

# SINAMICS S120 Combi

Equipment Manual · 05/2010

SINAMICS

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## SINAMICS

### S120 SINAMICS S120 Combi

#### Manual

#### Preface


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## Legal information

### Warning notice system

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

 <b>DANGER</b>
indicates that death or severe personal injury <b>will</b> result if proper precautions are not taken.

 <b>WARNING</b>
indicates that death or severe personal injury <b>may</b> result if proper precautions are not taken.

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

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

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


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

### Qualified Personnel

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

### Proper use of Siemens products

Note the following:

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

### Trademarks

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

### Disclaimer of Liability

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



# Preface

## Preface

### SINAMICS documentation

The SINAMICS documentation is organized in 2 parts:

- General documentation / Catalogs
- Manufacturer / Service documentation

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

- Ordering documentation

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

- Downloading documentation

Further links for downloading files from Service & Support

- Researching documentation online

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

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

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

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

- Training and FAQs

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

## Usage phases

Table 1 Usage phase and the available documents/tools

Usage phase	Tools
Orientation	SINAMICS S Sales Documentation
Planning/configuration	SIZER configuration tool
Decision making/ordering	SINAMICS S Catalogs
Configuring/installation	<ul style="list-style-type: none"> <li>• SINAMICS S120 Manuals</li> <li>• SINAMICS S120 Combi Manual</li> <li>• SINUMERIK 828D PPU Manual</li> </ul>
Commissioning	<ul style="list-style-type: none"> <li>• SINAMICS S120 Combi List Manual</li> <li>• SINUMERIK 828D Turning and Milling Commissioning Manual</li> </ul>
Usage/operation	<ul style="list-style-type: none"> <li>• SINAMICS S120 Function Manual FH1</li> <li>• SINAMICS S120 Combi List Manual</li> </ul>
Maintenance/Service	<ul style="list-style-type: none"> <li>• SINAMICS S120 Combi Manual</li> <li>• SINAMICS S120 Combi List Manual</li> </ul>

## Target group

This Manual addresses planners, installation technicians, design engineers.

## Benefits

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

## Standard scope

This documentation only describes the functionality of the standard version. Extensions or changes made by the machine tool manufacturer are documented by the machine tool manufacturer.

Other functions not described in this documentation might be able to be executed in the drive system. This does not, however, represent an obligation to supply such functions with a new control or when servicing.

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

## Technical support

If you have any questions, please contact our hotline:

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

	Americas
Telephone	+1 423 262 2522
Fax	+1 423 262 2200
E-mail	<a href="mailto:techsupport.sea@siemens.com">mailto:techsupport.sea@siemens.com</a>

	Asia/Pacific
Telephone	+86 1064 757575
Fax	+86 1064 747474
E-mail	<a href="mailto:support.asia.automation@siemens.com">mailto:support.asia.automation@siemens.com</a>

### Note

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

## Spare parts

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

## Questions about the documentation

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

Fax	+49 9131 98 2176
E-mail	E-mail to: <a href="mailto:docu.motioncontrol@siemens.com">docu.motioncontrol@siemens.com</a>

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

## Internet address for SINAMICS

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

## Test certificates

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

## EC Declarations of Conformity

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

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

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

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

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### Note

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

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### Note

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

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### Note

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

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

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 **DANGER**

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

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

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

The relevant safety notes in each chapter must be observed.

## ESD information

 **CAUTION**

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

Regulations for handling ESD components:

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

Personnel may only come into contact with electronic components, if

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

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

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

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

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

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

### Safety information

 **DANGER**

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

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

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

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

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

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

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

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

 **DANGER**

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

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

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

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

** DANGER**

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

** DANGER**

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




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

** WARNING**

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

## Explanation of symbols

Table 2 Symbols

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

## Residual risks

### Residual risks of power drive systems

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

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

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

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

1. Unintentional movements of driven machine components during commissioning, operation, maintenance, and repairs caused by, for example:
  - Hardware defects and/or software errors in the sensors, controllers, actuators, and connection technology
  - Response times of the controller and drive
  - Operating and/or ambient conditions not within the scope of the specification
  - Condensation / conductive contamination
  - Parameterization, programming, cabling, and installation errors
  - Use of radio devices / cellular phones in the immediate vicinity of the controller
  - External influences / damage
2. Exceptional temperatures as well as emissions of light, noise, particles, or gas caused by, for example:
  - Component malfunctions
  - Software errors
  - Operating and/or ambient conditions not within the scope of the specification
  - External influences / damage
3. Hazardous shock voltages caused by, for example:
  - Component malfunctions
  - Influence of electrostatic charging
  - Induction of voltages in moving motors
  - Operating and/or ambient conditions not within the scope of the specification
  - Condensation / conductive contamination
  - External influences / damage



4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc. if they are too close.
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly.

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



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# System overview

## 1.1 SINAMICS S120 Combi components

### System components

- Line-side power components such as fuses and contactors to switch the energy supply
- Reactors and filters to maintain EMC regulations
- Motor Modules for 1 - 2 expansion axes, which operate as inverters and provide the energy to the connected motors
- DC link components (Braking Module, Control Supply Module) used optionally for stabilizing the DC link voltage
- Additional system components and encoder system connections to expand the functionality and to handle various interfaces for encoders and process signals.

The SINAMICS S120 Combi is intended for installation in a control cabinet. It sets itself apart as a result of the following properties:

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

### Application and cooling method

The S120 Combi Power Module is optimized as a drive for machine tools and processing machines with 3-6 axes. The Power Module is available with the "external air cooling" cooling method.

Motor Modules in the booksize compact format are used as expansion axes.

1.1 SINAMICS S120 Combi components

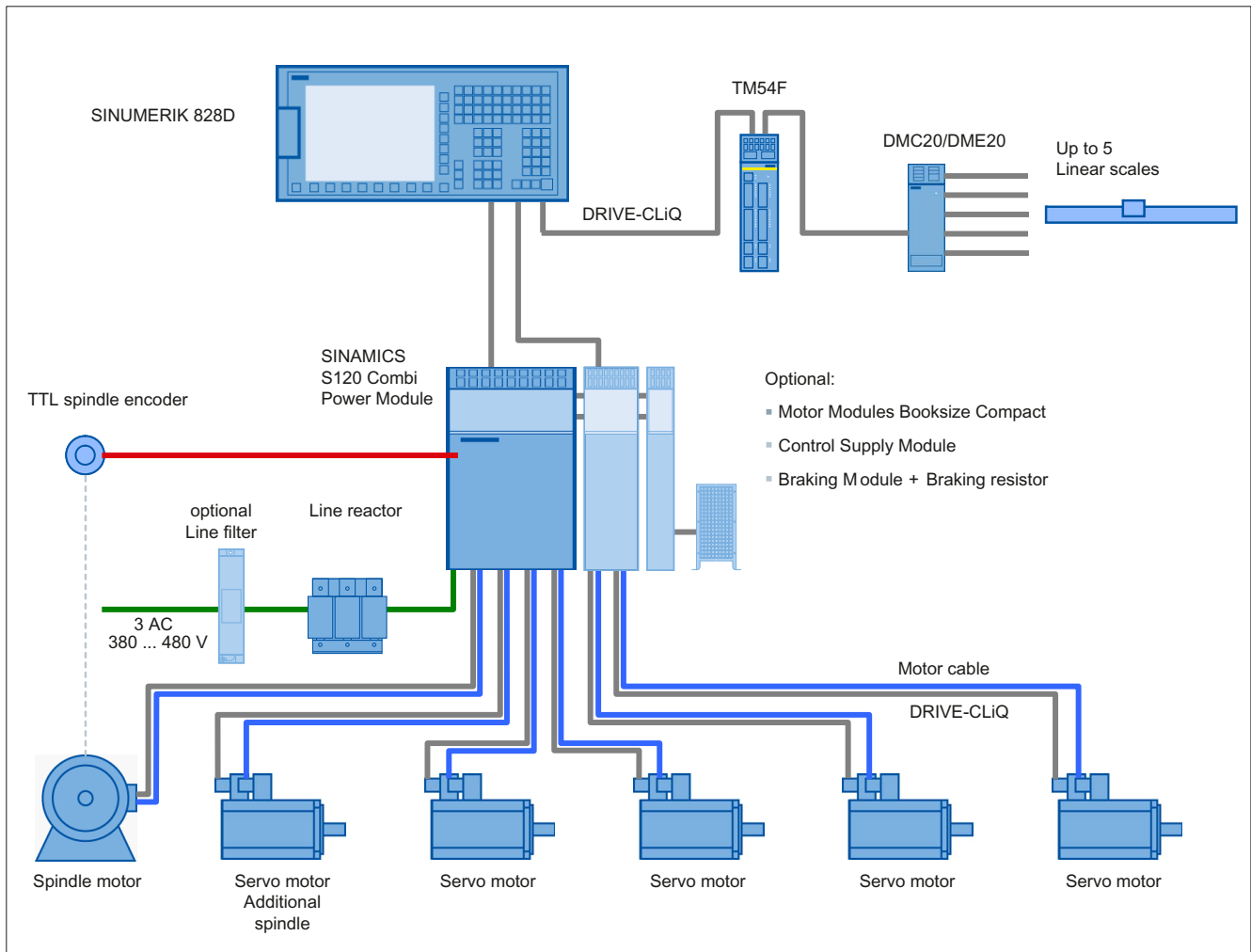


Figure 1-1 Connection example, S120 Combi 4 axes Power Module with 2 expansion axes (maximum expansion stage)

## 1.2 System data

### Technical data

The following technical data apply for SINAMICS S120 Combi Power Modules.

<b>Electrical data</b>	
Line connection voltage	3-ph. 380 V AC -10 % to 3-ph. 480 V AC +10 % Above 2000 m installation altitude, refer to the characteristic for voltage derating
Line frequency	45 Hz to 66 Hz
Line supply types	TN, TT, and IT line supplies
Electronics power supply	24 V DC -15/+20 % <sup>1)</sup> , safety extra-low voltage DVC A (PELV)
Short-circuit current rating SCCR in accordance with UL508C (up to 600 V)	1.1 kW – 447 kW: 65 kA
Interference suppression to EN 61800-3	Category C2 for plant and system versions in conformance with the documentation
Overvoltage category	III acc. to EN 60664-1
Degree of contamination	II acc. to EN 60664-1

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

<b>Environmental conditions</b>	
<b>Functional safety of SINAMICS components</b>	
The components must be protected against conductive pollution. This can be achieved e.g. by installing them in a control cabinet with degree of protection IP54B acc. to EN 60529. Provided that conductive pollution can be prevented at the installation site, the degree of protection for the cabinet can be decreased accordingly.	
Degree of protection	IP20 or IPXXB to EN 60529, open type to UL508
Protection class for line current circuits Protection class for electronic circuits	I (with protective conductor connection) and III (protective extra low voltage DVC A / PELV) acc. to EN 61 800-5-1
Permissible cooling medium temperature (air) and installation altitude in operation	0 °C to +45 °C up to an installation altitude of 1000 m without derating, installation altitude >1000 °C up to 4000 m, see the derating characteristic with respect to the installation altitude or reduction of the ambient temperature by 3.5 K per 500 m.
Chemically active substances <ul style="list-style-type: none"> <li>Long-term storage in the transport packaging</li> <li>Transport in the transport packaging</li> <li>Operation</li> </ul>	Class 1C2 to EN 60721-3-1 Class 2C2 to EN 60721-3-2 Class 3C2 to EN 60721-3-3
Biological environmental conditions <ul style="list-style-type: none"> <li>Long-term storage in the transport packaging</li> <li>Transport in the transport packaging</li> <li>Operation</li> </ul>	Class 1B1 to EN 60721-3-1 Class 2B1 to EN 60721-3-2 Class 3B1 to EN 60721-3-3

System overview

1.2 System data

Environmental conditions	
Vibratory load <ul style="list-style-type: none"> <li>• Long-term storage in the transport packaging</li> <li>• Transport in the transport packaging</li> <li>• Operation</li> </ul>	Class 1M2 to EN 60721-3-1 Class 2M3 to EN 60721-3-2 Test values: Frequency range: 10 Hz to 58 Hz With constant deflection of 0.075 mm Frequency range: 58 Hz to 200 Hz With constant acceleration of 1 g
Shock load <ul style="list-style-type: none"> <li>• Long-term storage in the transport packaging</li> <li>• Transport in the transport packaging</li> <li>• Operation</li> </ul>	Class 1M2 acc. to EN 60721-3-1 Class 2M3 acc. to EN 60721-3-2 Test values: 15 g / 11 ms
Climatic environmental conditions <ul style="list-style-type: none"> <li>• Long-term storage in the transport packaging</li> <li>• Transport in the transport packaging</li> <li>• Operation</li> </ul>	Class 1K4 acc. to EN 60721-3-1 Temperature -25 °C to +55 °C Class 2K4 acc. to EN 60721-3-2 Temperature -40 °C to +70 °C Class 3K3 acc. to EN 60721-3-3 Temperature +0 °C to +45 °C Relative air humidity 5 % to 95 % Oil mist, salt mist, formation of ice, moisture condensation, dripping, spraying, splashing water, and water jets not permissible

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

## 1.3 Standards

### Note

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

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

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

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

1.3 Standards

Standards*	Title
IEC 60287-1 to -3	Cables - Calculation of the current carrying capacity Part 1: Current carrying capacity equations (100 % load factor) and calculating the losses Part 2: Thermal resistance - Part 3: Main sections for operating conditions
HD 60364-x-x IEC 60364-x-x DIN VDE 0100-x-x VDE 0100-x-x	Erection of power installations with nominal voltages up to 1000 V; Part 200: Definitions Part 410: Protection for safety, protection against electric shock Part 420: Protection for safety, protection against thermal effects Part 430: Protection of cables and conductors for over-current Part 450: Protection for safety, protection against undervoltage Part 470: Protection for safety; use of protection for safety Part 5xx: Selecting and erecting electrical equipment Part 520: Wiring systems Part 540: Earthing, protective conductor, potential bonding conductor Part 560: Electrical equipment for safety purposes
EN 60439 IEC 60439 DIN EN 60439 VDE 0660-500	Low-voltage switchgear assemblies; Part 1: Type-tested and partially type-tested assemblies
EN 60529 IEC 60529 DIN EN 60529 VDE 0470-1	Degrees of protection provided by enclosures (IP code)
EN 60721-3-x IEC 60721-3-x DIN EN 60721-3-x	Classification of environmental conditions Part 3-0: Classification of environmental parameters and their severities; Introduction Part 3-1: Classification of environmental parameters and their severities; Long-term storage Part 3-2: Classification of environmental parameters and their severities; Transport Part 3-3: Classification of environmental parameters and their severities; stationary use, weather protected
EN 60947-x-x IEC 60947 -x-x DIN EN 60947-x-x VDE 0660-x	Low-voltage switchgear
EN 61000-6-x IEC 61000-6-x DIN EN 61000-6-x VDE 0839-6-x	Electromagnetic compatibility (EMC) Part 6-1: Generic standard; Immunity for residential, commercial and light-industrial environments Part 6-2: Generic standards; Immunity for industrial environments Part 6-3: Generic standards; Generic standard emission for residential, commercial and light-industrial environments Part 6-4: Generic standards; Generic standard noise emission for industrial environments
EN 61140 IEC 61140 DIN EN 61140 VDE 0140-1	Protection against electric shock; Common aspects for installation and equipment
EN 61800-2 IEC 61800-2 DIN EN 61800-2 VDE 0160-102	Adjustable-speed electrical power drive systems; Part 2: General requirements - Rating specifications for low-voltage adjustable frequency a.c. power drive systems
EN 61800-3 IEC 61800-3 DIN EN 61800-3 VDE 0160-103	Adjustable-speed electrical power drive systems; Part 3: EMC - Requirements and specific test methods

Standards*	Title
EN 61800-5-x IEC 61800-5-x DIN EN 61800-5-x VDE 0160-105-x	Adjustable-speed electrical power drive systems; Part 5: Safety requirements; Main section 1: Electrical, thermal and energy requirements Main section 2: Functional safety requirements
EN 62061 IEC 62061 DIN EN 62061 VDE 0113-50	Safety of machinery; Functional safety of safety-related electrical, electronic and programmable electronic control systems
UL 50 CSA C22.2 No. 94.1	Enclosures for Electrical Equipment
UL 508 CSA C22.2 No. 142	Industrial Control Equipment Process Control Equipment
UL 508C CSA C22.2 No. 14	Power Conversion Equipment Industrial Control Equipment

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





# Line-side power components

## 2.1 Introduction

The following components should be used to connect the S120 Combi drive line-up to the line supply:

- Line disconnector
- Overcurrent protection device (line fuse or circuit breaker)
- Line contactor (this is required for electrical isolation)
- Line filter
- Line reactor (always required)

The line connection for a SINAMICS S120 Combi comprises in addition to the regionally required protective devices, an optional line filter and a line reactor:

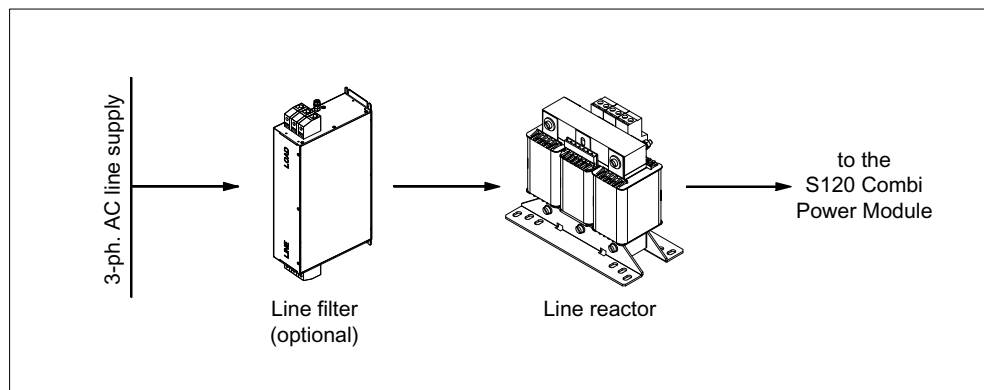


Figure 2-1 Overview diagram, line connection

## 2.2 Information on the disconnecter unit

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

<b>NOTICE</b>
<p>If an operational drive line-up is switched off using a line disconnecter, then the voltage at interface X21, terminal 3 (EP +24 V) and 4 (EP M) must first be interrupted at the S120 Combi. This can be achieved with a leading disconnecting auxiliary contact (<math>\geq 10</math> ms), for example.</p> <p>This protects external loads located parallel to the drive on the same switching component.</p>

The accessories required for the line disconnecter must be selected from the manufacturer catalogs. See also catalog NC61.

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

Line fuses and circuit breakers should be used for the line/overcurrent protection in order to limit the damage to the S120 Combi if a fault does occur. NH, D, and DO type fuses with a gL characteristic or suitable circuit breakers according to IEC 60947 can be used for this purpose.

Table 2- 1 Characteristics of the line fuses and circuit breakers for S120 Combi Power Modules

Infeed	Protective device				Prospective short-circuit current	
	Fuse		Circuit breaker		Minimum value	Maximum value
	Rated current	Tripping time	Rated current	Tripping time		
16 kW	35 A	< 10 ms	35 A	< 15 ms	> 1 kA	< 65 kA
20 kW	63 A	< 10 ms	63 A	< 15 ms	> 2.5 kA	< 65 kA

Table 2- 2 Recommended LV HRC line fuses (gL) and circuit breakers for S120 Combi Power Modules

Infeed	Recommended line fuse	Recommended circuit breaker
16 kW	3NA3814	3RV1031-4FA10
20 kW	3NA3822	3RV1041-4JA10

 **DANGER**

As a general rule, the higher loop impedance of TT line supplies means they are not suitable for tripping the installed overcurrent protection devices within the prescribed period should an insulation fault occur. If TT line supplies are used, residual-current-operated circuit breakers (refer to the chapter titled "Residual-current-operated circuit breakers (RCD)") should ideally be used in addition to the overcurrent protection devices.

 **WARNING****Selecting the overcurrent protection devices**

In order to avoid the risk of fire or electric shock, overcurrent protection devices should be dimensioned so that in the case of a fault, the equipment is switched off sufficiently quickly. At the place of installation, measurements should be performed to check whether a suitably high short-circuit current flows to trip the protective devices quickly enough.

To do this, the loop impedance (faulted-circuit impedance) should be measured and the prospective short-circuit current calculated as well as the time-current characteristics of the overcurrent protection devices calibrated using measuring instruments according to EN 61557-3.

If the necessary break times are not maintained, then the next smaller overcurrent protection device must be used.

 **WARNING**

It is not permissible to overdimension fuses as this can result in significant levels of danger and also faults.

**Note**

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

### Information on the tripping time of line fuses

In order that the line fuses trip in a timely manner, the loop resistance as well as the vector group of the feeding line transformer must ensure that, if a fault occurs, the touch voltage of the devices is disconnected by the fuses provided within the permissible tripping time (see figure below, in accordance with EN 61800-5-1 Ed. 2).

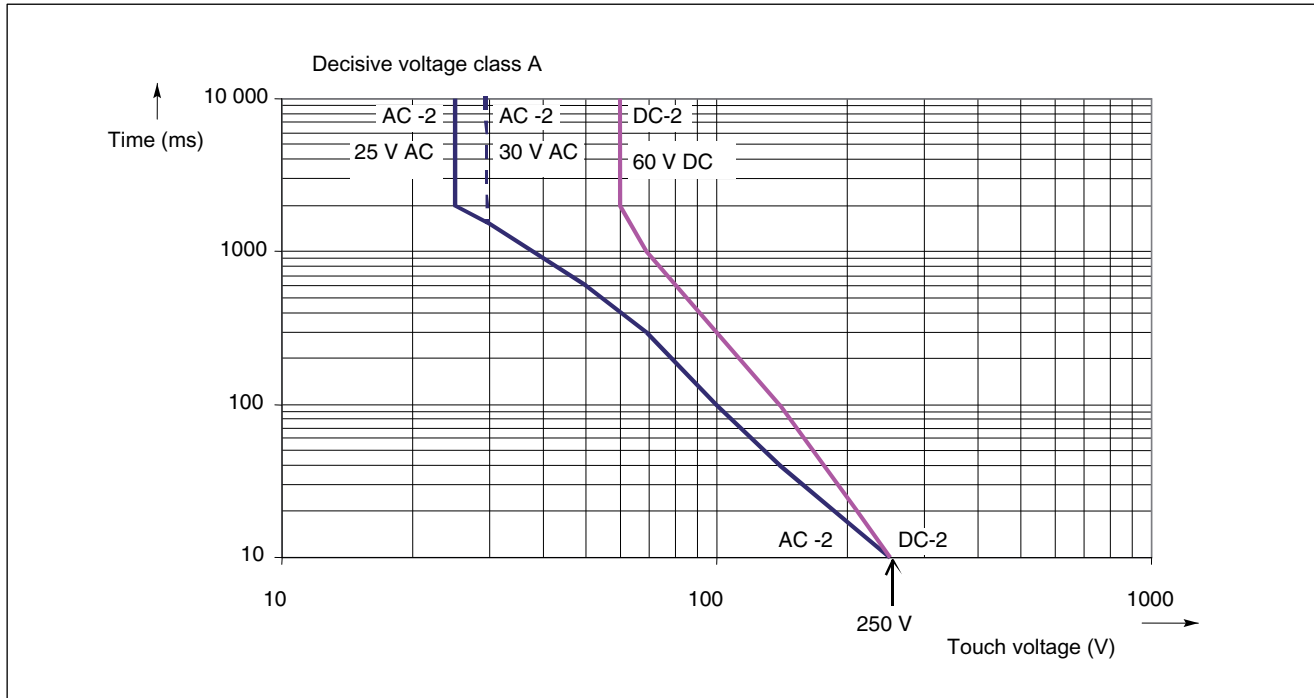


Figure 2-2 Permissible tripping time of fuses

The boundary conditions indicated above also serve to avoid a fire in case of a fault. If you do not comply with these boundary conditions, you must take additional measures, e.g., residual current transformer.

Fuse and plant conditions such as loop resistance and short-circuit power must be harmonized to one another so that the limit curve is not exceeded. This guarantees the shock-hazard protection.

## 2.4 Line supply connection via residual-current devices

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

### CAUTION

Residual-current devices have to be installed if the line supply conditions in terms of short-circuit power and loop impedance at the infeed point are not such that the installed overcurrent protection devices will trip within the prescribed period if a fault occurs. Since TT line supplies do not generally meet this requirement, residual-current devices must always be installed for this type of system.

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

### DANGER

Residual-current operated circuit breakers alone are not permissible to provide protection against direct and indirect contact.

### When using residual-current operated circuit breakers, it should be noted that

- It is only permissible to use a delayed tripping, selective AC/DC-sensitive residual-current operated circuit breaker, type B.
- The max. permitted grounding resistance of the "selective protective device" is observed (83  $\Omega$  max. for residual-current devices with 0.3 A rated differential current).
- Accessible parts of the Power Drive System and the machine are connected to the system's protective ground conductor.
- The maximum total length of the shielded power cables in the drive line-up (motor cables incl. line supply cables from the line filter to the connecting terminals of the S120 Combi) is 175 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 (line disconnecter, contactors) for connecting and disconnecting the drive line-up have max. 35 ms delay time between the closing/opening of the individual main contacts.

2.5 Overvoltage protection

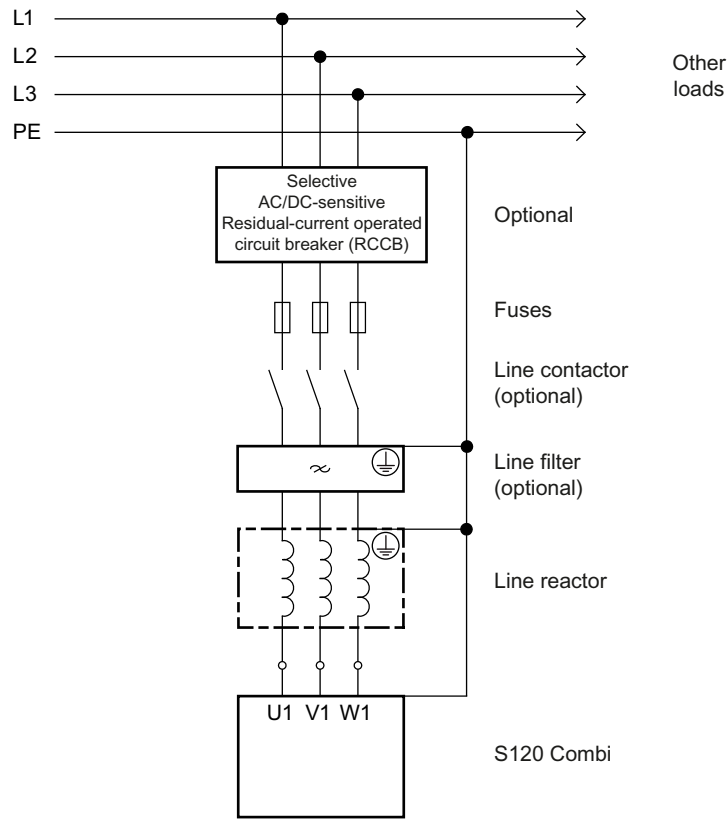


Figure 2-3 Connecting a residual-current operated circuit breaker

Recommendation

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

<b>NOTICE</b>
AC or pulse-sensitive RCCBs are not suitable.

2.5 Overvoltage protection

To protect the units against line-side surge voltages, you are advised to install an overvoltage protection device directly at the infeed point (upstream of the main switch). To fulfill the requirements of CSA C22.2 no. 14-05, surge protection is essential. For examples of suitable voltage surge arresters, see [www.raycap.com](http://www.raycap.com) (for example)

## 2.6 Line filters

### 2.6.1 Description

Line filters have the task to attenuate conducted interference emission in the frequency range according to the specifications of EMC legislation. They are mainly effective in the frequency range from 150 kHz to 30 MHz; this is the range relevant to ensure compliance with the appropriate standard.

In conjunction with a line filter and the associated line reactor, drive line-ups with S120 Combi Power Modules fulfill Category C2 according to EN 61800-3. An EMC compliant design is always assumed.

Line filters for 16 kW and 20 kW are designed for use with systems and equipment with a maximum total cable length of 175 m of category C2 to EN 61800-3.

---

#### Note

The line filter is only suitable for direct connection to TN line supplies. When connected to other line supplies, an isolation transformer is required.

---

### 2.6.2 Safety information

 <b>DANGER</b>
---

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

- |   |
|---|
| <ul style="list-style-type: none"> <li>• stationary connection and protective conductor connection by means of <math>\geq 10 \text{ mm}^2</math> Cu or <math>\geq 16 \text{ mm}^2</math> Al</li> <li>• stationary connection and installation of a second protective conductor with the same cross-section as the first protective conductor</li> <li>• stationary connection and automatic shutdown of the line supply if the protective conductor is interrupted</li> <li>• Connection with a plug connector for industrial applications in accordance with EN 60309 and a minimum protective conductor cross-section of <math>\geq 2.5 \text{ mm}^2</math> Cu as part of a multi-core supply cable with appropriate strain relief</li> </ul> |
|---|

 <b>DANGER</b>
---

<p><b>Risk of electric shock</b></p>
--------------------------------------

<p>A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off.</p>
---

 **WARNING**

**Cooling clearances**

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

 **WARNING**

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

- incoming line supply cable to LINE L1, L2, L3
- outgoing cable to line reactor at LOAD L1', L2', L3'

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

 **CAUTION**

The S120 Combi must only be connected to the SINAMICS line filter via the associated line reactor. Additional loads must be connected upstream of the SINAMICS line filter (if required, via a separate line filter). If this is not observed, other loads could be damaged or destroyed.

**CAUTION**

According to product standard IEC 61800-3, RFI suppression commensurate with the relevant rated conditions must be provided and is a legal requirement in the EU (EMC Directive). Line filters and line reactors are required to achieve this.

Only line filters listed in this Manual should be used. The use of filters of other makes can lead to limit value violations, resonances, overvoltages and irreparable damage to motors or other equipment. The machine manufacturer must provide verification that the machine equipped with the drive products and the installed suppression elements, e.g. line filters, are CE/EMC-compliant before the machines are placed in the market.

**Note**

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



## 2.6.3 Interface description

### 2.6.3.1 Overview

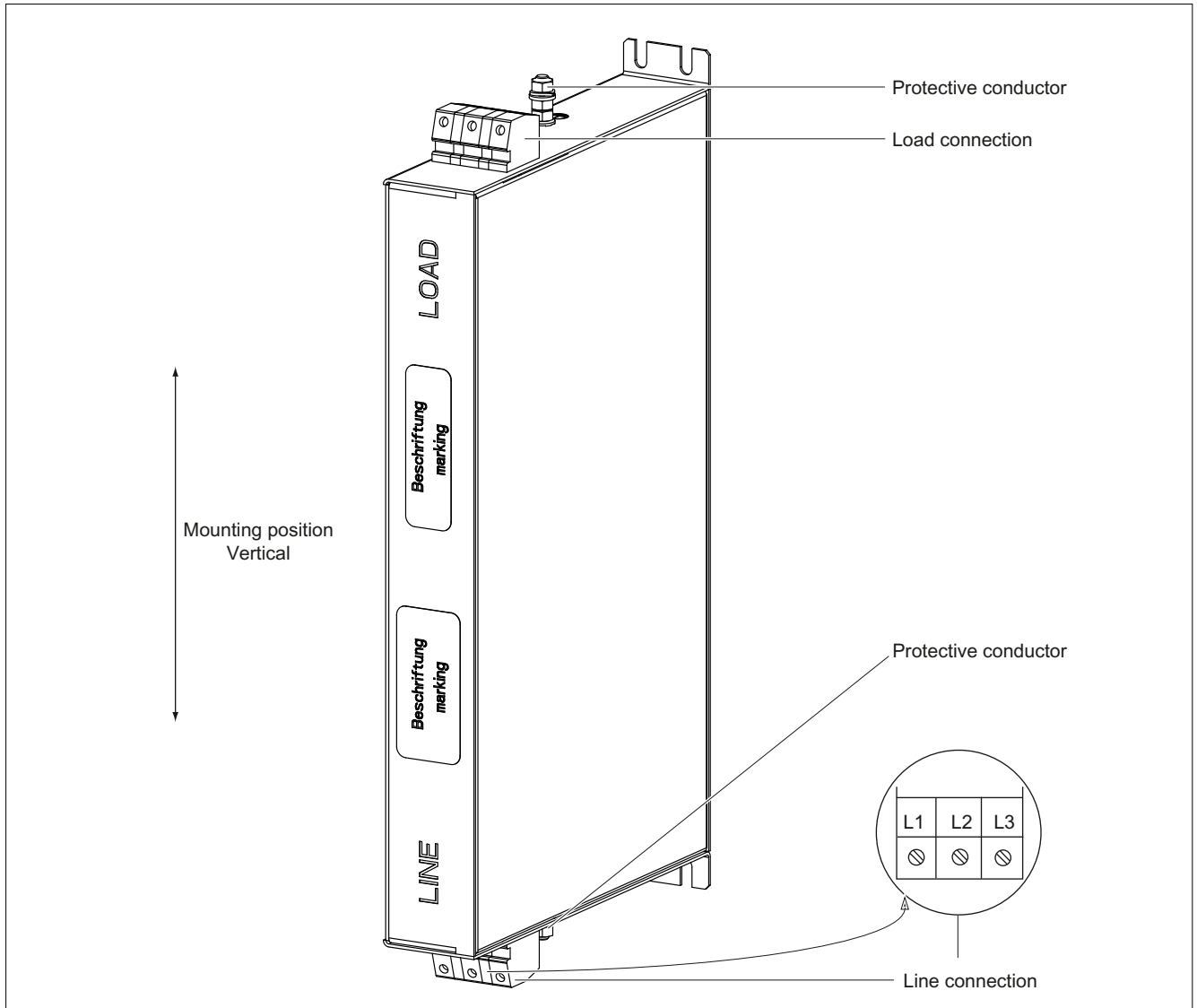


Figure 2-4 Line filter for S120 Combi

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

### 2.6.3.2 Line/load connection

Table 2- 3 Line filter connection

<b>Order number</b>	<b>6SL3000-0BE21-6DA1</b>
Rated infeed power	16 kW and 20 kW
Line connection L1, L2, L3	Screw terminal 10 mm <sup>2</sup> <sup>1)</sup> 1.5 - 1.8 Nm
Load connection L1', L2', L3' (U, V, W)	Screw terminal 10 mm <sup>2</sup> <sup>1)</sup> 1.5 - 1.8 Nm
PE connection	Grounding bolt for M5 ring cable lug according to DIN 46234 6 Nm

1) see Chapter "Control cabinet installation and EMC / connection system" - screw terminal 6

---

#### Note

The line filter 6SL3000-0BE21-6DA1 can be used for all S120 Combi Power Modules.

---

## 2.6.4 Dimension drawing

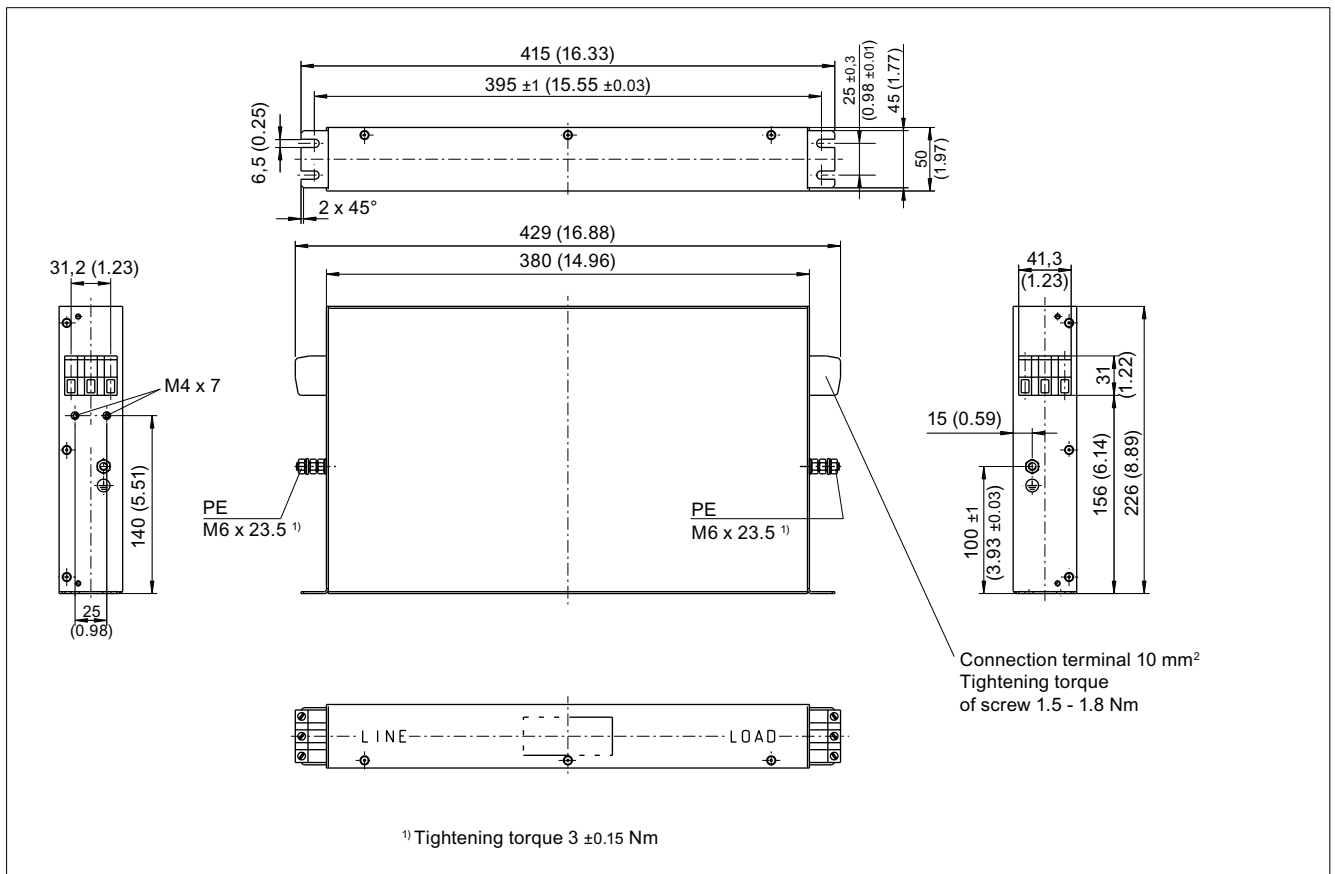


Figure 2-5 Dimension drawing of the line filter, all dimensions in mm and (inches)

## 2.6.5 Technical data

Table 2-4 Technical data, line filter

	Unit	6SL3000-0BE21-6DA1
Rated power	kW	16 and 20
Connection voltage:		
Line supply voltage	V <sub>AC</sub>	3-ph. 380 AC -10 % (-15 % < 1 min) to 3-ph. 480 AC +10 %
Line frequency	Hz	47 to 63 Hz
Rated current	A <sub>AC</sub>	36
Power loss <sup>1)</sup>	W	16
Dimensions (W x H x D)	mm	50 x 420 x 226
Weight, approx.	kg	5
Degree of protection		IP20

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

## 2.7 Line reactors

### 2.7.1 Description

Line reactors for the S120 Combi limit low-frequency line harmonics to permissible values. For this reason, line reactors should always be used.

### 2.7.2 Safety information

#### CAUTION

Only the line reactors described in this Manual must be used.

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

- The infeed in the S120 Combi may be damaged/destroyed.
- Line harmonics may occur that damage/destroy loads connected to the same line supply.



#### CAUTION

The line reactors may reach high surface temperatures of  $> 80\text{ °C}$ . To prevent adjacent components from being damaged due to these high temperatures, a clearance of 100 mm must be maintained around the reactors.

If this clearance cannot be observed, additional measures such as shielding plates or a cooling must be provided.

#### CAUTION

Reactors generate magnetic fields. Components and cables which could be subject to interference or be affected by these fields must, therefore, be located a sufficient distance (at least 200 mm) away or be shielded accordingly.

---

#### Note

##### Connecting cables

The connecting cables between the line reactor and S120 Combi must be kept as short as possible.

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

When using unshielded connecting cables, the cores must be protected from rubbing against the shield connection clip.

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

---

## 2.7.3 Connection description

### 2.7.3.1 Overview

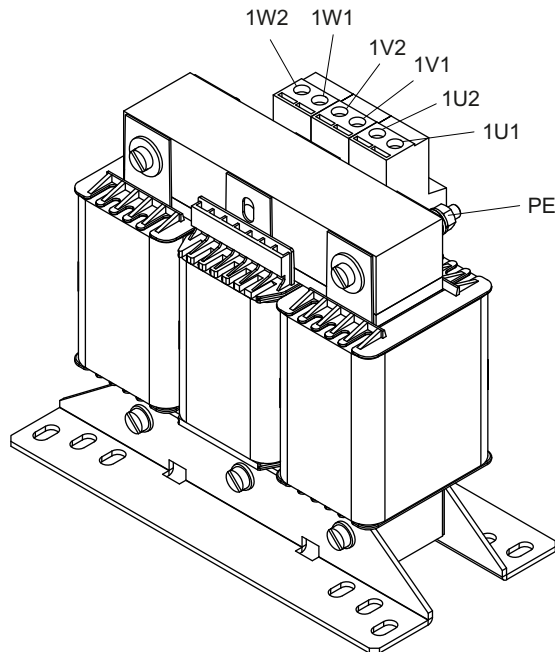


Figure 2-6 Line reactor for S120 Combi (example for 16 kW infeed)

### 2.7.3.2 Line/load connection

Table 2- 5 Connection of line reactors

Order number	6SL3100-0EE21-6AA0	6SL3100-0EE22-0AA0
Power [kW]	16	20
Line connection 1U1, 1V1, 1W1	Screw terminal <sup>1)</sup> 16 mm <sup>2</sup> 1.5 - 1.8 Nm	Screw terminal <sup>1)</sup> 16 mm <sup>2</sup> 1.5 - 1.8 Nm
Load connection 1U2, 1V2, 1W2	Screw terminal <sup>1)</sup> 16 mm <sup>2</sup> 1.5 - 1.8 Nm	Screw terminal <sup>1)</sup> 16 mm <sup>2</sup> 1.5 - 1.8 Nm
PE connection	Grounding studs for M6 ring cable lugs according to DIN 46234	Grounding studs for M6 ring cable lugs according to DIN 46234

1) see Chapter "Control cabinet installation and EMC / connection system" - screw terminal 7

### 2.7.4 Dimension drawings

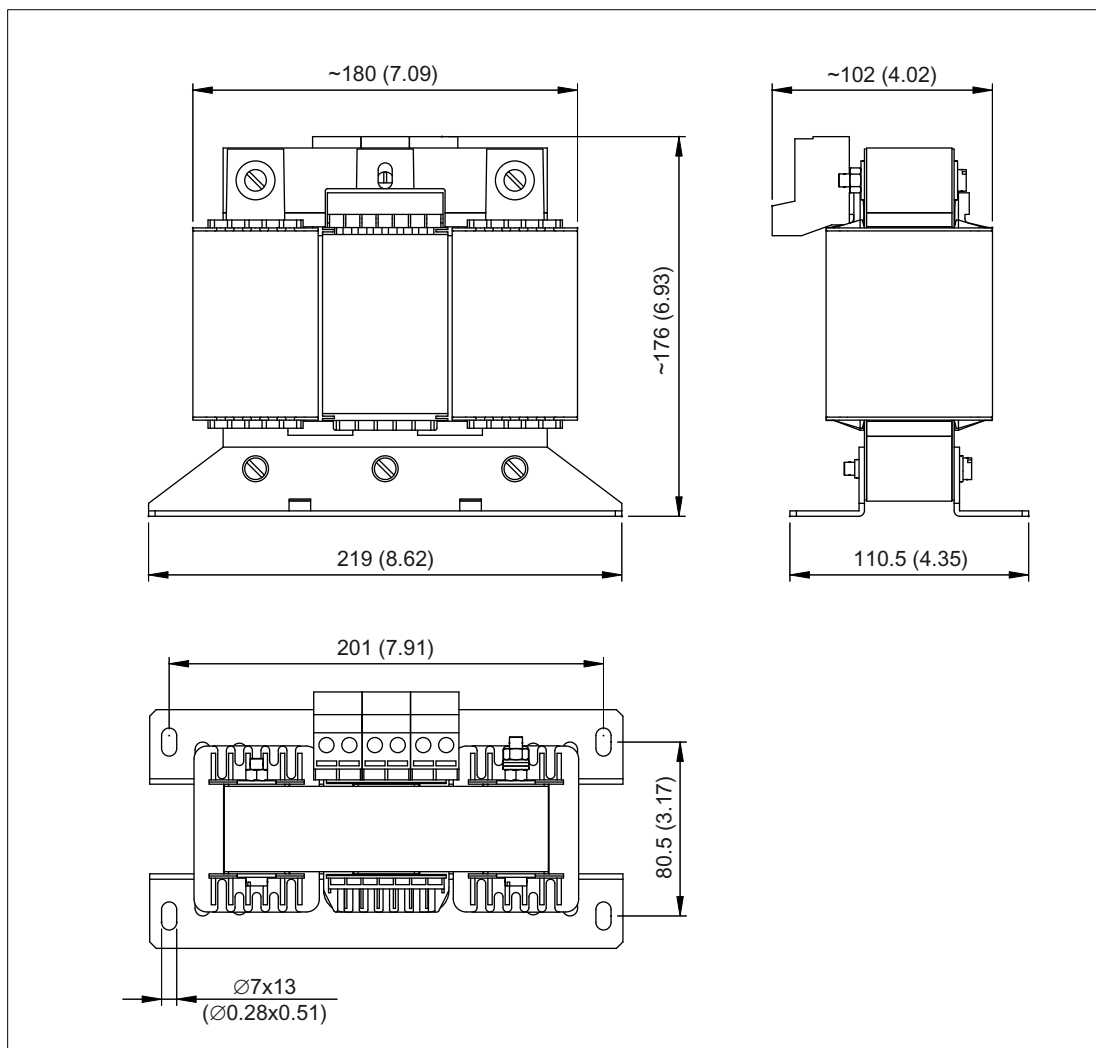


Figure 2-7 Dimension drawing of line reactor for S120 Combi (16 kW infeed), all dimensions in mm and (inches)

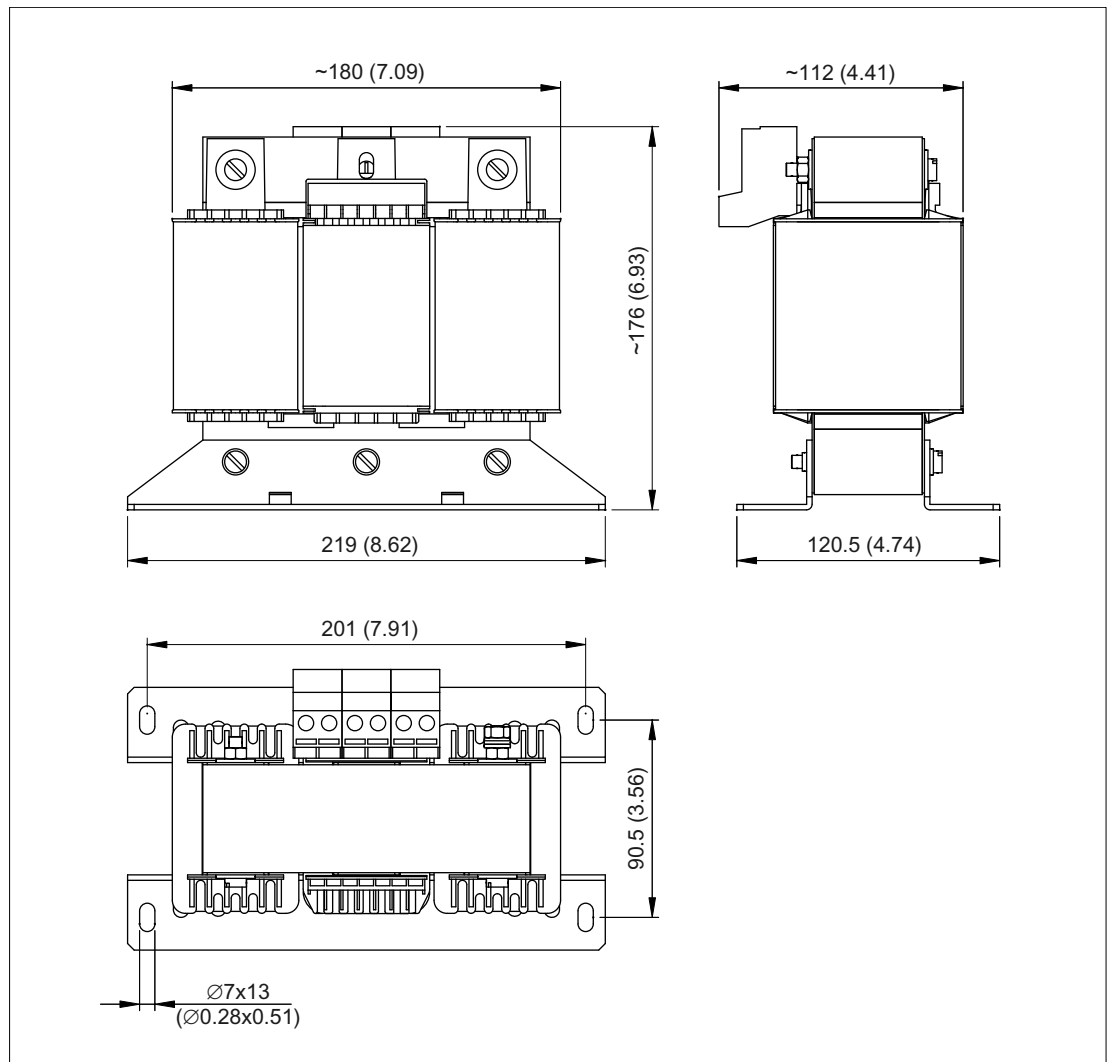


Figure 2-8 Dimension drawing of the line reactor for S120 Combi (20 kW infeed), all dimensions in mm and (inches)

## 2.7.5 Technical data

Table 2- 6 Technical data, line reactors for S120 Combi

	Unit	6SL3100-0EE21-6AA0	6SL3100-0EE22-0AA0
Rated power	kW	16	20
Rated current	$A_{rms}$	28	33
Power loss <sup>1)</sup>	W	75	98
Dimensions (W x H x D)	mm	219 x 176 x 120	219 x 176 x 130
Weight	kg	10.7	10.9
Degree of protection		IP20	IP20

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

## 2.8 Line connection versions

### 2.8.1 Ways of connecting the line supply

A distinction is made between:

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

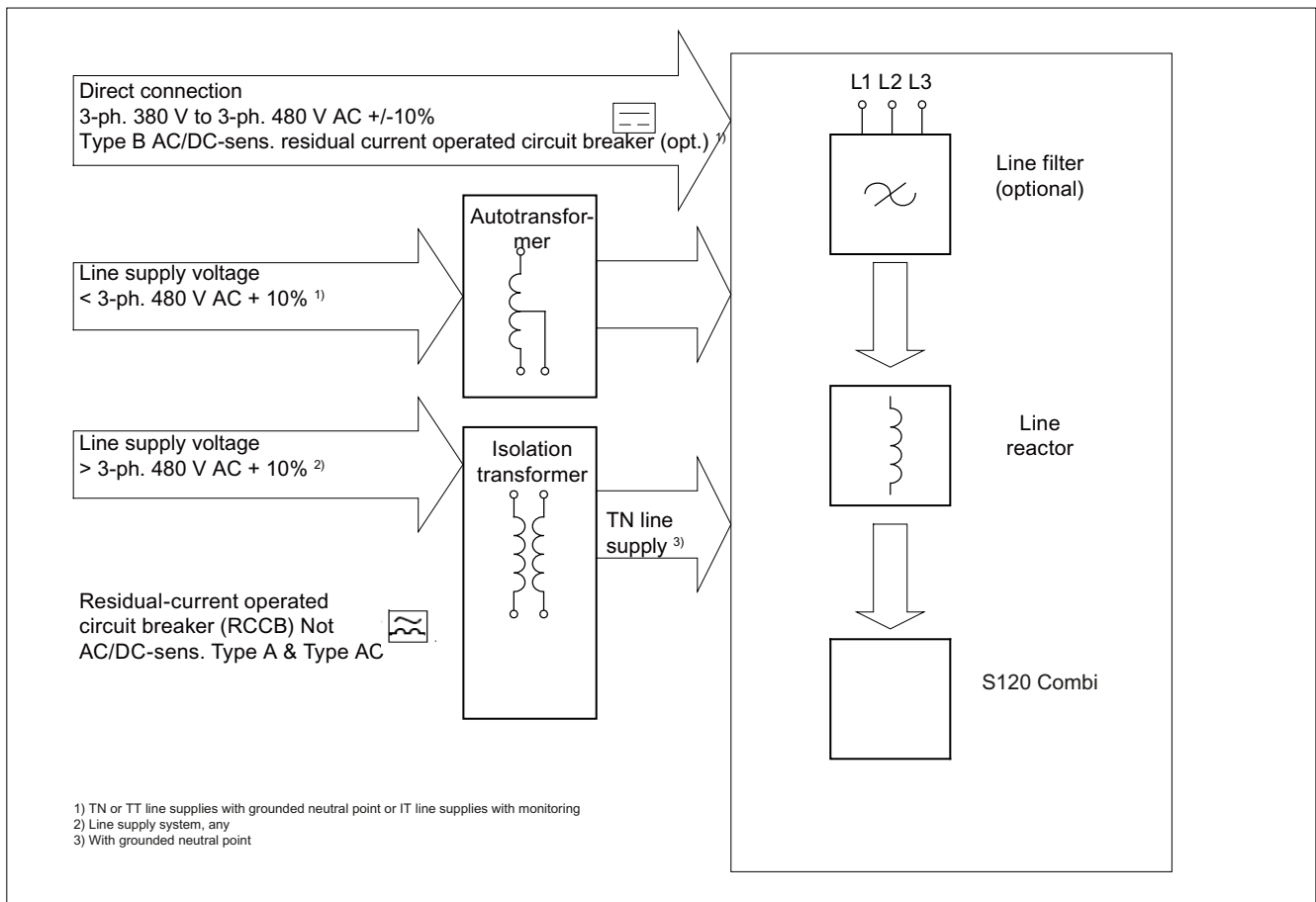


Figure 2-9 Overview of line connection versions



**Note**

**Line connection of motors**

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

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

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

**2.8.2 Operating line connection components on the line supply**

The SINAMICS S120 Combi drive system is designed to be directly connected to TN, TT, and IT line supplies with a rated voltage of 3-ph. 380 V to 3-ph. 480 V AC.

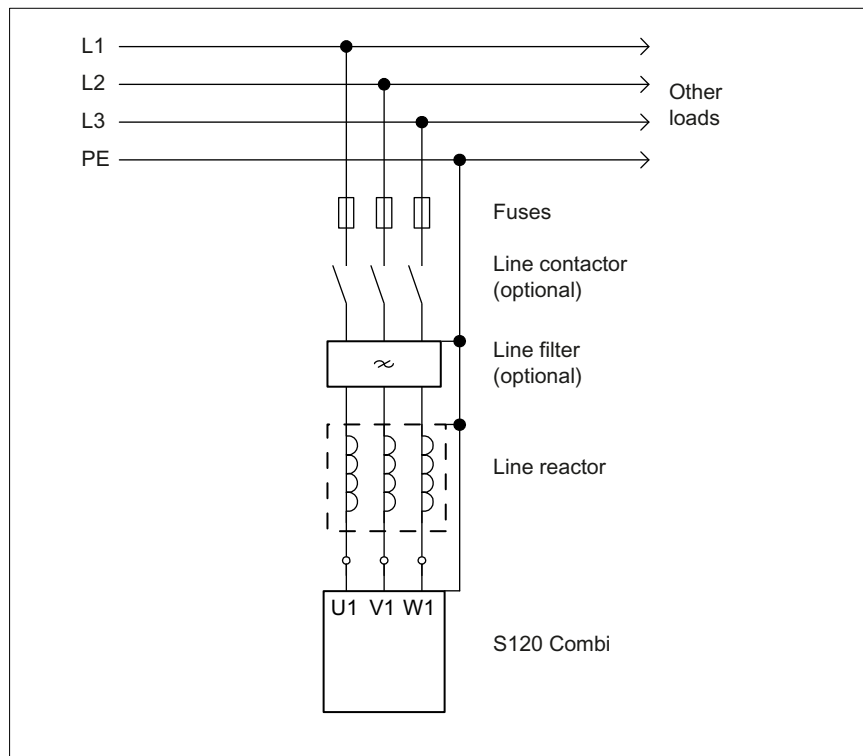


Figure 2-10 Direct operation on the line supply

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

### 2.8.3.1 Safety information

<b>CAUTION</b>
The integrated infeed can be damaged/destroyed when using line filters that have not been approved by SIEMENS for the SINAMICS S120 Combi Power Modules. Furthermore, line harmonics can occur that damage/destroy loads connected to the same line supply. It is not permissible to connect other loads after the line filter.

<b>NOTICE</b>
If the system fault level is too low, this can result in faults at the integrated infeed of the SINAMICS S120 Combi Power Modules. It can also cause faults and damage to other equipment and devices that are connected at the same line connection point as the S120 Combi Power Module.

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**Note**

Using a transformer with the S120 Combi Power Module does not replace the external line reactor.

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### 2.8.3.2 Line connection conditions

The S120 Combi is approved for operation on line supplies from  $S_{K \text{ line}}/P_n \geq 70$ .

If a TN line supply is specified on the secondary side, then a transformer with grounded neutral point must be used. However, the loop resistance must be small enough to trigger the fuses as fast as required.

### Vector group

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

### Dimensioning and selecting the matching transformer for several loads

An S120 Combi Power Module with integrated infeed and other loads / machines are connected to the matching transformer.

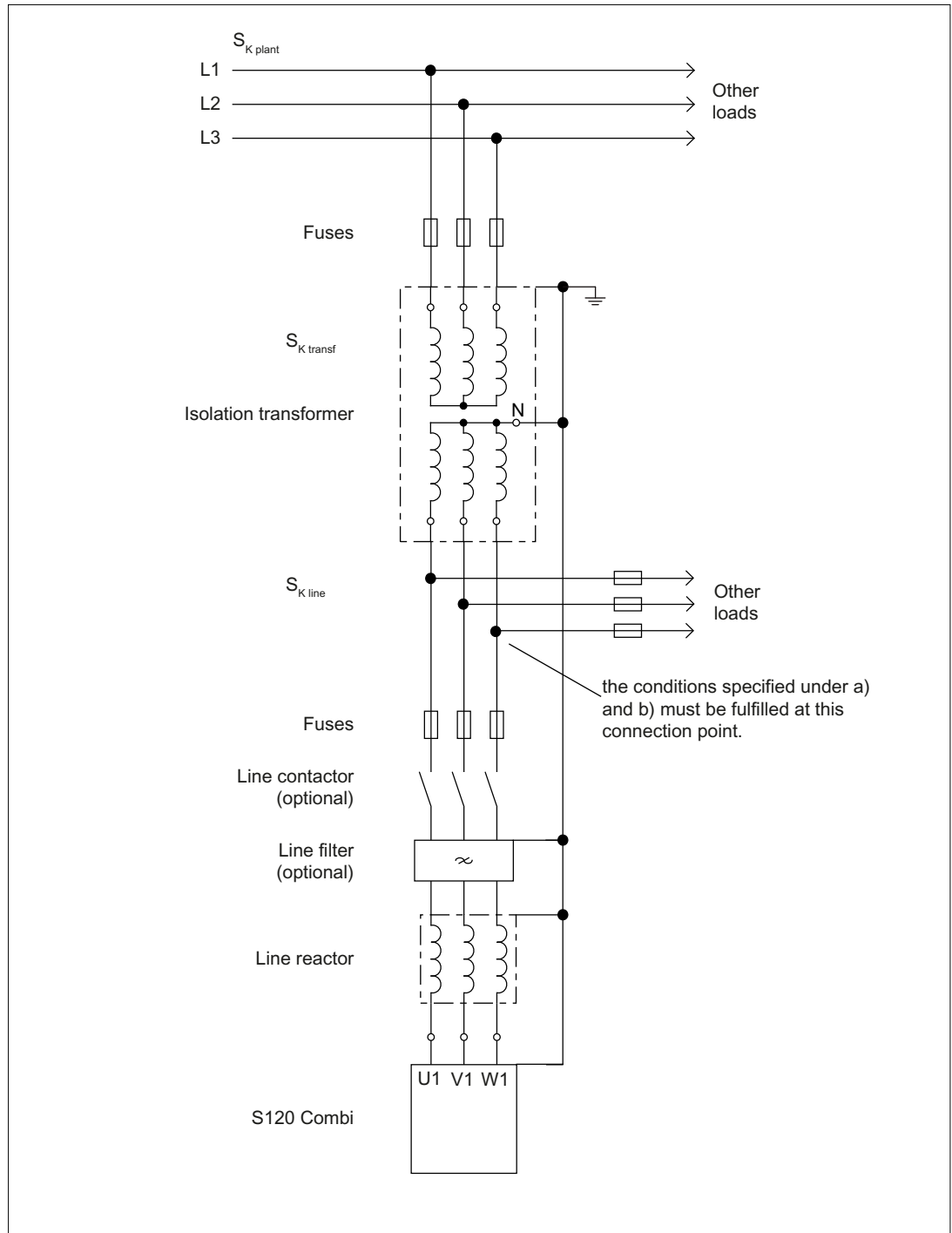


Figure 2-11 Operating several loads through a matching transformer

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

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

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

$u_k$  = short-circuit voltage of the matching transformer in %  
(must be between 1% and 3% for the S120 Combi)

$S_k$  = short-circuit power.

**⚠ WARNING**

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

**Boundary condition a) Rated power**

The rated power of the matching transformer  $S_{n1}$  must always be a factor of 1.27 higher than the rated power  $P_n$  of the S120 Combi Power Module.

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

Example:

The minimum rated power of a matching transformer for a 16 kW S120 Combi Power Module is 21 kVA.

**Boundary condition b) Short-circuit power**

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

$$S_{k \text{ line}} \geq 70 \cdot P_n$$

Special case:

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

$$S_{k \text{ line}} \geq 0.73 \cdot 70 \cdot P_n$$

For example  $S_{k \text{ line}}$  for 16 kW S120 Combi Power Module:  $S_{k \text{ line}} = 0.82 \text{ MVA} = 820 \text{ kVA}$

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

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

**Note:**

The system fault level (short-circuit power) at the plant connection  $S_{K \text{ plant}}$  plays a decisive role in dimensioning/selecting the matching transformer.

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

Table 2- 7 Transformer configuration instructions

S120 Combi Power Module $P_n$	Required rated power $S_n$ of the isolation transformer/autotransformer	Required short-circuit voltage $u_k$	Required system fault level $S_{K \text{ line}}$
16 kW	$S_n \geq 21 \text{ kVA}$	$u_k \leq 3 \%$	$S_{K \text{ line}} \geq 1.12 \text{ MVA}$
20 kW	$S_n \geq 26 \text{ kVA}$	$u_k \leq 3 \%$	$S_{K \text{ line}} \geq 1.4 \text{ MVA}$

**Note**

Ask your local power utility company for the system fault level  $S_{K \text{ line}}$ .

**Example 1**

$u_k$  matching transformer = 3 %  
 $S_{K \text{ plant}} = 50000 \text{ kVA}$   
 $S_{K \text{ line}} = 16 \text{ kW} \cdot 70 \cdot 0.73 = 820 \text{ kVA}$

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

According to b)

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

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

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

### Example 2

$u_k$  matching transformer = 1 %  
 $S_{K \text{ plant}} = 50000 \text{ kVA}$   
 $S_{K \text{ line}} = 16 \text{ kW} \cdot 70 \cdot 0.73 = 820 \text{ kVA}$

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

According to b)

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

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

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

### Example 3

If  $S_{K \text{ plant}}$  is lower, then a higher-rating transformer must be used.

$u_k$  matching transformer = 3 %  
 $S_{K \text{ plant}} = 3000 \text{ kVA}$   
 $S_{K \text{ line}} = 16 \text{ kW} \cdot 70 \cdot 0.73 = 820 \text{ kVA}$

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

According to b)

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

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

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

#### Example 4

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

$u_k$  matching transformer = 1 %,

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

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

according to a)

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

According to b)

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

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

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

---

#### Note


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

---

### 2.8.3.3 Operation via a matching transformer

#### Operating line connection components via an autotransformer

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

 <b>DANGER</b>
To ensure protective separation an isolation transformer must be used for voltages greater than 3-ph. 480 V AC + 10 %.

Application example:

- The motor insulation must be protected from excessive voltages.

