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SINAMICS S120

Booksize Power Units

Manual

Edition 04/2014

Answers for industry.

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SINAMICS

S120
Booksize Power Units

Manual

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(GH2), 04/2014
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Legal information

Warning notice system

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

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

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

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

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

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

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Preface

Preface SINAMICS general

SINAMICS documentation

The SINAMICS documentation is organized in the following categories:

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

Additional information

The following link provides information on the topics:

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

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

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

docu.motioncontrol@siemens.com

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

http://support.automation.siemens.com

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SINAMICS

You can find information on SINAMICS at:

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

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

Table 1 Usage phases and the available documents/tools

Usage phase	Document/tool
Orientation	SINAMICS S Sales Documentation
Planning/configuration	• SIZER Engineering Tool • Configuration Manuals, Motors
Deciding/ordering	SINAMICS S120 catalogs • SIMOTION, SINAMICS S120 and Motors for Production Machines (Catalog PM 21) • SINAMICS and Motors for Single-axis Drives (Catalog D 31) • SINUMERIK & SINAMICS Equipment for Machine Tools (Catalog NC 61) • SINUMERIK 840D sl Type 1B Equipment for Machine Tools (Catalog NC 62)
Installation/assembly	• SINAMICS S120 Equipment Manual for Control Units and Additional System Components • SINAMICS S120 Equipment Manual for Booksize Power Units • SINAMICS S120 Equipment Manual for Chassis Power Units • SINAMICS S120 Equipment Manual for AC Drives • SINAMICS S120M Equipment Manual Distributed Drive Technology • SINAMICS HLA System Manual Hydraulic Drive
Commissioning	• STARTER Commissioning Tool • SINAMICS S120 Getting Started • SINAMICS S120 Commissioning Manual • SINAMICS S120 CANopen Commissioning Manual • SINAMICS S120 Function Manual • SINAMICS S120 Safety Integrated Function Manual • SINAMICS S120/S150 List Manual • SINAMICS HLA System Manual Hydraulic Drive
Usage/operation	• SINAMICS S120 Commissioning Manual • SINAMICS S120/S150 List Manual • SINAMICS HLA System Manual Hydraulic Drive

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Usage phase	Document/tool
Maintenance/servicing	• SINAMICS S120 Commissioning Manual • SINAMICS S120/S150 List Manual
References	• SINAMICS S120/S150 List Manual

Target group

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

Benefits

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

Standard scope

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

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

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

Technical Support

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

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

EC Declaration of Conformity

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

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

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

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Note

Complying with the low-voltage directive

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

Note

Fulfilling the EMC Directive

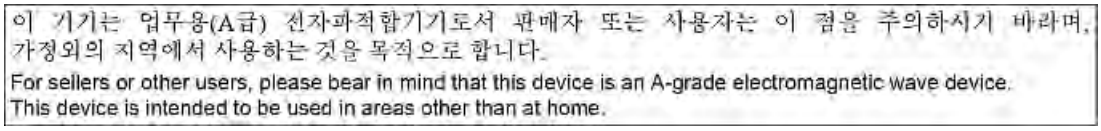
SINAMICS S units fulfill EMC Directive 2004/108/EC in the configuration specified in the associated EC Declaration of Conformity for EMC and when the EMC installation guideline provided in the Configuration Manual with Order No. 6FC5297-0AD30-0AP3 is implemented.

Note

Ensuring reliable operation

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

EMC limit values in South Korea



The EMC limit values to be complied with for South Korea correspond to the limit values of the EMC product standard for variable-speed electric drives EN 61800-3, Category C2 or limit value class A, Group 1 according to EN 55011. By applying suitable supplementary measures, the limit values according to Category C2 or according to limit value class A, Group 1, are maintained. Further, additional measures may be required, for instance, using an additional radio interference suppression filter (EMC filter).
The measures for EMC-compliant design of the system are described in detail in this manual respectively in the EMC Installation Guideline Configuration Manual.
The final statement regarding compliance with the standard is given by the respective label attached to the individual unit.

Spare parts

Spare parts are available on the Internet at:

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

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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

1.1 General safety instructions



DANGER

Danger to life due to live parts and other energy sources

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

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

Generally, six steps apply when establishing safety:

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

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



WARNING

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

Touching live components can result in death or severe injury.

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

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⚠WARNING

Danger to life when live parts are touched on damaged devices

Improper handling of devices can cause damage.

For damaged devices, hazardous voltages can be present at the enclosure or at exposed components; if touched, this can result in death or severe injury.

- Ensure compliance with the limit values specified in the technical data during transport, storage and operation.
- Do not use any damaged devices.



⚠WARNING

Danger to life through electric shock due to unconnected cable shields

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

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



⚠WARNING

Danger to life due to electric shock when not grounded

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

- Ground the device in compliance with the applicable regulations.



⚠WARNING

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

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

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

⚠WARNING

Danger to life due to fire spreading if housing is inadequate

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

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

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⚠WARNING

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

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

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

⚠WARNING

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

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

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

⚠WARNING

Danger to life due to fire if overheating occurs because of insufficient ventilation clearances

Inadequate ventilation clearances can cause overheating of components with subsequent fire and smoke. This can cause severe injury or even death. This can also result in increased downtime and reduced service lives for devices/systems.

- Ensure compliance with the specified minimum clearance as ventilation clearance for the respective component.

⚠WARNING

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

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

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

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NOTICE

Device damage caused by incorrect voltage/insulation tests

Incorrect voltage/insulation tests can damage the device.

- Before carrying out a voltage/insulation check of the system/machine, disconnect the devices as all converters and motors have been subject to a high voltage test by the manufacturer, and therefore it is not necessary to perform an additional test within the system/machine.

⚠ WARNING

Danger to life when safety functions are inactive

Safety functions that are inactive or that have not been adjusted accordingly can cause operational faults on machines that could lead to serious injury or death.

- Observe the information in the appropriate product documentation before commissioning.
- Carry out a safety inspection for functions relevant to safety on the entire system, including all safety-related components.
- Ensure that the safety functions used in your drives and automation tasks are adjusted and activated through appropriate parameterizing.
- Perform a function test.
- Only put your plant into live operation once you have guaranteed that the functions relevant to safety are running correctly.

Note

Important safety notices for safety functions

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

1.2 Safety instructions for electromagnetic fields (EMF)



⚠ 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.

- Ensure that the persons involved are the necessary distance away (minimum 2 m).

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1.3 Handling electrostatic sensitive devices (ESD)

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



NOTICE

Damage through electric fields or electrostatic discharge

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

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

1.4 Industrial security

Note

Industrial security

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

Information and newsletters can be found at:

http://support.automation.siemens.com

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

For more detailed information, go to:

http://www.siemens.com/industrialsecurity

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⚠WARNING

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

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

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

1.5 Residual risks of power drive systems

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

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

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

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

1. Unintentional movements of driven machine components during commissioning, operation, maintenance, and repairs caused by, for example:
   - Hardware defects and/or software errors in the sensors, controllers, actuators, and connection technology
   - Response times of the controller and drive
   - Operating and/or ambient conditions outside of the specification
   - Condensation / conductive contamination
   - Parameterization, programming, cabling, and installation errors
   - Use of radio devices / cellular phones in the immediate vicinity of the controller
   - External influences / damage

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2. In the event of a fault, exceptionally high temperatures, including an open fire, as well as emissions of light, noise, particles, gases, etc. can occur inside and outside the inverter, e.g.:
   - Component malfunctions
   - Software errors
   - Operating and/or ambient conditions outside of the specification
   - External influences / damage

   Inverters of the Open Type / IP20 degree of protection must be installed in a metal control cabinet (or protected by another equivalent measure) such that the contact with fire inside and outside the inverter is not possible.
3. Hazardous shock voltages caused by, for example:
   - Component malfunctions
   - Influence of electrostatic charging
   - Induction of voltages in moving motors
   - Operating and/or ambient conditions outside of the specification
   - Condensation / conductive contamination
   - External influences / damage
4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc. if they are too close.
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly.

Note

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

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

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

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System overview

2

2.1 Field of application

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

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

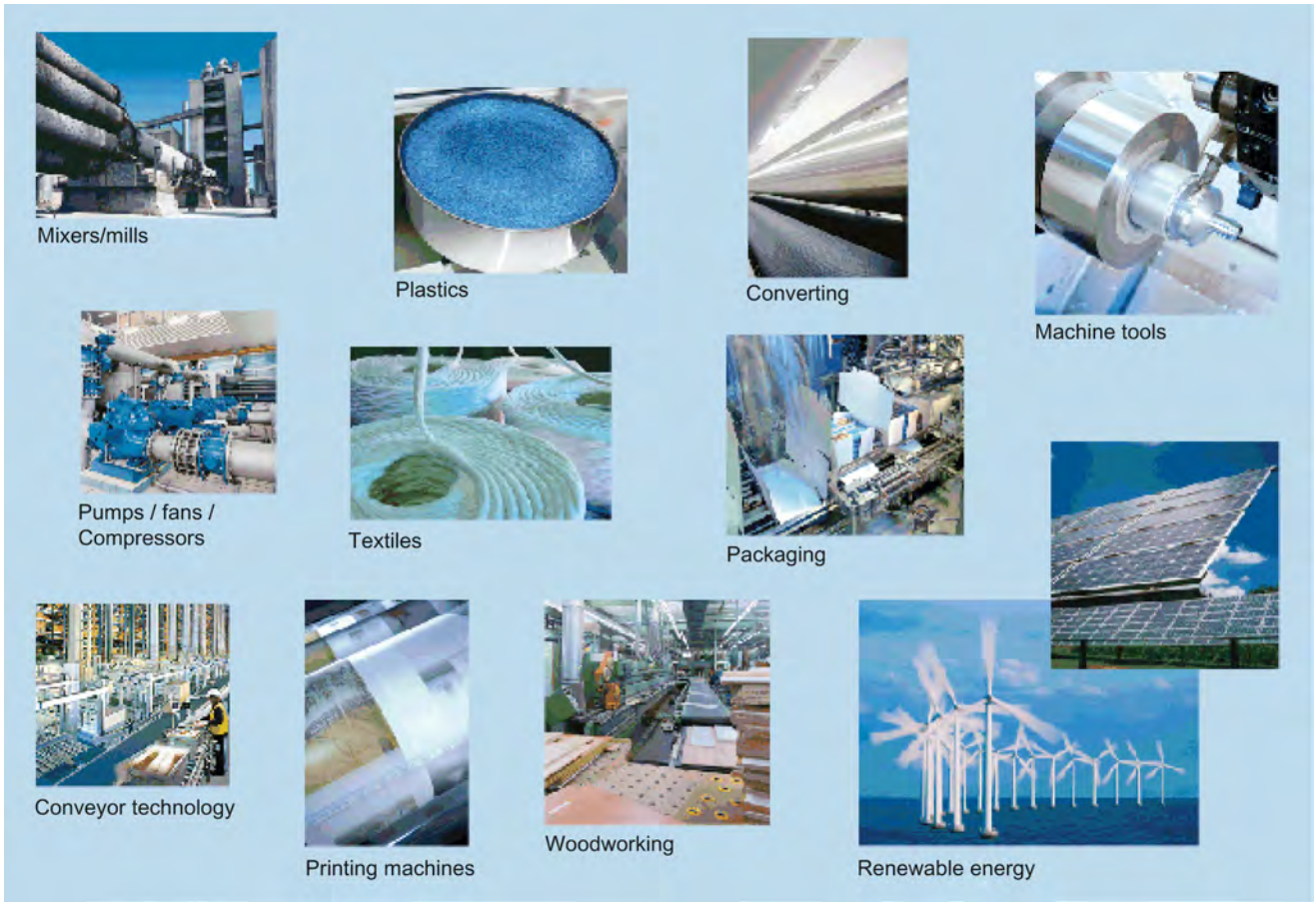


Figure 2-1 SINAMICS applications

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

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

2.2 Platform Concept and Totally Integrated Automation

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

Totally Integrated Automation (TIA) with SINAMICS S120

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

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

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

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

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

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2.3 Introduction

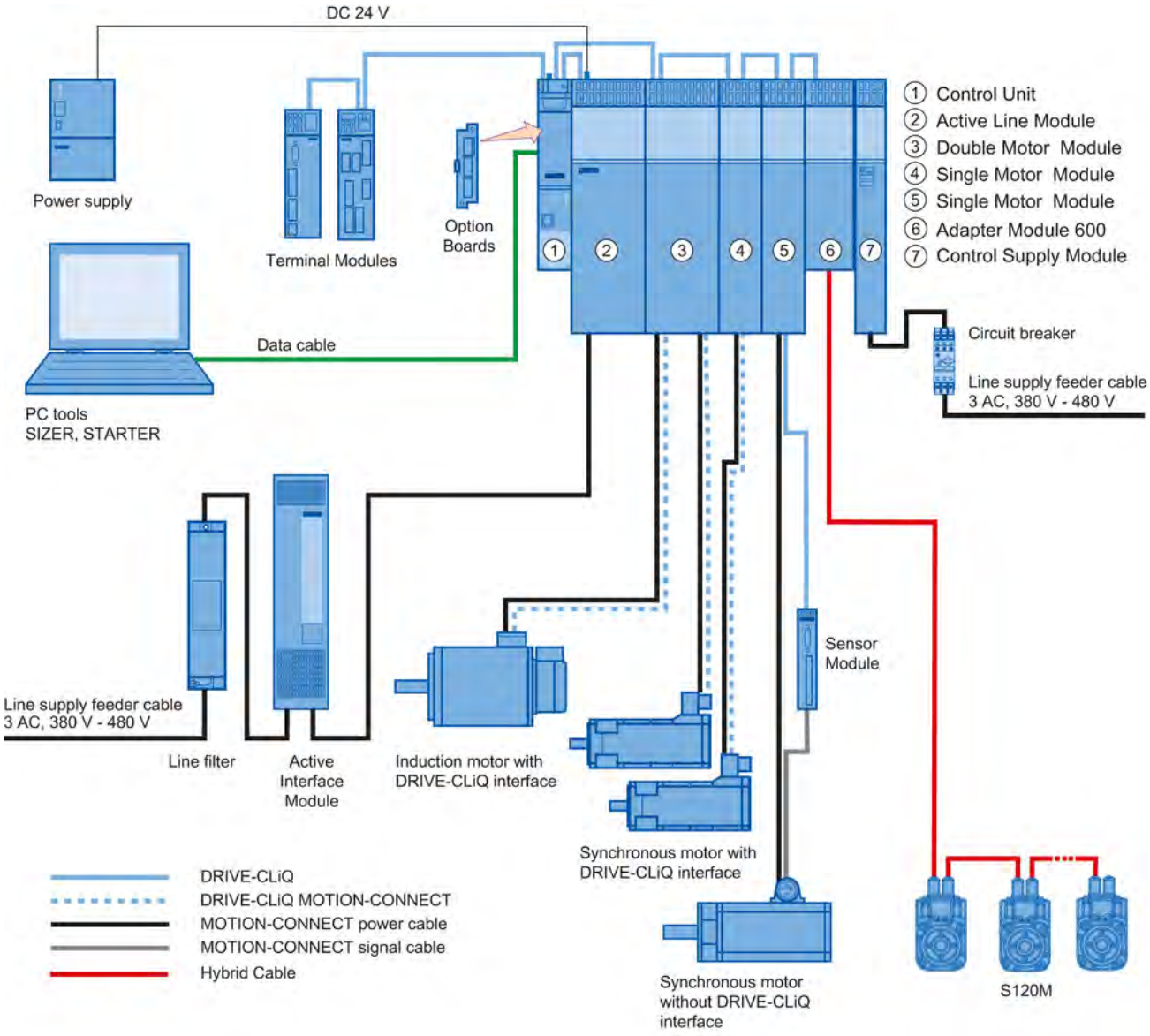


Figure 2-3 SINAMICS S120 system overview

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.

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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.

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2.4 SINAMICS S120 components

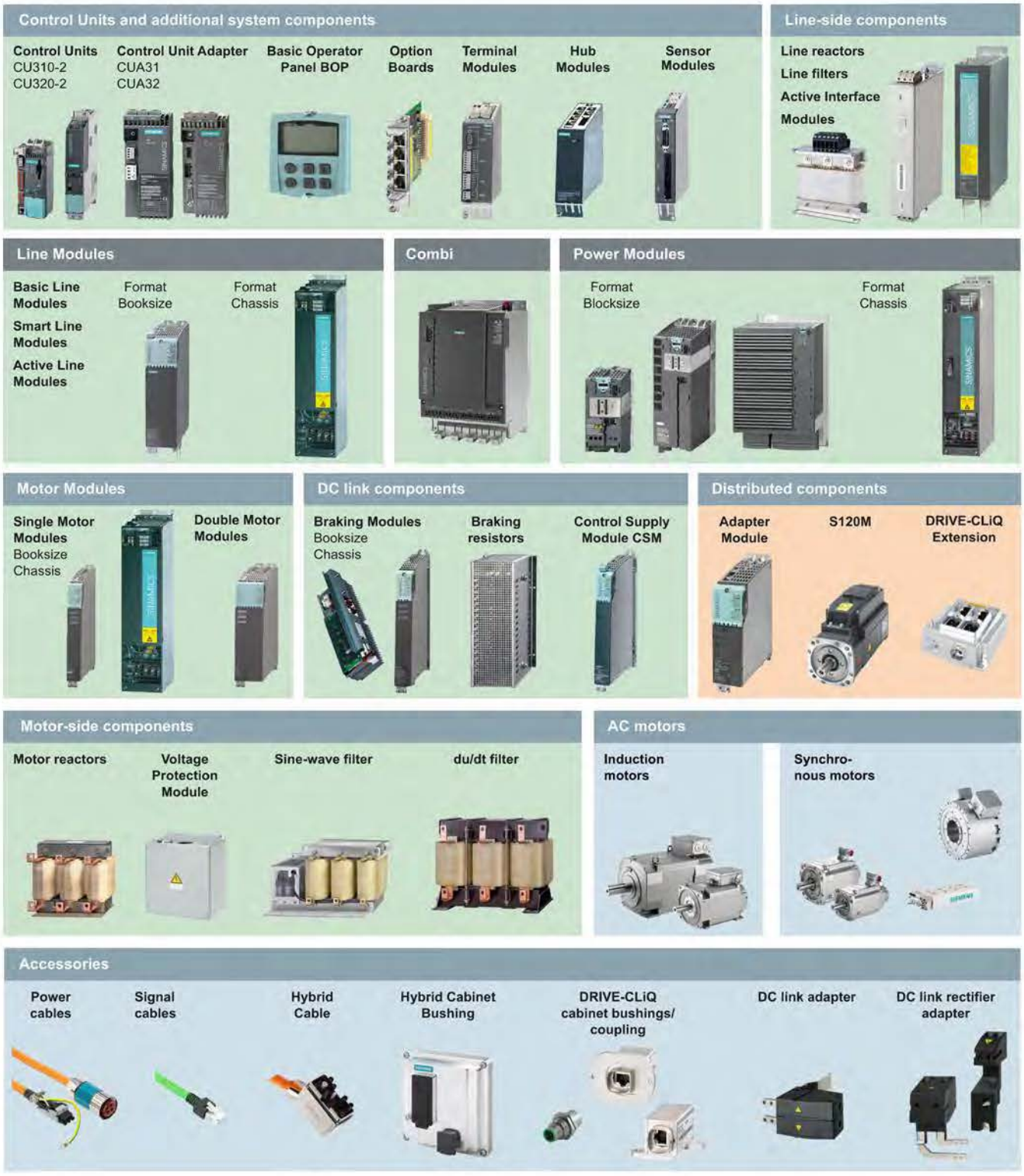


Figure 2-4 Overview of SINAMICS S120 components

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System components

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

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

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

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

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

Note

Installation location in the cabinet

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

Booksize format

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

The booksize format offers various cooling options:

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

Booksize compact format

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

The booksize compact format offers the following cooling options:

- Internal air cooling
- Cold plate cooling

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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.

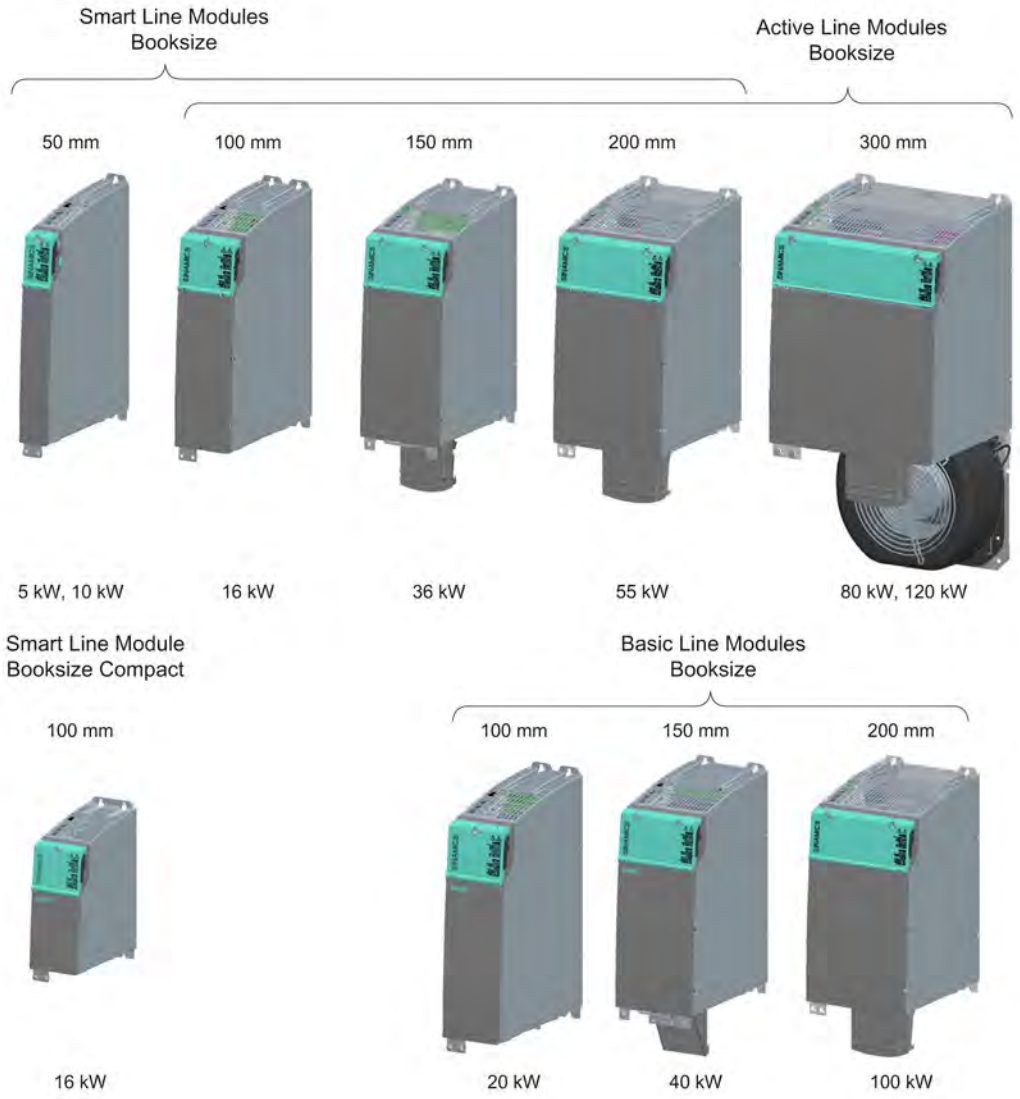


Figure 2-5 Overview of Line Modules

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General characteristics of the Line Modules

- Supply voltage, 3 AC 380 V to 480 V ±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.

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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:

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

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

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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).

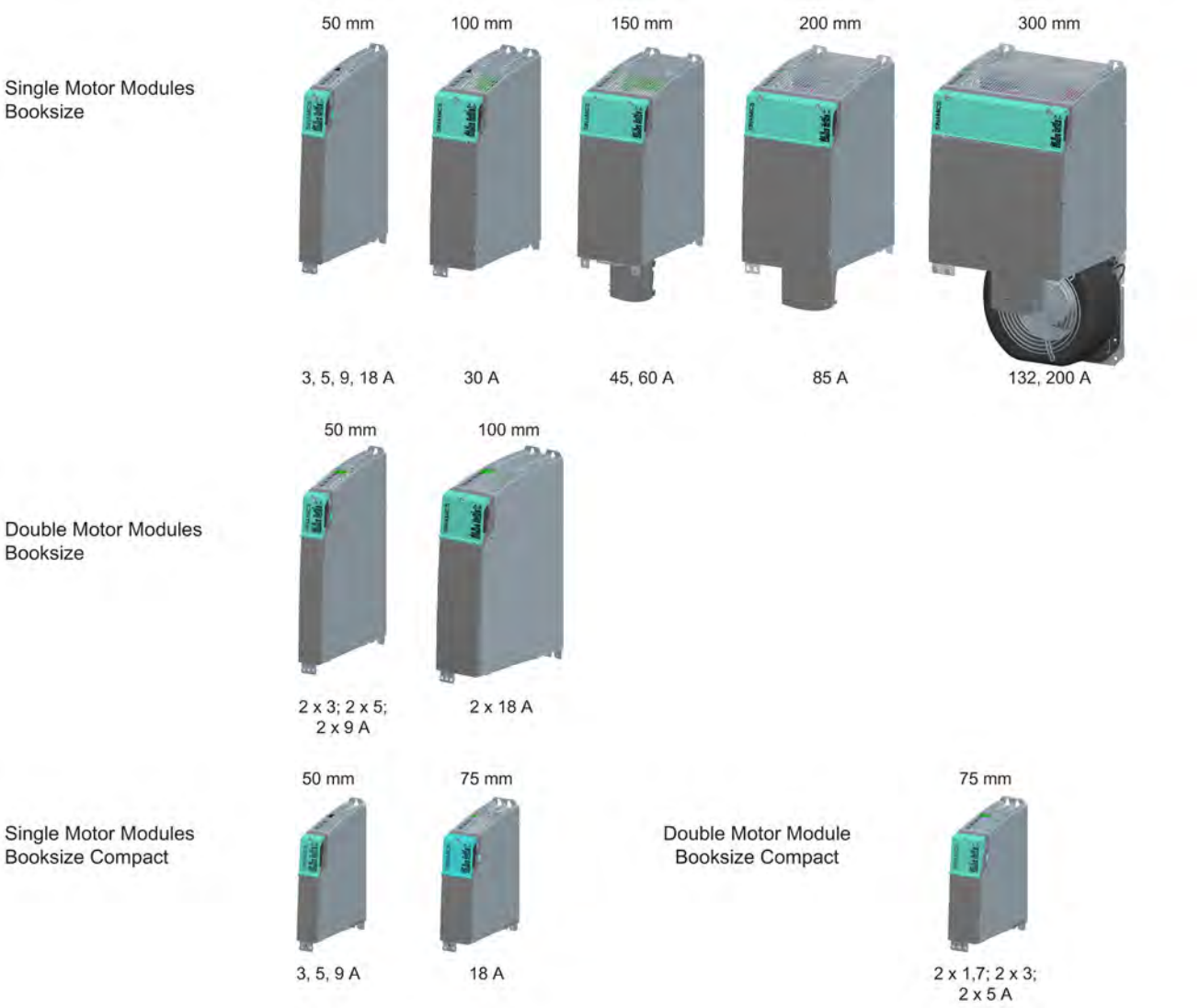


Figure 2-6 Overview of Motor Modules

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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

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2.5 System data

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

Table 2- 1 Electrical data

Line connection voltage	3 AC 380 … 480 V ±10 % (-15 % < 1 min)
Line frequency	47 … 63 Hz
Electronics power supply	24 V DC -15/+20 %[1], Safety extra-low voltage (PELV or SELV) (see Chapter 24 V DC supply voltage (Page 719))
Short-circuit current rating SCCR according to UL508C (up to 600 V)	• 1.1 … 447 kW: 65 kA • 448 … 671 kW: 84 kA • 672 … 1193 kW: 170 kA • ≥ 1194 kW: 200 kA
Radio interference suppression acc. to EN 61800-3	Category C2 (optional) for system versions conformant with documentation
Overvoltage category	III
Degree of contamination	2

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

Table 2- 2 Modules

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

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Table 2- 3 Environmental conditions

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

Table 2- 4 Certificates

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

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

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

Restrictions

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

Table 2- 5 Air pressure for various installation altitudes

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

Measures

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

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

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Line connection and line-side power components 3

3.1 Introduction

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

- Disconnector unit (for Active Line Modules, Basic Line Modules, Smart Line Modules)
- Overcurrent protection device (line fuse or circuit breaker)
- Line contactor (this is required for 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

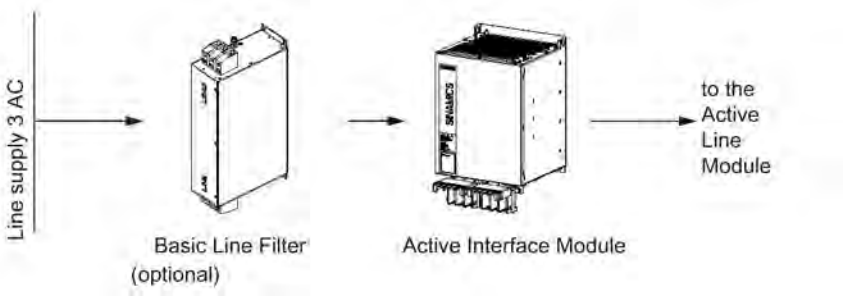


Figure 3-1 Overview diagram, line connection with Active Interface Module

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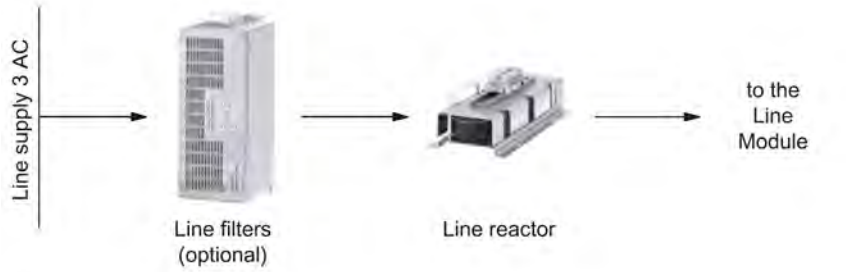


Figure 3-2 Overview diagram, line connection with line filter and line reactor

3.2 Information on the disconnector unit

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

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

NOTICE

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

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

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

The accessories required for the disconnector unit must be selected from the manufacturer catalogs. Refer also to catalogs PM21 and NC61.

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3.3 Overcurrent protection by means of line fuses and circuit breakers

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

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

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

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

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

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

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

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

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

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

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

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

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



WARNING

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

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

- To protect personnel and for fire protection purposes, at the infeed point, the short-circuit rating and loop impedance must correspond to the specifications in the documentation in order for the installed overcurrent protection devices to trip within the specified time.
- In addition to suitable overcurrent protection devices, in TT line systems use ground-fault circuit interrupters (residual current devices - RCD); from an infeed power of 55 kW or for plants and systems extending over a wide area, in addition also use differential current monitoring devices (residual current monitors - RCM).

Note

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

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3.4 Line supply connection via residual-current devices

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

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

3.4.1 Residual-current operated circuit breakers (RCD)

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

Note

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

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

- Only use a delayed tripping, selective AC/DC-sensitive residual-current operated circuit breaker, type B.
- Ensure that the loop impedance is maintained corresponding to local installation regulations.
- Check the total length of the shielded power cables (motor cables incl. line supply conductors from line filters to the connecting terminals of the Line Module) in the drive line-up. The total length must be less than 350 m.
- Only operate the system with the recommended line filters.
- If you connect residual-current devices in series, then they must all have the same characteristics.
- Ensure that the switching elements (disconnector unit, contactors) for connecting and disconnecting the drive system have max. 35 ms delay time between the closing/opening of the individual main contacts.

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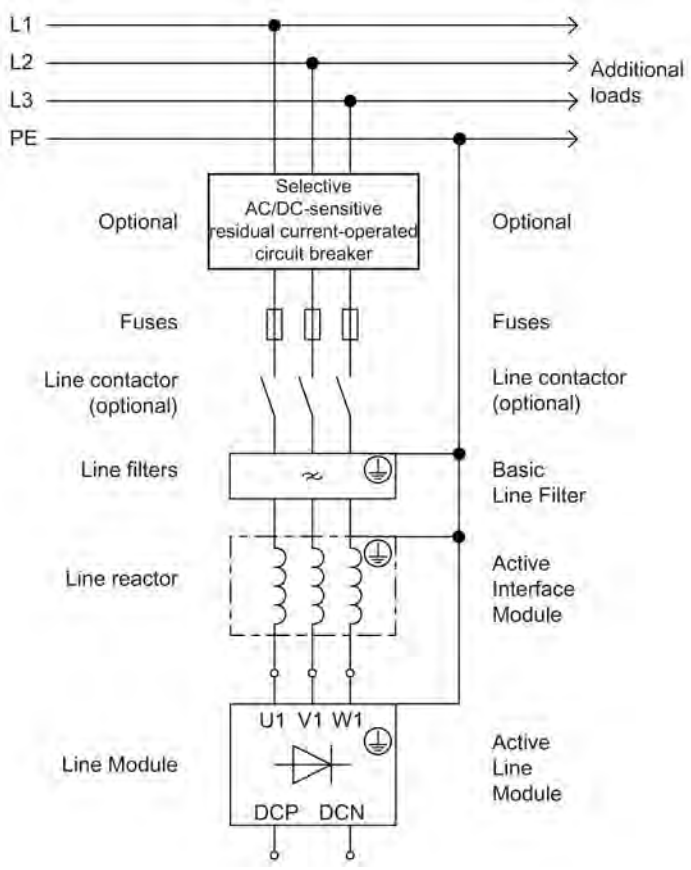


Figure 3-3 Connecting a residual-current operated circuit breaker

Recommendation

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

Note

AC or pulse-sensitive RCCBs are not suitable.

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3.4.2 Residual-current monitors (RCM)

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

⚠WARNING

Fire hazard and danger of a plant standstill when residual currents occur

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

- Always install residual-current monitors in conjunction with suitable circuit breakers.

Note the points below when using residual-current monitors:

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

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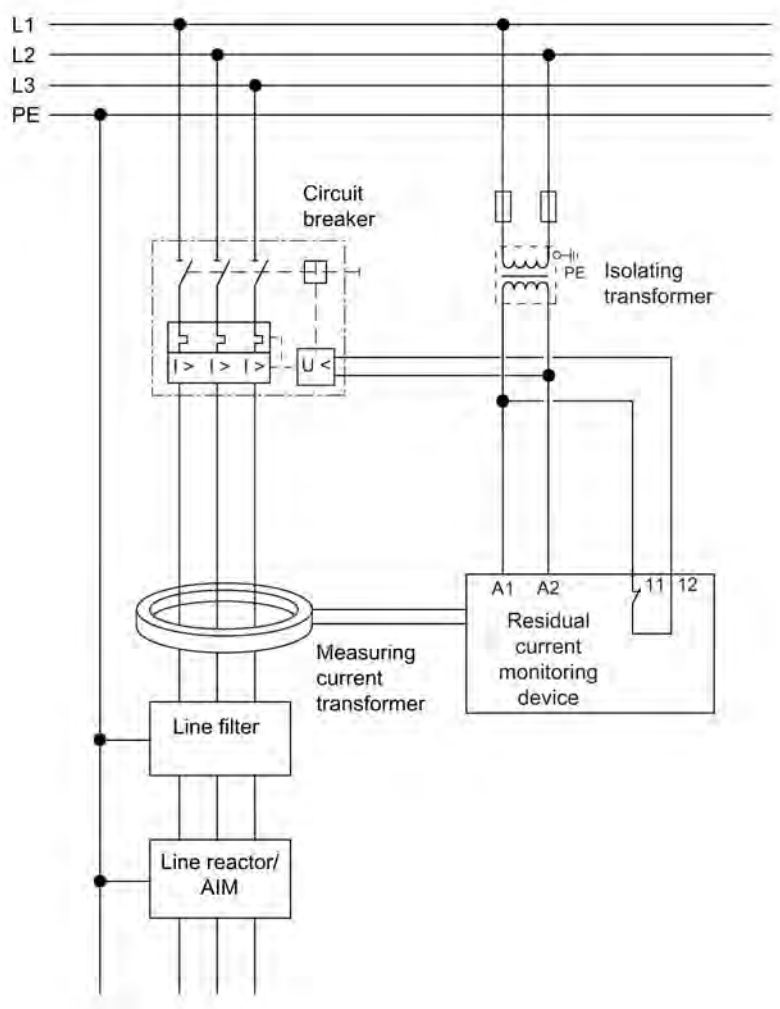


Figure 3-4 Connecting a differential current monitoring device

Recommendation

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

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3.5 Overvoltage protection

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

3.6 Line contactors

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

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

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

Note

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

Note

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

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

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3.7 Line filters

3.7.1 Safety instructions for line filters

⚠WARNING

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

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

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



⚠DANGER

Danger to life due to electric shock in the event of missing touch protection

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

- For the line filter, use touch protection according to IPXXA or corresponding to the local installation regulations.

⚠CAUTION

Risk of burns due to high surface temperatures of the line filter

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

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

NOTICE

Line filter damage by connecting to impermissible line supplies

Line filters are only suitable for direct connection to TN line supplies. Damage will occur if the line filter is connected to other line supplies.

- Only connect the line filter when TN line supplies are being used.

NOTICE

Line filter damage due to interchanged connections

The line filter will be damaged if the input and output connections are interchanged.

- Connect the incoming line supply cable to LINE L1, L2, L3.
- Connect the outgoing line to line reactor at LOAD L1´, L2´, L3´ (U, V, W).

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⚠WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

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

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

NOTICE

Damage to the system caused by a line filter that is not permissible

A line filter that is not permissible can cause system damage.

- Only use the line filter with the components specified in Chapter Combination options lined reactors and line filter (Page 136).

NOTICE

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

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

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

NOTICE

Destruction or damage to components by incorrectly connecting the line filter

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

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

Note

Disconnect the line filter for a high-voltage test

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

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Note

Length of connecting cables

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

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

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

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

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

3.7.2 Overview of line filters

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

NOTICE

Damage caused by connecting several loads to the same line infeed point

Damage can be caused if several loads are connected to the same line infeed point.

- Provide interference suppression for the other loads using appropriate line filters. To prevent mutual interference, it is not permissible that this line filter is equipped with capacitors with respect to ground. Filter series B84144A*R120 (EPCOS) is recommended.

NOTICE

Damage caused by using third party filters

According to product standard EN 61800-3, RFI suppression commensurate with the relevant rated conditions must be provided and is a legal requirement in the EU (EMC Directive). Line filters and line reactors are required in order to comply with this standard. The use of filters of other makes can lead to limit value violations, resonances, overvoltages, and irreparable damage to motors or other equipment.

- The machine manufacturer must provide verification that the machine equipped with the drive products and the installed suppression elements, e.g. line filters, is EMC-compliant before the machines are placed in the market.

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

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

Table 3- 4 Overview of line filters

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

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3.7.3 Basic Line Filters for Active Line Modules

3.7.3.1 Description

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

Basic Line Filters can be used in conjunction with a line reactor for 16 kW, 36 kW, and 55 kW Active Line Modules or with an Active Interface Module for 16 kW, 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules. Assuming that an EMC-compatible design is used, the interference voltage categories listed below will be achieved (see also Chapter Possible line reactor and line filter combinations (Page 136)).

Basic Line Filter for Active Line Modules and line reactor

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

Basic Line Filters for Active Line Modules and Active Interface Modules

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

Note

Use of unshielded cables for short distances

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

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

- The machine/system must only be used in industrial line supplies
- Only connect the Basic Line Filters to TN systems; otherwise an isolating transformer will be required
- Number of axes ≤ 12 when using a Basic Line Filter with an Active Line Module and a line reactor

Note

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

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

3.7.3.2 Interface description

Overview

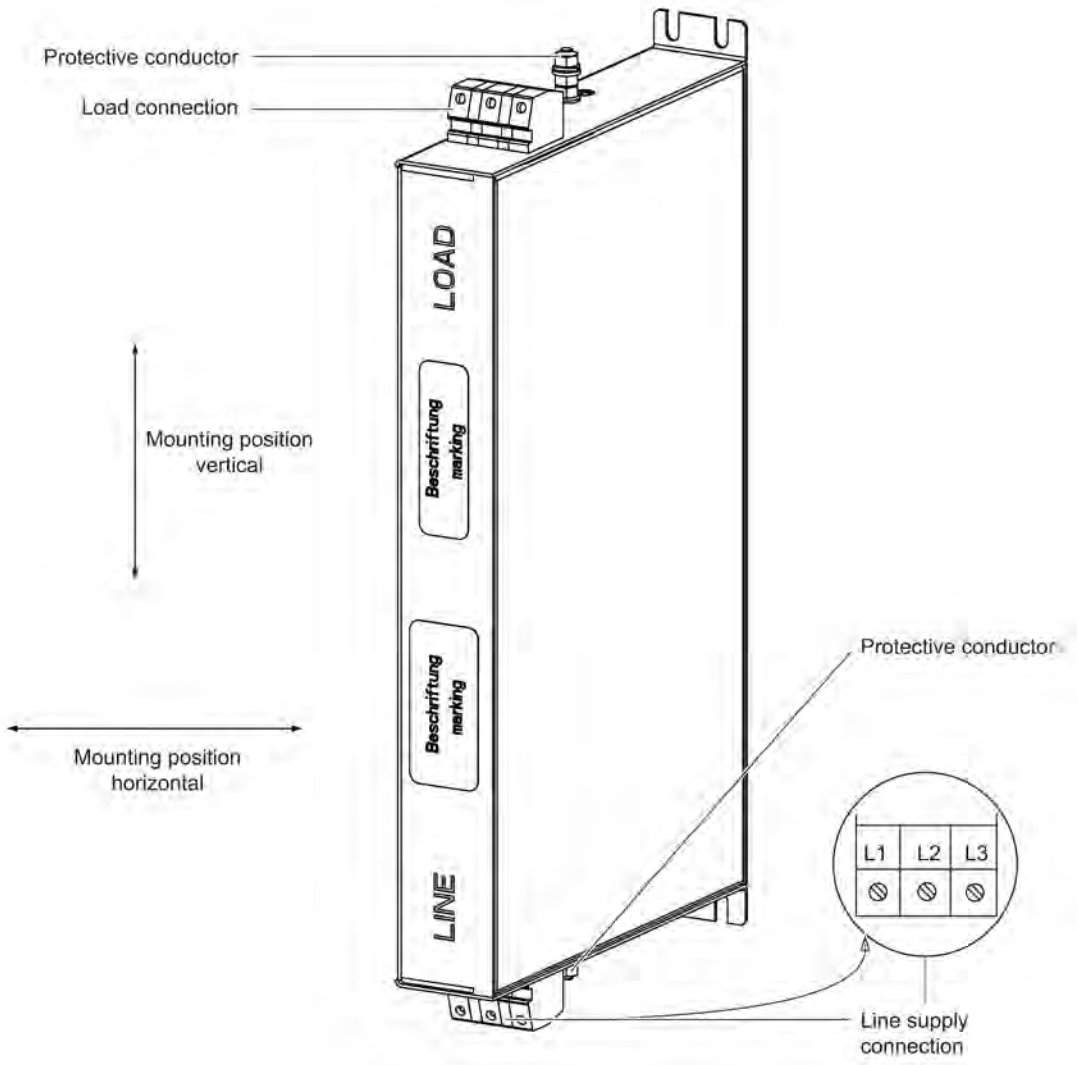


Figure 3-5 Interface overview, Basic Line Filter for Active Line Modules (example: 16 kW)

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

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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 mm² 3 pole 1.5 ... 1.8 Nm	Screw terminals: 35 mm², 3 pole 3.2 ... 3.7 Nm	Screw terminals: 50 mm², 3 pole 6 ... 8 Nm	Screw terminals: 95 mm², 3-pole 15 ... 20 Nm	
Load connection L1´, L2´, L3´,					
PE connection[1)]	Terminal studs M6 / 6 Nm	Terminal studs M6 / 6 Nm	Terminal studs M8 / 8 Nm	Terminal studs M10 / 10 Nm	

[1)] For ring cable lugs without insulation

3.7.3.3 Dimension drawings

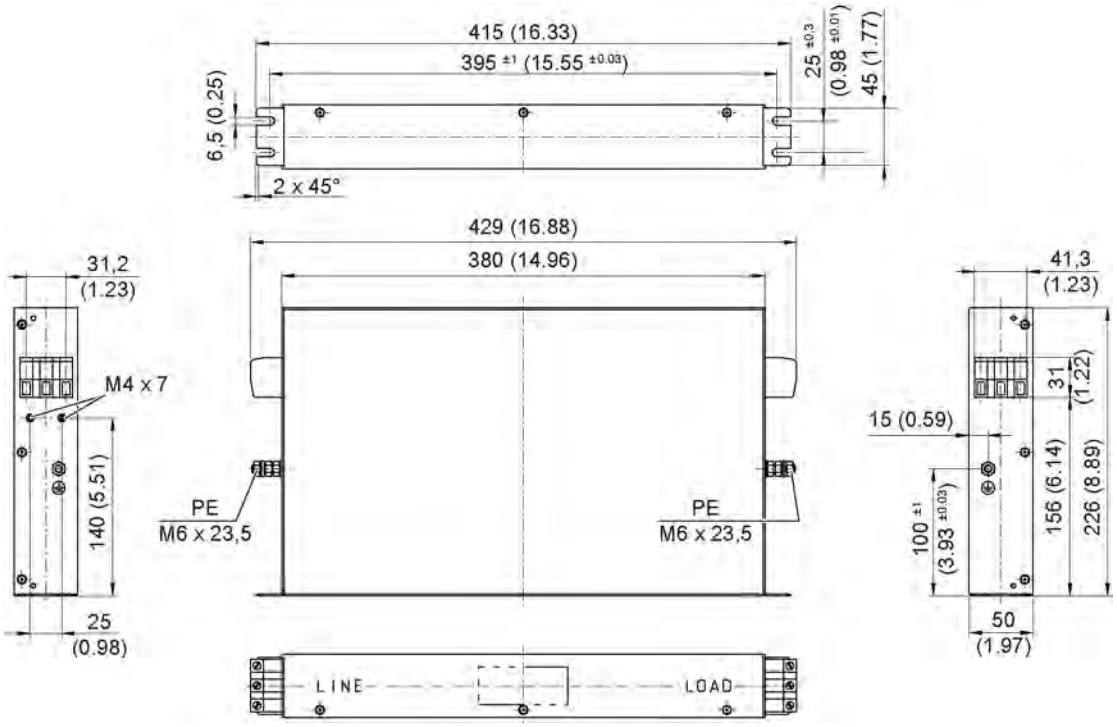


Figure 3-6 Dimension drawing of the Basic Line Filter for Active Line Modules 16 kW, all data in mm and (inches)

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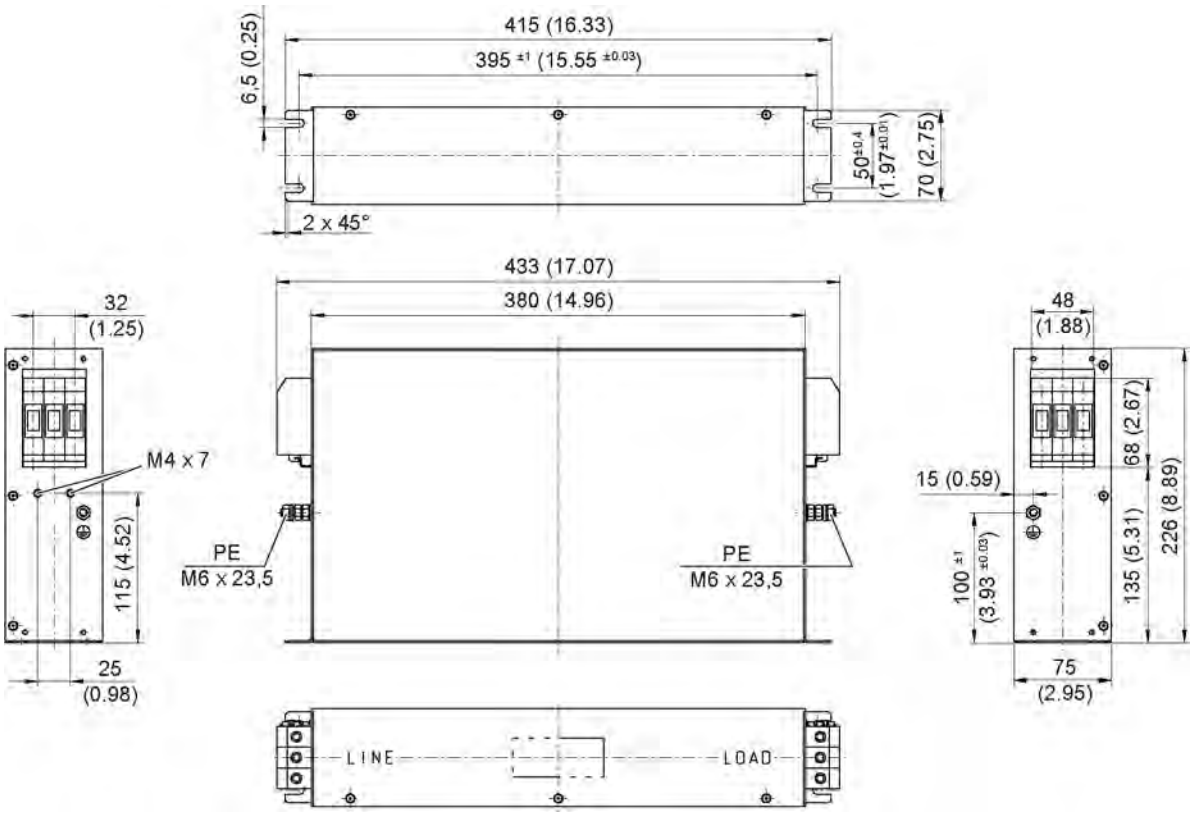


Figure 3-7 Dimension drawing of Basic Line Filter for Active Line Modules 36 kW, all data in mm and (inches)

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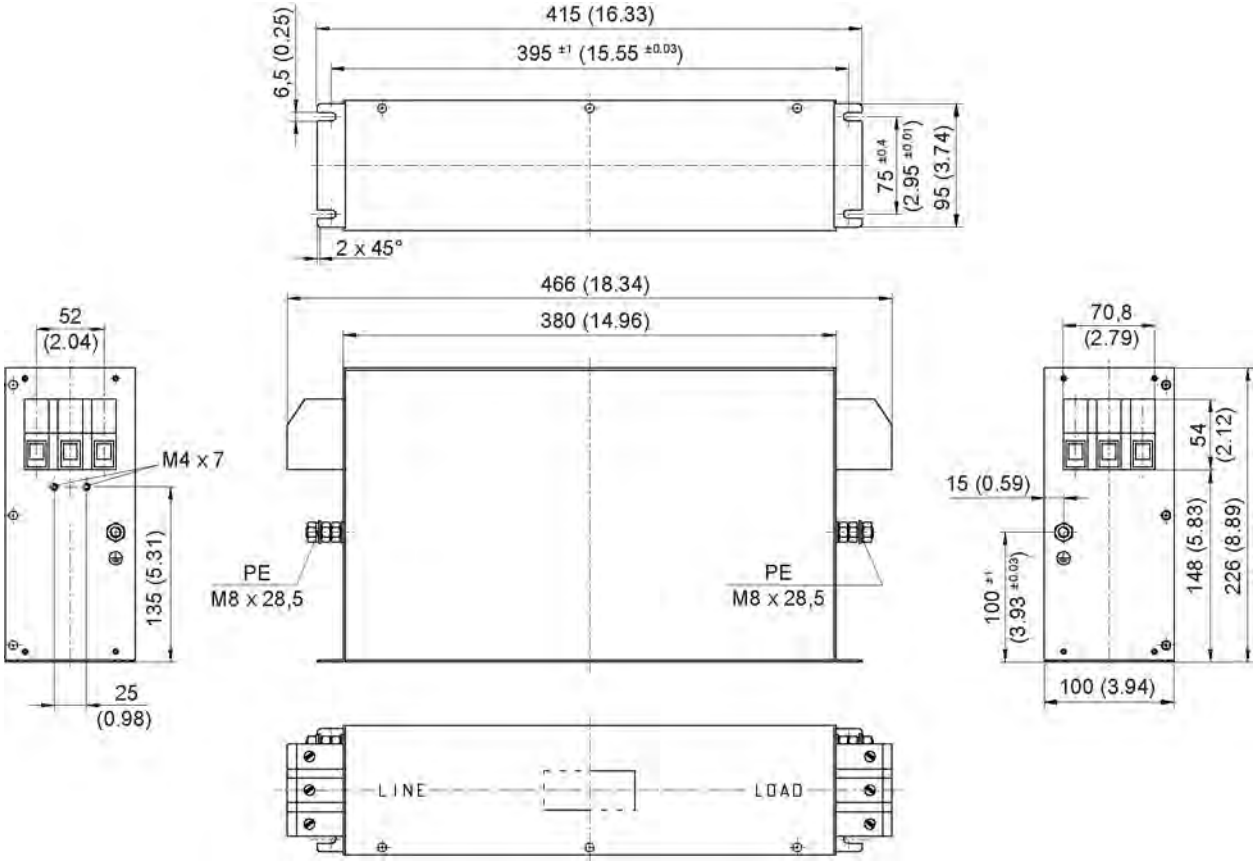


Figure 3-8 Dimension drawing of Basic Line Filter for Active Line Modules 55 kW, all data in mm and (inches)

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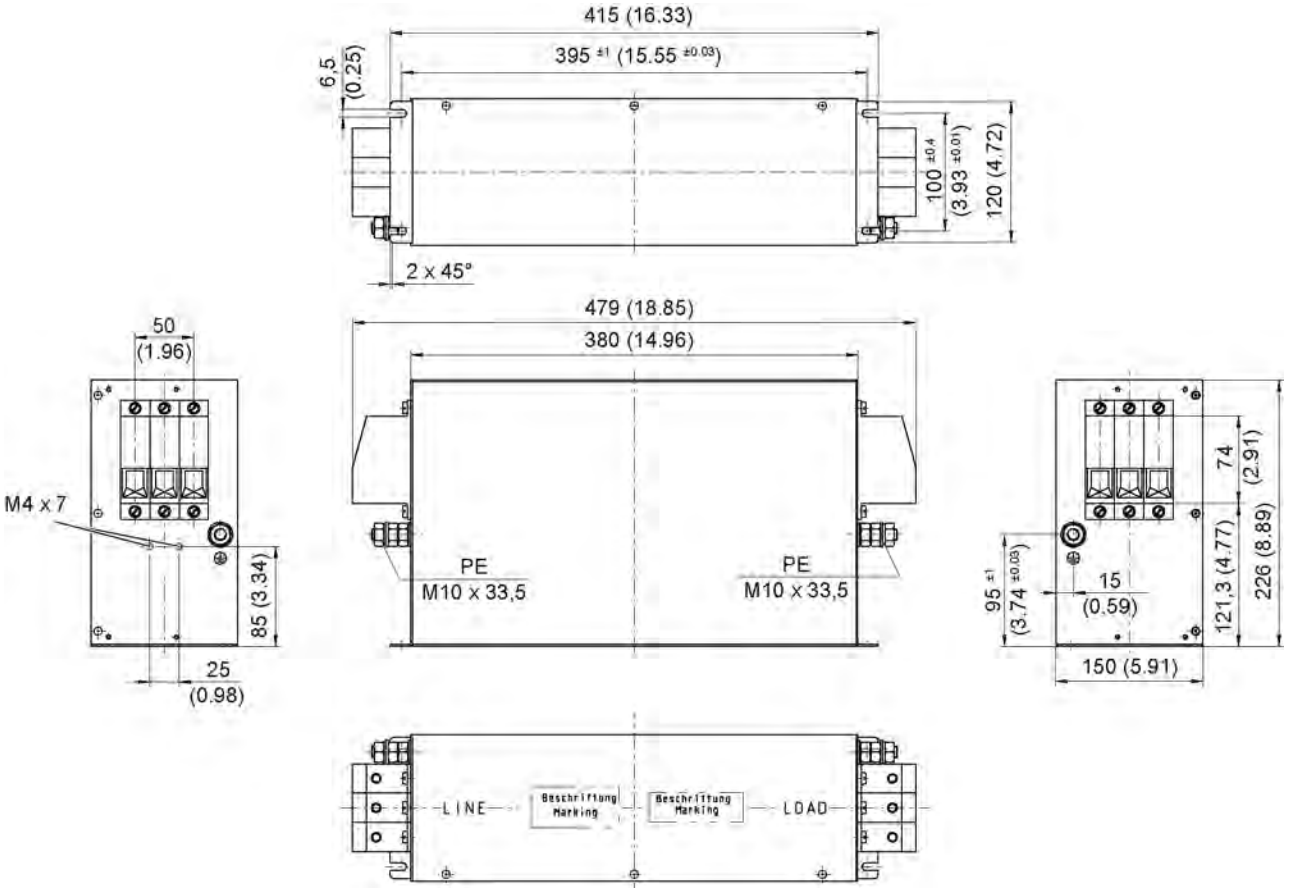


Figure 3-9 Dimension drawing of Basic Line Filter for Active Line Modules 80 kW and 120 kW, all dimensions in mm and (inches)

3.7.3.4 Technical data

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

	6SL3000-	0BE21-6DAx	0BE23-6DA1	0BE25-5DAx	0BE28-0DAx	0BE31-2DAx
Rated power	kW	16	36	55	80	120
Supply voltage: Line voltage Line frequency	 V_{AC} Hz	3 AC 380 -10 % (-15 % < 1 min) … 3 AC 480 +10 % 47 … 63 Hz				
Rated current	A_{AC}	36	74	105	132	192
Power loss (see power loss tables (Page 781))	W	16	26	43	56	73
Weight	kg	5	7,5	11,5	17,5	18,5

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3.7.4 Wideband Line Filter for Active Line Modules

3.7.4.1 Description

Wideband Line Filters for Active Line Modules are mainly effective in the frequency range from 150 kHz to 30 MHz; this is the range relevant to ensure compliance with the appropriate standard. Wideband Line Filters can also effectively limit low-frequency line harmonics of 2 kHz and above; this protects additional loads connected to the same supply system against disturbances and damage. As a result, these line filters have an extended function range, with which a certain degree of independence can be achieved regarding the machine installation location with generally unknown line supply parameters (e.g. line impedance).

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

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

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

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

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3.7.4.2 Interface description

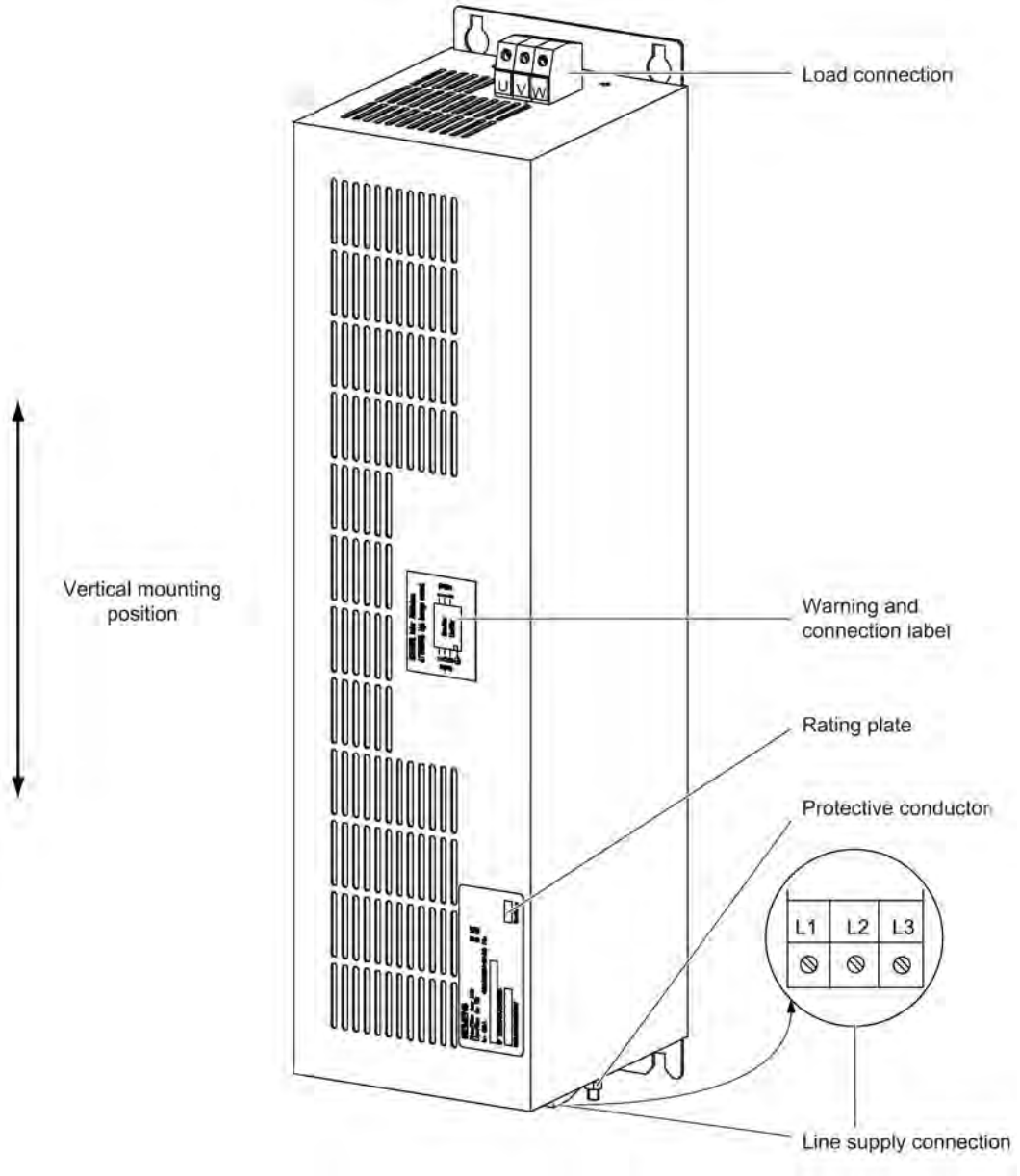


Figure 3-10 Interface overview, Wideband Line Filter for Active Line Modules (example: 16 kW)

NOTICE
Damage caused by overheating as a result of an inadmissible mounting position If the component is not operated in a vertical position with the line supply terminals at the bottom, then the component can be damaged. • Only operate the components in a vertical position with the line terminals at the bottom.

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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 mm² 3 pole M4 / 1.5 ... 1.8 Nm	Screw terminals 50 mm² 3–pole M6 / 6 ... 8 Nm		Screw terminals 95 mm² 3–pole M8 / 15 ... 20 Nm	Connecting lugs d = 11 mm M10 / 25 Nm **Note: No touch protection (IP00 acc. to EN 60529)**
Load connection U, V, W					
PE connection[1)]	Terminal studs M5 / 3 Nm	Terminal studs M8 / 13 Nm	Terminal studs M8 / 13 Nm	Terminal studs M8 / 13 Nm	Terminal studs M10 / 25 Nm

[1)] For ring cable lugs without insulation

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3.7.4.3 Dimension drawings

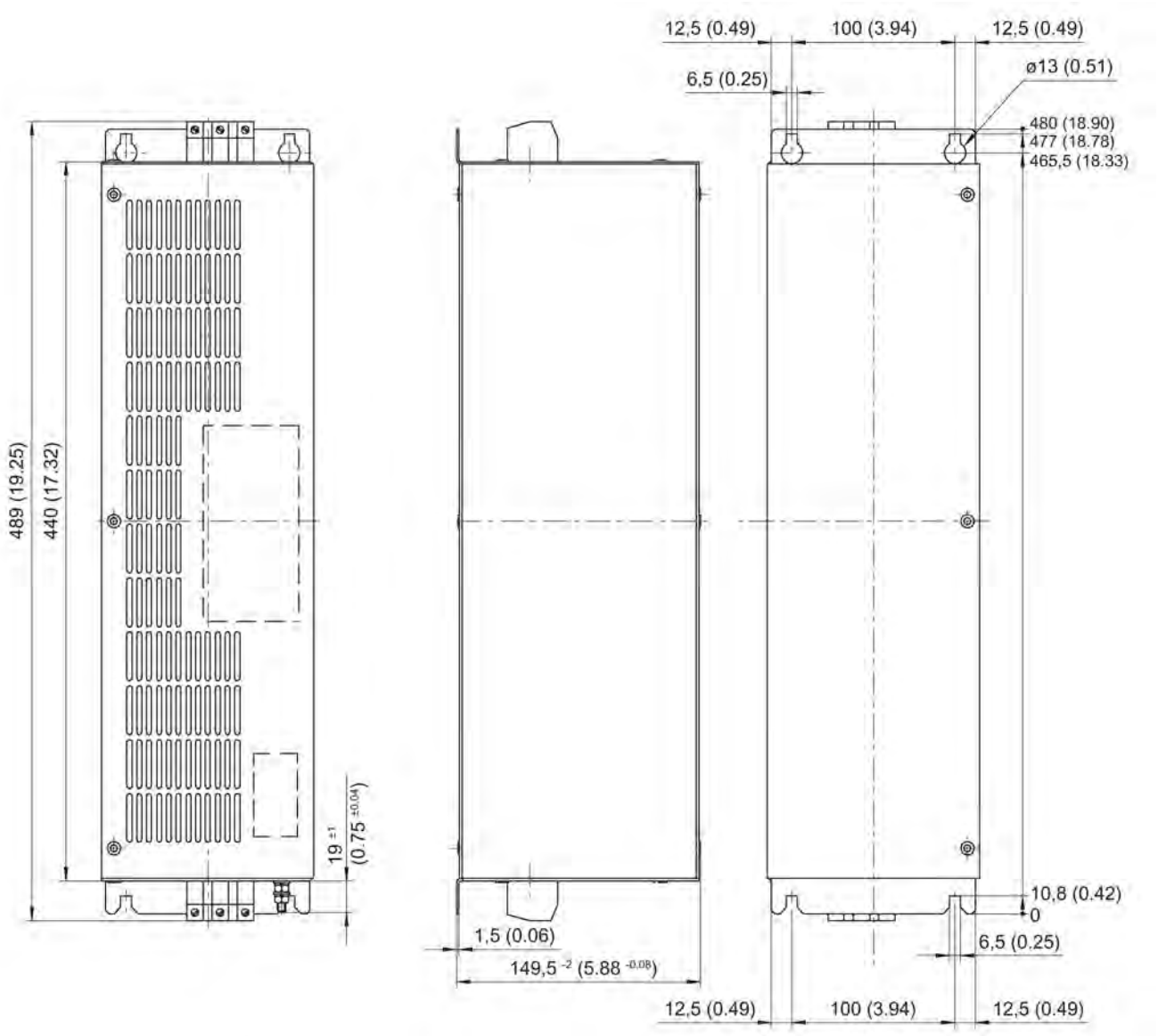


Figure 3-11 Dimension drawing of Wideband Line Filter 16 kW for Active Lines Modules, all dimensions in mm and (inches)

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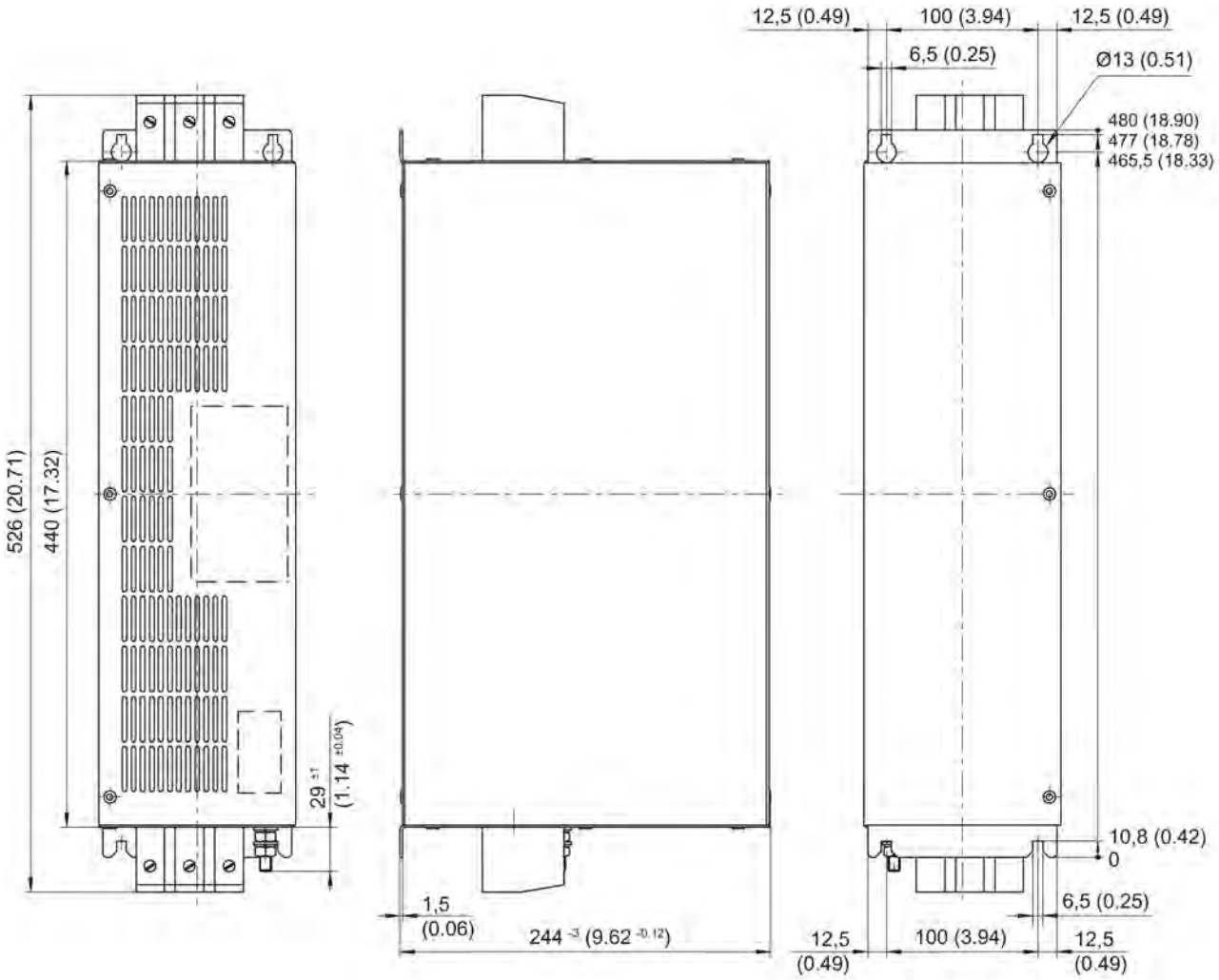


Figure 3-12 Dimension drawing of Wideband Line Filter 36 kW for Active Lines Modules, all dimensions in mm and (inches)

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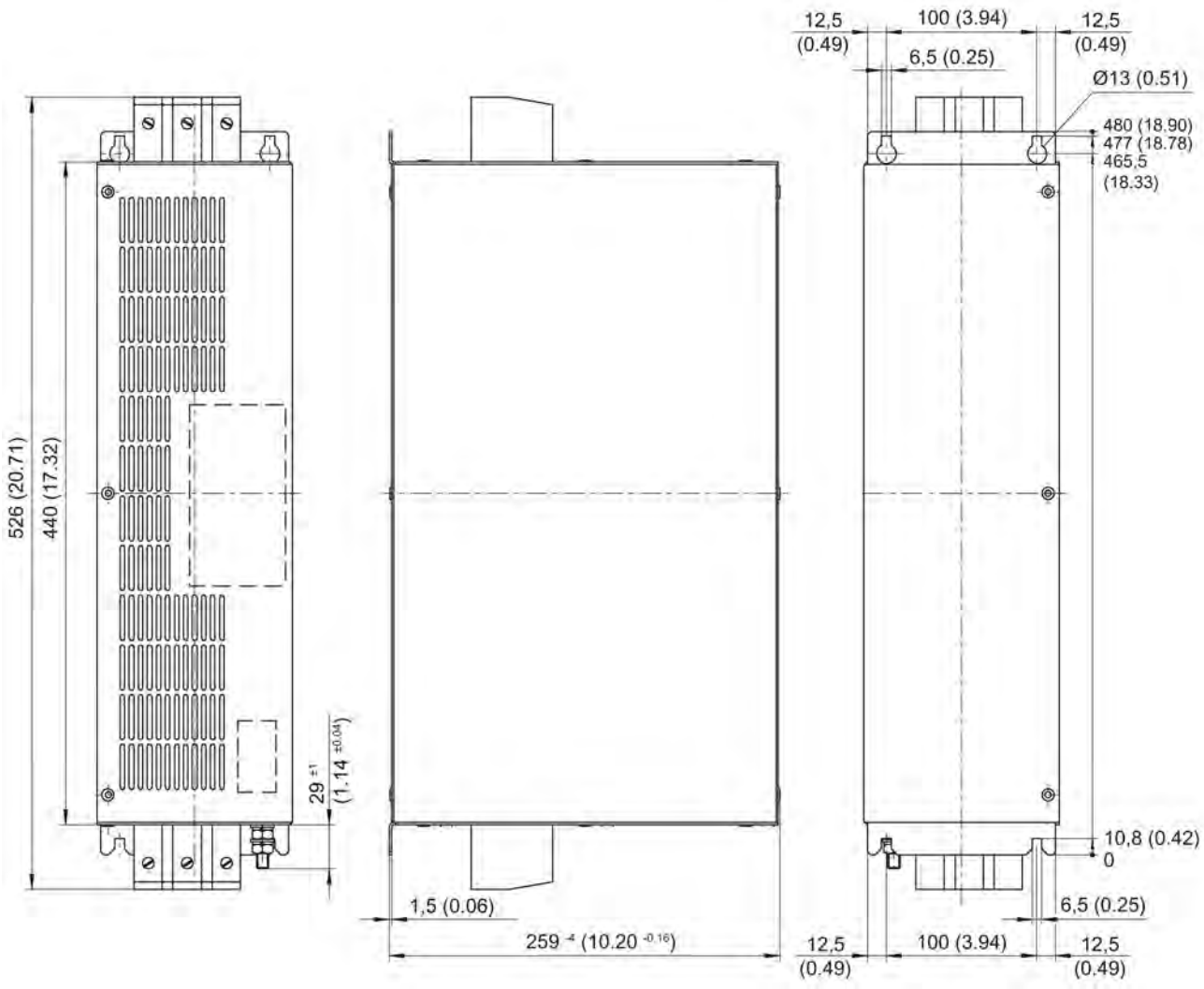


Figure 3-13 Dimension drawing of Wideband Line Filter 55 kW for Active Lines Modules, all dimensions in mm and (inches)

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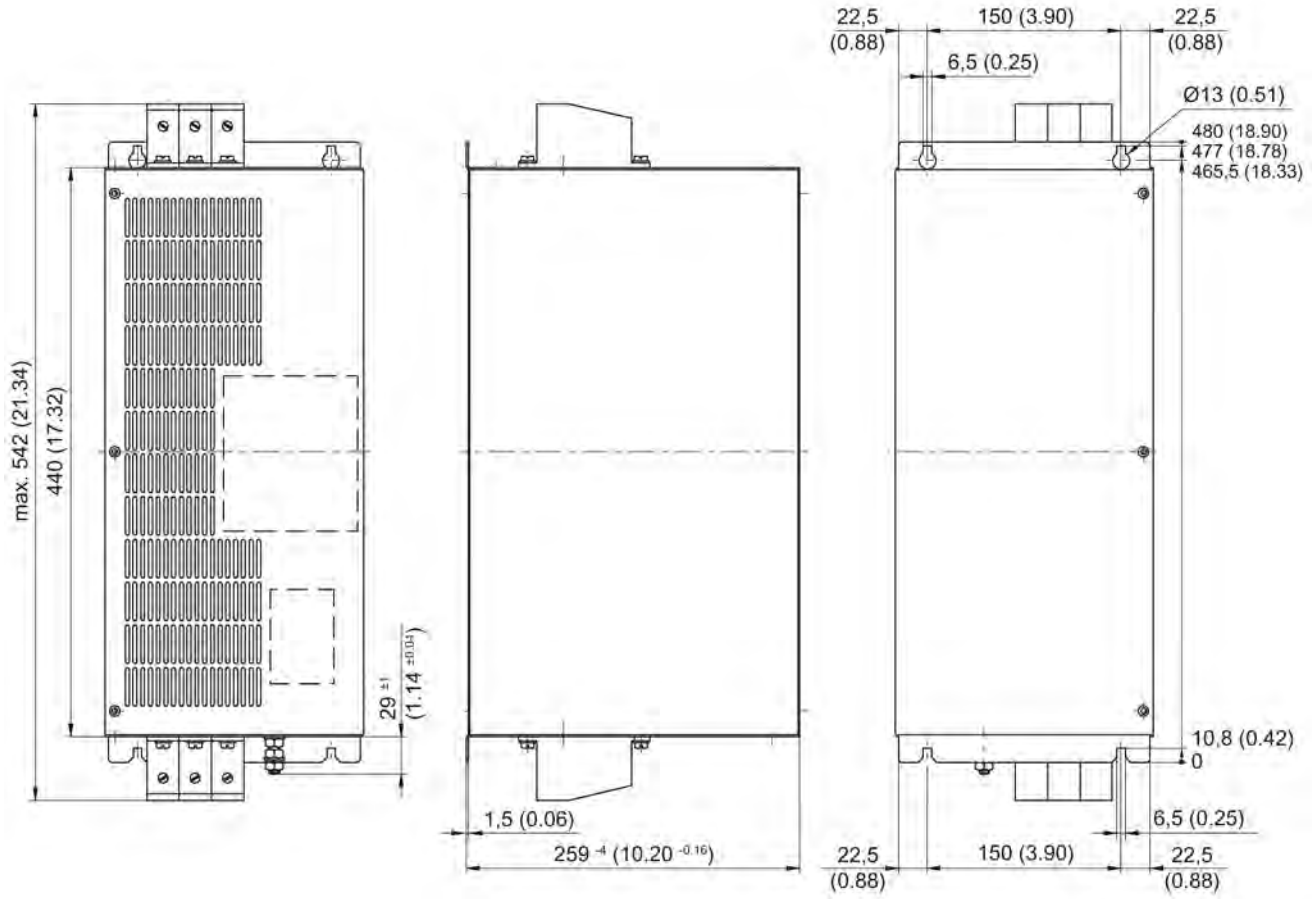


Figure 3-14 Dimension drawing of Wideband Line Filter 80 kW for Active Lines Modules, all dimensions in mm and (inches)

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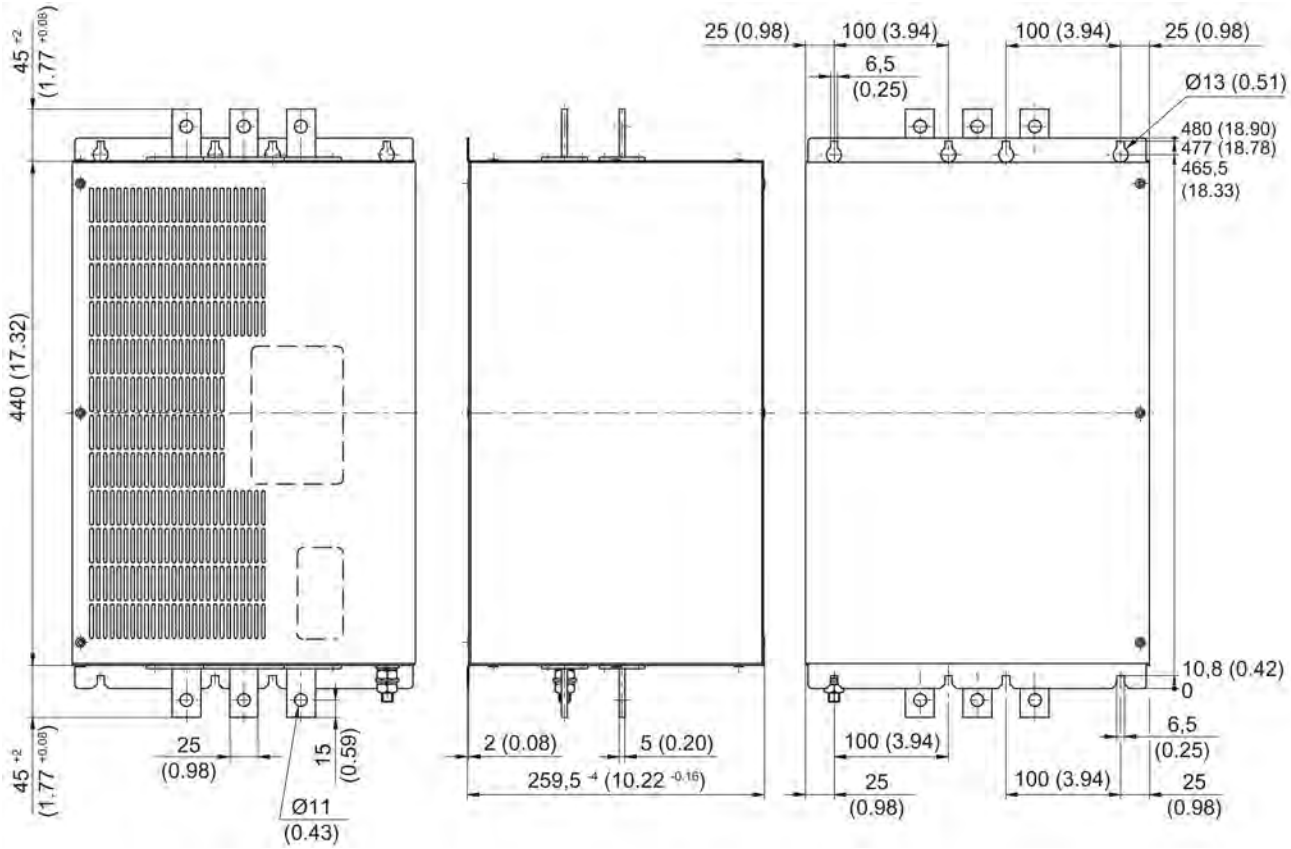


Figure 3-15 Dimension drawing of Wideband Line Filter 120 kW for Active Lines Modules, all dimensions in mm and (inches)

3.7.4.4 Technical data

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

	6SL3000 unit	0BE21-6AAx	0BE23-6AAx	0BE25-5AAx	0BE28-0AAx	0BE31-2AAx
Rated power	kW	16	36	55	80	120
Supply voltages: Line voltage Line frequency	 V_{AC} Hz	3 AC 380 -10 % (-15 % < 1 min) … 3 AC 480 +10 % 47 … 63 Hz				
Rated current	A_{AC}	30	67	103	150	225
Power loss (see power loss tables (Page 781))	W	70	90	110	150	200
Weight	kg	8,5	14,5	15,5	26	34,5

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3.7.5 Basic Line Filter for Basic Line Modules

3.7.5.1 Description

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

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

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

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

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

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3.7.5.2 Interface description

Overview

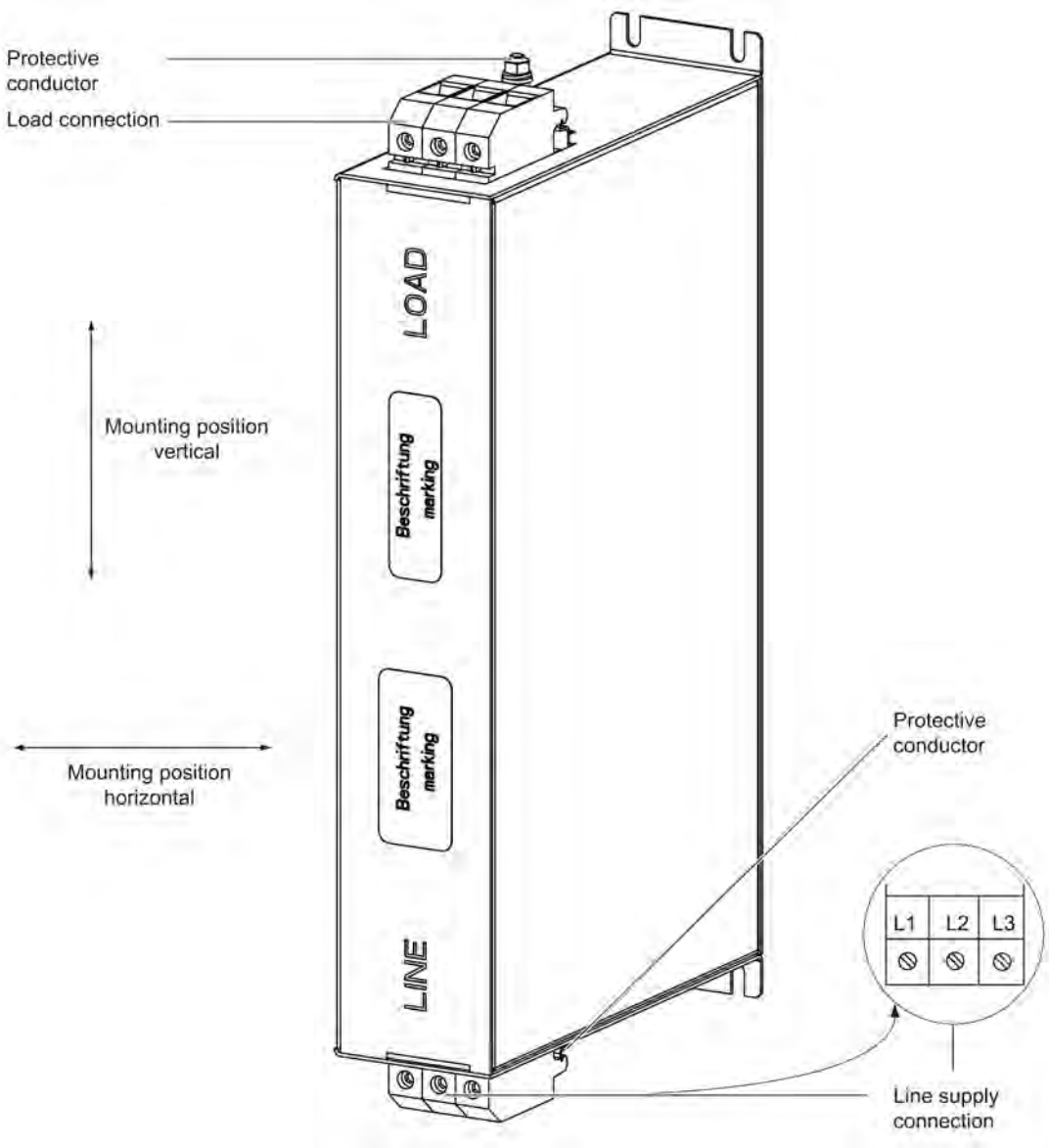


Figure 3-16 Interface overview, Basic Line Filter for Basic Line Modules (example: 40 kW)

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

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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 mm², 3 pole 1.5 ... 1.8 Nm	Screw terminals 35 mm², 3 pole 3.2 ... 3.7 Nm	Screw terminals 95 mm², 3-pole 15 ... 20 Nm
Load connection L1´, L2´, L3´			
PE connection[1)]	Terminal studs M6 / 6 Nm	Terminal studs M6 / 6 Nm	Terminal studs M10 / 10 Nm

1) For ring cable lugs without insulation

3.7.5.3 Dimension drawings

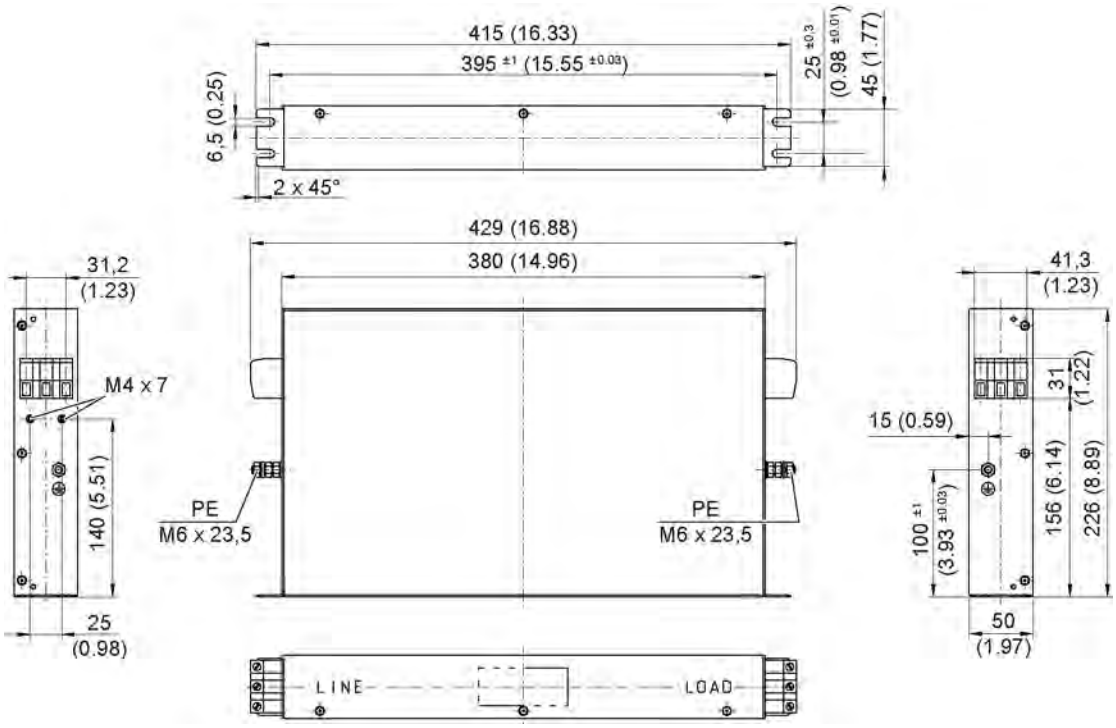


Figure 3-17 Dimension drawing of Basic Line Filter for Basic Line Modules 20 kW, all data in mm and (inches)

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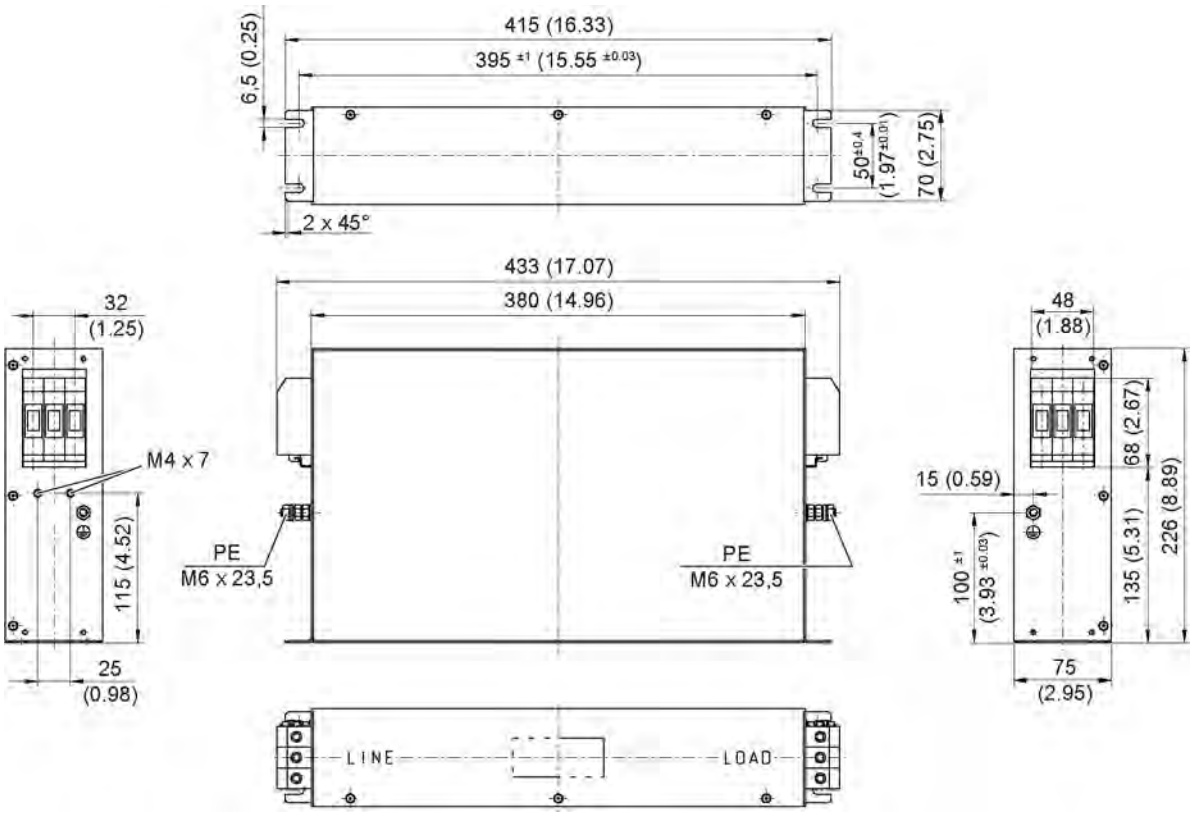


Figure 3-18 Dimension drawing of Basic Line Filter for Basic Line Modules 40 kW, all data in mm and (inches)

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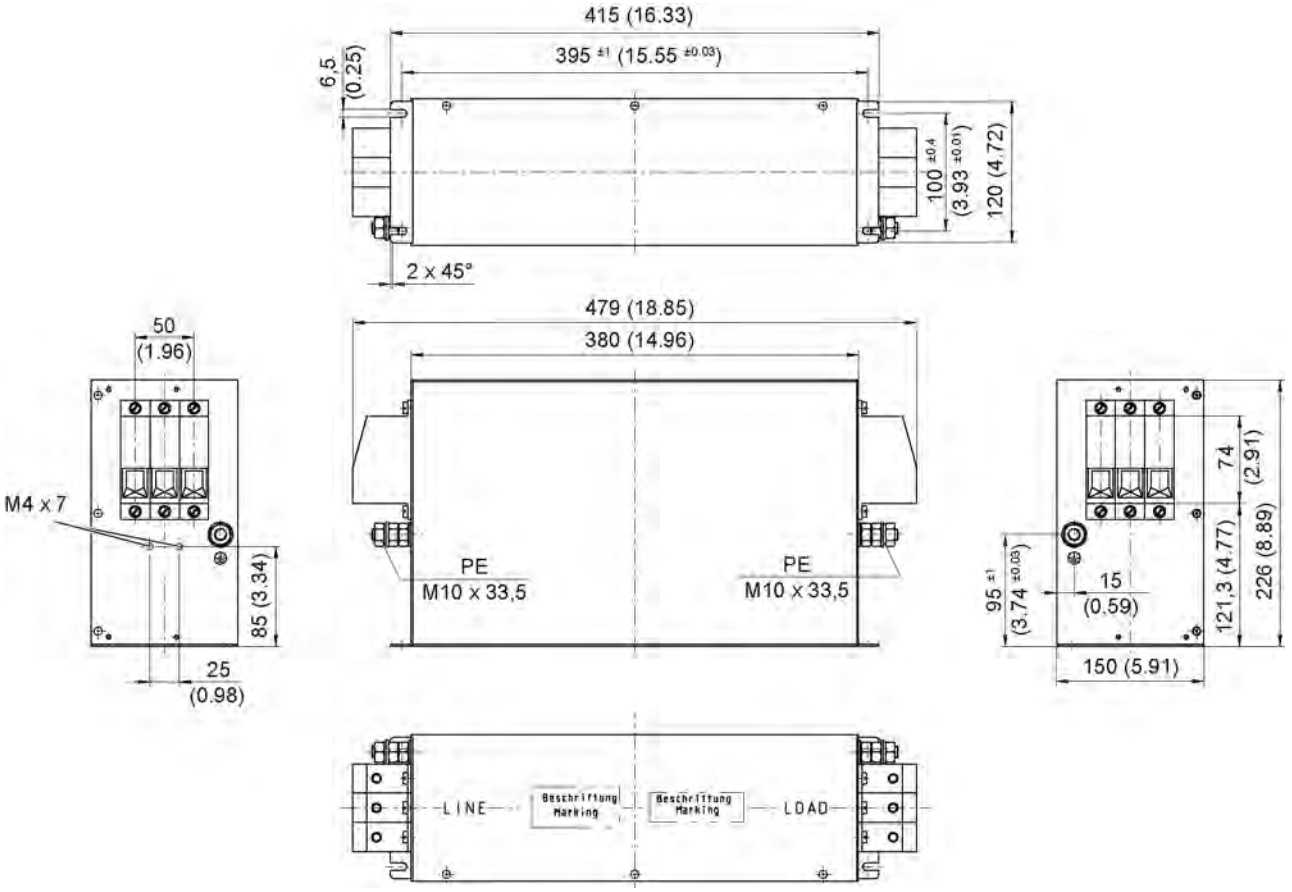


Figure 3-19 Dimension drawing of Basic Line Filter for Basic Line Modules 100 kW, all data in mm and (inches)

3.7.5.4 Technical specifications

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

	6SL3000-	0BE21-6DAx	0BE23-6DA1	0BE31-2DAx
Rated power	kW	20	40	100
Supply voltage: Line voltage Line frequency	 V_{AC} Hz	3 AC 380 -10 % (-15 % < 1 min) … 3 AC 480 +10 % 47 … 63 Hz		
Rated current	A_{AC}	36	74	192
Power loss (see power loss tables (Page 781))	W	16	26	43
Weight	kg	5	7,5	18,5

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3.7.6 Basic Line Filter for Smart Line Modules

3.7.6.1 Description

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

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

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

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

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

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3.7.6.2 Interface description

Overview

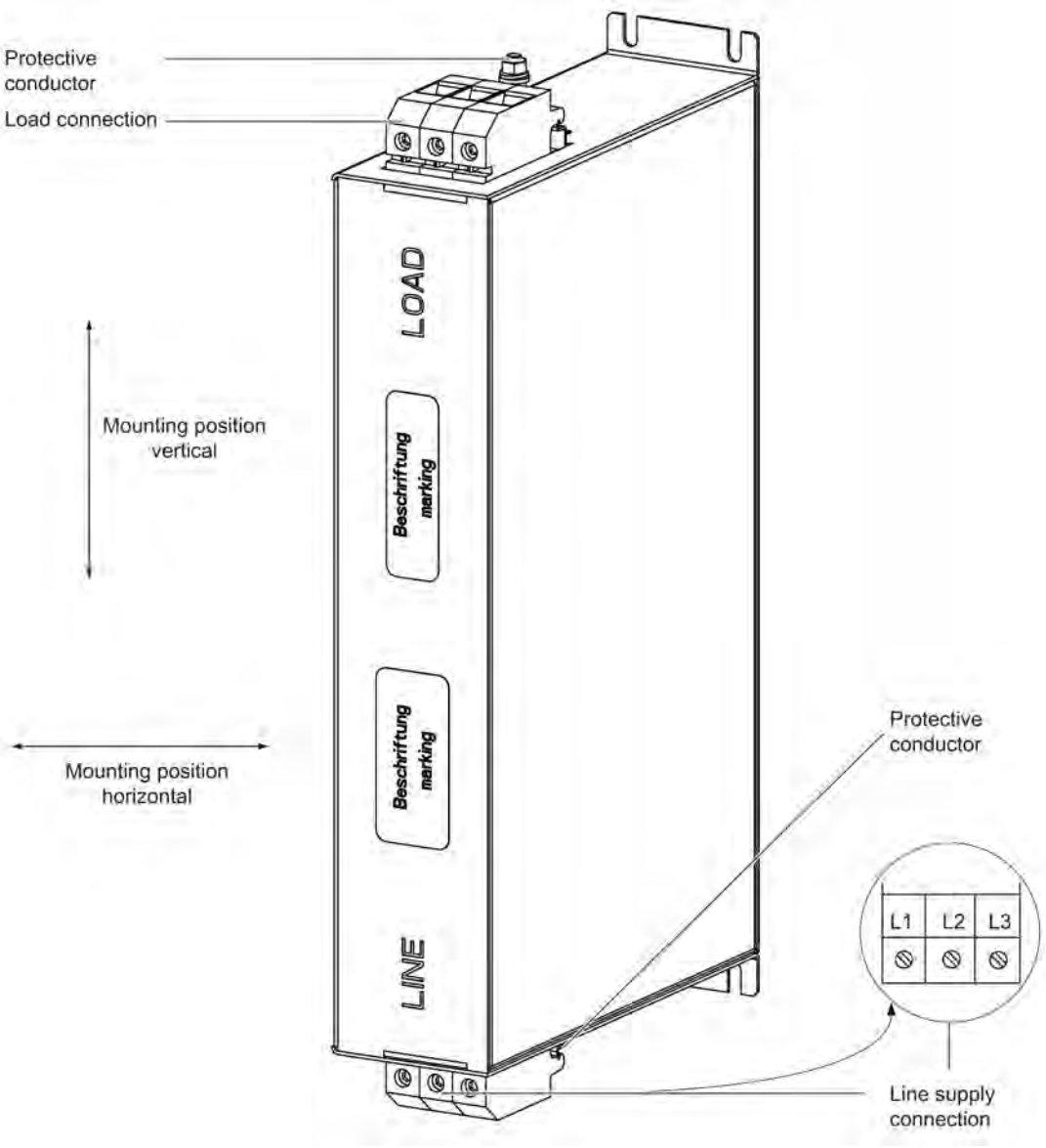


Figure 3-20 Interface overview, Basic Line Filter for Smart Line Modules (example: 36 kW)

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

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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 mm², 3 pole 1.2 ... 1.5 Nm			Screw terminals 35 mm², 3 pole 3.2 ... 3.7 Nm	Screw terminals 50 mm², 3 pole 6 ... 8 Nm
Load connection L1´, L2´, L3´					
PE connection[1)]	Terminal studs M6 / 6 Nm			Terminal studs M6 / 6 Nm	Terminal studs M8 / 8 Nm

1) For ring cable lugs without insulation

3.7.6.3 Dimension drawings

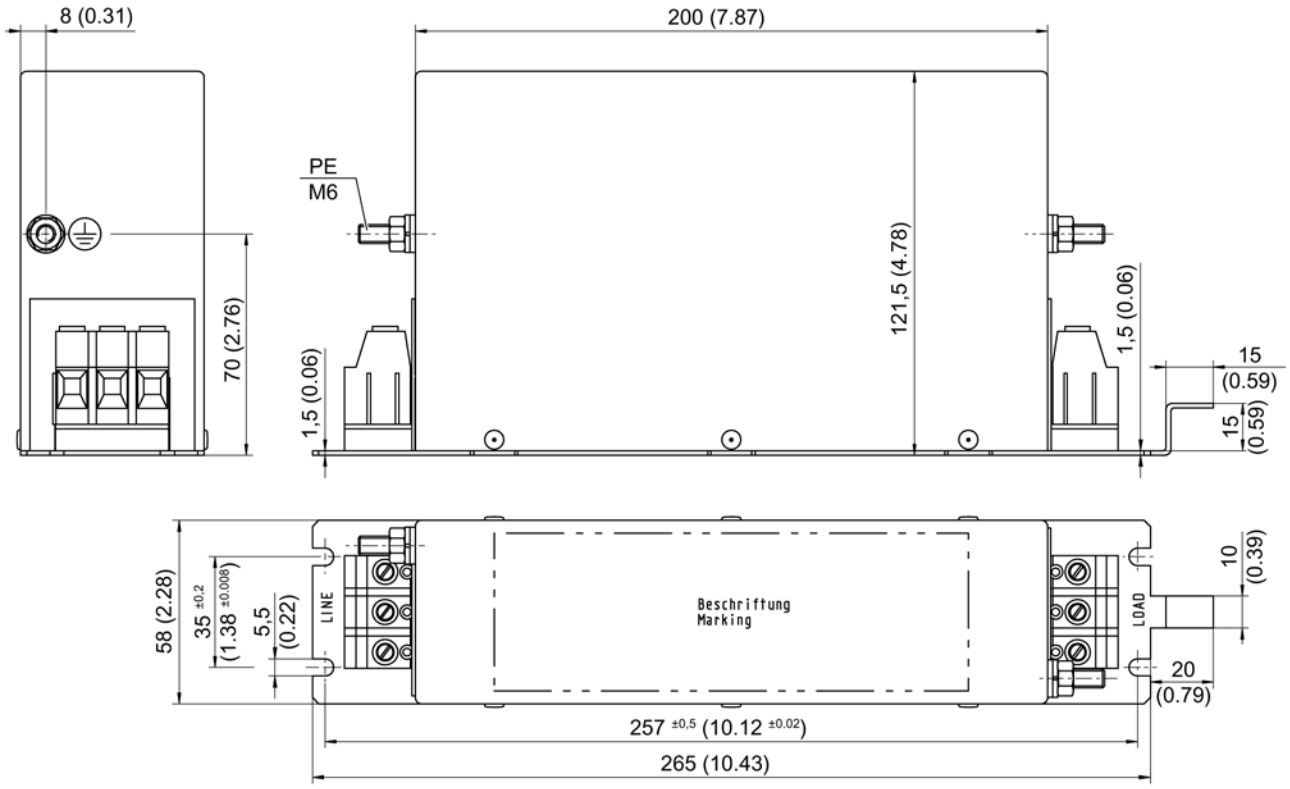


Figure 3-21 Dimension drawing of Basic Line Filter for 5 kW and 10 kW Smart Line Modules, all dimensions in mm and (inches)

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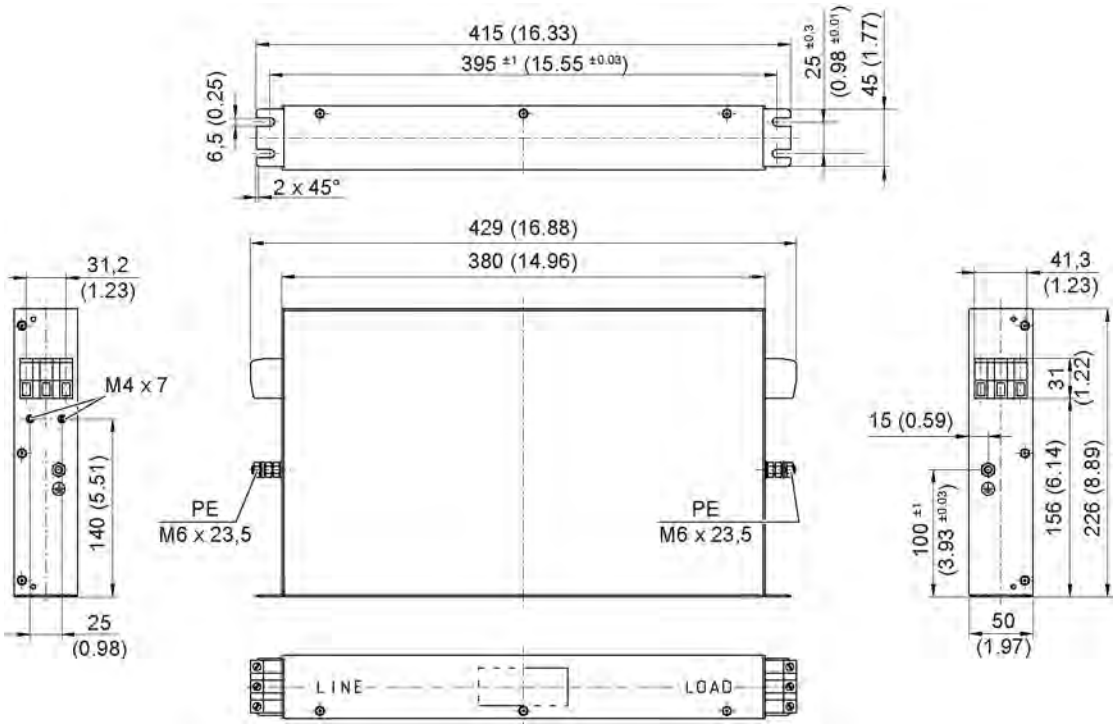


Figure 3-22 Dimension drawing of Basic Line Filter for Smart Line Modules 16 kW, all data in mm and (inches)

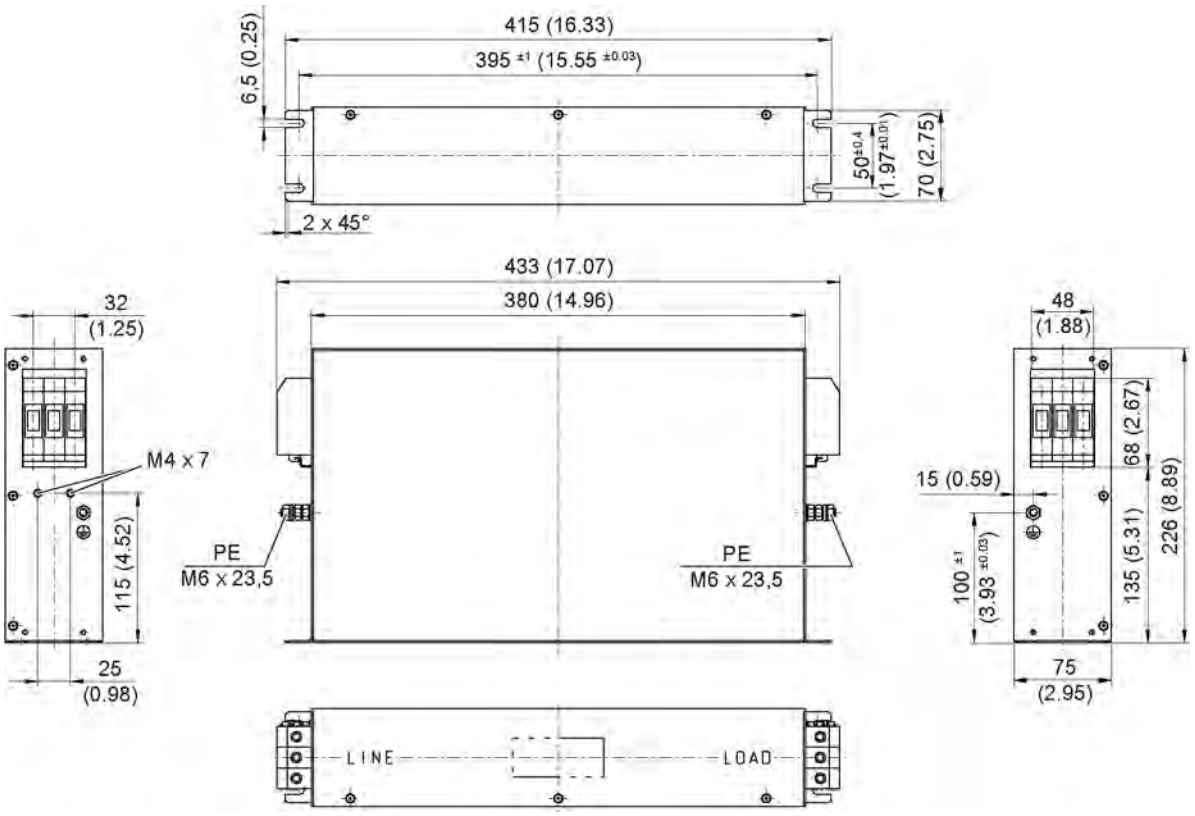


Figure 3-23 Dimension drawing of Basic Line Filter for Smart Line Modules 36 kW, all data in mm and (inches)

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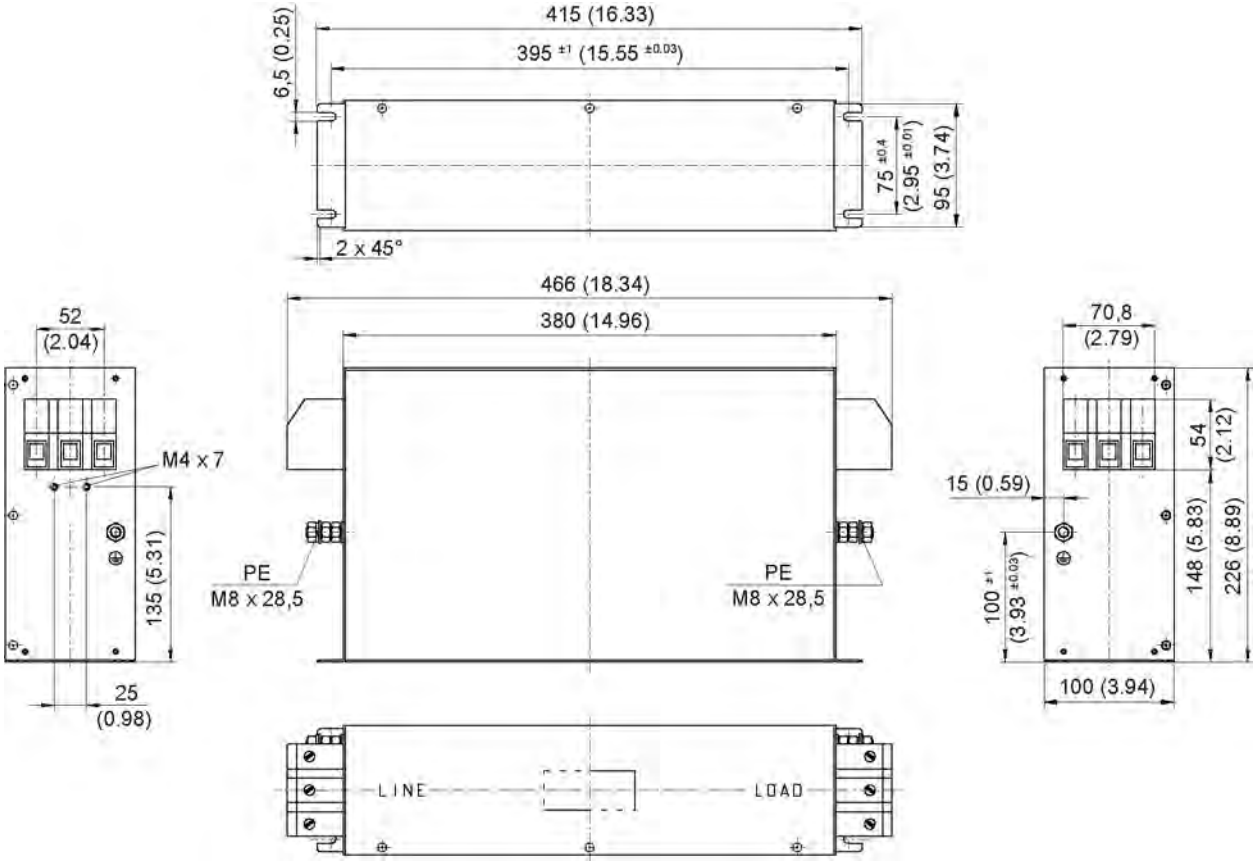


Figure 3-24 Dimension drawing of Basic Line Filter for Smart Line Modules 55 kW, all data in mm and (inches)

3.7.6.4 Technical Specifications

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

	6SL3000-	0HE15-0AAx	0HE21-0AAx	0BE21-6DAx	0BE23-6DA1	0BE25-5DAx
Rated power	kW	5	10	16	36	55
Supply voltage: Line voltage Line frequency	 V_{AC} Hz	3 AC 380 -10 % (-15 % < 1 min) … 3 AC 480 +10 % 47 … 63 Hz				
Rated current	A_{AC}	12	25	36	74	105
Power loss (see power loss tables (Page 781))	W	20	20	16	26	43
Weight	kg	2.1	2.3	5	7.5	11.5

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3.8 Line reactors

3.8.1 Safety instructions for line reactors

⚠WARNING

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

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

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



⚠DANGER

Danger to life due to electric shock in the event of missing touch protection

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

- For the line reactors, use touch protection according to IPXXA or corresponding to the local installation regulations.



⚠WARNING

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

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

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

- Connect a damping resistor to the HFD line reactor.

⚠CAUTION

Risk of burns due to high surface temperature of the line reactor

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

- 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.

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

Note

Malfunctions through magnetic fields

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

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

Note

Length of connecting cables

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

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

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

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

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

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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. This results in increased operational reliability and extends the service life.

