing of shield connecting plate on a 300 mm Liquid Cooled component, all dimensions in mm and (inches)



11.1.4.5 Active Interface Modules

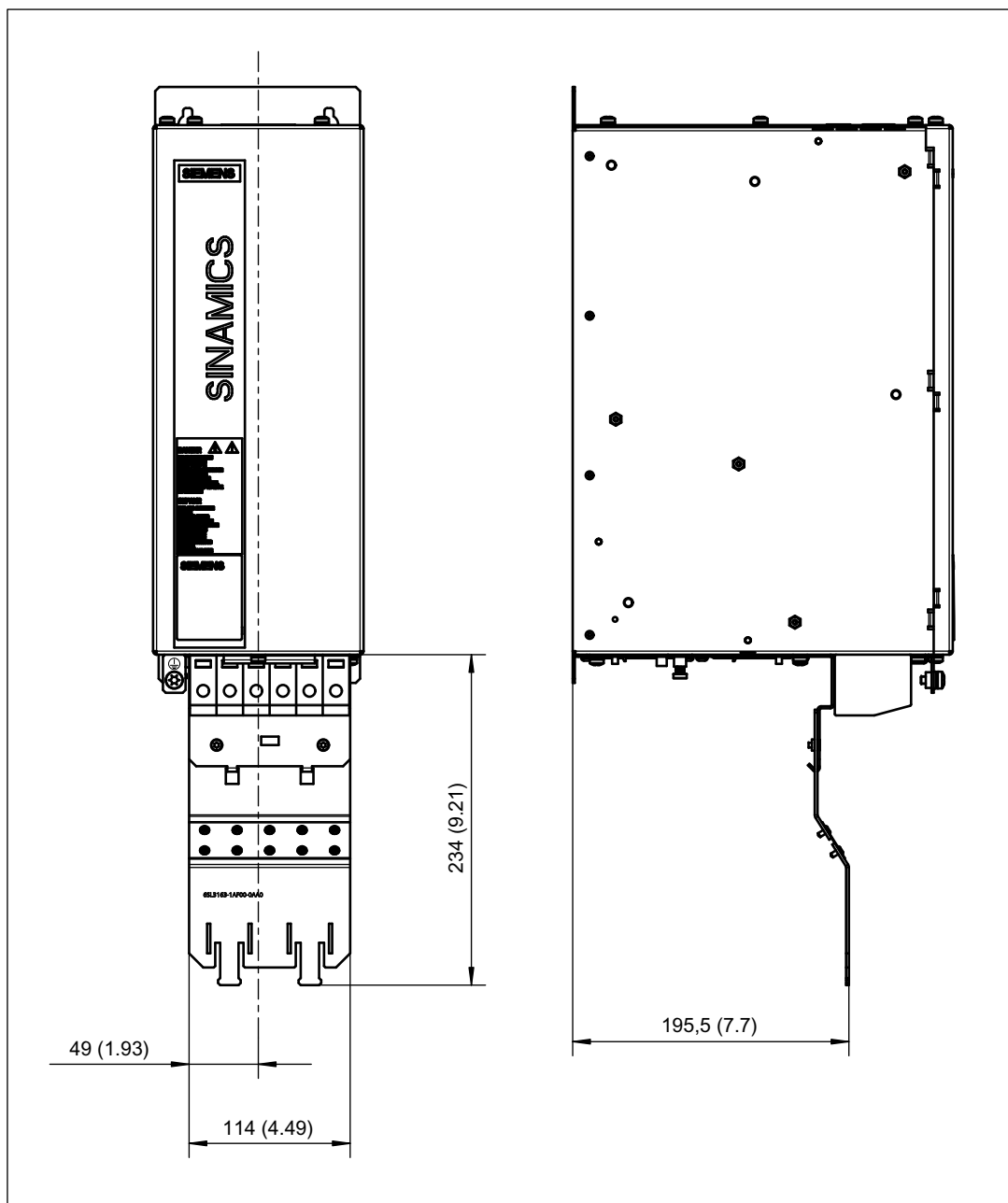


Figure 11-18 Dimension drawing of shield connecting plate on the 36 kW Active Interface Module, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

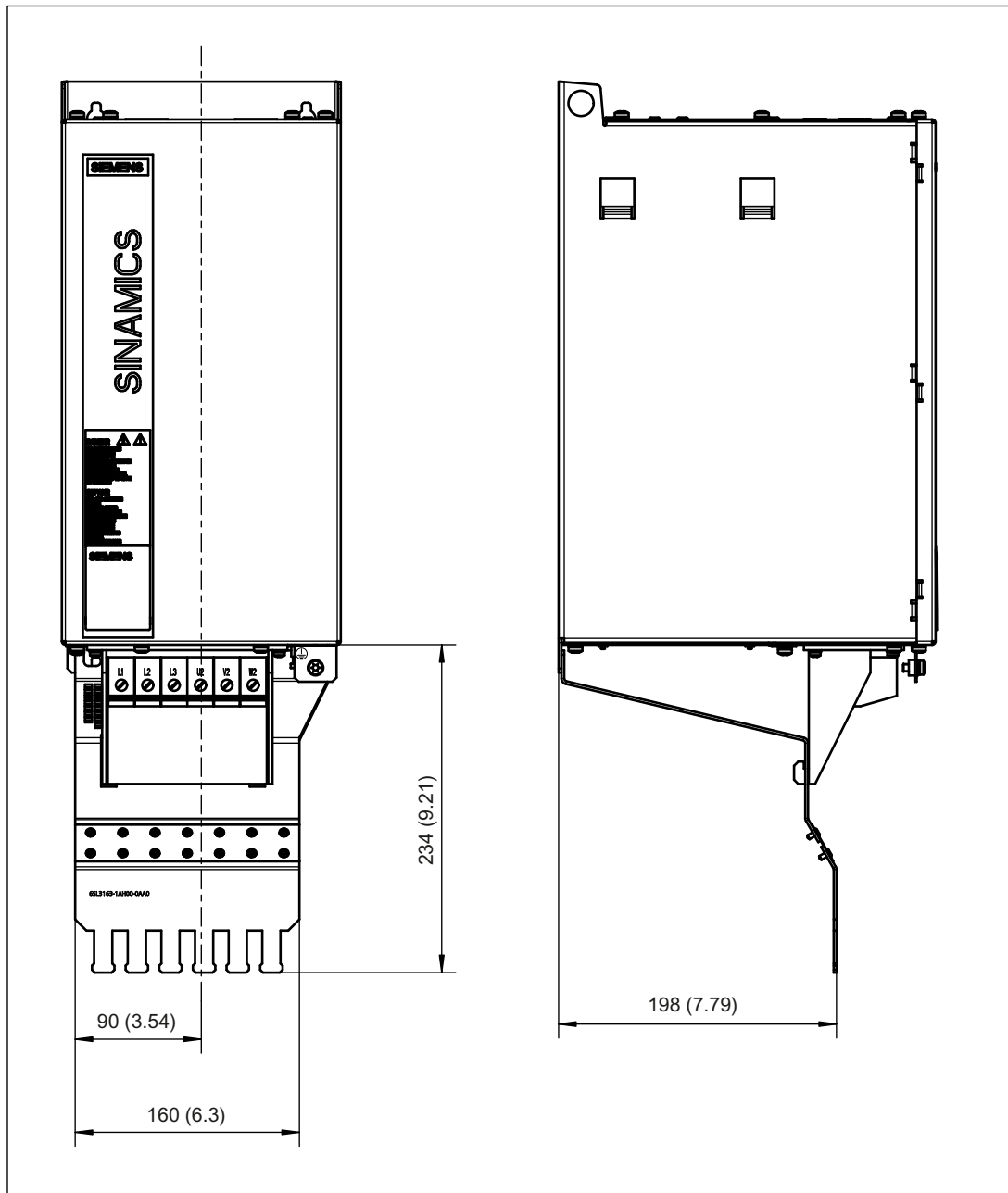


Figure 11-19 Dimension drawing of shield connecting plate on the 55 kW Active Interface Module, all dimensions in mm and (inches)

11.1 Shield connecting plates for power supply and motor cables

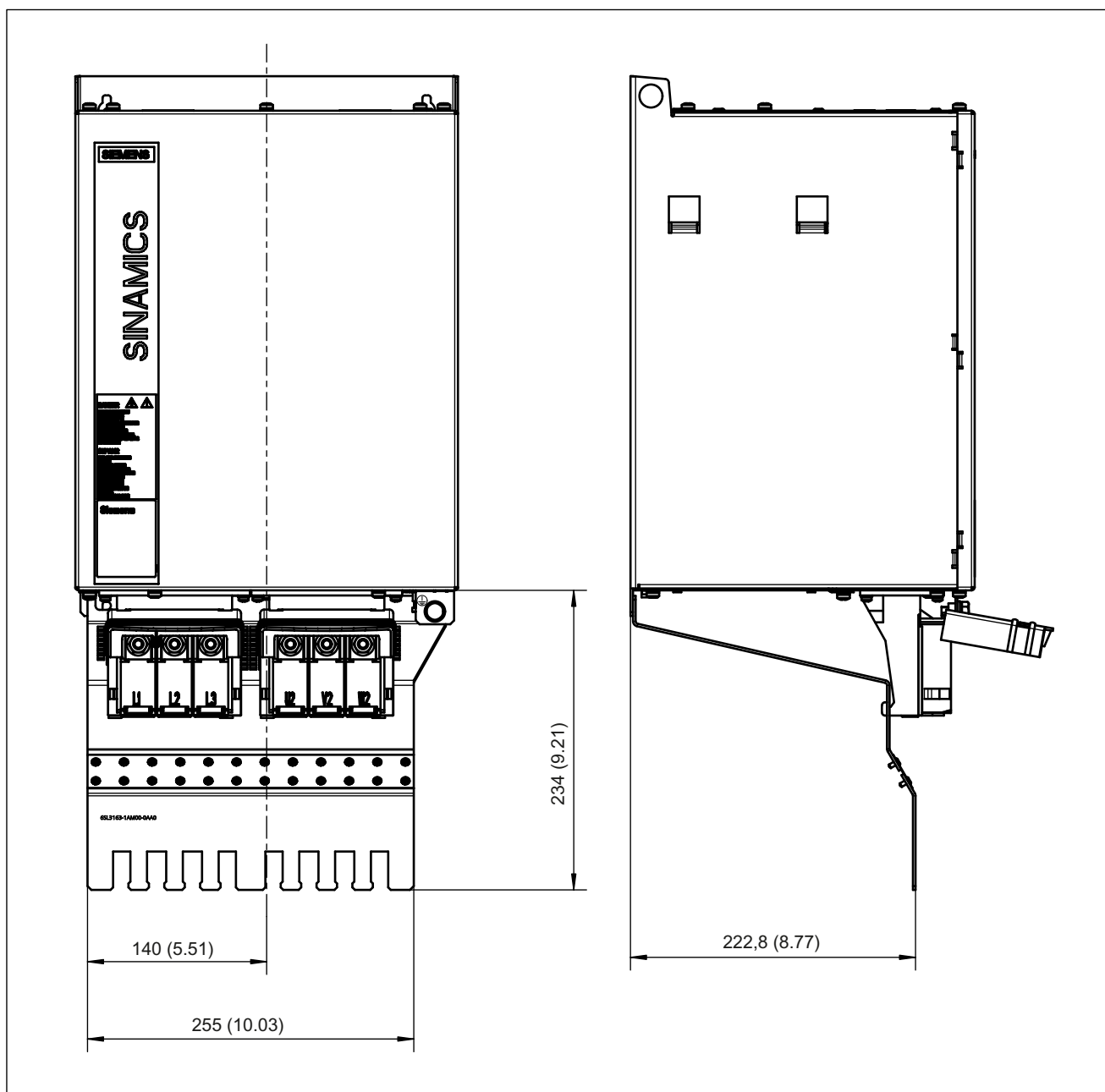


Figure 11-20 Dimension drawing of shield connecting plate on the 80 and 120 kW Active Interface Module, all dimensions in mm and (inches)

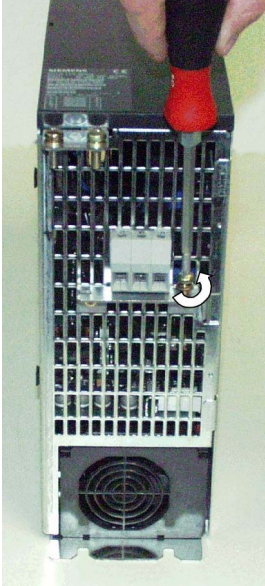
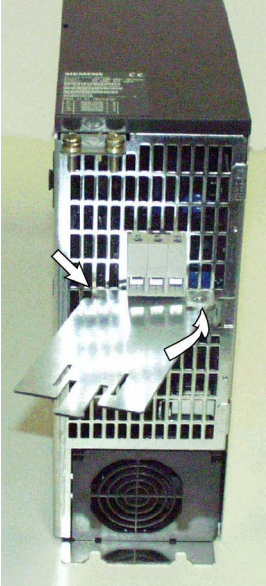
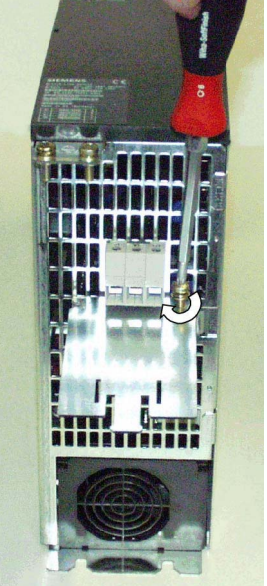

11.1 Shield connecting plates for power supply and motor cables

11.1.5 Installation

Tools required:

- Torx screwdriver T25 for shield connecting plate

Table 11- 5 Installing the shield connecting plate to a 100 mm component using as an example, internal air cooling


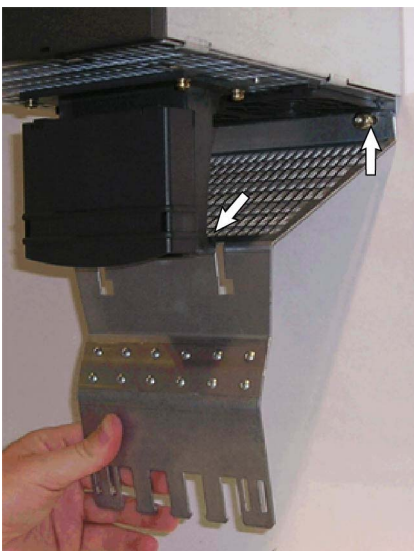
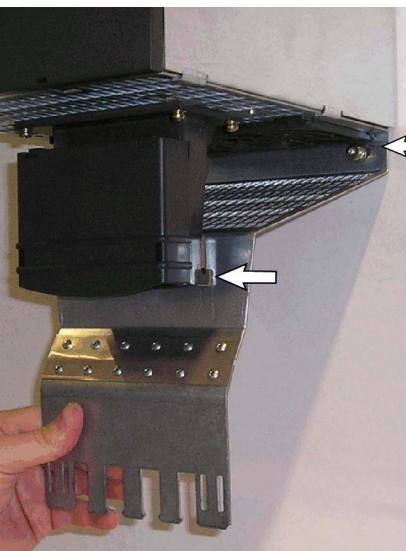
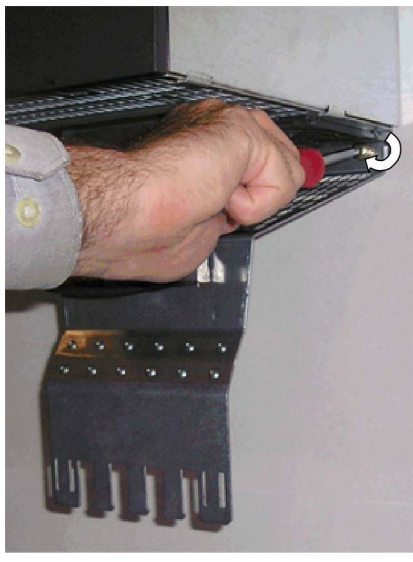
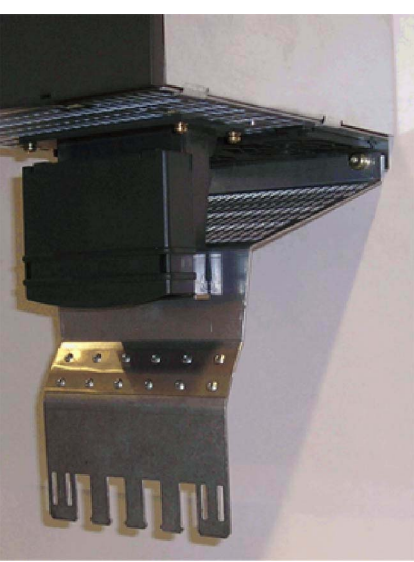
			
<p>Remove the screw</p>	<p>Hook the shield connecting plate into place</p>	<p>Tighten the shield connecting plate Tightening torque: 3 Nm</p>	<p>Installed shield connecting plate</p>

Tools required:

- Screwdriver for fixing screws used

11.1 Shield connecting plates for power supply and motor cables

Table 11-6 Installing the shield connecting plate to a 200 mm component using as an example, internal air cooling

		
<p>Loosen the lower fixing screws</p>	<p>Hook the shield connecting plate into the screws and on the line/motor connection</p>	<p>Secure the shield connecting plate by shifting it to the left</p>
		
<p>Tighten the shield connecting plate Tightening torque: 6 Nm</p>	<p>Installed shield connecting plate</p>	

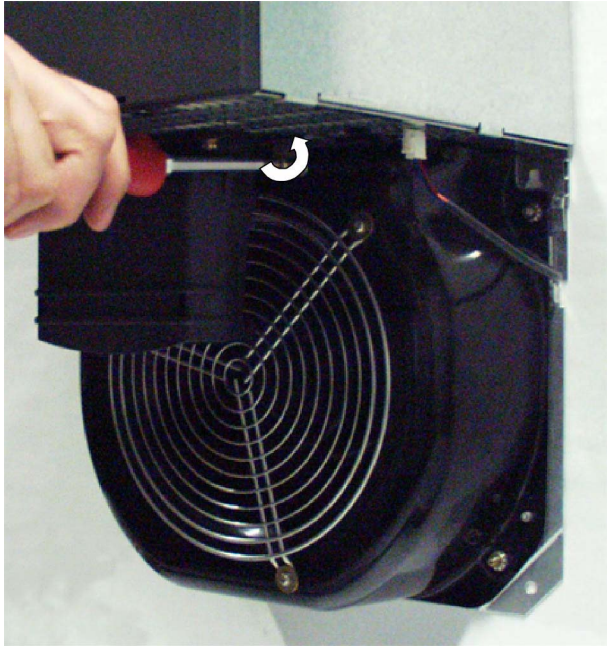
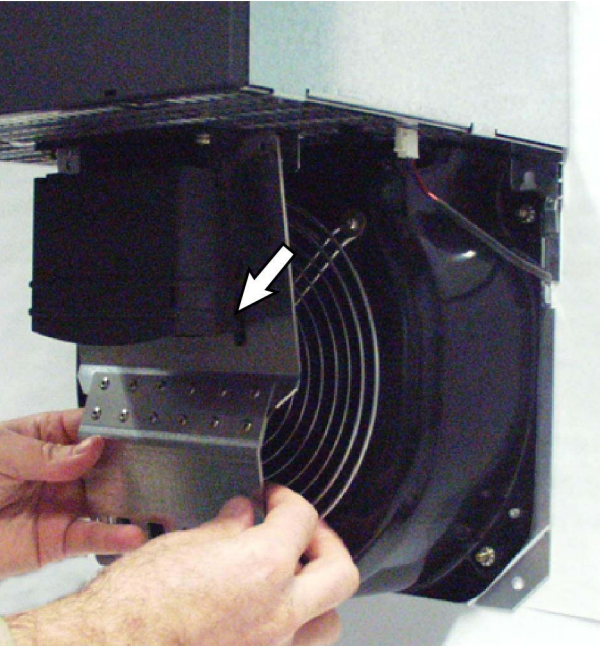
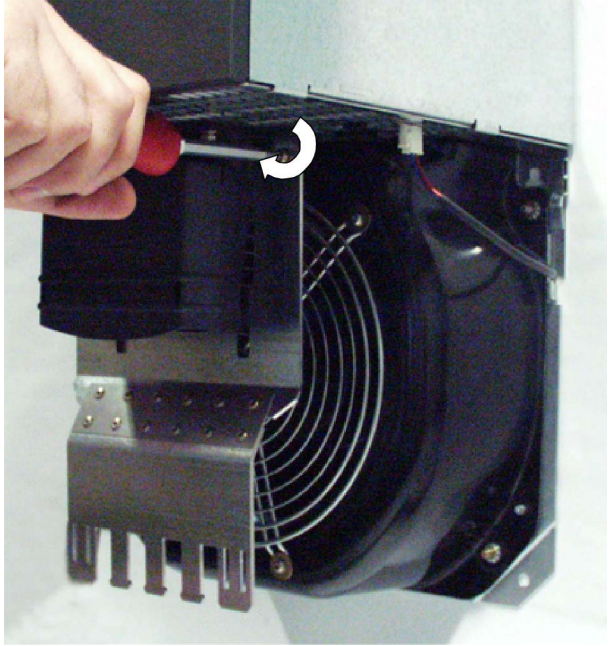
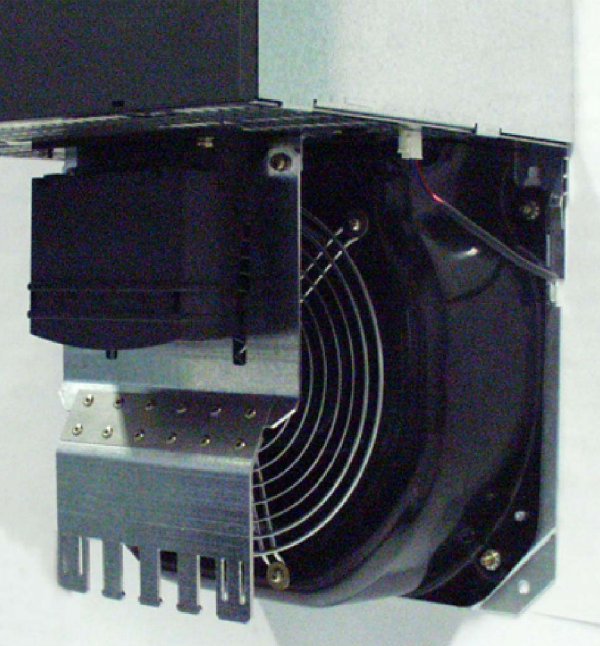
Tools required:

- Torx screwdriver T25 for shield connecting plate



11.1 Shield connecting plates for power supply and motor cables

Table 11- 7 Installing the shield connecting plate to a 300 mm component using as an example, internal air cooling

	
<p>Remove the screw</p>	<p>Hook the shield connecting plate into the line/motor connection</p>
	
<p>Tighten the shield connecting plate Tightening torque: 3 Nm</p>	<p>Installed shield connecting plate</p>

11.1 Shield connecting plates for power supply and motor cables

11.1.6 Connecting the power cables

Required tools:

- Torx screwdriver T25 for protective conductor connection (Torx slot)
- Flat-bladed screwdriver size 4 for power cables
- Flat-bladed screwdriver for hose clip

Table 11- 8 Connecting power cables for a 100 mm component using internal air cooling as an example

<p>Attach the protective conductor (PE) Tightening torque: 3 Nm</p>	<p>Attach the power cable Tightening torque: 1.8 Nm</p>	<p>Tighten the hose clip at the shield connecting plate</p>	<p>The power cable is connected.</p>

Required tools:

- Torx screwdriver T25 for protective conductor connection (Torx slot)
- (Torque) wrench M8 for power cables
- Flat-bladed screwdriver for hose clip



11.1 Shield connecting plates for power supply and motor cables

Table 11- 9 Connecting power cables for a 200 mm component using internal air cooling as an example

<p>Unlock and remove the cover of the terminal strip.</p>	<p>Remove nuts M8</p>	<p>Attach the protective conductor and the power cable Tightening torque: 13 Nm</p>
<p>Adapt a restrictor collar for the purpose of touch protection (by means of a suitable tool)</p>	<p>Attach the restrictor collars</p>	<p>Tighten the hose clip at the shield connecting plate</p>





Close the cover of the terminal strip.

## 11.2 Releasing the DC link protective cover

The protective covers for the DC link on the SINAMICS S120 components feature an interlock mechanism, which is operated using a slot-head screwdriver (1 x 5.5).

Table 11- 10 Opening the protective cover for the DC link using a screwdriver

<p>Protective cover with interlock mechanism</p>	<p>To open the protective cover, use the screwdriver to turn the interlock screw a little, in the direction of the arrow (counter-clockwise)</p>	<p>Opened protective cover</p>

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

## 11.3 DC link rectifier adapter for Booksize format

### 11.3.1 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.

Mounting on components with reinforced DC link busbars is **not** possible.

---

#### Note

When a DC link rectifier adapter and DC busbars are used, the limit values for radio interference suppression under Category C2 according to EN 61800-3 can no longer be observed.

---

Table 11- 11 Available DC link rectifier adapters

Order number	Screw terminals	Used for Line/Motor Modules with these sizes
6SL3162-2BD00-0AA0	0.5 to 10 mm <sup>2</sup>	50 mm; 100 mm
6SL3162-2BM00-0AA0	35 to 95 mm <sup>2</sup>	150 mm; 200 mm; 300 mm

## 11.3.2 Safety instructions for DC link rectifier adapters

### Note

When using a DC link rectifier adapter, also observe the safety instructions in Section 1.

### WARNING

#### Fire hazard and device damage through ground fault / short-circuit

The DC link connection cables must be laid so that a ground fault or short-circuit is impossible. A ground fault can cause a fire with smoke development.

- Use the local installation regulations to avoid this fault.
- Protect the cables against mechanical damage.

Also implement one of the following measures:

- Use cables with double insulation.
- Maintain adequate clearance, using spacers, for example
- Lay the cables in separate cable ducts or conduits.

### NOTICE

#### Maximum permissible cable length

The total length of the DC link (including the connection cables) must not exceed 10 m.

### NOTICE

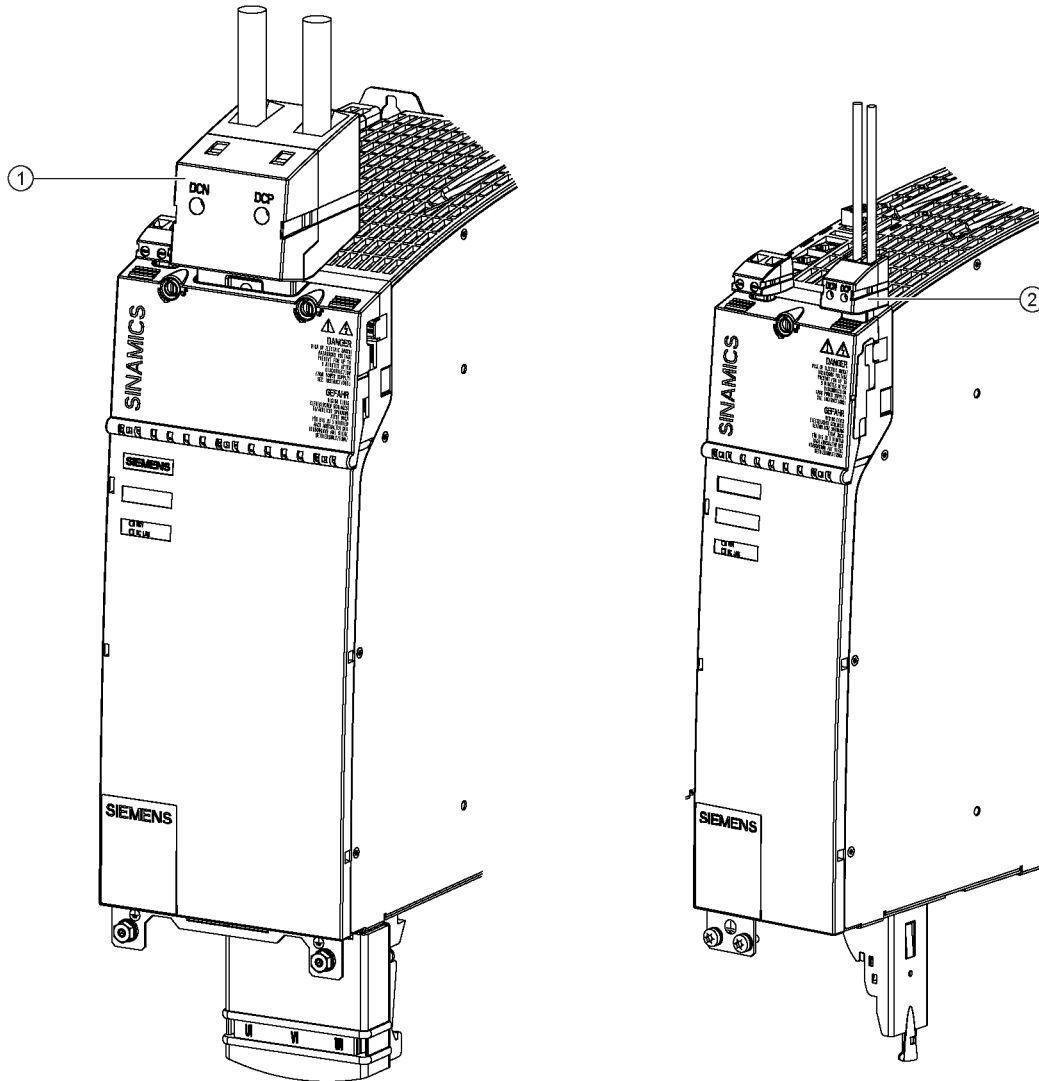
#### Device damage without safe electrical separation

Damage on the devices can occur without safe electrical separation between the 24 V supply cables and the DC link connection cables.

- Maintain a clearance of at least 100 mm between the 24 V supply cables and the DC link connection cables or
- Use doubly insulated cables (e.g. sheathed cables) for the 24 V supply cables.

### 11.3.3 Interface description

#### 11.3.3.1 Overview



- ① DC link rectifier adapter (35 mm<sup>2</sup> to 95 mm<sup>2</sup>) on a 150 mm component
- ② DC link rectifier adapter (0.5 mm<sup>2</sup> to 10 mm<sup>2</sup>) on a 100 mm component

Figure 11-21 Installed DC link rectifier adapter, using the example of components with a width of 100 mm and 150 mm

### 11.3.3.2 DC link connection

Table 11- 12 DC link rectifier adapter – description of the terminals

Terminal	Function	Technical specifications
DCP	DC link positive	<b>Supply voltage:</b> 720 V-VDE/600 V-UL <b>Direct supply 0.5 – 10 mm<sup>2</sup></b> Current carrying capacity: 43 A connection cross-section: 0.5 – 10 mm <sup>2</sup> Stripped length: 11 mm <b>Direct supply 35 – 95 mm<sup>2</sup></b> Current carrying capacity: 200 A connection cross-section: 35 – 95 mm <sup>2</sup> Stripped length: 27 mm
DCN	DC link negative	

### 11.3.4 Dimension drawings

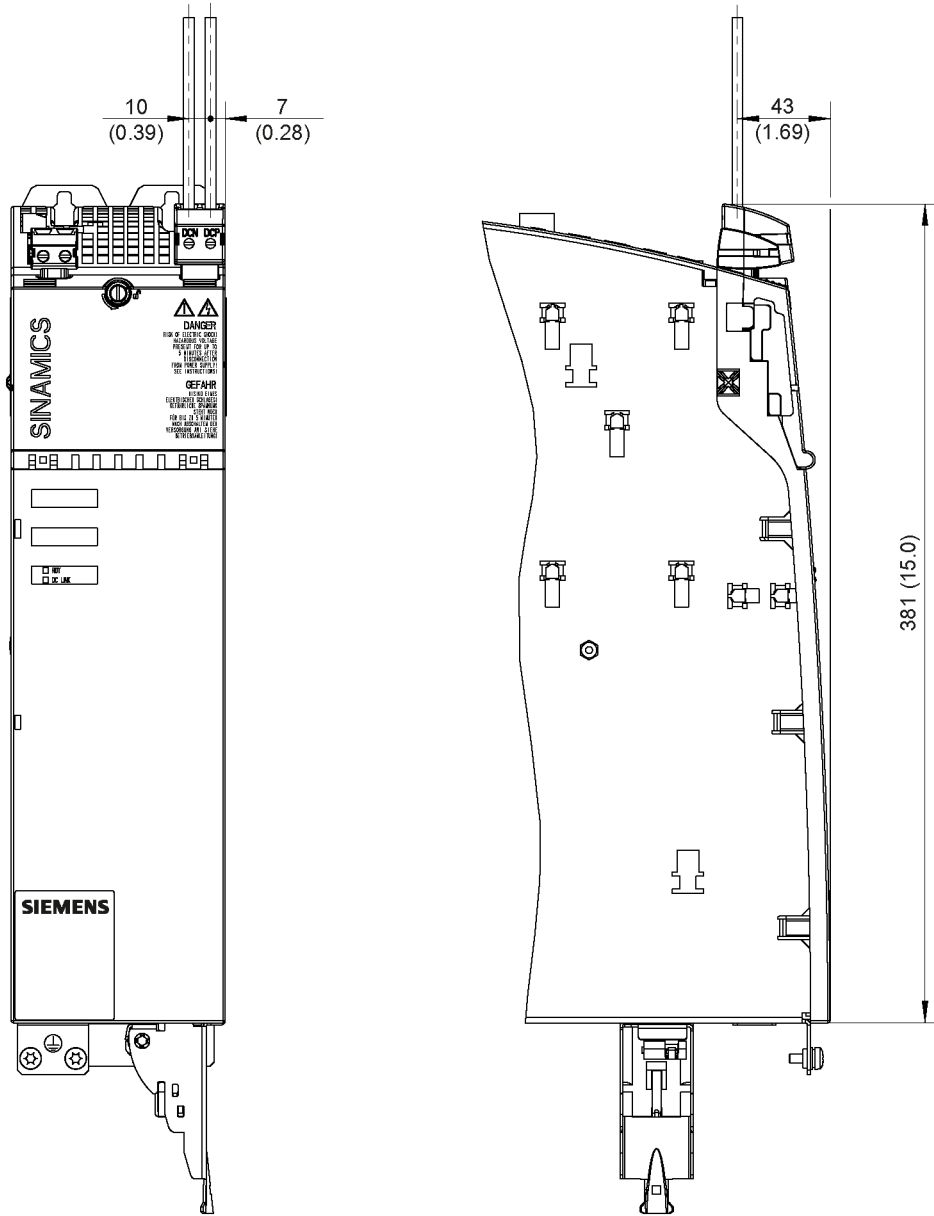


Figure 11-22 Dimension drawing of 100 mm component with DC link rectifier adapter for 0.5 mm<sup>2</sup> to 10 mm<sup>2</sup>, all dimensions in mm and (inch)

11.3 DC link rectifier adapter for Booksize format

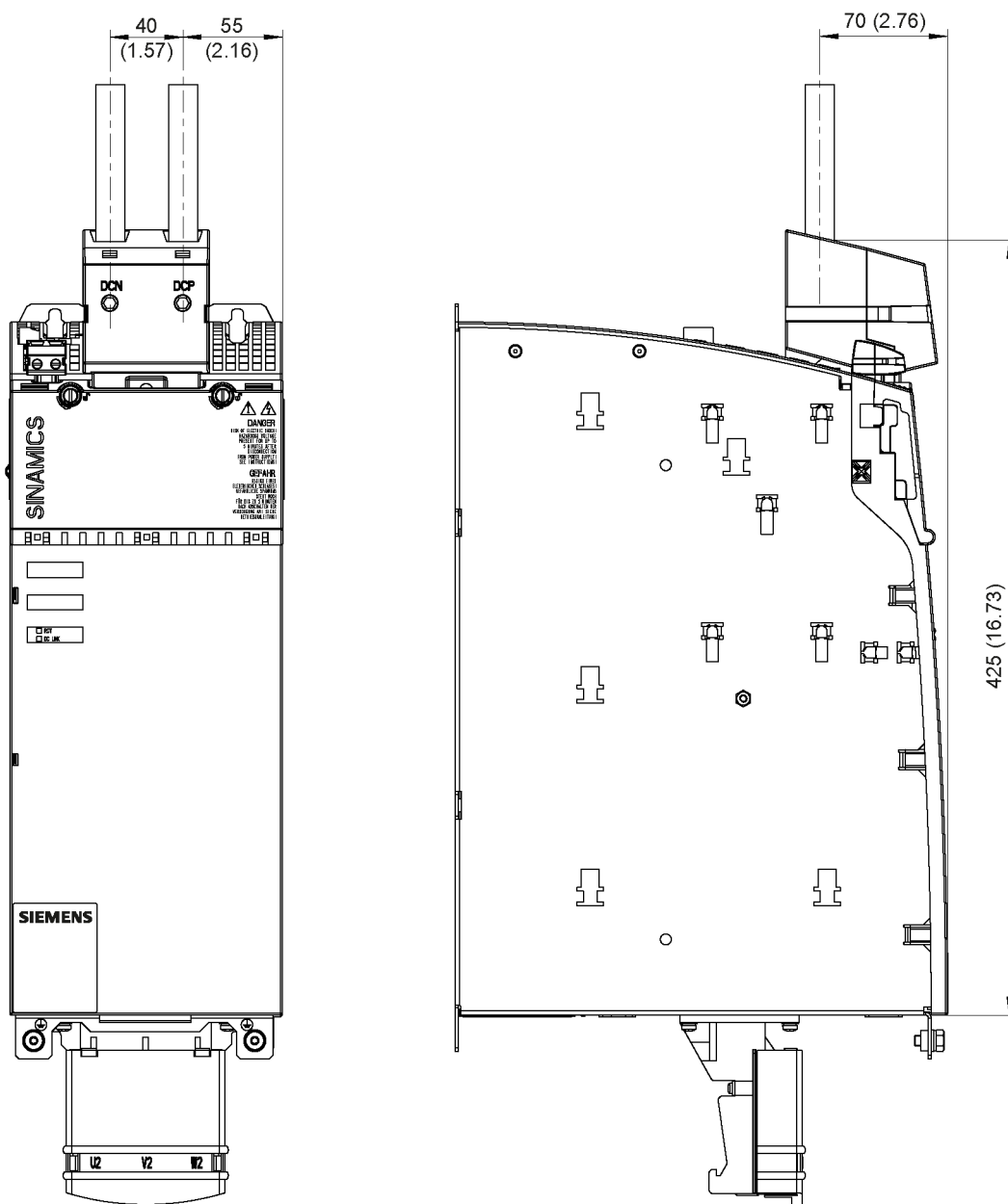


Figure 11-23 Dimension drawing of 150 mm component with DC link rectifier adapter for 35 mm<sup>2</sup> to 95 mm<sup>2</sup>, all dimensions in mm and (inch)

### 11.3.5 Mounting

 <b>CAUTION</b>
--

<b>Risk of electric shock if the cutout in the protective cover has been broken out</b>
---

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. Operation with broken out cutouts in the protective cover is not permitted!
---

#### 11.3.5.1 Installation on components that are 50 mm and 100 mm wide



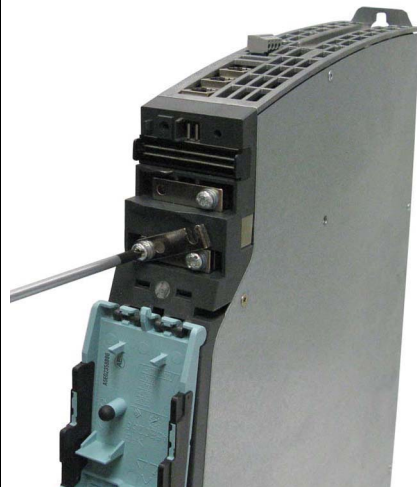

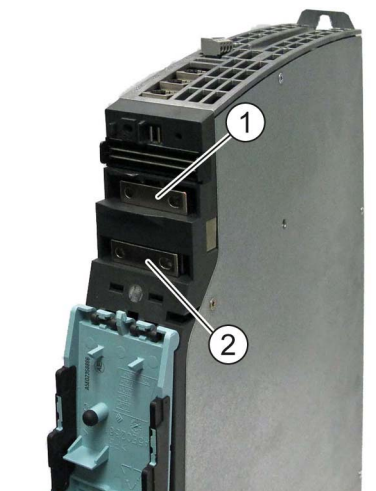
Required tools:

- Slot-head screwdriver (1 x 5.5) for releasing the protective cover
- Torx T10 screwdriver to fasten the 24 V terminal adapter
- Torx screwdriver T20 for DC link screws (Torx slot)
- Pliers for breaking out the cutouts



11.3 DC link rectifier adapter for Booksize format

Table 11- 13 Removing the DC link busbars

		
<p>Release and open the protective cover</p>	<p>Remove the top left screw and the DC link bridge</p>	<p>Remove the bottom left screw and the DC link bridge</p>
		<p>To install the DC link rectifier adapter, it is essential to leave the DC link busbars ① and ② in the components (hold firmly to prevent them falling out).</p>
<p>Remove the top and bottom right screws on the DC link</p>		

11.3 DC link rectifier adapter for Booksize format

Table 11- 14 Installing the DC link rectifier adapter and 24 V terminal adapter

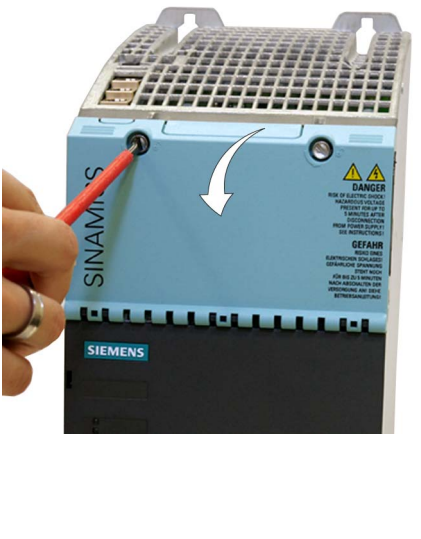
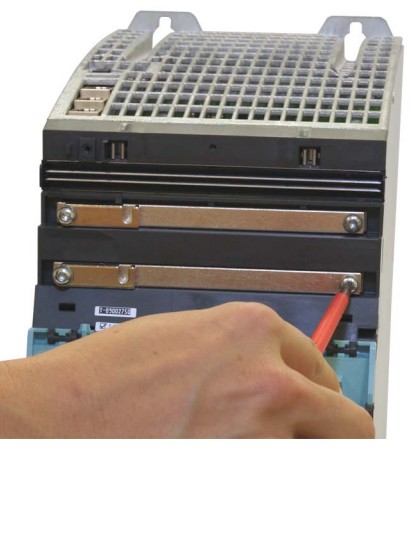


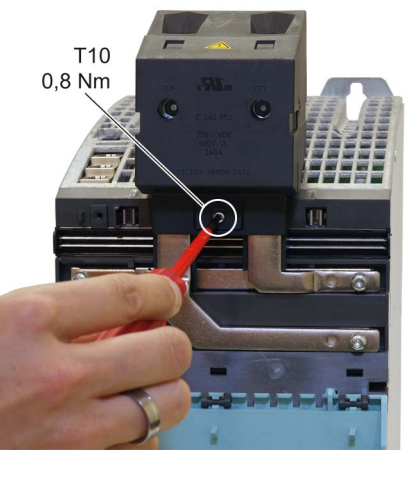
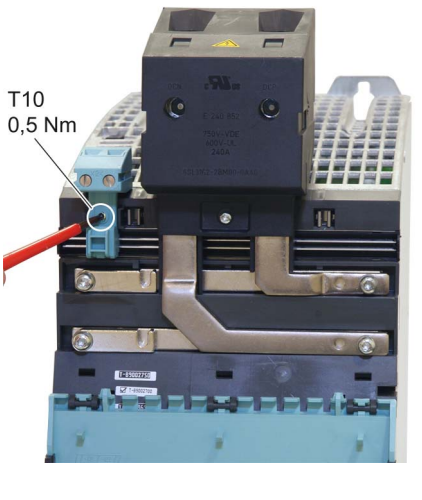
<p>Fixing and fastening (top and bottom) the DC line rectifier adapter with the <b>long DC link screws</b>.</p>	<p>It is <b>NOT</b> permissible to insert the screws at the top markings on the DC link busbar!</p>	<p>Attach and screw on the 24 V terminal adapter, using the corresponding screw provided in the accessories pack</p>
<p>Knock out the cutouts on the protective cover</p>	<p>Close the protective cover until you hear it snap into place</p>	<p>Component with installed DC link rectifier adapter and 24 V terminal adapter</p>

### 11.3.5.2 Installation on components that are 150 mm, 200 mm and 300 mm wide

Required tools:

- Slot-head screwdriver (1 x 5.5) for releasing the protective cover
- Torx T10 screwdriver to attach the adapter
- Torx screwdriver T20 for DC link screws (Torx slot)
- Pliers for knocking out the cutouts

Table 11- 15 Installation of the DC link rectifier adapter for 150 mm, 200 mm, and 300 mm components

		
<p>Release and open the protective cover</p>	<p>Unscrew the DC link screws</p>	<p>Engage the adapter in the grid</p>
		
<p>Attach the adapter bars using the previously removed DC link screws</p>	<p>Attached the adapter with the associated screw (accessories pack)</p>	<p>Attach and screw on the 24 V terminal adapter, using the associated screw provided in the accessories pack</p>

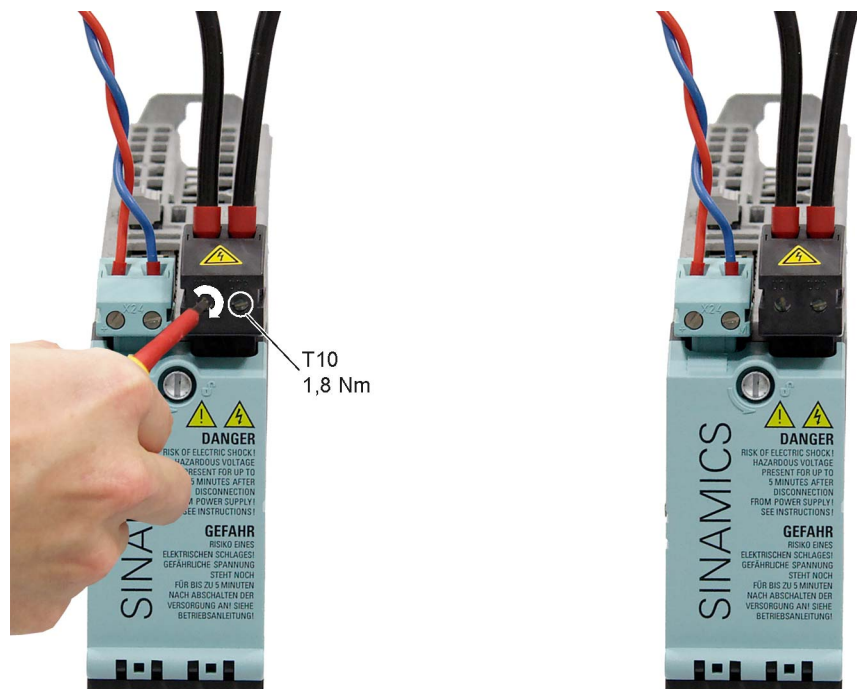


11.3 DC link rectifier adapter for Booksize format

<p>Knock out the cutouts on the protective cover</p>	<p>Close the protective cover until you hear it snap into place</p>	

11.3.6 Electrical connection

Table 11- 16 Connecting the DC link rectifier adapter for 50 mm and 100 mm components

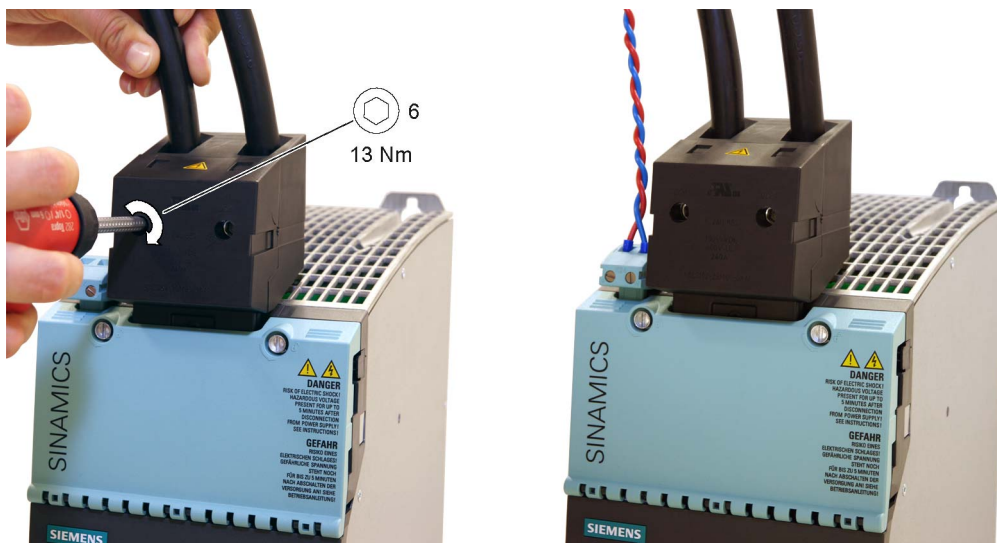


Install the cables at the DC link rectifier adapter (Torx T10)

Connected DC link rectifier adapter

11.3 DC link rectifier adapter for Booksize format

Table 11- 17 Connecting the DC link rectifier adapter for 150 mm, 200 mm, and 300 mm components



Install the cables at the DC link rectifier adapter (hexagon socket-head screw)

Connected DC link rectifier adapter

### 11.3.7 Technical specifications

Table 11- 18 Technical specifications DC link rectifier adapter

DC link rectifier adapter	Unit	6SL3162-2BD00-0AA0 0.5 – 10 mm <sup>2</sup>	6SL3162-2BM00-0AA0 35 – 95 mm <sup>2</sup>
Current carrying capacity	A	36	240
Conductor cross-section	mm <sup>2</sup>	0.5 – 10	35 – 95
Stripped length	mm	11	27
Tightening torque			
- Terminals	Nm	1.8	13
- DC link busbars	Nm	1.8	1.8

## 11.4 DC link adapter

### 11.4.1 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<sup>2</sup> to 95 mm<sup>2</sup>). Shielded individual cores are recommended.

