

Equipment Manual 04/2004 Edition

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SINAMICS S120
Booksize Power Sections

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SINAMICS S120 Booksize Power Sections

Equipment Manual

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SINAMICS® Documentation

Printing history

Brief details of this edition and previous editions are listed below.

The status of each edition is shown by the code in the "Remarks" column.

Status code in the "Remarks" column:

- A** New documentation
- B** Unrevised reprint with new order no.
- C** Revised edition with new status

If factual changes have been made on the page in relation to the same software version, this is indicated by a new edition coding in the header on that page.

Edition	Order No.	Remarks
04.04	6SL3097-2AC00-0BP0	A

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We have checked that the contents of this document correspond to the hardware and software described. Nonetheless, differences might exist and therefore we cannot guarantee that they are completely identical. The information contained in this document is, however, reviewed regularly and any necessary changes will be included in the next edition. We welcome suggestions for improvement.

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Preface

Preface

Information on the SINAMICS S documentation

The SINAMICS S documentation is divided into the following areas:

- General documentation/catalogs
- Manufacturer/service documentation
- Electronic documentation

This documentation is an integral part of the manufacturer/service documentation developed for SINAMICS. All documents can be obtained separately.

You can obtain detailed information about the documents named in the documentation overview and other documents available for SINAMICS from your local Siemens office.

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

The contents of this documentation are not part of an earlier or existing agreement, a promise, or a legal agreement, nor do they change this. All obligations entered into by Siemens result from the respective contract of sale that contains the complete and sole valid warranty arrangements. These contractual warranty provisions are neither extended nor curbed as a result of the statements made in this documentation.

Audience

This documentation is aimed at machine and plant builders, commissioning engineers, and service personnel who use SINAMICS.

Objective

This manual describes the hardware components of the SINAMICS S system. It provides information about installation, electrical connection, and cabinet design.

Danger and warning notices – symbol explanations

The following danger and warning notices are used in this document:



Danger

Indicates an imminently hazardous situation which, if not avoided, will result in death, serious injury, or substantial damage to property.



Warning

Indicates an potentially hazardous situation which, if not avoided, could result in death, or serious injury, or substantial property damage.



Caution

Used with the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or property damage.

Caution

Used without safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

Notice

Used without the safety alert symbol indicates a potential situation which, if not avoided, may result in an undesirable result or state.

Note

This notice indicates that there are further issues to be taken into consideration.

Definition: Qualified personnel

With reference to this manual and the warning labels on the product, a "qualified person" is someone who is familiar with the installation, mounting, startup, and operation of the equipment and who has certified qualifications for the type of responsibility involved, such as:

- Training and instruction, i.e. authority to switch on and off, to earth and to label circuits and equipment according to safety regulations.
- Training and instruction in maintenance and use of adequate safety equipment according to safety regulations.
- First aid training.

Finding information

To help you find information more easily, the following sections have been included in the appendix in addition to the table of contents:

1. References
2. Index

Technical information

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Internet address

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ESD notices



Caution

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

Regulations for handling ESD components:

When handling components, make sure that personnel, workplaces, and packaging are well earthed!

Personnel in ESD areas with conductive flooring may only handle electronic components if
They are grounded with an ESD wrist band

They are wearing ESD shoes or ESD shoe grounding straps.

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

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

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

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

Measurements must only be taken on boards when

the measuring instrument is grounded (via protective conductors, for example)

the measuring probe is briefly discharged before measurements are taken with an isolated measuring device (for example, touching a bare metal housing).

Safety guidelines



Danger

Commissioning shall not start until you have ensured that the machine in which the components described here are to be installed complies with Directive 98/37/EC.

SINAMICS S equipment must only be commissioned by suitably qualified personnel.

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

When electrical equipment and motors are operated, the electrical circuits automatically conduct a dangerous voltage.

Dangerous mechanical movements may occur in the system during operation.

All work on the electrical system must be performed after the system has been switched off and disconnected from the power supply.

SINAMICS S equipment with three-phase motors may only be connected to the line system via residual current devices (RCDs) if compatibility of the SINAMICS equipment with the RCD has been ensured as specified in EN 50178, Subsection 5.2.11.2.



Warning

Correct and safe operation of SINAMICS S equipment assumes correct transportation, storage, setup, and installation, as well as careful operation and maintenance.

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

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

Only protective extra-low voltages (PELVs) that comply with EN60204-1 must be connected to all connections and terminals between 0 and 48 V.

Caution

As part of routine tests, SINAMICS equipment with three-phase motors will undergo a voltage test in accordance with EN 50178. Before the voltage test is performed on the electrical equipment of industrial machines to EN 60204-1, Section 19.4, all connectors of SINAMICS equipment must be disconnected/unplugged to prevent the equipment from being damaged.

Motors must be connected in accordance with the circuit diagram provided. They must not be connected directly to the three-phase supply because this will damage them.

Note

When operated in dry operating areas, SINAMICS equipment with three-phase motors conforms to low-voltage Directive 73/23/EEC.

SINAMICS equipment with three-phase motors conforms to EMC Directive 89/336/EEC in the configurations specified in the associated EC Certificate of Conformity.

Caution

Operating the equipment in the immediate vicinity (< 1.5 m) of mobile telephones with a transmitter power of > 1 W may lead to incorrect operation.

Notes

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System Overview

1.1 Applications

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

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

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

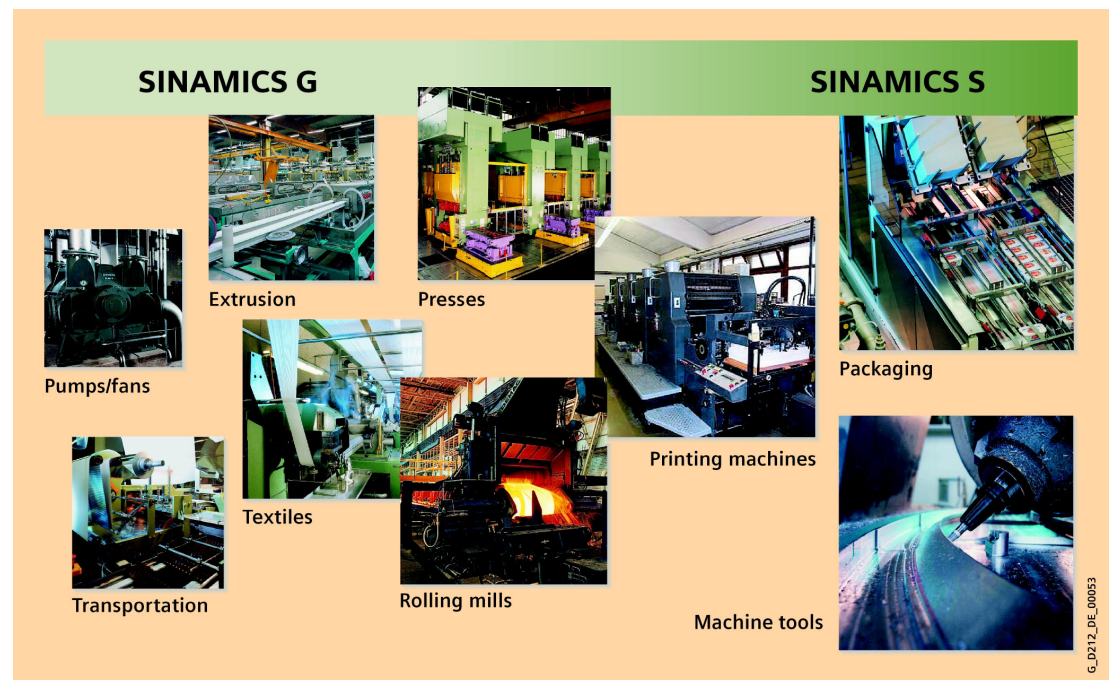


Figure 1-1 SINAMICS applications

1.2 Versions

SINAMICS offers different versions designed to meet a range of requirements:

- SINAMICS G is designed for standard applications with asynchronous motors. These applications have less stringent requirements regarding the dynamics and accuracy of the motor speed.
- SINAMICS S handles complex drive tasks with synchronous/asynchronous motors and fulfills stringent requirements regarding
 - Dynamics and accuracy,
 - Integration of extensive technological functions in the drive control system.

1.3 Platform concept and Totally Integrated Automation

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

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

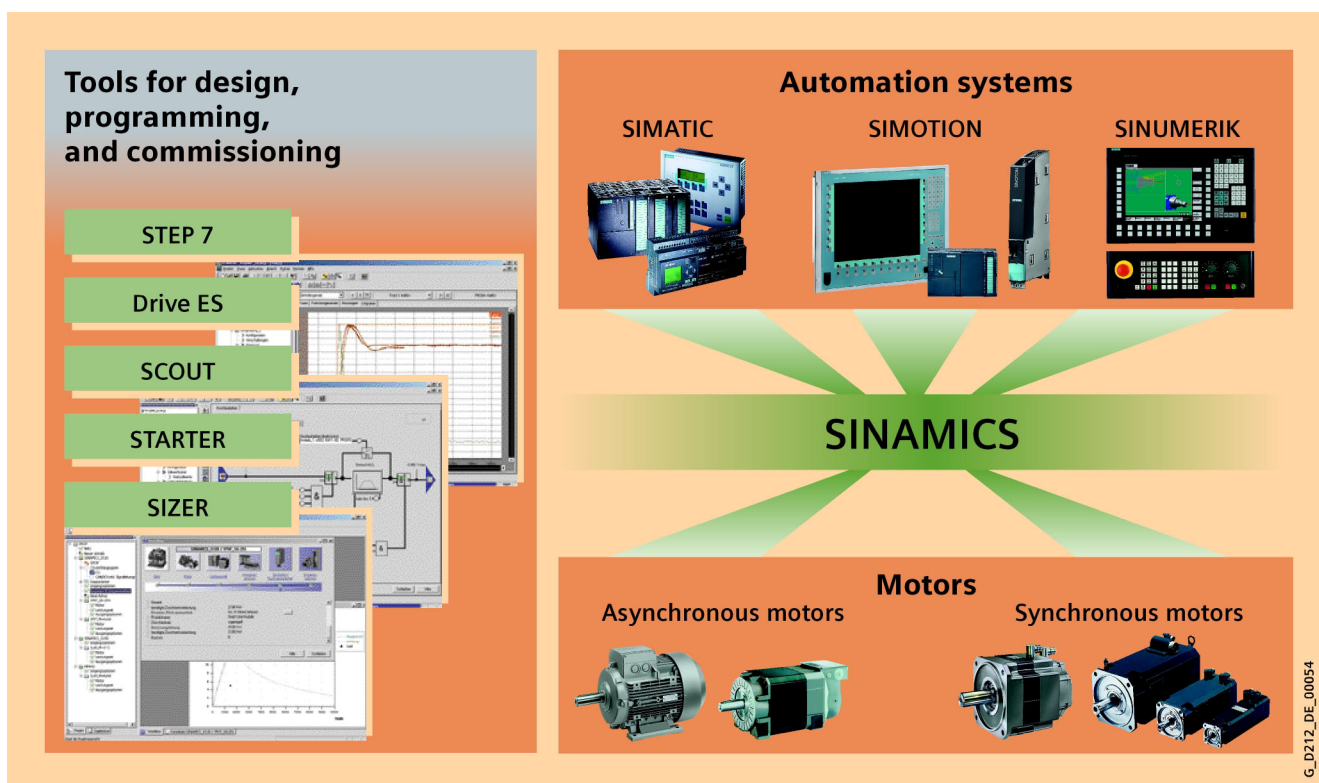


Figure 1-2 SINAMICS as part of the Siemens modular automation system

1.4 Introduction

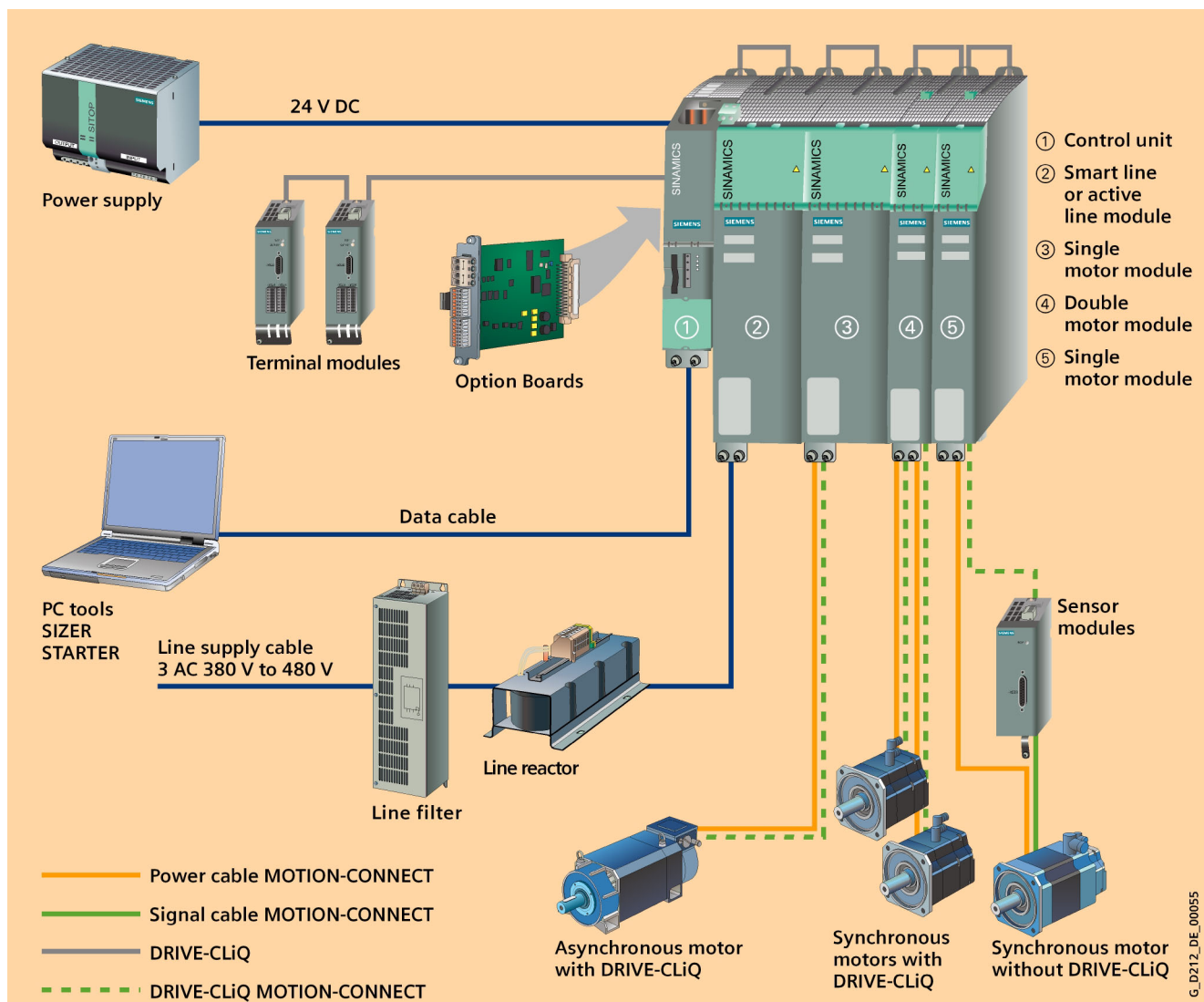


Figure 1-3 SINAMICS S120 System Overview

Modular system for complex 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 configuration tool, makes it easier to choose and determine the optimum drive configuration.

SINAMICS S120 is enhanced by a wide range of motors. Whether synchronous or asynchronous, all motor types are supported by SINAMICS S120.

Drive for multi-axis applications

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

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

New system architecture with a central control unit

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

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

DRIVE-CLiQ – a digital interface between all components

All 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.

Converter boards for converting standard encoder signals to DRIVE-CLiQ are available for third-party motors or retrofit applications.

Electronic type plates in all components

All SINAMICS S120 components have an electronic type plate that contains all the relevant 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 in-built motor encoder. The control unit records this data automatically via DRIVE-CLiQ so that it does not need to be entered during commissioning or if the equipment is replaced.

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

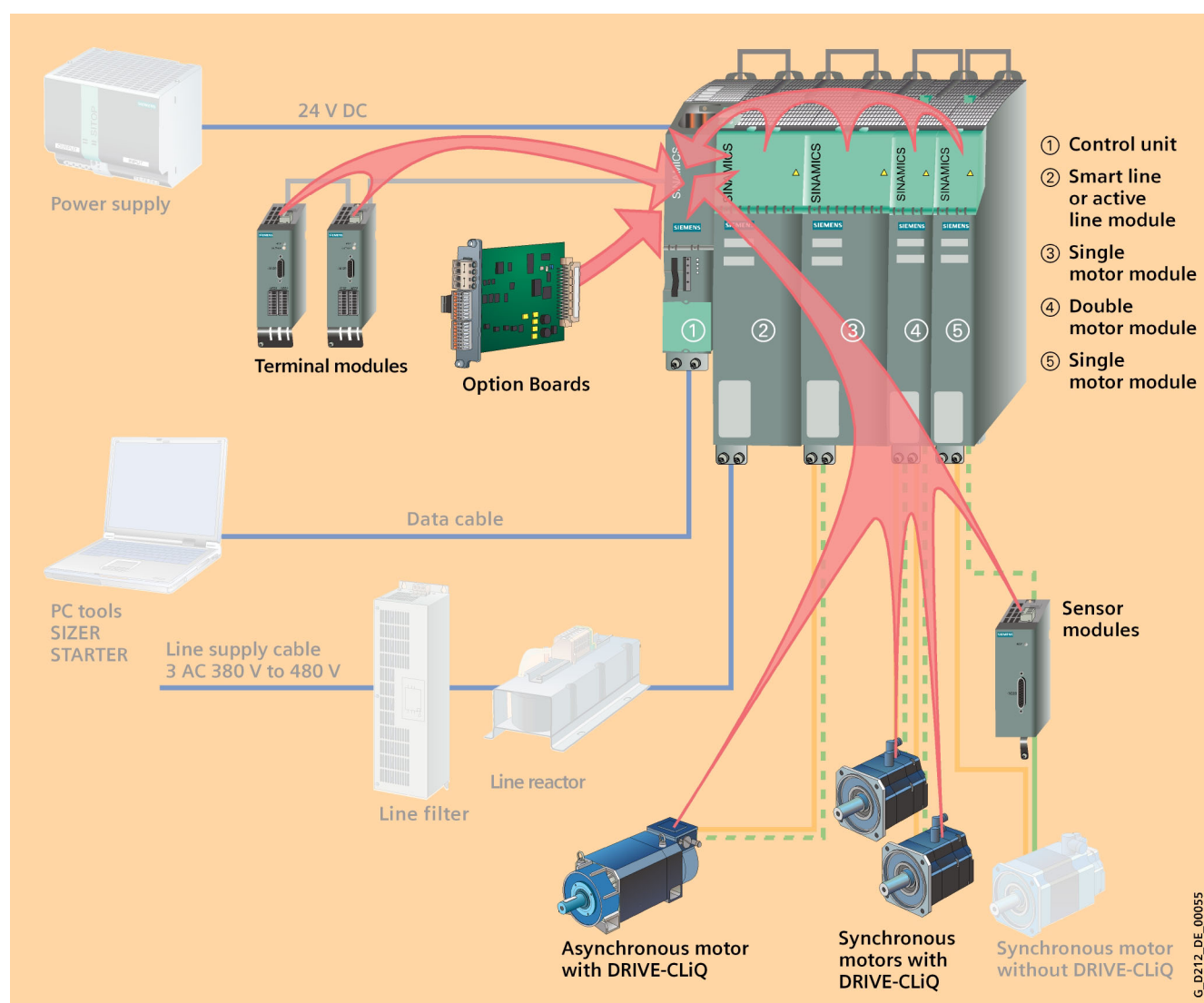


Figure 1-4 The electronic type plate for SINAMICS S120

1.5 SINAMICS S120 components

This overview features the SINAMICS S120 components that are primarily used for multi-axis drive tasks.

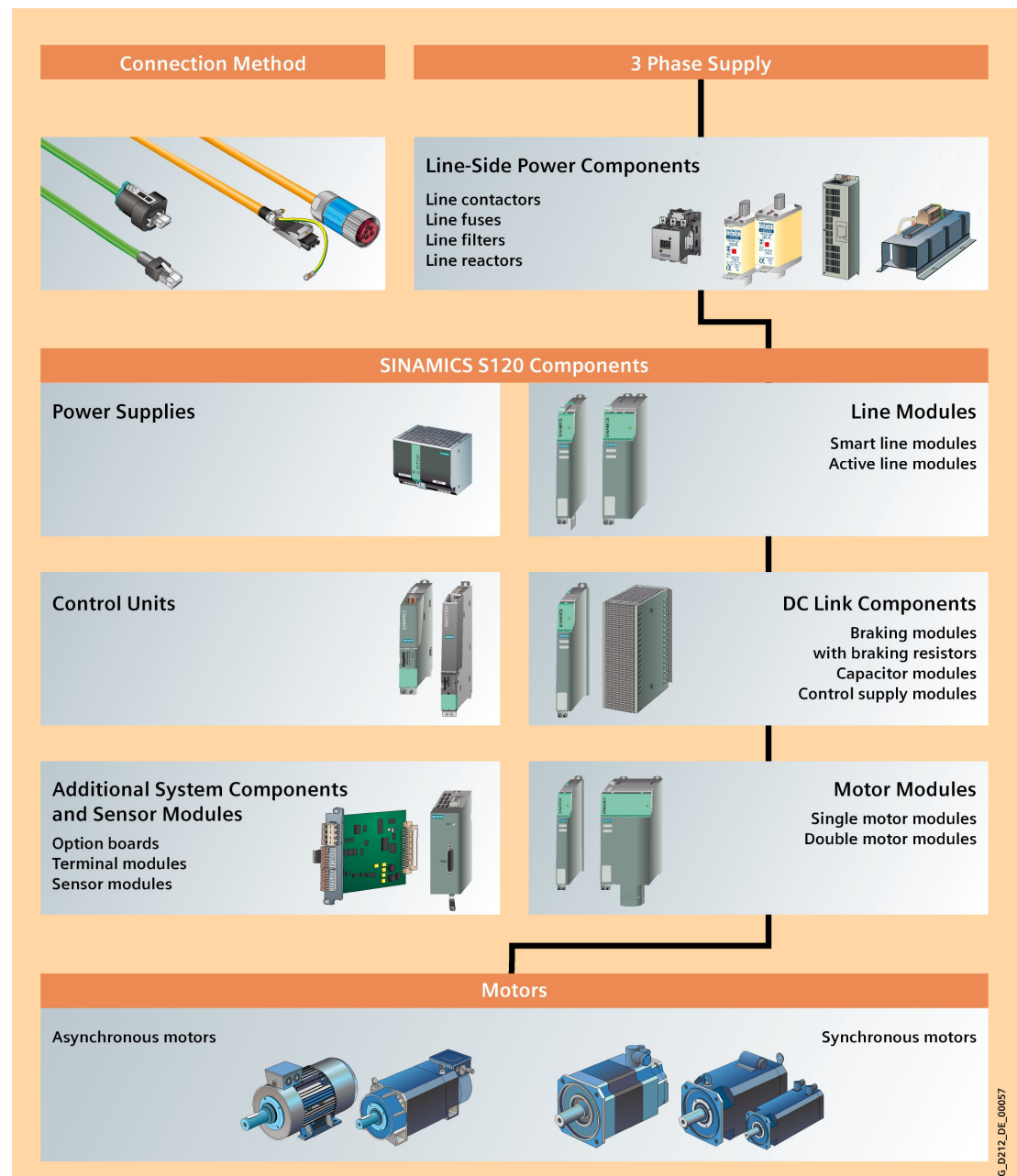


Figure 1-5 SINAMICS S120 component overview

The following power components are available:

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

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

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

The SINAMICS S120 components were developed for installation in cabinets. They have the following features and characteristics:

- Easy to handle, simple installation and wiring
- Practical connection system, cable routing in accordance with EMC requirements
- Standardized design, seamless integration
- Internal ventilators (other cooling methods available on request).

1.6 Power sections

Line modules

Convert the three-phase supply into a DC voltage for the DC link.

- Smart line modules

The smart line modules generate a non-stabilized DC link voltage and are capable of regenerative feedback.

- Active line modules

The active line modules generate a stabilized DC link voltage and are capable of regenerative feedback.

Motor modules

- Convert energy from the DC link for the connected motors with variable voltage and variable frequency.

1.7 System data

Technical specifications

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

Electrical data	
Line connection voltage	3 AC 380 V to 480 V $\pm 10\%$ ($-15\% < 1 \text{ min}$)
Line frequency	47 – 63 Hz
Electronics power supply	24 V DC, $-15/+20\%$ *
Radio interference suppression • Standard • With line filter	No radio interference suppression Class A1 to EN 55011
Overvoltage category	Class III to EN 60 664-1

*If a motor holding brake is used, restricted tolerances may have to be taken into account.

Mechanical data	
Vibratory load • Transportation • Operation	EN 60 721-3-2, class 2M3 EN 60 721-3-3, class 3M4
Shock load • Transportation • Operation	EN 60 721-3-2, class 2M3 EN 60 721-3-3, class 3M4

Ambient conditions	
Degree of protection	IP 20 to EN 60 529
Protection class	Class I (with protective conductor system) and Class III (PELV) to EN 61 800-5-1
Type of cooling	Internal ventilator, power sections with increased air cooling by in-built fans
Permissible ambient and coolant temperature (air) during operation for line-side components, line modules and motor modules	0 °C to 40 °C without derating, >40 °C to +55 °C see derating characteristics
Permissible ambient and coolant temperature (air) during operation for control units, additional system components, DC link components and sensor modules	0 °C to +55 °C

Climatic ambient conditions • Storage • Transportation • Operation	Class 1K3 to EN 60 721-3-1 Temperature -25 °C to +55 °C Class 2K4 to EN 60 721-3-3 Temperature -40 °C to +70 °C Max. humidity 95 % at 40 °C Class 3K3 to EN 60 721-3-3 Relative air humidity 5 to 65 % annual average, ≤ 80 % above the maximum for 2 months a year. Avoid splashing water and do not allow condensation or ice to form (EN 60 204, Part 1)
Environmental class/harmful chemical substances • Storage • Transportation • Operation	Class 1C2 to EN 60 721-3-1 Class 2C2 to EN 60 721-3-2 Class 3C2 to EN 60 721-3-3
Organic/biological influences • Storage • Transportation • Operation	Class 1B1 to EN 60 721-3-1 Class 2B1 to EN 60 721-3-2 Class 3B1 to EN 60 721-3-3
Degree of contamination	2 to EN 60 664-1
Installation altitude	Up to 1,000 m above sea level without derating, >1,000 m to 5,000 m above sea level see derating characteristics

Approbation	
Certification	CE (low-voltage and EMC Directives), cULus (file nos.: E192450, E164110 and E70122)
Safety Integrated – safe standstill (SH) and safe brake control (SBC)	Safety Integrity Level (SIL) 2 to IEC 61508, control category 3 to EN 954-1

Modules	
Line modules in booksize format • Rated supply voltage	3AC 380 V
Active line modules in booksize format • Rated pulse frequency	8 kHz
Motor modules in booksize format • DC link connection voltage • Rated pulse frequency	510 V DC to 750 V DC 4 kHz

Line Connection Booksize

2.1 Introduction

The line connection for a SINAMICS booksize drive line-up comprises the following components:

- A line filter (optional)
- A line reactor

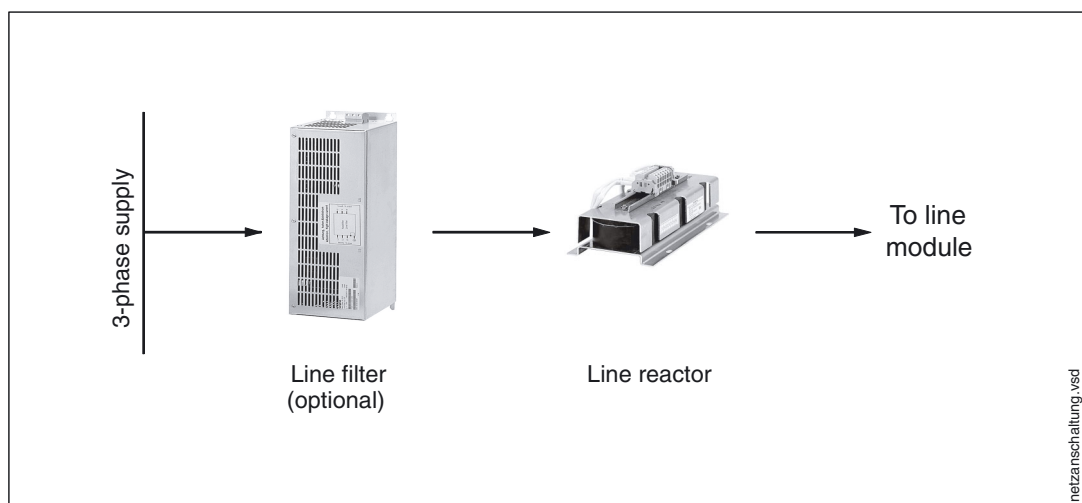


Figure 2-1 Overview diagram: Line connection

Note

The limit values for the radio interference voltage are only observed when the filter is used.

2.2 Line connection variations

2.2.1 Methods of line connection

A distinction is made between:

- Direct operation of the line connection components on the supply
- Operation of the Line Connection Components via an Autotransformer
- Operation of the Line Connection Components via an Isolating Transformer

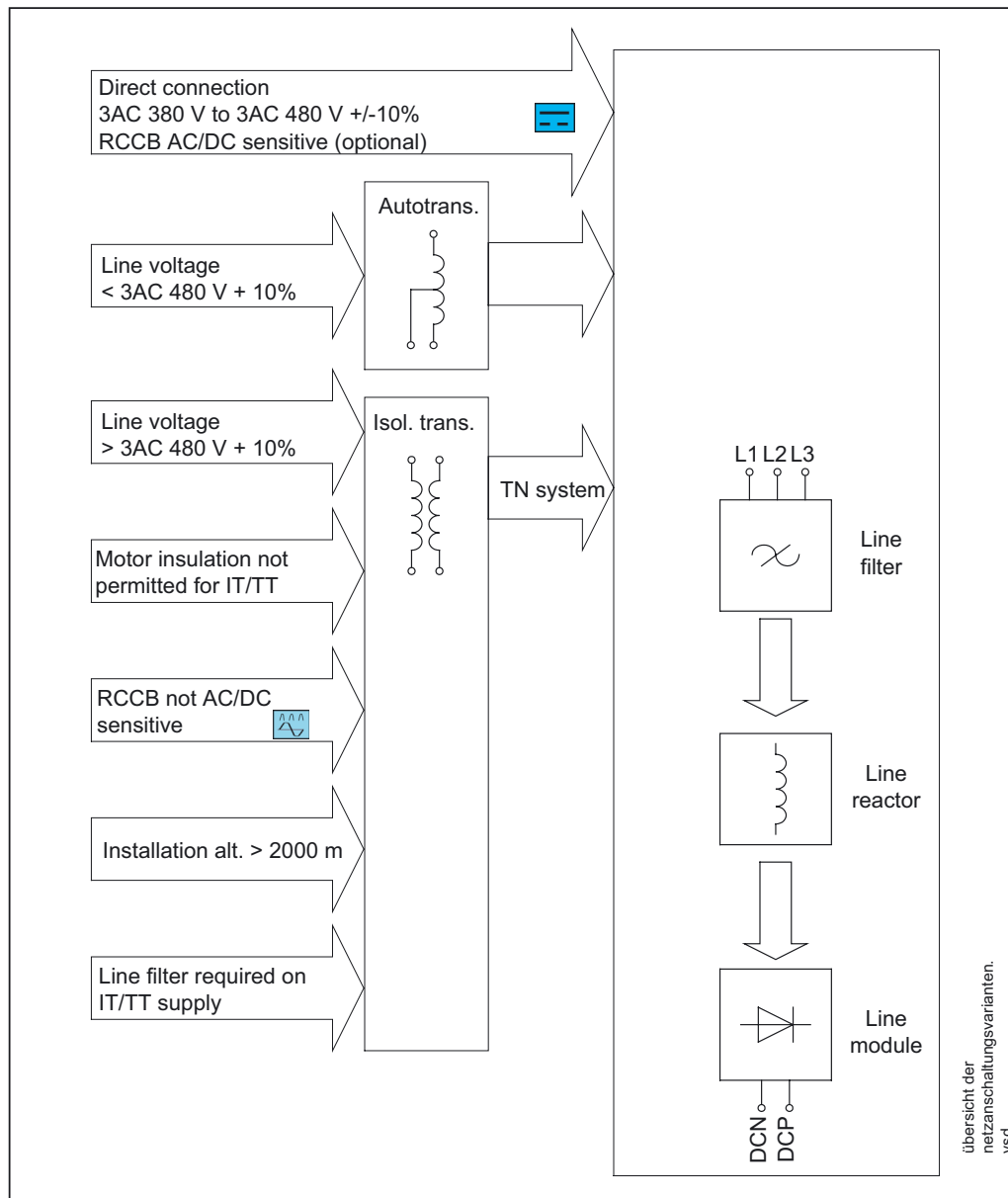


Figure 2-2 Overview of line connection variants

2.2.2 Operation of the line connection components on the supply network

The SINAMICS S booksize drive system is rated for direct operation on TN, TT, and IT supply systems with a nominal voltage of 3AC 380 V to 3AC 480 V. Operation with a line filter is only permitted for a TN supply system.

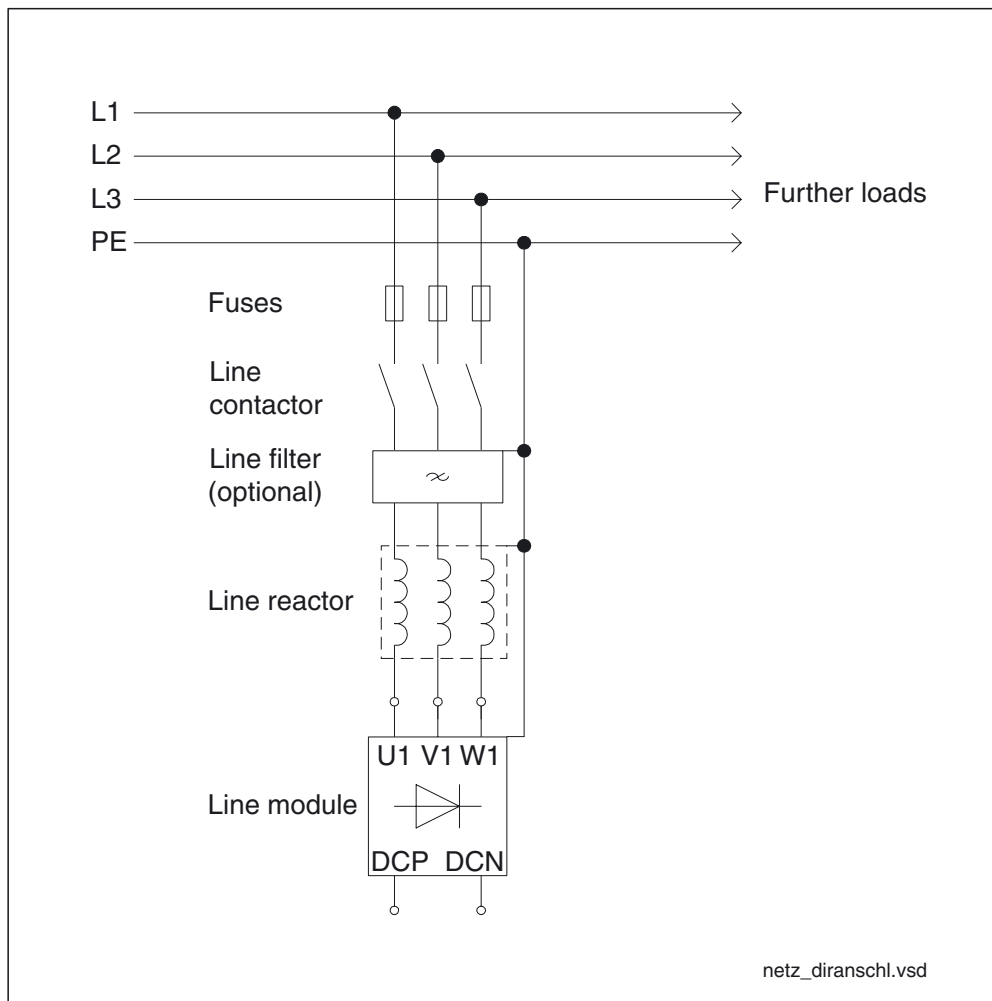


Figure 2-3 Direct operation on the supply network

2.2.3 Operation of the line connection components via an autotransformer

An autotransformer can be used for voltage adaptation in the range up to 480 V 3AC +10%.

Applications:

- The motor insulation must be protected from excessive voltages.
- The active line module must provide a stabilized DC link voltage. It can be in the range 380 V to 415 V.

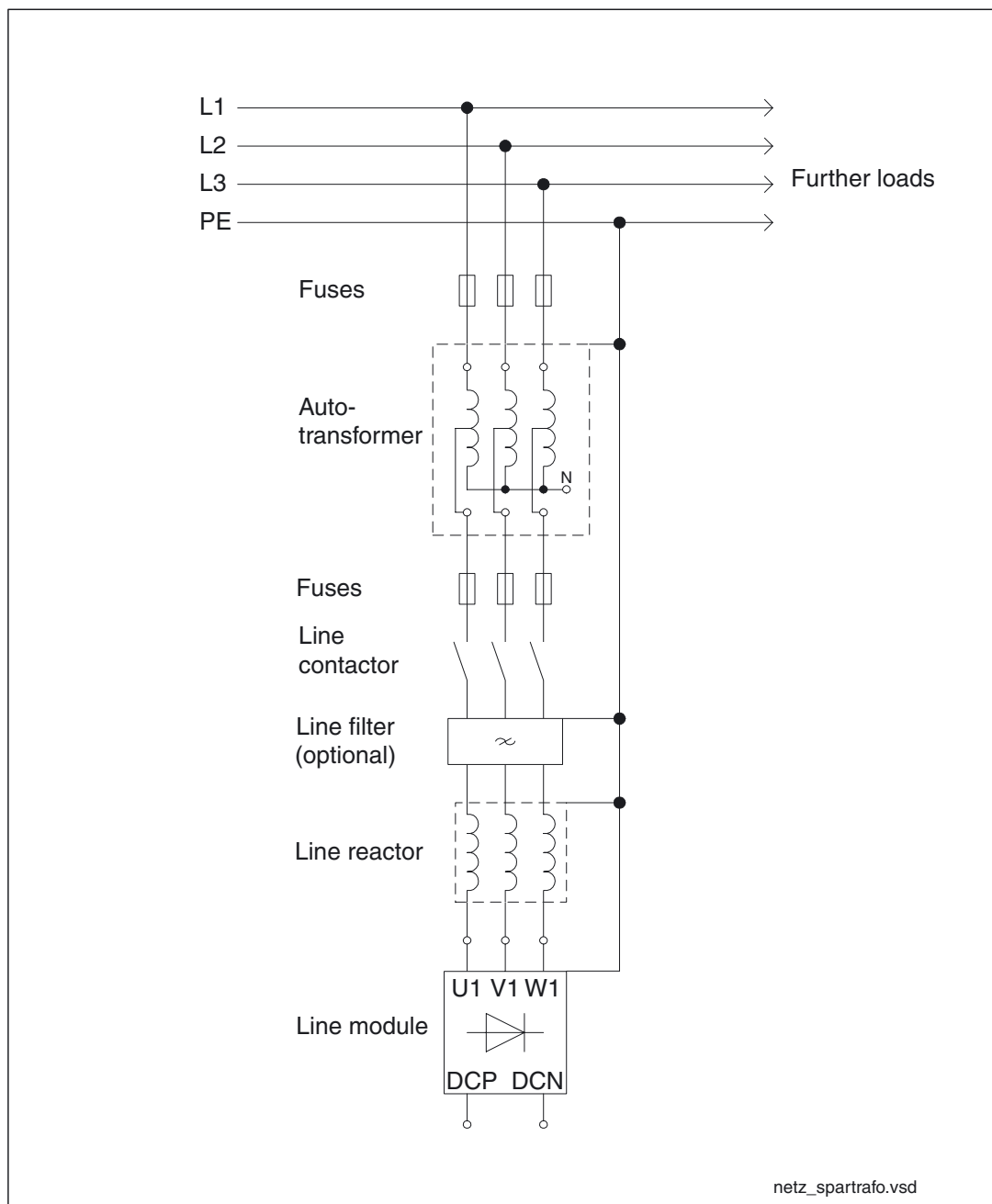


Figure 2-4 Autotransformer

2.2.4 Operation of the line connection components via an isolating transformer

The isolating transformer converts the network configuration of the system (e.g. IT/TT system) to a TN system. Additional voltage adaptation to the permissible voltage tolerance range is possible.

An isolating transformer must be used in the following cases:

- The line voltage is higher than 480 V 3AC + 10%. The voltage must be reduced to a permissible line connection voltage via an isolating transformer with a suitable transformation ratio.
- The motors are not approved for use in IT/TT systems.
- A residual-current circuit-breaker is required.
- The installation altitude is higher than 2000 m.
- A line filter is envisaged in an IT/TT system.