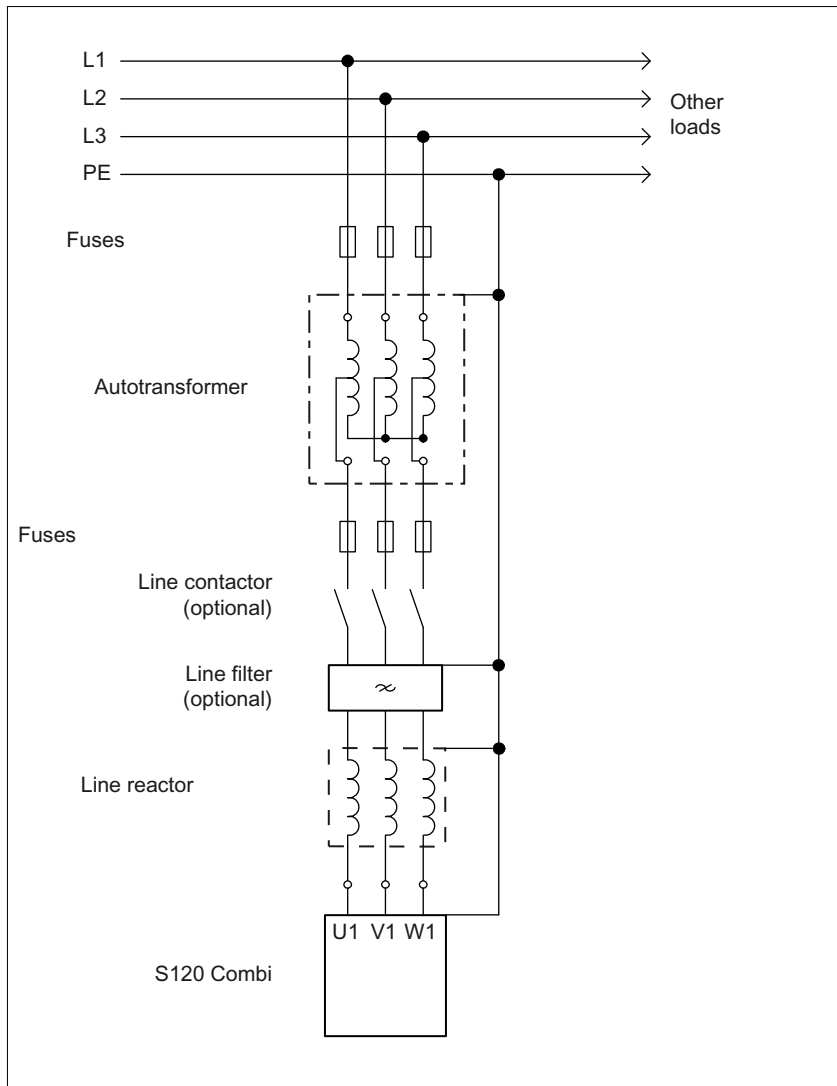


Figure 2-12 Operation via an autotransformer



## Assignment of autotransformers to S120 Combi versions

Table 2- 8 Autotransformers for 480 / 440 V input voltage

	S120 Combi Power Modules	
	16 kW	20 kW
Rated power [kVA] Autotransformer IP00	21	46.5
Input voltage [V]	3-ph. 480 / 440 V AC $\pm$ 10%; 50 Hz - 5% to 60 Hz + 5%	
Output voltage [V]	3-ph. 400 V AC	
Vector group	Yna0	
Permiss. ambient temperature Operation [°C]	-25 to +40, for power derating up to +55 °C, ISOKL: H, $t_a = 40$	
Humidity class based on DIN EN 60721-3-3	Cl. 3K5, Condensation and icing excluded Low air temperature 0 °C (+32 °F)	
Degree of protection to EN 60529 (IEC 60529) IP00	Degree of protection IP00: _ → Order No. A	
Order No.	4AP2796-0EL40-2X_0	4AU3696-0ER20-2X_0
Power loss [W] Autotransformer IP00	160	430
Short-circuit voltage $u_k$ [%]	$\leq 1.5$	
Conn. cross-section, max. primary/secondary sides	16 mm <sup>2</sup>	35 mm <sup>2</sup>
Fuse, primary side	35 A gL	80 A gL
Weight [kg], approx. for Degree of protection IP00	29	52
Terminal arrangement	1U1 / 1U3 / 1V1 / 1V3 / 1W1 / 1W3 / 2U1 / 2V1 / 2W1 / N	
	1U1 to 1W1 = 480 V input, 1U3 to 1W3 = 440 V input, 2U1 to 2W1 = 400 V output, N = neutral point	

Table 2- 9 Autotransformers for 220 V input voltage

	S120 Combi Power Modules	
	16 kW	20 kW
Rated power [kVA] Autotransformer IP00	21	46.5
Input voltage [V]	3-ph. 220 V AC $\pm$ 10%; 50 Hz - 5% to 60 Hz + 5%	
Output voltage [V]	3-ph. 400 V AC	
Vector group	Yna0	
Permiss. ambient temperature Operation [°C]	-25 to +40, for power derating up to +55 °C, ISOKL: H, t <sub>a</sub> = 40	
Humidity rating in accordance with DIN EN 60721-3-3	Cl. 3K5, Condensation and icing excluded Low air temperature 0 °C (+32 °F)	
Degree of protection to EN 60529 (IEC 60529) IP00	Degree of protection IP00: _ → Order No. 0	
Order No.:	4AU3696-0ER30-2XA0	4BU4395-0CB6_-8B
Power loss [W] Autotransformer IP00	550	900
Short-circuit voltage u <sub>k</sub> [%]	≤ 1.5	
Conn. cross-section, max. primary/secondary sides	16/16 mm <sup>2</sup>	70/50 mm <sup>2</sup>
Fuse, primary side	63 A gL	160 A gL
Weight [kg], approx. for Degree of protection IP00	57	110
Terminal arrangement	1U1 to 1W1 = 220 V input, 2U1 to 2W1 = 400 V output, N = neutral point	

### 2.8.3.4 Operation via an isolation transformer

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

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

An isolating transformer must be used in the following cases:

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

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

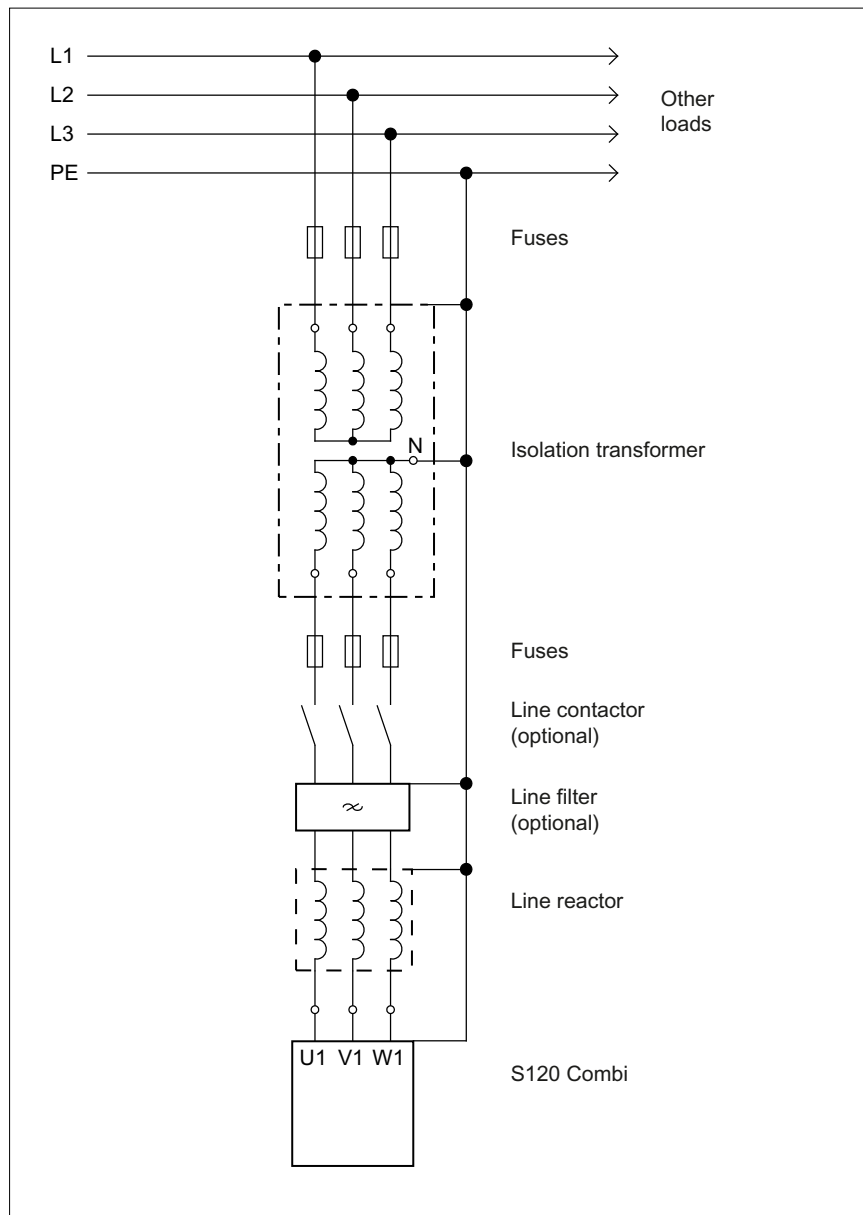


Figure 2-13 Operation via an isolation transformer

## Assignment of isolation transformers to S120 Combi versions

Table 2- 10 Matching transformers with isolated windings for 50/60 Hz line supplies

	S120 Combi Power Modules	
	16 kW infeed	20 kW infeed
Rated power [kVA]	21	47
Power loss, max. [W]	650	1200
Vector group	Yyn0	
Degree of protection acc. to DIN EN 60529 (IEC 60529)	Degree of protection IP00: _ → Order No. 0	
Humidity rating in accordance with DIN EN 60721-3-3	Cl. 3K5, Condensation and icing excluded Low air temperature 0 °C (+32 °F)	
Permissible ambient temperature Operation [°C]	-25 to +40, for power derating up to +55, ISOKL: H, t <sub>a</sub> = 40	
Approx. weight for degree of protection IP00	120	200
Max. conn., secondary [mm <sup>2</sup> ]	16	35
<b>Input voltage, 3-ph. 575 V AC - 500 V AC - 480 V AC ± 10 %; 50 Hz – 5 % to 60 Hz + 5 %</b>		
Rated input current [A]	26	58
Max. conn., primary [mm <sup>2</sup> ]	16	35
Short-circuit voltage u <sub>k</sub> [%]	2.49	2.64
Order No.	4BU4395-0SA7_-0C	4BU4795-0SC3_-0C
<b>Input voltage, 3-ph. 440 V AC - 415 V AC - 400 V AC ± 10 %; 50 Hz – 5 % to 60 Hz + 5 %</b>		
Rated input current [A]	31	69.5
Max. conn., primary [mm <sup>2</sup> ]	16	35
Short-circuit voltage u <sub>k</sub> [%]	2.47	2.63
Order No.	4BU4395-0SA8_-0C	4BU4795-0SC4_-0C
<b>Input voltage, 3-ph. 240 V AC - 220 V AC - 200 V AC ± 10 %; 50 Hz – 5 % to 60 Hz + 5 %</b>		
Rated input current [A]	62	138.5
Max. conn., primary [mm <sup>2</sup> ]	35	70
Short-circuit voltage u <sub>k</sub> [%]	2.43	2.59
Order No.	4BU4395-0SB0_-0C	4BU4795-0SC5_-0C

### 2.8.3.5 Dimension drawings of the transformers

#### Safety, isolating, control and line transformers 4AP and safety, isolating, control, line, and autotransformers with selectable voltages $4AP \leq 16$ kVA

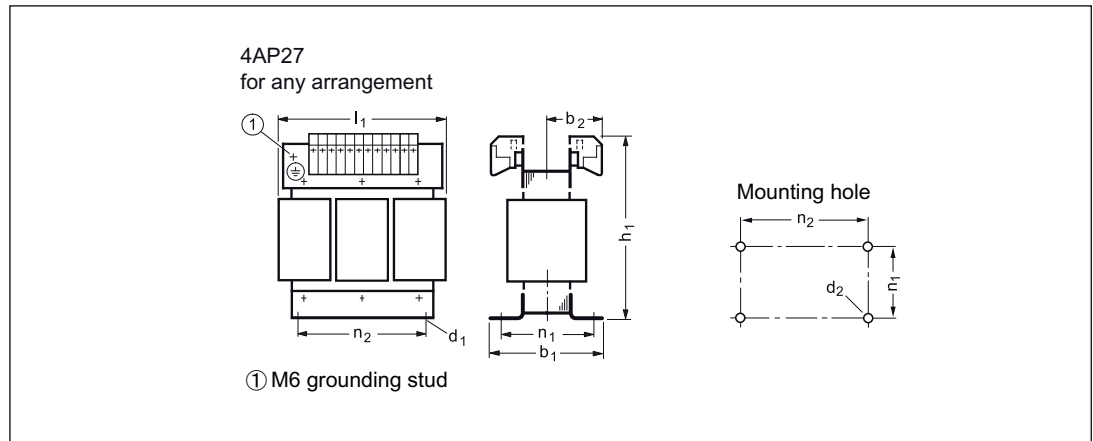


Figure 2-14 Dimension drawing for 4AP27 transformers

Table 2- 11 Dimensions 4AP27, part 1

Type	Rated power kVA <sup>1)</sup>	Designation as per DIN 41302	b <sub>1</sub>	b <sub>2</sub> max.	d <sub>1</sub>	d <sub>2</sub>	h <sub>1</sub> max.	l <sub>1</sub>
4AP27	2.5	3UI 132/70	133	103	10 x 18	M8	242	264

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

Table 2- 12 Dimensions 4AP27, part 2

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

**Safety, isolating, control and line transformers 4AU and safety, isolating, control, line, and autotransformers with selectable voltages 4AU ≤ 16 kVA**

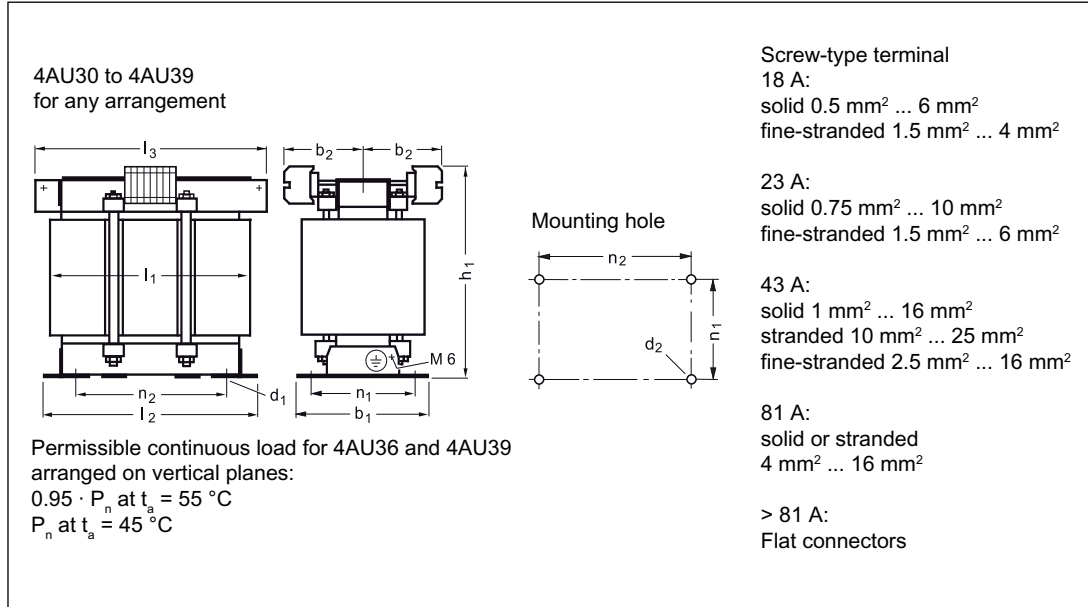


Figure 2-15 Dimension drawing for 4AU30 to 4AU39 transformers

Table 2- 13 Dimensions 4AU30 to 4AU39, part 1

Type	Rated power kVA <sup>1)</sup>	Designation as per DIN 41302	b <sub>1</sub>	b <sub>2</sub>	d <sub>1</sub>	d <sub>2</sub>	h <sub>1</sub>	l <sub>1</sub>
4AU36	8; 10	3UI 180/75	169	134	10 × 18	M8	320	360
4AU39	12.5; 16	3UI 210/70	174	131	12 × 18	M10	370	420

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

Table 2- 14 Dimensions 4AU30 to 4AU39, part 2

Type	l <sub>2</sub>	l <sub>3</sub>	n <sub>1</sub>	n <sub>2</sub>	Max. no. of terminals per side			
					18 A	23 A	43 A	81 A
4AU36	314	360	138	264	43	38	28	17
4AU39	366	410	141	316	50	45	33	20

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

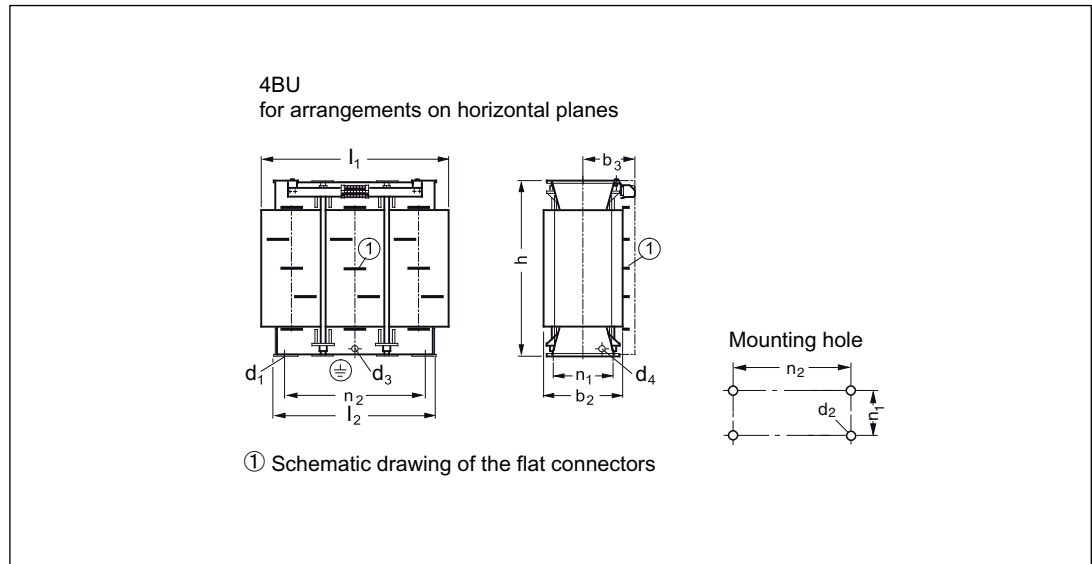


Figure 2-16 Dimension drawing for 4BU transformers

Terminal size	Screw connection for cross section			Current carrying capacity	
	solid mm <sup>2</sup>	stranded mm <sup>2</sup>	fine-stranded mm <sup>2</sup>	t <sub>a</sub> = 40 °C A	t <sub>a</sub> = 55 °C A
4	0.5 ... 6	--	1.5 ... 4	24	18
6	2.5 ... 10	--	1.5 ... 6	32	23
16	1.5 ... 16	10 ... 25	4 ... 16	60	43
35	10 ... 16	10 ... 50	10 ... 35	114	81

Table 2- 15 Dimensions 4BU, part 1

Type	Rated power kVA <sup>1)</sup>	Type size in line with DIN 41302	b1	b2	b3 ± 3 for terminal size				d1	d2
					4	6	16	35		
4BU43	18; 20; 22.5	3UI 230/80	203	194	153	157	160	170	15	M12
4BU45	25; 28	3UI 230/107	230	221	162	166	169	179	15	M12
4BU47	31.5; 35,5; 40	3UI 230/137	260	251	182	186	189	199	15	M12
4BU52	45	3UIS 220/120	295	225	169	173	176	186	12.5	M10
4BU54	63; 71	3UIS 305/125	265	240	176	180	183	193	15	M12
4BU55	80	3UIS 305/140	280	255	184	188	191	201	15	M12
4BU58	112; 125; 140	3UIS 395/150	315	269	191	195	198	208	15	M12
4BU60	180	3UIS 395/195	360	314	213	217	220	230	15	M12

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

Table 2- 16 Dimensions 4BU, part 2

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

2.8.3.6 Technical specifications of the transformers

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

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

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

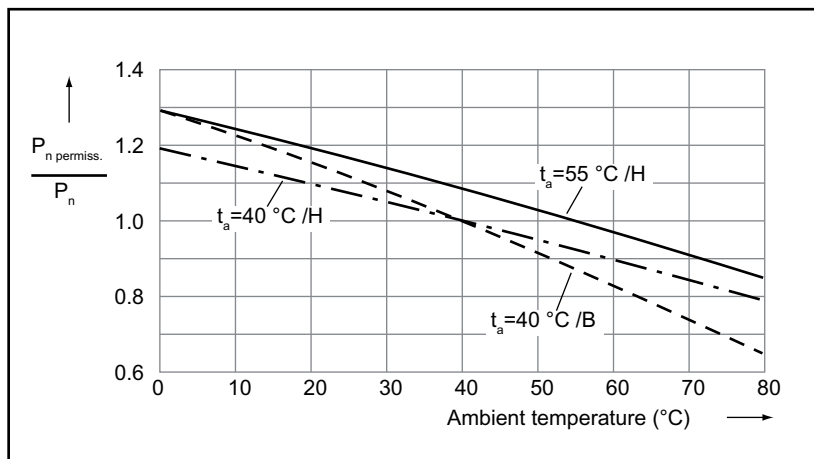


Figure 2-17 Load characteristics in relation to the ambient temperature



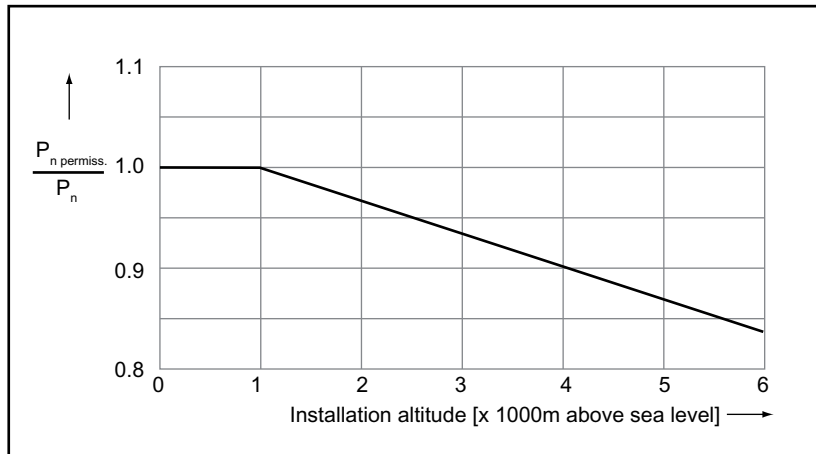


Figure 2-18 Load characteristics in relation to the installation altitude

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



# S120 Combi Power Modules

## 3.1 Introduction

### 3.1.1 Description

#### The SINAMICS S120 Combi

The S120 Combi is a Power Module with integrated infeed, Motor Modules (inverter) for 3 or 4 axes and a TTL encoder evaluation for the spindle. The S120 Combi is available in the following versions for various current ratings:

- 3 axes Power Module with infeed, spindle and 2 feed axes
- 4 axes Power Module with infeed, spindle and 3 feed axes

The Power Modules are cooled using external air cooling that employs through-hole technology. The required fan unit is optionally available. A fan solution on the customer side with comparable rated data is possible.

The S120 Combi is infeed/energy-recovery capable. The infeed provides the integrated Motor Modules with an uncontrolled DC voltage.

In the infeed mode regarding the current and voltage waveforms, the infeed has a typical characteristic of a 6-pulse diode rectifier bridge. In the energy recovery mode, the current waveform is a square wave.

The energy recovery is switched in depending on the power that is fed back. Energy recovery is deactivated when the infeed is operating under no-load conditions.

The integrated Motor Modules operate with a fixed IGBT clock frequency of 4 kHz.

The overload factor for the infeed and all axes is  $\leq 2$ .

The S120 Combi is suitable for direct operation on TN, IT and TT line supplies.

#### Controlling the motor holding brake

The S120 Combi has an integrated brake control function for a motor holding brake. The motor holding brake is connected at terminal X11. The assignment of the motor holding brake to the feed axes of the S120 Combi can be freely parameterized using the software. Motor holding brakes up to 1 A are controlled.

#### Temperature sensor connection

A temperature sensor can either be connected using terminal X21 or alternatively using the sub-D connector of the TTL encoder (X220). The interface used is selected using the software. In this case, only the selected evaluation is available.

### Encoder connection

The S120 Combi supports sin/cos encoders and TTL encoders with a 5 V supply for motors. The TTL encoder is connected via the integrated X220 encoder interface and is permanently assigned to spindle output X2. The sin/cos encoder for spindle output X2 is connected to interface X205 via an SMx20 Sensor Module. In this particular case, encoder interface X220 is automatically inactive.

Fixed topology rules apply when connecting DRIVE-CLiQ encoders. Each feed axis is precisely assigned one DRIVE-CLiQ interface (see Chapter "Topology rules for DRIVE-CLiQ").

HTL encoders, SSI encoders and a 24 V encoder power supply are not supported.

### Interface assignment

The assignment of the interfaces on the S120 Combi is permanently defined and must not be changed.

The DRIVE-CLiQ connection of the expansion axes is always implemented via DRIVE-CLiQ interface X101 at the SINUMERIK control. A detailed description is provided in the chapters "Interface description" of the S120 Combi and "Topology rules for DRIVE-CLiQ".

Measuring systems and additional encoders should always be connected via the DMC20 Hub Module.

### Internal temperature sensing and internal fan

The internal temperature of the S120 Combi is sensed. In conjunction with this is the temperature-dependent control of the internal fan to cool the inside of the unit. The S120 Combi Power Module is switched off if its internal temperature becomes too high.

An operating hours counter for the internal fan is available via the software in parameter P0254 (infeed).

### 3.1.2 Module versions

Table 3- 1 S120 Combi versions

Infeed [kW]	Spindle Motor Module 1 [A <sub>rms</sub> ]	Feedrate 1 Motor Module 2 [A <sub>rms</sub> ]	Feedrate 2 Motor Module 3 [A <sub>rms</sub> ]	Feedrate 3 Motor Module 4 [A <sub>rms</sub> ]	Order number
<b>3 axes</b>					
16	18	5	5	-	6SL3111-3VE21-6FA0
16	24	9	9	-	6SL3111-3VE21-6EA0
20	30	9	9	-	6SL3111-3VE22-0HA0
<b>4 axes</b>					
16	18	9	5	5	6SL3111-4VE21-6FA0
16	24	9	9	9	6SL3111-4VE21-6EA0
20	30	12	9	9	6SL3111-4VE22-0HA0

### 3.1.3 Approved controls

The S120 Combi is approved for operation with the following controls:

- SINUMERIK 828D with PPU versions
  - PPU 24x.2
  - PPU 26x.2
  - PPU 28x.2

Table 3- 2 Overview of the order numbers of the approved SINUMERIK 828D controls

PPU version	Keyboard	Order number (without CNC software)
240.2	Vertical	6FC5370-4AT20-0AA0 (Turning) 6FC5370-4AM20-0AA0 (Milling)
241.2	Horizontal	6FC5370-3AT20-0AA0 (Turning) 6FC5370-3AM20-0AA0 (Milling)
260.2	Vertical	6FC5370-6AA20-0AA0
261.2	Horizontal	6FC5370-5AA20-0AA0
280.2	Vertical	6FC5370-8AA20-0AA0
281.2	Horizontal	6FC5370-7AA20-0AA0

### 3.1.4 Expansion axes that can be connected

The S120 Combi can be expanded with Motor Modules from the SINAMICS S120 Booksize Compact series by one or two axes.

Table 3- 3 Expansion axes for the S120 Combi Power Modules

Motor Module Booksize Compact	Width	Order number
Single Motor Module 3 A	50 mm	6SL3420-1TE13-0AA0
Single Motor Module 5 A	50 mm	6SL3420-1TE15-0AA0
Single Motor Module 9 A	50 mm	6SL3420-1TE21-0AA0
Single Motor Module 18 A	75 mm	6SL3420-1TE21-8AA0
Double Motor Module 2 x 1.7 A	75 mm	6SL3420-2TE11-7AA0
Double Motor Module 2 x 3 A	75 mm	6SL3420-2TE13-0AA0
Double Motor Module 2 x 5 A	75 mm	6SL3420-2TE15-0AA0


**NOTICE**

**Number of expansion axes**

A maximum of two expansion axes can be connected to an S120 Combi Power Module, i.e. two Single Motor Modules or one Double Motor Module.

For a description of the Motor Modules Booksize Compact, see Chapter "Motor Modules Booksize Compact as expansion axes".


## 3.2 Safety information

 **DANGER**


**Risk of electric shock**


A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off.  
The front cover must not be opened until this time has elapsed.

It is only permissible to operate the S120 Combi when the front cover is mounted. When operating without expansion axes, the factory-mounted DC link cover must not be removed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

 **DANGER**


If cables are not connected to terminals X1 (line connection) and X2 (motor connection - spindle), then touch protection according to degree of protection IP20 to EN 60529 is not guaranteed.

 <b>DANGER</b>
<b>DC-link discharge time</b> The danger note for the DC link discharge time must be placed on the component in the national language. A set of labels in 16 languages is provided with the component.

 <b>DANGER</b>
If the S120 Combi is not disconnected from the line supply system (e.g. via the line contactor or main switch), the DC link remains charged.

<b>CAUTION</b>
<b>DC link busbars</b> After the S120 Combi has been expanded with expansion axes and/or DC link components, the correct tightening torque of the DC link busbar bolts must be checked (1.8 Nm, tolerance +30 %). The check is made before commissioning when the overall plant or system is in a no-voltage state with the DC link discharged. After transportation, the screws must be tightened.

<b>CAUTION</b>
<b>Operation on line supplies where energy recovery is not possible</b> In a line supply system without energy recovery capability (e.g. diesel generator), the energy recovery capability of the S120 Combi must be deactivated using parameter p3533 (see description of functions). The braking energy must then be dissipated via an additional Braking Module with braking resistor provided in the drive line-up.


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


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**Note****System fault level at the infeed point**


In order to limit the line harmonics to an appropriate level for additional loads, the system fault level at the infeed point must be at least a factor 70 higher than the rated power of the integrated infeed.

---

 <b>DANGER</b>
<p>The drive components generate high leakage currents in the protective conductor. The components may only be operated in control cabinets or in locked, electrical equipment rooms. They must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or system must be implemented in accordance with one of the following measures:</p> <ul style="list-style-type: none"><li>• Fixed connection and protective conductor connection with <math>\geq 10 \text{ mm}^2</math> Cu or <math>\geq 16 \text{ mm}^2</math> Al</li><li>• stationary connection and installation of a second protective conductor with the same cross-section as the first protective conductor</li><li>• stationary connection and automatic shutdown of the line supply if the protective conductor is interrupted</li><li>• Connection with a plug connector for industrial applications in accordance with EN 60309; minimum protective conductor cross-section of <math>\geq 2.5 \text{ mm}^2</math> Cu as part of a multi-core supply cable with appropriate strain relief</li></ul>

 <b>DANGER</b>
<p>It is mandatory that the shield for the motor holding brake is connected. Motion-Connect cables must be used for the integrated motor holding brake, as otherwise the insulation strength of the cores is not guaranteed. Risk of electric shock.</p>

 <b>WARNING</b>
<p>Cable shields and unused power cable cores (e.g. brake cores) must be connected to PE potential to prevent capacitive cross-talk charges. Non-observance can cause lethal shock voltages.</p>

 <b>CAUTION</b>
<p><b>Cooling clearances</b></p> <p>The 80 mm clearances above and below the components must be observed.</p>

<b>CAUTION</b>
<p><b>Connection for temperature sensors</b></p> <p>Connecting cables to temperature sensors must always be installed with shielding. The cable shield must be connected at both ends and over a large surface area. Temperature sensor cables that are routed together with the motor cable must be twisted in pairs and shielded separately.</p>

<b>CAUTION</b>
<p>The total length of the power cables (motor feeder cables etc.) must not exceed 175 m.</p>

<b>CAUTION</b>
<p>Only cables from Siemens may be used for DRIVE-CLiQ connections.</p>



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

As a result of the external air cooling, the fan and the heat sinks can accumulate a lot of dirt. This causes the temperature monitoring to respond in the S120 Combi Power Module. Therefore, the fans and heat sink must be checked for pollution at regular intervals and, if necessary, cleaned.
--

<b>NOTICE</b>
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Operation without the line reactor is not permissible.
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**Note**

After installation, the seal on the optional fan unit must be checked to ensure that it tightly seals. Additional sealing can be used, if necessary.

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### 3.3 Interface description

#### 3.3.1 Overview diagrams

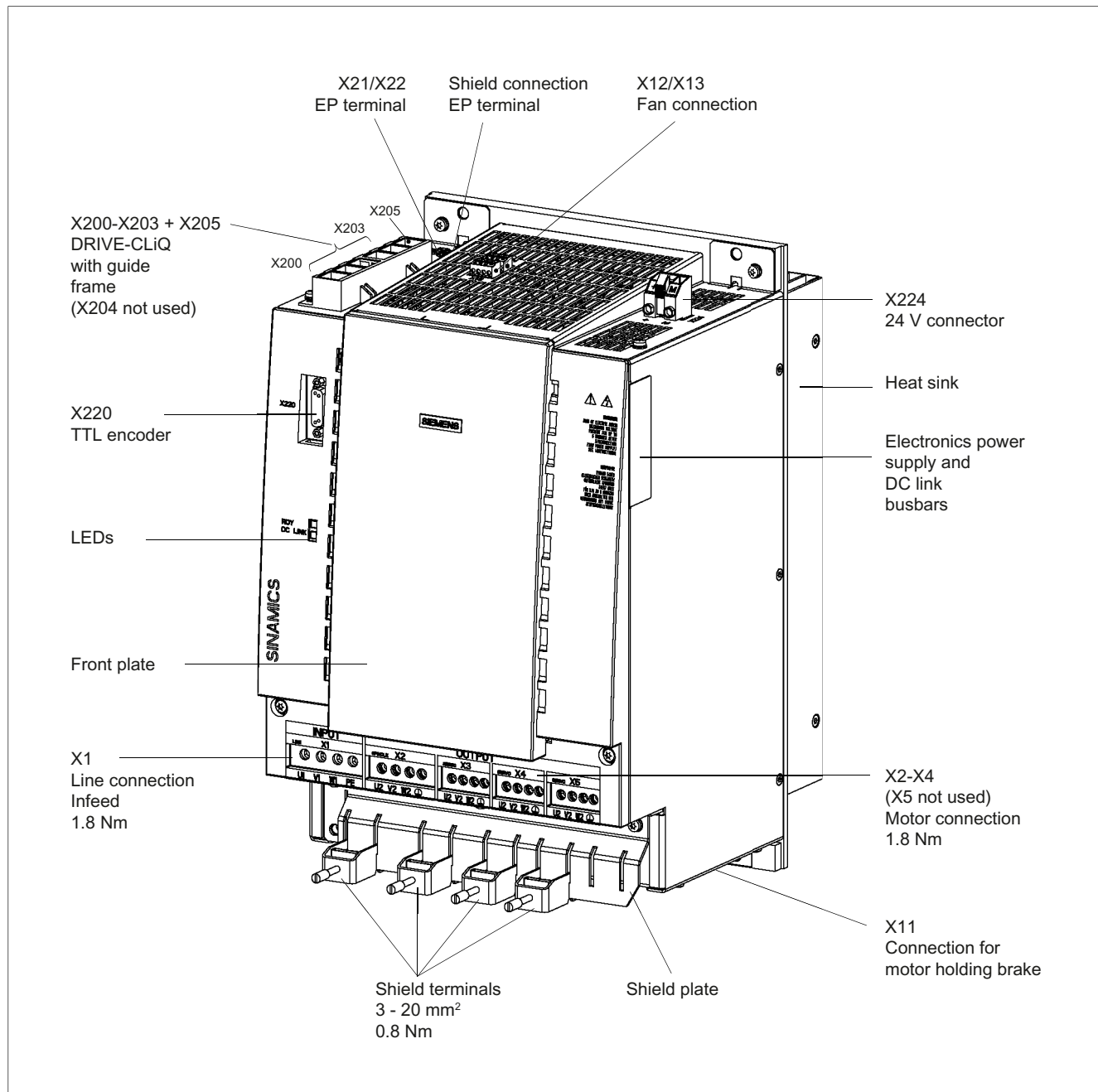


Figure 3-1 S120 Combi 3 axes Power Module

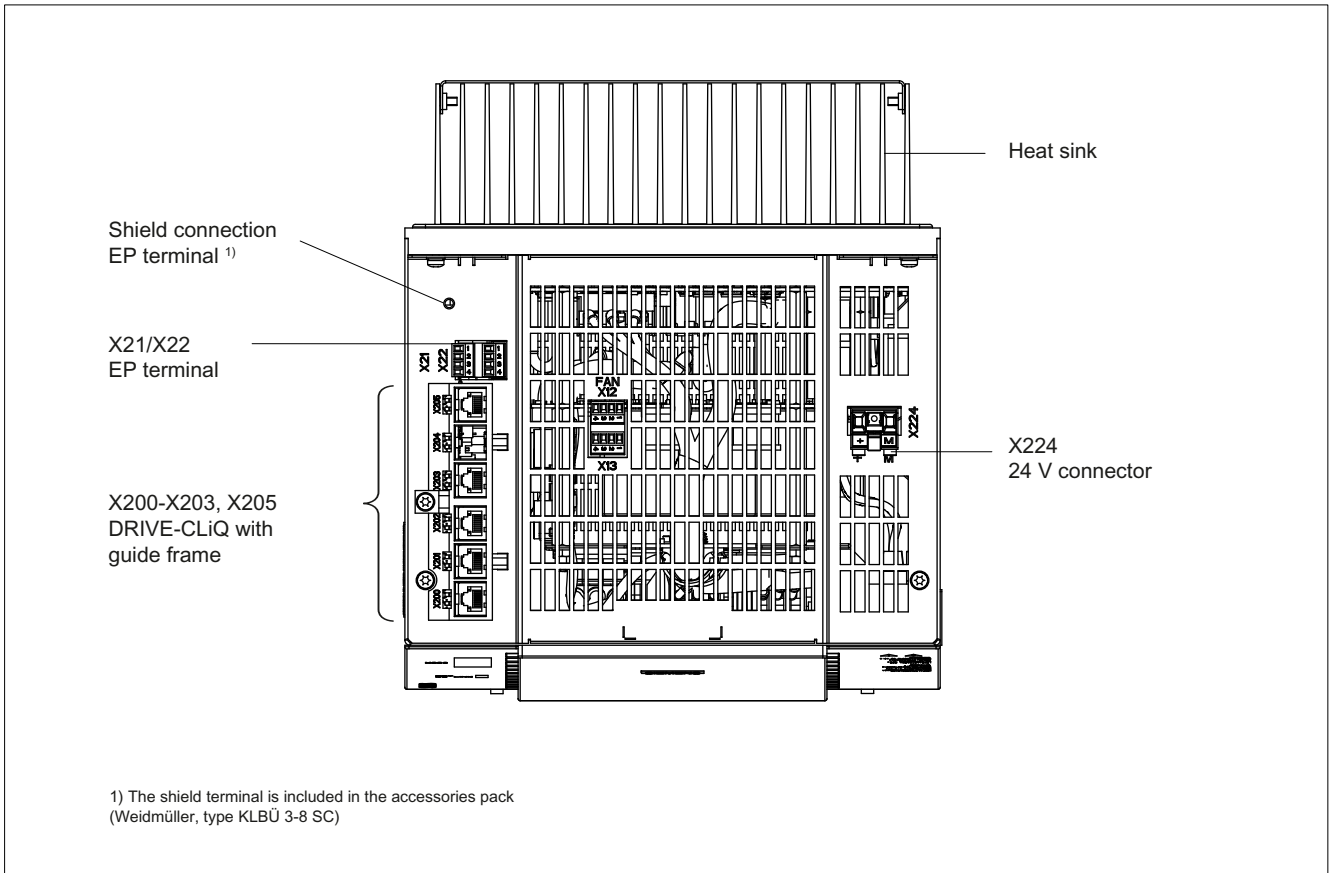


Figure 3-2 S120 Combi 3 axes Power Module: View from the top

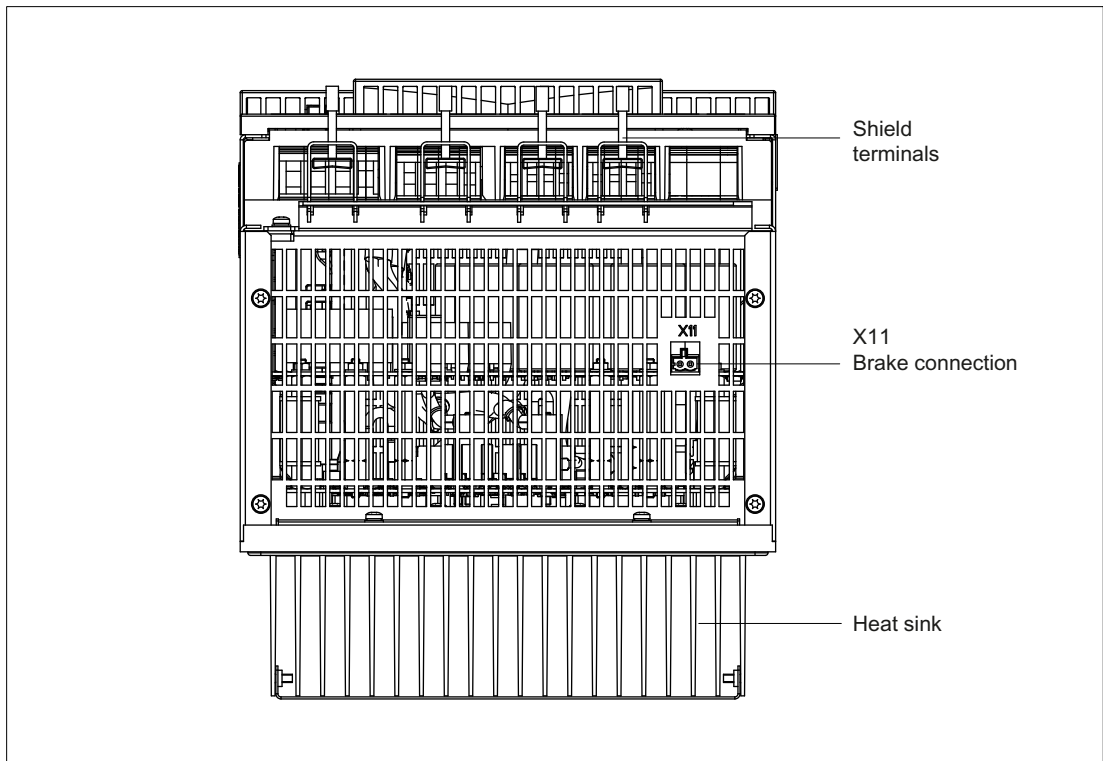


Figure 3-3 S120 Combi 3 axes Power Module: View from below

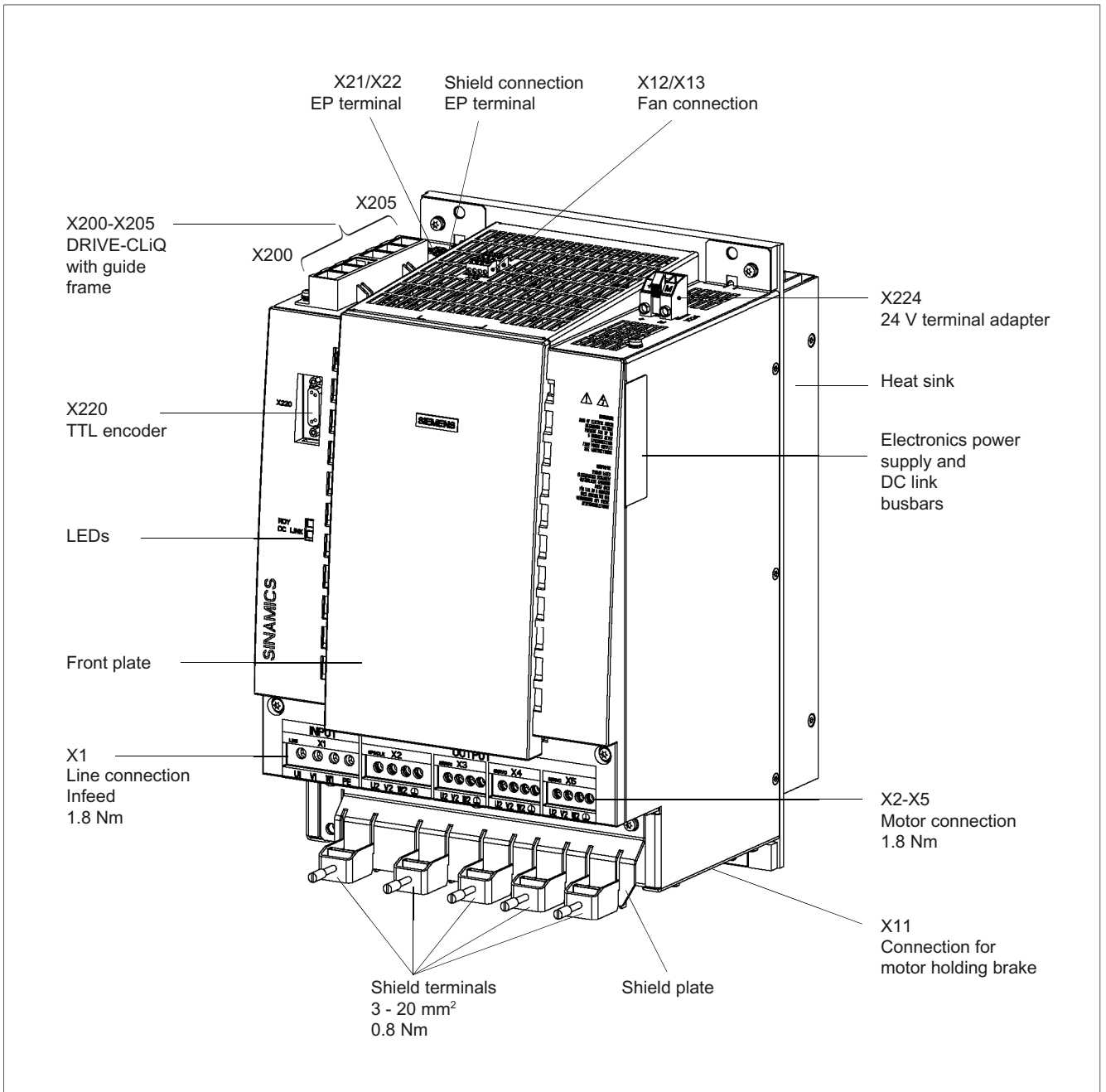


Figure 3-4 S120 Combi 4 axes Power Module

3.3 Interface description

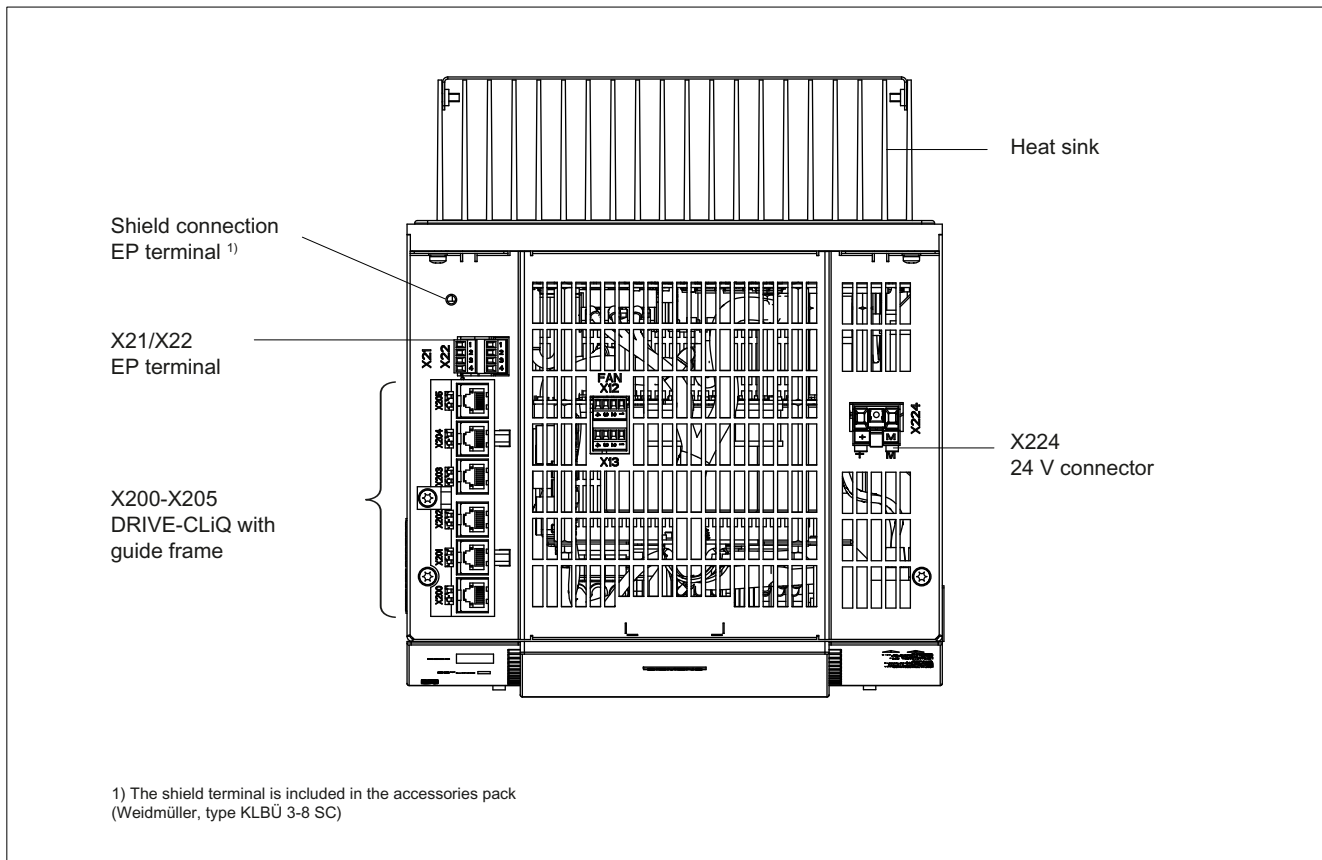


Figure 3-5 S120 Combi 4 axes Power Module: View from the top

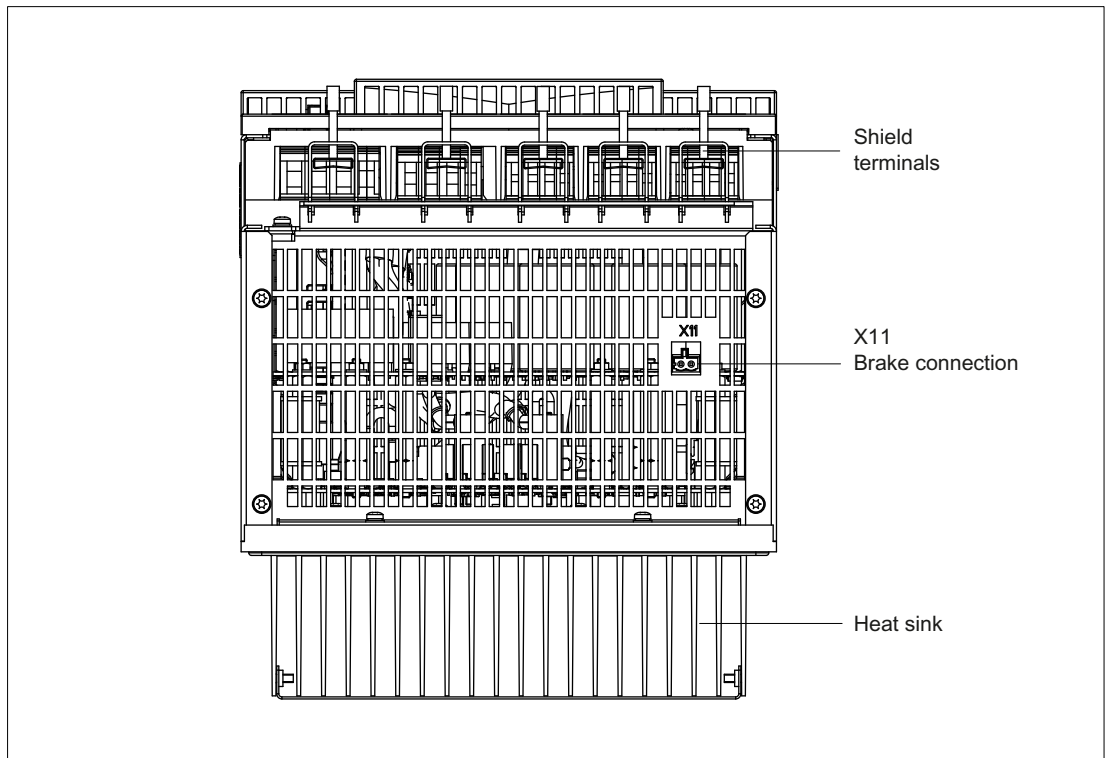


Figure 3-6 S120 Combi 4 axes Power Module: View from below

3.3.2 Connection example

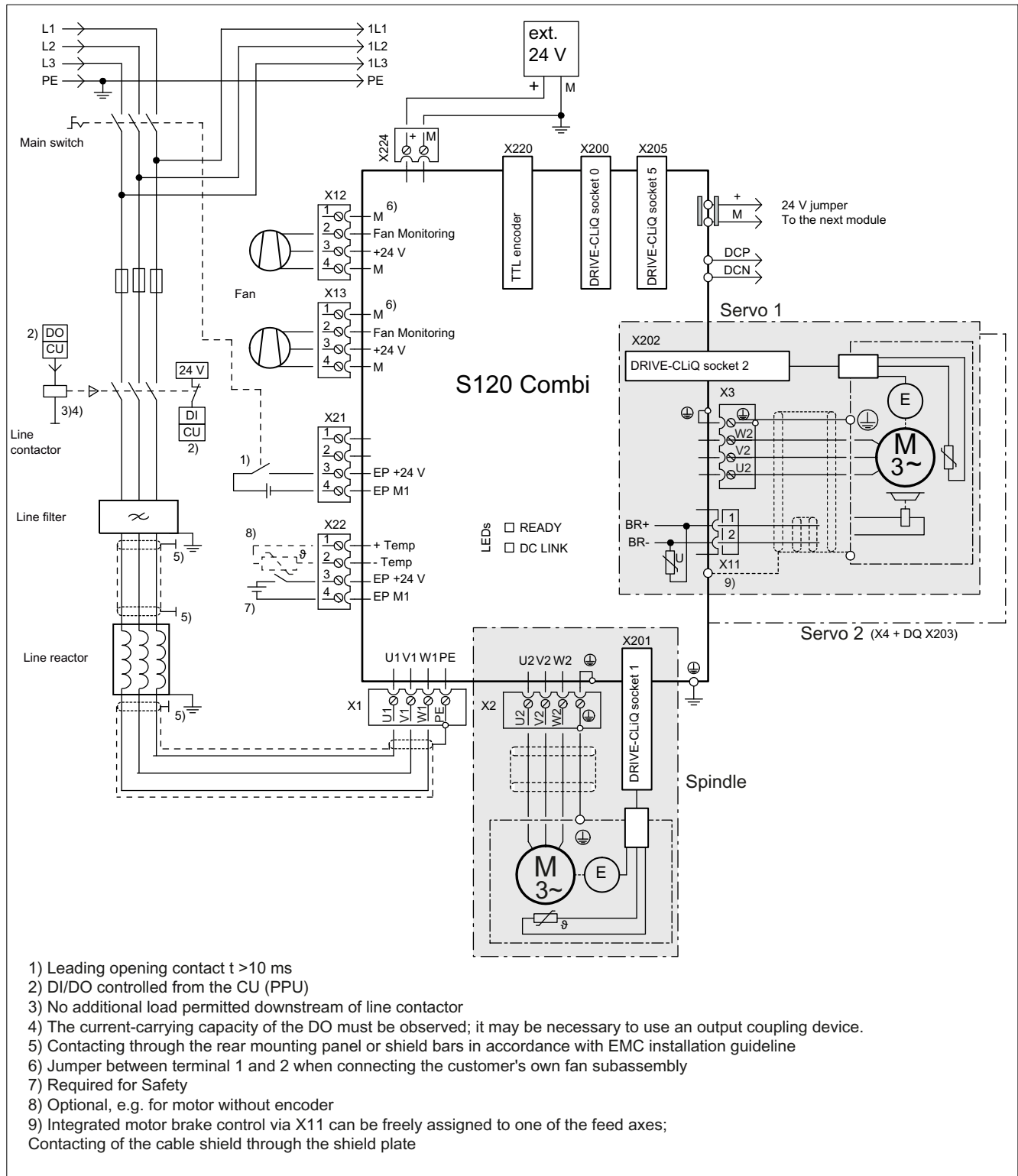
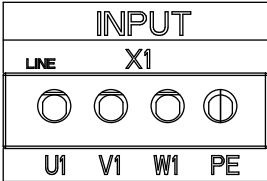


Figure 3-7 Connection example for an S120 Combi 3 axes Power Module



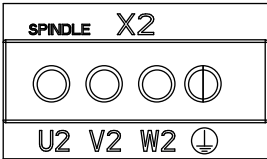
### 3.3.3 X1 line connection

Table 3- 4 Terminal strip X1, infeed

	Terminal	Technical specifications
	U1	Max. connectable cross-section: 16 mm <sup>2</sup> Type: Screw terminal 7 (see Chapter "Control cabinet installation and EMC / connection system") Tightening torque: 1.5 - 1.8 Nm
	V1	
	W1	
	PE connection	

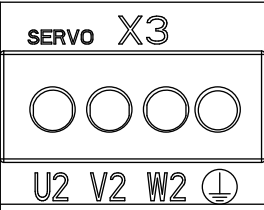
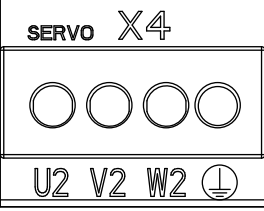
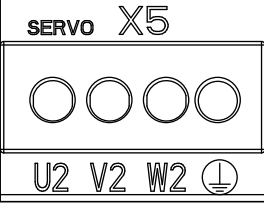
### 3.3.4 X2-X5 motor connection

Table 3- 5 Terminal strip X2 spindle (18 A, 24 A and 30 A Motor Modules)

	Terminal	Technical specifications
	U2	Motor connection Max. connectable cross-section: 10 mm <sup>2</sup> Type: Screw terminal 6 (see Chapter "Control cabinet installation and EMC / connection system") Tightening torque: 1.5 - 1.8 Nm
	V2	
	W2	
	PE connection	

3.3 Interface description

Table 3- 6 Terminal strip X3 to X5 feedrate (5 A, 9 A and 12 A Motor Modules)

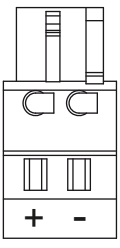
	Terminal	Technical specifications
 <p>SERVO X3</p> <p>U2 V2 W2 ⊕</p>	U2	Motor connection Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 (see Chapter "Control cabinet installation and EMC / connection system") Tightening torque: 1.5 - 1.8 Nm
	V2	
	W2	
	PE connection	
 <p>SERVO X4</p> <p>U2 V2 W2 ⊕</p>		
 <p>SERVO X5</p> <p>U2 V2 W2 ⊕</p>		
(only for 4 axes Power Module)		

**Note**

The total length of the power cables must not exceed 175 m.

### 3.3.5 X11 brake connection

Table 3- 7 Brake connection X11

	Terminal	Designation	Technical specifications
 Connector	BR +	Brake connection +	Voltage 24 V DC max. load current 1 A min. load current 0.1 A Max. connectable cross-section 2.5 mm <sup>2</sup> Type: Spring-loaded terminal 1 (see Chapter "Control cabinet installation and EMC / connection system") The brake connector is part of the prefabricated cable.
	BR -	Brake connection -	

 **WARNING**

Only protective extra-low voltages (PELV) must be connected to all connections and terminals between 0 and 48 V DC.

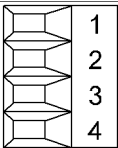
The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.

**Note**

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

### 3.3.6 X12/X13 fan connection

Table 3- 8 Terminal strip X12/X13 to connect the external fan unit

	Terminal	Designation	Technical specifications
	1	Ground	
	2	Fan monitoring	
	3	+24 V	Current-carrying capacity, 2 x 1 A or 1 x 2 A
	4	Ground	
Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")			

<p><b>CAUTION</b></p> <p>When connecting a customer's own fan unit using 2-core cables, terminals 1 and 2 must be connected using a jumper.</p>
---

<p><b>Note</b></p> <p>When connecting a customer's own fan unit using 3-core cables, the white core (fault signal) can be connected to terminal 2.</p>
--

### 3.3.7 X21/X22 EP terminals

Table 3- 9 Terminal strip X21 (infeed)

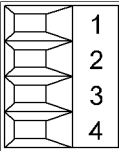
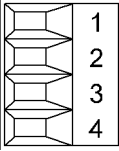

	Terminal	Designation	Technical specifications
	1	-	Reserved, do not use
	2	-	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V - 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs
	4	EP M1 (Enable Pulses)	
Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")			

Table 3- 10 Terminal strip X22 (axes)

	Terminal	Designation	Technical specifications
	1	+ Temp	Temperature sensors <sup>1)</sup> : KTY84–1C130 / PTC / bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V - 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (Enable Pulses)	
Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")			

1) The temperature sensor type can be selected by parameters (see the List Manual SINUMERIK 828D).

 <b>DANGER</b>
<b>Risk of electric shock!</b> Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If these instructions are not complied with, there is a risk of electric shock!

<b>NOTICE</b>
The KTY temperature sensor must be connected with the correct polarity.

3.3 Interface description

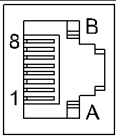
**NOTICE**  
The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

**Note**

The temperature sensor input is not needed if the motors feature an integrated DRIVE-CLiQ interface or if temperature values are detected by means of a different module (SMC, SME).

3.3.8 X200-X205 DRIVE-CLiQ interfaces

Table 3- 11 DRIVE-CLiQ interfaces X200-X205

	PIN	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	NC	
	5	NC	
	6	RXN	Receive data -
	7	NC	
	8	NC	
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground

Connector type: RJ45 socket  
 DRIVE-CLiQ port rubber plug included in the scope of delivery;  
 rubber plug (50 pieces) Order number: 6SL3066-4CA00-0AA0

**Note**

**DRIVE-CLiQ interface X204**

For 3 axes Power Modules of the S120 Combi, there is no DRIVE-CLiQ interface X204.

**Note**

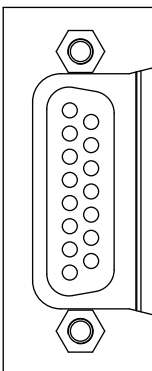
**Inserting/removing the DRIVE-CLiQ port rubber plug**

The rubber plugs must always be inserted in the DRIVE-CLiQ ports that are not required as the final step.

If it is necessary to remove the rubber plugs, then we recommend that the guiding frame is disassembled (Torx, slotted screw). As an alternative to disassembling the guiding frame, flat-nosed pliers can be used to remove the rubber plug.

### 3.3.9 X220 TTL encoder

Table 3- 12 Encoder interface X220

	Pin	Signal name	Technical specifications
	1	+ Temp	Motor temperature sensing KTY84-1C130 (KTY+) Temperature sensor KTY84-1C130 / PTC
	2	Clock	Clock
	3	Clock*	Inverse clock
	4	P encoder 5 V	Encoder power supply
	5	P encoder 5 V	
	6	P sense	Sense input of encoder power supply
	7	M encoder (M)	Ground for encoder power supply
	8	- Temp	Motor temperature sensing KTY84-1C130 (KTY+) Temperature sensor KTY84-1C130 / PTC
	9	M sense	Ground sense input
	10	R	Reference signal R
	11	R*	Inverse reference signal R
	12	B*	Inverse incremental signal B
	13	B	Incremental signal B
	14	A*	Inverse incremental signal A
	15	A	Incremental signal A

Type: Sub-D socket, 15-pin; TTL encoder; max. cable length 100 m

#### Note

Only 5 V TTL encoders are supported.

#### DANGER

##### Risk of electric shock!

Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp".

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

3.3 Interface description

Table 3- 13 Technical data of the encoder system supply

Encoder system supply	Unit	Value
Voltage	$V_{\text{encoder}}$	5 V DC (with or without Remote Sense) <sup>1)</sup>
Current	$A_{\text{encoder}}$	0.35
Encoder frequency that can be evaluated ( $f_{\text{encoder}}$ )	kHz	$\leq 300$

1) A controller compares the encoder system supply voltage - sensed via the Remote Sense cables - with the reference supply voltage of the encoder system, and adjusts the supply voltage for the encoder system at the output of the drive module until the required supply voltage is obtained directly at the encoder system.

Table 3- 14 Specification of TTL encoder systems that can be connected

Parameter	Designation	Threshold	Min.	Max.	Unit
Signal level, high <sup>1)</sup>	$V_{\text{Hdiff}}$		2	5	V
Signal level, low <sup>1)</sup>	$V_{\text{Ldiff}}$		-5	-2	V
Signal frequency	$f_{\text{S}}$		-	300	kHz
Edge clearance	$t_{\text{min}}$		100	-	ns
"Zero pulse inactive time" (before and after A=B=high)	$t_{\text{Lo}}$		640	$(t_{\text{ALo-BHi}} - t_{\text{Hi}})/2$ <sup>2)</sup>	ns
"Zero pulse active time" (while A=B=high and beyond) <sup>3)</sup>	$t_{\text{Hi}}$		640	$t_{\text{ALo-BHi}} - 2*t_{\text{Lo}}$ <sup>2)</sup>	ns

- 1) Other signal levels according to the RS 422 standard.
- 2)  $t_{\text{ALo-BHi}}$  is not a specified value, but is the time between the falling edge of track A and the next but one rising edge of track B.
- 3) Further information on setting the "Zero pulse active time" can be found in the following:  
References: SINAMICS S120 Function Manual (FH1), tolerant encoder monitoring for SMC30



Cable length as a function of the encoder current for encoders with 5 V supply (valid for cable cross-sections with 0.5 mm<sup>2</sup>):

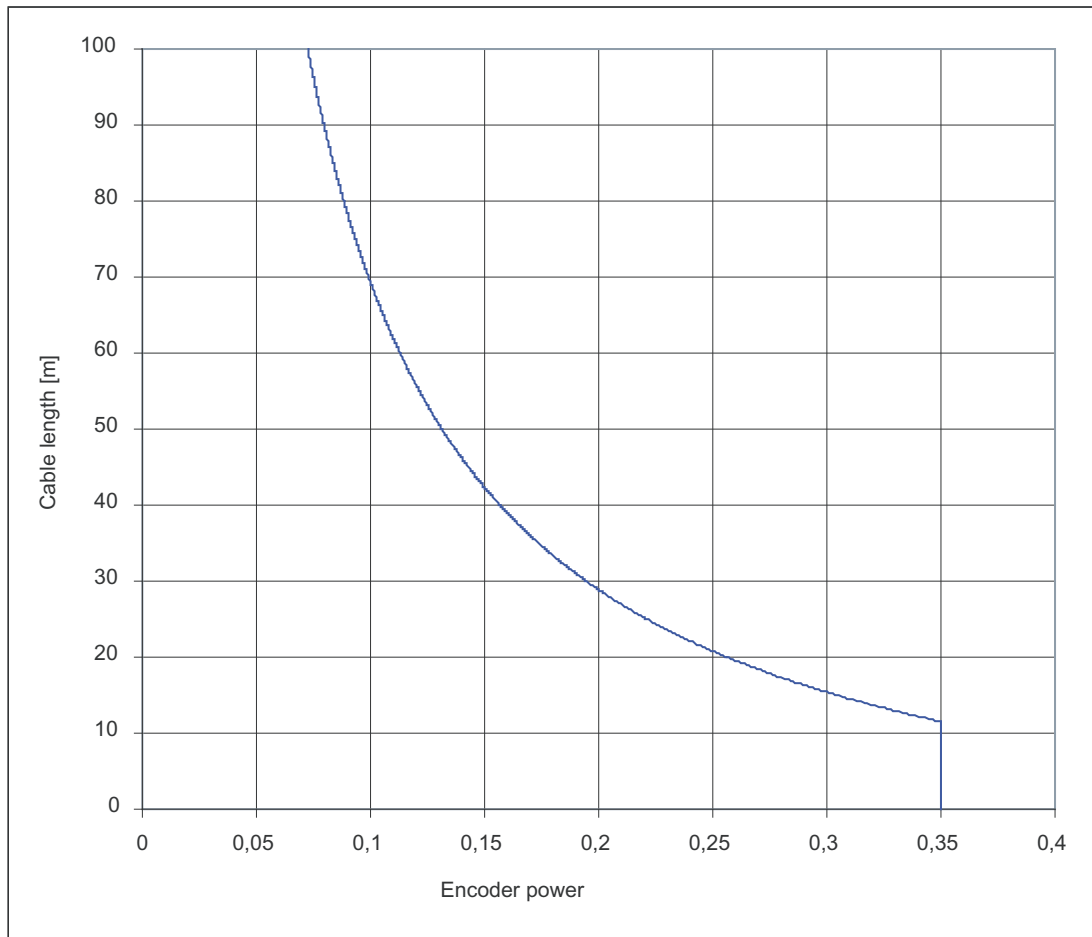


Figure 3-8 Max. cable length as a function of the encoder current drawn

For encoders without Remote Sense the permissible cable length is restricted to 100 m (reason: the voltage drop depends on the cable length and the encoder current).

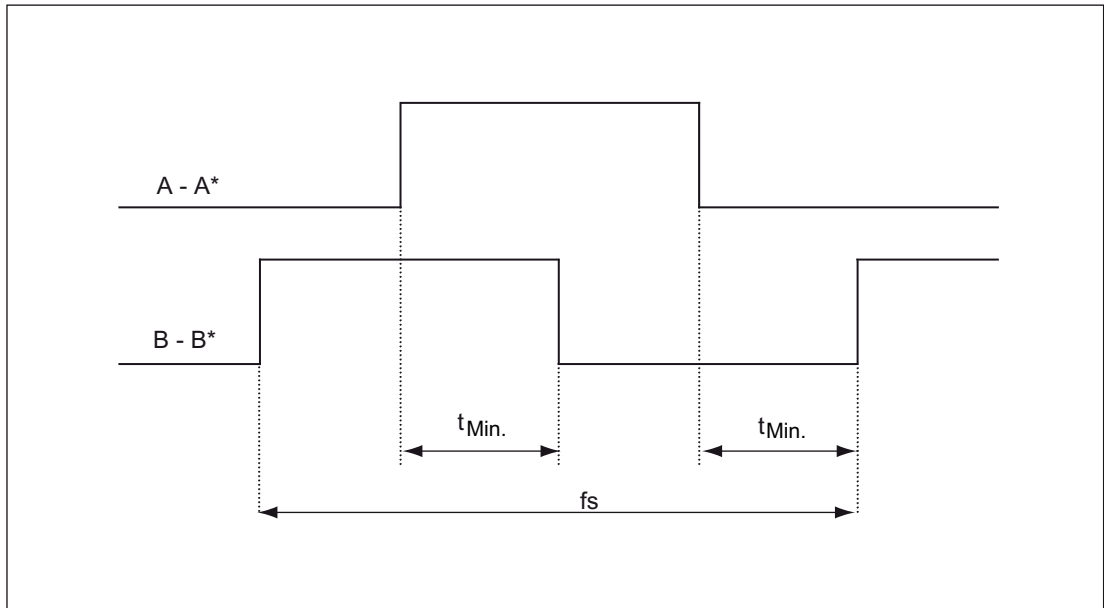


Figure 3-9 Signal characteristic of track A and track B between two edges: Time between two edges with pulse encoders

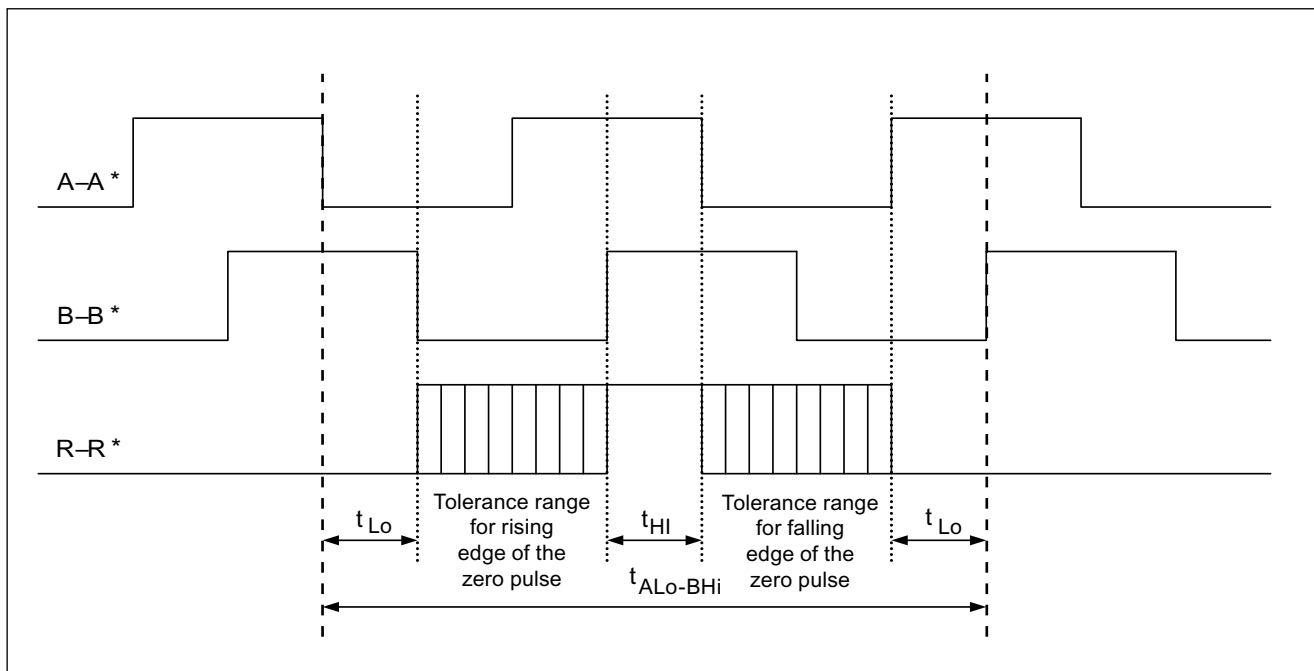
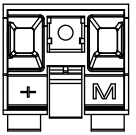


Figure 3-10 Position of the zero pulse to the track signals

### 3.3.10 X224 24 V DC plug

Table 3- 15 Terminal strip X224

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
<p>The 24 V DC plug belongs to the scope of delivery            Max. connectable cross-section: 6 mm<sup>2</sup>            Type: Screw terminal 5 (see Chapter "Control cabinet installation and EMC / connection system")</p>			

### 3.3.11 Meaning of the LEDs on the S120 Combi


The SINAMICS S120 Combi has two LEDs to display the status of the components. The software assigns a priority to the status signals from the individual components. The most important and/or most informative status is output for the complete S120 Combi.

The status is immediately output if any component develops a fault. The ready to run indication is only issued if all of the components have signaled that they are ready to run.

The LED statuses for the S120 Combi are described in the table below. The status display always refers to the complete S120 Combi.

Table 3- 16 Meaning of the LEDs on the S120 Combi

Status	DC LINK	Description, cause	Remedy
READY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	Connect/test the electronics power supply
Green	Off	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	-
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	-
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.	Check the line supply voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	-
Red	-	At least one fault is present in this component. <b>Note:</b> The LED is activated irrespective of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/Red (0.5 Hz)	-	Firmware is being downloaded.	
Green/Red (2 Hz)	-	Firmware has been downloaded. Wait for POWER ON.	Carry out a POWER ON
Green/Orange or Red/Orange	-	Component recognition via LED is activated (p0124). <b>Note:</b> Both options depend on the LED status when component recognition is activated via p0124 = 1.	-

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

### Cause and rectification of faults

The following reference material contains information about the cause of faults and how they are rectified:

SINAMICS S120 Function Manual Drive Functions (FH1)

SINUMERIK 828D Turning and Milling Commissioning Manual

## 3.4 Dimension drawings

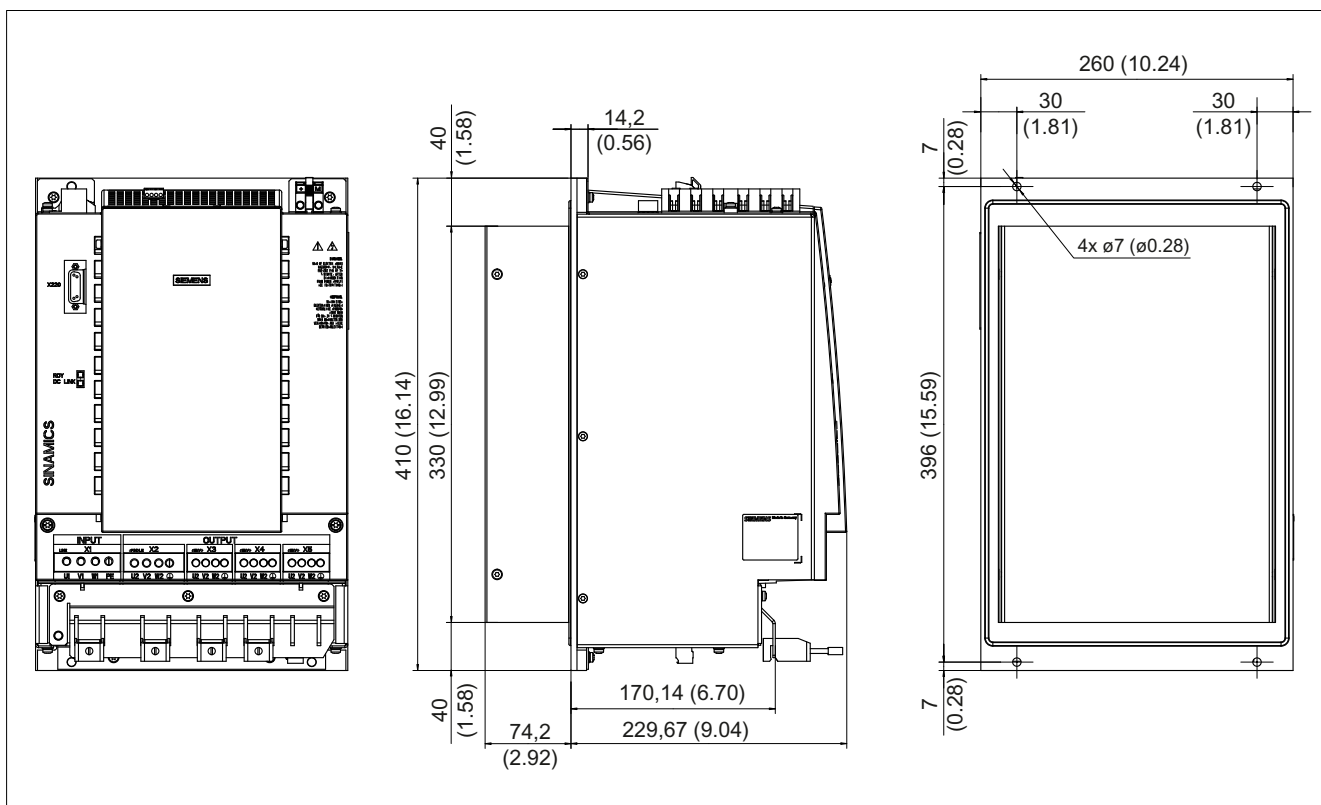


Figure 3-11 Dimension drawing of the S120 Combi 3 axes Power Module, all dimensions in mm and (inches)

3.5 Installation

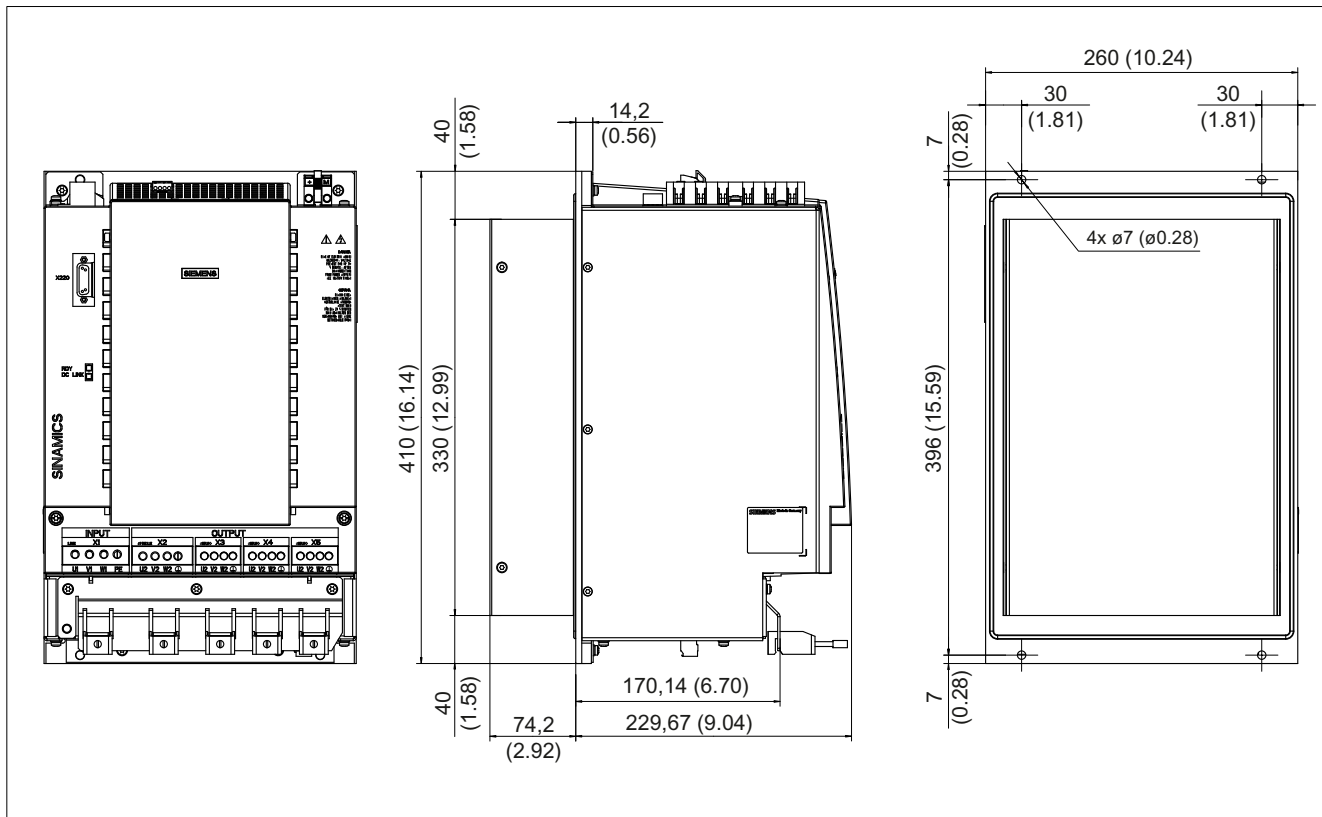


Figure 3-12 Dimension drawing of the S120 Combi 4 axes Power Module, all dimensions in mm and (inches)

### 3.5 Installation

#### 3.5.1 Drilling patterns and installation cut-outs

##### Preparing the mounting panel

The installation cut-outs shown below are for any S120 Combi Power Module and the external fan unit.