The DC link adapter can be used for all Line Modules and Motor Modules in the booksize format. Mounting on components with reinforced DC link busbars is **not** possible.

### 11.4.2 Safety instructions for DC link adapters

---

#### Note

When using a DC link adapter, also observe the safety instructions in Section 1.

---

 <b>WARNING</b>
---

<b>Fire hazard and device damage through ground fault / short-circuit</b>
---

The DC link connection cables must be laid so that a ground fault or short-circuit is impossible. A ground fault can cause a fire with smoke development.
---

- |   |
|---|
| <ul style="list-style-type: none"><li>• Use the local installation regulations to avoid this fault.</li><li>• Protect the cables against mechanical damage.</li></ul> |
|---|

Also implement one of the following measures:
---

- |  |
|--|
| <ul style="list-style-type: none"><li>• Use cables with double insulation.</li><li>• Maintain adequate clearance, using spacers, for example</li><li>• Lay the cables in separate cable ducts or conduits.</li></ul> |
|--|

<b>NOTICE</b>
---------------

<b>Maximum permissible cable length</b>
---

The total length of the DC link (including the connection cables) must not exceed 10 m.
---

### 11.4.3 Interface description

#### 11.4.3.1 Overview

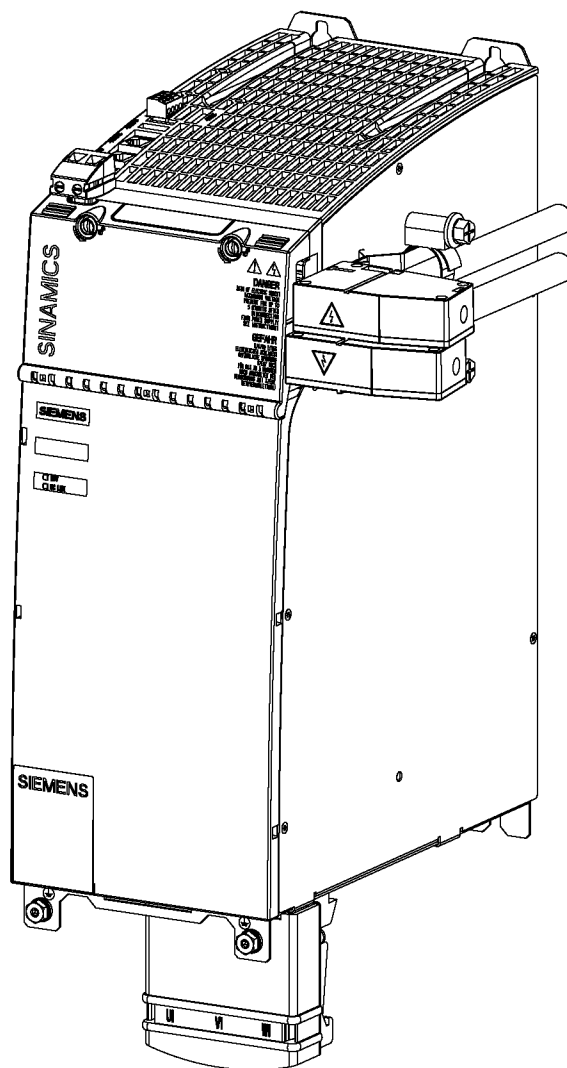


Figure 11-24 150 mm components with DC link adapter for two-row configuration 35 mm<sup>2</sup> to 95 mm<sup>2</sup>

#### 11.4.3.2 DC link connection

Table 11- 19 DC link connection

Terminal	Function	Technical data
DCP	DC link positive	Current carrying capacity: 200 A connection cross-section: 35 – 95 mm <sup>2</sup> Stripped length: 27 mm
DCN	DC link negative	

### 11.4.4 Dimension drawing

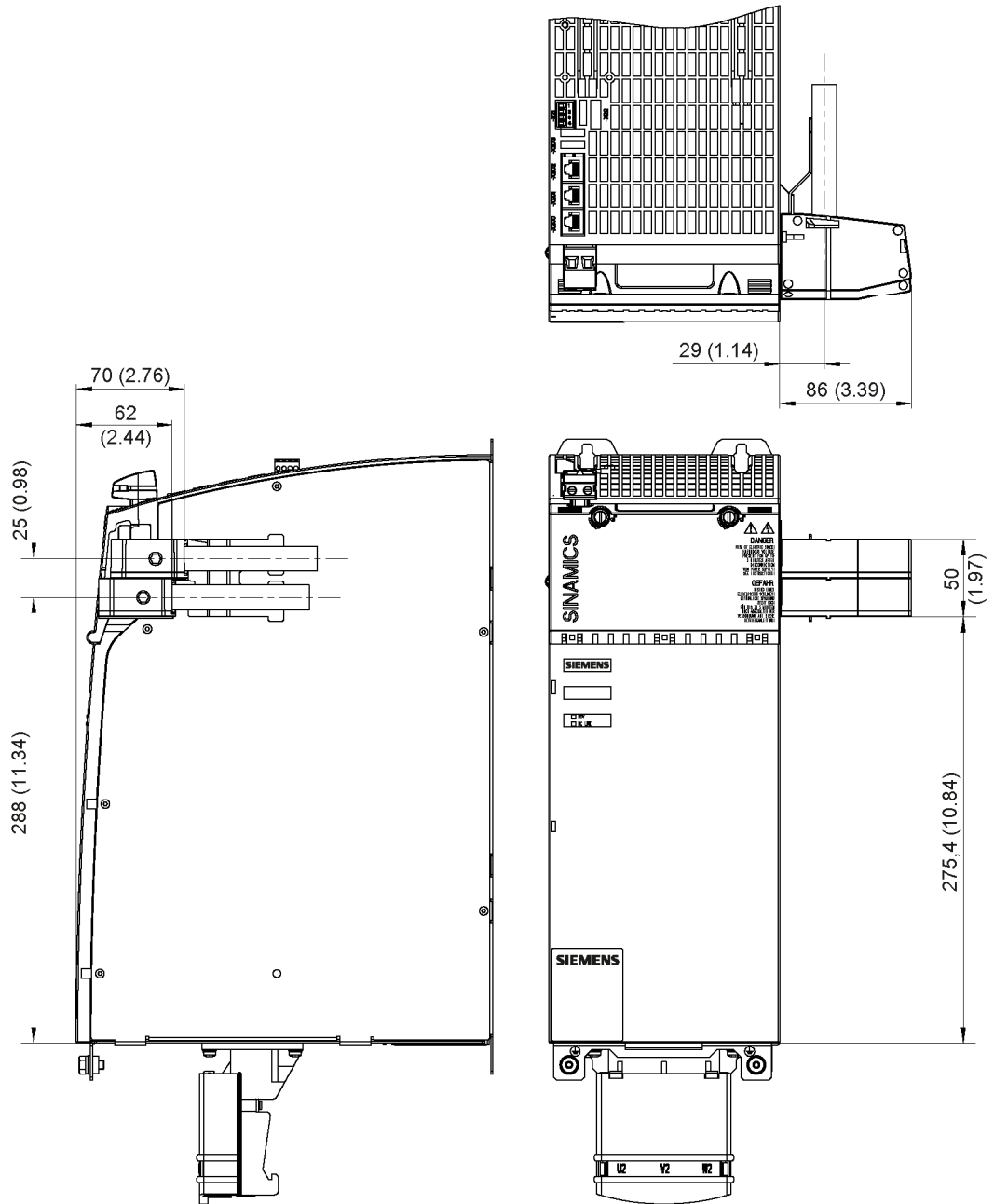


Figure 11-25 Dimension drawing of 150 mm component with DC link rectifier adapter for 35 mm<sup>2</sup> to 95 mm<sup>2</sup> for installation on two rows, all dimensions in mm and (inches)


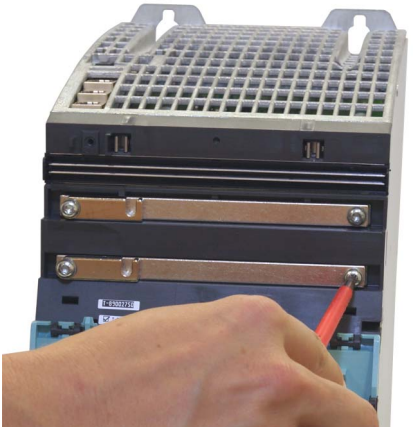
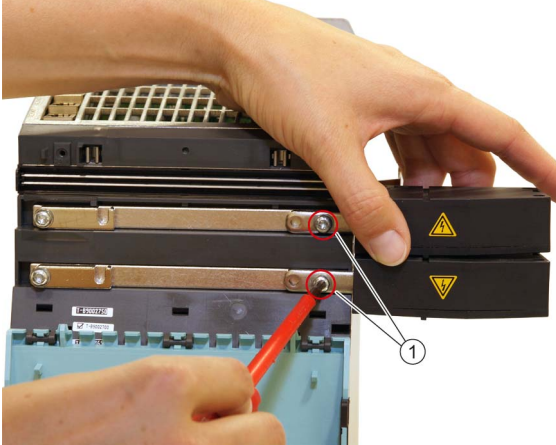



### 11.4.5 Installation

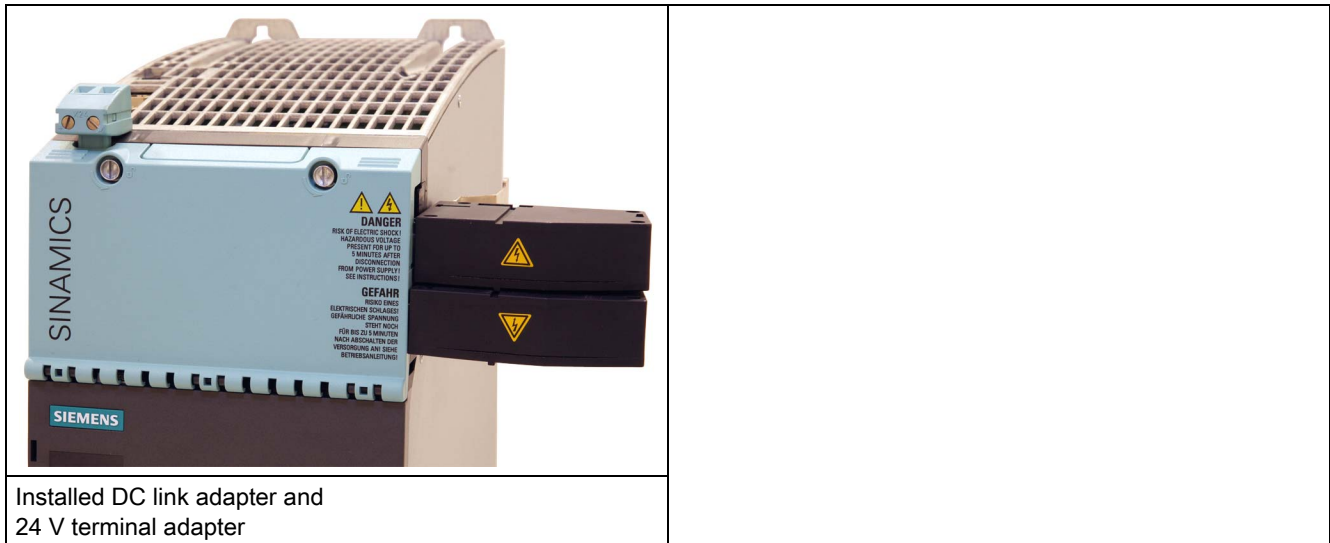
Required tools:

- Slot-head screwdriver (1 x 5.5) for releasing the protective cover
- Torx screwdriver T20 for DC link busbar screws (Torx slot)

Table 11- 20 Installing the DC link adapter in a 150 mm component

	
<p>Release and open the protective cover</p>	<p>Remove the DC link busbar screws</p>
	
<p>Screw the DC link adapter tight (1.8 Nm) using the previously removed DC link busbar screws at the <b>right-hand</b> holes ①</p>	<p>Remove the DC link side cover, install the 24 V terminal adapter (if required) and close the protective cover until it audibly clicks into place.</p>

11.4 DC link adapter



Installed DC link adapter and 24 V terminal adapter



**! DANGER**

**Danger to life through electric shock when touching the DC link busbars**

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

- The DC link adapters must be installed so that after closing the DC link cover they cannot be touched!



**! WARNING**

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

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

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

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

**Note**


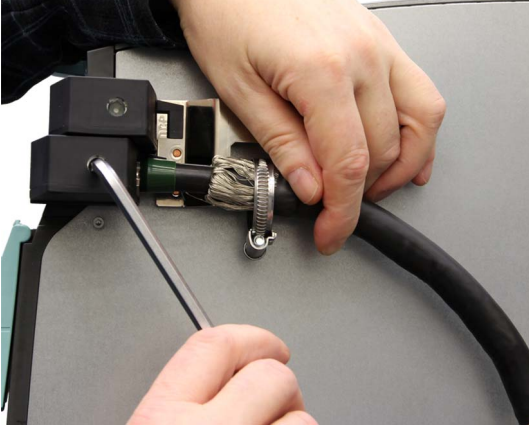
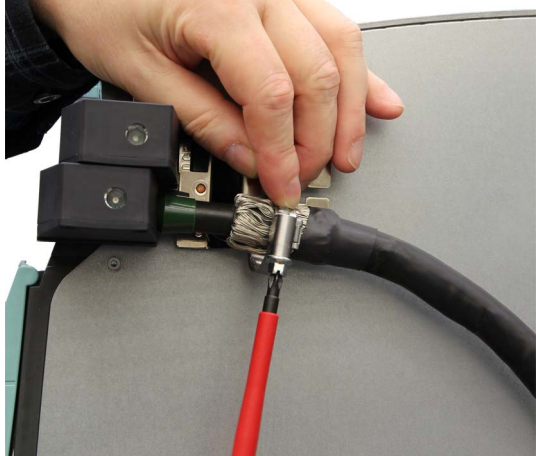
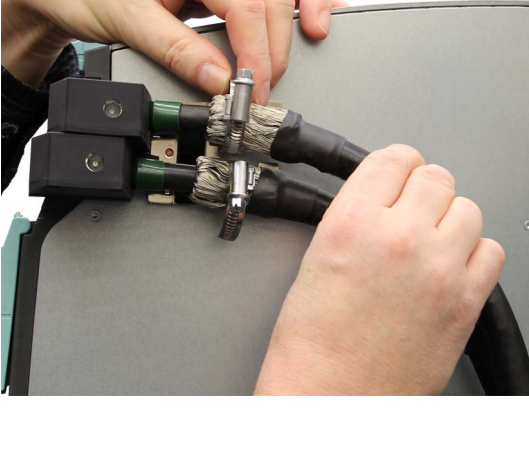

By moving the adapter housing, the DC link adapter can be fitted on either the left-hand or right-hand side of the component. This configuration is possible for all Active Line Modules.

**11.4.6 Electrical connection**

Required tools:

- Size 6 Allen key to attach the cables
- Suitable tool for hose clips, e.g. flat-bladed screwdriver

Table 11- 21 Connection of the DC link connection cables to the DC link adapters

	
<p>1. Hook the hose clip into the EMC contact spring. 2. Push the first conductor of the connection cable through the hose clip into the DCN connection of the DC link adapter.</p>	<p>3. Pull the cable tight with a hexagon socket-head screw.</p>
	
<p>4. Screw the hose clip tight with a screwdriver.</p>	<p>5. Connect the cable for the DCP connection as described in steps 1 to 4.</p>
	<p>The installed DC link connecting cable is shown in the adjacent diagram.</p>

**Note**

After installing the cables, ensure that the EMC tongues of the DC link adapter are in contact with the side panel of the component.

**Note**

Only use shielded cables.

The DC link adapter can be located at the right or left as required.

### 11.4.7 Technical specifications

Table 11- 22 Technical specifications DC link adapter

6SL3162-2BM01-0AA0	Unit	Value
Current carrying capacity	A	240
Conductor cross-section	mm <sup>2</sup>	35 – 95
Stripped length	mm	27
Tightening torque		
- Terminals	Nm	13
- DC link busbars	Nm	1.8

## 11.5 Reinforced DC link busbars

### 11.5.1 Description

If necessary, reinforced DC link busbars are used to increase the current carrying capacity of the components from 100 A to 150 A. They are available for 50 mm and 100 mm wide components of the Booksize and Booksize Compact series.

Table 11- 23 Reinforced DC link busbars

Reinforced DC link busbars	Order number
Suitable for 50 mm components	6SL3162-2DB00-0AAx
Suitable for 100 mm components	6SL3162-2DD00-0AAx

Notes on configuration and arrangement of the components in the drive line-up can be found in the Chapter, "Control cabinet installation and EMC/arrangement of components and devices".

#### Note

When using reinforced DC link busbars it is not possible to use a DC link adapter as well as a DC link rectifier adapter for 50 mm and 100 mm wide components.

### 11.5.2 Dimension drawings

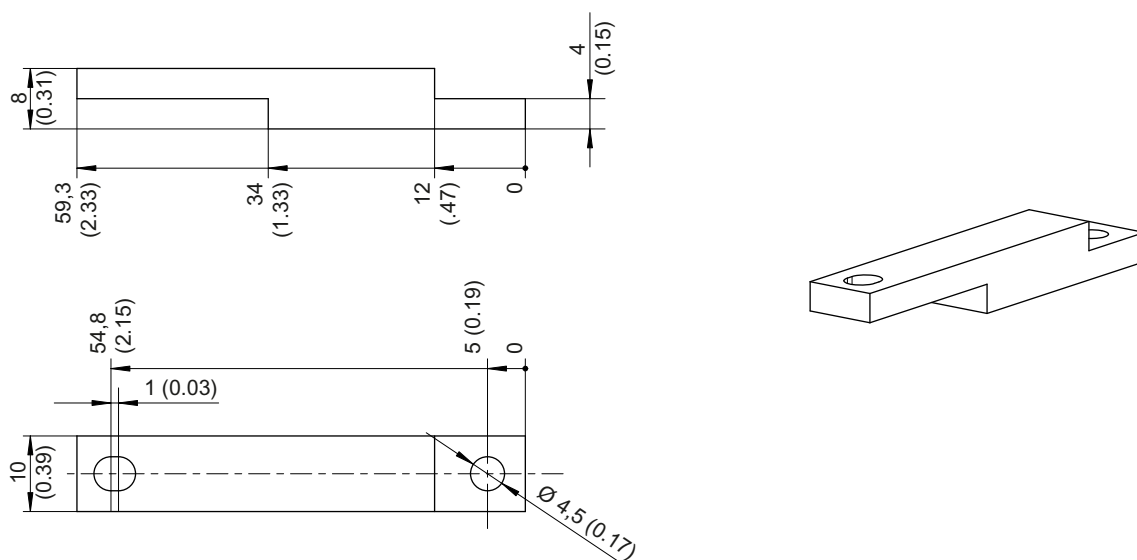


Figure 11-26 Dimension drawing of reinforced DC-link busbar 50 mm, all dimensions in mm and (inches)

11.5 Reinforced DC link busbars

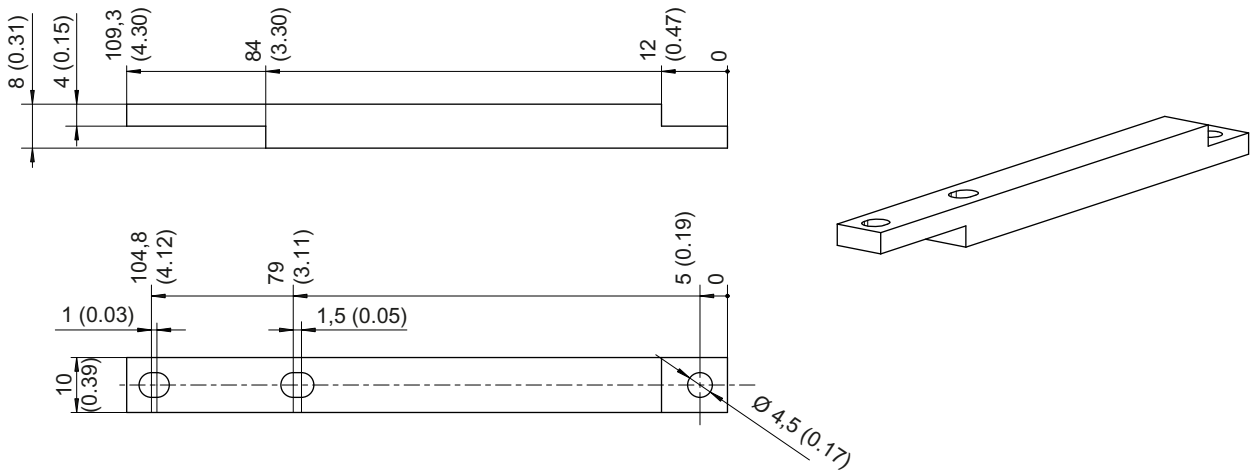


Figure 11-27 Dimension drawing of reinforced DC-link busbar 100 mm, all dimensions in mm and (inches)

11.5.3 Removing the DC link busbars

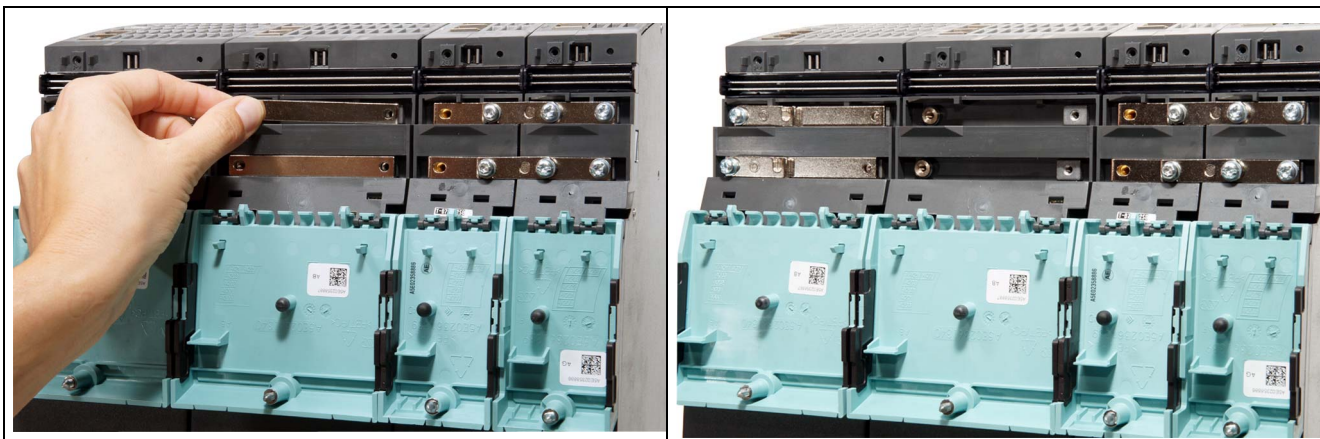
Required tools:

- Torx screwdriver T20 for DC link busbar screws (Torx slot)

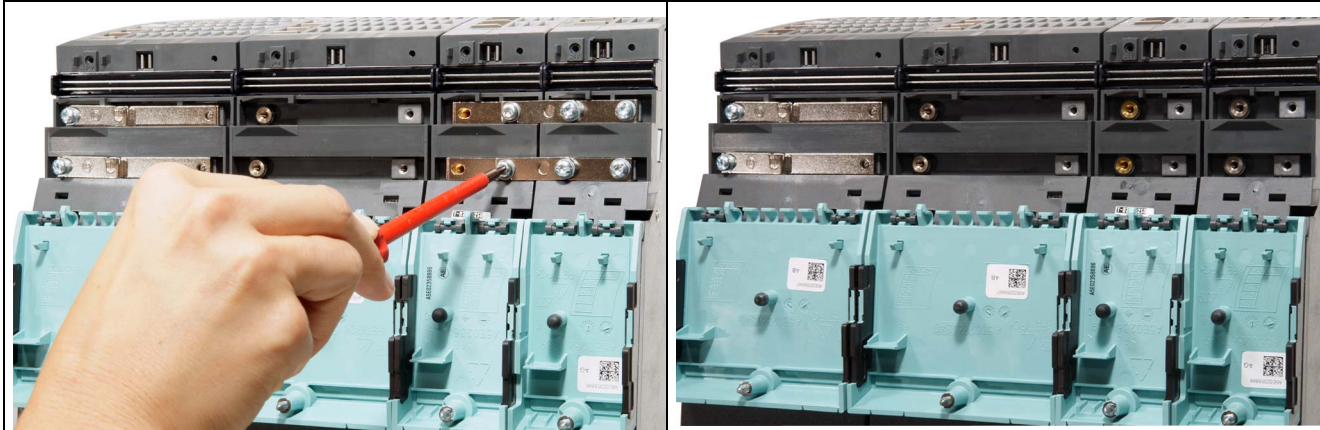
Table 11- 24 Removing the DC link busbars

<p>Unscrew the screws and remove the attached DC link bridge, starting at the second component.</p>	<p>Unscrew the screws and remove the attached DC link bridge of the adjacent components.</p>





Remove the DC link busbars on the second component.



Unscrew the screws and remove the DC link bridges and busbars on the other components.

Removed DC link busbars.


**⚠ WARNING**

**Danger to life through electric shock due to incorrectly installed DC link bridges**

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

- Remove the DC link bridges including the screws on a 50 mm-wide Motor Module. Do not tighten the screws without the DC link bridges.
- For all components that are 75 mm wide or wider, the DC link bridges must **not** be moved to the left or removed.

11.5 Reinforced DC link busbars

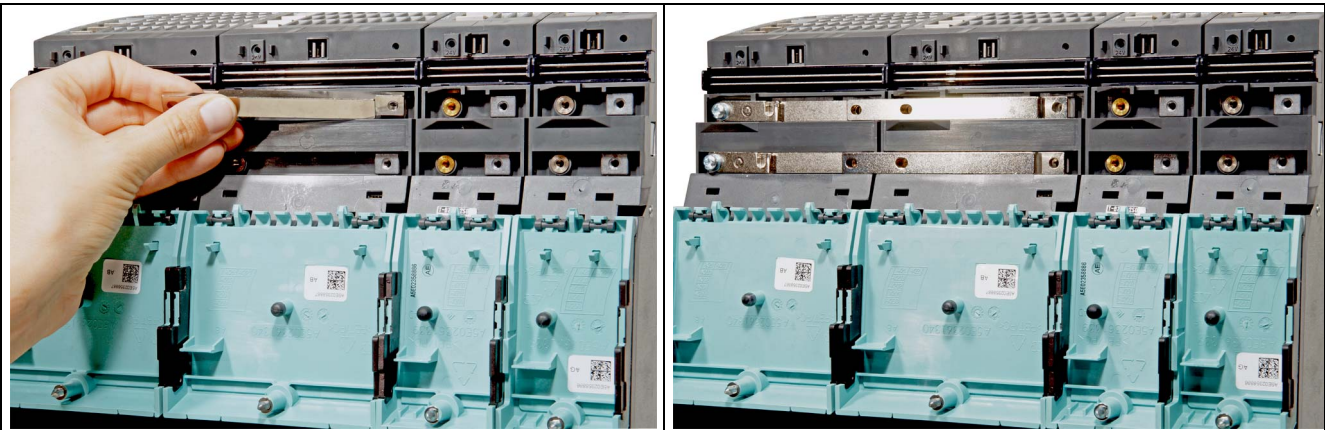
 <b>WARNING</b>
<b>Danger to life through electric shock due to incorrectly installed DC link busbars</b>
Incorrectly installed DC link busbars at the outside left component can cause an electric shock.
Do <b>NOT</b> remove the DC link busbars at the outside left component for mounting reinforced DC link busbars. The DC link busbars must remain in the component irrespective of the width of the component.

### 11.5.4 Installing the reinforced DC link busbars

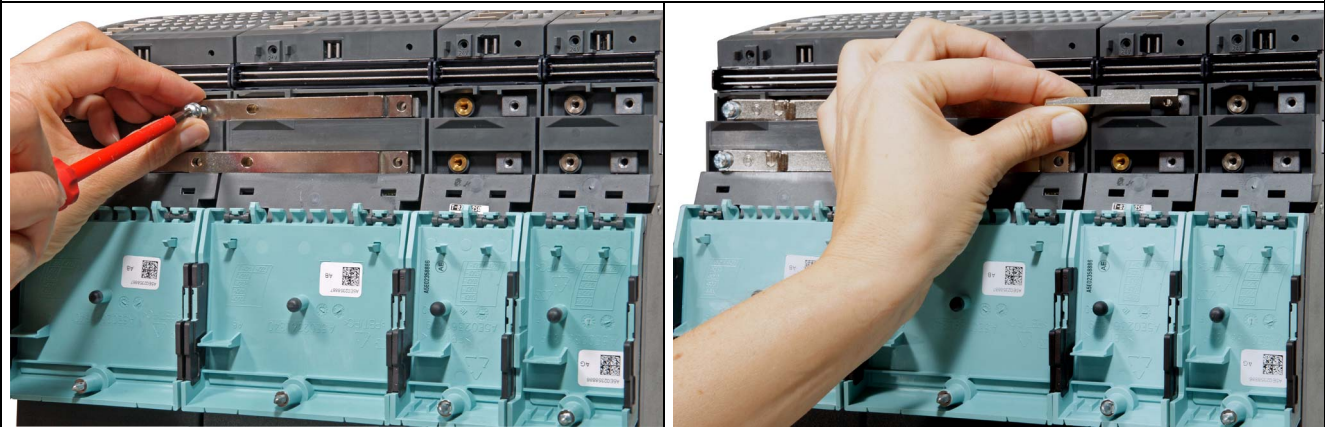
Required tools:

- Torx screwdriver T20 for DC link screws (Torx slot)

Table 11- 25 Installing the reinforced DC link busbars



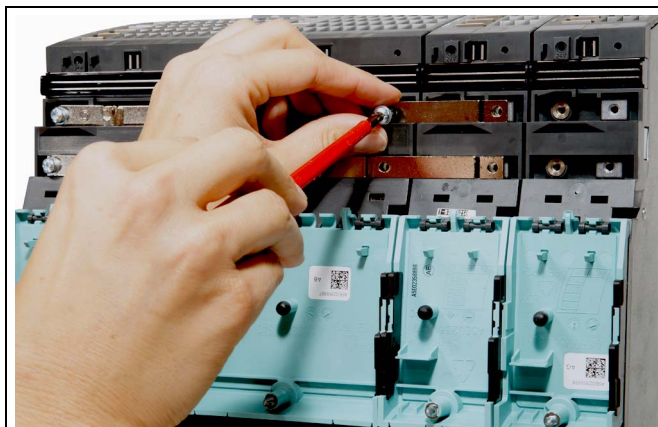
Install the reinforced DC link busbars, starting on the left



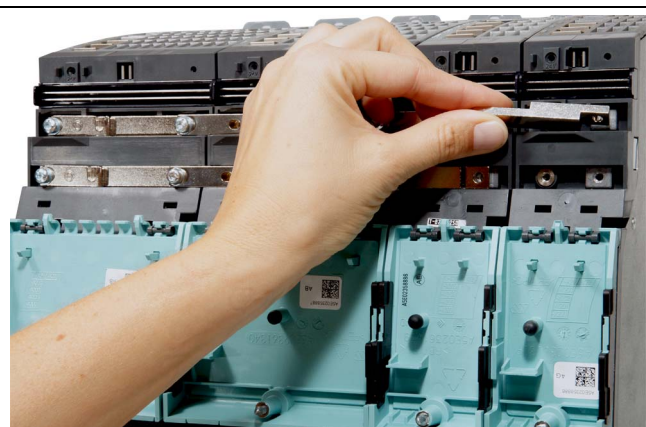
Insert the **long** DC link screws on the right of the first component; do not fully tighten the screws

Install the reinforced DC link busbars on the adjacent components.

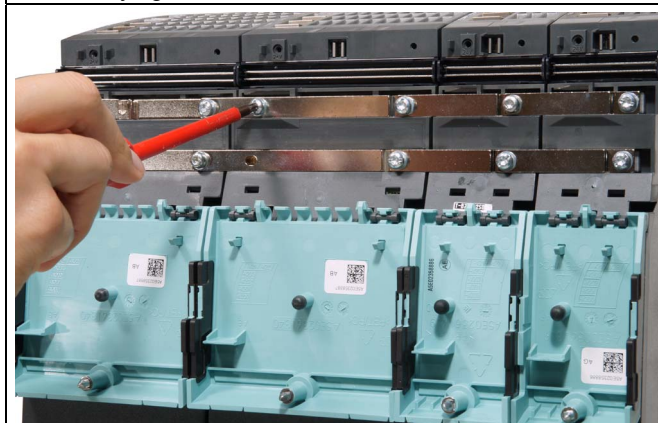




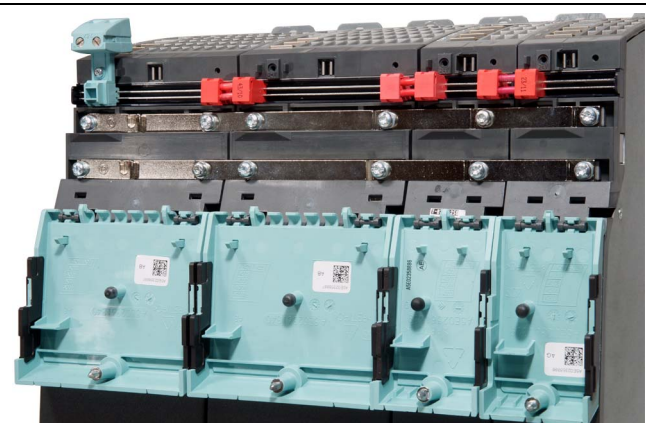
Insert the **long** DC link screws on the right of the second component;  
do not fully tighten the screws



Insert the reinforced DC link busbars on the last components and fasten the **long** DC link screws



Fasten the **short** DC link screws on the left of the second component  
Tightly secure all the screws to 1.8 Nm +30%



View of the mounted reinforced DC link busbars with 24 V connectors and 24 V terminal adapter

### Note

To connect the 24 V busbars of the individual components, please use the red 24 V connector in the accessories pack.

## 11.6 DRIVE-CLiQ cabinet bushings

### 11.6.1 Description

A DRIVE-CLiQ cabinet bushing is used to connect the DRIVE-CLiQ cables between the inside and outside of the control cabinet. It is used in a control cabinet panel. The data lines and the voltage supply contacts of the DRIVE-CLiQ are also routed through the bushing. The DRIVE-CLiQ cabinet bushing for DRIVE-CLiQ cables is available with RJ45 connector and M12 plug/socket.

#### **DRIVE-CLiQ cabinet bushing for RJ45 connectors**

The cabinet bushing has degree of protection IP54 according to EN 60529 from the outside towards the inside. Inside the control cabinet, a connection is established according to degree of protection IP20 or IPXXB acc. to EN 60529. So that the complete outside of the cabinet bushing, including the DRIVE-CLiQ interface, has degree of protection IP54, a DRIVE-CLiQ cable must be used, which as a minimum must also have degree of protection IP54.

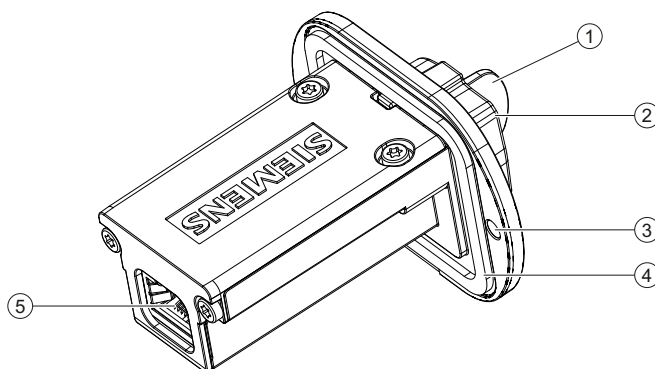
#### **DRIVE-CLiQ cabinet bushing for M12 plug/socket**

The cabinet bushing has degree of protection IP67 according to EN 60529 from the outside towards the inside. Inside the cabinet a connection according to degree of protection IP67 in compliance with EN 60529 is realized.

## 11.6.2 Interface description

### 11.6.2.1 Overview

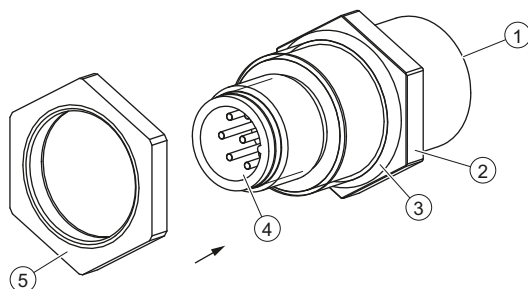
#### DRIVE-CLiQ cabinet bushing for DRIVE-CLiQ cables with RJ45 plug



- ① Protective cap, Yamaichi, order number: Y-ConAS-24-S
- ② DRIVE-CLiQ interface RJ45 on the outside (to connect DRIVE-CLiQ signal cables MOTION-CONNECT with IP67 degree of protection)
- ③ Mounting holes
- ④ Flange-type seal to ensure degree of protection IP54 on the outside of the control cabinet
- ⑤ DRIVE-CLiQ interface RJ45 on the inside (to connect DRIVE-CLiQ signal cables MOTION-CONNECT with IP20 degree of protection)

Figure 11-28 Interface overview, DRIVE-CLiQ cabinet bushing RJ45

#### DRIVE-CLiQ cabinet bushing for DRIVE-CLiQ cables with M12 plug/socket



- ① DRIVE-CLiQ interface with M12 socket (8-pin)
- ② Flange, SW18
- ③ Seal
- ④ DRIVE-CLiQ interface with M12 plug (8-pin)
- ⑤ O ring, SW20, tightening torque: 3 - 4 Nm

Figure 11-29 Interface overview, DRIVE-CLiQ cabinet bushing M12

11.6.3 Dimension drawings

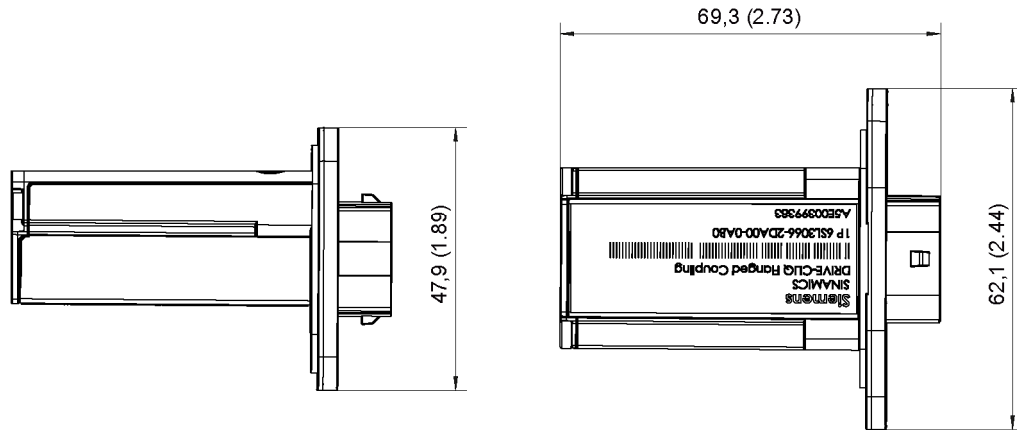
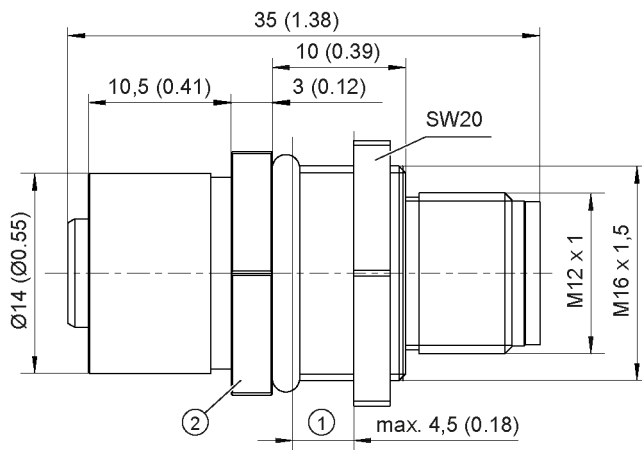


Figure 11-30 Dimension drawing of the DRIVE-CLiQ cabinet bushing RJ45, all dimensions in mm and (inches)



- ① Cabinet panel
- ② Flange, SW18

Figure 11-31 Dimension drawing of the DRIVE-CLiQ cabinet bushing M12, all dimensions in mm and (inches)

## 11.6.4 Mounting

### 11.6.4.1 DRIVE-CLiQ cabinet bushing for cables with RJ45 connectors

In order to install the DRIVE-CLiQ cabinet bushing RJ45, you must make a cutout in the control cabinet panel as shown in the diagram below.

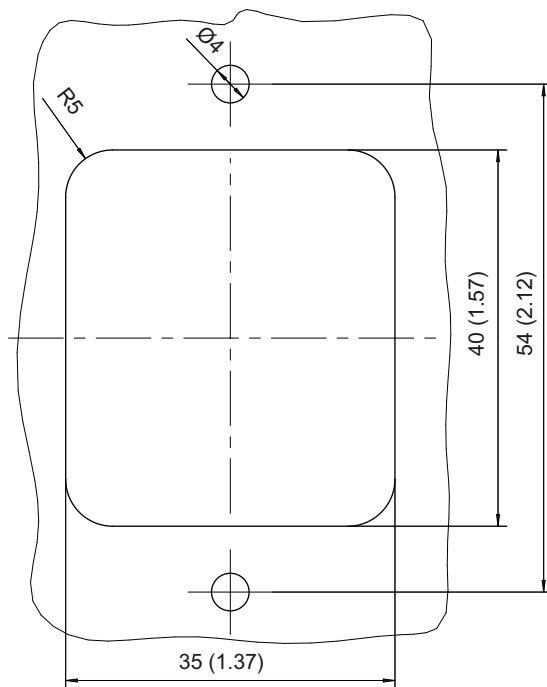
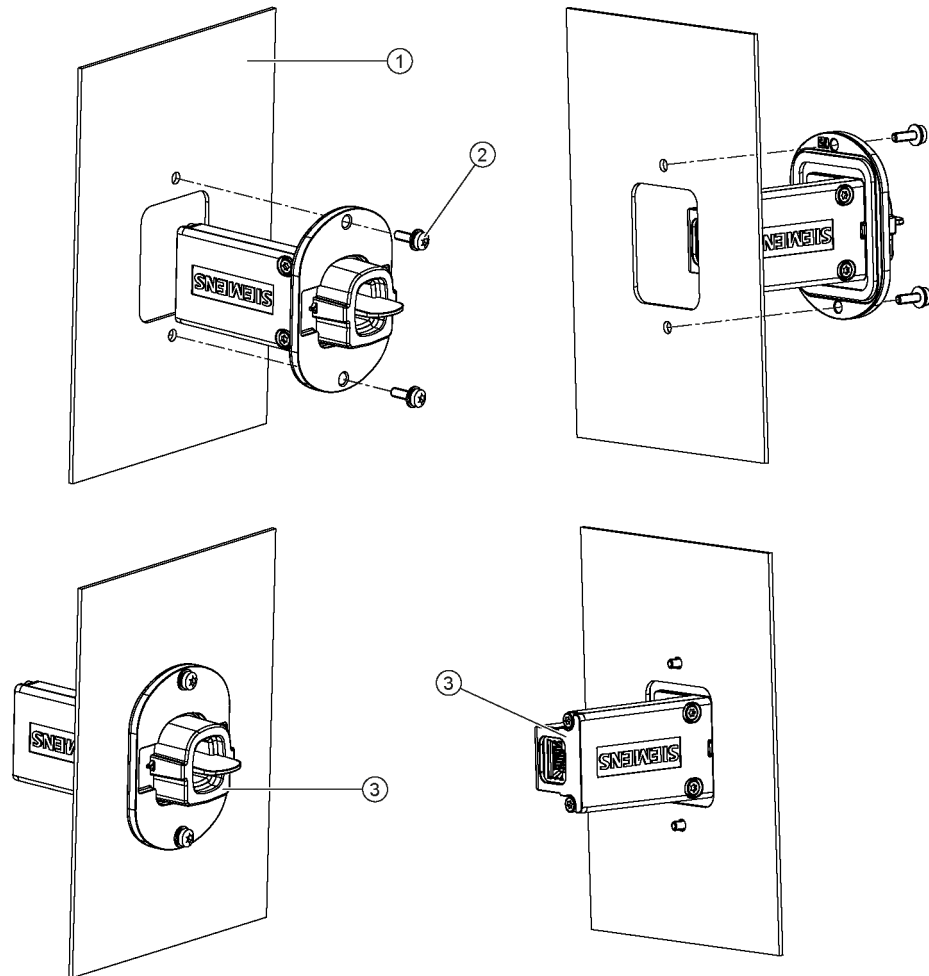


Figure 11-32 Cut-out for the cabinet

Installation

1. Insert the DRIVE CLiQ cabinet bushing from the outside of the control cabinet through the opening in the control cabinet.
2. Fix the DRIVE-CLiQ cabinet gland to the outer control cabinet panel 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 gland and the cabinet panel over a large surface area.