Note

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

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

Table 3- 13 Overview of line reactors

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

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3.8.3 Line reactors for Active Line Modules

3.8.3.1 Interface description

Overview

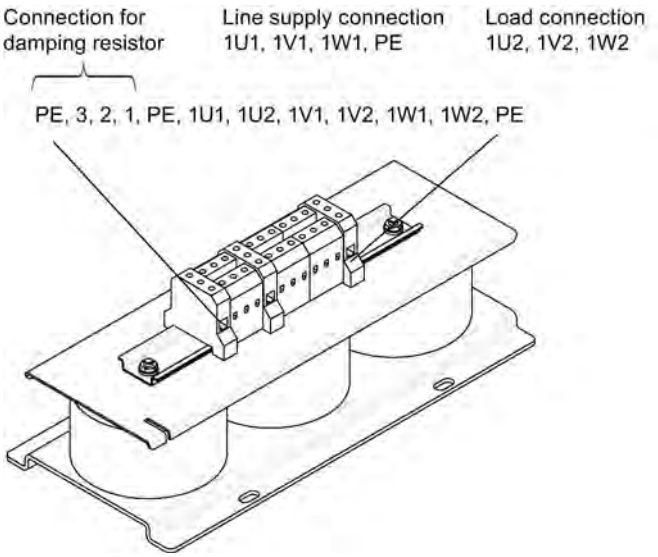


Figure 3-25 Interface overview, HFD line reactor 16 kW

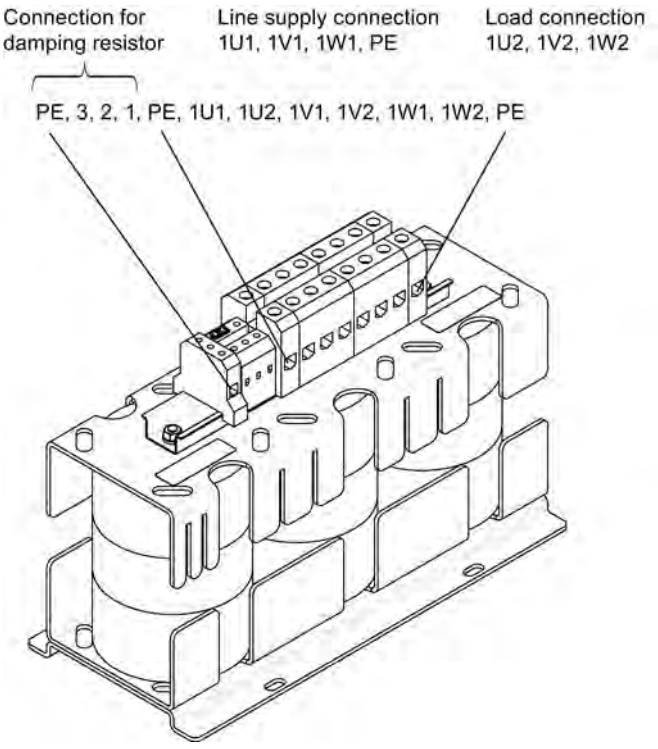


Figure 3-26 Interface overview, HFD line reactor 36 kW

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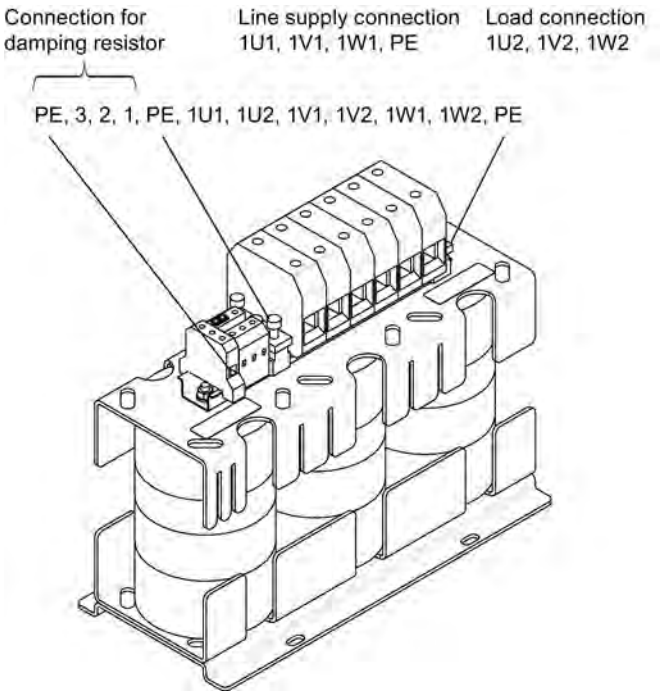


Figure 3-27 Interface overview, HFD line reactor 55 kW

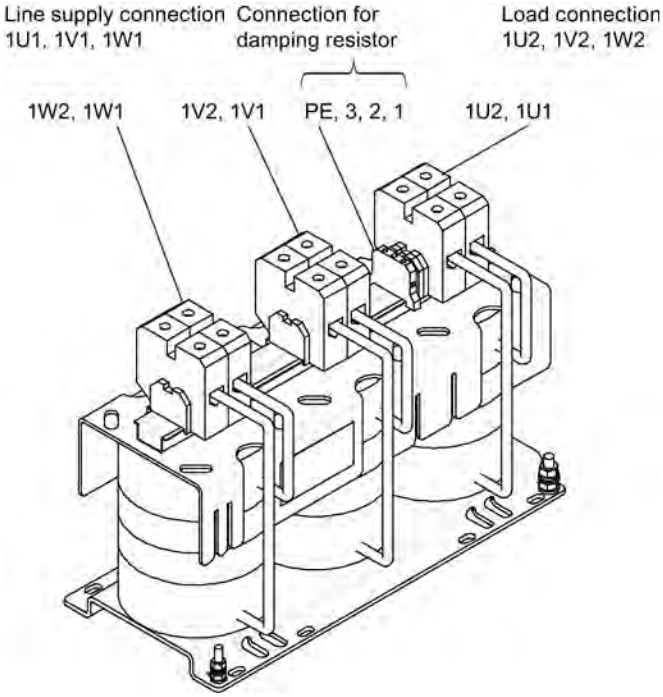


Figure 3-28 Interface overview, HFD line reactor 80 kW

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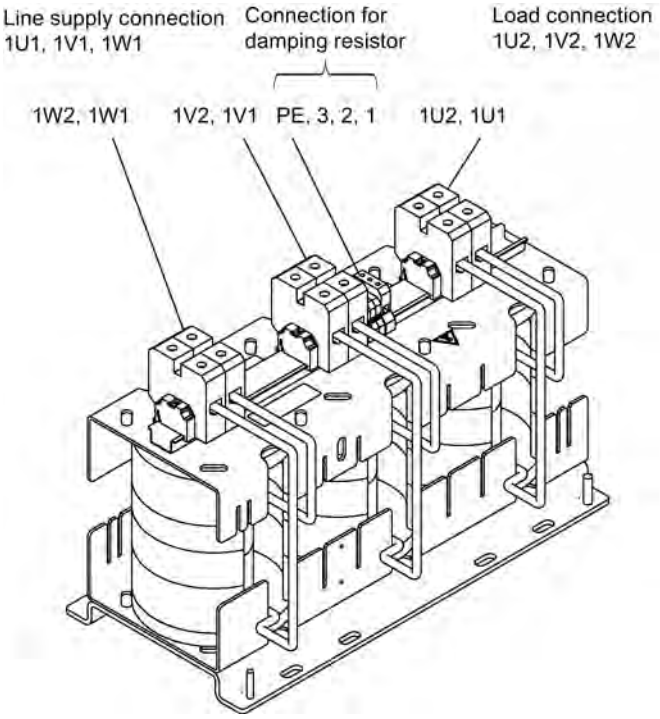


Figure 3-29 Interface overview, HFD line reactor 120 kW

Line/load connection

Table 3- 14 Connection of HFD line reactors

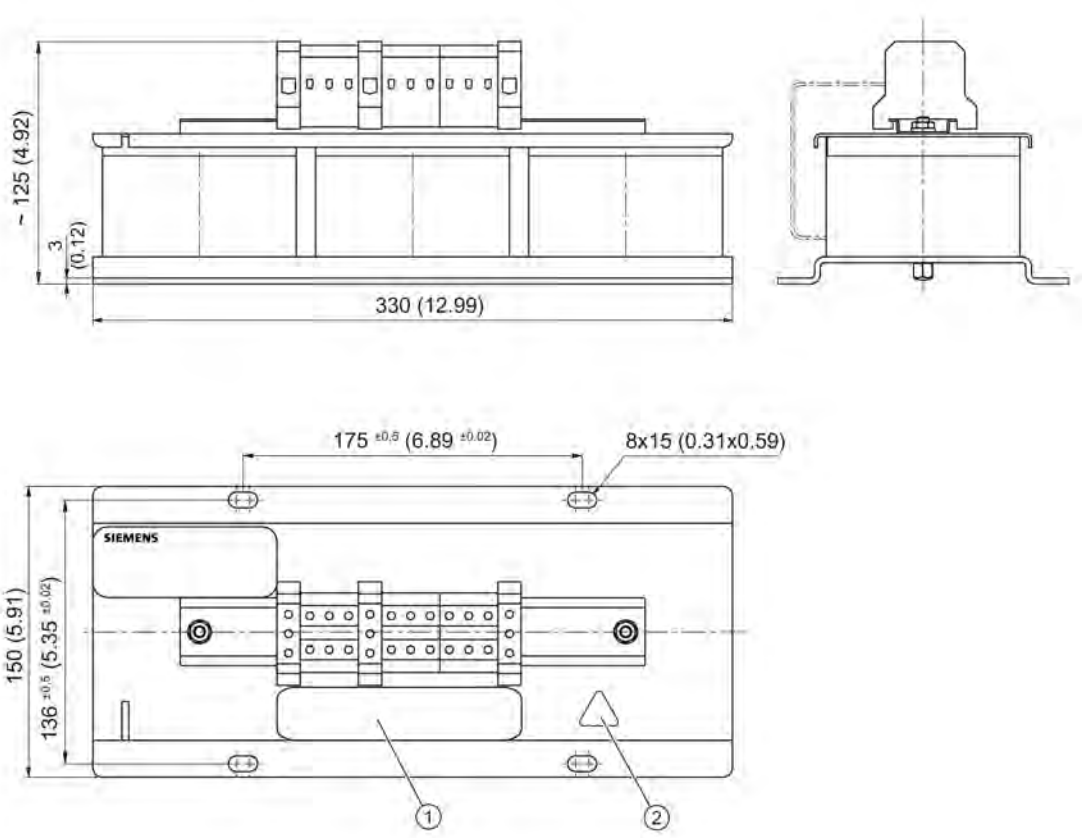
Order number	6SL3000-0DE21-6AAx	6SL3000-0DE23-6AAx	6SL3000-0DE25-5AAx	6SL3000-0DE28-0AAx	6SL3000-0DE31-2AAx
Power [kW]	16	36	55	80	120
Line supply connection 1U1, 1V1, 1W1	Screw terminal 16 mm² /1.2 Nm	Screw terminal 35 mm² /2.5 Nm	Screw terminal 70 mm² 6 … 10 Nm	Type: Spring-loaded terminal 4 (Page 754) Max. cross-section that can be connected: 95 mm²	
Load connection 1U2, 1V2, 1W2					
PE connection	Screw terminal 16 mm² /1.2 Nm				
Damping resistor connection 1, 2, 3 PE	Screw terminal 16 mm² /1.2 Nm				

Note

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

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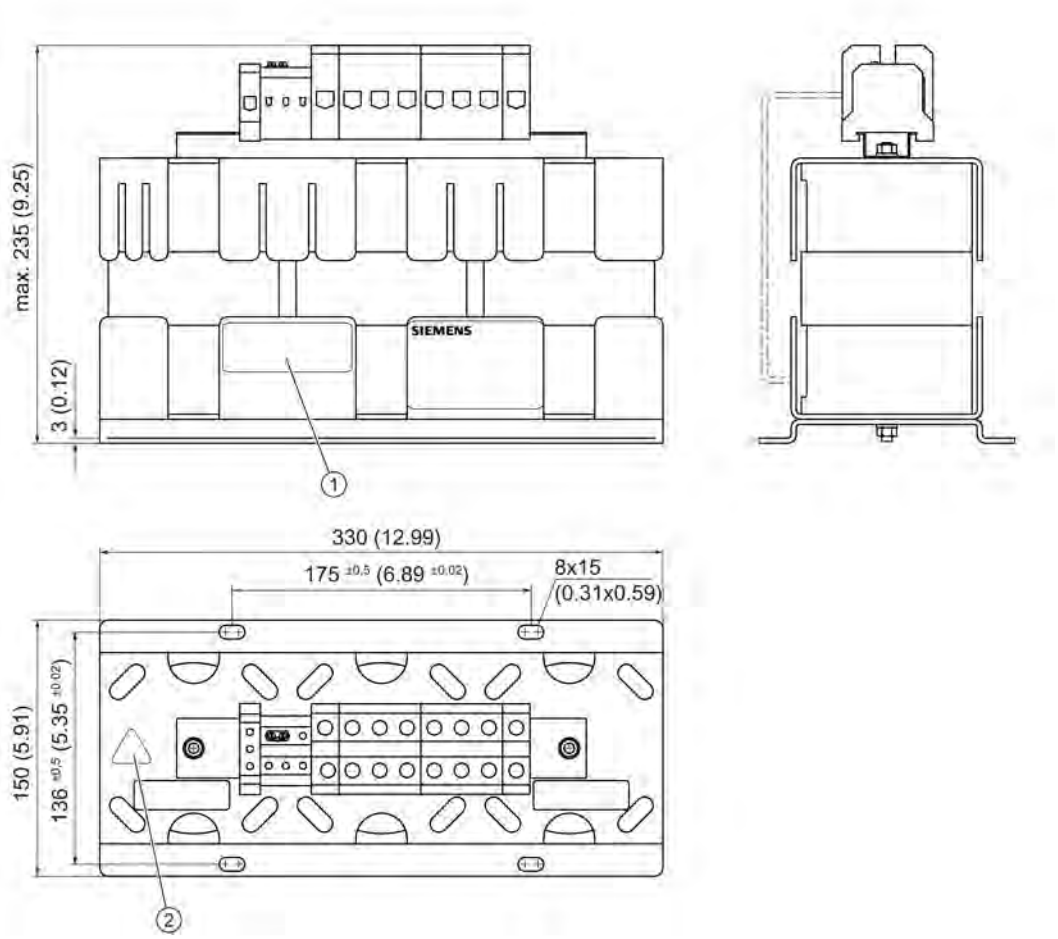
3.8.3.2 Dimension drawings



① Terminal arrangement
② Warning label

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

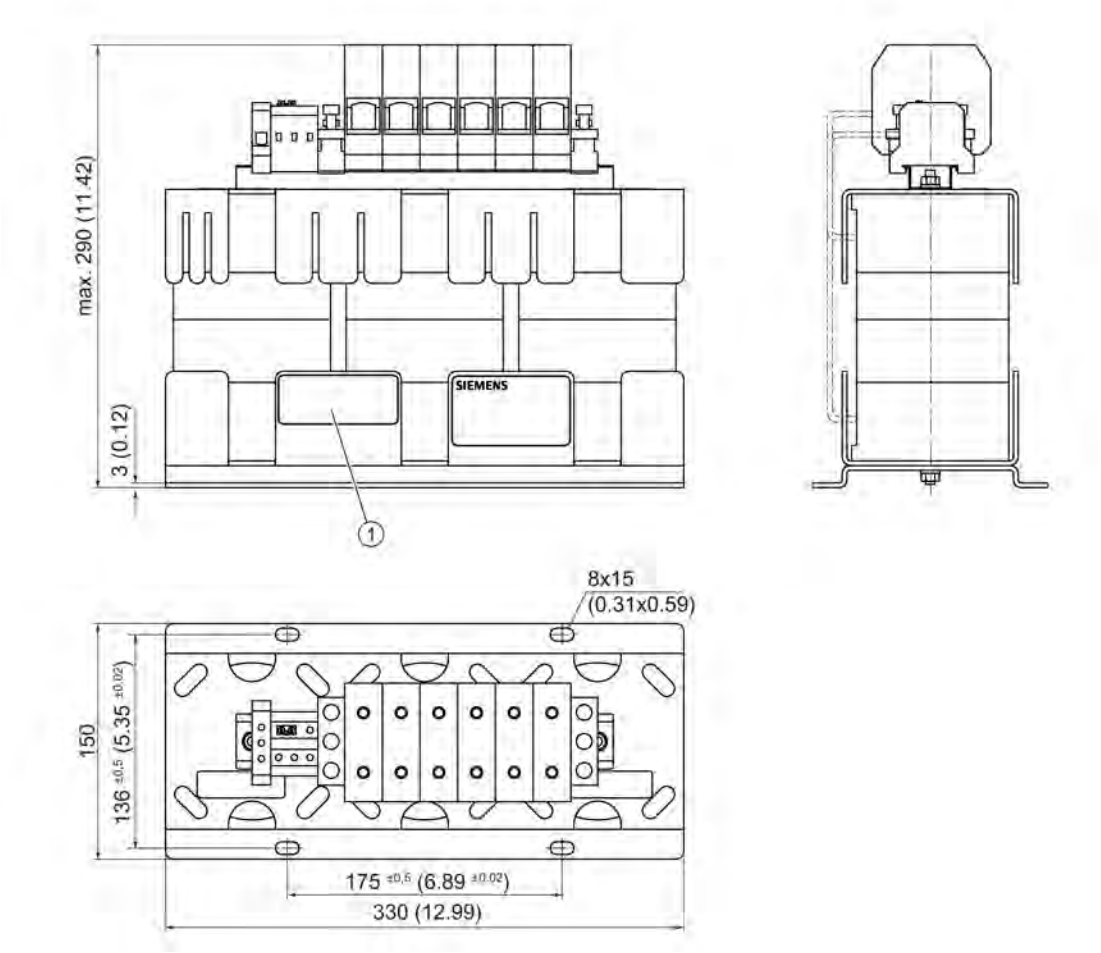
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① Terminal arrangement
② Warning label

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

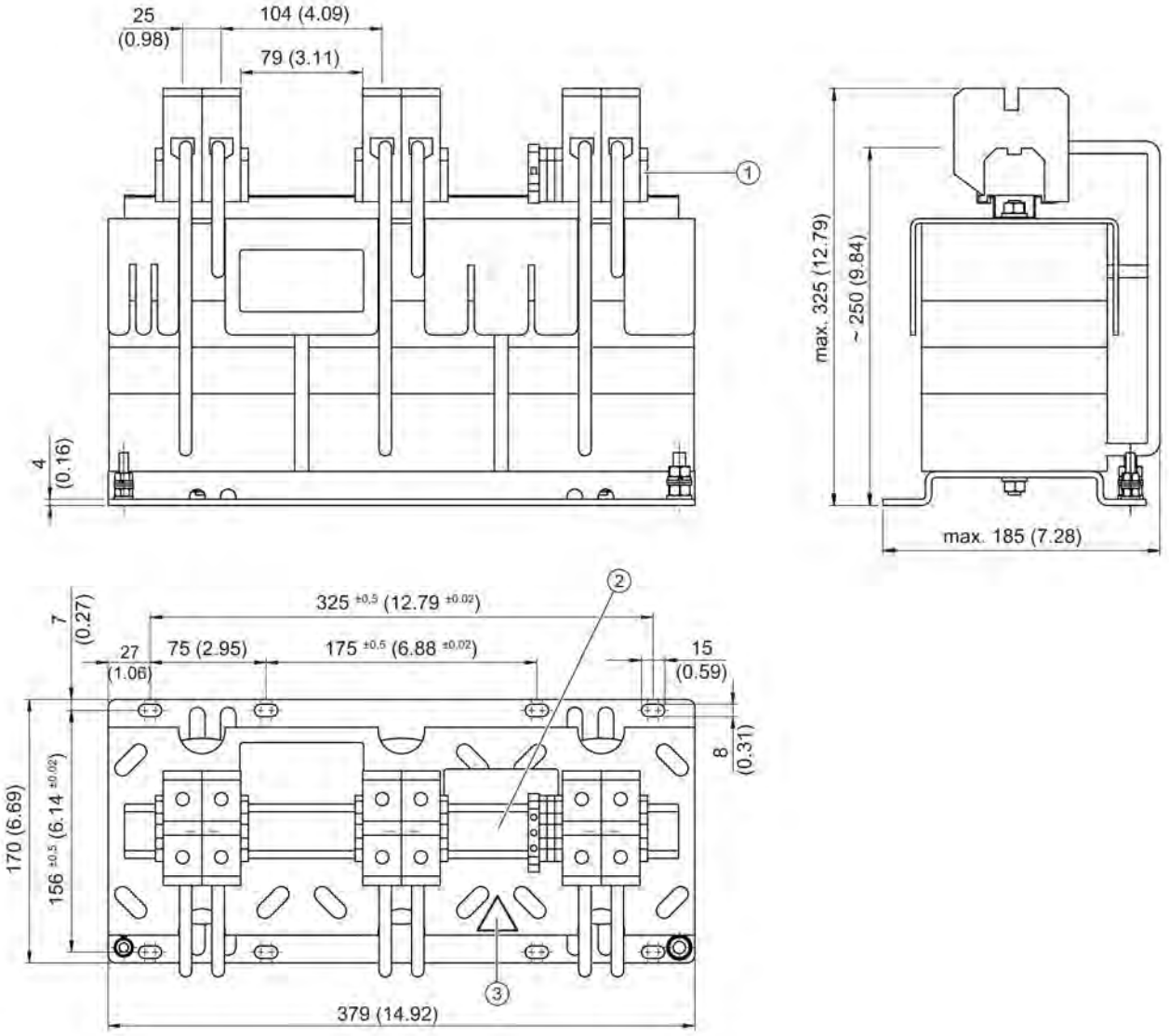
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① Terminal arrangement

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

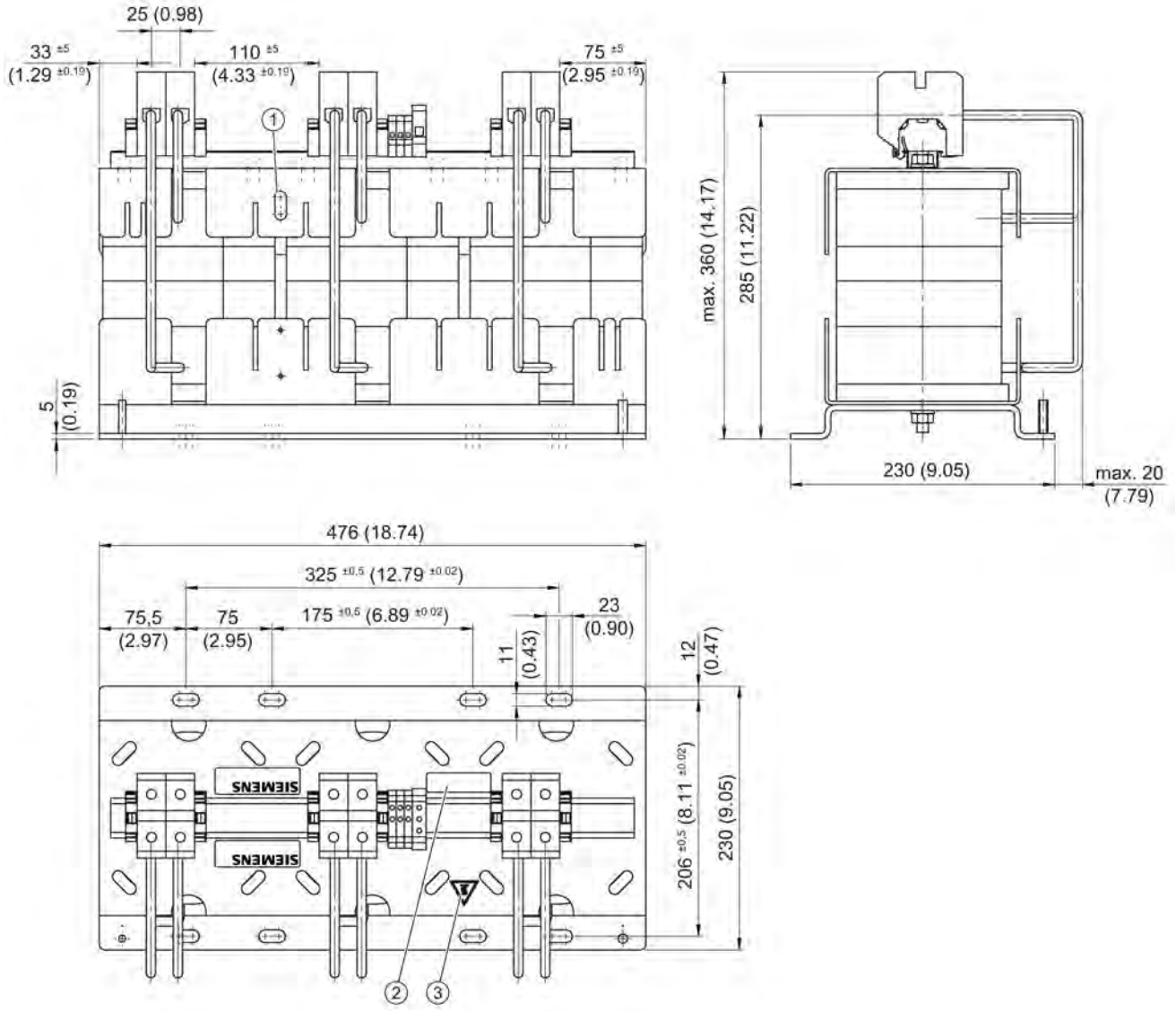
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① End retainers
② Terminal arrangement
③ Warning label

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

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

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

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3.8.3.3 Technical data

Table 3- 15 Technical data for HFD line reactors

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

1) Data for line operation

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3.8.4 Damping resistor for HFD line reactors

3.8.4.1 Description

Using a damping resistor

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

Note

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

3.8.4.2 Safety instructions for damping resistors for HFD reactors

⚠ CAUTION

Risk of burns due to high surface temperatures of the damping resistor

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

- 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.

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3.8.4.3 Dimension drawings

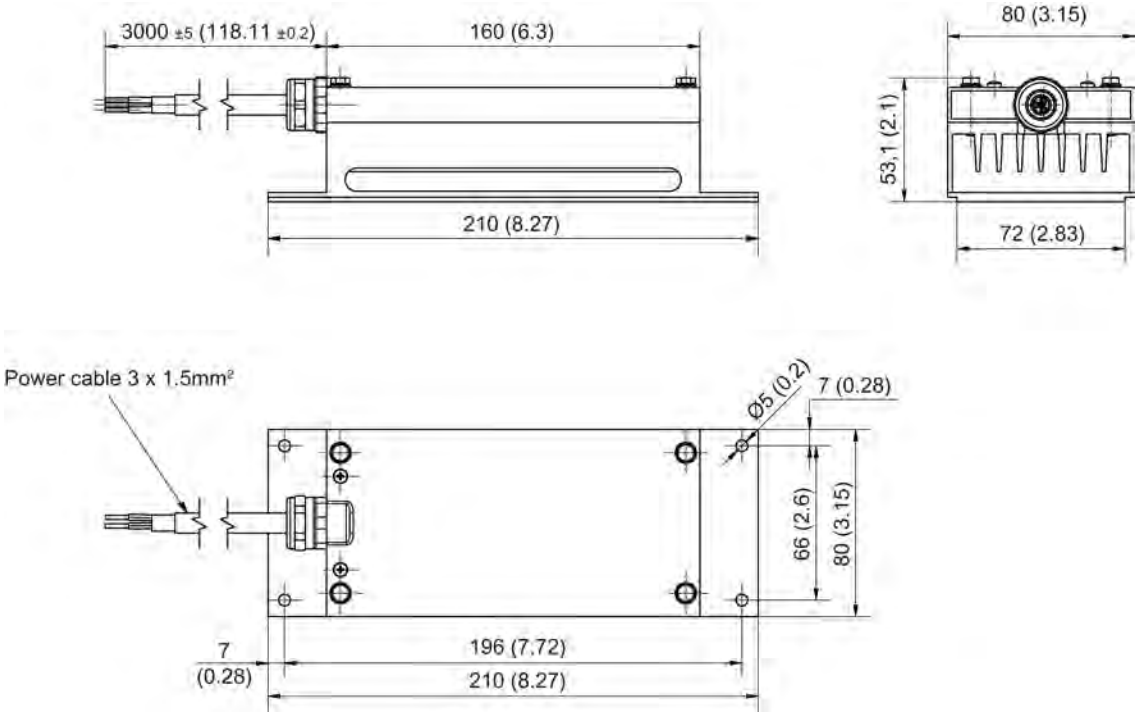


Figure 3-35 300 W damping resistor for HFD line reactors, all dimensions in mm and (inches)

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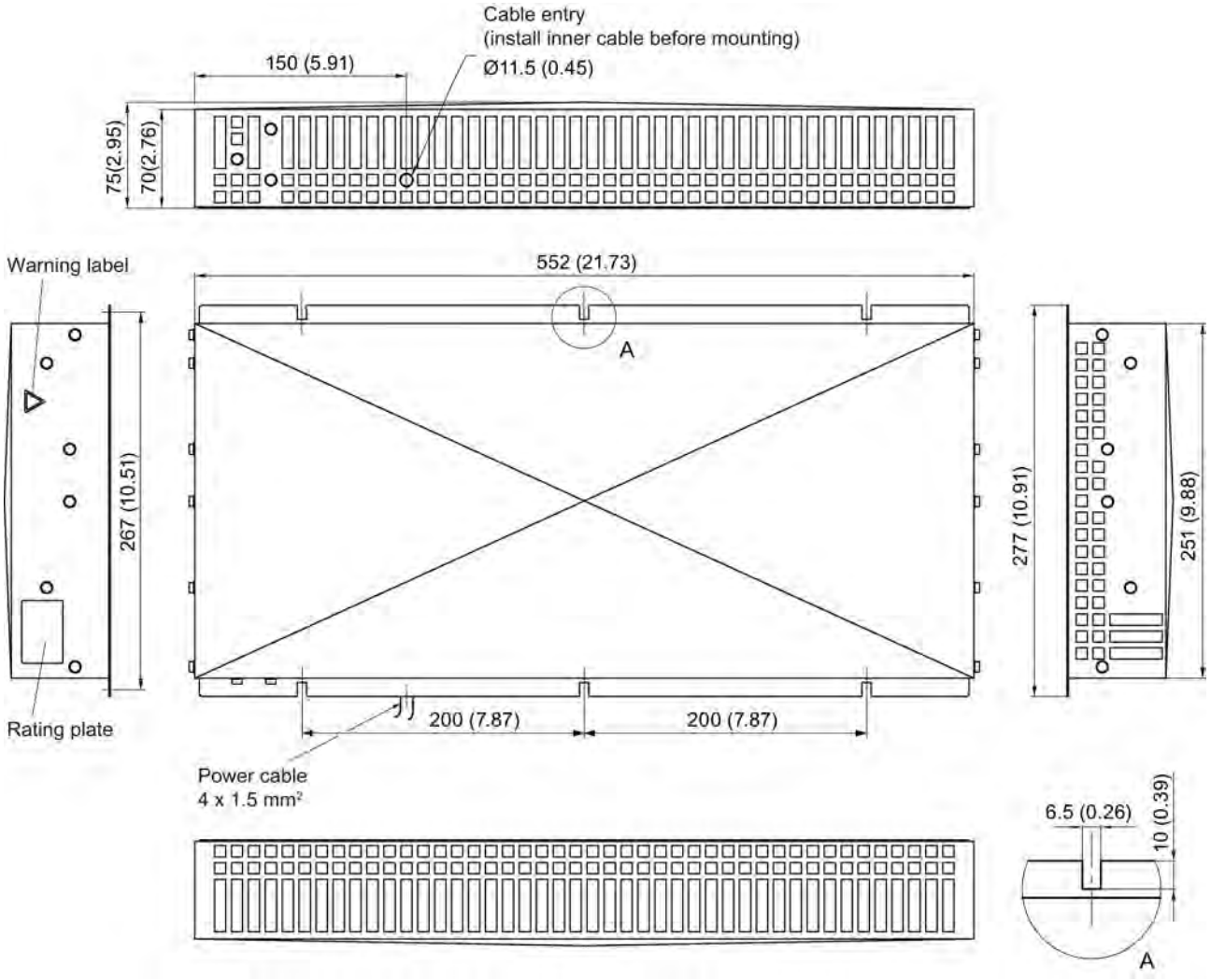


Figure 3-36 800 W damping resistor for HFD line reactors, all dimensions in mm and (inches)

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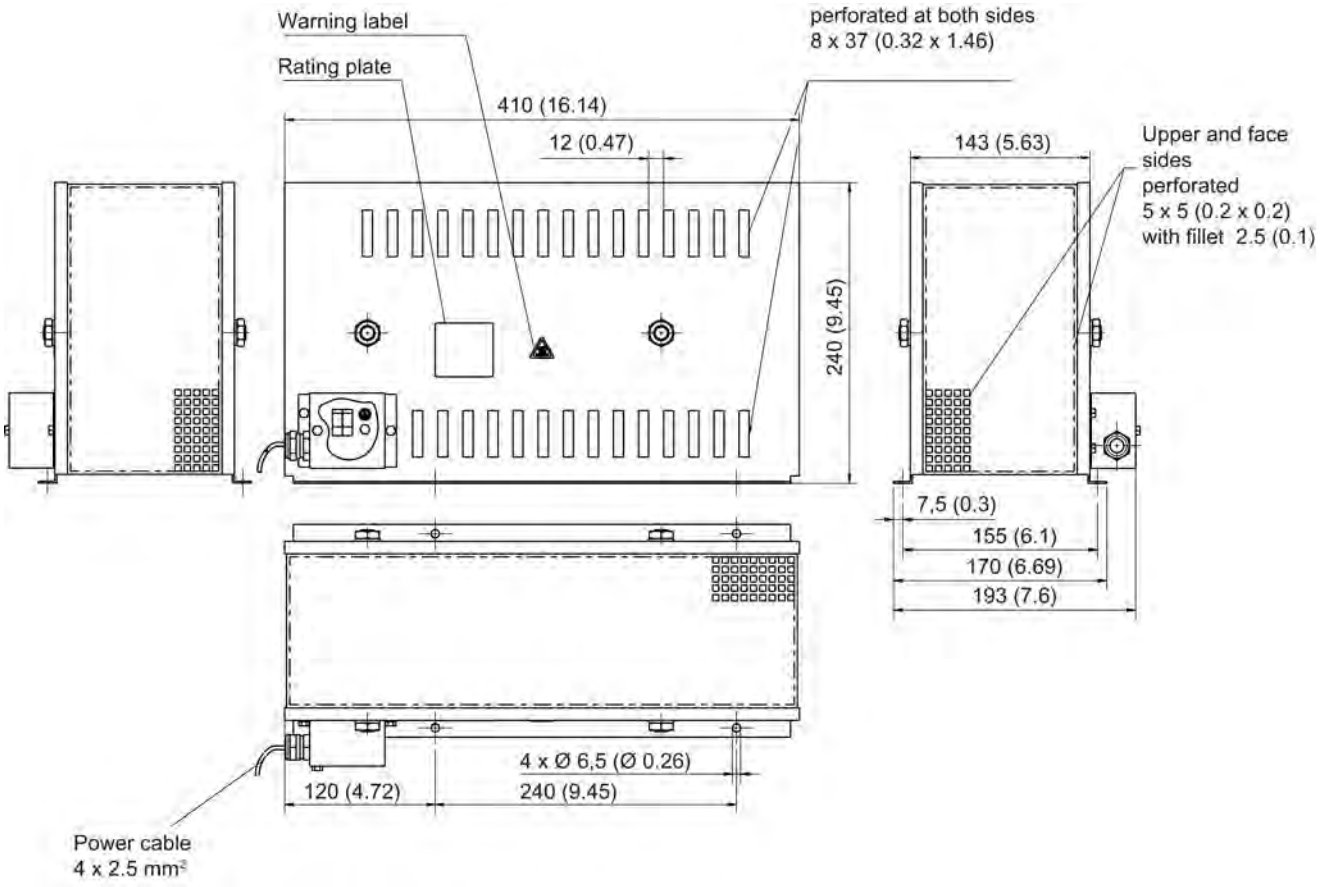


Figure 3-37 1500 W damping resistor for HFD line reactors, all dimensions in mm and (inches)

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3.8.4.4 Technical data

Together with the HFD line reactor, an external resistor must be used for damping purposes (refer to Chapter Wiring with the HFD line reactor (Page 103)).

Table 3- 16 Technical data for HFD damping resistors

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

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

2) Preferred type

3) Alternatively possible

Note

Use of the 800 W damping resistor is preferable.

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3.8.4.5 Wiring with the HFD line reactor

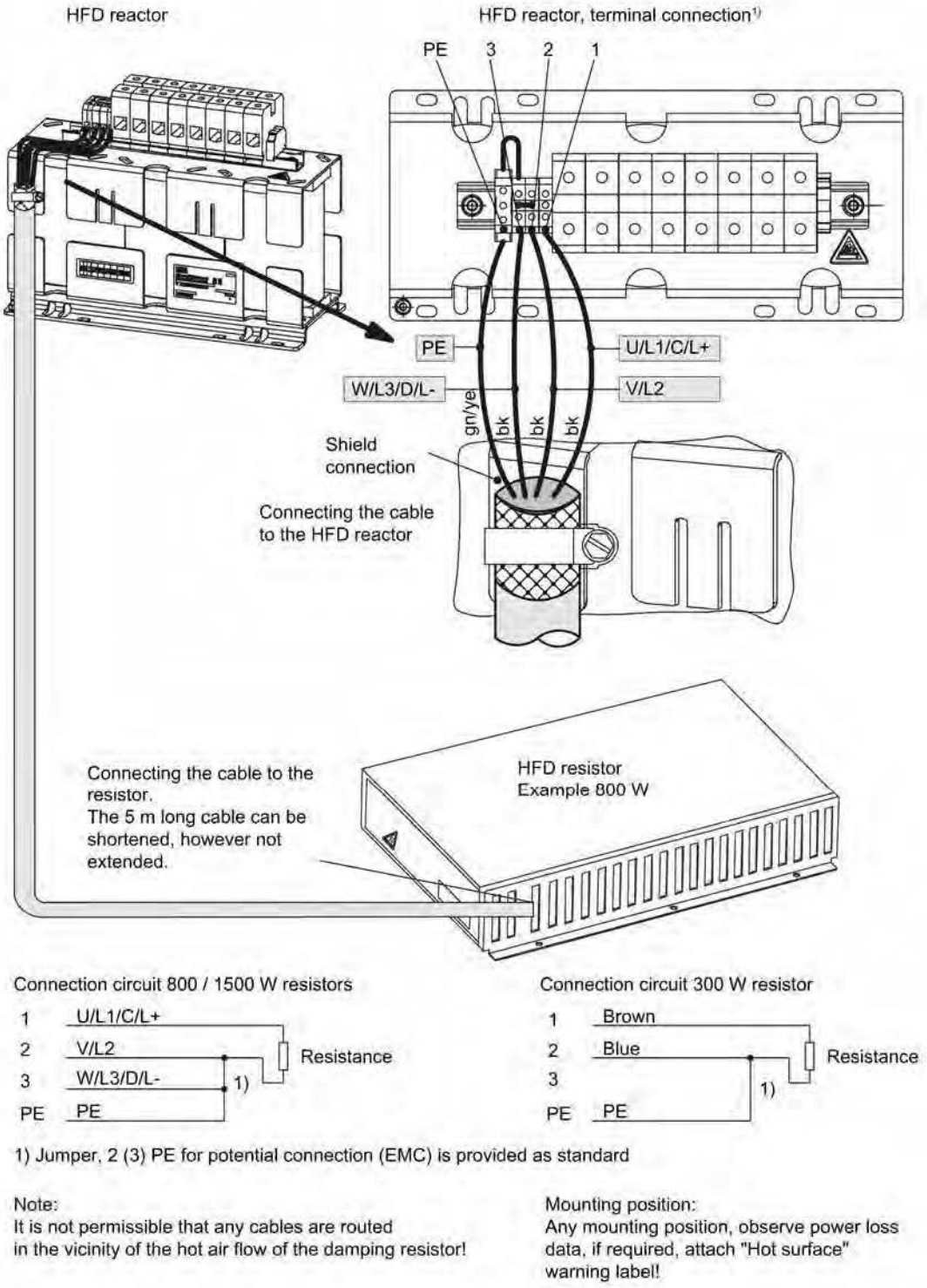


Figure 3-38 Wiring the HFD line reactor with a damping resistor

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3.8.5 Line reactors for Basic Line Modules

3.8.5.1 Interface description

Overview

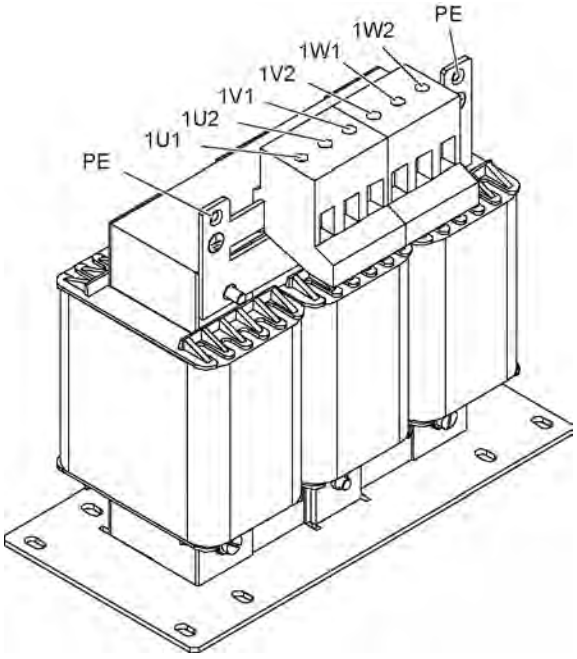


Figure 3-39 Interface overview, line reactor for Basic Line Modules (20 kW)

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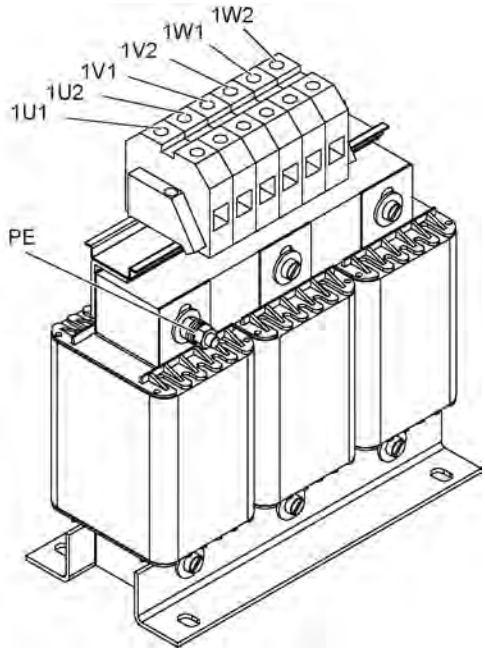


Figure 3-40 Interface overview, line reactor for Basic Line Modules (40 kW)

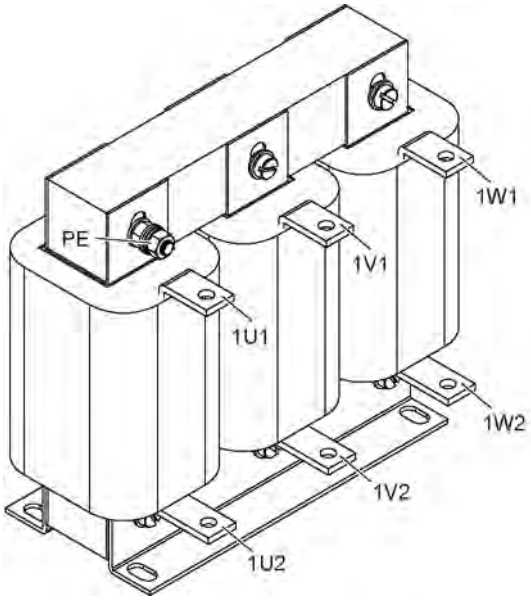


Figure 3-41 Interface overview, line reactor for Basic Line Modules (100 kW)

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Line/load connection

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

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

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3.8.5.2 Dimension drawings

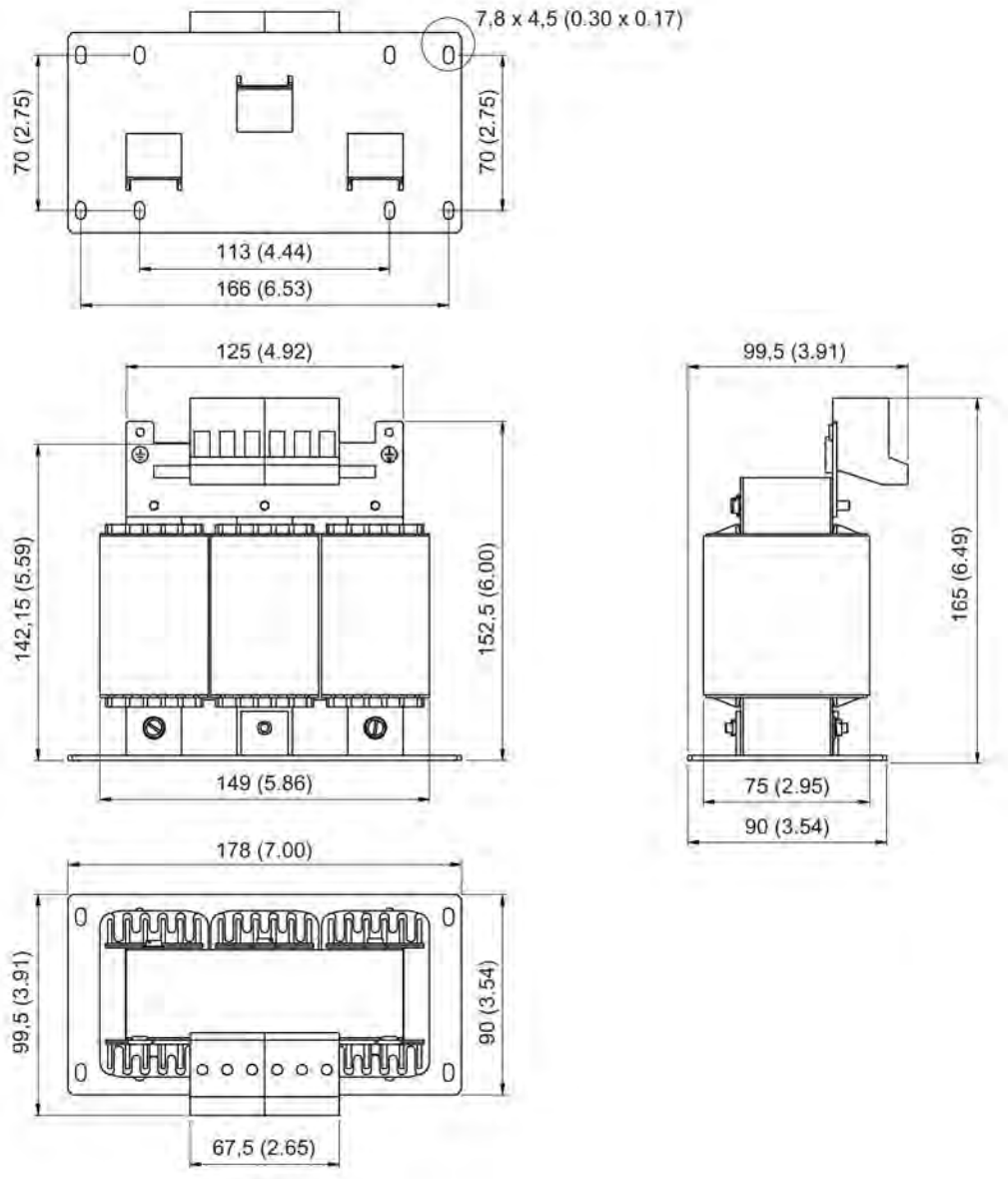


Figure 3-42 Dimension drawing of line reactor for Basic Line Module 20 kW, all dimensions in mm and (inches)

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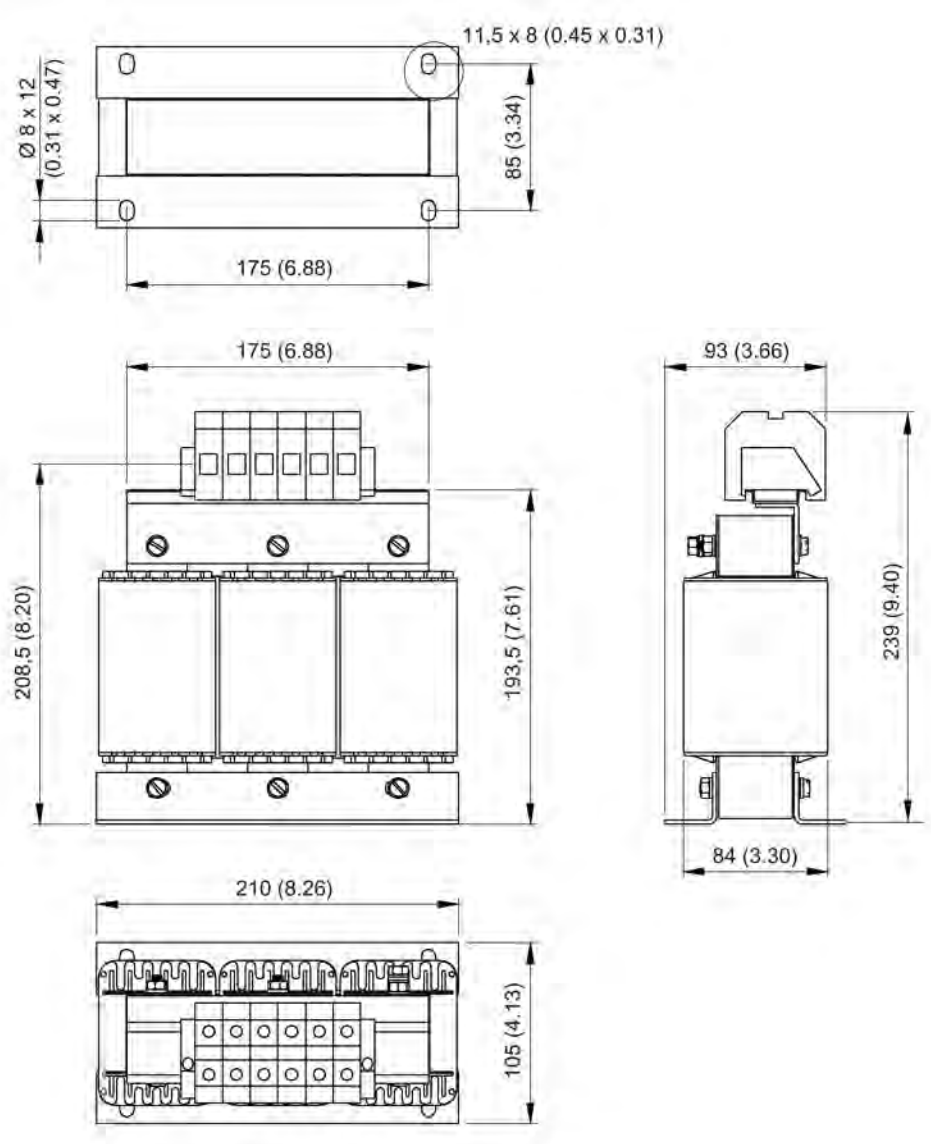


Figure 3-43 Dimension drawing of line reactor for Basic Line Module 40 kW, all dimensions in mm and (inches)

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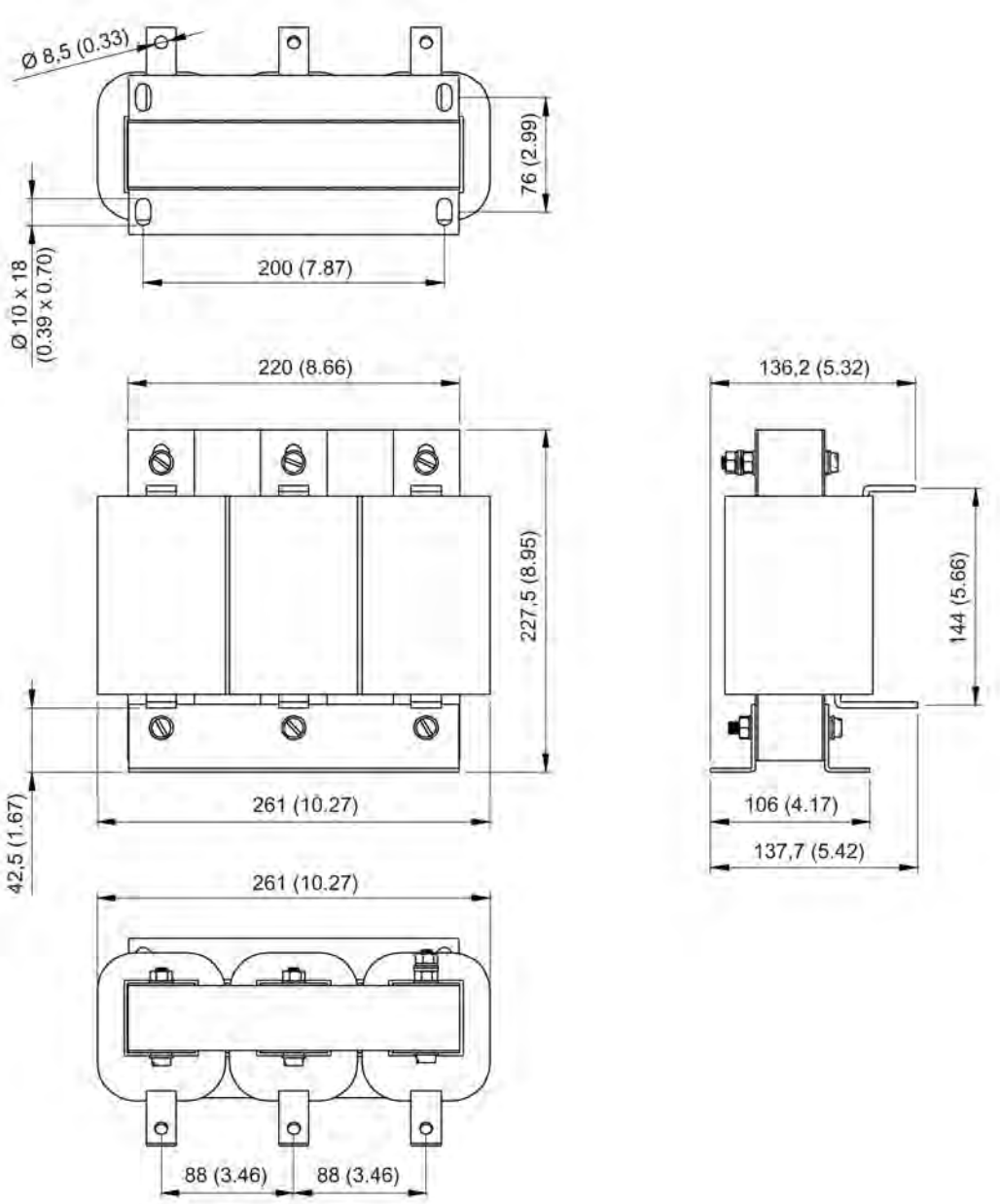


Figure 3-44 Dimension drawing of line reactor for Basic Line Module 100 kW, all dimensions in mm and (inches)

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3.8.5.3 Technical data

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

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

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3.8.6 Line reactors for Smart Line Modules

3.8.6.1 Interface description

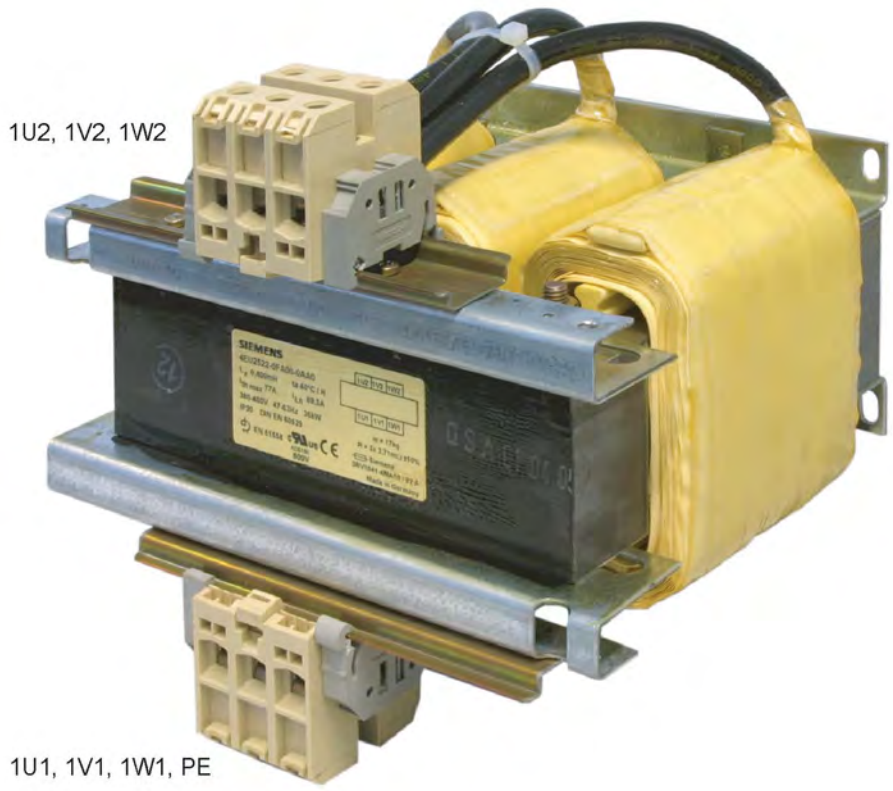


Figure 3-45 Interface overview, line reactors for Smart Line Modules (example: 36 kW)

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

Line/load connection

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

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

[1)] For ring cable lugs without insulation

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3.8.6.2 Dimension drawings

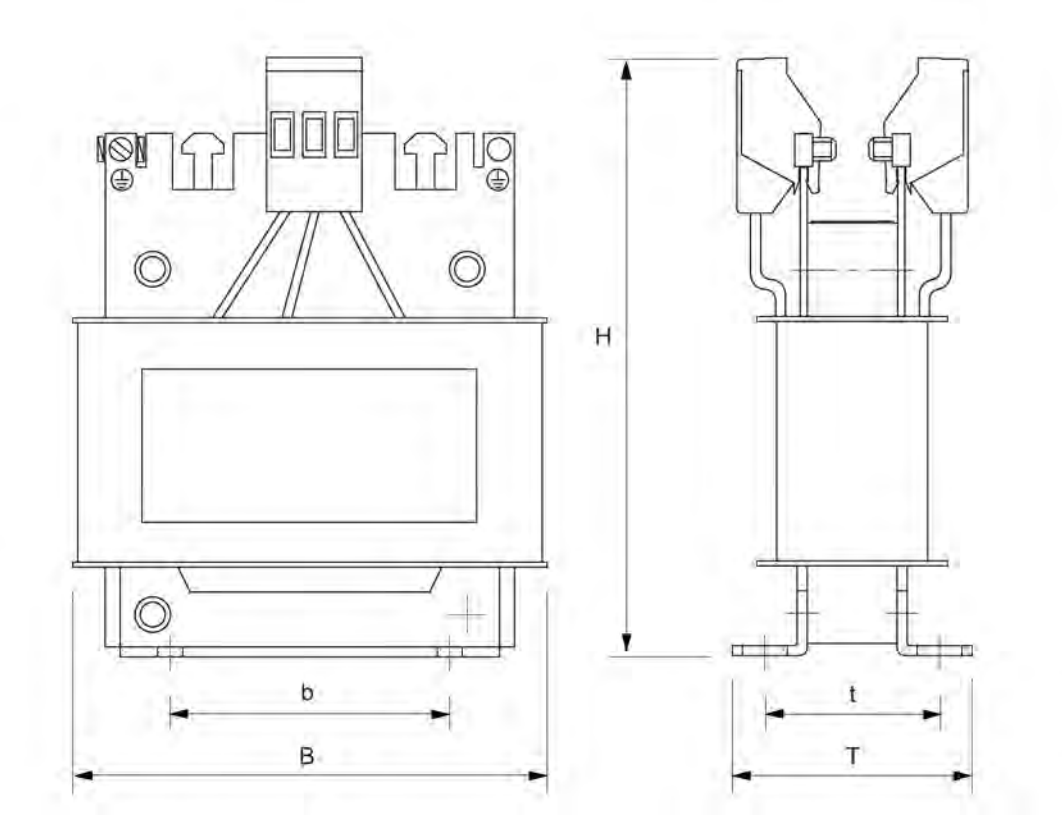


Figure 3-47 Dimension drawing of line reactor for Smart Line Modules 5 kW and 10 kW

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

	Order number 6SL3000-	B [mm] (inches)	b [mm] [1] (inches)	H [mm] (inches)	D [mm] (inches)	t [mm] [1] (inches)
5 kW	0CE-15-0AAx	150 (5.91)	113 (4.53)	175 (6.89)	66,5 (2.62)	49,5 (1.95)
10 kW	0CE-21-0AAx	177 (6.97)	136 (5.35)	196 (7.72)	86 (3.39)	67 (2.64)

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

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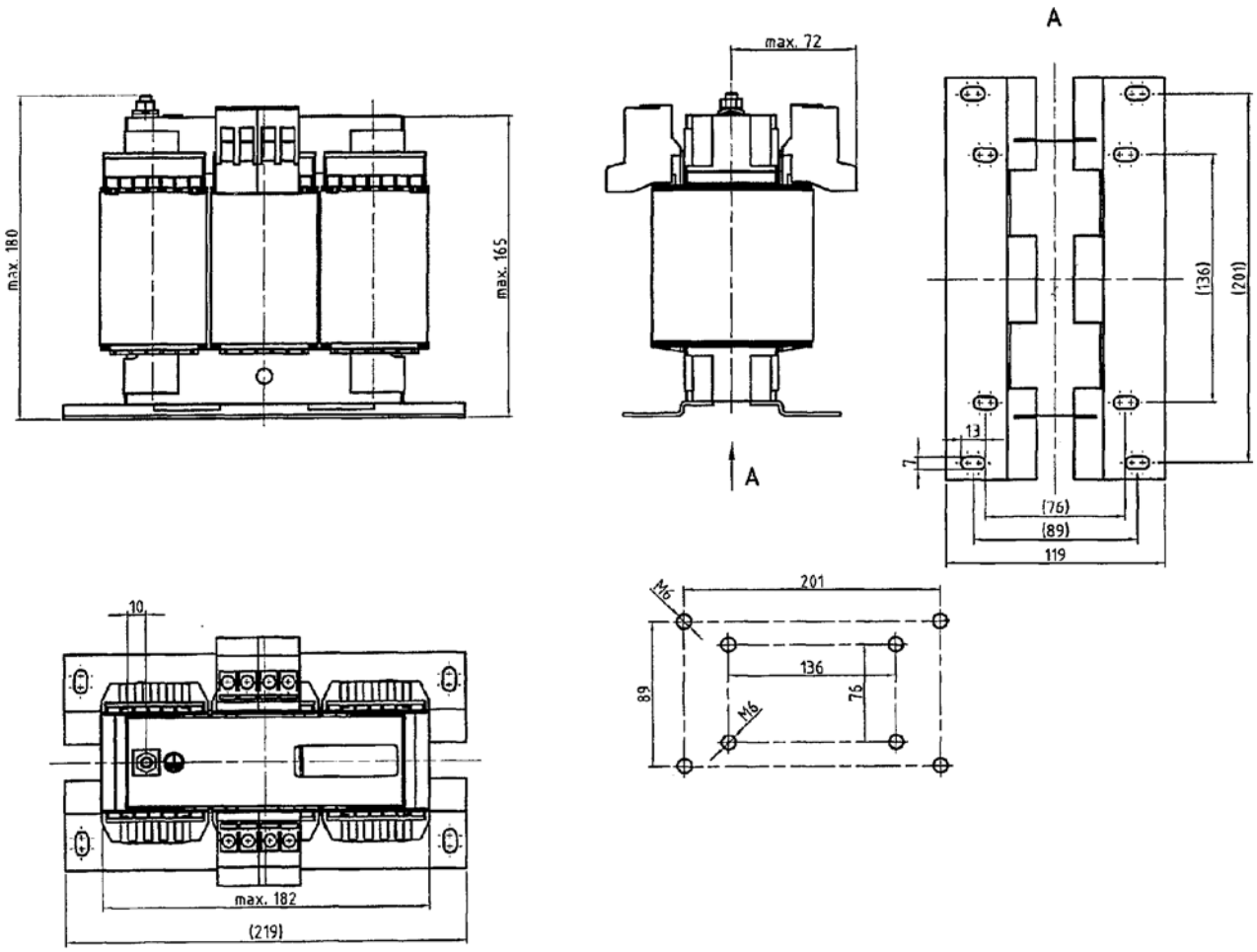


Figure 3-48 Dimension drawing of line reactor for Smart Line Module 16 kW

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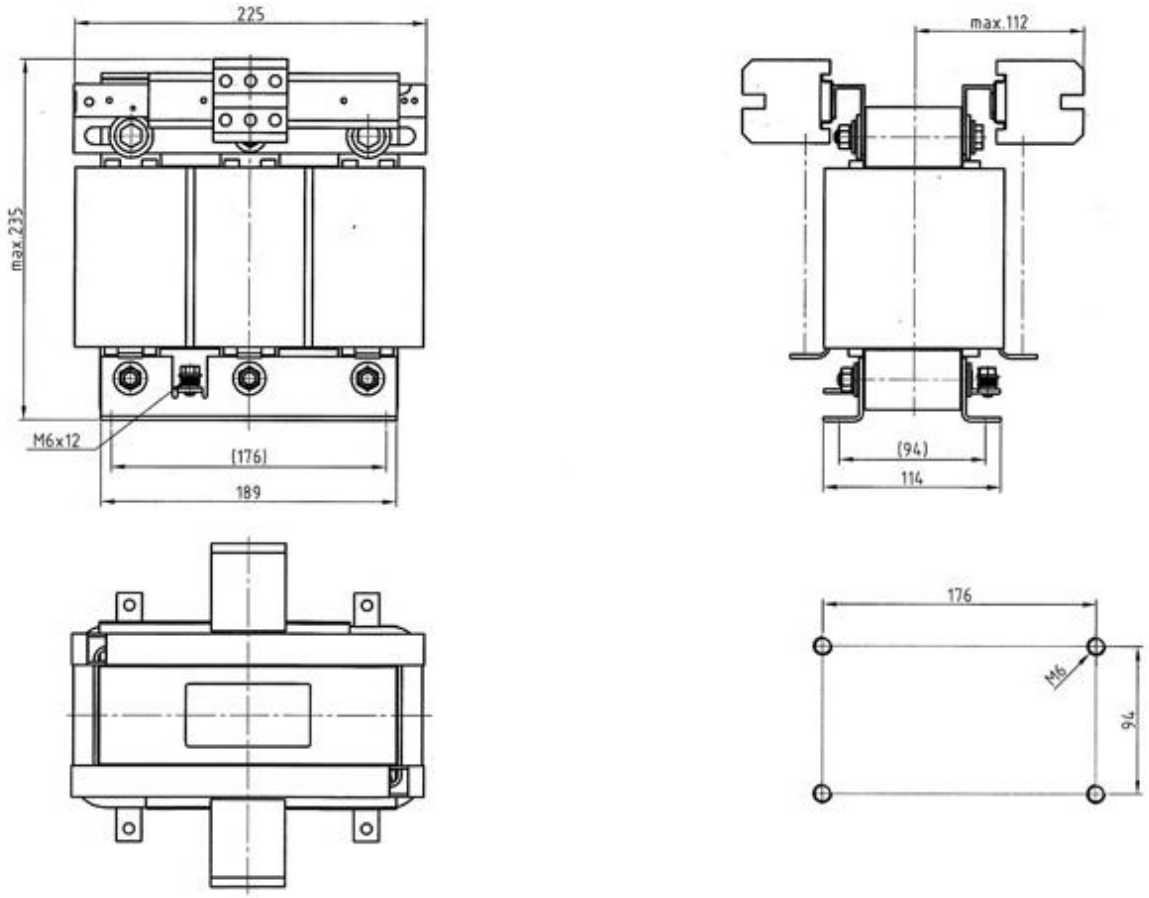


Figure 3-49 Dimension drawing of line reactor for Smart Line Module 36 kW

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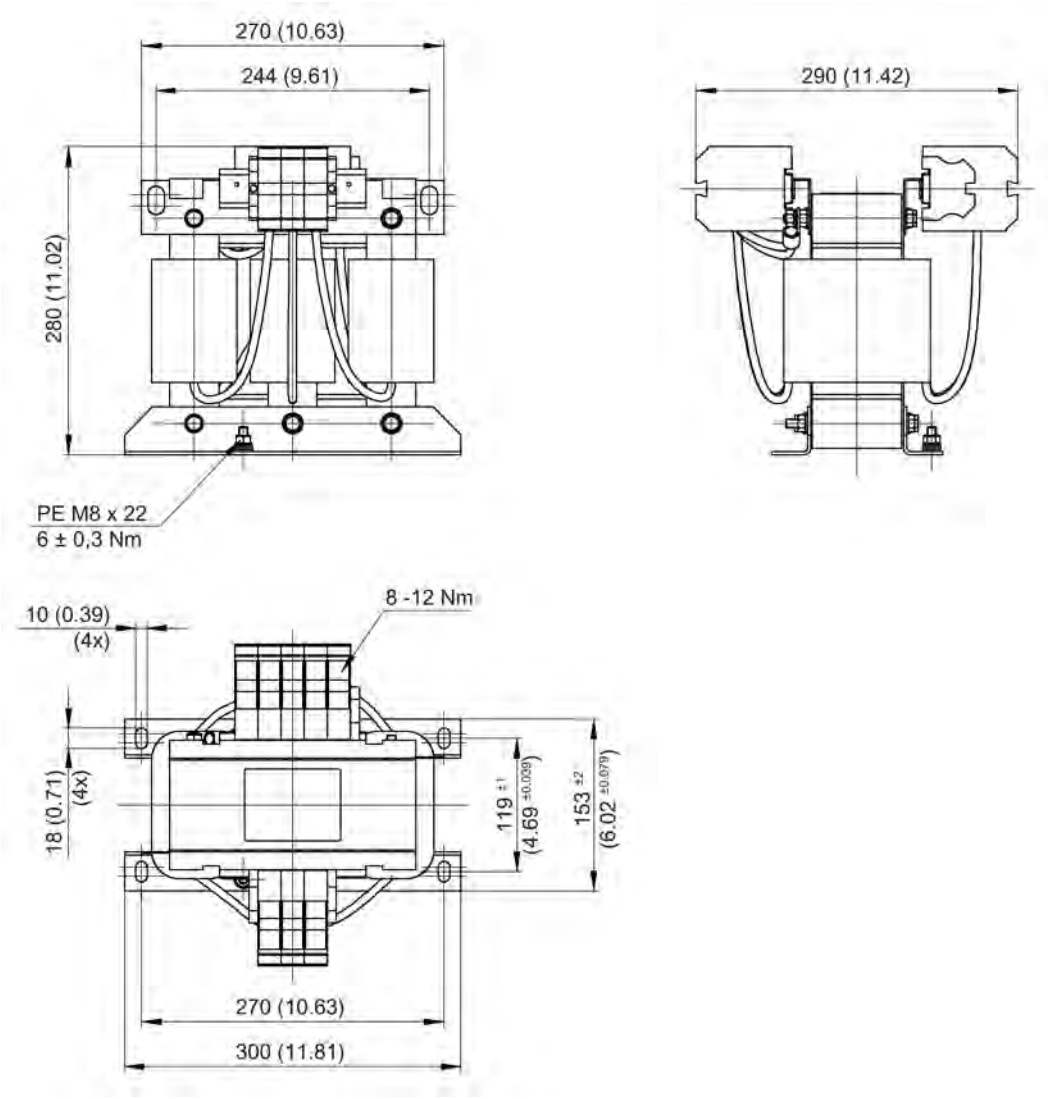


Figure 3-50 Dimension drawing of line reactor for Smart Line Module 55 kW, all dimensions in mm and (inches)

3.8.6.3 Technical data

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

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

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3.9 Active Interface Modules internal air cooling

3.9.1 Description

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

They contain the following functional units:

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

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

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

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

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3.9.2 Safety instructions for Active Interface Modules

⚠WARNING

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

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

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

NOTICE

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

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

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

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

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

NOTICE

Destruction of the Active Interface Module through incorrect or missing wiring

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

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

⚠WARNING

Fire hazard due to overheating when permissible cable lengths are exceeded

Excessively long cable lengths can cause components to overheat with the associated risk of fire and development of smoke.

- The total cable length between an Active Interface Module and Active Line Module as well as between an Active Interface Module and Basic Line Filter must not exceed 10 m.

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⚠WARNING

Danger to life through electric shock due to unconnected cable shields

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

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

NOTICE

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

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

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

Note

Functional disturbances as a result of line supply disturbances

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

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

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3.9.3 Interface description

3.9.3.1 Overview

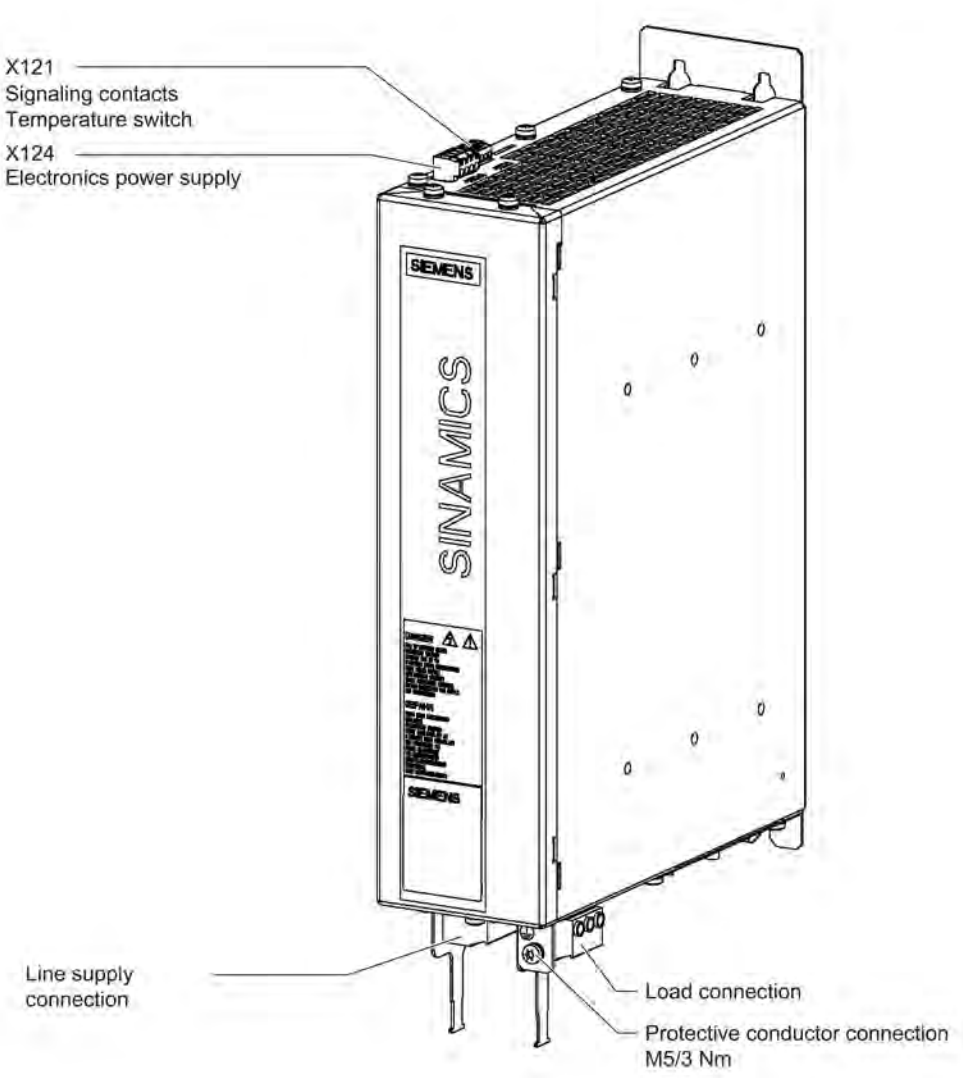


Figure 3-51 Interface overview, Active Interface Module 16 kW

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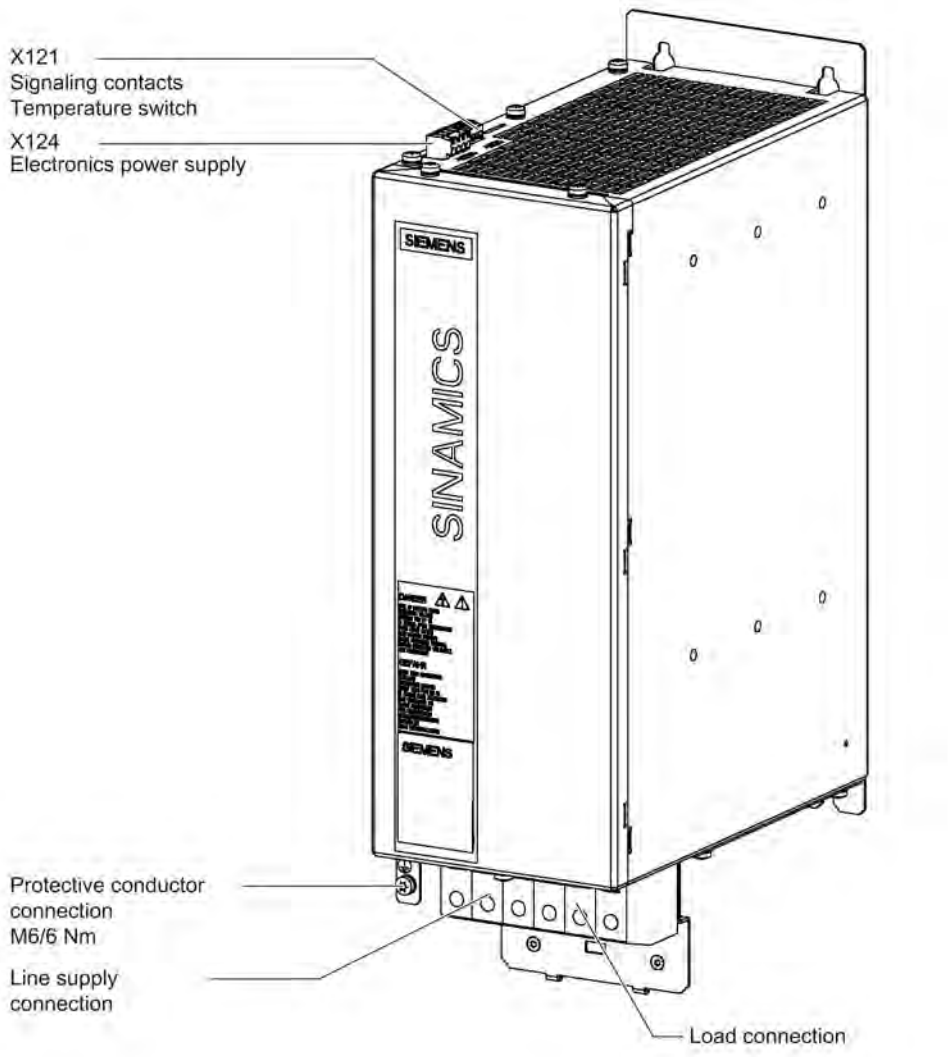


Figure 3-52 Interface overview, Active Interface Module 36 kW

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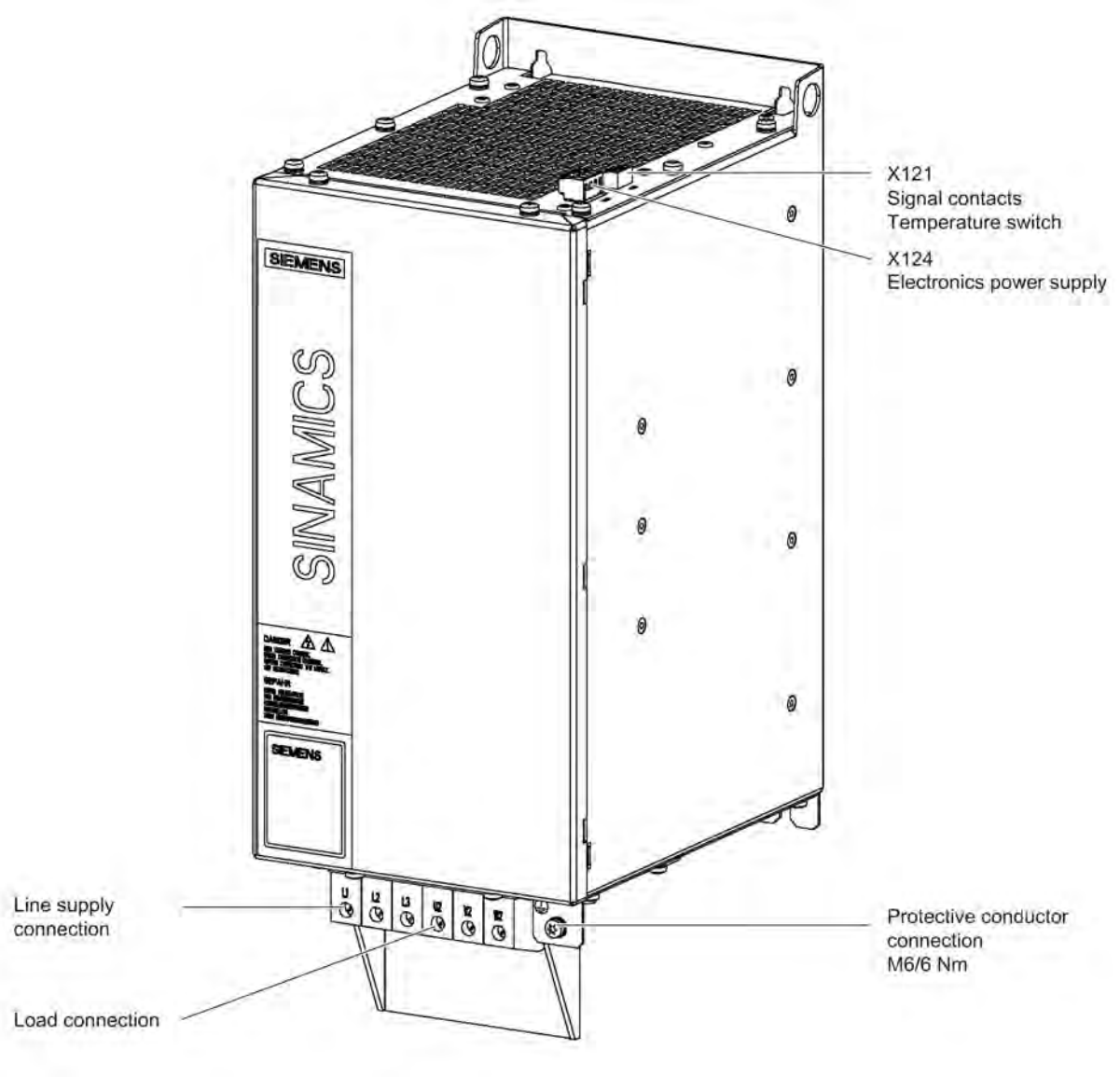


Figure 3-53 Interface overview, Active Interface Module 55 kW

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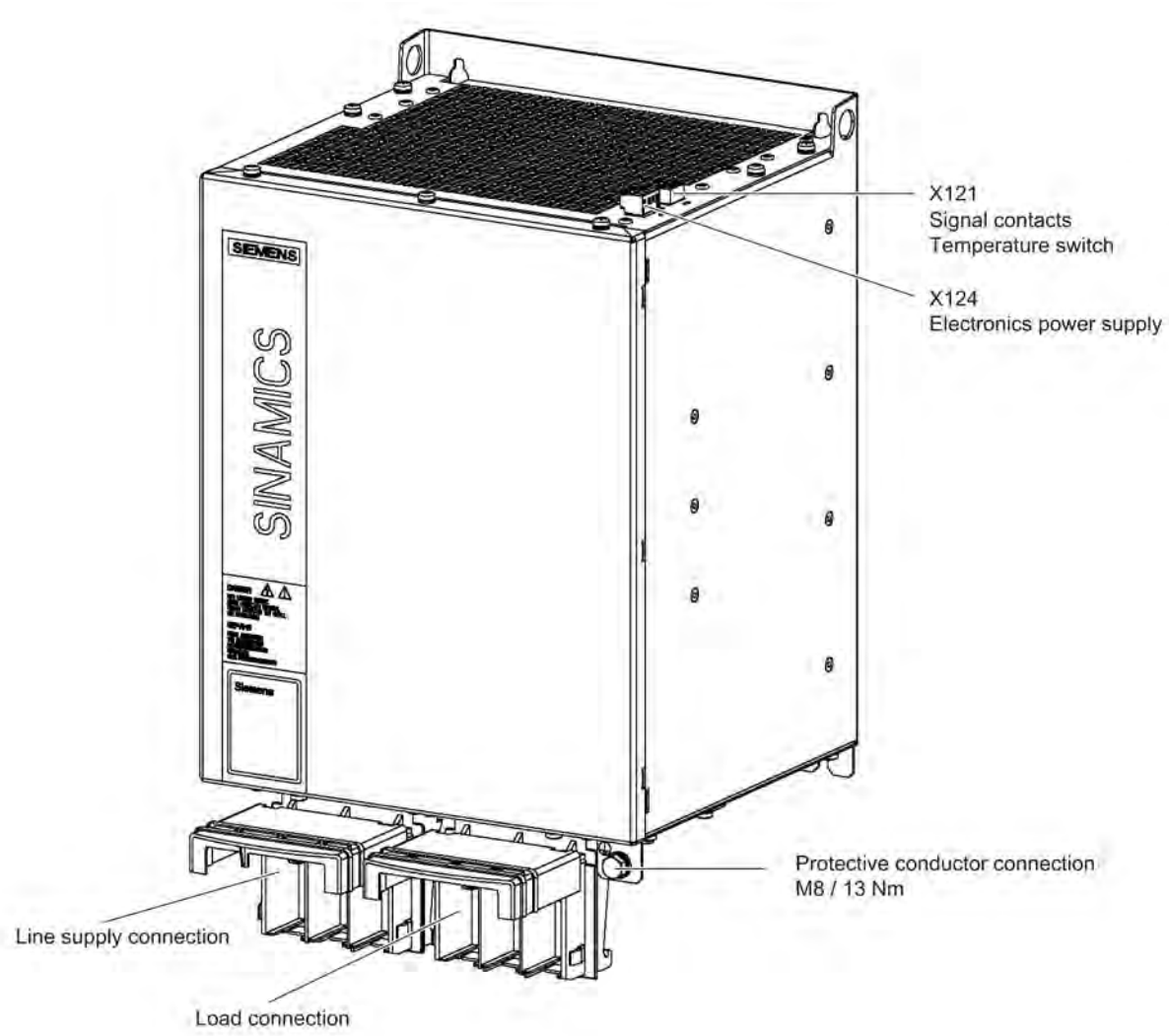


Figure 3-54 Interface overview, Active Interface Module 80 kW and 120 kW

3.9.3.2 Line/load connection

Table 3- 22 Line and load connection Active Interface Module

	6SL3100-0BE21-6ABx	6SL3100-0BE23-6ABx	6SL3100-0BE25-5ABx	6SL3100-0BE28-0ABx	6SL3100-0BE31-2ABx
Power	16 kW	36 kW	55 kW	80 kW	120 kW
Line supply connection L1, L2, L3	Connector, 16 mm², 1.7 Nm	Screw terminal 50 mm², end sleeve, 6 Nm	Screw terminal 50 mm², end sleeve, 6 Nm	Threaded bolt M8, cross-section 120 / 2 x 50 mm², 13 Nm[1)]	
Load connection U2, V2, W2					

1) For ring cable lugs without insulation

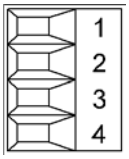
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Note

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

3.9.3.3 X121 temperature sensor and fan control

Table 3- 23 Plug-in screw terminal X121

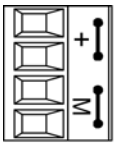
	Terminal	Designation	Technical data
	1	+Temp	Output temperature switch Must be connected to interface X21 of the Active Line Module.
	2	-Temp	Temperature switch output
	3	+24 V power supply for digital inputs	Current carrying capacity: 500 mA
	4	Disable Fan	**The fan can be disabled. The fan may be disabled only while the Active Line Module is disabled.**
Type: Screw terminal 1 (Page 755) Max. connectable cross-section: 1.5 mm²			

Note

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

3.9.3.4 X124 Electronics power supply

Table 3- 24 X124 Electronics power supply

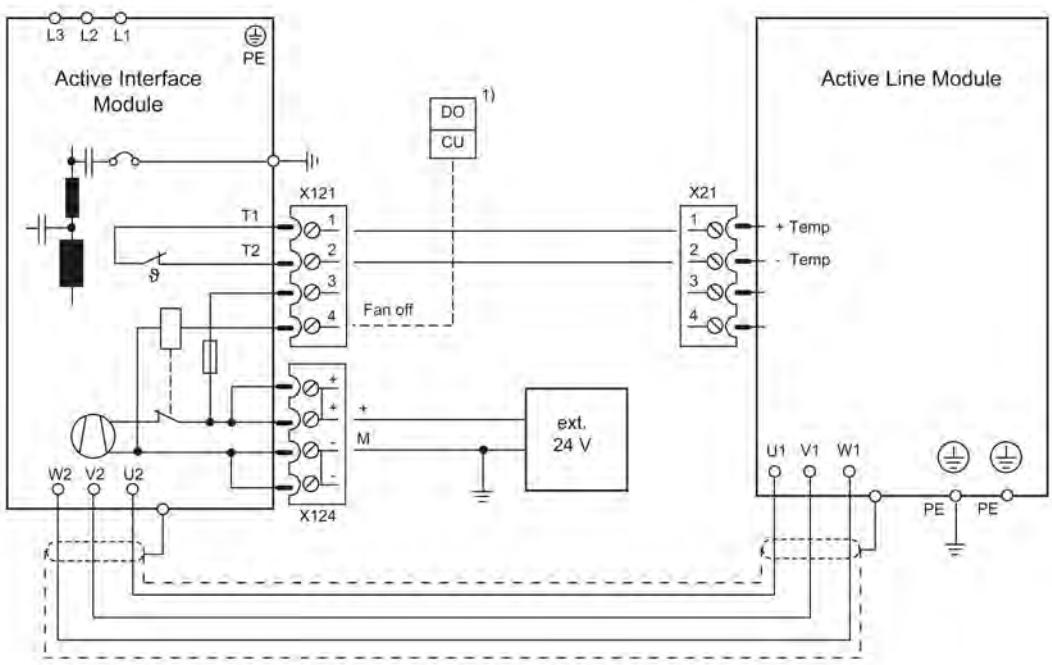
	Terminal	Function	Technical data
	+	Electronics power supply	Voltage: 24 VDC (20.4 ... 28.8 V) Current consumption: max. 1.6 A Max. current via jumper in connector: 20 A at 55° C
	+	Electronics power supply	
	M	Electronics ground	
	M	Electronics ground	
Type: Screw terminal 2 (Page 755) Max. connectable cross-section: 2.5 mm²			

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Note

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

3.9.4 Connection example



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

Figure 3-55 Connection example: Active Interface Module

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3.9.5 Dimension drawings

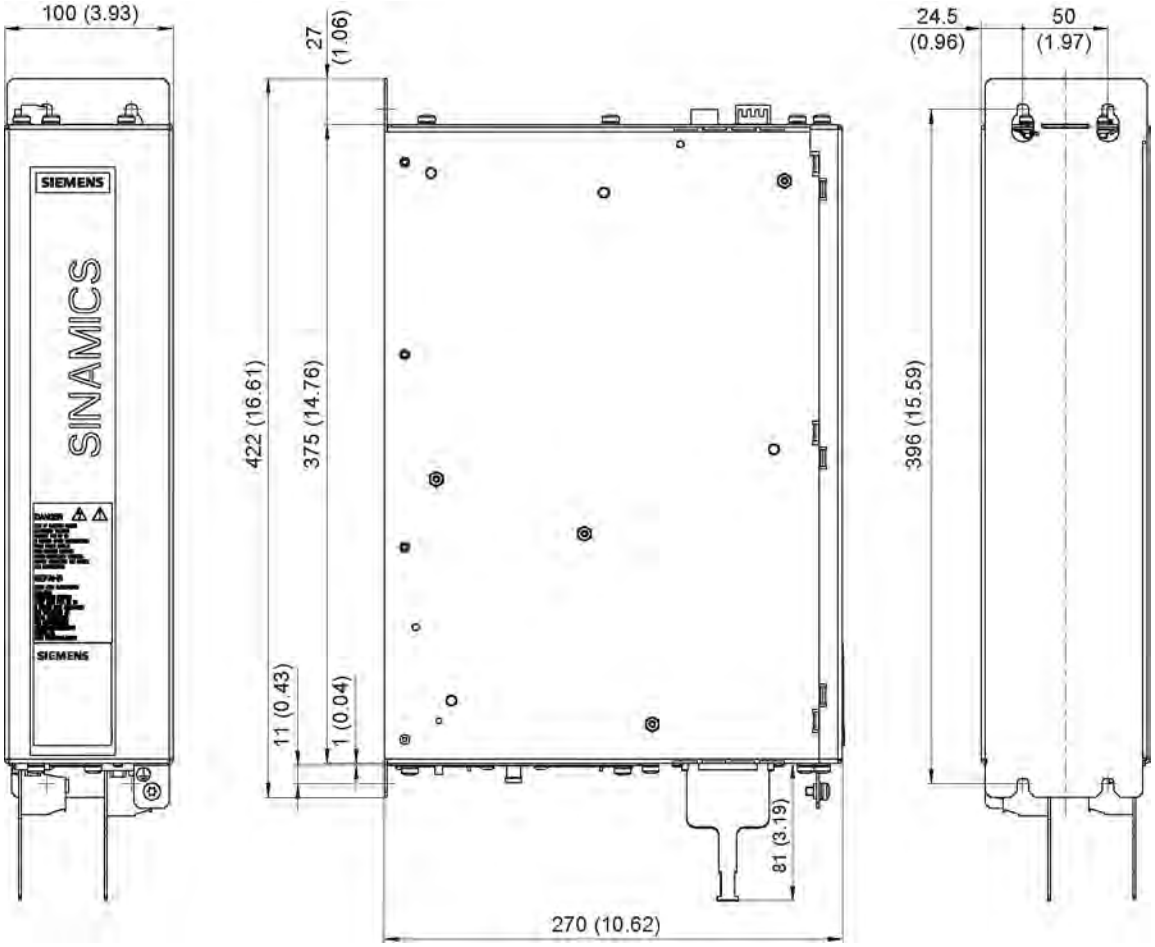


Figure 3-56 Dimension drawing of Active Interface Module 16 kW, all dimensions in mm and (inches)

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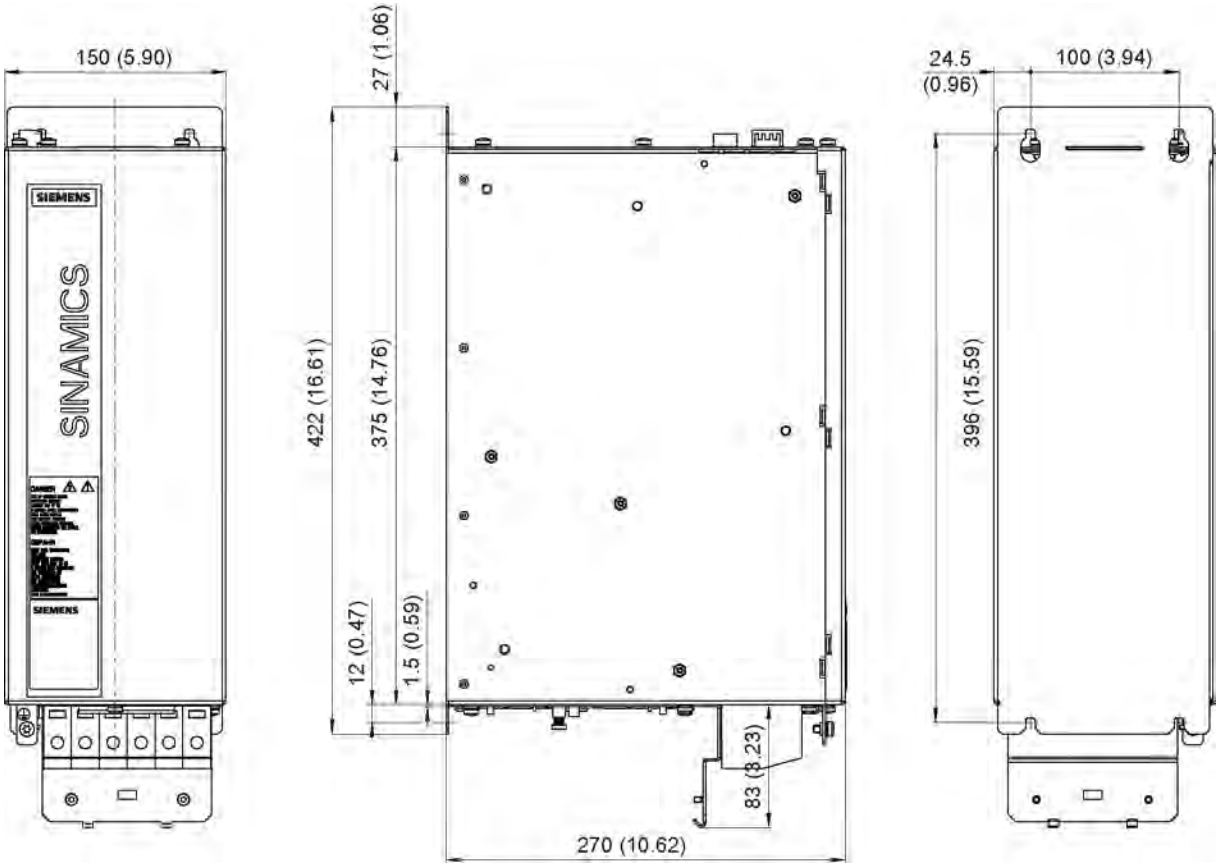


Figure 3-57 Dimension drawing of Active Interface Module 36 kW, all dimensions in mm and (inches)

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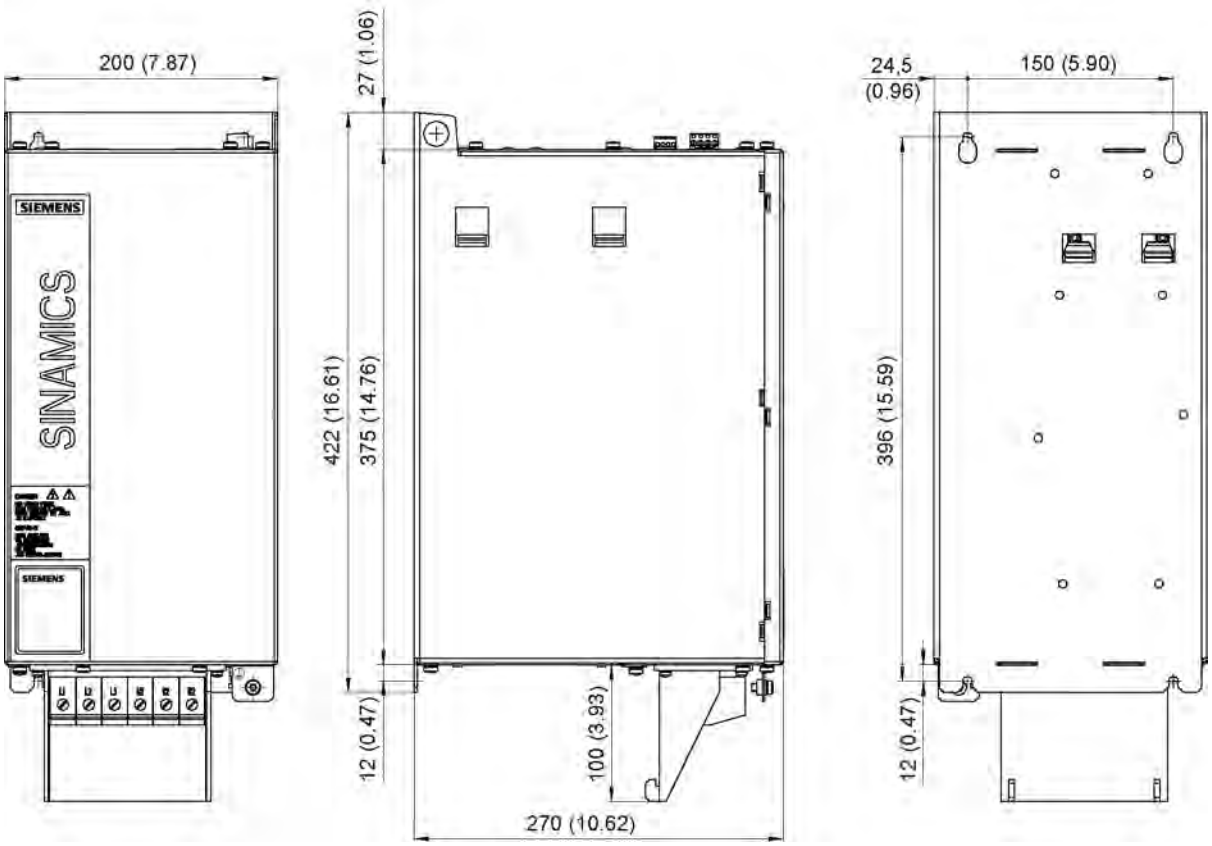


Figure 3-58 Dimension drawing of Active Interface Module 55 kW, all dimensions in mm and (inches)

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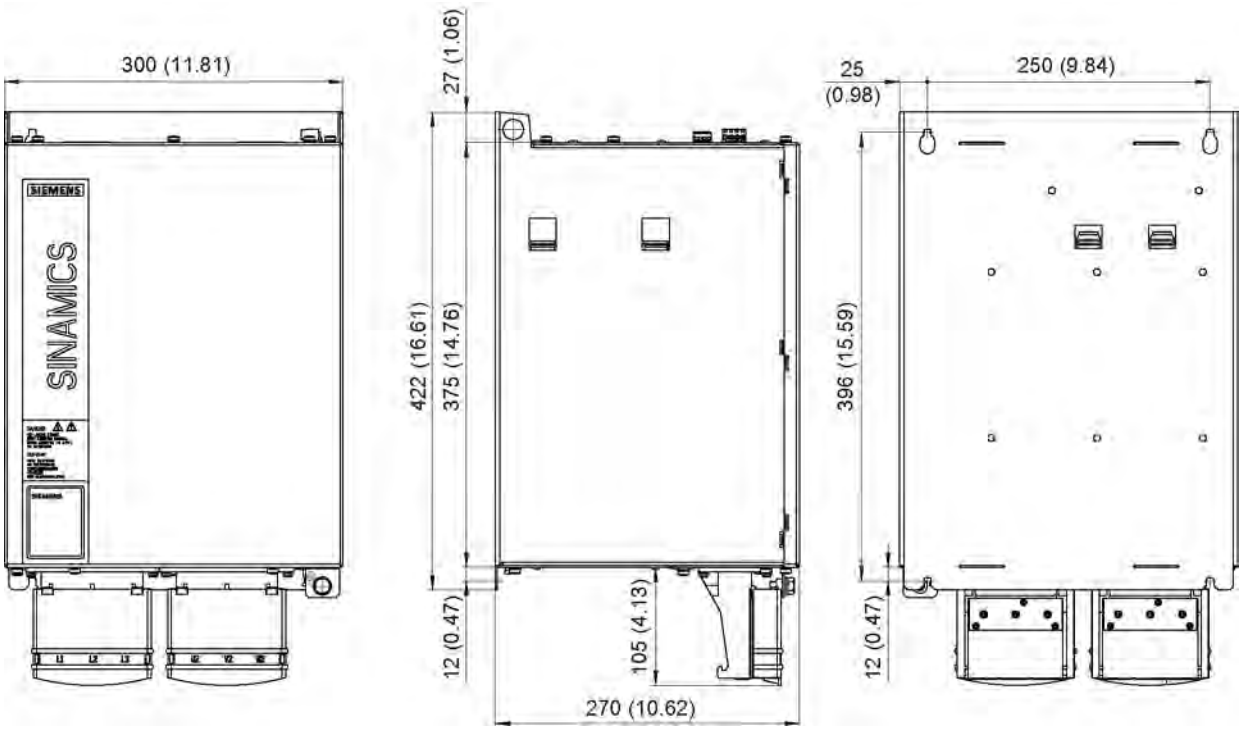
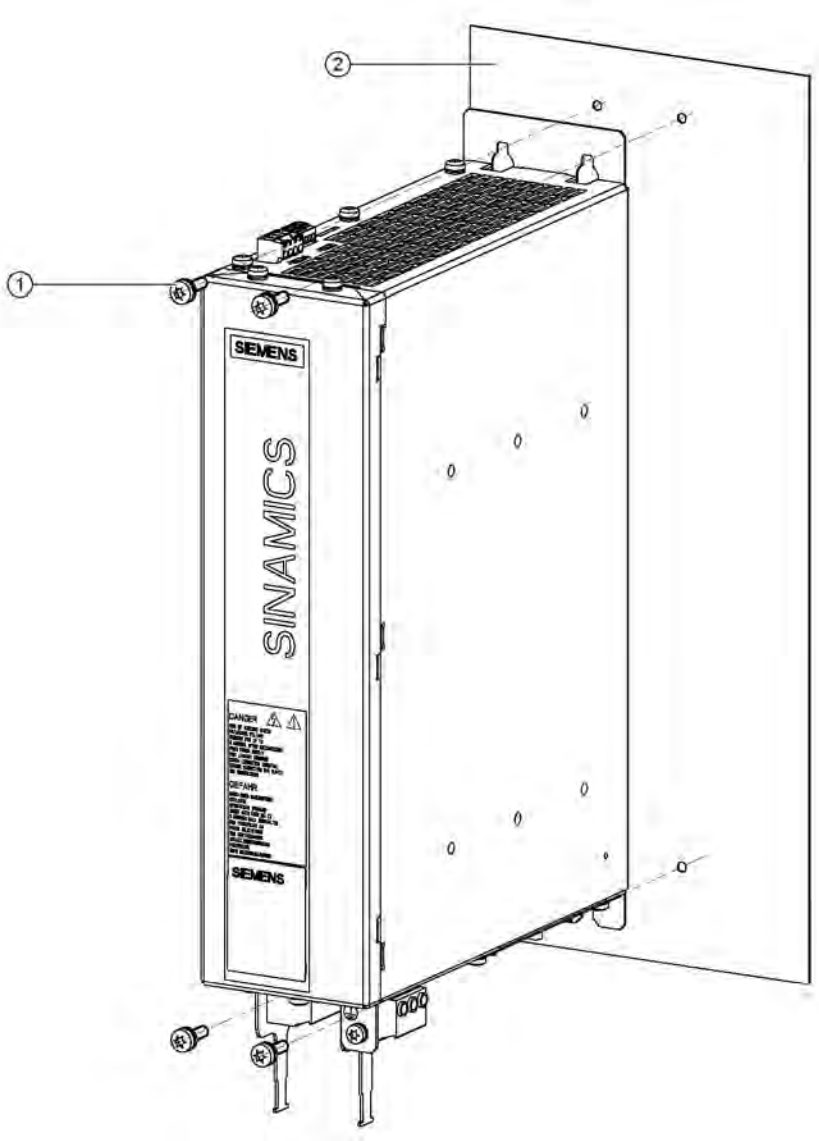


Figure 3-59 Dimension drawing of Active Interface Module 80 kW and 120 kW, all dimensions in mm and (inches)

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3.9.6 Installation

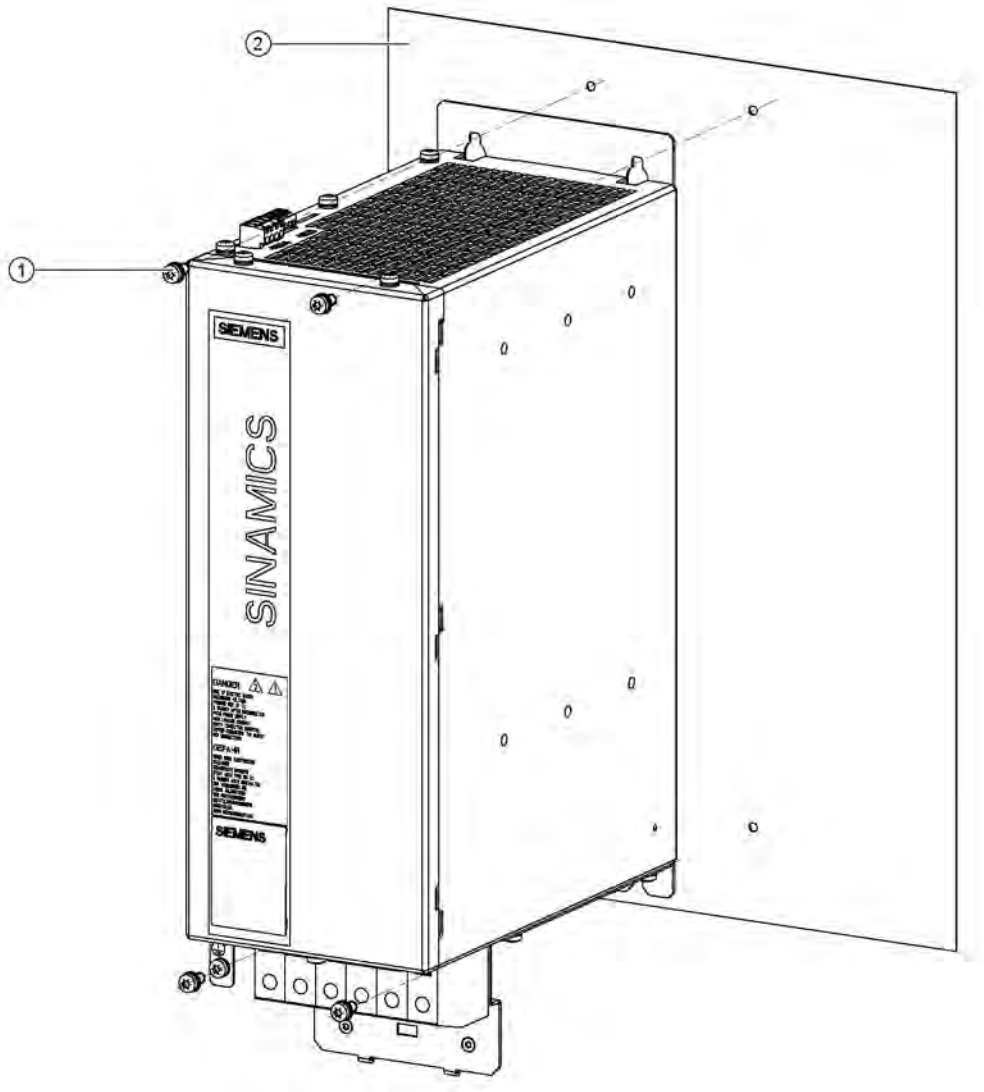
The Active Interface Modules are designed for installation in the control cabinet. The Active Interface Modules should if possible be mounted directly next to the Active Line Module.



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

Figure 3-60 Installation of 16 kW Active Interface Module

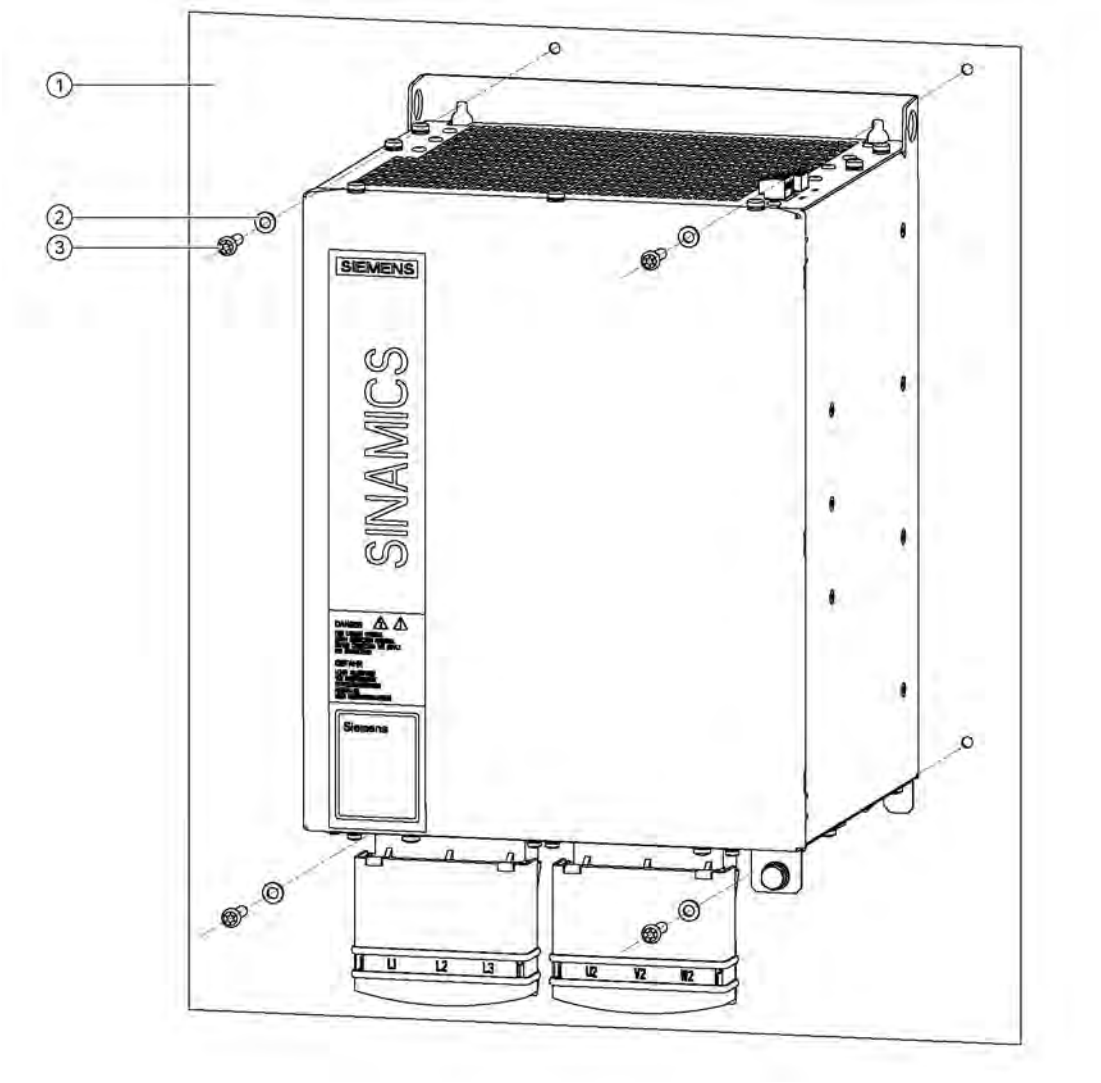
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① Mounting panel
② M6 screws, Torx T30 (not hexagon-head screws)

Figure 3-61 Installation of 36 kW Active Interface Module

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

Figure 3-62 Installation of 55 kW Active Interface Module

Tightening torque for all screws: 6 Nm

Table 3- 25 Protective conductor connection

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

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

IT system

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

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

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

Note

When an Active Interface Module is operated on an isolated-neutral line supply (IT system), the connection bracket for the interference-suppression capacitor in the Active Interface Module must be removed. The connection bracket for the interference-suppression capacitor is located on the lower side of the component.

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

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



DANGER

Danger to life caused by electric shock when the connection bracket is removed

Because of the capacitors, a hazardous voltage is present for up to 5 minutes after the power supply has been switched off.

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

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

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

Note

Installing the connection bracket for the interference-suppression capacitor

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

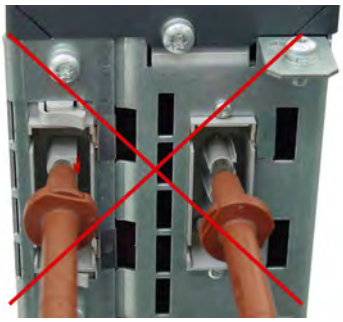
3.9.8 Electrical tests

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

		
Active Interface Module 16 kW	**RIGHT**: Measurement with original terminal connectors	**WRONG**: Measurement via the device sockets

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3.9.9 Technical data

Table 3- 27 Technical data

Active Interface Module	6SL3100-	0BE21-6ABx	0BE23-6ABx	0BE25-5ABx	0BE28-0ABx	0BE31-2ABx
		16 kW	36 kW	55 kW	80 kW	120 kW
P_{max}	kW	35	70	110	131	175
I_{rated}	A	27	60	88	132	200
I_{max}	A	59	117	176	218	292
Current requirement of the 24 VDC electronics power supply	A	0,25	0,49	0,6	1,2	1,2
Line voltage	V	3-phase 380°V°...°480°VAC ±°10%				
Line frequency	Hz	47 … 63				
Cooling air requirement	m^3/h	112	160	300	600	600
Power loss[1)] (see power loss tables (Page 781))	W	270	340	380	490	585
Weight	kg	10,7	18,5	21	29	35,5
Connection cross-section	mm^2	10	35	50	120	120
PE connecting studs		M5	M6	M6	M8	M8

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

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3.10 Combining line reactors and line filters

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

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 3-63 Combining line reactors and line filters

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3.11 Line connection variants

3.11.1 Ways of connecting the line supply

A distinction is made between the following line connection versions:

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

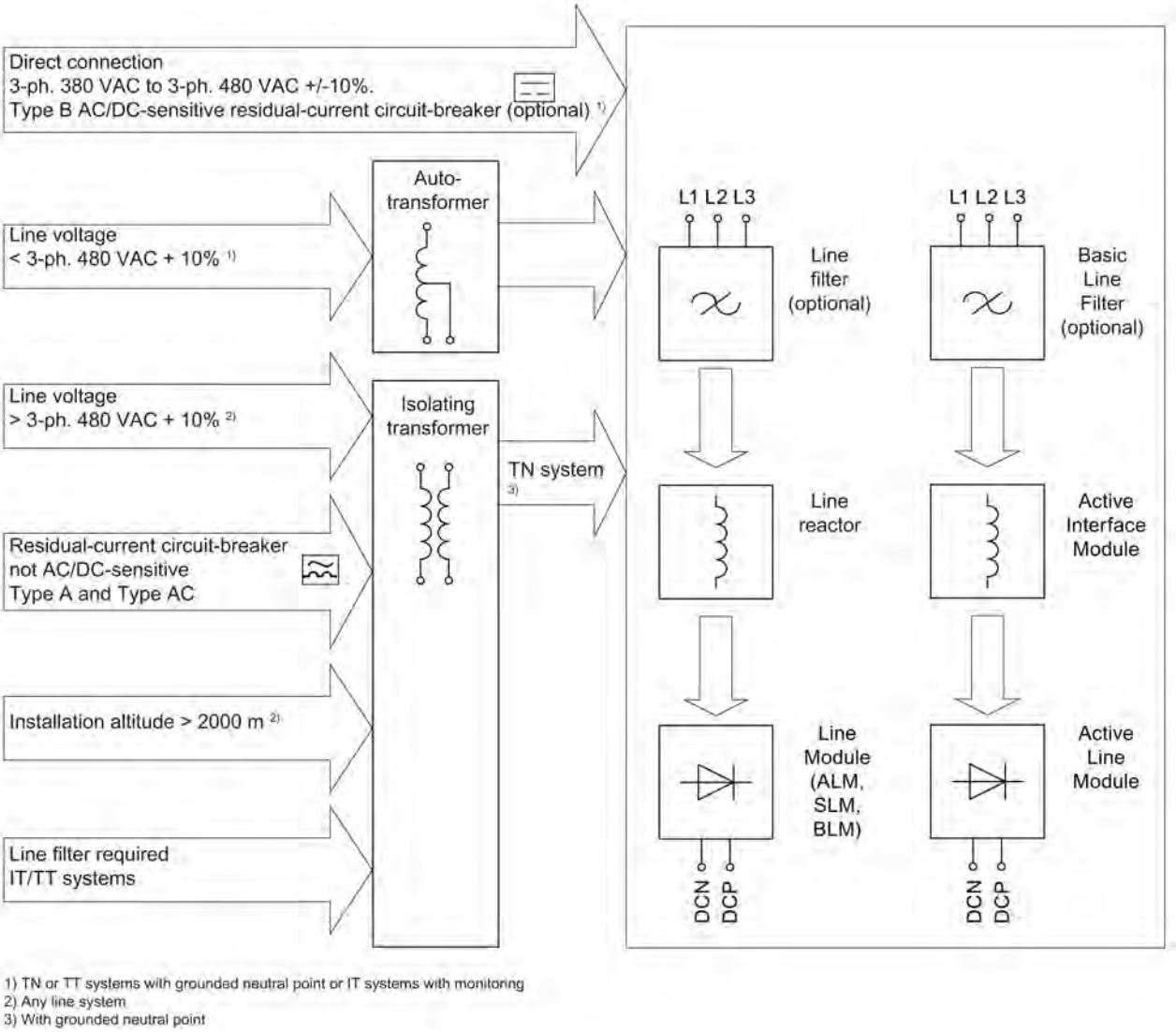


Figure 3-64 Overview of line connection versions

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Note

Permissible line supplies

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

⚠WARNING

Fire hazard for the motor due to overload of the insulation

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

TT line supply systems generally have a grounded line conductor.

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

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

NOTICE

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

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

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

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3.11.2 Operating line connection components on the line supply

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

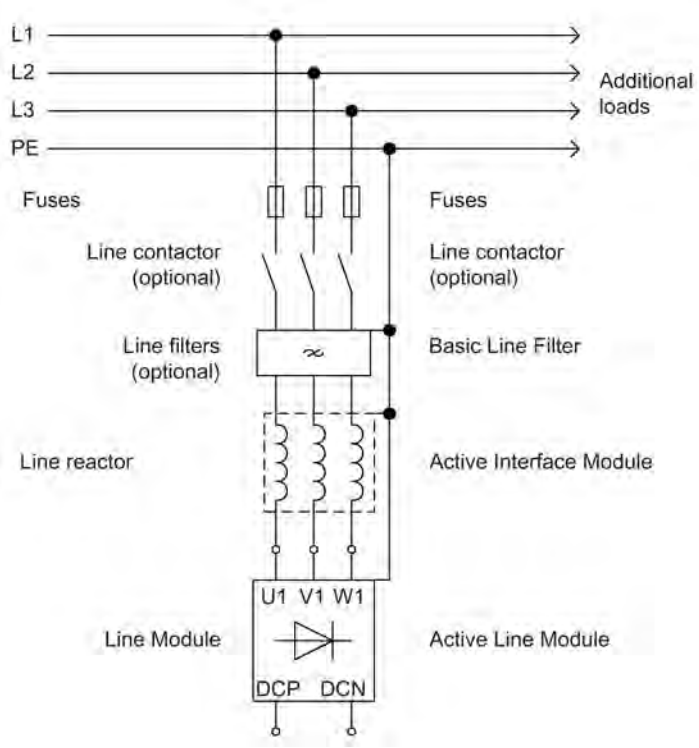


Figure 3-65 Direct operation on the line supply

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3.11.3 Operation of the line connection components via a transformer

3.11.3.1 Safety instructions for line connection components

NOTICE

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

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

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

NOTICE

Destruction or damage to additional loads as a result of incorrect connection

When incorrectly connecting the line filter, other loads can be destroyed or damaged.

- Connect additional loads upstream of the SINAMICS line filter (if required, via a separate line filter).

NOTICE

Damage and faults of devices connected to the Line Module as a result of overcurrent protective devices that do not trip

Overcurrent protective devices that do not trip can result in faults at the SINAMICS Line Modules. It can also result in faults and damage to other devices that are connected at the same point of the line supply as the Line Module.

- In order to avoid material damage, the short-circuit power must correspond to what is specified in the documentation. This then ensures that the installed overcurrent protective devices will trip.

Note

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

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3.11.3.2 Line supply connection conditions for Line Modules

Table 3- 28 Line supply connection conditions for Line Modules

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

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

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

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

Note

System fault level at the infeed point

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

Vector group

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

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3.11.3.3 Dimensioning an isolating transformer / autotransformer for several loads

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

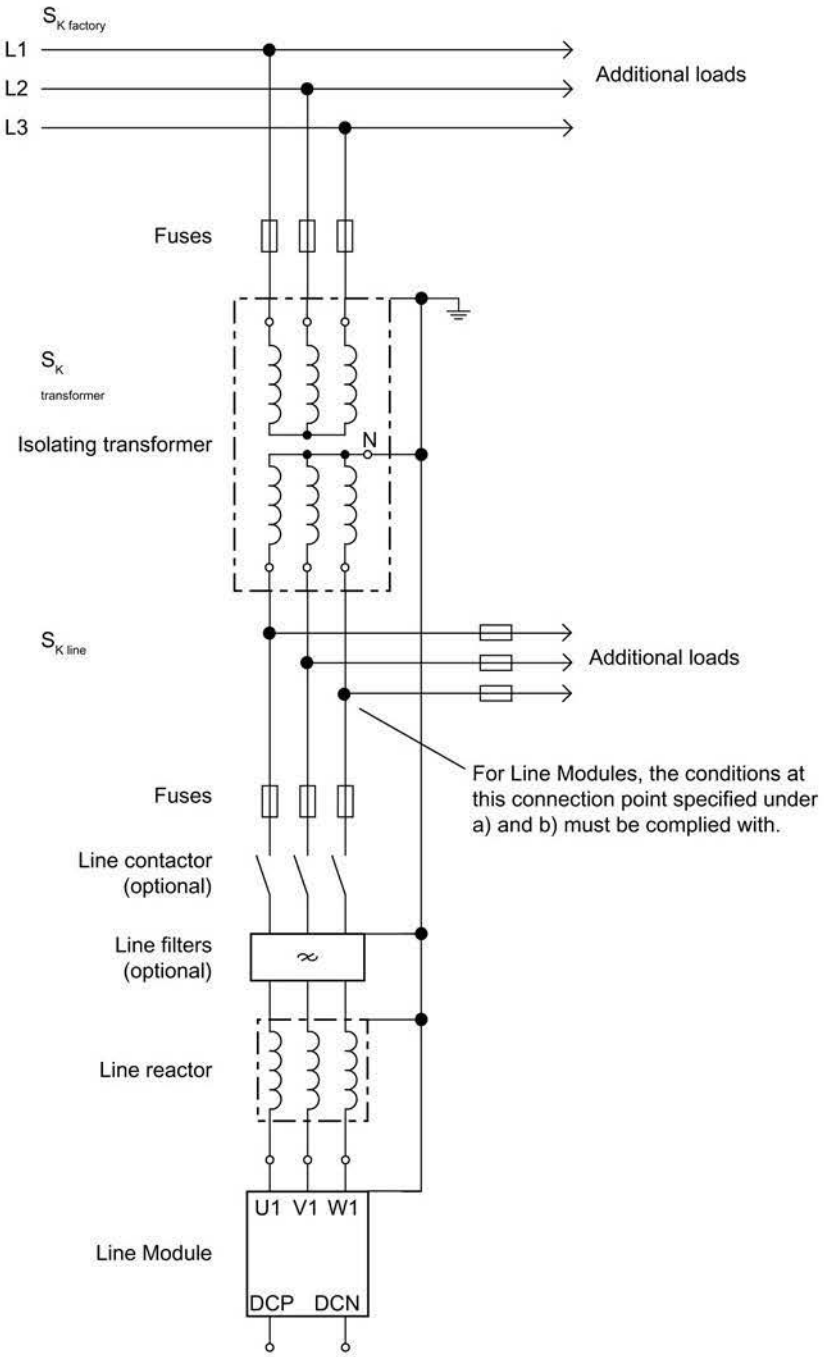


Figure 3-66 Operation of a Line Module and additional loads via an isolating transformer

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

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

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

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

S_K = short-circuit power.



WARNING

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

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

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

Supplementary condition

Limitation a)

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

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

Example:

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

Limitations b)

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

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

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

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Special case:

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

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

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

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

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

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

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 Module P_n	**Required rated power of the isolating transformer / autotransformer S_n (1.27 • P_n)**	**Required short-circuit voltage U_k**	**Minimum system fault level required S_{Kline} (70 • P_n)**
16 kW	≥ 21 kVA	≤ 3 %	≥ 1.12 MVA
36 kW	≥ 46 kVA	≤ 3 %	≥ 2.52 MVA
55 kW	≥ 70 kVA	≤ 3 %	≥ 3.85 MVA
80 kW	≥ 102 kVA	≤ 3 %	≥ 5.6 MVA
120 kW	≥ 153 kVA	≤ 3 %	≥ 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 • P_n)**	**Required short-circuit voltage U_k**	**Minimum system fault level required** S_{Kline} (70 • P_n)
5 kW	≥ 6.4 kVA	≤ 3 %	≥ 0.35 MVA
10 kW	≥ 13 kVA	≤ 3 %	≥ 0.7 MVA
16 kW	≥ 21 kVA	≤ 3 %	≥ 1.12 MVA
36 kW	≥ 46 kVA	≤ 3 %	≥ 2.52 MVA
55 kW	≥ 70 kVA	≤ 3 %	≥ 3.85 MVA

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

Note

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

Example 1

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

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

According to b)

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

$S_{n2} > S_{n1} \Rightarrow S_{n2}$ 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%,
$S_{K\ plant}$ = 50,000 kVA
$S_{K\ line}$ = 16 kW • 70 • 0.73 = 820 kVA

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

According to b)

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

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$S_{n1} > S_{n2} \Rightarrow S_{n1}$ 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 $S_{K\ plant}$ is smaller, the transformer must be stronger.