The drilling patterns differ by the number and width of the expansion axes. Select the appropriate drilling pattern corresponding to your individual design.

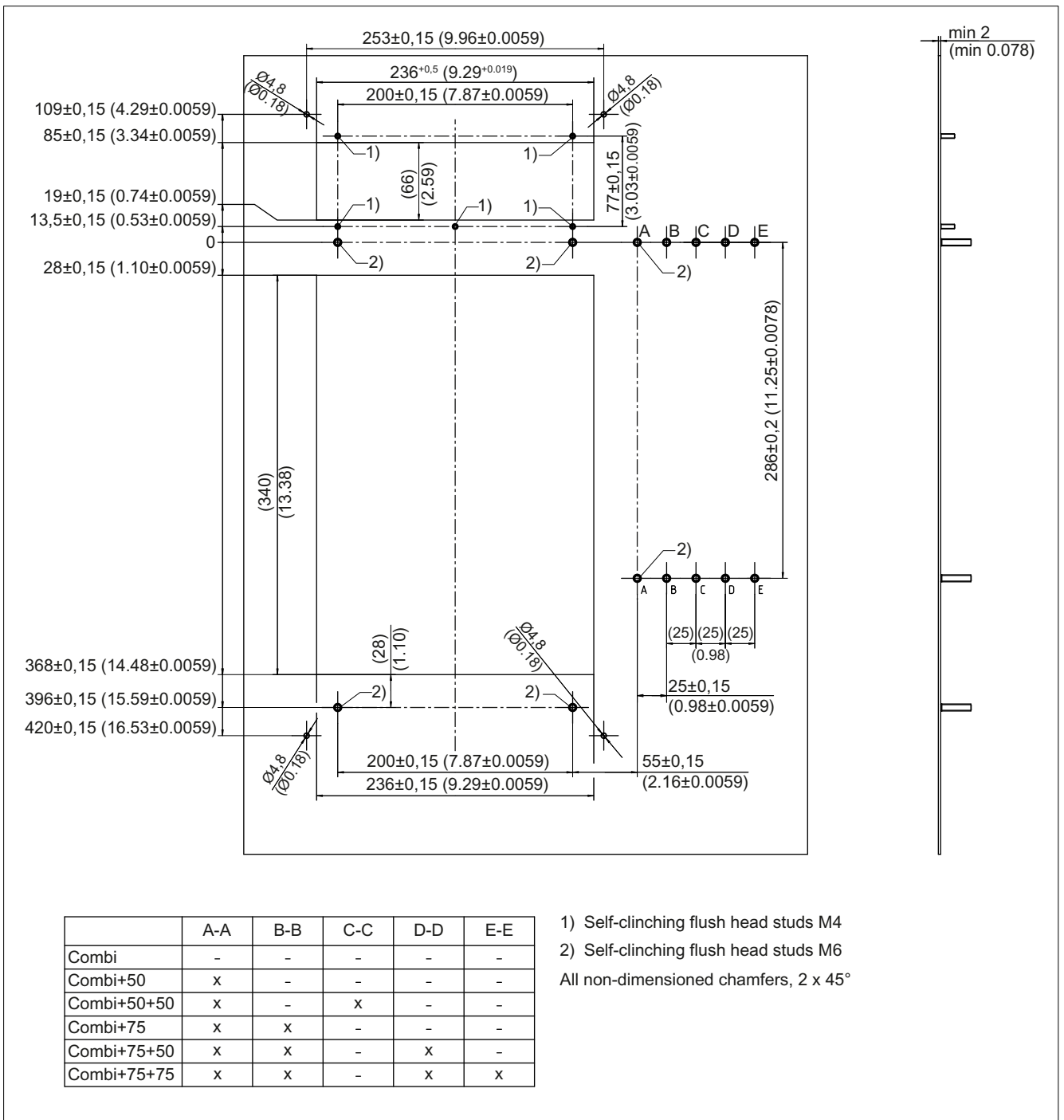


Figure 3-13 Dimensions for the installation cut-outs and drilling patterns for an S120 Combi Power Module with external fan unit, reinforcement plates and expansion axes, all dimensions in mm and (inches)

### 3.5.2 Installing the reinforcement plates for an S120 Combi Power Module

The reinforcement plates for the S120 Combi fulfill the following functions:

- Air is routed in a specific way to dissipate the heat of the external heat sink
- They stabilize the mounting panel

They should be installed at the rear of the mounting panel or the control cabinet before installing the S120 Combi Power Module and the external fan unit.

**Note**

The reinforcement plates are not included in the scope of delivery of the S120 Combi. They must be separately ordered (order number 6SL3161-1LP00-0AA0).

**Holes:**

4 x Ø 4.8 mm (for drilling pattern, refer to the Chapter "Drilling patterns and installation cut-outs")




**Screws to be used:**

M4 x 10 (ISO 7045 (DIN 7965), ISO 7380, DIN EN ISO 1207, ISO 1580M4)

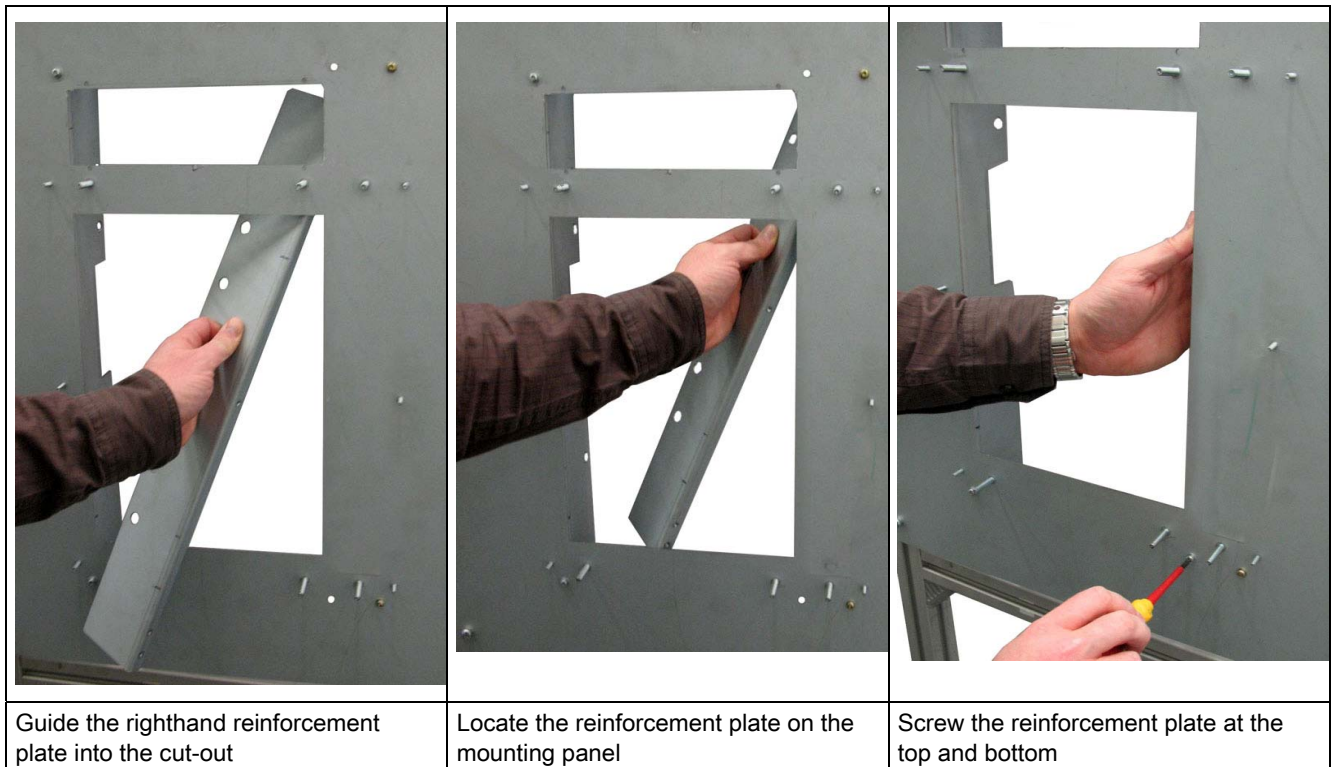
**Tightening torques:**

Initially tighten by hand (0.5 Nm), then tighten with 1.8 Nm

Table 3- 17 Installing the reinforcement plates

		
<p>Guide the lefthand reinforcement plate into the cut-out</p>	<p>Locate the reinforcement plate on the mounting panel</p>	<p>Screw the reinforcement plate at the top and bottom</p>





When installing the reinforcement plates, it is important to observe alignment.

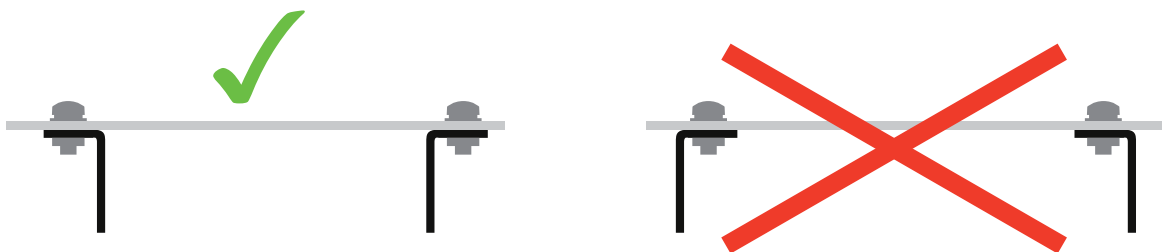


Figure 3-14 Alignment of the reinforcement plates

3.5 Installation

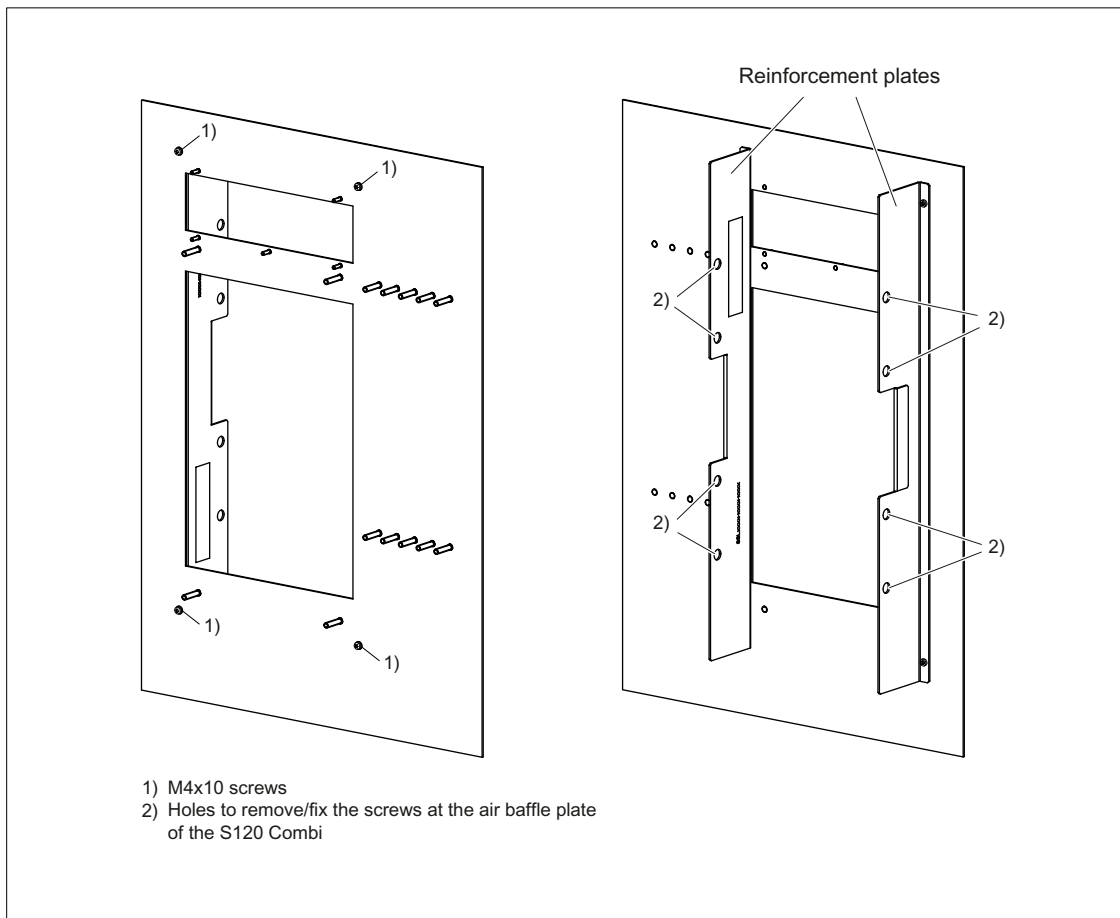


Figure 3-15 Installed reinforcement plates: View from the front and from the rear

**CAUTION**

The reinforcement plates must be installed so that the openings between the S120 Combi Power Module and the external fan unit are closed.

If the reinforcing plates are incorrectly fixed, this can result in an excessively high heat sink temperature and cause the S120 Combi Power Module to prematurely trip.

### 3.5.3 Installing an S120 Combi Power Module

An S120 Combi Power Module is installed after the reinforcement plates have been installed.

#### Installation steps

1. Mount the M6 self-clinching flush head studs
2. Locate the S120 Combi Power Module
3. Initially tighten the M6 nuts by hand (0.5 Nm).
4. Tighten the nuts in the specific sequence (1 to 4) with 10 Nm

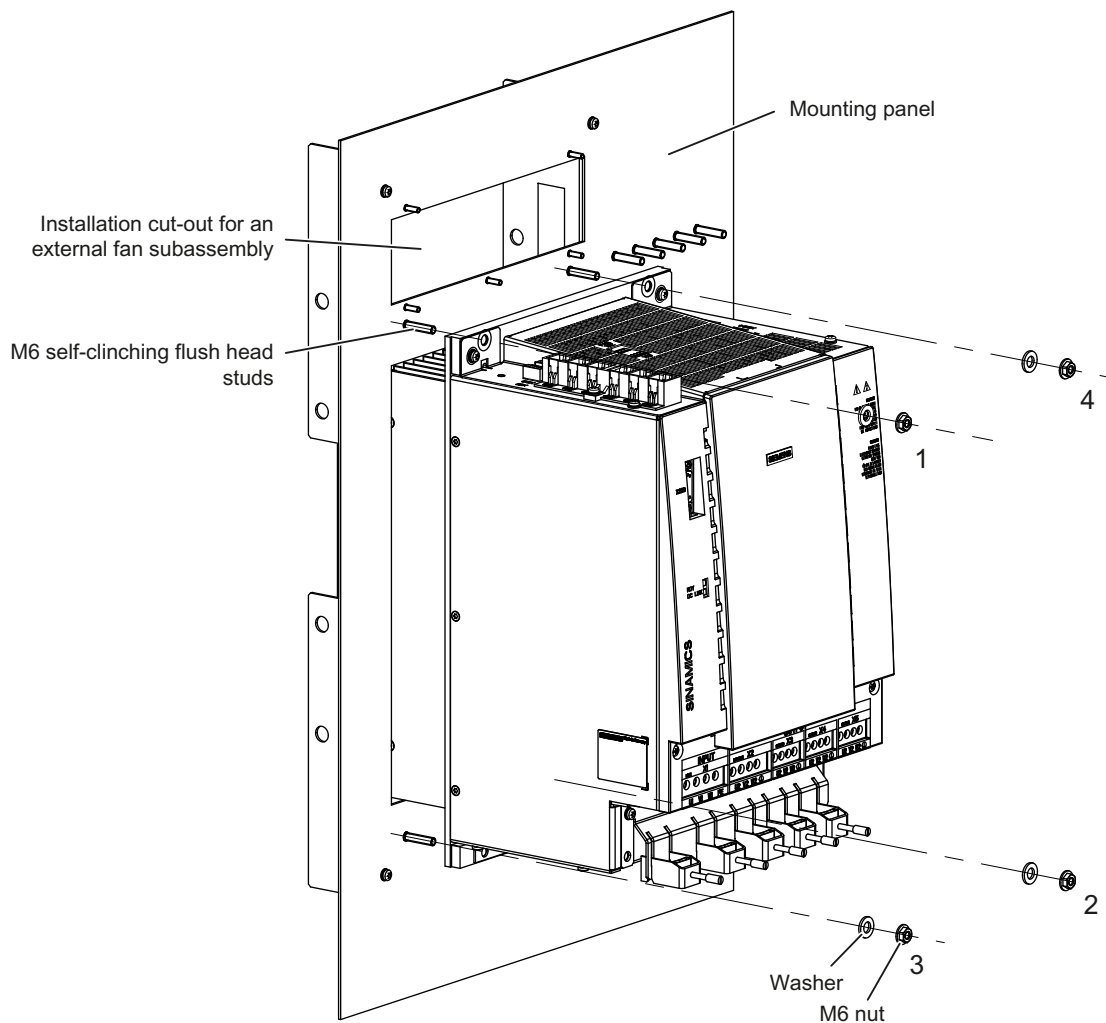


Figure 3-16 Installing an S120 Combi Power Module

### 3.6 Electrical connection

Non-assembled MOTION-CONNECT power cables must be appropriately prepared before being connected to the S120 Combi.

#### Cables without connection cables for the motor holding brake

1. Cut the cable jacket to dimension A from the table below
2. Strip the single cores U, V, W and PE and crimp on end sleeves according to DIN 46228

#### Cables with connection cables for the motor holding brake

1. Cut the cable jacket to  $250 \pm 5$  mm
2. Cut the single cores U, V, W and PE to dimension A from the table below, strip and crimp on end sleeves according to DIN 46228
3. Strip the connection cables for the motor holding brake and screw to the brake connector

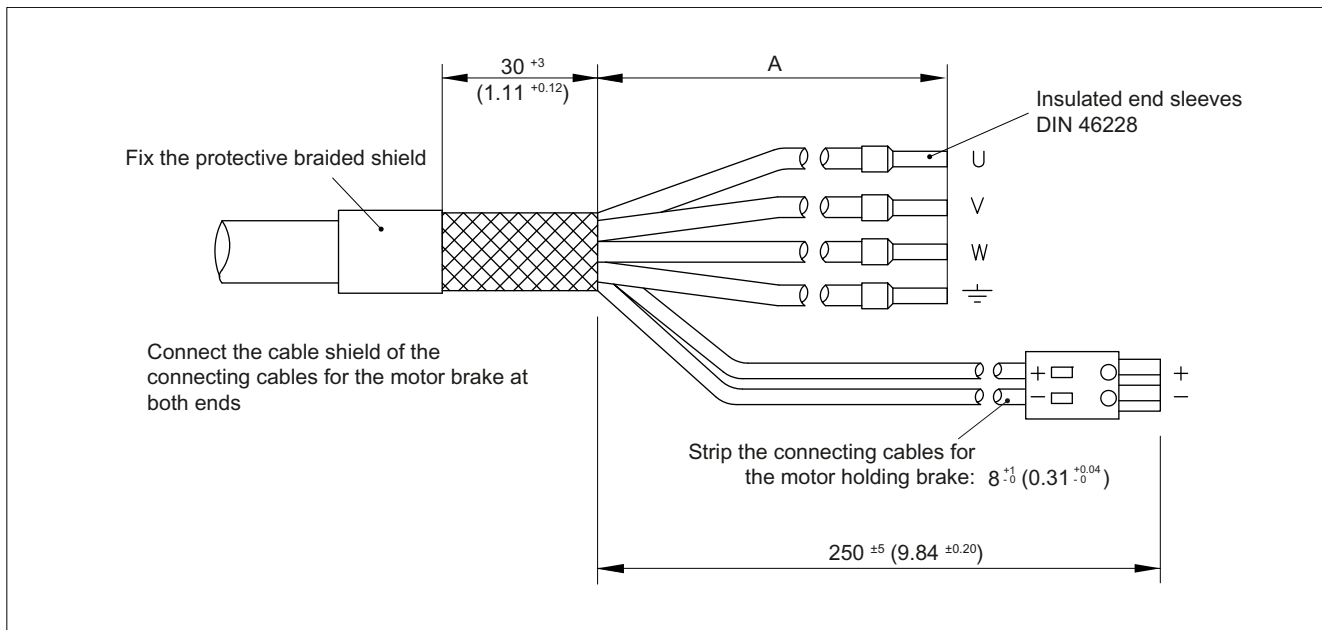


Figure 3-17 Stripped lengths for power cables

Cable cross-section in mm <sup>2</sup>	A in mm and (inches)
4 x 1.5	$55 \pm 3$ (2.17 $\pm 0.12$ )
4 x 2.5	$55 \pm 3$ (2.17 $\pm 0.12$ )
4 x 4	$55 \pm 3$ (2.17 $\pm 0.12$ )
4 x 6	$55 \pm 2$ (2.17 $\pm 0.08$ )
4 x 10	$55 \pm 2$ (2.17 $\pm 0.08$ )

### 3.6.1 Line supply cable

Shielded MOTION-CONNECT 500 and 800 line supply cables are recommended in order to maintain the EMC limit values. The line supply cable is connected at interface X1 (INPUT). The single cores of the cable are labeled with U, V, W and PE. Cables are connected at the S120 Combi corresponding to the terminal labeling. The cable shield should be connected and fixed using the shield clamp.

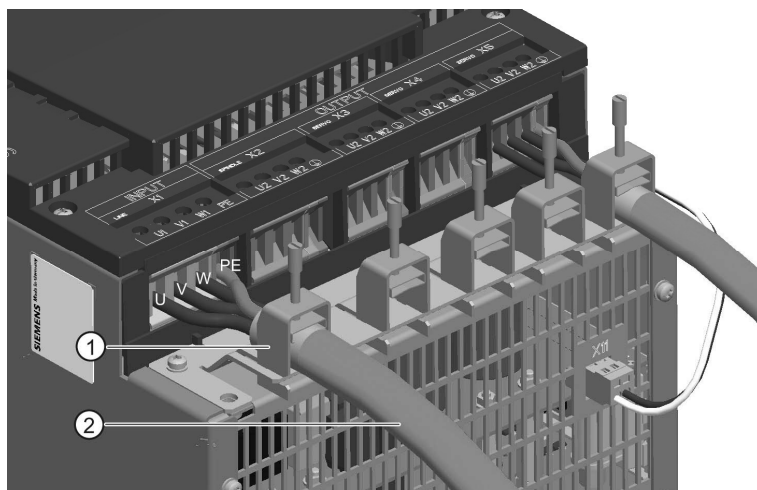


Figure 3-18 Line supply cable connected at the S120 Combi

- ① Shield clamp
- ② Line supply cable

#### NOTICE

The shield clamp does **not** provide strain relief. Strain relief for the power cable must be separately realized using a suitable measure.

#### CAUTION

When using unshielded power cables, the shield clamp must **not** be used, as otherwise the unshielded single cores could be damaged.

### 3.6.2 Power cables for motors

The motor power cables are connected at interfaces X2 to X5. The single cores of the cable are labeled with U, V, W and PE. The cables are connected corresponding to the terminal labels at the S120 Combi.

When using a power cable with connection cables for the motor holding brake, the cores for the motor holding brake are connected at interface X11 (see the diagram below). In this case, connect the cable shield of all cable cores. Fix the cable shield using the shield clamp.

When using a separate cable for the motor holding brake, the cable shield should be connected to a shield support of a motor power cable that is free. If there is no longer a free shield support, connect the cable shield of the brake cable to the connection at the outer right together with the cable shield of the motor power cable.

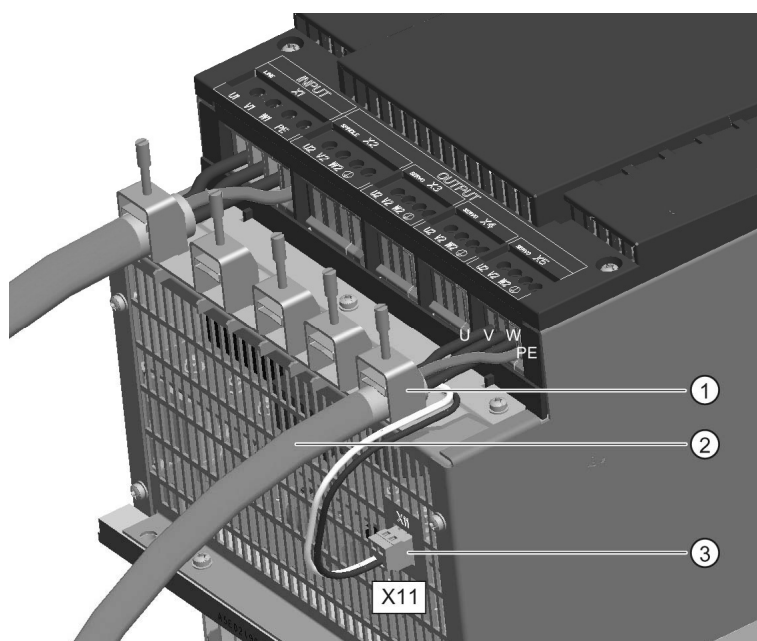


Figure 3-19 Power cable connected at the S120 Combi

- ① Shield clamp
- ② Power cable with connection cables for the motor holding brake
- ③ Connector for the motor holding brake

#### NOTICE

The shield clamp does **not** provide strain relief. Strain relief for the power cable must be separately realized using a suitable measure.

### 3.6.3 Signal cables at the EP terminals

The shields of the signal cables at the EP terminals X21 and X22 are connected using the shield clamp ① from the Completion Kit (Weidmüller: KLBÜ 4-13.5). The connection involves the following steps:

- Mount the shield clamp at the S120 Combi using an SW3 wrench with a tightening torque of 1.8 Nm
- Strip the insulation from the signal cables and crimp on end sleeves to the individual cores
- Connect the cores to the EP terminals (screw terminals)
- Connect the signal cable shields as shown below.

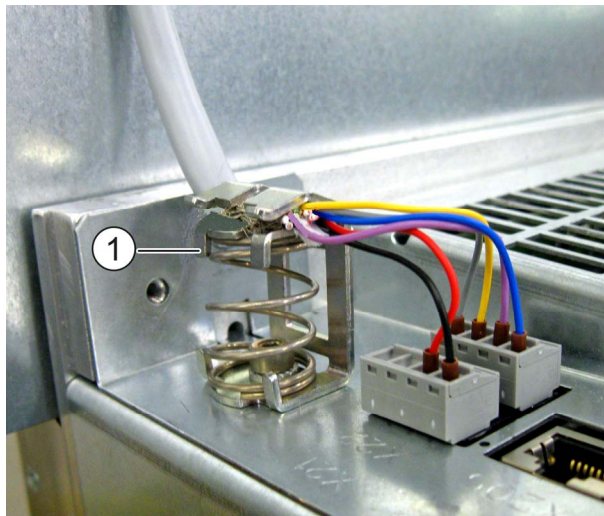


Figure 3-20 Signal cables connected with the correct shield support

## 3.7 Technical data

Table 3- 18 Technical data of the S120 Combi 3 axes Power Module

3 axes Power Module	6SL3111-	3VE21-6FA0	3VE21-6EA0	3VE22-0HA0
		16 kW / 18 A / 5 A / 5 A	16 kW / 24 A / 9 A / 9 A	20 kW / 30 A / 9 A / 9 A
<b>Infeed</b>				
<b>Infeed</b>				
Rated power (S1) <sup>1)</sup>	kW (Pn)	16	16	20
Infeed power (S6-40%) <sup>1)</sup>	kW (Ps6)	21	21	26.5
Peak infeed power <sup>1)</sup>	kW (Pmax)	35	35	40
<b>Regenerative feedback</b>				
Rated power (S1)	kW (Pn)	16	16	20
Peak regenerative power	kW (Pmax)	35	35	40
<b>Supply voltages</b>				
Line voltage	V <sub>AC</sub>	3-ph. 380 – 10 % up to 3-ph. 480 V AC + 10 %		
Line frequency	Hz	45 to 66		
Electronics power supply	V <sub>DC</sub>	24 (20.4 – 28.8)		
<b>Rated input current</b>				
at 400 V <sub>AC</sub>	A <sub>AC</sub>	28	28	34
at 380 V <sub>AC</sub> / 480 V <sub>AC</sub>	A <sub>AC</sub>	29 / 25	29 / 25	35 / 30
at 400 V; S6-40 %	A <sub>AC</sub>	35.5	35.5	44
at 400 V <sub>AC</sub> peak current	A <sub>AC</sub>	56	56	63.5
<b>Spindle</b>				
	<b>A</b>	<b>18</b>	<b>24</b>	<b>30</b>
Rated output current (I <sub>n</sub> )	A <sub>ACrms</sub>	18	24	30
Base-load current (I <sub>base</sub> )	A <sub>ACrms</sub>	15.3	20.4	25.5
Intermittent duty current (I <sub>s6</sub> ) 40 %	A <sub>ACrms</sub>	24	32	40
Peak current (I <sub>max</sub> )	A <sub>ACrms</sub>	36	48	56
<b>Rated power</b>				
for 540 V DC link voltage	kW	8.7	11.7	14.4
for 600 V DC link voltage	kW	9.7	13	16
Spindle pulse frequency	kHz	4		
Output voltage	V <sub>ACrms</sub>	0 - 0.7 x DC link voltage		
<b>Feedrate 1</b>				
	<b>A</b>	<b>5</b>	<b>9</b>	<b>9</b>
Rated output current (I <sub>n</sub> )	A <sub>ACrms</sub>	5	9	9
Base-load current (I <sub>base</sub> )	A <sub>ACrms</sub>	4.3	7.7	7.7
Intermittent duty current (I <sub>s6</sub> ) 40 %	A <sub>ACrms</sub>	6.5	12	12
Peak current (I <sub>max</sub> )	A <sub>ACrms</sub>	10	18	18
<b>Rated power</b>				
for 540 V DC link voltage	kW	2.4	4.3	4.3
for 600 V DC link voltage	kW	2.7	4.8	4.8
Pulse frequency, feedrate 1	kHz	4		
Output voltage	V <sub>ACrms</sub>	0 - 0.7 x DC link voltage		



3 axes Power Module	6SL3111-	3VE21-6FA0	3VE21-6EA0	3VE22-0HA0
<b>Feedrate 2</b>				
	<b>A</b>	<b>5</b>	<b>9</b>	<b>9</b>
Rated output current ( $I_n$ )	$A_{ACrms}$	5	9	9
Base-load current ( $I_{base}$ )	$A_{ACrms}$	4.3	7.7	7.7
Intermittent duty current ( $I_{S6}$ ) 40 %	$A_{ACrms}$	6.5	12	12
Peak current ( $I_{max}$ )	$A_{ACrms}$	10	18	18
<b>Rated power</b> for 540 V DC link voltage for 600 V DC link voltage	kW kW	2.4 2.7	4.3 4.8	4.3 4.8
Pulse frequency, feedrate 2	kHz	4		
Output voltage	$V_{ACrms}$	0 - 0.7 x DC link voltage		
<b>Output for expansion axis</b>				
DC link output current ( $I_n$ )	$A_{DC}$	40		
DC link voltage	$V_{DC}$	460 – 720		
Max. electronics output current for an expansion axis	$A_{24Vmax}$	20		
<b>General data</b>				
<b>Electronics current consumption at 24 V DC</b> without external fan unit with external fan unit	A A	1.5 2.3	1.5 2.3	1.5 2.3
<b>Total power loss</b> <sup>2)</sup> (including electronics losses) <sup>3)</sup> internal external	W W W	425 81 344	537 91 446	634 102 532
<b>Max. ambient temperature</b> Without derating With derating	°C °C	45 55	45 55	45 55
DC link voltage Overvoltage trip Undervoltage trip	$V_{DC}$ $V_{DC}$ $V_{DC}$	460 – 720 820 ± 2 % 380 ± 2 %		
DC link capacitance	µF	1645	1880	2115
<b>Circuit breaker (UL)</b> Type designation Rated current: Resulting rated short-circuit current SCCR at 480 $V_{AC}$	A A kA	3VL2105-2KN30 50 65	3VL2105-2KN30 50 65	3VL2106-2KN30 60 65
<b>Fuses (UL)</b> Type AJT Class J <sup>4)</sup> Rated current Resulting rated short-circuit SCCR at 480 $V_{AC}$ at 600 $V_{AC}$	A kA kA	AJT 35 35 65 200	AJT 35 35 65 200	AJT 60 60 65 200
Cooling method		External air cooling		

3.7 Technical data

3 axes Power Module	6SL3111-	3VE21-6FA0	3VE21-6EA0	3VE22-0HA0
Cooling air requirement	m <sup>3</sup> /h	160	160	160
Weight	kg	18.35	18.4	18.5

- 1) The specified power ratings apply for the line supply voltage range from 380 V to 480 V
- 2) The external fan unit 6SL3161-0EP00-0AA0 has been taken into account for the specified losses - also refer to the power loss calculation for partial load operation in Chapter "Control cabinet installation".
- 3) For an overview, see the power loss tables in Chapter "Control cabinet installation"
- 4) Source of supply: Ferraz Shawmut, <http://de.ferrazshawmut.com>

Table 3- 19 Technical data of the S120 Combi 4 axes Power Module

4 axes Power Module	6SL3111-	4VE21-6FA0	4VE21-6EA0	4VE22-0HA0
		<b>16 kW / 18 A / 9 A / 5 A / 5 A</b>	<b>16 kW / 24 A / 9 A / 9 A / 9 A</b>	<b>20 kW / 30 A / 12 A / 9 A / 9 A</b>
<b>Infeed</b>				
<b>Infeed</b>				
Rated power (S1) <sup>1)</sup>	kW (P <sub>n</sub> )	16	16	20
Infeed power (S6-40%) <sup>1)</sup>	kW (P <sub>s6</sub> )	21	21	26.5
Peak infeed power <sup>1)</sup>	kW (P <sub>max</sub> )	35	35	40
<b>Regenerative feedback</b>				
Rated power (S1)	kW (P <sub>n</sub> )	16	16	20
Peak regenerative power	kW (P <sub>max</sub> )	35	35	40
<b>Supply voltages</b>				
Line voltage	V <sub>AC</sub>	3-ph. 380 – 10 % up to 3-ph. 480 V AC + 10 %		
Line frequency	Hz	45 to 66		
Electronics power supply	V <sub>DC</sub>	24 (20.4 – 28.8)		
<b>Rated input current</b>				
at 400 V <sub>AC</sub>	A <sub>AC</sub>	28	28	34
at 380 V <sub>AC</sub> / 480 V <sub>AC</sub>	A <sub>AC</sub>	29 / 25	29 / 25	35 / 30
at 400 V; S6-40 %	A <sub>AC</sub>	35.5	35.5	44
at 400 V <sub>AC</sub> peak current	A <sub>AC</sub>	56	56	63.5
<b>Spindle</b>				
	<b>A</b>	<b>18</b>	<b>24</b>	<b>30</b>
Rated output current (I <sub>n</sub> )	A <sub>ACrms</sub>	18	24	30
Base-load current (I <sub>base</sub> )	A <sub>ACrms</sub>	15.3	20.4	25.5
Intermittent duty current (I <sub>s6</sub> ) 40 %	A <sub>ACrms</sub>	24	32	40
Peak current (I <sub>max</sub> )	A <sub>ACrms</sub>	36	48	56
Rated power for 540 V DC link voltage for 600 V DC link voltage	kW	8.7	11.7	14.4
	kW	9.7	13	16
Spindle pulse frequency	kHz	4		
Output voltage	V <sub>ACrms</sub>	0 - 0.7 x DC link voltage		
<b>Feedrate 1</b>				
	<b>A</b>	<b>9</b>	<b>9</b>	<b>12</b>
Rated output current (I <sub>n</sub> )	A <sub>ACrms</sub>	9	9	12
Base-load current (I <sub>base</sub> )	A <sub>ACrms</sub>	7.7	7.7	10.3
Intermittent duty current (I <sub>s6</sub> ) 40 %	A <sub>ACrms</sub>	12	12	16
Peak current (I <sub>max</sub> )	A <sub>ACrms</sub>	18	18	24

4 axes Power Module	6SL3111-	4VE21-6FA0	4VE21-6EA0	4VE22-0HA0
Rated power for 540 V DC link voltage	kW	4.3	4.3	5.8
for 600 V DC link voltage	kW	4.8	4.8	6.5
Pulse frequency, feedrate 1	kHz	4		
Output voltage	V <sub>ACrms</sub>	0 - 0.7 x DC link voltage		
<b>Feedrate 2</b>				
	<b>A</b>	<b>5</b>	<b>9</b>	<b>9</b>
Rated output current (I <sub>n</sub> )	A <sub>ACrms</sub>	5	9	9
Base-load current (I <sub>base</sub> )	A <sub>ACrms</sub>	4.3	7.7	7.7
Intermittent duty current (I <sub>s6</sub> ) 40 %	A <sub>ACrms</sub>	6.5	12	12
Peak current (I <sub>max</sub> )	A <sub>ACrms</sub>	10	18	18
Rated power for 540 V DC link voltage	kW	2.4	4.3	4.3
for 600 V DC link voltage	kW	2.7	4.8	4.8
Pulse frequency, feedrate 2	kHz	4		
Output voltage	V <sub>ACrms</sub>	0 - 0.7 x DC link voltage		
<b>Feedrate 3</b>				
	<b>A</b>	<b>5</b>	<b>9</b>	<b>9</b>
Rated output current (I <sub>n</sub> )	A <sub>ACrms</sub>	5	9	9
Base-load current (I <sub>base</sub> )	A <sub>ACrms</sub>	4.3	7.7	7.7
Intermittent duty current (I <sub>s6</sub> ) 40 %	A <sub>ACrms</sub>	6.5	12	12
Peak current (I <sub>max</sub> )	A <sub>ACrms</sub>	10	18	18
Rated power for 540 V DC link voltage	kW	2.4	4.3	4.3
for 600 V DC link voltage	kW	2.7	4.8	4.8
Pulse frequency, feedrate 3	kHz	4		
Output voltage	V <sub>ACrms</sub>	0 - 0.7 x DC link voltage		
<b>Output for expansion axis</b>				
DC link output current (I <sub>n</sub> )	A <sub>DC</sub>	40		
DC link voltage	V <sub>DC</sub>	460 – 720		
Max. electronics output current for an expansion axis	A <sub>24Vmax</sub>	20		
<b>General data</b>				
<b>Electronics current consumption 24 V</b> without external fan unit	A	1.6	1.6	1.6
with external fan unit	A	2.4	2.4	2.4
<b>Total power loss</b> <sup>2)</sup> (including electronics losses) <sup>3)</sup>	W	492	607	733
internal	W	87	100	113
external	W	405	507	620
<b>Max. ambient temperature</b> Without derating	°C	45	45	45
With derating	°C	55	55	55
DC link voltage	V <sub>DC</sub>	460 – 720		
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %		
Undervoltage trip	V <sub>DC</sub>	380 ± 2 %		

3.7 Technical data

4 axes Power Module	6SL3111-	4VE21-6FA0	4VE21-6EA0	4VE22-0HA0
DC link capacitance	µF	1645	2115	2520
<b>Circuit breaker (UL)</b> Type designation Rated current: Resulting rated short-circuit current SCCR at 480 V <sub>AC</sub>	A  kA	3VL2105-2KN30 50 65	3VL2105-2KN30 50 65	3VL2106-2KN30 60 65
<b>Fuses (UL)</b> Type AJT Class J <sup>4)</sup> Rated current Resulting rated short-circuit SCCR at 480 V <sub>AC</sub> at 600 V <sub>AC</sub>	A  kA kA	AJT 35 35 65 200	AJT 35 35 65 200	AJT 60 60 65 200
Cooling method		External air cooling		
Cooling air requirement	m <sup>3</sup> /h	160	160	160
Weight	kg	18.9	18.95	19.05

- 1) The specified power ratings apply for the line supply voltage range from 380 V to 480 V
- 2) The external fan unit 6SL3161-0EP00-0AA0 has been taken into account for the specified losses - also refer to the power loss calculation for partial load operation in Chapter "Control cabinet installation".
- 3) For an overview, see the power loss tables in Chapter "Control cabinet installation"
- 4) Source of supply: Ferraz Shawmut, <http://de.ferrazshawmut.com>

### 3.7.1 Characteristics

#### Rated duty cycles, infeed

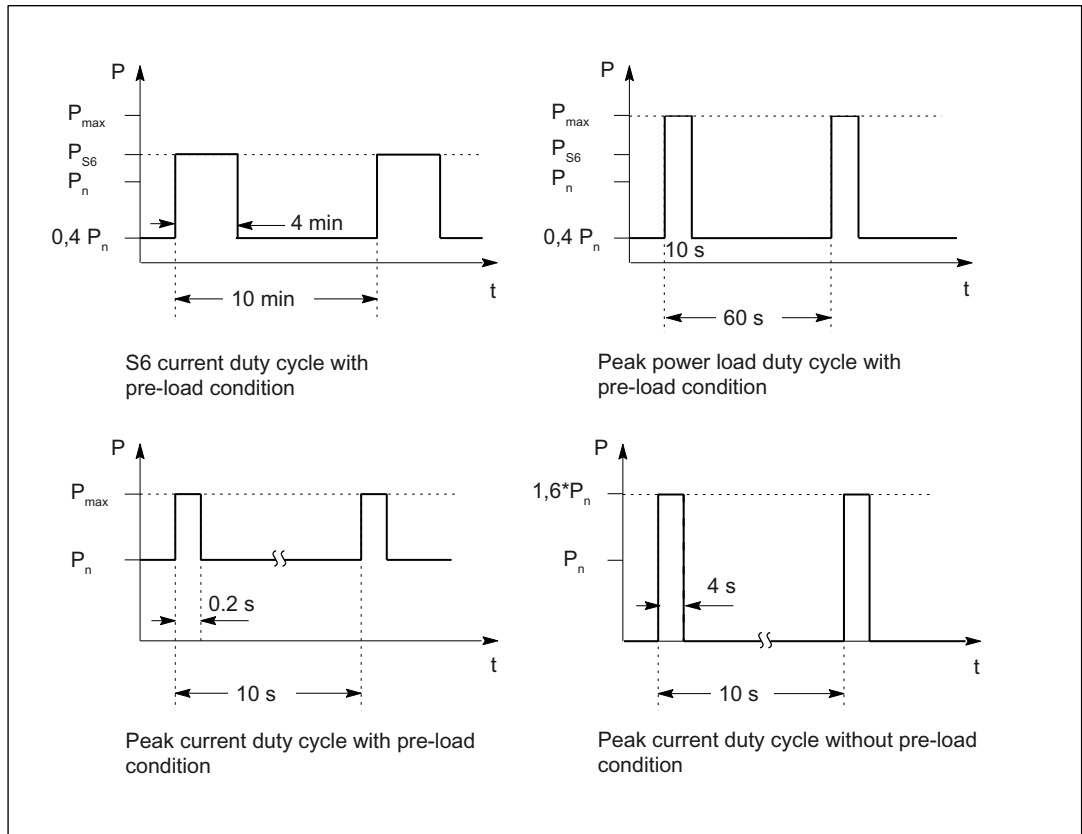


Figure 3-21 Rated duty cycles, infeed

Rated duty cycles, spindle and feedrate

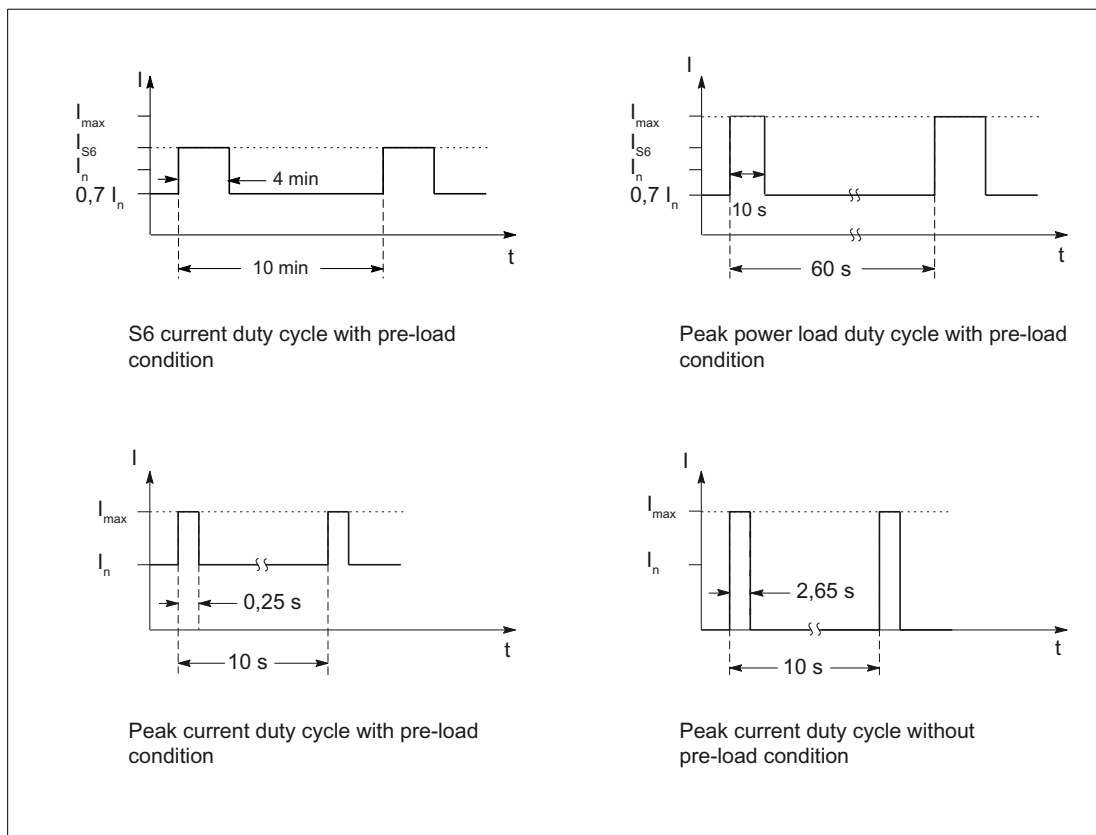


Figure 3-22 Rated duty cycles, spindle and feedrate

Derating characteristics

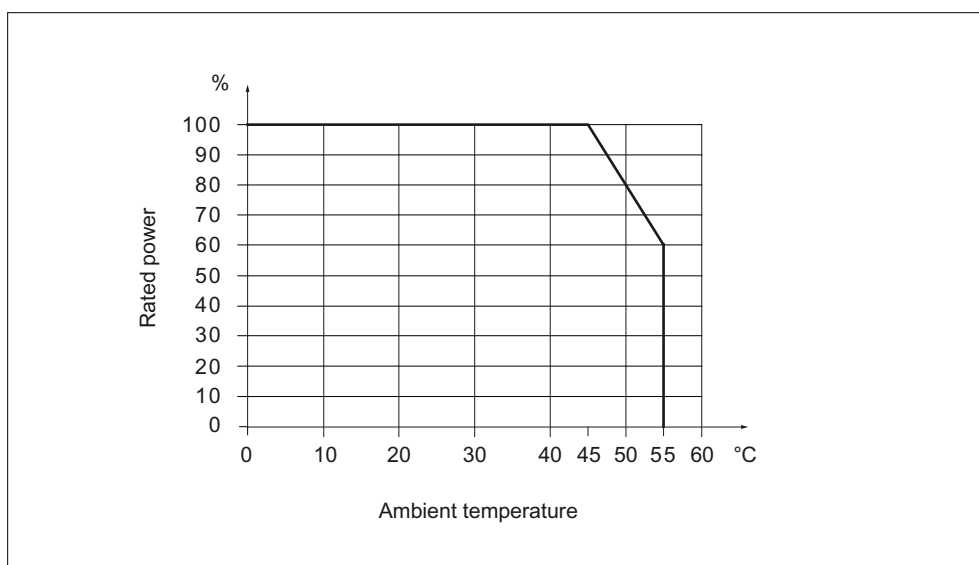


Figure 3-23 Rated power as a function of the temperature

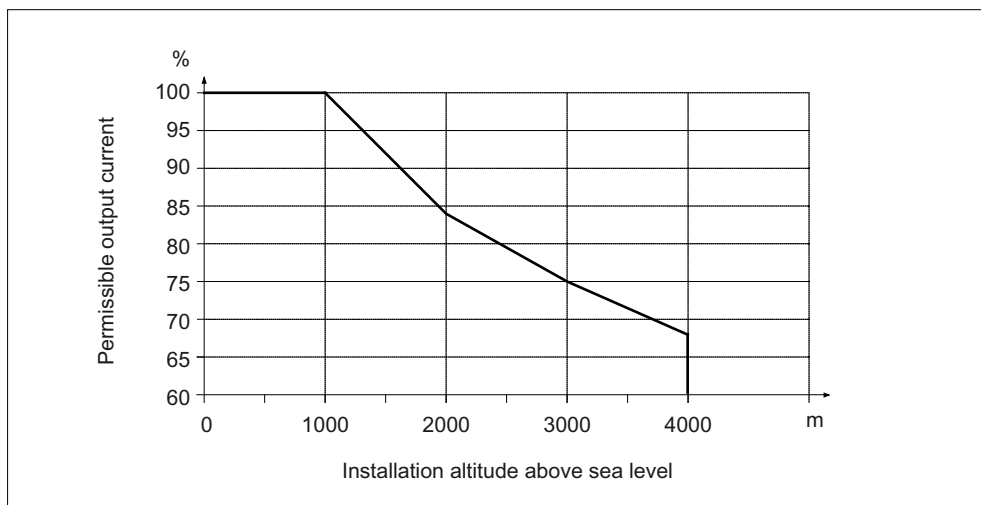


Figure 3-24 Output current as a function of the installation altitude

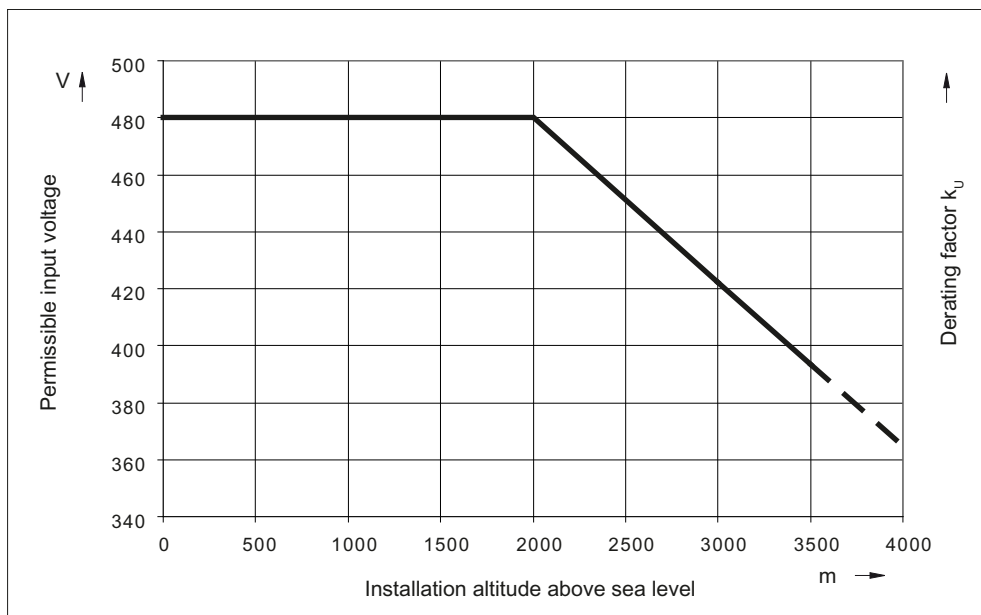


Figure 3-25 Voltage derating as a function of the installation altitude





## External fan unit

### 4.1 Description

The S120 Combi provides an integrated fan control and supply for an external 24 V fan unit. The fan unit is connected via interface X12/X13. The output is designed for a maximum current of 2 A and is short-circuit and ground-fault proof.

The following functions are available when using the external fan unit:

- Operating hours counter (p0251)
- Setting the maximum operation time (P0252)
- Evaluating fault signals

## 4.2 Overview

The external fan unit comprises the following components:

- Fan cradle with seal for installation in the control cabinet
- Connection cables with 4-pin connector
- Double fan
- Fan support plate
- Air baffle plate

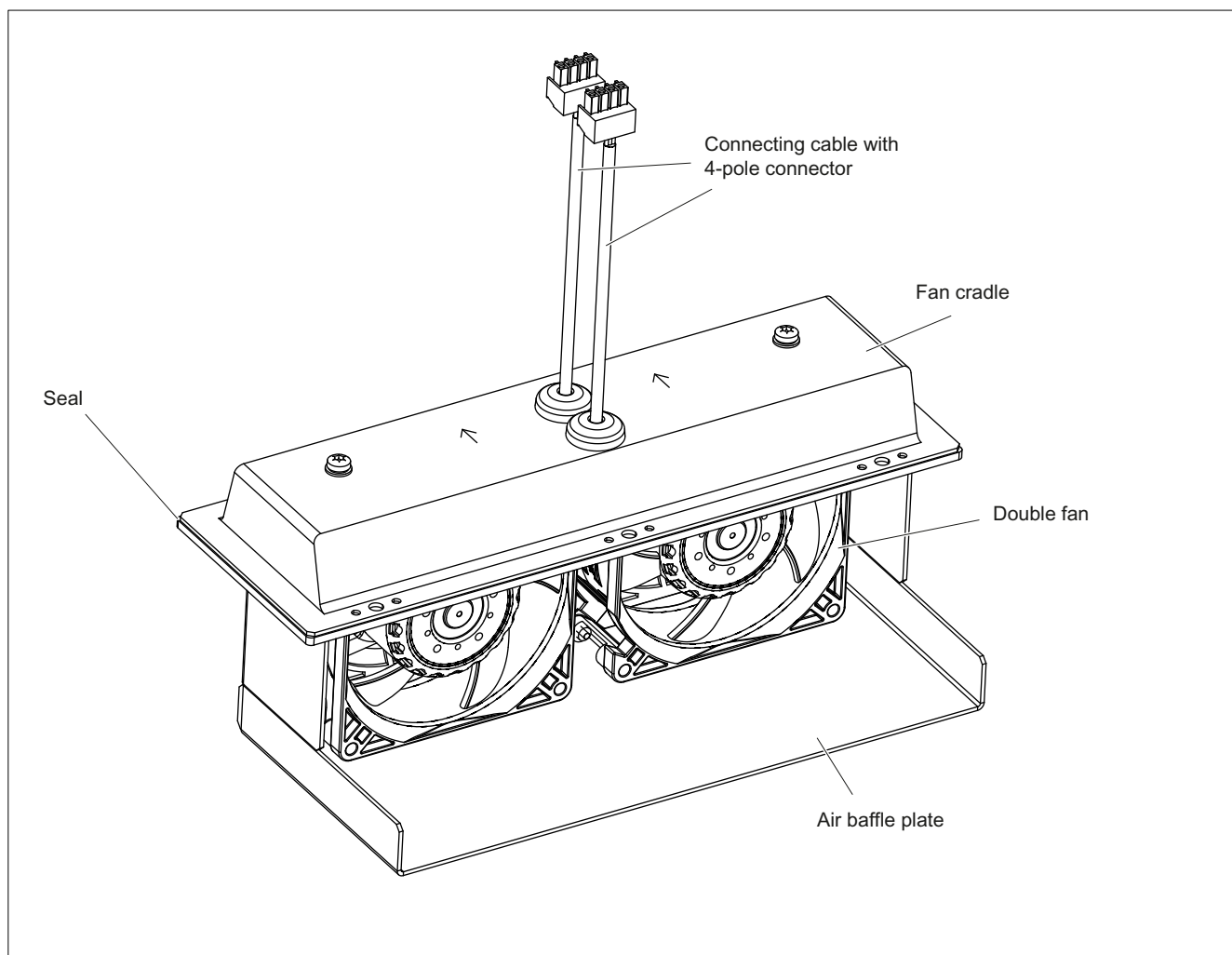


Figure 4-1 External fan unit

When a fan fails, the complete external fan unit must be replaced.

### 4.3 Dimension drawing

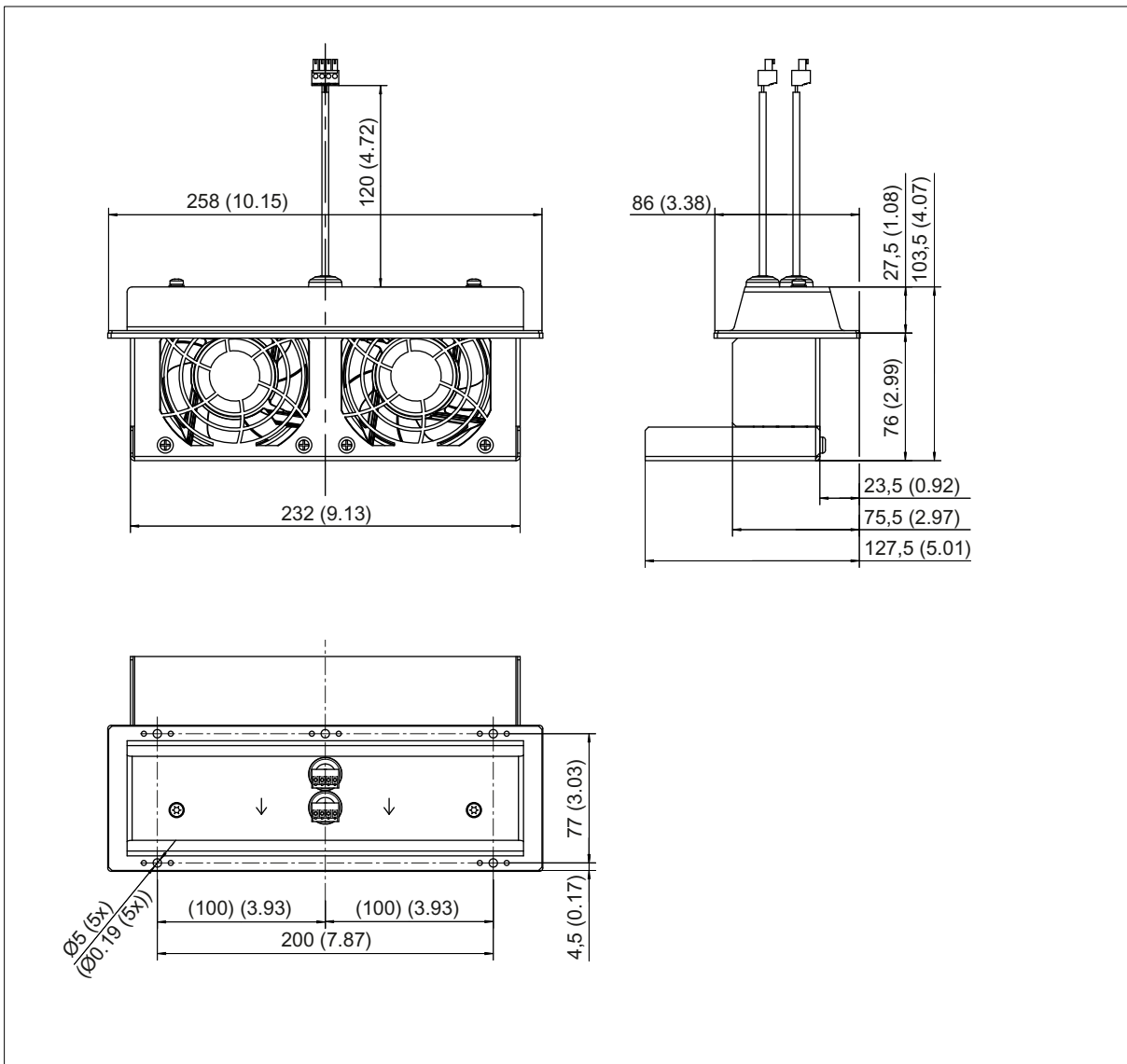


Figure 4-2 Dimension drawing of the external fan unit, all dimensions in mm and (inches)

## 4.4 Installation

### Preparation

The external fan unit is always installed above the S120 Combi in the control cabinet.

Make an installation cut-out in the control cabinet panel. The position depends on the installation cut-out for the S120 Combi Power Module (for details, see Chapter "S120 Combi Power Modules / Installation").

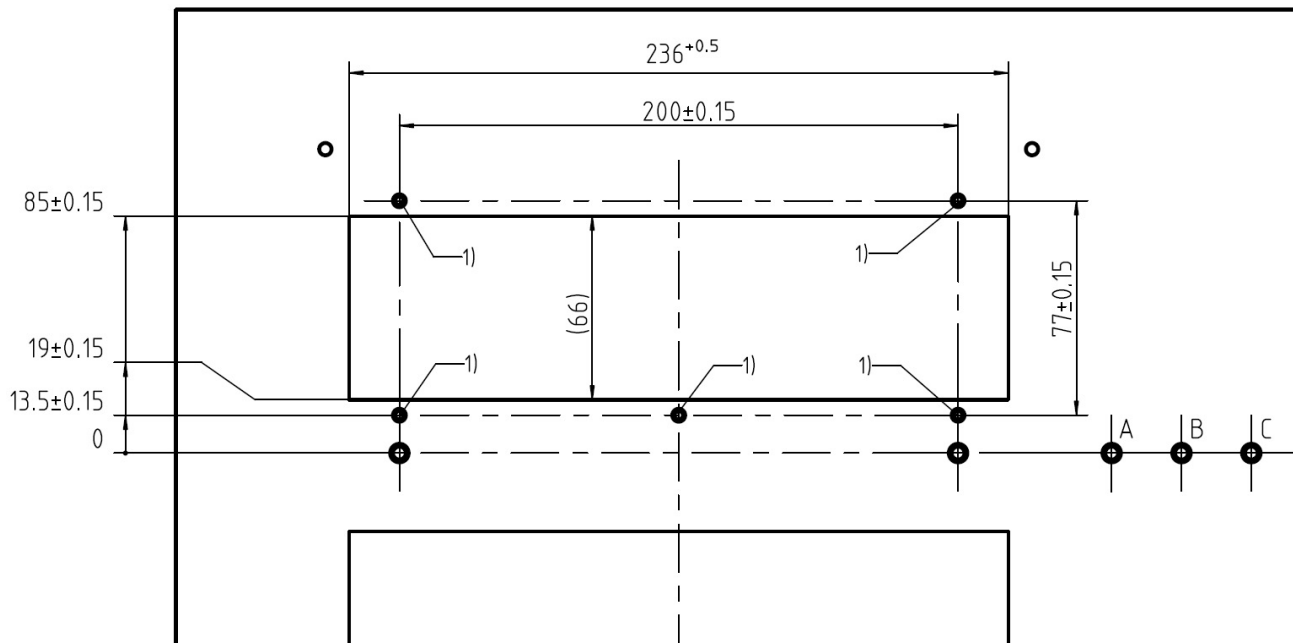
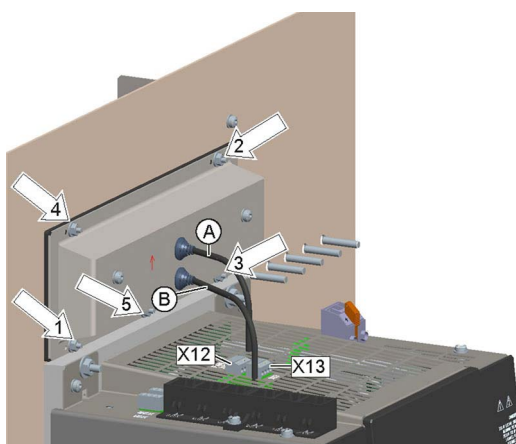
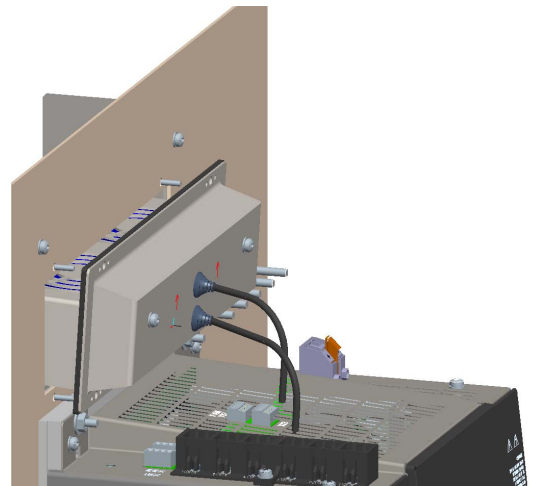
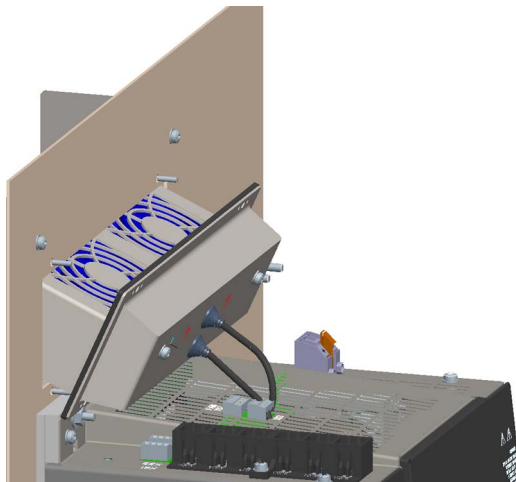
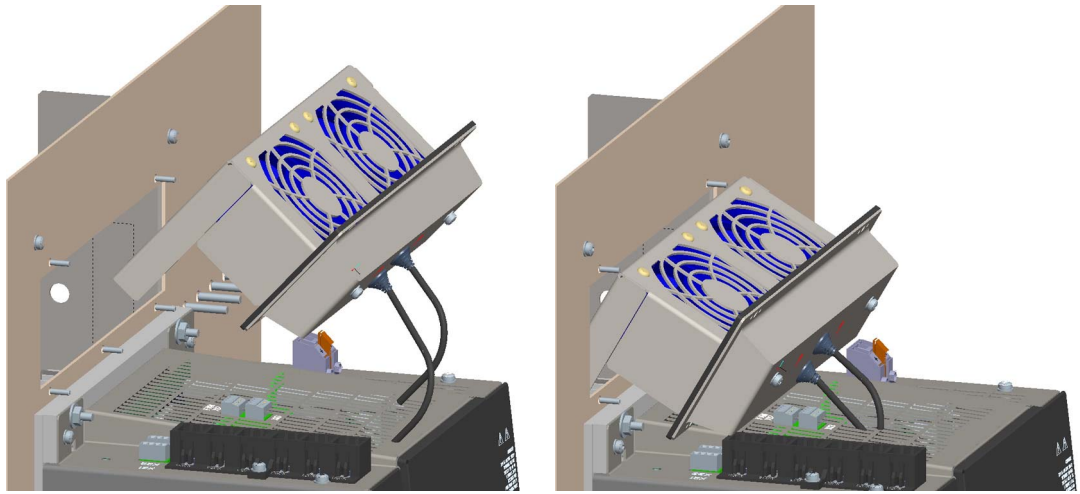


Figure 4-3 Cut-out from the drilling pattern and installation cut-out S120 Combi for the external fan unit

The zero line shown above runs at the height of the upper bolts used to mount the S120 Combi Power Module.

### Installation

1. Mount the self-clinching flush head studs - position 1) in the diagram above.
2. Mount the fan unit as shown below.
3. Connect the power supply cables of the fan unit to the S120 Combi Power Module.
  - Cable A to terminal X12
  - Cable B to terminal X13



Initially, tighten the nuts by hand:  
0.5 Nm

Then tighten the nuts with a tightening  
torque of 1.8 Nm in the specified mounting  
sequence 1 to 5.

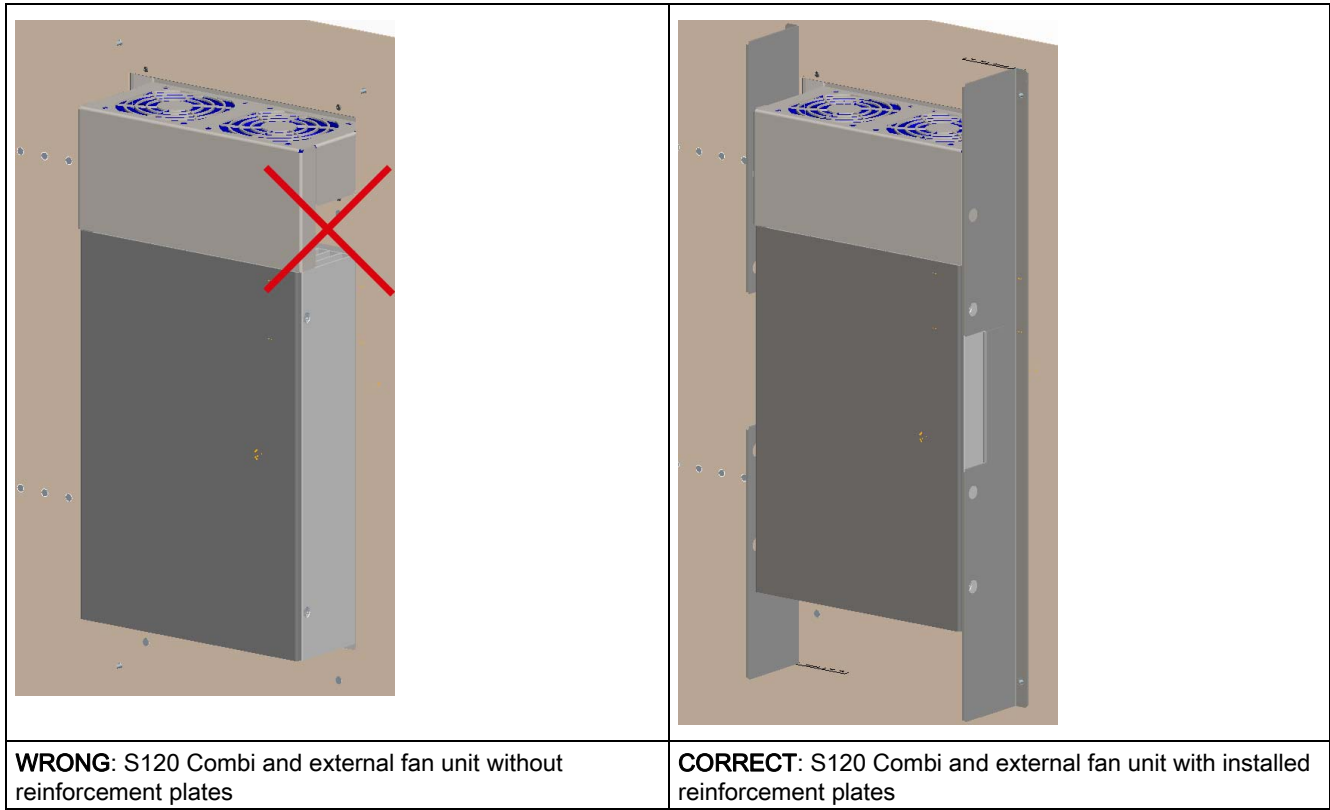
4.4 Installation

Table 4- 1 Mounting accessories

Number	Designation	Specification
5	Self-clinching flush head studs	M4, steel, strength class 8.8, zinc-plated, length: 15 mm
5	Nut	M4, steel, strength class 8, zinc-plated

The reinforcement plates must always be installed when operating the S120 Combi with the external fan unit.

<p><b>CAUTION</b></p> <p>Operation without the reinforcement plates is not permissible. If the reinforcement plates are incorrectly fixed, this can result in an excessively high heat sink temperature and cause the S120 Combi to prematurely trip.</p>
---



## 4.5 Technical data

Table 4- 2 Technical data of the external fan unit

<b>6SL3161-0EP00-0AA0</b>	<b>Unit</b>	<b>Value</b>
Input voltage	V	20.4 - 28.8
Power consumption	W	18
Electronics current consumption at 24 V DC	A	0.8
Volumetric rate of air flow	m <sup>3</sup> /h	290
Dimensions (W x H x D)	mm	258 x 104 x 86





## Topology rules for DRIVE-CLiQ

### Topology rules for DRIVE-CLiQ

There are fixed DRIVE-CLiQ topology rules for the S120 Combi. These rules must be observed. If violated, then a corresponding alarm is displayed.

### Assigning the DRIVE-CLiQ interfaces

Table 5- 1 Assigning the DRIVE-CLiQ interfaces on the S120 Combi

DRIVE-CLiQ interface	Connection with
X200	X100 of the PPU
X201	Motor encoder, spindle
X202	Motor encoder, feedrate 1
X203	Motor encoder, feedrate 2
X204	Motor encoder, feedrate 3 -> only for 4 axes Power Module remains empty for 3 axes Power Module
X205	Optional: 2. Direct sin/cos encoder for spindle (via SMx20) <sup>1)</sup> remains empty when a direct TTL spindle encoder is connected via X220

1) in this case, the TTL encoder interface X220 remains free

Table 5- 2 Assigning the DRIVE-CLiQ interfaces to the SINUMERIK 828D (PPU)

DRIVE-CLiQ interface	Connection with
X100	X200 of the S120 Combi
X101	X200 of a Single Motor Module or Double Motor Module
X102	X500 of the Terminal Module TM54F X500 of the Hub Modules (DMx20) <sup>1)</sup>

1) when using a TM54F, the DMx20 is connected in series at the TM54F via the DRIVE-CLiQ interface X501

Table 5- 3 Assigning the DRIVE-CLiQ interfaces of the expansion axes

DRIVE-CLiQ interface	Connection with
First Single Motor Module	
X200	X102 of the PPU
X201 <sup>1)</sup>	X200 of the second Single Motor Module
X202	Motor encoder for feedrate 1st expansion axis (via Sensor Module)
Second Single Motor Module	
X200	X201 of the first Single Motor Module
X201	Remains empty
X202	Motor encoder for feedrate 2nd expansion axis (via Sensor Module)
Double Motor Module	
X200	X205 of the S120 Combi
X201	Remains empty
X202	Motor encoder for feedrate 1st expansion axis
X203	Motor encoder for feedrate 2nd expansion axis

1) remains empty, if only one Single Motor Module is used

Table 5- 4 Assigning the DRIVE-CLiQ interfaces at the TM54F

DRIVE-CLiQ interface	
X500	X102 of the control (PPU)
X501	X500 of the DMx20 if a DMx20 is not used, then this interface remains empty

Table 5- 5 Assigning the DRIVE-CLiQ interfaces at the DMx20 to assign a direct measuring system to the feed axes.