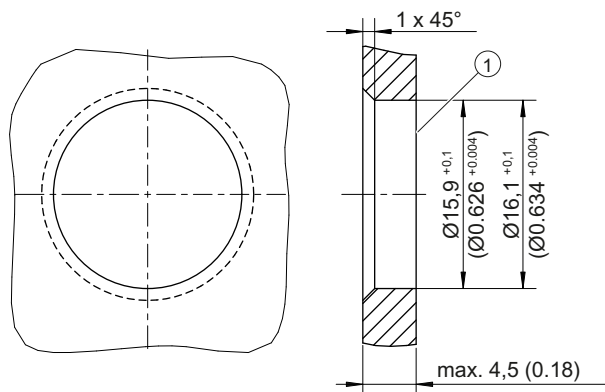
- ① Control cabinet panel
- ② M3 screw, tightening torque 0.8 Nm
- ③ DRIVE-CLiQ cabinet bushing RJ45

Figure 11-33 Mounting DRIVE-CLiQ cabinet bushings for cables with RJ45 connectors

### 11.6.4.2 DRIVE-CLiQ cabinet bushing for cables with M12 plug/socket

Prepare the cabinet panel for mounting the DRIVE-CLiQ cabinet bushing M12 as shown below. The removable O ring can be screwed from the inside or the outside.

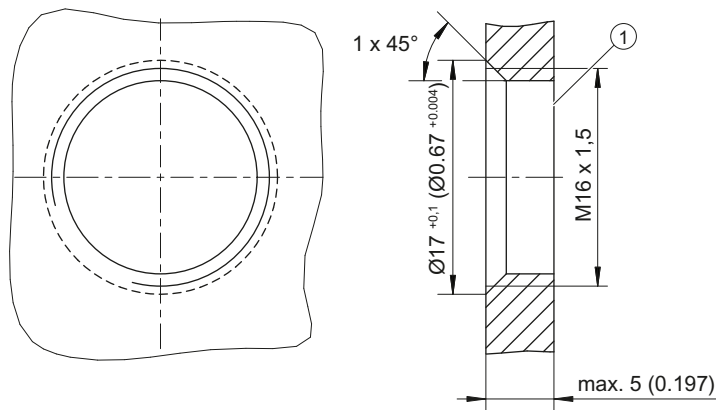
#### Mounting from the inside using an O ring that can be screwed



① Through-hole with chamfer

Figure 11-34 Through-hole for mounting the DRIVE-CLiQ cabinet bushing M12 with an O-ring that can be screwed from the inside

#### Mounting from the outside using an O ring that can be screwed



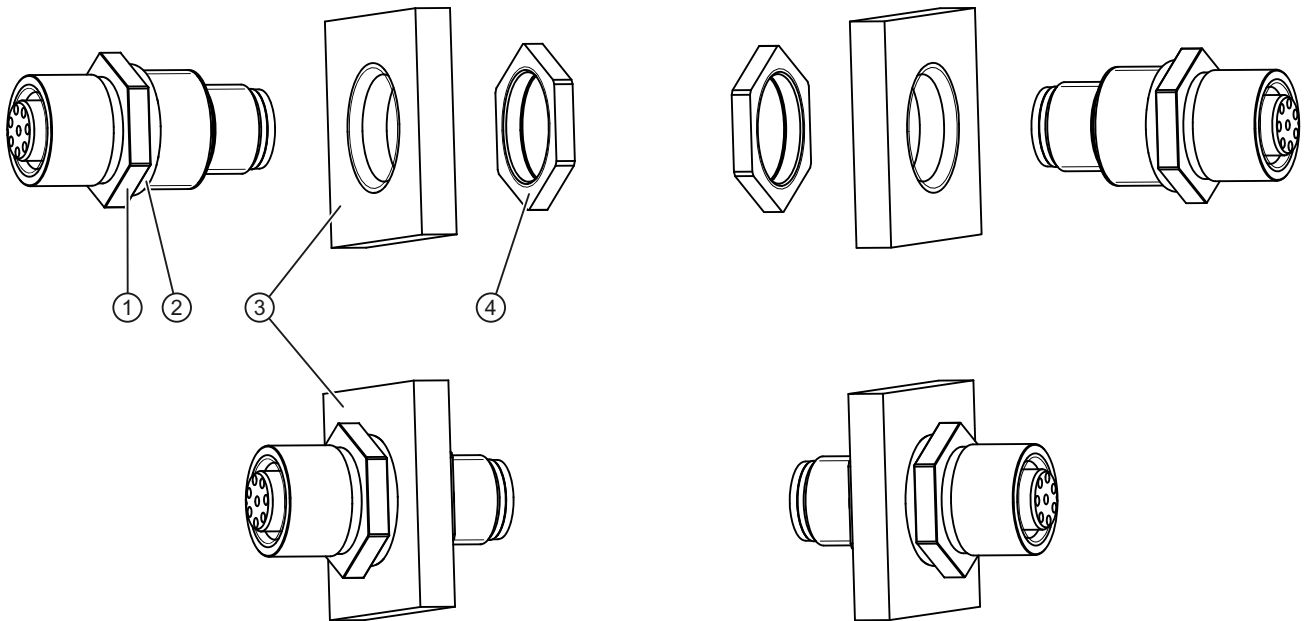
① Threaded hole with chamfer

Figure 11-35 Threaded hole for mounting the DRIVE-CLiQ cabinet bushing M12 with an O-ring that can be screwed from the outside

11.6 DRIVE-CLiQ cabinet bushings

**Installation**

1. Insert the DRIVE-CLiQ cabinet bushing through the opening in the cabinet.
2. Fasten the DRIVE-CLiQ cabinet bushing using the associated O ring with a tightening torque of 3 - 4 Nm



- ① Flange, SW18
- ② Seal
- ③ Cabinet panel
- ④ O ring, SW20, tightening torque: 3 - 4 Nm

Figure 11-36 Mounting DRIVE-CLiQ cabinet bushings for cables with M12 connectors

**11.6.5 Technical data**

Table 11- 26 Technical data of DRIVE-CLiQ cabinet bushings

	Unit	6SL3066-2DA00-0AA0 RJ45	6FX2003-0DT67 M12
Weight	kg	0.165	0.035
Degree of protection according to EN 60529		IP54 outside the control cabinet IP20 or IPXXB inside the control cabinet	IP67



## 11.7 DRIVE-CLiQ coupling

### 11.7.1 Description

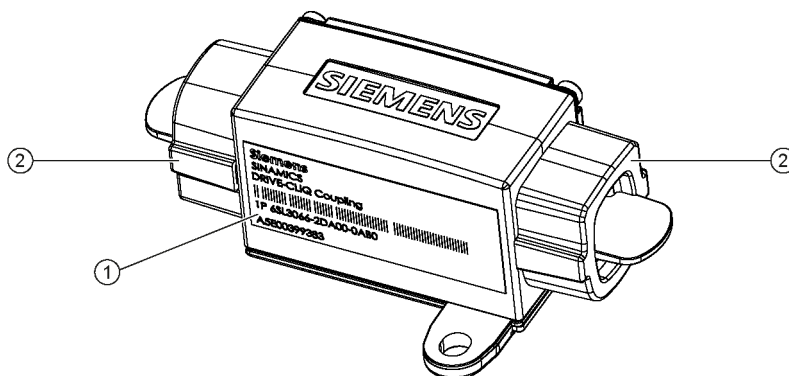
The DRIVE-CLiQ coupling is used to connect two DRIVE-CLiQ cables in accordance with degree of protection IP67 acc. to EN 60529.

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 signal cables".

### 11.7.2 Interface description

#### 11.7.2.1 Overview



- ① Rating plate
- ② Protective cap, Yamaichi, order number: Y-ConAS-24-S

Figure 11-37 Interface overview, DRIVE-CLiQ coupling

### 11.7.3 Dimension drawing

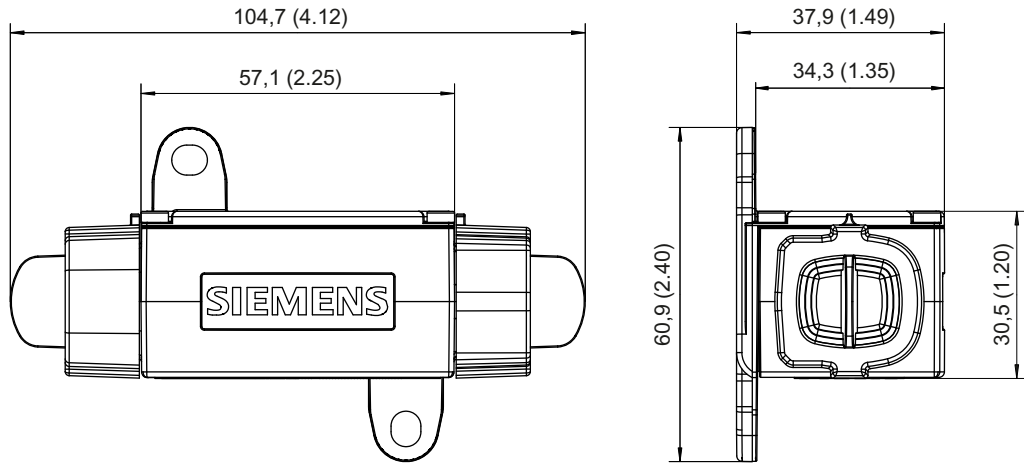
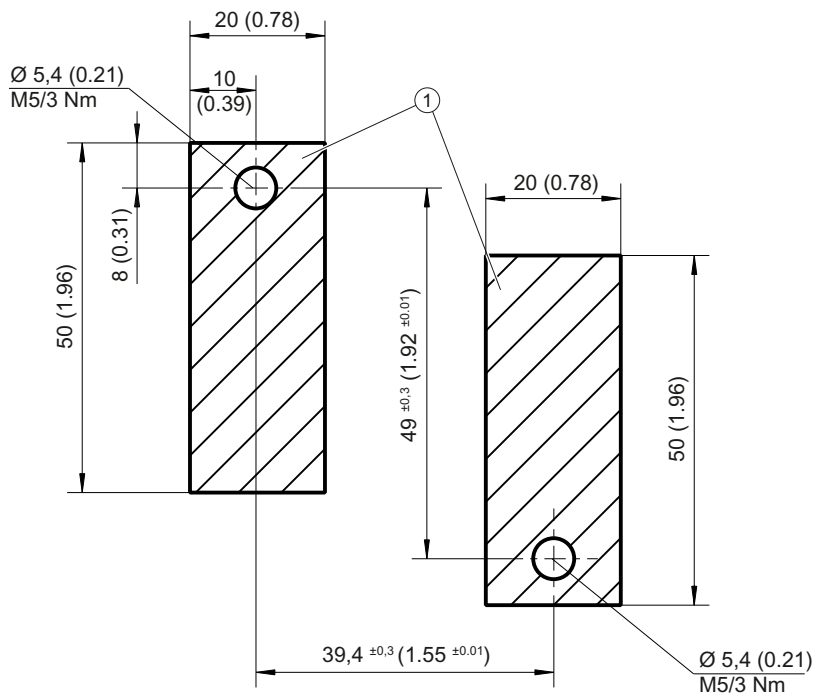


Figure 11-38 Dimension drawing of the DRIVE-CLiQ coupling, all dimensions in mm and (inches)

### 11.7.4 Mounting



① Contact surface

Figure 11-39 Hole drilling pattern for installation

## Mounting

1. Attach the DRIVE-CLiQ coupling to the mounting surface as shown in the drilling pattern.
2. Remove the protective caps of the DRIVE-CLiQ coupling.
3. Latch the DRIVE-CLiQ connectors at both sides of the DRIVE-CLiQ coupling.

### 11.7.5 Technical data

Table 11- 27 Technical data

<b>DRIVE-CLiQ coupling 6SL3066-2DA00-0AB0</b>	<b>Unit</b>	
Weight	kg	0,272
Degree of protection	IP67 acc. to EN 60529	

## 11.8 Spacing bolt for Booksize Compact components

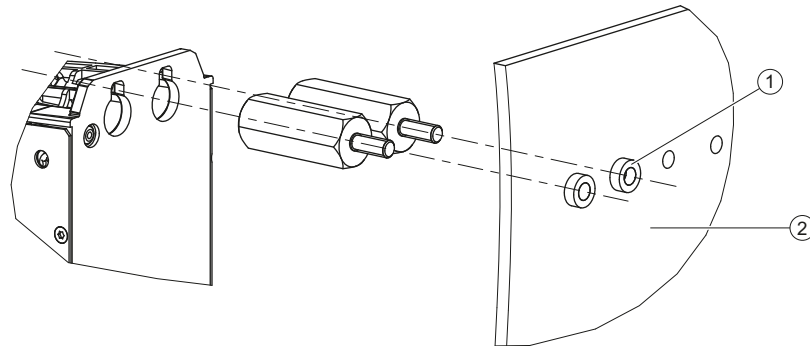
To increase the mounting depth of modules in Booksize Compact format, use spacing bolts (order number: 6SL3462-1CC00-0AA0). In this way, it is possible to combine modules in Booksize Compact format directly with booksize modules with internal air cooling.

Table 11- 28 Number of spacing bolts and holes for various module widths

Module width in [mm]	Number of spacing bolts	Number of holes/press-in nuts
50	2	2
75	4	4
100	4	4

### Mounting the spacing bolts with press-in nuts

- Inserting M6 press-in nuts into the mounting panel
- Distance 25 mm ± 0.15 mm for module width 75 mm
- Distance 50 mm ± 0.15 mm for module width 100 mm



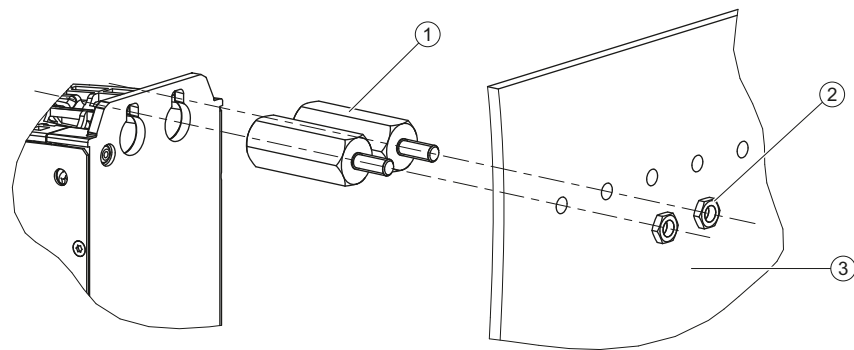
- ① M6 press-in nuts
- ② Mounting wall

Figure 11-40 Mounting the M6 press-in nuts on the rear of the mounting panel

As an alternative to press-in nuts, you can secure spacing bolts with M6 nuts to the rear of the mounting panel.

**Mounting spacing bolts with nuts**

- Drill  $\varnothing$  6.5 mm holes for spacing bolts
- Distance 25 mm  $\pm$  0.15 mm for module width 75 mm
- Distance 50 mm  $\pm$  0.15 mm for module width 100 mm

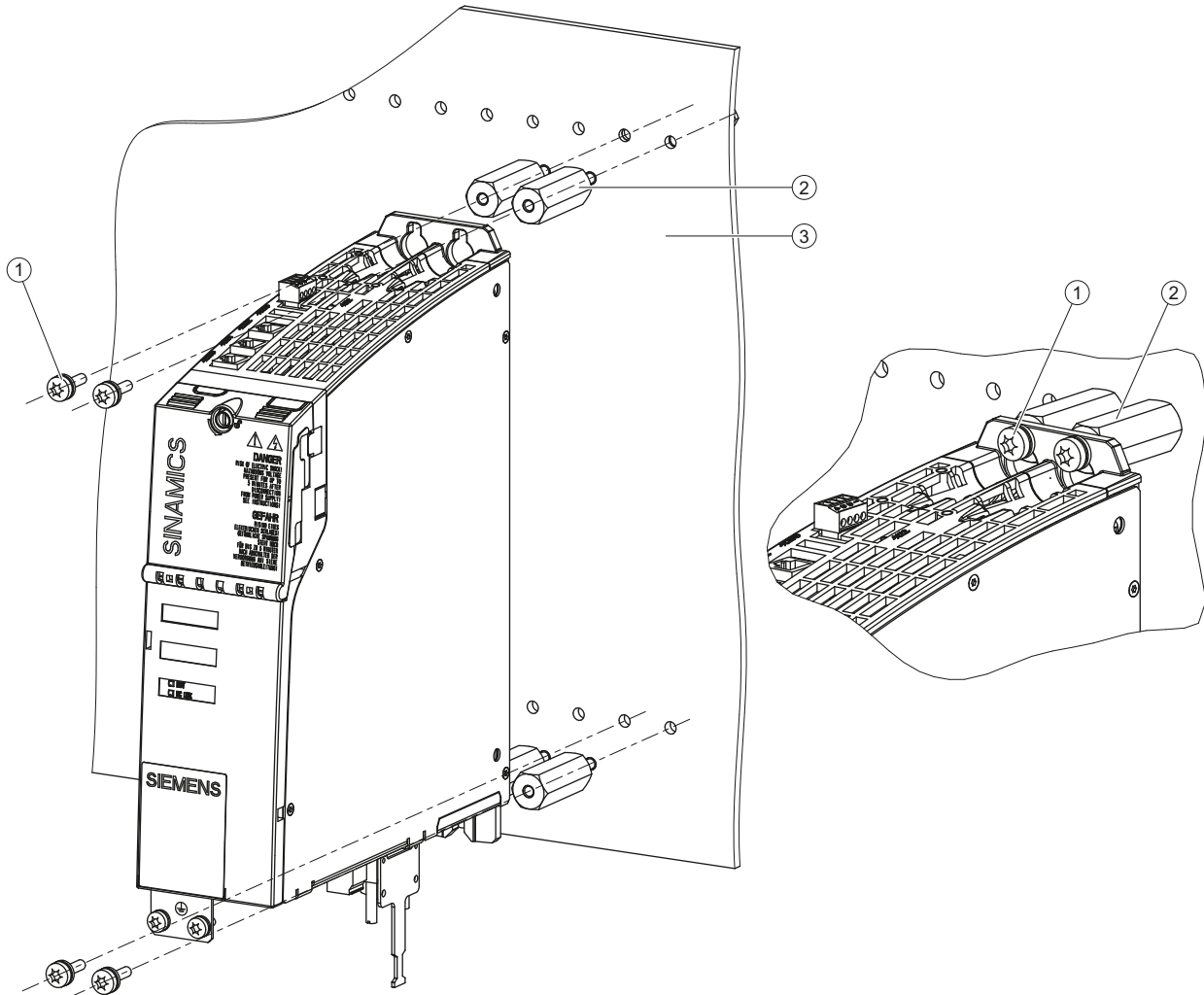


Spacing bolt  
M6 nuts  
Mounting wall

Figure 11-41 Mounting the spacing bolts with M6 nuts on the rear of the mounting panel

**Tightening torque: 6 Nm**

Mounting a component in booksize compact format with spacing bolts



- 1 M6 x 20 screw, Torx T27
- 2 Spacing bolts, SW 17 (6SL3462-1CC00-0AA0)
- 3 Mounting wall

Figure 11-42 Mounting a component in booksize compact format with spacing bolts (example: Motor Module Booksize Compact, 18 A)

**Tightening torque: 6 Nm**

## 12.1 General information

The SINAMICS S components are designed in accordance with degree of protection IP20 or IPXXB according to EN 60529 and as open-type devices to UL 50. This ensures protection against electric shocks.

To ensure protection against mechanical stress and climatic conditions too, the components should only be operated in housing, cabinets or enclosed electrical operating areas that fulfill at least degree of protection IP54 and, as enclosure type 12, are designed to UL 50.

Prefabricated MOTION-CONNECT cables are recommended.

---

### Note

#### Functional safety of SINAMICS components

Installation in a cabinet with degree of protection 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

## 12.2 Safety instructions when mounting and installing the control cabinet

### NOTICE

#### Short-circuits and damage to the insulation through foreign bodies in the housing

Drilling chips, end sleeves, etc. can cause short-circuits and damage to the insulation.

- Observe the safety regulations with regard to the touch protection. See also EN 60204-1.
- Only perform installation and other work when the devices are current-free.
- Cover the ventilation slots when mounting and installing the control cabinet and remove the cover before switching on.

### NOTICE

#### Malfunctions or defects due to static discharge

If static discharge occurs on surfaces or interfaces that cannot be easily accessed, this can cause malfunctions and/or defects.

### Note

#### Maximum voltage drop of 4%

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 drive system 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.



## 12.3 Directives

The product satisfies the protection targets of the following EU Directives applicable within the European Economic Area (EEA):

Table 12- 1 Directives

Directive	Description
2006/95/EC	Directive of the European Parliament and Council of December 12, 2006, on the approximation of the laws of the member states relating to electrical equipment designed for use within certain voltage limits (Low-Voltage Directive).
2004/108/EC	Directive of the European Parliament and Council of December 15, 2004, which repeals directive 89/336/EEC, on the approximation of laws of the member states relating to electromagnetic compatibility (EMC Directive).

## 12.4 Notes on electromagnetic compatibility (EMC)

Requirements to implement the EMC are listed in EN 61000-6-2, EN 61000-6-4, EN 61800-3, EN 60204-1 and in the Configuration Manual, EMC installation guideline (order number 6FC5297-0AD30-0□P□). Conformance with the EMC Directive of the EC can be ensured by following the measures described in the Configuration Manual, EMC installation guideline. When installing components in cabinets, in order to fulfill the EMC Directive, the following conditions must be additionally observed:

- Connected to TN and TT systems with grounded neutral point and grounded line conductor as well as to IT systems.
- Observance of information about cable shielding and equipotential bonding.
- Use of the recommended power and signal cables from Siemens.
- Only cables from Siemens may be used for DRIVE-CLiQ connections.

---

### Note

#### Malfunctions when not using original Siemens accessories

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

- Only use the DRIVE-CLiQ coupling and DRIVE-CLiQ cabinet bushing described in Section "Accessories" for the DRIVE-CLiQ connections.
- 

### Note

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

Faulty operation of the machine can occur when the shielding is incorrect or the cables are too long.

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

## 12.5 Arrangement of components and equipment

### 12.5.1 General information

The arrangement of the components and equipment takes account of

- Space requirements
- Cable routing
- Bending radii of the connecting cables  
MOTION-CONNECT cables, refer to catalog PM21 or NC61
- Heat dissipation
- EMC

The components of the drive line-up should preferably be mounted on a conductive mounting surface to ensure low impedance between the component and the mounting surface. Mounting plates with a galvanized surface are suitable.

Components are usually located centrally in a cabinet. The necessary mounting and installation clearances above and below the components can, under certain circumstances, exceed the minimum clearances specified in the product documentation.

The components can be arranged in one or more tiers. In a multiple-tier arrangement, vertical mounting or, in a cabinet row, side-by-side mounting in different cabinet sections is possible.

To determine the cross-section, 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).

### 12.5.2 Current carrying capacity of the DC link busbar

The current carrying capacity of the DC link busbar must be observed for the configuration and arrangement of the drive line-up. The maximum current carrying capacity of the DC link busbar differs for the various module widths.

Table 12- 2 Maximum current carrying capacity of the DC link busbar

Current carrying capacity of the DC link busbar	Components
100 A	<ul style="list-style-type: none"> <li>• Motor Modules from 50 mm to 100 mm wide</li> <li>• DC link components</li> </ul>
150 A	<ul style="list-style-type: none"> <li>• Motor Modules from 50 mm to 100 mm wide with reinforced DC link busbars</li> </ul>
200 A	<ul style="list-style-type: none"> <li>• Motor Modules from 150 mm to 300 mm wide</li> </ul>

To calculate the load of the DC link busbar, add the DC link currents  $I_d$  of the connected Motor Modules. If the current carrying capacity of the DC link busbars is exceeded for the planned configuration, two solutions are possible:

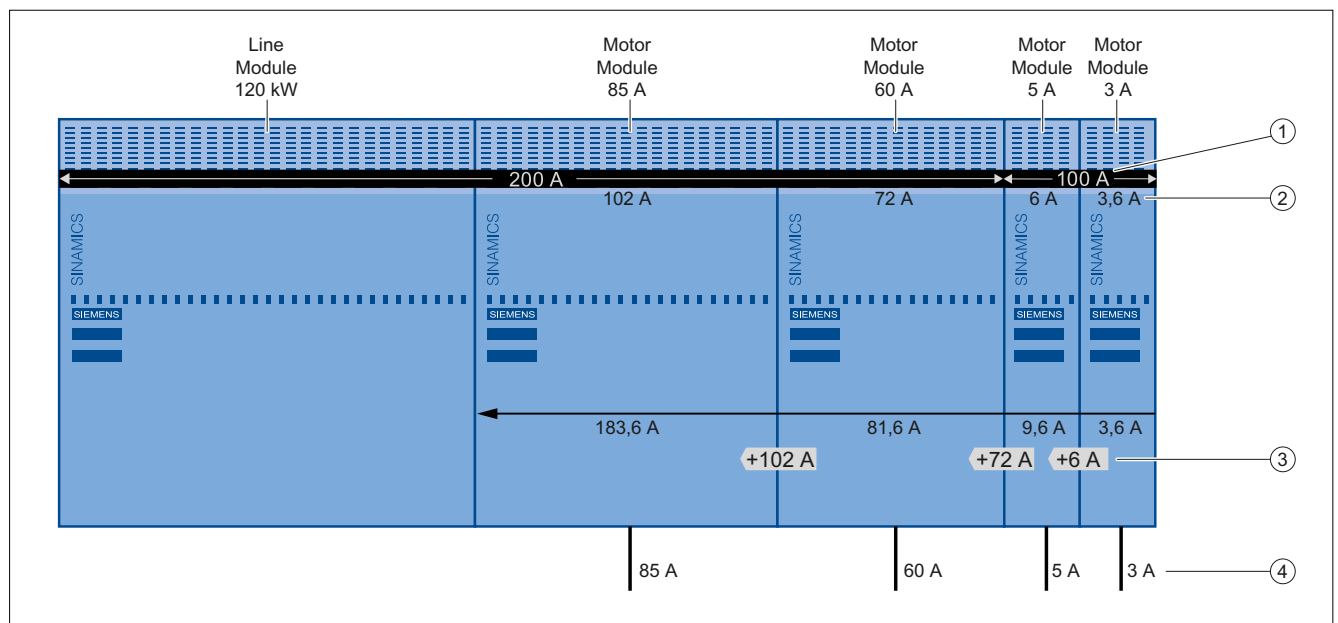
- Center infeed: Arrangement of the drive line-up with infeed to the left and right (example 2)
- Use of another Line Module

### Note

The following examples are based on the simultaneous use and loading of the Motor Modules with the rated current  $I_n$ . The values of the DC link current were taken from the technical data of the Motor Modules in the Power Units Booksize Manual.

### Example 1:

Connection of several Motor Modules with different current carrying capacity of the DC link busbar to a Line Module.

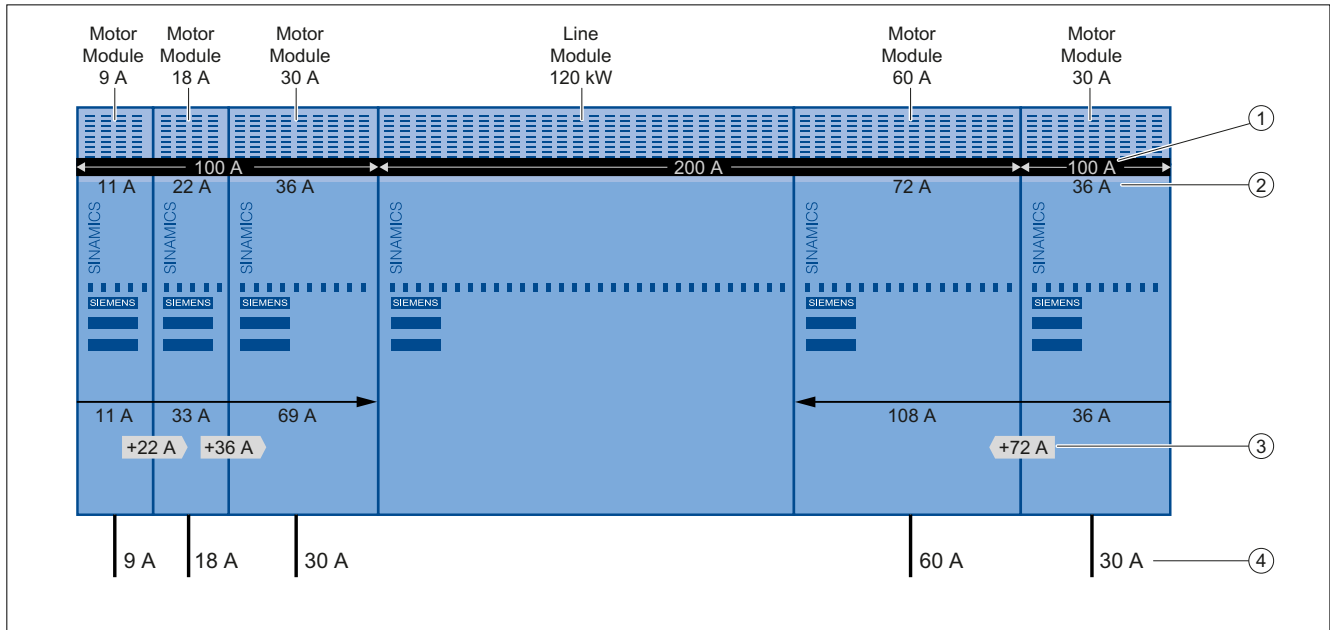


- ① DC link busbar current carrying capacity
- ② DC link busbar load: DC link current  $I_d$  at the rated current  $I_n$  of the Motor Module
- ③ Increased load of the DC link busbar
- ④ Motor current = rated output current  $I_n$  of the Motor Module

Figure 12-1 Regular arrangement with infeed to the right of the DC link, DC link busbar not overloaded

**Example 2:**

Connection of several Motor Modules with different current carrying capacity of the DC link busbar to a Line Module with center infeed



- ① DC link busbar current carrying capacity
- ② DC link busbar load: DC link current  $I_d$  at the rated current  $I_n$  of the Motor Module
- ③ Increased load of the DC link busbar
- ④ Motor current = rated output current  $I_n$  of the Motor Module

Figure 12-2 Center infeed - infeed from left and right to the DC link

A center infeed with Motor Modules to the right and left of the Line Module can be configured for all Line Modules in compliance with current carrying capacity.  
Exception: Smart Line Modules 5 kW and 10 kW

**Note**

For Smart Line Modules 5 kW and 10 kW, the arrangement of the drive line-up must be made to the right!

### 12.5.3 Single-tier drive line-up

Due to the current carrying capacity of the DC-link busbars and their function in particular, the components should be arranged according to the following rule. From left to right:

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

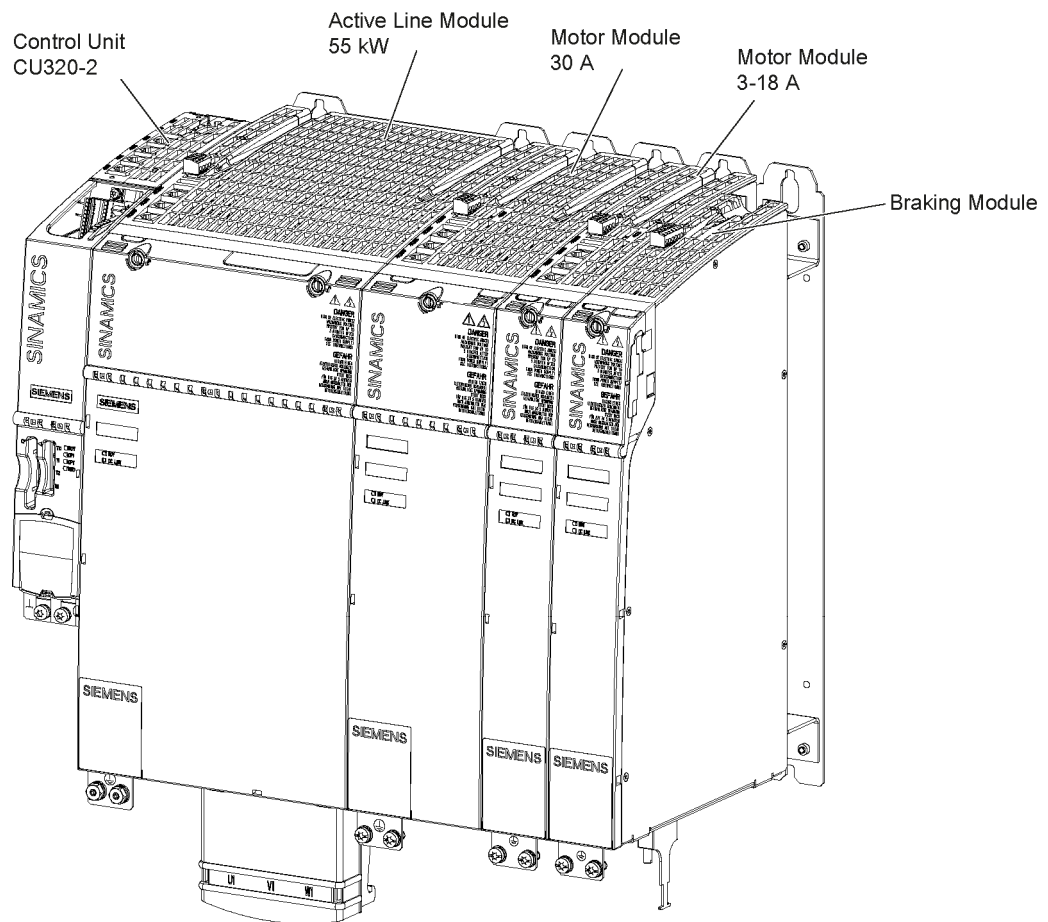


Figure 12-3 Example of a single drive line-up with internal air cooling

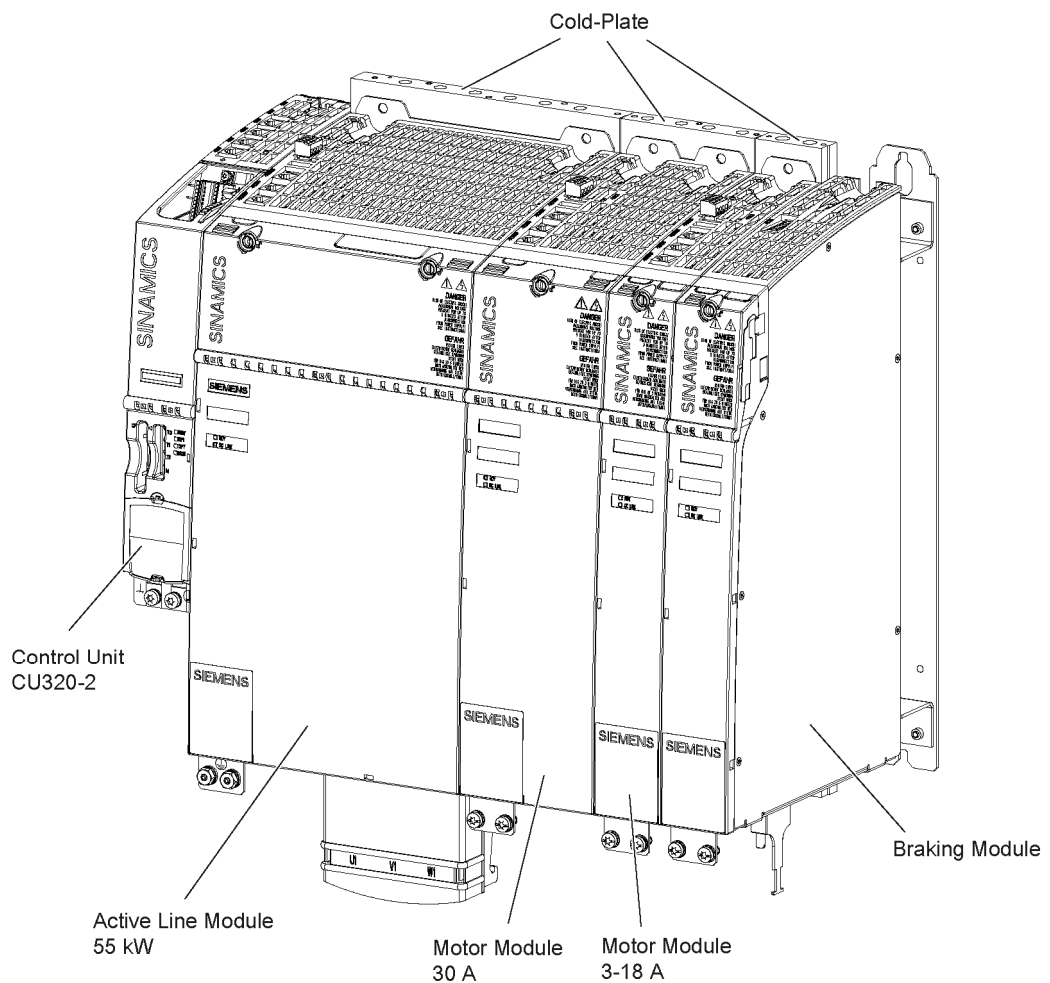


Figure 12-4 Example of a single drive line-up with cold plate

## 12.5.4 Multi-tier drive line-up

### 12.5.4.1 Arrangement rules

#### 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, see Section "Accessories") using single-core, finely-stranded, shielded cables.  
The cables must be laid according to IEC 61800-5-2 so that a ground fault or short-circuit is impossible.

- The distance between the tiers of modules primarily depends on the wiring, the cable cross-section and the bending radius of the power cables to be connected.
- The inlet temperature of the air sucked in for cooling the module must not exceed 40° C (with derating, it must not exceed 55° C). This must be ensured by means of suitable air guidance, the distance between the module rows, or by air baffle plates.

**NOTICE****Operating faults due to incorrectly laid cables**

Particularly with regard to satisfying the EMC requirements, signal cables should not be laid parallel to power cables.

**Note****Arrangement of the components for infeed of the DC link voltage from the right**

If the infeed is on the right-hand side of the drive line-up (e.g. in a multi-tier configuration), the rules described in Section "Single-tier drive line-up" apply in reverse. This means that:

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

**Wiring rules for DRIVE-CLiQ**

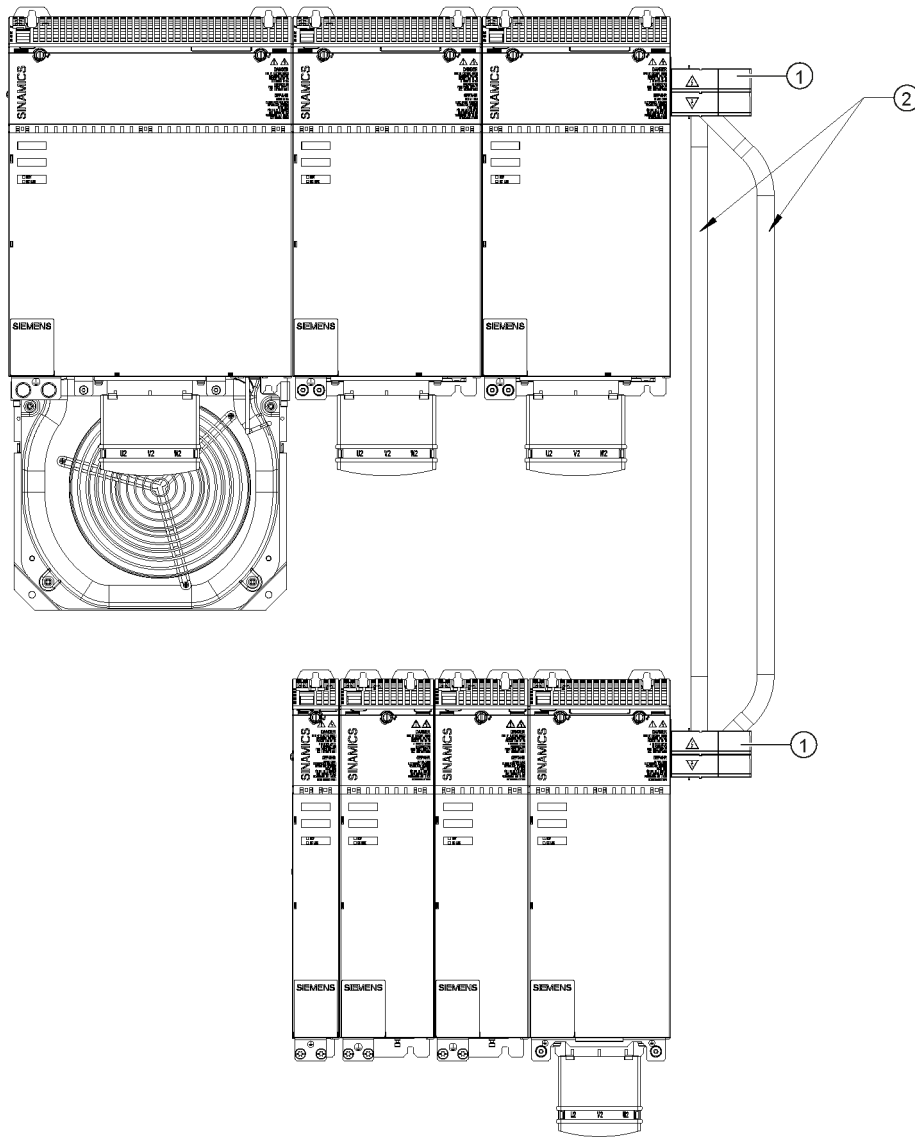
Refer to the Commissioning Manual.

**Selecting the DC link adapter and DC link rectifier adapter**

Table 12- 3 Overview of the DC link rectifier adapter and DC link adapter

	Suitable for module width	Max. connectable cross-section	Max. current carrying capacity
<b>DC link rectifier adapter (cable outlet on top)</b>			
6SL3162-2BD00-0AAx	50 mm, 100 mm	10 mm <sup>2</sup>	43 A
6SL3162-2BM00-0AAx	150 mm, 200 mm, 300 mm	95 mm <sup>2</sup>	240 A
<b>DC link adapter (cable outlet on side)</b>			
6SL3162-2BM01-0AAx	All	95 mm <sup>2</sup>	240 A

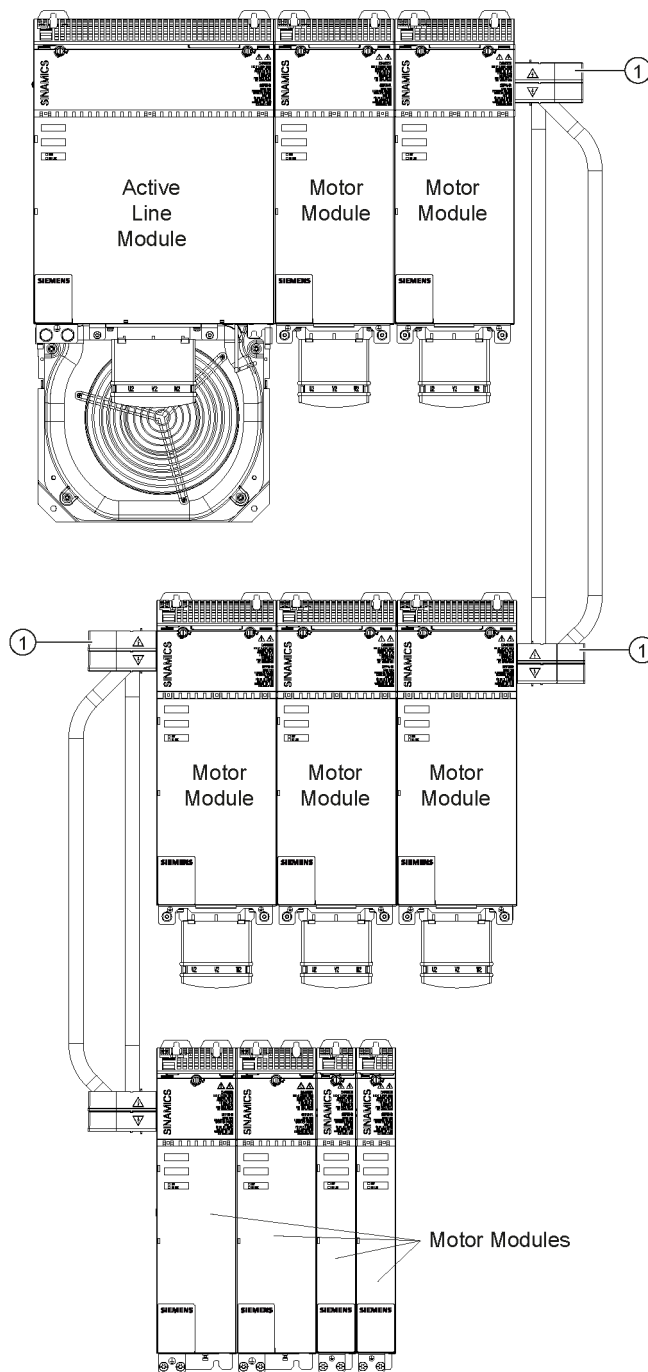
12.5.4.2 Examples of a multi-tier configuration



- ① DC link adapter
- ② Power cable shielded

Figure 12-5 Example of a two-tier configuration for a drive line-up with internal air cooling





① DC link adapter

Figure 12-6 Example of a three-tier configuration for a drive line-up with internal air cooling

12.5.4.3 Connection example

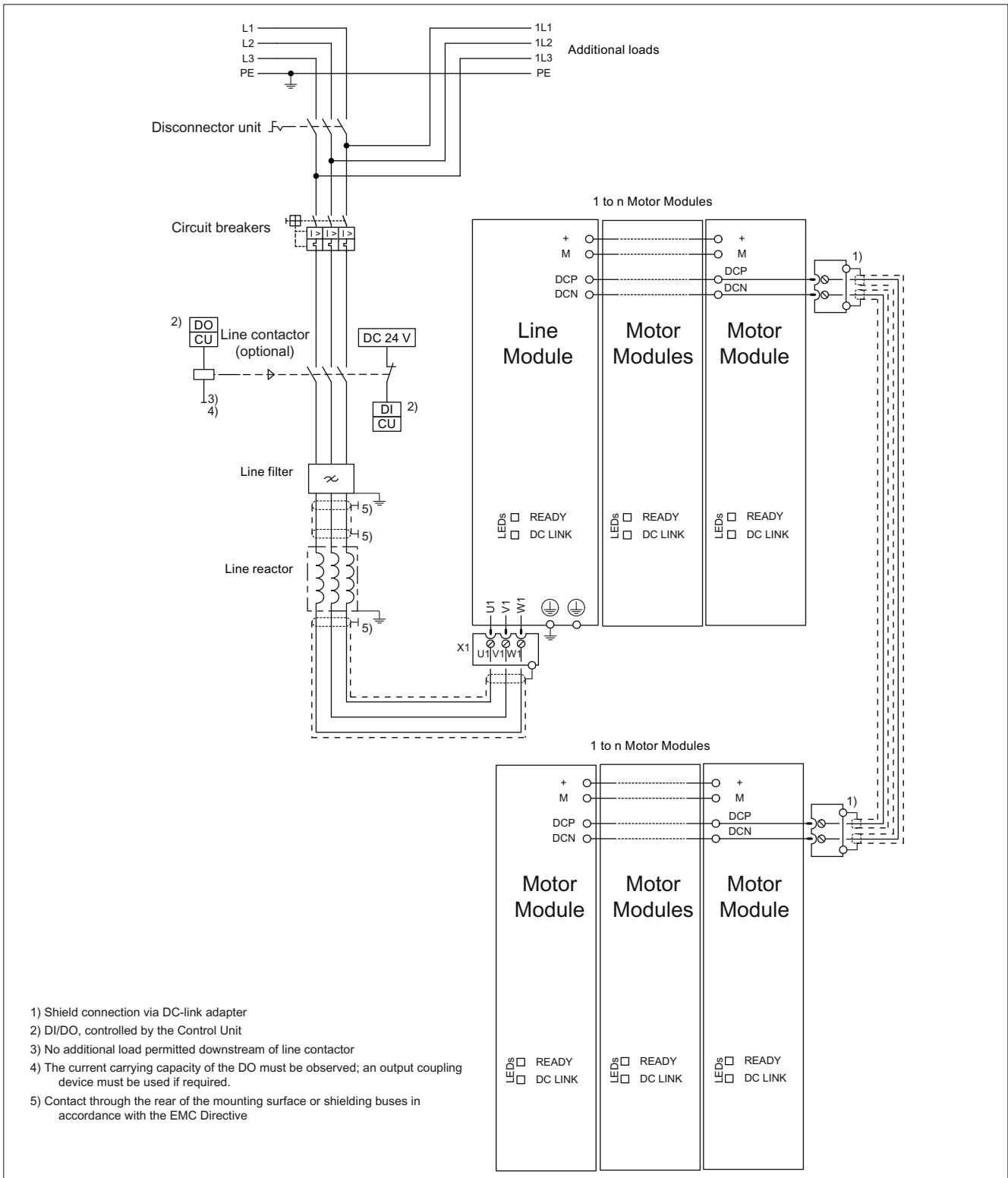


Figure 12-7 Connection example for a two-tier drive line-up

## 12.6 Electrical connection

### 12.6.1 Connection of the DC link busbars and 24 V busbars

The DC link busbars and 24 V busbars of the components must be connected in a drive line-up before commissioning. Note the information about the arrangement of the components as well as the current carrying capacity of the DC link busbars in the previous sections. The connection of components with reinforced DC link busbars is described in Section "Accessories / Reinforced DC link busbars (Page 653)".