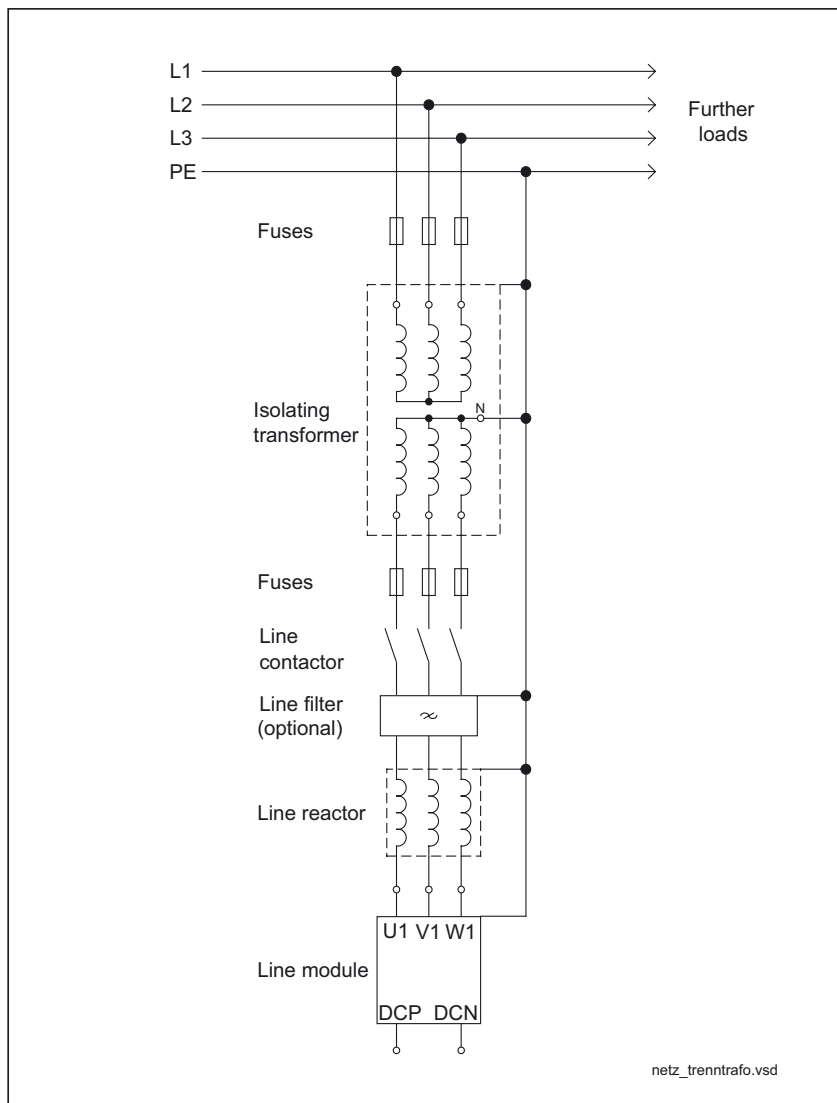


Figure 2-5 Isolating transformer

2.2.5 Line connection via a ground-fault circuit interrupter

In addition to protection measures against hazardous shock current (e.g. overcurrent trip), selectively tripping AC/DC-sensitive residual-current circuit-breakers can be used.

Note

A direct connection to a power system with selectively tripping AC/DC-sensitive residual-current circuit-breakers is only possible with the 5 kW, 10 kW, 16 kW and 36 kW line modules.

Selectively tripping AC/DC-sensitive residual-current circuit-breakers can be used without restriction as a protective measure against hazardous shock currents.

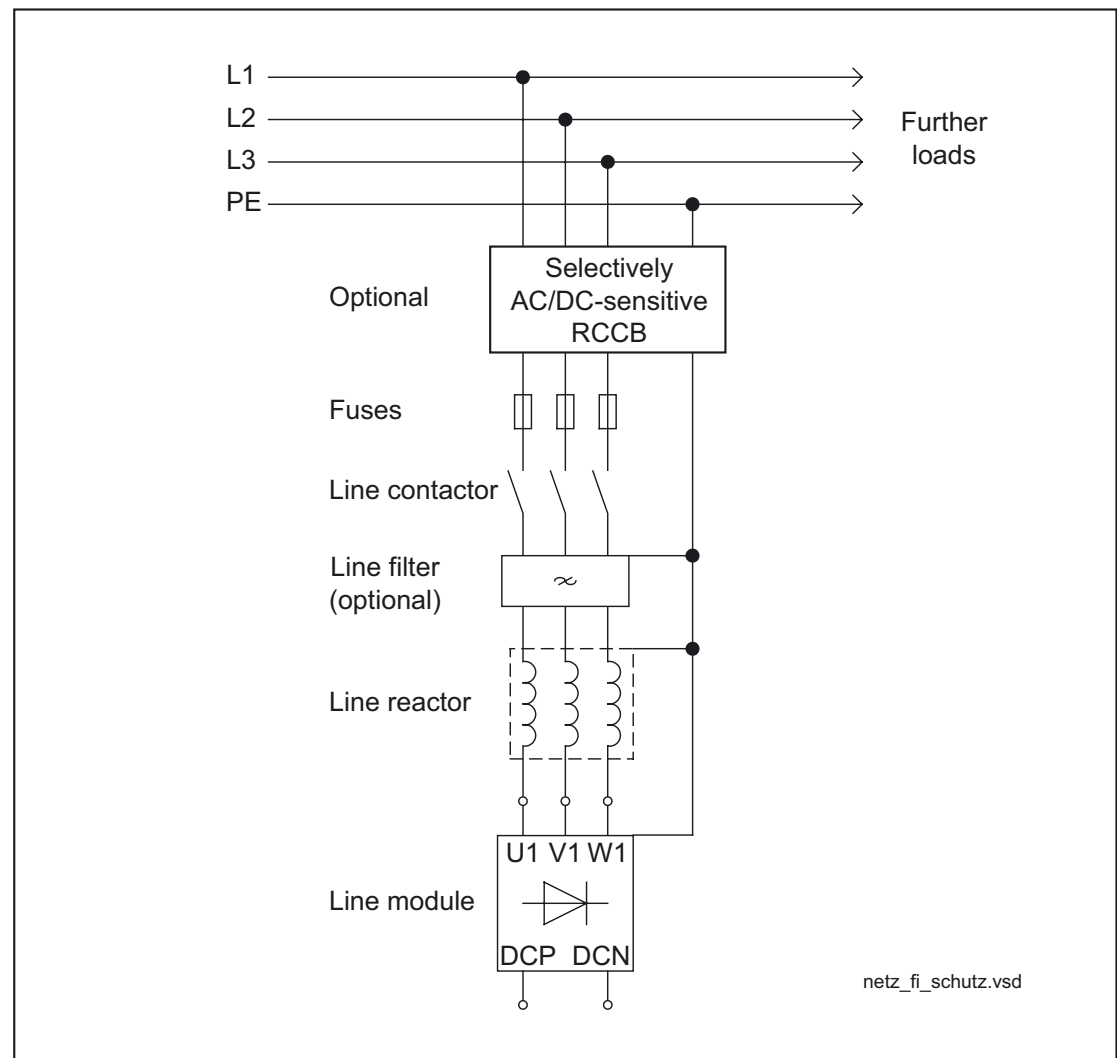


Figure 2-6 Residual-current circuit-breaker (RCCB)

Please note the following

- Only the use of a delayed-tripping (selective) AC/DC-sensitive RCCB is permitted.
- The maximum permissible ground resistance of the "selective protection device" must be observed (max. 83 Ω for residual-current circuit-breakers with a rated differential current of 0.3 A).
- Parts of the electrical equipment and machine that can be touched are integrated in a protective grounding system.
- The total length of the shielded power cables used in the drive line-up (motor cable incl. line supply cables from line filters to line feed terminals) must be less than 350 m.
- Only recommended line filters must be used during operation.
- Only one residual-current circuit-breaker may be connected in series (cascading is not possible).
- Switching elements (main circuit-breakers, contactors) for connecting and disconnecting the drive line-up must feature a max. 35 ms delay time between closing and opening individual main contacts.

Recommendation

SIEMENS selectively switching AC/DC-sensitive residual-current circuit-breakers to EN 50178, type 5SZ (e.g. 5SZ6 468–0KG00 or 5SZ6468–0KG30 with auxiliary disconnecter (1NC/1NO) for rated current 63 A, rated fault current 0.3 A) (see also catalog CA01).

Notice

AC or pulse-sensitive RCCBs are not suitable.

2.3 Line filters

2.3.1 Description

Line filters limit the conducted interference emitted by the converter units to permissible values for industry.

2.3.2 Safety information



Caution

Line filters are only suitable for direct connection to TN systems.



Danger

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

Caution

The terminals must be correctly connected:

Incoming line cable to LINE/NETZ L1, L2, L3

Outgoing cable to the reactor to LOAD/LAST U, V, W.

Non-observance may damage the line filter.

Caution

The line filters listed conduct a high leakage current via the PE conductor. Because of the high leakage current of the line filters, a permanent PE connection of the line filter or switching cabinet is required.

Measures according to EN 50178/94 Part 5.3.2.1 must be taken, e.g. PE conductor ($\geq 10 \text{ mm}^2 \text{ Cu}$) or laying of a second conductor, electrically parallel to the PE conductor, via separate terminals. This conductor must also fully meet the requirements for PE conductors according to IEC 364-5-543.

Note

If a high-potential test is conducted with alternating voltage in the system, the line filter must be disconnected to obtain correct measurement results.

Caution

Only the line filters listed in Catalog NC Z must be used. Other line filters can lead to line harmonics that can interfere with or damage other loads powered from the network.

2.3.3 Interface description

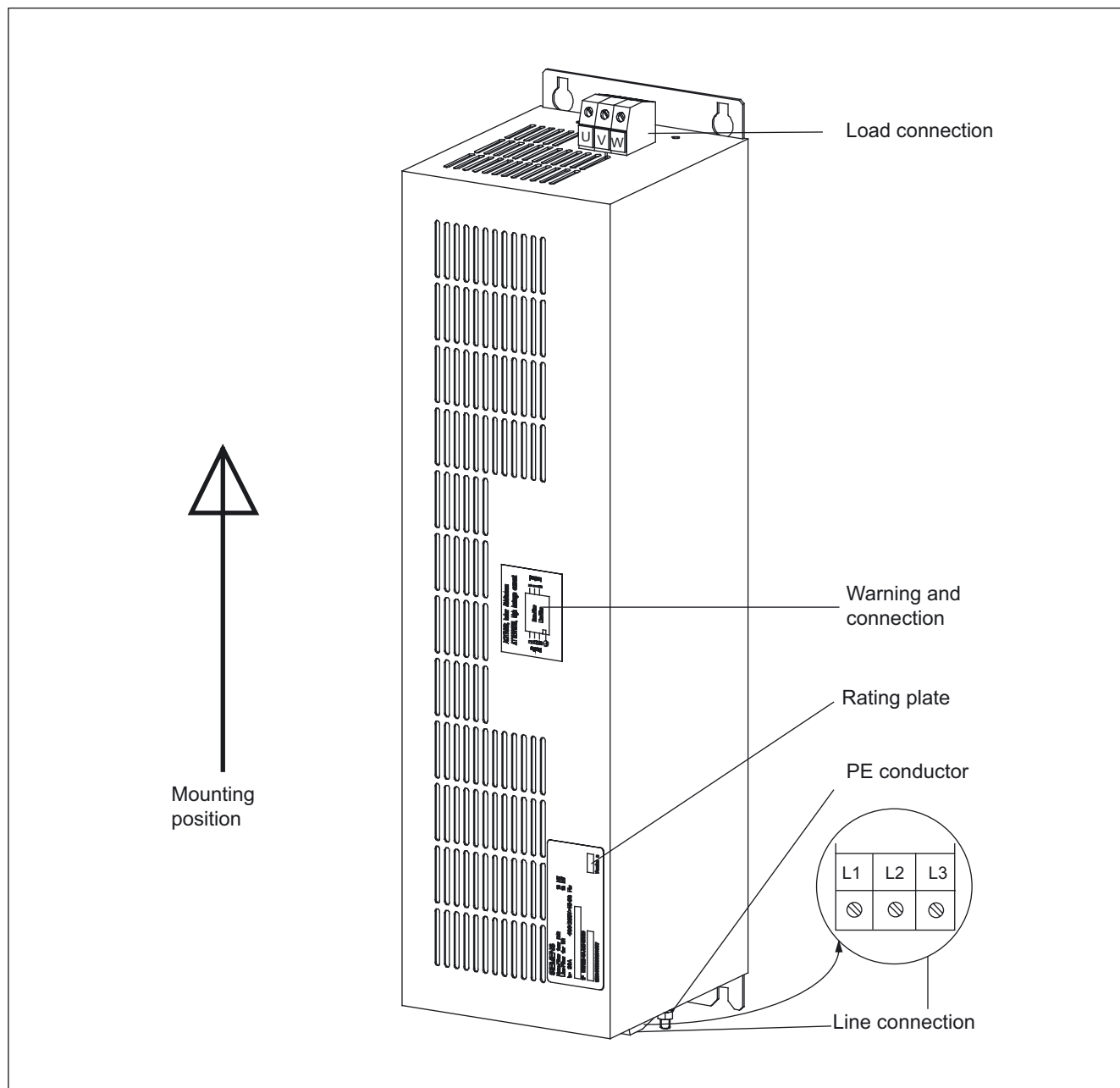


Figure 2-7 Line filter (example: 16 kW)

2.3 Line filters

Line/load connection

The line filter is rated for a voltage range from 380 V 3AC -10% to 480 V 3AC +10% (-15% <1 min) at 47 Hz to 63 Hz

Table 2-1 Type of connection

Terminals	Designations
Line connection (line)	L1, L2, L3, PE
Load connection (load)	U, V, W
Line filters for active line modules	
16 kW	Screw terminal: 10 mm ² 3-pin/1.5 Nm (see Connection methods) Ground stud: M5/3 Nm ¹⁾ Rated current: 30 A
36 and 55 kW	Screw terminal: 50 mm ² 3-pin/6 Nm (see Connection methods) Ground stud: M8/13 Nm ¹⁾ Rated current (36 kW): 67 A Rated current (55 kW): 103 A
80 kW	Screw terminal: 95 mm ² 3-pin/15 Nm (see Connection methods) Ground stud: M8/13 Nm ¹⁾ Rated current: 150 A
120 kW	Connection strap: d = 11 mm (M10/25 Nm) Ground stud: M8/13 Nm ¹⁾ Rated current: 225 A
Line filters for smart line modules	
5 kW	Screw terminal: 10 mm ² 3-pin/1.5 Nm (see Connection methods) Ground stud: M6/4.8 Nm ¹⁾ Rated current: 12 A
10 kW	Screw terminal: 10 mm ² 3-pin/1.5 Nm (see Connection methods) Ground stud: M6/4.8 Nm ¹⁾ Rated current: 24 A
1) For ring cable lugs to DIN 46234	

2.3.4 Dimension drawing

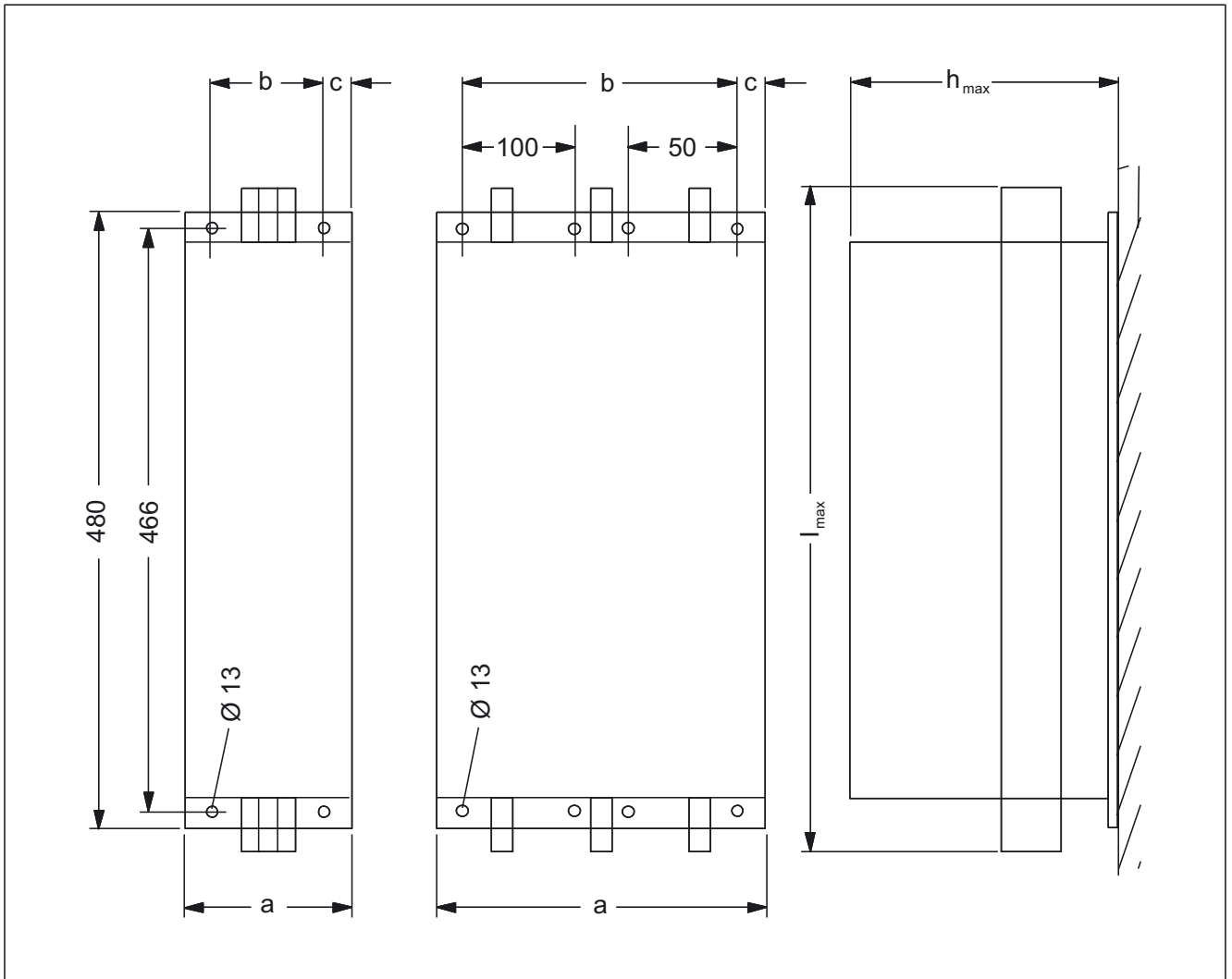


Figure 2-8 Dimension drawings: Line filter

Table 2-2 Dimensions of line filter

For active line module	Order number: 6SL3000-	a [mm]	w [mm]	c [mm]	h _{max} [mm]	l _{max} [mm]
16 kW	0BE-21-6AAx	130	100	15	150	489
36 kW	0BE-23-6AAx	130	100	15	245	526
55 kW	0BE-25-5AAx	130	100	15	260	526
80 kW	0BE-28-0AAx	200	150	25	260	539
120 kW	0BE-31-2AAx	300	250	25	260	530

Table 2-3 Dimensions of line filter

For smart line module	Order number: 6SL3000-	a [mm]	w [mm]	c [mm]	h _{max} [mm]	l _{max} [mm]
5 kW	0BE-15-0AAx	60	35	12.5	122	285
10 kW	0BE-21-0AAx	60	35	12.5	122	285

2.3.5 Technical specification

Table 2-4 Technical specifications of line filters for the active line module

	6SL3000-unit	0BE21-6AA0	0BE23-6AA0	0BE25-5AA0	0BE28-0AA0	0BE31-2AA0
Connection voltages: Supply voltage Line frequency	V _{AC} Hz	3AC 380 -10% to 3AC 480 +10% (-15% < 1 min) 47 to 63 Hz				
Rated current	A _{AC}	30	67	103	150	225
Power loss	W	170	250	350	450	590
Weight	kg	9	16	19	22	32

Table 2-5 Technical specifications of line filters for the smart line module

	6SL3000-unit	0BE15-0AA0	0BE21-0AA0
Supply voltage	V	480	480
Rated current	A	12	24
Weight	kg	2	2.4

2.4 Line reactors

2.4.1 Description

Line reactors limit low-frequency line harmonics to permissible values. In conjunction with active line modules, they are also used to store energy.

2.4.2 Safety information

Caution

The 100 mm clearances above and below the components must be observed.

Note

The connection lines to the line module must be kept as short as possible (max. 5 m).

Caution

Only the line filters listed in Catalog NC Z must be used.

Using line reactors not approved by SIEMENS for SINAMICS 6SL31:

- Can damage/destroy line modules.
 - Cause line reactions that can damage or destroy other loads powered from the same network.
-



Caution

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

2.4.3 Interface description

The line reactor is rated for a voltage range from 380 V 3AC -10% to 480 V 3AC +10% at 47 Hz to 63 Hz.

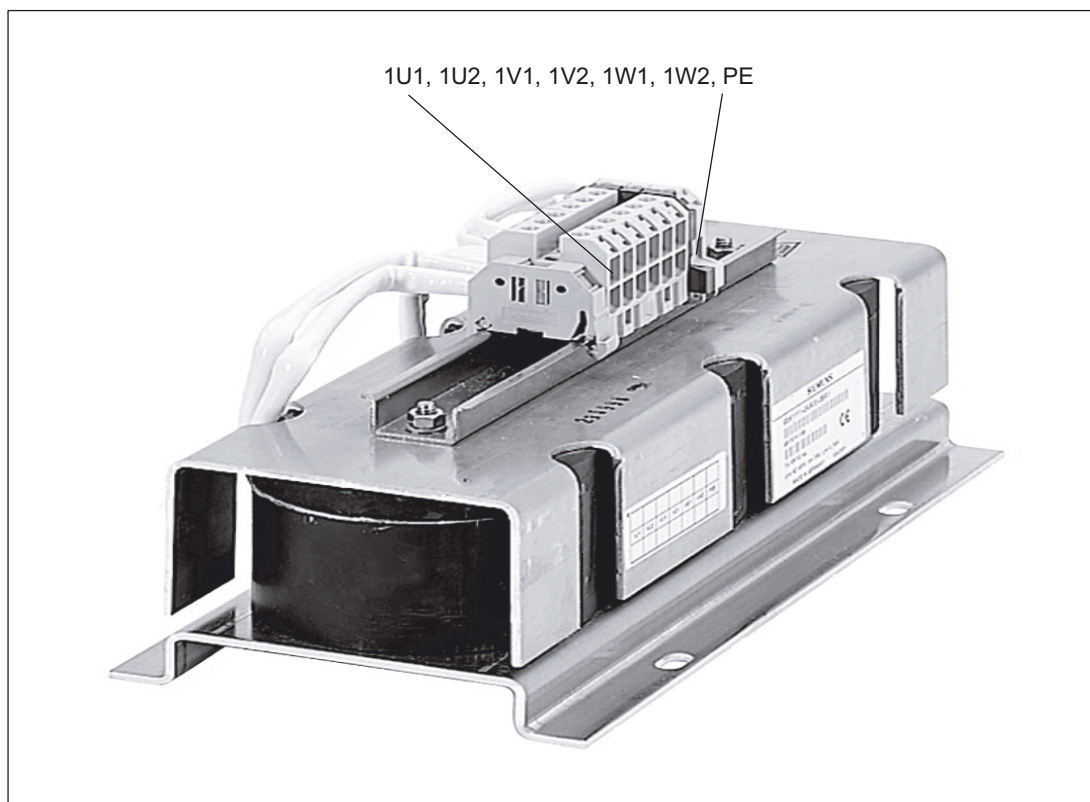


Figure 2-9 Line reactor (example: 16 kW)

Line/load connection

Table 2-6 Connection methods for line reactor

Terminals	Designations
Line connection	1U1, 1V1, 1W1, PE
Load connection	1U2, 1V2, 1W2
Line reactors for active line modules	
16 kW	Screw terminal 16 mm ² 3-pin / 6 Nm*
36 kW	Screw terminal 35 mm ² 3-pin / 6 Nm*
55 kW	Screw terminal 70 mm ² 3-pin / 6 Nm*
80 kW	Connection strap d = 9 mm ² (M10/25 Nm) for ring cable lugs to DIN 46234
120 kW	Connection strap d = 10 mm ² (M10/25 Nm) for ring cable lugs to DIN 46234
Line reactors for smart line modules	
5 kW	Screw terminal 4 mm ² 3-pin*
10 kW	Screw terminal 10 mm ² 3-pin*

* see Connection methods

2.4.4 Dimension drawing

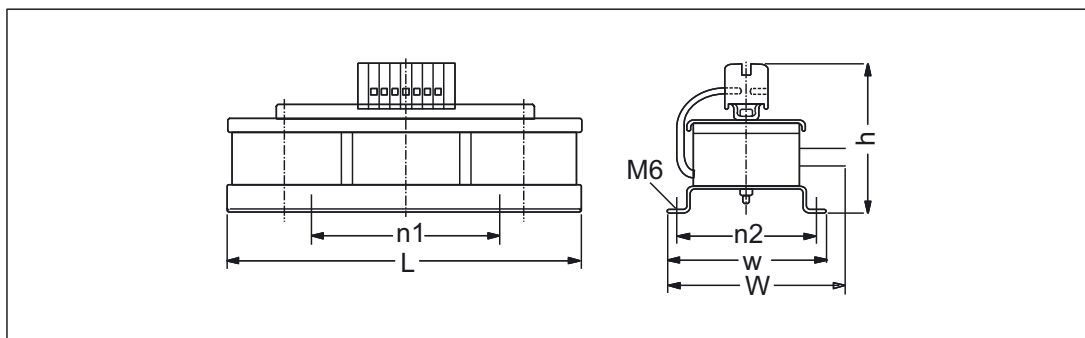


Figure 2-10 Dimension drawing of line reactor

Table 2-7 Dimensions of line reactor

For active line module	Order number 6SN1111-	L [mm]	W [mm]	h [mm]	w [mm]	n1 [mm] ¹⁾	n2 [mm] ¹⁾
16 kW	0AA00-0BA1	330	150	145	150	175	136
36 kW	0AA00-0CA1	330	150	230	150	175	136
55 kW	0AA00-0DA1	330	150	280	150	175	136
80 kW	0AA00-1EA0	380	225	200	170	325	156
120 kW	0AA00-1FA0	380	225	300	170	325	156

1) Dimensions n1 and n2 correspond to the drill hole spacing

Table 2-8 Dimensions of line reactor

For smart line module	Order number 6SL3000-	L [mm]	W [mm]	h [mm]	w [mm]	n1 [mm] ¹⁾	n2 [mm] ¹⁾
5 kW	0CE-15-0AA0	150	90	170	90	113	50
10 kW	0CE-21-0AA0	180	110	197	110	135	67

1) Dimensions n1 and n2 correspond to the drill hole spacing

2.4.5 Technical specifications

Table 2-9 Technical specifications of line reactors for the active line module

	6SN1111-0AA00- Unit	0BA1	0CA1	0DA1	1EA0	1FA0
Output	kW	16	36	55	80	120
Voltage drop/phase	V _{AC}	8.6	12.3	12.3	11.1	15.2
Rated current	A _{rms}	30	67	103	150	225
Phase inductance	mH	0.7	0.4	0.27	0.23	0.2
Power loss	See: Power Loss of Components in Rated Operation					
Weight	[kg]	8.5	13	18	40	50

Table 2-10 Technical specifications of line reactors for the smart line module

	6SL3000- unit	0CE15-0AA0	0CE21-0AA0
Output	kW	5	10
Rated current	A _{rms}	14	28
Phase inductance	mH	2.3	1.3
Power loss	See: Power Loss of Components in Rated Operation		
Weight	kg	3.7	7.5

Line Modules Booksize

3.1 Introduction

Line modules generate a DC voltage that is used to power the motor modules from the connected supply voltage.

General characteristics of the line modules

- Connection voltage 380 V 3AC -10% to 480 V 3AC +10% (-15% <1 min) (47 to 63 Hz)
- Suitable for TN, TT, and IT supply systems
- 100% regenerative feedback capability
- Integrated DC link and 24 V DC busbar connection
- Operating status and error status via LEDs

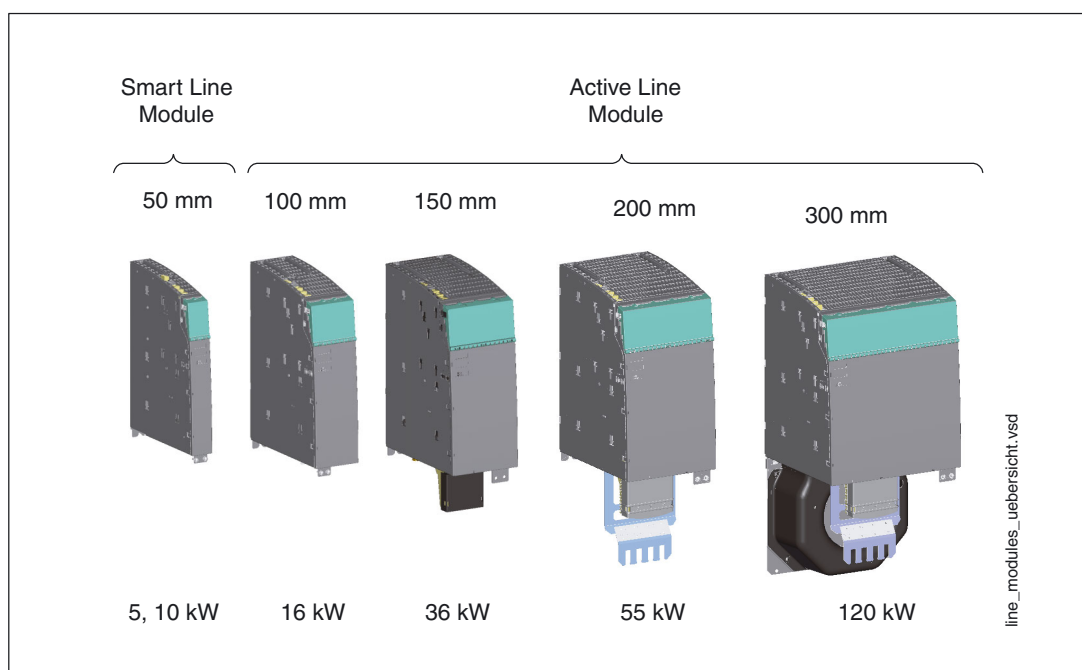


Figure 3-1 Overview of line modules

Characteristics of the active line modules

- Regulated DC link voltage via controlled rectifier
- Regulated regenerative feedback capability
- Operation without effect on supply system due to reduced line harmonics

Characteristics of the smart line modules

- Unregulated DC link voltage via uncontrolled rectifier
- Regenerative feedback capability
- "Ready" and "Reset" terminals available

3.2 Active line modules booksize internal air cooling

3.2.1 Description

The motor modules are connected to the power supply network via the active line modules which provide the motor modules with a constant DC link voltage. This ensures that they are not influenced by network fluctuations. The regenerative feedback capability of the modules can be deactivated by parameterization.

The active line modules are suitable for direct operation on TN, IT, and TT systems.

When the motors are in feedback mode, active line modules supply power back to the network.

The ratio of line short-circuit power to rated power must be ≥ 70 .

3.2.2 Safety information



Warning

After disconnecting all the supply voltages, a hazardous voltage will be present in all components for another 5 minutes. The protective cover must not be opened until this time has elapsed.

The DC link protective cover must be released using an insulated screwdriver.

Caution

The DC link discharge time hazard warning must be affixed to the modules in the local language.

A set of labels in 12 languages is available using order number: 6SL3166-3AB00-0AAx.

Notice

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

For the 80 kW and 120 kW active line modules, a ventilation clearance of 50 mm must be observed in front of the fan.

Caution

The tightening torque of the DC link busbar screws (1.8 Nm) must be checked before startup.

In a supply system without regenerative feedback capability (e.g. diesel generator), the regenerative feedback capability of the active line module must be deactivated via a parameter (see Description of Functions). The braking energy must then be dissipated via an additional braking module with a braking resistor in the drive line-up.

Caution

The total length of the power cables (motor supply cables and DC link cables) must not exceed 350 m in sinusoidal current mode.

3.2.3 Interface description

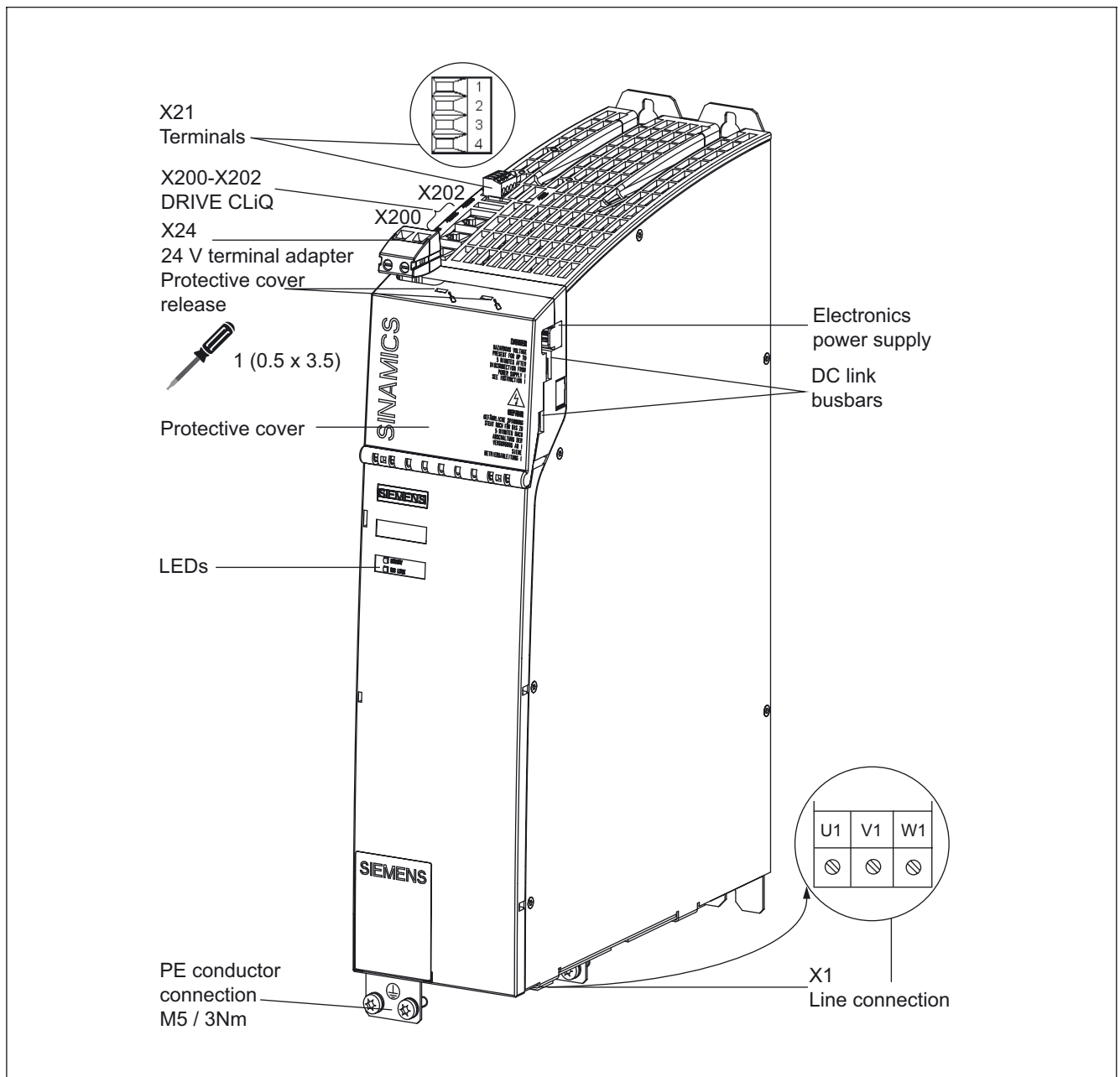


Figure 3-2 Active line module (example: 16 kW)

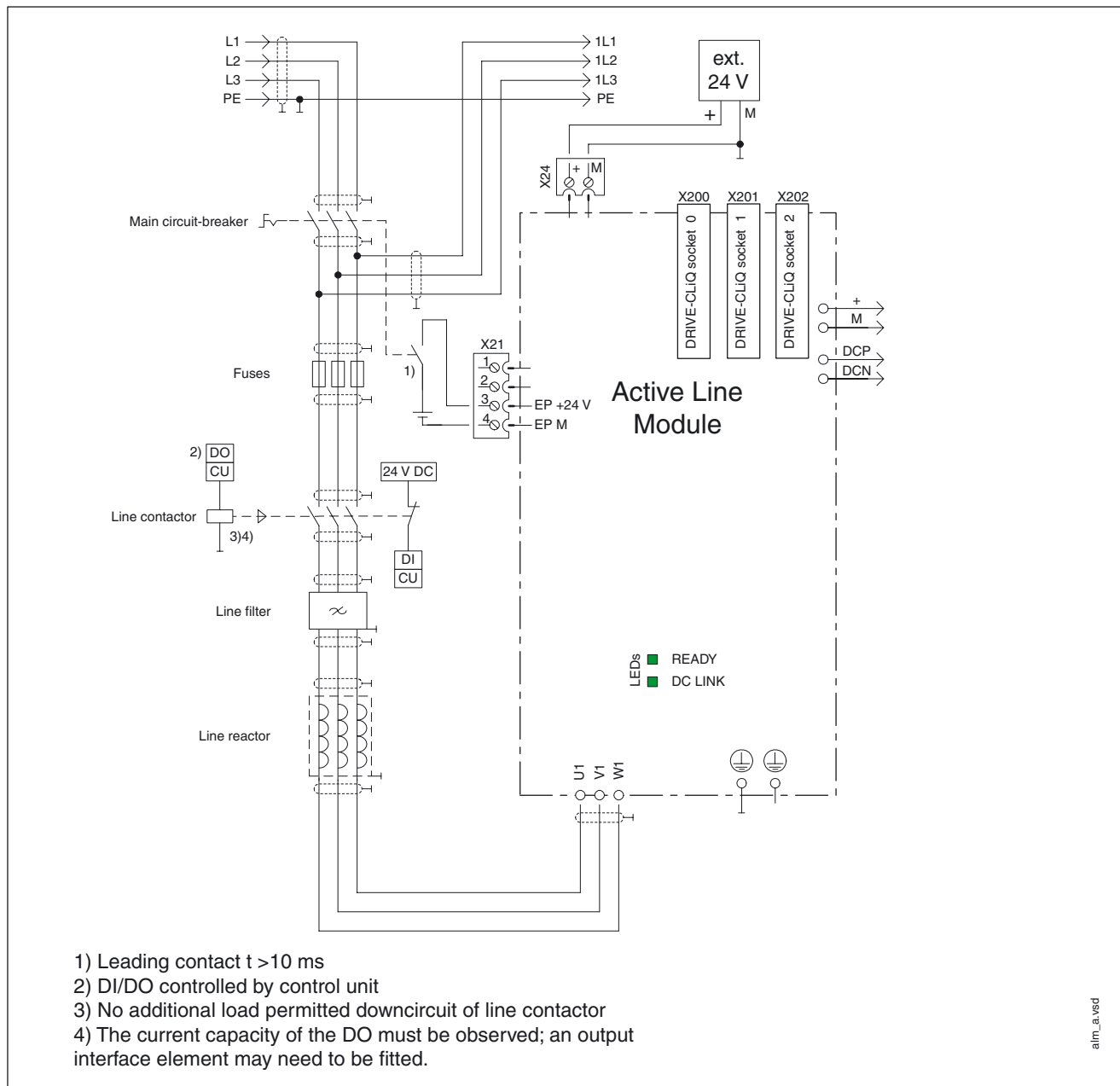


Figure 3-3 Example connection of active line module

Line connection

The active line module is rated for the voltage range 3AC 380 V -10% to 3AC 480 V +10% (-15% < 1min) at 47 Hz to 63 Hz.

Table 3-1 Connection methods active line module

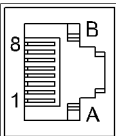
Terminals	Designations
Line connection	X1 (U1, V1, W1)
Active line modules	
16 kW	Screw terminal 10 mm ² 3-pin / 1.5 Nm ²⁾ Threaded hole for PE: M5/3 Nm ¹⁾
36 kW	Threaded bolt M6/6 Nm ¹⁾ Threaded hole for PE: M6/3 Nm ¹⁾
55 kW	Threaded bolt M8/13 Nm ¹⁾ Threaded hole for PE: M6/6 Nm ¹⁾
80 kW to 120 kW	Threaded bolt M8/13 Nm ¹⁾ Threaded hole for PE: M8/6 Nm ¹⁾

1) For ring cable lugs to DIN 46234

2) See Connection methods

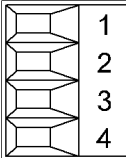
X200-X202 DRIVE-CLiQ interfaces

Table 3-2 DRIVE-CLiQ interface X200-X202

	PIN	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 V power supply
	B	GND (0 V)	Electronic ground
Blanking plate for DRIVE-CLiQ interface: Molex, order number: 85999-3255			

EP terminals X21

Table 3-3 Terminal block X21

	Terminal	Designation	Technical specifications
	1	Reserved, do not use	
	2	Reserved, do not use	
	3	EP +24 V (Enable Pulses)	Voltage 24 V DC Current consumption: 10 mA Signal propagation times: L → H: 100 μs H → L: 1000 μs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm² Type: Screw terminal 1 (see Connection methods)			

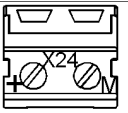
Note

For operation, 24 V DC must be connected to terminal 3 and ground to terminal 4. Upon removal, pulse inhibit is activated.

If the line module is not disconnected from the network, the DC link remains charged (e.g. a main contactor is not installed).

X24 24 V terminal adapter

Table 3-4 Terminal block X24

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

Meaning of the LEDs on the active line module

Table 3-5 Meaning of the LEDs on the active line module

LED	Color	State	Description
READY	-	OFF	Electronics power supply outside permissible tolerance range.
	Green	Continuous	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
	Orange	Continuous	DRIVE-CLiQ communication is being established.
	Red	Continuous	At least one fault is present in this component.
	Green Red	Flashing 2 Hz	The firmware is being downloaded. Component recognition via LED is activated (p0124).
DC LINK	-	OFF	Electronics power supply outside permissible tolerance range.
	Orange	Continuous	DC link voltage within permissible tolerance range (only when ready for operation).
	Red	Continuous	DC link voltage outside the permissible tolerance range (only when active line module is ready for operation).

