SIEMENS

SINUMERIK, SINAMICS

SINUMERIK 840D sl, SINAMICS S120
Guidelines for machine configuration

System Manual

Valid for NCU SW 4.5 SP1 and higher

MA 01/2013

6FC5397-6CP10-0BA2

Legal information

Warning notice system

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

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

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

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

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

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

Qualified Personnel

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

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

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Disclaimer of Liability

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

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Preface

SINUMERIK/SINAMICS documentation

The SINUMERIK and SINAMICS documentation is organized in the following categories:

- General documentation
- User documentation
- Manufacturer/service documentation

Further information

Click the following link to find information on the the following topics:

- Ordering documentation/overview of documentation
- Additional links to download documents
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FAQs

You can find Frequently Asked Questions in the Service&Support pages under **Product Support**:
http://support.automation.siemens.com

Target group

This manual is intended for experienced drive and CNC configuration engineers. Its purpose is to give you a compact guide to integrating the components of SINAMICS S120 and SINUMERIK 840D sl.

Use and standard scope

This document supplements product-related equipment, software installation, and function manuals for SINAMICS S120 and SINUMERIK 840D sl. It shows examples of the mechanical layout of components, functional integration, as well as logical connections to the signal interfaces of a processing machine.

This documentation is limited to the following series or functions:

- SINUMERIK 840D sl Type 1B (NCU 7x0.3, NX1x.3)
- SINAMICS in booksize format
- Communication between SINUMERIK NCU and the SINAMICS drives (communication with operating, programming, and visualization units is not part of this documentation)

For reasons of clarity, this documentation does not contain all of the detailed information on all of the product types. It also cannot take into consideration every conceivable type of installation, operation, and service/maintenance. If you have any questions that go beyond the scope of the information provided here, please contact your local representative.

Utilization phases and the available tools/documents

Where necessary for the understanding and for important general conditions, this guide contains extracts from the product manuals listed below. You can find there detailed descriptions for the product-internal functions and properties, and for the mechanical and electrical user interfaces.

Table 1 Utilization phases and the available tools/documents

Utilization phase	Tools
Orientation	SINAMICS S sales documentation
Planning/engineering	• SIZER configuration tool • Configuration manuals, motors
Decision making/ordering	SINAMICS S120 catalogs • SIMOTION, SINAMICS S120 and Motors for Production Machines (Catalog PM 21) • SINAMICS and Motors for Single-Axis Drives (catalog D 31) • SINUMERIK 840D sl Type 1B Equipment for Machine Tools (Catalog NC 62)

Utilization phase	Tools
Configuring/installation	• SINAMICS S120 Equipment Manual for Control Units and Additional System Components • SINAMICS S120 Booksize Power Units Equipment Manual • SINAMICS S120 Chassis Power Units Equipment Manual • SINAMICS S120 Equipment Manual Liquid Cooled Chassis Power Units • SINAMICS S120 Equipment Manual for AC Drives • SINAMICS S120M Equipment Manual Distributed Drive Technology • SINUMERIK 840D sl Equipment Manual NCU 7x0.3 PN
Commissioning	• STARTER commissioning tool • SIMATIC S7 Manager • SINAMICS S120 Getting Started • SINAMICS S120 Commissioning Manual • SINAMICS S120 CANopen Commissioning Manual • SINAMICS S120 Function Manual • SINAMICS S120 Safety Integrated Function Manual • SINAMICS S120/S150 List Manual • SINUMERIK 840D sl Commissioning Manual CNC: NCK, PLC, drive • SINUMERIK 840D sl Safety Integrated Function Manual
Using/operating	• SINAMICS S120 Commissioning Manual • SINAMICS S120/S150 List Manual
Maintenance/Service	• SINAMICS S120 Commissioning Manual • SINAMICS S120/S150 List Manual
References	• SINAMICS S120/S150 List Manual

Functionality

This documentation may also mention components that have not been released for use with SINUMERIK 840D sl. The NC62 catalog is binding for the permitted combinations.

Technical Support

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

http://support.automation.siemens.com

SINUMERIK

You can find information on SINUMERIK at:

http://www.siemens.com/sinumerik

SINAMICS

You can find information on SINAMICS at:

http://www.siemens.com/sinamics

EC Declarations of Conformity

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

http://support.automation.siemens.com

Enter there the number **15257461** as a search term or contact your local Siemens office.

Table of contents

Fundamental safety instructions 1

1.1 General safety instructions

DANGER

Danger to life when live parts are touched

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

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

Generally, six steps apply when establishing safety:

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

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

WARNING

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

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

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

WARNING

Danger to life when live parts are touched on damaged devices

Improper handling of devices can cause damage.

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

- Ensure compliance with the limit values specified in the technical data during transport, storage and operation.
- Do not use any damaged devices.
- Protect the components against conductive pollution, e.g., by installing them in a control cabinet with IP54 degree of protection according to IEC 60529 or NEMA 12. Provided conductive pollution can be prevented at the installation site, the degree of protection for the cabinet can be decreased accordingly.

WARNING

Danger of fire spreading due to inadequate housing

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

- Install devices without a protective housing in a metal control cabinet (or protect the device by another equivalent measure) in such a way that contact with fire inside and outside the device is prevented.
- Additionally, select the installation site so that an uncontrolled spreading of smoke can be avoided in the case of a fire.
- Ensure that smoke can escape via designated paths.

WARNING

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

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

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

WARNING

Fire hazard for the motor due to overload of the insulation

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

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

⚠ **WARNING**

Fire hazard due to overheating because of inadequate ventilation clearances

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

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

⚠ **WARNING**

Danger to life through electric shock due to unconnected cable shields

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

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

⚠ **WARNING**

Danger to life when safety functions are inactive

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

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

Note

Important safety notices for safety functions

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

1.2 Safety instructions for electromagnetic fields (EMF)

WARNING

Danger to life from electromagnetic fields

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

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

- Keep a distance of at least 2 m.

1.3 Handling electrostatic sensitive devices (ESD)

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

NOTICE

Damage through electric fields or electrostatic discharge

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

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

1.4 Residual risks of power drive systems

Residual risks of power drive systems

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

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

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

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

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

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

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

Note

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

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

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

System overview 2

2.1 Application

Features

SINUMERIK 840D sl is a universal and flexible CNC system in which the SINAMICS S120 drive system is integrated.

- Maximum performance and flexibility, above all for complex multi-axis systems.
- Uniform openness from operation up to the NC core.
- Optimum integration into networks.
- Uniform structure in respect of operation, programming and visualization.
- Integrated safety functions for man and machine: SINUMERIK Safety Integrated
- Operating and programming software such as SINUMERIK Operate and SINUMERIK Integrate can be used for the production sector.

Fields of application

The SINUMERIK 840D sl can be used worldwide for turning, drilling, milling, grinding, laser machining, nibbling, punching, in tool and mold making, for high-speed cutting applications, for wood and glass processing, for handling operations, in transfer lines and rotary indexing machines, for mass production and Job Shop production.

The SINUMERIK 840DE sl is available as an export version for use in countries requiring an export authorization.

2.2 System configuration

The heart of the SINUMERIK 840D sl is the Numerical Control Unit (NCU). It combines NCK, HMI, PLC, closed-loop control and communication tasks.

Components

For operation, programming, and visualization purposes, the corresponding operating software is already integrated into the CNC software for the NCU and therefore runs on the high-performance NCU multi-processor module. For increased operating performance requirements, the SINUMERIK PCU 50.5 industrial PC can be used.

With the TCU (Thin Client Unit), the operator panel can be installed as much as 100 meters away. Up to four distributed operator panel fronts can be operated on an NCU or PCU 50.5.

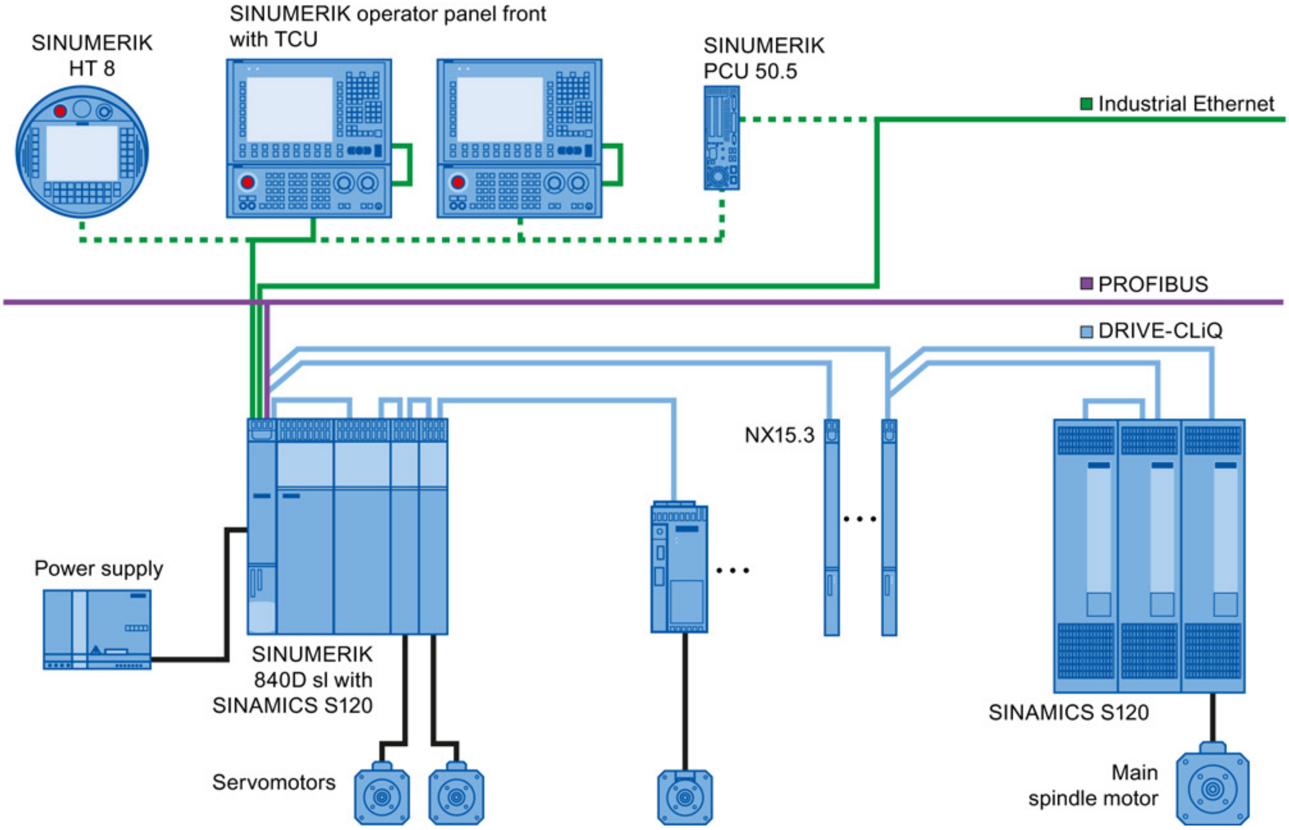


Figure 2-1 Typical topology of the SINUMERIK 840D sl complete system

The following components can be connected to the PPU:

- SINUMERIK operator panel front with TCU/PCU 50.5 and machine control panel/pushbutton panel
- Handheld units
- SIMATIC CE panel
- SIMATIC S7-300 I/O
- Distributed PLC I/O via PROFIBUS DP connection or PROFINET IO
- Programming device
- SINAMICS S120 drive system with feed and main spindle motors, such as
  - 1FT/1FK/1FN/1FW6/1FE1/2SP1 synchronous motors
  - 1PH/1PM asynchronous motors

The SINUMERIK 840D sl offers integrated PROFINET functionality.

The following are supported:

- PROFINET CBA functionality (CBA = Component Based Automation)

  The CBA functionality integrated in the NCU allows users to modularize machinery and systems: Rapid real-time communication (up to 10 ms) between the controllers means that systems lend themselves better to standardization and can be reused or expanded more easily. Response to customer demands is faster and more flexible and startup is simplified and speeded up by pretesting at component level.
- PROFINET IO

  As part of PROFINET, PROFINET IO is a communication concept that is used to implement modular, distributed applications. PROFINET IO is based on Industrial Ethernet and allows distributed field and I/O equipment to be connected to the central processing unit.

  128 PROFINET IO devices can be operated on the NCU as an IO controller.

2.3 Variants

Thanks to the scalability of the hardware and software, both in the controller and operating areas, the SINUMERIK 840D sl can be used in many sectors. The possibilities range from simple positioning tasks up to complex multi-axis systems.

Application areas and performance

- Up to eight axes can be implemented on an NCU 710.3 PN in SERVO control mode, with a sampling time of 125 µs for both the speed and current controllers. In order to achieve this maximum number of axes, the NCU 710.3 PN must be extended by up to two NX modules.

Note

Connection of SINAMICS S120 Combi

An NCU 710.3 PN is required in order to use a SINAMICS S120 Combi drive system.

This version is not discussed in this document.

- On the NCU 720.3 PN/730.3 PN, the number of axes can be increased to as many as 31 and/or the drive control performance can be improved in SERVO control mode, with a sampling time of 125 µs for both the speed and current controllers. This is achieved by using the NX10.3/NX15.3 module. The NCU 720.3 PN/730.3 PN can be extended by up to five NX10.3/NX15.3 modules for the purposes of drive control performance and number of axes.
- Using the Option Board CBE30-2, three NCU 7x0.3 PN can be linked to each other by means of the NCU link functionality, so that 93 axes in total can be controlled by an NCU.
- The NCU 730.3 PN is recommended for maximum dynamics and accuracy in mold making applications or the high-speed cutting sector. Since it has the highest PLC capacity, it represents the most advanced configuration within the SINUMERIK 840D sl range.

Further information

Please refer to the following for detailed information on the number of axes and controller axis performance:
/FH1/ SINAMICS S120 Function Manual Drive Functions, 01/2012 edition, Chapter 12.12.

2.4 SINAMICS S120 / SINUMERIK 840D sl Component Overview

Introduction

Coordinated drives that carry out a drive and motion task together are used in many mechanical and plant engineering applications. These require drives with a coupled DC link, which allows for cost-saving energy compensation between braking and driving axes.

SINAMICS S120 features Line Modules (infeed modules) and Motor Modules (inverter modules) covering a wide performance range which, having been designed in booksize format for seamless installation, pave the way for compact multi-axis drive configurations.

The SINAMICS S120 control module, the CU320-2 Control Unit, is able to handle simple technological tasks by itself. For challenging numerical tasks, it is replaced by or extended to include powerful modules from the SINUMERIK 840D sl product range.

The SINUMERIK NCU 7x0.3 PN Numerical Control Units can be positioned in or next to the SINAMICS S120 drive line-up and connected via DRIVE-CLiQ.

In the case of tasks that require a greater number of motion axes due to the machine kinematics, the system base units can be expanded with the additional NX10.3/NX15.3 Control Units.

Components of the SINAMICS S120 drive system and SINUMERIK 840D sl control

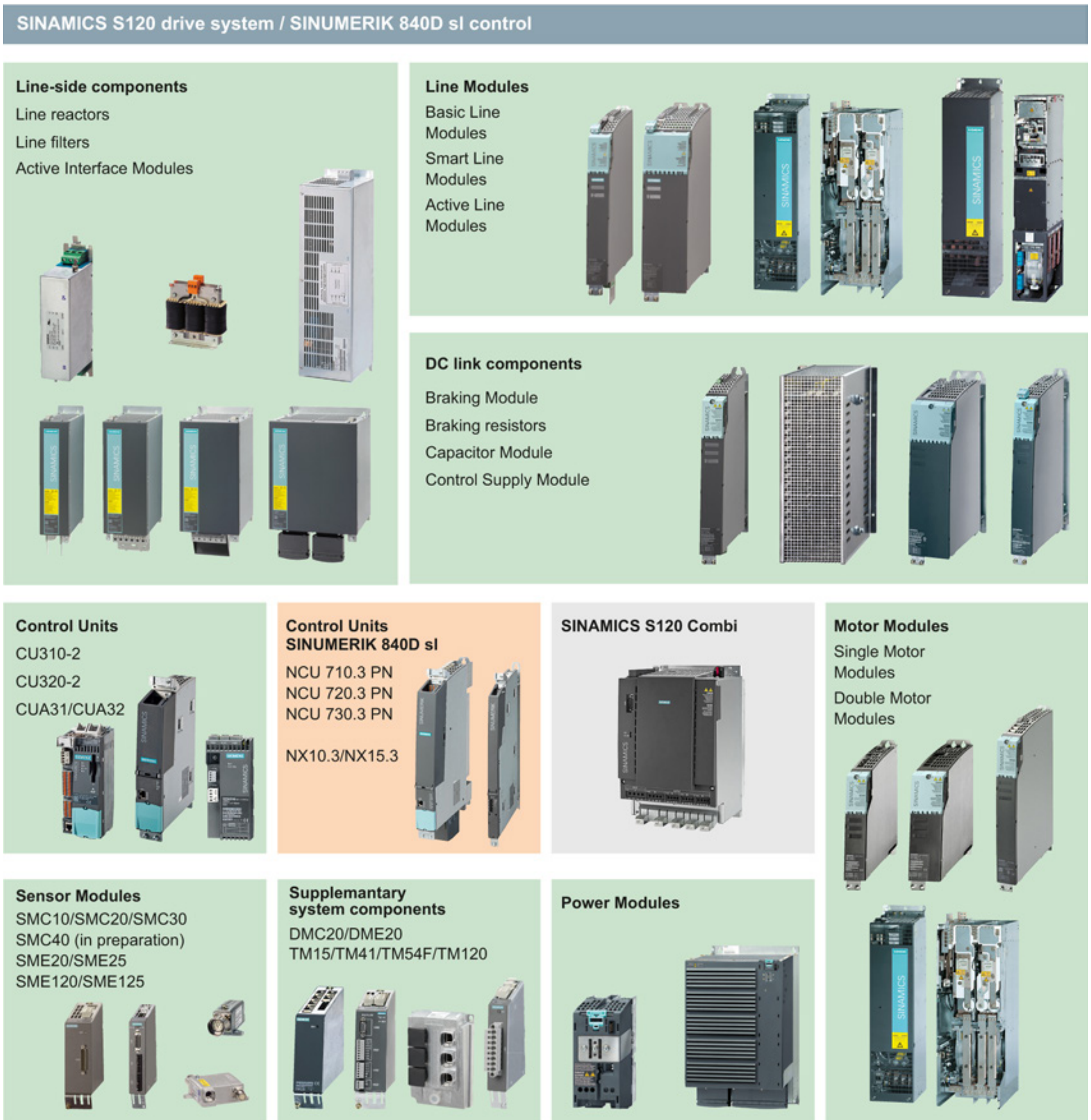


Figure 2-2 SINAMICS and SINUMERIK components

Function of components

- Line-side power components such as fuses, contactors, reactors, and filters are used for switching the energy supply and meeting EMC requirements.
- Line Modules generate DC voltage from the three-phase line voltage, and transfer the central energy supply to the DC link and, if necessary, the regenerative feedback to the network.
  - Basic Line Modules (BLM) generate a non-stabilized DC link voltage and are not capable of regenerative feedback. They are not generally used for multi-axis drive configurations.
  - Smart Line Modules generate a non-stabilized DC link voltage and are capable of regenerative feedback.
  - Active Line Modules generate a stabilized DC link voltage and are capable of regenerative feedback.
- DC link components such as Braking Modules and Capacitor Modules are used as an option for the purpose of stabilizing the DC link voltage.
- Motor Modules work as inverters. They draw their power from the DC link and supply the connected motors.
- Additional system components expand the range of functions and cover different interfaces for encoders and process signals.
- The Control Unit processes cross-axis drive and technological functions.

Overview

The table below only takes into account those SINAMICS S120 booksize format components that are supported by SINUMERIK 840D sl.

Table 2- 1 SINAMICS and SINUMERIK components (selection)

Product family	Component group	Component/function	Types
SINUMERIK	Numerical Control Units	Control center	• NCU 710.3 PN • NCU 720.3 PN • NCU 730.3 PN
SINUMERIK	Numeric Control Extensions	Expansion modules for the NCU (computing power and DRIVE-CLiQ interfaces)	• NX10.3 • NX15.3
SINUMERIK	Operating unit	Industrial PC	• PCU 50.5
SINUMERIK	Operating unit	Thin Client Unit	• TCU
SINUMERIK	Operator panels	Operator panels with display and keyboard that can be connected as distributed components	• OP 08T • OP 010/OP 010S/OP 010C • OP 012 • OP 015/OP 015A/OP 015AT • TP 015A/TP 015AT • OP 019

Product family	Component group	Component/function	Types
SINUMERIK	Communication Board Ethernet (CBE)	CBE for NCU link	• CBE30-2
SINAMICS S120 Booksize	Line-side components	Active Interface Module	• 16 kW • 36 kW • 55 kW • 80 kW • 120 kW
SINAMICS S120 Booksize	Line-side components	High frequency line reactor with a damping resistor (HFD reactor) for ALM	• 16 kW • 36 kW • 55 kW • 80 kW • 120 kW
SINAMICS S120 Booksize	Line-side components	Line reactor for SLM	• 5 kW • 10 kW • 16 kW • 36 kW • 55 kW
SINAMICS S120 Booksize	Line-side components	Basic Line Filter for ALM	• 16 kW • 36 kW • 55 kW
SINAMICS S120 Booksize	Line-side components	Wideband Line Filter for ALM	• 16 kW • 36 kW • 55 kW • 80 kW • 120 kW
SINAMICS S120 Booksize	Line-side components	Line filters for SLM	• 5 kW • 10 kW • 16 kW • 36 kW • 55 kW
SINAMICS S120 Booksize	Line Modules	Active Line Module (ALM)	• 16 kW • 36 kW • 55 kW • 80 (64) kW • 120 (84) kW

Product family	Component group	Component/function	Types
SINAMICS S120 Booksize	Line Modules	Smart Line Module (SLM)	• 5 kW • 10 kW • 16 kW • 36 kW • 55 kW
SINAMICS S120 Booksize	DC link components	Braking Module (BM)	• 1.5 kW/100 kW
SINAMICS	DC link components	Braking resistors	• 0.3 kW/25 kW • 1.5 kW/100 kW • 5 kW/30 kW • 12.5 kW/75 kW
SINAMICS	DC link components	Capacitor Module	• 4000 μF
SINAMICS	DC link components	Control Supply Module (CSM)	• 3 AC 380 ... 480 V
SINAMICS	Control units	Control Unit for more straightforward functions	• CU320-2 PN • CU320-2 DP
SINAMICS	Motor Modules	Single Motor Module (SMM)	• 3 A/5 A/9 A/18 A/30 A/45 A/60 A/85 A/132 A/200 A
SINAMICS	Motor Modules	Double Motor Module (DMM)	• 2x3 A/2x5 A/2x9 A/2x18 A
SINAMICS	Sensor Modules	Sensor Modules Cabinet	• SMC10/SMC20/SMC30 SMC40 (in development)
SINAMICS	Sensor Modules	Sensor Modules External	• SME20/SME25 • SME120/SME125
SINAMICS	DRIVE-CLiQ hubs	DRIVE-CLiQ hub Cabinet	• DMC20
SINAMICS	DRIVE-CLiQ hubs	External DRIVE-CLiQ hub	• DME20
SINAMICS	Terminal Modules	Terminal expansion	• TM15
SINAMICS	Terminal Modules	Emulating an incremental encoder	• TM41
SINAMICS	Terminal Modules	Temperature sensor evaluation with safe electrical separation	• TM120
SINAMICS	Voltage Protection Module	DC link voltage limit	• VPM120 • VPM200 • VPM200 Dynamic
SINAMICS	Additional system component	Control Unit Adapter	• CUA31

2.5 User interface software (HMI software)

The HMI software is used to operate and program machine tools. It is available in several versions as user interface software integrated into the CNC software:

- SINUMERIK Operate
- SINUMERIK Integrate

Connection of the NCU 7x0.3 to the HMI software

A Thin Client Unit (TCU) or, if higher operating performance is required, an industrial PC PCU 50.5, is responsible for communication between the NCU and the operator panel front.

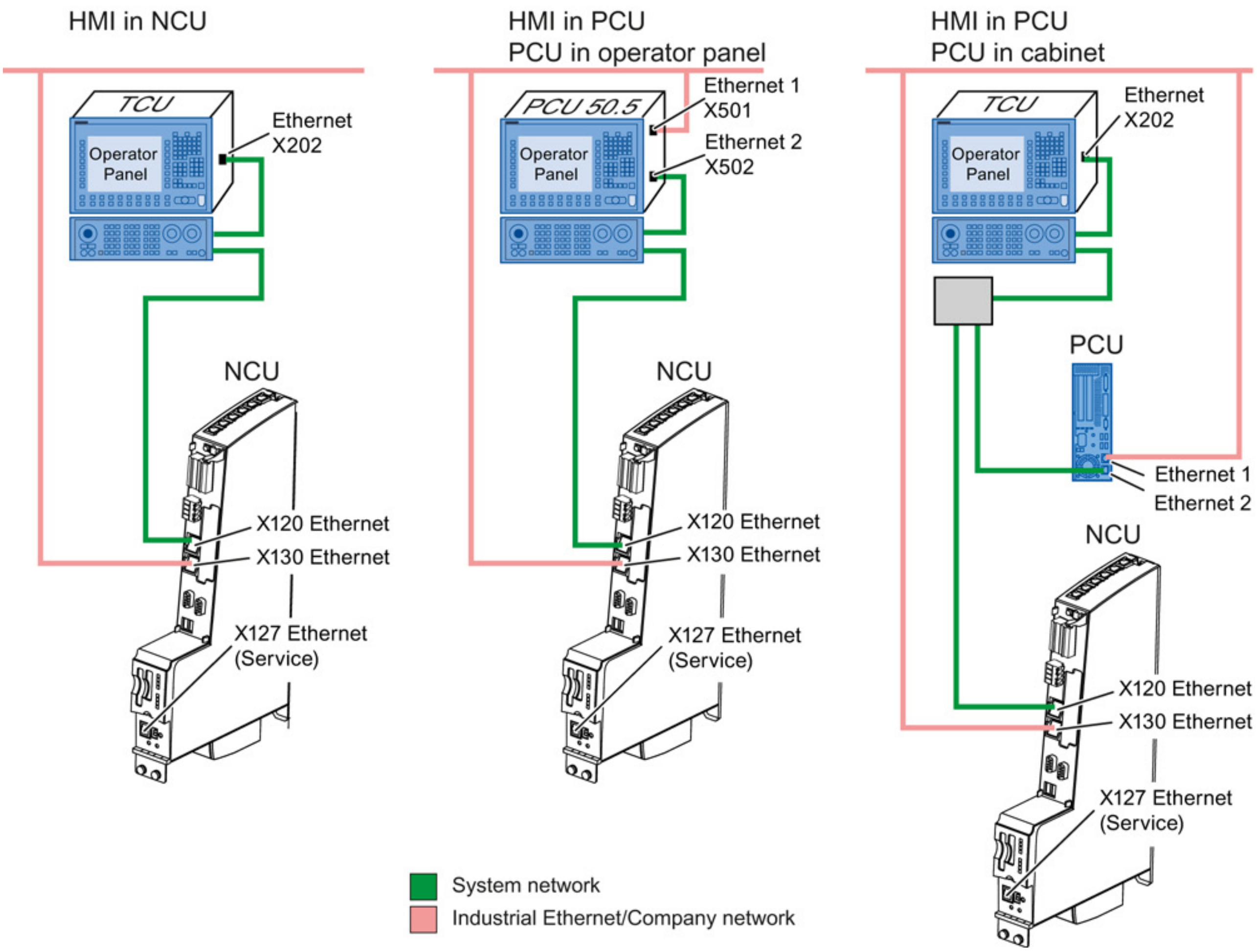


Figure 2-3 HMI software connection options

Switching between operator panels

When an Ethernet switch is used, you can switch between embedded HMI (available on NCU) and HMI-Advanced (available on PCU 50.5).

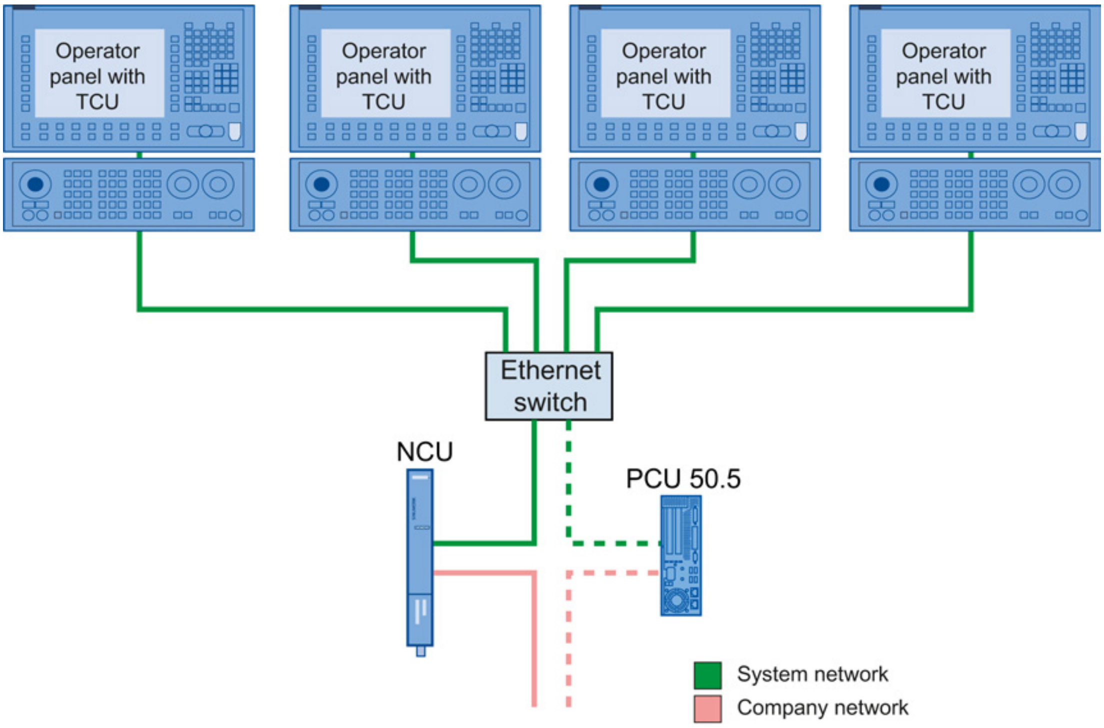


Figure 2-4 HMI connection with switch

Note

Detailed information about the operator panels, TCU and PCU 50.5 is contained in the "sl Operator Components Equipment Manual" and in "CNC Commissioning, Part 2 (HMI)".

2.6 Function of installation altitude and ambient temperature

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

Table 2- 2 Air pressure for various installation altitudes

Installation altitude above sea level in [m]	0	1000	2000	3000	4000	5000
Air pressure in mbar [kPa]	100	90	80	70	62	54

SINUMERIK 840D sl components

The components of the SINUMERIK 840D sl system are intended for a weatherproof, fixed location. The rated conditions exceed requirements according to EN 61131-2.

SINUMERIK components are designed for operation at ambient temperatures of 0° to 55 °C and at installation altitudes of up to 1000 m above sea level. At altitudes of 1000 m and higher, the max. ambient temperature decreases by 3 °C with every 1000 m increase in altitude.

SINAMICS S120 power units

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

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

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

- TN system with grounded neutral point (no grounded line conductor)
- IT system

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

SINUMERIK 840D sl 3

3.1 Control Unit NCU 7x0.3 PN

3.1.1 Description

The modular concept behind the SINUMERIK 840D sl CNC is suitable for decentralized and flexible system structures. A Numerical Control Unit (NCU) serves as the control center. It is available in three configuration levels, which have largely identical structures.

Table 3- 1 Differences between the NCU configuration levels:

	NCU 710.3 PN	NCU 720.3 PN	NCU 730.3 PN
CNC user memory	3 MB (max. 9 MB)	3 MB (max. 15 MB)	3 MB (max. 15 MB)
Max. power consumption	281 W	374 W	374 W
Power loss	21 W	46 W	46 W
DRIVE-CLiQ interfaces	4	6	6
Supported axes	8	31	31
Heat dissipation	Open-circuit ventilation; double fan connected if necessary	Open-circuit ventilation; double fan connected if necessary	Cooling fins; double fan connected if necessary

3.1.2 Interface description

Overview

The following diagram shows an NCU 730.3 PN with its interfaces and control and display elements (fault displays and status indicators):

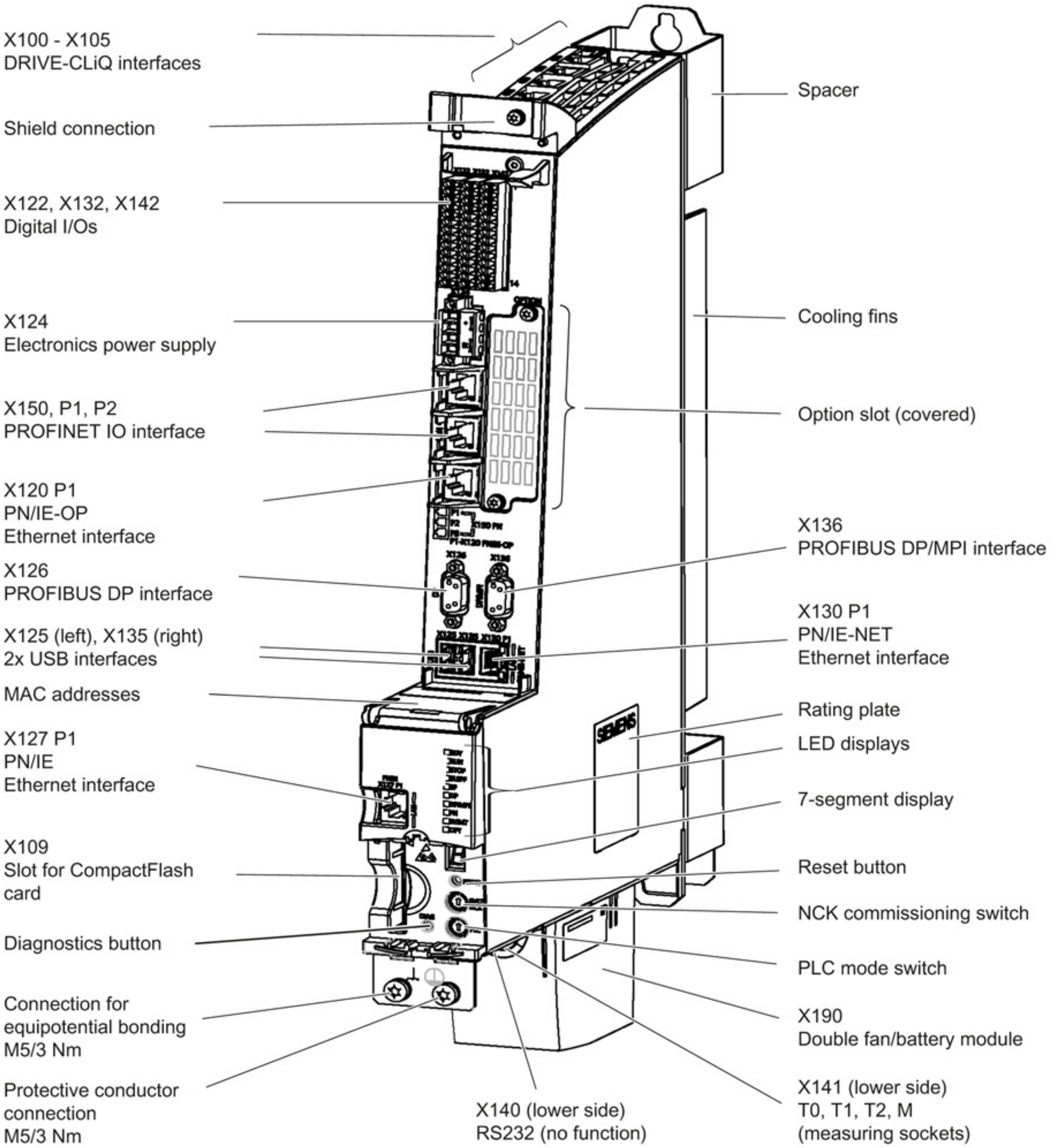


Figure 3-1 NCU 730.3 PN interfaces

The information below contains detailed descriptions of those interface terminal assignments which are used to connect components of the SINAMICS drive line-up.

You can find information on the other interfaces in the "SINUMERIK 840D sl, NCU 7x0.3 PN" Equipment Manual.

3.1.3 Interfaces and their terminal assignments

3.1.3.1 DRIVE-CLiQ interfaces X100-X105 (X103)

Properties

The NCU 7x0.3 PN and its NX1x.3 expansion units are connected to SINAMICS S120 components using the common serial interface DRIVE-CLiQ. Device data (electronic rating plate) is also transmitted via these lines; this enables the correct data to be configured in a straightforward way. The standardized cables and connectors reduce the variety of different parts and cut storage costs.

Use

The following components can be connected via the DRIVE-CLiQ interfaces of the NCU 7x0.3 PN:

Table 3- 2 Components with DRIVE-CLiQ connection

Component	Description
NX10/15	Drive expansion module for three to six axes.
Active/Smart/Basic Line Module	Line Modules provide the central energy supply to the DC link.
Single/Double Motor Module	Motor Modules draw their power from the DC link to supply the connected motors.
SMC10/20/30 (SMC40 in development)	Sensor Modules Cabinet-Mounted are needed when a motor with a DRIVE-CLiQ interface is not available and when external encoders are required in addition to the motor encoder.
SME20/25 SME120/125	Measuring systems outside the cabinet can be connected directly to the Sensor Module External.
DMC20/DME20	DRIVE-CLiQ Hub Modules are used to implement star-shaped distribution of a DRIVE-CLiQ line.
TM15	The number of available digital inputs and outputs within a drive system can be expanded with the TM15 Terminal Module.
TM41	An incremental encoder can be emulated using the TM41 Terminal Module.

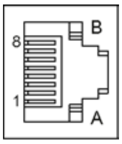
Component	Description
TM120	The TM120 Terminal Module is used for temperature evaluation with protective separation. It can be used for 1FN and 1FW6 motors as well as motors from third-party manufacturers.
CUA31	The CUA31 Control Unit Adapter converts the PM-IF interface to a DRIVE-CLiQ interface. The CUA31 Control Unit Adapter makes it possible to operate Power Modules in blocksize format on an NCU 7x0.3 PN as well.

Note

Although the TM31, TM54F, and TM150 Terminal Modules and the CUA32 Control Unit Adapter are DRIVE-CLiQ components, they are not supported by SINUMERIK 840D sl and for this reason are not addressed in this documentation.

Terminal assignment

Table 3- 3 DRIVE-CLiQ interfaces X100-X105 (with NCU 710.3 PN only X100-X103)

	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Connector type	RJ45 jack		

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

Blanking covers (50 pieces) Order number: 6SL3066-4CA00-0AA0

For additional specifications for the DRIVE-CLiQ interface and various DRIVE-CLiQ topologies, see the chapter titled DRIVE-CLiQ topologies (Page 99).

3.1.3.2 Digital inputs/outputs X122, X132 and X142

The NCU 7x0.3 PN has three terminal strips, each with 14 terminals. These are used to control a total of 16 digital inputs, 4 digital outputs, and 8 digital input/outputs. The DIs/DOs of terminal strips X122 and X132 are used for connecting SINAMICS drives, while the DIs/DOs of X142 are used for controller connection purposes. When an NCU 7x0.3 PN is commissioned using the integrated drive wizard in the SINUMERIK Operate HMI software, a number of terminals are preassigned concrete functions.

X122 terminal assignment (NCU 7x0.3 PN) using the drive wizard

Pin no.	Function	Assignment recommendation	BICO source/sink	
1	Input[1]	ON/OFF 1 infeed for: Line Module **with** DRIVE-CLiQ connection	CU: r0722.0	Line Module: p0840
		Alternative assignment: "Infeed ready signal" for: Line Module **without** DRIVE-CLiQ connection	SLM X21.1	Each drive p0864
2	Input	"OFF3 – rapid stop"	CU: r0722.1	Each drive 2. OFF3, p0849
3	Input	SH/SBC 1 - Group 1 SINAMICS Safety Integrated (STO enable = p9601)	CU: r0722.2	p9620 (all drives in the group)
4	Input	SH/SBC 1 - Group 2 SINAMICS Safety Integrated (STO enable = p9601)	CU: r0722.3	p9620 (all drives in the group)
5	Input	No system default		
6	Input	No system default		
7	Ground for pins 1 to 6			
8	Ground for pins 9, 10, 12, 13			
9	Output	SH/SBC 1 - Group 1 SINAMICS Safety Integrated	CU: p0738	p9774 Bit 1 BICO from CU after the first drive in the group
10	Output	SH/SBC 1 - Group 2 SINAMICS Safety Integrated	CU: p0739	p9774 Bit 1 BICO from CU after the first drive in the group
11	Ground for pins 9, 10, 12, 13			
12	Input	BERO 1 – external zero mark	CU: r0722.10	p0495 = 2
13	Input	Probe 1 - central measuring (check that MD13210 = 0)	CU: p0680[0] = 3	Each drive p0488[1...3] = 0
14	Ground for pins 9, 10, 12, 13			

[1] positive edge required!

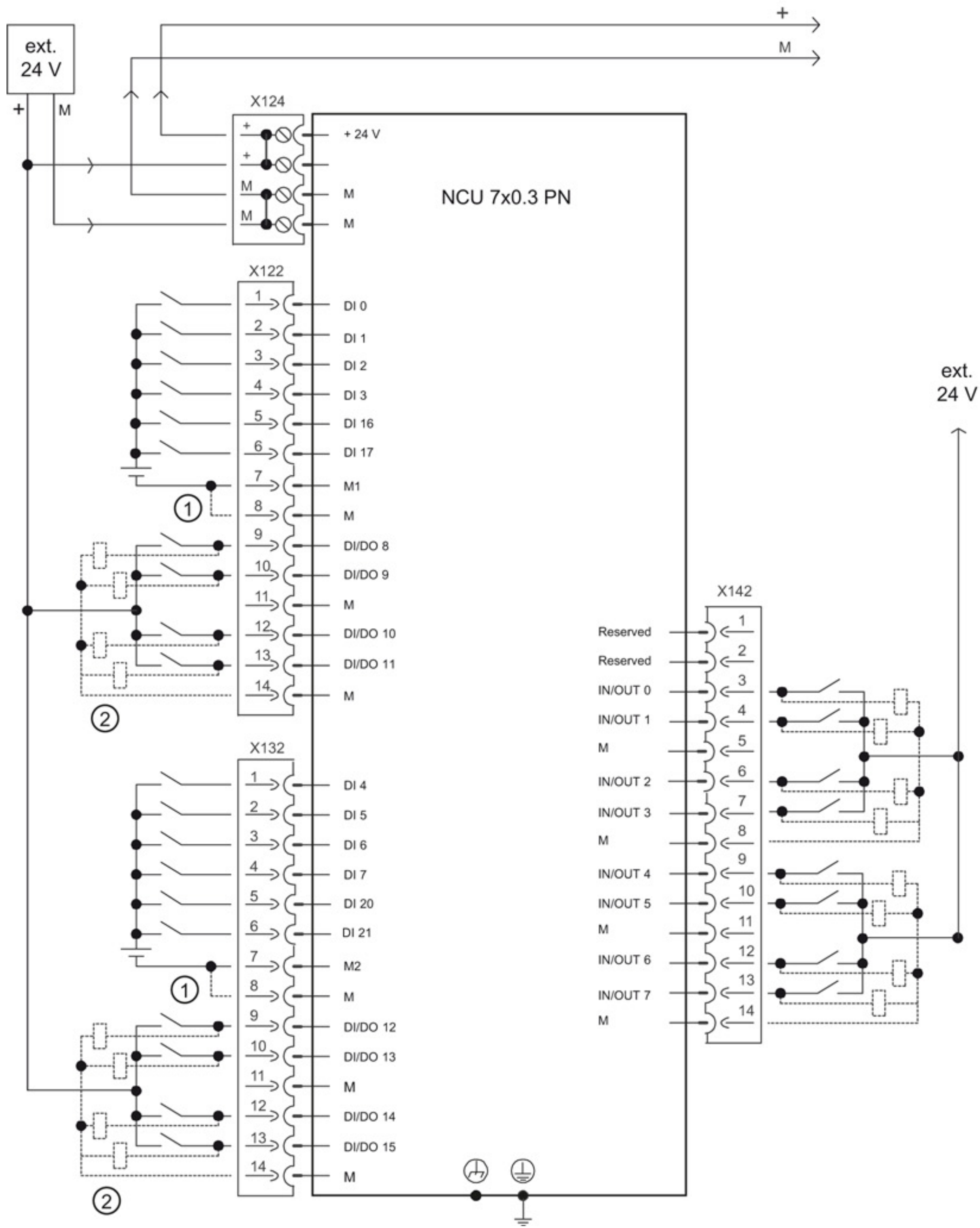
X132 terminal assignment (for NCU 7x0.3 PN) using the drive wizard

Pin no.	Function	Assignment recommendation	BICO source/sink	
1	Input	No system default		
2	Input	No system default		
3	Input	No system default		
4	Input	Line contactor, feedback signal	CU: r0722.7	Line Module: p0860
5	Input	2. OFF 2	CU: r0722.20	Drive: p0845
6	Input	No system default		
7	Ground for pins 1...6			
8	Ground for pins 9, 10, 12, 13			
9	Output	Infeed operation (Line Module with DRIVE-CLiQ connection)	LM : r0863.0	CU: p0742
10	Output	Infeed ready to start (if Line Module with DRIVE-CLiQ connection)	LM : r0899.0	CU: p0743
11	Ground for pins 9, 10, 12, 13			
12	Output	Line contactor control	LM : r0863.1	CU: p0744
	Otherwise: Input	BERO 2 – external zero mark	CU: r0722.14	Drive: p0495 = 5
13	Input	Probe 2 - central measuring (check that MD13210 = 0)	CU: p0680[1] = 6 CU: p0728 Bit 15=0	Each drive p0489[1...3] = 0
14	Ground for pins 9, 10, 12, 13			

X142 terminal assignment (for NCU 7x0.3 PN) using the drive wizard

Pin no	Function	
1	Reserved (not connected)	
2	Reserved (not connected)	
3	Input	Digital input $A_IN[1]
4	Input	Digital input $A_IN[2]
5	Ground for pins 3, 4, 6, 7, 9, 10, 12, 13	
6	Input	Digital input $A_IN[3]
7	Input	Digital input $A_IN[4]
8	Ground for pins 3, 4, 6, 7, 9, 10, 12, 13	
9	Output	Digital output $A_OUT[1]
10	Output	Digital output $A_OUT[2]
11	Ground for pins 3, 4, 6, 7, 9, 10, 12, 13	
12	Output	Digital output $A_OUT[3]
13	Output	Digital output $A_OUT[4]
14	Ground for pins 3, 4, 6, 7, 9, 10, 12, 13	

DI-DO block diagram of NCU 7x0.3 PN



① Jumper open: galvanic isolation for digital inputs

② Assign parameters as digital input/output

Figure 3-2 Block diagram of X122, X132, and X142 interfaces

Note

On terminal strip X142, IN/OUT 0 to IN/OUT 3 are permanently assigned as digital inputs, and IN/OUT 4 to IN/OUT 7 as digital outputs, via the software.

3.1.3.3 PROFINET interface X150 P1, P2

Properties

The PROFINET interface X150 is equipped with an integrated 2-port switch and a TCP/IP address for both ports.

Use

You can install the following communication networks using the PROFINET interface:

- PROFINET CBA (Computer-Based Automation):

  Communication between controllers as components in distributed systems
- PROFINET IO (input/output devices)

  Communication between the PLC controller and field devices
  - No support from isochronous mode (PROFINET IRT)

Cable specification

For PROFINET, you always require a data transmission rate of 100 Mbps (Fast Ethernet) in full duplex mode. For data transfer purposes, you can use twisted-pair copper cables (4-wire, 100Base-T).

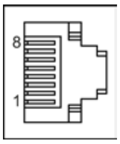
Table 3- 4 Cable specification for X150 ports 1, 2

Characteristic	Version
Connector type	RJ45 jack[1)]
Cable type	Industrial Ethernet cable (CAT5)
Max. cable length	100 m

[1)] please use the Fast Connect connector.

X150 pin assignment

Table 3- 5 PROFINET interface X150 ports 1, 2

	Pin	Signal name	Signal type	Meaning
	1	TXP	B	Transmit data +
	2	TXN	B	Transmit data -
	3	RXP	B	Receive data +
	4	-	-	Reserved, do not use
	5	-	-	Reserved, do not use
	6	RXN	B	Receive data -
	7	-	-	Reserved, do not use
	8	-	-	Reserved, do not use
Signal type: B = bidirectional				

Note

The PROFINET interface has what is known as MDI/MDI-X autocrossing functionality; i.e. when required, transmit and receive lines are switched over. Thus, no crossover cables are necessary.

3.1.3.4 PROFIBUS interface X126

Properties

- Isochronous mode possible
- Isolated RS 485 interface
- Max. data rate 12 MBaud
- Supports master/slave operation
- PROFIBUS address is set via configuration

Note

Isochronous operation with PROFIBUS DP for the NCU is only possible at the line of terminal X126.

On the line of terminal X136, only signals from the PLC I/O, and not from SINAMICS drive units, can be evaluated. Therefore, this terminal will not be taken into account in the description that follows.

Use

The following devices can be connected to PROFIBUS DP interface X126:

- Distributed I/O
- Drive units with PROFIBUS DP interface (standard slaves)

Cable specification

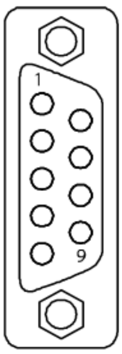
The PROFIBUS cable is 2-wire, twisted, and shielded with defined technical data.

Table 3- 6 Cable specifications for X126

Features	Version
Connector type	9-pin SUB D connector
Cable type	PROFIBUS cable
Max. cable length	100 m at 12 Mbps

X126 pin assignment

Table 3- 7 PROFIBUS DP interface X126

	Pin	Signal name	Meaning	Area
	1	-	Reserved, not assigned	
	2	M24_SERV	Power supply for teleservice, ground	0 V
	3	RxD/TxD-P	Receive/transmit data P (B)	RS485
	4	CNTR-P	Control signal	TTL
	5	DGND	PROFIBUS data reference potential	
	6	VP	Supply voltage plus	5 V ±10%
	7	P24_SERV	24 V for teleservice, short-circuit proof, 150 mA maximum	24 V (-15% to +20%)
	8	RxD/TxD-N	Receive/transmit data P (A)	RS485
	9	-	Reserved, not assigned	
Connector type: 9-pin SUB-D connector The supply voltage VP is provided exclusively for the bus terminal				

A teleservice adapter can be connected to the PROFIBUS interface for remote diagnostics purposes. The power supply for the teleservice (pins 2 and 7) can have a load of up to 150 mA.

NOTICE
Destruction of components if equipotential bonding conductor is missing
If an equipotential bonding conductor is not used, high leakage currents that could destroy the Control Unit or other PROFIBUS nodes can be conducted via the PROFIBUS cable. • An equipotential bonding conductor with a cross-section of at least 25 mm² must be used between components in a system that are located at a distance from each other.

PROFIBUS connector

For the first and last nodes in a bus line, the terminating resistors must be switched-in. Otherwise, data transmission will not function correctly.

The bus terminating resistors are activated in the connector.

The cable shield must be connected at both ends through a large surface area.

3.1.4 LED displays

Position of the display and operator controls

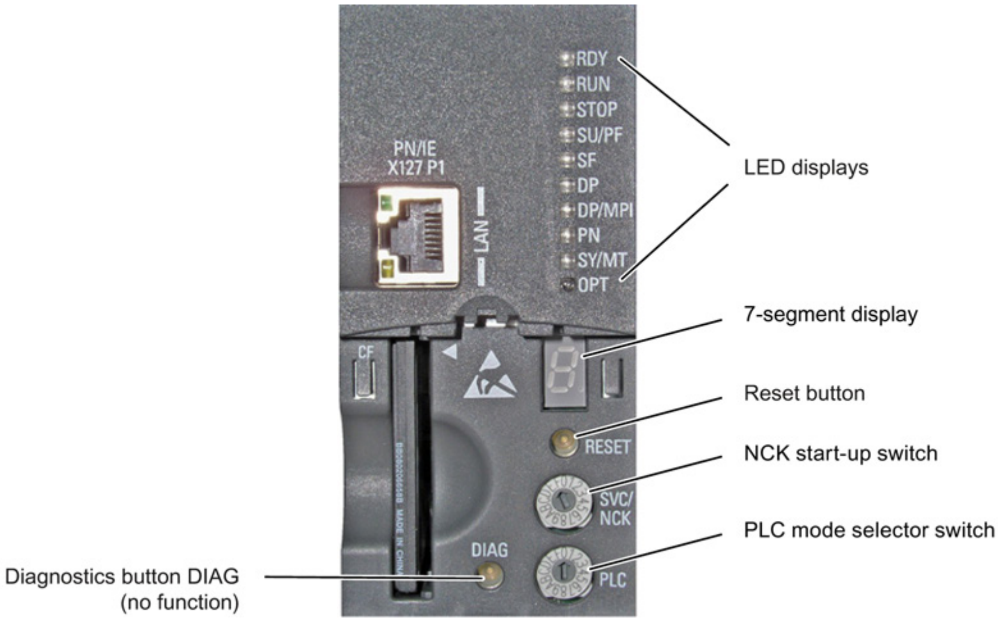


Figure 3-3 NCU7x0.3 PN display and operator controls

Meaning of LED states

Table 3- 8 Meaning of LED states

Name	Function	Status	Meaning
RDY	Ready	Red	There is at least one fault (e.g. RESET, watchdog monitoring etc.) or the Control Unit is booting up.
		Flashing red/orange (0.5 Hz)	Error accessing CompactFlash Card
		Orange	Accessing CompactFlash Card
		Flashing orange (0.5 Hz)	Updating the firmware of the connected DRIVE-CLiQ components
		Flashing orange (2 Hz)	Firmware update is complete for components. Wait for POWER ON for the components in question.
		Green	NC powered up and everything in cyclic mode
		Flashing green/orange or red/orange (1 Hz)	LED-supported recognition of connected DRIVE-CLiQ component is activated: (p0124[0] = 1).
RUN	PLC RUN	Green	PLC (programmable logic controller) ready for operation
STOP	PLC STOP	Orange	PLC stopped
SU/PF	PLC FORCE	Red	FORCE activated
SF	PLC SF	Red	PLC group error
DP	BUS1 F	Red	PROFIBUS group error X126
DP/MPI	BUS2 F	Red	PROFIBUS group error X136
PN	PN Fault	Red	PROFINET IO group error X150
SY/MT	MAINT	Orange	• Synchronization status (SY): No function • Maintenance status (MT) of the NCU: Maintenance request pending
OPT	-	-	No function

Note

PLC memory reset

If all the LEDs are flashing, the PLC (programmable logic controller) must be reset via the mode selector (move switch to position "3" to reboot).

Note

When a connected SINAMICS Control Unit is powering up, all LEDs on the NCU briefly light up orange. You can carry out a detailed diagnosis using a PG/PC and the operating software.

Meaning of the additional display and operator controls

7-segment display	Used during commissioning in order to issue test and diagnostic messages, as well as during power-up in order to display status messages.
Reset button	You can use the reset button to reset the NCU and force a cold restart.
NCK commissioning switch	The NCK switch must be in the "0" position in order to operate the NCU.
PLC mode switch	You can select the PLC operating mode using this coding switch (0 = standard mode).
Diagnostics button DIAG	Currently has no function

Additional references

- You can find a detailed description of LED states during power-up in the "NCU Operating System (IM7)" section of the Basesoftware and Operating Software Commissioning Manual.
- For information on drive faults and alarms, see also:
  SINAMICS S120/S150 List Manual (LH1)

3.2 NX1x.3 extension units

3.2.1 Description

Properties

You can use Numeric Control Extensions (NX1x.3) to enhance the performance of an axis grouping of the CNC automation system SINUMERIK 840D sl. Each NX10 expands the axis grouping by up to three additional axes, and each NX15 by up to six.

The NX10/15 has the following interfaces:

- 4 DRIVE-CLiQ (X100 – X103)
- Terminal strip (X122) for six digital inputs and four digital inputs/outputs
- Power supply (X124)

3.2.2 Representation of the NX1x.3

Interfaces

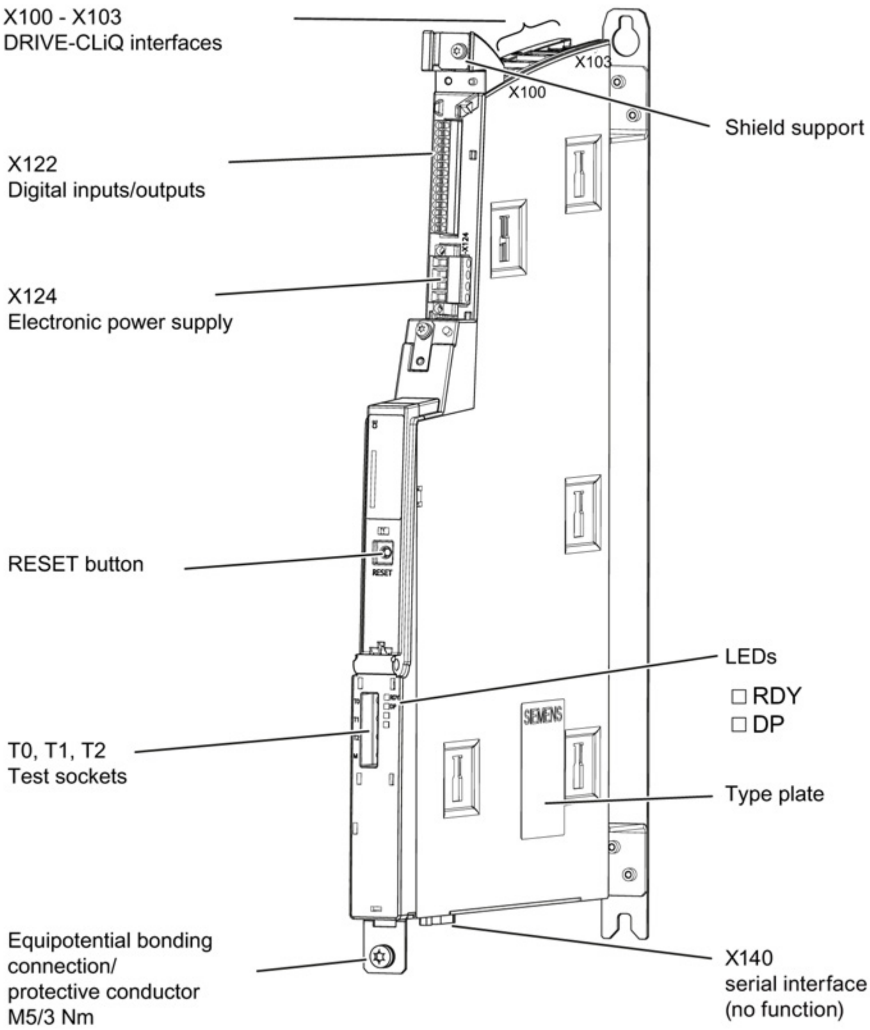


Figure 3-4 NX15.3 interfaces

LED displays

Table 3- 9 Description of LEDs on the NX10/15

LED	Color	Status	Description
RDY, READY H1	Off		Electronics power supply outside permissible tolerance range
	Green	Continuous light	NX10/15 is ready for operation
		Flashing 2 Hz	Writing to CompactFlash card of the connected NCU
	Red	Continuous light	At least one fault is pending (e.g., RESET, watchdog monitoring, basic system fault). NX10/15 is booting up.
		Flashing 0.5 Hz	Boot error (e.g. firmware cannot be loaded into the RAM)
	Orange	Continuous light	Firmware loading into RAM
		Flashing 0.5 Hz	Unable to load firmware into RAM
		Flashing 2 Hz	Firmware CRC fault
DP1, CU_LINK H2	Off		Electronics power supply outside the permissible tolerance range, NX10/15 is not ready for operation.
	Green	Continuous light	CU_LINK is ready for communication and cyclic communication is running
		Flashing 0.5 Hz	CU_LINK is ready for communication and no cyclic communication is running
	Red	Continuous light	At least one CU_LINK fault is present. CU_LINK not ready for operation (e.g., after POWER ON)

RESET button

The RESET button is on the front of the module under the cover.

Note

When the button is pressed, the locally connected drive systems are brought to a standstill, without feedback to the control. In other words, the drive and controller run asynchronously once the drive has successfully booted up.

3.2.3 Interfaces and their terminal assignments

3.2.3.1 X122 digital inputs/outputs

The X122 terminal strip consists of 14 terminals, which are used to control 6 digital inputs and 4 digital inputs/outputs. When an NX1x is commissioned using the integrated drive wizard in the SINUMERIK Operate HMI software, a number of terminals are preassigned concrete functions.

X122 (NX10/15) terminal assignment using the drive wizard

Pin no.	Function	Assignment recommendation	BICO source/sink	
1	Input	No system default		
2	Input	No system default		
3	Input	SH/SBC 1 - Group 1 SINAMICS Safety Integrated (STO enable = p9601)	NX: r0722.2	p9620 (all drives in the group)
4	Input	SH/SBC 1 - Group 2 SINAMICS Safety Integrated (STO enable = p9601)	NX: r0722.3	p9620 (all drives in the group)
5	Input	2. OFF 2	NX: r0722.16	Drive: p0845
6	Input	No system default		
7	Ground for pins 1 to 6			
8	Ground for pins 9, 10, 12, 13			
9	Output	SH/SBC 1 - Group 1 SINAMICS Safety Integrated	NX: p0738	r9774 Bit 1 BICO from CU after the first drive in the group
10	Output	SH/SBC 1 - Group 2 SINAMICS Safety Integrated	NX: p0739	p9774 Bit 1 BICO from CU after the first drive in the group
11	Ground for pins 9, 10, 12, 13			
12	Input	BERO 1 – external zero mark	NX: r0722.10	Drive: p0495 = 2
13	Input	BERO 2 – external zero mark	NX: r0722.11	Drive: p0495 = 3
14	Ground for pins 9, 10, 12, 13			

DI-DO block diagram of NX1x.3

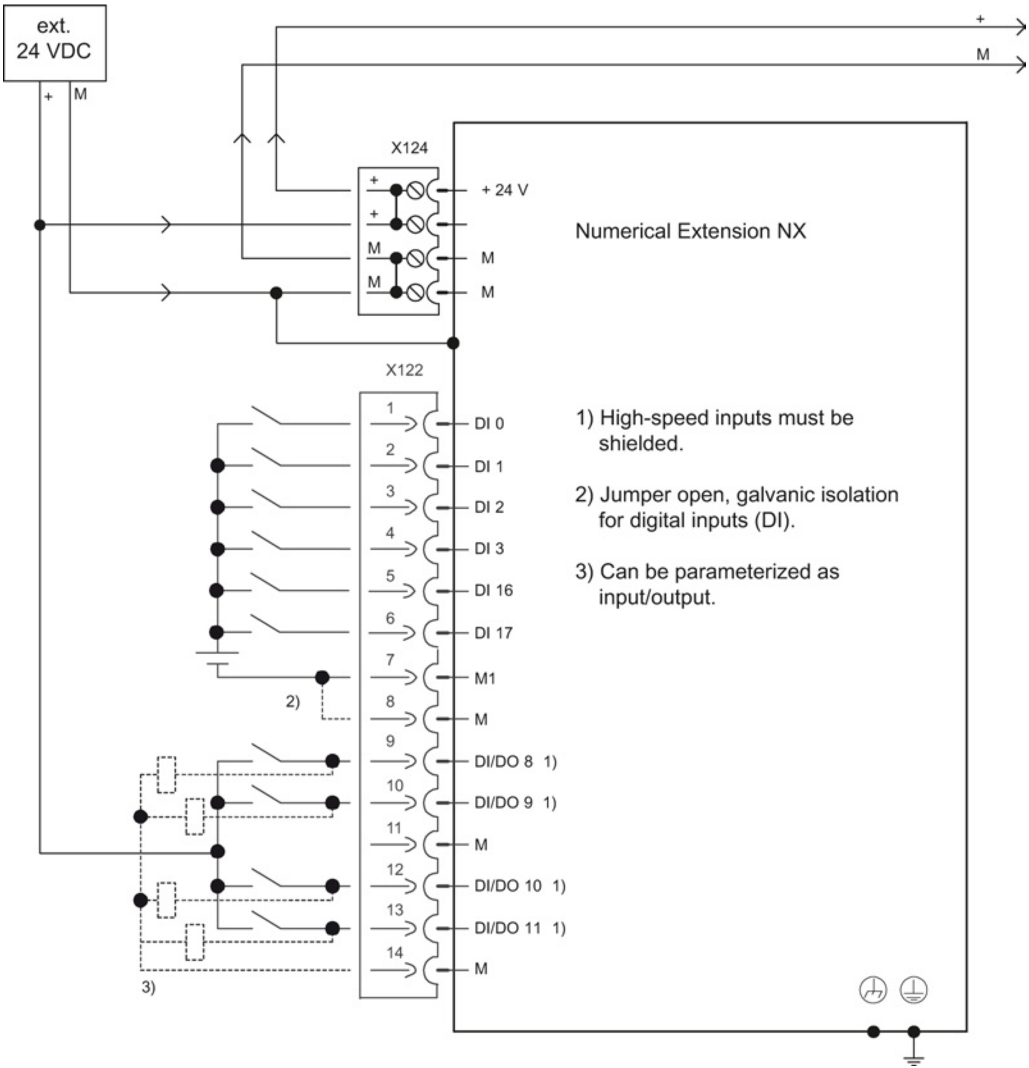


Figure 3-5 Block diagram of X122 interface

3.2.4 NX1x3 wiring

NX10/15 components can be connected to the control unit via DRIVE-CLiQ. The following rules apply to wiring of the NX10/15:

- Only one **star topology** is permitted between the NX10/15 and the Control Unit, as the address assignment is fixed (HW configuration). This means that only one NX10/15 can be operated per DRIVE-CLiQ port on a control unit.
- DRIVE-CLiQ ports not assigned to NX10/15 can be wired to other DRIVE-CLiQ components
- Once an NX10/15 has been connected and configured, you cannot simply insert it into a different DRIVE-CLiQ port, as the addresses of the integrated drives are set permanently from the point of view of the PLC. The following table illustrates this relation:

Table 3- 10 NX10/15 PROFIBUS addresses

DRIVE-CLiQ port on the NCU	Drive PROFIBUS addresses
X105	15
X104	14
X103	13
X102	12
X101	11

The following figure shows a sample topology:

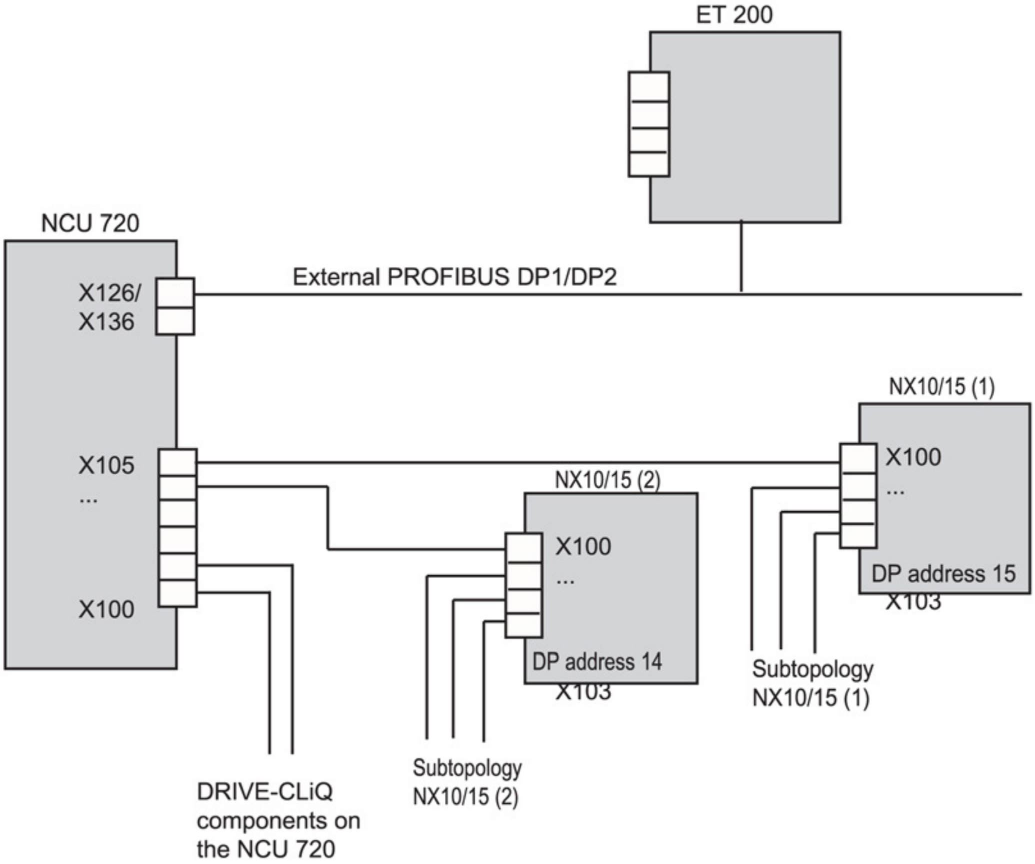


Figure 3-6 NX10/15 topology

Additional references

For information on commissioning NX components, please refer to the "IBN CNC: NCK, PLC, Drive Commissioning Manual".

3.3 Option Board CBE30-2

3.3.1 Description

Using the Communication Board Ethernet CBE30-2, NCU link communication with up to three NCU 7x0.3 PN Control Units can be configured on the basis of the generally released standard configuration. In this way, up to 93 axes can be controlled using an NCU. For CBE30-2, the option slot on the NCU is required.

Note

Only one option slot is available on an NCU 7x0.3 PN. This means that it is not possible to use a CBE30-2 and other optional modules in parallel.

Note

Project-specific expansion

For a specific project, an NCU link group with more than three NCUs is available on request from your regional Siemens contact person. Unless project-specific extensions are implemented, more than three NCUs will be rejected with alarm 380020.

Illustration

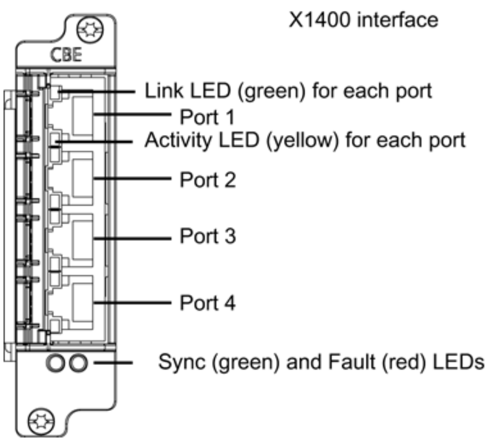


Figure 3-7 CBE30-2 Ethernet communication board

Link communication

The CBE30-2 is an optional PROFINET module for isochronous real-time communication (IRT) via Ethernet.

Note

CBE30-2 only for use as link module

The CBE30-2 can only be used for NCU link communication. It is not possible to use it for general PROFINET communication.

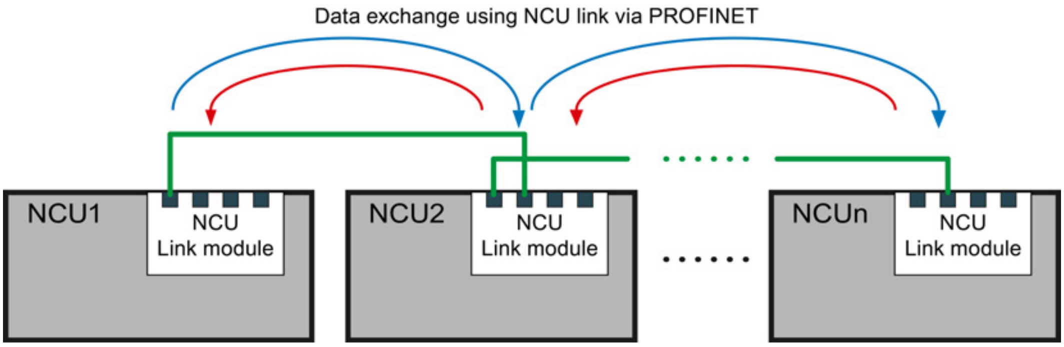


Figure 3-8 Principle of NCU link communication

The NCU link communication enables cross-NCU data exchange that is synchronous with the interpolation cycle. Depending on the active functions, cyclic and non-cyclic data transmissions occur between the NCUs involved in link communication.

Note

The NCU link communication is exclusively operated using ports 1 and 2. Ports 3 and 4 cannot be used and are not freely available.

Note

You can find more detailed information in the SINUMERIK 840D sl NCU 7x0.3 PN Equipment Manual, as well as in the SINUMERIK 840D sl/828D Extension Functions Function Manual.

SINAMICS drive line-up 4

4.1 Structure of the drive line-up

4.1.1 Description

The individual components, such as the Control Unit and power units, can be attached directly to each other without any separation. The specified safety and ventilation clearances above, below, and in front of the associated components must be observed. The maximum configuration of the drive line-up depends on the rated power of the Line Module or on the current-carrying capacity of the DC link busbars of the individual components.

The components can be arranged in a single row or multiple rows, or they can be distributed. In a multiple-row arrangement, vertical installation or, in a cabinet row, side-by-side installation in different cabinet sections is possible.

Line filters and line reactors are connected between the power supply and the Line Module in order to stabilize the line infeed and energy recovery. In the case of Active Line Modules, Active Interface Modules are generally used instead of line filters and reactors.

NOTICE

Risk of fire due to excessively long power cables

Excessively long power cables can lead to overheating and a risk of fire, which may result in the components being destroyed.

- Make sure that the total length of all the power cables does not exceed the values listed in the chapter titled Maximum cable lengths (Page 474).

Note

Arrangement of Motor Modules

Higher-power Motor Modules must be placed directly next to the Line Module. The lower-power components then follow. This prevents the DC link busbar of the associated component becoming overloaded (see the chapter titled Current-carrying capacity of the DC link busbar (Page 161)).

Note

Take appropriate measures to fulfill EMC requirements (see the chapters titled Line filters (Page 125) and Shielding and installing cables (Page 471)).

Note concerning the use of components with a width of 50 mm

⚠ DANGER
Danger to life due to electric shock resulting from incorrectly installed DC link bridges
Incorrectly installed DC link bridges at the left-hand end of the drive line-up can cause an electric shock. • Remove the DC link bridges including the screws on a 50 mm-wide Motor Module or DC link module. • Do not tighten the screws without the DC link bridges. • For all components that are 75 mm wide or wider, the DC link bridges must not be moved to the left or removed.

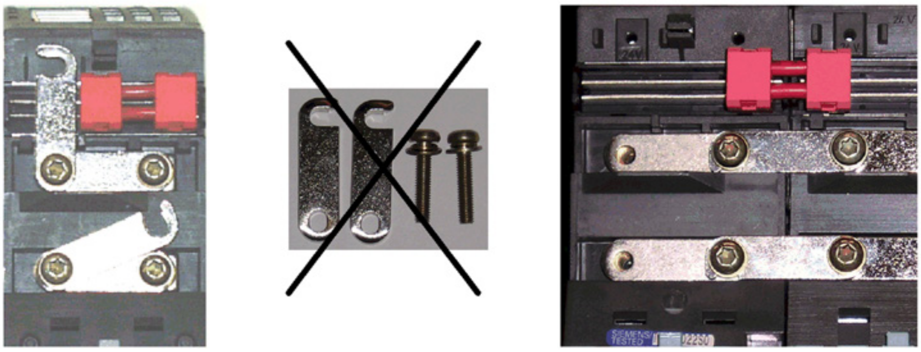


Figure 4-1 Removal of the DC link bridge

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

4.1.2 Single row layout

All required components, such as Control Unit and power units are arranged in a row. The drive line-up is constructed depending on the available space in the control cabinet.

The following rule is used as installation rule of the power units from left to right:

- Line Module
- Motor Modules depending on their power, starting with the highest power and ending with the lowest power
- DC link components (e.g. Braking Module, Control Supply Module, Capacitor Module)

Single row construction with line filter and line reactor

With Smart Line Modules and Basic Line Modules, line stabilizing technology line filters and line reactors are used.

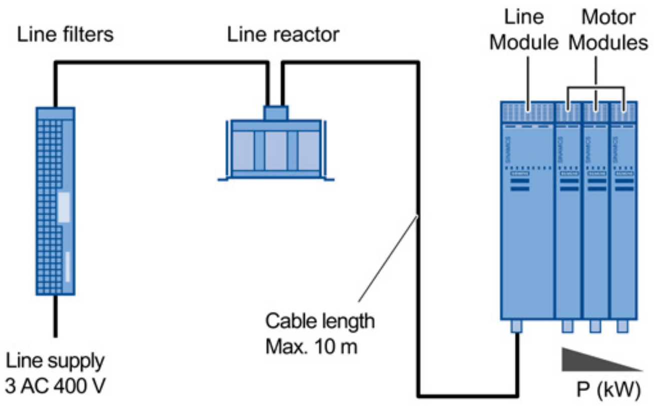


Figure 4-2 Single row construction with line filter and line reactor

Single row construction with Active Interface Module

Active Interface Modules are used exclusively in combination with Active Line Modules.

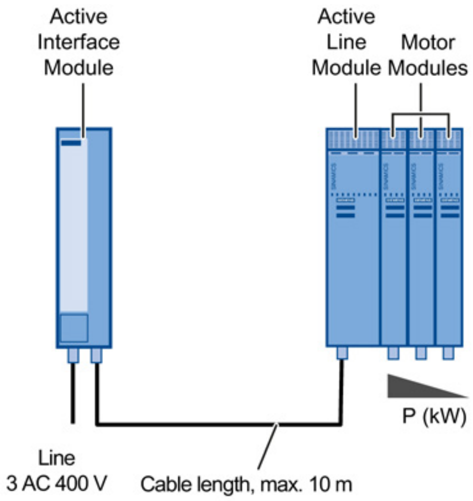


Figure 4-3 Single row construction with Active Interface Module

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Note

Lower radio interference voltage through the use of a Basic Line Filter

Installing a Basic Line Filter before the AIM improves the radio interference voltage category (see also the chapter titled Basic Line Filters for Active Line Modules (Page 127)).

See also

Connection of the SINUMERIK components (Page 66)

4.1.3 Two-row/Multiple-row construction

The components of the SINAMICS system can also be constructed as two or more rows. As described above, the limit is the maximum DC link length and the current-carrying capacity of the DC link busbar.

Note

Observe the installation and ventilation clearances in the chapter titled Note for connection cable installation clearance (Page 78).

Two/multi-row construction with line filter and line reactor

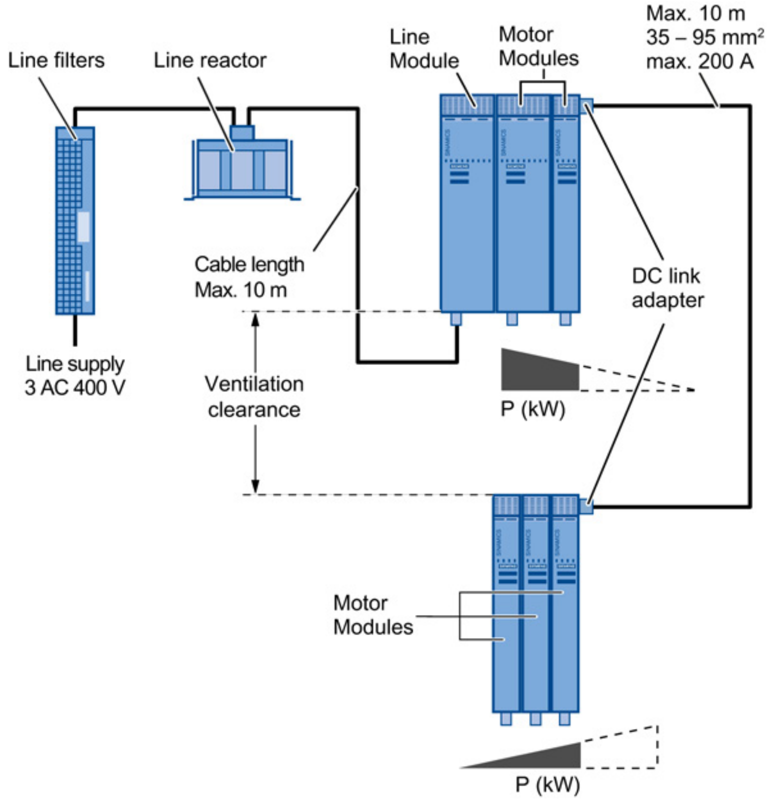

Figure 4-4 Two-row construction with line filter and line reactor

Two/multi-row construction with Active Interface Module

Active Interface Modules are used exclusively in combination with Active Line Modules.

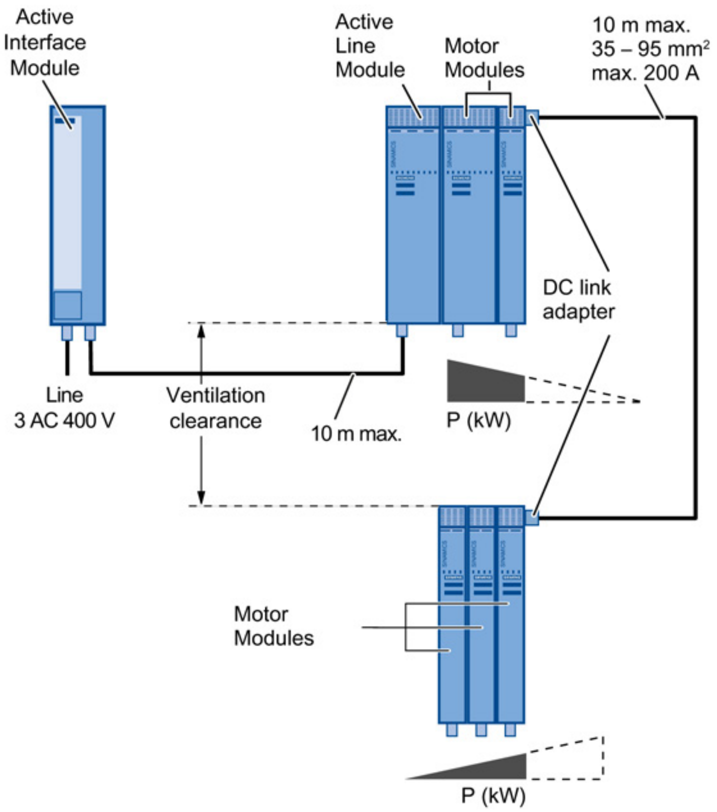

Figure 4-5 Two-row construction with Active Interface Module

DC link adapters are used to forward the DC link. Cross-sections of 35 mm² to 95 mm², max. 200 A, can be connected to the connection terminals.

The wiring outside the components is based on single-core, finely stranded, shielded cables. These should be laid in such a way that they are inherently short-circuit and earth fault proof.

The individual wires must be shielded, and the shield must be attached at both ends.

Note

For information on the NCU 7x0 or NX1x layout, see Connection of the SINUMERIK components (Page 66).

Note

Lower radio interference voltage through the use of a Basic Line Filter

Installing a Basic Line Filter before the AIM improves the radio interference voltage category (see also the chapter titled Basic Line Filters for Active Line Modules (Page 127)).

Minimum size for the ventilation clearances for the two-/multi-row construction

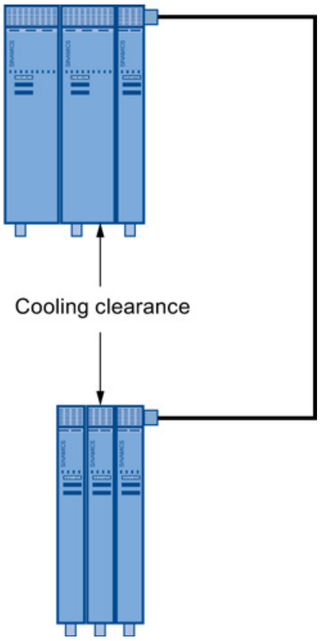

Figure 4-6 Ventilation clearance for the two-row construction

- The distance between the rows of components largely depends on the wiring, the cable cross-section, and the bending radius of the power cables to be connected.
- The inlet temperature of the air sucked in for cooling the components must not exceed 40 °C (with derating, it must not exceed 55 °C). This must be ensured by means of suitable air guidance, e.g. involving the distance between the component rows or air baffle plates.

4.1.4 Center infeed (single row construction) for 16 to 120 kW Line Modules

Another variant of the DC link supply is the center infeed. For the 16 to 120 kW Line Modules, the DC link can be fed from both the left and right side of the device. This allows the drive group to be mounted on both sides. The installation guidelines are the same as the previous guidelines.

Center infeed with line filter and line reactor

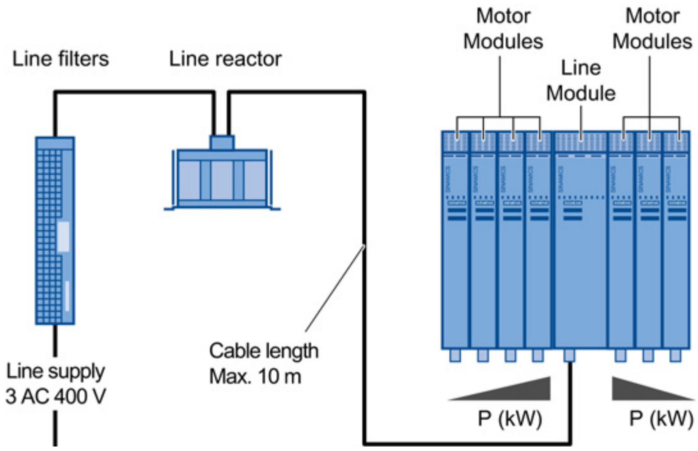

Figure 4-7 Construction of center infeed with line filter and line reactor

Center infeed with Active Interface Module

Active Interface Modules are used exclusively in combination with Active Line Modules.

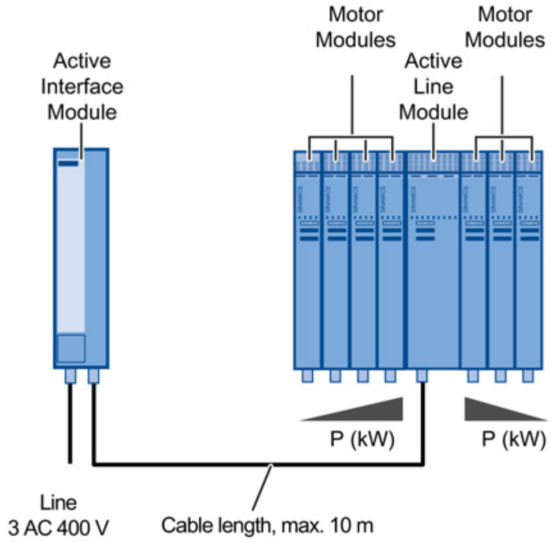

Figure 4-8 Center infeed installation with Active Interface Module

Note

Lower radio interference voltage through the use of a Basic Line Filter

Installing a Basic Line Filter before the AIM improves the radio interference voltage category (see also the chapter titled Basic Line Filters for Active Line Modules (Page 127)).

Note

For information on the NCU 7x0 or NX1x layout, see the chapter titled Connection of the SINUMERIK components (Page 66).

4.1.5 Distributed configuration

For the distributed installation, an external busbar is used for the DC link connection. From there, the cables are led to the power units. DC link rectifier adapters are used for the connection to the power units..

Depending on the component width, two variants are available:

Component width 50/100 mm

DC link rectifier adapter with connection option from 0.5 mm² to 10 mm²,
max. 36 A.

Component width 150 ... 300 mm

DC link rectifier adapter with connection option from 35 mm² to 95 mm²,
max. 240 A.

Safety instructions

⚠ WARNING

Ground fault and short-circuit-proof installation

The DC link connection cables must be laid in such a way that they are ground-fault and short-circuit proof in accordance with DIN/VDE 0100 or suitable fuse protection must be provided.

The total length of the DC link (including the connection cables) must not exceed 10 m.

Decentralized structure with line filter and line reactor

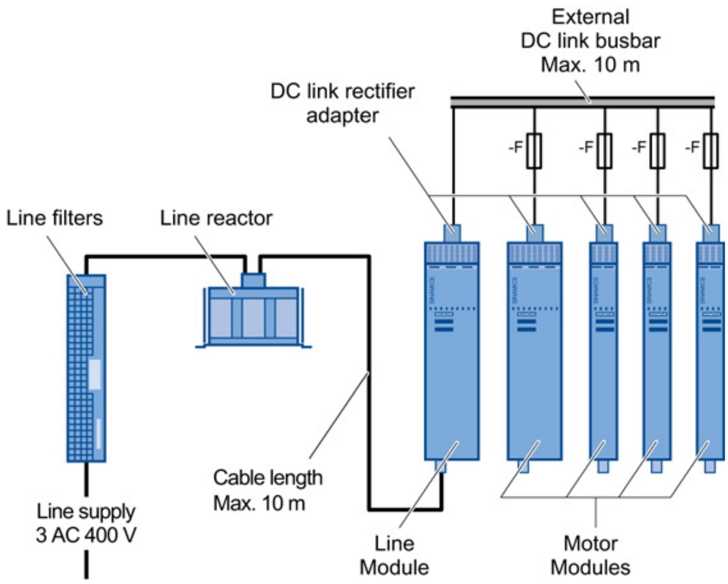

Figure 4-9 Decentralized structure with line filter and line reactor

Decentralized structure with Active Interface Module

Active Interface Modules are used exclusively in combination with Active Line Modules.

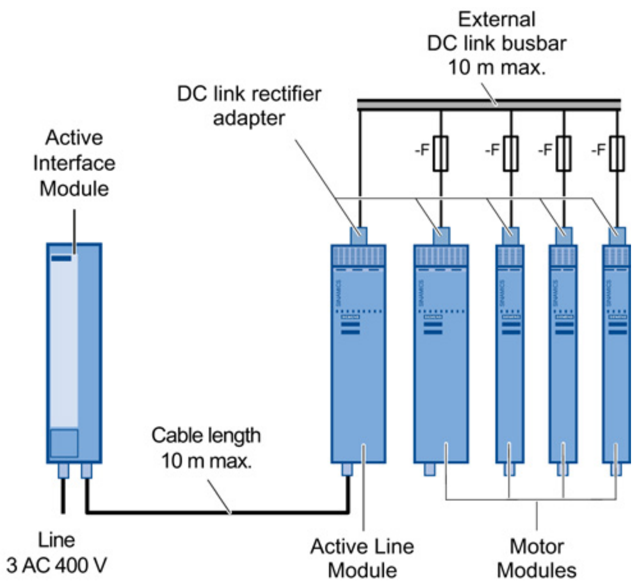

Figure 4-10 Decentralized structure with Active Interface Module

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Note

Lower radio interference voltage through the use of a Basic Line Filter

Installing a Basic Line Filter before the AIM improves the radio interference voltage category (see also the chapter titled Basic Line Filters for Active Line Modules (Page 127)).

Note

Fuses in the power units

The fuses shown in the figures above are optional, as booksize power units already have internal fuse protection. This also means that it is not essential to use short-circuit-proof cables.

Additional references

For details of DC link rectifier adapters in booksize format and how to install them, as well as information on cable installation, please refer to
/GH2/ SINAMICS S120/ Booksize Power Units Equipment Manual/.

4.2 Connection of the SINUMERIK components

4.2.1 Layout and fastening of the NCU/NX modules

Fastening the NCU 7x0/NX modules

For the fastening of the NCU / NX modules, a differentiation is made between fastening using direct installation, using fastening clip or using spacers.

The fastening of the NX component to the NCU differs depending on whether an NCU 710 or an NCU 720/730 is used (cooling fins on the rear side of the NCU 720/730).

Fastening Possibilities

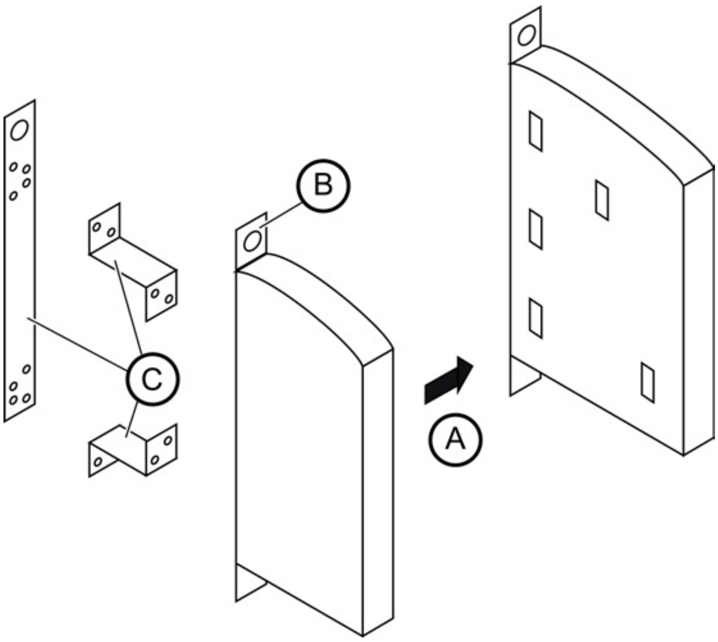


Figure 4-11 Main NCU-NX mounting types

Table 4- 1 Fastening possibilities for NCU 7x0 and NX

	NCU 7x0	NX	NCU 7x0+NXs
A (direct to the Line Module)	possible	possible	–
B (with fastening clip)	–	possible	–
C (with spacer)	possible	possible	possible

Note

To ensure the optimum reachability and the access to the connection plugs for digital signals / bus connections, the following placement notes should be observed.

4.2.2 Layout of the NX for single row construction integrated in the power unit group

If NX components are present, they should be added between the power unit and the NCU. This ensures the best-possible reachability and access to the connection plugs for digital signals / bus connections.

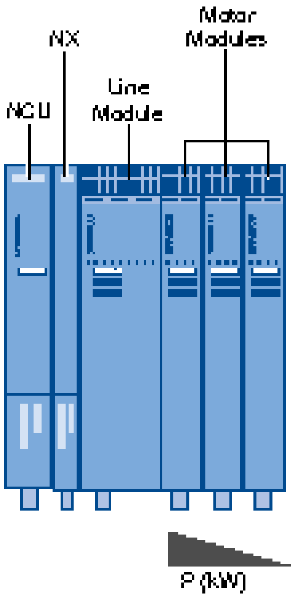


Figure 4-12 NX between NCU and Line Module

4.2.3 NCU/NX layout as offset solution

The DRIVE-CLiQ connection of the SINAMICS components permits any layout of the NCU / NX modules. The layout of the NCU / NX directly in the drive group is thus not mandatory. This type of installation involves fastening clips or spacers. To stabilize a group containing several NX components, specially prepared connection brackets can be fastened to the front of the NX between the components.

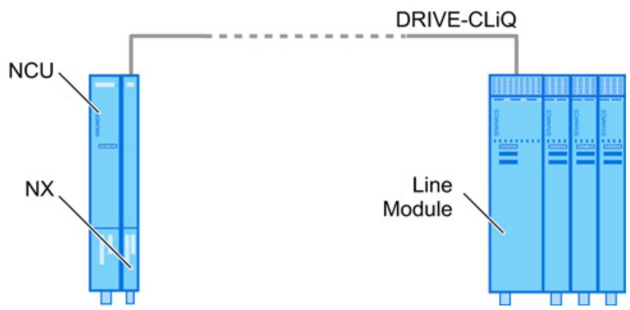


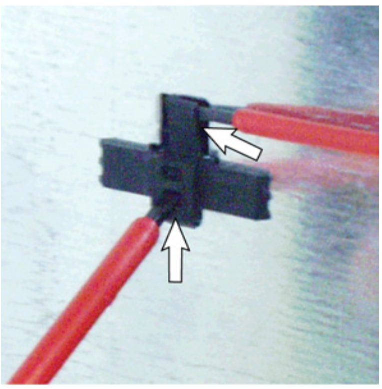
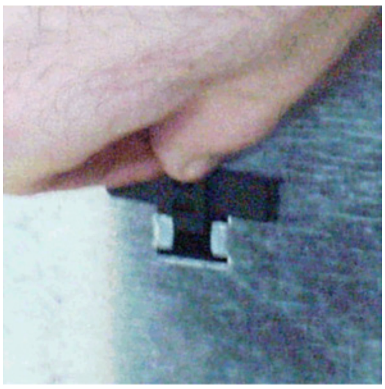
Figure 4-13 NCU/NX as offset solution

4.2.4 Direct installation of a CU-/NCU-/NX module on the Line Module

The Line Modules permit the docking of a CU320-/NCU-/NX component using the fastening elements present as standard on the left-hand side of the housing.

Remove the holder for securing the Control Unit.

If an additional component is to be flush-mounted to the left of the component, the holders for securing the Control Unit must be removed.

		
Use suitable tools to lift the interlocking mechanism and push up the holder (e.g. two 0.8 x 4.0 screwdrivers)	Remove the holder	After the removing the holder

4.3 Shield Connection

For information on the shield connection, please see the dimension drawings of the SINAMICS components.

For details of the shield connections of Active Interface Modules, refer to the relevant figures in the Overview chapter. The shield connections are located near the line supply connections.

4.3.1 SINAMICS Components Dimension Drawings (Internal Air Cooling)

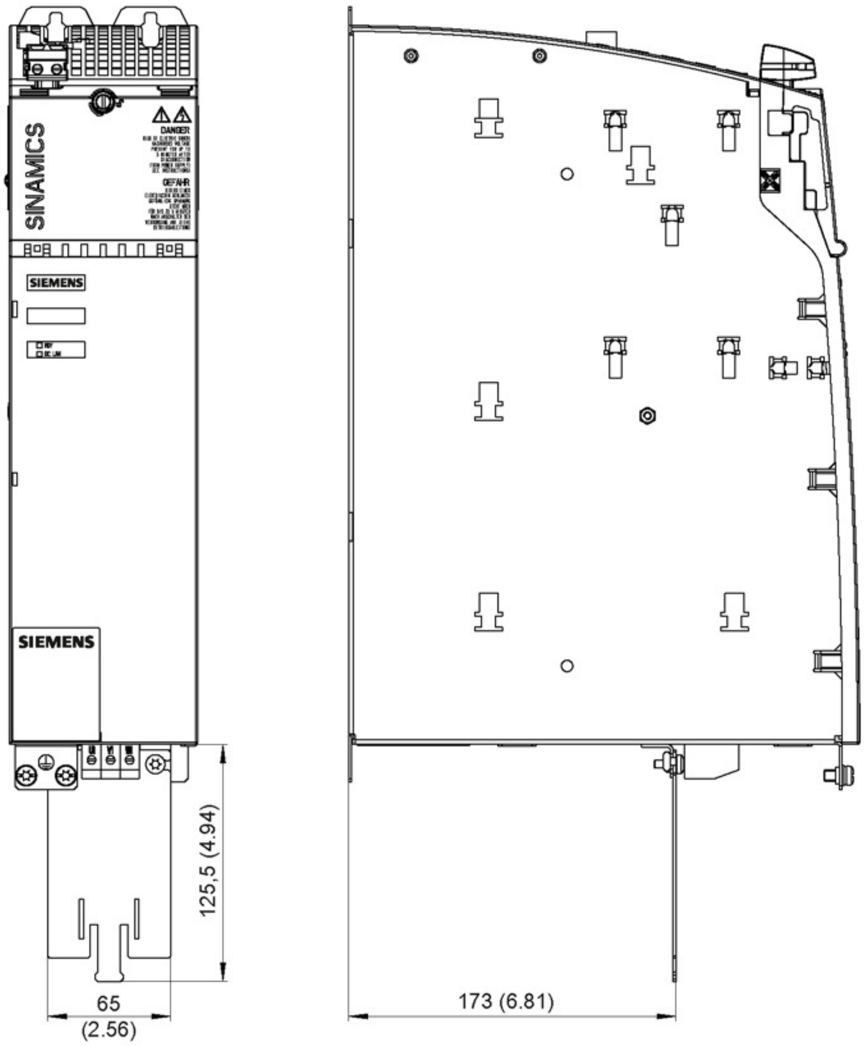


Figure 4-14 Dimension drawing of shield connecting plate on a 100 mm component with internal air cooling, all dimensions in mm and (inches)

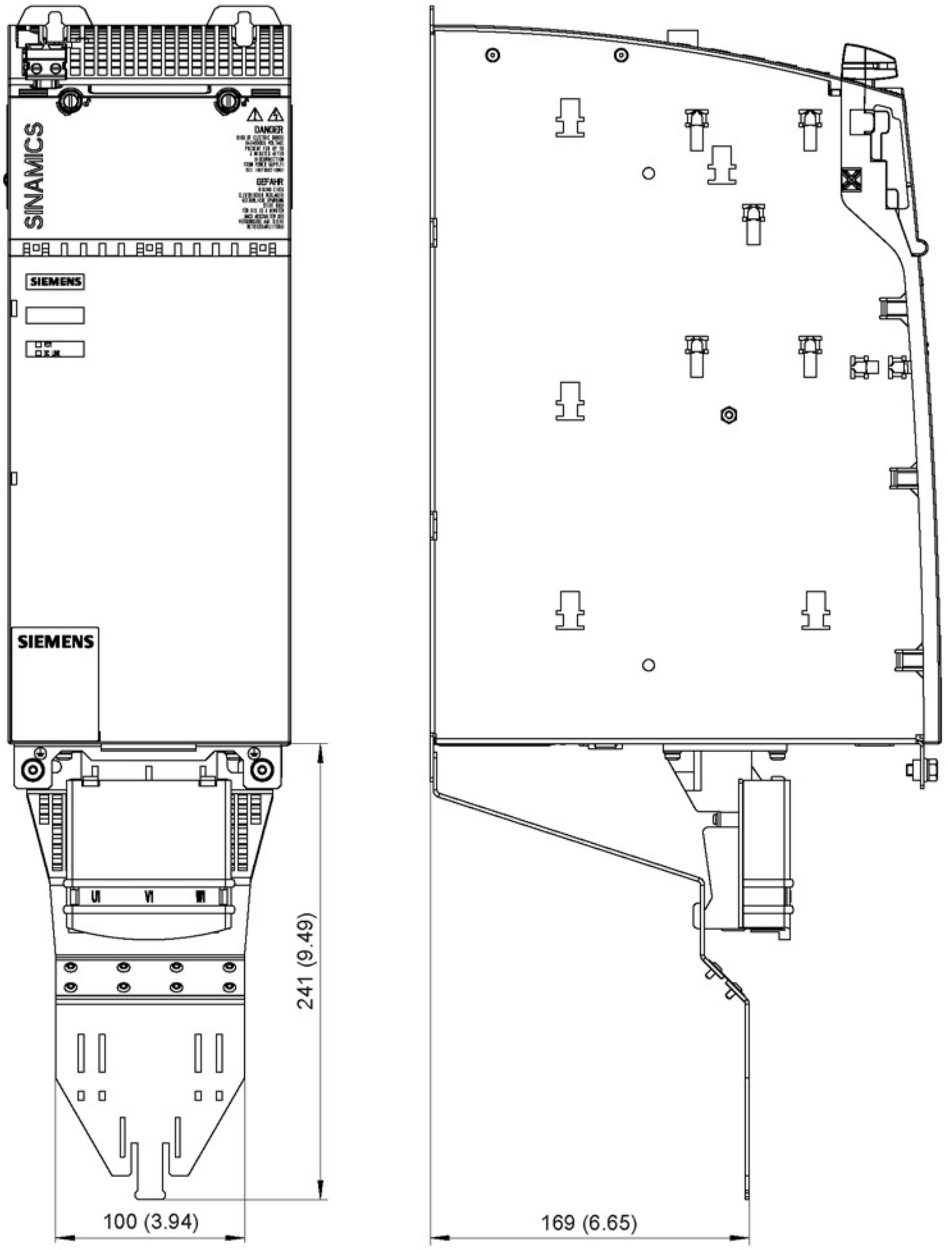


Figure 4-15 Dimension drawing of shield connecting plate on a 150 mm component with internal air cooling, all dimensions in mm and (inches)

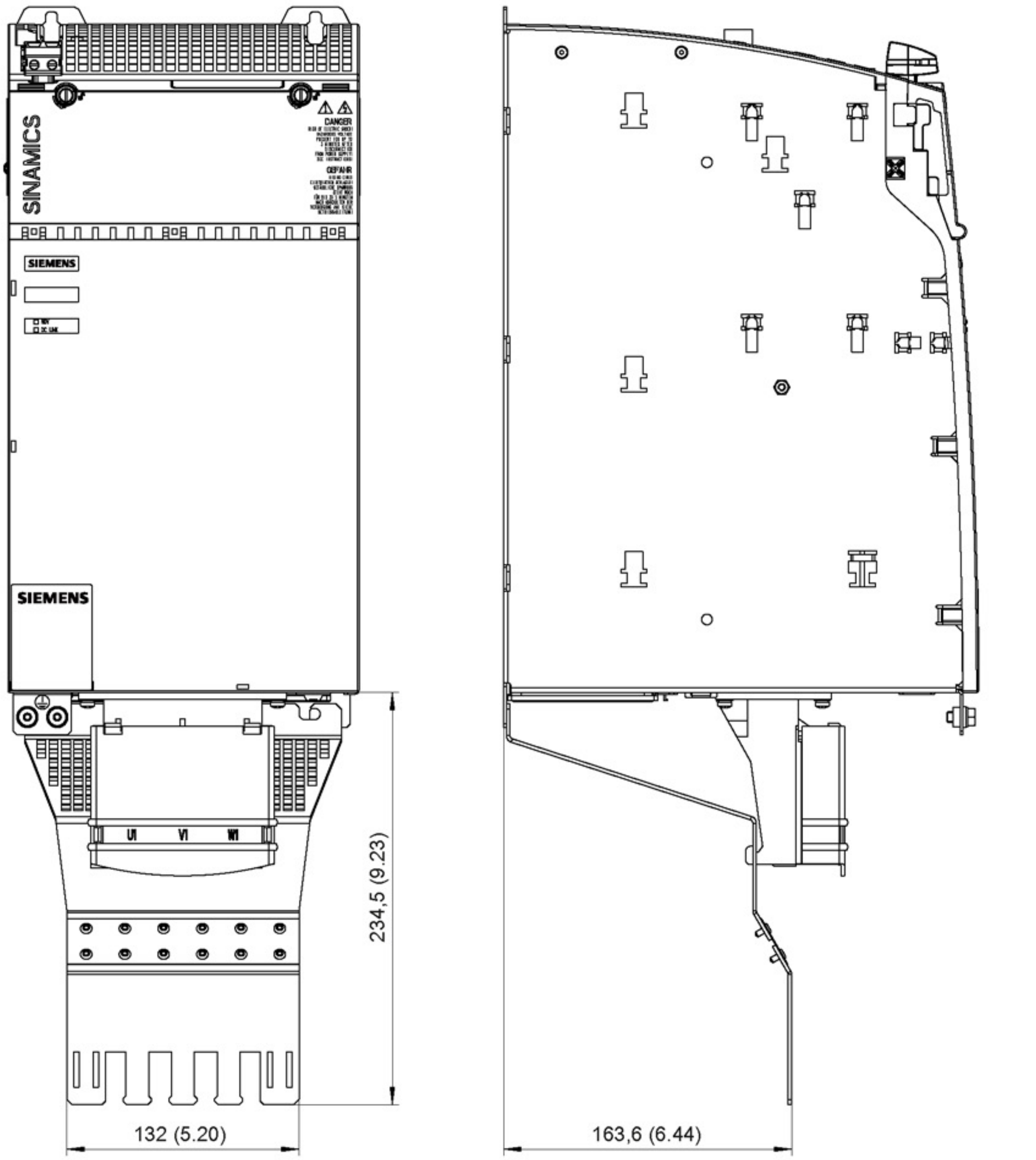


Figure 4-16 Dimension drawing of shield connecting plate on a 200 mm component with internal air cooling, all dimensions in mm and (inches)

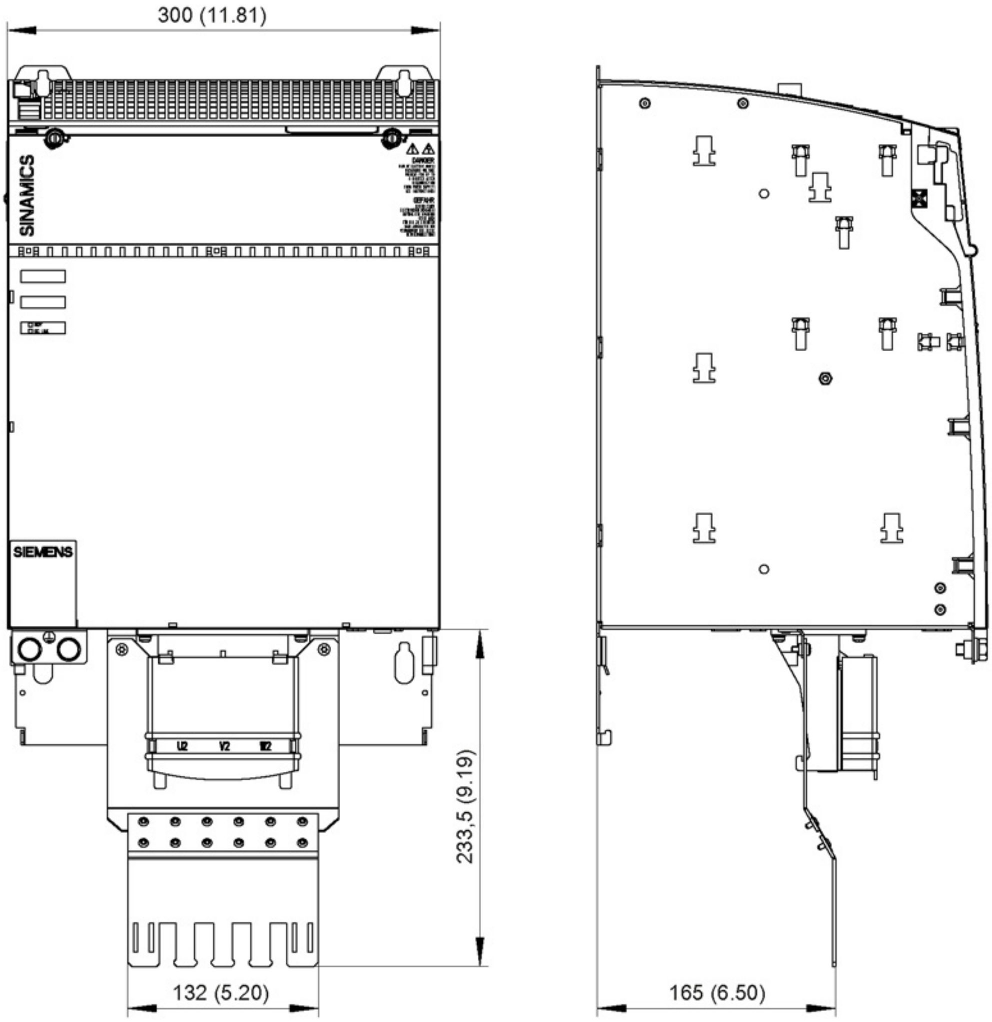


Figure 4-17 Dimension drawing of shield connecting plate on a 300 mm component with internal air cooling, all dimensions in mm and (inches)

4.3.2 SINAMICS Components Dimension Drawings (External Air Cooling)

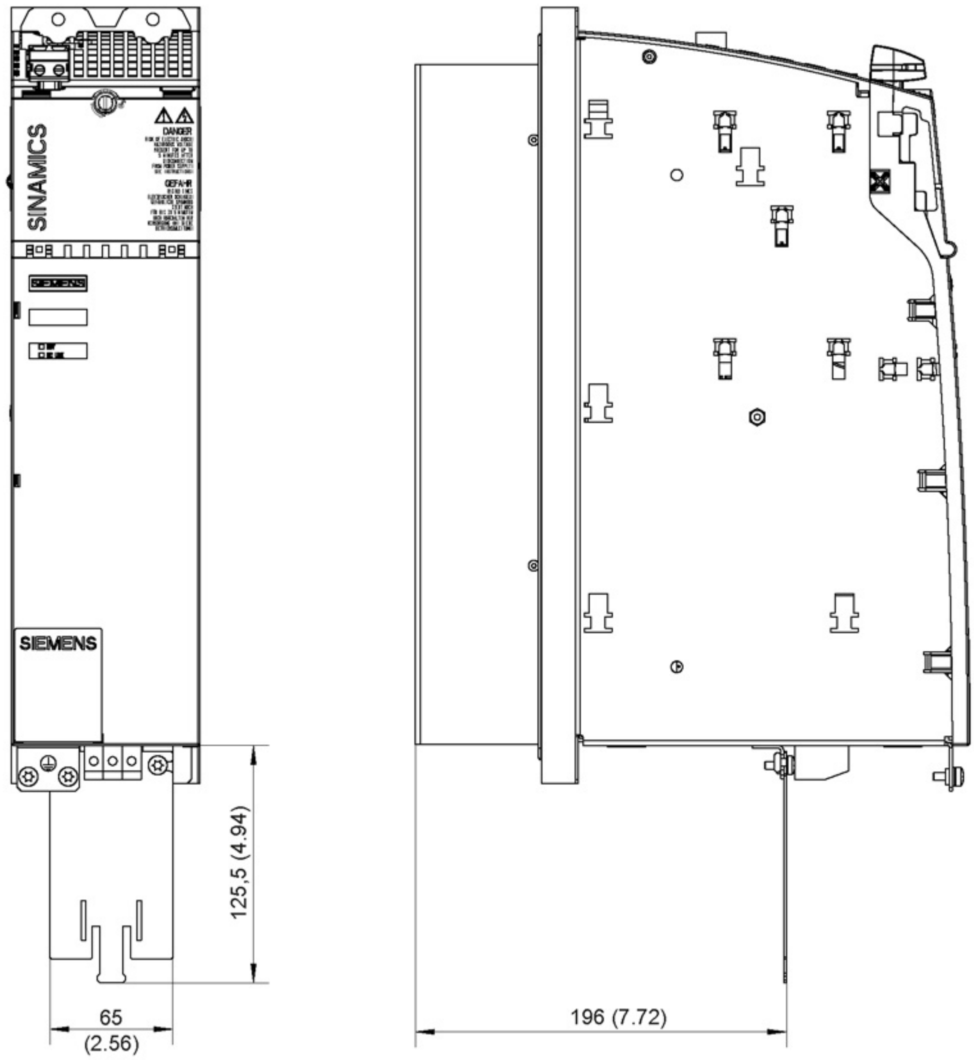


Figure 4-18 Dimension drawing of shield connecting plate on a 100 mm component with external air cooling, all dimensions in mm and (inches)

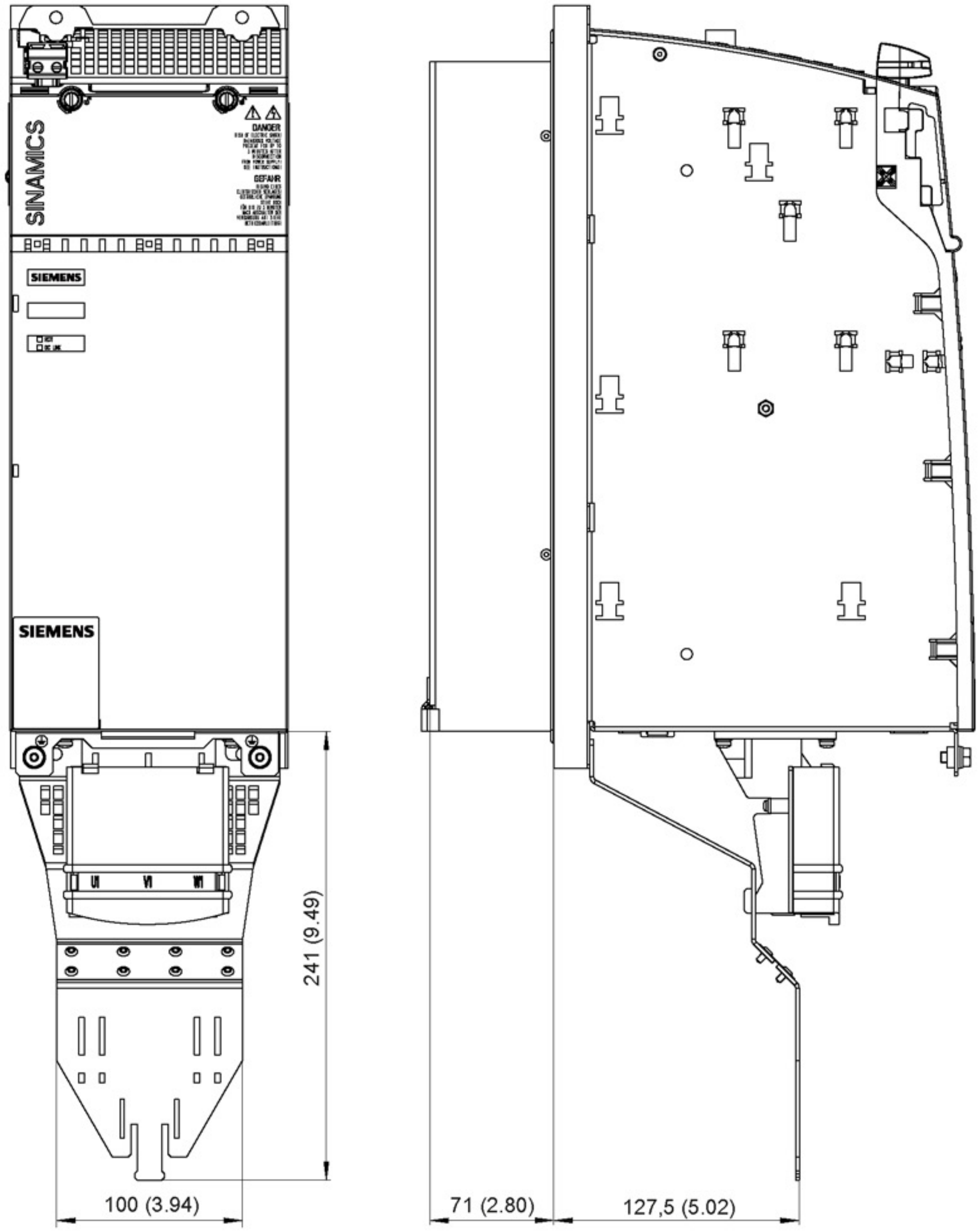


Figure 4-19 Dimension drawing of shield connecting plate on a 150 mm component with external air cooling, all dimensions in mm and (inches)

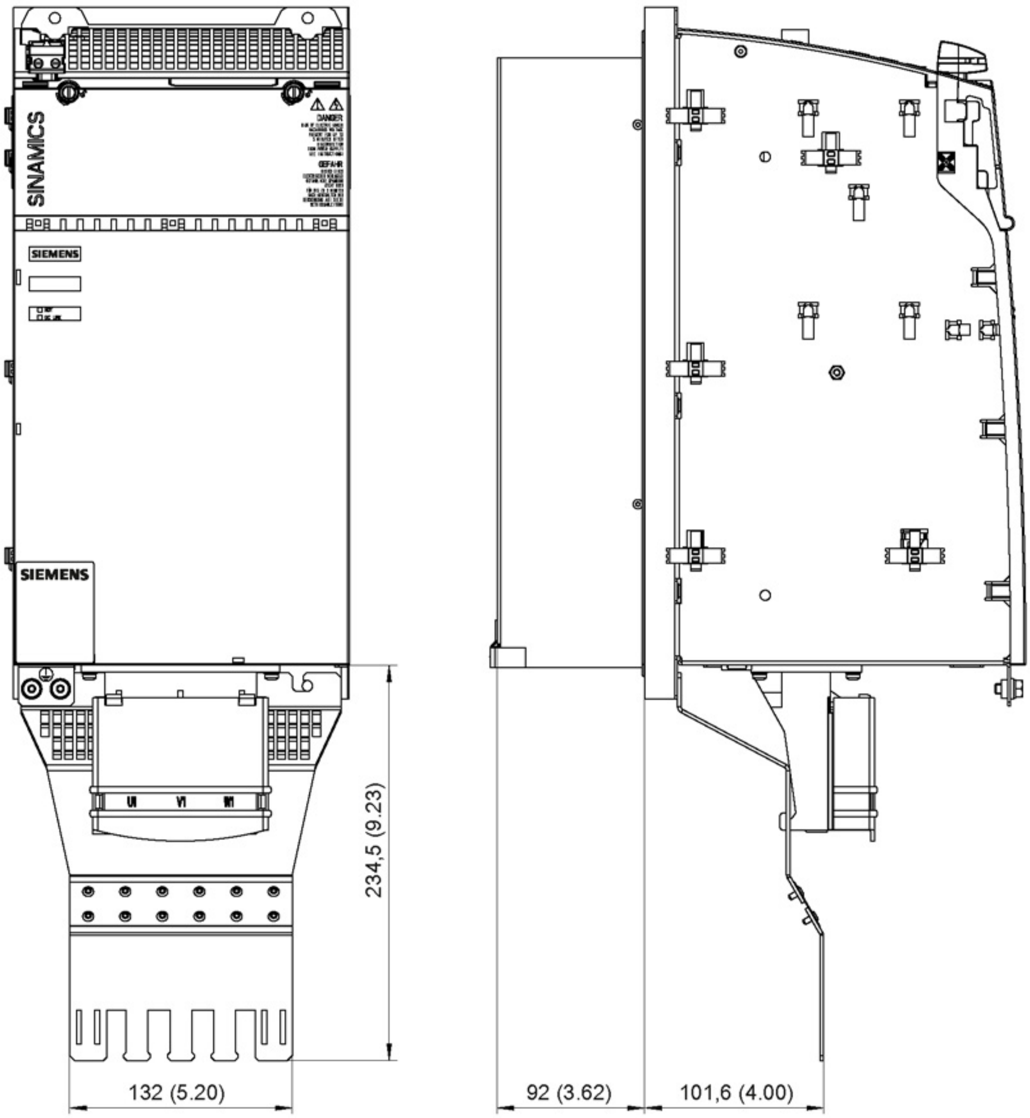


Figure 4-20 Dimension drawing of shield connecting plate on a 200 mm component with external air cooling, all dimensions in mm and (inches)

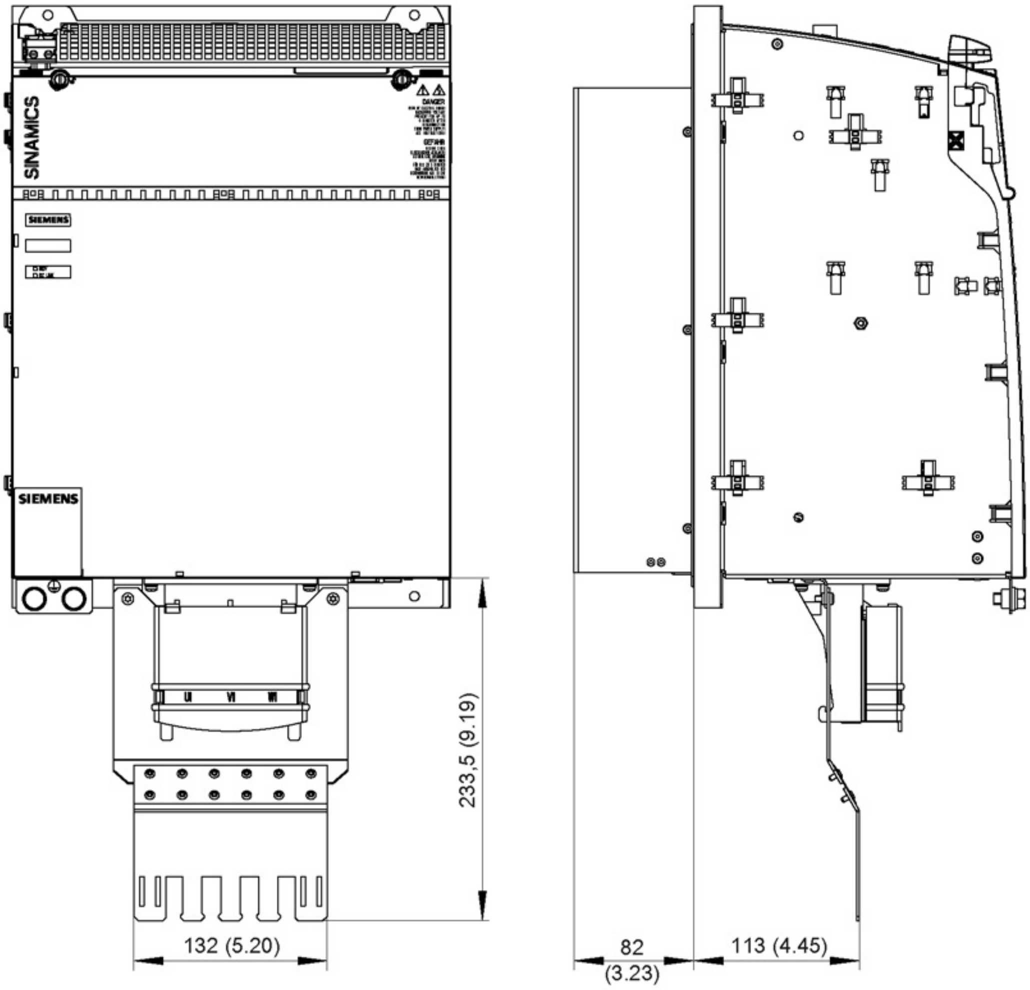
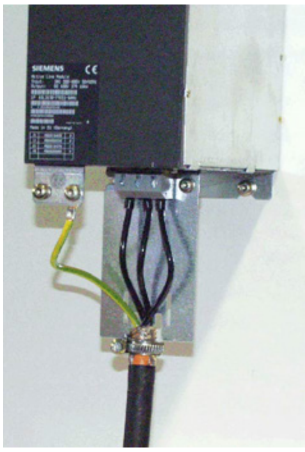
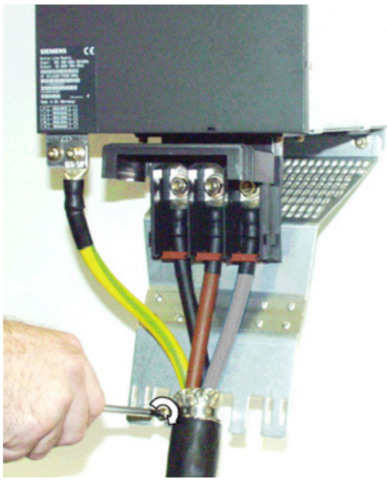


Figure 4-21 Dimension drawing of shield connecting plate on a 300 mm component with external air cooling, all dimensions in mm and (inches)

4.3.3 Shield Connection for Internal Heat Dissipation

The two examples for preassembled cables on power components of different width follow:

	
Preassembled cable on a 100 mm component	Preassembled cable on a 200 mm component

4.4 Note for the installation clearance for the connection cables

4.4.1 General information

The arrangement of the components and equipment takes account of

- Space requirements
- Cable routing
- Bending radii of the connection cables
  MOTION-CONNECT cables, refer to catalog PM21 or NC62
- Heat dissipation
- EMC

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

Components are usually located centrally in a cabinet. The necessary mounting and installation clearances above an below the components can, under certain circumstances, exceed the minimum clearances specified in the product documentation.