DRIVE-CLiQ interface	Feed axis
X500	X501 of the TM54F X102 of the PPU <sup>1)</sup>
X501	Feedrate 1 at the S120 Combi
X502	Feedrate 2 at the S120 Combi
X503	Feedrate 3 at the S120 Combi (4 axes Power Modules)
X504	Feedrate 1st expansion axis at the Motor Module
X505	Feedrate 2nd expansion axis at the Motor Module

1) only if a TM54F is not being used

## 5.1 Connection examples

### Examples of the DRIVE-CLiQ wiring for operation with 5 axes

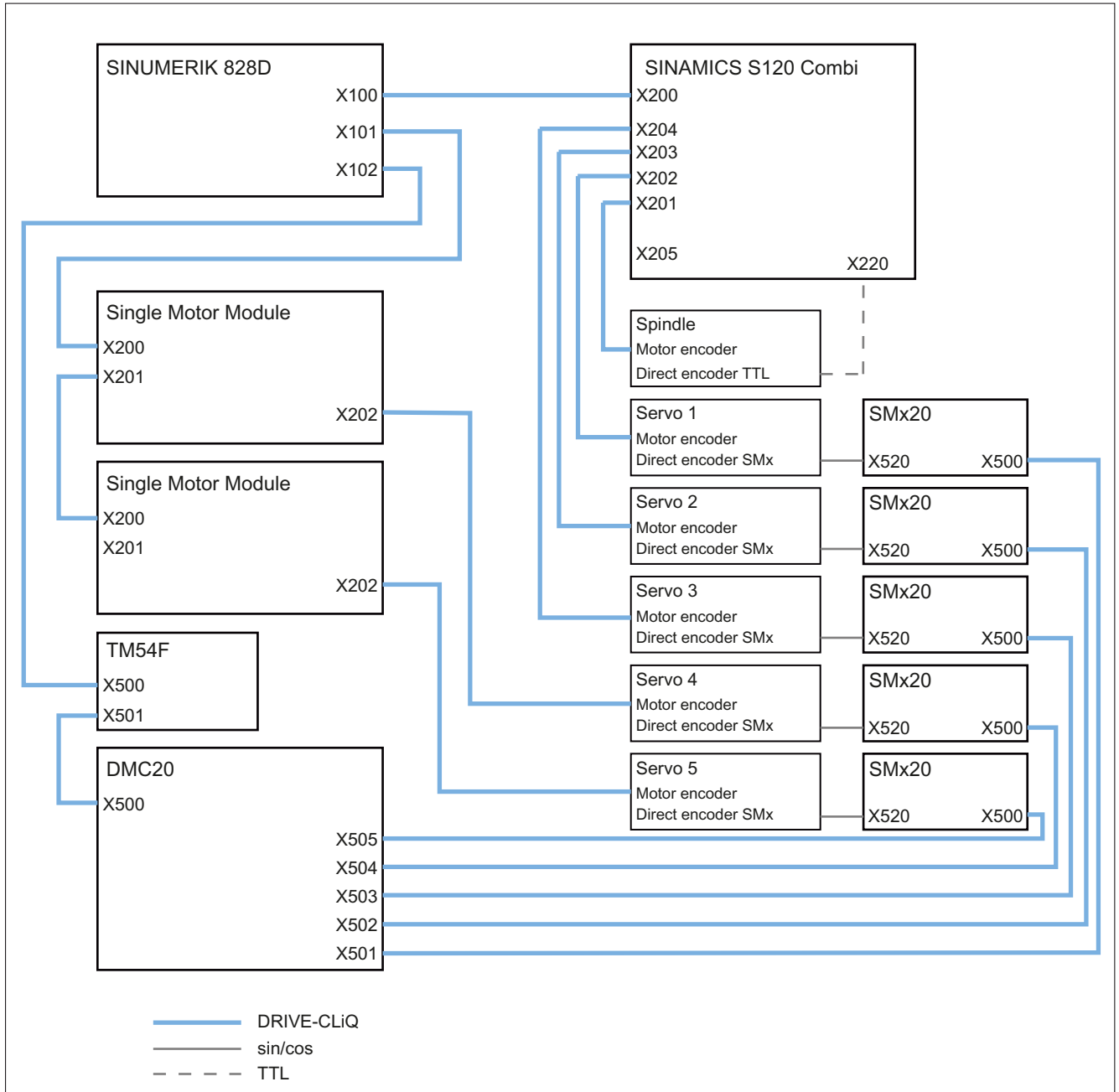


Figure 5-1 DRIVE-CLiQ wiring with TTL encoder for an S120 Combi 4 axes Power Module and two Single Motor Modules

5.1 Connection examples

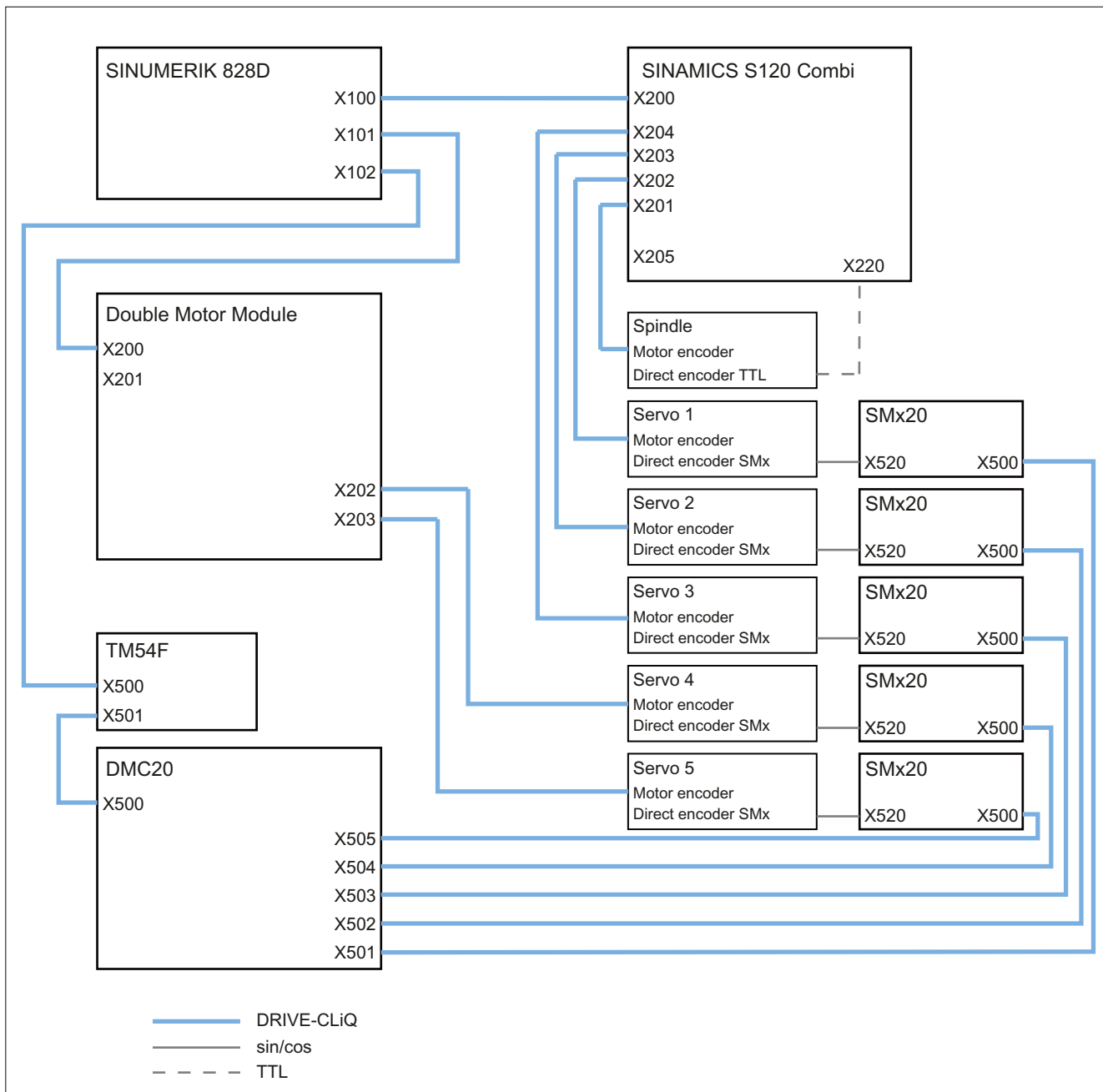


Figure 5-2 DRIVE-CLiQ wiring with TTL encoder for an S120 Combi 4 axes Power Module and a Double Motor Module

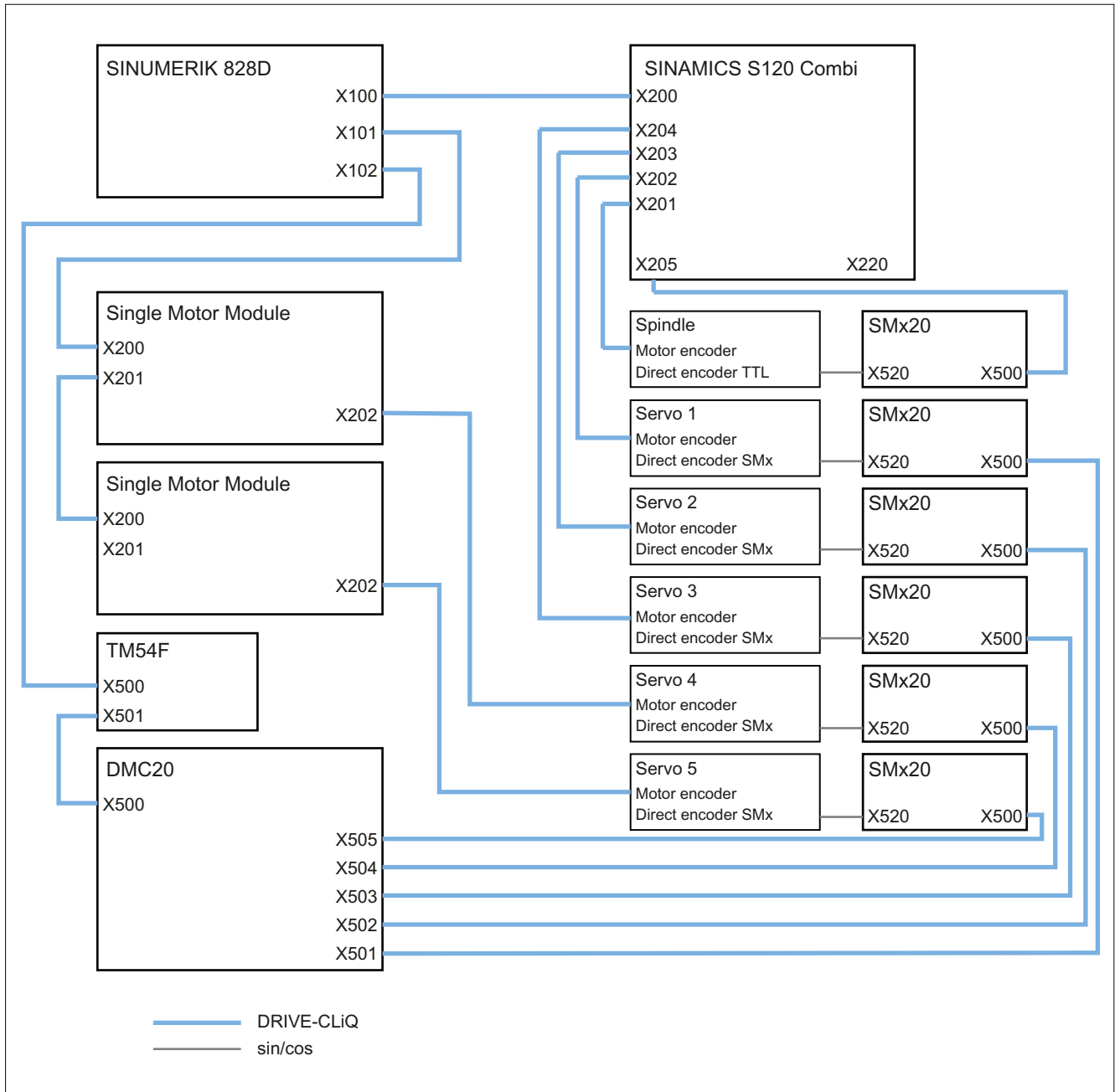


Figure 5-3 DRIVE-CLiQ wiring with angular encoder for an S120 Combi 4 axes Power Module and two Single Motor Modules



# Motor Modules Booksize Compact as expansion axes

# 6


## 6.1 Description


A Motor Module Booksize Compact is an inverter that provides the power for the connected motor(s). The power is supplied from the DC link of the S120 Combi. The Motor Modules must be connected to the SINUMERIK 828D control via DRIVE-CLiQ (see Chapter "Topology rules for DRIVE-CLiQ").


One motor can be connected to Single Motor Modules and two motors can be connected to Double Motor Modules.


The Motor Modules Booksize Compact are operated in combination with the S120 Combi using the "internal air cooling" cooling method.


## 6.2 Safety information


 <b>DANGER</b>
<b>Risk of electric shock</b> A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off. It is only permissible to open the protective cover after this time has expired. When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose. The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

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

 <b>DANGER</b>
<p>The drive components generate high leakage currents in the protective conductor. The components must only be operated in control cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:</p> <ul style="list-style-type: none"><li>• Stationary connection and protective conductor connection by means of <math>\geq 10 \text{ mm}^2</math> Cu or <math>\geq 16 \text{ mm}^2</math> Al</li><li>• stationary connection and installation of a second protective conductor with the same cross-section as the first protective conductor</li><li>• stationary connection and automatic shutdown of the line supply if the protective conductor is interrupted</li><li>• Connection with a plug connector for industrial applications in accordance with EN 60309 and a minimum protective conductor cross-section of <math>\geq 2.5 \text{ mm}^2</math> Cu as part of a multi-core supply cable with appropriate strain relief</li></ul>

 <b>DANGER</b>
<p>It is essential to apply the shield for the motor holding brake. Furthermore, only Motion-Connect cables must be used for integrated motor holding brakes, as otherwise insulation of the cores is not guaranteed. Risk of electric shock.</p>

 <b>WARNING</b>
<p>Cable shields and unused power cable cores (e.g. brake cores) must be connected to PE potential to prevent capacitive cross-talk charges.</p> <p>Non-observance can cause lethal shock voltages.</p>

 <b>CAUTION</b>
<p>The cooling clearances of 80 mm above and below the components must be observed.</p>

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

<b>CAUTION</b>
<p>Only cables from Siemens may be used for DRIVE-CLiQ connections.</p>



---

**CAUTION**

Connecting cables to temperature sensors must always be installed with shielding. The cable shield must be connected to the ground potential at both ends through a large surface area. Temperature sensor cables that are routed together with the motor cable must be twisted in pairs and shielded separately.

**CAUTION**

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

---

**Note**

A regulated DC power supply is required to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars. The voltage tolerances of the motor holding brakes ( $24\text{ V} \pm 10\%$ ) and the voltage drops of the connecting cables must be taken into account.

The DC power supply should be set to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:

- Use of Siemens three-phase motors
  - Use of Siemens MOTION-CONNECT power cables
  - Motor cable lengths: max. 70 m
-

## 6.3 Interface description

### 6.3.1 Overview

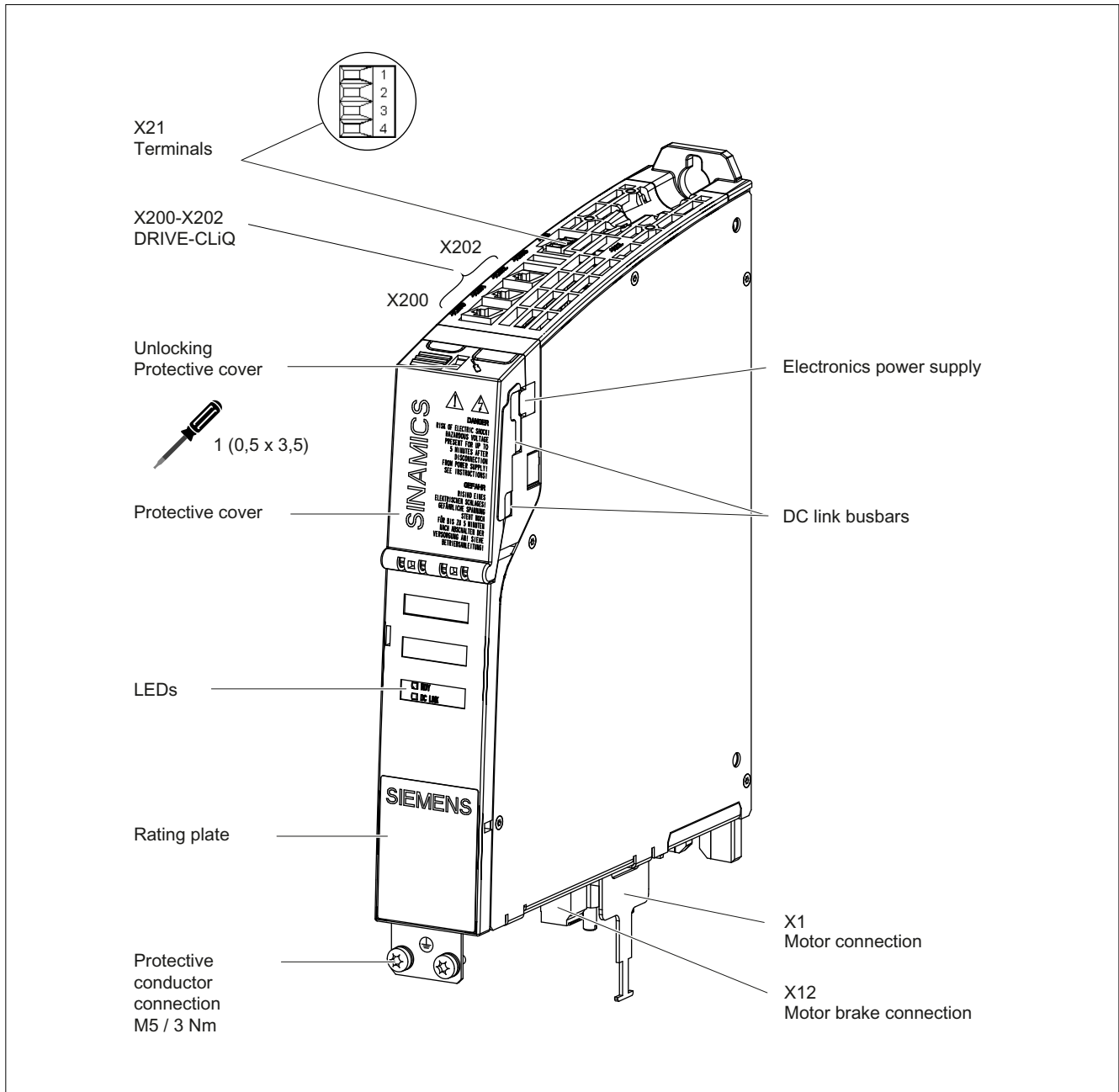


Figure 6-1 Single Motor Modules Booksize Compact 3 A, 5 A, and 9 A

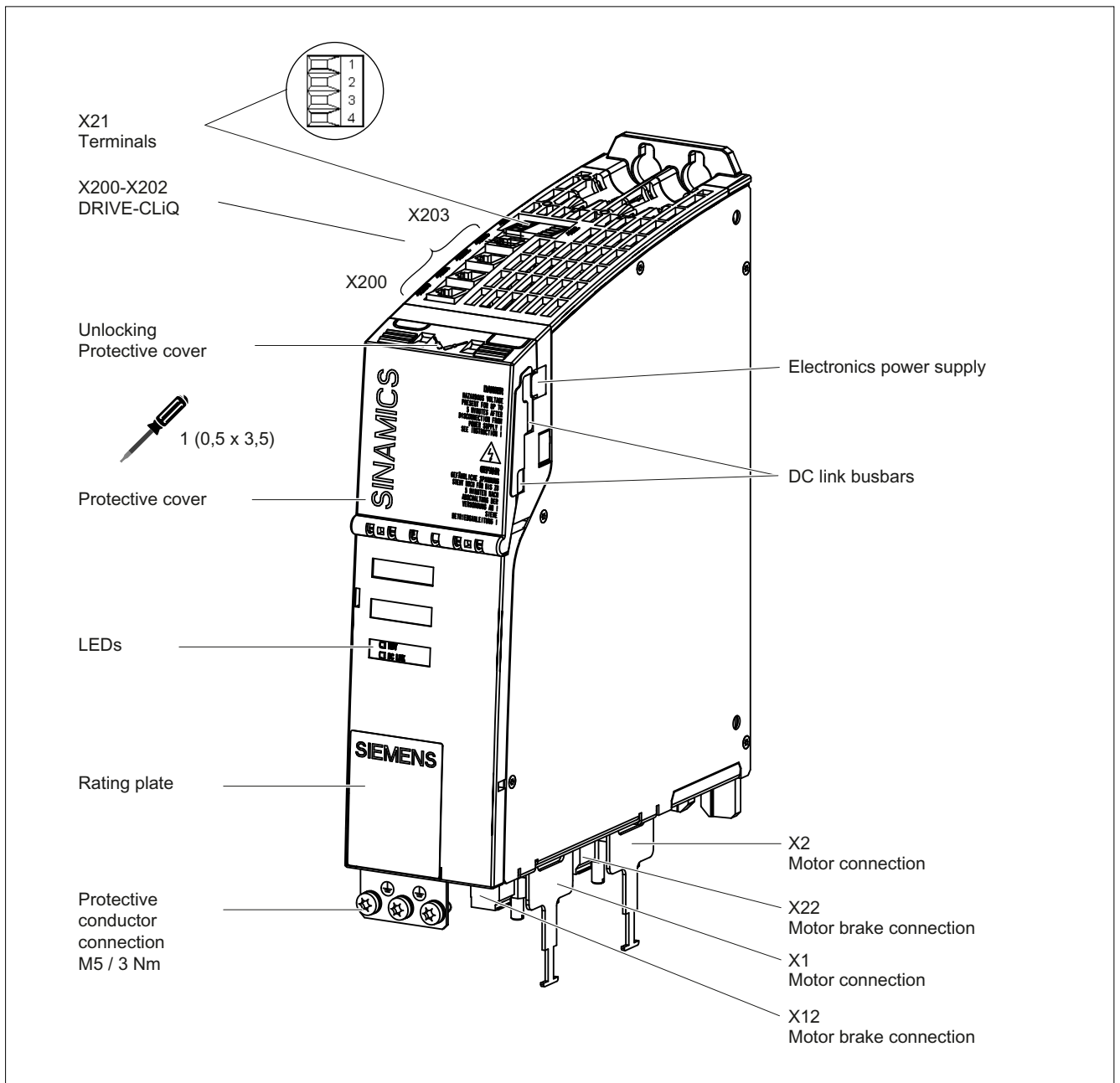


Figure 6-2 Double Motor Modules Booksize Compact 2 x 1.7 A, 2 x 3 A, 2 x 5 A

6.3.2 Connection example

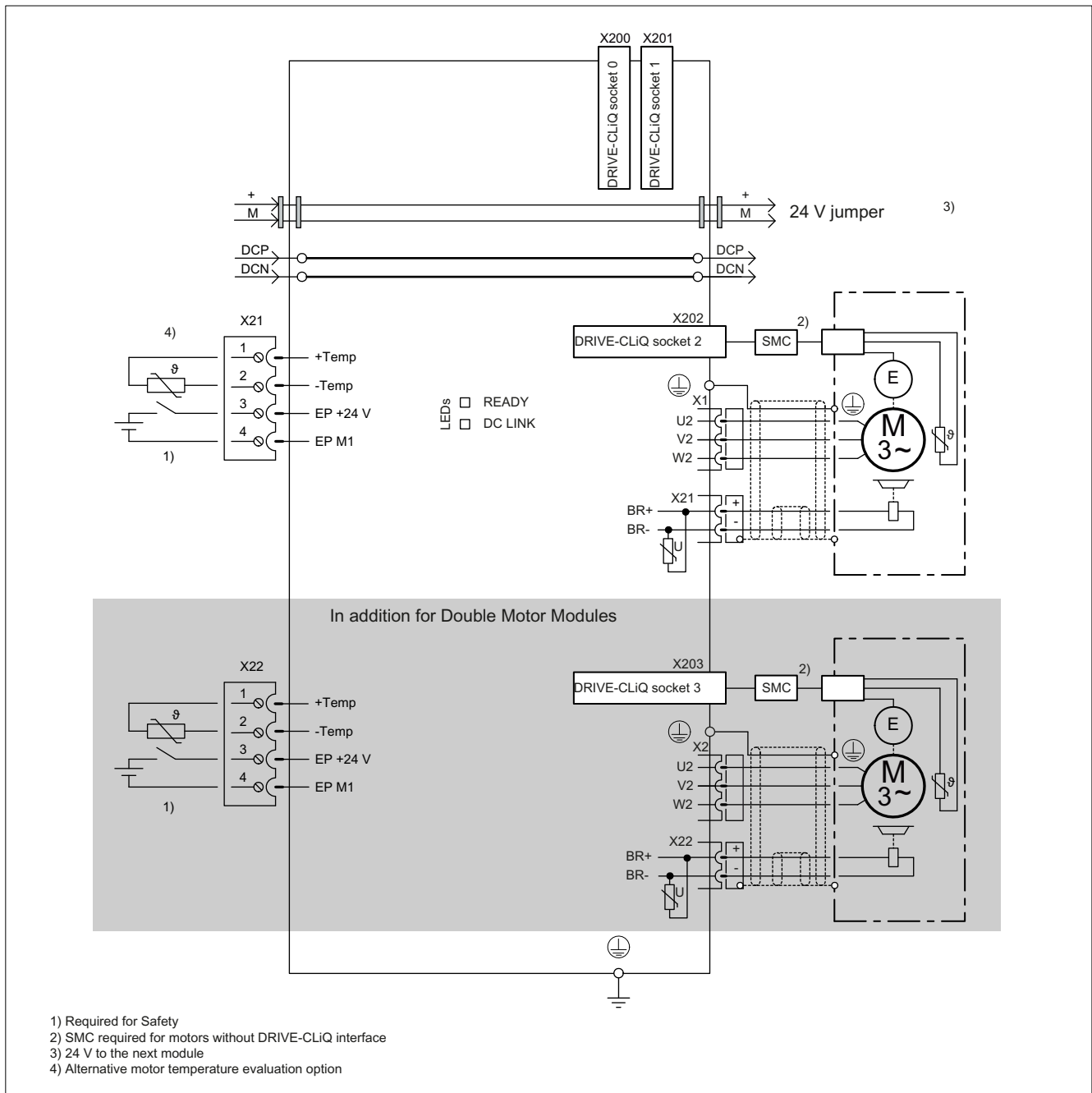
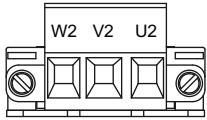
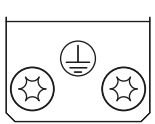
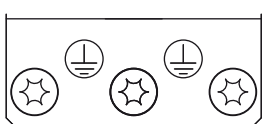


Figure 6-3 Connection example, Single Motor Modules Booksize Compact 3 A to 18 A and Double Motor Modules Booksize Compact 1.7 A to 5 A

### 6.3.3 X1 Motor connection

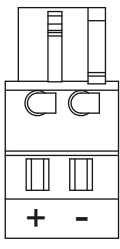
Table 6- 1 Terminal strip X1 Motor Module Booksize Compact

	Terminal	Technical specifications
	U2	Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 (see Chapter "Control cabinet installation and EMC / connection system") Tightening torque: 1.2 - 1.5 Nm
	V2	
	W2	
	PE connection	<b>Single Motor Module with a rated output current of 3 A to 18 A</b> Threaded hole M5/3 Nm <sup>1</sup>
		<b>Double Motor Module with a rated output current of 1.7 A to 5 A</b> Threaded hole M5/3 Nm <sup>1</sup>

1) For ring cable lugs in accordance with DIN 46234

### 6.3.4 X12 motor brake connection


Table 6- 2 Terminal strip X12 (brake connection)

	Terminals	Designation	Technical specifications
	BR+	Brake connection +	Voltage 24 V DC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm <sup>2</sup> Type: Spring-loaded terminal 1 (see Chapter "Control cabinet installation and EMC / connection system") Manufacturer: Wago; order number: 721-102/026-000/56-000 The brake connector is part of the scope of delivery
	BR-	Brake connection -	

The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally.

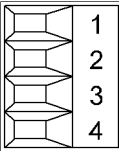
**Note**

The motor brake must be connected via connector X12 and X22 on Double Motor Modules. The BR- cable must not be connected directly to electronics ground (M).

 <b>WARNING</b>
Only protective extra-low voltages (DVC A) that comply with EN 60204-1 must be connected to all connections and terminals between 0 and 48 V DC.  The voltage tolerances of the motor holding brakes (24 V ± 10 %) must be taken into account.

### 6.3.5 X21/X22 EP terminals / temperature sensor Motor Module

Table 6-3 Terminal strip X21/X22

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors: KTY84–1C130 / PTC / bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V - 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (Enable Pulses)	
Max. connectable cross-section 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")			

#### NOTICE

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

#### NOTICE

The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

#### Note

The temperature sensor input is not needed if the motors feature an integrated DRIVE-CLiQ interface or if temperature values are detected by means of a different module (SMC, SME).

#### DANGER

##### Risk of electric shock!

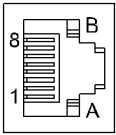
Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp".

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

6.3 Interface description

6.3.6 X200-X203 DRIVE-CLiQ interface

Table 6- 4 DRIVE-CLiQ interface X200-X202: Single Motor Module  
 DRIVE-CLiQ interface X200-X203: Double Motor Module

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



### 6.3.7 Meaning of the LEDs on the Motor Module Booksize Compact

Table 6- 5 LEDs on the Single Motor Module / Double Motor Module

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

 **DANGER**

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

### 6.4 Dimension drawings

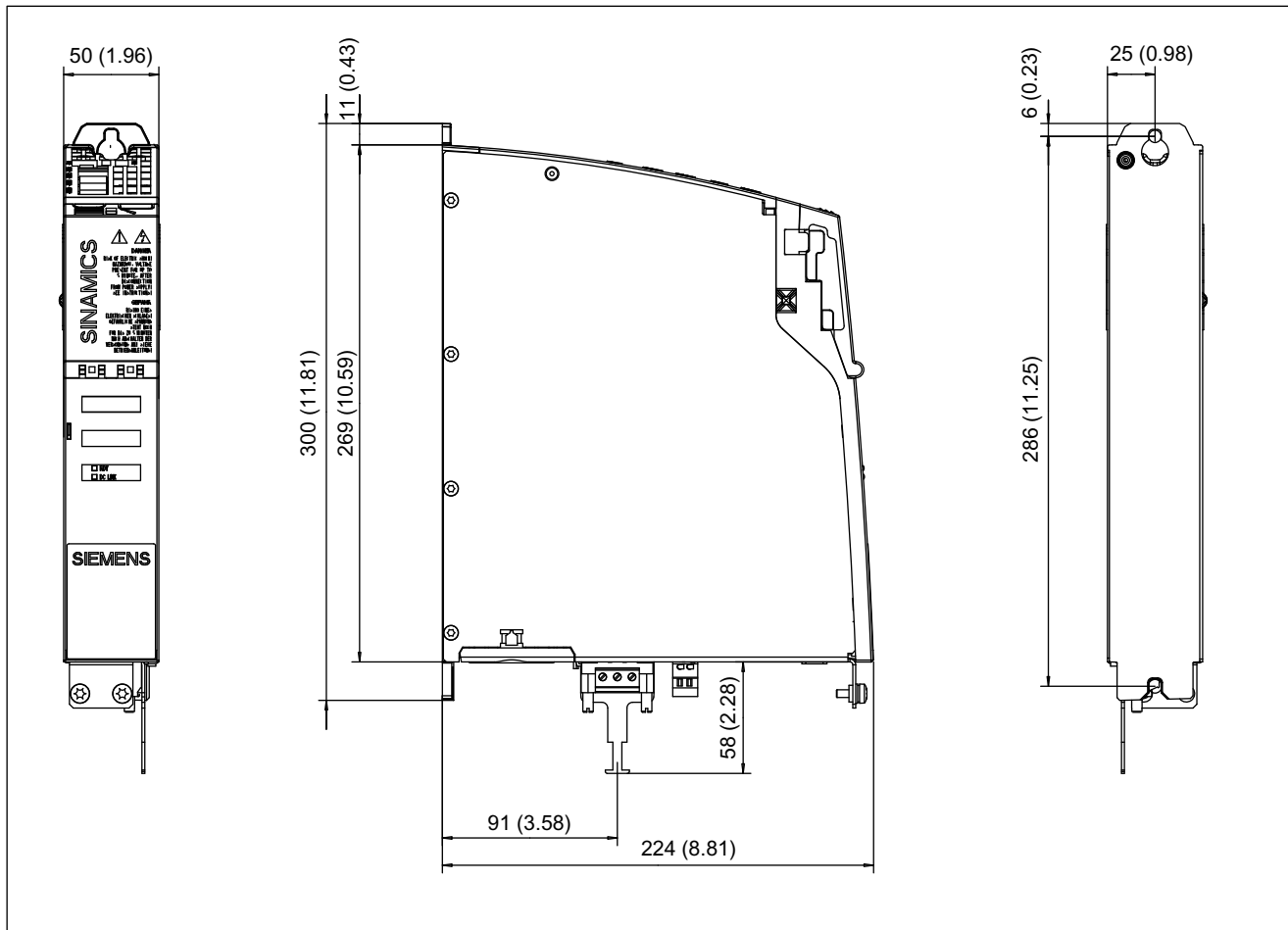


Figure 6-4 Dimension drawing of Motor Module in booksize compact format 3 A, 5 A, and 9 A, all dimensions in mm and (inches)

Table 6- 6 Motor Modules Booksize Compact 3 A, 5 A, and 9 A

Motor Module type	Order number
3 A	6SL3420-1TE13-0AAx
5 A	6SL3420-1TE15-0AAx
9 A	6SL3420-1TE21-0AAx

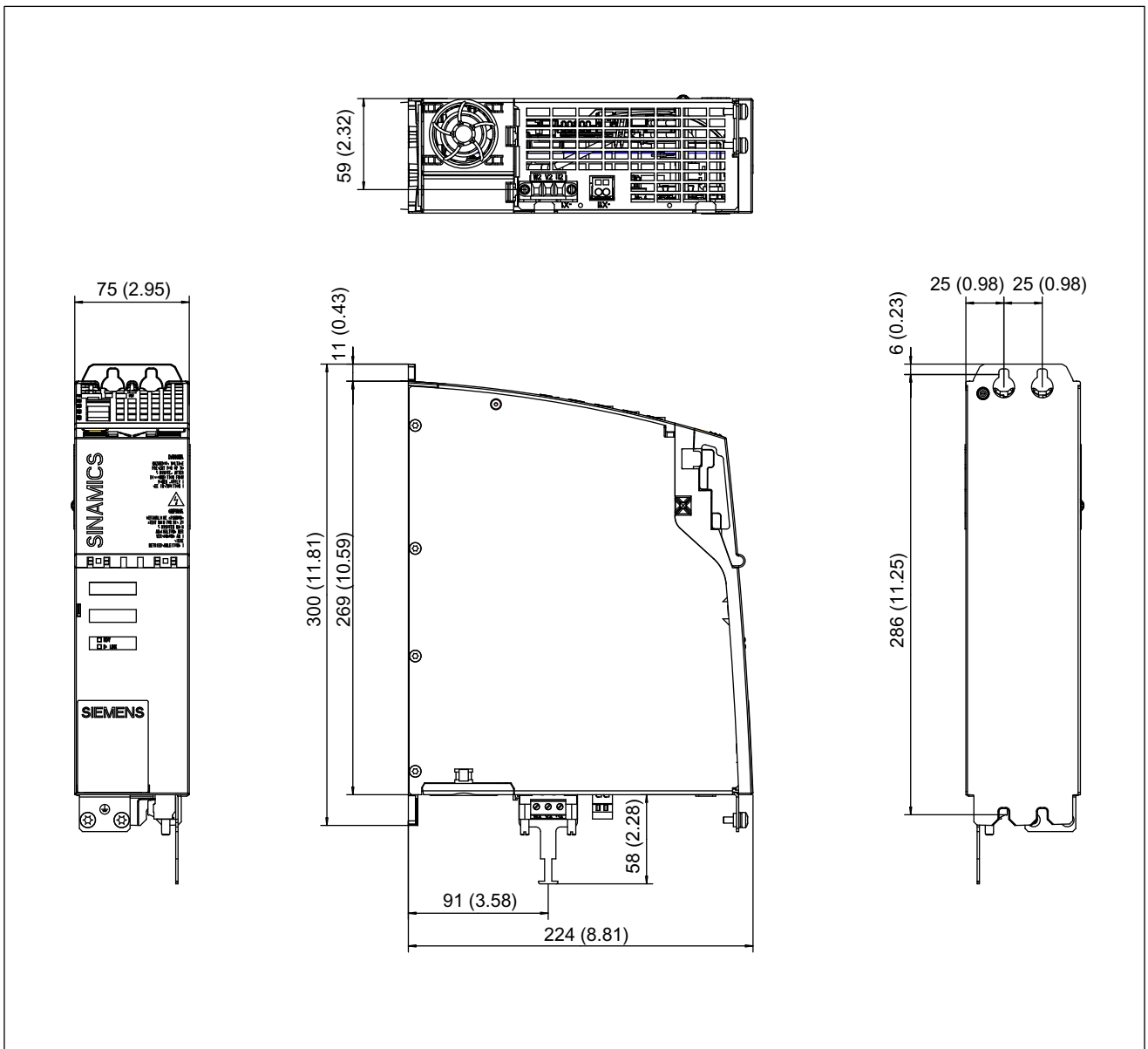


Figure 6-5 Dimension drawing of Motor Module in booksize compact format 18 A, all dimensions in mm and (inches)

Table 6-7 Motor Module Booksize Compact 18 A

Motor Module type	Order number
18 A	6SL3420-1TE21-8AAx

6.4 Dimension drawings

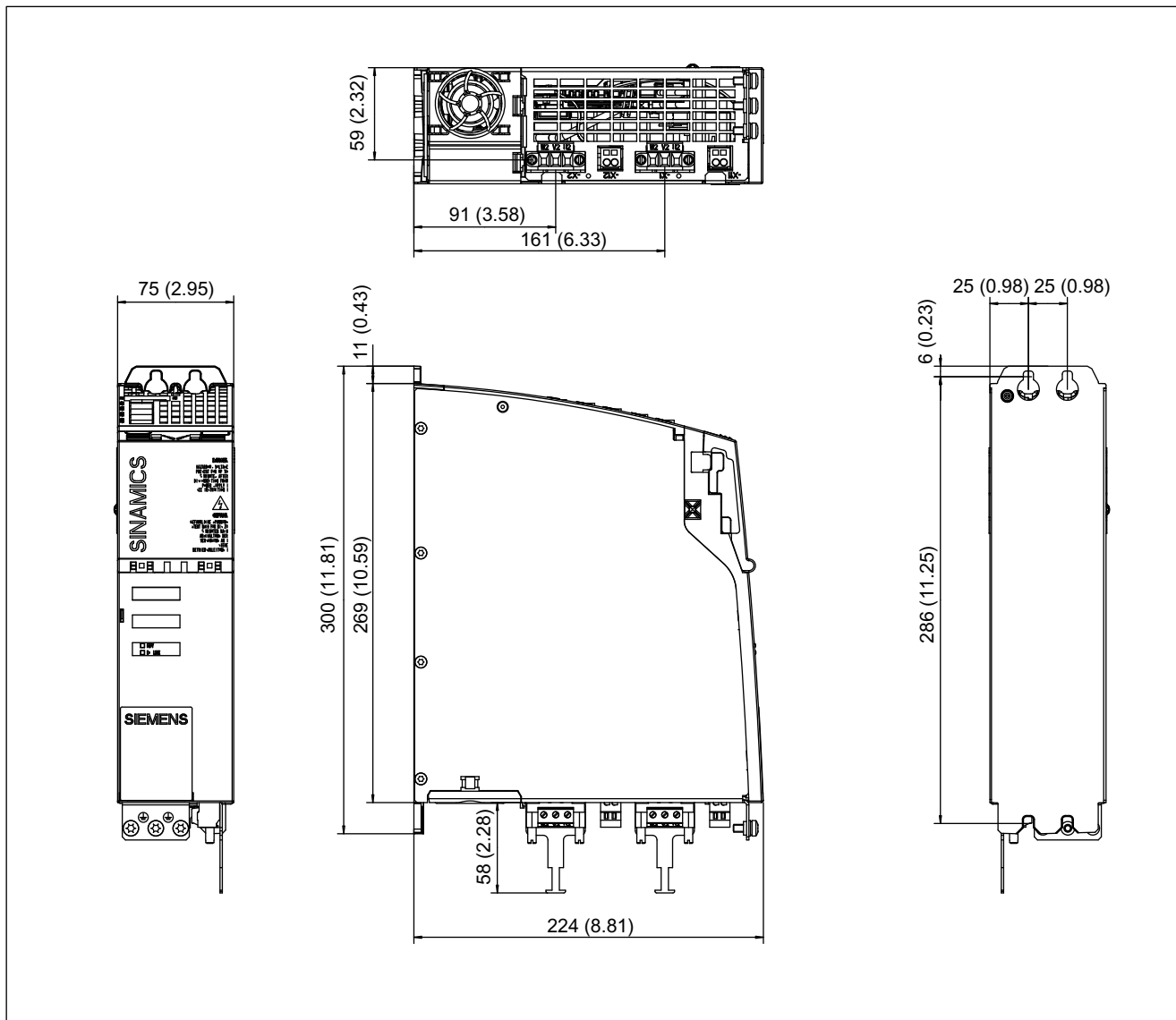


Figure 6-6 Dimension drawing of Double Motor Module in compact format 2 x 1.7 A, 2 x 3 A, and 2 x 5 A, all dimensions in mm and (inches)

Table 6-8 Double Motor Modules Booksize Compact 2 x 1.7 A, 2 x 3 A, and 2 x 5 A

Double Motor Module type	Order number
2 x 1.7 A	6SL3420-2TE11-0AAx
2 x 3 A	6SL3420-2TE13-0AAx
2 x 5 A	6SL3420-2TE15-0AAx

## 6.5 Installation

### Installing a Motor Module Booksize Compact

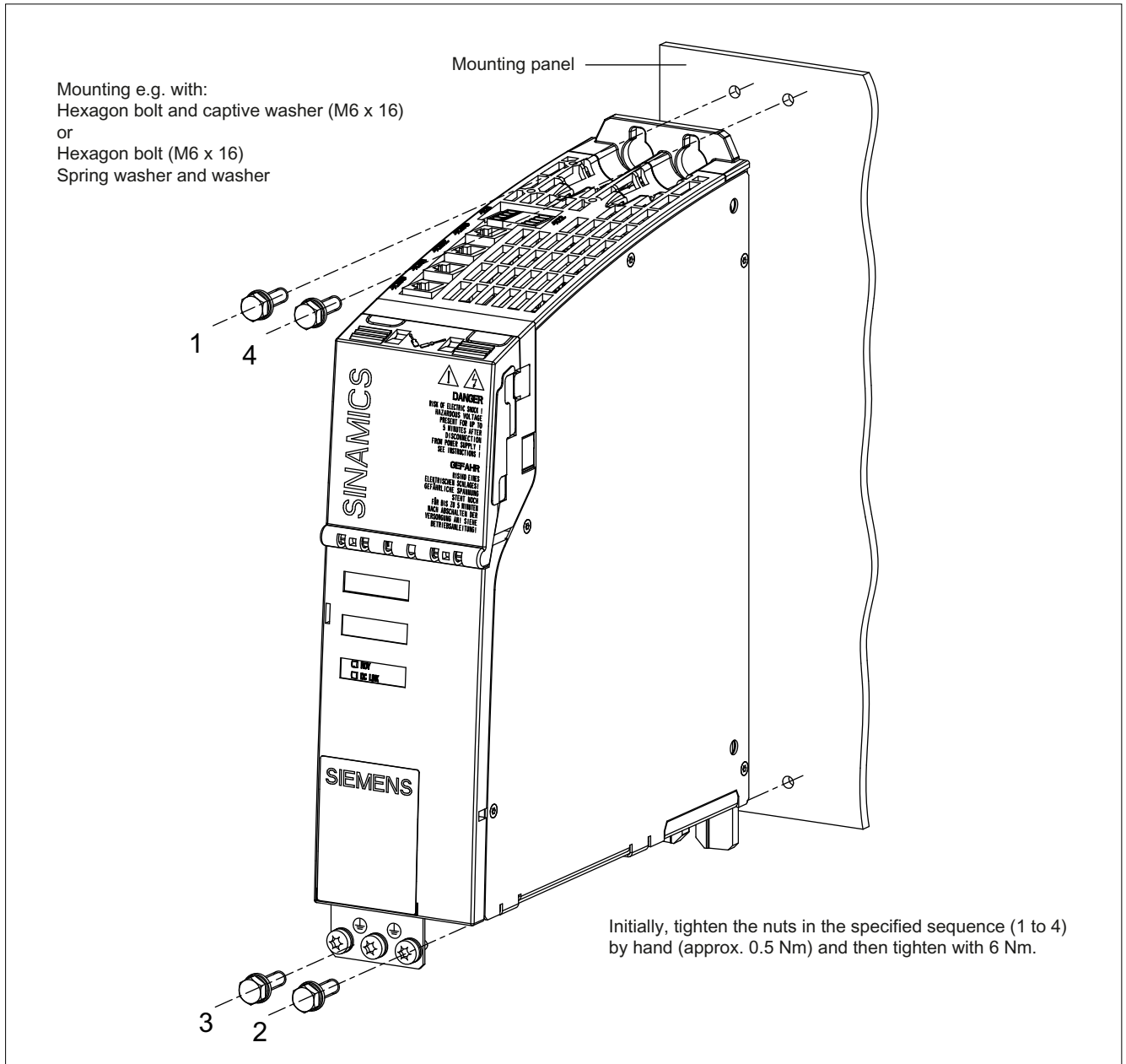


Figure 6-7 Installing a Motor Module Booksize Compact with internal air cooling

## 6.6 Technical data

Table 6- 9 Technical data Single Motor Modules Booksize Compact (3 A to 18 A)

Motor Modules Booksize Compact	6SL3420–	1TE13-0AAx	1TE15-0AAx	1TE21-0AAx	1TE21-8AAx
<b>Rated current</b>	<b>A</b>	<b>3</b>	<b>5</b>	<b>9</b>	<b>18</b>
<b>Voltage</b>					
<b>Infeed</b>					
DC link voltage	V <sub>DC</sub>	510 – 720			
Electronics power supply	V <sub>DC</sub>	24 (20.4 - 28.8)			
Output voltage	V <sub>ACrms</sub>	0 - 0.717 x DC link voltage			
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %			
Undervoltage trip <sup>1)</sup>	V <sub>DC</sub>	380 ± 2 %			
<b>Current</b>					
Electronics current consumption at 24 V DC	A <sub>DC</sub>	0.85	0.85	0.85	0.85
Rated output current (I <sub>n</sub> )	A <sub>ACrms</sub>	3	5	9	18
Base-load current (I <sub>base</sub> )	A	2.6	4.3	7.7	15.3
Intermittent duty current (I <sub>s6</sub> ) 40 %	A <sub>ACrms</sub>	3.5	6	10	24
Peak current (I <sub>max</sub> )	A <sub>ACrms</sub>	9	15	27	54
<b>Current carrying capacity</b>					
DC link busbar	A <sub>DC</sub>	100	100	100	100
Reinforced DC link busbars	A <sub>DC</sub>	150	150	150	150
24 V busbar	A <sub>DC</sub>	20	20	20	20
Max. current motor brake	A	2	2	2	2
<b>Power</b>					
Rated power (with DC link voltage of 600 V <sub>DC</sub> and pulse frequency of 4 kHz)	kW	1.6	2.7	4.8	9.7
<b>Total power loss</b> (including electronics losses) <sup>2)</sup>	W	68 at 8 kHz	98 at 8 kHz	100.4 at 4 kHz	185.4 at 4 kHz
<b>Max. pulse frequency</b>					
Without derating	kHz	8	8	4	4
With derating	kHz	16	16	16	16
<b>Max. ambient temperature</b>					
Without derating	°C	40			
With derating	°C	55			
<b>DC link capacitance</b>	µF	110	110	110	235
<b>Sound pressure level</b> with internal air cooling	dB(A)	<60	<60	<60	<60
<b>Cooling method</b>		Internal air cooling			
<b>Cooling air requirement</b>	m <sup>3</sup> /h	29.6	29.6	29.6	29.6
<b>Weight</b>	kg	2.7	2.7	2.7	3.4

1) Default for 400 V line supplies; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized line voltage.

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

Table 6- 10 Technical data Double Motor Modules Booksize Compact (2 x 1.7 A to 2 x 5 A)

Double Motor Modules Booksize Compact	6SL3420-	2TE11-0AAx	2TE13-0AAx	2TE15-0AAx
<b>Rated current</b>	<b>A</b>	<b>2 x 1.7</b>	<b>2 x 3</b>	<b>2 x 5</b>
<b>Voltage</b>				
<b>Infeed</b>				
DC link voltage	V <sub>DC</sub>	510 – 720		
Electronics power supply	V <sub>DC</sub>	24 (20.4 - 28.8)		
Output voltage	V <sub>ACrms</sub>	0 - 0.717 x DC link voltage		
Overvoltage trip	V <sub>DC</sub>	820 ± 2 %		
Undervoltage trip <sup>1)</sup>	V <sub>DC</sub>	380 ± 2 %		
<b>Current</b>				
Electronics current consumption at 24 V DC	A <sub>DC</sub>	1.15	1.15	1.15
Rated current (I <sub>n</sub> )	A	2 x 1.7	2 x 3	2 x 5
Base-load current (I <sub>base</sub> )	A	2 x 1.5	2 x 2.6	2 x 4.3
Intermittent duty current (I <sub>s6</sub> ) 40 %	A <sub>ACrms</sub>	2 x 2	2 x 3.5	2 x 6
Peak current (I <sub>max</sub> )	A <sub>ACrms</sub>	2 x 5.1	2 x 9	2 x 15
<b>Current carrying capacity</b>				
DC link busbar	A	100	100	100
Reinforced DC link busbars	A	150	150	150
24 V busbar	A	20	20	20
Max. current motor brake	A	2 x 2	2 x 2	2 x 2
<b>Power</b>				
Rated power (600 V, 8 kHz)	kW	2 x 1	2 x 1.6	2 x 2.7
<b>Total power loss</b> (including electronics losses) <sup>2)</sup> at 8 kHz	W	114	134	194
<b>Max. pulse frequency</b>				
Without derating	kHz	8	8	8
With derating	kHz	16	16	16
<b>Max. ambient temperature</b>				
Without derating	°C	40		
With derating	°C	55		
<b>DC link capacitance</b>	µF	165	165	165
<b>Sound pressure level</b>	dBA	<60	<60	<60
<b>Cooling method</b>		Internal air cooling using an integrated fan		
<b>Cooling air requirement</b>	m <sup>3</sup> /h	29.6	29.6	29.6
<b>Weight</b>	kg	3.4	3.4	3.4

1) Default for 400 V line supplies; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized line voltage.

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

### 6.6.1 Characteristics

#### Rated duty cycles Motor Modules Booksize Compact

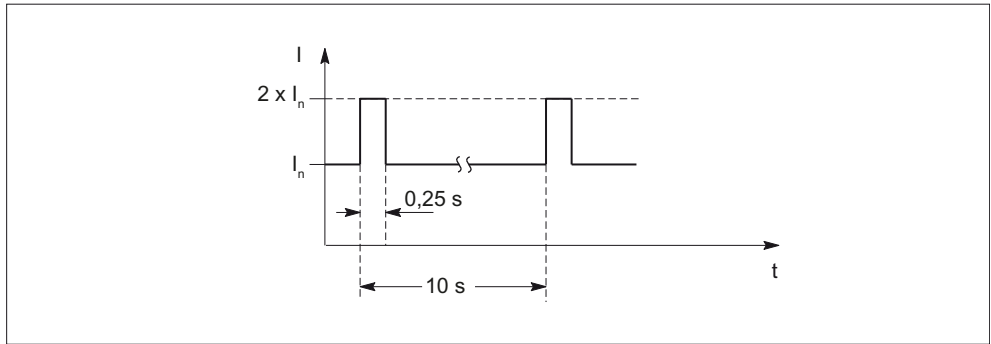


Figure 6-8 Duty cycle with initial load

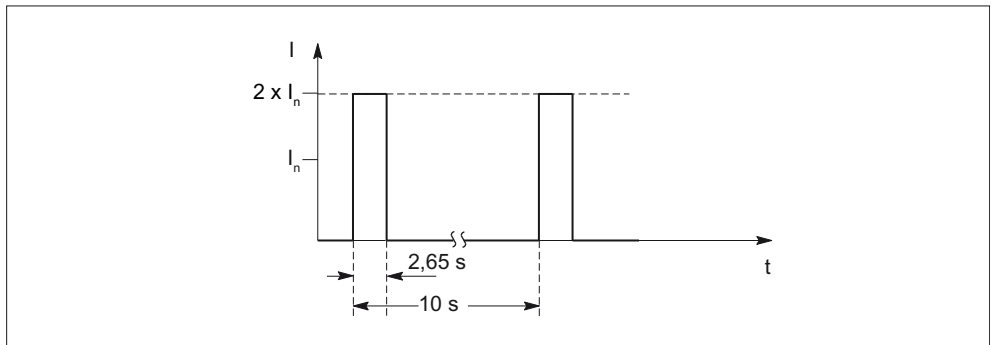


Figure 6-9 Duty cycle without initial load

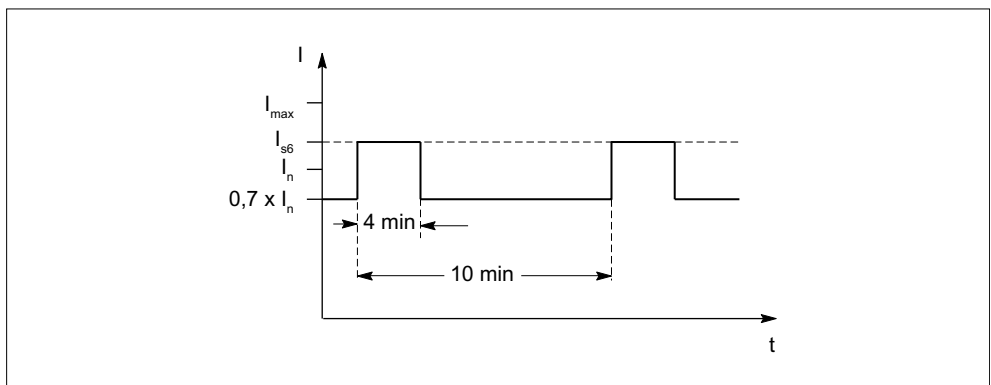


Figure 6-10 S6 duty cycle with initial load with a duty cycle duration of 600 s



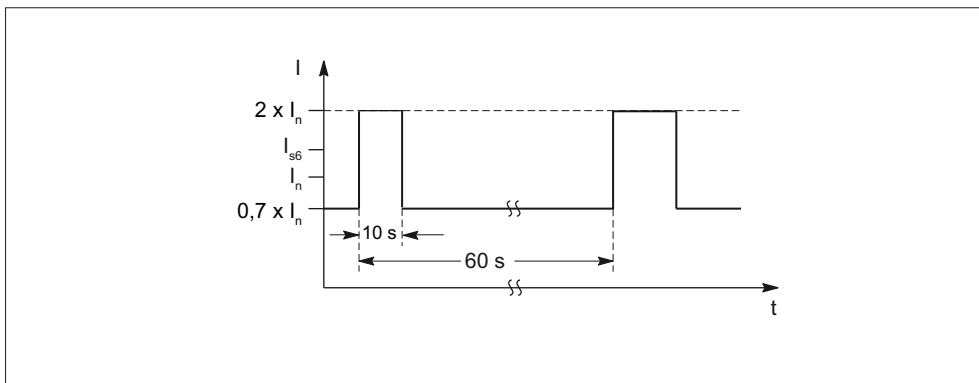


Figure 6-11 S6 duty cycle with initial load with a duty cycle duration of 60 s

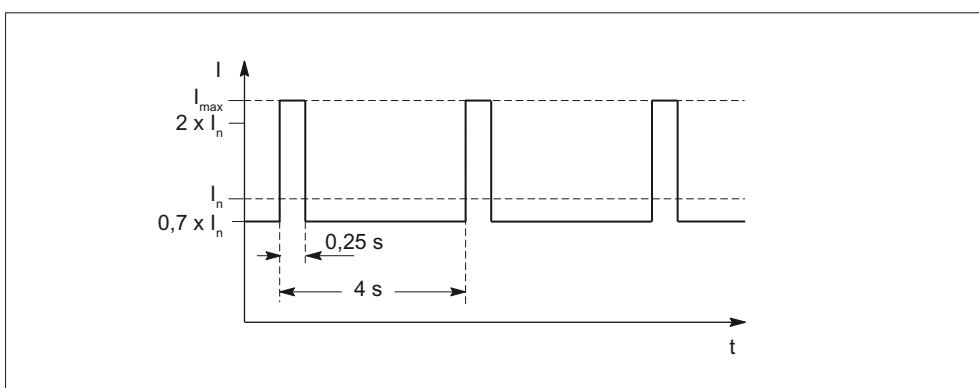


Figure 6-12 Peak current duty cycle with initial load

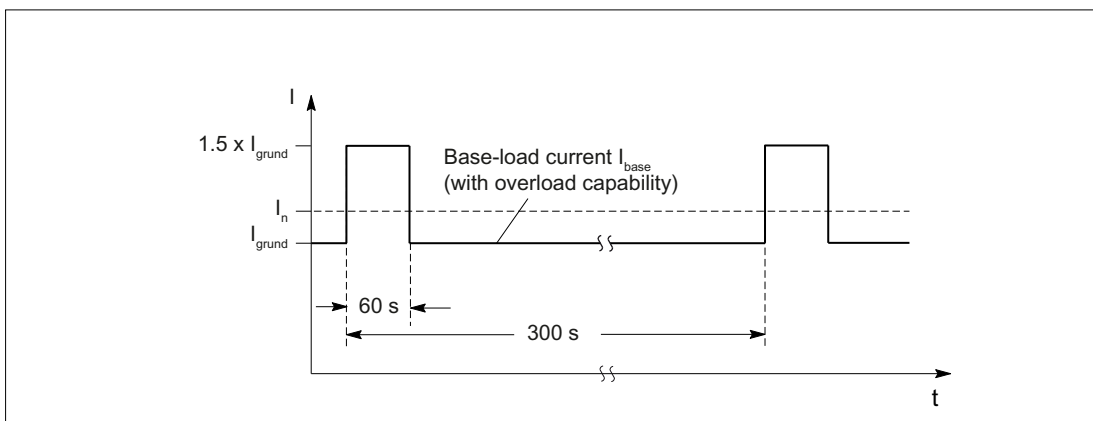


Figure 6-13 Duty cycle with 60 s overload with a duty cycle duration of 300 s

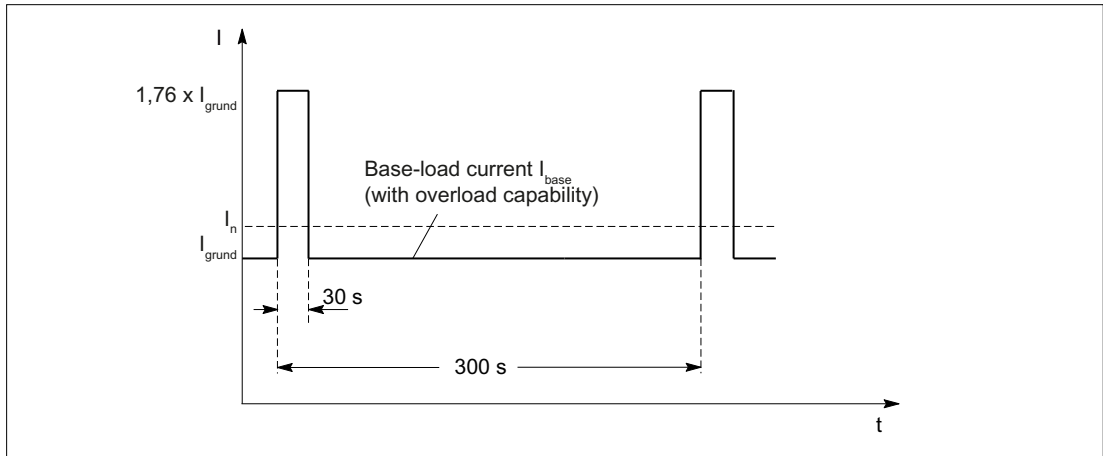


Figure 6-14 Duty cycle with 30 s overload with a duty cycle duration of 300 s

### Derating characteristics for Motor Modules Booksize Compact

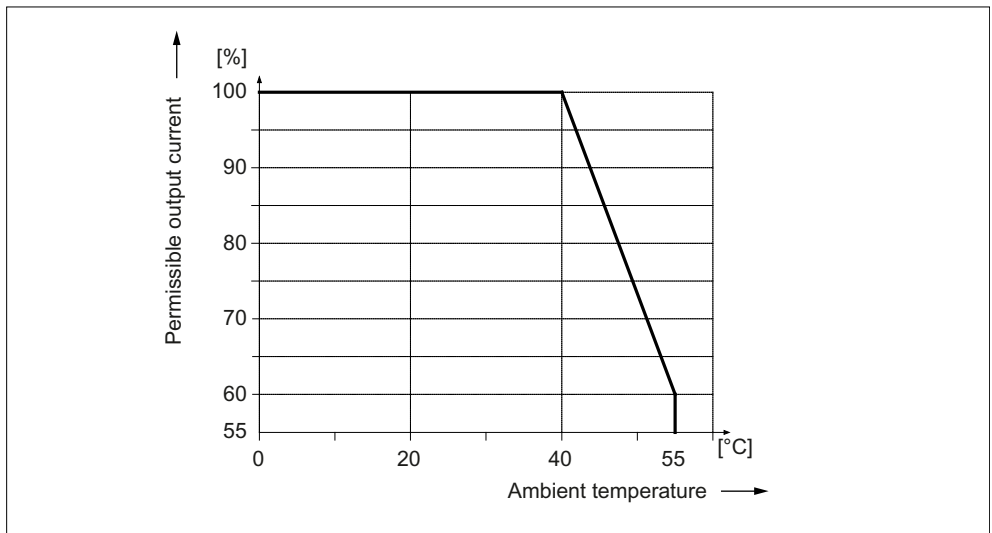


Figure 6-15 Output current as a function of the ambient temperature

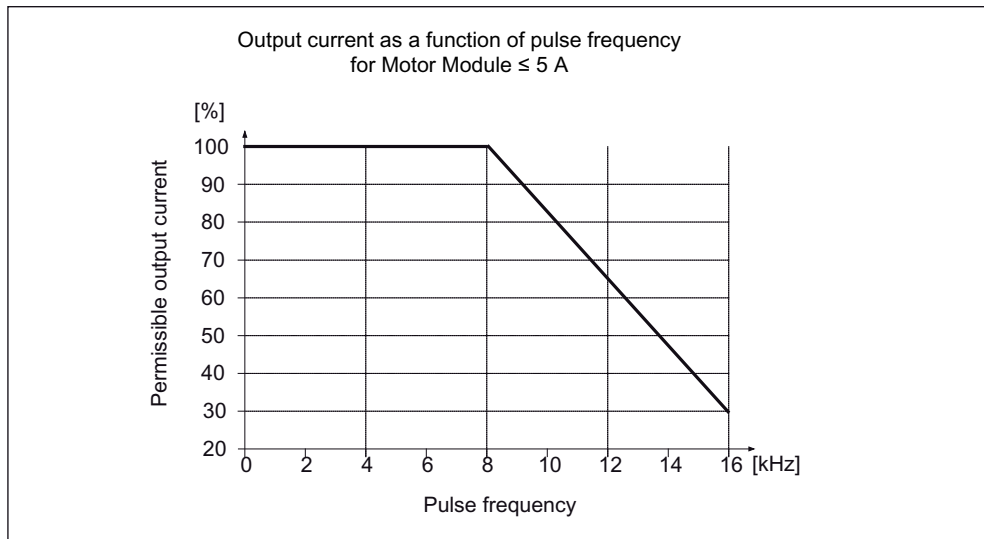


Figure 6-16 Output current as a function of the pulse frequency for the Motor Module  $\leq 5$  A

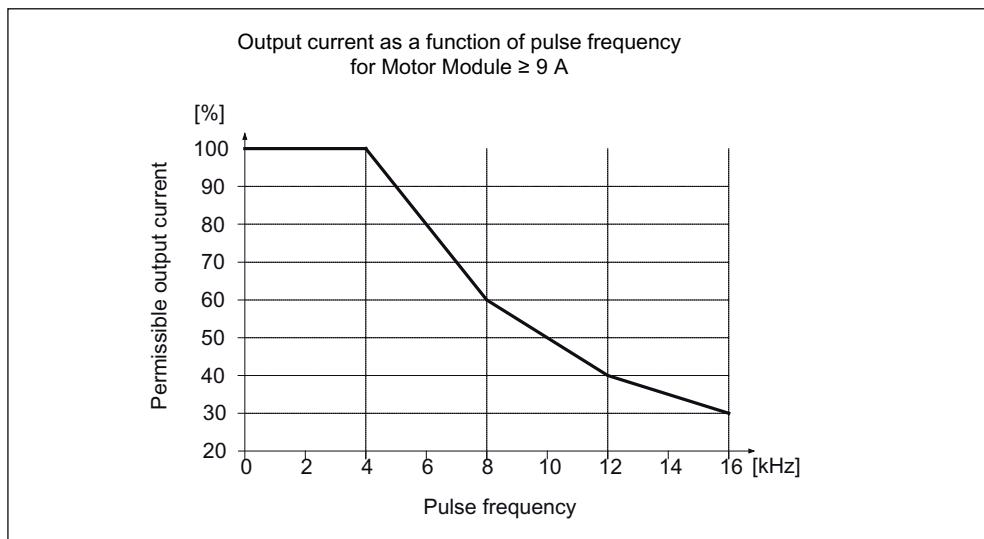


Figure 6-17 Output current as a function of the pulse frequency for the Motor Module  $\geq 9$  A

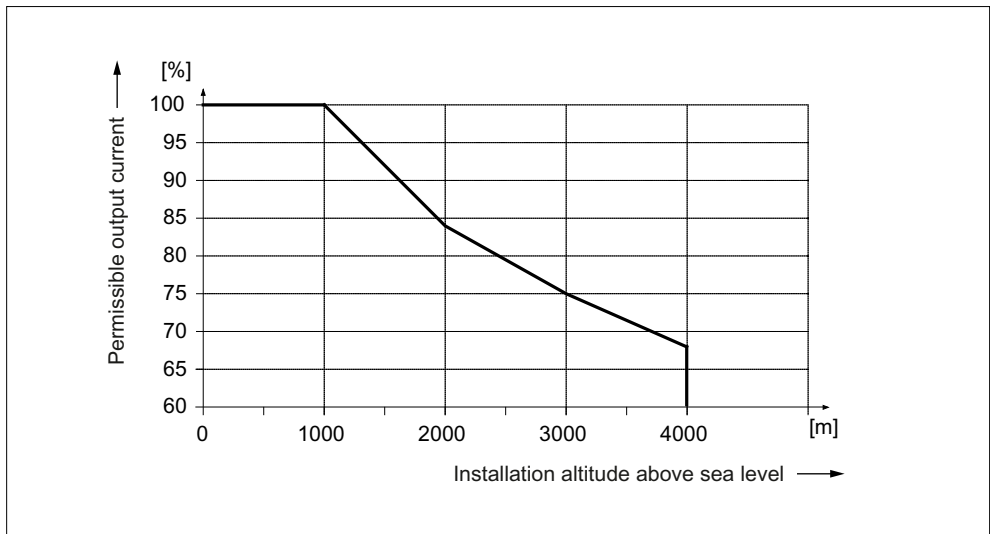


Figure 6-18 Output current as a function of the installation altitude

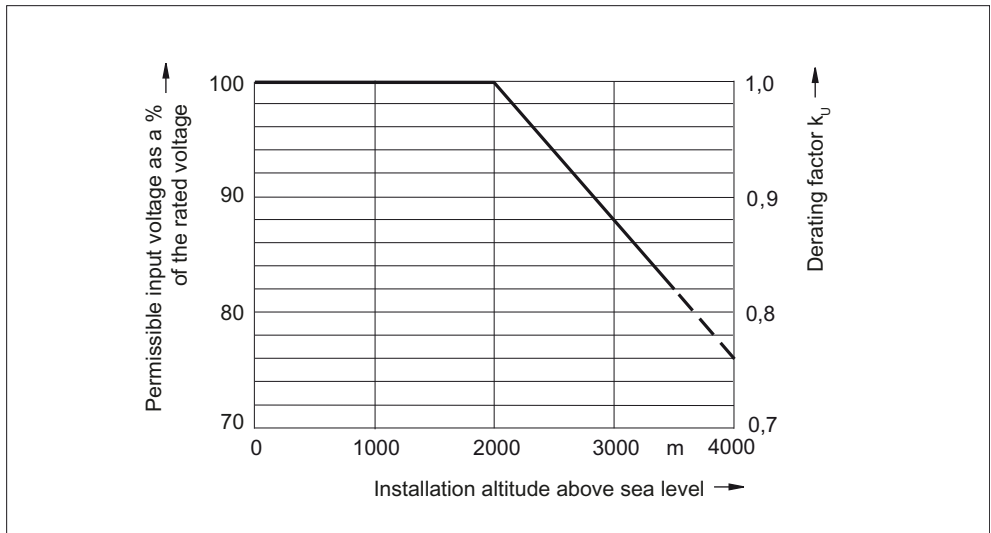


Figure 6-19 Voltage derating as a function of the installation altitude

## DC link components

### 7.1 Braking Module

#### 7.1.1 Description

A Braking Module with an external braking resistor is required in order to

- be able to stop the S120 Combi and expansion axes in a controlled fashion when the power fails (e.g. emergency retraction or EMERGENCY OFF Category 1).
- limit the DC link voltage for brief generator operation, if e.g. the energy recovery function is deactivated or is not adequately dimensioned.

The Braking Module includes the necessary power electronics and control. The Braking Module is operational, the regenerative energy is dissipated as thermal energy in an external braking resistor.

Furthermore, the Braking Module can also be used with a braking resistor to quickly discharge the DC link. The DC link is discharged in a controlled manner via the braking resistor once the infeed has been switched off and the line-up has been disconnected from the line supply (e.g. using a main switch, line contactor). The function can be activated via a digital input on the braking module.

---

#### Note

Only the components that are connected to each other via the DC link busbar can be included in the total capacitance.

---


#### Note


The fast discharge function is used for discharging the capacitors in the DC link after interruption of the line supply. This makes sense, for example, when maintenance tasks are to be performed on the S120 Combi and/or motor installation (reduction of the discharge time). For this purpose, the drive system must be completely disconnected from the line supply and the motors must be in standstill position.

---

The cable between the braking module and the braking resistor is limited to 10 m.


### 7.1.2 Safety information

 <b>DANGER</b>
<b>Risk of electric shock</b> A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off. It is only permissible to open the protective cover after this time has expired. A suitable tool (e.g. screwdriver or the unlocking tool supplied) must be used to open the protective cover of the DC link. The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be used further, otherwise this could result in secondary damage or accidents.

 <b>DANGER</b>
A DC-link discharge voltage danger notice in the relevant national language must be attached to all of the components. A set of labels in 16 languages is supplied with the component. With a connected braking resistor, the Braking Module is ground-fault proof.

<b>CAUTION</b>
The connection to the braking resistors must be made using a shielded cable. The tightening torque of the DC link busbar screws (1.8 Nm, tolerance +30 %) must be checked before commissioning. After transportation, the screws must be tightened.

<b>CAUTION</b>
The DC link lateral covers are supplied as standard with the components; they can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

 <b>WARNING</b>
The cooling clearances of 80 mm above and below the components must be observed.

---

#### Note

If braking resistors other than 6SN1113-1AA00-0DA0 and 6SL3100-01BE31-0AAx as described in Chapter "Braking resistors for Braking Modules", are used then these could be destroyed.