#### ! WARNING

##### Danger to life through electric shock due to incorrectly installed DC link bridges

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

- For all 50 mm wide modules (exception: Smart Line Module), remove the DC link bridge, including the screws. Do not tighten the screws without the DC link bridges.
- For all components that are 75 mm wide or wider, the DC link bridges must not be moved to the left or removed.

The connection of a Line Module to a Motor Module is shown in the following.

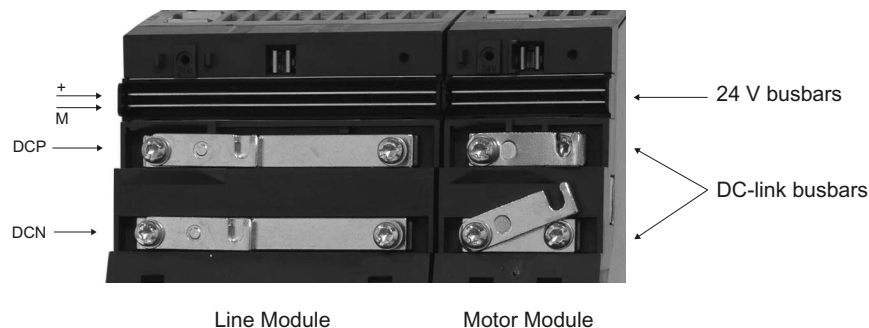


Figure 12-8 Line Module and Motor Module as delivered

### Connection of the DC link busbars

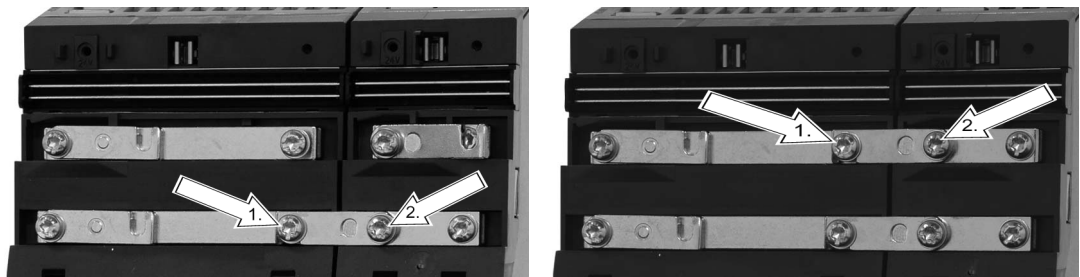
Always connect the lower DC link busbars first and then the upper DC link busbars.

**Tool:** Screwdriver Torx T20

Working steps:

- Loosen the DC link busbar screws.
- Turn over the DC link bridge.
- Screw the DC link busbar screws tight. It is important that you follow the sequence shown below (1 and 2).

**Tightening torque:** 1.8 Nm



1. Connection of the lower DC link busbars    2. Connection of the upper DC link busbars

### Connection of the 24 V busbars

The 24 V busbars of the components are connected with the help of the red 24 V connectors in the accessories pack. A 24 V connector must be plugged onto the 24 V busbars between the Line Module, Motor Module and DC link component. The 24 V connectors must be attached before the drive line-up is commissioned!

Working steps:

- Place the 24 V connectors on to the 24 V busbars.
- Press the 24 V connectors down until they click into place.
- If required, mount the 24 V terminal adapter to supply the 24 VDC.



- ① Mounted 24 V terminal adapter (Torx T10, tightening torque 0.5 Nm)
- ② Mounted 24 V connector

#### CAUTION

##### Risk of fire

The red 24 V connectors may only be used when the DC link busbars of the components are also connected. Otherwise the 24 V connectors may burn off.

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

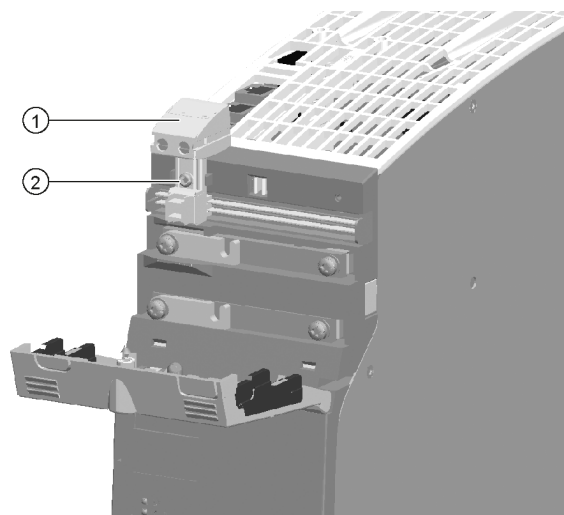
**NOTICE****Unplugging and plugging the 24 V connectors**

- Unplugging and plugging the 24 V connectors are only permissible in a de-energized state.
- A maximum of five unplugging and plugging cycles is permissible.

**12.6.2 Installation of the 24 V terminal adapter**

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

The 24 V terminal adapter is suitable for connecting cable cross-sections of 0.5 mm<sup>2</sup> up to 6 mm<sup>2</sup>. The 24 V terminal adapter is included in the scope of delivery of Line Modules and Control Supply Modules. It can be ordered as a spare part (order number: 6SL3162-2AA00-0AA0).



- ① 24 V terminal adapter
- ② Screw for fixing: SHR, PT-TORX K30-3, 0X16-ST-A2F WN1452 / from the EJ company

**⚠ WARNING****Danger to life through electric shock**



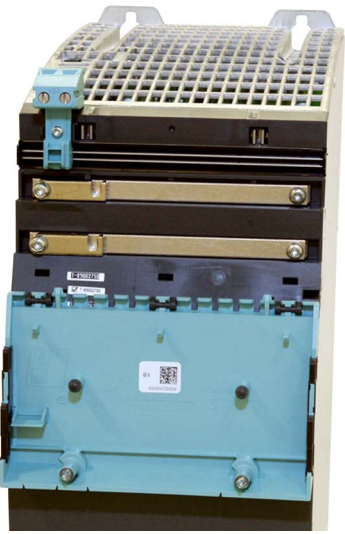


The 24 V terminal adapter must not be removed or plugged in with 24 V applied. The 24 V terminal adapter may only be withdrawn vertically to the front plate (i.e. not at an angle).

You require the following tools to install the 24 V terminal adapter:

- Slot-head screwdriver 1 x 5.5 for releasing the protective cover
- Torx T10 screwdriver to fasten the 24 V terminal adapter
- Suitable pliers to break out the cutout in the protective cover

12.6 Electrical connection

Table 12- 4 Installing the 24 V terminal adapter using an Active Line Module (36 kW) as example

		
<p>Release the protective cover.</p>	<p>Open the protective cover.</p>	<p>Clip the 24 V terminal adapter on to the 24 V busbars. Screw the 24 V terminal adapter tight with the supplied screw. <b>Tightening torque: 0.5 Nm</b></p>
		
<p>Break out the cutout in the protective cover.</p>	<p>Close the protective cover. --&gt; The protective cover must audibly click into place.</p>	

 **WARNING**

**Danger to life through electric shock if the cutout in the protective cover has been broken out**

If the 24 V terminal adapter is removed, the protective cover whose cutout has been broken out must be replaced by a new one for safety reasons. Operation with broken-out cutout in the protective cover is not permitted.

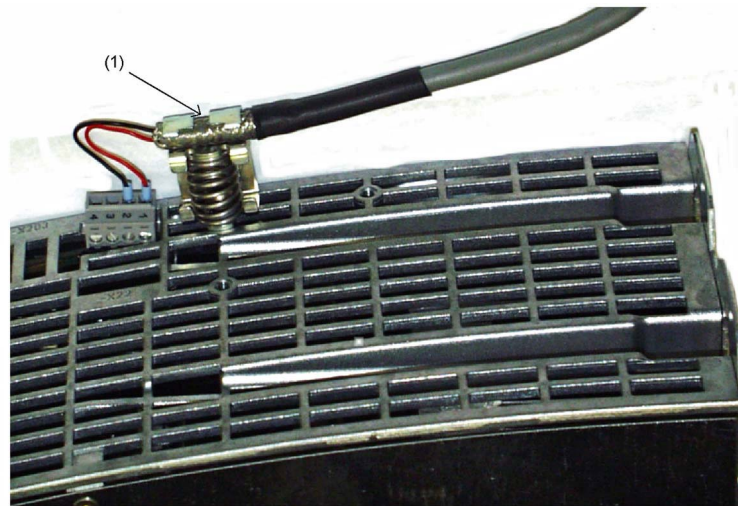
**Note**

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.

### 12.6.3 Shield connection for terminals X21/X22 on the Motor Module

The figure below shows a typical shield connection terminal for the shield support of the cables to terminal X21.



① Shield connection clamp: Weidmüller, type KLBÜ 3-8 SC

Figure 12-9 Shield connection clamp for the shield support

#### NOTICE

**Observe the permissible insertion depth of the screws**

Only use screws with a permissible insertion depth of 4 - 6 mm.



## 12.7 24 V DC supply voltage

### 12.7.1 General information

The 24 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 electronics power supply has to be supplied by the user as described in Section "System data" 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.

---

 <b>DANGER</b>
---

<b>Using motors equipped with a holding brake that is not safely electrically isolated</b>
--

<p>Only motors with a safe electrically isolated holding brake may be connected. The brake conductors must also be safely electrically isolated. The voltage tolerances of the motor holding brakes (<math>24\text{ V} \pm 10\%</math>) must be taken into account.</p>
---

<p>If the motor power cable is connected to intermediate terminals, the power cables and brake cables must be routed apart (<math>\geq 300\text{ mm}</math>).</p>
---

 <b>DANGER</b>
---

<b>Safety extra-low voltages at connections and terminals</b>
---

<p>At all DVC A connections and terminals of the electronic modules, only safety extra-low voltage (SELV; protection class III) or protective extra-low voltages (PELV) with a maximum of 60 V may be connected.</p>
--

<p>These voltages must be safely isolated from all hazardous voltages.</p>
--

<b>NOTICE</b>
---------------

<b>Overvoltage protection for additional loads connected to the power supply</b>
--

<p>If other consumers are connected to the power supply, connected inductance devices (contactors, relays) must be fitted with suitable overvoltage protection circuits.</p>
--

---

**Note**

A regulated DC power supply is required to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars. The voltage tolerances of the motor holding brakes ( $24\text{ V} \pm 10\%$ ) and the voltage drops of the connection cables must be taken into account.

The DC power supply should be set to 26 V. The Control Supply Module supplies 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:

- Use of Siemens three-phase motors
  - Use of Siemens MOTION-CONNECT power cables
  - Motor cable lengths, max. 100 m
- 

## 12.7.2 Options for the 24 V supply of the components

In a drive line-up, the Line Modules, Motor Modules and DC link components are connected to the 24 V power supply via the integrated 24 V busbars. The current carrying capacity of these busbars is 20 A. The 24 V infeed can be realized in two ways:

### 1. Using a Control Supply Module

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

---

**Note**

If you use cables with a cross-section of  $2.5\text{ mm}^2$ , no additional protection is required on the 24 V side for the following cable types:

- Cables of the XLPE type
  - Cables of the EPR type
  - Cable with a similar quality and with a thermal stability of up to  $90^\circ\text{ C}$
-

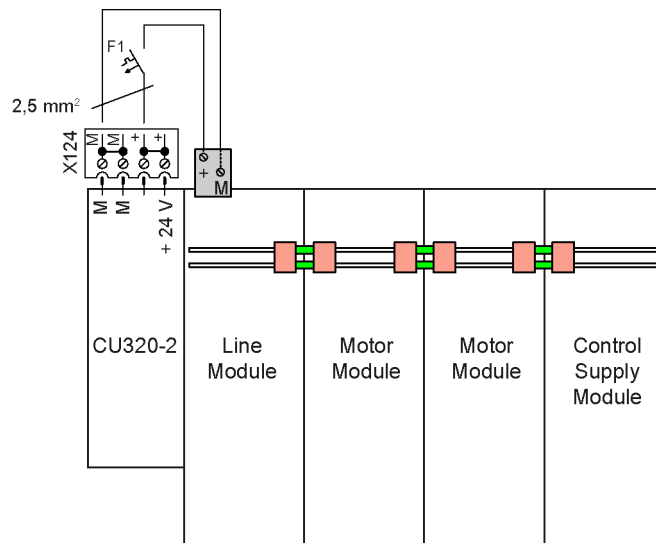


Figure 12-10 Example of a 24 V supply via a Control Supply Module

## 2. Using an external 24 V power supply

When using an external 24 V power supply, e.g. SITOP, the 24 V terminal adapter must be used. The external power supply should be located very close to the load (max. cable length 10 m). We recommend using miniature circuit breakers with tripping characteristic D as overcurrent protection devices for the cables and busbars. The ground potential M must be connected to the protective conductor system (DVC A).

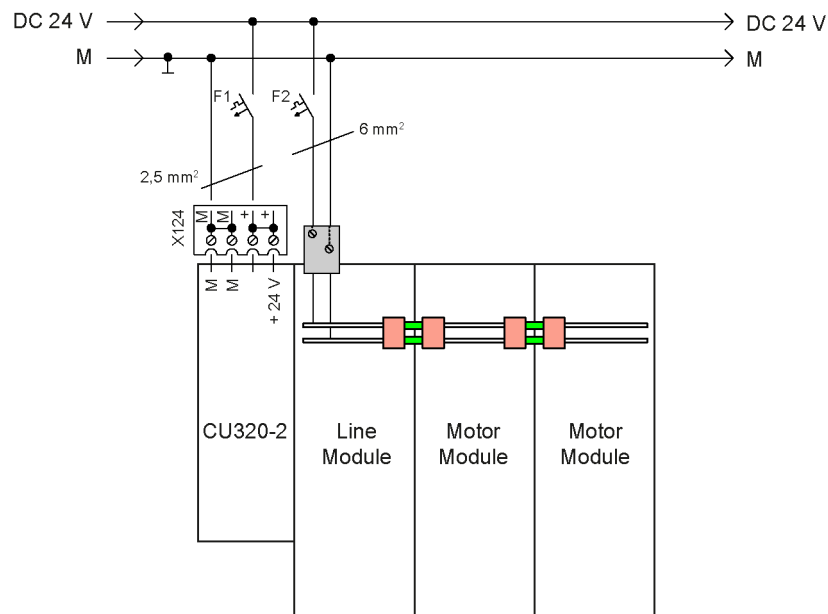


Figure 12-11 Example of a 24 V supply via an external power supply

### 12.7.3 Overcurrent protection

The cables on the primary and secondary sides of the 24 V supply unit must be protected against overcurrent.

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

Secondary side protection depends on the prevailing situation. Please note the following:

- Loading due to loads, including simultaneity factor depending on machine operation
- Current carrying capacity of the conductors used and cables in normal and short-circuit conditions
- Ambient temperature
- Cable bundling (laying cables in a common duct)
- Cable routing method according to EN 60204-1

The overcurrent protection devices can be determined according to EN 60204-1, Section 14.

Circuit breakers from the Siemens NSK catalog are recommended as overcurrent protection devices on the primary side.

Miniature circuit breakers or SITOP select (order number 6EP1961-2BA00) are recommended as overcurrent protection devices on the secondary side. The MCBs can be selected according to Siemens catalog "BETA Modular Installation Devices - ET B1".

When selecting the miniature circuit breaker, the following standards must be carefully observed:

- EN 61800-5-1
- EN 60204-1
- IEC 60364-5-52
- IEC 60287-1 to -3
- EN 60228
- UL 508C

Table 12- 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 mm <sup>2</sup>	10 A	6 A
2.5 mm <sup>2</sup>	16 A	10 A
4 mm <sup>2</sup>	25 A	16 A
6 mm <sup>2</sup>	32 A	20 A
24 V busbar	20 A	20 A

The trip characteristic of the MCBs must be selected to match the loads to be protected and the max. current provided by the power supply unit in the event of a short-circuit.

## 12.7.4 Overvoltage protection

Overvoltage protection devices are needed if long cables are used.

- Supply cables > 10 m
- Signal cables > 30 m

The following Weidmüller overvoltage protectors are recommended for protecting the components' 24 V power supply and the 24 V signal cables from overvoltage:

Table 12- 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

The overvoltage protection components must always be placed next to the area to be protected, e.g. at the entry point to the control cabinet. All 24 V cables which exit the protected area must be routed through an overvoltage protection element.

The diagram below uses a CU320-2 DP as an example to show how the overvoltage protection components are connected.

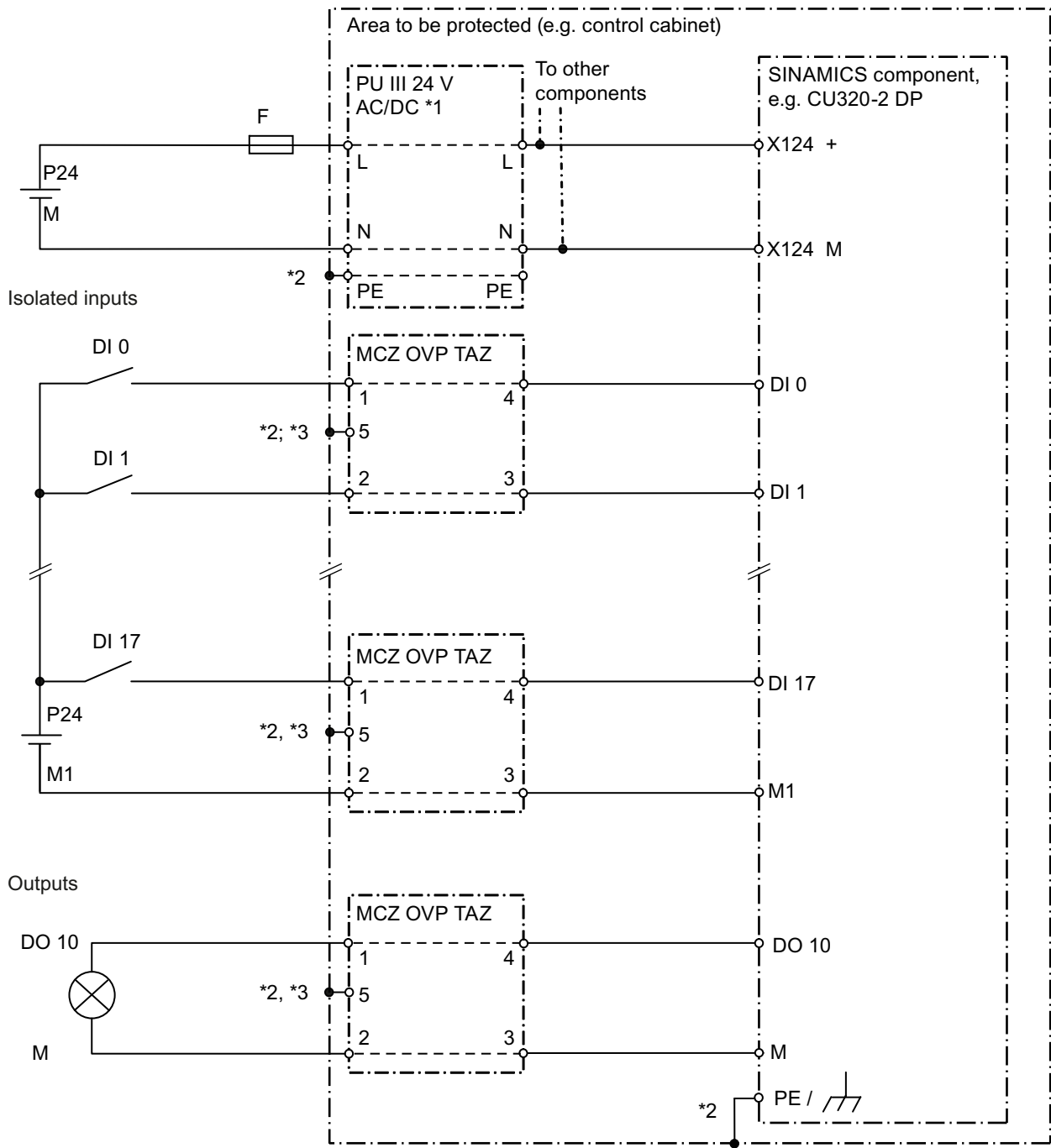


Figure 12-12 Connection example: Overvoltage protection components from Weidmüller to SINAMICS components

\*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.

### 12.7.5 Typical 24 V current consumption of the components

A separate 24 V power supply must be used for the SINAMICS S120 drive line-up.

The following table can be used to calculate the 24 VDC power supply. The values for typical current consumption are used as a basis for configuration.

Table 12- 7 Overview of the 24VDC current consumption

Component	Typical current consumption [A <sub>dc</sub> ]
<b>Control Units</b>	
CU320-2 without load	1.0
Per digital output	0.1
<b>Sensor Modules Cabinet</b>	
SMC10 without/with encoder system	0,20 / 0,35
SMC20 without/with encoder system	0,20 / 0,35
SMC30 without/with encoder system	0,20 / 0,55
SMC40 without/with encoder system	0,1 / 0,3
<b>Sensor Modules External</b>	
SME20 without/with encoder system	0,15 / 0,25
SME25 without/with encoder system	0,15 / 0,25
SME120 without/with encoder system	0,20 / 0,30
SME125 without/with encoder system	0,20 / 0,30

Component	Typical current consumption [A <sub>DC</sub> ]
<b>Terminal Modules</b>	
TM15 (without digital outputs, without DRIVE-CLiQ) Per digital output / DRIVE-CLiQ	0,15 0,5
TM31 (without digital outputs, without DRIVE-CLiQ) Sum of all digital outputs (with switchover to current limitation) Per DRIVE-CLiQ	0,2 0.1/1 0,5
TM41 (without digital outputs, without DRIVE-CLiQ) Per digital output / DRIVE-CLiQ	0,2 0,5
TM54F (without digital outputs, without DRIVE-CLiQ) Per digital output / DRIVE-CLiQ	0,2 0,5
TM120 (without DRIVE-CLiQ) Per DRIVE-CLiQ	0,1 0,5
TM150 (without DRIVE-CLiQ) Per DRIVE-CLiQ	0,07 0,5
<b>Additional system components</b>	
TB30 (without digital outputs) Per digital output	< 0,05 0,1
DMC20 (without DRIVE-CLiQ) Per DRIVE-CLiQ	0,15 0,5
DME20 (without DRIVE-CLiQ) Per DRIVE-CLiQ	0,15 0,5
VSM10 (without DRIVE-CLiQ) DRIVE-CLiQ	0,3 0,5
CBC10	0,1
CBE20	0,1
<b>Active Interface Modules</b>	
16 kW	0,25
36 kW	0,49
55 kW	0,6
80 kW	1,2
120 kW	1,2
<b>Active Line Modules (internal/external air cooling)</b>	
16 kW	0,95
36 kW	1,5
55 kW	1,9
80 kW	1,4
120 kW	1,8
<b>Active Line Module (cold plate)</b>	
16 kW	0,85
36 kW	1,05
55 kW	1,15
80 kW	1,4



Component	Typical current consumption [A <sub>DC</sub> ]
120 kW	1,8
<b>Active Line Module (liquid-cooled)</b>	
120 kW	1,8
<b>Smart Line Modules (internal/external air cooling)</b>	
5 kW	0,8
10 kW	0,9
16 kW	0,95
36 kW	1,5
55 kW	1,9
<b>Smart Line Modules (cold plate)</b>	
5 kW	0,6
10 kW	0,7
<b>Smart Line Modules Booksize Compact</b>	
16 kW (internal air cooling)	0,95
16 kW (cold plate cooling)	0,85
<b>Basic Line Modules (internal/external air cooling)</b>	
20 kW	1
40 kW	1,4
100 kW	2
<b>Basic Line Modules (cold plate)</b>	
20 kW	0,9
40 kW	1,1
100 kW	1,6
<b>DRIVE-CLiQ and brake</b>	
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
<b>Single Motor Modules (internal/external air cooling)</b>	
3 A (+1 x DRIVE-CLiQ; +1 x brake)	0,85
5 A (+1 x DRIVE-CLiQ; +1 x brake)	0,85
9 A (+1 x DRIVE-CLiQ; +1 x brake)	0,85
18 A (+1 x DRIVE-CLiQ; +1 x brake)	0,85
30 A (+1 x DRIVE-CLiQ; +1 x brake)	0,8
45 A (+1 x DRIVE-CLiQ; +1 x brake)	1,05
60 A (+1 x DRIVE-CLiQ; +1 x brake)	1,05
85 A (+1 x DRIVE-CLiQ; +1 x brake)	1,5
132 A (+1 x DRIVE-CLiQ; +1 x brake)	0,85
200 A (+1 x DRIVE-CLiQ + 1 x brake)	0,85
<b>Single Motor Modules (cold plate)</b>	
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

Component	Typical current consumption [A <sub>bc</sub> ]
30 A (+1 x DRIVE-CLiQ; +1 x brake)	0,65
45 A (+1 x DRIVE-CLiQ; +1 x brake)	0,75
60 A (+1 x DRIVE-CLiQ; +1 x brake)	0,75
85 A (+1 x DRIVE-CLiQ; +1 x brake)	0,8
132 A (+1 x DRIVE-CLiQ; +1 x brake)	0,85
200 A (+1 x DRIVE-CLiQ; +1 x brake)	0,85
<b>Single Motor Modules (liquid-cooled)</b>	
200 A (+1 x DRIVE-CLiQ; +1 x brake)	0,85
<b>Single Motor Modules Booksize Compact (internal air cooling)</b>	
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
<b>Single Motor Modules Booksize Compact (cold plate)</b>	
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
<b>Double Motor Modules (internal and external air cooling)</b>	
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
<b>Double Motor Modules (cold plate)</b>	
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
<b>Double Motor Modules Booksize Compact (internal air cooling)</b>	
2 x 1.7 A (+2 x DRIVE-CLiQ; +2 x brake)	1,15
2 x 3 A (+2 x DRIVE-CLiQ; +2 x brake)	1,15
2 x 5 A (+2 x DRIVE-CLiQ; +2 x brake)	1,15
<b>Double Motor Modules Booksize Compact (cold plate)</b>	
2 x 1.7 A (+2 x DRIVE-CLiQ; +2 x brake)	0,9
2 x 3 A (+2 x DRIVE-CLiQ; +2 x brake)	0,9
2 x 5 A (+2 x DRIVE-CLiQ; +2 x brake)	0,9
<b>Braking Module Booksize</b>	0,5
<b>Braking Module Booksize Compact</b>	0,4

If no other specifications are made to the contrary, the Line Modules and Motor Modules listed here are components in booksize format.

**Example: Calculating 24 V current requirements**

Table 12- 8 Example of 24 V current requirements

Component	Quantity	Current consumption [A]	Total current consumption [A]
CU320-2	1	1,0	1,0
8 digital outputs	8	0,1	0,8
Active Line Module 36 kW	1	1,5	1,5
Motor Module 18 A	2	0,85	1,7
Motor Module 30 A	3	0,8	2,4
Encoders	5	0,25	1,25
Brake	5	1,1	5,5
<b>Total:</b>			14,15

**12.7.6 Selecting power supply units**

You are advised to use the devices in the following table. These devices meet the applicable requirements of EN 60204-1.


Table 12- 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 12- 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	6SL3100-1DE22-0AAx

Refer also to Catalog PM21 or NC61.

 <b>WARNING</b>
<p>When using external power supplies, e.g. SITOP, the following points must be observed:</p> <ul style="list-style-type: none"> <li>• The ground potential M must be connected to the protective conductor terminal (DVC A).</li> <li>• The power supply must be mounted close to the drive line-up.</li> </ul> <p>Ideally, they should be mounted on a common mounting plate. If different mounting plates are used, their electrical interconnection must comply with the EMC installation guideline.</p> <p>This installation guideline covers protection against electric shock, protection against fire, and best possible electromagnetic compatibility.</p>

## 12.8 Connection systems

### 12.8.1 DRIVE-CLiQ signal cables

#### 12.8.1.1 Overview

To connect DRIVE-CLiQ components, various pre-assembled and non-assembled DRIVE-CLiQ signal cables are available. The following pre-assembled DRIVE-CLiQ signal cables will be discussed in more detail in the next sections:

- Signal cables without 24 V cores with RJ45 connectors
- MOTION-CONNECT signal cables with RJ45 connectors
- MOTION-CONNECT signal cables with RJ45 connector and M12 socket

Table 12- 11 Overview of pre-assembled DRIVE-CLiQ signal cables

Type of DRIVE-CLiQ signal cable	24 V cores	Degree of protection		Connector type
		IP20	IP67	
6SL3060-4A.. 6FX2002-1DC..	--	x	x	RJ45
6FX5002-2DC00.. to .. -2DC20.. 6FX8002-2DC00.. to .. -2DC20..	x	x	x	RJ45
6FX5002-2DC30.. 6FX8002-2DC30..	x	X (RJ45)	X (M12)	RJ45 / M12

### 12.8.1.2 DRIVE-CLiQ signal cables without 24 V DC cores

Pre-assembled DRIVE-CLiQ signal cables without 24 V DC cores are used to connect components with DRIVE-CLiQ connection, which have a separate or external 24 V DC power supply. They are mainly intended for use in control cabinets. The signal cables are available with RJ45 connectors in degrees of protection IP20 and IP67.

Table 12- 12 Actual lengths of the DRIVE-CLiQ jumpers for Line Modules and Motor Modules

DRIVE-CLiQ bridge	Cable length L <sup>1)</sup>
50 mm	110 mm
100 mm	160 mm
150 mm	210 mm
200 mm	260 mm
250 mm	310 mm
300 mm	360 mm
350 mm	410 mm

1) Cable length without connector

Cable lengths from 600 mm and higher are used to connect to other applications (e.g. establish a 2nd line in the drive line-up, establish wiring in a star configuration etc. )

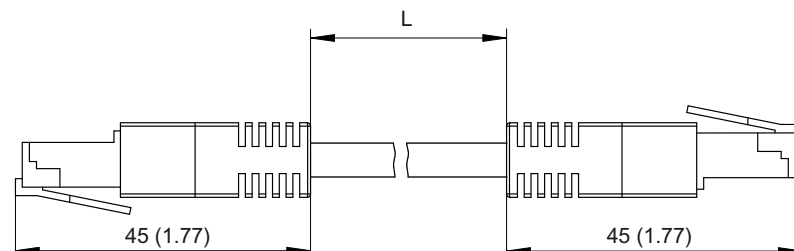


Figure 12-13 DRIVE-CLiQ signal cables without 24 V DC cores (IP20)

### 12.8.1.3 DRIVE-CLiQ signal cables MOTION-CONNECT with RJ45 connectors

The MOTION-CONNECT DRIVE-CLiQ signal cables with RJ45 plugs have 24 V cores. They are used for components with DRIVE-CLiQ connection if higher requirements must be complied with, such as mechanical stress and resistance to oil. For example, the signal cables are used for connections outside the control cabinet:

- Connections between Motor Modules and Sensor Modules
- Connections between Motor Modules and motors with DRIVE-CLiQ interface

The maximum length of the DRIVE-CLiQ MOTION-CONNECT signal cables with RJ45 plugs is:

- 100 m for MOTION-CONNECT 500 cables
- 75 m for MOTION-CONNECT 800PLUS cables

The signal cables are available in degrees of protection IP20 and IP67.

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#### Note

#### DRIVE-CLiQ cabinet bushing for RJ45 connectors

For information on the cabinet bushings, see Section "DRIVE-CLiQ cabinet bushings (Page 658)".

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### 12.8.1.4 DRIVE-CLiQ signal cables MOTION-CONNECT with RJ45 plug and M12 socket

The MOTION-CONNECT DRIVE-CLiQ signal cables with RJ45 plug and M12 socket have 24 VDC cores. They establish the connection between components with a DRIVE-CLiQ connection and a direct measuring system equipped with DRIVE-CLiQ ASIC with 8-pin M12 connector. Measuring systems from third-party manufacturers can be directly connected to the SINAMICS S120.

#### Basic cable

The pre-assembled basic cable has eight cores, of which four are used for data transmission and two for the 24 V supply. It is used to convert from a RJ45 plug (IP20) to an M12 socket (IP67).



Figure 12-14 DRIVE-CLiQ basic cable with RJ45 plug and M12 socket

## Extension

The pre-assembled extension of a basic cable has an M12 plug (IP67) and an M12 socket (IP67).



Figure 12-15 DRIVE-CLiQ extension with M12 plug and M12 socket

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### Note

#### Maximum permissible total cable length

The maximum permissible total cable length between the measuring system and the RJ45 socket of the SINAMICS S120 device is 30 m. For a longer total cable length data transfer errors may occur. This is the reason that no additional extension can be connected to a 30 m long basic cable.

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### Note

#### Maximum number of extensions

A maximum of two extensions can be used. More than two extensions can result in data transfer errors.

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### Note

#### DRIVE-CLiQ cabinet bushing with M12 plug

For information on the cabinet bushings, see Section "DRIVE-CLiQ cabinet bushings (Page 658)".

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12.8.1.5 Comparison of DRIVE-CLiQ signal cables

DRIVE-CLiQ signal cables are designed for various applications. The following table provides an overview of the most important properties.

Table 12- 13 Properties of DRIVE-CLiQ signal cables

DRIVE-CLiQ signal cable	DRIVE-CLiQ	DRIVE-CLiQ MOTION-CONNECT 500	DRIVE-CLiQ MOTION-CONNECT 800PLUS
<b>Approvals</b>			
VDE cURus or UR/CSA	Yes UL STYLE 2502/CSA- N.210.2-M90	Yes UL STYLE 2502/CSA- N.210.2-M90	Yes UL STYLE 2502/CSA- N.210.2-M90
UR-CSA File No. <sup>1)</sup> in conformance with RoHS	Yes Yes	Yes Yes	Yes Yes
<b>Rated voltage V<sub>0</sub>/V in accordance with EN 50395</b>	30 V	30 V	30 V
<b>Test voltage, rms</b>	500 V	500 V	500 V
<b>Operating temperature at the surface</b>			
Permanently installed	-20 to +80 °C	-20 to +80°C	-20 to +80°C
Moveable	-	0 to 60°C	-20 to +60°C
<b>Tensile load, max.</b>			
Permanently installed	45 N/mm <sup>2</sup>	80 N/mm <sup>2</sup>	50 N/mm <sup>2</sup>
Moveable	-	30 N/mm <sup>2</sup>	20 N/mm <sup>2</sup>
<b>Smallest bending radius</b>			
Permanently installed	50 mm	35 mm	35 mm
Moveable	-	125 mm	75 mm
<b>Torsional stress</b>	-	30°/m absolute	30°/m absolute
<b>Bending operations</b>	-	100000	10 million
<b>Max. traversing speed</b>	-	30 m/min	300 m/min
<b>Max. acceleration</b>	-	2 m/s <sup>2</sup>	50 m/s <sup>2</sup> (3 m traversing distance) <sup>2)</sup>
<b>insulation material</b>	CFC/silicone-free	CFC/silicone-free	CFC/halogen/silicone-free IEC 60754-1 / DIN VDE 0472-815
<b>Oil resistance</b>	EN 60811-2-1	EN 60811-2-1 (mineral oil only)	EN 60811-2-1
<b>Protective jacket</b>	PVC Gray RAL 7032	PVC DESINA color green RAL 6018	PUR, HD22.10 S2 (VDE 0282, Part 10) DESINA color green, RAL 6018
<b>Flame retardant</b>	EN 60332-1-1 to 1-3	EN 60332-1-1 to 1-3	EN 60332-1-1 to 1-3

1) The File Number is printed on the cable jacket.

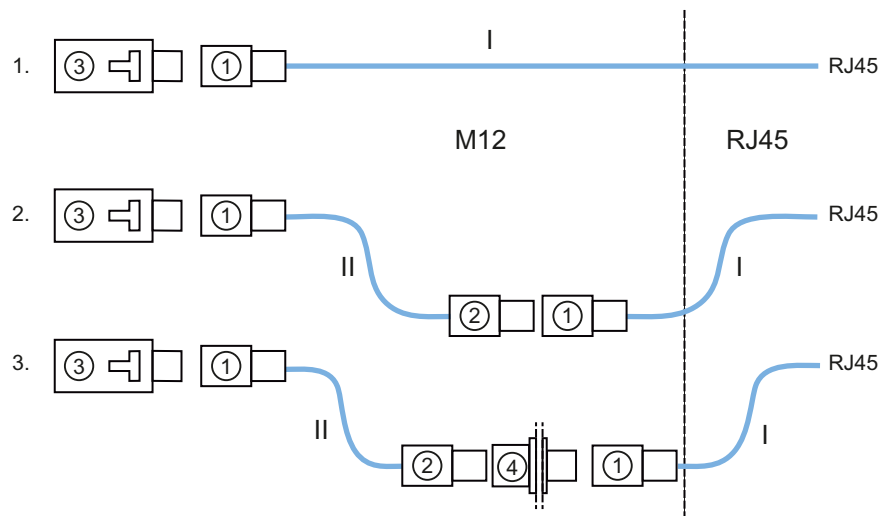
2) Characteristic curves for accelerating can be found in Catalog D31 in Chapter "MOTION-CONNECT connection system".



### 12.8.1.6 Connecting a direct measuring system

The various options of connecting a direct measuring system with DRIVE-CLiQ ASIC and M12 plug via MOTION-CONNECT cables to a DRIVE-CLiQ component are shown in the following diagram.

1. Direct connection via the basic cable
2. Basic cable and 1-2 extensions
3. Basic cable, cabinet bushing and a maximum of one extension



- ① M12 socket (IP67) connected to a MOTION-CONNECT DRIVE-CLiQ signal cable
- ② M12 plug (IP67) connected to a MOTION-CONNECT DRIVE-CLiQ signal cable
- ③ M12 plug (IP67) connected to a third-party measuring system
- ④ DRIVE-CLiQ cabinet bushing M12
- I Basic cable
- II Extension

Figure 12-16 Connecting a direct measuring system with M12 plug to a DRIVE-CLiQ component with RJ45 socket (IP20)

### 12.8.1.7 Combined use of MOTION-CONNECT 500 and MOTION-CONNECT 800PLUS

In principle, MOTION-CONNECT 500 cables and MOTION-CONNECT 800PLUS cables be used together.

Basic cables and extensions for MOTION-CONNECT cables with RJ45 plug and M12 socket can be combined without any restrictions.

For the combined use of MOTION-CONNECT cables with RJ45 connectors, the conditions below apply.

**Use of DRIVE-CLiQ couplings**

DRIVE-CLiQ couplings are used to combine MOTION-CONNECT 500 cables and MOTION-CONNECT 800PLUS cables with RJ45 plugs. The maximum permissible cable length is calculated as follows:

$$\Sigma MC500 + 4/3 * \Sigma MC800PLUS + n_c * 5 \text{ m} \leq 100 \text{ m}$$

$\Sigma MC500$ : Total length of all MC500 cable segments (fixed routing)

$\Sigma MC800PLUS$ : Total length of all MC800PLUS cable segments (tow chain)

$n_c$ : Number of DRIVE-CLiQ couplings (max. 0..3)

With this combination, DRIVE-CLiQ cables with a maximum length of over 75 m can also implemented for applications involving a tow chain.

Table 12- 14 Examples of maximum cable lengths when using a DRIVE-CLiQ coupling

$\Sigma MC500$ (fixed routing)	87 m	80 m	66 m	54 m	40 m	30 m	20 m	10 m	5 m
$\Sigma MC800PLUS$ (tow chain)	5 m	10 m	20 m	30 m	40 m	48 m	55 m	63 m	66 m
$\Sigma MC500+$ $\Sigma MC800PLUS$	92 m	90 m	86 m	84 m	80 m	78 m	75 m	73 m	71 m

**Using a DRIVE CLiQ Hub Module**

A DRIVE-CLiQ Hub Module (DMC20 or DME20) can be used to double the maximum permissible cable length for MOTION-CONNECT cables with RJ45 plugs. After the hub, the same length conditions apply as before the hub.

$$\Sigma MC500 + 4/3 * \Sigma MC800PLUS + n_c * 5 \text{ m} \leq 100 \text{ m before the hub}$$

$$\Sigma MC500 + 4/3 * \Sigma MC800PLUS + n_c * 5 \text{ m} \leq 100 \text{ m after the hub}$$

It is possible to connect two DRIVE-CLiQ Hub Modules in series (cascade connection).

## 12.8.2 Power cables for motors

### 12.8.2.1 Configuring the cable length

Where a long motor cable is required, a higher rating of Motor Module must be selected or the permissible continuous output current  $I_{\text{continuous}}$  must be reduced in relation to the rated output current  $I_{\text{rated}}$ . The configuring data for booksize format Motor Modules are given in the following table:

Table 12- 15 Permissible cable lengths for shielded motor cables

Motor Module	Length of motor cable (shielded)			
	> 50 ... 100 m	> 100 ... 150 m	> 150 ... 200 m	> 200 m
Rated output current $I_N$				
3 A/5 A	Use 9 A Motor Module	Use 9 A Motor Module	Not permissible	Not permissible
9 A	Use 18 A Motor Module	Use 18 A Motor Module	Not permissible	Not permissible
18 A	Use 30 A Motor Module or $I_{\text{max}} \leq 1.5 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.95 \times I_{\text{rated}}$	Use 30 A Motor Module	Not permissible	Not permissible
30 A	Always permitted	$I_{\text{max}} \leq 1.35 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.9 \times I_{\text{rated}}$	$I_{\text{max}} \leq 1.1 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.85 \times I_{\text{rated}}$	Not permissible
45 A/60 A	Always permitted	$I_{\text{max}} \leq 1.75 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.9 \times I_{\text{rated}}$	$I_{\text{max}} \leq 1.5 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.85 \times I_{\text{rated}}$	Not permissible
85 A/132 A	Always permitted	$I_{\text{max}} \leq 1.35 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.95 \times I_{\text{rated}}$	$I_{\text{max}} \leq 1.1 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.9 \times I_{\text{rated}}$	Not permissible
200 A	Always permitted	$I_{\text{max}} \leq 1.25 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.95 \times I_{\text{rated}}$	$I_{\text{max}} \leq 1.1 \times I_{\text{rated}}$ $I_{\text{continuous}} \leq 0.9 \times I_{\text{rated}}$	Not permissible

When using a motor holding brake, the maximum motor cable length is 100 m.

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

Motor reactors can also be used on motors operating in vector and V/f control modes to allow the use of longer motor cables.

### 12.8.2.2 Comparison of MOTION-CONNECT power cables

MOTION-CONNECT 500 power cables are mainly suitable for permanent routing. MOTION-CONNECT 800PLUS power cables fulfill all of the high mechanical requirements for use in tow chains. They are resistant to cutting oils.

Table 12- 16 Comparison of the MOTION-CONNECT 500 and MOTION-CONNECT 800PLUS power cables

Power cable	MOTION-CONNECT 500	MOTION-CONNECT 800PLUS
<b>Approvals</b>		
VDE <sup>1)</sup> cURus or UR/CSA UR-CSA File No. <sup>2)</sup> in conformance with RoHS	Yes UL758-CSA-C22.2-N.210.2-M90 Yes Yes	Yes UL758-CSA-C22.2-N.210.2-M90 Yes Yes
<b>Rated voltage <math>V_0/V</math> in accordance with EN 50395</b>		
Supply cores Signal cores	600 V / 1000 V 24 V (EN) 1000 V (UL/CSA)	600 V / 1000 V 24 V (EN) 1000 V (UL/CSA)
<b>Test voltage, rms</b>		
Supply cores Signal cores	4 kV 2 kV	4 kV 2 kV
<b>Operating temperature at the surface</b>		
Permanently installed Moveable	-20 to +80°C 0 to 60°C	-50 to +80°C -20 to +60°C
<b>Tensile load, max.</b>		
Permanently installed Moveable	50 N/mm <sup>2</sup> 20 N/mm <sup>2</sup>	50 N/mm <sup>2</sup> 20 N/mm <sup>2</sup>
<b>Smallest bending radius</b>		
Permanently installed Moveable	5 x D <sub>max</sub> approx. 18 x D <sub>max</sub>	4 x D <sub>max</sub> approx. 8 x D <sub>max</sub>
<b>Torsional stress</b>		
	30°/m absolute	30°/m absolute
<b>Bending operations</b>		
	100000	10 million
<b>Max. traversing speed</b>		
	30 m/min	Up to 300 m/min
<b>Max. acceleration</b>		
	2 m/s <sup>2</sup>	50 m/s <sup>2</sup> (3 m) <sup>3)</sup>
<b>insulation material</b>		
	CFC/silicone-free	CFC/halogen/silicone-free IEC 60754-1 / DIN VDE 0472-815
<b>Oil resistance</b>		
	EN 60811-2-1 (mineral oil only)	EN 60811-2-1
<b>Protective jacket</b>		
	PVC DESINA color, orange RAL 2003	PUR, HD22.10 S2 (VDE 0282, Part 10) DESINA color, orange, RAL 2003
<b>Flame retardant</b>		
	EN 60332-1-1 to 1-3	EN 60332-1-1 to 1-3

1) The registration number is printed on the cable jacket.