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

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

A ventilation clearance of 100 mm must be maintained around the line reactor (not including the mounting surface).

DANGER

Risk of electric shock by incorrectly installed DC link bridge

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

- Remove the DC link bridges including the screws on a 50 mm-wide Motor Module or DC link module.
- Do not tighten the screws without the DC link bridges.
- For all components that are 75 mm wide or wider, the DC link bridges must not be moved to the left or removed.

4.4.2 Clearance of the Power Components

The installation clearance is defined by

- Ventilation clearance
- Cable clearance

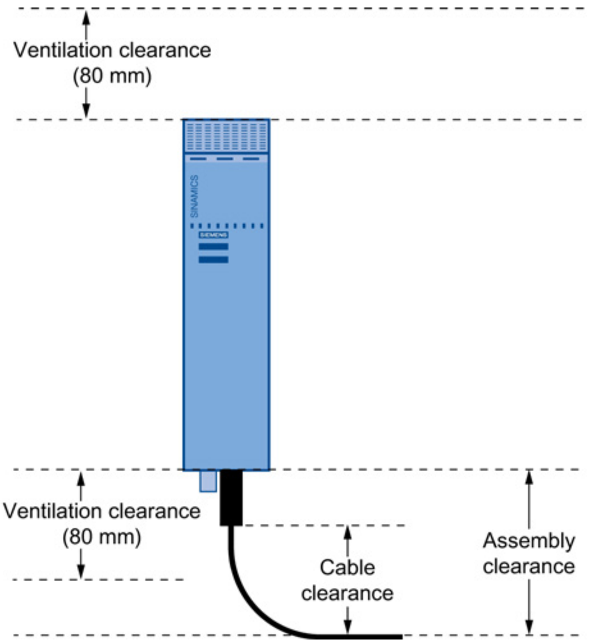


Figure 4-22 Clearance in the vicinity of the power components

4.4.3 Ventilation Clearances of the SINUMERIK Components

Table 4- 2 Ventilation clearances above and below the components

Component	Clearance [mm]
NCU 7x0	80 mm
NX1x	80 mm

4.5 Heat Dissipation of the Control Cabinet

4.5.1 Control cabinet cooling options

The following options are available for cooling the control cabinet:

- Filter fans
- Heat exchangers
- Cooling units
- Liquid cooling
- External air cooling
- External liquid cooling

The device to be used depends on the associated environmental conditions and the required cooling capacity.

The air routing within the control cabinet and the cooling clearances specified must be observed. No components may be installed and no cables routed in the cooling clearance spaces.

NOTICE
Failure of components due to incorrect installation Installing SINAMICS components incorrectly in the cabinet can reduce their service life and cause them to fail prematurely. • Observe the guidelines for installing SINAMICS components in the cabinet.

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

- Ventilation clearance
- Wiring and cabling
- Air guidance, air-conditioner

4.5.2 General information on ventilation

SINAMICS components are force-ventilated using integrated fans, and in some cases through natural convection. The fans are not equipped with temperature-dependent speed control; only the states "on" or "off" exist.

The fans start when the pulse enable is set, and switch off with a small hysteresis as soon as the temperature falls below the heat sink temperature saved in the power stack data (typically 56 °C). The run-on time of the fan depends on various factors such as ambient temperature, output current, duty cycle and, therefore, cannot be determined directly.

Note

For the 5 kW and 10 kW Smart Line Modules, the fan runs permanently.

⚠ WARNING

Risk of fire due to overheating as a result of insufficient ventilation clearances

Insufficient ventilation clearances can cause overheating and present a risk for personnel due to smoke development and fire. This can also result in more failures and reduced service lives of devices and systems.

- Maintain ventilation clearances of at least 80 mm above and below the components.
- Make sure that warm air can escape at the top.
- If you are using filter fans, heat exchangers, or air conditioners, make sure that the air is flowing in the right direction.

⚠ WARNING

Risk of fire due to overheating resulting from covered ventilation slots

Covered ventilation slots can cause overheating and present a risk for personnel due to smoke development and fire. This can also result in more failures and reduced service lives of devices and systems.

- Route the connected signal and power cables to the components in such a way that they do not cover the ventilation slots.

⚠ WARNING

Risk of fire due to hot spots resulting from a lack of air circulation in sealed cabinets

If air cannot circulate in the cabinet, this can lead to hot spots that present a risk for personnel due to smoke development and fire. This can also result in more failures and reduced service lives of devices and systems.

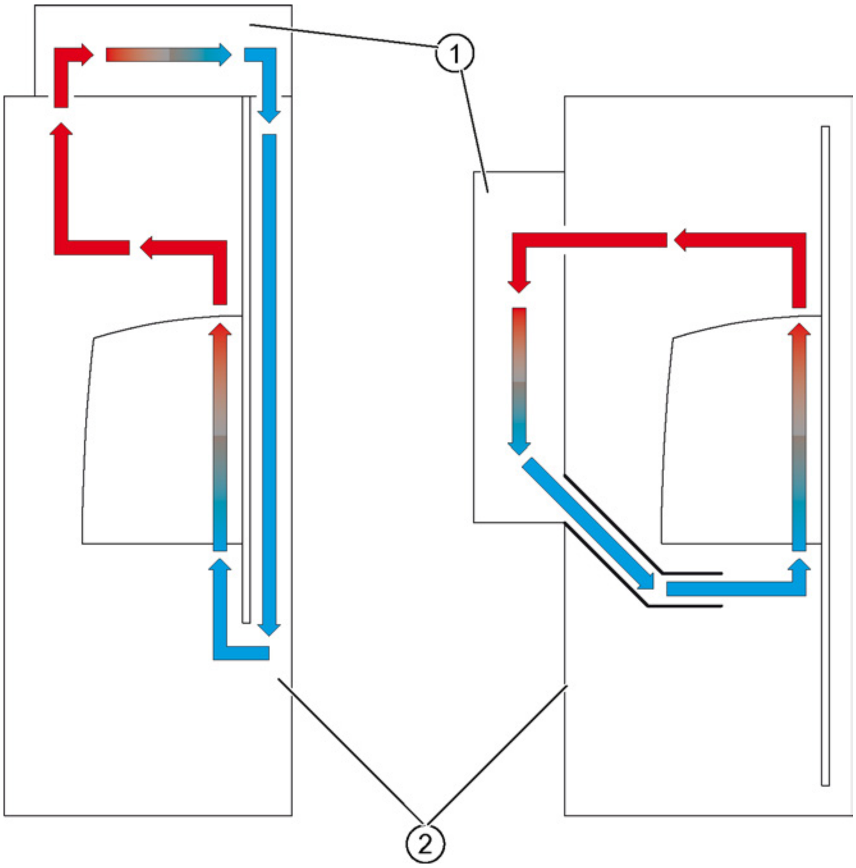
- Install an internal air circulation system that will ensure the air can flow.
- Install the fan above the components to optimize the air flow (suction).

Air circulation is not required if you are using switchgear with a passive heat dissipation system.

Note

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

The distance between the blow-out aperture of the air conditioner and the electronic equipment must be at least 200 mm. With distances that are shorter than this, air baffle plates must be used in order to divert the air.



① Cooling unit
② Control cabinet

Figure 4-23 Examples of cabinet ventilation

NOTICE

Failure of components due to condensation

If air conditioners are used, the relative air humidity of the expelled air increases as the air in the air conditioner cools and may exceed the dew point. If the relative humidity of the air entering the SINAMICS components is over 80% for an extended period of time, it can be assumed that the insulation of the components will fail as a result of electrochemical reactions.

- Select the air guidance and arrangement of the cooling equipment in such a way that no condensation can form on the components.
- Use air baffle plates, for example, to ensure that the cold air expelled from the air conditioner mixes with warm air in the cabinet before it enters the components. This reduces the relative air humidity to uncritical values.
- Prevent cold air from being blown directly onto electronic equipment.
- If required, install cabinet enclosure heating.

4.5.3 Cooling clearances

Table 4- 3 Cooling clearances required above and below SINAMICS components

Component	Clearance [mm]
CU320-2	80
Sensor Modules Cabinet-Mounted SMCxx	50
Terminal Modules TMx	50
Line filter for Line Modules	100
Active Interface Modules	80
Line reactors for Line Modules	100
Active Line Modules 16 kW – 55 kW 80 kW – 120 kW	 80 80 (additional 50 in front of fan)
Smart Line Modules in booksize format	80
Basic Line Modules	80
Motor Modules Booksize < 132 A 132 A and 200 A	 80 80 (additional 50 in front of fan)
Braking Module Booksize	80
Control Supply Module	80
Capacitor Module	80

Drive line-up with internal air cooling

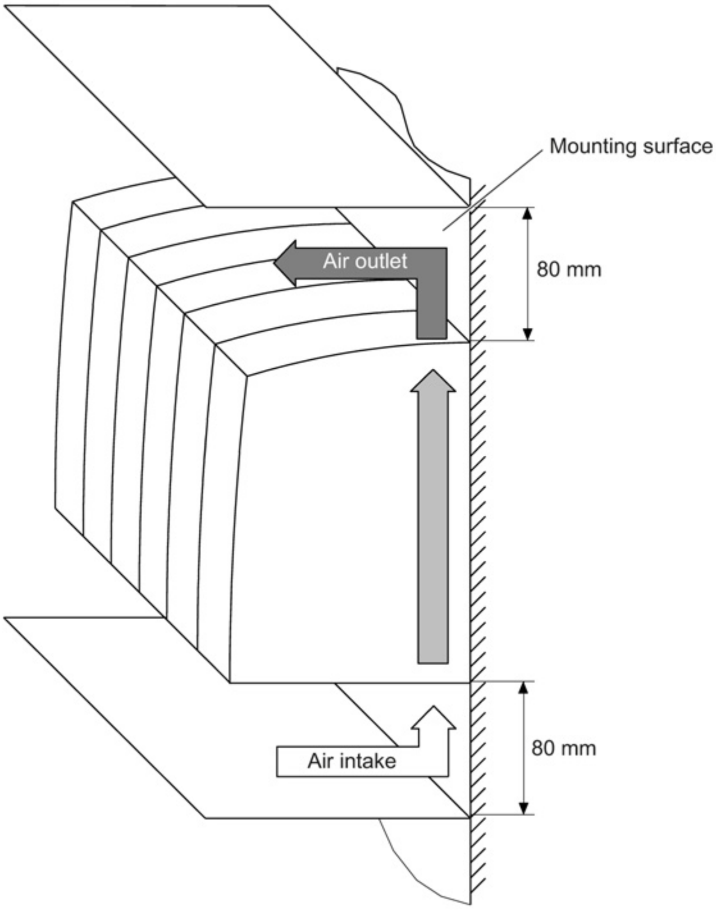


Figure 4-24 Cooling clearances for a drive line-up with internal air cooling (components up to 200 mm width)

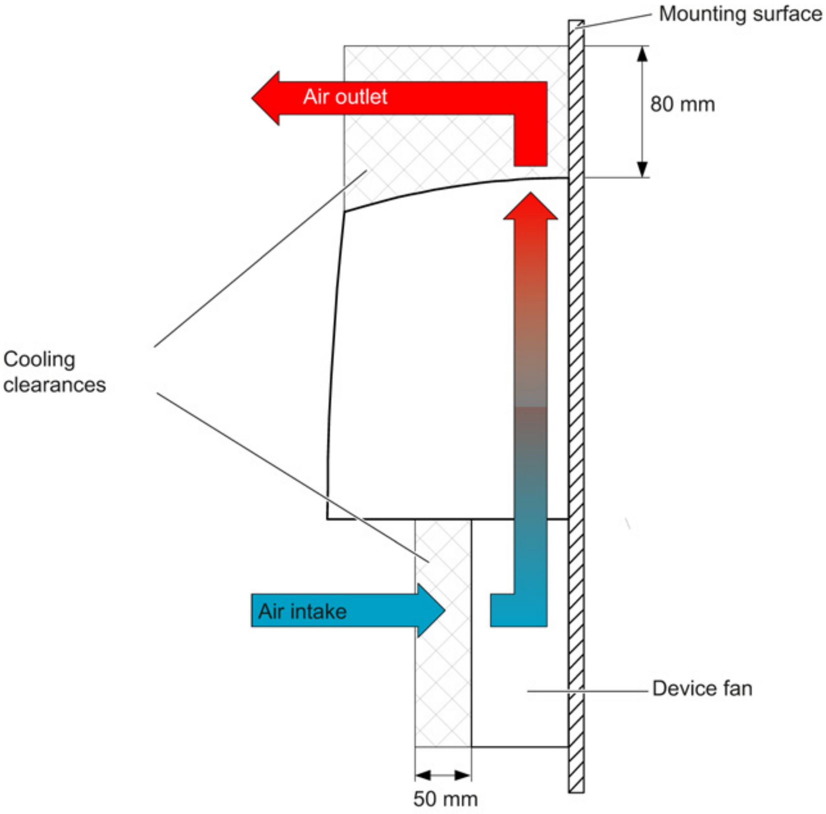


Figure 4-25 Cooling clearances for 300 mm wide components with internal air cooling with mounted unit fan

Drive line-up with external air cooling

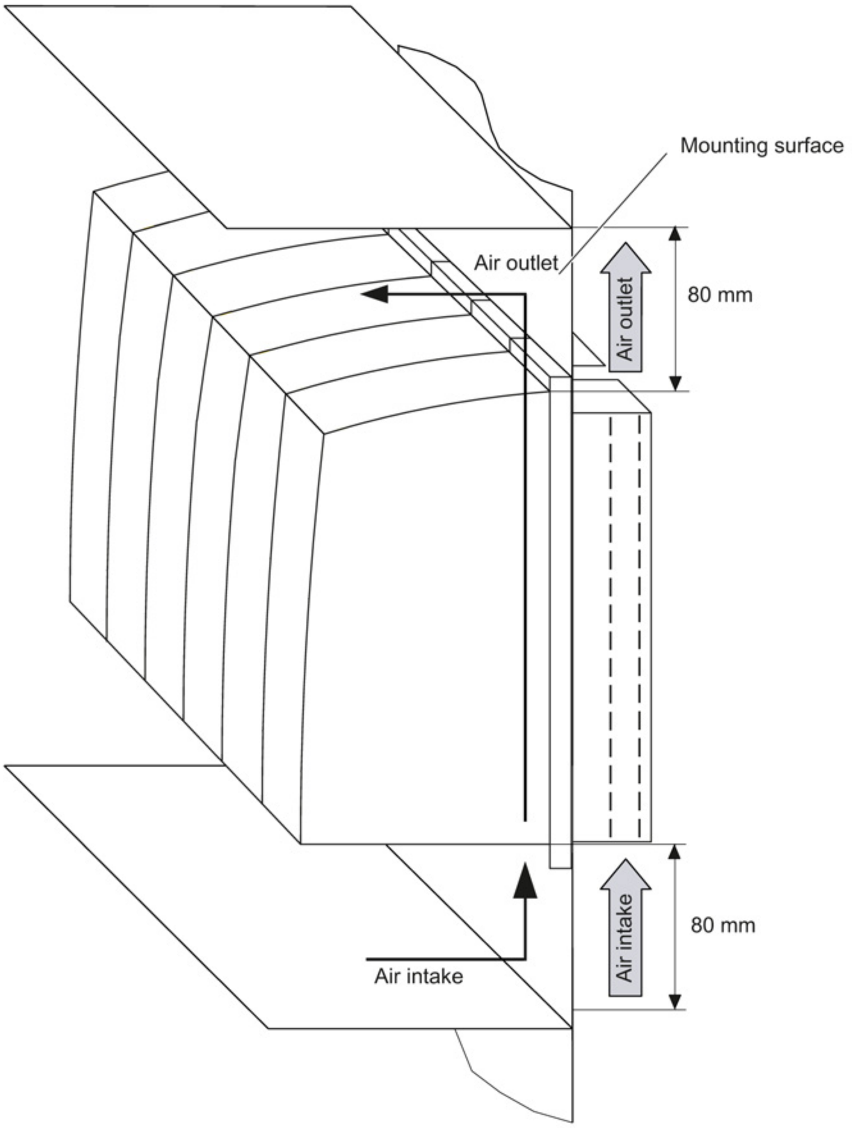


Figure 4-26 Cooling clearances for a drive line-up with external air cooling (components up to 200 mm width)

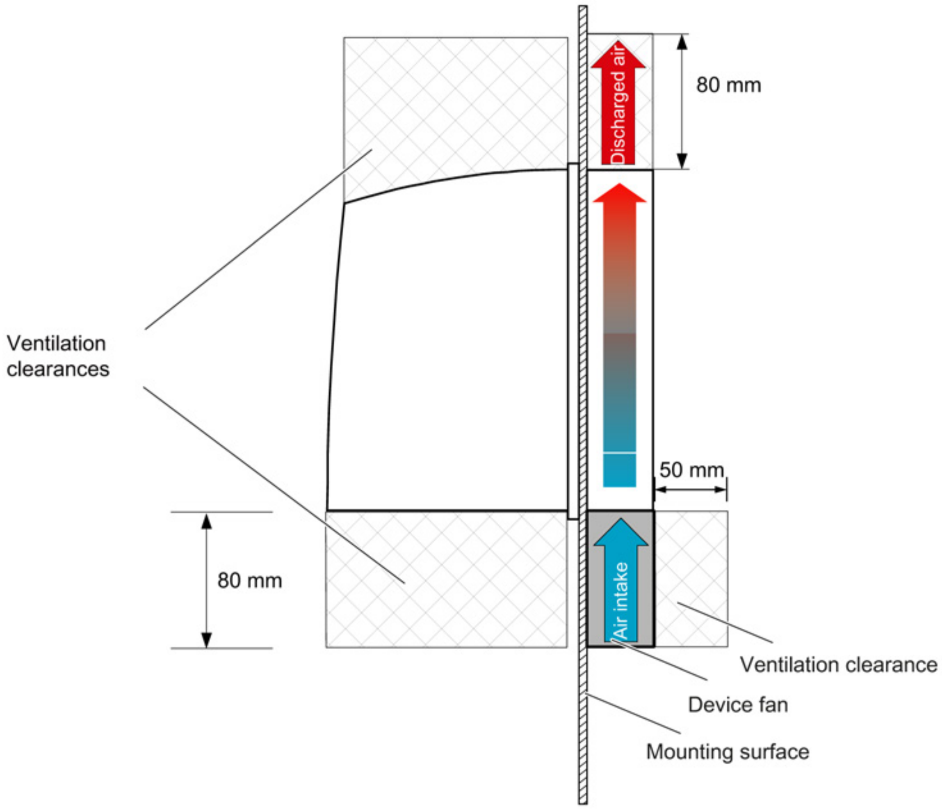


Figure 4-27 Cooling clearances for 300 mm wide components with external air cooling with mounted unit fan

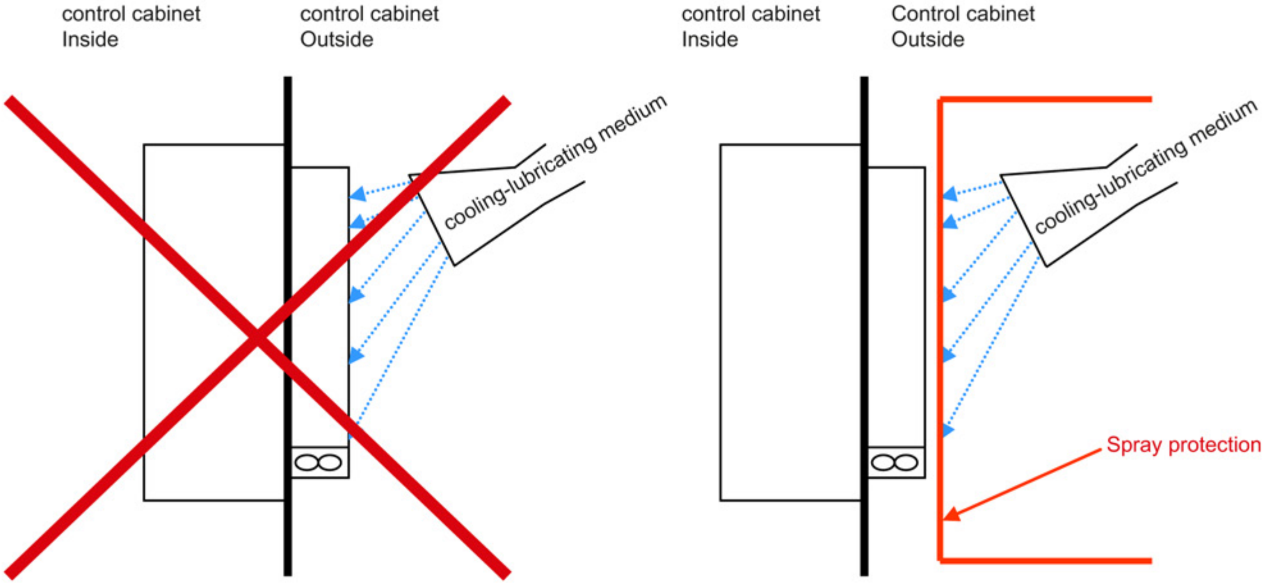


Figure 4-28 Spray protection for a drive line-up with external air cooling

Rail-mounted components

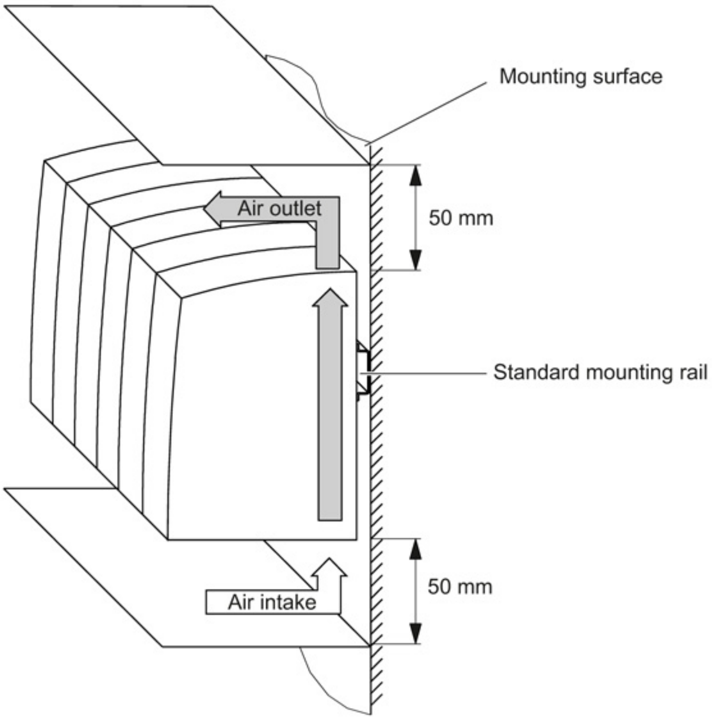


Figure 4-29 Ventilation clearances for rail-mounted components (e.g. SMC, TM, DMC)

4.5.4 Dimensioning Climate Control Equipment

Cabinet manufacturers provide calculation programs for selecting climate control equipment. It is important to know the power losses for the components and devices in the control cabinet.

Formula to calculate the power loss

$q = Q - k \cdot A \cdot \Delta T$

q = thermal power that has to be dissipated through a refrigerator [W]
Q = internal power loss (incl. electronics losses) [W]
ΔT = temperature difference between the room and cabinet interior [K]
k = heat transfer coefficient, e.g. sheet steel, painted 5.5 [W/(m^2 * K)]
A = freestanding cabinet surface area [m^2]

Example

Table 4- 4 Power loss calculation for a drive configuration

Component	Number	Total power loss [W] (including electronic losses)	Total power loss [W]
CU320-2	1	24	24
Basic Line Filter for AIM/ALM 36 kW	1	26	26
Active Interface Module 36 kW	1	340	340
Active Line Module 36 kW	1	666	666
Motor Module 18 A	2	185.4	370.8
Motor Module 30 A	3	309.2	927.6
SMC	5	10	50
SITOP 20	1	53	53
Line contactor	1	12	12
Total:			**2469.4**

- Assumption:
  - freestanding cabinet surface area A = 5 m^2
  - temperature difference between the room and cabinet interior ΔT = 10 K

$q = 2469.4\ W - 5.5\ W/(m^2\ K) \cdot 5\ m^2 \cdot\ 10\ K = 2194.4\ W.$

See also

Power Loss of the SINUMERIK Components (Page 516)

Power loss of SINAMICS components (Page 516)

4.6 Cooling of power units

With the SINAMICS S120 system, there are four distinct cooling methods for cooling power units:

- Internal air cooling
- External air cooling
- Cold plate cooling
- Liquid cooling (liquid cooled)

4.6.1 Internal Air Cooling

All SINAMICS S120 booksize components are installed within a control cabinet. The total heat loss of all components is dissipated in the control cabinet. There are three ways to remove the heat from the control cabinet:

- Filter fans
- Heat exchangers
- Cooling units

The device to be used depends on the associated environmental conditions and the required cooling capacity. The configuring must also maintain the specified clearances for the ventilation. No other components may be placed in these areas.

4.6.2 External Air Cooling

The external air cooling is a cooling system for SINAMICS booksize power units. The through-hole technology is used for this construction form. The booksize power unit with its heat sink can be placed in the rectangular cutout of the control cabinet rear wall and installed with a seal. The heat sink with its cooling fins and fan (contained in scope of delivery) extends at the back out of the control cabinet and the heat dissipation is made externally from the control cabinet or in a separate air duct.

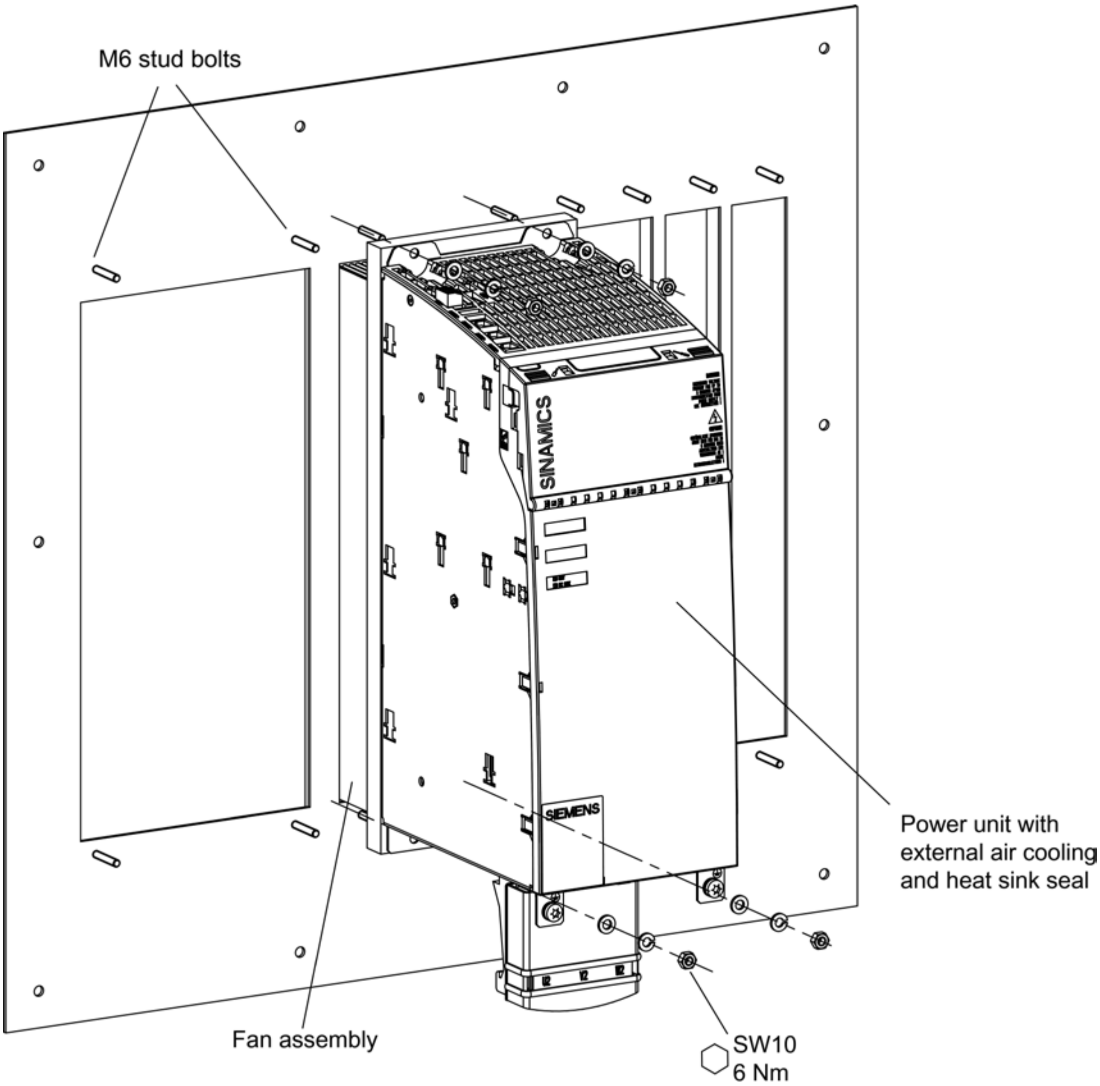


Figure 4-30 Installation of a booksize power section with external air cooling

4.6.3 Cold plate cooling

Cold plate cooling is a cooling system for SINAMICS S120 booksize power units. The flat aluminum cooling plate located at the rear side of the devices serves as thermal interface.

Special advantages of the cold plate technology

1. It is particularly suitable for machine concepts in which a high level of dirt accumulates in the machine vicinity. The reduction of the cabinet-internal heat loss simplifies the heat dissipation of a sealed control cabinet (IP54).
2. Advantageous for machine concepts for which liquid is already present in the process. This heat dissipation method is thus suitable for both internal and external cold plate cooling of the power components.

A distinction is made between:

- **Cold plate with air heat sink**
  The components of the drive line-up are typically all attached with screws to the cooling fins of an air heat sink.
- **Cold plate with liquid heat sink**
  The components of the drive line-up are typically all attached with screws to the liquid heat sink.
- **Cold plate with internal liquid heat sink**
  This is considered to be a liquid cooling using a connection adapter. The liquid passes through the integrated channels in the cold plate.

Note

Derating at a temperature of 40 °C and above

In the case of 300 mm-wide modules, derating must be applied due the heat transferred to the external heat sink. If the temperature at the interface to the power unit is 40 °C, derating is 20% for 6SL3136-7TE28-0AAx/6SL3126-1TE31-3AAx and 30% for 6SL3136-7TE31-2AAx/6SL3126-1TE32-0AAx.
When the Active Line Modules and Motor Modules feature direct (internal) liquid cooling (6SL3135-7TE31-2AA3/6SL3125-1TE32-0AA3), this derating does not apply to the cold plate components referred to above.

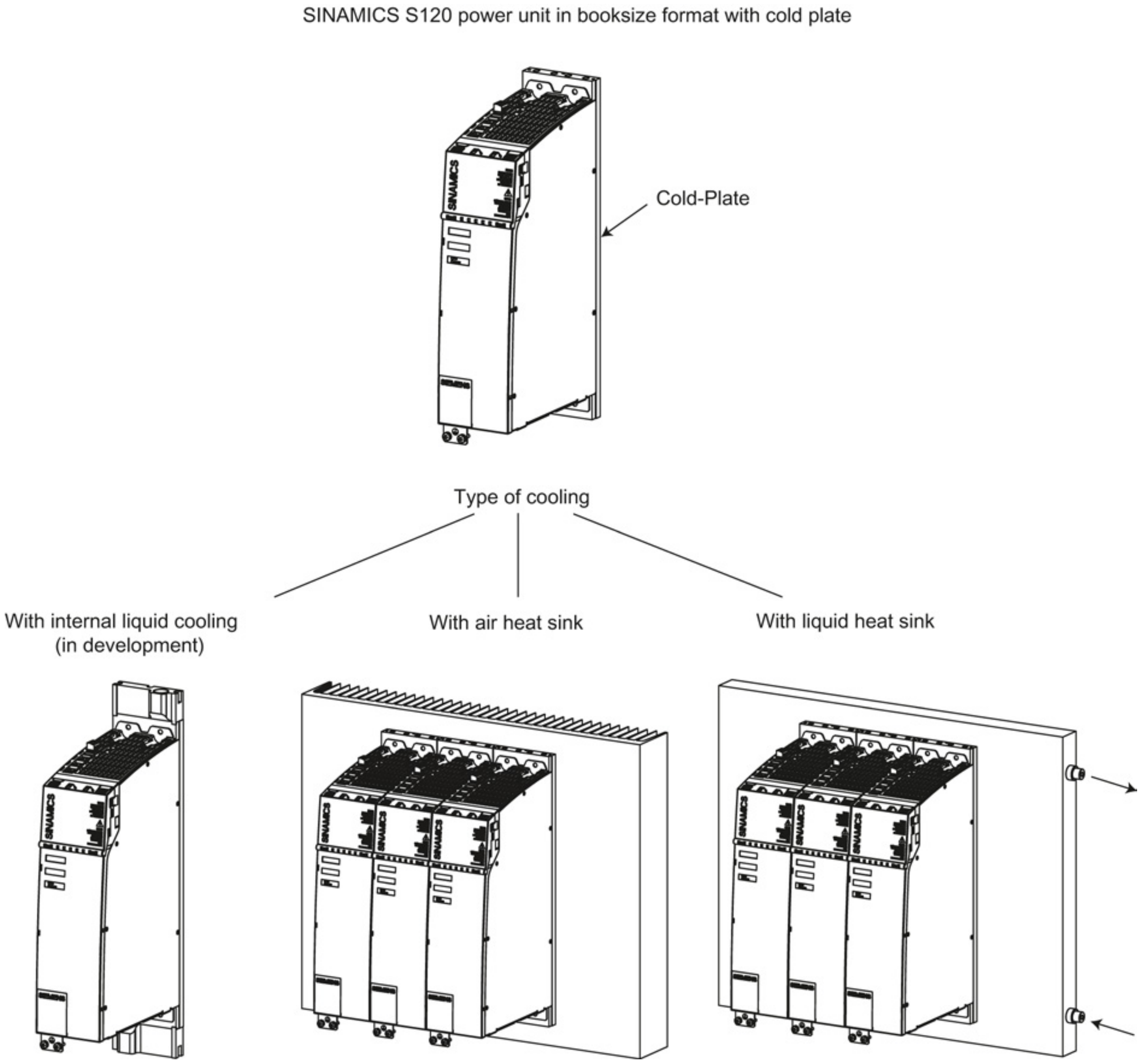


Figure 4-31 Cooling systems for cold plate

Note

Important for configuration

The associated notes contained in the manuals must be observed for the configuring and the layout of the corresponding component. This ensures that devices in the control cabinet are not damaged as a result of leaks, etc.

4.6.4 Liquid cooling (liquid cooled)

Liquid cooling is used only for large power units (Active Line Module 120 kW as well as single Motor Module 200 A).

For liquid cooling, the power semiconductors are mounted on a heat sink, through which the coolant flows. The power loss of the device is, to large extent, absorbed by the cooling medium and can be dissipated outside the cabinet.

Additional references

/GH2/ SINAMICS S120 Booksize Power Modules, chapter "Cooling circuit and coolant properties".

Communication within the system 5

5.1 Communication overview

The NCU 7x0.3 PN establishes the connection to the operating components and service units via its Ethernet interfaces. Communication takes place via various networks.

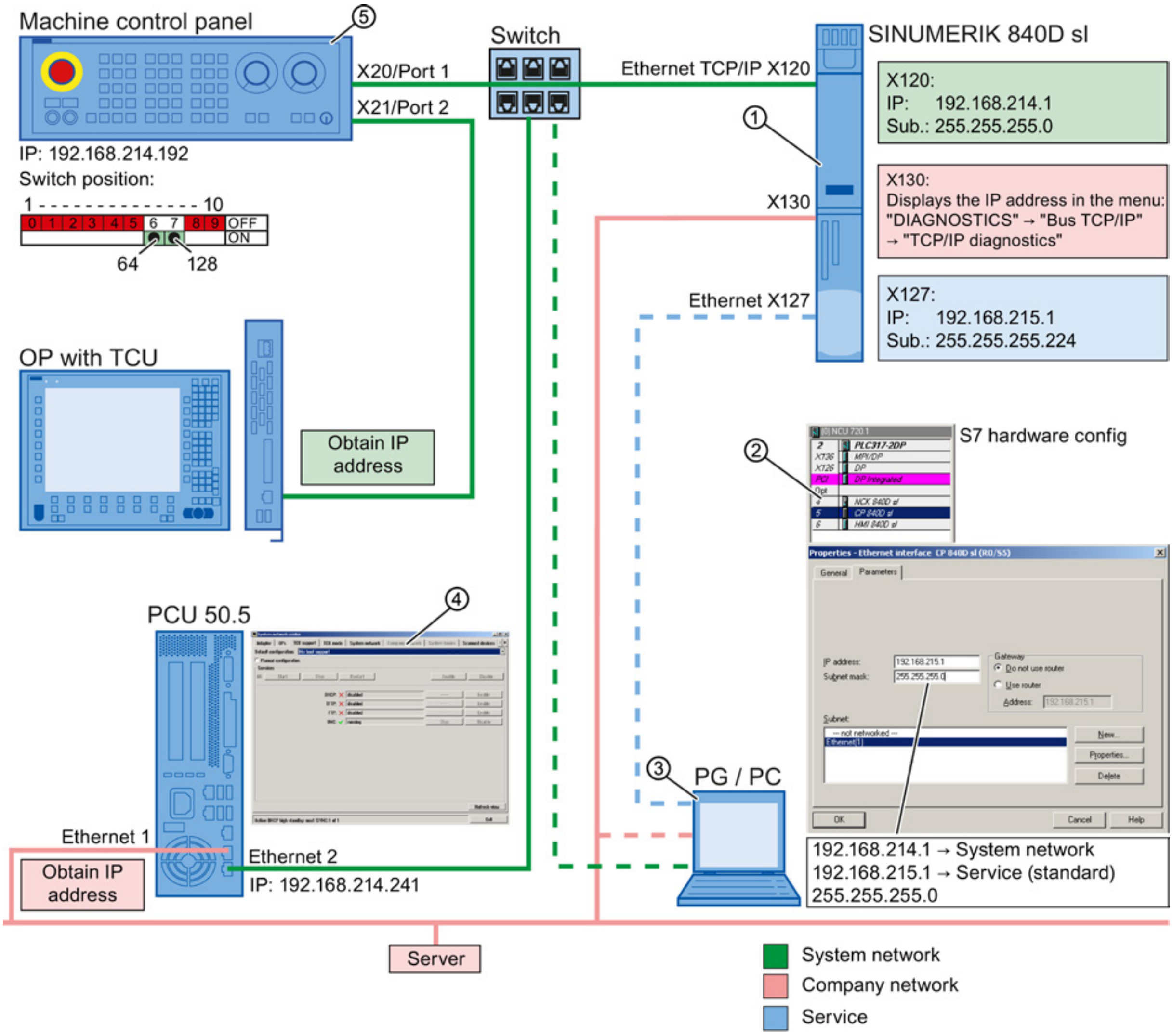


Figure 5-1 Example based on the SINUMERIK 840D sl network configuration

Note

The significance of items ① to ⑤ is explained on the pages that follow.

① (NCU)

- IP assignment of the server
- The ports need to be activated if VNC and HMI/Step7 are to be used (SW2.4.xxx and higher):

```
/user/system/etc/basesys.ini

[LinuxBase]

FirewallOpenPorts="TCP/102 TCP/5900"
```

② (S7 Hardware Config)

Access parameters need to be set in the S7 hardware configuration.

1. Check the network connection (ping on selected access path X120/X130/X127).
2. Select the PG/PC interface in SIMATIC Manager.

Note

Do not select "TCP/IP (AUTO)…" or "ISO Ind. Ethernet ..." under any circumstances!

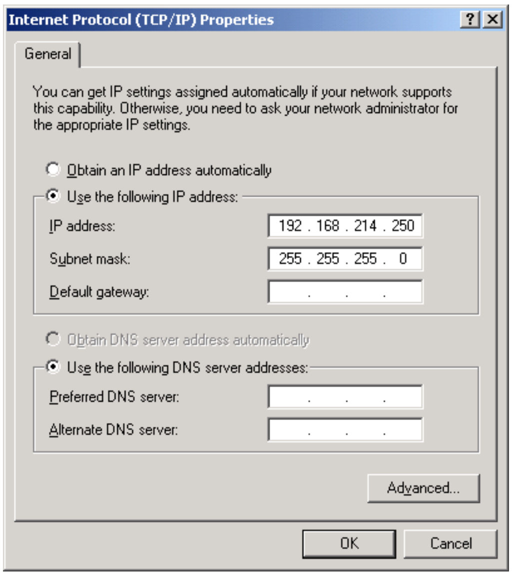
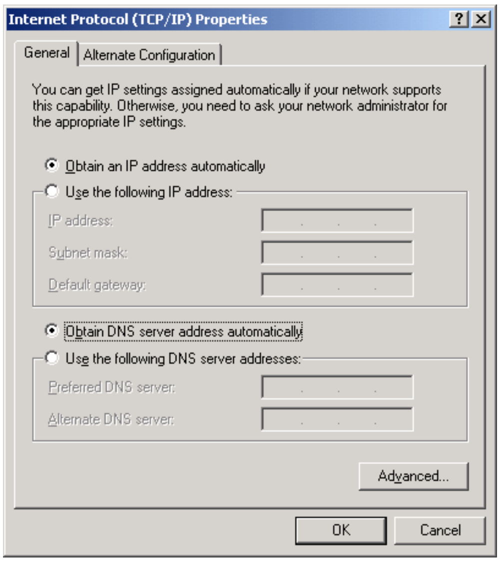
3. Set parameters for HW Config → Machine control panel using the selected access IP address (X120/X130/X127).
4. Load the parameter assignment to the station.

Note

As of SW 2.4:

The ports must first be activated where connections via the company network are involved (X130).

③ (PG/PC)

On the system network (X120):	On the service network (X127):
	
• TCP/IP Internet protocol – properties – general – Set fixed IP addresses • Example: – IP: 192.168.214.250 – Sub.: 255.255.255.0	• TCP/IP Internet protocol – properties – general – IP address obtained automatically

④ (System Network Center > TCU support)

When TCU – PCU50.5 (HMI Advanced) is powered up, the IP address of the PCU must be entered in the
/user/common/<TCU-Name>/common/tcu/config.ini
file:

```
[Station]
mcpIndex=…
tcuIndex=…
dckEnable=…
MaxHostIndex=1
[host_1]
Address=192.168.214.241
```

- If the DHCP of the NCU (X120) is active:
  Set the "Settings system network" program on the "TCU support" tab.
- Set "No boot support".

⑤ (machine control panel – Industrial Ethernet)

Note

The Service menu (Backup/Restore) is only available for an analog monitor, TCU OP, or PCU OP.

- **mcp_client.ini file**:
  - copy mcp_client.ini from
    /siemens/sinumerik/mcp_client/mcp_client.ini
    to
    /user/sinumerik/mcp_client/mcp_client.ini
  - "addrMode" change: 1=DNS (default) 0=HWS
    This may be required after a change of software if the machine control panel no longer uses PROFIBUS for communication
- **Organization block 100 (OB100):**

```
CALL "RUN_UP" , "gp_par

"MCPNum :=1

MCP1BusAdr :=192 // bus address in accordance with MCP switch

MCPMPI :=FALSE

MCPSDB210 :=FALSE

MCPCopyDB77 :=FALSE

MCPBusType :=B#16#55 (PROFIBUS = 3)
```

Note

In B#16#55, the initial "5" refers to the first machine control panel and the last "5" refers to the second.

5.2 DRIVE-CLiQ Topologies

5.2.1 DRIVE-CLiQ topology

Introduction

DRIVE-CLiQ (Drive Component Link with IQ) is a communication system for connecting the various SINAMICS components (e.g. Control Unit, Line Module, Motor Modules, motors, and encoders).

In SINAMICS contexts, the term "topology" refers to the structure of a drive system, including its DRIVE-CLiQ wiring and other wiring elements.

DRIVE-CLiQ supports the following functions:

- Automatic detection of components by the Control Unit (NCU 7x0.3 or CU320-2)
- Standard interfaces to all components
- Standardized diagnostics down to component level
- Standardized service down to component level

Electronic rating plate

DRIVE-CLiQ components have an electronic type plate in which the characteristic device data is stored. When connecting the device to the Control Unit, the following information is transferred via DRIVE-CLiQ:

- Component type (e.g. SMC20)
- Order number (e.g. 6SL3055-0AA0-5BA0)
- Manufacturer (e.g. SIEMENS)
- Hardware version (e.g. A)
- Serial number (e.g. T-PD3005049)
- Technical data (e.g. rated current)

Actual topology

The actual topology is the actual DRIVE-CLiQ cabling tree, which is detected automatically via DRIVE-CLiQ when the drive system components are started up.

Target topology

The target topology is stored on the memory card on the Control Unit and is compared with the actual topology when the Control Unit is started up.

The target topology can be specified in two ways and saved on the memory card:

- Via the SINUMERIK 840D sl drive wizard or via the STARTER commissioning tool (by creating the configuration and loading it to the drive unit)
- Via quick commissioning (automatic configuration):
  the actual topology is read and the target topology written to the memory card.

Comparison of topologies at Power On

Comparing the topologies prevents a component from being controlled/evaluated incorrectly (e.g. drive 1 and 2).

When the drive system starts up, the Control Unit compares the detected actual topology and the electronic rating plates with the relevant target topology stored on the memory card.

You can specify how the electronic rating plates are compared for all the components of a Control Unit via p9906. The type of comparison can be changed subsequently for each individual component. You can use p9908 for this or right-click in the topology view in the STARTER tool. All data on the electronic rating plate are compared by default.

The following data in the target and actual topologies is compared depending on the settings made in p9906/9908:

- p9906/p9908 = 0 component type, order number, hardware version, manufacturer, serial number
- p9906/p9908 = 1 component type, order number
- p9906/p9908 = 2 component type
- p9906/p9908 = 3 component class (e.g. Sensor Module or Motor Module)

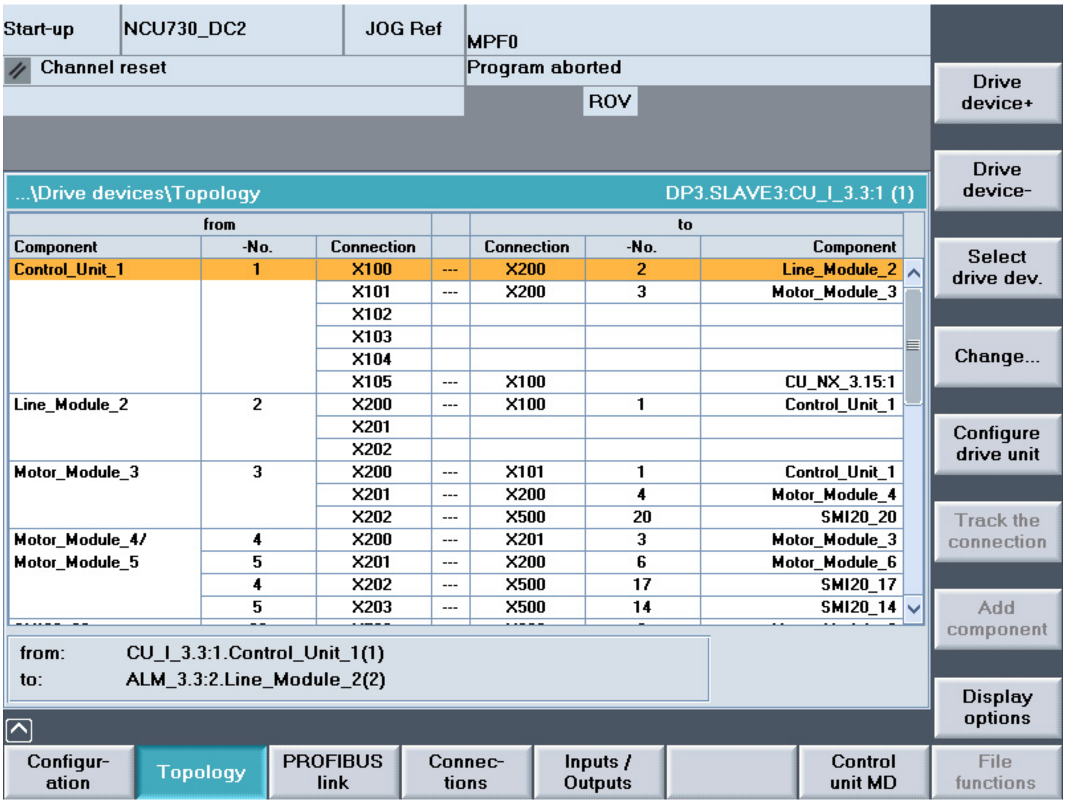


Figure 5-2 Topology of the SINUMERIK drive wizard

Note

The Control Unit and the Option Board are not monitored. A replacement of components is accepted automatically and not displayed.

5.2.2 DRIVE-CLiQ wiring

Note

Unless otherwise specified, Control Unit always refers to a SINUMERIK NCU 7x0.3 in the information below.

Note

The components of the SINAMICS S120 drive family and the Control Unit are interconnected using DRIVE-CLiQ. When connecting the components, please note the following rules.

Rules for wiring DRIVE-CLiQ

Boundary conditions

- On the SINUMERIK 840D sl, only SERVO control is possible. Vector operation is not possible.
- The following information about quantity structures only applies if Terminal Modules of type TM120 alone are being used. With a sampling time of 125 μs, a maximum of two TM120 modules are allowed; with 62.5 μs, a maximum of one.
- Add-ons in addition to the linear axis or the rotary safety axis are not permitted.
- The current hardware configuration specifies the components to be considered. Deactivated drive objects/Sensor Modules must also be taken into account in the quantity structure.
- SINUMERIK Safety Integrated is intended for all axes.
- PROFIBUS DP ≥ 2 ms cycle

  SINUMERIK Safety Integrated ≥ 12 ms cycle
- The sampling times are set using parameter p0112:

  p0112 = 3: Standard (125 μs)

  p0112 = 4: High Performance (62.5 μs)

  p0112 = 5: High Performance (31.25 μs)

MANDATORY conditions

- A maximum of 14 nodes are permitted on an NCU DRIVE-CLiQ socket. A Double Motor Module counts as two components. The maximum possible number of nodes is reduced in the case of a faster clock rate.

Clock rate	Max. number of nodes
125 μs	14
62.5 μs	5
31.25 μs	2

Dependence of clock rate and number of nodes on a DRIVE-CLiQ interface

- Drive modules are connected in series (line topology) with the Motor Modules. Ring wiring is not permitted. The measuring systems assigned to these drives must relate to the same Control Unit or NX.
- A maximum of eight nodes in series is permissible. A Double Motor Module counts as two nodes. A row is always regarded as starting at the control unit.
- NX modules must be wired from the NCU using a point-to-point configuration. Cascading is not permitted. NX modules may not be operated downstream of a DRIVE-CLiQ hub or another DRIVE-CLiQ component.
- The components may not be double-wired, i.e. a DRIVE-CLiQ component must not be associated with two DRIVE-CLiQ cables.

- Only one ALM/SLM may be connected per Control Unit. The DC links of different ALMs/SLMs may not be connected to one another.
- To enable the "Automatic configuration" function to assign the encoders to the drives, the rules below must be observed:
  - The connection from the Control Unit to the first infeed and the first Motor Module must each be established at the X200 interface.
  - The DRIVE-CLiQ cables between the Motor Modules must each be connected from the X201 interface to the X200 interface on the next component.
  - The power line to the motor and the associated motor encoder must be connected to a Motor Module.
  - The following applies to Double Motor Modules:

    X200: from the previous node

    X201 standard assignment: to the next node or SMx for 2nd axis

    X202 standard assignment: SMx 1st axis

    X203 standard assignment: SMx 2nd axis

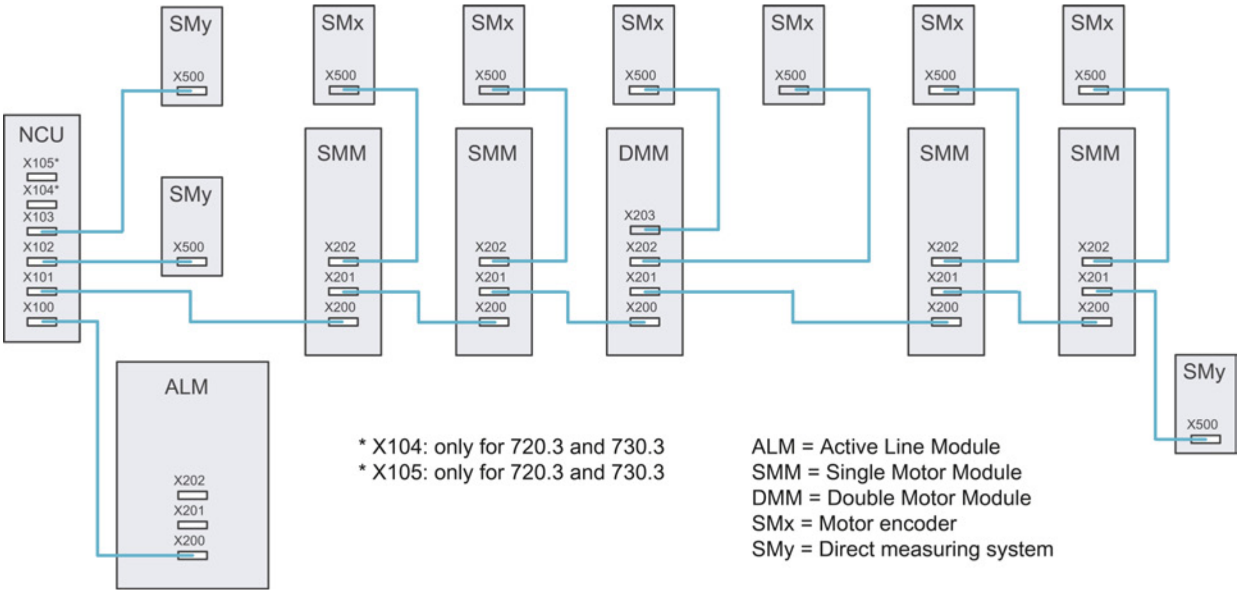


Figure 5-3 DRIVE-CLiQ topology for NCU 7x0.3

Note

ALM and Motor Modules should preferably have a star topology

The Active Line Module and the Motor Modules can also be connected with a line topology. In order to achieve more uniform utilization, however, a star topology (i.e. connection to separate DRIVE-CLiQ lines) is preferable.

Tips for optimum commissioning

- The Active Line Module or Smart Line Module should always be assigned the DO number "2".
- The motor measuring systems should be connected to the associated Motor Modules (X202/X203).
- NX modules should always be populated on the NCU from the rear. This means that they will automatically be assigned with PROFIBUS addresses in reverse order (15 - 12).
- A DRIVE-CLiQ hub should ideally be attached to a separate DRIVE-CLiQ port on the NCU, so as not to exceed the maximum quantity structures of DRIVE-CLiQ components. If there are no free connectors here, the DRIVE-CLiQ hub is connected to the last Motor Module (observe the rule of 14 components in a line, and a maximum of eight of these in series).
- A DRIVE-CLiQ cycle of less than 125 μs should only be used if an increased pulse frequency is necessary due to an increased speed.
- A Double Motor Module, a DMC20, and a DME20 each correspond to two DRIVE-CLiQ nodes. This also applies to Double Motor Modules, at which just one drive is configured.
- If the current controller sampling time for a drive object has to be changed in such a way that the modified sampling time is no longer in line with the other drive objects on the DRIVE-CLiQ line, the following options are available:
  – Reconnect the drive object to a separate DRIVE-CLiQ line.
  – Change the current controller sampling times and/or the sampling times of the inputs/outputs of the other drive objects so that they fit into the new pattern.

Maximum quantity structures for stand-alone system and extended systems

Table 5- 1 Standard applications with the same DQ cycle

Quantity structures	DQ cycle	NCU	NX	ALM	Motor Module	Motor measuring systems	Direct measuring systems	DRIVE-CLiQ Hub
Stand alone	125 μs	1	1-5	1	6	6	6	4
NX15	125 μs			1	6	6	6	4
NX15	62.5 μs			1	3	3	3	1
NX15	31.25 μs			1	1	1	1	1
NX10	125 μs			1	3	3	3	1
NX10	62.5 μs			1	1	1	1	

Table 5- 2 Special applications with mixed DQ cycle

Quantity structures	DQ cycle	NCU	NX	ALM	MoMo 62.5 μs	MoMo 125 μs	Motor measuring systems	Direct measuring systems	DRIVE-CLiQ Hub
Stand alone	mixed	1	1-5	1	1	4	5	5	1
NX15	mixed			1	1	4	5	5	1

Specifications for sampling times

- For Active Line Modules in booksize format, only a current controller sampling time of 125.0 μs or 250.0 μs can be set.
- A current controller sampling time between 31.25 μs and 250.0 μs can be set for servo drives (31.25 μs ≤ p0115[0] ≤ 250.0 μs).
- For servo drives with a current controller sampling time of p0115[0] = 62.5 μs, the following applies:

  - only possible in booksize and blocksize format

  - maximum quantity structure:

  – booksize: 2x servo with p0115[0] = 62.5 μs + Line Module (connected to a different DRIVE-CLiQ line)

  – servo drives in booksize format can be combined on one DRIVE-CLiQ line with a servo with p0115[0] = 125.0 μs (but with same quantity structure).

  – A DRIVE-CLiQ hub DMC20 cannot be operated with servo drives with p0115[0] = 62.5 μs on a DRIVE-CLiQ line but must instead be connected to a separate DRIVE-CLiQ line.

  – blocksize: 1 servo with p0115[0] = 62.5 μs
- When a unit in chassis format is connected to a DRIVE-CLiQ line, the smallest current controller sampling time must be at least 250 μs.
  Example: A mixture of chassis and booksize units on a DRIVE-CLiQ line.
- Motor Modules in chassis format with different current controller cycles must be connected to separate DRIVE-CLiQ lines. For this reason, Chassis Motor Modules and Booksize Motor Modules with a current controller sampling time < 250 μs must also be connected to separate DRIVE-CLiQ lines.
- The sampling times (p0115[0] and p4099) of all components that are connected to a DRIVE-CLiQ line must be divisible by one another with an integer result.

Table 5- 3 Connecting the motor encoder to the Motor Module via DRIVE-CLiQ

Component	Connecting the motor encoder via DRIVE-CLiQ
Single Motor Module booksize	• Encoder at X202
Double Motor Module booksize	• Motor connection X1: Encoder at X202 • Motor connection X2: Encoder at X203

Note

If an additional encoder is connected to a Motor Module, it is assigned to this drive as encoder 2 in the automatic configuration.

Note

The SINAMICS S120 Function Manual contains further information on the DRIVE-CLiQ topology.

Line connection

6

6.1 Power Supply Interface Variants

6.1.1 Ways of connecting the line supply

A distinction is made between:

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

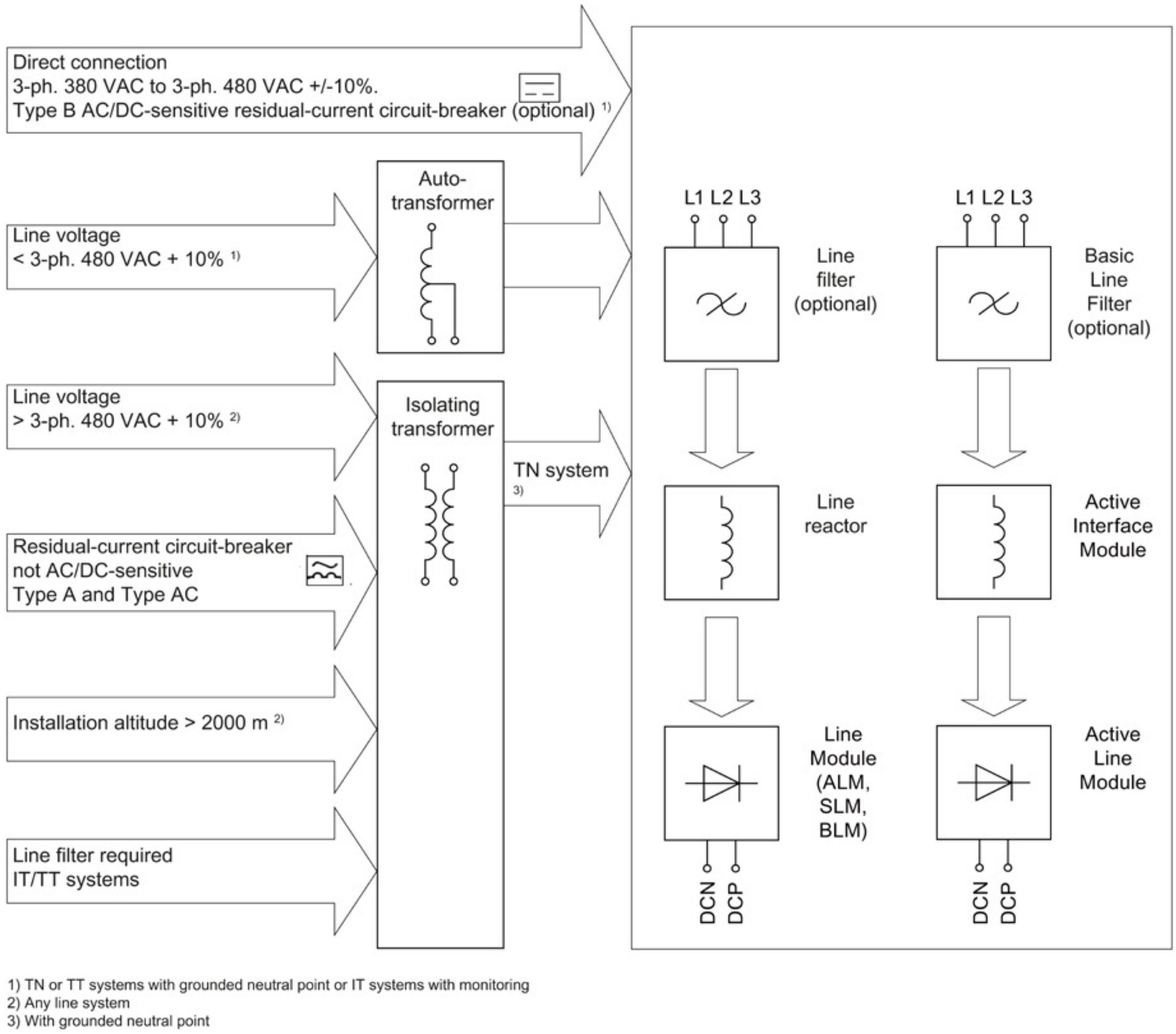


Figure 6-1 Overview of line connection versions

Note

Line connection of motors

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

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

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

6.1.2 Operation of the line connection components on the supply network

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

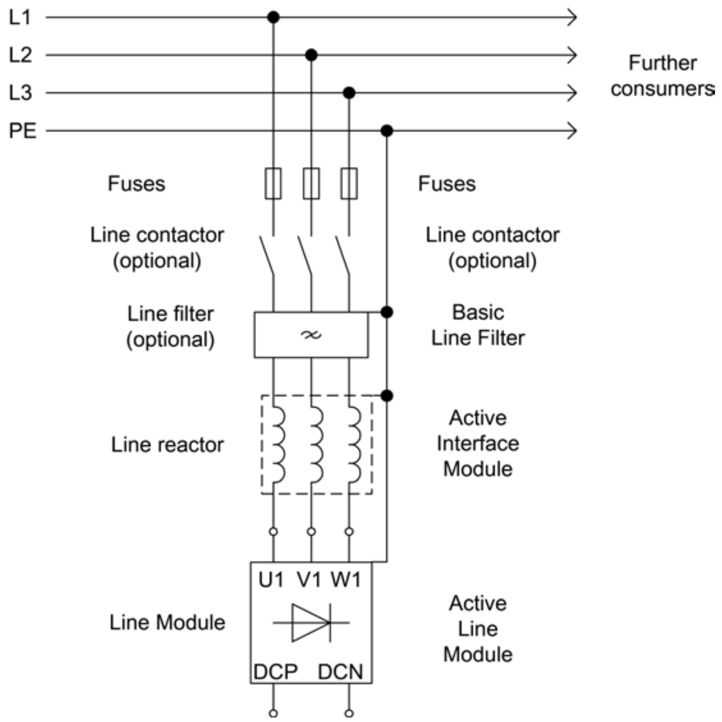


Figure 6-2 Direct operation on the line supply

6.1.3 Operating line connection components via an autotransformer

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

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

Applications:

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

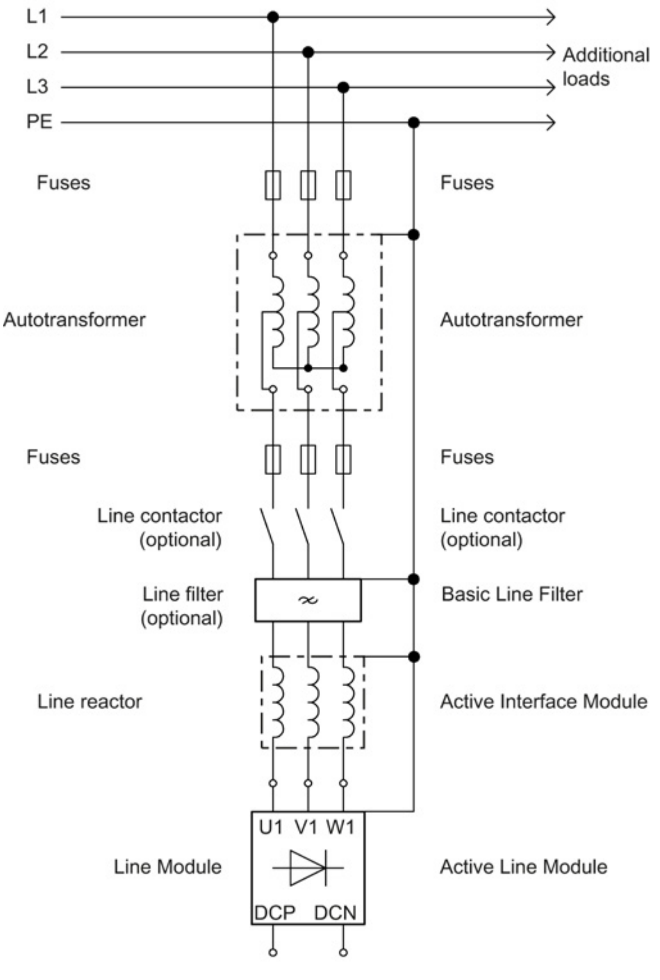


Figure 6-3 Operation of a Line Module via an autotransformer

6.1.4 Operating line connection components via an isolating transformer

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

An isolating transformer must be used in the following cases:

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

⚠DANGER
Danger to life through electric shock 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.

An isolating transformer must have the following properties:

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

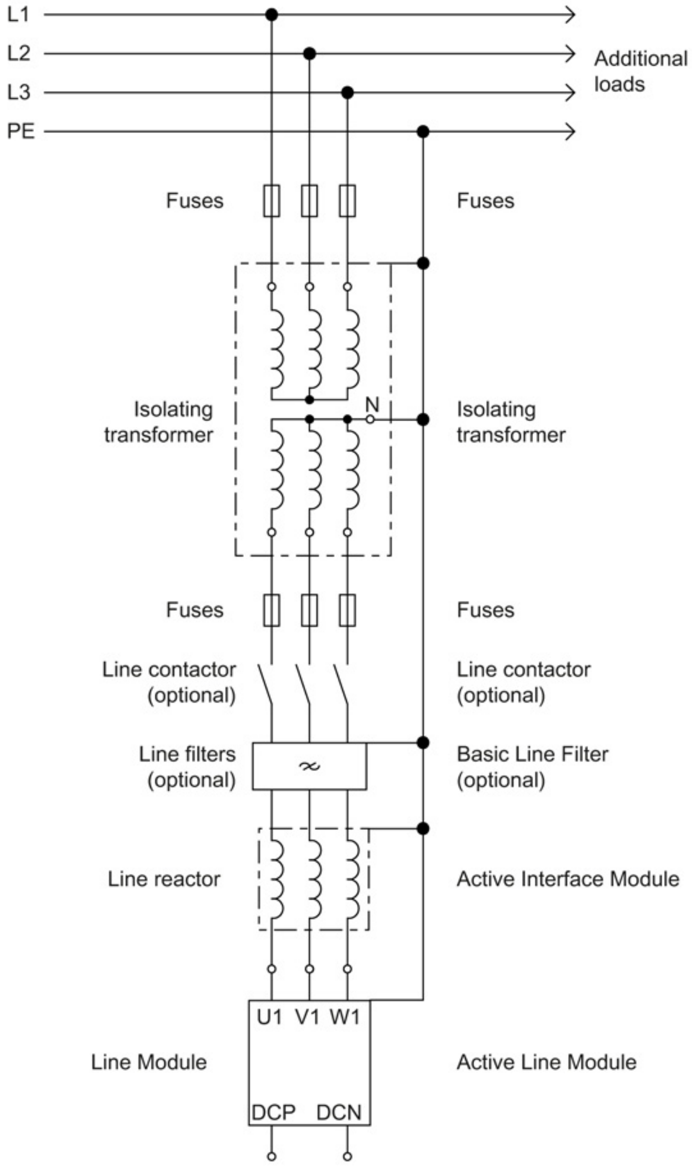


Figure 6-4 Operation of a Line Module via an isolating transformer

6.1.5 Residual-current operated circuit breakers (RCD)

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

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

Note

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

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

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

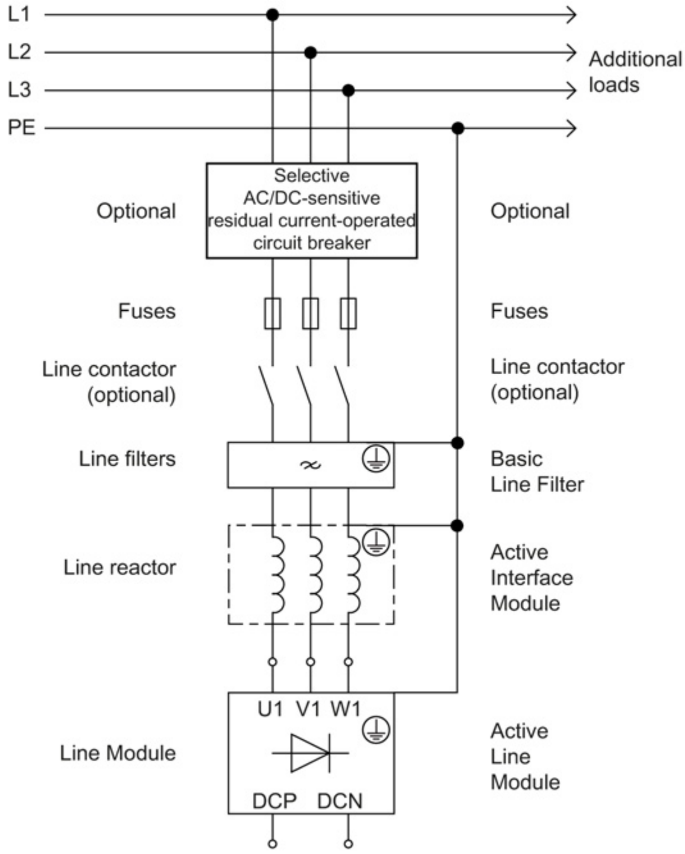


Figure 6-5 Connecting a residual-current operated circuit breaker

Recommendation

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

Note

AC or pulse-sensitive RCCBs are not suitable.

6.1.6 Residual-current monitors (RCM)

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

⚠ WARNING

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

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

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

Note the points below when using residual-current monitors:

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

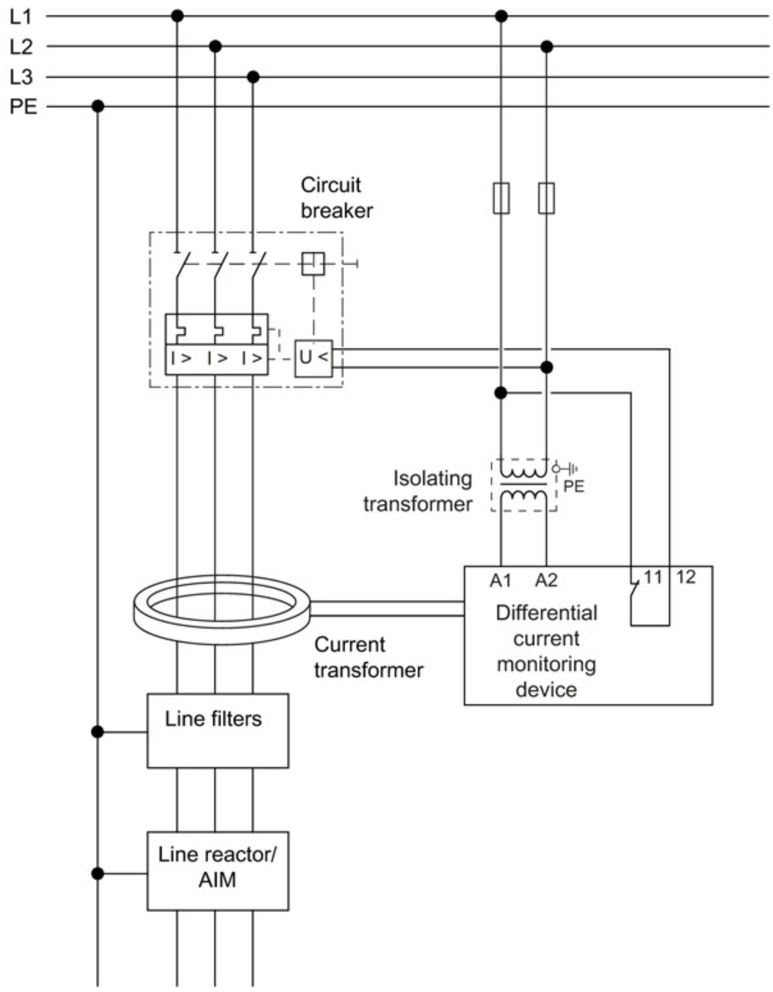


Figure 6-6 Connecting a residual-current monitor

Recommendation

- Bender AC/DC-sensitive residual-current monitor RCMA471LY, with measuring current transformer W120B (120 mm) or W210B (210 mm)
- Circuit breaker with thermal overload release, short-circuit release, and undervoltage release

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

6.2 Overcurrent protection by means of line fuses and circuit breakers

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

Table 6- 1 Recommended line fuses and circuit breakers for Active Line Modules

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

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

Table 6- 2 Recommended line fuses and circuit breakers for Smart Line Modules in booksize and booksize compact format

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

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

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

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

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

⚠ WARNING

Risk of electric shock and risk of fire due to insufficient overcurrent protection devices

In order to avoid the risk of fire or electric shock, overcurrent protection devices should be dimensioned so that, when a fault occurs, the equipment is switched off sufficiently quickly.

Measurements must be taken at the installation site to determine whether the short-circuit current is sufficient to trip the protective devices quickly enough. Not only must the loop impedance be measured and the expected short-circuit current calculated, but the time-current characteristics of the overcurrent protection devices must also be compared, using measuring instruments in accordance with EN 61557-3.

If the necessary break times are not maintained, then the next smallest overcurrent protection devices must be used. Under no circumstances may fuses with a higher rated current I_n than specified be used.

Note

The devices can be connected to supply systems of up to 480 V_{AC}, which can supply a maximum of 65 kA symmetrically ("prospective current" according to EN 60269-1).

6.3 Line Contactor Control

The line contactor is used for the electrical isolation of the drive group and the DC link from the energy supply system.

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

⚠ CAUTION

Line contactors must not be switched under load.

Note

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

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

6.3.1 Line contactor control for Line Modules without DRIVE-CLiQ interface (5 kW and 10 kW versions)

If a line contactor is required for Line Modules without DRIVE-CLiQ interface, it must be controlled and monitored using an external controller.

NOTICE
Device damage due to incorrect activation or deactivation sequence The line contactor or Line Module may be destroyed if an incorrect activation or deactivation sequence is used. • When controlling the line contactor, make sure that switching of it is largely load-free. • It is essential that you adhere to the following specifications for activation and deactivation:

Activation:

Once the line contactor has been activated and a feedback is present, the pulse enable (Enable Pulses) of the -X21:3/4 terminal can be made.

Deactivation:

Deactivation of the line contactor (LC) may only be carried out in a specific timing for the pulse enable (Enable Pulses) (-X21:3/4) and/or Ready (-X21:1) signals.

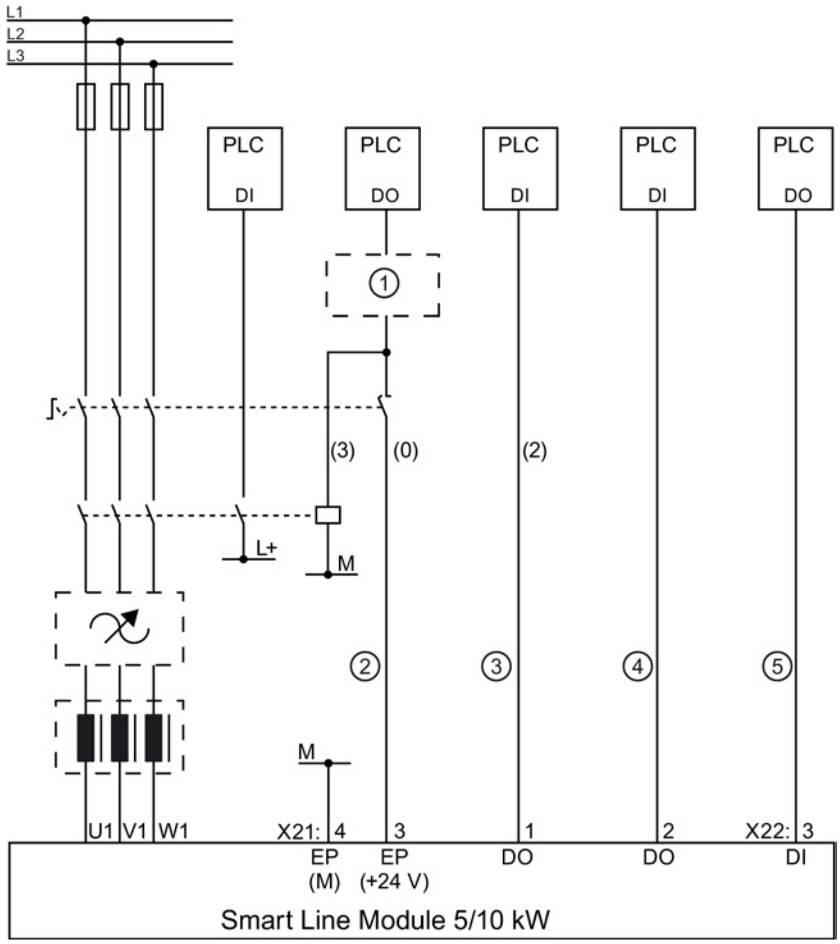
- Pulse enable (EP):

  A deactivation of the line contactor may only be made when the pulse enable (EP) signal has been removed previously (t ≥ 10 ms). The current is removed during the delay time.

- Ready:

  When the ready message leaves the SLM, the line contactor may only, if required, be deactivated after a delay time (t ≥ 10 ms). The current is removed during the delay time.

Figure 6-7 Line contactor control signal chart



① Safety control
② Pulse enable
③ Ready
④ Prewarning
⑤ Reset

The numbers in brackets (3), (0), (2) refer to the numbers in the previous graphic.

Figure 6-8 Line Contactor Control for Smart Line Module without DRIVE-CLiQ

Note

If the line contactor should also be safely disconnected (safety), the control must be integrated in an existing safety control. This is the only way to ensure the line contactor is switched in accordance with the required safety categories; see also the chapter titled Safety Integrated (Page 483).

6.3.2 Line Contactor Control for Line Modules with DRIVE-CLiQ Interface

Line Modules with DRIVE-CLiQ interface can control an external line contactor. The closing and opening of the line contactor can be monitored by evaluating the feedback contact of the line contactor. This control ensures that the line contactor always switches in a defined manner and so prevents overloading or damaging the line contactor and/or the infeed.

The line contactor can be controlled using the r0863.1 bit of the INFEED drive object (for 840D sl and 16 kW to 120 kW Line Module).

Note

For further information about the line contactor, refer to the device manuals.

Note

If the line contactor should also be safely disconnected (safety), the control must be integrated in an existing safety control. This is required so that the line contactor is switched in accordance with the required safety categories. See also Section Safety Integrated (Page 483).

6.3.3 Line Contactor Control Commissioning using an Example

Assumption:

- Line contactor control uses a digital output of the Control Unit (DI/DO 14)
- Line contactor feedback uses a digital input of the Control Unit (DI/DO 7)
- Line contactor switching time is less than 100 ms

Note

The parameter assignment for interface X132 at pins 4 and 12 must be changed using the "SINUMERIK Operate" drive commissioning wizard.

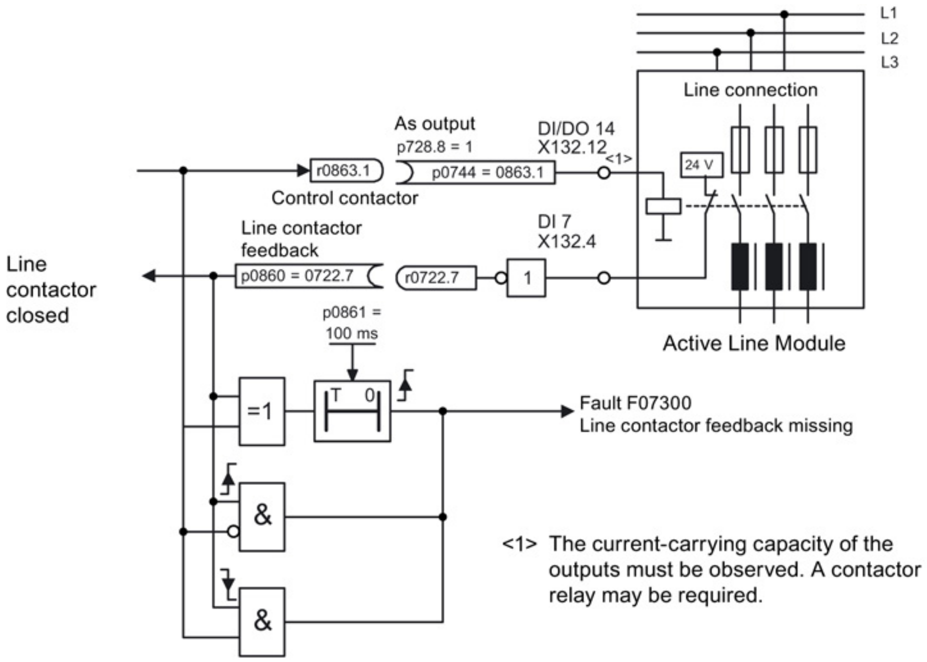


Figure 6-9 Line Contactor Control

Commissioning steps:

Note

If the current carrying capacity of the digital output may be exceeded, an auxiliary contactor must be used (refer to the Booksize Power Units Equipment Manual).

---

1. Connect control contact of the line contactor to DI/DO 14.
2. Parameterize DI/DO 14 as output (p0728.14 = 1).
3. Interconnect (BI: p0744 = r0863.1 of NCU) DI/DO 14 with "control contactor" signal (r0863.1 of infeed).
4. Connect the feedback contact of the line contactor to DI 7.
5. Interconnect (BI: p0860 = r0722.7) p0860 with inverted input signal (p0722.7).
6. Enter the monitoring time of the line contactor (p0861 = 100 ms).

Function diagram overview

- 8934 missing enables, line contactor control

Parameter overview

- r0863.1 CO/BO: Drive coupling status word/control word
- p0860 BI: Line contactor feedback

References

/LH1/SINAMICS S120/S150 List Manual

6.4 Line filters

6.4.1 Safety instructions for line filters

Note

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

⚠CAUTION

Risk of burns due to high surface temperatures

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

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

NOTICE

Line filter damage by connecting to impermissible line supplies

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

NOTICE

Line filter damage due to interchanged connections

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

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

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

⚠WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

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

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

NOTICE

Using an incorrect line filter

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

NOTICE

Damage or destruction of additional loads as a result of undesirable line harmonics

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

NOTICE

Damage or destruction of additional loads by connecting after the line filter

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

Note

Disconnect the line filter for a high-voltage test

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

6.4.2 Overview of line filters

Used in conjunction with line reactors and a consistent EMC-compliant system configuration, line filters limit the conducted electromagnetic emissions generated by the Line Modules to limit values that conform to EN 61800-3. For the SINAMICS S120 drive line-up, a separate line filter must be used on the basis of the table below.

Note

Avoid mutual interference of multiple line filters

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

Note

According to product standard EN 61800-3, RFI suppression commensurate with the relevant rated conditions must be provided and is a legal requirement in the EU (EMC Directive). Line filters and line reactors are required in order to comply with this standard. The use of filters of other makes can lead to limit value violations, resonances, overvoltages, and irreparable damage to motors or other equipment. The machine manufacturer must provide verification that the machinery to be operated with the drive products and the installed suppression elements, e.g. line filters, are CE/EMC-compliant before the machines are approved for delivery.

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

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

Table 6- 3 Overview of line filters

	Order number
Basic Line Filter for Active Line Modules with line reactor	
16 kW	6SL3000-0BE21-6DAx
36 kW	6SL3000-0BE23-6DA1
55 kW	6SL3000-0BE25-5DAx
Basic Line Filter for Active Line Modules with Active Interface Modules	
16 kW	6SL3000-0BE21-6DAx
36 kW	6SL3000-0BE23-6DA1
55 kW	6SL3000-0BE25-5DAx
80 kW	6SL3000-0BE28-0DAx
120 kW	6SL3000-0BE31-2DAx

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

6.4.3 Wideband Filter for Active Line Modules

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

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

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

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

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

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Note

Further information

For more detailed information on Wideband Line Filters, refer to the SINAMICS S120 Booksize Power Units Equipment Manual.

6.4.4 Basic Line Filters for Active Line Modules

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

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

Basic Line Filter for Active Line Modules and line reactor

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

Basic Line Filters for Active Line Modules and Active Interface Module

- EN 61800-3 category C2 up to a total cable length [1)] of 350 m (shielded) for 16 kW, 36 kW, 55 kW, 80 kW, and 120 kW components
- EN 61800-3, category C3, up to a total cable length [1)] of
  – 630 m (shielded) for 16 kW and 36 kW components
  – 1000 m (shielded) for 55 kW, 80 kW and 120 kW components.

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

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

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

---

Note

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

Note

Further information

For more detailed information on Basic Line Filters, refer to the SINAMICS S120 Booksize Power Units Equipment Manual.

6.4.5 Basic Line Filter for Smart Line Modules

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

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

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

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

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

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Note

Further information

For more detailed information on Basic Line Filters, refer to the SINAMICS S120 Booksize Power Units Equipment Manual.

6.5 Active Interface Module (AIM)

6.5.1 Description

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

They contain the following functional units:

- Line reactor
- Low-frequency/switching frequency filters
- Line filter to EN61800-3, category C3, max. total motor cable length 350 m (shielded)
- Reduction of the stress on the motor insulation from system-dependent resonance factors

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

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

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

6.5.2 Safety instructions for Active Interface Modules

Note

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

NOTICE

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

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

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

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

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

With firmware version SINAMICS V2.5, the default setting in STARTER/SCOUT is "Wideband Line Filter". Parameter p0220 must be changed to "AIM".
Operation with a SINAMICS firmware less than V2.5 is not permitted.

NOTICE

Destruction of the Active Interface Module through incorrect/missing wiring

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

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

⚠ CAUTION

Risk of burns due to high surface temperatures

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

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

WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

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

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

NOTICE

Permitted mounting position

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

NOTICE

Connection cables

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

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

6.5.3 Interface description

6.5.3.1 Overview

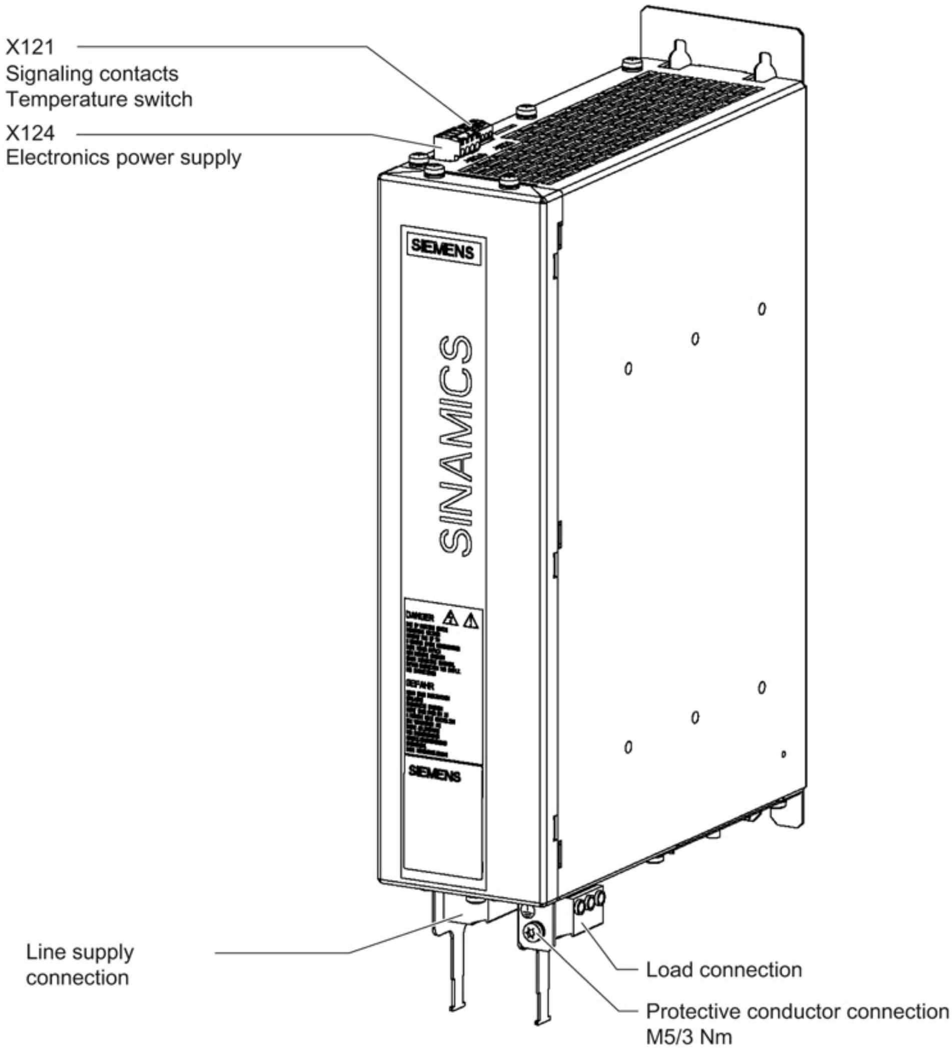


Figure 6-10 Interface overview, Active Interface Module 16 kW

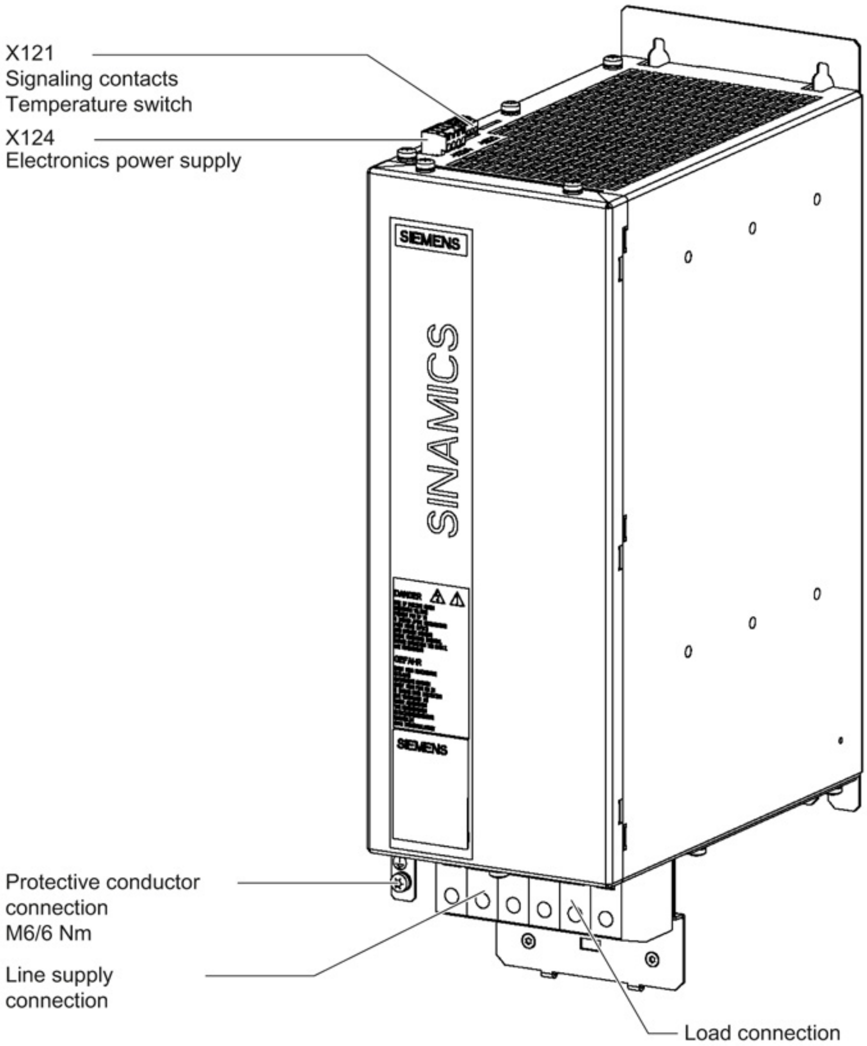


Figure 6-11 Interface overview, Active Interface Module 36 kW

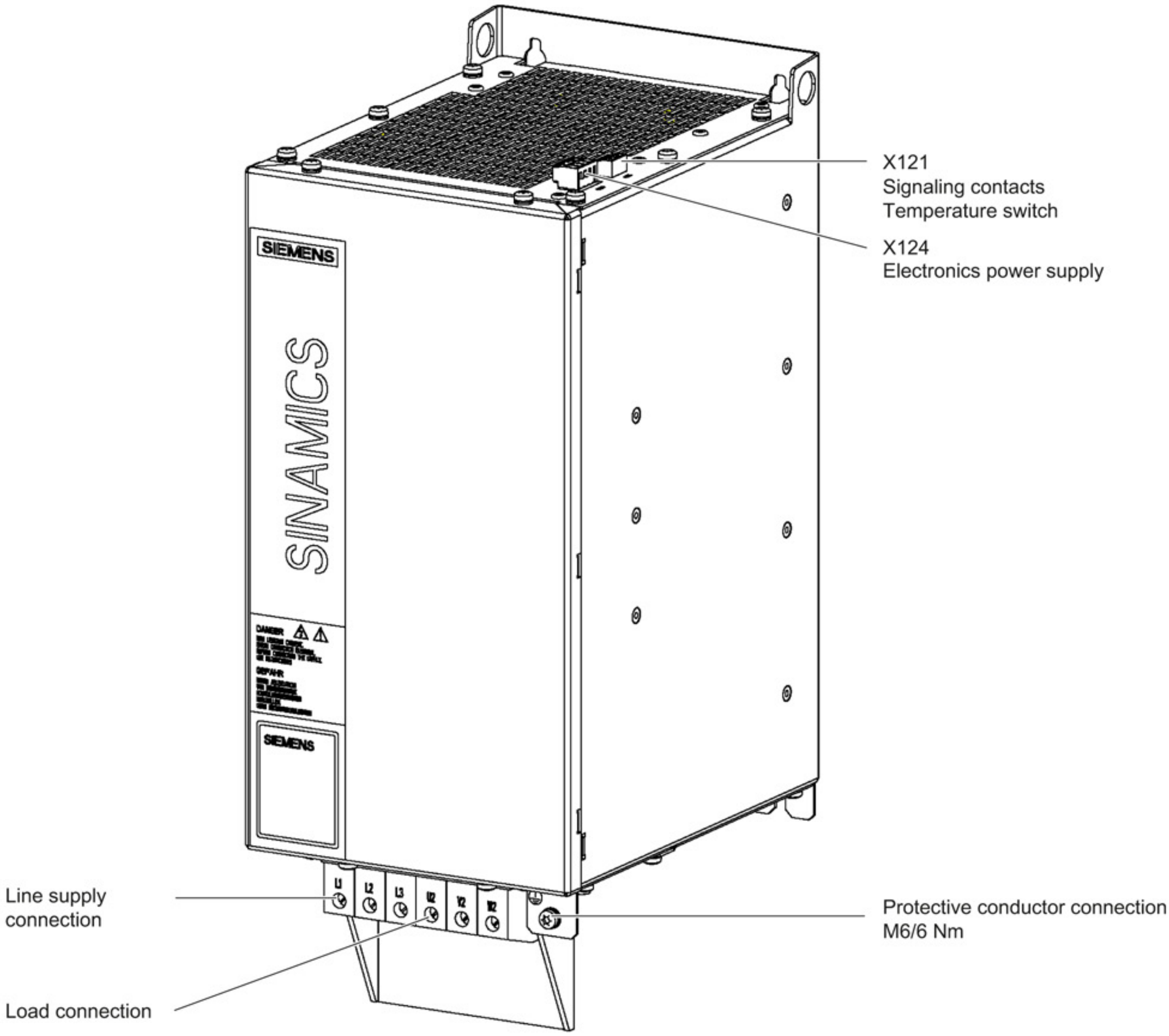


Figure 6-12 Interface overview, Active Interface Module 55 kW

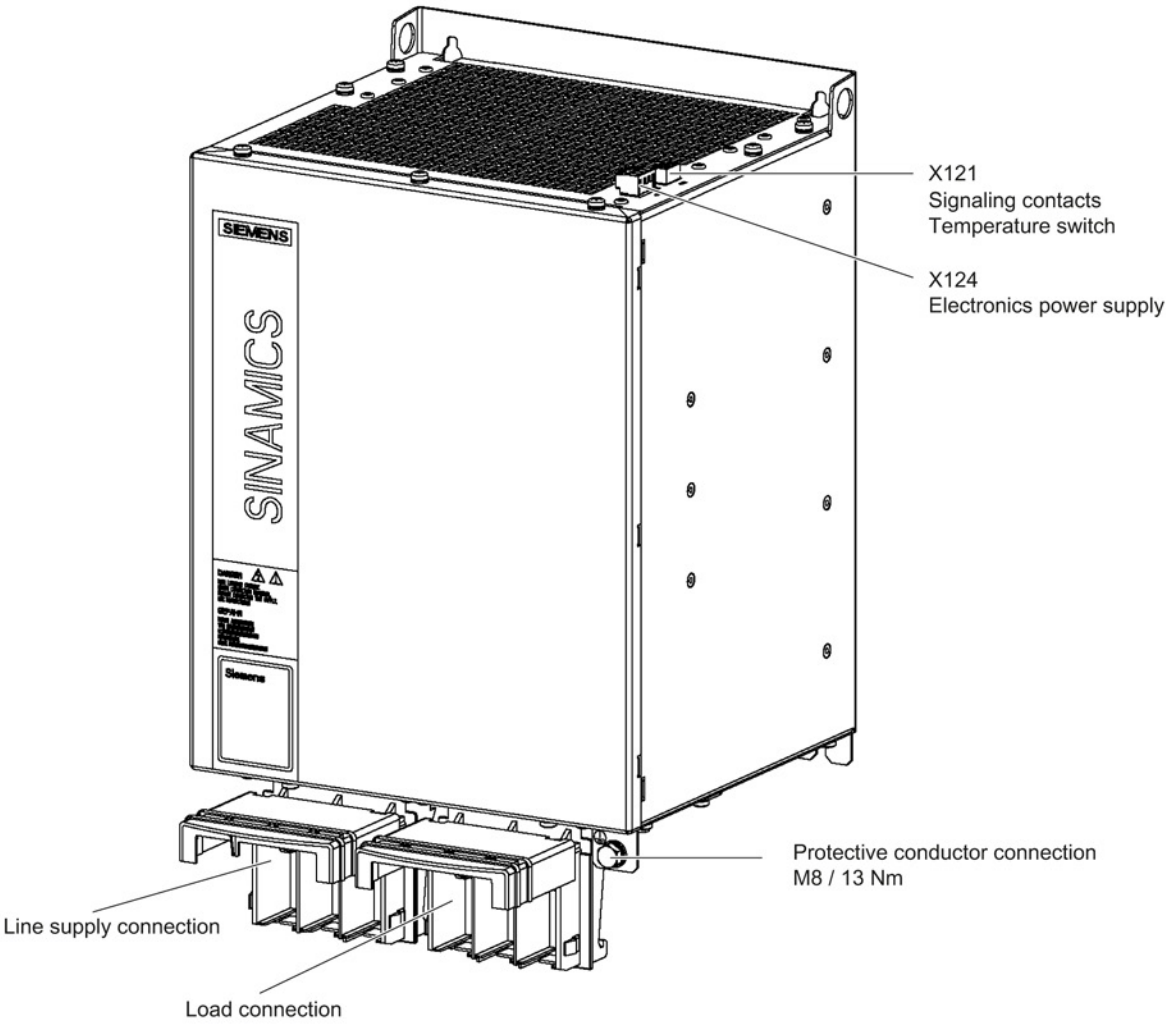


Figure 6-13 Interface overview, Active Interface Module 80 kW and 120 kW

6.5.3.2 Line/load connection

Table 6- 4 Line and load connection Active Interface Module

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

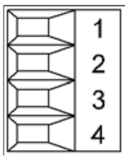
1) For ring cable lugs in accordance with DIN 46234

Note

The connection terminals of the 36 kW and 55 kW Active Interface Modules are only certain to be safe from touch protection according to EN 60529 if cables with a minimum cross-section of 25 mm² and insulated end sleeve are used.

6.5.3.3 X121 temperature sensor and fan control

Table 6- 5 Plug-in screw terminal X121

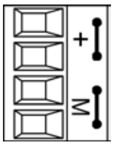
	Terminal	Designation	Technical specifications
	1	+Temp	Output temperature switch Must be connected to X21 of the Active Line Module
	2	-Temp	Temperature switch output
	3	+24 V power supply for digital inputs	Current carrying capacity: 500 mA
	4	Disable Fan	**The fan can be disabled. The fan may only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

Note

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

6.5.3.4 Electronics power supply X124

Table 6- 6 Terminal block X124

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

Note

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

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

6.5.4.1 IT systems

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

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

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

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

Note

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

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

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

⚠ DANGER

De-energize the device before removing the connection bracket

The connecting bracket may only be removed in the de-energized state.
Risk of electric shock. A hazardous voltage is still present for up to five minutes after the power supply has been switched off.

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

6.5.5 Connection example

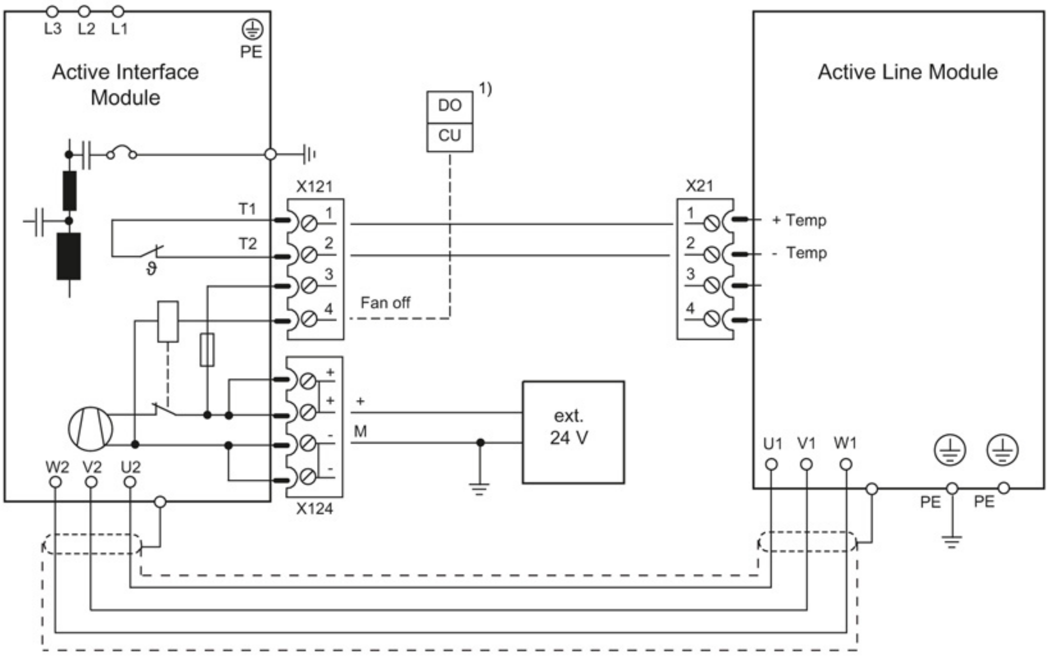


Figure 6-14 Connection example: Active Interface Module

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

6.5.6 Technical data

Table 6- 7 Technical data

Active Interface Module	**6SL3100-**	**0BE21-6ABx**	**0BE23-6ABx**	**0BE25-5ABx**	**0BE28-0ABx**	**0BE31-2ABx**
		16 kW	**36 kW**	**55 kW**	**80 kW**	**120 kW**
P_{max}	kW	35	70	110	131	175
I_{rated}	A	27	60	88	132	200
I_{max}	A	59	117	176	218	292
Current requirements of the 24 VDC electronics power supply	A	0.25	0.49	0.6	1.2	1.2
Line voltage	V	380 V to 480 V 3 AC ±10%				
Line frequency	Hz	47 - 63				
Cooling air requirement	m^3/h	112	160	300	600	600
Power loss [1)]	W	270	340	380	490	585
Weight	kg	10.7	18.5	21	29	35.5
Connection cross-section	mm^2	10	35	50	120	120
PE connecting studs		M5	M5	M6	M8	M8

[1)] Based on $V_{DC\ link}$ 600 V; for an overview, see the power loss tables in Appendix A.3

6.6 Line reactors

6.6.1 Safety instructions for line reactors

Note

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

WARNING

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

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

- Connect a damping resistor to the HFD line reactor.

CAUTION

Risk of burns due to high surface temperatures

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

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

NOTICE

Damage or destruction of components

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

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

Note

Malfunctions through magnetic fields

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

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

Note

Keep the connection cables as short as possible

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

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

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

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

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

6.6.2 HFD line reactors for Active Line Module

6.6.2.1 Description

HFD line reactors are used in older systems for connecting regulated infeed/regenerative feedback components (Active Line Modules) to the network.

They perform the following functions:

- Limiting of low-frequency line reactions
- Energy store for the step-up operation of the infeed units
- Current limiting for line supply oscillations
- Together with a damping resistor, the HFD line reactors as an HFD package dampen the system oscillations of the converter system.