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

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

According to b)

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

$S_{n2} > S_{n1} \Rightarrow S_{n2}$ 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 $S_{K\ plant}$ is smaller, you can use, alternatively to example 3, a transformer with a smaller u_k.
u_k matching transformer = 1%,
$S_{K\ plant}$ = 3,000 kVA
$S_{K\ line}$ = 16 kW • 70 • 0.73 = 820 kVA

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

According to b)

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

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

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3.11.3.4 Operating line connection components via an autotransformer

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



⚠DANGER

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

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

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

Applications:

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

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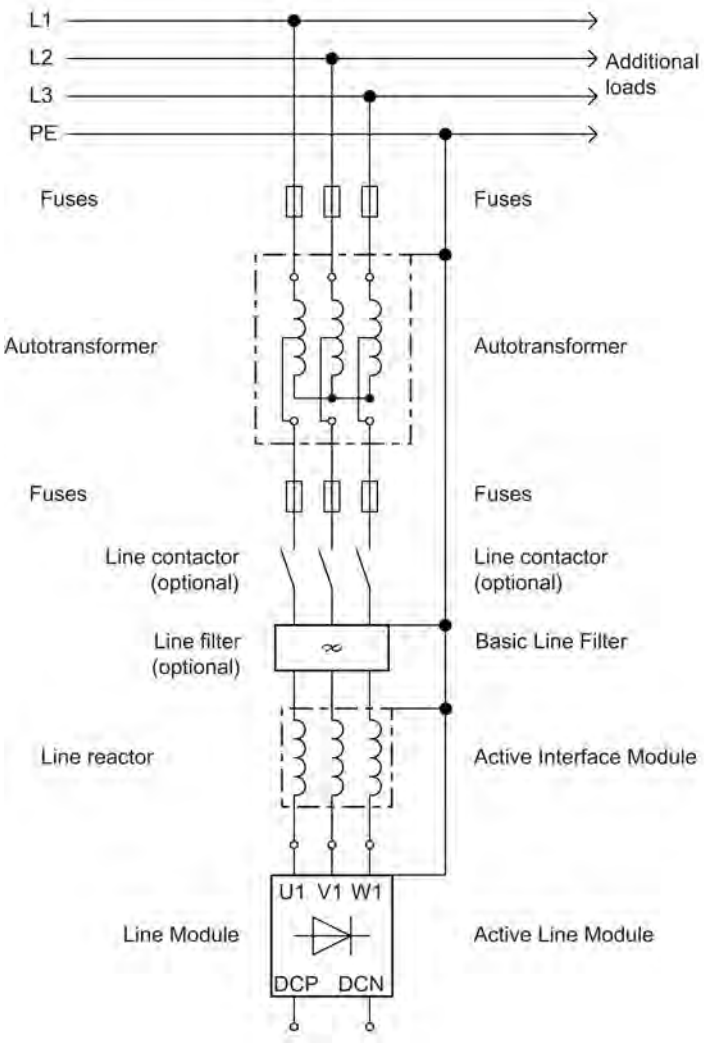


Figure 3-67 Operation of a Line Module via an autotransformer

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3.11.3.5 Operating line connection components via an isolating transformer

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

An isolating transformer must be used in the following cases:

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



DANGER

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

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

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

An isolating transformer must have the following properties:

- The transformer secondary side must have the star connection (a delta connection is not permissible).
- The neutral conductor must be brought out. It must be connected to the PE of the line filter, line reactor or AIM and Line Module (infeed).
  Caution: If the neutral conductor is not brought out and/or not connected, then all of the restrictions of an IT system apply.

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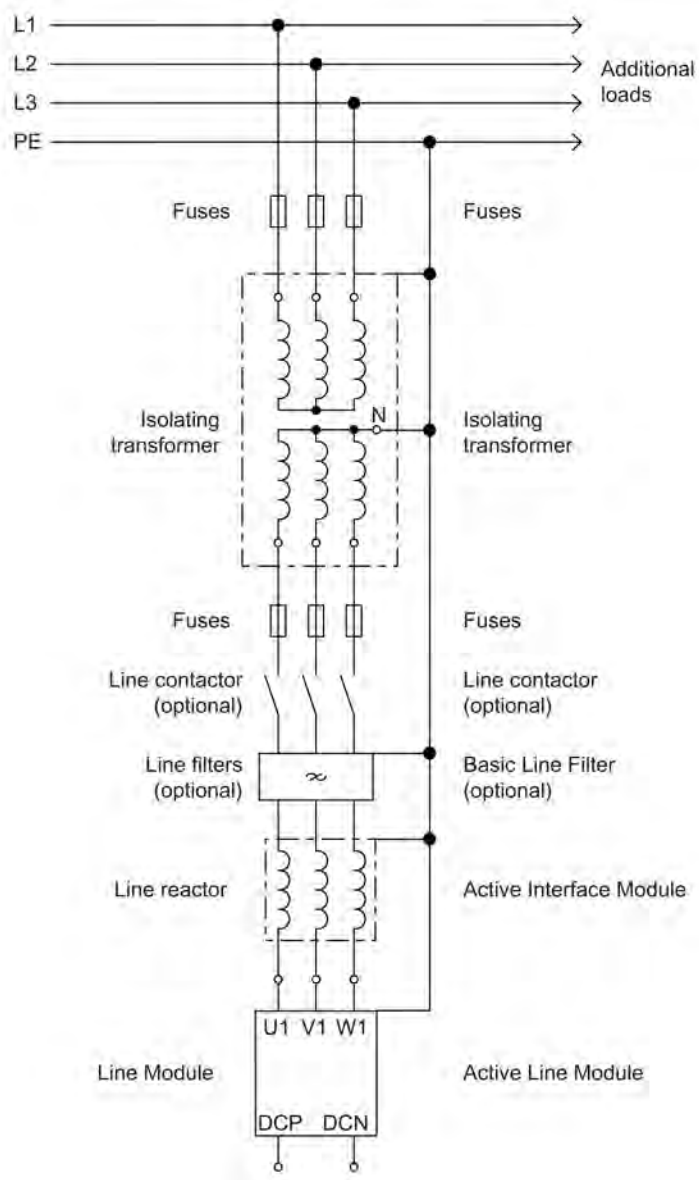


Figure 3-68 Operation of a Line Module via an isolating transformer

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Line Modules Booksize

4

4.1 Safety instructions for Line Modules Booksize

⚠ WARNING

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

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

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



⚠ DANGER

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

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

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



⚠ DANGER

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

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

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



⚠ DANGER

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

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

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

- Do not open the protective cover of the DC link until 5 minutes have elapsed.
- Measure the voltage before starting work on the DCP and DCN DC link terminals.

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DANGER

Danger to life through electric shock when the protective cover of the DC link is open

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

- Only operate the components with closed protective cover.



WARNING

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

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

- Ensure that the external protective conductor satisfies at least one of the following conditions:
  - It has been laid so that it is protected against mechanical damage. [1)]
  - If it is a single conductor, it has a cross-section of at least 10 mm² Cu.
  - If it is a conductor of a multi-conductor cable, it has a cross-section of at least 2.5 mm² Cu.
  - It has a second protective conductor in parallel with the same cross-section.
  - It complies with the local regulations for equipment with increased leakage current.

[1)] Cables laid within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.



WARNING

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

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

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



WARNING

Danger to life through electric shock due to incorrectly installed DC link bridges

Incorrectly installed DC link bridges **at the left-hand end of the drive line-up** can cause an electric shock.

- For all 50 mm wide modules[1)] (exception: Smart Line Module[2)]), remove the DC link bridge, including the screws. Do not tighten the screws without the DC link bridges.
- For all components that are 75 mm wide or wider, the DC link bridges may neither be swung over to the left nor removed[3)].

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

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WARNING

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

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

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

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

WARNING

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

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

- Attach the component warning labels in the national language.

WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

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

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

CAUTION

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

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

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

NOTICE

Material damage due to loose power connections

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

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

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NOTICE

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

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

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

NOTICE

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

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

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

NOTICE

Damage through use of incorrect DRIVE-CLiQ cables

Damage or malfunctions can occur on the devices or system when DRIVE-CLiQ cables are used that are either incorrect or have not been approved for this purpose.

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

Note

Operation on line supplies where energy recovery is not possible

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

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

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

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

Note

Malfunctions due to polluted DRIVE-CLiQ interfaces

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

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

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Special features for Line Modules with external air cooling

Note

Component failure due to the pollution of external heat sinks

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

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

Note

Checking the seal

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

Note

Using an installation frame

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

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4.2 Active Line Modules with internal air cooling

4.2.1 Description

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

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

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

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

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

⚠ WARNING

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

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

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

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4.2.2 Interface description

4.2.2.1 Overview

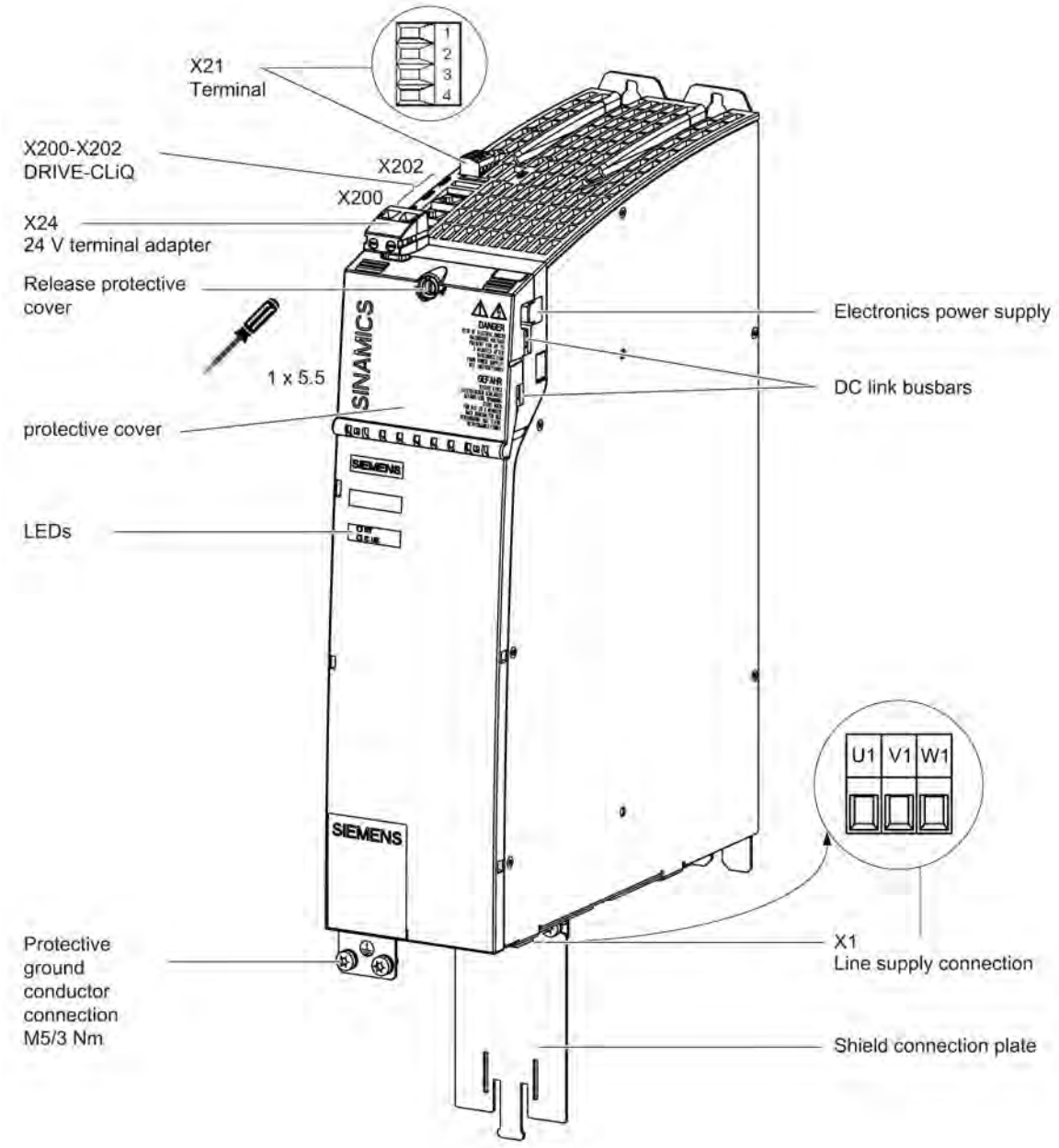
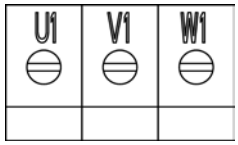
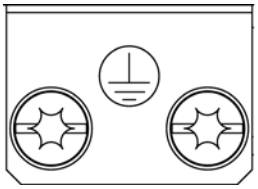


Figure 4-1 Interface overview, Active Line Module with internal air cooling (example: 16 kW)

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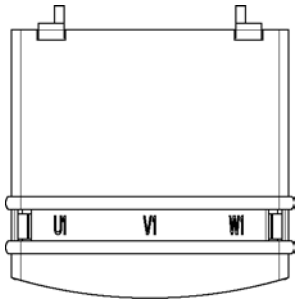
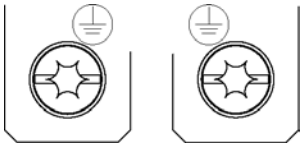
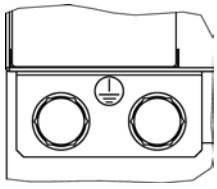
4.2.2.2 X1 line connection

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

	Terminal	Technical data
	U1 V1 W1	Max. connectable cross-section: 10 mm² Type: Screw terminal 6 (Page 755) Tightening torque: 1.5 … 1.8 Nm
	PE connection	Threaded hole M5 / 3 Nm[1)]

1) For ring cable lugs without insulation

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

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

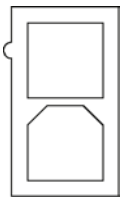
1) For ring cable lugs without insulation

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4.2.2.3 X12 fan connection

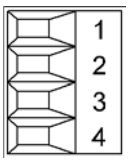
Active Line Modules 80 kW and 120 kW are equipped with an interface for connecting the sub-chassis fan. The interface is located on the underside of the Line Module.

Table 4- 3 X12 fan connection

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

4.2.2.4 X21 EP terminals

Table 4- 4 X21 EP terminal / temperature sensor

	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors[1]: KTY 84–1C130[2]/PTC[2]/bimetallic switch with NC contact If an Active Interface Module is used, the temperature input must be connected to the Active Interface Module sensor (bimetallic switch with NC contact).
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage: 24 V DC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm^2			

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

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

Terminals X21.1 and X21.2

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

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Terminals X21.3 and X21.4



⚠WARNING

Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected

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

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

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

- Neutralize the voltage in the DC link.

NOTICE

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

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

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



⚠WARNING

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

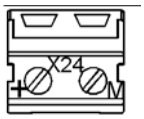
Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

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4.2.2.5 X24 24 V terminal adapter

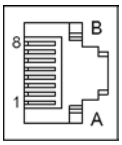
Table 4- 5 X24: 24 V terminal adapter

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

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

4.2.2.6 X200-X202 DRIVE-CLiQ interfaces

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

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

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

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

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4.2.3 Connection example

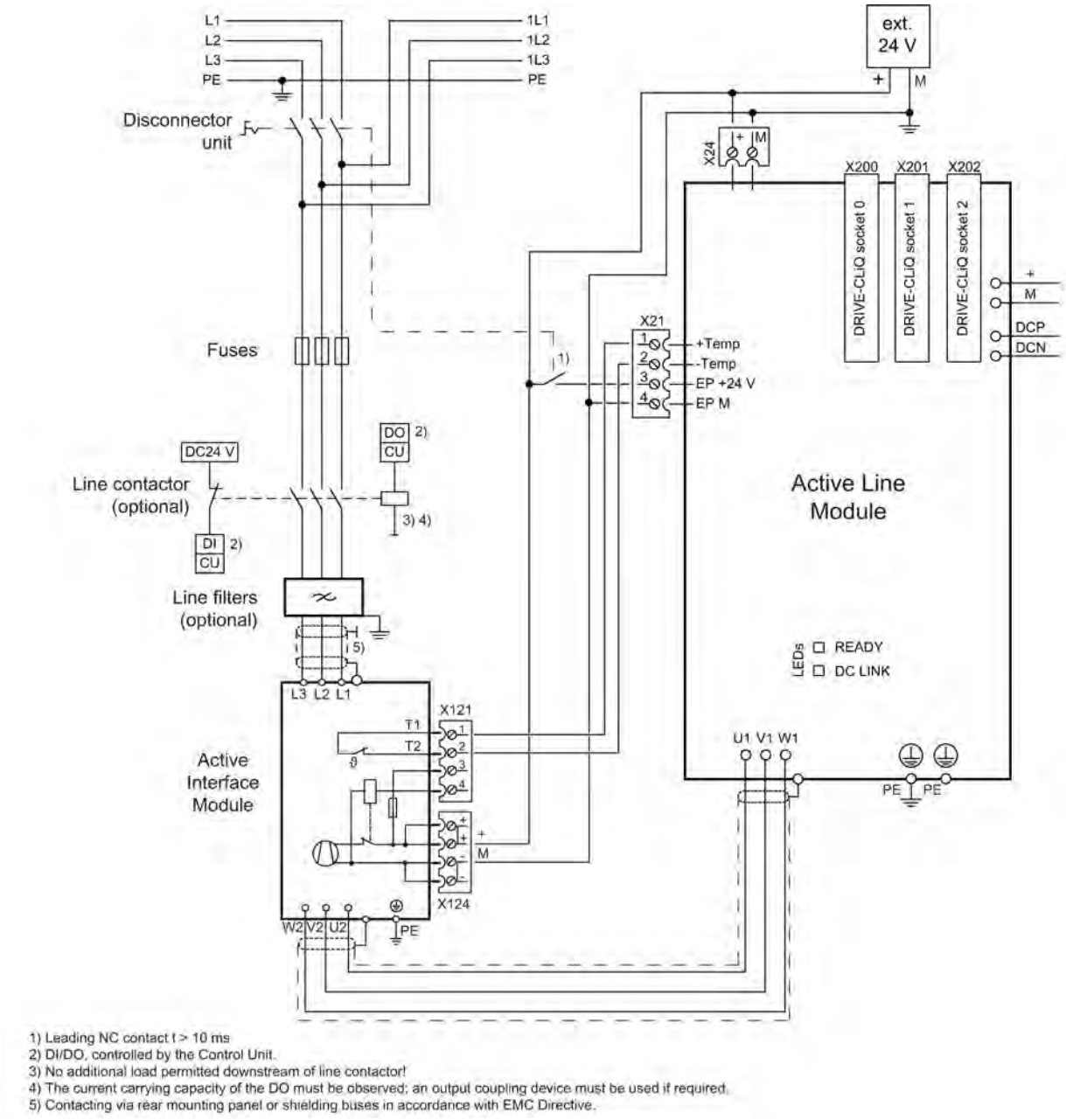


Figure 4-2 Example connection of Active Line Module

Note

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

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4.2.4 Meaning of LEDs

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

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

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



WARNING

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

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

- Observe the warning information on the component.

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4.2.5 Dimension drawings

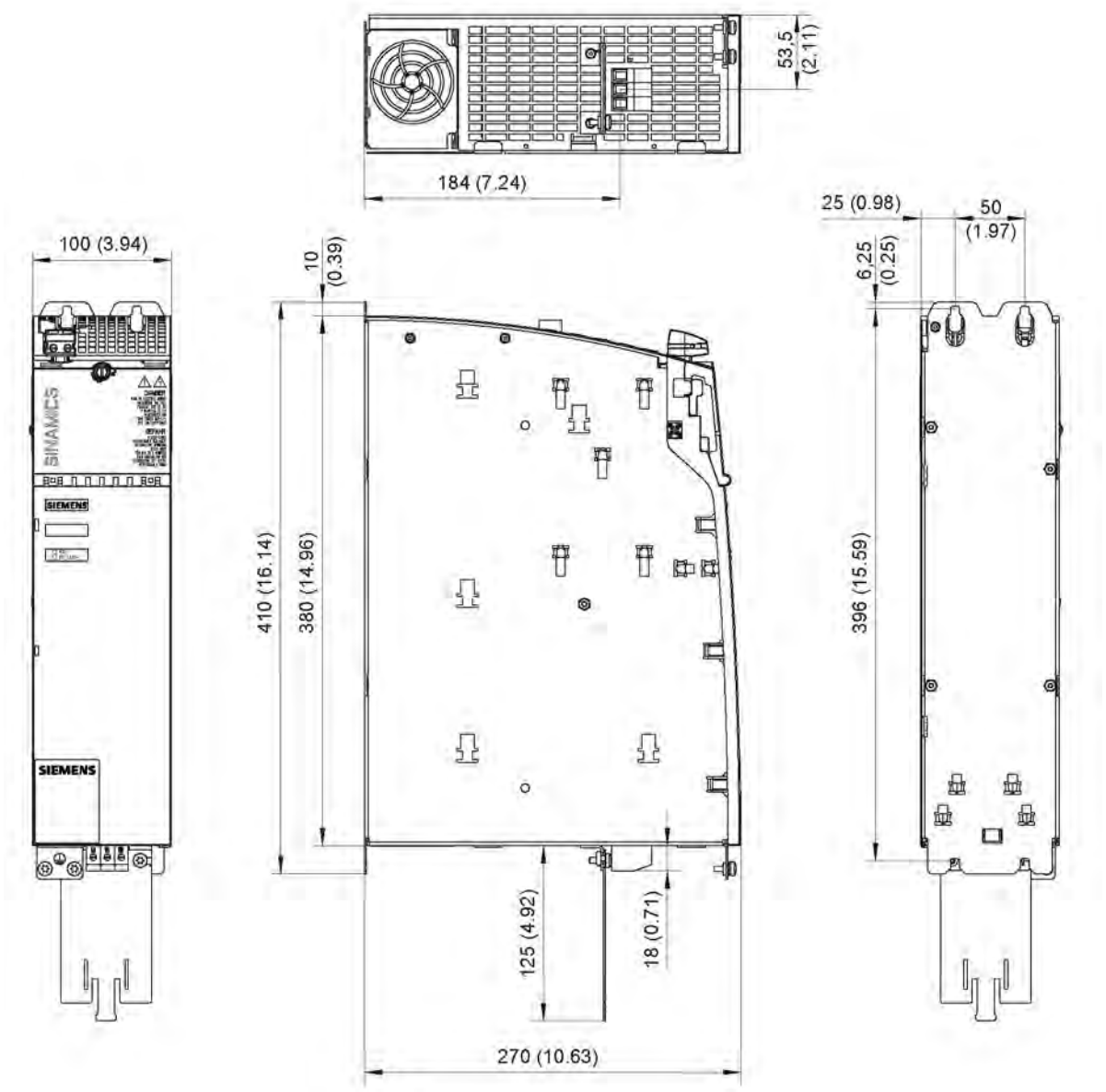


Figure 4-3 Dimension drawing of 16 kW Active Line Module with internal air cooling, all dimensions in mm and (inches)

Note

The shield connecting plate is supplied as standard with a 100 mm Line Module.
For more information, see Chapter Shield connecting plates for power supply and motor cables (Page 617).

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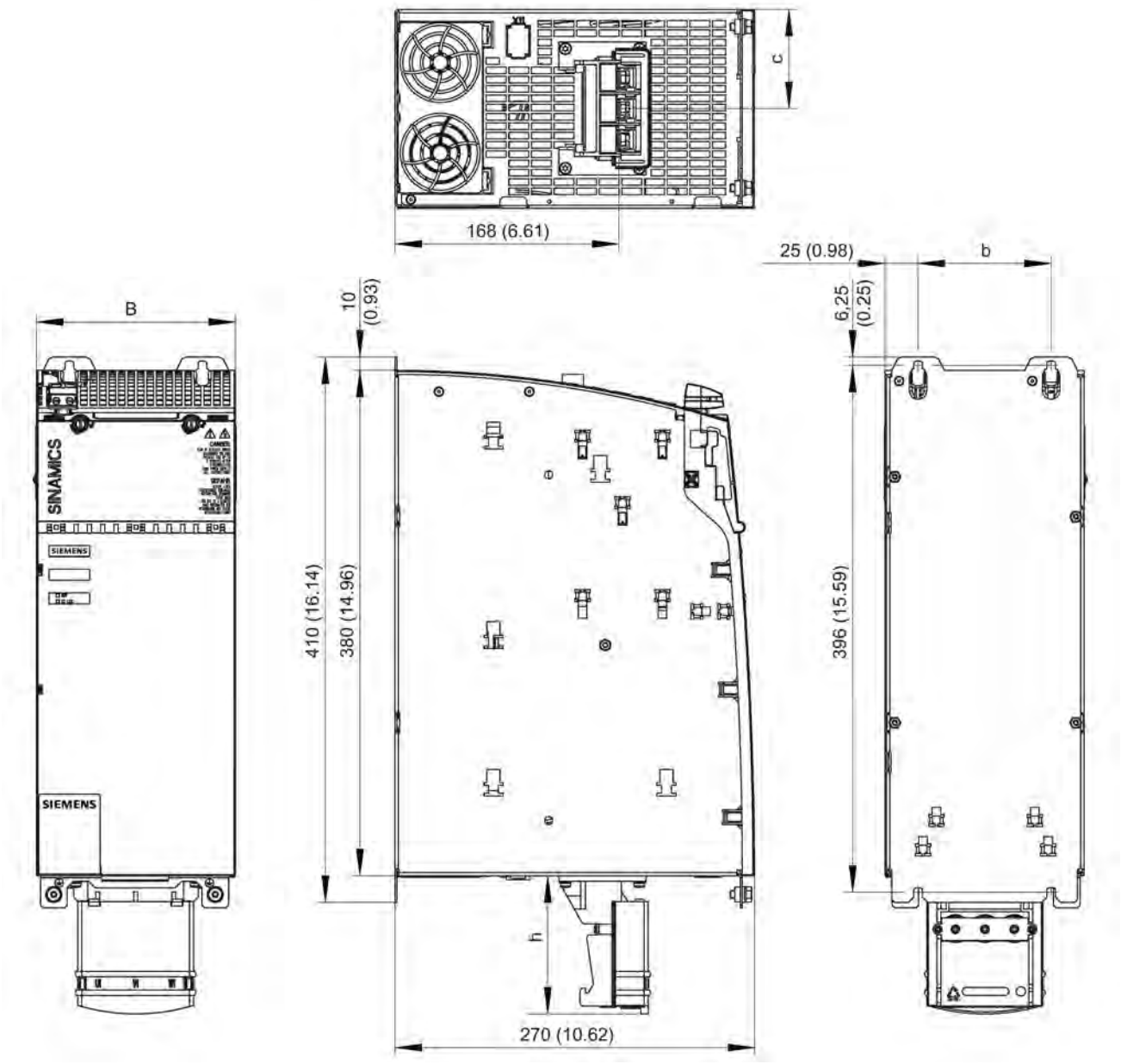


Figure 4-4 Dimension drawing of 36 kW and 55 kW Active Line Modules with internal air cooling (example, 36 kW), all dimensions in mm and (inches)

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)

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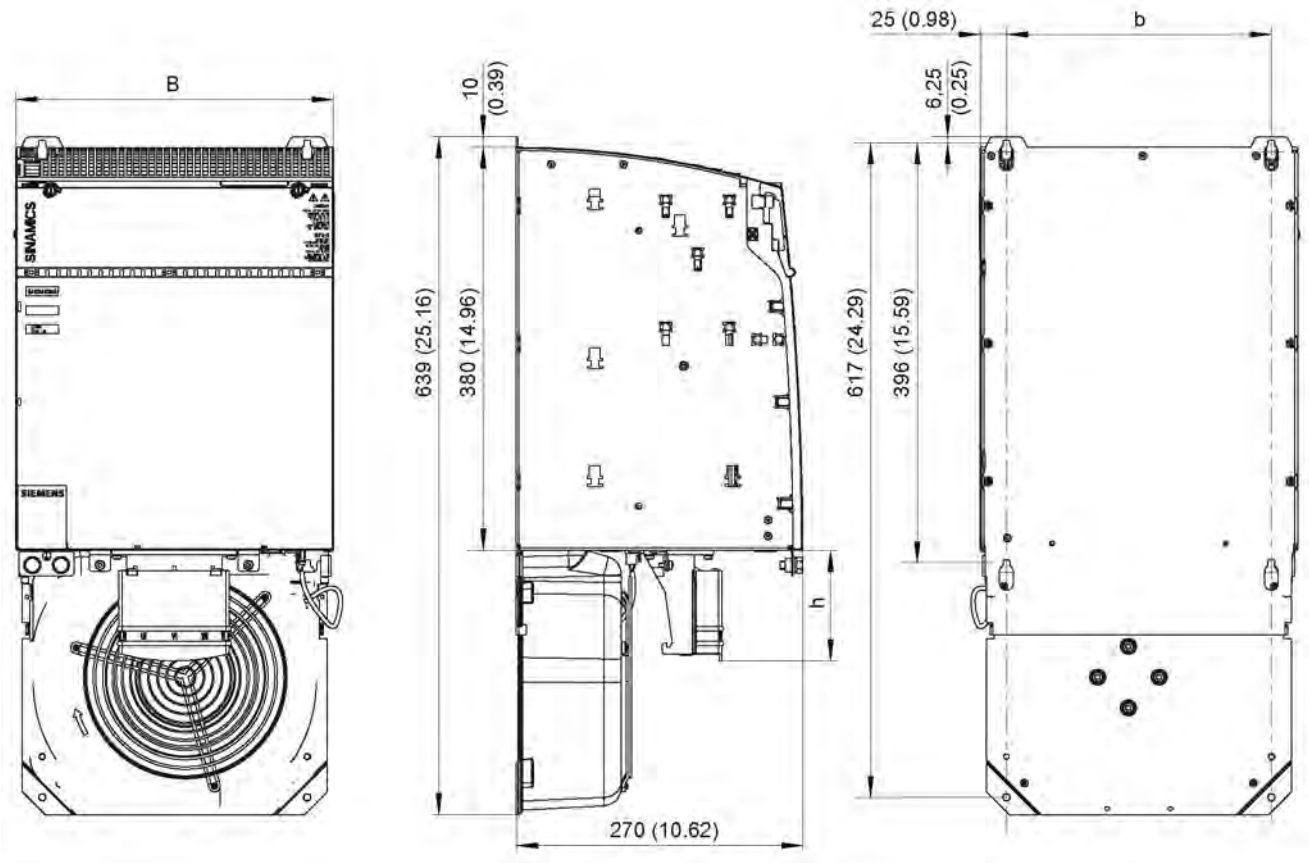


Figure 4-5 Dimension drawing of 80 kW and 120 kW Active Line Modules with internal air cooling, all dimensions in mm and (inches)

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)

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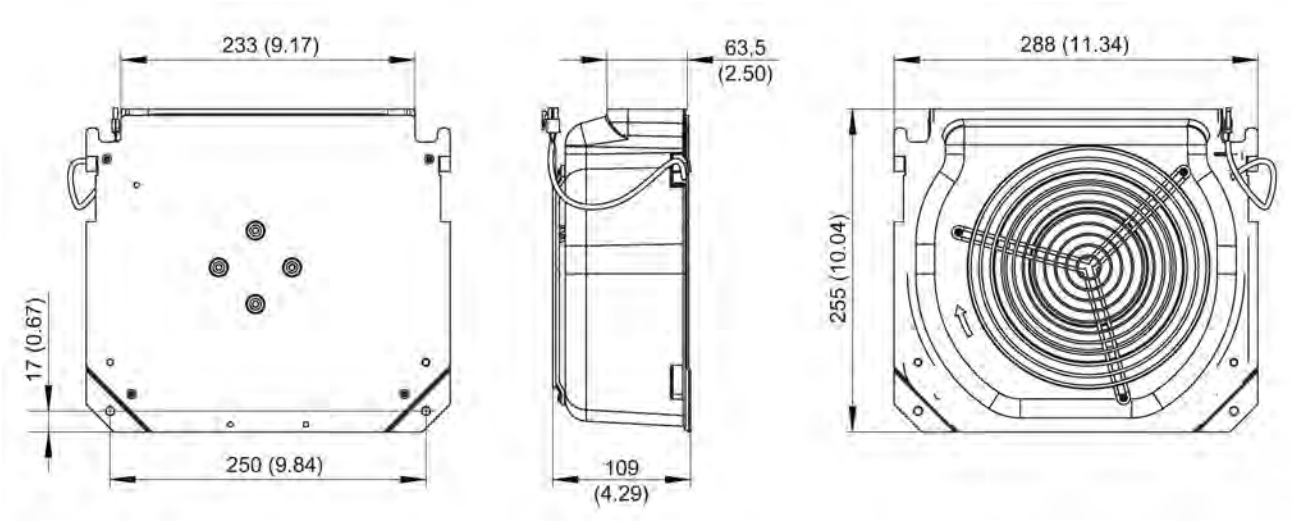


Figure 4-6 Dimension drawing of fan for 80 kW and 120 kW Active Line Modules with internal air cooling, all dimensions in mm and (inches)

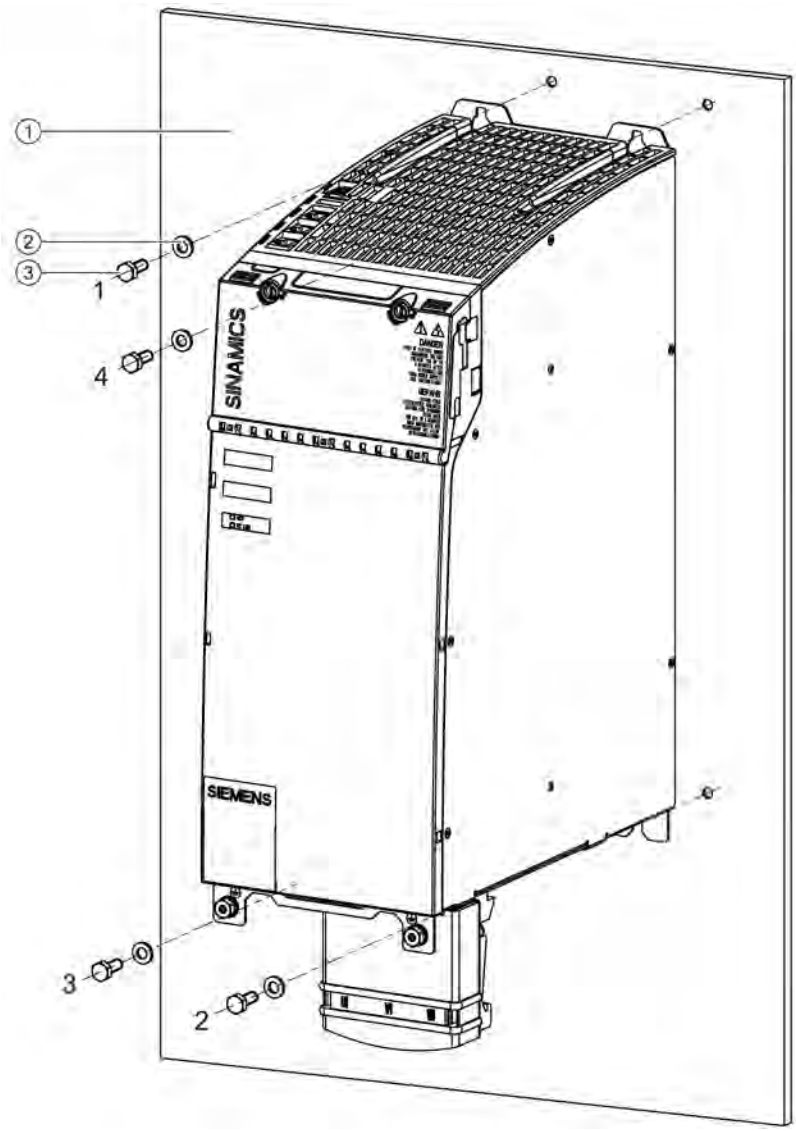
Note

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

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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:

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

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Installing the sub-chassis fan

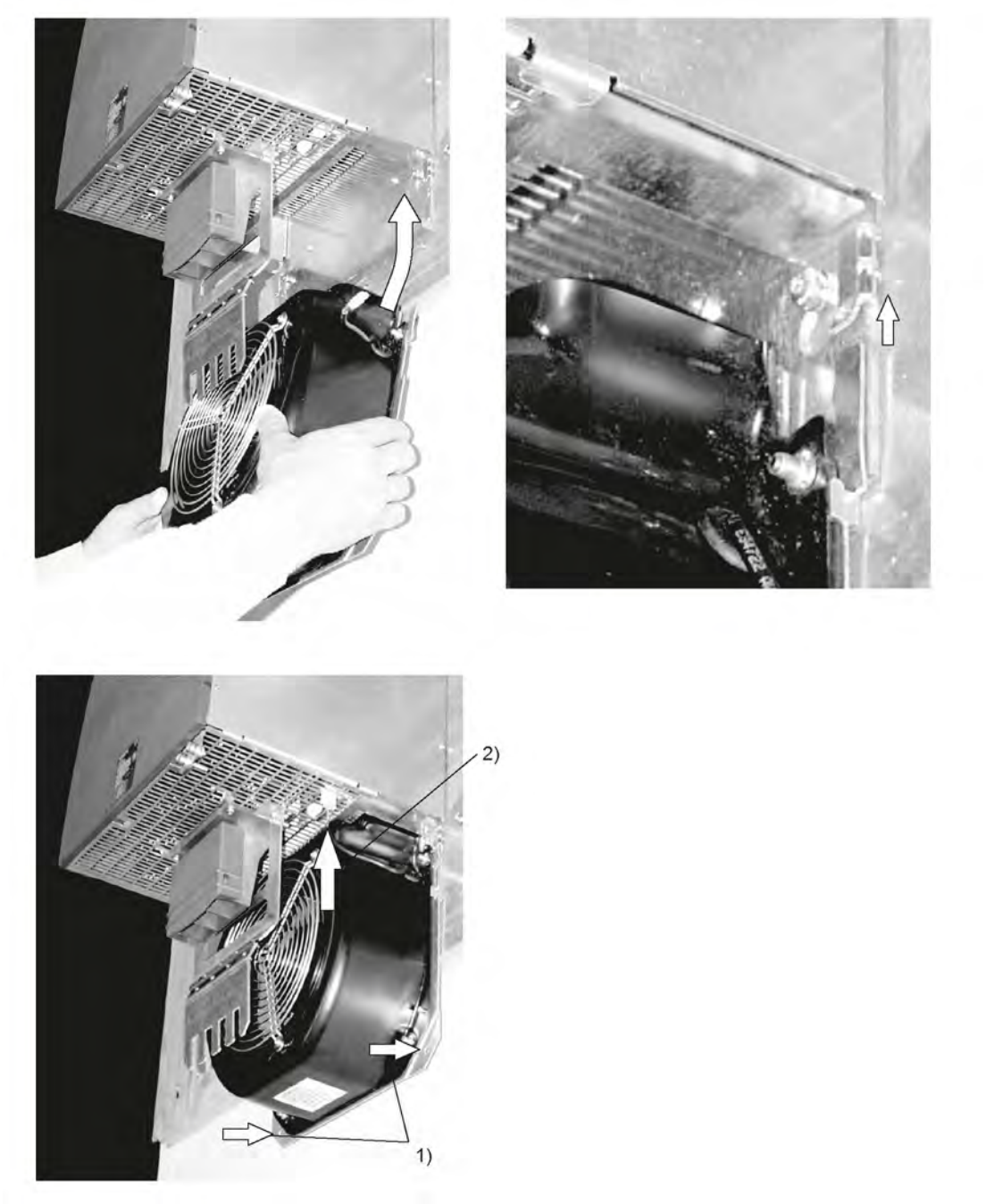


Figure 4-8 Mounting the fan for Active Line Modules 80 kW and 120 kW

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

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4.2.7 Technical data

Table 4- 10 Technical data of Active Line Modules

Internal air cooling	**6SL3130–**	**7TE21–6AAx**	**7TE23–6AAx**	**7TE25–5AAx**	**7TE25–5AA3 + Active Interface Module**
Rated power	**kW**	**16**	**36**	**55**	**55**
Infeed					
Rated power (S1)[1)]	kW (P_n)	16	36	55	55
Infeed power (S6 - 40 %)[1)]	kW (P_{s6})	21	47	71	71
Peak infeed power[1)]	kW (P_{max})	35	70	91	110
Regenerative feedback					
Continuous regenerative power	kW	16	36	55	55
Peak regenerative power	kW	35	70	91	110
Supply voltages					
Line voltage	V_{ACrms}	3 AC 380 … 480 ± 10 % (-15 % < 1 min)			
Line frequency	Hz	47 … 63			
Electronics power supply	V_{DC}	24 (20.4 … 28.8)			
DC link voltage	V_{DC}	510 … 720			
Overvoltage trip	V_{DC}	820 ± 2 %			
Undervoltage trip[2)]	V_{DC}	360 ± 2 %			
Input currents					
Rated input current:					
for AC 400 V	A_{AC}	25	55	84	84
Input current:					
for AC 380 V / AC 480 V	A_{AC}	26 / 21	58 / 46	88 / 70	88 / 70
for AC 400 V; S6 - 40 %	A_{AC}	32	71	108	108
for AC 400 V; peak current	A_{AC}	54	107	139	168
DC link currents					
Rated DC link current:					
for 600 V	A_{DC}	27	60	92	92
DC link current:					
for 600 V DC; for S6 - 40 %	A_{DC}	35	79	121	121
for 600 V DC; peak current	A_{DC}	59	117	152	176
Current carrying capacity					
DC link busbars	A_{DC}	100	200	200	200
Reinforced DC link busbars	A_{DC}	150	--	--	--
24 V DC busbars	A_{DC}	20	20	20	20
Electronics current drawn					
at 24 V DC	A_{DC}	0.95	1.5	1.9	1.9
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	282.8	666	945.6	945.6
Max. ambient temperature					
without derating	° C	40	40	40	40
with derating	° C	55	55	55	55
DC link capacitance					
Active Line Module	µF	705	1410	1880	1880
Drive line-up, max.	µF	20000	20000	20000	20000
Power factor	cosϕ	1	1	1	1

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

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

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

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

Table 4- 11 Technical data of Active Line Modules

Internal air cooling	**6SL3130–**	**7TE28–0AAx**	**7TE31–2AAx**
Rated power	**kW**	**80**	**120**
Infeed			
Rated power (S1)[1)]	kW (P_n)	80	120
Infeed power (S6 - 40 %)[1)]	kW (P_{s6})	106	145
Peak infeed power[1)]	kW (P_{max})	131	175
Regenerative feedback			
Continuous regenerative power	kW	80	120
Peak regenerative power	kW	131	175
Supply voltages			
Line voltage	V_{ACrms}	3 AC 380 … 480 ± 10 % (-15 % < 1 min)	
Line frequency	Hz	47 … 63	
Electronics power supply	V_{DC}	24 (20.4 … 28.8)	
DC link voltage	V_{DC}	510 … 720	
Overvoltage trip	V_{DC}	820 ± 2 %	
Undervoltage trip[2)]	V_{DC}	360 ± 2 %	
Input currents			
Rated input current:			
for AC 400 V	A_{AC}	122	182
Input current:			
for AC 380 V / AC 480 V	A_{AC}	128 / 102	192 / 152
for AC 400 V; S6 - 40 %	A_{AC}	161	220
for AC 400 V; peak current	A_{AC}	200	267

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Internal air cooling	**6SL3130–**	**7TE28–0AAx**	**7TE31–2AAx**
Rated power	**kW**	**80**	**120**
DC link currents Rated DC link current: for 600 V: DC link current: for 600 V DC; for S6 - 40 % for 600 V DC; peak current	 A_{DC} A_{DC} A_{DC}	 134 176 218	 200 244 292
Current carrying capacity DC link busbar: 24 V busbar:	 A_{DC} A_{DC}	 200 20	 200 20
Electronics current drawn at 24 V DC	 A_{DC}	 1.4	 1.8
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	1383.6	2243.2
Max. ambient temperature without derating with derating	 ° C ° C	 40 55	 40 55
DC link capacitance Active Line Module Drive line-up, max.	 µF µF	 2820 20000	 3995 20000
Power factor	cosϕ	1	1
Circuit breaker (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 51)	
Rated short-circuit current SCCR[3)]	kA	65	65
Cooling method (internal air cooling)		Mounted fan	Mounted fan
Sound pressure level	dB(A)	< 73	< 73
Cooling air requirement	m^3/h	520	520
Max. permissible heat sink temperature	° C	70	75
Rated voltage for rated data 3 AC 380 V			
Weight	kg	23	23

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

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

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

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4.2.7.1 Characteristics

Rated duty cycles for Active Line Modules

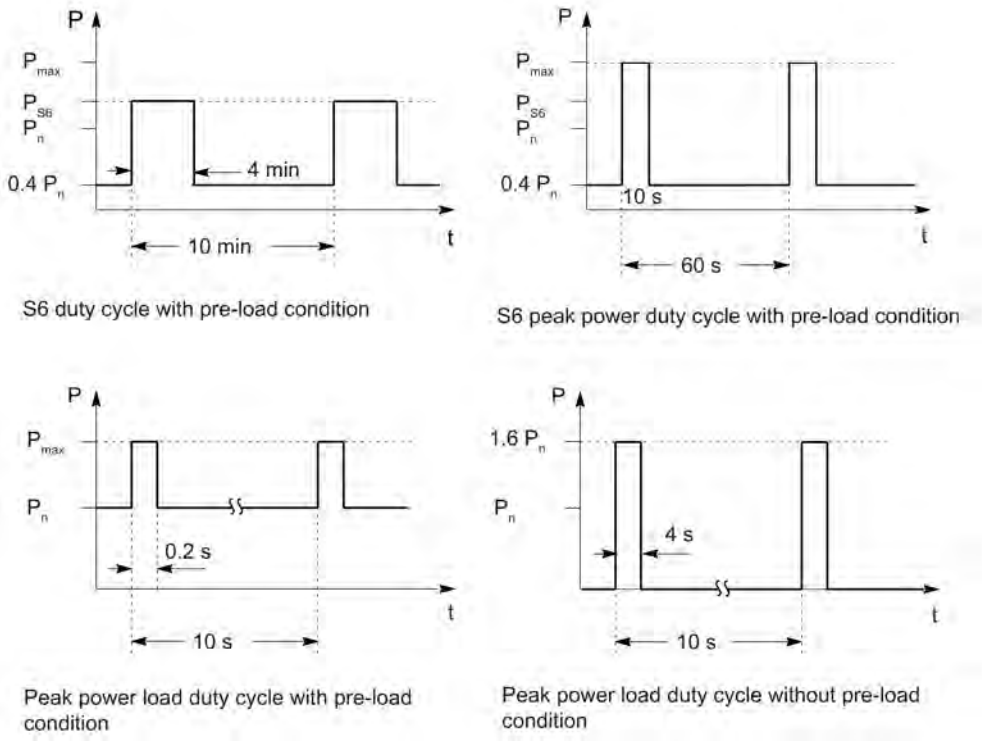


Figure 4-9 Rated duty cycles for Active Line Modules (**exception**: not applicable for 55 kW Active Line Module with Active Interface Module)

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Rated duty cycles for Active Line Modules with Active Interface Modules

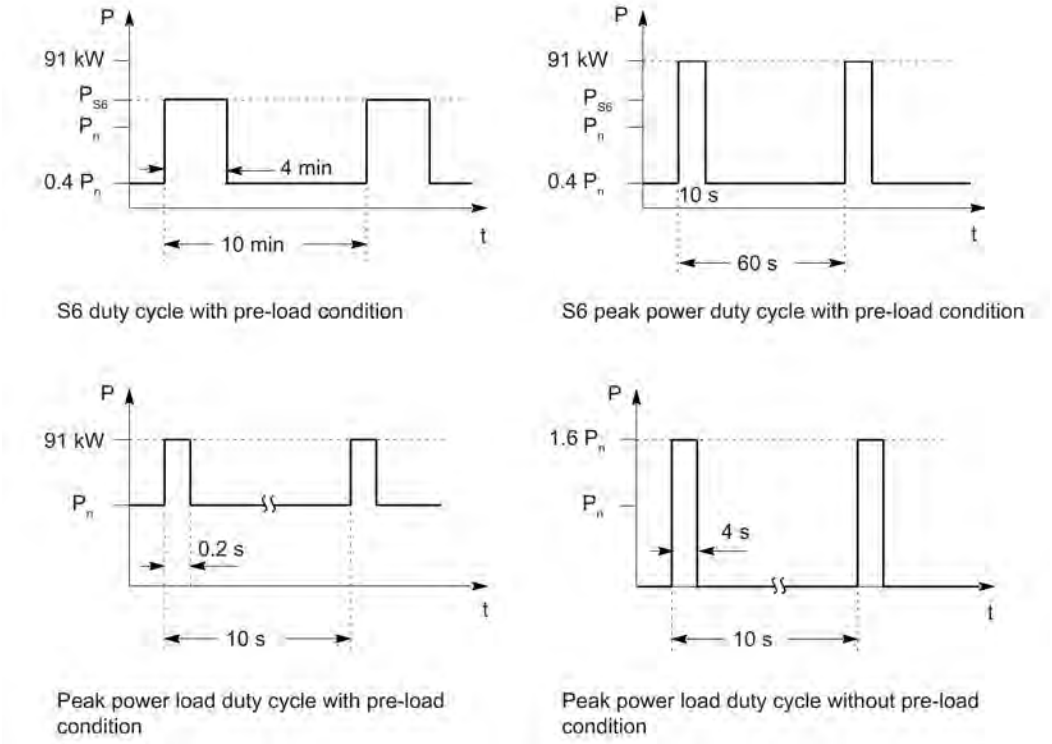


Figure 4-10 Load cycles for 55 kW Active Line Modules with Active Interface Module

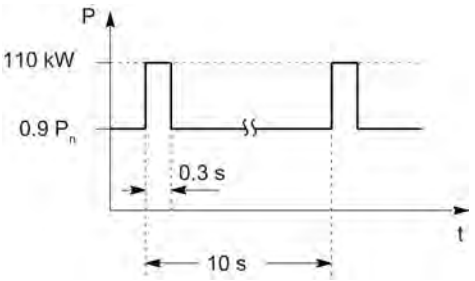


Figure 4-11 Peak load cycle with initial load for 55 kW Active Line Modules with Active Interface Module

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Derating characteristics

Note

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

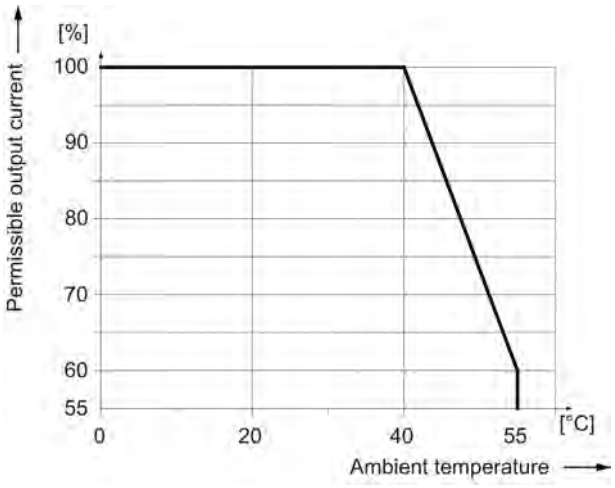


Figure 4-12 Output current as a function of the ambient temperature

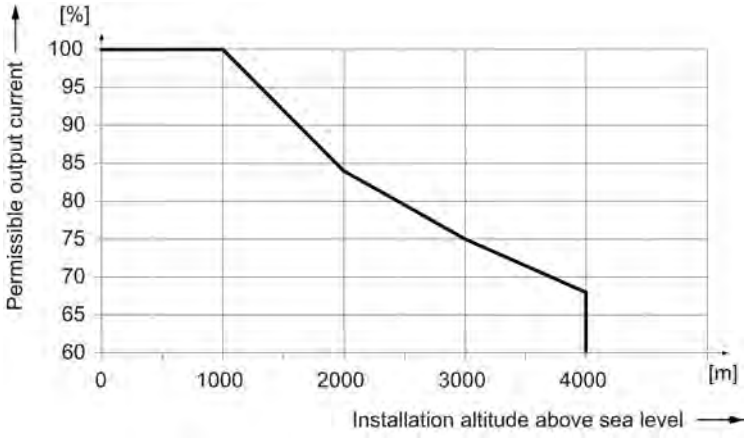


Figure 4-13 Output current as a function of the installation altitude

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4.3 Active Line Modules with external air cooling

4.3.1 Description

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

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

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

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

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

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

⚠WARNING

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

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

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

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4.3.2 Interface description

4.3.2.1 Overview

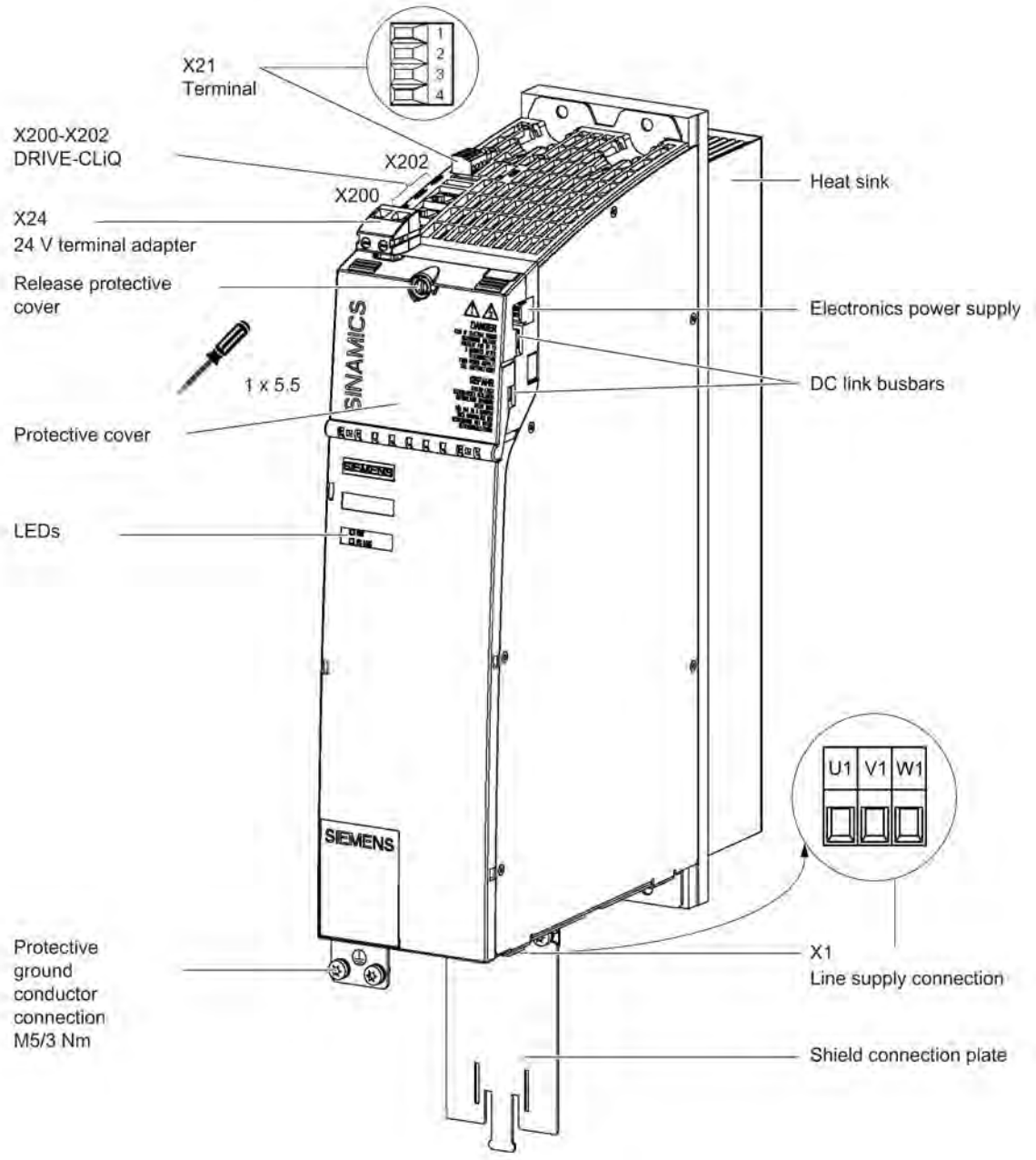
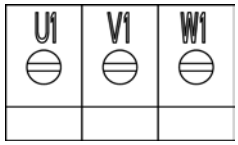
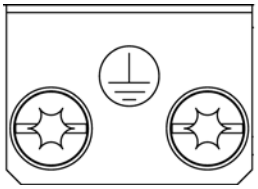


Figure 4-14 Interface overview, Active Line Module with external air cooling (example: 16 kW)

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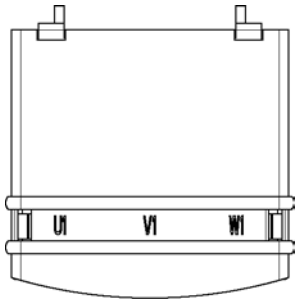
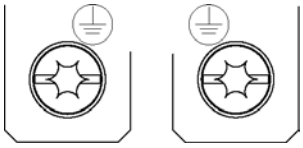
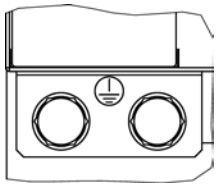
4.3.2.2 X1 line connection

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

	Terminal	Technical data
	U1 V1 W1	Max. connectable cross-section: 10 mm² Type: Screw terminal 6 (Page 755) Tightening torque: 1.5 … 1.8 Nm
	PE connection	Threaded hole M5 / 3 Nm[1)]

1) For ring cable lugs without insulation

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

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

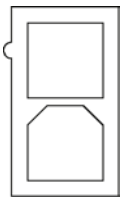
1) For ring cable lugs without insulation

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4.3.2.3 X12 fan connection

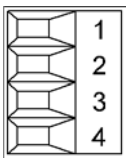
Active Line Modules 80 kW and 120 kW are equipped with an interface for connecting the sub-chassis fan. The interface is located on the underside of the Line Module.

Table 4- 14 X12 fan connection

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

4.3.2.4 X21 EP terminals

Table 4- 15 X21 EP terminal / temperature sensor

	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors[1]: KTY 84–1C130[2]/PTC[2]/bimetallic switch with NC contact If an Active Interface Module is used, the temperature input must be connected to the Active Interface Module sensor (bimetallic switch with NC contact).
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage: 24 V DC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm^2			

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

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

Terminals X21.1 and X21.2

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

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Terminals X21.3 and X21.4



⚠WARNING

Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected

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

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

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

- Neutralize the voltage in the DC link.

NOTICE

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

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

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



⚠WARNING

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

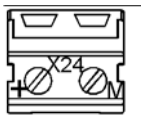
Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

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4.3.2.5 X24 24 V terminal adapter

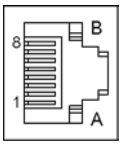
Table 4- 16 X24: 24 V terminal adapter

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

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

4.3.2.6 X200-X202 DRIVE-CLiQ interfaces

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

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

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

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

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4.3.3 Connection example

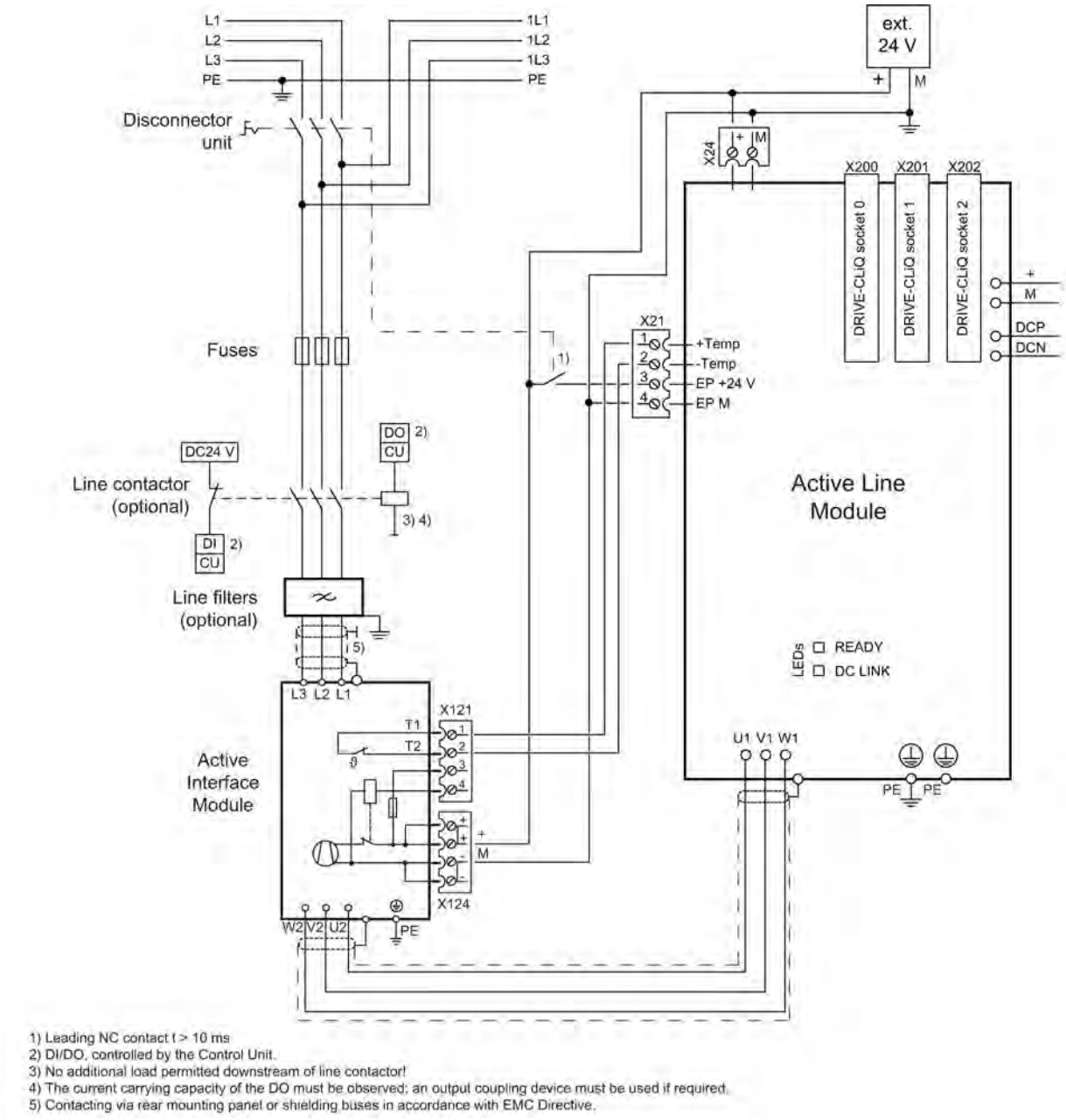


Figure 4-15 Example connection of Active Line Module

Note

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

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4.3.4 Meaning of LEDs

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

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

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



WARNING

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

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

- Observe the warning information on the component.

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4.3.5 Dimension drawings

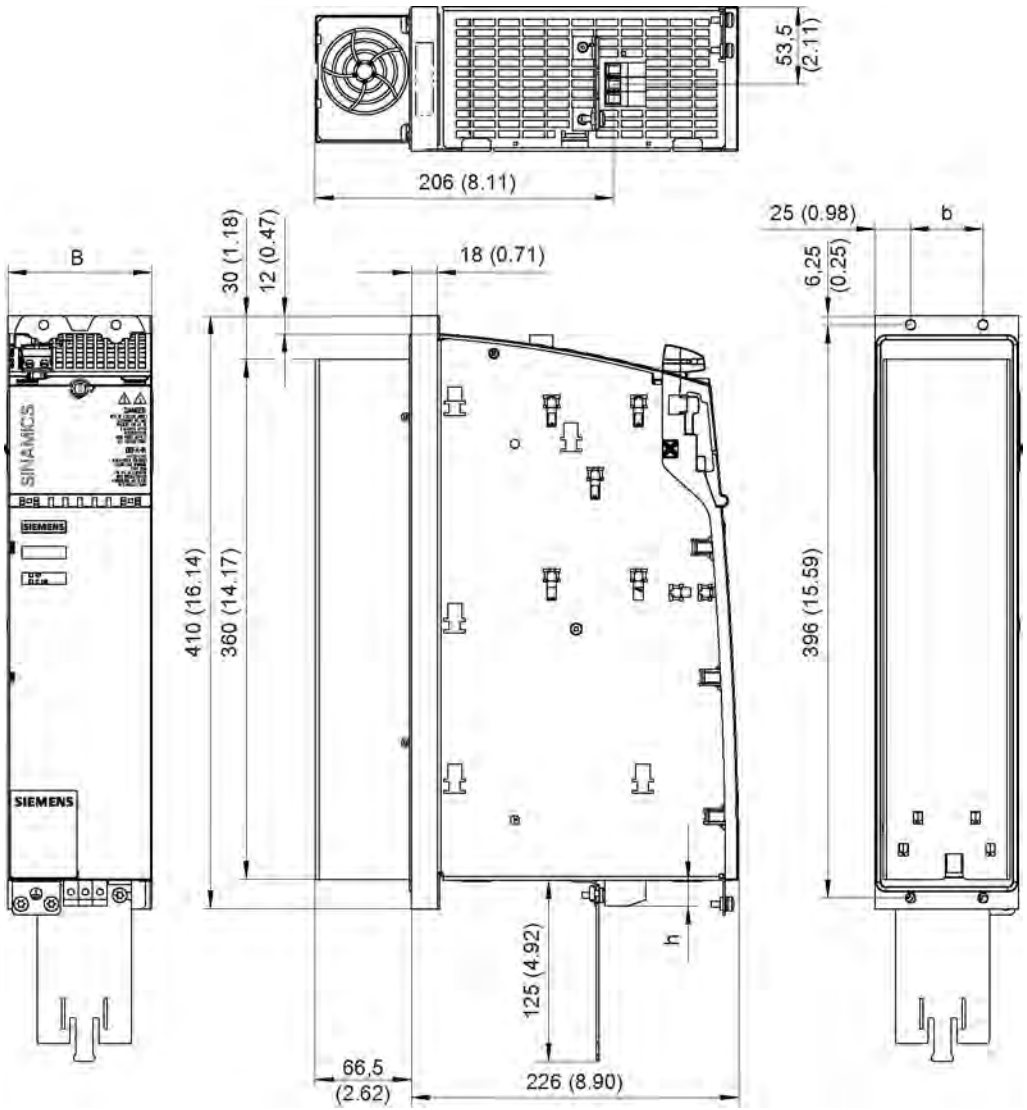


Figure 4-16 Dimension drawing of 16 kW Active Line Module with external air cooling, all dimensions in mm and (inches)

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

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

Note

The shield connecting plate is supplied as standard with a 100 mm Line Module.
For more information, see Chapter Shield connecting plates for power supply and motor cables (Page 617).

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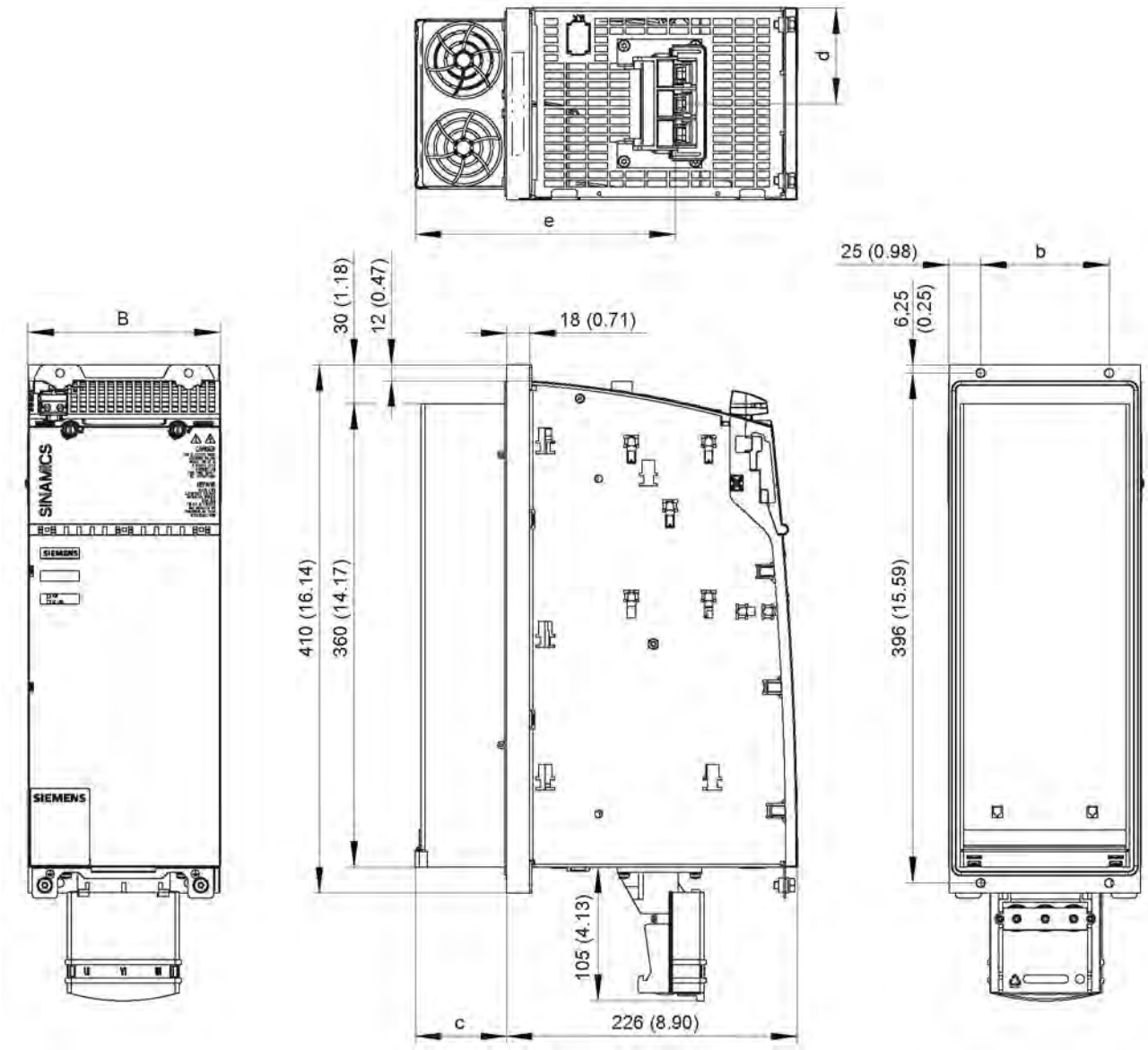


Figure 4-17 Dimension drawing of 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules with external air cooling (example 36 kW), all dimensions in mm and (inches)

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)

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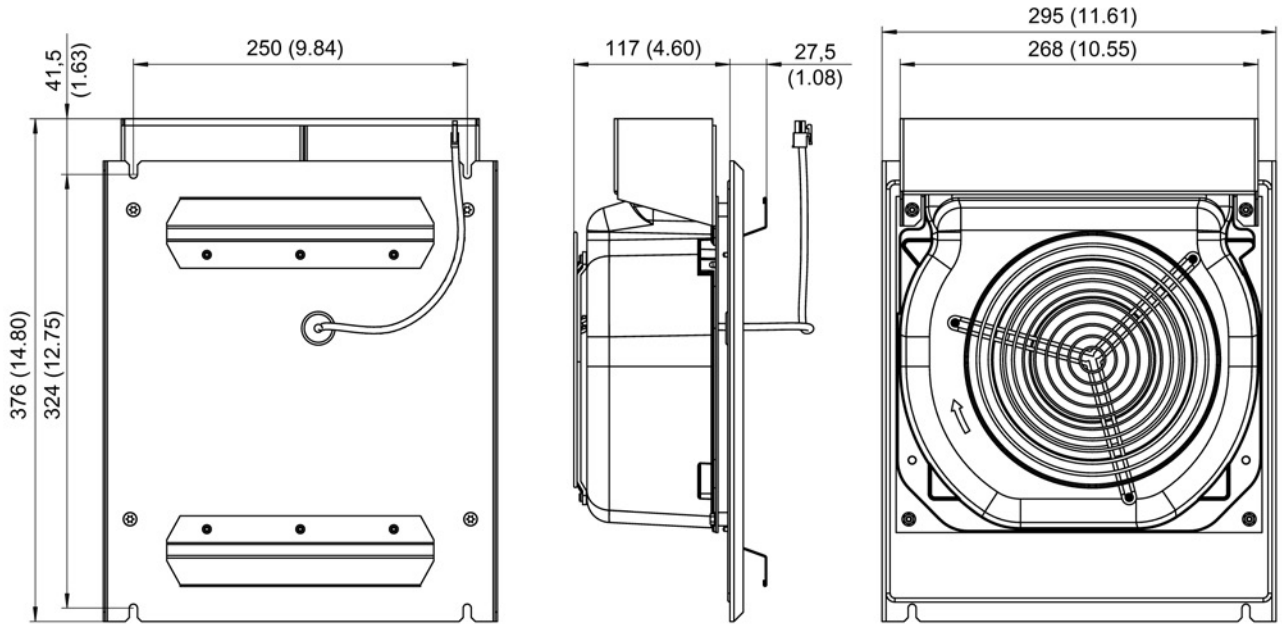
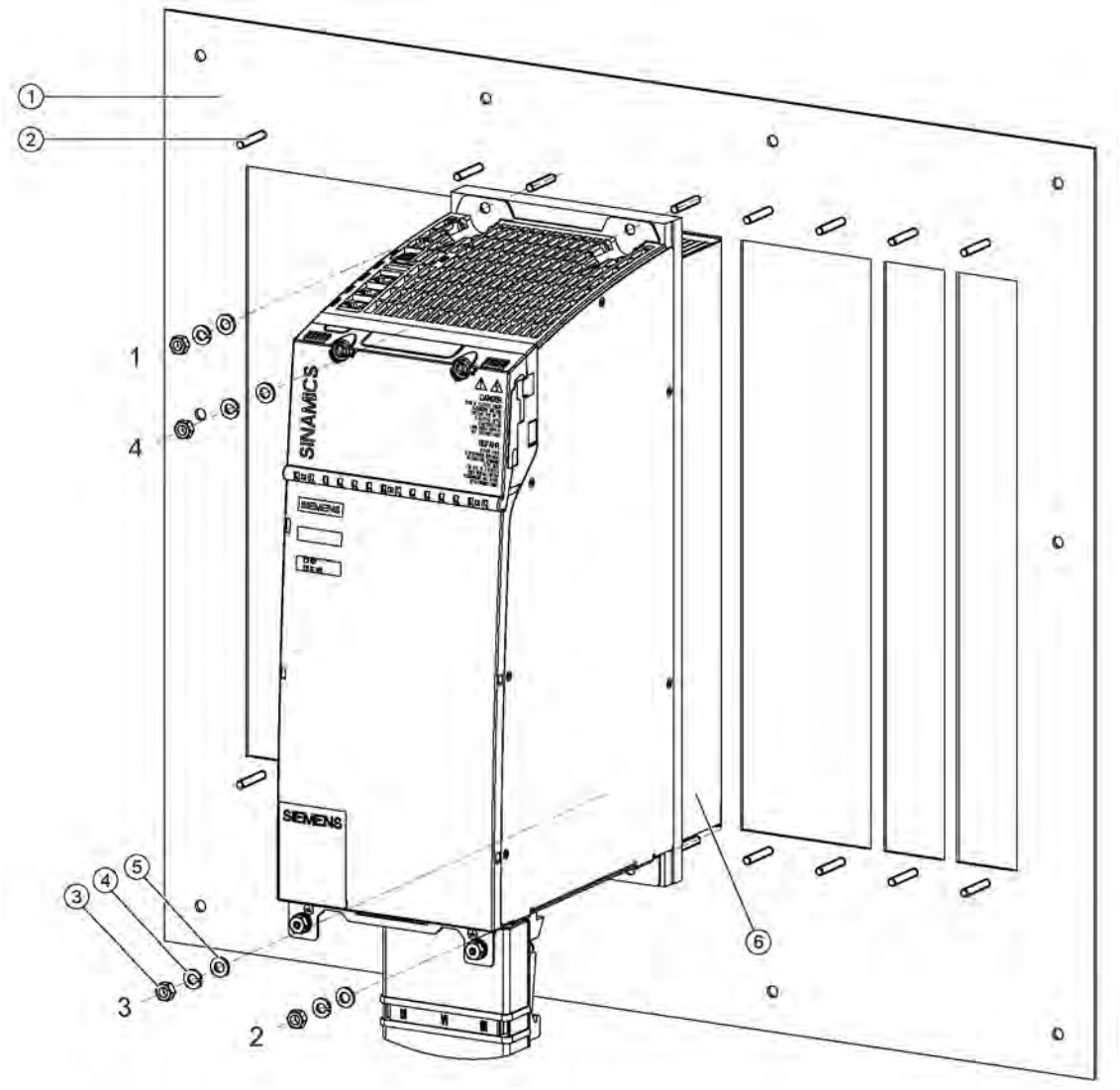


Figure 4-18 Dimension drawing of fan for 80 kW and 120 kW Active Line Modules with external air cooling, all dimensions in mm and (inches)

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4.3.6 Mounting



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

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

Tightening torques:

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

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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

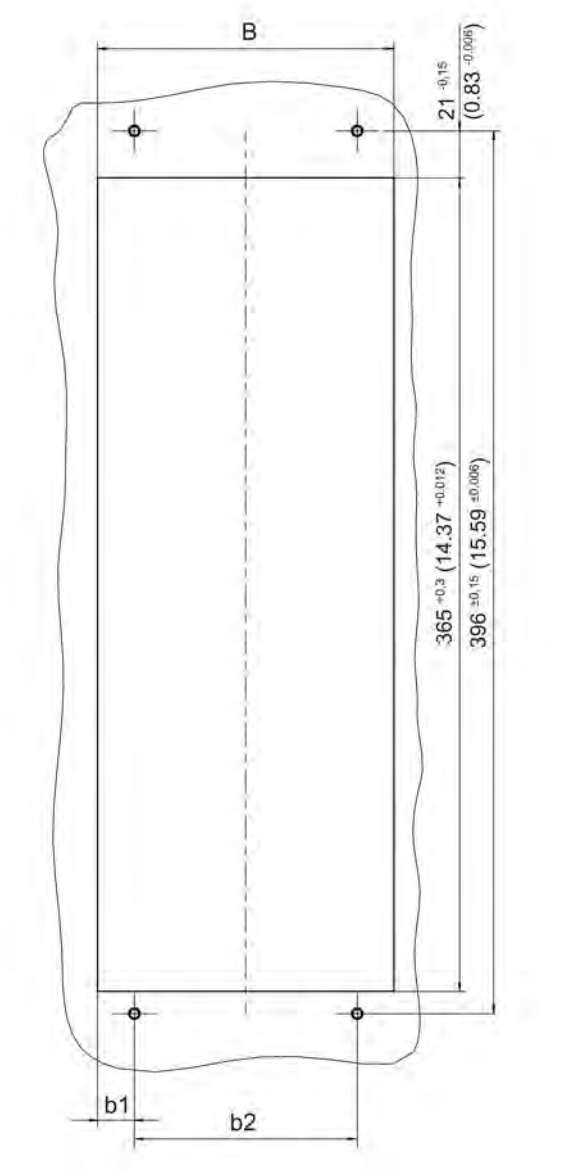
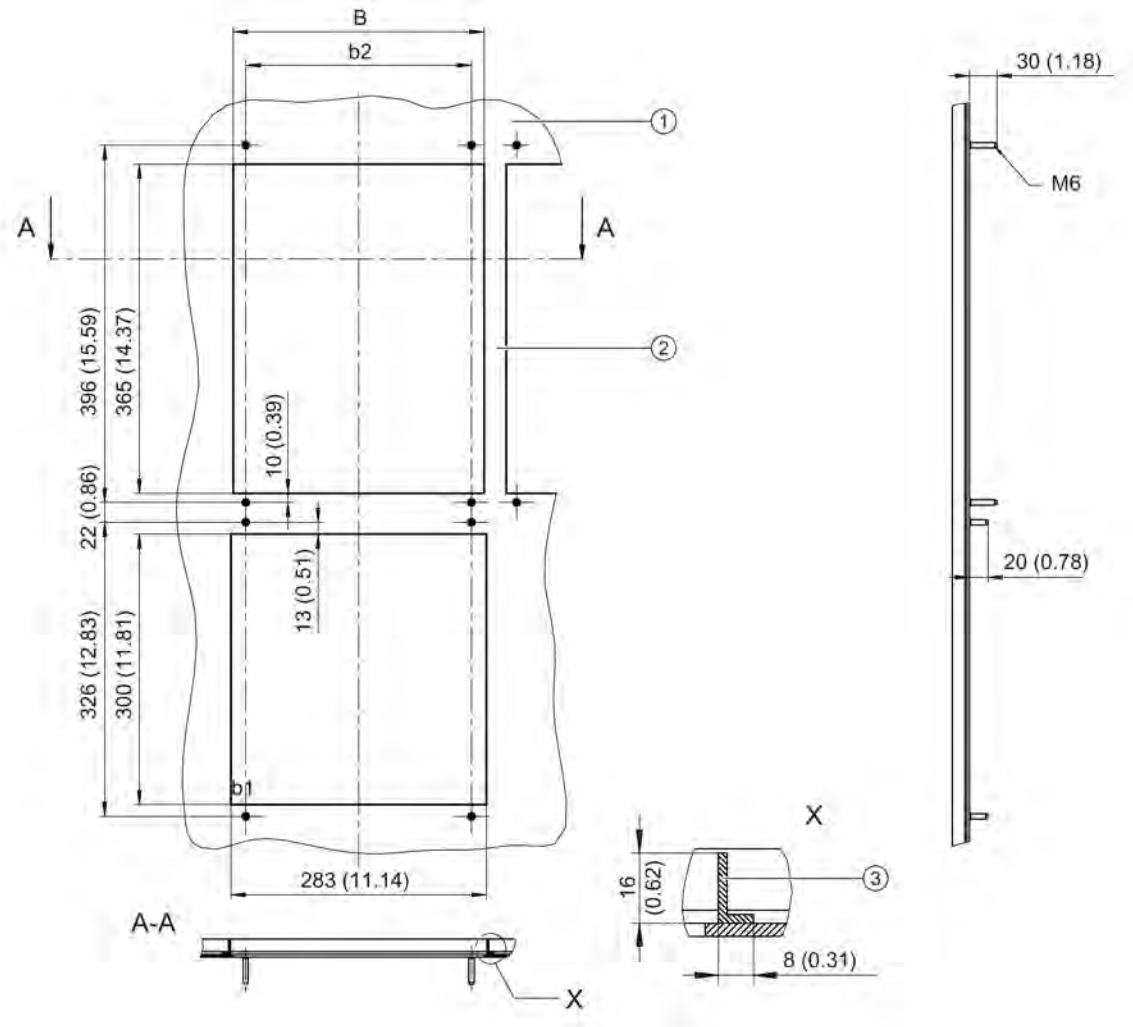


Figure 4-20 Openings to mount Active Line Modules 50 mm to 200 mm with external air cooling, all data in mm and (inches)

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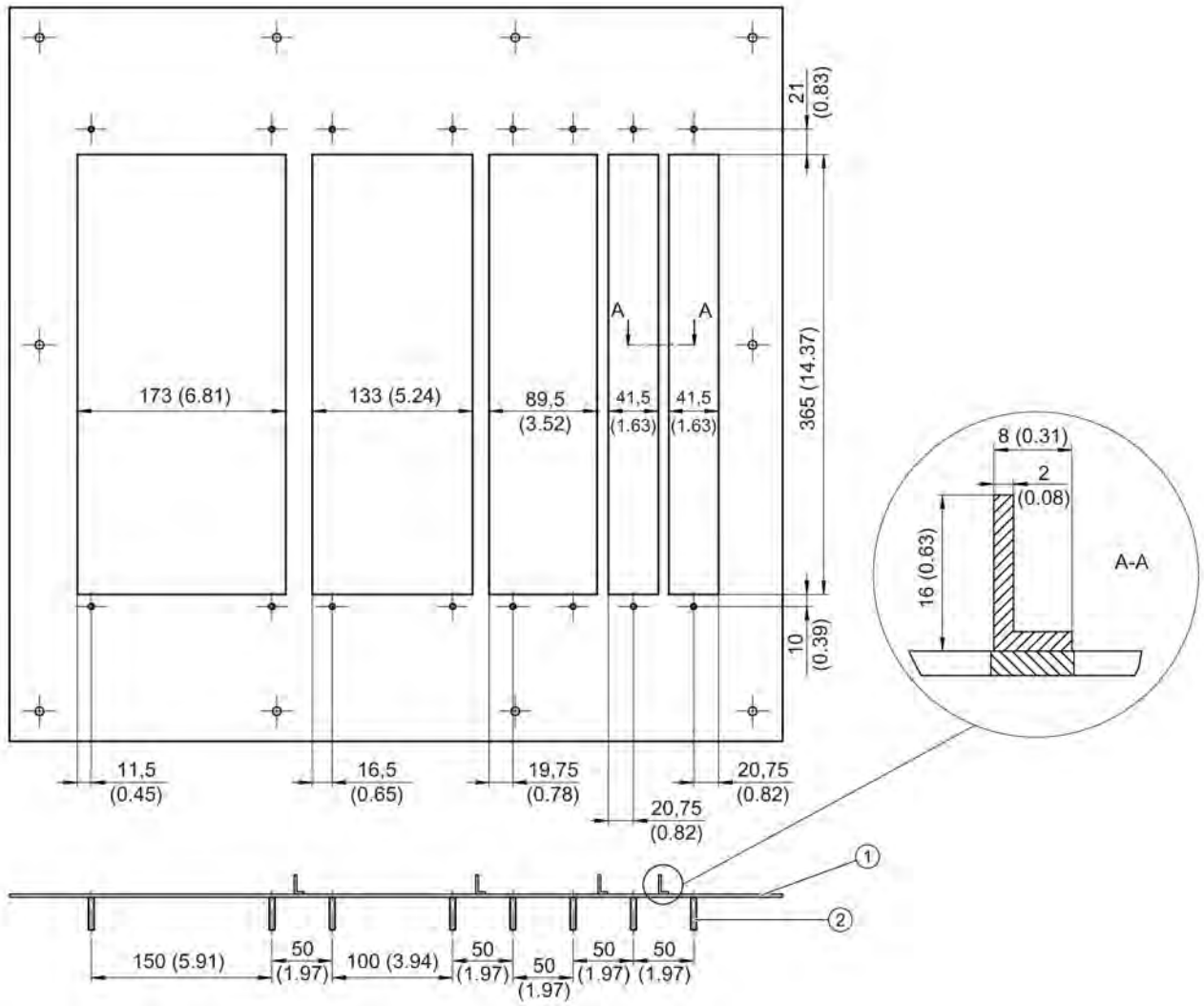
① Insert plate or mounting plate
② Cross-piece
③ Reinforcing bracket

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

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

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

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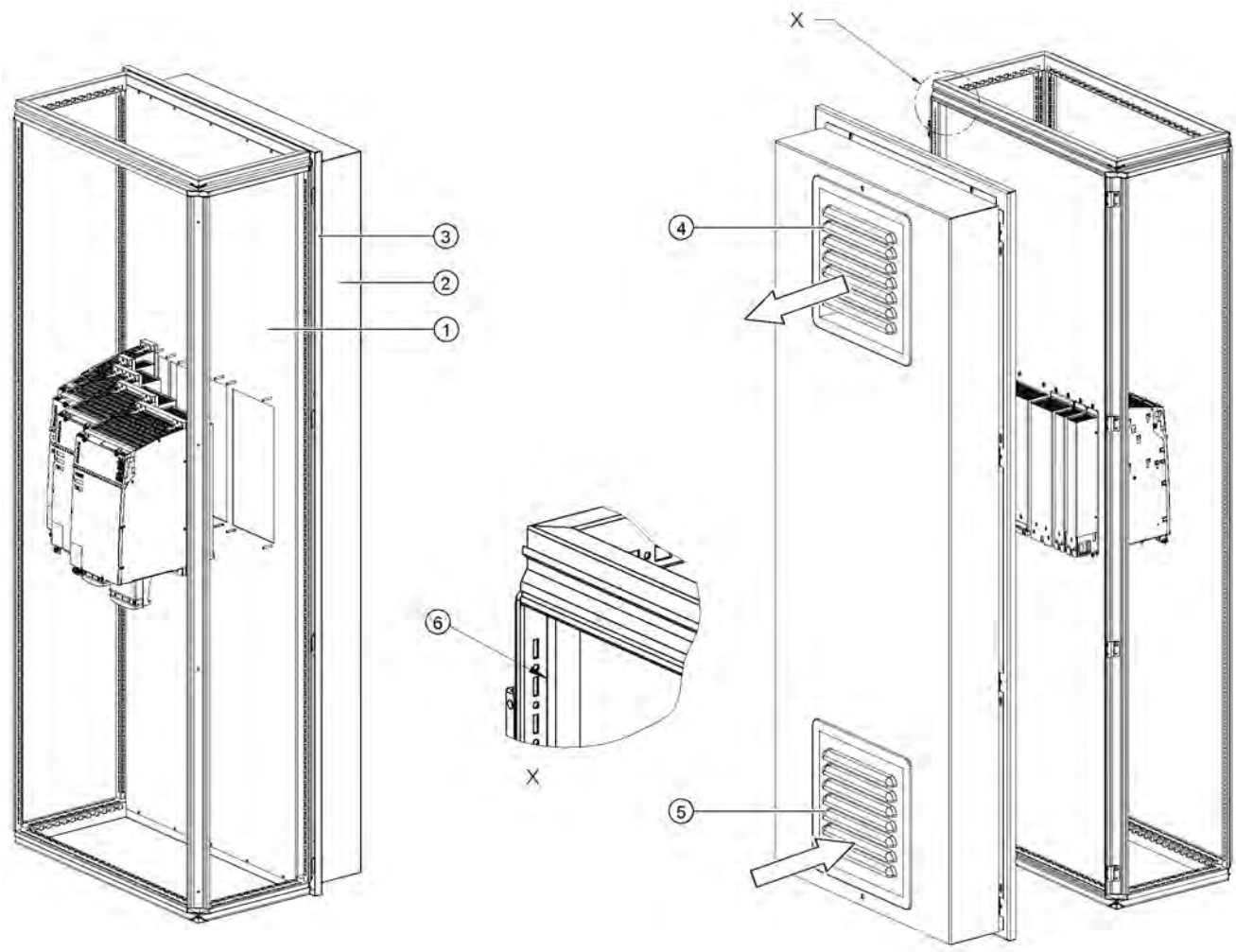
① Insert plate or mounting plate
② Threaded bolts M5 x 28

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

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

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

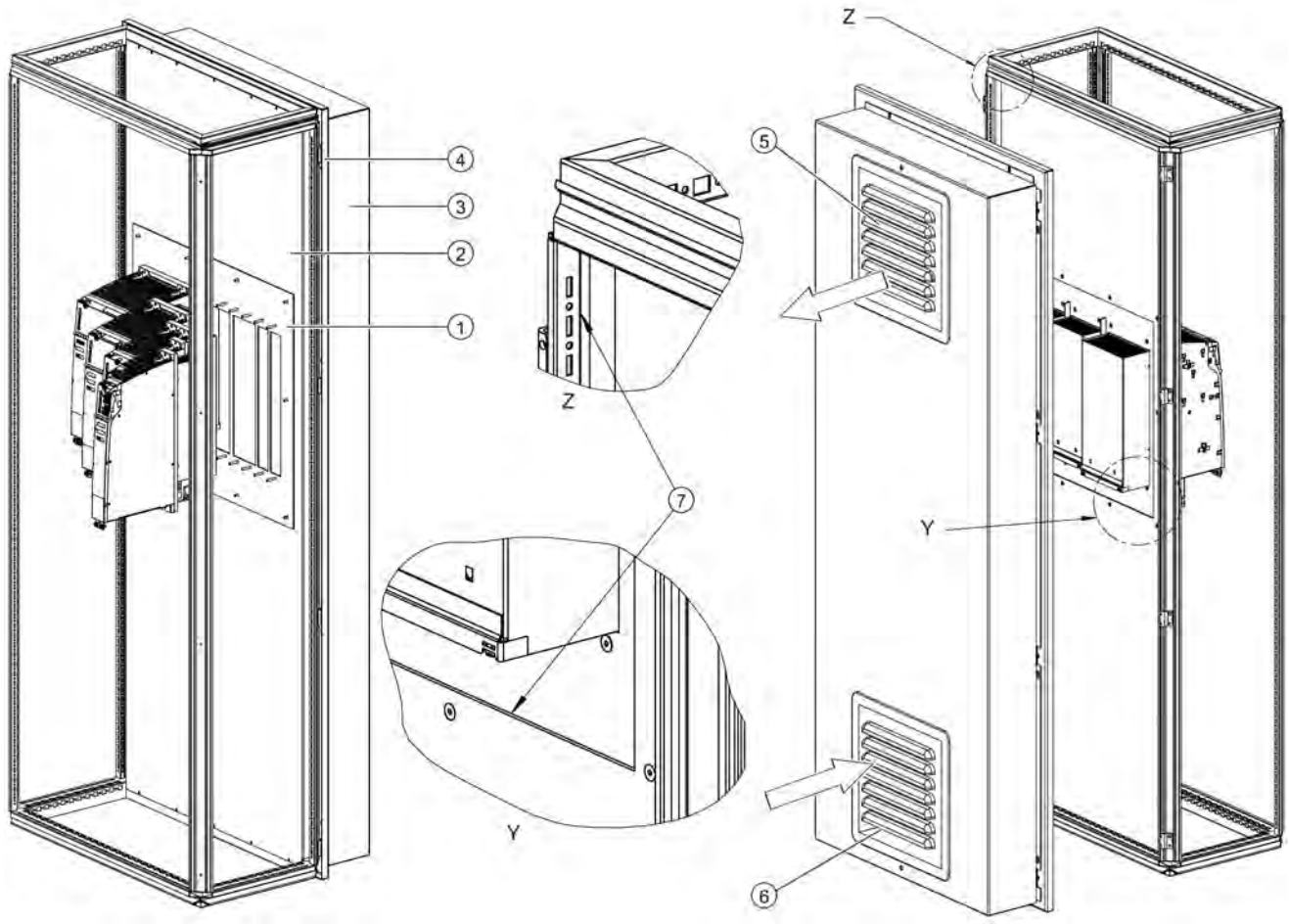
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① Mounting plate
② Cover
③ Rear panel
④ Air discharge
⑤ Air inlet - filter with filter fan
⑥ To comply with degree of protection IP54, the surfaces ⑥ between the mounting plate and the cabinet strip must be sealed all round. (for example, sealant Terostat-91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

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

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

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

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

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

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Note

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

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

4.3.7 Technical data

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

External air cooling	6SL3131–	7TE21–6AAx	7TE23–6AAx	7TE25–5AAx	7TE25–5AA3 + Active Interface Module
Rated power	**kW**	**16**	**36**	**55**	**55**
Infeed					
Rated power (S1)[1)]	kW (P_n)	16	36	55	55
Infeed power (S6 - 40 %)[1)]	kW (P_{s6})	21	47	71	71
Peak infeed power[1)]	kW (P_{max})	35	70	91	110
Regenerative feedback					
Continuous regenerative power	kW	16	36	55	55
Peak regenerative power	kW	35	70	91	110
Supply voltages					
Line voltage	V_{ACrms}	3 AC 380 … 480 ± 10 % (15 % < 1 min)			
Line frequency	Hz	47 … 63 Hz			
Electronics power supply	V_{DC}	24 (20.4 … 28.8)			
DC link voltage	V_{DC}	510 … 720			
Overvoltage trip	V_{DC}	820 ± 2 %			
Undervoltage trip[2)]	V_{DC}	360 ± 2 %			
Input currents					
Rated input current:					
for AC 400 V	A_{AC}	25	55	84	84
Input current:					
for AC 380 V / AC 480 V	A_{AC}	26 / 21	58 /46	88 / 70	88 /70
for AC 400 V; S6 - 40 %	A_{AC}	32	71	108	108
for AC 400 V; peak current	A_{AC}	54	107	139	168
DC link currents					
Rated DC link current:					
for 600 V	A_{DC}	27	60	92	92
DC link current:					
for 600 V DC; for S6 - 40 %	A_{DC}	35	79	121	121
for 600 V DC; peak current	A_{DC}	59	117	152	176
Current carrying capacity					
DC link busbars	A_{DC}	100	200	200	200
Reinforced DC link busbars	A_{DC}	150	--	--	--
24 V DC busbars	A_{DC}	20	20	20	20
Electronics current drawn					
at 24 V DC	A_{DC}	0,95	1,5	1,9	1,9

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

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

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

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

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

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

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

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

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

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

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4.3.7.1 Characteristics

Rated duty cycles for Active Line Modules

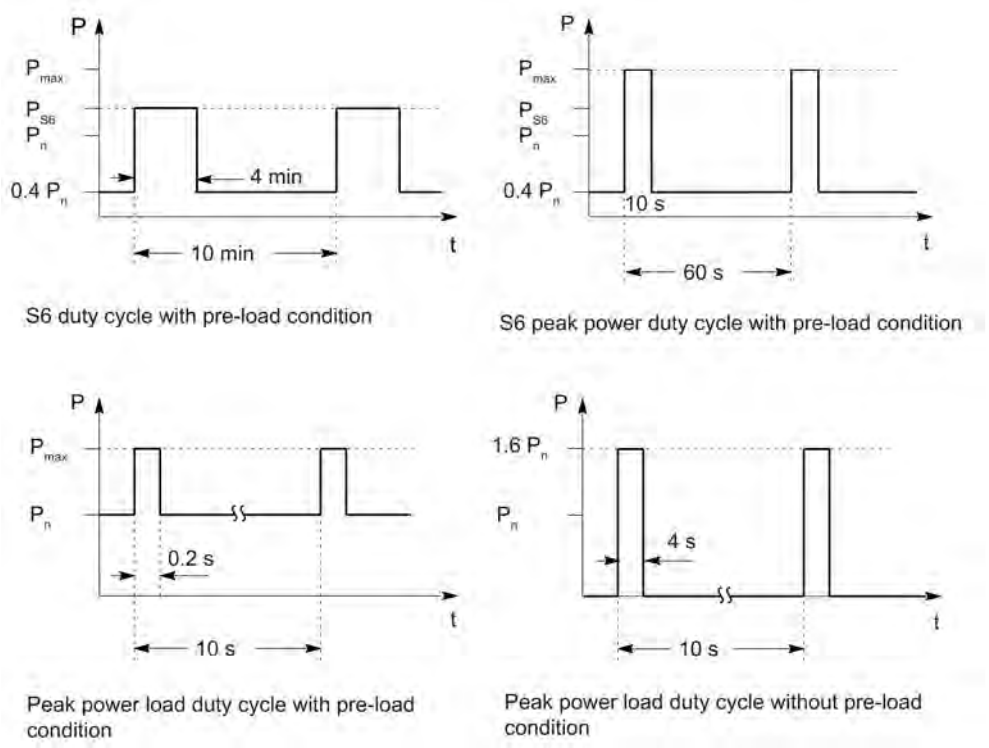


Figure 4-25 Rated duty cycles for Active Line Modules (**exception**: not applicable for 55 kW Active Line Module with Active Interface Module)

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Rated duty cycles for Active Line Modules with Active Interface Modules

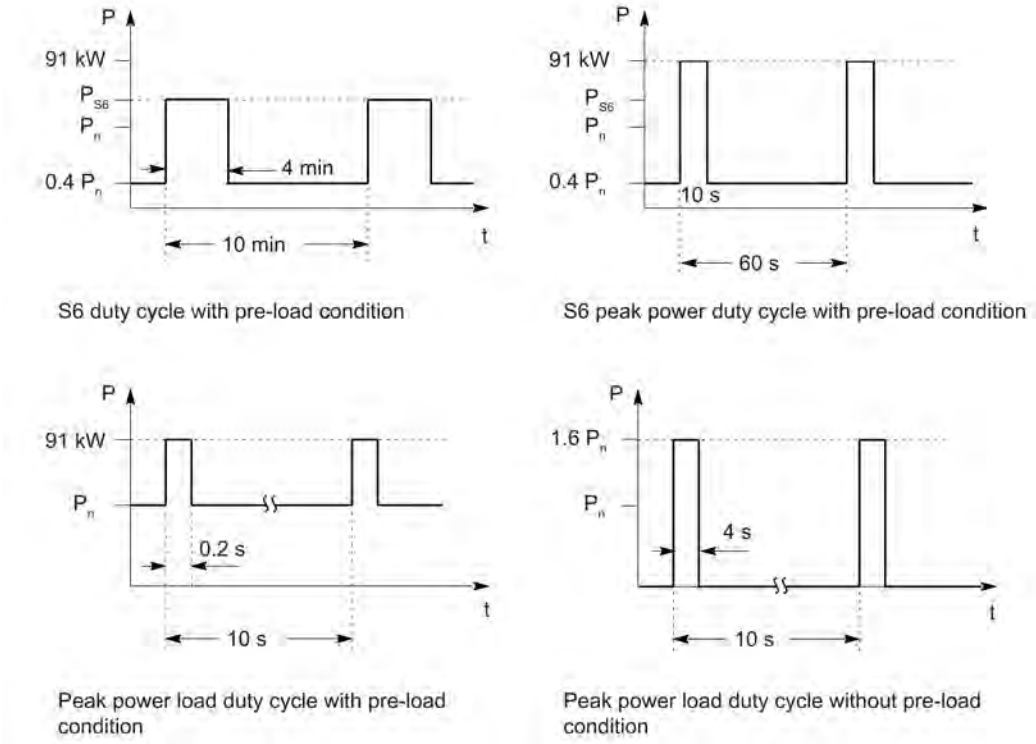


Figure 4-26 Load cycles for 55 kW Active Line Modules with Active Interface Module

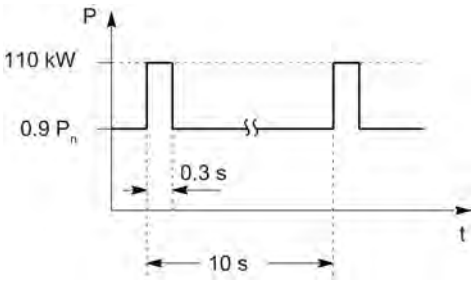


Figure 4-27 Peak load cycle with initial load for 55 kW Active Line Modules with Active Interface Module

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Derating characteristics

Note

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

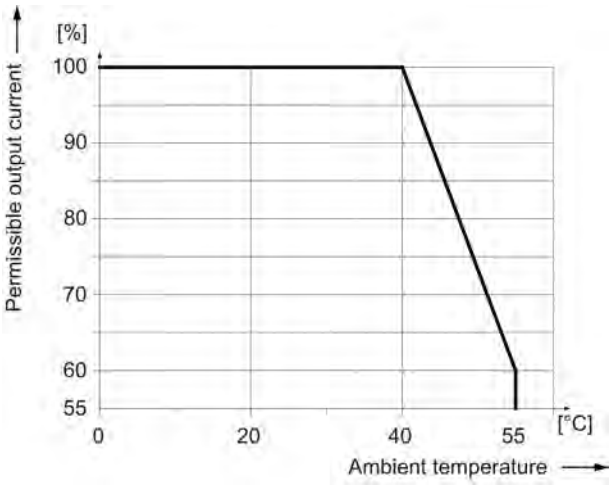


Figure 4-28 Output current as a function of the ambient temperature

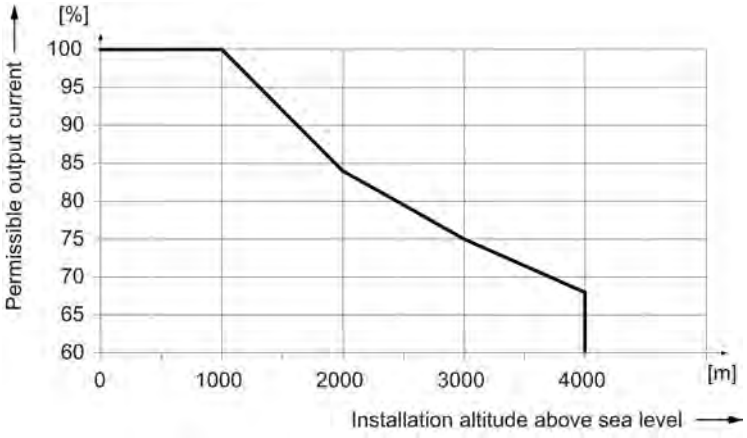


Figure 4-29 Output current as a function of the installation altitude

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4.4 Active Line Modules with cold plate

4.4.1 Description

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

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

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

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

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

WARNING

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

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

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

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4.4.2 Interface description

4.4.2.1 Overview

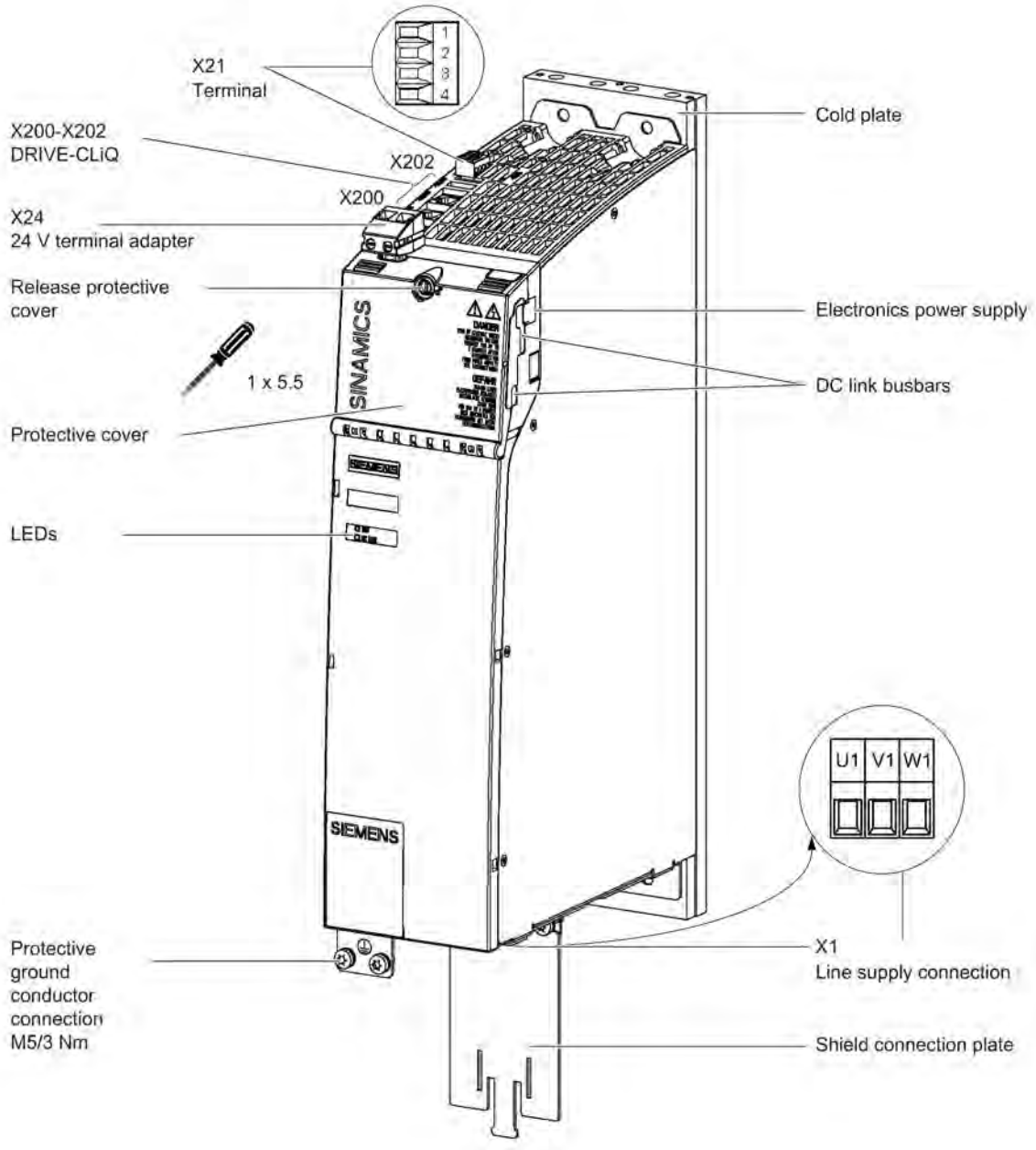
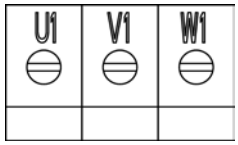
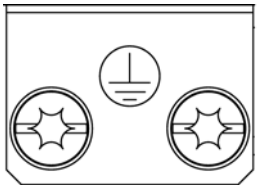


Figure 4-30 Interface overview, Active Line Module with cold plate (example: 16 kW)

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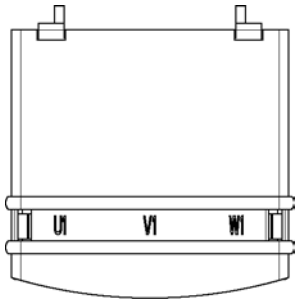
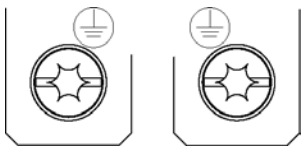
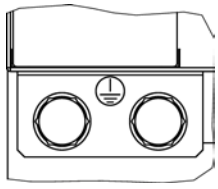
4.4.2.2 X1 line connection

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

	Terminal	Technical data
	U1 V1 W1	Max. connectable cross-section: 10 mm² Type: Screw terminal 6 (Page 755) Tightening torque: 1.5 … 1.8 Nm
	PE connection	Threaded hole M5 / 3 Nm[1)]

1) For ring cable lugs without insulation

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

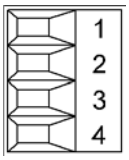
	Terminal	Technical data
	U1 V1 W1	Supply voltage: 380 … 480 V 3 AC, 50/60 Hz **36 kW:** Threaded bolts M6 / 6 Nm[1)] **55 kW, 80 kW and 120 kW:** Threaded bolts M8 / 13 Nm[1)]
	PE connection	**36 kW and 55 kW:** Threaded hole M6 / 6 Nm[1)]
		**80 kW and 120 kW:** Threaded hole M8 / 13 Nm[1)]

1) For ring cable lugs without insulation

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4.4.2.3 X21 EP terminals

Table 4- 26 X21 EP terminal / temperature sensor

	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors[1]: KTY 84–1C130[2]/PTC[2]/bimetallic switch with NC contact If an Active Interface Module is used, the temperature input must be connected to the Active Interface Module sensor (bimetallic switch with NC contact).
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage: 24 V DC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm²			

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

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

Terminals X21.1 and X21.2

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

Terminals X21.3 and X21.4



WARNING

Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected

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

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

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

- Neutralize the voltage in the DC link.

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NOTICE

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

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

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



⚠WARNING

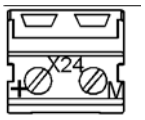
Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor

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

- Use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

4.4.2.4 X24 24 V terminal adapter

Table 4- 27 X24: 24 V terminal adapter

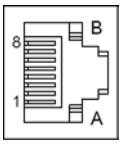
	Terminal	Designation	Technical data
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm^2			

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

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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

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4.4.3 Connection example

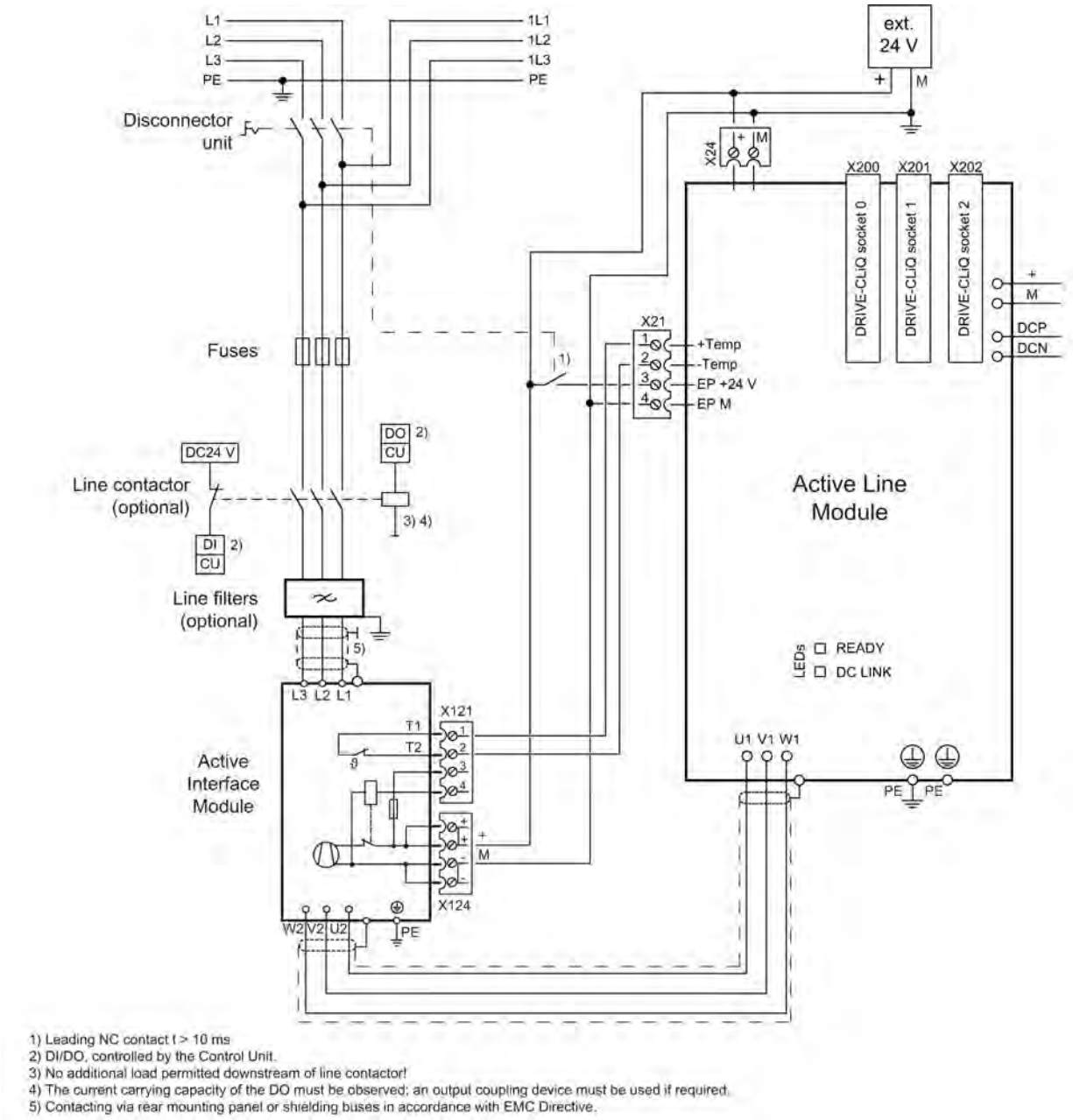


Figure 4-31 Connection example: Active Line Module with cold plate

Note

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

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4.4.4 Meaning of LEDs

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

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

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



WARNING

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

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

- Observe the warning information on the component.

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4.4.5 Dimension drawings

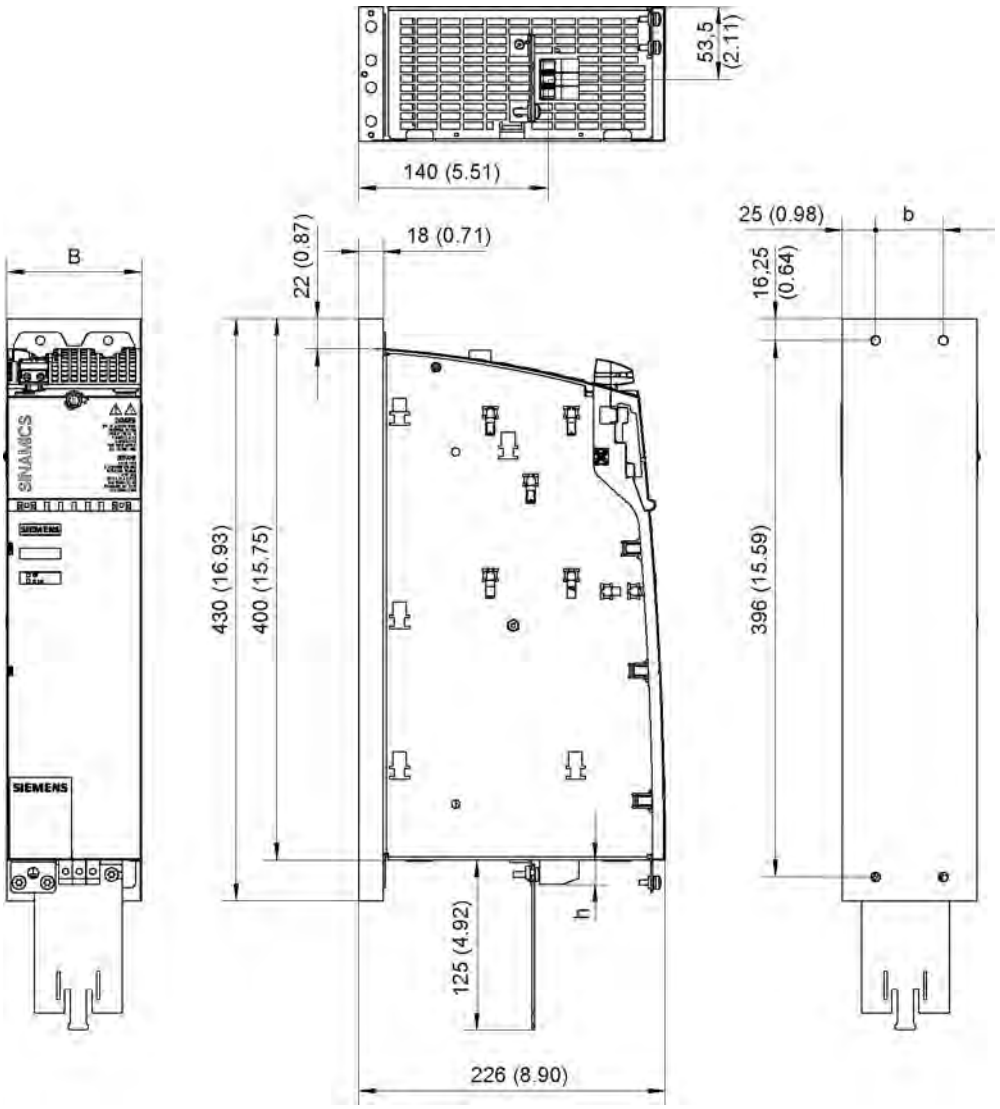


Figure 4-32 Dimension drawing of 16 kW Active Line Module with cold plate, all dimensions in mm and (inches)

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)

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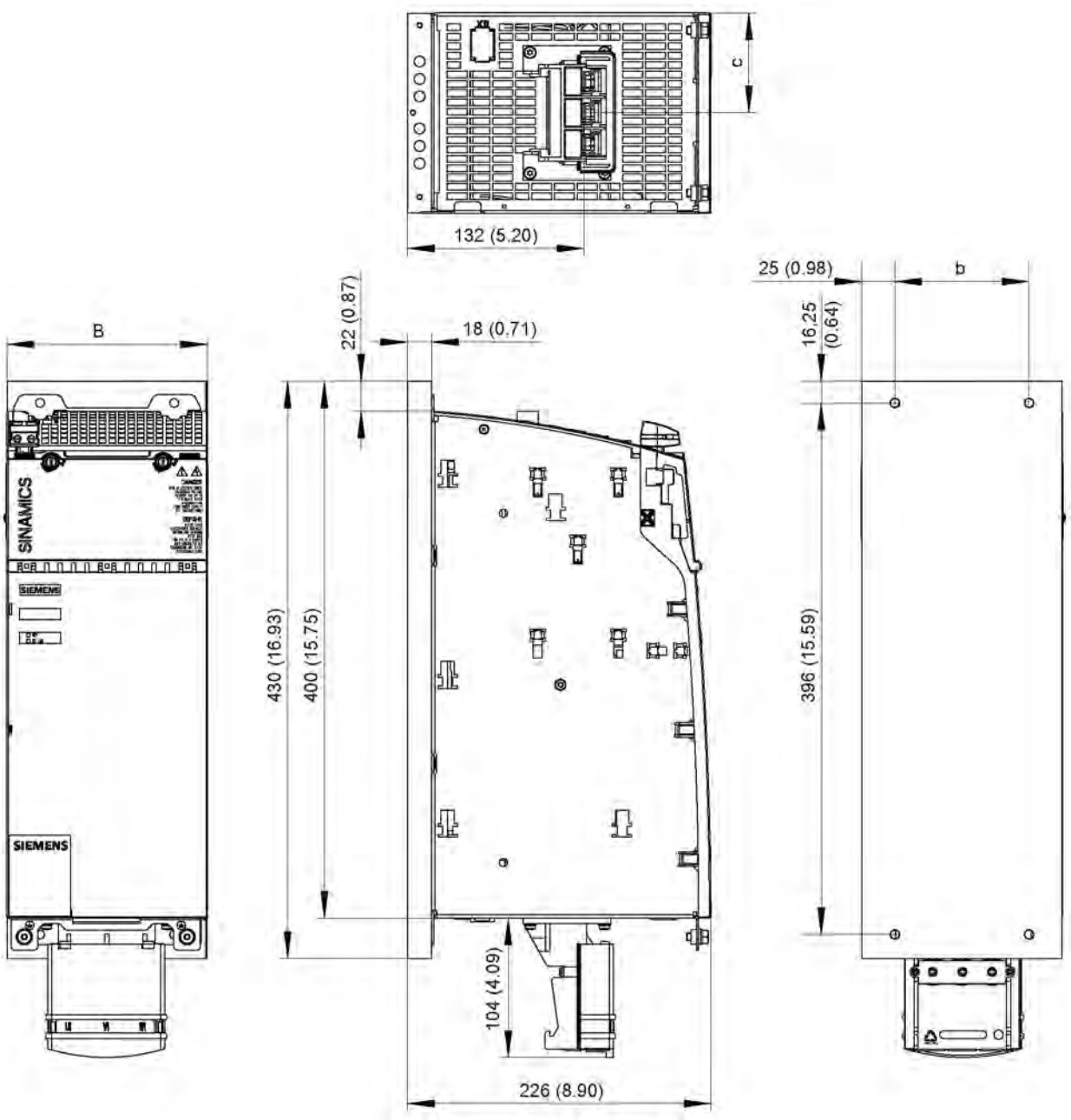


Figure 4-33 Dimension drawing of 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules with cold plate, all dimensions in mm and (inches)

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)

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4.4.6 Mounting

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

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

Note

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

Table 4- 32 Overview of heat-conducting foils

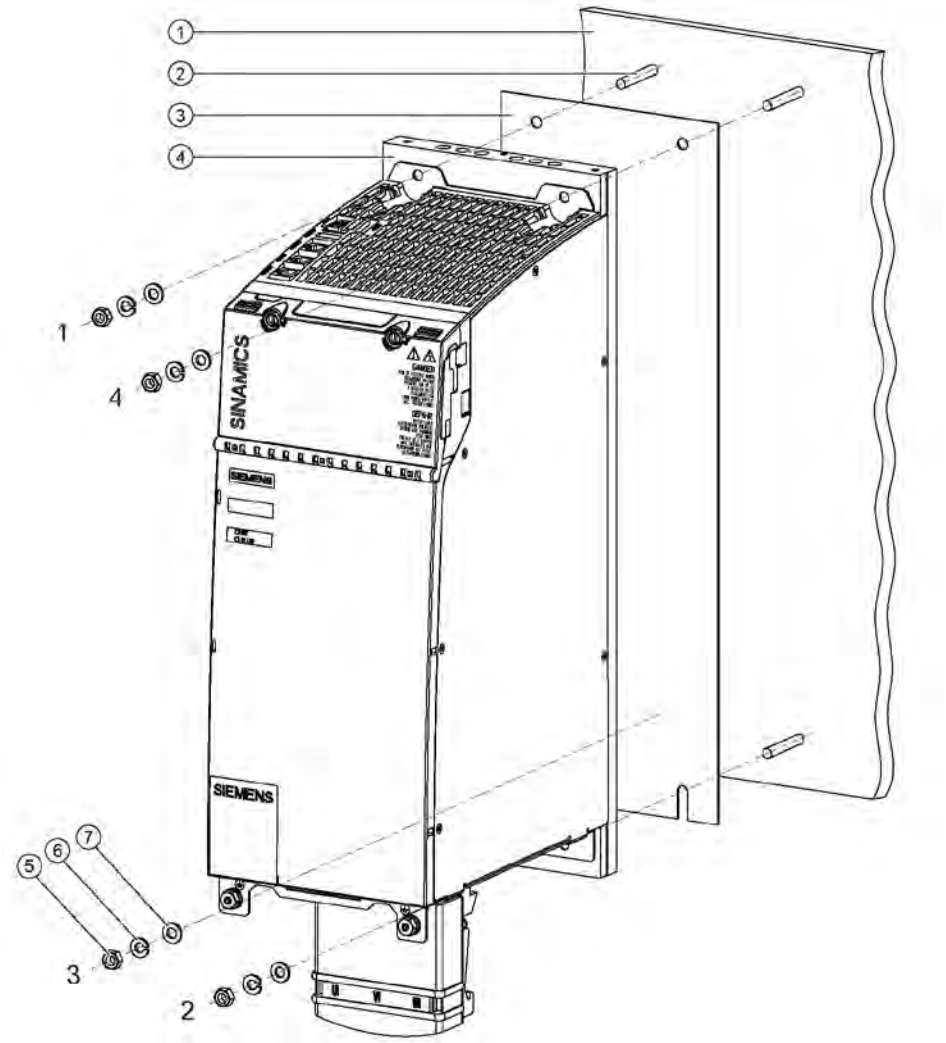
	Order number
Heat-conducting foil, 50 mm	6SL3162-6FB00-0AA0
Heat-conducting foil, 100 mm	6SL3162-6FD00-0AA0
Heat-conducting foil, 150 mm	6SL3162-6FF00-0AA0
Heat-conducting foil, 200 mm	6SL3162-6FH00-0AA0
Heat-conducting foil, 300 mm	6SL3162-6FM00-0AA0

Note

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

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Mounting



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

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

Tightening torques:

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

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Help with the mechanical control cabinet design is available from:

Siemens AG
Industry Sector, IA DT MC MF - WKC AS
TCCCC (Technical Competence Center Cabinets Chemnitz)
Postfach 1124
09070 Chemnitz, Germany

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

Properties of the heat sink

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

Note

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

NOTICE

Damage to the cold plate caused by incorrect mounting

The screw bolts can be damaged when mounting the cold plate.