Cause and rectification of faults

The following reference contains information about the cause and rectification of faults:

Reference: /IH1/ SINAMICS S120, Installation and Start-Up Manual

3.2.4 Dimension drawing

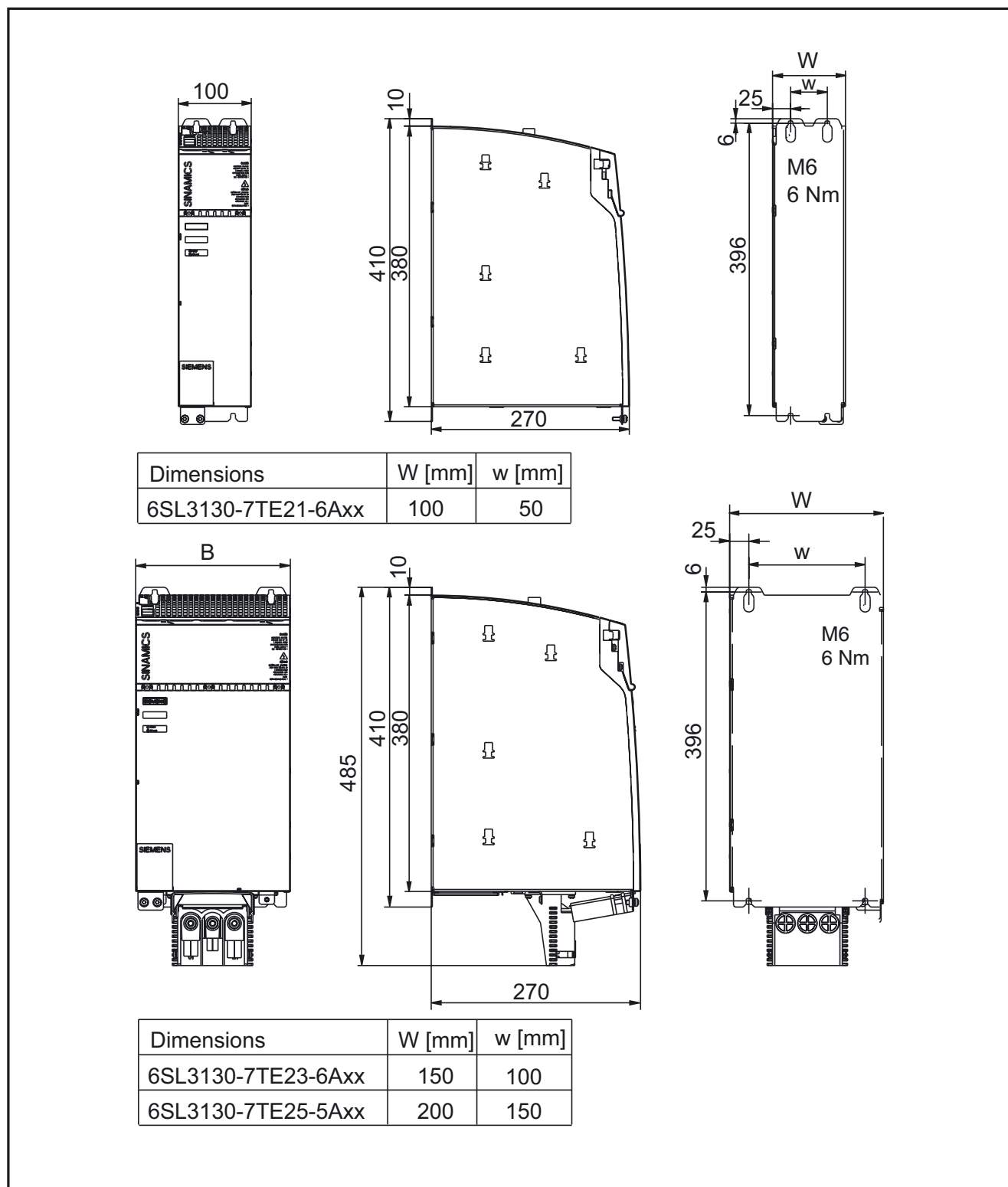


Figure 3-4 Dimension drawings of the active line modules 16 kW, 36 kW, and 55 kW

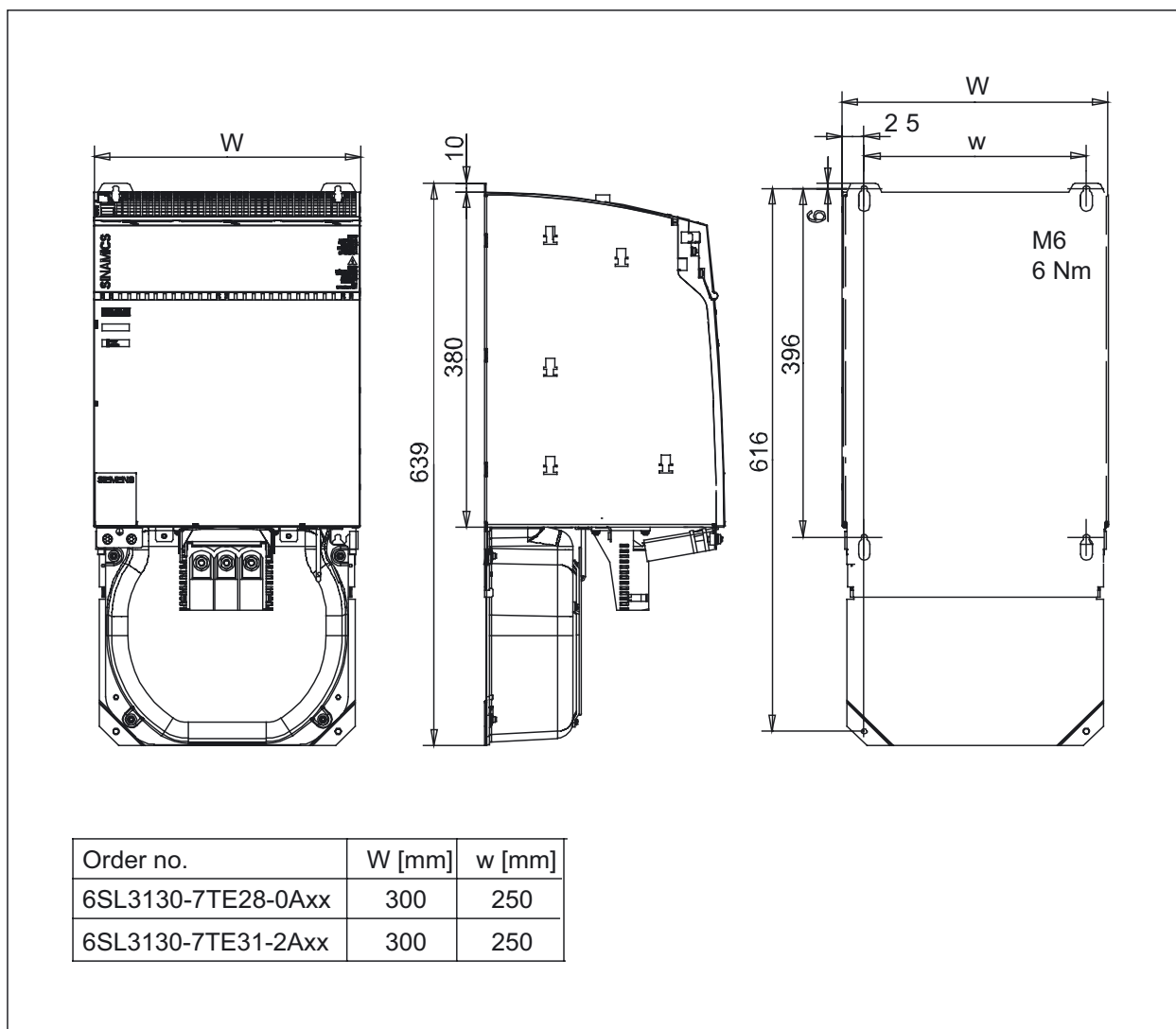


Figure 3-5 Dimension drawing of the active line modules 80 kW and 120 kW

3.2.5 Installation

Installing the fan on active line modules 80 kW and 120 kW

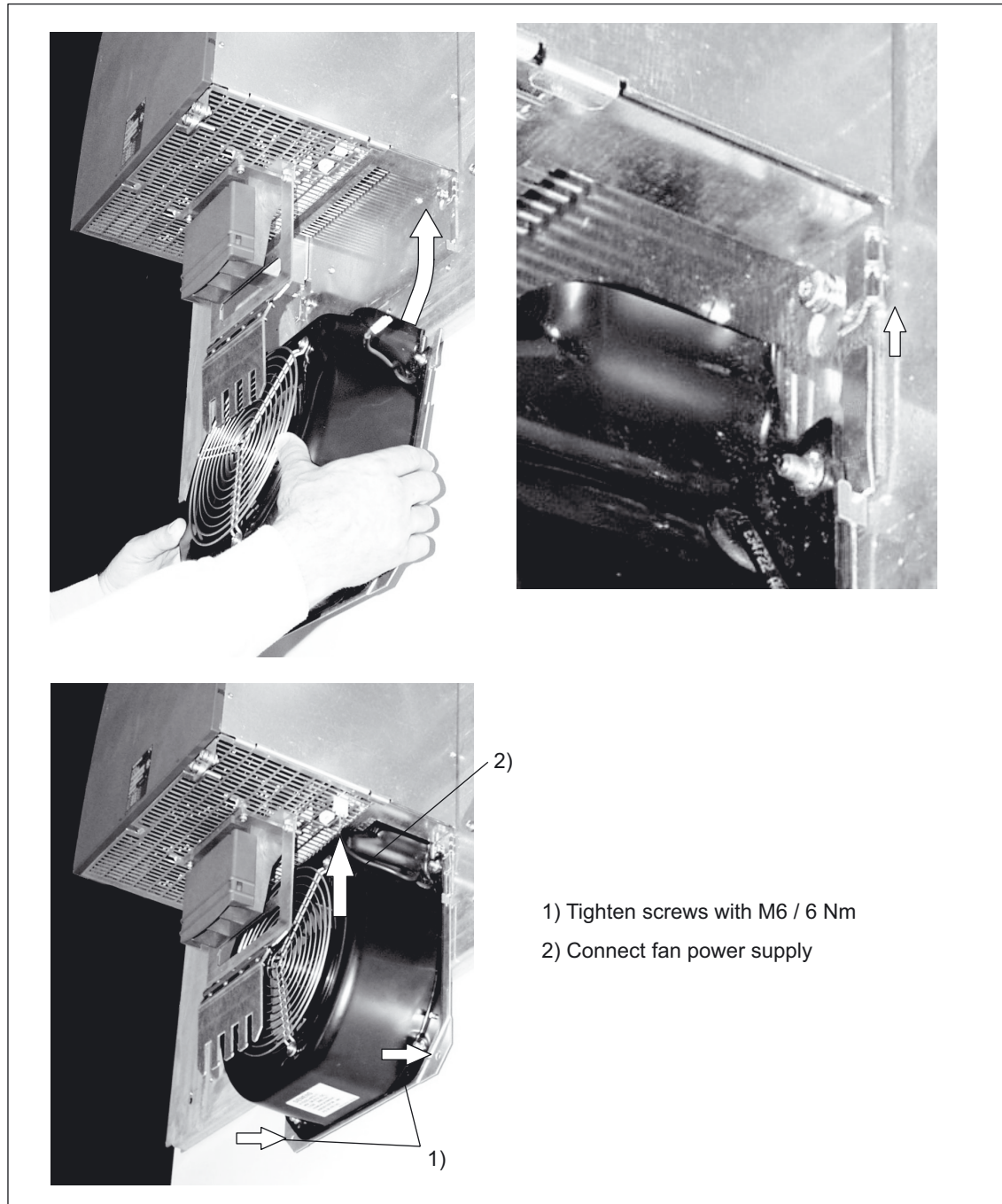


Figure 3-6 Installing the fan for 300 mm modules

3.2.6 Electrical connection

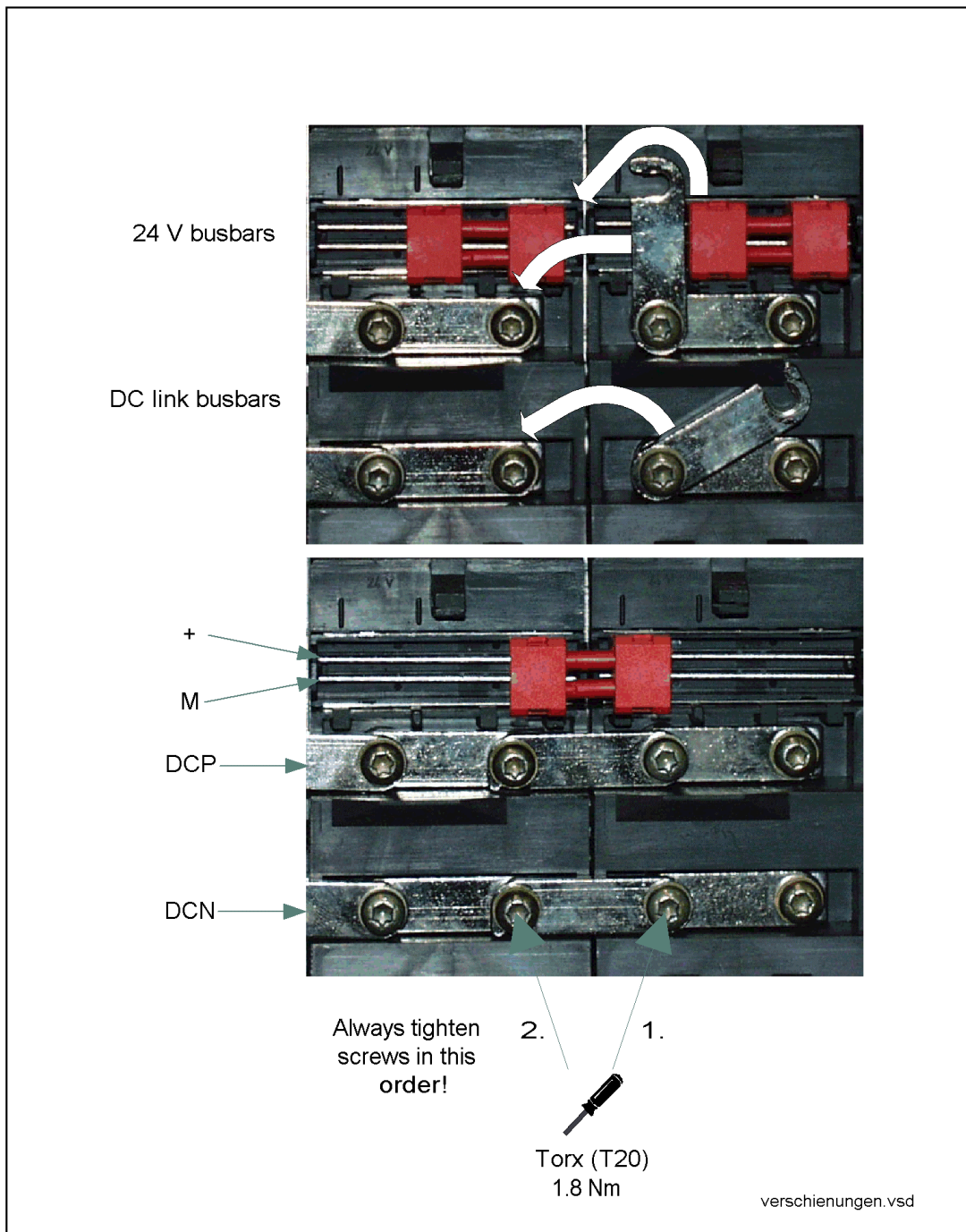


Figure 3-7 Busbar connections for booksize components

3.2 Active line modules booksize internal air cooling

3.2.7 Technical specifications

Table 3-6 Technical specifications of active line modules

Internal air cooling	6SL3130–	7TE21– 6AAx	7TE23– 6AAx	7TE25– 5AAx	7TE28–0AAx	7TE31–2AAx
Rated power	kW	16	36	55	80	120
Powers						
Supply voltages:						
Rated power (S1)*	kW (Pn)	16	36	55	80	120
power rating	kW (Ps6)	21	47	71	106	145
(S6-40%)						
Peak infeed power	kW (Pmax)	35	70	91	131	175
rating						
Regenerative feedback:						
Continuous feedback	kW	16	36	55	80	120
power rating						
Peak feedback	kW	35	70	91	131	175
power rating						
Connection voltages:		3AC 380 -10% to 3AC 480 +10% (-15% < 1 min) 47 to 63 Hz 24 (20.4 – 28.8)				
Line voltage	V _{Ac rms}					
Line frequency	Hz					
Electronics power	V _{DC}					
supply						
DC link	V _{DC}	510 - 750				
voltage						
Overvoltage tripping	V _{DC}	820 ± 2%				
Undervoltage	V _{DC}	360 ± 2%				
tripping						
Supply currents:						
At 380 V _{AC}	A _{AC}	26	58	88	128	192
At 480 V _{AC} /528 V _{AC}	A _{AC}	21 / 19	46 / 42	70 / 64	102 / 93	152 / 139
At 480 V; S6-40%	A _{AC}	27	60	92	134	201
Peak current	A _{AC}	54 / 45	107 / 89	139 / 116	200 / 166	267 / 222
(at 400 V _{AC} /480 V _{AC})						
Output currents at 600						
V _{DC} :						
Rated current	A _{DC}	27	60	92	134	200
at S6-40%	A _{DC}	35	79	121	176	244
Peak current	A _{DC}	59	117	152	218	292
DC link busbar current	A _{DC}	100	100	200	200	200
capacity						
24 V busbar	A _{DC}	20	20	20	20	20
current capacity						
Electronics current	A _{DC}	See Cabinet Design				
consumption						
Max. ambient temperature	°C	40	40	40	40	40
without derating						
Max. ambient temperature	°C	55	55	55	55	55
with derating						

Internal air cooling	6SL3130–	7TE21– 6AAx	7TE23– 6AAx	7TE25– 5AAx	7TE28–0AAx	7TE31–2AAx
Rated power	kW	16	36	55	80	120
DC link capacitance	μF	705	1 410	1 880	2 820	3 995
Charging limit	μF	20 000	20 000	20 000	20 000	20 000
Power factor	$\cos\phi$	1	1	1	1	1
Efficiency	η	0.95	0.95	0.95	0.95	0.95
Cooling method		Internal fan	Internal fan	Internal fan	Separate mounted fan	Separate mounted fan
Cooling air requirement	m^3/h	56	112	160	520	520
Sound pressure level	dB(A)	<60	<65	<60	<75	<75
Rated voltage for rated data 3 AC 380 V						
Weight	kg	7	10.3	17	23	23

*Values valid for 380 V and not 380 V – 10%.

Rated duty cycles of active line modules

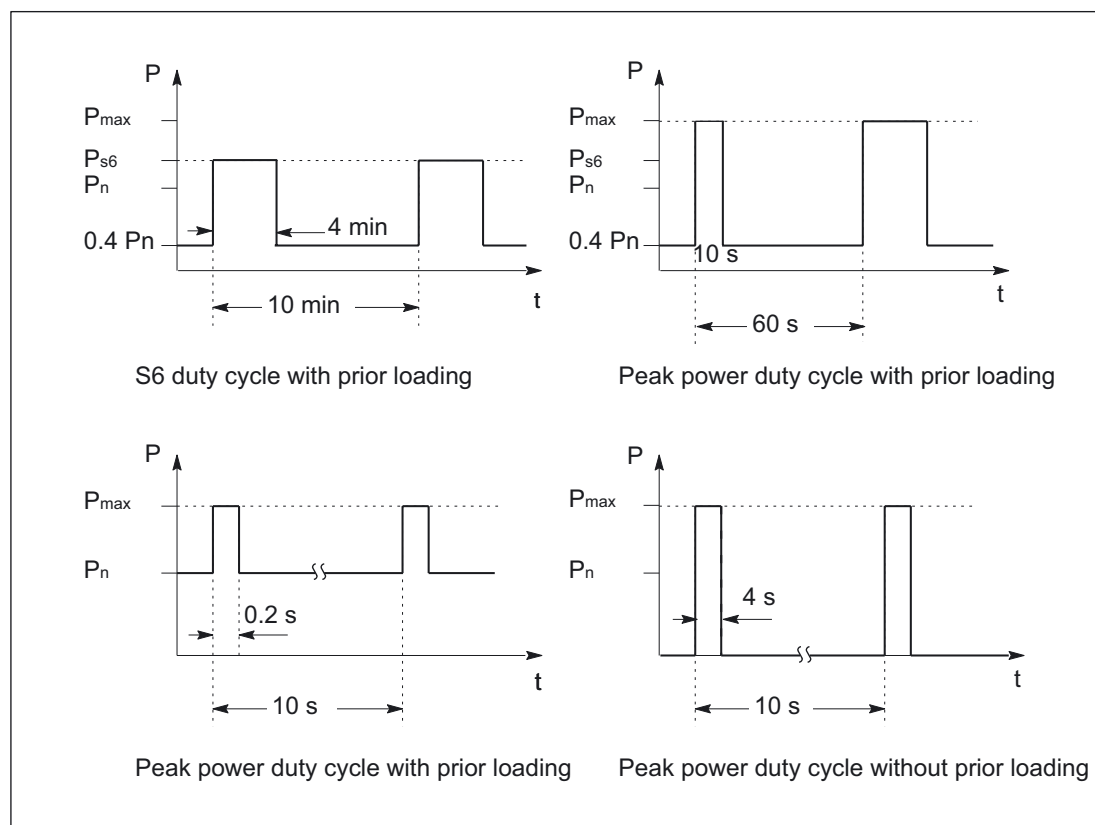


Figure 3-8 Rated duty cycles of active line modules

Derating as a function of the ambient temperature

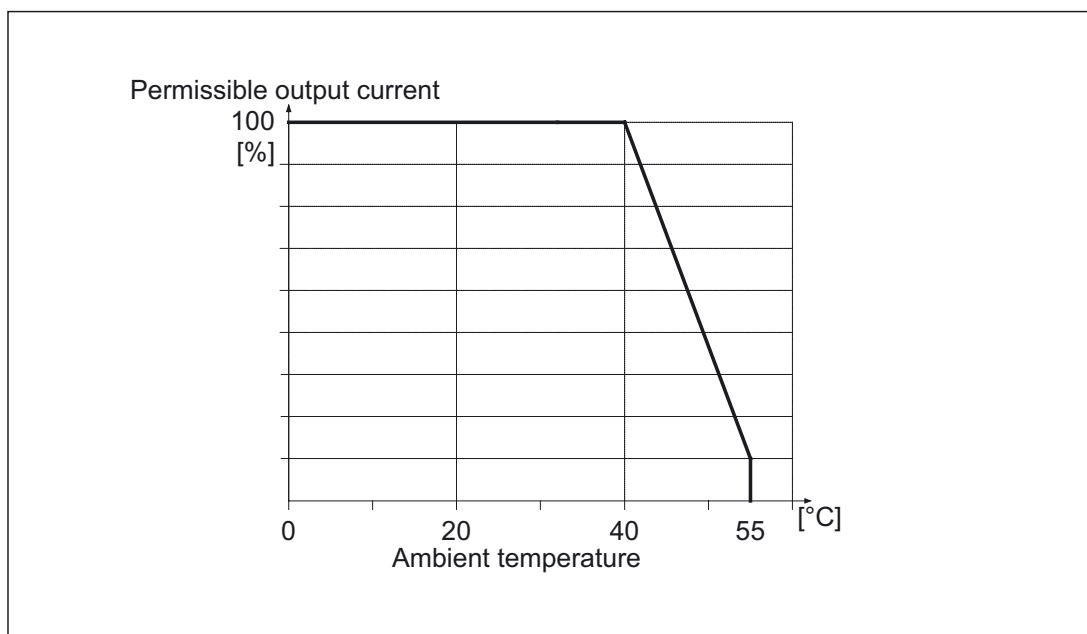


Figure 3-9 Derating as a function of the ambient temperature

Derating as a function of the installation altitude

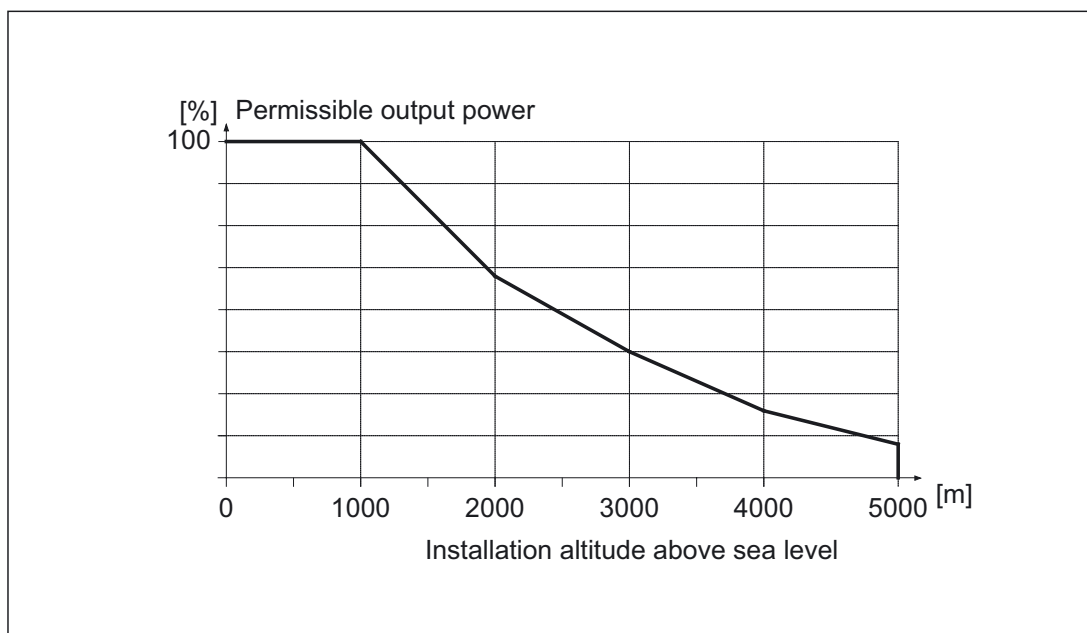


Figure 3-10 Derating as a function of the installation altitude

3.3 Smart line module booksize internal air cooling

3.3.1 Description

The motor modules are connected to the power supply network via the smart line modules which provide the motor modules with an unregulated DC link voltage. Smart line modules are unregulated feed/feedback units with 100% regenerative feedback capability. The regenerative feedback capability of the modules can be deactivated by means of a digital input. The smart line modules are suitable for direct operation on TN, IT, and TT systems.

When the motors are in feedback mode, smart line modules supply power back to the network.

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

3.3.2 Safety information



Warning

After disconnecting all the supply voltages, a hazardous voltage will be present in all components for another 5 minutes. The protective cover must not be opened until this time has elapsed.

The DC link protective cover must be released using an insulated screwdriver.



Caution

The DC link discharge time hazard warning must be affixed to the modules in the local language.

A set of labels in 12 languages is available using order number: 6SL3166-3AB00-0AAx.

Notice

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

Caution

The tightening torque of the DC link busbar screws (1.8 Nm) must be checked before startup.



Danger

In a supply system without regenerative feedback capability (e.g. diesel generator), the regenerative feedback capability of the smart line module must be deactivated by means of a jumper between terminals X22.3 and X22.4. The braking energy must then be dissipated via an additional braking module with a braking resistor in the drive line-up.

Caution

The total length of the power cables (motor supply cables and DC link cables) must not exceed 350 m in sinusoidal current mode.

3.3.3 Interface description

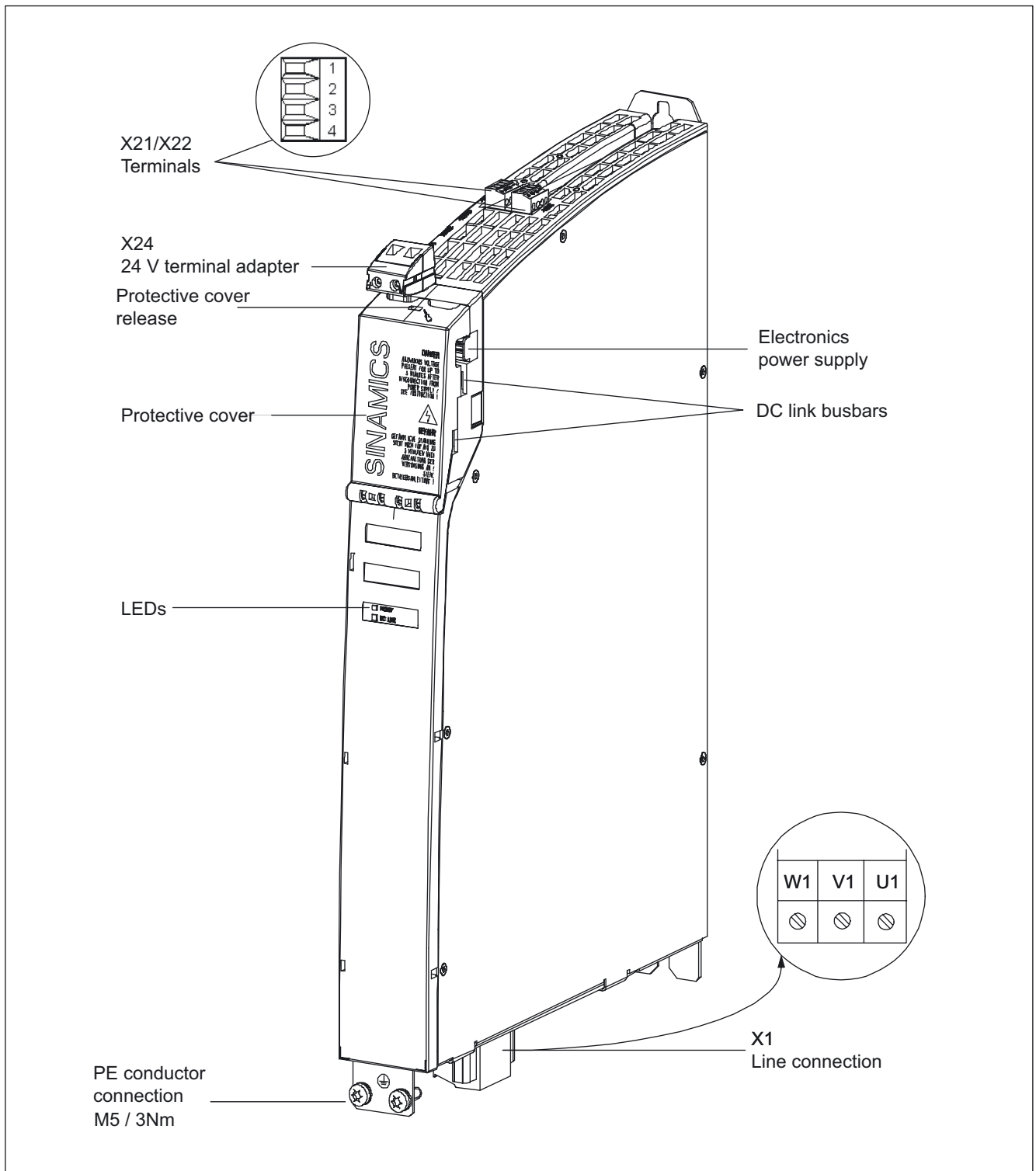


Figure 3-11 Smart line module (example: 5 kW)

3.3 Smart line module booksize internal air cooling

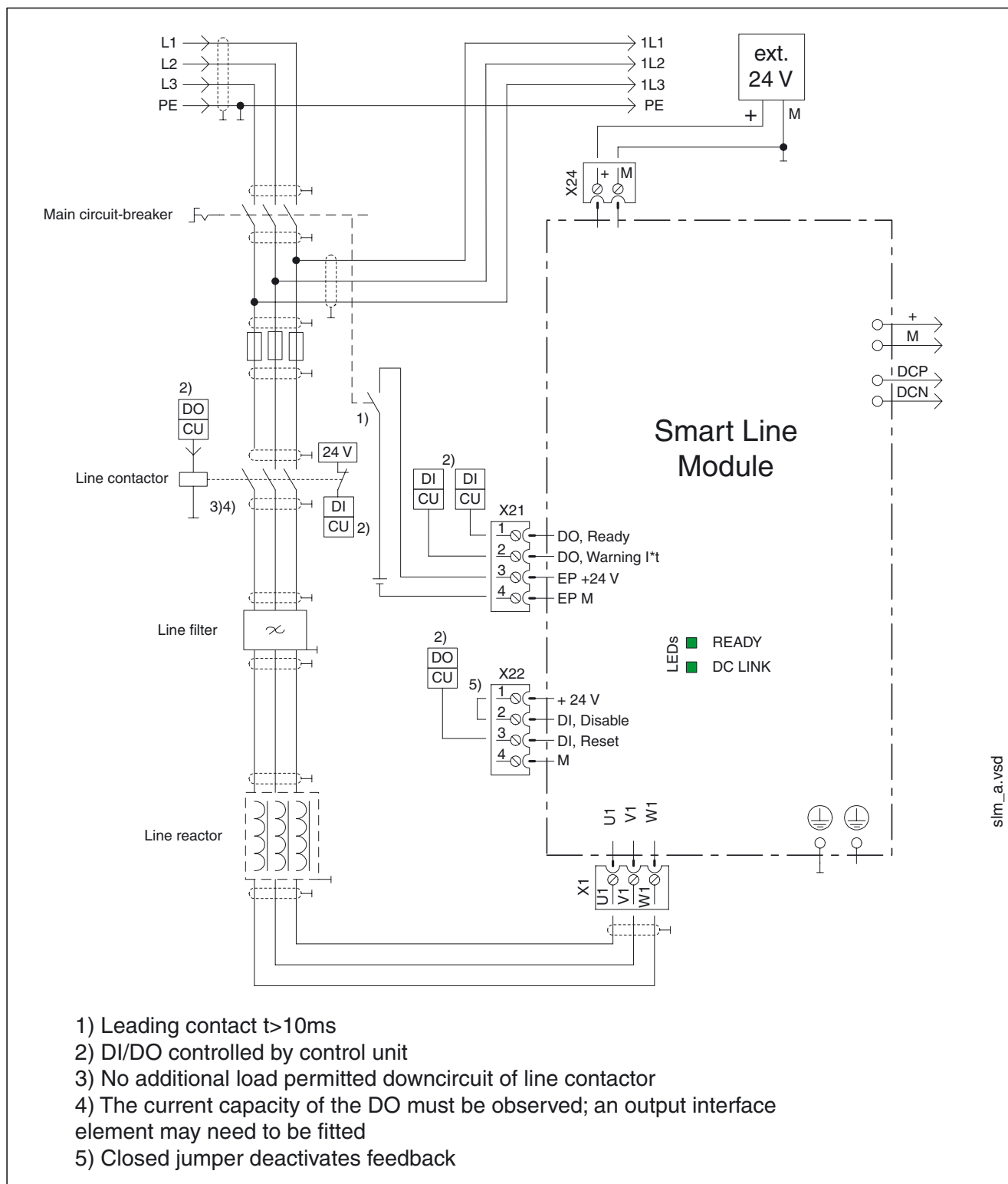


Figure 3-12 Example connection of smart line module

Line connection

The smart line module is rated for a voltage range from 380 V 3AC -10% to 480 V 3AC +10% (-15% <1 min) at 47 Hz to 63 Hz.

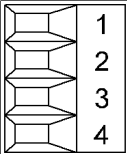
Table 3-7 Connection methods for the smart line module

Terminals	Designations ¹⁾
Line connection	X1 (U1, V1, W1)
Smart line modules	
5 kW and 10 kW	Screw terminal 6 mm ² 3-pin/0.8 Nm (see Connection methods) Threaded hole for PE: M5/3 Nm ¹⁾

1) For ring cable lugs to DIN 46234

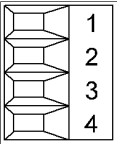
X21 terminals: Smart line module

Table 3-8 Terminal block X21

	Terminal	Designation	Technical specifications
	1	Ready	Checkback: Smart line module ready
	2	Pre Warning	Prewarning threshold overtemperature / I x t
	3	Enable Pulses	
	4	Enable Pulses Ground	
Max. connectable cross-section: 1.5 mm ²			

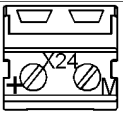
X22 terminals: Smart line module

Table 3-9 Terminal block X22

	Terminal	Designation	Technical specifications
	1	24 V power supply	Electronics power supply
	2	Disable generation	Feedback deactivated
	3	Reset	Reset faults (positive edge)
	4	Ground	Electronic ground
Max. connectable cross-section: 1.5 mm ²			

X24 24 V terminal adapter

Table 3-10 Terminal block X24

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

Meaning of the LEDs on the smart line module

Table 3-11 Meaning of the LEDs on the smart line module

LED	Color	State	Description
READY	Green	Continuous	Ready to run
	Yellow	Continuous	Precharging not yet complete
	Red	Continuous	Overtemperature/overcurrent switch-off, or Electronics power supply outside permissible tolerance range, or DC link voltage outside permissible tolerance range
DC LINK		OFF	Electronics power supply outside permissible tolerance range
	Yellow	Continuous	DC link voltage within permissible tolerance range
	Red	Continuous	DC link voltage outside permissible tolerance range

Cause and rectification of faults

The following reference contains information about the cause and rectification of faults:

Reference: /IH1/ SINAMICS S120, Installation and Start-Up Manual

3.3.4 Dimension drawing

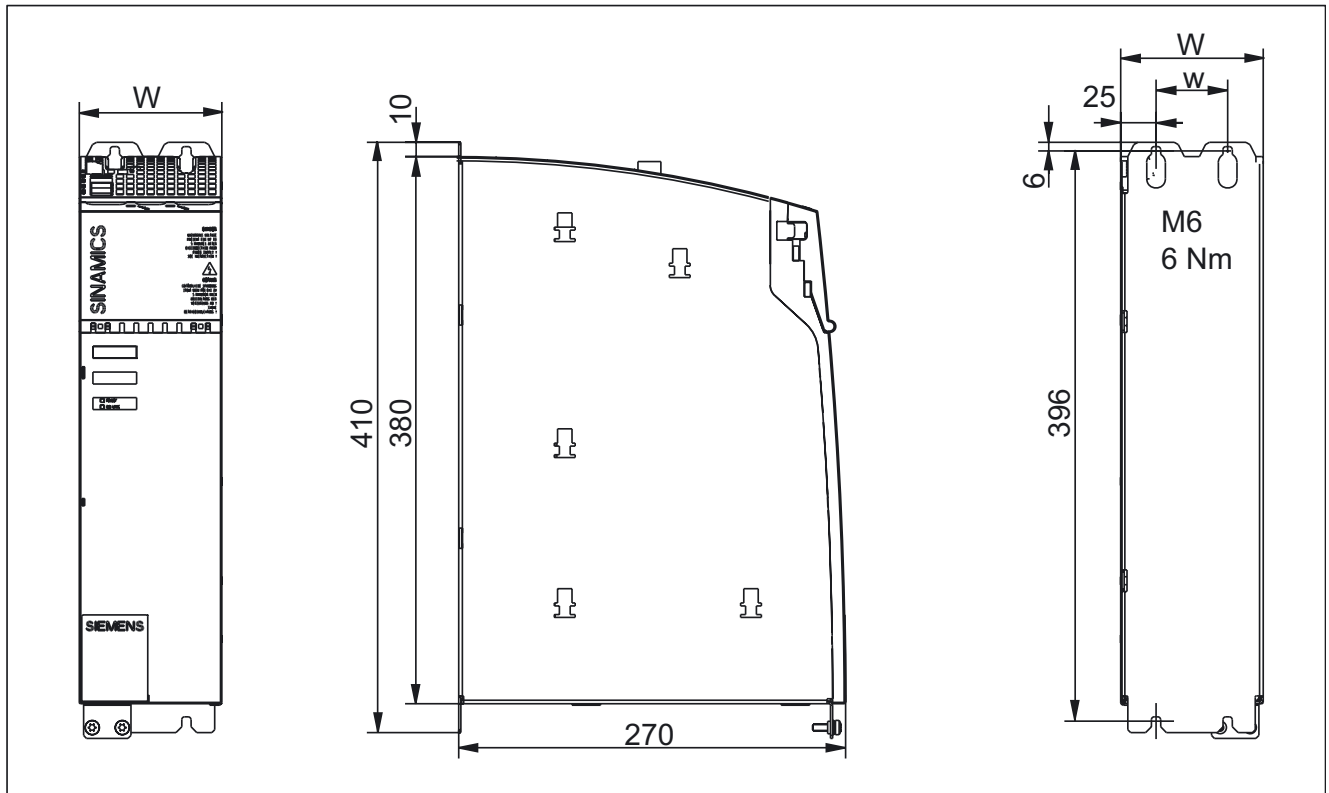


Figure 3-13 Dimension drawing of the smart line module

Table 3-12 Dimensions

Line module type	Order number	W [mm]	w [mm]
Smart line module: Internal air cooling			
5 kW	6SL3130-6AE15-0AAx	50	0
10 kW	6SL3130-6AE21-0AAx	50	0