The HFD line reactor should be mounted as close as possible to the line supply infeed component.

Note

In newer systems, Active Interface Modules are usually used in place of HFD packages (see the chapter titled Active Interface Module (AIM) (Page 129)

6.6.2.2 Interface description

Overview

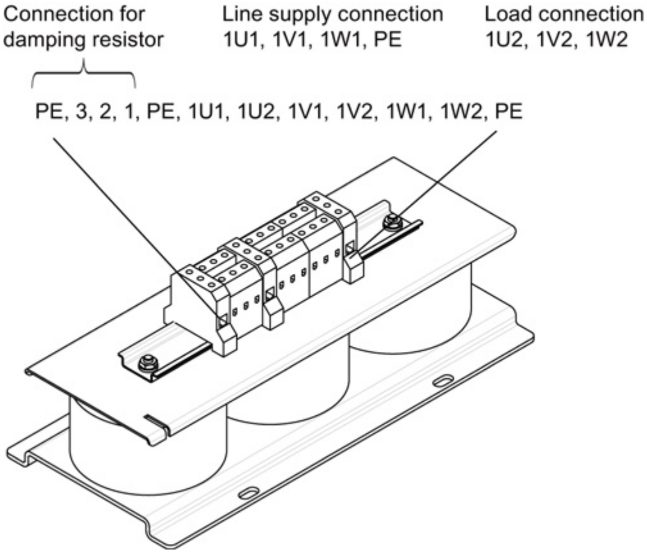


Figure 6-15 HFD line reactor 16 kW

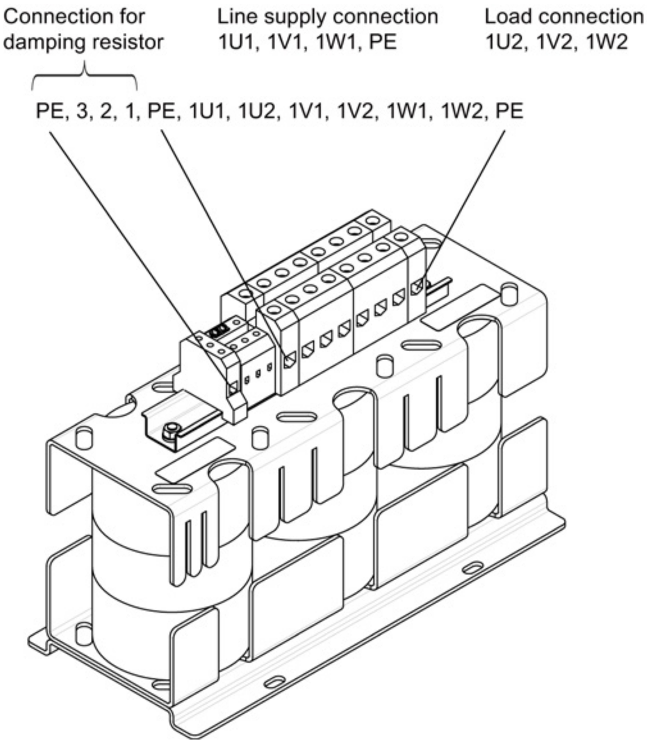


Figure 6-16 HFD line reactor 36 kW

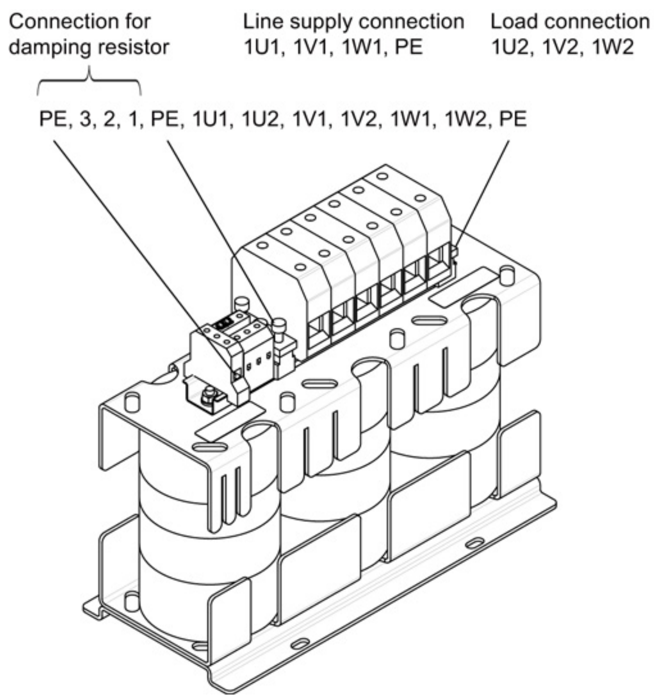


Figure 6-17 HFD line reactor 55 kW

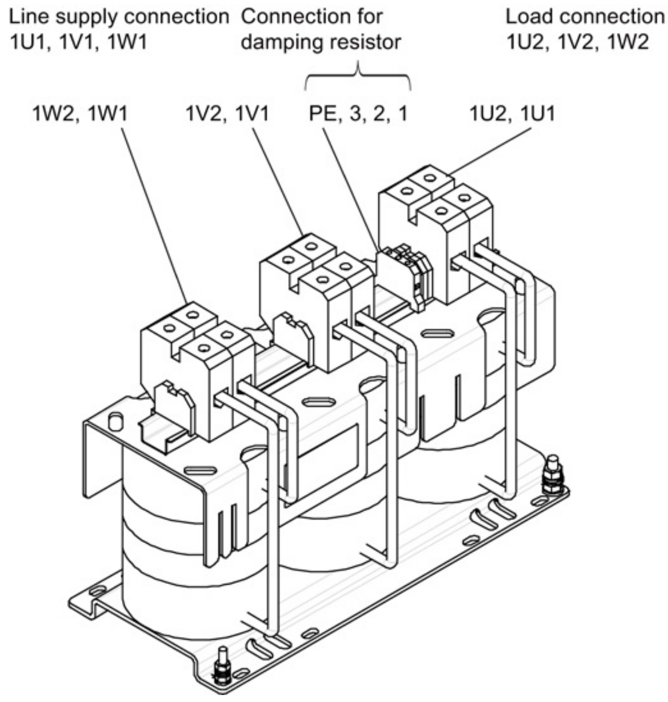


Figure 6-18 HFD line reactor 80 kW

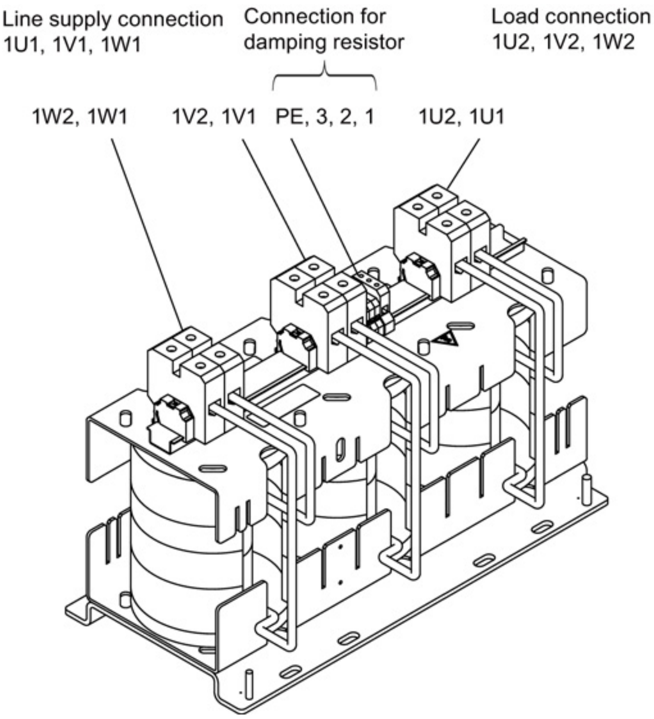
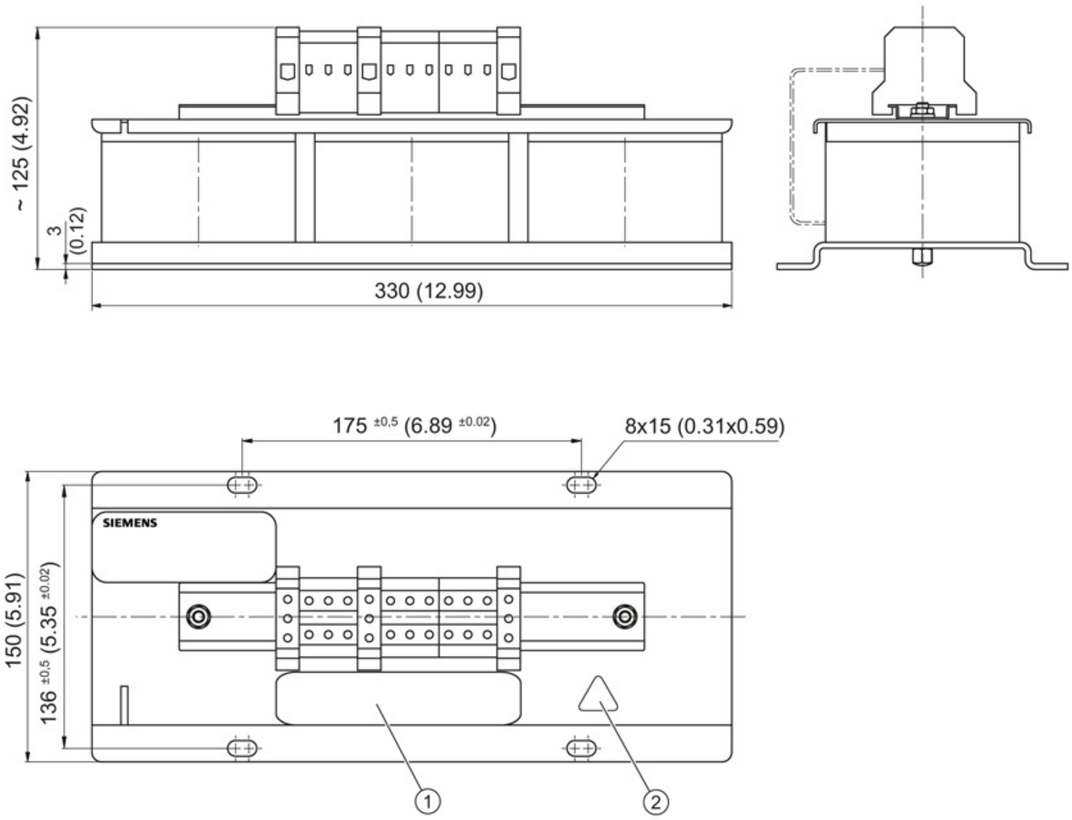


Figure 6-19 HFD line reactor 120 kW

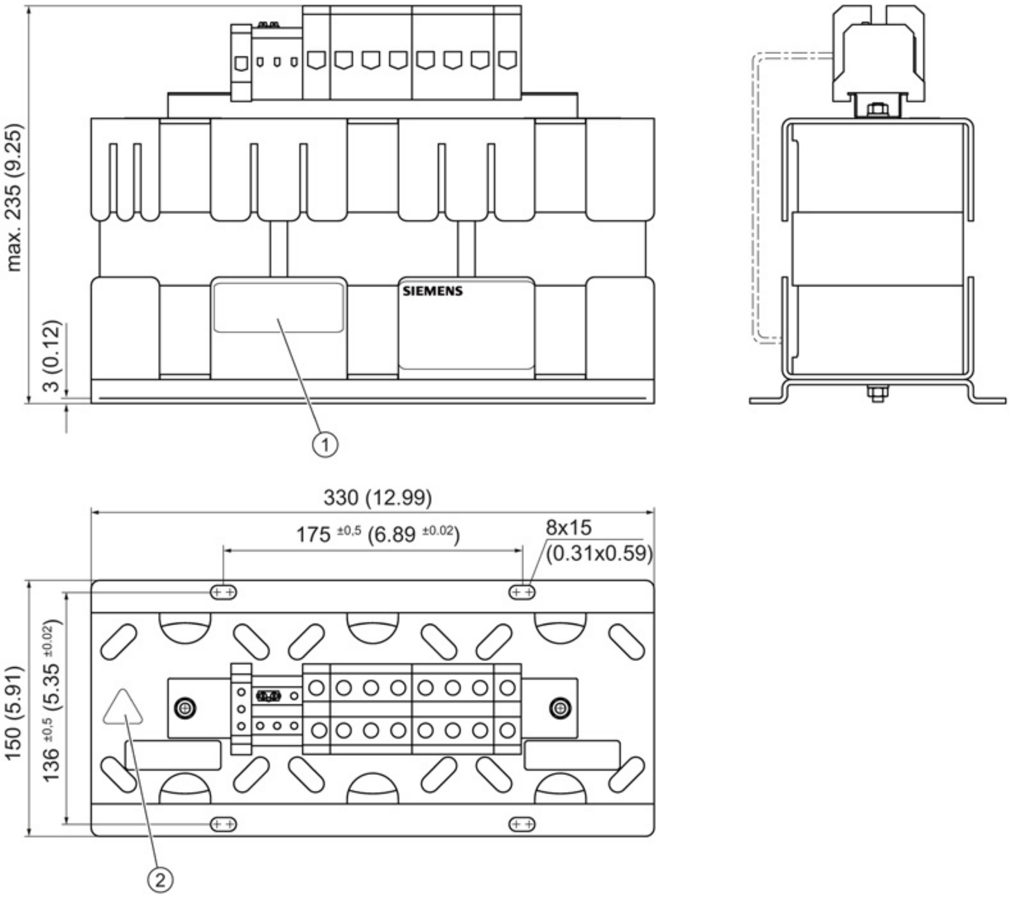
6.6.2.3 Dimension drawings



① Terminal arrangement

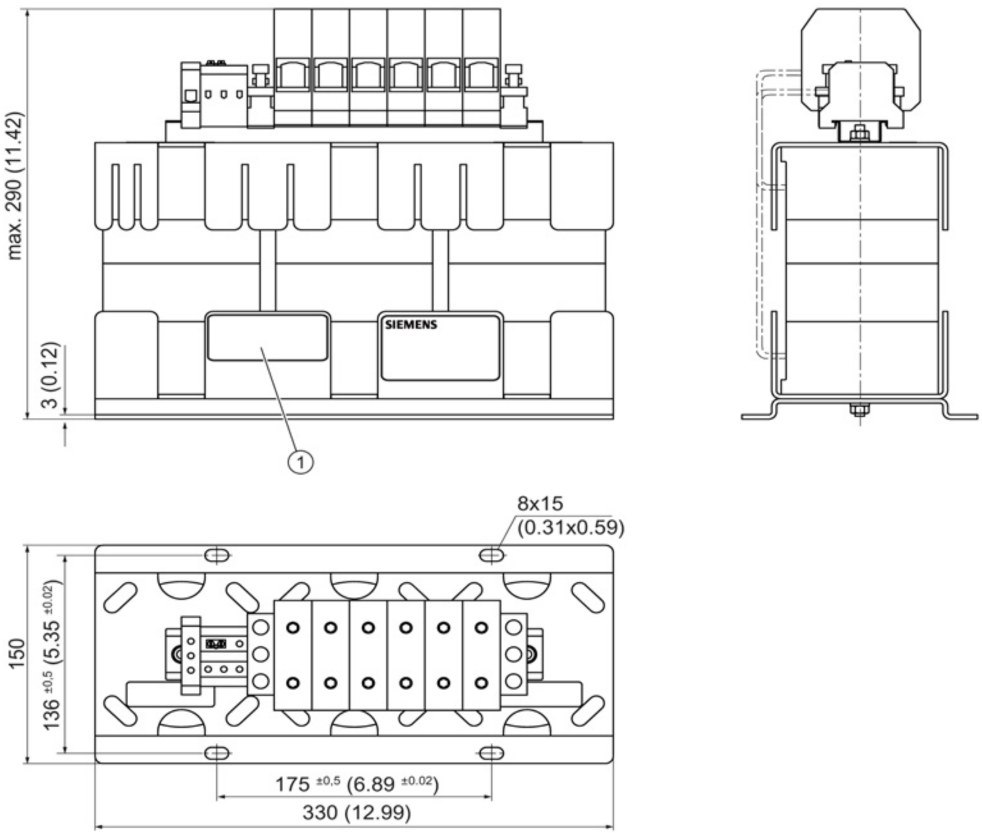
② Warning label

Figure 6-20 Dimension drawing of HFD line reactor 16 kW, all dimensions in mm and (inches)



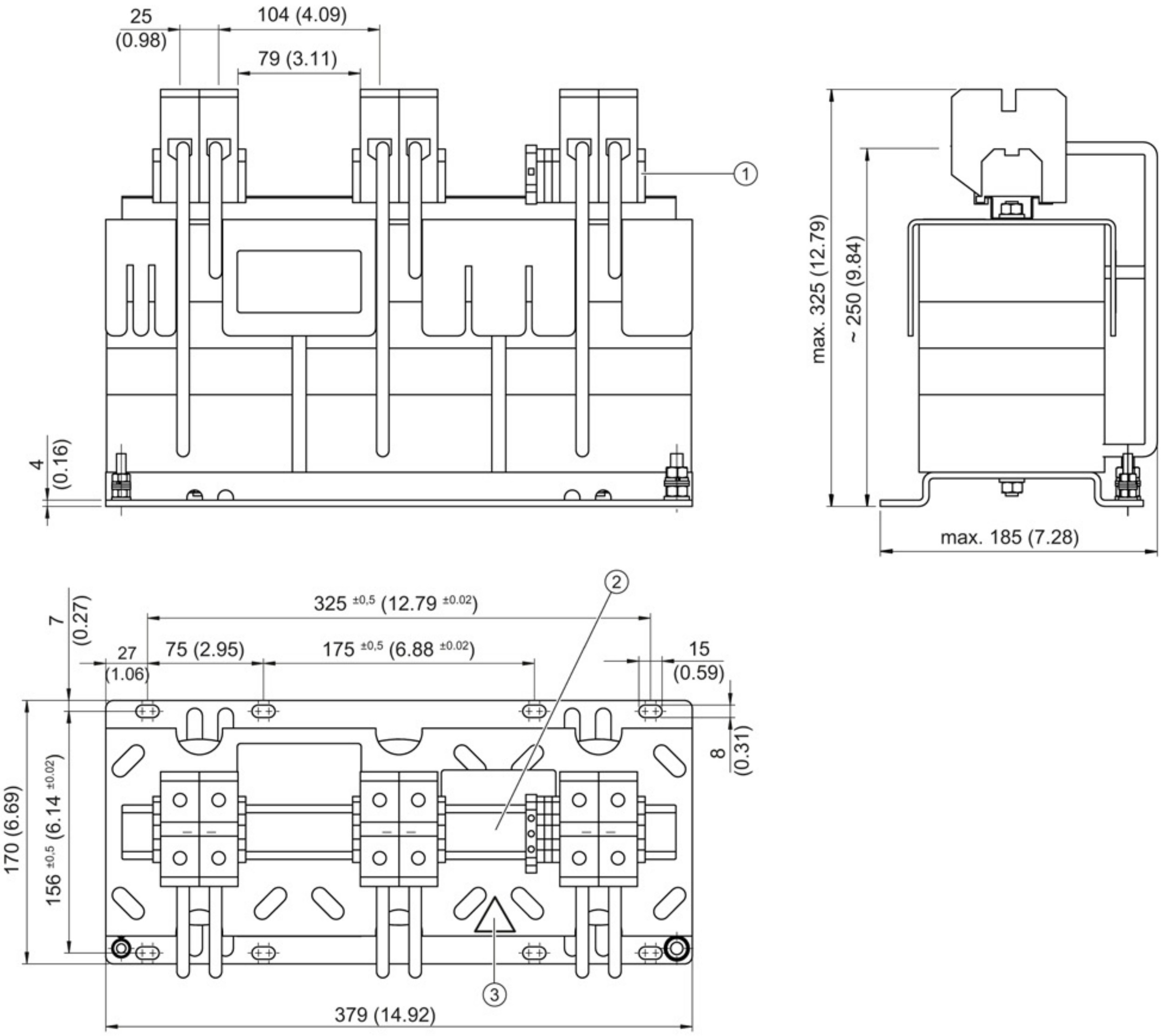
① Terminal arrangement
② Warning label

Figure 6-21 Dimension drawing of HFD line reactor 36 kW, all dimensions in mm and (inches)



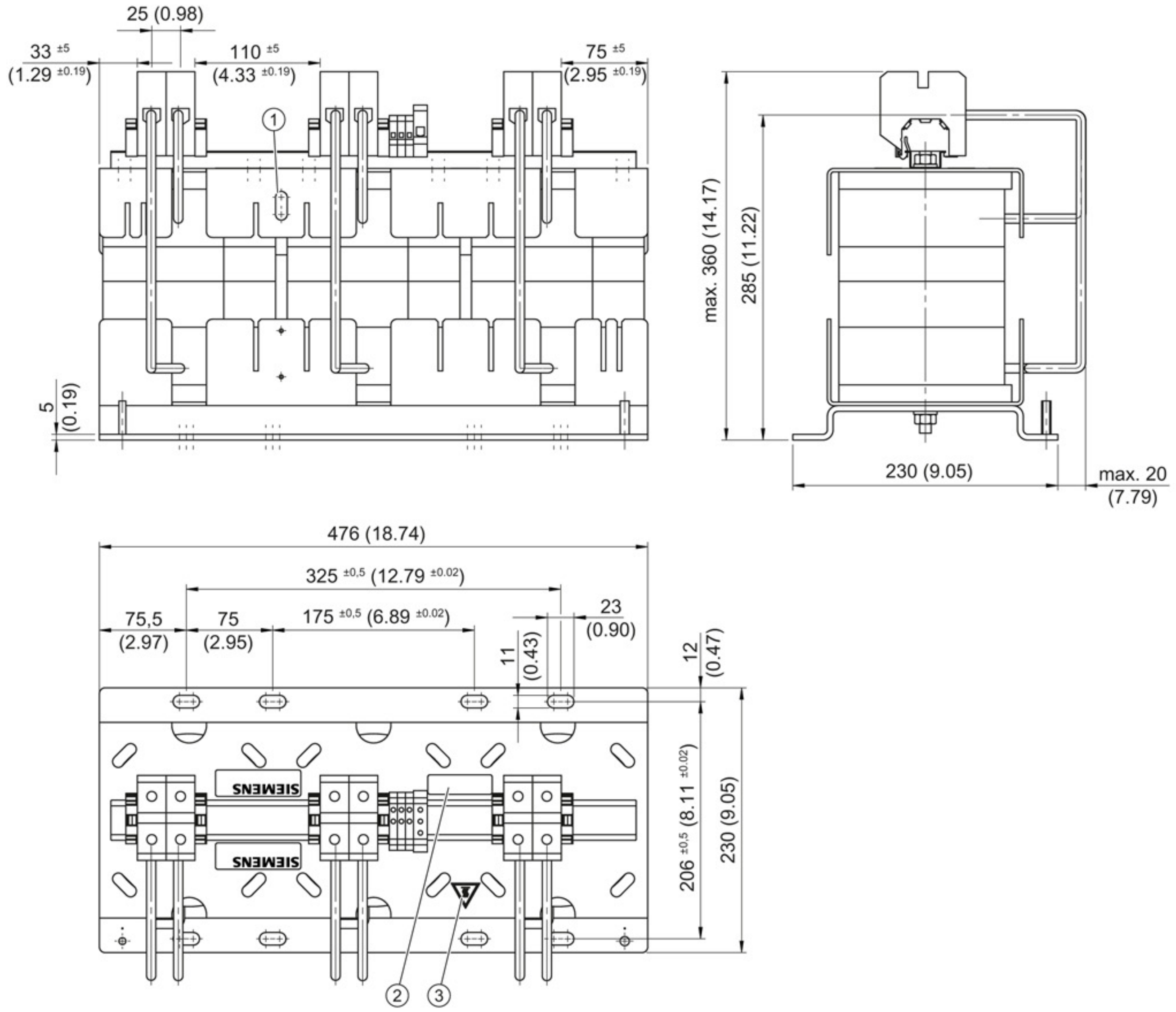
① Terminal arrangement

Figure 6-22 Dimension drawing of HFD line reactor 55 kW, all dimensions in mm and (inches)



① End retainers
② Terminal arrangement
③ Warning label

Figure 6-23 Dimension drawing of HFD line reactor 80 kW, all dimensions in mm and (inches)



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

Figure 6-24 Dimension drawing of HFD line reactor 120 kW, all dimensions in mm and (inches)

6.6.2.4 Technical data

Table 6- 8 Technical data for HFD line reactors

<table>
<tr><th></th><th>Unit</th><th>6SL3000–0DE21-6AAx</th><th>6SL3000–0DE23-6AAx</th><th>6SL3000–0DE25-5AAx</th><th>6SL3000–0DE28-0AAx</th><th>6SL3000-0DE31-2AAx</th></tr>
<tr><td>Power</td><td>kW</td><td>16</td><td>36</td><td>55</td><td>80</td><td>120</td></tr>
<tr><td>Rated current</td><td>A_{rms}</td><td>30</td><td>67</td><td>103</td><td>150</td><td>225</td></tr>
<tr><td>Power loss[1)]</td><td>W</td><td>170</td><td>250</td><td>350</td><td>450</td><td>590</td></tr>
<tr><td>Line connection
1U1, 1V1, 1W1</td><td></td><td rowspan="2">Screw terminal
16 mm^2/1.2 Nm</td><td rowspan="2">Screw terminal
35 mm^2/2.5 Nm</td><td rowspan="2">Screw terminal
70 mm^2/7 Nm</td><td rowspan="2" colspan="2">Power cage clamps 95 mm^2/self-locking [2)]</td></tr>
<tr><td>Load connection
1U2, 1V2, 1W2</td><td></td></tr>
<tr><td>PE connection</td><td></td><td>Screw terminal
16 mm^2/1.2 Nm</td><td>Screw terminal
35 mm^2/2.5 Nm</td><td>Screw terminal
70 mm^2/3.5 Nm</td><td colspan="2">PE connecting lug M10/25 Nm for ring cable lugs according to DIN 46234 [3)]</td></tr>
<tr><td>Damping-resistor connection
1, 2, 3 PE</td><td></td><td colspan="5">Screw terminal max. 1.5 mm^2/1.2 Nm</td></tr>
<tr><td>Weight</td><td>kg</td><td>9</td><td>21</td><td>27</td><td>37</td><td>67</td></tr>
<tr><td>Mounting position</td><td></td><td colspan="5">Any</td></tr>
</table>

1) For specifications concerning rated operation/for an overview, see the power loss tables in the Appendix

2) See Appendix "Spring-loaded terminals"

3) No touch protection (IP00B acc. to EN 60529)

Note

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

6.6.3 Line reactors for Smart Line Modules

6.6.3.1 Interface description

Overview

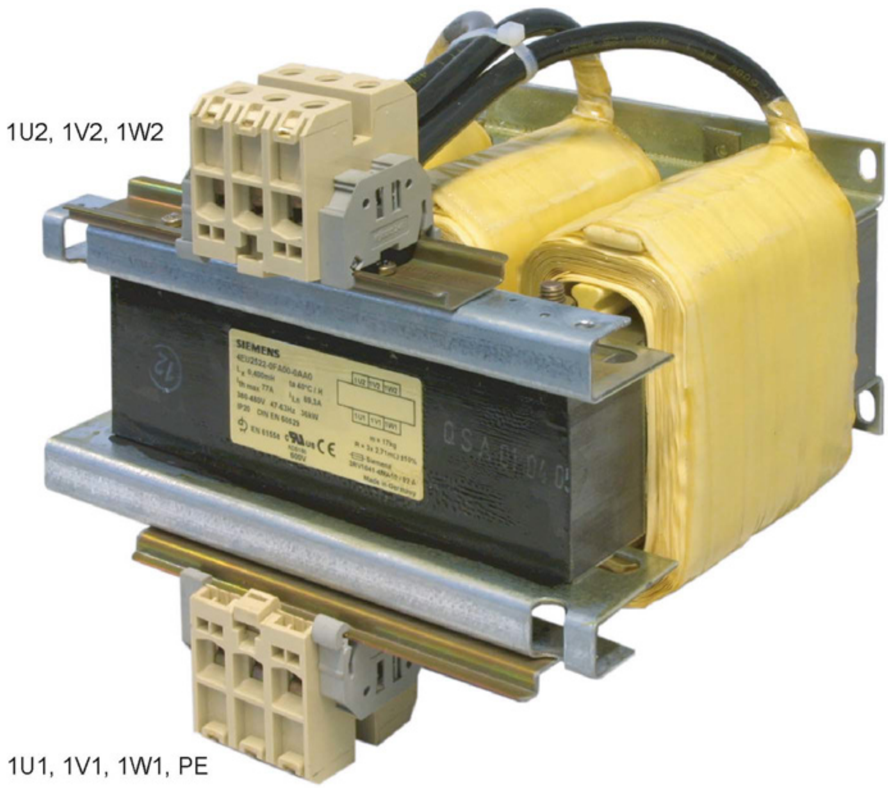


Figure 6-25 Interface overview, line reactors for Smart Line Modules (example: 36 kW)

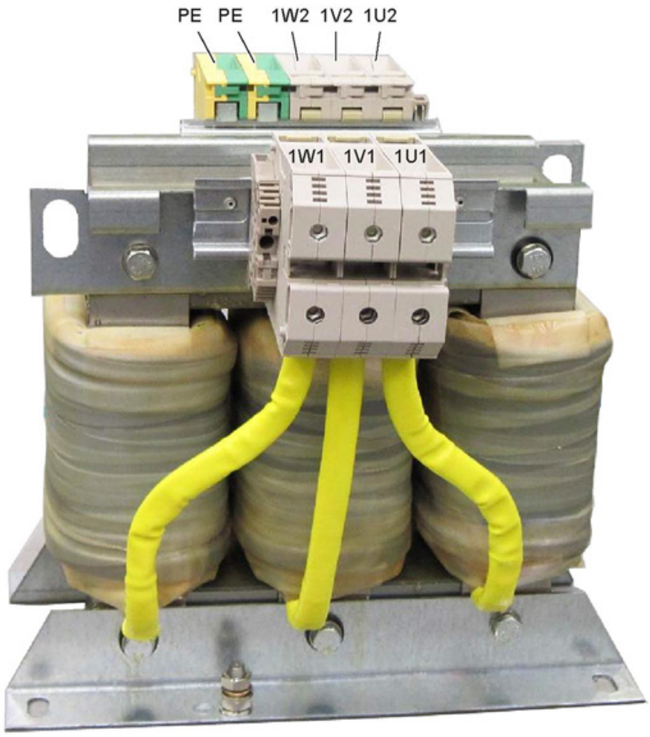


Figure 6-26 Interface overview, line reactors for Smart Line Modules (example: 55 kW)

Line/load connection

Table 6- 9 Line and load connection line reactors for Smart Line Modules

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

1) For ring cable lug in accordance with DIN 46234

6.6.3.2 Dimension drawings

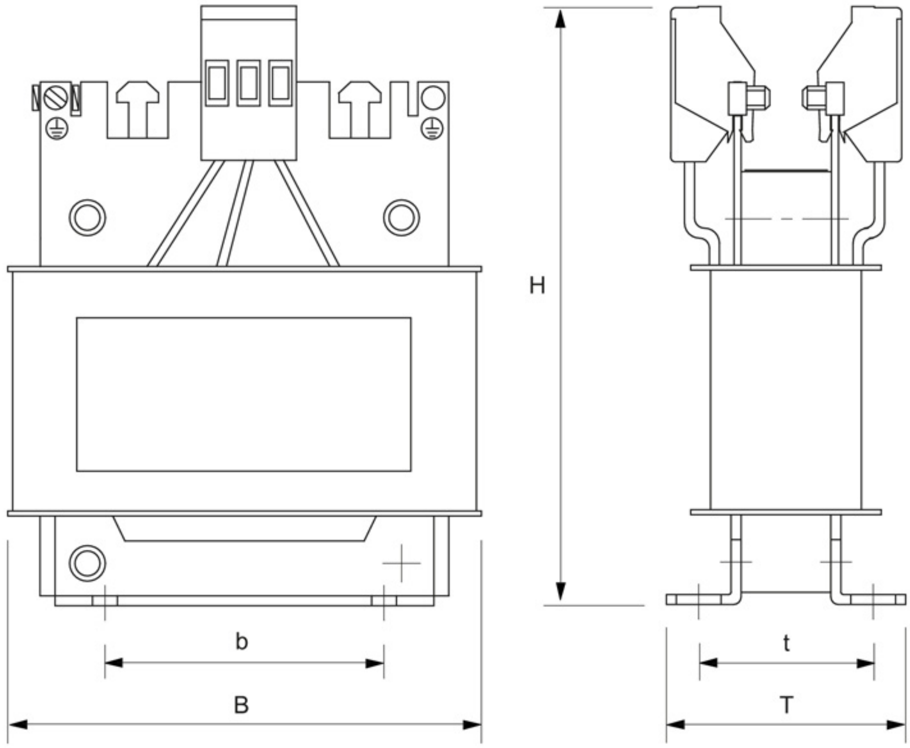


Figure 6-27 Dimension drawing of line reactor for Smart Line Modules (5 kW and 10 kW)

Table 6- 10 Dimensions of line reactors for Smart Line Modules (5 kW and 10 kW)

	Order number 6SL3000-	B [mm] (inches)	b [mm] 1) (inches)	H [mm] (inches)	D [mm] (inches)	t [mm] 1) (inches)
5 kW	0CE-15-0AAx	150 (5.91)	113 (4.53)	175 (6.89)	66.5 (2.62)	49.5 (1.95)
10 kW	0CE-21-0AAx	177 (6.97)	136 (5.35)	196 (7.72)	86 (3.39)	67 (2.64)

1) The lengths b and t correspond to the hole spacing

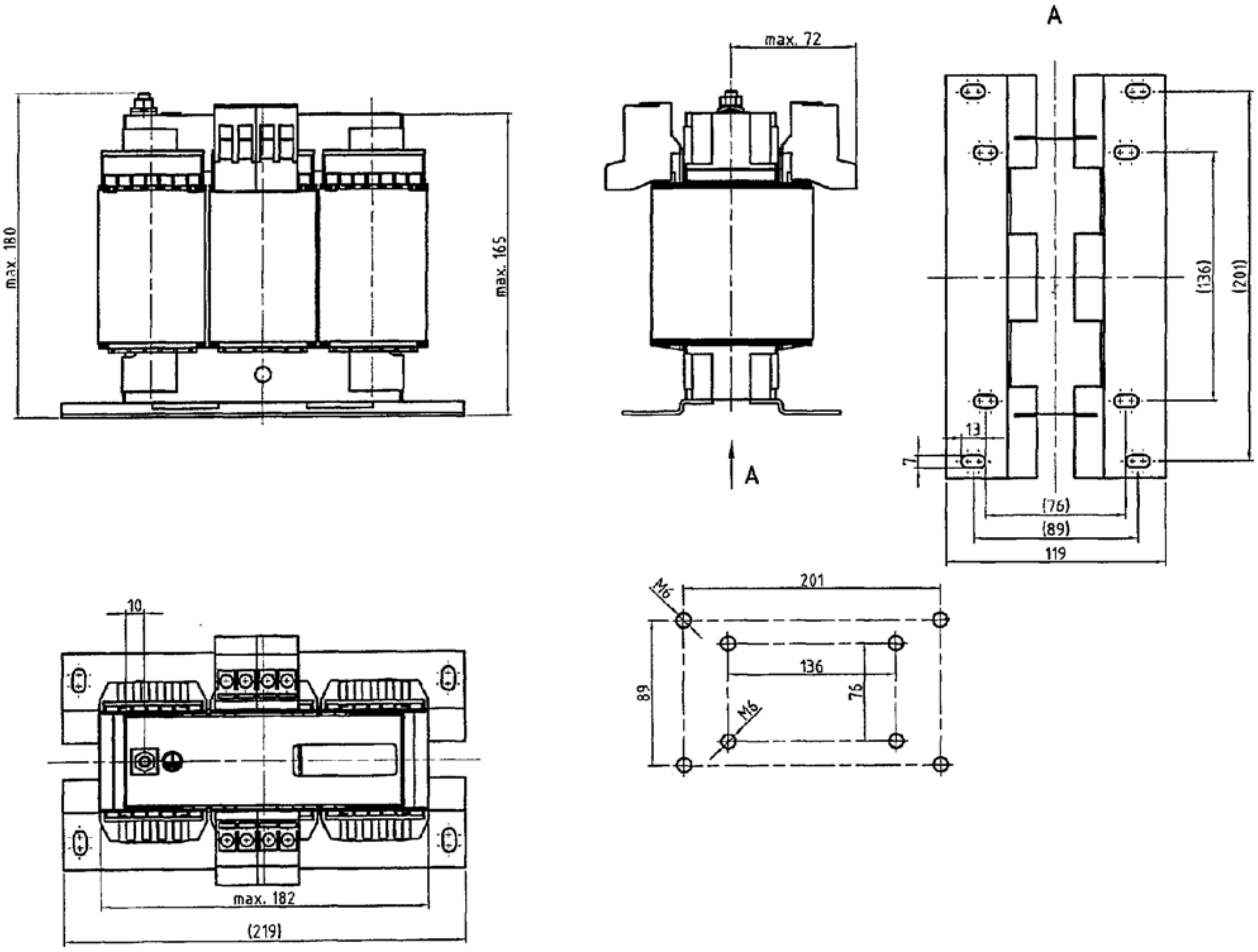


Figure 6-28 Dimension drawing of line reactor for Smart Line Module 16 kW

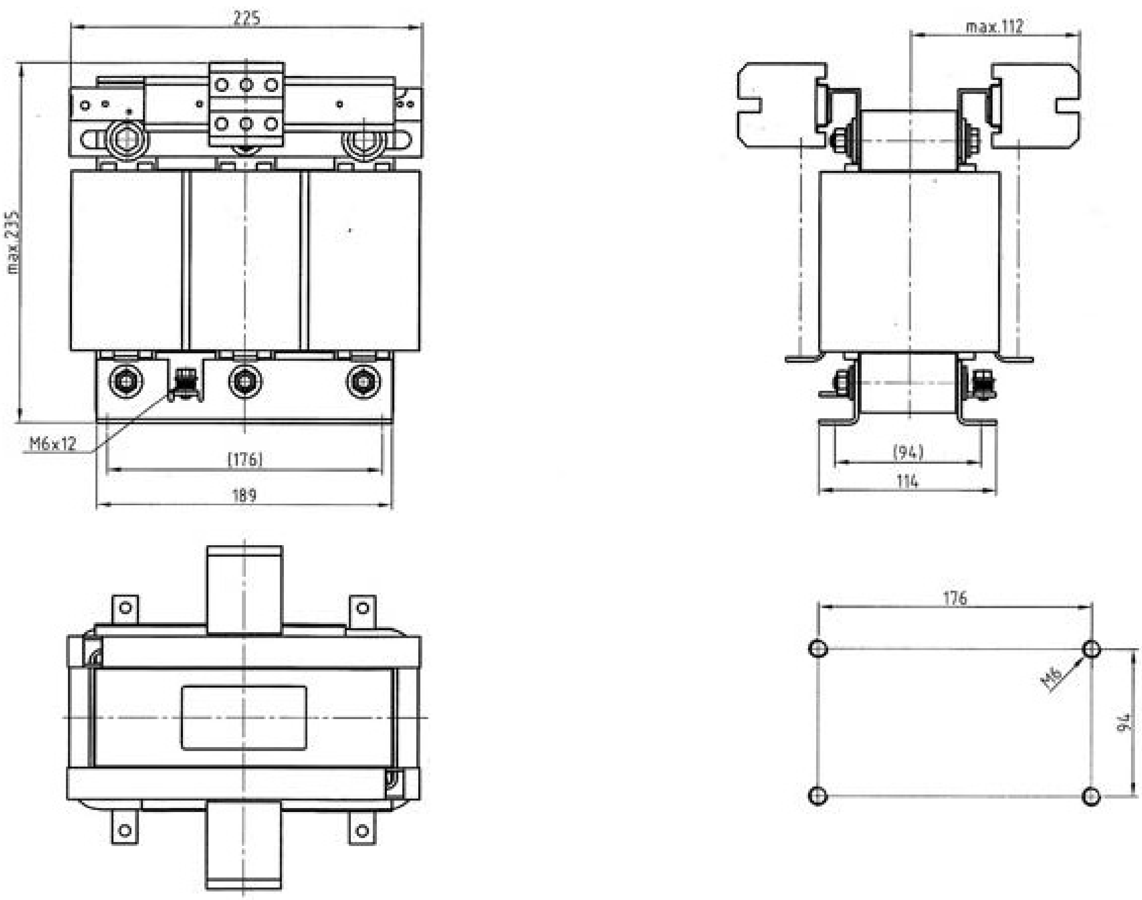


Figure 6-29 Dimension drawing of line reactor for Smart Line Module 36 kW

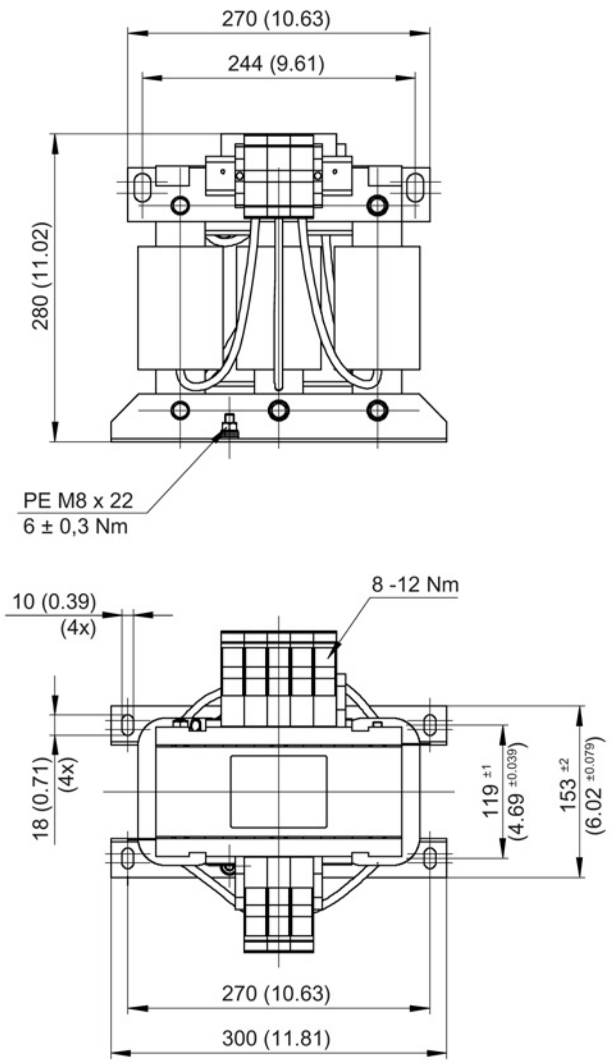


Figure 6-30 Dimension drawing of line reactor for Smart Line Module 55 kW, all dimensions in mm and (inches)

6.6.3.3 Technical data

Table 6- 11 Technical data of line reactors for the Smart Line Module

		6SL3000-0CE15-0AAx	6SL3000-0CE21-0AAx	6SL3000-0CE21-6AAx	6SL3000-0CE23-6AAx	6SL3100-0CE25-5AAx
Power	kW	5	10	16	36	55
Rated current	A_{rms}	14	28	35	69	103
Power loss [1)]	W	62	116	110	170	190
Weight	kg	3.7	7.5	9.5	17	37

1) For an overview, see the power loss tables in the Appendix

6.7 Possible combinations of line reactors and line filters

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

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

Note

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

Figure 6-31 Options for combining line reactors and line filters

7 DC link

7.1 Function of the DC link

Properties

Line Modules generate a DC voltage from the three-phase line voltage, and feed this into the DC link. The DC link is used as a source of energy, which supplies DC voltage to the Motor Modules (inverters). There are DC link components which buffer energy or dissipate excess energy in order to stabilize the energy supply.

DC link busbars or DC link adapters are used for voltage transfer within the DC link.

7.2 DC link components

The information below provides only a brief explanation of the DC link components. For more detailed information, refer to the SINAMICS S120 Booksize Power Units Equipment Manual.

Note

Safety instructions in the Booksize Power Units Equipment Manual

Observe the safety instructions for DC link components in the SINAMICS S120 Booksize Power Units Equipment Manual.

Note

Information on the Control Supply Module (CSM)

You can find information on the Control Supply Module in the chapter titled Internal power supply via the Control Supply Module (CSM) (Page 178)

7.2.1 Braking Module

The Braking Module Booksize is always used together with an external braking resistor. It has the following tasks:

- Specific stop of the drives in the event of a line failure
(e.g. emergency retraction or EMERGENCY OFF category 1).
- Limit the DC link voltage for brief periods of generator operation (e.g. if the regenerative feedback capability of the Line Module is deactivated or is not adequately dimensioned).
- Convert braking energy into thermal energy if a Line Module without regenerative feedback capability (BLM) is being used.

The Braking Module includes the necessary power electronics and control. When the Braking Module is in operation, the energy which is fed back into the DC link is dissipated via an external braking resistor.

External braking resistors

Braking resistors without thermostatic switch 6SN1113-1AA00-0DA0 (P_N = 0.3 kW) and 6SL3100-1BE31-0AA0 (P_N = 1.5 kW) can be operated at the Braking Module Booksize.
The cable lengths between the Braking Module and braking resistor is limited to a maximum of 10 m.
The scope of delivery of the braking resistor 6SN1113-1AA00-0DA0 includes a shielded connection cable (3 m, 3 x 1.5 mm^2).

Rapid discharge of DC link capacitors

Furthermore, the Braking Module Booksize can used with a braking resistor to quickly discharge the DC link capacitors The DC link is discharged in a controlled manner via the braking resistor once the infeed unit has been switched off and the line-up has been disconnected from the line supply (e.g. via the main switch or line contactor). The function can be activated via a digital input on the braking module. A quick discharge makes sense, for example, when maintenance tasks are to be performed at the Motor Module and/or motor installation (reduction of the discharge time).

⚠ CAUTION
Rapid discharge only when motors are at a standstill
The drive system must be completely disconnected from the line supply in order for rapid discharge to take place. The motors must be at a standstill.

Monitoring functions

- Automatic detection of braking resistors and braking power monitoring
- I^2t monitoring of the braking resistors.
- Temperature monitoring of the Braking Module
- Short circuit and overload detection
- Ground fault detection

7.2.2 Capacitor Module

Capacitor Modules are used for making energy savings, particularly in multi-axis systems. They store the energy supplied to the DC link in such a way that it is neither dissipated as heat loss nor returned to the line system in a way that is subject to losses. If the energy requirements of the connected Motor Modules increase, the energy is removed from storage.

Only when this energy store is fully charged is the additional excess energy dissipated as heat loss via a braking resistor.

Due to its storage capacity the Capacitor Module can also bridge short-term power failures.

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

Several capacitor modules can be operated in parallel.

7.3 Current Carrying Capacity of the DC Link Busbar

The current carrying capacity of the DC link busbar must be observed for the configuring and the construction of the drive group.

Depending on the width of the power units, the maximum current carrying capacity of the DC link busbar is represented by the following values:

- With power units between 3 A and 30 A (max. width 100 mm) and DC link components (Braking, Capacitor, and Control Supply Modules), the DC link busbar can be loaded with **100 A**
- With power units between 45 A and 200 A (150/300 mm width), the DC link busbar can be loaded with **200 A**

DC link busbar gain

Gain is possible as an option. It may be required if the drive group is fed via a Line Module > 55 kW or a DC link adapter.
Using reinforced DC link busbars raises the current-carrying capacity from 100 A to 150 A for all booksize components with widths of 50 mm or 100 mm.

Table 7- 1 "Reinforced DC link busbar" option

Area	Order No.
Suitable for 50 mm components	6SL3162-2DB00-0AAx
Suitable for 100 mm components	6SL3162-2DD00-0AAx

Optimizing current load

The current in the DC link busbar is directly dependent on the current active power of the motor. To calculate the current generated, the entire process operation associated with the drive group connected to the DC link needs to be considered. The current load for the DC link busbar can be optimized if influencing variables such as partial load, duty cycles, and the simultaneity factors of the individual drive motors are taken into account.

If the current carrying capacity of the DC link busbar is exceeded, two solutions are possible: either the building of the drive group with infeed from left and right (center infeed; see below) or the use of another Line Module.

Note

The following examples are based on the concurrent use and loading of the Motor Modules with the rated output current of the Motor Modules. The current values are taken from the Booksize Power Units Equipment Manual or the NC62 catalog.

Example 1:

Connection of several Motor Modules with different current carrying capacity of the DC link busbar to a Line Module.

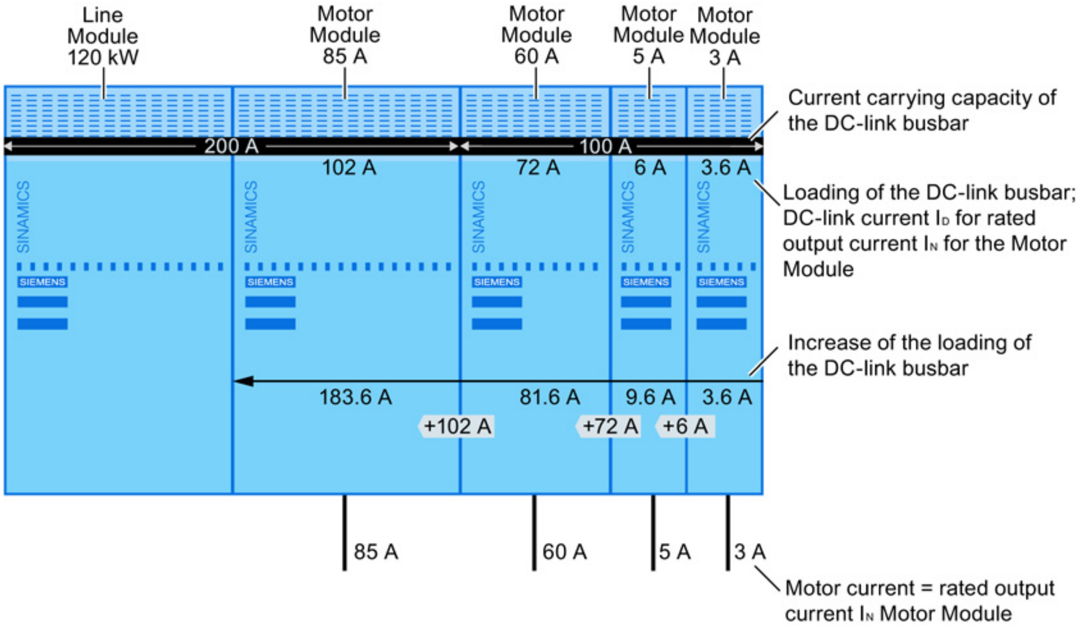


Figure 7-1 Regular construction; DC link busbars not overloaded

Example 2:

Connection of several Motor Modules with the same current carrying capacity of the DC link busbar to a Line Module with center infeed.

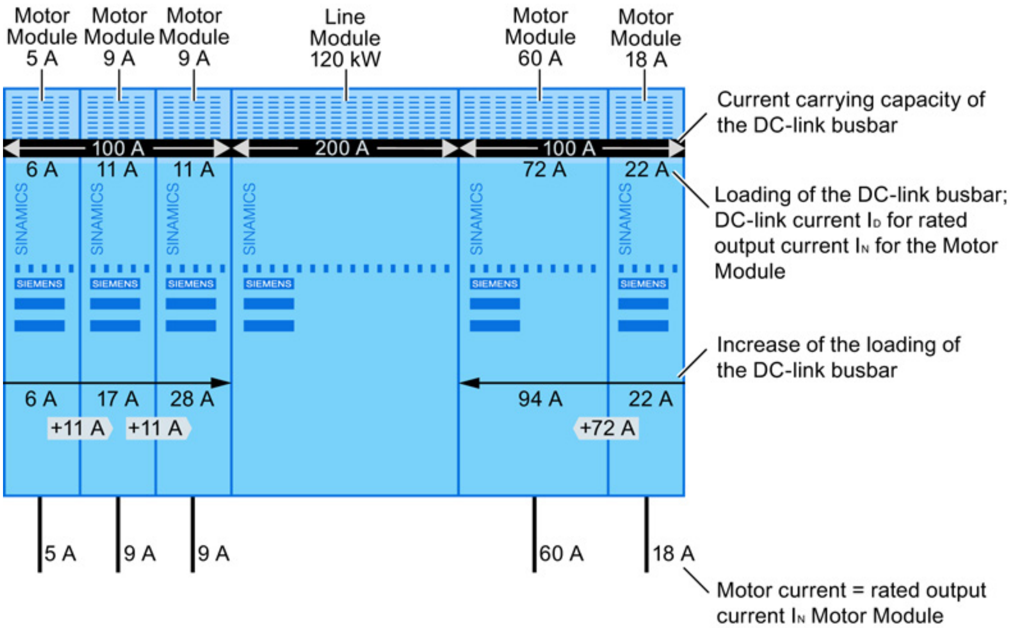


Figure 7-2 Infeed from left and right (center infeed)

Note

A center infeed with Motor Modules to the right and left of the Line Module can be configured for all Line Modules.
Exception: Smart Line Modules 5 kW and 10 kW

A single-sided infeed would overload the DC link busbar for a 60 A Motor Module. This type of configuration is therefore not permitted.

7.4 DC link rectifier adapter

The DC link rectifier adapter supplies the DC link voltage directly. It is best used for supplying an individual component. With a direct supply, each component is connected to the DC link separately. The internal DC link busbar is not used here.

If the DC link rectifier adapter is to be used for supplying more than one component, it is important to remember that it can only be installed on the component on the far right. The choice of connection cable diameter should be based on the required summation current for all the connected components.

The connection cables must be fused accordingly.

Mounting on components with reinforced DC link busbars is **not** possible.

Note

When a DC link rectifier adapter and DC busbars are used, the limit values for radio interference suppression under Category C2 according to EN 61800-3 can no longer be observed.

Table 7- 2 Available DC link rectifier adapters

Order number	Screw terminals	Used for Line/Motor Modules with these sizes
6SL3162-2BD00-0AA0	0.5 to 10 mm²	50 mm; 75 mm; 100 mm
6SL3162-2BM00-0AA0	35 to 95 mm²	150 mm; 200 mm; 300 mm

Note

Safety instructions

For more details of the DC link rectifier adapter, refer to the SINAMICS S120 Booksize Power Units Equipment Manual.

In particular, please observe the associated safety instructions.

7.5 DC link adapter

The DC link adapter is required when the drive line-up needs to be divided up (e.g. into two rows). The sub-line-ups are connected using cables (35 mm^2 to 95 mm^2). Shielded individual cores are recommended.

The DC link adapter can be used for all Line Modules and Motor Modules in the booksize format. Mounting on components with reinforced DC link busbars is **not** possible.

Note

Safety instructions

For more details of the DC link adapter, refer to the SINAMICS S120 Booksize Power Units Equipment Manual.

In particular, please observe the associated safety instructions.

Connection of the components in SINAMICS drive system

8

8.1 Electronics Power Supply

For the electronics power supply, a differentiation is made between:

- external power supply with SITOP modular
- internal power supply with Control Supply Module (CSM)

8.1.1 External power supply (SITOP)

An external SITOP modular power supply must be provided for the electronics power supply of the individual SINAMICS components. This ensures the trouble-free operation of all SINAMICS components. The SITOP electronics power supply also has the advantage that the power supply is already equipped with an internal line filter (class B in accordance with EN55022). This ensures an EMC-conform operation.

If a power supply other than SITOP is used, the required rated data (see Equipment Manual for Booksize Power Units) must be observed to ensure a trouble-free operation.

24 VDC power is required to supply

- the electronics of the SINAMICS components using the integrated 24 V busbar
- the electronics for Control Units, Option Boards and Sensor Modules, and the process voltage of their digital inputs
- the load voltage of the digital outputs
- the motor holding brakes

Other consumers may be connected to the power supply devices provided they have separate protection against excess current.

⚠ CAUTION
If other consumers are connected to the power supply, switch inductances (contactors, relays) must be provided with suitable over-voltage protective circuits.

The operation of motors with integrated holding brake requires a regulated DC power supply. The power is supplied from the internal 24 V busbars. The voltage tolerances of the motor holding brakes and the voltage losses of the connection cables must be observed.

The DC power supply should be set to 26 V. The Control Supply Module supplies 26 V. This ensures that the voltage supplied to the brake lies within the permitted range when the following general conditions are satisfied:

- Use of Siemens three-phase motors
- Use of Siemens MOTION-CONNECT power cables
- Motor cable lengths maximum 100 m

8.1.1.1 Selection of the Power Supply Devices

Devices specified in the following table are recommended. These devices satisfy the associated EN 60204-1 requirements.

Table 8- 1 SITOP Power modular recommendation

Rated output current [A]	Input voltage range [V]	Short-circuit current [A]	Order number
5	2AC 85-132/170 – 550	5.5	6EP1333-3BA00
10	2AC 85-132/176 – 550	30 for 25 ms	6EP1334-3BA00
20	3AC 320 – 550	23	6EP1436-3BA.0
40	3AC 320 – 550	46	6EP1437-3BA.0

Table 8- 2 Control Supply Module recommendation

Rated output current [A]	Input voltage range [V]	Short-circuit current [A]	Order number
20	3AC 380 -10% (-15% < 1 min) to 3AC 480 +10%	DC 300 – 800 < 24	6SL3100-1DE22-0AA0

See also NC62 catalog.

⚠ WARNING

Danger to life due to missing protective conductor connection

When using external power supplies, e.g. SITOP, the ground potential must be connected using the protective conductor connection (PELV).

8.1.1.2 24 V current consumption of the components

A separate 24 V power supply must be used for the SINAMICS S120 drive group.

The following table can be used to calculate the 24 VDC power supply for the components. The values of the typical power consumption serve as configuring basis.

Table 8- 3 Overview of 24 VDC current consumption

Component	Typical current consumption [A_{DC}]
NCU 7x0 (without load at the digital outputs)	2.1
NX1x	0.8
CSM	1.1
CU320 without load each digital output PROFIBUS teleservice	0.8 0.1
CBC10	0.1
Active Line Modules	
16 kW	1.1
36 kW	1.5
55 kW	1.9
80 kW	1.7
120 kW	2.1
Smart Line Modules	
5 kW	0.9
10 kW	1.0
16 kW	1.1
36 kW	1.5
DRIVE-CLiQ and brake	
DRIVE-CLiQ (e.g. motors with DRIVE-CLiQ interface)	typ. 0.25, max. 0.45
Brake (e.g. motor holding brake)	typ. 0.4 to 1.1; max. 2
Single Motor Modules	
3 A (+ 1 x DRIVE-CLiQ; + 1 x brake)	0.85
5 A (+ 1 x DRIVE-CLiQ; + 1 x brake)	0.85
9 A (+ 1 x DRIVE-CLiQ; + 1 x brake)	0.85
18 A (+ 1 x DRIVE-CLiQ; + 1 x brake)	0.85
30 A (+ 1 x DRIVE-CLiQ; + 1 x brake)	0.9
45 A (+ 1 x DRIVE-CLiQ; + 1 x brake)	1.2
60 A (+ 1 x DRIVE-CLiQ; + 1 x brake)	1.2
85 A (+ 1 x DRIVE-CLiQ; + 1 x brake)	1.5
132 A (+ 1 x DRIVE-CLiQ; + 1 x brake)	1.2
200 A (+ 1 x DRIVE-CLiQ; + 1 x brake)	1.2

Component	Typical current consumption [A_{DC}]
Double Motor Modules	
2 x 3 A (+ 2 x DRIVE-CLiQ; + 2 x brake)	1.15
2 x 5 A (+ 2 x DRIVE-CLiQ; + 2 x brake)	1.15
2 x 9 A (+ 2 x DRIVE-CLiQ; + 2 x brake)	1.15
2 x 18 A (+ 2 x DRIVE-CLiQ; + 2 x brake)	1.3
Sensor Modules Cabinet	
SMC 10	0.25
SMC 20	0.25
SMC 30	0.33
Sensor Modules External	
SME 20	0.19
SME 25	0.19
SME 120	0.24
SME 125	0.24
Additional system components	
Braking Module	0.5

The details apply to Motor Modules / Line Modules with internal/external heat dissipation.

8.1.1.3 Calculation of the 24 VDC Power Requirement Example

Table 8- 4 Example of 24 VDC current requirements

Component	Number	Current consumption [A]	Total current consumption [A]
NCU7x0 8 digital outputs	1 8	2.10 0.10	2.10 0.80
Active Line Module 36 kW	1	1.50	1.50
Motor Module 18 A	2	0.85	1.70
Motor Module 30 A	3	0.90	2.70
SMC	5	0.25	1.25
Brake	5	1.10	5.50
Total:			**15.55**

The following conditions should be considered for the configuring:

- The line infeed of the power supply devices must be tapped in front of the line filter of the Line Module.
- The line connection of the power supply should be made directly and without additional switched feeders.
- The dimensioning of the output rated current of the power supply is determined by the load of the connected consumers.
- A load reserve should be provided; a utilization of 0.7 to 0.8 I_N is recommended.
- The total length (sum of all cables) of the supply cables for the 24 VDC electronics power supply between the power supply and the SINAMICS components must not exceed 10 meters.
- The connection cable does not need to be shielded nor twisted. The maximum value of the ripple voltage, however, must not be exceeded. If this is the case, appropriate measures must be adopted.
- Where possible, the additional supply for consumers exterior to the SINAMICS system, such as contactors, valves, etc., should come from a separate power supply. This reduces any interactions (voltage dips, etc.).

8.1.1.4 Assignment of the power supply to other components

For Smart/Active Line Module, Motor Module and for the NX component, the supply voltage is monitored by the system. The components are connected using DRIVE-CLiQ; the monitoring is performed in the Control Unit.

Connection via 24 V terminal adapter

The component's front cover will need to be opened before establishing a 24 V connection to a module in booksize format. This exposes other live components, such as DC link busbars.

> ⚠ DANGER
>
> **Risk of electric shock**
>
> A hazardous DC link voltage is present for up to 5 minutes after the power supply has been switched off.
> The protective cover may only be opened after this time has elapsed.
>
> 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.

An integrated 24 VDC busbar is used for the electronic power supply of the Line/Motor/Braking and Capacitor Modules. The current carrying capacity of this busbar is max. 20 A. The integrated busbar also supplies the motor brake control terminals of the Motor Modules.

The infeed of the electronic power supply is normally made directly on the Line Module using the 24 V terminal adapter (max. connectable cross-section 6 mm², max. fuse 20 A) supplied with the Line Modules.

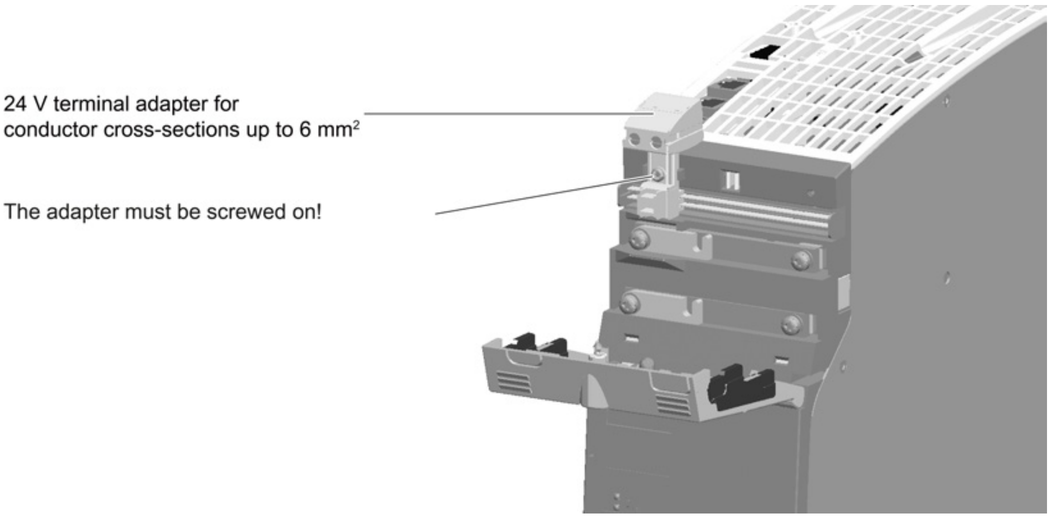
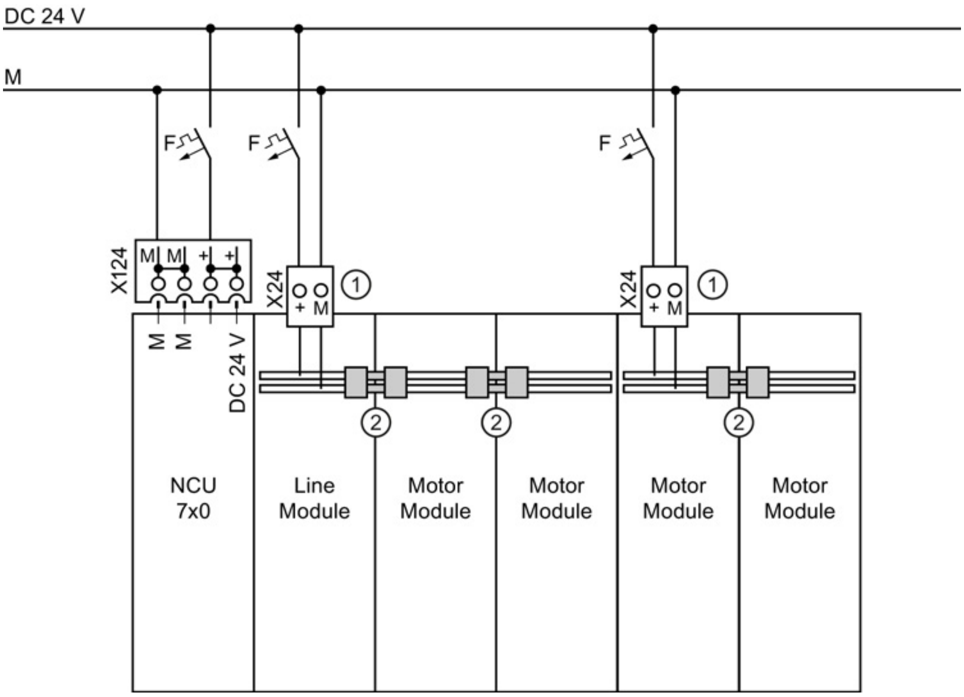


Figure 8-1 24 V terminal adapter on the booksize module, front cover open

The 24 V busbar is used to pass the 24 VDC power between the individual components. 24 V jumper plugs (supplied with the Line Modules) are used to jumper the 24 V busbar at the component transitions.

If the maximum current carrying capacity (20 A) of the 24 V busbar is exceeded, an additional electronic current infeed must be provided. This must be implemented, for example, on a Motor Module using an additional 24 V terminal adapter, which must be ordered separately (order no. 6SL3162-2AA00-0AA0). The 24 V busbar must not be jumpered upstream of the new infeed, because a new potential begins downstream of the additional infeed.



① DC 24 V terminal adapter

② Jumper plugs

Figure 8-2 Electronic power supply infed more than once

For all other components, such as Control Unit or Sensor Module, the electronic power supply is connected using appropriate infeed plugs at the associated component. The infeed plugs are identical for all components. The maximum connectable cross-section is 2.5 mm^2 and the maximum current carrying capacity is 20 A.

To improve the wiring of the individual components with each other, a potential jumpering at the infeed plugs is possible. The total current of all attached components, however, must not exceed 20 A.

Power is supplied to the digital inputs/outputs at the Control Unit and Sensor Module, for example, via appropriate terminals (max. 0.5 mm^2).

8.1.1.5 Overcurrent protection

On the primary side and on the secondary side of the power supply device, devices and cables must be protected from over-current using suitable protection devices.

Primary side

Recommended circuit-breakers (IEC 898) in the suppy cable can be found in the technical data of the SITOP devices in the KT 10.1 catalog. The cable cross-section must be considered.

The primary protection is responsible for providing device protection for the SITOP power supply as well as line protection between the protective device and the power supply.

Secondary side

For the protection of the secondary side, particular attention must be paid to:

- Loading due to loads, possibly the simultaneity factor in response to machine operation
- The current carrying capacity of the cables in normal operation and in a short-circuit situation
- The ambient temperature
- The effect of bundling together cables, e.g. where these are laid in a common duct
- Cable laying method to EN 60204-1

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

Protection of the load feeders

Load feeders must be protected selectively. Circuit-breakers are suitable (order no.: 5S…, ETB1 catalog) or the SITOP select diagnostic component (order no.: 6EP1961-2BA.0).

Configuration details for the secondary protection of the load feeders are contained in the KT 10.1 catalog (SITOP Power Supplies, "Technical Information and Configuration Notes" section).

The rated size of the protective devices depends on the current need. The protective device also performs the line protection and sometimes also the device protection of the attached consumers. In a fault situation, the used power supply must be able to supply the required power until being controlled.

Regulated power supplies (such as SITOP power) must be provided, in accordance with EN 60204-1, with integrated electronic short-circuit protection capable of independently protecting SITOP power and the supplied 24 VDC circuits against overloading in the event of overloads/short circuits.

Circuit-breakers

When selecting circuit breakers from the table below, the following cable conditions need to be considered:

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

Table 8- 5 Types of circuit breaker depending on conductor cross-section and temperature

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

The tripping characteristic of the circuit-breakers must be chosen appropriately for the consumers to be protected and the maximum current provided by the power supply device in a short-circuit situation.

The MCBs can be selected according to Siemens catalog "BETA Modular Installation Devices - ET B1".

8.1.1.6 Line formation

The corresponding different supply lines should be configured and constructed depending on the size of the drive group and the overall length. This ensures that should one line fail, the power supply to all attached consumers does not fail. The fault-free consumer lines remain operational.

The maximum connectable cross-section of the consumers must also be considered:

- 6.0 mm^2 for the 24 V power supply terminal adapter of the power busbar
- 2.5 mm^2 for the 24 V power supply infeed terminal of the CU and SMC components
- 0.5 mm^2 for the digital inputs/outputs and analog inputs/outputs

Example for the splitting of the consumer lines:

- NCU / NX
- Line / Motor Modules
- Supply of the Sensor Modules
- Consumers such as relays, valves, etc.
- Additional brakes not supplied from the Motor Module

Multiple power supplies are recommended for larger plant concepts.

Example of the separation:

- Power supply for the direct drive system (NCU, NX, LM, MM, SME and SMC)
- Power supply for additional consumers, such as brakes, valves and power contactors

If required, the circuit-breakers can be equipped with additional auxiliary switches. If these signal contacts are fed to a higher-level controller, a detailed fault diagnosis can be performed when the circuit-breakers trip.

Notes

- SINAMICS components have a reverse polarity protection on the 24 VDC infeed side.
- Line, Motor, Braking, Capacitor and Control Supply Modules are short-circuit resistant on the 24 V busbar for a maximum current of 20 A. The 24 V terminal adapter for the infeed has a maximum connection cross-section of 6 mm^2.
- If no higher short-circuit current can occur, a protection can be omitted. This means the components can be connected directly to the power supply.
- If higher short-circuit current occur, a protection against over-current / short-circuit must be provided, max. 20 A, however. In a fault situation, the used power supply must be able to supply the required current until tripping.
- The maximum protection of the power supply infeed for Control Unit and Sensor Module Cabinet depends on the connected cable cross-section (max. 2.5 mm^2), maximum 20 A, however.
- The maximum protection of the controller inputs/outputs at the other components depends on the connected cable cross-section:

Table 8- 6 Controller inputs/outputs and their connectable cross-sections

Component	max. cable cross-section
Control Unit NCU7x0.3	1.5 mm^2
NX1x.3 extension unit	1.5 mm^2
CU320-2 Control Unit	1.5 mm^2
Active Line Module	1.5 mm^2
Smart Line Module	1.5 mm^2
Motor Module	1.5 mm^2
Sensor Module Cabinet (SMC)	1.5 mm^2
TM15, TM41 Terminal Modules	1.5 mm^2
TM120 Terminal Module	6.0 mm^2

- Controller outputs at the Line, Motor and Braking Module, Control Unit and Sensor Module Cabinet are short-circuit resistant.

8.1.1.7 Power Supply Connection Example

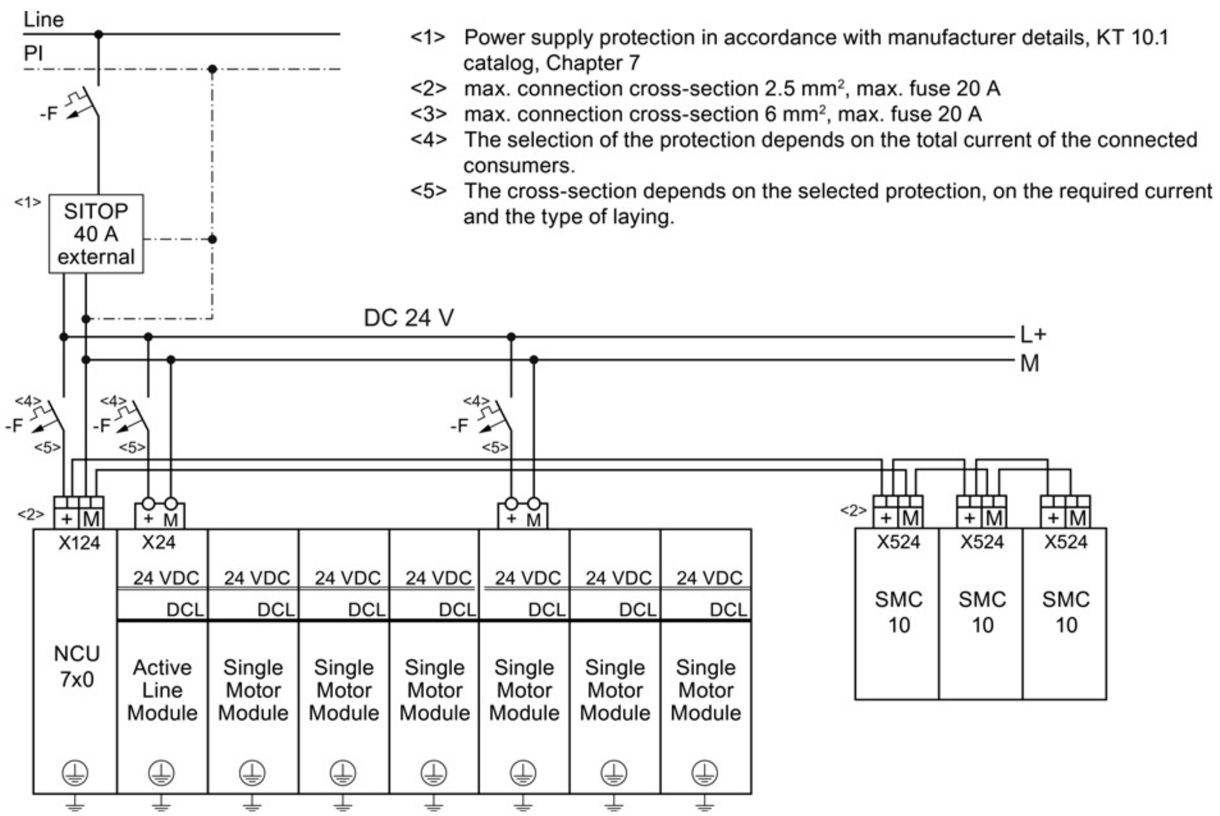


Figure 8-3 Power Supply Connection Example

8.1.2 Internal power supply via the Control Supply Module (CSM)

The Control Supply Module (CSM) is a 24 VDC power supply unit integrated as a separate SINAMICS component in the drive line-up. It provides an output voltage of 24 VDC - 28.8 VDC. This can be adjusted using an integrated potentiometer.

The CSM supplies all SINAMICS components in the drive line-up and also components, such as Control Unit or Sensor Module Cabinet with 24 VDC. The maximum output current is 20 A DC. An external power supply is not essential.

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. Depending on the energy content in the DC link, the CSM can maintain the supply of the 24 V busbar. This allows transient line fluctuations to be bridged without the drive line-up failing.

To achieve longer bridging times, additional Capacitor Modules can be used to increase the DC link capacity. The consequent increased storage capacity of the DC link acts positively should the line voltage drop.

Specific emergency return movements, such as those required in the machine tool area, can also be initiated. This is necessary, for example, to stop rapidly rotating spindles as fast as possible or to protect expensive workpieces by making appropriate return movements of the axes. Further measures, however, must be considered for the realization.

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

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

Temperature and voltages are internally monitored.

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

Voltage monitoring:
When the monitoring threshold (32 V) of the output voltage is exceeded for more than 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 be operated individually or as part of a parallel connection of up to ten Control Supply Modules. The switchover between single and parallel operation is realized in a no-current state using a DIP switch on the upper side of the module.

Note

Compatibility

The new Control Supply Module 6SL3100-1DE22-0AA1 with extended functions described here replaces Control Supply Module 6SL3100-1DE22-0AA0. The modules are spare-part-compatible.

CSM in the event of line failure

When planning the line failure concepts, those components located outside the SINAMICS drive line-up must also be considered (line contactor, controller, etc.). If, in the event of a fault, the primary energy supply of the CSM comes from the DC link, this can be performed only in the voltage range $U_{DC\ link}$ = 430 - 882 V_{DC} (300 - 430 V_{DC} for < 1 min). If these limits are overshot or undershot, the corresponding error messages will be generated by the system and internal pulse suppression will be triggered. The drives coast to a standstill and can no longer be controlled. To limit the maximum/minimum DC link voltage, the use of Capacitor and Braking Modules may be necessary.

Note

The supply voltage corresponds to PELV (protective extra-low voltage). The required connection of the ground potential to the protective conductor system is realized in the CSM.

Note

Safety instructions and other information

You can find detailed information on the Control Supply Module in the SINAMICS S120 Booksize Power Units Equipment Manual.

It is absolutely essential that you follow the safety instructions listed there.

8.1.2.1 Connection

The Control Supply Module is connected to the line supply (3-ph. 380 VAC –10 % to 480 VAC +10 %) via interface X1 (screw terminals 0.2 to 4 mm^2) This connection should preferably be made without using an isolating device (e.g. a contactor).

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

The CSM also features a current limitation function. When using cables with a cross-section of 2.5 mm^2, 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 thermal stability of up to 90 °C.

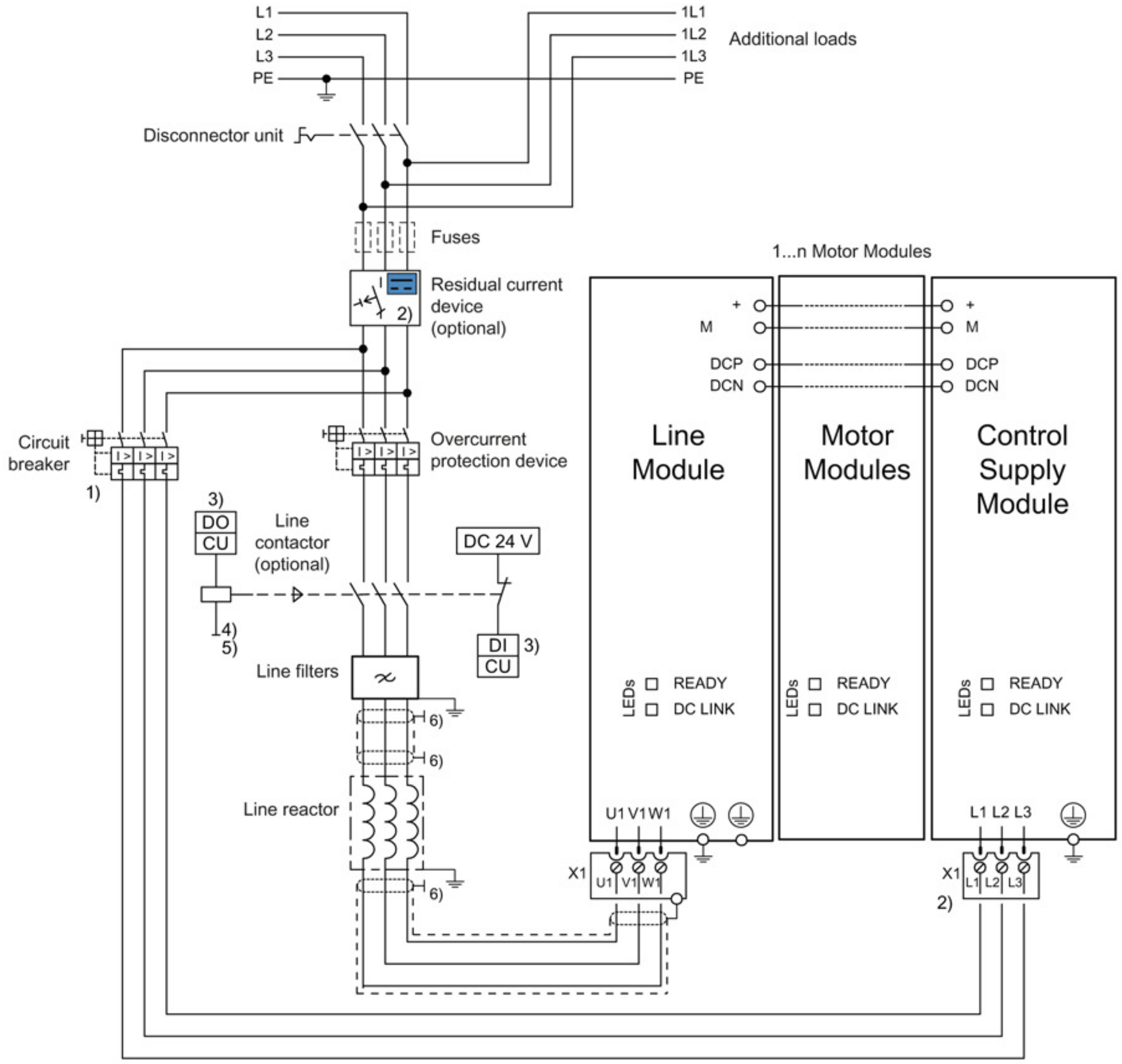
Note

Observe the connection sequence

If a selectively tripping, AC/DC-sensitive RCCB is used for the drive line-up, the Control Supply Module must always be connected to the line supply downstream of this circuit breaker. Otherwise, the residual current operated circuit breaker will trip erroneously if the direct-current component is asymmetrically withdrawn in certain operating states.

8.1.2.2 Single operation

When used alone, the Control Supply Module must be connected to the drive line-up via the DC link busbars as well as the 24 V busbars. The red 24 V connector from the accessories pack provided must be inserted under all circumstances. The DIP switch on the Control supply Module must be set to "single mode" The connection can be established as shown below.



1) Permissible types:
   a) Circuit breaker type SIRIUS, 3RV 1021 1DA10, set to 3A
   b) Branch circuit fuse type KTS-R-6 (class RK1)
2) The mains connection must always be available
3) DI/DO, controlled by the Control Unit.
4) No additional load permitted downstream of line contactor!
5) The current carrying capacity of the DO must be observed; an output coupling device must be used if required.
6) Contacting via rear mounting panel or shielding buses in accordance with EMC Directive

Figure 8-4 Connection example for Control Supply Module in single operation

8.1.2.3 Parallel operation

A maximum of 10 Control Supply Modules can be connected in parallel.

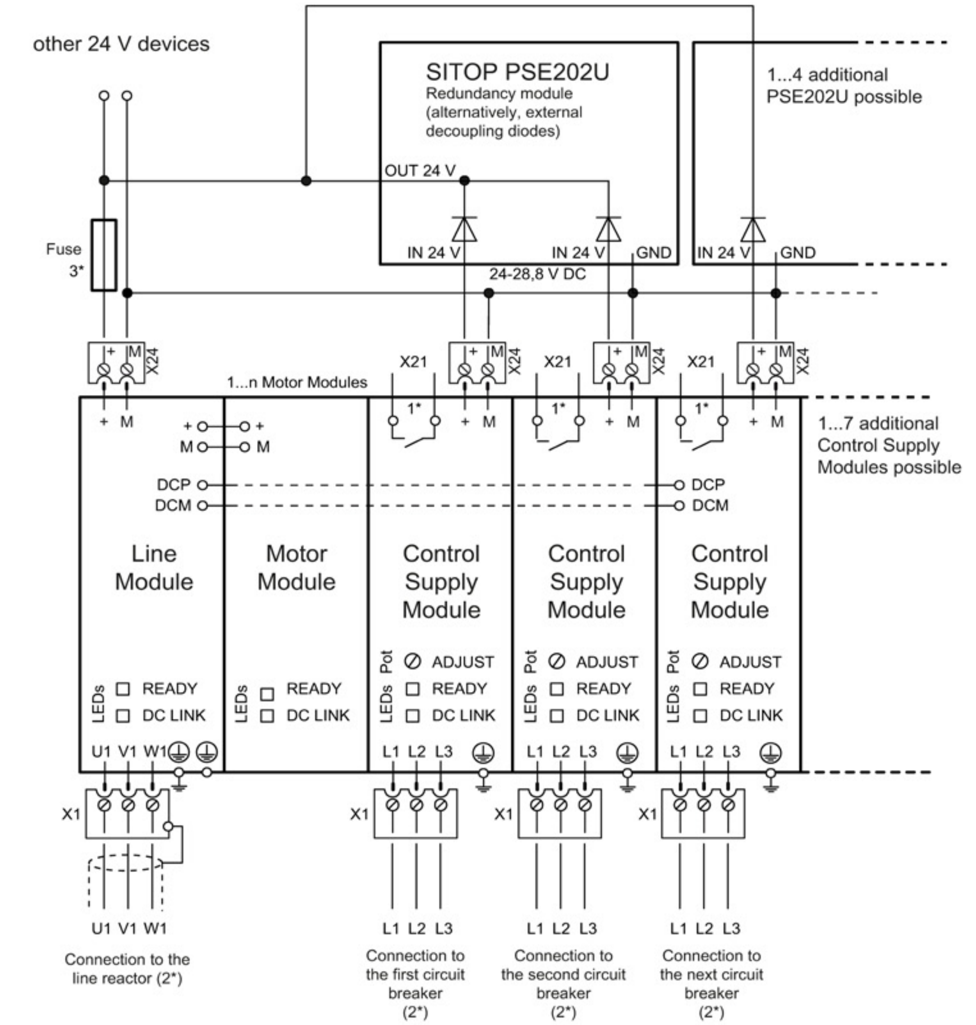
The DIP switch of the Control supply Module must be set to "parallel mode". The same output voltage must be set for all modules at the adjusting potentiometer.

In parallel mode, each Control Supply Module should supply the 24 VDC voltage via the 24 V terminal adapter. For this reason, the red 24 V connector must **not** be used (see connection examples).

Use of a SITOP redundancy module (6EP1961-3BA20) is recommended for parallel connection. One SITOP redundancy module must be used for two Control Supply Modules in this case. Alternatively, a connection with external diodes to decouple the individual Control Supply Modules is possible. If a Control Supply Module fails, an alarm is generated and provided via the X21 signaling contact. The 24 V supply is maintained via the second module.

Note

Only Control Supply Modules with order number 6SL3100-1DE22-0AA1 may be used for parallel connection.



1* connection to digital interface (SCADA or PLC); closed, means: 24 V OK
2* continue as in "Connection example Control Supply Module in individual operation"
3* max. permissible 20A continuous current (refer to the fuse characteristics)

Figure 8-5 Connection example for parallel connection of 2 to 10 Control Supply Modules via SITOP PSE202U redundancy module

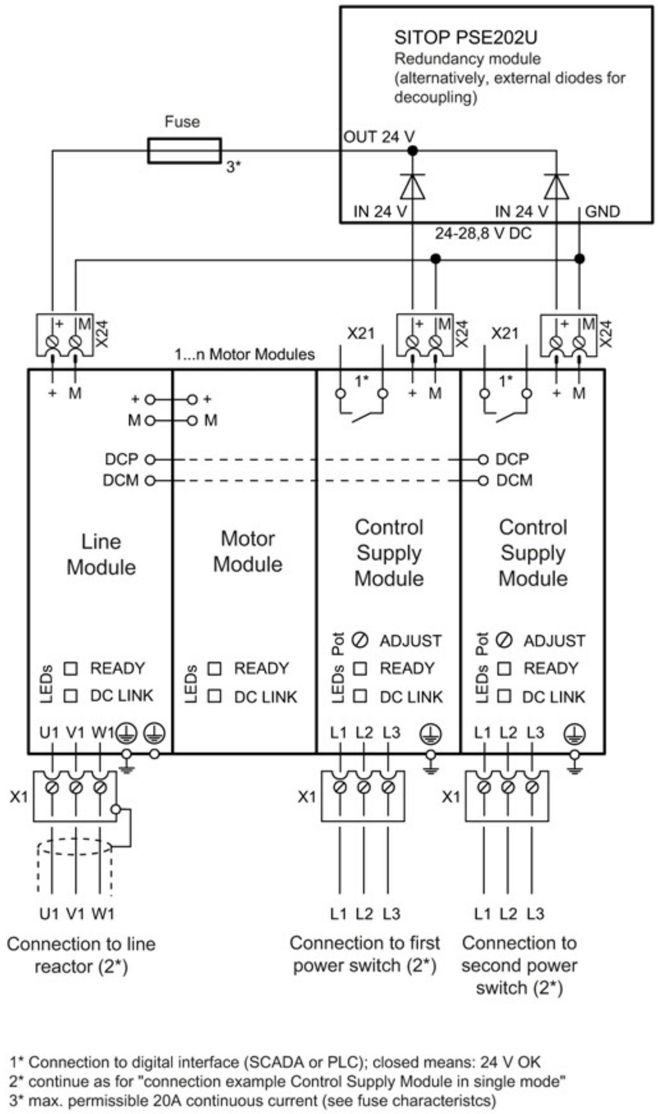
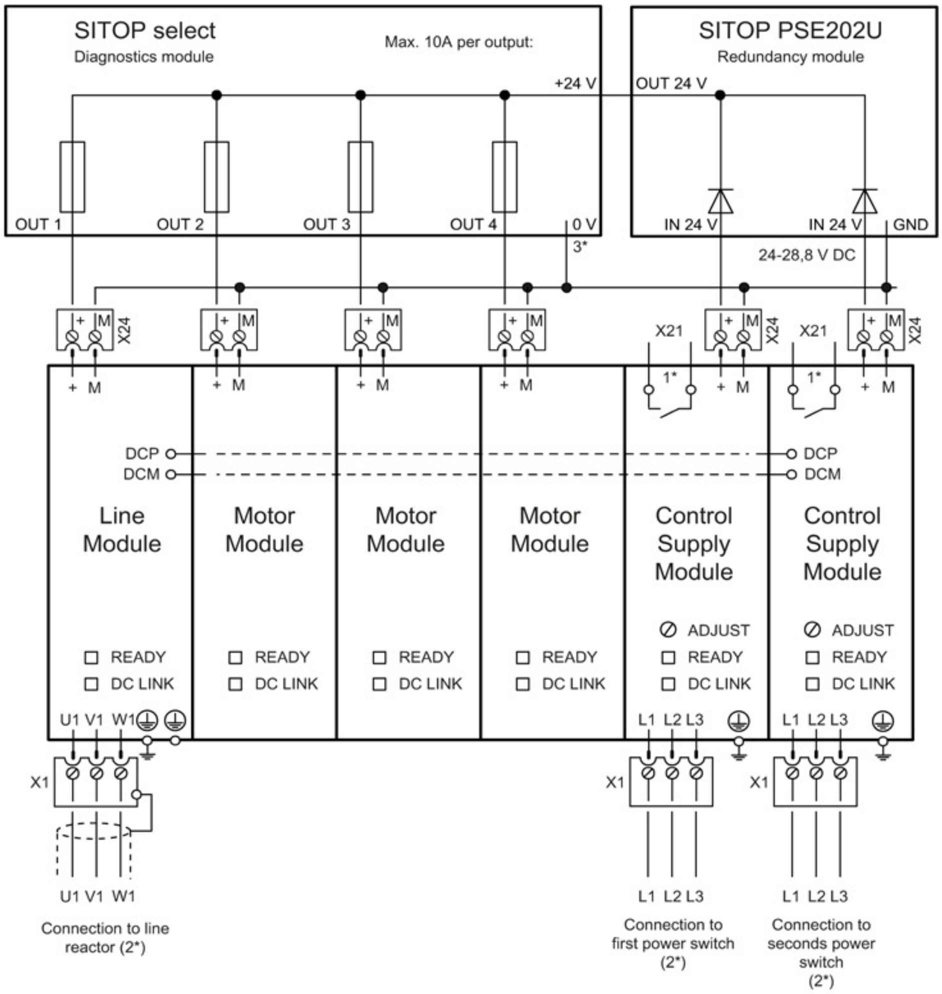


Figure 8-6 Connection example for a redundancy circuit with two Control Supply Modules via SITOP PSE202U redundancy module



1* Connection to digital interface (SCADA or PLC); closed means: 24 V OK
2* continue as for "connection example Control Supply Module in single mode"
3* Functional reference point (not load with high current)

Figure 8-7 Connection example for parallel connection of Control Supply Modules via SITOP PSE202U redundancy module and a SITOP select diagnostic module (6EP1961-2BA00)

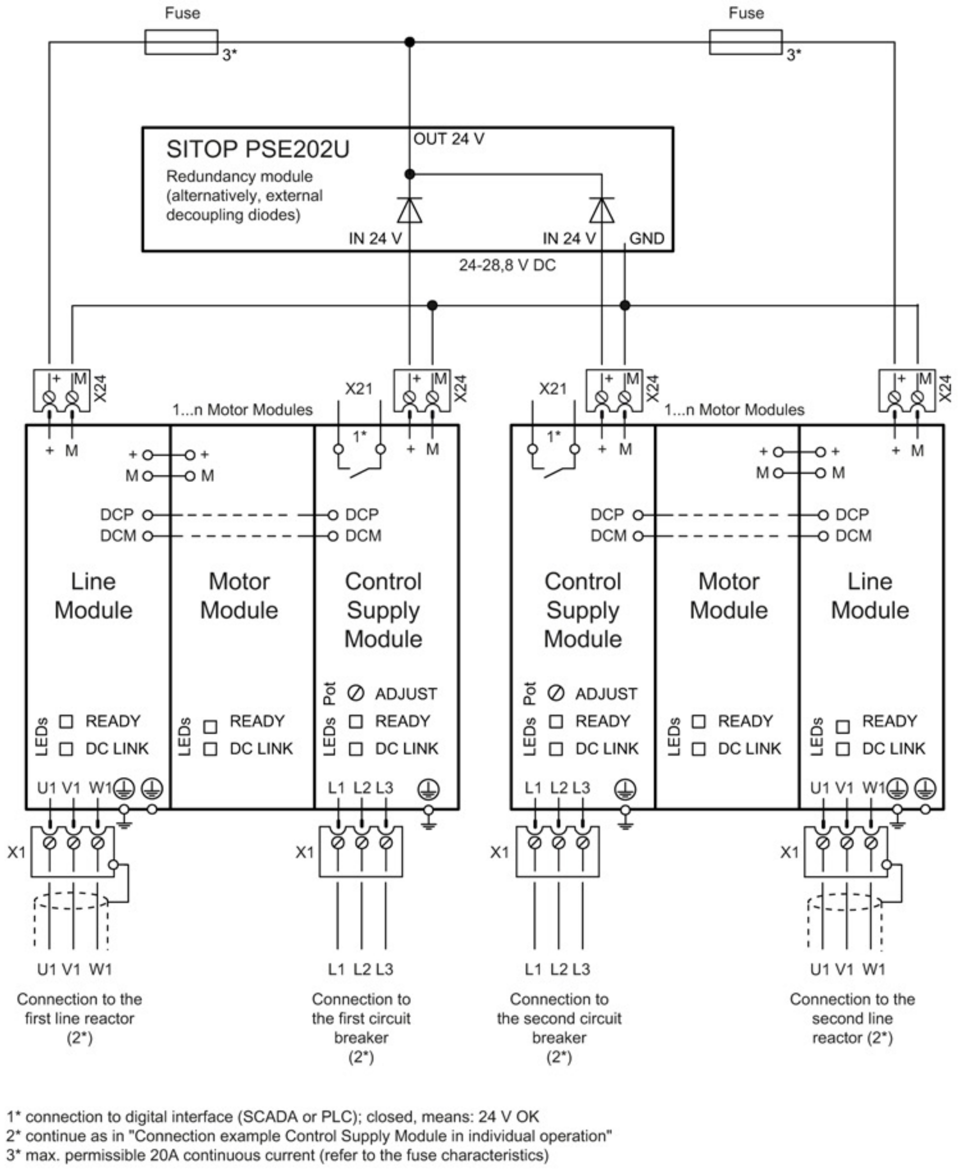


Figure 8-8 Connection example for operation of 2 units with Control Supply Modules via a SITOP PSE202U redundancy module

8.2 Connection of a SINAMICS Control Unit CU320-2

The SINUMERIK NCU 7x0.3 PN can function as a higher-level control for multiple SINAMICS S120 drive line-ups. In this case, the drive line-ups often have a separate SINAMICS CU320-2; this is responsible for straightforward functions such as positioning.

The CU320-2 is connected via PROFINET IO or via PROFIBUS DP.

Connection via PROFINET IO

The NCU 7x0.3 PN generation comes with PROFINET interfaces as standard, so that the SINAMICS CU320-2 can be connected directly via a port of the X150 interface without additional components. The maximum transmission rate is 100 Mbps.

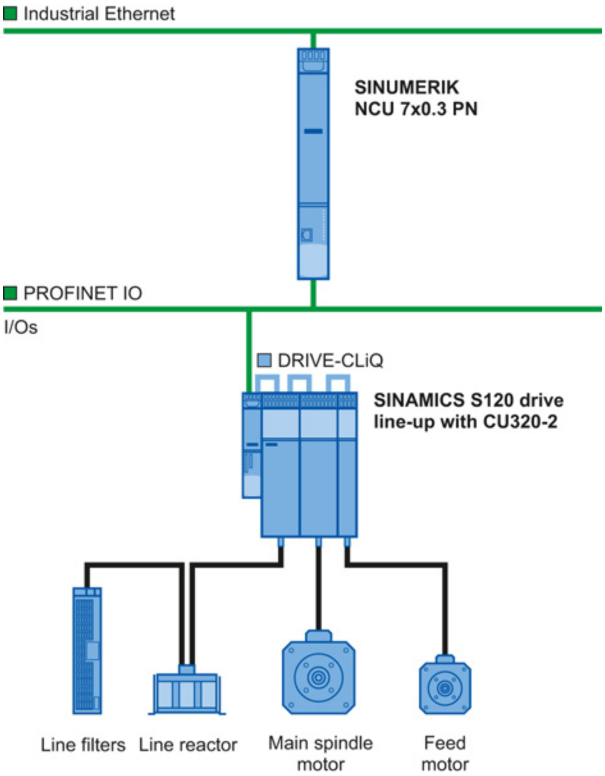


Figure 8-9 NCU 7x0.3 - CU320-2 connection via PROFINET IO

Connection via PROFIBUS DP

The conventional method of connecting the SINAMICS CU320-2 via PROFIBUS DP can be used with the NCU 7x0.3 PN too. The connection is established via the X126 interface. The maximum transmission rate is 12 Mbps.

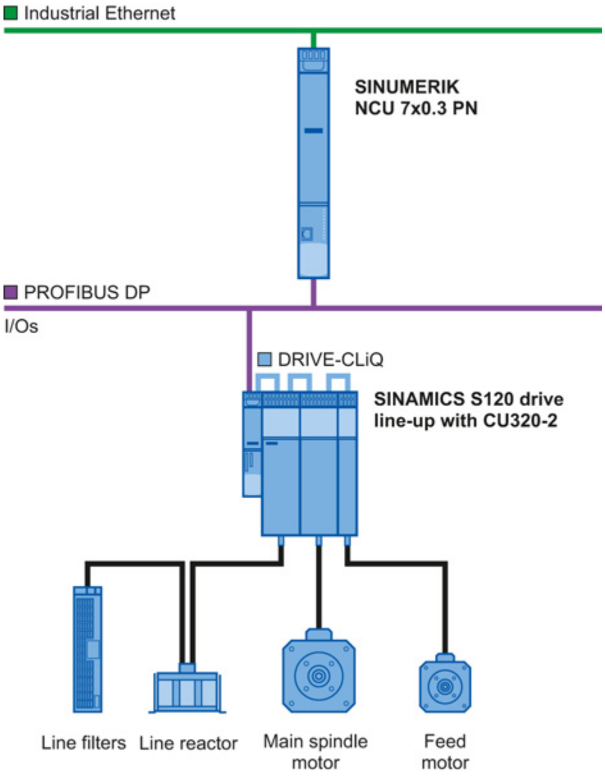


Figure 8-10 NCU 7x0.3 - CU320-2 connection via PROFIBUS DP

8.3 Connection of line modules

8.3.1 Introduction

The Line Module is used to connect the drive group to the energy supply system.

The Line Module is used for the power infeed into the DC link.

In generator operation, the energy of the drives fed into the DC link is returned to the energy supply system. For an energy supply system that cannot accept any regenerative energy (e.g. diesel generator), the regenerative capability of the Line Module must be deactivated. The braking energy must then be converted into heat via a Braking Module with braking resistor that also needs to be included in the drive group.

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

Active Line Module

The self-managed infeed/regenerative unit with booth converter creates an increased controlled DC link voltage. This makes the connected Motor Modules independent of tolerances in the energy supply system.

The Control Unit is used to control, trigger and monitor the Active Line Module. Data exchange is performed via the DRIVE-CLiQ interface.

Control types:

The Active Line Module operates in two different control types depending on the parameterized line voltage (p0210).

- Active Mode

  The Active Line Module can control the DC link voltage in a rated voltage range of 3 AC 380 V to 3 AC 415 V (input voltage); boost converter with controlled DC link voltage and sinusoidal line voltage.

- Smart Mode

  In the rated voltage range of 3 AC 416 V to 3 AC 480 V (input voltage), Smart Mode is automatically activated and the supply system transistors are switched so that they are synchronous with the supply system. The DC link voltage is not regulated, but is based on the rectified line voltage according to the following formula: $U_{DC\ link} = U_{supply} * 1.35$.

  The setpoint for the DC link voltage (p3510) will be preassigned automatically.

The following DC link values will be attained for the Active Line Module in Active / Smart Mode:

Table 8- 7 Active Line Module DC link voltages

Line voltage p0210	380 V	400 V	415 V	440 V	460 V	480 V
Active Mode (default values) V_{DC} set p3510 [V] (with boost converter p3400.0=1)	600 V	600 V	600 V	-	-	-
Smart Mode (p0210 x 1.35) (without boost converter p3400.0=1)	513 V[1)]	540 V[1)]	561 V[1)]	594 V[2)]	621 V[2)]	648 V[2)]

1) Smart Mode can be selected using parameter p3400.0=0.

2) Smart Mode sets itself automatically during the parameter assignment for the line voltage p0210 > 416 V. It is possible to select Active Mode if the connected motors are suitable for > 650 V_{DC}.

Note

Observe the insulation voltage

The setpoint for the DC link voltage (p3510) can be changed. The insulation voltage of the motors must be observed. (See the NC62 catalog or the Configuration Manual for the motors.)

CAUTION

Dangerous voltage at the DC link

As soon as the energy supply is present at the infeed terminals (-X1:U1/V1/W1) of the Active Line Module, the DC link will be precharged ($U_{DC\ link}$ = U_{Supply} x 1.35).

Once the "Enable Pulses" enabling signal is also present at the Active Line Module, the boost converter increases the DC link to the specified setpoint p3510 (e.g. $U_{DC\ link}$ = 600 V for U_{supply} = 400 V).

Smart Line Module

The Smart Line Module is a non-regulated infeed/regenerative feedback unit. The regenerative capability can be deactivated using a digital input.

The DC link is supplied using an uncontrolled diode bridge. The size of the DC link voltage is based on the line voltage according to the following formula: $U_{DC\ link} = U_{supply} * 1.35$.

The following DC link values are achieved for the Smart Line Module:

Table 8- 8 Smart Line Module DC link voltages

Line voltage	380 V	400 V	415 V	440 V	460 V	480 V
$U_{DC\ link}$	513 V	540 V	561 V	594 V	621 V	648 V

Note

Observe the insulation voltage

The insulation voltage of the motors must be observed. (See the NC62 catalog or the Configuration Manual for the motors.)

⚠ CAUTION

Dangerous voltage at the DC link

As soon as the energy supply is present at the infeed terminals (-X1:U1/V1/W1) of the Smart Line Module, the DC link will be precharged.

For the 5/10 kW types, control and monitoring of the Smart Line Module is carried out exclusively via digital inputs/outputs. No connection to the Control Unit using DRIVE-CLiQ exists.

Basic Line Module

The Basic Line Module can only feed energy from the supply system into the DC link; energy cannot be fed back into the supply system. Therefore, this module is only suitable for applications in which there is no regenerative energy, or in which the energy exchange takes place between the motor-driven and generator-driven axes in the DC link.

This documentation does not contain a description of the Basic Line Module.

Additional references

/GH2/ SINAMICS S120, Booksize Power Units, chapter titled "Line Modules Booksize".

8.3.2 Safety instructions for Line Modules Booksize

Note

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

DANGER

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

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

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

DANGER

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

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

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

DANGER

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

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

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

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

DANGER

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

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

- Only operate the components with closed protective cover.

WARNING

Danger to life through interruption of the external protective conductor due to high leakage currents

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

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

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

WARNING

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

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

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

WARNING

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

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

- For all 50 mm wide modules (exception: Smart Line Modules), remove the DC link bridge, including the screws. Do not tighten the screws without the DC link bridges.
- For all components that are 75 mm wide or wider, the DC link bridges must not be moved to the left or removed.

WARNING

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

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

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

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

WARNING

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

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

- Attach the component warning labels in the national language.

WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

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

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

CAUTION

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

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

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

NOTICE

Material damage due to loose power connections

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

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

NOTICE

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

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

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

NOTICE

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

Excess energy that is not fed back can damage equipment.

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

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

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

NOTICE

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

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

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

NOTICE

Damage through use of incorrect DRIVE-CLiQ cables

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

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

Note

Malfunctions due to polluted DRIVE-CLiQ interfaces

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

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

Special features for Line Modules with external air cooling

NOTICE

Component failure due to the pollution of external heat sinks

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

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

Note

Checking the seal

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

Note

Using an installation frame

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

Note

The Active Line Module (16 kW, 36 kW) and the Smart Line Module (16 kW, 36 kW) interfaces are identical.

8.3.3 Active Line Modules with internal air cooling

8.3.3.1 Description

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

This ensures that they are not influenced by network fluctuations.

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

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

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

8.3.3.2 Interface description

Overview

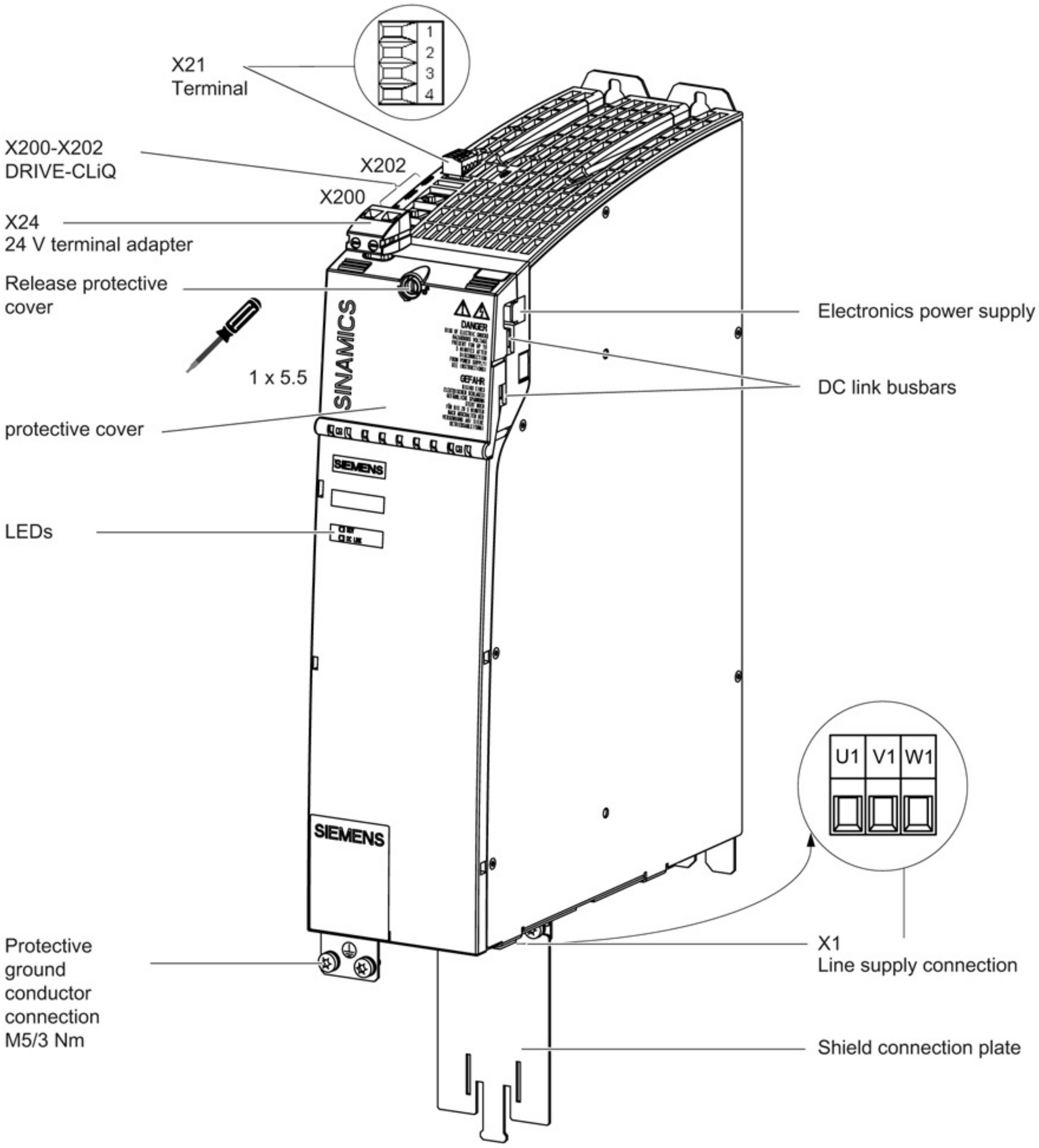
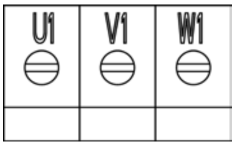
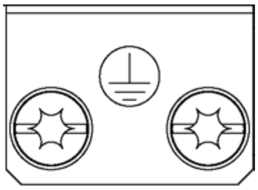


Figure 8-11 Interface overview, Active Line Module with internal air cooling (example: 16 kW)

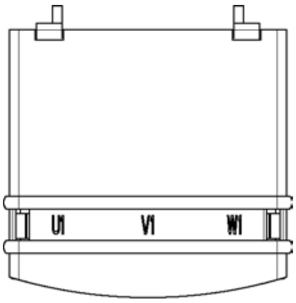
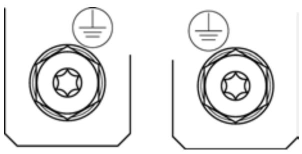
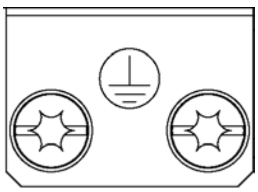
X1 line connection

Table 8- 9 X1: Line connection for Active Line Modules 16 kW

	Terminal	Technical specifications
	U1 V1 W1	Max. connectable cross-section: 10 mm² Type: Screw terminal 6 (see Appendix, Chapter "Screw terminals") Tightening torque: 1.5 - 1.8 Nm
	PE connection	Threaded hole M5/3 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

Table 8- 10 X1: Line connection for Active Line Modules 36 kW to 120 kW

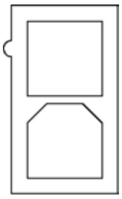
	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 3 AC 380 V - 480 V, 50/60 Hz **36 kW:** Threaded bolts M6/6 Nm 1) **55 kW, 80 kW and 120 kW:** Threaded bolts M8/13 Nm 1)
	PE connection	**36 kW:** Threaded hole M6/6 Nm 1)
		**55 kW:** Threaded hole M6/6 Nm 1) **80 kW and 120 kW:** Threaded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

1) For ring cable lugs in accordance with DIN 46234

X12 fan connection

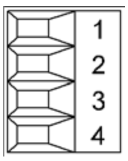
Active Line Modules 80 kW and 120 kW are equipped with an interface for connecting the sub-chassis fan. The interface is located on the underside of the Line Module.

Table 8- 11 X12 fan connection

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

X21 EP terminals

Table 8- 12 X21 EP terminal/temperature sensor

	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors[1]: KTY84–1C130[2]/PTC[2]/bimetallic switch with NC contact If an Active Interface Module is used, the temperature input must be connected to the Active Interface Module sensor (bimetallic switch with NC contact).
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Voltage: 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see Appendix, Chapter "Screw terminals")			

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

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

⚠ CAUTION

Connecting the temperature sensor

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

⚠ WARNING

Danger to life due to charged DC link

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

Note

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

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

⚠ DANGER

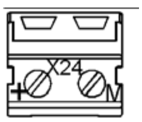
Risk of electric shock!

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

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

X24 24 V terminal adapter

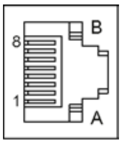
Table 8- 13 X24 24 V terminal adapter

	Terminal	Description	Technical specifications
	+	24 V power supply	24 VDC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm² Type: Screw terminal 5 (see Appendix, Chapter "Screw terminals")			

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

X200-X202 DRIVE-CLiQ interfaces

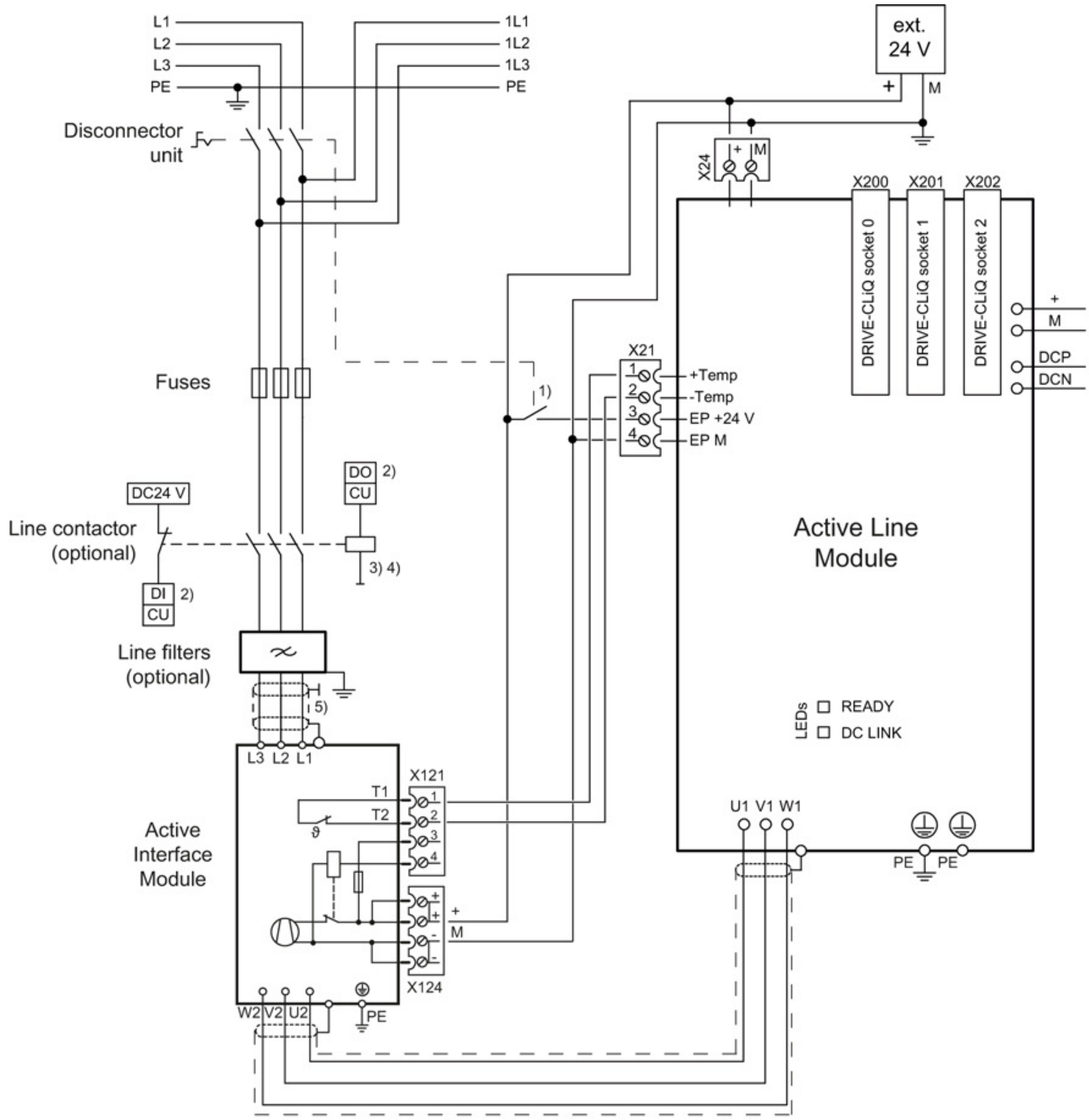
Table 8- 14 X200-X202 DRIVE-CLiQ interfaces

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

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

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

8.3.3.3 Connection example



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

Figure 8-12 Example connection of Active Line Module

8.3.3.4 Meaning of LEDs

Table 8- 15 Meaning of the LEDs on the Active Line Module

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

WARNING

Danger to life due to high DC link voltage, regardless of LED display

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.