- Do not damage the cold plate.

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4.4.7 Technical data

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

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

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

1) Derating must be applied due to the transfer of heat to the external heat sink. At a temperature of 40° C at the interface to the power unit, 80% derating occurs for 6SL3136-7TE28-0AAx and 70% for 6SL3136-7TE31-2AAx

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

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

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

Note

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

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4.4.7.1 Characteristics

Rated duty cycles for Active Line Modules

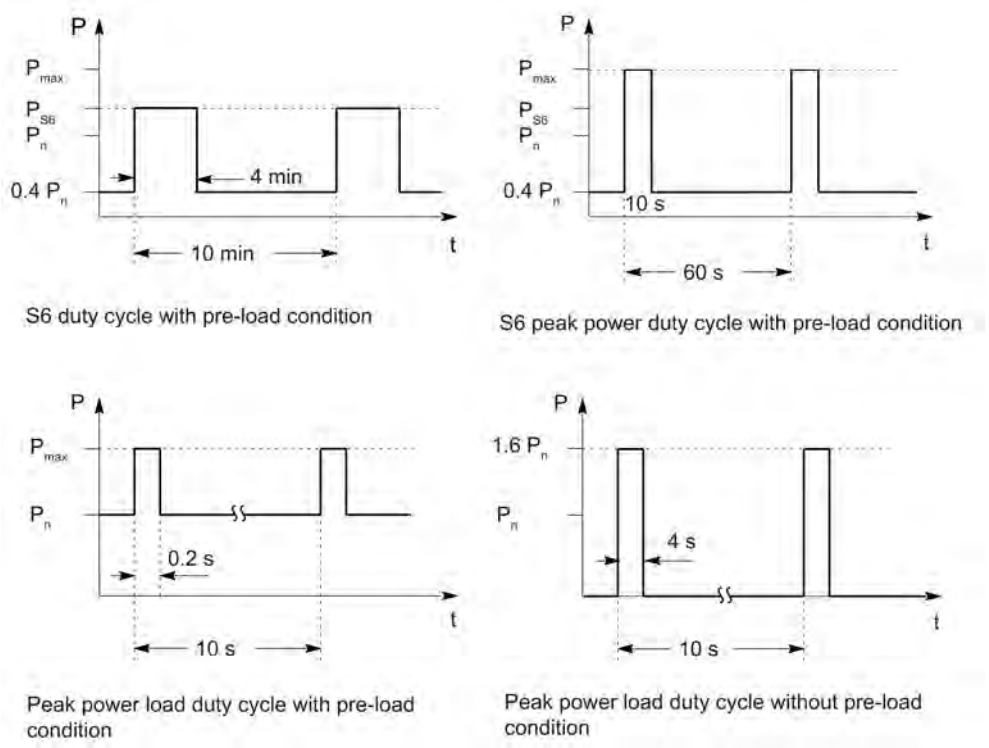


Figure 4-35 Rated duty cycles for Active Line Modules (**exception**: not applicable for 55 kW Active Line Module with Active Interface Module)

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Rated duty cycles for Active Line Modules with Active Interface Modules

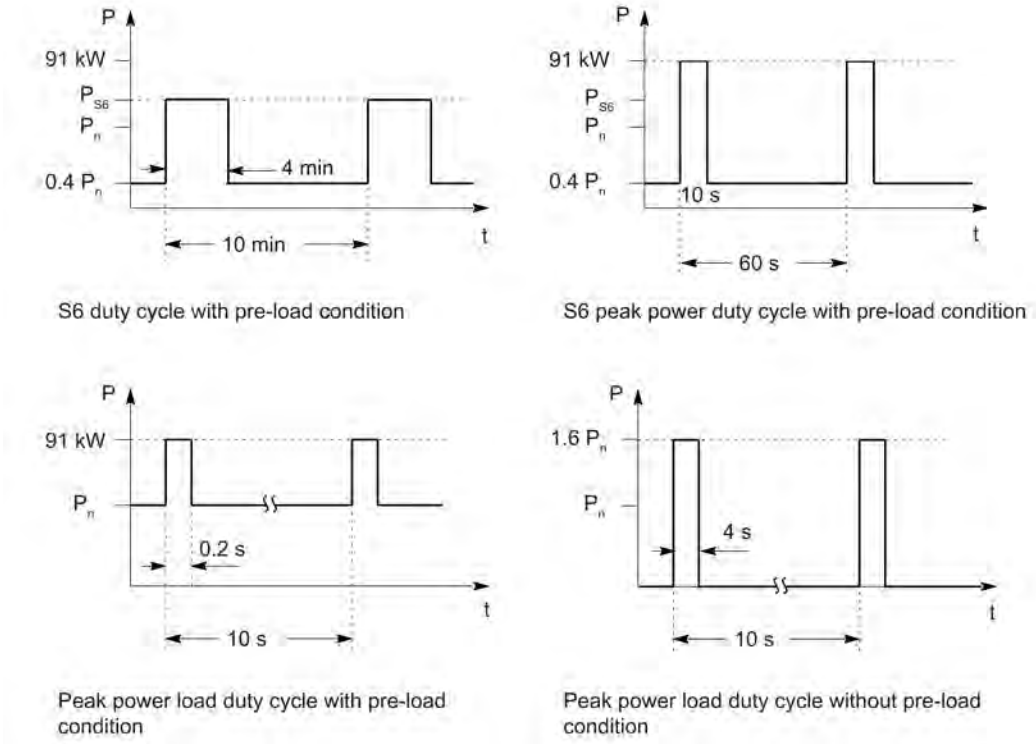


Figure 4-36 Load cycles for 55 kW Active Line Modules with Active Interface Module

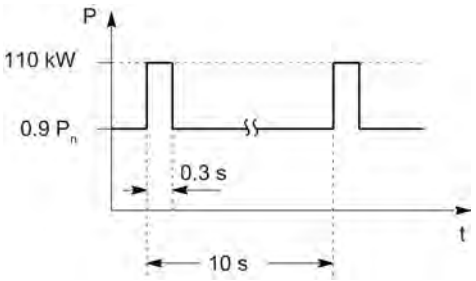


Figure 4-37 Peak load cycle with initial load for 55 kW Active Line Modules with Active Interface Module

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Derating characteristics

Note

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

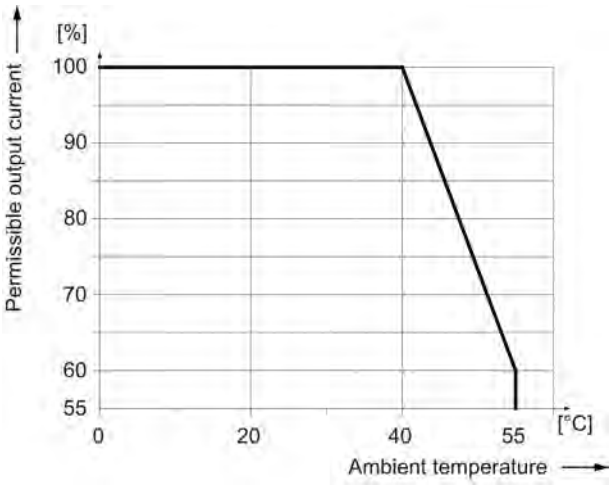


Figure 4-38 Output current as a function of the ambient temperature

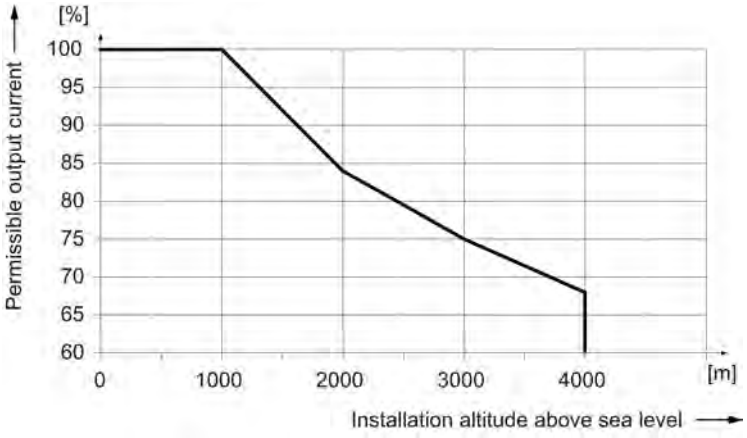


Figure 4-39 Output current as a function of the installation altitude

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4.5 Active Line Modules Liquid Cooled

4.5.1 Description

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

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

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

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

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

WARNING

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

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

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

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4.5.2 Interface description

4.5.2.1 Overview

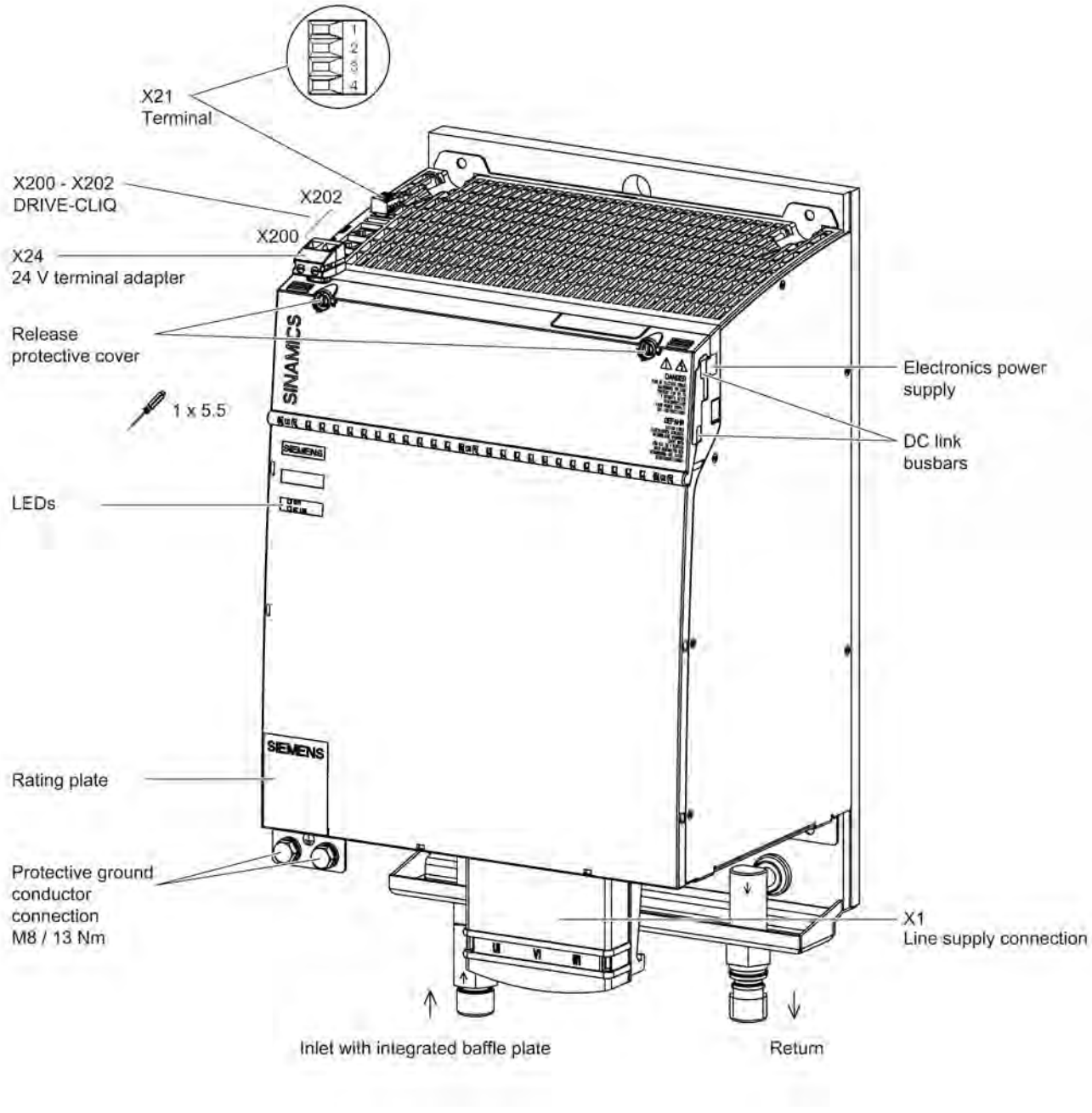
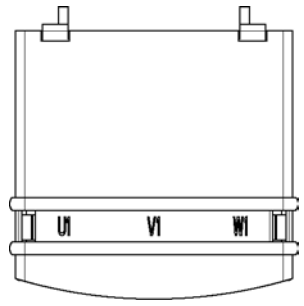
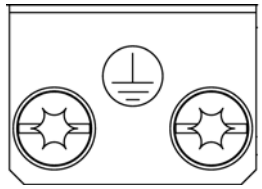


Figure 4-40 Interface overview, Active Line Module Liquid Cooled (120 kW)

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4.5.2.2 X1 line connection

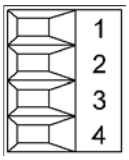
Table 4- 34 X1 line connection

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

1) For ring cable lugs without insulation

4.5.2.3 X21 EP terminals

Table 4- 35 X21 EP terminal / temperature sensor

	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors[1)]: KTY 84–1C130[2)]/PTC[2)]/bimetallic switch with NC contact If an Active Interface Module is used, the temperature input must be connected to the Active Interface Module sensor (bimetallic switch with NC contact).
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage: 24 V DC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm²			

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

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

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Terminals X21.1 and X21.2

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

Terminals X21.3 and X21.4



⚠WARNING

Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected

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

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

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

- Neutralize the voltage in the DC link.

NOTICE

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

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

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



⚠WARNING

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

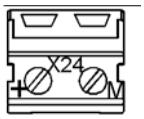
Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

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4.5.2.4 X24 24 V terminal adapter

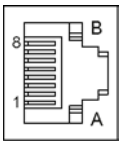
Table 4- 36 X24: 24 V terminal adapter

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

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

4.5.2.5 X200-X202 DRIVE-CLiQ interfaces

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

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

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

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

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4.5.3 Connection example

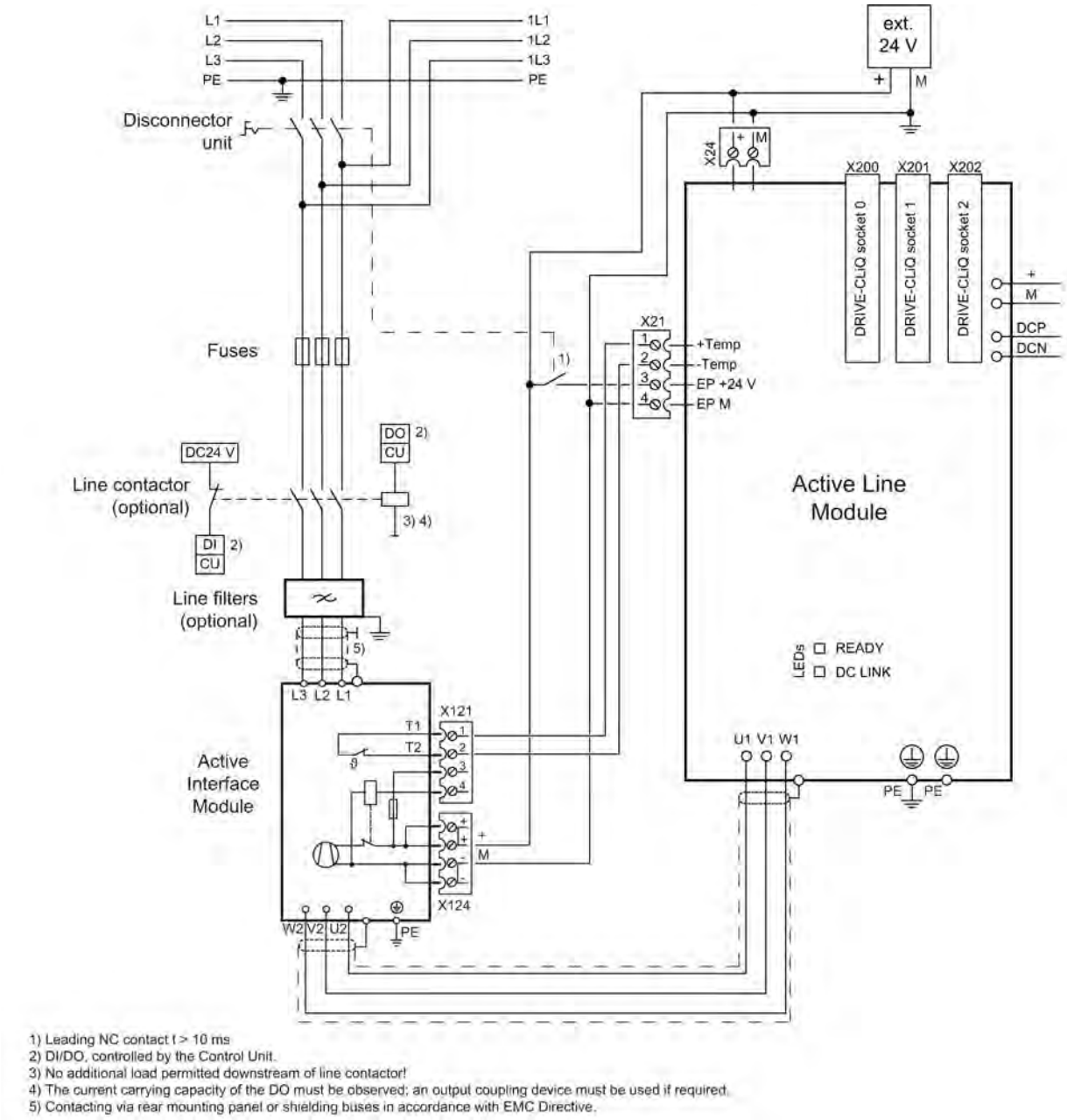


Figure 4-41 Example connection of Active Line Module

Note

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

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4.5.4 Meaning of LEDs

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

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

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



WARNING

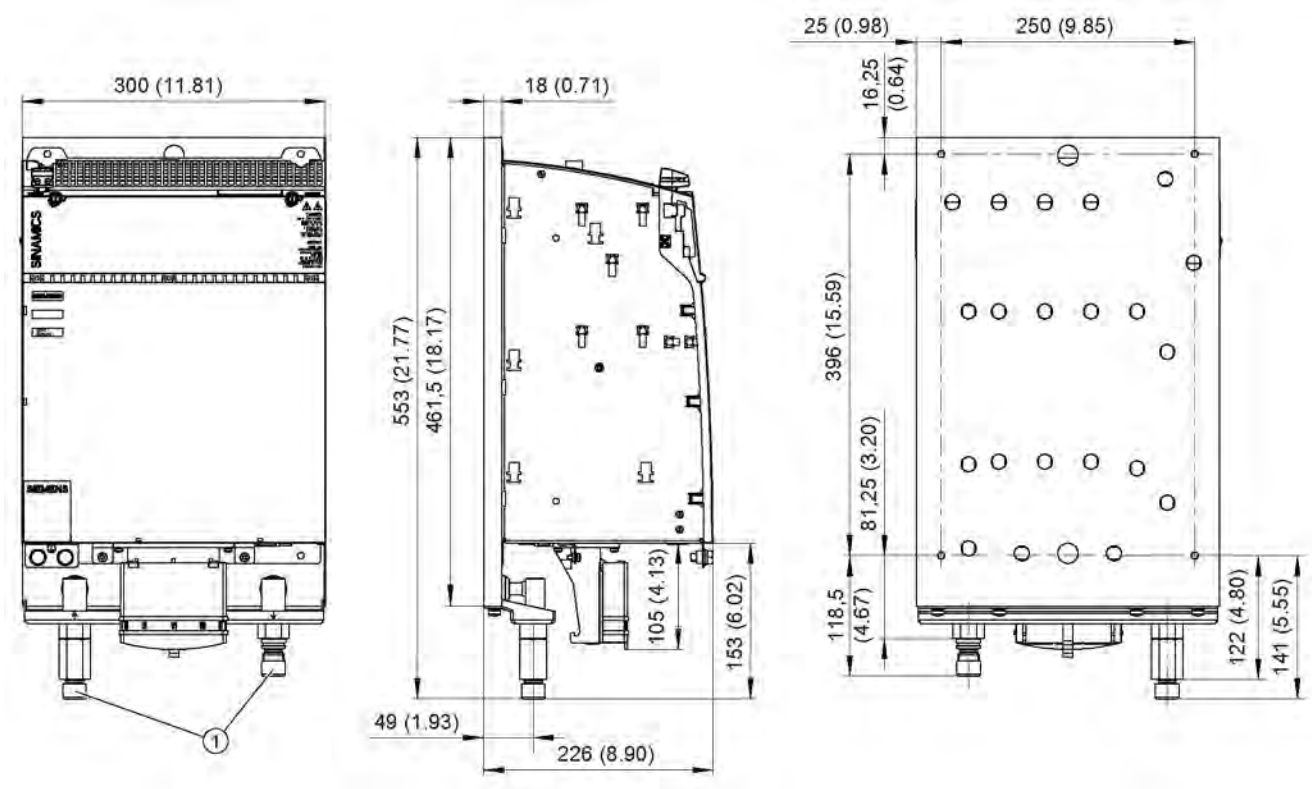
Danger of death when live parts of the DC link are touched

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

- Observe the warning information on the component.

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4.5.5 Dimension drawing

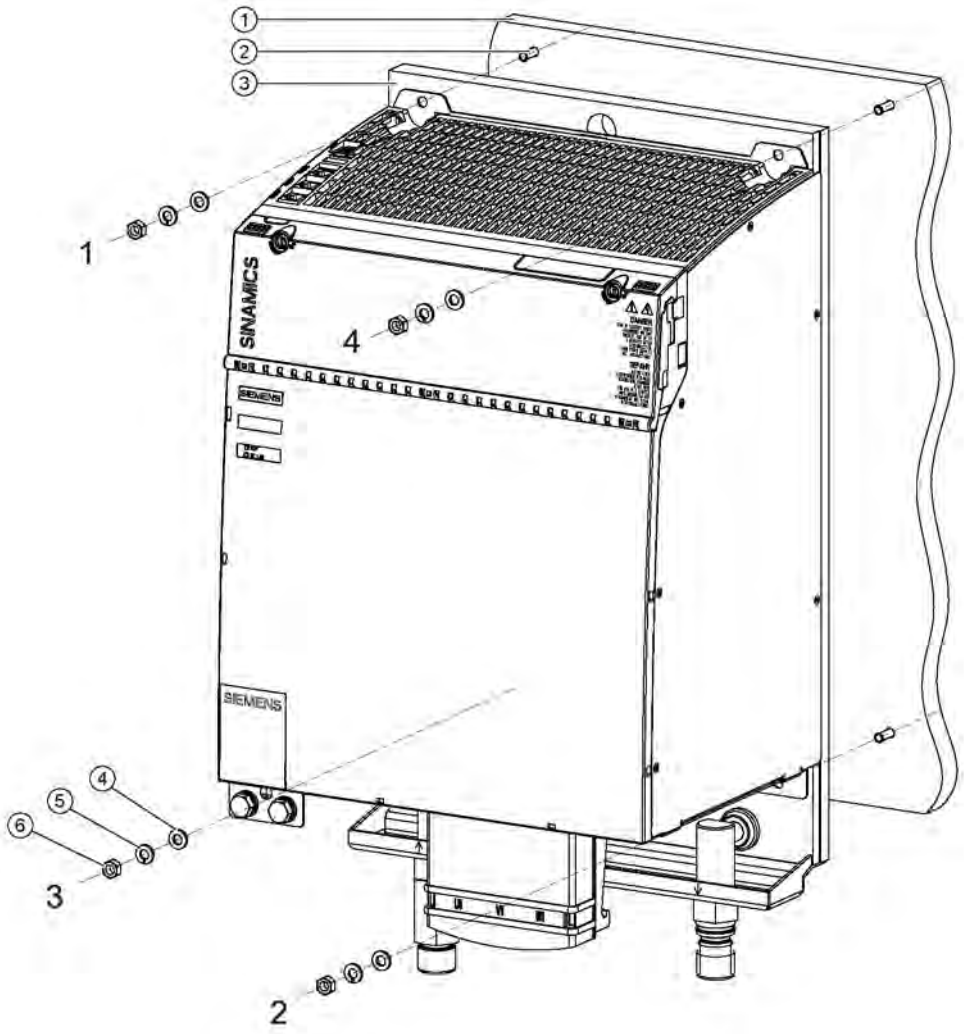


① Pipe thread ISO 228 G ½ B.

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

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4.5.6 Installation



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

Figure 4-43 Mounting an Active Line Module Liquid Cooled

Tightening torques:

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

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

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

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

4.5.7 Technical data

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

Liquid Cooled		**6SL3135-7TE31-2AA3**
Rated power	**kW**	**120**
Infeed		
Rated power (S1)[1)]	kW (P_n)	120
Infeed power (S6 - 40 %)[1)]	kW (P_{S6})	145
Peak infeed power[1)]	kW (P_{max})	175
Regenerative feedback		
Continuous regenerative power	kW	120
Peak regenerative power	kW	175
Supply voltages		
Line voltage	V_{ACrms}	3 AC 380 … 480 ±10 % (- 15 % < 1 min)
Line frequency	Hz	47 … 63
Electronics power supply	V_{DC}	24 (20.4 … 28.8)
DC link voltage	V_{DC}	510 … 720
Overvoltage trip	V_{DC}	820 ± 2 %
Undervoltage trip[2)]	V_{DC}	360 ± 2 %
Input currents		
Rated input current:		
for AC 400 V:	A_{AC}	182
Input current		
for AC 380 V / AC 480 V	A_{AC}	192 / 152
for AC 400 V; S6 - 40 %	A_{AC}	220
for AC 400 V; peak current	A_{AC}	267
DC link currents		
Rated DC link current:		
for 600 V:	A_{DC}	200
DC link current:		
for 600 V DC; for S6 - 40 %	A_{DC}	244
for 600 V DC; peak current	A_{DC}	292
Current carrying capacity		
DC link busbars	A_{DC}	200
24 V DC busbars	A_{DC}	20
Electronics current drawn at 24 V DC	A_{DC}	1.8
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	2243.2

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Liquid Cooled		**6SL3135-7TE31-2AA3**
Rated power	**kW**	**120**
Max. ambient temperature without derating with derating	 ° C ° C	 40 55
DC link capacitance: Active Line Module Drive line-up, max.	 µF µF	 3995 20000
Power factor	cosϕ	1
Circuit breaker (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 51)
Rated short-circuit current SCCR[3)]	kA	65
Rated flow rate for water at 70 kPa pressure drop (for other coolants, see Cooling circuit and coolant properties (Page 795)	l/min	8
Volume of liquid internal	ml	100
Max. coolant temperature without derating with derating	 ° C ° C	 45 50
Max. permissible heat sink temperature	° C	80
Weight	kg	23

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

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

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

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4.5.7.1 Characteristics

Rated duty cycles of Active Line Modules Liquid Cooled

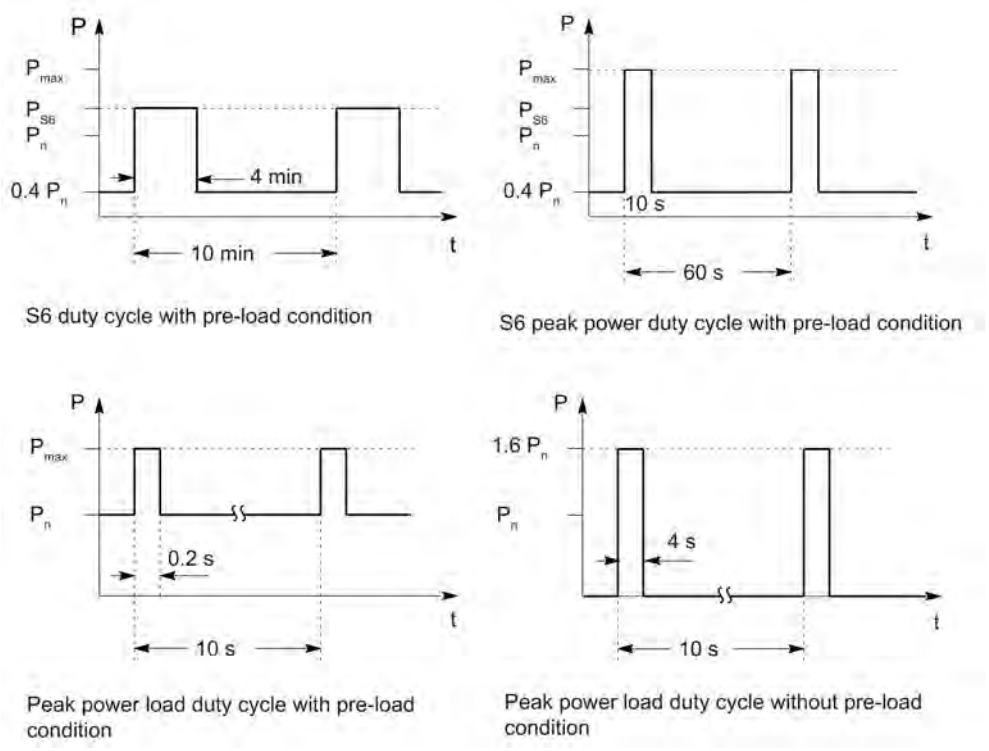


Figure 4-44 Rated duty cycles of Active Line Modules

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Derating characteristics

Note

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

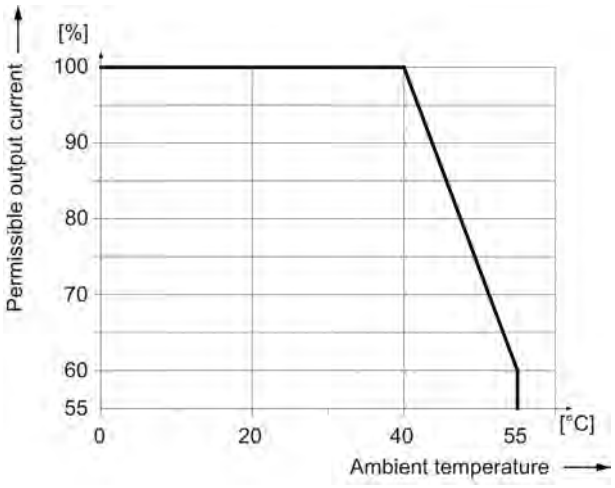


Figure 4-45 Output current as a function of the ambient temperature

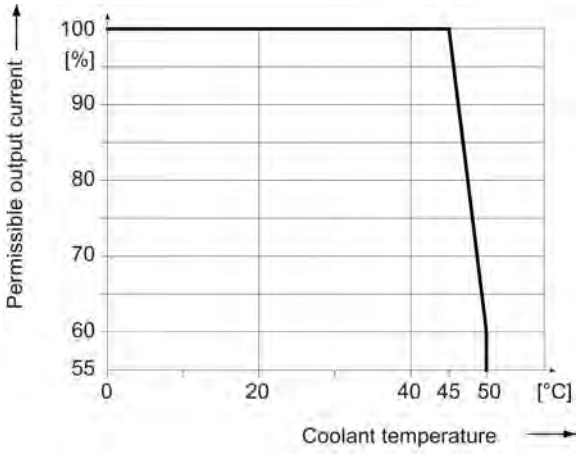


Figure 4-46 Output current as a function of the coolant temperature

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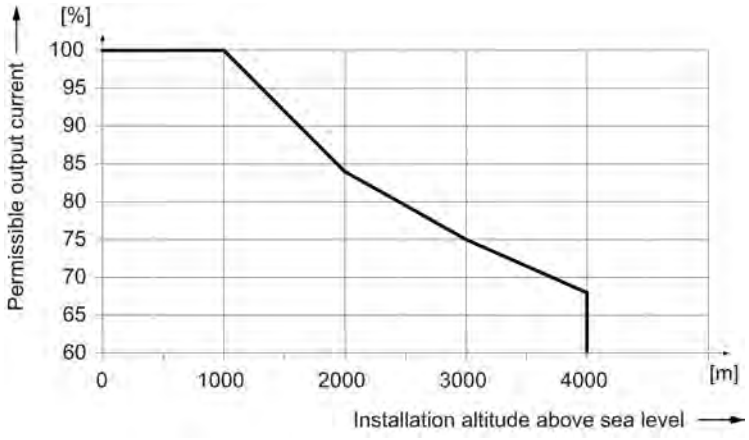


Figure 4-47 Output current as a function of the installation altitude

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4.6 Basic Line Modules with internal air cooling

4.6.1 Description

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

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

For 100 kW Basic Line Modules, an external braking unit is required for degradation of energy. Either Braking Modules Booksize Compact (also in a parallel connection) or a MASTERDRIVES braking unit (see Chapter "Braking units for 100 kW Basic Line Modules (Page 544)") can be used.

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

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

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

The maximum total cable length is as follows:

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

WARNING

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

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

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

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4.6.2 Interface description

4.6.2.1 Overview

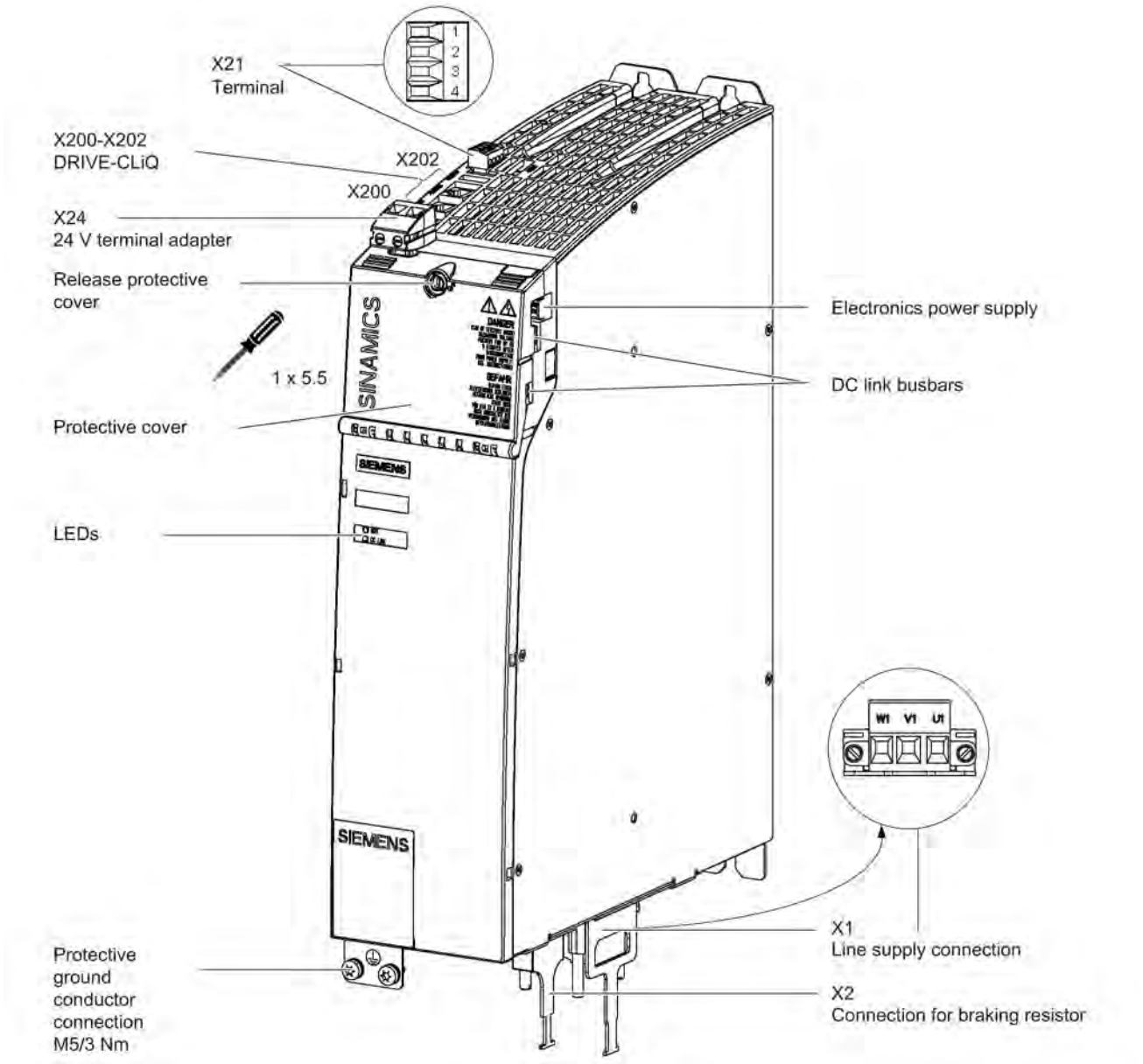
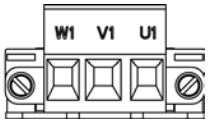
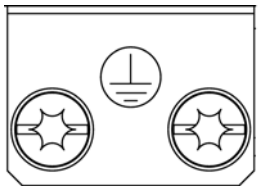


Figure 4-48 Interface overview, Basic Line Module with internal air cooling (example: 20 kW)

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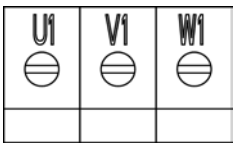
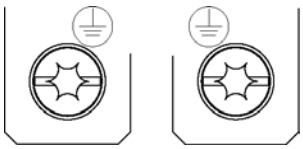
4.6.2.2 X1 line connection

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

	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 … 480 V, 50 / 60 Hz Max. connectable cross-section: 16 mm² Type: Screw terminal 7 (Page 755) Tightening torque: 1.5 … 1.7 Nm
	PE connection	Threaded hole M5 / 3 Nm[1]

1) For ring cable lugs without insulation

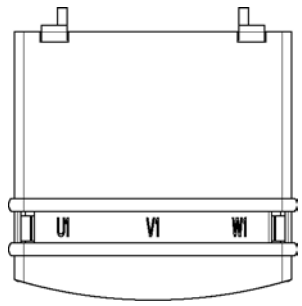
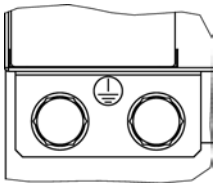
Table 4- 41 X1: Line supply connection for Basic Line Modules 40 kW

	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 … 480 V, 50 / 60 Hz Max. connectable cross-section, 50 mm², end sleeves Tightening torque, min. 6 Nm
	PE connection	Threaded hole M6 / 6 Nm[1)]

1) For ring cable lugs without insulation

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

	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 … 480 V, 50 / 60 Hz Type: Threaded bolts M8[1)] Max. connectable cross-section: 120 mm² Tightening torque: 13 Nm
	PE connection	Threaded hole M6 / 6 Nm[1)]

1) For ring cable lugs without insulation

4.6.2.3 X2 braking resistor connection

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

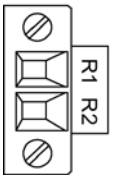
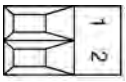
	Terminal	Designation	Technical data
	1	Braking resistor connection R1	Type: Screw terminal 4 (Page 755) Max. cross-section that can be connected: 4 mm² Tightening torque: 0.5 … 0.6 Nm
	2	Braking resistor connection R2	

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

	Terminal	Designation	Technical data
	1	Braking resistor connection R1	Type: Screw terminal 6 (Page 755) Max. cross-section that can be connected: 10 mm² Tightening torque: min 1.5 ... 1.8 Nm
	2	Braking resistor connection R2	

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

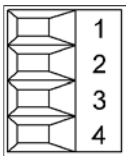
Braking resistor	R in Ω	P_N in kW	4 x P_N in kW	P_{max} in kW
6SE7018-0ES87-2DC0	80	1,25	5	7,5
6SE7021-6ES87-2DC0	40	2,5	10	15
6SE7023-2ES87-2DC0	20	5	20	30
6SE7028-0ES87-2DC0[1)]	8	12,5	50	75

1) Not suitable for 20 kW Basic Line Module

For detailed technical information on the braking resistors, see the section entitled Braking resistors (Page 577).

4.6.2.4 X21 EP terminals

Table 4- 46 X21 EP terminal / temperature sensor

	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors[1)]: KTY84-1C130[2)] / PTC[2)] / bimetallic switch with NC contact With the 20 kW and 40 kW Basic Line Modules, the temperature sensor of the braking resistor (bimetallic switch with NC contact) is connected to the temperature input. **Response thresholds** of the temperature input: Temperature at the braking resistor in the operating range → resistance value ≤ 100 ohms Overtemperature at the braking resistor → resistance value > 100 ohms **Fault reactions**: An alarm is output and the Basic Line Module is deactivated with a fault after one minute, if overtemperature is still present at the braking resistor. If there is no braking resistor, terminals 1 and 2 must be jumpered to deactivate the overtemperature.
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage 24 V DC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm²			

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

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

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Terminals X21.1 and X21.2

NOTICE

Risk of the resistor overheating if the temperature switch is not connected

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

- Connect the temperature switch.

Terminals X21.3 and X21.4



⚠WARNING

Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected

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

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

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

- Neutralize the voltage in the DC link.



⚠WARNING

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

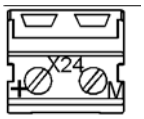
Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

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4.6.2.5 X24 24 V terminal adapter

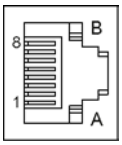
Table 4- 47 X24: 24 V terminal adapter

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

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

4.6.2.6 X200-X202 DRIVE-CLiQ interfaces

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

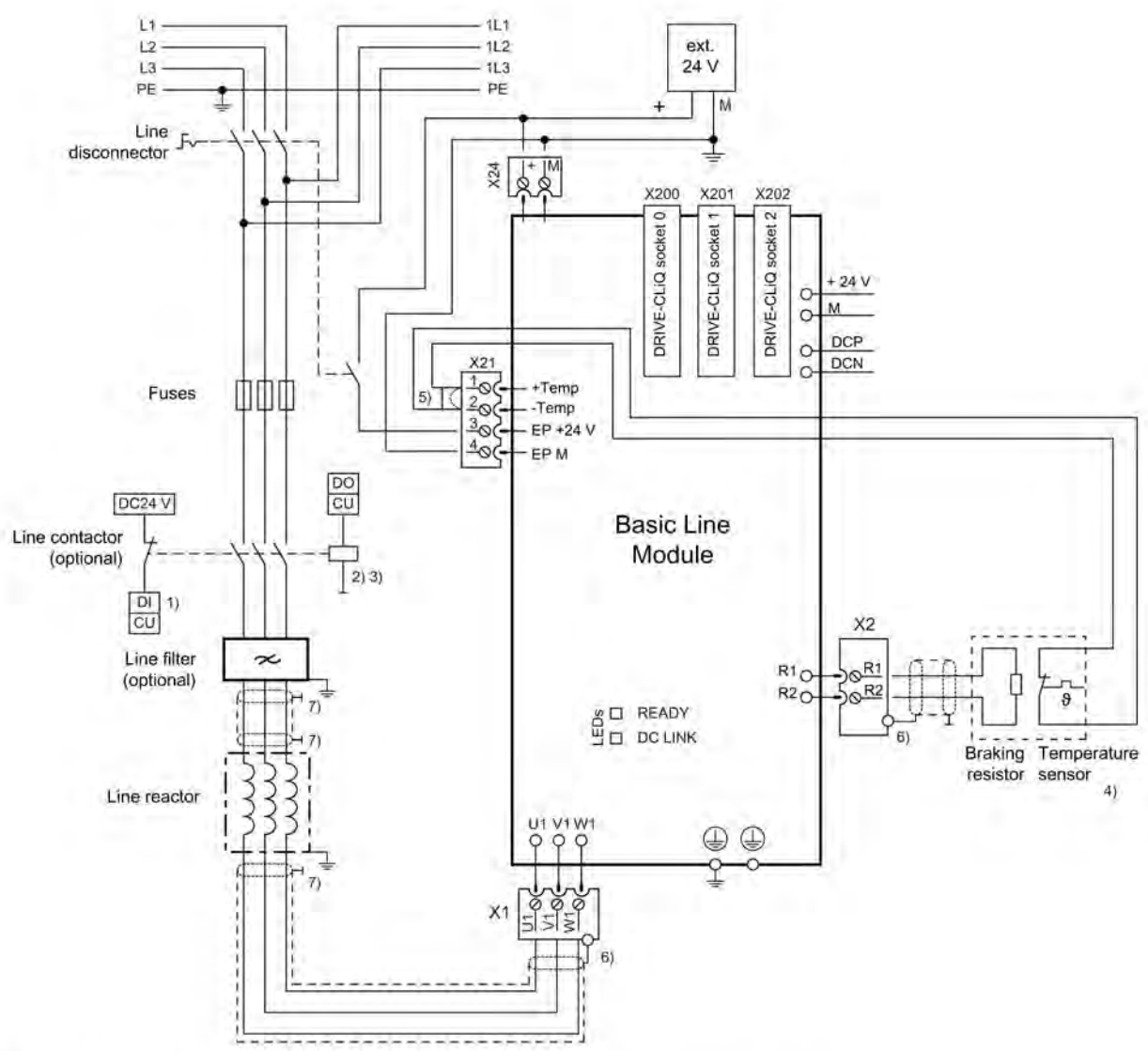
	PIN	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+(24 V)	24 V power supply
	B	M (0 V)	Electronics ground

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

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

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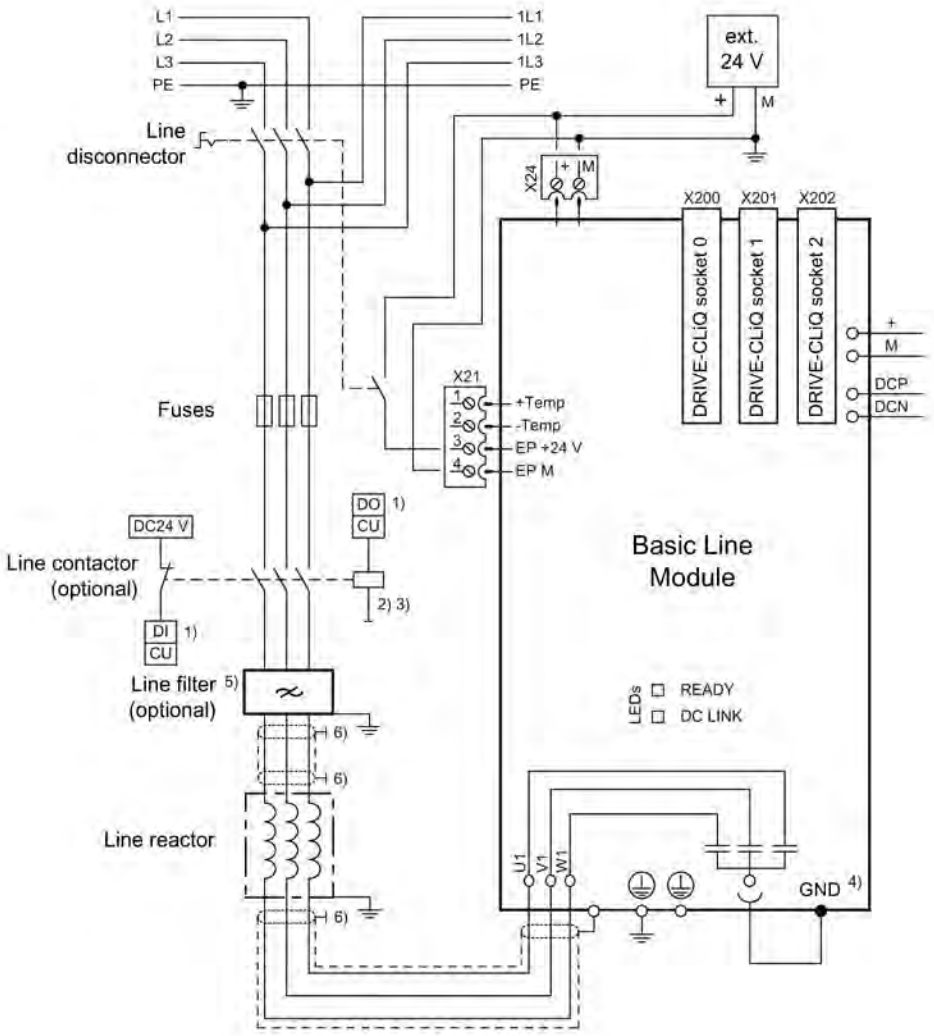
4.6.3 Connection examples



1) DI/DO, controlled from the Control Unit.
2) No additional load permitted downstream of the line contactor!
3) The current carrying capacity of the digital output (DO) must be observed; an output coupling device must be used if required.
4) When closed, the bimetallic switch with wiring must not exceed a resistance value of 100 Ohm.
5) Jumper to deactivate the temperature monitoring for the braking resistor.
6) Contact established through the connector (20 kW) or shield plate (40 kW).
7) Contact established via rear mounting panel or shield buses in accordance with the EMC installation guideline

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

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1) DI/DO, controlled from the Control Unit.
2) No additional load permitted downstream of the line contactor!
3) The current carrying capacity of the DO must be observed; an output coupling device must be used if required.
4) The connection bracket must be removed when the component is connected to an IT line supply.
5) Line filter is required so that the radio interference voltage complies with Category C2.
6) Contact established via rear mounting panel or shield buses in accordance with the EMC installation guideline

Figure 4-50 Connection example: Basic Line Module (100 kW)

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4.6.4 Meaning of LEDs

Table 4- 49 Meaning of the LEDs on the Basic Line Module

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

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



⚠ WARNING

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

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

- Observe the warning information on the component.

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4.6.5 Dimension drawings

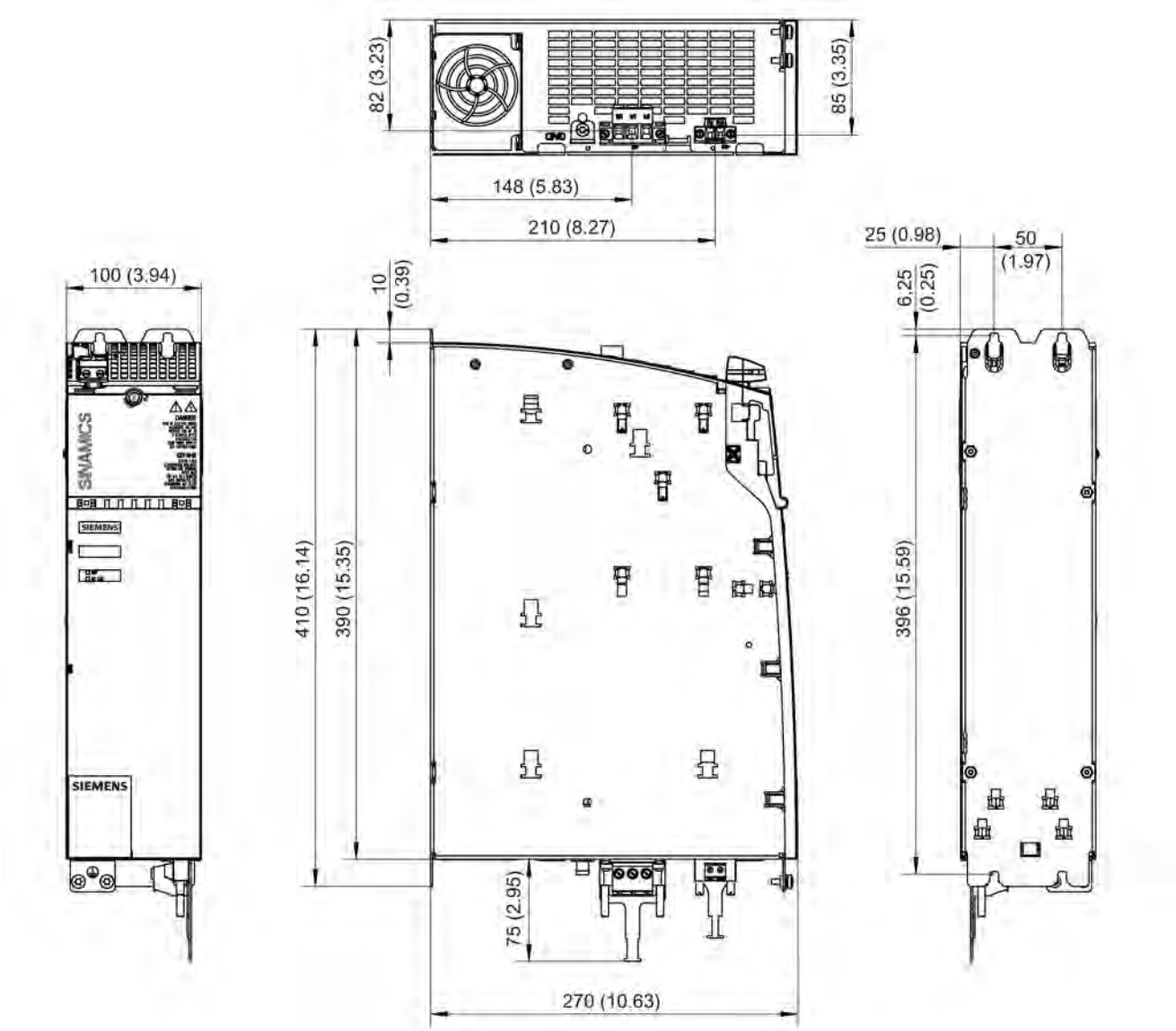


Figure 4-51 Dimension drawing of 20 kW Basic Line Module with internal air cooling, all dimensions in mm and (inches)

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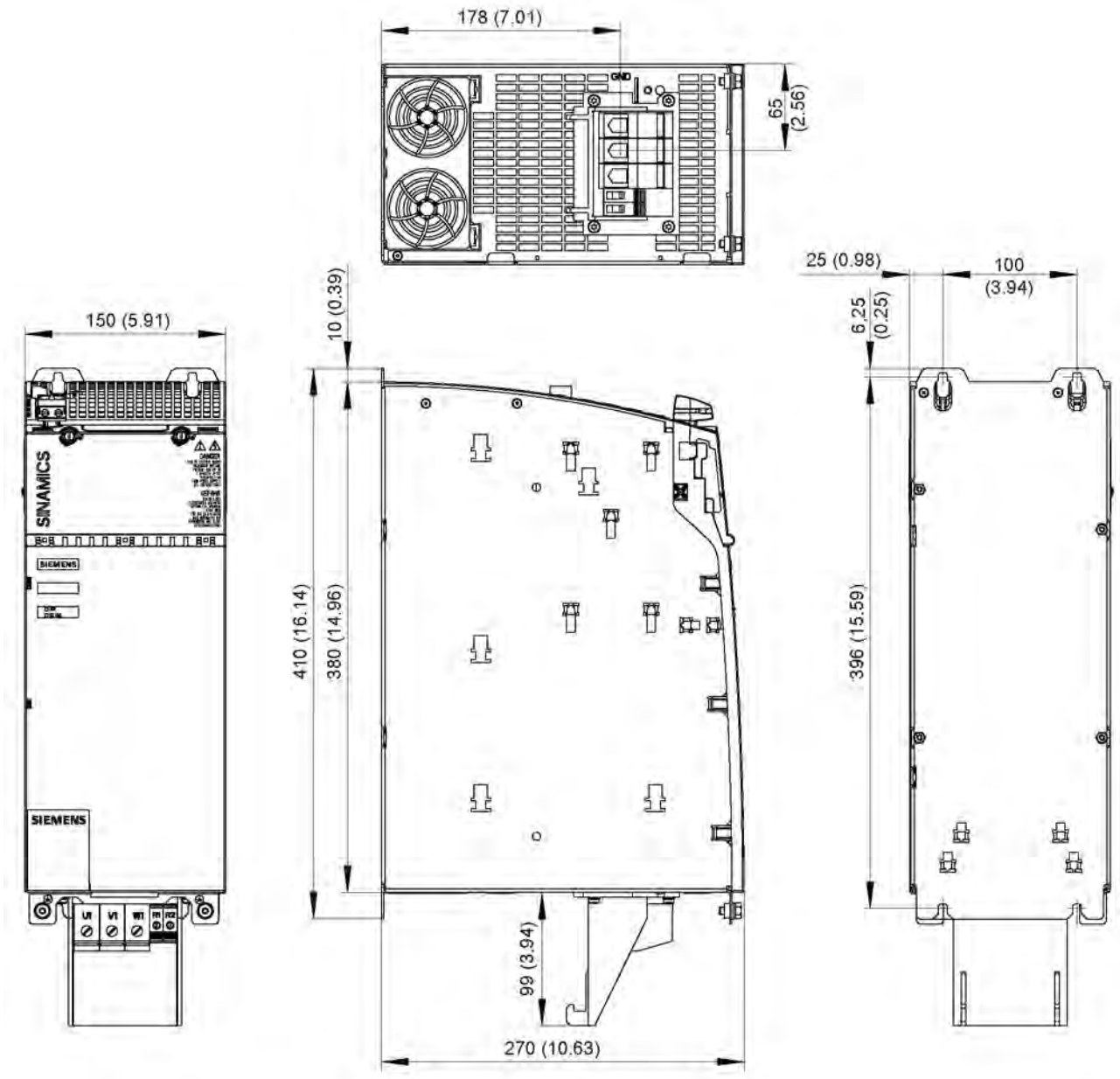


Figure 4-52 Dimension drawing of 40 kW Basic Line Module with internal air cooling, all dimensions in mm and (inches)

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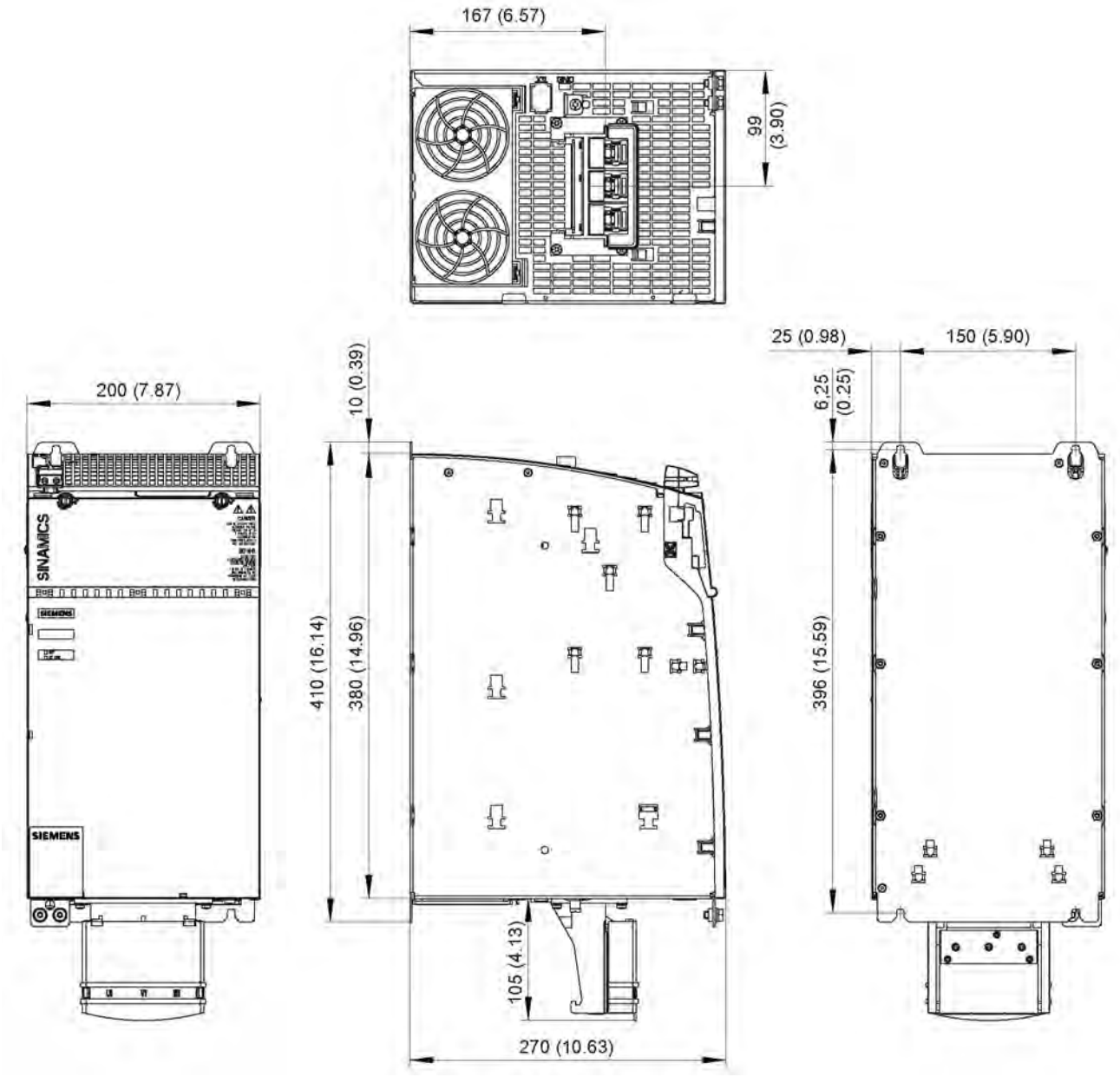
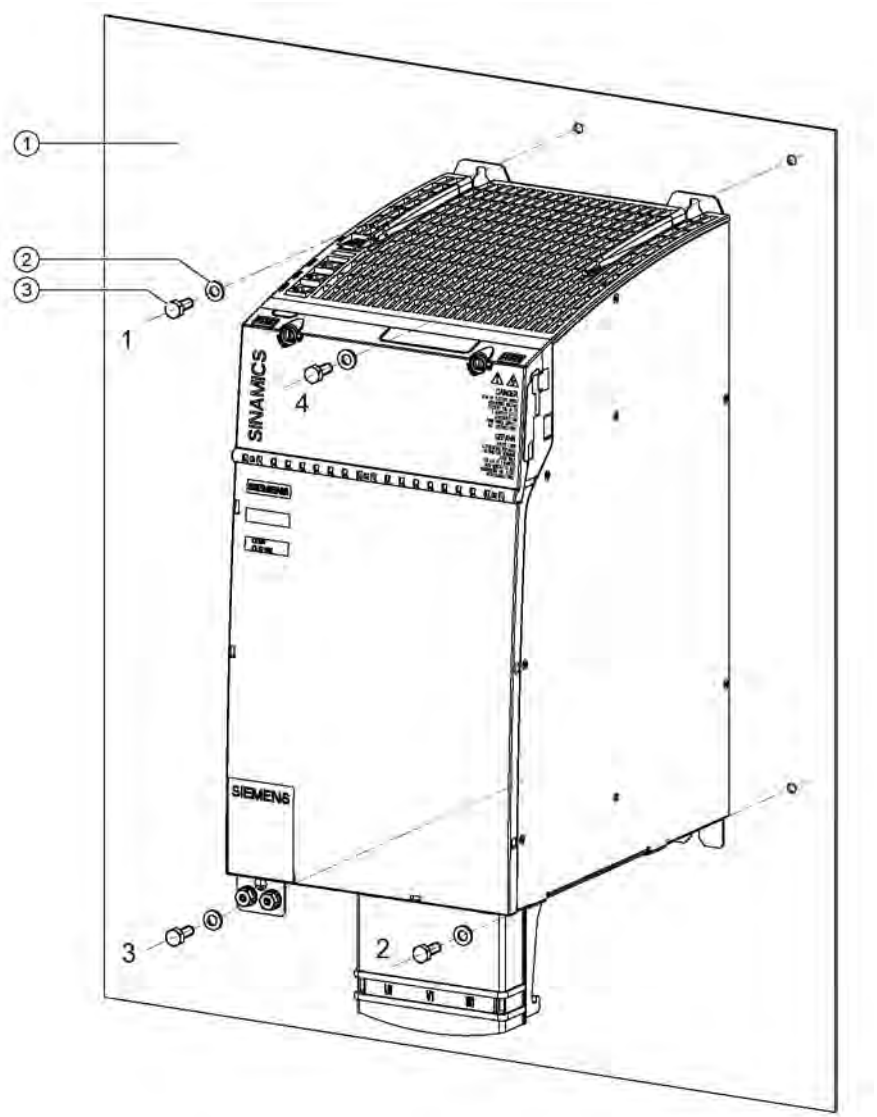


Figure 4-53 Dimension drawing of 100 kW Basic Line Module with internal air cooling, all dimensions in mm and (inches)

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4.6.6 Installation

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



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

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

Tightening torques:

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

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

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

Note

Connection bracket to the interference suppression capacitor has not been removed

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

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

Note

Installing the connection bracket for the interference-suppression capacitor

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

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4.6.8 Technical data

Table 4- 50 Technical data: Basic Line Modules

Internal air cooling	6SL3130-	1TE22-0AA0	1TE24-0AA0	1TE31-0AA0
Rated power	kW	20	40	100
Infeed				
Rated power (S1)[1]	kW (P_n)	20	40	100
Infeed power (S6 - 40 %)[1]	kW (P_{s6})	26	52	130
Peak infeed power[1]	kW (P_{max})	60	120	175
Braking power				
Continuous power	kW (P_n)	5	10	-
Peak power	kW (P_{max})	40	80	-
Supply voltages				
Line voltage	V_{ACrms}	3 AC 380 … 480 ±10 % (- 15 % < 1 min)[2]		
Line frequency	Hz	47 … 63		
Electronics power supply	V_{DC}	24 (20.4 … 28.8)		
DC link voltage	V_{DC}	480 … 720		
Overvoltage trip	V_{DC}	820 ± 2 %		
Undervoltage trip [3]	V_{DC}	360 ± 2 %		
Input currents				
Rated input current:				
for AC 400 V	A_{AC}	33	66	166
Input current:				
for AC 380 V / AC 480 V	A_{AC}	35 / 28	70 / 55	172 / 138
for AC 400 V; S6 - 40 %	A_{AC}	43	86	216
for AC 400 V; peak current	A_{AC}	100	199	290
DC link currents				
Rated DC link current:				
for 600 V	A_{DC}	33.5	67	167
DC link current:				
for 540 V	A_{DC}	37	48	185
for DC 600 V; S6 - 40 %	A_{DC}	43	87	217
for DC 600 V; peak current	A_{DC}	100	200	292
Current carrying capacity				
DC link busbars	A_{DC}	100	200	200
Reinforced DC link busbars	A_{DC}	150	--	--
24 V DC busbars	A_{DC}	20	20	20
Electronics current drawn at 24 V DC	A_{DC}	1	1.4	2.0
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	144	283.6	628
Max. ambient temperature				
without derating	° C	40	40	40
with derating	° C	55	55	55
DC link capacitance				
Basic Line Module	µF	940	1880	4100
Drive line-up, max.	µF	20000	20000	50000
Power factor[4]	cosϕ	0.98	0.98	0.98
Circuit breaker (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 51)		

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Internal air cooling	**6SL3130-**	**1TE22-0AA0**	**1TE24-0AA0**	**1TE31-0AA0**
Rated short-circuit current SCCR[5)]	kA	65	65	65
Cooling method (internal air cooling)		Internal fan		
Sound pressure level	dB(A)	< 60	< 65	< 65
Cooling air requirement	m^3/h	56	112	180
Max. permissible heat sink temperature	° C	65	70	70
Rated voltage for rated data 3 AC 380 V				
Weight	kg	6.8	11.3	15.8

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

2) Can also be operated on supply systems with 200 ... 240 V 3 AC ±10 % with appropriate parameterization and reduced power.

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

4) Only the fundamental component

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

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4.6.8.1 Characteristics

Rated duty cycles for Basic Line Modules

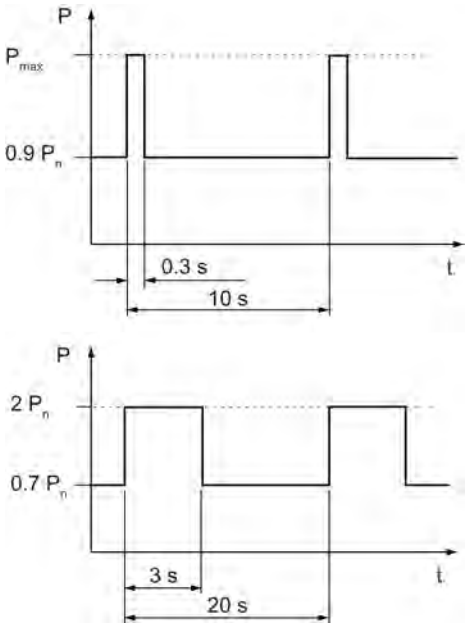


Figure 4-55 Duty cycles with initial load

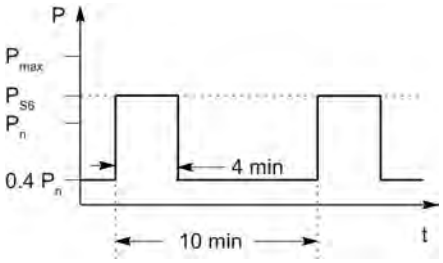


Figure 4-56 S6 duty cycle with pre-load condition

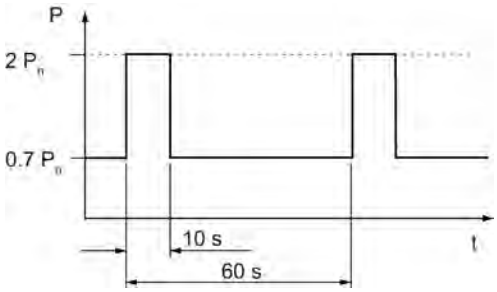


Figure 4-57 Duty cycle with pre-load condition for 20 kW and 40 kW Basic Line Modules

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Braking duty cycle for Basic Line Modules

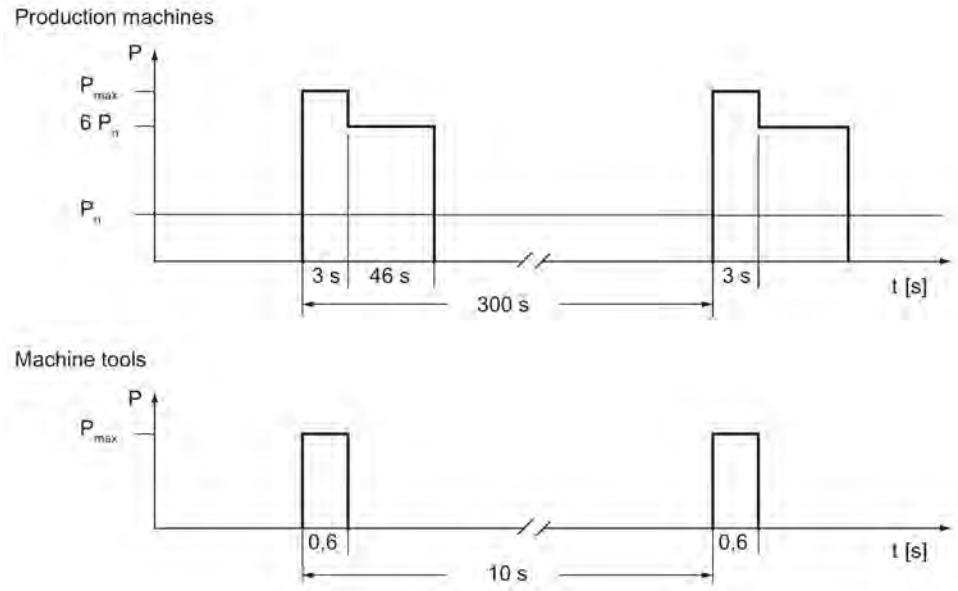


Figure 4-58 Braking duty cycle for Basic Line Modules

Derating characteristics

Note

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

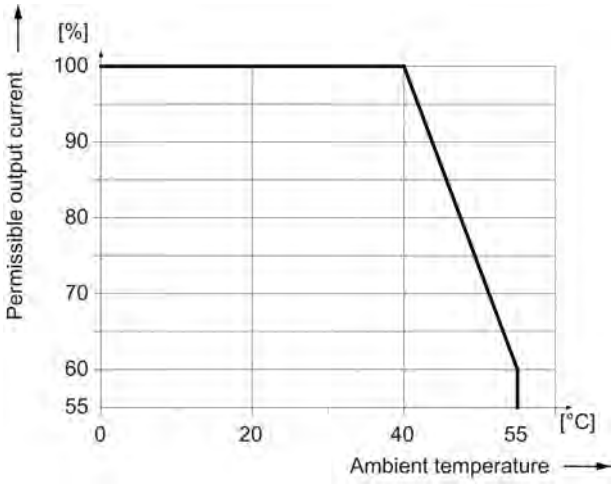


Figure 4-59 Output current as a function of the ambient temperature

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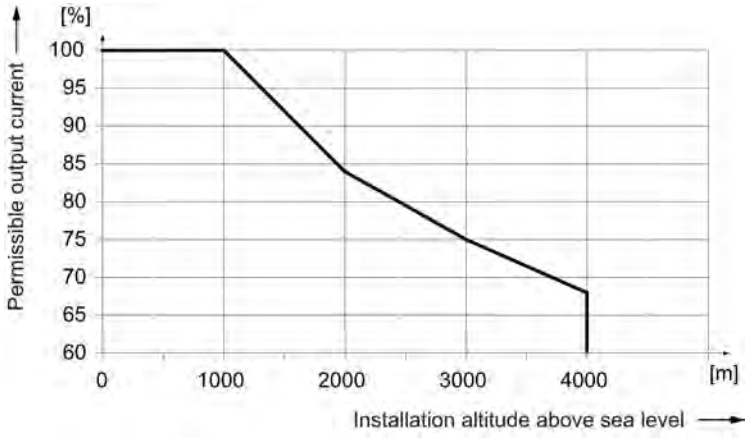


Figure 4-60 Output current as a function of the installation altitude

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4.7 Basic Line Modules with cold plate

4.7.1 Description

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

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

For 100 kW Basic Line Modules, an external braking unit is required for degradation of energy. Either Braking Modules Booksize Compact (also in a parallel connection) or a MASTERDRIVES braking unit (see Chapter "Braking units for 100 kW Basic Line Modules (Page 544)") can be used.

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

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

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

The maximum total cable length is as follows:

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

WARNING

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

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

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

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4.7.2 Interface description

4.7.2.1 Overview

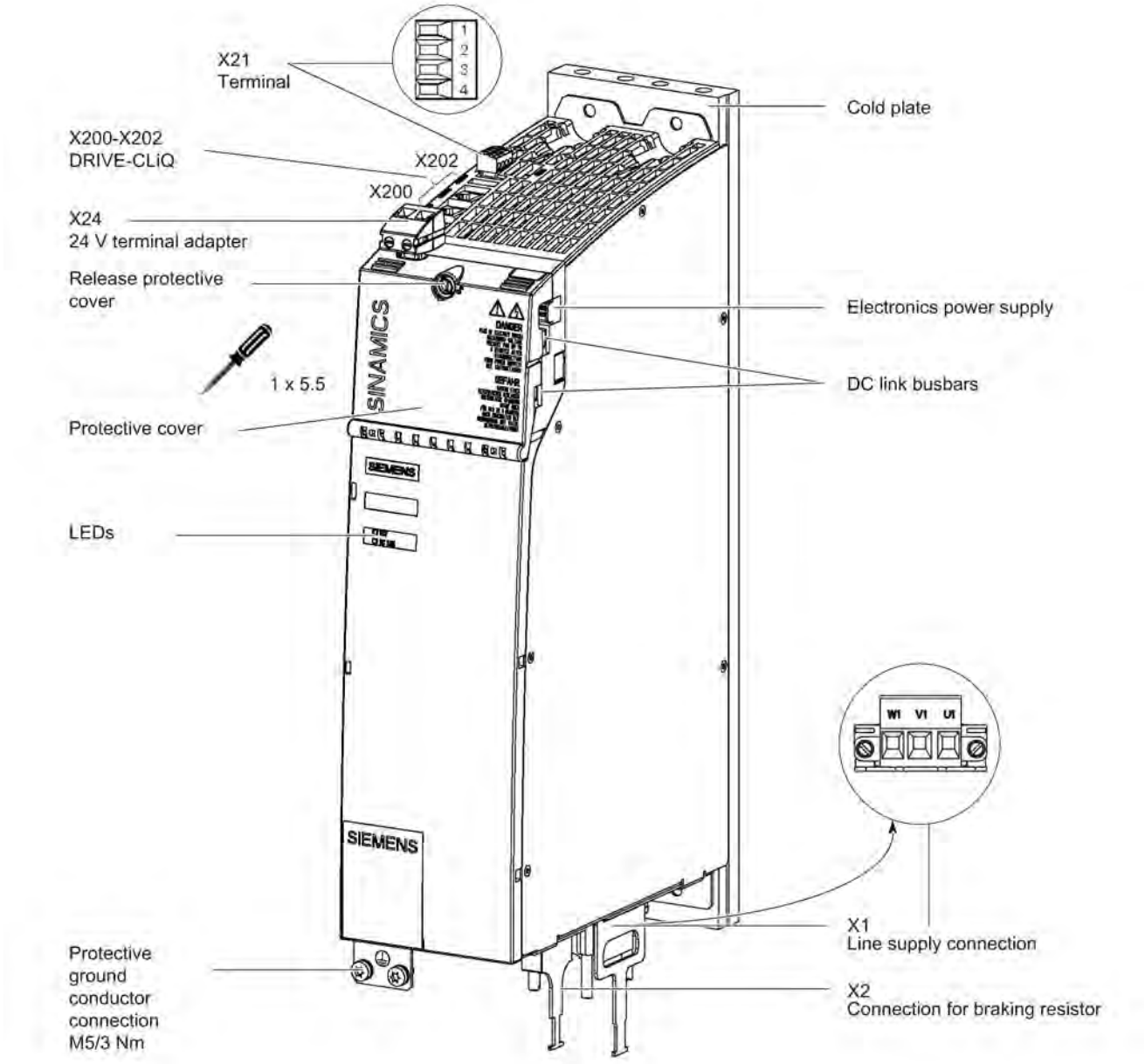
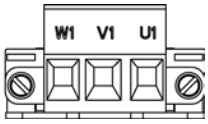
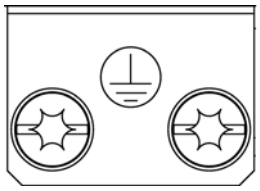


Figure 4-61 Interface overview, Basic Line Module with cold plate (example: 20 kW)

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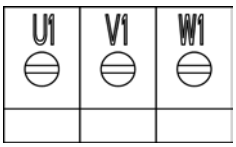
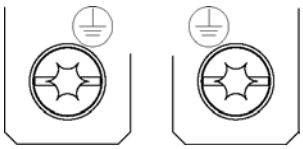
4.7.2.2 X1 line connection

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

	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 … 480 V, 50 / 60 Hz Max. connectable cross-section: 16 mm² Type: Screw terminal 7 (Page 755) Tightening torque: 1.5 … 1.7 Nm
	PE connection	Threaded hole M5 / 3 Nm[1]

1) For ring cable lugs without insulation

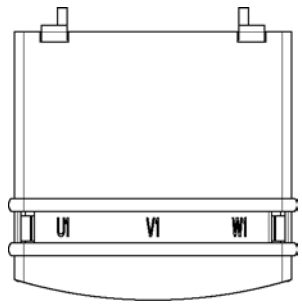
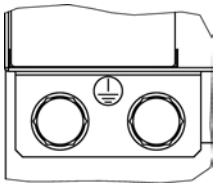
Table 4- 52 X1: Line supply connection for Basic Line Modules 40 kW

	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 … 480 V, 50 / 60 Hz Max. connectable cross-section, 50 mm², end sleeves Tightening torque, min. 6 Nm
	PE connection	Threaded hole M6 / 6 Nm[1)]

1) For ring cable lugs without insulation

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

	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 … 480 V, 50 / 60 Hz Type: Threaded bolts M8[1)] Max. connectable cross-section: 120 mm² Tightening torque: 13 Nm
	PE connection	Threaded hole M6 / 6 Nm[1)]

1) For ring cable lugs without insulation

4.7.2.3 X2 braking resistor connection

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

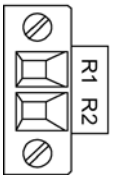
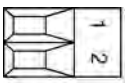
	Terminal	Designation	Technical data
	1	Braking resistor connection R1	Type: Screw terminal 4 (Page 755) Max. cross-section that can be connected: 4 mm² Tightening torque: 0.5 … 0.6 Nm
	2	Braking resistor connection R2	

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

	Terminal	Designation	Technical data
	1	Braking resistor connection R1	Type: Screw terminal 6 (Page 755) Max. cross-section that can be connected: 10 mm² Tightening torque: min 1.5 ... 1.8 Nm
	2	Braking resistor connection R2	

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

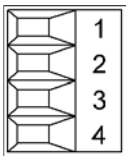
Braking resistor	R in Ω	P_N in kW	4 x P_N in kW	P_{max} in kW
6SE7018-0ES87-2DC0	80	1,25	5	7,5
6SE7021-6ES87-2DC0	40	2,5	10	15
6SE7023-2ES87-2DC0	20	5	20	30
6SE7028-0ES87-2DC0[1)]	8	12,5	50	75

1) Not suitable for 20 kW Basic Line Module

For detailed technical information on the braking resistors, see the section entitled Braking resistors (Page 577).

4.7.2.4 X21 EP terminals

Table 4- 57 X21 EP terminal / temperature sensor

	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors[1)]: KTY84-1C130[2)] / PTC[2)] / bimetallic switch with NC contact With the 20 kW and 40 kW Basic Line Modules, the temperature sensor of the braking resistor (bimetallic switch with NC contact) is connected to the temperature input. **Response thresholds** of the temperature input: Temperature at the braking resistor in the operating range → resistance value ≤ 100 ohms Overtemperature at the braking resistor → resistance value > 100 ohms **Fault reactions**: An alarm is output and the Basic Line Module is deactivated with a fault after one minute, if overtemperature is still present at the braking resistor. If there is no braking resistor, terminals 1 and 2 must be jumpered to deactivate the overtemperature.
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage 24 V DC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm^2			

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

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

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Terminals X21.1 and X21.2

NOTICE

Risk of the resistor overheating if the temperature switch is not connected

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

- Connect the temperature switch.

Terminals X21.3 and X21.4



⚠WARNING

Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected

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

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

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

- Neutralize the voltage in the DC link.



⚠WARNING

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

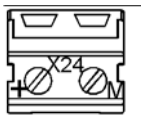
Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

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4.7.2.5 X24 24 V terminal adapter

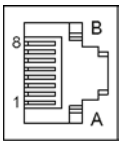
Table 4- 58 X24: 24 V terminal adapter

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

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

4.7.2.6 X200-X202 DRIVE-CLiQ interfaces

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

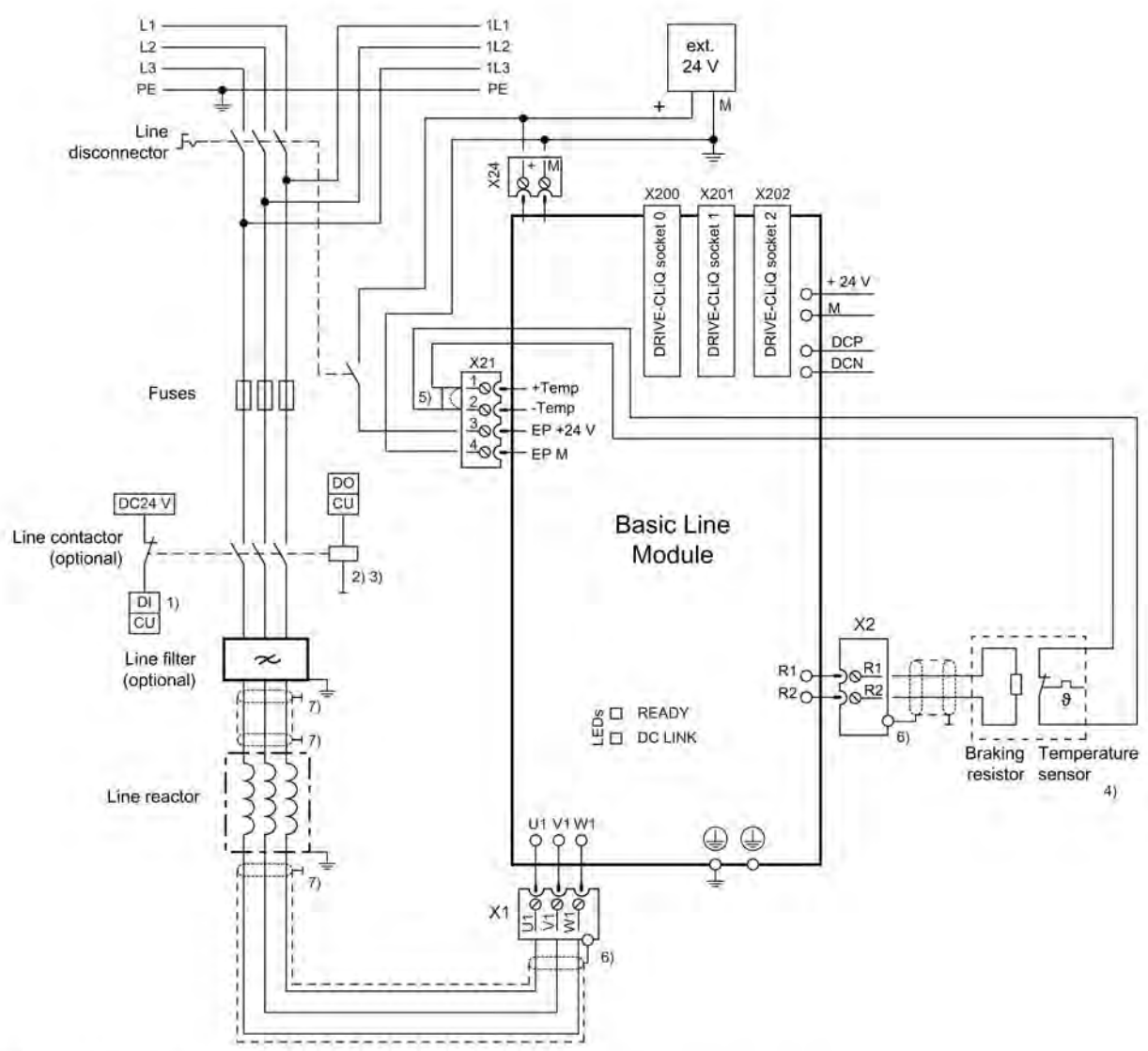
	PIN	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+(24 V)	24 V power supply
	B	M (0 V)	Electronics ground

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

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

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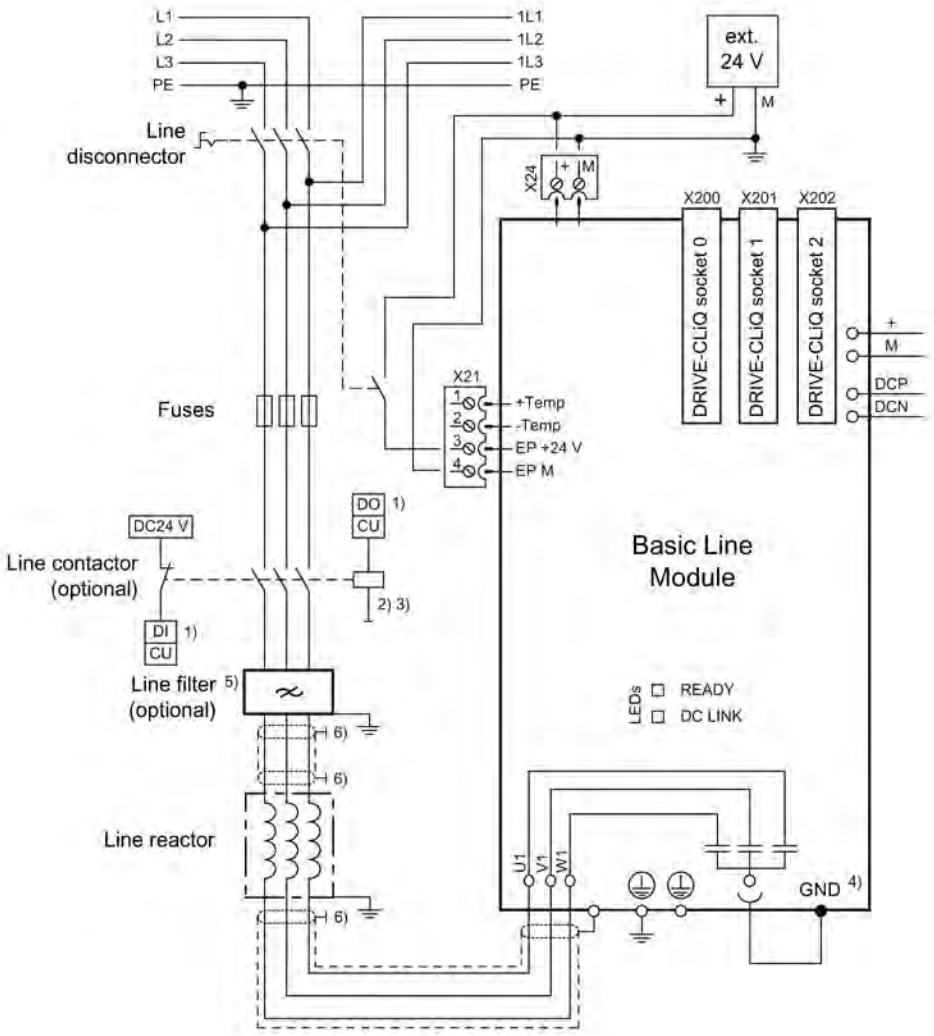
4.7.3 Connection examples



1) DI/DO, controlled from the Control Unit.
2) No additional load permitted downstream of the line contactor!
3) The current carrying capacity of the digital output (DO) must be observed; an output coupling device must be used if required.
4) When closed, the bimetallic switch with wiring must not exceed a resistance value of 100 Ohm.
5) Jumper to deactivate the temperature monitoring for the braking resistor.
6) Contact established through the connector (20 kW) or shield plate (40 kW).
7) Contact established via rear mounting panel or shield buses in accordance with the EMC installation guideline

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

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1) DI/DO, controlled from the Control Unit.
2) No additional load permitted downstream of the line contactor!
3) The current carrying capacity of the DO must be observed; an output coupling device must be used if required.
4) The connection bracket must be removed when the component is connected to an IT line supply.
5) Line filter is required so that the radio interference voltage complies with Category C2.
6) Contact established via rear mounting panel or shield buses in accordance with the EMC installation guideline

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

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4.7.4 Meaning of LEDs

Table 4- 60 Meaning of the LEDs on the Basic Line Module

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

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



⚠ WARNING

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

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

- Observe the warning information on the component.

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4.7.5 Dimension drawings

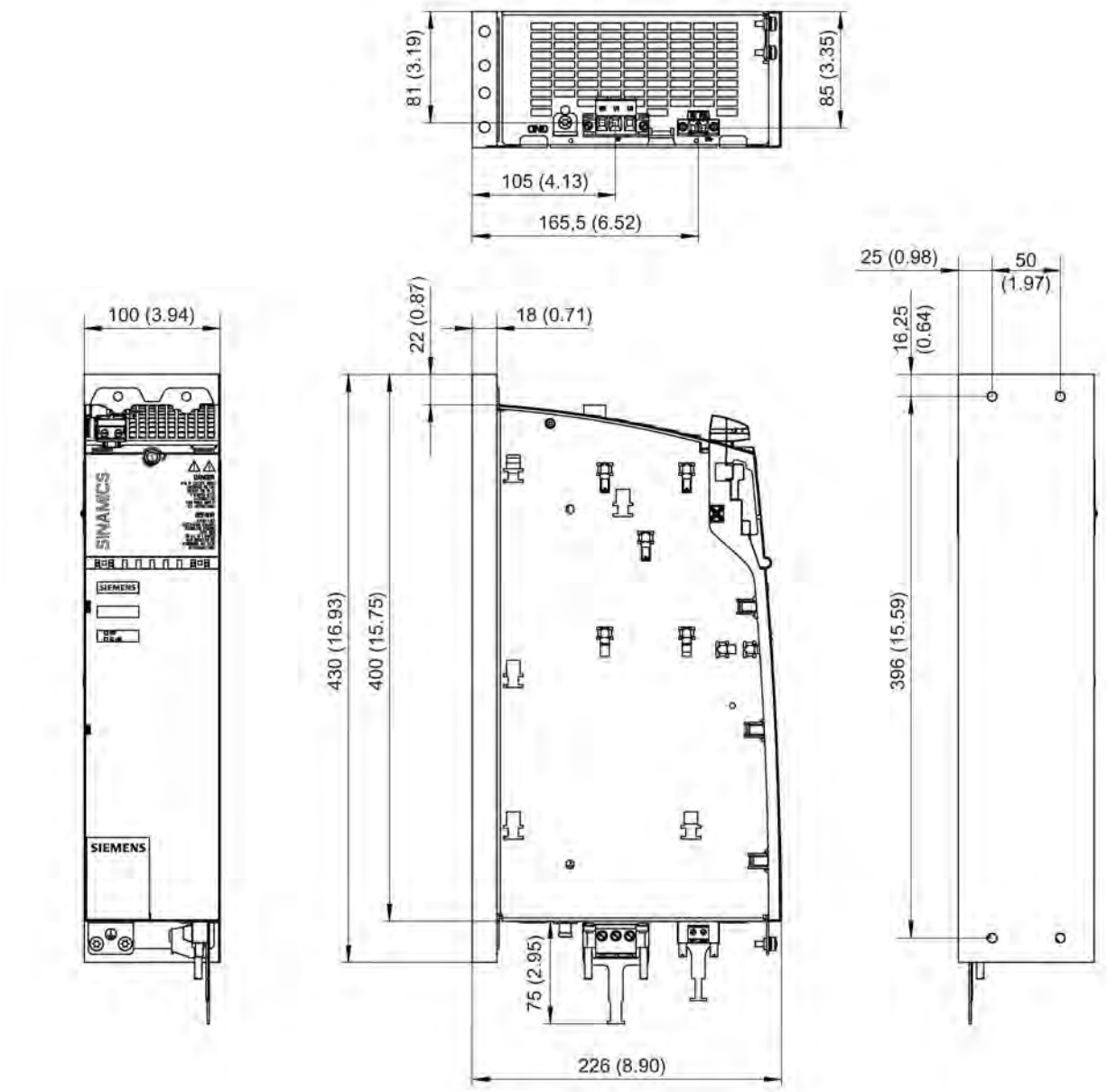


Figure 4-64 Dimension drawing of 20 kW Basic Line Module with cold plate, all dimensions in mm and (inches)

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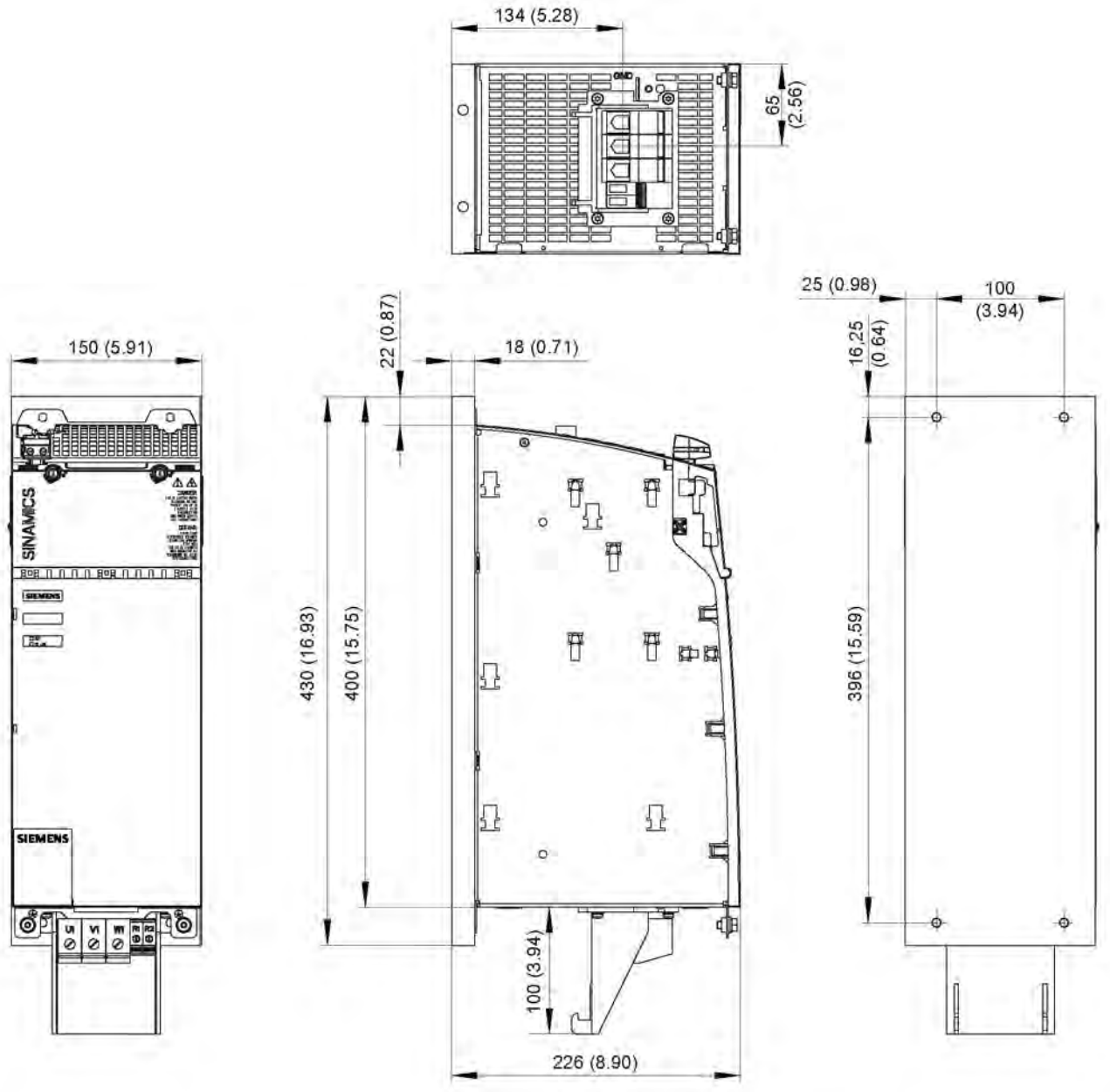


Figure 4-65 Dimension drawing of 40 kW Basic Line Module with cold plate, all dimensions in mm and (inches)

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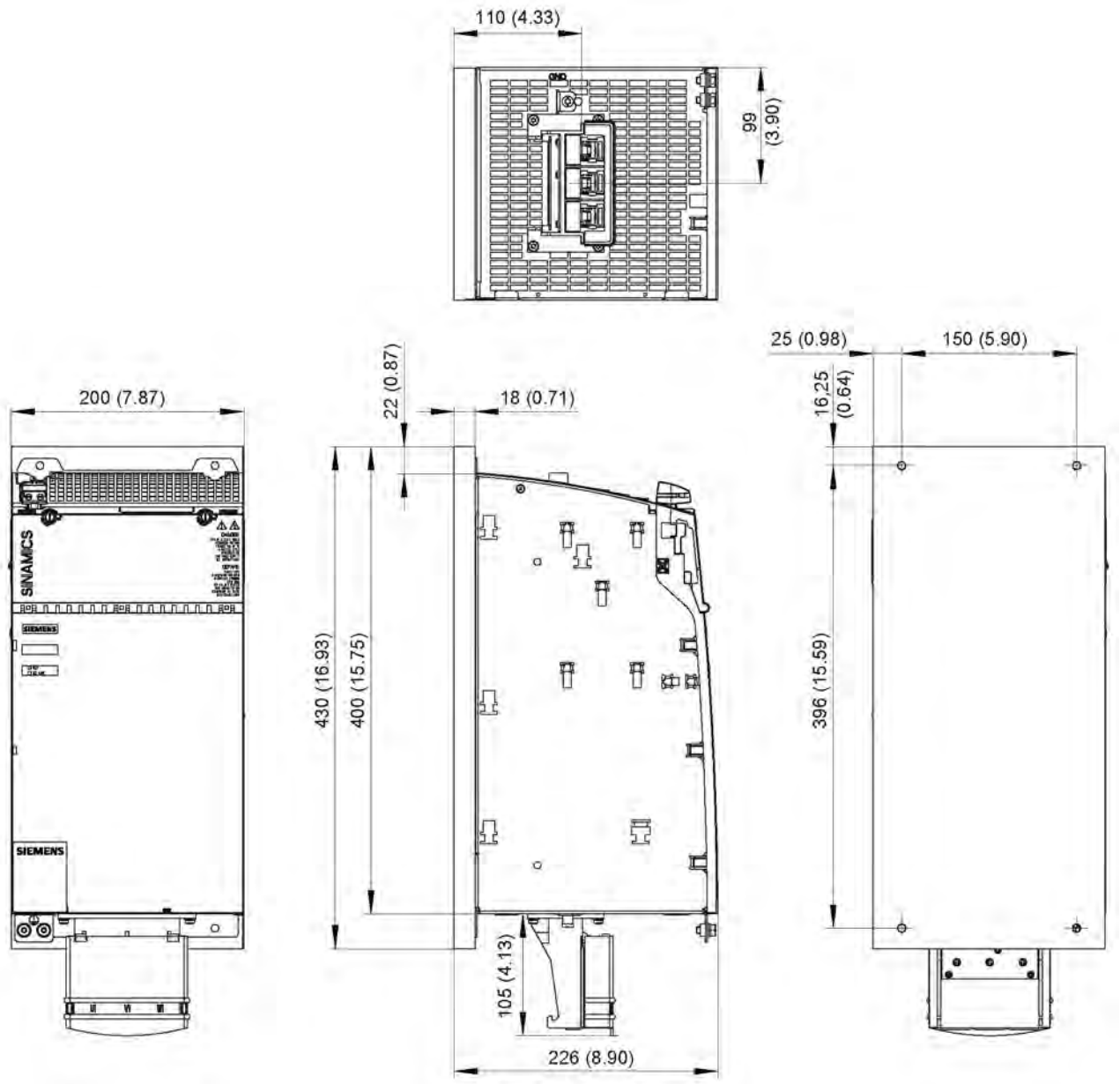


Figure 4-66 Dimension drawing of 100 kW Basic Line Module with cold plate, all dimensions in mm and (inches)

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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.

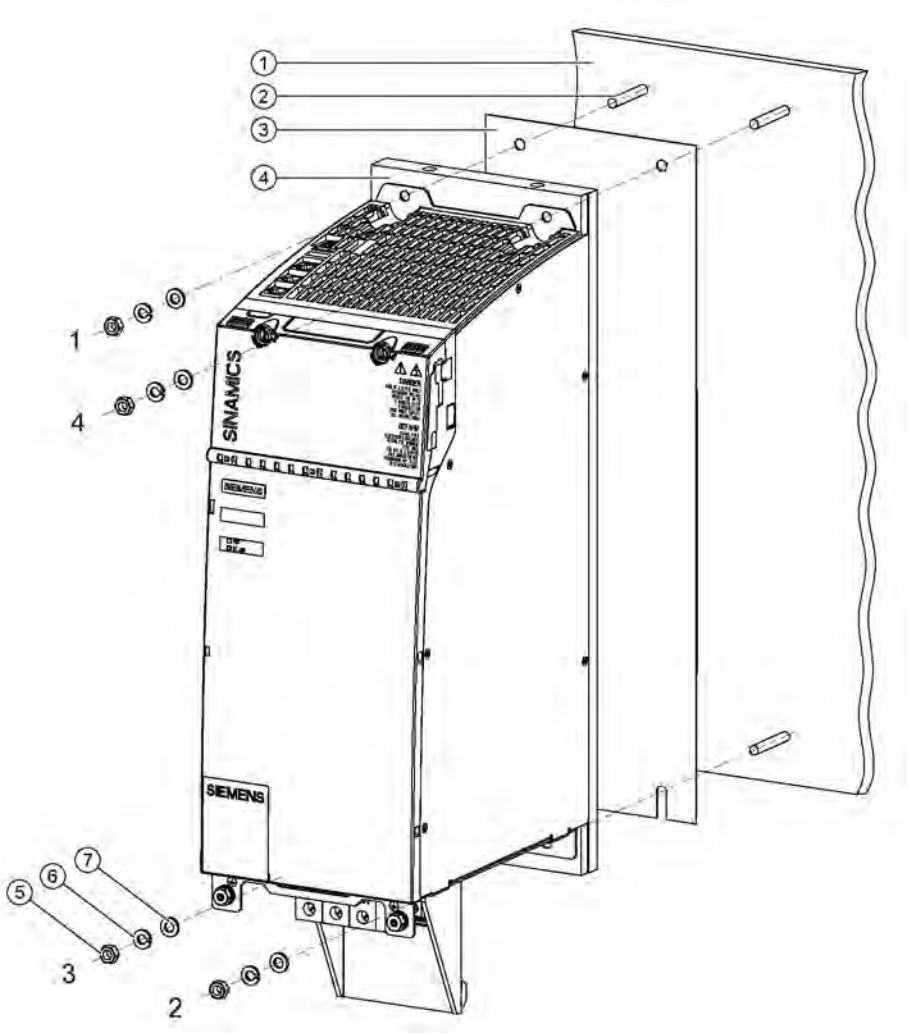
Table 4- 61 Overview of heat-conducting foils

	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.

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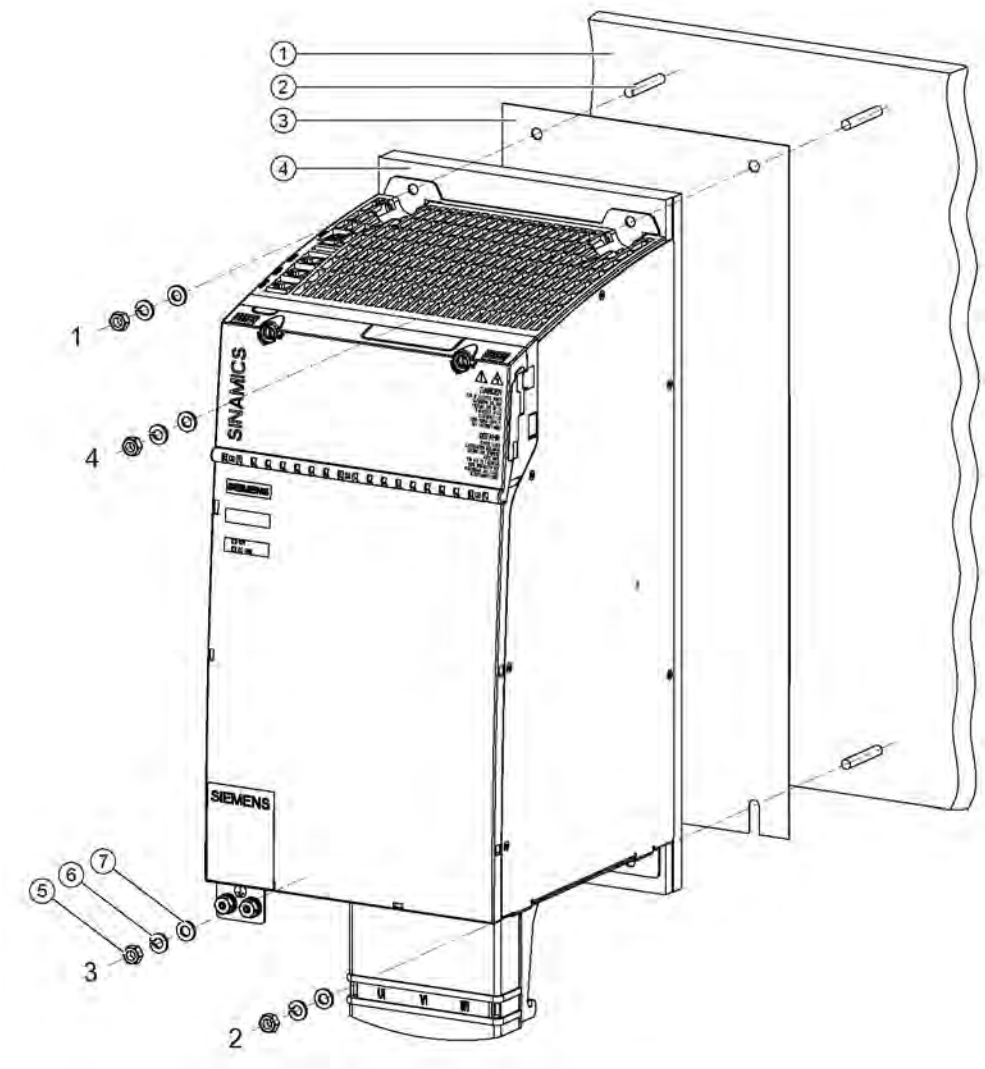
① External heat sink
② M6 studs
③ Heat-conducting foil
④ Cold plate
⑤ M6 nut
⑥ Spring washer
⑦ Washer

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

Tightening torques:

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

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

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

Tightening torques:

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

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Help with the mechanical control cabinet design is available from:

Siemens AG
Industry Sector, IA DT MC MF - WKC AS
TCCCC (Technical Competence Center Cabinets Chemnitz)
Postfach 1124
09070 Chemnitz, Germany

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

Properties of the heat sink

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

Note

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

NOTICE

Damage to the cold plate caused by incorrect mounting

The screw bolts can be damaged when mounting the cold plate.

- Do not damage the cold plate.

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

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

Note

Connection bracket to the interference suppression capacitor has not been removed

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

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

Note

Installing the connection bracket for the interference-suppression capacitor

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

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4.7.8 Technical data

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

	6SL3136-	1TE22-0AA0	1TE24-0AA0	1TE31-0AA0
Rated power	**kW**	**20**	**40**	**100**
Infeed				
Rated power (S1)[1]	kW (P_n)	20	40	100
Infeed power (S6 - 40 %)[1]	kW (P_{S6})	26	52	130
Peak infeed power[1]	kW (P_{max})	60	120	175
Braking power				
Continuous power	kW (P_n)	5	10	-
Peak power	kW (P_{max})	40	80	-
Supply voltages				
Line voltage	V_{ACrms}	3 AC 380 … 480 ± 10 % (-15 % < 1 min)		
Line frequency	Hz	47 … 63		
Electronics power supply	V_{DC}	24 (20.4 … 28.8)		
DC link voltage	V_{DC}	510 … 720		
Overvoltage trip	V_{DC}	820 ± 2 %		
Undervoltage trip [2]	V_{DC}	360 ± 2 %		
Rated input currents				
at AC 380 V	A_{AC}	34,5	69	172
at AC 480 V / AC 528 V	A_{AC}	31 / 29	62 / 58	154 / 145
at 480 V; S6 - 40 %	A_{AC}	38	78	193
Peak current				
at AC 400 V / AC 480 V)	A_{AC}	113 / 91	208 / 172	265 / 252
DC link currents				
Rated DC link current:				
for 600 V	A_{DC}	33,5	67	167
DC link current:				
for 540 V	A_{DC}	37	48	185
for DC 600 V; S6 - 40 %	A_{DC}	43	87	217
for DC 600 V; peak current	A_{DC}	100	200	292
Current carrying capacity				
DC link busbars	A_{ACrms}	100	200	200
Reinforced DC link busbars	A_{ACrms}	150	--	--
24 V DC busbars	A_{ACrms}	20	20	20
Electronics current drawn				
at 24 V DC	A_{DC}	0,9	1,1	1,6
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	141,6	276,4	618,4
DC link capacitance				
Basic Line Module	µF	940	1880	4100
Drive line-up, max.	µF	20000	20000	20000
Power factor[3]	cosϕ	Approx. 0.98		
Circuit breaker (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 51)		
Rated short-circuit current SCCR[4]	kA	65	65	65

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

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

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

3) Only the fundamental component

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

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4.7.8.1 Characteristics

Rated duty cycles for Basic Line Modules

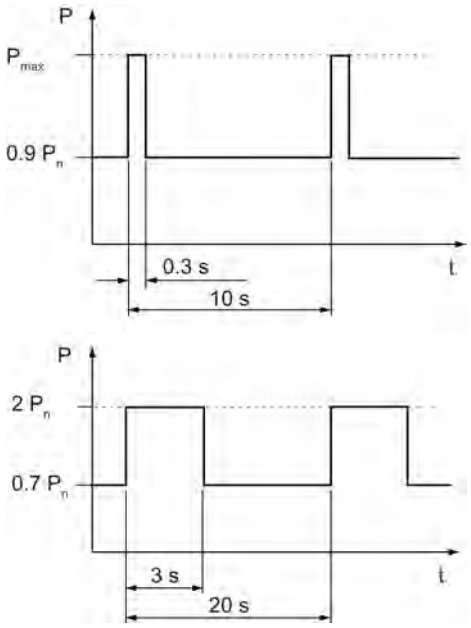


Figure 4-69 Duty cycles with initial load

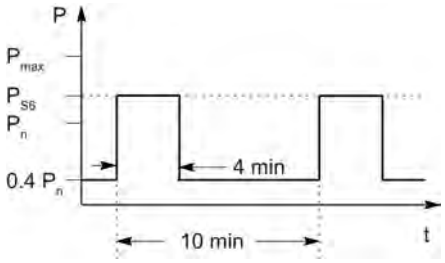


Figure 4-70 S6 duty cycle with pre-load condition

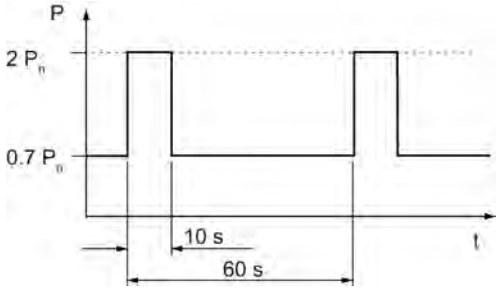


Figure 4-71 Duty cycle with pre-load condition for 20 kW and 40 kW Basic Line Modules

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Braking duty cycle for Basic Line Modules

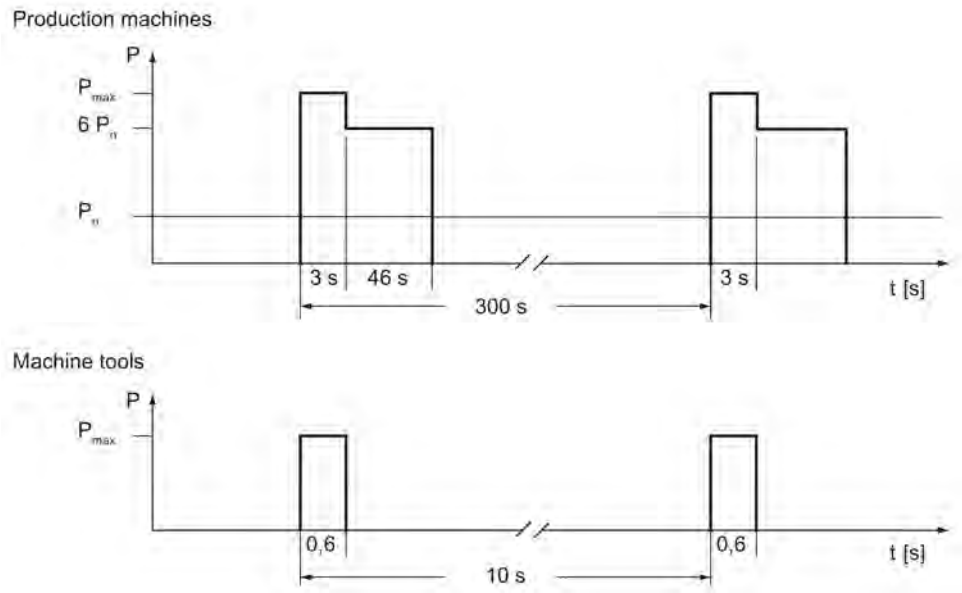


Figure 4-72 Braking duty cycle for Basic Line Modules

Derating characteristics

Note

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

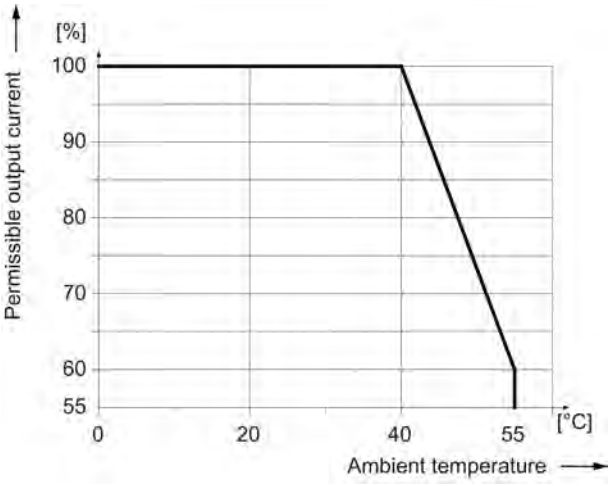


Figure 4-73 Output current as a function of the ambient temperature

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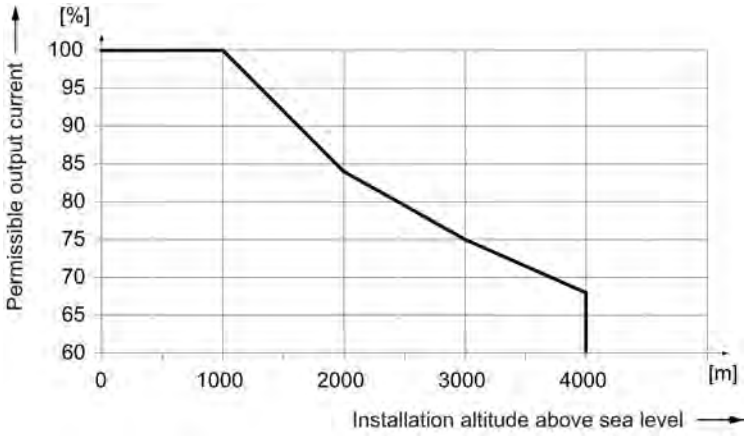


Figure 4-74 Output current as a function of the installation altitude

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4.8 Smart Line Modules with internal air cooling

4.8.1 Description

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

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

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

Smart Line Modules are suitable for direct operation on TN, IT and TT systems. The Line Modules have an integrated overvoltage protection function.

4.8.2 Safety instructions for Smart Line Modules Booksize

⚠ WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

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NOTICE

Destruction of the Smart Line Module for an incorrect switch-on or switch-off sequence

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair.