2) The File Number is printed on the cable jacket.

3) Characteristic curves for accelerating can be found in Catalog D31 or in PM21 in Chapter "MOTION-CONNECT connection system".

### 12.8.3 Current-carrying capacity and derating factors for power cables and signal cables

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

Routing types

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

Table 12- 17 Current carrying capacity according to EN 60204-1 for 40° C ambient temperature

Cross-section mm <sup>2</sup>	Current carrying capacity, effective; AC 50/60 Hz or DC For routing type		
	B1 A	B2 A	C A
<b>Signal cables</b>			
0.20	–	4.3	4.4
0.50	–	7.5	7.5
0.75	–	9	9.5
<b>Power cables</b>			
0,75	8,6	8,5	9,8
1,00	10,3	10,1	11,7
1,50	13,5	13,1	15,2
2,50	18,3	17,4	21
4	24	23	28
6	31	30	36
10	44	40	50
16	59	54	66
25	77	70	84
35	96	86	104
50	117	103	125
70	149	130	160
95	180	165	194
120	208	179	225

Table 12- 18 Current carrying capacity according to IEC 60364-5-52 for 40° C ambient temperature

Cross-section mm <sup>2</sup>	Current carrying capacity, effective; AC 50/60 Hz or DC For routing type		
	B1 A	B2 A	C A
<b>Power cables</b>			
150	–	–	344
185	–	–	392
> 185	Values must be taken from the standard		

Table 12- 19 Derating factors for deviating ambient temperatures

Ambient air temperature [° C]	Derating factor according to EN 60204-1, Table D1
30	1,15
35	1,08
40	1,00
45	0,91
50	0,82
55	0,71
60	0,58

## 12.8.4 Maximum cable lengths

The table below provides an overview of the maximum permissible cable lengths for signal and supply cables, power cables, and DC link cables.

Table 12- 20 Maximum cable lengths

Type	Maximum length [m]
24 VDC supply cables <sup>1)</sup>	10
24 V signal cables <sup>1)</sup>	30
DRIVE-CLiQ signal cables MC500 (RJ45)	100
DRIVE-CLiQ signal cables MC500 (M12)	30
DRIVE-CLiQ signal cables MC800PLUS (RJ45)	75
DRIVE-CLiQ signal cables MC800PLUS (M12)	30
DC link, including extensions	10
Total cable length for Active Line Modules 16 kW and 36 kW with Active Interface Module <sup>4)</sup>	630 (shielded) <sup>3)</sup>
Total cable length for Active Line Modules 55 kW up to 120 kW with Active Interface Module <sup>4)</sup>	1000 (shielded) <sup>3)</sup>
Total cable length for Active Line Modules with line reactor <sup>4)</sup>	350 (shielded) <sup>3)</sup>
Total cable length for Basic Line Modules <sup>4)</sup>	630 (shielded) <sup>3)</sup>
Total cable length for Smart Line Modules <sup>4)</sup>	350 (shielded) <sup>3)</sup>
Power cable between line filter and line reactor	10 (shielded/unshielded) <sup>2)</sup>
Power cable between line reactor and Line Module	10 (shielded/unshielded) <sup>2)</sup>
Power cable between motor and Motor Module up to $I_n = 9 \text{ A}$	50 (shielded) 75 (unshielded)
Power cable between motor and Motor Module $I_n = 18 \text{ A}$	70 (shielded) 100 (unshielded)
Power cable between motor and Motor Module $I_n \geq 30 \text{ A}$	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, "Overvoltage protection" under "24 VDC supply")

2) To comply with EMC limit values, shielded cables (preferably MOTION CONNECT cables) must be used.

3) Restrictions regarding the total cable length and the secondary conditions in order to comply with the corresponding radio interference suppression category are listed in Chapter 2.10 (overview in Fig. "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.

### 12.8.5 Connectable conductor cross-sections and tightening torques for motor and power cables

Table 12- 21 Connectable conductor cross-sections Part 1: Line cable / motor cable

Component	Terminal type / tightening torque	Connection cross-section [mm <sup>2</sup> ]					
		1.5	2.5	4	6	10	16
Motor Module Booksize 3 A to 30 A 2 x 3 A to 2 x 18 A	Motor connector 30 A 3+2 pole /	X	X	X	X	X	
Motor Module Booksize Compact 1.7 A - 18 A	Screw terminal 1.2 - 1.5 Nm	X	X	X	X		
Motor Module 45 A to 60 A	Threaded bolts M6 6 Nm <sup>1)</sup>				X	X	X
Motor Module 85 A	Threaded bolts M8 / 13 Nm <sup>2)</sup>						X
Smart Line Module Booksize 5 kW to 10 kW	Screw terminal 1.2 - 1.5 Nm	X	X	X	X		
Smart Line Module Booksize Compact 16 kW	Screw terminal 1.5 - 1.8 Nm				X	X	X
Active Line Module 16 kW Smart Line Module 16 kW	Screw terminal 1.5 - 1.8 Nm				X	X	
Active Line Module 36 kW Smart Line Module 36 kW	Threaded bolts M6 6 Nm <sup>1)</sup>						X
Active Interface Module 16 kW	Screw terminal 1.7 Nm				X	X	X
Active Interface Module 36 kW	Screw terminal 6 Nm						X

1) For ring cable lugs according to DIN 46234

clamping area ensured for flexible cable with end sleeve, ring cable lug M6 or M8

IP2xB according to EN 60529; Note: The restrictor collar installed as standard for the purpose of touch protection must be used or adapted as required.

2) Alternatively, two cable lugs according to DIN 46234 can be connected to each threaded bolt to facilitate the parallel connection of two cables with a maximum cross-section of 50 mm<sup>2</sup>. Both cable lugs should be mounted "back to back".



Table 12- 22 Connectable conductor cross-sections Part 2: Line cable / motor cable,

Component	Terminal type / tightening torque	Connection cross-section [mm <sup>2</sup> ]					
		25	35	50	70	95	120
Motor Module 45 A to 60 A	Threaded bolts M6 6 Nm <sup>1)</sup>	X	X	X			
Motor Module 85 A	Threaded bolts M8 13 Nm <sup>2)</sup>	X	X	X	X	X	X
Motor Module 132 A to 200 A	Threaded bolts M8 13 Nm <sup>2)</sup>	X	X	X	X	X	X
Active Line Module 36 kW Smart Line Module 36 kW	Threaded bolts M6 6 Nm	X	X	X			
Active Line Module 55 kW Smart Line Module 55 kW	Threaded bolts M8 13 Nm <sup>2)</sup>		X	X	X	X	X
Active Line Module 80 kW to 120 kW	Threaded bolts M8 13 Nm <sup>2)</sup>				X	X	X
Active Interface Module 36 kW	Screw terminal 6 Nm	X	X	X			
Active Interface Module 55 kW	Screw terminal 6 Nm		X	X			
Active Interface Module 80 kW to 120 kW	Threaded bolts M8 13 Nm <sup>2)</sup>				X	X	X

- 1) For ring cable lugs according to DIN 46234  
clamping area ensured for flexible cable with end sleeve, ring cable lug M6 or M8  
IP2xB according to EN 60529; Note: The restrictor collar installed as standard for the purpose of touch protection must be used or adapted as required.
- 2) Alternatively, two cable lugs according to DIN 46234 can be connected to each threaded bolt to facilitate the parallel connection of two cables with a maximum cross-section of 50 mm<sup>2</sup>. Both cable lugs should be mounted "back to back".

Table 12- 23 Connectable conductor cross-sections Part 3: Line cable / connection for braking resistor

Component	Terminal type / tightening torque	Connection cross-section [mm <sup>2</sup> ]					
		1,5	2,5	4	6	10	16
Basic Line Module 20 kW line cable connection	Screw terminal 1.5 - 1.7 Nm				x	x	x
Basic Line Module 20 kW Braking resistor connection	Screw terminal 0.5 - 0.6 Nm	x	x	x			
Basic Line Module 40 kW Braking resistor connection	Screw terminal 1.5 - 1.8 Nm			x	x	x	

Table 12- 24 Connectable conductor cross-sections Part 4: Line supply cable

Component	Terminal type / tightening torque	Connection cross-section [mm <sup>2</sup> ]					
		25	35	50	70	95	120
Basic Line Module 40 kW Line cable connection	Screw terminal 6 Nm	x	x	x			
Basic Line Module 100 kW Line cable connection <sup>1)</sup>	Threaded bolts M8 13 Nm				x	x	x

1) Alternatively, two cable lugs according to DIN 46234 can be connected to each threaded bolt to facilitate the parallel connection of two cables with a maximum cross-section of 50 mm<sup>2</sup>. Both cable lugs should be mounted "back to back".

**NOTICE**

**Hazard due to motor cables with too small a cross-section**

The internal overload monitoring function of Motor Module only protects the cable if it has been dimensioned in accordance with the currents of the Motor Module. If smaller cross-sections are selected, you must ensure the appropriate level of conductor protection in another way, e.g. by suitably setting the control parameters.

**Note**

**Compliance with the IP20 degree of protection for Basic Line Modules 40 kW**

The 40 kW Basic Line Module only provides the IP20 degree of protection when used with power cables with insulated end sleeves and a cross-section > 25 mm<sup>2</sup>.

**Note**

**Cross-section of the protective conductor**

The cross-section of the PE conductor must be selected according to DIN EN 60204-1, DIN EN 61800-5-1 and VDE 0100-540 (IEC 60364-5-54). Note that some components conduct an increased leakage current. The EN 61800-5-1 regulations must be taken into account.

**Note**

**Selection of the line supply conductor**

When selecting the line supply conductor, note the loop resistance so that the relevant protective components (line fuse, RCCB, etc.) function properly and that no hazardous shock currents or voltages occur in the event of a fault.

## 12.8.6 Motor connection plug

Motor Modules 3 A to 30 A are supplied without a motor connector. Prefabricated MOTION-CONNECT power cables with pre-assembled motor connectors or unassembled power cables can be used to connect motors. In this case the motor connector must be ordered separately.

The motor connector is equipped with an interlock mechanism. Mounting on the Motor Module is described in the following.

### 12.8.6.1 Mounting on the Motor Module

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.

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#### Note

With Double Motor Modules, the rear motor connection plug must be installed first and then locked.

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### Installation on Motor Modules without pre-assembled interlock bolt

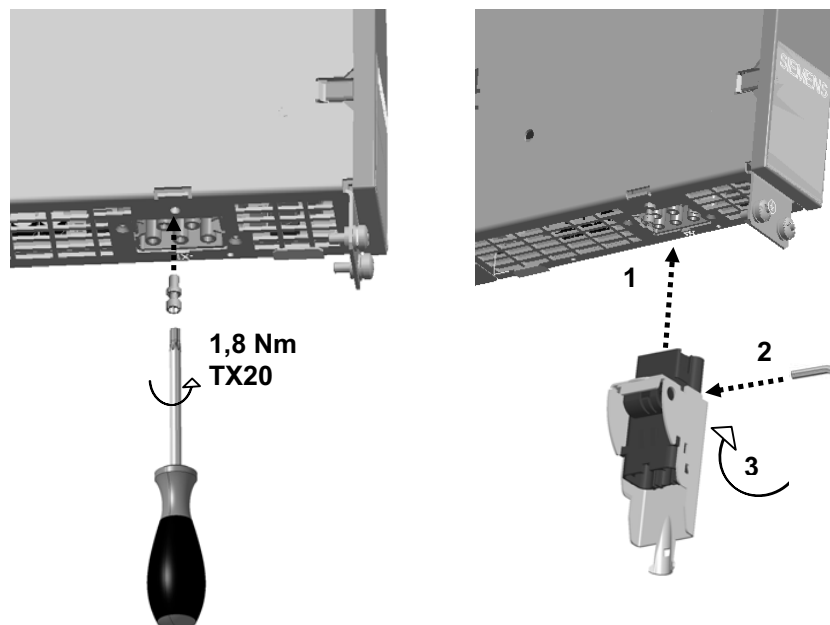


Figure 12-17 Installation example: Crimp plug

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.

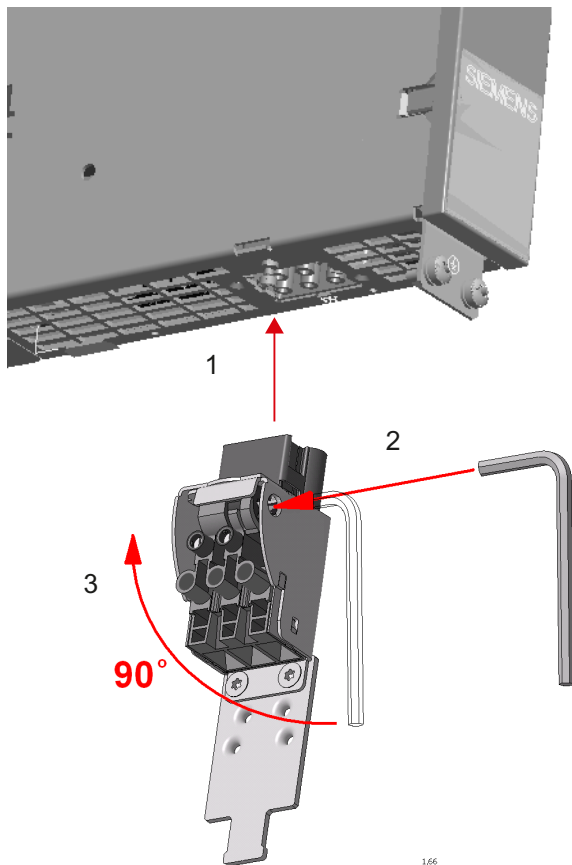


Figure 12-18 Installation example: Screw connector

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°).

### 12.8.6.2 Connecting the motor connector to self-fabricated cables

#### Preparing the power cable

Non-assembled power cables must be appropriately prepared before the motor connector is connected.

1. Cut the cable jacket to  $200 \pm 5$  mm
2. Fix the braided shield (e.g. with heat-shrink tubing)
3. Cut the single cores U, V, W and connecting cables for the motor holding brake according to the drawing shown below and remove the insulation
4. Strip the insulation from the single PE core, and crimp on a ring cable lug according to DIN 46234

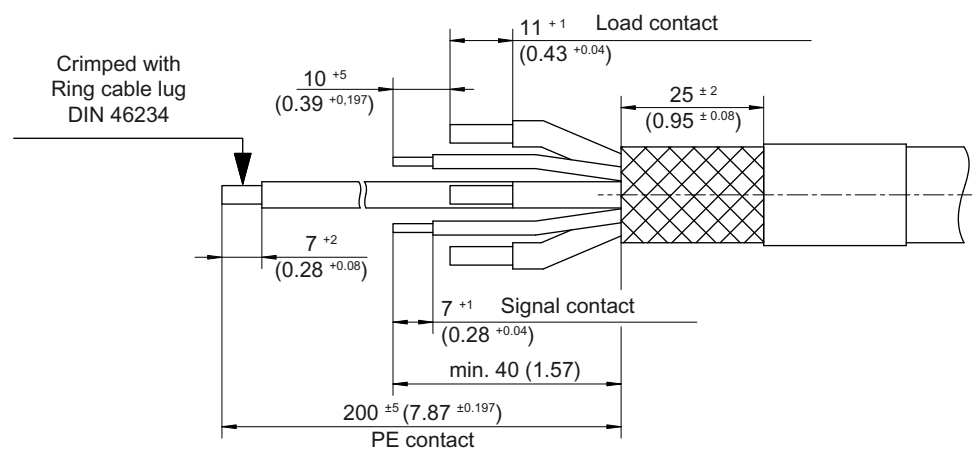
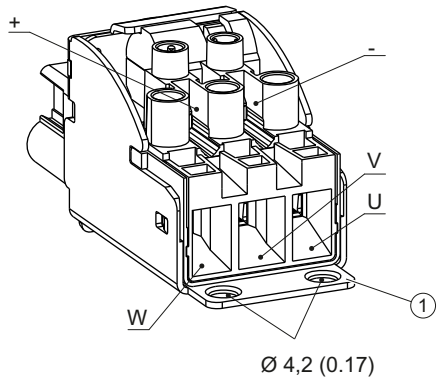


Figure 12-19 Stripped lengths for self-fabricated motor power cables, all data in mm and (inches)

### Connecting the motor connector

The connections for the single cores at the motor connector can be taken from the following diagram.

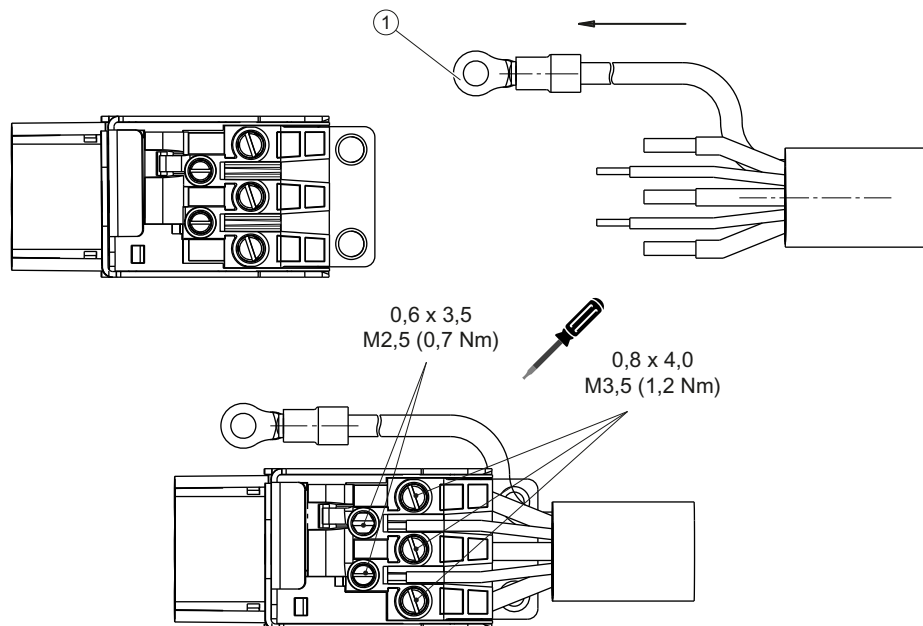


- 1 Connection for shield plate supplied with the equipment

Figure 12-20 Connections at the motor connector, screw version

The motor connector is connected as shown below.

1. Secure the individual cores U, V, W in the associated terminals of the motor connector
2. Secure the individual cores for the motor holding brake in the associated terminals of the motor connector



- 1 Ring cable lug insulated to DIN 46234

Figure 12-21 Connecting the motor connector, screw version

### 12.8.6.3 Removing the motor connector plug from prefabricated power cables

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.

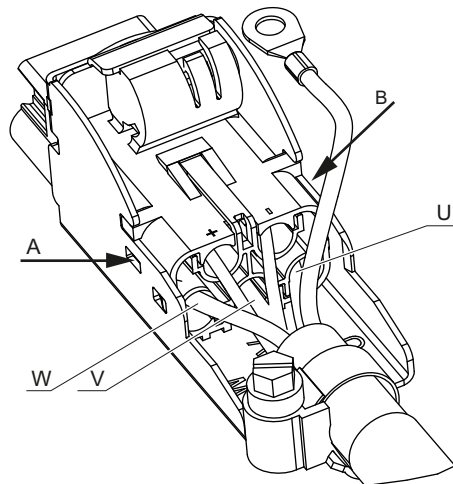


Figure 12-22 Motor connector, crimped version

#### Removing the motor connection plug

1. First loosen the clamp.
2. Simultaneously press the tabs A and B on both sides of the connector using a screwdriver.
3. Keep both tags pressed and lift the interlock mechanism e.g. using a screwdriver.
4. Remove the Insert and withdraw the motor cable out of the connector.

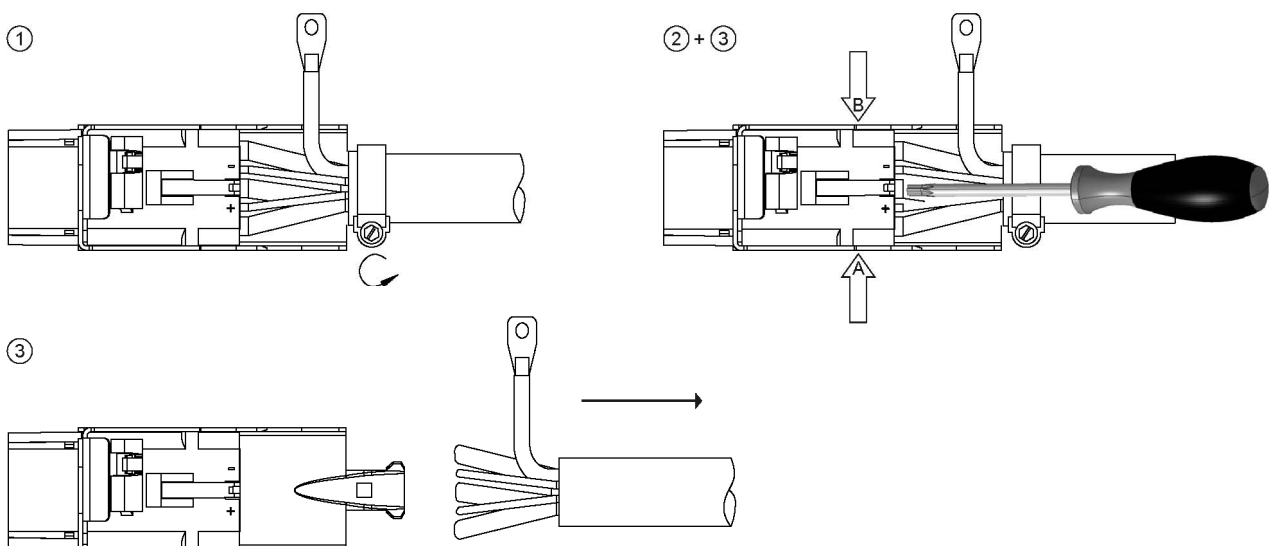


Figure 12-23 Removing the motor connector, crimped version

### 12.8.6.4 Coding

The motor connection plug is coded using coding plugs. The coding plugs are included in the scope of supply of the motor connection plug. Coding can be used to prevent motor cables being incorrectly connected, particularly in the case of Double Motor Modules.

The coding of a motor connection plug is illustrated below, using the example of a plug with screwed joint.



Motor connection plug with associated coding plugs from the accessories pack

Motor connection plug with mounted coding plugs

### 12.8.6.5 Shield connection

The following options are available for cable shield support:




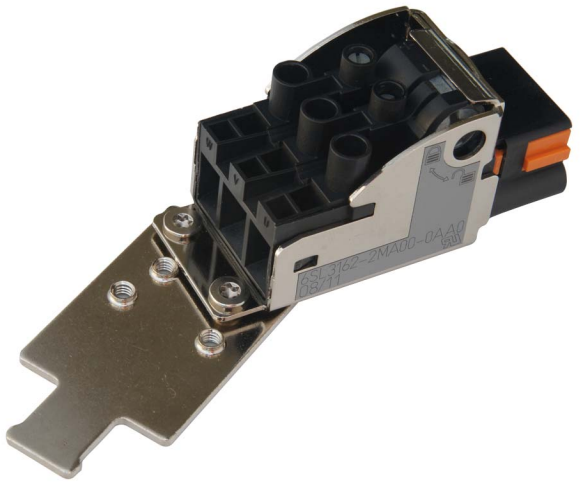
1. Shield support with shield plate supplied
2. Shield support on a toothed rail
3. Fixing your own shield support at the shield connection of the motor connection plug

#### Shield support with shield plate supplied

A shield plate is always provided with the screw version of the motor connection plug. The shield of a prefabricated motor power cable should be preferably connected at this shield plate that is provided.



Table 12- 25 Possible installations of the shield plate

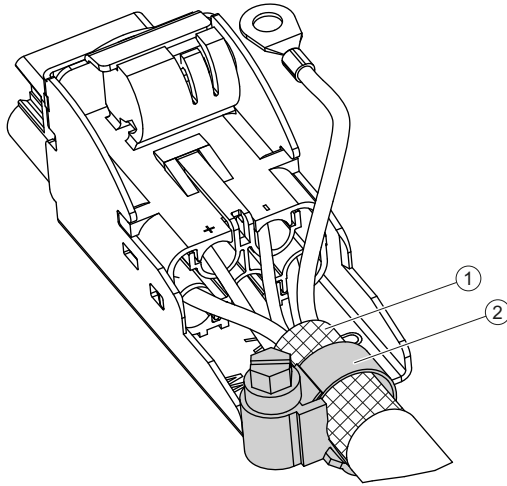
	
<p>Shield plate supplied for the motor connection plug</p>	<p>Frontal alignment of the shield plate</p>
	
<p>Lateral alignment of the shield plate</p>	<p>Lateral alignment of the shield plate</p>

The shield plate can be mounted at various angles at the motor connection plug using two screws (M4) that are provided (tightening torque 1.8 Nm).

**Note**

The motor power cable should be fixed to the shield plate using a steel clamp, in order to ensure that the cable shield is connected through the largest possible surface area.

The shield is connected as shown below



- 1 Protective braided shield
- 2 Steel clamp

Figure 12-24 Shield connection using a motor connection plug, crimped version, as example

#### Shield support on a toothed rail

The toothed rail should be mounted at a distance of  $\leq 150$  mm below the drive line-up to ensure a good contact. Wherever possible, the brake cores must be kept physically separate from U/V/W connections.

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#### 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.

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With these versions, the shield for the brake connection wires must be laid together with the cable shield.

## 12.8.7 Spring-loaded terminals

The type of spring-loaded terminal can be taken from the interface description of the particular component.

Table 12- 26 Connectable conductor cross-sections for 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 mm <sup>2</sup> to 0.5 mm <sup>2</sup> 0.14 mm <sup>2</sup> to 0.5 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 0.5 mm <sup>2</sup> 26 to 20
	Stripping length	8 mm	
2	Connectable conductor cross-sections	Flexible	0.08 mm <sup>2</sup> to 2.5 mm <sup>2</sup>
	Stripping length	8 to 9 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 mm <sup>2</sup> to 1 mm <sup>2</sup> 0.2 mm <sup>2</sup> to 1.5 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 1.5 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 0.75 mm <sup>2</sup> 24 to 16
	Stripping length	8 mm	
3_1	Connectable conductor cross-sections	Rigid Flexible Flexible with end sleeve without plastic sleeve Flexible with end sleeve with plastic sleeve AWG/kcmil	0.2 mm <sup>2</sup> to 1.5 mm <sup>2</sup> 0.2 mm <sup>2</sup> to 1.5 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 1.5 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 0.75 mm <sup>2</sup> 24 to 16
	Stripping length	10 mm	
4	Connectable conductor cross-sections	25 mm <sup>2</sup> to 95 mm <sup>2</sup> AWG 4 to 4/0	
	Stripping 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 mm <sup>2</sup> to 10 mm <sup>2</sup> 0.2 mm <sup>2</sup> to 6 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 6 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 4 mm <sup>2</sup> 24 to 8
	Stripping length	15 mm	

### 12.8.8 Screw terminals

The type of screw terminal can be taken from the interface description of the particular component.

Table 12- 27 Connectable conductor cross-sections and tightening torques for 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 mm <sup>2</sup> to 1.5 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 1.5 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 0.5 mm <sup>2</sup>
	Stripping length	7 mm	
	Tool	Screwdriver 0.4 x 2.0 mm	
	Tightening torque	0.22 to 0.25 Nm	
1_1	Connectable conductor cross-sections	Rigid, flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.14 mm <sup>2</sup> to 1.5 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 1.5 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 0.5 mm <sup>2</sup>
	Stripping length	7 mm	
	Tool	Screwdriver 0.4 x 2.5 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 mm <sup>2</sup> to 2.5 mm <sup>2</sup> 0.5 mm <sup>2</sup> to 2.5 mm <sup>2</sup> 0.5 mm <sup>2</sup> to 1.5 mm <sup>2</sup>
	Stripping 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 mm <sup>2</sup> to 2.5 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 1 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 1 mm <sup>2</sup>
	Stripping 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 mm <sup>2</sup> to 4 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 4 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 4 mm <sup>2</sup>
	Stripping 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 mm <sup>2</sup> to 6 mm <sup>2</sup> 0.5 mm <sup>2</sup> to 6 mm <sup>2</sup> 0.5 mm <sup>2</sup> to 6 mm <sup>2</sup>
	Stripping length	12 mm	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.2 to 1.5 Nm	

Screw terminal type			
6	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.5 mm <sup>2</sup> to 10 mm <sup>2</sup> 0.5 mm <sup>2</sup> to 10 mm <sup>2</sup> 0.5 mm <sup>2</sup> to 10 mm <sup>2</sup>
	Stripping 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 mm <sup>2</sup> to 16 mm <sup>2</sup>	
	Stripping length	14 mm	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.5 to 1.7 Nm	

### 12.8.9 Handling restrictor collars for touch protection

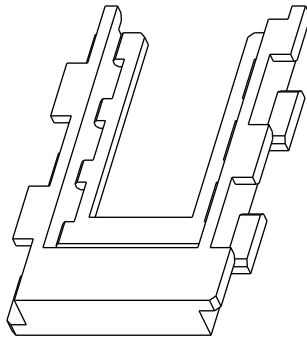
#### Handling restrictor collars for touch protection and when connecting cables

Restrictor collars are used to provide touch protection in accordance with EN 60529. They must be removed and adapted if necessary before the line supply conductor and/or motor cable is connected, after which they must be reattached. For information on adapting touch protection, refer also to "Electrical connection" in the chapter titled "Shield connecting plates".

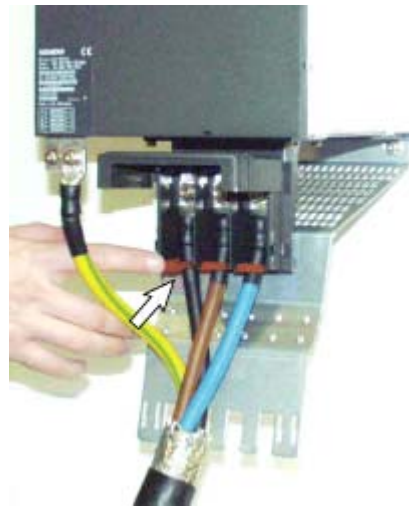
**Exception:** The cross-section of the connected cables is large enough to ensure that the threaded bolts and the ends of the cables cannot be touched when the cover is closed.

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

## 12.9 Cable shielding and routing

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

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

Alternative measures (e.g. routing behind mounting plates, suitable clearances) can also be used provided they have similar results. This excludes measures that relate to the design, installation, and routing of motor power cables and signal cables.

If unshielded cables are used between the line supply connection point and line filter, make sure that no interfering cables are routed in parallel.

Power and signal cables must always be routed separately. For this purpose, it is practical to arrange the various cables according to cable groups. Cables belonging to a group can be combined in a bundle. The various cable groups must be routed with the necessary clearance between them. A minimum clearance of 20 cm has proven itself in practice. As an alternative, shielding plates with the appropriate contacts at several locations can be used between the cable bundles.

All cables inside the cabinet must be routed as closely as possible to parts connected with cabinet ground, such as a mounting plate or cabinet wall. Ducts made of sheet steel or cables routed between steel sheets (e.g. between the mounting plate and back wall) should provide adequate shielding.


All cables must be kept as short as possible, to minimize the antenna effect.

Signal and power cables may cross each other (if absolutely necessary), but must never be routed closely to one and other in parallel over longer distances.

Signal cables must be routed with a minimum clearance of 20 cm from strong magnetic fields (motors, transformers). Alternatively, shield plates with the appropriate contacts at several locations along their length can be used to provide the appropriate clearance.

**Note:** Cables for the 24 V supply should be treated just like signal cables.

Avoid, where possible, routing unshielded cables, connected to the drive line-up, in the immediate vicinity of noise sources, e.g. transformers. Signal cables (shielded and unshielded) connected to the drive line-up must be laid at a great distance from strong external magnetic sources (e.g. transformers, line reactors). In both cases, a distance of  $\geq 300$  mm is usually sufficient.

 <b>WARNING</b>
<b>Danger to life due to high leakage currents</b>
Always connect an appropriate protective conductor to the protective conductor connection of all devices of protection class I. The protective conductor connection of the individual components must have at least 4 mm <sup>2</sup> .

### Shield connection

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

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

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

### **Routing 24 V cables**

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

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

#### **Conditions of use for 24 V cables**

- Ambient temperature 55° C
- Conductor temperature limit  $\leq 70^{\circ}$  C for operation with the rated load current
- Cable length max.:
  - 10 m for the 24 V supply cables
  - 30 m for signal lines without additional connections



## 12.10 Protective connection and equipotential bonding

### Protective connections

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

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

Table 12- 28 Conductor cross-section for copper protective connections

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

For materials other than copper, the cross-section should be increased so that as a minimum, the same conductivity is attained.

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


The protective connection (PE connection) for the motors used must be established through the motor cable. For EMC reasons, the shield of the motor cable should be connected through a large surface area both at the Motor Module as well as at the motor.


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

Copper cables with appropriate cross-sections (>2.5 mm<sup>2</sup>) must be used for the ground connection of PROFIBUS nodes.

For more information about grounding PROFIBUS, see:

[http://www.profibus.com/fileadmin/media/wbt/WBT\\_Assembly\\_V10\\_Dec06/index.html](http://www.profibus.com/fileadmin/media/wbt/WBT_Assembly_V10_Dec06/index.html)

 <b>DANGER</b>
<b>Danger to life as a result of electric shock and fire</b>
To protect against electric shock and to avoid any fire spreading, the components should only be operated in closed electrical operating areas or in cabinets.

 <b>DANGER</b>
<b>Danger to life due to high leakage currents</b> The drive 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: <ul style="list-style-type: none"><li>• Fixed connection and protective conductor connection using <math>\geq 10 \text{ mm}^2</math> Cu or <math>\geq 16 \text{ mm}^2</math> Al</li><li>• Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted</li></ul>

### Functional equipotential bonding

A mounting plate, which is connected with the protective conductor connection of the control cabinet through a low impedance connection, simultaneously serves as the functional equipotential bonding surface. This means that no additional functional equipotential bonding is required within the drive line-up.

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

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

<b>NOTICE</b>
<b>Avoiding leakage currents</b> A functional equipotential bonding conductor with a cross-section of at least $25 \text{ mm}^2$ 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, high leakage currents that could destroy the Control Unit or other PROFIBUS nodes can be conducted via the PROFIBUS cable.

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

- Copper  $6 \text{ mm}^2$
- Aluminium  $16 \text{ mm}^2$
- Steel  $50 \text{ mm}^2$

Additional information about equipotential bonding for PROFIBUS can be found at:  
[http://www.profibus.com/fileadmin/media/wbt/WBT\\_Assembly\\_V10\\_Dec06/index.html](http://www.profibus.com/fileadmin/media/wbt/WBT_Assembly_V10_Dec06/index.html)

<b>NOTICE</b>
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<b>Complying with requirements for functional equipotential bonding</b>
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The functional equipotential bonding directives mentioned above must be carefully observed. Failure to observe these directives can cause the fieldbus interfaces to malfunction or devices to malfunction.
---

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**Note**

**PROFINET**

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

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## 12.11 Information on cold plate cooling

### 12.11.1 General information

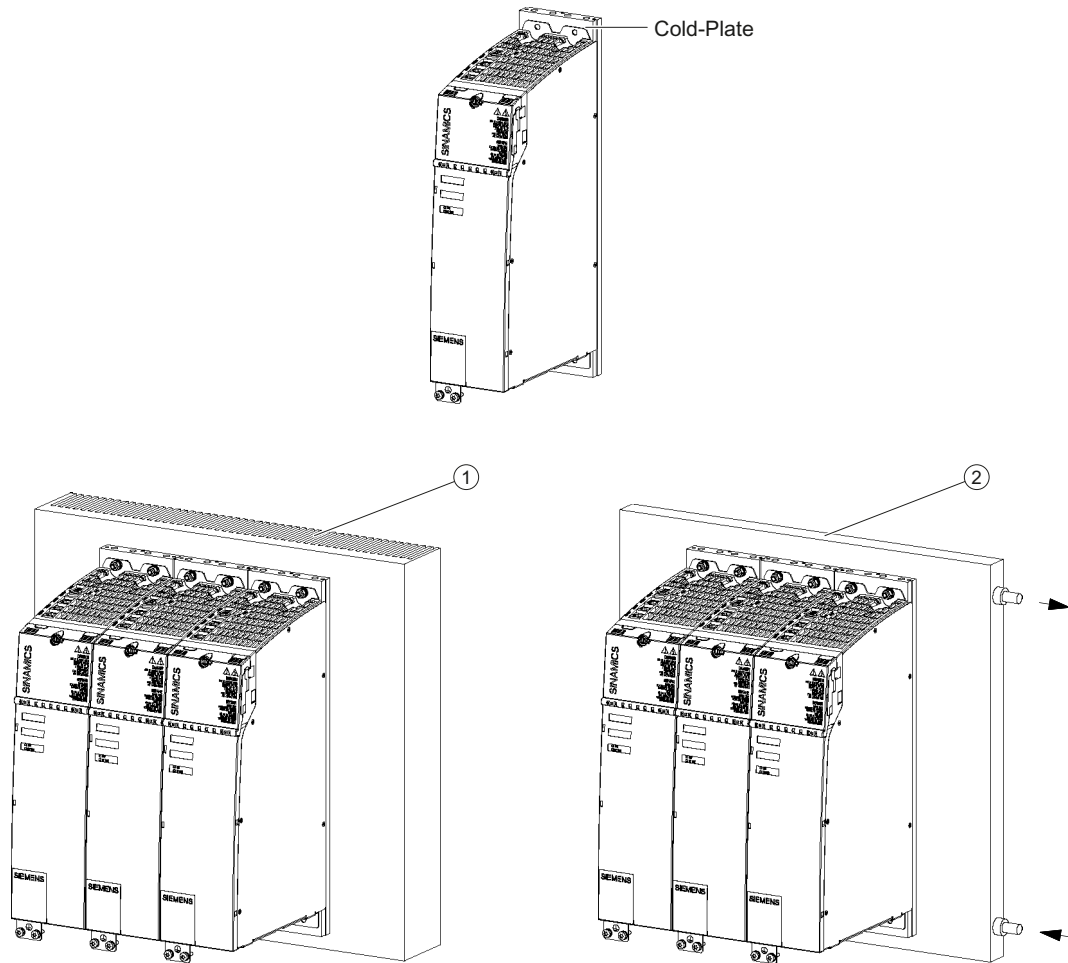
Cold plate cooling is a cooling method that can be used for SINAMICS S120 power units in booksize format. The flat aluminum cold plate (cold plate), which is located on the rear of the device, acts as a thermal interface in cold plate cooling.

The cold plate cooling is especially suitable for the following machine concepts:

- Plants and systems with high degree of pollution in the vicinity of the machine (e.g. in the textiles or timber industry).
  - Reducing cabinet-internal thermal losses facilitates cooling within a sealed cabinet (IP54).
- Plants and systems where liquid cooling is already being used in the process.
  - The existing cooling circuit can be used to externally cool the power components with cold plate.

There are two ways of configuring this type of cooling:

1. Cold plate cooling with an external air heat sink  
The components of the drive line-up are typically all screwed on to the cooling fins of an air heat sink located outside the control cabinet.
2. Cold plate cooling with an external liquid heat sink  
The components of the drive line-up are typically all screwed on to a liquid heat sink located outside the control cabinet.



- 1 Cold plate components on an external air heat sink
- 2 Cold plate components on an external liquid heat sink

Figure 12-25 Overview of cooling types for drive line-ups with cold plate

## 12.11.2 Cold plate with external air heat sink

### 12.11.2.1 Configuration and conditions

The conditions described below must be taken into account when cooling a cold-plate drive line-up by means of an external air heat sink.

**General conditions to be observed:**

1. The maximum temperature within the cabinet is 40°C (inlet air temperature of the power sections). The maximum temperature inside the cabinet for derating is 55 °C. For the relevant specifications, refer to the "Technical data".
2. The maximum permissible heat-sink temperature is module-dependent. Refer to the "Technical data" for more information. A temperature sensor in the power unit measures the temperature and can be read via parameter 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").

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**Note**

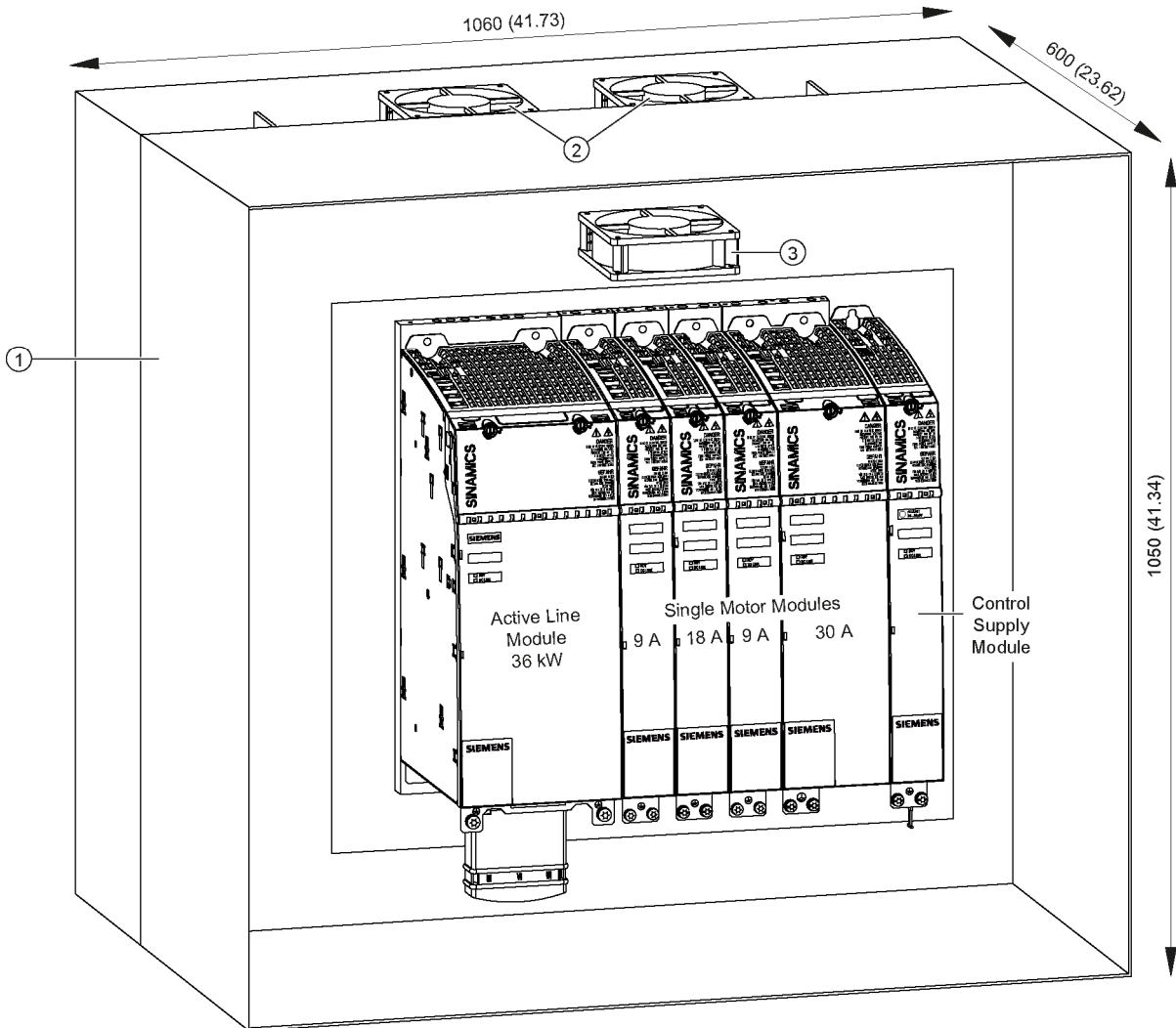
If the components are installed in a sealed cabinet, an internal fan must be installed to prevent hot spots. It is best to install the fan above the modules to optimize the air flow (suction).

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).

12.11.2.2 Setup example, drive line-up, cold plate with external air heat sink



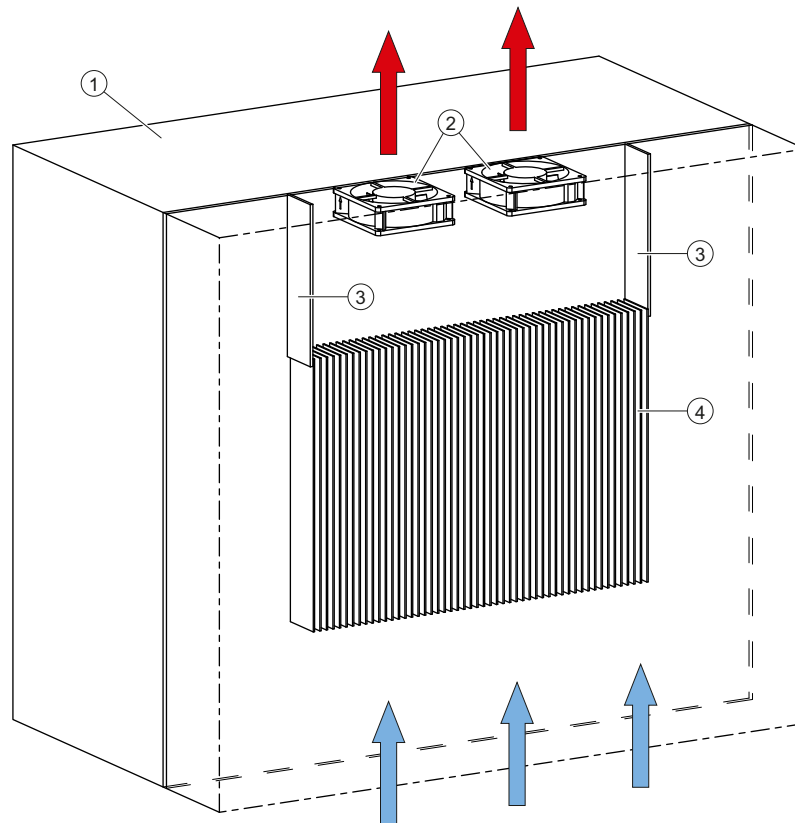
- ① Control cabinet
- ② External fan
- ③ Internal fan

Figure 12-26 Front view of a control cabinet with drive line-up, cold plate and external air heat sink

Setup:

- Infeed: Active Line Module 36 kW
- 4 Single Motor Modules
- Control Supply Module for 24 V supply
- Internal fan at the top of the control cabinet
- One shared external air heat sink

To optimize usage of the external air heat sink, it is best to arrange the components in such a way that the heat is dissipated equally over the surface of the external heat sink. This means that, if possible, a large power section should be situated next to a smaller one. The current carrying capacity of the DC-link busbars must be taken into account here.