- Observe the warning information on the component.

8.3.3.5 Dimension drawings

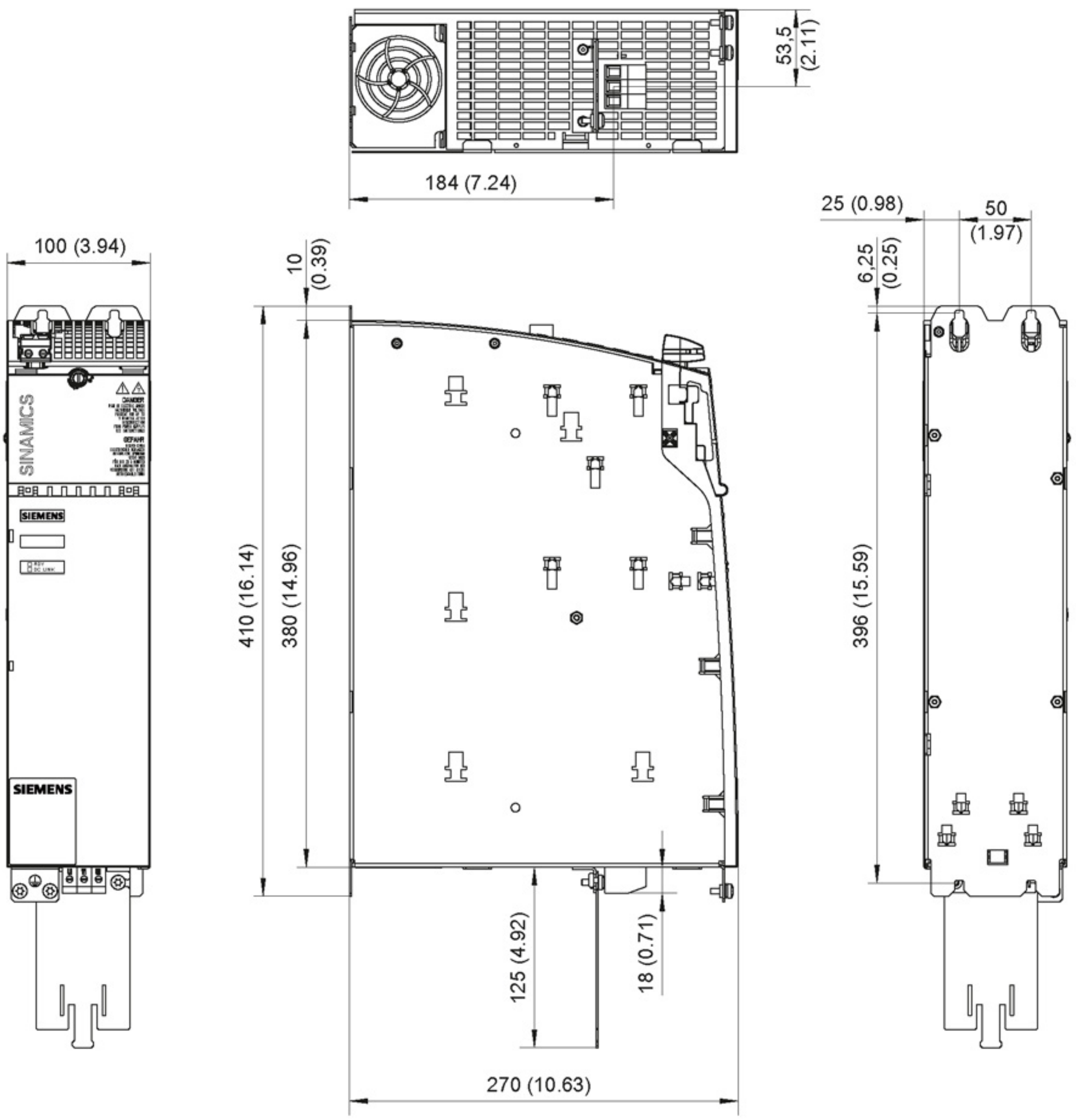


Figure 8-13 Dimension drawing of 16 kW Active Line Module with internal air cooling, all dimensions in mm and (inches)

Note

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

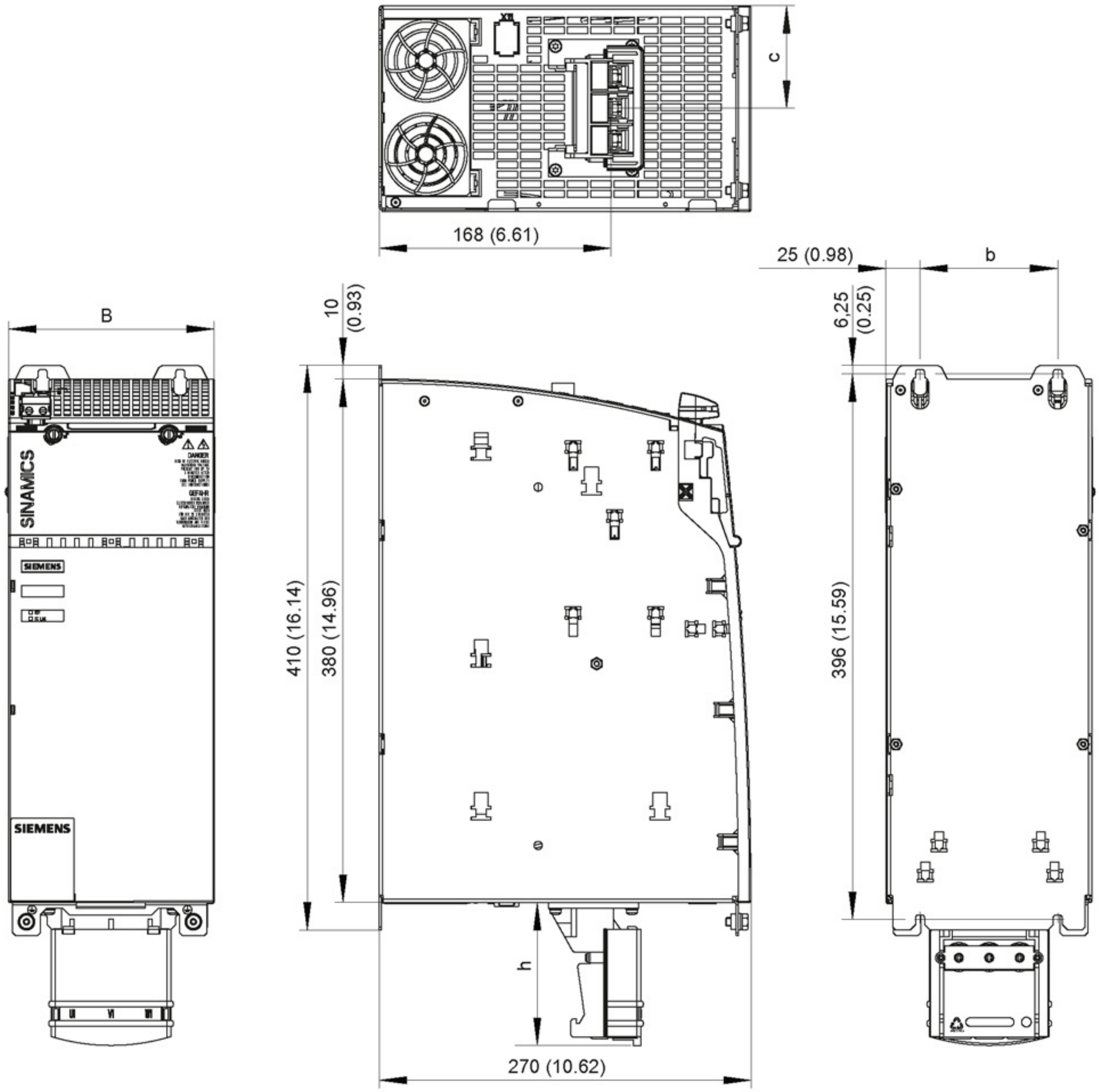


Figure 8-14 Dimension drawing of 36 kW and 55 kW Active Line Modules with internal air cooling (example, 36 kW), all dimensions in mm and (inches)

Table 8- 16 Dimensions of 36 kW and 55 kW Active Line Modules with internal air cooling

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

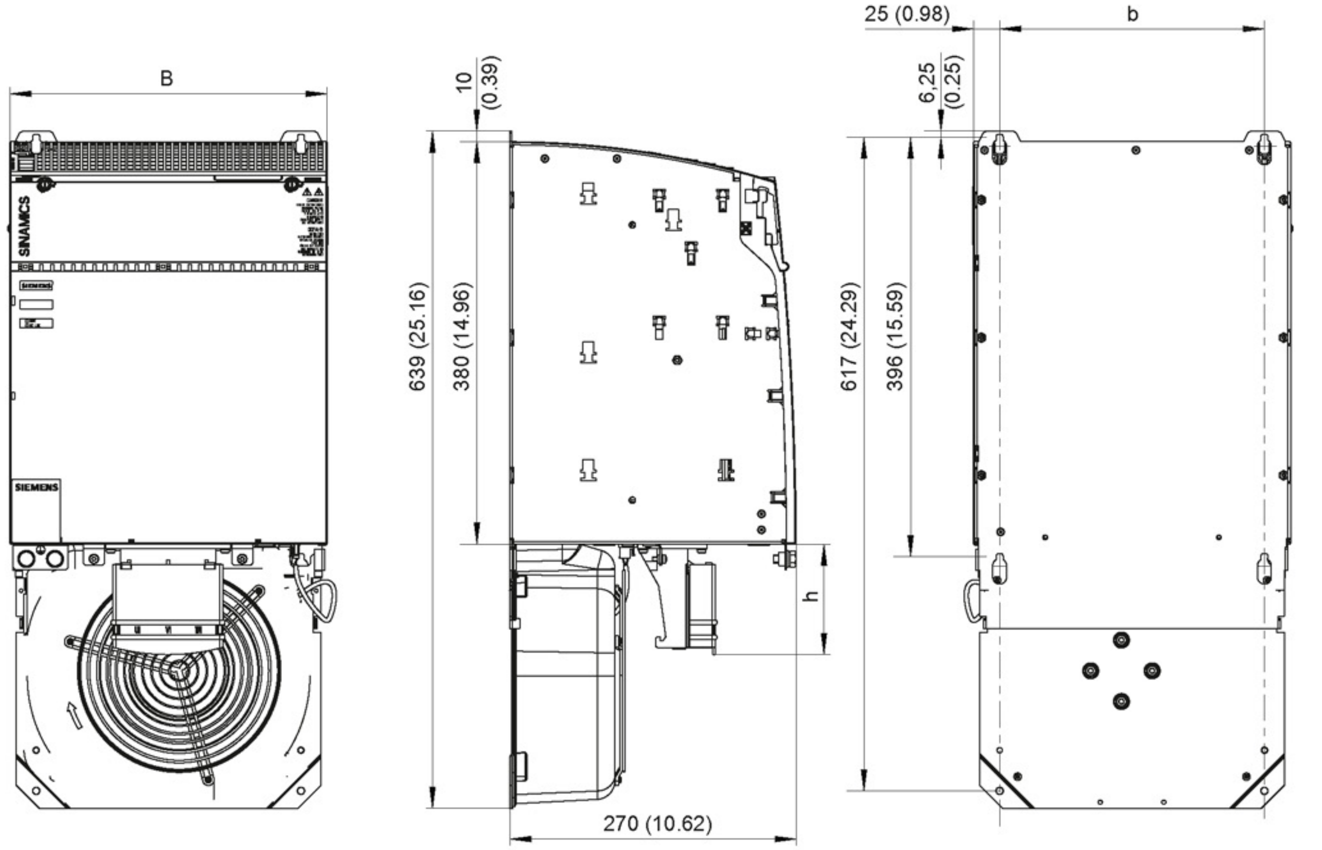


Figure 8-15 Dimension drawing of 80 kW and 120 kW Active Line Modules with internal air cooling, all dimensions in mm and (inches)

Table 8- 17 Dimensions of 80 kW and 120 kW Active Line Modules with internal air cooling

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

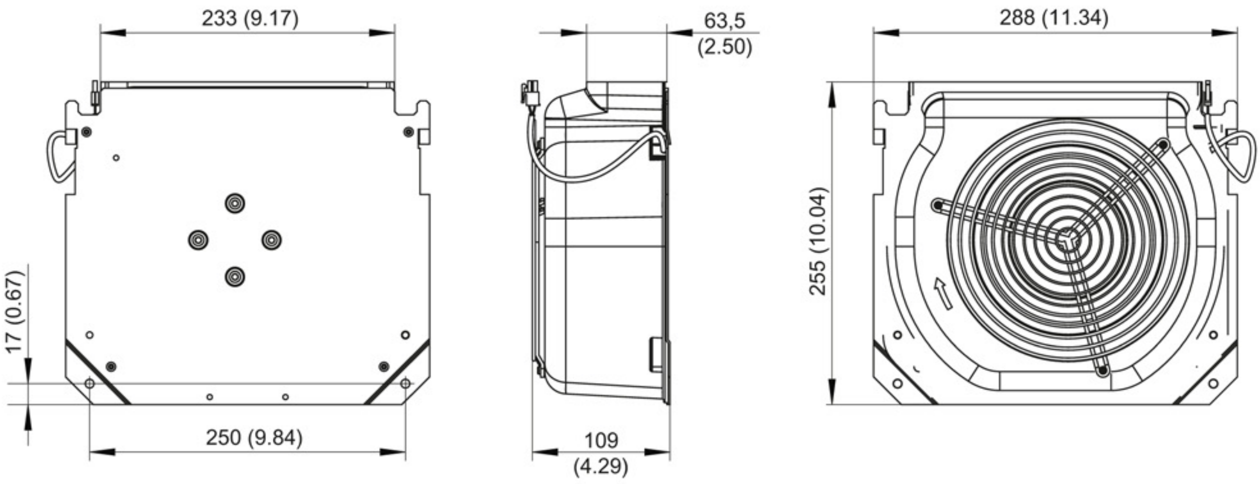


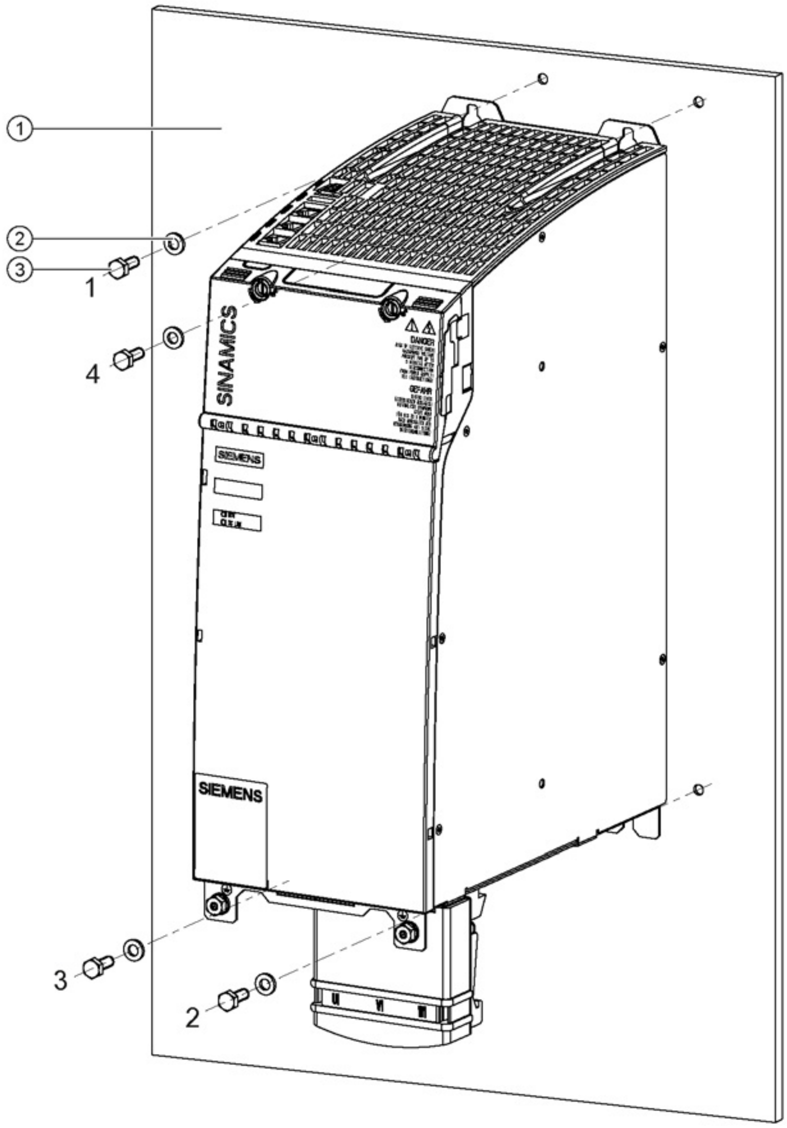
Figure 8-16 Dimension drawing of fan for 80 kW and 120 kW Active Line Modules with internal air cooling, all dimensions in mm and (inches)

Note

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

8.3.3.6 Installation

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



① Control cabinet panel/mounting panel

② Washer

③ M6 screw

Figure 8-17 Mounting an Active Line Module with internal air cooling (example: 36 kW)

Tightening torques:

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

Installing the sub-chassis fan

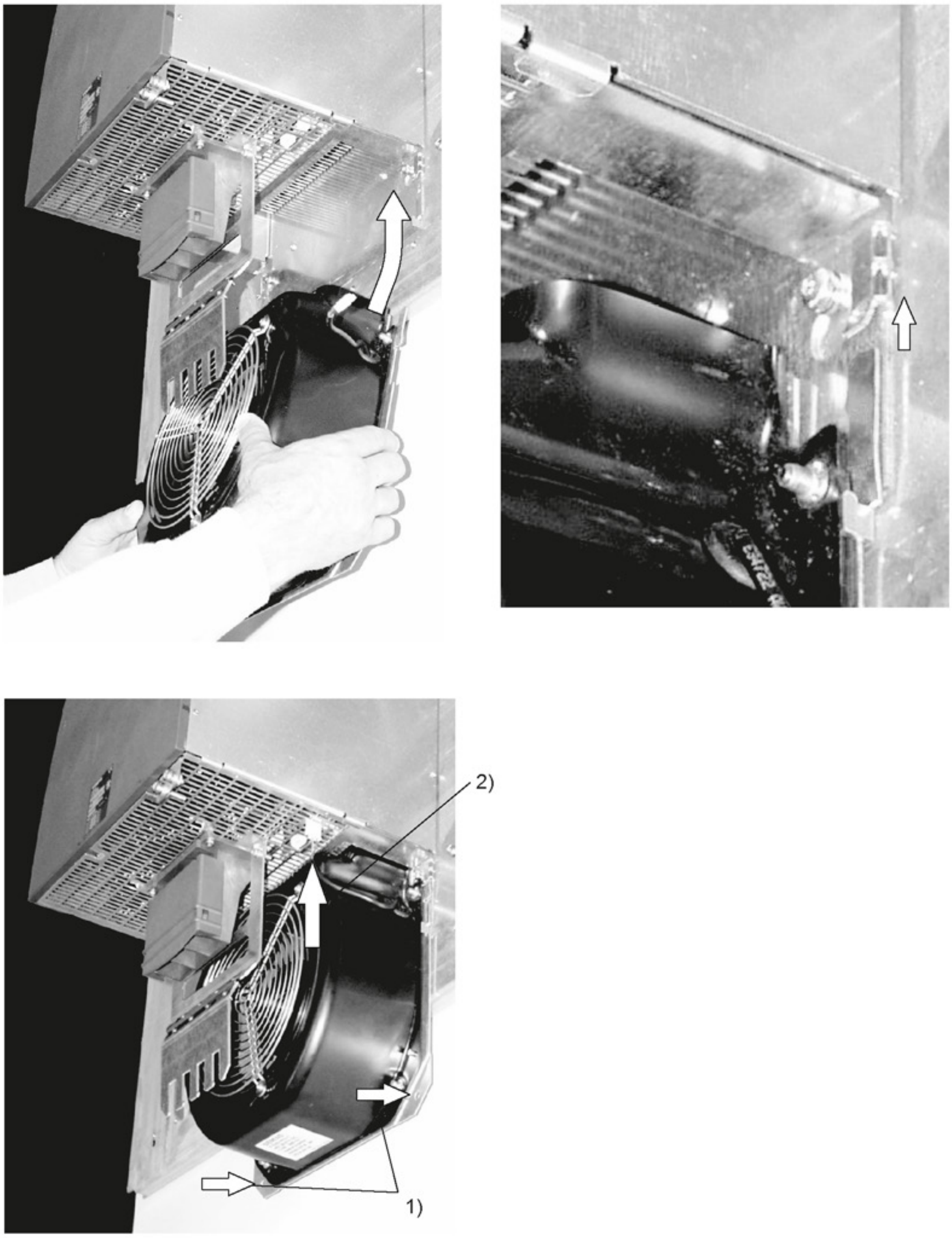


Figure 8-18 Mounting the fan for Active Line Modules 80 kW and 120 kW

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

8.3.3.7 Technical specifications

Table 8- 18 Technical data of Active Line Modules

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

Internal air cooling	**6SL3130–**	**7TE21–6AAx**	**7TE23–6AAx**	**7TE25–5AAx**	**7TE25–5AA3 + Active Interface Module**
Rated power	**kW**	**16**	**36**	**55**	**55**
Circuit breaker (IEC 60947 and UL)		See Chap. "Overcurrent protection using line fuses and circuit breakers (Page 116)"			
Rated short-circuit current SCCR[4]:	kA	65	65	65	65
Cooling method (internal air cooling)		Internal fan	Internal fan	Internal fan	Internal fan
Sound pressure level	dB(A)	<60	<65	<60	<60
Cooling air requirement	m^3/h	56	112	160	160
Max. permissible heat sink temperature	°C	85	90	83	83
Rated voltage for rated data 3 AC 380 V					
Weight	kg	7	10	17	17

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

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

3) For an overview, see the power loss tables in the Appendix

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

Table 8- 19 Technical data of Active Line Modules

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

Internal air cooling	6SL3130–	7TE28–0AAx	7TE31–2AAx
Rated power	**kW**	**80**	**120**
DC link currents Rated DC link current at 600 V: DC link current: at 600 V_{DC}; at S6-40% at 600 V_{DC}; peak current	 A_{DC} A_{DC} A_{DC}	 134 176 218	 200 244 292
Current-carrying capacity DC link busbar: 24 V busbar:	 A_{DC} A_{DC}	 200 20	 200 20
Electronics current consumption at 24 V DC	A_{DC}	1.4	1.8
Total power loss (including electronics losses)[3]	W	1383.6	2243.2
Max. ambient temperature without derating with derating	 °C °C	 40 55	 40 55
DC link capacitance Active Line Module Drive line-up, max.	 µF µF	 2820 20000	 3995 20000
Power factor	cosϕ	1	1
Circuit breaker (IEC 60947 and UL)		See Chap. "Overcurrent protection using line fuses and circuit breakers (Page 116)"	
Rated short-circuit current SCCR[4]:	kA	65	65
Cooling method (internal air cooling)		Mounted fan	Mounted fan
Sound pressure level	dB(A)	<73	<73
Cooling air requirement	m^3/h	520	520
Max. permissible heat sink temperature	°C	70	75
Rated voltage for rated data 3 AC 380 V			
Weight	kg	23	23

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

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

3) For an overview, see the power loss tables in the Appendix

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

Characteristics

Rated duty cycles for Active Line Modules

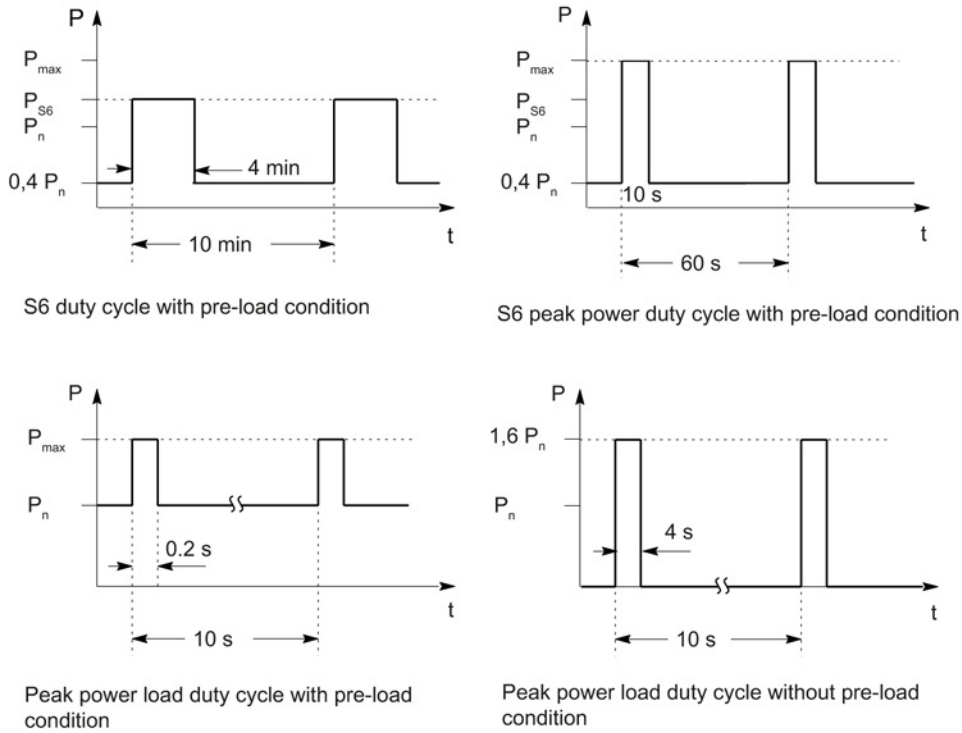


Figure 8-19 Rated duty cycles for Active Line Modules (**exception**: not applicable for 55 kW Active Line Module with Active Interface Module)

Rated duty cycles for Active Line Modules with Active Interface Modules

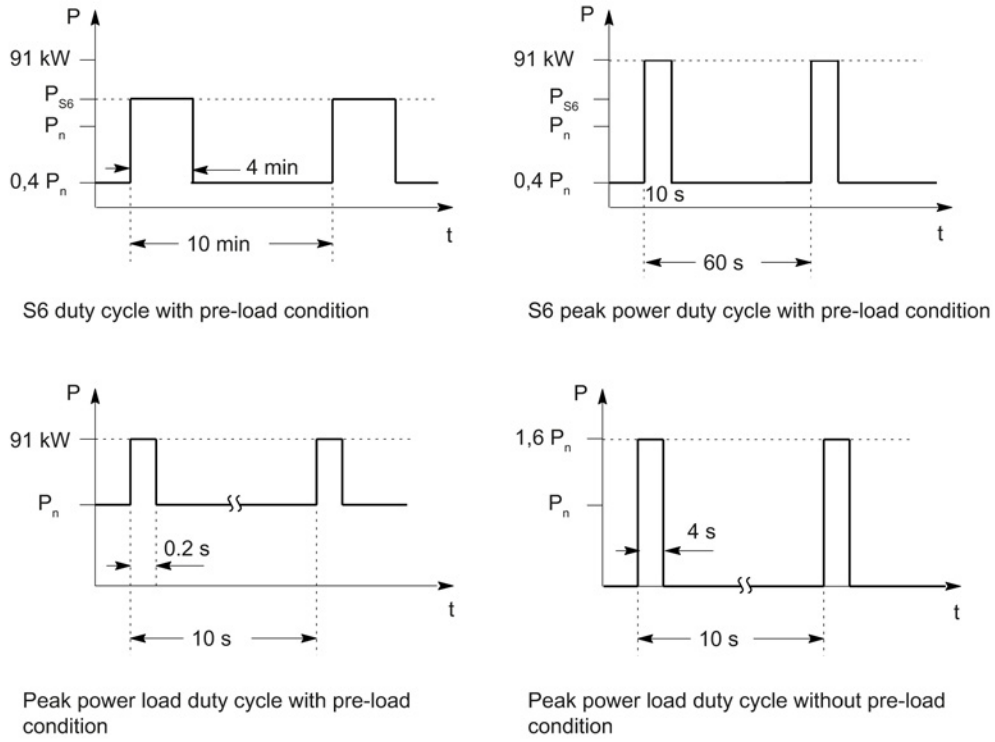


Figure 8-20 Duty cycles for 55 kW Active Line Modules with Active Interface Modules

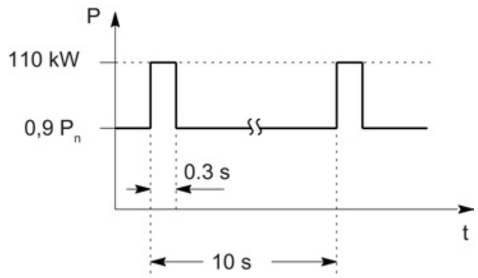


Figure 8-21 Peak duty cycle with initial load for 55 kW Active Line Modules with Active Interface Modules

Derating characteristics

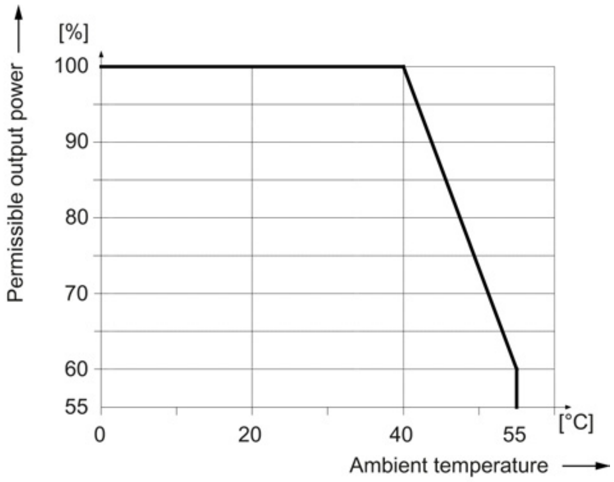


Figure 8-22 Output power as a function of the ambient temperature

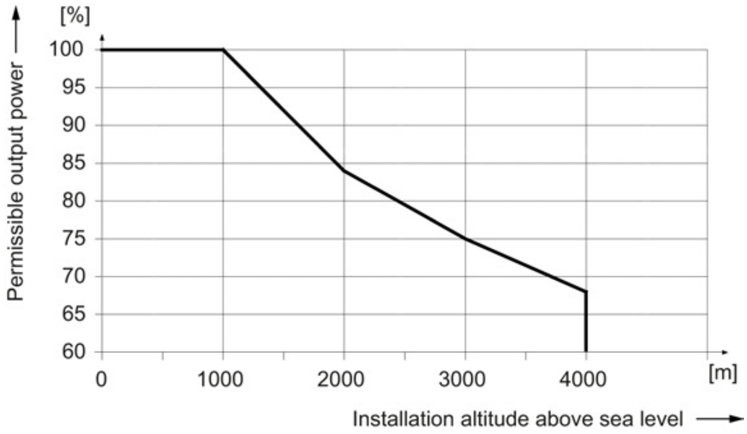


Figure 8-23 Output power as a function of the installation altitude

At installation altitudes > 2000 m, an isolation transformer must be used (see the chapter titled "System overview/Function of installation altitude and ambient temperature" (Page 32)). The design of the secondary line system must be as follows:

- TN system with grounded neutral point (no grounded line conductor)
- IT system

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

8.3.4 Active Line Modules with external air cooling

8.3.4.1 Description

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

This ensures that they are not influenced by network fluctuations.

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

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

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

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

8.3.4.2 Interface description

Overview

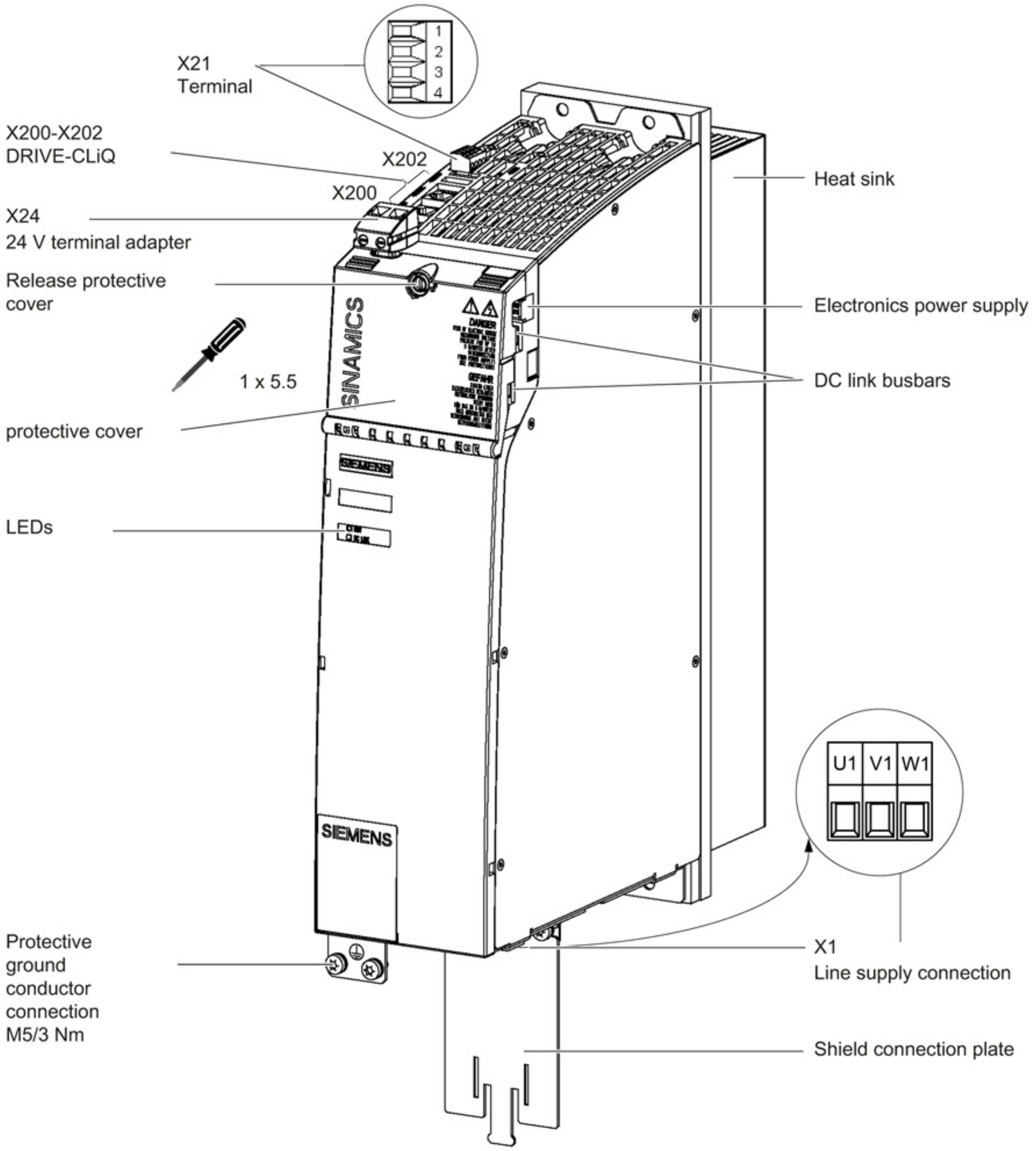
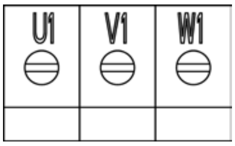
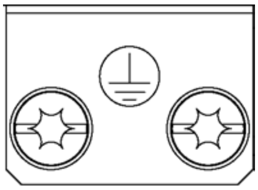


Figure 8-24 Interface overview, Active Line Module with external air cooling (example: 16 kW)

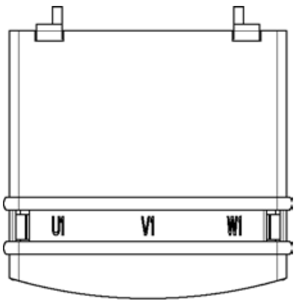
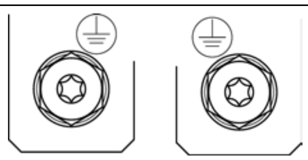
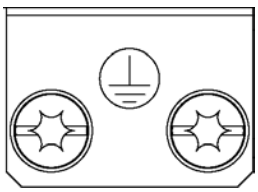
X1 line connection

Table 8- 20 X1: Line connection for Active Line Modules 16 kW

	Terminal	Technical specifications
	U1	Max. connectable cross-section: 10 mm² Type: Screw terminal 6 (see Appendix, "Screw terminals") Tightening torque: 1.5 - 1.8 Nm
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

Table 8- 21 X1: Line connection for Active Line Modules 36 kW to 120 kW

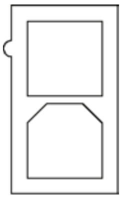
	Terminal	Technical specifications
	U1	Supply voltage: 3 AC 380 V - 480 V, 50/60 Hz **36 kW:** Threaded bolts M6/6 Nm 1) **55 kW, 80 kW and 120 kW:** Threaded bolts M8/13 Nm 1)
	V1	
	W1	
	PE connection	**36 kW:** Threaded hole M6/6 Nm 1)
		**55 kW:** Threaded hole M6/6 Nm 1) **80 kW and 120 kW:** Threaded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

1) For ring cable lugs in accordance with DIN 46234

X12 fan connection

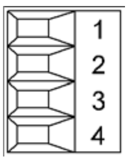
Active Line Modules 80 kW and 120 kW are equipped with an interface for connecting the sub-chassis fan. The interface is located on the underside of the Line Module.

Table 8- 22 X12 fan connection

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

X21 EP terminals

Table 8- 23 X21 EP terminal/temperature sensor

	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors[1]: KTY84–1C130[2]/PTC[2]/bimetallic switch with NC contact If an Active Interface Module is used, the temperature input must be connected to the Active Interface Module sensor (bimetallic switch with NC contact).
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see Appendix, "Screw terminals")			

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

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

⚠ CAUTION

Connecting the temperature sensor

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

⚠ WARNING

Danger to life due to charged DC link

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

Note

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

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

⚠ DANGER

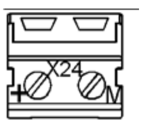
Risk of electric shock!

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

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

X24 24 V terminal adapter

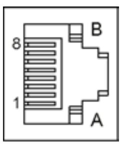
Table 8- 24 X24 24 V terminal adapter

	Terminal	Description	Technical specifications
	+	24 V power supply	24 VDC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see Appendix, "Screw terminals")			

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

X200-X202 DRIVE-CLiQ interfaces

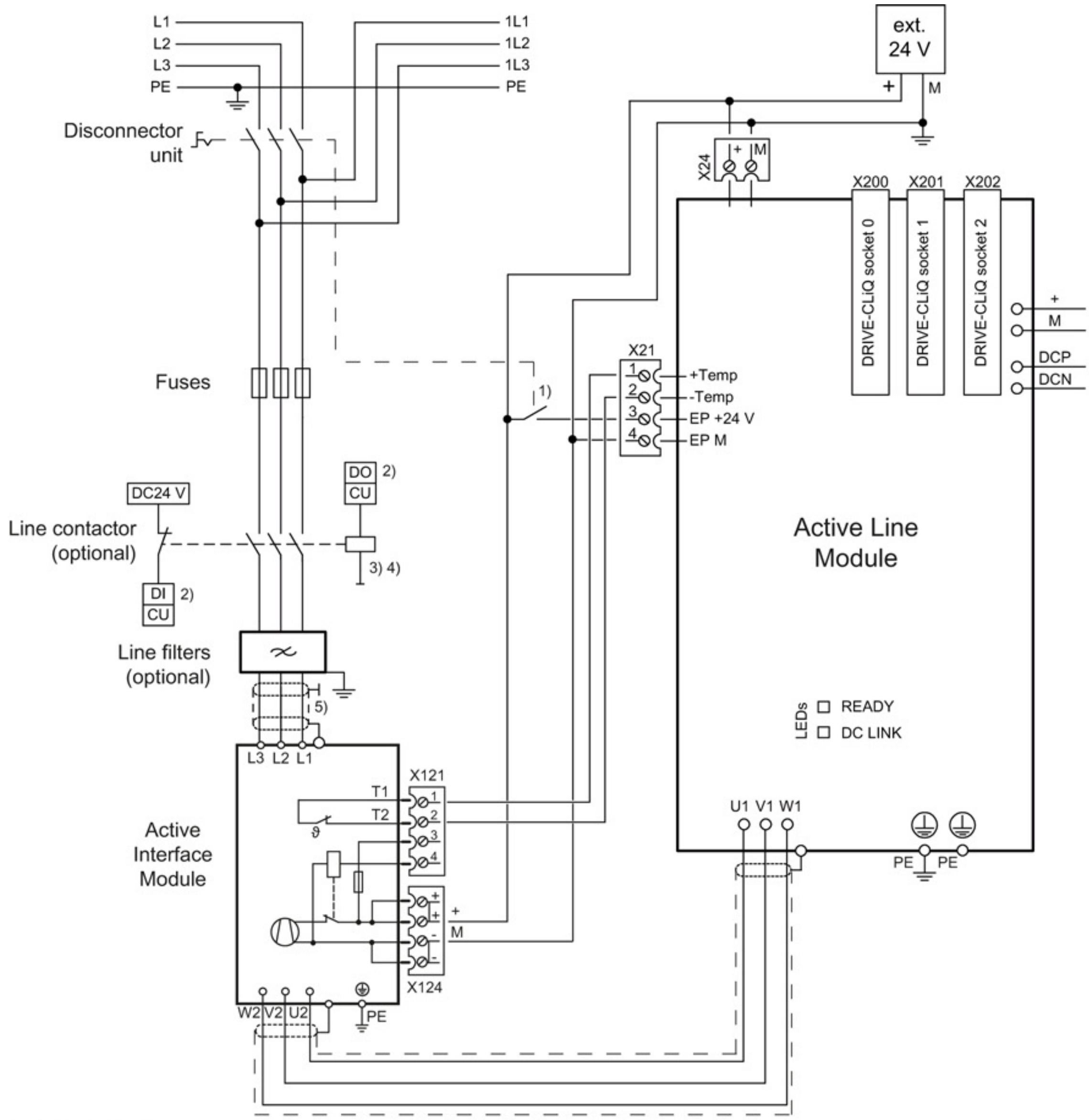
Table 8- 25 X200-X202 DRIVE-CLiQ interfaces

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

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

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

8.3.4.3 Connection example



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

Figure 8-25 Example connection of Active Line Module

8.3.4.4 Meaning of LEDs

Table 8- 26 Meaning of the LEDs on the Active Line Module

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

⚠ WARNING

Danger to life due to high DC link voltage, regardless of LED display

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.

- Observe the warning information on the component.

8.3.4.5 Dimension drawings

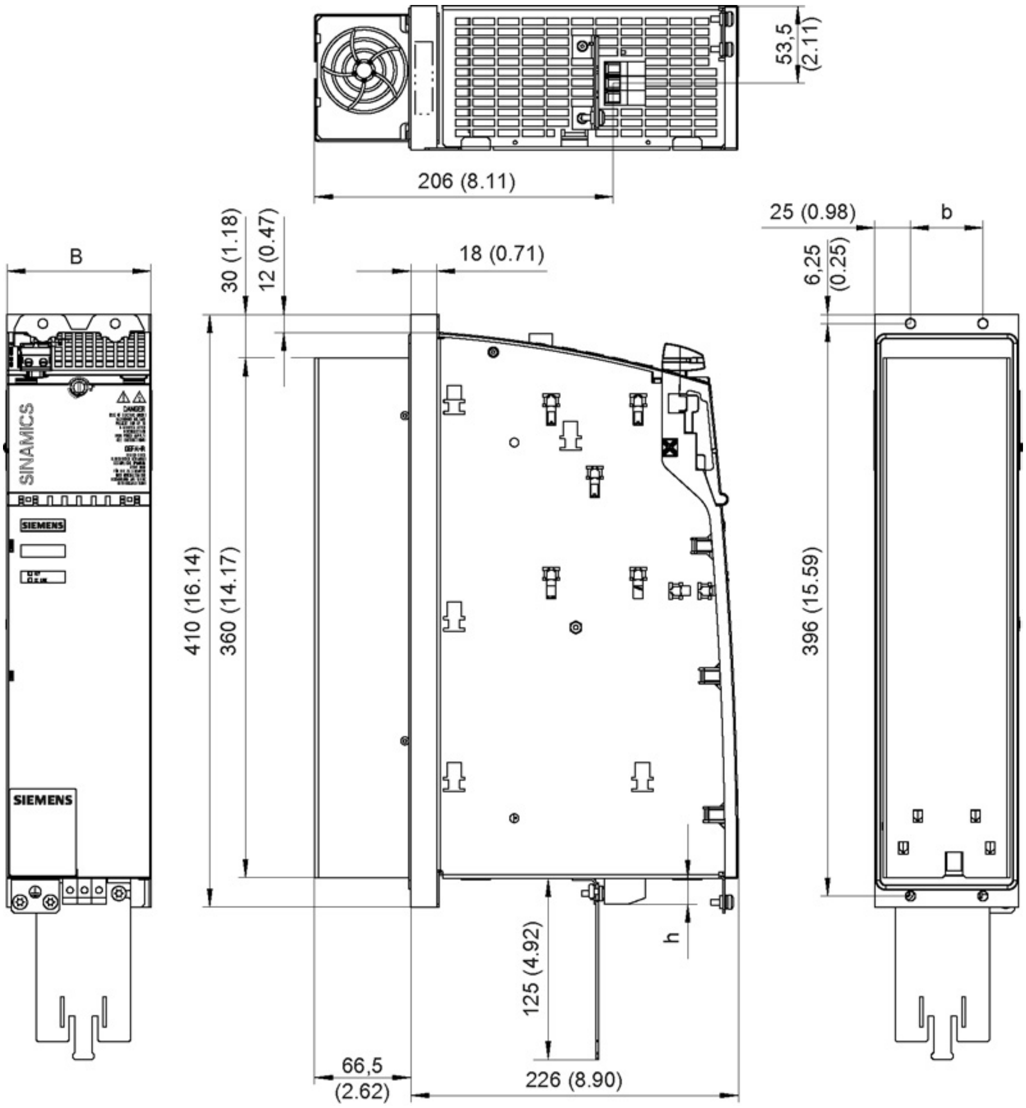


Figure 8-26 Dimension drawing of 16 kW Active Line Module with external air cooling, all dimensions in mm and (inches)

Table 8- 27 Dimensions of 16 kW Active Line Module with external air cooling

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

Note

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

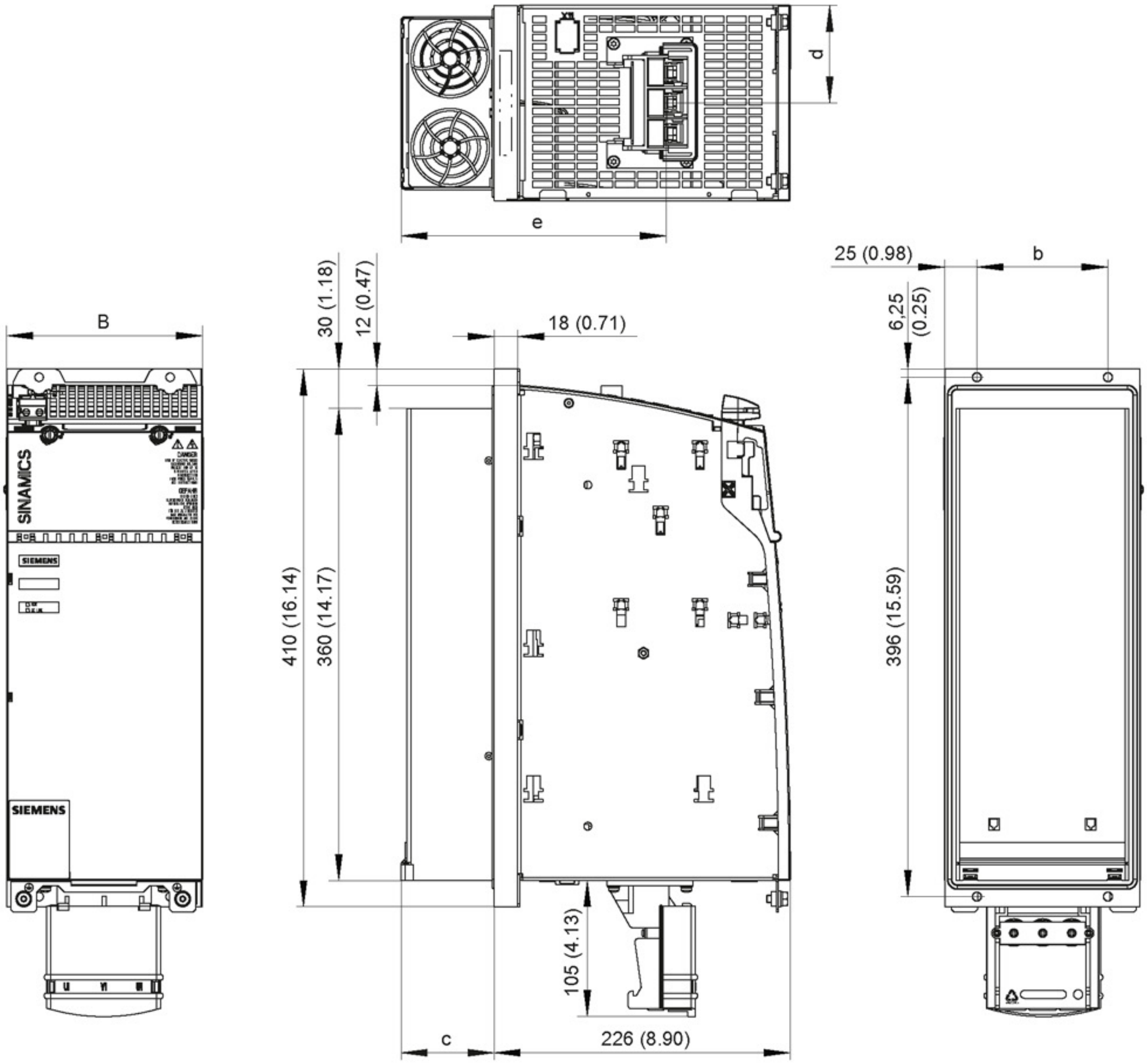


Figure 8-27 Dimension drawing of 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules with external air cooling (example 36 kW), all dimensions in mm and (inches)

Table 8- 28 Dimensions of 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules with external air cooling

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

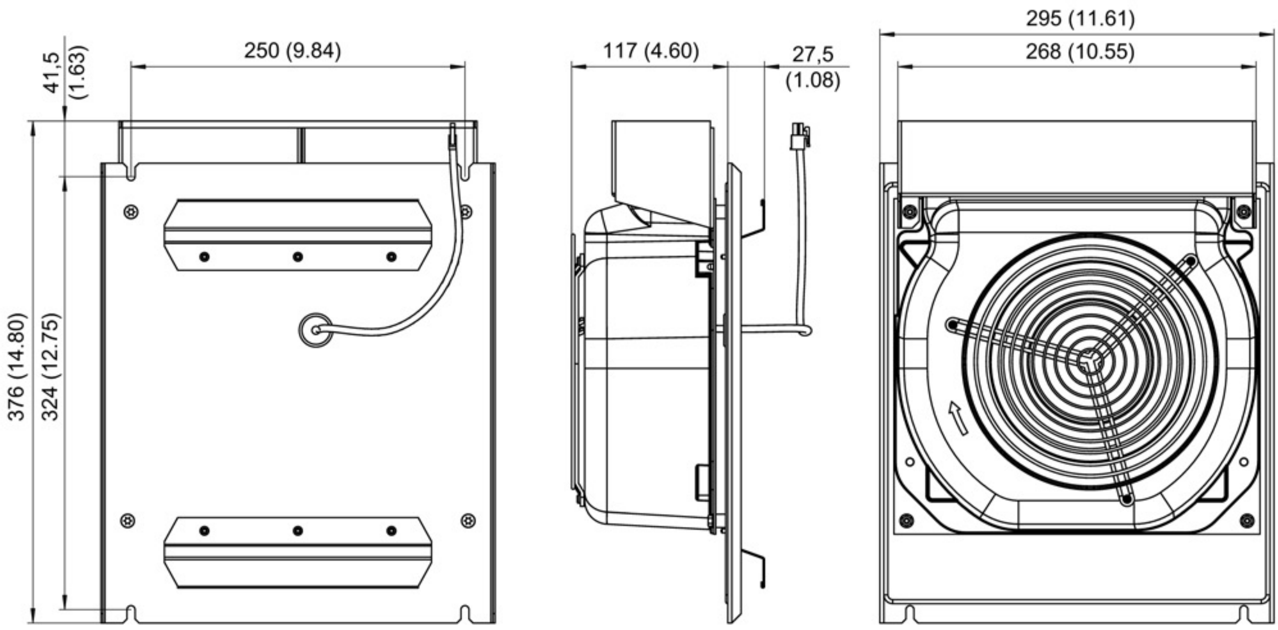
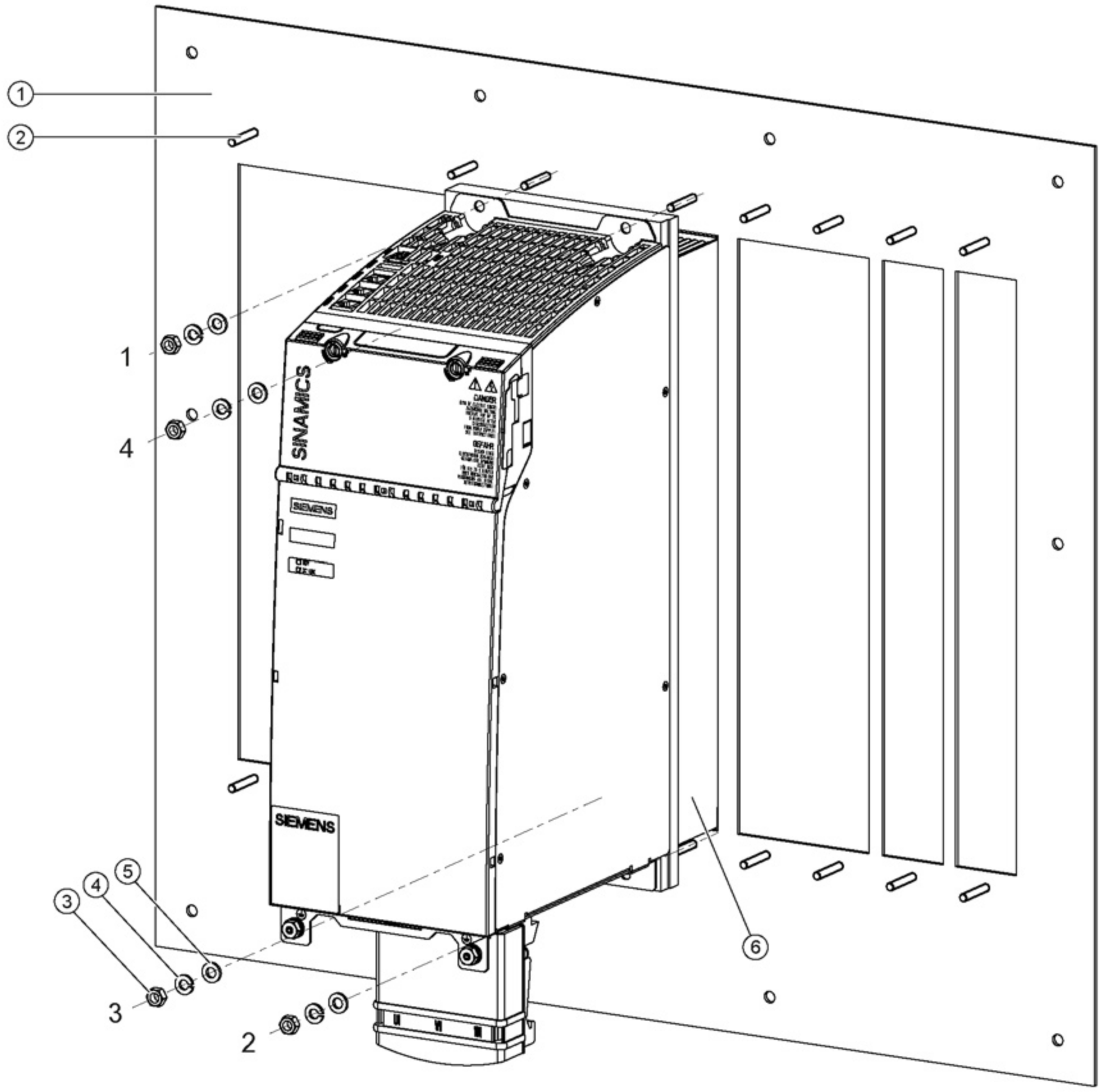


Figure 8-28 Dimension drawing of fan for 80 kW and 120 kW Active Line Modules with external air cooling, all dimensions in mm and (inches)

8.3.4.6 Installation



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

Figure 8-29 Mounting an Active Line Module with external air cooling (example: 36 kW)

Tightening torques:

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

Help with the mechanical control cabinet installation is available from:

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

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

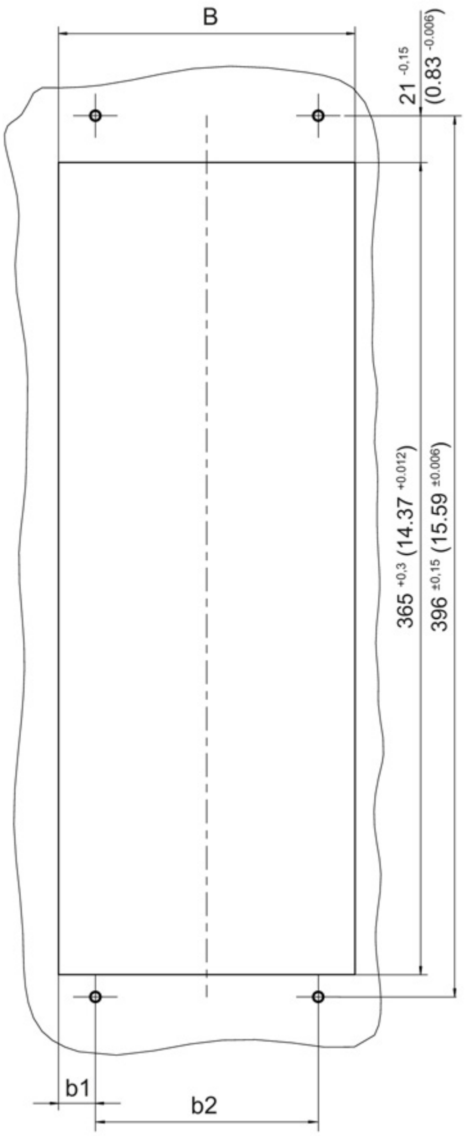
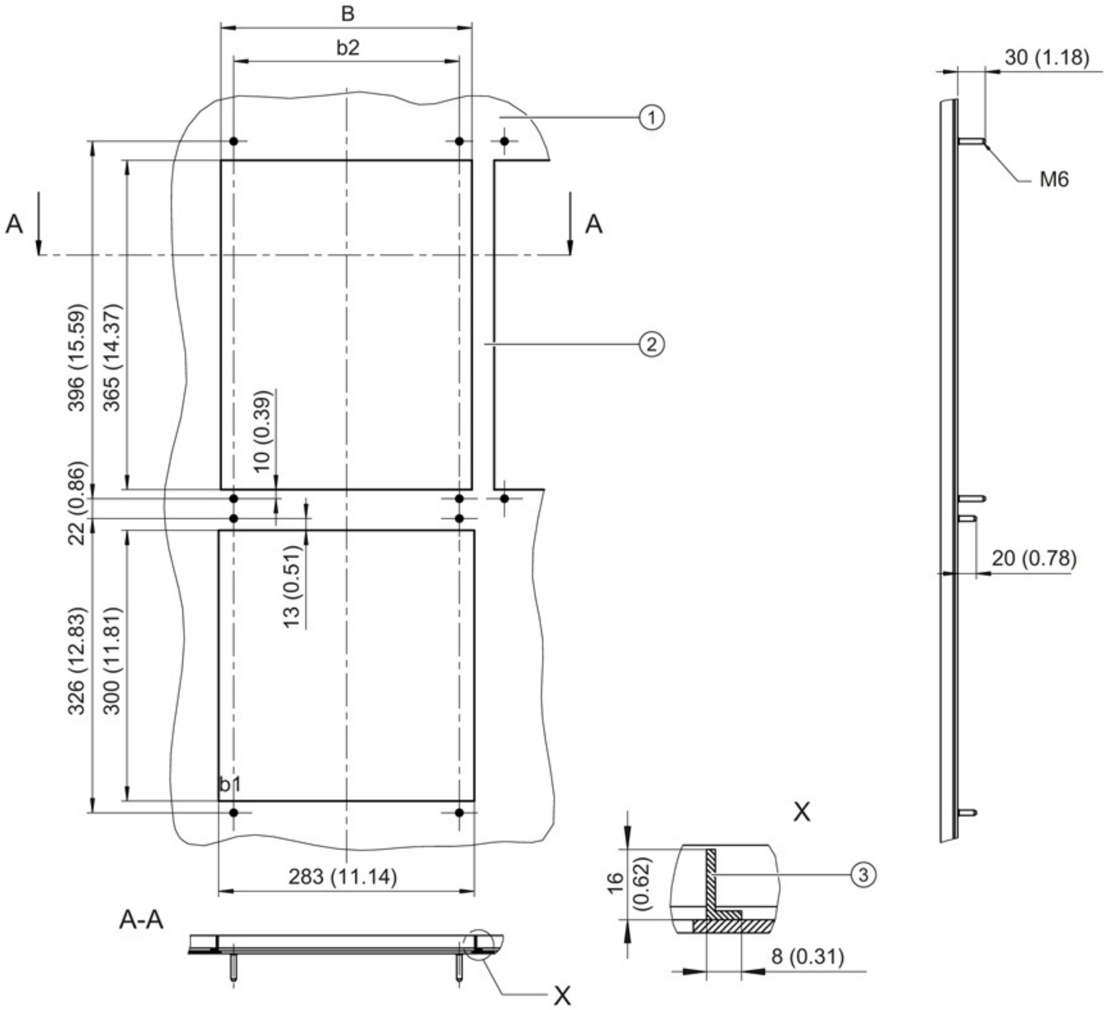


Figure 8-30 Installation openings for Active Line Modules 50 mm to 200 mm with external air cooling, all data in mm and (inches)

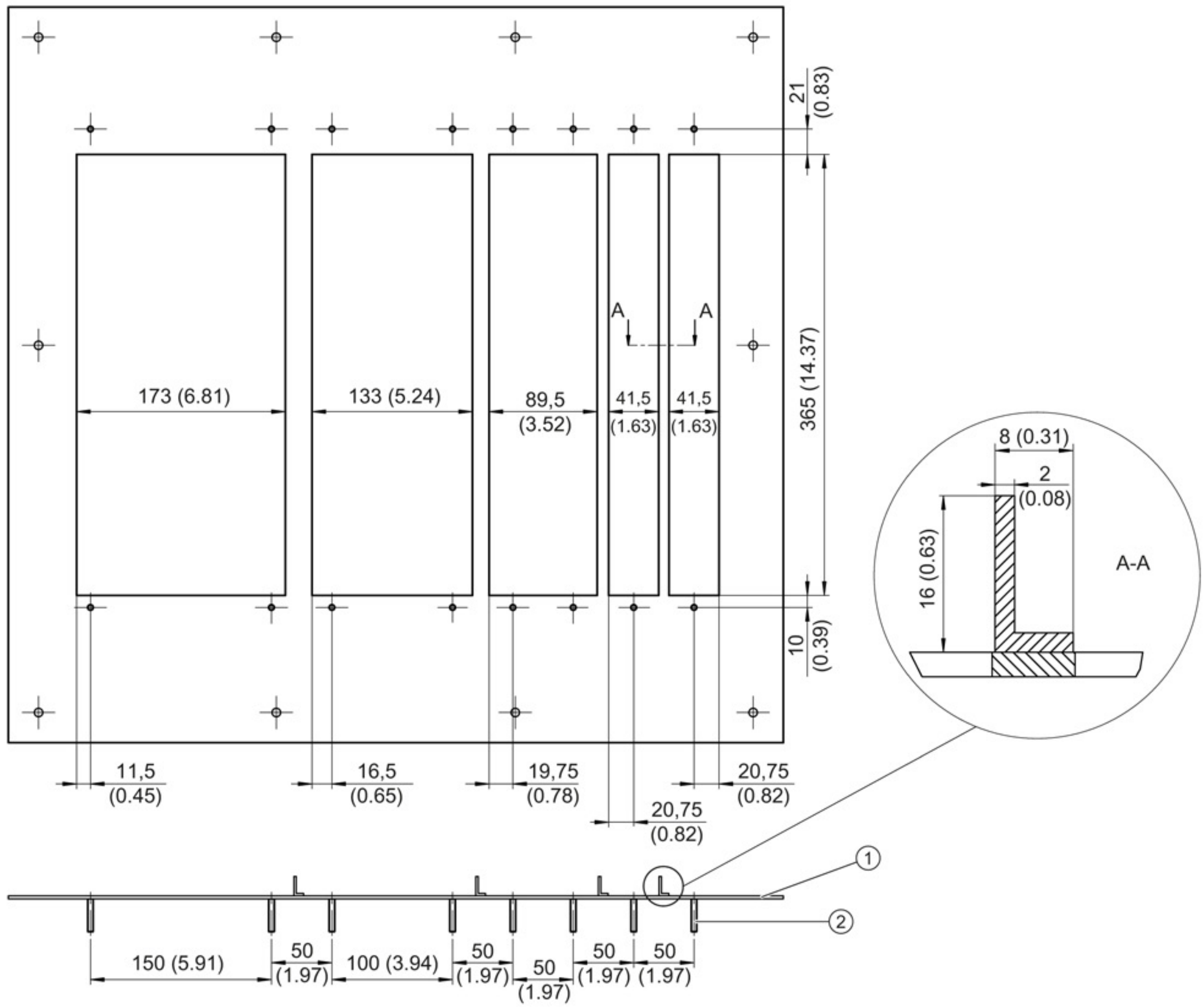


① Insert or mounting plate
② Cross-piece
③ Reinforcing bracket

Figure 8-31 Installation openings for an Active Line Modules 300 mm with external air cooling, all data in mm and (inches)

Table 8- 29 Dimensions of installation openings for Active Line Modules with external air cooling

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



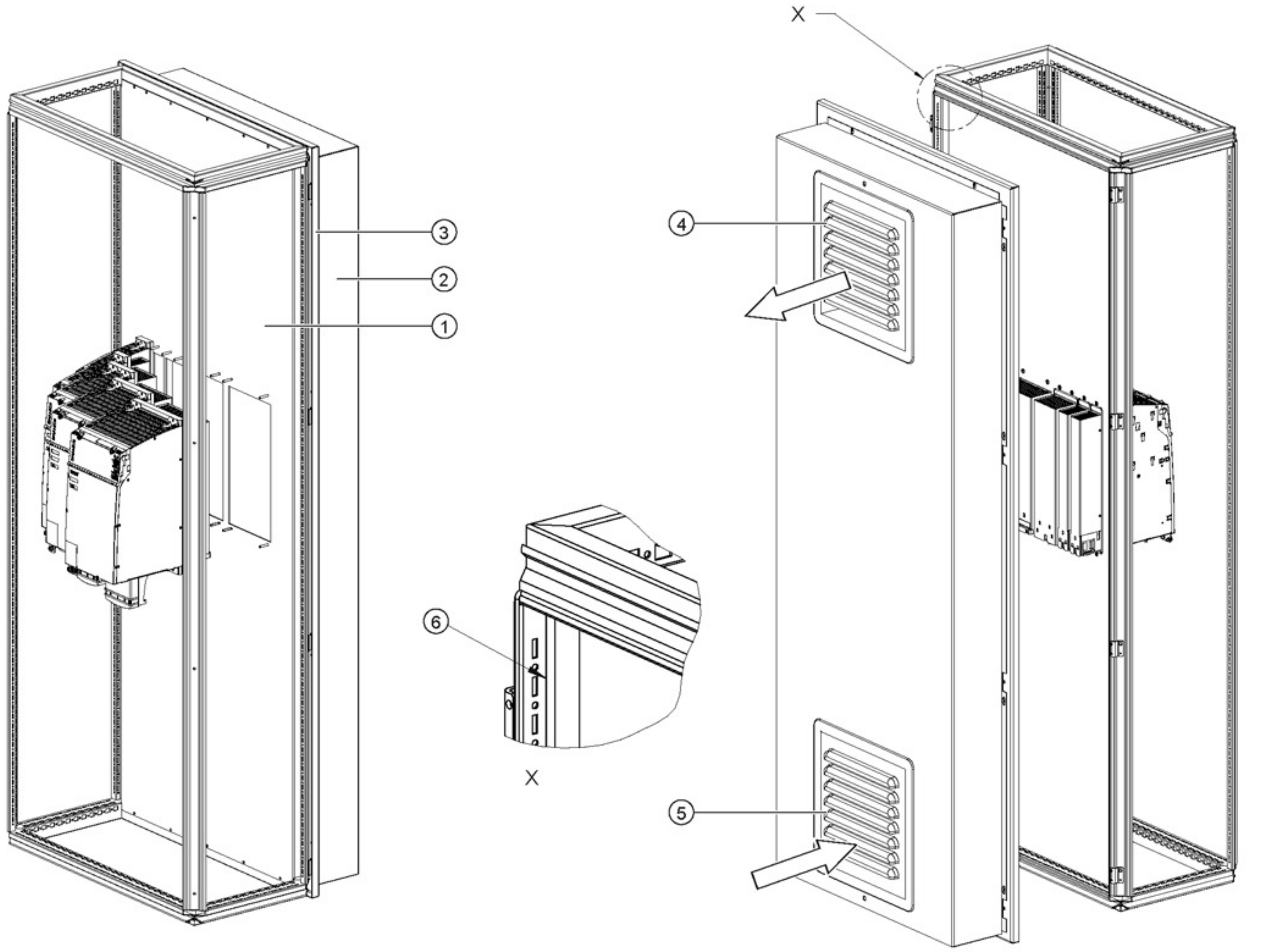
① Insert or mounting plate

② Threaded bolts M5 x 28

Figure 8-32 Example of a mounting plate for a drive line-up with external air cooling

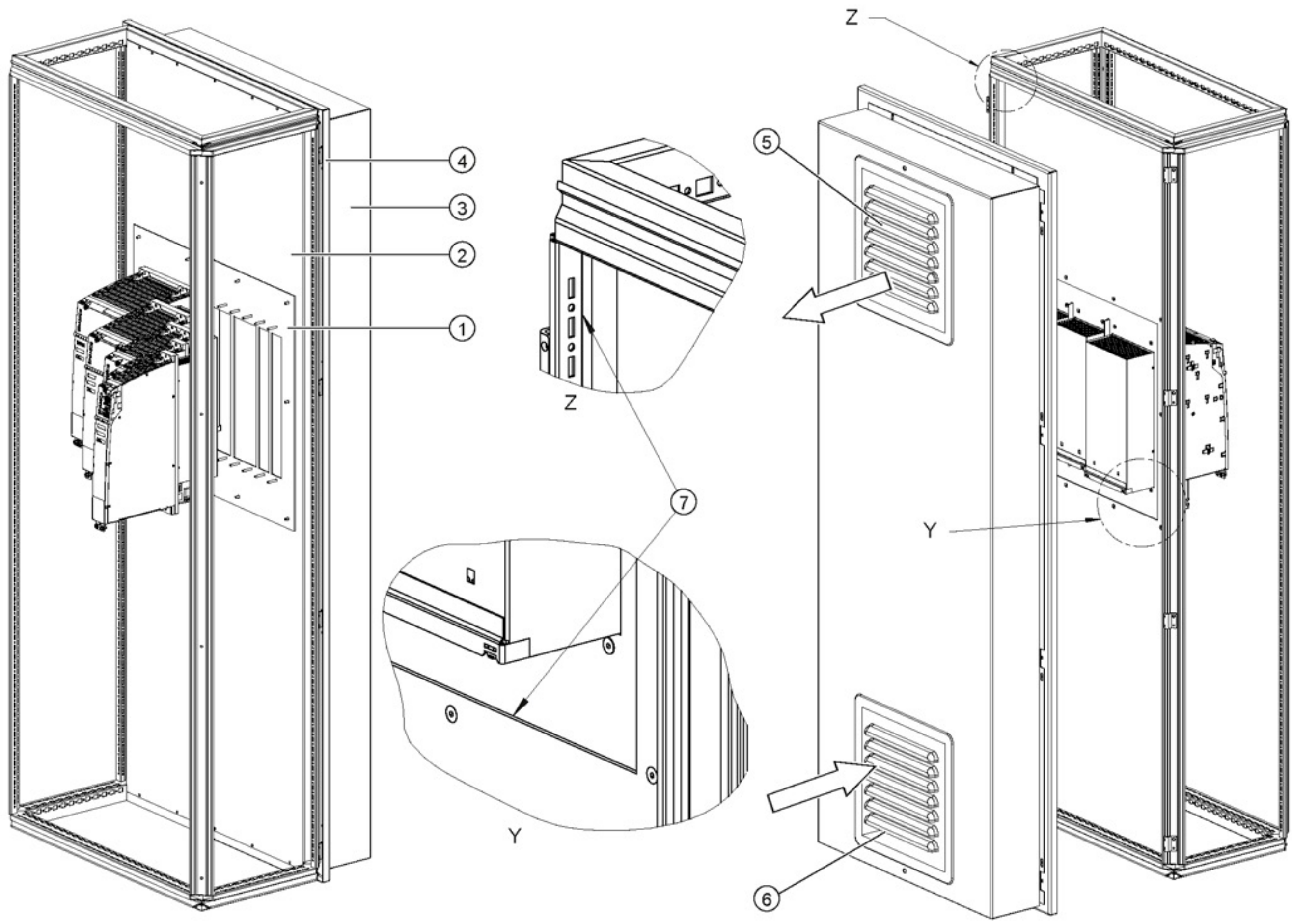
During installation it must be ensured that the component's seal is tight throughout. The cross-pieces must have the appropriate stability. If necessary, the cross-pieces of the openings must be reinforced.

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



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

Figure 8-33 Example 1: installation in cabinet with mounting plate



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

Figure 8-34 Example 2: installation in cabinet with mounting plate

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

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

Note

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

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

8.3.4.7 Technical data

Table 8- 30 Technical data for Active Line Modules with external air cooling, part 1

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

External air cooling	**6SL3131–**	**7TE21–6AAx**	**7TE23–6AAx**	**7TE25–5AAx**	**7TE25–5AA3 + Active Interface Module**
Rated power	**kW**	**16**	**36**	**55**	**55**
Electronics current consumption at 24 V DC	A_{DC}	0.95	1.5	1.9	1.9
Total power loss (including electronics losses)[3]	W	282.8	666	945.6	945.6
Max. ambient temperature without derating with derating	 °C °C	 40 55	 40 55	 40 55	 40 55
DC link capacitance Active Line Module Drive line-up, max.	 μF μF	 705 20000	 1410 20000	 1880 20000	 1880 20000
Power factor	cosφ	1	1	1	1
Circuit breaker (IEC 60947 and UL)		See Chap. "Overcurrent protection using line fuses and circuit breakers (Page 116)"			
Rated short-circuit current SCCR[4]	kA	65	65	65	65
Sound pressure level	dB(A)	<60	<65	<60	<60
Cooling air requirement	m^3/h	56	112	160	160
Max. permissible heat sink temperature	°C	85	90	88	88
Rated voltage for rated data 3 AC 380 V					
Weight	kg	8.78	13.77	18.5	18.5

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

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

3) For an overview, see the power loss tables in the Appendix

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

Table 8- 31 Technical data for Active Line Modules with external air cooling, part 2

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

External air cooling	6SL3131–	7TE28–0AAx	7TE31-2AAx
Rated power	**kW**	**80**	**120**
DC link voltage Overvoltage trip Undervoltage trip2)	V_{DC} V_{DC} V_{DC}	510 - 720 820 ±2% 360 ±2%	
Input currents Rated input current at 400 V_{AC}: Input current at 380 V_{AC}/480 V_{AC} at 400 V_{AC}; S6-40% at 400 V_{AC}; peak current	 A_{AC} A_{AC} A_{AC} A_{AC}	 122 128 / 102 161 200	 182 192 / 152 220 267
DC link currents Rated DC link current at 600 V: DC link current: at 600 V_{DC}; at S6-40% at 600 V_{DC}; peak current	 A_{DC} A_{DC} A_{DC}	 134 176 218	 200 244 292
Current-carrying capacity DC link busbar: 24 V busbar:	 A_{DC} A_{DC}	 200 20	 200 20
Electronics current consumption at 24 V DC	A_{DC}	1.4	1.8
Total power loss (including electronics losses)3)	W	1383.6	2243.2
Max. ambient temperature without derating with derating	 °C °C	 40 55	 40 55
DC link capacitance Active Line Module Drive line-up, max.	 μF μF	 2820 20000	 3995 20000
Power factor	cosφ	1	1
Circuit breaker (IEC 60947 and UL)		See Chap. "Overcurrent protection using line fuses and circuit breakers (Page 116)"	
Rated short-circuit current SCCR4)	kA	65	65
Sound pressure level	dB(A)	<73	<73
Cooling air requirement	m^3/h	520	520
Max. permissible heat sink temperature	°C	73	83
Rated voltage for rated data 3 AC 380 V			
Weight	kg	27.66	30.74

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

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

3) For an overview, see the power loss tables in the Appendix

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

Characteristics

Rated duty cycles for Active Line Modules

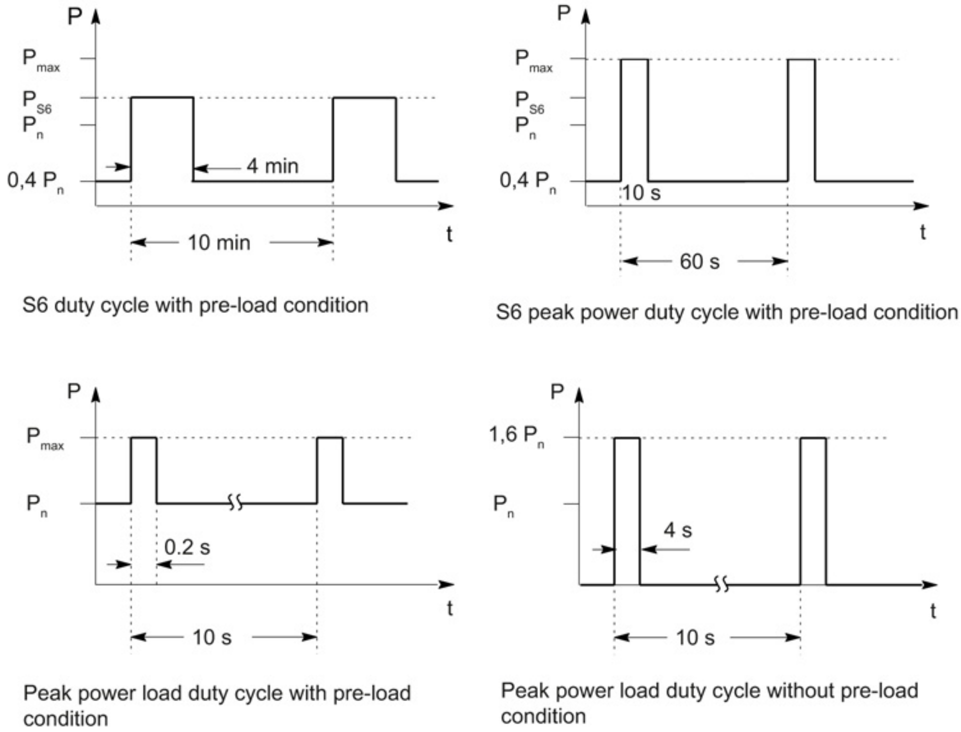


Figure 8-35 Rated duty cycles for Active Line Modules (**exception**: not applicable for 55 kW Active Line Module with Active Interface Module)

Rated duty cycles for Active Line Modules with Active Interface Modules

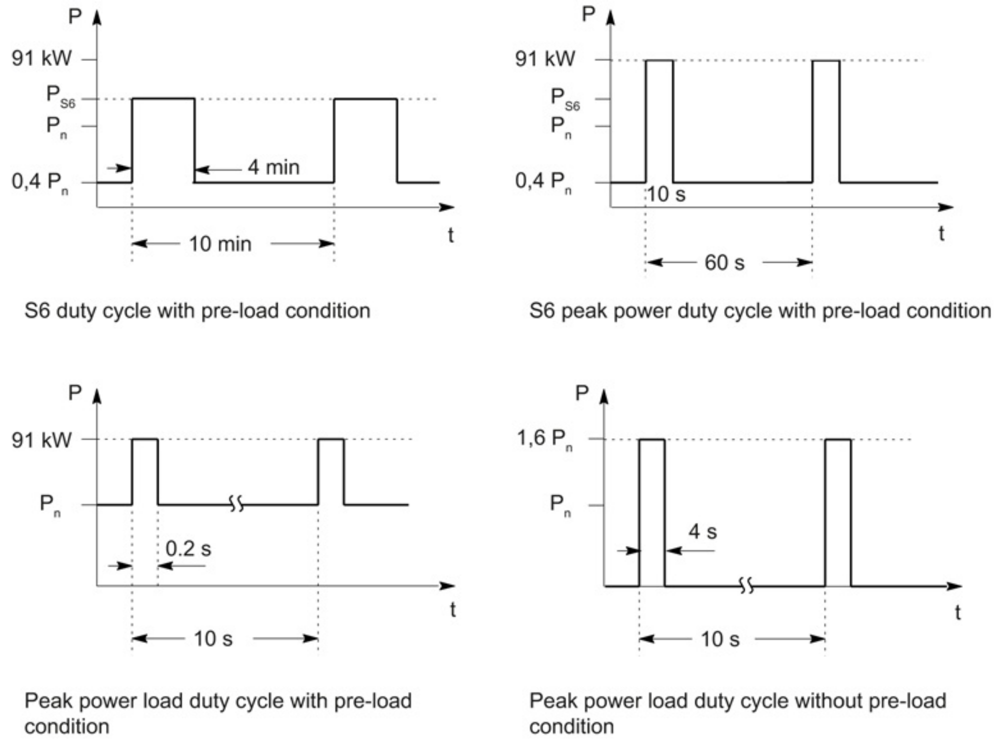


Figure 8-36 Duty cycles for 55 kW Active Line Modules with Active Interface Modules

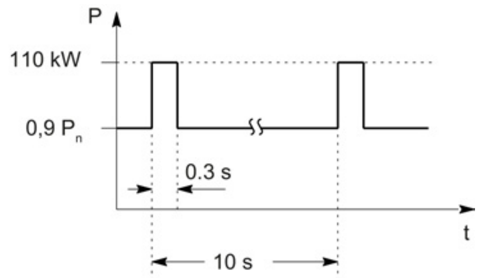


Figure 8-37 Peak duty cycle with initial load for 55 kW Active Line Modules with Active Interface Modules

Derating characteristics

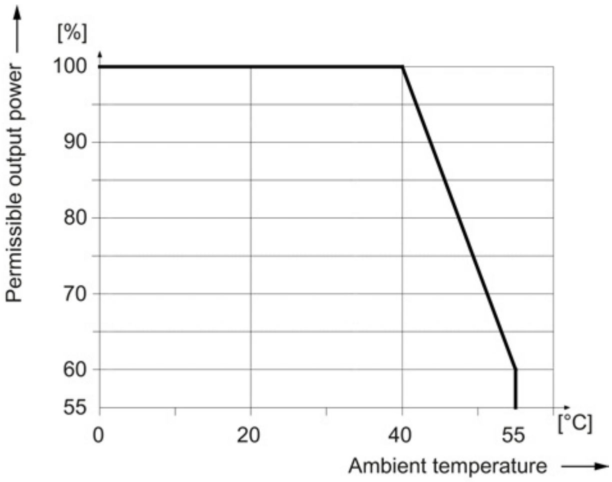


Figure 8-38 Output power as a function of the ambient temperature

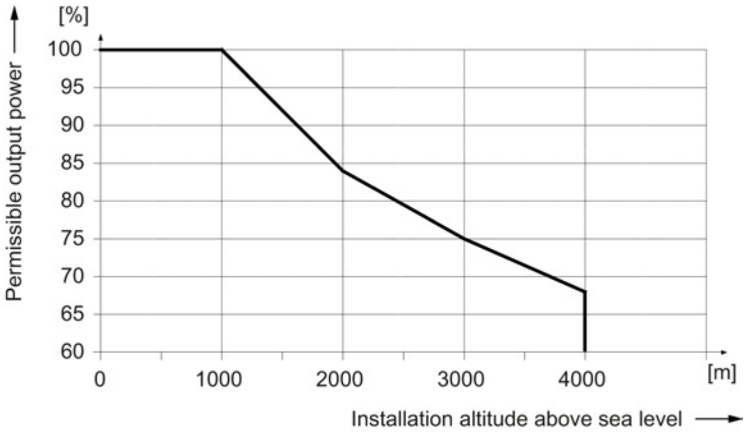


Figure 8-39 Output power as a function of the installation altitude

At installation altitudes > 2000 m, an isolation transformer must be used (see the chapter titled "System overview/Function of installation altitude and ambient temperature" (Page 32)). The design of the secondary line system must be as follows:

- TN system with grounded neutral point (no grounded line conductor)
- IT system

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

8.3.5 Active Line Modules with cold plate

8.3.5.1 Description

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

This ensures that they are not influenced by network fluctuations.

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

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

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

8.3.5.2 Interface description

Overview

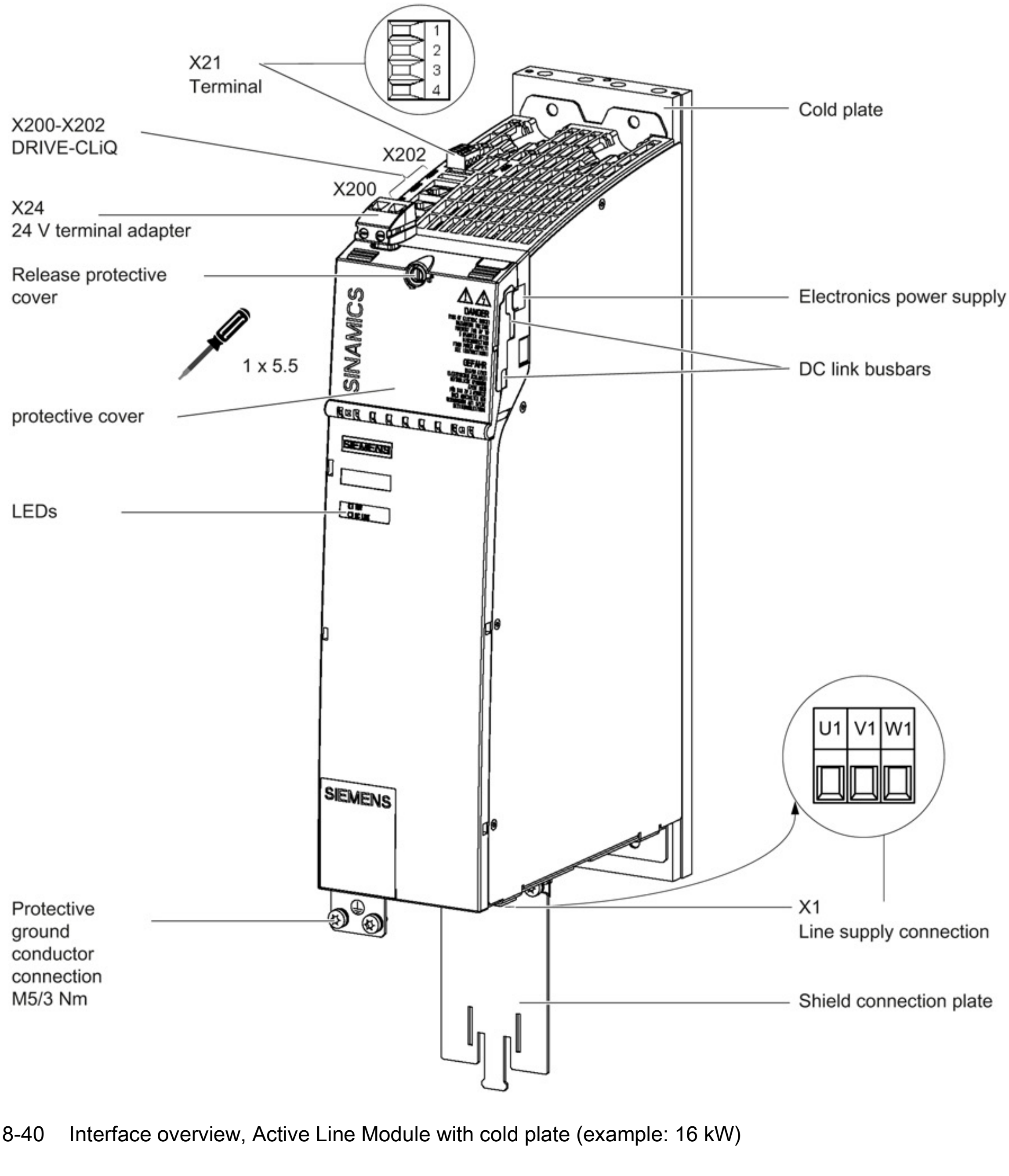
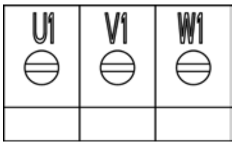
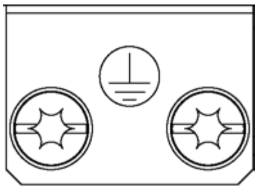


Figure 8-40 Interface overview, Active Line Module with cold plate (example: 16 kW)

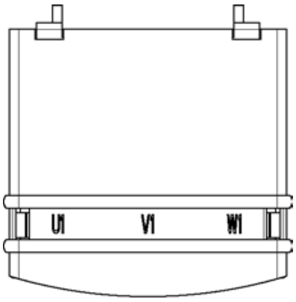
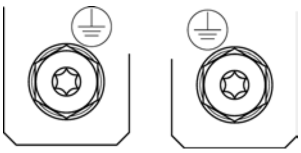
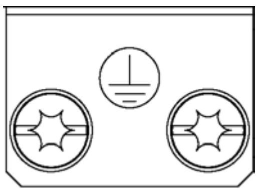
X1 line connection

Table 8- 32 X1: Line connection for Active Line Modules 16 kW

	Terminal	Technical specifications
	U1 V1 W1	Max. connectable cross-section: 10 mm² Type: Screw terminal 6 (see Appendix, Chapter "Screw terminals") Tightening torque: 1.5 - 1.8 Nm
	PE connection	Threaded hole M5/3 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

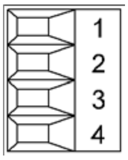
Table 8- 33 X1: Line connection for Active Line Modules 36 kW to 120 kW

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

1) For ring cable lugs in accordance with DIN 46234

X21 EP terminals

Table 8- 34 X21 EP terminal/temperature sensor

	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors[1]: KTY84–1C130[2]/PTC[2]/bimetallic switch with NC contact If an Active Interface Module is used, the temperature input must be connected to the Active Interface Module sensor (bimetallic switch with NC contact).
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see Appendix, Chapter "Screw terminals")			

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

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

CAUTION

Connecting the temperature sensor

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

WARNING

Danger to life due to charged DC link

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

Note

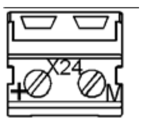
If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals 3 (EP +24 V) and 4 (EP M) must be interrupted beforehand. This can be carried out using a leading (≥ 10 ms) breaking auxiliary contact, for example.

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

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

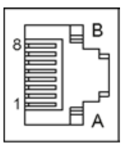
X24 24 V terminal adapter

Table 8- 35 X24 24 V terminal adapter

	Terminal	Description	Technical specifications
	+	24 V power supply	24 VDC supply voltage
	M	Ground	Electronics ground
The 24 V terminal adapter is included in the scope of delivery. Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see Appendix, Chapter "Screw terminals")			

X200-X202 DRIVE-CLiQ interfaces

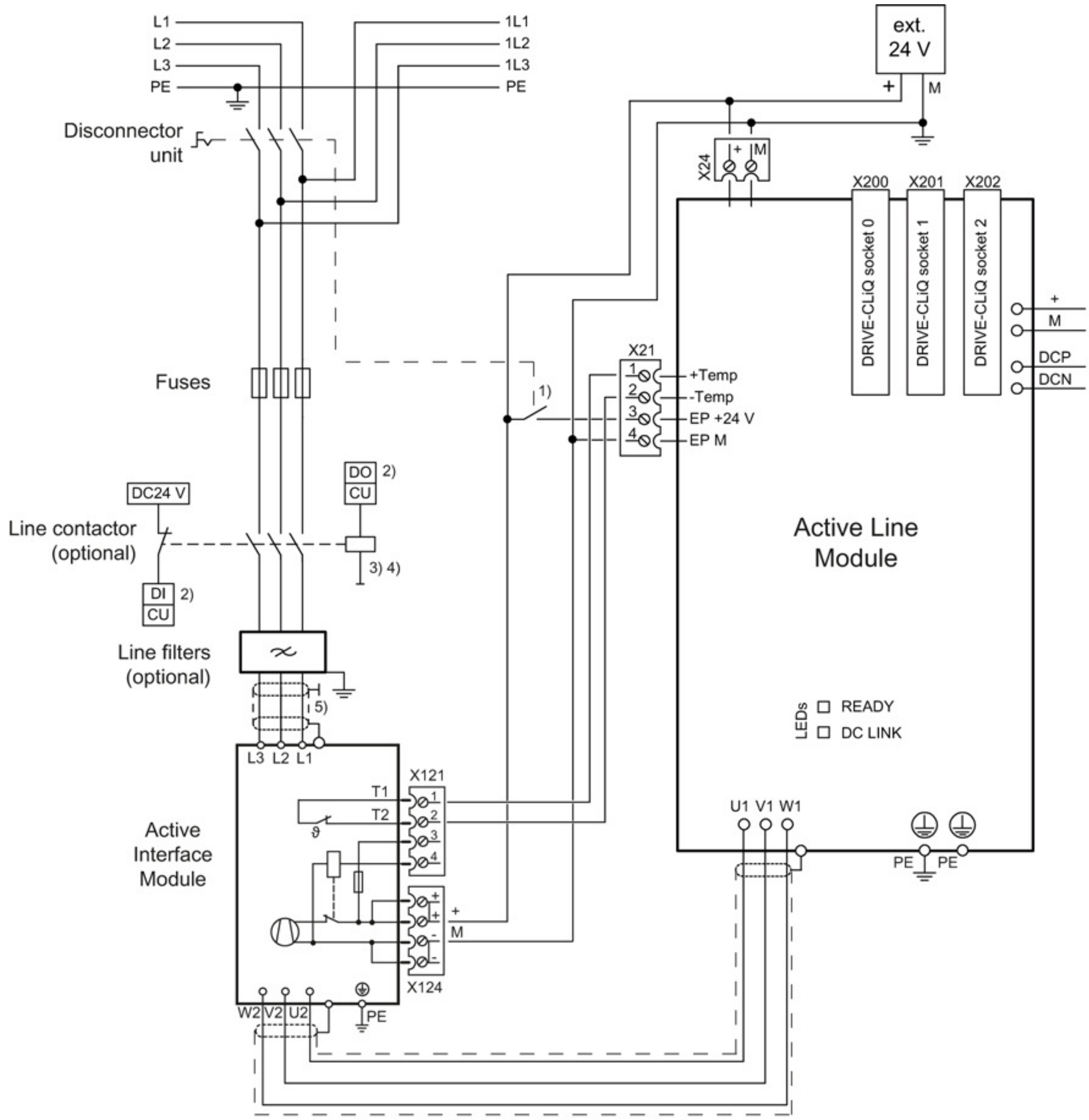
Table 8- 36 X200-X202 DRIVE-CLiQ interfaces

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

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

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

8.3.5.3 Connection example



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

Figure 8-41 Connection example: Active Line Module with cold plate

8.3.5.4 Meaning of LEDs

Table 8- 37 Meaning of the LEDs on the Active Line Module

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

⚠ WARNING

Danger to life due to high DC link voltage, regardless of LED display

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.

- Observe the warning information on the component.

8.3.5.5 Dimension drawings

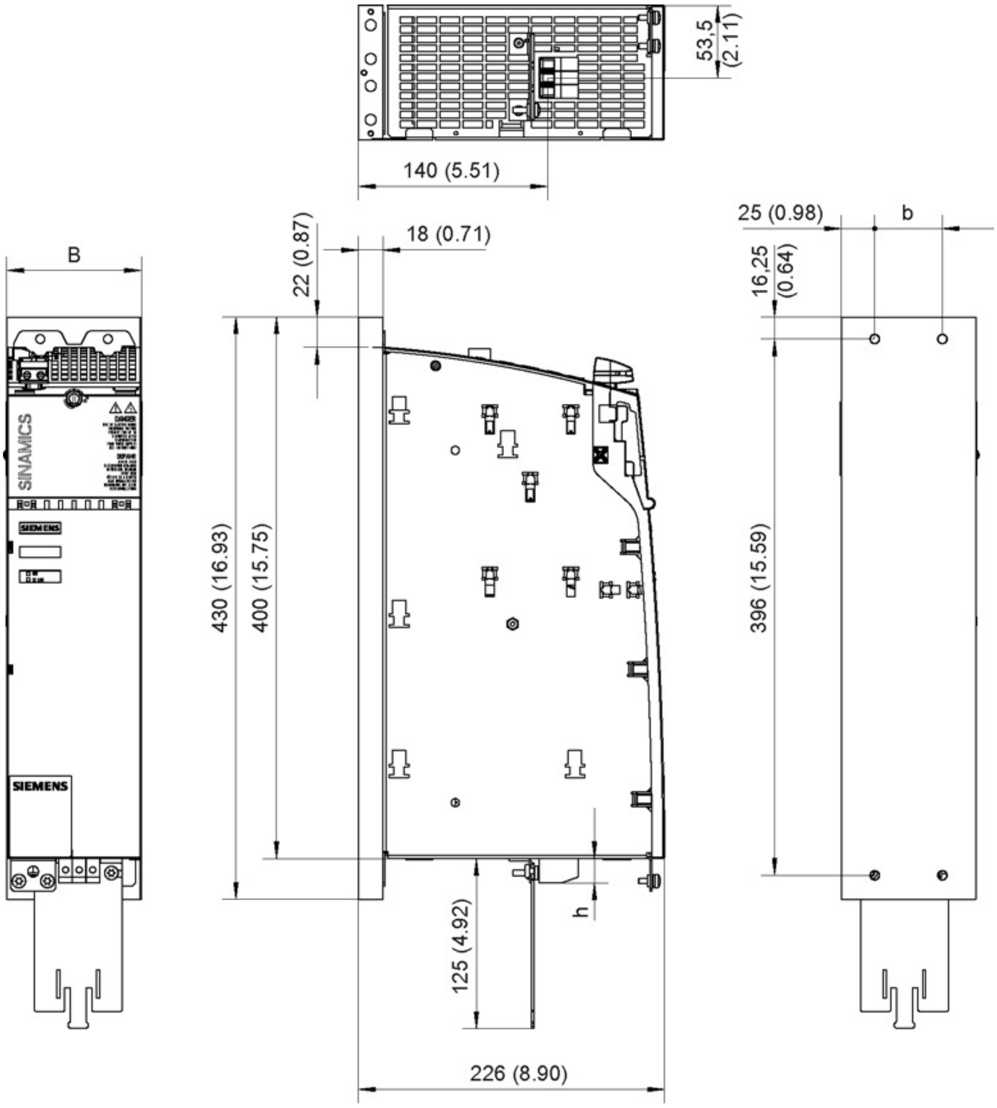


Figure 8-42 Dimension drawing of 16 kW Active Line Module with cold plate, all dimensions in mm and (inches)

Table 8- 38 Dimensions of 16 kW Active Line Module with cold plate

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

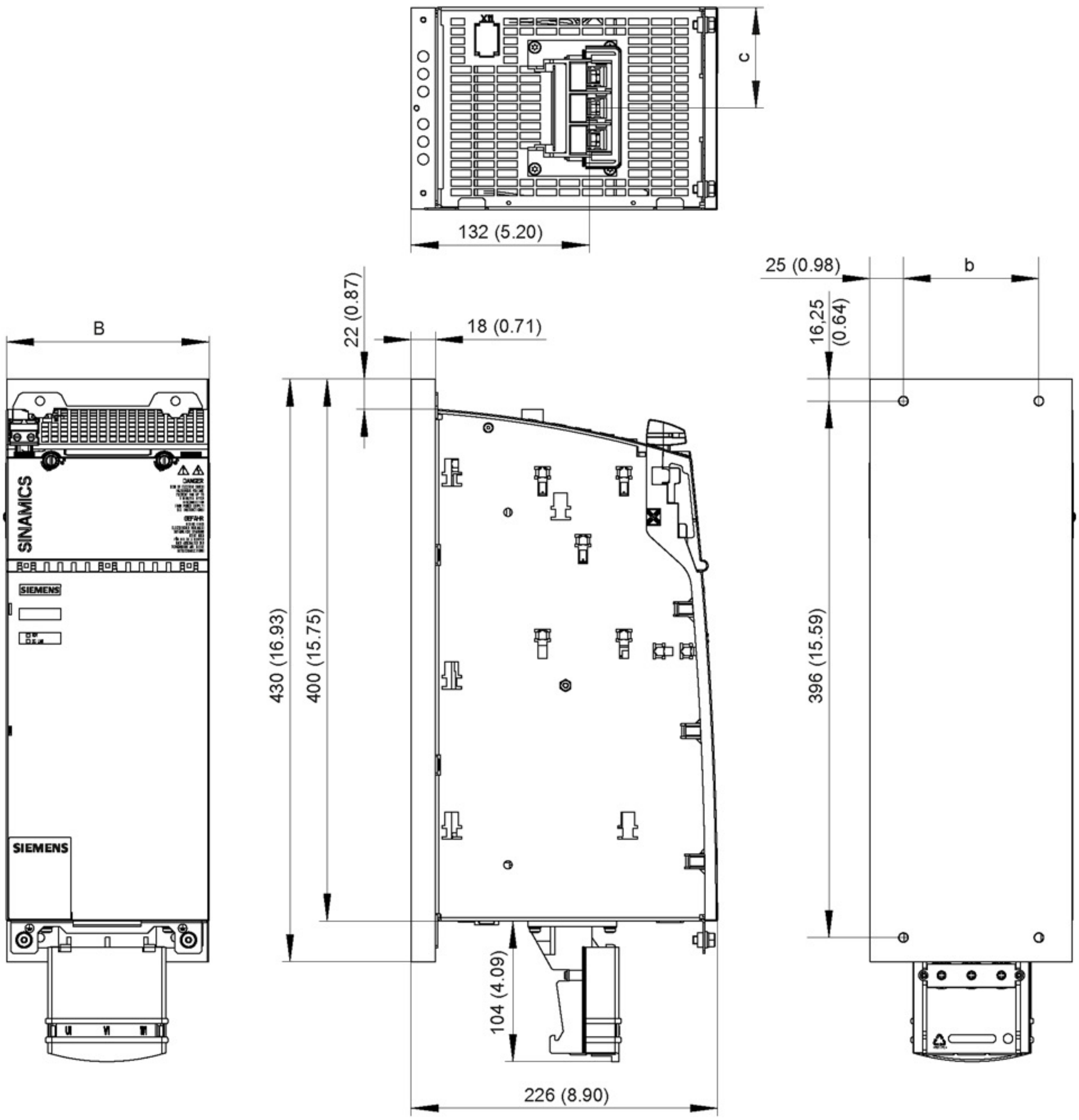


Figure 8-43 Dimension drawing of 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules with cold plate, all dimensions in mm and (inches)

Table 8- 39 Dimensions of 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules with cold plate

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

8.3.5.6 Installation

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

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

Note

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

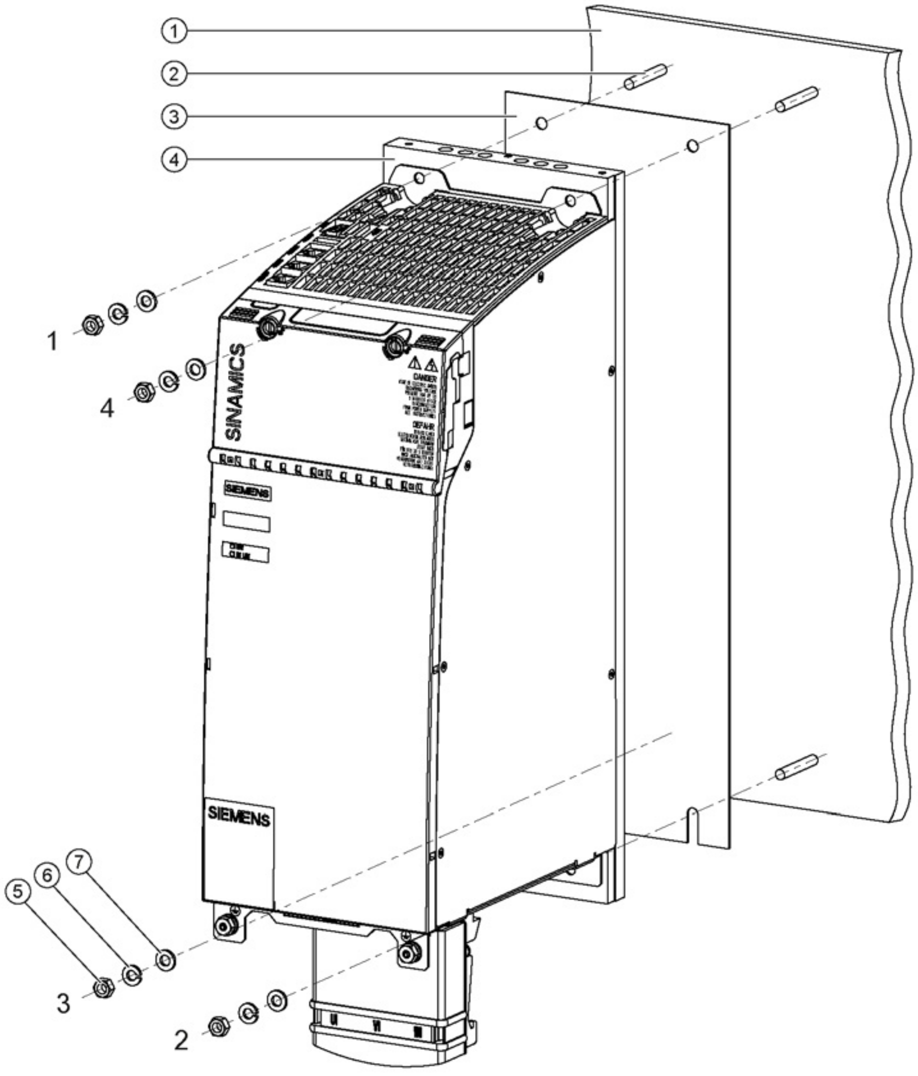
Table 8- 40 Overview of heat-conducting foils

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

Note

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

Installation



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

Figure 8-44 Mounting an Active Line Module with cold plate on an external heat sink (example: 36 kW)

Tightening torques:

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

Help with the mechanical control cabinet installation is available from:

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

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

Properties of the heat sink

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

Note

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

Note

Avoid damage to the cold plate

During the installation, you must ensure that the threaded bolts do not damage the cold plate.

8.3.5.7 Technical specifications

Table 8- 41 Technical data for Active Line Modules with cold plate cooling

Cold plate	6SL3136-7TE	21-6AAx	23-6AAx	25-5AAx	25-5AA3 + Active Interface Module	28-0AAx	31-2AAx
Rated power	**kW**	**16**	**36**	**55**	**55**	**80 (64)[1)]**	**120 (84)[1)]**
Infeed Rated power (S1)[2)] Infeed power (S6-40%) [2)] Peak infeed power[2)]	 kW (P_n) kW (P_{s6}) kW (P_{max})	 16 21 35	 36 47 70	 55 71 91	 55 71 110	 80 (64)[1)] 106 (85)[1)] 131	 120 (84)[1)] 145 (116)[1)] 175
Energy recovery Continuous regenerative power Peak regenerative power	 kW kW	 16 35	 36 70	 55 91	 55 110	 80 (64)[1)] 131	 120 (84)[1)] 175
Supply voltages Line voltage Line frequency Electronics power supply	 V_{ACrms} Hz V_{DC}	 3 AC 380 to 480 ±10% (-15% < 1 min) 47 to 63 24 (20.4 – 28.8)					
DC link voltage Overvoltage trip Undervoltage trip[3)]	V_{DC} V_{DC} V_{DC}	510 – 720 820 ±2% 360 ±2%					
Input currents Rated input current at 400 V_{AC}: Input current at 380 V_{AC} at 480 V_{AC} at 400 V_{AC}; S6-40% at 400 V_{AC}; peak current	 A_{AC} A_{AC} A_{AC} A_{AC} A_{AC}	 25 26 21 32 54	 55 58 46 71 107	 84 88 70 108 139	 84 88 70 108 168	 122 (98)[1)] 128 (102)[1)] 102 (82) [1)] 161 (129)[1)] 200	 182 (127)[1)] 192 (134)[1)] 152 (106)[1)] 220 (154)[1)] 267
DC link currents Rated DC link current at 600 V: DC link current: at 600 V_{DC}; at S6-40% at 600 V_{DC}; peak current	 A_{DC} A_{DC} A_{DC}	 27 35 59	 60 79 117	 92 121 152	 92 121 176	 134 (99)[1)] 176 (141)[1)] 195	 200 (140) 244 (171)[1)] 292
Current-carrying capacity DC link busbar Reinforced DC link busbars: 24 V busbar:	 A_{ACrms} A_{ACrms} A_{ACrms}	 100 150 20	 200 -- 20	 200 -- 20	 200 -- 20	 200 -- 20	 200 -- 20
Electronics current consumption at 24 VDC	A_{DC}	0.85	1.05	1.15	1.15	1.4	1.8
Total power loss[5)] (including electronics losses)	W	280.4	655.2	927.6	927.6	1383.6	2243.2
DC link capacitance Active Line Module Drive line-up, max.:	 µF µF	 710 20000	 1410 20000	 1880 20000	 1880 20000	 2820 20000	 3760 20000

Cold plate	6SL3136-7TE	21-6AAx	23-6AAx	25-5AAx	25-5AA3 + Active Interface Module	28-0AAx	31-2AAx
Power factor	cosϕ	1	1	1	1	1	1
Circuit breaker (IEC 60947 and UL)		See Chap. "Overcurrent protection using line fuses and circuit breakers (Page 116)"					
Rated short-circuit current SCCR[4)]	kA	65	65	65	65	65	65
Max. permissible heat sink temperature	°C	70	73	83	83	75	80
Max. ambient temperature Without derating With derating	 °C °C	 40 55	 40 55	 40 55	 40 55	 40 55	 40 55
Weight	kg	6.1	10.2	13.8	13.8	20.3	20.4

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

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

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

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

5) For an overview, see the power loss tables in the Appendix

Note

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

Characteristics

Rated duty cycles for Active Line Modules

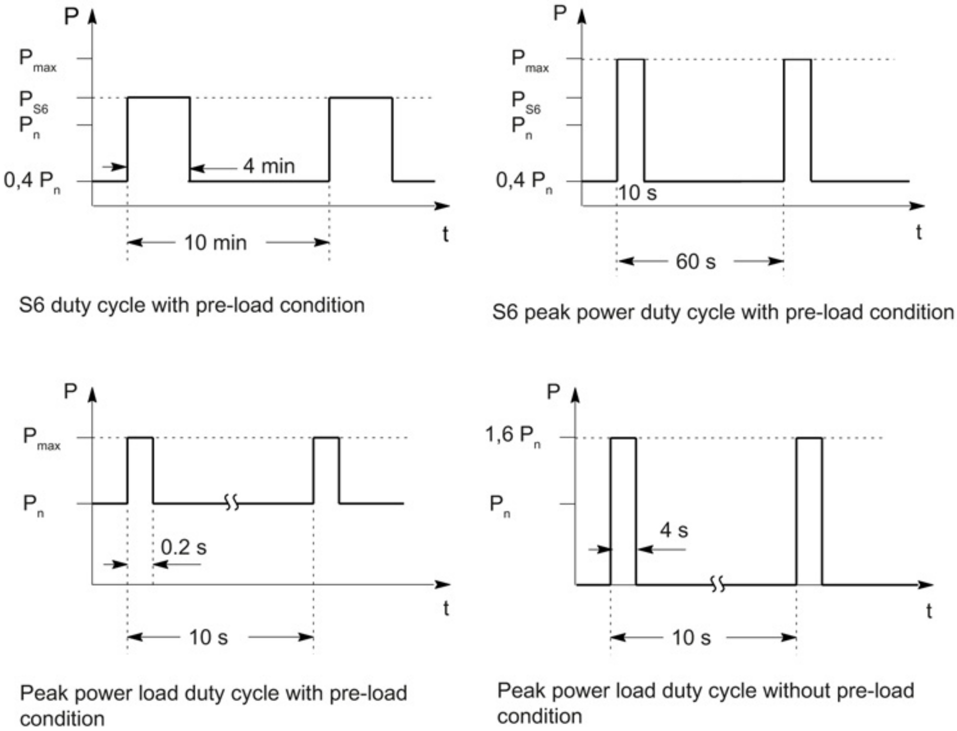


Figure 8-45 Rated duty cycles for Active Line Modules (**exception**: not applicable for 55 kW Active Line Module with Active Interface Module)

Rated duty cycles for Active Line Modules with Active Interface Modules

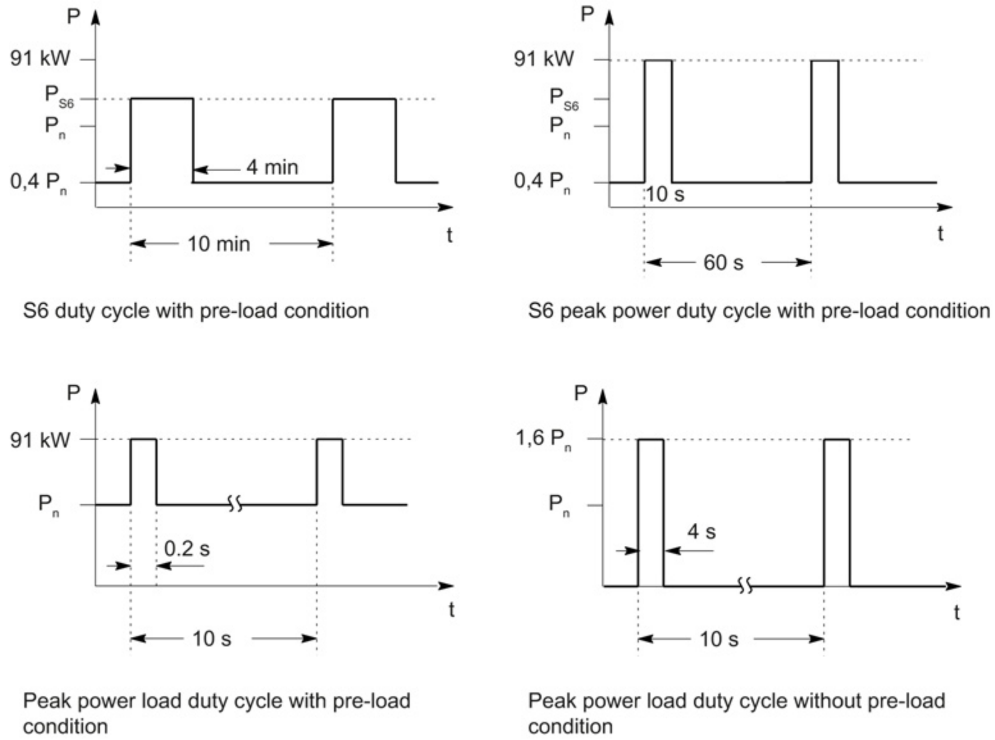


Figure 8-46 Duty cycles for 55 kW Active Line Modules with Active Interface Modules

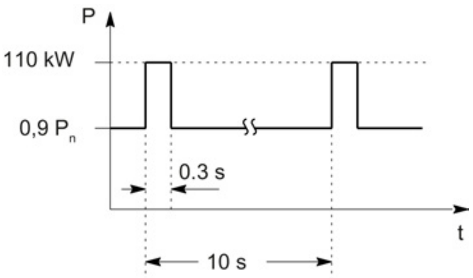


Figure 8-47 Peak duty cycle with initial load for 55 kW Active Line Modules with Active Interface Modules

Derating characteristics

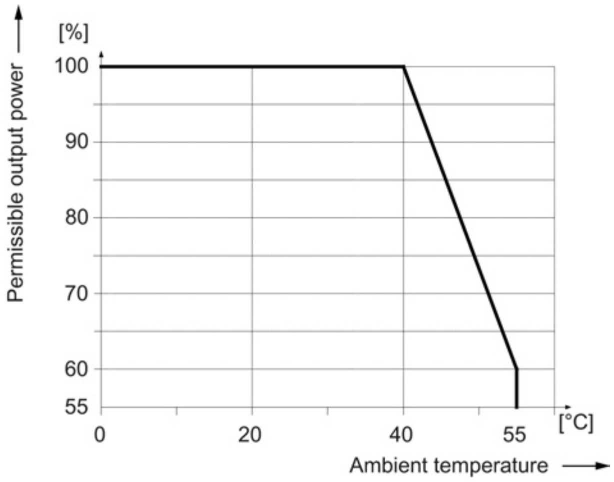


Figure 8-48 Output power as a function of the ambient temperature

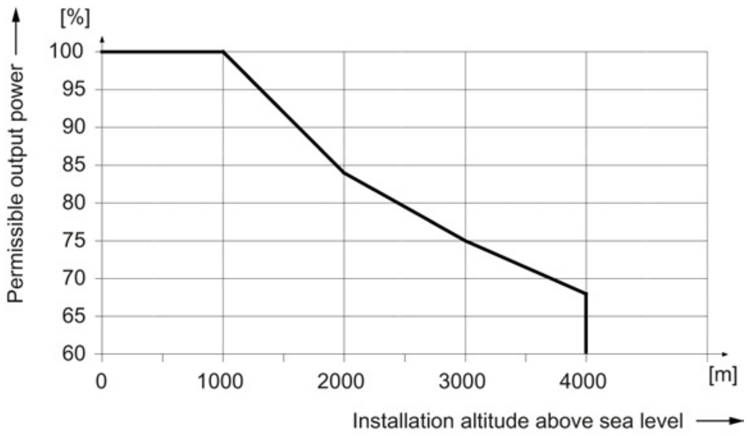


Figure 8-49 Output power as a function of the installation altitude

At installation altitudes > 2000 m, an isolation transformer must be used (see the chapter titled "System overview/Function of installation altitude and ambient temperature" (Page 32)). The design of the secondary line system must be as follows:

- TN system with grounded neutral point (no grounded line conductor)
- IT system

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

8.3.6 Active Line Modules Liquid Cooled

8.3.6.1 Description

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

This ensures that they are not influenced by network fluctuations.