- Observe the "Ready" signal at output terminal X21.1:

  Switch on:
  - 24 V DC supply X24 ON
  - Line contactor ON
  - EP signal X21.3 and X21.4 ON
  - Wait until precharging has been completed
  - "Ready" signal at terminal X21.1 switched to high
  - Infeed is ready, pulse enable possible for motors

  Switch off:
  - Shut drives down
  - Cancel pulse enable for motors (OFF1 signal)
  - EP signal X21.3 and X21.4 OFF
  - Line contactor OFF
  - 24 V DC supply X24 OFF

  Overload:
  - "Prewarning" signal at terminal X21.2 switches to low
  - Shut drives down via the control system
  - "Ready" signal at terminal X21.1 switches to low
  - Pulse inhibit for all the drives supplied by this infeed within 4 ms

Note

Connected to the public low-voltage network

Smart Line Modules have been designed for use in the industrial environment and generate current harmonics on the line side as a result of the rectifier circuit.

When connecting a machine with integrated Smart Line Modules to the public low-voltage line supply (grid), authorization is required in advance from the local power supply company (utility company) in the following cases:

- The rated current of the motor ≤ 16 A per conductor.
- The rated motor current does not comply with the requirements specified in EN 61000-3-2 regarding current harmonics.

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4.8.3 Interface description

4.8.3.1 Overview

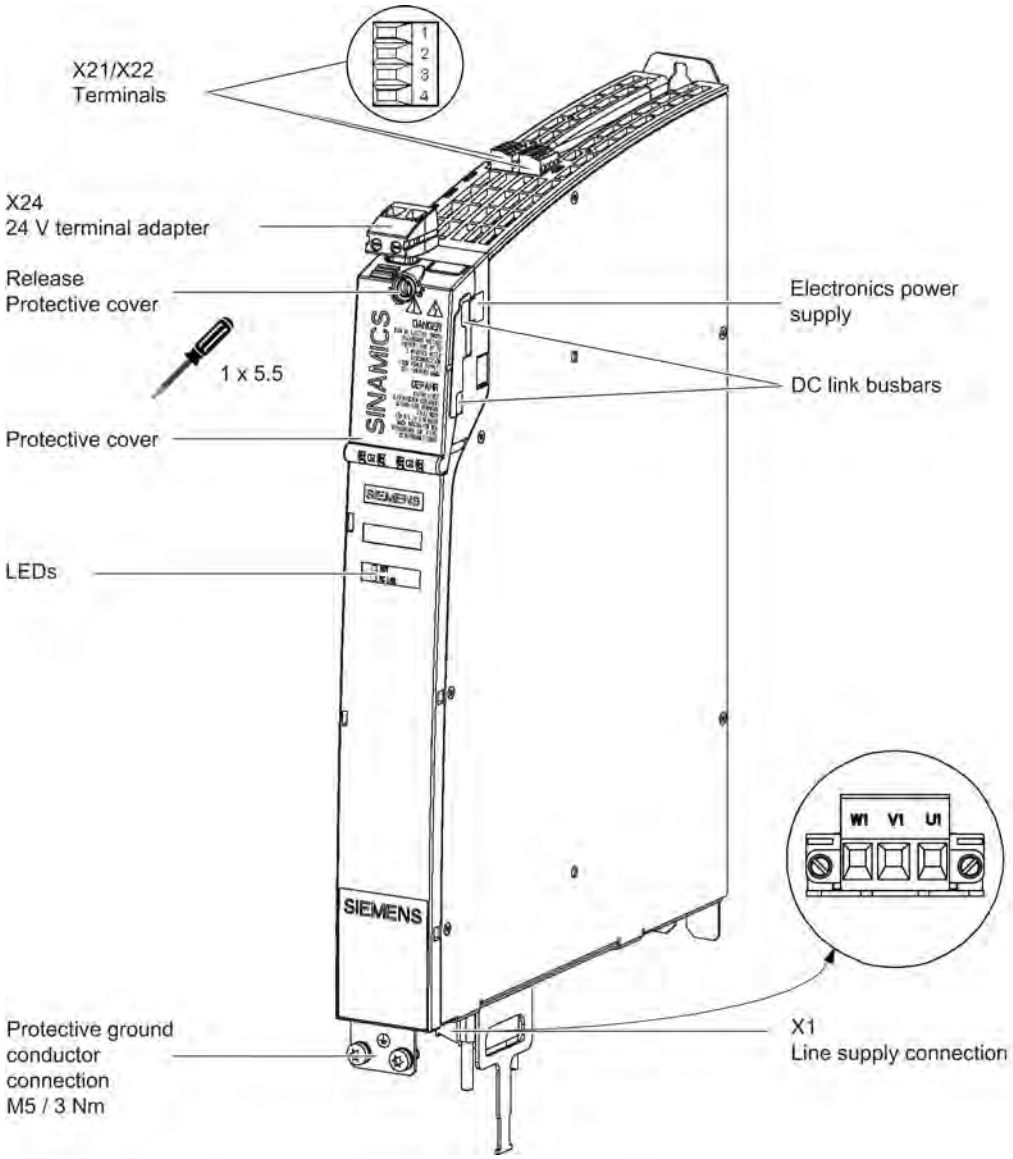


Figure 4-75 Interface overview, 5 kW and 10 kW Smart Line Modules with internal air cooling (example: 5 kW)

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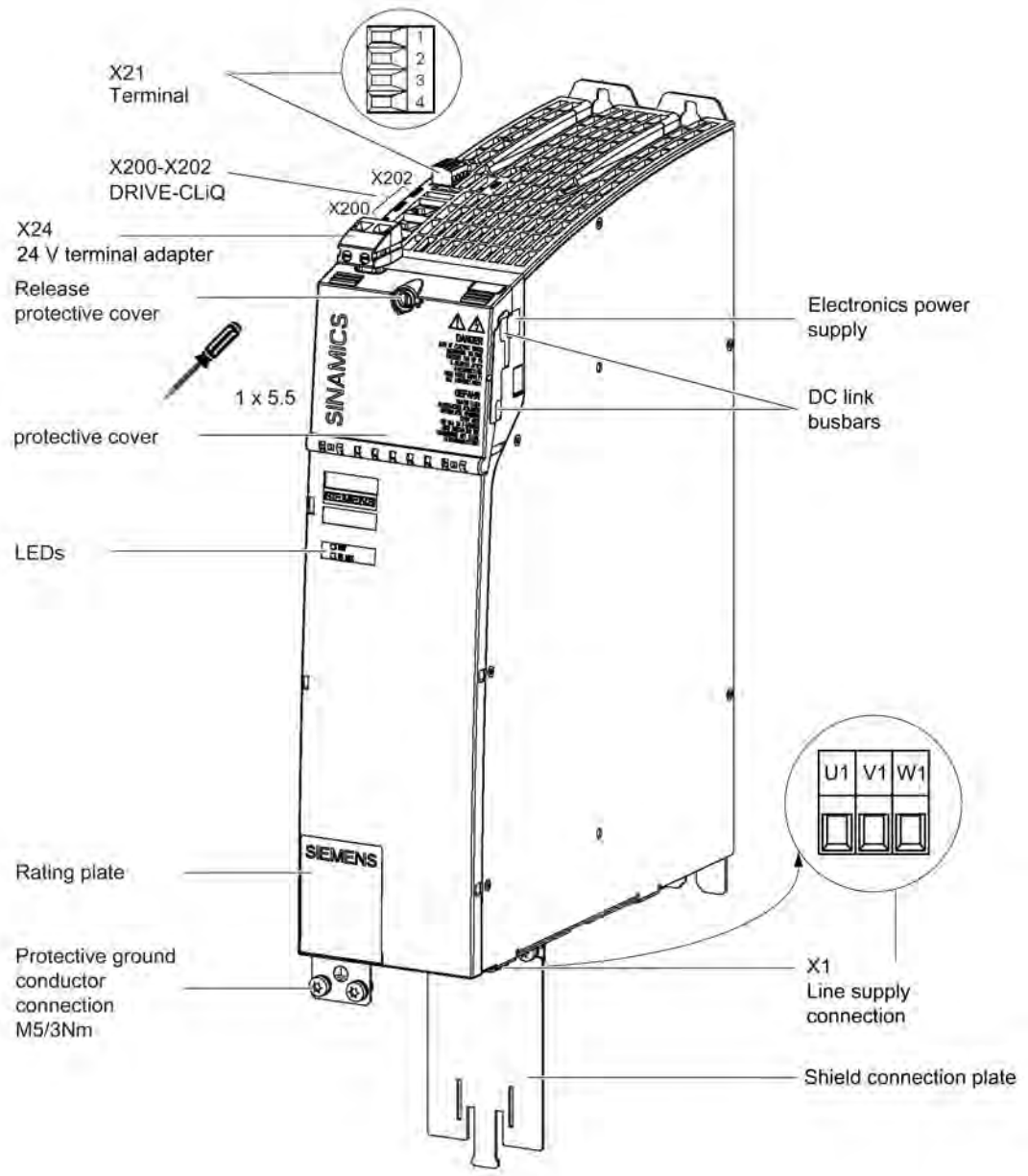


Figure 4-76 Interface overview, 16 kW Smart Line Module with internal air cooling

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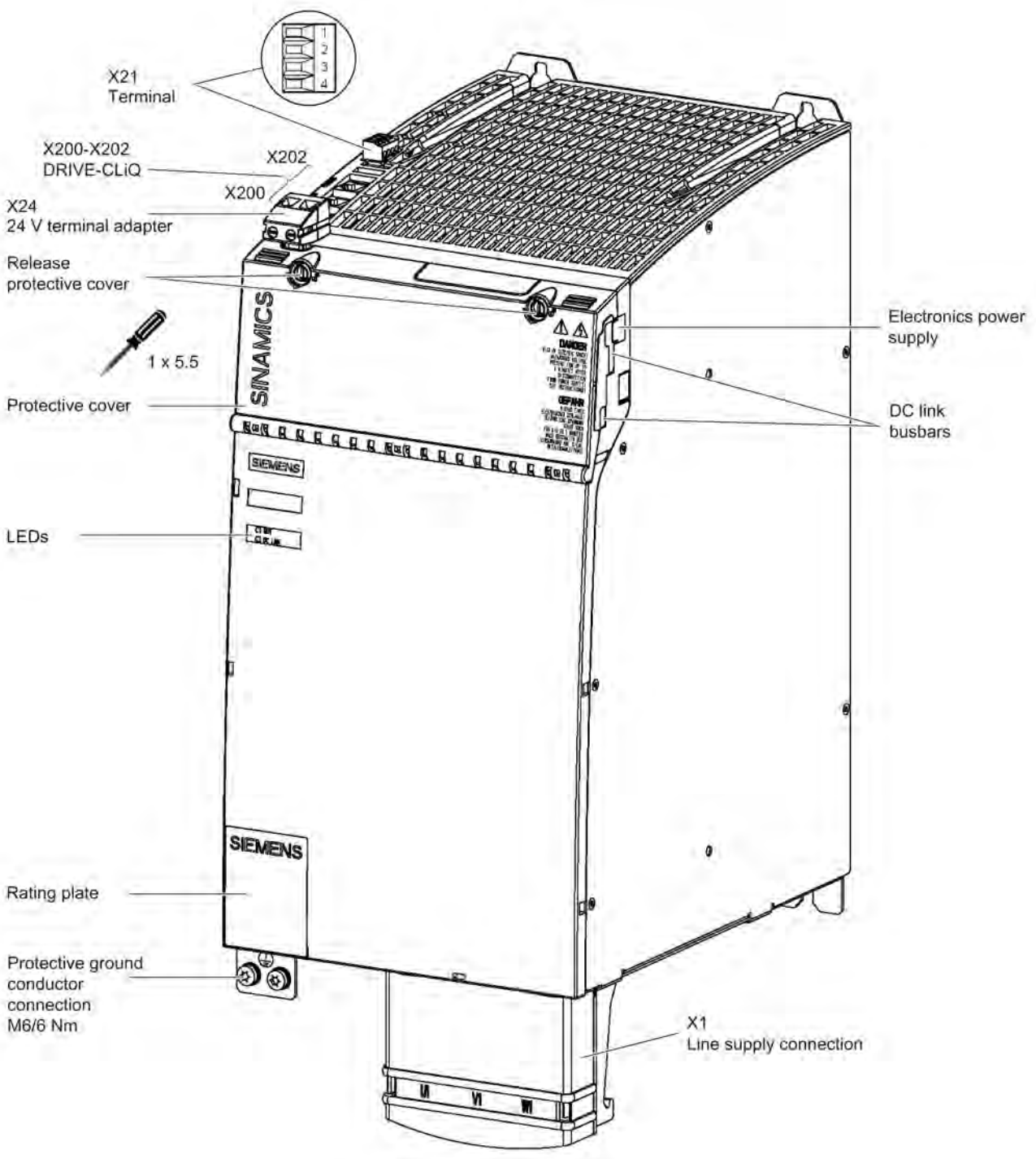
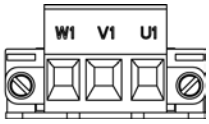
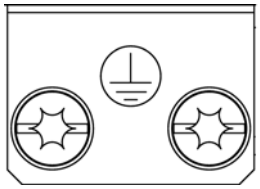


Figure 4-77 Interface overview, 36 kW and 55 kW Smart Line Modules with internal air cooling (example: 55 kW)

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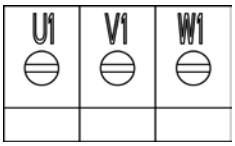
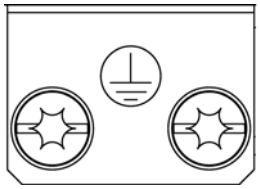
4.8.3.2 X1 line connection

Table 4- 63 X1: Line connection for Smart Line Modules 5 kW and 10 kW

	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm² Tightening torque: 1.2 … 1.5 Nm
	PE connection	Threaded hole M5 / 3 Nm[1]

1) For ring cable lugs without insulation

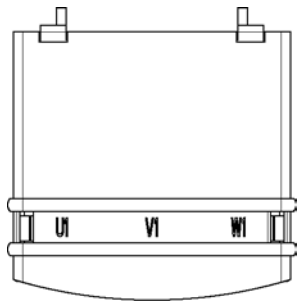
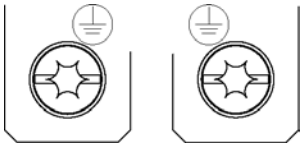
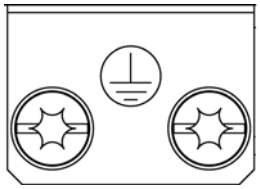
Table 4- 64 X1: Line supply connection for Smart Line Modules 16 kW

	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz Type: Screw terminal 6 (Page 755) Max. cross-section that can be connected: 10 mm² Tightening torque: 1.5 … 1.8 Nm
	PE connection	Threaded hole M5 / 3 Nm[1]

1) For ring cable lugs without insulation

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Table 4- 65 X1: Line connection for Smart Line Modules 36 kW and 55 kW

	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 … 480 V, 50 / 60 Hz **36 kW**: Threaded bolt M6 / 6 Nm[1)] **55 kW**: Threaded bolts M8 / 13 Nm[1)]
	PE connection	**36 kW**: Threaded hole M6 / 6 Nm[1)]
		**55 kW**: Threaded hole M6 / 6 Nm[1)]

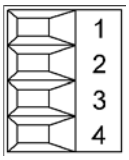
1) For ring cable lugs without insulation

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4.8.3.3 X21 EP terminals

Smart Line Modules 5 kW and 10 kW

Table 4- 66 X21 EP terminal for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation	Technical data
	1	DO: Ready	Feedback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: • Electronics power supply (X24) OK • DC link is precharged • Pulses enabled (X21.3/4) • No overtemperature • No overcurrent
	2	DO: Prewarning	DO: Prewarning High = no prewarning Low = prewarning • Overtemperature warning threshold/I^2t 5 kW prewarning: 64 °C, overtemperature threshold: 69 °C 10 kW prewarning: 68 °C, overtemperature threshold: 73 °C • No regenerative feedback capability due to a line fault [only monitored when feedback is activated (see terminal X22.2)]
	3	EP +24 V (pulse enable)	Voltage 24 V DC Current consumption: 10 mA Isolated input
	4	EP M (Enable Pulses)	
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm^2			

Terminals X21.1 and X21.2

Note

Wiring to a digital input of the Control Unit

Output terminal X21.1 must be wired to a digital input on the CU. The drives supplied with power from the Smart Line Module have to use this signal as a ready signal. This ensures that a pulse enable can only be issued for the drives (motor or generator operation) when the infeed is ready.
If interconnection with a digital input on the CU is not possible, the signal must be evaluated by a higher-level control system instead. It is not permissible that the control system sets the drives to ready until the infeed "Ready" signal is present.

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Note

Evaluating the "Prewarning" signal

The "Prewarning" signal at output terminal X21.2 warns against an overload. If this signal is set, the control system shuts the drives down before the "Ready" signal switches to "low". If the "Ready" signal switches to "low", the drive pulses must be suppressed within 4 ms.

Note

The Smart Line Module signals that it is "ready", even if one of the line conductors is not available. In this case, regenerative feedback is deactivated and an alarm is output at X21.2 (DO, Warning I^2t). 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^2t).

Terminals X21.3 and X21.4



WARNING

Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4.

Pulse cancellation is activated if the power supply is disconnected. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example, because a line contactor is not installed, then the DC link remains charged.

Death or serious injury can result when live parts are touched.

- Neutralize the voltage in the DC link.

NOTICE

Damage to the drive electronics when switching the line contactor under load

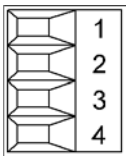
When switching the line contactor (type according to the recommended selection) under load, then the contacts will be subject to premature wear. This can cause the contactor to malfunction, with subsequent damage to the drive electronics.

- Use a leading opening auxiliary contact or use a Voltage Sensing Module (VSM10).
- If this is not possible, then avoid switching the line contactor under load.

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16 kW to 55 kW Smart Line Modules

Table 4- 67 X21 EP terminal / temperature sensor for 16 kW to 55 kW Smart Line Modules

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors[1]: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage: 24 V DC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm²:			

[1] The temperature sensor type and the temperature output can be selected by parameter (see the SINAMICS S120/S150 List Manual).
Temperatures are sensed, but are not evaluated in the Smart Line Module.

Terminals X21.1 and X21.2 - temperature sensor connection



WARNING

Danger to life due to electric shock in the event of voltage flashovers on the temperature sensor cable

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Only use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

NOTICE

Risk of the motor overheating due to an incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY sensor with the correct polarity.

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Terminals X21.3 and X21.4



⚠WARNING

Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4.

Pulse cancellation is activated if the power supply is disconnected. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example, because a line contactor is not installed, then the DC link remains charged.

Death or serious injury can result when live parts are touched.

- Neutralize the voltage in the DC link.

NOTICE

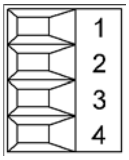
Damage to the drive electronics when switching the line contactor under load

When switching the line contactor (type according to the recommended selection) under load, then the contacts will be subject to premature wear. This can cause the contactor to malfunction, with subsequent damage to the drive electronics.

- Use a leading opening auxiliary contact or use a Voltage Sensing Module (VSM10).
- If this is not possible, then avoid switching the line contactor under load.

4.8.3.4 X22 digital inputs

Table 4- 68 X22 digital inputs for Smart Line Modules 5 kW and 10 kW

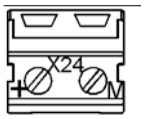
	Terminal	Designation[1)]	Technical data
	1	24 V power supply	Electronics power supply for controlling digital inputs X22.2 and 3
	2	DI: Disable Regeneration	Deactivate regenerative feedback (high active) No power is supplied back to the network from the DC link. The regenerative energy of the motors may have to be reduced using a combination of the Braking Module and braking resistor.
	3	DI: Reset	Reset faults (negative edge)
	4	Ground	Electronics ground
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm^2			

1) DI: Digital input

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4.8.3.5 X24 24 V terminal adapter

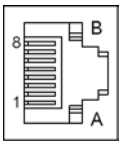
Table 4- 69 X24: 24 V terminal adapter

	Terminal	Designation	Technical data
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm^2			

The 24 V terminal adapter is included in the scope of supply.

4.8.3.6 X200-X202 DRIVE-CLiQ interfaces

Table 4- 70 X200-X202: DRIVE-CLiQ interfaces

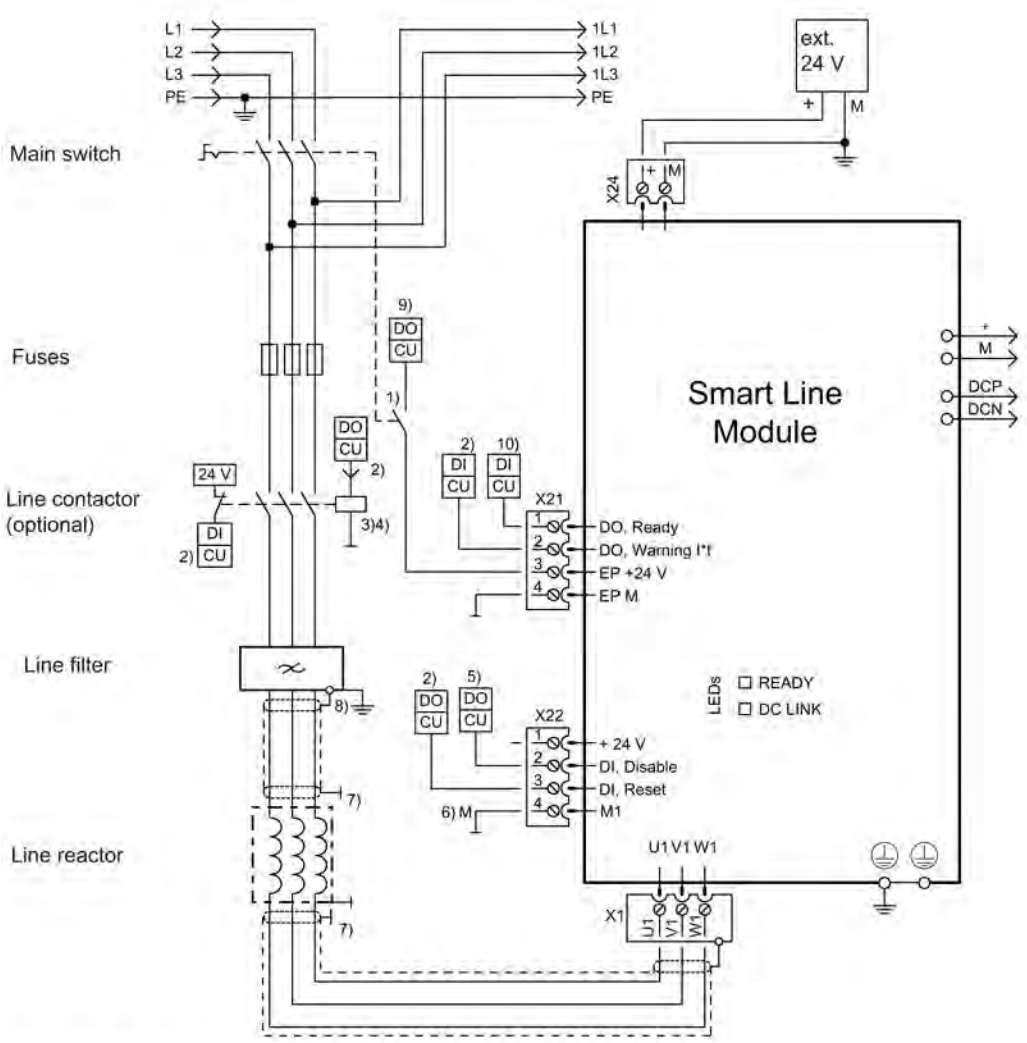
	PIN	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+(24 V)	24 V power supply
	B	M (0 V)	Electronics ground

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

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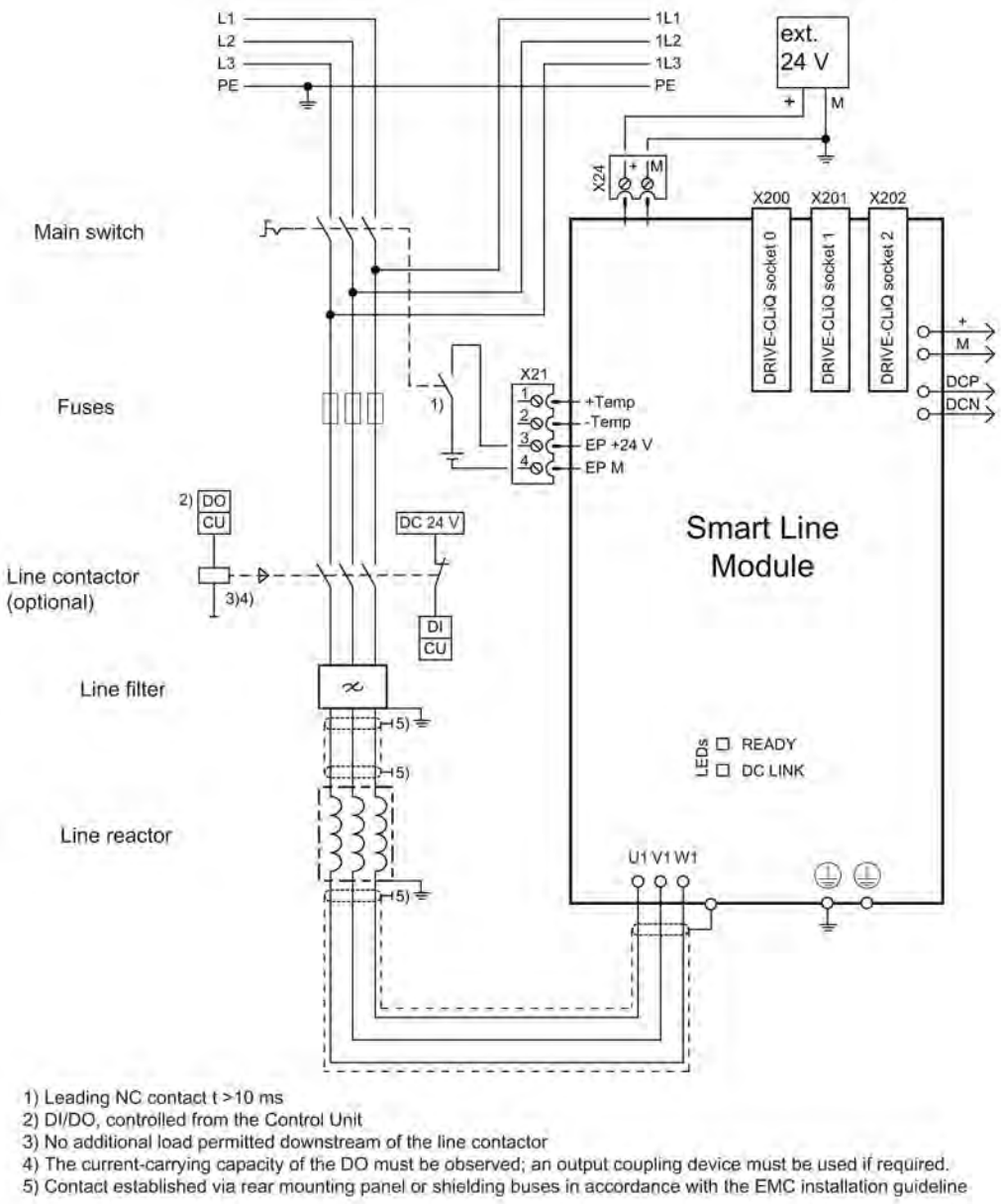
4.8.4 Connection examples



1) Leading NC contact t >10 ms, 24 VDC and ground must be set up for operation.
2) DI/DO controlled from the Control Unit
3) No additional load permitted downstream of the line contactor
4) The current-carrying capacity of the DO must be observed; an output coupling device must be used if required.
5) DO high, regenerative feedback deactivated (a jumper can be inserted between X22 pin 1 and pin 2 for permanent deactivation).
6) X22 pin 4 must be connected to ground (ext. 24 V).
7) Contact established via rear mounting panel or shielding buses in accordance with the EMC installation guideline
8) 5 kW and 10 kW line filters via shield connection
9) Signal output of the control, to avoid interference of the 24 VDC supply on the EP terminal.
10) Interconnection via BICO to parameter p0864

Figure 4-78 Connection example for 5 kW and 10 kW Smart Line Modules

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1) Leading NC contact t >10 ms
2) DI/DO, controlled from the Control Unit
3) No additional load permitted downstream of the line contactor
4) The current-carrying capacity of the DO must be observed; an output coupling device must be used if required.
5) Contact established via rear mounting panel or shielding buses in accordance with the EMC installation guideline

Figure 4-79 Connection example for 16 kW to 55 kW Smart Line Modules

Note

If you are using a VSM10 Voltage Sensing Module, the leading opening contact can be omitted.

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4.8.5 Meaning of LEDs

4.8.5.1 Smart Line Modules 5 kW and 10 kW

Table 4- 71 Meaning of the LEDs on 5 kW and 10 kW Smart Line Modules

LED	Color	Status	Description, cause	Remedy
RDY	–	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation.	–
	Yellow	Continuous light	The precharging has not yet been completed. The bypass relay has dropped out. The EP terminals are not supplied with 24 V DC.	–
	Red	Continuous light	Overtemperature overcurrent	Diagnose the fault (using the output terminals) and acknowledge (using the input terminal).
DC LINK	–	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
	Yellow	Continuous light	The DC link voltage is within permissible tolerance range.	–
	Red	Continuous light	The DC link voltage is outside the permissible tolerance range or a line fault is present.	Check the line supply voltage.



⚠WARNING

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

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4.8.5.2 16 kW to 55 kW Smart Line Modules

Table 4- 72 Meaning of the LEDs on Smart Line Modules ≥ 16 kW

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
Green	--	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is outside the permissible tolerance range.	Check the line supply voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	This component has at least one fault. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Resolve and acknowledge the fault.
Green/red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download has been completed. The system waits for POWER ON.	Carry out a POWER ON.
Green/orange or red/orange	--	Component recognition via LED is activated[1)]. **Note:** Both options depend on the LED status when component recognition is activated.	–

[1)] See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



WARNING

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

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4.8.6 Dimension drawings

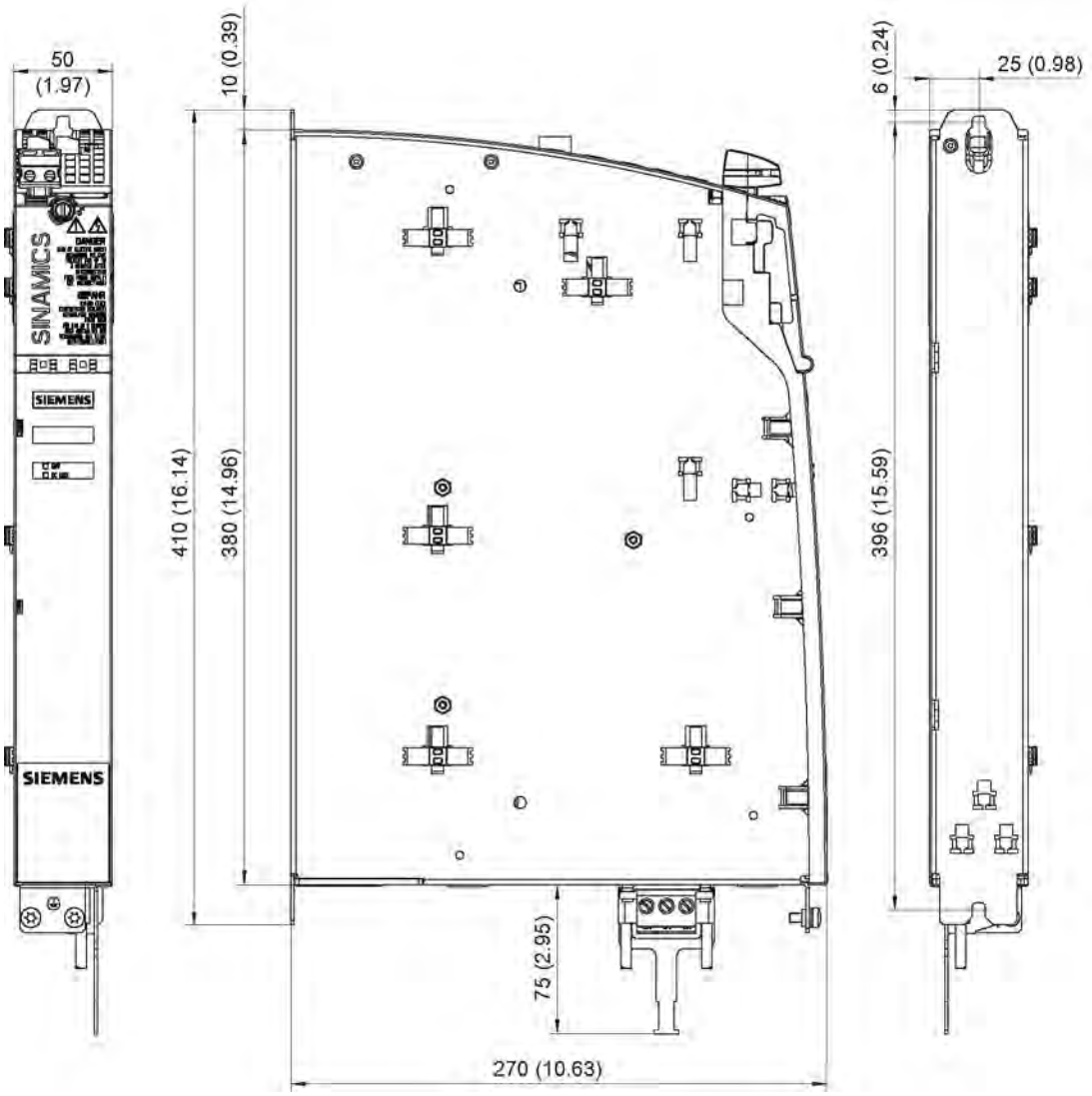


Figure 4-80 Dimension drawing of 5 kW and 10 kW Smart Line Modules with internal air cooling, all dimensions in mm and (inches)

Note

The shield connecting plate is integrated in the line connector of the 50 mm Smart Line Modules.

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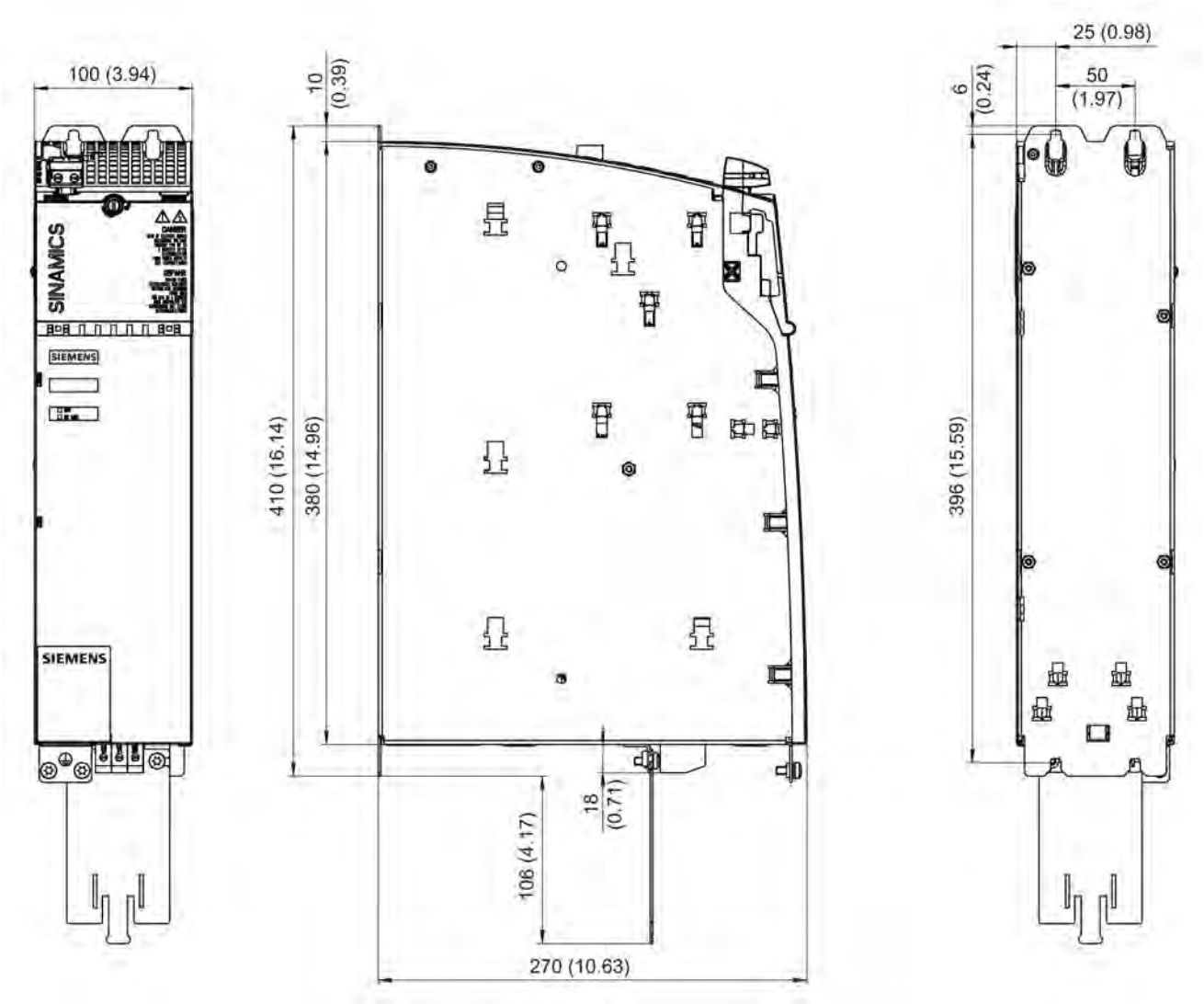


Figure 4-81 Dimension drawing of 16 kW Smart Line Module with internal air cooling, all dimensions in mm and (inches)

Note

The shield connecting plate is part of the scope of delivery of the 100 mm Smart Line Modules.

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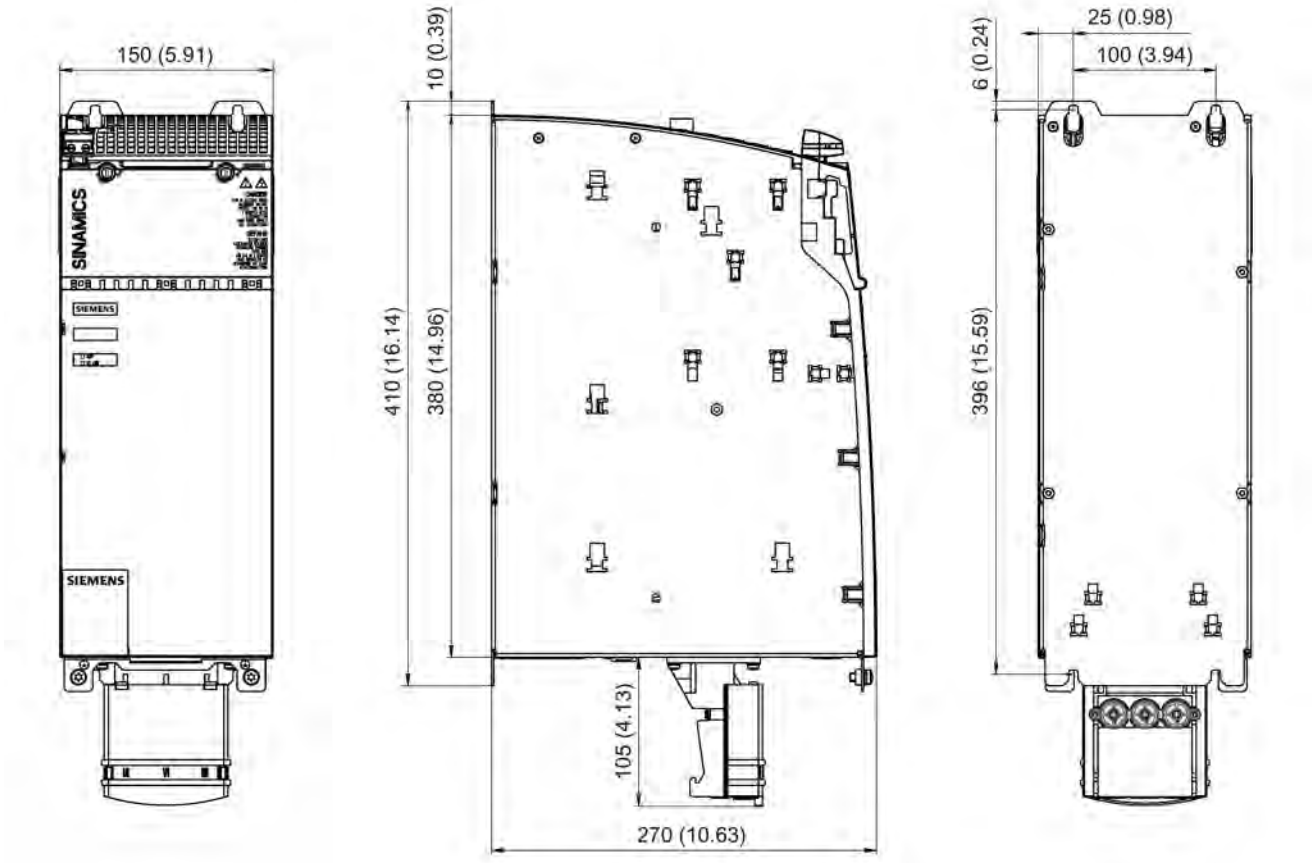


Figure 4-82 Dimension drawing of 36 kW Smart Line Module with internal air cooling, all dimensions in mm and (inches)

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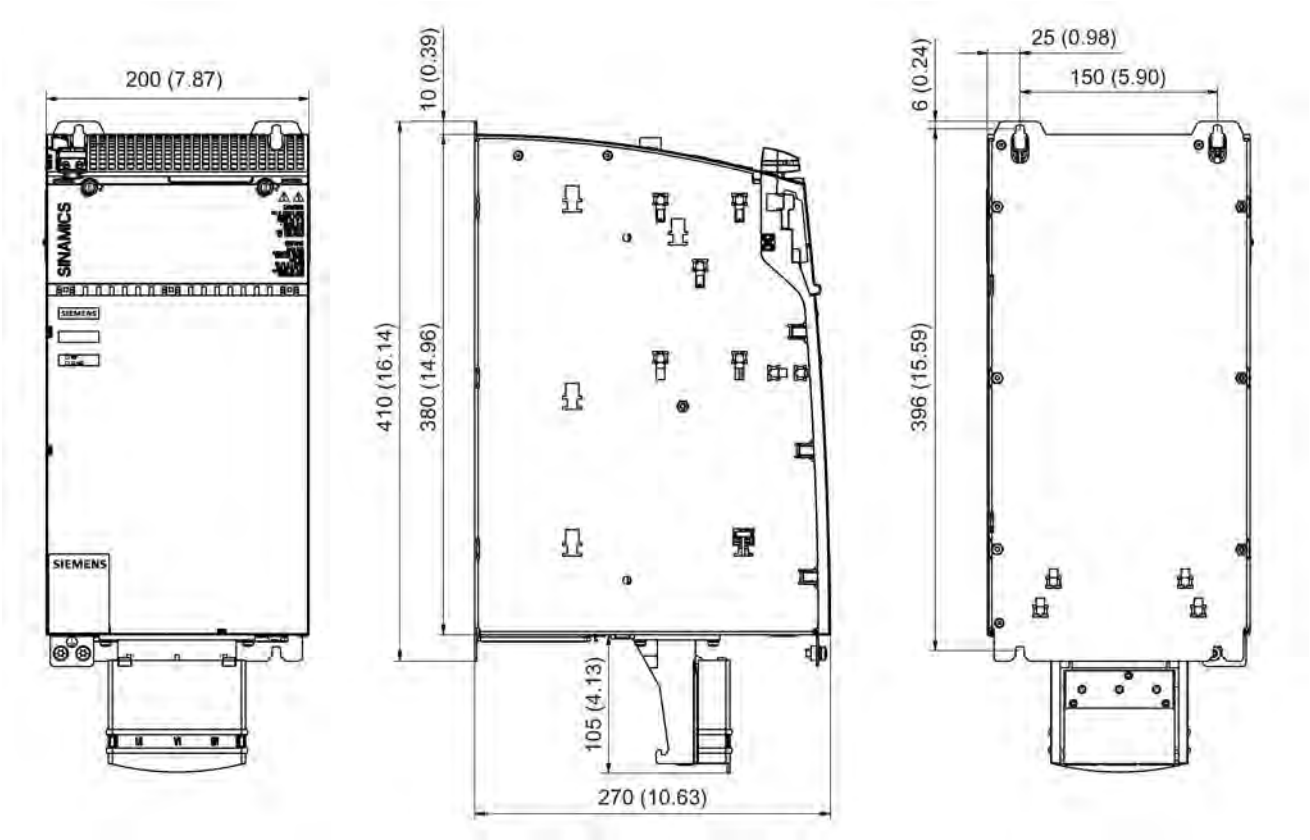
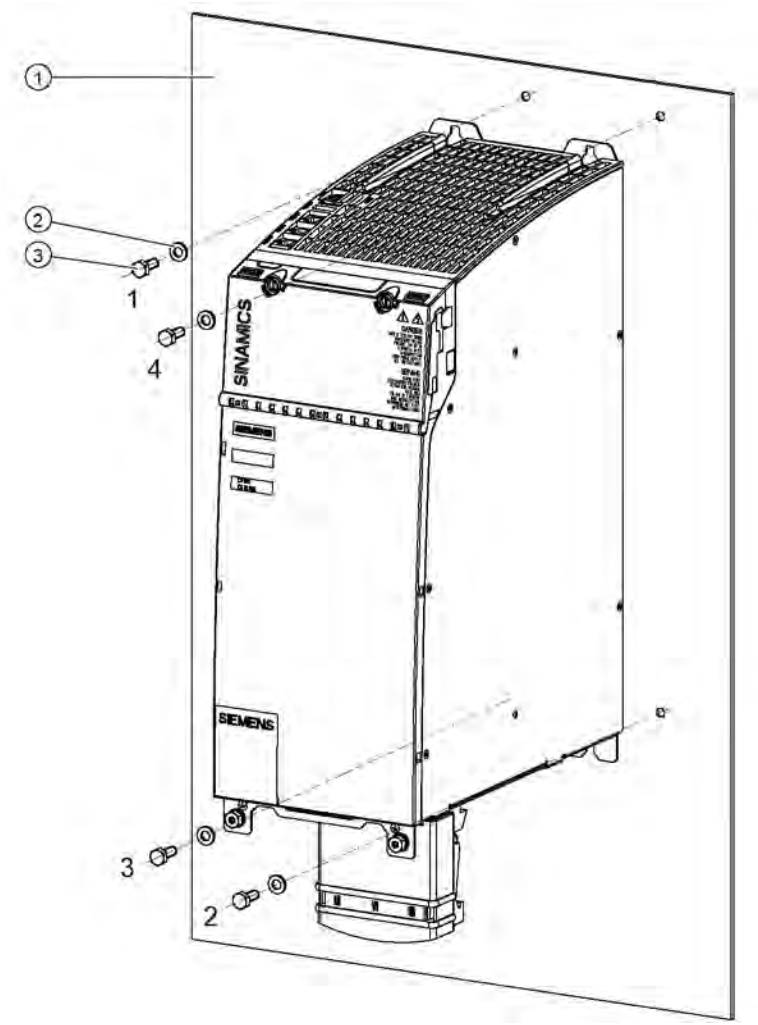


Figure 4-83 Dimension drawing of 55 kW Smart Line Module with internal air cooling, all dimensions in mm and (inches)

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4.8.7 Installation

Smart Line Modules are designed for installation in the control cabinet. They are fixed to the control cabinet panel or a mounting panel using M6 screws.



① Control cabinet panel/mounting panel
② Washer
③ M6 screw

Figure 4-84 Mounting a Smart Line Module with internal air cooling (example: 36 kW)

Tightening torques:

- Firstly, tighten the nuts by hand.
  Tightening torque. 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
  Tightening torque: 6 Nm

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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**	**6TE25-5AAx**
Rated power	**kW**	**5**	**10**	**16**	**36**	**55**
Infeed						
Rated power (S1)[1)]	kW (P_n)	5	10	16	36	55
S6 operation (40 %)[1)]	kW (P_{S6})	6,5	13	21	47	71
Peak infeed power[1)]	kW (P_{max})	10	20	35	70	91
Regenerative feedback						
Continuous regenerative power	kW	5	10	16	36	55
Peak regenerative power	kW	10	20	35	70	91
Supply voltages						
Line voltage	V_{AC}	3 AC 380 … 480 ± 10 % (-15 % < 1 min)				
Line frequency	Hz	47 … 63				
Electronics power supply	V_{DC}	24 (20.4 … 28.8)				
DC link voltage	V_{DC}	510 … 720				
Overvoltage trip	V_{DC}	820 ± 2 %				
Undervoltage trip[2)]	V_{DC}	360 ± 2 %				
Input currents						
Rated input current						
at AC 400 V	A_{AC}	8,1	16,2	27,5	59	90
at AC 380 V / AC 480 V	A_{AC}	8,6 / 6,7	17 / 12,8	29 / 24,5	62 / 51	94 / 77
S6 (40 %)						
at AC 400 V	A_{AC}	10,6	21,1	35	76	106
Peak current						
at AC 400 V	A_{AC}	15,7	31,2	57,5	112	130
DC link currents						
DC link output current						
at 600 V	A_{DC}	8,3	16,6	27	60	92
at 540 V	A_{DC}	9,3	18,5	30	67	105
S6 (40 %)						
at DC 600 V	A_{DC}	11	22	35	79	138
Peak current						
at DC 600 V	A_{DC}	16,6	33,2	59	118	178
Current carrying capacity						
DC link busbars	A_{DC}	100	100	100	200	200
Reinforced DC link busbars						
24 V DC busbars	A_{DC}	150	150	150	--	--
	A_{DC}	20	20	20	20	20
Electronics current drawn						
at 24 V DC	A_{DC}	0,8	0,9	0,95	1,5	1,9
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	79,2	141,6	187,8	406	665,6
Max. ambient temperature						
without derating	° C	40				
with derating	° C	55				

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Internal air cooling	**6SL3130–**	**6AE15–0Axx**	**6AE21–0Axx**	**6TE21-6Axx**	**6TE23-6Axx**	**6TE25-5AAx**
Rated power	**kW**	**5**	**10**	**16**	**36**	**55**
DC link capacitance Smart Line Module Drive line-up, max.	 µF µF	 220 6000	 330 6000	 705 20000	 1410 20000	 1880 20000
Power factor	cos ϕ	0,98				
Circuit breaker (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 51)				
Rated short-circuit current SCCR[3)]	kA	65	65	65	65	65
Cooling method (internal air cooling)		Internal fan				
Sound pressure level	dB(A)	< 60	< 60	< 60	< 65	< 60
Cooling air requirement	m^3/h	29,6	29,6	56	112	160
Max. permissible heat sink temperature	° C	69[4)]	73[4)]	77	80	75
Rated voltage for rated data 3 AC 380 V						
Weight	kg	4,7	4,8	7	10	17

1) The specified power ratings apply to the line voltage range from 380 V to 480 V.

2) For 16 kW and 36 kW Smart Line Modules: Default for 400 V line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.

3) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker – and the Line Module in the drive system.

4) Values cannot be read out by the system (STARTER).

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4.8.8.1 Characteristics

Rated duty cycles of Smart Line Modules

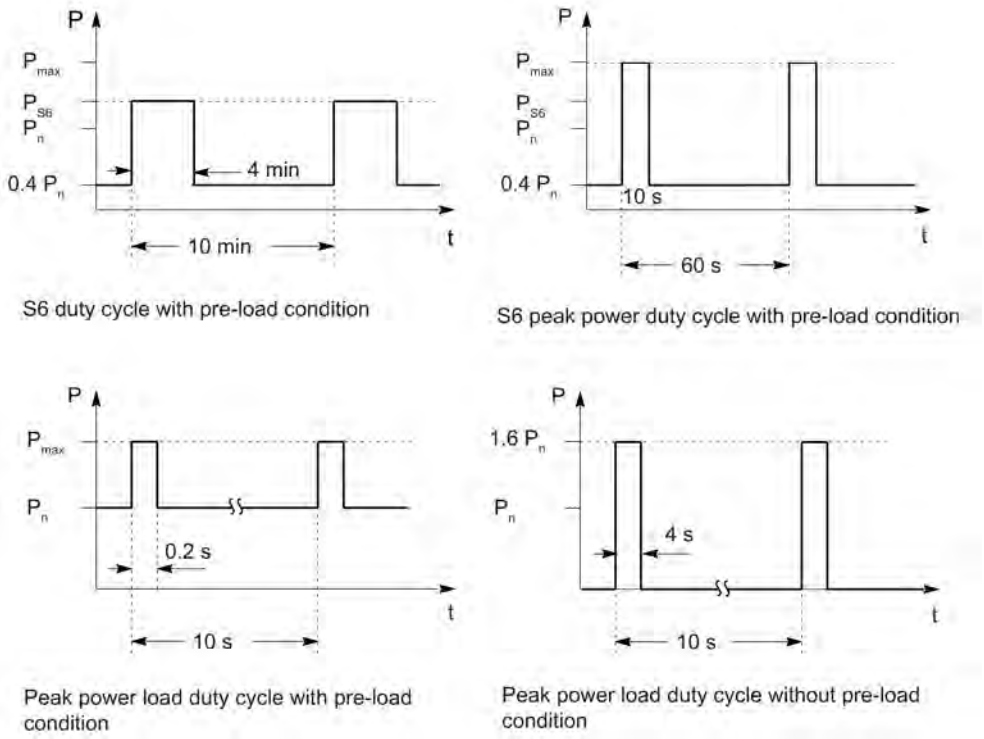


Figure 4-85 Rated duty cycles of Smart Line Modules

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Derating characteristics

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

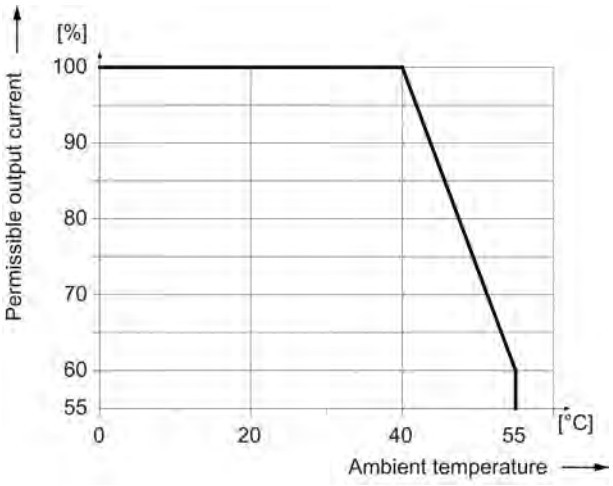


Figure 4-86 Output current as a function of the ambient temperature

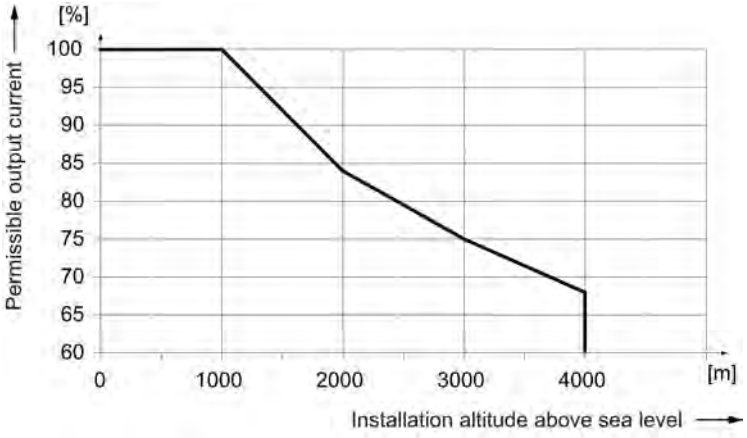


Figure 4-87 Output current as a function of the installation altitude

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4.9 Smart Line Modules with external air cooling

4.9.1 Description

The Smart Line Module is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module with a non-regulated DC voltage at the DC output. In the infeed mode the Smart Line Module exhibits the typical current and voltage waveforms of a 6-pulse diode rectifier bridge.

In feedback mode, the current waveform is square waved. Regenerative feedback can be deactivated if required. On 5 kW and 10 kW Smart Line Modules, this is done via a terminal, since these modules do not feature a DRIVE-CLiQ connection. On 16 kW to 55 kW Smart Line Modules, regenerative feedback can be deactivated via parameters, as, just like Active Line Modules, these modules are equipped with a DRIVE-CLiQ connection.

The DC link starts precharging as soon as the line voltage is applied and is independent of its phase sequence direction. Load can be applied to the DC link after the module has been enabled. An optional main contactor is required for disconnecting the voltage.

Smart Line Modules are suitable for direct operation on TN, IT and TT systems. The Line Modules have an integrated overvoltage protection function.

External air cooling uses the "through-hole" method. This is a cooling method that is only available for SINAMICS booksize units. The Smart Line Module and its heat sink can be inserted in a rectangular knockout at the rear of the control cabinet and mounted with a seal. The heat sink and the fan (included in the scope of supply) project beyond the rear of the control cabinet and the heat is dissipated outside the control cabinet or in a separate air duct.

4.9.2 Safety instructions for Smart Line Modules Booksize

⚠ WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

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NOTICE

Destruction of the Smart Line Module for an incorrect switch-on or switch-off sequence

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair.

- Observe the "Ready" signal at output terminal X21.1:

  Switch on:
  - 24 V DC supply X24 ON
  - Line contactor ON
  - EP signal X21.3 and X21.4 ON
  - Wait until precharging has been completed
  - "Ready" signal at terminal X21.1 switched to high
  - Infeed is ready, pulse enable possible for motors

  Switch off:
  - Shut drives down
  - Cancel pulse enable for motors (OFF1 signal)
  - EP signal X21.3 and X21.4 OFF
  - Line contactor OFF
  - 24 V DC supply X24 OFF

  Overload:
  - "Prewarning" signal at terminal X21.2 switches to low
  - Shut drives down via the control system
  - "Ready" signal at terminal X21.1 switches to low
  - Pulse inhibit for all the drives supplied by this infeed within 4 ms

Note

Connected to the public low-voltage network

Smart Line Modules have been designed for use in the industrial environment and generate current harmonics on the line side as a result of the rectifier circuit.

When connecting a machine with integrated Smart Line Modules to the public low-voltage line supply (grid), authorization is required in advance from the local power supply company (utility company) in the following cases:

- The rated current of the motor ≤ 16 A per conductor.
- The rated motor current does not comply with the requirements specified in EN 61000-3-2 regarding current harmonics.

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4.9.3 Interface description

4.9.3.1 Overview

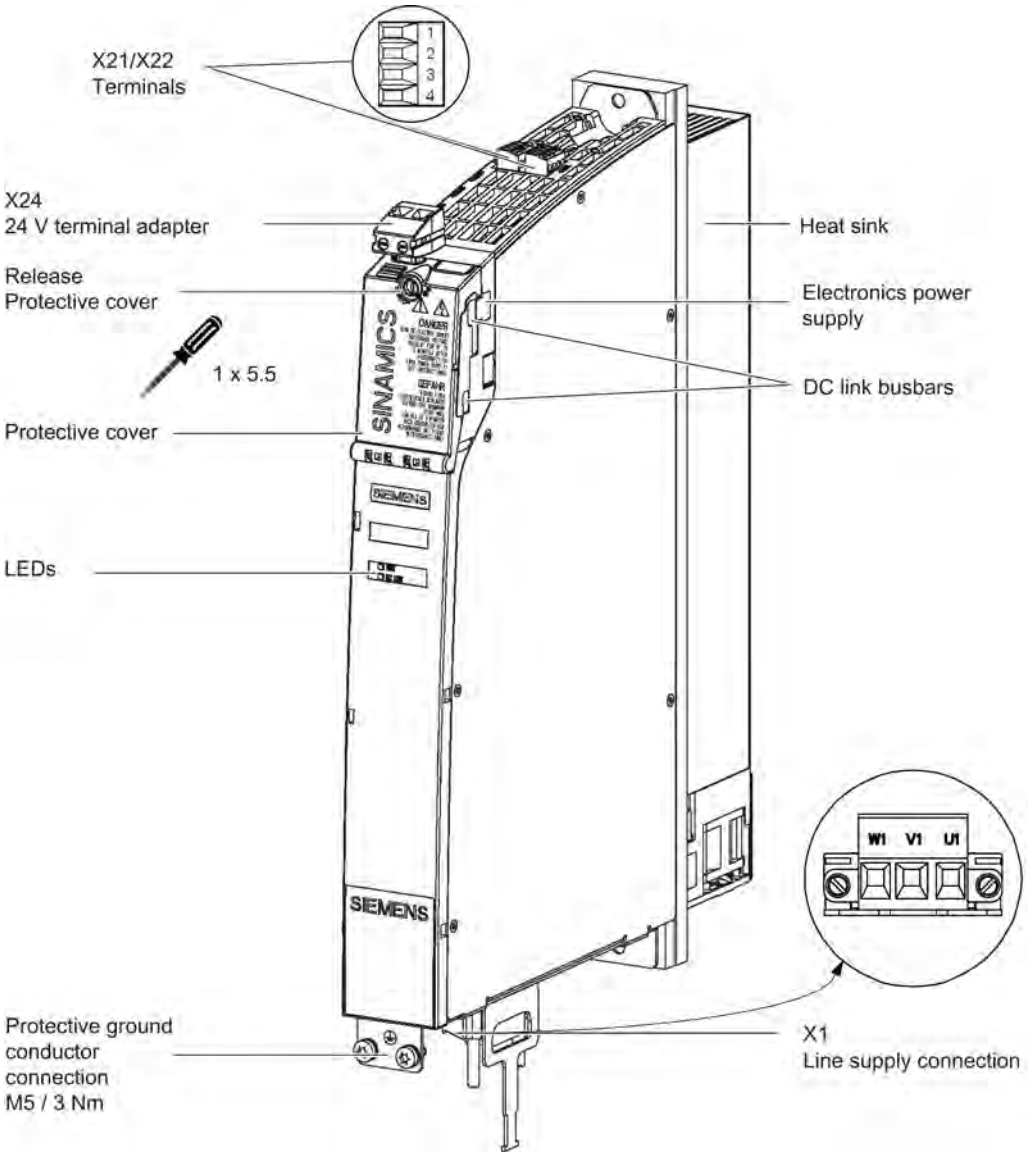


Figure 4-88 Interface overview, 5 kW and 10 kW Smart Line Modules with external air cooling (example: 5 kW)

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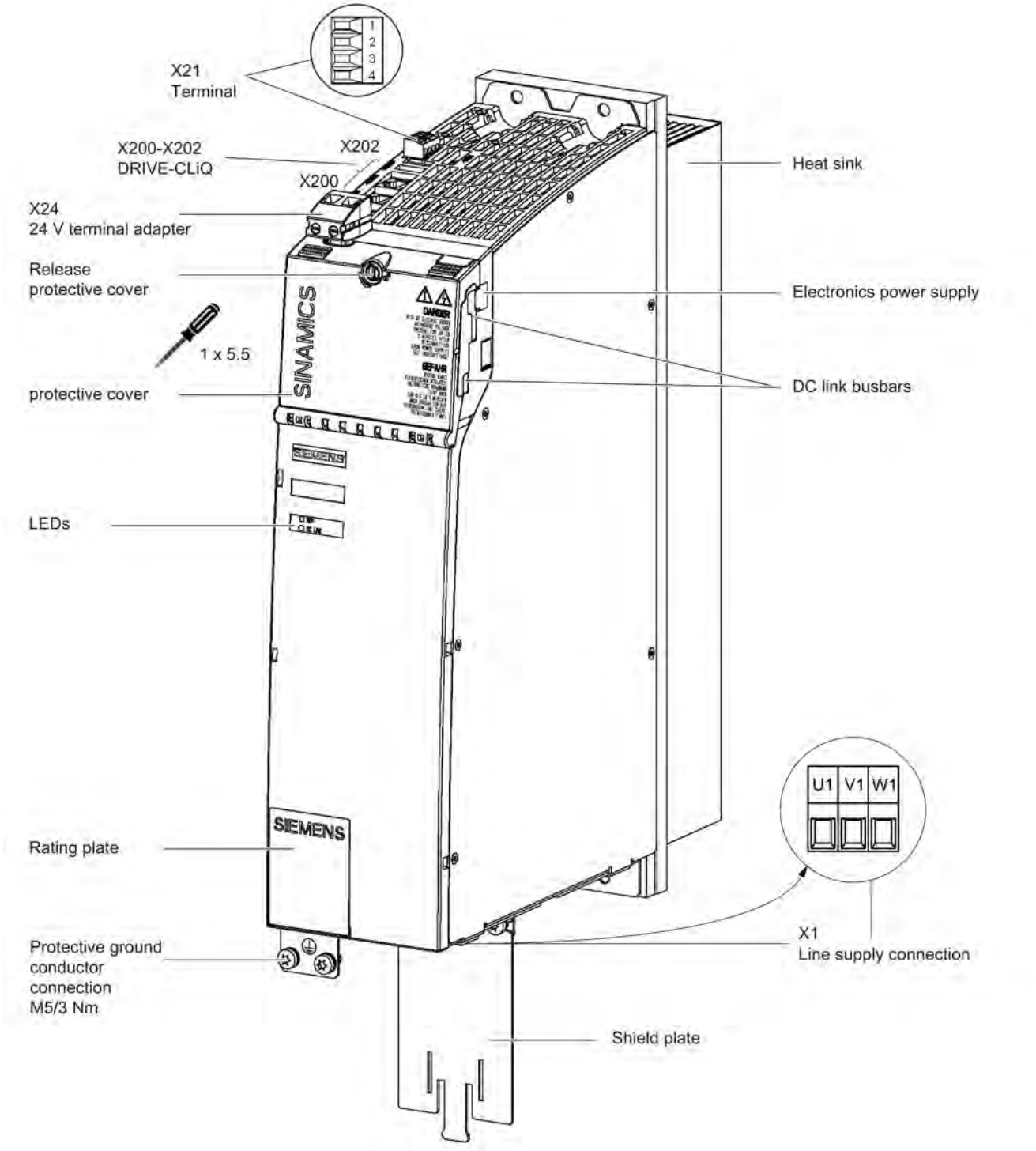


Figure 4-89 Interface overview, 16 kW Smart Line Module with external air cooling

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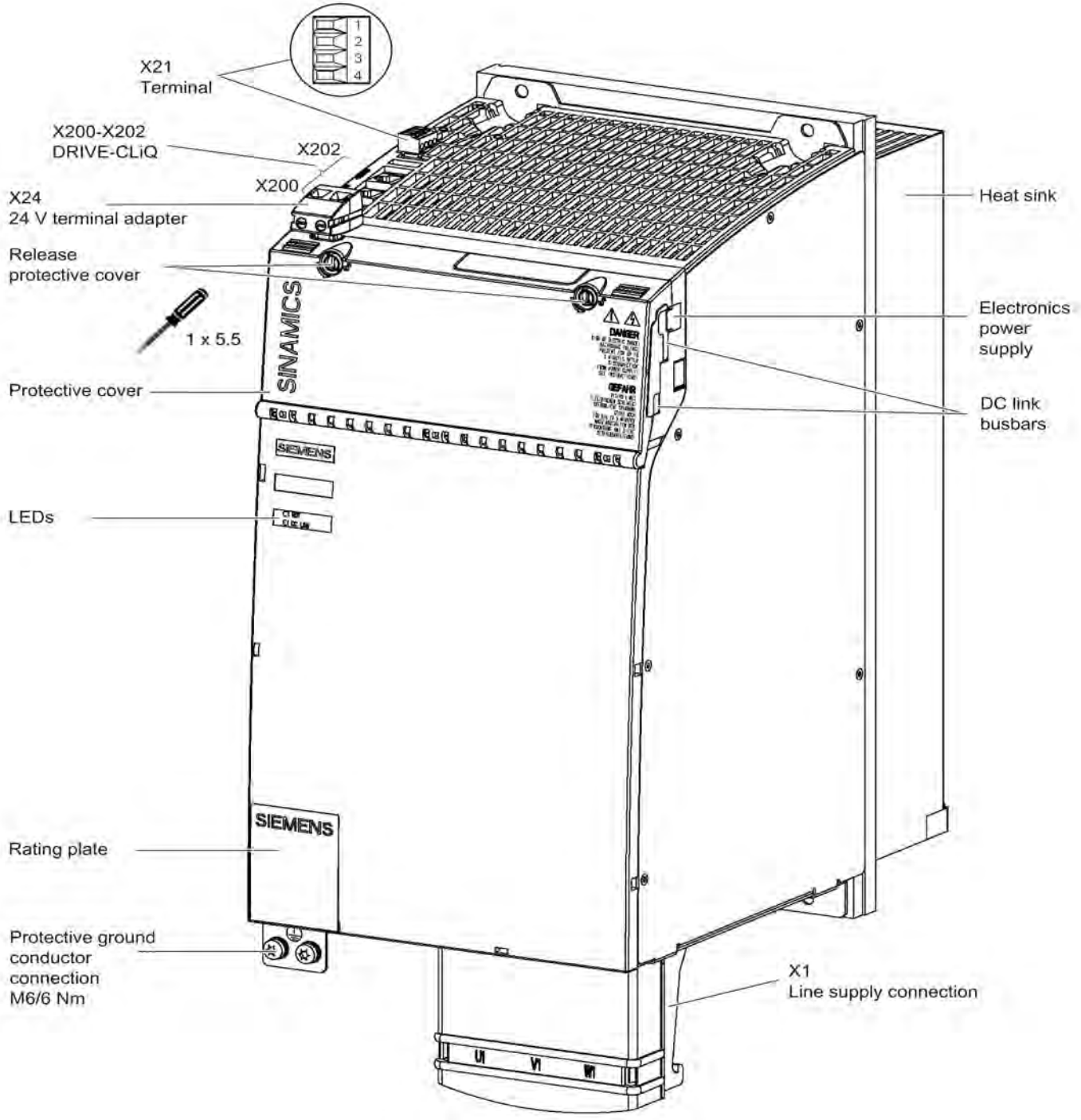
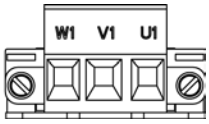
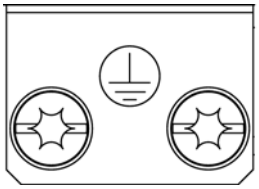


Figure 4-90 Interface overview, 36 kW and 55 kW Smart Line Modules with external air cooling (example: 55 kW)

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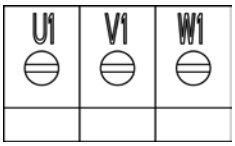
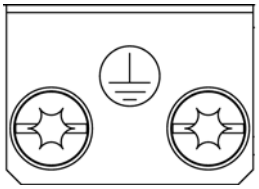
4.9.3.2 X1 line connection

Table 4- 74 X1: Line connection for Smart Line Modules 5 kW and 10 kW

	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 … 480 V, 50 / 60 Hz Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm² Tightening torque: 1.2 … 1.5 Nm
	PE connection	Threaded hole M5 / 3 Nm[1]

1) For ring cable lugs without insulation

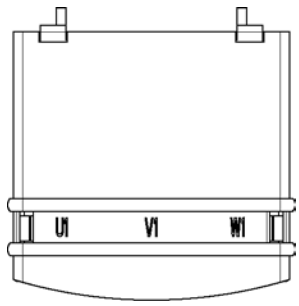
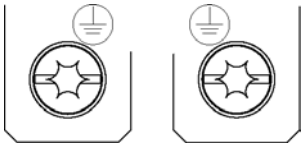
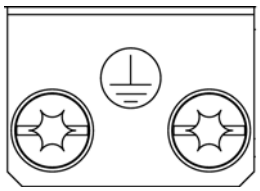
Table 4- 75 X1: Line supply connection for Smart Line Modules 16 kW

	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 … 480 V, 50 / 60 Hz Type: Screw terminal 6 (Page 755) Max. cross-section that can be connected: 10 mm² Tightening torque: 1.5 … 1.8 Nm
	PE connection	Threaded hole M5 / 3 Nm[1]

1) For ring cable lugs without insulation

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Table 4- 76 X1: Line connection for Smart Line Modules 36 kW and 55 kW

	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 ... 480 V, 50 / 60 Hz **36 kW**: Threaded bolt M6 / 6 Nm[1)] **55 kW**: Threaded bolts M8 / 13 Nm[1)]
	PE connection	**36 kW**: Threaded hole M6 / 6 Nm[1)]
		**55 kW**: Threaded hole M6 / 6 Nm[1)]

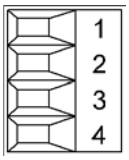
1) For ring cable lugs without insulation

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4.9.3.3 X21 EP terminals

Smart Line Modules 5 kW and 10 kW

Table 4- 77 X21 EP terminal for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation	Technical data
	1	DO: Ready	Feedback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: • Electronics power supply (X24) OK • DC link is precharged • Pulses enabled (X21.3/4) • No overtemperature • No overcurrent
	2	DO: Prewarning	DO: Prewarning High = no prewarning Low = prewarning • Overtemperature warning threshold/I^2t 5 kW prewarning: 64 °C, overtemperature threshold: 69 °C 10 kW prewarning: 68 °C, overtemperature threshold: 73 °C • No regenerative feedback capability due to a line fault [only monitored when feedback is activated (see terminal X22.2)]
	3	EP +24 V (pulse enable)	Voltage 24 V DC Current consumption: 10 mA Isolated input
	4	EP M (Enable Pulses)	
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm^2			

Terminals X21.1 and X21.2

Note

Wiring to a digital input of the Control Unit

Output terminal X21.1 must be wired to a digital input on the CU. The drives supplied with power from the Smart Line Module have to use this signal as a ready signal. This ensures that a pulse enable can only be issued for the drives (motor or generator operation) when the infeed is ready.
If interconnection with a digital input on the CU is not possible, the signal must be evaluated by a higher-level control system instead. It is not permissible that the control system sets the drives to ready until the infeed "Ready" signal is present.

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Note

Evaluating the "Prewarning" signal

The "Prewarning" signal at output terminal X21.2 warns against an overload. If this signal is set, the control system shuts the drives down before the "Ready" signal switches to "low". If the "Ready" signal switches to "low", the drive pulses must be suppressed within 4 ms.

Note

The Smart Line Module signals that it is "ready", even if one of the line conductors is not available. In this case, regenerative feedback is deactivated and an alarm is output at X21.2 (DO, Warning I^2t). 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^2t).

Terminals X21.3 and X21.4



WARNING

Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4.

Pulse cancellation is activated if the power supply is disconnected. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example, because a line contactor is not installed, then the DC link remains charged.

Death or serious injury can result when live parts are touched.

- Neutralize the voltage in the DC link.

NOTICE

Damage to the drive electronics when switching the line contactor under load

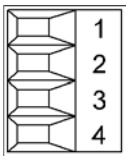
When switching the line contactor (type according to the recommended selection) under load, then the contacts will be subject to premature wear. This can cause the contactor to malfunction, with subsequent damage to the drive electronics.

- Use a leading opening auxiliary contact or use a Voltage Sensing Module (VSM10).
- If this is not possible, then avoid switching the line contactor under load.

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16 kW to 55 kW Smart Line Modules

Table 4- 78 X21 EP terminal / temperature sensor for 16 kW to 55 kW Smart Line Modules

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors[1]: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage: 24 V DC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm²:			

1) The temperature sensor type and the temperature output can be selected by parameter (see the SINAMICS S120/S150 List Manual).
Temperatures are sensed, but are not evaluated in the Smart Line Module.

Terminals X21.1 and X21.2 - temperature sensor connection



WARNING

Danger to life due to electric shock in the event of voltage flashovers on the temperature sensor cable

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Only use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

NOTICE

Risk of the motor overheating due to an incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY sensor with the correct polarity.

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Terminals X21.3 and X21.4



⚠WARNING

Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4.

Pulse cancellation is activated if the power supply is disconnected. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example, because a line contactor is not installed, then the DC link remains charged.

Death or serious injury can result when live parts are touched.

- Neutralize the voltage in the DC link.

NOTICE

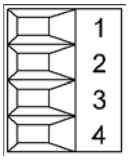
Damage to the drive electronics when switching the line contactor under load

When switching the line contactor (type according to the recommended selection) under load, then the contacts will be subject to premature wear. This can cause the contactor to malfunction, with subsequent damage to the drive electronics.

- Use a leading opening auxiliary contact or use a Voltage Sensing Module (VSM10).
- If this is not possible, then avoid switching the line contactor under load.

4.9.3.4 X22 digital inputs

Table 4- 79 X22 digital inputs for Smart Line Modules 5 kW and 10 kW

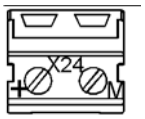
	Terminal	Designation[1)]	Technical data
	1	24 V power supply	Electronics power supply for controlling digital inputs X22.2 and 3
	2	DI: Disable Regeneration	Deactivate regenerative feedback (high active) No power is supplied back to the network from the DC link. The regenerative energy of the motors may have to be reduced using a combination of the Braking Module and braking resistor.
	3	DI: Reset	Reset faults (negative edge)
	4	Ground	Electronics ground
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm^2			

1) DI: Digital input

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4.9.3.5 X24 24 V terminal adapter

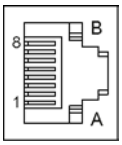
Table 4- 80 X24: 24 V terminal adapter

	Terminal	Designation	Technical data
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm^2			

The 24 V terminal adapter is included in the scope of supply.

4.9.3.6 X200-X202 DRIVE-CLiQ interfaces

Table 4- 81 X200-X202: DRIVE-CLiQ interfaces

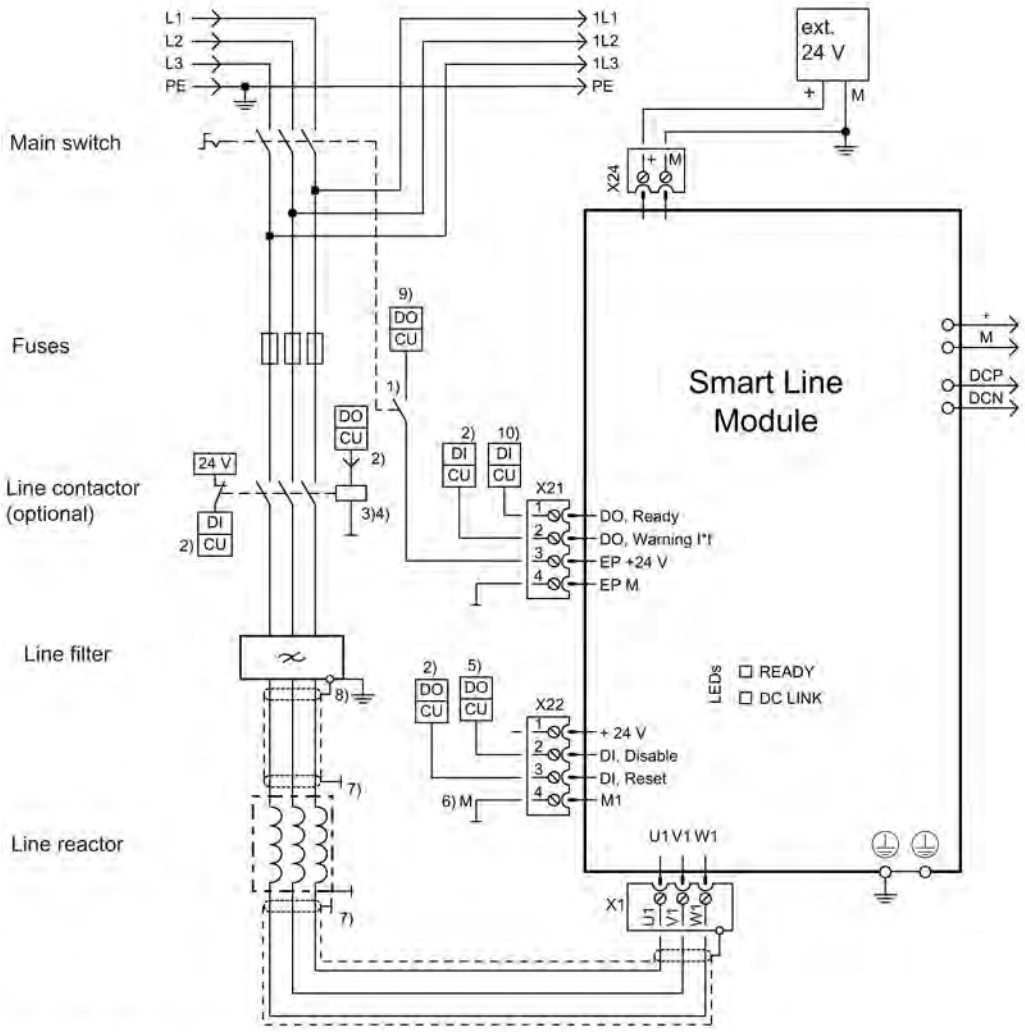
	PIN	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+(24 V)	24 V power supply
	B	M (0 V)	Electronics ground

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

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4.9.4 Connection examples



1) Leading NC contact t >10 ms, 24 VDC and ground must be set up for operation.
2) DI/DO controlled from the Control Unit
3) No additional load permitted downstream of the line contactor
4) The current-carrying capacity of the DO must be observed; an output coupling device must be used if required.
5) DO high, regenerative feedback deactivated (a jumper can be inserted between X22 pin 1 and pin 2 for permanent deactivation).
6) X22 pin 4 must be connected to ground (ext. 24 V).
7) Contact established via rear mounting panel or shielding buses in accordance with the EMC installation guideline
8) 5 kW and 10 kW line filters via shield connection
9) Signal output of the control, to avoid interference of the 24 VDC supply on the EP terminal.
10) Interconnection via BICO to parameter p0864

Figure 4-91 Connection example for 5 kW and 10 kW Smart Line Modules

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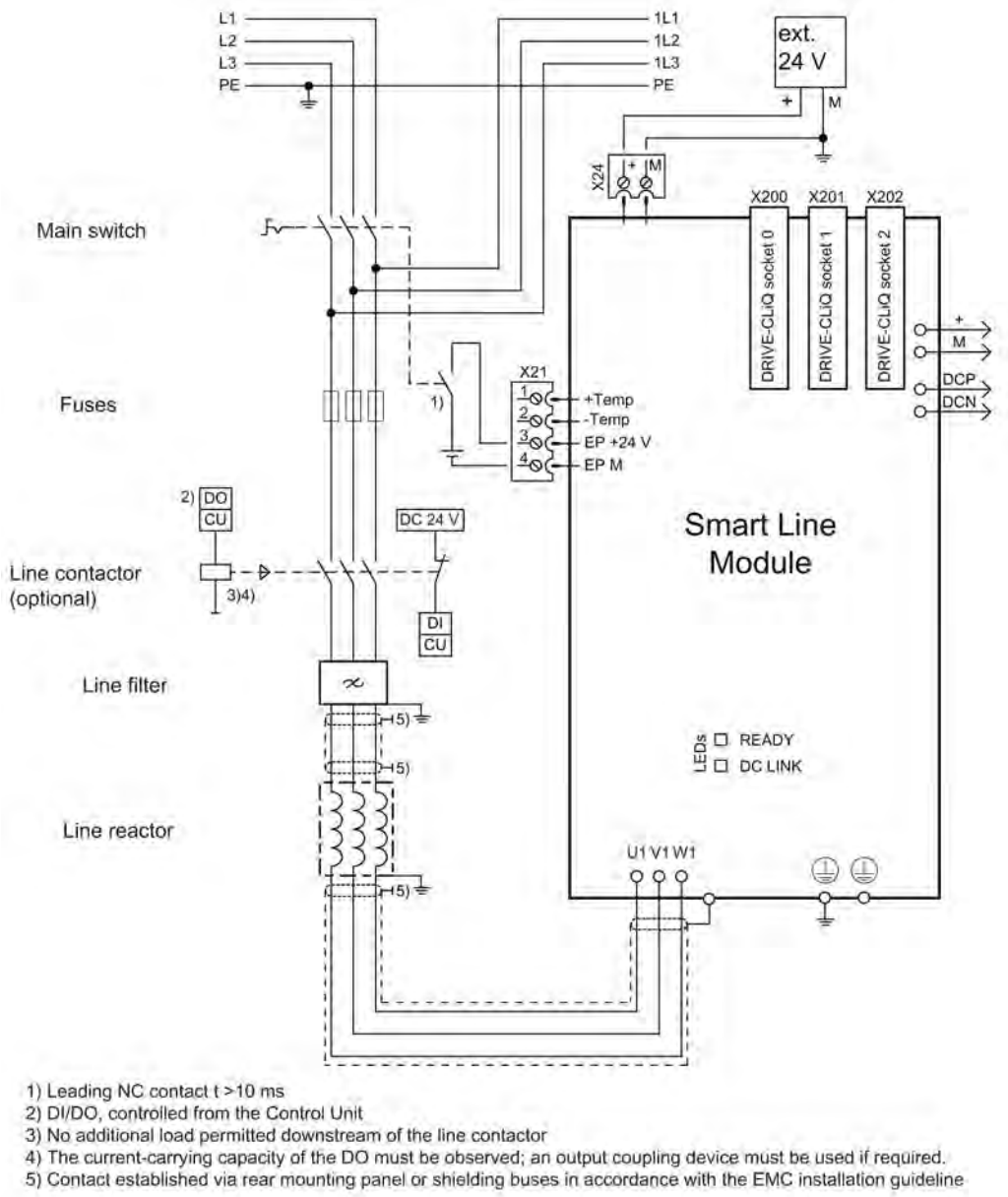


Figure 4-92 Connection example for 16 kW to 55 kW Smart Line Modules

Note

If you are using a VSM10 Voltage Sensing Module, the leading opening contact can be omitted.

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4.9.5 Meaning of LEDs

4.9.5.1 Smart Line Modules 5 kW and 10 kW

Table 4- 82 Meaning of the LEDs on 5 kW and 10 kW Smart Line Modules

LED	Color	Status	Description, cause	Remedy
RDY	–	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation.	–
	Yellow	Continuous light	The precharging has not yet been completed. The bypass relay has dropped out. The EP terminals are not supplied with 24 V DC.	–
	Red	Continuous light	Overtemperature overcurrent	Diagnose the fault (using the output terminals) and acknowledge (using the input terminal).
DC LINK	–	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
	Yellow	Continuous light	The DC link voltage is within permissible tolerance range.	–
	Red	Continuous light	The DC link voltage is outside the permissible tolerance range or a line fault is present.	Check the line supply voltage.



⚠WARNING

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

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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	The electronics power supply is missing or outside the permissible tolerance range.	–
Green	--	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is outside the permissible tolerance range.	Check the line supply voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	This component has at least one fault. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Resolve and acknowledge the fault.
Green/red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download has been completed. The system waits for POWER ON.	Carry out a POWER ON.
Green/orange or red/orange	--	Component recognition via LED is activated[1]. **Note:** Both options depend on the LED status when component recognition is activated.	–

[1] See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



⚠WARNING

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

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4.9.6 Dimension drawings

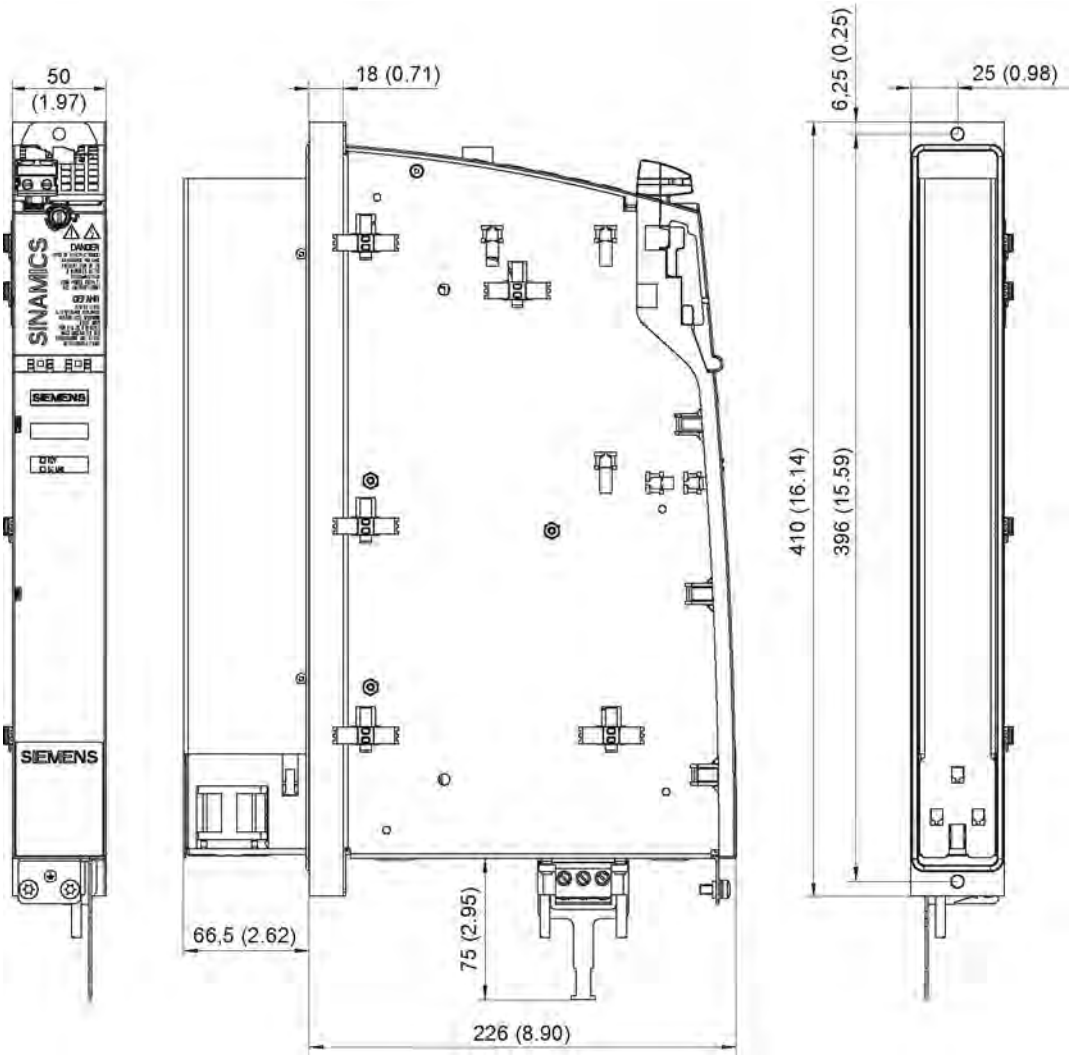


Figure 4-93 Dimension drawing of 5 kW and 10 kW Smart Line Modules with external air cooling, all dimensions in mm and (inches)

Note

The shield connecting plate is integrated in the power supply connector of the 50 mm Smart Line Modules.

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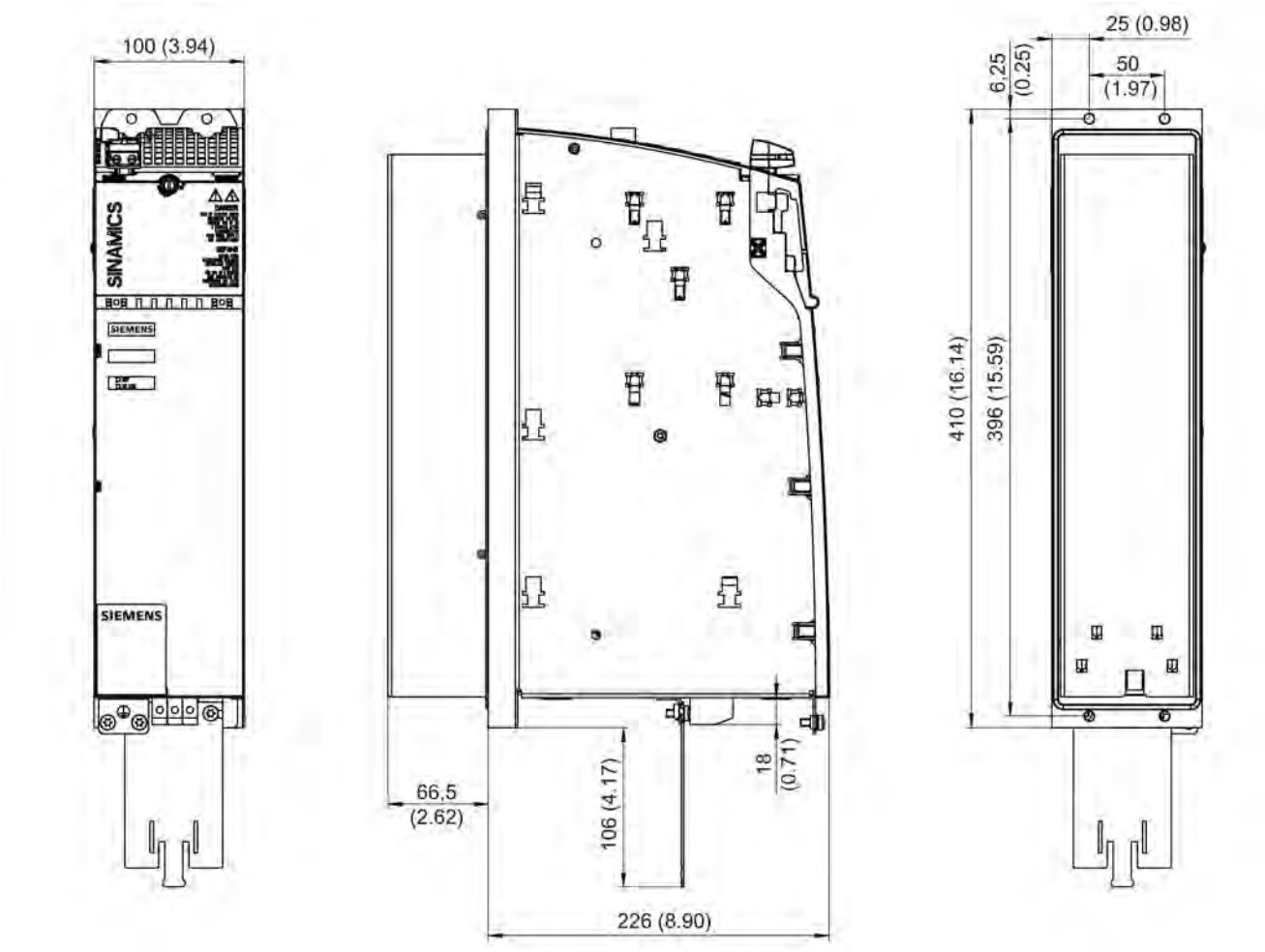


Figure 4-94 Dimension drawing of 16 kW Smart Line Module with external air cooling, all dimensions in mm and (inches)

Note

The shield connecting plate is part of the scope of delivery of the 100 mm Smart Line Modules.

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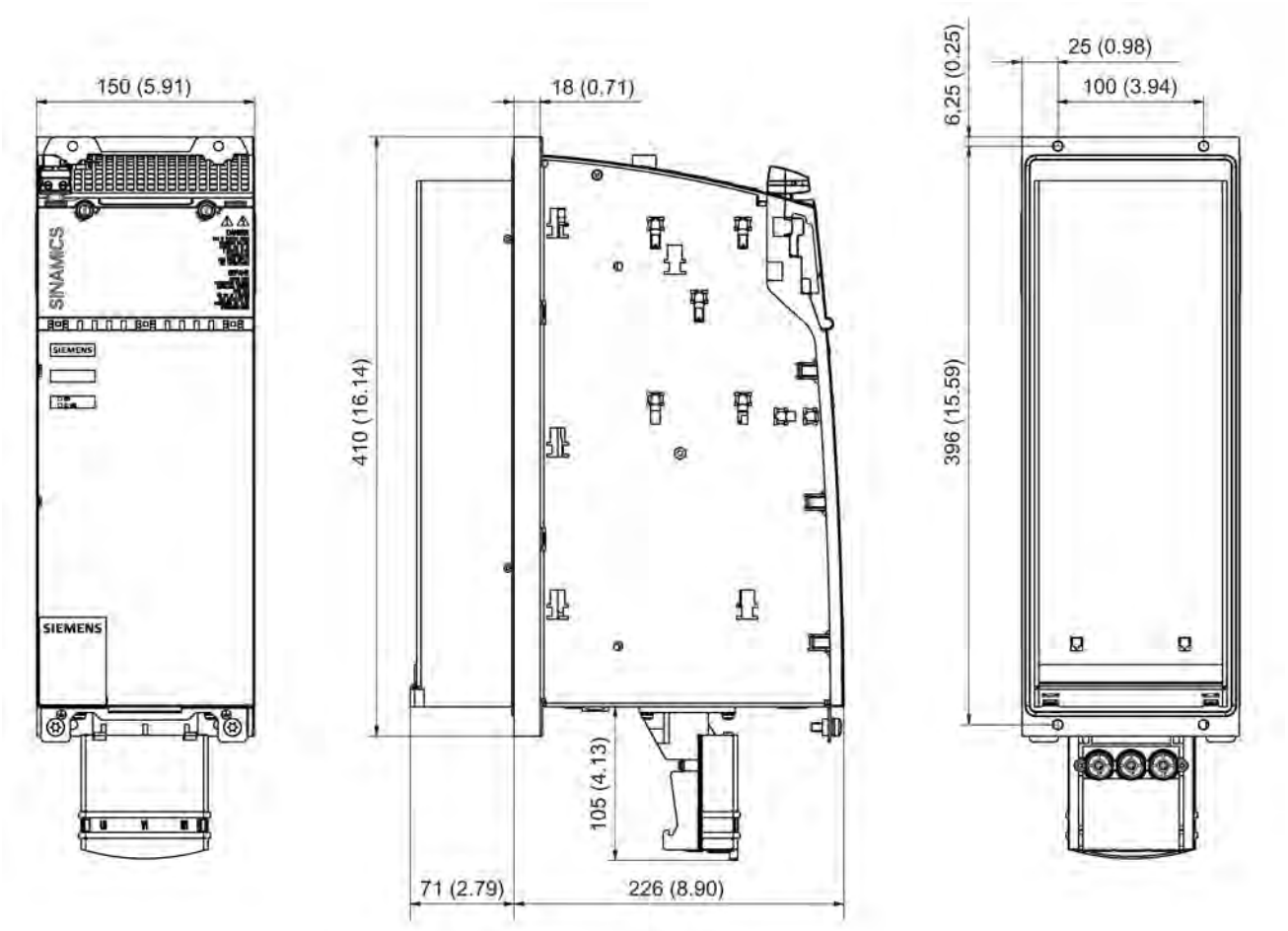


Figure 4-95 Dimension drawing of 36 kW Smart Line Module with external air cooling, all dimensions in mm and (inches)

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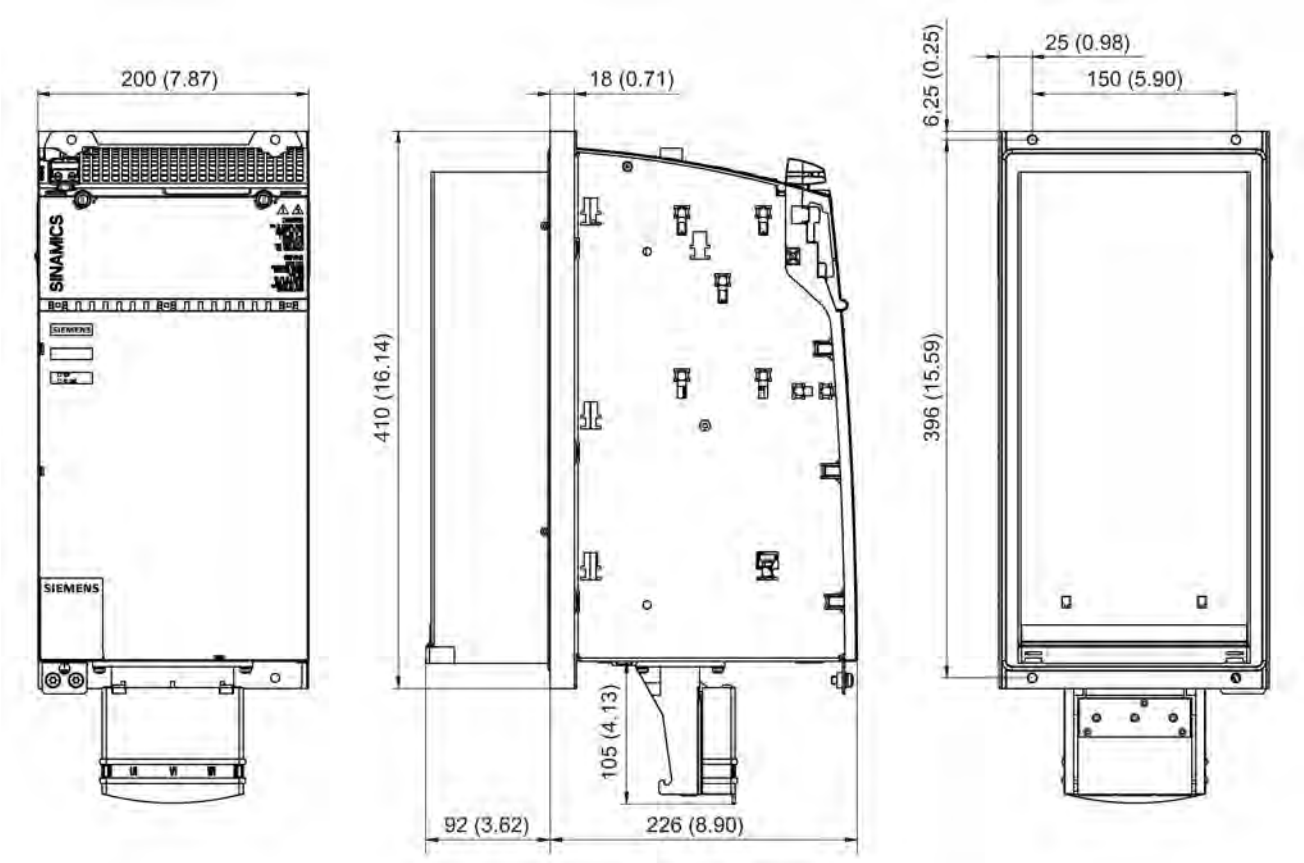
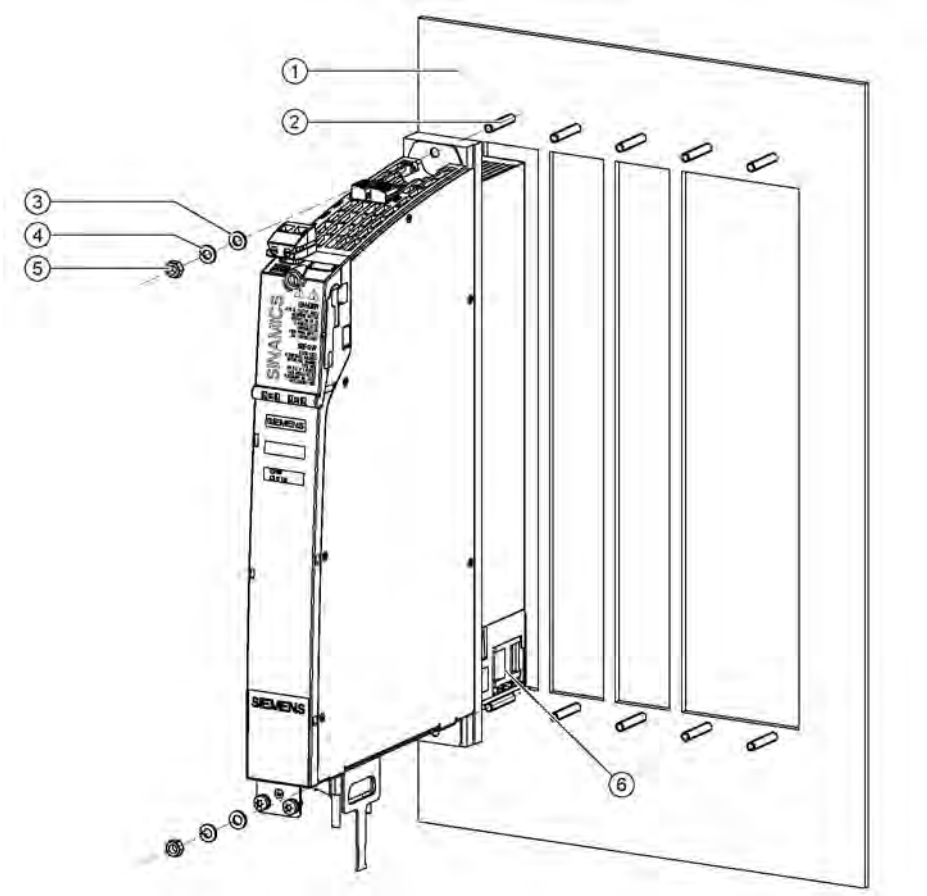


Figure 4-96 Dimension drawing of 55 kW Smart Line Module with external air cooling, all dimensions in mm and (inches)

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4.9.7 Mounting



① Mounting plate with openings
② M6 studs
③ Washer
④ Spring washer
⑤ M6 nut, width A/F 10 (hexagon head)
⑥ Fan assembly

Figure 4-97 Mounting a Smart Line Module with external air cooling on a mounting plate, using a 5 kW Smart Line Module as an example

Tightening torques:

- Firstly, tighten the nuts by hand.
  Tightening torque: 0.5 Nm
- Then tighten the nuts.
  Tightening torque: 6 Nm

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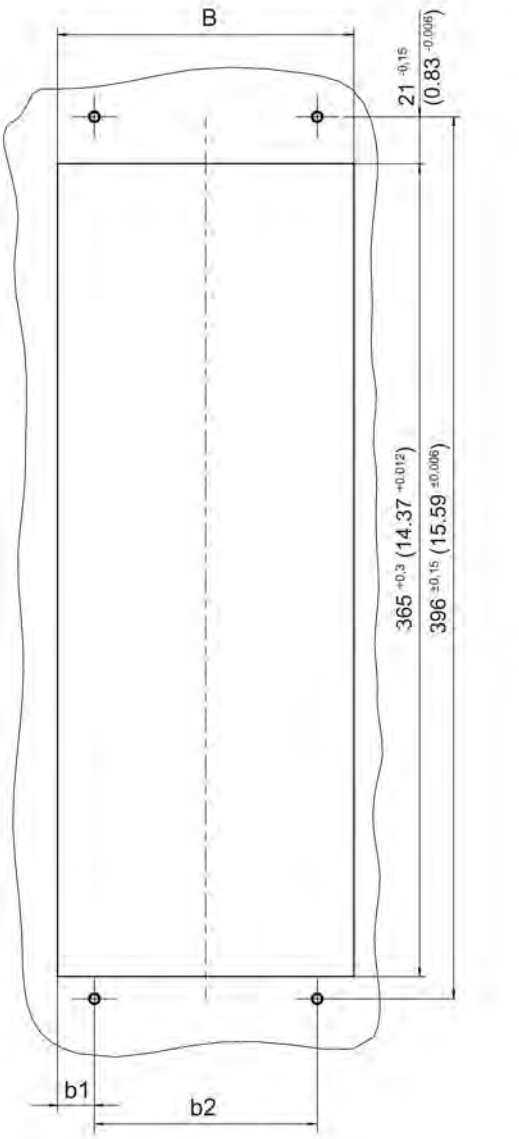
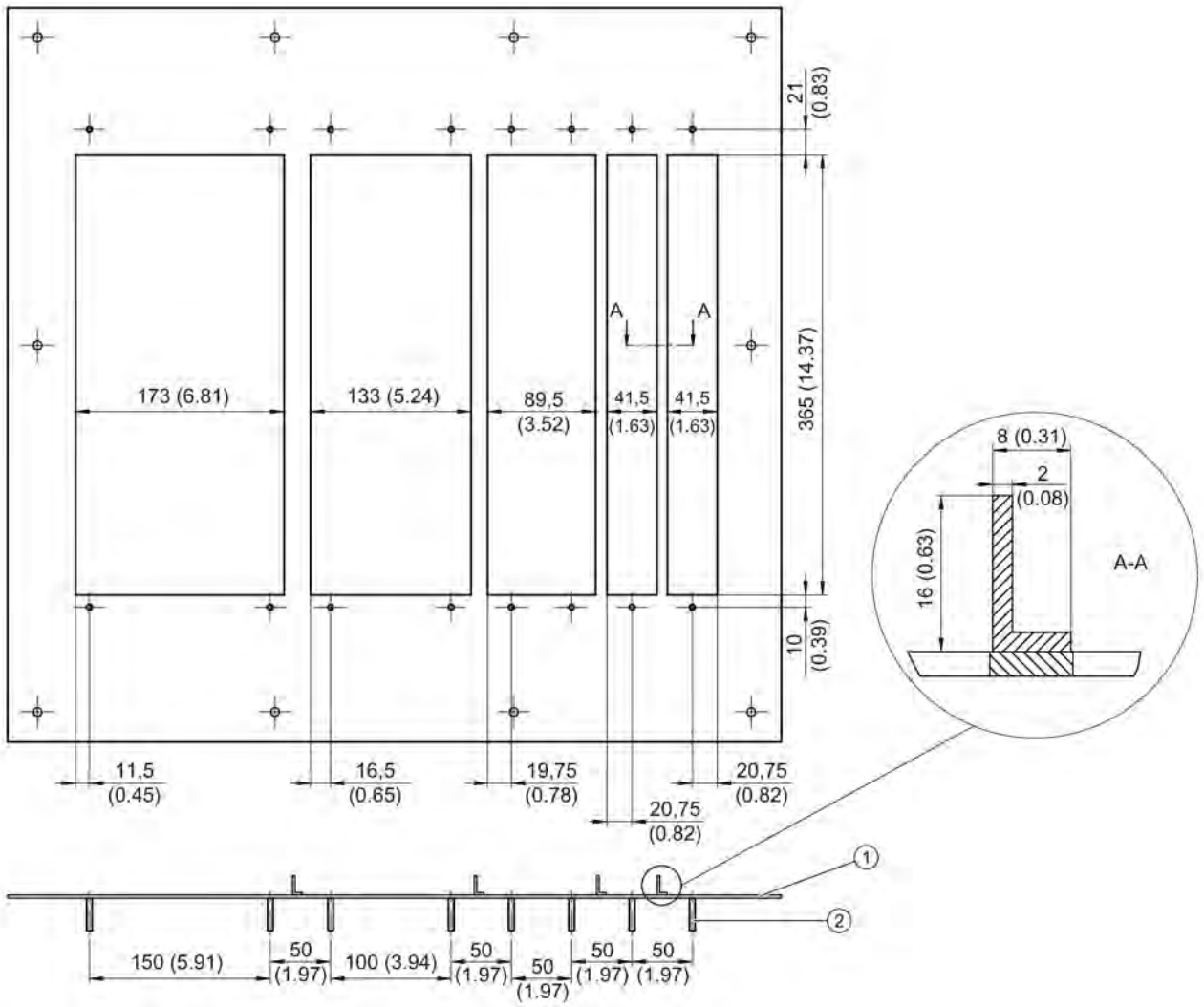


Figure 4-98 Opening to mount Smart Line Modules 50 mm to 200 mm with external air cooling, all data in mm and (inches)

Table 4- 84 Dimensions of openings to mount Smart Line Modules with external air cooling

Module width	W in mm (inches)	w1 in mm (inches)	w2 in mm (inches)
50 mm	41.5 +0.3 (1.63 +0.012)	20.75 +0.15 (0.82 +0.006)	--
100 mm	89.5 +0.3 (3.52 +0.012)	19.75 +0.15 (0.78 +0.006)	50 ±0.15 (1.97 ±0.006)
150 mm	133 +0.3 (5.24 +0.012)	16.5 +0.15 (0.65 +0.006)	100 ±0.15 (3.94 ±0.006)
200 mm	173 +0.3 (6.81 +0.012)	11.5 +0.15 (0.45 +0.006)	150 ±0.15 (5.91 ±0.006)

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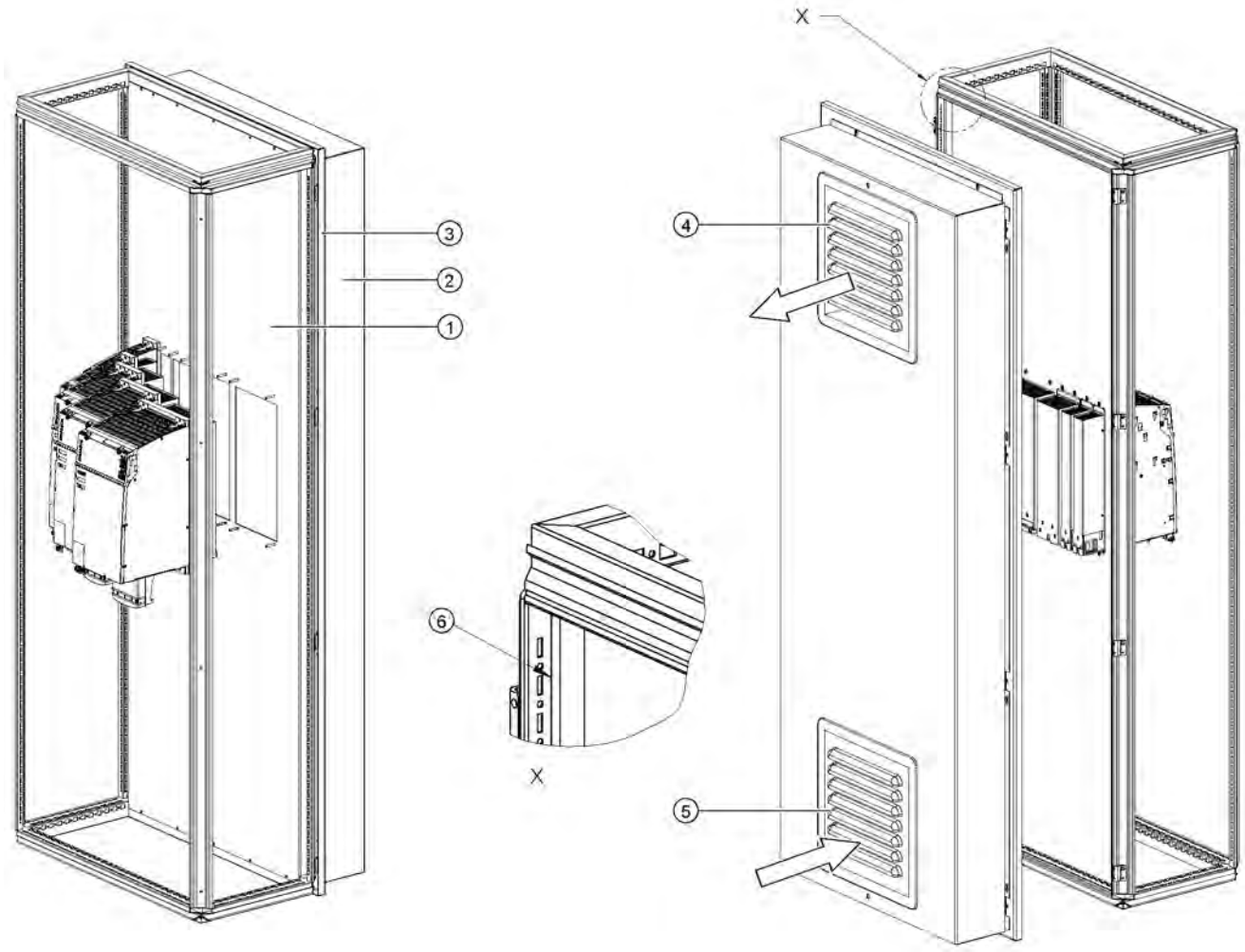
① Insert plate or mounting plate
② Threaded bolts M5 x 28

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 the example, the cross-pieces have been reinforced using brackets according to EN 755-9. You are free to select the way that the bracket is attached to the insert.

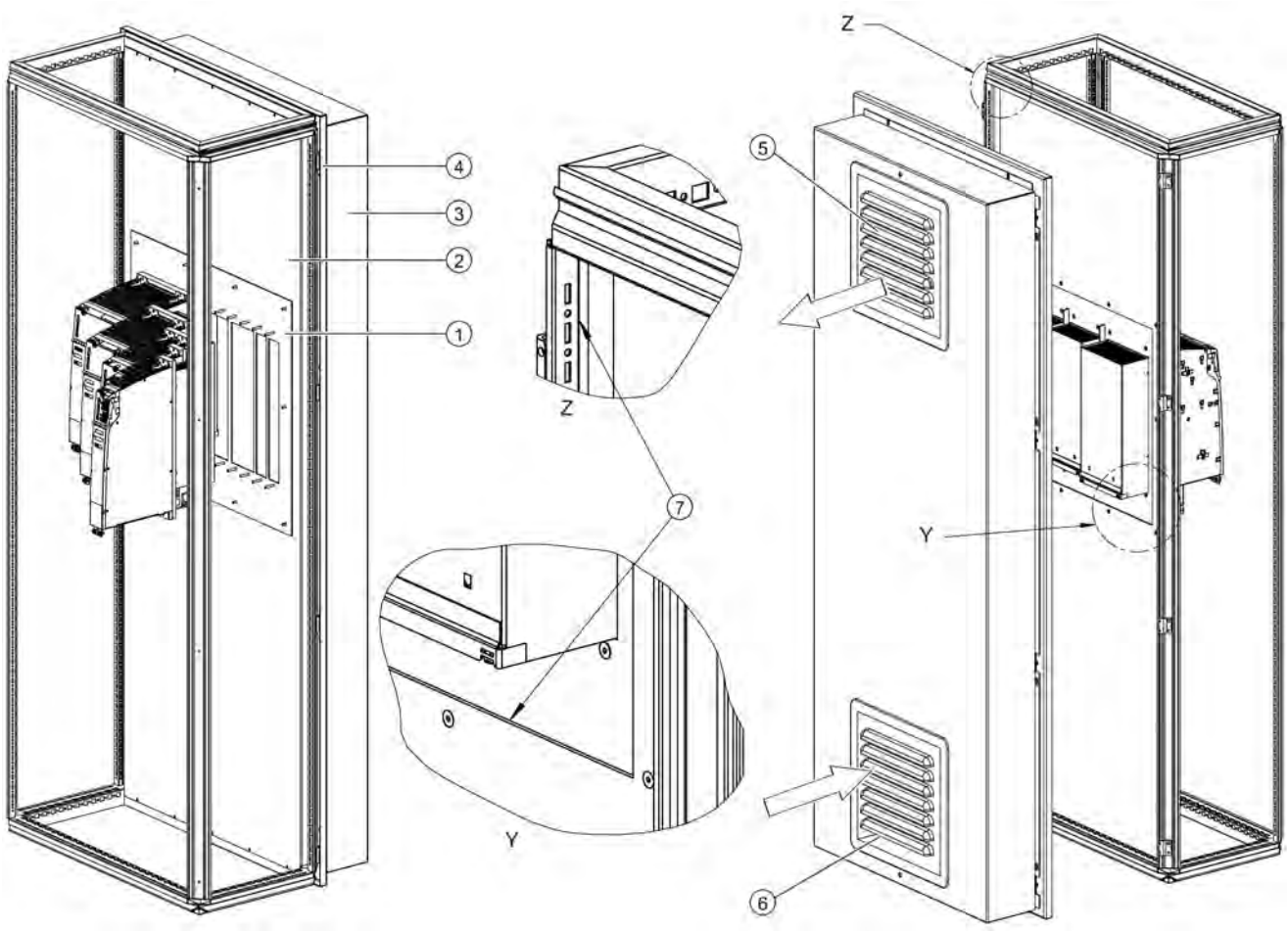
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① Mounting plate
② Cover
③ Rear panel
④ Air discharge
⑤ Air inlet - filter with filter fan
⑥ To comply with degree of protection IP54, the surfaces ⑥ between the mounting plate and the cabinet strip must be sealed all round. (for example, sealant Terostat-91 from the Teroson company)

Figure 4-100 Example 1: mounting in the cabinet with mounting plate

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① Insert plate
② Mounting plate
③ Cover
④ Rear panel
⑤ Air discharge
⑥ Air inlet - filter with filter fan
⑦ To maintain the degree of protection IP54, the surfaces ⑦ between the mounting plate and the cabinet strip as well as between the mounting plate and insert plate must be sealed all around. (for example, sealant Terostat-91 from the Teroson company)

Figure 4-101 Example 2: mounting in the cabinet with mounting plate

It is recommended that you attach a cover and filter fan to the cabinet.

The filtered fan must be fitted in such a way that the cooling air required by the drive line-up is not restricted. The overall cooling air requirement is obtained from the sum of the individual components (see Section "Technical data").

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Note

If the cooling air requirement is not covered by the filtered fan, the components cannot output their specified power.

The filters with filter fan must be regularly checked for dirt and cleaned if necessary.