- ① Control cabinet
- ② External fan
- ③ Air baffle plates
- ④ External air heat sink

Figure 12-27 Rear view of a control cabinet with drive line-up, cold plate and external air heat sink

In this example, two axial fans with a diameter of 150 mm ensure forced convection. The ribbed heat sink, which is attached to the rear, is located in an air duct (approx. 150 mm deep). Additional air guides at the sides improve air guidance and significantly optimize the power unit cooling.

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**Note**

The external heat sink must be sealed with respect to the control cabinet in accordance with IP65.

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**Example: external air heat sink**

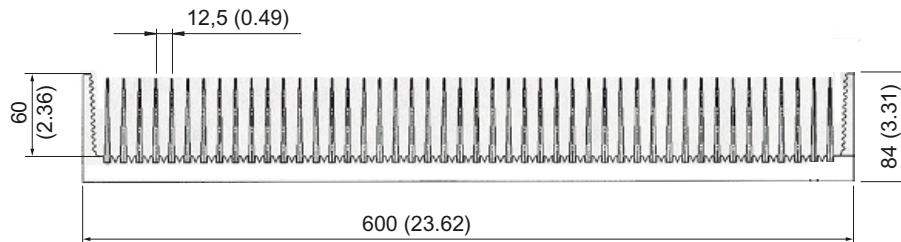


Figure 12-28 External air heat sink, all data in mm and (inches); height: 500 mm (19.69 inch)

Aluminum air heat sinks are recommended.

The heat sinks and fans must be dimensioned for the power loss to be dissipated. For the component-specific power loss in rated operation, refer to "Technical data". (Mean power loss in periodic duty is lower.)

The heat sinks and fans are not part of the scope of supply.

Recommended suppliers for heat sinks include:

Alcan company, Singen:

Sykatec company, Erlangen:

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**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".

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### 12.11.3 Cold plate with an external liquid heat sink

#### 12.11.3.1 Configuration and conditions

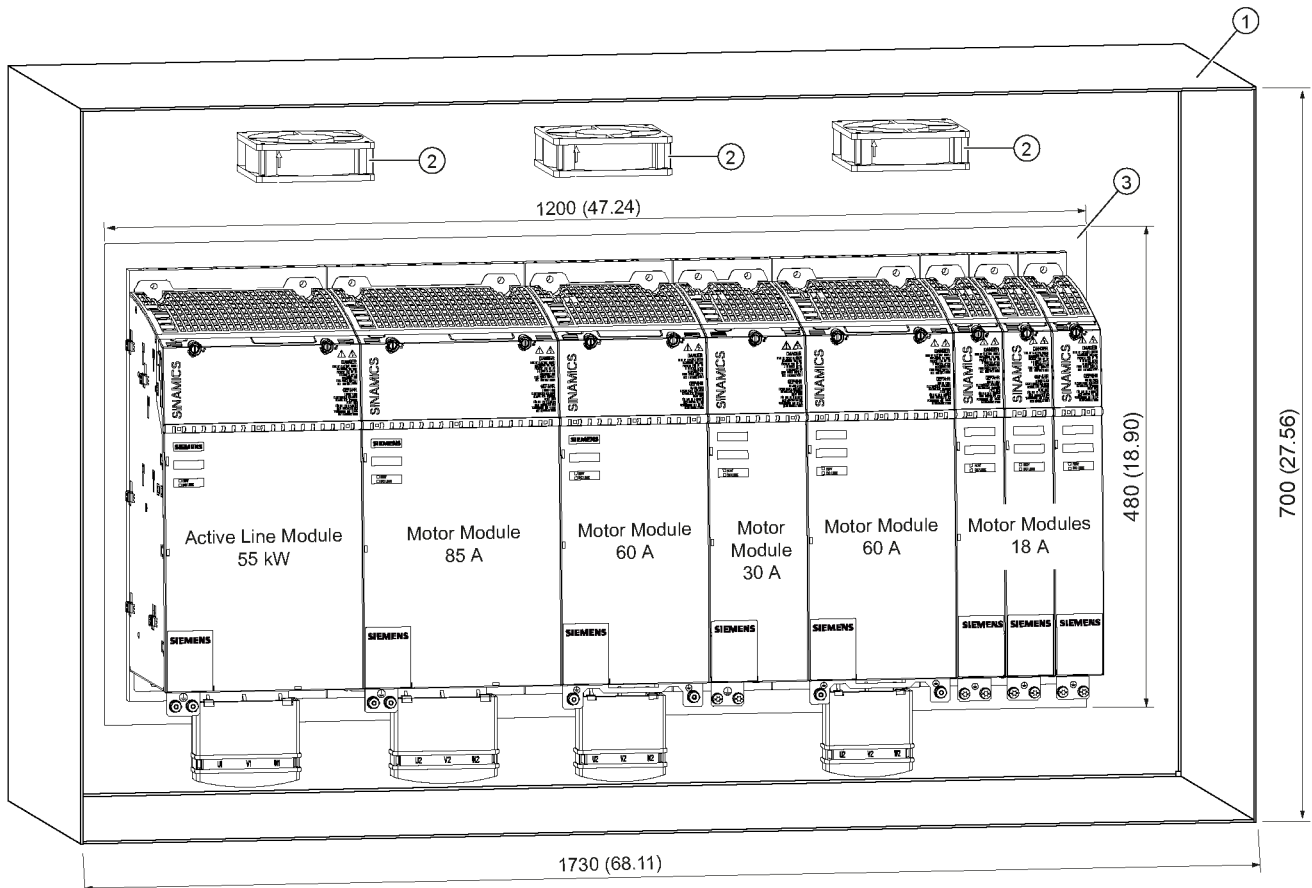
When an external liquid heat sink is used, the power sections are all installed on a plate through which cooling water flows to cool the power units. The size of the liquid heat sink can be adjusted in line with the size of the drive line-up.

**General conditions to be observed**

1. The maximum temperature within the cabinet is 40°C (inlet air temperature of the power sections). The maximum temperature inside the cabinet for derating is 55 °C. For the relevant specifications, refer to the "Technical data".
2. The maximum permissible heat-sink temperature is module-dependent. Refer to the "Technical data" for more information. A temperature sensor in the power unit measures the temperature and can be read via parameter 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").



### 12.11.3.2 Setup example, drive-line-up, cold plate with external liquid heat sink



- ① Control cabinet
- ② Fan inside the control cabinet
- ③ External liquid heat sink

Figure 12-29 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 included in the scope of delivery.

Recommended supplier for the liquid heat sink:

DAU Ges.m.b.H & CO.KG., Ligest (Austria)

Rittal GmbH & Co. KG, Herborn

## 12.12 Notes on electrical cabinet cooling

### 12.12.1 Control cabinet cooling options

The following options are available for cooling the control cabinet:

- Filter fans
- Heat exchangers
- Cooling units
- Liquid cooling
- External air cooling
- External liquid cooling

The device to be used depends on the associated environmental conditions and the required cooling capacity.

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

#### NOTICE

##### **Reduction of the component service lives through incorrect mounting**

If you do not observe the guidelines for mounting SINAMICS components in the cabinet, this can reduce the service life of the equipment and result in premature component failure.

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

- Ventilation clearance
- Wiring and cabling
- Air guidance, air-conditioner

### 12.12.2 General information on ventilation

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

#### **Fan operation up to firmware version 2.5**

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

The fans start at the heat sink temperature specified in the power stack data (normally 56° C) and are switched off – with a slight hysteresis – as soon as the heat sink temperature decreases again. The run-on time of the fan depends on various factors such as ambient temperature, output current, duty cycle and, therefore, cannot be determined directly.

### **Fan operation as of firmware version 2.6**

The fans start when the pulse enable is set, and switch off with a small hysteresis as soon as the heat sink temperature, saved in the power stack data (typically 56° C), is fallen below. The run-on time of the fan depends on various factors such as ambient temperature, output current, duty cycle and, therefore, cannot be determined directly.

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#### **Note**

For the 5 kW and 10 kW Smart Line Modules, the fan runs permanently.

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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.

<b>NOTICE</b>
<b>Overheating due to covered ventilation slots</b>
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.

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#### **Note**

The distance between the blow-out aperture of the air conditioner and the electronic equipment must be at least 200 mm.

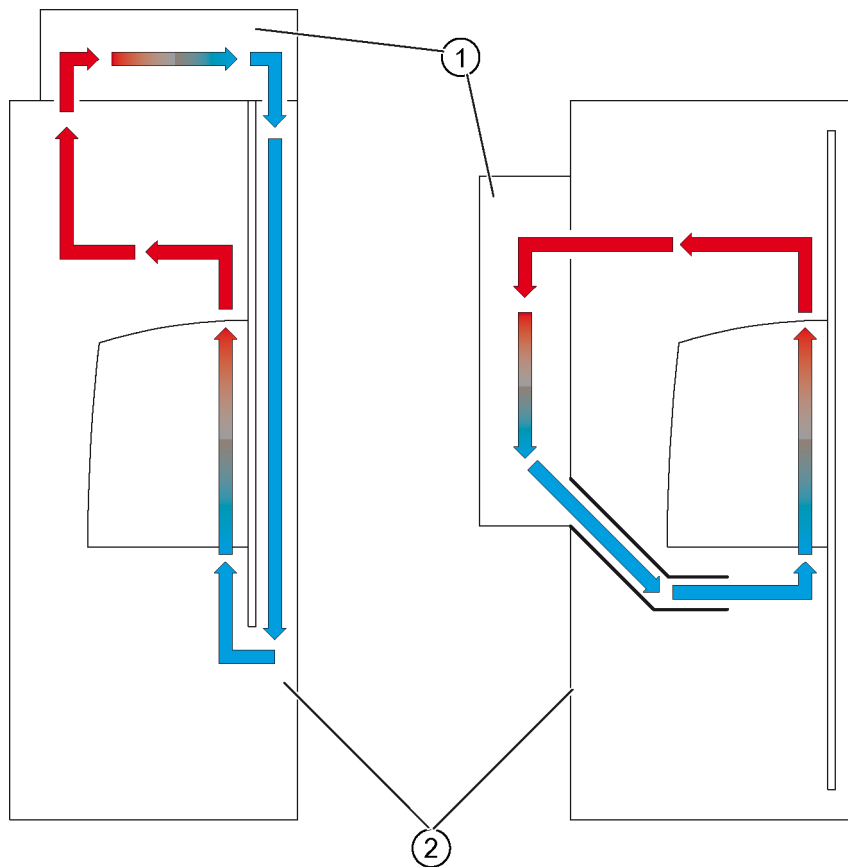
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#### **Note**

If the components are mounted in a sealed cabinet, an internal air cooling system must be installed to circulate the air and prevent hot spots. It is best to mount the fan above the components to optimize the air flow (suction).

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- ① Cooling unit
- ② Control cabinet

Figure 12-30 Examples of cabinet ventilation

**NOTICE**

**Damage to the component through condensation**

Condensation on the components can result in their failure.

- Select the air circuit and arrangement of the cooling equipment in such a way that no condensation can form on the components.
- If required, an anti-condensation heater must be installed in the cabinet.

If air conditioners are used, the relative air humidity of the expelled air increases as the air in the air conditioner cools and may exceed the dew point. If the relative humidity of the air entering the SINAMICS components is over 80% for an extended period of time, it can be assumed that the insulation of the components will fail as a result of electrochemical reactions (see Section: 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 components. This reduces the relative air humidity to uncritical values.

### 12.12.3 Cooling clearances

Table 12- 29 Cooling clearances required above and below SINAMICS components

<b>Component</b>	<b>Clearance [mm]</b>
CU320-2	80
Sensor Modules Cabinet-Mounted SMCxx	50
Terminal Modules TMx	50
Line filter for Line Modules	100
Active Interface Modules	80
Line reactors for Line Modules	100
Active Line Modules 16 kW – 55 kW 80 kW – 120 kW	80 80 (additional 50 in front of fan)
Smart Line Modules Booksize	80
Smart Line Modules Booksize Compact	80
Basic Line Modules	80
Motor Modules Booksize < 132 A 132 A and 200 A	80 80 (additional 50 in front of fan)
Motor Modules Booksize Compact	80
Braking Module Booksize	80
Braking Module Booksize Compact	80
Control Supply Module	80
Capacitor Module	80

Drive line-up with internal air cooling

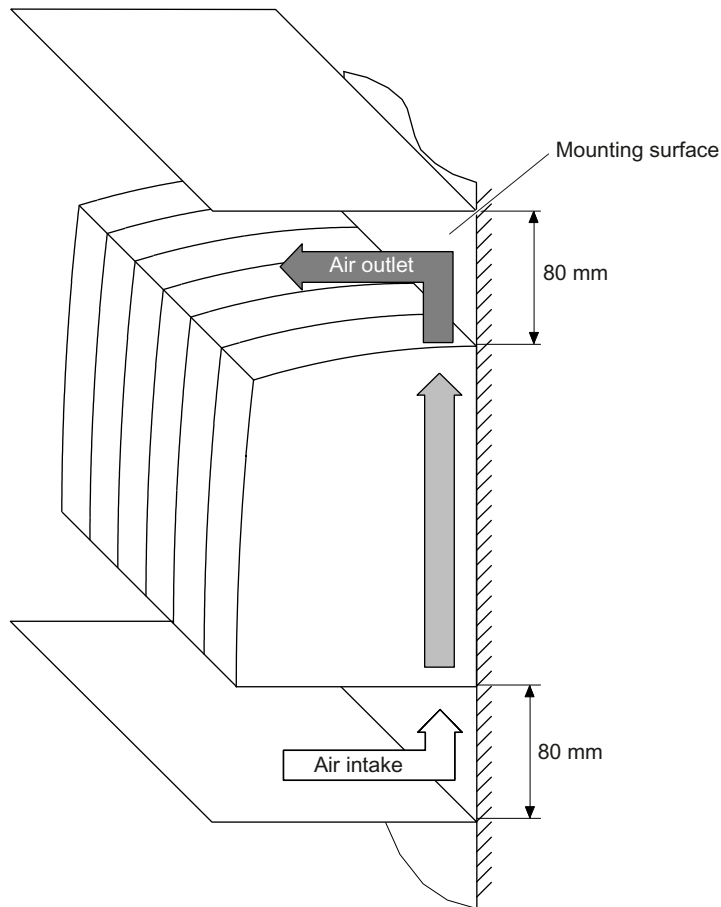


Figure 12-31 Cooling clearances for a drive line-up with internal air cooling (components up to 200 mm width)

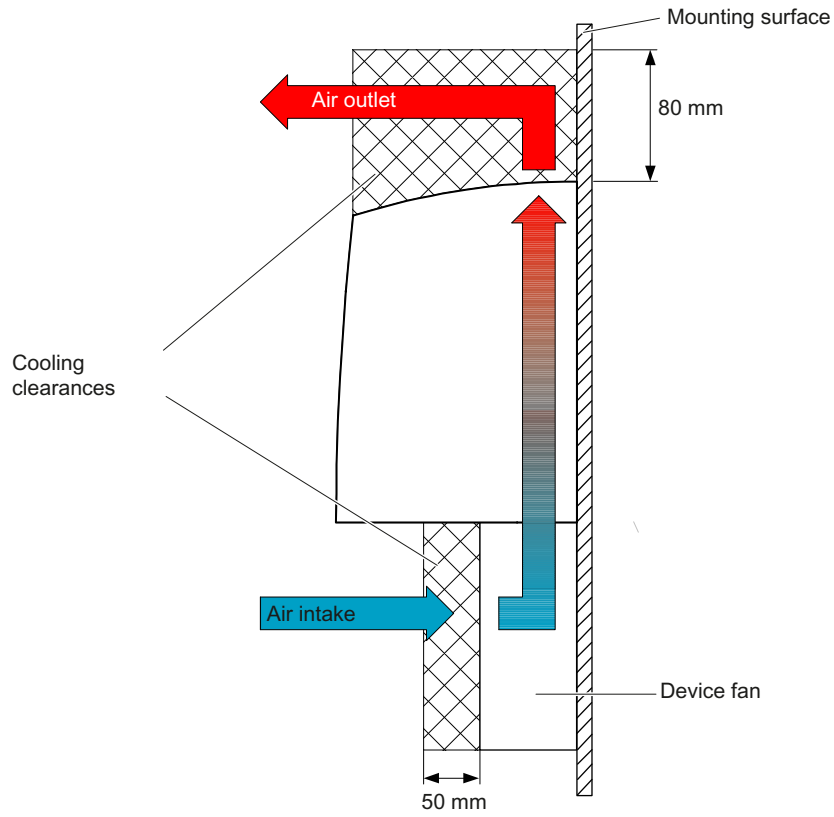


Figure 12-32 Cooling clearances for 300 mm wide components with internal air cooling with mounted unit fan

Drive line-up with external air cooling

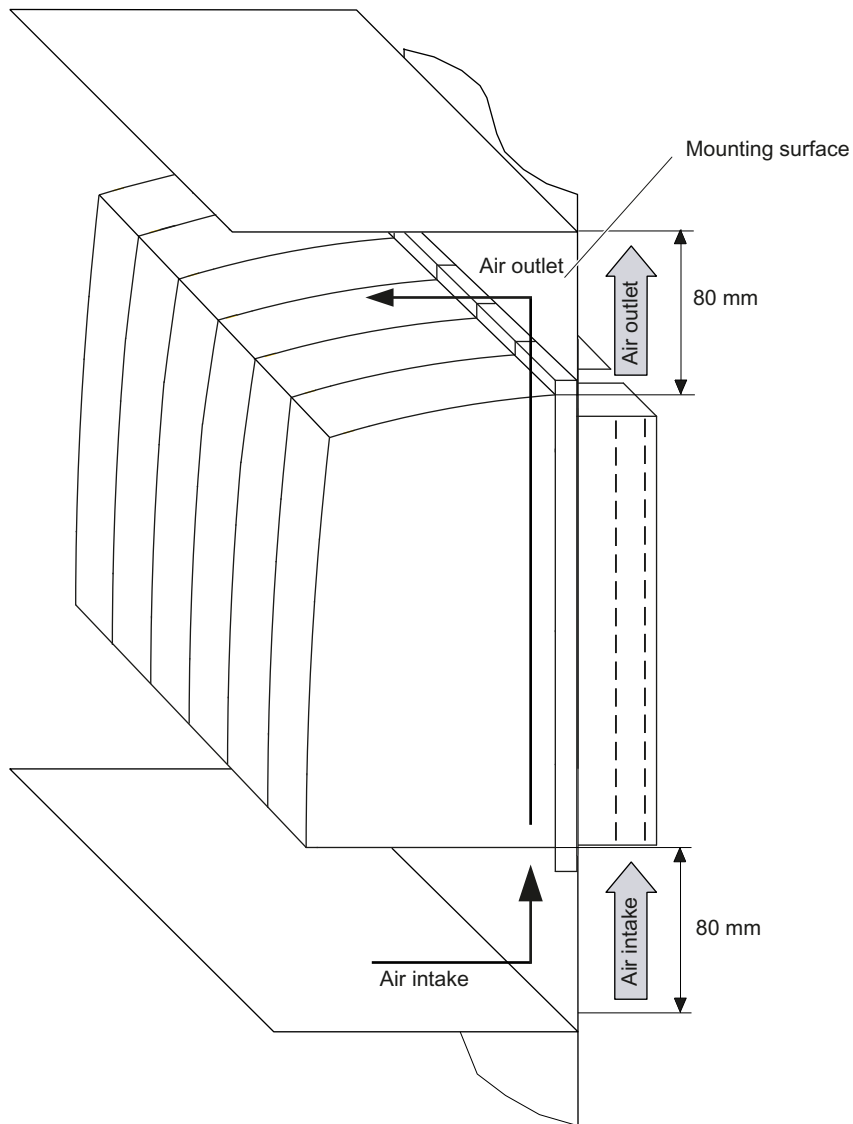


Figure 12-33 Cooling clearances for a drive line-up with external air cooling (components up to 200 mm width)



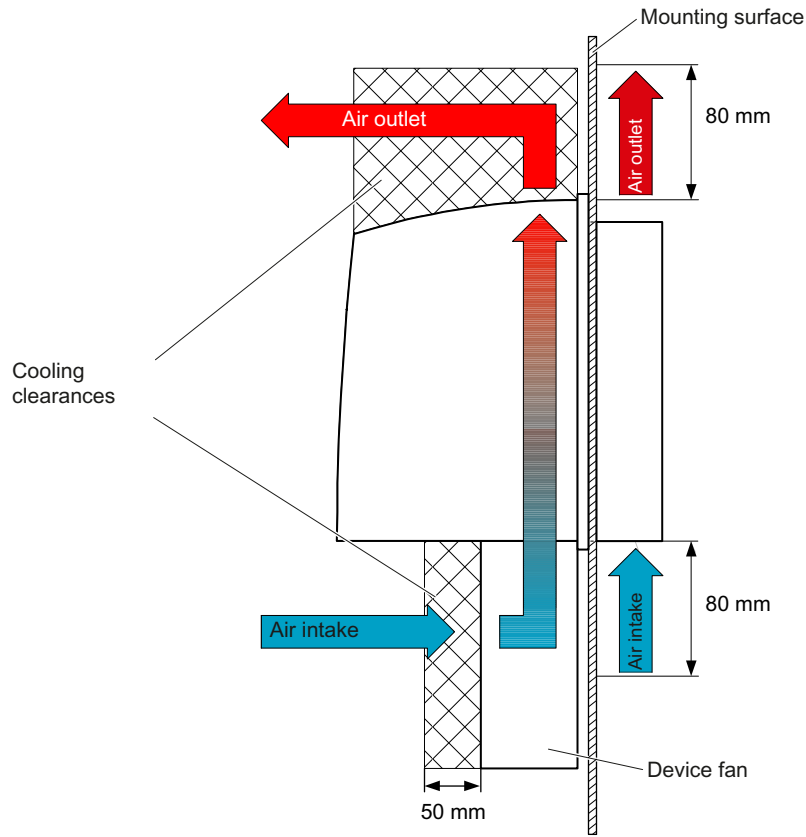


Figure 12-34 Cooling clearances for 300 mm wide components with external air cooling with mounted unit fan

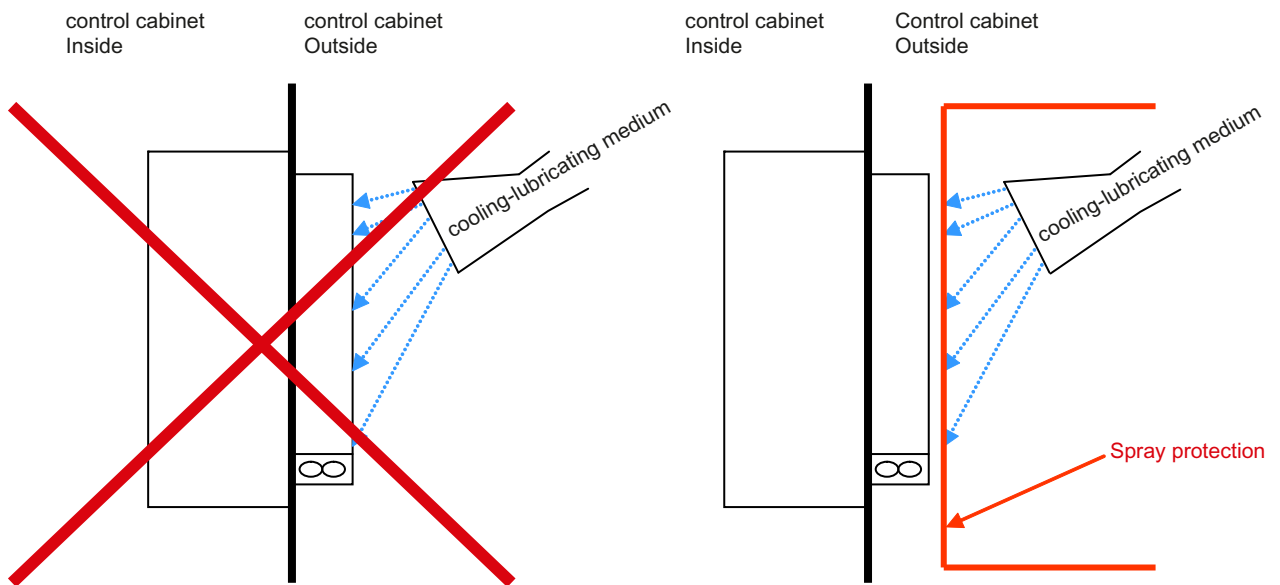


Figure 12-35 Spray protection for a drive line-up with external air cooling

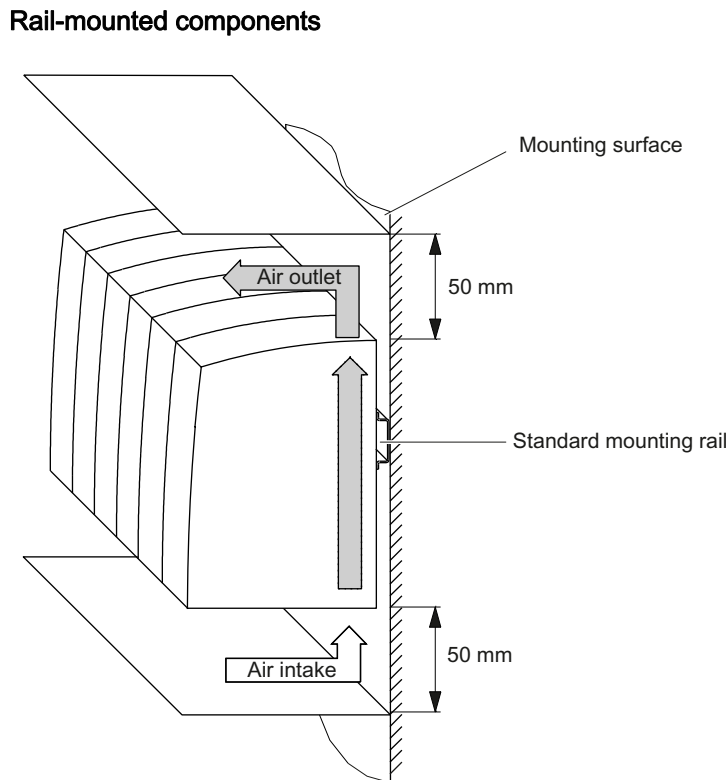


Figure 12-36 Cooling clearances for rail-mounted components (e.g. VSM, SMC, TM, DMC)

## 12.12.4 Notes on ventilation with cold plate

### Notes on ventilation with cold plate

With cold-plate cooling, the SINAMICS devices must always be ventilated separately by means of a fan in the cabinet 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 temperature inside the control cabinet, see the "Technical data" for the power units.

**Measures for remaining within temperature limits**

1. One or more fans should be installed.
2. If necessary, the drive line-up can be operated with derating.

**12.12.5 Dimensioning Climate Control Equipment**

Cabinet manufacturers provide calculation programs for selecting climate control equipment. It is always necessary to know the power loss of the components and equipment installed in the cabinet.

The physical relationship is shown in the following example.

$$q = Q - k \times A \times \Delta T$$

Formula to calculate the power loss

q = thermal power that has to be dissipated through a cooling unit [W]

Q = power loss [W]

$\Delta T$  = temperature difference between the room and cabinet interior [K]

k = thermal resistance value, e.g. sheet-steel, painted 5.5 [W / (m<sup>2</sup> \* K)]

A = free-standing cabinet surface area [m<sup>2</sup>]

Table 12- 30 Example, calculating the power loss of a drive configuration

Component	Quantity	Total power loss [W] (including electronic losses)	Total power loss [W]
CU320-2	1	24	24
Basic Line Filter for AIM / ALM 36 kW	1	26	26
Active Interface Module	1	340	340
Active Line Module 36 kW	1	666	666
Motor Module 18 A	2	185.4	370.8
Motor Module 30 A	3	309,2	927,6
SMC	5	10	50
SITOP 20	1	53	53
Line contactor	1	12	12
<b>Total:</b>			<b>2469,4</b>

Assumption:

Free-standing cabinet surface area A = 5 m<sup>2</sup>

Temperature difference between the room and cabinet interior  $\Delta T$  = 10 K

$$q = 2469.4 \text{ W} - 5.5 \text{ W} / (\text{m}^2 \text{ K}) * 5 \text{ m}^2 * 10 \text{ K} = 2194.4 \text{ W}$$

## 12.13 Power losses of the components

### 12.13.1 General information

The tables below provide an overview of the power loss of all components during rated operation. The characteristic values apply for the following conditions:

- Line voltage for Line Modules 400 V
- Pulse frequency of the Motor Modules 4 kHz
- Rated pulse frequency of the Active Line Modules 8 kHz
- Operating components at their rated power

The total losses of the relevant power unit (Line Module, Motor Module) are calculated from the power loss and the corresponding electronics loss of the power unit.

### 12.13.2 Power loss for Control Units, Sensor Modules, and other system components

Table 12- 31 Overview of power loss during rated operation for Control Units, Sensor Modules, and other system components

	Unit	Power loss
Control Units and Option Boards		
CU320-2	W	24
TB30	W	< 3
CBC10	W	< 3
CBE20	W	2.8
Sensor Modules		
SMC10	W	< 10
SMC20	W	< 10
SMC30	W	< 10
SME20/25	W	≤ 4
SME120/125	W	≤ 4.5
Terminal Modules		
TM15	W	< 3
TM31	W	< 10
TM41	W	12
TM54F	W	4.5
Additional system components		
VSM10	W	< 10
DC link components		
Braking Module Booksize	W	20
Braking Module Booksize Compact	W	< 40

	Unit	Power loss
Capacitor Module	W	25
Control Supply Module	W	70
Line DC link		65
Voltage Clamping Module	W	50

### 12.13.3 Power loss for line filters and line reactors

Table 12- 32 Overview of power loss during rated operation for line filters and line reactors

	Unit	Power loss
<b>Basic Line Filters for Active Line Modules</b>		
16 kW	W	16
36 kW	W	26
55 kW	W	43
80 kW	W	56
120 kW	W	73
<b>Basic Line Filter for Active Line Modules with Active Interface Module</b>		
16 kW	W	16
36 kW	W	26
55 kW	W	43
80 kW	W	56
120 kW	W	73
<b>Wideband Line Filter for Active Line Modules</b>		
16 kW	W	70
36 kW	W	90
55 kW	W	110
80 kW	W	150
120 kW	W	200
<b>Basic Line Filter for Smart Line Modules</b>		
5 kW	W	5
10 kW	W	9
16 kW	W	16
36 kW	W	26
55 kW	W	43
<b>Basic Line Filter for Basic Line Modules</b>		
20 kW	W	16
40 kW	W	26
100 kW	W	73
<b>Active Interface Modules</b>		
16 kW	W	270 <sup>1)</sup>

12.13 Power losses of the components

	Unit	Power loss
36 kW	W	340 <sup>1)</sup>
55 kW	W	380 <sup>1)</sup>
80 kW	W	490 <sup>1)</sup>
120 kW	W	585 <sup>1)</sup>
Line reactors for Active Line Modules		
16 kW	W	170
36 kW	W	250
55 kW	W	350
80 kW	W	450
120 kW	W	590
Line reactors for Smart Line Modules		
5 kW	W	62
10 kW	W	116
16 kW	W	110
36 kW	W	170
55 kW	W	200
Line reactors for Basic Line Modules		
20 kW	W	130
40 kW	W	270
100 kW	W	480

1) Referred to  $V_{DC \text{ link } 600 \text{ V}}$

12.13.4 Power loss for power units with internal air cooling

Table 12- 33 Overview of power loss at rated operation for power units with internal air cooling (including electronics losses)

	Unit	Power loss
Active Line Modules		
16 kW	W	282.8
36 kW	W	666
55 kW	W	945.6
80 kW	W	1383.6
120 kW	W	2243.2
Smart Line Modules Booksize		
5 kW	W	79.2
10 kW	W	141.6
16 kW	W	187.8
36 kW	W	406
55 kW	W	665.6
Smart Line Modules Booksize Compact		

	Unit	Power loss
16 kW	W	187.8
Basic Line Modules		
20 kW	W	144
40 kW	W	283.6
100 kW	W	628
Single Motor Modules Booksize		
3 A	W	50.4
5 A	W	73.4
9 A	W	100.4
18 A	W	185.4
30 A	W	309.2
45 A	W	455.2
60 A	W	615.2
85 A	W	786
132 A	W	1270.4
200 A	W	2070.4
Single Motor Modules Booksize Compact		
3 A	W	68 <sup>1)</sup>
5 A	W	98 <sup>1)</sup>
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 <sup>1)</sup>
3 A	W	134 <sup>1)</sup>
5 A	W	194 <sup>1)</sup>

1) Power loss at 8 kHz

### 12.13.5 Power loss for power units with external air cooling

Table 12- 34 Overview of power loss at rated operation for power units with external air cooling (including electronics losses)

	Unit	Internal Power loss <sup>1)</sup>	External power loss	Total power loss
<b>Active Line Modules</b>				
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
<b>Smart Line Modules</b>				
5 kW	W	41.2 (22 + 19,2)	38	79.2
10 kW	W	66.6 (45 + 21,6)	75	141.6
16 kW	W	64.8 (42 + 22,8)	123	187.8
36 kW	W	116 (80 + 36)	290	406
55 kW	W	185.6 (140 + 45,6)	480	665.6
<b>Single Motor Modules</b>				
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
<b>Double Motor Modules</b>				
3 A	W	62.6 (35 + 27,6)	35	97.6
5 A	W	72.6 (45 + 27,6)	60	132.6
9 A	W	92.6 (65 + 27,6)	95	187.6
18 A	W	111.2 (80 + 31,2)	240	351.2

1) Power loss of the power electronics + power loss of the 24 V electronics



### 12.13.6 Power loss for power units with cold plate

With cold-plate cooling, only part of the power loss remains in the cabinet.  
The table below shows the internal and external power loss of the components.

Table 12- 35 Overview of power loss at rated operation for power units with cold plate (including electronics losses)

	Unit	Internal power loss <sup>1)</sup>	External power loss	Total power loss
<b>Active Line Modules</b>				
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
<b>Smart Line Modules Booksize</b>				
5 kW	W	34.4 (20 + 14,4)	40	74.4
10 kW	W	56.8 (40 + 16,8)	80	136.8
<b>Smart Line Modules Booksize Compact</b>				
16 kW	W	56.6 (36,2 + 20,4)	130	186.6
<b>Basic Line Modules</b>				
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
<b>Single Motor Modules Booksize</b>				
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
<b>Single Motor Modules Booksize Compact</b>				
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
<b>Double Motor Modules Booksize</b>				
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

12.13 Power losses of the components

	Unit	Internal power loss <sup>1)</sup>	External power loss	Total power loss
Double Motor Modules Booksize Compact				
2x1.7 A	W	42 (20,4 + 21,6)	72	114
2x3 A	W	44 (22,4 + 21,6)	90	134
2x5 A	W	59 (37,4 + 21,6)	135	194

1) Power loss of the power electronics + power loss of the 24 V electronics

**Note**

Lower average power losses are obtained for intermittent duty.

**12.13.7 Power loss for liquid-cooled power units**

Table 12- 36 Overview of power loss during rated operation for liquid-cooled power units (including electronics losses)

	Unit	Internal power loss <sup>1)</sup>	External power loss	Total power loss
Active Line Modules				
120 kW	W	443.2 (400 + 43,2)	1800	2243.2
Single Motor Modules				
200 A	W	370.4 (350 + 20,4)	1700	2070.4

1) Power loss of the power electronics + power loss of the 24 V electronics

**12.13.8 Electronics losses of power units**

Table 12- 37 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

Component		Internal/external air cooling Power loss [W]
Single Motor Modules Booksize Compact	3 A	20.4
	5 A	20.4
	9 A	20.4
	18 A	20.4
Double Motor Modules	3 A	27.6
	5 A	27.6
	9 A	27.6
	18 A	31.2
Double Motor Modules Booksize Compact	1.7 A	27.6
	3 A	27.6
	5 A	27.6
Active Line Modules	16 kW	22.8
	36 kW	36.0
	55 kW	45.6
	80 kW	33.6
	120 kW	43.2
Basic Line Modules	20 kW	24
	40 kW	33.6
	100 kW	48
Smart Line Module	5 kW	19.2
	10 kW	21.6
	16 kW	22.8
	36 kW	36.0
	55 kW	45.6
Smart Line Module Booksize Compact	16 kW	22.8

12.13 Power losses of the components

Table 12- 38 Electronics losses for power units with cold plate

Component		Cold plate Power loss [W]
Motor Modules Booksize	3 A	15.6
	5 A	15.6
	9 A	15.6
	18 A	15.6
	30 A	15.6
	45 A	18.0
	60 A	18.0
	85 A	19.2
	132 A	20.4
	200 A	20.4
	2x3 A	21.6
	2x5 A	21.6
	2x9 A	21.6
2x18 A	25.2	
Motor Modules Booksize Compact	3 A	15.6
	5 A	15.6
	9 A	15.6
	18 A	15.6
	2x1.7 A	21.6
	2x3 A	21.6
	2x5 A	21.6
Active Line Modules	16 kW	20.4
	36 kW	25.2
	55 kW	27.6
	80 kW	33.6
	120 kW	43.2
Smart Line Module Booksize	5 kW	14.4
	10 kW	16.8
Smart Line Module Booksize Compact	16 kW	20.4
Basic Line Modules	20 kW	21.6
	40 kW	26.4
	100 kW	38.4

Table 12- 39 Electronics losses for liquid-cooled power units

Component		Liquid cooled Power loss [W]
Motor Module	200 A	20.4
Active Line Module	120 kW	43.2

### 12.13.9 Maximum power losses in the partial load range

#### Losses in the partial load range for Line Modules and Motor Modules

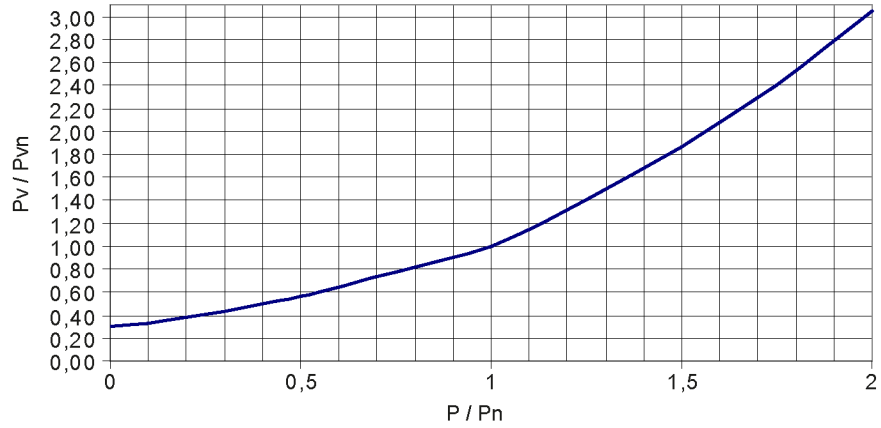


Figure 12-37 Losses in the partial load range for Active Line Modules and Smart Line Modules

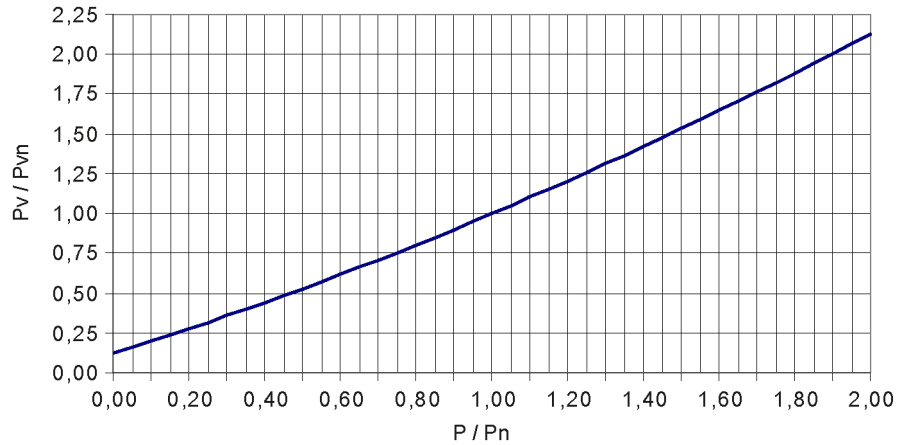


Figure 12-38 Losses in the partial load range for Basic Line Modules

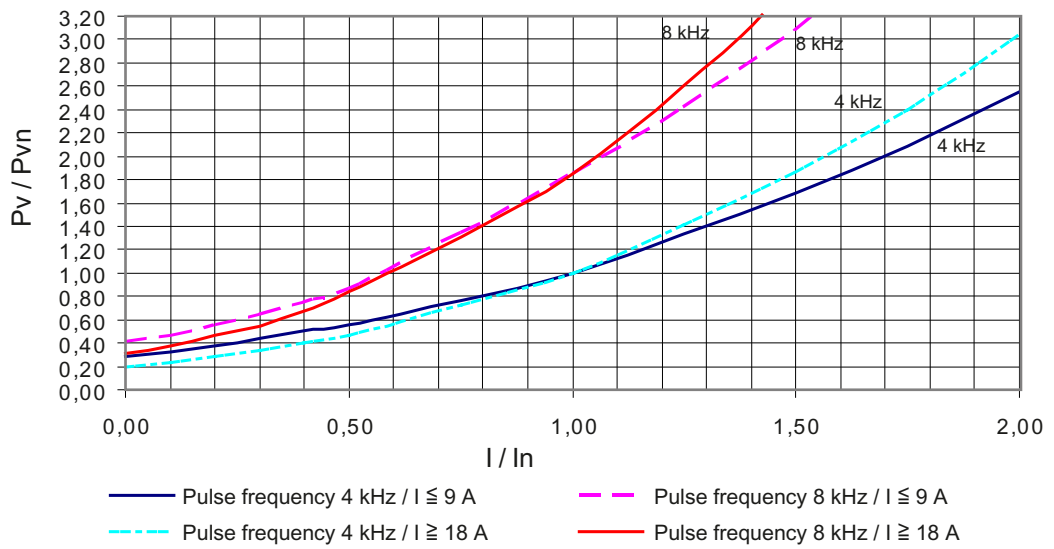


Figure 12-39 Losses in the partial load range for Motor Modules

Losses in the partial load range for line reactors and Active Interface Modules

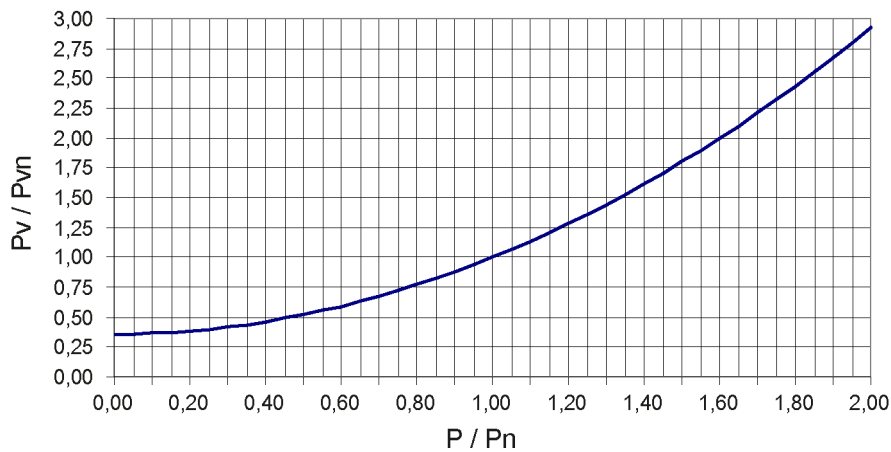


Figure 12-40 Losses in the partial load range for Active Interface Modules

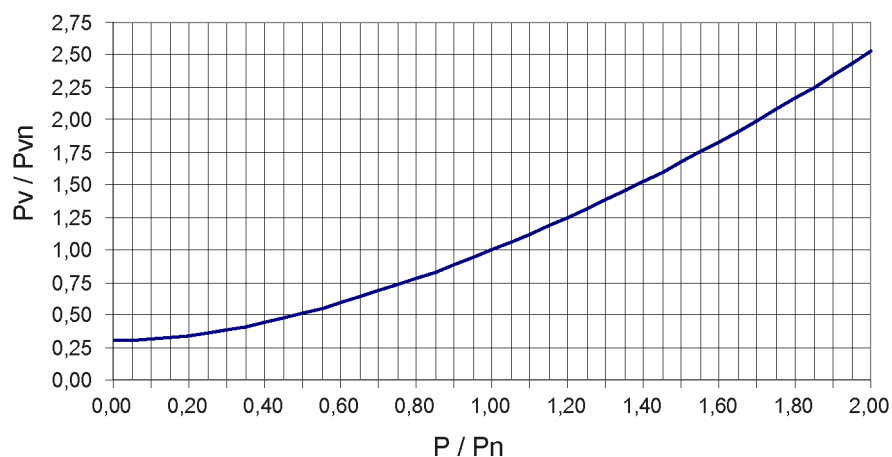


Figure 12-41 Losses in the partial load range for line reactors for Smart Line Modules

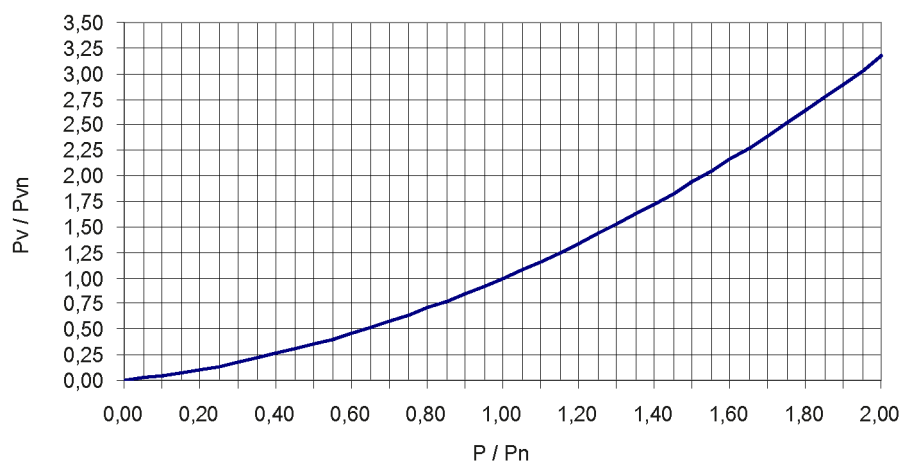


Figure 12-42 Losses in the partial load range for line reactors for Basic Line Modules

### 12.13.10 Typical power losses for Motor Modules

The information on the power losses in the previous chapters are maximum values, which occur in the most unfavorable case. For typical applications, the losses are lower.