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

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

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

8.3.6.2 Interface description

Overview

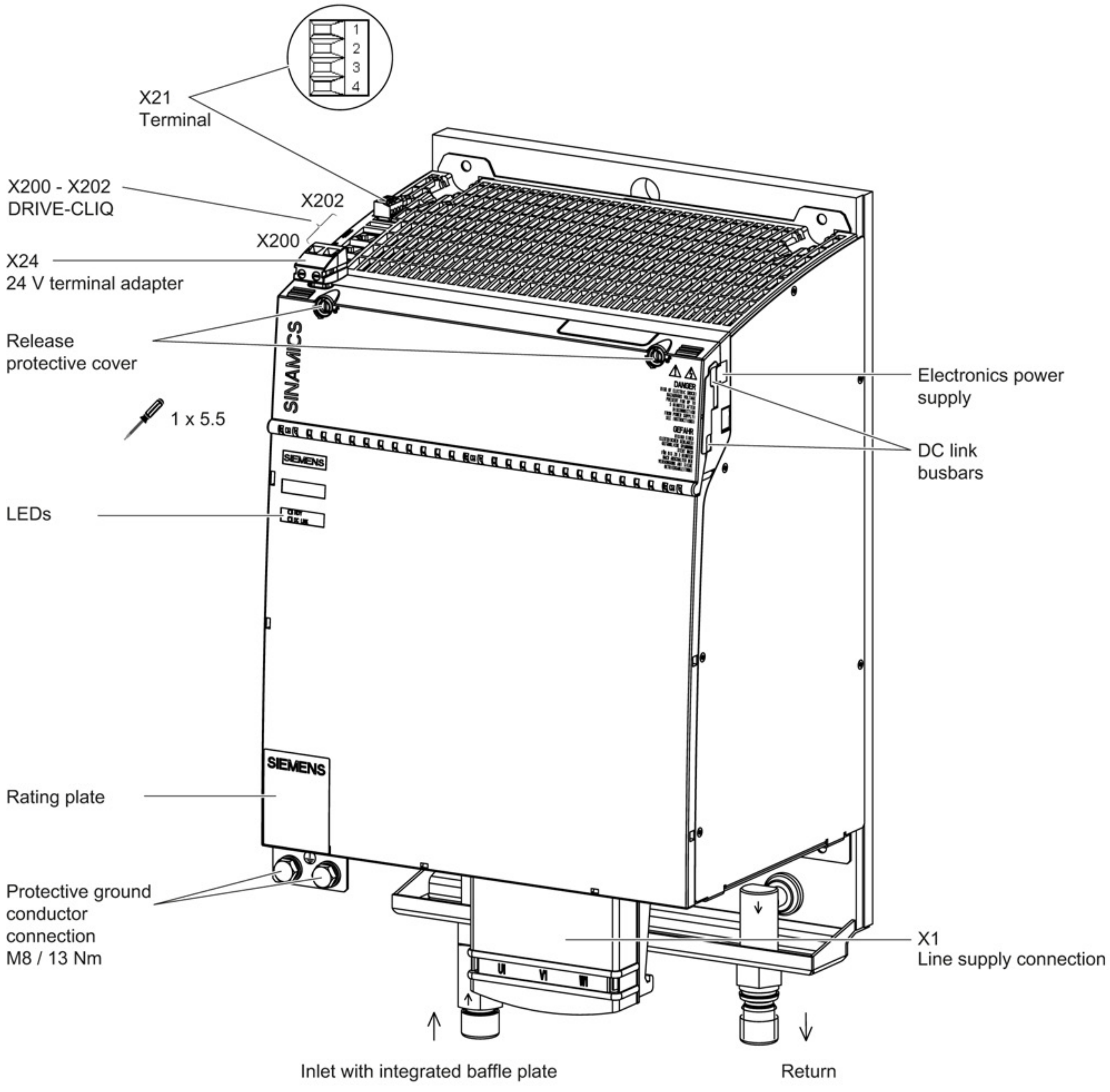
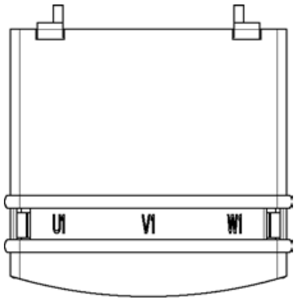
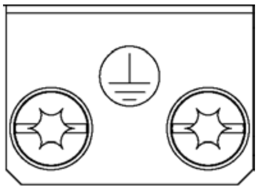


Figure 8-50 Interface overview, Active Line Module Liquid Cooled (120 kW)

X1 line connection

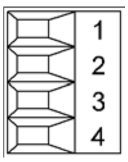
Table 8- 42 X1 line connection

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

1) For ring cable lugs in accordance with DIN 46234

X21 EP terminals

Table 8- 43 X21 EP terminal/temperature sensor

	Terminal	Designation	Technical data
	1	+ Temp	Temperature sensors1): KTY84–1C1302)/PTC2)/bimetallic switch with NC contact If an Active Interface Module is used, the temperature input must be connected to the Active Interface Module sensor (bimetallic switch with NC contact).
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see Appendix, Chapter "Screw terminals")			

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

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

CAUTION

Connecting the temperature sensor

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

WARNING

Danger to life due to charged DC link

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

Note

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

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

DANGER

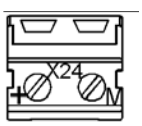
Risk of electric shock!

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

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

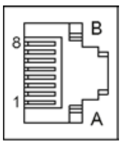
X24 24 V terminal adapter

Table 8- 44 X24 24 V terminal adapter

	Terminal	Description	Technical specifications
	+	24 V power supply	24 VDC supply voltage
	M	Ground	Electronics ground
The 24 V terminal adapter is included in the scope of delivery. Max. connectable cross-section: 6 mm² Type: Screw terminal 5 (see Appendix, Chapter "Screw terminals")			

X200-X202 DRIVE-CLiQ interfaces

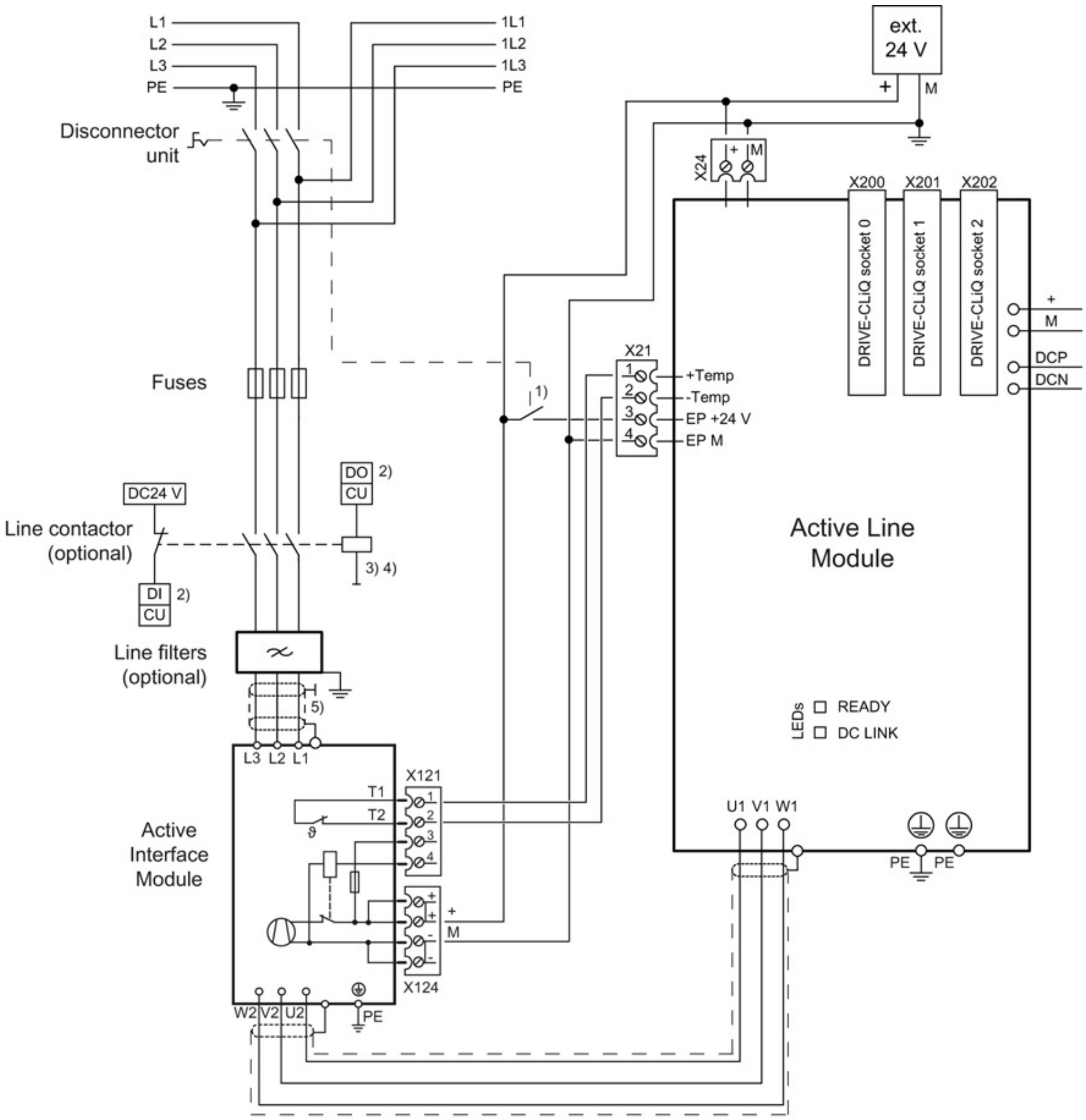
Table 8- 45 X200-X202 DRIVE-CLiQ interfaces

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

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

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

8.3.6.3 Connection example



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

Figure 8-51 Example connection of Active Line Module

8.3.6.4 Meaning of LEDs

Table 8- 46 Meaning of the LEDs on the Active Line Module

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

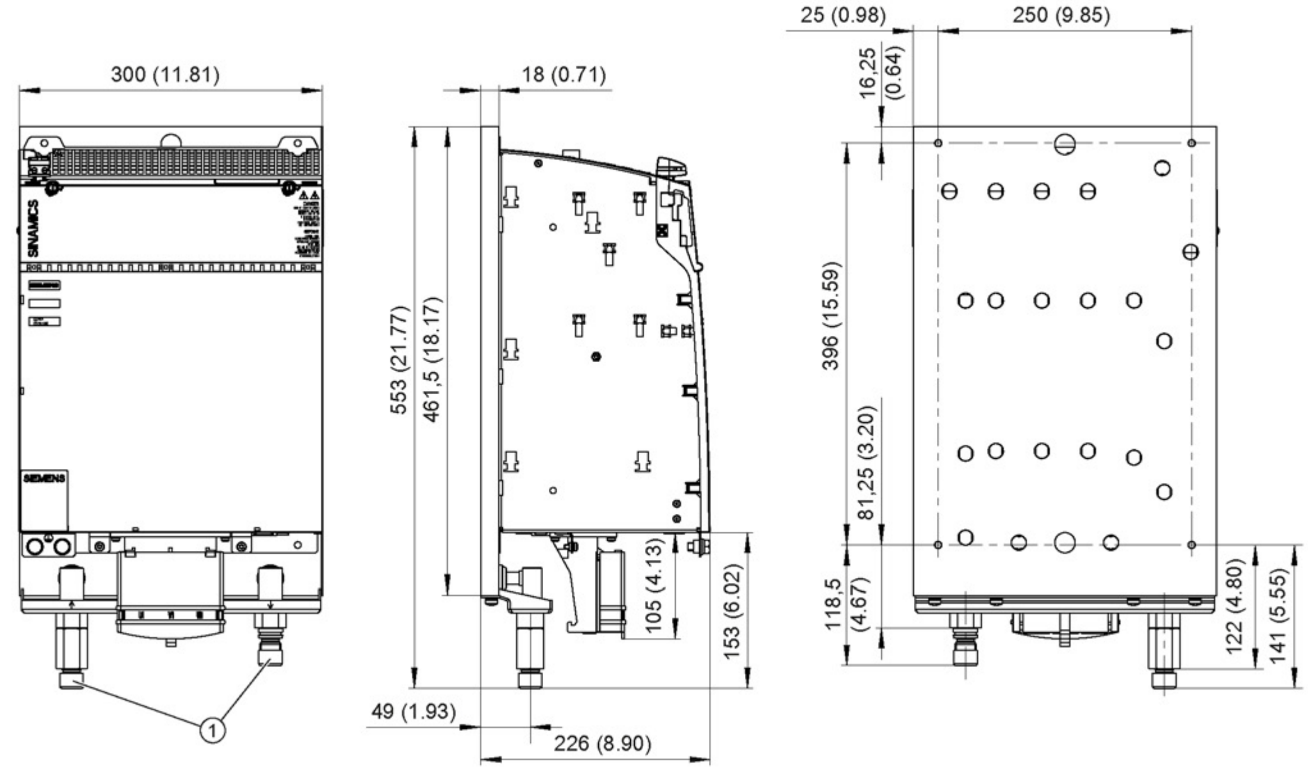
⚠ WARNING

Danger to life due to high DC link voltage, regardless of LED display

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.

- Observe the warning information on the component.

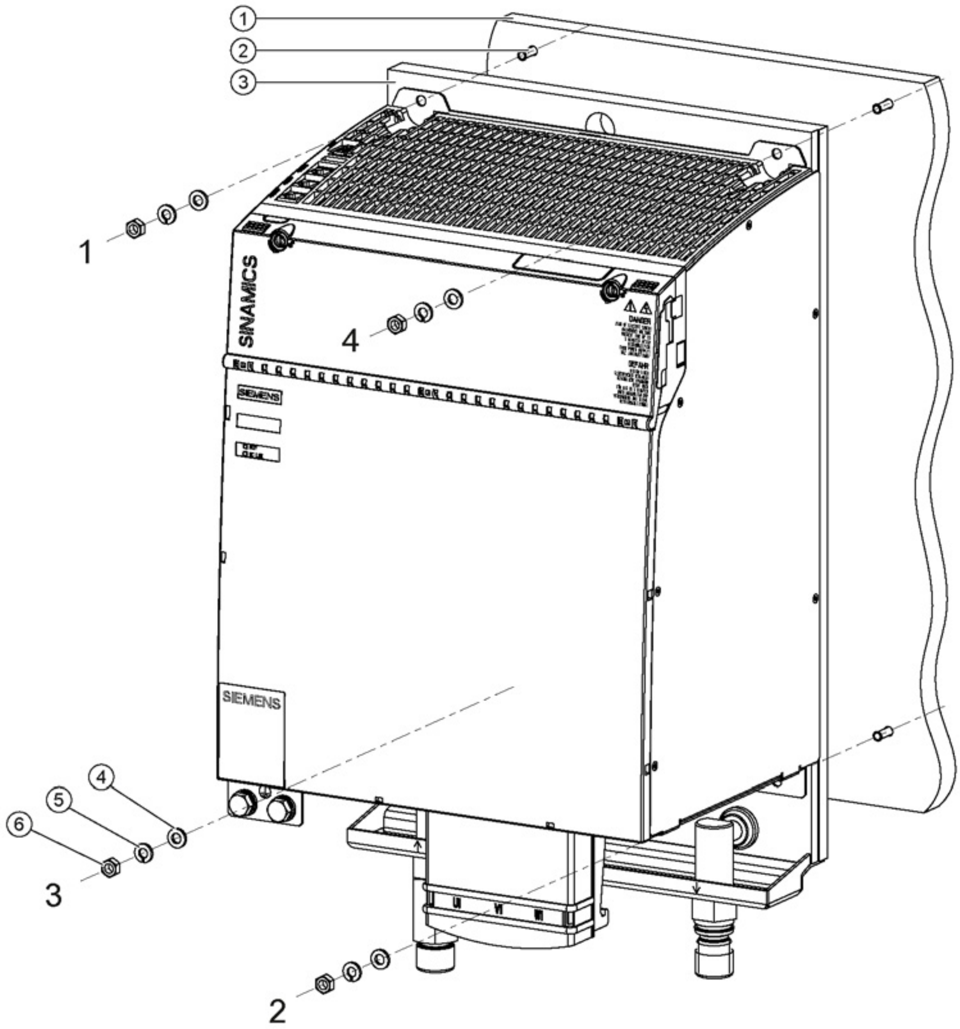
8.3.6.5 Dimension drawing



① Pipe thread ISO 228 G ½ B.

Figure 8-52 Dimension drawing of Active 120 kW Line Module Liquid Cooled, all dimensions in mm and (inches)

8.3.6.6 Installation



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

Figure 8-53 Mounting an Active Line Module Liquid Cooled

Tightening torques:

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

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

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

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

8.3.6.7 Technical specifications

Table 8- 47 Technical data for an Active Line Module Liquid Cooled

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

Liquid Cooled		6SL3135-7TE31-2AA3
Rated power	**kW**	**120**
Max. ambient temperature without derating with derating	 °C °C	 40 55
DC link capacitance: Active Line Module Drive line-up, max.	 µF µF	 3995 20000
Power factor	cosϕ	1
Circuit breaker (IEC 60947 and UL)		See Chap. "Overcurrent protection using line fuses and circuit breakers (Page 116)"
Rated short-circuit current SCCR[4)]	kA	65
Rated volumetric flow for water at 70 kPa pressure drop[5)]	l/min	8
Volume of liquid internal	ml	100
Max. coolant temperature without derating with derating	 °C °C	 45 50
Max. permissible heat sink temperature	°C	80
Weight	kg	23

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

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

3) For an overview, see the power loss tables in the Appendix

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

5) This value applies to the water coolant option; for other coolant types, see the SINAMICS S120 Booksize Power Units Equipment Manual (GH2), Chapter "Cooling circuit and coolant properties".

Characteristics

Rated duty cycles of Active Line Modules Liquid Cooled

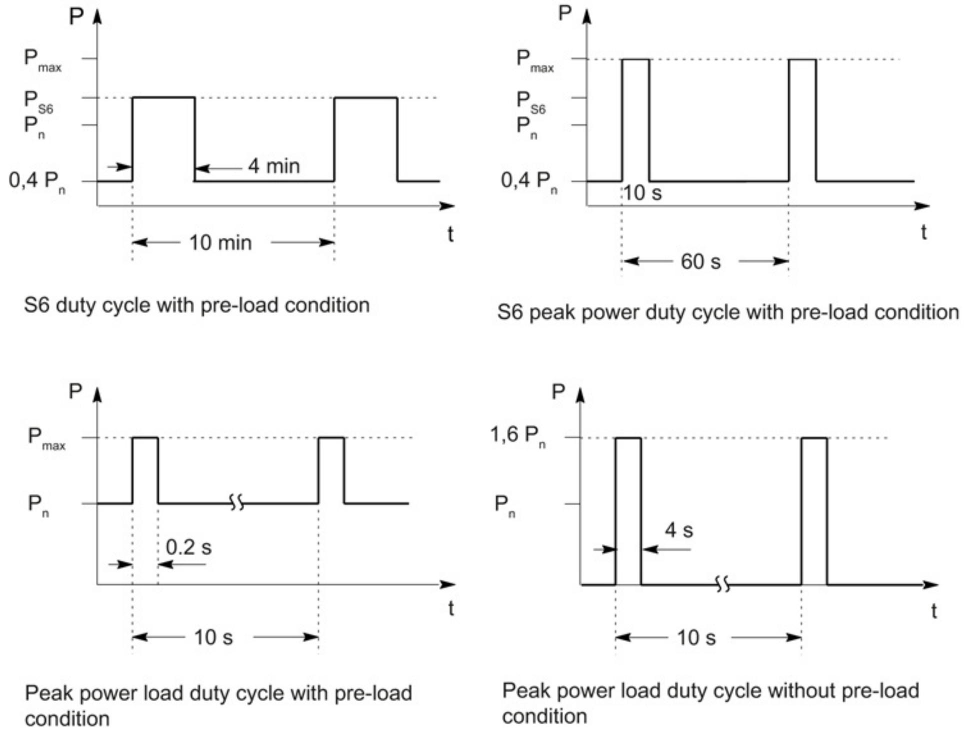


Figure 8-54 Rated duty cycles of Active Line Modules

Derating characteristics

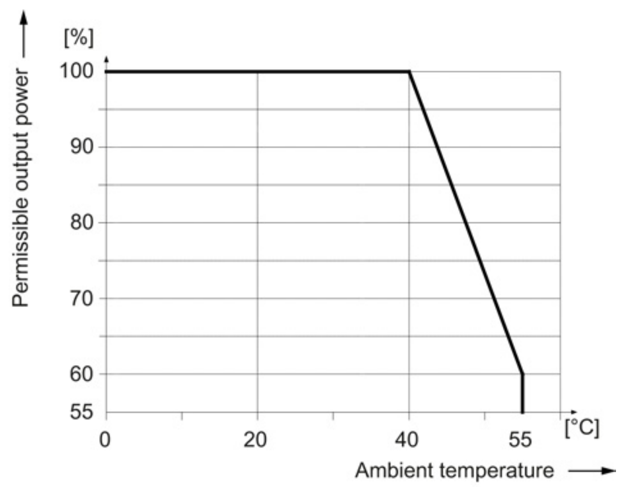


Figure 8-55 Output power as a function of the ambient temperature

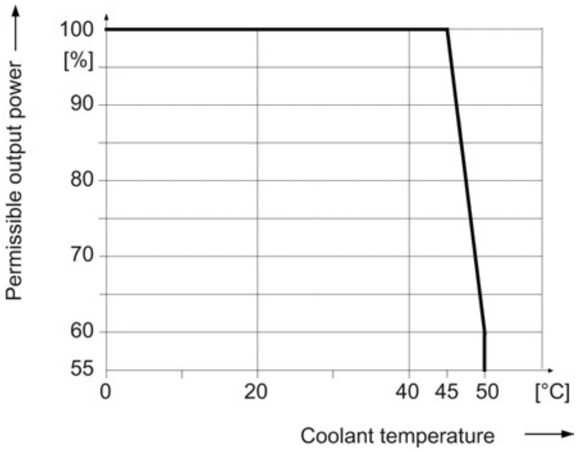


Figure 8-56 Output power as a function of the coolant temperature

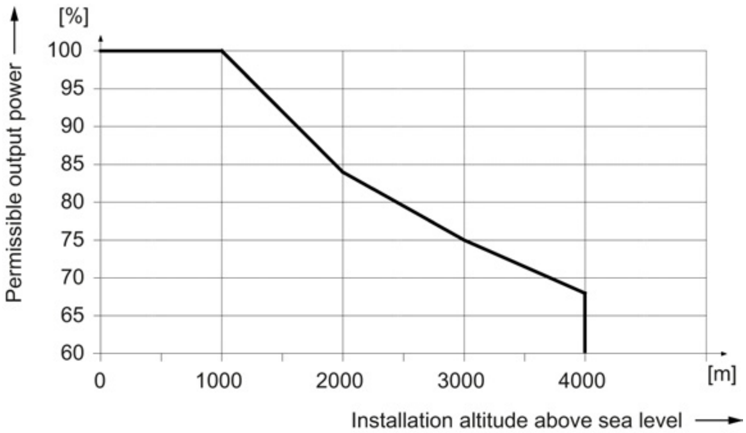


Figure 8-57 Output power as a function of the installation altitude

At installation altitudes > 2000 m, an isolation transformer must be used (see the chapter titled "System overview/Function of installation altitude and ambient temperature" (Page 32)). The design of the secondary line system must be as follows:

- TN system with grounded neutral point (no grounded line conductor)
- IT system

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

8.3.7 Smart Line Modules with internal air cooling

8.3.7.1 Description

The Smart Line Module is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module(s) with a non-regulated DC voltage at the DC output. In the infeed mode the Smart Line Module exhibits the typical current and voltage waveforms of a 6-pulse diode rectifier bridge.

In feedback mode, the current waveform is square waved. Regenerative feedback can be deactivated if required. On 5 kW and 10 kW Smart Line Modules, this is done via a terminal, since these modules do not feature a DRIVE-CLiQ connection. On 16 kW to 55 kW Smart Line Modules, regenerative feedback can be deactivated via parameters, as, just like Active Line Modules, these modules are equipped with a DRIVE-CLiQ connection.

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

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

8.3.7.2 Product-specific safety information for the Smart Line Modules in booksize format

The safety instructions described in this chapter apply specifically to Smart Line Modules in booksize format.

In addition, you should strictly observe the safety instructions in Chapter 1.

NOTICE
Device damage due to incorrect activation or deactivation sequence It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21.1. **Activation**: • 24 VDC power supply X24 ON • Line contactor ON • EP signal X21 pins 3 and 4 ON • Wait until precharging is complete • "Ready" signal at terminal X21 pin 1 set to "high" • Infeed is ready, pulse enable possible for motors **Deactivation**: • Shut drives down • Cancel pulse enable for motors (OFF1 signal) • EP signal X21 pins 3 and 4 OFF • Line contactor OFF • 24 VDC power supply X24 OFF **Overload**: • "Prewarning" signal at terminal X21 pin 2 set to "low" • Shut drives down via the control system • "Ready" signal at terminal X21 pin 1 set to "low" • Pulse inhibit for all the drives supplied by this infeed within 4 ms

Note

Operation without the line reactor is not permissible.

Note

Connection to the public low-voltage network

Smart Line Modules have been designed for use in the industrial environment and generate current harmonics on the line side as a result of the rectifier circuit.

When connecting a machine with integrated Smart Line Modules to the public low-voltage network, authorization is required in advance from the local power supply company (utility company) if

- The rated current of the machine ≤ 16 A per conductor, and
- The rated machine current does not comply with the requirements specified in EN 61000-3-2 regarding current harmonics.

8.3.7.3 Interface description

Overview

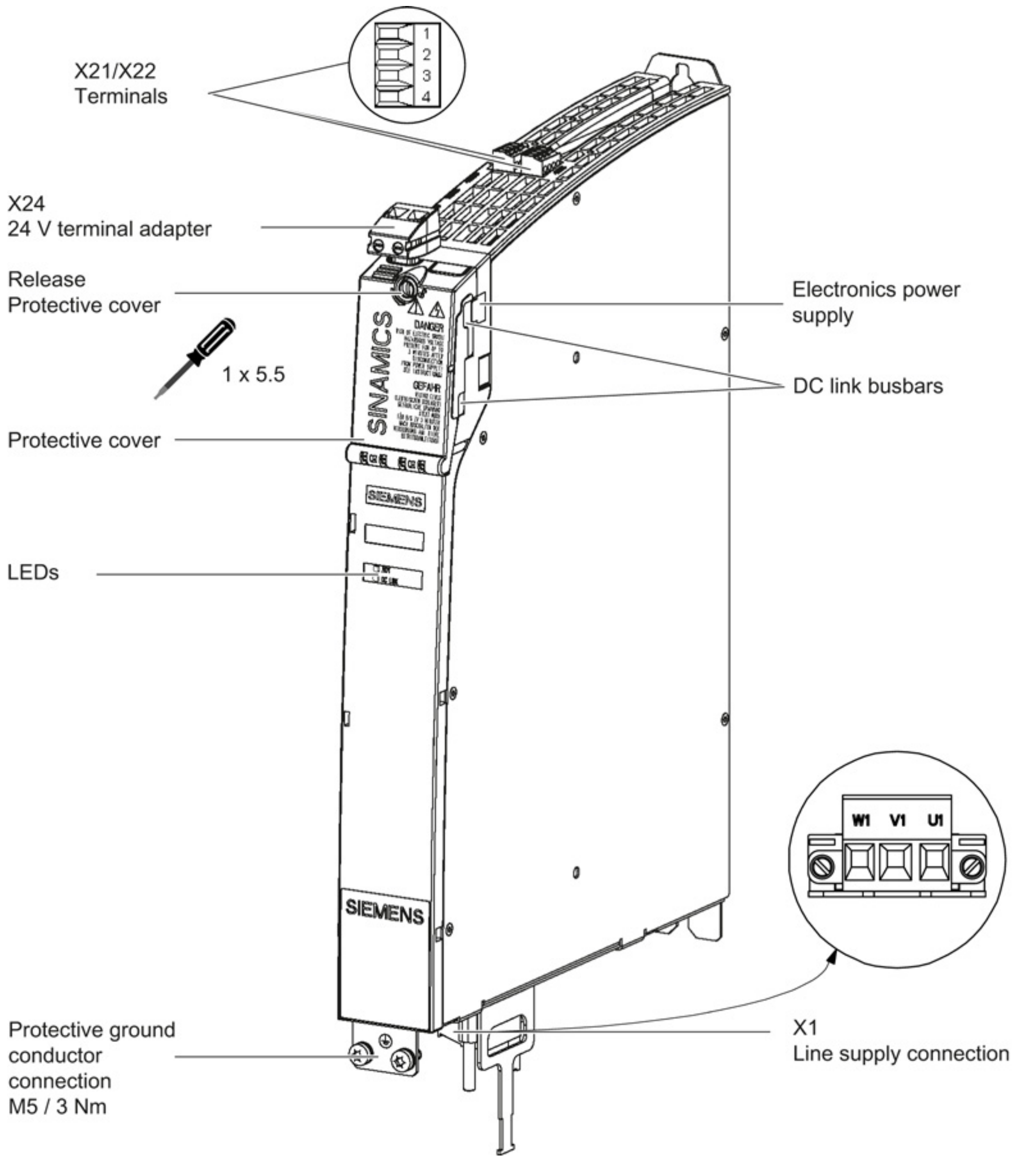


Figure 8-58 Interface overview, 5 kW and 10 kW Smart Line Modules with internal air cooling (example: 5 kW)

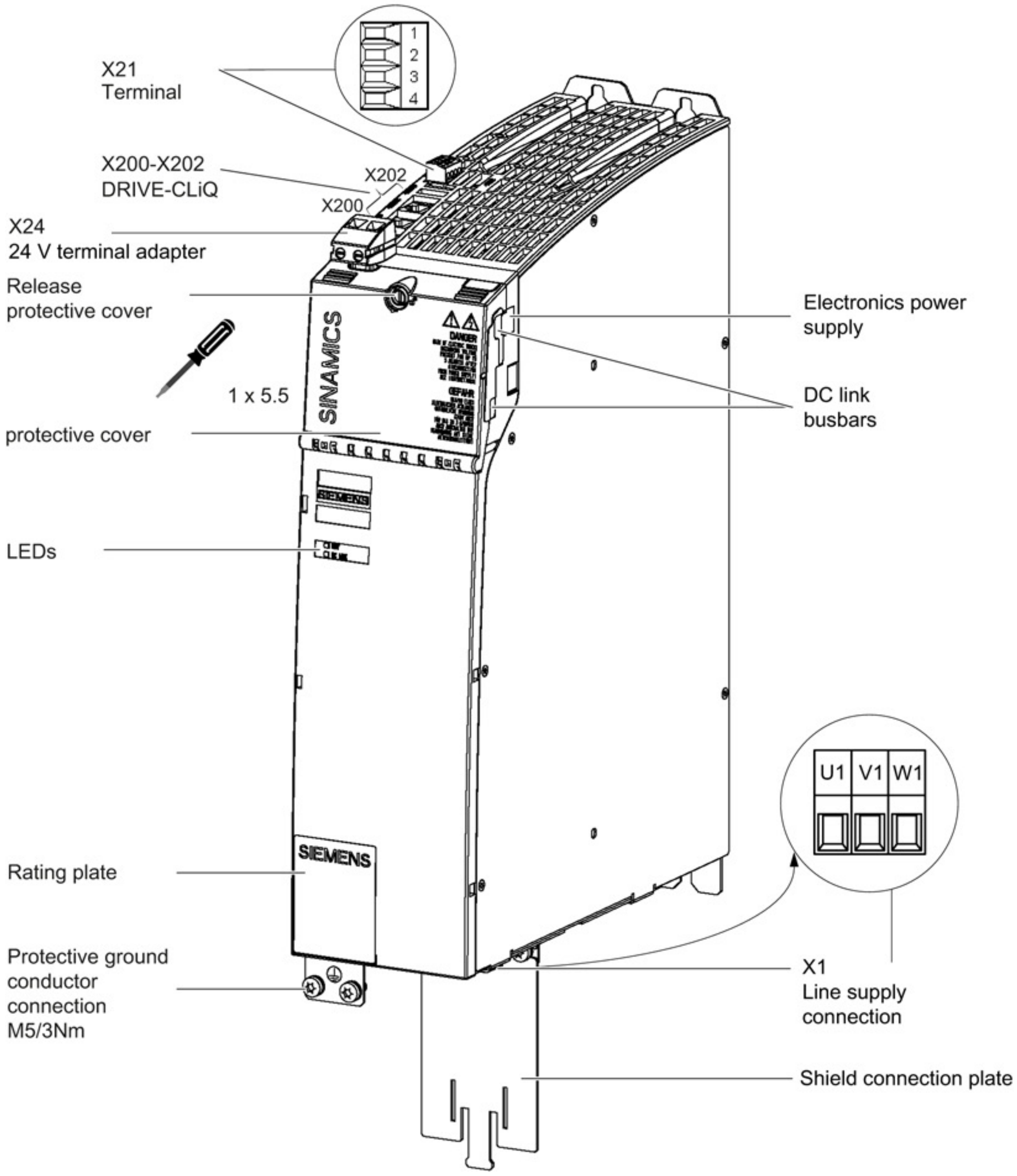


Figure 8-59 Interface overview, 16 kW Smart Line Module with internal air cooling

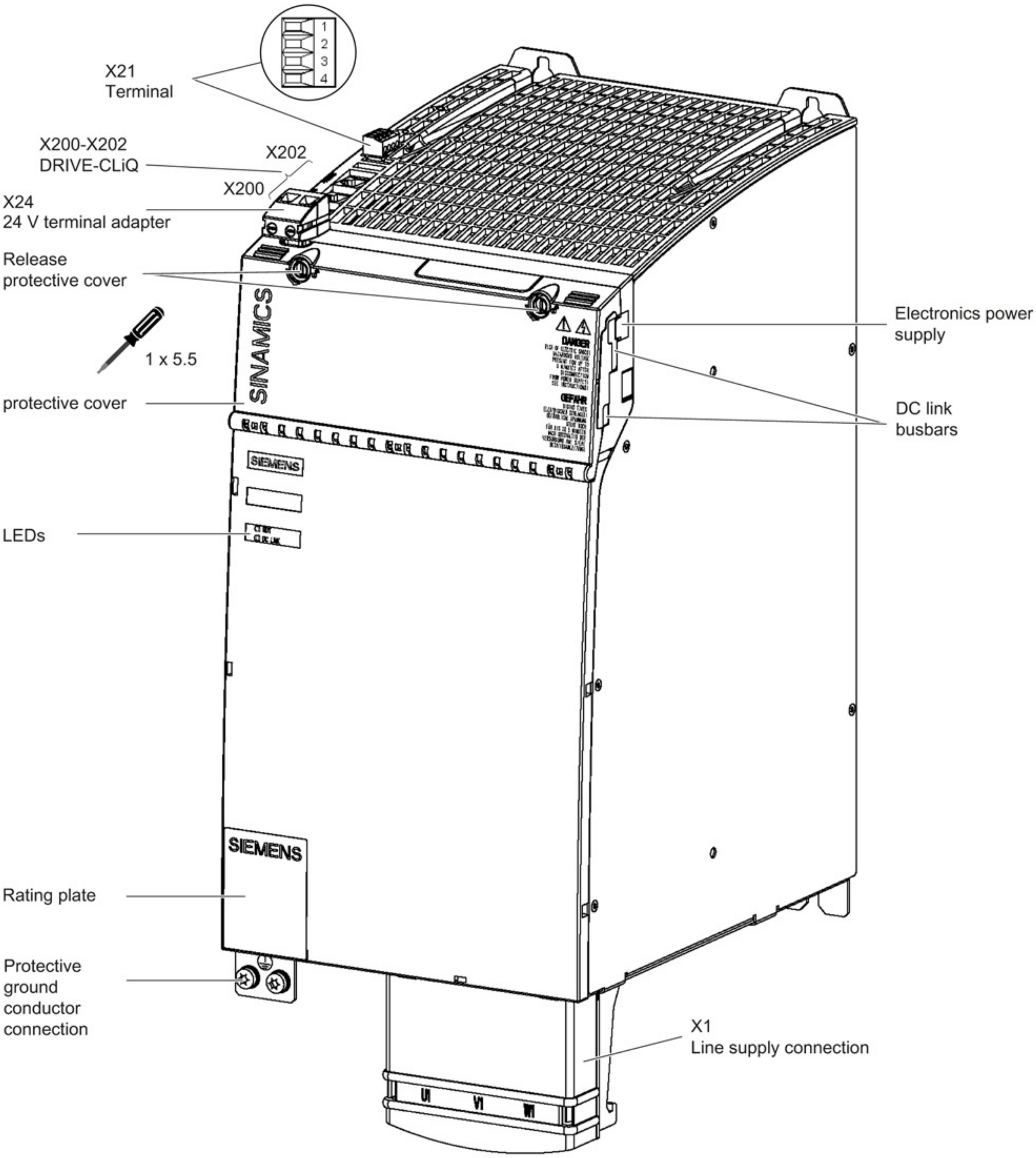
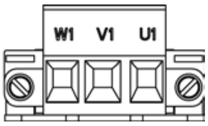
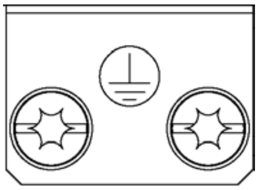


Figure 8-60 Interface overview, 36 kW and 55 kW Smart Line Modules with internal air cooling (example: 55 kW)

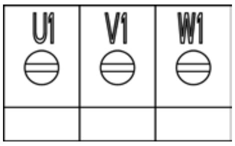
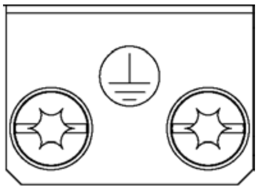
X1 line connection

Table 8- 48 X1: Line connection for Smart Line Modules 5 kW and 10 kW

	Terminal	Technical specifications
	U1	Supply voltage: 3 AC 380 V - 480 V, 50/60 Hz Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see Appendix, Chapter "Screw terminals") Tightening torque: 1.2 - 1.5 Nm
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm [1)]

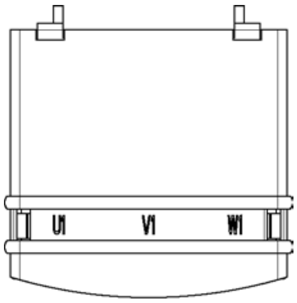
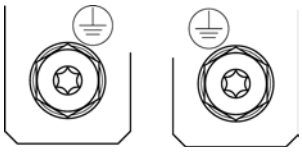
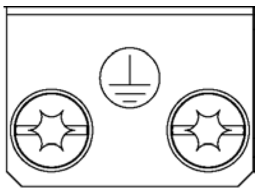
1) For ring cable lugs in accordance with DIN 46234

Table 8- 49 X1: Line supply connection for Smart Line Modules 16 kW

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

1) For ring cable lugs in accordance with DIN 46234

Table 8- 50 X1: Line connection for Smart Line Modules 36 kW and 55 kW

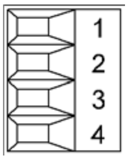
	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 3 AC 380 V - 480 V, 50/60 Hz **36 kW**: Threaded bolt M6/6 Nm 1) **55 kW**: Threaded bolt M8/13 Nm 1)
	PE connection	**36 kW**: Threaded hole M6/6 Nm 1)
		**55 kW**: Threaded hole M6/6 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

X21 EP terminals

Smart Line Modules 5 kW and 10 kW

Table 8- 51 X21 EP terminal for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation	Technical data
	1	DO: Ready	Checkback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: • Electronics power supply (X24) OK • DC link is precharged • Pulses enabled (X21.3/4) • No overtemperature • No overcurrent
	2	DO: Prewarning	DO: Prewarning High = no prewarning Low = prewarning • Overtemperature warning threshold/I^2t 5 kW prewarning: 64°C, overtemperature threshold: 69°C 10 kW prewarning: 68°C, overtemperature threshold: 73°C • No regenerative feedback capability due to a line fault [only monitored when regenerative feedback is activated (see terminal X22.2)]
	3	EP +24 V (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm² Type: Screw terminal 1 (see Appendix, Chapter "Screw terminals")			

WARNING

Danger to life due to charged DC link

For operation, the 24 VDC voltage must be connected to terminal X21.3 and ground to terminal X21.4. When withdrawn, pulse suppression is activated. The regenerative feedback is deactivated. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

NOTICE

Device damage due to incorrect activation or deactivation sequence

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair.

- To prevent this, evaluate the "Ready" signal at output terminal X21.1 (see the chapter titled "Safety instructions").

Note

Output terminal X21.1 must be wired to a digital input on the CU. The drives supplied with power by the Smart Line Module have to use this signal as a "Ready" message (BI: p0864 = digital input). This ensures that a pulse enable can only be issued for the drives (motor or generator operation) when the infeed is ready.
If interconnection with a digital input on the CU is not possible, the signal must be evaluated by a higher-level control instead. The control system cannot set the drives to ready until the infeed "Ready" signal is present.

Note

The "Prewarning" signal at output terminal X21.2 warns against an overload. If this signal is set, the control system should shut the drives down before the "Ready" signal switches to "low". If the "Ready" signal switches to "low", the drive pulses must be suppressed within 4 ms.

Note

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be carried out using a leading (≥ 10 ms) breaking auxiliary contact, for example.

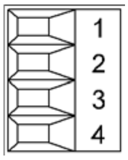
This protects external loads located parallel to the drive on the same switching component.

Note

The Smart Line Module signals that it is ready, even if one of the line conductors is not available. In this case, regenerative feedback is deactivated and an alarm is output at X21.2 (DO, Warning I^2t). If regenerative feedback was deactivated by applying a "high" signal to terminal X22.2 (DI, Disable), no alarm will be output at X21.2 (DO, Warning I^2t).

16 kW to 55 kW Smart Line Modules

Table 8- 52 X21 EP terminal/temperature Sensor for 16 kW to 55 kW Smart Line Modules

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors[1]: KTY84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Voltage: 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Max. connectable cross-section 1.5 mm² Type: Screw terminal 1 (see Appendix, Chapter "Screw terminals")			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual).
Temperatures are detected but not evaluated in the Smart Line Module.

WARNING

Danger to life due to charged DC link

For operation, the 24 VDC voltage must be connected to terminal X21.3 and ground to terminal X21.4. When withdrawn, pulse suppression is activated. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

Note

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be carried out using a leading (≥ 10 ms) breaking auxiliary contact, for example.

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

NOTICE

Risk of the motor overheating due to an incorrectly connected KTY temperature sensor

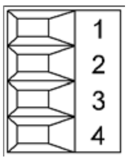
The KTY temperature sensor must be connected with the correct polarity.
If the sensor is connected with the incorrect polarity, it cannot detect if a motor overheats.

Temperature-sensor connection safety information

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

X22 digital inputs

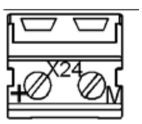
Table 8- 53 X22 digital inputs for Smart Line Modules 5 kW and 10 kW

	Terminal	Description 1)	Technical specifications
	1	24 V power supply	Electronic power supply for controlling digital inputs X22.2 and 3.
	2	DI: Disable Regeneration	Deactivate regenerative feedback (high active). No power is supplied back to the network from the DC link. The regenerative energy of the motors may have to be reduced using a combination of the Braking Module and braking resistor.
	3	DI: Reset	Reset faults (negative edge)
	4	Ground	Electronics ground
Max. connectable cross-section: 1.5 mm² Type: Screw terminal 1 (see Appendix, Chapter "Screw terminals")			

1) DI: Digital input

X24 24 V terminal adapter

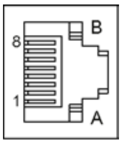
Table 8- 54 X24 24 V terminal adapter

	Terminal	Description	Technical specifications
	+	24 V power supply	24 VDC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm² Type: Screw terminal 5 (see Appendix, Chapter "Screw terminals")			

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

X200-X202 DRIVE-CLiQ interfaces

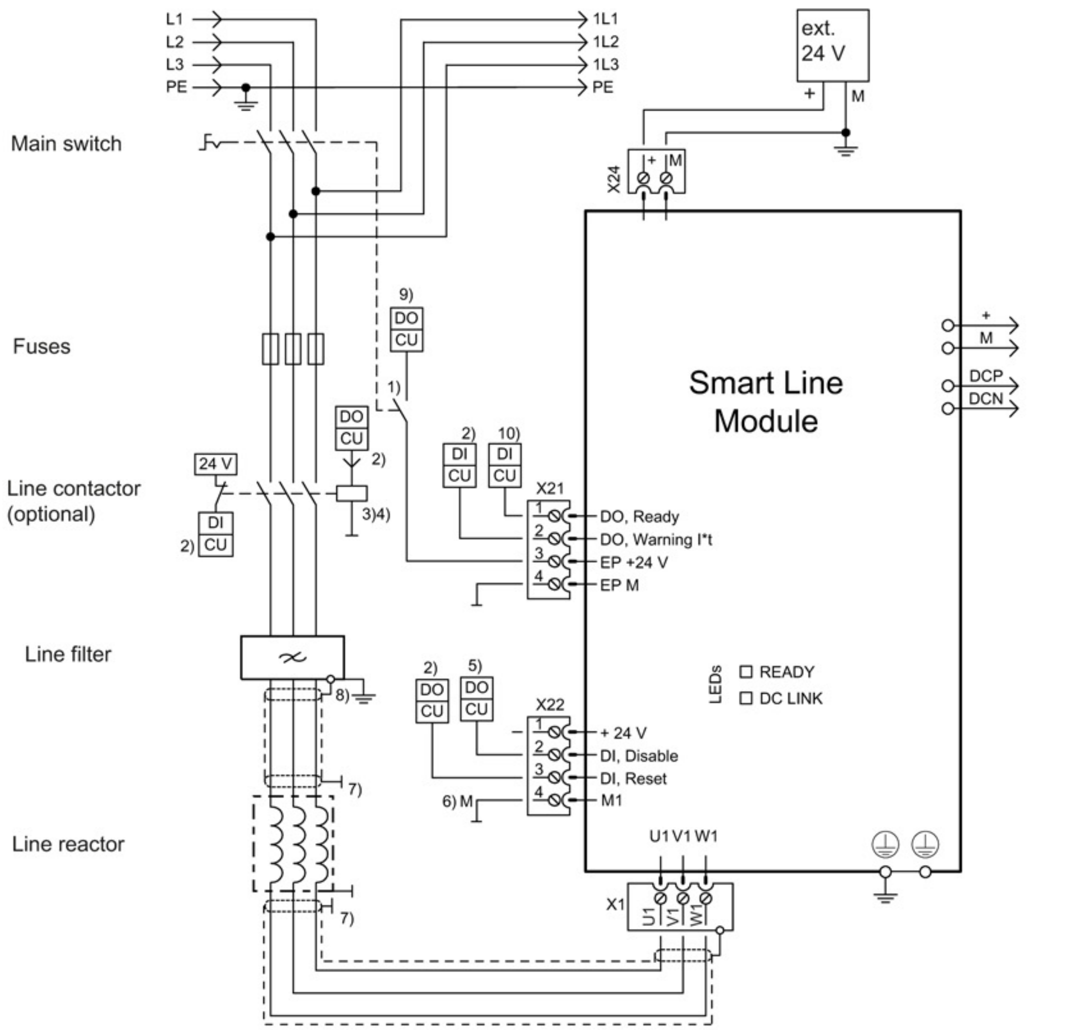
Table 8- 55 X200-X202 DRIVE-CLiQ interfaces

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

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

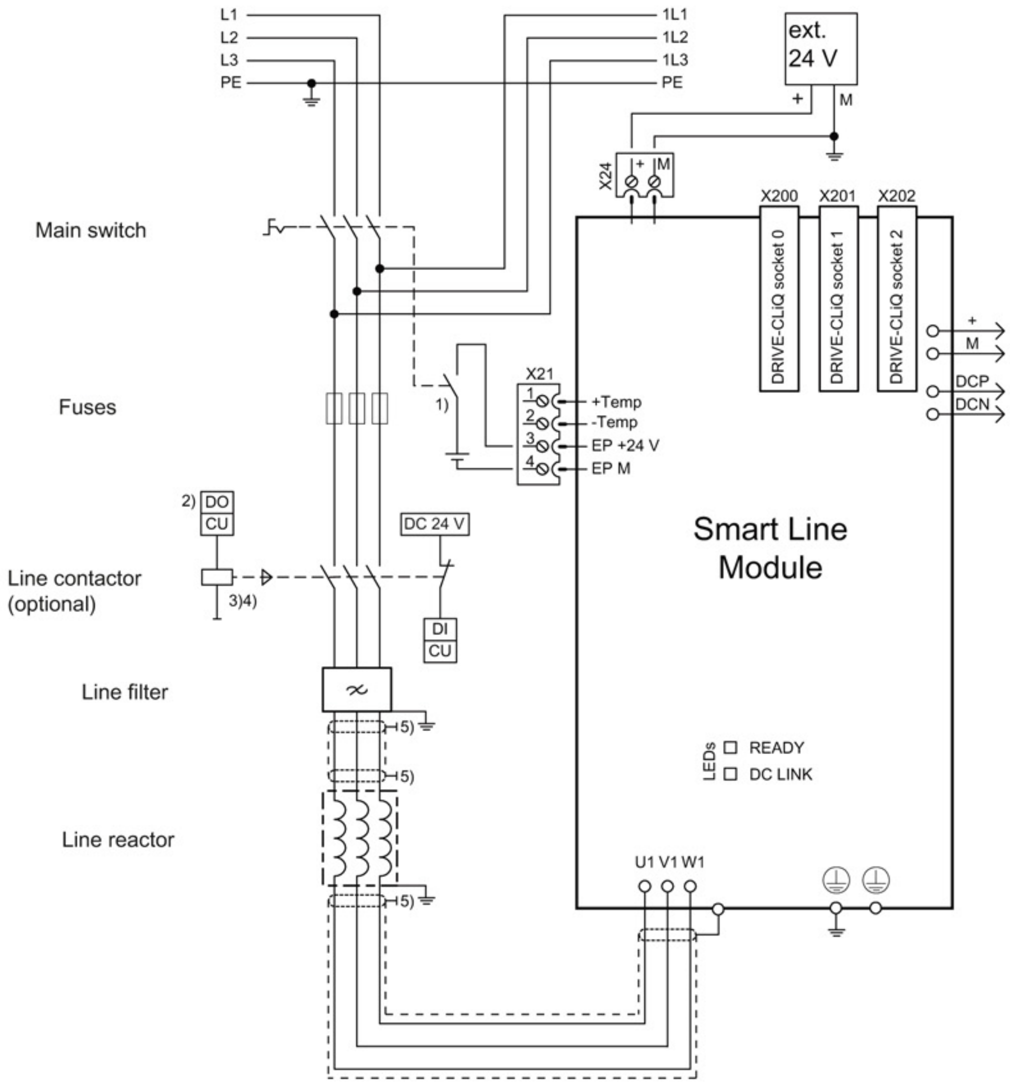
Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

8.3.7.4 Connection examples



1) Leading NC contact t >10 ms, 24 VDC and ground must be set up for operation.
2) DI/DO controlled from the Control Unit
3) No additional load permitted downstream of the line contactor
4) The current-carrying capacity of the DO must be observed; an output coupling device must be used if required.
5) DO high, regenerative feedback deactivated (a jumper can be inserted between X22 pin 1 and pin 2 for permanent deactivation).
6) X22 pin 4 must be connected to ground (ext. 24 V).
7) Contact established via rear mounting panel or shielding buses in accordance with the EMC installation guideline
8) 5 kW and 10 kW line filters via shield connection
9) Signal output of the control, to avoid interference of the 24 VDC supply on the EP terminal.
10) Interconnection via BICO to parameter p0864

Figure 8-61 Connection example for 5 kW and 10 kW Smart Line Modules



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

Figure 8-62 Connection example for 16 kW to 55 kW Smart Line Modules

8.3.7.5 Meaning of LEDs

Smart Line Modules 5 kW and 10 kW

Table 8- 56 Meaning of the LEDs on 5 kW and 10 kW Smart Line Modules

LED	Color	Status	Description, cause	Remedy
RDY	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	Component is ready to operate.	–
	Yellow	Continuous light	Pre-charging not yet complete. Bypass relay dropped out EP terminals not supplied with 24 VDC.	–
	Red	Continuous light	Overtemperature, overcurrent	Diagnose fault (via output terminals) and acknowledge it (via input terminal)
DC LINK	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Yellow	Continuous light	DC link voltage within permissible tolerance range.	–
	Red	Continuous light	DC link voltage outside permissible tolerance range. Power system fault.	Check line voltage.

⚠ WARNING

Danger to life due to high DC link voltage, regardless of LED display

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.

- Observe the warning information on the component.

16 kW to 55 kW Smart Line Modules

Table 8- 57 Meaning of the LEDs on Smart Line Modules ≥ 16 kW

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

⚠ WARNING

Danger to life due to high DC link voltage, regardless of LED display

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.

- Observe the warning information on the component.

8.3.7.6 Dimension drawings

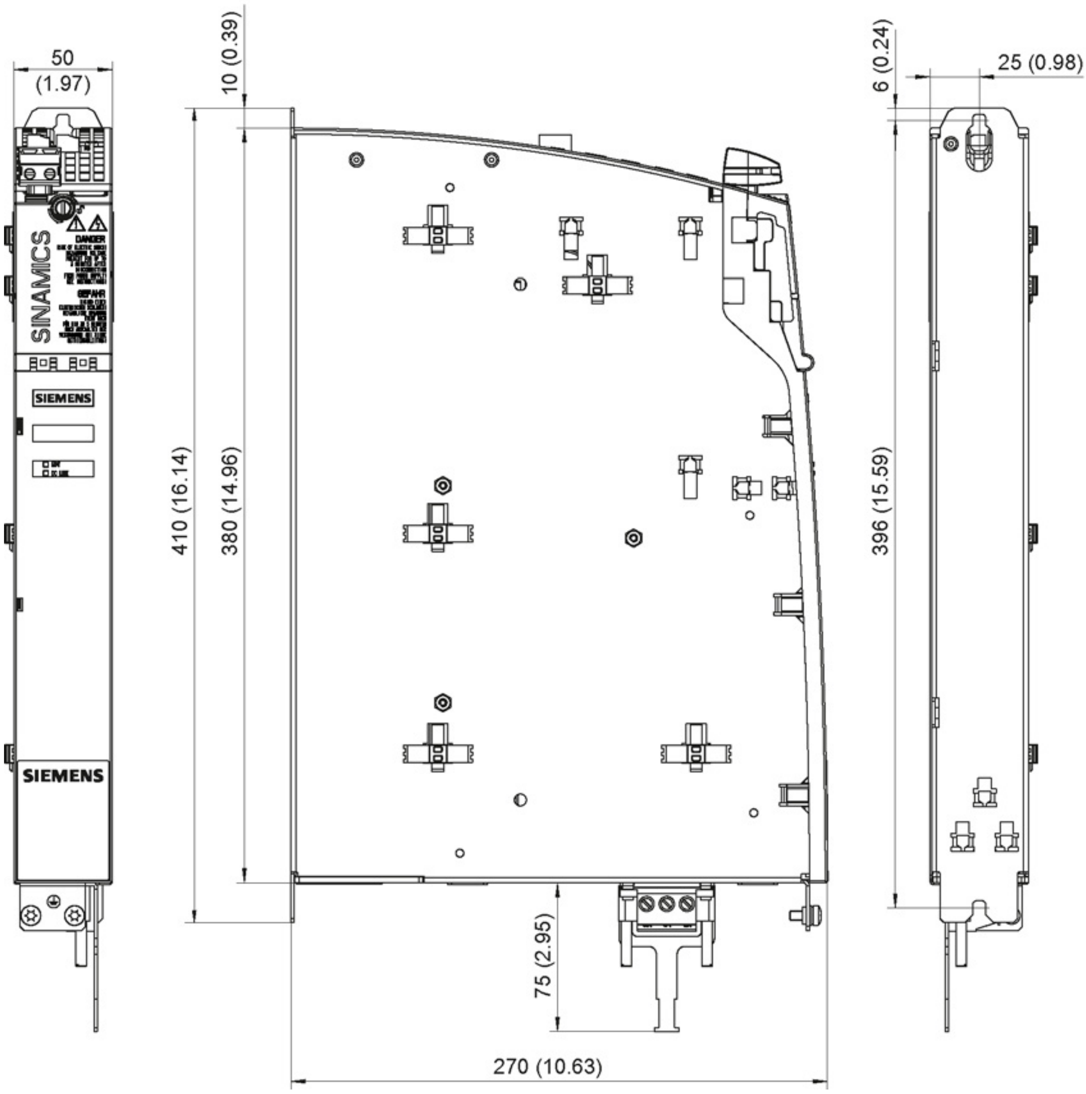


Figure 8-63 Dimension drawing of 5 kW and 10 kW Smart Line Modules with internal air cooling, all dimensions in mm and (inches)

Table 8- 58 Dimensions of Smart Line Modules with internal air cooling (5 kW and 10 kW)

Smart Line Module	Order number	W in mm (inches)
5 kW	6SL3130-6AE15-0Axx	50 (1.97)
10 kW	6SL3130-6AE21-0Axx	50 (1.97)

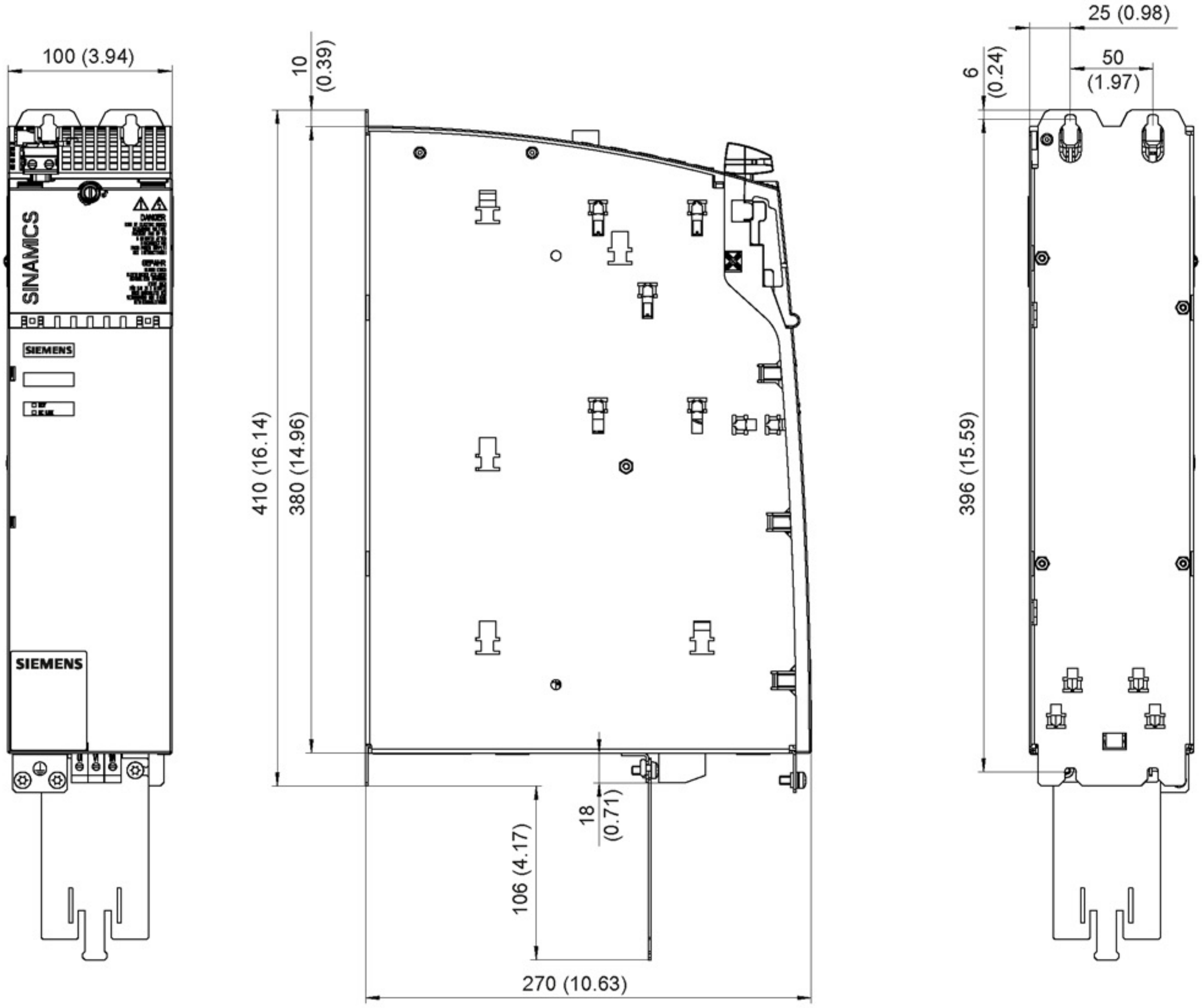


Figure 8-64 Dimension drawing of 16 kW Smart Line Module with internal air cooling, all dimensions in mm and (inches)

Note

The shield connecting plate is included in the scope of delivery of the 50 mm and 100 mm Smart Line Modules.

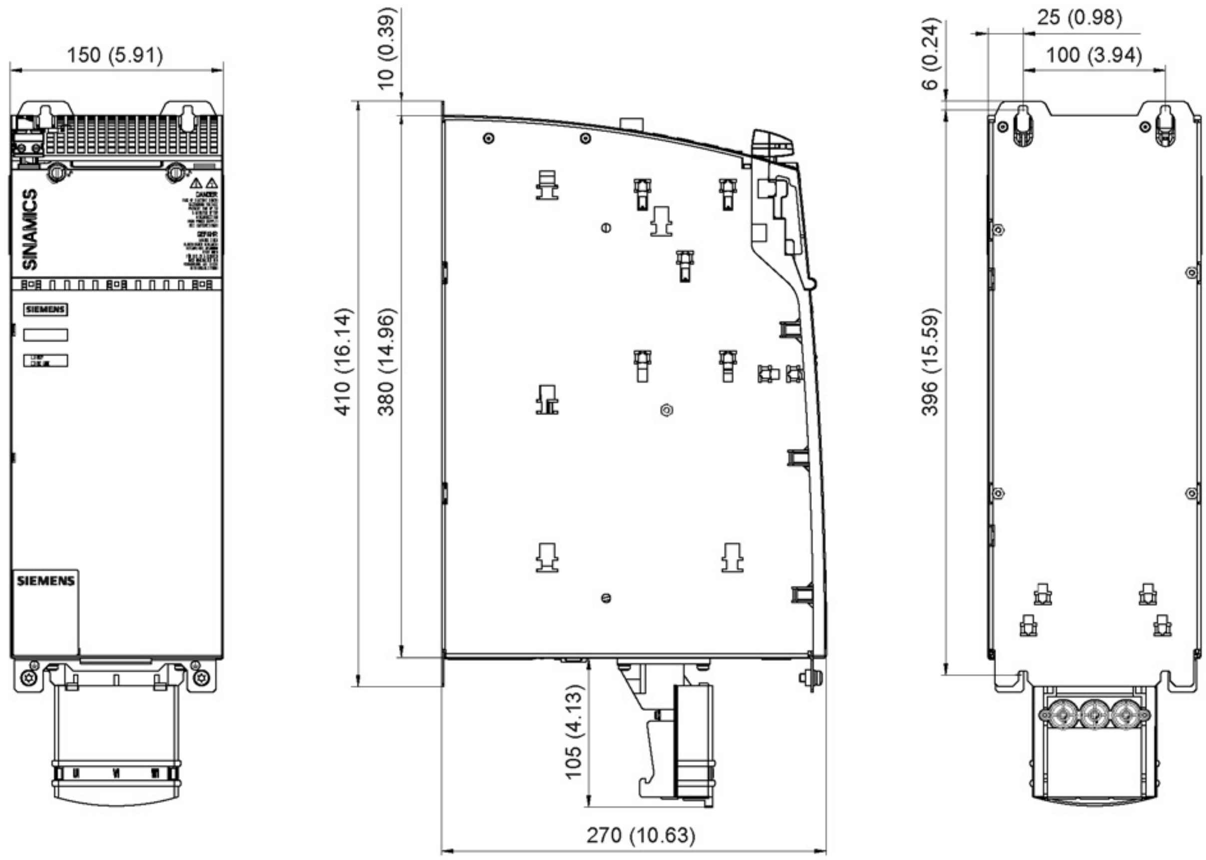


Figure 8-65 Dimension drawing of 36 kW Smart Line Module with internal air cooling, all dimensions in mm and (inches)

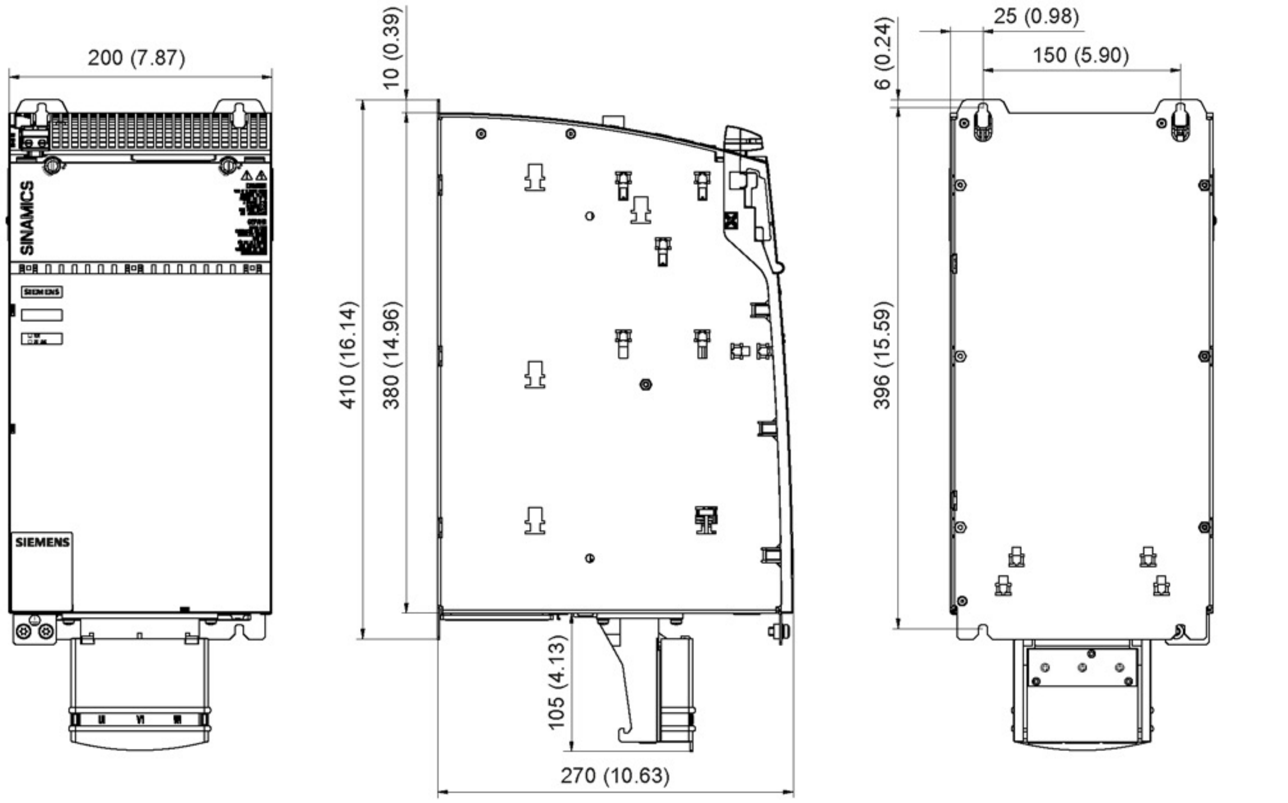
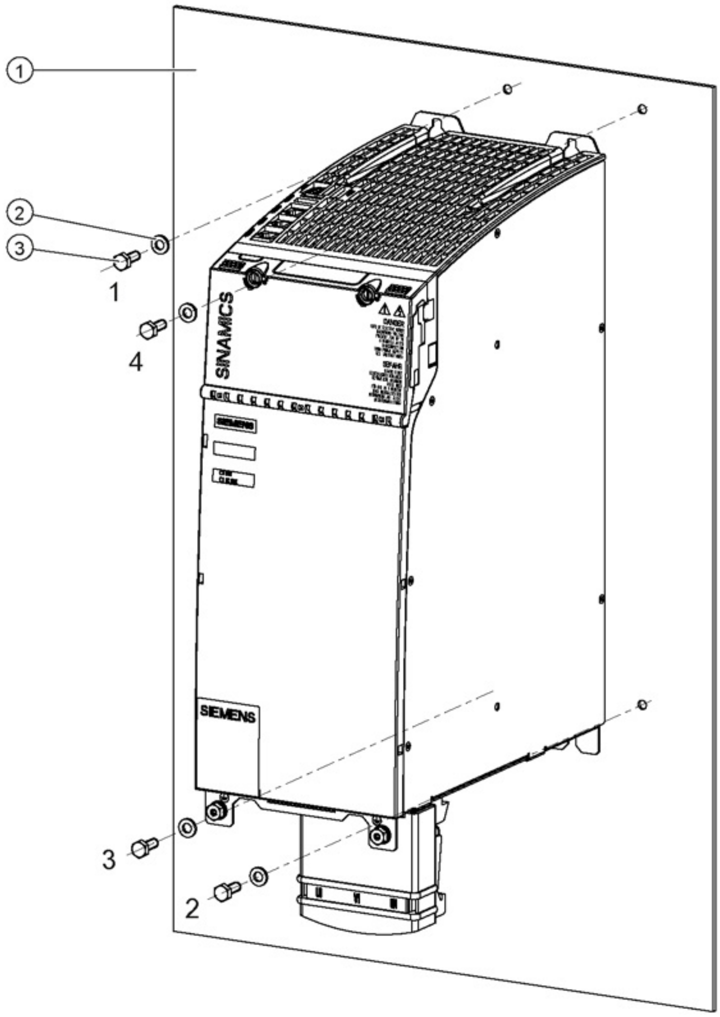


Figure 8-66 Dimension drawing of 55 kW Smart Line Module with internal air cooling, all dimensions in mm and (inches)

8.3.7.7 Installation

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



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

Figure 8-67 Mounting a Smart Line Module with internal air cooling (example: 36 kW)

Tightening torques:

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

8.3.7.8 Technical specifications

Technical specifications

Table 8- 59 Technical data for Smart Line Modules in booksize format with internal air cooling

Internal air cooling	6SL3130–	6AE15–0Axx	6AE21–0Axx	6TE21-6Axx	6TE23-6Axx	6TE25-5AAx
Rated power	**kW**	**5**	**10**	**16**	**36**	**55**
Infeed						
Rated power (S1)1)	kW (P_n)	5	10	16	36	55
S6 operation (40%)1)	kW (P_{S6})	6.5	13	21	47	71
Peak infeed power1)	kW (P_{max})	10	20	35	70	91
Energy recovery						
Continuous regenerative power	kW	5	10	16	36	55
Peak regenerative power	kW	10	20	35	70	91
Supply voltages						
Line voltage	V_{AC}	3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10%				
Line frequency	Hz	47 to 63				
Electronics power supply	V_{DC}	24 (20.4 - 28.8)				
DC link voltage	V_{DC}	510 – 720				
Overvoltage trip	V_{DC}	820 ±2%				
Undervoltage trip2)	V_{DC}	360 ±2%				
Input currents						
Rated input current						
at 400 V_{AC}	A_{AC}	8.1	16.2	27.5	59	90
at 380 V_{AC}/480 V_{AC}	A_{AC}	8.6 / 6.7	17 / 12.8	29 / 24.5	62 / 51	94 / 77
S6 (40%) at 400 V_{AC};	A_{AC}	10.6	21.1	35	76	106
Peak current at 400 V_{AC}	A_{AC}	15.7	31.2	57.5	112	130
DC link currents						
DC link output current						
at 600 V	A_{DC}	8.3	16.6	27	60	92
at 540 V	A_{DC}	9.3	18.5	30	67	105
S6 (40%) at 600 V_{DC}	A_{DC}	11	22	35	79	138
Peak current at 600 V_C	A_{DC}	16.6	33.2	59	118	178
Current-carrying capacity						
DC link busbar	A_{DC}	100	100	100	200	200
Reinforced DC link busbars:	A_{DC}	150	150	150	--	--
24 V busbar:	A_{DC}	20	20	20	20	20
Electronics current consumption at 24 VDC	A_{DC}	0.8	0.9	0.95	1.5	1.9
Total power loss (including electronics losses)3)	W	79.2	141.6	187.8	406	665.6
Max. ambient temperature						
without derating	°C	40				
with derating	°C	55				
DC link capacitance						
Smart Line Module	µF	220	330	705	1410	1880
Drive line-up, max.	µF	6000	6000	20000	20000	20000
Power factor	cos ϕ	0.98				

Internal air cooling	6SL3130–	6AE15–0Axx	6AE21–0Axx	6TE21-6Axx	6TE23-6Axx	6TE25-5AAx
Rated power	**kW**	**5**	**10**	**16**	**36**	**55**
Circuit breaker (IEC 60947 and UL)		See Chap. "Overcurrent protection using line fuses and circuit breakers (Page 116)"				
Rated short-circuit current SCCR[4)]	kA	65	65	65	65	65
Cooling method (internal air cooling)		Internal fan				
Sound pressure level	dB(A)	<60	<60	<60	<65	<60
Cooling air requirement	m^3/h	29.6	29.6	56	112	160
Max. permissible heat sink temperature	°C	69[5)]	73[5)]	77	80	75
Rated voltage for rated data 3 AC 380 V						
Weight	kg	4.7	4.8	7	10	17

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

2) For 16 kW and 36 kW Smart Line Modules: Default for 400 V line systems; undervoltage trip threshold is adjusted to the parameterized rated voltage.

3) For an overview, see the power loss tables in the Appendix.

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

5) Values cannot be read out by the system (STARTER).

Characteristics

Rated duty cycles of Smart Line Modules

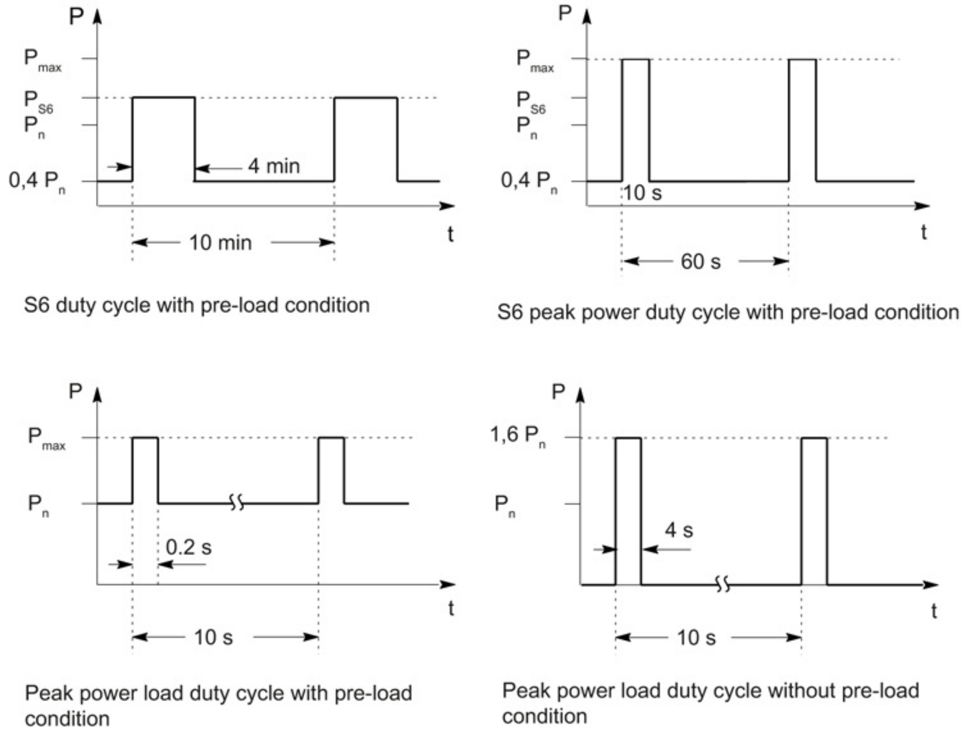


Figure 8-68 Rated duty cycles of Smart Line Modules

Derating characteristics

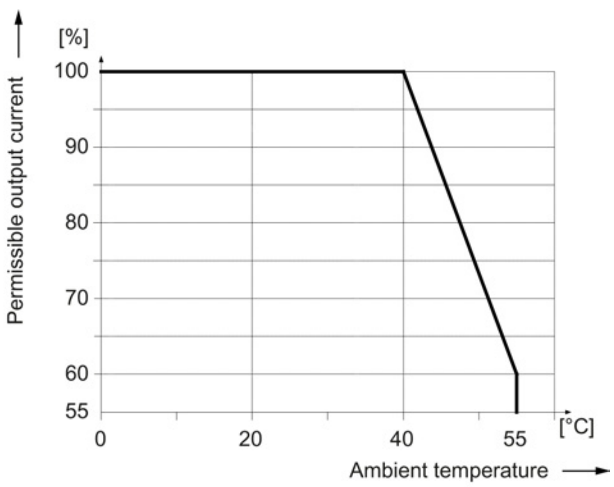


Figure 8-69 Output current as a function of the ambient temperature

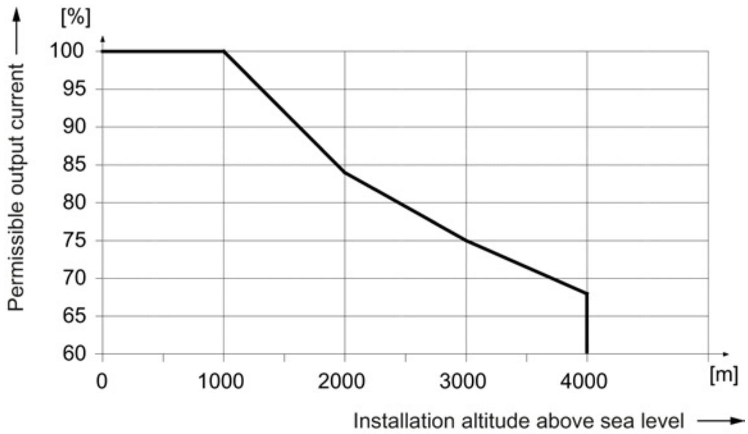


Figure 8-70 Output current as a function of the installation altitude

At installation altitudes > 2000 m, an isolation transformer must be used (see the chapter titled "System overview/Function of installation altitude and ambient temperature" (Page 32)). The design of the secondary line system must be as follows:

- TN system with grounded neutral point (no grounded line conductor)
- IT system

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

8.3.8 Smart Line Modules with external air cooling

8.3.8.1 Description

The Smart Line Module is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module(s) with a non-regulated DC voltage at the DC output. In the infeed mode the Smart Line Module exhibits the typical current and voltage waveforms of a 6-pulse diode rectifier bridge.

In feedback mode, the current waveform is square waved. Regenerative feedback can be deactivated if required. On 5 kW and 10 kW Smart Line Modules, this is done via a terminal, since these modules do not feature a DRIVE-CLiQ connection. On 16 kW to 55 kW Smart Line Modules, regenerative feedback can be deactivated via parameters, as, just like Active Line Modules, these modules are equipped with a DRIVE-CLiQ connection.

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

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

External air cooling uses the "through-hole" method. This is a cooling method that is only available for SINAMICS booksize units. The Smart Line Module and its heat sink can be inserted in a rectangular knockout at the rear of the control cabinet and mounted with a seal. The heat sink and the fan (included in the scope of supply) project beyond the rear of the control cabinet and the heat is dissipated outside the control cabinet or in a separate air duct.

8.3.8.2 Product-specific safety information for the Smart Line Modules in booksize format

The safety instructions described in this chapter apply specifically to Smart Line Modules in booksize format.

In addition, you should strictly observe the safety instructions in Chapter 1.

NOTICE
It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21.1. **Activation**: • 24 VDC power supply X24 ON • Line contactor ON • EP signal X21 pins 3 and 4 ON • Wait until precharging is complete • "Ready" signal at terminal X21 pin 1 set to "high" • Infeed is ready, pulse enable possible for motors **Deactivation**: • Shut drives down • Cancel pulse enable for motors (OFF1 signal) • EP signal X21 pins 3 and 4 OFF • Line contactor OFF • 24 VDC power supply X24 OFF **Overload**: • "Prewarning" signal at terminal X21 pin 2 set to "low" • Shut drives down via the control system • "Ready" signal at terminal X21 pin 1 set to "low" • Pulse inhibit for all the drives supplied by this infeed within 4 ms

Note

Operation without the line reactor is not permissible.

Note

Connection to the public low-voltage network

Smart Line Modules have been designed for use in the industrial environment and generate current harmonics on the line side as a result of the rectifier circuit.

When connecting a machine with integrated Smart Line Modules to the public low-voltage network, authorization is required in advance from the local power supply company (utility company) if

- The rated current of the machine ≤ 16 A per conductor, and
- The rated machine current does not comply with the requirements specified in EN 61000-3-2 regarding current harmonics.

8.3.8.3 Interface description

Overview

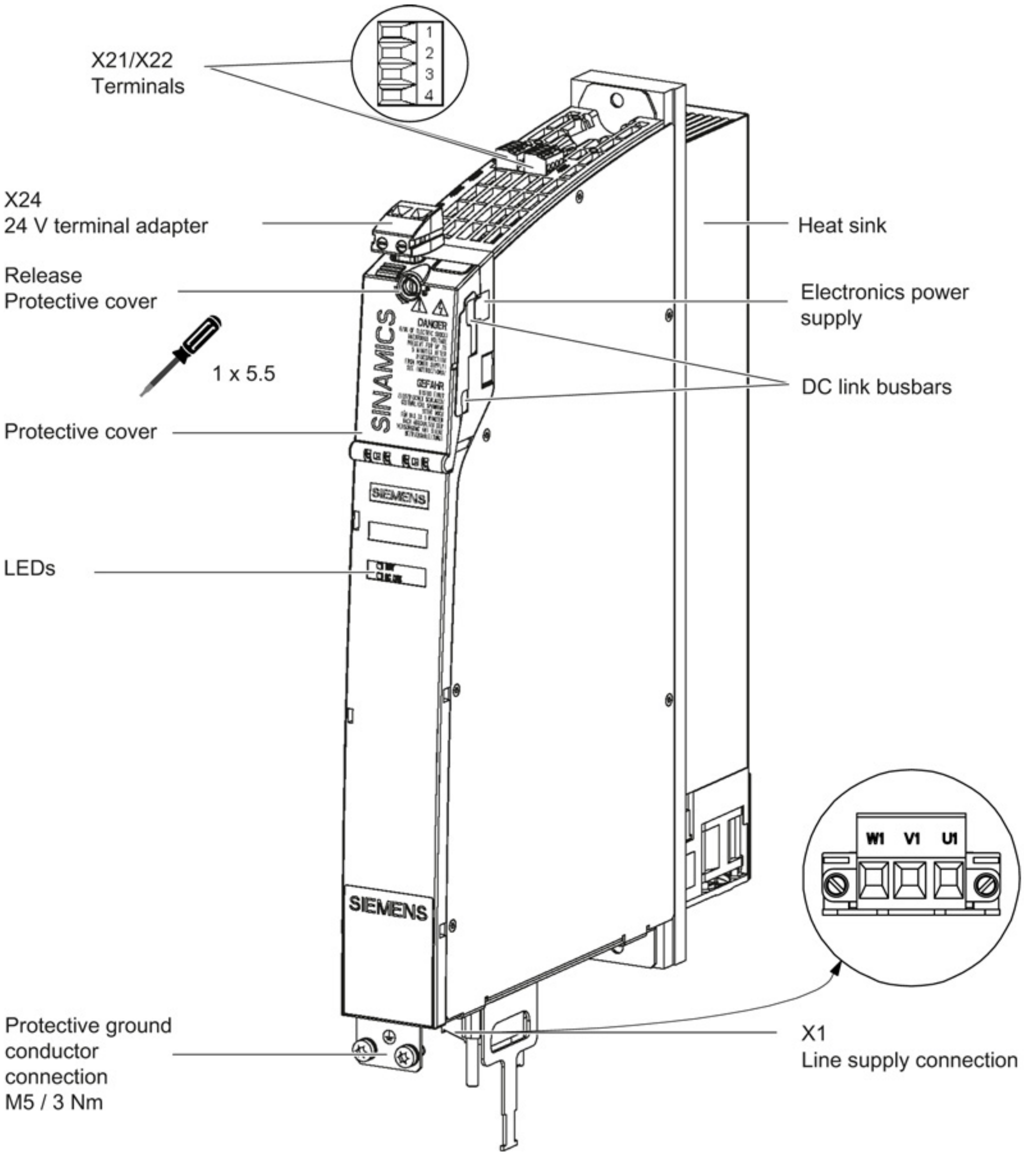


Figure 8-71 Interface overview, 5 kW and 10 kW Smart Line Modules with external air cooling (example: 5 kW)

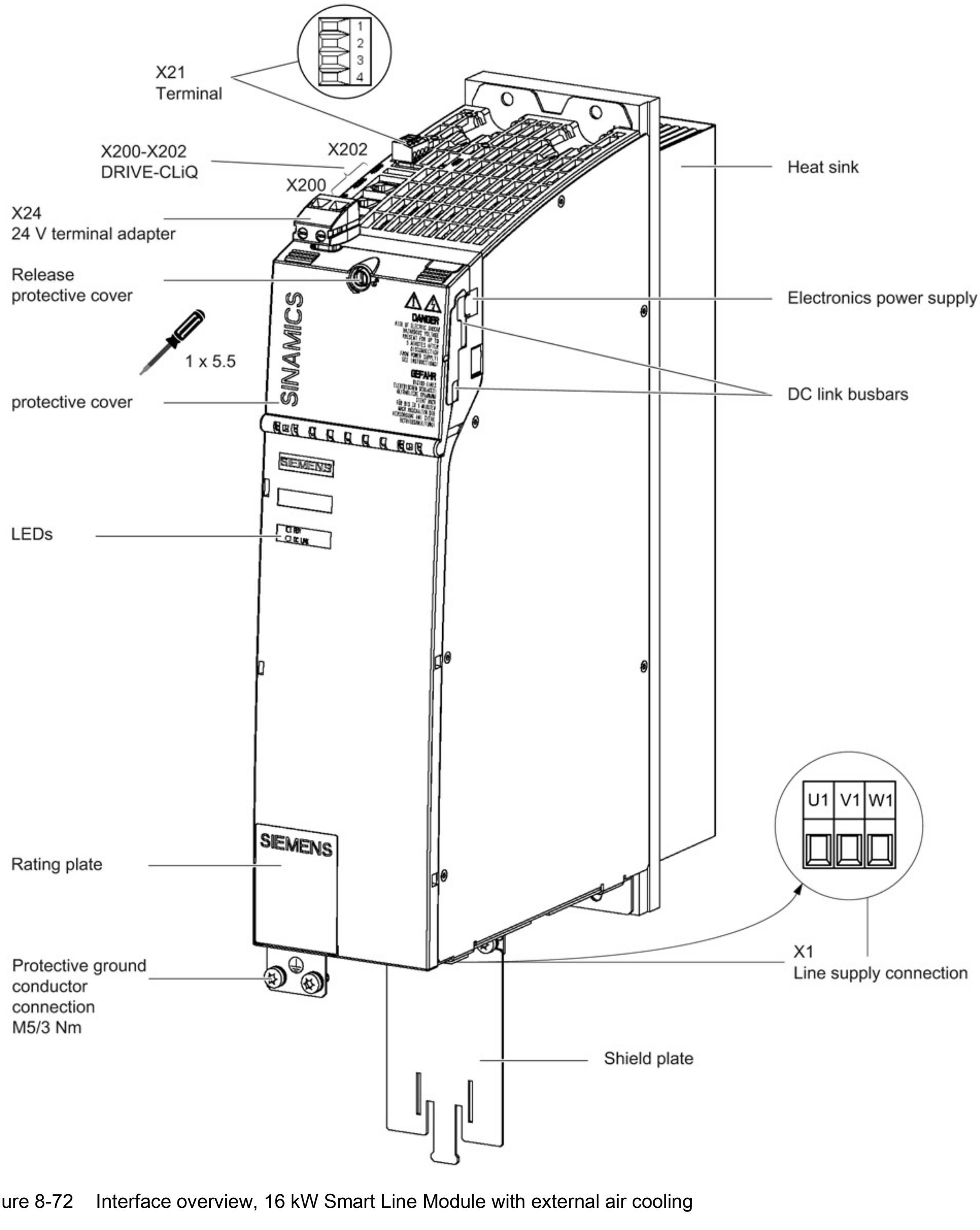


Figure 8-72 Interface overview, 16 kW Smart Line Module with external air cooling

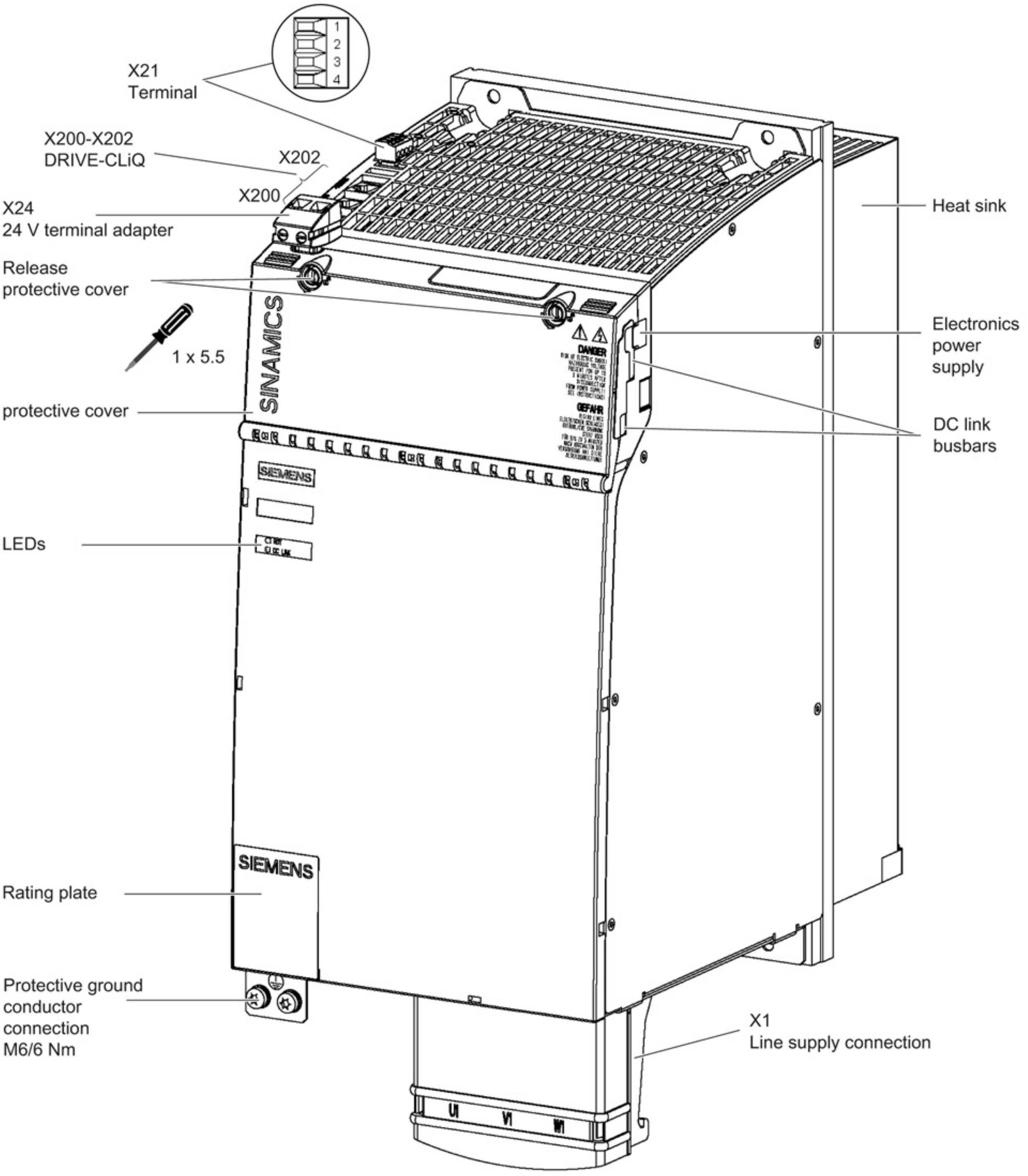
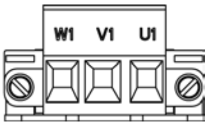
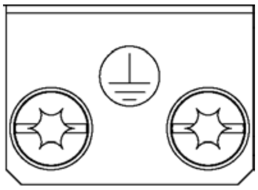


Figure 8-73 Interface overview, 36 kW and 55 kW Smart Line Modules with external air cooling (example: 55 kW)

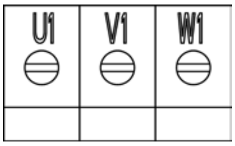
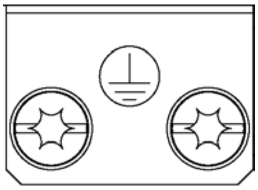
X1 line connection

Table 8- 60 X1: Line connection for Smart Line Modules 5 kW and 10 kW

	Terminal	Technical specifications
	U1	Supply voltage: 3 AC 380 V - 480 V, 50/60 Hz Max. connectable cross-section: 6 mm² Type: Screw terminal 5 (see Appendix, Chapter "Screw terminals") Tightening torque: 1.2 - 1.5 Nm
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm 1)

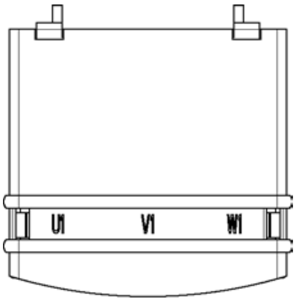
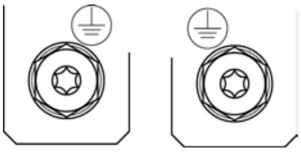
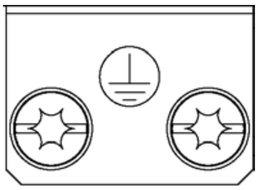
1) For ring cable lugs in accordance with DIN 46234

Table 8- 61 X1: Line supply connection for Smart Line Modules 16 kW

	Terminal	Technical specifications
	U1	Supply voltage: 3 AC 380 V - 480 V, 50/60 Hz Max. connectable cross-section: 10 mm² Type: Screw terminal 6 (see Appendix, Chapter "Screw terminals") Tightening torque: 1.5 - 1.8 Nm
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

Table 8- 62 X1: Line connection for Smart Line Modules 36 kW and 55 kW

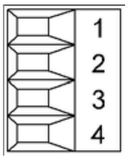
	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 3 AC 380 V - 480 V, 50/60 Hz **36 kW**: Threaded bolt M6/6 Nm 1) **55 kW**: Threaded bolt M8/13 Nm 1)
	PE connection	**36 kW**: Threaded hole M6/6 Nm 1)
		**55 kW**: Threaded hole M6/6 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

X21 EP terminals

Smart Line Modules 5 kW and 10 kW

Table 8- 63 X21 EP terminal for Smart Line Modules 5 kW and 10 kW

	Terminal	Description	Technical specifications
	1	DO: Ready	Checkback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: • Electronic power supply (X24) OK • DC link is precharged • Pulses enabled (X21.3/4) • No overtemperature • No overcurrent
	2	DO: Prewarning	DO: Prewarning High = no prewarning Low = prewarning • Overtemperature warning threshold/I^2t 5 kW prewarning: 64°C, overtemperature threshold: 69°C 10 kW prewarning: 68°C, overtemperature threshold: 73°C • No regenerative feedback capability due to a line fault [only monitored when regenerative feedback is activated (see terminal X22.2)]
	3	EP +24 V (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm² Type: Screw terminal 1 (see Appendix, Chapter "Screw terminals")			

⚠ WARNING

For operation, the 24 VDC voltage must be connected to terminal X21.3 and ground to terminal X21.4. When withdrawn, pulse suppression is activated. The regenerative feedback is deactivated. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

NOTICE
It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21.1 (see the chapter titled "Safety instructions")

Note

Output terminal X21.1 must be wired to a digital input on the CU. The drives supplied with power by the Smart Line Module have to use this signal as a "Ready" message (BI: p0864 = digital input). This ensures that a pulse enable can only be issued for the drives (motor or generator operation) when the infeed is ready.
If interconnection with a digital input on the CU is not possible, the signal must be evaluated by a higher-level control system instead. The control system cannot set the drives to ready until the infeed "Ready" signal is present.

Note

The "Prewarning" signal at output terminal X21.2 warns against an overload. If this signal is set, the control system shuts the drives down before the "Ready" signal switches to "low". If the "Ready" signal changes to "low", the drive pulses must be suppressed within 4 ms.

Note

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be carried out using a leading (≥ 10 ms) breaking auxiliary contact, for example.

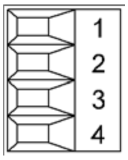
This protects external loads located parallel to the drive on the same switching component.

Note

The Smart Line Module signals that it is ready, even if one of the line conductors is not available. In this case, regenerative feedback is deactivated and an alarm is output at X21.2 (DO, Warning I^2t). If regenerative feedback was deactivated by applying a "high" signal to terminal X22.2 (DI, Disable), no alarm will be output at X21.2 (DO, Warning I^2t).

16 kW to 55 kW Smart Line Modules

Table 8- 64 X21 EP terminal/temperature Sensor for 16 kW to 55 kW Smart Line Modules

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors[1)]: KTY84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Voltage: 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs
	4	EP M (Enable Pulses)	
Max. connectable cross-section 1.5 mm² Type: Screw terminal 1 (see Appendix, Chapter "Screw terminals")			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual).
Temperatures are detected but not evaluated in the Smart Line Module.

WARNING

For operation, the 24 VDC voltage must be connected to terminal X21.3 and ground to terminal X21.4. When withdrawn, pulse suppression is activated. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

Note

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be carried out using a leading (≥ 10 ms) breaking auxiliary contact, for example.

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

Note

The KTY temperature sensor must be connected with the correct polarity.
If the sensor is connected with the incorrect polarity, it cannot detect if a motor overheats.

DANGER

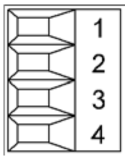
Risk of electric shock!

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

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

X22 digital inputs

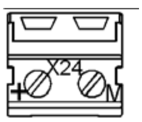
Table 8- 65 X22 digital inputs for Smart Line Modules 5 kW and 10 kW

	Terminal	Description [1)]	Technical specifications
	1	24 V power supply	Electronic power supply for controlling digital inputs X22.2 and 3.
	2	DI: Disable regeneration	Deactivate regenerative feedback (high active). No power is supplied back to the network from the DC link. The regenerative energy of the motors may have to be reduced using a combination of the Braking Module and braking resistor.
	3	DI: Reset	Reset faults (negative edge)
	4	Ground	Electronics ground
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see Appendix, Chapter "Screw terminals")			

1) DI: Digital input

X24 24 V terminal adapter

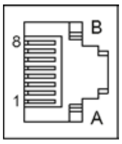
Table 8- 66 X24 24 V terminal adapter

	Terminal	Description	Technical specifications
	+	24 V power supply	24 VDC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see Appendix, Chapter "Screw terminals")			

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

X200-X202 DRIVE-CLiQ interfaces

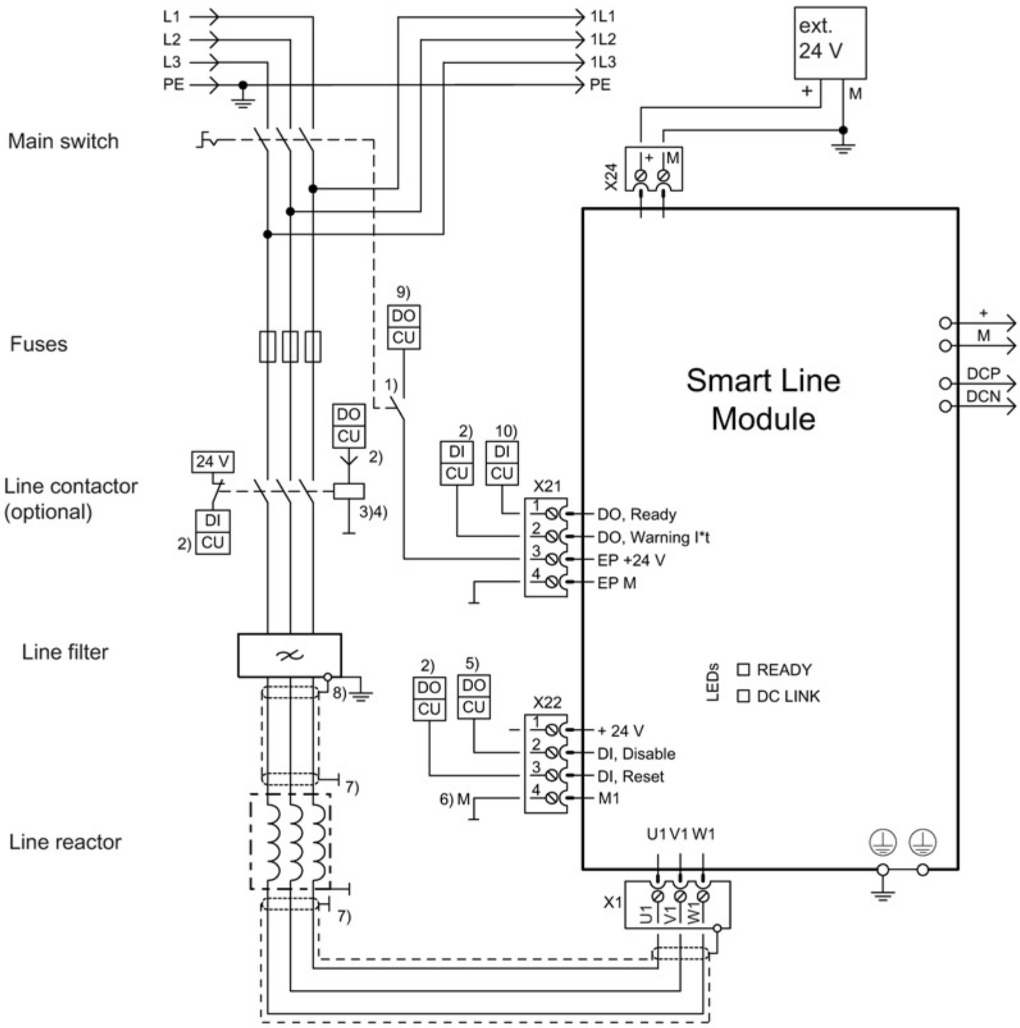
Table 8- 67 X200-X202 DRIVE-CLiQ interfaces

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

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

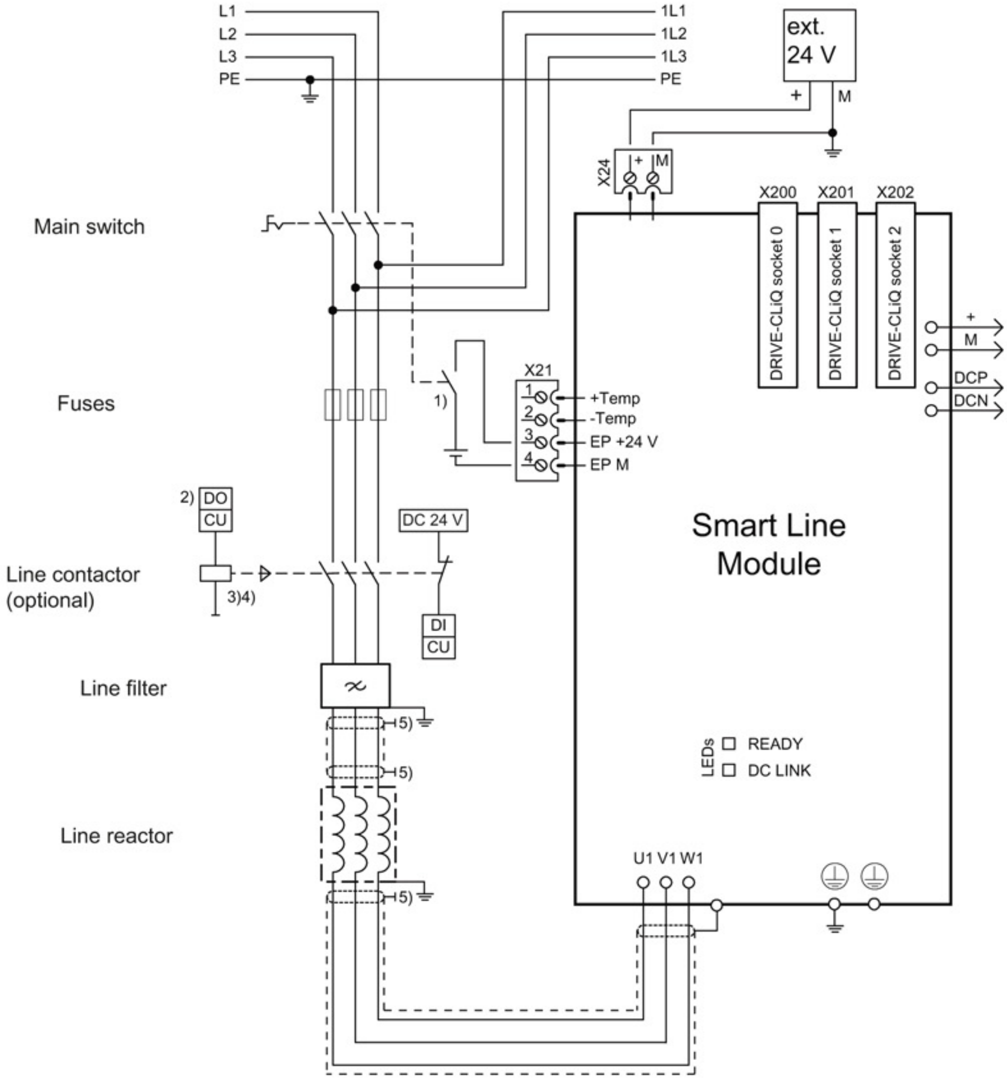
Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

8.3.8.4 Connection examples



1) Leading NC contact t >10 ms, 24 VDC and ground must be set up for operation.
2) DI/DO controlled from the Control Unit
3) No additional load permitted downstream of the line contactor
4) The current-carrying capacity of the DO must be observed; an output coupling device must be used if required.
5) DO high, regenerative feedback deactivated (a jumper can be inserted between X22 pin 1 and pin 2 for permanent deactivation).
6) X22 pin 4 must be connected to ground (ext. 24 V).
7) Contact established via rear mounting panel or shielding buses in accordance with the EMC installation guideline
8) 5 kW and 10 kW line filters via shield connection
9) Signal output of the control, to avoid interference of the 24 VDC supply on the EP terminal.
10) Interconnection via BICO to parameter p0864

Figure 8-74 Connection example for 5 kW and 10 kW Smart Line Modules



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

Figure 8-75 Connection example for 16 kW to 55 kW Smart Line Modules

8.3.8.5 Meaning of LEDs

Smart Line Modules 5 kW and 10 kW

Table 8- 68 Meaning of the LEDs on 5 kW and 10 kW Smart Line Modules

LED	Color	Status	Description, cause	Remedy
RDY	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	Component is ready to operate.	–
	Yellow	Continuous light	Pre-charging not yet complete. Bypass relay dropped out EP terminals not supplied with 24 VDC.	–
	Red	Continuous light	Overtemperature, overcurrent	Diagnose fault (via output terminals) and acknowledge it (via input terminal)
DC LINK	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Yellow	Continuous light	DC link voltage within permissible tolerance range.	–
	Red	Continuous light	DC link voltage outside permissible tolerance range. Power system fault.	Check line voltage.

WARNING

Danger to life due to high DC link voltage, regardless of LED display

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.

- Observe the warning information on the component.

16 kW to 55 kW Smart Line Modules

Table 8- 69 Meaning of the LEDs on Smart Line Modules ≥ 16 kW

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

⚠ **WARNING**

Danger to life due to high DC link voltage, regardless of LED display

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.

- Observe the warning information on the component.

8.3.8.6 Dimension drawings

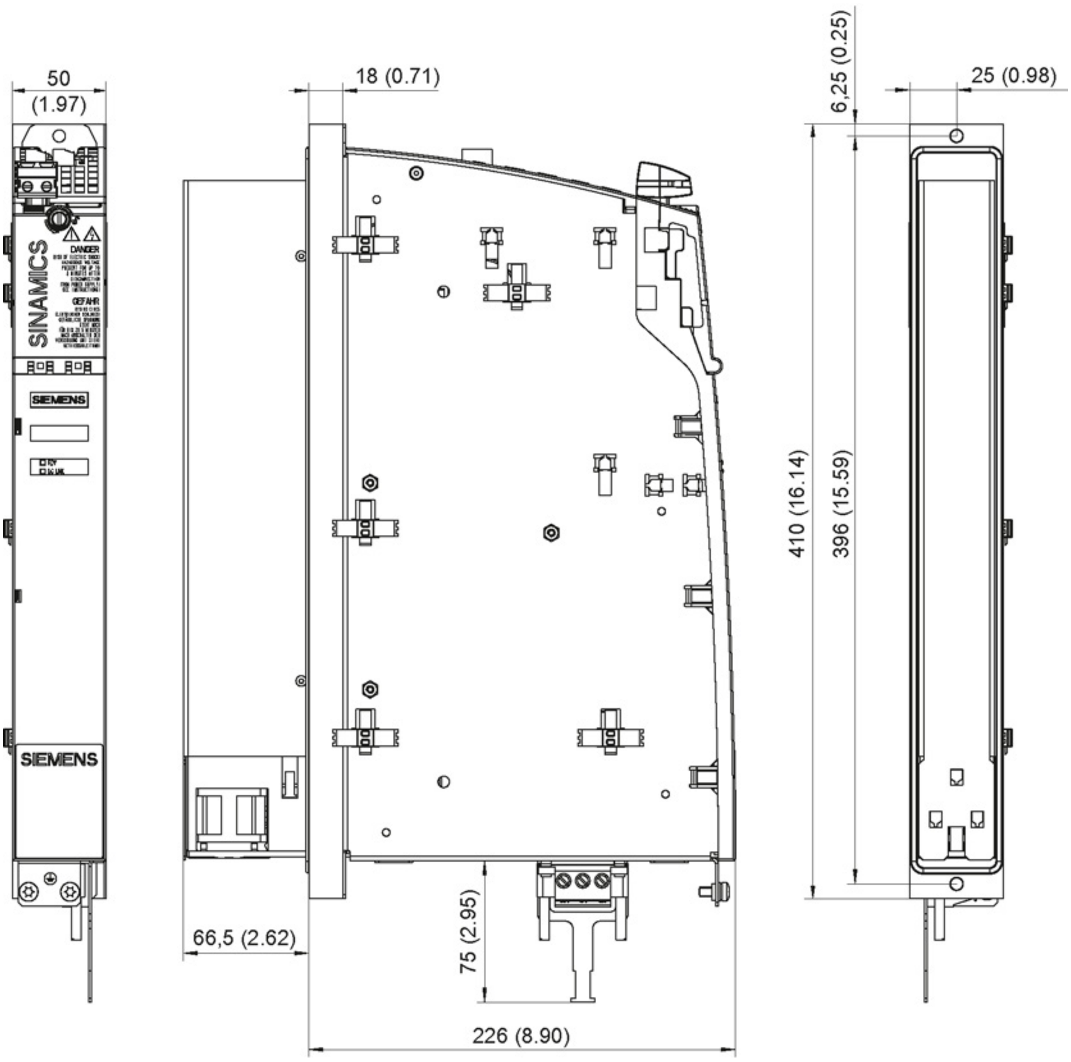


Figure 8-76 Dimension drawing of 5 kW and 10 kW Smart Line Modules with external air cooling, all dimensions in mm and (inches)

Table 8- 70 Dimensions of Smart Line Modules with external air cooling

Line Module	Order number	W [mm] (inches)
5 kW	6SL3131-6AE15-0AAx	50 (1.97)
10 kW	6SL3131-6AE21-0AAx	50 (1.97)

Note

The shield connecting plate is part of the scope of supply of the 50 mm Smart Line Module.