Help with the mechanical control cabinet design is available from:

Siemens AG
Industry Sector, IA DT MC MF - WKC AS
TCCCC (Technical Competence Center Cabinets Chemnitz)
Postfach 1124
09070 Chemnitz, Germany

E-mail: cc.cabinetcooling.aud@siemens.com

4.9.8 Technical data

Table 4- 85 Technical data Smart Line Modules Booksize external air cooling

Internal air cooling	**6SL3131–**	**6AE15–0AAx**	**6AE21–0AAx**	**6TE21-6AAx**	**6TE23-6AAx**	**6TE25-5AAx**
Rated power	**kW**	**5**	**10**	**16**	**36**	**55**
Infeed						
Rated power (S1)[1)]	kW (P_n)	5	10	16	36	55
S6 operation (40 %)[1)]	kW (P_{s6})	6,5	13	21	47	71
Peak infeed power[1)]	kW (P_{max})	10	20	35	70	91
Regenerative feedback						
Continuous regenerative power	kW	5	10	16	36	55
Peak regenerative power	kW	10	20	35	70	91
Supply voltages						
Line voltage	V_{AC}	3 AC 380 … 480 ± 10 % (-15 % < 1 min)				
Line frequency	Hz	47 … 63				
Electronics power supply	V_{DC}	24 (20.4 … 28.8)				
DC link voltage	V_{DC}	510 … 720				
Overvoltage trip	V_{DC}	820 ± 2 %				
Undervoltage trip[2)]	V_{DC}	360 ± 2 %				
Input currents						
Rated input current						
at AC 400 V	A_{AC}	8,1	16,2	27,5	59	90
at AC 380 V / AC 480 V	A_{AC}	8,6 / 6,7	17 / 12,8	29 / 24,5	62 / 51	94 / 77
S6 (40 %)						
at AC 400 V	A_{AC}	10,6	21,1	35	76	106
Peak current						
at AC 400 V	A_{AC}	15,7	31,2	57,5	112	130

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Internal air cooling	**6SL3131–**	**6AE15–0AAx**	**6AE21–0AAx**	**6TE21-6AAx**	**6TE23-6AAx**	**6TE25-5AAx**
Rated power	**kW**	**5**	**10**	**16**	**36**	**55**
DC link currents DC link output current at DC 600 V at DC 540 V S6 (40 %) at DC 600 V Peak current at DC 600 V	 A_{DC} A_{DC} A_{DC} A_{DC}	 8,3 9,3 11 16,6	 16,6 18,5 22 33,2	 27 30 35 59	 60 67 79 118	 92 105 138 178
Current carrying capacity DC link busbars Reinforced DC link busbars 24 V DC busbars	 A_{DC} A_{DC} A_{DC}	 100 150 20	 100 150 20	 100 150 20	 200 -- 20	 200 -- 20
Electronics current drawn at 24 V DC	 A_{DC}	 0,8	 0,9	 0,95	 1,5	 1,9
Total power loss (incl. electronics losses) internal external (see power loss tables (Page 781))	W W W	79,2 41,2 38	141,6 66,6 75	187,8 64,8 123	406 116 290	665,6 185,6 480
Max. ambient temperature without derating with derating	 ° C ° C	 40 55				
DC link capacitance Smart Line Module Drive line-up, max.	 µF µF	 220 6000	 330 6000	 705 20000	 1410 20000	 1880 20000
Power factor	cos ϕ	0.98	0.98	0.98	0.98	0.98
Circuit breaker (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 51)				
Rated short-circuit current SCCR[3)]	kA	65	65	65	65	65
Sound pressure level	dB(A)	< 60	< 60	< 60	< 65	< 60
Cooling air requirement	m^3/h	29.6	29.6	56	112	160
Max. permissible heat sink temperature	° C	69[4)]	73[4)]	77	80	75
Rated voltage for rated data 3 AC 380 V						
Weight	kg	5.3	5.4	8.8	13.8	18.5

1) The specified power ratings apply to the line voltage range from 380 V to 480 V.

2) For 16 kW and 36 kW Smart Line Modules: Default for 400 V line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.

3) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker – and the Line Module in the drive system.

4) Values cannot be read out by the system (STARTER).

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4.9.8.1 Characteristics

Rated duty cycles of Smart Line Modules

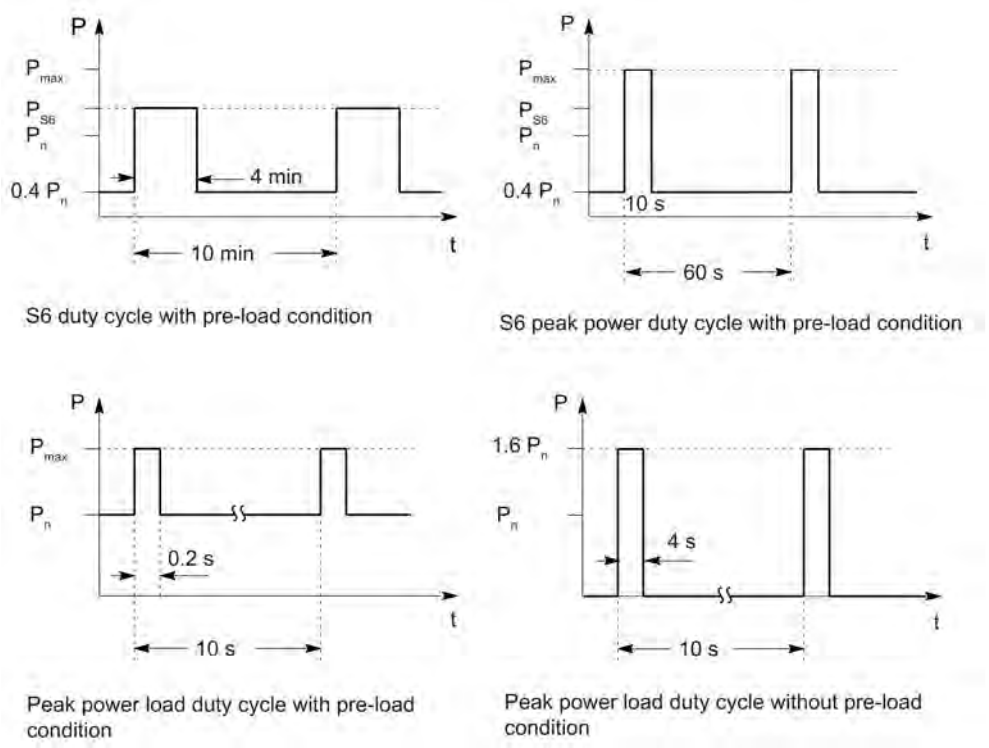


Figure 4-102 Rated duty cycles of Smart Line Modules

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Derating characteristics

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

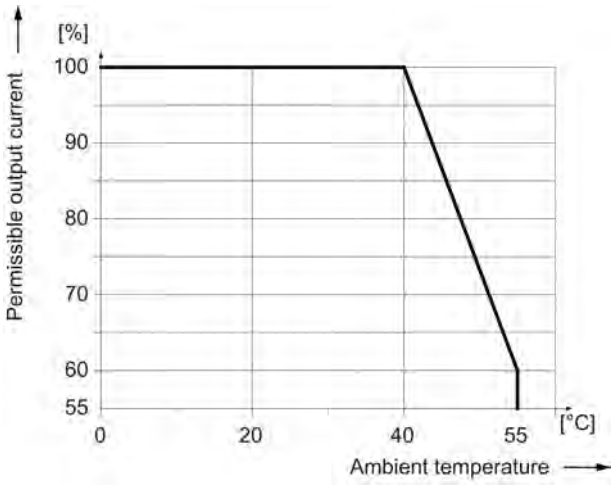


Figure 4-103 Output current as a function of the ambient temperature

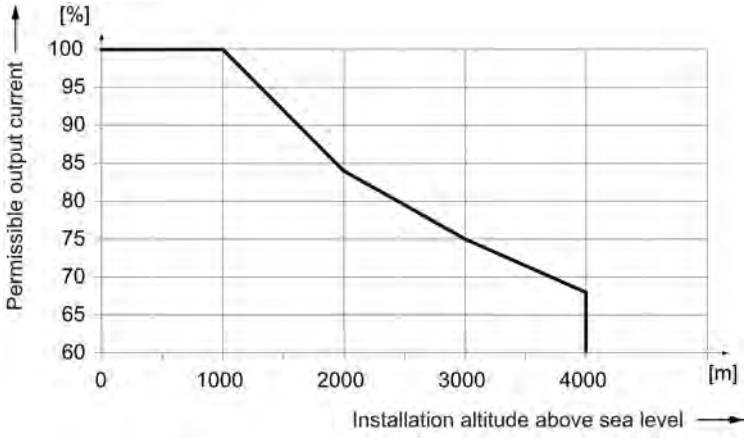


Figure 4-104 Output current as a function of the installation altitude

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4.10 Smart Line Modules with cold plate

4.10.1 Description

The Smart Line Module is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module with a non-regulated DC voltage at the DC output. In the infeed mode the Smart Line Module exhibits the typical current and voltage waveforms of a 6-pulse diode rectifier bridge.

In feedback mode, the current waveform is square waved. Feedback can be deactivated by means of a terminal because these Smart Line Modules are not equipped with a DRIVE-CLiQ connection.

The DC link starts precharging as soon as the line voltage is applied and is independent of its phase sequence direction. Load can be applied to the DC link after the module has been enabled. An optional main contactor is required for disconnecting the voltage.

Smart Line Modules are suitable for direct operation on TN, IT and TT systems. The Line Modules have an integrated overvoltage protection function.

4.10.2 Safety instructions for Smart Line Modules Booksize

⚠WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

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NOTICE

Destruction of the Smart Line Module for an incorrect switch-on or switch-off sequence

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair.

- Observe the "Ready" signal at output terminal X21.1:

  Switch on:
  - 24 V DC supply X24 ON
  - Line contactor ON
  - EP signal X21.3 and X21.4 ON
  - Wait until precharging has been completed
  - "Ready" signal at terminal X21.1 switched to high
  - Infeed is ready, pulse enable possible for motors

  Switch off:
  - Shut drives down
  - Cancel pulse enable for motors (OFF1 signal)
  - EP signal X21.3 and X21.4 OFF
  - Line contactor OFF
  - 24 V DC supply X24 OFF

  Overload:
  - "Prewarning" signal at terminal X21.2 switches to low
  - Shut drives down via the control system
  - "Ready" signal at terminal X21.1 switches to low
  - Pulse inhibit for all the drives supplied by this infeed within 4 ms

Note

Connected to the public low-voltage network

Smart Line Modules have been designed for use in the industrial environment and generate current harmonics on the line side as a result of the rectifier circuit.

When connecting a machine with integrated Smart Line Modules to the public low-voltage line supply (grid), authorization is required in advance from the local power supply company (utility company) in the following cases:

- The rated current of the motor ≤ 16 A per conductor.
- The rated motor current does not comply with the requirements specified in EN 61000-3-2 regarding current harmonics.

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4.10.3 Interface description

4.10.3.1 Overview

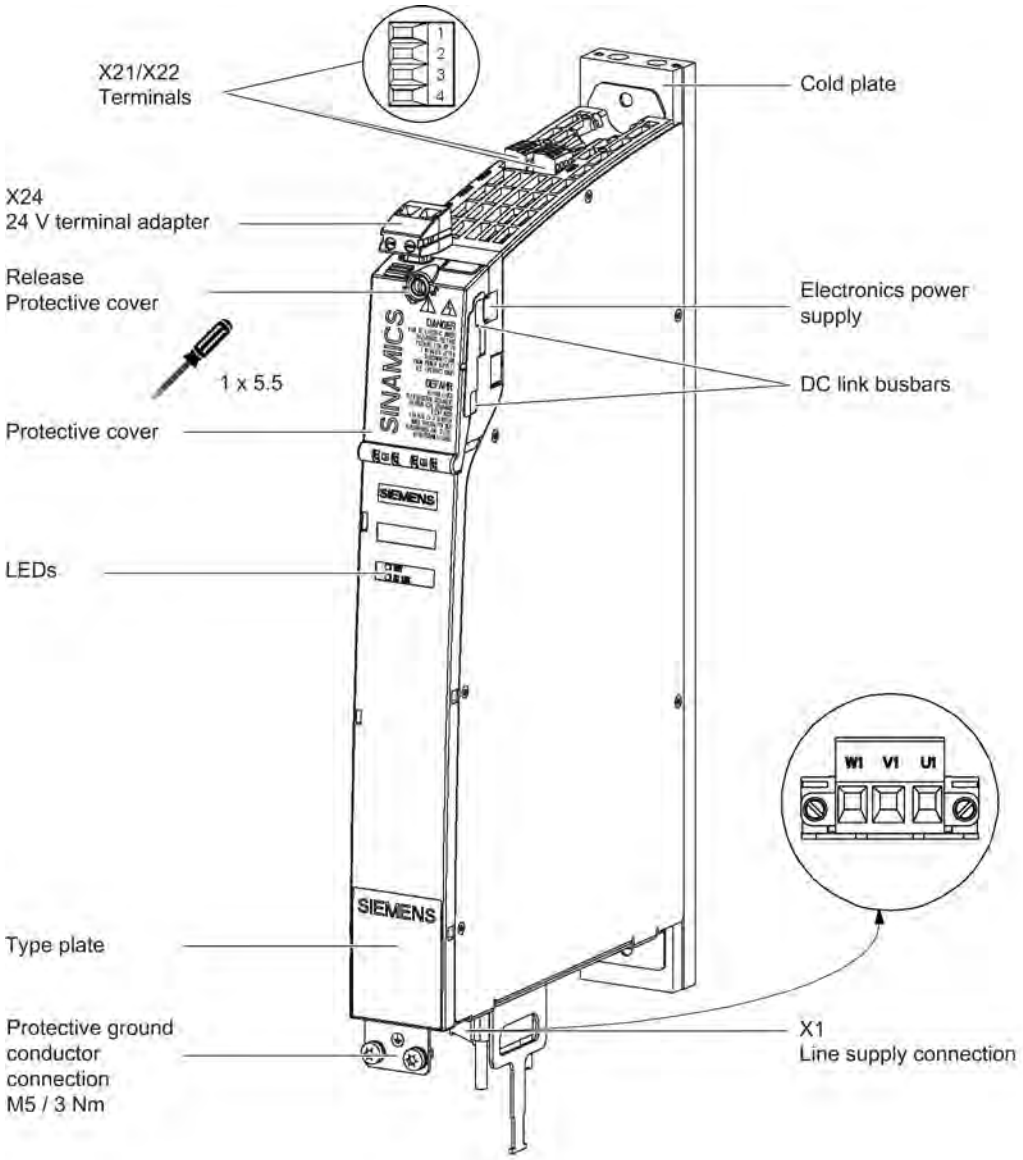
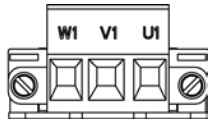
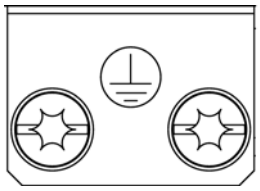


Figure 4-105 Interface overview, Smart Line Module with cold plate (example: 5 kW)

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4.10.3.2 X1 line connection

Table 4- 86 X1 line connection

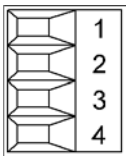
	Terminal	Technical data
	U1 V1 W1	Supply voltage: 3 AC 380 … 480 V, 50 / 60 Hz Max. connectable cross-section: 6 mm² Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm² Tightening torque: 1.2 … 1.5 Nm
	PE connection	Threaded hole M5 / 3 Nm[1]

1) For ring cable lugs without insulation

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4.10.3.3 X21 EP terminals

Table 4- 87 X21 EP terminals

	Terminal	Designation	Technical data
	1	DO: Ready	Feedback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: • Electronics power supply (X24) OK • DC link is precharged • Pulses enabled (X21.3/.4) • No overtemperature • No overcurrent switch-off
	2	DO: Prewarning	DO: Prewarning High = no prewarning Low = prewarning • Overtemperature warning threshold / I*t 5 kW prewarning: 64° C, disconnection: 69° C 10 kW prewarning: 68° C, disconnection: 73° C • No regenerative feedback capability due to a line fault [only monitored when feedback is activated (see terminal X22.2)]
	3	EP +24 V (pulse enable)	Voltage 24 V DC Current consumption: 10 mA Isolated input
	4	EP M (Enable Pulses)	
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm²			

Terminals X21.1 and X21.2

Note

Wiring to a digital input of the Control Unit

Output terminal X21.1 must be wired to a digital input on the CU. The drives supplied with power from the Smart Line Module have to use this signal as a ready signal. This ensures that a pulse enable can only be issued for the drives (motor or generator operation) when the infeed is ready.
If interconnection with a digital input on the CU is not possible, the signal must be evaluated by a higher-level control system instead. It is not permissible that the control system sets the drives to ready until the infeed "Ready" signal is present.

Note

Evaluating the "Prewarning" signal

The "Prewarning" signal at output terminal X21.2 warns against an overload. If this signal is set, the control system shuts the drives down before the "Ready" signal switches to "low". If the "Ready" signal switches to "low", the drive pulses must be suppressed within 4 ms.

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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^2t). 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^2t).

Terminals X21.3 and X21.4



WARNING

Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4.

Pulse cancellation is activated if the power supply is disconnected. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example, because a line contactor is not installed, then the DC link remains charged.

Death or serious injury can result when live parts are touched.

- Neutralize the voltage in the DC link.

NOTICE

Damage to the drive electronics when switching the line contactor under load

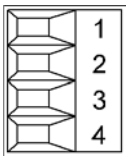
When switching the line contactor (type according to the recommended selection) under load, then the contacts will be subject to premature wear. This can cause the contactor to malfunction, with subsequent damage to the drive electronics.

- Use a leading opening auxiliary contact or use a Voltage Sensing Module (VSM10).
- If this is not possible, then avoid switching the line contactor under load.

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4.10.3.4 X22 digital inputs

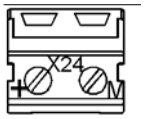
Table 4- 88 X22 digital inputs for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation[1)]	Technical data
	1	24 V power supply	Electronics power supply for controlling digital inputs X22.2 and 3
	2	DI: Disable Regeneration	Deactivate regenerative feedback (high active) No power is supplied back to the network from the DC link. The regenerative energy of the motors may have to be reduced using a combination of the Braking Module and braking resistor.
	3	DI: Reset	Reset faults (negative edge)
	4	Ground	Electronics ground
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected: 1.5 mm^2			

1) DI: Digital input

4.10.3.5 X24 24 V terminal adapter

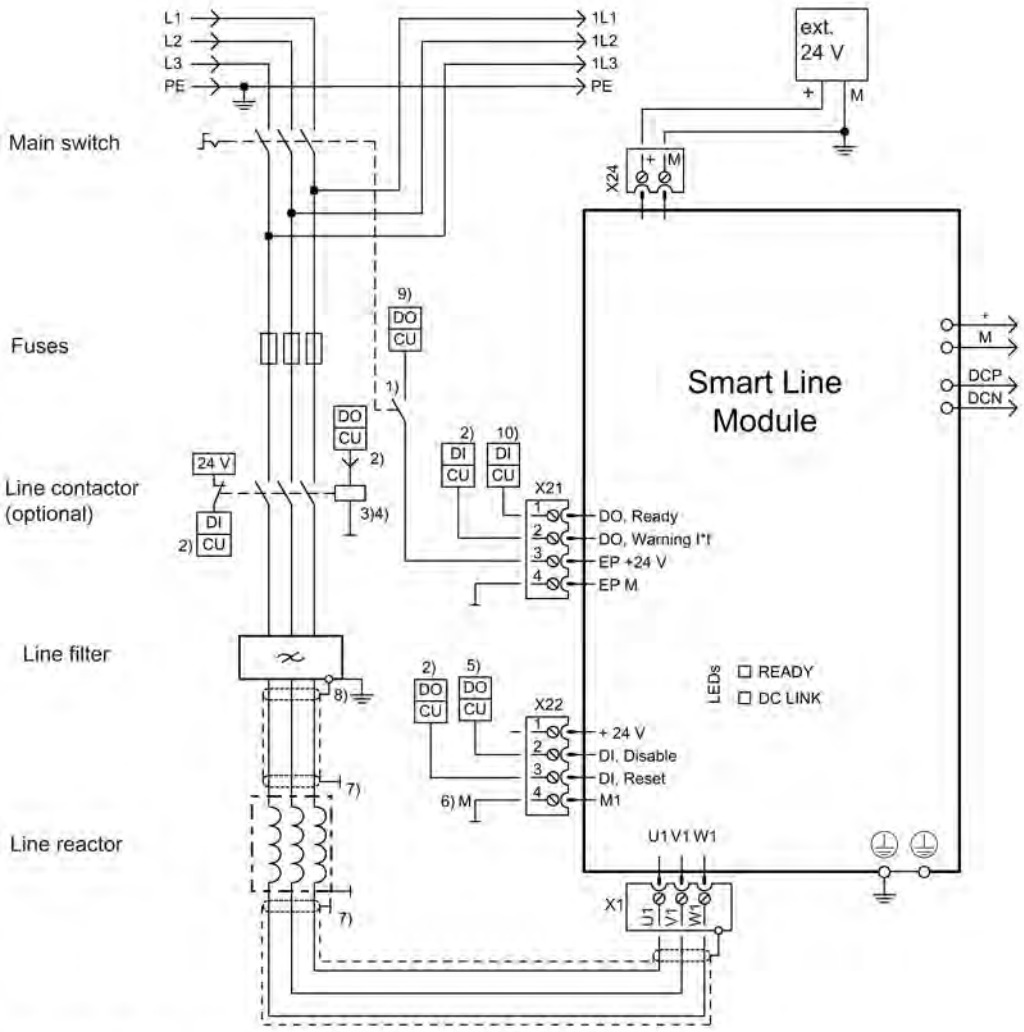
Table 4- 89 X24: 24 V terminal adapter

	Terminal	Designation	Technical data
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm^2			

The 24 V terminal adapter is included in the scope of supply.

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4.10.4 Connection example



1) Leading NC contact t >10 ms, 24 VDC and ground must be set up for operation.
2) DI/DO controlled from the Control Unit
3) No additional load permitted downstream of the line contactor
4) The current-carrying capacity of the DO must be observed; an output coupling device must be used if required.
5) DO high, regenerative feedback deactivated (a jumper can be inserted between X22 pin 1 and pin 2 for permanent deactivation).
6) X22 pin 4 must be connected to ground (ext. 24 V).
7) Contact established via rear mounting panel or shielding buses in accordance with the EMC installation guideline
8) 5 kW and 10 kW line filters via shield connection
9) Signal output of the control, to avoid interference of the 24 VDC supply on the EP terminal.
10) Interconnection via BICO to parameter p0864

Figure 4-106 Connection example for 5 kW and 10 kW Smart Line Modules

Note

If you are using a VSM10 Voltage Sensing Module, the leading opening contact can be omitted.

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4.10.5 Meaning of LEDs

Table 4- 90 Meaning of the LEDs on 5 kW and 10 kW Smart Line Modules

LED	Color	Status	Description, cause	Remedy
RDY	–	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation.	–
	Yellow	Continuous light	The precharging has not yet been completed. The bypass relay has dropped out. The EP terminals are not supplied with 24 V DC.	–
	Red	Continuous light	Overtemperature overcurrent	Diagnose the fault (using the output terminals) and acknowledge (using the input terminal).
DC LINK	–	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
	Yellow	Continuous light	The DC link voltage is within permissible tolerance range.	–
	Red	Continuous light	The DC link voltage is outside the permissible tolerance range or a line fault is present.	Check the line supply voltage.



⚠WARNING

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

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4.10.6 Dimension drawings

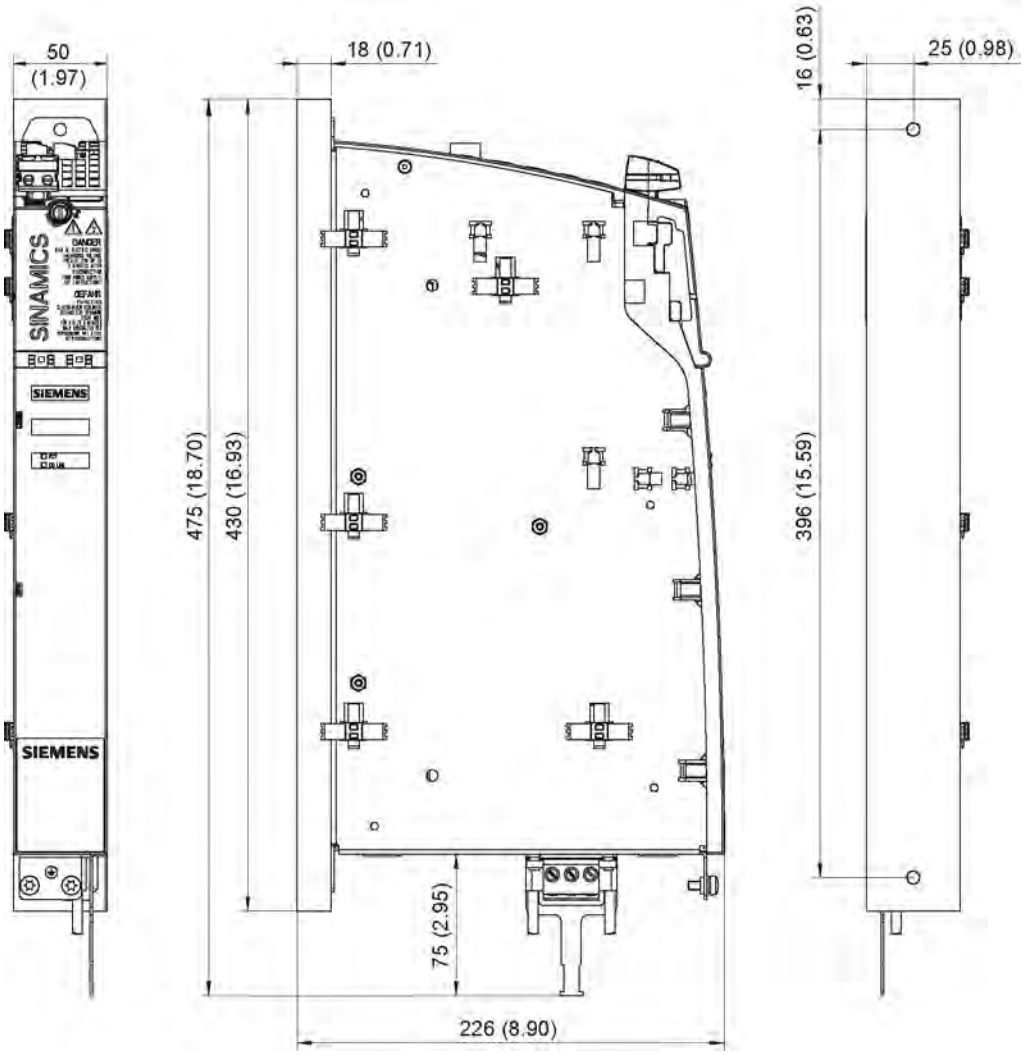


Figure 4-107 Dimension drawing of Smart Line Module with cold plate (5 kW and 10 kW), all dimensions in mm and (inches)

Note

The shield connecting plate is integrated in the power supply connector of the 50 mm Smart Line Modules.

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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).

Note

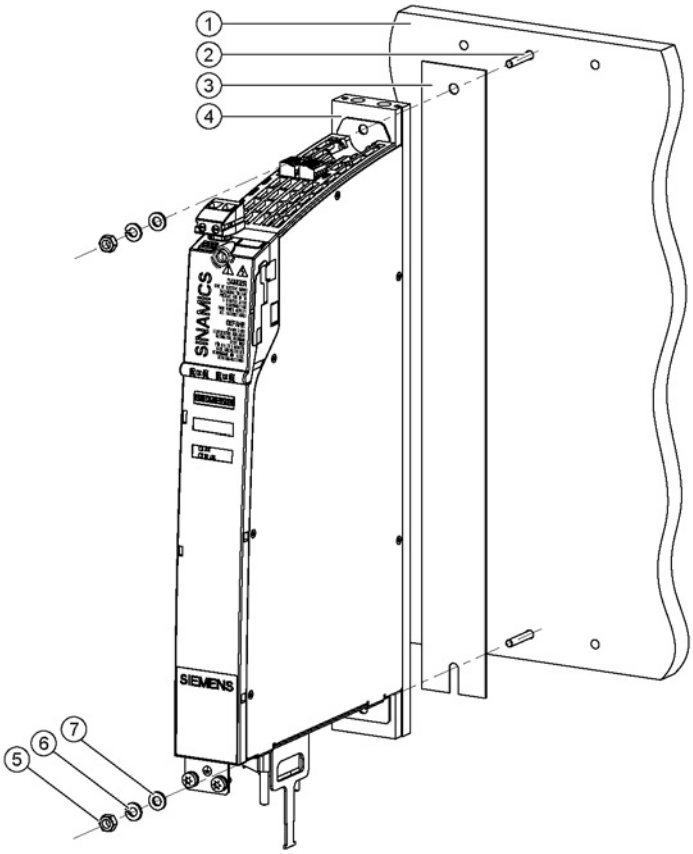
- Also replace the heat-conducting foil when replacing a component.
- Only use heat-conducting foil released or supplied by Siemens.

	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.

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① External heat sink (air or liquid)
② M6 studs
③ Heat-conducting foil
④ Cold plate
⑤ M6 nut
⑥ Spring washer
⑦ Washer

Figure 4-108 Mounting a Smart Line Module with cold plate on an external heat sink, using a 5 kW Smart Line Module as an example

Tightening torques:

- Firstly, only tighten the nuts by hand.
  Tightening torque: 0.5 Nm
- Then tighten the nuts.
  Tightening torque: 10 Nm

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Help with the mechanical control cabinet design is available from:
Siemens AG
Industry Sector, IA DT MC MF - WKC AS
TCCCC (Technical Competence Center Cabinets Chemnitz)
Postfach 1124
09070 Chemnitz, Germany
E-mail: cc.cabinetcooling.aud@siemens.com

Properties of the heat sink

We recommend using AlMgSi 0.5 as the heat sink material.
The roughness of the external heat sink surface should be at least Rz 16 and the contact surface between the heat sink and cold plate should have an evenness of 0.2 mm.

Note

Machine manufacturers can adapt the heat sink version to their special requirements. The specified rated data for the Power Modules can only be achieved if the power losses can be dissipated by the external heat sink under the specified general conditions.

NOTICE
Damage to the cold plate caused by incorrect mounting The screw bolts can be damaged when mounting the cold plate. • Do not damage the cold plate.

4.10.8 Technical data

Table 4- 91 Technical data for Smart Line Modules with cold plate cooling

	6SL3136-	6AE15-0AAx	6AE21-0AAx
Rated power	**kW**	**5**	**10**
Infeed			
Rated power (S1)[1)]	kW (P_n)	5	10
Infeed power (S6 - 40 %)[1)]	kW (P_{S6})	6,5	13
Peak infeed power[1)]	kW (P_{max})	10	20
Regenerative feedback			
Continuous regenerative power	kW	5	10
Peak regenerative power	kW	10	20
Supply voltages			
Line voltage	V_{AC}	3 AC 380 … 480 ± 10 % (-15 % < 1 min)	
Line frequency	Hz	47 … 63	
Electronics power supply	V_{DC}	24 (20.4 … 28.8)	
DC link voltage	V_{DC}	510 … 720	
Overvoltage trip	V_{DC}	820 ± 2 %	
Undervoltage trip	V_{DC}	360 ± 2 %	

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	6SL3136-	6AE15-0AAx	6AE21-0AAx
Input currents			
Rated input current			
at AC 400 V	A_{AC}	8,1	16,2
Input current			
at AC 380 V / AC 480 V	A_{AC}	8,6 / 6,7	17 / 12,8
at AC 400 V; S6 - 40 %	A_{AC}	10,6	21,1
at AC 400 V; peak current	A_{AC}	15,7	31,2
DC link currents			
Rated DC link current			
at 600 V	A_{DC}	8.3	16.6
DC link current			
at 540 V	A_{DC}	9.3	18.5
at DC 600 V; S6 - 40 %	A_{DC}	11	22
at DC 600 V; peak current	A_{DC}	16.6	33.2
Current carrying capacity			
DC link busbars	A_{DC}	100	100
Reinforced DC link busbars	A_{DC}	150	150
24 V DC busbars	A_{DC}	20	20
Electronics current drawn			
at 24 V DC	A_{DC}	0.6	0.7
Power loss distribution			
(incl. electronics losses)			
internal	W	34.4	56.8
external	W	40	80
(see power loss tables (Page 781))			
DC link capacitance			
Smart Line Module	µF	220	330
Drive line-up, max.	µF	6000	6000
Power factor	cosϕ	1	1
Circuit breaker (IEC 60947 and UL)		See Section Overcurrent protection using line fuses and circuit breakers (Page 51)	
Rated short-circuit current SCCR[2)]	kA	65	65
Max. permissible heat-sink temperature	° C	60	65
Max. ambient temperature			
without derating	° C	40	40
with derating	° C	55	55
Weight	kg	4,0	4,0

1) The specified power ratings apply to the line voltage range from 380 V to 480 V.

2) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker – and the Line Module in the drive system.

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4.10.8.1 Characteristics

Rated duty cycles of Smart Line Modules

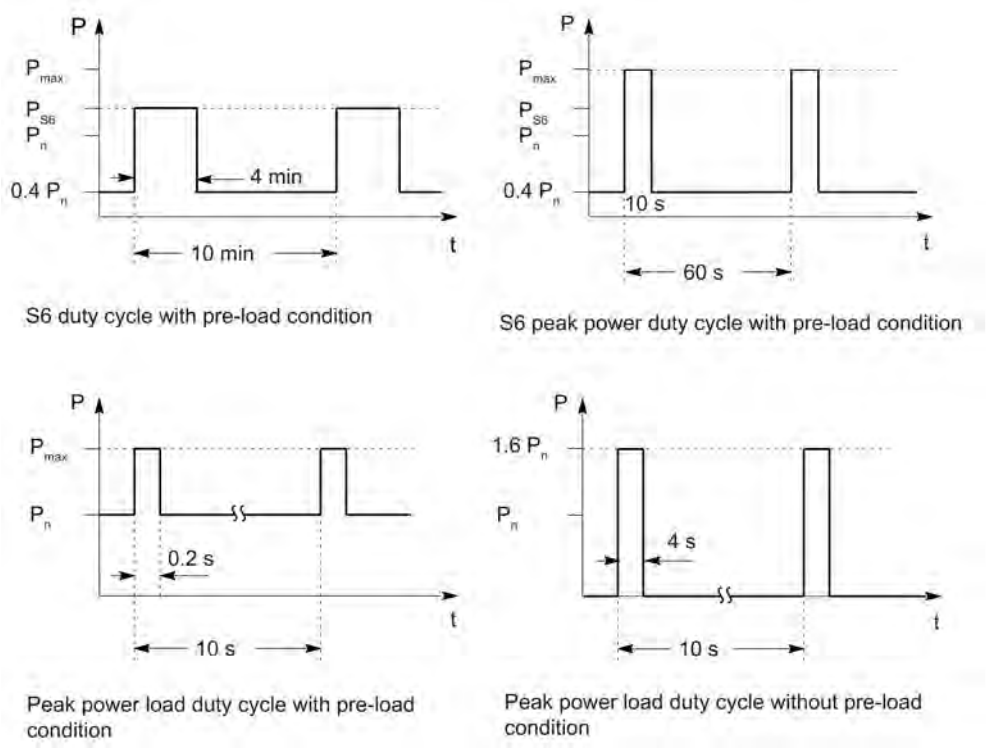


Figure 4-109 Rated duty cycles of Smart Line Modules

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Derating characteristics

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

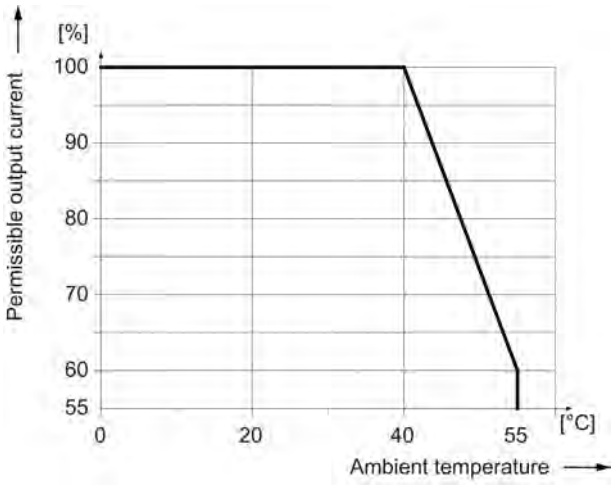


Figure 4-110 Output current as a function of the ambient temperature

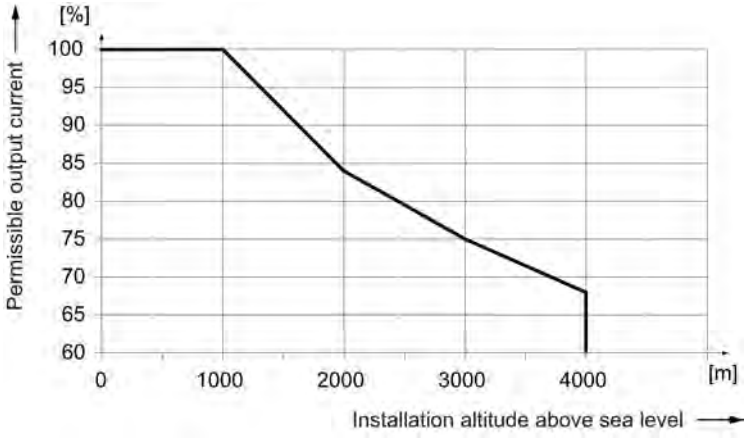


Figure 4-111 Output current as a function of the installation altitude

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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.

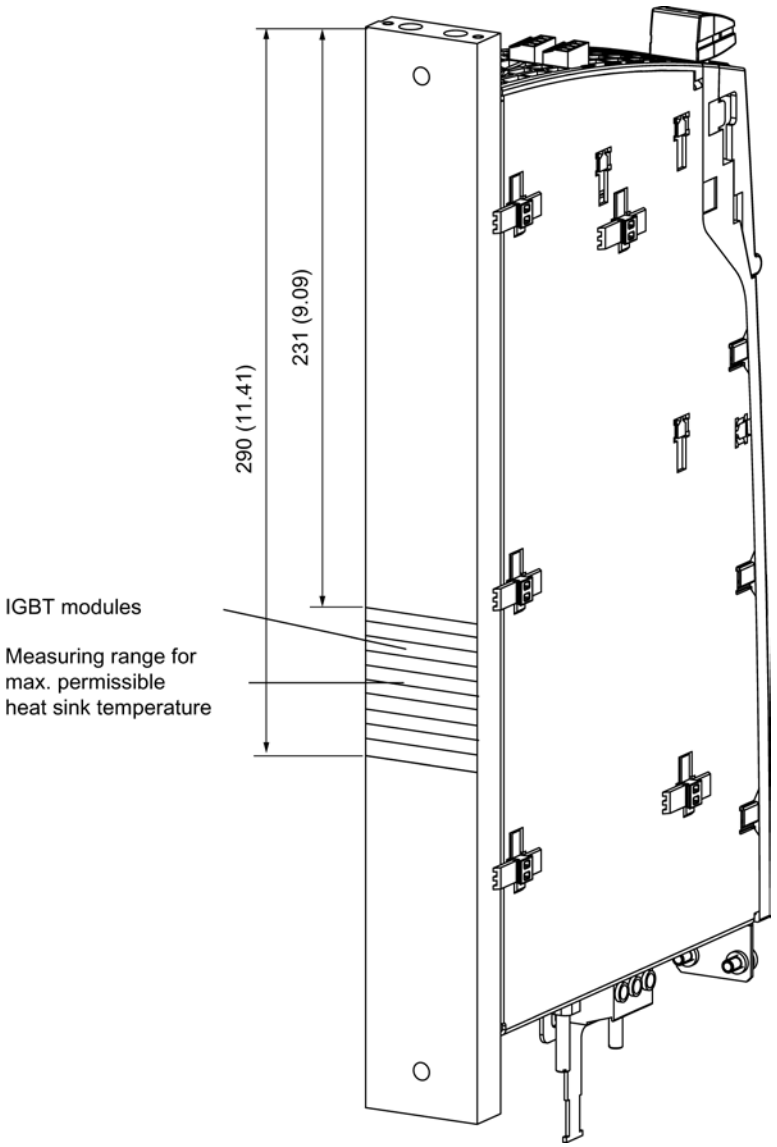


Figure 4-112 Measuring range for max. permissible heat-sink temperature for a Smart Line Module with cold plate

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Line Modules Booksize Compact

5

5.1 Smart Line Modules Booksize Compact

5.1.1 Description

The Smart Line Module booksize compact is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module with a non-regulated DC voltage at the DC output. In the infeed mode the Smart Line Module exhibits the typical current and voltage waveforms of a 6-pulse diode rectifier bridge.

In feedback mode, the current waveform is square waved. The regenerative feedback can be deactivated by means of parameters.

A line contactor can be installed on the line side if the system has to be electrically isolated from the line supply.

The Smart Line Module in booksize compact format can be used with cooling types "internal air cooling" or "cold plate". The cooling type is selected by parameter (see the SINAMICS S120/S150 List Manual).

Smart Line Modules are suitable for direct operation in TN, IT, and TT systems. The Line Modules have an integrated overvoltage protection function.

5.1.2 Safety instructions for Smart Line Modules Booksize Compact

⚠ WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

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WARNING

Danger to life through electric shock as well as fire hazard due to overcurrent protective devices that trip too late

Overcurrent protective devices that do not trip or trip too late can cause an electric shock or fire.

- To protect personnel and for fire protection purposes, at the infeed point, the short-circuit rating and loop impedance must correspond to the specifications in the documentation in order for the installed overcurrent protection devices to trip within the specified time.



DANGER

Danger to life through electric shock due to a high DC link voltage

As long as the Line Module is connected to the line supply, the DC link is charged with a high voltage. Contact with components can result in death or serious injury.

- Isolate the Line Module from the line supply during installation or maintenance work, e.g. via the line contactor or main switch.



DANGER

Danger to life through electric shock due to the residual charge of the DC link capacitors

Because of the DC link capacitors, a hazardous voltage is present for up to five minutes after the power supply has been switched off.

Contact with live parts can result in death or serious injury.

- Do not open the protective cover of the DC link until 5 minutes have elapsed.
- Measure the voltage before starting work on the DCP and DCN DC link terminals.



DANGER

Danger to life through electric shock when the protective cover of the DC link is open

Contact with live parts can result in death or serious injury.

- Only operate the components with closed protective cover.



WARNING

Danger to life through electric shock due to incorrect connection to the DC link

Incorrect connections can lead to overheating and therefore a risk of fire. There is also a risk of an electric shock. This can result in serious injury or death.

- Only use adapters (DC link adapters and DC link rectifier adapters) released by Siemens for the connection to the DC link.

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⚠WARNING

Danger to life through electric shock due to missing DC link side covers

There is a danger of an electric shock through contact when the side covers of the DC link are missing.

- Mount the side covers on the first and last component in the drive line-up.

You can order missing side covers (order number: 6SL3162-5AA00-0AA0).



⚠WARNING

Danger to life due to high leakage currents caused by an interrupted external protective conductor

The drive components conduct a high leakage current via the protective conductor. Touching conductive parts when the protective conductor is interrupted can result in death or serious injury.

- Ensure that the external protective conductor satisfies at least one of the following conditions:
  - It has been laid so that it is protected against mechanical damage.[1)]
  - If it is a single conductor, it has a cross-section of at least 10 mm² Cu.
  - If it is a conductor of a multi-conductor cable, it has a cross-section of at least 2.5 mm² Cu.
  - It has a second protective conductor in parallel with the same cross-section.
  - It complies with the local regulations for equipment with increased leakage current.

  [1)] Cables laid within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.

⚠WARNING

Danger of an accident due to missing warning labels in the national language.

Missing warning labels in the national language can result in death or serious injury.

- Attach the component warning labels in the national language.

⚠WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

Inadequate ventilation clearances can cause overheating with a risk for personnel due to smoke and fire. This can also result in increased failure rates and a shorter service life for Line Modules.

- Maintain the 80 mm clearances above and below the Line Modules.

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⚠ CAUTION

Fire hazard due to overheating when the total length of the power cables is exceeded

Overheating and a fire can result when the total length of the power cables is exceeded.

- Ensure that the total length of the power cables (motor supply cables and DC link cables) does not exceed the values specified in Chapter Combining line reactors and line filters (Page 136).

Note

Operation on line supplies where energy recovery is not possible

In line supply systems without energy recovery capability (e.g. a diesel generator), device faults can occur as the braking energy cannot be dissipated.

- For line supplies without regenerative feedback capability (e.g. diesel generator), deactivate the regenerative feedback capability of the Line Modules using the appropriate parameter (see SINAMICS S120/S150 List Manual).
- The braking energy must then be dissipated via an additional Braking Module with braking resistor in the drive line-up.

Exception: For 5 kW and 10 kW Smart Line Modules, the regenerative feedback capability must be deactivated as follows:

- Jumper between terminals X22.1 and X22.2
- Ground at X22.4

NOTICE

Damage to the drive electronics when switching the line contactor under load

When switching the line contactor (type according to the recommended selection) under load, then the contacts will be subject to premature wear. This can cause the contactor to malfunction, with subsequent damage to the drive electronics.

- Use a leading opening auxiliary contact or use a Voltage Sensing Module (VSM10).
- If this is not possible, then avoid switching the line contactor under load.

NOTICE

Damage through use of incorrect DRIVE-CLiQ cables

Damage or malfunctions can occur on the devices or system when DRIVE-CLiQ cables are used that are either incorrect or have not been approved for this purpose.

- Only use suitable DRIVE-CLiQ cables that have been approved by Siemens for the particular application.

Note

Malfunctions due to polluted DRIVE-CLiQ interfaces

Malfunctions can occur in the system through the use of polluted DRIVE-CLiQ interfaces.

- Cover unused DRIVE-CLiQ interfaces with the supplied blanking covers.

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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

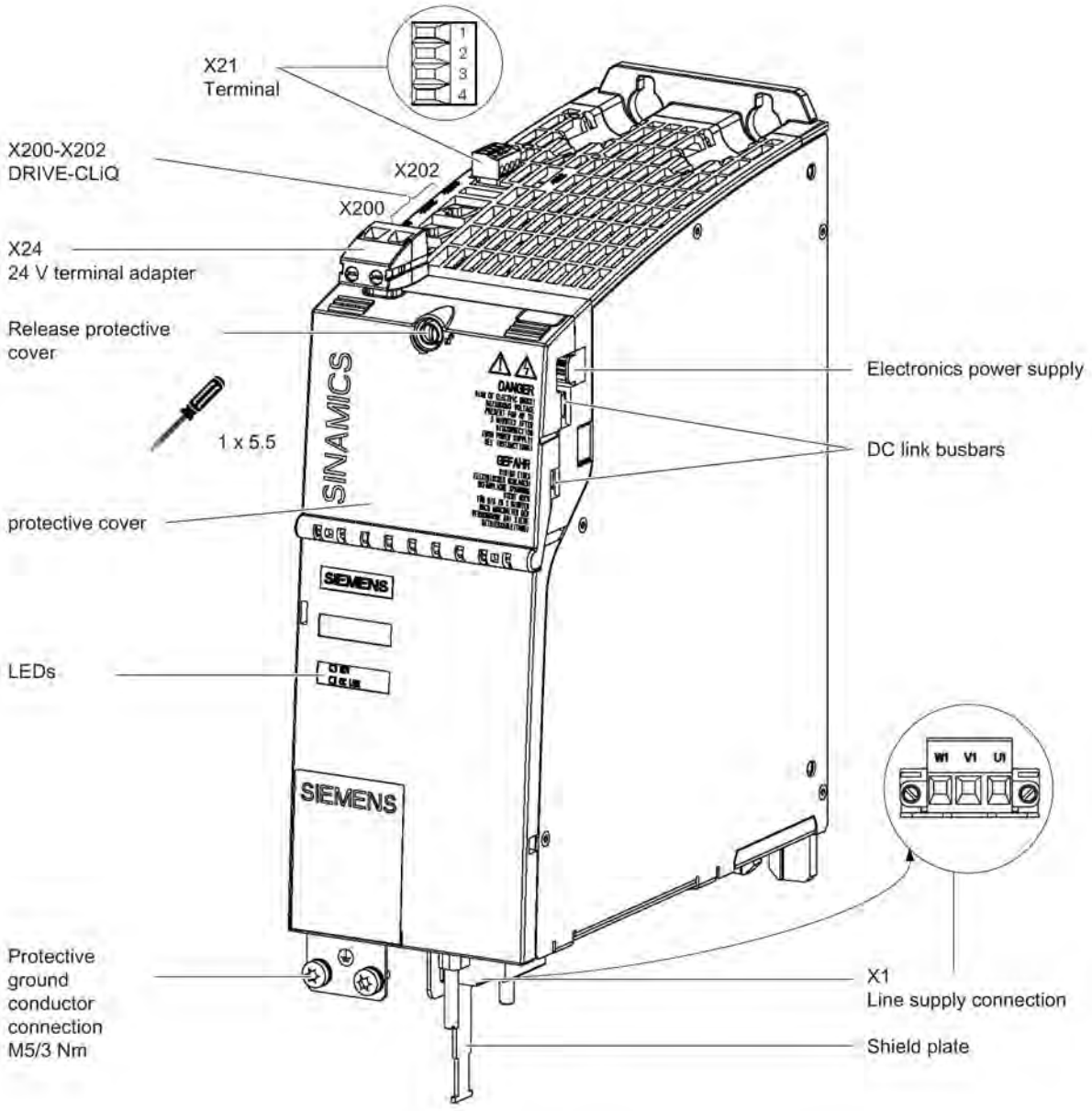
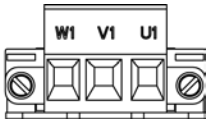
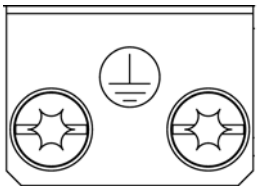


Figure 5-1 Interface overview, Smart Line Module in Booksize Compact format (16 kW)

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5.1.3.2 X1 line connection

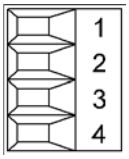
Table 5- 1 X1 line connection

	Terminal	Technical data
	U1	Supply voltage: 3 AC 380 … 480 V, 50 / 60 Hz Type: Screw terminal 7 (Page 755) Max. cross-section that can be connected: 16 mm² Tightening torque: 1.5 … 1.8 Nm
	V1	
	W1	
	PE connection	Threaded hole M5 / 3 Nm[1]

1) For ring cable lugs without insulation

5.1.3.3 X21 EP terminals

Table 5- 2 X21 EP terminal / temperature sensor

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors: KTY 84–1C130[1] / PTC[1] /bimetallic switch with NC contact The temperature sensor type and the temperature display can be selected via parameter and read-out.[2]
	2	- Temp	
	3	EP +24 V (pulse enable)	Voltage: 24 V DC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm²:			

1) The temperatures are detected but not evaluated in the Smart Line Module.

2) For further information see SINAMICS S120, Commissioning Manual

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Terminals X21.1 and X21.2 - temperature sensor connection



⚠WARNING

Danger to life due to electric shock in the event of voltage flashovers on the temperature sensor cable

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Only use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

NOTICE

Risk of the motor overheating due to an incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY sensor with the correct polarity.

Terminals X21.3 and X21.4



⚠WARNING

Danger to life when live parts are touched when terminals X21.3 and X21.4 are connected

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4.

Pulse cancellation is activated if the power supply is disconnected. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the line supply when the EP terminal is de-energized, for example, because a line contactor is not installed, then the DC link remains charged.

Death or serious injury can result when live parts are touched.

- Neutralize the voltage in the DC link.

NOTICE

Damage to the drive electronics when switching the line contactor under load

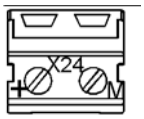
When switching the line contactor (type according to the recommended selection) under load, then the contacts will be subject to premature wear. This can cause the contactor to malfunction, with subsequent damage to the drive electronics.

- Use a leading opening auxiliary contact or use a Voltage Sensing Module (VSM10).
- If this is not possible, then avoid switching the line contactor under load.

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5.1.3.4 X24 24 V terminal adapter

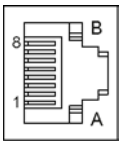
Table 5- 3 X24: 24 V terminal adapter

	Terminal	Designation	Technical data
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm^2			

The 24 V terminal adapter is included in the scope of supply.

5.1.3.5 X200-X202 DRIVE-CLiQ interfaces

Table 5- 4 X200-X202: DRIVE-CLiQ interfaces

	PIN	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+(24 V)	24 V power supply
	B	M (0 V)	Electronics ground

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

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5.1.4 Connection example

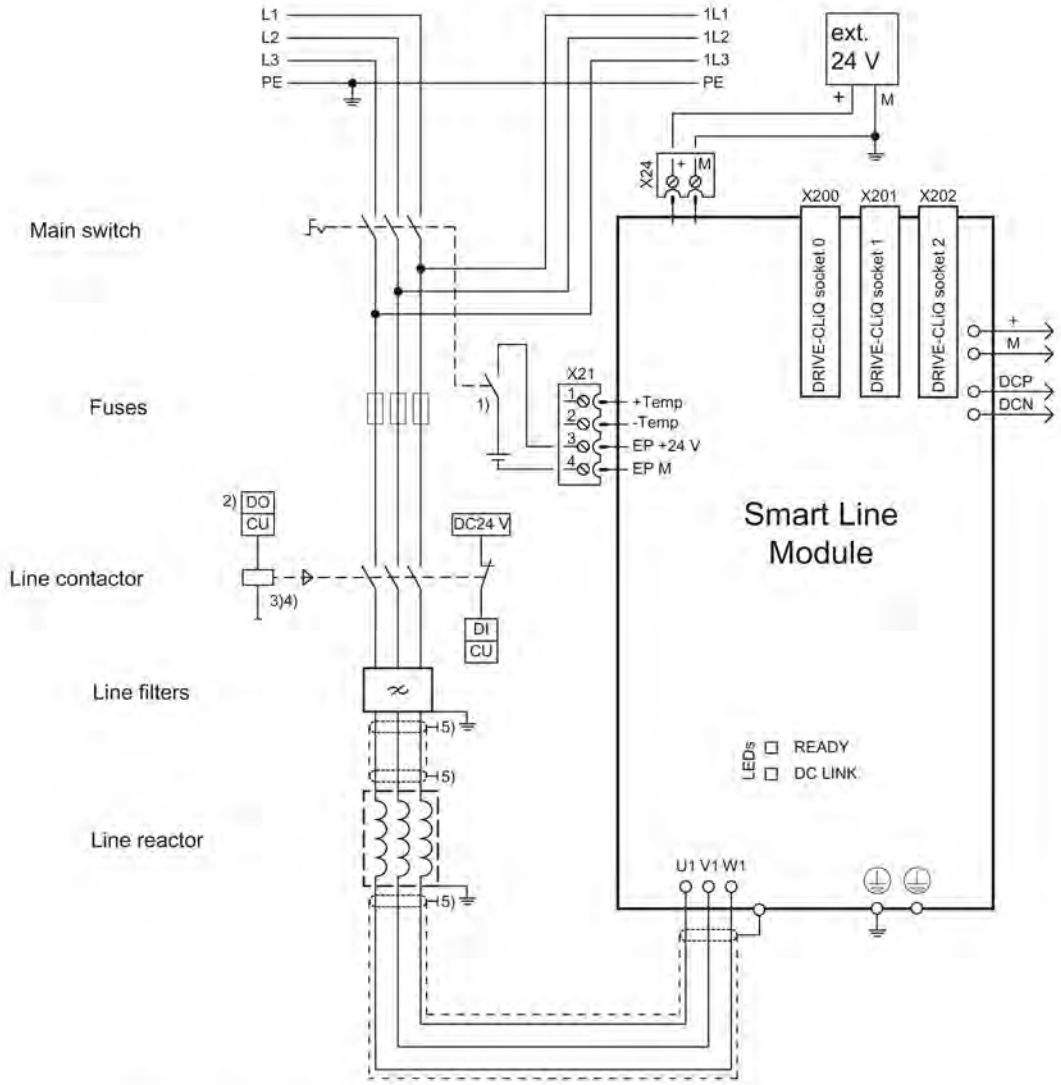


Figure 5-2 Connection example, Smart Line Module Booksize Compact 16 kW

Note

If you are using a VSM10 Voltage Sensing Module, the leading opening contact can be omitted.

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5.1.5 Meaning of the LEDs

Table 5- 5 Meaning of the LEDs on the Smart Line Module booksize compact

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
Green	--	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is outside the permissible tolerance range.	Check the line supply voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	This component has at least one fault. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Resolve and acknowledge the fault.
Green/red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download has been completed. The system waits for POWER ON.	Carry out a POWER ON.
Green/orange or Red/orange	--	Component recognition via LED is activated[1]. **Note:** Both options depend on the LED status when component recognition is activated.	–

[1] See SINAMICS S120/150 List Manual for the parameters to activate the recognition of components via LED



WARNING

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

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5.1.6 Dimension drawing

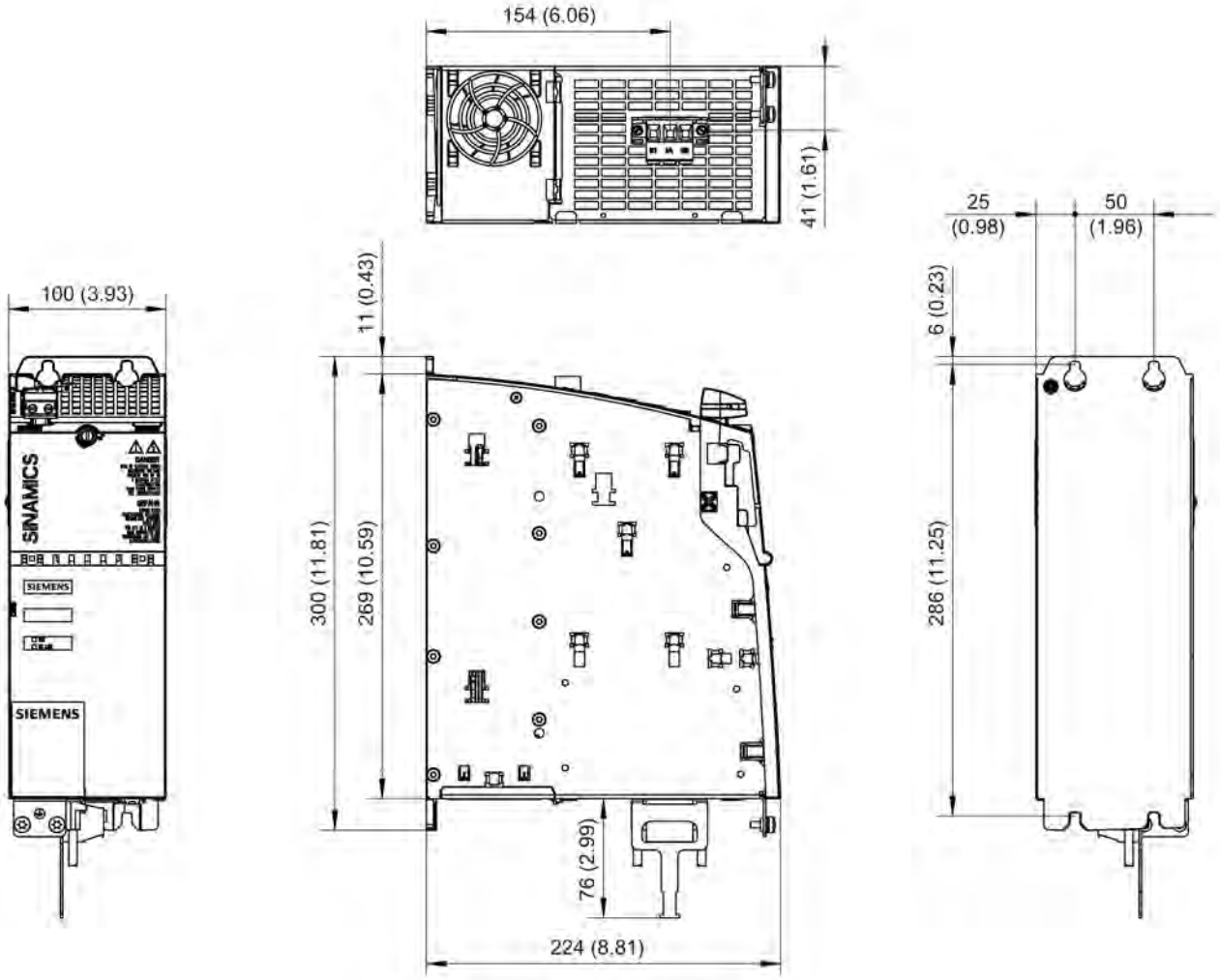


Figure 5-3 Dimension drawing Smart Line Module Booksize Compact format (16 kW), all dimensions in mm and (inches)

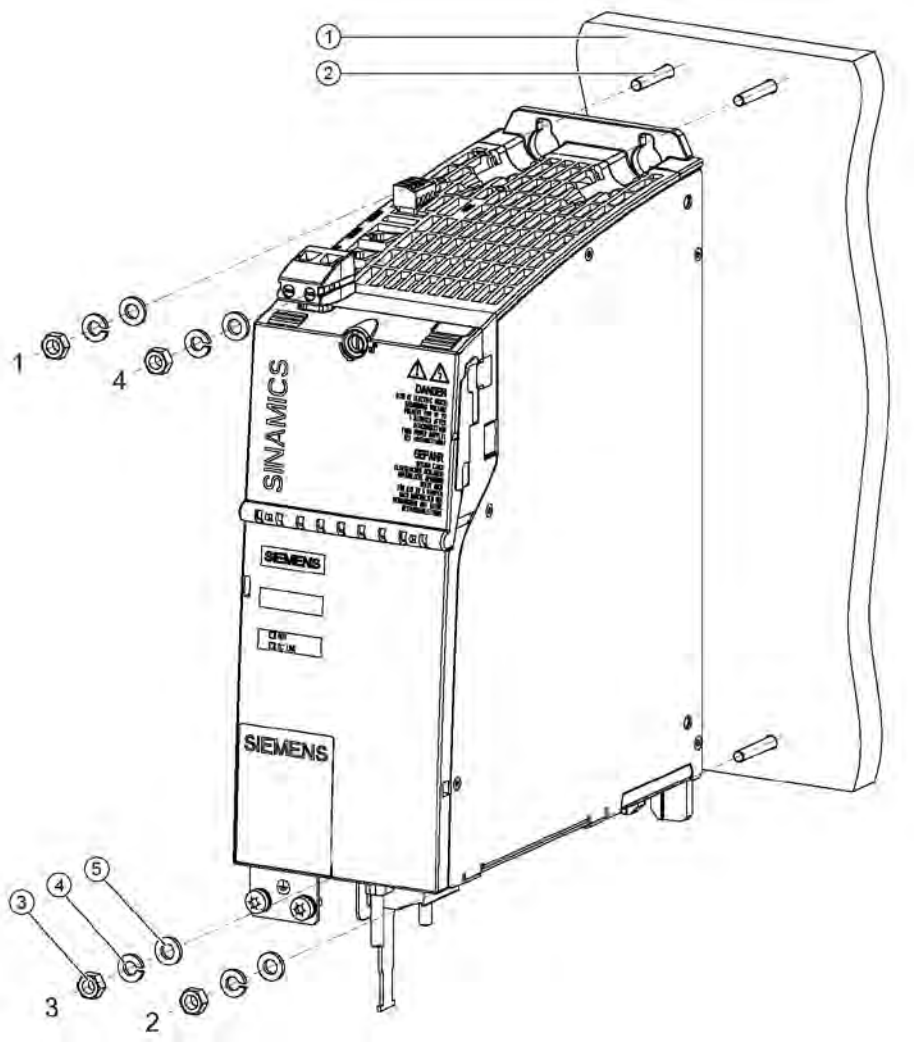
Note

The shield connecting plate is part of the scope of delivery of the Smart Line Modules Booksize Compact.

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5.1.7 Mounting

Mounting a Smart Line Module Booksize Compact with internal air cooling



① Mounting panel
② M6 studs
③ M6 nut
④ Spring washer
⑤ Washer

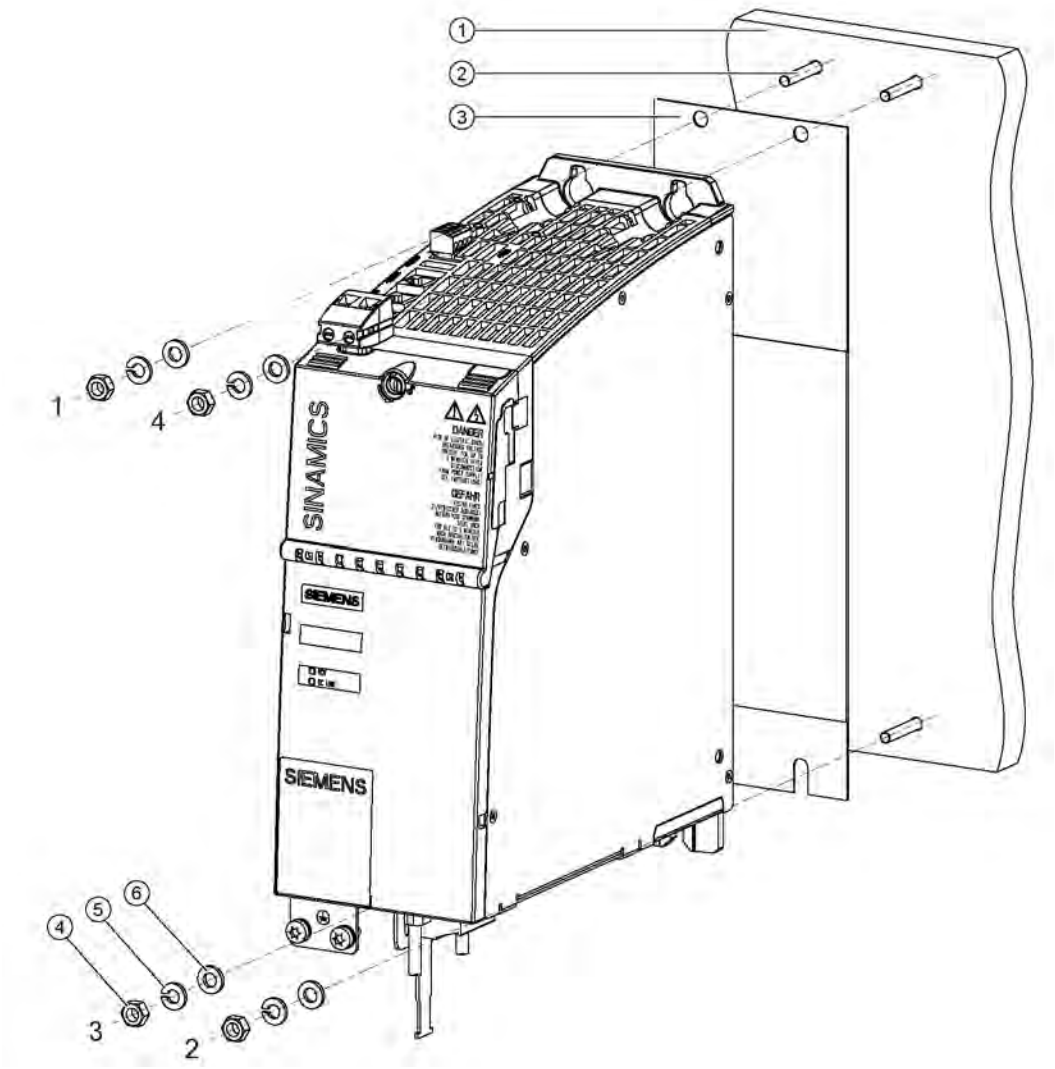
Figure 5-4 Mounting a Smart Line Module Booksize Compact with internal cooling

Tightening torques:

- Firstly, only tighten the nuts by hand.
  Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
  Tightening torque: 6 Nm

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Mounting a Smart Line Module Booksize Compact on a cold plate



① Cold plate
② M6 studs
③ Heat-conducting foil
④ M6 nut
⑤ Spring washer
⑥ Washer

Figure 5-5 Mounting a Smart Line Module Booksize Compact on a cold plate

Tightening torques:

- Firstly, only tighten the nuts by hand.
  Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
  Tightening torque: 10 Nm

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Special points to note in relation to mounting on a cold plate

To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every Smart Line Module Booksize Compact is supplied with heat-conducting foil cut to the right size. Note the mounting position of the heat-conducting foil.

Note

- Also replace the heat-conducting foil when replacing a component.
- Only use heat-conducting foil released or supplied by Siemens.

Table 5- 6 Heat-conducting foil

	Order number
Heat-conducting foil, 100 mm	6SL3162-6FD01-0AA0

5.1.8 Technical data

Table 5- 7 Technical data Smart Line Modules Booksize Compact

Smart Line Module Booksize Compact	6SL3430–	6TE21-6AAx
Rated power	**kW**	**16**
Infeed		
Rated power (S1)[1)]	kW (P_n)	16
Infeed power (S6 - 40 %)[1)]	kW (P_{S6})	21
Peak infeed power[1)]	kW (P_{max})	35
Regenerative feedback		
Continuous regenerative power	kW	16
Peak regenerative power	kW	35
Supply voltages		
Line voltage	V_{AC}	3 AC 380 … 480 ± 10 % (-15 % < 1 min)
Line frequency	Hz	47 … 63
Electronics power supply	V_{DC}	24 (20.4 … 28.8)
DC link voltage	V_{DC}	510 … 720
Overvoltage trip	V_{DC}	820 ± 2 %
Undervoltage trip[2)]	V_{DC}	360 ± 2 %
Input currents		
Rated input current		
at AC 400 V	A_{AC}	27.5
Input current		
at AC 380 V / AC 480 V	A_{AC}	29 / 24.5
at AC 400 V; S6 - 40 %	A_{AC}	35
at AC 400 V; peak current	A_{AC}	57.5

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Smart Line Module Booksize Compact	**6SL3430–**	**6TE21-6AAx**
Rated power	**kW**	**16**
DC link currents Rated DC link current at 600 V DC link current at 540 V at DC 600 V; S6 - 40 % at DC 600 V; peak current	 A_{DC} A_{DC} A_{DC} A_{DC}	 27 30 35 59
Current carrying capacity DC link busbar Reinforced DC link busbar: 24 V busbar:	 A_{DC} A_{DC} A_{DC}	 100 150 20
Electronics current consumption at 24 V DC For internal air cooling For cold plate cooling	 A_{DC} A_{DC}	 0.95 0.85
Total power loss internal air cooling (including electronics losses, see Power loss tables (Page 781))	W	187.8
Power loss distribution for cold plate (including electronics losses)[3] Internal External	W	 56.6 130
Max. ambient temperature without derating with derating	 °C °C	 40 55
DC link capacitance Smart Line Module Drive line-up, max.	 µF µF	 705 6000
Power factor	cos ϕ	0.98
Circuit breaker (IEC 60947 and UL)		See Chapter Overcurrent protection using line fuses and circuit breakers (Page 51)
Rated short-circuit current SCCR[3]	kA	65
Cooling methods		Internal air cooling Cold plate cooling
Cooling air requirement with internal air cooling	 m^3/h	 56
Max. permissible heat-sink temperature cold plate	° C	71
Sound pressure level	dB(A)	< 60
Weight	kg	5.3

1) The specified power ratings apply to the line voltage range from 380 V to 480 V.

2) Default for 400 V line systems; undervoltage trip threshold is adjusted to the parameterized rated voltage

3) The resulting rated short-circuit current is obtained from the combination of the fuse or circuit breaker – and the Line Module in the drive system.

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5.1.8.1 Characteristics

Rated duty cycles of Smart Line Modules

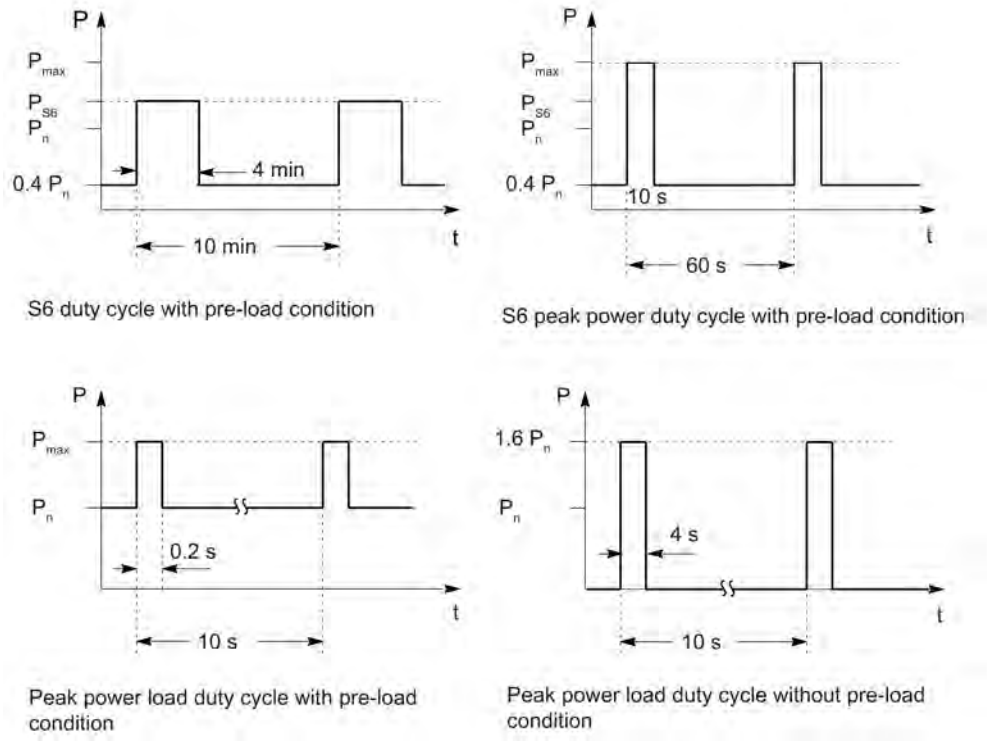


Figure 5-6 Rated duty cycles of Smart Line Modules

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Derating characteristics

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

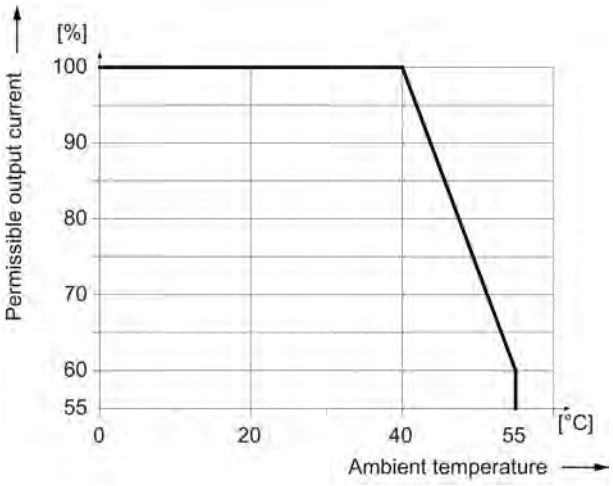


Figure 5-7 Output current as a function of the ambient temperature

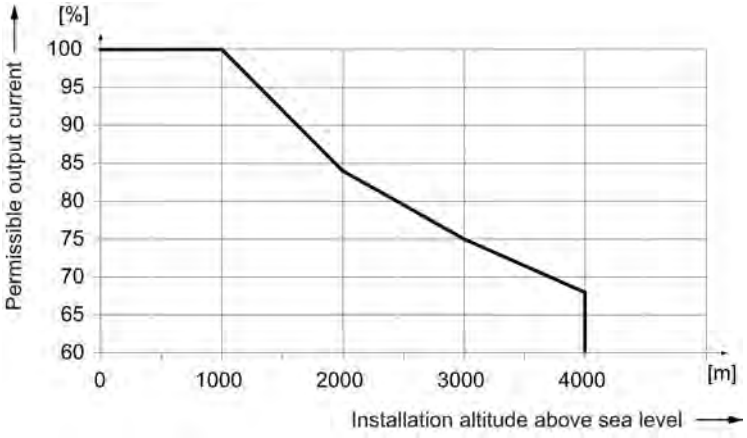


Figure 5-8 Output current as a function of the installation altitude

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Motor Modules Booksize

6

6.1 Safety instructions for Motor Modules Booksize

⚠WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.



⚠DANGER

Danger to life through electric shock due to the residual charge of the DC link capacitors

Because of the DC link capacitors, a hazardous voltage is present for up to five minutes after the power supply has been switched off.

Contact with live parts can result in death or serious injury.

- Do not open the protective cover of the DC link until 5 minutes have elapsed.
- Measure the voltage before starting work on the DCP and DCN DC link terminals.



⚠DANGER

Danger to life through electric shock when the protective cover of the DC link is open

Contact with live parts can result in death or serious injury.

- Only operate the components with closed protective cover.



⚠WARNING

Danger to life through electric shock due to 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.

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⚠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[1)] (exception: Smart Line Module[2)]), remove the DC link bridge, including the screws. Do not tighten the screws without the DC link bridges.
- For all components that are 75 mm wide or wider, the DC link bridges may neither be swung over to the left nor removed[3)].

[1)] For 50 mm wide modules, the DC link bridge cannot be swung inwards.
[2)] Smart Line Modules do not have a DC link bridge.
[3)] The DC link bridge guarantees the mechanical stability of the DC link busbars.



⚠WARNING

Danger to life through electric shock due to missing DC link side covers

There is a danger of an electric shock through contact when the side covers of the DC link are missing.

- Mount the side covers on the first and last component in the drive line-up.

You can order missing side covers (order number: 6SL3162-5AA00-0AA0).



⚠WARNING

Danger to life due to high leakage currents caused by an interrupted external protective conductor

The drive components conduct a high leakage current via the protective conductor. Touching conductive parts when the protective conductor is interrupted can result in death or serious injury.

- Ensure that the external protective conductor satisfies at least one of the following conditions:
  - It has been laid so that it is protected against mechanical damage.[1)]
  - If it is a single conductor, it has a cross-section of at least 10 mm² Cu.
  - If it is a conductor of a multi-conductor cable, it has a cross-section of at least 2.5 mm² Cu.
  - It has a second protective conductor in parallel with the same cross-section.
  - It complies with the local regulations for equipment with increased leakage current.

  [1)] Cables laid within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.

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WARNING

Danger to life through electric shock due to incorrectly laid brake cables

If brake cables are laid without safe electrical separation, the insulation can fail with an electric shock.

- Connect the holding brake with the specified MOTION-CONNECT cable.
- Only use third-party cables with safe electrically separated brake cores or lay the brake cores with safe electrical separation.

WARNING

Danger of an accident due to missing warning labels in the national language.

Missing warning labels in the national language can result in death or serious injury.

- Attach the component warning labels in the national language.

WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

Inadequate ventilation clearances can cause overheating with a risk for personnel due to smoke and fire. This can also result in increased failure rates and a shorter service life for Motor Modules.

- Maintain the 80 mm clearances above and below the Motor Modules.
- For the 132 A and 200 A Motor Modules, a ventilation clearance of 50 mm must also be maintained in front of the fan.

NOTICE

Material damage due to loose power connections

Insufficient tightening torques or vibration can result in faulty electrical connections. This can cause fire damage or malfunctions.

- Tighten all power connections with the specified tightening torques, e.g. line supply connection, motor connection, DC link connections.
- Check the tightening torques of all power connections at regular intervals and tighten them when required. This applies in particular after transport.

NOTICE

Damage to the equipment when performing a voltage test as a result of connections that are not disconnected

SINAMICS S components are subject to a voltage test as part of the routine test. Connected devices can be damaged.

- Disconnect or unplug all SINAMICS devices before the voltage test of the machine equipment according to EN 60204-1, Section 18.4.

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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.

NOTICE

Destruction of the motor or brake due to incorrect power supply

With an incorrect power supply, the brake can malfunction, i.e. the brake does not open reliably. If the motor constantly runs against the closed brake, the brake and/or the motor will be destroyed.

- Always use a regulated DC power supply to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars.
- Take note of the motor holding brake voltage tolerances (24 V ± 10%) and the connecting cable voltage drop.
- Set the DC power supply to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:
  - Siemens three-phase motors must be used
  - Siemens MOTION-CONNECT power cables must be used
  - Motor cable lengths, max. 100 m

NOTICE

Damage through use of incorrect DRIVE-CLiQ cables

Damage or malfunctions can occur on the devices or system when DRIVE-CLiQ cables are used that are either incorrect or have not been approved for this purpose.

- Only use suitable DRIVE-CLiQ cables that have been approved by Siemens for the particular application.

Note

Malfunctions due to polluted DRIVE-CLiQ interfaces

Malfunctions can occur in the system through the use of polluted DRIVE-CLiQ interfaces.

- Cover unused DRIVE-CLiQ interfaces with the supplied blanking covers.

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Special features for Motor Modules with external air cooling

Note

Insufficient cooling power when the external heat sinks are polluted

For components with external air cooling, the fan and the heat sinks can accumulate a lot of pollution. If the cooling air requirement is not provided by the filter fan, the components cannot output their specified power. This can cause the temperature monitoring function in the components to respond.

- Check the fans and heat sinks for pollution at regular intervals and clean them when necessary.

Note

Checking the seal

- After installation, check the seal on the rear of the device to ensure that it is tight.
- If required, use additional sealing.

Note

Using an installation frame

- Only use an installation frame when the cabinet has an unpainted metal surface.

Notes for UL applications

Note

The SINAMICS S120 Motor Modules Booksize provide short-circuit protection at the motor output terminals.

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6.2 Motor Modules with internal air cooling

6.2.1 Description

A Motor Module is a power unit (inverter) that provides the power for the connected motors. Power is supplied by the DC link of the drive unit. A Motor Module must be connected to a Control Unit via DRIVE-CLiQ. The open-loop and closed-loop control functions for the Motor Module are stored in the Control Unit.

One motor can be connected to Single Motor Modules and 2 motors can be connected to Double Motor Modules.

⚠WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

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6.2.2 Interface description

6.2.2.1 Overview

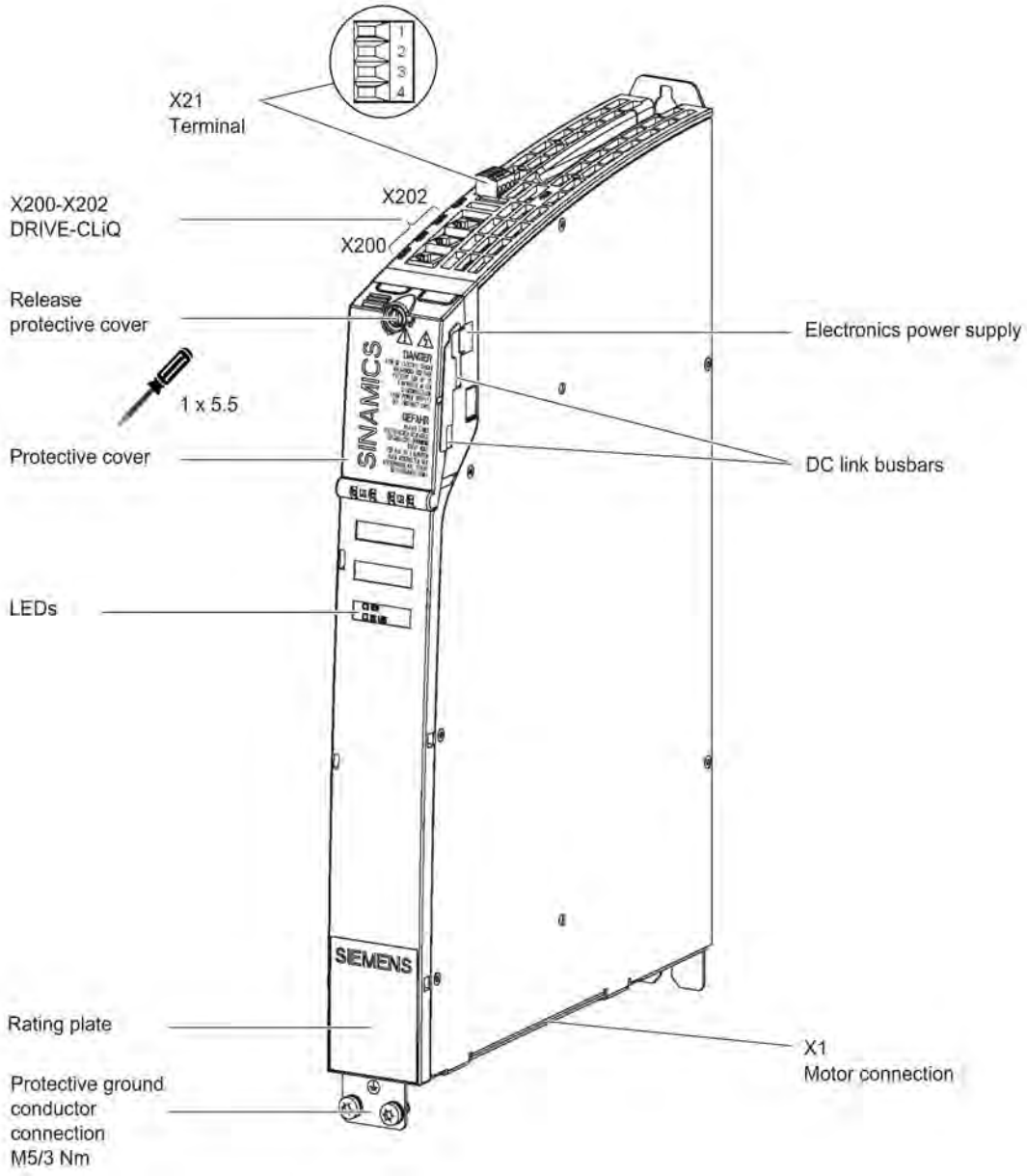


Figure 6-1 Interface overview, Single Motor Module Booksize with internal air cooling (example: 5 A)

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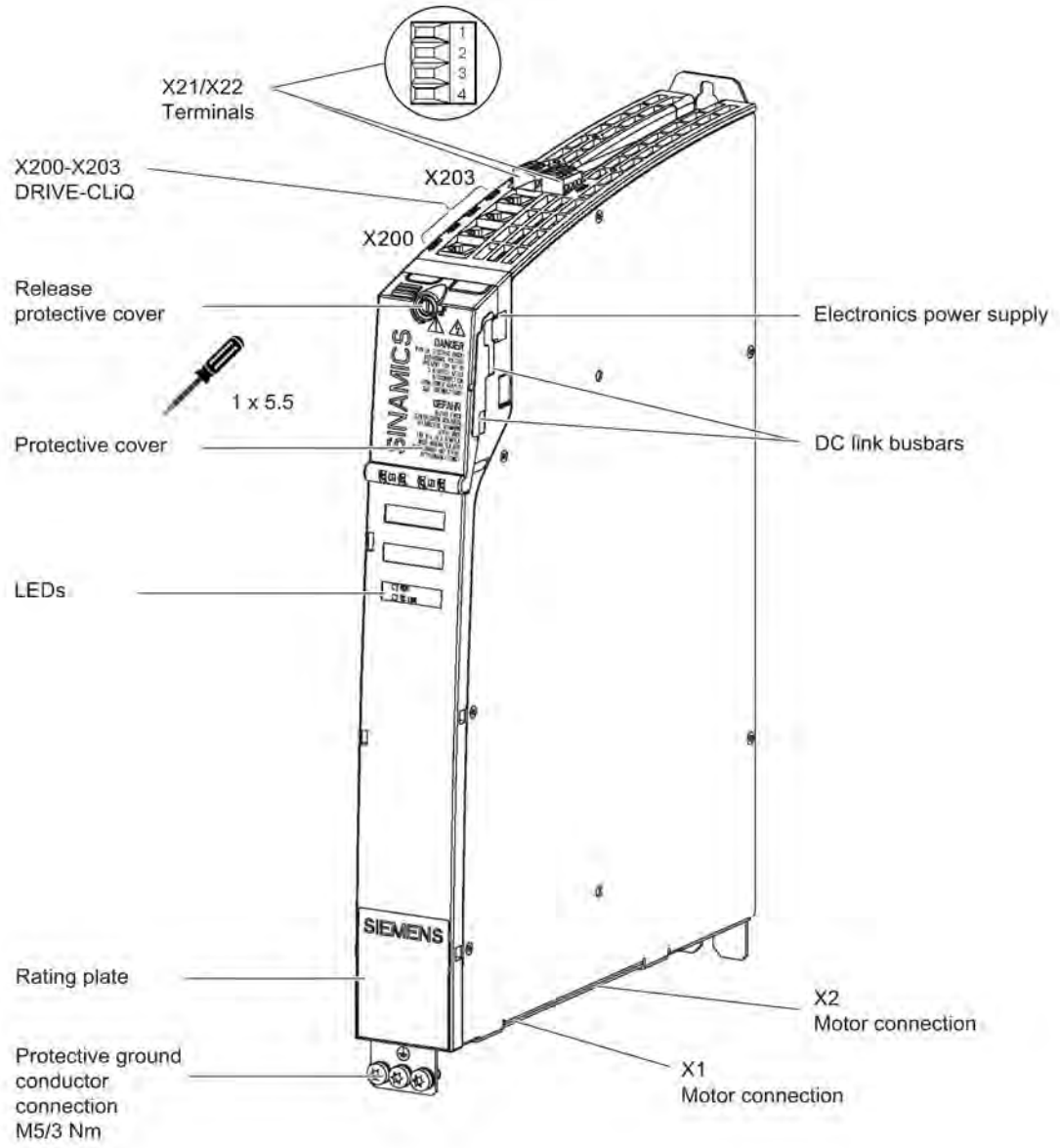
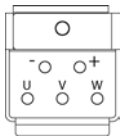
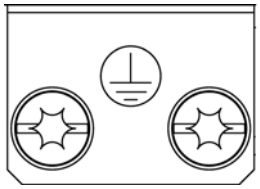
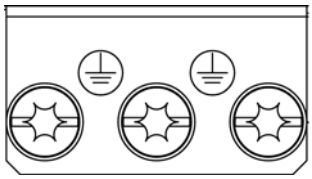


Figure 6-2 Interface overview, Double Motor Module Booksize with internal air cooling (example: 2 x 5 A)

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6.2.2.2 Motor and brake connection

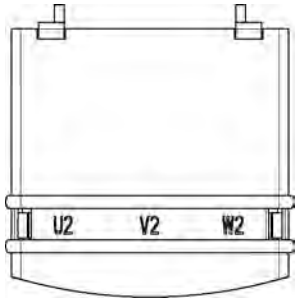
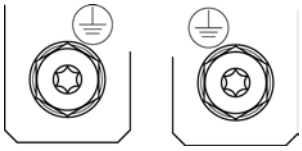
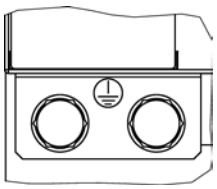
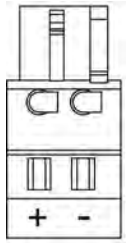
Table 6- 1 X1/X2 motor and brake connection for Single Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

	Terminal	Technical data
	U (U2)	Motor connection
	V (V2)	
	W (W2)	
	+ (BR+)	Brake connection Max. load current: 2 A Minimum load current: 0.1 A
	- (BR-)	
	PE connection	**Single Motor Modules 3 ... 30 A:** Threaded hole M5 / 3 Nm[1)]
		**Double Motor Modules 3 ... 18 A:** Threaded hole M5 / 3 Nm[1)]

[1)] For ring cable lugs without insulation

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Table 6- 2 X1 motor connection and X11 brake connection for Single Motor Modules 45 A to 200 A

	Terminal	Technical data
	U2 V2 W2	**45 ... 60 A:** Threaded bolts M6 / 6 Nm[1)] **85 A:** Threaded bolts M8 / 13 Nm[1)] **132 … 200 A:** Threaded bolts M8 / 13 Nm[1)]
	PE connection	**45 ... 60 A:** Threaded bolts for motor cables: M6 / 6 Nm[1)] Threaded hole for PE: M6 / 6 Nm[1)]
		**85 A:** Threaded bolts for motor cables: M8 / 13 Nm[1)] Threaded hole for PE: M6 / 6 Nm[1)] **132 ... 200 A:** Threaded bolts for motor cables: M8 / 13 Nm[1)] Threaded hole for PE: M8 / 13 Nm[1)]
	+ (BR+) - (BR-)	**X11 brake connector**[2)]: Voltage: 24 V DC Max. load current: 2 A Minimum load current: 0.1 A Type: Spring-loaded terminal 2 (Page 754) Max. cross-section that can be connected 2.5 mm²: The brake connector is part of the prefabricated cable.

1) For ring cable lugs without insulation

2) The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.



⚠WARNING

Danger to life as a result of a hazardous voltage at the 0 V to 48 V DC terminals

Death or serious injury can result when live parts are touched in the event of a fault.

- Only connect protective extra-low voltages (PELV / SELV) to all connections and terminals between 0 to 48 V DC.

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NOTICE

Destruction of the motor or motor holding brake as a result of high voltage tolerances of the motor holding brakes

If the voltage tolerances of the motor holding brakes are not complied with (24 V ± 10 %), then the brake will malfunction, i.e. the brake will not reliably open. If the motor constantly runs against the closed brake, the brake or the motor will be destroyed.

- Set the DC power supply to 26 V.

The following general conditions must be satisfied:

- Siemens three-phase motors must be used
- Siemens MOTION-CONNECT power cables must be used
- Motor cable lengths, max. 100 m

Note

The total length of the power cables (motor feeder cables and DC link cables) must not exceed the values listed in Chapter Combining line reactors and line filters (Page 136).

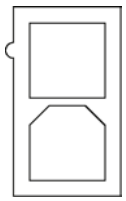
Note

The motor brake must be connected via connector X11. It is not permitted to directly connect the cable BR – to the electronics ground M.

6.2.2.3 X12 fan connection

The Motor Modules 132 A and 200 A are equipped with an interface to connect a sub-chassis fan. The interface is located on the underside of the Motor Module.

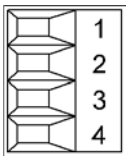
Table 6- 3 X12 fan connection

	Terminal	Function	Technical data
	1	Fan connection +	Voltage 48 V DC for the supplied fan
	2	Fan connection -	

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6.2.2.4 X21/X22 EP terminals/temperature sensor

Table 6- 4 X21/X22 EP terminals / temperature sensor

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (pulse enable)	Supply voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (enable pulses)	
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm²			

EP terminals

Parameters are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4 (see the SINAMICS S120/S150 List Manual). Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Section "Controlling the safety functions".

Note

Function of the EP terminals

The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

Temperature sensor connection

NOTICE

Risk of the motor overheating due to an incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY sensor with the correct polarity.

Note

The temperature sensor input is not needed if the motors feature an integrated DRIVE-CLiQ interface or if temperature values are detected by means of a different module (SMC, SME, TM).

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⚠WARNING

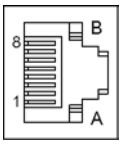
Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

6.2.2.5 X200-X203 DRIVE-CLiQ interface

Table 6- 5 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules
X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

	Pin	Name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

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6.2.3 Connection examples

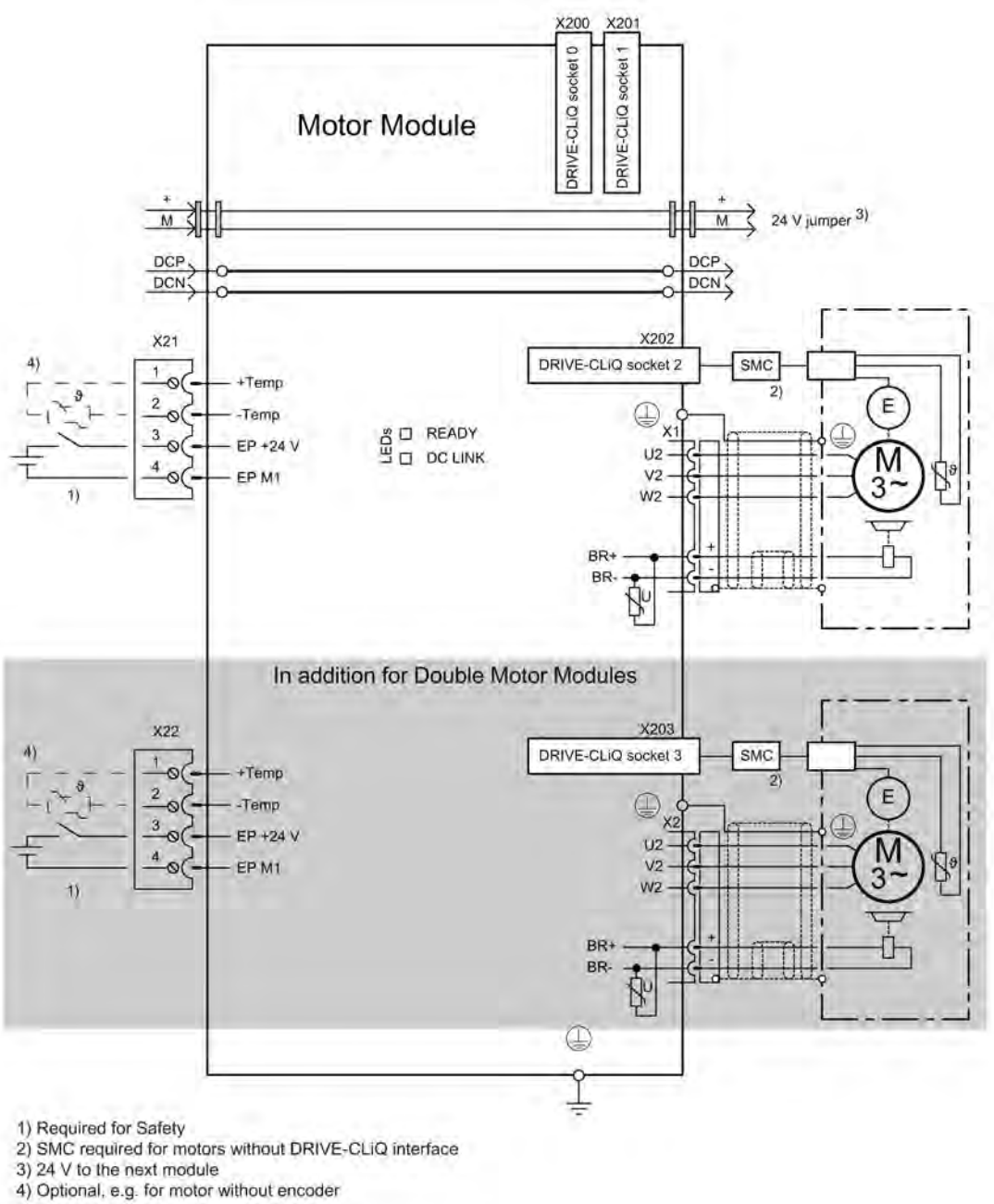


Figure 6-3 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

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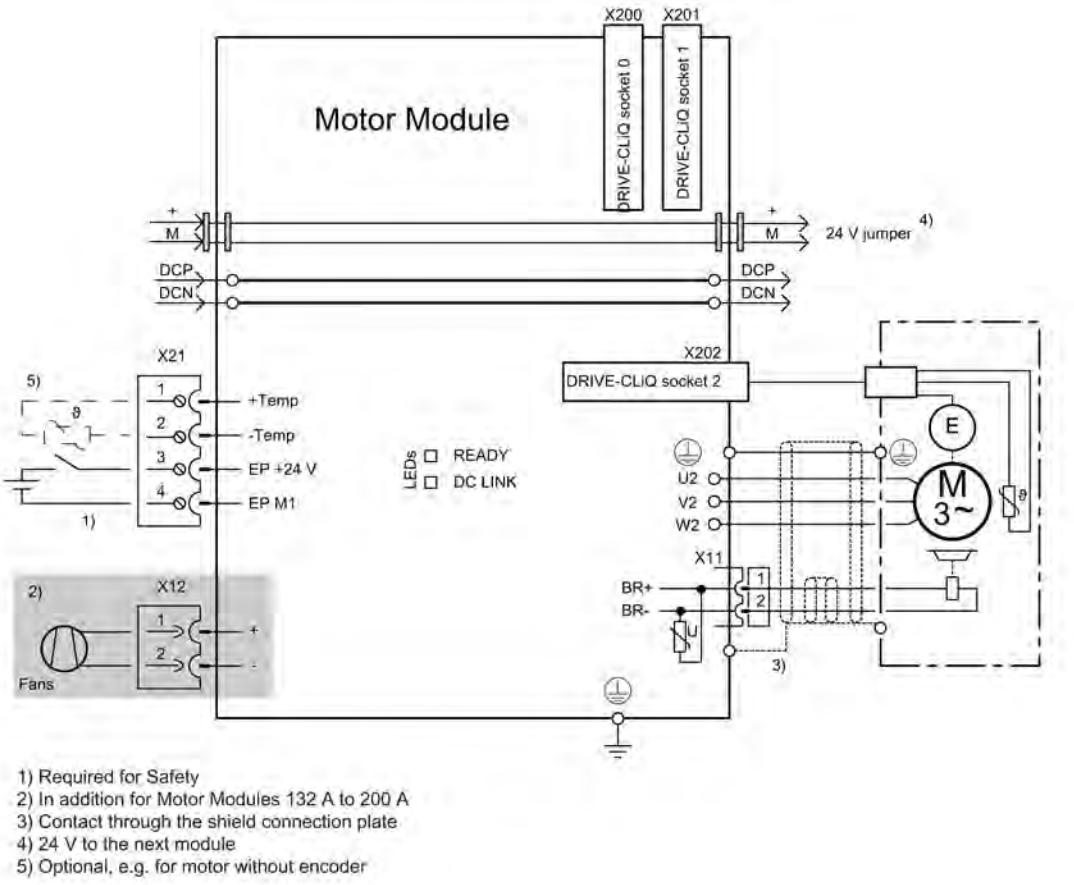


Figure 6-4 Example connection of Single Motor Modules 45 A to 200 A

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6.2.4 Meaning of LEDs

Table 6- 6 Meaning of the LEDs on the Motor Module

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
Green	--	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is outside the permissible tolerance range.	Check the line supply voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	At least one fault is present in this component. **Note:** The LED is driven irrespective of the corresponding messages being reconfigured.	Resolve and acknowledge the fault.
Green/red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download has been completed. The system waits for POWER ON.	Carry out a POWER ON.
Green/orange or red/orange	--	Component recognition via LED is activated[1)]. **Note:** Both options depend on the LED status when component recognition is activated.	–

[1)] See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



⚠WARNING

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

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6.2.5 Dimension drawings

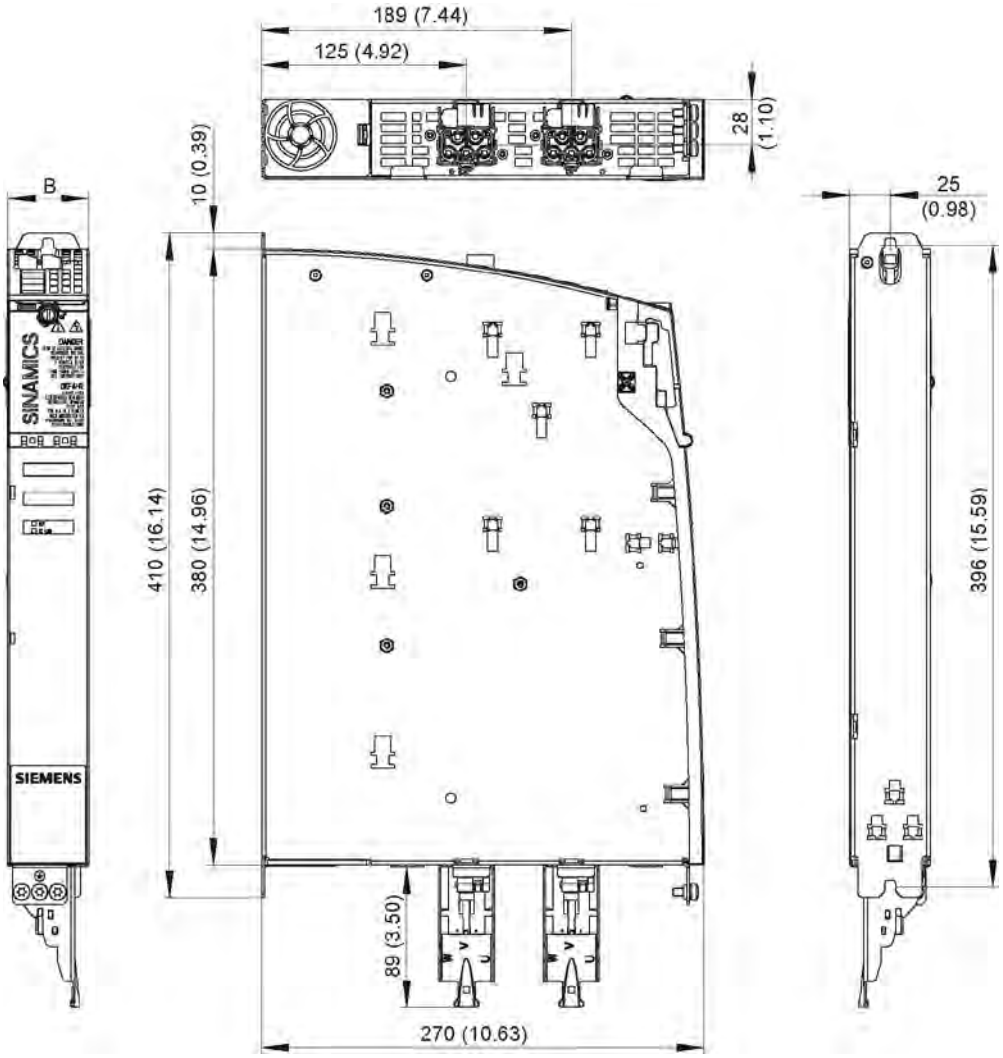


Figure 6-5 Dimension drawing of Motor Modules Booksize with internal air cooling 3 A to 18 A and 2 x 3 A to 2 x 9 A, all dimensions in mm and (inches); example: Double Motor Module 2 x 5 A

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	

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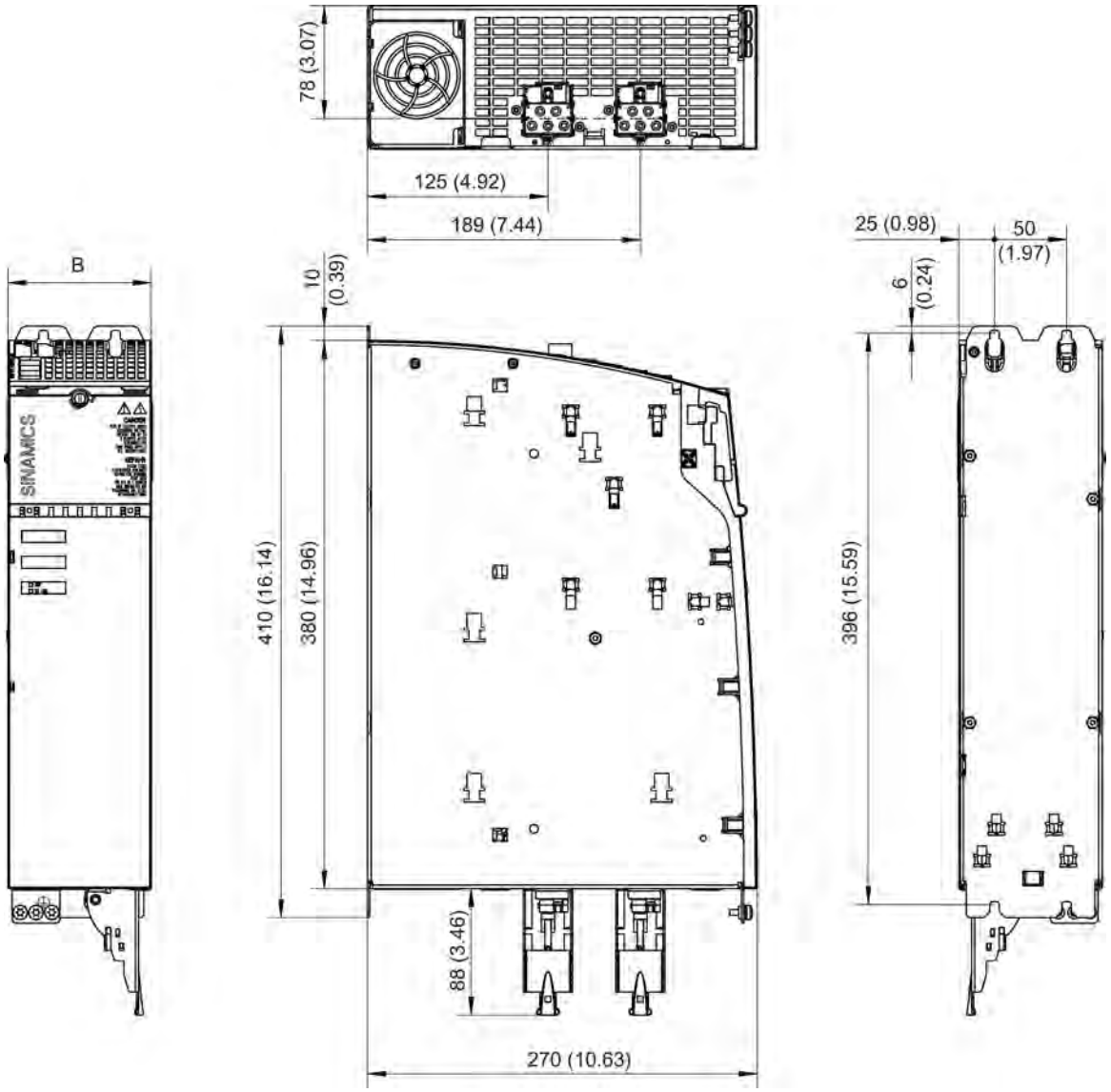


Figure 6-6 Dimension drawing of Motor Modules Booksize with internal air cooling 30 A and 2 x 18 A, all dimensions in mm and (inches); example: Double Motor Module 2 x 18 A

Table 6- 8 Dimensions of Motor Modules Booksize with internal air cooling 30 A and 2 x 18 A

Motor Module	Order number	B [mm] (inches)
Single Motor Module 30 A	6SL3120-1TE23-0AAx	100 (3.94)
Double Motor Module 18 A	6SL3120-2TE21-8AAx	

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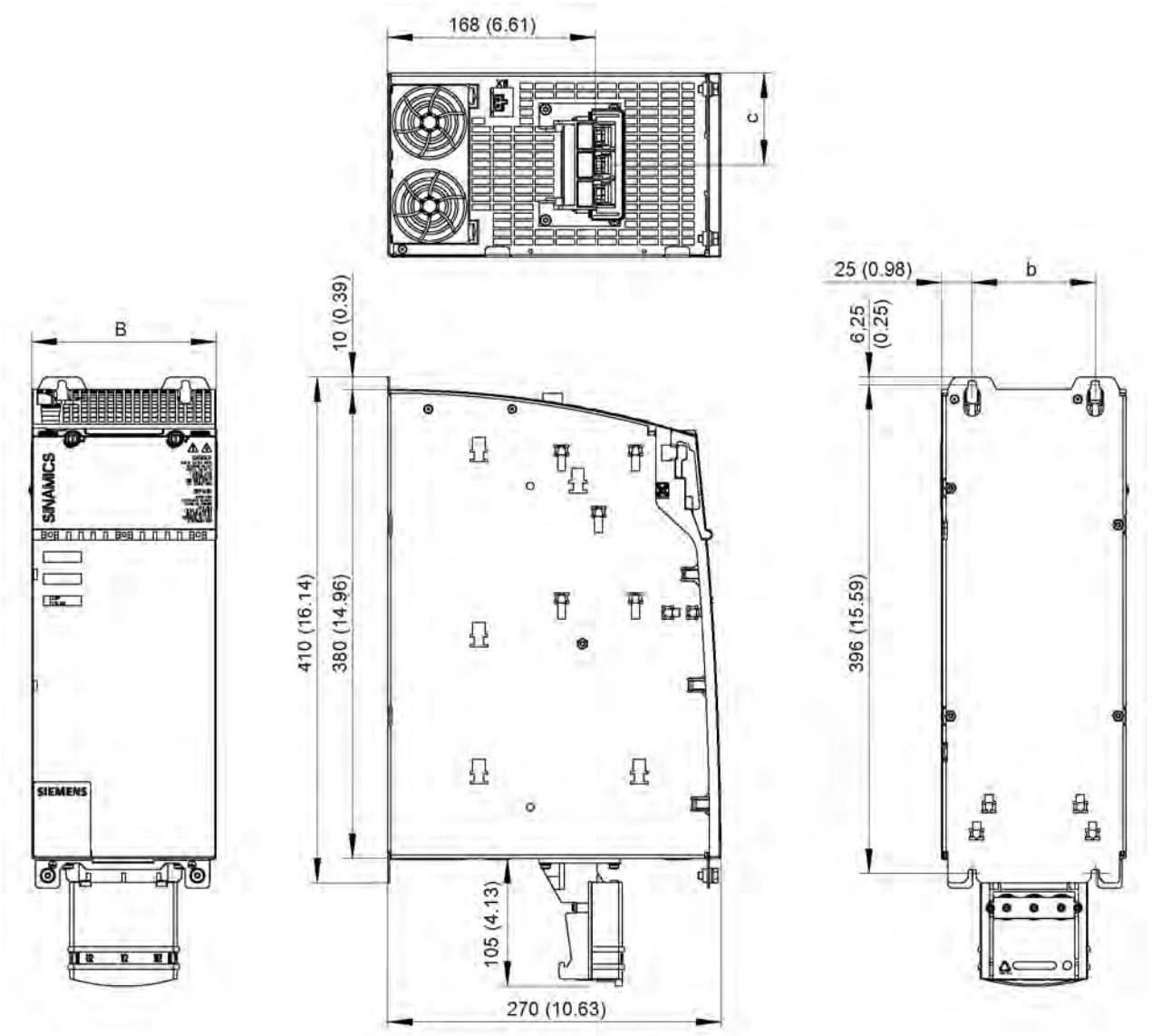


Figure 6-7 Dimension drawing of Motor Modules Booksize with internal air cooling 45 A to 85 A, all dimensions in mm and (inches); example 45 A

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)

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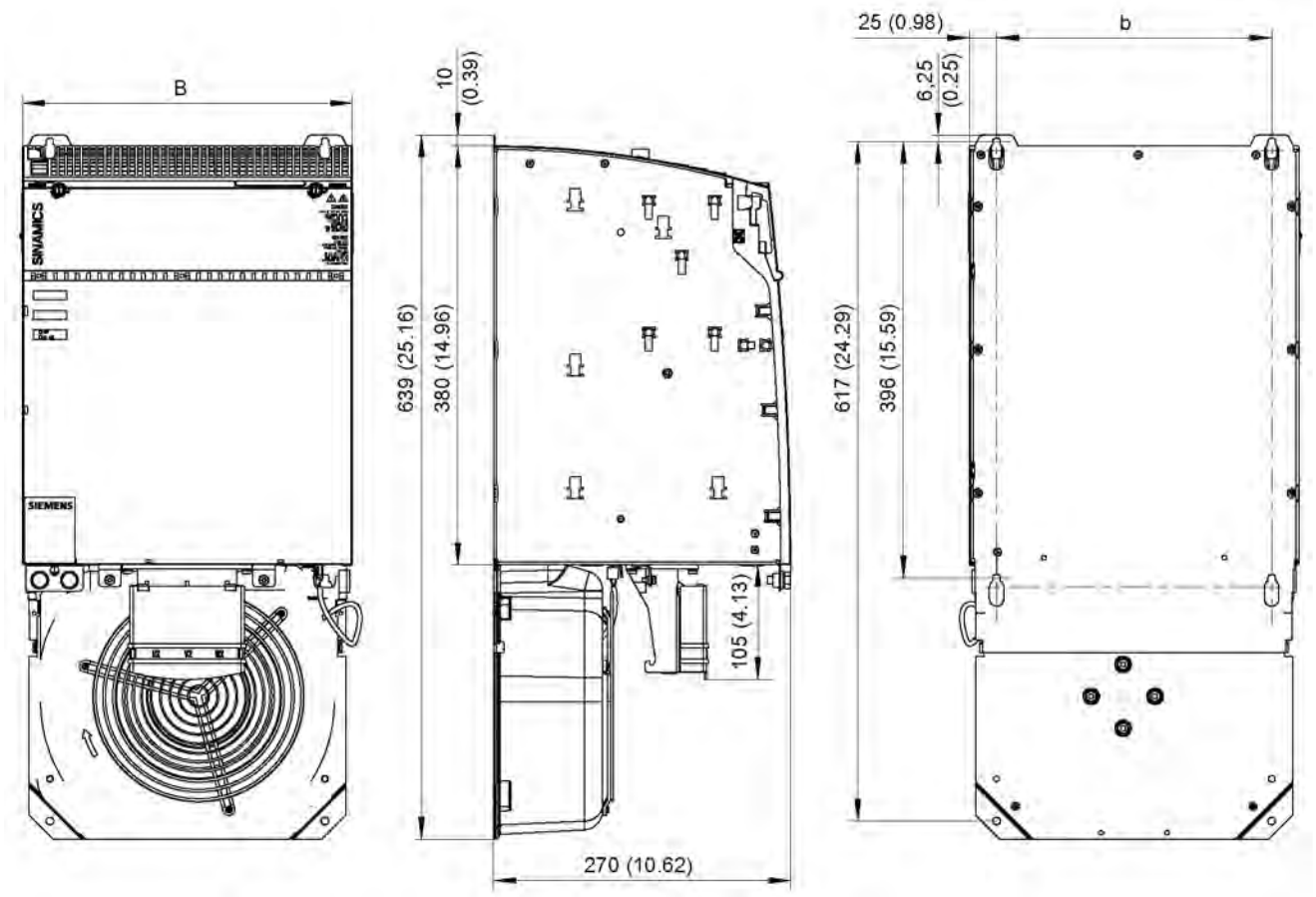


Figure 6-8 Dimension drawing of Motor Modules Booksize with internal air cooling 132 A and 200 A, all dimensions in mm and (inches)

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		

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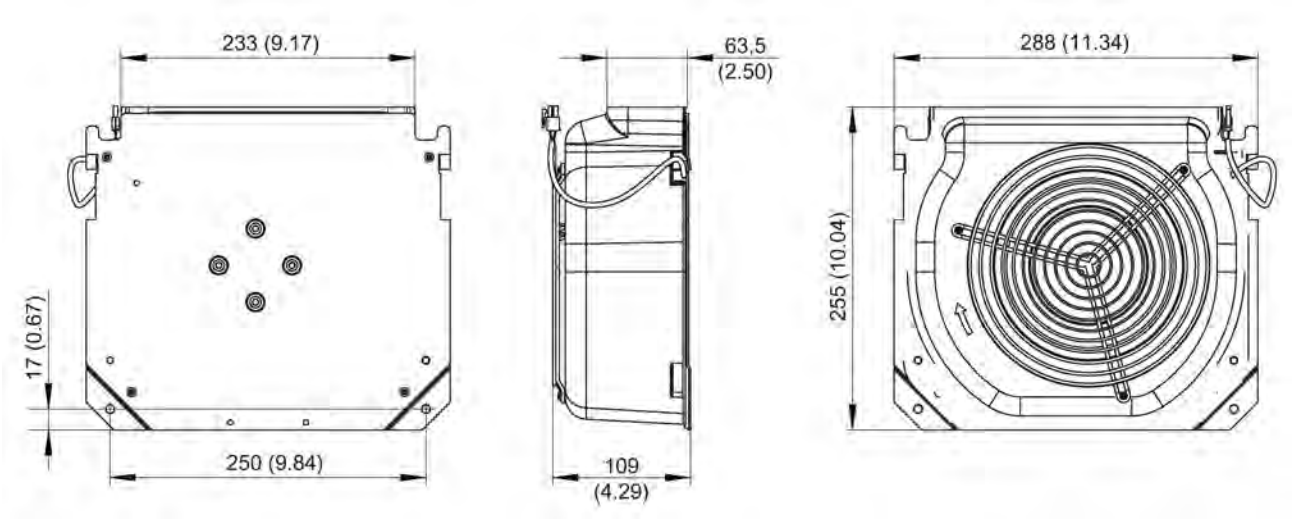


Figure 6-9 Dimension drawing of fans for Motor Modules 132 A and 200 A with internal air cooling, all dimensions in mm and (inches)

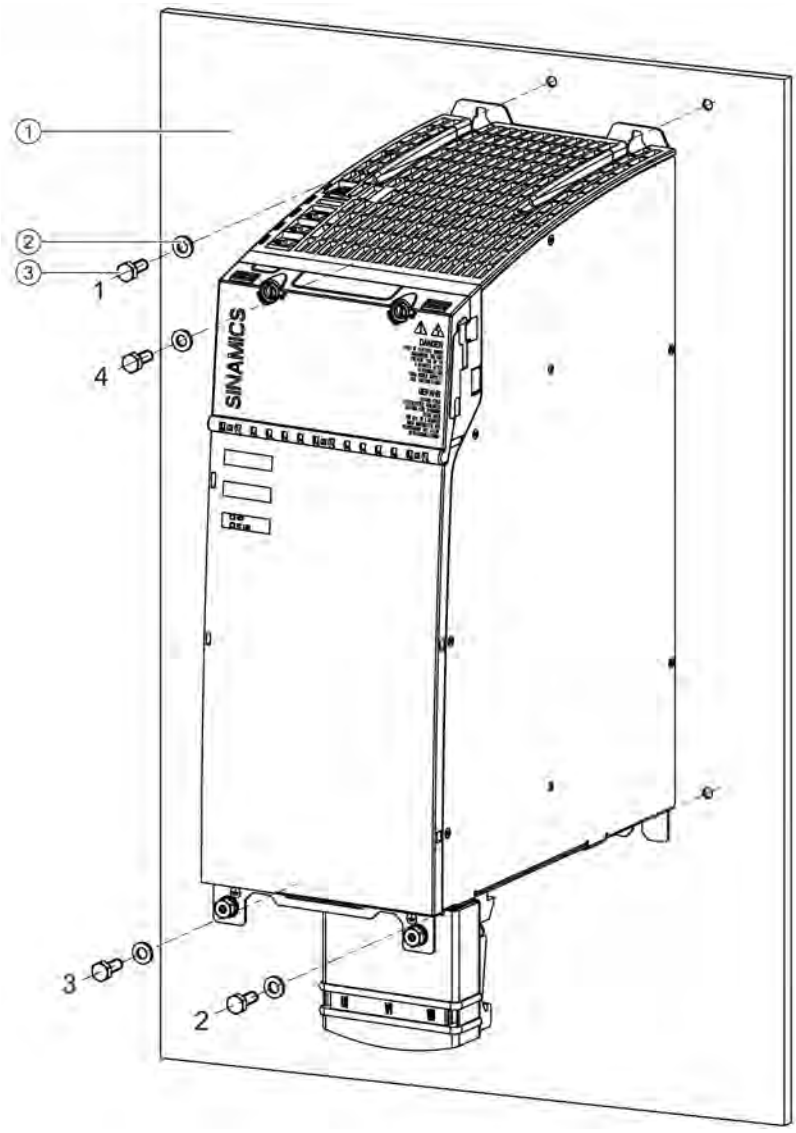
Note

The fan for the Motor Modules 132 A and 200 A is included in the scope of supply.