The following applies as typical application:

- Maximum motor cable length, 30 m
- 4 kHz pulse frequency
- DC link voltage 540 V - 600 V

The power loss for typical applications can be calculated using the following formula:

$$P_V [W] = a + S_1 \cdot (I_1 + I_2) + S_2 \cdot (I_1^2 + I_2^2)$$

- a            Electronics losses of the Motor Module
- S<sub>1</sub>, S<sub>2</sub>    Coefficients to calculate power loss
- I<sub>1</sub>         Current (arithmetic mean value) of the 1st axis
- I<sub>2</sub>         Current (arithmetic mean value) of the 2nd axis

### Overview of required coefficients

Table 12- 40 Coefficients to calculate the power loss in the control cabinet for internally cooled Motor Modules for typical applications

Motor Module	a [W]	S <sub>1</sub> [W/A]	S <sub>2</sub> [W/A <sup>2</sup> ]
Single Motor Module 3 A	14	3,29	0,205
Single Motor Module 5 A	14	3,29	0,205
Single Motor Module 9 A	14	3,29	0,205
Single Motor Module 18 A	14	3,29	0,205
Single Motor Module 30 A	20	4,71	0,113
Single Motor Module 45 A	25	5,50	0,054
Single Motor Module 60 A	25	5,50	0,054
Single Motor Module 85 A	36	6,11	0,030
Single Motor Module 132 A	150	6,01	0,018
Single Motor Module 200 A	150	6,01	0,017
Double Motor Module 3 A	19	5,20	0,200
Double Motor Module 5 A	19	5,20	0,200
Double Motor Module 9 A	19	5,18	0,247
Double Motor Module 18 A	22	5,57	0,091



Table 12- 41 Coefficients to calculate the power loss in the control cabinet for externally cooled Motor Modules for typical applications

Motor Module	a [W]	S <sub>1</sub> [W/A]	S <sub>2</sub> [W/A <sup>2</sup> ]
Single Motor Module 3 A	10	2,30	0,100
Single Motor Module 5 A	10	2,30	0,100
Single Motor Module 9 A	10	2,30	0,100
Single Motor Module 18 A	10	2,34	0,101
Single Motor Module 30 A	16	1,29	0,057
Single Motor Module 45 A	21	1,31	0,015
Single Motor Module 60 A	27	1,37	0,006
Single Motor Module 85 A	32	1,37	0,006
Single Motor Module 132 A	50	1,06	0,004
Single Motor Module 200 A	50	1,06	0,004
Double Motor Module 3 A	15	1,37	0,240
Double Motor Module 5 A	15	1,37	0,240
Double Motor Module 9 A	15	1,37	0,240
Double Motor Module 18 A	18	1,56	0,056

### Overview of typical power losses at the rated operating point

Table 12- 42 Typical power losses in the control cabinet for operation at the rated operating point for internally and externally cooled Motor Modules

Motor Module	P <sub>Vn</sub> [W] internal air cooling	P <sub>Vn</sub> [W] external air cooling
Single Motor Module 3 A	26	18
Single Motor Module 5 A	36	24
Single Motor Module 9 A	60	39
Single Motor Module 18 A	140	85
Single Motor Module 30 A	263	106
Single Motor Module 45 A	382	110
Single Motor Module 60 A	550	130
Single Motor Module 85 A	772	192
Single Motor Module 132 A	1257	260
Single Motor Module 200 A	2032	422
Double Motor Module 3 A	54	28
Double Motor Module 5 A	81	41
Double Motor Module 9 A	152	79
Double Motor Module 18 A	281	110

## 12.14 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

 <b>WARNING</b>
--

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 <sup>1)</sup> 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

 <b>WARNING</b>
--

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 <sup>1)</sup> 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 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

### 13.1 Cooling circuit requirements

#### 13.1.1 Technical cooling circuits

Technical cooling circuits can be divided into three systems:

1. **Closed cooling circuits (recommended)**

In closed systems, the circuit coolant is separated from the surrounding atmosphere, which prevents the ingress of oxygen. The coolant is only routed through 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.

### 13.1.2 Cooling system requirements

Open cooling systems must never be used for liquid-cooled power units. A closed cooling circuit with a membrane expansion tank, safety valve, and heat exchanger is recommended, which connects the cooling circuit to an external cooler (refer also to 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.

### 13.1.3 Cooling circuit configuration

The liquid-cooled power units are designed to be connected in parallel to the cooling circuit. The pressure drop in the joint supply and return lines is to be kept at negligible levels by choosing a sufficiently large pipe diameter. The supply line has a differential pressure  $p$  compared to the return line; this pressure is usually generated by a pump.

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  $p_1$  (measured between the supply and return lines of the individual component), the volume of coolant required to enable the component to achieve its rated power or rated current is to flow through each component. At the maximum differential pressure  $p_2$  (measured between the supply and return lines of the individual component), the volumetric flow must not result in damage to the component, for example by means of cavitation. If necessary, pressure reducing valves such as baffle plates will have to be installed in the piping; these must be easy to access, clean, and/or replace.

When the pump is switched off, static pressure occurs in the system. The static pressure can be influenced by the primary pressure of the membrane expansion tank and should be at least 30 kPa on the pump's suction side. If the static pressure is too low, 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 H<sub>2</sub>O). Up to 50 kPa must be added for the pressure drop in a (contaminated) filter and in connection pipes. The intersection of the pump characteristic curve and the pressure drop of the whole cooling system yields the volumetric flow  $V_n$  of the coolant at this operating point.

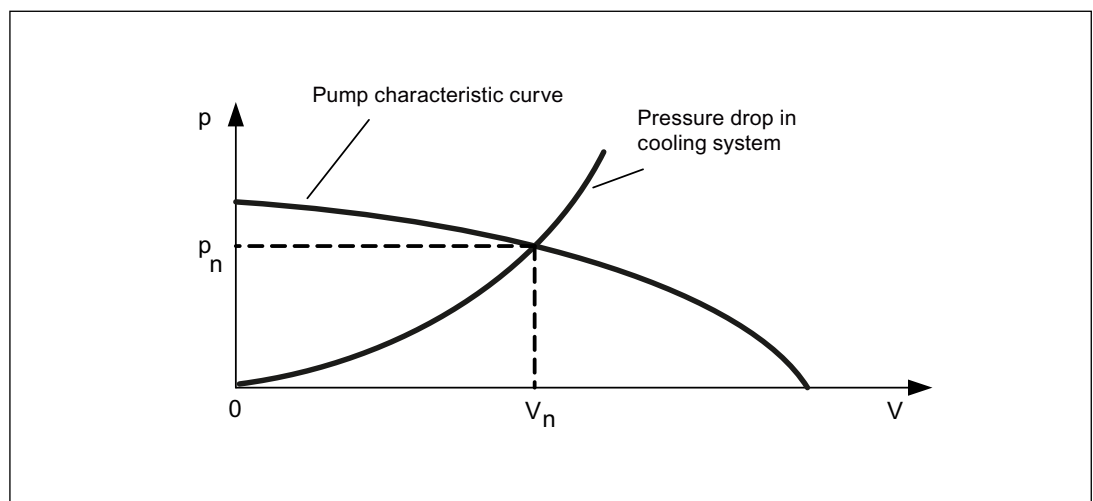


Figure 13-1 Pump characteristic curve

**Permissible system pressure**

The maximum permissible system pressure is 600 kPa. If a pump that is capable of exceeding this maximum permissible system pressure is used, the customer must take steps (e.g. safety valve  $p \leq 600$  kPa, pressure control, or similar) to ensure that the maximum pressure limit is not exceeded.

**Permissible pressure difference**

The maximum permissible pressure difference for a heat sink is 200 kPa. Higher pressure differences significantly increase the risk of cavitation and abrasion. The lowest possible differential pressure between the coolant in the supply and return lines should be selected to allow pumps with a flat characteristic to be used.

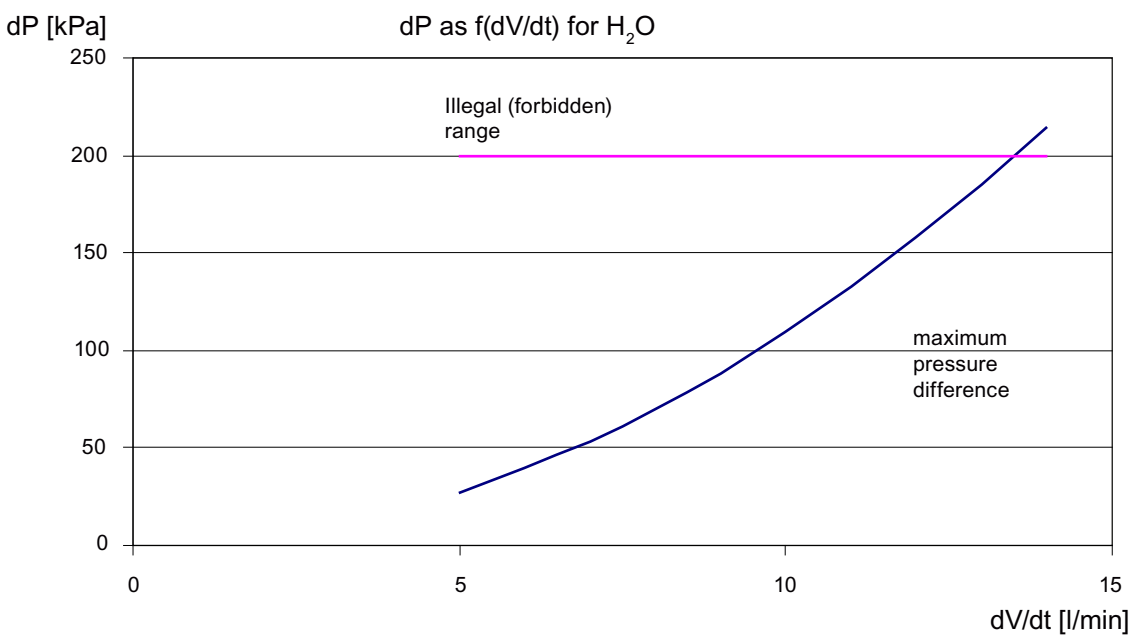


Figure 13-2 Pressure difference as a function of volumetric flow

**Pressure difference and pressure drop when using coolant mixtures**

If a mixture of Antifrogen N and H<sub>2</sub>O is used as a coolant, the rated pressure must be calculated according to the mixing ratio. The following table specifies the pressure drop across components at different coolant temperatures for a coolant with mixing ratio 45 % Antifrogen N.

Table 13- 1 Pressure drop at different coolant temperatures for Antifrogen N/H<sub>2</sub>O: 45 %

dV/dt H <sub>2</sub> O [l/min]	dP H <sub>2</sub> O [kPa]	dP Antifrogen N 0 °C [kPa]	dP Antifrogen N 20 °C [kPa]	dP Antifrogen N 45 °C [kPa]	dP Antifrogen N 50 °C [kPa]
8	70	121	97	81	78



The characteristic curves for the pressure drop across the heatsinks as a function of volumetric flow vary depending on the temperature and the Antifrogen N / water coolant mix.

dp as dV/dt for various coolants

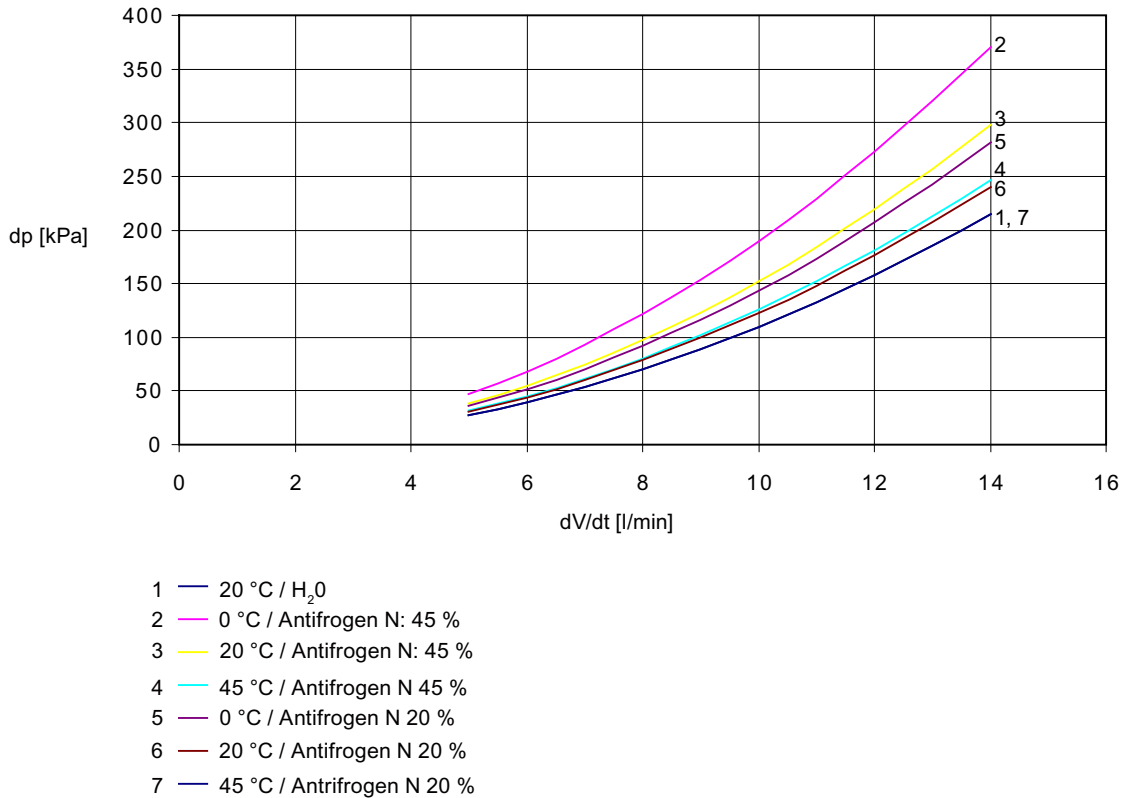


Figure 13-3 Pressure difference as a function of volumetric flow

## Operating pressure

The **operating pressure** must be set according to the flow conditions in the supply and return lines of the cooling circuit. The required coolant flow rate per time unit must be set according to the technical data of the components. The components are normalized to a rated pressure of 70 kPa (for coolant type H<sub>2</sub>O) 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:

$$\sum dP_i < dP_{\text{Syst}} < \sum dP_i + 30 \text{ kPa}$$

The individual pressure drops  $P_i$  represent the pressure drops of components (heat exchanger, piping, 70 kPa for the SINAMICS devices connected in parallel, valves, dirt traps, pipe bends, etc.).

Coolant pipes must be routed with extreme care. The pipes must never come into contact with electrically live components. An insulation clearance of  $> 13 \text{ mm}$  must always be maintained between pipes and live parts. The pipes must be securely mounted and checked for leaks.

### 13.1.4 Installation

A closed stainless-steel cooling circuit, preferably combined with monitoring of the coolant quality, is strongly recommended to ensure the longest possible service life for the heat sink.

#### NOTICE

##### Risk of a short-circuit through incorrectly routed coolant pipes

- Route the coolant pipes very carefully.
- Fix the pipes securely and check them for leaks.
- Ensure that the pipes never come into contact with live components.

### Materials and connections

Stainless-steel pipes are used to route the coolant through the cooling plates on the liquid-cooled power units. For power units with cold plate, the coolant is routed by means of integrated channels in the aluminum cold plate.

To minimize the electrochemical processes taking place in the cooling system, the materials must be coordinated with one another accordingly. Combining different materials, such as copper, brass, iron, zinc, or halogenated plastic (PVC hoses and seals), should be avoided or 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; the Semperit company, Wimpassing - Austria)
- DEMITEL® hoses made of PE / EPDM (the Telle company, Nuremberg)
- Clips according to DIN 2871, available for example from Telle.

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All control cabinets must be designed with a PE busbar and a good electrical connection must be established between them.

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**Note**

The sealing materials must be free of chlorides, graphite, and carbon (Viton® or EPDM).  
Teflon-based seals are not permitted.

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**Note**

When non-conductive hoses are used, particular attention must be paid to the equipotential bonding of all components (see Section "Equipotential bonding").

---

**Note**

- Check the cooling system for tightness after installation.
- 

### 13.1.5 Preventing cavitation

The following applies to all cooling circuits:

- The cooling circuit must always be designed in such a way that the pressure compensator is located on the suction side of the pump (if possible, directly 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.

### 13.1.6 Commissioning

When commissioning the cooling water circuit, the following sequence must be observed:

- Ventilate the heat sink the first time the devices are filled.
- Remove the fixing glands located in front of the vent valve.
- Perform ventilation.
- Close the vent valve.
- Screw the fixing glands tight again.
- Check the seals.

13.2 Coolant requirements

- 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.

<b>NOTICE</b>
Ventilation must only be performed when the system is at zero voltage.

## 13.2 Coolant requirements

### 13.2.1 Coolant properties

#### Properties of the cooling medium

Water or a water/anti-freeze mixture that meets the relevant requirements can be used as a cooling medium. The cooling medium must be chemically neutral, clean, and not contain any solids.

The cooling water must fulfill the following requirements over the long term:

Table 13- 2 Cooling water specifications

		<b>Liquid Cooled</b>
Properties		Chemically neutral, clean, free of solids
Max. inlet temperature (during operation)	°C	45 (55 with derating)
Max. coolant temperature	°C	55
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 <sub>n</sub>	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 as a result of supercooling**

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****Seawater cooling is not permitted**

The heat sink material is not resistant to seawater. Direct cooling with seawater will damage the heat sink.

**Note**

As a general rule, tap water is not suitable for use in the cooling circuit, although it can be mixed with de-ionized water. Losses must always be replenished with de-ionized water.

**Note**

The flow created when the heat sinks are filled results in automatic ventilation, so there is no need for the devices to be ventilated separately.

The coolant should be checked 3 months after the cooling circuit is filled for the first time and, subsequently, once a year. If the cooling water becomes cloudy, is colored, or becomes contaminated by mould spores, the cooling circuit must be cleaned and refilled.

An inspection glass should be provided in the cooling circuit to make it easier to check the cooling water.

### 13.2.2 Corrosion Inhibitor Additive (Inhibiting)

Nalco 00GE056 (Nalco company) is recommended as anti-corrosion agent. The concentration of anti-corrosion agent in the cooling water must be at least 2500 ppm (250 ml/100 liters KW).

The water quality must meet the specifications contained in the chapter titled "Coolant properties" or the water used must be de-ionized.

**Note**

Corrosion inhibitor does not need to be added if the anti-freeze Antifrogen N is used in the right concentration (refer to the chapter titled "Addition of antifreeze").

### 13.2.3 Anti-Freeze Additive

Antifrogen N (the Clariant company) is recommended as antifreeze. The proportion of antifreeze must be between 20% and 30%. This ensures frost protection in temperatures down to -10 °C.

<b>NOTICE</b>
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<b>Incorrect antifreeze ratio</b>
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If the proportion of antifreeze added is greater than 30%, this can inhibit the transfer of heat and prevent the devices from functioning correctly.
--

<b>NOTICE</b>
---------------

<b>Leaks</b>
--------------

Cooling water mixtures with Antifrogen N are highly conductive. In the event of leakage, the insulating systems must be cleaned.
--

<b>NOTICE</b>
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<b>Damage to EPDM hoses as a result of additives containing oil</b>
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When EPDM hoses are used, oily corrosion inhibitor additives must not be used because additives can corrode and destroy EPDM.
---

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**Note**

**Adapting the pump power**

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.

### 13.2.4 Biocide additives (only if required)

Closed cooling circuits with soft water ( $^{\circ}\text{DH} > 4$ ) are susceptible to microbes. The risk of corrosion caused by microbes is virtually non-existent in chlorinated drinking water systems.

If Antifrogen N antifreeze is used with a concentration of 20% or higher, it can be assumed that there is an adequate biocide effect.

The following types of bacteria are encountered in practice:

- 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.

**Recommendation**

It is recommended that Nalco N 77352 should be dosed twice a month. The dosing quantity is 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.

It is not permissible that biocides and Antifrogen N are mixed.

Antifrogen N has a biocidal effect even at the minimum required concentration of > 20%.

## 13.3 Anti-condensation measures

The customer must take measures to protect the devices against condensation

Condensation occurs when the inlet temperature of the cooling medium is significantly lower than room temperature (ambient temperature). The permissible temperature difference between coolant and air varies as a function of the relative humidity  $\phi$  of the ambient air. The air temperature at which the aqueous phase precipitates is referred to as the "dew point".

The table below shows the dew points (in °C) for an atmospheric pressure of 100 kPa ( $\approx$  installation altitude: 0...500 m). If the temperature of the coolant is below the specified value, condensation may occur (i.e. the coolant temperature must always be  $\geq$  the dew point temperature).

Table 13-3 Dew point temperature as a function of the relative air humidity ( $\Phi$ ) and the room temperature at an installation altitude of between 0 m and 500 m

T <sub>room</sub> °C	Dew point temperature in °C at a relative humidity $\Phi$ in %										
	20%	30%	40%	50%	60%	70%	80%	85%	90%	95%	100%
10	<0	<0	<0	0.2	2.7	4.8	6.7	7.6	8.4	9.2	10
20	<0	2	6	9.3	12	14.3	16.4	17.4	18.3	19.1	20
25	0.6	6.3	10.5	13.8	16.7	19.1	21.2	22.2	23.2	24.1	25
30	4.7	10.5	14.9	18.4	21.3	23.8	26.1	27.1	28.1	29.1	30
35	8.7	14.8	19.3	22.9	26.1	28.6	30.9	32.1	33.1	34.1	35
38	11.1	17.4	22	25.7	28.8	31.5	33.8	34.9	36.1	36.9	38
40	12.8	19.1	23.7	27.5	30.6	33.4	35.8	36.9	37.9	38.9	40
45	16.8	23.3	28.2	32.1	35.3	38.1	40.6	41.8	42.9	43.9	45
50	20.8	27.5	32.6	36.6	40.1	42.9	45.5	46.6	47.8	48.9	50
55	24.9	31.9	37.1	41.2	44.7	47.7	50.4	51.7	52.8	53.9	55

### 13.4 Equipotential bonding in the cooling system

The dew point also depends on the absolute pressure (i.e. the installation altitude).

The dew points for lower atmospheric pressures are located under the dew points for a height=0 m, therefore selecting the coolant inlet temperature for the height 0 m always sufficient.

**Various measures can be taken to prevent condensation:**

1. Temperature-controlled valves in the supply line.  
In the cooling circuit, a temperature-controlled valve must be provided in the supply line.
2. Water temperature control.  
The water temperature is adjusted 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.

## 13.4 Equipotential bonding in the cooling system

Equipotential bonding between the components in the cooling system is required (SINAMICS S120, heat exchanger, piping, pump, etc.). This must be effected using a copper bar or stranded copper with the appropriate conductor cross-sections to prevent the electrochemical processes.

All cabinets must be bolted together in such a way as to ensure good conductivity (e.g. cabinet beams directly connected to ensure 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.



## 13.5 Using heat exchangers

### 13.5.1 Water-to-water heat exchanger

If a cooling circuit that does not exceed 35 °C but does not fulfill the cooling water requirements is already installed in the system, the two cooling circuits can be linked via a water-to-water heat exchanger.

The coolers for the Line Modules are attached via a distributor in such a way as to ensure the required flow rate without exceeding the maximum permissible pressure. Conditions, such as height differences and distances, must be taken into account here.

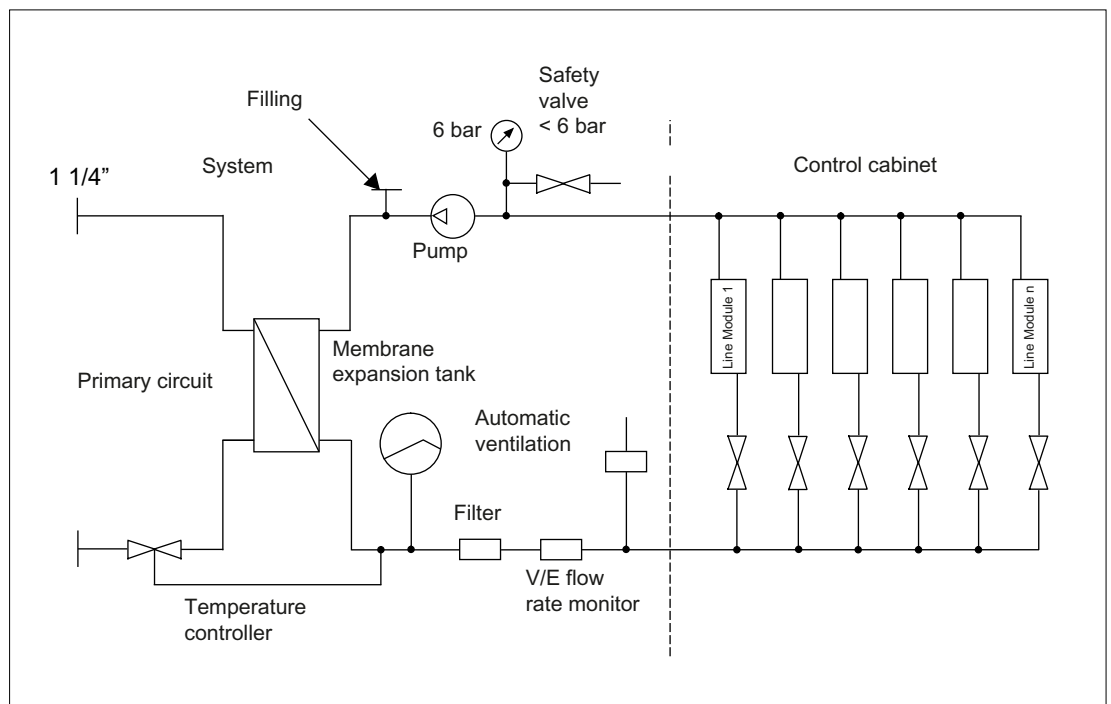


Figure 13-4 Water-to-water heat exchanger

### 13.5.2 Air-to-water heat exchanger

If no process-water 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.

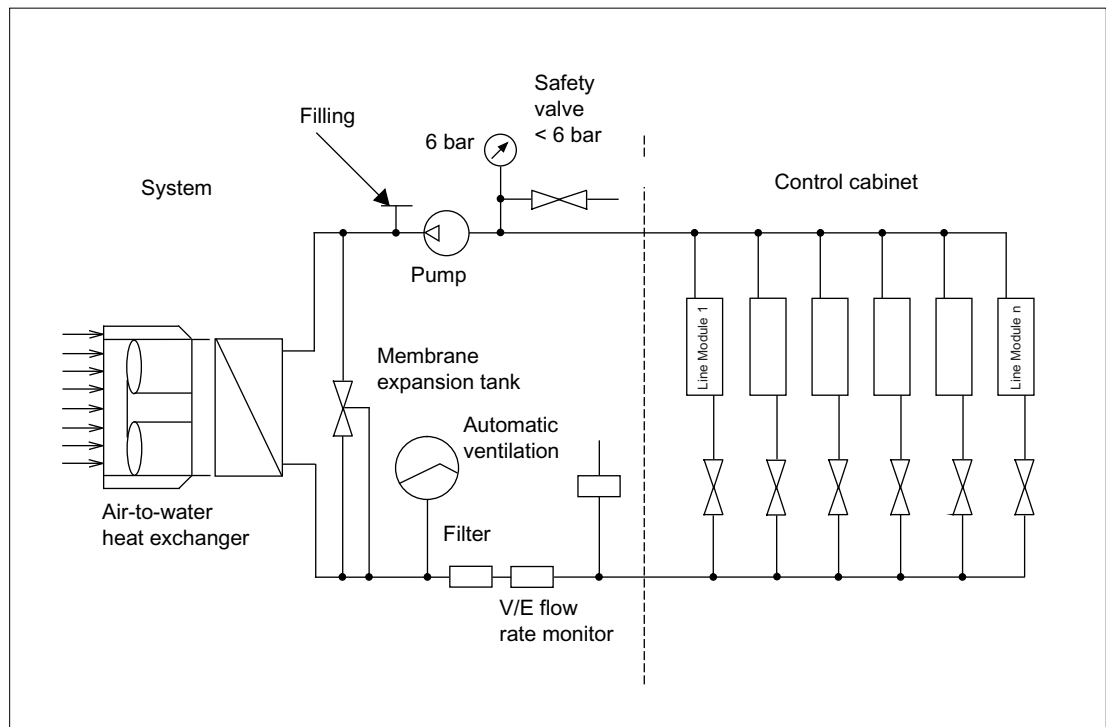


Figure 13-5 Air-to-water heat exchanger

### 13.5.3 Active cooling unit

If no process-water network has been installed and the ambient air is  $> 35\text{ }^{\circ}\text{C}$  ( $35\text{ }^{\circ}\text{C} < \tau < 40\text{ }^{\circ}\text{C}$ ), an active cooling unit can be used. This unit works in the same way as a refrigerator.

The following diagram shows the configuration of the cooling circuit in respect of Line Modules.

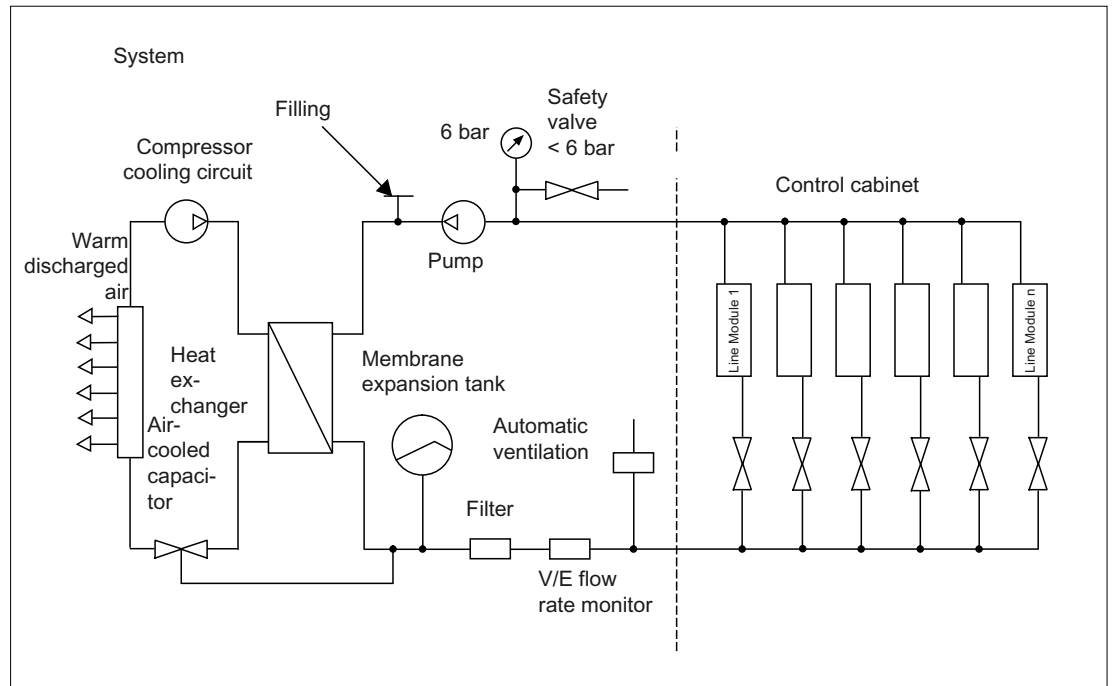


Figure 13-6 Active cooling unit



## Service and Support Booksize

### 14.1 Spare parts

Spare parts are available on the Internet at:

<http://support.automation.siemens.com/WW/view/de/16612315>

### 14.2 Replacing the fan

#### 14.2.1 Safety instructions when replacing a fan



##### **Danger to life through electric shock**

Before replacing the fan, you must switch off the power supplies (400 VAC and 24 VDC). A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off.

- Remove the device cover or the fan cover only after a certain time.
- Check for zero voltage before removing the component.

---

##### **Note**

When replacing the fan, you must observe the ESD regulations.

Only qualified personnel are permitted to install spare parts.

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### 14.2.2 Replacing the fan for components with internal and external air cooling

#### Replacing the fan for components, sizes 50 mm to 200 mm

Table 14- 1 Removing the fan


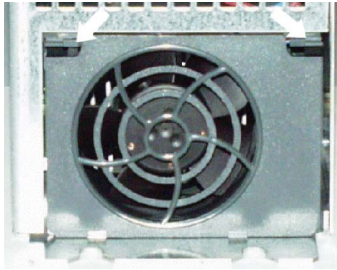
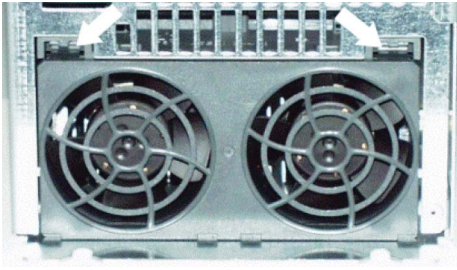
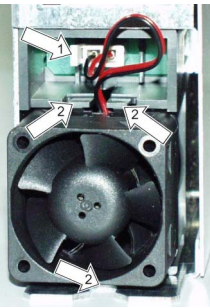
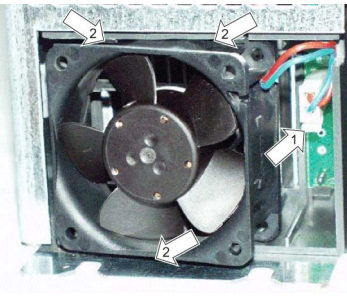
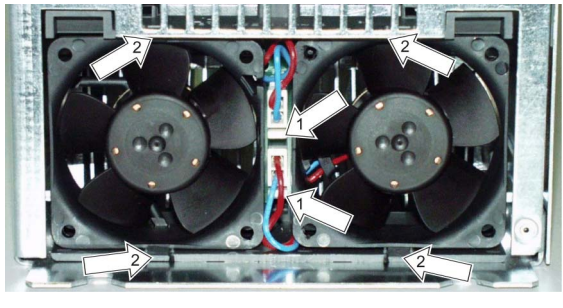
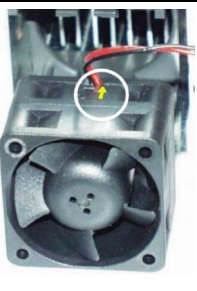
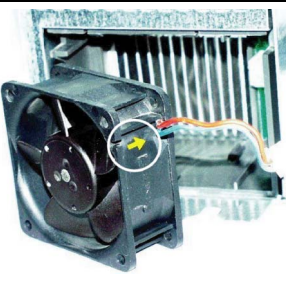
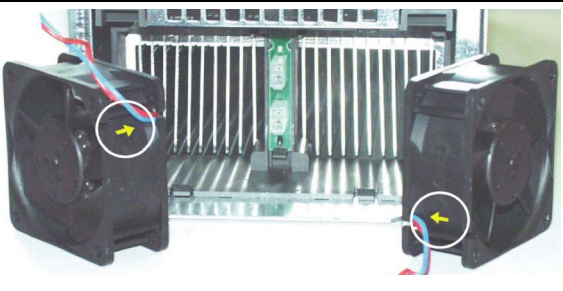
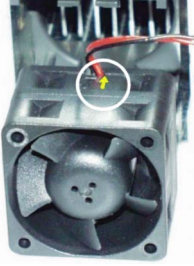
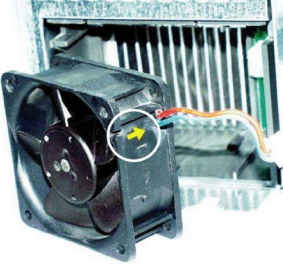
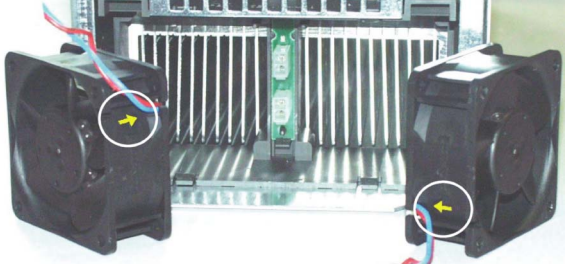
Size 50 mm	Size 100 mm	Sizes 150 mm and 200 mm
<ul style="list-style-type: none"> <li>Remove the module from the drive line-up.</li> <li>Release the snap hooks to open the fan cover.</li> </ul>		
		
<ul style="list-style-type: none"> <li>Release and pull out the connection plugs (1).</li> <li>Release the snap hooks (2) and remove the fan.</li> </ul>		
		
		

Table 14-2 Installing a fan

Size 50 mm	Size 100 mm	Sizes 150 mm and 200 mm
<ul style="list-style-type: none"> <li>Before installing the fan, check the air flow direction (the arrow on the fan must point towards the cooling ribs).</li> </ul>		
		
<ul style="list-style-type: none"> <li>Keep moving the fan into position until it is fully engaged <b>Notice!</b> Do not crush the connection cables!</li> <li>Insert the connection plug until it is fully engaged.</li> <li>Insert the fan cover.</li> </ul>		

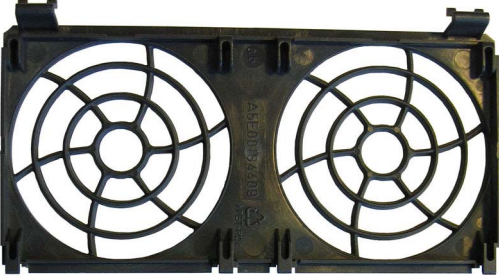
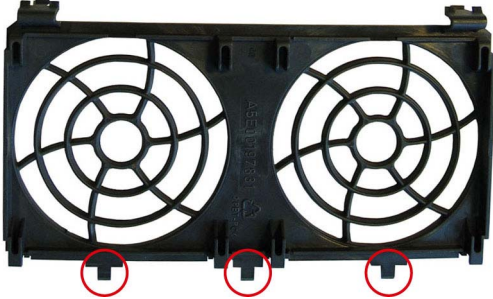
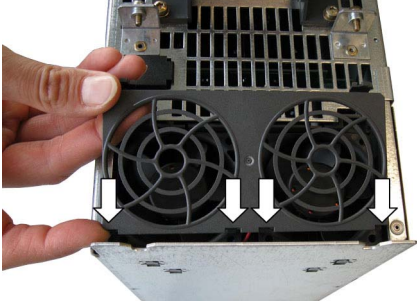
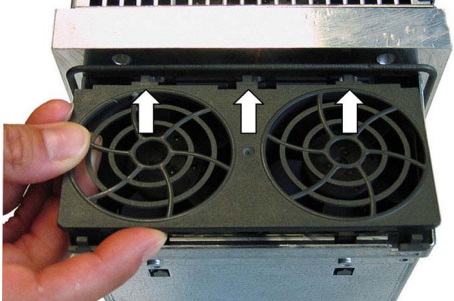
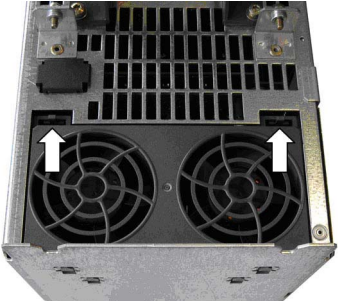

**Note**

The spare parts pack for components, sizes 150 mm and 200 mm contains two different fan covers: One is for components with internal air cooling, the other for components with external air cooling. Make sure you use the right fan cover!



14.2 Replacing the fan

Table 14- 3 Attaching the fan cover on components, sizes 150 mm and 200 mm

Internal air cooling	External air cooling
 <p data-bbox="121 701 655 730">Fan cover for components with internal air cooling</p>	 <p data-bbox="791 701 1406 757">Fan cover with three installation lugs for components with external air cooling</p>
 <p data-bbox="121 1077 336 1106">Insert the fan cover.</p>	 <p data-bbox="791 1077 1230 1106">Insert the fan cover (installation lugs first).</p>
 <p data-bbox="121 1426 663 1456">Push the fan cover in until the snap hooks engage.</p>	 <p data-bbox="791 1426 1334 1456">Push the fan cover in until the snap hooks engage.</p>

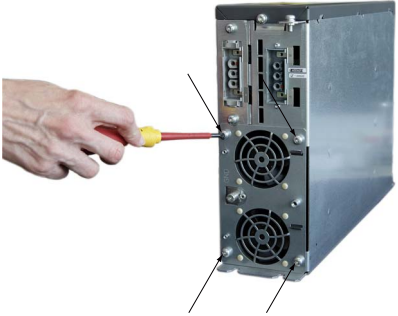
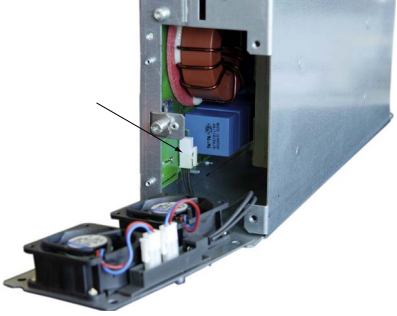
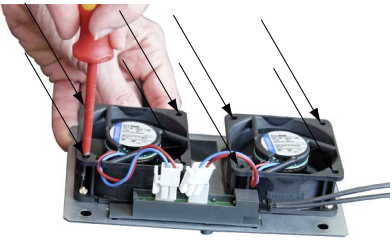
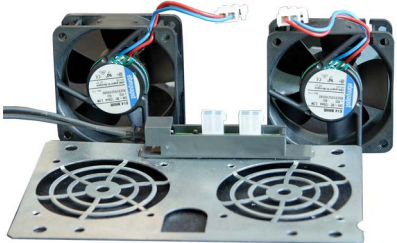

Replacing the fan for components, size 300 mm

Installing the fan module on 300 mm wide components is described in the Chapter "Installation" of the respective component. The fan module is removed in the inverse sequence to installing.



### 14.2.3 Replacing the fan on an Active Interface Module

Table 14- 4 Replacing the fan in an Active Interface Module, 16 kW

	
<p>Open the fan cover. Unscrew the combination screws M5 / 3 Nm</p>	<p>Open the fan cover and remove the connector</p>
	
<p>Break through the 8 expansion rivets</p>	<p>Take out the fans</p>
	
<p>Secure the fans with 8 new expansion rivets</p>	

To install, carry out the above steps in reverse order. The torques must be carefully observed.