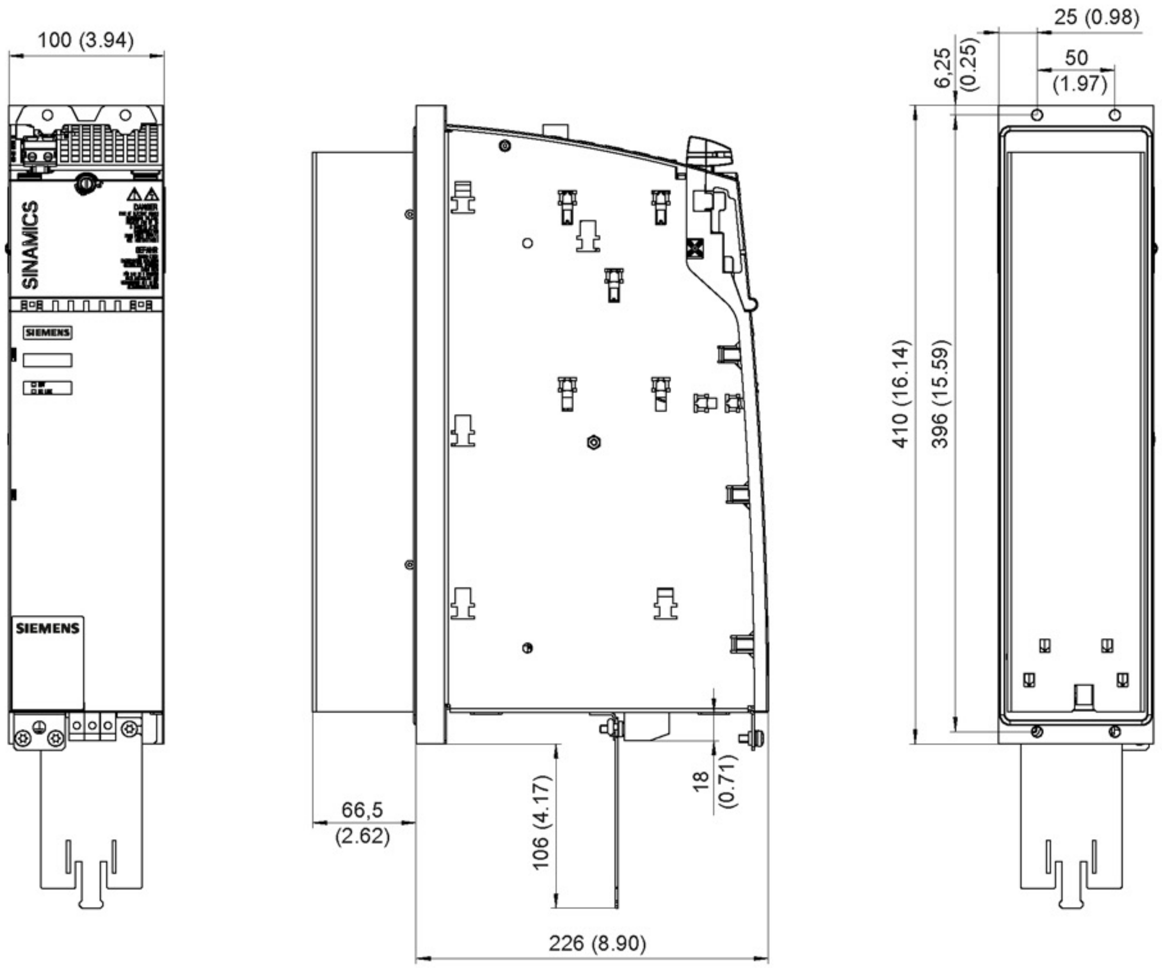


Figure 8-77 Dimension drawing of 16 kW Smart Line Module with external air cooling, all dimensions in mm and (inches)

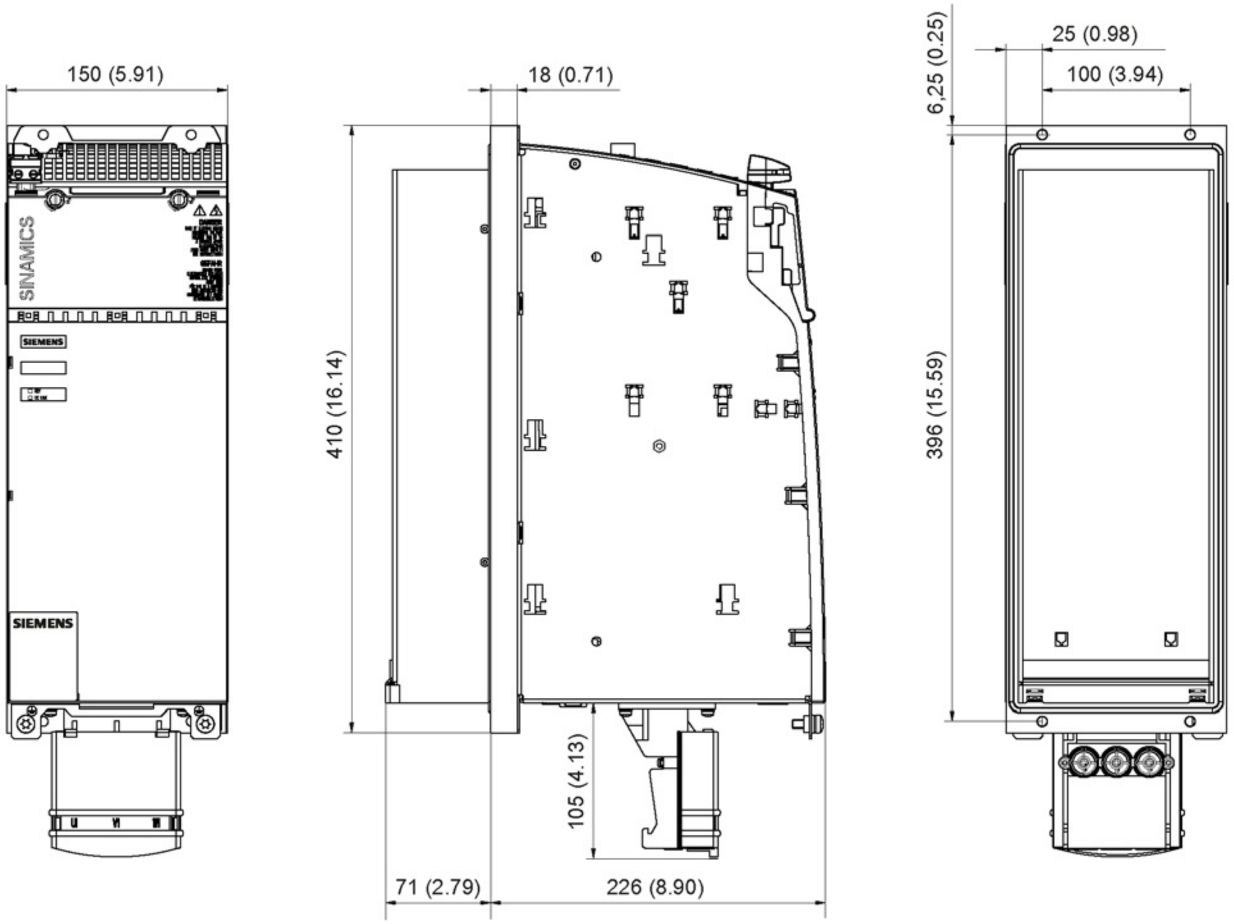


Figure 8-78 Dimension drawing of 36 kW Smart Line Module with external air cooling, all dimensions in mm and (inches)

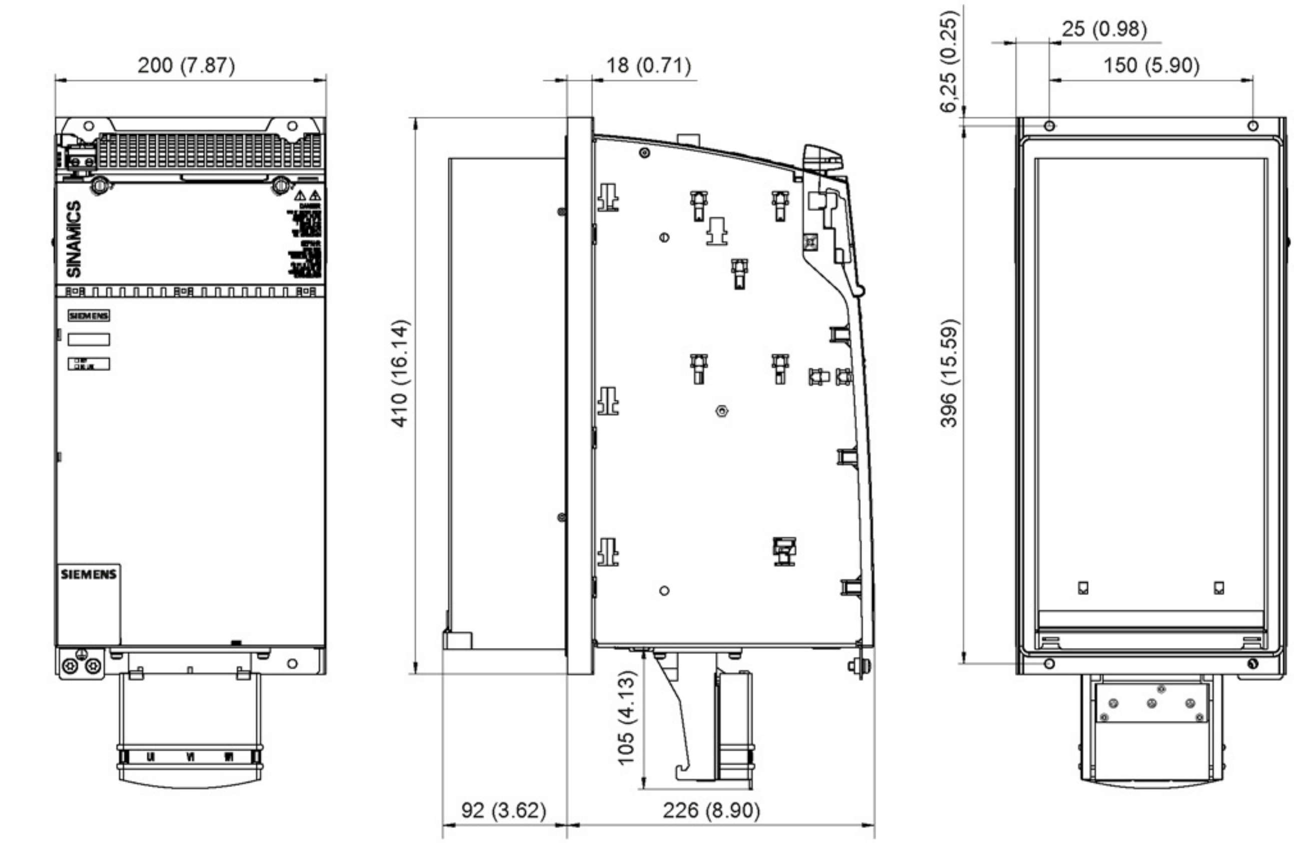
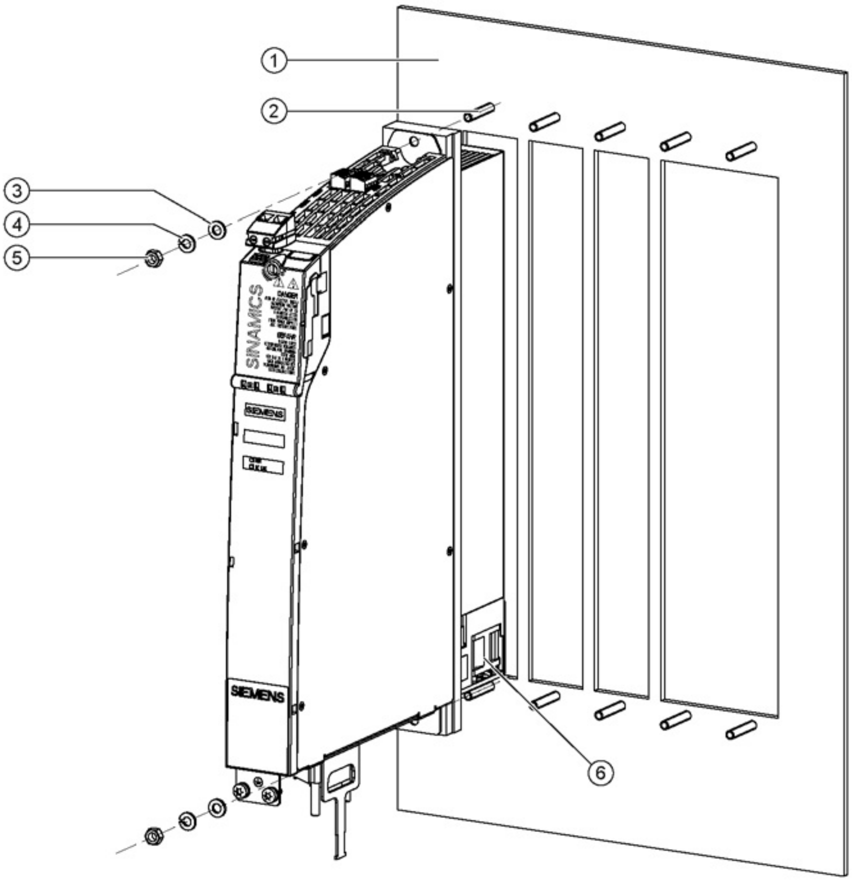


Figure 8-79 Dimension drawing of 55 kW Smart Line Module with external air cooling, all dimensions in mm and (inches)

8.3.8.7 Installation



① Mounting plate with openings
② M6 studs
③ Washer
④ Spring washer
⑤ M6 nut, width A/F 10 (hexagon head)
⑥ Fan assembly

Figure 8-80 Installing a Smart Line Module with external air cooling on a mounting plate, using a 5 kW Smart Line Module as an example

Tightening torques:

- Initially, tighten by hand (0.5 Nm)
- Then tighten with 6 Nm.

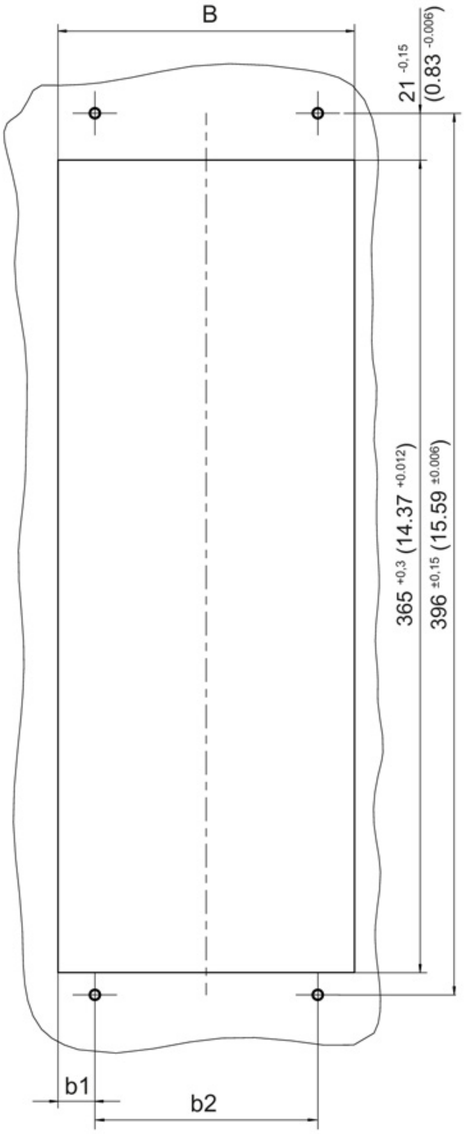
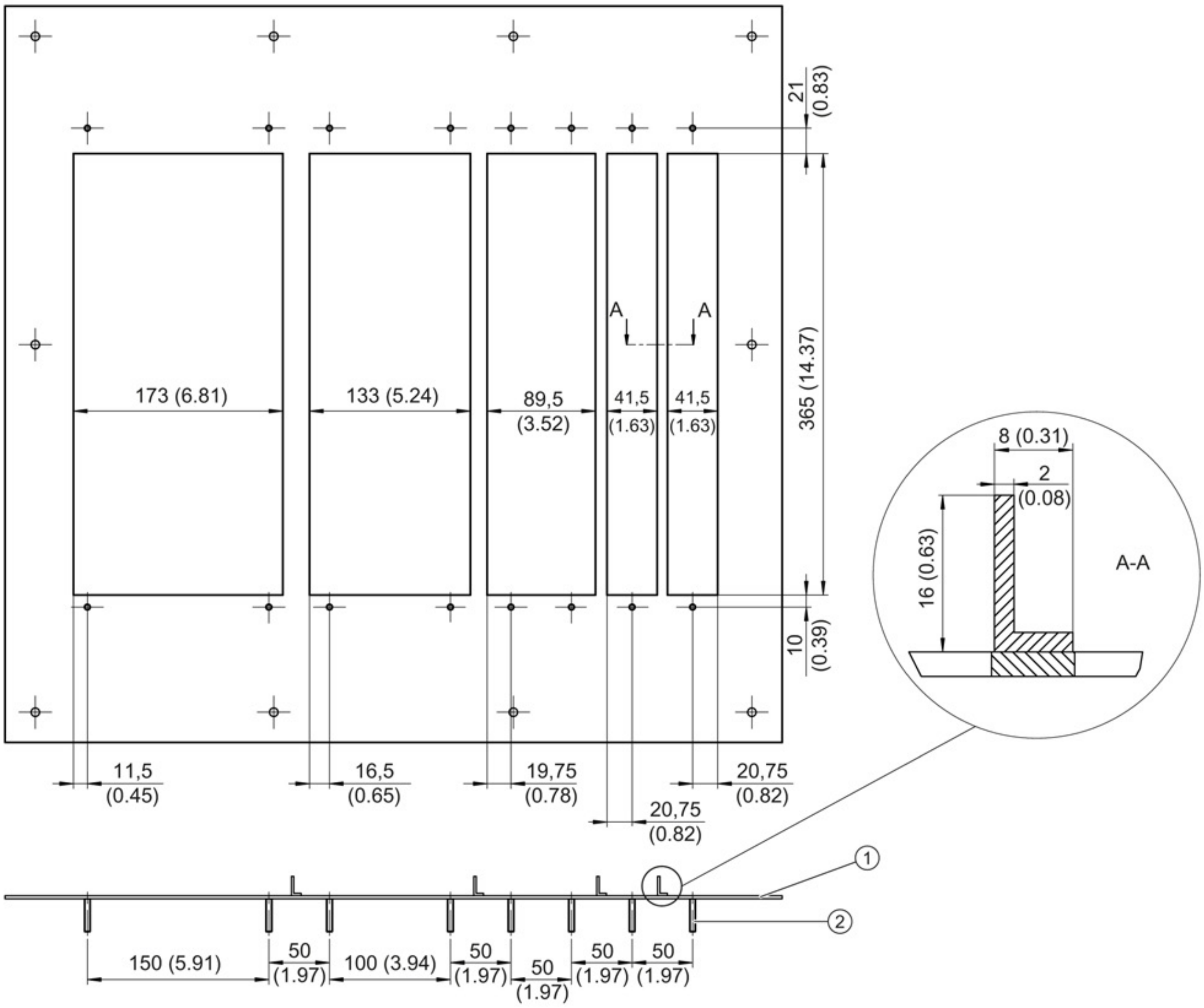


Figure 8-81 Installation opening for Smart Line Modules 50 mm to 200 mm with external air cooling, all data in mm and (inches)

Table 8- 71 Dimensions of installation openings for Smart Line Modules with external air cooling

Module width	W in mm (inches)	w1 in mm (inches)	w2 in mm (inches)
50 mm	$41.5^{+0.3}$ ($1.63^{+0.012}$)	$20.75^{+0.15}$ ($0.82^{+0.006}$)	--
100 mm	$89.5^{+0.3}$ ($3.52^{+0.012}$)	$19.75^{+0.15}$ ($0.78^{+0.006}$)	$50^{\pm0.15}$ ($1.97^{\pm0.006}$)
150 mm	$133^{+0.3}$ ($5.24^{+0.012}$)	$16.5^{+0.15}$ ($0.65^{+0.006}$)	$100^{\pm0.15}$ ($3.94^{\pm0.006}$)
200 mm	$173^{+0.3}$ ($6.81^{+0.012}$)	$11.5^{+0.15}$ ($0.45^{+0.006}$)	$150^{\pm0.15}$ ($5.91^{\pm0.006}$)



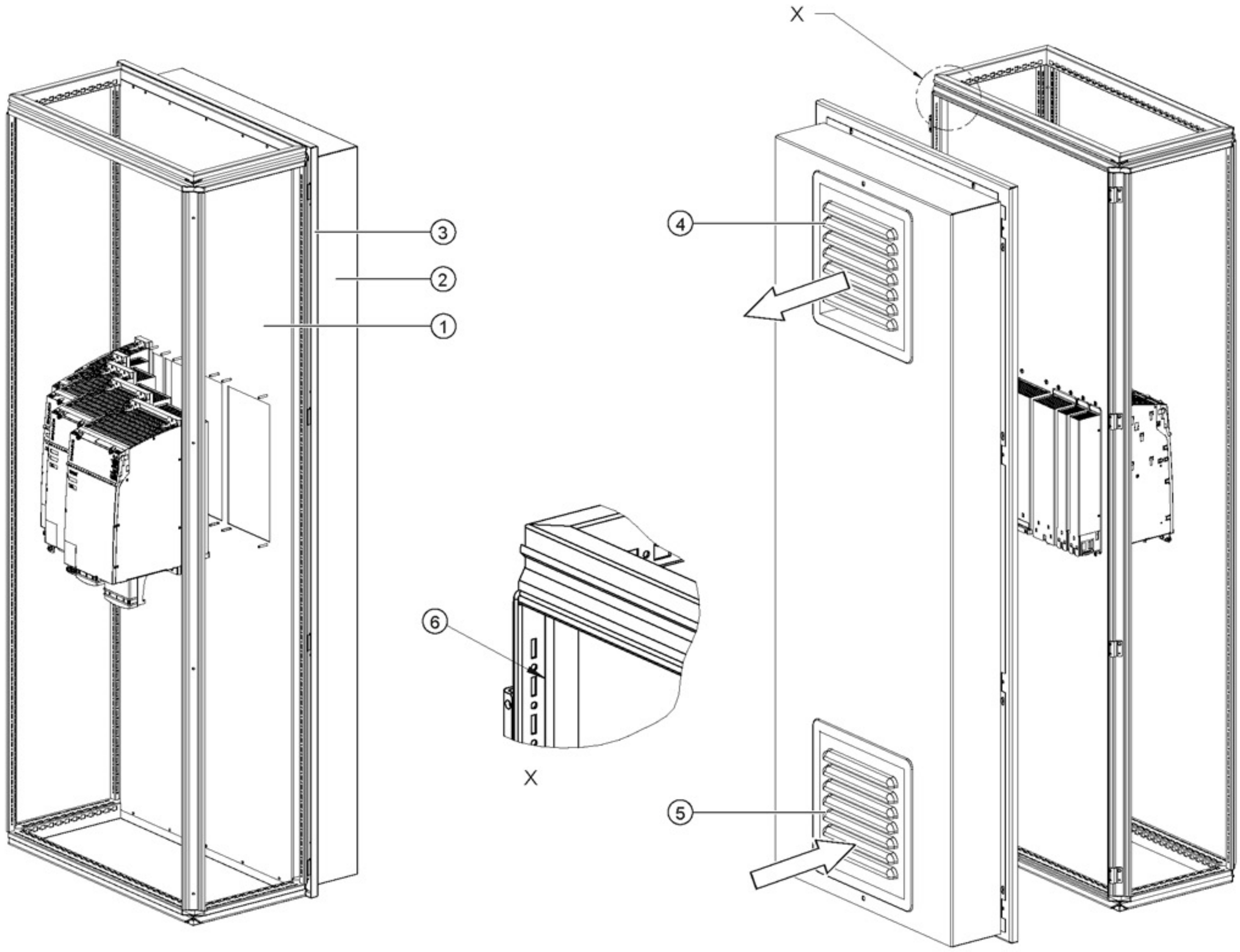
① Insert or mounting plate

② Threaded bolts M5 x 28

Figure 8-82 Example of a mounting plate for a drive line-up with external air cooling

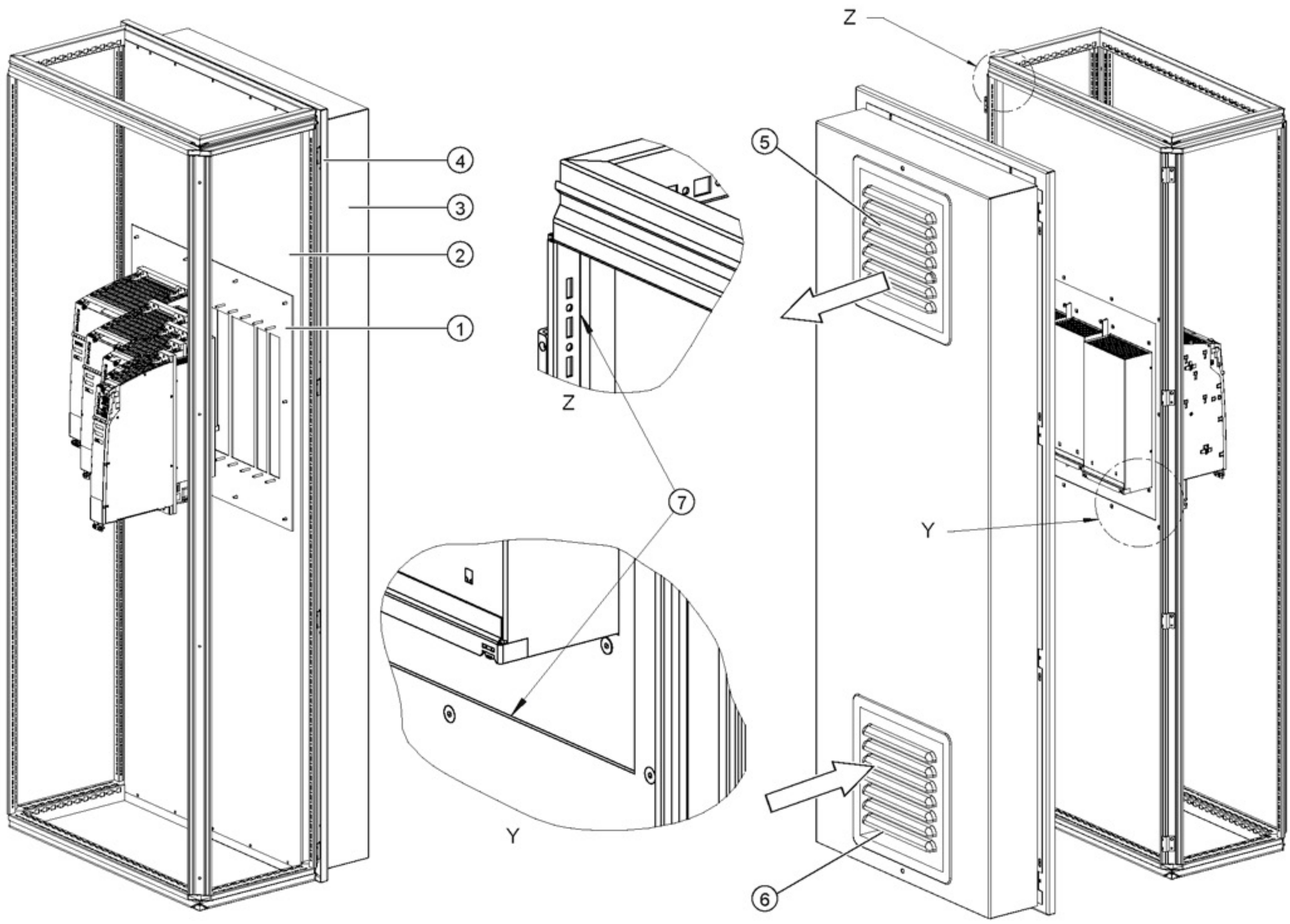
During installation it must be ensured that the component's seal is tight throughout. The cross-pieces must have the appropriate stability. If necessary, the cross-pieces of the openings must be reinforced.

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



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

Figure 8-83 Example 1: installation in cabinet with mounting plate



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

Figure 8-84 Example 2: installation in cabinet with mounting plate

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

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

Note

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

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

Help with the mechanical control cabinet installation is available from:

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

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

8.3.8.8 Technical specifications

Table 8- 72 Technical data Smart Line Modules Booksize external air cooling

Internal air cooling	6SL3131–	6AE15–0AAx	6AE21–0AAx	6TE21-6AAx	6TE23-6AAx	6TE25-5AAx
Rated power	**kW**	**5**	**10**	**16**	**36**	**55**
Infeed Rated power (S1)[1)] S6 operation (40%)[1)] Peak infeed power[1)]	 kW (P_n) kW (P_{s6}) kW (P_{max})	 5 6.5 10	 10 13 20	 16 21 35	 36 47 70	 55 71 91
Energy recovery Continuous regenerative power Peak regenerative power	 kW kW	 5 10	 10 20	 16 35	 36 70	 55 91
Supply voltages Line voltage Line frequency Electronics power supply	 V_{AC} Hz V_{DC}	 3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10% 47 to 63 24 (20.4 - 28.8)				
DC link voltage Overvoltage trip Undervoltage trip[2)]	V_{DC} V_{DC} V_{DC}	510 – 720 820 ±2% 360 ±2%				
Input currents Rated input current at 400 V_{AC} at 380 V_{AC}/480 V_{AC} S6 (40%) at 400 V_{AC}; peak current at 400 V_{AC}	 A_{AC} A_{AC} A_{AC} A_{AC}	 8.1 8.6 / 6.7 10.6 15.7	 16.2 17 / 12.8 21.1 31.2	 27.5 29 / 24.5 35 57.5	 59 62 / 51 76 112	 90 94 / 77 106 130
DC link currents DC link output current at 600 V_{DC} at 540 V_{DC} S6 (40%) at 600 V_{DC} Peak current at 600 V_{DC}	 A_{DC} A_{DC} A_{DC} A_{DC}	 8.3 9.3 11 16.6	 16.6 18.5 22 33.2	 27 30 35 59	 60 67 79 118	 92 105 138 178

Internal air cooling	6SL3131–	6AE15–0AAx	6AE21–0AAx	6TE21-6AAx	6TE23-6AAx	6TE25-5AAx
Rated power	**kW**	**5**	**10**	**16**	**36**	**55**
Current-carrying capacity DC link busbar Reinforced DC link busbars: 24 V busbar:	 A_{DC} A_{DC} A_{DC}	 100 150 20	 100 150 20	 100 150 20	 200 -- 20	 200 -- 20
Electronics current consumption at 24 VDC	A_{DC}	0.8	0.9	0.95	1.5	1.9
Total power loss (incl. electronics losses)[3)] Internal External	W W W	79.2 41.2 38	141.6 66.6 75	187.8 64.8 123	406 116 290	665.6 185.6 480
Max. ambient temperature without derating with derating	 °C °C	 40 55				
DC link capacitance Smart Line Module Drive line-up, max.	 µF µF	 220 6000	 330 6000	 705 20000	 1410 20000	 1880 20000
Power factor	cos ϕ	0.98	0.98	0.98	0.98	0.98
Circuit breaker (IEC 60947 and UL)		See Chap. "Overcurrent protection using line fuses and circuit breakers (Page 116)"				
Rated short-circuit current SCCR[4)]	kA	65	65	65	65	65
Sound pressure level	dB(A)	< 60	< 60	< 60	<65	< 60
Cooling air requirement	m^3/h	29.6	29.6	56	112	160
Max. permissible heat sink temperature	°C	69[5)]	73[5)]	77	80	75
Rated voltage for rated data 3 AC 380 V						
Weight	kg	5.3	5.4	8.8	13.8	18.5

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

2) For 16 kW and 36 kW Smart Line Modules: Default for 400 V line systems; undervoltage trip threshold is adjusted to the parameterized rated voltage.

3) For an overview, see the power loss tables in the Appendix

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

5) Values cannot be read out by the system (STARTER).

Characteristics

Rated duty cycles of Smart Line Modules

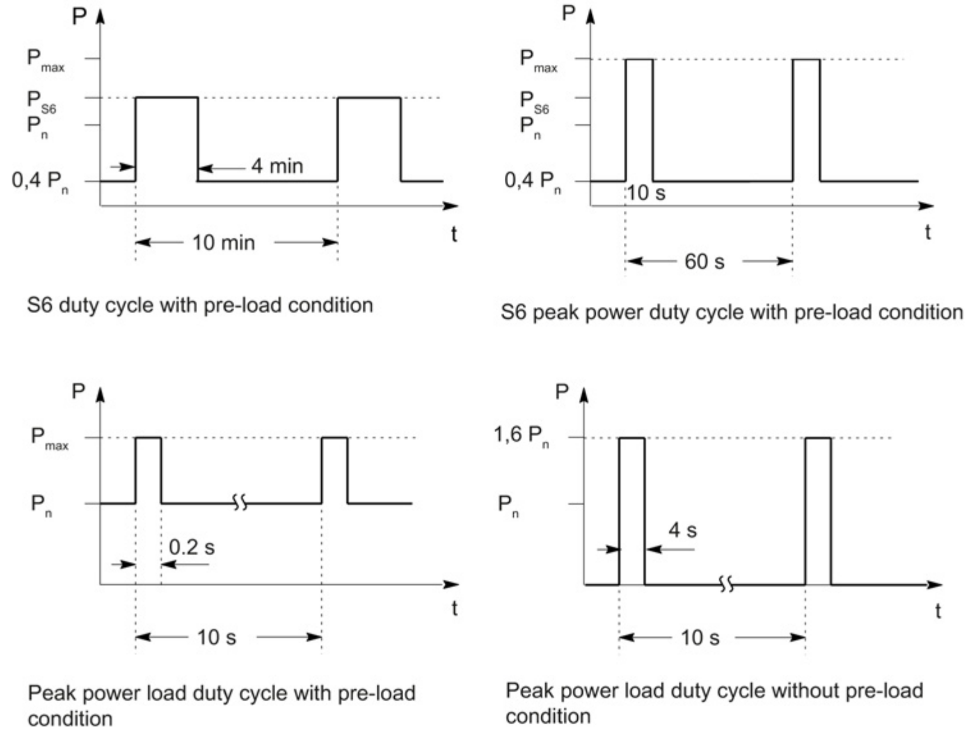


Figure 8-85 Rated duty cycles of Smart Line Modules

Derating characteristics

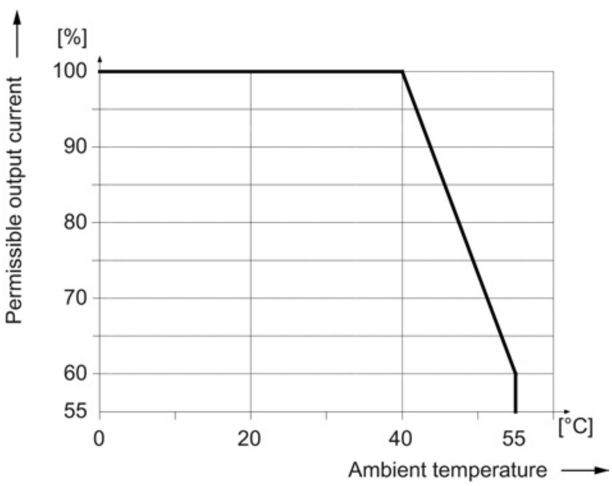


Figure 8-86 Output current as a function of the ambient temperature

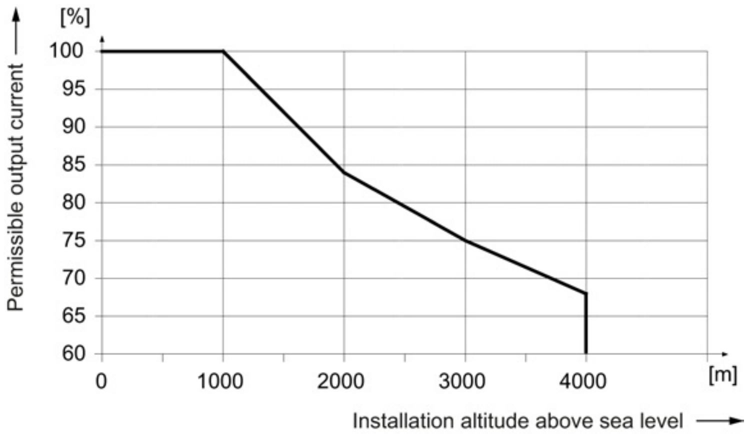


Figure 8-87 Output current as a function of the installation altitude

At installation altitudes > 2000 m, an isolation transformer must be used (see the chapter titled "System overview/Function of installation altitude and ambient temperature" (Page 32)). The design of the secondary line system must be as follows:

- TN system with grounded neutral point (no grounded line conductor)
- IT system

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

8.3.9 Smart Line Modules with cold plate

8.3.9.1 Description

The Smart Line Module is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module(s) with a non-regulated DC voltage at the DC output. In the infeed mode the Smart Line Module exhibits the typical current and voltage waveforms of a 6-pulse diode rectifier bridge.

In feedback mode, the current waveform is square waved. Feedback can be deactivated by means of a terminal because these Smart Line Modules are not equipped with a DRIVE-CLiQ connection.

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

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

8.3.9.2 Product-specific safety information for the Smart Line Modules in booksize format

The safety instructions described in this chapter apply specifically to Smart Line Modules in booksize format.

In addition, you should strictly observe the safety instructions in Chapter 1.

NOTICE

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21.1.

Activation:

- 24 VDC power supply X24 ON
- Line contactor ON
- EP signal X21 pins 3 and 4 ON
- Wait until precharging is complete
- "Ready" signal at terminal X21 pin 1 set to "high"
- Infeed is ready, pulse enable possible for motors

Deactivation:

- Shut drives down
- Cancel pulse enable for motors (OFF1 signal)
- EP signal X21 pins 3 and 4 OFF
- Line contactor OFF
- 24 VDC power supply X24 OFF

Overload:

- "Prewarning" signal at terminal X21 pin 2 set to "low"
- Shut drives down via the control system
- "Ready" signal at terminal X21 pin 1 set to "low"
- Pulse inhibit for all the drives supplied by this infeed within 4 ms

Note

Operation without the line reactor is not permissible.

Note

Connection to the public low-voltage network

Smart Line Modules have been designed for use in the industrial environment and generate current harmonics on the line side as a result of the rectifier circuit.

When connecting a machine with integrated Smart Line Modules to the public low-voltage network, authorization is required in advance from the local power supply company (utility company) if

- The rated current of the machine ≤ 16 A per conductor, and
- the rated machine current does not comply with the requirements specified in EN 61000-3-2 regarding current harmonics.

8.3.9.3 Interface description

Overview

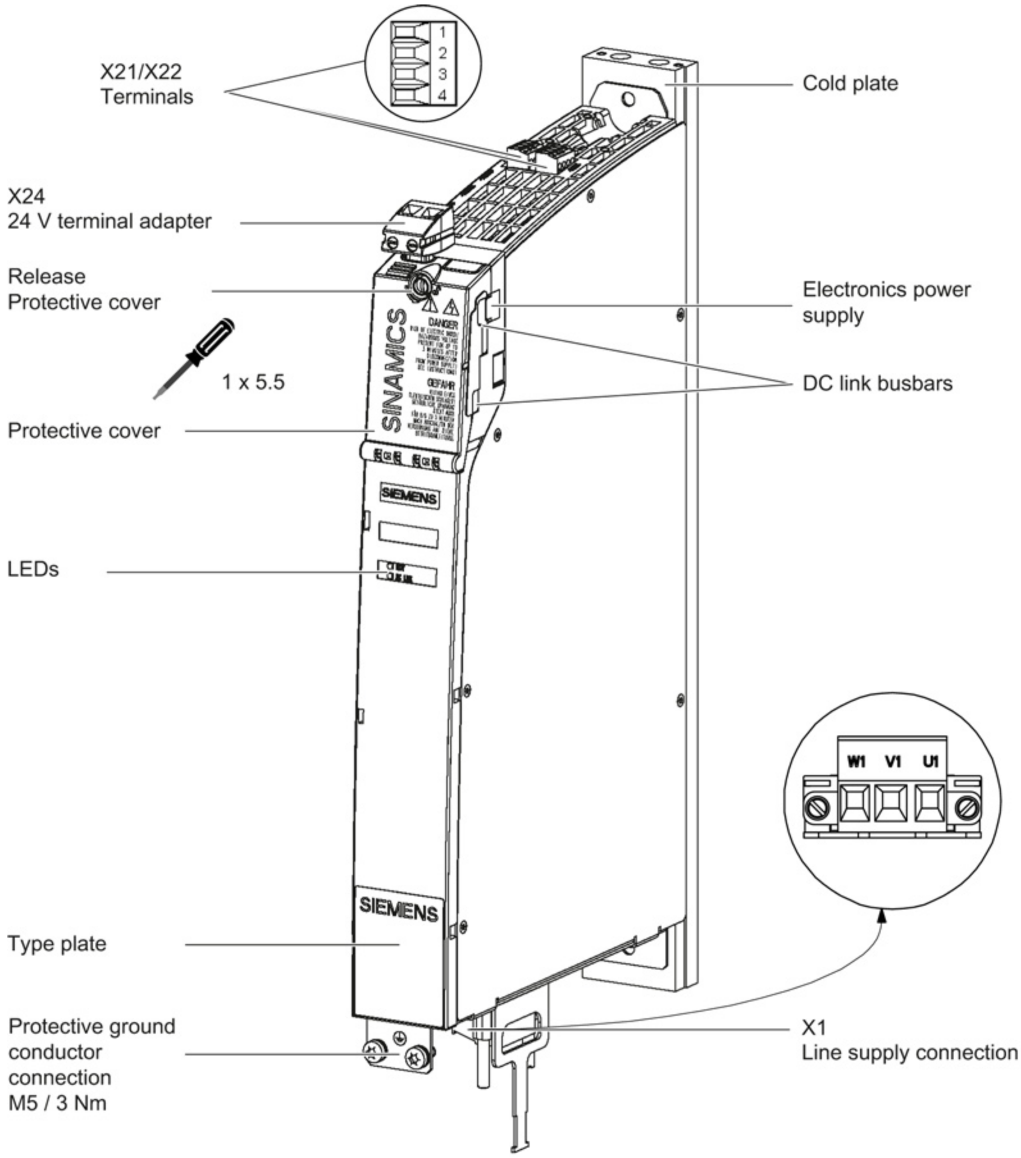
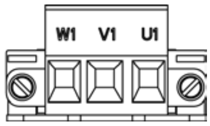
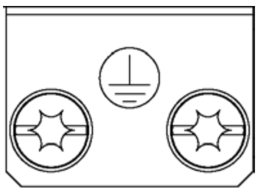


Figure 8-88 Interface overview, Smart Line Module with cold plate (example: 5 kW)

X1 line connection

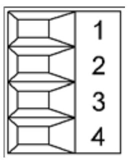
Table 8- 73 X1 line connection

	Terminal	Technical specifications
	U1	Supply voltage: 3 AC 380 V - 480 V, 50/60 Hz Max. connectable cross-section: 6 mm² Type: Screw terminal 5 (see Appendix, Chapter "Screw terminals") Tightening torque: 1.2 - 1.5 Nm
	V1	
	W1	
	PE connection	Threaded hole M5/3 Nm [1)]

1) For ring cable lugs in accordance with DIN 46234

X21 EP terminals

Table 8- 74 X21 EP terminals

	Terminal	Designation	Technical data
	1	DO: Ready	Checkback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: • Electronics power supply (X24) OK • DC link is precharged • Pulses enabled (X21.3/.4) • No overtemperature • No overcurrent switch-off
	2	DO: Prewarning	DO: Prewarning High = no prewarning Low = prewarning • Overtemperature warning threshold / I*t 5 kW prewarning: 64 °C, disconnection: 69 °C 10 kW prewarning: 68 °C, disconnection: 73°C • No regenerative feedback capability due to a line fault [only monitored when regenerative feedback is activated (see terminal X22.2)]
	3	EP +24 V (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm² Type: Screw terminal 1 (see Appendix, Chapter "Screw terminals")			

⚠ WARNING

Danger to life due to charged DC link

For operation, the 24 VDC voltage must be connected to terminal X21.3 and ground to terminal X21.4. When withdrawn, pulse suppression is activated. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

NOTICE

Device damage due to incorrect activation or deactivation sequence

It is essential that a particular switch-on and switch-off sequence is followed in order to control the Smart Line Modules; if this sequence is not observed, the Smart Line Module could be destroyed.

- To prevent this, evaluate the "Ready" signal at output terminal X21.1 (see the chapter titled "Safety instructions").

Note

Output terminal X21.1 must be wired to a digital input on the CU. The drives supplied with power by the Smart Line Module have to use this signal as a "Ready" message (BI: p0864 = digital input). This ensures that a pulse enable can only be issued for the drives (motor or generator operation) when the infeed is ready.
If interconnection with a digital input on the CU is not possible, the signal must be evaluated by a higher-level control instead. The control may not set the drives to ready until the infeed "Ready" signal is present.

Note

The "Prewarning" signal at output terminal X21.2 warns against an overload. If this signal is set, the control system should shut the drives down before the "Ready" signal switches to "low". If the "Ready" signal switches to "low", the drive pulses must be suppressed within 4 ms.

Note

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be carried out using a leading (≥ 10 ms) breaking auxiliary contact, for example.

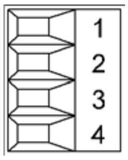
This protects external loads located parallel to the drive on the same switching component.

Note

The Smart Line Module signals that it is ready, even if one of the line conductors is not available. In this case, regenerative feedback is deactivated and an alarm is output at X21.2 (DO, Warning I^2t). If regenerative feedback was deactivated by applying a "high" signal to terminal X22.2 (DI, Disable), no alarm will be output at X21.2 (DO, Warning I^2t).

X22 digital inputs

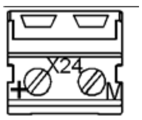
Table 8- 75 X22 digital inputs for Smart Line Modules 5 kW and 10 kW

	Terminal	Description [1)]	Technical specifications
	1	24 V power supply	Electronic power supply for controlling digital inputs X22.2 and 3.
	2	DI: Disable regeneration	Deactivate regenerative feedback (high active). No power is supplied back to the network from the DC link. The regenerative energy of the motors may have to be reduced using a combination of the Braking Module and braking resistor.
	3	DI: Reset	Reset faults (negative edge)
	4	Ground	Electronics ground
Max. connectable cross-section: 1.5 mm² Type: Screw terminal 1 (see Appendix, Chapter "Screw terminals")			

1) DI: Digital input

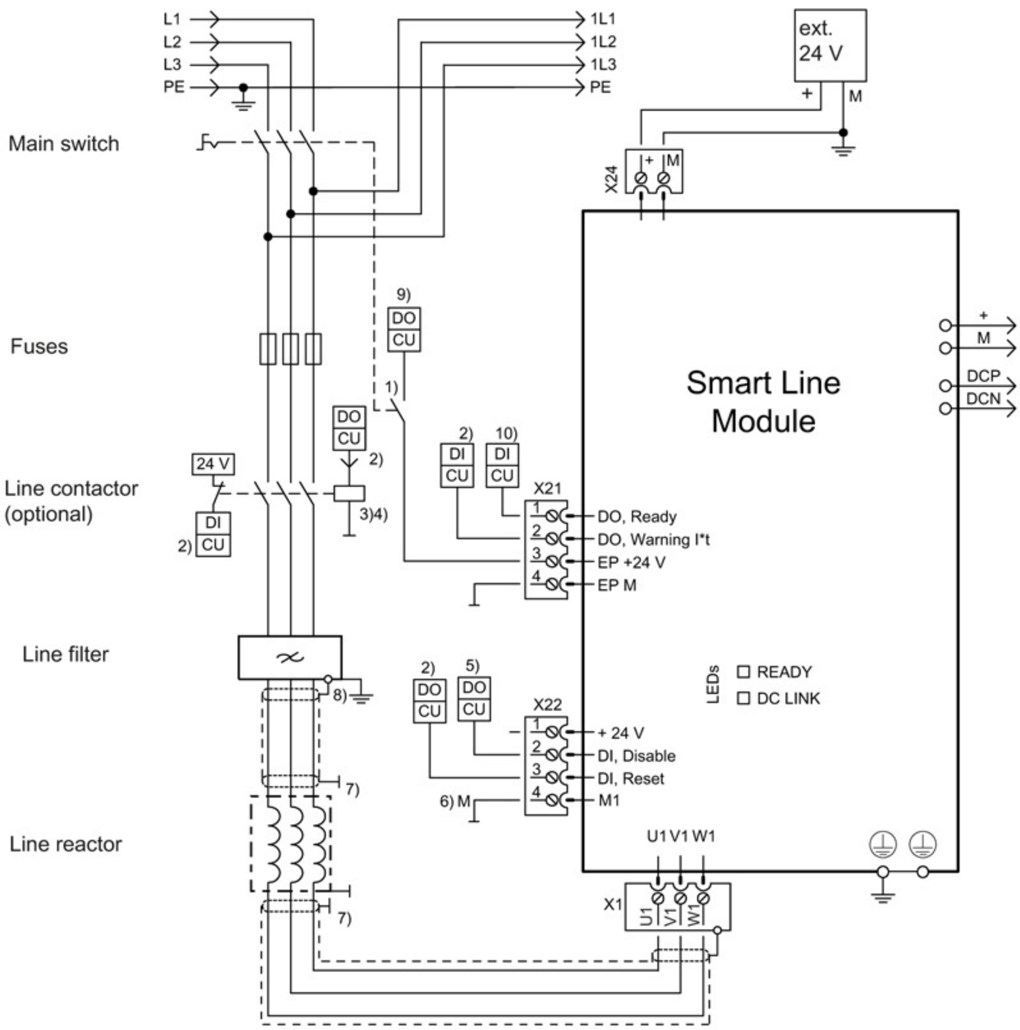
X24 24 V terminal adapter

Table 8- 76 X24 24 V terminal adapter

	Terminal	Description	Technical specifications
	+	24 V power supply	24 VDC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm² Type: Screw terminal 5 (see Appendix, Chapter "Screw terminals")			

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

8.3.9.4 Connection example



1) Leading NC contact t >10 ms, 24 VDC and ground must be set up for operation.
2) DI/DO controlled from the Control Unit
3) No additional load permitted downstream of the line contactor
4) The current-carrying capacity of the DO must be observed; an output coupling device must be used if required.
5) DO high, regenerative feedback deactivated (a jumper can be inserted between X22 pin 1 and pin 2 for permanent deactivation).
6) X22 pin 4 must be connected to ground (ext. 24 V).
7) Contact established via rear mounting panel or shielding buses in accordance with the EMC installation guideline
8) 5 kW and 10 kW line filters via shield connection
9) Signal output of the control, to avoid interference of the 24 VDC supply on the EP terminal.
10) Interconnection via BICO to parameter p0864

Figure 8-89 Connection example for 5 kW and 10 kW Smart Line Modules

8.3.9.5 Meaning of LEDs

Table 8- 77 Meaning of the LEDs on 5 kW and 10 kW Smart Line Modules

LED	Color	Status	Description, cause	Remedy
RDY	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	Component is ready to operate.	–
	Yellow	Continuous light	Pre-charging not yet complete. Bypass relay dropped out EP terminals not supplied with 24 VDC.	–
	Red	Continuous light	Overtemperature, overcurrent	Diagnose fault (via output terminals) and acknowledge it (via input terminal)
DC LINK	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Yellow	Continuous light	DC link voltage within permissible tolerance range.	–
	Red	Continuous light	DC link voltage outside permissible tolerance range. Power system fault.	Check line voltage.

WARNING

Danger to life due to high DC link voltage, regardless of LED display

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.

- Observe the warning information on the component.

8.3.9.6 Dimension drawings

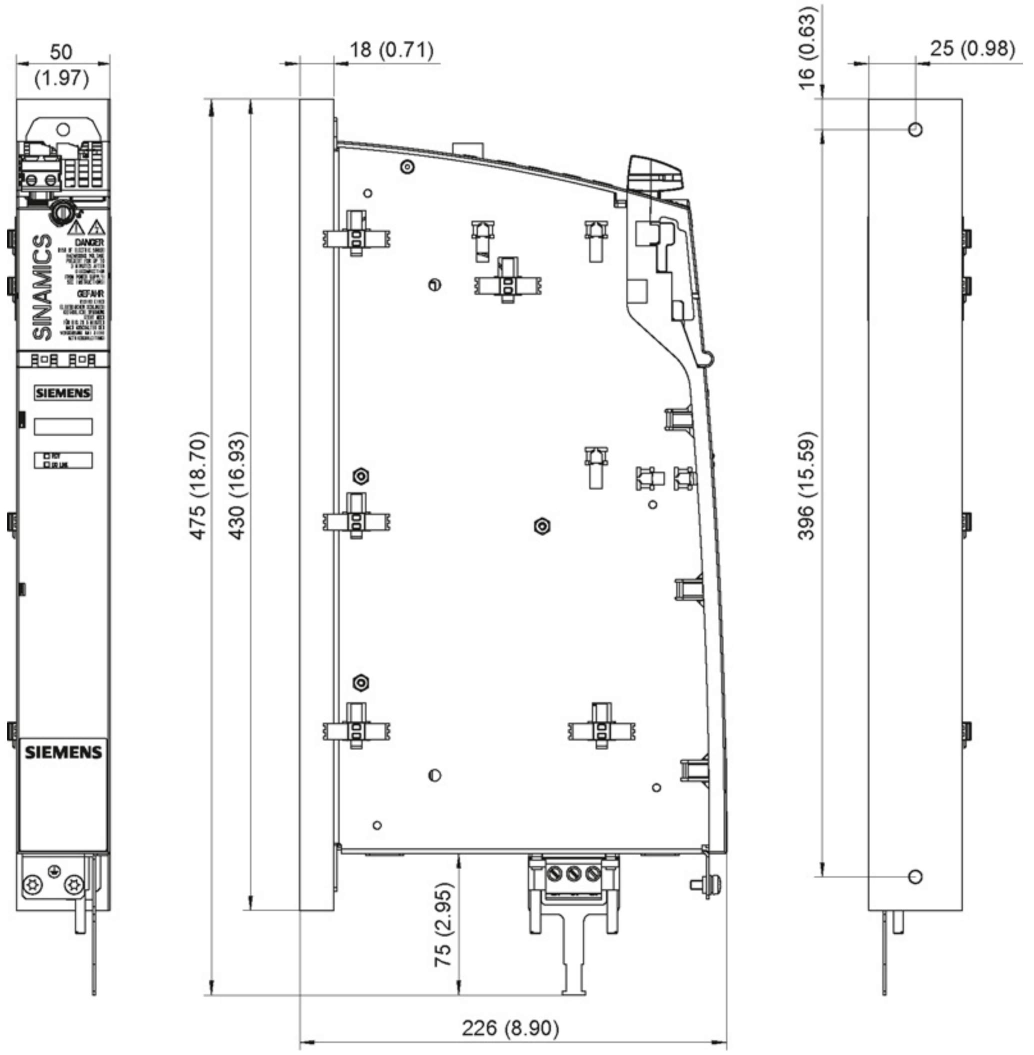


Figure 8-90 Dimension drawing of Smart Line Module with cold plate (5 kW and 10 kW), all dimensions in mm and (inches)

Table 8- 78 Dimensions of Smart Line Modules with cold plate

Line Module	Order number	W [mm] (inches)
5 kW	6SL3136-6AE15-0AAx	50 (1.97)
10 kW	6SL3136-6AE21-0AAx	50 (1.97)

8.3.9.7 Installation

Please note the following before installing a Smart Line Module with cold plate on a customer-specific heat sink:

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

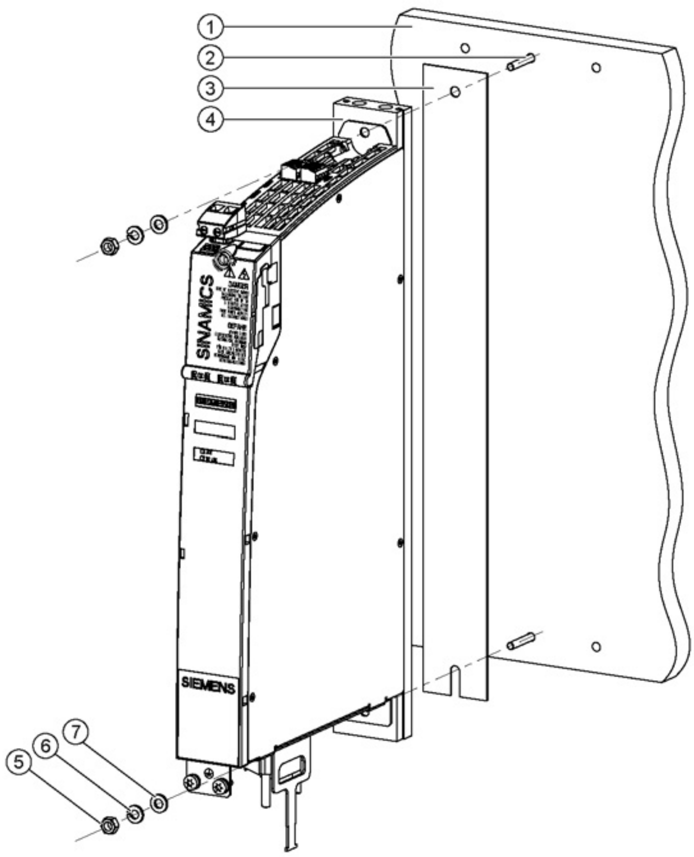
Note

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

	Order number
Heat-conducting foil, 50 mm	6SL3162-6FB00-0AA0

Note

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



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

Figure 8-91 Installing a Smart Line Module with cold plate on an external heat sink, using a 5 kW Smart Line Module as an example

Tightening torques:

- Initially, only tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm.

Help with the mechanical control cabinet installation is available from:
Siemens AG
Industry Sector, IA SE WKC
TCCCC (Technical Competence Center Cabinets Chemnitz)
P.O. Box 1124
09070 Chemnitz, Germany
E-mail: cc.cabinetcooling.aud@siemens.com

Properties of the heat sink

We recommend using AlMgSi 0.5 as the heat sink material.
The roughness of the external heat sink surface should be at least Rz 16 and the contact surface between the heat sink and cold plate should have an evenness of 0.2 mm.

Note

The machine manufacturer can adapt the heat sink version to his special requirements. The specified rated data for the Power Modules can only be achieved if the power losses can be dissipated by the external heat sink under the specified general conditions.

Note

When mounting, ensure that the threaded bolts do not damage the cold plate.

8.3.9.8 Technical data

Table 8- 79 Technical data for Smart Line Modules with cold plate cooling

	6SL3136-6AE	15-0AAx	21-0AAx
Rated power	**kW**	**5**	**10**
Infeed Rated power (S1)[1] Infeed power (S6-40%)[1] Peak infeed power[1]	 kW (P_n) kW (P_{S6}) kW (P_{max})	 5 6,5 10	 10 13 20
Energy recovery Continuous regenerative power Peak regenerative power	 kW kW	 5 10	 10 20
Supply voltages Line voltage Line frequency Electronics power supply	 V_{AC} Hz V_{DC}	 3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10% 47 to 63 24 (20.4 - 28.8)	
DC link voltage Overvoltage trip Undervoltage trip	V_{DC} V_{DC} V_{DC}	510 – 720 820 ±2% 360 ±2%	
Input currents Rated input current at 400 V_{AC}: Input current at 380 V_{AC}/480 V_{AC} at 400 V_{AC}; S6-40% at 400 V_{AC}; peak current	 A_{AC} A_{AC} A_{AC} A_{AC}	 8.1 8.6 / 6.7 10.6 15.7	 16.2 17 / 12.8 21.1 31.2
DC link currents Rated DC link current at 600 V: DC link current at 540 V: at 600 V_{DC}; at S6-40% at 600 V_{DC}; peak current	 A_{DC} A_{DC} A_{DC} A_{DC}	 8.3 9.3 11 16.6	 16.6 18.5 22 33.2

	6SL3136-6AE	15-0AAx	21-0AAx
Current-carrying capacity DC link busbar Reinforced DC link busbars: 24 V busbar:	 A_{DC} A_{DC} A_{DC}	 100 150 20	 100 150 20
Electronics current consumption at 24 V DC	A_{DC}	0.6	0.7
Power loss distribution (incl. electronics losses)[2)] internal external	 W W	 34.4 40	 56.8 80
DC link capacitance Smart Line Module Drive line-up, max.	 µF µF	 220 6000	 330 6000
Power factor	cosϕ	1	1
Circuit breaker (IEC 60947 and UL)		See Chap. "Overcurrent protection using line fuses and circuit breakers (Page 116)"	
Rated short-circuit current SCCR[3)]	kA	65	65
Max. permissible heat sink temperature	°C	60	65
Max. ambient temperature without derating with derating	 °C °C	 40 55	 40 55
Weight	kg	4.0	4.0

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

2) For an overview, see the power loss tables in the Appendix

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

Characteristics

Rated duty cycles of Smart Line Modules

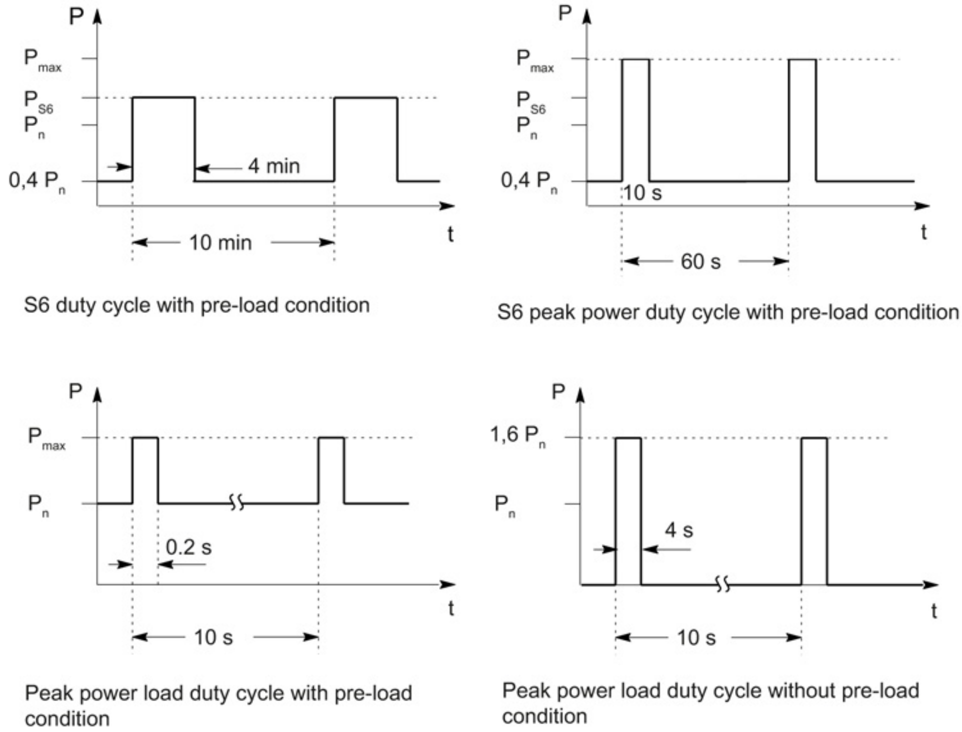


Figure 8-92 Rated duty cycles of Smart Line Modules

Derating characteristics

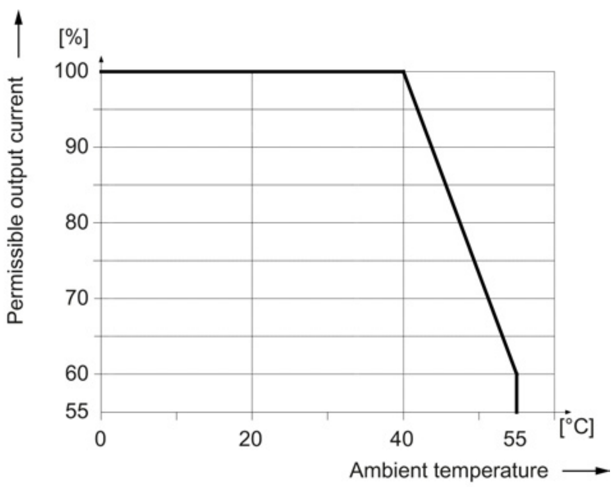


Figure 8-93 Output current as a function of the ambient temperature

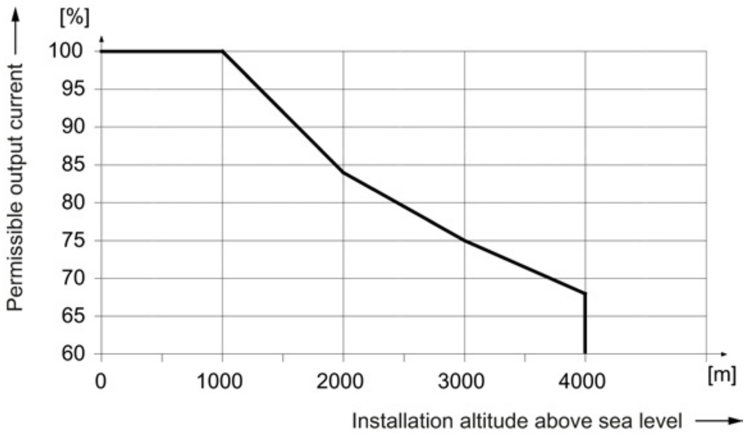


Figure 8-94 Output current as a function of the installation altitude

At installation altitudes > 2000 m, an isolation transformer must be used (see the chapter titled "System overview/Function of installation altitude and ambient temperature" (Page 32)). The design of the secondary line system must be as follows:

- TN system with grounded neutral point (no grounded line conductor)
- IT system

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

Measuring the heat sink temperature

The maximum permissible heat sink temperature is calculated at the cold plate in the measuring range shown below.

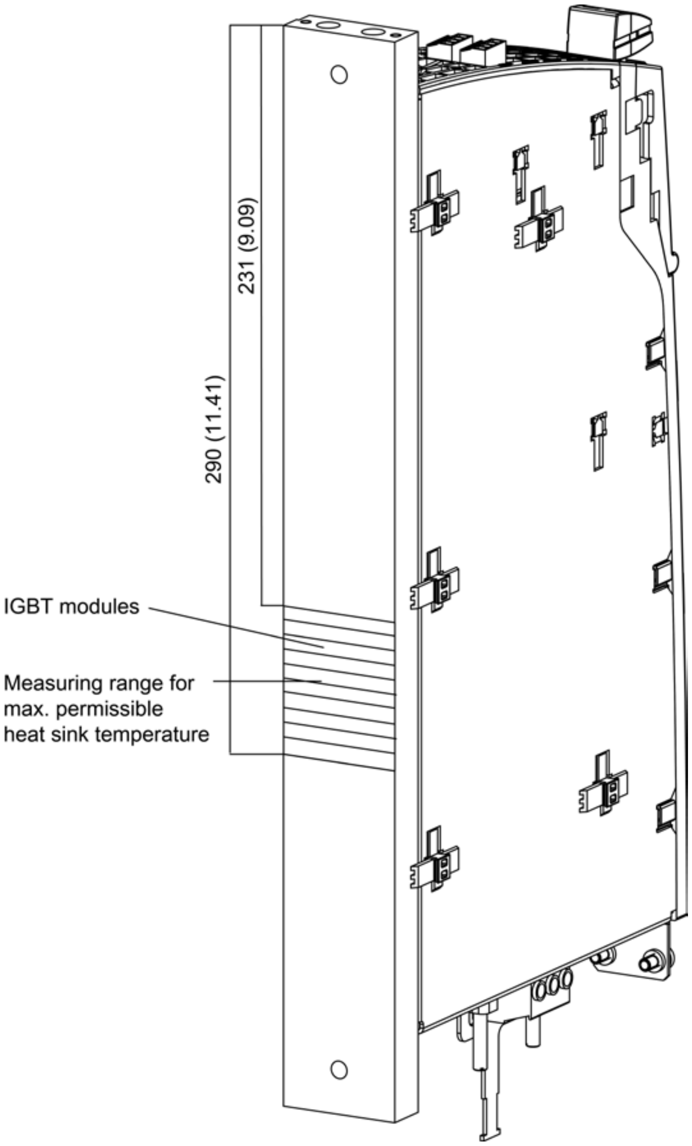


Figure 8-95 Measuring range for max. permissible heat-sink temperature for a Smart Line Module with cold plate

8.4 Connection of motor modules

8.4.1 Safety instructions for Motor Modules Booksize

Note

When using a Motor Module Booksize, also observe the safety instructions in Section 1.

DANGER

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

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

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

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

DANGER

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

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

- Only operate the components with closed protective cover.

WARNING

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

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

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

WARNING

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

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

- For all 50 mm wide modules (exception: Smart Line Module), remove the DC link bridge, including the screws. Do not tighten the screws without the DC link bridges.
- For all components that are 75 mm wide or wider, the DC link bridges must not be moved to the left or removed.

⚠WARNING

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

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

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

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

⚠WARNING

Danger to life through interruption of the external protective conductor due to high leakage currents

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

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

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

⚠WARNING

Danger to life through electric shock due to incorrectly laid brake cables

If brake cables are laid without safe electrical separation, the insulation can fail with an electric shock.

- Close the holding brake with the specified MOTION-CONNECT cable.
- Only use third-party cables with safe electrically separated brake cores or lay the brake cores with safe electrical separation.

⚠WARNING

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

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

- Attach the component warning labels in the national language.

⚠ WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

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

- Maintain the 80 mm clearances above and below the Motor Modules.
- For the 132 A and 200 A Motor Modules, a ventilation clearance of 50 mm must also be maintained in front of the fan.

NOTICE

Material damage due to loose power connections

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

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

NOTICE

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

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

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

NOTICE

Temperature signal disturbances and failure of components as a result of unshielded or incorrectly routed cables

With unshielded or incorrectly laid cables, it can be expected that interference will be coupled into the signal processing electronics from the power side. This can result in significant disturbances (fault messages) up to failure of individual components (destruction of the devices).

- Only use shielded cables as temperature sensor cables.
- Only use temperature sensor cables that are routed together with the motor cable and twisted in pairs and shielded separately.
- Connect the cable shield to the chassis potential at both ends over a large surface area.

NOTICE

Destruction of the motor/brake due to incorrect power supply

With an incorrect power supply, the brake can malfunction, i.e. the brake does not open reliably. If the motor constantly runs against the closed brake, the brake and/or the motor will be destroyed.

- Always use a regulated DC power supply to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars.
- Take note of the motor holding brake voltage tolerances (24 V ± 10%) and the connecting cable voltage drop.
- Set the DC power supply to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:
  - Use of Siemens three-phase motors
  - Use of Siemens MOTION-CONNECT power cables
  - Motor cable lengths, max. 100 m

NOTICE

Damage through use of incorrect DRIVE-CLiQ cables

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

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

Note

Malfunctions due to polluted DRIVE-CLiQ interfaces

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

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

Special features for Motor Modules with external air cooling

Note

Insufficient cooling power when the external heat sinks are polluted

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

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

Note

Checking the seal

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

Note

Using an installation frame

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

8.4.2 Motor Modules with internal air cooling

8.4.2.1 Description

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

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

8.4.2.2 Interface description

Overview

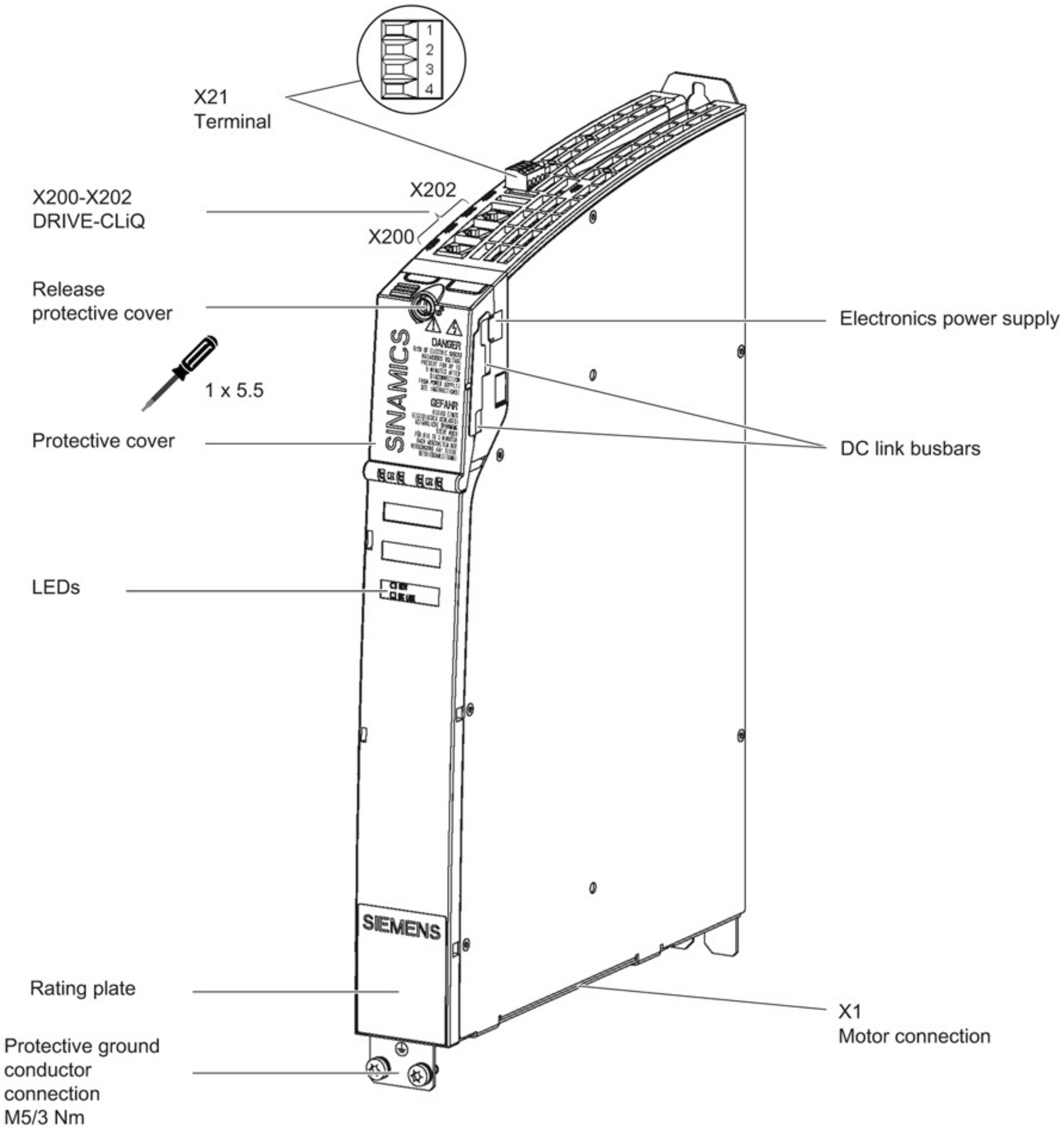


Figure 8-96 Interface overview, Single Motor Module Booksize with internal air cooling (example: 5 A)

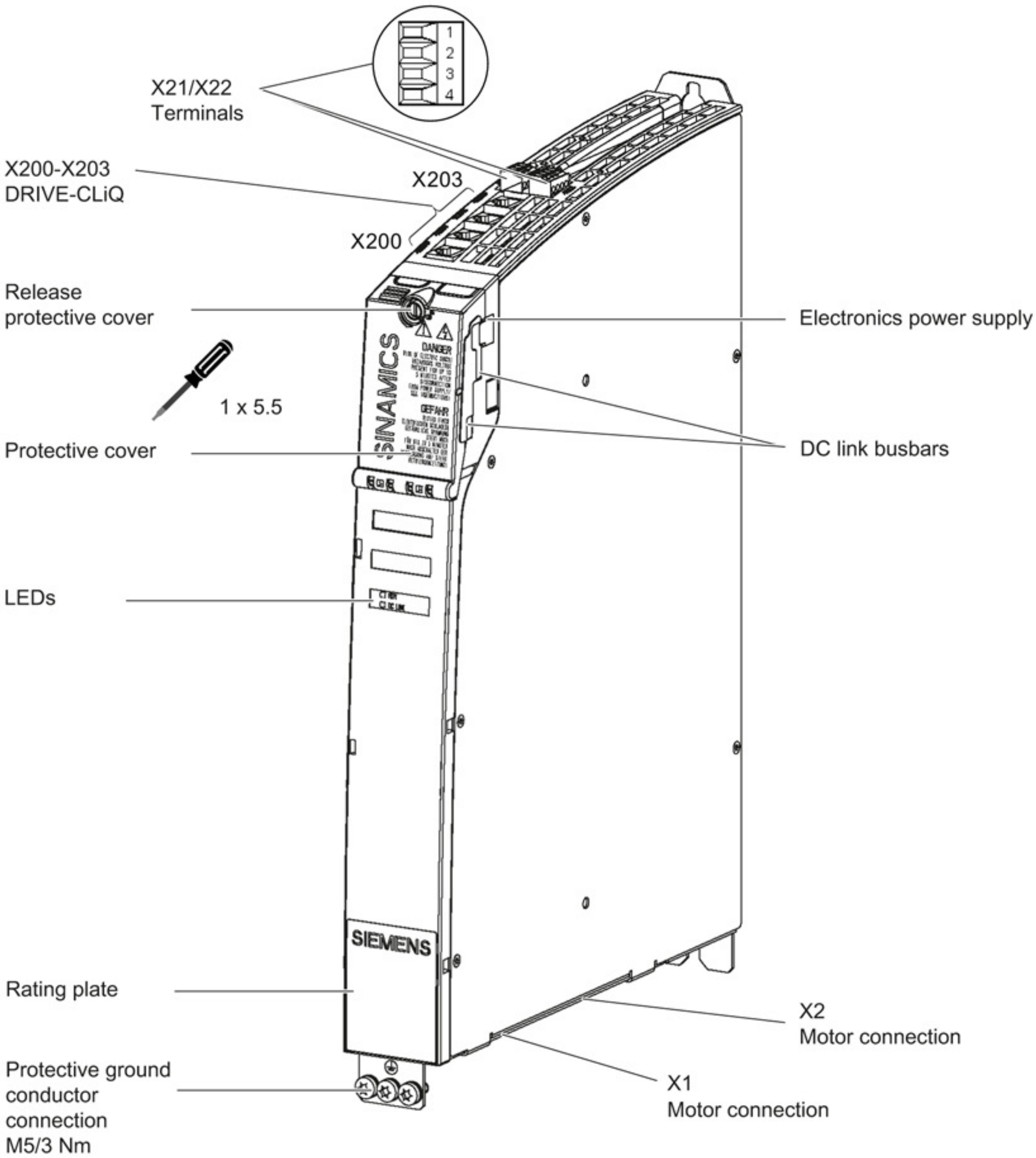
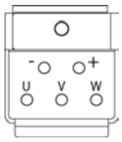
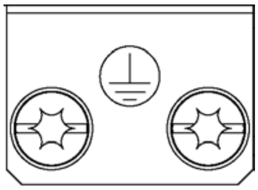
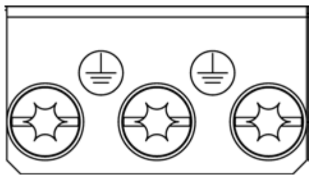


Figure 8-97 Interface overview, Double Motor Module Booksize with internal air cooling (example: 2 x 5 A)

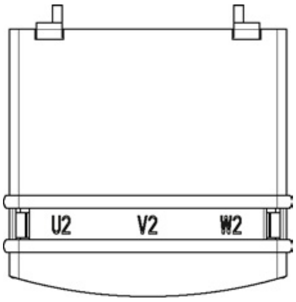
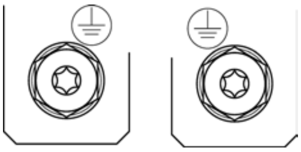
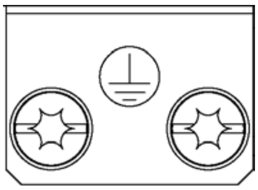
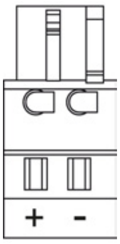
Motor and brake connection

Table 8- 80 X1/X2 motor and brake connection for Single Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

<table>
<tr><th></th><th>Terminal</th><th>Technical data</th></tr>
<tr><td rowspan="5"></td><td>U (U2)</td><td rowspan="3">Motor connection</td></tr>
<tr><td>V (V2)</td></tr>
<tr><td>W (W2)</td></tr>
<tr><td>+ (BR+)</td><td rowspan="2">Brake connection
max. load current 2 A
min. load current 0.1 A</td></tr>
<tr><td>- (BR-)</td></tr>
<tr><td></td><td rowspan="2">PE connection</td><td>Single Motor Modules 3 A to 30 A:
Threaded hole M5/3 Nm 1)</td></tr>
<tr><td></td><td>Double Motor Modules 3 A to 18 A:
Threaded hole M5/3 Nm 1)</td></tr>
</table>

1) For ring cable lugs in accordance with DIN 46234

Table 8- 81 X1 motor connection and X11 brake connection for Single Motor Modules 45 A to 200 A

	Terminal	Technical data
	U2 V2 W2	**45 A to 60 A:** Threaded bolts M6/6 Nm 1) **85 A:** Threaded bolts M8/13 Nm 1) **132 A to 200 A:** Threaded bolts M8/13 Nm 1)
	PE connection	**45 A to 60 A:** Threaded bolts for motor cables: M6/6 Nm 1) Threaded hole for PE: M6 / 6 Nm 1)
		**85 A:** Threaded bolts for motor cables: M8/13 Nm 1) Threaded hole for PE: M6 / 6 Nm 1) **132 A to 200 A:** Threaded bolts for motor cables: M8/13 Nm 1) Threaded hole for PE: M8 / 13 Nm 1)
	+ (BR+) - (BR-)	**X11 brake connector** 2): Voltage 24 VDC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm^2 Type: Spring-loaded terminal 2 (see Appendix, Chapter "Spring-loaded terminals") The brake connector is part of the prefabricated cable

1) For ring cable lugs in accordance with DIN 46234

2) The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.

Note

The total length of the power cables (motor supply cables and DC link cables) must not exceed the values listed in the chapter titled "Possible line reactor and line filter combinations (Page 158)".

Note

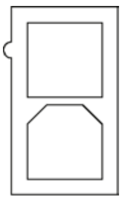
The motor brake must be connected via connector X11. Directly connecting the BR– cable to the electronics ground M is not permitted.

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

X12 fan connection

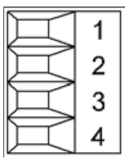
The Motor Modules 132 A and 200 A are equipped with an interface to connect a sub-chassis fan. The interface is located on the underside of the Motor Module.

Table 8- 82 X12 fan connection

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

X21/X22 EP terminals/temperature sensor

Table 8- 83 X21/X22 EP terminals/temperature sensor

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors: KTY84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 VDC (20.4 V - 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (enable pulses)	
Max. connectable cross-section 1.5 mm² Type: Screw terminal 1 (see Appendix A.1)			

EP terminals

Parameters p9651 and p9851 are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4. Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Chapter "Controlling the safety functions".

Note

Function of the EP terminals

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

Temperature sensor connection

NOTICE

Risk of the motor overheating due to an incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Always connect the KTY temperature sensor with the correct polarity.

Note

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

⚠ DANGER

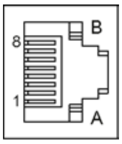
Danger to life through electric shock

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

If these instructions are not complied with, there is danger to life!

X200-X203 DRIVE-CLiQ interface

Table 8- 84 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules
X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

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

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

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

8.4.2.3 Connection examples

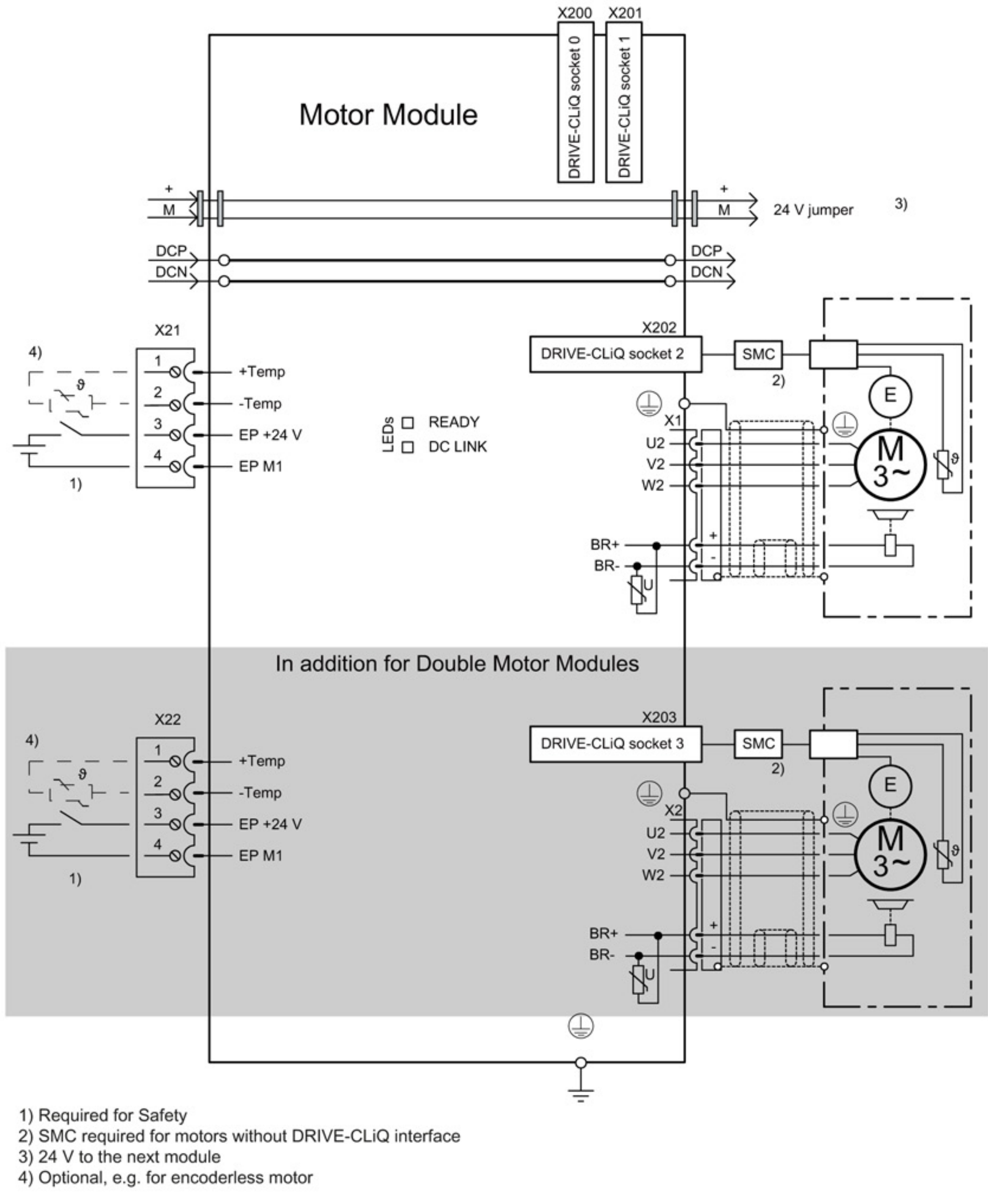
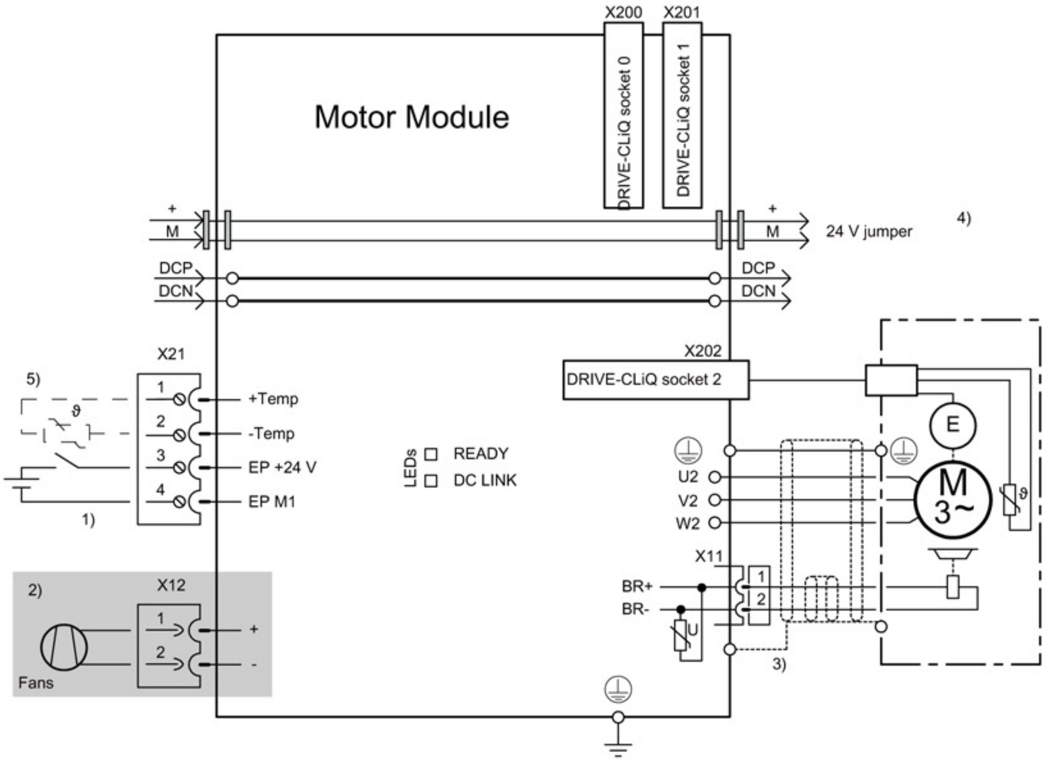


Figure 8-98 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A



1) Required for Safety
2) In addition for Motor Modules 132 A to 200 A
3) Contact through the shield connection plate
4) 24 V to the next module
5) Optional, e.g. for encoderless motor

Figure 8-99 Example connection of Single Motor Modules 45 A to 200 A

8.4.2.4 Meaning of LEDs

Table 8- 85 Meaning of the LEDs on the Motor Module

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

> ⚠ **DANGER**
>
> **Hazardous DC link voltage**
>
> 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!

8.4.2.5 Dimension drawings

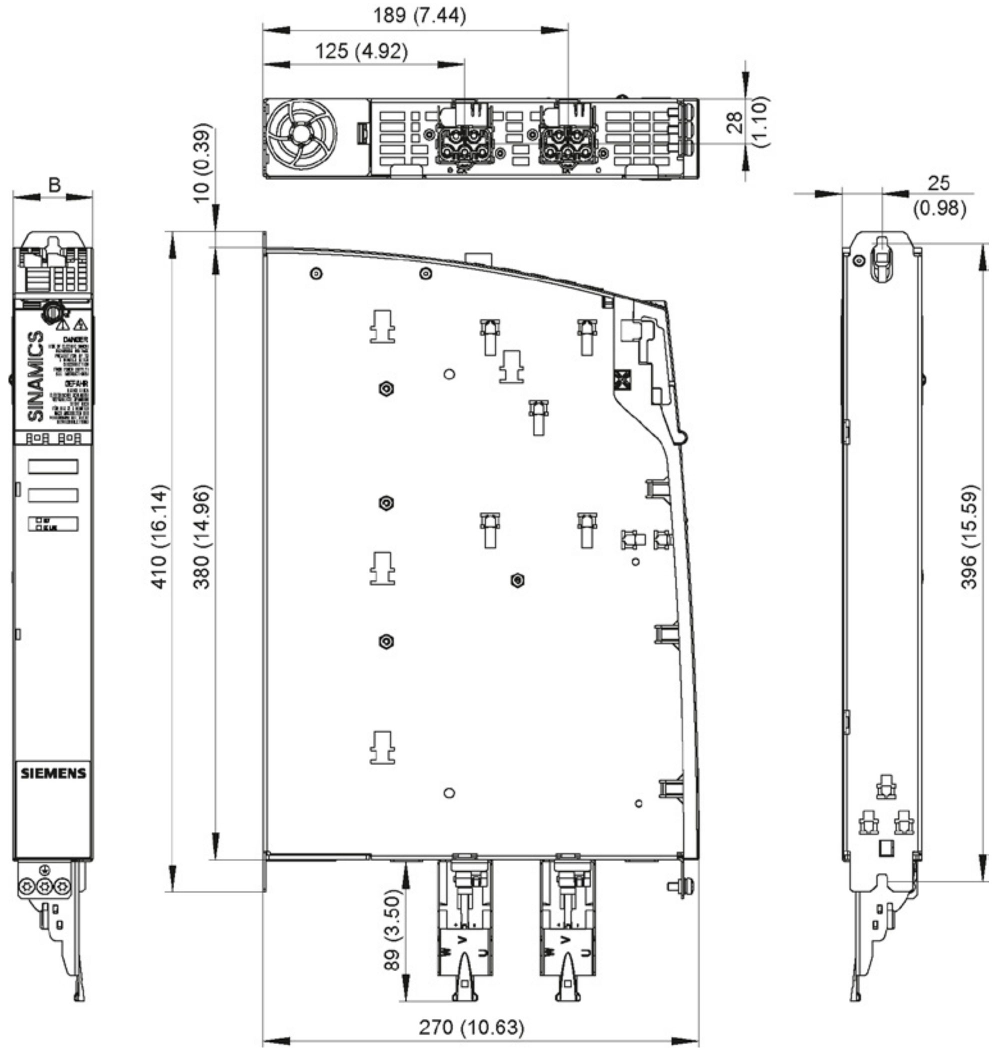


Figure 8-100 Dimension drawing of Motor Modules Booksize with internal air cooling 3 A to 18 A and 2 x 3 A to 2 x 9 A, all dimensions in mm and (inches); example: Double Motor Module 2 x 5 A

Table 8- 86 Dimensions of Motor Modules Booksize with internal air cooling 3 A to 18 A and 2 x 3 A to 2 x 9 A

Motor Module	Order number	B [mm] (inches)
Single Motor Module 3 A	6SL3120-1TE13-0AAx	50 (1.97)
Single Motor Module 5 A	6SL3120-1TE15-0AAx	
Single Motor Module 9 A	6SL3120-1TE21-0AAx	
Single Motor Module 18 A	6SL3120-1TE21-8AAx	
Double Motor Module 3 A	6SL3120-2TE13-0AAx	
Double Motor Module 5 A	6SL3120-2TE15-0AAx	
Double Motor Module 9 A	6SL3120-2TE21-0AAx	

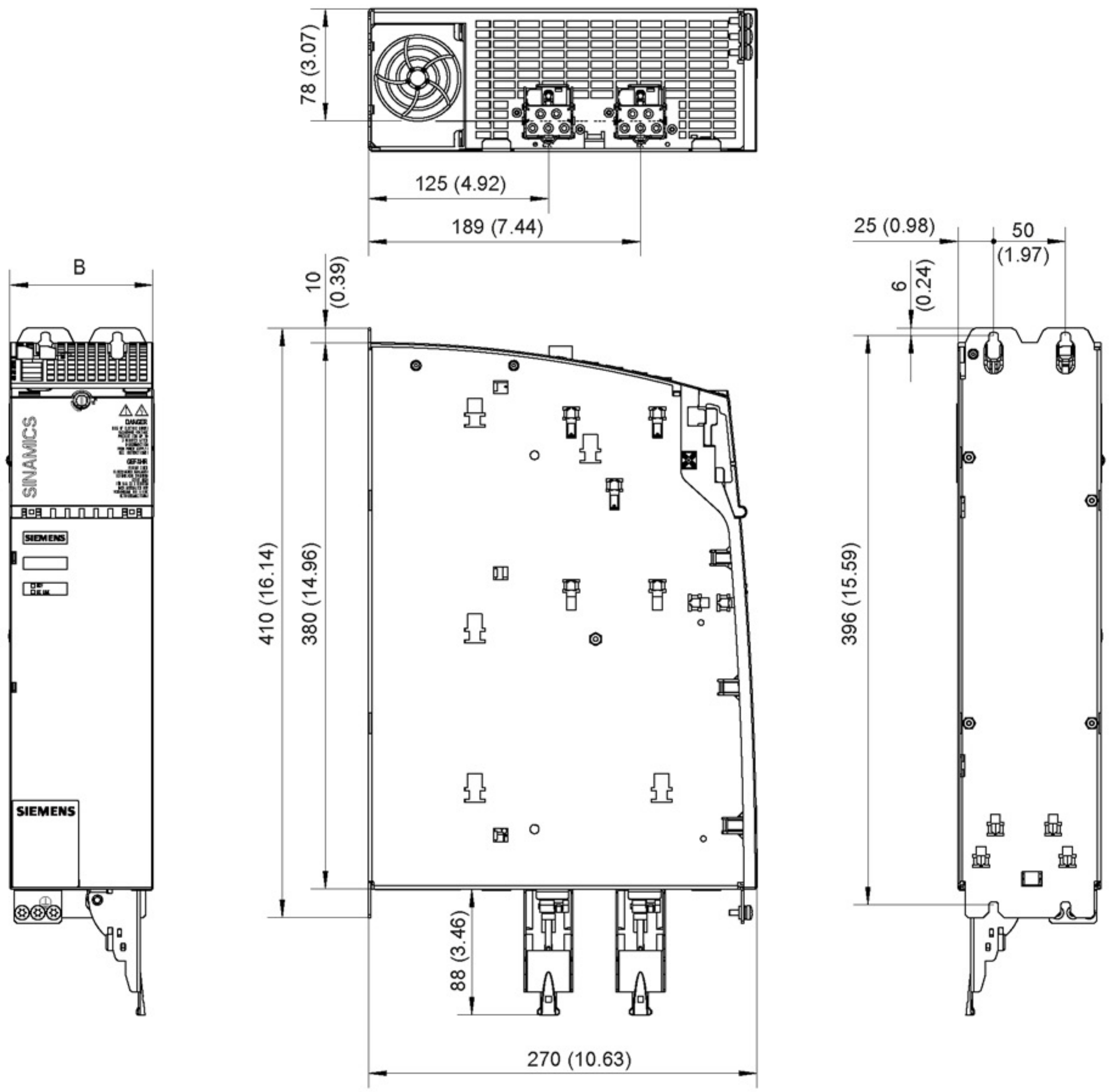


Figure 8-101 Dimension drawing of Motor Modules Booksize with internal air cooling 30 A and 2 x 18 A, all dimensions in mm and (inches); example: Double Motor Module 2 x 18 A

Table 8- 87 Dimensions of Motor Modules Booksize with internal air cooling 30 A and 2 x 18 A

Motor Module	Order number	B [mm] (inches)
Single Motor Module 30 A	6SL3120-1TE23-0AAx	100 (3.94)
Double Motor Module 18 A	6SL3120-2TE21-8AAx	

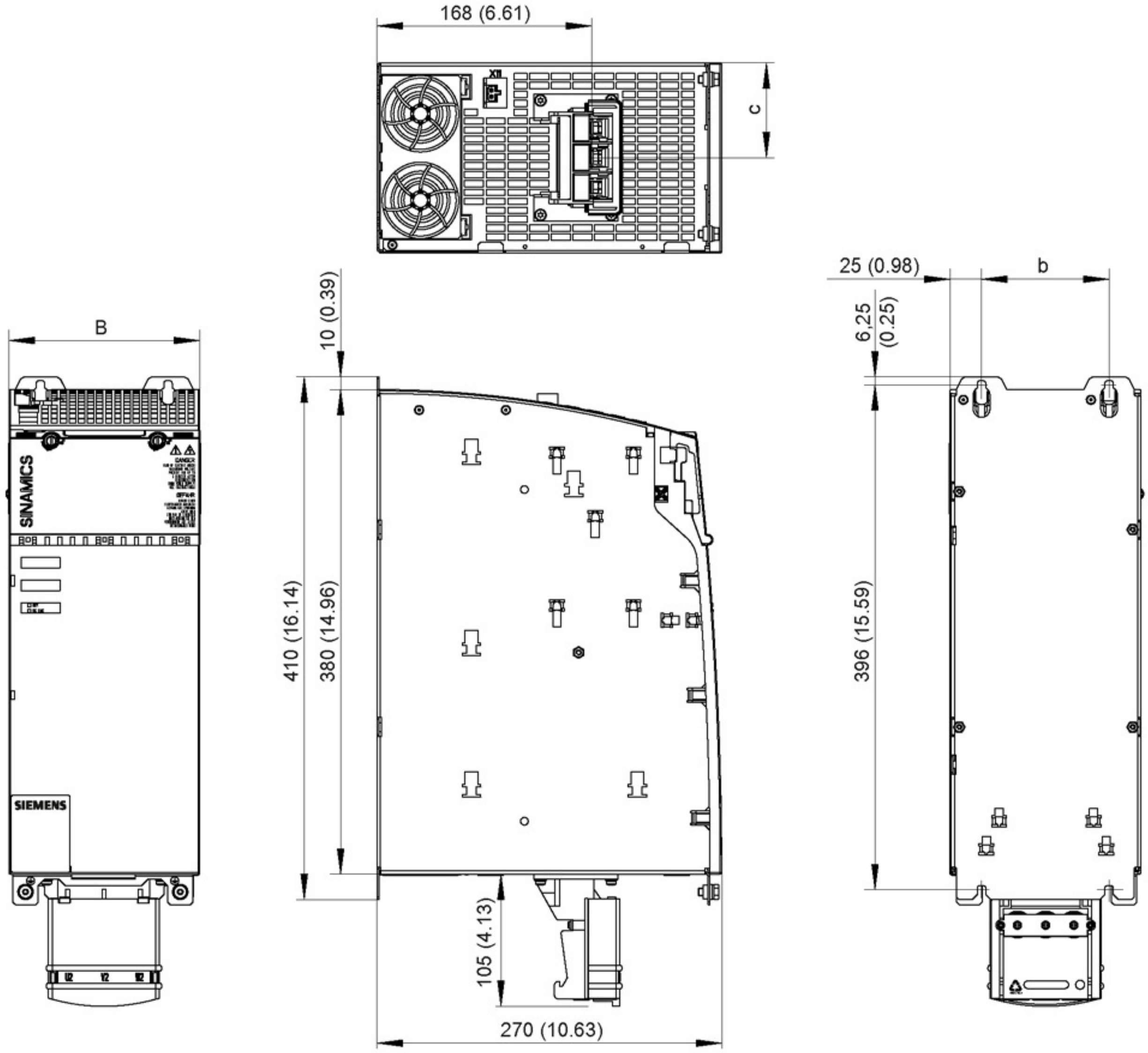


Figure 8-102 Dimension drawing of Motor Modules Booksize with internal air cooling 45 A to 85 A, all dimensions in mm and (inches); example 45 A

Table 8- 88 Dimensions of Motor Modules Booksize with internal air cooling 45 A to 85 A

Motor Module	Order number	B [mm] (inches)	b [mm] (inches)	c [mm] (inches)
Single Motor Module 45 A	6SL3120-1TE24-5AAx	150 (5.91)	100 (3.94)	75 (2.95)
Single Motor Module 60 A	6SL3120-1TE26-0AAx			
Single Motor Module 85 A	6SL3120-1TE28-5AAx	200 (7.87)	150 (5.91)	100 (3.94)

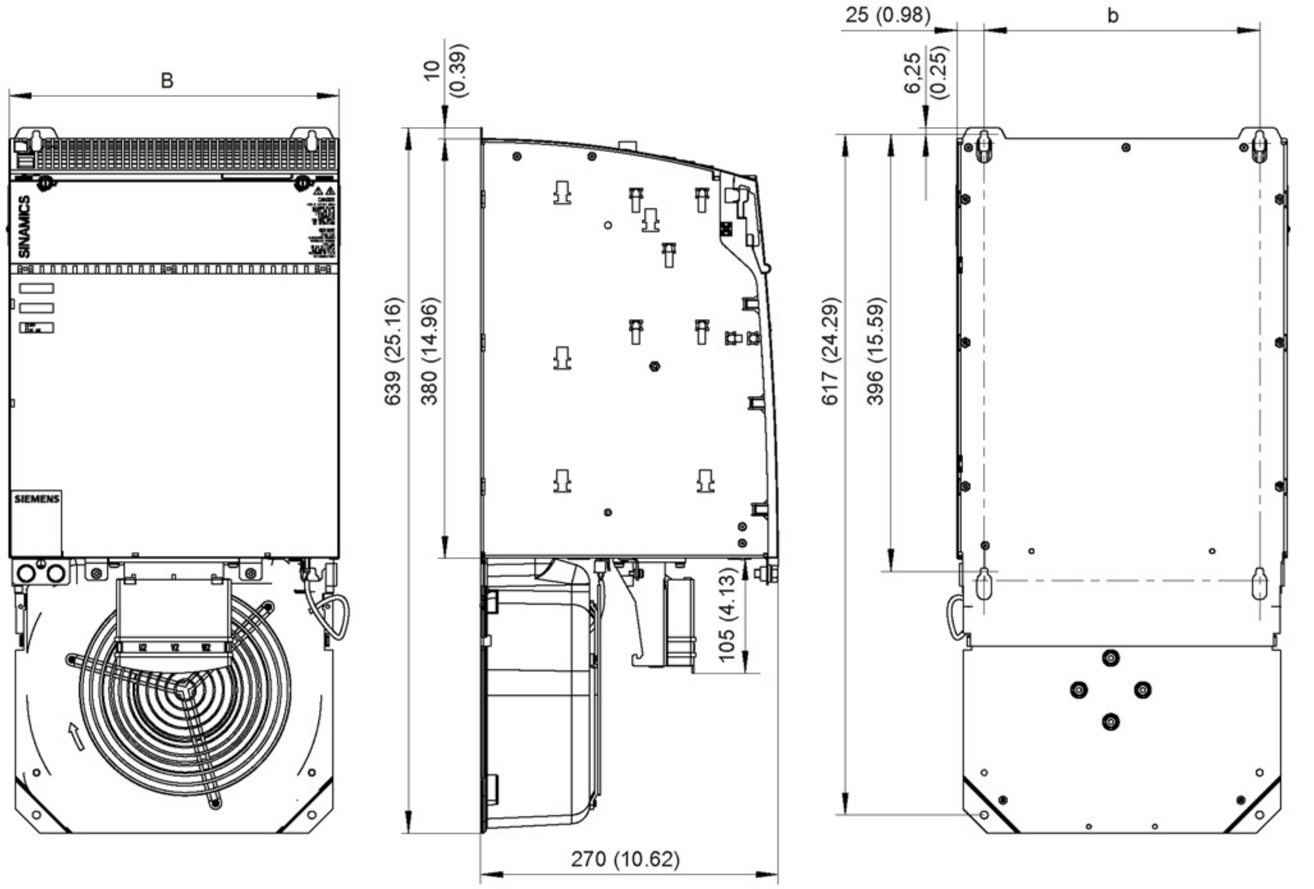


Figure 8-103 Dimension drawing of Motor Modules Booksize with internal air cooling 132 A and 200 A, all dimensions in mm and (inches)

Table 8- 89 Dimensions of Motor Modules Booksize with internal air cooling 132 A and 200 A

Motor Module	Order number	B [mm] (inches)	b [mm] (inches)
Single Motor Module 132 A	6SL3120-1TE31-3AAx	300 (11.81)	250 (9.84)
Single Motor Module 200 A	6SL3120-1TE32-0AAx		

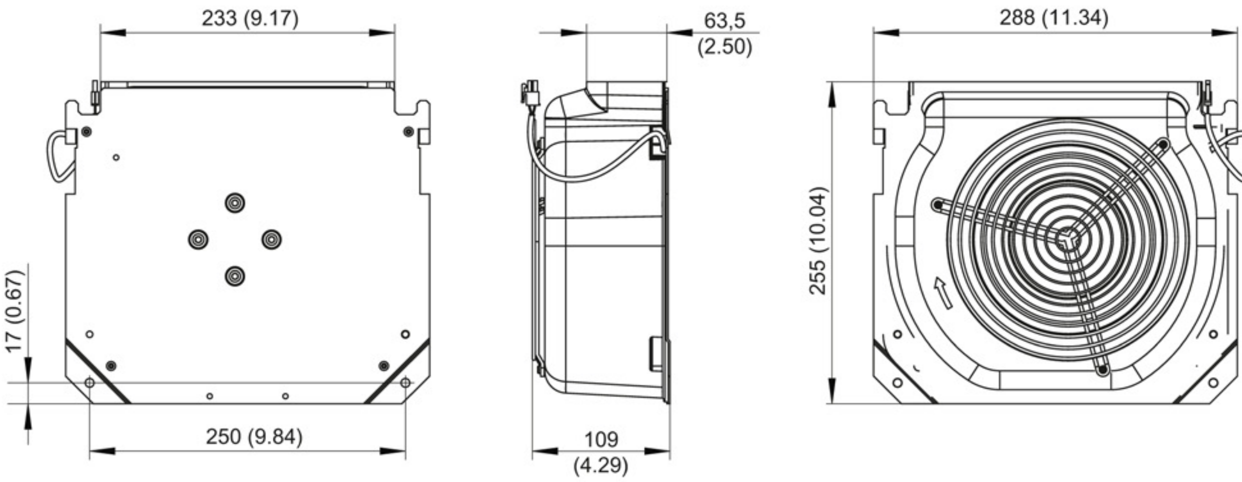


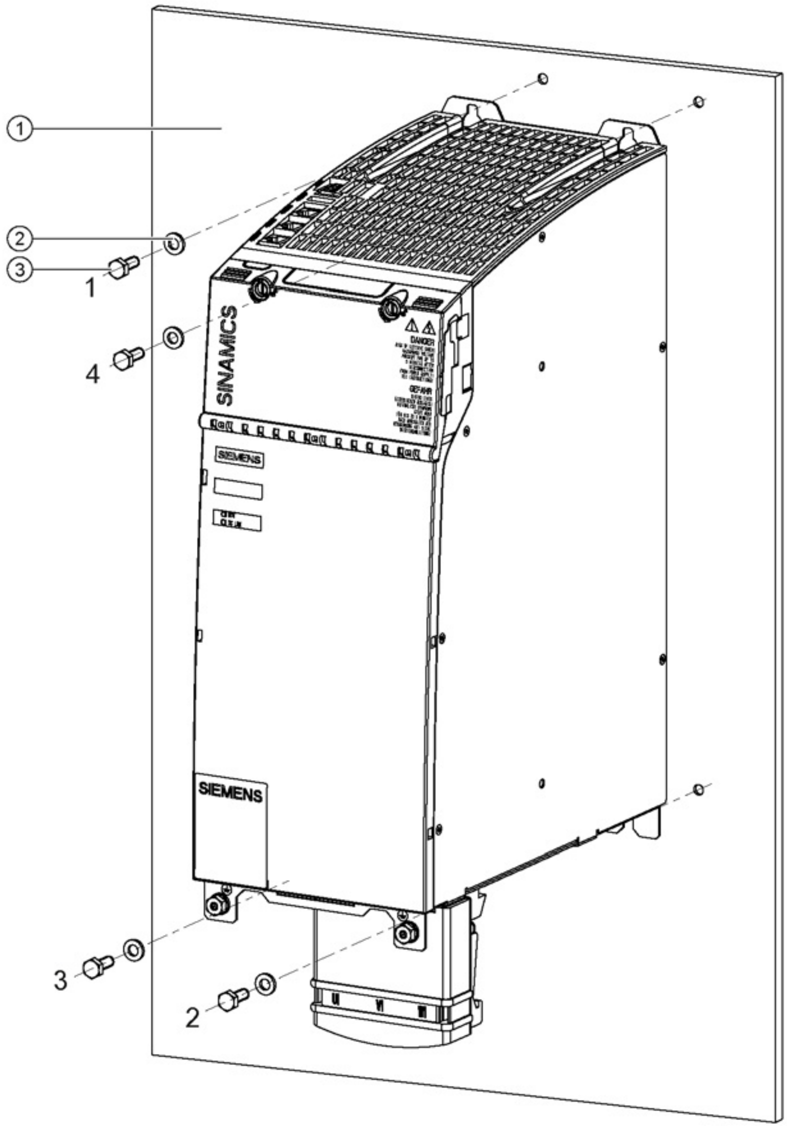
Figure 8-104 Dimension drawing of fans for Motor Modules 132 A and 200 A with internal air cooling, all dimensions in mm and (inches)

Note

The fan for the Motor Modules 132 A and 200 A is included in the scope of supply.

8.4.2.6 Installation

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



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

Figure 8-105 Installation of a Motor Module with internal air cooling (example 45 A)

Tightening torques:

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

Installing the sub-chassis fan

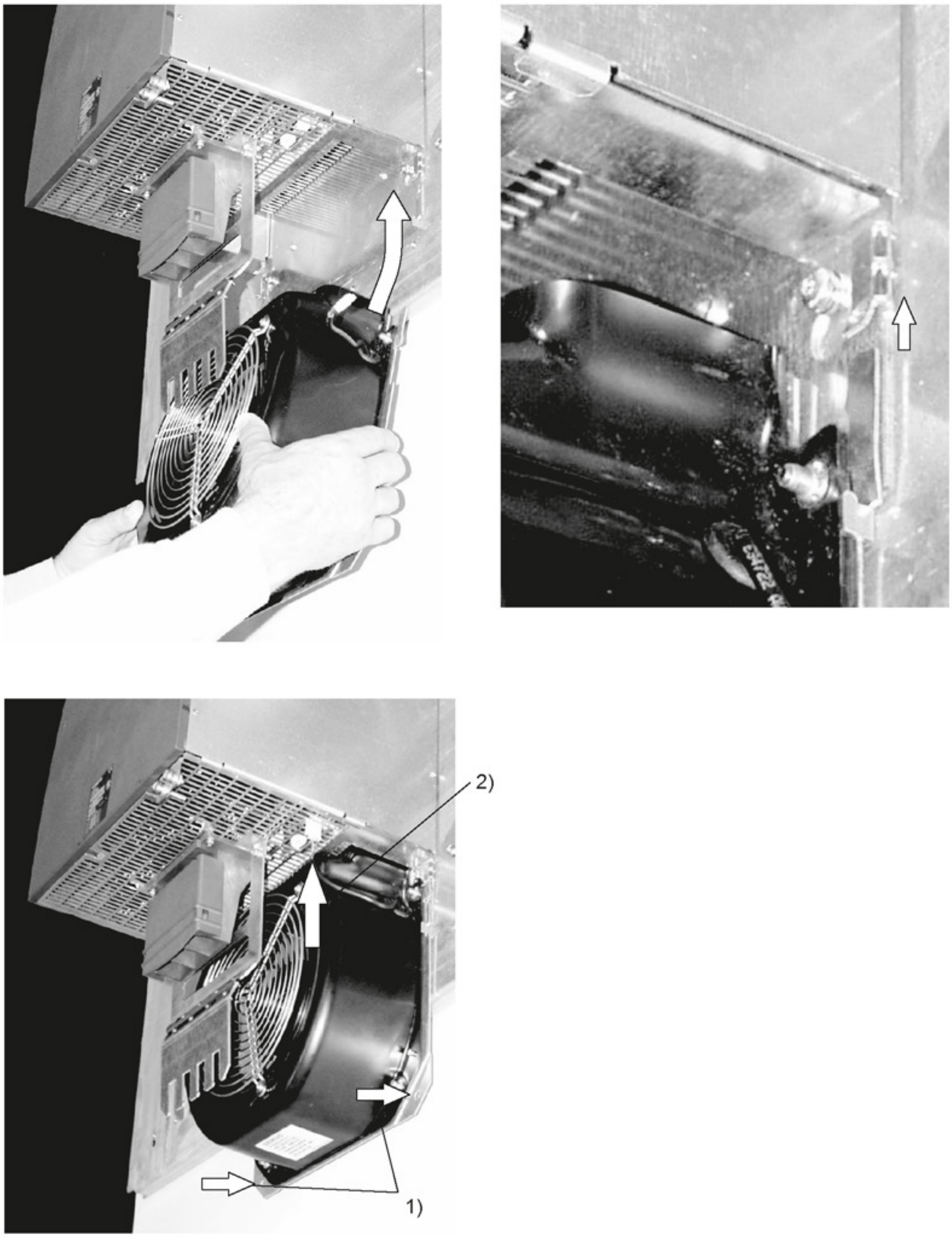


Figure 8-106 Installing the fan for Motor Modules 132 A and 200 A

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

8.4.2.7 Technical specifications

Single Motor Modules

Table 8- 90 Technical data Single Motor Modules Booksize (3 to 30 A)

Internal air cooling	**6SL3120–**	**1TE13-0AAx**	**1TE15-0AAx**	**1TE21–0AAx**	**1TE21–8AAx**	**1TE23-0AAx**
Output current Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{s6}) 40% Peak current (I_{max})	 A_{ACrms} A A_{ACrms} A_{ACrms}	 **3** 2.6 3.5 6	 **5** 4.3 6 10	 **9** 7.7 10 18	 **18** 15.3 24 36	 **30** 25.5 40 56
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage				
DC link current I_d	A_{DC}	3.6	6	11	22	36
DC link voltage (up to 2000 m above sea level)	V_{DC}	510 – 720				
DC link capacitance	µF	110	110	110	220	705
Overvoltage trip Undervoltage trip[1]	V_{DC} V_{DC}	820 ±2% 380 ±2%				
Electronics power supply	V_{DC}	24 (20.4 - 28.8)				
Electronics current consumption at 24 V DC	A_{DC}	0.85	0.85	0.85	0.85	0.8
Current carrying capacity DC link busbars Reinforced DC link busbars 24 VDC busbars	 A_{DC} A_{DC} A_{DC}	 100 150 20				
Unit rating Based on I_n (600 V_{DC}; 4 kHz) Based on I_H	 kW kW	 1.6 1.4	 2.7 2.3	 4.8 4.1	 9.7 8.2	 16 13.7
Total power loss (including electronics losses)[2]	W	50.4	73.4	100.4	185.4	309.2
Max. pulse frequency without derating with derating	 kHz kHz	 4 16				
Max. ambient temperature without derating with derating	 °C °C	 40 55				
Sound pressure level	dB(A)	<60	<60	<60	<60	<60
Cooling method		Internal fan				
Cooling air requirement	m^3/h	29.6	29.6	29.6	29.6	56
Max. permissible heat sink temperature	°C	75	75	79	82	85
Weight	kg	5	5	5	5	6.9

1) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

2) For an overview, see the power loss tables in the Appendix

Table 8- 91 Technical data Single Motor Modules Booksize (45 to 200 A)

Internal air cooling	6SL3120 –	1TE24-5AAx	1TE26-0AAx	1TE28-5AAx	1TE31-3AAx	1TE32-0AAx
Output current Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{s6}) 40% Peak current (I_{max})	 A_{ACrms} A A_{ACrms} A_{ACrms}	 **45** 38 60 85	 **60** 51 80 113	 **85** 68 110 141	 **132** 105 150 210	 **200** 141 230 282
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage				
DC link current I_d	A_{DC}	54	72	102	158	200
DC link voltage (up to 2000 m above sea level)	 V_{DC}	 510 – 720				
DC link capacitance	µF	1175	1410	1880	2820	3995
Overvoltage trip Undervoltage trip[1]	V_{DC} V_{DC}	820 ±2% 380 ±2%				
Electronics power supply	V_{DC}	24 (20.4 - 28.8)				
Electronics current consumption at 24 V DC	 A_{DC}	 1.05	 1.05	 1.5	 0.85	 0.85
Current carrying capacity DC link busbars 24 VDC busbars	 A_{DC} A_{DC}	 200 20	 200 20	 200 20	 200 20	 200 20
Unit rating Based on I_n (600 V_{DC}; 4 kHz) Based on I_H	 kW kW	 24 21	 32 28	 46 37	 71 57	 107 76
Total power loss (incl. electronics losses)[2]	 W	 455.2	 615.2	 786	 1270.4	 2070.4
Max. pulse frequency without derating with derating	 kHz kHz	 4 16				
Max. ambient temperature without derating with derating	 °C °C	 40 55				
Sound pressure level	dB(A)	<65	<65	<60	<73	<73
Cooling method (with fan)		Internal fan			Mounted fan	
Cooling air requirement	m^3/h	112	112	160	520	520
Max. permissible heat sink temperature	°C	85	90	83	70	80 (70% derating)
Weight	kg	9	9	15	21	21

[1] Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V (exception: 132 A and 200 A Motor Modules) and is adjusted to the parameterized rated voltage.