---

## 7.1.3 Interface description

### 7.1.3.1 Overview

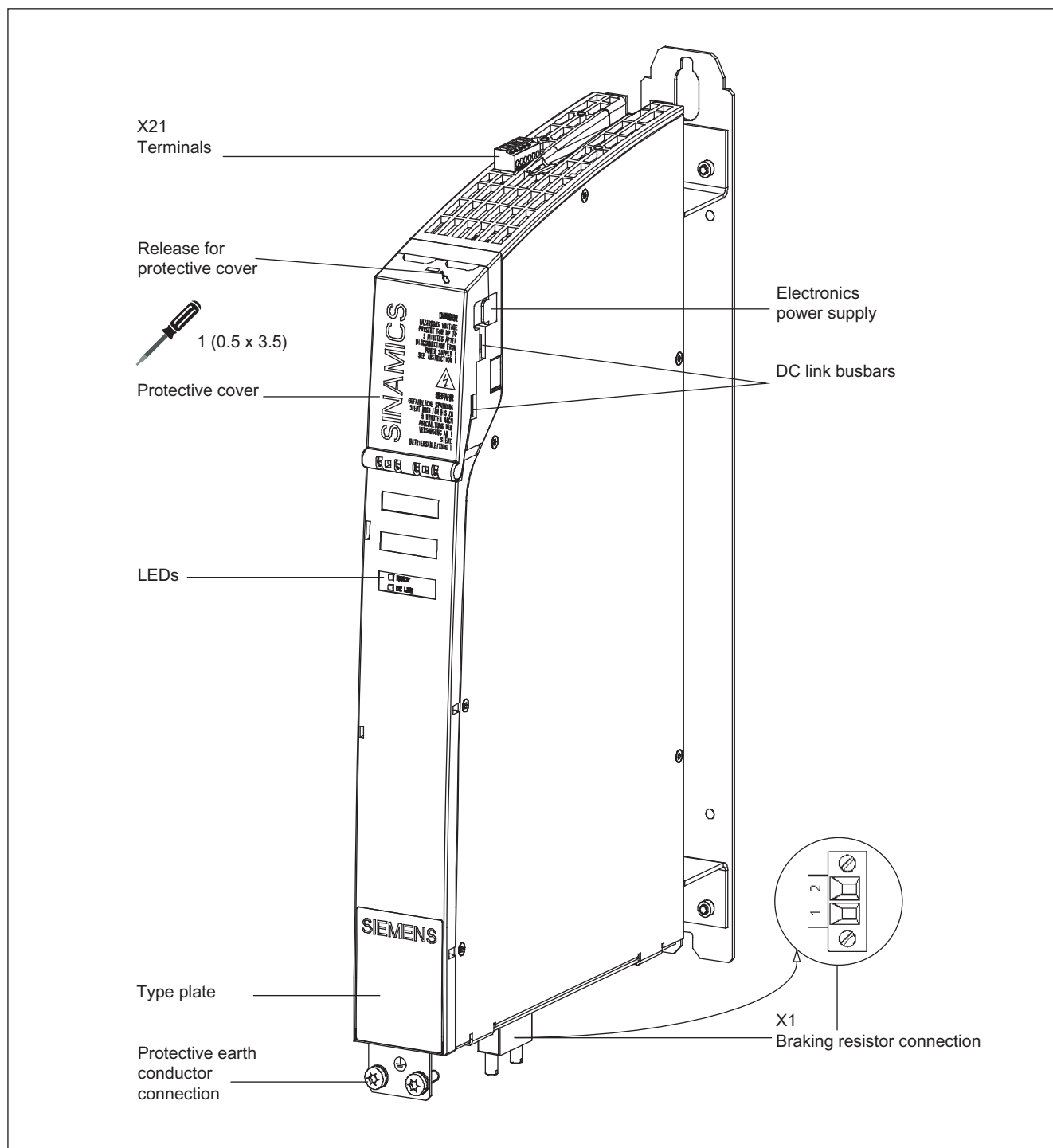


Figure 7-1 Interface description of Braking Module

7.1.3.2 Connection example

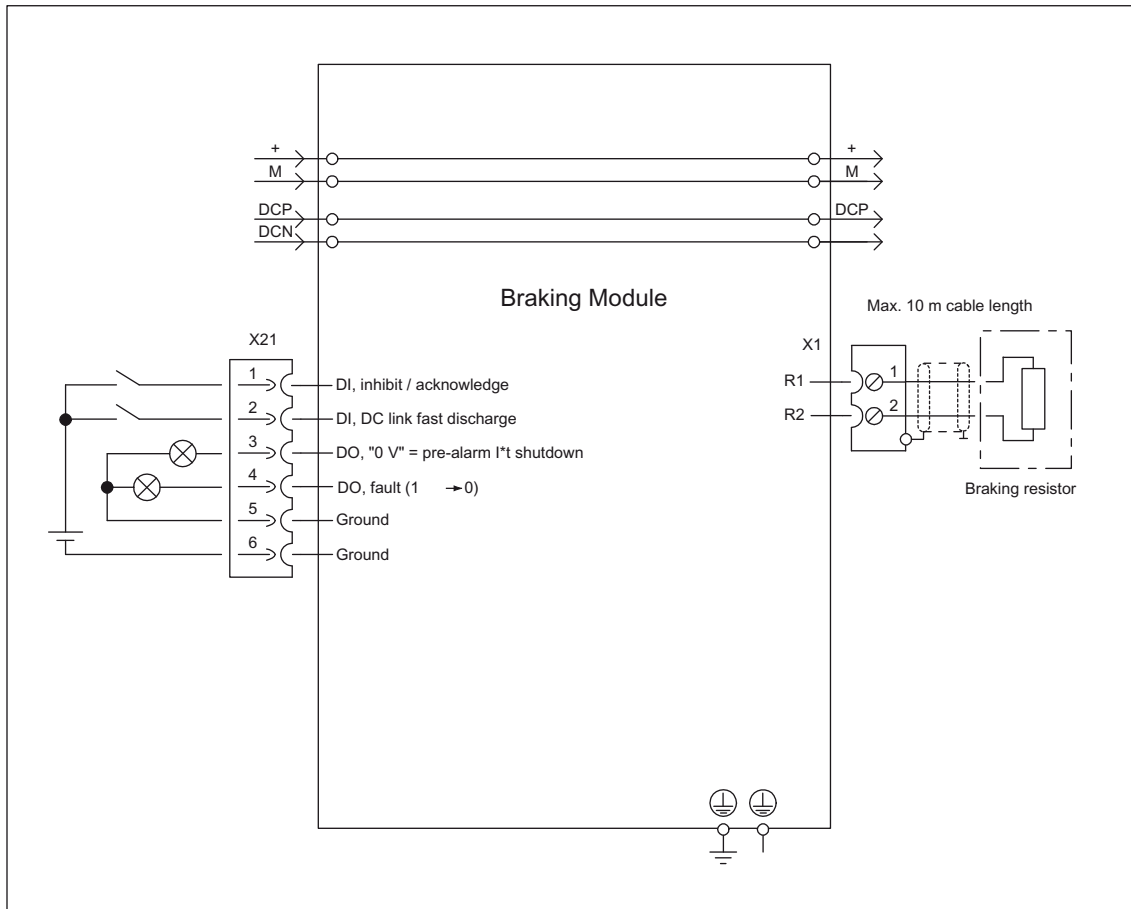
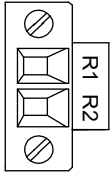


Figure 7-2 Example connection of Braking Module

7.1.3.3 X1 braking resistor connection

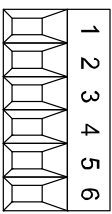
Table 7- 1 Terminal strip X1

	Terminal	Designation	Technical specifications
	1	Braking resistor connection R1	Continued-short-circuit-proof
	2	Braking resistor connection R2	
Max. connectable cross-section: 4 mm <sup>2</sup> Type: Screw terminal 4 (see Chapter "Control cabinet installation and EMC / connection system")			




## 7.1.3.4 X21 digital inputs/outputs

Table 7- 2 Terminal strip X21

	Terminal	Designation <sup>1)</sup>	Technical specifications
	1	DI low: enable Braking Module DI high: inhibit / acknowledge Edge change high -> low: fault acknowledgement	Voltage: -3 V to 30 V Typical current consumption: 10 mA at 24 V DC Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V
	2	DI low: braking resistor not activated manually DI high: braking resistor activated manually (fast discharge) <sup>2)</sup> Safety functions remain active, I <sup>*t</sup> protection remains active  If X21.1 and 2 are activated simultaneously, the Braking Module inhibit has priority.	
	3	DO high: no pre-warning for I <sup>*t</sup> shutdown DO low: Advance warning for I <sup>*t</sup> shutdown (80 % of max. ON time reached)	Max. load current per output: 100 mA Continued-short-circuit-proof Voltage: 24 V DC
	4	DO high: ready for operation, no fault DO low: Fault (1→0)	
	5	Ground	
	6		
Max. connectable cross-section 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")			

1) DI: digital input; DO: digital output; M: Electronics ground

2) The fast discharge function is used for discharging the capacitors in the DC link after interruption of the line supply and may be used a maximum of 1-2 times per week.

 <b>DANGER</b>
<p>Prior to performing maintenance task at the drive system, the following tasks must be performed:</p> <ol style="list-style-type: none"> <li>1. Disconnect the system.</li> <li>2. Protect against reconnection.</li> <li>3. Make sure that the equipment is de-energized.</li> <li>4. Ground and short-circuit.</li> <li>5. Cover or enclose adjacent components that are still live</li> </ol> <p>These tasks must be performed in the above mentioned order prior to maintenance. After maintenance proceed in the reverse order.</p>

**Note**

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

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

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

### 7.1.3.5 Meaning of the LEDs on the Braking Module

Table 7- 3 Meaning of the LEDs on the Braking Module

LED	Color	Status	Description
READY	-	Off	Electronics power supply outside the permissible tolerance range.
	Green	Continuous light	The component is ready for operation.
	Red	Continuous light	<ul style="list-style-type: none"> <li>• Braking Module inhibited via DI X21.1</li> <li>• Braking Module shutdown</li> </ul> Possible reasons: <ul style="list-style-type: none"> <li>- Overcurrent</li> <li>- Overtemperature heat sink</li> <li>- Braking resistor overload (I*t shutdown)</li> </ul>
DC LINK	-	Off	Braking resistor switched off (DC link discharge not active)
	Green	Flashing	Braking resistor switched on (DC link discharge active)

**Note**

To protect the braking resistor, the current fault cannot be acknowledged until after a waiting period of approx. 3 min after an I\*t shutdown of the braking module.

### 7.1.4 Dimension drawing

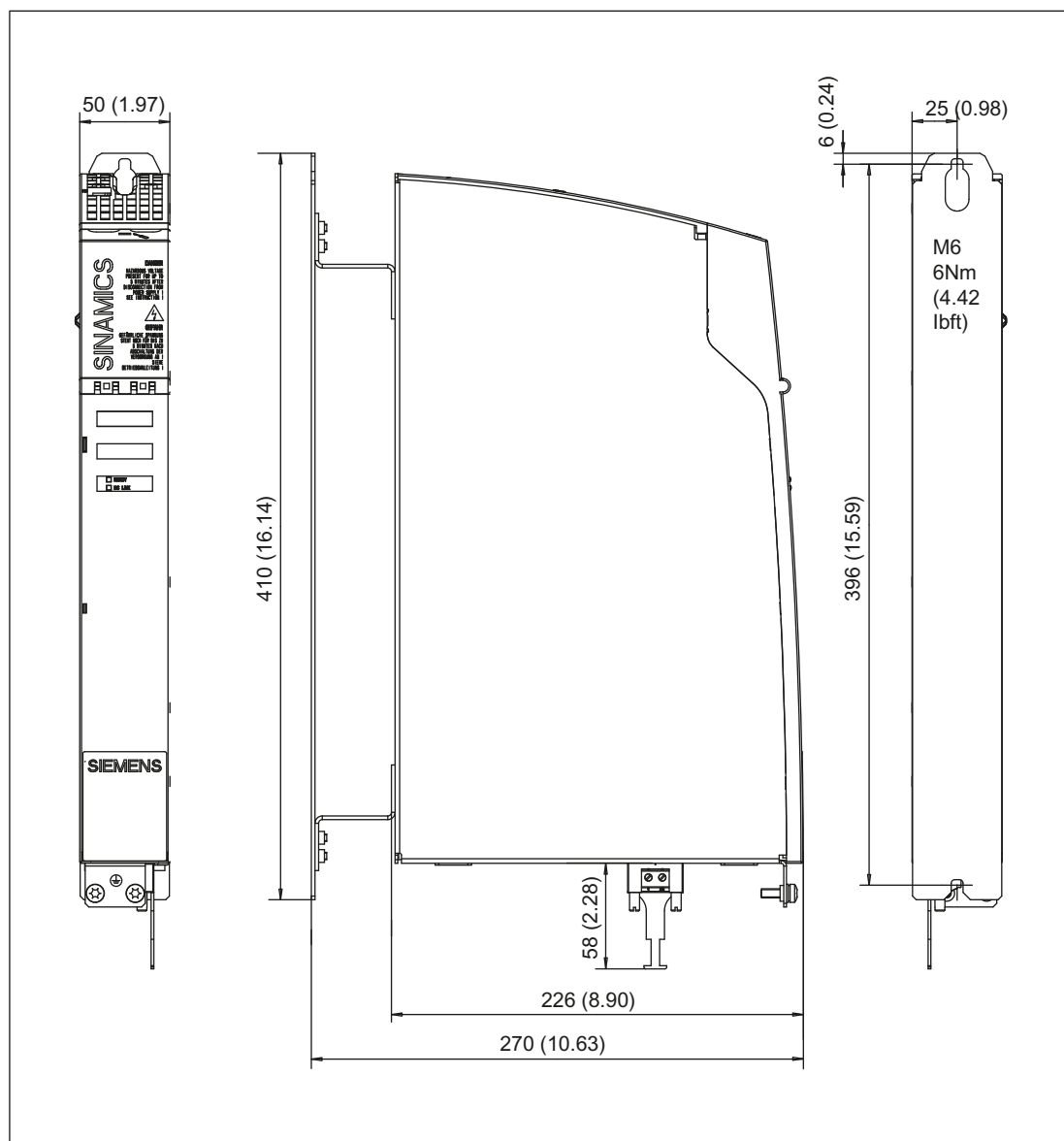


Figure 7-3 Dimension drawing of Braking Module, all dimensions in mm and (inches)

### 7.1.5 Installation

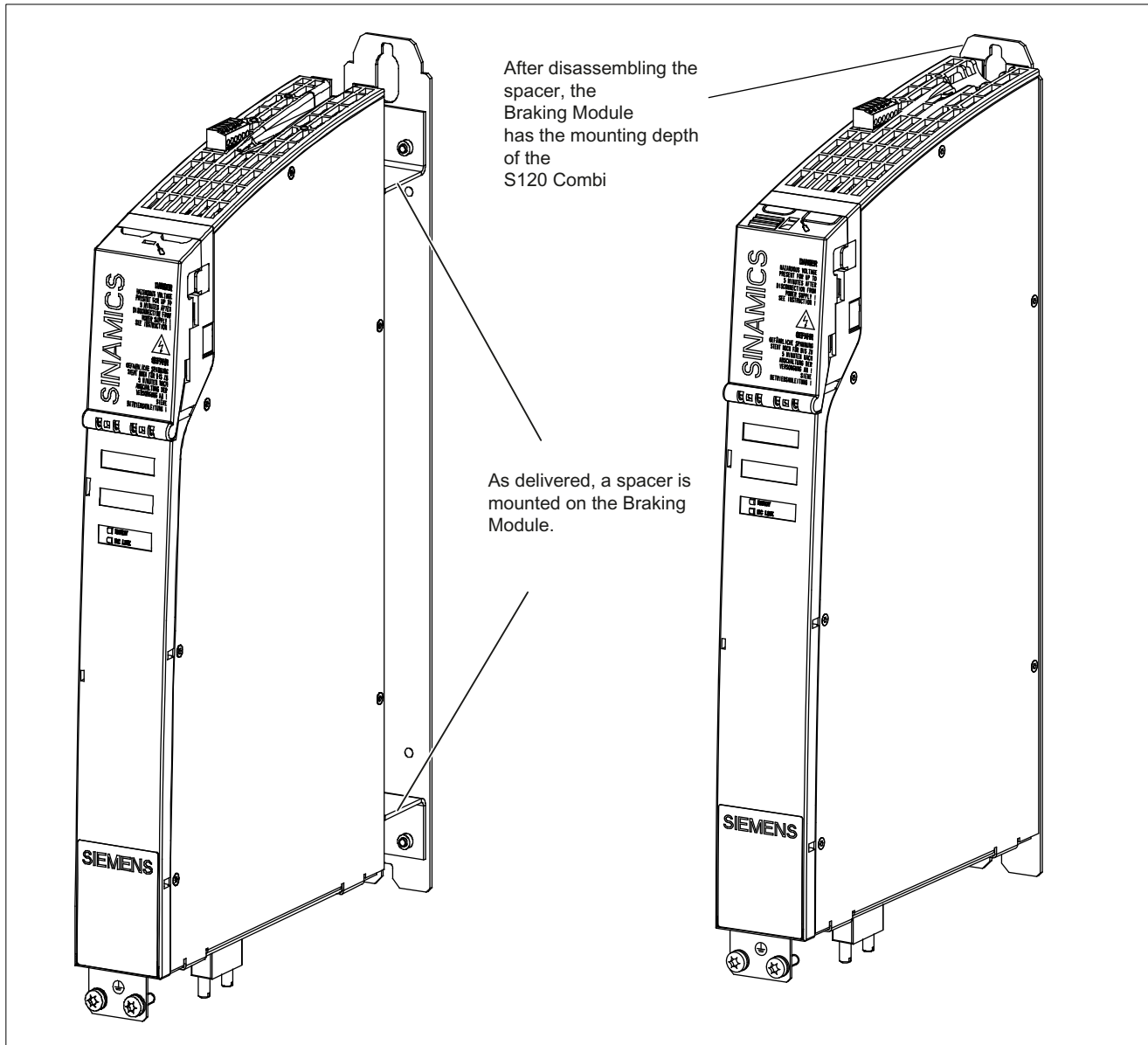


Figure 7-4 Methods of installing Braking Modules with/without spacer elements

## 7.1.6 Technical data

Table 7- 4 Technical data

Braking Module Booksize		
Voltages		
Infeed:		
DC link voltage	V <sub>DC</sub>	510 - 720
ON threshold	V	770
Electronics power supply	V <sub>DC</sub>	24 (20.4 – 28.8)
Electronics current consumption (at 24 V DC)	A <sub>DC</sub>	0.5
Current carrying capacity DC link busbar	A <sub>DC</sub>	100
Current carrying capacity 24 V busbar	A <sub>DC</sub>	20
Max. braking power	kW	100
Continuous braking power	kW	1.5
Power loss <sup>1</sup>	W	20
Cooling method		Natural convection
Weight	kg	4.1

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

## 7.1.7 Braking resistors for Braking Modules

### 7.1.7.1 Installation of the braking resistors

Ideally, external braking resistors should be installed outside of the control cabinet to prevent the heat lost by the resistors from subjecting the cabinet to thermal stress.

The resistor may be installed inside the control cabinet either standing on the cabinet floor or suspended (horizontally or vertically) from the cabinet wall. You must ensure that the braking resistors do not obstruct the flow of cooling air to the drive line-up.

#### CAUTION

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

**Note**

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

**Connection cables**

A shielded connection cable (3 m long; 3 x 1.5 mm<sup>2</sup>) is supplied with braking resistor 6SN1113-1AA00-0DA0.

Braking resistor 6SL3100-1BE31-0AA0 is supplied without a connection cable (4 mm<sup>2</sup>).

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

**7.1.7.2 Dimension drawings**

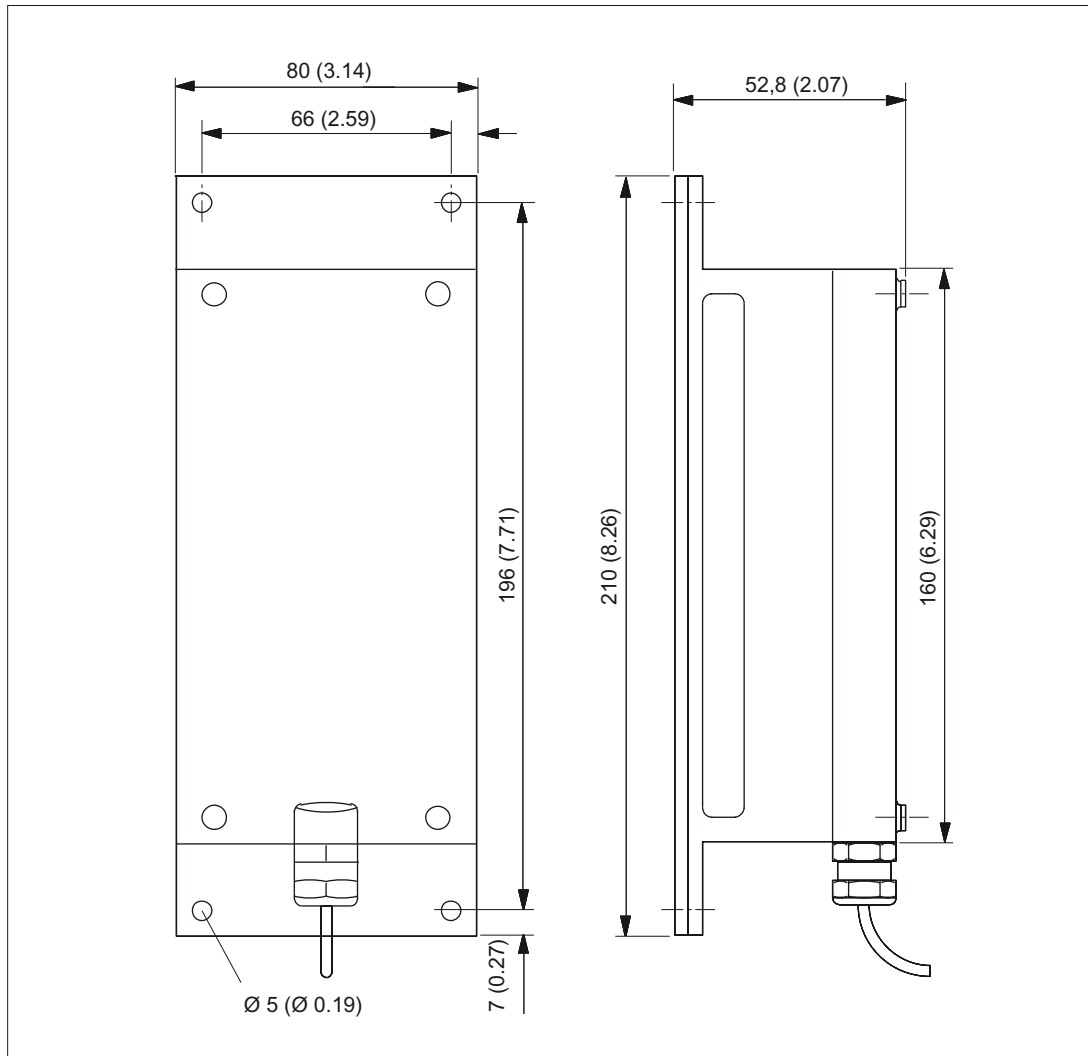


Figure 7-5 Dimension drawing of braking resistor 0.3 kW / 25 kW, all dimensions in mm and (inches)

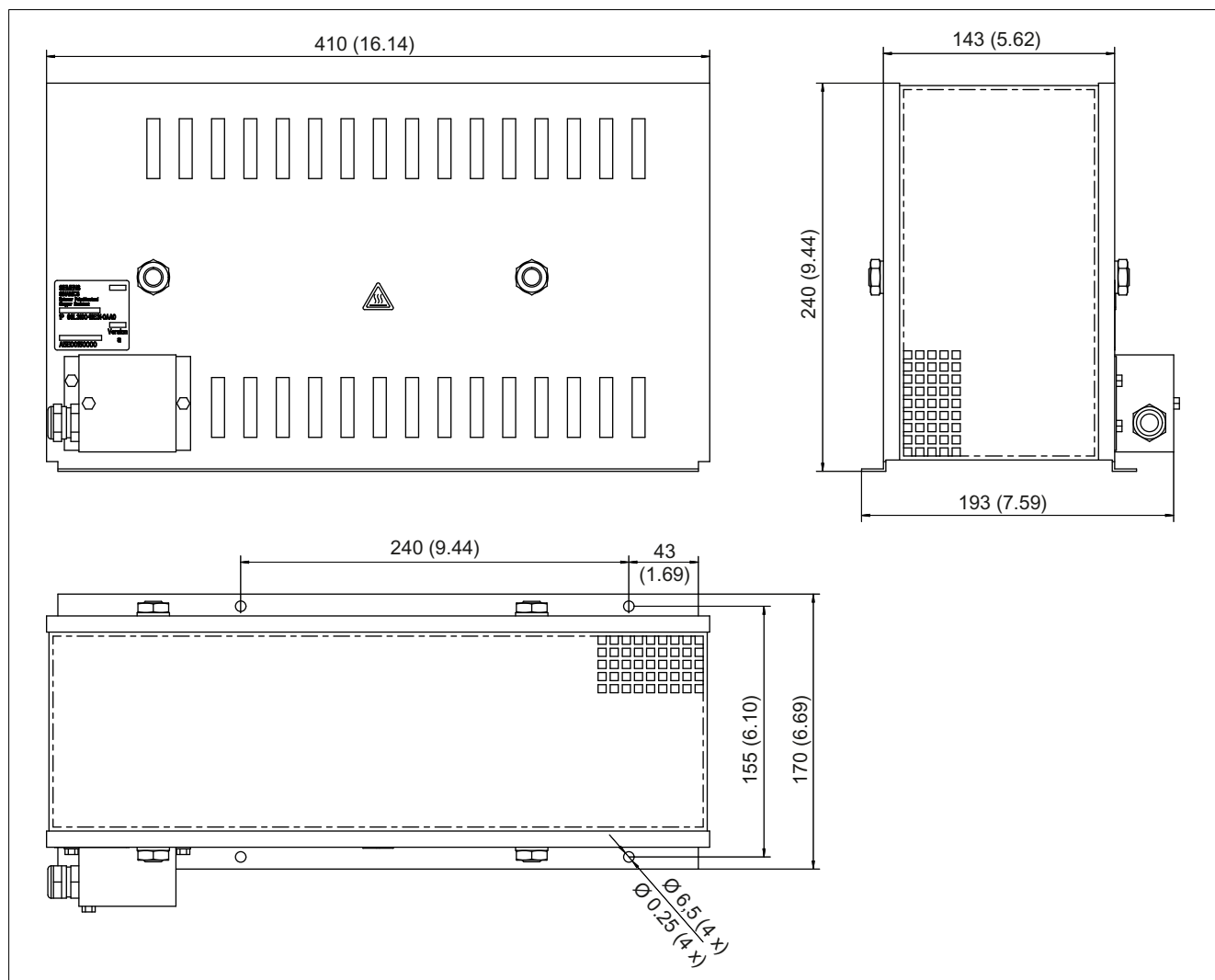


Figure 7-6 Dimension drawing of braking resistor 1.5 kW / 100 kW, all dimensions in mm and (inches)

7.1.7.3 Technical data

Table 7- 5 Technical data

	Unit	Braking resistor 6SN1113-1AA00-0DA0	Braking resistor 6SL3100-1BE31-0AAx
Rated power $P_n$	kW	0.3	1.5
Peak power $P_{max}$	kW	25	100
Weight	kg	3.4	5.6
Dimensions (W x H x D)	mm	80 x 210 x 53	193 x 410 x 240
Degree of protection		IP54B acc. to EN 60529	IP20 to EN 60529

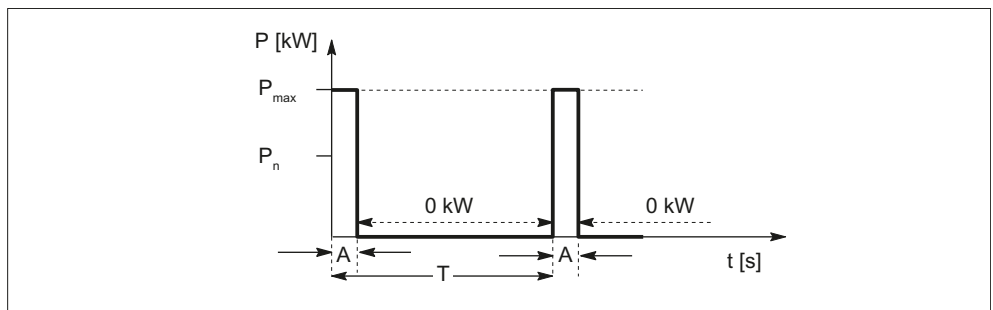


Figure 7-7 Duty cycle for braking resistors

T [s] period duration of braking duty cycle

A [s] load duration

$P_n$  [W] continuous braking power of braking resistor

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

Table 7- 6 Example of duty cycles

	Unit	6SN1113-1AA00-0DA0		6SL3100-1BE31-0AAx	
		Short duty cycle	Long duty cycle	Short duty cycle	Long duty cycle
A	s	0.1	0.4	1	2
T	s	11.5	210	68	460



## 7.2 Control Supply Module CSM

### 7.2.1 Description

The Control Supply Module provides an output voltage of 24 V - 28.8 V DC. The output voltage can be adjusted using an integrated potentiometer.

In normal operation, the Control Supply Module is supplied from the line voltage. In the event of a power failure, the module automatically changes over to supply from the DC link. This makes it possible, for example, to make retraction movements in the event of the failure of the line supply.

The Control Supply Module has safe electrical separation between the line potential and the DC-link potential. This therefore ensures that the DC link is not unintentionally charged. The Control Supply Module can therefore remain connected to the line supply if the S120 Combi is electrically isolated from the line supply, for example via a line contactor.

The 24 V ground of the Control Supply Module is internally grounded.  
The Control Supply Module is cooled using an internal fan.

Temperature and voltages are internally monitored.

#### **Temperature monitoring:**


In the event of an overtemperature in the Control Supply Module, a temperature advance warning is issued via a signaling contact. If the temperature falls below the limit value within the advance warning time, then the module remains operational and the signaling contact is de-energized. If the overtemperature condition persists, the module is switched off and restarted.


#### **Voltage monitoring:**


When the monitoring threshold (32 V) of the output voltage is exceeded for > 20 ms, the control supply module switches off and attempts a restart after 10 s. This is supplemented by a hardware-based overvoltage limiting. This prevents that more than 35 V can be output in the case of a fault.

The Control Supply Module can either be operated individually or in a parallel connection with a maximum of 10 devices. The switchover between single and parallel operation is realized in a no-current state using a DIP switch on the upper side of the module.

### 7.2.2 Safety information

 <b>DANGER</b>
<b>Risk of electric shock</b> This component is equipped with two supply circuits! A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off. It is only permissible to open the protective cover after this time has expired.  A suitable tool (e.g. screwdriver or the unlocking tool supplied) must be used to open the protective cover of the DC link.  The components must only be operated when the protective cover of the DC link is closed. Damaged components (e.g. with a defective lock on the protective cover) must not be operated further.

 <b>DANGER</b>
The DC link discharge voltage hazard warning in the local language must be attached to all of the components. A set of labels in 16 languages is supplied with the component.

 <b>WARNING</b>
The cooling clearances of 80 mm above and below the components must be observed.

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

<b>CAUTION</b>
The DC link lateral covers are supplied as standard with the components; they can also be ordered separately, if required (order no.: 6SL3162-5AA00-0AA0).

## 7.2.3 Interface description

### 7.2.3.1 Overview

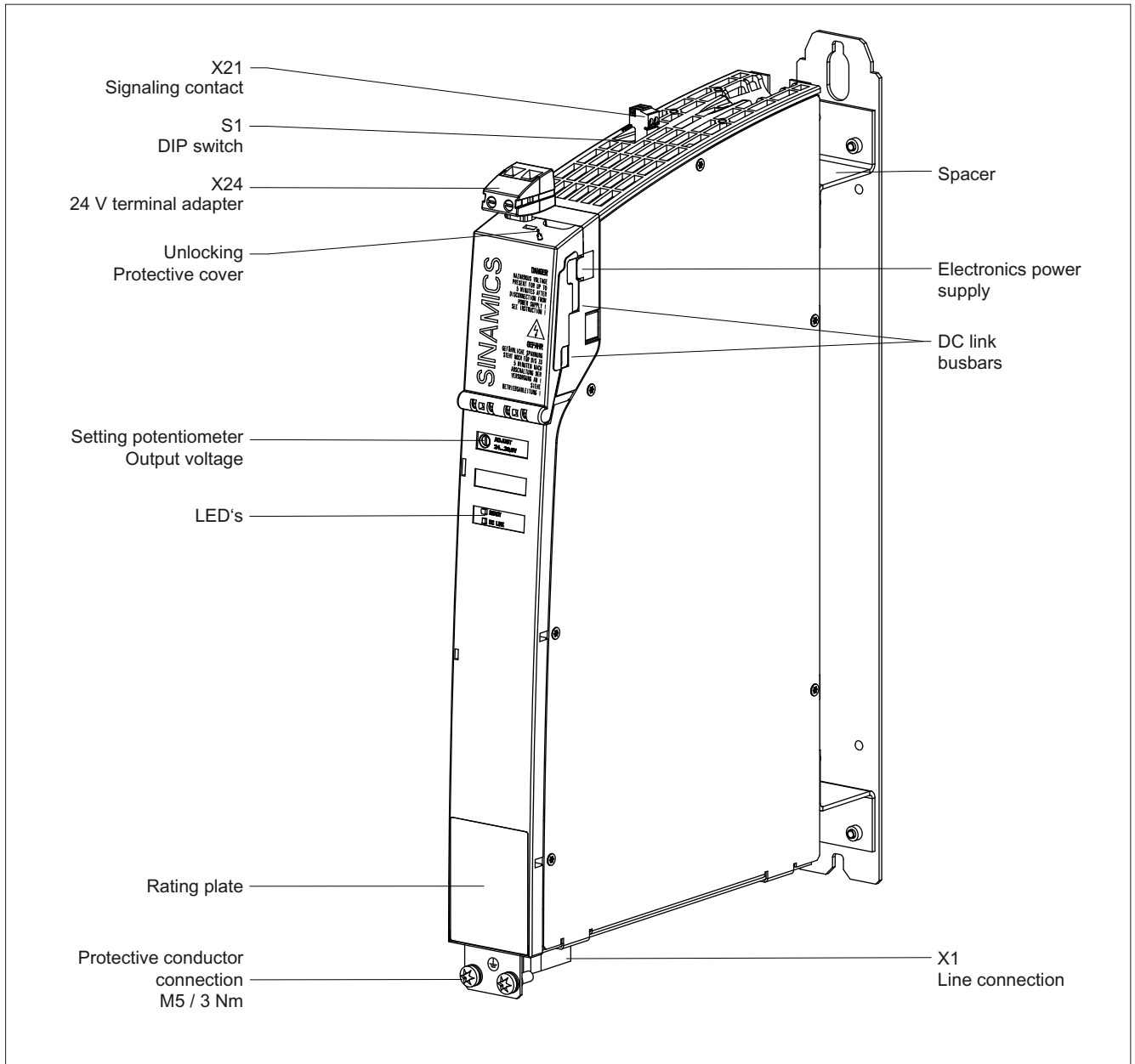


Figure 7-8 Interface description: control supply module

### 7.2.3.2 Connection examples

The Control Supply Module is connected to the line supply (3-ph. 380 V AC  $-10\%$  to 480 V AC  $+10\%$ ) via interface X1 (screw terminals 0.2 to 4 mm<sup>2</sup>) This connection should preferably be made without using an isolating device (e.g. contactor).

The CSM has an internal line filter (class A for TN line supplies), and the pre-charging circuit for the DC link inside the unit is electrically isolated from the 24 V supply.

The CSM also features a current limitation function. When using cables with a cross-section of 2.5 mm<sup>2</sup>, no additional protection is required on the 24 V side if a type XLPE or EPR cable is used or a cable with a similar quality and with a thermal stability of up to 90°C.

---

#### Note

If a selectively tripping, AC/DC-sensitive RCCB is used for the drive line-up, the Control Supply Module must always be connected to the line supply downstream of this circuit breaker.

---

#### Note

##### Connecting to the line supply

When configuring the line supply for the Control Supply Module, it should be noted that the CSM must not be connected to the line supply after the S120 Combi has been connected to the line supply. When charging, this prevents the DC link from being immediately loaded by the CSM.

---

The DIP switch must be set to "single operation" to connect the Control Supply Module to the S120 Combi drive line-up. The connection can be established as shown below.

The CSM must be connected to the S120 Combi Power Module and the expansion axes via the DC link busbars as well as also via the 24 V busbars. The red 24 V connector from the Completion Kit provided must be inserted under all circumstances.

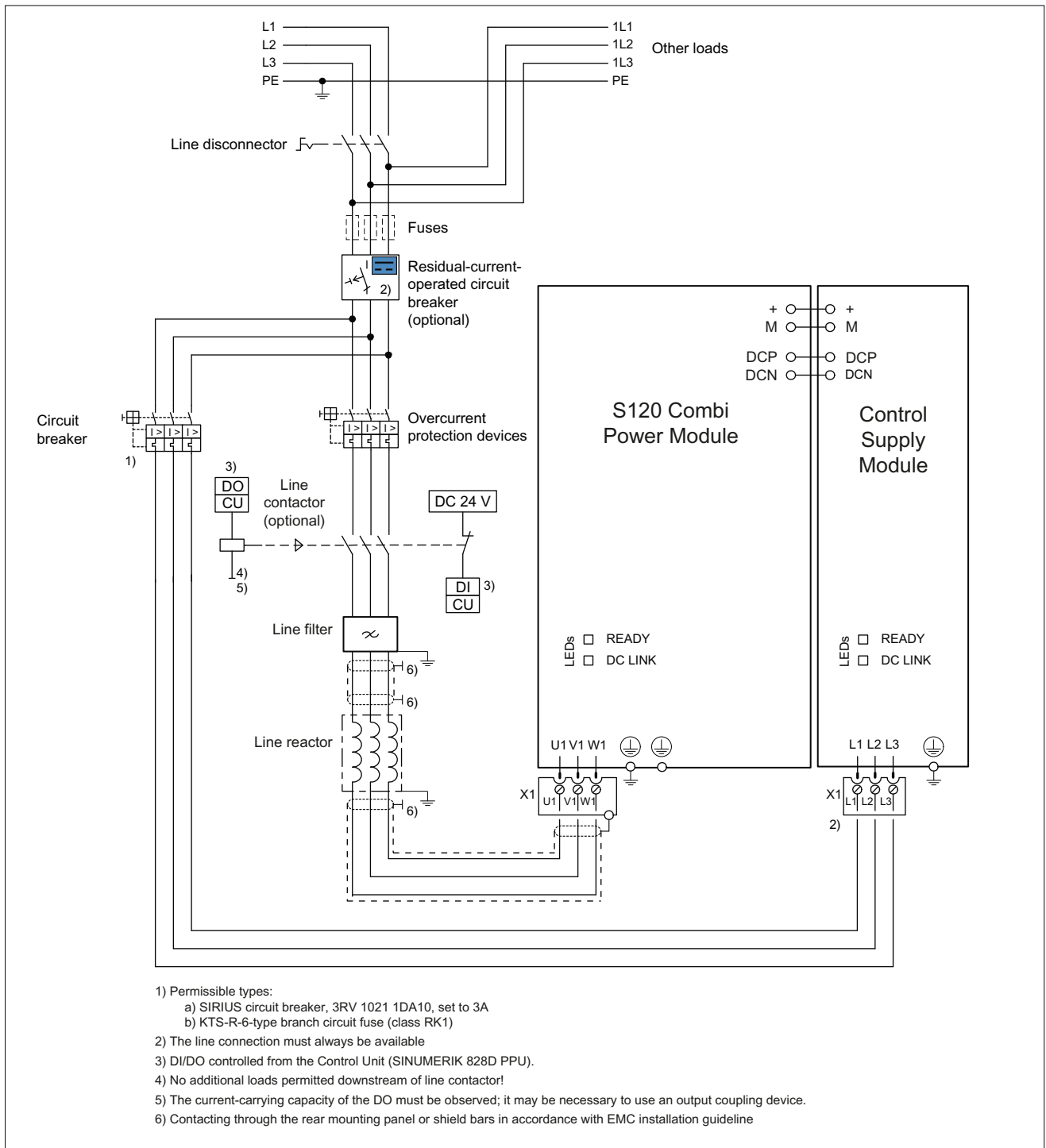
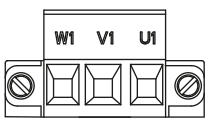
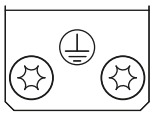


Figure 7-9 Connection example of Control Supply Module CSM in single operation

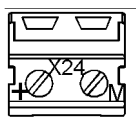
7.2.3.3 X1 line connection

Table 7- 7 Terminal strip X1

	Terminal	Technical specifications
	U1	Supply voltage: 3-ph. 380 V - 480 V AC, 50 / 60 Hz Max. connectable cross-section: 4 mm <sup>2</sup> Type: Screw terminal 4 (see Chapter "Control cabinet installation and EMC / connection system") Tightening torque: 0.5 - 0.6 Nm
	V1	
	W1	
	PE connection	M5 screw / 3 Nm at the housing

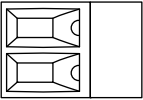
7.2.3.4 X24 24 V terminal adapter

Table 7- 8 Terminal strip X24

	Terminal	Designation	Technical specifications
	+	24 V power supply	Supply voltage 24 - 28.8 V DC
	M	Ground	Electronics ground
The 24 V terminal adapter is supplied as standard Max. connectable cross-section: 6 mm <sup>2</sup> Type: Screw terminal 5 (see Chapter "Control cabinet installation and EMC / connection system")			

### 7.2.3.5 X21 signaling contact

Table 7- 9 Terminal strip X21 (signaling contact)

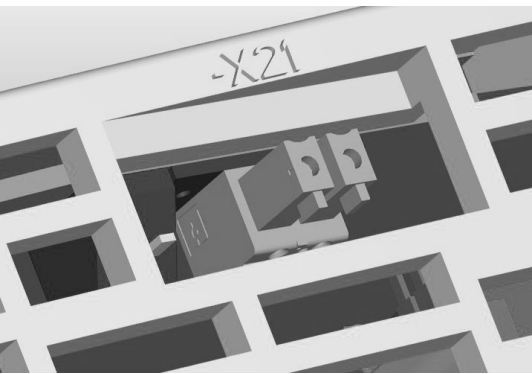
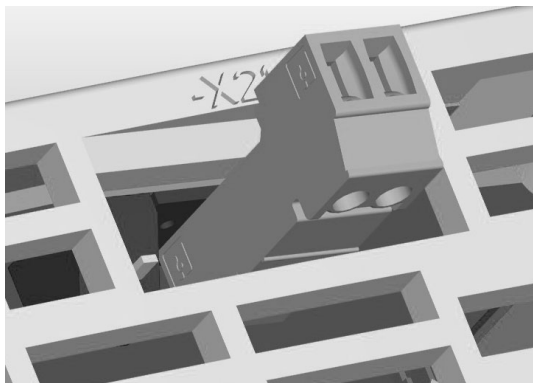
	Terminal	Technical specifications
	1	Voltage 24 V DC max. load current 0.5 A (ohmic load)
	2	
Max. connectable cross-section 1.5 mm <sup>2</sup> Type: Screw terminal 2 (see Chapter "Control cabinet installation and EMC / connection system")		

The 2-pole terminal connector for the signaling contact is included in the Completion Kit provided.

The signaling contact must be wired to a digital input (DI) of the control.

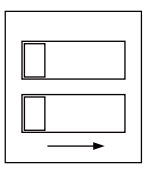
The signaling contact operates as an isolated NO contact. In the case of a fault (overtemperature, wire breakage, short-circuit, etc.) the "not OK" message is present. The Control Supply Module is correspondingly switched off.

Table 7- 10 Installing the signaling contact

	
Signaling contact without terminal connector in the delivery condition	Signaling contact, complete with terminal connector

7.2.3.6 S1 DIP switch

Table 7- 11 DIP switch S1

	Terminal	Designation	Technical specifications
	1	Changeover switch, single operation / parallel operation	Left: Single operation Right: Parallel operation Changing over the output characteristic
	2	Dummy contact (not used)	

The changeover is only made in the no-voltage state.

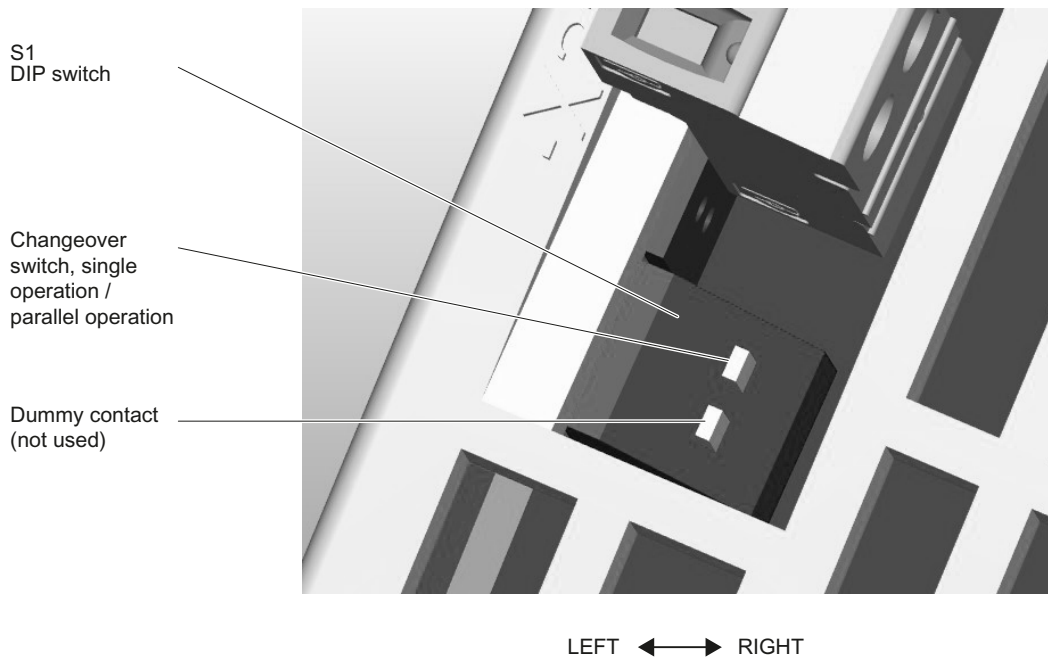


Figure 7-10 DIP switch on the upper side of the component

When delivered, "single operation" is set. Both switches are set to the left.

**Note**

The DIP switch must be set to "single operation" when operating the Control Supply Module on the S120 Combi.



### 7.2.3.7 Meaning of the LEDs on the Control Supply Module

Table 7- 12 Control Supply Module - Description of the LEDs

LED	Color	Status	Description
READY	-	Off	Electronics power supply outside the permissible tolerance range or temperature advance warning active
	Green	Continuous light	Ready for operation. Output voltage in the tolerance range and temperature advance warning inactive
DC LINK	-	Off	DC input voltage $V_{E\ DC} < 280...300\ V$ Buffer operation not possible
	Yellow	Continuous light	DC input voltage in the range $360...380 < V_{E\ DC} < 820\ V \pm 3\ %$ Buffer operation possible
	Red	Continuous light	DC input voltage outside the tolerance range: $V_{E\ DC} < 360...380\ V$ or $V_{E\ DC} > 820\ V \pm 3\ %$

7.2.4 Dimension drawing

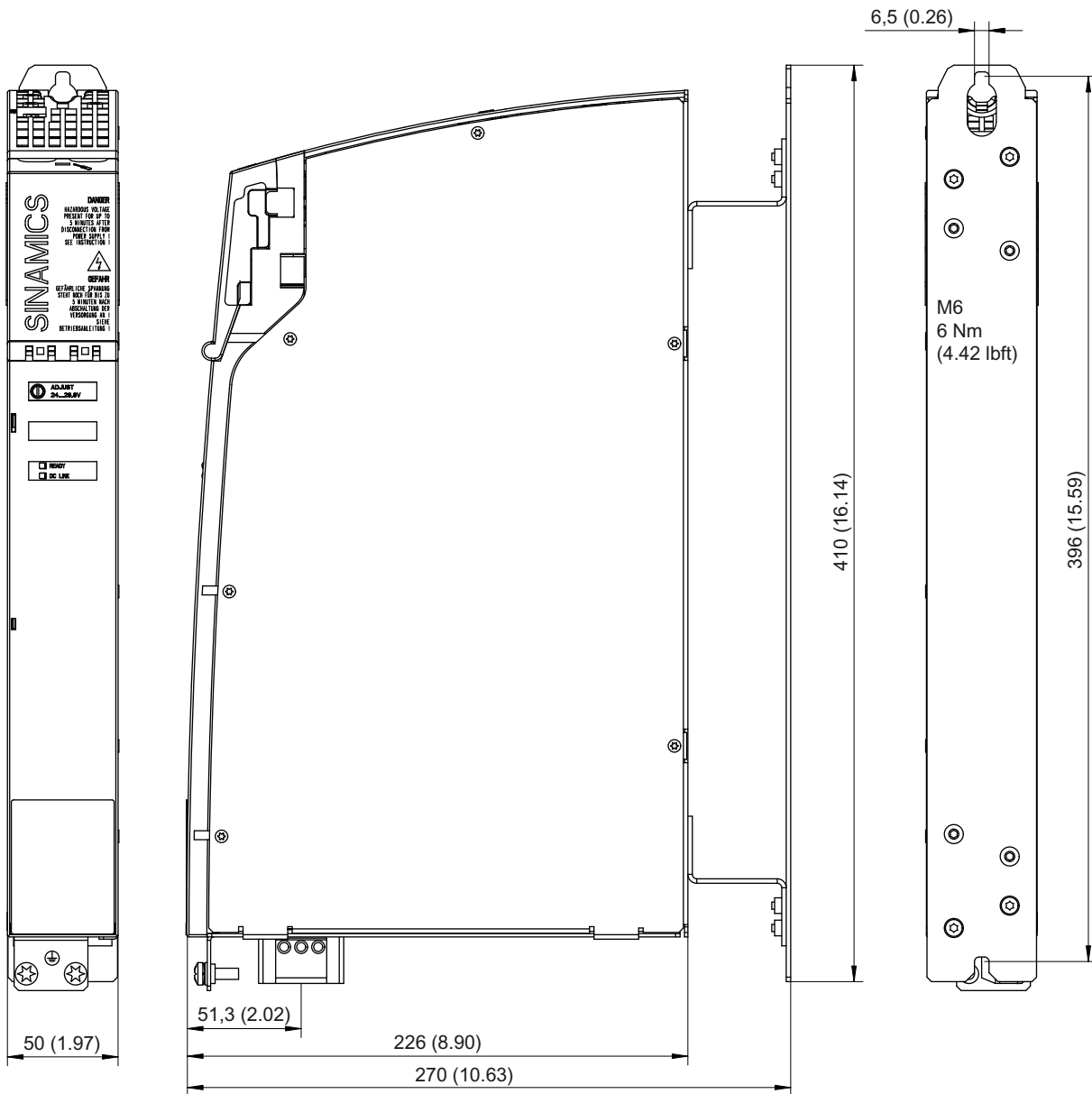


Figure 7-11 Dimension Control Supply Module, all dimensions in mm and (inches)

## 7.2.5 Installation

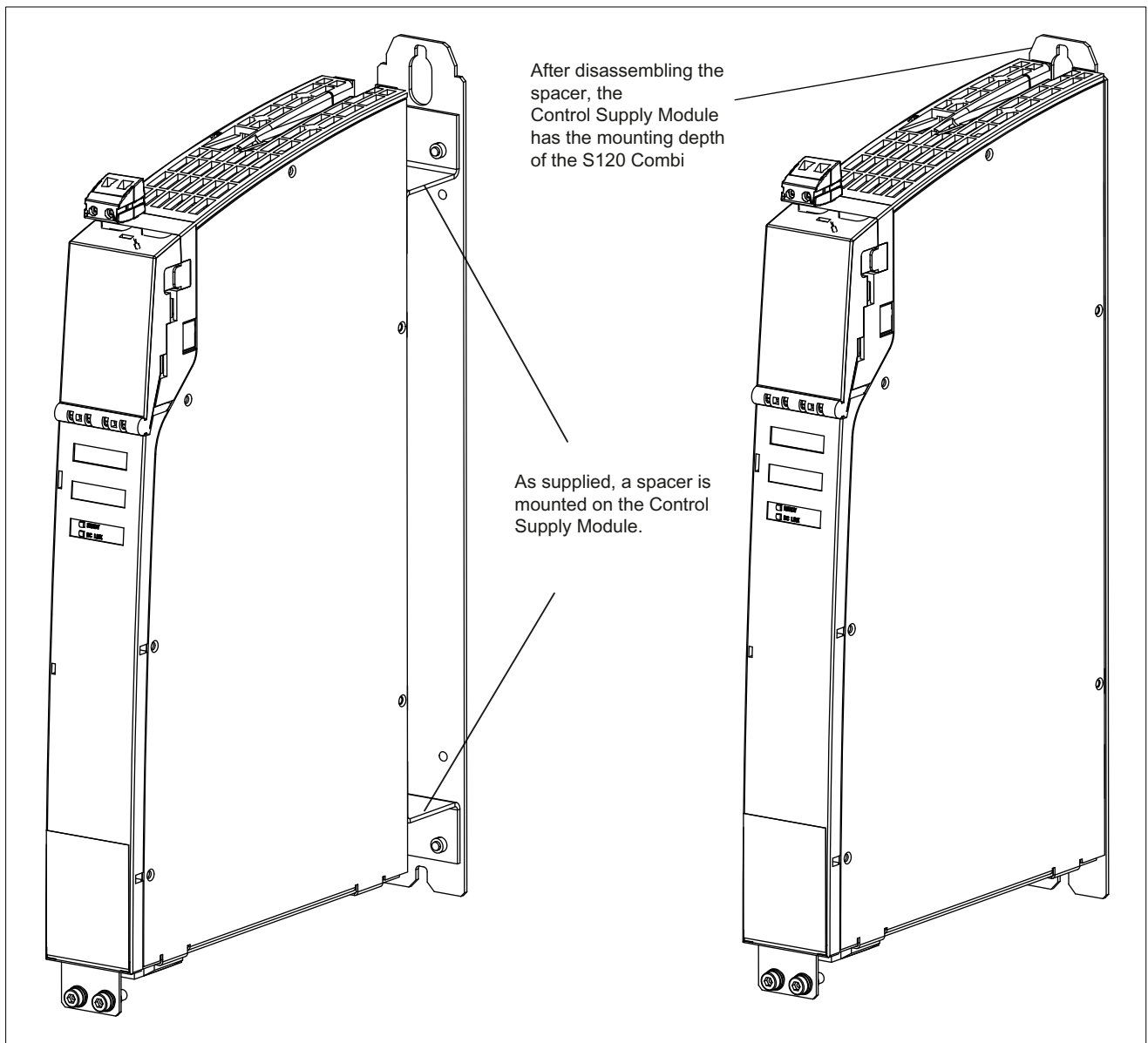


Figure 7-12 Methods of installing the Control Supply Module with and without spacer

## 7.2.6 Technical data

Table 7- 13 Technical data

6SL3100-1DE22-0AA1	Unit	Value
<b>Input data, AC input</b>		
Line voltage	V <sub>AC</sub>	3-ph. 380 - 480 V <sub>AC</sub> ± 15 %
Line frequency	Hz	45 to 66
Rated input current		
Rated value (at V <sub>E rated</sub> )	A <sub>AC</sub>	≤ 2
Starting current inrush	A <sub>AC</sub>	≤ 28 at > 5 ms
<b>Input data, DC input</b>		
Rated input voltage	V <sub>DC</sub>	600
Input voltage range	V <sub>DC</sub>	300 - 882
DC link voltage (continuous input voltage)	V <sub>DC</sub>	430 to 800 300 - 430 < 1 min 800 - 853 < 1 min 853 - 882 < 10 s
Supply current (at 600 V)	A <sub>DC</sub>	1.1
Overvoltage trip	V <sub>DC</sub>	> 882
Undervoltage trip	V <sub>DC</sub>	280 ± 3 %
<b>Output data</b>		
Rated output voltage V <sub>A rated</sub> :	V <sub>DC</sub>	24 - 28.8 V
Rated output current I <sub>A rated</sub>	A <sub>DC</sub>	20
Rated output power P <sub>A rated</sub>	W	576
Overcurrent limitation for short-circuit	A <sub>DC</sub>	approx. 23
Surge suppression	V	< 35
24 V DC busbar current carrying capacity	A <sub>DC</sub>	20
Residual ripple (clock frequency approx. 50 kHz)	mV <sub>pp</sub>	< 100
Cycle peaks (bandwidth 20 MHz)	mV <sub>pp</sub>	< 200
Power loss ride-through (at 400 V <sub>AC</sub> )	ms	5
Power loss (line supply) <sup>1)</sup>	W	70
Power loss (DC link)		65
Efficiency	%	>83
Weight	kg	4.8

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

# Electrically connecting Motor Modules and DC link components

# 8

## 8.1 Introduction

The S120 Combi offers the possibility of connecting the following expansion axes and DC link components to the DC link and the 24 V electronics power supply:

- Motor Modules Booksize Compact
- Braking Module
- Control Supply Module


For the S120 Combi, the DC link connection and the 24 V busbars are located at the front behind the front cover. Signal and power cables of the additional components must be connected corresponding to Chapter "Motor Modules Booksize Compact" and "DC link components". The specified cooling clearances of 80 mm for the S120 Combi also apply when operating the additional components.

## 8.2 Removing the front cover and opening the DC link cover on the S120 Combi

To electrically connect additional components, the front cover of the S120 Combi must be removed. The DC link busbars are located under the DC link cover.

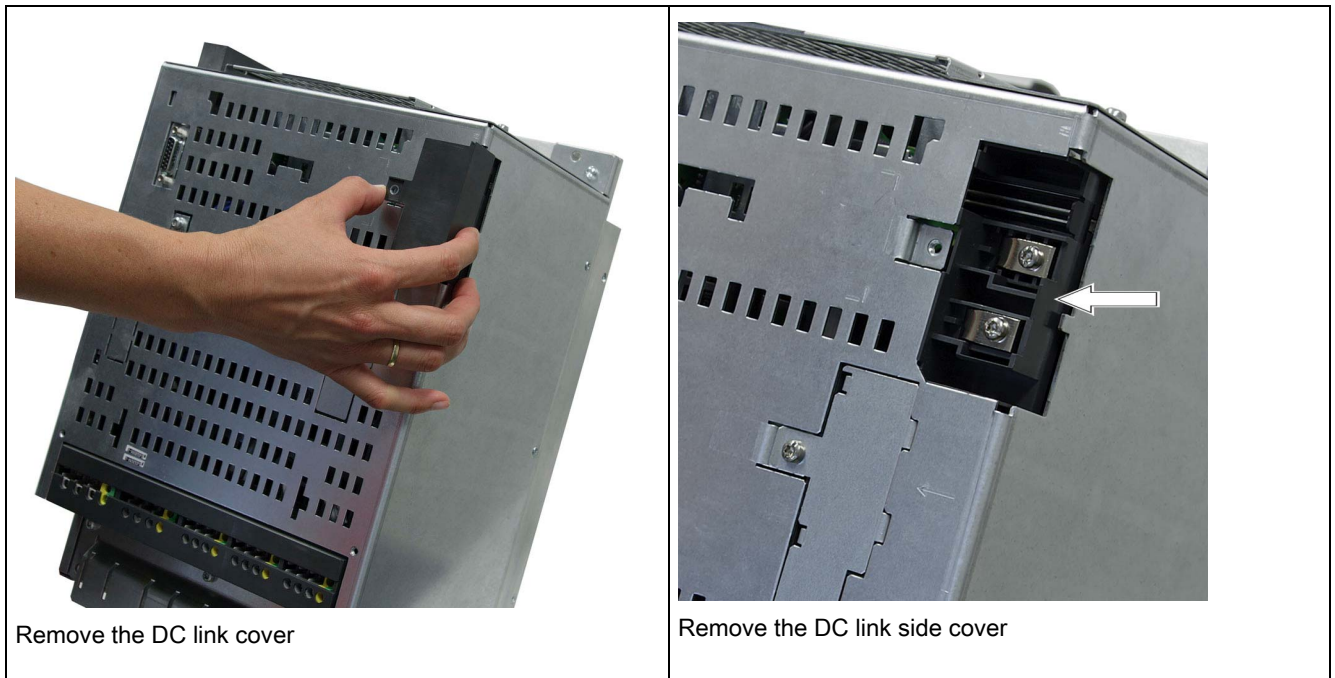
**Tool:**

Torx T20 or slotted 1.2 x 6 screwdriver

 <b>DANGER</b>
<b>Risk of electric shock</b> A hazardous voltage is present for up to 5 minutes after the power supply has been switched off. The front cover may only be removed after this time has expired.

8.2 Removing the front cover and opening the DC link cover on the S120 Combi





### 8.3 Connecting the DC link busbars and 24 V busbars

The following steps are necessary to connect a component to the DC link and the 24 V busbars of the S120 Combi:

1. Open the protective cover of the components to be connected using a suitable tool (completion kit provided with the components to be connected)
2. Remove the DC link side cover at the connection location

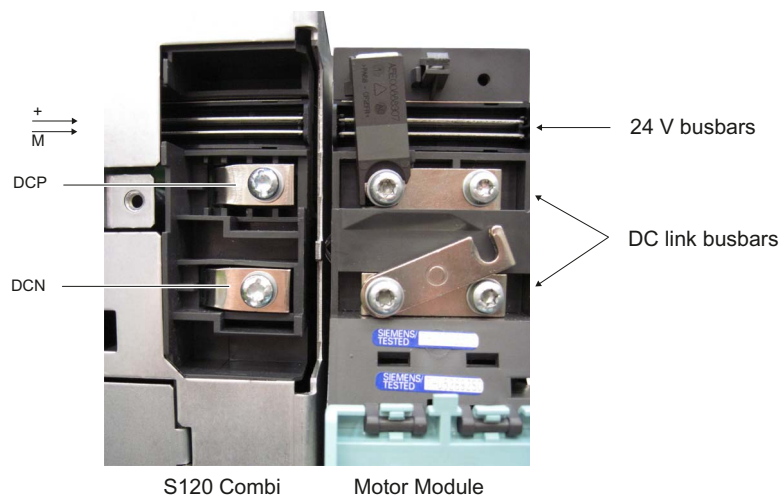
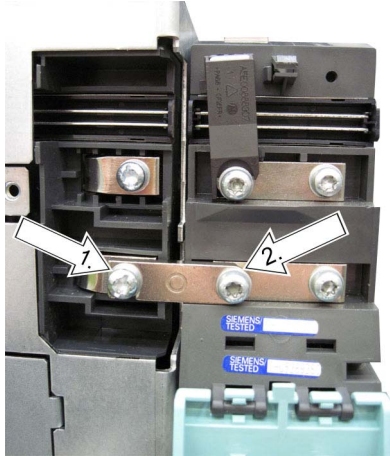


Figure 8-1 S120 Combi and Motor Module without DC link covers



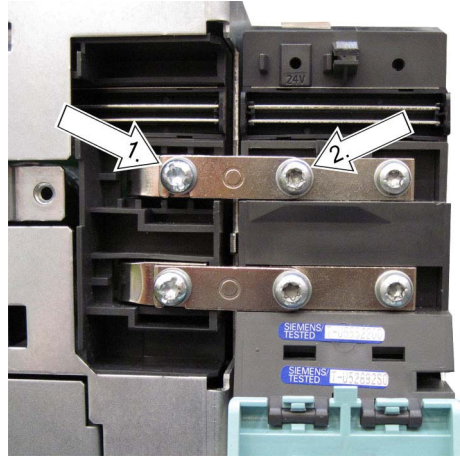
3. Install the lower and upper DC link busbars

Install the lower DC link busbar



- Release the screws
- Turn the DC link bridge
- Observe the sequence when tightening the screws!

Install the upper DC link busbar



- Release the screws
- Remove the plastic cap on the DC link bridge
- Turn the DC link bridge
- Observe the sequence when tightening the screws!

Screwdriver                      Torx T20 for Motor Module  
    Torx T20 or slotted 1.2 x 6 for S120 Combi

Tightening torque            1.8 Nm

4. Install the red 24 V connector (completion kit of the component to be connected)

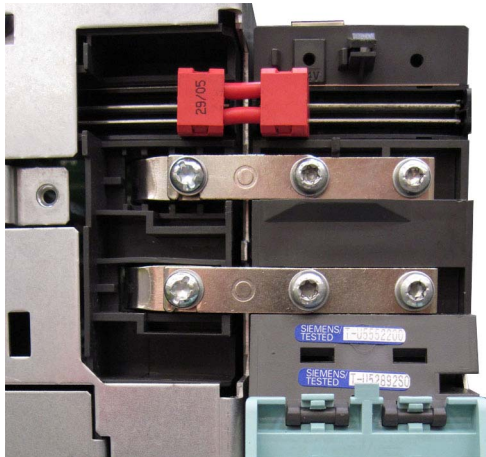


Figure 8-2    S120 Combi and Motor Module with installed 24 V connector

5. Close the protective cover of the connected component
6. Install the front cover on the S120 Combi



**CAUTION**

Before commissioning the drive line-up, it must be ensured, that:

- The outer DC link side cover is inserted at the connected component.
- The protective cover of the connected component is closed.
- The front cover of the S120 Combi is reinstalled.

**CAUTION**

After removing the additional components, before recommissioning the system, the touch protection of the DC link busbars on the S120 Combi power module must be reinstalled. The touch protection can be ordered as a spare part.

## 8.4 Connecting an additional component

An additional component is connected as follows to the DC link busbars and the 24 V busbars:

1. Open the protective cover of the component to be connected using a suitable tool (in the completion kit of the component to be connected)
2. Remove the DC link side covers of both components at the connection location

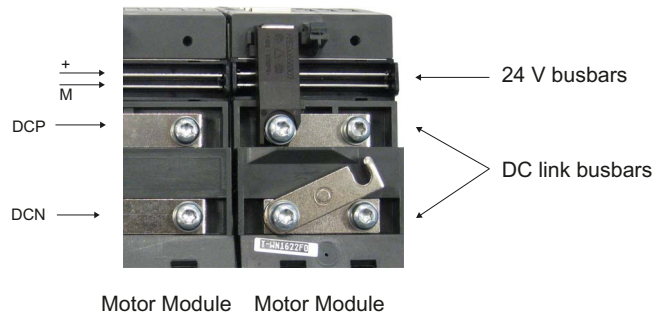


Figure 8-3 Prepared Motor Modules to connect the DC link busbars

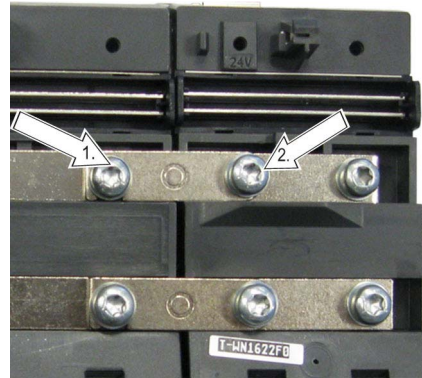
3. Install the lower and upper DC link busbars

Install the lower DC link busbar



- Release the screws
- Turn the DC link bridge
- Observe the sequence when tightening the screws

Install the upper DC link busbar



- Release the screws
- Remove the plastic cap on the DC link bridge
- Turn the DC link bridge
- Observe the sequence when tightening the screws

Screwdriver            Torx T20  
 Tightening torque    1.8 Nm

4. Install the red 24 V connector (completion kit of the component to be connected)



Figure 8-4 Motor Modules with installed 24 V connector

5. Close the protective covers of both components

<p><b>CAUTION</b></p> <p>Before commissioning the drive line-up, it must be ensured, that:</p> <ul style="list-style-type: none"> <li>• The DC link side cover is inserted at the outer component (touch protection).</li> <li>• The protective covers of all of the components are closed.</li> </ul>
--

## Additional system components

### 9.1 Terminal Module TM54F

#### 9.1.1 Description

The Terminal Module TM54F is a terminal expansion for snapping on to an EN 60715 DIN rail. The TM54F offers safe digital inputs and outputs for controlling SINAMICS Safety Integrated functions.

The TM54F must be directly connected to the PPU of SINUMERIK 828D via DRIVE-CLiQ. In so doing, the topology rules must be observed.

TM54F features the following interfaces:

Table 9- 1 Interface overview of the TM54F

Type	Number
Fail-safe digital outputs (F-DO)	4
Fail-safe digital inputs (F-DI)	10
Sensor <sup>1)</sup> power supplies, dynamization supported <sup>2)</sup>	2
Sensor <sup>1)</sup> power supply, no dynamization	1
Digital inputs to check F_DO for a test stop	4

1) Sensors: Fail-safe devices to issue commands and sense - for example, emergency stop buttons and safety locks, position switches and light arrays/light curtains.

2) Dynamization: The sensor power supply is cycled on and off by the TM54F when the forced checking procedure is active for the sensors, cable routing, and the evaluation electronics.

The TM54F has 4 fail-safe digital outputs and 10 fail-safe digital inputs. A fail-safe digital output comprises a 24 V DC switching output, a ground-switching output and a digital input to monitor the switching state. A fail-safe digital input comprises two digital inputs.

---

#### Note

The rated values of the F-DO meet the requirements of EN 61131-2 for digital DC outputs with 0.5 A rated current.

The operating ranges of the F-DI meet the requirements of EN 61131-2 for Type 1 digital inputs.

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#### Note

Please note that the F-DIs must take the form of shielded cables if they are > 30 m in length.

---

## 9.1.2 Safety information

 <b>WARNING</b>
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The ventilation spaces of 50 mm above and below the component must be observed.
---

### 9.1.3 Interface description

#### 9.1.3.1 Overview

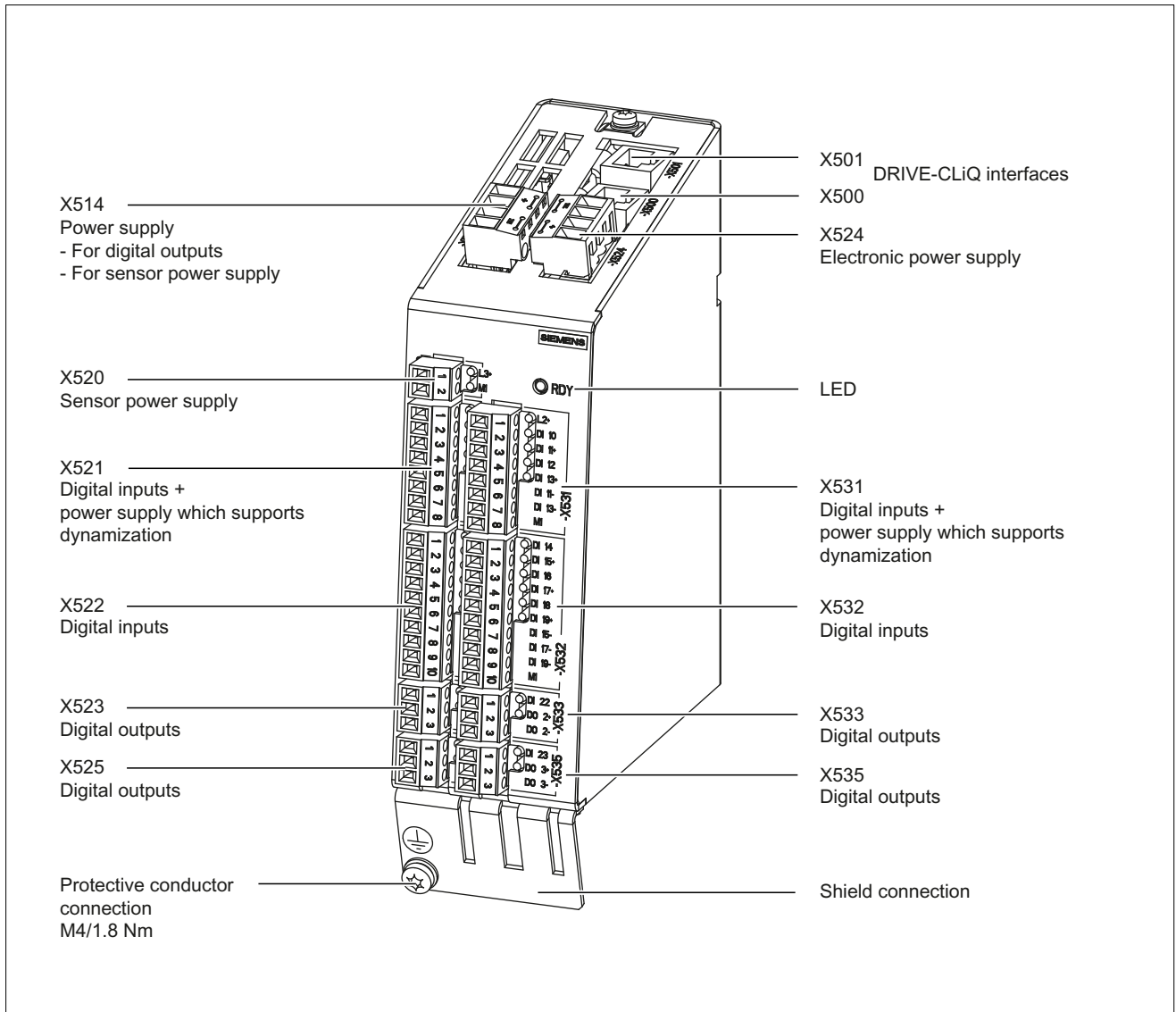


Figure 9-1 Interface description of the TM54F

9.1.3.2 Connection example

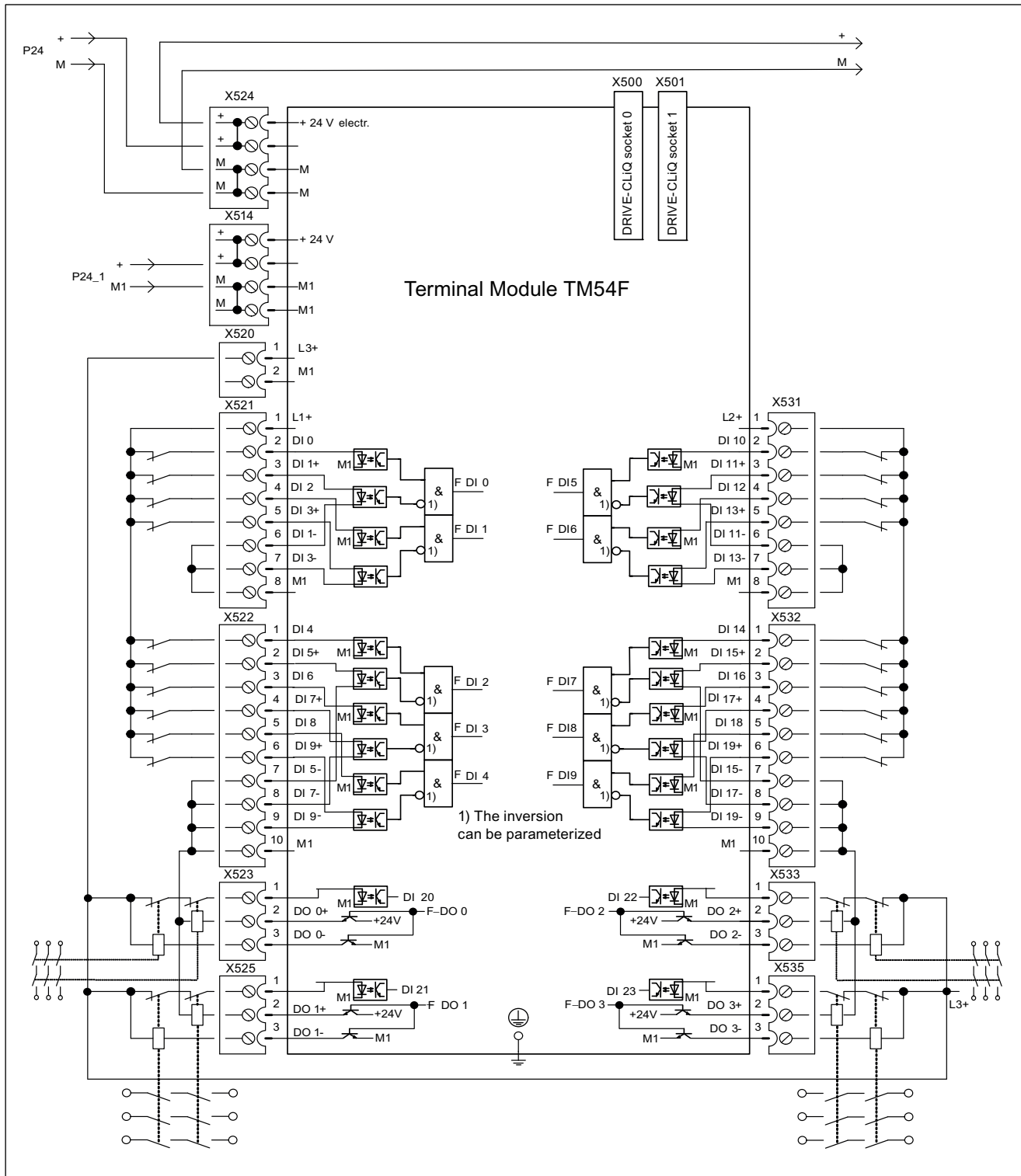


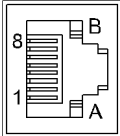
Figure 9-2 Connection example off TM54F

Additional circuit examples are included in:

- SINAMICS S120 Safety Integrated Function Manual
- System Manual: The safety program for world industry, order number: 6ZB5000-0AA01-0BA1, 5 Edition, Supplement: 6ZB5000-0AB01-0BA0

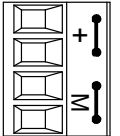
### 9.1.3.3 X500 and X501 DRIVE-CLiQ interface

Table 9- 2 DRIVE-CLiQ interfaces X500 and X501

	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)	Power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces included in the scope of delivery; blanking plate (50 pieces) order number: 6SL3066-4CA00-0AA0			

### 9.1.3.4 X514 power supply for digital outputs and sensors

Table 9- 3 Terminals for the power supply X514

	Terminal	Designation	Technical specifications
	+	Power supply	Voltage: 24 V DC (20.4 V – 28.8 V) Current consumption: max. 4 A <sup>1)</sup> Max. current via jumper in connector: 20 A
	+	Power supply	
	M1	Electronics ground	
	M1	Electronics ground	
Max. connectable cross-section: 2.5 mm <sup>2</sup> Type: Screw terminal 3 (see Chapter "Control cabinet installation and EMC / connection system")			

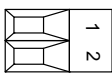
1) including the current consumption for the digital outputs and to supply the sensor

#### Note

The two "+" and "M1" terminals are jumpered in the connector. This ensures that the supply voltage is looped through.