3.3.5 Electrical connection

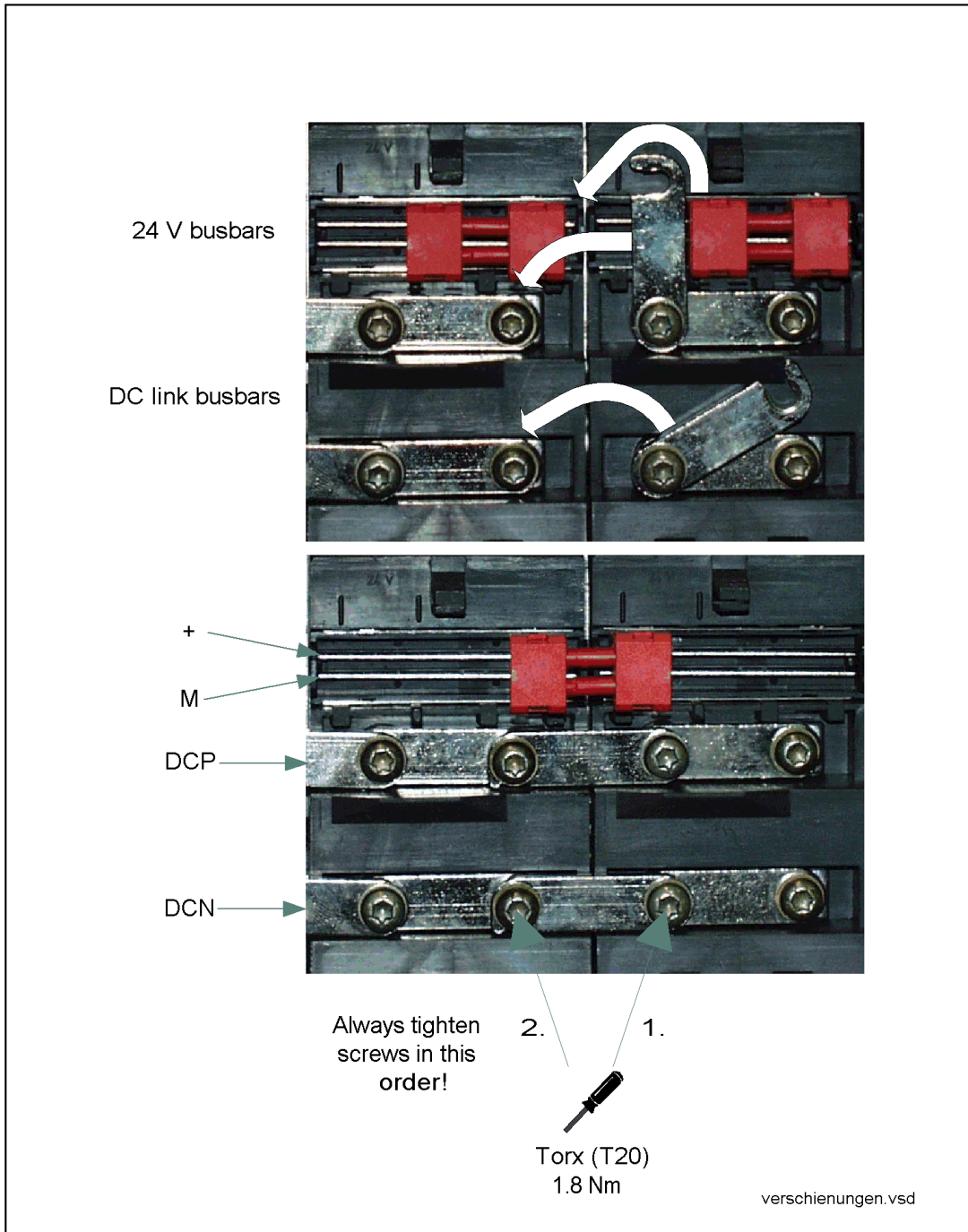


Figure 3-14 Busbar connections for booksize components

3.3.6 Technical specification

Table 3-13 Technical specifications for smart line modules in booksize format with internal air cooling

Internal air cooling	6SL3130–	6AE15–0AAx	6AE21–0AAx
Rated power	kW	5	10
Supply voltages:			
Rated power (S1)*	kW (Pn)	5	10
S6 infeed			
Power rating (S6-40%)	kW (Ps6)	6.5	13
Peak infeed power rating	kW (Pmax)	10	20
Regenerative feedback:			
Continuous feedback power rating	KW	5	10
Peak feedback power rating	kW	10	20
Connection voltages:			
Line voltage	V _{AC}	3AC 380 -10% to 3AC 480 +10% (-15% < 1 min)	
Line frequency	Hz	47 to 63	
Electronics power supply	V _{DC}	24 (20.4 – 28.8)	
DC link voltage	V _{DC}	510 – 750	
Overvoltage trip threshold	V _{DC}	820 ± 2%	
Undervoltage trip threshold	V _{DC}	360 ± 2%	
Supply currents:			
At 380 V _{AC}	A _{AC}	12	24
at 480 V _{AC} /528 V _{AC}	A _{AC}	9.3/8.5	18/16.5
At 480 V; S6-40%	A _{AC}	12	24
Peak current (at 400 V _{AC} /480 V _{AC})	A _{AC}	22/18.5	44/37
Output currents at 600 V _{DC} :			
Rated current	A _{DC}	8,3	16.6
At S6-40%	A _{DC}	11	22
Peak current	A _{DC}	16.6	33.2
26 V DC busbar	A _{DC}	100	100
DC link busbar			
26 V DC busbar	A _{DC}	20	20
Current capacity			
Max. ambient temperature without derating	°C	40	40
Max. ambient temperature with derating	°C	55	55
DC link capacitance	µF	220	330
Charging limit	µF	6000	6000
Power factor	cos φ	1	1
Efficiency	η	0.98	0.98
Cooling method		Internal fan	Internal fan

3.3 Smart line module booksize internal air cooling

Internal air cooling	6SL3130–	6AE15–0AAx	6AE21–0AAx
Rated power	kW	5	10
Sound pressure level	dB(A)	<60	<60
Cooling air requirement	m ³ /h	29.6	29.6
Rated voltage for rated data 3 AC 380 V			
Weight	kg	4.68	4.78

* These values apply to 380 V and not 380 V -10%

Rated duty cycles of smart line modules

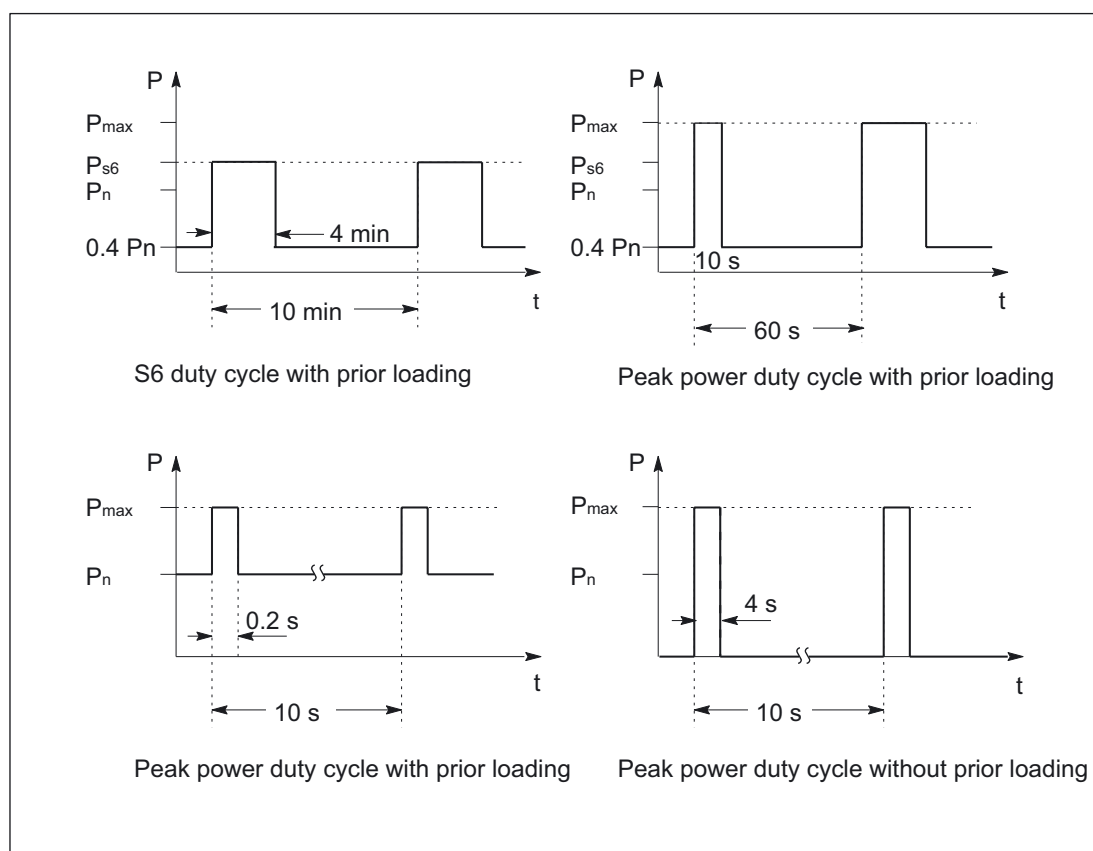


Figure 3-15 Rated duty cycles of smart line modules

Derating as a function of the ambient temperature

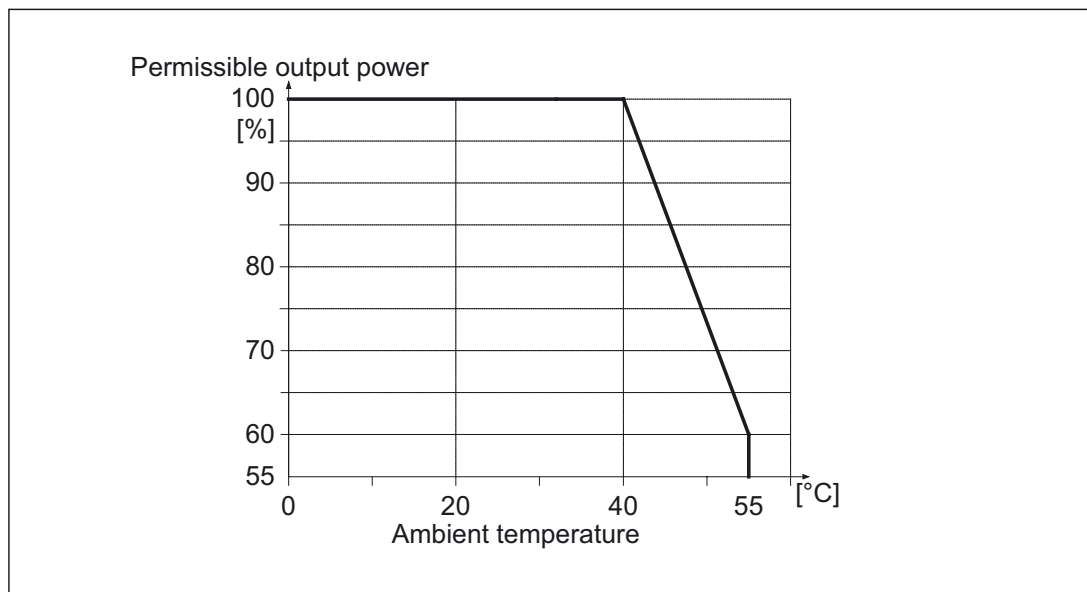


Figure 3-16 Derating as a function of the ambient temperature

Derating as a function of the installation altitude

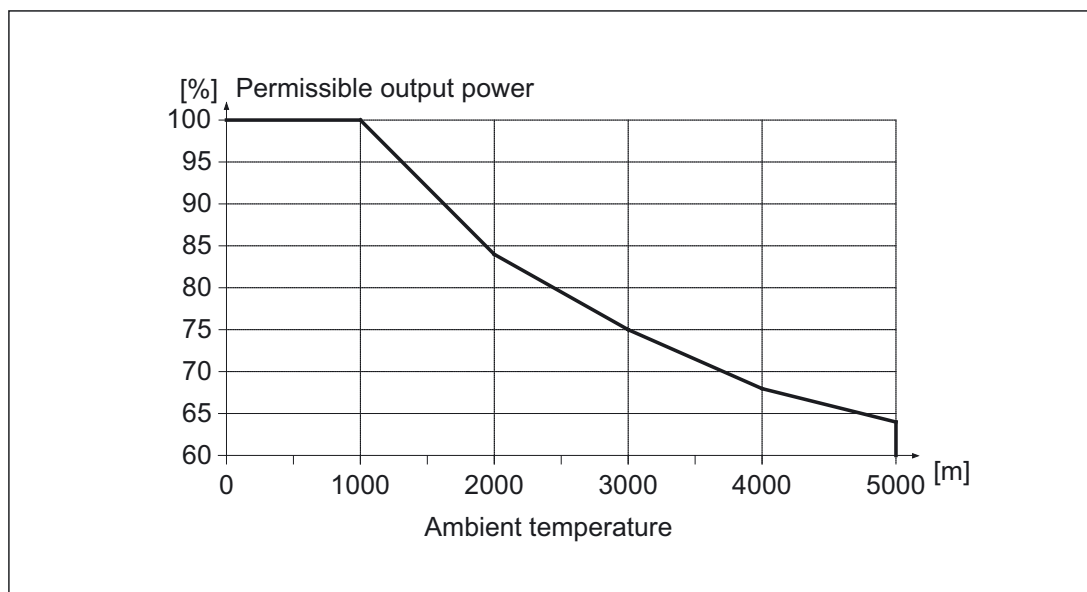


Figure 3-17 Derating as a function of the installation altitude

Motor Modules Booksize

4.1 Introduction

The motor modules in the SINAMICS S system in “booksize” format are inverters. 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).

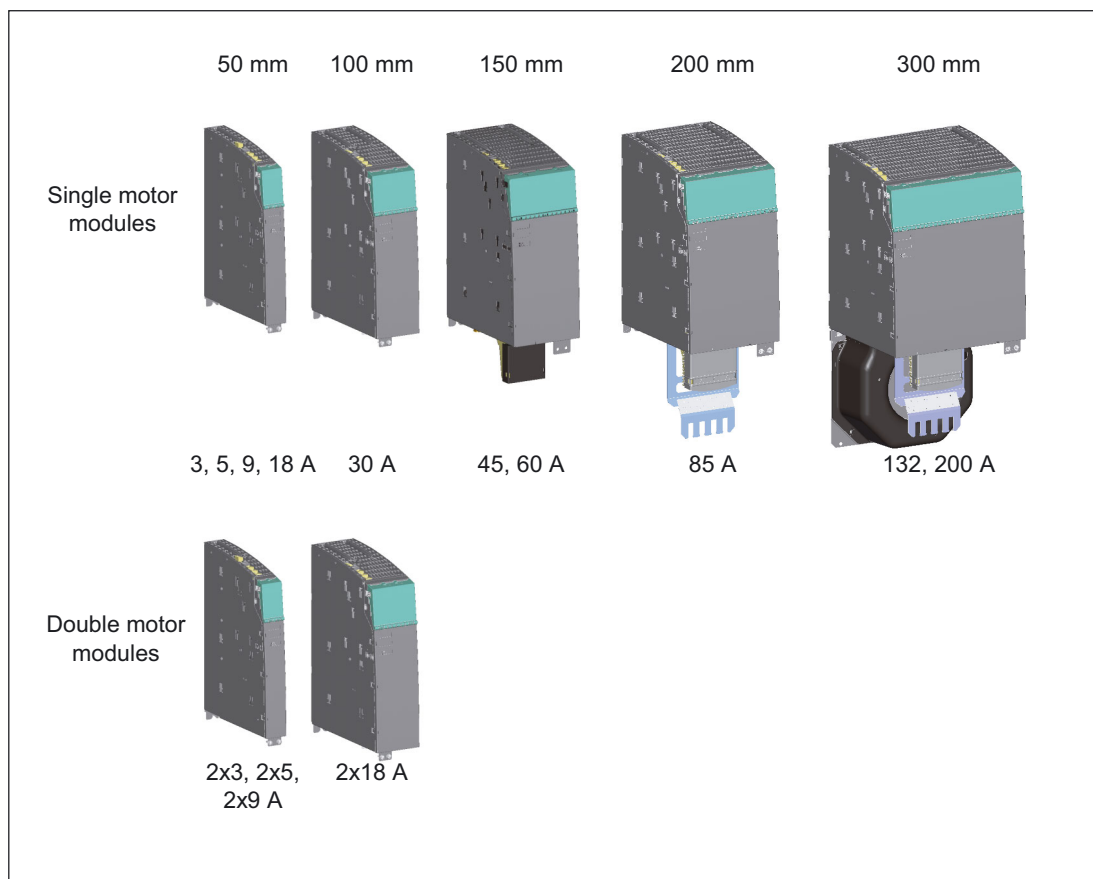


Figure 4-1 Overview of motor modules booksize (currents are continuous rms)

Characteristics of the motor modules:

- Single type from 3 A to 200 A
- Double type from 2x3 A to 2x18 A
- Internal air cooling
- Short-circuit/ground-fault-proof
- Integrated DC link and electronics current busbar connection
- Integrated "safe motor brake control"
- Electronic type 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

4.2 Motor modules booksize internal air cooling

4.2.1 Description

A motor module is a power unit (inverter) that provides the power supply for the connected motor(s). Power is supplied by means of the DC link of the drive unit. A motor module must be connected to a control unit via DRIVE-CLiQ. The open-loop and closed-loop control functions for the motor module are stored in the control unit.

Single motor modules and double motor modules are available. Just one motor can be connected to and operated using a single motor module. Two motors can be connected to and operated with a double-motor module.

4.2.2 Safety information



Warning

After disconnecting all the supply voltages, a hazardous voltage will be present in all components for another 5 minutes. The protective cover must not be opened until this time has elapsed.

The DC link protective cover must be released using an insulated screwdriver.



Caution

The DC link discharge voltage hazard warning must be affixed to the modules in the local language.

Notice

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

For the 132 A and 200 A motor modules, a ventilation clearance of 50 mm must be observed in front of the fan.

Caution

The tightening torque of the DC link busbar screws (1.8 Nm) must be checked before startup.



Warning

Cable shields and unused power cable conductors (e.g. brake conductors) must be connected to PE potential to prevent capacitive cross-talk charges.

Non-observance can cause lethal shock voltages.

4.2.3 Interface description

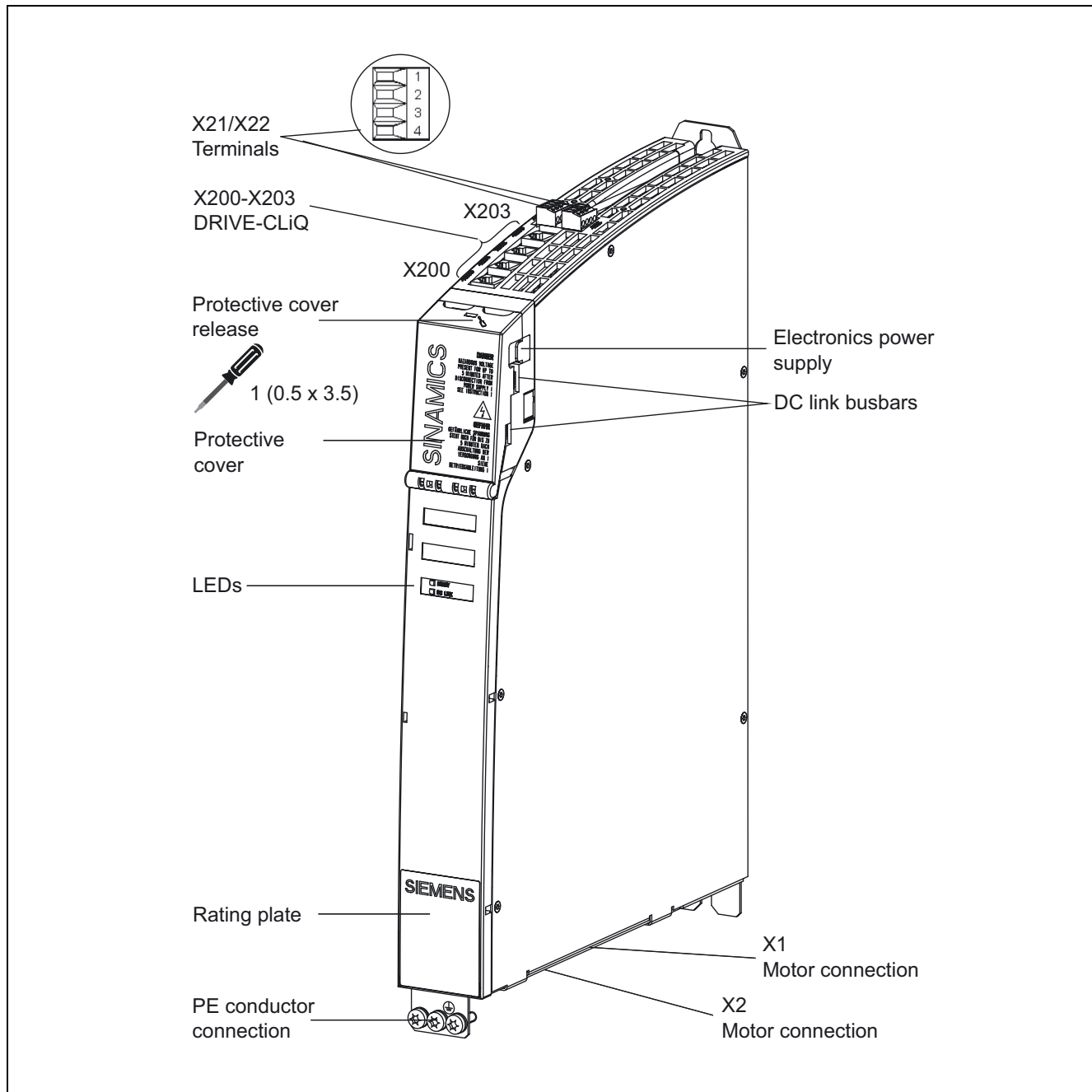


Figure 4-2 Example: Double motor module (2 x 3 A)

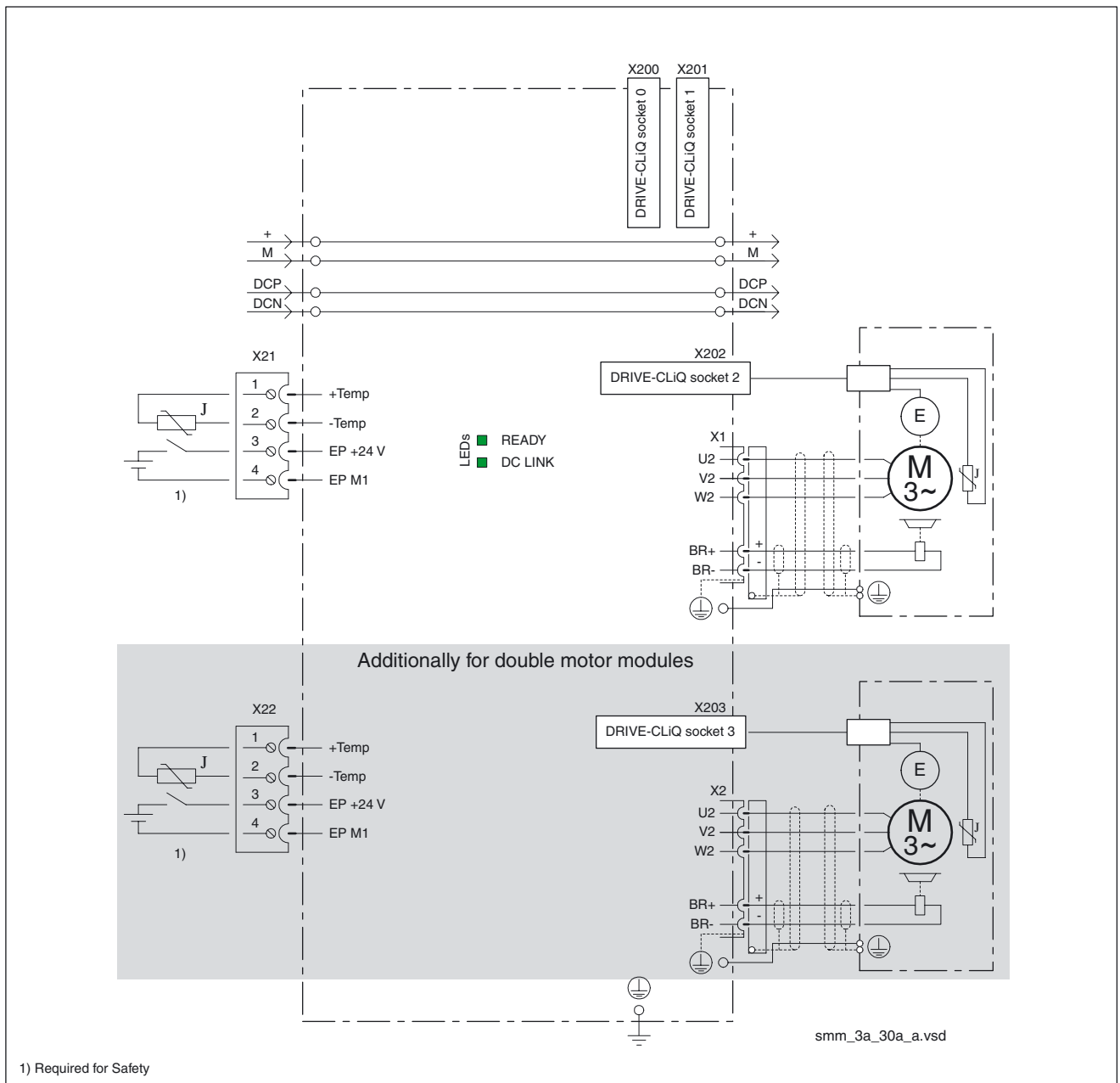


Figure 4-3 Example connection of motor modules 3 A to 30 A and 2x3 A to 2x18 A

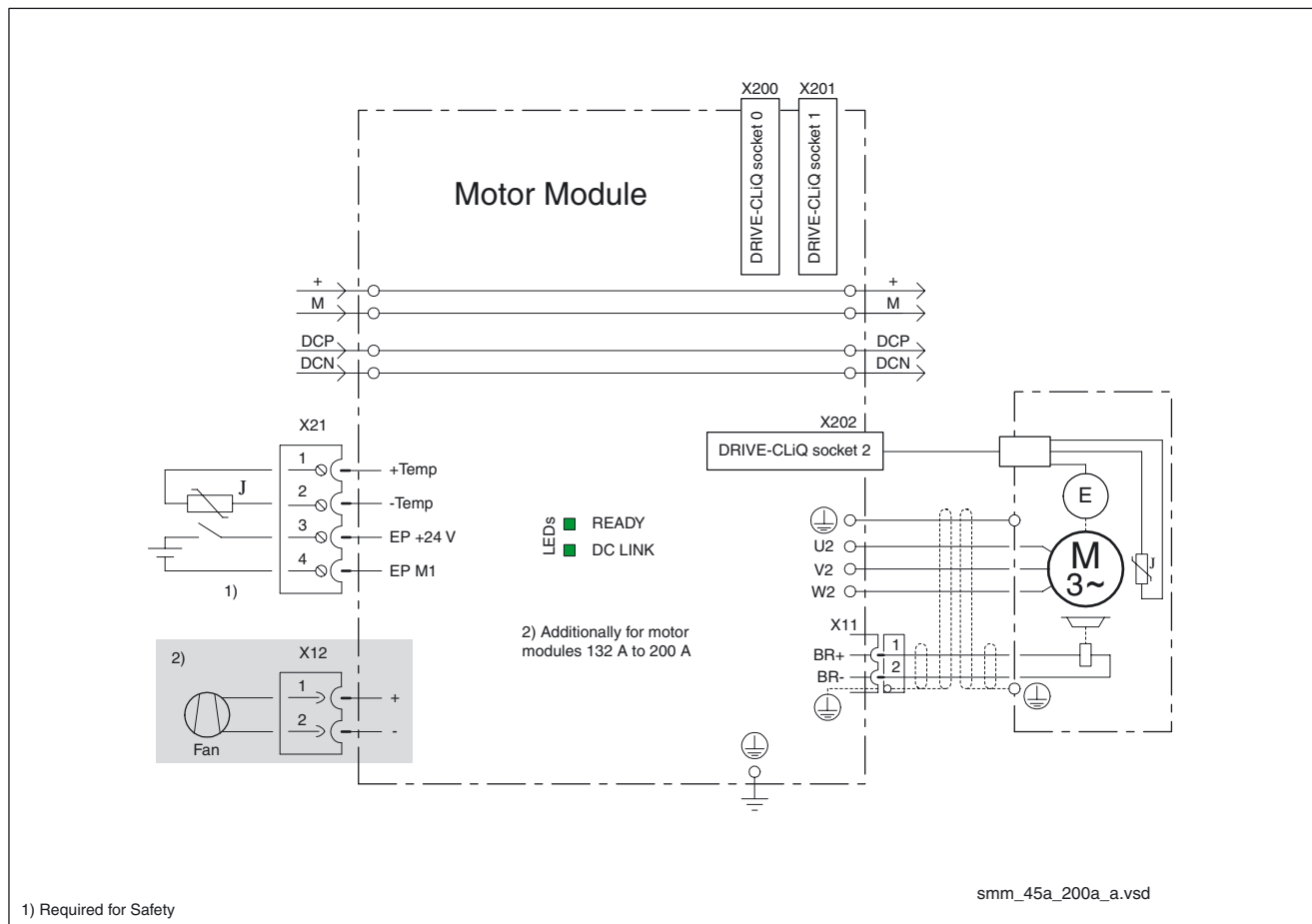


Figure 4-4 Example connection of single motor modules 45 A to 200 A

Motor/brake connection

Table 4-1 Connection methods

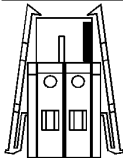
Motor connection terminals	Designations
Double motor module with a rated output current of 2 x 3 A or 2 x 18 A	Motor: X1/X2, (U2, V2, W2) Brake: X1/X2, (1:24 V, 2: Ground) ²⁾ Motor connector, 5-pin Threaded hole for PE: M5 ¹⁾
Single motor module with a rated output current of 3 A to 30 A	Motor: X1 (U2, V2, W2) Brake: X1 (1:24 V, 2: Ground) ²⁾ Motor connector, 5-pin Threaded hole for PE: M5 ¹⁾
Single motor module with a rated output current of 45 A to 132 A Single motor module with a rated output current of 85 A Single motor module with a rated output current of 132 A to 200 A	Motor: (U2, V2, W2) Brake: X11, (1:24 V, 2: Ground) ²⁾ Brake connector ²⁾ : Max. 1.5 mm ²
	Threaded bolt for motor cables: M6/6 Nm ¹⁾ Threaded hole for PE: M6/6 Nm ¹⁾
	Threaded bolt for motor cables: M8/13 Nm ¹⁾ Threaded hole for PE: M6/6 Nm ¹⁾
	Threaded bolt for motor cables: M8/13 Nm ¹⁾ Threaded hole for PE: M8/6 Nm ¹⁾
1) For ring cable lugs to DIN 46234 2) The circuit for protecting the brakes against overvoltage is integrated in the motor module and does not need to be installed externally.	

Note

The total length of the shielded power cables (motor supply cables and DC link cables) must not exceed 350 m.

Brake connector X11

Table 4-2 Terminal block X11

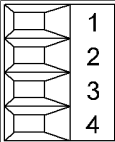
	Terminal	Function	Technical specifications
BR+ BR- 	BR +	Brake connection +	Voltage 24 V DC Max. load current 2 A
	BR-	Brake connection -	
The brake connector is part of the prefabricated cable Max. connectable cross-section: 2.5 mm ² Type: Spring-loaded terminal 2 (see Connection methods) Manufacturer: Wago; order number: 231-102/037-000			

Note

The motor brake must be connected via connector X11. Cable BR - must not be connected directly to electronic ground (M).

X21/X22 EP terminals / temperature sensor connection motor module

Table 4-3 Terminal block X21/X22

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensor connection KTY84–1C130
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V – 28.8 V) Current consumption: 10 mA Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M1 (Enable Pulses)	
Max. connectable cross-section 1.5 mm² Type: Screw terminal 1 (see Connection methods)			

Notice

The KTY temperature sensor must be connected with the correct polarity.

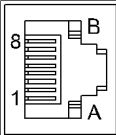
Note

The temperature sensor connection is required for motors where the temperature is not transmitted via DRIVE-CLiQ.

For operation, 24 V DC must be connected to terminal 3 and ground to terminal 4. Upon removal, pulse inhibit is activated.

X200-X203 DRIVE-CLiQ interface

Table 4-4 DRIVE-CLiQ interface X200-X202: Single motor module
DRIVE-CLiQ interface X200-X203: Double motor module

	Pin	Name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	GND (0 V)	Electronic ground
Blanking plate for DRIVE-CLiQ interface: Molex, order number: 85999-3255			

Meaning of the LEDs on the motor module

Table 4-5 Meaning of the LEDs on the motor module

LED	Color	State	Description
READY	-	OFF	Electronics power supply outside permissible tolerance range.
	Green	Continuous	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
	Orange	Continuous	DRIVE-CLiQ communication is being established.
	Red	Continuous	At least one fault is present in this component.
	Green Red	Flashing 2 Hz	The firmware is being downloaded. Component recognition via LED is activated (p0124).
DC LINK	-	OFF	Electronics power supply outside permissible tolerance range.
	Orange	Continuous	DC link voltage within permissible tolerance range (only when ready for operation).
	Red	Continuous	DC link voltage outside permissible tolerance range (only when ready for operation).

Cause and rectification of faults

The following reference contains information about the cause and rectification of faults:

Reference: /IH1/ SINAMICS S120, Installation and Start-Up Manual

Table 4-6 Dimensions

Order number	W [mm]	w ₁ [mm]	w ₂ [mm]
6SL3120-1TE13-0AAx	50	0	28
6SL3120-1TE21-0AAx	50	0	28
6SL3120-1TE21-8AAx	50	0	28
6SL3120-1TE23-0AAx	100	50	78
6SL3120-2TE13-0AAx	50	0	28
6SL3120-2TE15-0AAx	50	0	28
6SL3120-2TE21-0AAx	50	0	28
6SL3120-2TE21-8AAx	100	50	78

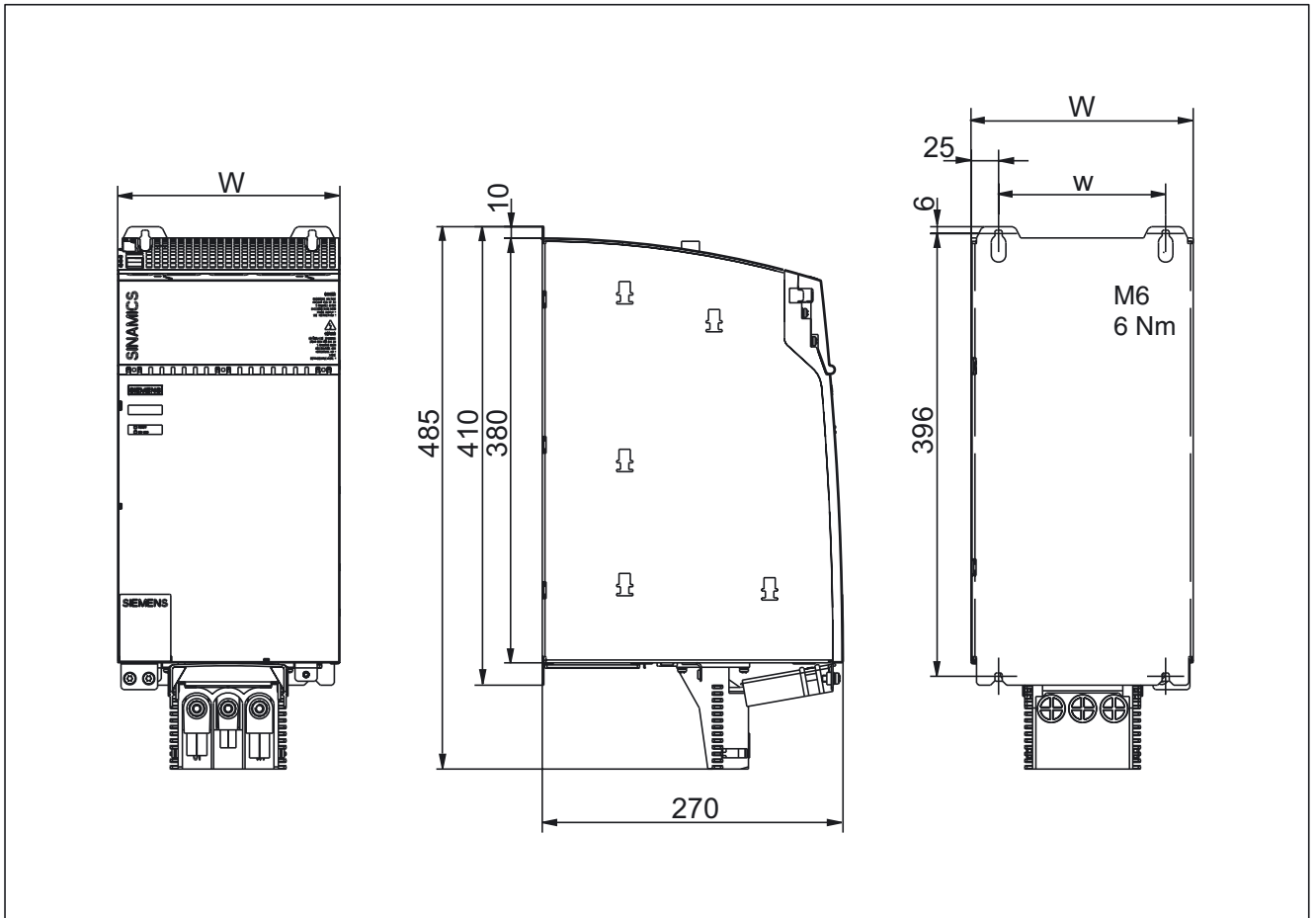


Figure 4-6 Dimension drawing of motor module < 45 to 85 A

Table 4-7 Dimensions

Order number	W [mm]	w [mm]
6SL3120-1TE24-5AAx	150	100
6SL3120-1TE26-0AAx	150	100
6SL3120-1TE28-5AAx	200	150