[2] For an overview, see the power loss tables in the Appendix

Double Motor Modules

Table 8- 92 Technical data Double Motor Modules Booksize (3 to 18 A)

Internal air cooling	**6SL3120-**	**2TE13-0AAx**	**2TE15-0AAx**	**2TE21-0AAx**	**2TE21-8AAx**
Output current					
Rated current (I_n)	A_{ACrms}	**2 x 3**	**2 x 5**	**2 x 9**	**2 x 18**
Base-load current (I_H)	A	2 x 2.6	2 x 4.3	2 x 7.7	2 x 15.3
Intermittent duty current (I_{s6}) 40%	A_{ACrms}	2 x 3.5	2 x 6	2 x 10	2 x 24
Peak current (I_{max})	A_{ACrms}	2 x 6	2 x 10	2 x 18	2 x 36
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage			
DC link current I_d	A_{DC}	7.2	12	22	43
DC link voltage	V_{DC}	510 – 720			
DC link capacitance	μF	220	220	220	705
Overvoltage trip	V_{DC}	820 ±2%			
Undervoltage trip[1)]	V_{DC}	380 ±2%			
Electronics power supply	V_{DC}	24 (20.4 - 28.8)			
Electronics current consumption at 24 V DC	A_{DC}	1.15	1.15	1.15	1.3
Current carrying capacity					
DC link busbars	A_{DC}	100			
Reinforced DC link busbars	A_{DC}	150			
24 VDC busbars	A	20			
Unit rating					
Based on I_n (600 V_{DC}, 4 kHz)	kW	2 x 1.6	2 x 2.7	2 x 4.8	2 x 9.7
Based on I_H	kW	2 x 1.4	2 x 2.3	2 x 4.1	2 x 8.2
Total power loss (including electronics losses)[2)]	W	97.6	132.6	187.6	351.2
Max. pulse frequency					
without derating	kHz	4			
with derating	kHz	16			
Max. ambient temperature					
without derating	°C	40			
with derating	°C	55			
Sound pressure level	dBA	<60	<60	<60	<60
Cooling method		Internal fan			
Cooling air requirement	m^3/h	29.6	29.6	29.6	56
Max. permissible heat sink temperature	°C	85	90	89	90
Weight	kg	5.3	5.3	5.5	6.8

1) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

2) For an overview, see the power loss tables in the Appendix

Characteristics

Rated duty cycles Motor Modules Booksize

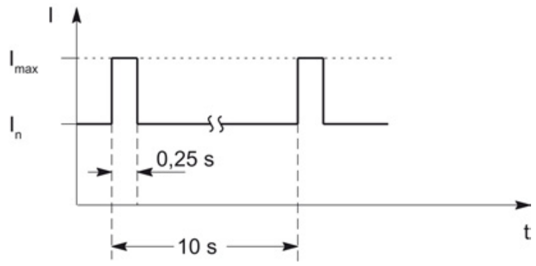


Figure 8-107 Duty cycle with initial load (for servo drives)

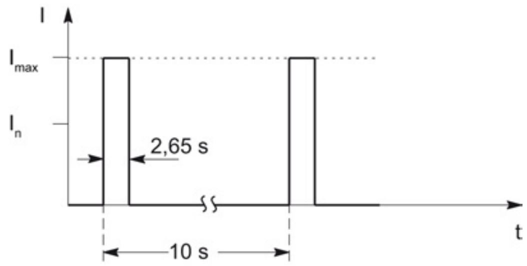


Figure 8-108 Duty cycle without initial load (for servo drives)

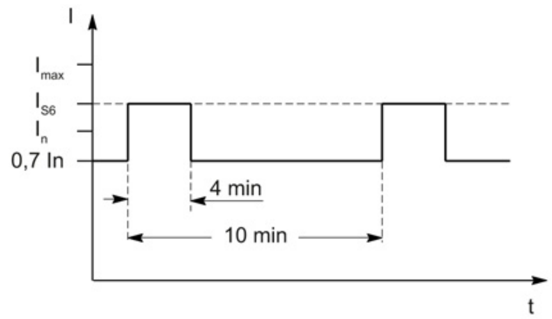


Figure 8-109 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

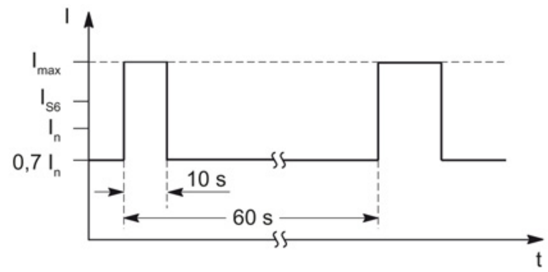


Figure 8-110 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

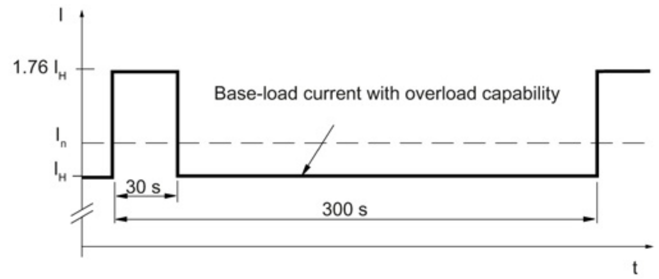


Figure 8-111 Duty cycle with 30 s overload for a duty cycle duration of 300 s

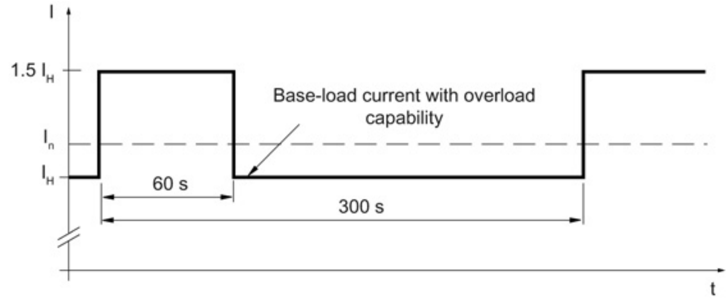


Figure 8-112 Duty cycle with 60 s overload for a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize

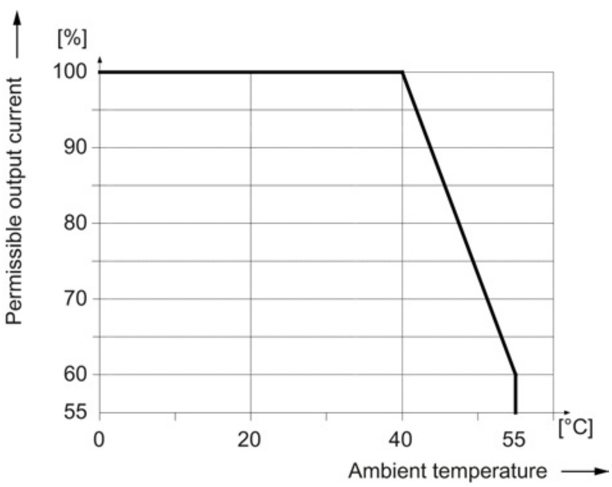


Figure 8-113 Output current as a function of the ambient temperature

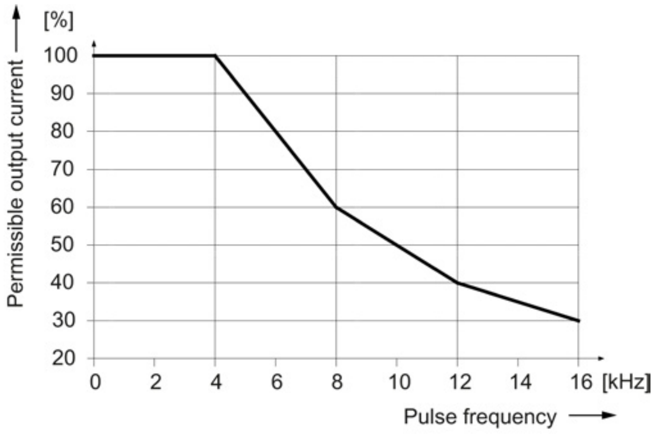


Figure 8-114 Output current as a function of the pulse frequency

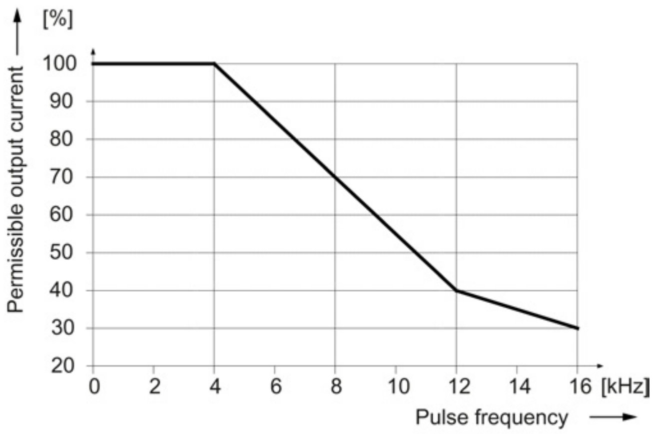


Figure 8-115 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

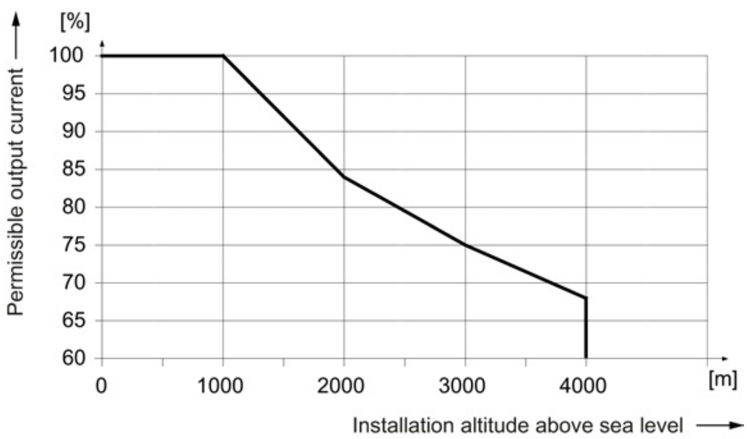


Figure 8-116 Output current as a function of the installation altitude

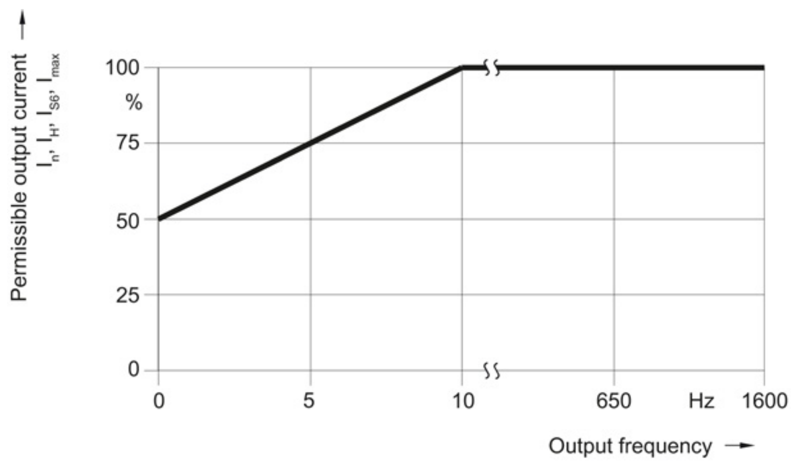


Figure 8-117 Output current as a function of the output frequency

At installation altitudes > 2000 m, an isolation transformer must be used (see the chapter titled "System overview/Function of installation altitude and ambient temperature" (Page 32)). The design of the secondary line system must be as follows:

- TN system with grounded neutral point (no grounded line conductor)
- IT system

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

8.4.3 Motor Module with external air cooling

8.4.3.1 Description

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

Motor Modules with external air cooling are offered as Single Motor Modules and Double Motor Modules. One motor can be connected to Single Motor Modules and two motors can be connected to Double Motor Modules.

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

8.4.3.2 Interface description

Overview

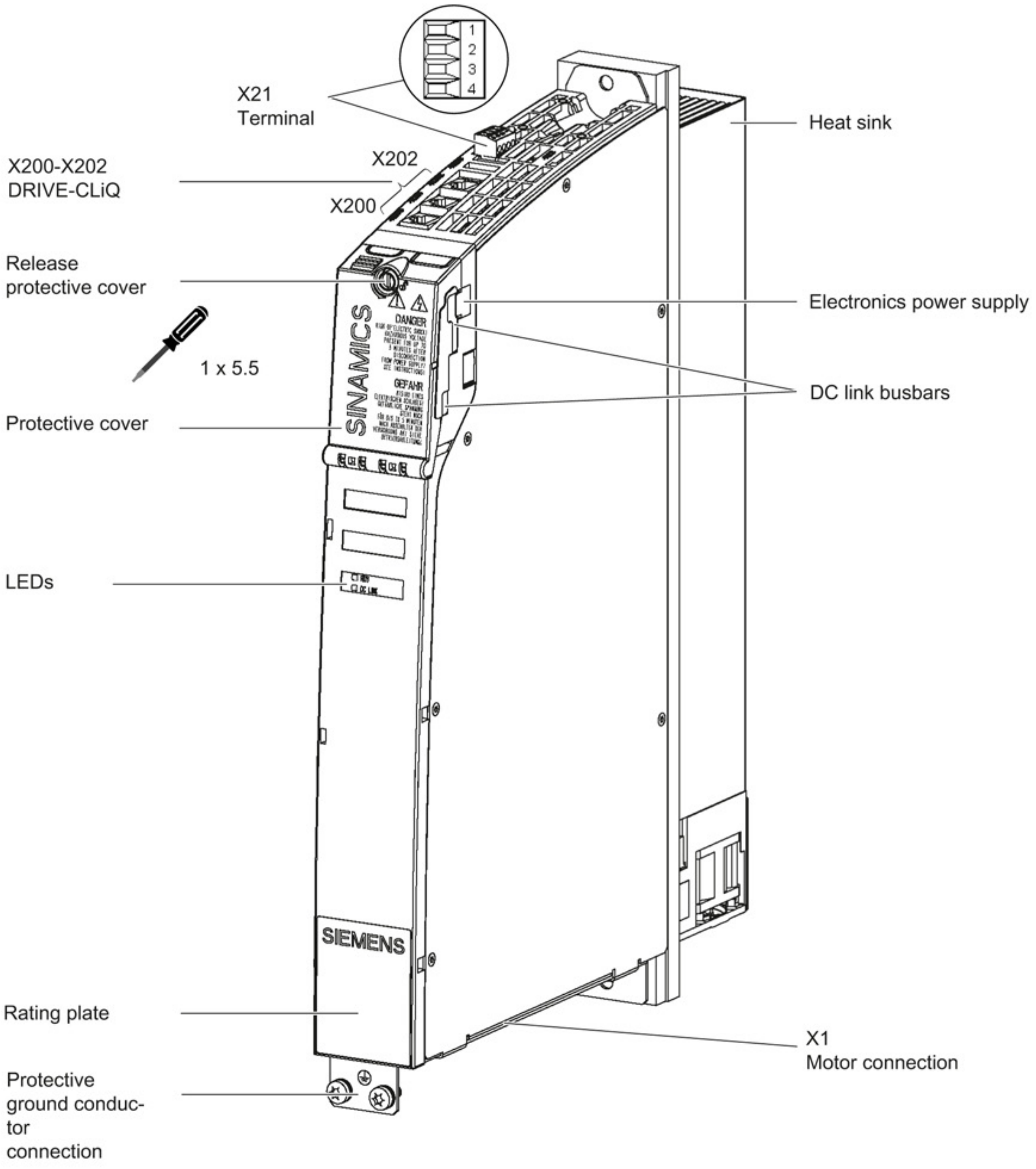


Figure 8-118 Interface overview, Single Motor Module Booksize with external air cooling (example: 5 A)

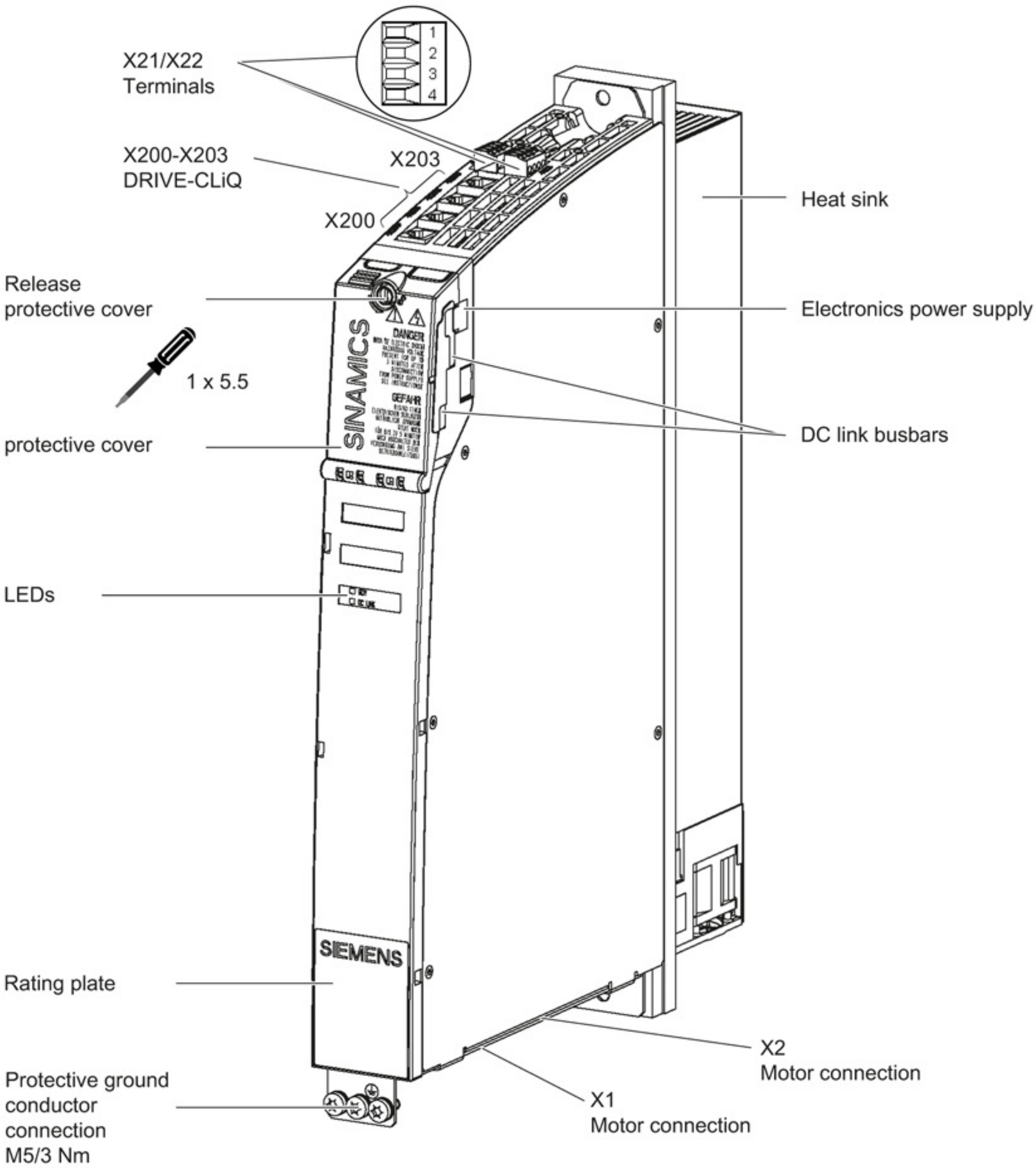
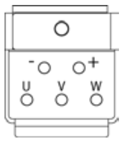
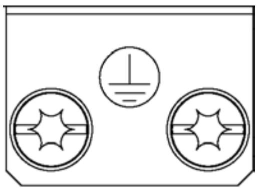
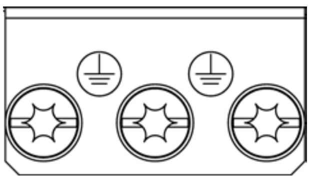


Figure 8-119 Interface overview, Double Motor Module Booksize with external air cooling (example: 2 x 5 A)

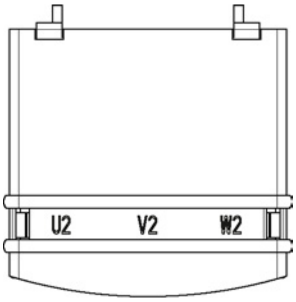
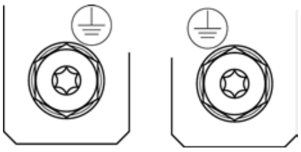
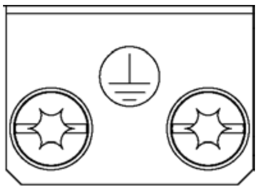
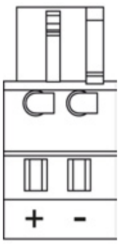
Motor and brake connection

Table 8- 93 X1/X2 motor and brake connection for Single Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

	Terminal	Technical data
	U (U2)	Motor connection
	V (V2)	
	W (W2)	
	+ (BR+)	Brake connection max. load current 2 A min. load current 0.1 A
	- (BR-)	
	PE connection	**Single Motor Modules 3 A to 30 A:** Threaded hole M5/3 Nm [1)]
		**Double Motor Modules 3 A to 18 A:** Threaded hole M5/3 Nm [1)]

1) For ring cable lugs in accordance with DIN 46234

Table 8- 94 X1 motor connection and X11 brake connection for Single Motor Modules 45 A to 200 A

	Terminal	Technical data
	U2 V2 W2	**45 A to 60 A:** Threaded bolts M6/6 Nm 1) **85 A:** Threaded bolts M8/13 Nm 1) **132 A to 200 A:** Threaded bolts M8/13 Nm 1)
	PE connection	**45 A to 60 A:** Threaded bolts for motor cables: M6/6 Nm 1) Threaded hole for PE: M6 / 6 Nm 1)
		**85 A:** Threaded bolts for motor cables: M8/13 Nm 1) Threaded hole for PE: M6 / 6 Nm 1) **132 A to 200 A:** Threaded bolts for motor cables: M8/13 Nm 1) Threaded hole for PE: M8 / 13 Nm 1)
	+ (BR+) - (BR-)	**X11 brake connector** 2): Voltage 24 VDC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm^2 Type: Spring-loaded terminal 2 (see Appendix, Chapter "Spring-loaded terminals") The brake connector is part of the prefabricated cable

1) For ring cable lugs in accordance with DIN 46234

2) The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.

Note

The total length of the power cables (motor supply cables and DC link cables) must not exceed the values listed in the chapter titled "Possible line reactor and line filter combinations (Page 158)".

Note

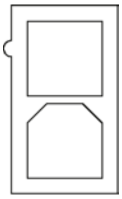
The motor brake must be connected via connector X11. Directly connecting the BR– cable to the electronics ground M is not permitted.

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

X12 fan connection

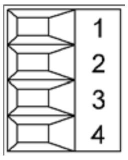
The Motor Modules 132 A and 200 A are equipped with an interface to connect a sub-chassis fan. The interface is located on the underside of the Motor Module.

Table 8- 95 X12 fan connection

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

X21/X22 EP terminals/temperature sensor

Table 8- 96 X21/X22 EP terminals/temperature sensor

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors: KTY84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 VDC (20.4 V - 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (Enable Pulses)	
Max. connectable cross-section 1.5 mm^2 Type: Screw terminal 1 (see Appendix A.1)			

EP terminals

Parameters p9651 and p9851 are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4. Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Chapter "Controlling the safety functions".

Note

Function of the EP terminals

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

Temperature sensor connection

NOTICE
Risk of the motor overheating due to an incorrectly connected KTY temperature sensor
A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.
• Always connect the KTY temperature sensor with the correct polarity.

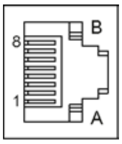
Note

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

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

X200-X203 DRIVE-CLiQ interface

Table 8- 97 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules
X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

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

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

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

8.4.3.3 Connection examples

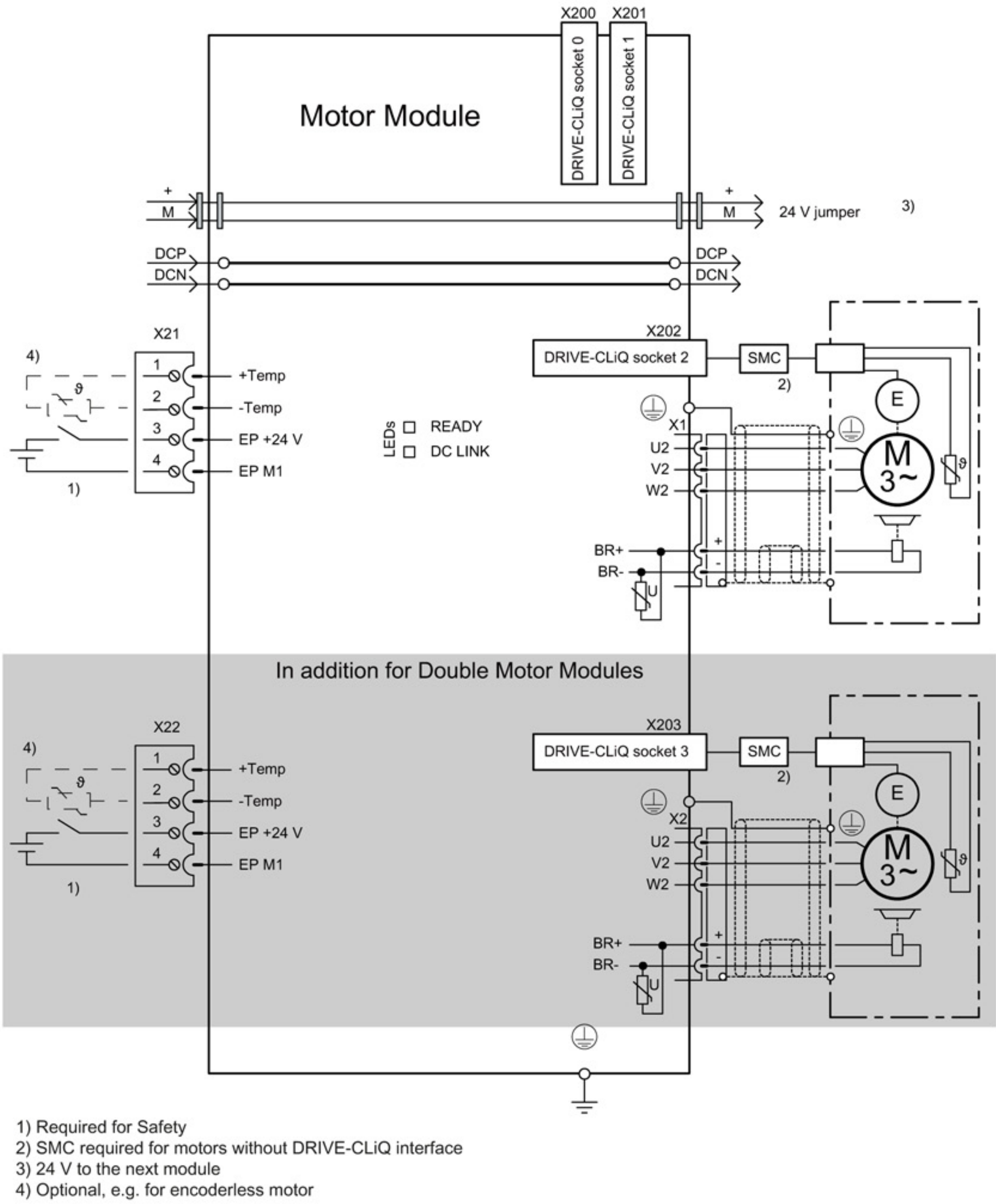
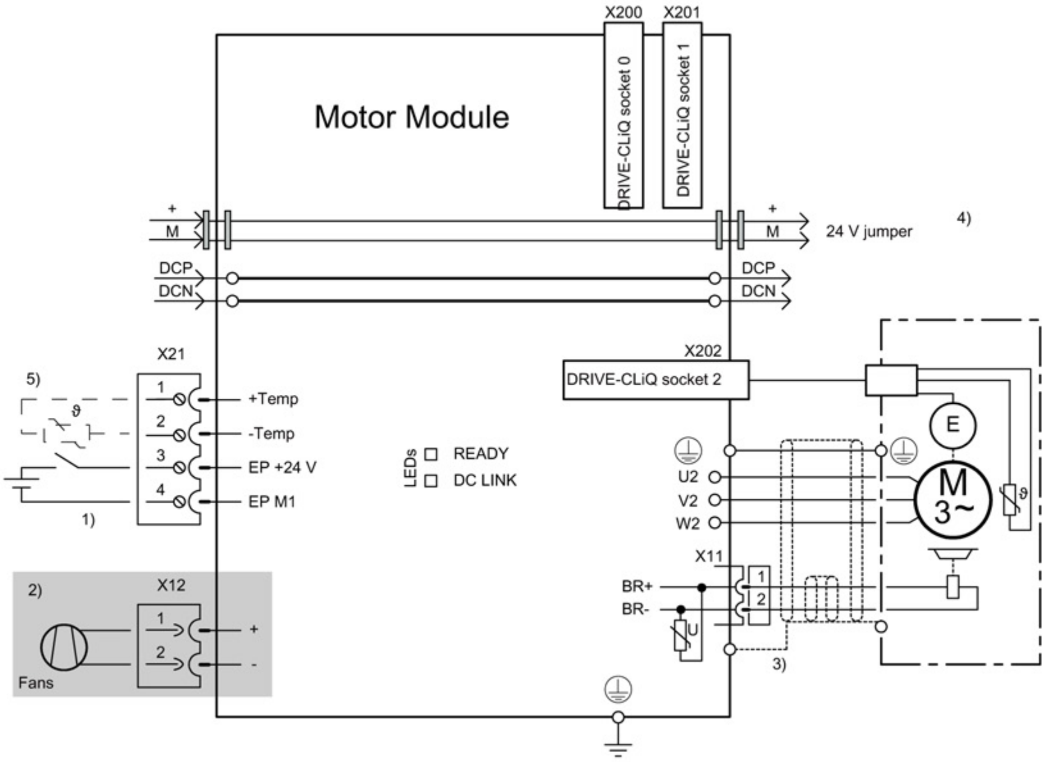


Figure 8-120 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A



1) Required for Safety
2) In addition for Motor Modules 132 A to 200 A
3) Contact through the shield connection plate
4) 24 V to the next module
5) Optional, e.g. for encoderless motor

Figure 8-121 Example connection of Single Motor Modules 45 A to 200 A

8.4.3.4 Meaning of LEDs

Table 8- 98 Meaning of the LEDs on the Motor Module

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

⚠ **DANGER**

Hazardous DC link voltage

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!

8.4.3.5 Dimension drawings

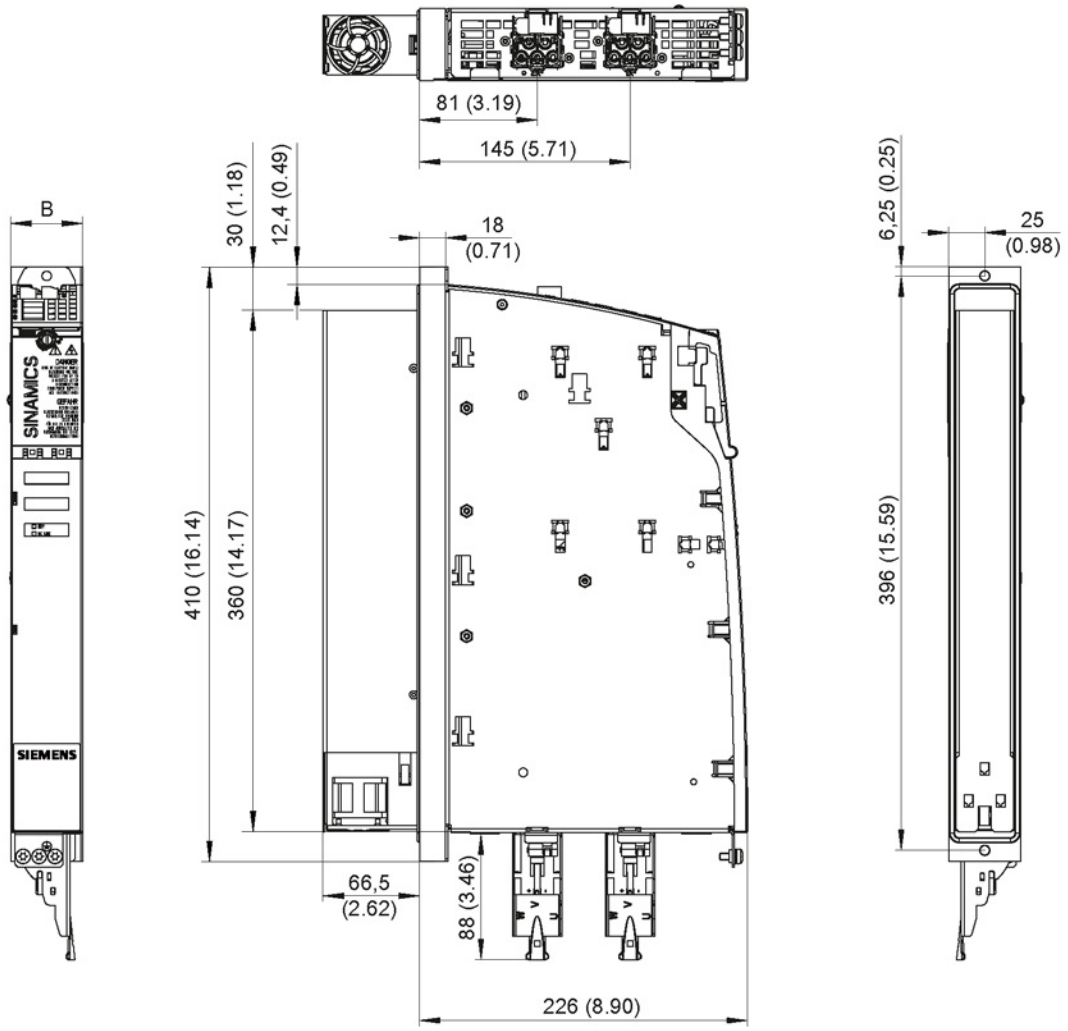


Figure 8-122 Dimension drawing of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches); example: 2 x 5 A Double Motor Module

Table 8- 99 Dimensions of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with external air cooling

Motor Module	Order number	B [mm] (inches)
3 A Single Motor Module	6SL3121-1TE13-0AAx	50 (1.97)
5 A Single Motor Module	6SL3121-1TE15-0AAx	
9 A Single Motor Module	6SL3121-1TE19-0AAx	
18 A Single Motor Module	6SL3121-1TE21-8AAx	
3 A Double Motor Module	6SL3121-2TE13-0AAx	
5 A Double Motor Module	6SL3121-2TE15-0AAx	
9 A Double Motor Module	6SL3121-2TE21-0AAx	

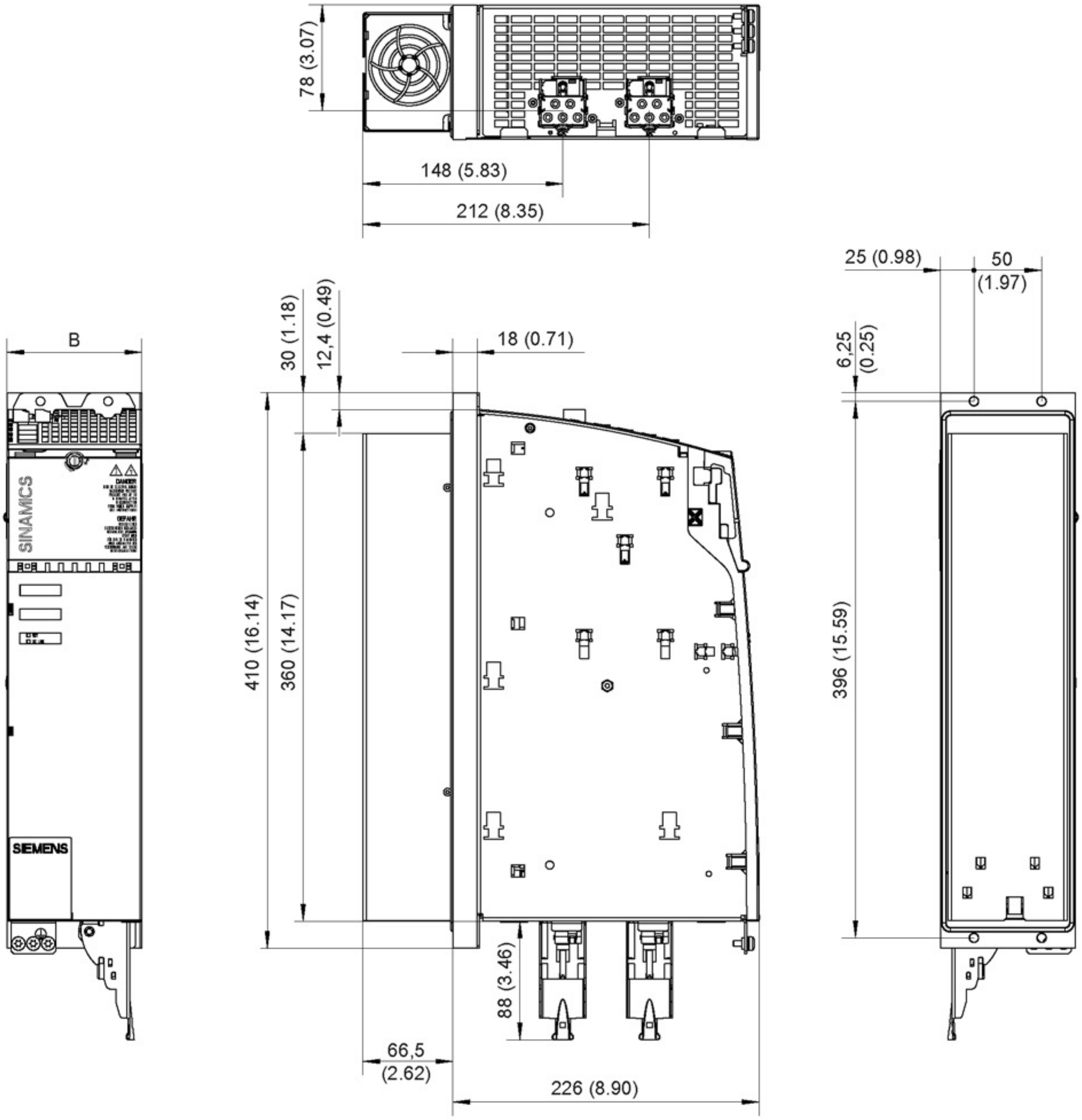


Figure 8-123 Dimension drawing of 30 A and 2 x 18 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches); example: 2 x 18 A Double Motor Module

Table 8- 100 Dimensions of 30 A and 2 x 18 A Motor Modules Booksize with external air cooling

Motor Module	Order number	B [mm] (inches)
30 A Single Motor Module	6SL3121-1TE23-0AAx	100 (3.94)
18 A Double Motor Module	6SL3121-2TE21-8AAx	

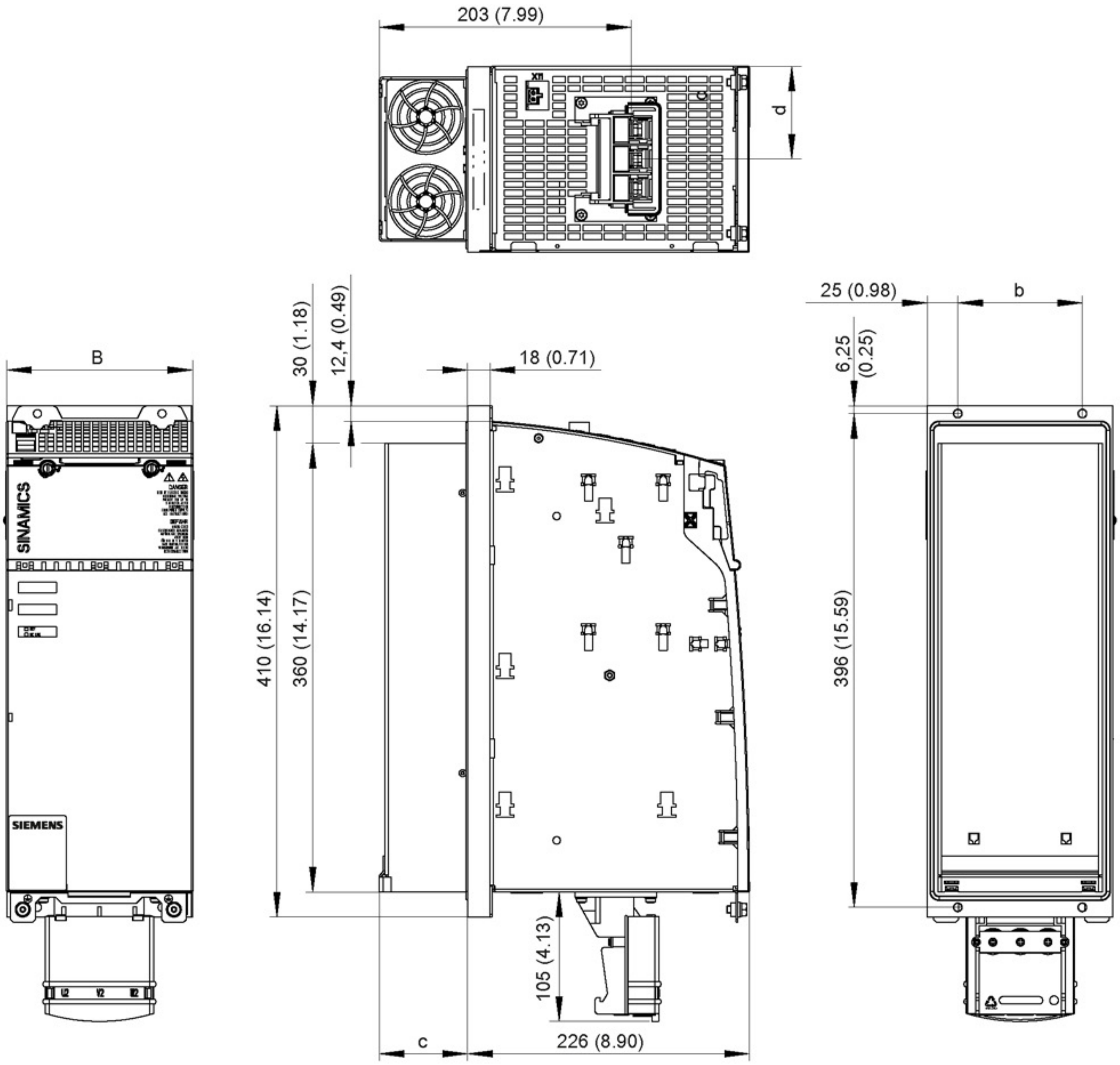


Figure 8-124 Dimension drawing of 45 A, 60 A, and 85 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches); example 45 A

Table 8- 101 Dimensions of 45 A, 60 A, and 85 A Motor Modules Booksize with external air cooling

Motor Module	Order number	B [mm] (inches)	b [mm] (inches)	c [mm] (inches)	d [mm] (inches)
Single Motor Module 45 A	6SL3121-1TE24-5AAx	150 (5.91)	100 (3.94)	71 (2.80)	75 (2.95)
Single Motor Module 60 A	6SL3121-1TE26-0AAx				
Single Motor Module 85 A	6SL3121-1TE28-5AAx	200 (7.87)	150 (5.91)	92 (3.62)	100 (3.94)

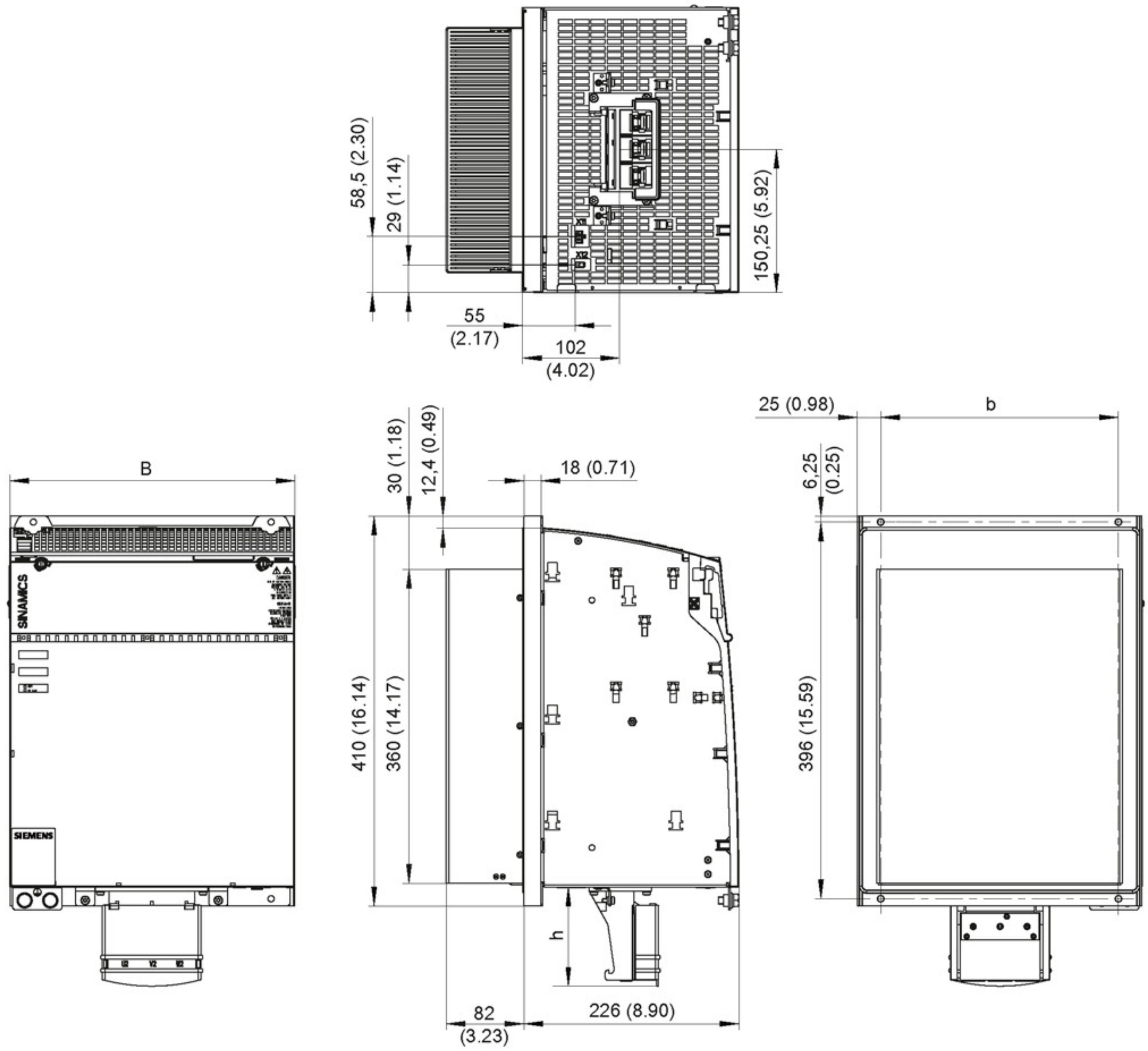


Figure 8-125 Dimension drawing of 132 A and 200 A Motor Modules Booksize, all dimensions in mm and (inches); example: 200 A Single Motor Module

Table 8- 102 Dimensions of 132 A and 200 A Motor Modules Booksize with external air cooling

Motor Module	Order number	B [mm] (inches)	b [mm] (inches)	h [mm] (inches)
Single Motor Module 132 A	6SL3121-1TE31-3AAx	300 (11.81)	250 (9.84)	105 (4.13)
Single Motor Module 200 A	6SL3121-1TE32-0AAx			

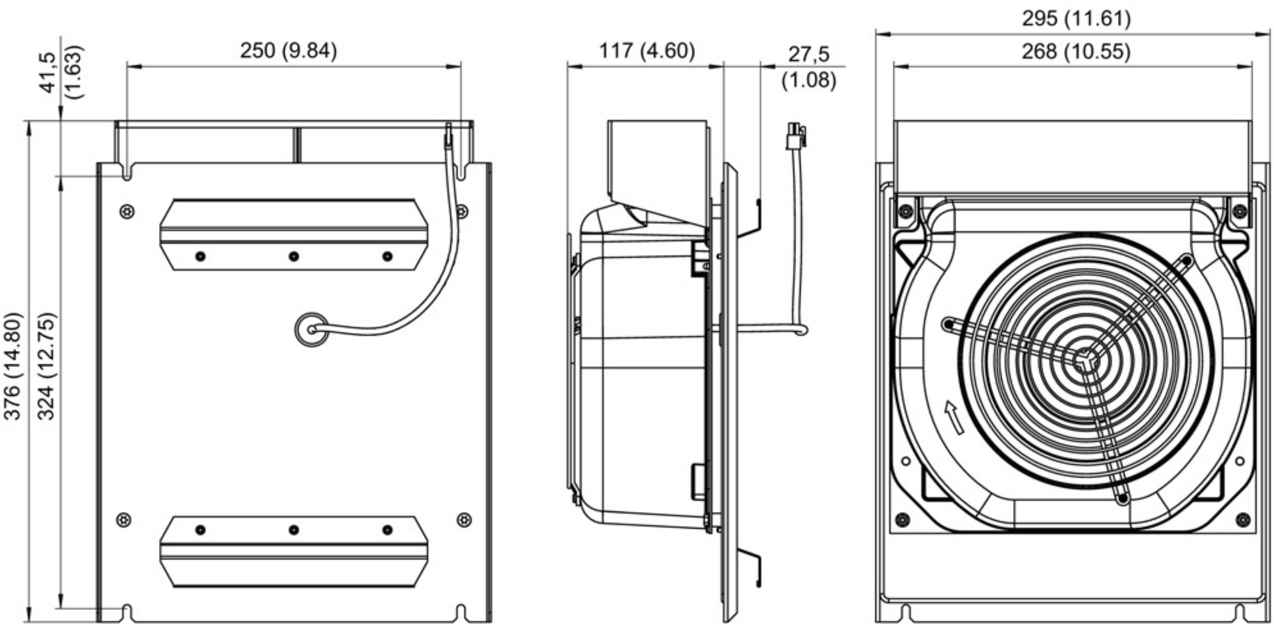
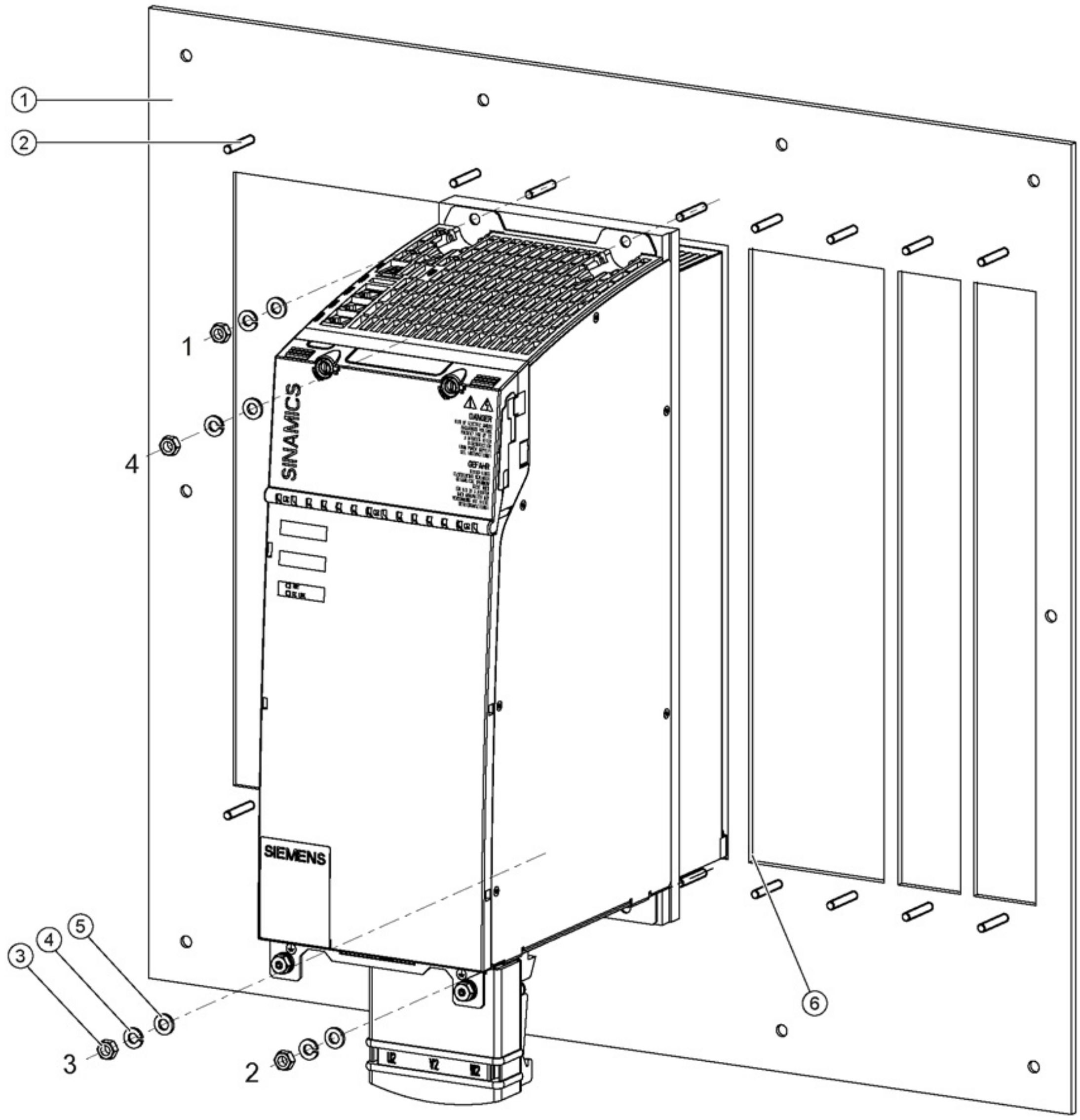


Figure 8-126 Dimension drawing of fan for 132 A and 200 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches)

Note

The fans for the 132 kW and 200 kW Motor Modules are included in the scope of delivery.

8.4.3.6 Mounting



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

Figure 8-127 Mounting a Motor Module with external air cooling

Tightening torques:

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

Help with the mechanical control cabinet design is available from:

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

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

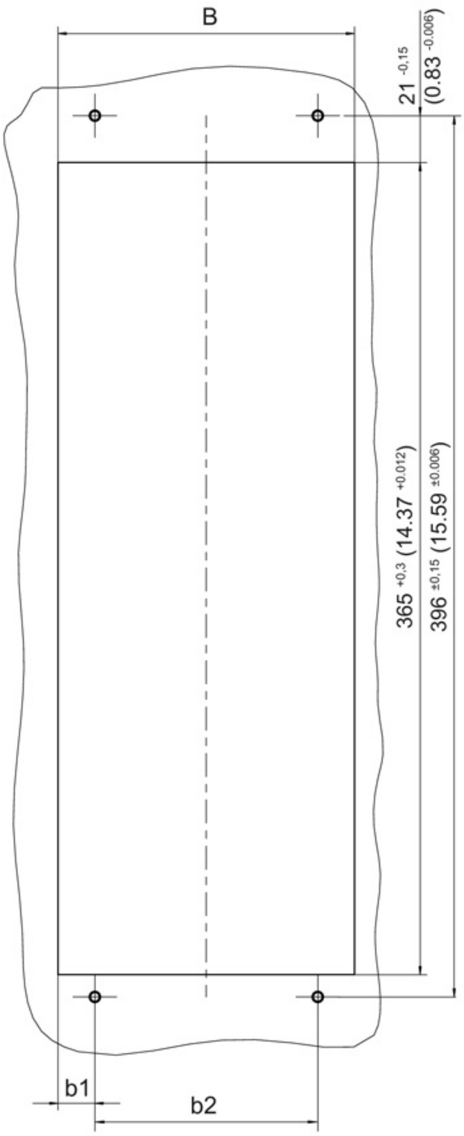
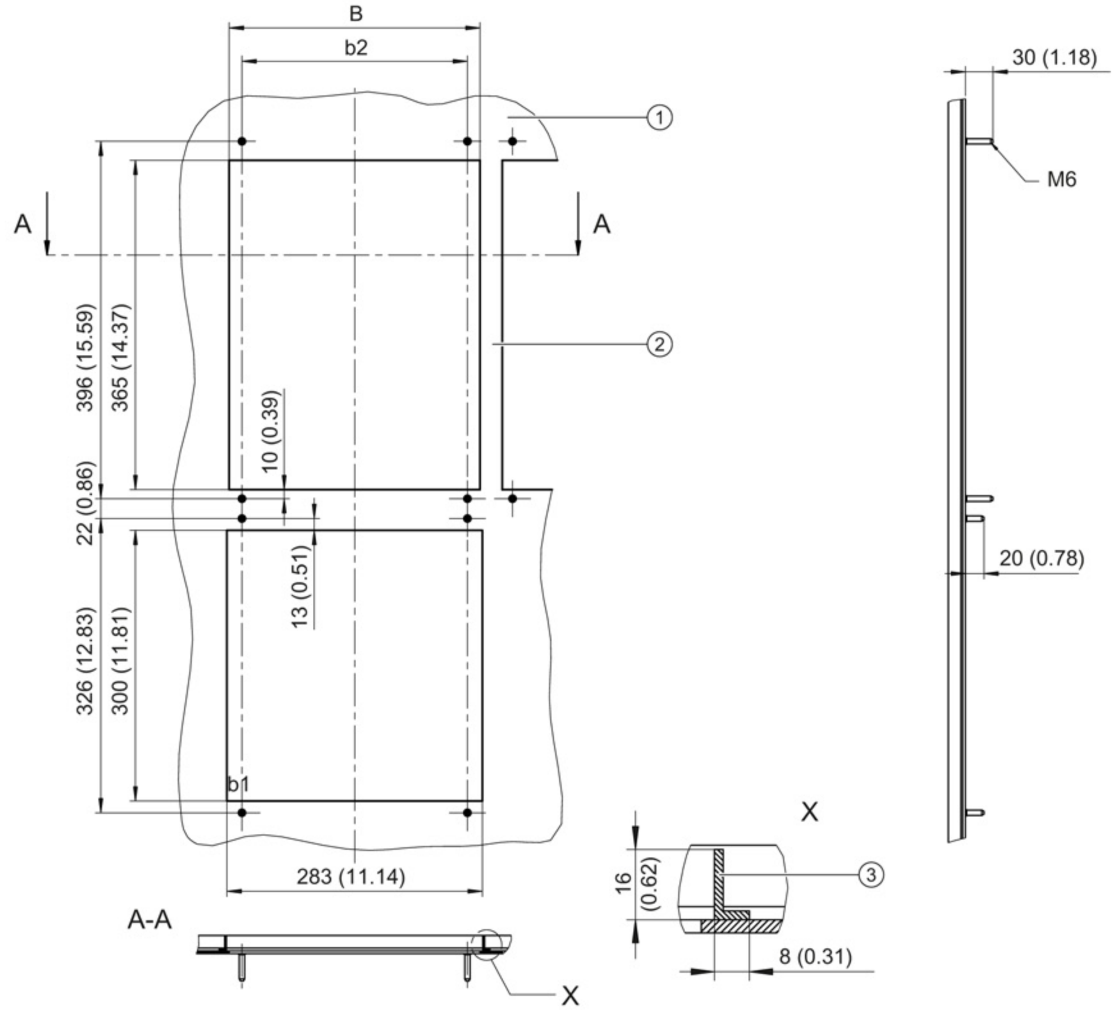


Figure 8-128 Opening to mount Motor Modules 50 mm to 200 mm with external air cooling, all data in mm and (inches)

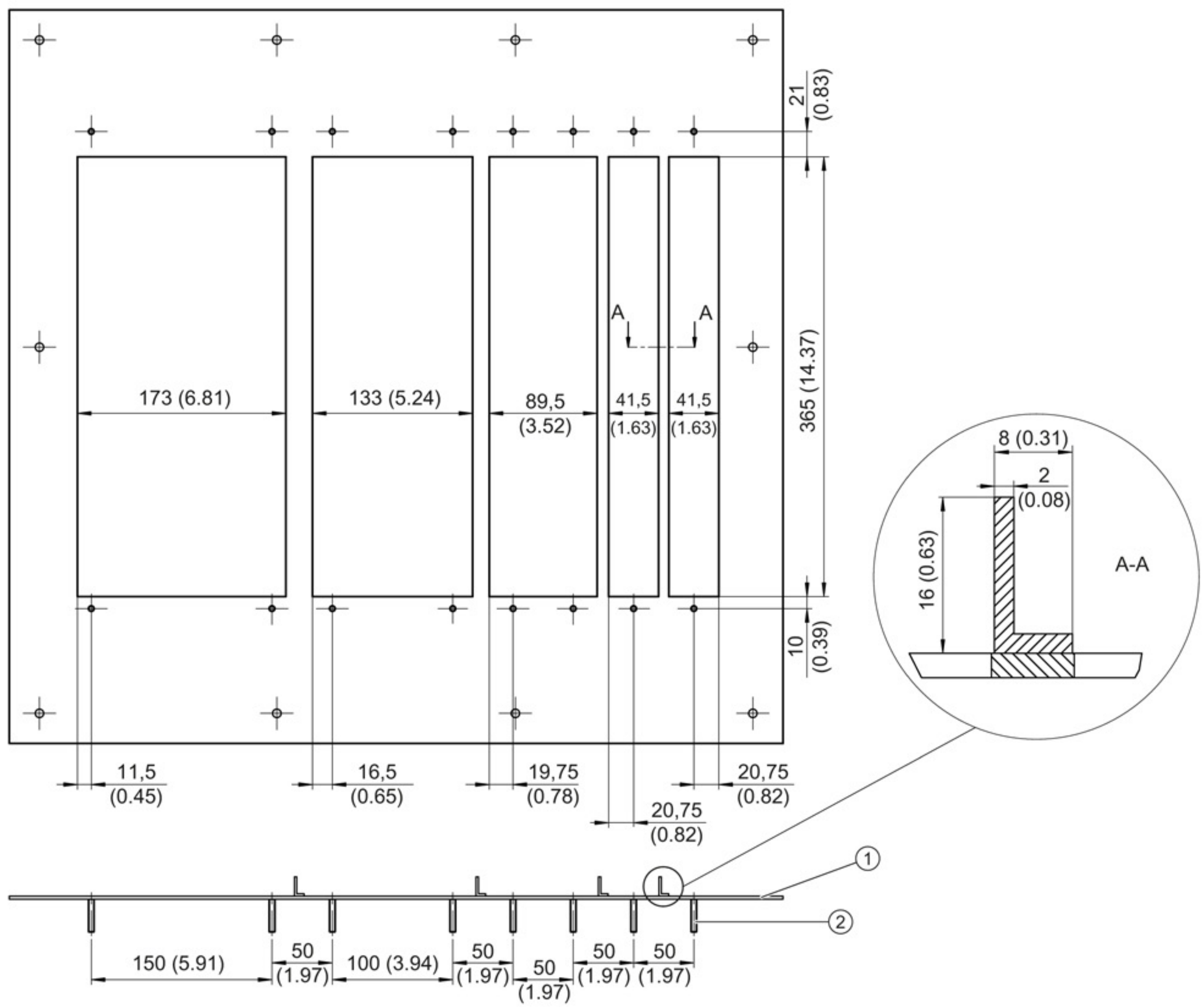


① Insert plate or mounting plate
② Cross-piece
③ Reinforcing bracket

Figure 8-129 Openings to mount a Motor Module 300 mm with external air cooling, all data in mm and (inches)

Table 8- 103 Dimensions of openings to mount Motor Modules with external air cooling

Component width	W [mm] (inches)	b1 [mm] (inch)	b2 [mm] (inch)
50 mm	41.5 $^{+0,3}$ (1.63 $^{+0.012}$)	20.75 $^{+0.15}$ (0.82 $^{+0.006}$)	0
100 mm	89,5 $^{+0,3}$ (3.52 $^{+0.012}$)	19,75 $^{+0,15}$ (0.78 $^{+0.006}$)	50 $^{\pm0,15}$ (1.97 $^{\pm0.006}$)
150 mm	133 $^{+0,3}$ (5.24 $^{+0.012}$)	16,5 $^{+0,15}$ (0.65 $^{+0.006}$)	100 $^{\pm0,15}$ (3.94 $^{\pm0.006}$)
200 mm	173 $^{+0,3}$ (6.81 $^{+0.012}$)	11,5 $^{+0,15}$ (0.45 $^{+0.006}$)	150 $^{\pm0,15}$ (5.91 $^{\pm0.006}$)
300 mm	278 $^{+0,3}$ (10.94 $^{+0.012}$)	14,0 $^{\pm 0,15}$ (0.55 $^{\pm0.006}$)	250 $^{+0,15}$ (9.84 $^{+0.006}$)



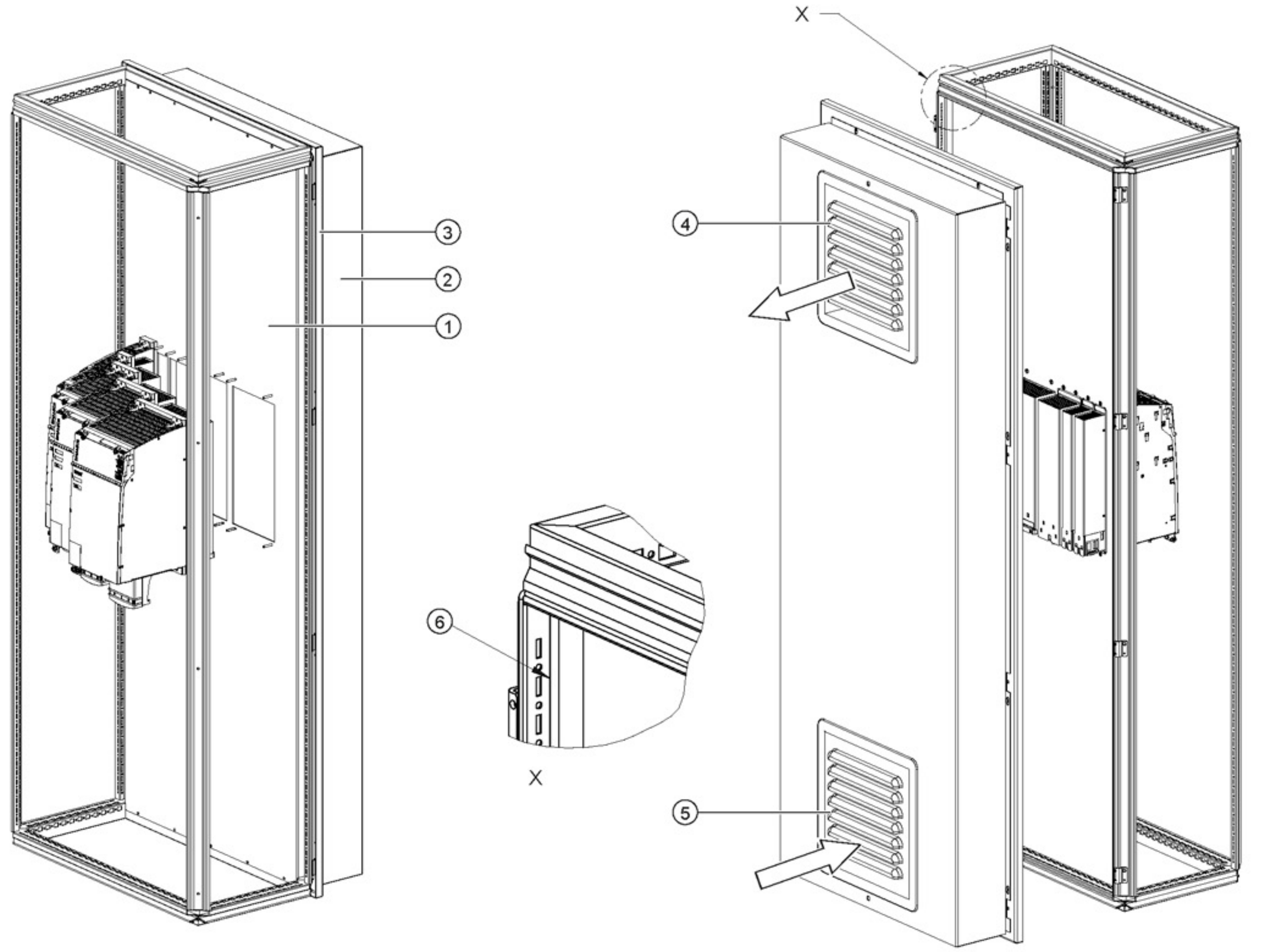
① Insert plate or mounting plate

② Threaded bolts M5 x 28

Figure 8-130 Example of a mounting plate for a drive line-up with external air cooling

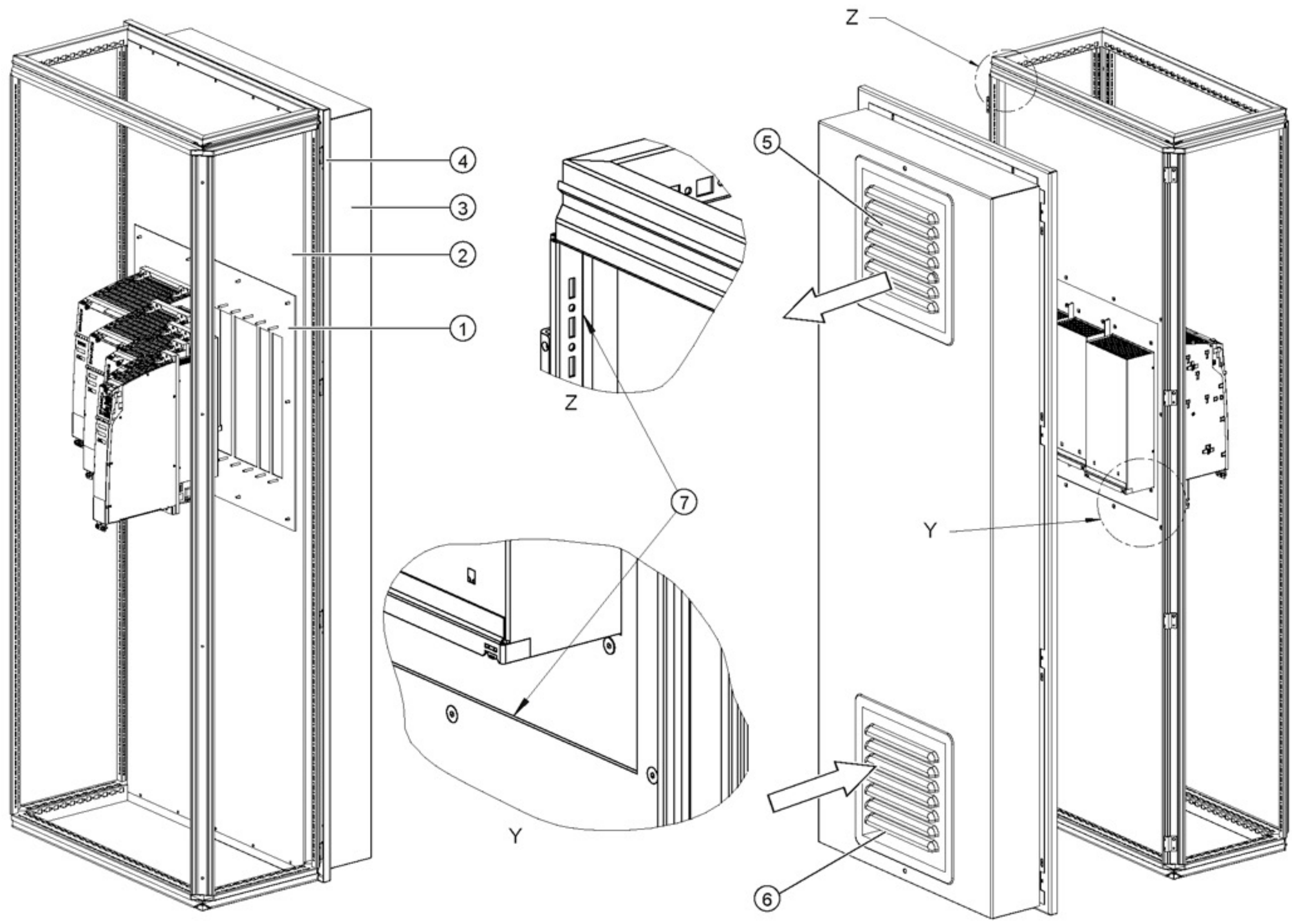
When mounting it must be ensured that the component's seal is tight throughout. The cross-pieces must have the appropriate stability. If necessary, the cross-pieces of the openings must be reinforced.

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



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

Figure 8-131 Example 1: mounting in the cabinet with mounting plate



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

Figure 8-132 Example 2: mounting in the cabinet with mounting plate

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

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

Note

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

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

8.4.3.7 Technical data

Single Motor Modules

Table 8- 104 Technical data Single Motor Modules Booksize (3 to 30 A)

External air cooling	**6SL3121–**	**1TE13-0AAx**	**1TE15-0AAx**	**1TE21–0AAx**	**1TE21–8AAx**	**1TE23-0AAx**
Output current Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{s6}) 40% Peak current (I_{max})	 A_{ACrms} A A_{ACrms} A_{ACrms}	 **3** 2.6 3.5 6	 **5** 4.3 6 10	 **9** 7.7 10 18	 **18** 15.3 24 36	 **30** 25.5 40 56
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage				
DC link current I_d	A_{DC}	3.6	6	11	22	36
DC link voltage	V_{DC}	510 – 720				
DC link capacitance	µF	110	110	110	220	705
Overvoltage trip Undervoltage trip[1]	V_{DC} V_{DC}	820 ±2% 380 ±2%				
Electronics power supply	V_{DC}	24 (20.4 - 28.8)				
Electronics current consumption at 24 V DC	A_{DC}	0.85	0.85	0.85	0.85	0.8
Current carrying capacity DC link busbars Reinforced DC link busbars 24 VDC busbars	 A_{DC} A_{DC} A_{DC}	 100 150 20	 100 150 20	 100 150 20	 100 150 20	 100 150 20
Unit rating Based on I_n (600 V_{DC}; 4 kHz) Based on I_H	 kW kW	 1.6 1.4	 2.7 2.3	 4.8 4.1	 9.7 8.2	 16 13.7
Total power loss (incl. electronics losses)[2]	W	50.4	73.4	100.4	185.4	309.2
Max. pulse frequency without derating with derating	 kHz kHz	 4 16				
Max. ambient temperature without derating with derating	 °C °C	 40 55				
Sound pressure level	dB(A)	<60	<60	<60	<60	<60
Cooling air requirement	m^3/h	29.6	29.6	29.6	29.6	56
Max. permissible heat sink temperature	°C	70	70	73	82	85
Weight	kg	5.7	5.7	5.7	5.7	8.4

1) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

2) For an overview, see the power loss tables in the Appendix

Table 8- 105 Technical data Single Motor Modules Booksize (45 to 200 A)

External air cooling	**6SL3121–**	**1TE24-5AAx**	**1TE26-0AAx**	**1TE28-5AAx**	**1TE31-3AAx**	**1TE32-0AAx**
Output current Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{s6}) 40% Peak current (I_{max})	 A_{ACrms} A A_{ACrms} A_{ACrms}	 **45** 38 60 85	 **60** 51 80 113	 **85** 68 110 141	 **132** 105 150 210	 **200** 141 230 282
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage				
DC link current I_d	A_{DC}	54	72	102	158	200
DC link voltage	V_{DC}	510 – 720				
DC link capacitance	µF	1175	1410	1880	2820	3995
Overvoltage trip Undervoltage trip1)	V_{DC} V_{DC}	820 ±2% 380 ±2%				
Electronics power supply	V_{DC}	24 (20.4 - 28.8)				
Electronics current consumption at 24 V DC	A_{DC}	1.05	1.05	1.5	0.85	0.85
Current carrying capacity DC link busbars 24 VDC busbars	 A_{DC} A_{DC}	 200 20	 200 20	 200 20	 200 20	 200 20
Unit rating Based on I_n (600 V_{DC}; 4 kHz) Based on I_H	 kW kW	 24 21	 32 28	 46 37	 71 57	 107 76
Total power loss (incl. electronics losses)2)	W	455.2	615.2	786	1270.4	2070.4
Max. pulse frequency without derating with derating	 kHz kHz	 4 16				
Max. ambient temperature without derating with derating	 °C °C	 40 55				
Sound pressure level	dB(A)	< 65	< 65	< 60	< 73	< 73
Cooling air requirement	m^3/h	112	112	160	520	520
Max. permissible heat sink temperature	°C	85	90	88	73	80 (70% derating)
Weight	kg	13.2	13.3	17.2	27.1	28

1) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V (exception: 132 A and 200 A Motor Modules) and is adjusted to the parameterized rated voltage.

2) For an overview, see the power loss tables in the Appendix

Double Motor Modules

Table 8- 106 Technical data Double Motor Modules Booksize (3 to 18 A)

External air cooling	6SL3121-	2TE13-0AAx	2TE15-0AAx	2TE21-0AAx	2TE21-8AAx
Output current Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{s6}) 40% Peak current (I_{max})	 A_{ACrms} A A_{ACrms} A_{ACrms}	 **2 x 3** 2 x 2.6 2 x 3.5 2 x 6	 **2 x 5** 2 x 4.3 2 x 6 2 x 10	 **2 x 9** 2 x 7.7 2 x 10 2 x 18	 **2 x 18** 2 x 15.3 2 x 24 2 x 36
Output voltage	V_{ACrms}	0 -480			
DC link current I_d	A_{DC}	7.2	12	22	43
DC link voltage	V_{DC}	510 – 720			
DC link capacitance	µF	110	220	220	705
Overvoltage trip Undervoltage trip[1)]	V_{DC} V_{DC}	820 ±2% 380 ±2%			
Electronics power supply	V_{DC}	24 (20.4 - 28.8)			
Electronics current consumption at 24 V DC	A_{DC}	1.15	1.15	1.15	1.3
Current carrying capacity DC link busbars Reinforced DC link busbars 24 VDC busbars	 A_{DC} A_{DC} A	 100 150 20	 100 150 20	 100 150 20	 100 150 20
Unit rating Based on I_n (600 V_{DC}; 4 kHz) Based on I_H	 kW kW	 2 x 1.6 2 x 1.4	 2 x 2.7 2 x 2.3	 2 x 4.8 2 x 4.4	 2 x 9.7 2 x 8.2
Total power loss (including electronics losses)[2)]	W	97.6	132.6	187.6	351.2
Max. pulse frequency without derating with derating	 kHz kHz	 4 16			
Max. ambient temperature without derating with derating	 °C °C	 40 55			
Sound pressure level	dBA	<60	<60	<60	<60
Cooling air requirement	m^3/h	29.6	29.6	29.6	56
Max. permissible heat sink temperature	°C	80	85	89	90
Weight	kg	5.8	5.8	5.7	8.6

1) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

2) For an overview, see the power loss tables in the Appendix

Characteristics

Rated duty cycles Motor Modules Booksize

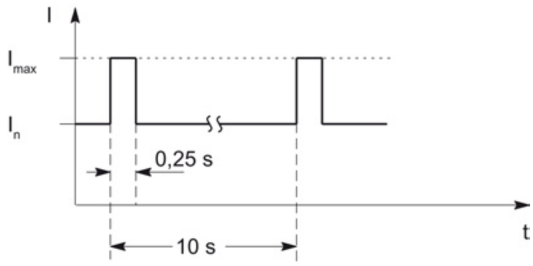


Figure 8-133 Duty cycle with initial load (for servo drives)

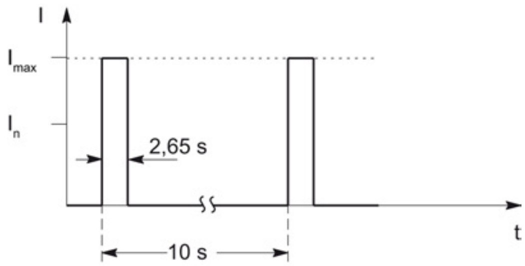


Figure 8-134 Duty cycle without initial load (for servo drives)

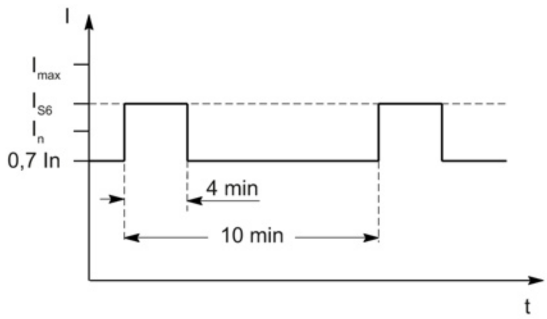


Figure 8-135 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

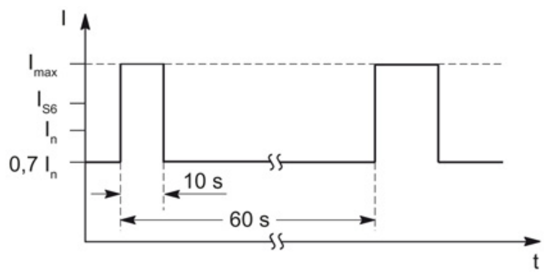


Figure 8-136 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

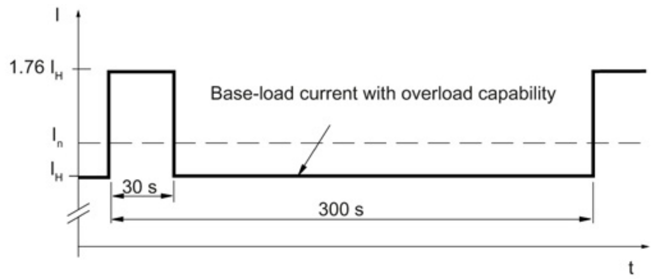


Figure 8-137 Duty cycle with 30 s overload for a duty cycle duration of 300 s

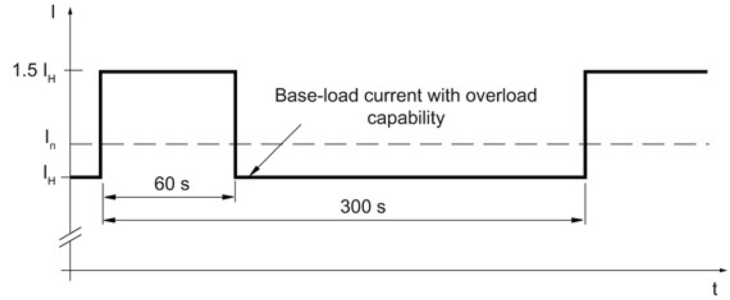


Figure 8-138 Duty cycle with 60 s overload for a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize

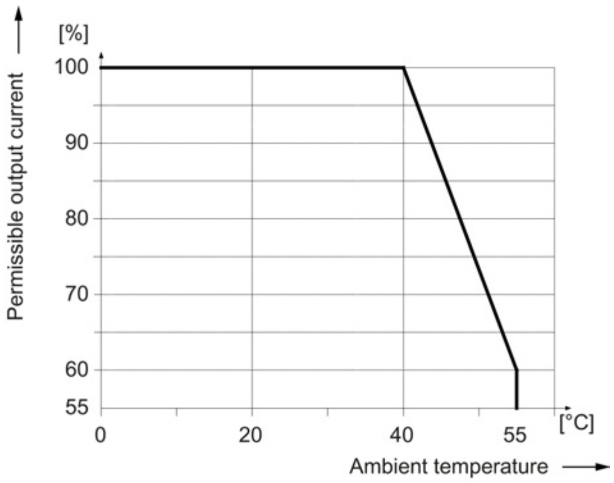


Figure 8-139 Output current as a function of the ambient temperature

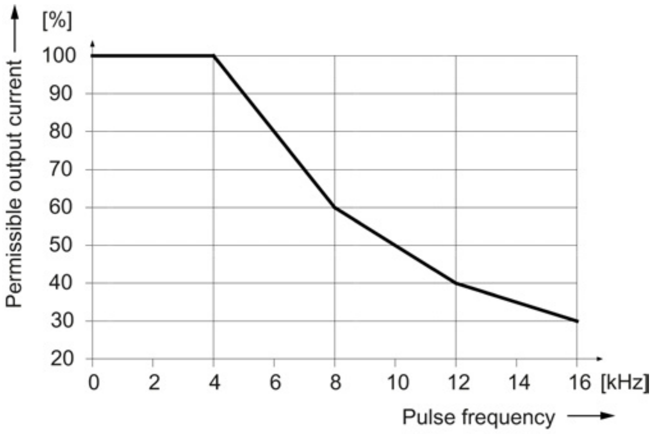


Figure 8-140 Output current as a function of the pulse frequency

Figure 8-141 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

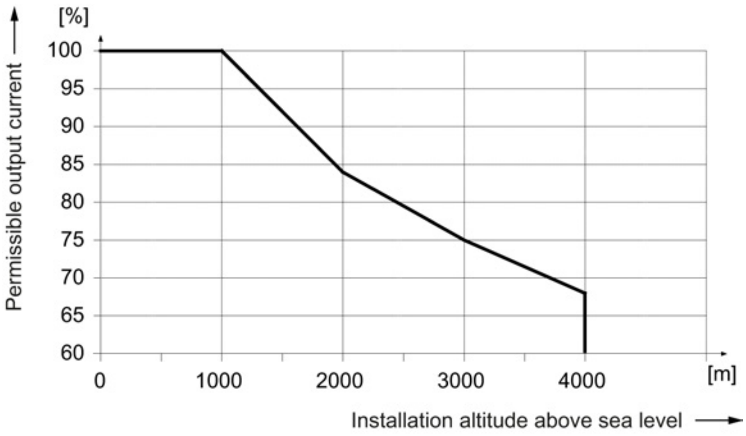


Figure 8-142 Output current as a function of the installation altitude

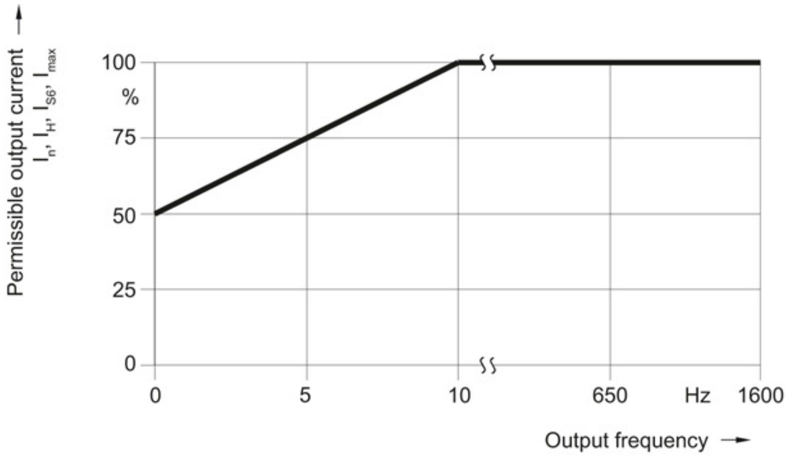


Figure 8-143 Output current as a function of the output frequency

At installation altitudes > 2000 m, an isolation transformer must be used (see the chapter titled "System overview/Function of installation altitude and ambient temperature" (Page 32)). The design of the secondary line system must be as follows:

- TN system with grounded neutral point (no grounded line conductor)
- IT system

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

8.4.4 Motor Modules with cold plate

8.4.4.1 Description

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

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

8.4.4.2 Interface description

Overview

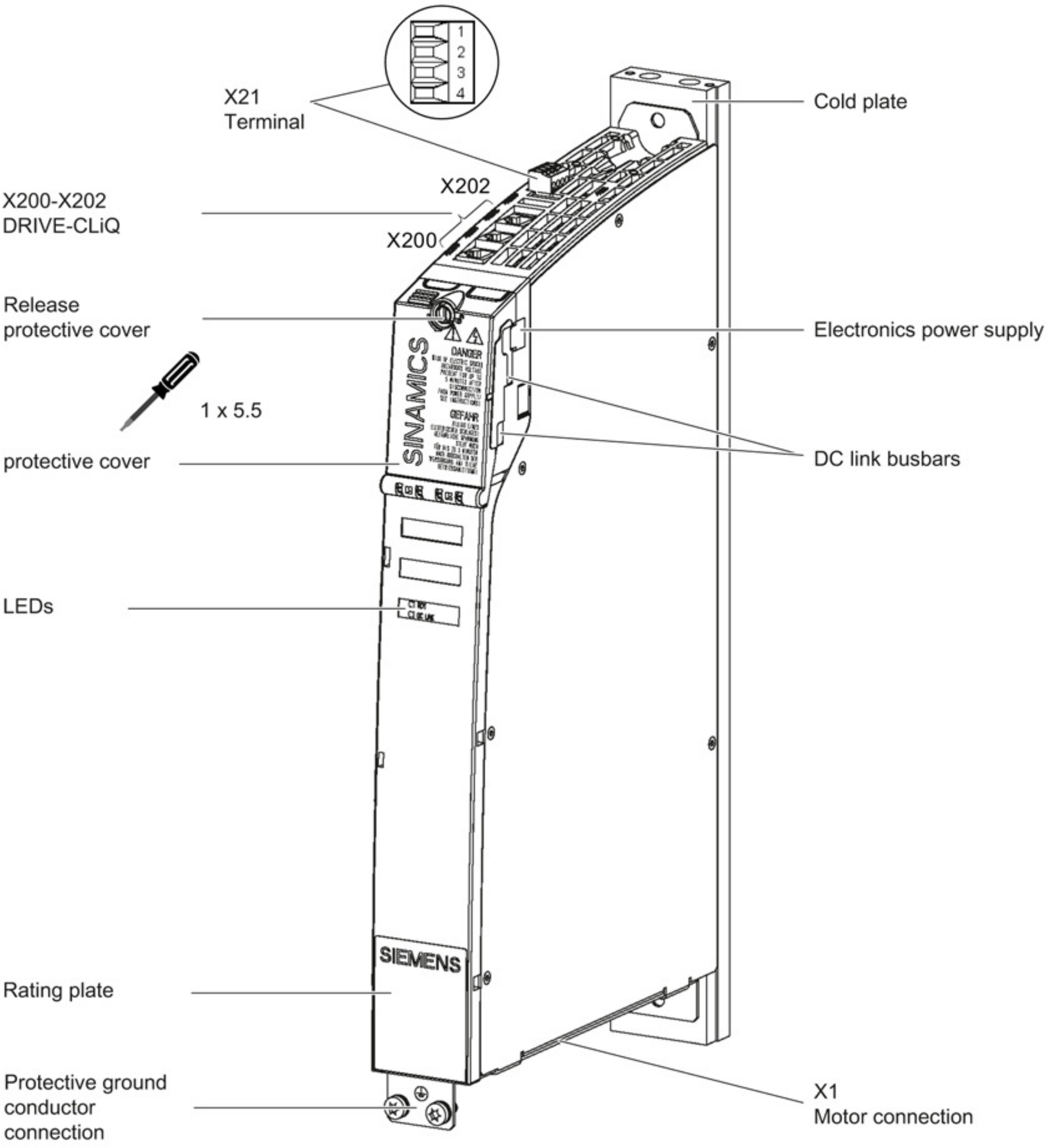


Figure 8-144 Interface overview, Single Motor Module Booksize with cold plate (example: 5 A)

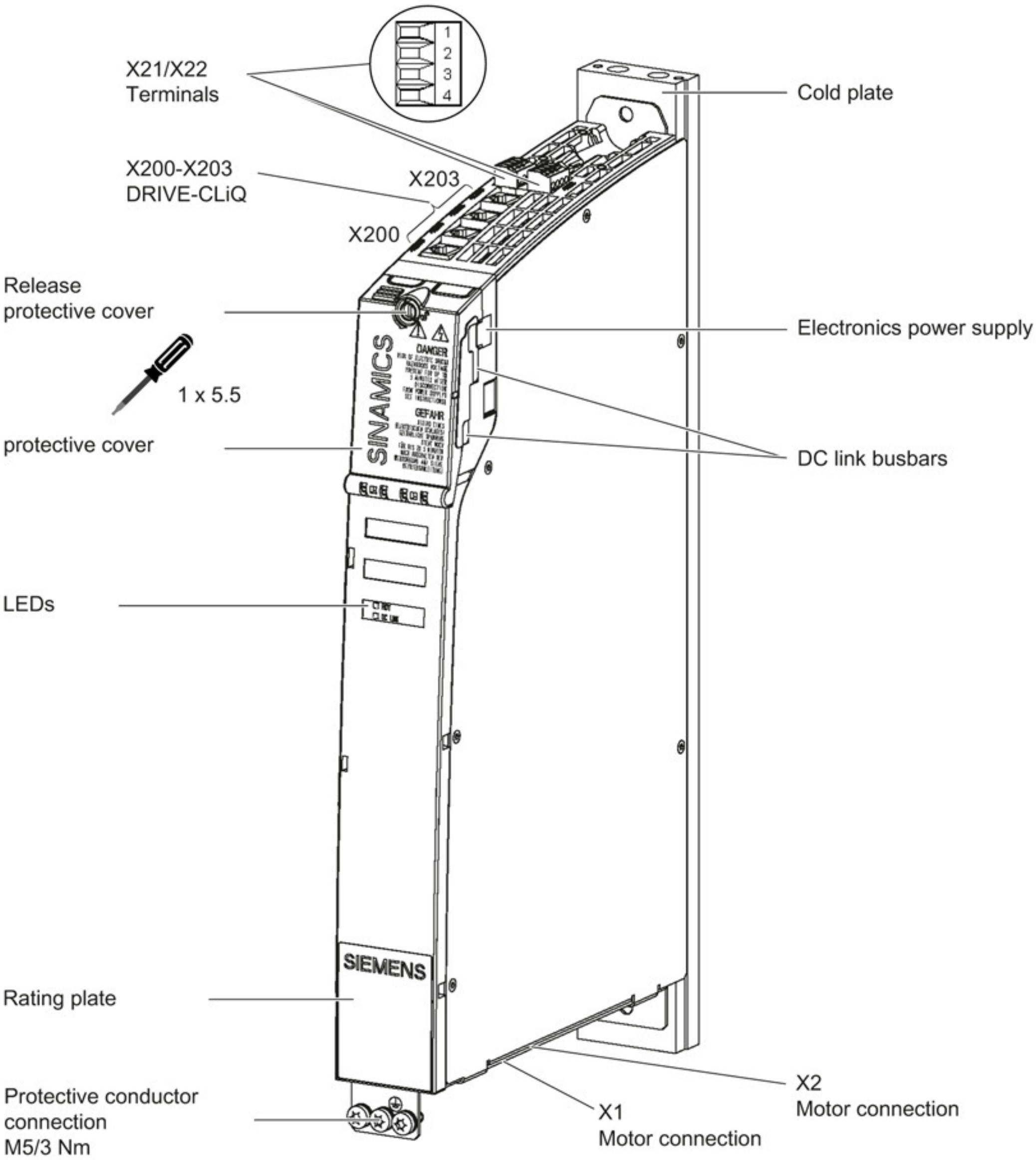
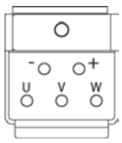
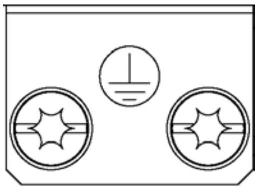
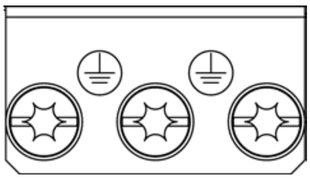


Figure 8-145 Interface overview, Double Motor Module Booksize with cold plate (example: 2 x 5 A)

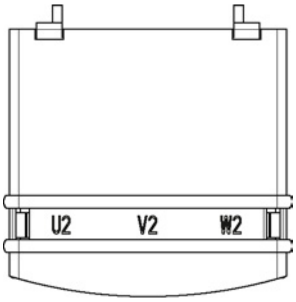
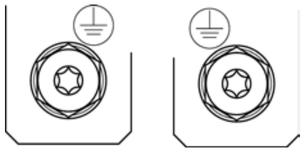
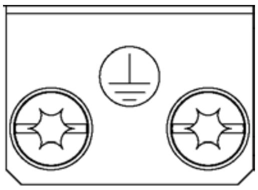
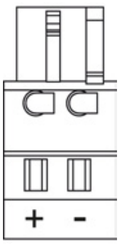
Motor and brake connection

Table 8- 107 X1/X2 motor and brake connection for Single Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

	Terminal	Technical data
	U (U2)	Motor connection
	V (V2)	
	W (W2)	
	+ (BR+)	Brake connection max. load current 2 A min. load current 0.1 A
	- (BR-)	
	PE connection	**Single Motor Modules 3 A to 30 A:** Threaded hole M5/3 Nm [1)]
		**Double Motor Modules 3 A to 18 A:** Threaded hole M5/3 Nm [1)]

1) For ring cable lugs in accordance with DIN 46234

Table 8- 108 X1 motor connection and X11 brake connection for Single Motor Modules 45 A to 200 A

	Terminal	Technical data
	U2 V2 W2	**45 A to 60 A:** Threaded bolts M6/6 Nm 1) **85 A:** Threaded bolts M8/13 Nm 1) **132 A to 200 A:** Threaded bolts M8/13 Nm 1)
	PE connection	**45 A to 60 A:** Threaded bolts for motor cables: M6/6 Nm 1) Threaded hole for PE: M6 / 6 Nm 1)
		**85 A:** Threaded bolts for motor cables: M8/13 Nm 1) Threaded hole for PE: M6 / 6 Nm 1) **132 A to 200 A:** Threaded bolts for motor cables: M8/13 Nm 1) Threaded hole for PE: M8 / 13 Nm 1)
	+ (BR+) - (BR-)	**X11 brake connector** 2): Voltage 24 VDC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm^2 Type: Spring-loaded terminal 2 (see Appendix, Chapter "Spring-loaded terminals") The brake connector is part of the prefabricated cable

1) For ring cable lugs in accordance with DIN 46234

2) The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.

Note

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

Note

The motor brake must be connected via connector X11. Directly connecting the BR– cable to the electronics ground M is not permitted.

⚠ WARNING

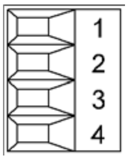
Safety extra-low voltages at connections and terminals

Only protective extra-low voltages (DVC A) that comply with EN 60204-1 may be connected to all connections and terminals between 0 and 48 VDC.

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

X21/X22 EP terminals/temperature sensor

Table 8- 109 X21/X22 EP terminals/temperature sensor

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors: KTY84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 VDC (20.4 V - 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (Enable Pulses)	
Max. connectable cross-section 1.5 mm² Type: Screw terminal 1 (see Appendix A.1)			

EP terminals

Parameters p9651 and p9851 are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4. Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Chapter "Controlling the safety functions".

Note

Function of the EP terminals

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

Temperature sensor connection

NOTICE
Risk of the motor overheating due to an incorrectly connected KTY temperature sensor
A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats. • Always connect the KTY temperature sensor with the correct polarity.

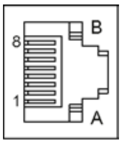
Note

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

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

X200-X203 DRIVE-CLiQ interface

Table 8- 110 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules
X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

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

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

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

8.4.4.3 Connection examples

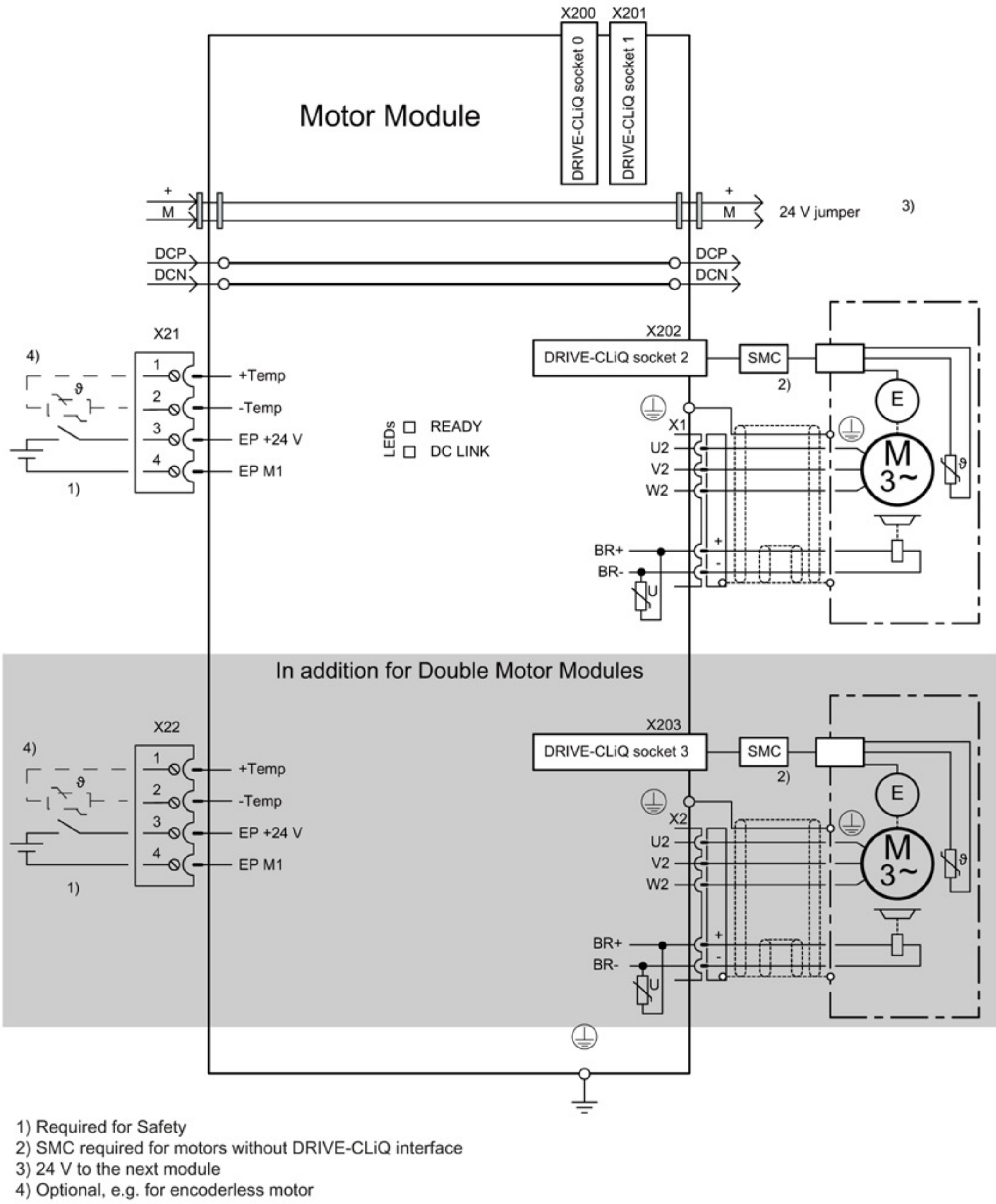


Figure 8-146 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

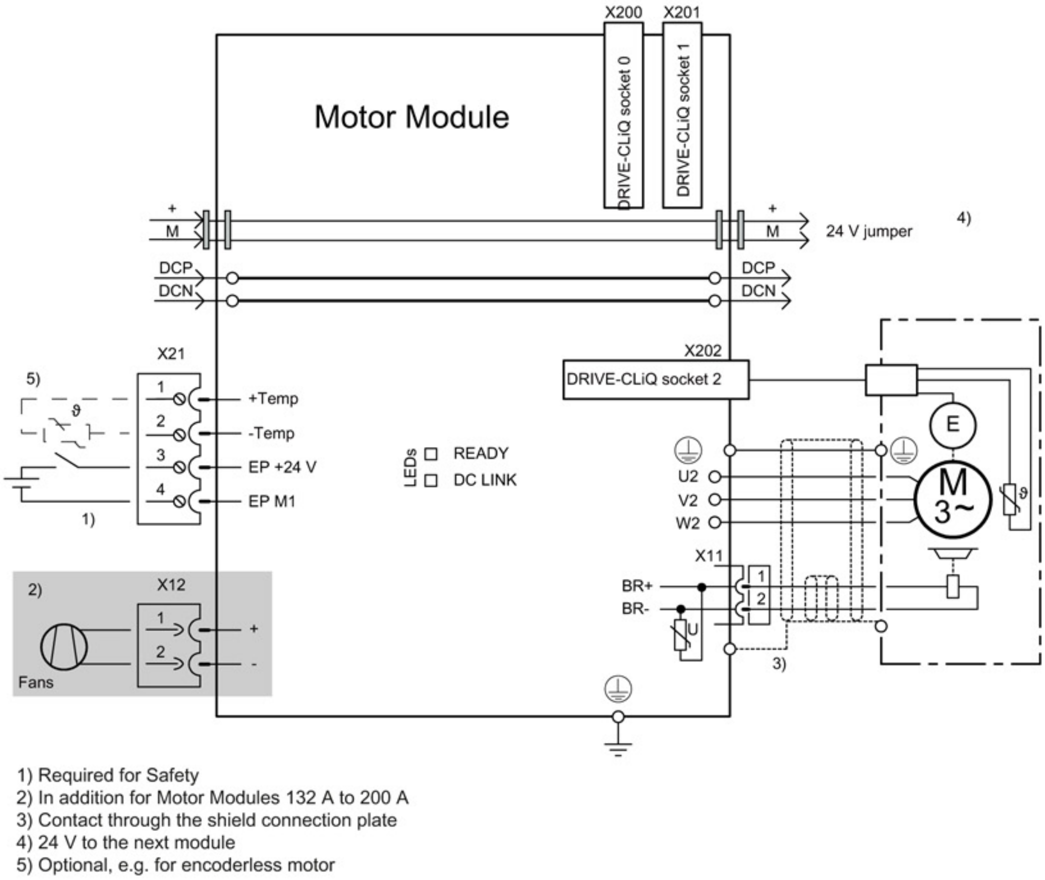


Figure 8-147 Example connection of Single Motor Modules 45 A to 200 A

8.4.4.4 Meaning of LEDs

Table 8- 111 Meaning of the LEDs on the Motor Module

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

DANGER

Hazardous DC link voltage

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!

8.4.4.5 Dimension drawings

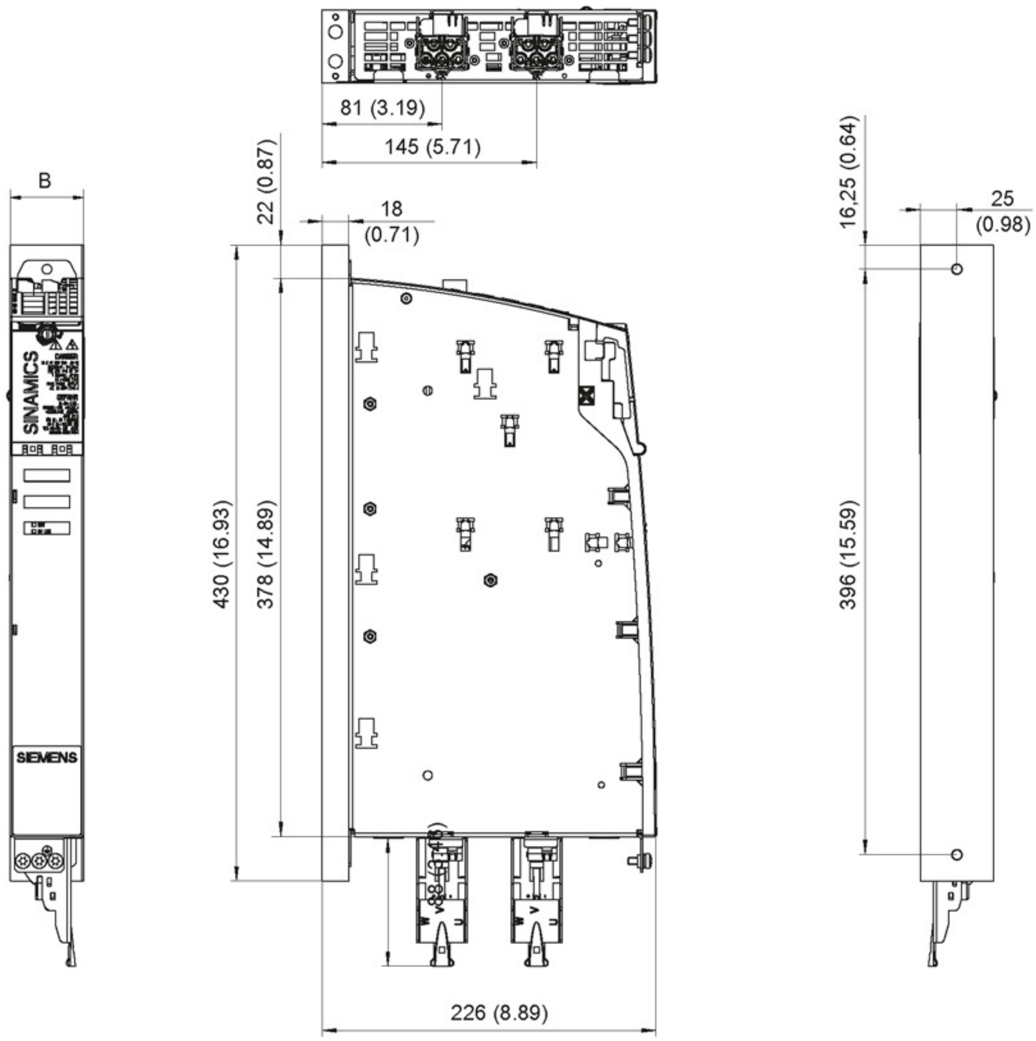


Figure 8-148 Dimension drawing of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with cold plate, all dimensions in mm and (inches); example: 2 x 5 A Double Motor Module

Table 8- 112 Dimensions of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with cold plate

Motor Module	Order number	B [mm] (inches)
3 A Single Motor Module	6SL3126-1TE13-0AAx	50 (1.97)
5 A Single Motor Module	6SL3126-1TE15-0AAx	
9 A Single Motor Module	6SL3126-1TE21-0AAx	
18 A Single Motor Module	6SL3126-1TE21-8AAx	
3 A Double Motor Module	6SL3126-2TE13-0AAx	
5 A Double Motor Module	6SL3126-2TE15-0AAx	
9 A Double Motor Module	6SL3126-2TE21-0AAx	

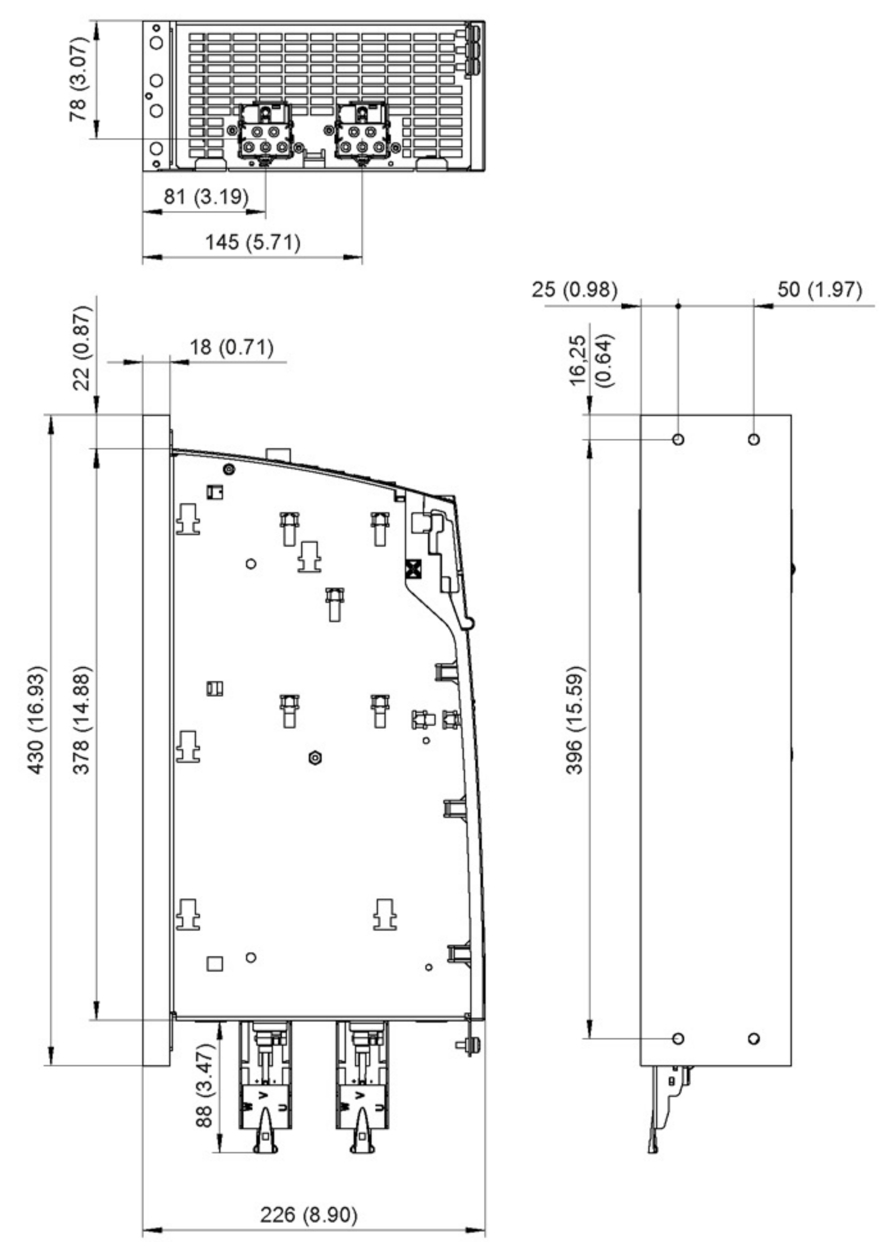


Figure 8-149 Dimension drawing of 30 A and 2 x 18 A Motor Modules Booksize with cold plate, all dimensions in mm and (inches)

Table 8- 113 Dimensions of 30 A and 2 x 18 A Motor Modules Booksize with cold plate

Motor Module	Order number	B [mm] (inches)
30 A Single Motor Module	6SL3126-1TE23-0AAx	100 (3.94)
18 A Double Motor Module	6SL3126-2TE21-8AAx	

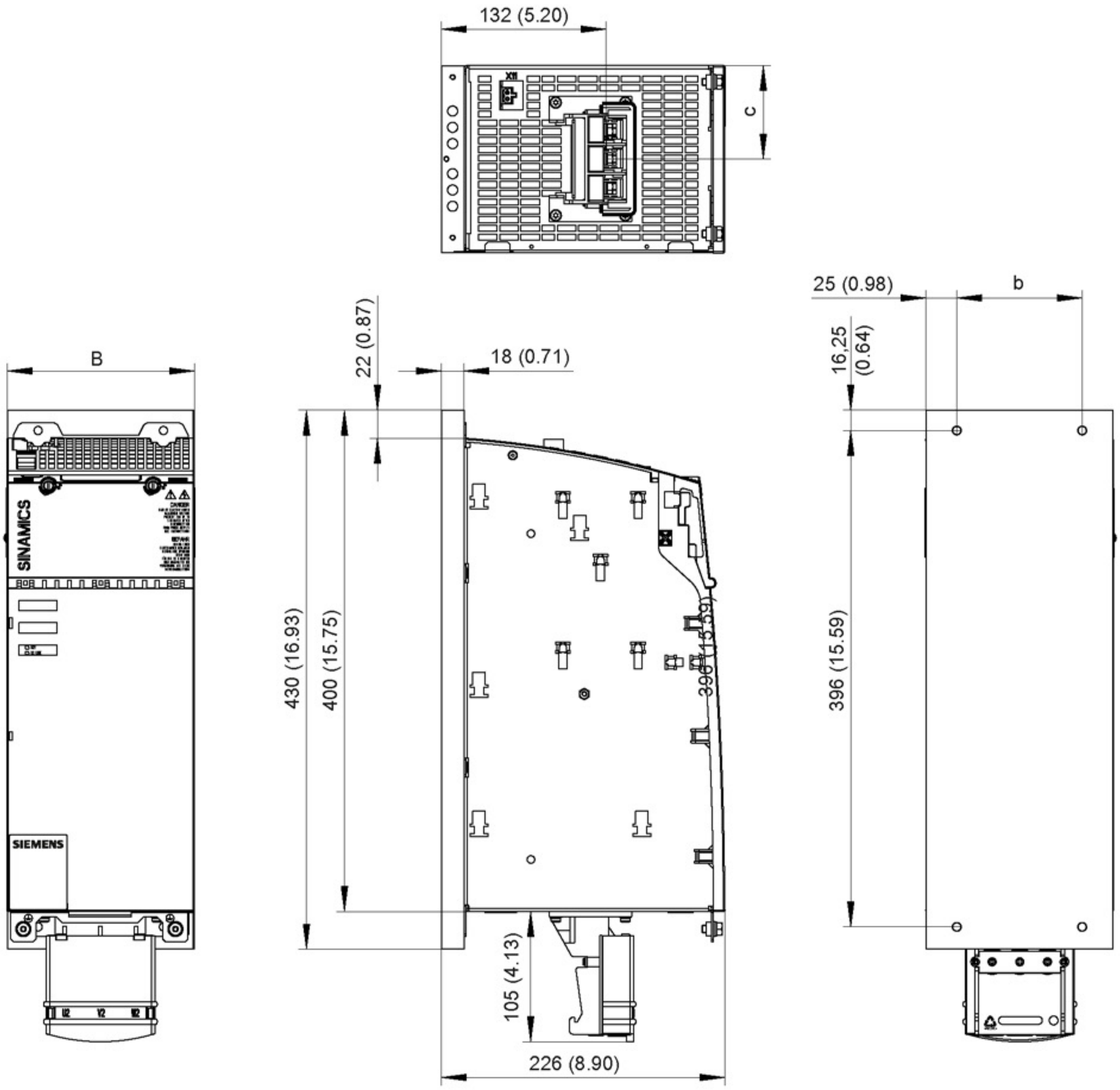


Figure 8-150 Dimension drawing of Motor Modules Booksize 45 A, 60 A, and 85 A with cold plate, all dimensions in mm and (inches); example for Motor Module 45 A

Table 8- 114 Dimensions of 45 A, 60 A, and 85 A Motor Modules Booksize with cold plate

Motor Modules	Order number	B [mm] (inches)	b [mm] (inches)	c [mm] (inches)
Single Motor Module 45 A	6SL3126-1TE24-5AAx	150 (5.91)	100 (3.94)	75 (2.95)
Single Motor Module 60 A	6SL3126-1TE26-0AAx			
Single Motor Module 85 A	6SL3126-1TE28-5AAx	200 (7.87)	150 (5.91)	100 (3.94)

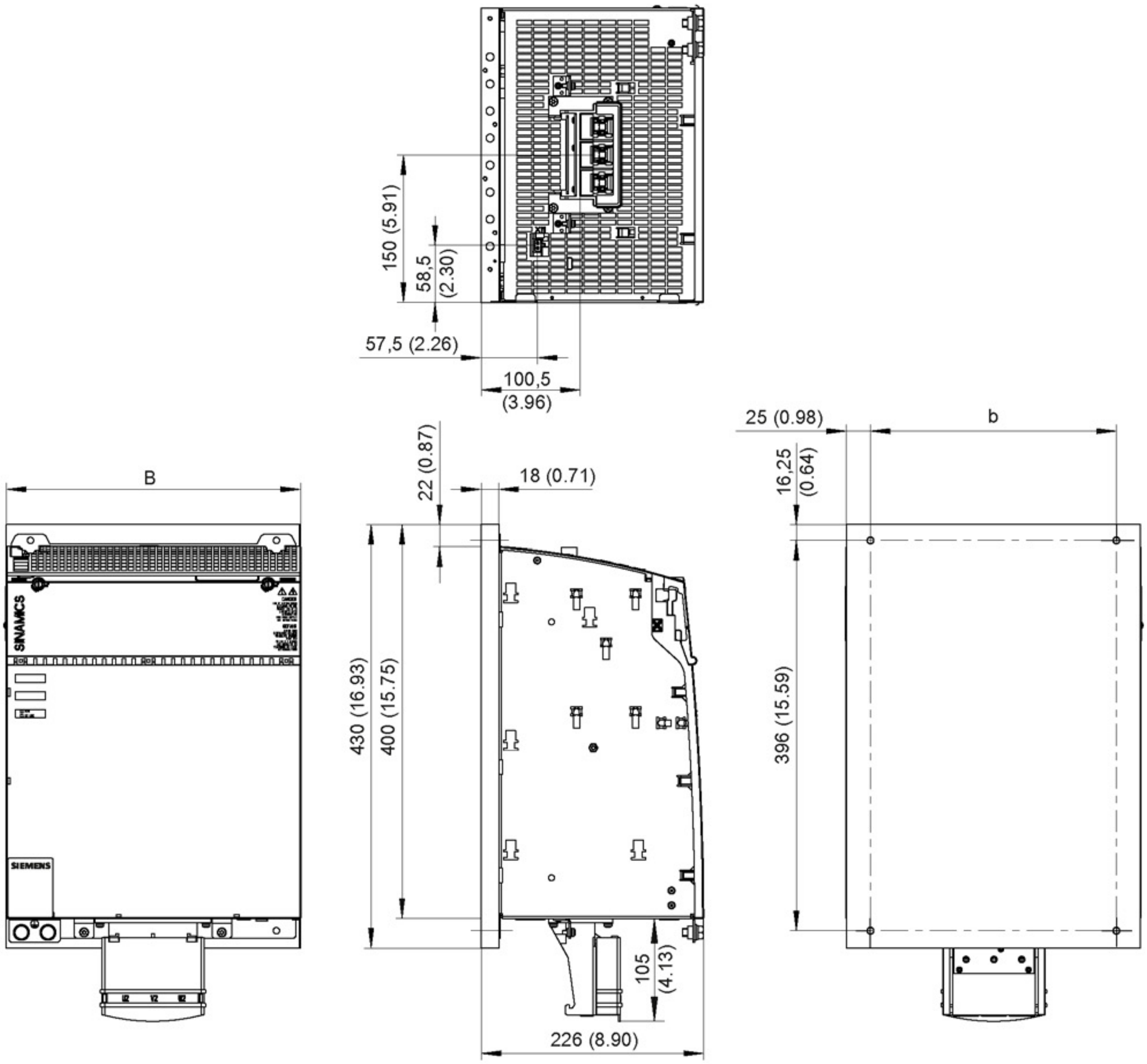


Figure 8-151 Dimension drawing of Motor Modules Booksize 132 A and 200 A with cold plate, all dimensions in mm and (inches); example for Motor Module 200 A

Table 8- 115 Dimensions of 132 A and 200 A Motor Modules Booksize with cold plate

Motor Module	Order number	B [mm] (inches)	b [mm] (inches)
Single Motor Module 132 A	6SL3126-1TE31-3AAx	300 (11.81)	250 (9.84)
Single Motor Module 200 A	6SL3126-1TE32-0AAx		

8.4.4.6 Mounting

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

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

Note

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

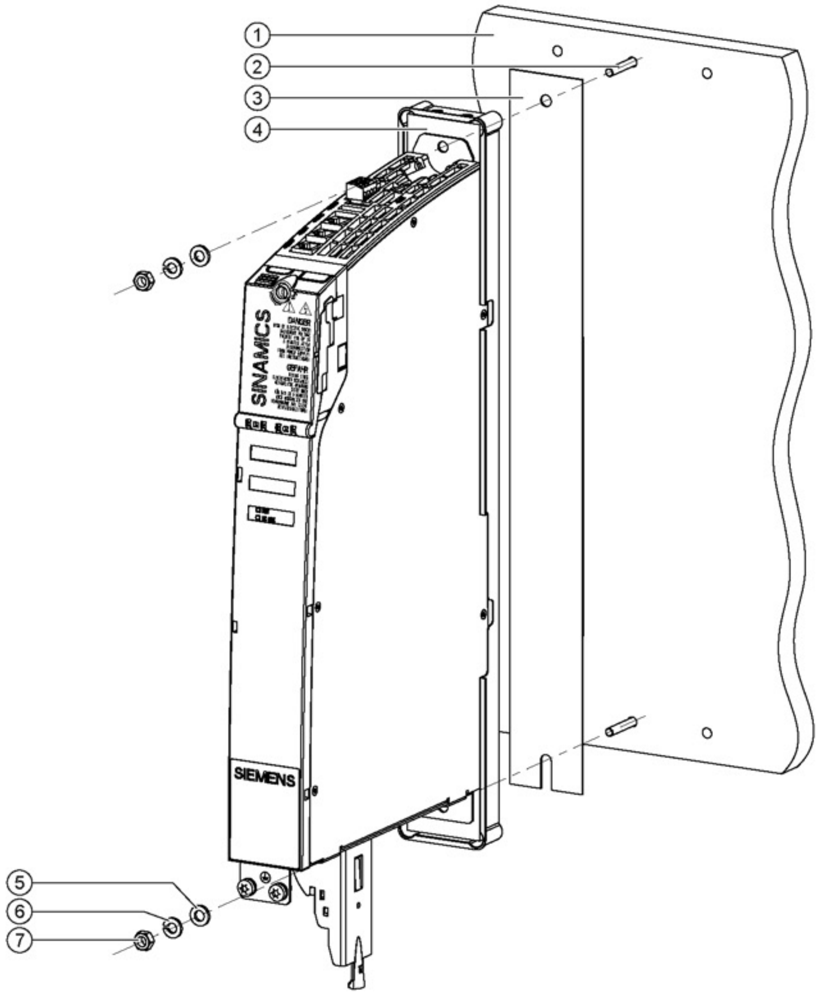
Table 8- 116 Overview of heat-conducting foils

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

Note

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

Mounting



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

Figure 8-152 Mounting a Motor Module with cold plate on an external heat sink (example: 3 A Motor Module)

Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm.