### 9.1.3.5 X520 sensor power supply

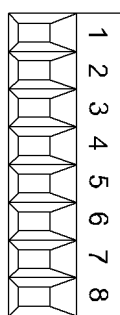
Table 9- 4 Terminal X520

	Terminal	Designation	Technical specifications
	1	L3	500 mA, 24 V
	2	M1	

Without forced dormant error detection

### 9.1.3.6 X521 Digital inputs and dynamically adjustable power supply

Table 9- 5 Screw terminal X521

	Terminal	Designation <sup>1)</sup>	Technical specifications
	1	L1+	Voltage: +24 V DC Max. total load current: 500 mA
	2	DI 0	Voltage: - 3 V to +30 V Typical current consumption: 3.2 mA at 24 V DC Electrical isolation: Reference potential, refer to terminals 6, 7, 8 All digital inputs are electrically isolated. Input delay: <sup>2)</sup> - for "0" to "1": 30 µs (100 Hz) - for "1" to "0": 60 µs (100 Hz) Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V
	3	DI 1+	
	4	DI 2	
	5	DI 3+	
	6	DI 1-	
	7	DI 3-	Reference potential for DI 3+
	8	M1	Reference potential for DI 0, DI 2, L1+

An F-DI comprises a digital input and a 2nd digital input where, in addition, the cathode of the optocoupler is fed-out.  
 F-DI 0 = terminals 2, 3 and 6  
 F-DI 1 = terminals 4, 5 and 7

Max. connectable cross-section: 1.5 mm<sup>2</sup>

Type: Screw terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")

1) DI: Digital input; M1: Ground reference

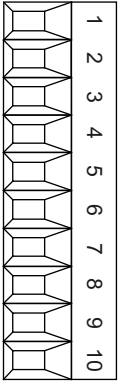
2) Pure hardware delay



NOTICE
For the digital inputs DIx+ to function, the particular reference potential must be connected to input DIx. This is achieved by: 1) Routing the ground reference of the digital inputs as well, or 2) A jumper between DIx and terminal M1.

### 9.1.3.7 X522 digital inputs

Table 9-6 Screw terminal X522

	Terminal	Designation <sup>1)</sup>	Technical specifications
	1	DI 4	Voltage: - 3 V to +30 V Typical current consumption: 3.2 mA at 24 V DC Electrical isolation: Reference potential, refer to terminals 7, 8, 9, 10 All digital inputs are electrically isolated. Input delay: <sup>2)</sup> - for "0" to "1": 30 μs (100 Hz) - for "1" to "0": 60 μs (100 Hz) Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V
	2	DI 5+	
	3	DI 6	
	4	DI 7+	
	5	DI 8	
	6	DI 9+	
	7	DI 5-	Reference potential for DI 5+
	8	DI 7-	Reference potential for DI 7+
	9	DI 9-	Reference potential for DI 9+
	10	M1	Reference potential for DI 4, DI 6 and DI 8
An F-DI comprises a digital input and a 2nd digital input where, in addition, the cathode of the optocoupler is fed-out. F-DI 2 = terminals 1, 2 and 7 F-DI 3 = terminals 3, 4 and 8 F-DI 4 = terminals 5, 6 and 9			
Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")			

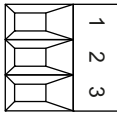
1) DI: Digital input; M1: Ground reference

2) Pure hardware delay

<p><b>NOTICE</b></p> <p>For the digital inputs DIx+ to function, the particular reference potential must be connected to input DIx.</p> <p>This is achieved by:</p> <ol style="list-style-type: none"> <li>1) Routing the ground reference of the digital inputs as well, or</li> <li>2) A jumper between DIx and terminal M1.</li> </ol>
---

### 9.1.3.8 X523 digital outputs

Table 9-7 Screw terminal X523

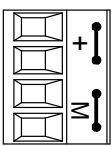
	Terminal	Designation <sup>1)</sup>	Technical specifications
	1	DI 20	Voltage: - 3 V to +30 V Typical current consumption: 3.2 mA at 24 V DC Electrical isolation: Reference potential is Terminal M1 The digital input is electrically isolated. Input delay: <sup>2)</sup> - for "0" to "1": 30 µs (100 Hz) - for "1" to "0": 60 µs (100 Hz) Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V
	2	DO 0+	0.5 A Reference potential is terminal M1
	3	DO 0-	0.5 A Reference potential is L1+, L2+ or L3+ Output delay: <sup>2)</sup> - for "0" to "1": 300 µs - for "1" to "0": 350 µs Total current consumption of all DOs: 2 A Max. leakage current: < 0.5 mA Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
An F-DO comprises two digital outputs and a digital input to feed back the signal F-DO 0 = terminals 1, 2 and 3 Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")			

1) DI: Digital input; DO: Digital output

2) Pure hardware delay

### 9.1.3.9 X524 Electronics power supply

Table 9- 8 Terminals for the electronics power supply

	Terminal	Designation	Technical specifications
	+	Electronics power supply	Voltage: 24 V DC (20.4 V – 28.8 V) Current consumption: Max. 0.7 A
	+	Electronics power supply	
	M	Electronics ground	Max. current via jumper in connector: 20 A
	M	Electronics ground	
Max. connectable cross-section: 2.5 mm <sup>2</sup> Type: Screw terminal 3 (see Chapter "Control cabinet installation and EMC / connection system")			

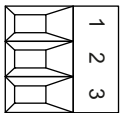
#### Note

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

The current consumption increases by the value for the DRIVE-CLiQ node.

9.1.3.10 X525 digital outputs

Table 9- 9 Screw terminal X525

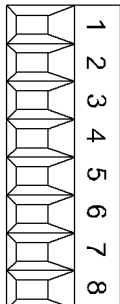
	Terminal	Designation <sup>1)</sup>	Technical specifications
	1	DI	Voltage: - 3 V to +30 V Typical current consumption: 3.2 mA at 24 V DC Electrical isolation: Reference potential is terminal M1 The digital input is electrically isolated. Input delay: <sup>2)</sup> - for "0" to "1": 30 µs (100 Hz) - for "1" to "0": 60 µs (100 Hz) Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V
	2	DO 1+	0.5 A Reference potential is terminal M1
	3	DO 1-	0.5 A Reference potential is terminal L1+, L2+ or L3+ Output delay: <sup>2)</sup> - for "0" to "1": 300 µs - for "1" to "0": 350 µs Total current consumption of all DOs: 2 A Max. leakage current: < 0.5 mA Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
An F-DO comprises two digital outputs and a digital input F-DO 1 = terminals 1, 2 and 3:			
Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")			

1) DI: Digital input; DO: Digital output

2) Pure hardware delay

## 9.1.3.11 X531 digital inputs and dynamically adjustable power supply

Table 9- 10 Screw terminal X531

	Terminal	Designation <sup>1)</sup>	Technical specifications
	1	L 2+	Voltage: +24 V DC Max. total load current: 500 mA
	2	DI 10	Voltage: - 3 V to +30 V Typical current consumption: 3.2 mA at 24 V DC Electrical isolation: Reference potential, refer to terminals 6, 7, 8 All digital inputs are electrically isolated. Input delay: <sup>2)</sup> - for "0" to "1": 30 µs (100 Hz) - for "1" to "0": 60 µs (100 Hz) Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V
	3	DI 11+	
	4	DI 12	
	5	DI 13+	
	6	DI 11-	Reference potential to DI 11+
	7	DI 13-	Reference potential to DI 13+
	8	M1	Reference potential to DI 10, DI 12, L2+
An F-DI comprises a digital input and a 2nd digital input where, in addition, the cathode of the optocoupler is fed-out. F-DI 5 = terminals 2, 3 and 6 F-DI 6 = terminals 4, 5 and 7			
Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")			

1) DI: Digital input; M1: Ground reference

2) Pure hardware delay

**NOTICE**

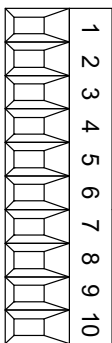
For the digital inputs DIx+ to function, the particular reference potential must be connected to input DIx.

This is achieved by:

- 1) Routing the ground reference of the digital inputs as well, or
- 2) A jumper between DIx and terminal M1.

### 9.1.3.12 X532 digital inputs

Table 9- 11 Screw terminal X532

	Terminal	Designation <sup>1)</sup>	Technical specifications
	1	DI 14	Voltage: - 3 V to +30 V Typical current consumption: 3.2 mA at 24 V DC Electrical isolation: Reference potential, refer to terminals 7, 8, 9, 10. All digital inputs are electrically isolated. Input delay: <sup>2)</sup> - for "0" to "1": 30 µs (100 Hz) - for "1" to "0": 60 µs (100 Hz)
	2	DI 15+	
	3	DI 16	
	4	DI 17+	
	5	DI 18	
	6	DI 19+	
	7	DI 15-	Reference potential to DI 15+
	8	DI 17-	Reference potential to DI 17+
	9	DI 19-	Reference potential to DI19+
	10	M1	Reference potential to DI14, DI16, DI18
An F-DI comprises a digital input and a 2nd digital input where, in addition, the cathode of the optocoupler is fed out. F-DI 7 = terminals 1, 2 and 7 F-DI 8 = terminals 3, 4 and 8 F-DI 9 = terminals 5, 6 and 9 Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")			

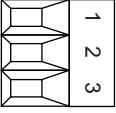
1) DI: Digital input; M1: Ground reference

2) Pure hardware delay

NOTICE
For the digital inputs DIx+ to function, the particular reference potential must be connected to input DIx.  This is achieved by: 1) Routing the ground reference of the digital inputs as well, or 2) A jumper between DIx and terminal M1.

## 9.1.3.13 X533 digital outputs

Table 9- 12 Screw terminal X533

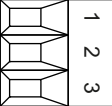
	Terminal	Designation <sup>1)</sup>	Technical specifications
	1	DI 22	Voltage: - 3 V to +30 V Typical current consumption: 3.2 mA at 24 V DC Electrical isolation: Reference potential is terminal M1 The digital input is electrically isolated. Input delay: <sup>2)</sup> - for "0" to "1": 30 µs (100 Hz) - for "1" to "0": 60 µs (100 Hz) Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V
	2	DO+	0.5 A Reference potential is terminal M1
	3	DO-	0.5 A Reference potential is terminal L1+, L2+ or L3+ Output delay: <sup>2)</sup> - for "0" to "1": 300 µs - for "1" to "0": 350 µs Total current consumption of all DOs: 2 A Max. leakage current: < 0.5 mA Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
An F-DO comprises two digital outputs and a digital input for the feedback signal F-DO 2 = terminals 1, 2 and 3 Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")			

1) DI: Digital input; DO: Digital output

2) Pure hardware delay

9.1.3.14 X535 digital outputs

Table 9- 13 X535 digital inputs/outputs

	Terminal	Designation <sup>1)</sup>	Technical specifications
	1	DI 23	Voltage: - 3 V to +30 V Typical current consumption: 3.2 mA at 24 V DC Electrical isolation: Reference potential is terminal M1 The digital input is electrically isolated. Input delay: <sup>2)</sup> - for "0" to "1": 30 µs (100 Hz) - for "1" to "0": 60 µs (100 Hz) Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V
	2	DO 3+	0.5 A Reference potential is terminal M1
	3	DO 3-	0.5 A Reference potential is terminal L1+, L2+ or L3+ Output delay: <sup>2)</sup> - for "0" to "1": 300 µs - for "1" to "0": 350 µs Total current consumption of all DOs: 2 A Max. leakage current: < 0.5 mA Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
An F-DO comprises two digital outputs and a digital input for the feedback signal F-DO 3 = terminals 1, 2 and 3 Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")			

1) DI: Digital input; DO: Digital output

2) Pure hardware delay



### 9.1.3.15 Meaning of the LEDs on the Terminal Module TM54F

Table 9- 14 Terminal Module TM54F - description of LEDs

LED	Color		Status	Description, cause	Remedy
READY	-		Off	Electronics power supply is missing or outside permissible tolerance range.	-
	Green		Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	-
	Orange		Continuous light	DRIVE-CLiQ communication is being established.	-
	Red		Continuous light	At least one fault is present in this component. <b>Note:</b> The LED is activated irrespective of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
	Green/red		0.5 Hz flashing light	Firmware is being downloaded.	-
			2 Hz flashing light	Firmware download is complete. Wait for POWER ON	Carry out a POWER ON
	Green / Orange or Red / Orange		Flashing light	Component recognition via LED is activated (p0154). <b>Note:</b> Both options depend on the LED status when component recognition is activated via p0154 = 1.	-
L1+, L2+,	-		ON	The controllable sensor power supply is functioning fault-free.	-
	Red		Continuous light	There is a fault in the controllable sensor power supply.	-
L3+	-		ON	Sensor power supply is functioning fault-free.	
	Red		Continuous light	There is a fault in the sensor power supply.	
<b>Fail-safe inputs / double inputs</b>					
F_DI z (input x, (x+1)+, (x+1)-)	LED x	LED x+1		<b>NC contact / NC contact <sup>1)</sup>: (z = 0..9, x = 0, 2, ..18)</b> Different signal states at input x and x+1 No signal at input x and no signal at input x+1	-
	-	Red	Continuous light	-	
	-	Red	Continuous light	<b>NC contact / NO contact <sup>1)</sup>: (z = 0..9, x = 0, 2, ..18)</b> Same signal states at input x and x+1 No signal at input x and a signal at input x+1	
	-	-	-	-	
LED x	LED x+1			<b>NC contact / NC contact <sup>1)</sup>: (z = 0..9, x = 0, 2, ..18)</b> A signal at input x and a signal at input x+1	-
	Green	Green	Continuous light	<b>NC contact / NO contact <sup>1)</sup>: (z = 0..9, x = 0, 2, ..18)</b> A signal at input x and no signal at input x+1	
Green	Green	Continuous light			
<sup>1)</sup> Inputs x+1 (DI 1+, 3+, .. 19+) can be set individually via parameter p10040 (TM54F). p10040 (TM54F) = 0: Input x+1 is an NC contact. p10040 (TM54F) = 1: Input x+1 is NO contact. Factory setting: p10040 (TM54F) = 0 for all inputs x+1.					

LED	Color	Status	Description, cause	Remedy
<b>Single digital inputs, not fail-safe</b>				
DI x	–	Off	No signal at digital input x (x = 20..23)	–
	Green	Continuous light	Signal at digital input x	–
<b>Fail-safe digital outputs with associated readback channel</b>				
F_DO y (0+..3+, 0-..3-)	Green	Continuous light	Output y (y=0 .. 3) carries a signal	–
Readback input DI 2y for output F_DO y (y = 0..3) at test stop. The status of the LEDs also depends on the type of external circuit.				
DI 2y	–	Off	One of the two output lines y+ or y- or both lines of output y carry a signal	–
	Green	Continuous light	Both output lines y+ and y- carry no signal	–

### Cause and rectification of faults

The following reference contains information about the cause of faults and how they can be rectified:

SINAMICS S120 Combi List Manual

9.1.4 Dimension drawing

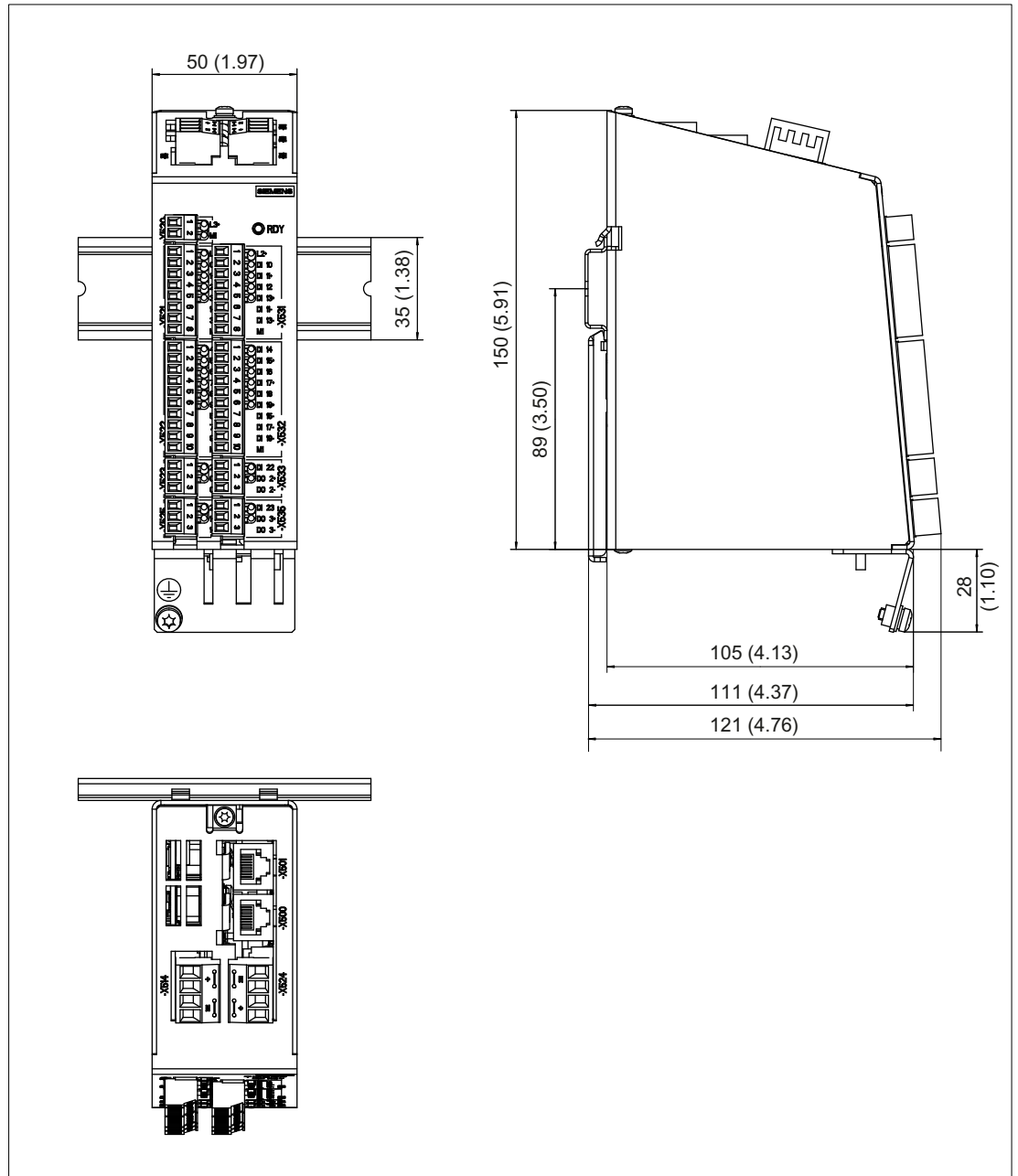


Figure 9-3 Dimension drawing of Terminal Module TM54F, all data in mm and (inches)

## 9.1.5 Installation

### Installation

1. Tilt the component backwards slightly and attach it to the DIN rail using the hook.
2. Push the component towards the DIN rail until you hear the mounting slide at the rear latch into position.
3. You can now move the component to the left or right along the DIN rail, until it reaches its final position.

### Removal

1. The lug on the mounting slide first needs to be pushed down to unlock the slide from the DIN rail.
2. The component can now be tilted forwards and pulled up and off the DIN rail.

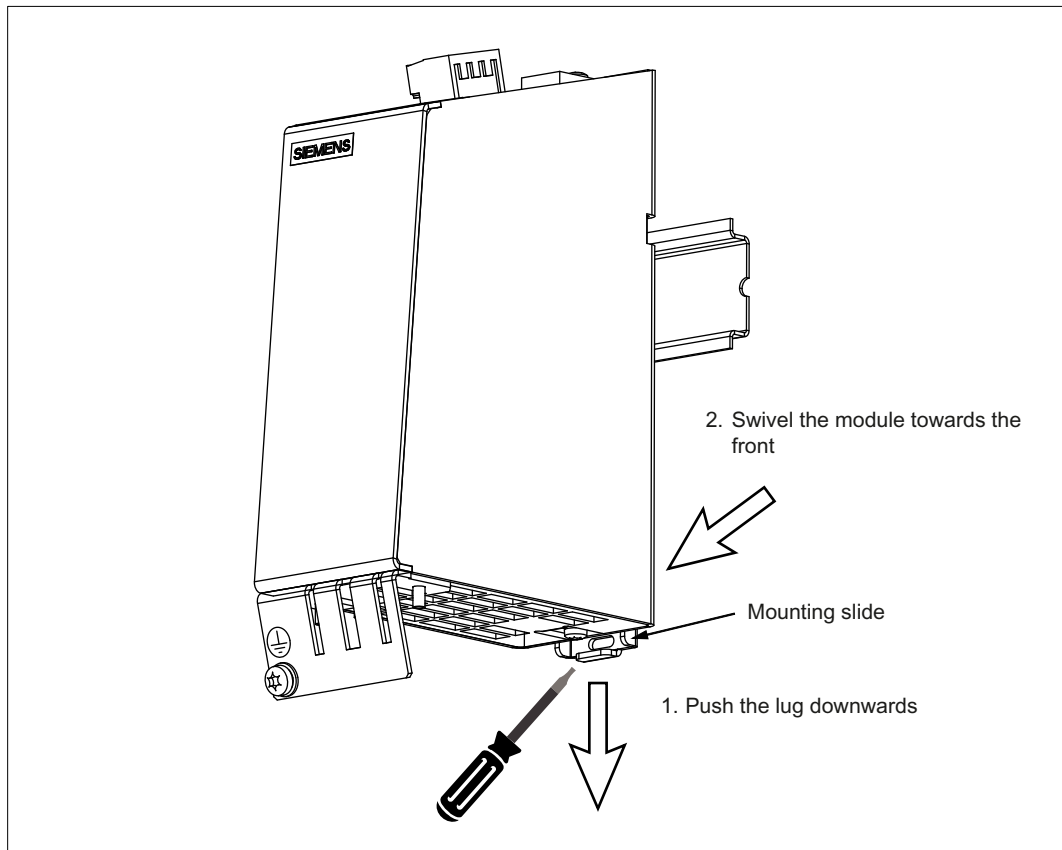


Figure 9-4 Removal of a component from a DIN rail

### 9.1.6 Protective conductor connection and shield support

It is always advisable to shield the digital I/O wiring.

The following figure shows typical Weidmüller shield connection clamps for the shield supports.

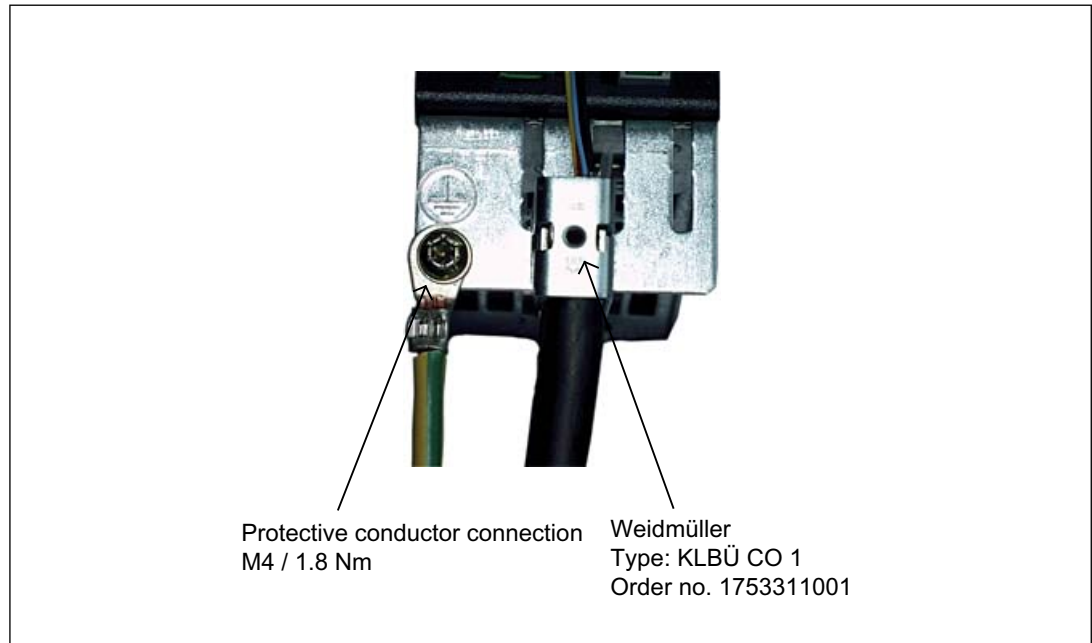


Figure 9-5 Shield supports and protective conductor connection

**Weidmüller website address:** <http://www.weidmueller.com>

**⚠ DANGER**

If the shielding procedures described and the specified cable lengths are not observed, the machine may not operate properly.

**NOTICE**

Only use screws with a permissible mounting depth of 4 - 6 mm.

### 9.1.7 Technical data

Table 9- 15 Technical data

6SL3055-0AA00-3BAx	Unit	Value
Current requirement (X524 at 24 V DC) without DRIVE-CLiQ supply	mA	160
Current requirement (X514 at 24 V DC) without digital outputs and sensor power supply	mA	38
Sensor power supply with and without forced dormant error detection (L1+, L2+, L3+)		
• Voltage	V	24
• Max. load current per output	A	0.5
- Cable length for the 24 V supply: - For longer cable lengths, the "Weidmüller Type No. PU DS 24 16A" surge protector must be used.	m	< 30
• Fail-safe digital inputs (F-DI) (with electrical isolation)		10
• Fail-safe digital outputs (F-DO) (with electrical isolation)		4
• Standard digital inputs (with electrical isolation)		4
Fail-safe digital inputs (F-DI) and standard digital inputs		
• Voltage	V	0 to 30
• Low-level (an open digital input is interpreted as "low")	V	-3 to +5
• High level	V	15 to 30
• Current consumption (at 24 V DC)	mA	>2
• Input delay <sup>1)</sup>		
– for "0" to "1"	µs	approx. 30 (100 Hz)
– for "1" to "0"	µs	approx. 60 (100 Hz)
Fail-safe digital outputs (F-DO), continuous short-circuit proof		
• Voltage	V	24
• Max. load current per digital output	A	0.5
• Output delay <sup>1)</sup>		
– for "0" to "1"	µs	300
– for "1" to "0"	µs	350
Power loss	W	4.5 at 24 V
PE/ground connection		On enclosure with M4 screw
Weight	kg	approx. 0.9

<sup>1)</sup> Pure hardware delay

## 9.2 DRIVE-CLiQ Hub Module DMC20

### 9.2.1 Description

The DRIVE-CLiQ Hub Module DMC20 is a DRIVE-CLiQ component and can be snapped onto a standard mounting rail (EN 60715). It is only used to connect direct measuring systems for the feed axes and expansion axes of the S120 Combi.

---

**Note**

The DMC20 should also be used if only one feed axis is coupled with a direct measuring system.

---

A fixed topology applies when assigning the particular feed axis to a DRIVE-CLiQ interface (see Chapter "Topology rules for DRIVE-CLiQ") and this must be observed.

### 9.2.2 Safety information

 <b>WARNING</b>
--

The ventilation spaces of 50 mm above and below the component must be observed.
---

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

The unused DRIVE-CLiQ ports must be closed using a rubber plug that is included in the scope of delivery.
---

---

**Note**

All components operated on the DRIVE-CLiQ must be integrated into the equipotential bonding concept.  
They should preferably be connected by installing them on bare machine parts and devices, which are all equipotentially bonded to one another.  
Alternatively, equipotential bonding can be achieved by means of a conductor (min. 6 mm<sup>2</sup>), which should be routed parallel to the DRIVE-CLiQ where possible. This involves all distributed DRIVE-CLiQ participants.

---

### 9.2.3 Interface description

#### 9.2.3.1 Overview

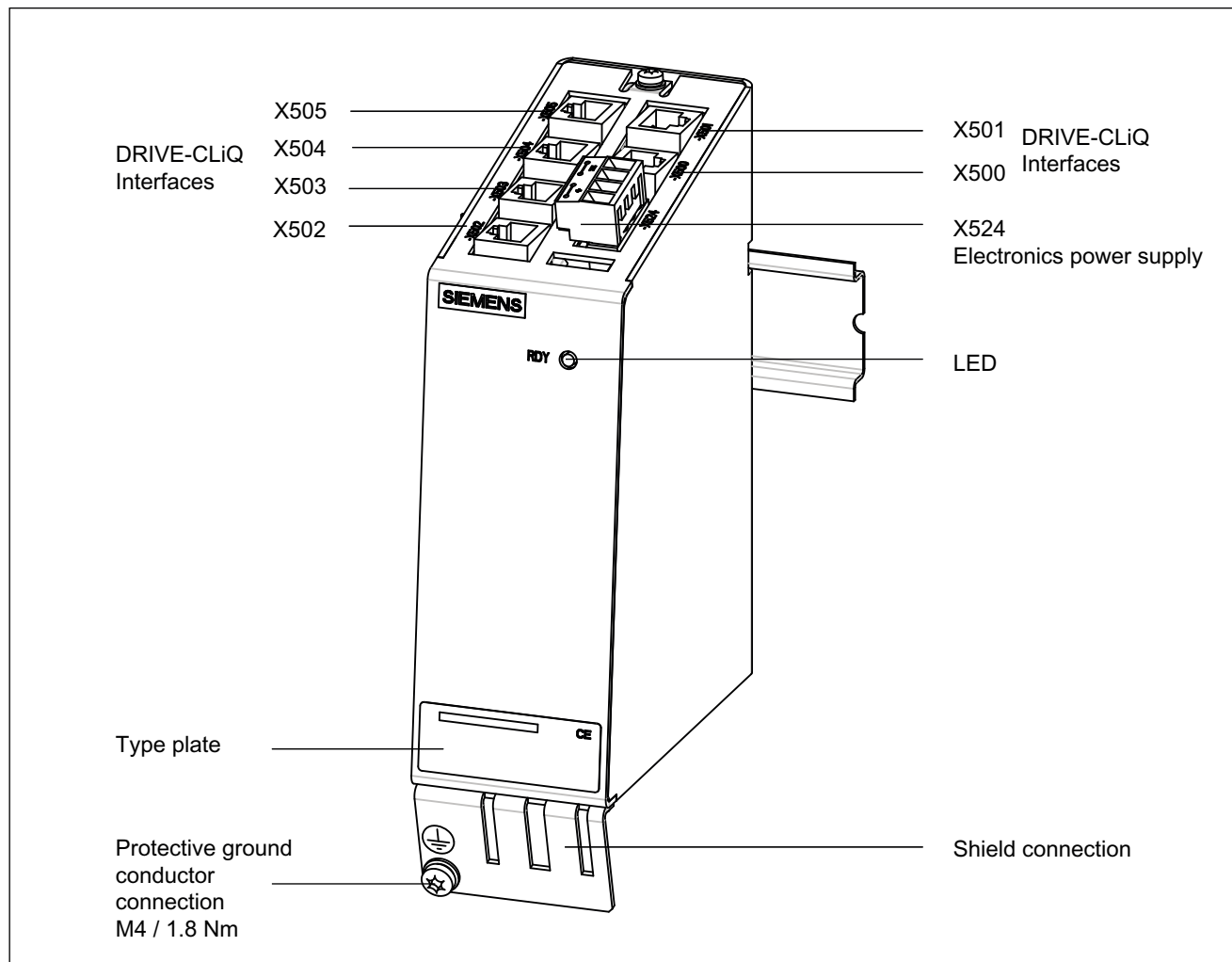
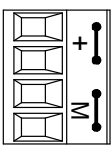


Figure 9-6 Interface description of the DMC20



### 9.2.3.2 X524 Electronics power supply

Table 9- 16 Terminals for the electronics power supply

	Terminal	Designation	Technical specifications
	+	Electronics power supply	Voltage: 24 V DC (20.4 V – 28.8 V) Current consumption: Max. 0.5 A  Max. current via jumper in connector: 20 A
	+	Electronics power supply	
	M	Electronics ground	
	M	Electronics ground	
Max. connectable cross-section: 2.5 mm <sup>2</sup> Type: Screw terminal 3 (see Chapter "Control cabinet installation and EMC / connection system")			

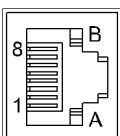
**Note**

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

The current consumption increases by the value for the DRIVE-CLiQ participants.

### 9.2.3.3 X500 - X505 DRIVE-CLiQ interfaces

Table 9- 17 DRIVE-CLiQ interfaces X500 - X505

	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)	Power supply
	B	M (0 V)	Electronics ground
Connector type: RJ45 socket DRIVE-CLiQ port rubber plug included in the scope of delivery; rubber plug (50 pieces) Order number: 6SL3066-4CA00-0AA0			

**Note**

Only MOTION-CONNECT DRIVE-CLiQ cables may be used to establish connections. The maximum length of MOTION-CONNECT 500 cables is 100 m and of MOTION-CONNECT 800 cables 50 m.

### 9.2.3.4 Meaning of the LED on the DMC20

Table 9- 18 Meaning of the LED on the DMC20

LED	Color	Status	Description
READY	-	Off	Electronics power supply is missing or outside permissible tolerance range.
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
	Orange	Continuous light	DRIVE-CLiQ communication is being established.
	Red	Continuous light	At least one fault is present in this component. <b>Note:</b> The LED is activated irrespective of whether the corresponding messages have been reconfigured.
	Green / Red	Flashing light 0.5 Hz	Firmware is being downloaded.
		Flashing 2 Hz	Firmware download is complete. Wait for POWER ON
	Green / Orange or Red / Orange	Flashing light	Component recognition via LED is activated (p0154). <b>Note:</b> Both options depend on the LED status when component recognition is activated via p0154 = 1.

#### Cause and rectification of faults

The following reference contains information about the cause of faults and how they can be rectified:

SINAMICS S120 Function Manual (FH1)

SINAMICS S120 Combi List Manual

### 9.2.4 Dimension drawing

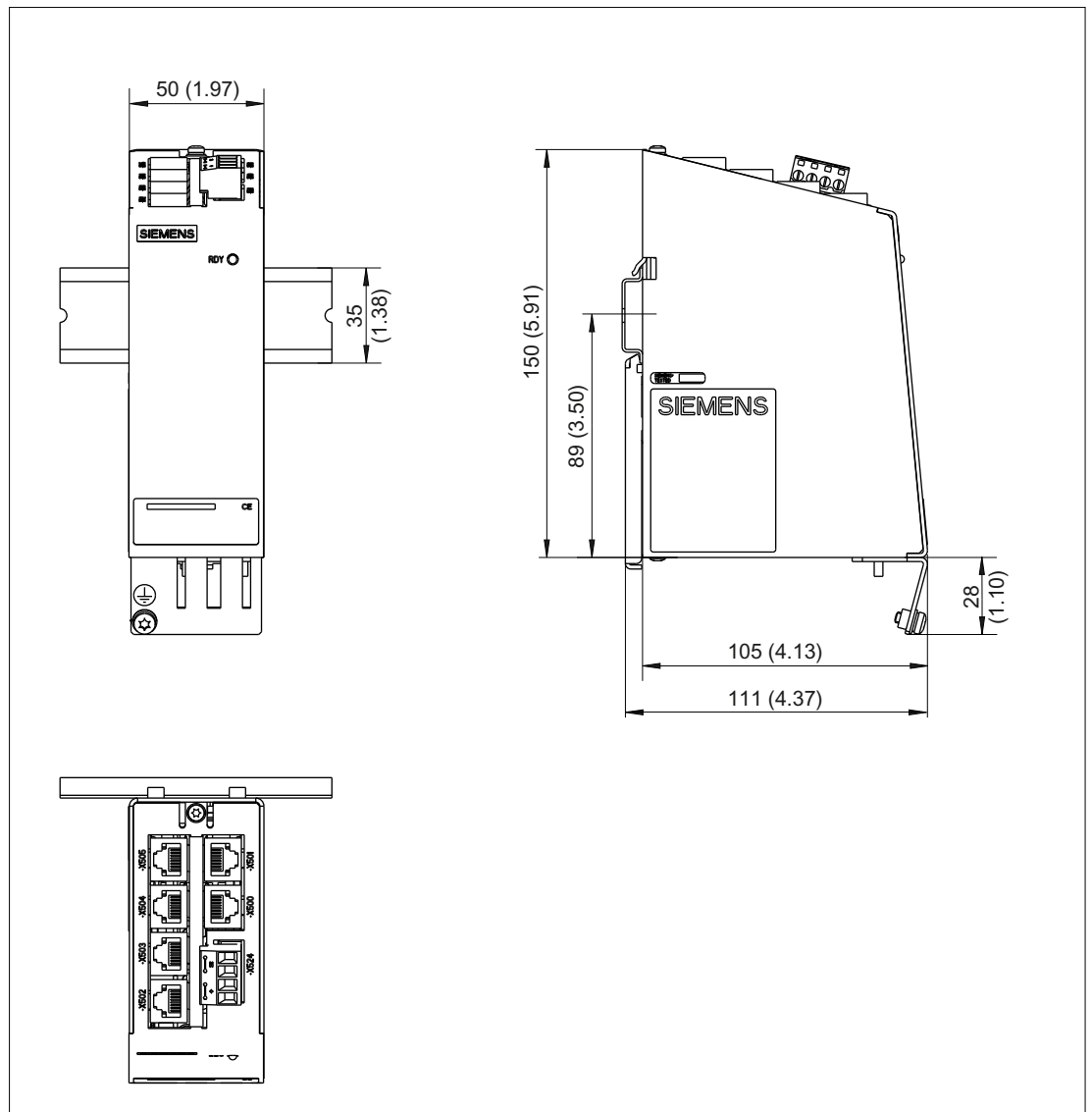


Figure 9-7 Dimension drawing of the DRIVE-CLiQ Hub Module DMC20, all data in mm and (inches)

## 9.2.5 Installation

### Installation

1. Tilt the component backwards slightly and attach it to the DIN rail using the hook.
2. Push the component towards the DIN rail until you hear the mounting slide at the rear latch into position.
3. You can now move the component to the left or right along the DIN rail, until it reaches its final position.

### Removal

1. The lug on the mounting slide first needs to be pushed down to unlock the slide from the DIN rail.
2. The component can now be tilted forwards and pulled up and off the DIN rail.

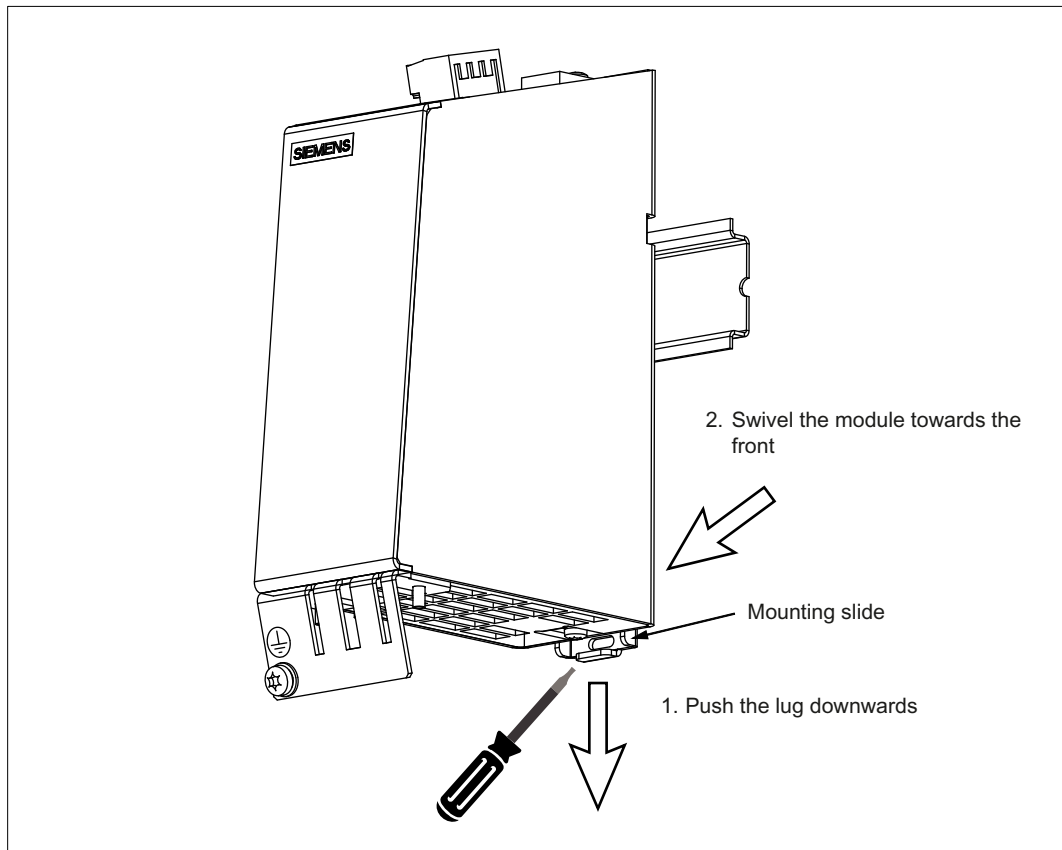


Figure 9-8 Removal of a component from a DIN rail

## 9.2.6 Technical data

Table 9- 19 Technical data of the DMC20

<b>6SL3055-0AA00-6AAx</b>	<b>Unit</b>	<b>Value</b>
Electronics power supply		
Voltage	V <sub>DC</sub>	24 DC (20.4 – 28.8)
Current (without DRIVE-CLiQ consumer)	A <sub>DC</sub>	0.15
PE/ground connection	At the housing with M4/1.8 Nm stud	
Weight	kg	0.8

## 9.3 DRIVE-CLiQ Hub Module External DME20

### 9.3.1 Description

The DRIVE-CLiQ Hub Module External DME20, just like the DRIVE-CLiQ Hub Module DMC20, is only used to connect direct measuring systems for the feed axes and expansion axes of the S120 Combi.

The component has degree of protection IP67.

---

**Note**

The DME20 should also be used if only one feed axis is coupled with a direct measuring system.

---

A fixed topology applies when assigning the particular feed axis to a DRIVE-CLiQ interface (see Chapter "Topology rules for DRIVE-CLiQ") and this must be observed.

### 9.3.2 Safety information

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

In order to guarantee degree of protection IP67, all of the plug connectors must be correctly screwed into place and appropriately locked.
--

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

The unused DRIVE-CLiQ ports must be closed using a rubber plug that is included in the scope of delivery.
---

---

**Note**

All components operated on the DRIVE-CLiQ must be integrated into the equipotential bonding concept.

They should preferably be connected by installing them on bare machine parts and devices, which are all equipotentially bonded to one another.

Alternatively, equipotential bonding can be achieved by means of a conductor (min. 6 mm<sup>2</sup>), which should be routed parallel to the DRIVE-CLiQ where possible. This applies to all distributed DRIVE-CLiQ participants.

For the DME20 this also applies to the 24 V power supply.

---

### 9.3.3 Interface description

#### 9.3.3.1 Overview

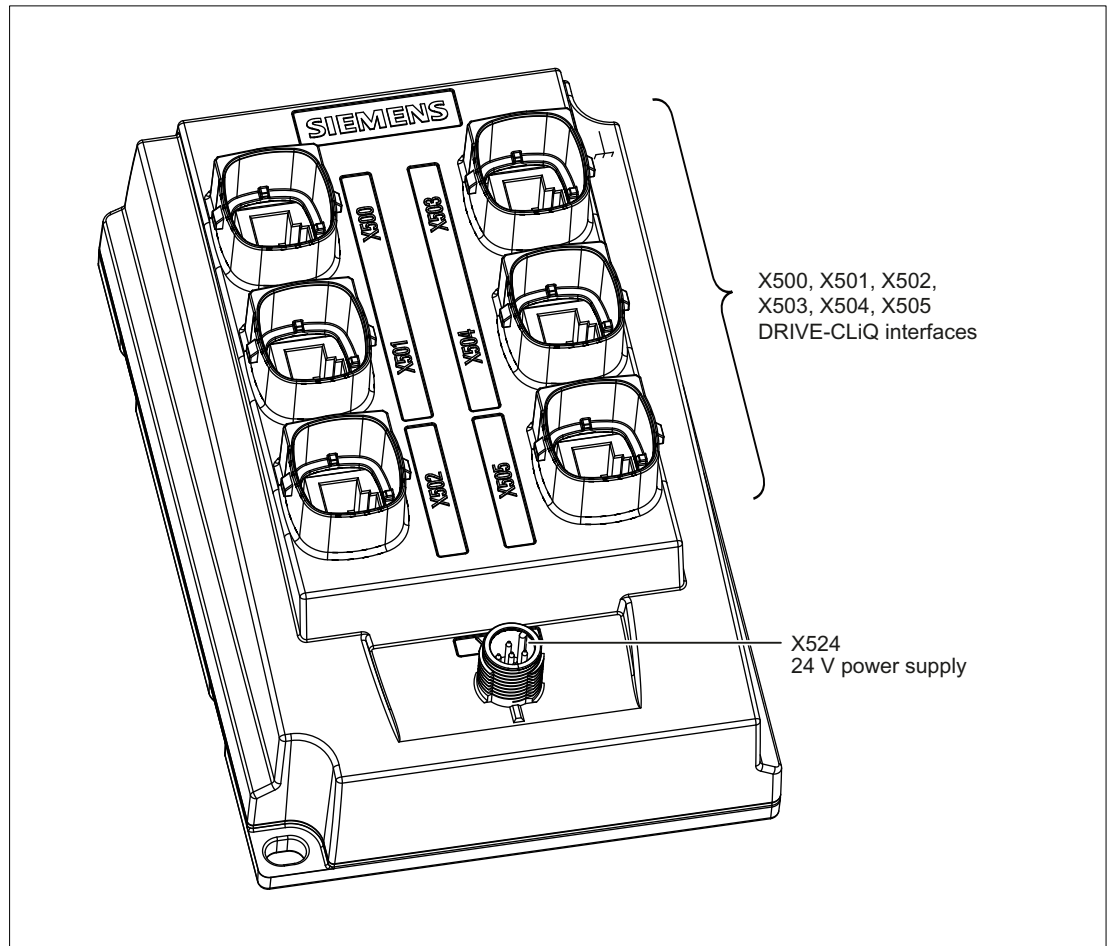
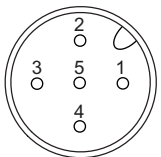


Figure 9-9 Interface description of the DME20

### 9.3.3.2 X524 Electronics power supply

Table 9- 20 X524 socket for the electronics power supply

	Pin	Designation	Technical specifications
	1	Electronics power supply	The connection voltage of 20.4 V – 28.8 V refers to the (terminal) voltage at the DME20. This must be taken into account when selecting the cable cross-section and supply cable lengths. Pins 1 and 2: jumpered internally Pins 3 and 4: jumpered internally
	2	Electronics power supply	
	3	Electronics ground	
	4	Electronics ground	
	5	not connected	
Max. connectable cross-section: 4 x 0.75 mm <sup>2</sup> e.g. 5-pole shielded connector, user-assembled: Phoenix company, Order No.: 1508365, 4-pole non-shielded connector, user-assembled, Speedcon quick-lock: Phoenix company, Order No. 1521601			

#### Note

The maximum cable length for the 24 V supply of the DME20 is 100 m.

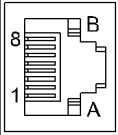
Table 9- 21 Cable length of P24 supply cable

connected loads <sup>1)</sup>	1	2	3	4	5
<b>Cross section</b>					
0.34 mm <sup>2</sup>	75 m	45 m	30 m	25 m	20 m
2 x 0.34 mm <sup>2</sup>	100 m	90 m	65 m	50 m	40 m
0.75 mm <sup>2</sup>	100 m	100 m	75 m	60 m	50 m
2 x 0.75 mm <sup>2</sup>	100 m	100 m	100 m	100 m	100 m
<sup>1)</sup> Connected motors with DRIVE-CLiQ encoder, DRIVE CLiQ mounted encoder SME Ta = 55 °C 100 m DRIVE-CLiQ					



### 9.3.3.3 X500 - X505 DRIVE-CLiQ interfaces

Table 9- 22 DRIVE-CLiQ interfaces X500 - X505

	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)	Power supply	
	B	M (0 V)	Electronics ground	
	Connector type: RJ45 socket; blanking plate for DRIVE-CLiQ interfaces included in the scope of delivery; blanking plate (50 pieces) order number: 6SL3066-4CA00-0AA0			

#### Note

Only MOTION-CONNECT DRIVE-CLiQ cables may be used to establish connections. The maximum length of MOTION-CONNECT 500 cables is 100 m and of MOTION-CONNECT 800 cables 50 m.

### 9.3.4 Dimension drawing

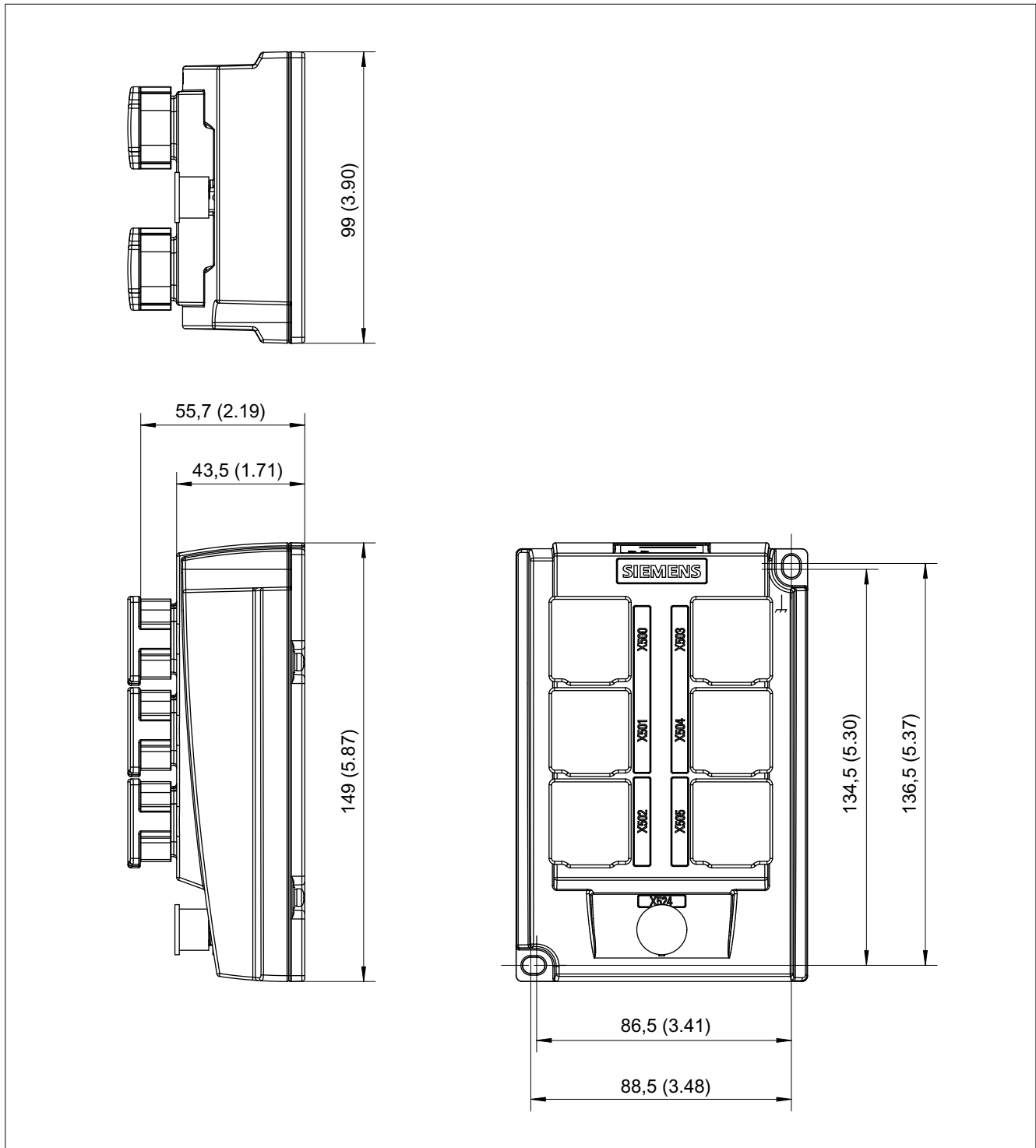


Figure 9-10 Dimension drawing of the DRIVE-CLiQ Hub Module External DME20, all data in mm and (inches)

### 9.3.5 Installation

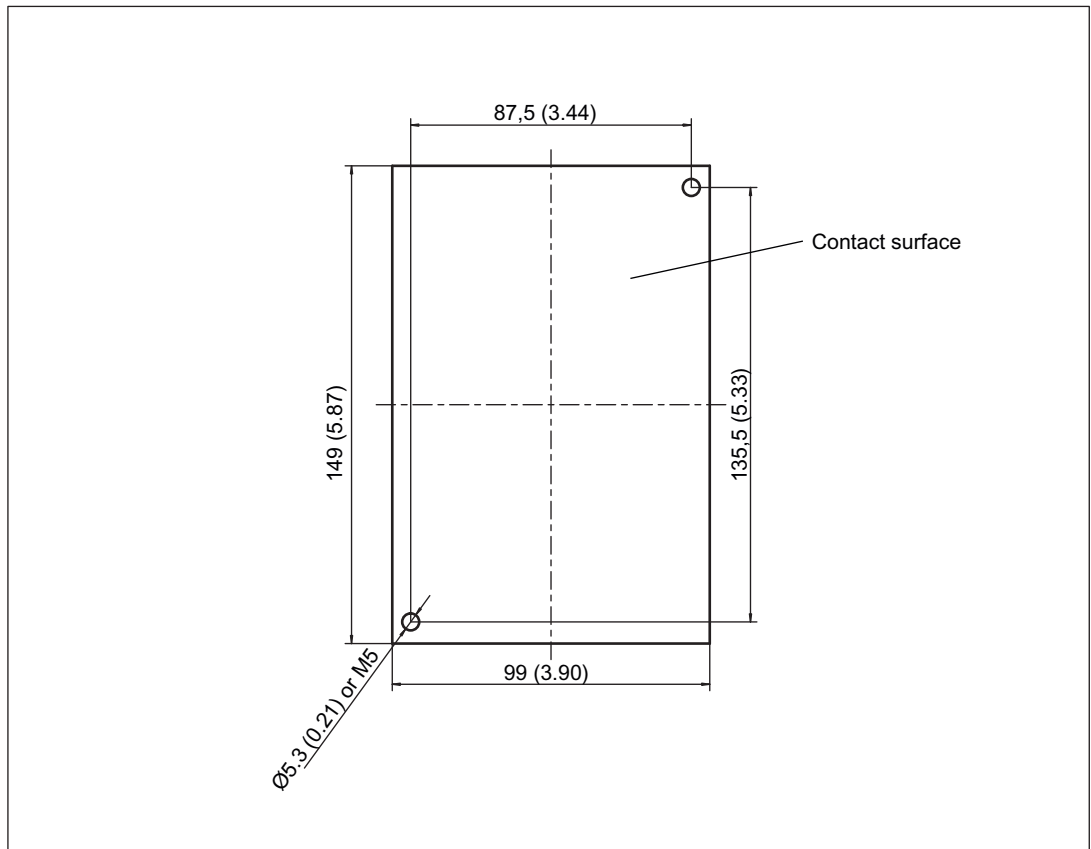


Figure 9-11 DME20 installation

#### Installation

1. Place the hole drilling template on the contact surface.
2. The contact surfaces must be unpainted metal.
3. Holes Ø5.3 or threads M5
4. Tighten with a tightening torque of 6.0 Nm.

### 9.3.6 Technical data

Table 9- 23 Technical data of the DME20

6SL3055-0AA00-6ABx	Unit	Value
Electronics power supply		
Voltage	V <sub>DC</sub>	24 DC (20.4 – 28.8)
Current (without DRIVE-CLiQ node)	A <sub>DC</sub>	0.15
PE/ground connection	Fastened to housing M5 / 6 Nm	
Degree of protection	IP67	
Weight	kg	0.8

### 9.3.7 Specifications for use with UL approval

#### Pre-assembled cables

Sensor/actuator cable, 5-pin, variable cable,  
free cable end at straight socket M12-SPEEDCON,  
cable length: 2, 5, 10, 15 m  
SAC-5P-xxx-186/FS SCO  
Up to 100 m on request

Phoenix Contact, [www.phoenixcontact.com](http://www.phoenixcontact.com)

#### Cables to be assembled by the user

Cable	Connector
Cable coil, black PUR/PVC, 5-pin Conductor colors: brown/white/blue/black/gray Cable length: 100 m SAC-5P-100.0-186/0.75 Order number: 1535590	Sensor/actuator connector, socket, straight, 5-pin, M12, A-coded Screw connection, metal knurl, cable gland Pg9 SACC-M12FS-5CON-PG9-M Order number: 1681486
Phoenix Contact, <a href="http://www.phoenixcontact.com">www.phoenixcontact.com</a>	

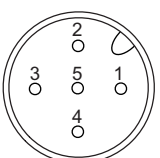
#### Power supply

The DME20 must be connected to a 24 V power supply with voltage limitation.

- SITOP 6EP1x.. or 6ES7307..
- SINAMICS Control Supply Module 6SL3100-1DE22-0Axx

#### Pin assignment of the cable

Table 9- 24 Connection to X524 electronics power supply

	Pin	Designation	Technical specifications
	1 (brown) <sup>1)</sup>	Electronics power supply	The connection voltage of 20.4 V – 28.8 V refers to the (terminal) voltage at the DME20. This must be taken into account when selecting the cable cross-section and supply cable lengths. Pins 1 and 2: jumpered internally Pins 3 and 4: jumpered internally
	2 (white) <sup>1)</sup>	Electronics power supply	
	3 (black) <sup>1)</sup>	Electronics ground	
	4 (blue) <sup>1)</sup>	Electronics ground	
	5 (gray) <sup>1)</sup>	Not connected internally	

1) The colors stated refer to the cable specified above



## Encoder system connection

### 10.1 Sensor Module Cabinet-Mounted SMC20

#### 10.1.1 Description

The Sensor Module Cabinet-Mounted SMC20 evaluates encoder signals and transmits the speed, actual position value, rotor position and, if necessary, the motor temperature and reference point via DRIVE-CLiQ to the S120 Combi.

The SMC20 is used to evaluate encoder signals from incremental encoders with SIN/COS (1 Vpp) or absolute encoders with EnDat 2.1 or SSI.

#### 10.1.2 Safety information

 <b>WARNING</b>
--

The ventilation spaces of 50 mm above and below the component must be observed.
---

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

Only one encoder system may be connected per Sensor Module.
---

---

**Note**

There must be no electrical connection between the encoder system housing and the signal cables, or the encoder system electronics. If this is not carefully observed, under certain circumstances the system will not be able to reach the required interference immunity level (there is then a danger of equalization currents flowing through the electronics ground).

 <b>CAUTION</b>
--

Connecting cables to temperature sensors must always be installed with shielding. The cable shield must be connected to the ground potential at both ends over a large surface area. Temperature sensor cables that are routed together with the motor cable must be twisted in pairs and shielded separately.
--

### 10.1.3 Interface description

#### 10.1.3.1 Overview

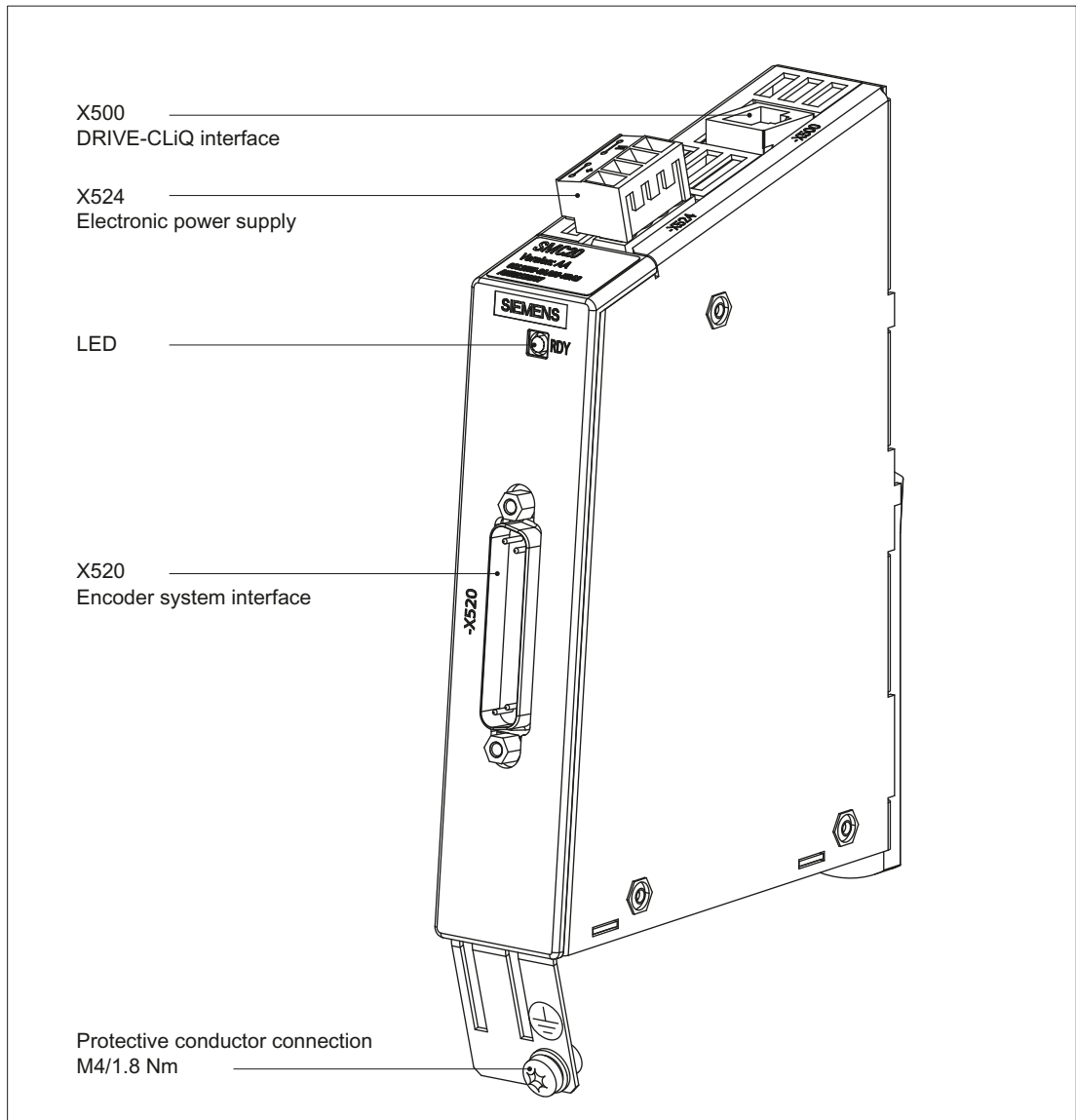
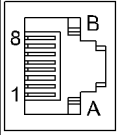


Figure 10-1 Interface description of the SMC20



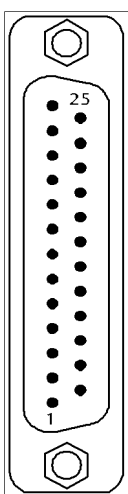
## 10.1.3.2 DRIVE-CLiQ interface X500


Table 10- 1 DRIVE-CLiQ interface X500

	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	Reserved, do not use	
	B	GND (0 V)	Electronics ground

10.1.3.3 X520 encoder system interface

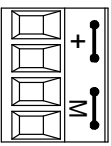
Table 10- 2 X520 encoder system interface

	Pin	Signal name	Technical specifications
	1	P encoder	Encoder power supply
	2	M encoder	Ground for encoder power supply
	3	A	Incremental signal A
	4	A*	Inverse incremental signal A
	5	Ground	Ground (for internal shield)
	6	B	Incremental signal B
	7	B*	Inverse incremental signal B
	8	Ground	Ground (for internal shield)
	9	Reserved, do not use	
	10	Clock	Clock, EnDat interface, SSI clock
	11	Reserved, do not use	
	12	Clock*	Inverted clock, EnDat interface, inverted SSI clock
	13	+ Temp	Motor temperature measurement KTY84-1C130 (KTY+) Temperature sensor KTY84-1C130 / PTC
	14	P sense	Sense input encoder power supply
	15	Data	Data, EnDat interface, SSI data
	16	M sense	Ground sense input encoder power supply
	17	R	Reference signal R
	18	R*	Inverse reference signal R
	19	C	Absolute track signal C
	20	C*	Inverse absolute track signal C
	21	D	Absolute track signal D
	22	D*	Inverse absolute track signal D
	23	Data*	Inverse data, EnDat interface, Inverse SSI data
	24	Ground	Ground (for internal shield)
	25	- Temp	Motor temperature measurement KTY84-1C130 (KTY-) Temperature sensor KTY84-1C130 / PTC

 <b>DANGER</b>
<p><b>Risk of electric shock!</b></p> <p>Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp".</p> <p>If these instructions are not complied with, there is a risk of electric shock!</p>

### 10.1.3.4 X524 Electronics power supply

Table 10- 3 X524 terminal strip

	Terminal	Function	Technical specifications
	+	Electronics power supply	Voltage: 24 V (20.4 V – 28.8 V) Current consumption: Max. 0.35 A Maximum current via jumper in connector: 20 A
	+	Electronics power supply	
	M	Electronics ground	
	M	Electronics ground	

Max. connectable cross-section: 2.5 mm<sup>2</sup>  
 Type: Screw terminal 3 (see Chapter "Control cabinet installation and EMC / connection system")

#### Note

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

### 10.1.3.5 Meaning of LEDs on the Sensor Module Cabinet-Mounted SMC20

Table 10- 4 Sensor Module Cabinet-Mounted SMC20 – description of the LEDs

LED	Color	Status	Description, cause	Remedy
RDY READY	-	Off	Electronics power supply is missing or outside permissible tolerance range.	-
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	-
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	-
	Red	Continuous light	At least one fault is present in this component. <b>Note:</b> The LED is activated irrespective of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
	Green / Red	0.5 Hz flashing light	Firmware is being downloaded.	-
		2 Hz flashing light	Firmware download is complete. Wait for POWER ON	Carry out a POWER ON
	Green / Orange or Red / Orange	Flashing light	Component recognition via LED is activated (p0144). <b>Note:</b> Both options depend on the LED status when component recognition is activated via p0144 = 1.	-

#### Cause and rectification of faults

The following reference contains information about the cause of faults and how they can be rectified:

References: SINAMICS S120 Commissioning Manual (IH1)

10.1.4 Dimension drawing

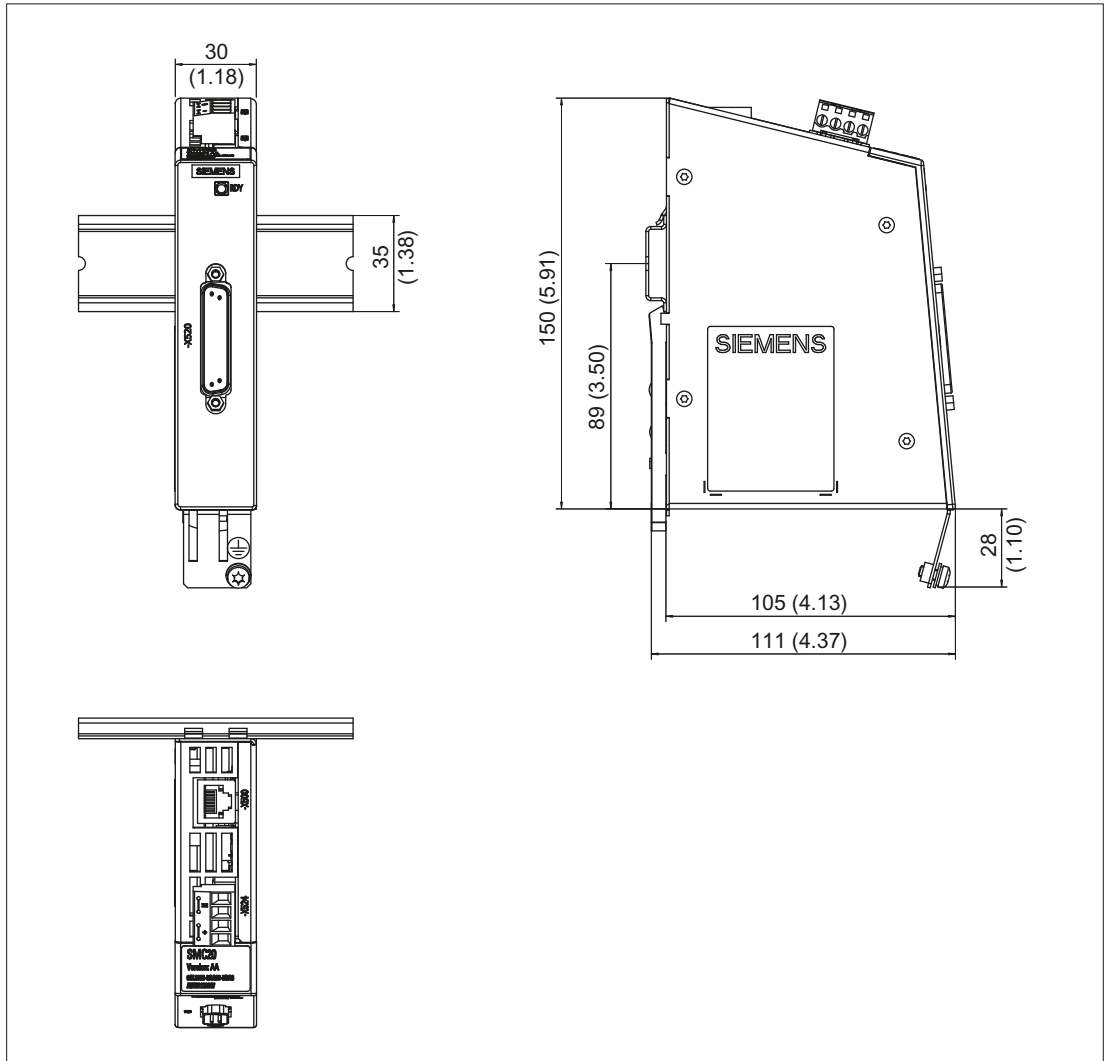


Figure 10-2 Dimension drawing of the Sensor Module Cabinet SMC20, all data in mm and (inches)

## 10.1.5 Installation

### Installation

1. Tilt the component backwards slightly and attach it to the DIN rail using the hook.
2. Push the component towards the DIN rail until you hear the mounting slide at the rear latch into position.
3. You can now move the component to the left or right along the DIN rail, until it reaches its final position.