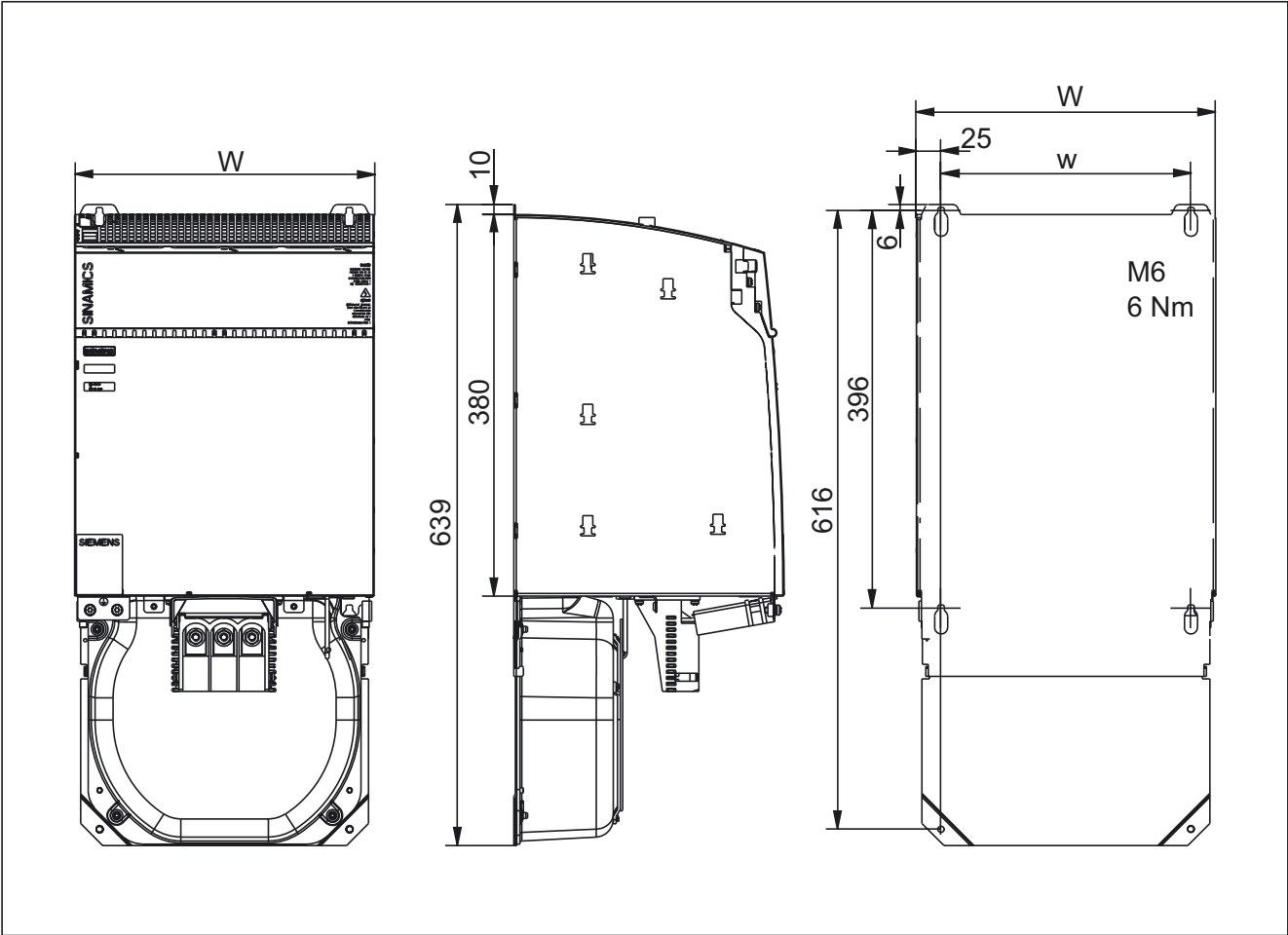


Figure 4-7 Dimension drawing of motor module 132 A and 200 A

Table 4-8 Dimensions

Order number	W [mm]	w [mm]
6SL3120-1TE31-3AAx	300	250
6SL3120-1TE32-0AAx	300	250

4.2.5 Installation

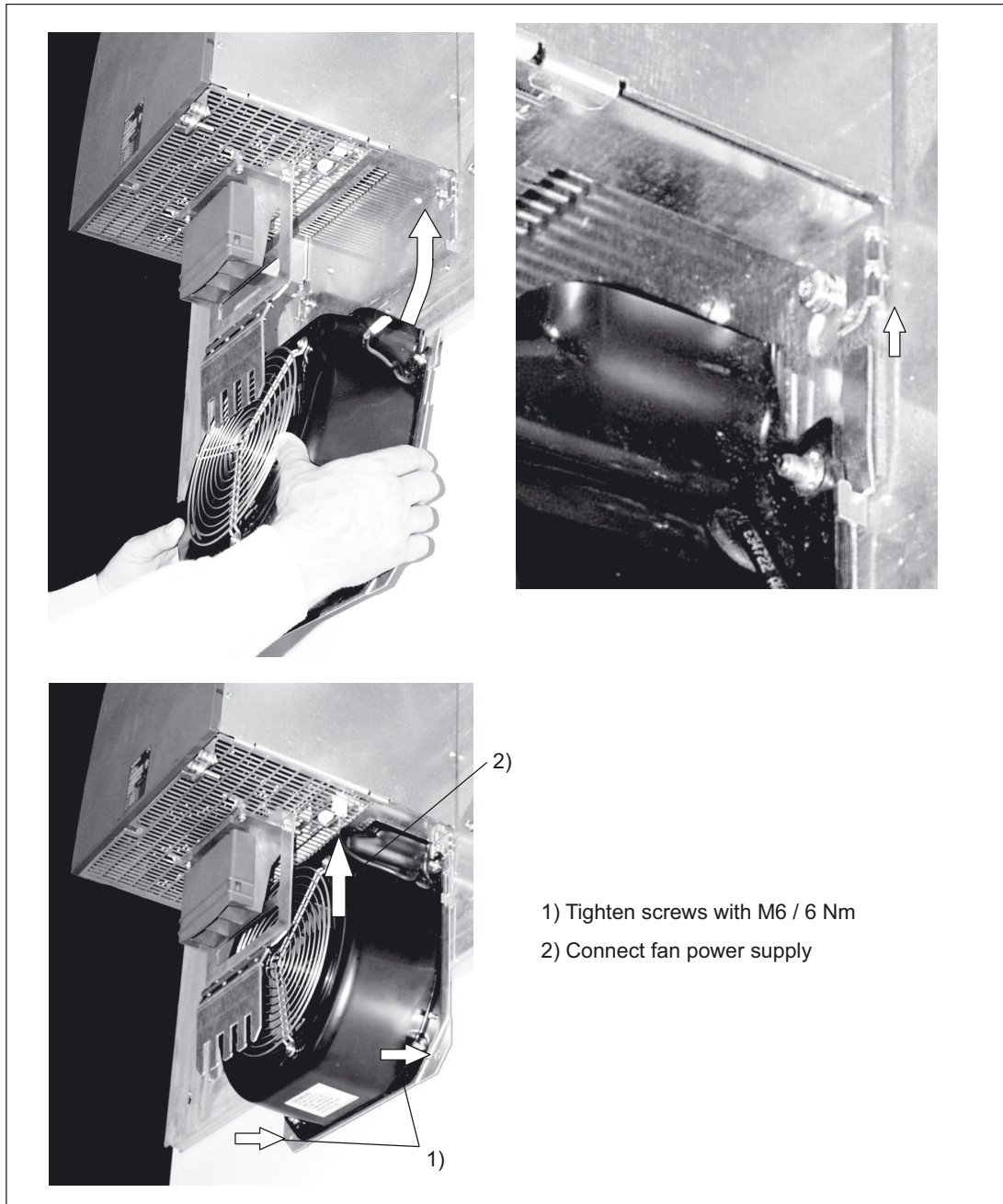


Figure 4-8 Installing the fan for 300 mm modules

4.2.6 Electrical connection

Shield contact for the terminals

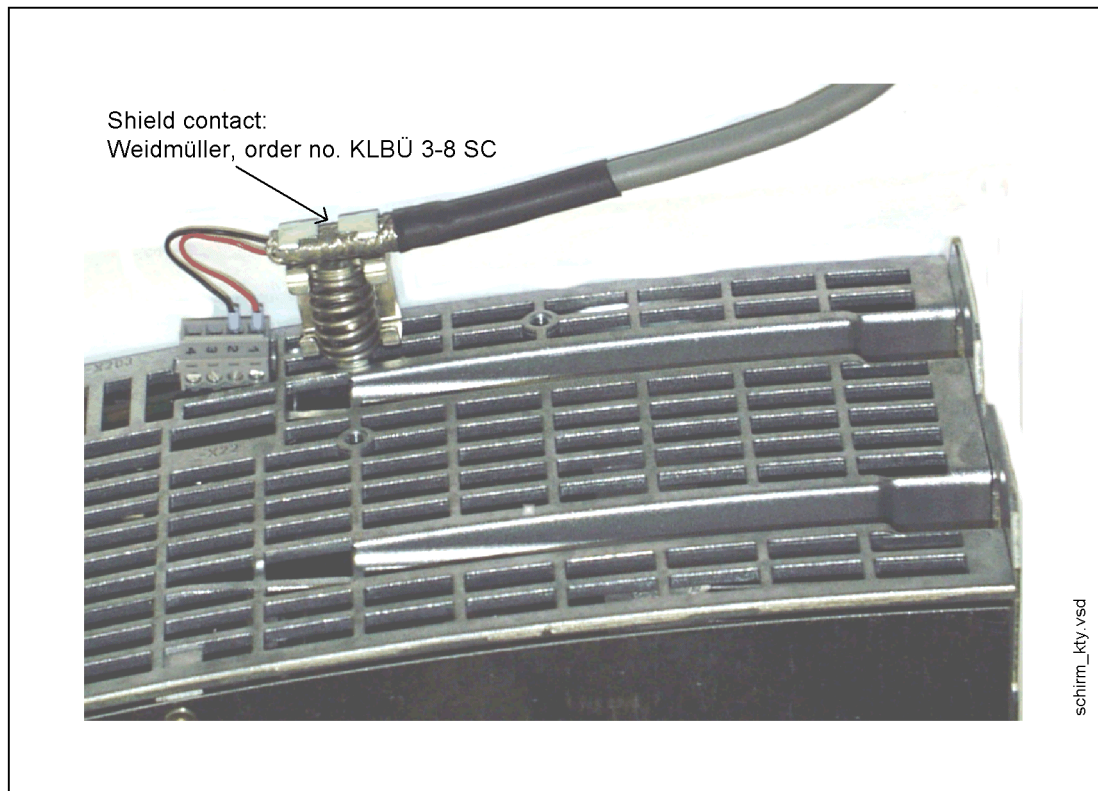


Figure 4-9 Shield contact for the terminals

Internet address:

Weidmüller: <http://www.weidmueller.com>

4.2.7 Technical specifications

Table 4-9 Technical specifications for single motor modules booksize (3 to 30 A)

Internal air cooling	6SL3120–	1TE13-0AA0	1TE15-0AA0	1TE21-0AAx	1TE21-8AAx	1TE23-0AAx
Rated current	A	3	5	9	18	30
Voltage						
Supply voltages:						
DC link voltage	V_{DC}	510 – 750				
Electronics power supply	V_{DC}	24 (20.4 – 28.8)				
Output voltage	V_{ACrms}	0 – 480				
Overvoltage tripping	V_{DC}	820 ± 2%				
Undervoltage tripping	V_{DC}	380				
Electronics current consumption at 24 V	A_{DC}	See Cabinet Design Booksize				
Rated output current (I_n)	A_{ACrms}	3	5	9	18	30
Base load current (I_{base})	A	2.9	3.6	6.4	12.7	20.9
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
DC link busbar current capacity	A_{DC}	100	100	100	100	100
24 V busbar current capacity	A_{DC}	20	20	20	20	20
Rated power (DC link voltage 600 V_{DC} and pulse frequency 4 kHz)	kW	1.6	2.7	4.8	9.7	16
Max. pulse frequency without derating	kHz	4	4	4	4	4

4.2 Motor modules booksize internal air cooling

Internal air cooling	6SL3120–	1TE13-0AA0	1TE15-0AA0	1TE21-0AAx	1TE21-8AAx	1TE23-0AAx
Rated current	A	3	5	9	18	30
Max. pulse frequency with derating	kHz	16	16	16	16	16
Max. ambient temperature without derating	°C	40	40	40	40	40
Max. ambient temperature with derating	°C	55	55	55	55	55
DC link capacitance	µF	110	110	110	220	705
Efficiency (4kHz)	η	0.97	0.97	0.97	0.97	0.97
Sound pressure level	dB(A)	<60	<60	<60	<60	<60
Type of cooling		Internal fan	Internal fan	Internal fan	Internal fan	Internal fan
Cooling air requirement	m³/h	29.6	29.6	29.6	29.6	56
Weight	kg	5.1	5.1	5	5	6.9

Table 4-10 Technical specifications for single motor modules booksize (45 to 200 A)

Internal air cooling	6SL3120–	1TE24-5AAx	1TE26-0AAx	1TE28-5AAx	1TE31-3AAx	1TE32-0AAx
Rated current	A	45	60	85	132	200
Voltage						
Supply voltages:						
DC link voltage	V _{DC}	510 – 750				
Electronics power supply	V _{DC}	24 (20.4 – 28.8)				
Output voltage	V _{ACrms}	0 – 480				
Overvoltage tripping	V _{DC}	820 ± 2%				
Undervoltage tripping	V _{DC}	380				
Electronics current consumption at 24 V	A _{DC}	See Cabinet Design Booksize				
Rated output current (I _n)	A _{ACrms}	45	60	85	132	200
Base load current (I _{geund})	A	32	42	59	93	141

Internal air cooling	6SL3120–	1TE24-5AAx	1TE26-0AAx	1TE28-5AAx	1TE31-3AAx	1TE32-0AAx
Rated current	A	45	60	85	132	200
Intermittent duty current (I_{s6}) 40%	A _{ACrms}	60	80	110	150	230
Peak current (I_{max})	A _{ACrms}	85	113	141	210	282
DC link busbar current capacity	A _{DC}	100	100	200	200	200
24 V busbar current capacity	A _{DC}	20	20	20	20	20
Rated power (DC link voltage 600 V _{DC} and clock frequency 4 kHz)	kW	24	32	46	71	107
Max. pulse frequency without derating	kHz	4	4	4	4	4
Max. pulse frequency with derating	kHz	16	16	16	16	16
Max. ambient temperature without derating	°C	40	40	40	40	40
Max. ambient temperature with derating	°C	55	55	55	55	55
DC link capacitance	μF	1175	1410	1880	2820	3995
Efficiency (4kHz)	η	0.97	0.97	0.97	0.97	0.97
Sound pressure level	dB(A)	<65	<65	<60	<75	<75
Type of cooling		Internal fan	Internal fan	Internal fan	Internal fan	Internal fan
Cooling air requirement	m³/h	112	112	160	520	520
Weight	kg	9	9	15	21	21

4.2 Motor modules booksize internal air cooling

Table 4-11 Technical specifications for double motor modules booksize (2x3 to 2x18A)

Internal air cooling	6SL3120-	2TE13-0AA0	2TE15-0AA0	2TE21-0AA0	2TE21-8AA0
Rated current	A	2x3	2x5	2x9	2x18
Voltage					
Supply voltages:					
DC link voltage	V _{DC}	510 – 750			
Electronics power supply	V _{DC}	24 (20.4 – 28.8)			
Output voltage	V _{ACrms}	0-480			
Overvoltage tripping	V _{DC}	820 ± 2%			
Undervoltage tripping	V _{DC}	380			
Electronics current consumption at 24 V	A _{DC}	See Cabinet Design Booksize			
Rated output current (I _n)	A	2x3	2x5	2x9	2x18
Base load current (I _{base})	A	2x2.28	2x3.64	2x6.37	2x20.93
Intermittent duty current (I _{S6}) 40%	A _{ACrms}	3.5	6	10	24
Peak current (I _{max})	A _{ACrms}	6	10	18	36
DC link busbar current capacity	A	100	100	100	100
24 V busbar current capacity	A	20	20	20	20
Rated power (600V, 4kHz)	kW	1.6	2.7	4.8	9.7
Max. pulse frequency without derating	kHz	4	4	4	4
Max. pulse frequency with derating	kHz	16	16	16	16
Max. ambient temperature without derating	°C	40	40	40	40
Max. ambient temperature with derating	°C	55	55	55	55
DC link capacitance	µF	110	220	220	705
Efficiency (4kHz)	η	0.97	0.97	0.97	0.97
Sound pressure level	dBA	<60	<60	<60	<60
Type of cooling		Internal fan	Internal fan	Internal fan	Internal fan

Internal air cooling	6SL3120-	2TE13-0AA0	2TE15-0AA0	2TE21-0AA0	2TE21-8AA0
Rated current	A	2x3	2x5	2x9	2x18
Cooling air requirement	m ³ /h	29.6	29.6	29.6	56
Weight	kg	5.3	5.3	5.5	6.8

Rated duty cycles of motor modules booksize

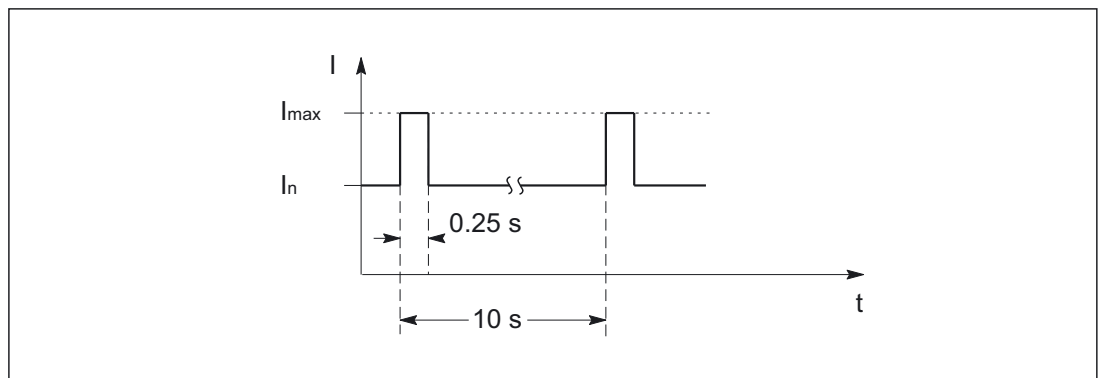


Figure 4-10 Peak current duty cycle with prior loading

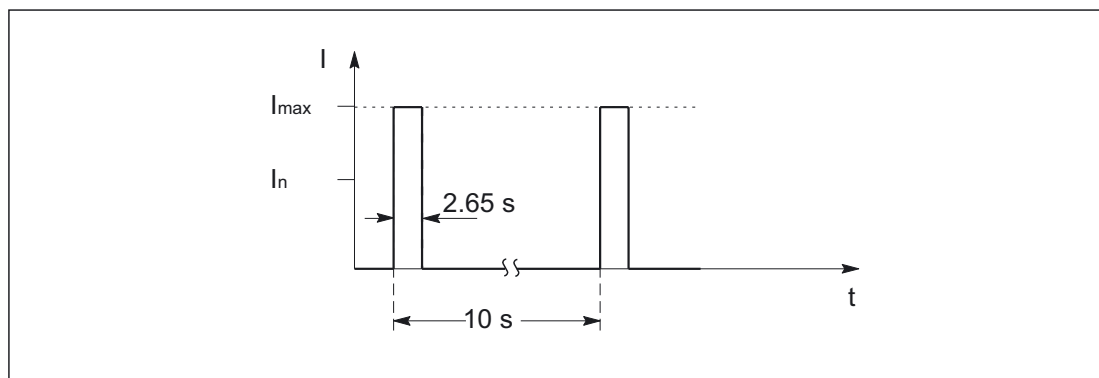


Figure 4-11 Peak current duty cycle without prior loading

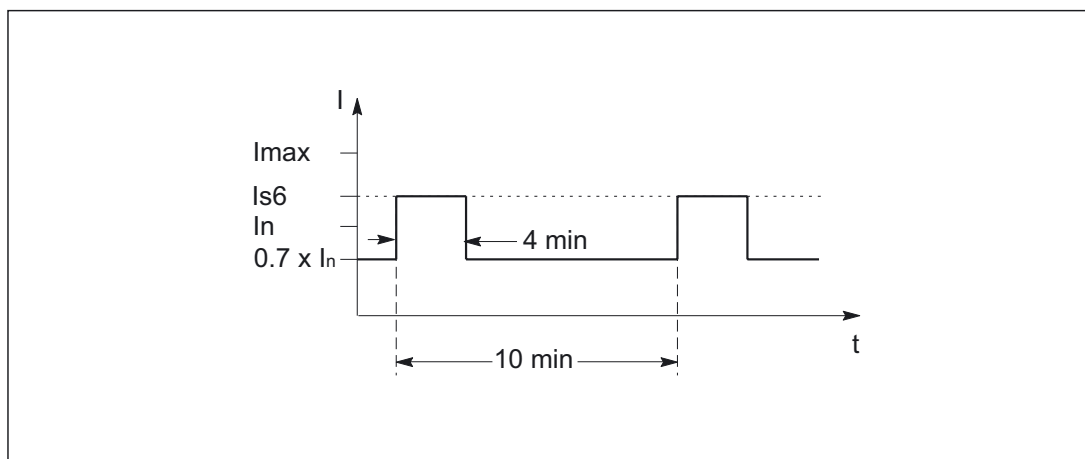


Figure 4-12 S6 current duty cycle with prior loading

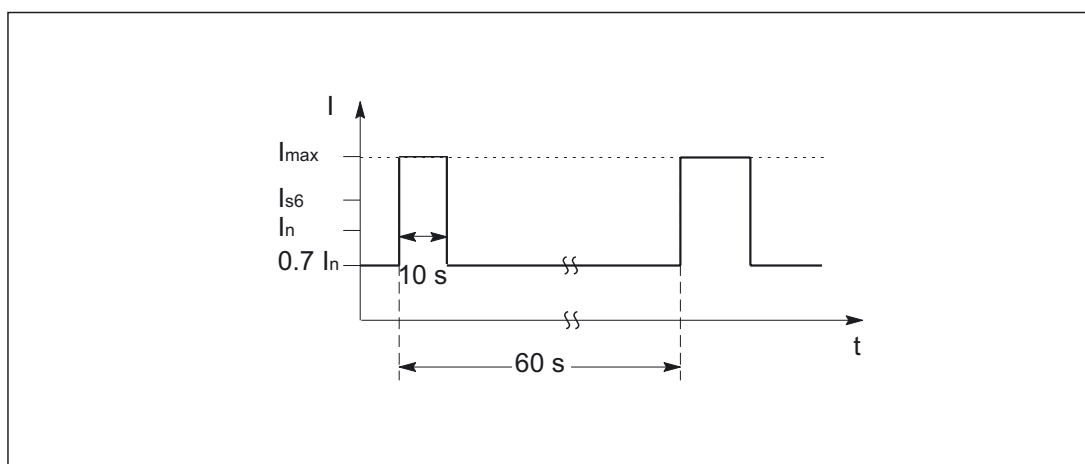


Figure 4-13 S6 peak current duty cycle with prior loading

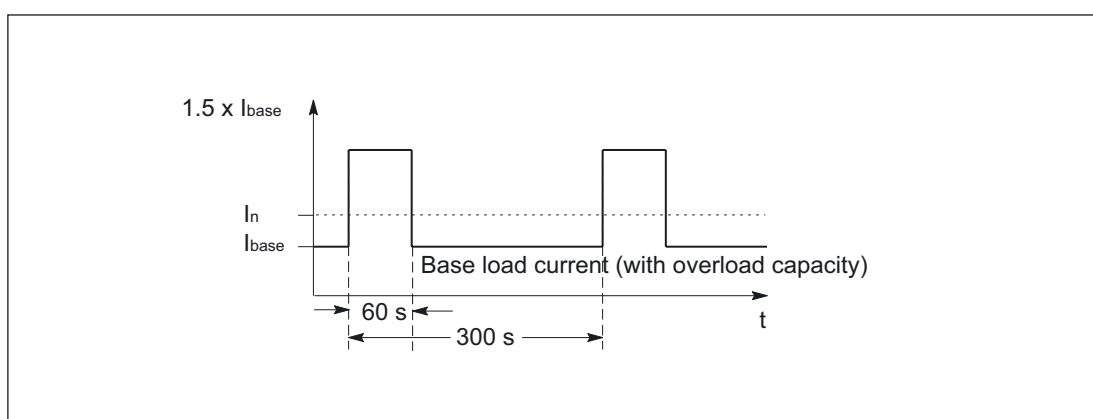


Figure 4-14 Current duty cycle with prior loading

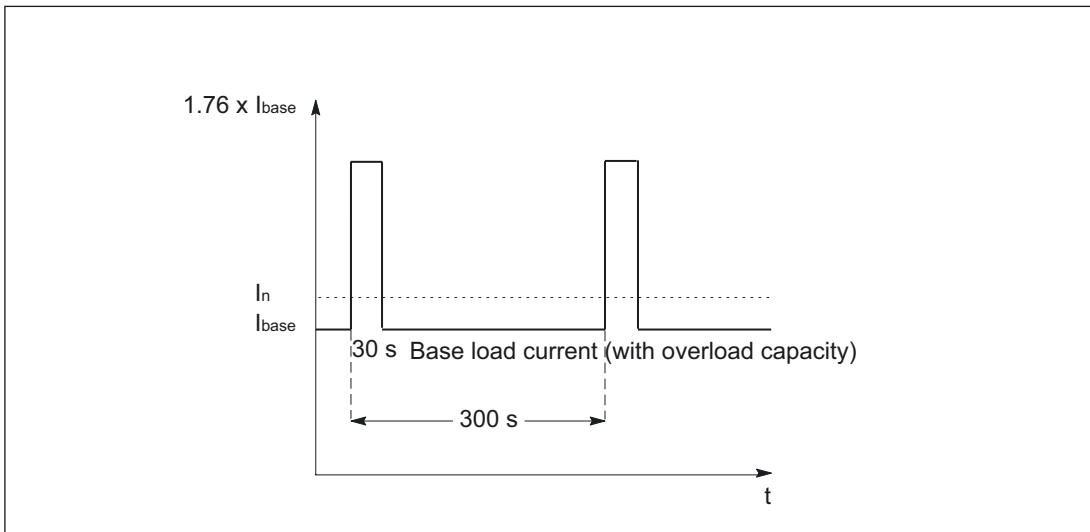


Figure 4-15 Current duty cycle with prior loading

Derating as a function of the ambient temperature

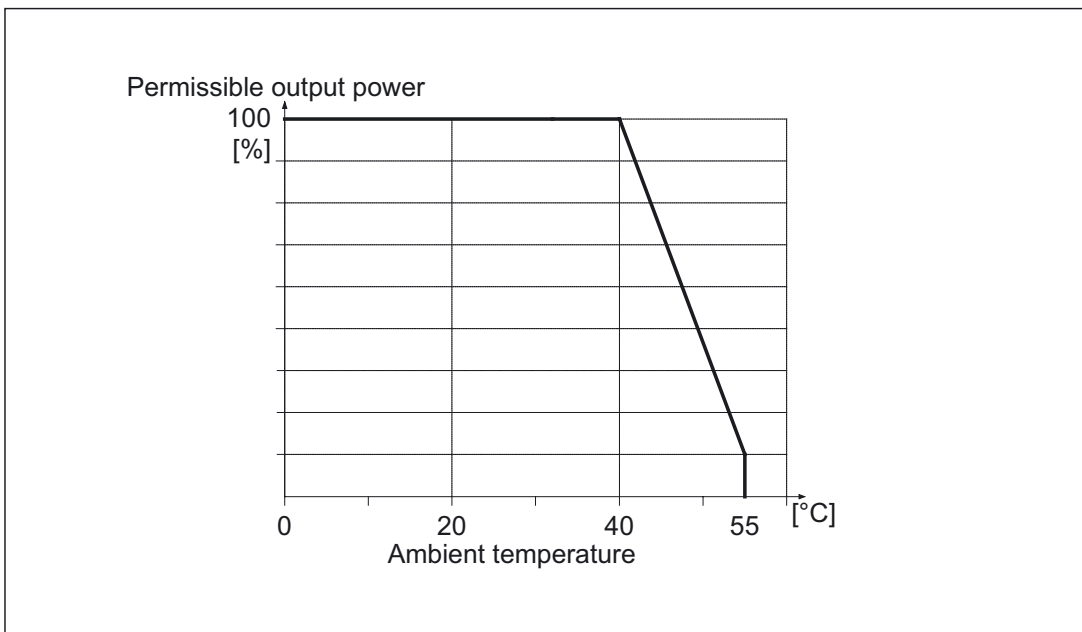


Figure 4-16 Derating as a function of the ambient temperature

Derating as a function of the pulse frequency

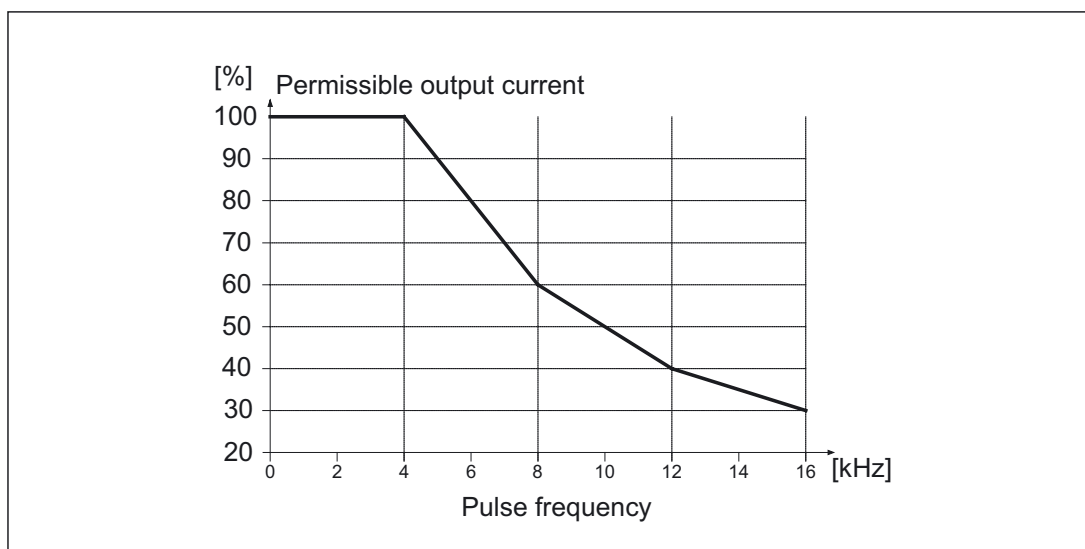


Figure 4-17 Derating as a function of the pulse frequency

Derating as a function of the installation altitude

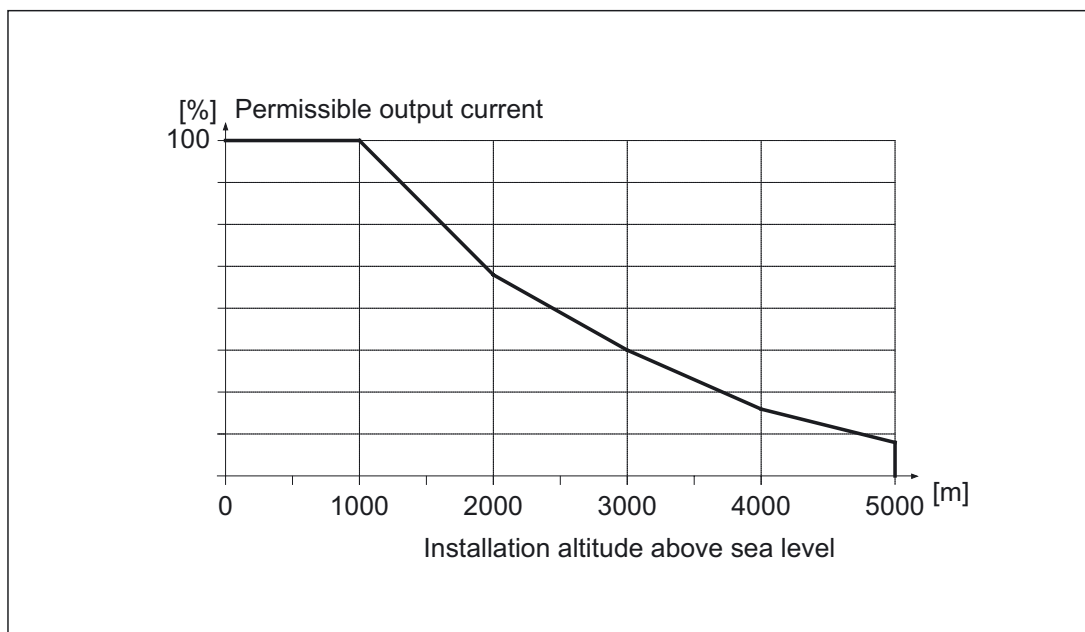


Figure 4-18 Derating as a function of the installation altitude

DC Link Components Booksize

5.1 Braking module booksize

5.1.1 Description

Braking modules can be used to reduce the DC link energy in supply systems without regenerative feedback capability (diesel generator) during controlled braking (e.g. emergency retraction) or for fast discharging of the DC link. The DC link energy is converted to heat loss in an external braking resistor. Several braking modules can be connected in parallel (no more than one braking module per 500 μ F DC link capacitance; the DC link capacitances are given in the relevant technical specifications).

Using braking resistors, the heat loss can be dissipated outside the cabinet. The cable between the braking module and the braking resistor is limited to 10 m.

5.1.2 Safety information



Warning

After disconnecting all the supply voltages, a hazardous voltage will be present in all components for another 5 minutes. The protective cover must not be opened until this time has elapsed.

The DC link protective cover must be released using an insulated screwdriver.



Caution

The DC link discharge voltage hazard warning must be affixed to the modules in the local language.

A set of labels in 12 languages is available using order number: 6SL3166-3AB00-0AAx.

Notice

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

Caution

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

The tightening torque of the DC link busbar screws (1.8 Nm) must be checked before startup.

Note

Using braking resistors not approved by SIEMENS for SINAMICS 6SL31 can destroy them.

5.1.3 Interface descriptions

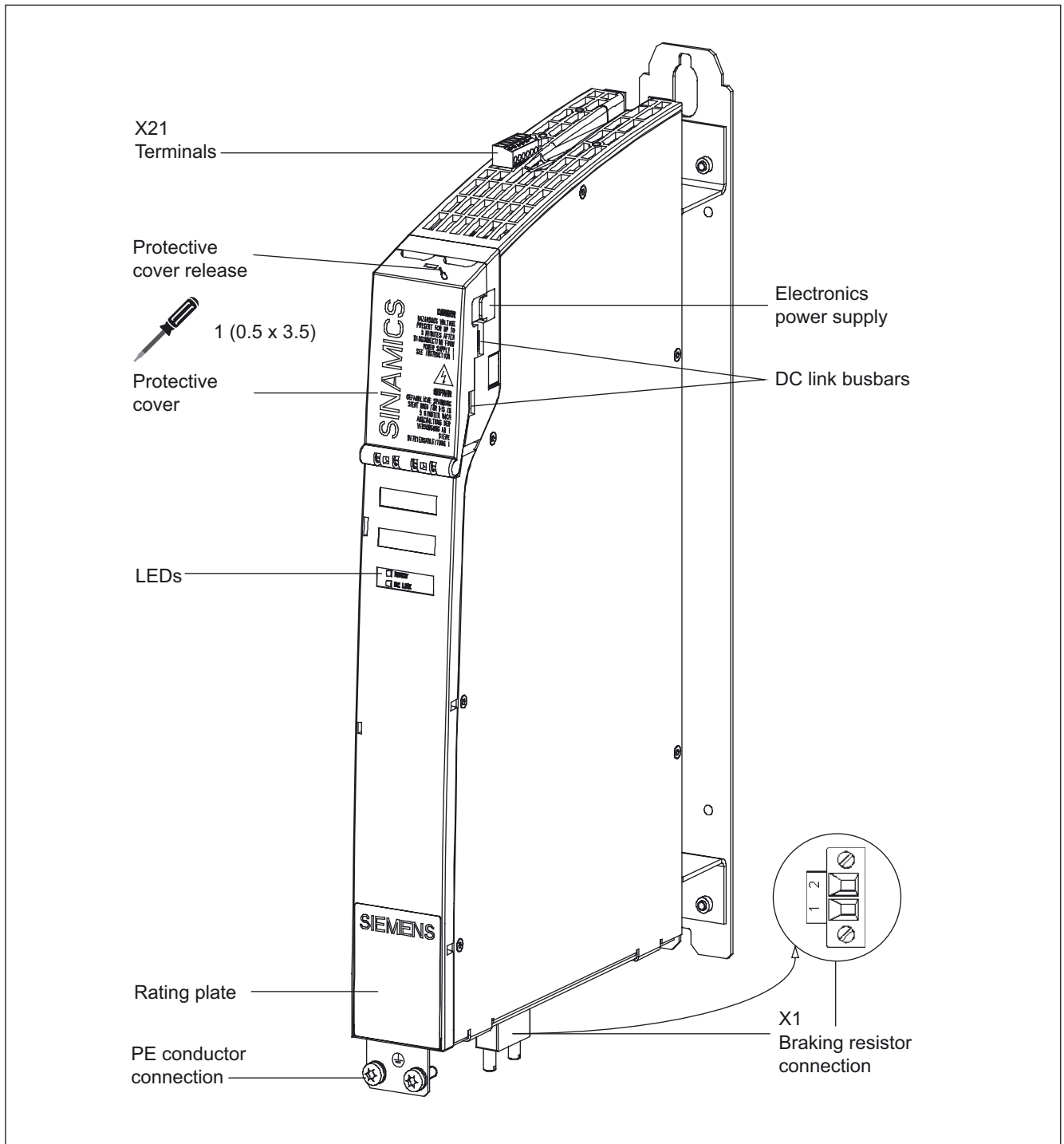


Figure 5-1 Interface description braking module

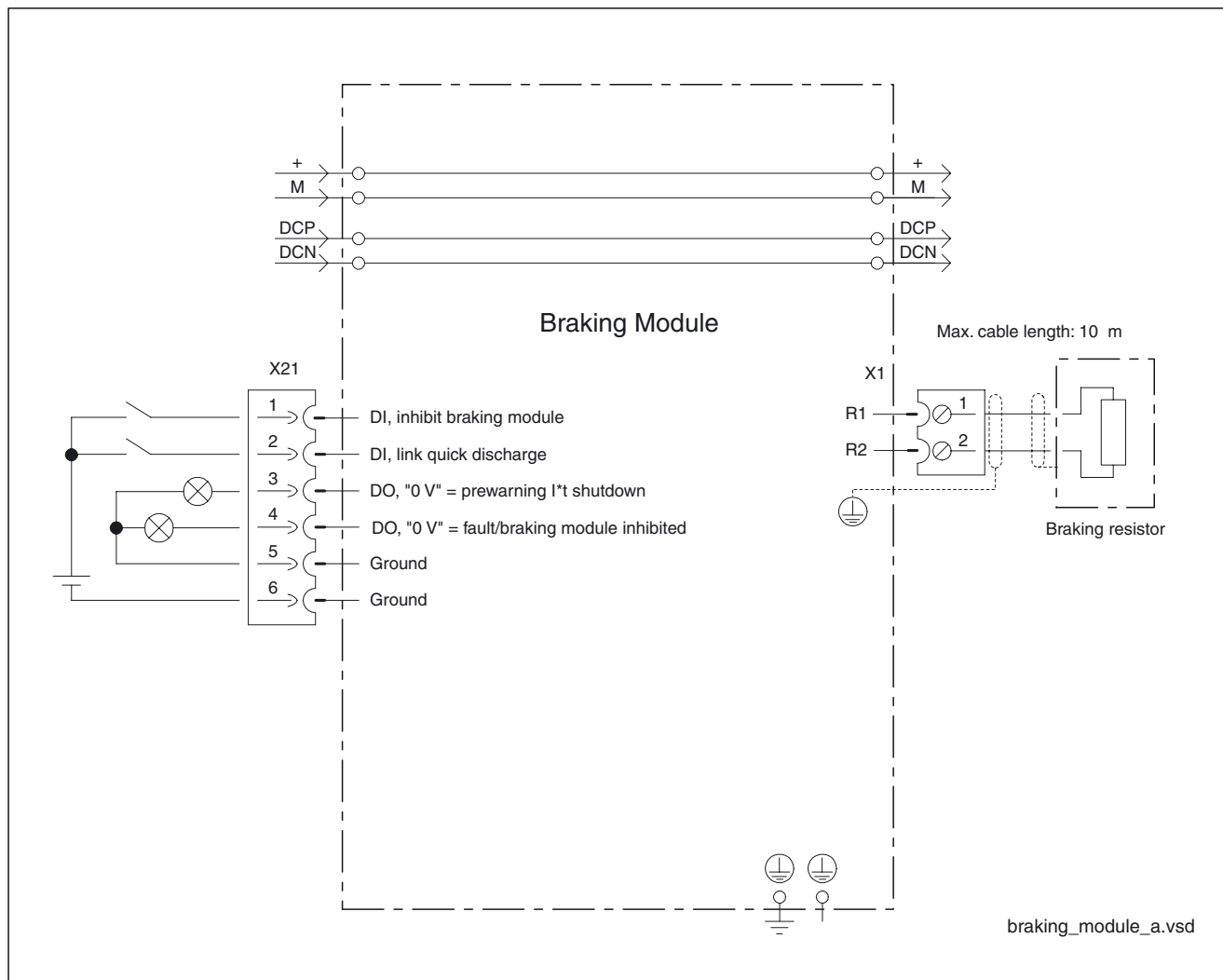
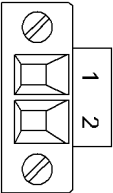


Figure 5-2 Example connection of braking module

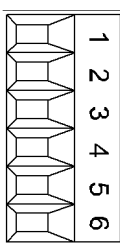
Braking resistor connection X1

Table 5-1 Terminal block X1

	Terminal	Designation	Technical specifications
	1	Braking resistor connection R1	Continued-short-circuit-proof
	2	Braking resistor connection R2	
Max. connectable cross-section: 4 mm²			
Type: Screw terminal 4 (see Connection methods)			

Digital inputs/outputs X21

Table 5-2 Terminal block X21

	Terminal	Name ¹⁾	Technical specifications
	1	DI inhibit braking module / acknowledge error	Voltage: -3 V to 30 V Typical current consumption: 10 mA at 24 V DC
	2	DI DC link fast discharge	Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V
	3	DO, "0 V" = prewarning I*t shutdown	Max. load current per output: Max. 100 mA Continued-short-circuit-proof
	4	DO, "0 V" = fault/braking module inhibited	Voltage: 24 V DC
	5	Ground	
	6		
Max. connectable cross-section 1.5 mm ² Type: Screw terminal 1 (see Connection methods)			

1) DI: Digital input; DO: Digital output; M: Electronic ground

Note

Applying a high signal to terminal X21.1 inhibits the braking module. On a falling edge, pending error signals are acknowledged.

The prewarning for I*t monitoring is output as a high level on reaching 80% of the maximum braking resistor ON time.

Only braking resistors approved by Siemens for this component are identified automatically.

Meaning of the LEDs on the braking module

Table 5-3 Meaning of the LEDs on the braking module

LED	Color	State	Description
READY	-	OFF	Electronics power supply outside permissible tolerance range. Braking module deactivated via terminal.
	Green	Continuous	The component is ready for operation.
	Red	Continuous	- Overtemperature Note: - On overtemperature, the fault cannot be acknowledged until a cooling time has elapsed. I²t monitoring Ground fault/short-circuit
DC LINK	-	OFF	- Electronics power supply outside permissible tolerance range. - DC link discharge not active.
	Green	Flashing	DC link discharge active (braking resistor active).

Note

In the event of an overtemperature, the error cannot be acknowledged until a cooling time of approx. 2 mins has elapsed.