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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:

- Firstly, tighten the nuts by hand.
  Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
  Tightening torque: 6 Nm

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Mounting the sub-chassis fan

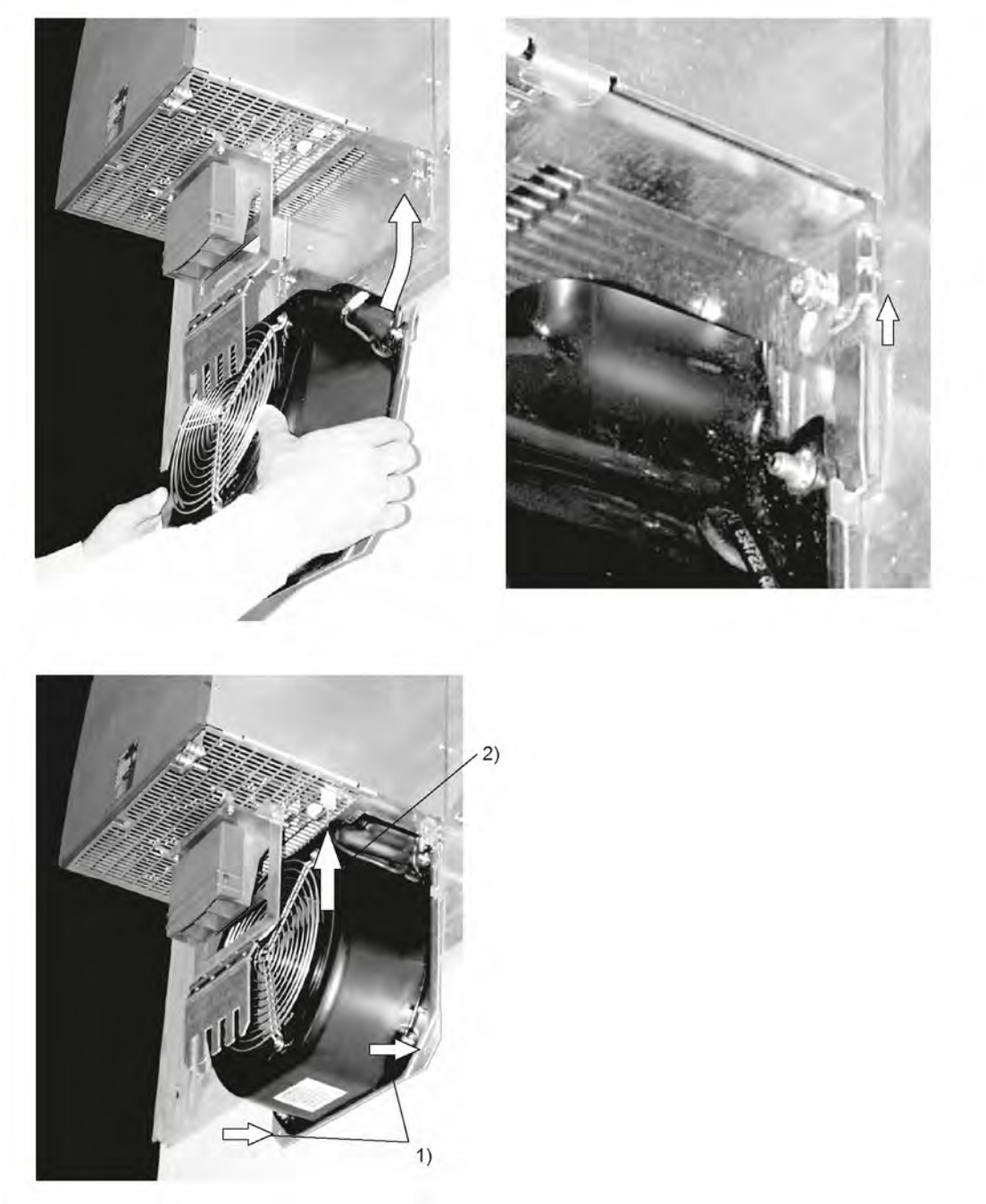


Figure 6-11 Mounting the fan for Motor Modules 132 A and 200 A

1. Fix the fan with M6 screws
   Tightening torque: 6 Nm
2. Connect the fan power supply.

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6.2.7 Technical data

6.2.7.1 Single Motor Modules

Table 6- 11 Technical data Single Motor Modules Booksize (3 to 30 A)

Internal air cooling	**6SL3120–**	**1TE13-0AAx[1)]**	**1TE15-0AAx[1)]**	**1TE21–0AAx[1)]**	**1TE21–8AAx[1)]**	**1TE23-0AAx**
Output current						
Rated current (I_n)	A_{ACrms}	**3**	**5**	**9**	**18**	**30**
Base-load current (I_H)	A	2,6	4,3	7,7	15,3	25,5
Intermittent duty current (I_{S6}) 40%	A_{ACrms}	3,5	6	10	24	40
Peak current (I_{max})	A_{ACrms}	6	10	18	36	56
Output voltage	V_{ACrms}	0 … 0.717 x DC-link voltage				
DC-link current $I_{d\ max}$	A_{DC}	3,6	6	11	22	36
DC-link voltage (up to 2000 m above sea level)	V_{DC}	510 … 720				
DC-link capacitance	µF	110	110	110	220	705
Overvoltage trip	V_{DC}	820 ± 2 %				
Undervoltage trip[2)]	V_{DC}	380 ± 2 %				
Electronics power supply	V_{DC}	24 (20,4 … 28,8)				
Electronics current drawn at 24 VDC	A_{DC}	0,85	0,85	0,85	0,85	0,8
Current carrying capacity						
DC-link busbars	A_{DC}	100				
Reinforced DC-link busbars	A_{DC}	150				
24 VDC busbars	A_{DC}	20				
Unit rating[3)]						
Based on I_n (600 VDC; 4 kHz)	kW	1,6	2,7	4,8	9,7	16
Based on I_H	kW	1,4	2,3	4,1	8,2	13,7
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	50,4	73,4	100,4	185,4	309,2
Max. pulse frequency						
without derating	kHz	4				
with derating	kHz	16				
Max. ambient temperature						
without derating	° C	40				
with derating	° C	55				
Sound pressure level	dB(A)	< 60	< 60	< 60	< 60	< 60
Cooling method		Internal fan				
Cooling air requirement	m^3/h	29,6	29,6	29,6	29,6	56
Max. permissible heat sink temperature	° C	75	75	79	82	85
Weight	kg	5	5	5	5	6,9

1) Applies only to order numbers with x = 0 .. 3

2) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

3) Rated power of a typical standard induction motor at 400 V 3 AC.

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Table 6- 12 Technical data Single Motor Modules Booksize (45 to 200 A)

Internal air cooling	**6SL3120 –**	**1TE24-5AAx**	**1TE26-0AAx**	**1TE28-5AAx**	**1TE31-3AAx**	**1TE32-0AAx**
Output current Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{s6}) 40% Peak current (I_{max})	 A_{ACrms} A A_{ACrms} A_{ACrms}	 **45** 38 60 85	 **60** 51 80 113	 **85** 68 110 141	 **132** 105 150 210	 **200** 141 230 282
Output voltage	V_{ACrms}	0 … 0.717 x DC-link voltage				
DC-link current $I_{d\ max}$	A_{DC}	54	72	102	158	200
DC-link voltage (up to 2000 m above sea level)	V_{DC}	510 … 720				
DC-link capacitance	µF	1175	1410	1880	2820	3995
Overvoltage trip Undervoltage trip[1)]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %				
Electronics power supply	V_{DC}	24 (20,4 … 28,8)				
Electronics current drawn at 24 VDC	A_{DC}	1,05	1,05	1,5	0,85	0,85
Current carrying capacity DC-link busbars 24 VDC busbars	 A_{DC} A_{DC}	 200 20	 200 20	 200 20	 200 20	 200 20
Unit rating[2)] Based on I_n (600 VDC; 4 kHz) Based on I_H	 kW kW	 24 21	 32 28	 46 37	 71 57	 107 76
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	455,2	615,2	786	1270,4	2070,4
Max. pulse frequency without derating with derating	 kHz kHz	 4 16				
Max. ambient temperature without derating with derating	 ° C ° C	 40 55				
Sound pressure level	dB(A)	< 65	< 65	< 60	< 73	< 73
Cooling method (with fan)		Internal fan			Mounted fan	
Cooling air requirement	m^3/h	112	112	160	520	520
Max. permissible heat sink temperature	° C	85	90	83	70	80 (70% derating)
Weight	kg	9	9	15	21	21

1) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V (exception: 132 A and 200 A Motor Modules) and is adjusted to the parameterized rated voltage.

2) Rated power of a typical standard induction motor at 400 V 3 AC.

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6.2.7.2 Double Motor Modules

Table 6- 13 Double Motor Modules Booksize (3 to 18 A) technical data

Internal air cooling	**6SL3120-**	**2TE13-0AAx[1)]**	**2TE15-0AAx[1)]**	**2TE21-0AAx[1)]**	**2TE21-8AAx**
Output current Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{s6}) 40% Peak current (I_{max})	 A_{ACrms} A A_{ACrms} A_{ACrms}	 **2 x 3** 2 x 2.6 2 x 3.5 2 x 6	 **2 x 5** 2 x 4.3 2 x 6 2 x 10	 **2 x 9** 2 x 7.7 2 x 10 2 x 18	 **2 x 18** 2 x 15.3 2 x 24 2 x 36
Output voltage	V_{ACrms}	0 … 0.717 x DC-link voltage			
DC-link current $I_{d\ max}$	A_{DC}	7,2	12	22	43
DC-link voltage	V_{DC}	510 … 720			
DC-link capacitance	µF	220	220	220	705
Overvoltage trip Undervoltage trip[2)]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %			
Electronics power supply	V_{DC}	24 (20,4 28,8)			
Electronics current drawn at 24 VDC	A_{DC}	1,15	1,15	1,15	1,3
Current carrying capacity DC-link busbars Reinforced DC-link busbars 24 VDC busbars	 A_{DC} A_{DC} A	 100 150 20			
Unit rating[3)] Based on I_n (600 VDC; 4 kHz) Based on I_H	 kW kW	 2 x 1.6 2 x 1.4	 2 x 2.7 2 x 2.3	 2 x 4.8 2 x 4.1	 2 x 9.7 2 x 8.2
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	97,6	132,6	187,6	351,2
Max. pulse frequency without derating with derating	 kHz kHz	 4 16			
Max. ambient temperature without derating with derating	 ° C ° C	 40 55			
Sound pressure level	dB(A)	< 60	< 60	< 60	< 60
Cooling method		Internal fan			
Cooling air requirement	m^3/h	29,6	29,6	29,6	56
Max. permissible heat sink temperature	° C	85	90	89	90
Weight	kg	5,3	5,3	5,5	6,8

1) Applies only to order numbers with x = 0 .. 3

2) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

3) Rated power of a typical standard induction motor at 400 V 3 AC.

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6.2.7.3 Characteristics

Rated duty cycles Motor Modules Booksize

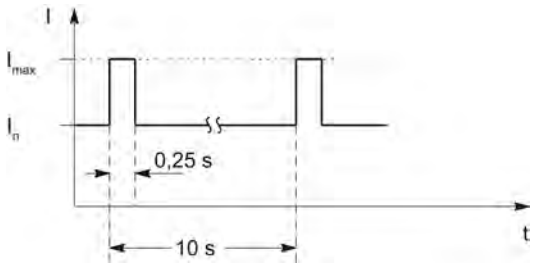


Figure 6-12 Duty cycle with initial load (for servo drives)

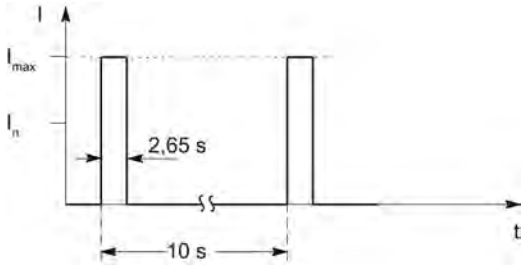


Figure 6-13 Duty cycle without initial load (for servo drives)

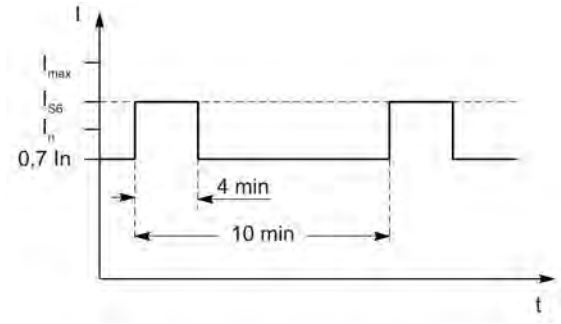


Figure 6-14 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

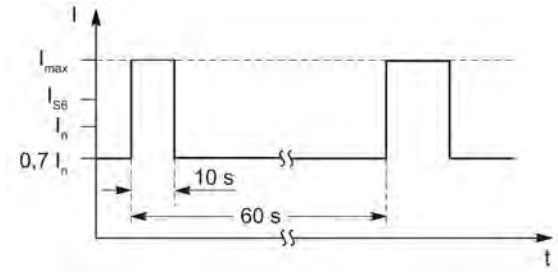


Figure 6-15 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

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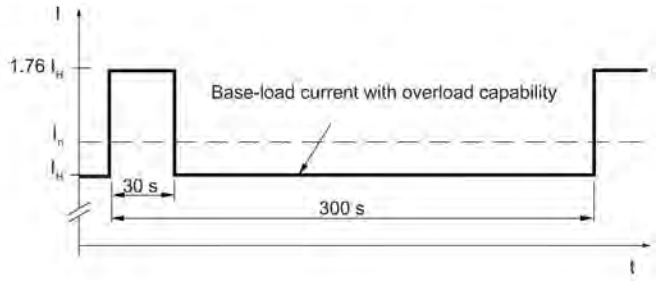


Figure 6-16 Duty cycle with 30 s overload for a duty cycle duration of 300 s

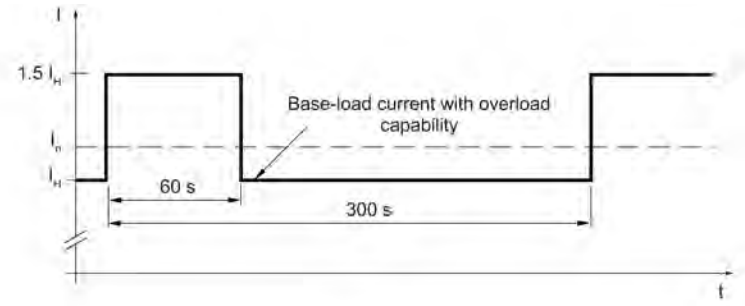


Figure 6-17 Duty cycle with 60 s overload for a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

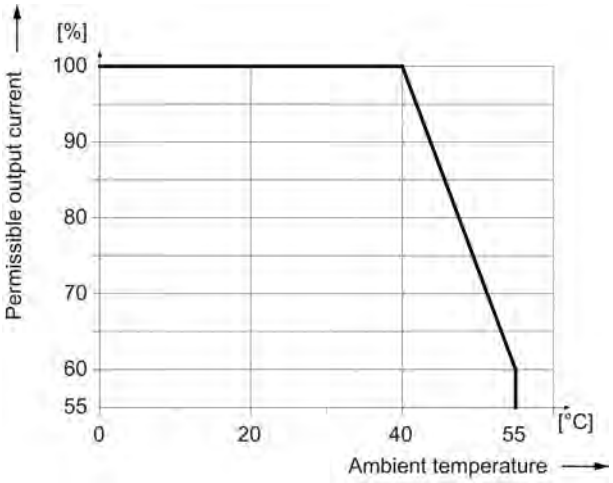


Figure 6-18 Output current as a function of the ambient temperature

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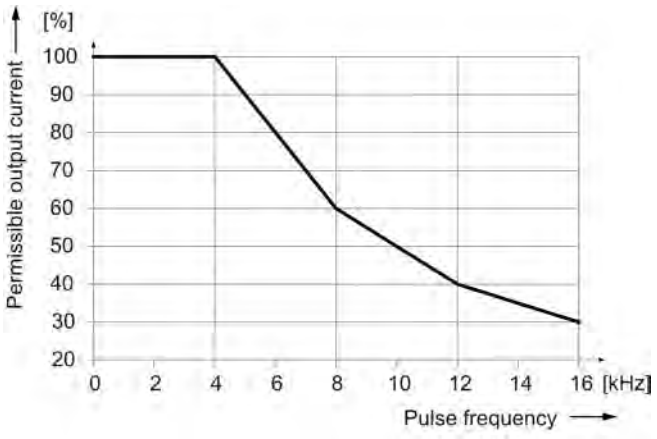


Figure 6-19 Output current as a function of the pulse frequency

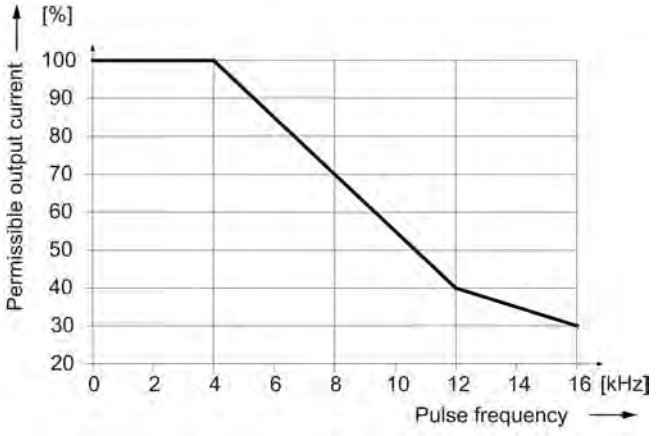


Figure 6-20 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

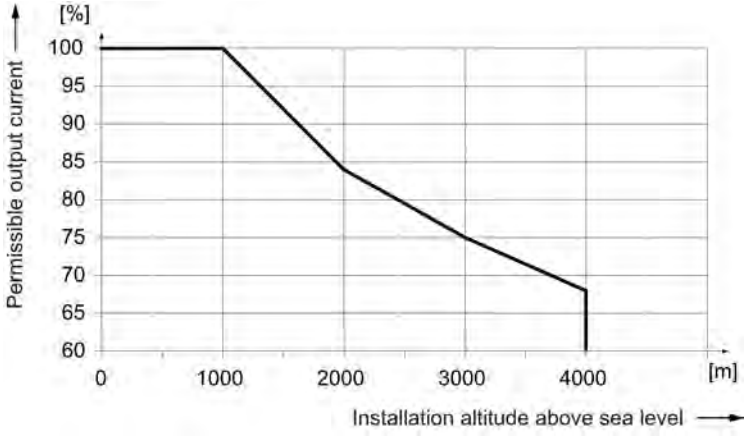


Figure 6-21 Output current as a function of the installation altitude

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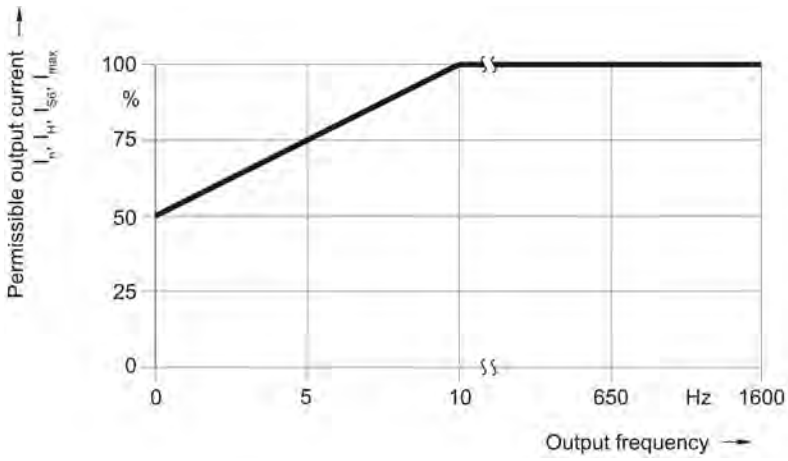


Figure 6-22 Output current as a function of the output frequency

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6.2.8 Technical data for Motor Modules Booksize with 300% overload

6.2.8.1 Single Motor Modules (300% overload)

Table 6- 14 Technical data Single Motor Modules Booksize (3 to 18 A) with 300% overload

Internal air cooling	**6SL3120–**	**1TE13-0AA4**	**1TE15-0AA4**	**1TE21–0AA4**	**1TE21–8AA4**
Output current Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{s6}) 40% Peak current (I_{max})	 A_{ACrms} A A_{ACrms} A_{ACrms}	 **3** 2,6 3,5 9	 **5** 4,3 6 15	 **9** 7,7 10 27	 **18** 15,3 24 54
Output voltage	V_{ACrms}	0 … 0.717 x DC-link voltage			
DC-link current $I_{d\ max}$	A_{DC}	3,6	6	11	22
DC-link voltage (up to 2000 m above sea level)	V_{DC}	510 … 720			
DC-link capacitance	µF	110	110	110	220
Overvoltage trip Undervoltage trip[1)]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %			
Electronics power supply	V_{DC}	24 (20,4 … 28,8)			
Electronics current drawn at 24 VDC	 A_{DC}	 0,85	 0,85	 0,85	 0,85
Current carrying capacity DC-link busbars Reinforced DC-link busbars 24 VDC busbars	 A_{DC} A_{DC} A_{DC}	 100 150 20			
Unit rating[2)] Based on I_n (600 VDC; 4 kHz) Based on I_H	 kW kW	 1,6 1,4	 2,7 2,3	 4,8 4,1	 9,7 8,2
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	50,4	73,4	100,4	185,4
Max. pulse frequency without derating with derating	 kHz kHz	 4 16			
Max. ambient temperature without derating with derating	 ° C ° C	 40 55			
Sound pressure level	dB(A)	< 60			
Cooling method		Internal fan			
Cooling air requirement	m^3/h	29,6			
Max. permissible heat sink temperature	° C	74	74	75	90
Weight	kg	5	5	5	5

1) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

2) Rated power of a typical standard induction motor at 400 V 3 AC.

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Note

Disturbance of the 18 A Single Motor Module with 300% overload during operation on a 16 kW Line Module

The maximum output of a 16 kW Line Module is not sufficient for the operation of an 18 A Single Motor Module with 300% overload.

- Do NOT operate the 18 A Single Motor Module with 300% overload on a 16 kW Line Module.
- Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.
- Only operate an 18 A Single Motor Module on a 16 kW Line Module when the maximum current is limited to 2 x I_{rated}.

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6.2.8.2 Double Motor Modules (300% overload)

Table 6- 15 Technical data Double Motor Modules Booksize (2 x 3 to 2 x 9 A) with 300% overload

Internal air cooling	6SL3120-	2TE13-0AA4	2TE15-0AA4	2TE21-0AA4
Output current				
Rated current (I_n)	A_{ACrms}	**2 x 3**	**2 x 5**	**2 x 9**
Base-load current (I_H)	A	2 x 2.6	2 x 4.3	2 x 7.7
Intermittent duty current (I_{s6}) 40%	A_{ACrms}	2 x 3.5	2 x 6	2 x 10
Peak current (I_{max})	A_{ACrms}	2 x 9	2 x 15	2 x 27
Output voltage	V_{ACrms}	0 … 0.717 x DC-link voltage		
DC-link current $I_{d\ max}$	A_{DC}	7,2	12	22
DC-link voltage (up to 2000 m above sea level)	V_{DC}	510 … 720		
DC-link capacitance	µF	220		
Overvoltage trip	V_{DC}	820 ± 2 %		
Undervoltage trip[1)]	V_{DC}	380 ± 2 %		
Electronics power supply	V_{DC}	24 (20,4 … 28,8)		
Electronics current drawn at 24 VDC	A_{DC}	1,15		
Current carrying capacity				
DC-link busbars	A_{DC}	100		
Reinforced DC-link busbars	A_{DC}	150		
24 VDC busbars	A	20		
Unit rating[2)]				
Based on I_n (600 VDC; 4 kHz)	kW	2 x 1.6	2 x 2.7	2 x 4.8
Based on I_H	kW	2 x 1.4	2 x 2.3	2 x 4.1
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	97,6	132,6	187,6
Max. pulse frequency				
without derating	kHz	4		
with derating	kHz	16		
Max. ambient temperature				
without derating	° C	40		
with derating	° C	55		
Sound pressure level	dB(A)	< 60		
Cooling method		Internal fan		
Cooling air requirement	m^3/h	29,6		
Max. permissible heat sink temperature	° C	84	78	92
Weight	kg	5,3	5,3	5,5

1) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

2) Rated power of a typical standard induction motor at 400 V 3 AC.

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Note

Disturbance of the 2 x 9 A Double Motor Module with 300% overload during operation on a 16 kW Line Module

The maximum output of a 16 kW Line Module is not sufficient for the operation of a 2 x 9 A Double Motor Module with 300% overload.

- Do NOT operate the 2 x 9 A Double Motor Module with 300% overload on a 16 kW Line Module.
- Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.
- Only operate a 2 x 9 A Double Motor Module on a 16 kW Line Module when the maximum current is limited to 2 x I_{rated}.

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6.2.8.3 Characteristics for Motor Modules Booksize with 300% overload

Rated duty cycles Motor Modules Booksize with 300% overload

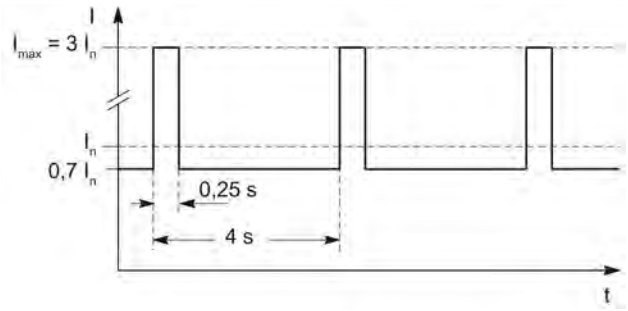


Figure 6-23 Peak current duty cycle with initial load (300% overload)

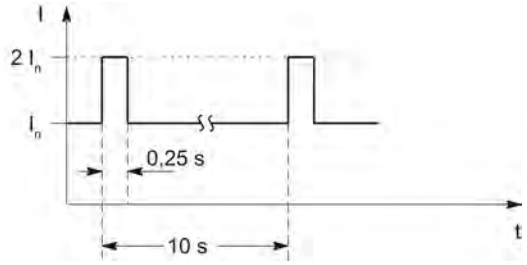


Figure 6-24 Duty cycle with initial load

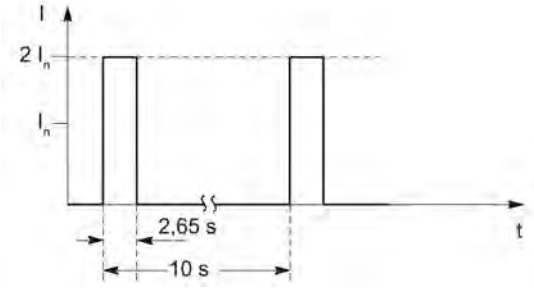


Figure 6-25 Duty cycle without initial load

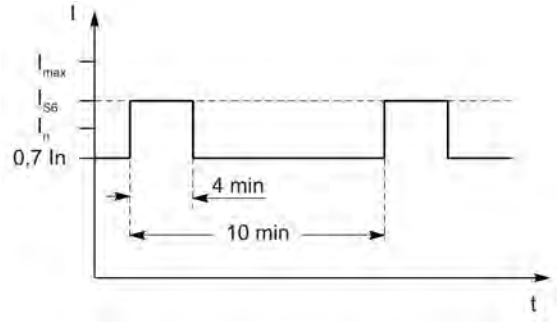


Figure 6-26 S6 duty cycle with initial load for a duty cycle duration of 600 s

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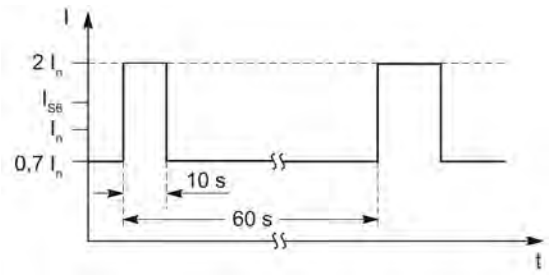


Figure 6-27 S6 duty cycle with initial load for a duty cycle duration of 60 s

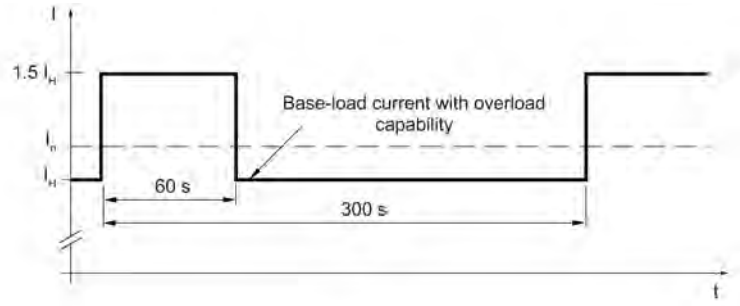


Figure 6-28 Duty cycle with 60 s overload for a duty cycle duration of 300 s

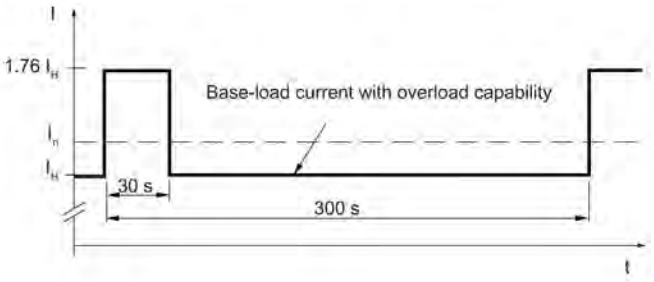


Figure 6-29 Duty cycle with 30 s overload for a duty cycle duration of 300 s

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Derating characteristics for Motor Modules Booksize with 300% overload

Note

For additional information, see Chapter Combining line reactors and line filters (Page 136).

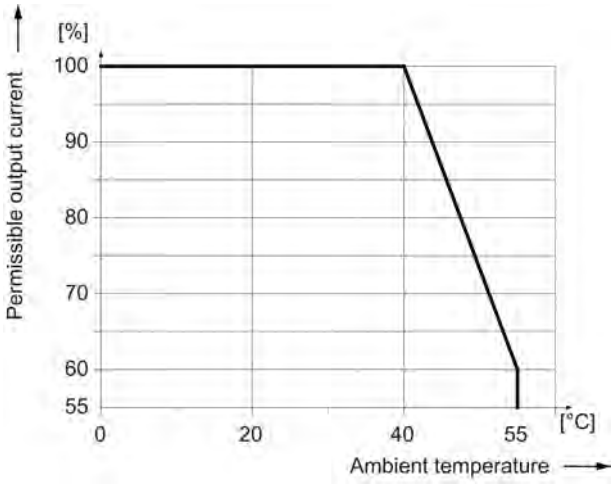


Figure 6-30 Output current as a function of the ambient temperature

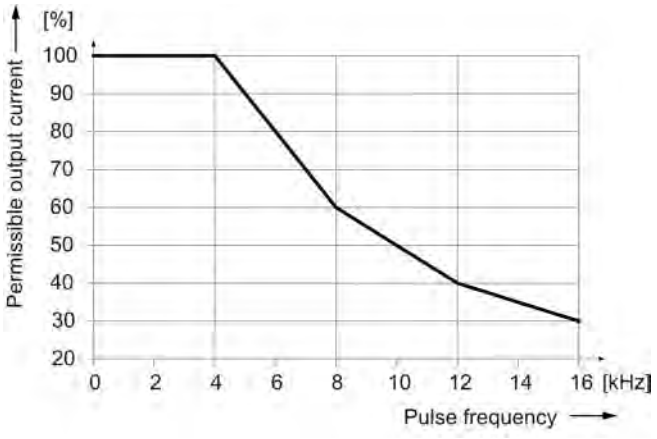


Figure 6-31 Output current as a function of the pulse frequency

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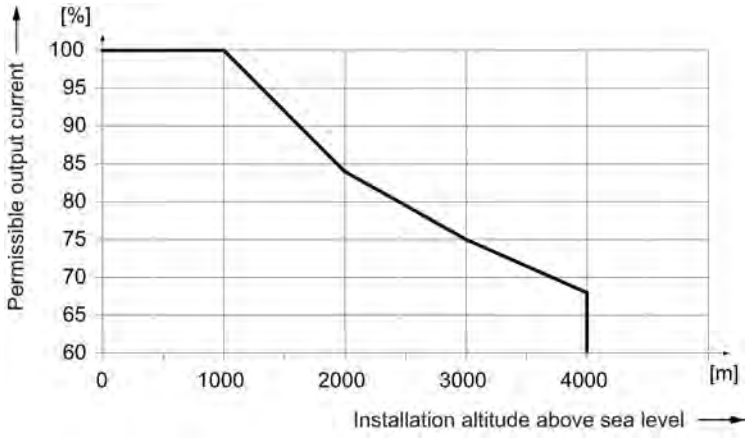


Figure 6-32 Output current as a function of the installation altitude

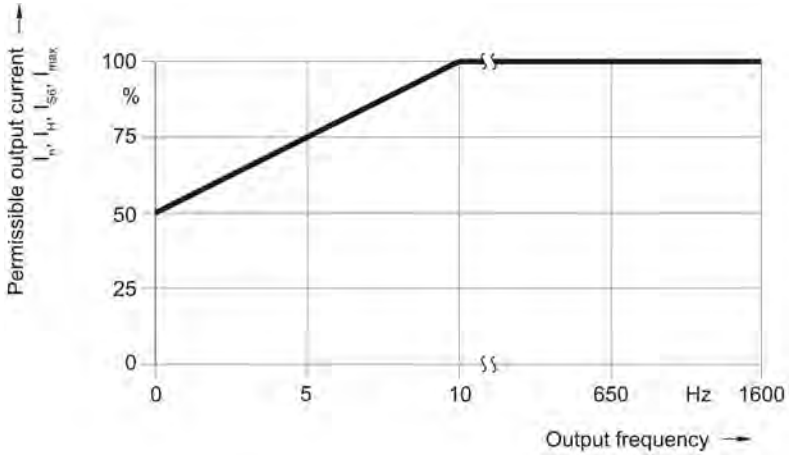


Figure 6-33 Output current as a function of the output frequency

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6.3 Motor Module with external air cooling

6.3.1 Description

A Motor Module with external cooling is a power unit (inverter) that provides the power for the connected motors. Power is supplied by the DC link of the drive unit. A Motor Module must be connected to a Control Unit via DRIVE-CLiQ. The open-loop and closed-loop control functions for the Motor Module are stored in the Control Unit.

Motor Modules with external air cooling are offered as Single Motor Modules and Double Motor Modules. One motor can be connected to Single Motor Modules and 2 motors can be connected to Double Motor Modules.

External air cooling uses the "through-hole" method. The power unit and its heat sink can be inserted in a rectangular knockout at the rear of the control cabinet and mounted with a seal. The heat sink fins and the fan (included in the scope of delivery) project beyond the rear of the control cabinet and the heat is dissipated outside the control cabinet or in a separate air duct.

WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

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6.3.2 Interface description

6.3.2.1 Overview

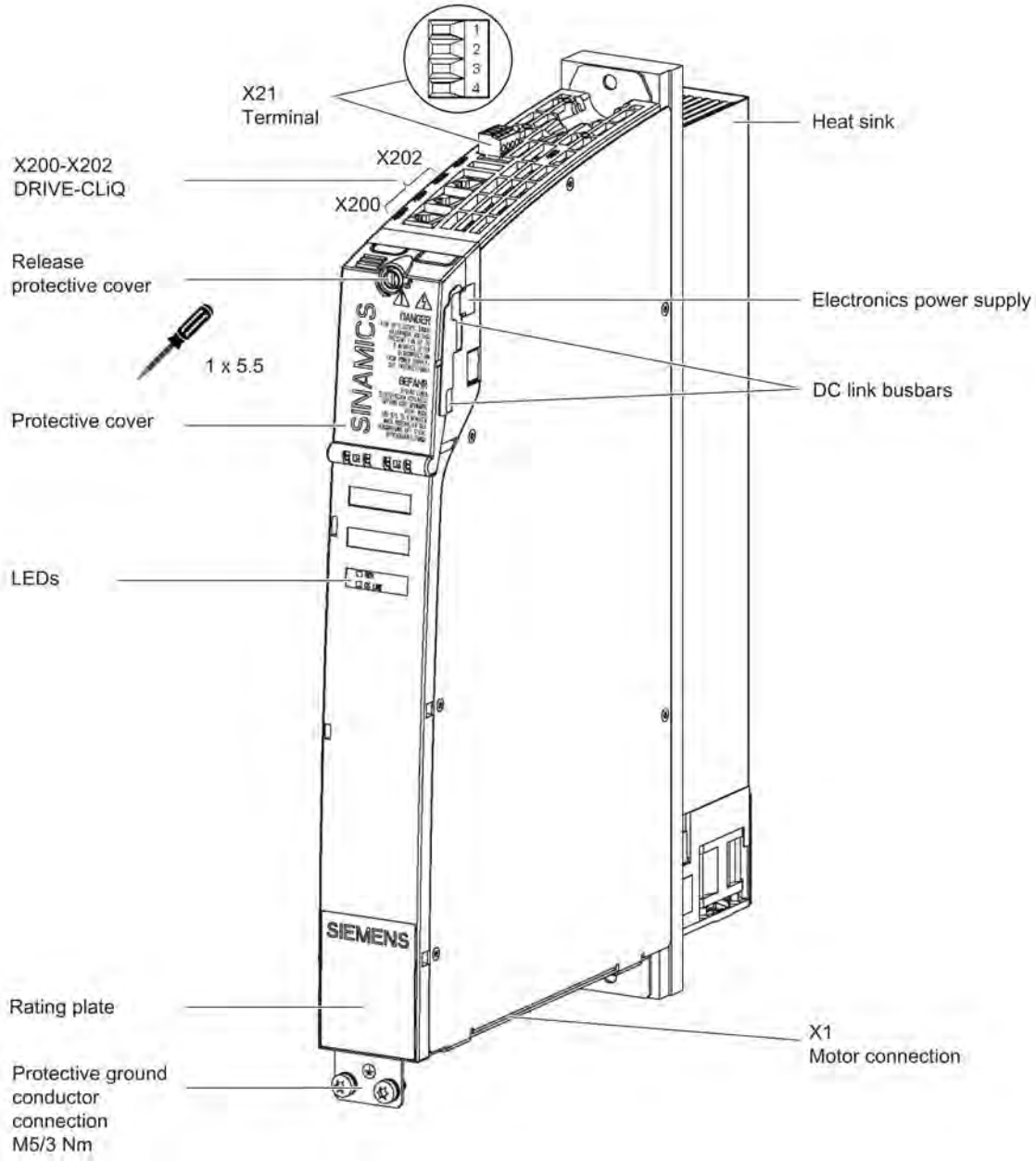


Figure 6-34 Interface overview, Single Motor Module Booksize with external air cooling (example: 5 A)

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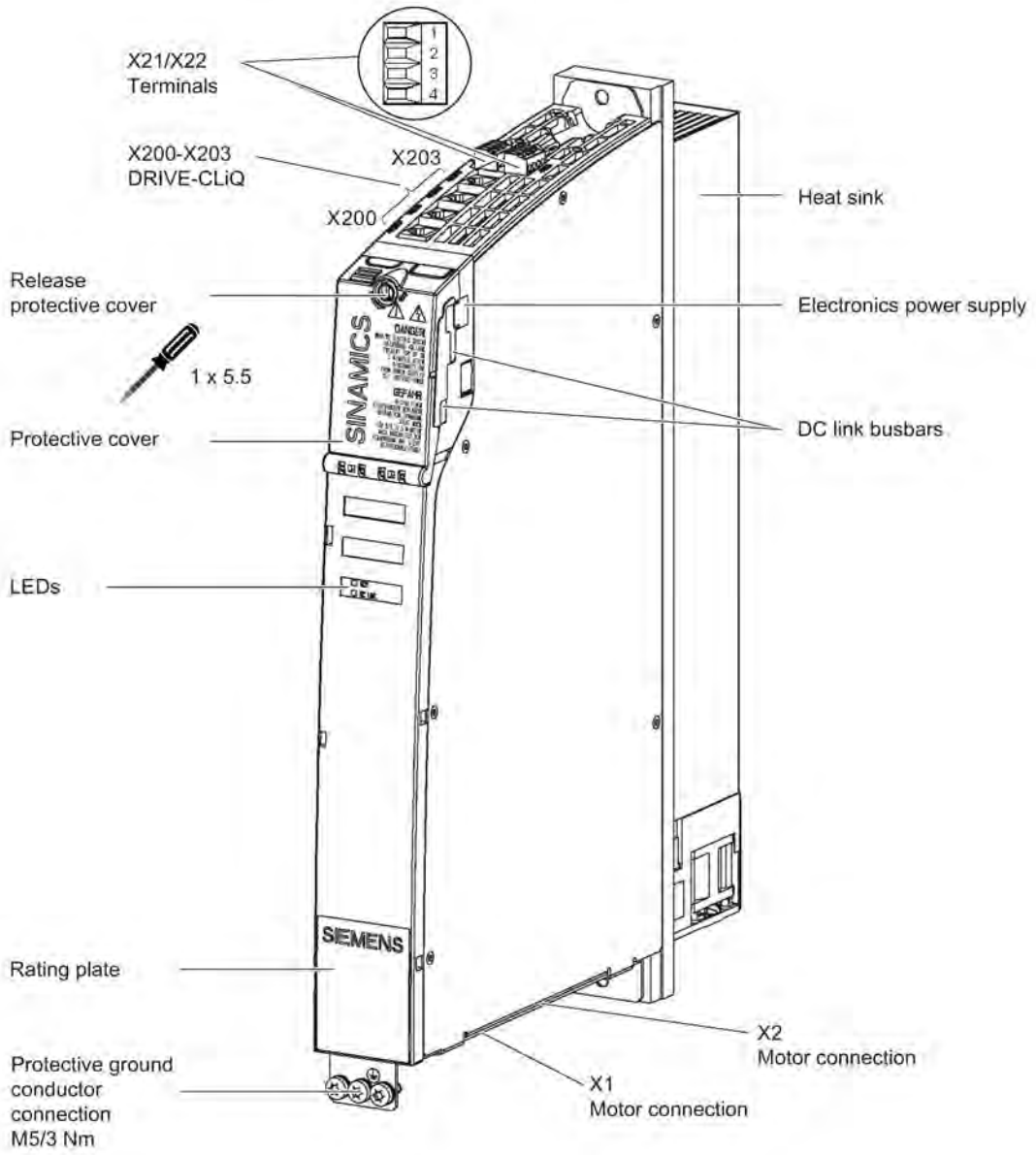
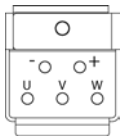
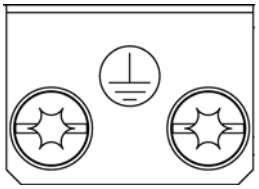
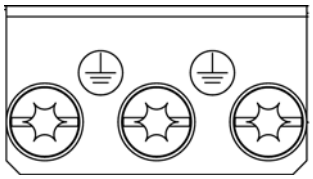


Figure 6-35 Interface overview, Double Motor Module Booksize with external air cooling (example: 2 x 5 A)

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6.3.2.2 Motor and brake connection

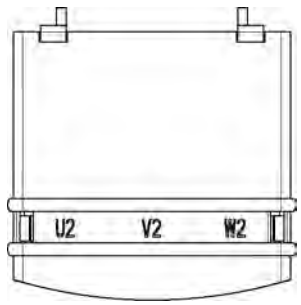
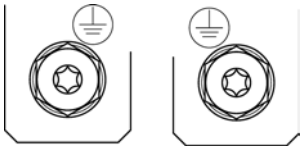
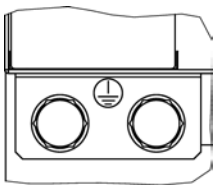
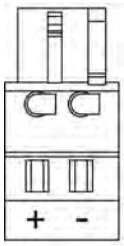
Table 6- 16 X1/X2 motor and brake connection for Single Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

	Terminal	Technical data
	U (U2)	Motor connection
	V (V2)	
	W (W2)	
	+ (BR+)	Brake connection Max. load current: 2 A Minimum load current: 0.1 A
	- (BR-)	
	PE connection	**Single Motor Modules 3 ... 30 A:** Threaded hole M5 / 3 Nm[1)]
		**Double Motor Modules 3 ... 18 A:** Threaded hole M5 / 3 Nm[1)]

[1)] For ring cable lugs without insulation

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Table 6- 17 X1 motor connection and X11 brake connection for Single Motor Modules 45 A to 200 A

	Terminal	Technical data
	U2 V2 W2	**45 ... 60 A:** Threaded bolts M6 / 6 Nm[1)] **85 A:** Threaded bolts M8 / 13 Nm[1)] **132 ... 200 A:** Threaded bolts M8 / 13 Nm[1)]
	PE connection	**45 ... 60 A:** Threaded bolts for motor cables: M6 / 6 Nm[1)] Threaded hole for PE: M6 / 6 Nm[1)]
		**85 A:** Threaded bolts for motor cables: M8 / 13 Nm[1)] Threaded hole for PE: M6 / 6 Nm[1)] **132 ... 200 A:** Threaded bolts for motor cables: M8 / 13 Nm[1)] Threaded hole for PE: M8 / 13 Nm[1)]
	+ (BR+) - (BR-)	**X11 brake connector**[2)]: Voltage: 24 V DC Max. load current: 2 A Minimum load current: 0.1 A Type: Spring-loaded terminal 2 (Page 754) Max. cross-section that can be connected 2.5 mm²: The brake connector is part of the prefabricated cable.

1) For ring cable lugs without insulation

2) The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.



⚠WARNING

Danger to life as a result of a hazardous voltage at the 0 V to 48 V DC terminals

Death or serious injury can result when live parts are touched in the event of a fault.

- Only connect protective extra-low voltages (PELV / SELV) to all connections and terminals between 0 to 48 V DC.

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NOTICE
Destruction of the motor or motor holding brake as a result of high voltage tolerances of the motor holding brakes If the voltage tolerances of the motor holding brakes are not complied with (24 V ± 10 %), then the brake will malfunction, i.e. the brake will not reliably open. If the motor constantly runs against the closed brake, the brake or the motor will be destroyed. • Set the DC power supply to 26 V. The following general conditions must be satisfied: • Siemens three-phase motors must be used • Siemens MOTION-CONNECT power cables must be used • Motor cable lengths, max. 100 m

Note

The total length of the power cables (motor feeder cables and DC link cables) must not exceed the values listed in Chapter Combining line reactors and line filters (Page 136).

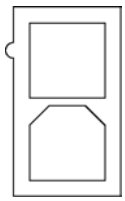
Note

The motor brake must be connected via connector X11. It is not permitted to directly connect the cable BR – to the electronics ground M.

6.3.2.3 X12 fan connection

The Motor Modules 132 A and 200 A are equipped with an interface to connect a sub-chassis fan. The interface is located on the underside of the Motor Module.

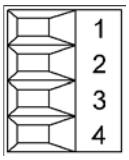
Table 6- 18 X12 fan connection

	Terminal	Function	Technical data
	1	Fan connection +	Voltage 48 V DC for the supplied fan
	2	Fan connection -	

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6.3.2.4 X21/X22 EP terminals/temperature sensor

Table 6- 19 X21/X22 EP terminals / temperature sensor

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (pulse enable)	Supply voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (enable pulses)	
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm²			

EP terminals

Parameters are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4 (see the SINAMICS S120/S150 List Manual). Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Section "Controlling the safety functions".

Note

Function of the EP terminals

The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

Temperature sensor connection

NOTICE

Risk of the motor overheating due to an incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY sensor with the correct polarity.

Note

The temperature sensor input is not needed if the motors feature an integrated DRIVE-CLiQ interface or if temperature values are detected by means of a different module (SMC, SME, TM).

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⚠WARNING

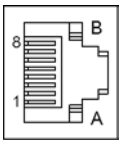
Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

6.3.2.5 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

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6.3.3 Connection examples

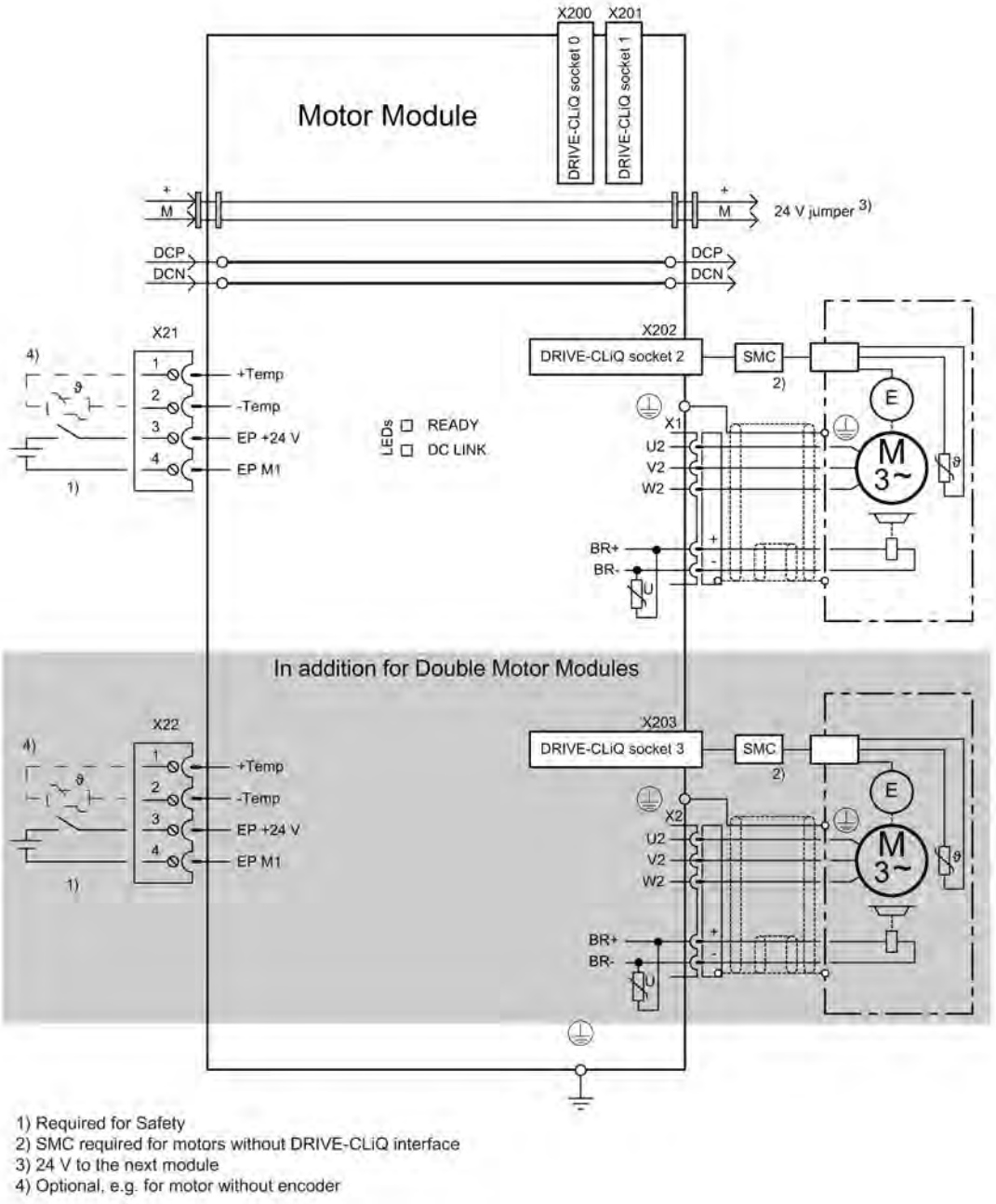
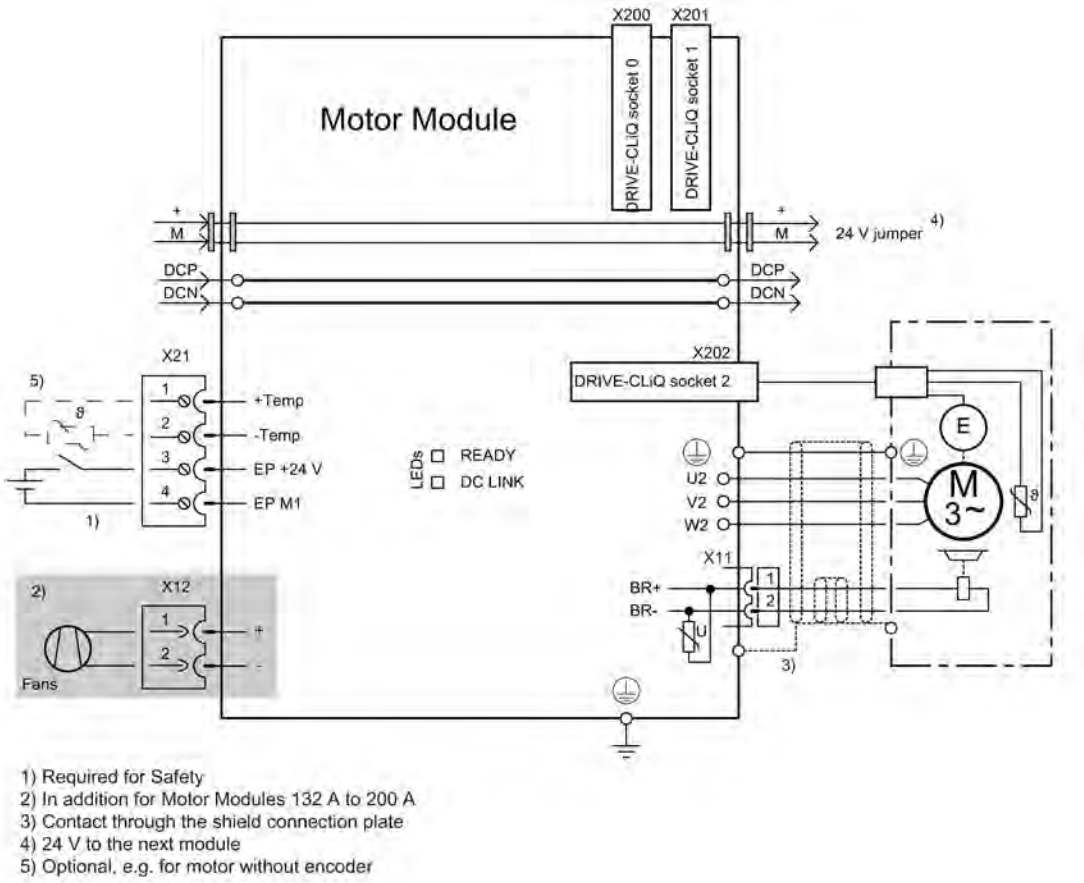


Figure 6-36 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

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1) Required for Safety
2) In addition for Motor Modules 132 A to 200 A
3) Contact through the shield connection plate
4) 24 V to the next module
5) Optional, e.g. for motor without encoder

Figure 6-37 Example connection of Single Motor Modules 45 A to 200 A

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6.3.4 Meaning of LEDs

Table 6- 21 Meaning of the LEDs on the Motor Module

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
Green	--	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is outside the permissible tolerance range.	Check the line supply voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	At least one fault is present in this component. **Note:** The LED is driven irrespective of the corresponding messages being reconfigured.	Resolve and acknowledge the fault.
Green/red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download has been completed. The system waits for POWER ON.	Carry out a POWER ON.
Green/orange or red/orange	--	Component recognition via LED is activated[1]. **Note:** Both options depend on the LED status when component recognition is activated.	–

[1] See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



WARNING

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

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6.3.5 Dimension drawings

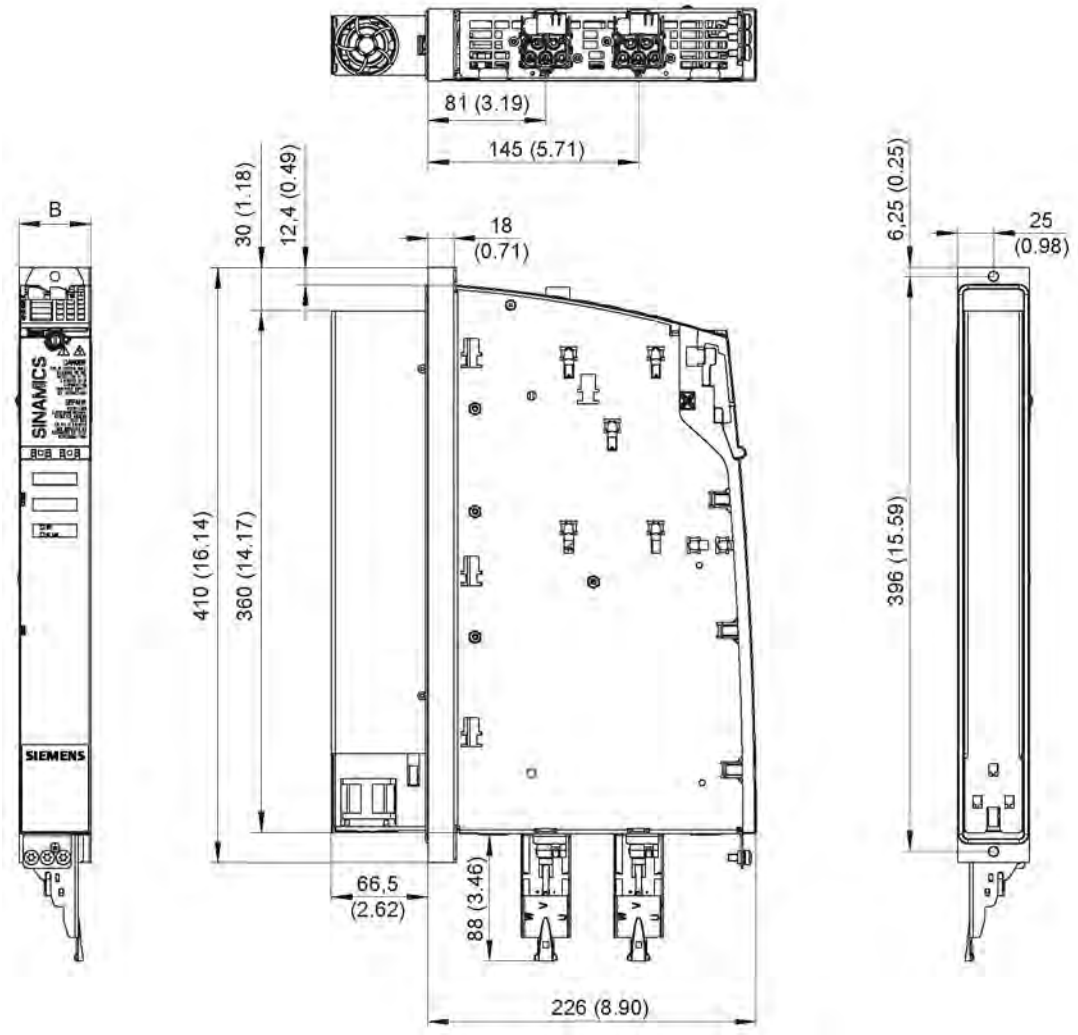


Figure 6-38 Dimension drawing of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches); example: 2 x 5 A Double Motor Module

Table 6- 22 Dimensions of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with external air cooling

Motor Module	Order number	B [mm] (inches)
Single Motor Module 3 A	6SL3121-1TE13-0AAx	50 (1.97)
Single Motor Module 5 A	6SL3121-1TE15-0AAx	
Single Motor Module 9 A	6SL3121-1TE19-0AAx	
Single Motor Module 18 A	6SL3121-1TE21-8AAx	
Double Motor Module 3 A	6SL3121-2TE13-0AAx	
Double Motor Module 5 A	6SL3121-2TE15-0AAx	
Double Motor Module 9 A	6SL3121-2TE21-0AAx	

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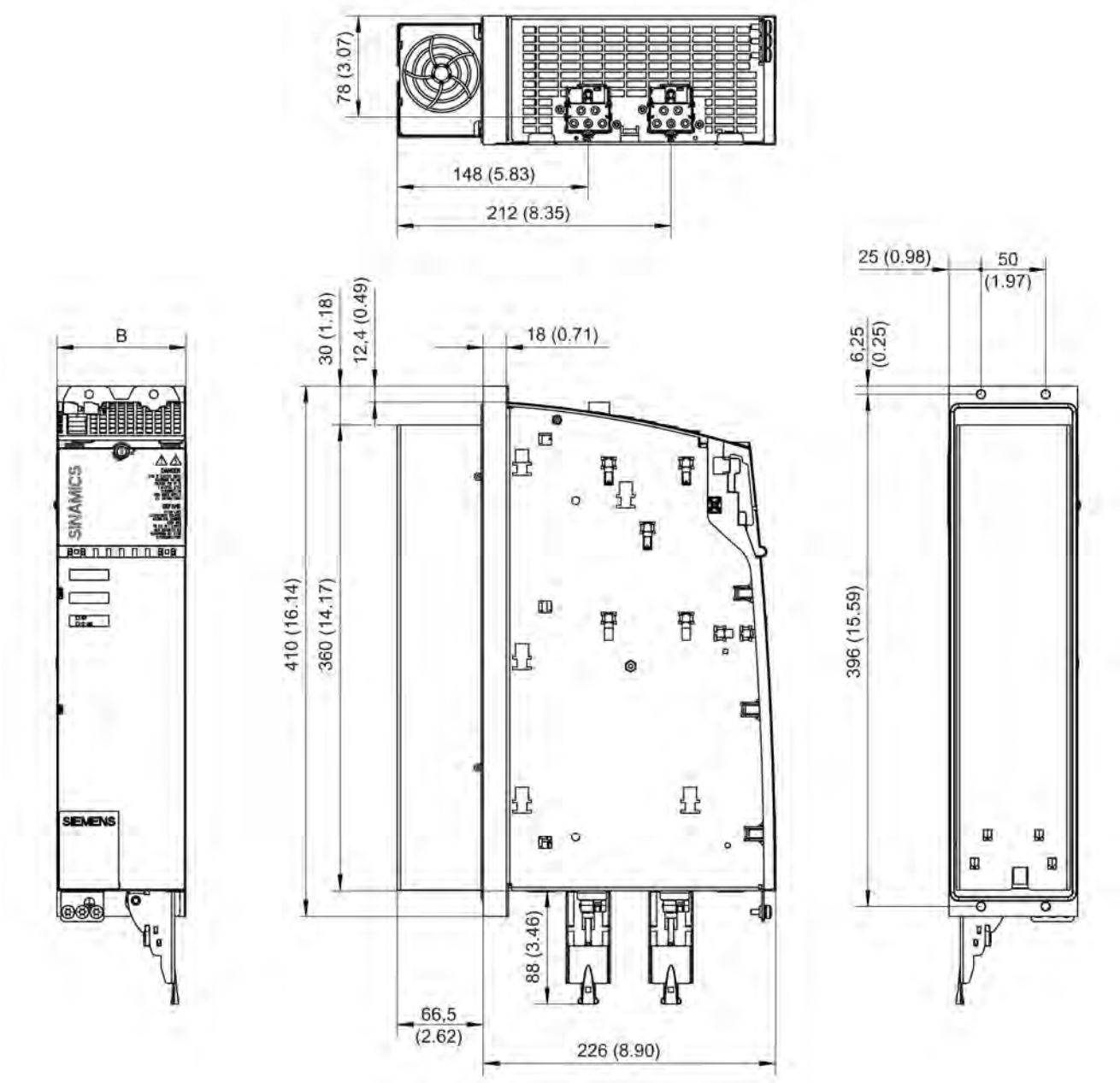


Figure 6-39 Dimension drawing of 30 A and 2 x 18 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches); example: 2 x 18 A Double Motor Module

Table 6- 23 Dimensions of 30 A and 2 x 18 A Motor Modules Booksize with external air cooling

Motor Module	Order number	B [mm] (inches)
Single Motor Module 30 A	6SL3121-1TE23-0AAx	100 (3.94)
Double Motor Module 18 A	6SL3121-2TE21-8AAx	

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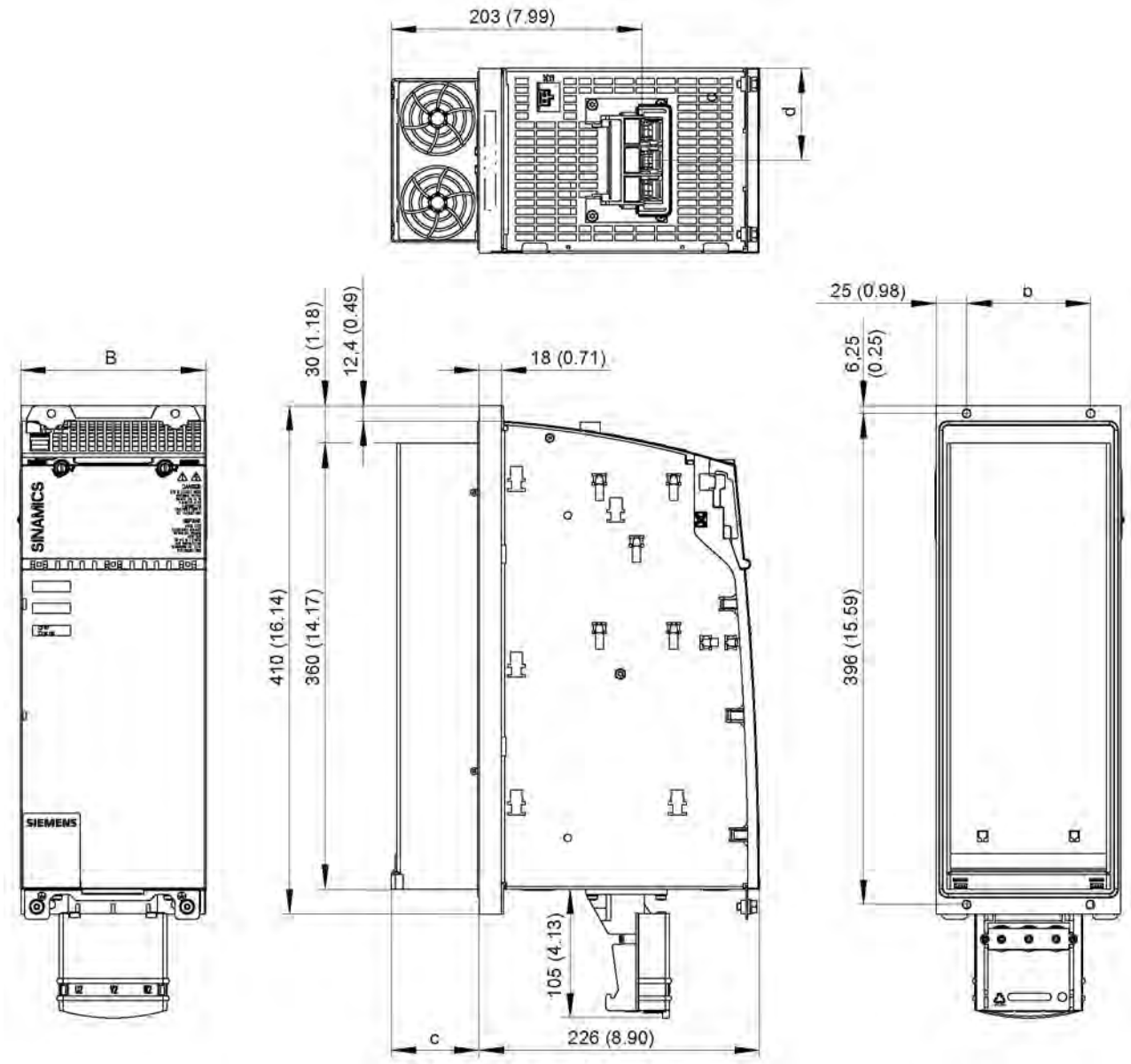


Figure 6-40 Dimension drawing of 45 A, 60 A and 85 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches); example 45 A

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)

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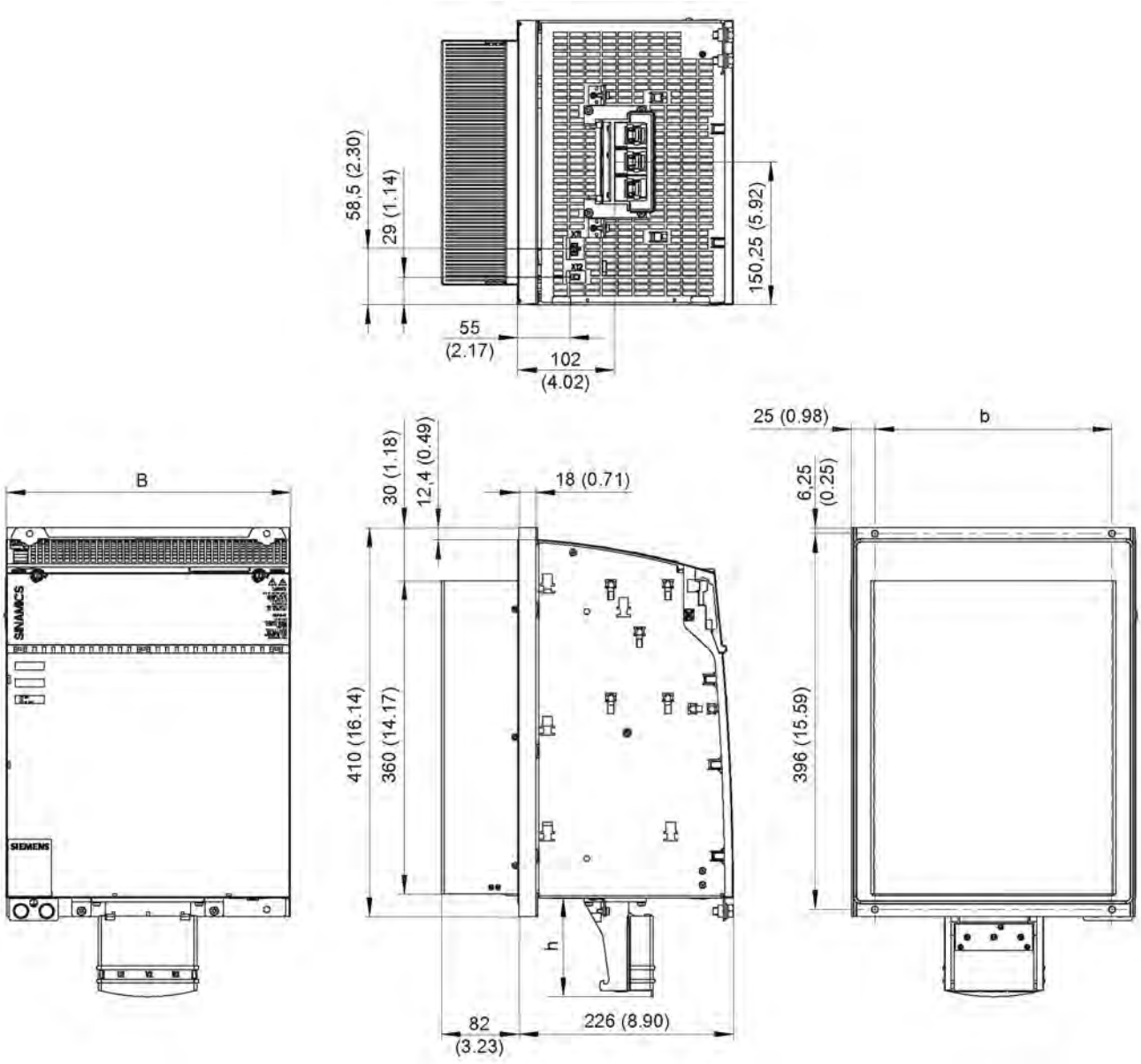


Figure 6-41 Dimension drawing of 132 A and 200 A Motor Modules Booksize, all dimensions in mm and (inches); example: 200 A Single Motor Module

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			

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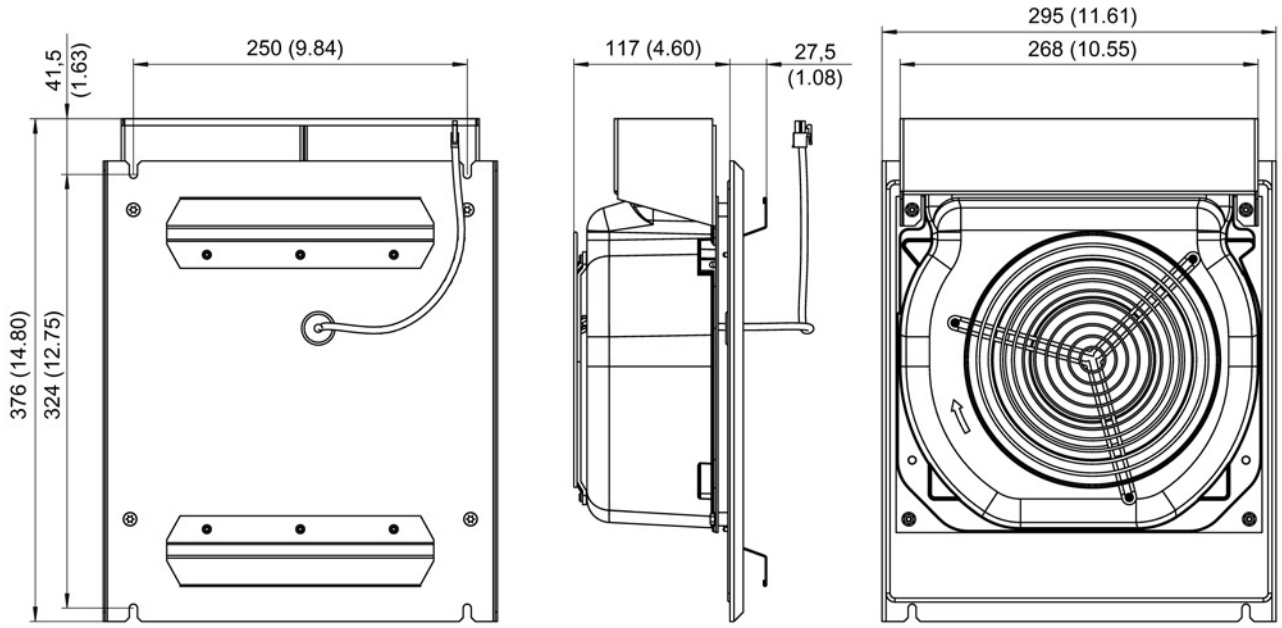


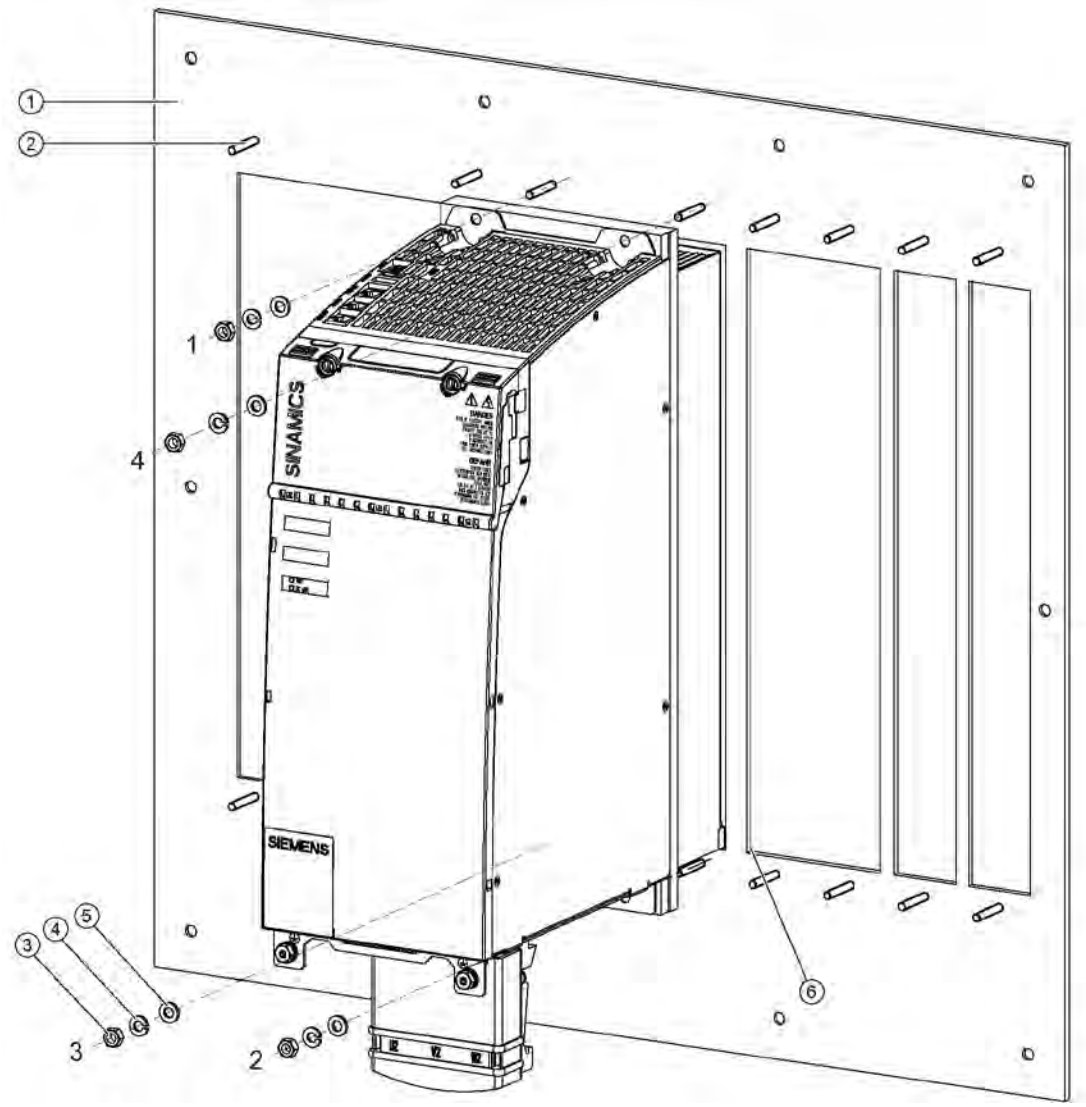
Figure 6-42 Dimension drawing of fan for 132 A and 200 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches)

Note

The fans for the 132 kW and 200 kW Motor Modules are included in the scope of delivery.

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6.3.6 Mounting



① Mounting plate with openings for mounting
② M6 studs
③ M6 nut
④ Spring washer
⑤ Washer
⑥ Fan assembly

Figure 6-43 Mounting a Motor Module with external air cooling

Tightening torques:

- Firstly, tighten the nuts by hand.
  Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
  Tightening torque: 6 Nm

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Help with the mechanical control cabinet design is available from:

Siemens AG
Industry Sector, IA DT MC MF - WKC AS
TCCCC (Technical Competence Center Cabinets Chemnitz)
P.O. Box 1124
09070 Chemnitz, Germany

e-mail: cc.cabinetcooling.aud@siemens.com

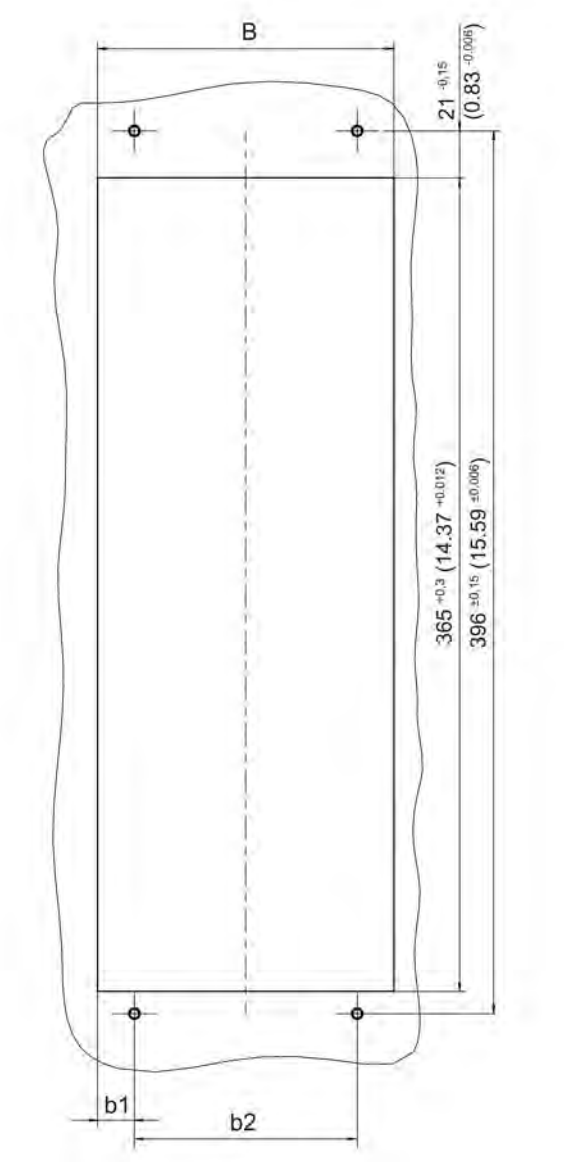
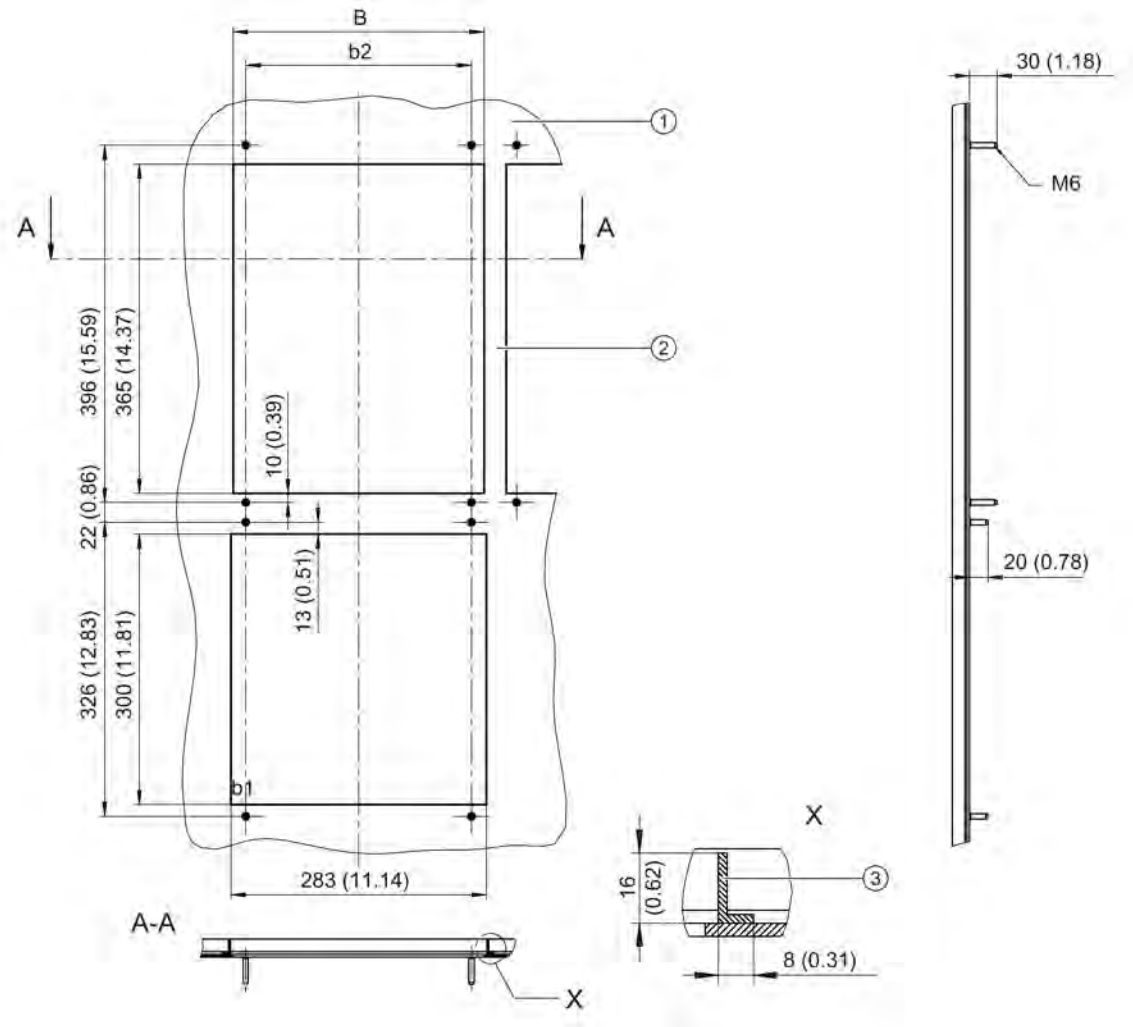


Figure 6-44 Opening to mount Motor Modules 50 mm to 200 mm with external air cooling, all data in mm and (inches)

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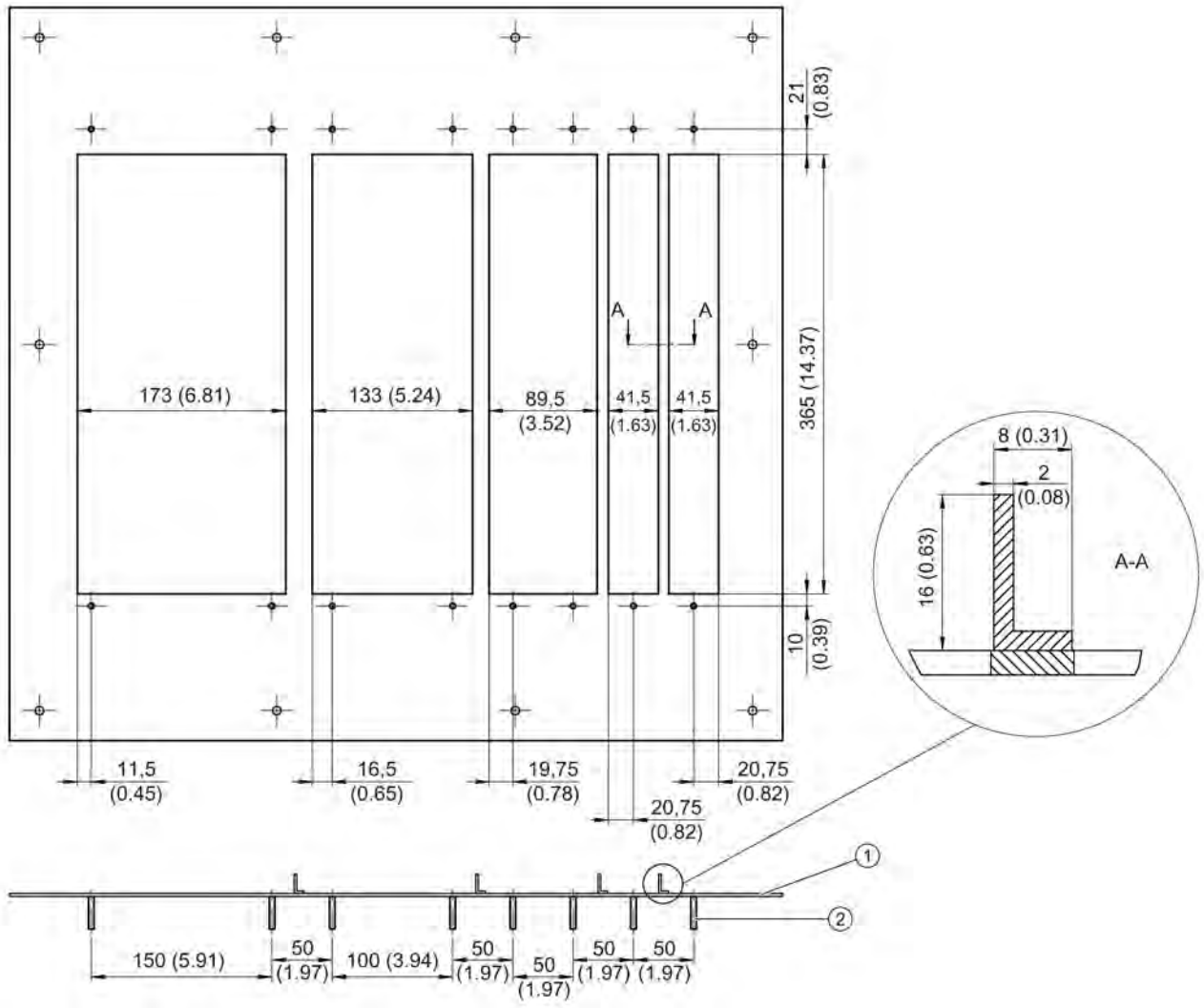
① Insert plate or mounting plate
② Cross-piece
③ Reinforcing bracket

Figure 6-45 Openings to mount a Motor Module 300 mm with external air cooling, all data in mm and (inches)

Table 6- 26 Dimensions of openings to mount Motor Modules with external air cooling

Component width	W [mm] (inches)	b1 [mm] (inch)	b2 [mm] (inch)
50 mm	41.5 $^{+0.3}$ (1.63 $^{+0.012}$)	20.75 $^{+0.15}$ (0.82 $^{+0.006}$)	0
100 mm	89.5 $^{+0.3}$ (3.52 $^{+0.012}$)	19.75 $^{+0.15}$ (0.78 $^{+0.006}$)	50 $^{\pm0.15}$ (1.97 $^{\pm0.006}$)
150 mm	133 $^{+0.3}$ (5.24 $^{+0.012}$)	16.5 $^{+0.15}$ (0.65 $^{+0.006}$)	100 $^{\pm0.15}$ (3.94 $^{\pm0.006}$)
200 mm	173 $^{+0.3}$ (6.81 $^{+0.012}$)	11.5 $^{+0.15}$ (0.45 $^{+0.006}$)	150 $^{\pm0.15}$ (5.91 $^{\pm0.006}$)
300 mm	278 $^{+0.3}$ (10.94 $^{+0.012}$)	14.0 $^{\pm 0.15}$ (0.55 $^{\pm0.006}$)	250 $^{+0.15}$ (9.84 $^{+0.006}$)

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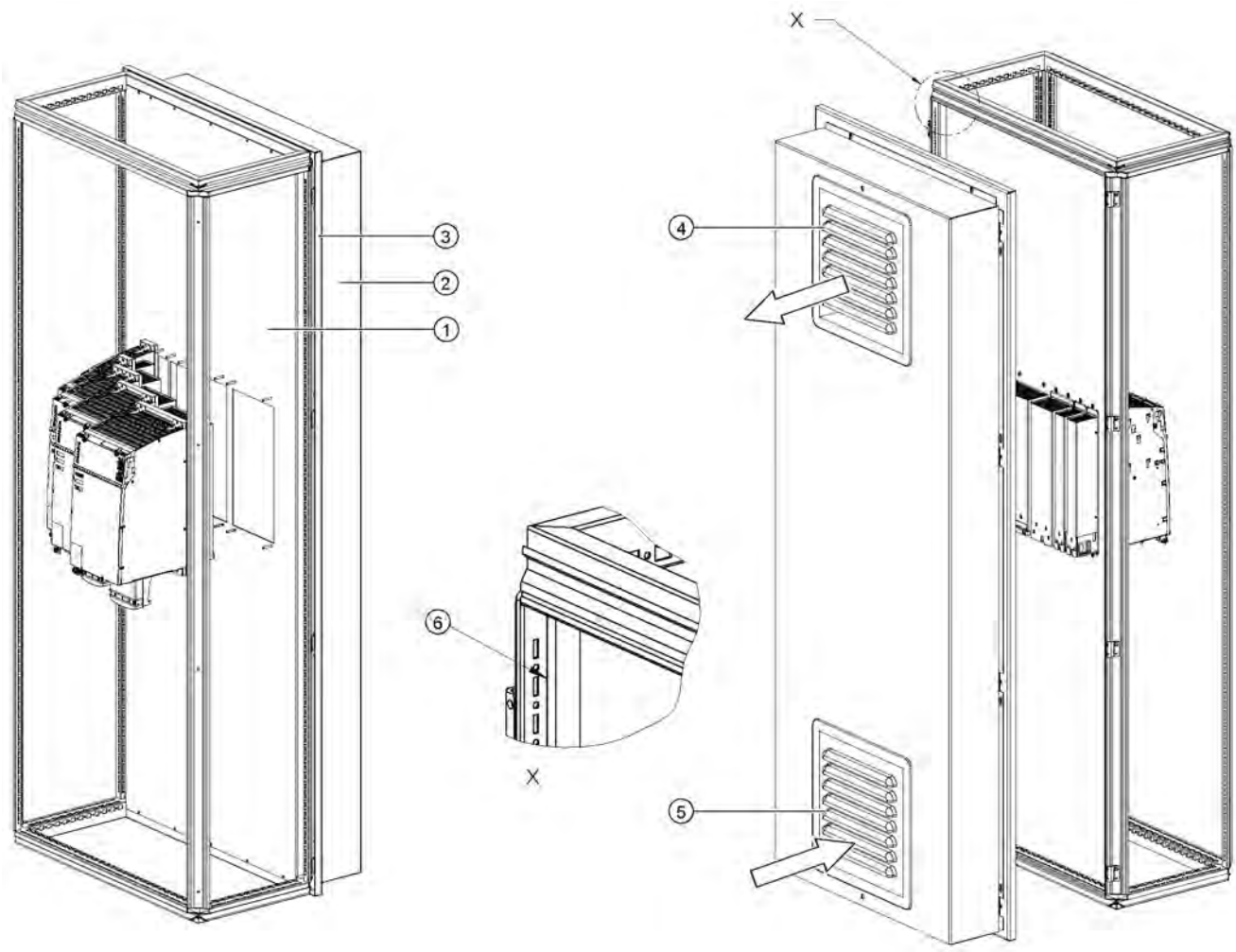
① Insert plate or mounting plate
② Threaded bolts M5 x 28

Figure 6-46 Example of a mounting plate for a drive line-up with external air cooling

When mounting it must be ensured that the component's seal is tight throughout. The cross-pieces must have the appropriate stability. If necessary, the cross-pieces of the openings must be reinforced.

In the example, the cross-pieces have been reinforced using brackets according to EN 755-9. You are free to select the way that the bracket is attached to the insert.

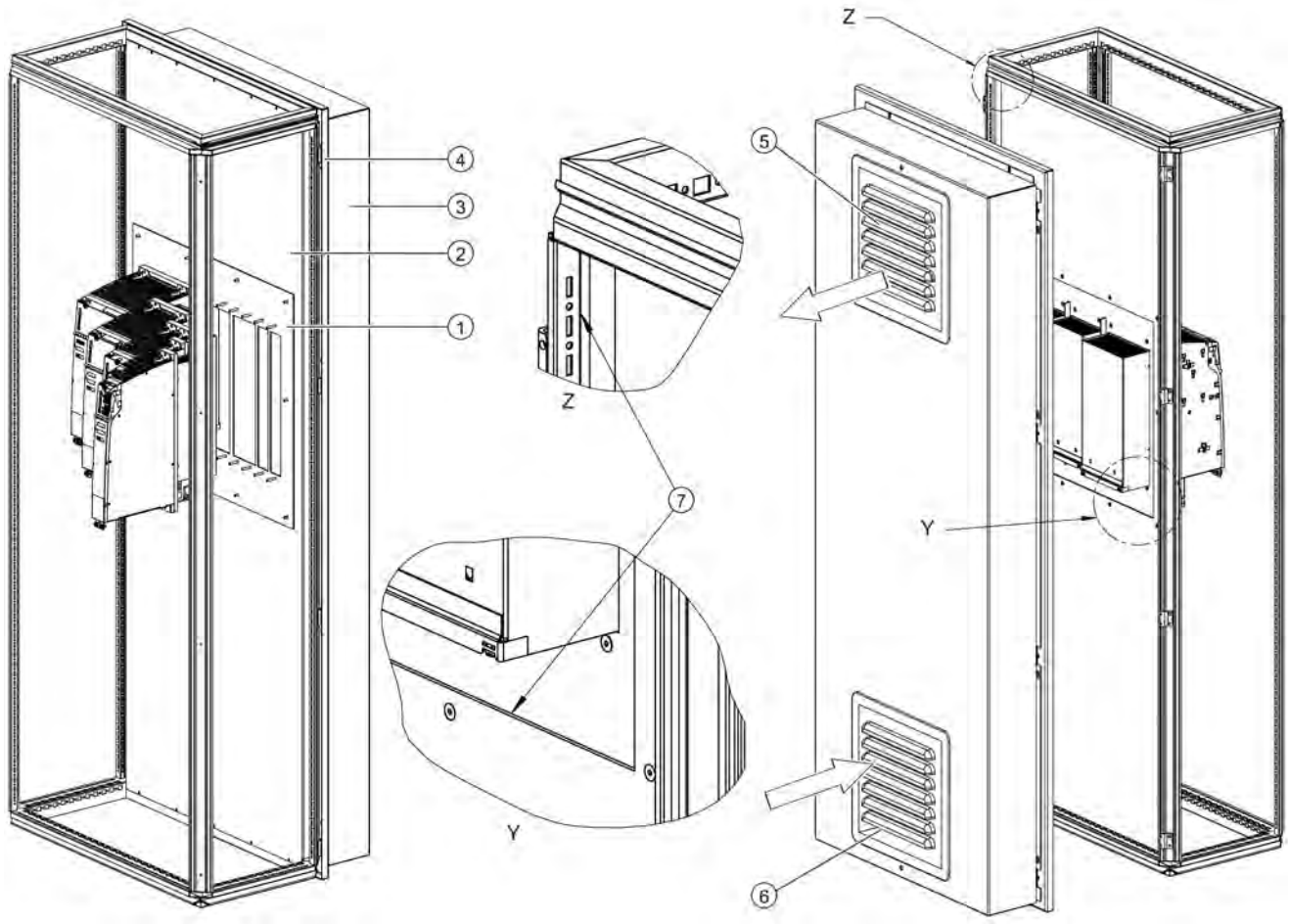
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① Mounting plate
② Cover
③ Rear panel
④ Air discharge
⑤ Air inlet - filter with filter fan
⑥ To comply with degree of protection IP54, the surfaces ⑥ between the mounting plate and the cabinet strip must be sealed all round. (for example, sealant Terostat-91 from the Teroson company)

Figure 6-47 Example 1: mounting in the cabinet with mounting plate

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① Insert plate
② Mounting plate
③ Cover
④ Rear panel
⑤ Air discharge
⑥ Air inlet - filter with filter fan
⑦ To maintain the degree of protection IP54, the surfaces ⑦ between the mounting plate and the cabinet strip as well as between the mounting plate and insert plate must be sealed all around. (for example, sealant Terostat-91 from the Teroson company)

Figure 6-48 Example 2: mounting in the cabinet with mounting plate

It is recommended that you attach a cover and filter fan to the cabinet.

The filtered fan must be fitted in such a way that the cooling air required by the drive line-up is not restricted. The overall cooling air requirement is obtained from the sum of the individual components (see Chapter Technical data (Page 423)).

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Note

If the cooling air requirement is not covered by the filtered fan, the components cannot output their specified power.

The filters with filter fan must be regularly checked for dirt and cleaned if necessary.

6.3.7 Technical data

6.3.7.1 Single Motor Modules

Table 6- 27 Technical data Single Motor Modules Booksize (3 to 30 A)

External air cooling	**6SL3121–**	**1TE13-0AAx[1)]**	**1TE15-0AAx[1)]**	**1TE21–0AAx[1)]**	**1TE21–8AAx[1)]**	**1TE23-0AAx**
Output current						
Rated current (I_n)	A_{ACrms}	**3**	**5**	**9**	**18**	**30**
Base-load current (I_H)	A	2,6	4,3	7,7	15,3	25,5
Intermittent duty current (I_{s6}) 40%	A_{ACrms}	3,5	6	10	24	40
Peak current (I_{max})	A_{ACrms}	6	10	18	36	56
Output voltage	V_{ACrms}	0 … 0.717 x DC-link voltage				
DC-link current $I_{d\ max}$	A_{DC}	3,6	6	11	22	36
DC-link voltage	V_{DC}	510 … 720				
DC-link capacitance	µF	110	110	110	220	705
Overvoltage trip	V_{DC}	820 ± 2 %				
Undervoltage trip[2)]	V_{DC}	380 ± 2 %				
Electronics power supply	V_{DC}	24 (20,4 … 28,8)				
Electronics current drawn at 24 VDC	A_{DC}	0,85	0,85	0,85	0,85	0,8
Current carrying capacity						
DC-link busbars	A_{DC}	100	100	100	100	100
Reinforced DC-link busbars	A_{DC}	150	150	150	150	150
24 VDC busbars	A_{DC}	20	20	20	20	20
Unit rating[3)]						
Based on I_n (600 VDC; 4 kHz)	kW	1,6	2,7	4,8	9,7	16
Based on I_H	kW	1,4	2,3	4,1	8,2	13,7
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	50,4	73,4	100,4	185,4	309,2
Max. pulse frequency						
without derating	kHz	4				
with derating	kHz	16				

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External air cooling	6SL3121–	1TE13-0AAx[1)]	1TE15-0AAx[1)]	1TE21–0AAx[1)]	1TE21–8AAx[1)]	1TE23-0AAx
Max. ambient temperature without derating with derating	 ° C ° C	 40 55				
Sound pressure level	dB(A)	< 60	< 60	< 60	< 60	< 60
Cooling air requirement	m^3/h	29,6	29,6	29,6	29,6	56
Max. permissible heat sink temperature	° C	70	70	73	82	85
Weight	kg	5,7	5,7	5,7	5,7	8,4

1) Applies only to order numbers with x = 0 .. 3

2) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

3) Rated power of a typical standard induction motor at 400 V 3 AC.

Table 6- 28 Technical data Single Motor Modules Booksize (45 to 200 A)

External air cooling	6SL3121–	1TE24-5AAx	1TE26-0AAx	1TE28-5AAx	1TE31-3AAx	1TE32-0AAx
Output current Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{s6}) 40% Peak current (I_{max})	 A_{ACrms} A A_{ACrms} A_{ACrms}	 **45** 38 60 85	 **60** 51 80 113	 **85** 68 110 141	 **132** 105 150 210	 **200** 141 230 282
Output voltage	V_{ACrms}	0 … 0.717 x DC-link voltage				
DC-link current $I_{d\ max}$	A_{DC}	54	72	102	158	200
DC-link voltage	V_{DC}	510 … 720				
DC-link capacitance	µF	1175	1410	1880	2820	3995
Overvoltage trip Undervoltage trip[1)]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %				
Electronics power supply	V_{DC}	24 (20,4 - 28,8)				
Electronics current drawn at 24 VDC	A_{DC}	1,05	1,05	1,5	0,85	0,85
Current carrying capacity DC-link busbars 24 VDC busbars	 A_{DC} A_{DC}	 200 20	 200 20	 200 20	 200 20	 200 20
Unit rating[2)] Based on I_n (600 VDC; 4 kHz) Based on I_H	 kW kW	 24 21	 32 28	 46 37	 71 57	 107 76
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	455,2	615,2	786	1270,4	2070,4
Max. pulse frequency without derating with derating	 kHz kHz	 4 16				

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External air cooling	6SL3121–	1TE24-5AAx	1TE26-0AAx	1TE28-5AAx	1TE31-3AAx	1TE32-0AAx
Max. ambient temperature without derating with derating	 ° C ° C			 40 55		
Sound pressure level	dB(A)	< 65	< 65	< 60	< 73	< 73
Cooling air requirement	m^3/h	112	112	160	520	520
Max. permissible heat sink temperature	° C	85	90	88	73	80 (70% derating)
Weight	kg	13,2	13,3	17,2	27,1	28

1) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V (exception: 132 A and 200 A Motor Modules) and is adjusted to the parameterized rated voltage.

2) Rated power of a typical standard induction motor at 400 V 3 AC.

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6.3.7.2 Double Motor Modules

Table 6- 29 Technical data Double Motor Modules Booksize (3 to 18 A)

External air cooling	6SL3121-	2TE13-0AAx[1]	2TE15-0AAx[1]	2TE21-0AAx[1]	2TE21-8AAx
Output current					
Rated current (I_n)	A_{ACrms}	**2 x 3**	**2 x 5**	**2 x 9**	**2 x 18**
Base-load current (I_H)	A	2 x 2.6	2 x 4.3	2 x 7.7	2 x 15.3
Intermittent duty current (I_{s6}) 40%	A_{ACrms}	2 x 3.5	2 x 6	2 x 10	2 x 24
Peak current (I_{max})	A_{ACrms}	2 x 6	2 x 10	2 x 18	2 x 36
Output voltage	V_{ACrms}	0 … 480			
DC-link current $I_{d\ max}$	A_{DC}	7,2	12	22	43
DC-link voltage	V_{DC}	510 … 720			
DC-link capacitance	µF	110	220	220	705
Overvoltage trip	V_{DC}	820 ± 2 %			
Undervoltage trip[2]	V_{DC}	380 ± 2 %			
Electronics power supply	V_{DC}	24 (20,4 … 28,8)			
Electronics current drawn at 24 VDC	A_{DC}	1,15	1,15	1,15	1,3
Current carrying capacity					
DC-link busbars	A_{DC}	100	100	100	100
Reinforced DC-link busbars	A_{DC}	150	150	150	150
24 VDC busbars	A	20	20	20	20
Unit rating[3]					
Based on I_n (600 VDC; 4 kHz)	kW	2 x 1.6	2 x 2.7	2 x 4.8	2 x 9.7
Based on I_H	kW	2 x 1.4	2 x 2.3	2 x 4.4	2 x 8.2
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	97,6	132,6	187,6	351,2
Max. pulse frequency					
without derating	kHz	4			
with derating	kHz	16			
Max. ambient temperature					
without derating	° C	40			
with derating	° C	55			
Sound pressure level	dB(A)	< 60	< 60	< 60	< 60
Cooling air requirement	m^3/h	29,6	29,6	29,6	56
Max. permissible heat sink temperature	° C	80	85	89	90
Weight	kg	5,8	5,8	5,7	8,6

1) Applies only to order numbers with x = 0 .. 3

2) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

3) Rated power of a typical standard induction motor at 400 V 3 AC.

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6.3.7.3 Characteristics

Rated duty cycles Motor Modules Booksize

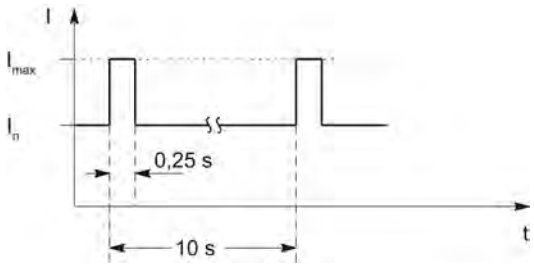


Figure 6-49 Duty cycle with initial load (for servo drives)

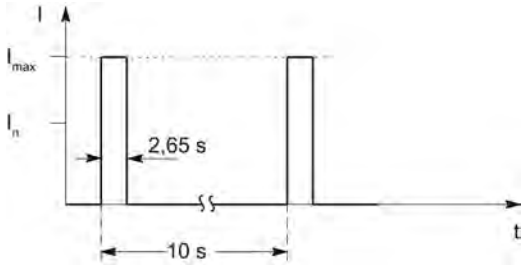


Figure 6-50 Duty cycle without initial load (for servo drives)

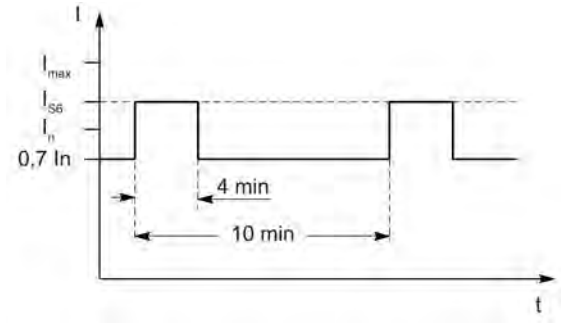


Figure 6-51 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

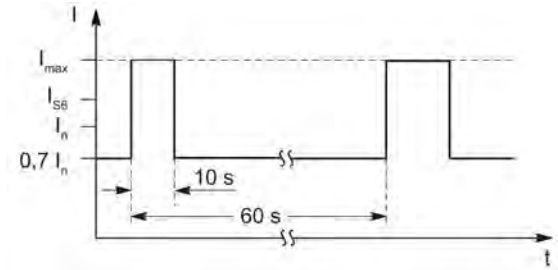


Figure 6-52 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

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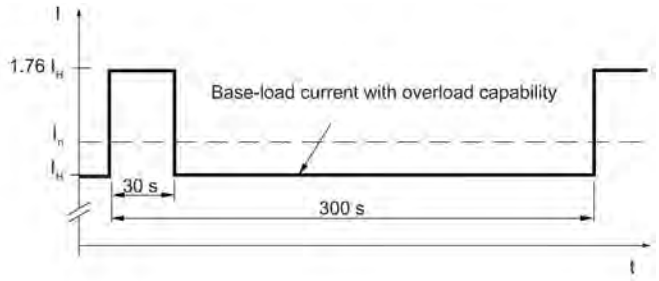


Figure 6-53 Duty cycle with 30 s overload for a duty cycle duration of 300 s

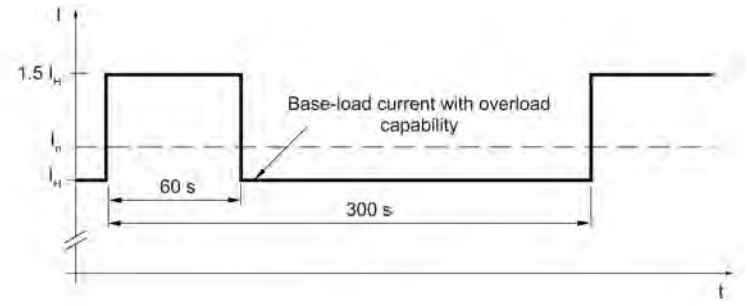


Figure 6-54 Duty cycle with 60 s overload for a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

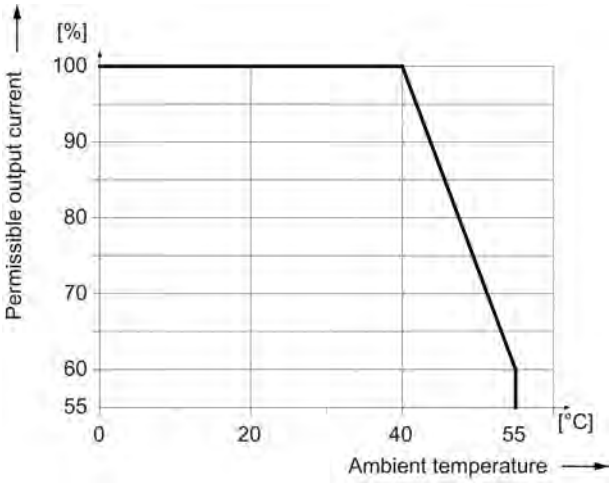


Figure 6-55 Output current as a function of the ambient temperature

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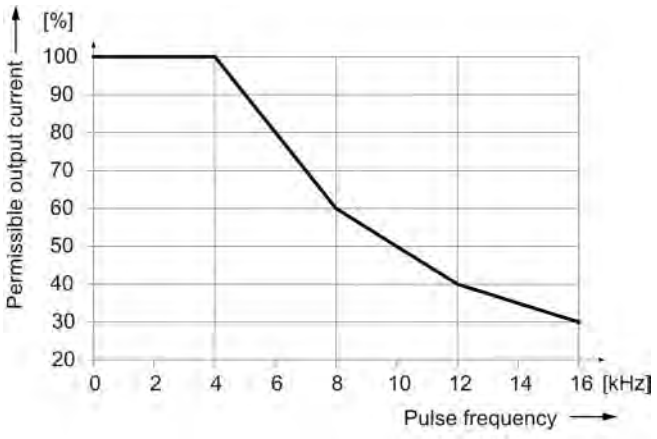


Figure 6-56 Output current as a function of the pulse frequency

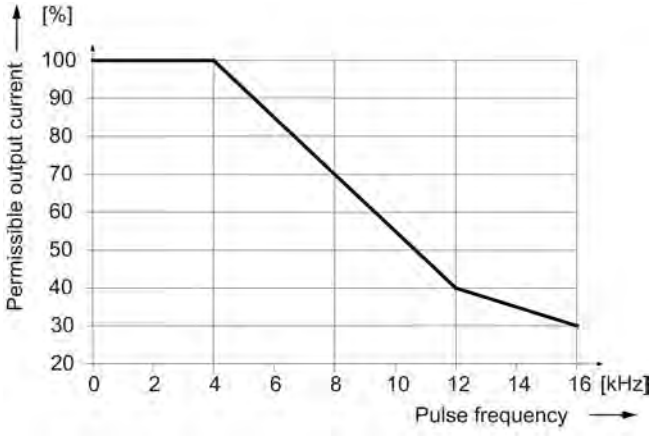


Figure 6-57 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

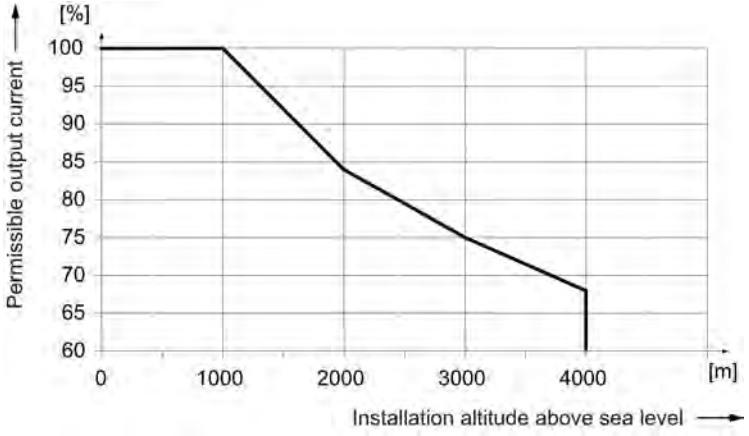


Figure 6-58 Output current as a function of the installation altitude

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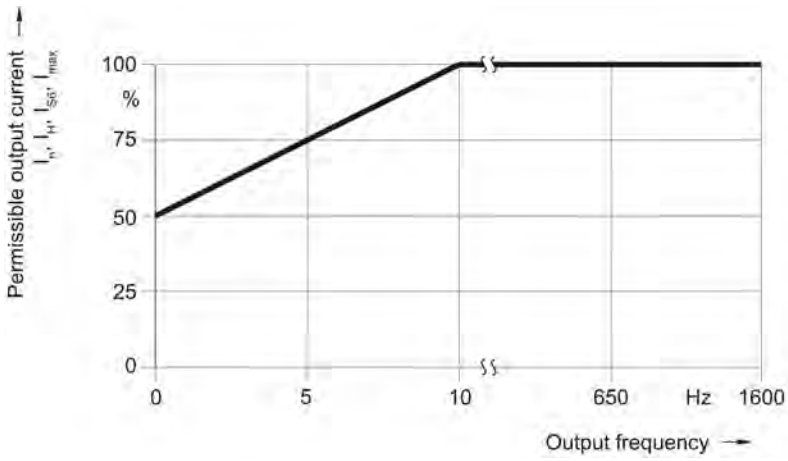


Figure 6-59 Output current as a function of the output frequency

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6.3.8 Technical data for Motor Modules Booksize with 300% overload

6.3.8.1 Single Motor Modules (300% overload)

Table 6- 30 Technical data Single Motor Modules Booksize (3 to 18 A) with 300% overload

External air cooling	6SL3121–	1TE13-0AA4	1TE15-0AA4	1TE21–0AA4	1TE21–8AA4
Output current					
Rated current (I_n)	A_{ACrms}	**3**	**5**	**9**	**18**
Base-load current (I_H)	A	2,6	4,3	7,7	15,3
Intermittent duty current (I_{s6}) 40%	A_{ACrms}	3,5	6	10	24
Peak current (I_{max})	A_{ACrms}	9	15	27	54
Output voltage	V_{ACrms}	0 … 0.717 x DC-link voltage			
DC-link current $I_{d\ max}$	A_{DC}	3,6	6	11	22
DC-link voltage	V_{DC}	510 … 720			
DC-link capacitance	µF	110	110	110	220
Overvoltage trip	V_{DC}	820 ± 2 %			
Undervoltage trip[1)]	V_{DC}	380 ± 2 %			
Electronics power supply	V_{DC}	24 (20,4 … 28,8)			
Electronics current drawn at 24 VDC	A_{DC}	0,85			
Current carrying capacity					
DC-link busbars	A_{DC}	100			
Reinforced DC-link busbars	A_{DC}	150			
24 VDC busbars	A_{DC}	20			
Unit rating[2)]					
Based on I_n (600 VDC; 4 kHz)	kW	1,6	2,7	4,8	9,7
Based on I_H	kW	1,4	2,3	4,1	8,2
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	50,4	73,4	100,4	185,4
Max. pulse frequency					
without derating	kHz	4			
with derating	kHz	16			
Max. ambient temperature					
without derating	° C	40			
with derating	° C	55			
Sound pressure level	dB(A)	< 60			
Cooling air requirement	m^3/h	29,6			
Max. permissible heat sink temperature	° C	70	70	70	90
Weight	kg	5,7	5,7	5,7	5,7

1) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

2) Rated power of a typical standard induction motor at 400 V 3 AC.

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Note

Disturbance of the 18 A Single Motor Module with 300% overload during operation on a 16 kW Line Module

The maximum output of a 16 kW Line Module is not sufficient for the operation of an 18 A Single Motor Module with 300% overload.

- Do NOT operate the 18 A Single Motor Module with 300% overload on a 16 kW Line Module.
- Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.
- Only operate an 18 A Single Motor Module on a 16 kW Line Module when the maximum current is limited to 2 x I_{rated}.

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Table 6- 31 Technical data Double Motor Modules Booksize (2 x 3 to 2 x 9 A) with 300% overload

External air cooling	**6SL3121-**	**2TE13-0AA4**	**2TE15-0AA4**	**2TE21-0AA4**
Output current				
Rated current (I_n)	A_{ACrms}	**2 x 3**	**2 x 5**	**2 x 9**
Base-load current (I_H)	A	2 x 2.6	2 x 4.3	2 x 7.7
Intermittent duty current (I_{s6}) 40%	A_{ACrms}	2 x 3.5	2 x 6	2 x 10
Peak current (I_{max})	A_{ACrms}	2 x 9	2 x 15	2 x 27
Output voltage	V_{ACrms}	0 … 480		
DC-link current $I_{d\ max}$	A_{DC}	7,2	12	22
DC-link voltage	V_{DC}	510 … 720		
DC-link capacitance	µF	110	220	220
Overvoltage trip	V_{DC}	820 ± 2 %		
Undervoltage trip[1)]	V_{DC}	380 ± 2 %		
Electronics power supply	V_{DC}	24 (20,4 … 28,8)		
Electronics current drawn				
at 24 VDC	A_{DC}	1,15		
Current carrying capacity				
DC-link busbars	A_{DC}	100		
Reinforced DC-link busbars	A_{DC}	150		
24 VDC busbars	A	20		
Unit rating[2)]				
Based on I_n (600 VDC; 4 kHz)	kW	2 x 1.6	2 x 2.7	2 x 4.8
Based on I_H	kW	2 x 1.4	2 x 2.3	2 x 4.4
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	97,6	132,6	187,6
Max. pulse frequency				
without derating	kHz	4		
with derating	kHz	16		
Max. ambient temperature				
without derating	° C	40		
with derating	° C	55		
Sound pressure level	dB(A)	< 60		
Cooling air requirement	m^3/h	29,6		
Max. permissible heat sink temperature	° C	78	78	78
Weight	kg	5,8	5,8	5,7

1) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

2) Rated power of a typical standard induction motor at 400 V 3 AC.

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Note

Disturbance of the 2 x 9 A Double Motor Module with 300% overload during operation on a 16 kW Line Module

The maximum output of a 16 kW Line Module is not sufficient for the operation of a 2 x 9 A Double Motor Module with 300% overload.

- Do NOT operate the 2 x 9 A Double Motor Module with 300% overload on a 16 kW Line Module.
- Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.
- Only operate a 2 x 9 A Double Motor Module on a 16 kW Line Module when the maximum current is limited to 2 x I_{rated}.