### Removal

1. The lug on the mounting slide first needs to be pushed down to unlock the slide from the DIN rail.
2. The component can now be tilted forwards and pulled up and off the DIN rail.

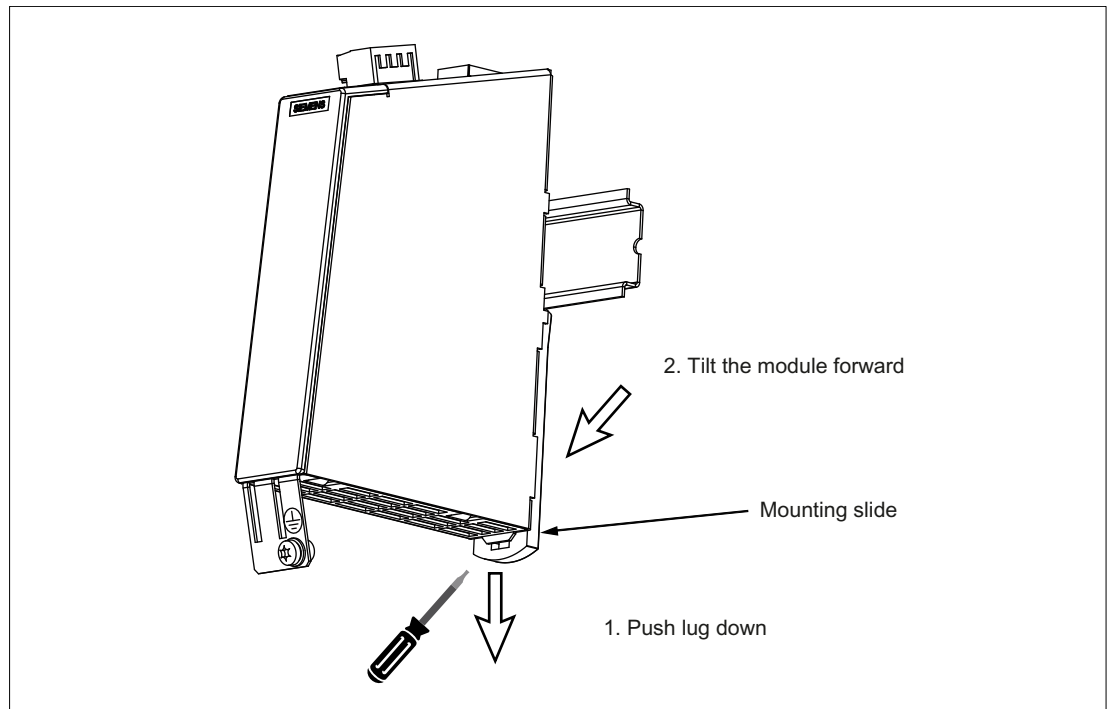


Figure 10-3 Removal of a component from a DIN rail

## 10.1.6 Technical data

Table 10- 5 Technical data

6SL3055-0AA00-5BAx	Unit	Value
<b>Electronics power supply</b>		
Voltage	V <sub>DC</sub>	24 DC (20.4 – 28.8)
Current (without encoder system)	A <sub>DC</sub>	≤ 0.20
Current (with encoder system)	A <sub>DC</sub>	≤ 0.35
Power loss	W	≤ 10
<b>Encoder system power supply</b>		
Voltage	V <sub>encoder</sub>	5 V DC (with Remote Sense) <sup>1)</sup>
Current	A <sub>encoder</sub>	0.35
Encoder frequency that can be evaluated (f <sub>encoder</sub> )	kHz	≤ 500
SSI baud rate <sup>2)</sup>	kHz	100 (6SL3055-0AA00-5BA2) 100 - 250 (6SL3055-0AA00-5BA3)
Max. encoder cable length	m	100
PE/ground connection		On housing with M4/1.8 Nm screw
Weight	kg	0.45
Degree of protection		IP20 or IPXXB

1) A controller compares the encoder system supply voltage - sensed via the Remote Sense cables - with the reference supply voltage of the encoder system, and adjusts the supply voltage for the encoder system at the output of the drive module until the required supply voltage is obtained directly at the encoder system (only for 5 V encoder system power supply).

2) Only possible for SSI encoders with 5 V supply

## 10.2 Sensor Module External SME20

### 10.2.1 Description

Direct encoder systems outside the cabinet can be connected to the Sensor Module External SME20. The SME20 evaluates these encoder systems and converts the calculated values to DRIVE-CLiQ.

Incremental direct encoder systems with SIN/COS (1 Vpp) and reference signal can be connected.

It is possible to connect a motor with a 17-pole circular connector for the encoder to the 12-pole circular connector of the SME20 using adapter cable 6FX 8002-2CA88-xxxx.

- KTY/PTC temperature sensors can be used for evaluation of the motor temperature.
- The Sensor Module is only suitable for motors without absolute track signals (C/D track):
  - Induction motors (e.g. 1PH)
  - Synchronous motors with pole position identification (e.g. 1FN, 1FW, 1FE)

Neither motor nor encoder data are saved in the SME20.

### 10.2.2 Safety Information

<b>CAUTION</b>
Connecting cables to temperature sensors must always be installed with shielding. The cable shield must be connected to the chassis potential at both ends over a large surface area. Temperature sensor cables that are routed together with the motor cable must be twisted in pairs and shielded separately.

### 10.2.3 Interface description

#### 10.2.3.1 Overview

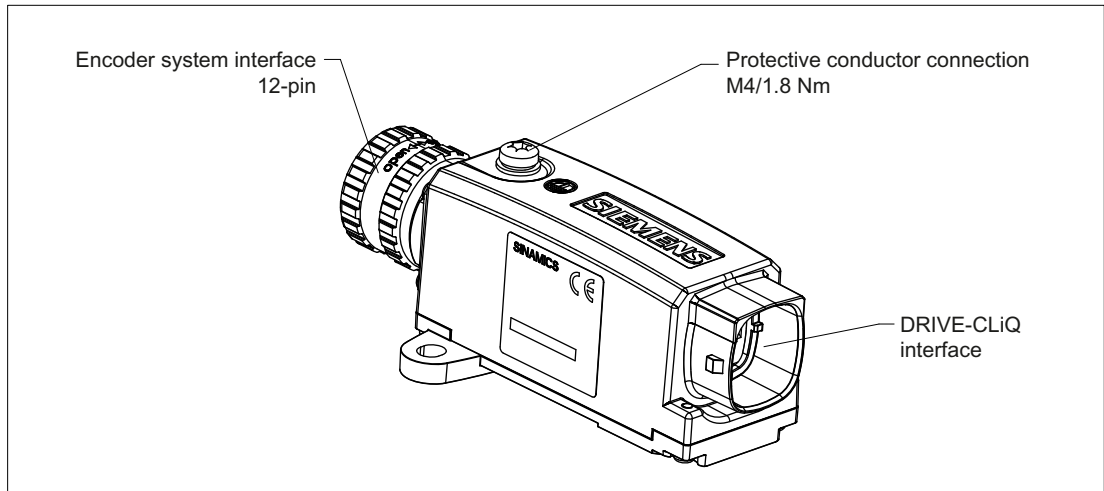


Figure 10-4 Interface description SME20

#### 10.2.3.2 Connection example

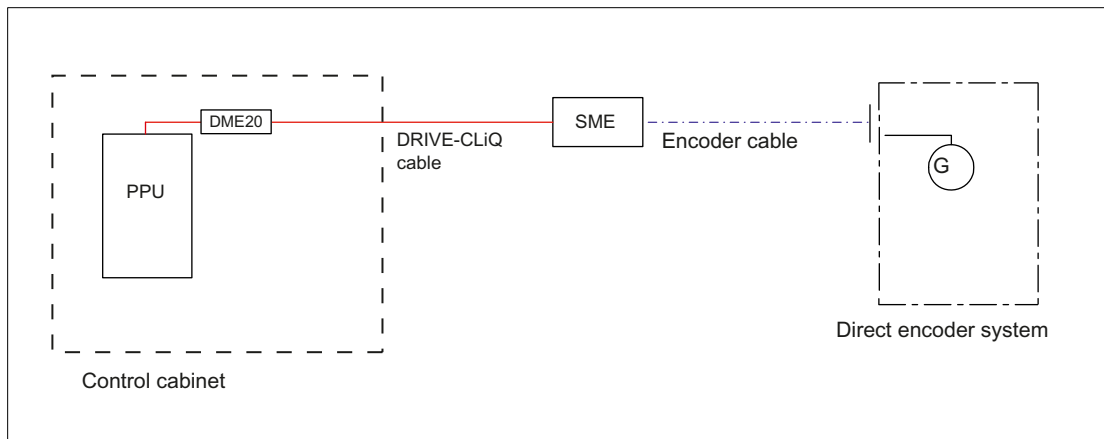
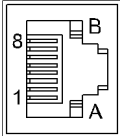


Figure 10-5 Connection of a direct encoder system via a Sensor Module External (SME)



### 10.2.3.3 DRIVE-CLiQ interface

Table 10- 6 DRIVE-CLiQ interface

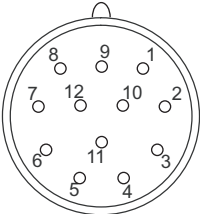
	Pin	Signal name	Technical specifications	
	1	TXP	Transmit data +	
	2	TXN	Transmit data -	
	3	RXP	Receive data +	
	4	Reserved, do not use		
	5	Reserved, do not use		
	6	RXN	Receive data -	
	7	Reserved, do not use		
	8	Reserved, do not use		
	A	+ (24 V)	Power supply	
	B	M (0 V)	Electronics ground	
	DRIVE-CLiQ port rubber plug included in the scope of delivery; rubber plug (50 pieces) Order number: 6SL3066-4CA00-0AA0 Current consumption: max. 0.25 A			

**Note**

Only MOTION-CONNECT DRIVE-CLiQ cables may be used for connections. The maximum cable length for MOTION-CONNECT 500 cables is 100 m and for MOTION-CONNECT 800 cables, 50 m.


10.2.3.4 Encoder system interface

Table 10- 7 Encoder system interface SME20

	Pin	Signal name	Technical specifications
	1	B*	Inverse incremental signal B
	2	P5	Encoder power supply
	3	R	Reference signal R
	4	R*	Inverse reference signal R
	5	A	Incremental signal A
	6	A*	Inverse incremental signal A
	7	-Temp	Temperature sensor connection <sup>1)</sup> KTY841-C130 or PTC
	8	B	Incremental signal B
	9	+Temp	Temperature sensor connection <sup>1)</sup> KTY841-C130 or PTC
	10	M	Ground for encoder power supply
	11	M	Ground for encoder power supply
	12	P5	Encoder power supply

Blanking plate for encoder system interface: Pöppelmann GmbH & Co. KG, Lohne,  
 Order No.: GPN 300 F211  
 connector kits, 12-pole, Order No.: 6FX2003-0SA12

1) Connection cable: Order number 6FX8002-2CA88-xxxx

 <b>DANGER</b>
<p><b>Risk of electric shock!</b></p> <p>Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp".</p> <p>If these instructions are not complied with, there is a risk of electric shock!</p>

### 10.2.4 Dimension drawing

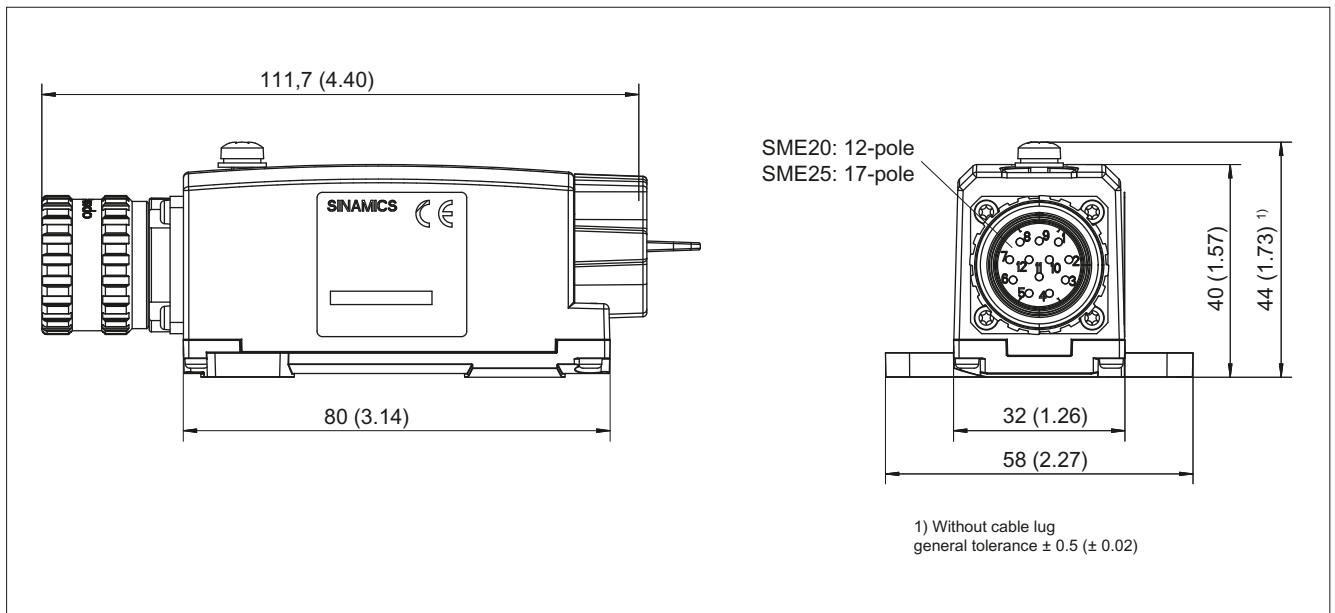


Figure 10-6 Dimension drawing of Sensor Module External SME20, all data in mm and (inches), order number 6SL3055-0AA00-5EA3

### 10.2.5 Installation

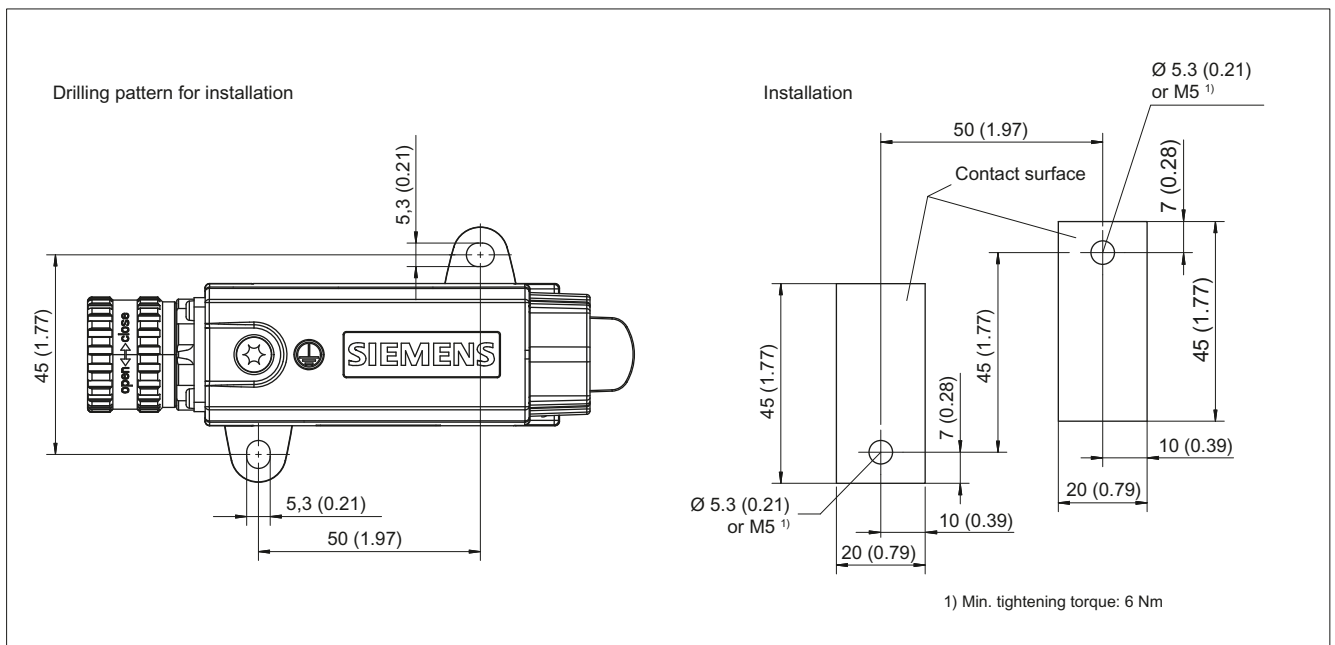


Figure 10-7 SME20/SME25 installation

**Procedure**

1. Place the drilling pattern on the bright contact surface
2. Holes  $\varnothing$  5.3 or threads M5
3. Tighten with a min. torque of 6 Nm.

**10.2.6 Technical data**

Table 10- 8 Technical data

6SL3055-0AA00-5EA3	Unit	Value
Electronics power supply		
Voltage	$V_{DC}$	24 DC (20.4 – 28.8)
Current (without encoder system)	$A_{DC}$	$\leq 0.15$
Current (with encoder system)	$A_{DC}$	$\leq 0.25$
Power loss	W	$\leq 4$
Encoder system power supply		
Voltage	$V_{encoder}$	5 VDC
Current	$A_{encoder}$	0.35
Encoder frequency that can be evaluated ( $f_{encoder}$ )	kHz	$\leq 500$
PE/ground connection		On enclosure with M4/1.8 Nm screw
Weight	kg	0.31
Degree of protection		IP67

The maximum cable length at the encoder system interface depends on the current consumption of the encoder system and the cross-section of the supply cores in the cable. However, the maximum length is 10 m.

For encoder systems that operate in a supply voltage range from 4.75 V to 5.25 V, the following diagram is obtained. The sample parameters shown are 0.28 mm<sup>2</sup> cross-section (0.14 mm<sup>2</sup> supply cores plus 0.14 mm<sup>2</sup> Remote Sense cores) and 0.64 mm<sup>2</sup> (0.5 mm<sup>2</sup> supply cores plus 0.14 mm<sup>2</sup> Remote Sense cores).

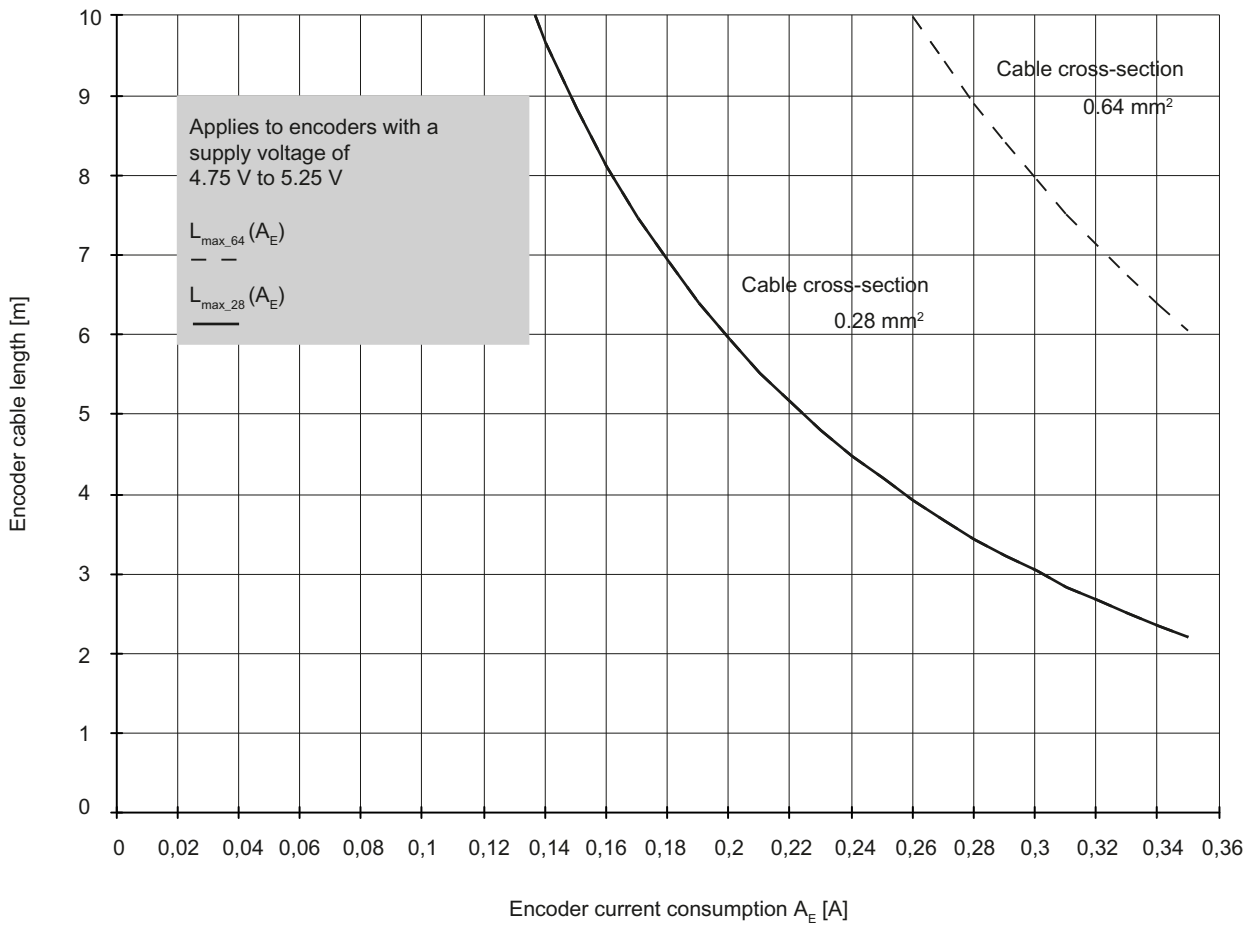


Figure 10-8 Max. cable length as a function of the current drawn by the encoder system

In addition to the encoder systems for a supply voltage range of 4.75 V to 5.25 V in the figure above, encoder systems are also available for an extended range down to 3.6 V. These can be generally operated using encoder system cables up to 10 m long provided that the total cross-section of the supply core plus Remote Sense cores does not fall below 0.14 mm<sup>2</sup>.

## 10.3 Sensor Module External SME25

### 10.3.1 Description

Direct encoder systems outside the cabinet can be connected to the Sensor Module External SME25. The SME25 evaluates these encoder systems and converts the calculated values to DRIVE-CLiQ.

Direct encoder systems with EnDat 2.1 or SSI with SIN/COS (1 Vpp) incremental signals can be connected, however without reference signal.

Neither motor nor encoder data are saved in the SME25.

### 10.3.2 Interface description

#### 10.3.2.1 Overview

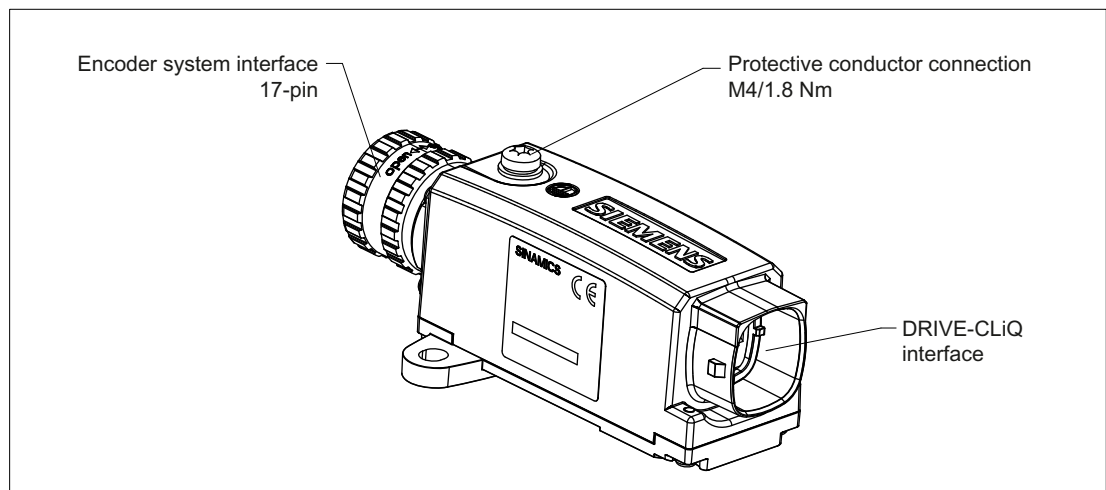


Figure 10-9 Interface description SME25

### 10.3.2.2 Connection example

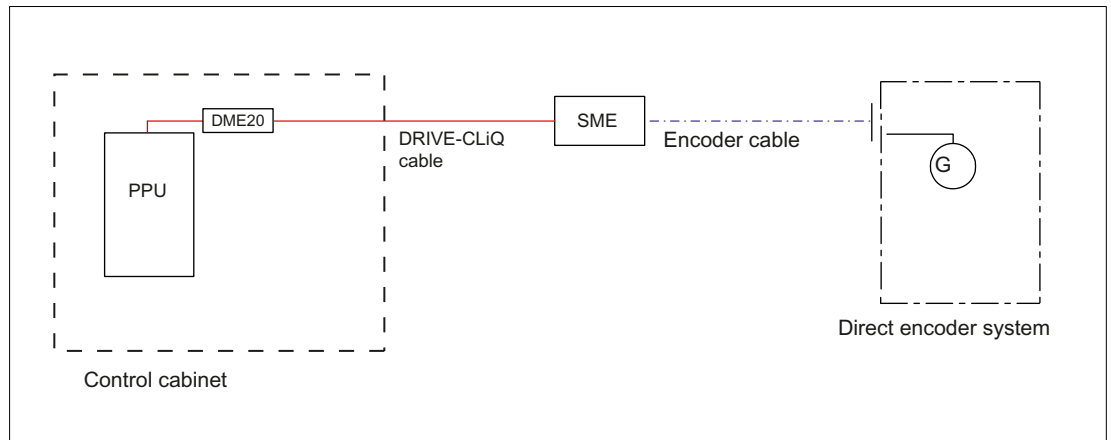


Figure 10-10 Connection of a direct encoder system via a Sensor Module External (SME)

### 10.3.2.3 DRIVE-CLiQ interface

Table 10-9 DRIVE-CLiQ interface

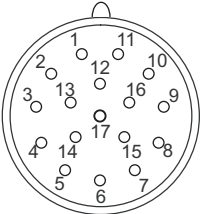
	Pin	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
	DRIVE-CLiQ port rubber plug included in the scope of delivery; rubber plug (50 pieces) Order number: 6SL3066-4CA00-0AA0 Current consumption: max. 0.25 A		

#### Note

Only MOTION-CONNECT DRIVE-CLiQ cables may be used for connections. The maximum cable length for MOTION-CONNECT 500 cables is 100 m and for MOTION-CONNECT 800 cables, 50 m.

10.3.2.4 Encoder system interface

Table 10- 10 Encoder system interface SME25

	Pin	Signal name	Technical specifications
	1	P5	Encoder power supply
	2	Reserved, do not use	
	3	Reserved, do not use	
	4	M	Ground for encoder power supply
	5	Reserved, do not use	
	6	Reserved, do not use	
	7	P5	Encoder power supply
	8	Clock	Clock, EnDat interface, SSI clock <sup>1)</sup>
	9	Clock*	Inverse clock, EnDat interface, Inverse SSI clock <sup>1)</sup>
	10	M	Ground for encoder power supply
	11	Enclosure potential	
	12	B	Incremental signal B
	13	B*	Inverse incremental signal B
	14	Data	Data, EnDat interface, SSI data <sup>1)</sup>
	15	A	Incremental signal A
	16	A*	Inverse incremental signal A
	17	Data*	Inverse data EnDat interface, Inverse SSI data <sup>1)</sup>

Blanking plate for encoder system interface: Pöppelmann GmbH & Co. KG, Lohne,  
 Order No.: GPN 300 F211  
 connector kits, 17-pin, Order No.: 6FX2003-0SA17



### 10.3.3 Dimension drawing

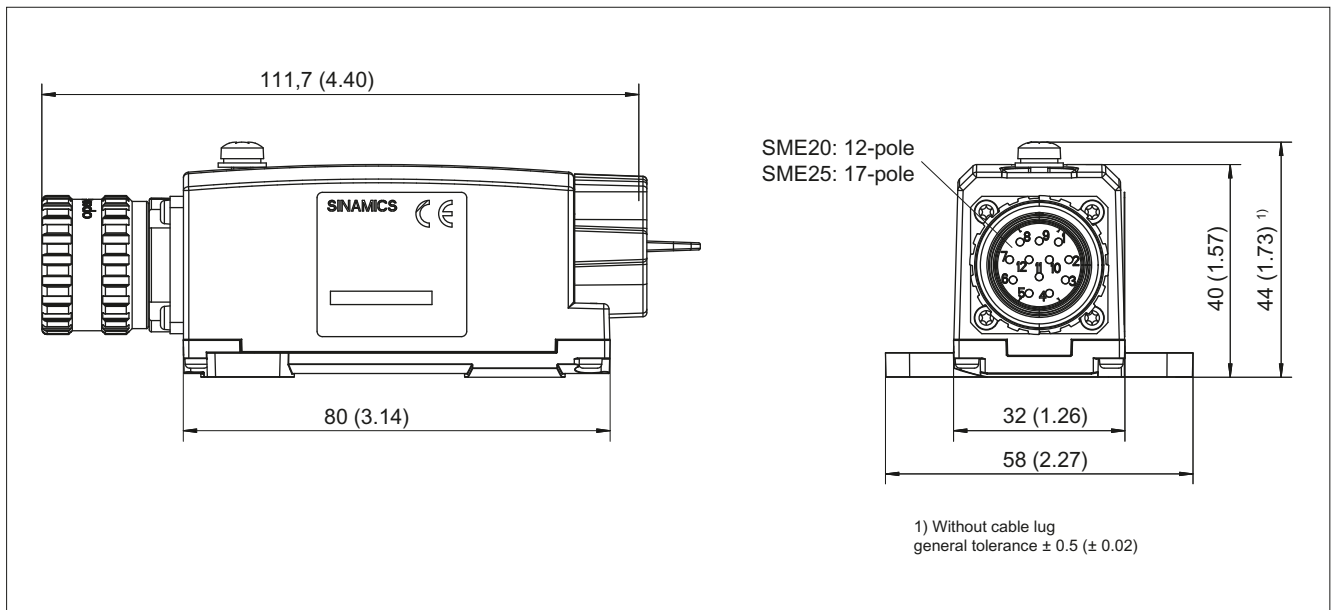


Figure 10-11 Dimension drawing of Sensor Module External SME25, all data in mm and (inches), order number 6SL3055-0AA00-5HA3

### 10.3.4 Installation

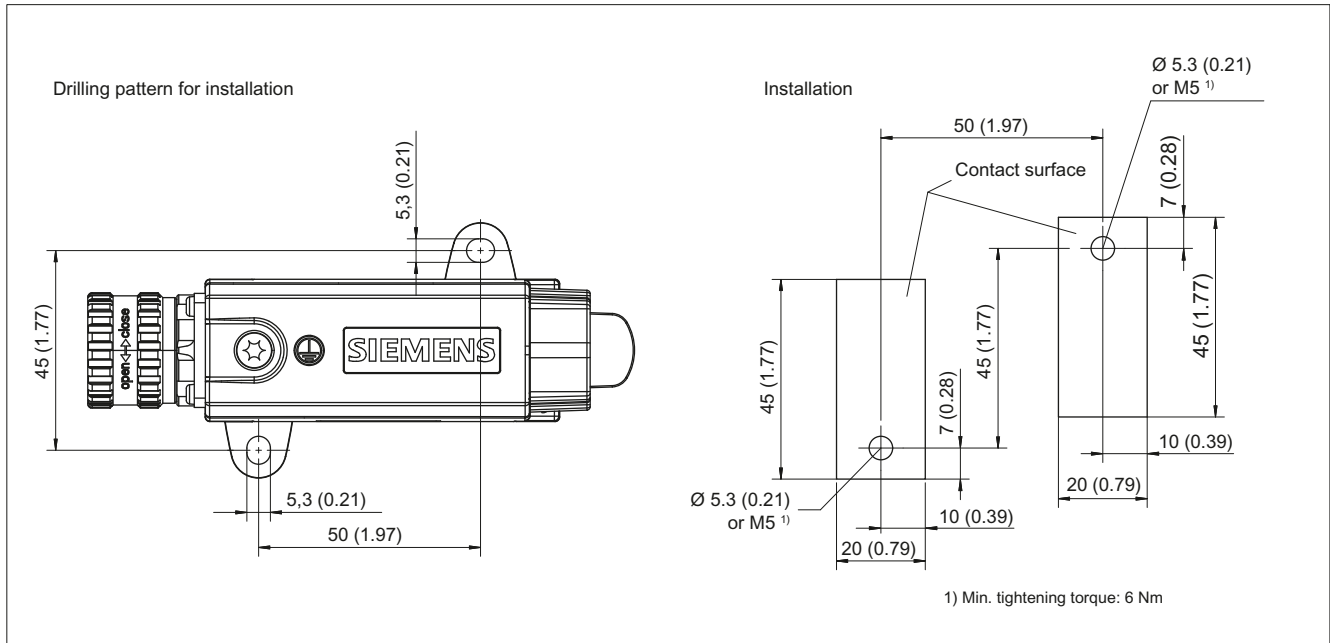


Figure 10-12 SME20/SME25 installation

#### Procedure

1. Place the drilling pattern on the bright contact surface
2. Holes Ø 5.3 or threads M5
3. Tighten with a min. torque of 6 Nm.

### 10.3.5 Technical data

Table 10- 11 Technical data

<b>6SL3055-0AA00-5HA3</b>	<b>Unit</b>	<b>Value</b>
Electronics power supply		
Voltage	$V_{DC}$	24 DC (20.4 – 28.8)
Current (without encoder system)	$A_{DC}$	$\leq 0.15$
Current (with encoder system)	$A_{DC}$	$\leq 0.25$
Power loss	$W$	$\leq 4$
Encoder system power supply		
Voltage	$V_{encoder}$	5 VDC
Current	$A_{encoder}$	0.35
Encoder frequency that can be evaluated ( $f_{encoder}$ )	$kHz$	$\leq 500$
SSI/EnDat 2.1 baud rate	$kHz$	100
PE/ground connection		On enclosure with M4/1.8 Nm screw
Weight	$kg$	0.31
Degree of protection		IP67

The maximum cable length at the encoder system interface depends on the current consumption of the encoder system and the cross-section of the supply cores in the cable. However, the maximum length is 10 m.

For encoder systems that operate in a supply voltage range from 4.75 V to 5.25 V, the following diagram is obtained. The sample parameters shown are 0.28 mm<sup>2</sup> cross-section (0.14 mm<sup>2</sup> supply cores plus 0.14 mm<sup>2</sup> Remote Sense cores) and 0.64 mm<sup>2</sup> (0.5 mm<sup>2</sup> supply cores plus 0.14 mm<sup>2</sup> Remote Sense cores).

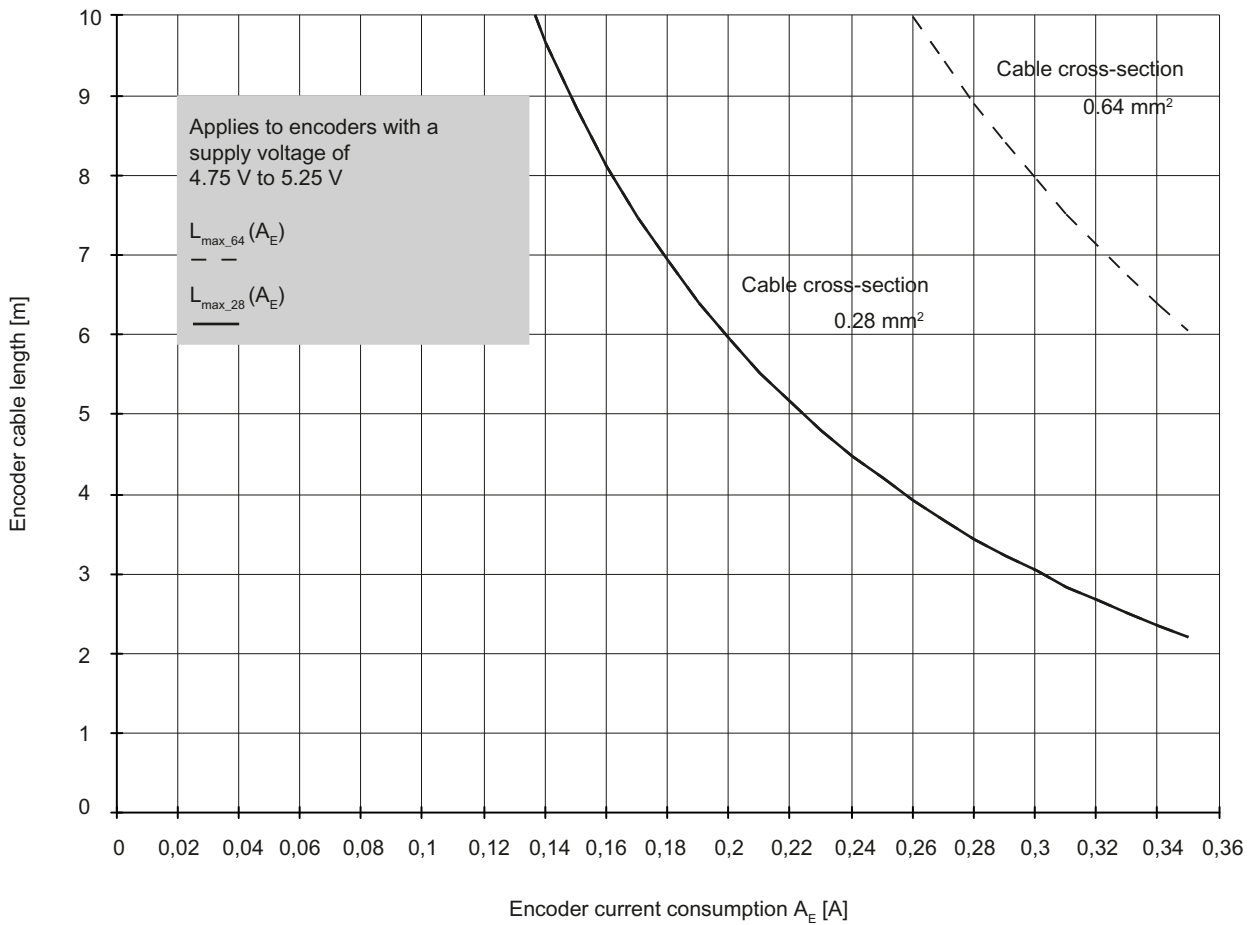


Figure 10-13 Max. cable length as a function of the current drawn by the encoder system

In addition to the encoder systems for a supply voltage range of 4.75 V to 5.25 V in the figure above, encoder systems are also available for an extended range down to 3.6 V. These can be generally operated using encoder system cables up to 10 m long provided that the total cross-section of the supply core plus Remote Sense cores does not fall below 0.14 mm<sup>2</sup>.

## Accessories

### 11.1 DRIVE-CLiQ cabinet bushing

#### 11.1.1 Description

The DRIVE-CLiQ cabinet bushing is used to connect two DRIVE-CLiQ cables and can be installed in a control cabinet wall.

At the interface outside the control cabinet, a DRIVE-CLiQ connection is established with degree of protection IP67 according to EN 60529; however, inside the control cabinet, a connection is created with degree of protection IP20 or IPXXB according to EN 60529. The interface between the control cabinet wall and the DRIVE-CLiQ cabinet bushing requires degree of protection IP54 according to EN 60529.

In addition to the data lines, the power supply contacts of DRIVE-CLiQ are also routed via the coupling.

#### 11.1.2 Safety Information

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**Note**

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

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### 11.1.3 Interface description

#### 11.1.3.1 Overview

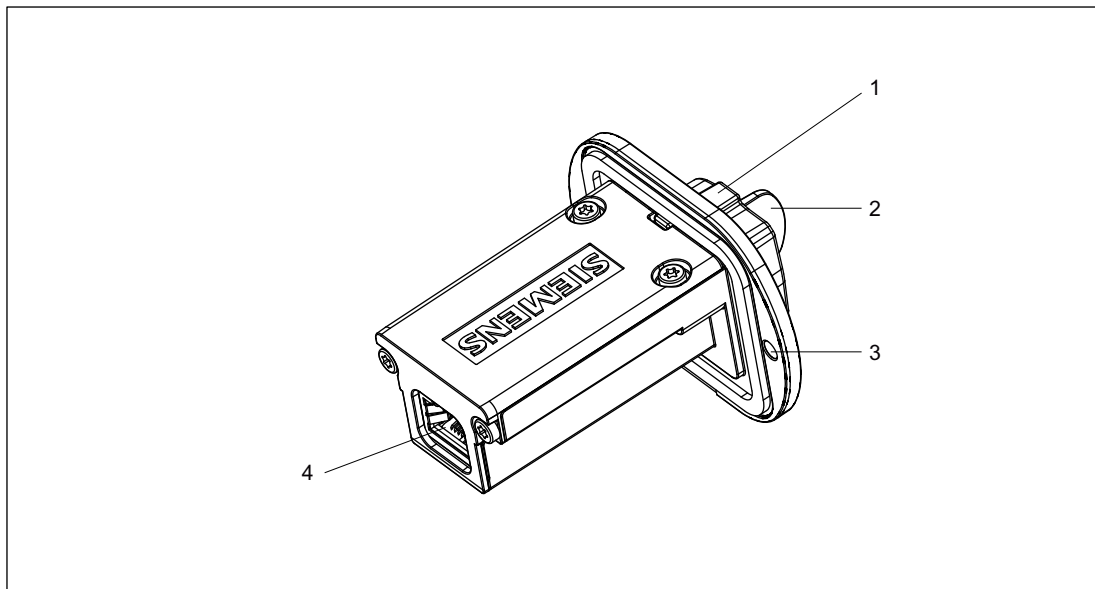


Figure 11-1 DRIVE-CLiQ cabinet bushing

1	Covering cap, Yamaichi, order number: Y-ConAS-24-S
2	IP67 interface according to EN 60529
3	Mounting holes
4	IP20 or IPXXB interface according to EN 60529

## 11.1.4 Dimension drawing

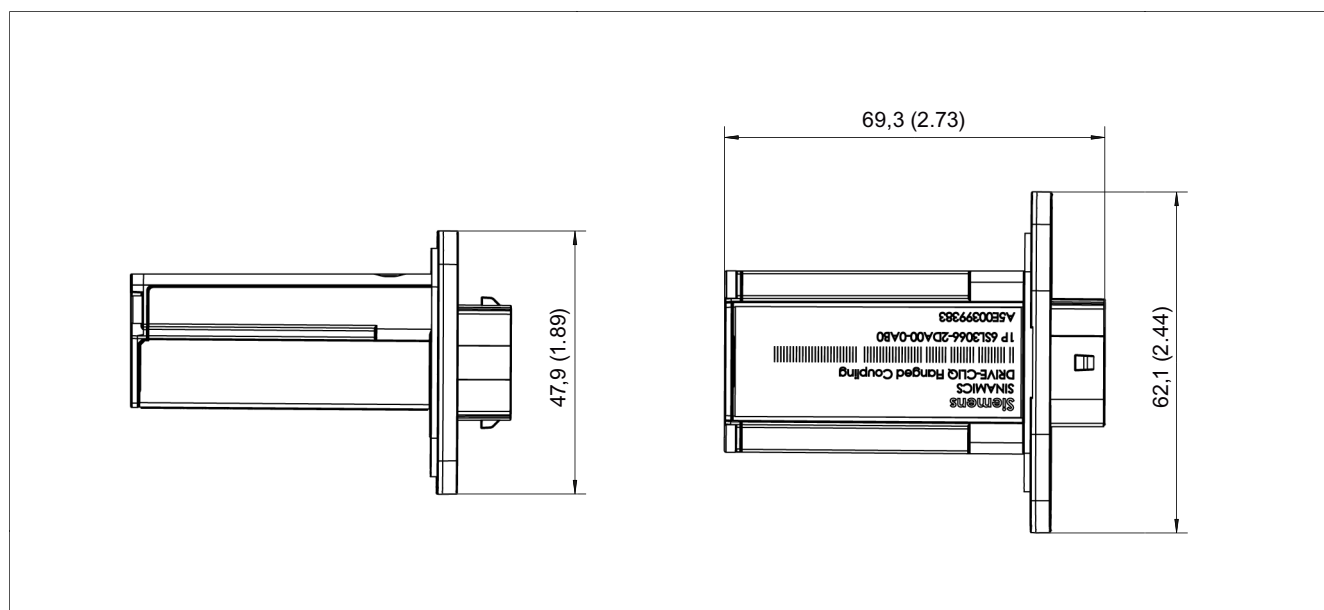


Figure 11-2 Dimension drawing of the DRIVE-CLiQ cabinet bushing, all dimensions in mm and (inches)

### 11.1.5 Installation

In order to install the DRIVE-CLiQ cabinet bushing, a cut-out must be made in the control cabinet panel according to the diagram shown below.

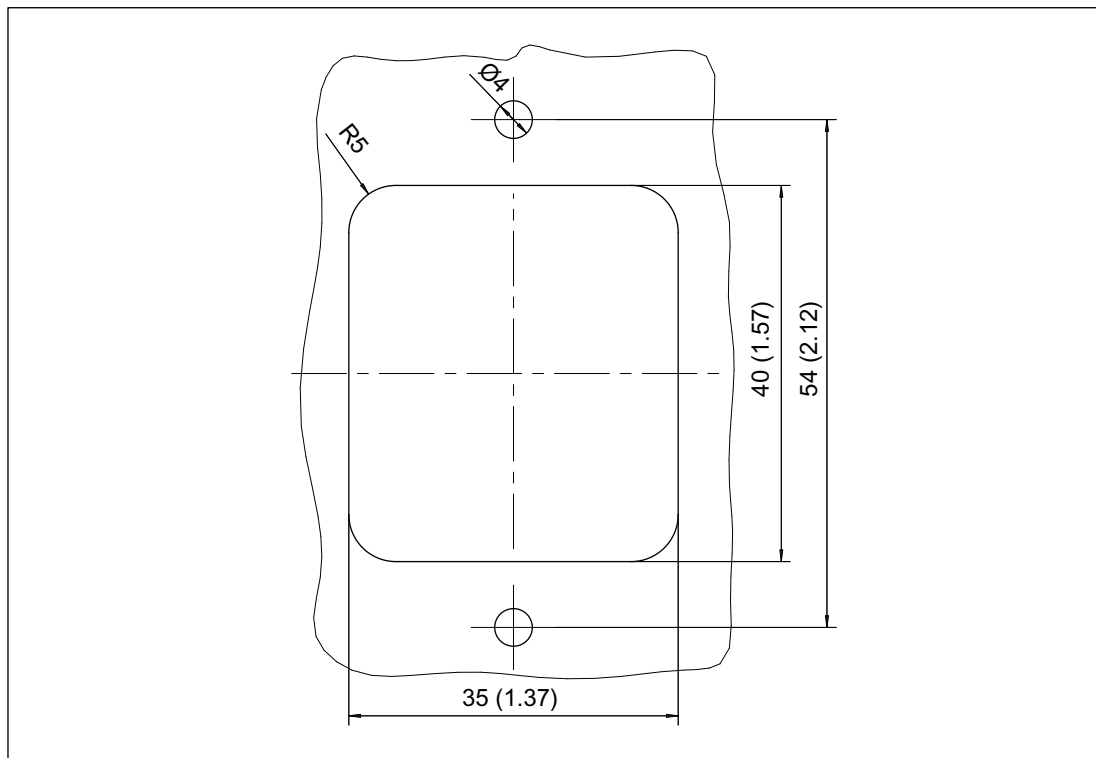


Figure 11-3 Cut-out for the cabinet



## Installation

1. Insert the components from the outer side of the cabinet through the opening in the cabinet.
2. Secure the DRIVE-CLiQ cabinet bushing to the outer control cabinet wall using two M3 screws and two nuts. In order to ensure good electromagnetic compatibility, a good electrical connection must be established between the DRIVE-CLiQ cabinet bushing and the cabinet wall over a large surface area.

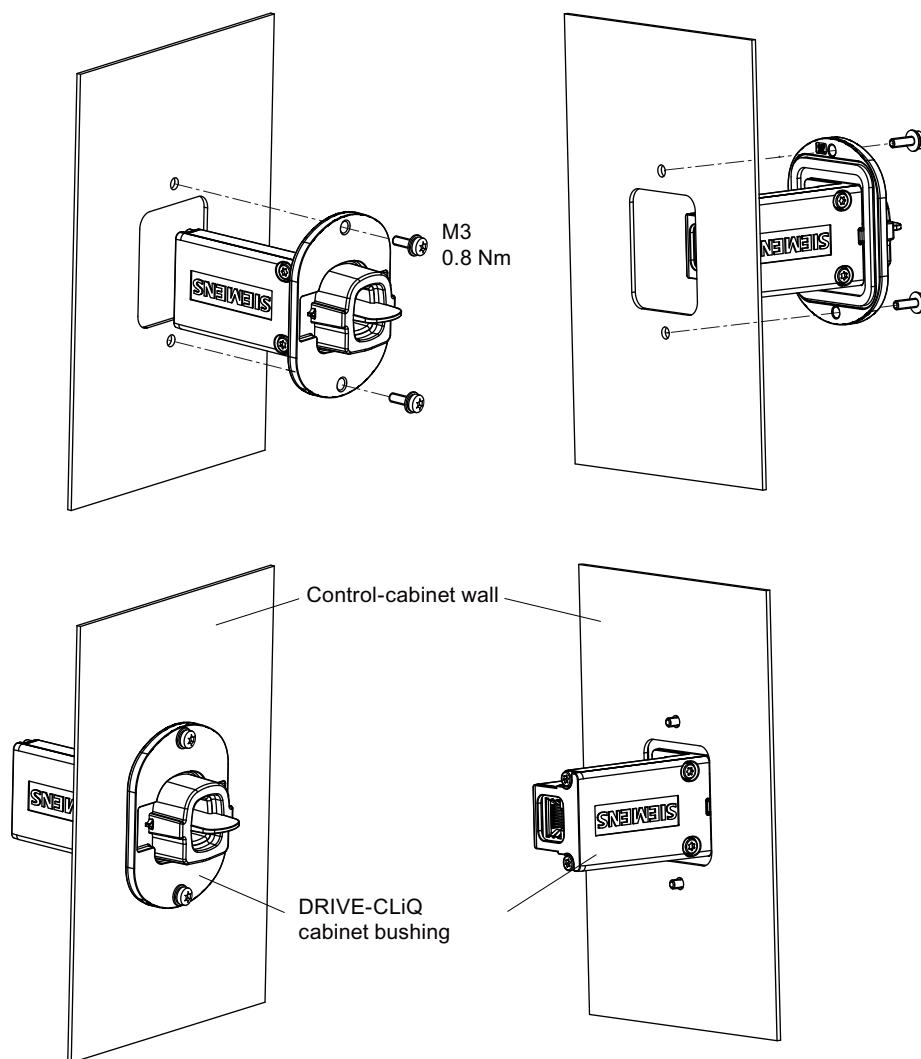


Figure 11-4 Installing the DRIVE-CLiQ cabinet bushing

### 11.1.6 Technical data

Table 11- 1 Technical data

<b>DRIVE-CLiQ cabinet bushing 6SL3066-2DA00-0AA0</b>	<b>Unit</b>	
Weight	kg	0.165
Degree of protection	IP20 or IPXXB acc. to EN 60529 in the electrical cabinet IP54 to EN 60529 outside the electrical cabinet	

## 11.2 DRIVE-CLiQ coupling

### 11.2.1 Description

The DRIVE-CLiQ coupling is used to connect two DRIVE-CLiQ cables in accordance with degree of protection IP67 acc. to EN 60529.

In addition to the data lines, the power supply contacts of DRIVE-CLiQ are also routed via the coupling.

You can find information on the permissible cable length in the chapter "DRIVE-CLiQ signal cables".

### 11.2.2 Safety information

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#### Note

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

---

### 11.2.3 Interface description

#### 11.2.3.1 Overview

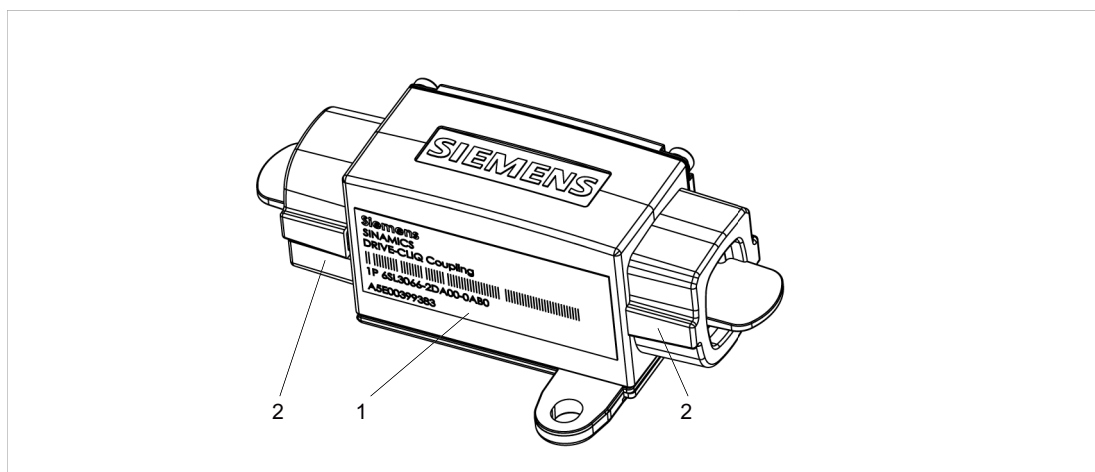


Figure 11-5 DRIVE-CLiQ coupling

1	Rating plate
2	Covering caps, Yamaichi, order number: Y-ConAS-24-S

### 11.2.4 Dimension drawing

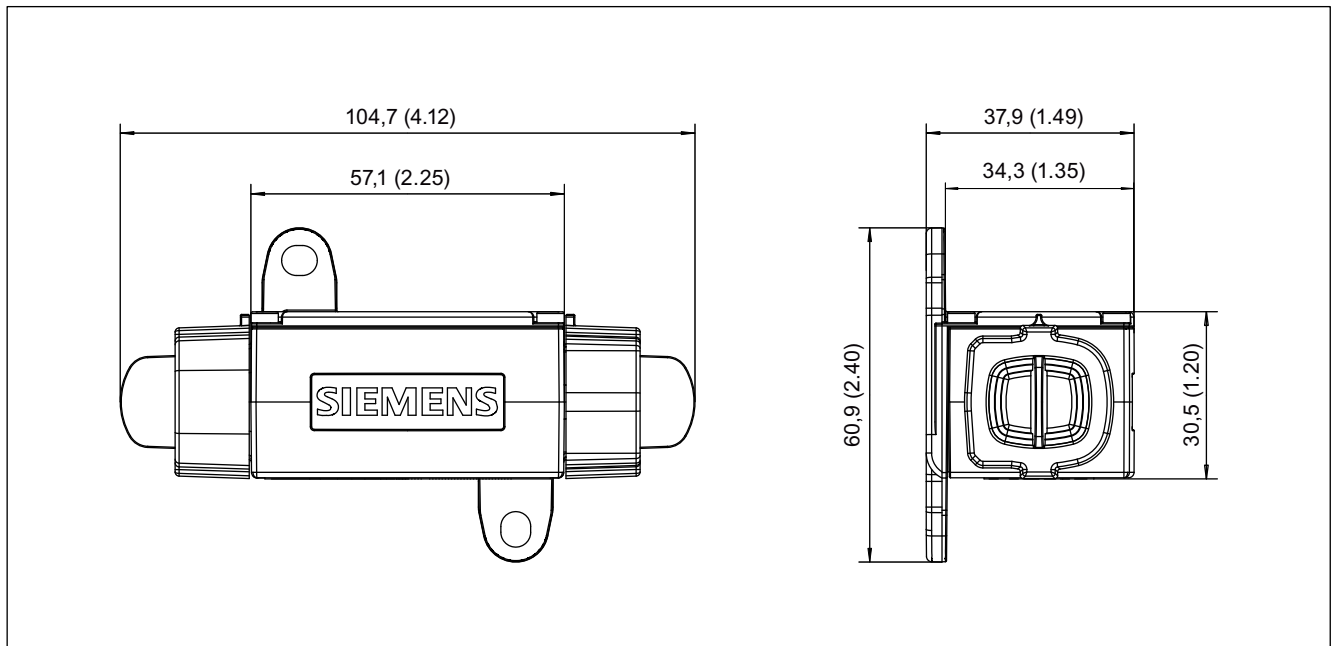


Figure 11-6 Dimension drawing of the DRIVE-CLiQ coupling, all dimensions in mm and (inches)

## 11.2.5 Installation

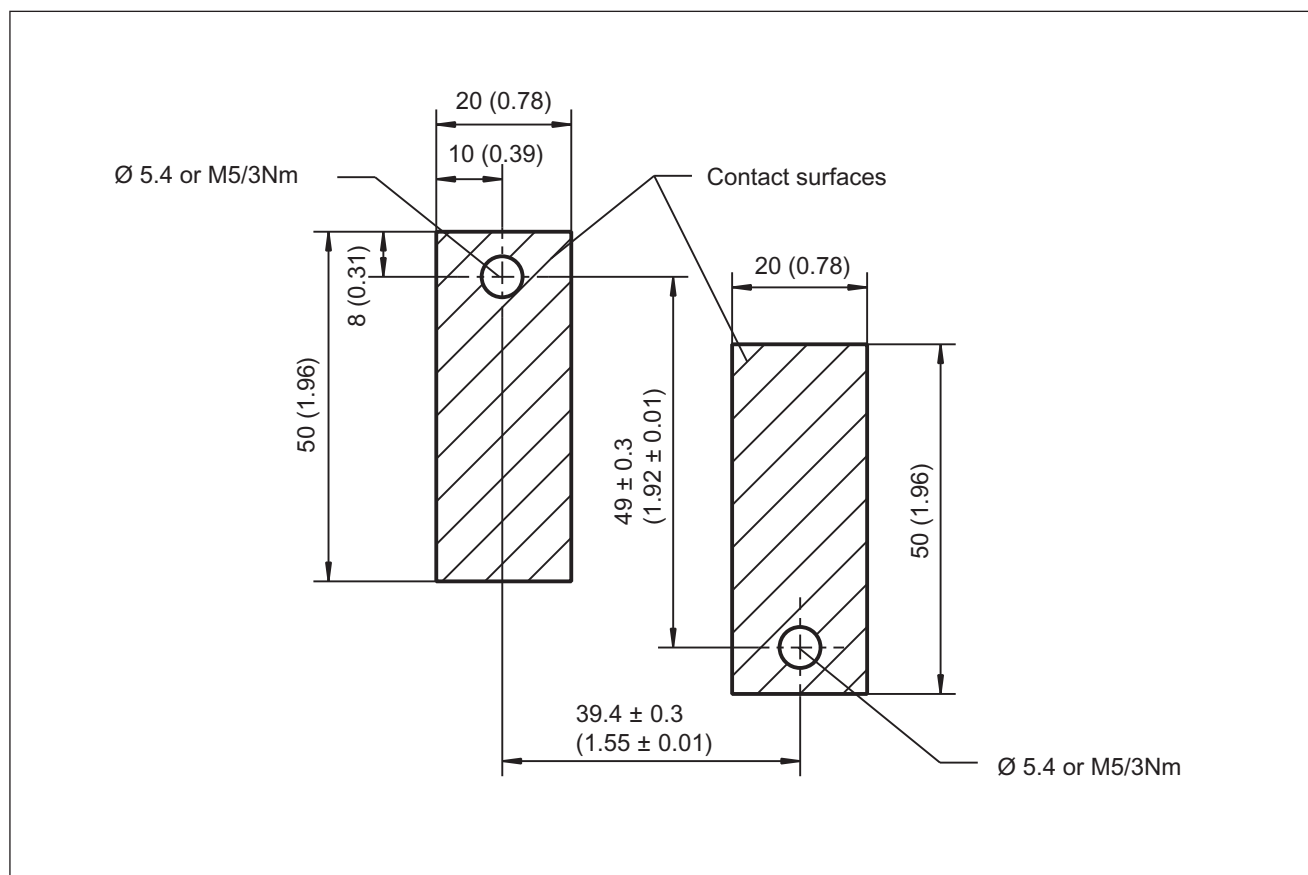


Figure 11-7 Hole drilling pattern for installation

1. Fit the DRIVE-CLiQ coupling to the mounting surface in accordance with the drilling pattern.
2. Remove the protective caps from the DRIVE-CLiQ coupling.
3. Insert the DRIVE-CLiQ plugs at both ends of the DRIVE-CLiQ coupling until they latch into place.

## 11.2.6 Technical data

Table 11- 2 Technical data

DRIVE-CLiQ coupling 6SL3066-2DA00-0AB0	Unit	
Weight	kg	0.272
Degree of protection	IP67 acc. to EN 60529	



## 12.1 General information

The S120 Combi Power Modules fulfill the requirements according to degree of protection IP20 in compliance with EN 60529. This provides protection against electric shock for built-in units. As far as UL 50 is concerned, the components are classified and certified as open type.

Protection against mechanical and climatic stressing must be ensured by installing the modules in enclosures, cabinets or electrical rooms that can be closed and locked. Higher-level enclosures must, as a minimum, have degree of protection IP54 according to EN 60529 or be classified as enclosure type 12 in compliance with UL 50.

Prefabricated MOTION-CONNECT cables are recommended.

---

### Note

#### Functional safety of SINAMICS components

The components must be protected against conductive pollution. This can be achieved e.g. by installing them in a control cabinet with degree of protection IP54B acc. to EN 60529. Provided that conductive pollution can be prevented at the installation site, the degree of protection for the cabinet can be decreased accordingly.

---

#### Low-voltage switchgear and controlgear assemblies

If the S120 Combi is used for the electrical equipment of machines, the applicable requirements of EN 60204-1 must also be adhered to.

#### Safety of machinery


Electrical equipment of machines


All information for device selection in this section applies to

- Operation on TN and TT line supply systems with grounded neutral point and grounded phase conductor
- Operation on IT line supply systems

## 12.2 Safety information

<b>CAUTION</b>
<p>The voltage drop between the start of the consumer's installation and the consuming equipment being supplied should generally not exceed 4% in operation with rated values.</p> <p>The relevant tables in Supplement 5 of the standard DIN VDE 0100 should be consulted. The following note must be included in the technical user documentation: The machine manufacturer must ensure that the voltage drop between the start of the load system and the PDS in operation with rated values does not exceed 4 %." (VDE 0100-520)</p> <p>Checking the documented development stipulations regarding the above requirement, implementation in the production documentation and execution in the device.</p>

 <b>DANGER</b>
<p>When installing the cabinet, you must cover the ventilation slots to prevent drill swarf, end sleeves, and so on from falling into the enclosure, which could result in short-circuits or damage the insulation.</p> <p>Safety regulations governing shock protection must be observed. See also EN 60204-1.</p>

 <b>WARNING</b>
<p>If static discharge occurs on surfaces or interfaces that cannot be easily accessed, this can cause malfunctions and/or defects.</p>

## 12.3 Directives

The product satisfies the protection targets of the following EU Directives applicable within the European Economic Area (EEA):

Table 12- 1 Directives

Directive	Description
2006/95/EC	Directive of the European Parliament and Council of December 12, 2006, on the approximation of the laws of the member states relating to electrical equipment designed for use within certain voltage limits (Low-Voltage Directive).
2004/108/EC	Directive of the European Parliament and Council of December 15, 2004, which repeals directive 89/336/EEC, on the approximation of laws of the member states relating to electromagnetic compatibility (EMC Directive).



## 12.4 Notes on electromagnetic compatibility (EMC)

Requirements to implement EMC are listed in EN 61000-6-2, EN 61000-6-4, EN 61800-3, EN 60204-1 and in the EMC installation guideline - Order No. 6FC5297-0AD30-0\*P2 (\*A: German, \*B: English). Conformance with the EMC Directive of the EC can be secured by following the measures described in the EMC installation guideline.

When mounting components in cabinets, in order to fulfill the EMC Directive, the following conditions must be additionally observed:

- Connected to TN and TT line supplies with grounded neutral point and grounded phase conductor as well as to IT line supplies.
- Observance of information about cable shielding and equipotential bonding.
- Only the recommended Siemens power and signal cables are used
- Only cables from Siemens may be used for DRIVE-CLiQ connections.

### CAUTION

If couplings or cabinet glands are needed for the DRIVE-CLiQ connections, only the DRIVE-CLiQ coupling and DRIVE-CLiQ cabinet gland, described in the Chapter Accessories, may be used.



### DANGER

If the shielding procedures described and the specified cable lengths are not observed, the machine may not operate properly.

## 12.5 Equipotential bonding

The S120 Combi is designed for use in control cabinets with a protective conductor connection.

The protective conductor connection of the S120 Combi must be connected to the protective conductor connection of the control cabinet as follows:

Table 12- 2 Cross-section for copper protective conductors

Line supply cable in mm <sup>2</sup>	Protective connection in mm <sup>2</sup> copper
Up to 16 mm <sup>2</sup>	The same as the line supply cable
From 16 mm <sup>2</sup> to 35 mm <sup>2</sup>	16 mm <sup>2</sup>
From 35 mm <sup>2</sup>	0.5 * line supply cable

For materials other than copper, the cross-section should be increased so that as a minimum, the same conductivity is attained.

All plant and machine parts must be incorporated in the protective concept.

The protective ground connection of the motors used must be established through the motor cable. For EMC reasons, these protective ground connections should be connected at the S120 Combi.

In order to maintain the EMC limit values, the S120 Combi drive line-up - including the expansion axes and DC link components - must be arranged together on a bare metal mounting plate. The mounting plate serves as an equipotential bonding surface. This means that no additional equipotential bonding is required within the drive line-up. The mounting plate must be connected to the protective conductor connection of the control cabinet through a low impedance.

If a common bare metal mounting plate is not available, then an equally good equipotential bonding must be established using cable cross-sections as listed in the table above or as a minimum with the same conductivity.

When mounting components on standard mounting rails, the equipotential bonding data listed in the table apply. If only smaller connection cross-sections are permissible at the components, then the largest possible cross-section should be used, e.g. 6 mm<sup>2</sup> for SMC. These requirements also apply to distributed components located outside the control cabinet.

<b>NOTICE</b>
Devices can malfunction if the above specifications relating to equipotential bonding are not observed.

## 12.6 24 V DC supply

### 12.6.1 General information

The 24 V DC voltage is required to supply the

1. electronics of the S120 Combi and the expansion axes (Motor Modules) via the integrated 24 V busbar
2. Electronics of the SINUMERIK 828D PPU, the Sensor Modules, the Terminal Module, the Braking Module as well as the process voltage of its digital inputs
3. Load voltage of the digital outputs
4. Motor holding brake

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

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#### Note

The electronic power supply has to be supplied by the user as described in the System Data chapter of this documentation.

When connecting to a "DC power supply" in the sense of EN 60204-1:1997, Chapter 4.3.3, functional faults can occur due to the voltage interruptions that are permitted there.

---

 <b>DANGER</b>
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Only motors with a safe electrically isolated holding brake may be connected. The brake cores must also be safely electrically isolated.
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If the motor power cable is connected to intermediate terminals, the power cables and brake cables must be routed separately ( $\geq 300$ mm).
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 <b>DANGER</b>
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Only safety extra-low voltages (DVC A) that comply with EN 61800-5-1 must be connected to the connections and terminals with ratings of between 0 and 48 V DC.
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**Note**

A regulated DC power supply is required to operate motors with a built-in holding brake. The power supply is realized via the internal 24 V busbars. The voltage tolerances of the motor holding brakes ( $24\text{ V} \pm 10\%$ ) and the voltage drops of the connecting cables must be taken into account.

The DC power supply should be set to 26 V. The Control Supply Module supplies 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:

- Use of Siemens three-phase motors
- Use of Siemens MOTION-CONNECT power cables
- Motor cable lengths, max. 50 m

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

## 12.6.2 24 V supply and connection of the components

The S120 Combi with the expansion axes (Motor Modules) and DC link components are connected to the 24 V DC via the integrated 24 V busbars. The current carrying capacity of these busbars is 20 A.

The power can be supplied in two ways:

1. When using an external 24 V power supply, (e.g. SITOP), the 24 V DC plug must be used. The external power supply should be located very close to the load (max. cable length 10 m). Miniature circuit breakers with tripping characteristic D are recommended as overcurrent. The ground potential M must be connected to the protective conductor system (DVC A).

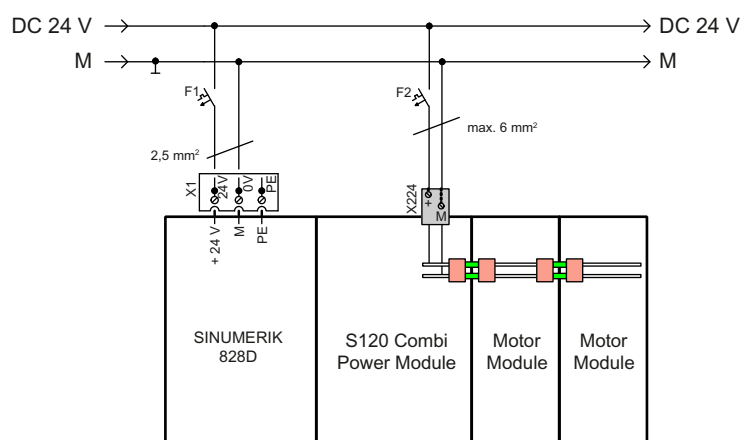


Figure 12-1 Example of an external 24 V power supply

2. When a Control Supply Module is used, the 24 V DC supply can be directly established through the busbars. The electronic current limiting function integrated in the Control Supply Module protects the busbar system when a fault occurs. Additional loads can be connected via the 24 V DC plug.

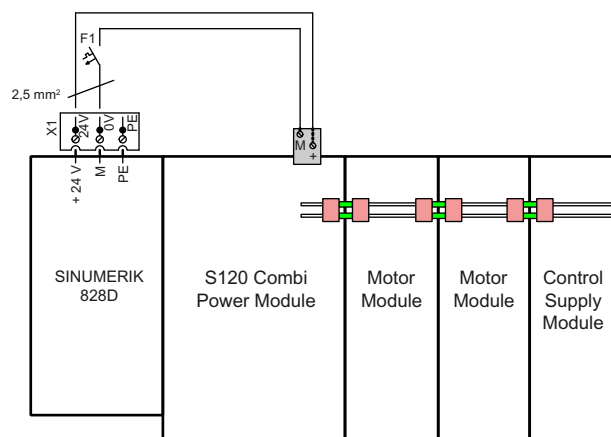


Figure 12-2 Example of a 24 V supply with Control Supply Module

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**Note**

When using cables with a cross-section of 2.5 mm<sup>2</sup>, no additional protection is required on the 24 V side if a type XLPE or EPR cable is used or a cable with a similar quality and with a thermal stability of up to 90°C.

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**Using the 24 V connector**

- A 24 V connector must be inserted on the 24 V busbar between the S120 Combi, expansion axes and DC link components
- Insertion and withdrawal are only permissible in a de-energized state
- Only 5 withdrawal and insertion cycles are permissible

**12.6.3 Overcurrent protection in the 24 V solid-state circuit**

Cables on both the primary and secondary side of the 24 V 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 carrying capacity of the conductors used and cables in normal and short-circuit conditions
- Ambient temperature
- The bunching of the cables in a single duct
- Cable laying method to EN 60204-1

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

Circuit breakers from the Siemens NSK catalog are recommended as overcurrent protection devices on the primary side, and miniature circuit breakers or SITOP select 6EP1961-2BA00 as overcurrent protection devices on the secondary side. The MCBs can be selected according to Siemens catalog "BETA Modular Installation Devices - ET B1".

When selecting the miniature circuit breakers, you must take into account the following standards:

EN 61800-5-1, EN 60204-1, IEC 60364-5-52, IEC 60287-1 to -3, EN 60228 and UL 508C.

The following conditions for the conductors/cables should be used as basis:

- Ambient temperature 55 °C
- Limit conductor temperature, ≤ 70 °C for operation with the rated load current
- Cable length max.:
  - 10 m for the supply cables
  - 30 m for signal cables

In addition, the conductors/cables should be routed so that

- max. 1 conductor pair, bundled and
- the 24 V conductors should be separately routed away from other cables and conductors that could conduct the operating current.

Table 12- 3 MCBs by core cross-section and temperature

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

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

### 12.6.4 Typical 24 V current consumption of the components

A separate 24 V power supply must be used for the SINAMICS S120 drive line-up.

The following table can be used to calculate the 24 VDC power supply. The values for typical current consumption are used as a basis for configuration.