5.1.4 Dimension drawing

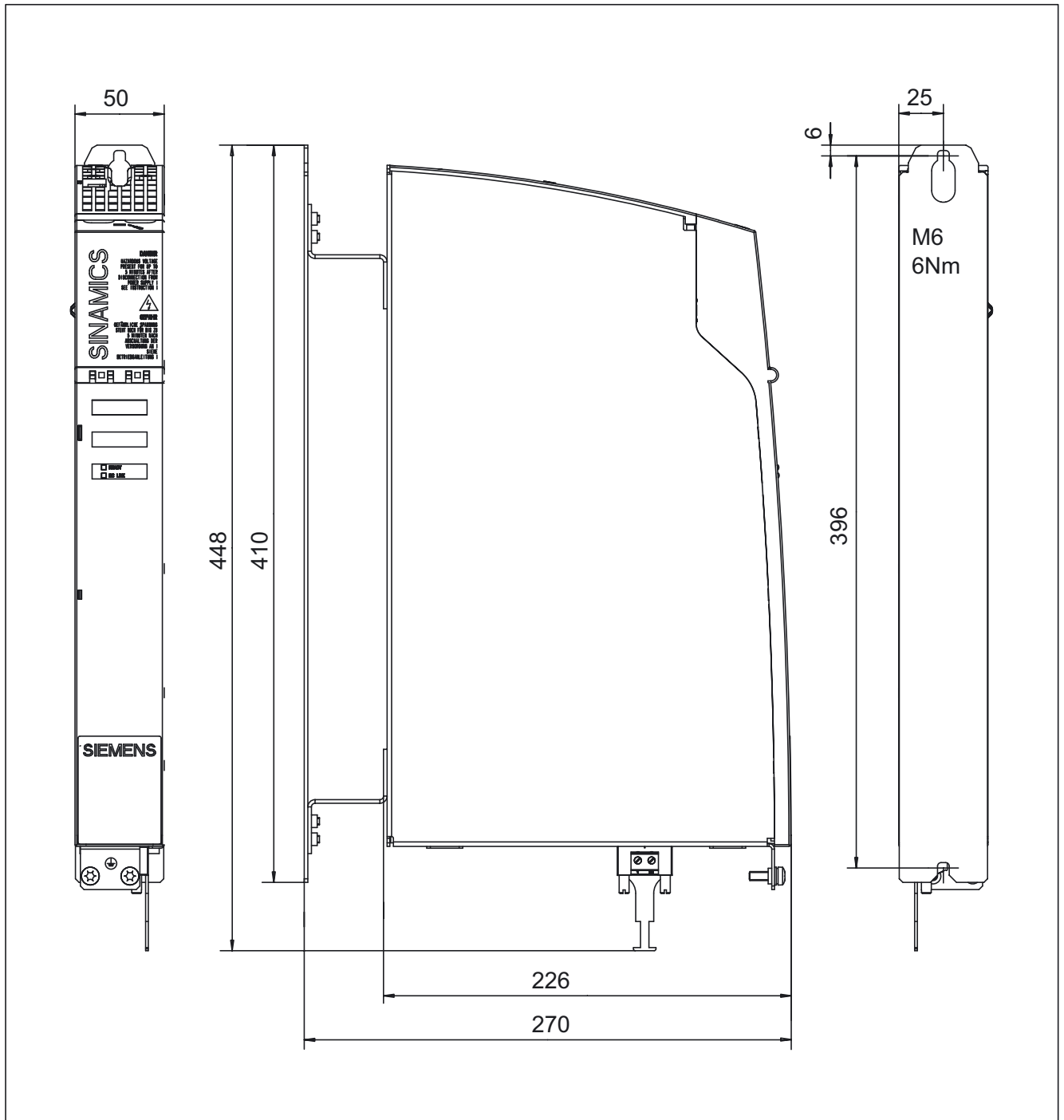


Figure 5-3 Dimension drawing of the braking module

5.1.5 Mounting

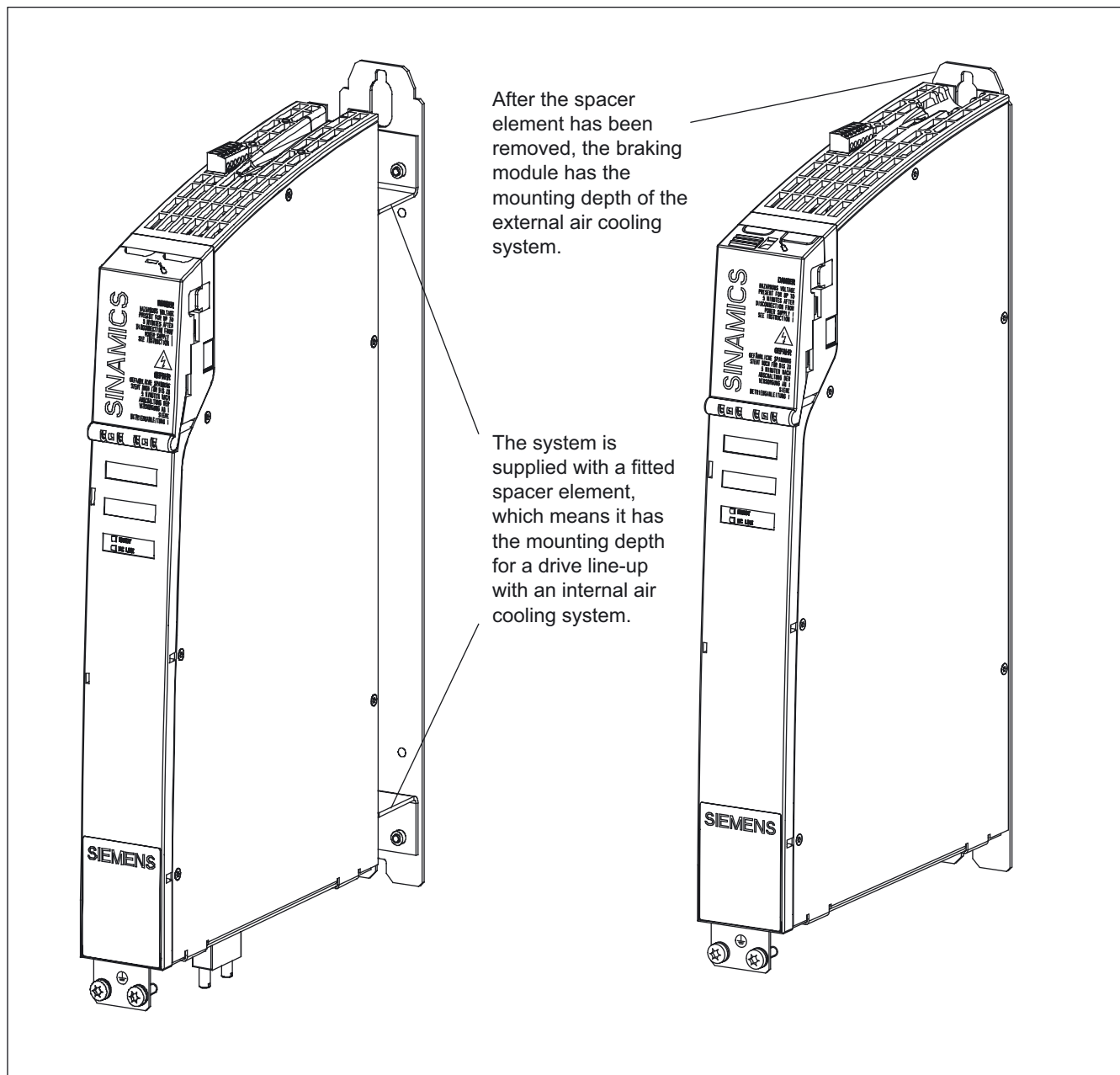


Figure 5-4 Methods of installing braking modules with/without spacer elements

5.1.6 Technical specifications

Table 5-4 Technical specifications

Braking module booksize		
Voltages		
Supply voltages:		
DC link voltage	V_{DC}	510 - 750
ON threshold	V	770
Electronics power supply	V_{DC}	24 (20.4 – 28.8)
Electronics current consumption (at 24 V DC)	A_{DC}	0.2
26 V DC busbar Current capacity	A_{DC}	100
26 V DC busbar Current capacity	A_{DC}	20
Max. braking power	kW	100
Continuous braking power	kW	1.5
• Type of cooling		Natural convection
• Weight	kg	4.1

5.2 Braking resistors

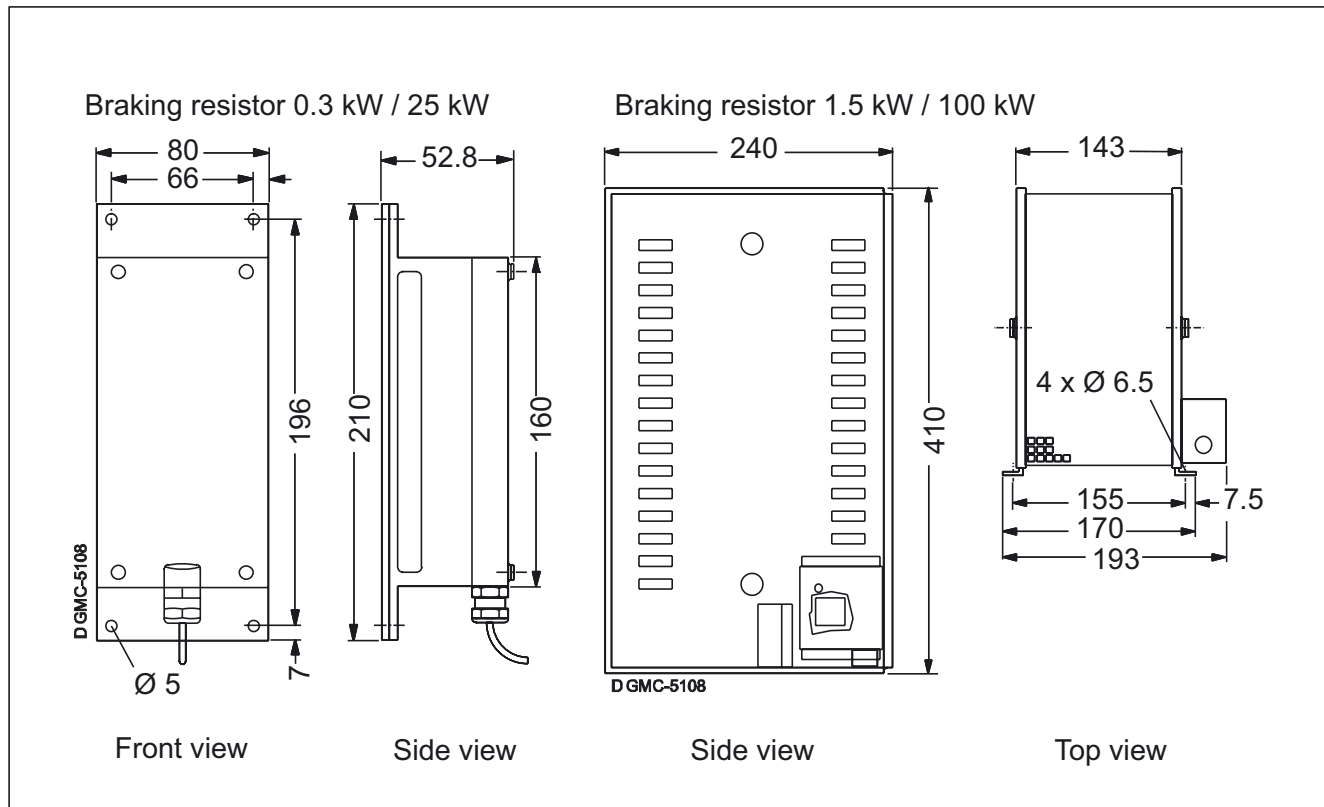


Figure 5-5 Dimension drawings of braking resistors



Caution

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

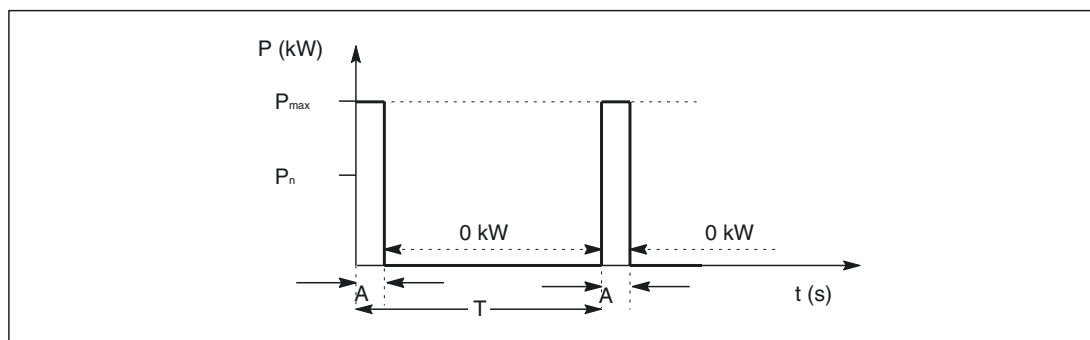


Figure 5-6 Duty cycle for braking resistors

T [s] period duration of braking duty cycle

A [s] load duration

P_n [W] continuous braking power of braking resistor

$P_{\max}$ [W] peak braking power of braking resistor

Table 5-5 Example of duty cycles

	Unit	Braking resistor 6SN1113-1AA00-0DA0	Braking resistor 6SL3100-1BE31-0AAx
$P_{\max}$	kW	25	100
P_n	kW	0.3	1.5
$A =$	s	0.4	2
$T =$	s	33	133
Weight	kg	3.4	5.6
Degree of protection		IP54	IP20

Connection cables

A shielded connection cable (3 m long; 1.5 mm²), which is supplied as standard, is fitted to a braking resistor with 25 kW.

A shielded connection cable (4 mm²), which is supplied as standard, must be connected to a braking resistor with 100 kW.

The maximum cable length for both braking resistors is 10 m.

5.3 Capacitor module booksize

5.3.1 Description

Capacitor modules are used to increase the DC link capacitance to bridge momentary power losses.

Capacitor modules are connected to the DC link voltage via the integrated DC link busbars. Capacitor modules function autonomously.

5.3.2 Safety information



Warning

After disconnecting all the supply voltages, a hazardous voltage will be present in all components for another 5 minutes. The protective cover must not be opened until this time has elapsed.

The DC link protective cover must be released using an insulated screwdriver.



Caution

The DC link discharge voltage hazard warning must be affixed to the modules in the local language.

A set of labels in 12 languages is available using order number: 6SL3166-3AB00-0AAx.

Notice

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

Notice

The capacitor module is precharged by the line module. The relevant charging limits of the line modules must be taken into account.

5.3.3 Interface description

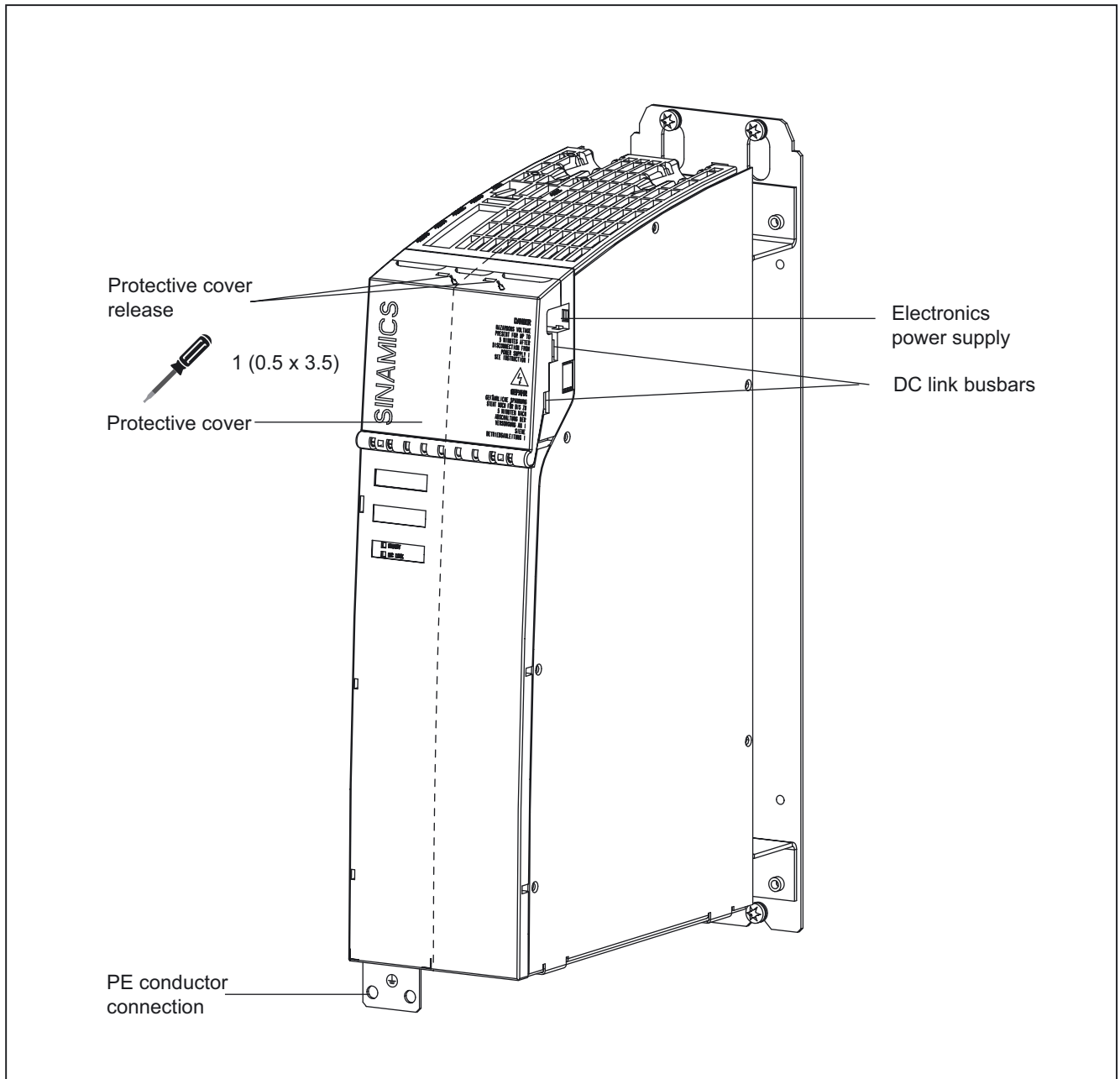


Figure 5-7 Interface description of the capacitor module

5.3.4 Dimension drawing

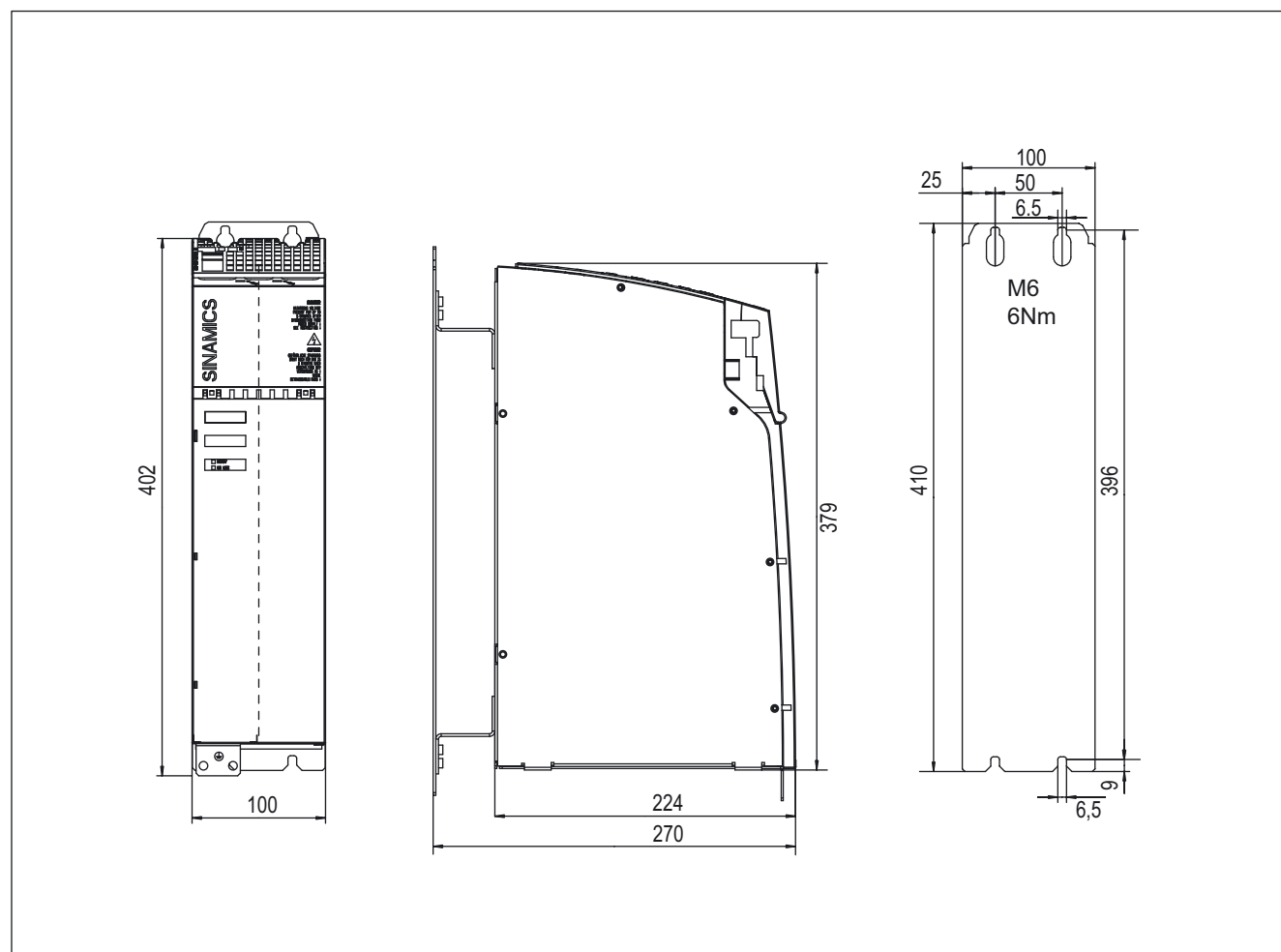


Figure 5-8 Dimension drawing of the capacitor module

5.3.5 Installation

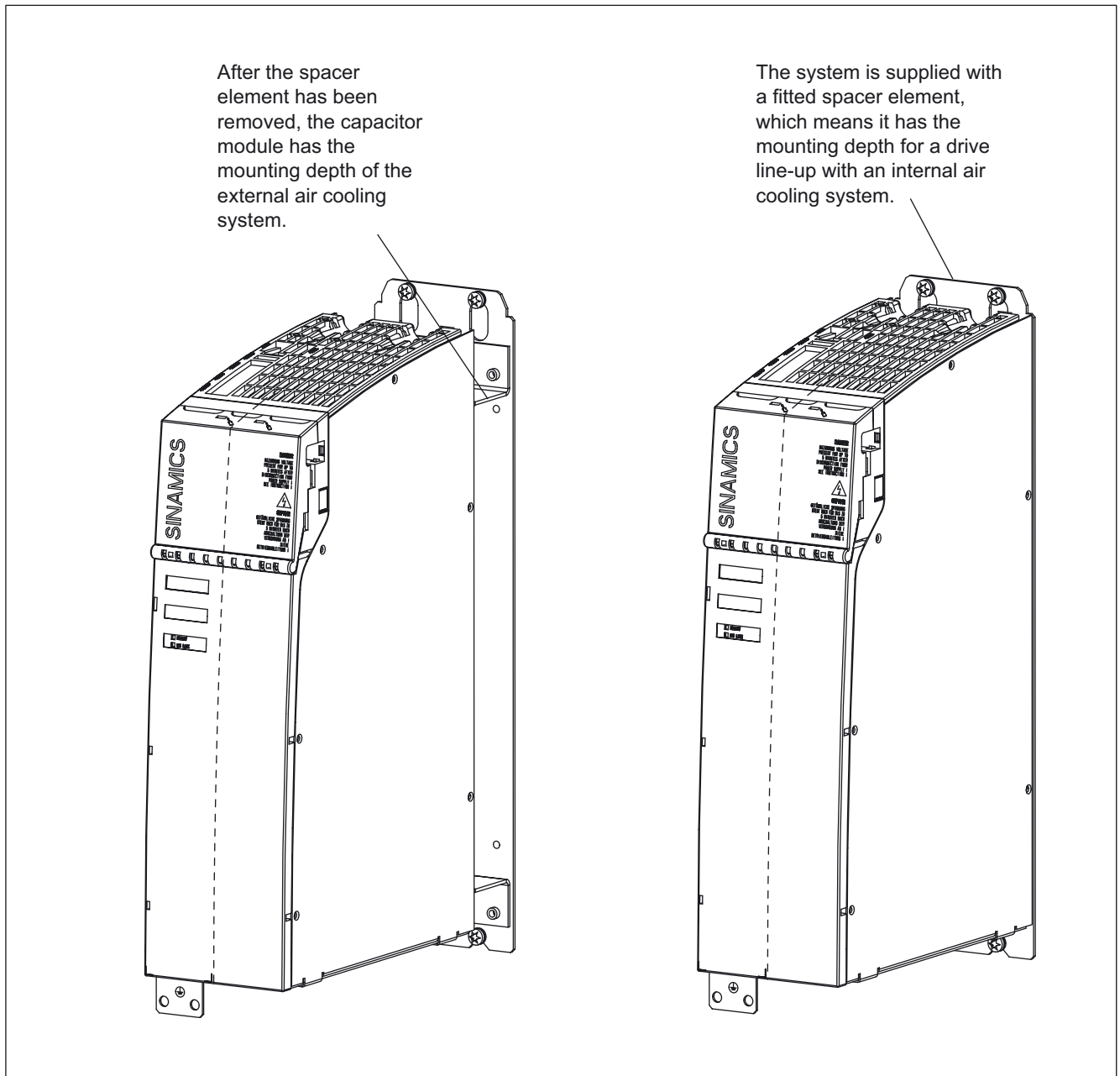


Figure 5-9 Installing a capacitor module with/without spacer elements

The capacitor module can be attached to the cabinet with or without spacer elements.

5.3.6 Technical specification

Table 5-6 Technical specifications

Capacitor module		
Connection voltages:		
Line voltage	V_{ACrms}	3AC 380 -10% to 3AC 480 +10% (-15% < 1 min)
Line frequency	Hz	47 to 63 Hz
Electronics power supply	V_{DC}	24 (20.4 – 28.8)
DC link voltage	V_{DC}	510 - 750
Capacitance	μF	4000
24 V DC busbar current capacity	A	20
DC link busbar current capacity	A	100
Weight	kg	7.2

5.4 Control supply module (available soon)

5.4.1 Description

The control supply module provides the electronics with power via the supply system or DC link.

During emergency retraction, the control supply module provides a 24 V supply independently of the line voltage.

Benefits:

- No wiring
- Compact design
- Higher AC/DC input range (323-576 V_{AC}, 300-800 V_{DC})
- Power loss ride-through (provided that 300 V is present in the DC link (> 6 ms))

5.4.2 Safety information



Warning

After disconnecting all the supply voltages, a hazardous voltage will be present in all components for another 5 minutes. The protective cover must not be opened until this time has elapsed.

The DC link protective cover must be released using an insulated screwdriver.

Caution

The DC link discharge time hazard warning must be affixed to the modules in the local language.

A set of labels in 12 languages is available using order number: 6SL3166-3AB00-0AAx.

Notice

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

Caution

The tightening torque of the DC link busbar screws (1.8 Nm) must be checked before startup.



Danger

In addition to the line module, the control supply module must be disconnected from the supply system to electrically isolate the DC link from the supply network.

If a selectively tripping AC/DC-sensitive residual-current circuit-breaker is used, the control supply module must be connected downstream of this.

5.4.3 Interface description

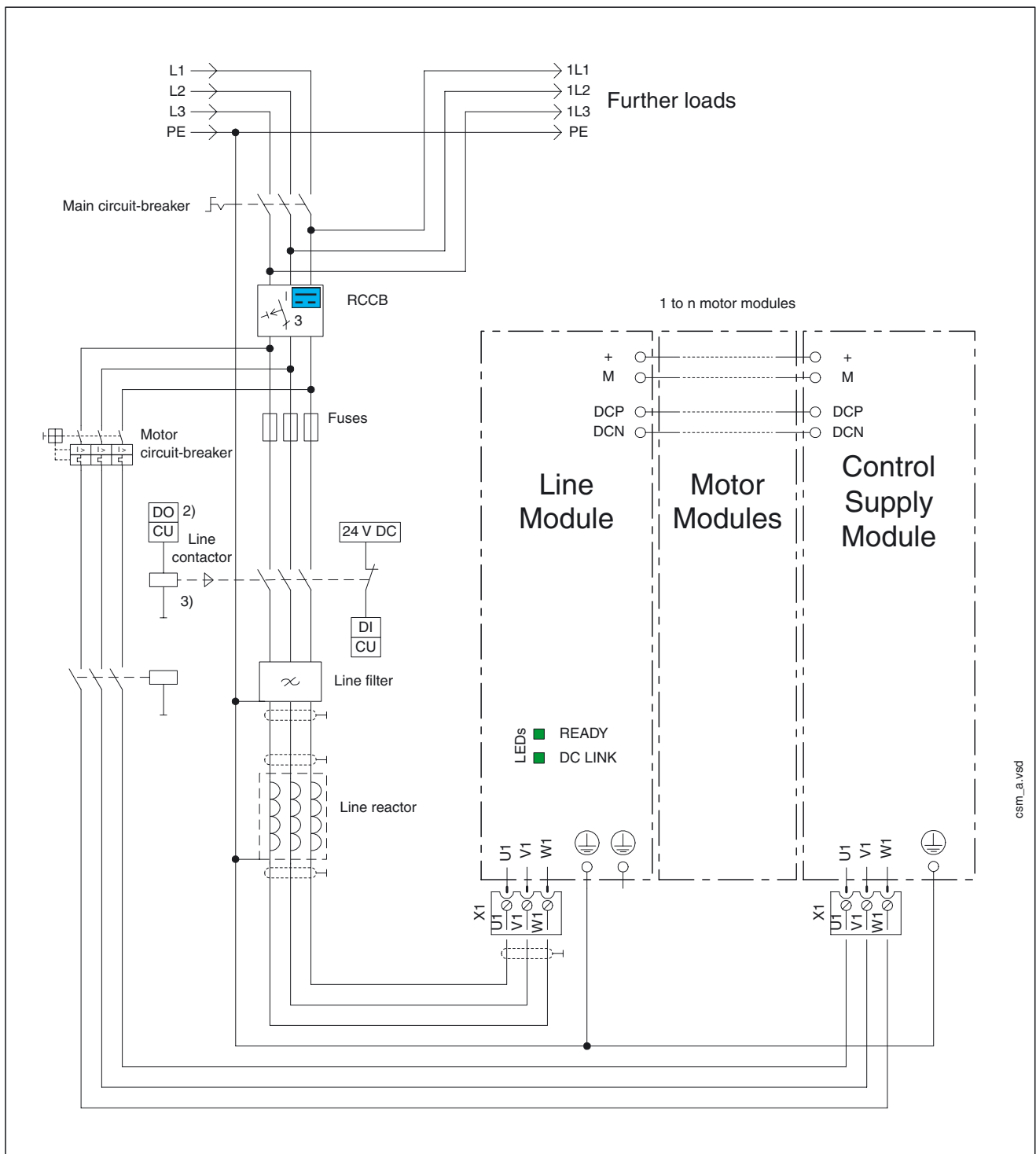


Figure 5-10 Example connection of control supply module

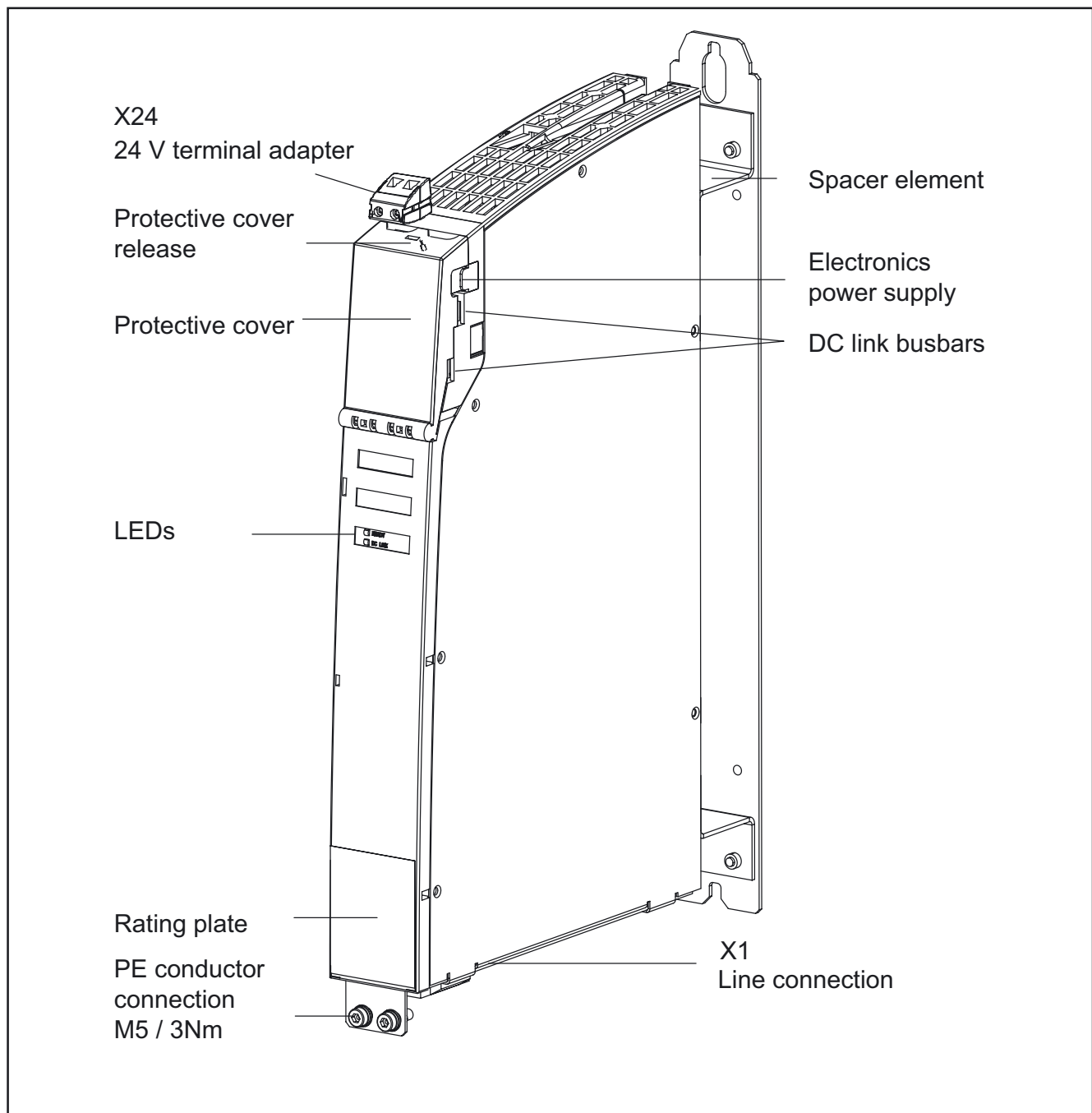


Figure 5-11 Interface description control supply module

Table 5-7 Control supply module - description of the LEDs

LED	Color	State	Description
READY	-	OFF	Electronics power supply outside permissible tolerance range.
	Green	Continuous	Ready for operation. Output voltage within tolerance range.
	Red	Continuous	Overcurrent tripping or overtemperature.
DC LINK	-	OFF	Electronics power supply outside permissible tolerance range. Inactive.
	Orange	Continuous	DC link voltage within permissible tolerance range (only when ready for operation).
	Red	Continuous	No power in the DC link; component is supplied with power from supply system.

5.4.4 Dimension drawing

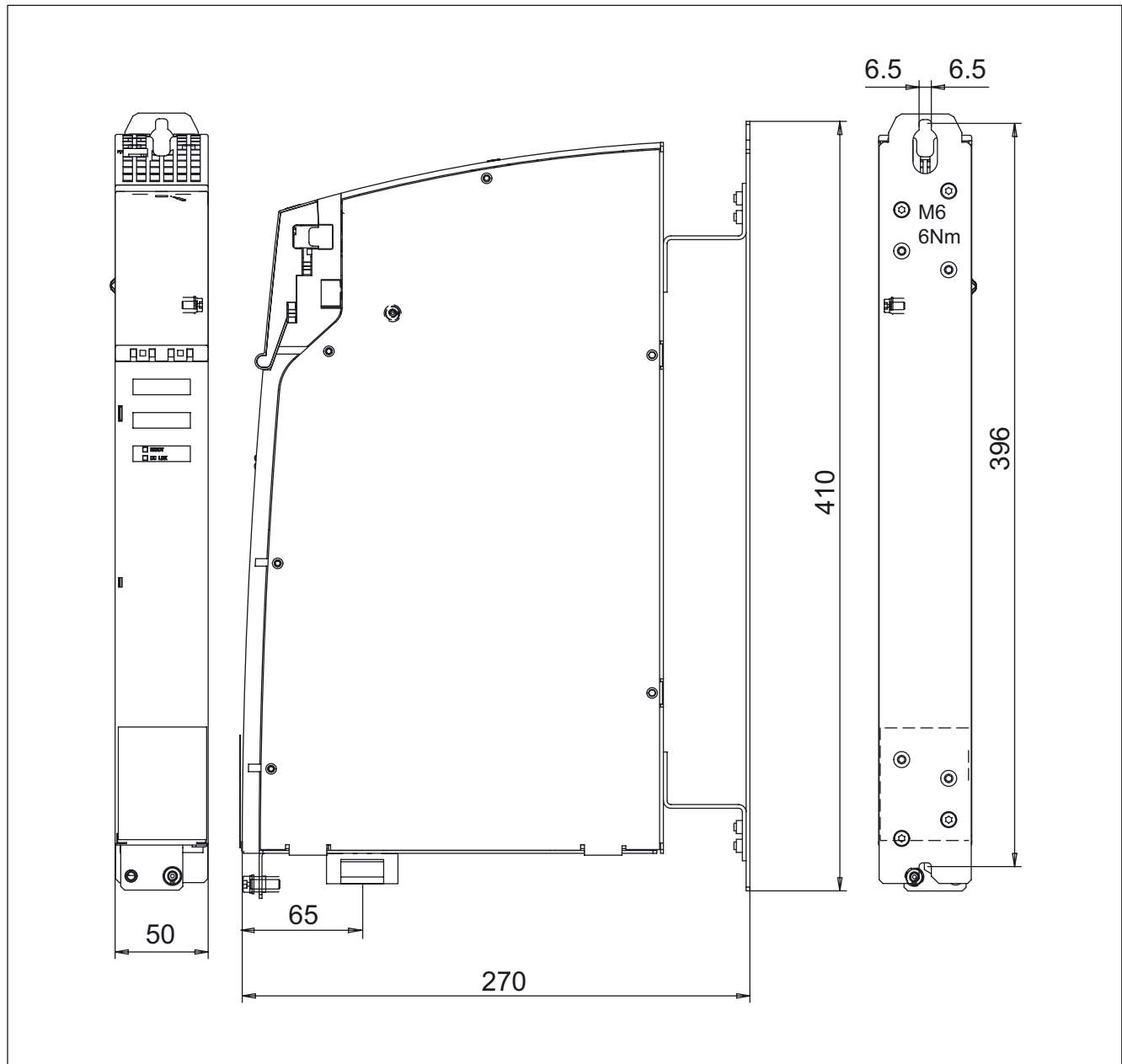


Figure 5-12 Dimension drawing of the control supply module

5.4.5 Technical specification

Table 5-8 Technical specifications

Control supply module	Unit	Value
Input data		
Line voltage	V _{AC}	3AC 380 -10% to 3AC 480 +10% (-15% < 1 min)
Line frequency	Hz	47 to 63
Connection currents		
Rated value	A _{AC}	Approx. 2.2
Switch-on current limit (+25 °C)	A _{AC}	Approx. 10
Power loss ride-through (at 400 V _{AC})	ms	> 6
DC link voltage	V _{DC}	600
Supply current (at 600 V)	A _{DC}	1.1
Output data		
Output voltage	V _{DC}	26 +/- 2%
Output current	A _{DC}	20
Startup to short-circuit	A _{DC}	≤ 24
Short-circuit during operation	A _{DC}	Normally 23 (continuous)
26 V DC busbar current capacity	A _{DC}	20
Efficiency U _{aRated} I _{aRated}	-	Approx. 0.9
Residual ripple (clock frequency approx. 50 kHz)	mV _{pp}	< 100
Cycle peaks (bandwidth 20 MHz)	mV _{pp}	< 200
Weight	kg	4.8

Cabinet Configuration and EMC Booksize

6.1 Information

6.1.1 General

SINAMICS S series components are designed for mounting in an enclosure, for example because of the required degree of shock protection. Cabinets are the type of enclosure normally used but other mounting compartments affording protection against shock and harmful environmental influences may be used. The applicable standard is EN 60439-1.

Low-voltage switchgear and controlgear assemblies

Part 1: Type-tested and partially type-tested low-voltage switchgear assemblies

If the SINAMICS S drive line-up is used for the electrical equipment of machines, the applicable requirements of EN 60204-1 must also be adhered to.

Safety of machinery

Electrical equipment of machines

Part 1: General requirements

All information for device selection in this section applies to

- Operation in a TN system
- Operating voltage range 3AC 360 V to 3AC 440 V

6.1.2 Safety information

Note

When installing the equipment in cabinets, the ventilation slots must be covered to prevent drill swarf, wire end ferrules, and the like from falling into the housing.

Safety regulations governing shock protection must be observed. See also EN 60204–1.

Caution

The tightening torque of the DC link busbar screws (1.8 Nm) must be checked before startup.

To ensure that the encoder system works properly, you are advised to use the original Siemens accessories from catalogs D21.2 and NC Z.

Only motors with a safe electrically isolated holding brake may be connected. The brake conductors must also be safely electrically isolated.

If the motor power cable is connected to intermediate terminals, the power cables and brake cables must be routed apart (≥ 300 mm).



Warning

Cable shields and unused conductors of power cables (e.g. brake conductors) must be connected to PE potential.

Non-observance can cause lethal shock voltages.

6.1.3 Directives and standards

The following directives and standards apply within the European Union:

Table 6-1 Directives

Directive	Description
73/23/EEC	Directive of the Council of February 19, 1973, on the approximation of the laws of the member states relating to electrical equipment designed for use within certain voltage limits Low-Voltage Directive
98/37/EC	Directive of the Council of August 12, 1998, on the approximation of laws of the member states relating to machinery Machine Directive
93/68/EEC	Directive of the Council on the approximation of laws of the member states relating to electromagnetic compatibility EMC Directive

Conformance with the harmonized standards is an indication of conformance with the basic requirements of these laws.

The following table lists some application-relevant standards:

Table 6-2 Standards

Standard	Description
EN 292-1	Safety of machinery General principles for design Part 1: Basic terminology, methodology
EN 292-2	Safety of machinery General principles for design Part 2: General requirements
EN 954-1	Safety of machinery General principles for design Part 1: Safety-related parts of control systems
EN 1037	Safety of machinery Prevention of unexpected startup
EN 1921	Safety of integrated manufacturing systems
EN 50081-2	Electromagnetic compatibility (EMC) Generic standard emission Part 2: Industrial environments
EN 50178	Electronic equipment for use in power installations
EN 60204-1	Safety of machinery Electrical equipment of machines Part 1: General requirements

Standard	Description
EN 60439-1	Low-voltage switchgear and controlgear assemblies Part 1: Type-tested and partially type-tested assemblies
EN 60529	Degrees of protection provided by enclosures
EN 61000-6-2	Electromagnetic compatibility (EMC) Part 2: Generic standard immunity, industrial environments
EN 61800-3	Adjustable speed electrical power drive systems Part 3: EMC product standard including specific test methods
UL 508C	Power conversion equipment

6.2 Selection of devices required for operation of SINAMICS

6.2.1 General

The following components are required for connection to the power supply network:

- Line Disconnecting Device
- Line fuse
- Line contactor (required with electrical isolation)
- Line filter (see Line Connection)
- Line reactor (see Line Connection)

6.2.2 Information about line isolating devices

A line disconnecting device for the electrical equipment may be used for correct isolation of the drive line-up from the power supply. The line disconnecting device must be suitable for electrical equipment of machinery in conformance with the requirements of EN 60204-1, Section 5.3. The relevant technical specifications must be taken into account during selection. Further loads of the electrical equipment must be included in the selection where applicable.

The line disconnecting device must be fitted with a leading auxiliary switch ($t \geq 10$ ms), which must be integrated in the switching-off path of the active line modules (EP terminals).

The necessary accessories for line disconnecting devices must be selected from the appropriate manufacturer catalogs. See also catalog D21.2.

6.2.3 Overcurrent protection by line fuse or circuit-breaker

The cables for the drive line-up power supply must be protected against overcurrent. LV HBC, D-type, and DO-type fuses with a gL characteristic or suitable circuit-breakers can be used.

The following tables list the requirements regarding line fuses and circuit-breakers for the active line modules and smart line modules.