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6.3.8.2 Characteristics for Motor Modules Booksize with 300% overload

Rated duty cycles Motor Modules Booksize with 300% overload

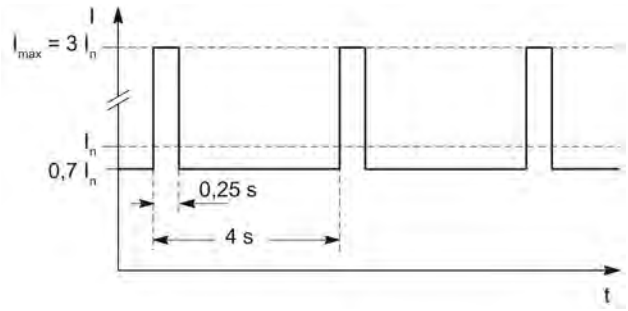


Figure 6-60 Peak current duty cycle with initial load (300% overload)

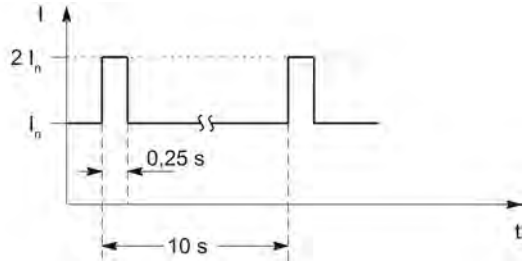


Figure 6-61 Duty cycle with initial load

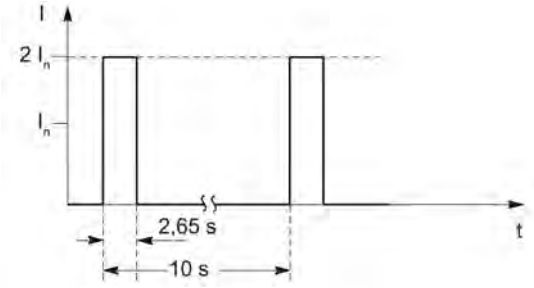


Figure 6-62 Duty cycle without initial load

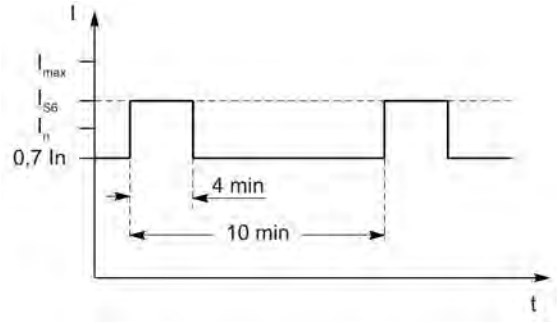


Figure 6-63 S6 duty cycle with initial load for a duty cycle duration of 600 s

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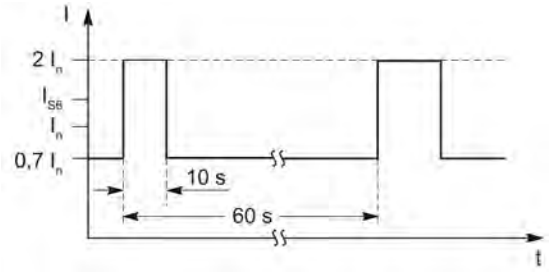


Figure 6-64 S6 duty cycle with initial load for a duty cycle duration of 60 s

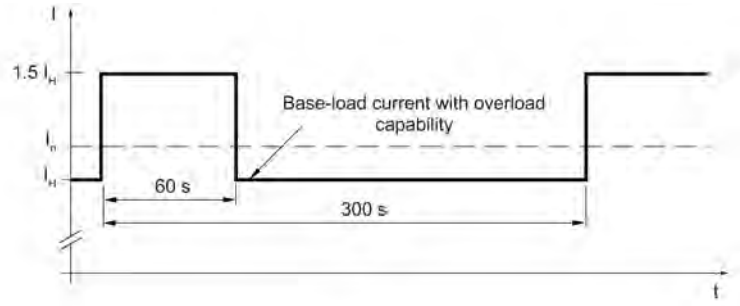


Figure 6-65 Duty cycle with 60 s overload for a duty cycle duration of 300 s

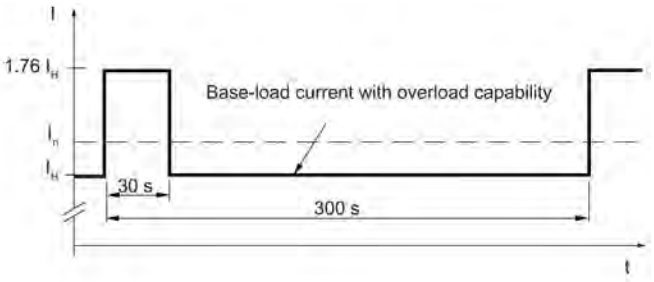


Figure 6-66 Duty cycle with 30 s overload for a duty cycle duration of 300 s

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Derating characteristics for Motor Modules Booksize with 300% overload

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

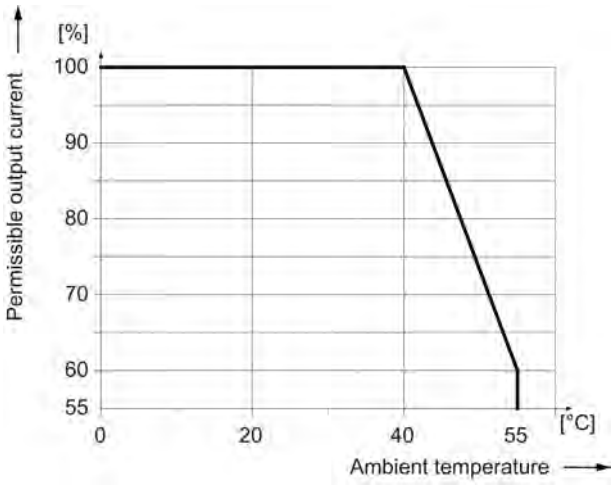


Figure 6-67 Output current as a function of the ambient temperature

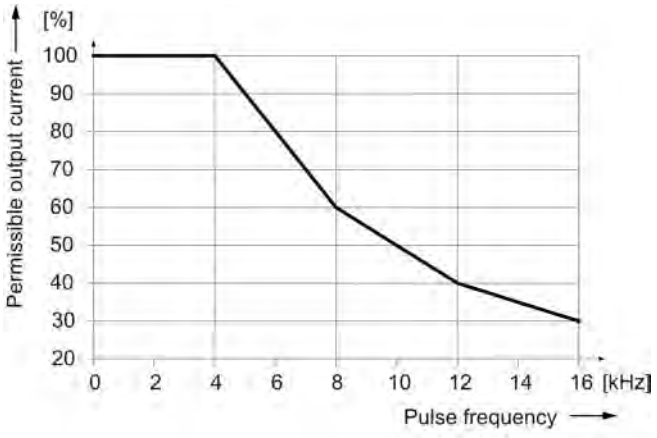


Figure 6-68 Output current as a function of the pulse frequency

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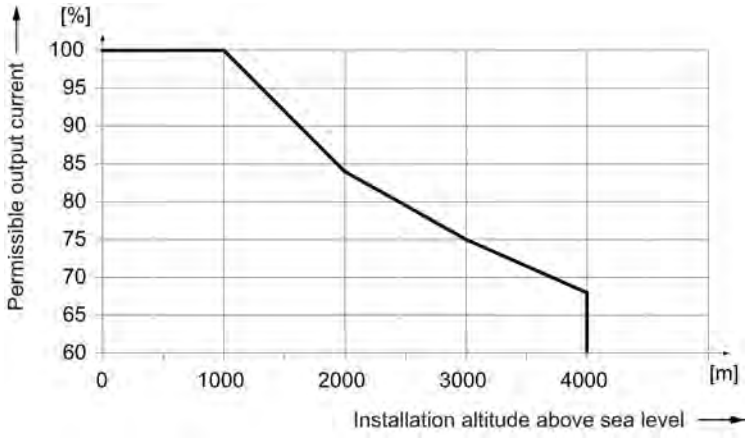


Figure 6-69 Output current as a function of the installation altitude

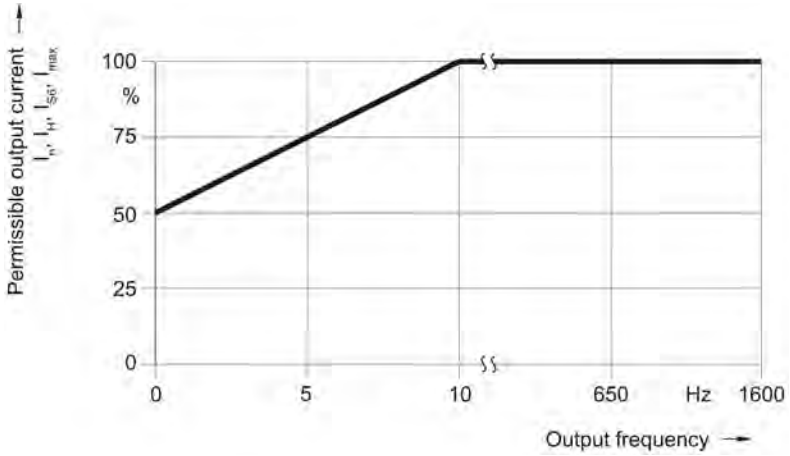


Figure 6-70 Output current as a function of the output frequency

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6.4 Motor Modules with cold plate

6.4.1 Description

A Motor Module is a power unit (inverter) that provides the power for the connected motors. Power is supplied by the DC link of the drive unit. A Motor Module must be connected to a Control Unit via DRIVE-CLiQ. The open-loop and closed-loop control functions for the Motor Module are stored in the Control Unit.

One motor can be connected to Single Motor Modules and 2 motors can be connected to Double Motor Modules.

⚠ WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

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6.4.2 Interface description

6.4.2.1 Overview

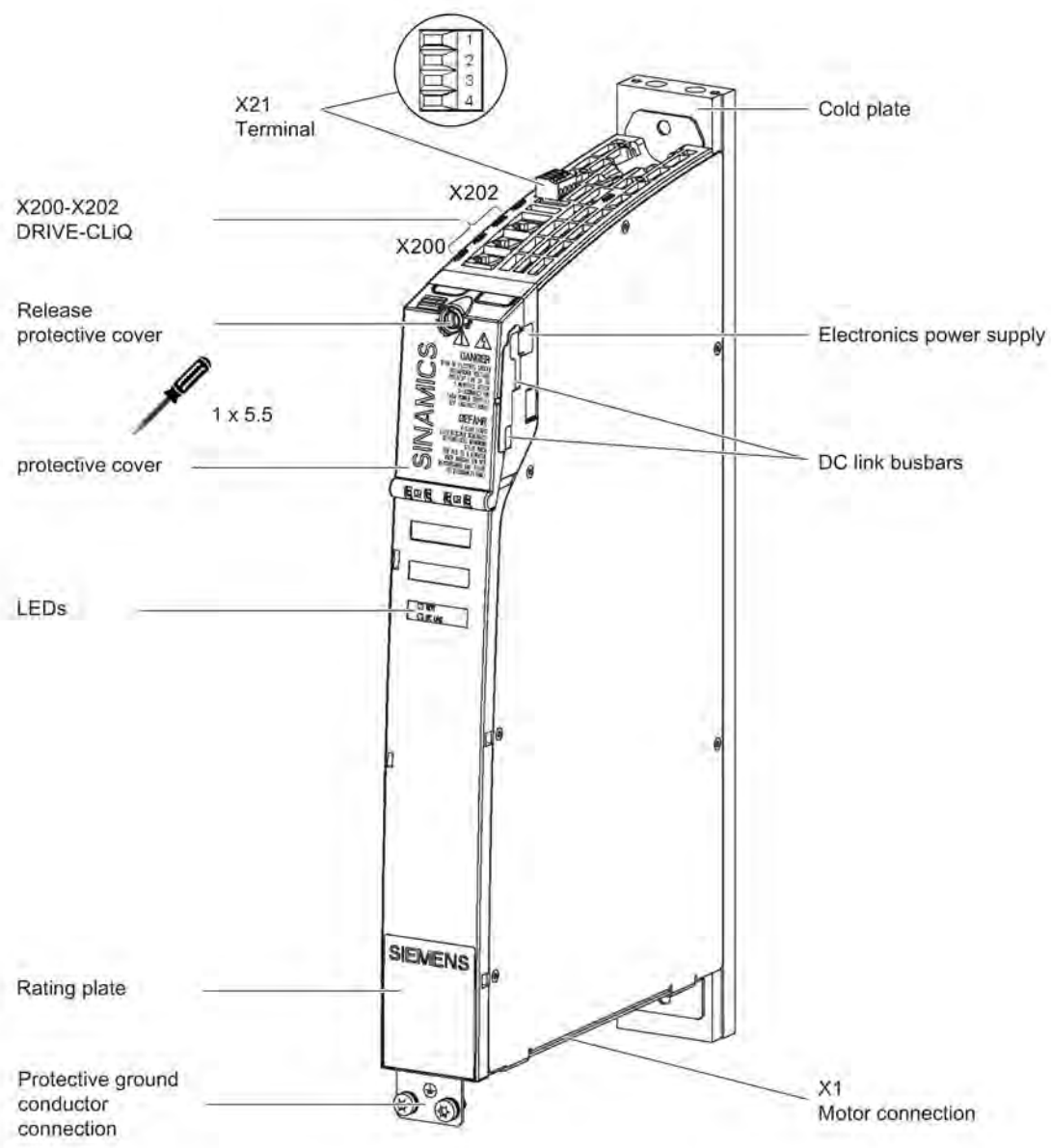


Figure 6-71 Interface overview, Single Motor Module Booksize with cold plate (example: 5 A)

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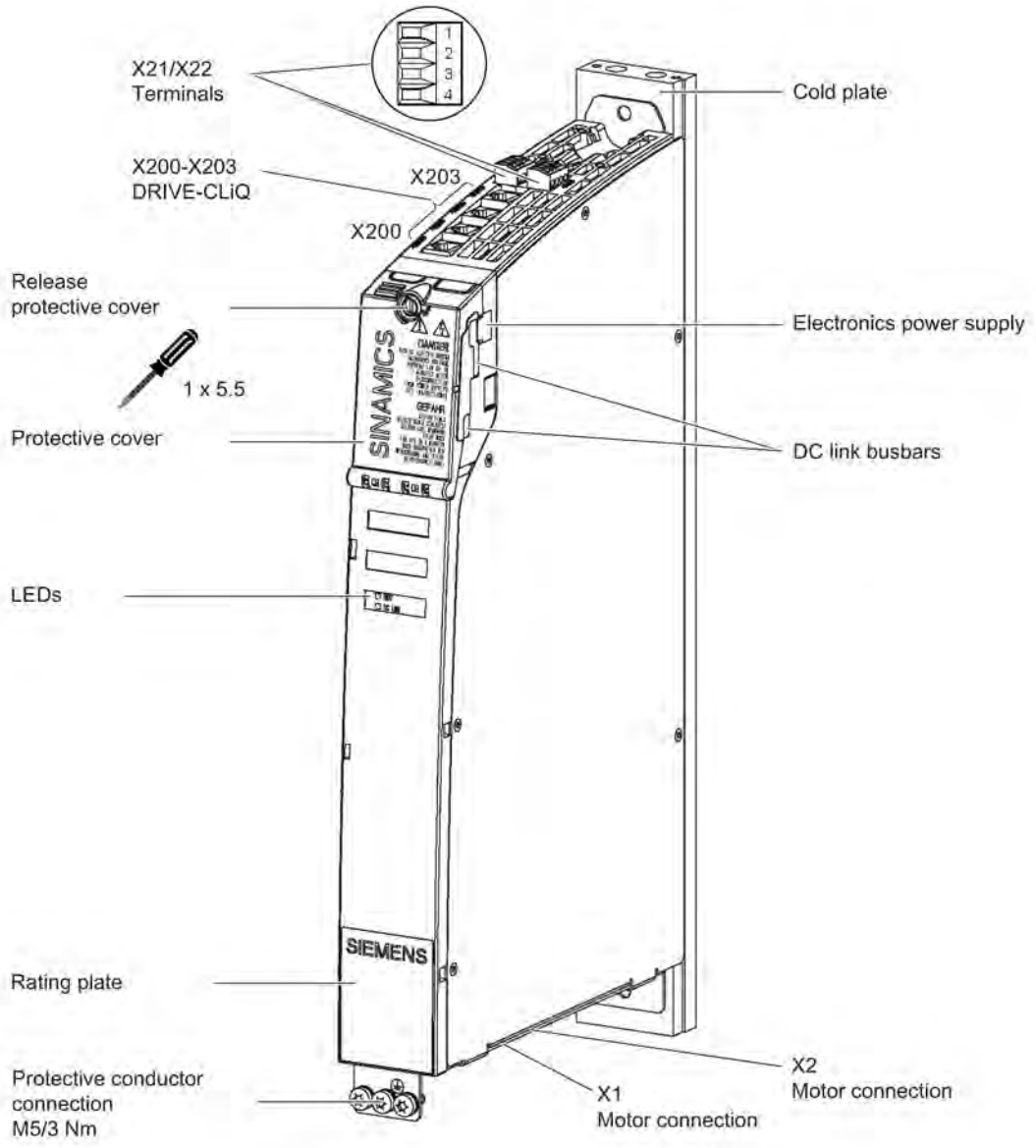
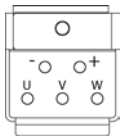
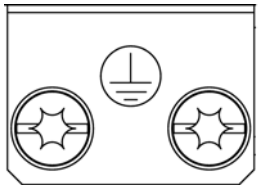
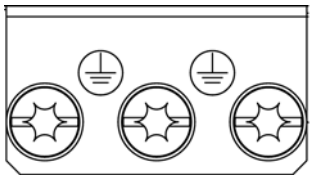


Figure 6-72 Interface overview, Double Motor Module Booksize with cold plate (example: 2 x 5 A)

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6.4.2.2 Motor and brake connection

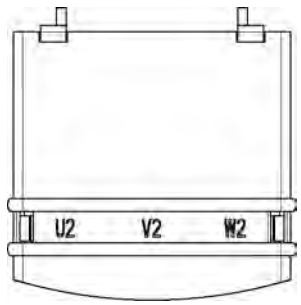
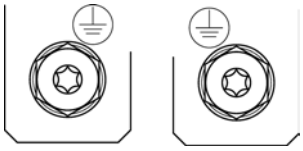
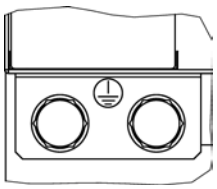
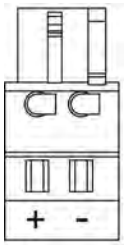
Table 6- 32 X1/X2 motor and brake connection for Single Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

	Terminal	Technical data
	U (U2)	Motor connection
	V (V2)	
	W (W2)	
	+ (BR+)	Brake connection Max. load current: 2 A Minimum load current: 0.1 A
	- (BR-)	
	PE connection	**Single Motor Modules 3 ... 30 A:** Threaded hole M5 / 3 Nm[1)]
		**Double Motor Modules 3 ... 18 A:** Threaded hole M5 / 3 Nm[1)]

1) For ring cable lugs without insulation

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Table 6- 33 X1 motor connection and X11 brake connection for Single Motor Modules 45 A to 200 A

	Terminal	Technical data
	U2 V2 W2	**45 ... 60 A:** Threaded bolts M6 / 6 Nm[1)] **85 A:** Threaded bolts M8 / 13 Nm[1)] **132 ... 200 A:** Threaded bolts M8 / 13 Nm[1)]
	PE connection	**45 ... 60 A:** Threaded bolts for motor cables: M6 / 6 Nm[1)] Threaded hole for PE: M6 / 6 Nm[1)]
		**85 A:** Threaded bolts for motor cables: M8 / 13 Nm[1)] Threaded hole for PE: M6 / 6 Nm[1)] **132 ... 200 A:** Threaded bolts for motor cables: M8 / 13 Nm[1)] Threaded hole for PE: M8 / 13 Nm[1)]
	+ (BR+) - (BR-)	**X11 brake connector**[2)]: Voltage: 24 V DC Max. load current: 2 A Minimum load current: 0.1 A Type: Spring-loaded terminal 2 (Page 754) Max. cross-section that can be connected 2.5 mm²: The brake connector is part of the prefabricated cable.

1) For ring cable lugs without insulation

2) The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.



⚠WARNING

Danger to life as a result of a hazardous voltage at the 0 V to 48 V DC terminals

Death or serious injury can result when live parts are touched in the event of a fault.

- Only connect protective extra-low voltages (PELV / SELV) to all connections and terminals between 0 to 48 V DC.

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NOTICE

Destruction of the motor or motor holding brake as a result of high voltage tolerances of the motor holding brakes

If the voltage tolerances of the motor holding brakes are not complied with (24 V ± 10 %), then the brake will malfunction, i.e. the brake will not reliably open. If the motor constantly runs against the closed brake, the brake or the motor will be destroyed.

- Set the DC power supply to 26 V.

The following general conditions must be satisfied:

- Siemens three-phase motors must be used
- Siemens MOTION-CONNECT power cables must be used
- Motor cable lengths, max. 100 m

Note

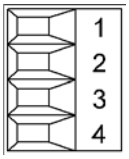
The total length of the power cables (motor feeder cables and DC link cables) must not exceed the values listed in Chapter Combining line reactors and line filters (Page 136).

Note

The motor brake must be connected via connector X11. It is not permitted to directly connect the cable BR – to the electronics ground M.

6.4.2.3 X21/X22 EP terminals/temperature sensor

Table 6- 34 X21/X22 EP terminals / temperature sensor

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (pulse enable)	Supply voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (enable pulses)	
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm²			

EP terminals

Parameters are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4 (see the SINAMICS S120/S150 List Manual). Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern

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tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Section "Controlling the safety functions".

Note

Function of the EP terminals

The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

Temperature sensor connection

NOTICE

Risk of the motor overheating due to an incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY sensor with the correct polarity.

Note

The temperature sensor input is not needed if the motors feature an integrated DRIVE-CLiQ interface or if temperature values are detected by means of a different module (SMC, SME, TM).



⚠WARNING

Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor

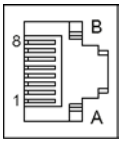
Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

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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

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6.4.3 Connection examples

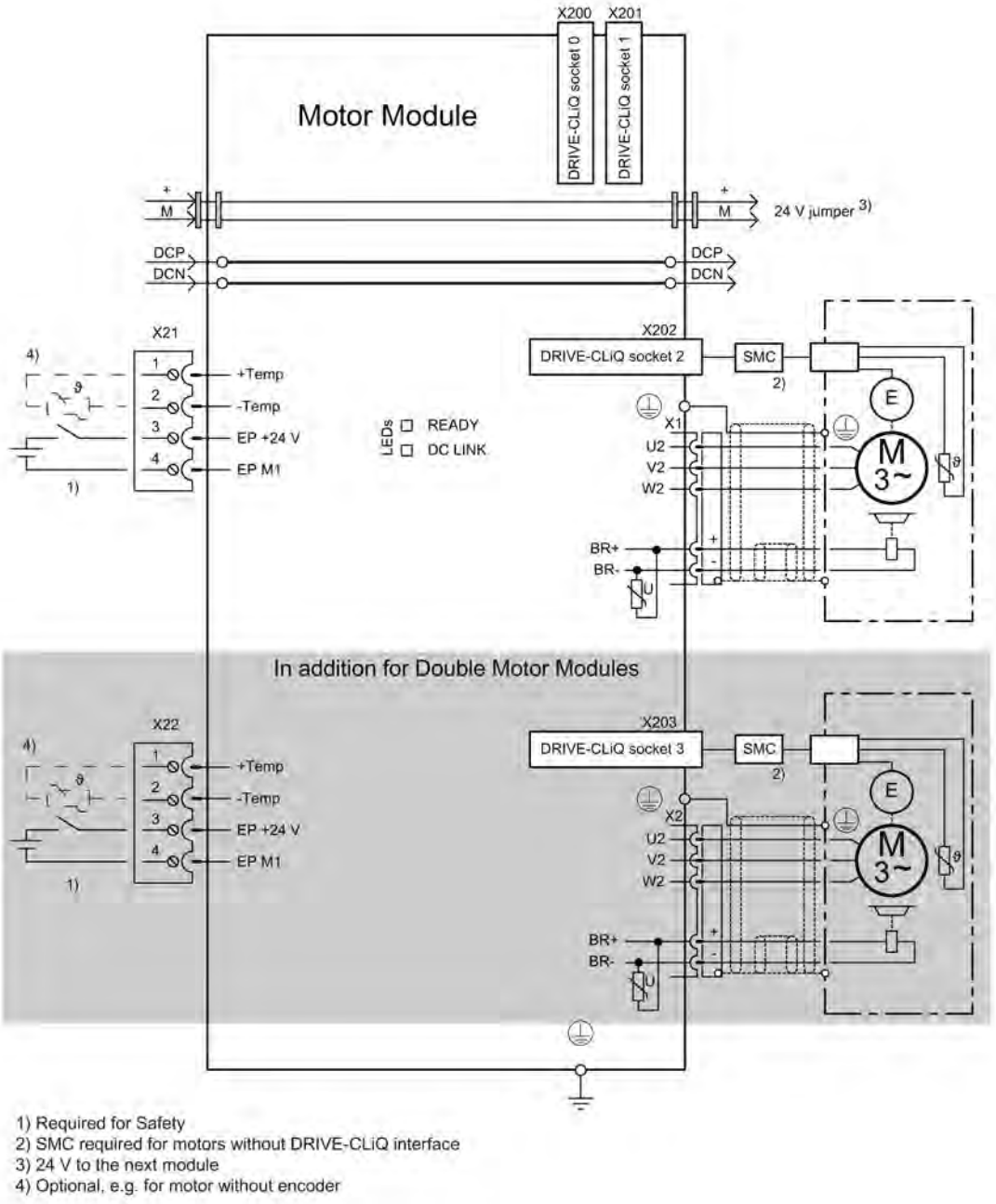


Figure 6-73 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

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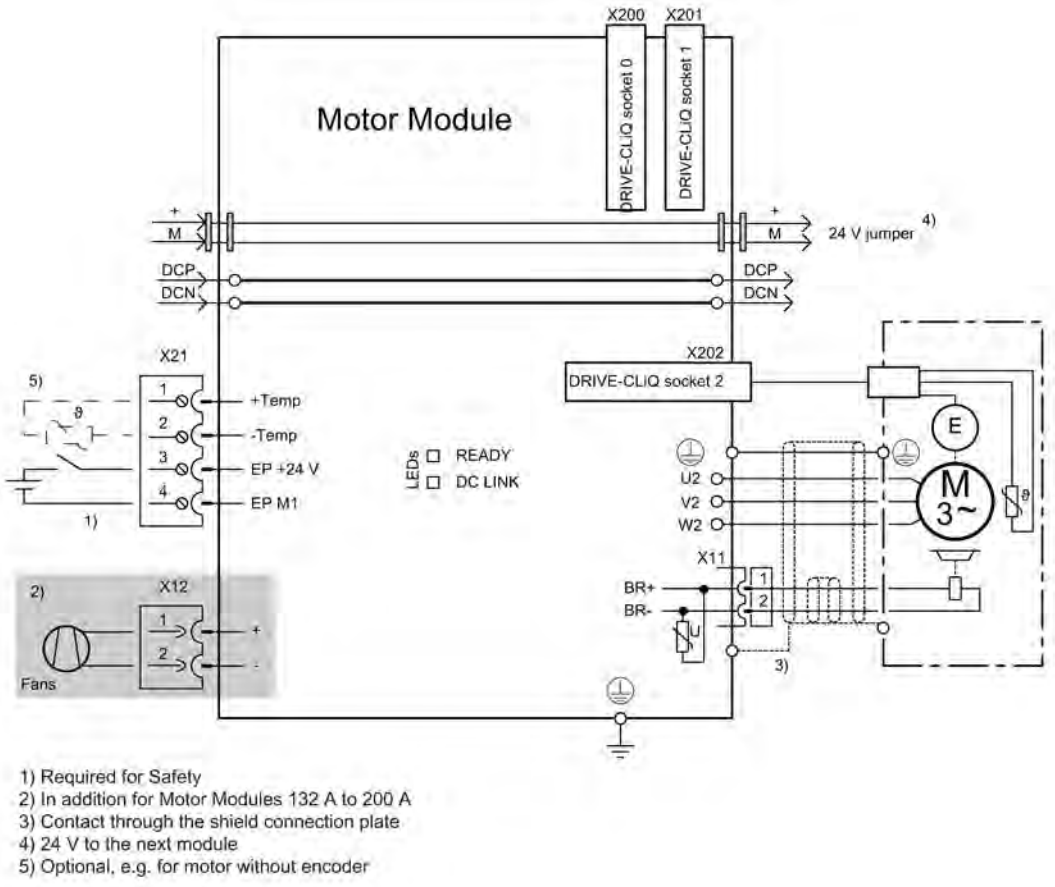


Figure 6-74 Example connection of Single Motor Modules 45 A to 200 A

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6.4.4 Meaning of LEDs

Table 6- 36 Meaning of the LEDs on the Motor Module

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
Green	--	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is outside the permissible tolerance range.	Check the line supply voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	At least one fault is present in this component. **Note:** The LED is driven irrespective of the corresponding messages being reconfigured.	Resolve and acknowledge the fault.
Green/red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download has been completed. The system waits for POWER ON.	Carry out a POWER ON.
Green/orange or red/orange	--	Component recognition via LED is activated[1]. **Note:** Both options depend on the LED status when component recognition is activated.	–

[1] See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



WARNING

Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

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6.4.5 Dimension drawings

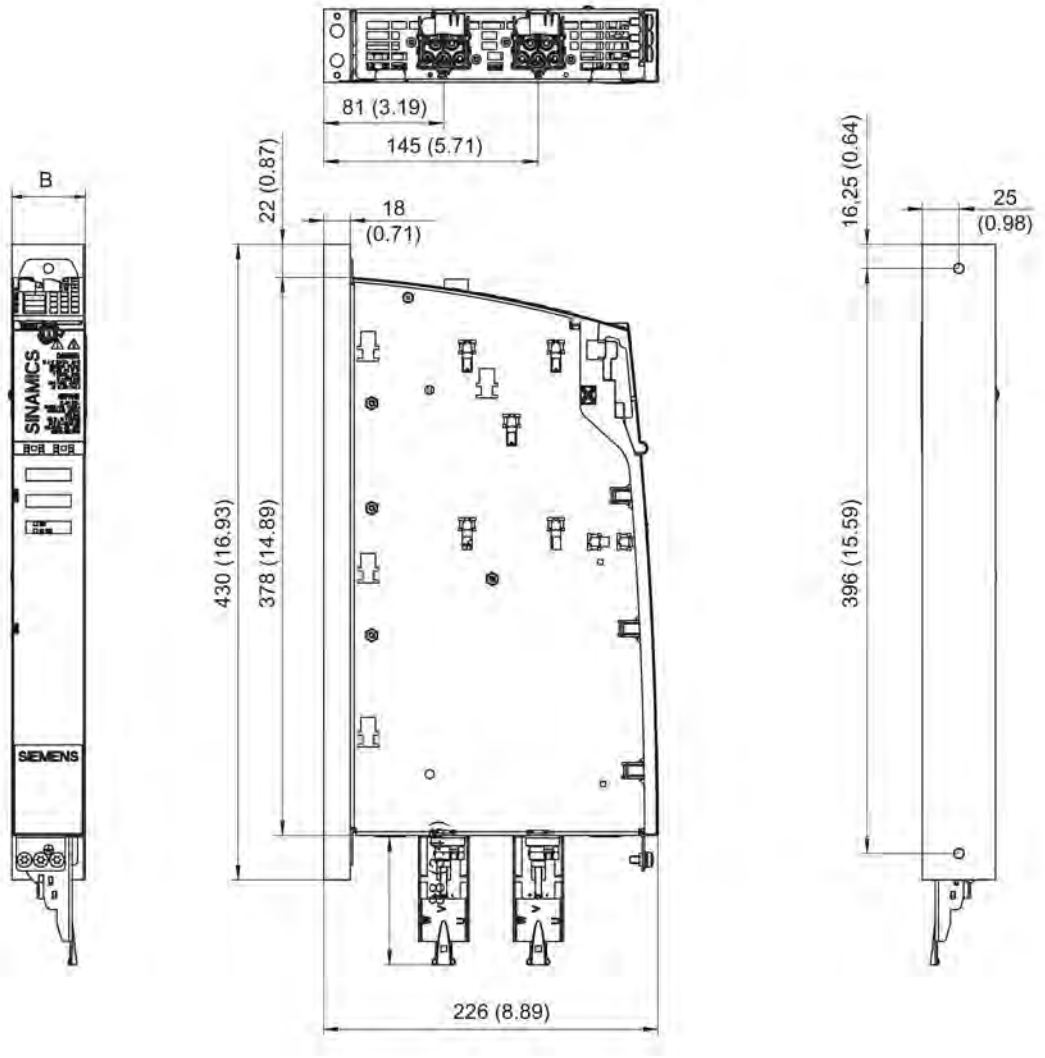


Figure 6-75 Dimension drawing of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with cold plate, all dimensions in mm and (inches); example: 2 x 5 A Double Motor Module

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	

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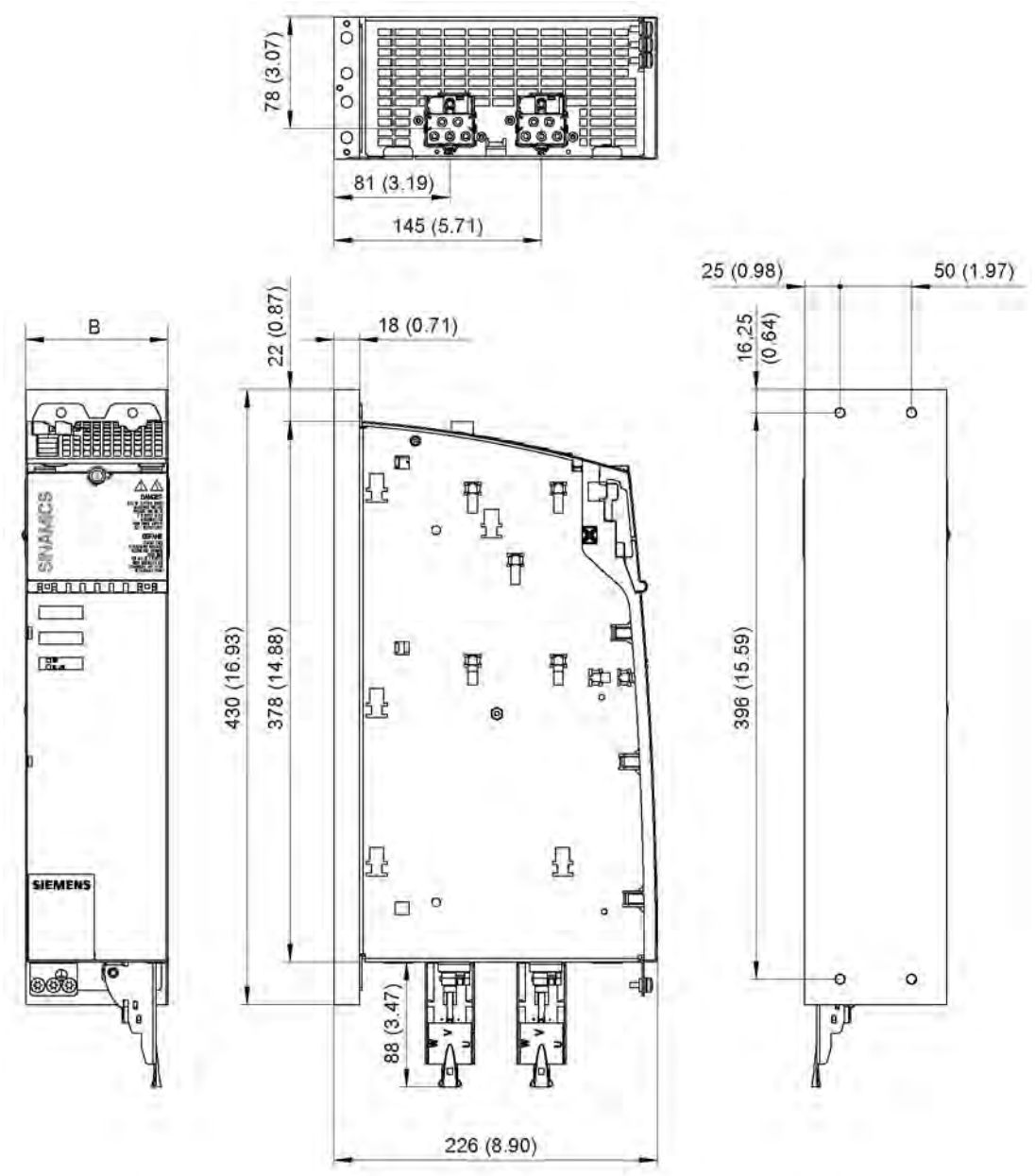


Figure 6-76 Dimension drawing of 30 A and 2 x 18 A Motor Modules Booksize with cold plate, all dimensions in mm and (inches)

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	

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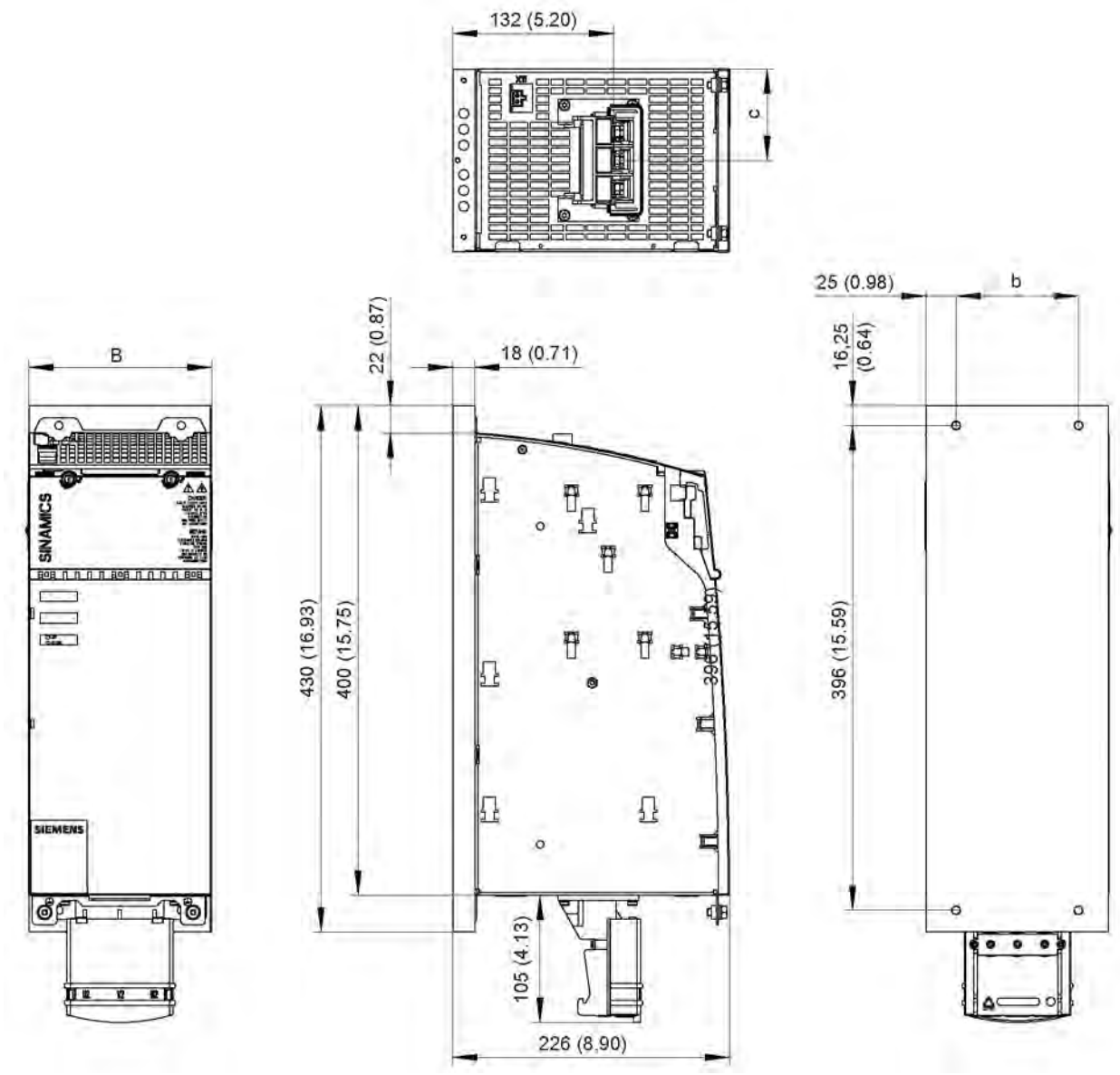


Figure 6-77 Dimension drawing of Motor Modules Booksize 45 A, 60 A, and 85 A with cold plate, all dimensions in mm and (inches); example for Motor Module 45 A

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)

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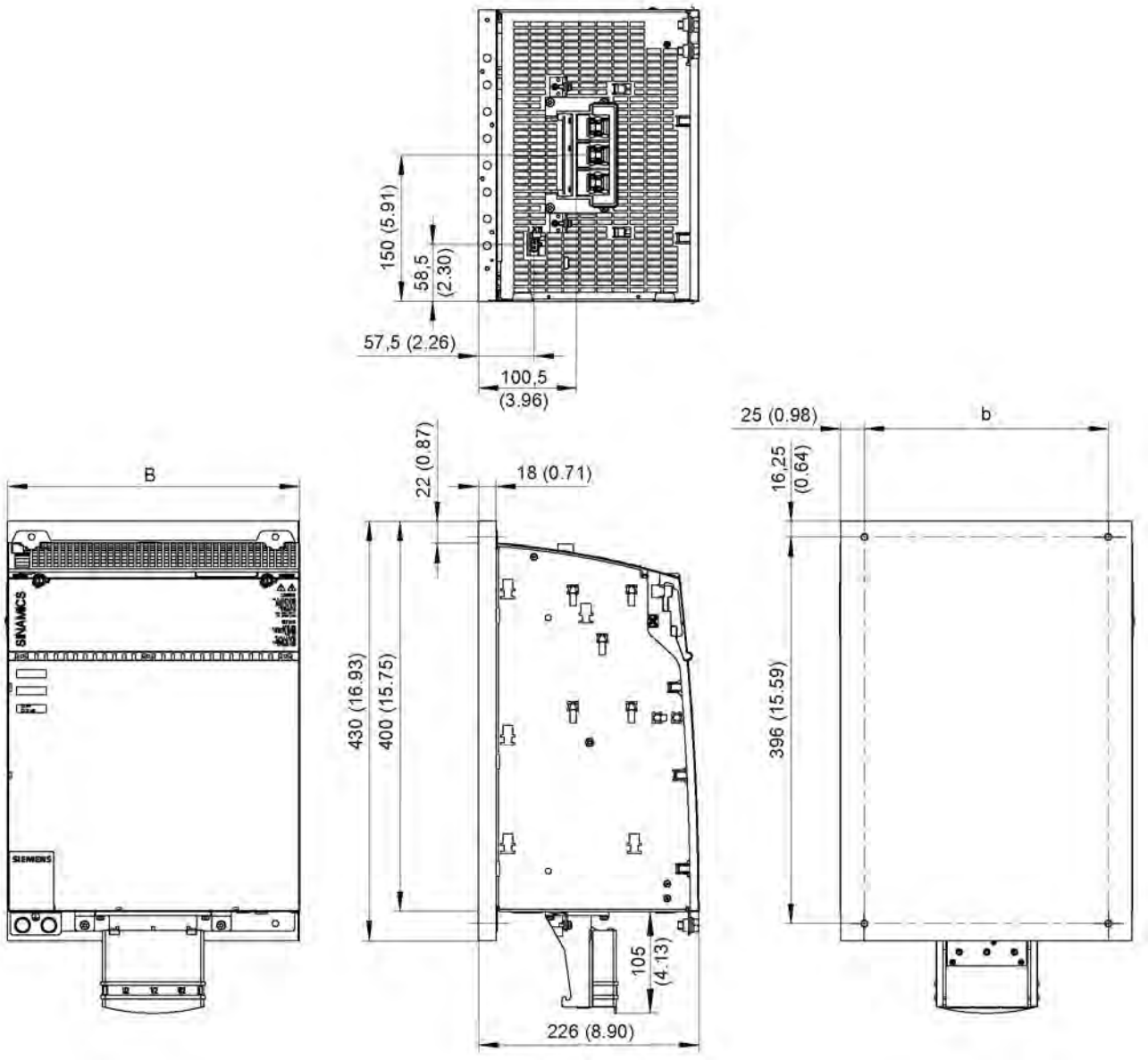


Figure 6-78 Dimension drawing of Motor Modules Booksize 132 A and 200 A with cold plate, all dimensions in mm and (inches); example for Motor Module 200 A

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		

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6.4.6 Mounting

Please note the following before mounting a Motor Module with cold plate on a customer-specific heat sink:

- Check the surface of the heat sink to ensure that it is not damaged.
- To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every component with cold plate is supplied with heat-conducting foil cut to the right size. Note the mounting position of the heat-conducting foil (see diagram below).

Note

- Also replace the heat-conducting foil when replacing a component.
- Only use heat-conducting foil released or supplied by Siemens.

Table 6- 41 Overview of heat-conducting foils

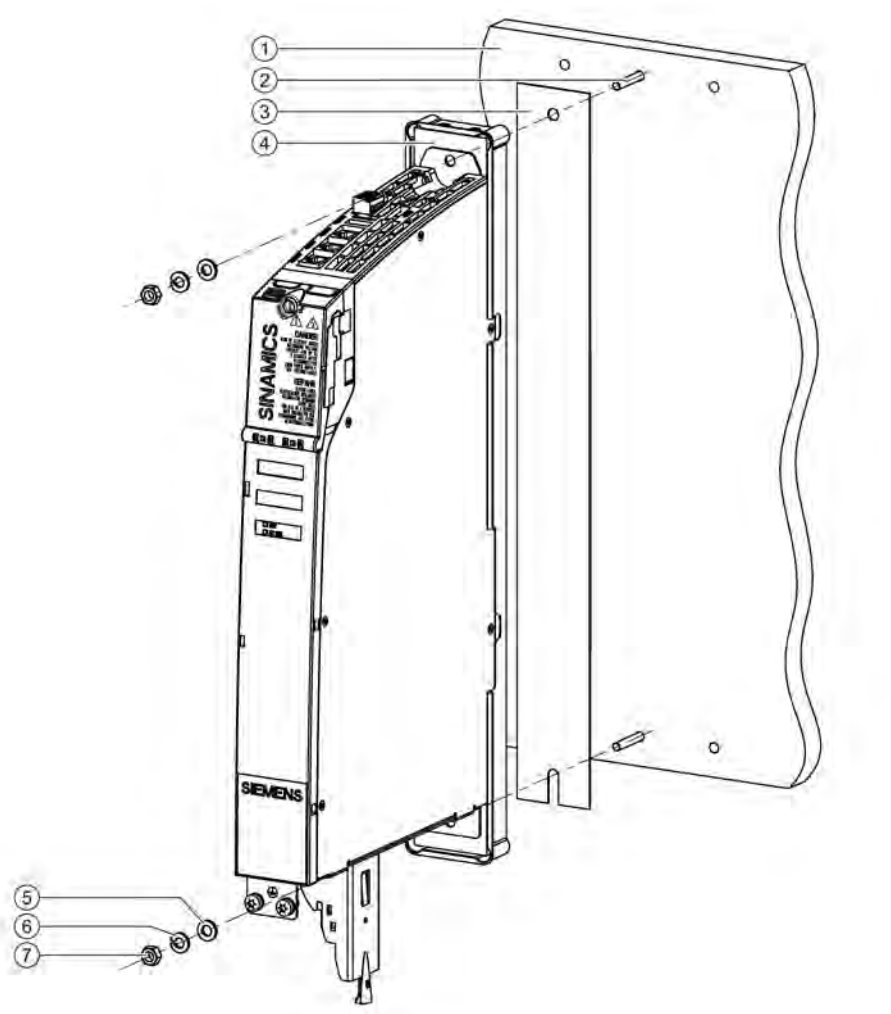
	Order number
Heat-conducting foil, 50 mm	6SL3162-6FB00-0AA0
Heat-conducting foil, 100 mm	6SL3162-6FD00-0AA0
Heat-conducting foil, 150 mm	6SL3162-6FF00-0AA0
Heat-conducting foil, 200 mm	6SL3162-6FH00-0AA0
Heat-conducting foil, 300 mm	6SL3162-6FM00-0AA0

Note

M6 studs and hexagon nuts or grub screws (ISO 7436-M6x40-14 H, property class 8.8) are recommended for mounting the components.

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Mounting



① External heat sink (air or liquid)
② M6 studs
③ Heat-conducting foil
④ Cold plate
⑤ Washer
⑥ Spring washer
⑦ M6 nut

Figure 6-79 Mounting a Motor Module with cold plate on an external heat sink (example: 3 A Motor Module)

Tightening torques:

- Firstly, tighten the nuts by hand.
  Tightening torque: 0.5 Nm
- Then tighten the nuts.
  Tightening torque: 10 Nm

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Note

- Where components have four fixing points, the nuts must be tightened evenly by alternating diagonally between them.

Help with the mechanical control cabinet design is available from:

Siemens AG
Industry Sector, IA DT MC MF - WKC AS
TCCCC (Technical Competence Center Cabinets Chemnitz)
P.O. Box 1124
09070 Chemnitz, Germany

e-mail: cc.cabinetcooling.aud@siemens.com

Properties of the heat sink

We recommend using AlMgSi 0.5 as the heat sink material.
The roughness of the external heat sink surface should be at least Rz 16. The contact surface between the heat sink and cold plate should have an evenness of 0.2 mm (applicable to a height of 450 mm and a width of 300 mm).

Note

Machine manufacturers can adapt the heat sink version to their special requirements. The specified rated data for the Motor Modules can only be achieved if the power losses can be dissipated by the external heat sink under the specified general conditions.

NOTICE

Damage to the cold plate caused by incorrect mounting

The screw bolts can be damaged when mounting the cold plate.

- Do not damage the cold plate.

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6.4.7 Technical data

6.4.7.1 Single Motor Modules

Table 6- 42 Technical data Single Motor Modules Booksize (3 to 30 A)

Cold plate	**6SL3126-**	**1TE13-0AAx[1)]**	**1TE15-0AAx[1)]**	**1TE21-0AAx[1)]**	**1TE21-8AAx[1)]**	**1TE23-0AAx**
Output current Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{S6}) 40% Peak current (I_{max})	 A_{ACrms} A A_{ACrms} A_{ACrms}	 **3** 2,6 3,5 6	 **5** 4,3 6 10	 **9** 7,7 10 18	 **18** 15,3 24 36	 **30** 25,5 40 56
Output voltage	V_{ACrms}	0 … 0.717 x DC-link voltage				
DC-link current $I_{d\ max}$	A_{DC}	3,6	6	11	22	36
DC-link voltage (up to 2000 m above sea level)	V_{DC}	510 … 720				
DC-link capacitance	µF	110	110	110	220	710
Overvoltage trip Undervoltage trip[2)]	V_{DC} V_{DC}	820 ± 2 % 380				
Electronics power supply	V_{DC}	24 (20,4 … 28,8)				
Electronics current drawn at 24 VDC	 A_{DC}	 0,65				
Current carrying capacity DC-link busbars Reinforced DC-link busbars 24 VDC busbars	 A_{DC} A_{DC} A_{DC}	 100 150 20				
Unit rating[3)] Based on I_n (600 VDC; 4 kHz) Based on I_H	 kW kW	 1,6 1,1	 2,7 2,3	 4,8 4,1	 9,7 8,2	 16 13,7
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	45,5	70,6	95,6	180,6	305,6
Max. pulse frequency without derating with derating	 kHz kHz	 4 16				
Max. ambient temperature without derating with derating	 ° C ° C	 40 55				
Max. permissible heat sink temperature	° C	80	80	80	80	70
Weight	kg	4,2	4,2	4,5	4,5	6,1

1) Applies only to order numbers with x = 0 .. 3

2) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

3) Rated power of a typical standard induction motor at 400 V 3 AC.

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Table 6- 43 Technical data Single Motor Modules (45A to 200A)

Cold plate	**6SL3126-**	**1TE24-5AAx**	**1TE26-0AAx**	**1TE28-5AAx**	**1TE31-3AAx**	**1TE32-0AAx**
Output current Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{S6}) 40% Peak current (I_{max})	 A_{ACrms} A A_{ACrms} A_{ACrms}	 **45** 38 60 85	 **60** 51 80 113	 **85** 68 110 141	 **132** (105)[1] 105 (84)[1] 150 (120)[1] 210	 **200** (140)[1] 141 (99)[1] 230 (161)[1] 282
Output voltage	V_{ACrms}	0 … 480				
DC-link current $I_{d\ max}$	A_{DC}	54	72	102	158	200
DC-link voltage (up to 2000 m above sea level)	V_{DC}	510 … 720				
DC-link capacitance	µF	1175	1410	1880	2820	3995
Overvoltage trip Undervoltage trip[2]	V_{DC} V_{DC}	820 ± 2 % 380				
Electronics power supply	V_{DC}	24 (20,4 … 28,8)				
Electronics current drawn at 24 VDC	A_{DC}	0,75	0,75	0,8	0,85	0,85
Current carrying capacity DC-link busbars 24 VDC busbars	 A_{DC} A_{DC}	 200 20				
Unit rating[3] Based on I_n (600 VDC; 4 kHz) Based on I_H	 kW kW	 24 21	 32 28	 46 37	 71 (57)[1] 57 (46)[1]	 107 (75)[1] 76 (53)[1]
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	448	608	769,2	1270,4	2070,4
Max. pulse frequency without derating with derating	 kHz kHz	 4 16				
Max. ambient temperature without derating with derating	 ° C ° C	 40 55				
Max. permissible heat sink temperature	° C	80	73	83	75	79 (70% derating)
Weight	kg	9,1	9,1	12,5	18,0	18,0

1) Derating must be applied due to the transfer of heat to the external heat sink. At a temperature of 40° C at the interface to the power unit, 80% derating occurs for 6SL3126-1TE31-3AAx and 70% for 6SL3126-1TE32-0AAx.

2) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V (exception: 132 A and 200 A Motor Modules) and is adjusted to the parameterized rated voltage.

3) Rated power of a typical standard induction motor at 400 V 3 AC.

Note

New systems with 132 A and 200 A Motor Modules should ideally be designed with 200 A liquid-cooled Motor Modules in order to avoid current derating.

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6.4.7.2 Double Motor Modules

Table 6- 44 Technical data Double Motor Modules (2 x 3 to 2 x 18 A)

Cold plate	**6SL3126-**	**2TE13-0AAx[1)]**	**2TE15-0AAx[1)]**	**2TE21-0AAx[1)]**	**2TE21-8AAx**
Output current					
Rated current (I_n)	A_{ACrms}	**2 x 3**	**2 x 5**	**2 x 9**	**2 x 18**
Base-load current (I_H)	A	2 x 2.6	2 x 4.3	2 x 7.7	2 x 15.3
Intermittent duty current (I_{S6}) 40%	A_{ACrms}	2 x 3.5	2 x 6	2 x 10	2 x 24
Peak current (I_{max})	A_{ACrms}	2 x 6	2 x 10	2 x 18	2 x 36
Output voltage	V_{ACrms}	0 … 480			
DC-link current $I_{d\ max}$	A_{DC}	7,2	12	22	43
DC-link voltage	V_{DC}	510 … 720			
DC-link capacitance	µF	110	220	220	705
Overvoltage trip	V_{DC}	820 ± 2 %			
Undervoltage trip[2)]	V_{DC}	380			
Electronics power supply	V_{DC}	24 (20,4 … 28,8)			
Electronics current drawn					
at 24 VDC	A_{DC}	0,9	0,9	0,9	1,05
Current carrying capacity					
DC-link busbars	A_{DC}	100	100	100	100
Reinforced DC-link busbars	A_{DC}	150	150	150	150
24 VDC busbars	A_{DC}	20	20	20	20
Unit rating[3)]					
Based on I_n (600 VDC; 4 kHz)	kW	2 x 1.6	2 x 2.7	2 x 4.8	2 x 9.7
Based on I_H	kW	2 x 1.4	2 x 2.3	2 x 4.1	2 x 8.2
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	91,6	126,6	181,6	345,2
Max. pulse frequency					
without derating	kHz	4			
with derating	kHz	16			
Max. ambient temperature					
without derating	° C	40			
with derating	° C	55			
Max. permissible heat sink temperature	° C	80	80	90	90
Weight	kg	4,5	4,5	4,5	5,9

1) Applies only to order numbers with x = 0 .. 3

2) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

3) Rated power of a typical standard induction motor at 400 V 3 AC.

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6.4.7.3 Characteristics

Rated duty cycles Motor Modules Booksize

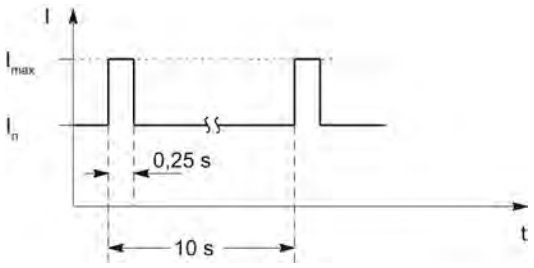


Figure 6-80 Duty cycle with initial load (for servo drives)

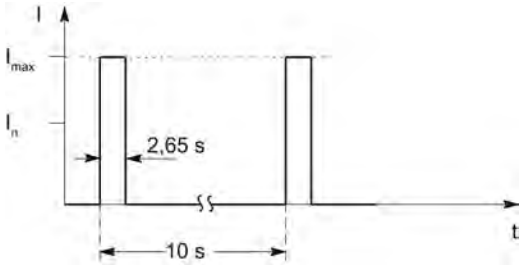


Figure 6-81 Duty cycle without initial load (for servo drives)

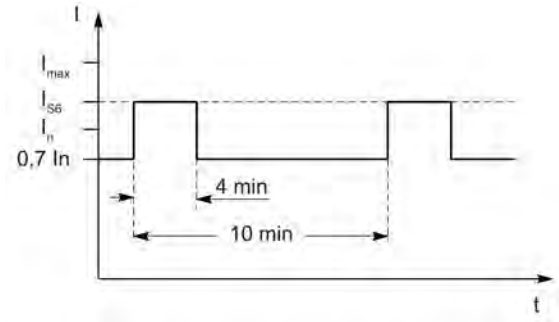


Figure 6-82 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

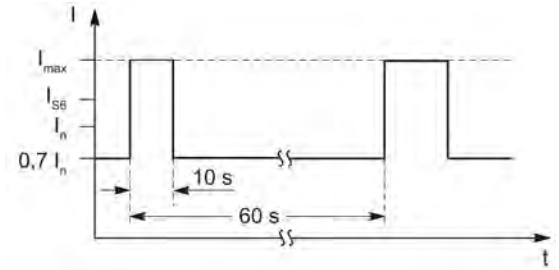


Figure 6-83 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

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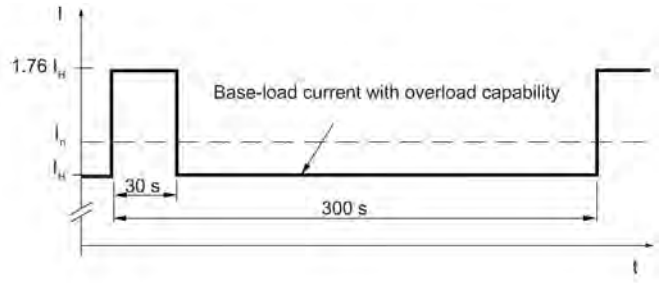


Figure 6-84 Duty cycle with 30 s overload for a duty cycle duration of 300 s

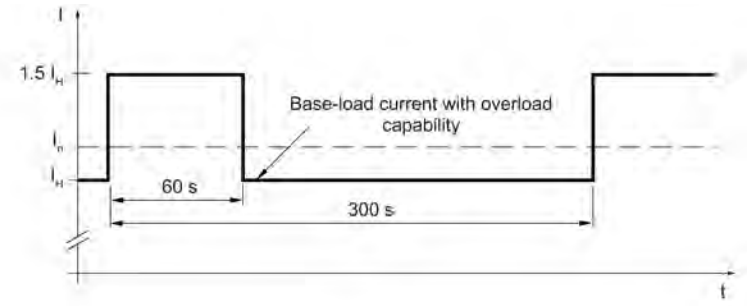


Figure 6-85 Duty cycle with 60 s overload for a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

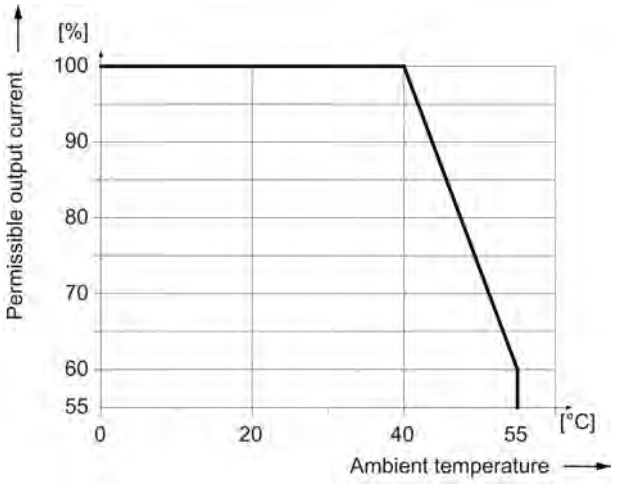


Figure 6-86 Output current as a function of the ambient temperature

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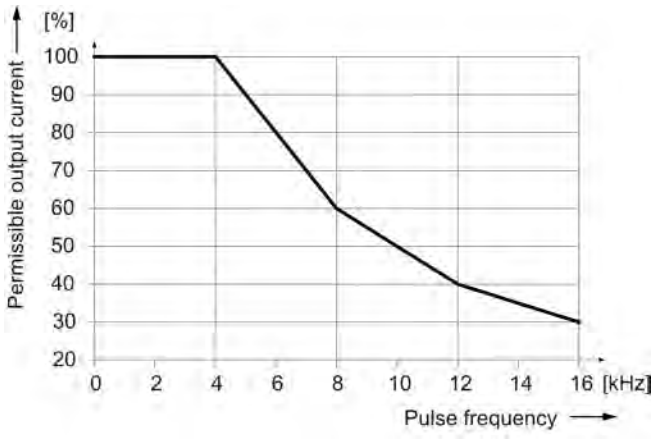


Figure 6-87 Output current as a function of the pulse frequency

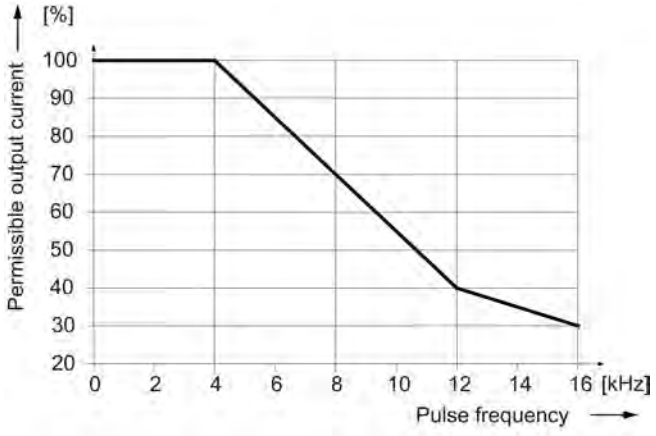


Figure 6-88 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

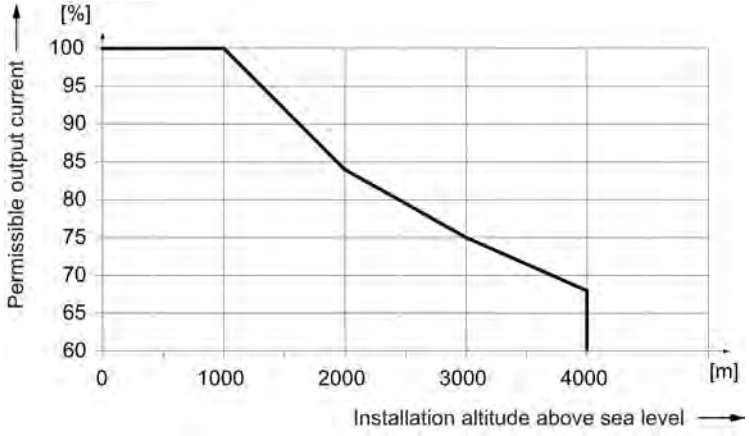


Figure 6-89 Output current as a function of the installation altitude

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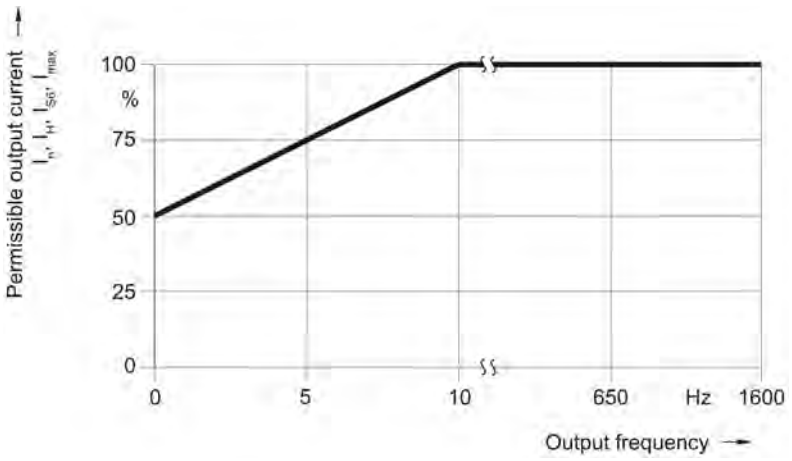


Figure 6-90 Output current as a function of the output frequency

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6.4.8 Technical data for Motor Modules Booksize with 300% overload

6.4.8.1 Single Motor Modules (300% overload)

Table 6- 45 Technical data Single Motor Modules (3 to 18 A) with 300% overload

Cold plate	6SL3126-	1TE13-0AA4	1TE15-0AA4	1TE21-0AA4	1TE21-8AA4
Output current					
Rated current (I_n)	A_{ACrms}	**3**	**5**	**9**	**18**
Base-load current (I_H)	A	2,6	4,3	7,7	15,3
Intermittent duty current (I_{S6}) 40%	A_{ACrms}	3,5	6	10	24
Peak current (I_{max})	A_{ACrms}	9	15	27	54
Output voltage	V_{ACrms}	0 … 0.717 x DC-link voltage			
DC-link current $I_{d\ max}$	A_{DC}	3,6	6	11	22
DC-link voltage (up to 2000 m above sea level)	V_{DC}	510 … 720			
DC-link capacitance	µF	110	110	110	220
Overvoltage trip	V_{DC}	820 ± 2 %			
Undervoltage trip[1)]	V_{DC}	380			
Electronics power supply	V_{DC}	24 (20,4 … 28,8)			
Electronics current drawn at 24 VDC	A_{DC}	0,65			
Current carrying capacity					
DC-link busbars	A_{DC}	100			
Reinforced DC-link busbars	A_{DC}	150			
24 VDC busbars	A_{DC}	20			
Unit rating[2)]					
Based on I_n (600 VDC; 4 kHz)	kW	1,6	2,7	4,8	9,7
Based on I_H	kW	1,1	2,3	4,1	8,2
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	45,5	70,6	95,6	180,6
Max. pulse frequency					
without derating	kHz	4			
with derating	kHz	16			
Max. ambient temperature					
without derating	° C	40			
with derating	° C	55			
Max. permissible heat sink temperature	° C	70	70	70	70
Weight	kg	4,2	4,2	4,5	4,5

1) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

2) Rated power of a typical standard induction motor at 400 V 3 AC.

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Note

Disturbance of the 18 A Single Motor Module with 300% overload during operation on a 16 kW Line Module

The maximum output of a 16 kW Line Module is not sufficient for the operation of an 18 A Single Motor Module with 300% overload.

- Do NOT operate the 18 A Single Motor Module with 300% overload on a 16 kW Line Module.
- Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.
- Only operate an 18 A Single Motor Module on a 16 kW Line Module when the maximum current is limited to 2 x I_{rated}.

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6.4.8.2 Double Motor Modules (300% overload)

Table 6- 46 Technical data Double Motor Modules (2 x 3 to 2 x 9 A) with 300% overload

Cold plate	**6SL3126-**	**2TE13-0AA4**	**2TE15-0AA4**	**2TE21-0AA4**
Output current				
Rated current (I_n)	A_{ACrms}	**2 x 3**	**2 x 5**	**2 x 9**
Base-load current (I_H)	A	2 x 2.6	2 x 4.3	2 x 7.7
Intermittent duty current (I_{S6}) 40%	A_{ACrms}	2 x 3.5	2 x 6	2 x 10
Peak current (I_{max})	A_{ACrms}	2 x 9	2 x 15	2 x 27
Output voltage	V_{ACrms}	0 … 480		
DC-link current $I_{d\ max}$	A_{DC}	7,2	12	22
DC-link voltage (up to 2000 m above sea level)	V_{DC}	510 … 720		
DC-link capacitance	µF	110	220	220
Overvoltage trip	V_{DC}	820 ± 2 %		
Undervoltage trip[1)]	V_{DC}	380		
Electronics power supply	V_{DC}	24 (20,4 … 28,8)		
Electronics current drawn				
at 24 VDC	A_{DC}	0,9	0,9	0,9
Current carrying capacity				
DC-link busbar	A_{DC}	100	100	100
Reinforced DC-link busbars	A_{DC}	150	150	150
24 V busbar	A_{DC}	20	20	20
Unit rating[2)]				
Based on I_n (600 VDC; 4 kHz)	kW	2 x 1.6	2 x 2.7	2 x 4.8
Based on I_H	kW	2 x 1.4	2 x 2.3	2 x 4.1
Total power loss (including electronics losses, see Power loss tables (Page 781))	W	91,6	126,6	181,6
Max. pulse frequency				
without derating	kHz	4		
with derating	kHz	16		
Max. ambient temperature				
without derating	° C	40		
with derating	° C	55		
Max. permissible heat sink temperature	° C	77	77	77
Weight	kg	4,5	4,5	4,5

1) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

2) Rated power of a typical standard induction motor at 400 V 3 AC.

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Note

Disturbance of the 2 x 9 A Double Motor Module with 300% overload during operation on a 16 kW Line Module

The maximum output of a 16 kW Line Module is not sufficient for the operation of a 2 x 9 A Double Motor Module with 300% overload.

- Do NOT operate the 2 x 9 A Double Motor Module with 300% overload on a 16 kW Line Module.
- Use at least a 36 kW Active Line Module or Smart Line Module for operation with 300% overload.
- Only operate a 2 x 9 A Double Motor Module on a 16 kW Line Module when the maximum current is limited to 2 x I_{rated}.

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6.4.8.3 Characteristics for Motor Modules Booksize with 300% overload

Rated duty cycles Motor Modules Booksize with 300% overload

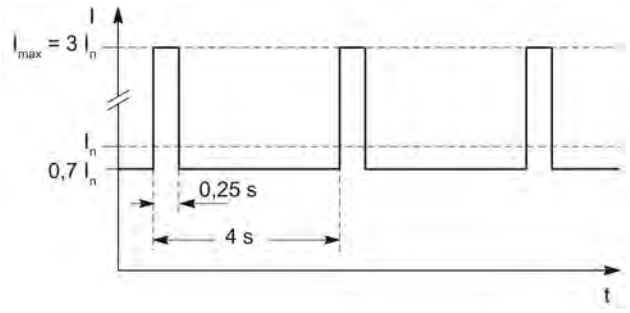


Figure 6-91 Peak current duty cycle with initial load (300% overload)

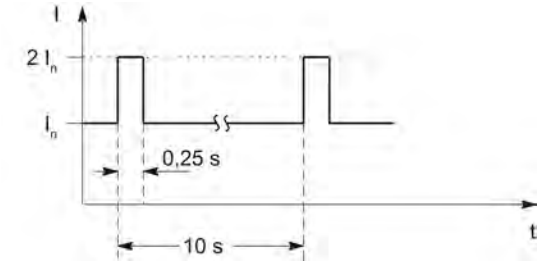


Figure 6-92 Duty cycle with initial load

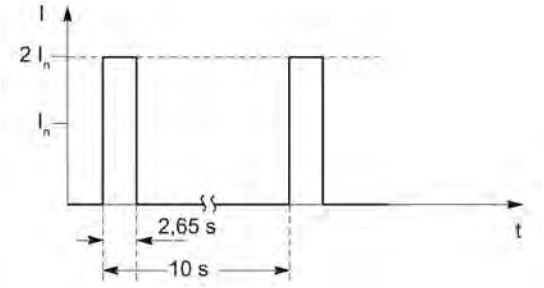


Figure 6-93 Duty cycle without initial load

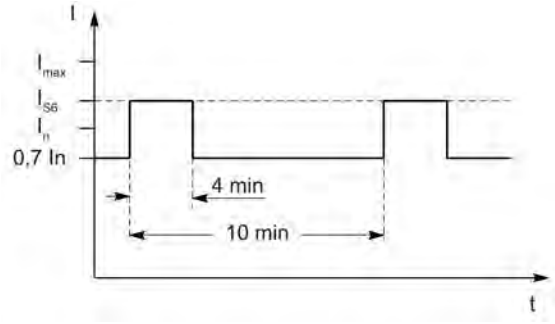


Figure 6-94 S6 duty cycle with initial load for a duty cycle duration of 600 s

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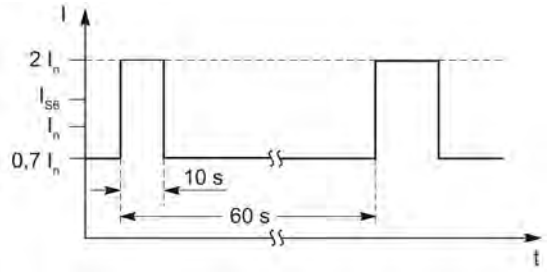


Figure 6-95 S6 duty cycle with initial load for a duty cycle duration of 60 s

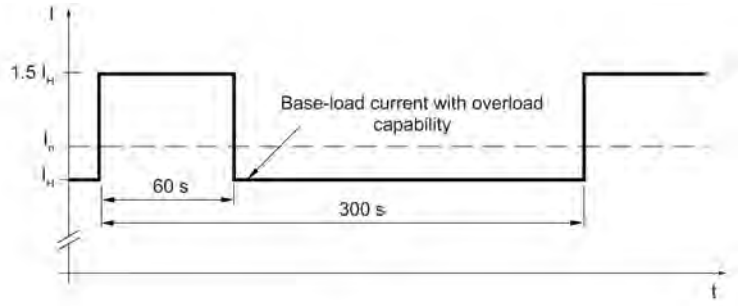


Figure 6-96 Duty cycle with 60 s overload for a duty cycle duration of 300 s

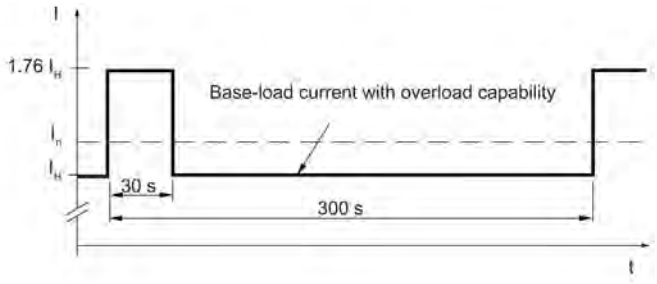


Figure 6-97 Duty cycle with 30 s overload for a duty cycle duration of 300 s

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Derating characteristics for Motor Modules Booksize with 300% overload

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

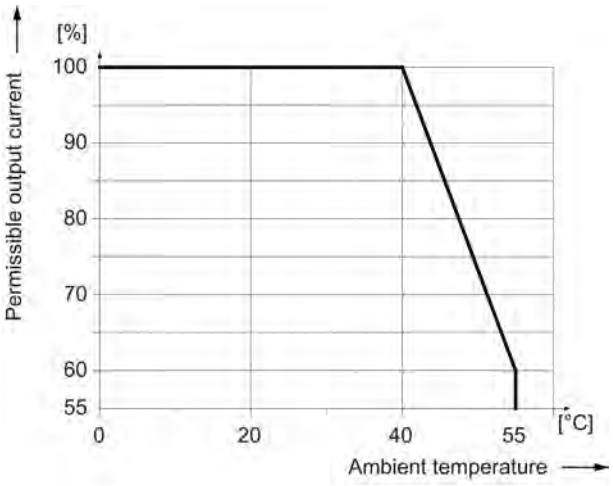


Figure 6-98 Output current as a function of the ambient temperature

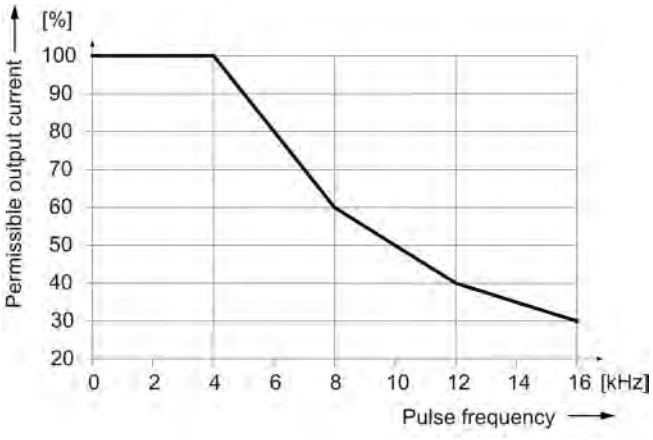


Figure 6-99 Output current as a function of the pulse frequency

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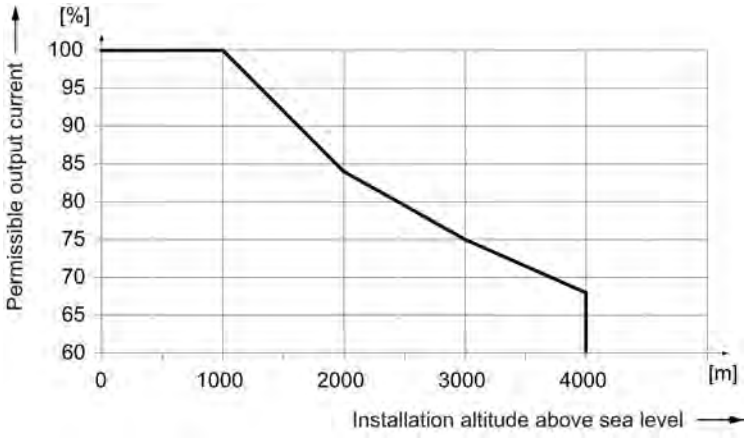


Figure 6-100 Output current as a function of the installation altitude

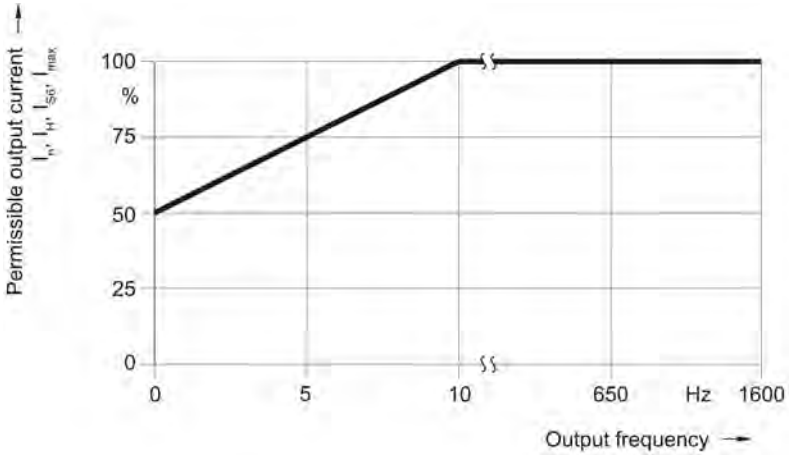


Figure 6-101 Output current as a function of the output frequency

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6.5 Motor Modules Liquid Cooled

6.5.1 Description

A Motor Module is a power unit (inverter) that provides the power for the connected motor or motors. Power is supplied by the DC link of the drive unit. A Motor Module must be connected to a Control Unit via DRIVE-CLiQ. The open-loop and closed-loop control functions for the Motor Module are stored in the Control Unit.

⚠WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

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6.5.2 Interface description

6.5.2.1 Overview

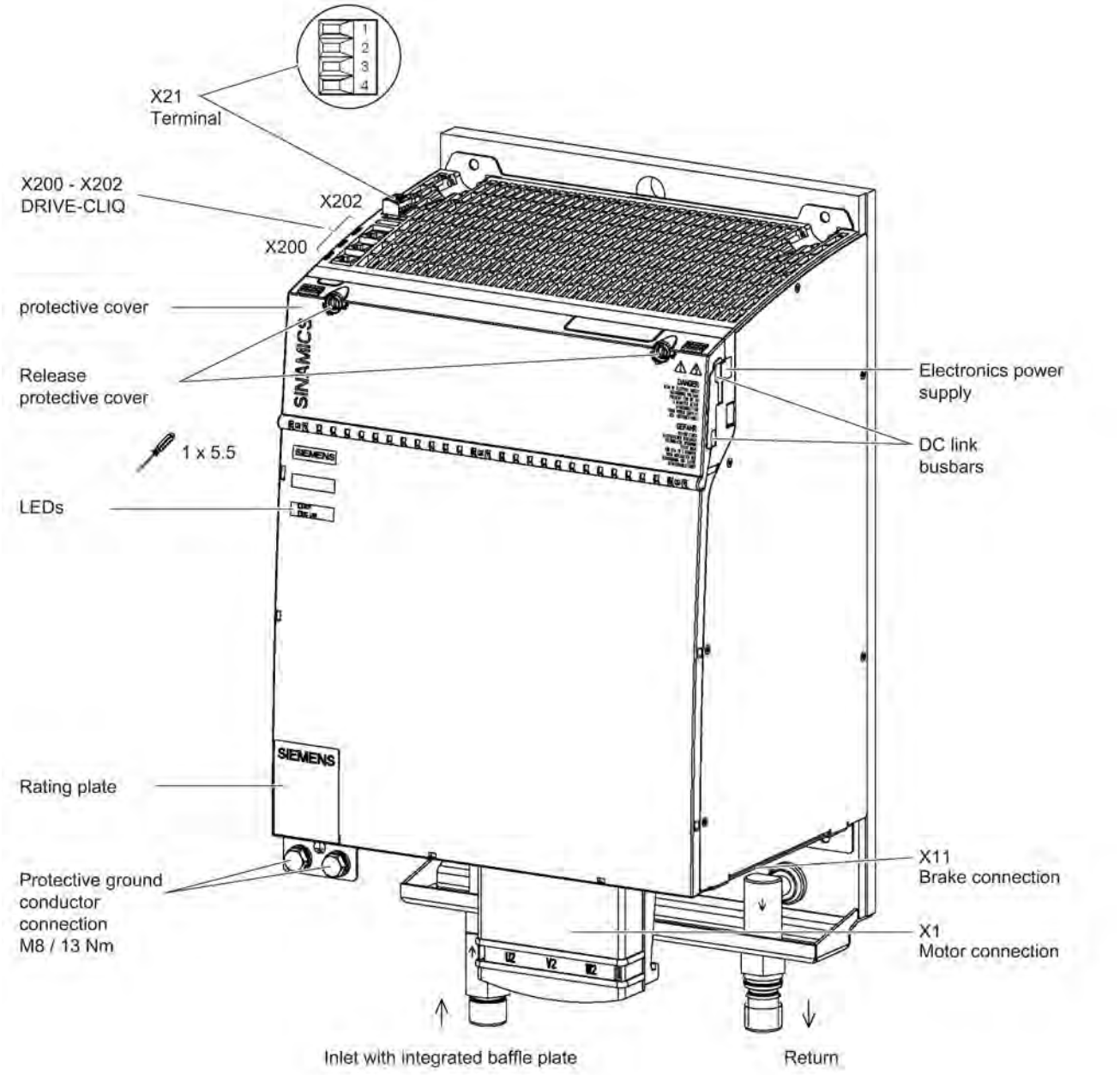
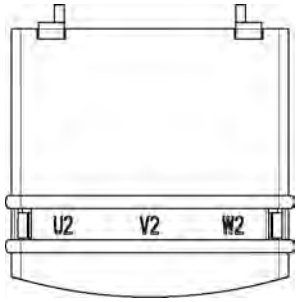
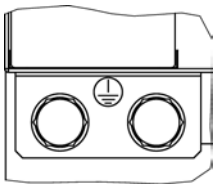


Figure 6-102 Interface overview, Motor Module Liquid Cooled (200 A)

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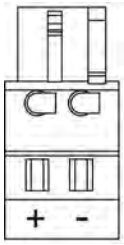
6.5.2.2 Motor and brake connection

Table 6- 47 X1 Motor connection

	Terminal	Technical data
	U2	Threaded bolts M8 / 13 Nm[1)] (refer to Chapter Connection systems (Page 731))
	V2	
	W2	
	- (BR-)	
	PE connection	Threaded hole M8 / 13 Nm[1)]

1) For ring cable lugs without insulation

Table 6- 48 X11 brake connector

	Terminal	Technical data
	+ (BR+)	Voltage 24 V DC Max. load current 2 A Min. load current 0.1 A Type: Spring-loaded terminal 2 (Page 754) Max. cross-section that can be connected 2.5 mm^2: The brake connector is part of the prefabricated cable.
	- (BR-)	

The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.



⚠WARNING

Danger to life as a result of a hazardous voltage at the 0 V to 48 V DC terminals

Death or serious injury can result when live parts are touched in the event of a fault.

- Only connect protective extra-low voltages (PELV / SELV) to all connections and terminals between 0 to 48 V DC.

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NOTICE

Destruction of the motor or motor holding brake as a result of high voltage tolerances of the motor holding brakes

If the voltage tolerances of the motor holding brakes are not complied with (24 V ± 10 %), then the brake will malfunction, i.e. the brake will not reliably open. If the motor constantly runs against the closed brake, the brake or the motor will be destroyed.

- Set the DC power supply to 26 V.

The following general conditions must be satisfied:

- Siemens three-phase motors must be used
- Siemens MOTION-CONNECT power cables must be used
- Motor cable lengths, max. 100 m

Note

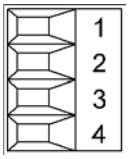
The motor brake must be connected via connector X11. It is not permitted to directly connect the cable BR – to the electronics ground M.

Note

The total length of the power cables (motor feeder cables and DC link cables) must not exceed the values listed in Chapter Combining line reactors and line filters (Page 136).

6.5.2.3 X21 EP terminal/temperature sensor

Table 6- 49 X21 EP terminal / temperature sensor

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (pulse enable)	Supply voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (enable pulses)	
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm²			

EP terminals

The filter times to debounce terminals X21.3 and X21.4 can be parameterized (see SINAMICS S120/S150 List Manual). Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Section "Controlling the safety functions".

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Note

Function of the EP terminals

The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

Temperature sensor connection

NOTICE

Risk of the motor overheating due to an incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY sensor with the correct polarity.

Note

The temperature sensor input is not needed if the motors feature an integrated DRIVE-CLiQ interface or if temperature values are detected by means of a different module (SMC, SME, TM).



WARNING

Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor

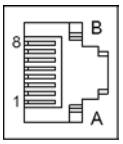
Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

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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

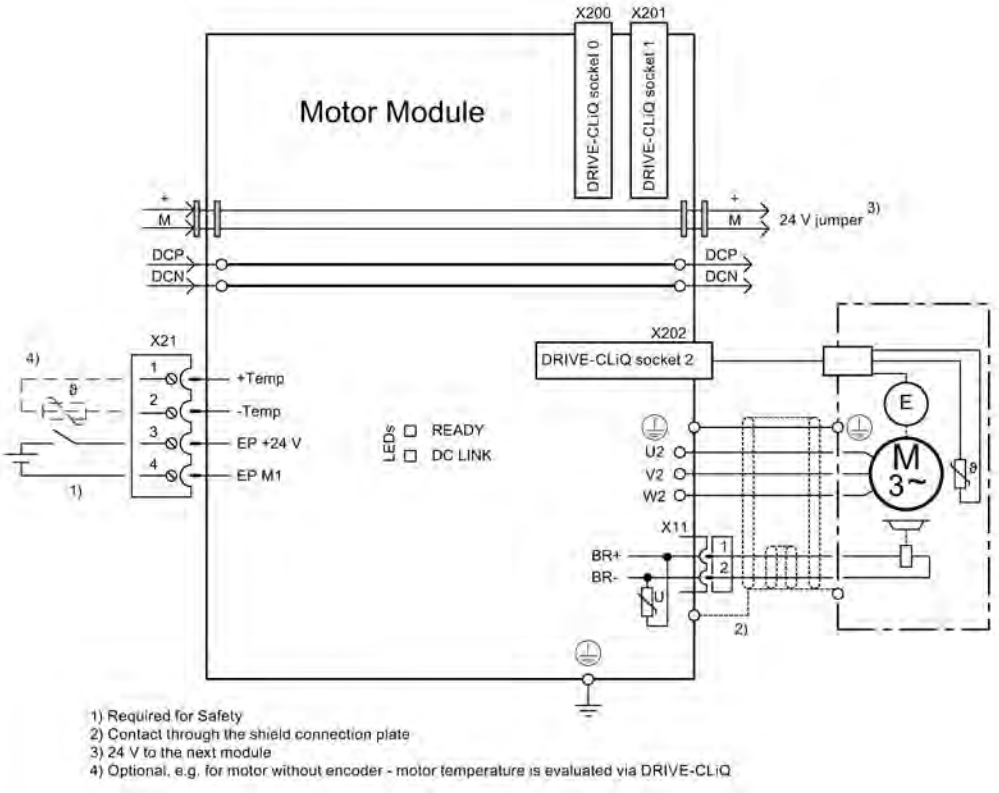


Figure 6-103 Connection example for Motor Module Liquid Cooled (200 A)

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6.5.4 Meaning of LEDs

Table 6- 51 Meaning of LEDs

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
Green	--	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is outside the permissible tolerance range.	Check the line supply voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	This component has at least one fault. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Resolve and acknowledge the fault.
Green/red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download has been completed. The system waits for POWER ON.	Carry out a POWER ON.
Green/orange or Red/orange	--	Detection of the components via LED is activated[1)]. **Note:** Both options depend on the LED status when activated.	–

1) See SINAMICS S120/S150 List Manual for the parameters to activate the recognition of components via LED



WARNING

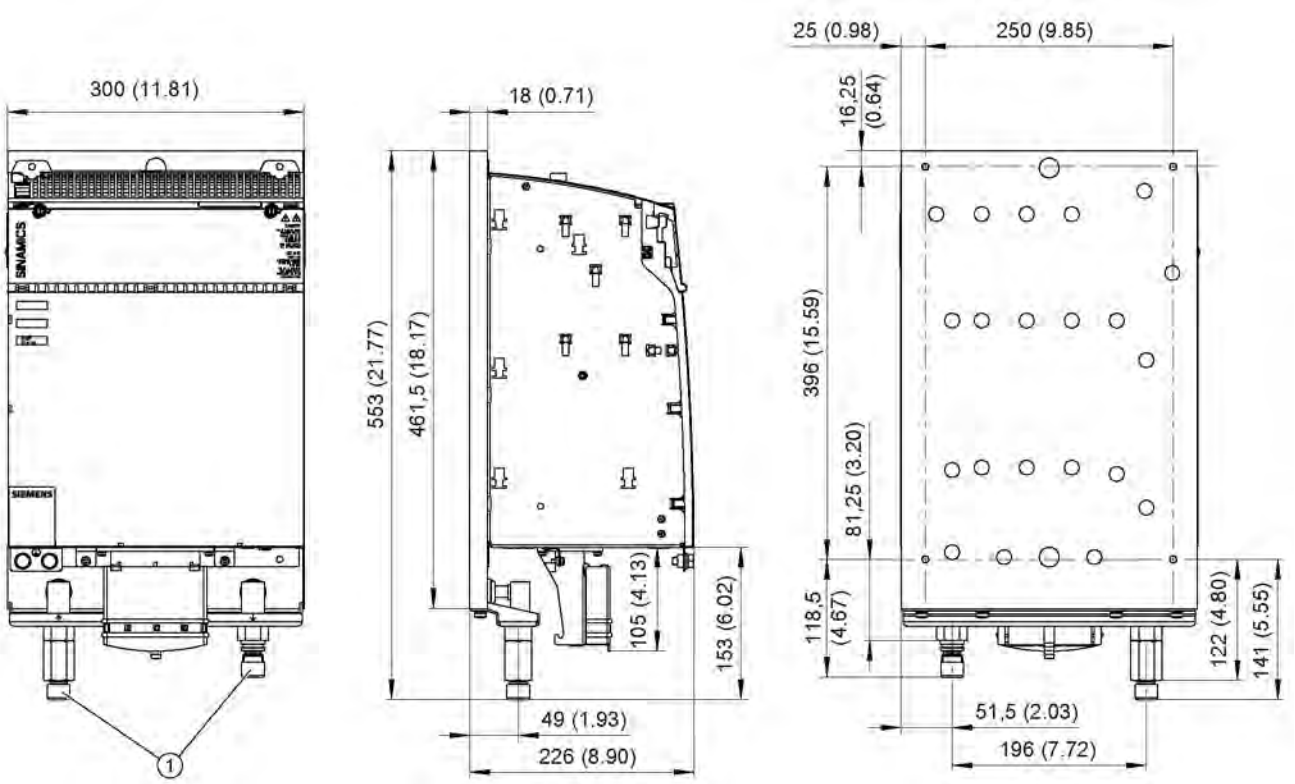
Danger of death when live parts of the DC link are touched

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means the touching of live parts can result in death or serious injury.

- Observe the warning information on the component.

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6.5.5 Dimension drawing

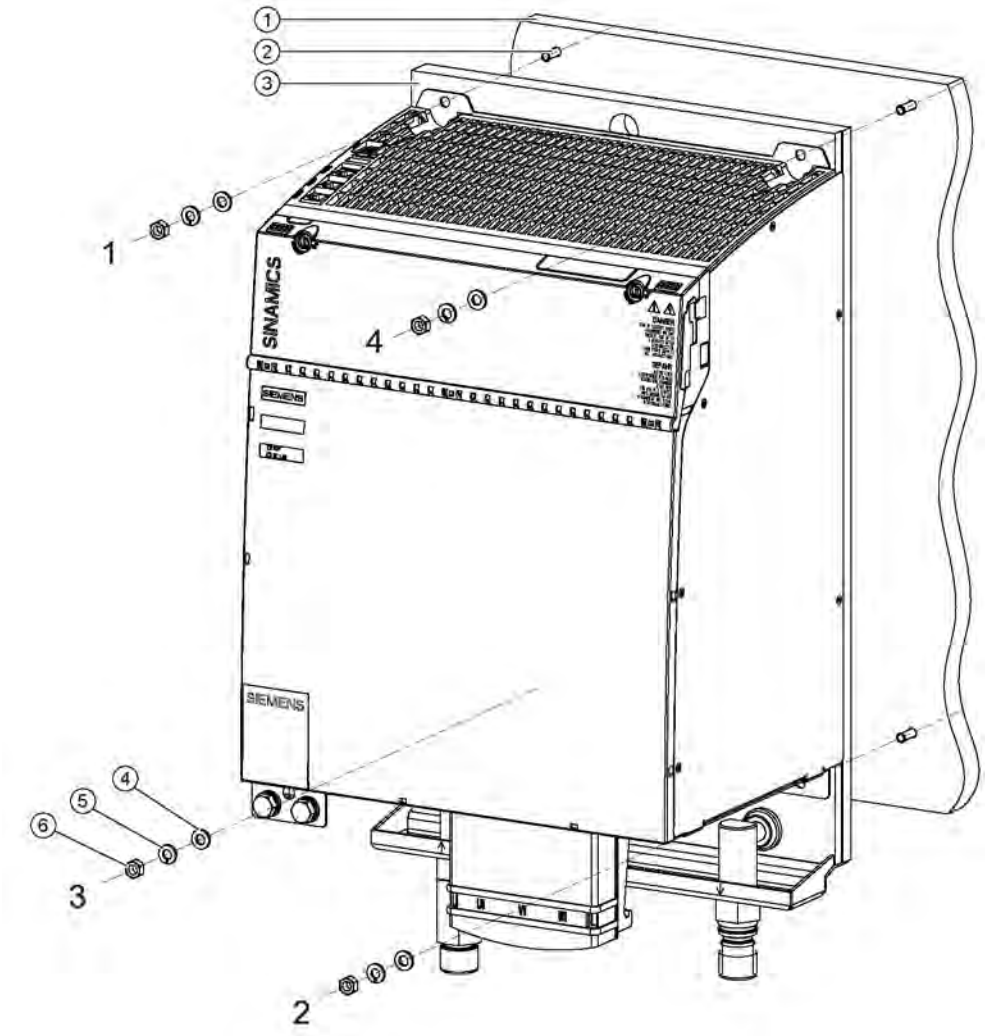


① Pipe thread ISO 228 G ½ B.

Figure 6-104 Dimension drawing of Motor Module Liquid Cooled (200 A), all dimensions in mm and (inches)

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6.5.6 Installation



① Mounting surface
② M6 studs
③ Heat sink
④ Washer
⑤ Spring washer
⑥ M6 nut

Figure 6-105 Installing a Motor Module Liquid Cooled

Tightening torques:

- Firstly, tighten the nuts by hand.
  Tightening torque: 0.5 Nm
- Then tighten the nuts in the specified sequence 1 to 4.
  Tightening torque: 10 Nm

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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.

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6.5.7 Technical data

Table 6- 52 Technical data for Motor Module Liquid Cooled 200 A

Liquid Cooled		**6SL3125-1TE32-0AAx**
Output current Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{S6}) 40% Peak current (I_{max})	 A_{ACrms} A $A_{ACrms(Is6)}$ $A_{ACrms(Imax)}$	 **200** 141 230 282
Output voltage	V_{ACrms}	0 … 480
DC-link current $I_{d\ max}$	A_{DC}	200
DC-link voltage (up to 2000 m above sea level)	V_{DC}	510 ... 720
DC-link capacitance	µF	3995
Overvoltage trip Undervoltage trip[1)]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %
Electronics power supply	V_{DC}	24 (20,4 … 28,8)
Electronics current drawn at 24 VDC	 A_{DC}	 0,85
Current carrying capacity DC-link busbars 24 VDC busbars	 A_{DC} A_{DC}	 200 20
Unit rating[2)] Based on I_n (600 VDC; 4 kHz) Based on I_H	 kW kW	 107 76
Total power loss(including electronics losses, see Power loss tables (Page 781))	W	2070,4
Max. pulse frequency without derating with derating	 kHz kHz	 4 16
Max. ambient temperature without derating with derating	 ° C ° C	 40 55
Max. coolant temperature without derating with derating	 ° C ° C	 45 50
Max. permissible heat sink temperature	° C	79 (70% derating)
Rated flow rate for water at 70 kPa pressure drop (for other coolant (Page 795))	l/min	8
Volume of liquid internal	ml	100
Weight	kg	21

1) Default for 400 V line systems; undervoltage trip threshold is adjusted to the parameterized rated voltage

2) Rated power of a typical standard induction motor at 400 V 3 AC.

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6.5.7.1 Characteristics

Motor Modules Booksize Liquid Cooled

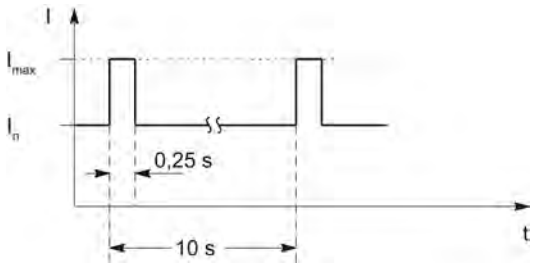


Figure 6-106 Duty cycle with initial load (for servo drives)

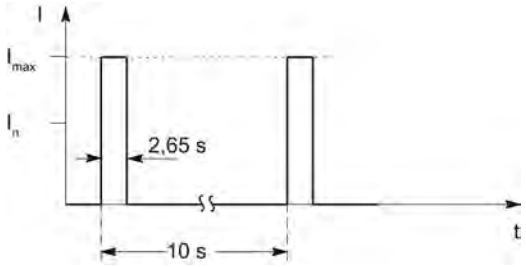


Figure 6-107 Duty cycle without initial load (for servo drives)

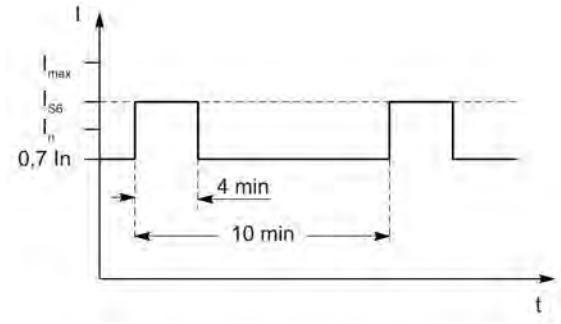


Figure 6-108 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

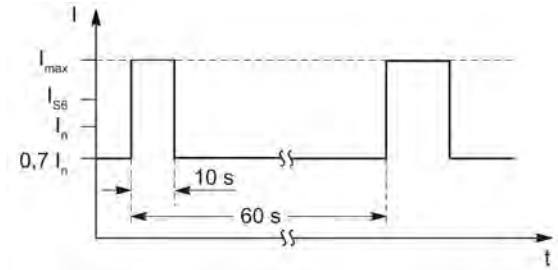


Figure 6-109 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

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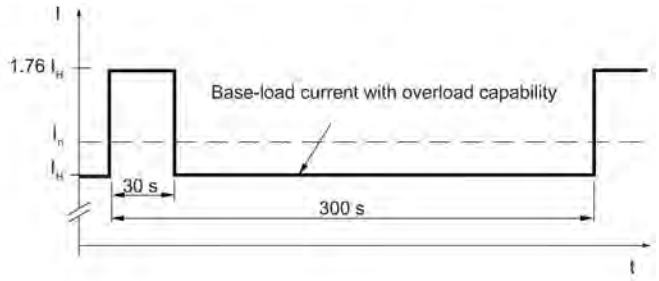


Figure 6-110 Duty cycle with 30 s overload for a duty cycle duration of 300 s

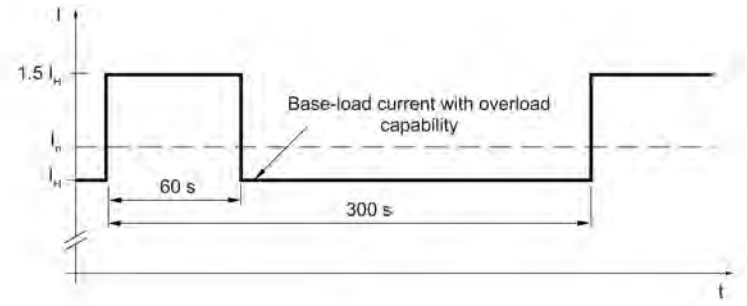


Figure 6-111 Duty cycle with 60 s overload for a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize Liquid Cooled

Note

For additional information, see Chapter Derating as a function of the installation altitude and ambient temperature (Page 47).

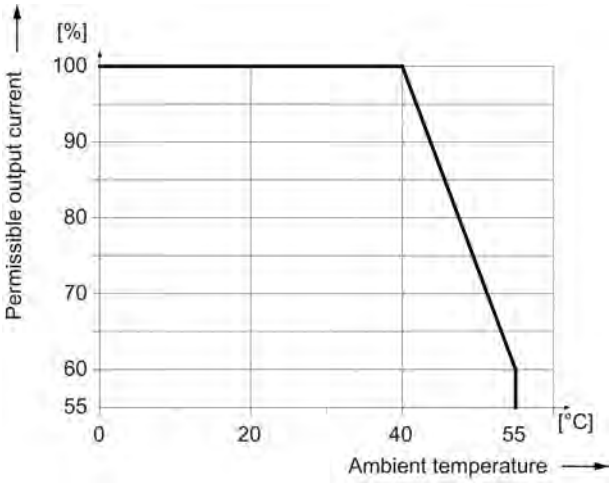


Figure 6-112 Output current as a function of the ambient temperature

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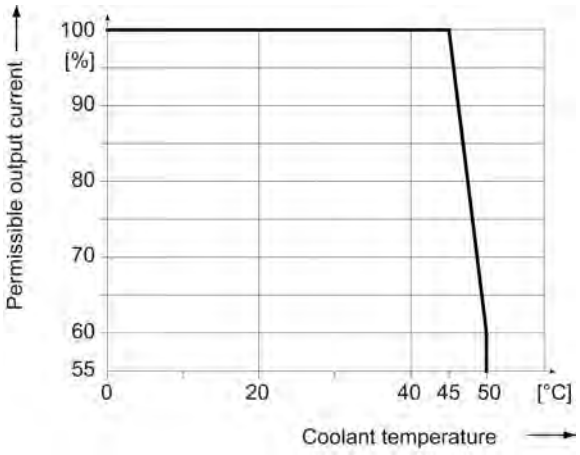


Figure 6-113 Output current as a function of the coolant temperature

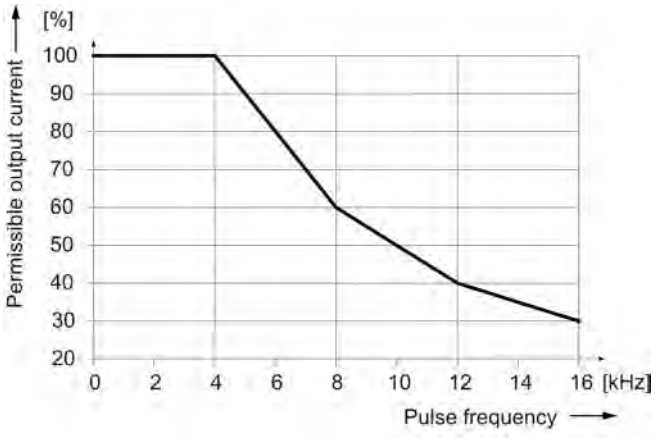


Figure 6-114 Output current as a function of the pulse frequency

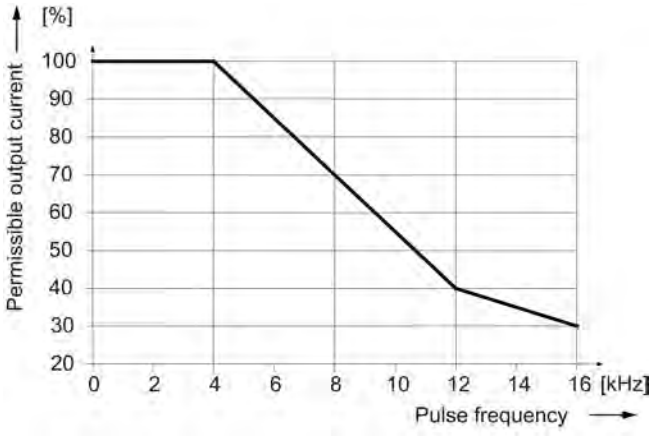


Figure 6-115 Output current as a function of the pulse frequency
(applies from order number 6SL312x-1TE32-0AA4)

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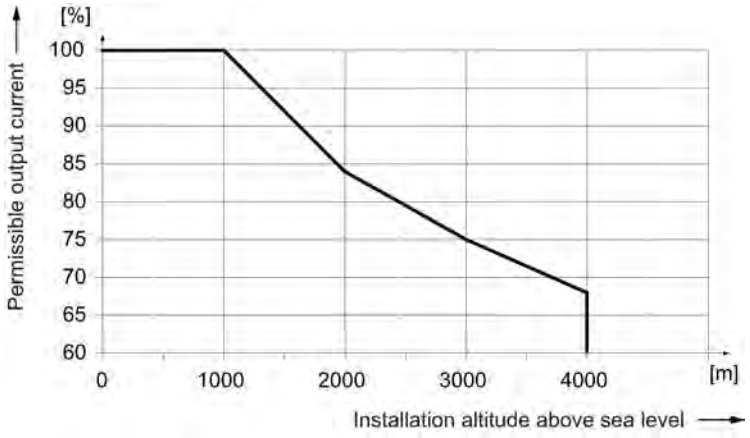


Figure 6-116 Output current as a function of the installation altitude

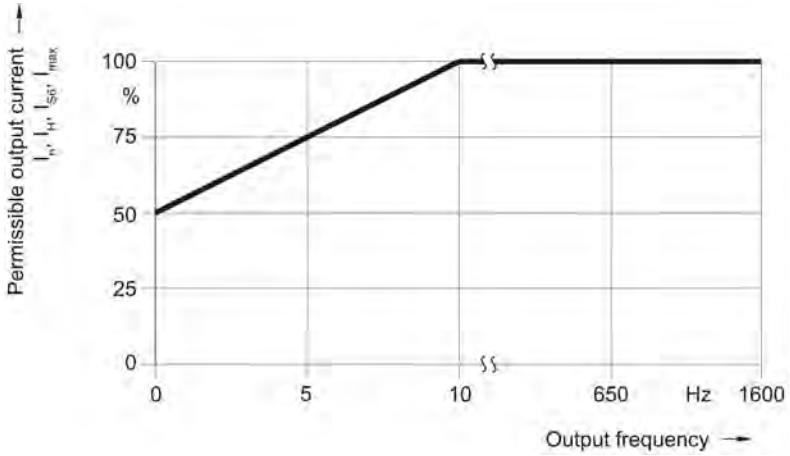


Figure 6-117 Current derating as a function of the output frequency

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Motor Modules Booksize Compact 7

7.1 Safety instructions for Motor Modules Booksize Compact

⚠WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

If the fundamental safety instructions and remaining risks in Chapter 1 (Page 25) are not observed, accidents involving severe injuries or death may occur.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.



⚠DANGER

Danger to life through electric shock due to the residual charge of the DC link capacitors

Because of the DC link capacitors, a hazardous voltage is present for up to five minutes after the power supply has been switched off.

Contact with live parts can result in death or serious injury.

- Do not open the protective cover of the DC link until 5 minutes have elapsed.
- Measure the voltage before starting work on the DCP and DCN DC link terminals.



⚠DANGER

Danger to life through electric shock when the protective cover of the DC link is open

Contact with live parts can result in death or serious injury.

- Only operate the components with closed protective cover.



⚠WARNING

Danger to life through electric shock due to 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.

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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[1)] (exception: Smart Line Module[2)]), remove the DC link bridge, including the screws. Do not tighten the screws without the DC link bridges.
- For all components that are 75 mm wide or wider, the DC link bridges may neither be swung over to the left nor removed[3)].

[1)] For 50 mm wide modules, the DC link bridge cannot be swung inwards.
[2)] Smart Line Modules do not have a DC link bridge.
[3)] The DC link bridge guarantees the mechanical stability of the DC link busbars.



WARNING

Danger to life through electric shock due to missing DC link side covers

There is a danger of an electric shock through contact when the side covers of the DC link are missing.

- Mount the side covers on the first and last component in the drive line-up.

You can order missing side covers (order number: 6SL3162-5AA00-0AA0).



WARNING

Danger to life due to high leakage currents caused by an interrupted external protective conductor

The drive components conduct a high leakage current via the protective conductor. Touching conductive parts when the protective conductor is interrupted can result in death or serious injury.

- Ensure that the external protective conductor satisfies at least one of the following conditions:
  - It has been laid so that it is protected against mechanical damage.[1)]
  - If it is a single conductor, it has a cross-section of at least 10 mm² Cu.
  - If it is a conductor of a multi-conductor cable, it has a cross-section of at least 2.5 mm² Cu.
  - It has a second protective conductor in parallel with the same cross-section.
  - It complies with the local regulations for equipment with increased leakage current.

[1)] Cables laid within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.

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⚠WARNING

Danger to life through electric shock due to incorrectly laid brake cables

If brake cables are laid without safe electrical separation, the insulation can fail with an electric shock.

- Connect the holding brake with the specified MOTION-CONNECT cable.
- Only use third-party cables with safe electrically separated brake cores or lay the brake cores with safe electrical separation.

⚠WARNING

Danger of an accident due to missing warning labels in the national language.

Missing warning labels in the national language can result in death or serious injury.

- Attach the component warning labels in the national language.

⚠WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

Inadequate ventilation clearances can cause overheating with a risk for personnel due to smoke and fire. This can also result in increased failure rates and a shorter service life for Motor Modules.

- Maintain the 80 mm clearances above and below the Motor Modules.

NOTICE

Material damage due to loose power connections

Insufficient tightening torques or vibration can result in faulty electrical connections. This can cause fire damage or malfunctions.

- Tighten all power connections with the specified tightening torques, e.g. line supply connection, motor connection, DC link connections.
- Check the tightening torques of all power connections at regular intervals and tighten them when required. This applies in particular after transport.

NOTICE

Damage to the equipment when performing a voltage test as a result of connections that are not disconnected

SINAMICS S components are subject to a voltage test as part of the routine test. Connected devices can be damaged.

- Disconnect or unplug all SINAMICS devices before the voltage test of the machine equipment according to EN 60204-1, Section 18.4.

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NOTICE

Device failure as a result of unshielded or incorrectly routed cables to temperature sensors

Unshielded or incorrectly routed cables to temperature sensors can result in interference being coupled into the signal processing electronics from the power side. This can result in significant disturbance of all signals (fault messages) up to failure of individual components (destruction of the devices).

- Only use shielded cables as temperature sensor cables.
- If temperature sensor cables are routed together with the motor cable, use separately shielded cables twisted in pairs.
- Connect the cable shield to ground potential at both ends through a large surface area.
- Recommendation: Use suitable Motion Connect cables.

Note

Operating motors with a built-in holding brake

A regulated DC power supply is required to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars.

- Take note of the motor holding brake voltage tolerances (24 V ± 10%) and the connecting cable voltage drop.
- Set the DC power supply to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:
  - Siemens three-phase motors must be used
  - Siemens MOTION-CONNECT power cables must be used
  - Motor cable lengths, max. 100 m

NOTICE

Damage through use of incorrect DRIVE-CLiQ cables

Damage or malfunctions can occur on the devices or system when DRIVE-CLiQ cables are used that are either incorrect or have not been approved for this purpose.

- Only use suitable DRIVE-CLiQ cables that have been approved by Siemens for the particular application.

Note

Malfunctions due to polluted DRIVE-CLiQ interfaces

Malfunctions can occur in the system through the use of polluted DRIVE-CLiQ interfaces.

- Cover unused DRIVE-CLiQ interfaces with the supplied blanking covers.

Notes for UL applications

Note

The SINAMICS S120 Motor Modules Booksize Compact provide short-circuit protection at the motor output terminals.

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7.2 Description

A Motor Module Booksize Compact is a power unit (inverter) that provides the power supply for one motor or several motors. Power is supplied by the DC link of the drive unit. A Motor Module must be connected to a Control Unit via DRIVE-CLiQ. The open-loop and closed-loop control functions for the Motor Module are stored in the Control Unit.

1 motor can be connected to Single Motor Modules and 2 motors can be connected to Double Motor Modules.

Motor Modules Booksize Compact can be used either with cooling type "internal air cooling" or cooling type "cold plate". The cooling type is selected by parameter (see the SINAMICS S120/S150 List Manual).

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7.3 Interface description

7.3.1 Overview

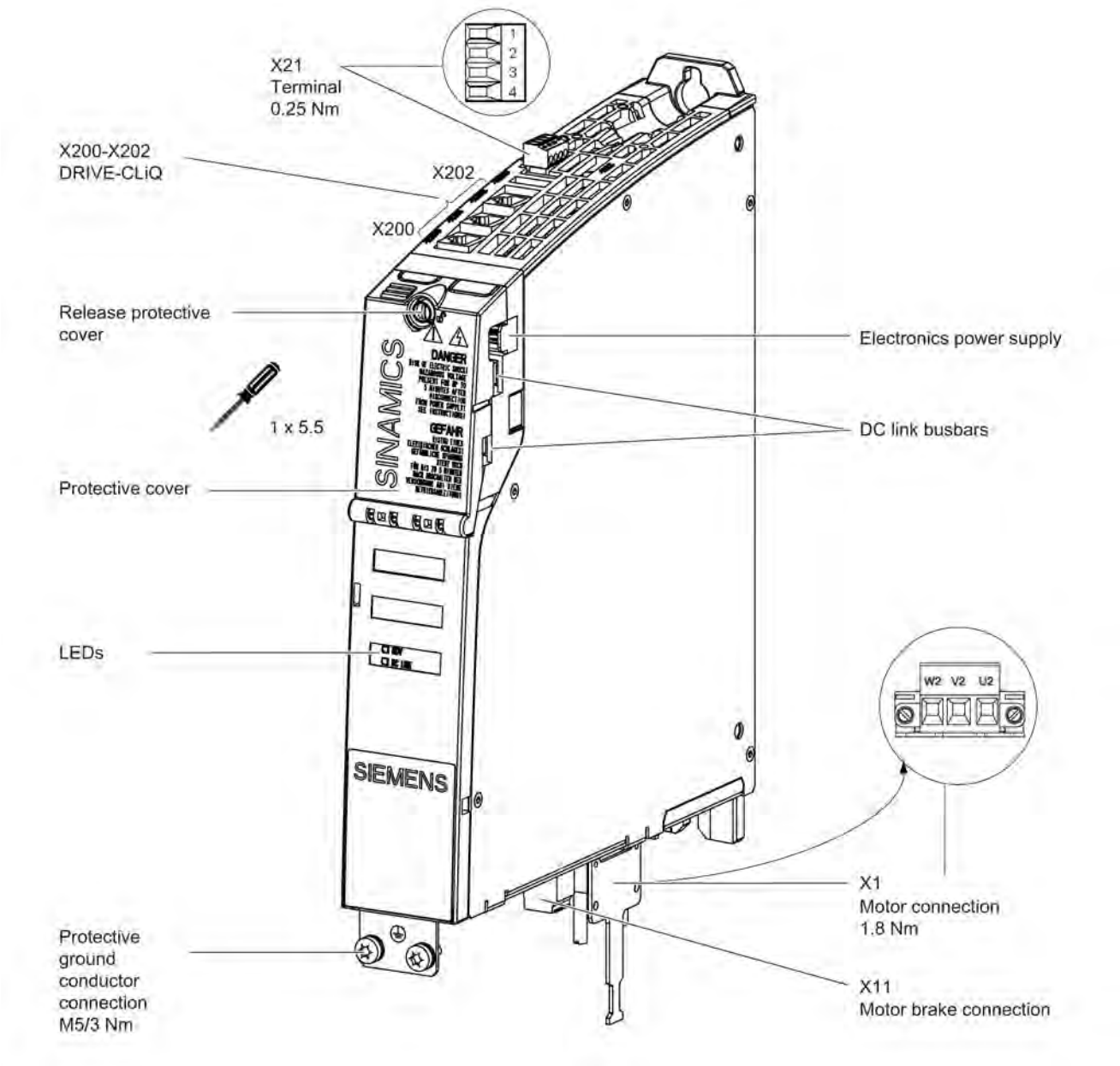


Figure 7-1 Interface overview, Single Motor Module Booksize Compact (example: 5 A)

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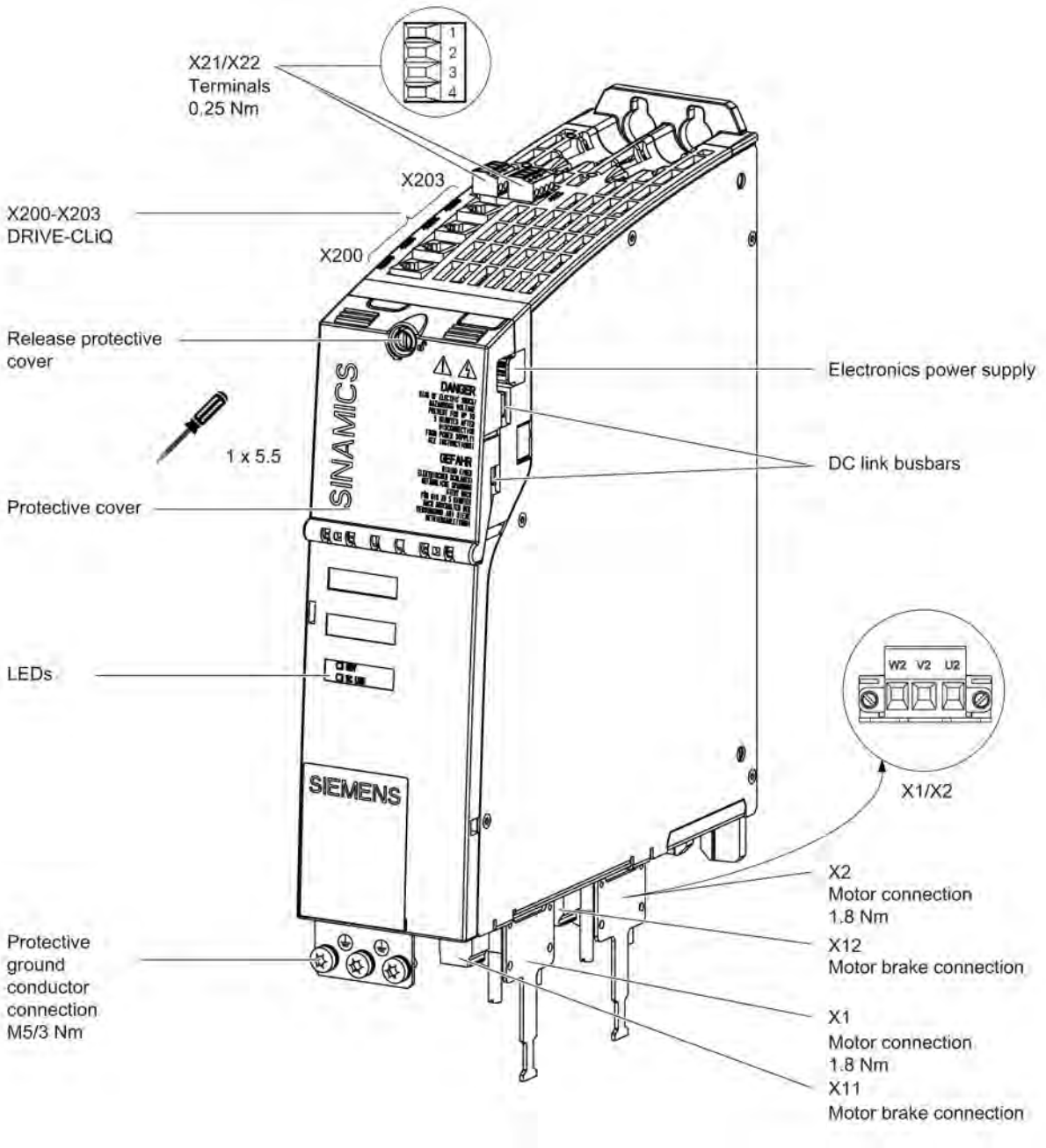
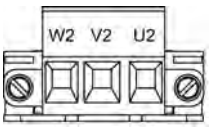
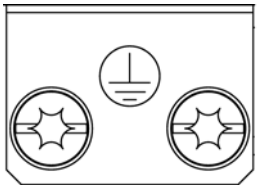
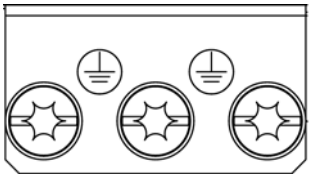


Figure 7-2 Interface overview, Double Motor Module Booksize Compact (example: 2 x 5 A)

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7.3.2 X1/X2 motor connection

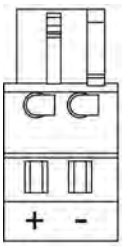
Table 7- 1 X1/X2 motor connection

	Terminal	Technical data
	U2 V2 W2	Type: Screw terminal 5 (Page 755) Max. cross-section that can be connected: 6 mm² Tightening torque: 1.2 … 1.5 Nm
	PE connection	**Single Motor Modules 3 … 18 A** Threaded hole M5 / 3 Nm[1]
		**Double Motor Modules 1.7 … 5 A** Threaded hole M5 / 3 Nm[1]

1) For ring cable lugs without insulation

7.3.3 X11/X12 motor brake connection

Table 7- 2 X11/X12 motor brake connection

	Terminals	Technical data
	+ (BR+) - (BR-)	Brake connector[1]: Voltage 24 V DC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm² Type: Spring-loaded terminal 2 (Page 754) Manufacturer: Wago; order number: 721-102/026-000/56-000 The brake connector is part of the scope of delivery.

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.

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Note

The total length of the power cables (motor feeder cables and DC link cables) must not exceed the values listed in Chapter Combining line reactors and line filters (Page 136).

Note

The motor brake must be connected via connector X11 and X12 on Double Motor Modules. It is not permitted to directly connect the cable BR- to the electronics ground M.

NOTICE

Destruction of the motor or motor holding brake as a result of high voltage tolerances of the motor holding brakes

If the voltage tolerances of the motor holding brakes are not complied with (24 V ± 10 %), then the brake will malfunction, i.e. the brake will not reliably open. If the motor constantly runs against the closed brake, the brake or the motor will be destroyed.

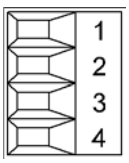
- Set the DC power supply to 26 V.

The following general conditions must be satisfied:

- Siemens three-phase motors must be used
- Siemens MOTION-CONNECT power cables must be used
- Motor cable lengths, max. 100 m

7.3.4 X21/X22 EP terminals/temperature sensor

Table 7- 3 X21/X22 EP terminals / temperature sensor

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (pulse enable)	Supply voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (enable pulses)	
Type: Screw terminal 1 (Page 755) Max. cross-section that can be connected 1.5 mm²			

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EP terminals

Parameters are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4 (see the SINAMICS S120/S150 List Manual). Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Section "Controlling the safety functions".

Note

Function of the EP terminals

The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

Temperature sensor connection

NOTICE

Risk of the motor overheating due to an incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY sensor with the correct polarity.

Note

The temperature sensor input is not needed if the motors feature an integrated DRIVE-CLiQ interface or if temperature values are detected by means of a different module (SMC, SME, TM).



WARNING

Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor

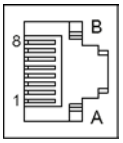
Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

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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

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