Table 12- 4 Overview of 24 V DC current consumption

Component	Typical current consumption [A <sub>DC</sub> ]
<b>Controller</b>	
SINUMERIK 828D - PPU without load	1.2
SINUMERIK 828D - PPU with full load (USB, handwheel...)	2.5
<b>Sensor Modules</b>	
SMC20 without/with encoder system	0.20 / 0.355
SME20 without/with encoder system	0.15 / 0.25
SME25 without/with encoder system	0.15 / 0.25
<b>Terminal Modules</b>	
TM54F (without digital outputs, without DRIVE-CLiQ)	0.2
Per digital output/DRIVE-CLiQ	0.5
<b>Additional system components</b>	
DMC20 (without DRIVE-CLiQ) per DRIVE-CLiQ	0.15 0.5
DME20 (without DRIVE-CLiQ) per DRIVE-CLiQ	0.15 0.5
<b>S120 Combi 3 axes Power Module</b>	
16 kW / 18 A / 5 A / 5 A	1.5
16 kW / 24 A / 9 A / 9 A	1.5
20 kW / 30 A / 9 A / 9 A	1.5
<b>S120 Combi 4 axes Power Module</b>	
16 kW / 18 A / 9 A / 5 A / 5 A	1.6
16 kW / 24 A / 9 A / 9 A / 9 A	1.6
20 kW / 30 A / 12 A / 9 A / 9 A	1.6
<b>DRIVE-CLiQ and brake</b>	
DRIVE-CLiQ (e.g. motors with DRIVE-CLiQ interface)	0.19
Brake (e.g. motor holding brake)	max. 1
<b>Single Motor Modules Booksize Compact</b>	
3 A (+1 x DRIVE-CLiQ; +1 x brake)	0.75
5 A (+1 x DRIVE-CLiQ; +1 x brake)	0.75
9 A (+1 x DRIVE-CLiQ; +1 x brake)	0.75
18 A (+1 x DRIVE-CLiQ; +1 x brake)	0.75



Component	Typical current consumption [A <sub>DC</sub> ]
<b>Double Motor Modules Booksize Compact</b>	
2 x 1.7 A (+2 x DRIVE-CLiQ; +2 x brake)	1
2 x 3 A (+2 x DRIVE-CLiQ; +2 x brake)	1
2 x 5 A (+2 x DRIVE-CLiQ; +2 x brake)	1
<b>External fan unit</b>	0.8
<b>Braking Module</b>	0.5
<b>Motor encoder</b>	0.25

### Example of calculating the 24 V DC current requirement

Table 12- 5 Example, 24 V DC current requirement

Component	Number	Current consumption [A]	Total current consumption [A]
SINUMERIK 828D	1	2.5	2.5
S120 Combi 4 axes Power Module with external fan unit	1	2.4	2.4
Motor Module 9 A	1	0.75	0.75
Motor Module 18 A	1	0.75	0.75
Motor encoder	6	0.25	1.50
Brake	1	1	1
<b>Total:</b>			<b>8.9</b>

### 12.6.5 Selecting power supply units

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

Table 12- 6 Recommended SITOP Power

Rated output current [A]	Phases	Rated input voltage [V] Working voltage range [V]	Short-circuit current [A]	Order number
5	1 / 2	120 – 230 / 230 - 500 85 – 264 / 176 - 550 AC	Approx. 5.5 (power up), typ. 15 for 25 ms (operation)	6EP1333-3BA00-8AC0
10	1 / 2	120 – 230 / 230 - 500 85 – 264 / 176 - 550 AC	Approx. 12 (power up), typ. 30 for 25 ms (operation)	6EP1334-3BA00-8AB0
20	1 / 2	120 / 230 85 – 132 / 176 - 264 AC	Approx. 23 (power up), typ. 60 for 25 ms (operation)	6EP1336-3BA00-8AA0
	3	3-ph. 230 / 400 to 288 / 500 320 - 550 AC		6EP1436-3BA00-8AA0
40	1 / 2	120 / 230 85 - 132/176 - 264 AC	Approx. 46 (power up), typ. 120 for 25 ms (operation)	6EP1337-3BA00-8AA0
	3	3-ph. 230 / 400 to 288 / 500 320 - 550 AC		6EP1437-3BA00-8AA0

#### Note

When using an external 24 V power supply with a continuous current > 20 A, an overcurrent protection device must be used for the S120 Combi Power Module, the cables and the busbars. A circuit breaker is recommended as overcurrent protection device.

The tripping characteristic of the circuit breaker depends on

- the loads to be protected and
- the maximum current provided by the power supply unit in the case of a short-circuit.

Table 12- 7 Recommendation for Control Supply Module

Rated output current [A]	Phases	Input voltage range [V]	Short-circuit current [A]	Order number
20	3	380 V AC -10 % (-15 % < 1 min) to 480 V AC +10 % DC 300 – 800	< 24	6SL3100-1DE22-0AA1

See also catalog NC61.

#### WARNING


When an external power supply is used, e.g. SITOP, the ground potential must be connected to the protective conductor system (DVC A).

## 12.7 Cable shielding and routing

### 12.7.1 General information

In order to comply with the EMC requirements, certain cables must be routed apart from other cables and from certain components. To full EMC requirements, the following cables must be used with shields:

- Line supply cables from the line filter via the line reactor to the S120 Combi Power Module
- All motor cables (if necessary, including cables for motor holding brake)
- Cables for analog direct voltage/current signals
- Signal cables for sensors
- Cables for temperature sensors

 <b>DANGER</b>
A suitable PE conductor must be connected to all devices in protection class I. The PE conductor connection of the individual components must have at least 4 mm <sup>2</sup> .


Alternative measures (e.g. routing behind mounting plates, suitable clearances) can also be used provided they have similar results. This excludes measures that relate to the design, installation, and routing of motor power cables and signal cables. If unshielded cables are used between the line connection point and line filter, make sure that no interfering cables are routed in parallel.

The cable shields must be connected to the shield bars through a large surface area.

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

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 rear wall) should provide adequate shielding.

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

 <b>DANGER</b>
<p>The drive components generate high leakage currents in the protective conductor. The components must only be operated in control cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:</p> <ul style="list-style-type: none"><li>• Stationary connection and protective conductor connection by means of <math>\geq 10</math> mm<sup>2</sup> Cu or <math>\geq 16</math> mm<sup>2</sup> Al</li><li>• stationary connection and installation of a second protective conductor with the same cross-section as the first protective conductor</li></ul>

### 12.7.2 Signal cables and 24 V supply cables

If you are using unshielded signal cables and 24 V supply cables (e.g. 24 V infeed from an external supply), the following unshielded cable lengths are permissible:

- 24 V supply cables: max. length 10 m
- Signal cables: max. length 30 m without any additional protective circuitry

<b>NOTICE</b>
The connected signal and power cables must be routed to the components in such a way that they do not cover the ventilation slots.

<b>CAUTION</b>
Unshielded signal cables must not be routed parallel to power cables.

### 12.7.3 DRIVE-CLiQ signal cables

**Note**

Only MOTION-CONNECT 500 and MOTION-CONNECT 800 DRIVE-CLiQ cables are permitted for the connection. The maximum cable length for MOTION-CONNECT 500 cables is 100 m, for MOTION-CONNECT 800 cables, 50 m.

If DRIVE-CLiQ couplings are used, the permissible cable length can be calculated as follows:

$$\Sigma MC500 + 2 \times \Sigma MC800 + n_c \times 5 \text{ m} \leq 100 \text{ m}$$

$\Sigma MC500$ : Total length of all MC500 cable sections

$\Sigma MC800$ : Total length of all MC800 cable sections

$n_c$ : Number of DRIVE-CLiQ connectors (max. 0...3)

Table 12- 8 Comparison between DRIVE-CLiQ MOTION-CONNECT 500 and MOTION-CONNECT 800 cables

DRIVE-CLiQ signal cable	MOTION-CONNECT 500	MOTION-CONNECT 800
<b>Approvals</b>		
VDE cUL or UL/CSA UL-CSA File No. 1) RoHS conformance	Yes UL STYLE 2502/CSA-N.210.2-M90 Yes Yes	Yes UL STYLE 20236/CSA-N.210.2-M90 Yes Yes
<b>Rated voltage <math>V_0/V</math> in accordance with EN 50395</b>	30 V	30 V
<b>Test voltage, rms</b>	500 V	500 V
<b>Operating temperature at the surface</b>		
Permanently installed Moveable	-20 to +80°C 0 to 60°C	-20 to +80°C -20 to +60°C
<b>Tensile load, max.</b>		
Permanently installed Moveable	80 N/mm <sup>2</sup> 30 N/mm <sup>2</sup>	50 N/mm <sup>2</sup> 20 N/mm <sup>2</sup>
<b>Smallest bending radius</b>		
Permanently installed Moveable	35 mm 125 mm	60 mm 100 mm
<b>Torsional stress</b>	30°/m absolute	30°/m absolute
<b>Bending operations</b>	100000	10 million
<b>Max. traversing speed</b>	30 m/min	180 m/min
<b>Max. acceleration</b>	2 m/s <sup>2</sup>	5 m/s <sup>2</sup> (5 m); 10 m/s <sup>2</sup> (2.5 m)
<b>insulation material</b>	CFC/silicone-free	CFC/halogen-free/silicon-free
<b>Oil resistance</b>	EN 60811-2-1 (mineral oil only)	EN 60811-2-1
<b>Protective jacket</b>	PVC	PUR, HD22.10 S2 (VDE 0282, Part 10)
<b>Flame retardant</b>	EN 60332-1-1 to 1-3	EN 60332-1-1 to 1-3

1) The file number is printed on the cable jacket.

12.7.4 Power cables for motor

12.7.4.1 Approved power cables

**Note**

Only MOTION-CONNECT 500 and MOTION-CONNECT 800 power cables are permissible for the S120 Combi.

Table 12- 9 Approved power cables for motors connected to the S120 Combi - pre-assembled

Motor	Order number 6FX□002-	Description	D <sub>max</sub>	
			6FX5	6FX8
1PH8 with terminal box	5CE02	Power cable 1PH808 4 x 2.5	10.0	12.1
1PH8 with terminal box	5CE04	Power cable 1PH810 4 x 4	11.4	13.2
1PH8 with terminal box	5CE06	Power cable 1PH813 4 x 6	13.6	16.0
1FT7/1FK7 with fast release	5CF10	Power cable 4 x 1.5 GR.1 SC	8.4	10.4
	5DF10	Power cable 4 x 1.5 + 2 x 1.5 GR.1 SC	10.8	12.9
1PH8 with connector with fast release	5DF11	Power cable 4 x 2.5 GR.1.5 SC	10.0	12.1
1PH8 with connector with fast release	5CF12	Power cable 4 x 4 GR.1.5 SC	11.4	13.2
1PH8 with connector without fast release	5CF13	Power cable 4 x 10 GR.3	20	19.4

□... 5 = MC500, 8 = MC800

**Note**

If the connecting cables for a 24 V motor holding brake are included in the power cable, then only the specified cables must be used. These cables must have a separate shield for the 24 V and must be suitable for safe electrical separation.

The cable shield of the motor holding brake cores must be connected at both ends.

**Note**

In order that the specified EMC limit values (EN 61800-3) are maintained, only shielded type MC500 and MC800 power cables must be used. The permissible cable length is 25 m for rated output currents I<sub>n</sub> from 5 A to 30 A.

The total cable length for the complete drive line-up is 175 m.

### Comparison of MOTION-CONNECT power cables

MOTION-CONNECT 500 power cables are mainly suitable for permanent routing. MOTION-CONNECT 800 power cables fulfill all of the high mechanical requirements for use in tow chains. They are resistant to cutting oils.

Table 12- 10 Comparison of the MOTION-CONNECT 500 and MOTION-CONNECT 800 power cables

Power cable	MOTION-CONNECT 500	MOTION-CONNECT 800
<b>Approvals</b>		
VDE <sup>1)</sup> cUL or UL/CSA UL-CSA File No. <sup>2)</sup> RoHS conformance	Yes UL758-CSA-C22.2-N.210.2-M90 Yes Yes	Yes UL758-CSA-C22.2-N.210.2-M90 Yes Yes
<b>Rated voltage <math>V_0/V</math> in accordance with EN 50395</b>		
Supply cores Signal cores	600 V / 1000 V 24 V (EN) 1000 V (UL/CSA)	600 V / 1000 V 24 V (EN) 1000 V (UL/CSA)
<b>Test voltage, rms</b>		
Supply cores Signal cores	4 kV 2 kV	4 kV 2 kV
<b>Operating temperature at the surface</b>		
Permanently installed Moveable	-20 to +80°C 0 to 60°C	-20 to +80°C -20 to +60°C
<b>Tensile load, max.</b>		
Permanently installed Moveable	50 N/mm <sup>2</sup> 20 N/mm <sup>2</sup>	50 N/mm <sup>2</sup> 20 N/mm <sup>2</sup>
<b>Smallest bending radius</b>		
Permanently installed Moveable	5 x D <sub>max</sub> approx. 20 x D <sub>max</sub>	6 x D <sub>max</sub> approx. 12 x D <sub>max</sub>
<b>Torsional stress</b>	30°/m absolute	30°/m absolute
<b>Bending operations</b>	100000	10 million from 10 mm <sup>2</sup> : 3 million
<b>Max. traversing speed</b>	30 m/min	180 m/min from 10 mm <sup>2</sup> : 100 m/min
<b>Max. acceleration</b>	2 m/s <sup>2</sup>	5 m/s <sup>2</sup> (5 m); 10 m/s <sup>2</sup> (2.5 m)
<b>insulation material</b>	CFC/silicone-free	CFC/halogen/silicone-free IEC 60754-1 / DIN VDE 0472-815
<b>Oil resistance</b>	EN 60811-2-1 (mineral oil only)	EN 60811-2-1
<b>Protective jacket</b>	PVC	PUR, HD22.10 S2 (VDE 0282, Part 10)
<b>Flame retardant</b>	EN 60332-1-1 to 1-3	EN 60332-1-1 to 1-3

1) The registration number is printed on the cable jacket.

2) The file number is printed on the cable jacket.

### 12.7.5 Current-carrying capacity and derating factors for power cables and signal cables

The current-carrying capacity of PVC/PUR-insulated copper cables is specified for routing types B1, B2 and C under continuous operating conditions in the table with reference to an ambient air temperature of 40°C. For other ambient temperatures, the values must be corrected by the factors listed in the "Derating factors for deviating conditions" table.

Table 12- 11 Current-carrying capacity according to EN 60204-1 for 40°C ambient temperature

Cross section mm <sup>2</sup>	Current-carrying capacity, effective; AC 50/60 Hz or DC for routing type		
	B1 A	B2 A	C A
<b>Electronics</b>			
0.20	–	4.3	4.4
0.50	–	7.5	7.5
0.75	–	9	9.5
<b>Power</b>			
0.75	8.6	8.5	9.8
1.00	10.3	10.1	11.7
1.50	13.5	13.1	15.2
2.50	18.3	17.4	21
4	24	23	28
6	31	30	36
10	44	40	50
16	59	54	66

**Installation types**

B1 cables in conduits or installation ducts

B2 multi-core cables in conduits or installation ducts

C cables along walls/panels without conduits and installation ducts

Table 12- 12 Derating factors for deviating conditions

Ambient temperature [°C]	Derating factor according to EN 60204-1 Table D1
30	1.15
35	1.08
40	1.00
45	0.91
50	0.82
55	0.71
60	0.58



### Example for dimensioning a power cable

**Boundary conditions:**

Module: S120 Combi 4 axes Power Module with 20 kW infeed  
Rated input current at 400 V<sub>AC</sub>: 34 A (from the technical data)  
Ambient temperature: 45°C  
Installation type: B2

**Calculation/dimensioning:**

With installation type B2 and a rated input current of 34 A<sub>AC</sub>, from the table showing the current-carrying capacity, a cable cross-section of 10 mm<sup>2</sup> is obtained.

With a derating factor of 0.91 for 45°C ambient temperature, the current-carrying capacity of the selected power cable decreases to 36.4 A.

**Result:**

Under the given boundary conditions, a power cable with a cross-section of 10 mm<sup>2</sup> can be used.

## 12.8 Connection system

### 12.8.1 Connectable conductor cross-sections for spring-loaded terminals

Table 12- 13 Spring-loaded terminals

Spring-loaded terminal type			
1	Connectable conductor cross-sections	Flexible	0.08 mm <sup>2</sup> to 2.5 mm <sup>2</sup>
	Stripped length	8 to 9 mm	
	Tool	Screwdriver 0.4 x 2.0 mm	

### 12.8.2 Connectable conductor cross-sections for screw terminals

The type of screw terminal can be taken from the interface description of the particular module.

Table 12- 14 Screw terminals

Screw terminal type			
1	Connectable conductor cross-sections	Rigid, flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve	0.08 mm <sup>2</sup> to 1.5 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 1.5 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 0.5 mm <sup>2</sup>
	Stripped length	7 mm	
	Tool	Screwdriver 0.4 x 2.0 mm	
	Tightening torque	0.22 to 0.25 Nm	
2	Connectable conductor cross-sections	Rigid, flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve	0.14 mm <sup>2</sup> to 1.5 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 1.5 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 0.5 mm <sup>2</sup>
	Stripped length	7 mm	
	Tool	Screwdriver 0.4 x 2.5 mm	
	Tightening torque	0.22 to 0.25 Nm	
3	Connectable conductor cross-sections	Rigid, flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve	0.08 mm <sup>2</sup> to 2.5 mm <sup>2</sup> 0.5 mm <sup>2</sup> to 2.5 mm <sup>2</sup> 0.5 mm <sup>2</sup> to 1.5 mm <sup>2</sup>
	Stripped length	7 mm	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 to 0.6 Nm	
4	Connectable conductor cross-sections	Flexible With end sleeve, without plastic sleeve with end sleeve, with plastic sleeve	0.2 mm <sup>2</sup> to 4 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 4 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 4 mm <sup>2</sup>
	Stripped length	7 mm	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 to 0.6 Nm	

Screw terminal type			
5	Connectable conductor cross-sections	Flexible With end sleeve, without plastic sleeve with end sleeve, with plastic sleeve	1 mm <sup>2</sup> to 6 mm <sup>2</sup> 1 mm <sup>2</sup> to 6 mm <sup>2</sup> 1 mm <sup>2</sup> to 6 mm <sup>2</sup>
	Stripped length	10 mm	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.5 to 1.8 Nm	
6	Connectable conductor cross-sections	Flexible With end sleeve, without plastic sleeve with end sleeve, with plastic sleeve	1 mm <sup>2</sup> to 10 mm <sup>2</sup> 1 mm <sup>2</sup> to 10 mm <sup>2</sup> 1 mm <sup>2</sup> to 10 mm <sup>2</sup>
	Stripped length	10 mm	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.5 to 1.8 Nm	
7	Connectable conductor cross-sections	Flexible With end sleeve, without plastic sleeve with end sleeve, with plastic sleeve	1.5 mm <sup>2</sup> to 16 mm <sup>2</sup> 1.5 mm <sup>2</sup> to 16 mm <sup>2</sup> 1.5 mm <sup>2</sup> to 16 mm <sup>2</sup>
	Stripped length	11 mm	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.5 to 1.8 Nm	

## 12.9 Note on control cabinet cooling

### 12.9.1 General information

The cabinet can be cooled, among others, by using:

- Filter fans
- Heat exchangers
- Refrigerators
- external air cooling

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

The air routing inside the control cabinet and the cooling clearances specified here, must be carefully observed. Other components or cables must not be installed/routed in these areas.

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

---

#### Note

When the line reactor is being installed, it is best not to install it in the same control cabinet (max. distance approx. 0.5 m). If necessary, it can be installed on the heat sink.

---

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

- Ventilation clearance
- Wiring and cabling
- Air guidance, air-conditioner

Table 12- 15 Ventilation clearances above and below the components

Component	Order number	Clearance [mm]
S120 Combi 3 axes Power Module	6SL3111-3VE2x-xxA0	80
S120 Combi 4 axes Power Module	6SL3111-4VE2x-xxA0	80
Motor Modules Booksize Compact	6SL3420-xTExx-xAAx	80
Line filters	6SL3000-0BE21-6DA1	100
Line reactors	6SL3100-0EE2x-xAA0	100
Braking Module	6SL3100-1AE31-0AAx	80
Control Supply Module	6SL3100-1DE22-0AAx	80
SMC20	6SL3055-0AA00-5EAx	50
DMC20	6SL3055-0AA00-6AAx	50
Terminal Module TM54F	6SL3055-0AA00-3BAx	50

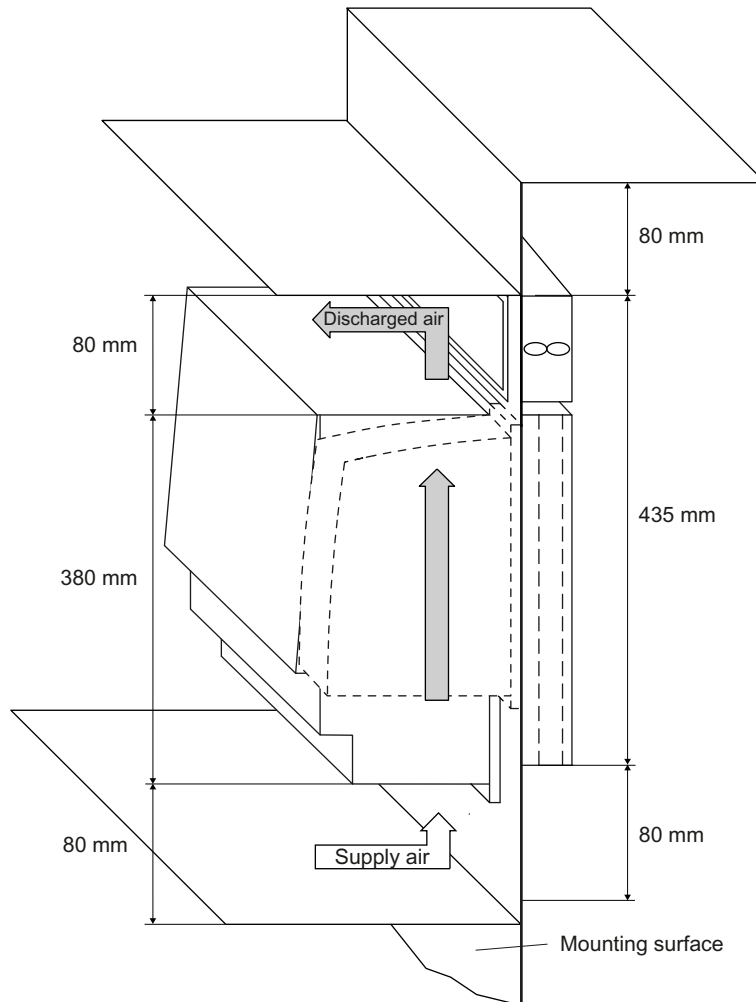


Figure 12-3 Cooling clearances for an S120 Combi Power Module with expansion axis

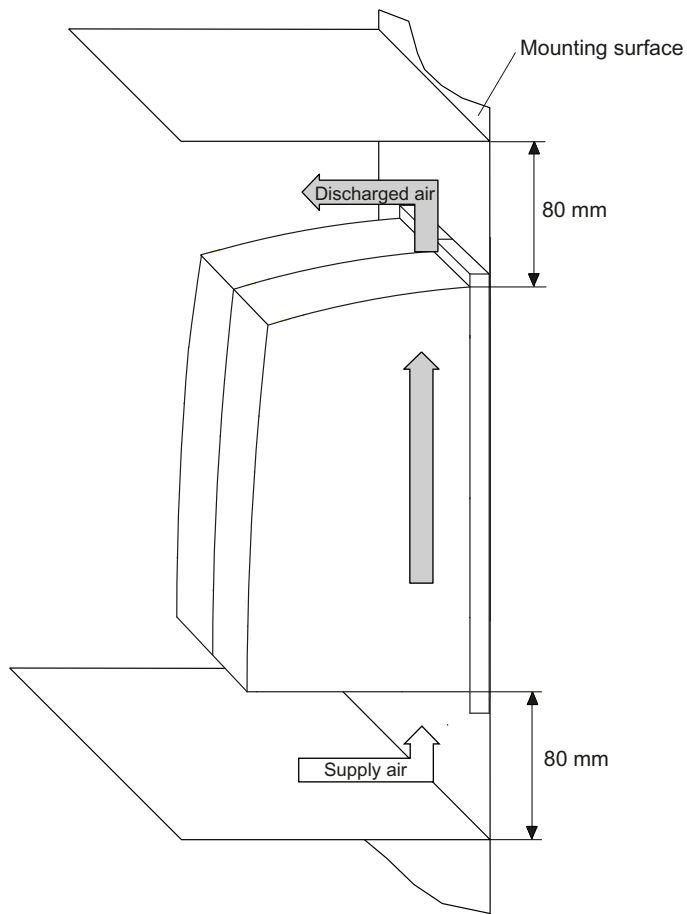


Figure 12-4 Cooling clearances for Motor Modules Booksize Compact

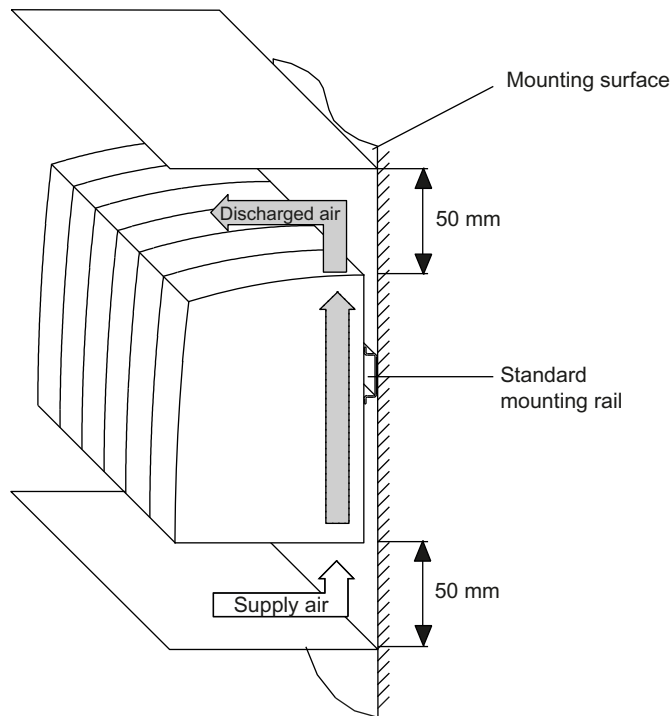


Figure 12-5 Cooling clearances for modules mounted on standard rails (e.g. SMC, DMC)

## 12.9.2 Ventilation

The S120 Combi is equipped with an internal fan to circulate the air inside the unit.

The cooling air must flow vertically through the external heat sink of the S120 Combi.

When using filter fans, heat exchangers, or air conditioners to cool the control cabinet, it must be ensured that the air is flowing in the correct direction. You must also ensure that the warm air can escape at the top. A ventilation clearance of at least 80 mm above and below must be observed.

### NOTICE

The connected signal and power cables must be routed to the components in such a way that they do not cover the ventilation slots.

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

### Note

The distance between the discharge opening of the air conditioner and the electronic equipment must be at least 200 mm.

**Note**

If the components are installed in a sealed cabinet, an internal air cooling system must be installed to circulate the air and prevent hot spots. It is best to install the fan above the components to optimize the air flow (suction).

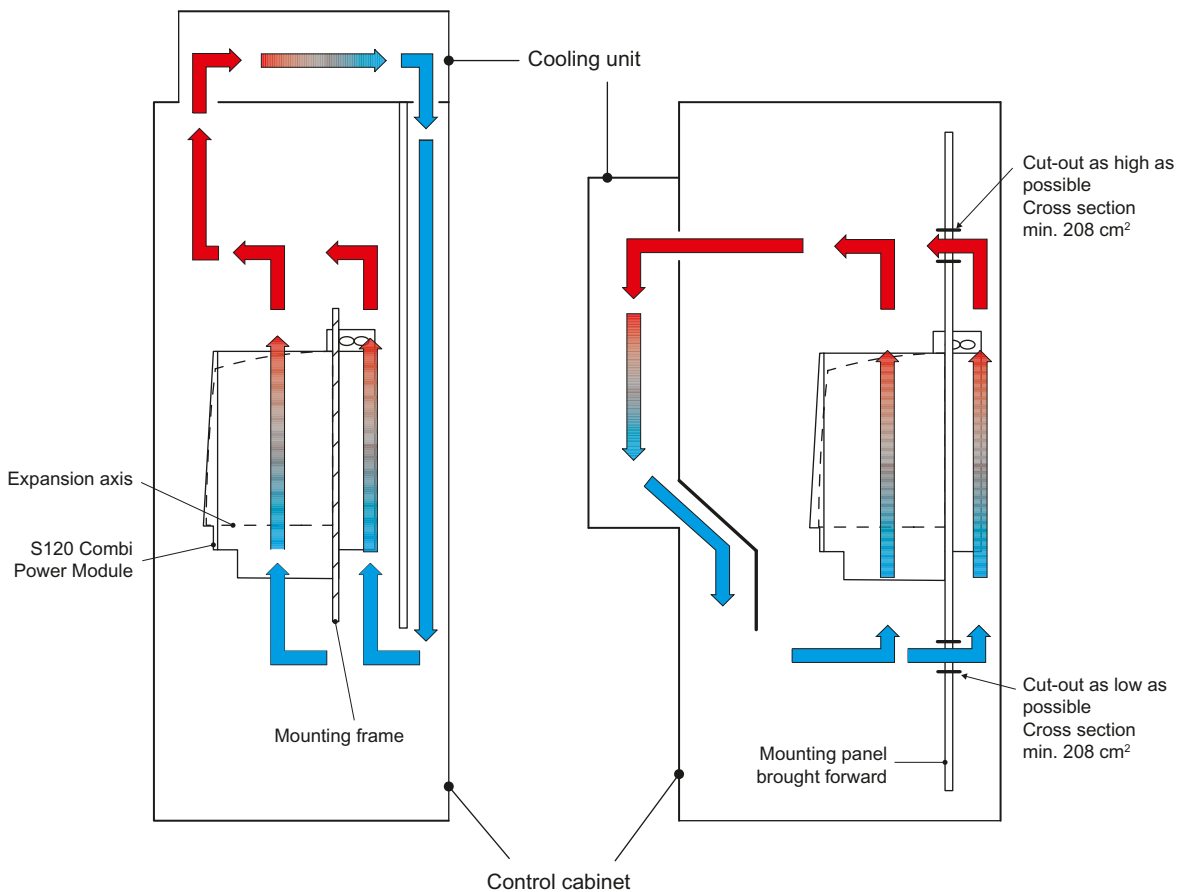


Figure 12-6 Examples of cabinet ventilation

**CAUTION**

The air guidance and arrangement of the cooling equipment must be chosen in such a way that no condensation can form on the components. 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 Chapter "System overview"). Using air baffle plates, for example, you must ensure that the cold air expelled from the air conditioner mixes with warm air in the cabinet before it enters the unit. This reduces the relative air humidity to uncritical values.

### 12.9.3 Dimensioning Climate Control Equipment

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

The physical relationship is shown in the following example.

Calculating the thermal power to be dissipated:  $q = Q - k \times A \times \Delta T$

with

$q$  = thermal power that has to be dissipated using a cooling unit [W]

$Q$  = power loss [W]

$\Delta T$  = difference between the room temperature and the temperature inside the cabinet [K]

$k$  = heat transfer coefficient, e.g. sheet-steel, painted 5.5 [W/(m<sup>2</sup> \* K)]

$A$  = free-standing cabinet surface area [m<sup>2</sup>]

Table 12- 16 Example, calculating the power loss of a drive configuration

Component	Number	Total power loss [W] (including electronic losses)	Total power loss [W]
SINUMERIK 828D	1	28	28
Line filter	1	16	16
Line reactor	1	98	98
S120 Combi 3 axes Power Module 20 kW	1	634	634
Motor Module 9 A	1	100.4	100.4
Motor Module 18 A	1	185.4	185.4
SMC	2	10	20
SITOP 20	1	53	53
Line contactor	1	12	12
<b>Total:</b>			1146.8

Assumption:

free-standing control cabinet surface  $A = 5 \text{ m}^2$

difference between the room temperature and the temperature inside the control cabinet  $\Delta T = 10 \text{ K}$

$q = 1644 \text{ W} - 5.5 \text{ W} / (\text{m}^2 \text{ K}) * 5 \text{ m}^2 * 10 \text{ K} = 871.8 \text{ W}$

## 12.9.4 Power loss of components in rated operation

### 12.9.4.1 General information

The tables below provide an overview of the power loss of all components during rated operation. The characteristic values apply for the following conditions:

- Line supply voltage 400 V
- Pulse frequency of the Motor Modules 4 kHz
- Operating components at their rated power

The total losses of the relevant components (S120 Combi, Motor Module) are calculated from the power loss and the corresponding losses from the electronics.

### 12.9.4.2 Power losses for SINUMERIK 828D, DC link components and supplementary system components

Table 12- 17 Overview of power losses at rated operation for SINUMERIK 828D, DC link components and supplementary system components

	Unit	Power loss
SINUMERIK 828D	W	28
SMC20	W	< 10
SME20/25	W	< 4
TM54F	W	4.5
Braking Module	W	20
Control Supply Module		
Line	W	70
DC link	W	65

### 12.9.4.3 Power losses for S120 Combi Power Modules

#### Power losses in rated operation

The following table provides an overview of the internal and external losses of the S120 Combi Power Modules for rated operation.

Table 12- 18 Overview of power losses in rated operation for S120 Combi Power Modules

	Unit	Internal power loss	External power loss	Total power loss <sup>1)</sup>
<b>S120 Combi 3 axes Power Module</b>				
16 kW / 18 A / 5 A / 5 A	W	81	344	425
16 kW / 24 A / 9 A / 9 A	W	91	446	537
20 kW / 30 A / 9 A / 9 A	W	102	532	634
<b>S120 Combi 4 axes Power Module</b>				
16 kW / 18 A / 9 A / 5 A / 5 A	W	87	405	492
16 kW / 24 A / 9 A / 9 A / 9 A	W	100	507	607
20 kW / 30 A / 12 A / 9 A / 9 A	W	113	620	733

1) The external fan unit has been taken into account in the specified power losses

### 12.9.4.4 Power loss for line filters and line reactors

Table 12- 19 Overview of power loss during rated operation for line filters and line reactors

	Unit	Power loss
<b>Line filters</b>		
16 kW	W	16
20 kW	W	16
<b>Line reactors</b>		
16 kW	W	75
20 kW	W	98

**12.9.4.5 Electronics losses of power units**

Table 12- 20 Electronics losses for Motor Modules Booksize Compact and S120 Combi Power Modules

Component		Power loss [W]
Single Motor Module	3 A	20.4
	5 A	20.4
	9 A	20.4
	18 A	20.4
Double Motor Module	1.7 A	27.6
	3 A	27.6
	5 A	27.6
S120 Combi 3 axes Power Module	16 kW / 18 A / 5 A / 5 A	24.0
	16 kW / 24 A / 9 A / 9 A	31.2
	20 kW / 30 A / 9 A / 9 A	26.4
S120 Combi 4 axes Power Module	16 kW / 18 A / 9 A / 5 A / 5 A	24.0
	16 k W 24 A / 9 A / 9 A / 9 A	31.2
	20 kW / 30 A / 12 A / 9 A / 9 A	26.4

**12.9.4.6 Losses in partial-load operation**

**Losses in the partial-load range for the S120 Combi**

The losses of the S120 Combi in partial-load operation can be calculated using the following formula:

$$P_v = a + b + IN1 \times P1 + S1 \times I1 + S2 \times I2 + S3 \times I3 + S4 \times I4$$

With:

- a: Electronics losses of the S120 Combi
- b: Electronics losses of the external fan unit (Order No.: 6SL3161-0EP00-0AA0)
- IN1, S1 - S4: Coefficients to calculate the power loss
- P1: Infeed power [kW] (LINE X1)
- I1: Spindle current [A] (SPINDLE X2)
- I2: Current of the 1st feed axis (servo X3)
- I3: Current of the 2nd feed axis (servo X4)
- I4: Current of the 3rd feed axis (servo X5)

Table 12- 21 Overview of the coefficients to calculate the total power loss  $P_V$  in the partial-load range

Power Module	a	b	IN1	S1	S2	S3	S4
3 axes Power Module							
16 kW / 18 A	36	19.2	11.05	7.1	6.5	6.5	
16 kW / 24 A	36	19.2	11.2	7.2	7.2	7.2	
20 kW / 30 A	36	19.2	11.5	7.3	7.2	7.2	
4 axes Power Module							
16 kW / 18 A	38.4	19.2	11.05	7.1	7.2	6.5	6.5
16 kW / 24 A	38.4	19.2	11.4	7.2	7.2	7.2	7.2
20 kW / 30 A	38.4	19.2	11.7	7.3	7.7	7.2	7.2

Table 12- 22 Overview of the coefficients to calculate the power loss  $P_V$  in the control cabinet for external cooling

Power Module	a	b	IN1	S1	S2	S3	S4
3 axes Power Module							
16 kW / 18 A	36	0	1.95	0.6	0.4	0.4	
16 kW / 24 A	36	0	2.1	0.6	0.4	0.4	
20 kW / 30 A	36	0	2.03	0.6	0.4	0.4	
4 axes Power Module							
16 kW / 18 A	38.4	0	1.95	0.6	0.4	0.4	0.4
16 kW / 24 A	38.4	0	2.3	0.6	0.4	0.4	0.4
20 kW / 30 A	38.4	0	2.23	0.6	0.4	0.4	0.4

### Losses in the partial-load range for line reactors

The losses of the line reactors in partial-load operation can be calculated using the following formula:

$$P_V = D1 \times P1$$

With:

D1: Coefficient to calculate the power loss

P1: Infeed power [kW]

Table 12- 23 Overview of the coefficients to calculate the power loss  $P_V$  in the partial-load range

Line reactor	D1
6SL3100-0EE21-6AA0 (16 kW)	4.7
6SL3100-0EE22-0AA0 (20 kW)	4.9



## Service and maintenance

### 13.1 Technical Support

#### Technical support

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

Technical Support

Tel.: +49 (0) 180 5050 – 222

Fax: +49 (0) 180 5050 – 223

E-mail: [adsupport@siemens.com](mailto:adsupport@siemens.com)

Please send any questions about the documentation (suggestions for improvement, corrections, and so on) to the following fax number or e-mail address:

Fax: +49 (0) 9131 98 – 2176

E-mail: [docu.motioncontrol@siemens.com](mailto:docu.motioncontrol@siemens.com)

#### Internet Address

Up-to-date information about our products can be found on the Internet at the following address:

<http://www.ad.siemens.de/mc>

## 13.2 Spare parts

### S120 Combi spare parts list

An overview of all of the S120 Combi spare parts is provided in the table below

Table 13- 1 List of available spare parts for the S120 Combi

Designation	MLFB
S120 Combi front cover	6SL3161-3FP00-0AA0
S120 Combi guiding frame for DRIVE-CLiQ cables	6SL3161-3EP00-0AA0
S120 Combi DC link lateral cover	6SL3161-3AP00-0AA0
S120 Combi internal fan	6SL3161-0IP00-0AA0
S120 Combi external fan unit	6SL3161-0EP00-0AA0
S120 Combi Completion Kit <b>Contents:</b> 24 V DC plug Plug for motor brake interface 4 DRIVE-CLiQ port rubber plugs 2 signal plugs (4-pole) for X12/X13 2 signal plugs (4-pole) for X21/X22 5 shield clamps for motor power cables Shield clamp for EP signal cables	6SL3161-8AP00-0AA0

### Spare parts list, additional components

You will find spare parts for all of the other components and modules in the Internet under:

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



## 13.3 Replacing the fan

### 13.3.1 Replacing the Internal fan on the S120 Combi Power Module

When required, the internal S120 Combi fan can be replaced. It can be ordered as a spare part (order number: 6SL3161-0IP00-0AA0).

<b>NOTICE</b>
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When replacing the fan, you must observe the ESD regulations. Only qualified personnel are permitted to install spare parts!
---



<b>DANGER</b>
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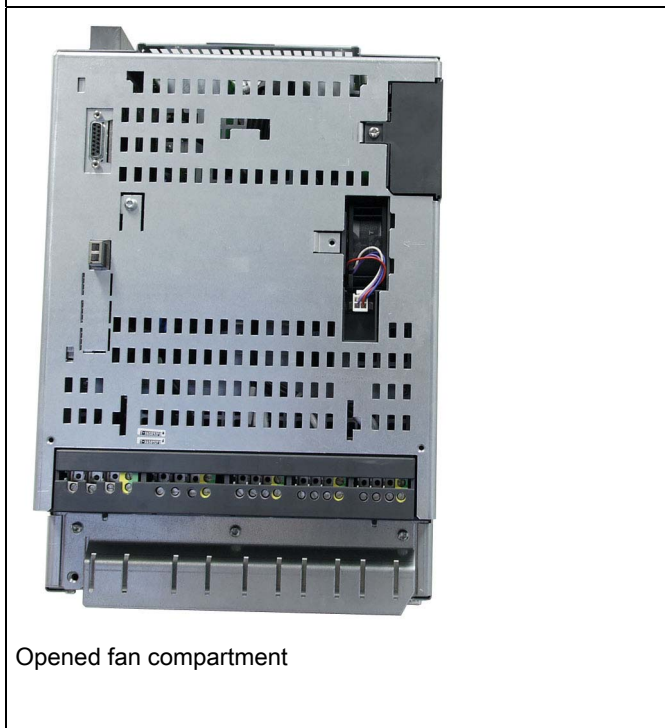
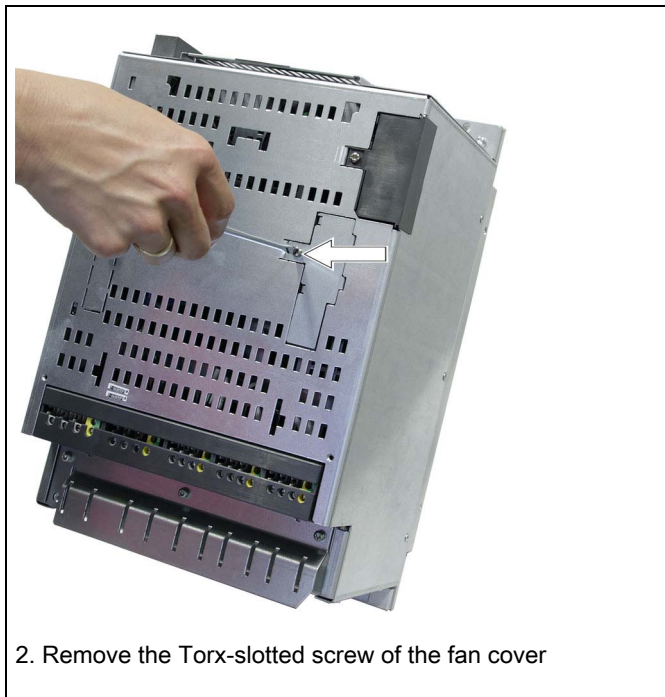
<b>Risk of electric shock</b>
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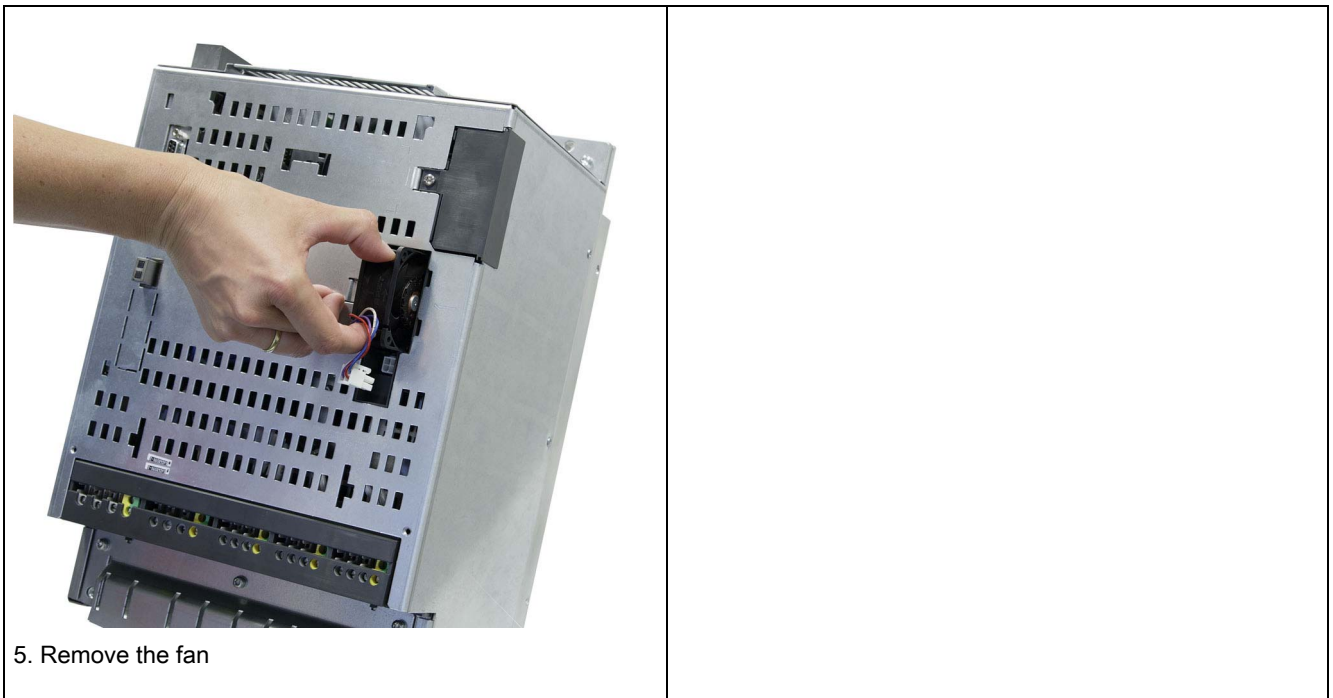
Before replacing the fan, the power supply (400 V AC) must be switched off. A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off.
--

Before removing the component, check that the system is in a no-voltage condition!
--

### Removing the internal fan

1. Remove the S120 Combi front cover (see Chapter "Electrical connection of Motor Modules and DC link components")





### Installing the internal fan

1. Before installing the fan, check the air flow direction (arrows on the fan must match the diagram shown below)




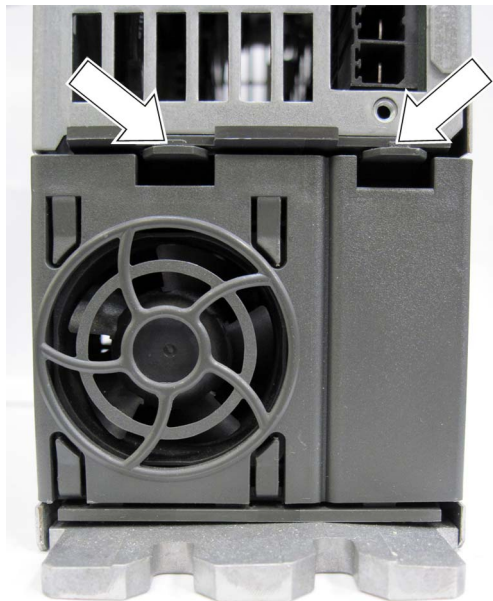
Figure 13-1 Arrows on the fan for the air flow direction

2. Installing the fan  
The connecting cables must not be crushed!
3. Insert the connector (the connector must audibly click into place)
4. Close the fan cover.
5. Fix the Torx-slotted screw on the fan cover
6. Mount the front cover and tighten the screws at the front

### 13.3.2 Replacing the fan on the Motor Modules Booksize Compact

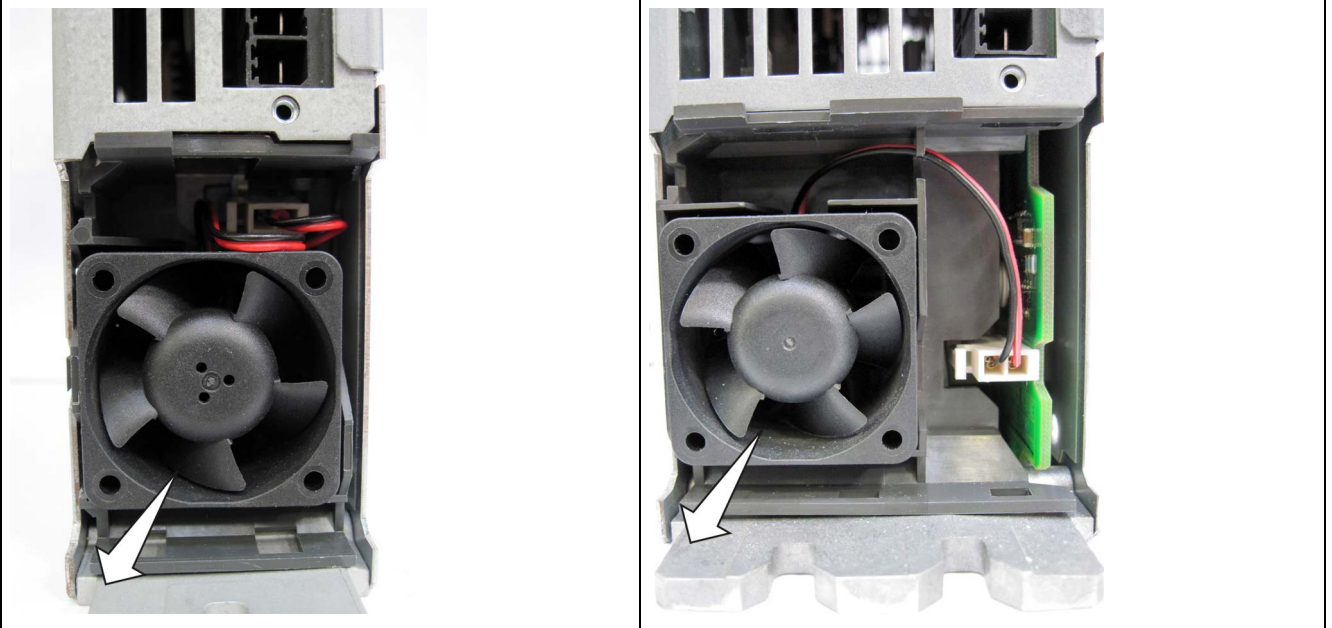
<b>NOTICE</b>
When replacing the fan, you must observe the ESD regulations. Only qualified personnel are permitted to install spare parts!
<b>⚠ DANGER</b>
<b>Risk of electric shock</b> Switch off the power supply (400 V AC) before replacing the fan. A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off. Before removing the component, check that the system is in a no-voltage condition!

Table 13-2 Removing the fan

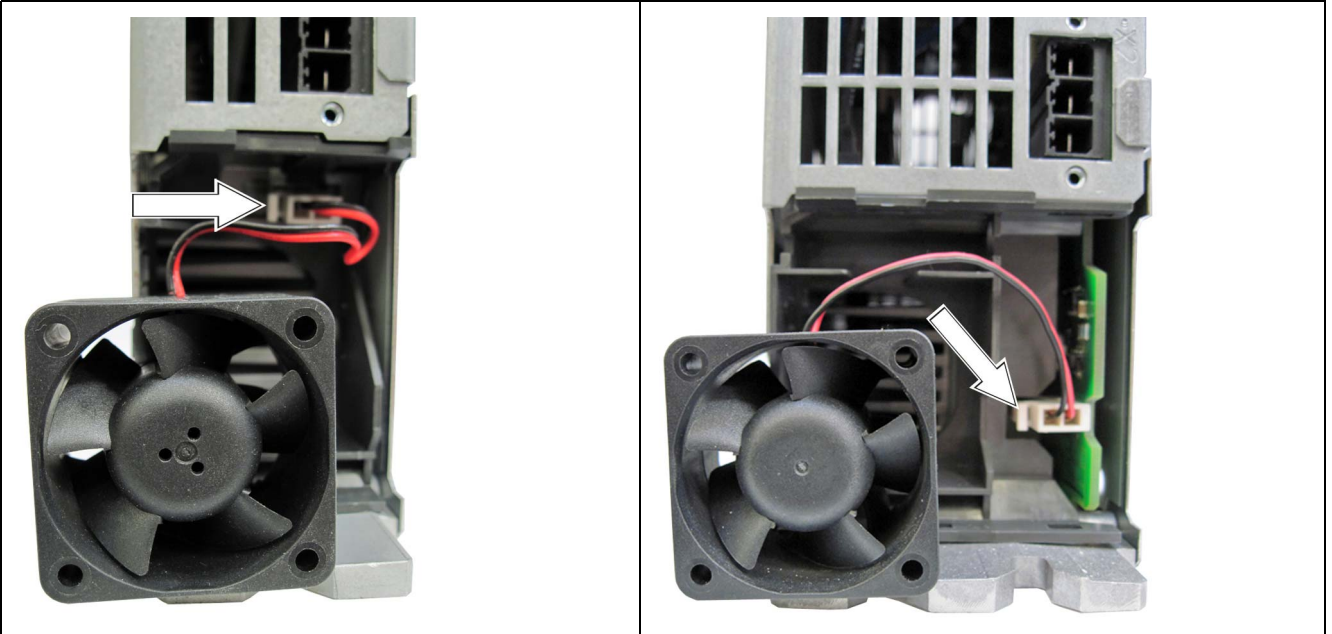
Module width: 50 mm	Module width: 75 mm
<ul style="list-style-type: none"> <li>Removing the Motor Module from the drive line-up</li> <li>Remove the fan cover at the lower side of the Motor Module by releasing the snap hook</li> </ul>	
	



- Carefully remove the fan


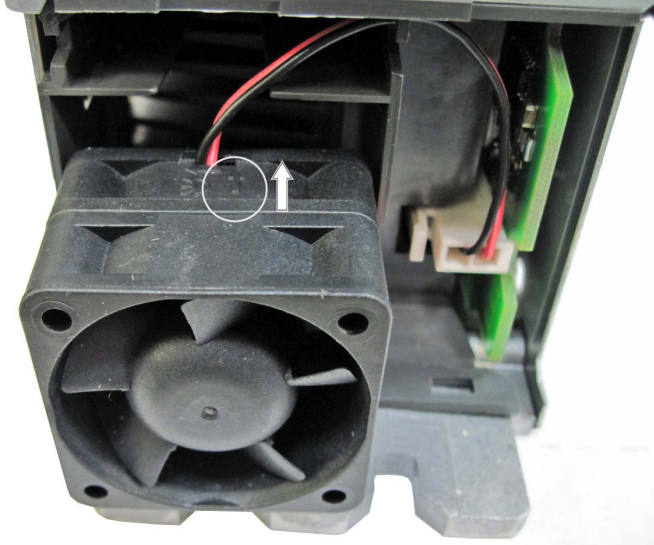


- Release and withdraw the connector



13.3 Replacing the fan

Table 13- 3 Installing the fan

Module width: 50 mm	Module width: 75 mm
<ul style="list-style-type: none"><li>• Before installing the fan, check the air flow direction (the arrow on the fan must point towards the cooling ribs).</li></ul>	
	
<ul style="list-style-type: none"><li>• Insert the connector until it clicks into place</li><li>• Installing the fan Notice! Do not crush the connection cables!</li><li>• Insert the fan cover.</li></ul>	

### 13.3.3 Replacing the fan on the Control Supply Module

Replacement fan (order number: 6SL3160-0AB00-0AA0)

<b>NOTICE</b>
When replacing the fan, you must observe the ESD regulations. Only qualified personnel are permitted to install spare parts!



 <b>DANGER</b>
<b>Risk of electric shock</b> The power supply (400 V AC) must be switched off before replacing a fan. A hazardous voltage is present for up to 5 minutes after the supply has been switched off. Before removing the component, check that the system is in a no-voltage condition.

Table 13- 4 **Removing the fan**

<ol style="list-style-type: none"> <li>1. Switch off the power supplies (3-ph. 400 V AC for Control Supply Module <b>and</b> S120 Combi)</li> <li>2. Remove the component from the drive line-up.</li> <li>3. Open the device cover (6 TX10 screws)</li> </ol>	
	
<ol style="list-style-type: none"> <li>1. Unlatch and pull out the plug connector</li> <li>2. Release the 2 Torx screws (TX20)</li> </ol>	<ol style="list-style-type: none"> <li>3. Remove the fan</li> </ol>



#### Installing the fan

1. Before installing the fan, check the air flow direction (the arrow on the fan must point towards the cooling ribs).
2. Insert the connector until it fully engages.
3. Tighten the 2 Torx screws (TX20); torque 1.2 Nm
4. Close the device cover (TX10); torque 0.8 Nm

## 13.4 Cleaning the S120 Combi heat sink

The S120 Combi heat sink should be cleaned at regular intervals using either compressed air or high-pressure water jets.

To clean the heat sink, the air baffle plate at the rear of the S120 Combi must be removed as follows:




Table 13- 5 Removing the air baffle plate on the S120 Combi

<p>Releasing the fixing screws through the holes in the reinforcement plates</p>		<p>Screws: Slotted or cross slot M4 x 10, DIN EN ISO 7046-1/2</p>
<p>Remove the air baffle plate in the direction of the arrow</p>		<p>The heat sink can now be cleaned</p>

After cleaning the heat sink, the air baffle plate is reinstalled in the reverse sequence.  
**Tightening torque** for the screws: 1.8 Nm.

## 13.5 Forming the DC link capacitors

 <b>CAUTION</b>
If the S120 Combi Power Modules and the Motor Modules Booksize Compact have been kept in storage for more than two years, the DC link capacitors have to be reformed. If the capacitors are not reformed, then there is a danger that the components could be damaged when switching on.

### Note

The storage period is calculated from the date of manufacture and not from the date that the equipment was shipped.

A defined voltage and a limited current are applied to the DC link capacitors when forming them. As a consequence, the internal relationships required for the DC link capacitors to function correctly are re-established.

### Date of manufacture

The date of manufacture can be determined from the following assignment to the serial number (e.g. T-XN2067000015 for 2009, November):

Table 13- 6 Production year and month

Character	Year of manufacture	Character	Month of manufacture
X	2009	1 to 9	January to September
A	2010	O	October
B	2011	N	November
C	2012	D	December
D	2013		

The serial number is found on the rating plate.

## Forming circuit

The S120 Combi Power Module has internal PTC resistors to pre-charge the DC link capacitors. The resistors can be used to form the DC link capacitors of the S120 Combi Module as well as the expansion axes (Motors Modules Booksize Compact).

During the forming process, it is not permissible for the S120 Combi Power Module to receive a switch-on command. Therefore, disconnect the 24 V power supply to the S120 Combi Power Module.

### Procedure

#### S120 Combi Power Modules

1. Connect the S120 Combi Power Module with line reactor to the line supply (see the connection example in Chapter "S120 Combi Power Modules / interface description").
2. Keep the module connected to the line supply for approx. 1 hour without issuing a switch-on command.

#### Expansion axis (Motor Module Booksize Compact)

1. Connect the expansion axis to be formed to the DC link of the S120 Combi Power Module.
2. Connect the S120 Combi Power Module with line reactor to the line supply (see the connection example in Chapter "S120 Combi Power Modules / interface description").
3. Keep the S120 Combi Power Module and the expansion axis connected to the line supply for approx. 1 hour without issuing a switch-on command.

 <b>DANGER</b>
---

<b>Risk of electric shock</b>
-------------------------------

As a result of the DC link capacitors, a hazardous voltage is present for up to 5 minutes after the power supply has been switched off. Work may only be carried out on the components after this time has elapsed.
---



# Appendix

## A.1 List of abbreviations

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**Note:**

The following list of abbreviations includes all abbreviations and their meanings used in the entire SINAMICS user documentation.

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Abbreviation	Source of abbreviation	Meaning
<b>A</b>		
A...	Alarm	Alarm
AC	Alternating Current	Alternating current
ADC	Analog Digital Converter	Analog digital converter
AI	Analog Input	Analog input
AIM	Active Interface Module	Active Interface Module
ALM	Active Line Module	Active Line Module
AO	Analog Output	Analog output
AOP	Advanced Operator Panel	Advanced Operator Panel
APC	Advanced Positioning Control	Advanced Positioning Control
AR	Automatic Restart	Automatic restart
ASC	Armature Short Circuit	Armature short circuit
ASCII	American Standard Code for Information Interchange	American standard code for information interchange
ASM	Asynchronmotor	Induction motor
<b>B</b>		
BERO	-	Contactless proximity switch
BI	Binector Input	Binector input
BIA	Berufsgenossenschaftliches Institut für Arbeitssicherheit	Germany's Institute for Occupational Safety and Health
BICO	Binector Connector Technology	Binector connector technology
BLM	Basic Line Module	Basic Line Module
BO	Binector Output	Binector output
BOP	Basic Operator Panel	Basic Operator Panel

Abbreviation	Source of abbreviation	Meaning
<b>C</b>		
C	Capacitance	Capacitance
C...	-	Safety message
CAN	Controller Area Network	Serial bus system
CBC	Communication Board CAN	Communication board CAN
CD	Compact Disc	Compact Disc
CDC	Crosswise data comparison	Crosswise data comparison
CDS	Command Data Set	Command data set
CF Card	CompactFlash Card	CompactFlash Card
CI	Connector Input	Connector input
CLC	Clearance Control	Clearance control
CNC	Computer Numerical Control	Computer numerical control
CO	Connector Output	Connector output
CO/BO	Connector Output/Binector Output	Connector/binector output
COB ID	CAN Object Identification	CAN Object identification
COM	Common contact of a changeover relay	Center contact of a changeover contact
COMM	Commissioning	Commissioning
CP	Communication Processor	Communication processor
CPU	Central Processing Unit	Central processing unit
CRC	Cyclic Redundancy Check	Cyclic redundancy check
CSM	Control Supply Module	Control Supply Module
CU	Control Unit	Control Unit
CUA	Control Unit Adapter	Control Unit Adapter
CUD	Control Unit DC MASTER	Control Unit DC MASTER
<b>D</b>		
DAC	Digital Analog Converter	Digital analog converter
DC	Direct Current	DC current
DC link	DC link	DC link
DCB	Drive Control Block	Drive Control Block
DCC	Drive Control Chart	Drive Control Chart
DCC	Data Cross Check	Crosswise data comparison
DCN	Direct Current Negative	DC current negative
DCP	Direct Current Positive	DC current positive
DDS	Drive Data Set	Drive data set
DI	Digital Input	Digital input
DI/DO	Digital Input/Digital Output	Digital input/output bidirectional
DMC	DRIVE-CLiQ Hub Module Cabinet	DRIVE-CLiQ Hub Module Cabinet
DME	DRIVE-CLiQ Hub Module External	DRIVE-CLiQ Hub Module External
DO	Digital Output	Digital output
DO	Drive Object	Drive object

<b>Abbreviation</b>	<b>Source of abbreviation</b>	<b>Meaning</b>
DP	Decentralized Peripherals	Distributed IOs
DPRAM	Dual Ported Random Access Memory	Memory with dual access ports
DRAM	Dynamic Random Access Memory	Dynamic memory
DRIVE-CLiQ	Drive Component Link with IQ	Drive Component Link with IQ
DSC	Dynamic Servo Control	Dynamic Servo Control
<b>E</b>		
EASC	External Armature Short Circuit	External armature short circuit
EDS	Encoder Data Set	Encoder data set
ESD	Electrostatic Sensitive Devices	Electrostatic sensitive devices
ELCB	Earth Leakage Circuit Breaker	Earth leakage circuit breaker
ELP	Earth Leakage Protection	Earth leakage protection
EMC	Electromagnetic Compatibility	Electromagnetic compatibility
EMF	Electromagnetic Force	Electromagnetic force
EMF	Electromagnetic force	Electromagnetic force
EMC	Electromagnetic compatibility	Electromagnetic compatibility
EN	European standard	European standard
EnDat	Encoder Data Interface	Encoder interface
EP	Enable Pulses	Pulse enable
EPOS	Einfachpositionierer	Basic positioner
ES	Engineering System	Engineering System
ESB	Equivalent circuit diagram	Equivalent circuit diagram
ESD	Electrostatic Sensitive Devices	Electrostatic sensitive devices
ESR	Extended Stop and Retract	Extended stop and retract
<b>F</b>		
F...	Fault	Fault
FAQs	Frequently Asked Questions	Frequently asked questions
FBL	Free Blocks	Free function blocks
FCC	Function Control Chart	Function Control Chart
FCC	Flux Current Control	Flux current control
FD	Function Diagram	Function diagram
F-DI	Failsafe Digital Input	Fail-safe digital input
F-DO	Failsafe Digital Output	Fail-safe digital output
FEM	Fremderregter Synchronmotor	Separately excited synchronous motor
FEPROM	Flash EPROM	Non volatile read and write memory
FG	Function Generator	Function generator
FI	-	Fault current
FOC	Fiber-Optic Cable	Fiber-optic cable
FP	Function diagram	Function diagram

<b>Abbreviation</b>	<b>Source of abbreviation</b>	<b>Meaning</b>
FPGA	Field Programmable Gate Array	Field Programmable Gate Array
FW	Firmware	Firmware
<b>G</b>		
GB	Gigabyte	Gigabyte
GC	Global Control	Global Control Telegram (Broadcast Telegramm)
GND	Ground	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as G)
GSD	Generic Station Description	Generic station description: Describes the characteristics of a PROFIBUS slave
GSV	Gate Supply Voltage	Gate Supply Voltage
GUID	Globally Unique Identifier	Globally unique identifier
<b>H</b>		
HF	High Frequency	High frequency
HFD	Hochfrequenzdrossel	High-frequency reactor
HMI	Human Machine Interface	Human machine interface
HTL	High-Threshold Logic	Logic with a high fault threshold
HW	Hardware	Hardware
<b>I</b>		
I/O	Input/Output	Input/output
I2C	Inter-Integrated Circuit	Internal serial data bus
IASC	Internal Armature Short Circuit	Internal armature short circuit
IBN	Inbetriebnahme	Commissioning
ID	Identifier	Identification
IE	Industrial Ethernet	Industrial Ethernet
IEC	International Electrotechnical Commission	International Electrotechnical Commission
IF	Interface	Interface
IGBT	Insulated Gate Bipolar Transistor	Insulated gate bipolar transistor
IGCT	Integrated Gate-Controlled Thyristor	Semiconductor power switch with integrated control electrode
IL	Impulslöschung	Pulse cancelation
IP	Internet Protocol	Internet Protocol
IPO	Interpolator	Interpolator
IT	Isolé Terré	Non-grounded three-phase power supply
IVP	Internal Voltage Protection	Internal voltage protection
<b>J</b>		
JOG	Jogging	Jogging



Abbreviation	Source of abbreviation	Meaning
<b>K</b>		
KIP	Kinetische Pufferung	Kinetic buffering
Kp	-	Proportional gain
KTY	-	Special temperature sensor
<b>L</b>		
L	-	Formula symbol for inductance
LED	Light Emitting Diode	Light Emitting Diode
LIN	Linear motor	Linear motor
LSB	Least Significant Bit	Least significant bit
LSC	Line-Side Converter	Line-side converter
LSS	Line Side Switch	Line side switch
LU	Length Unit	Length unit
<b>M</b>		
M	-	Formula symbol for torque
M	Ground	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as GND)
MB	Megabyte	Megabyte
MCC	Motion Control Chart	Motion Control Chart
MDS	Motor Data Set	Motor data set
MLFB	Machine-Readable Product Code	Machine-Readable Product Code
MMC	Man-Machine Communication	Man-machine communication
MMC	Micro Memory Card	Micro memory card
MSB	Most Significant Bit	Most significant bit
MSC	Motor-Side Converter	Motor-side converter
MSCY_C1	Master Slave Cycle Class 1	Cyclic communication between master (Class 1) and slave
MSR	Motorstromrichter	Motor-side converter
MT	Machine Tool	Machine tool
<b>N</b>		
N. C.	Not Connected	Not connected
N...	No Report	No message or internal message
NAMUR	Standardization association for measurement and control in the chemical industry	Standardization association for measurement and control in the chemical industry
NC	Normally Closed (contact)	NC contact
NC	Numerical Control	Numerical control
NEMA	National Electrical Manufacturers Association	Standardization body in the US
NM	Nullmarke	Zero mark
NO	Normally Open (contact)	NO contact

<b>Abbreviation</b>	<b>Source of abbreviation</b>	<b>Meaning</b>
NSR	Netzstromrichter	Line-side converter
NVRAM	Non-Volatile Random Access Memory	Non-volatile read/write memory
<b>O</b>		
OA	Open Architecture	Open Architecture
OC	Operating Condition	Operating condition
OEM	Original Equipment Manufacturer	Original Equipment Manufacturer
OLP	Optical Link Plug	Fiber-optic bus connector
OMI	Option Module Interface	Option module interface
<b>P</b>		
p...	-	Adjustable parameters
PB	PROFIBUS	PROFIBUS
PC	Position Controller	Position Controller
PcCtrl	PC Control	Control for master
PD	PROFIdrive	PROFIdrive
PDS	Power unit Data Set	Power unit data set
PE	Protective Earth	Protective earth
PELV	Protective Extra Low Voltage	Protective extra low voltage
PEM	Permanent-magnet synchronous motor	Permanent-magnet synchronous motor
PG	Programmiergerät	Programming device
PI	Proportional Integral	Proportional integral
PID	Proportional Integral Differential	Proportional integral differential
PLC	Programmable Logic Controller	Programmable logic controller
PLL	Phase-Locked Loop	Phase-locked loop
PN	PROFINET	PROFINET
PNO	PROFIBUS user organization	PROFIBUS user organization
PPI	Point-to-Point Interface	Point-to-point interface
PRBS	Pseudo Random Binary Signal	White noise
PROFIBUS	Process Field Bus	Serial data bus
PS	Power Supply	Power supply
PSA	Power Stack Adapter	Power Stack Adapter
PTC	Positive Temperature Coefficient	Positive temperature coefficient
PTP	Point-To-Point	Point-to-Point
PWM	Pulse Width Modulation	Pulse width modulation
PZD	Prozessdaten	Process data
<b>R</b>		
r...	-	Display parameters (read-only)
RAM	Random Access Memory	Read/write memory
RCCB	Residual Current Circuit Breaker	Residual current operated circuit breaker
RCD	Residual Current Device	Residual current operated circuit breaker
RCM	Residual Current Monitor	Residual current monitor

<b>Abbreviation</b>	<b>Source of abbreviation</b>	<b>Meaning</b>
RFG	Ramp-Function Generator	Ramp-function generator
RJ45	Registered Jack 45	Term for an 8-pin socket system for data transmission with shielded or non-shielded multi-wire copper cables
RKA	Rückkühlanlage	Cooling unit
RO	Read Only	Read only
RPDO	Receive Process Data Object	Receive process data object
RS232	Recommended Standard 232	Interface standard for cable-connected serial data transmission between a sender and receiver (also known under EIA232)
RS485	Recommended Standard 485	Interface standard for a cable-connected differential, parallel, and/or serial bus system (data transmission between a number of senders and receivers, also known under EIA485)
RTC	Real Time Clock	Real time clock
RZA	Raumzeigerapproximation	Space vector approximation
<b>S</b>		
S1	-	Uninterrupted duty
S3	-	Intermittent duty
SBC	Safe Brake Control	Safe brake control
SBH	Safe operating stop	Safe operating stop
SBR	-	Safe acceleration monitoring
SCA	Safe Cam	Safe cam
SD Card	SecureDigital Card	Secure digital memory card
SE	Sicherer Software-Endschalter	Safe software limit switch
SG	Sicher reduzierte Geschwindigkeit	Safely reduced speed
SGA	Sicherheitsgerichteter Ausgang	Safety-related output
SGE	Sicherheitsgerichteter Eingang	Safety-related input
SH	Sicherer Halt	Safe standstill
SI	Safety Integrated	Safety Integrated
SIL	Safety Integrity Level	Safety Integrity Level
SLM	Smart Line Module	Smart Line Module
SLP	Safely-Limited Position	Safely-limited position
SLS	Safely Limited Speed	Safely limited speed
SLVC	Sensorless Vector Control	Vector control without encoder
SM	Sensor Module	Sensor Module
SMC	Sensor Module Cabinet	Sensor Module Cabinet
SME	Sensor Module External	Sensor Module External
SN	Safe software cam	Safe software cam
SOS	Safe Operating Stop	Safe operating stop

<b>Abbreviation</b>	<b>Source of abbreviation</b>	<b>Meaning</b>
SP	Service Pack	Service pack
SPC	Setpoint Channel	Setpoint channel
SPI	Serial Peripheral Interface	Serial interface for connecting peripherals
SS1	Safe Stop 1	Safe stop 1 (monitored for time and ramping up)
SS2	Safe Stop 2	Safe stop 2
SSI	Synchronous Serial Interface	Synchronous serial interface
SSM	Safe Speed Monitor	Safe feedback for speed monitoring (n < nx)
SSP	SINAMICS Support Package	SINAMICS support package
STO	Safe Torque Off	Safe torque off
STW	Steuerwort	Control word
<b>T</b>		
TB	Terminal Board	Terminal Board
TIA	Totally Integrated Automation	Totally Integrated Automation
TM	Terminal Module	Terminal module
TN	Terre Neutre	Grounded three-phase supply network
Tn	-	Integral time
TPDO	Transmit Process Data Object	Transmit process data object
TT	Terre Terre	Grounded three-phase supply network
TTL	Transistor-Transistor Logic	Transistor-transistor logic
Tv	-	Rate time
<b>U</b>		
u.d.	under development	Under development: This feature is not currently available
UL	Underwriters Laboratories Inc.	Underwriters Laboratories Inc.
UPS	Uninterruptible Power Supply	Uninterruptible power supply
UTC	Universal Time Coordinated	Universal time coordinated
<b>V</b>		
VC	Vector Control	Vector control
Vdc	-	DC link voltage
VdcN	-	Partial DC link voltage negative
VdcP	-	Partial DC link voltage positive
VDE	Verband Deutscher Elektrotechniker	Association of German electrical engineers
VDI	Verein Deutscher Ingenieure	Association of German Engineers
VPM	Voltage Protection Module	Voltage Protection Module
Vpp	Volt peak-to-peak	Volt peak-to-peak
VSM	Voltage Sensing Module	Voltage Sensing Module

<b>Abbreviation</b>	<b>Source of abbreviation</b>	<b>Meaning</b>
<b>X</b>		
XML	Extensible Markup Language	Standard language for Web publishing and document management
<b>Z</b>		
ZM	Zero Mark	Zero mark
ZSW	Zustandswort	Status word



### Suggested improvements

If you come across any misprints in this document, please let us know using this form. We would also be grateful for any suggestions and recommendations for improvement.

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Suggestions and/or corrections





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