Table 6-3 Requirements regarding line fuses and circuit-breakers for the active line modules

	16 kW	36 kW	55 kW	80 kW	120 kW
$I_{\text{rated fuse}}$	35 A	80 A	125 A	160 A	250 A
$I_{\text{fuse 0.2s}}$	>180 A	>360 A	>450 A	>650 A	>865 A
$I_{\text{fuse 4s}}$	>130 A	>260 A	>350 A	>505 A	>675 A
$I_{\text{fuse 10 s}}$	>100 A	>200 A	>250 A	>360 A	>480 A
$I_{\text{fuse 240 s}}$	>60 A	>135 A	>200 A	>280 A	>380 A

Table 6-4 Requirements regarding line fuses and circuit-breakers for the smart line modules

	5 kW	10 kW
$I_{\text{rated fuse}}$	16 A	35 A
$I_{\text{fuse 0.2s}}$	>70 A	>100 A
$I_{\text{fuse 4s}}$	>50 A	>80 A
$I_{\text{fuse 10 s}}$	>42 A	>65 A
$I_{\text{fuse 240 s}}$	>30 A	>45 A

See catalog D21.2

6.2.4 Line contactors

Line contactors are required for electrical isolation of the drive line-up from the power supply network.

For selection of the line contactor, the characteristic values in the technical specifications apply. The cable routing, the bundling factor, and the factor for the ambient temperature according to EN 60204-1 must be taken into account in rating the conductors to be connected.



Caution

Line contactors must not be switched under load.

When the digital output is used to control the line contactor, the make/break capacity must be taken into account.

You are advised to connect overvoltage limiters to the contactor coils to limit the opening overvoltage. See catalog D21.2.

6.3 24 V DC supply voltage

6.3.1 General

The 24 V DC voltage is required for the power supply of

1. The electronics of the SINAMICS components via the integrated 24-V busbar
2. The electronics of the control units, option boards, sensor modules, and terminal modules, as well as the process voltage of their digital inputs
3. The load voltage of the digital outputs
4. The motor holding brakes

Other loads can be connected to these power supply units if they are separately protected from overcurrent.

Notice

If other consumers are connected to the power supply, connected inductance devices (contactors, relays) must be fitted with suitable overvoltage protection circuits.



Warning

Only protective extra-low voltages (PELVs) that comply with EN60204-1 must be connected to all connections and terminals between 0 and 48 V DC.

The voltage tolerances of the motor holding brakes must be taken into account.

6.3.2 Selection of power supply units

You are advised to use the devices in the following table. These devices meet the applicable requirements of EN 60204-1.

Table 6-5 Recommended SITOP Power

Rated output current [A]	Input voltage range [V]	Short-circuit current [A]
5	2AC 85-132/170 – 550	5.5
10	2AC 85-132/176 – 550	30 for 25 ms
20	3AC 320 – 550	23
40	3AC 320 – 550	46

Table 6-6 Recommendation for control supply module

Rated output current [A]	Input voltage range [V]	Short-circuit current [A]
20	3AC 380 -10% to 3AC 480 +10% (-15% < 1 min) DC 300 – 800	< 24 V

See catalog D21.2.

6.3.3 Typical 24-V component power consumption

The following table can be used to calculate the 24 V DC power supply for the components.

Table 6-7 Overview of 24 V DC current consumption with internal cooling

Component	Current consumption [A _{DC}]
CU320 without load	0.8
Per digital output	Max. 0.5 (typ. 0.4)
PROFIBUS Teleservice	Max. 0.15
TB30 (without digital outputs)	< 0.05
per digital output	Max. 0.5 (typ. 0.1)
CBC10	0.05
Active line modules	
16 kW	1.1
36 kW	1.5
55 kW	1.9
80 kW	2
120 kW	2.5
Smart line modules	
5 kW	1.0
10 kW	1.3
Single motor modules	
9 A (+1 x DRIVE-CLiQ; +1 x brake)	0.85 (+ typ. 0.25; + typ. 0.4 - 1.1)
18 A (+1 x DRIVE-CLiQ; +1 x brake)	0.85 (+ typ. 0.25; + typ. 0.4 - 1.1)
30 A (+1 x DRIVE-CLiQ; +1 x brake)	0.9 (+ typ. 0.25; + typ. 0.4 - 1.1)
60 A (+1 x DRIVE-CLiQ; +1 x brake)	1.2
85 A (+1 x DRIVE-CLiQ; +1 x brake)	1.5 (+ typ. 0.25; + max. 2)
132 A (+1 x DRIVE-CLiQ; +1 x brake)	1.5 (+ typ. 0.25; + max. 2)
200 A (+1 x DRIVE-CLiQ; +1 x brake)	1.5 (+ typ. 0.25 + max. 2)
Double motor modules	
2 x 3 A (+2 x DRIVE-CLiQ; +2 x brake)	1.0 (+typ. 0.5 + typ. 1.0 - 2.2)
2 x 5 A (+2 x DRIVE-CLiQ; +2 x brake)	1.0 (+typ. 0.5 + typ. 1.0 - 2.2)
2 x 9 A (+2 x DRIVE-CLiQ; +2 x brake)	1.0 (+typ. 0.5 + typ. 1.0 - 2.2)
2 x 18 A (+2 x DRIVE-CLiQ; +2 x brake)	1.0 (+typ. 0.5 + typ. 1.0 - 2.2)
Braking module	0.5
Sensor modules	
SMC10	Typ. 0.25
SMC20	Typ. 0.25
SMC30	Typ. 0.33
Additional system components	
TM31 (without digital outputs)	typ. 0.12
per digital output	Max. 0.5 (typ. 0.1)

6.3.4 Overcurrent protection

Cables on both the primary and the secondary side of the power supply unit must be protected from overcurrent. Primary side protection must be implemented according to the manufacturer's instructions. Secondary side protection must be rated to deal with the actual conditions. In particular:

- Loading due to loads, possibly the simultaneity factor in response to machine operation
- Current capacity of the conductors used and cables in normal and short-circuit conditions
- Ambient temperature
- Cable bundling (e.g. laying in a common duct)
- Cable laying method to EN 60204-1

EN 60204-1, Section 14, can be used to determine the overcurrent protection devices.

The recommended overcurrent protection devices on the primary side are circuit-breakers as specified in Siemens catalog NSK.

The recommended overcurrent protection devices on the secondary side are MCBs. The MCBs can be selected according to Siemens catalog I1.2.

The 24 V DC power supply of booksize

- Line modules
- Motor modules
- Braking modules
- Capacitor modules
- Control supply modules

is implemented in the components by means of a 24 V busbar for 24 V DC and reference potential. The current capacity of these bars is 20 A. The power supply is connected via a 24 V terminal adapter. MCBs are recommended to protect the cables from overcurrent. These overcurrent protection devices also protect the 24 V busbars. To protect against ground faults, the ground potential must be connected to the protective conductor system.

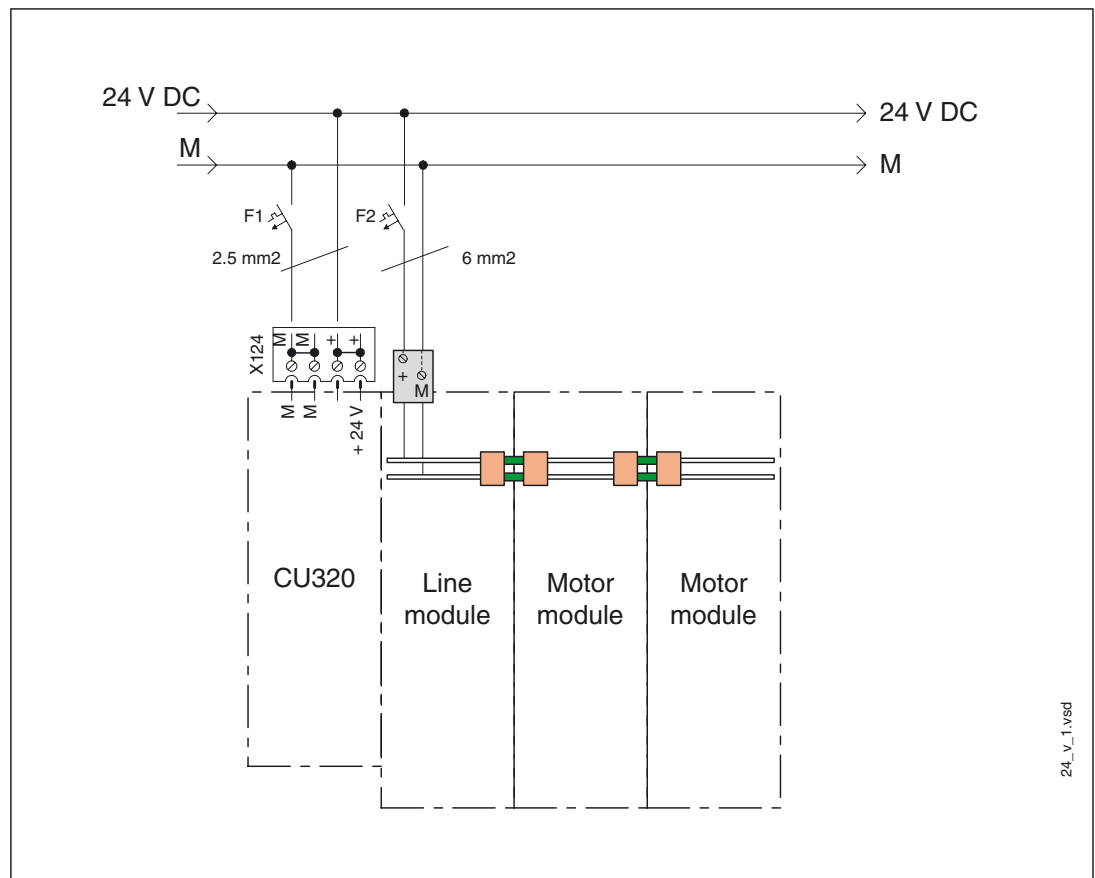


Figure 6-1 Example of 24 V DC fuse protection

The following conditions apply to the cables when the MCBs are selected from the following table:

- Ambient temperature 40 °C or 55 °C
- Max. 1 conductor pair, bundled
- Conductor limit temperature 70 °C for normal operation
- Cable length max.:
 - 10 m for the supply cables
 - 30 m for signal lines
- To be routed separately from other cables and conductors carrying operating current
- Cable type: PVC conductor cable

6.3 24 V DC supply voltage

Table 6-8 MCBs by conductor cross-section and temperature

Conductor cross-section	Max. value up to 40 °C	Max. value up to 55 °C
1.5 mm ²	10 A	10 A
2.5 mm ²	20 A	10 A
4 mm ²	25 A	16 A
6 mm ²	32 A	25 A
24 V busbar	20 A	20 A

The trip characteristic of the MCBs must be selected to match the loads to be protected and the max. current provided by the power supply unit in the event of a short-circuit.

Example for calculating 24 V DC current requirements

Table 6-9 Example of 24 V DC current requirements

Component	Number	Current consumption [A]	Total current consumption [A]
CU320	1	0.4	0.4
8 digital outputs	8	0.1	0.8
Active line module 36 kW	1	1.7	1.7
Motor module 18 A	2	0.7	1.4
Motor module 30 A	3	0.8	2.4
SMC20	10	0.25	2.5
Brake	5	1.1	5.5
Total:			14.7

6.4 Arrangement of components and devices

6.4.1 General

The arrangement of the components and equipment takes account of

- Space requirements
- Cable routing
- Heat dissipation
- EMC

Components are usually located centrally in a cabinet.

6.4.2 Drive line-up

Due to the current capacity of the DC link busbars and their function, the components must be arranged according to the following rule. From left to right

- Line module
- Motor modules in order of power from the highest power to the lowest power
- DC link components (e.g. braking module, control supply module, capacitor module)

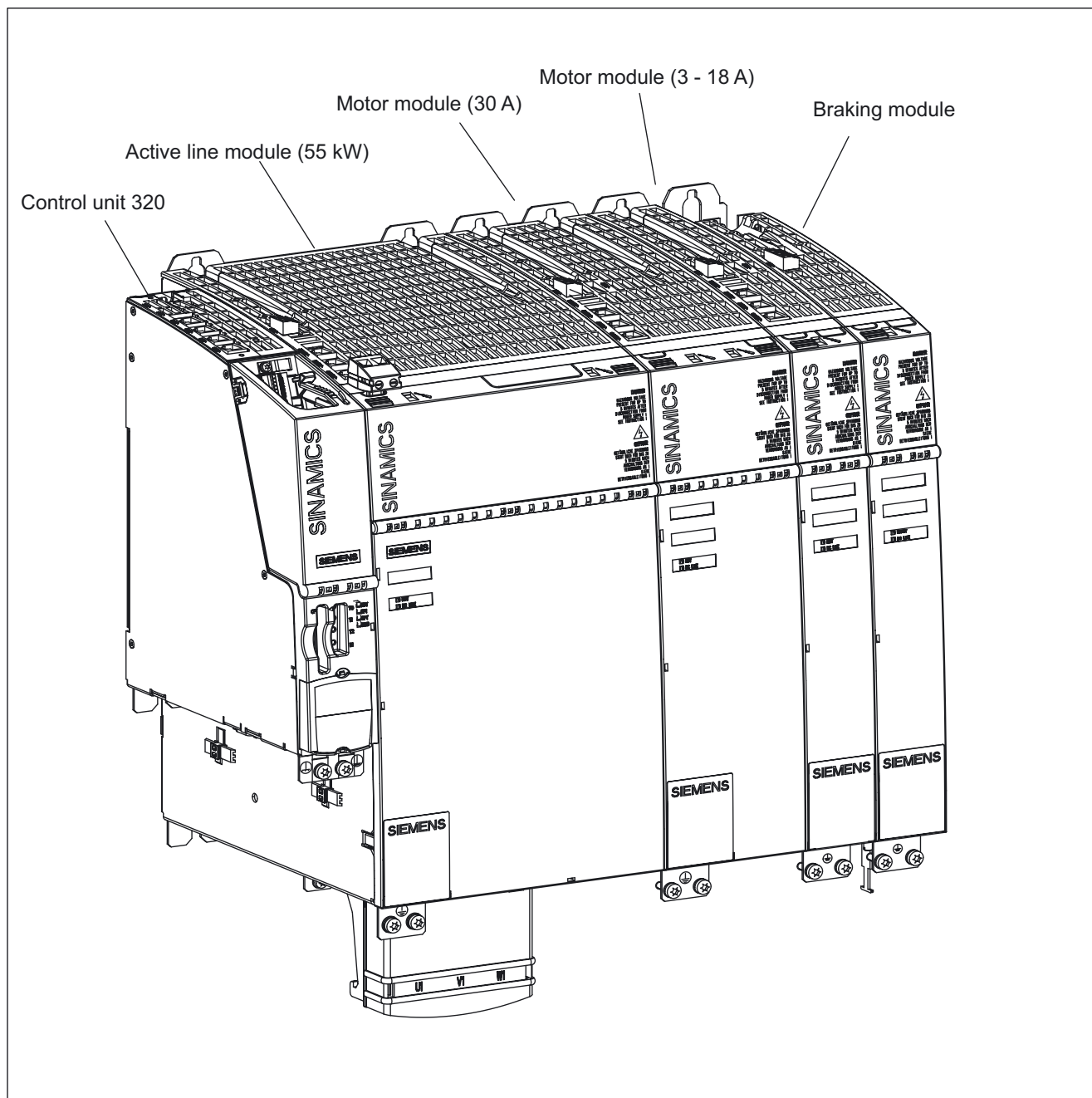


Figure 6-2 Example of a drive line-up

Note

When the power supply input is on the right-hand side of the drive line-up (e.g. in a multiple-tier configuration), the above rules apply in reverse.

The components of the drive line-up should preferably be installed on a conductive mounting surface to ensure low impedance between the component and the mounting surface. Mounting plates with a galvanized surface are suitable.

The components can be arranged in one or more tiers. In a multiple-tier arrangement, vertical installation or, in a cabinet row, side-by-side installation in different cabinet sections is possible.

To determine the cross-section, use the DC link busbar current capacity given in the relevant technical specifications.

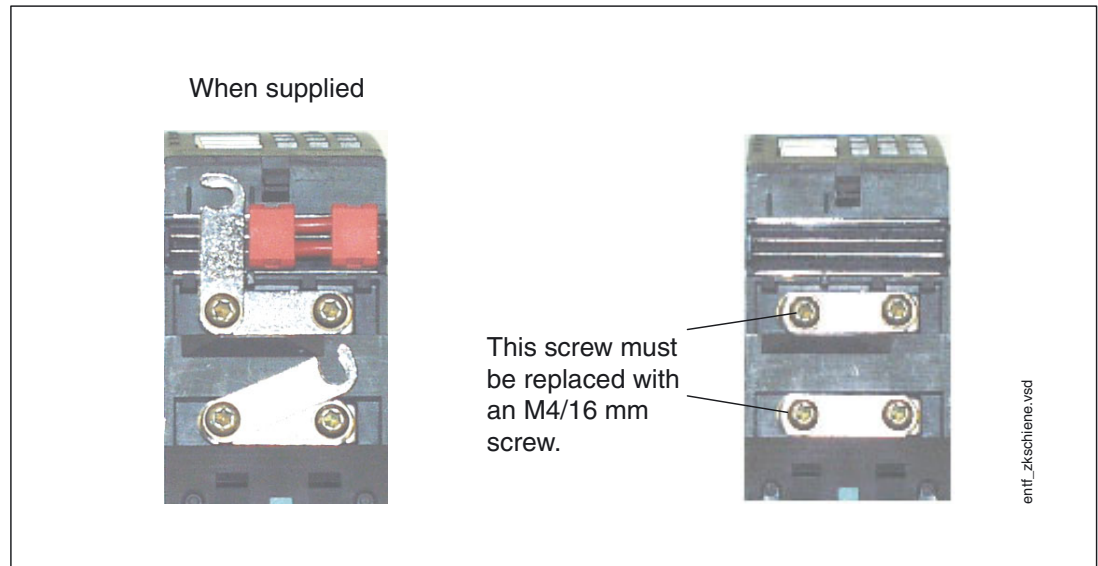


Figure 6-3 Removing the DC link bridges (two-tier arrangement)

The DC link bridges must be removed by unscrewing the M4 screws.

Caution

When the power supply input is on the right-hand side of the drive line-up and the last motor module is 50mm wide, the DC link bridges must be removed.

Continuation of the DC link with the DC link adapter (installation above) external to the components is achieved using single-core, finely-stranded and shielded cables that are laid so as to ensure they are short-circuit and ground-fault proof.

Two-tier configuration

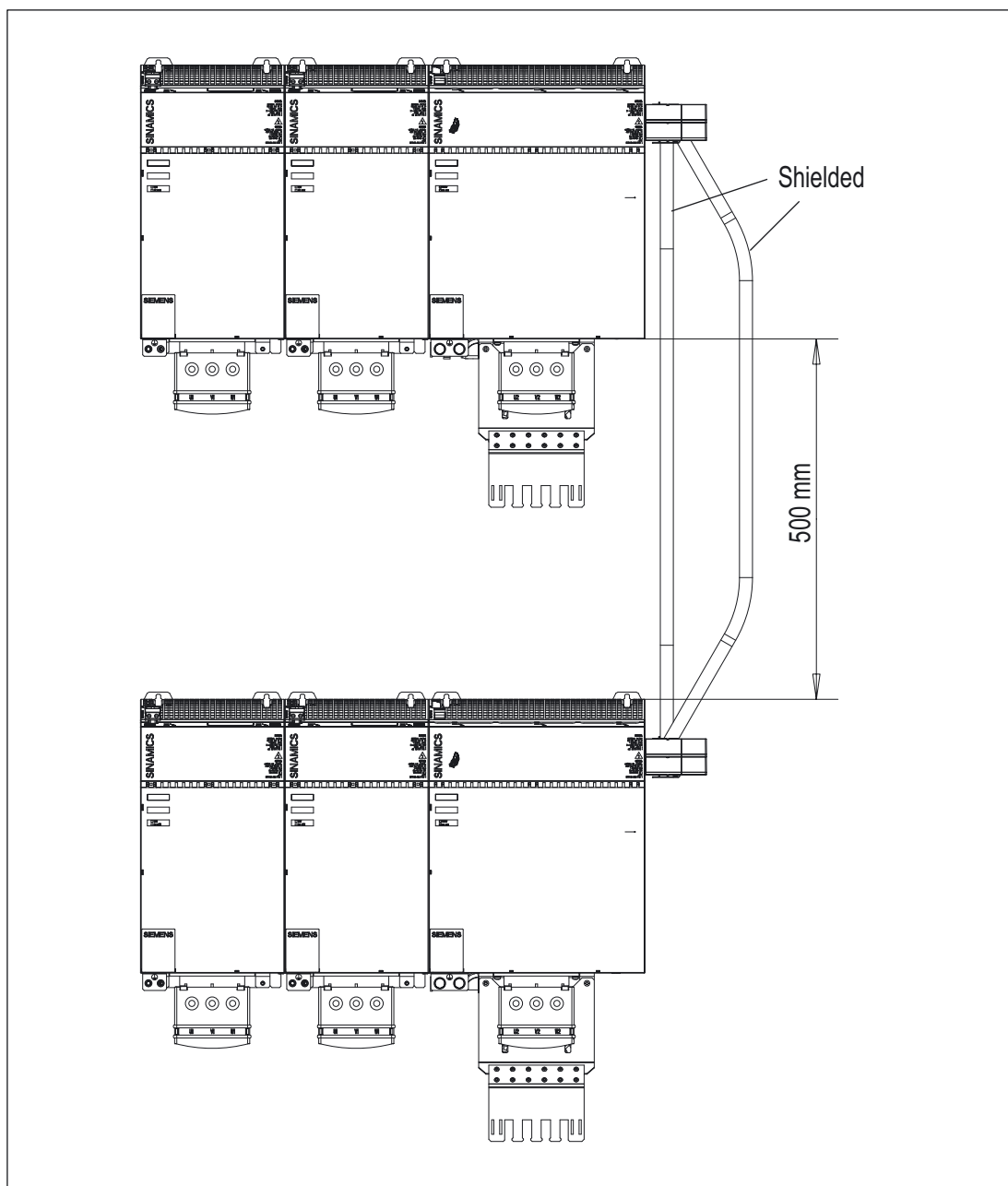


Figure 6-4 Example of a two-tier configuration with modules between 200 and 300 mm wide

The distance between the two module rows depends on the wiring and cable cross-section. For modules with a width of between 50 and 100 mm, the distance between the upper and lower module row must be at least 300 mm. For modules with a width of between 150 and 300 mm, the distance between the upper and lower module row must be at least 500 mm.

Caution

Signal cables must not be routed parallel to power cables.

6.5 Information about electromagnetic compatibility (EMC) and cable laying

6.5.1 General

EMC requirements can be found in EN 60439-1 and recommendations in EN60204-1. For the installation of components in cabinets, the following conditions must also be fulfilled to ensure compliance with the EMC Directive:

- Operation in TN systems with SINAMICS line filters
- Observance of information about cable shielding and equipotential bonding
- Use of recommended Siemens power and signal cables.

6.5.2 Cable shielding and laying

In order to comply with the EMC requirements, certain cables must be routed apart from other cables and from certain components. To meet these requirements, cables must be shielded as follows:

- Power supply cables between the line power outlet and the line filter, unless
 - The distance between cables upcircuit of the filter and downcircuit of the filter is ≥ 300 mm
 - The distance between the cables downcircuit of the line filter and the control unit ≥ 100 mm
- All motor cables (brake cables can also be part of the motor cable)
- Cables for “fast inputs” of the control unit
- Cables for analog inputs/outputs
- Signal lines for sensors
- Temperature sensor cables

The cable shields The cable shields must be connected as close to the conductor terminal connections as possible to ensure a low-impedance connection with cabinet ground. For Siemens power cables in which the shield is connected to the connector shell (see relevant catalog), this is a sufficiently good shield contact.

With components that do not have any special shield connection or where the shield connection is not sufficient, the cable shields can be connected to the metal mounting plate using hose clamps and toothed rails. The cable length between the shield contact point and the terminals for cable conductors must be kept as short as possible.

Shield contact plates with pre-prepared clip contacts are available for contacting the shields for power cables of line modules and motor modules. Up to a module width of 100 mm, these plates are part of the scope of supply of the components, or they are integrated in the connector.

All cables inside the cabinet must be connected as closely as possible to parts connected with cabinet ground, such as a mounting plate or cabinet wall. Ducts made of sheet steel or routing cables between steel sheets (e.g. between the mounting plate and back wall) should provide adequate shielding.

Avoid, where possible, routing unshielded cables, connected to the drive line-up, in the immediate vicinity of noise sources, e.g. transformers. Signal lines (shielded and unshielded) connected to the drive line-up, must be routed as far as possible away from strong external magnetic fields (e.g. transformers, line reactors). In both cases, a distance of ≥ 300 mm is usually sufficient.

Caution

The connected signal and power cables must not cover the ventilation slots.

Caution

Signal cables must not be routed parallel to power cables.

Table 6-10 Maximum cable lengths

Type	Maximum length [m]
24 V DC power supply cables	10
24 V DC signal cables	30
DC link, including extensions	10
Shielded power supply cables from the line power outlet up to line module + motor power cables	350 (shielded) 560 (unshielded)
Power cable between motor module and motor ≤ 30 A	50 (shielded) 75 (unshielded)
Power cable between motor module and motor ≥ 30 A	100 (shielded) 150 (unshielded)
DRIVE-CLiQ signal cables	100
Cable between the braking module and braking resistor	10

6.5.3 Equipotential bonding

The SINAMICS S booksize drive system is designed for use in cabinets with a PE conductor connection.

If the drive line-up is arranged on a common unpainted metal-surfaced mounting plate, e.g. with a galvanized surface, no additional equipotential bonding is needed within the drive line-up as

- All parts of the switchgear assembly are connected to the protective conductor system.
- The mounting plate is connected with the external PE conductor by means of a finely-stranded copper conductor with a cross-section of 16 mm², including the outer conductor. As of a cross-section of 25 mm² copper, the outer cross-section of the finely-stranded conductor is halved.

For other installation methods, equipotential bonding must be implemented using conductor cross-sections as stated in the second item in the list or at least equal to the conductance.

If components are mounted on DIN rails, the data listed in the second item applies for equipotential bonding. If only smaller connection cross-sections are permissible on components, the largest must be used (e.g. 6 mm² for TM31 and SMC). These requirements also apply to distributed components located outside the cabinet.

If, for example, the PROFIBUS or DRIVE-CLiQ cable is routed through several cabinets, the "PROFIBUS equipotential bonding conductor connection" on the control unit interface must be used for connecting the equipotential bonding conductor. A finely stranded copper conductor with a 4 mm² cross-section must be used. This conductor must be routed together with the PROFIBUS cable.

Equipotential bonding and shielding for PROFIBUS

The cable shield must be connected over a large contact surface area.

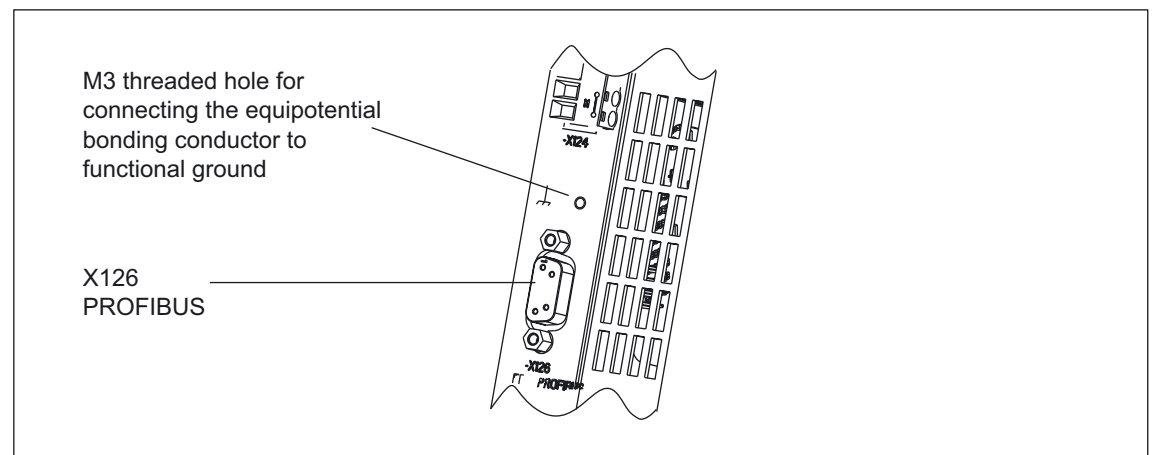


Figure 6-5 Functional ground connection for PROFIBUS

6.6 Connection methods

6.6.1 Spring-loaded terminals/screw terminals

Connectable conductor cross-sections of spring-loaded terminals

Table 6-11 Spring-loaded terminals

Spring-loaded terminal type			
1	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.14 mm ² to 1.5 mm ² 0.25 mm ² to 1.5 mm ² 0.25 mm ² to 0.5 mm ²
	Insulation stripping length	7 mm	
	Tool	Screwdriver 0.4 x 2.0 mm	
2	Connectable conductor cross-sections	Flexible	0.08 mm ² to 2.5 mm ²
	Insulation stripping length	8 to 9 mm	
	Tool	Screwdriver 0.4 x 2.0 mm	

Connectable conductor cross-sections of screw terminals

Table 6-12 Screw terminals

Screw terminal type			
1	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.14 mm ² to 1.5 mm ² 0.25 mm ² to 1.5 mm ² 0.25 mm ² to 0.5 mm ²
	Insulation stripping length	7 mm	
	Tool	Screwdriver 0.4 x 2.0 mm	
	Tightening torque	0.22 to 0.25 Nm	
2	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.2 mm ² to 2.5 mm ² 0.25 mm ² to 1 mm ² 0.5 mm ² to 1 mm ²
	Insulation stripping length	7 mm	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 to 0.6 Nm	
3	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.2 mm ² to 2.5 mm ² 0.25 mm ² to 1 mm ² 0.25 mm ² to 1 mm ²
	Insulation stripping length	9 mm	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 to 0.6 Nm	

Screw terminal type			
4	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.2 mm ² to 4 mm ² 0.25 mm ² to 4 mm ² 0.25 mm ² to 4 mm ²
	Insulation stripping length	7 mm	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 to 0.6 Nm	
5	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.5 mm ² to 6 mm ² 0.5 mm ² to 6 mm ² 0.5 mm ² to 6 mm ²
	Insulation stripping length	12 mm	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.2 to 1.5 Nm	
6	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.5 mm ² to 10 mm ² 0.5 mm ² to 10 mm ² 0.5 mm ² to 10 mm ²
	Insulation stripping length	11 mm	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.5 to 1.8 Nm	

6.6.2 Motor connector

The diagram below shows you how to remove the motor connector using a pair of engineer's pliers, for example, to pull the cable through narrow cable bushings.

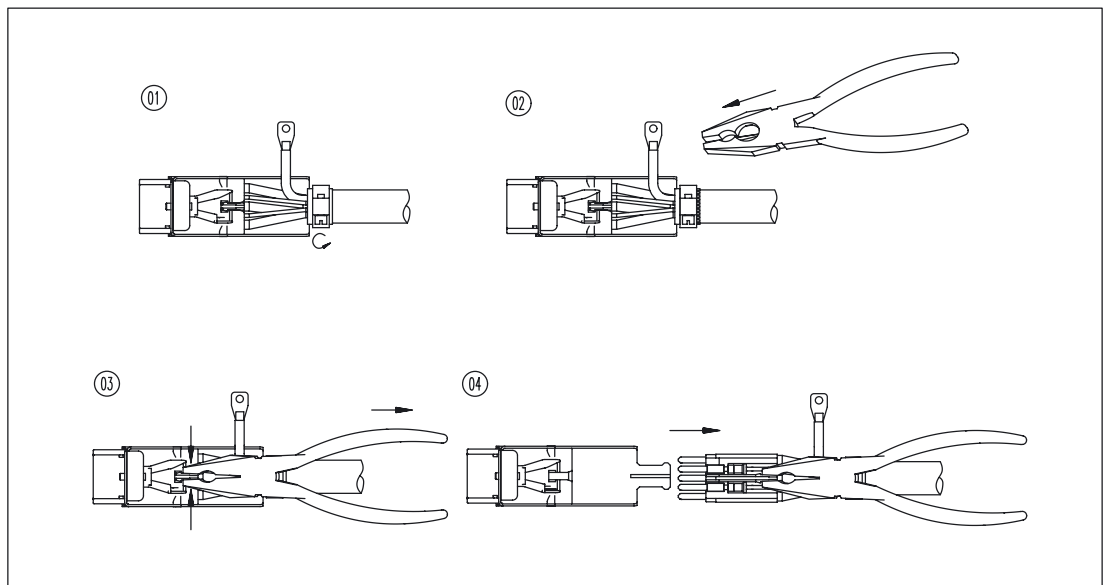


Figure 6-6 Removing the motor connector

The following figure shows how the motor connector is coded to prevent incorrect connection (especially relevant for double motor modules).

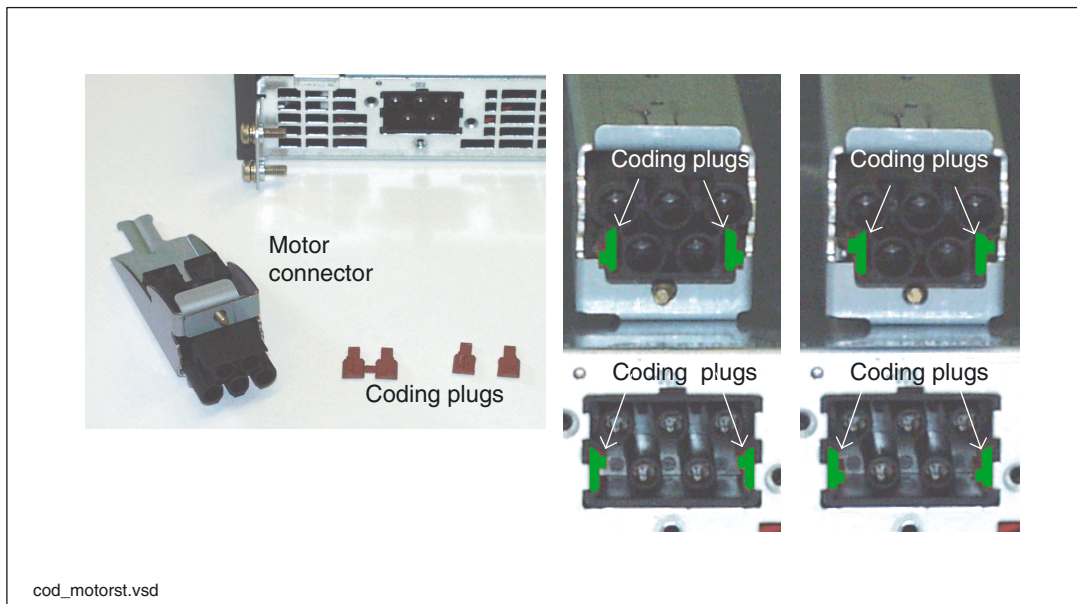
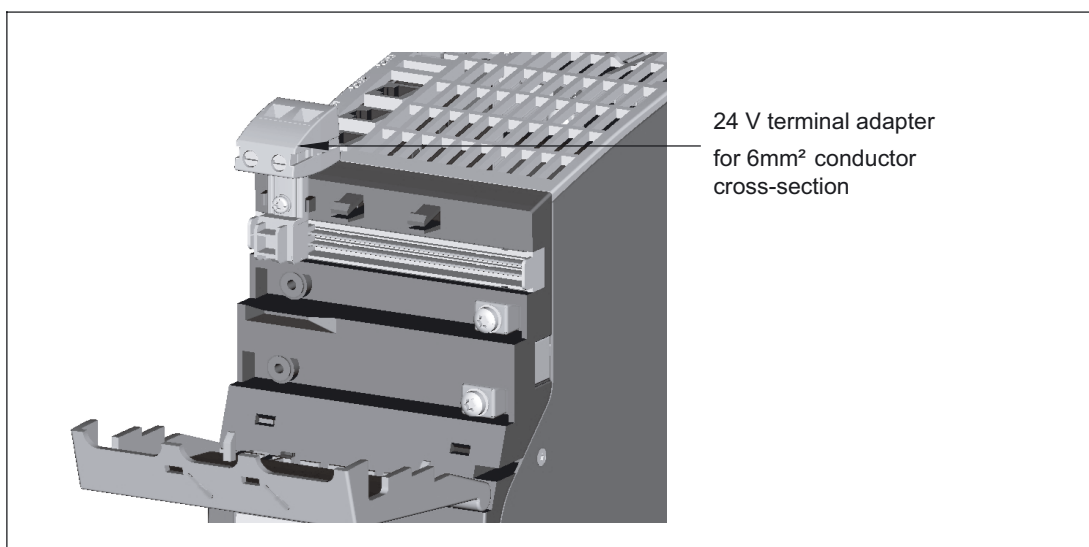


Figure 6-7 Coding the motor connector

The coding plugs are supplied with the motor cables.

6.6.3 24-V terminal adapter



24 V terminal adapter for a conductor cross-section of 6 mm²
Supplied with the line modules and control supply modules.

6.7 Information about heat dissipation

6.7.1 General

The following devices are available as cooling equipment:

- Filtered fans
- Heat exchangers or
- Cooling units

The decision in favor of one of these methods will depend on the prevailing ambient conditions and the cooling power required.

The ventilation clearances stated here must be observed. No other components or cables must be located in these areas.



Caution

If you do not observe the guidelines for installing SINAMICS equipment in the cabinet, this can significantly reduce the service life of the equipment and result in premature component failure.

You must take into account the following specifications when installing a SINAMICS drive line-up:

- Ventilation clearance
- Cable routing
- Air guidance, air-conditioner

Table 6-13 Ventilation clearances above and below the components

Component	Order number	Clearance [mm]
CU320	6SL3040-0MA00-0AAx	80
SMCxx	6SL3055-0AA00-5xAx	50
TM31	6SL3055-0AA00-3AAx	50
Line filter for line module 5 kW – 120 kW	6SL3000-0BExx-xAAx	100
Line reactor for active line module 16 kW – 120 kW	6SN1111-0AA00-xxAx	100
Line reactor for smart line module 5 kW – 10 kW	6SL3000-0CExx-0AAx	100
Active line module 16 kW – 55 kW 80 kW – 120 kW	6SL3130-7TExx-xAAx 6SL3130-7TExx-xAAx	80 80 (additional 50 in front of fan)
Smart line module 5 kW – 10 kW	6SL3130-6AExx-0AAx	80
Motor module < 132 A	6SL312x-1TExx-xAAx	80
Motor module 132 A and 200 A	6SL312x-1TE3x-xAAx	80 (additional 50 in front of fan)
Braking module	6SL3100-1AE31-0AAx	80
Control supply module	6SL3100-1DE22-0AAx	80
Capacitor Module	6SL3100-1CE14-0AAx	80

The specifications regarding ventilation clearances for two-tier configurations are provided in Drive Line-Up.

Note

The distance between the blow-out aperture of the air conditioner and the electronic equipment must be at least 200 mm.