14.2 Replacing the fan

Table 14- 5 Replacing the fan in an Active Interface Module, 36 kW

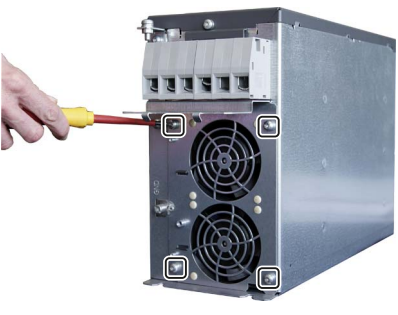



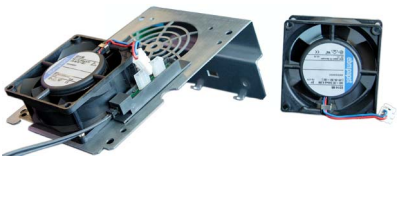

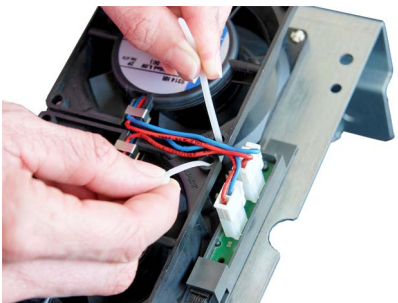
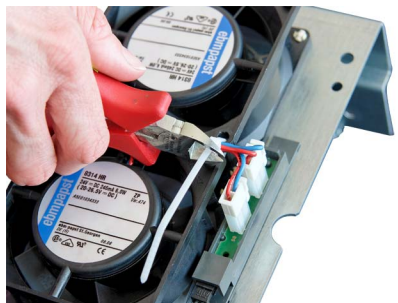

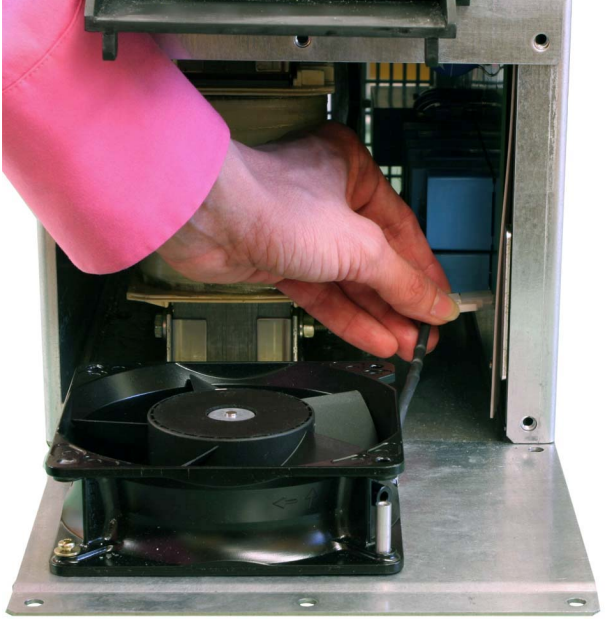
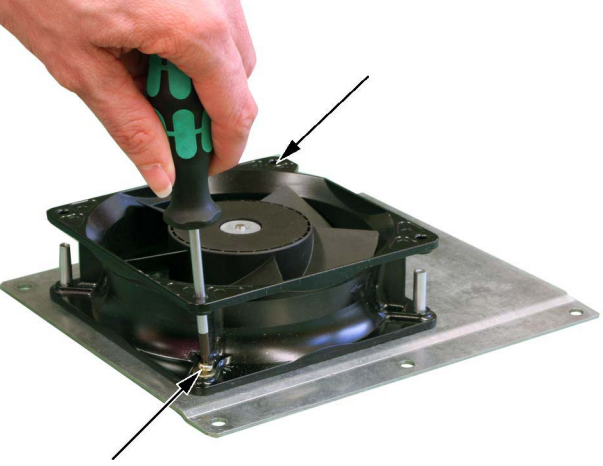







	
<p>Open the fan cover. Unscrew the combination screws M5 / 3 Nm</p>	<p>Open the fan cover and remove the connector</p>
	
<p>Remove the connection cable</p>	<p>Remove the 7 expansion rivets</p>
	
<p>Take out the fans</p>	<p>Secure the fans with 7 new expansion rivets</p>
	
<p>Attach a cable tie around the connection cables</p>	<p>Cut off the protruding end of the cable tie</p>

Table 14- 6 Replacing the fan in an Active Interface Module, 55 kW

	
<p>Open the fan cover. Unscrew the combination screws M5 / 3 Nm</p>	<p>Open the fan cover and remove the connector</p>
	
<p>Unscrew the screws M3 / 1.8 Nm</p>	<p>Take out the fan</p>

14.2 Replacing the fan

Table 14- 7 Replacing the fan in an Active Interface Module, 80 kW, 120 kW

		
<p>Open the fan cover. Unscrew the combination screws M5 / 3 Nm</p>	<p>Open the fan cover.</p>	<p>Remove the connector.</p>
		
<p>Unscrew the screws M3 / 1.8 Nm</p>	<p>Release the connection cables</p>	<p>Take out the fan</p>





14.2.4 Replacing the fan on the Control Supply Module

Replacement fan (Order. No. 6SL3160-0AB00-0AA0)

<p><b>⚠ WARNING</b></p>
<p><b>Danger due to high voltage</b></p>
<p>This component has more than one supply circuit.</p>



Table 14- 8 Removing the fan

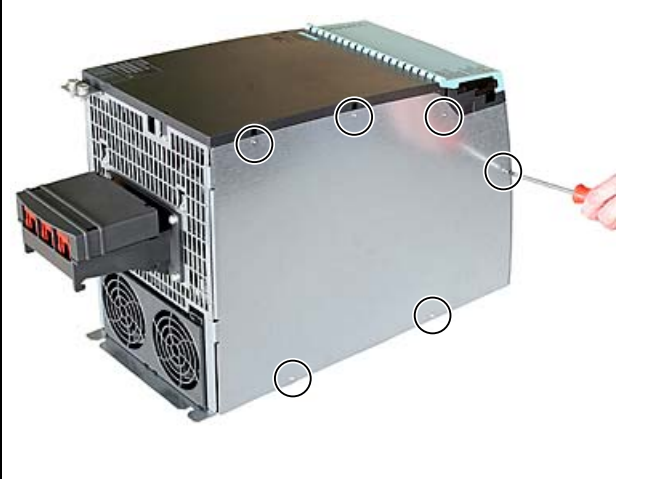
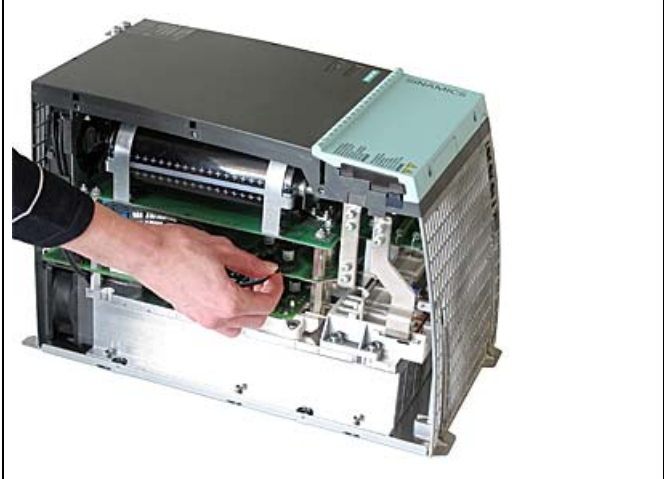
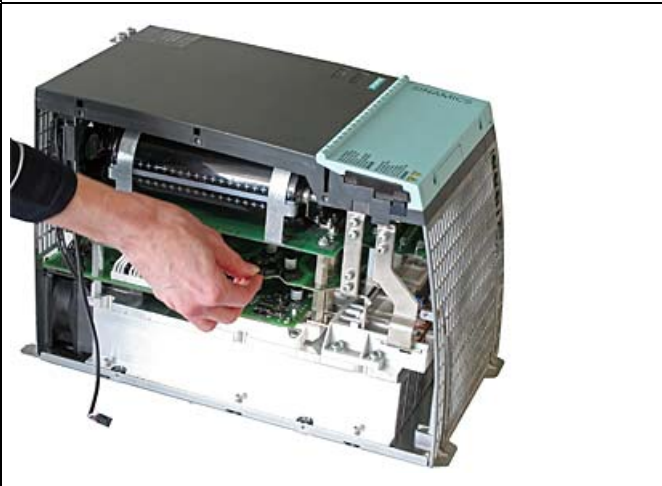
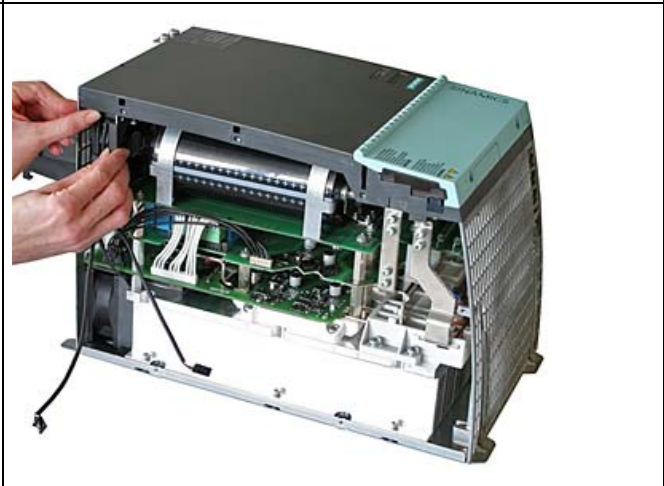
<ul style="list-style-type: none"> <li>Remove the component from the drive line-up.</li> <li>Loosen the six screws (Torx T10) of the enclosure cover and open the component</li> </ul>		
		
<ul style="list-style-type: none"> <li>Unlatch and pull out the plug connector</li> </ul>	<ul style="list-style-type: none"> <li>Loosen the two screws on the fan (Torx T20)</li> </ul>	<ul style="list-style-type: none"> <li>Remove the fan</li> </ul>
		

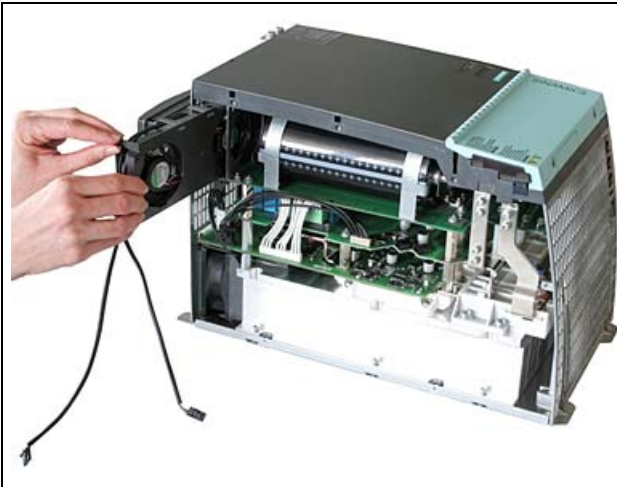
### Installing a fan

- Before installing the fan, check the air flow direction (the arrow on the fan must point towards the cooling ribs).
- Insert the connector until it fully engages.
- Screw in the two screws at the fan (Torx T20); tightening torque 1.2 Nm
- Close the enclosure cover and tighten the six screws (Torx T10); tightening torque 0.8 Nm

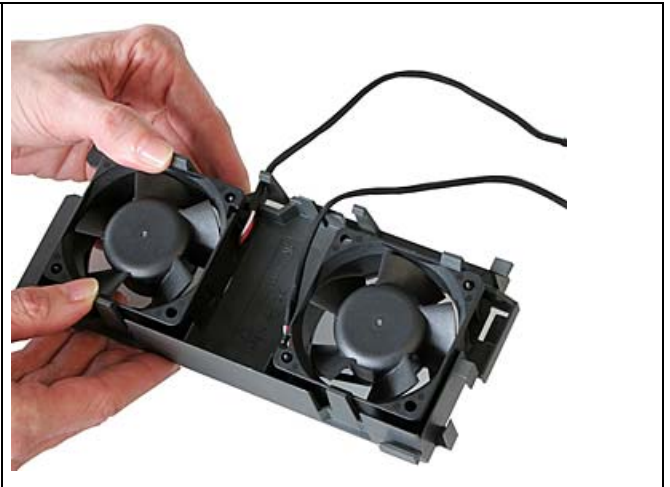
### 14.2.5 Replacing the fan on the 100 kW Basic Line Module for capacitor cooling

Table 14- 9 Removing the fan

	
<p>Open the right device cover by loosening the six marked screws</p>	<p>Pull the first fan cable by lightly pressing the connector together</p>
	
<p>Pull the second fan cable</p>	<p>Release the fan module</p>



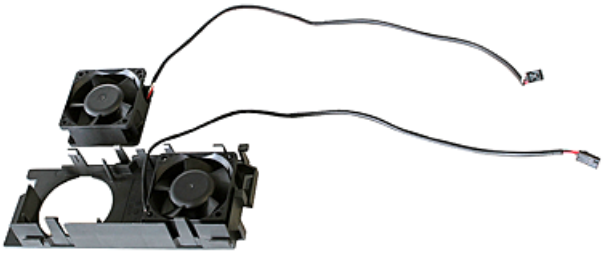
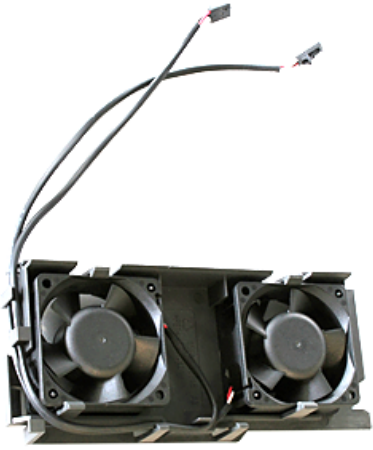
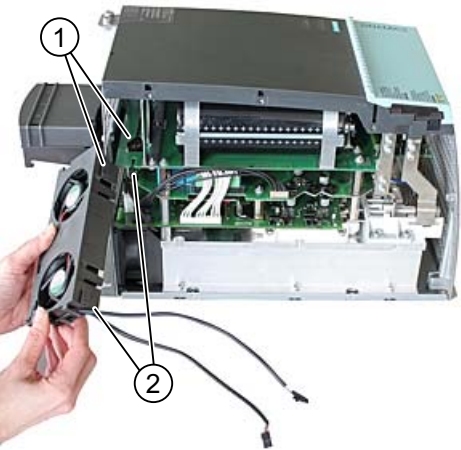
Completely pull out the fan module



Slightly push the fan holder apart and pull out the fan

14.2 Replacing the fan


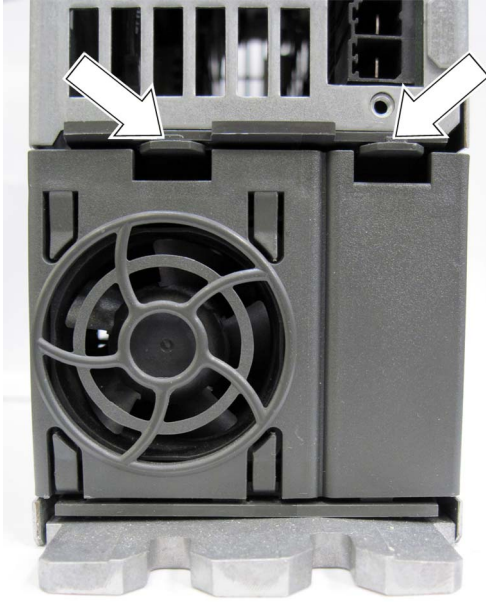
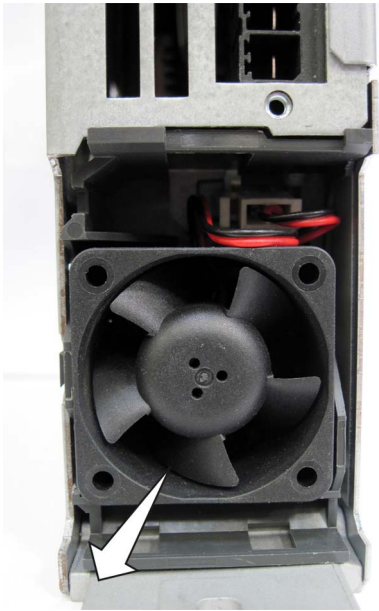
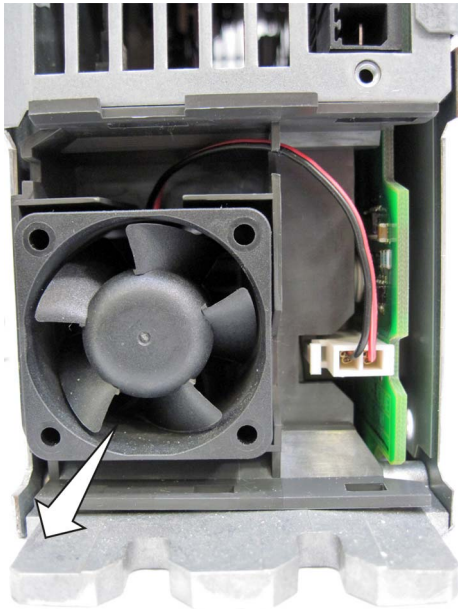
Table 14- 10 Installing a fan

	
<p>Observe the air flow direction markings when inserting the new fan</p>	<p>Observe the cable guide</p>
	<p>Connect the two fan cables. Close the enclosure cover and tighten the six screws, tightening torque: 0.8 Nm</p>
<p>Insert the fan holder into the guide rails ① and ②.</p>	



## 14.2.6 Replacing the fan for Booksize Compact components

Table 14- 11 Removing the fan

Size 50 mm	Size 75 mm
<ul style="list-style-type: none"><li>Remove the component from the drive line-up</li></ul>	
	
<ul style="list-style-type: none"><li>Remove the fan cover at the lower side of the component by releasing the snap hook</li></ul>	
	
<ul style="list-style-type: none"><li>Carefully remove the fan</li></ul>	

14.2 Replacing the fan

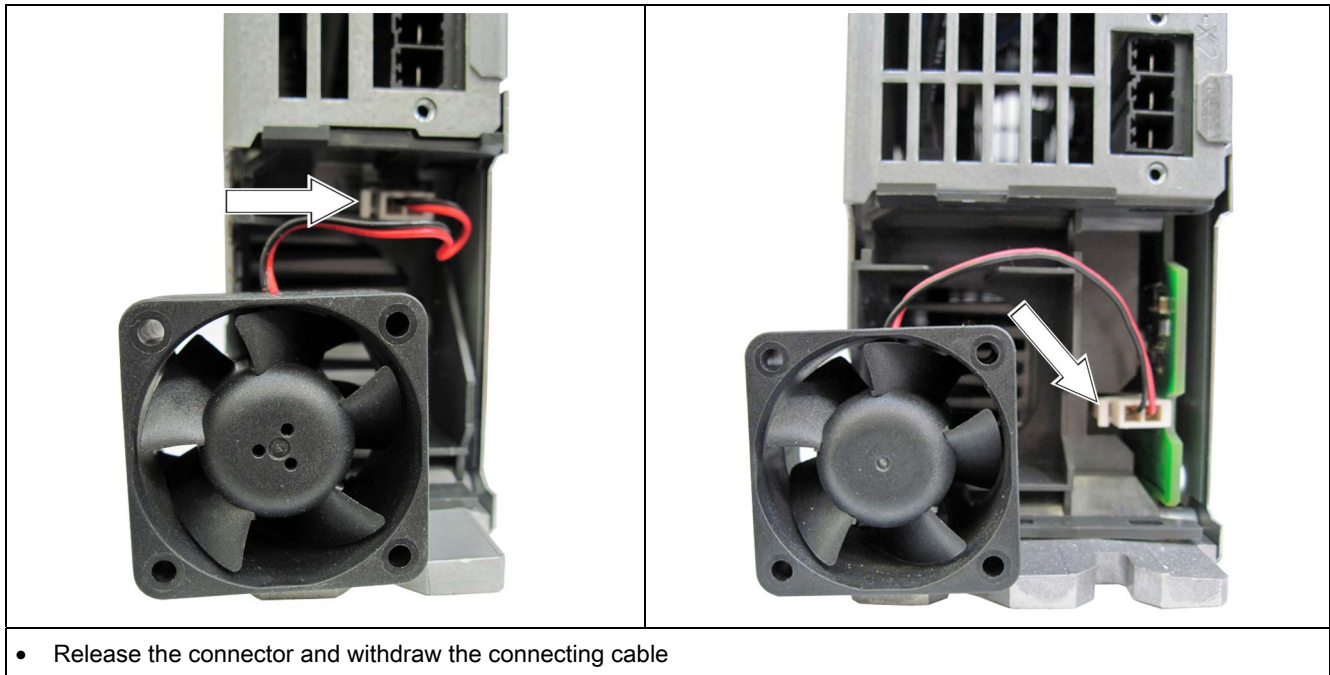
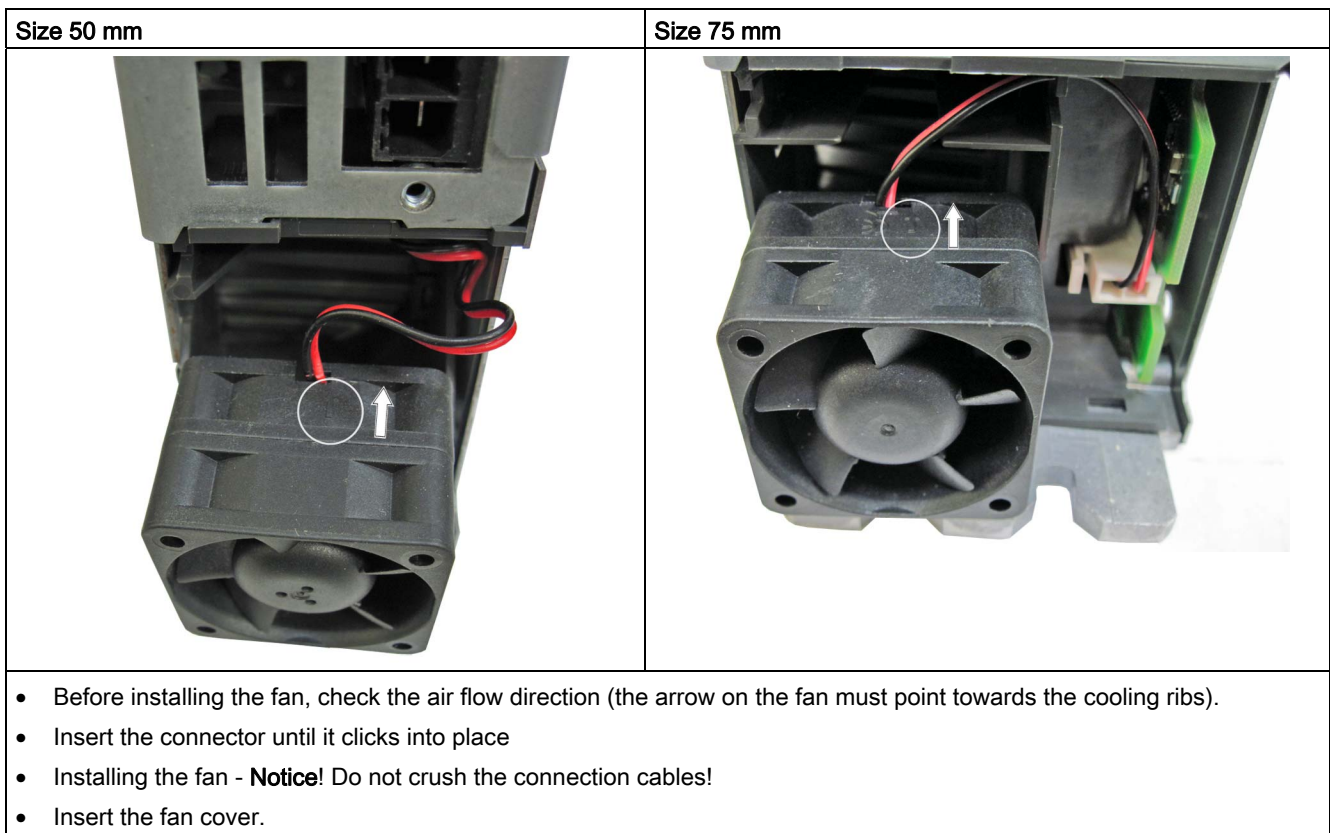


Table 14- 12 Installing a fan



## 14.3 Forming the DC link capacitors

### Description

If the Line Modules and Motor Modules are kept in storage for more than two years, the DC link capacitors have to be reformed. If this is not performed, the units could be damaged when they are switched on.

If the cabinet is commissioned within two years of its date of manufacture, the DC link capacitors do not need to be reformed. The date of manufacture can be taken from the serial number on the rating plate.

---

### Note

It is important that the storage period is calculated from the date of manufacture and not from the date that the equipment was shipped.

---

### Rating plate

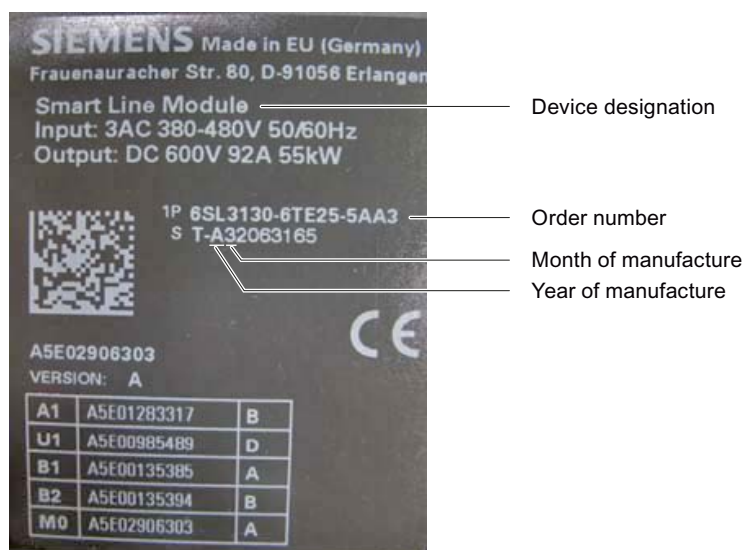


Figure 14-1 Rating plate using an Smart Line Module as example

**Date of manufacture**

The date of manufacture can be determined as follows:

Table 14- 13 Production year and month

Character	Year of manufacture	Character	Month of manufacture
S	2004	1 to 9	January to September
T	2005	O	October
U	2006	N	November
V	2007	D	December
W	2008		
X	2009		
A	2010		
B	2011		
C	2012		
D	2013		
E	2014		

The serial number is found on the rating plate.


**Forming circuit**

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.

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<sup>2</sup>
- 3 PTC resistors 350 R / 35 W  
(recommendation: PTC-35W PTC800620-350 Ohm, Michael Koch GmbH)
- 3 incandescent lamps 230 V / 100 W
- Various Small components, such as lamp socket, etc.

 <b>DANGER</b>
<p>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.</p>

**Note**

Line Modules must be enabled from the connected Motor Module.

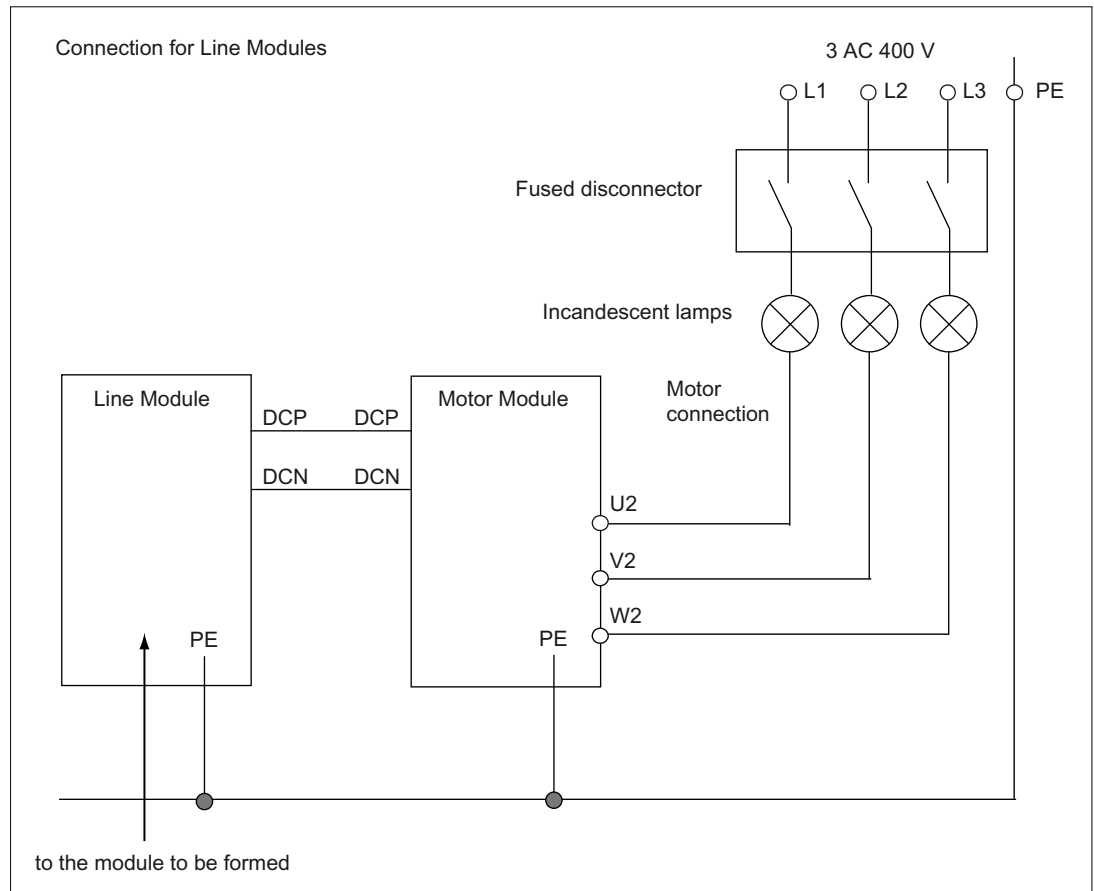


Figure 14-2 Forming circuit for Line Modules with incandescent lamps

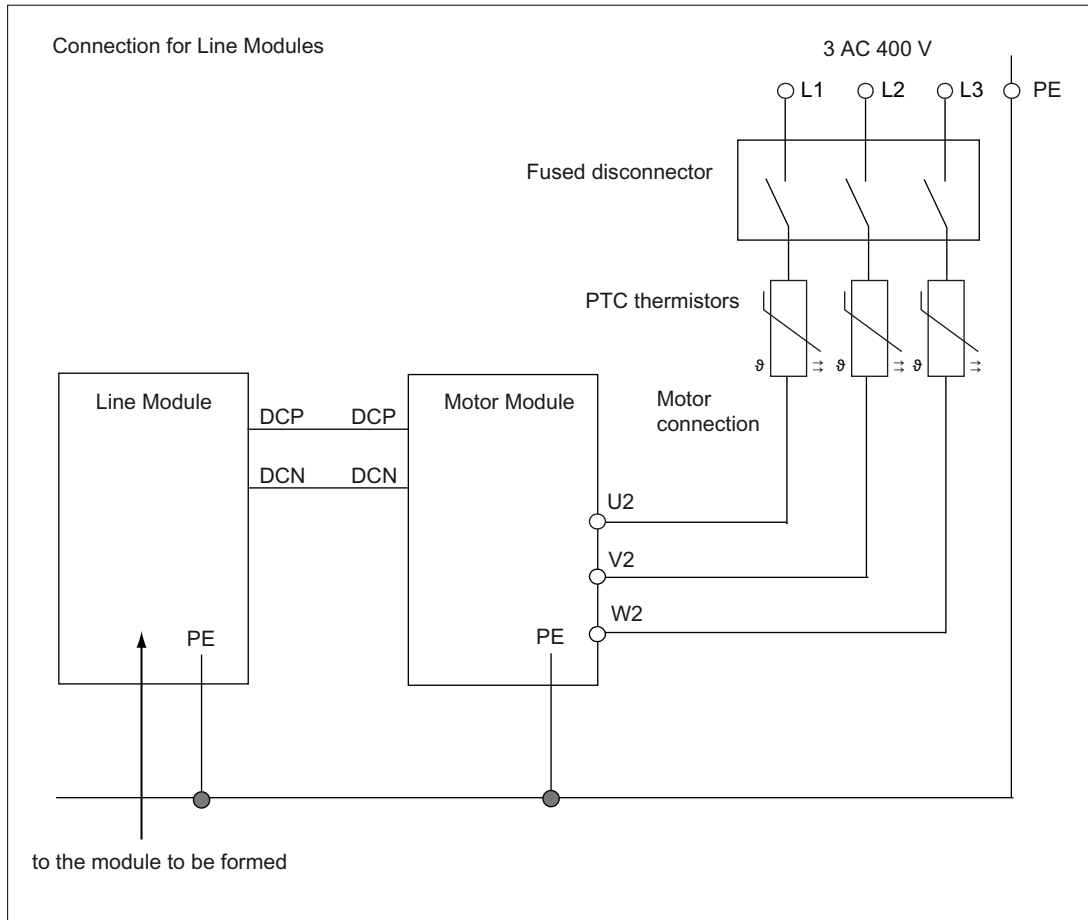


Figure 14-3 Forming circuit for Line Modules with PTC resistors

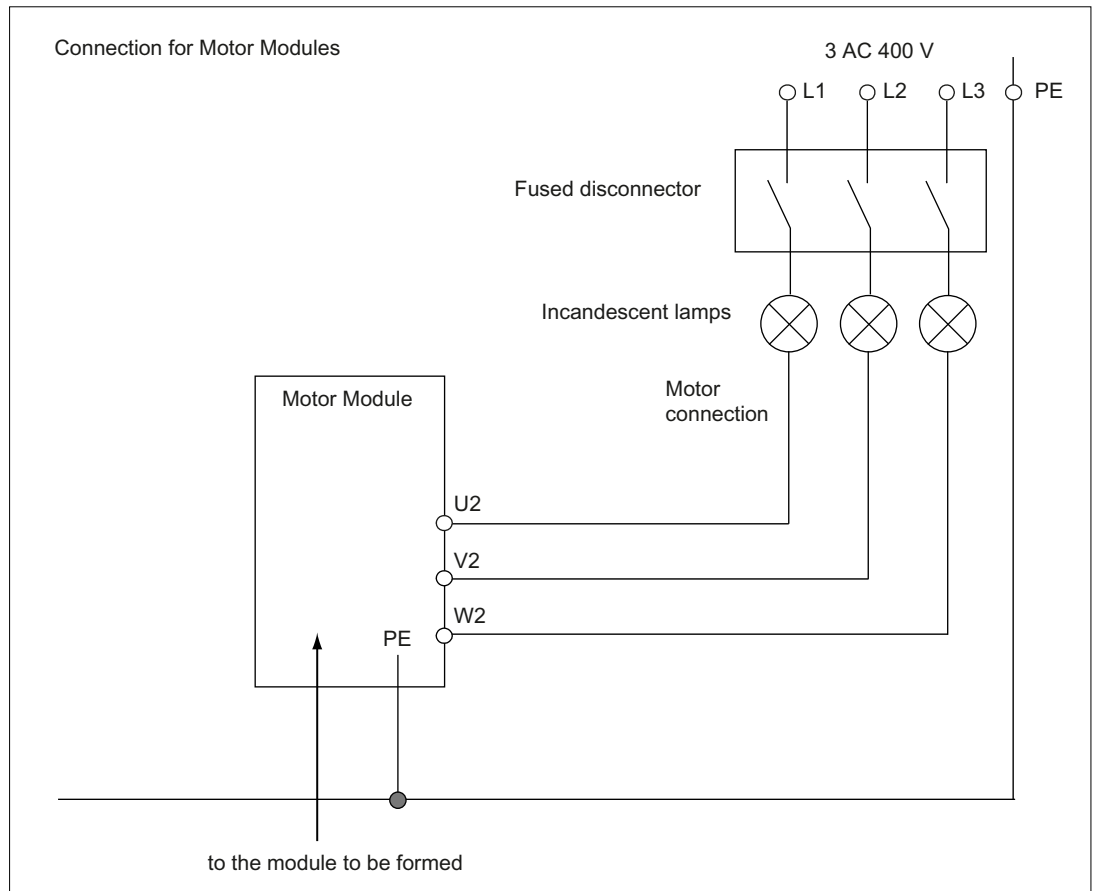


Figure 14-4 Forming circuit for Motor Modules with incandescent lamps

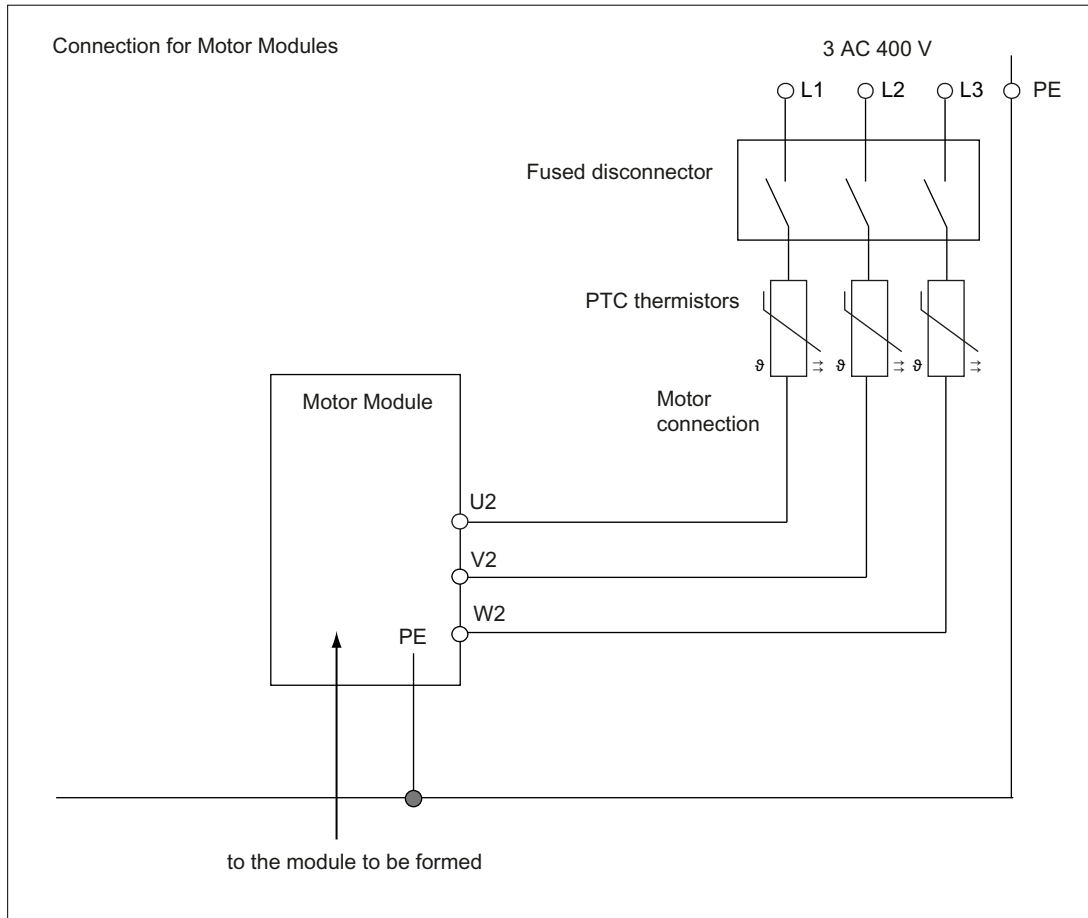


Figure 14-5 Forming circuit for Motor Modules with PTC resistors

### Procedure

- Be sure to remove the DC link bridge before forming the DC link capacitors.
- Make sure that the device **does not** receive a power-on command (e.g. from the keyboard, BOP20 or terminal block).
- Connect the forming circuit.
- While forming, the incandescent lamps must become less bright or go completely dark. If the incandescent lamps continue to be brightly lit, a fault has occurred in the drive unit or in the wiring.
- 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).



## **14.4 Recycling and disposal**

The applicable national guidelines must be observed when disposing of the product.

The products described in this Equipment Manual are extensively recyclable on account of the low-toxic composition of the materials used. For environmentally-compliant recycling and disposal of your electronic waste, please contact a company for the disposal of electronic waste.



## Appendix A

### A.1 List of abbreviations

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**Note:**

The following list of abbreviations includes all abbreviations and their meanings used in the entire SINAMICS user documentation.

---

Abbreviation	Source of abbreviation	Meaning
<b>A</b>		
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	Asynchronmotor	Induction motor
<b>B</b>		
BERO	-	Contactless proximity switch
BI	Binector Input	Binector input
BIA	Berufsgenossenschaftliches Institut für Arbeitssicherheit	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

## Appendix A

### A.1 List of abbreviations

---

<b>Abbreviation</b>	<b>Source of abbreviation</b>	<b>Meaning</b>
<b>C</b>		
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
CDC	Crosswise data comparison	Crosswise data comparison
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
<b>D</b>		
DAC	Digital Analog Converter	Digital analog converter
DC	Direct Current	DC current
DC link	DC link	DC link
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

<b>Abbreviation</b>	<b>Source of abbreviation</b>	<b>Meaning</b>
DP	Decentralized Peripherals	Distributed IOs
DPRAM	Dual Ported Random Access Memory	Memory with dual access ports
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
<b>E</b>		
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
EMC	Electromagnetic compatibility	Electromagnetic compatibility
EN	European standard	European standard
EnDat	Encoder Data Interface	Encoder interface
EP	Enable Pulses	Pulse enable
EPOS	Einfachpositionierer	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
<b>F</b>		
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	Fremderregter Synchronmotor	Separately excited synchronous motor
FEPRAM	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

A.1 List of abbreviations

Abbreviation	Source of abbreviation	Meaning
FW	Firmware	Firmware
<b>G</b>		
GB	Gigabyte	Gigabyte
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
<b>H</b>		
HF	High Frequency	High frequency
HFD	Hochfrequenzdrossel	High-frequency reactor
HMI	Human Machine Interface	Human machine interface
HTL	High-Threshold Logic	Logic with a high fault threshold
HW	Hardware	Hardware
<b>I</b>		
I/O	Input/Output	Input/output
I2C	Inter-Integrated Circuit	Internal serial data bus
IASC	Internal Armature Short Circuit	Internal armature short circuit
IBN	Inbetriebnahme	Commissioning
ID	Identifier	Identification
IE	Industrial Ethernet	Industrial Ethernet
IEC	International Electrotechnical Commission	International Electrotechnical Commission
IF	Interface	Interface
IGBT	Insulated Gate Bipolar Transistor	Insulated gate bipolar transistor
IGCT	Integrated Gate-Controlled Thyristor	Semiconductor power switch with integrated control electrode
IL	Impulslöschung	Pulse 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
<b>J</b>		
JOG	Jogging	Jogging

Abbreviation	Source of abbreviation	Meaning
<b>K</b>		
KIP	Kinetische Pufferung	Kinetic buffering
Kp	-	Proportional gain
KTY	-	Special temperature sensor
<b>L</b>		
L	-	Formula symbol for inductance
LED	Light Emitting Diode	Light Emitting Diode
LIN	Linear motor	Linear motor
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
<b>M</b>		
M	-	Formula symbol for torque
M	Masse	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as GND)
MB	Megabyte	Megabyte
MCC	Motion Control Chart	Motion Control Chart
MDS	Motor Data Set	Motor data set
MLFB	Maschinenlesbare Fabrikatebezeichnung	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	Motorstromrichter	Motor-side converter
MT	Machine Tool	Machine tool
<b>N</b>		
N. C.	Not Connected	Not connected
N...	No Report	No message or internal message
NAMUR	Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie	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	Nullmarke	Zero mark
NO	Normally Open (contact)	NO contact

Abbreviation	Source of abbreviation	Meaning
NSR	Netzstromrichter	Line-side converter
NVRAM	Non-Volatile Random Access Memory	Non-volatile read/write memory
<b>O</b>		
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
<b>P</b>		
p...	-	Adjustable parameters
PB	PROFIBUS	PROFIBUS
PC	Position Controller	Position Controller
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	Permanenterregter Synchronmotor	Permanent-magnet synchronous motor
PG	Programmiergerät	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 Nutzerorganisation	PROFIBUS user organization
PPI	Point-to-Point Interface	Point-to-point interface
PRBS	Pseudo Random Binary Signal	White noise
PROFIBUS	Process Field Bus	Serial data bus
PS	Power Supply	Power supply
PSA	Power Stack Adapter	Power Stack Adapter
PTC	Positive Temperature Coefficient	Positive temperature coefficient
PTP	Point-To-Point	Point-to-Point
PWM	Pulse Width Modulation	Pulse width modulation
PZD	Prozessdaten	Process data
<b>R</b>		
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



<b>Abbreviation</b>	<b>Source of abbreviation</b>	<b>Meaning</b>
RFG	Ramp-Function Generator	Ramp-function generator
RJ45	Registered Jack 45	Term for an 8-pin socket system for data transmission with shielded or non-shielded multi-wire copper cables
RKA	Rückkühlanlage	Cooling unit
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	Raumzeigerapproximation	Space vector approximation
<b>S</b>		
S1	-	Uninterrupted duty
S3	-	Intermittent duty
SBC	Safe Brake Control	Safe brake control
SBH	Sicherer Betriebshalt	Safe operating stop
SBR	-	Safe acceleration monitoring
SCA	Safe Cam	Safe cam
SD Card	SecureDigital Card	Secure digital memory card
SE	Sicherer Software-Endschalter	Safe software limit switch
SG	Sicher reduzierte Geschwindigkeit	Safely reduced speed
SGA	Sicherheitsgerichteter Ausgang	Safety-related output
SGE	Sicherheitsgerichteter Eingang	Safety-related input
SH	Sicherer Halt	Safe standstill
SI	Safety Integrated	Safety Integrated
SIL	Safety Integrity Level	Safety Integrity Level
SLM	Smart Line Module	Smart Line Module
SLP	Safely-Limited Position	Safely-limited position
SLS	Safely Limited Speed	Safely limited speed
SLVC	Sensorless Vector Control	Vector control without encoder
SM	Sensor Module	Sensor Module
SMC	Sensor Module Cabinet	Sensor Module Cabinet
SME	Sensor Module External	Sensor Module External
SN	Sicherer Software-Nocken	Safe software cam
SOS	Safe Operating Stop	Safe operating stop

A.1 List of abbreviations

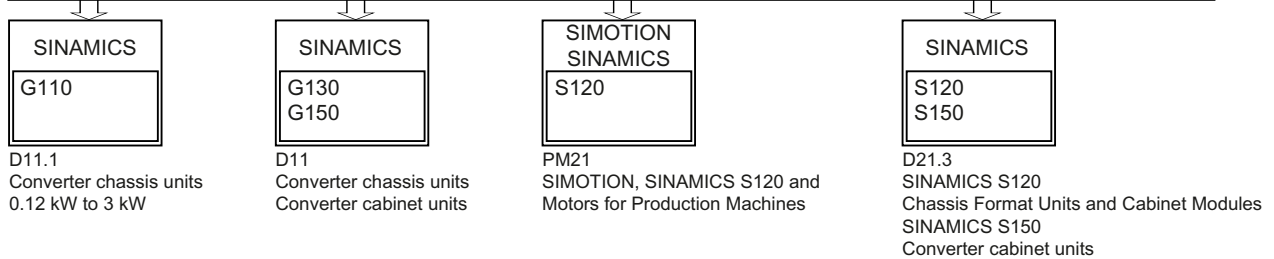
<b>Abbreviation</b>	<b>Source of abbreviation</b>	<b>Meaning</b>
SP	Service Pack	Service pack
SPC	Setpoint Channel	Setpoint channel
SPI	Serial Peripheral Interface	Serial interface for connecting peripherals
SS1	Safe Stop 1	Safe stop 1 (monitored for time and ramping up)
SS2	Safe Stop 2	Safe stop 2
SSI	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	Steuerwort	Control word
<b>T</b>		
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
<b>U</b>		
u.d.	under development	Under development: This feature is not currently available
UL	Underwriters Laboratories Inc.	Underwriters Laboratories Inc.
UPS	Uninterruptible Power Supply	Uninterruptible power supply
UTC	Universal Time Coordinated	Universal time coordinated
<b>V</b>		
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

<b>Abbreviation</b>	<b>Source of abbreviation</b>	<b>Meaning</b>
<b>X</b>		
XML	Extensible Markup Language	Standard language for Web publishing and document management
<b>Z</b>		
ZM	Zero Mark	Zero mark
ZSW	Zustandswort	Status word

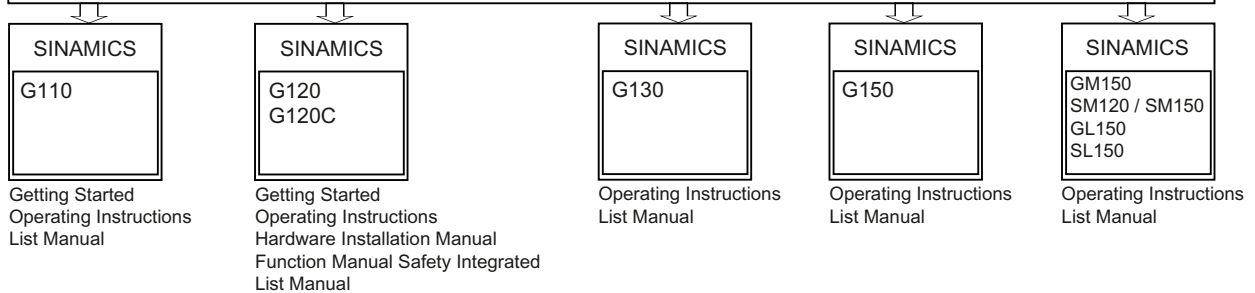


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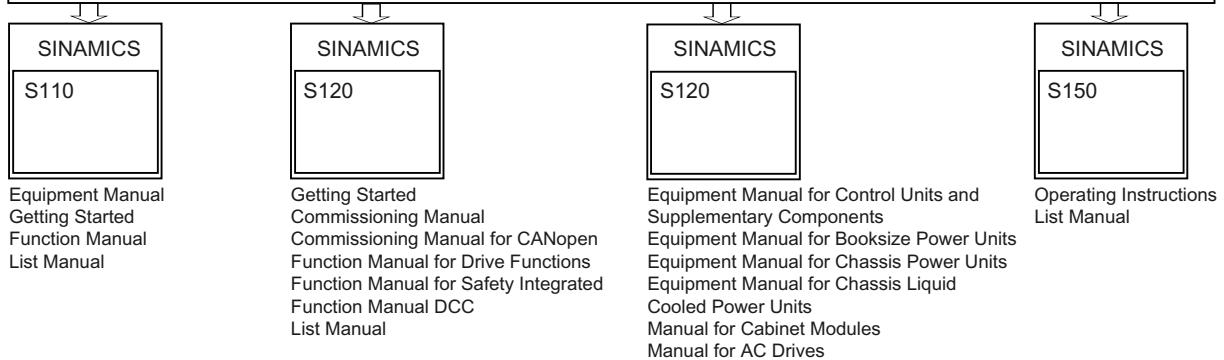
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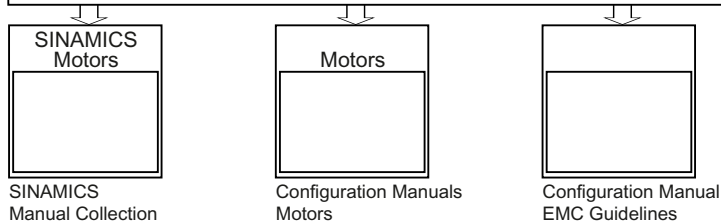
**Manufacturer / service documentation**



**Manufacturer / service documentation**



**Manufacturer / service documentation**





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Siemens AG  
Industry Sector  
Drive Technologies  
Motion Control Systems  
Postfach 3180  
91050 ERLANGEN  
GERMANY

[www.siemens.com/motioncontrol](http://www.siemens.com/motioncontrol)

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