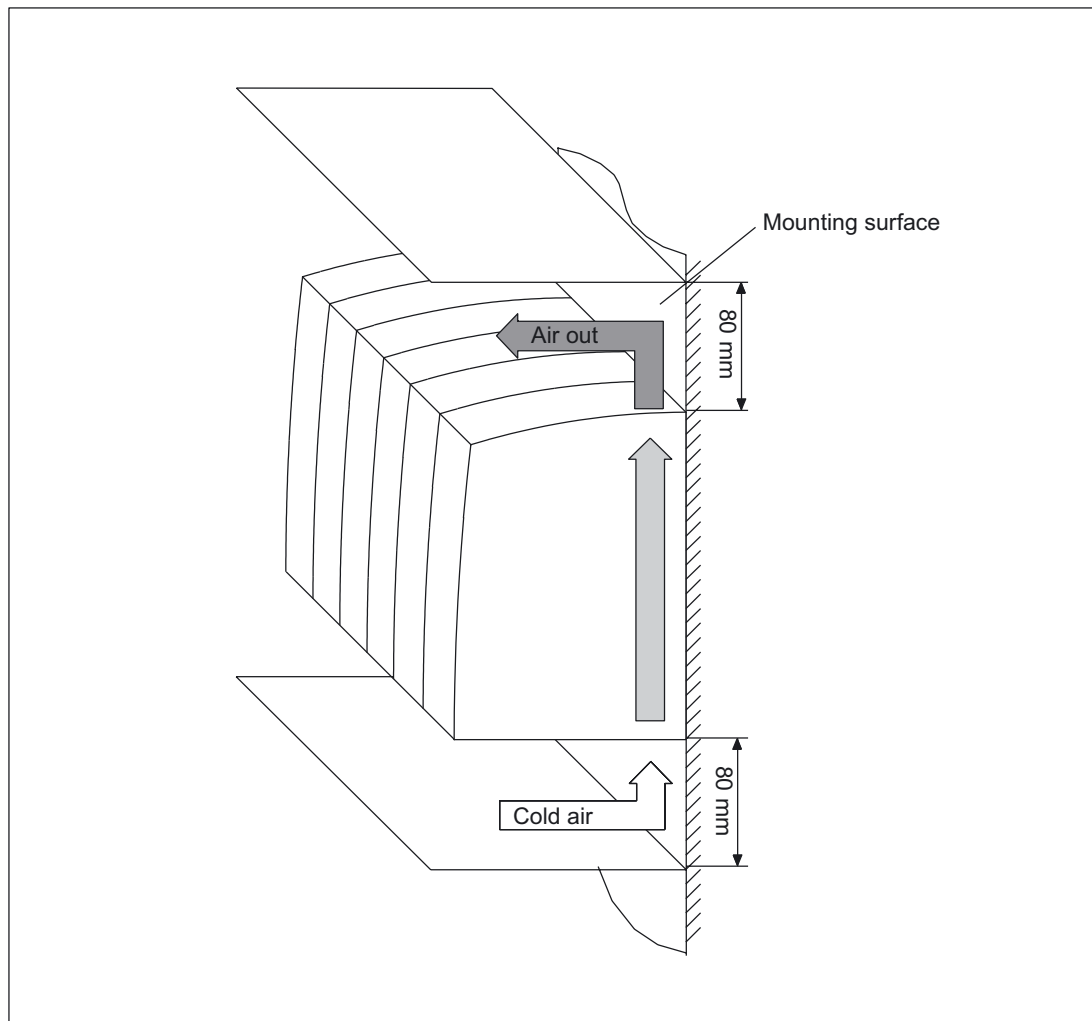


Figure 6-8 Ventilation clearances for booksize drive line-up

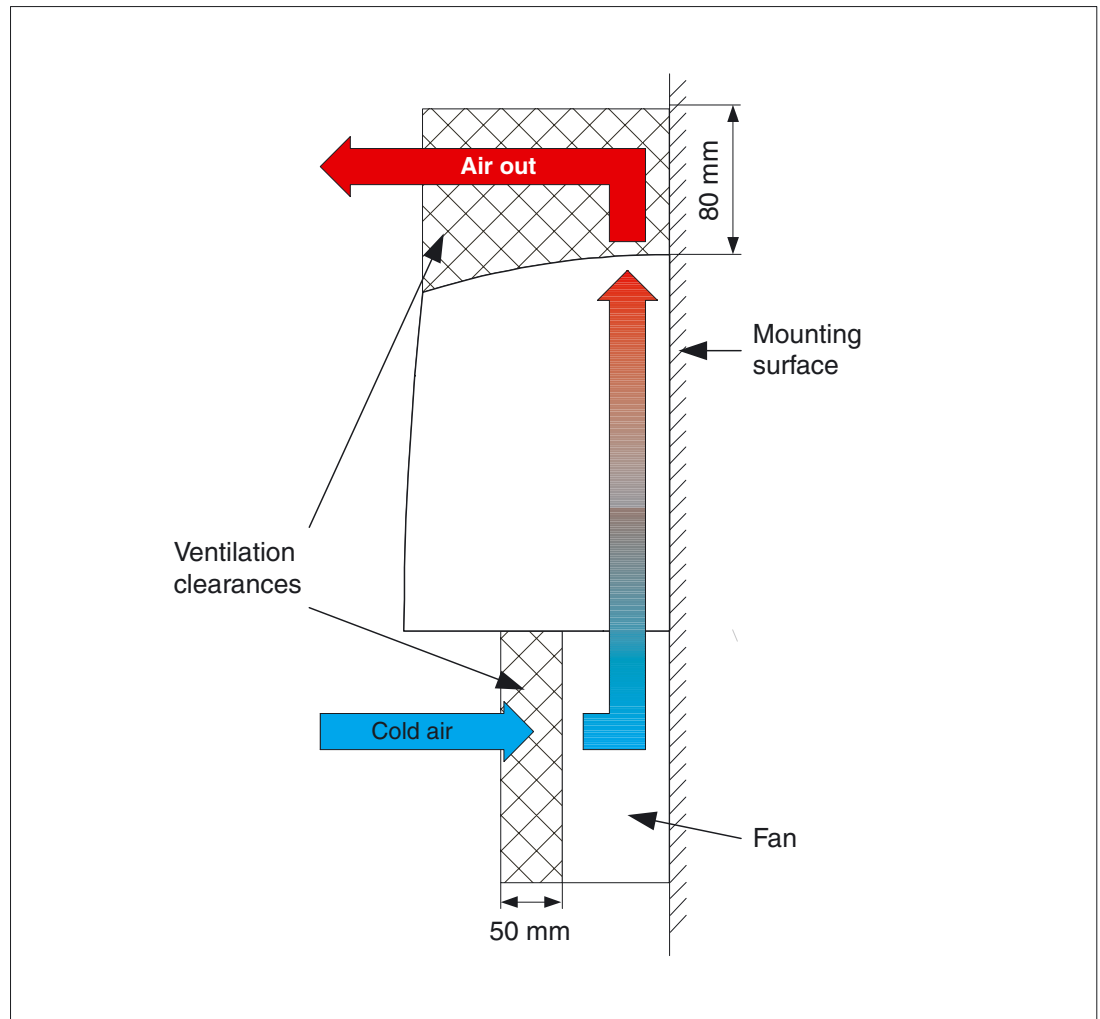


Figure 6-9 Ventilation clearances for 300 mm modules

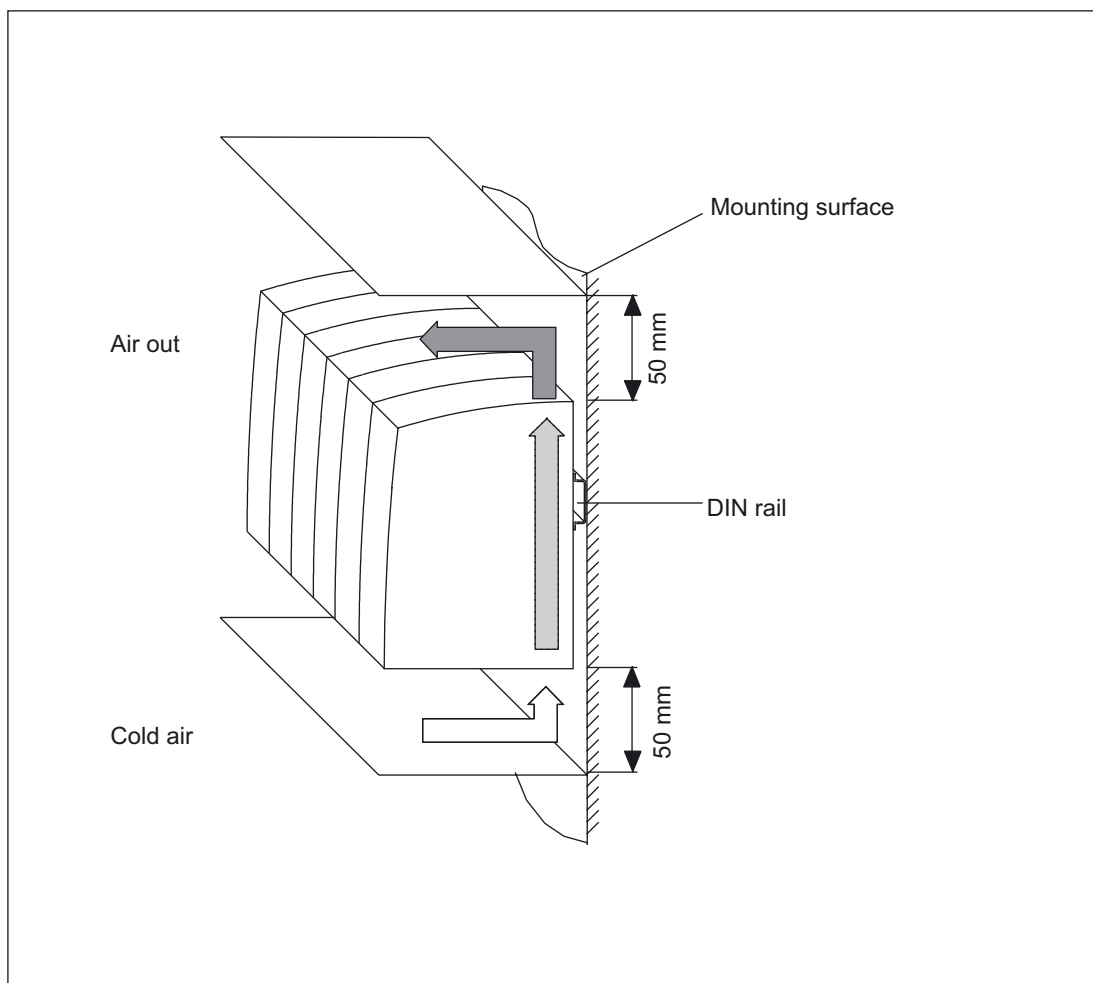


Figure 6-10 Ventilation clearances for DIN rail modules

6.7.2 Information about ventilation

The SINAMICS equipment is ventilated separately by means of integrated fans and is in some cases cooled by means of natural convection.

The cooling air must flow through the components vertically from bottom (cooler region) to top (region heated by operation).

If filtered fans, heat exchangers, or air conditioners are used, you must ensure that the air is flowing in the right direction. You must also ensure that the warm air can escape at the top. A ventilation clearance of at least 80 mm above and below must be observed.

Note

Cables must not be routed on the modules; the ventilation grilles must not be covered.

Cold air must not be allowed to blow directly onto electronic equipment.

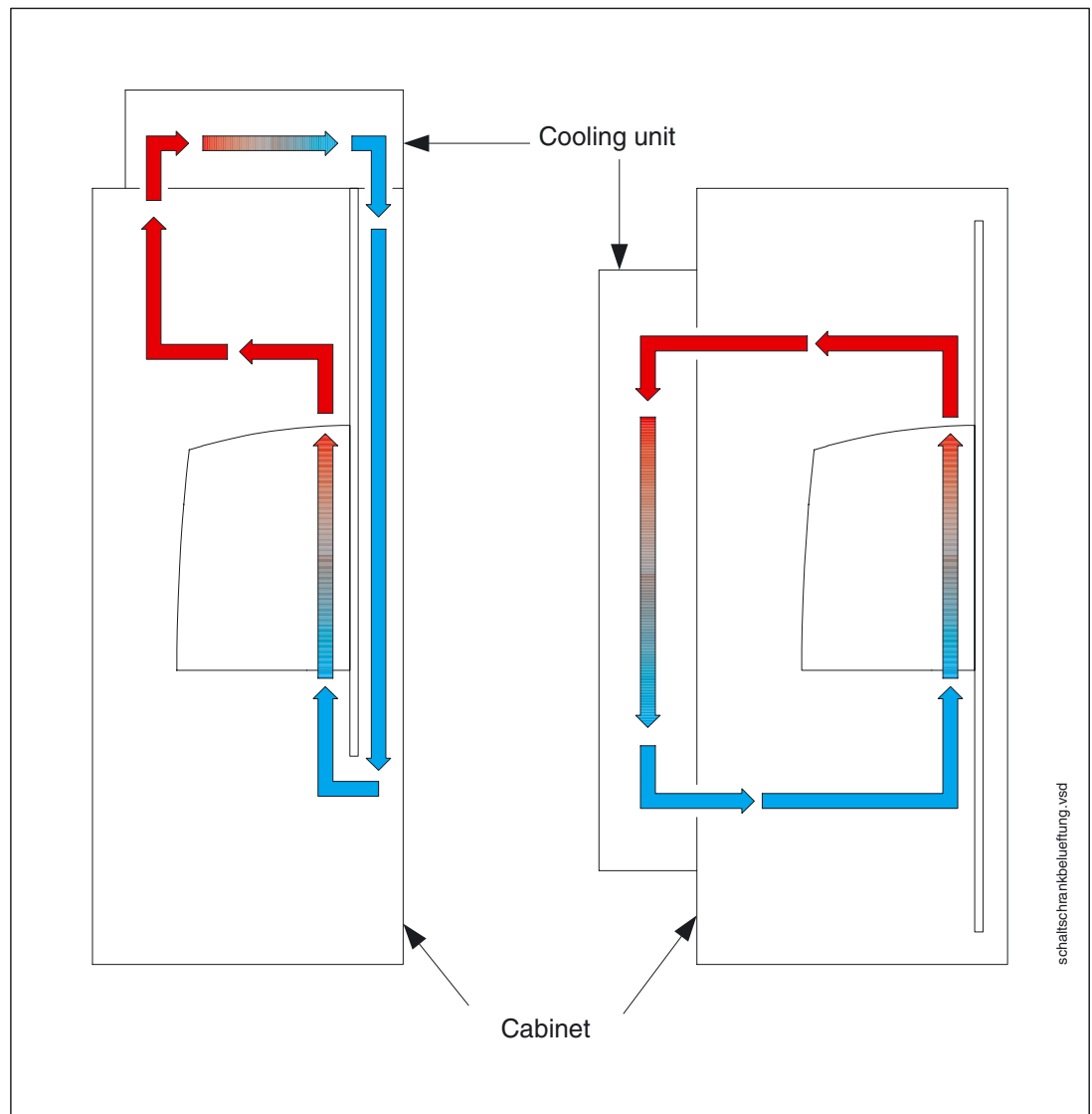


Figure 6-11 Examples of cabinet ventilation

Caution

The air guidance and arrangement of the cooling equipment must be chosen in such a way as to prevent condensation from forming.

If necessary, cabinet enclosure heating may have to be installed.

If air conditioners are used, the relative air humidity of the expelled air increases as the air in the air conditioner cools and may exceed the dew point. If the relative humidity of the air entering the SINAMICS equipment is over 80% for an extended period of time, the insulation in the equipment may fail to function properly due to electrochemical reactions (see System Data). Using air baffle plates, for example, you must ensure that the cold air expelled from the air conditioner mixes with warm air in the cabinet before it enters the equipment. This reduces the relative air humidity to uncritical values.

6.7.3 Power loss of components in rated operation

The following table shows the power loss for components with internal cooling. The characteristic values apply for the following conditions:

- Line voltage for line modules 400 V
- Pulse frequency of the motor modules 4 kHz
- Rated pulse frequency of the active line modules 8 kHz
- Operation of components with rated power

Overview: Power loss with internal cooling

Table 6-14 Overview: Power loss with internal cooling

	Unit	Power loss
Control units and option boards		
CU320	W	20
TB30	W	<3
CBC10	W	<10
Line filters for active line modules		
16 kW	W	170
36 kW	W	250
55 kW	W	350
80 kW	W	450
120 kW	W	590
Line filters for smart line modules		
5 kW	W	5
10 kW	W	9
Line reactors for active line modules		
16 kW	W	90
36 kW	W	160
55 kW	W	210
80 kW	W	450
120 kW	W	590
Line reactors for smart line modules		
5 kW	W	62
10 kW	W	116
Active line modules		
16 kW	W	260
36 kW	W	630
55 kW	W	900
80 kW	W	1350
120 kW	W	2200

	Unit	Power loss
Smart line modules		
5 kW	W	Available soon
10 kW	W	Available soon
Single motor modules		
9 A	W	80
18 A	W	165
30 A	W	290
85 A	W	750
200 A	W	2050
Double motor modules		
2x3 A	W	70
2x5 A	W	105
2x9 A	W	160
2x18 A	W	320
Sensor modules		
SMC20	W	<10
Additional system components		
TM31	W	<10
DC link components		
Braking module	W	20
Capacitor Module	W	25
Control supply module	W	60

6.7.4 Information about calculating power loss

Cabinet manufacturers provide calculation programs for selecting climate control equipment. It is always necessary to know the power loss of the components and equipment installed in the cabinet.

The physical relationship is shown in the following example.

$$q = \frac{Q}{(\Delta T)} - k * A$$

Figure 6-12 Example of dimensioning climate control equipment

q = power that has to be dissipated through a cooling unit [W / K]

Q = power loss [W]

ΔT = temperature difference between the room and cabinet interior [K]

k = thermal resistance value, e.g. sheet-steel, painted 5.5 [W / (m² * K)]

A = free-standing cabinet surface area [m²]

Table 6-15 Example of a power loss calculation

Component	Number	Power loss [W]	Total power loss [W]
CU320	1	20	20
Active line module 36 kW	1	580	580
Motor module 18 A	2	165	330
Motor module 30 A	3	290	870
SMC20	10	10	100
SITOP 20	1	53	53
Main contactor	1	12	12
Total:			1970

Assumption:

Free-standing cabinet surface area A = 5 m²

Temperature difference between the room and cabinet interior ΔT = 20 K

q = (1970 [W] / 20 [K]) - 5.5 [W / (m² * K)] * 5 [m²] = 71 [W/K]

Service and Support Booksize

7.1 Technical support

Technical support

If you have any further questions, please call our hotline:

A&D Technical Support

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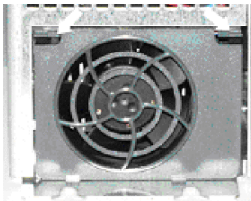
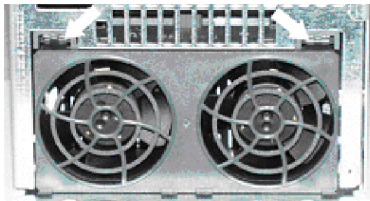
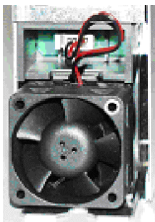
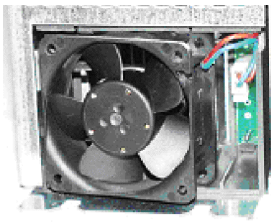
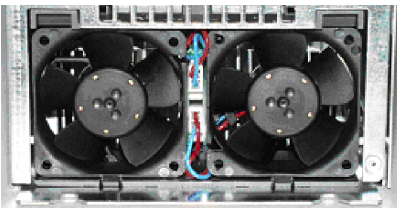
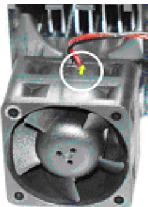
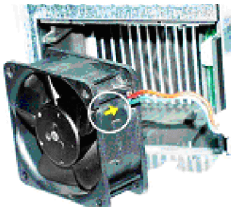
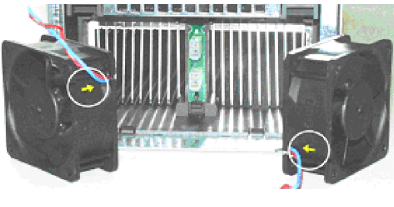
7.2 Replacing fans

Notice

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

Parts must only be replaced by trained personnel (danger of damage to sensitive components due to static electricity)!

Removing the fan:

1. Disconnect the power supply (24 V DC and 400 V AC) Wait 5 minutes while the DC link energy discharges! 2. Remove the component from the drive line-up 3. Open the fan cover		
Module width: 50 mm	Module width: 100 mm	Module width: 150 mm and 200 mm
		
4. Remove the fan 5. Remove the connector		
		
		

Replacing a fan in a module with a width of 300 mm: See: Motor modules with internal air cooling – Installation

Installing the fan:

1. Before installing the fan, check the through-flow direction
(the arrow on the fan must point towards the fins)
2. Insert the connector fully.
3. Insert the fan fully.
Do not squash the connection cables!
4. Close the fan cover.

7.3 List of spare parts

Table 7-1 List of spare parts for SINAMICS S120 (as at: October 08, 2003)

Component	Order number
Control Unit 320	6SL3040-0MA00-0AA1
24 V DC 4-pin tee unit (X124)	6SL3065-2AA00-0AA0
CU320 terminals (X122 or X132)	6SL3064-2AB00-0AA0
Protective flap for CU320	6SL3064-3AB00-0AA0
Cover (CU board)	6SL3064-3BB00-0AA0
Option slot protective cover for CU320	6SL3064-3CB00-0AA0
TB30	6SL3055-0AA00-2TA0
24 V DC 4-pin tee unit (X424)	6SL3065-2AA00-0AA0
TB30 terminal block (X481, X482, and X424)	6SL3065-2BA00-0AA0
TM31	6SL3055-0AA00-3AA0
24 V DC 4-pin tee unit (X524)	6SL3065-2AA00-0AA0
TM31 terminal block (X520, X521, X522, X530, X540, X541, X542, and X524)	6SL3065-2MB00-0AA0
SMC10	6SL3055-0AA00-5AA0
24 V DC 4-pin tee unit (X524)	6SL3065-2AA00-0AA0
SMC20	6SL3055-0AA00-5BA1
24 V DC 4-pin tee unit (X524)	6SL3065-2AA00-0AA0
SMC30	6SL3055-0AA00-5CA0
24 V DC 4-pin tee unit (X524)	6SL3065-2AA00-0AA0
SMC30 terminal block (X521, X531, and X524)	6SL3065-2CB00-0AA0
Line modules	
5kW smart line module (50mm)	6SL3130-6AE15-0AA0
10kW smart line module (50mm)	6SL3130-6AE21-0AA0
Safe standstill/KTY84 terminal block, 4-pin (X21 or X22)	6SL3162-2EA00-0AA0
24 V terminal adapter (X24)	6SL3162-2AA00-0AA0
Plastic inserts (CU<>line module)	6SL3064-3DB00-0AA0
Fan for 50mm line/motor module (incl. fan cover)	6SL3162-0AB00-0AA0
DC link cover for 50mm line/motor module	6SL3162-3AB00-0AA0
16kW smart line module (100mm)	6SL3130-6TE21-6AA0
16kW active line module (100mm)	6SL3130-7TE21-6AA1

Component	Order number
Safe standstill/KTY84 terminal block, 4-pin (X21)	6SL3162-2EA00-0AA0
24 V terminal adapter (X24)	6SL3162-2AA00-0AA0
Plastic inserts (CU<>line module)	6SL3064-3DB00-0AA0
Fan for 100mm line/motor module (incl. fan cover)	6SL3162-0AD00-0AA0
DC link cover for 100mm line/motor module	6SL3162-3AD00-0AA0
36kW smart line module (150mm)	6SL3130-6TE23-6AA0
36kW active line module (150mm)	6SL3130-7TE23-6AA1
Safe standstill/KTY84 terminal block, 4-pin (X21)	6SL3162-2EA00-0AA0
24 V terminal adapter (X24)	6SL3162-2AA00-0AA0
Plastic inserts (CU<>line module)	6SL3064-3DB00-0AA0
Fan for 150mm line/motor module (incl. fan cover)	6SL3162-0AF00-0AA0
DC link cover for 150mm line/motor module	6SL3162-3AF00-0AA0
Terminal board cover for 150mm smart/active line module	6SL3163-3CF00-0AA0
55kW active line module (200mm)	6SL3130-7TE25-5AA1
Safe standstill/KTY84 terminal block, 4-pin (X21)	6SL3162-2EA00-0AA0
24 V terminal adapter (X24)	6SL3162-2AA00-0AA0
Plastic inserts (CU<>line module)	6SL3064-3DB00-0AA0
Fan for 200mm line/motor module (incl. fan cover)	6SL3162-0AH00-0AA0
DC link cover for 200mm line/motor module	6SL3162-3AH00-0AA0
Terminal board cover for 200mm/300mm smart/active line module	6SL3163-3CM00-0AA0
80kW active line module (300mm)	6SL3130-7TE28-0AA0
120kW active line module (300mm)	6SL3130-7TE31-2AA0
Safe standstill/KTY84 terminal block, 4-pin (X21)	6SL3162-2EA00-0AA0
24 V terminal adapter (X24)	6SL3162-2AA00-0AA0
Plastic inserts (CU<>line module)	6SL3064-3DB00-0AA0
Fan for 300mm line/motor module	6SL3162-0AM00-0AA0
DC link cover for 300mm line/motor module	6SL3162-3AM00-0AA0
Terminal board cover for 200mm/300mm smart/active line module	6SL3163-3CM00-0AA0
Motor modules	
3A single motor module (50mm)	6SL3120-1TE13-0AA0
5A single motor module (50mm)	6SL3120-1TE15-0AA0
9A single motor module (50mm)	6SL3120-1TE21-0AA1
18A single motor module (50mm)	6SL3120-1TE21-8AA1
3A double motor module (50mm)	6SL3120-2TE13-0AA0
5A double motor module (50mm)	6SL3120-2TE15-0AA0
9A double motor module (50mm)	6SL3120-2TE21-0AA0
DRIVE-CLiQ cable, IP20/IP20, without 24 V DC, 110 mm	6SL3060-4AB00-0AA0
Safe standstill/KTY84 terminal block, 4-pin (X21 or X22)	6SL3162-2EA00-0AA0

7.3 List of spare parts

Component	Order number
24 V jumper	6SL3162-2AA01-0AA0
Fan for 50mm line/motor module (incl. fan cover)	6SL3162-0AB00-0AA0
DC link cover for 50mm line/motor module	6SL3162-3AB00-0AA0
30A single motor module (100mm)	6SL3120-1TE23-0AA1
18A double motor module (100mm)	6SL3120-2TE21-8AA0
DRIVE-CLiQ cable, IP20/IP20, without 24 V DC, 160 mm	6SL3060-4AD00-0AA0
Safe standstill/KTY84 terminal block, 4-pin (X21 or X22)	6SL3162-2EA00-0AA0
24 V jumper	6SL3162-2AA01-0AA0
Fan for 100mm line/motor module (incl. fan cover)	6SL3162-0AD00-0AA0
DC link cover for 100mm line/motor module	6SL3162-3AD00-0AA0
45A single motor module (150mm)	6SL3120-1TE24-5AA1
60A single motor module (150mm)	6SL3120-1TE26-0AA1
DRIVE-CLiQ cable, IP20/IP20, without 24 V DC, 210 mm	6SL3060-4AF00-0AA0
Safe standstill/KTY84 terminal block, 4-pin (X21)	6SL3162-2EA00-0AA0
24 V jumper	6SL3162-2AA01-0AA0
Fan for 150mm line/motor module (incl. fan cover)	6SL3162-0AF00-0AA0
DC link cover for 150mm line/motor module	6SL3162-3AF00-0AA0
Terminal board cover for 150mm motor module	6SL3162-3CF00-0AA0
85A single motor module (200mm)	6SL3120-1TE28-5AA1
DRIVE-CLiQ cable, IP20/IP20, without 24 V DC, 260 mm	6SL3060-4AH00-0AA0
Safe standstill/KTY84 terminal block, 4-pin (X21)	6SL3162-2EA00-0AA0
24 V jumper	6SL3162-2AA01-0AA0
Fan for 200mm line/motor module (incl. fan cover)	6SL3162-0AH00-0AA0
DC link cover for 200mm line/motor module	6SL3162-3AH00-0AA0
Terminal board cover for 200mm/300mm motor module	6SL3162-3CM00-0AA0
132A single motor module (300mm)	6SL3120-1TE31-3AA0
200A single motor module (300mm)	6SL3120-1TE32-0AA0
DRIVE-CLiQ cable, IP20/IP20, without 24 V DC, 360 mm	6SL3060-4AM00-0AA0
Safe standstill/KTY84 terminal block, 4-pin (X21)	6SL3162-2EA00-0AA0
24 V jumper	6SL3162-2AA01-0AA0
Fan for 300mm line/motor module	6SL3162-0AM00-0AA0
DC link cover for 300mm line/motor module	6SL3162-3AM00-0AA0
Terminal board cover for 200mm/300mm motor module	6SL3162-3CM00-0AA0
DC link components	
Braking module (50mm)	
X1	Available on request
X21	Available on request
24 V jumper	6SL3162-2AA01-0AA0

Component	Order number
DC link cover for 50mm line/motor module	6SL3162-3AB00-0AA0
Capacitor module (100mm)	
24 V jumper	6SL3162-2AA01-0AA0
DC link cover for 100mm line/motor module	6SL3162-3AD00-0AA0
Control supply module (50mm)	
24 V terminal adapter (X24)	6SL3162-2AA00-0AA0
24 V jumper	6SL3162-2AA01-0AA0
DC link cover for 50mm line/motor module	6SL3162-3AB00-0AA0

Appendix A

A.1 List of abbreviations

Table A-1 List of abbreviations

Abbreviation	English
A	
A...	Alarm
AC	Alternating Current
ADC	Analog Digital Converter
AI	Analog Input
AO	Analog Output
AOP	Advanced Operator Panel
ASCII	American Standard Code for Information Interchange
B	
BB	Operating condition
BERO	Tradename for a type of proximity switch
BI	Binector Input
BIA	Berufsgenossenschaftliches Institut für Arbeitssicherheit (German Institute for Occupational Safety)
BICO	Binector Connector Technology
C	
C	Capacitance
CAN	Controller Area Network
CBC	Communication Board CAN
CD	Compact Disc
CDS	Command Data Set
CI	Connector Input
CNC	Computer Numerical Control
CO	Connector Output
CO/BO	Connector Output/Binector Output
COM	Mid-position contact of a change-over contact
CP	Communications Processor

Abbreviation	English
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
CT	Constant Torque
CU	Control Unit
D	
DAC	Digital Analog Converter
DC	Direct Current
DCN	Direct Current Negative
DCP	Direct Current Positive
DDS	Drive Data Set
DI	Digital Input
DI/DO	Bidirectional Digital Input/Output
DMC	DRIVE-CLiQ Module Cabinet (Hub)
DO	Digital Output
DO	Drive Object
DPRAM	Dual Port Random Access Memory
DRAM	Dynamic Random Access Memory
DRIVE-CLiQ	Drive Component Link with IQ
DSC	Dynamic Servo Control
E	
EDS	Encoder Data Set
ESD	Electrostatic Sensitive Devices
EMK	Electromagnetic force
EMC	Electromagnetic Compatibility
EN	European Standard
EnDat	Encoder-Data-Interface
EP	Enable Pulses
ES	Engineering System
F	
F ...	Fault
FAQ	Frequently Asked Questions
FCC	Function Control Chart
FCC	Flux Current Control
FEPROM	Flash-EEPROM
FG	Function Generator
FI	Residual-Current Circuit-Breaker (RCCB)
FP	Function diagram
FW	Firmware
G	
GC	Global Control Telegram (broadcast telegram)
GSD	Device master file: describes the features of a PROFIBUS slave

Abbreviation	English
H	
HF	High Frequency
HFD	High frequency reactor
HLG	Ramp-function generator
HMI	Human Machine Interface
HTL	High Threshold Logic
HW	Hardware
I	
In preparation:	In preparation: this feature is currently not available
IBN	Commissioning
I/O	Input/Output
ID	Identifier
IEC	International Electrotechnical Commission
IGBT	Insulated Gate Bipolar Transistor
IT	Insulated three-phase supply network
J	
JOG	Jogging
K	
KDV	Data cross-checking
KIP	Kinetic buffering
Kp	Proportional gain
KTY	Positive temperature coefficient temperature sensor
L	
L	Inductance
LED	Light Emitting Diode
LSB	Least Significant Bit
M	
M (GND)	Reference potential, zero potential
MB	Megabyte
MCC	Motion Control Chart
MDS	Motor Data Set
MLFB	machine-readable product designation
MMC	Man-Machine Communication
MSB	Most Significant Bit
MSCY_C1	Master Slave Cycle Class 1
N	
NC	Normally Closed (contact)
NC	Numerical Control

Appendix A

A.1 List of abbreviations

Abbreviation	English
N. C.	Not Connected
NEMA	National Electrical Manufacturers Association
NM	Zero mark
NO	Normally Open (contact)
O	
OEM	Original Equipment Manufacturer
OLP	Optical Link Plug
OMI	Option Module Interface
P	
p ...	Adjustable parameter
PDS	Power Module Data Set
PE	Protective Earth
PELV	Protective Extra Low Voltage
PG	Programming terminal
PI	Proportional Integral
PLC	Programmable Logic Controller
PLL	Phase Locked Loop
PNO	PROFIBUS user organisation
PRBS	Pseudo Random Binary Signal
PROFIBUS	Process Field Bus
PS	Power Supply
PTC	Positive Temperature Coefficient
PTP	Point to Point
PWM	Pulse Width Modulation
PZD	PROFIBUS process data
Q	
R	
r ...	Display parameter (read only)
RAM	Random Access Memory
RCCB	Residual-Current Circuit-Breaker
RCD	Residual Current Device
RJ45	Standard. Describes an 8-pin plug connector with twisted pair Ethernet.
RO	Read Only
RS232	Serial interface
RS485	Standard. Describes the physical characteristics of a digital serial interface.
S	
S1	Continuous duty
S3	Periodic duty

Abbreviation	English
SBC	Safe Brake Control
SGE	Safe input signal
SH	Safe standstill
SI	Safety Integrated
SIL	Safety Integrity Level
SLVC	Sensorless Vector Control
SM	Sensor Module
SMC	Sensor Module Cabinet
SPC	Setpoint Channel
SPS	Programmable Logic Controller (PLC)
STW	PROFIBUS control word
T	
TB	Terminal Board
TIA	Totally Integrated Automation
TM	Terminal Module
TN	Grounded three-phase supply network
Tn	Integral time
TT	Grounded three-phase supply network
TTL	Transistor Transistor Logic
U	
UL	Underwriters Laboratories Inc.
V	
VC	Vector Control
Vdc	DC link voltage
VDE	Association of German Electrical Engineers
VDI	Association of German Engineers
Vpp	Volt peak to peak
VSM	Voltage Sensing Module
VT	Variable Torque
W	
WZM	Machine tool
X	
XML	Extensible Markup Language
Z	
ZK	DC link
ZSW	PROFIBUS Status Word

Appendix B

B.1 References

SINAMICS documentation

Catalogs

1. /DA51.2/ MICROMASTER Drive Converter 410/420/430/440. Catalog DA51.2 – 2002
Ordering information
Order no.: E86060-K5151-A121-A3-7600
2. /D11/ SINAMICS G150 Drive Converter
75 – 560 kW Cabinet Units
Order no.: E86060-K5511-A101-A1-7600
3. /D21.1/ SINAMICS S120 Vector Control
Drive system
Order no.: (in preparation)
4. /D21.2/ SINAMICS S120 Servo Control
Drive system (incl. servo motors)
Order no.: (in preparation)
5. /D21.3/ SINAMICS S120 Vector Control
Drive System Cabinet Units
Order no.: (in preparation)

Electronic documentation

1. /CD2/ SINAMICS
The SINAMICS Drive System
Order no.: 6SL3097-2CA00-0BP0, edition: 01.2004

User documentation

1. /BA1/ SINAMICS G150 Version A and C
Operating Instructions
Order no.: 6SL3798-1GX00-0BP0, edition: 03.2003
2. /GH1/ SINAMICS S120
Equipment Manual for Control Units and Additional System Components
Order no.: 6SL3097-2AH00-0BP0, edition: 01.2004

3. /GH2/ SINAMICS S120
Equipment Manual for Booksize Power Sections
Order no.: 6SL3097-2AC00-0BP0, edition: 01.2004
4. /GH3/ SINAMICS S120
Equipment Manual for Chassis Power Sections
Order no.: 6SL3097-2AE00-0BP0, edition: 01.2004
5. /GS1/ SINAMICS S120
Getting Started
Order no.: 6SL3097-2AG00-0BP0, edition: 01.2004
6. /IH1/ SINAMICS S120
Booksize Installation and Start-Up Manual
Order no.: 6SL3097-2AF00-0BP0, edition: 01.2004
7. /IH2/ SINAMICS S120
Installation and Start-up Manual for CANopen
Order no.: 6SL3097-2AA00-0BP0, edition: 01.2004
8. /LH1/ SINAMICS S
List Manual
Order no.: 6SL3097-2AP00-0BP0, edition: 01.2004

Catalogs for supplementary components

1. Components for Automation and Drive, Catalog CA 01
Ordering information
Order no.: E86060-D4001-A100-B8-7600
2. Cables, Connectors and System Components, Catalog NC Z
Ordering information
Order no.: E86060-K4460-A101-B1-7600
3. SIMATIC Products for Totally Integrated Automation, Catalog ST 70
Ordering information
Order no.: E86060-K4670-A111-A8-7600
4. SIMOTION Motion Control System, Catalog PM10 – 2002
Ordering information
Order no.: E86060-K4910-A101-A3-7600

Further supplementary documentation

1. SIMODRIVE AC Servo Motors 1FK7
Planning Guide
Order no.: 6SN1 197-0AC20-0BP0
2. SIMODRIVE AC Servo Motors 1FT6
Planning Guide
Order no.: 6SN1 197-0AD02-0BP0

3. SIMODRIVE AC Three-Phase Inductive Motors for Main Spindle Drives
1PH2, 1PH4, 1PH7
Planning Guide
Order no.: 6SN1 197-0AC60-0BP0
4. SIMODRIVE Hollow-Shaft Motors for Main Spindle Drives 1PM6 and 1PM4
Planning Guide
Order no.: 6SN1 197-0AD03-0BP0
5. SIMOTION SCOUT
Operating Instructions
SIMOTION Engineering System SCOUT
Order no.: 6AU1 900-0AD30-0BA0, edition: 02.2003
6. DRIVE ES Basic V5.1
Function Description
Engineering System for Drives from the Siemens A&D Product Range
Order no.: 6SW1 700-0JA00-0BA0, edition: 08.2001

PROFIBUS documentation

1. /IKPI/ Catalog IK PI 2002/2003
Industrial Communication and Field Equipment
Order no.: E86060-K6710-A101-B2-7600 (bound edition)
Order no.: E86060-K6710-A100-B2-7600 (loose-leaf edition)
2. /P1/ PROFIBUS-DP/DPV1 IEC 61158
Basics, Tips and Tricks for Users
Hüthig; Manfred Popp, 2nd edition
ISBN 3-7785-2781-9
3. /P2/ PROFIBUS-DP, Getting Started
PROFIBUS Nutzerorganisation e. V.; Manfred Popp
Order no.: 4.071
4. /P3/ Decentralization with PROFIBUS-DP
Architecture and Fundamentals, Configuration and Use of PROFIBUS-DP
with SIMATIC S7
SIEMENS; Publics MCD Verlag; Josef Weigmann, Gerhard Kilian
Order no.: A19100-L531-B714-7600
ISBN 3-89578-074-X
5. /P4/ Manual for PROFIBUS Networks, SIEMENS
Order no.: 6GK1 970-5CA10-0BA0
6. /P5/ PROFIBUS Profile PROFIdrive Profile Drive Technology
PROFIBUS Nutzerorganisation e. V.
Haid-und-Neu-Straße 7, 76131 Karlsruhe
Order no.: 3.171, Version 3, September 2000
7. /STPI/ PROFIBUS & AS Interface
Components on the Field Bus, Catalog ST PI 1999
Order no.: E86060-K4660-A101-A3-7600 (bound edition)
Order no.: E86060-K4660-A100-A3-7600 (loose-leaf edition)

8. /PPA/ PROFIdrive Profile Drive Technology
Draft PROFIBUS Profile
PROFIBUS Nutzerorganisation e. V.
Haid-und-Neu-Straße 7, 76131 Karlsruhe
Order no.: 3.172, Version 3.1, July 2002
9. /PPD/ PROFIBUS, Profile for Variable-Speed Drives, PROFIDRIVE
PROFIBUS Nutzerorganisation e. V.
Haid-und-Neu-Straße 7, 76131 Karlsruhe
Order no.: 3.071, edition: September 1997
10. /PDP/ PROFIBUS Installation Guideline
Installation Guideline for PROFIBUS-FMS/DP
Installation and Wiring Recommendation for RS 485 Transmission
Order no.: 2.111 (German)
2.112 (English), Version 1.0

Documentation for safety equipment

Note

For more information about technical documentation for Safety Integrated, visit the following address:

www.siemens.com/safety

Some of the available documentation relating to safety is listed below.

1. /NSK/ Low-Voltage Switchgear (with CD-ROM CA 01)
Catalog NS K
Order no.: E86060-K1002-A101-A2-7600
2. /NSCD/ Operating Instructions and Manuals for Low-Voltage Switchgear
CD-ROM
Order no.: E20001-D10-P301-V2-7400-7600
3. /MRL/ Directive 98/37/ECC of the European Parliament and Council
(Machine Directive)
Bundesanzeiger-Verlags GmbH, edition: 22.06.1998
4. /FBSI/ SINUMERIK 840D / SIMODRIVE 611 digital
Function Description SINUMERIK Safety Integrated
Order no.: 6FC5297-6AB80-0BP2, edition: 09.2003
5. /SIAH/ Safety Integrated
The Safety Program for International Industry
Application Manual, 4th edition, Siemens AG Automation and Drives
Order no.: 6ZB5000-0AA01-0BA0, edition: 01.2003
6. /SICD/ Safety Integrated
The Fully Integrated Safety System
CD-ROM
Order no.: E20001-D10-M103-X-7400-7600

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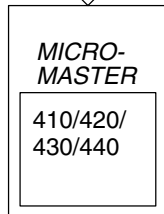
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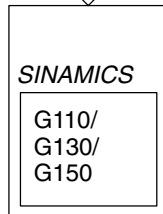
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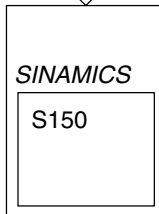
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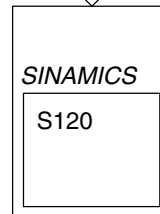
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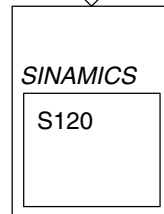
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75–560kW Cabinet Units



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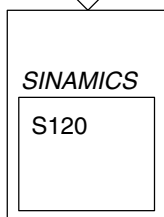


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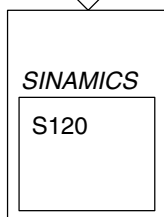


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Servo Control
Drive System
(incl. servo motors)

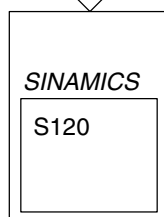
Manufacturer/Service Documentation



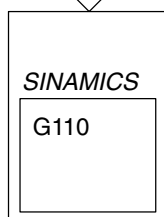
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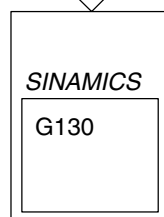
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Manual**
Booksize Power
Sections



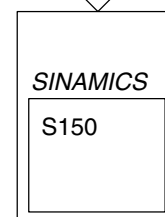
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Chassis Power
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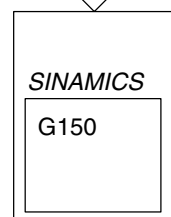
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**Operating
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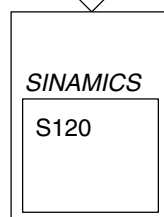


**Operating
Instructions**

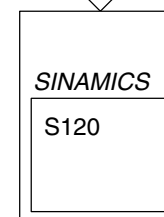


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Instructions**

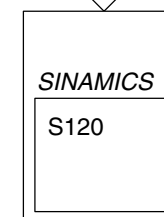
Manufacturer/Service Documentation



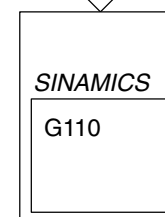
**Installation &
Start-Up Manual**
Booksize



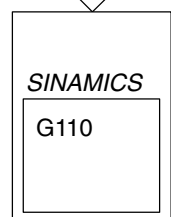
Getting Started



List Manual
Parameter,
Faults and Alarms
Function Diagrams

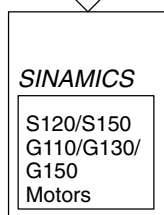


List Manual
Parameter,
Function Diagrams



Getting Started

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