Note

- Where components have four fixing points, the nuts must be tightened evenly by alternating diagonally between them.

Help with the mechanical control cabinet design is available from:

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

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

Properties of the heat sink

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

Note

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

NOTICE

Ensure that the threaded bolts do not damage the cold plate

- When mounting, ensure that the threaded bolts do not damage the cold plate.

8.4.4.7 Technical specifications

Single Motor Modules

Table 8- 117 Technical data Single Motor Modules Booksize (3 to 30 A)

Cold plate	6SL3126-	1TE13-0AAx	1TE15-0AAx	1TE21-0AAx	1TE21-8AAx	1TE23-0AAx
Output current Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{S6}) 40% Peak current (I_{max})	 A_{ACrms} A A_{ACrms} A_{ACrms}	 **3** 2.6 3.5 6	 **5** 4.3 6 10	 **9** 7.7 10 18	 **18** 15.3 24 36	 **30** 25.5 40 56
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage				
DC link current I_d	A_{DC}	3.6	6	11	22	36
DC link voltage (up to 2000 m above sea level)	V_{DC}	510 –720				
DC link capacitance	μF	110	110	110	220	710
Overvoltage trip Undervoltage trip[1)]	V_{DC} V_{DC}	820 ±2% 380				
Electronics power supply	V_{DC}	24 (20.4 – 28.8)				
Electronics current consumption at 24 V DC	A_{DC}	0.65				
Current carrying capacity DC link busbars Reinforced DC link busbars 24 VDC busbars	 A_{DC} A_{DC} A_{DC}	 100 150 20				
Unit rating Based on I_n (600 V_{DC}; 4 kHz) Based on I_H	 kW kW	 1.6 1.1	 2.7 2.3	 4.8 4.1	 9.7 8.2	 16 13.7
Total power loss (incl. electronics losses)[2)]	W	45.5	70.6	95.6	180.6	305.6
Max. pulse frequency without derating with derating	 kHz kHz	 4 16				
Max. ambient temperature without derating with derating	 °C °C	 40 55				
Max. permissible heat sink temperature	°C	80	80	80	80	70
Weight	kg	4.2	4.2	4.5	4.5	6.1

1) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

2) For an overview, see the power loss tables in the Appendix

Table 8- 118 Technical data Single Motor Modules (45A to 200A)

Cold plate	6SL3126-	1TE24-5AAx	1TE26-0AAx	1TE28-5AAx	1TE31-3AAx	1TE32-0AAx
Output current Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{S6}) 40% Peak current (I_{max})	 A_{ACrms} A A_{ACrms} A_{ACrms}	 **45** 38 60 85	 **60** 51 80 113	 **85** 68 110 141	 **132** (105)[1)] 105 (84)[1)] 150 (120)[1)] 210	 **200** (140)[1)] 141 (99)[1)] 230 (161)[1)] 282
Output voltage	V_{ACrms}	0 - 480				
DC link current I_d	A_{DC}	54	72	102	158	200
DC link voltage (up to 2000 m above sea level)	V_{DC}	510 –720				
DC link capacitance	μF	1175	1410	1880	2820	3995
Overvoltage trip Undervoltage trip[2)]	V_{DC} V_{DC}	820 ±2% 380				
Electronics power supply	V_{DC}	24 (20.4 – 28.8)				
Electronics current consumption at 24 V DC	A_{DC}	0.75	0.75	0.8	0.85	0.85
Current carrying capacity DC link busbars 24 VDC busbars	 A_{DC} A_{DC}	 200 20				
Unit rating Based on I_n (600 V_{DC}; 4 kHz) Based on I_H	 kW kW	 24 21	 32 28	 46 37	 71 (57) [1)] 57 (46) [1)]	 107 (75) [1)] 76 (53) [1)]
Total power loss (incl. electronics losses)[3)]	W	448	608	769.2	1270.4	2070.4
Max. pulse frequency without derating with derating	 kHz kHz	 4 16				
Max. ambient temperature without derating with derating	 °C °C	 40 55				
Max. permissible heat sink temperature	°C	80	73	83	75	79 (70% derating)
Weight	kg	9.1	9.1	12.5	18.0	18.0

1) Derating must be applied due to the transfer of heat to the external heat sink. At a temperature of 40 °C at the interface to the power unit, 80% derating occurs for 6SL3126-1TE31-3AAx and 70% for 6SL3126-1TE32-0AAx.

2) Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V (exception: 132 A and 200 A Motor Modules) and is adjusted to the parameterized rated voltage.

3) For an overview, see the power loss tables in the Appendix

Note

New systems with 132 A and 200 A Motor Modules should ideally be designed with 200 A liquid-cooled Motor Modules in order to avoid current derating.

Double Motor Modules

Table 8- 119 Technical data Double Motor Modules (2 x 3 to 2 x18 A)

Cold plate	6SL3126-	2TE13-0AAx	2TE15-0AAx	2TE21-0AAx	2TE21-8AAx
Output current Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{S6}) 40% Peak current (I_{max})	 A_{ACrms} A A_{ACrms} A_{ACrms}	 **2 x 3** 2 x 2.6 2 x 3.5 2 x 6	 **2 x 5** 2 x 4.3 2 x 6 2 x 10	 **2 x 9** 2 x 7.7 2 x 10 2 x 18	 **2 x 18** 2 x 15.3 2 x 24 2 x 36
Output voltage	V_{ACrms}	0 - 480			
DC link current I_d	A_{DC}	7.2	12	22	43
DC link voltage	V_{DC}	510 –720			
DC link capacitance	µF	110	220	220	705
Overvoltage trip Undervoltage trip[1]	V_{DC} V_{DC}	820 ±2% 380			
Electronics power supply	V_{DC}	24 (20.4 – 28.8)			
Electronics current consumption at 24 V DC	A_{DC}	0.9	0.9	0.9	1.05
Current carrying capacity DC link busbars Reinforced DC link busbars 24 VDC busbars	 A_{DC} A_{DC} A_{DC}	 100 150 20	 100 150 20	 100 150 20	 100 150 20
Unit rating Based on I_n (600 V_{DC}; 4 kHz) Based on I_H	 kW kW	 2 x 1.6 2 x 1.4	 2 x 2.7 2 x 2.3	 2 x 4.8 2 x 4.1	 2 x 9.7 2 x 8.2
Total power loss (incl. electronics losses)[2]	W	91.6	126.6	181.6	345.2
Max. pulse frequency without derating with derating	 kHz kHz	 4 16			
Max. ambient temperature without derating with derating	 °C °C	 40 55			
Max. permissible heat sink temperature	°C	80	80	90	90
Weight	kg	4.5	4.5	4.5	5.9

[1] Default for 400 V line systems; undervoltage trip threshold can be reduced by up to 80 V and is adjusted to the parameterized rated voltage

[2] For an overview, see the power loss tables in the Appendix

Characteristics

Rated duty cycles Motor Modules Booksize

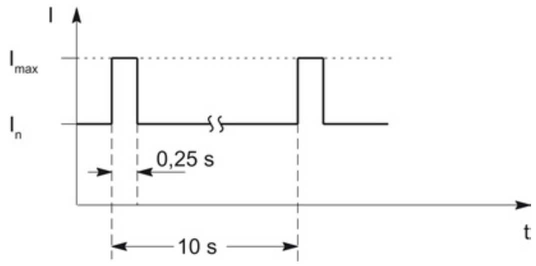


Figure 8-153 Duty cycle with initial load (for servo drives)

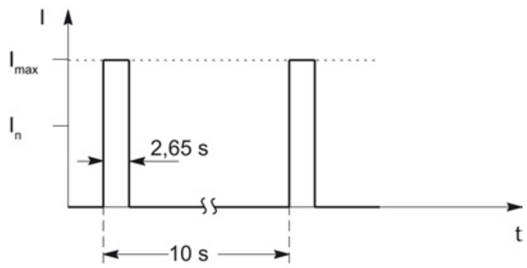


Figure 8-154 Duty cycle without initial load (for servo drives)

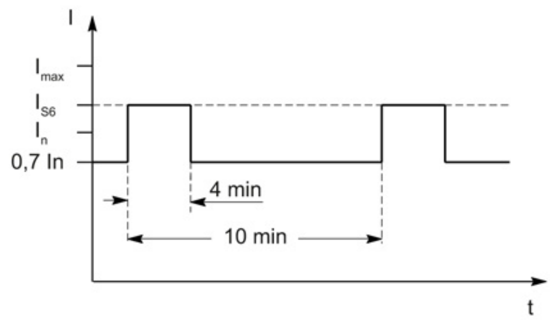


Figure 8-155 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

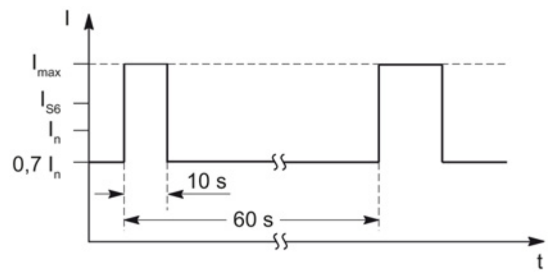


Figure 8-156 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

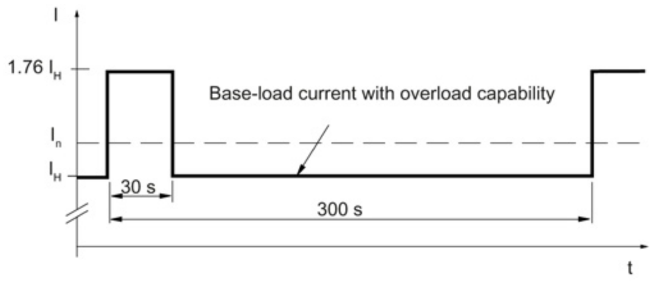


Figure 8-157 Duty cycle with 30 s overload for a duty cycle duration of 300 s

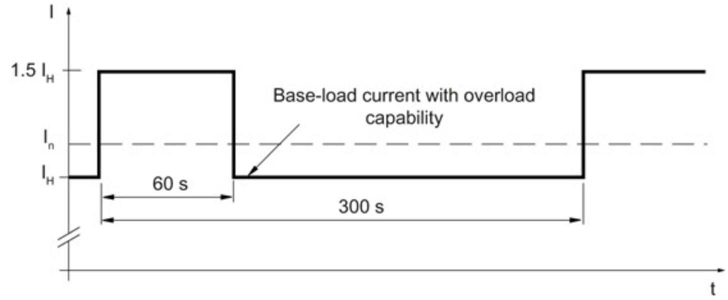


Figure 8-158 Duty cycle with 60 s overload for a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize

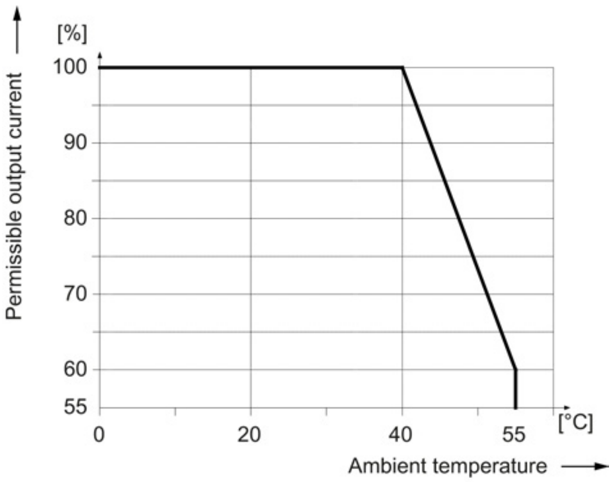


Figure 8-159 Output current as a function of the ambient temperature

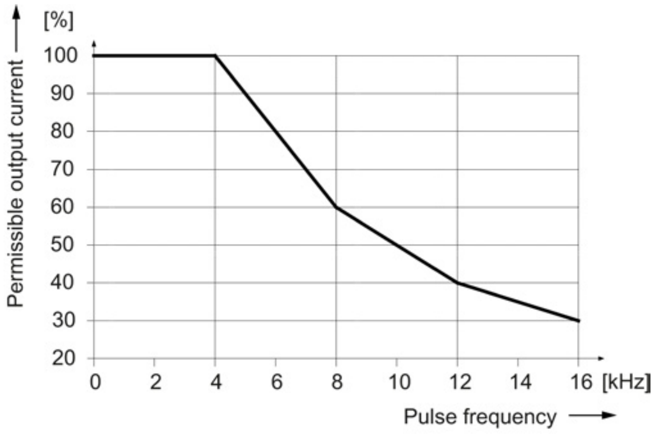


Figure 8-160 Output current as a function of the pulse frequency

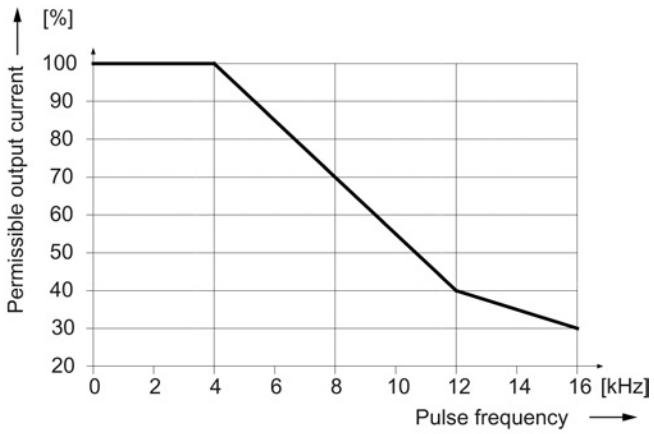


Figure 8-161 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

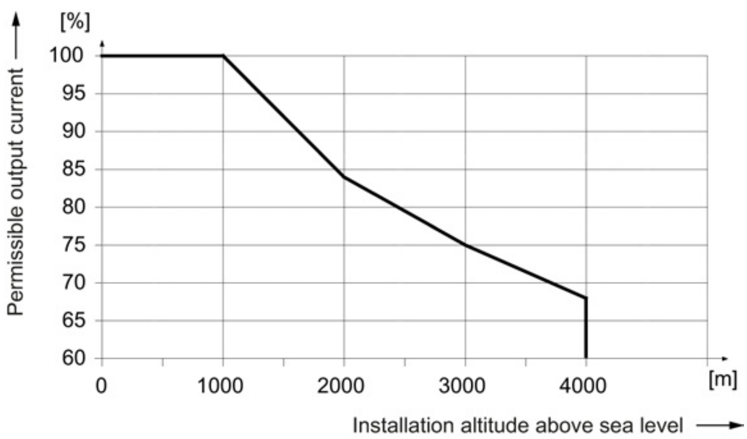


Figure 8-162 Output current as a function of the installation altitude

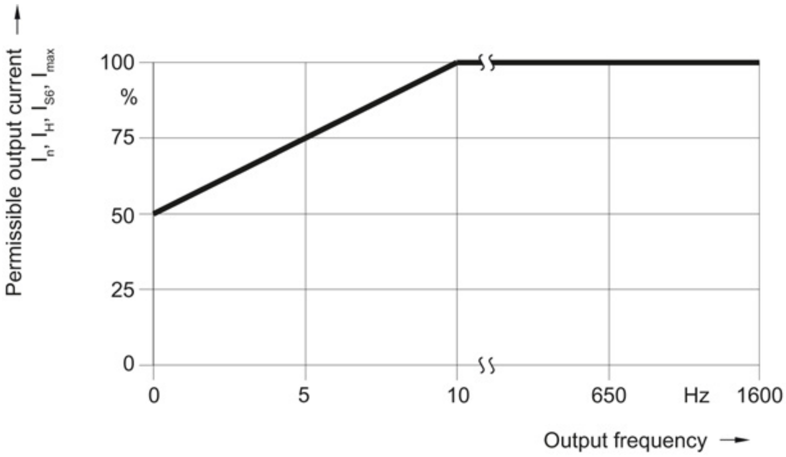


Figure 8-163 Output current as a function of the output frequency

At installation altitudes > 2000 m, an isolation transformer must be used (see the chapter titled "System overview/Function of installation altitude and ambient temperature"). The design of the secondary line system must be as follows:

- TN system with grounded neutral point (no grounded line conductor)
- IT system

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

8.4.5 Motor Modules Liquid Cooled

8.4.5.1 Description

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

8.4.5.2 Interface description

Overview

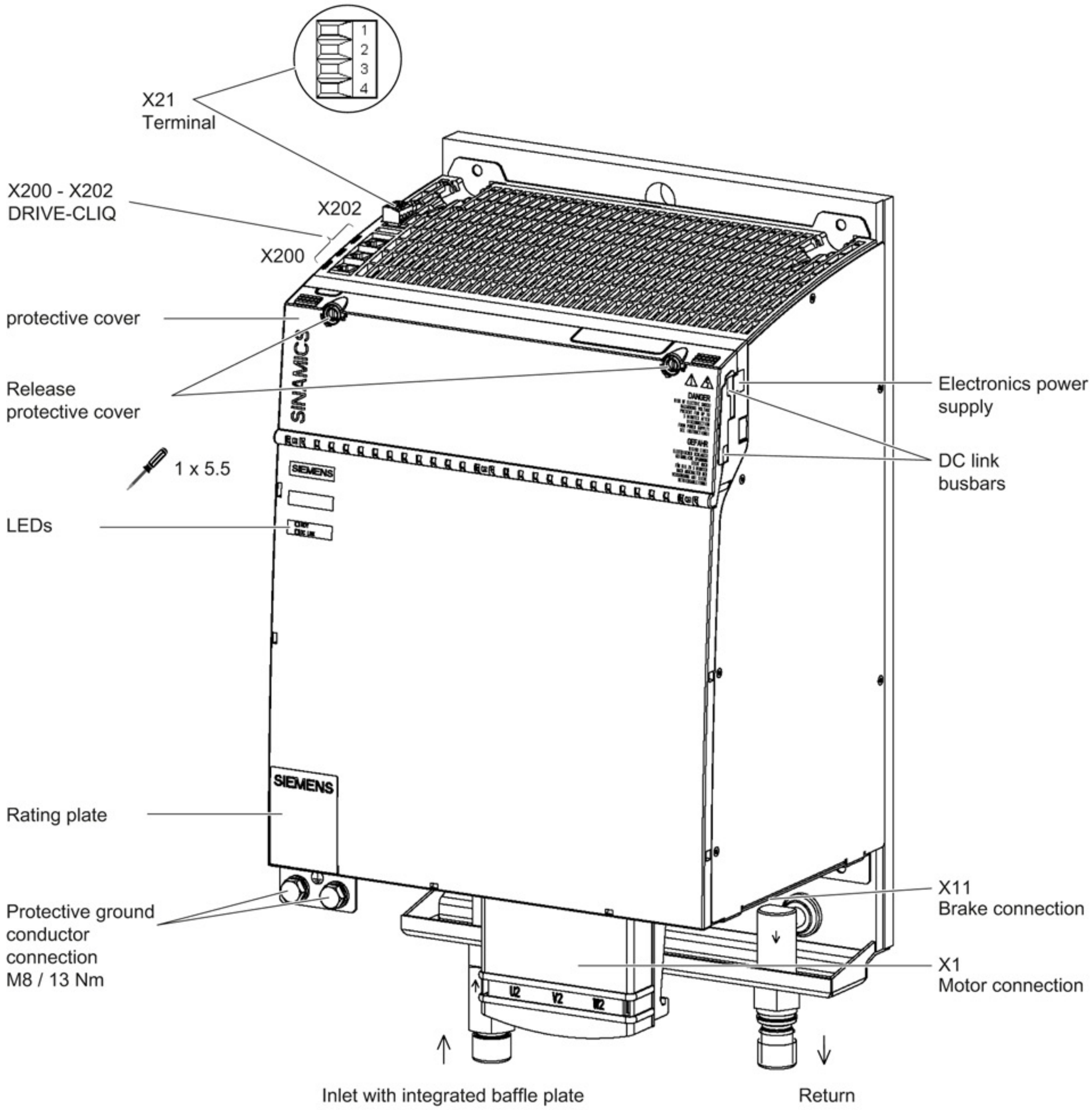
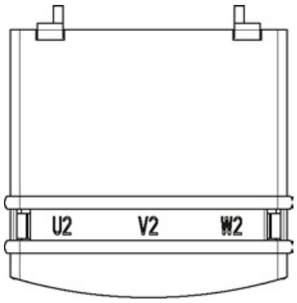
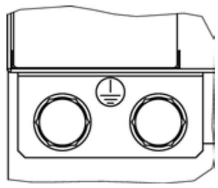


Figure 8-164 Interface overview, Motor Module Liquid Cooled (200 A)

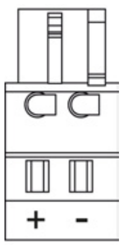
Motor and brake connection, Liquid Cooled

Table 8- 120 X1 Motor connection

	Terminal	Technical data
	U2	Threaded bolt M8/13 Nm [1)]
	V2	
	W2	
	- (BR-)	
	PE connection	Threaded hole M8/13 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

Table 8- 121 X11 brake connector

	Terminal	Technical data
	+ (BR+)	Voltage 24 VDC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm² Type: Spring-loaded terminal 2 (see Appendix, Chapter "Spring-loaded terminals") The brake connector is part of the prefabricated cable
	- (BR-)	

The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.

Note

The total length of the power cables (motor supply cables and DC link cables) must not exceed the values listed in the chapter titled "Possible line reactor and line filter combinations (Page 158)".

Note

The motor brake must be connected via connector X11. Directly connecting the BR– cable to the electronics ground M is not permitted.

⚠ WARNING

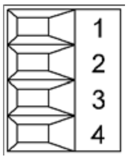
Safety extra-low voltages at connections and terminals

Only protective extra-low voltages (DVC A) that comply with EN 60204-1 may be connected to all connections and terminals between 0 and 48 VDC.

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

X21 EP terminal/temperature sensor

Table 8- 122 X21 EP terminal/temperature sensor

	Terminal	Function	Technical data
	1	+ Temp	Temperature sensors: KTY84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 VDC (20.4 V - 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (enable pulses)	
Max. connectable cross-section 1.5 mm² Type: Screw terminal 1 (see Appendix A.1)			

EP terminals

The filter times to debounce terminals X21.3 and X21.4 are set using parameter p9651. Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Chapter "Controlling the safety functions".

Note

Function of the EP terminals

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

Temperature sensor connection

NOTICE
Risk of the motor overheating due to an incorrectly connected KTY temperature sensor
A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats. • Always connect the KTY temperature sensor with the correct polarity.

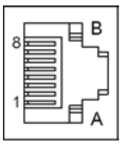
Note

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

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

X200-X202 DRIVE-CLiQ interface

Table 8- 123 X200-X202: DRIVE-CLiQ interfaces

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

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

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

8.4.5.3 Connection example

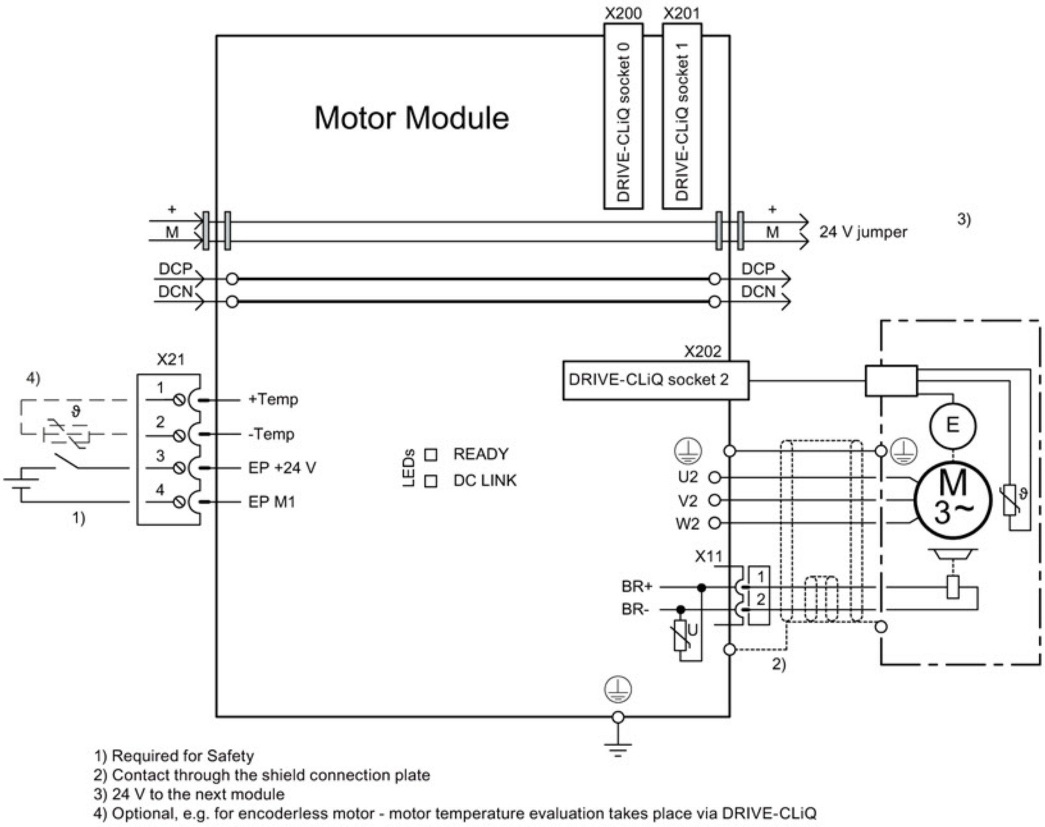


Figure 8-165 Connection example for Motor Module Liquid Cooled (200 A)

8.4.5.4 Meaning of LEDs

Table 8- 124 Meaning of LEDs

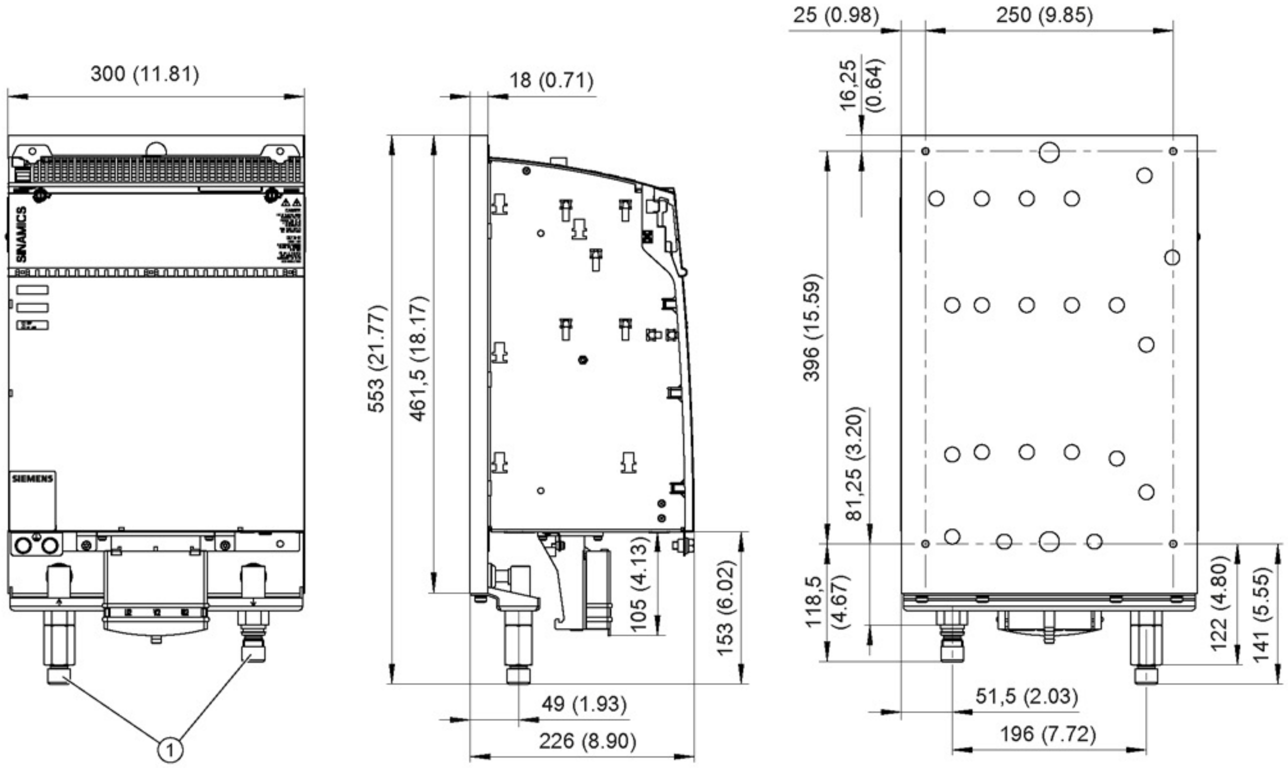
Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ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

WARNING

Hazardous DC link voltage

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!

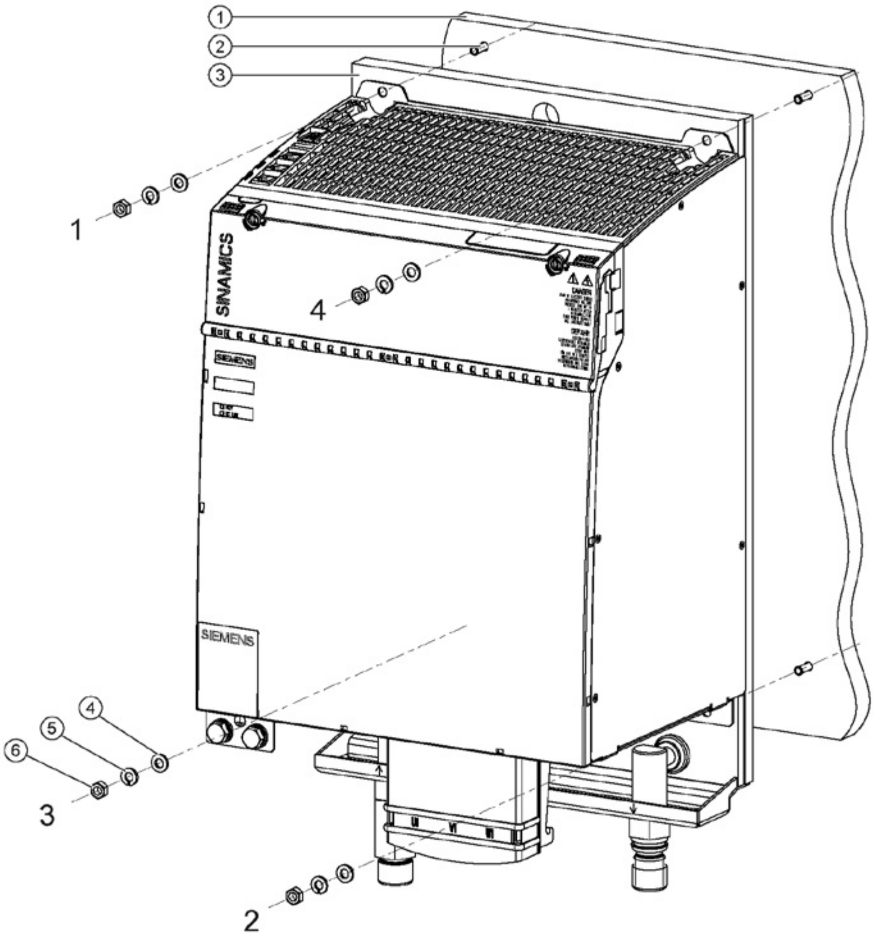
8.4.5.5 Dimension drawing



① Pipe thread ISO 228 G ½ B.

Figure 8-166 Dimension drawing of Motor Module Liquid Cooled (200 A), all dimensions in mm and (inches)

8.4.5.6 Installation



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

Figure 8-167 Installing a Motor Module Liquid Cooled

Tightening torques:

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

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

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

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

8.4.5.7 Technical specifications

Technical data

Table 8- 125 Technical data for Motor Module Liquid Cooled 200 A

Liquid Cooled		6SL3125-1TE32-0AAx
Output current Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{S6}) 40% Peak current (I_{max})	 A_{ACrms} A $A_{ACrms(Is6)}$ $A_{ACrms(Imax)}$	 **200** 141 230 282
Output voltage	V_{ACrms}	0 - 480
DC link current I_d	A_{DC}	200
DC link voltage (up to 2000 m above sea level)	V_{DC}	510 –720
DC link capacitance	µF	3995
Overvoltage trip Undervoltage trip[1)]	V_{DC} V_{DC}	820 ±2% 380 ±2%
Electronics power supply	V_{DC}	24 (20.4 – 28.8)
Electronics current consumption at 24 V DC	A_{DC}	0.85
Current carrying capacity DC link busbars 24 VDC busbars	 A_{DC} A_{DC}	 200 20
Unit rating Based on I_n (600 V_{DC}; 4 kHz) Based on I_H	 kW kW	 107 76
Total power loss(including electronics losses)[2)]	W	2070.4
Max. pulse frequency without derating with derating	 kHz kHz	 4 16
Max. ambient temperature without derating with derating	 °C °C	 40 55
Max. coolant temperature without derating with derating	 °C °C	 45 50
Max. permissible heat sink temperature	°C	79 (70% derating)
Rated volumetric flow for water at 70 kPa pressure drop[3)]	l/min	8
Volume of liquid internal	ml	100
Weight	kg	21

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

2) For an overview, see the power loss tables in Appendix A.3

3) This value applies to the water coolant option; for other coolant types, see the SINAMICS S120 Booksize Power Units Equipment Manual (GH2), Chapter "Cooling circuit and coolant properties".

Characteristics

Rated duty cycles Motor Modules Booksize

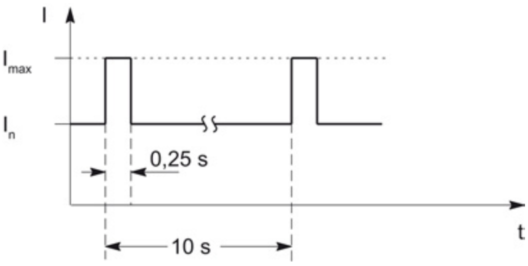


Figure 8-168 Duty cycle with initial load (for servo drives)

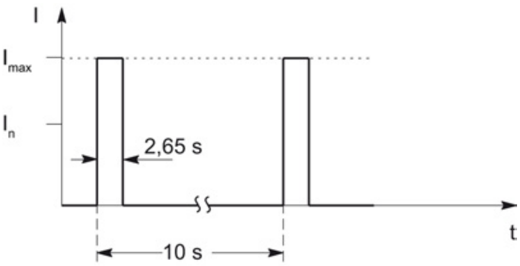


Figure 8-169 Duty cycle without initial load (for servo drives)

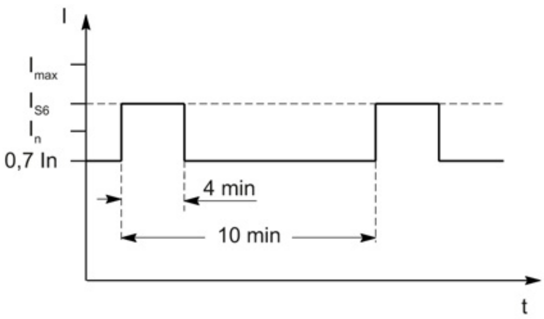


Figure 8-170 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

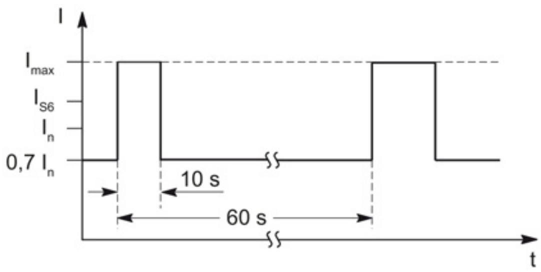


Figure 8-171 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

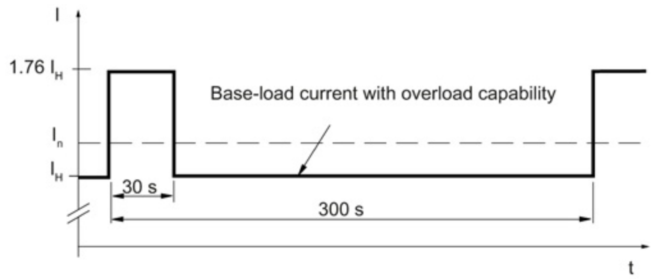


Figure 8-172 Duty cycle with 30 s overload for a duty cycle duration of 300 s

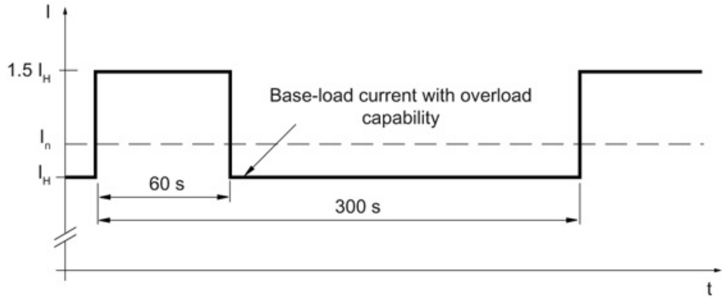


Figure 8-173 Duty cycle with 60 s overload for a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize

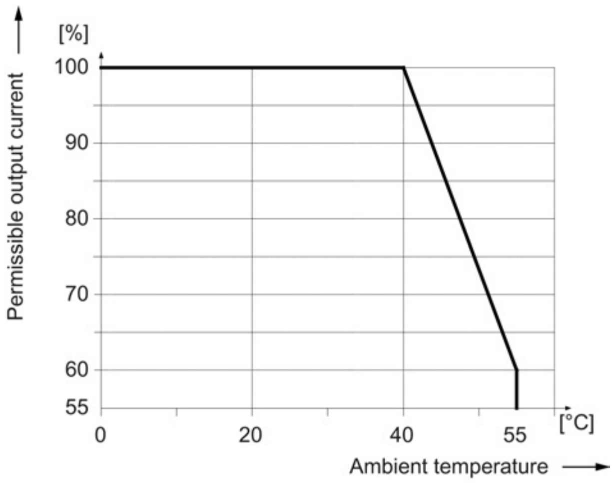


Figure 8-174 Output current as a function of the ambient temperature

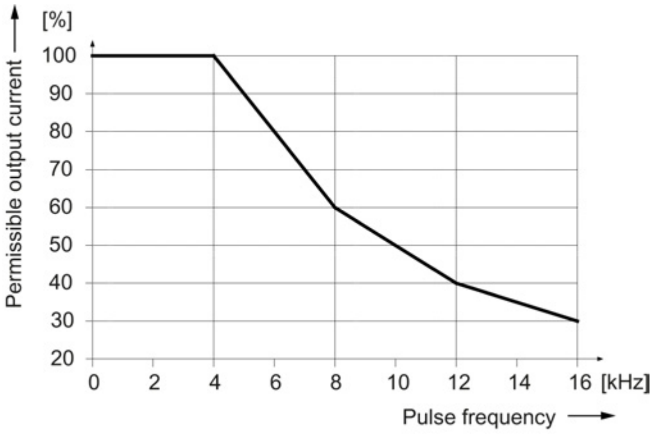


Figure 8-175 Output current as a function of the pulse frequency

Figure 8-176 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

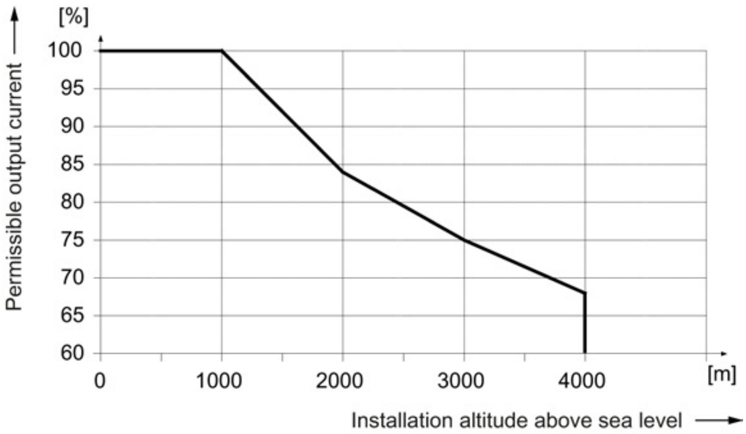


Figure 8-177 Output current as a function of the installation altitude

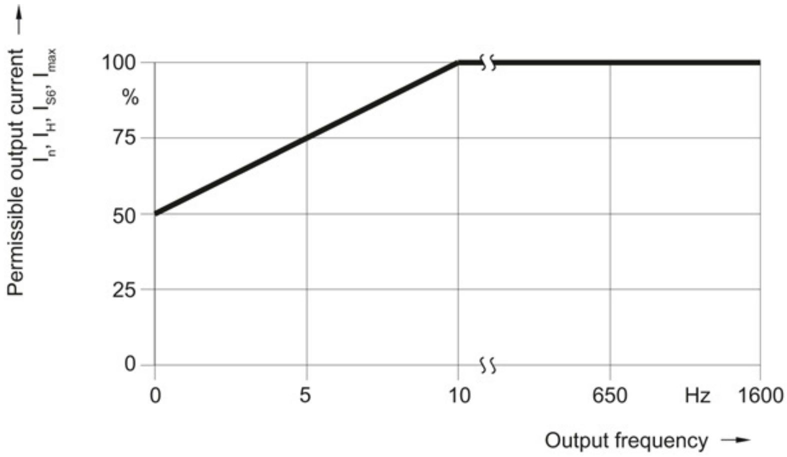


Figure 8-178 Output current as a function of the output frequency

At installation altitudes > 2000 m, an isolation transformer must be used (see the chapter titled "System overview/Function of installation altitude and ambient temperature" (Page 32)). The design of the secondary line system must be as follows:

- TN system with grounded neutral point (no grounded line conductor)
- IT system

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

8.5 DRIVE-CLiQ Hub Modules (DMC20, DME20)

8.5.1 DMC20

8.5.1.1 Description

The DMC20 DRIVE-CLiQ Hub Module is used to implement a star-shaped configuration of a DRIVE-CLiQ line. With the DMC20, an axis grouping can be expanded by up to 5 DRIVE-CLiQ sockets for additional subgroups.

The component is especially suitable for applications which require DRIVE-CLiQ nodes to be removed in groups, without interrupting the DRIVE-CLiQ line and, therefore, the data exchange process.

DMC20 can be used for the SINUMERIK 840D sl with CNC SW 2.6 and higher.

8.5.1.2 Overview

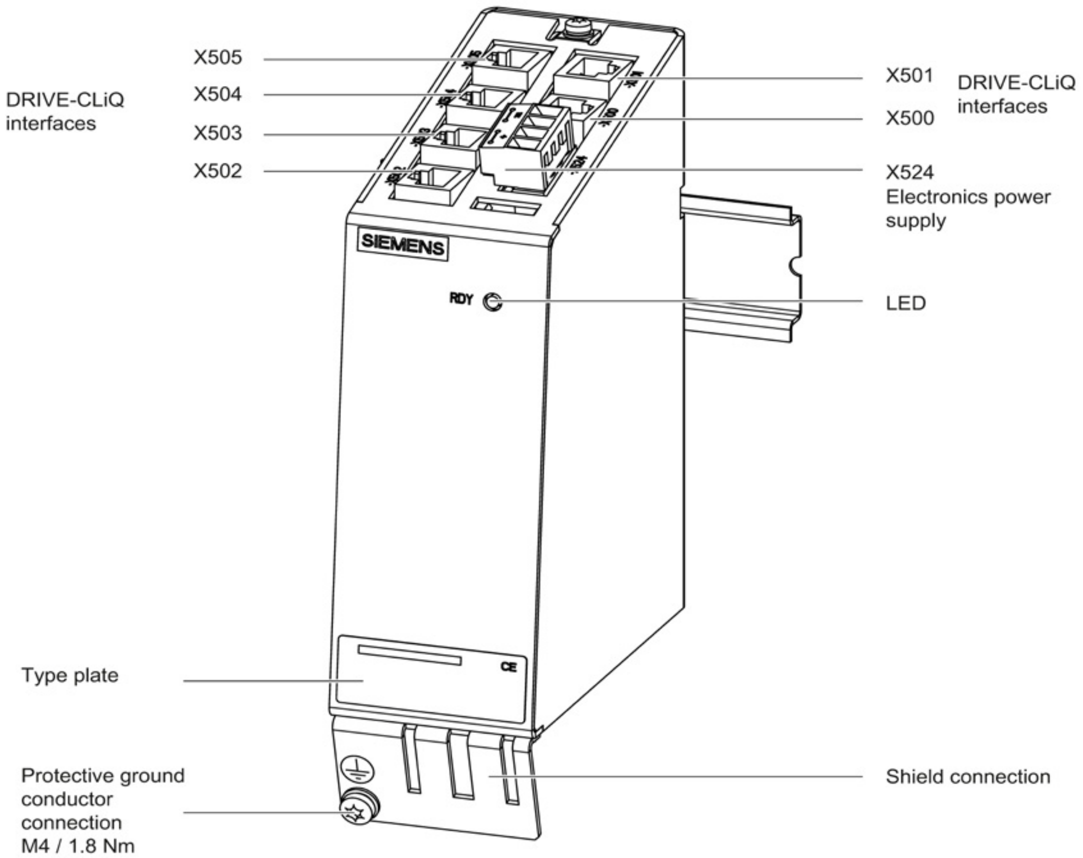
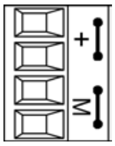


Figure 8-179 Interface description of the DMC20

8.5.1.3 Electronics power supply X524

Table 8- 126 X524 terminals for the electronics power supply

	Terminal	Name	Technical specifications
	+	Electronics power supply	24 DC (20.4 – 28.8)
	+	N. c.	
	M	Electronics ground	
	M	Electronics ground	
Maximum connectable cross-section: 2.5 mm² Type: Screw terminal type 2			

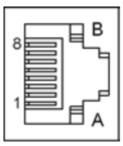
Note

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

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

8.5.1.4 DRIVE-CLiQ interface

Table 8- 127 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
Type: RJ45 plus socket Blanking plate for DRIVE-CLiQ interface: Yamaichi, order number: Y-ConAS-13			

Note

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

8.5.1.5 Significance of the LED on the DMC20

Table 8- 128 Significance of the LED on the DMC20

LED	Color	Status	Description
READY	-	Off	Electronics power supply outside the permissible tolerance range.
	Green	Steady light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
	Orange	Steady light	DRIVE-CLiQ communication is being established.
	Red	Steady light	At least one fault is present in this component.
	Green Red	Flashing 2 Hz	The firmware is being downloaded. Component recognition via LED is activated (p0154).

8.5.1.6 Dimension drawing

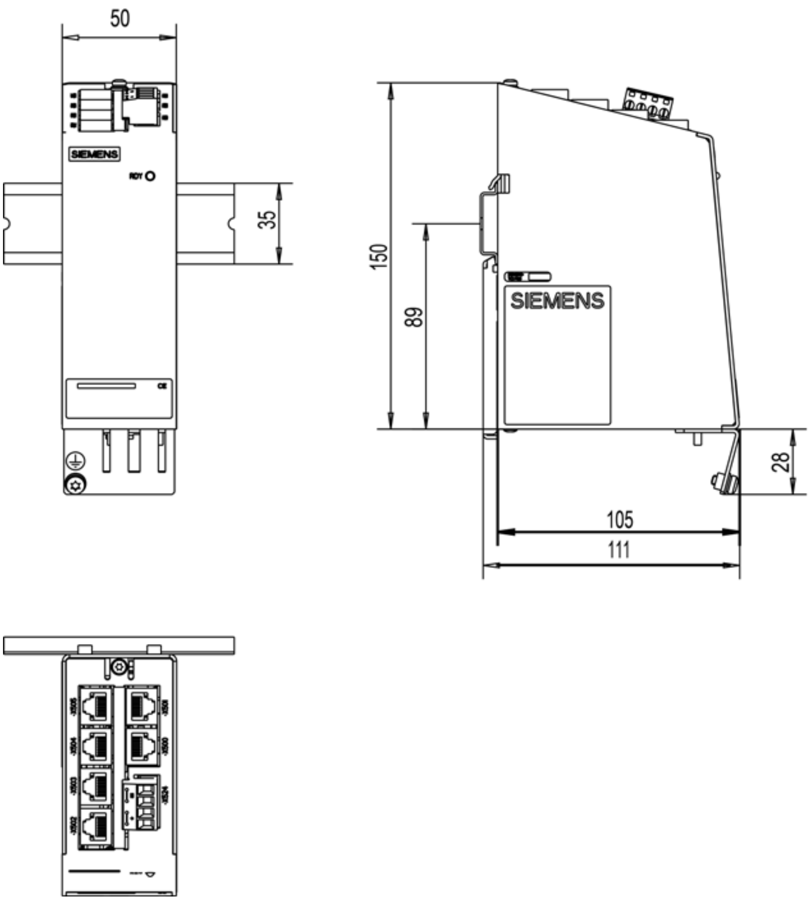


Figure 8-180 Dimension drawing of the DMC20

8.5.1.7 Technical data

Table 8- 129 Technical data of the DMC20

	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 DC (20.4 – 28.8)
Current (without DRIVE-CLiQ consumer)	A_{DC}	0.15
PE/ground connection	At the housing with M4/1.8 Nm stud	
Weight	kg	0.8

8.5.2 DME20

8.5.2.1 Description

The DRIVE-CLiQ Hub Module External DME20 is used to implement star-shaped distribution of a DRIVE-CLiQ line. With the DME20, an axis grouping can be expanded by up to 5 DRIVE-CLiQ sockets for additional subgroups.

The component has degree of protection IP67 and is especially suitable for applications which require DRIVE-CLiQ nodes to be removed in groups, without interrupting the DRIVE-CLiQ line and therefore the data exchange.

With firmware 2.6 and higher, the DME20 can be used in conjunction with the SINUMERIK 840D sl CNC SW2.6.

8.5.2.2 Safety information

Note

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

Note

The unused DRIVE-CLiQ interfaces must be closed using a protective cap (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 bright machine parts and devices, which are all bonded to one another in an equipotential manner.
Alternatively, equipotential bonding can be achieved by means of a conductor (min. 6 mm²), which should be routed parallel to the DRIVE-CLiQ where possible. This applies to all distributed DRIVE-CLiQ nodes, such as DM20, SME2x, SM12x, etc.
For the DME20 this also applies to the 24 V power supply.

8.5.2.3 Overview

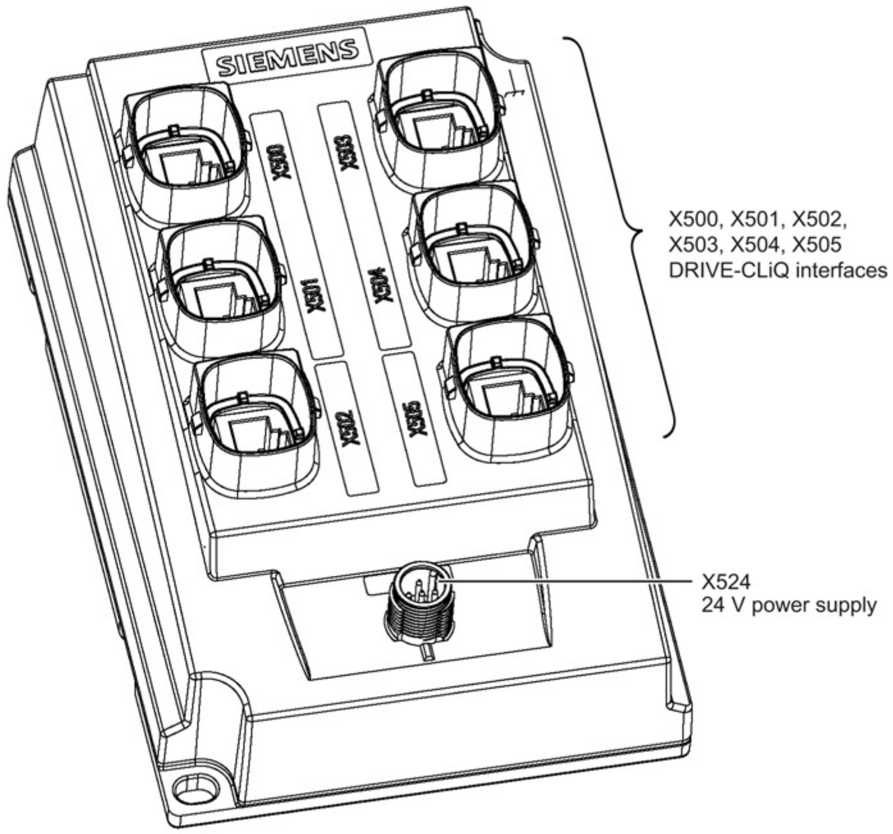
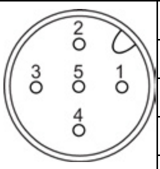


Figure 8-181 Interface overview: DME20

8.5.2.4 Electronics power supply X524

Table 8- 130 X524 socket for the electronics power supply

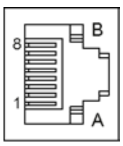
	Pin	Designation	Technical specifications
	1	Electronics power supply	The connection voltage of 20.4 V – 28.8 V refers to the (terminal) voltage at the DME20. This must be taken into account when selecting the cable cross-section and supply cable lengths. Pins 1 and 2: jumpered internally Pins 3 and 4: jumpered internally
	2	Electronics power supply	
	3	Electronics ground	
	4	Electronics ground	
	5	not connected	
Max. connectable cross-section: 4 x 0.75 mm² 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 P24 supply of the DME20 is 100 m.

8.5.2.5 DRIVE-CLiQ interface

Table 8- 131 DRIVE-CLiQ interface X500, X501, X502, X503, X504, 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
Type: RJ45 plus socket Blanking plates for DRIVE-CLiQ interfaces are included in the scope of delivery.			

Note

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

8.5.2.6 Cable lengths

Table 8- 132 Cable length of P24 supply cable:

Connected consumers [1)]	1	2	3	4	5
Cross section					
0.34 mm²	75 m	45 m	30 m	25 m	20 m
2 x 0.34 mm²	100 m	90 m	65 m	50 m	40 m
0.75 mm²	100 m	100 m	75 m	60 m	50 m
2 x 0.75 mm²	100 m	100 m	100 m	100 m	100 m
[1)] Connected motors with DRIVE-CLiQ encoder, DRIVE CLiQ mounted encoder SME					
Ta = 55 °C 100 m DRIVE-CLiQ					

8.5.2.7 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

Cables to be assembled by the user

Table 8- 133 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, www.phoenixcontact.com	

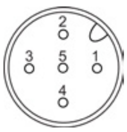
Power supply

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 8- 134 Connection to X524 electronics power supply

	Pin	Designation	Technical specifications
	1 (brown) 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 (white) 1)	Electronics power supply	
	3 (black) 1)	Electronics ground	
	4 (blue) 1)	Electronics ground	
	5 (gray) 1)	Not connected internally	

1) The colors stated refer to the cable specified above

8.5.2.8 Dimension drawing

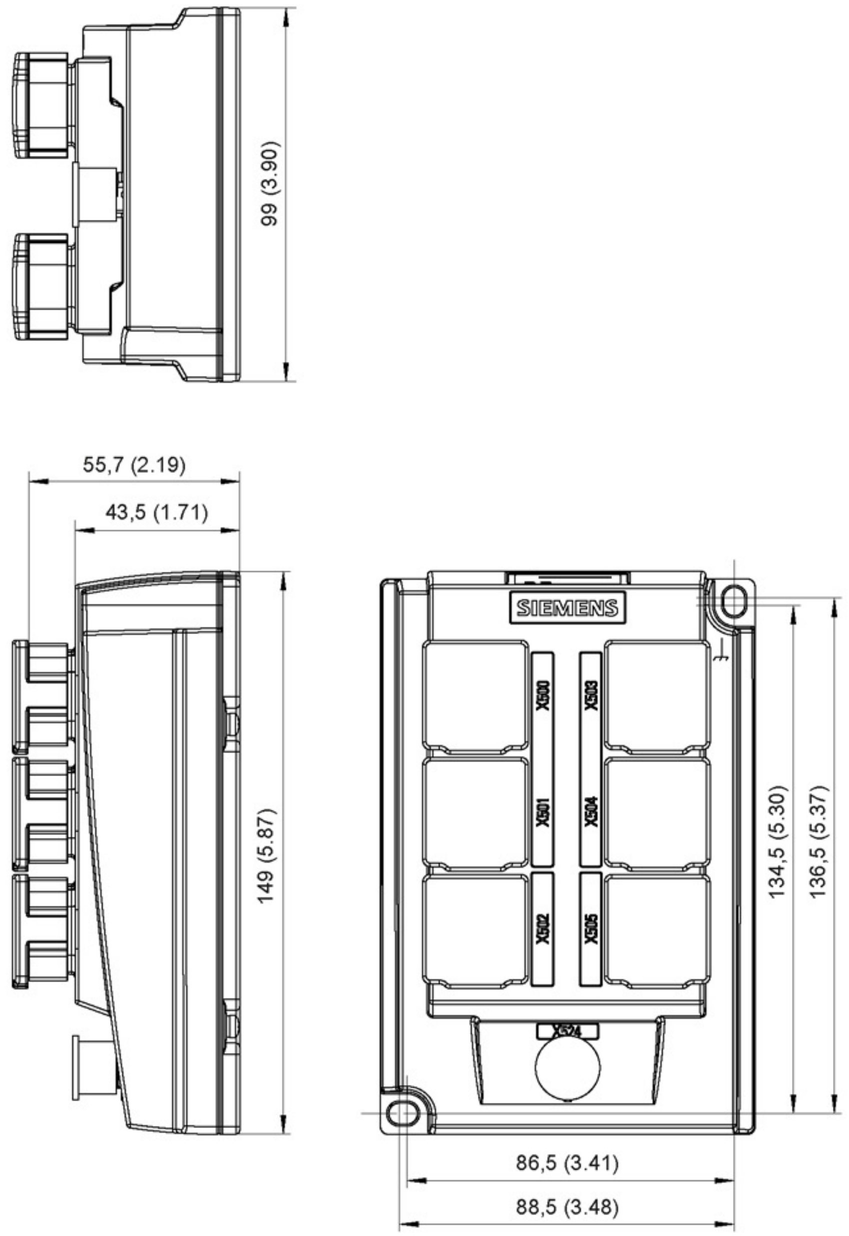


Figure 8-182 Dimension drawing: DME20

8.5.2.9 Installation

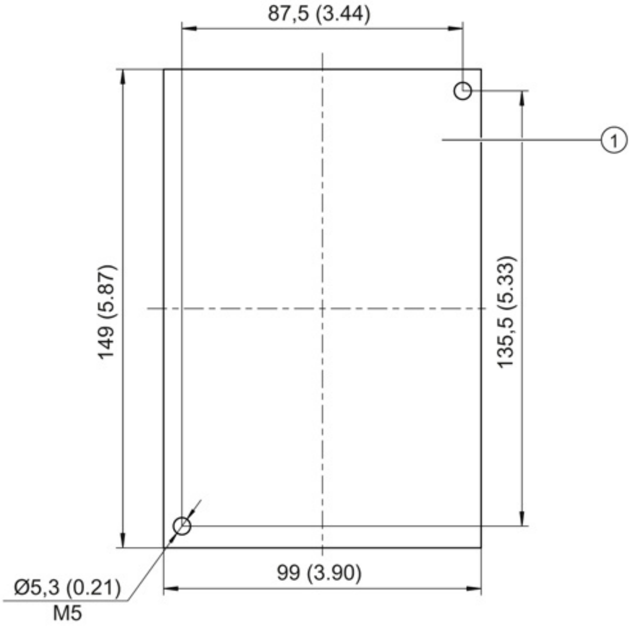


Figure 8-183 DME20 installation

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.

8.5.2.10 Technical data

Table 8- 135 Technical data of the DME20

	Unit	Value
Electronics power supply Voltage Current (without DRIVE-CLiQ node)	 V_{DC} A_{DC}	 24 DC (20.4 – 28.8) 0,15
PE/ground connection	Fastened to housing M5 / 6 Nm	
Degree of protection	IP67	
Weight	kg	0,8

8.6 Connecting Terminal Modules

8.6.1 TM15: Terminal expansion for digital inputs/outputs

The Terminal Module TM15 is a terminal expansion for snapping on to an EN 60715 DIN rail. The TM15 can be used to increase the number of available digital inputs/outputs within a drive system.

Table 8- 136 Interface overview of the TM15

Type	Number
DRIVE-CLiQ interfaces	2
Electronics power supply	1
Bidirectional digital inputs/outputs	24 (electrical isolation in three groups each with eight DI/DO)

Note

Please observe the safety instructions in Chapter 1 when using the Terminal Module.

8.6.2 TM41: Emulating an incremental encoder

The TM41 Terminal Module is an expansion module that is snapped onto an EN 60715 DIN rail.
The encoder interface of the TM41 can be used to emulate an incremental encoder. The TM41 can also be used to connect analog controls to SINAMICS.

The TM41 contains the following interfaces:

Table 8- 137 Interface overview of the TM41

Type	Number
DRIVE-CLiQ interfaces	2
Power supply	2
Digital inputs, floating	4
Bidirectional digital inputs/outputs	4
Analog inputs	1
TTL encoder output	1

Note

Please observe the safety instructions in Chapter 1 when using the Terminal Module.

8.6.3 TM120: DRIVE-CLiQ component for temperature evaluation with safe electrical separation

The TM120 Terminal Module is a DRIVE-CLiQ component for safe electrically isolated temperature evaluation. It can be used for 1FN, 1FW6, and third-party motors in which the temperature sensors cannot be installed with safe electrical separation. The TM120 is installed in the control cabinet and can be snapped on to a DIN rail (EN 60715).

When a TM120 is being used, temperature evaluation and encoder evaluation functions are separated off from one another. The TM120 can detect the motor temperature via 4 channels with different temperature sensors. Encoder evaluation functions are performed via Sensor Modules (e.g. SMCxx, SMExx). This means that, when connected to a Sensor Module SMCxx, the TM120 represents a control cabinet alternative to the SME120/SME125.

The TM120 contains the following interfaces:

Table 8- 138 Overview of the TM120 interfaces

Type	Number
DRIVE-CLiQ interfaces	2
Electronics power supply	1
Temperature sensor inputs	4

8.7 Sensor Systems Connection

8.7.1 Introduction

The encoder system should be connected to SINAMICS S120 via DRIVE-CLiQ.

Motors with DRIVE-CLiQ interfaces (e.g. synchronous motors 1FK7 and 1FT7, and induction motors 1PH7) are designed for this purpose. These motors simplify commissioning and diagnostics because the motor and encoder type are identified automatically.

Motors and external encoders without DRIVE-CLiQ interface

Motors without DRIVE-CLiQ interfaces, as well as external encoders without integrated DRIVE-CLiQ interfaces, must be connected via Sensor Modules to enable the encoder and temperature signals to be evaluated. Sensor Modules Cabinet-Mounted (SMC) are available for installation in control cabinets and Sensor Modules External (SME) for installation outside control cabinets.

If not otherwise specified, only one encoder system can be connected to each Sensor Module.

Motors and external encoders with DRIVE-CLiQ interface

Motors with DRIVE-CLiQ interfaces can be connected to the associated Motor Module directly via the MOTION-CONNECT DRIVE-CLiQ cables available. The connection of the MOTION-CONNECT DRIVE-CLiQ cable at the motor has degree of protection IP67.

The DRIVE-CLiQ interface supplies the motor encoder via the integrated 24 VDC supply and transfers the motor encoder and temperature signals and the electronic rating plate data, e.g. a unique identification number, rated data (voltage, current, torque), directly to the Control Unit. Different encoder cables are therefore no longer required for the various encoder types, e.g. resolvers or absolute encoders. Wiring can be effected throughout with a MOTION-CONNECT DRIVE-CLiQ cable.

DRIVE-CLiQ encoder

A DRIVE-CLiQ encoder is an absolute encoder with integrated DRIVE-CLiQ interface (see the chapter titled "DRIVE-CLiQ encoder").

⚠ CAUTION
Preventing encoder faults Unfavorable material combinations generate frictional electricity between the belt pulley and the belt. This electrostatic charge (several kV) can discharge via the motor shaft and the encoder, which leads to disturbance of the encoder signals (encoder error). Remedy: Use an antistatic version of the belt (special conductive polyurethane mixture).

Note

Disconnecting and connecting encoder cables

The encoder cables to Siemens motors may only disconnected and connected when the system is in a no-voltage condition.

For direct measuring systems (third-party encoders), ask the manufacturer whether it is permissible to disconnected/connect under voltage.

8.7.2 Overview of Sensor Modules

Sensor Modules Cabinet-Mounted (SMC)

Sensor Modules Cabinet-Mounted SMC10, SMC20 and SMC30 can be ordered and configured separately. They are used when a motor with a DRIVE-CLiQ interface is not available or when external encoders in addition to the motor encoder are required. Only one encoder system can be connected to each Sensor Module Cabinet-Mounted. The SMCs evaluate these measuring systems and convert the calculated values to DRIVE-CLiQ. Neither motor nor encoder data are saved.

Note

The SMC supplies the power to the encoder; the SMC, however, must be provided separately with 24 VDC power.

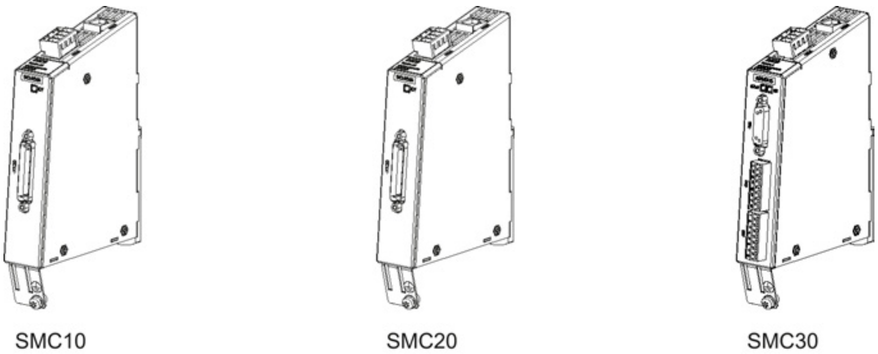


Figure 8-184 Overview of Sensor Modules Cabinet-Mounted (SMC)

Sensor Modules External (SME)

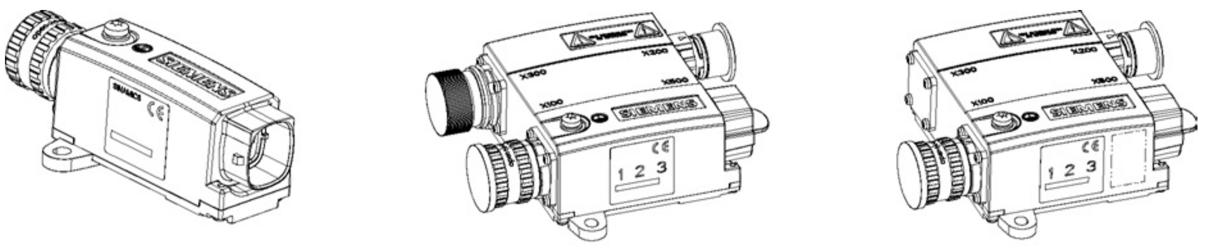
The Sensor Modules External SME20, SME25, SME120, and SME125 are only intended for use on machines (in North America, in accordance with the NFPA 79 "Electrical Standard for Industrial Machinery") and may only be connected to the DRIVE-CLiQ interfaces of the components.

Direct encoder systems outside the cabinet can be connected to the Sensor Modules External. The SMEs evaluate these encoder systems and convert the calculated values to DRIVE-CLiQ. No motor or encoder data is stored in the SMEs.

Note

The SME provides the encoder power supply. The power supply for the SME is provided from the connected DRIVE-CLiQ cable. This must be taken into consideration when the DRIVE-CLiQ cable is selected.

The Sensor Modules External have a higher degree of protection (IP67) and are therefore suitable for installation outside the cabinet.



SME20/25 SME120 SME125

Figure 8-185 Overview of Sensor Modules External (SME)

Connectable encoder systems

Table 8- 139 Overview of the connectable encoder systems

	SMC			SME			
Encoder systems	**SMC10**	**SMC20**	**SMC30**	**SME20**	**SME25**	**SME120**	**SME125**
Resolver	Yes	-	-	-	-	-	-
Incremental encoder sin/cos (1 Vpp) with/without reference signal	-	Yes	-	Yes	-	Yes	-
Absolute encoder EnDat 2.1	-	Yes	-	-	Yes	-	Yes
Incremental encoder TTL / HTL	-	-	Yes	-	-	-	-
Absolute encoder SSI	-	Yes 1)	Yes 2)	-	Yes 1)	-	Yes 1)
Temperature evaluation	Yes	Yes	Yes	Yes 3)	-	Yes (electrically isolated)	Yes (electrically isolated)

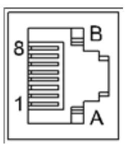
1) Only possible for SSI encoders with 5 V supply

2) Possible for SSI encoders with 5 V or 24 V supply

3) With prescribed adapter cable 6FX8002-2CA88

8.7.3 X200-X203 DRIVE-CLiQ interface

Table 8- 140 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			

8.7.4 Examples of encoder connections

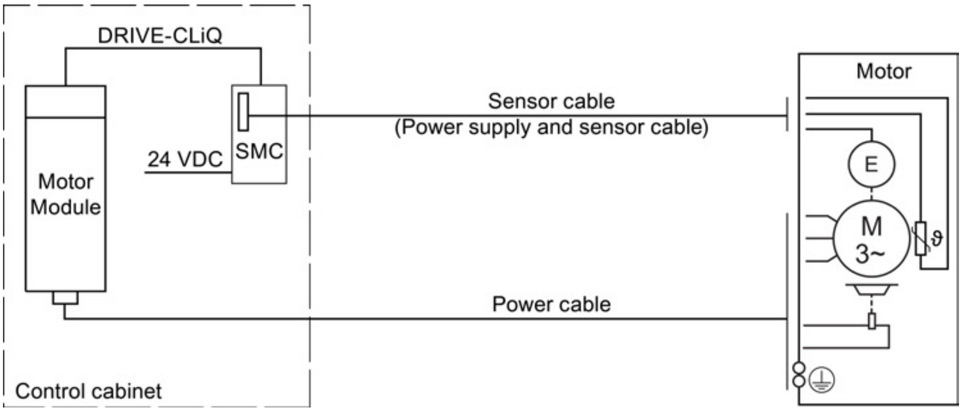


Figure 8-186 Sensor connection using Sensor Module Cabinet (SMC)

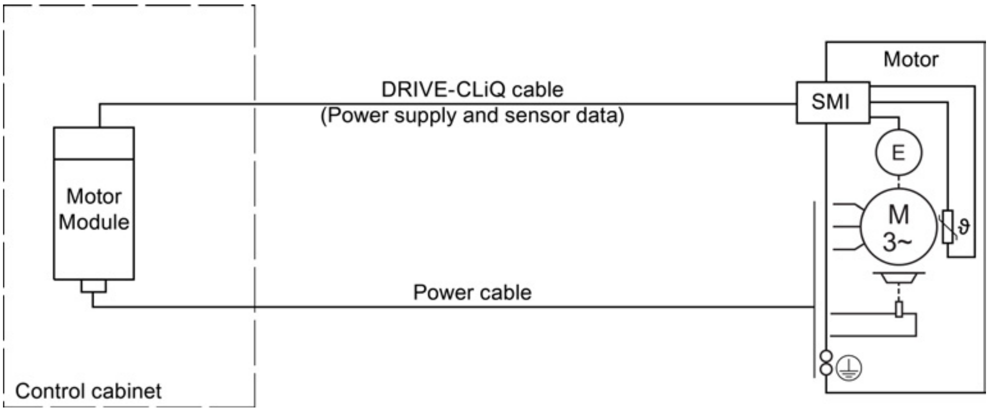


Figure 8-187 Sensor connection via a motor with a DRIVE-CLiQ interface

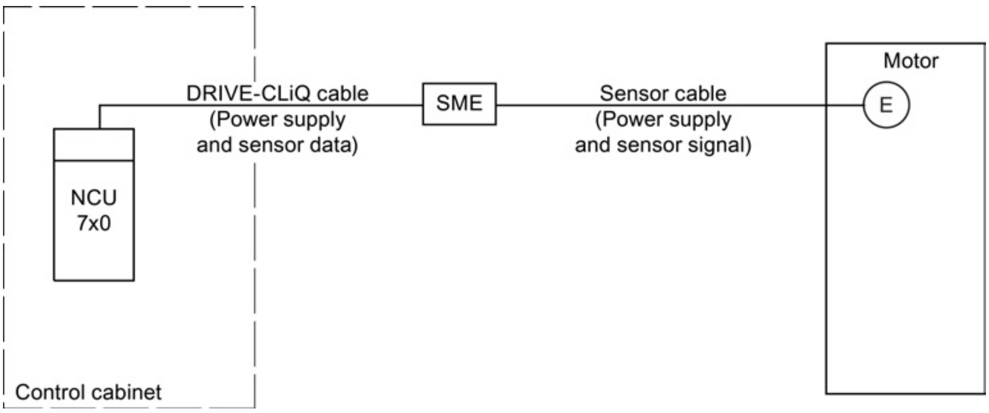


Figure 8-188 Sensor connection using Sensor Module External (SME)

8.8 Motor Connection

8.8.1 Motor connection plug

8.8.1.1 Introducing the motor connector

Motor Modules 3 A to 30 A are supplied without a motor connector. Prefabricated MOTION-CONNECT power cables with pre-assembled motor connectors or unassembled power cables can be used to connect motors. In this case the motor connector must be ordered separately.

The motor connector is equipped with an interlock mechanism. Mounting on the Motor Module is described in the following.

8.8.1.2 Installation of the motor connection plug with locking mechanism

Motor connection plugs with locking mechanism are available in two versions:

- Crimp plug for pre-assembled motor cables
- Screw connector for motor cables that need to be assembled

The way in which the motor connection plug is installed depends on the type of Motor Module used.

Note

With Double Motor Modules, the rear motor connection plug must be installed first and then locked.

Installation on Motor Modules without pre-assembled interlock bolt

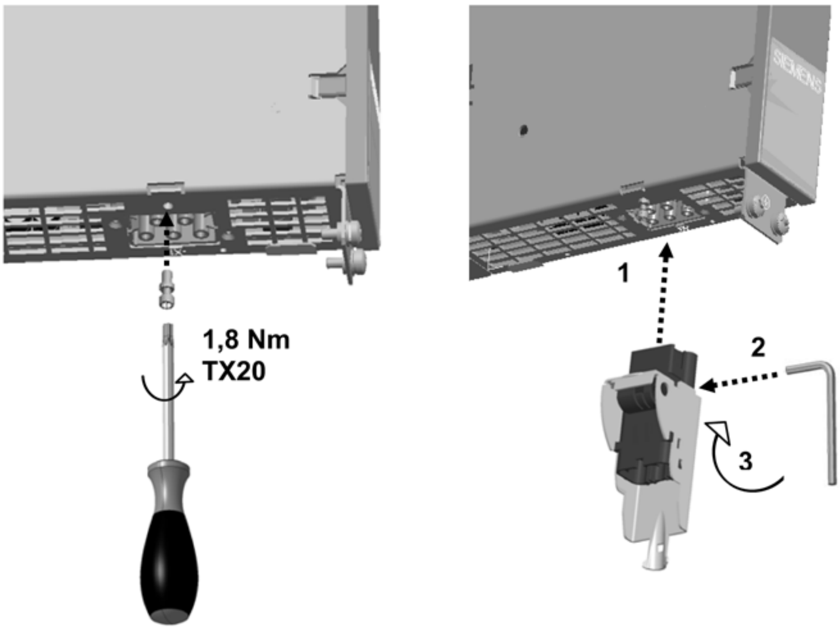


Figure 8-189 Installation example: Crimp plug

1. Screw the interlock bolt into the threaded socket provided in the enclosure.
2. Insert the plug, including the motor cable, and lock it in place by turning a screwdriver or size 4 hexagon socket-head screw clockwise by a ¼ turn (90°).

Installation on Motor Modules with pre-assembled interlock bolt

If Motor Modules with a pre-assembled interlock bolt are used, step 1 described above can be omitted.

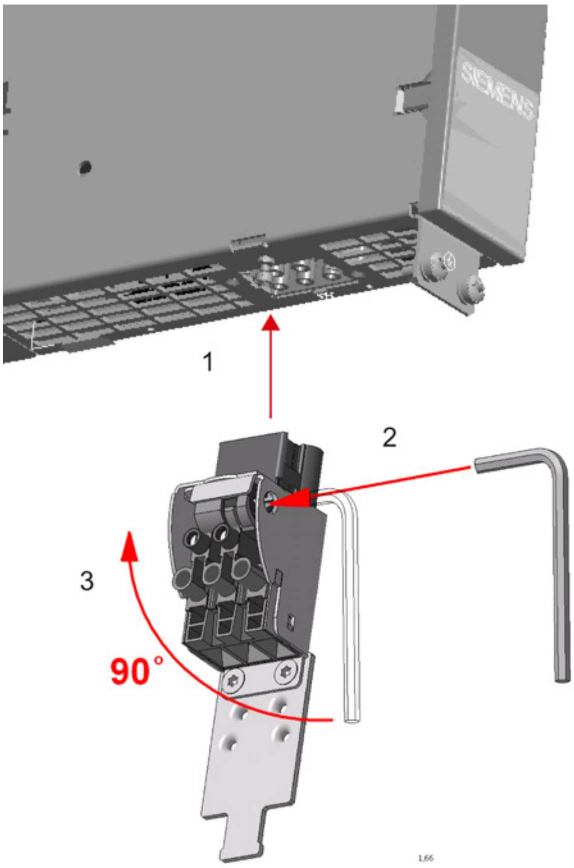


Figure 8-190 Installation example: Screw connector

Simply insert the connector, including the motor cable, and lock it in place by turning a screwdriver or size 4 hexagon socket-head screw clockwise by a ¼ turn (90°).

8.8.1.3 Installation of the motor connection plug with screwed joint

The way in which the motor connection plug with screwed joint is installed depends on the type of Motor Module used.

Note

With Double Motor Modules, the rear motor connection plug must be installed first and then locked.

Installation on Motor Modules with interlock bolt

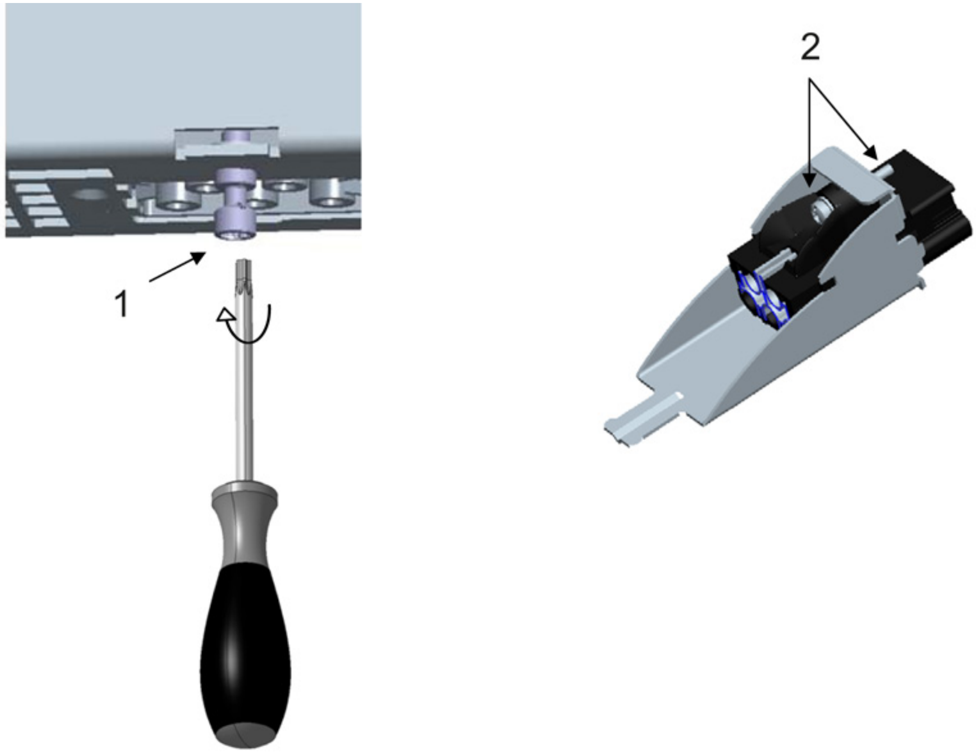


Figure 8-191 Installation of the motor connection plug with screwed joint

1. Use a TX20 screwdriver to remove the interlock bolt from the lower side of the enclosure.
2. Insert the plug, including the motor cable, and screw in with a TX20 screwdriver.

Installation on Motor Modules without interlock bolt

If the motor connection plug with screwed joint is being installed on a Motor Module without a pre-assembled interlock bolt, step 1 described above can be omitted.

Simply insert the plug, including the motor cable, and screw in with a TX20 screwdriver.

8.8.1.4 Removing the motor connector plug from prefabricated power cables

The motor connection plug of a pre-assembled motor cable might have to be removed if the cable needs to be routed through narrow cable glands, for example.

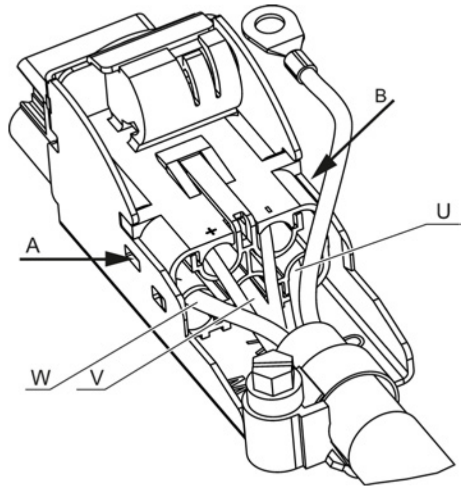


Figure 8-192 Motor connector, crimped version

Removing the motor connection plug

1. First loosen the clamp.
2. Simultaneously press tabs A and B on both sides of the connector using a screwdriver.
3. Keep both tabs pressed and lift the interlocking mechanism in the connector, e.g. using a screwdriver.
4. Remove the insert and withdraw the motor cable from the connector.

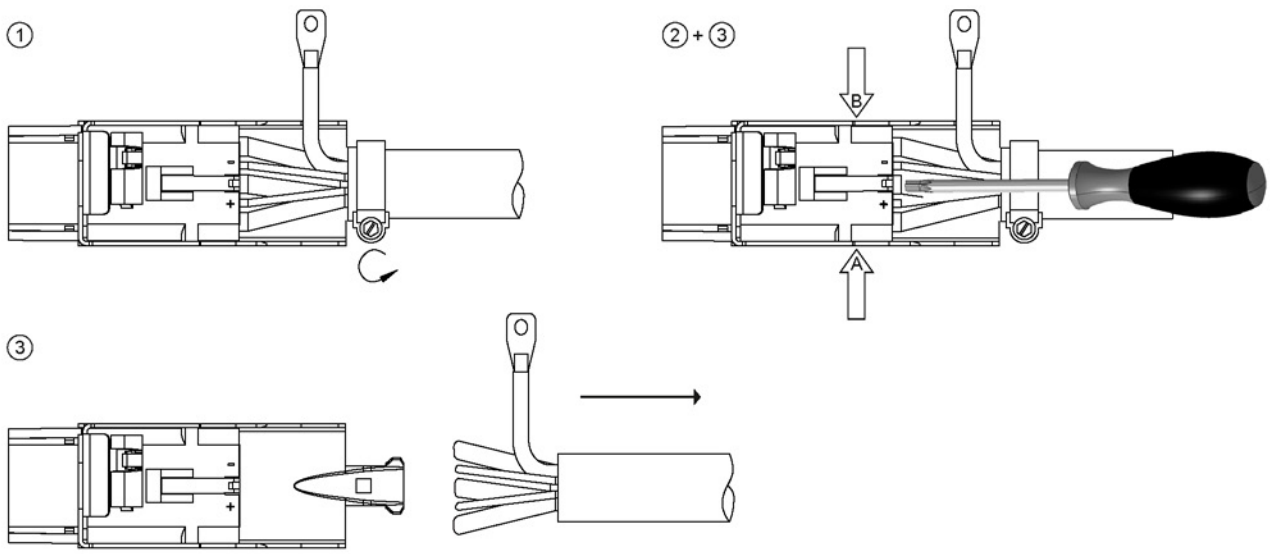


Figure 8-193 Removing the motor connector, crimped version

8.8.2 Brake connection

8.8.2.1 General Notes

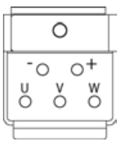
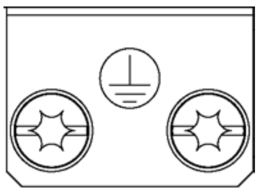
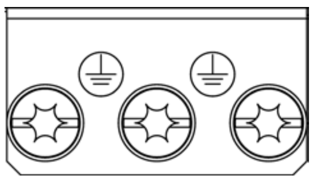
The motors are optionally available with integrated holding brake. The holding brake prevents the axes from making unwanted movements in the switched off state.

⚠ WARNING
The use of the motor holding brake as operational brake is not permitted!

⚠ WARNING
When holding brakes are used, the user must observe the special technological and machine-specific regulations and standards to ensure the person and machine protection. In addition, the residual risks must be evaluated, for example, the effects of hanging axes.

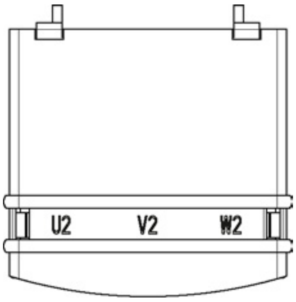
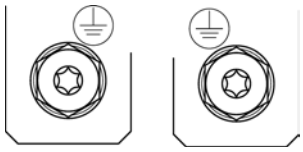
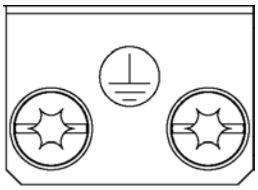
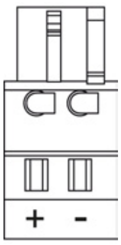
8.8.2.2 Motor and brake connection

Table 8- 141 X1/X2 motor and brake connection for Single Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

	Terminal	Technical data
	U (U2)	Motor connection
	V (V2)	
	W (W2)	
	+ (BR+)	Brake connection max. load current 2 A min. load current 0.1 A
	- (BR-)	
	PE connection	**Single Motor Modules 3 A to 30 A:** Threaded hole M5/3 Nm[1)]
		**Double Motor Modules 3 A to 18 A:** Threaded hole M5/3 Nm[1)]

1) For ring cable lugs in accordance with DIN 46234

Table 8- 142 X1 motor connection and X11 brake connection for Single Motor Modules 45 A to 200 A

	Terminal	Technical data
	U2 V2 W2	**45 A to 60 A:** Threaded bolts M6/6 Nm[1)] **85 A:** Threaded bolts M8/13 Nm[1)] **132 A to 200 A:** Threaded bolts M8/13 Nm[1)]
	PE connection	**45 A to 60 A:** Threaded bolts for motor cables: M6/6 Nm[1)] Threaded hole for PE: M6/6 Nm[1)]
		**85 A:** Threaded bolts for motor cables: M8/13 Nm[1)] Threaded hole for PE: M6/6 Nm[1)] **132 A to 200 A:** Threaded bolts for motor cables: M8/13 Nm[1)] Threaded hole for PE: M8/13 Nm[1)]
	+ (BR+) - (BR-)	**X11 brake connector**[2)]: Voltage 24 VDC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm^2 Type: Spring-loaded terminal 2 (see Appendix A.2) The brake connector is part of the prefabricated cable

1) For ring cable lugs in accordance with DIN 46234

2) The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.

Note

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

Note

The motor brake must be connected via connector X11. It is not permitted to directly connect the cable BR – to the electronics ground M.

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

See also

Spring-loaded terminals (Page 515)

Possible combinations of line reactors and line filters (Page 158)

8.8.2.3 Connection of the Brake Directly on the Motor Module

A brake control is integrated in the Motor Module. The maximum output current is 24 VDC 2 A.

The power supply for the BR+/BR- connection terminals is provided directly from the integrated 24 VDC power supply busbar.

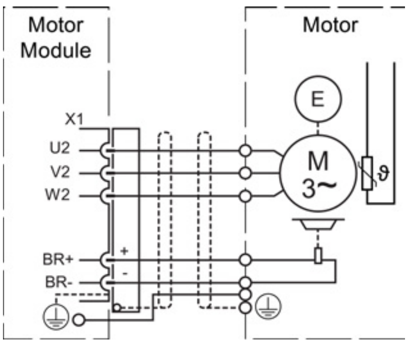
The connection of the brake supply cable is made at the appropriate terminal blocks provided on the Motor Module. The brake cables are normally integrated in the preassembled motor supply cable that is also shielded.

The maximum cable length of the brake supply cable is 50 meters.

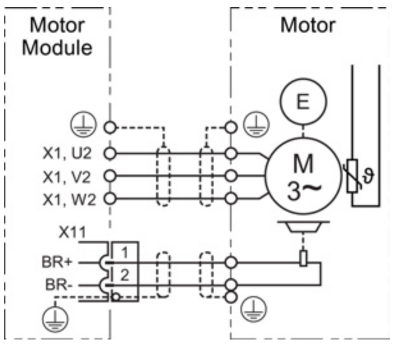
- Connection for the device size 3 A to 30 A or 2 x 3 A to 2 x 18 A

  The connection is made to the shared -X1 motor connection terminal: BR+/BR- terminal, max. connectable cross-section 1.5 mm^2
- Connection for device size 45 A to 200 A

  The connection is made to a separate -X11 brake connection terminal: BR+/BR- terminal, max. connectable cross-section 1.5 mm^2



Motor Module 3 A to 30 A;
2 x 3 A to 2 x 18 A



Motor Module 45 A to 200 A

The brake output is internally equipped with an overvoltage protection circuit. This reduces high voltage peaks that can occur when the brake is switched off and protects the electronic outputs. An additional external protective circuit for the brake output is not required. The brake output is short-circuit resistant. The following monitoring is also performed on the brake output:

- Current flow only when the brake is switched on; monitors whether a consumer is attached
- Wire breakage only when the brake is switched on

Note

The above-mentioned monitoring is possible only when the brake is directly attached to the Motor Module without interface contactor.

8.8.2.4 Connection of the Brake using Interface Relay

The motor holding brake can be attached directly to the provided connecting terminal or indirectly using an interface relay switched between. This may be necessary, for example, if the brake rated current I_{BR} > 2 A_{DC} or the supply voltage of the brake is 1AC 230 V. It is important, however, that the rated current of the interface relay is > 100 mA to prevent a fault message from the brake monitoring.

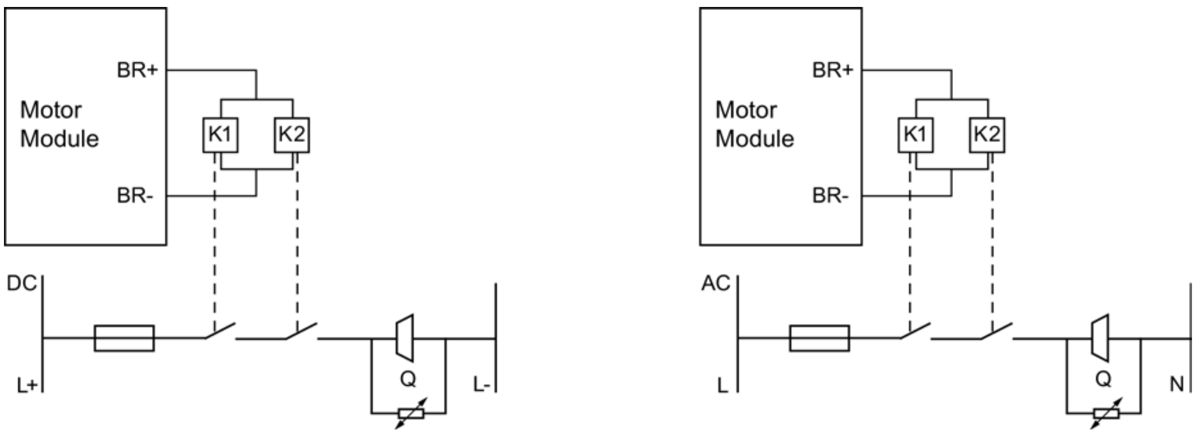


Figure 8-194 For brake current I_{BR} > 2 A_{DC} with direct current (left) and alternating current (right)

Brake activation via the brake connection on the Motor Module is carried out using a safe, two-channel method.

A protective circuit for the coupling relay (Kx) is not required because this function exists in the Motor Module. A protective circuit, however, must be provided for the brake (Q).

For the choice of the protective circuit, ensure that the demagnetization of the brake is achieved fast. This is performed, for example, with varistors for an AC supply power (also refer to the motors configuring guide).

Note

To determine whether the relays have switched, it is necessary to evaluate the feedback from both of them for diagnostics purposes.

8.8.2.5 Brake Control

For the brake control, a differentiation is made between:

- Conventional brake control and
- Safe brake control

The control command to open or close the holding brake is transferred directly to the Motor Module over the DRIVE-CLiQ from the Control Unit that logically links and monitors the signals with the system-internal execution sequences. The Motor Module then performs the action and controls the output for the holding brake appropriately.

Conventional brake control

The exact execution control is described in the SINAMICS S [2701…2704] List Manual. For example, the p1215, p1219, p1224 and p0855 parameters can be used to configure the operation of the holding brake.

The control (open/close) of the holding brake is differentiated as follows:

- Opening of the holding brake after pulse enable (e.g. using ON/OFF1)
- Immediate closing of the holding brake after pulse suppression (e.g. using BB/OFF2)

  The brake acts immediately after pulse suppression. It is possible that the holding brake operates against any motion that occurs. In the long term, this will damage the holding brake. Consequently, the direct pulse suppression and closing of the holding brake should be avoided.
- Close the holding brake only after braking with pulse suppression (e.g. using ON/OFF1=1->0)

  The holding brake acts when the motor has been brought to a standstill. The pulse suppression results after a deceleration time.
- Unconditional opening of the holding brake using the execution control command and the p0855 parameter.

  Note

  For the selection/deselection of the brake, any pending pulse enable will not be further influenced. Unconditional opening of the holding brake can, for example, lead to dangerous motions involving hanging axes. Additional safety measures may need to be adopted.

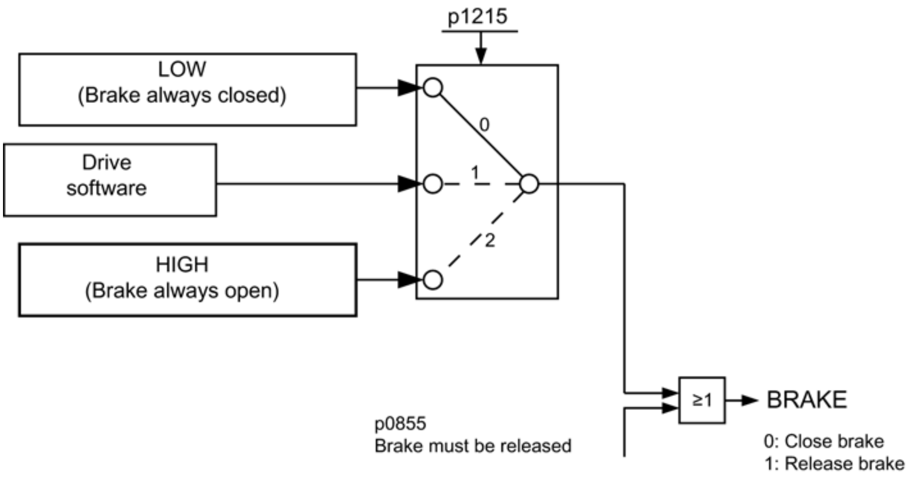


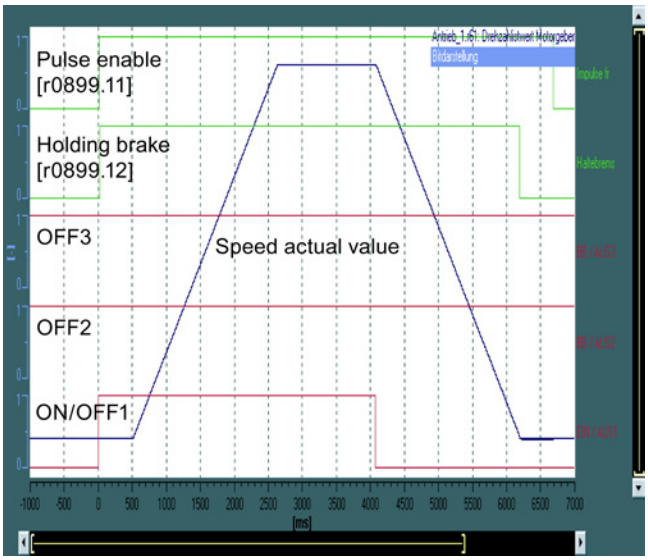
Figure 8-195 Operating modes of the conventional brake control

Timing examples:

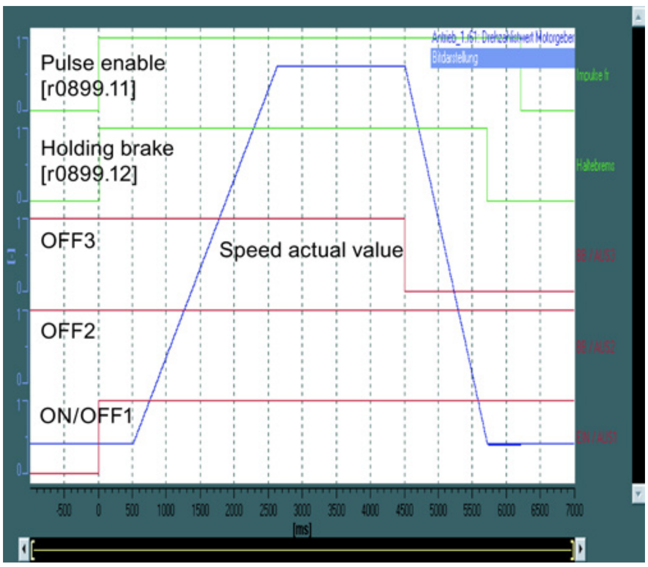
In all cases listed below, the drive starts the motion with an ON command (ON/OFF1). For clarification, the closing and opening times are set to 500 ms. The acceleration and deceleration times are 7 s (OFF1) and 4 s (OFF3), respectively. The drive will be accelerated to a speed of 2000 RPM. Important control and status bits (OFF1/2/3, holding brake status, pulse enable) are also shown.

Note

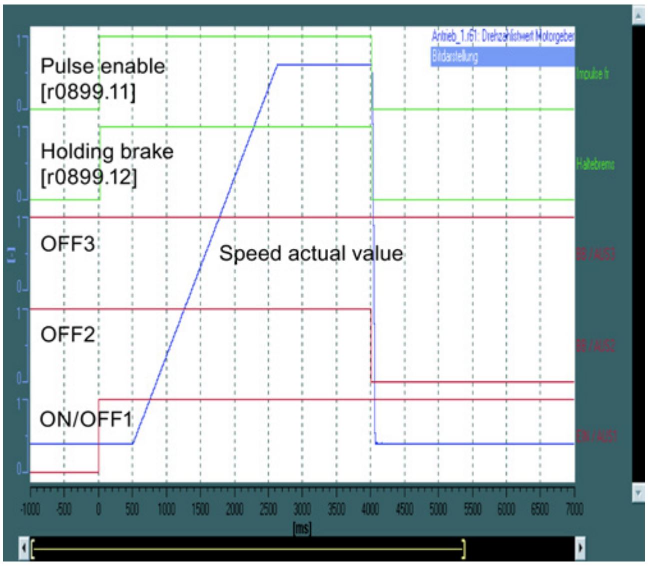
In the diagrams below, the motor is only accelerated to a fraction of the rated speed.



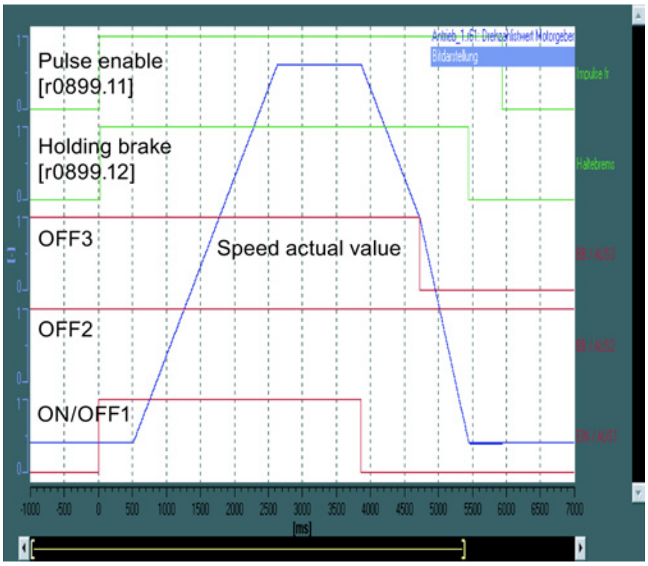
Start with ON command;
stop with OFF1 command



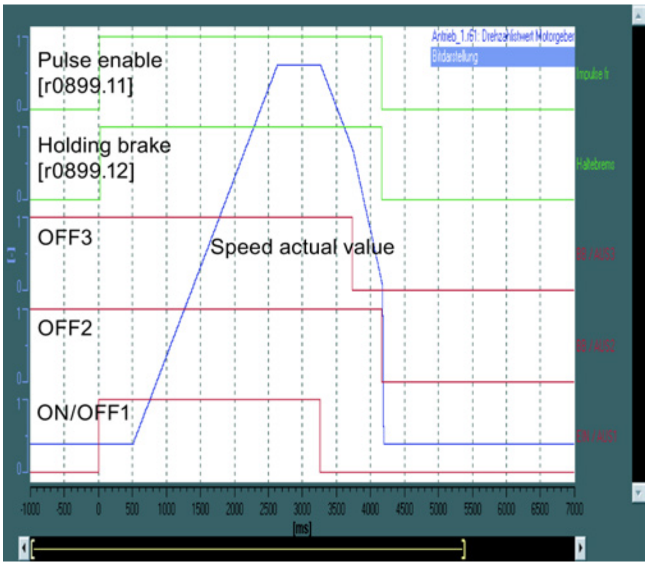
Start with ON command;
stop with OFF3 command (rapid stop)



Start with ON command;
stop with OFF2 command (coast down)



Start with ON command; stop with OFF1 command and during braking; stop with OFF3 Command



Start with ON command;
stop with OFF1 command;
stop with OFF3;
stop with OFF2

The switch-off behavior in a fault situation will be assigned to the associated fault numbers and largely corresponds to a stop behavior OFF1/2/3.

Safe Brake Control (SBC)

Note

The "Safe brake control" function is activated only in conjunction with the enable of the "Safe standstill" (SH) function.

"Safe brake control" does not detect any fault in the holding brake itself, such as a short circuit of the brake winding, worn out brake, etc.

Wire breakage will be monitored only for each activation of the brake, not, however, during operation.

The control paths must be provided as two channels for the "Safe brake control". This is performed by means of Control Unit and Motor Module control methods, which are logically separate. These logically separate units, which communicate via DRIVE-CLiQ, switch and monitor the brake control independently of one another.

For safety-related functions, it is necessary for the fault detection to perform in a defined interval a test using forced dynamization. In this case, the switch-off path must be performed and tested in the two monitoring channels at least once within a defined interval. The "forced checking procedure" cycle must be controlled externally and mechanically in the appropriate manner by means, for example, of a brief interruption to the two "Safe standstill" (SH) inputs on the Control Unit and on the Motor Module.

The dynamization is also performed:

- For each brake control with "open holding brake" and "close holding brake"
- For selection of the "Safe standstill" function

Note

The monitoring and the forced checking procedure of the brake outlet is only possible if the brake is connected directly to the connection terminals, and not using a coupling relay! The p9602 and p9802 parameters can be used to specify the control operation. The "Safe brake control" is performed independent of the setting in p1215. A "Safe brake initiation" always has priority over the conventional brake control.

When the "Safe standstill" function is selected, an internal OFF2 command will be issued and the holding brake closed immediately.

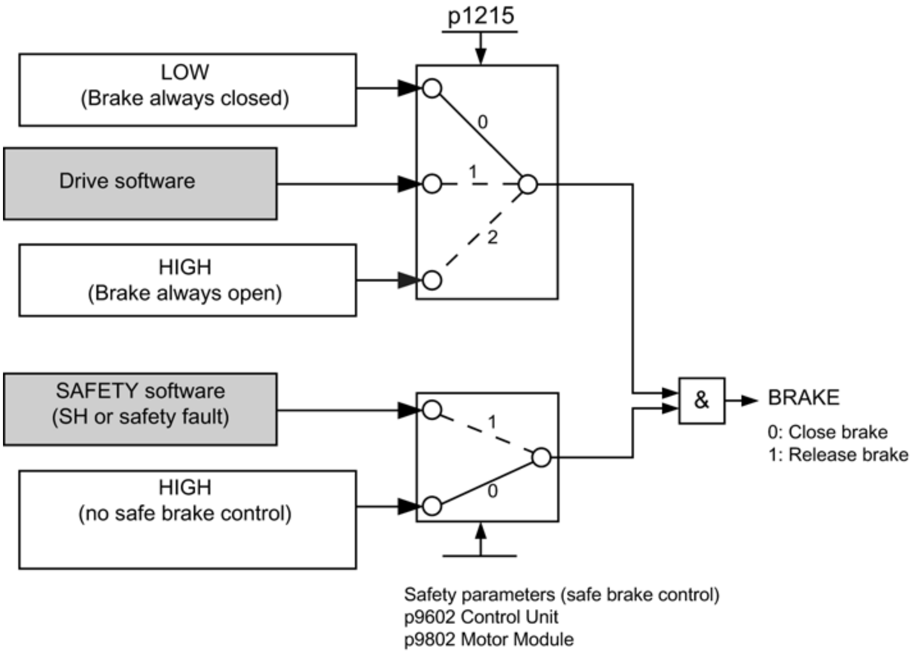
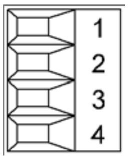


Figure 8-196 Operating modes of the safe brake control

8.8.3 X21/X22 EP terminals / temperature sensor Motor Module

Table 8- 143 Terminal strip X21/X22

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V - 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (Enable Pulses)	
Max. connectable cross-section 1.5 mm^2 Type: Screw terminal 1 (see chapter Connection methods)			

Note

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

Note

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

Note

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

8.9 Voltage Protection Module (VPM), external

General information

The external Voltage Protection Module (VPM) is used for the 1FE1 and 2SP1 motors and for motors with an electromagnetic force (EMF) of 800 V to 2,000 V to limit the DC link voltage at the converter in a fault situation.

If the line voltage fails when the motor is running at maximum speed, or as consequence the pulses at the converter are cleared, the motor returns high-voltage energy to the DC link. The Voltage Protection Module detects an excessive DC link voltage (> 800 V) and short-circuits the three motor supply cables. The energy stored in the motor is converted into heat by the short circuit between the motor supply cables.

Integration

- The installation must be performed in accordance with the VPM 120 or VPM 200 connection diagram.
- Above and below the device, clearance spaces of approx. 200 mm must be provided for the cable routing.
- Any installation position is possible.
- No switching elements may be added to the U, V, W connection cables between the drive, VPM and motor!
- The air intake temperature measured 10 mm below the device must not exceed 55 °C.

⚠ CAUTION

In the event of non-compliance and if the limit values specified in the "technical data" are exceeded (see VPM operating instructions), there is a danger of device overloading, irreparable damage to the device, and impairment of electrical safety.

Note

The device must be equipped with a safety switching unit and may be used only for its proper purpose. Other applications, e.g. armature short circuits in operation, are not permissible.

The warning notices attached to the device must be observed.

Operation with VPM is possible only in conjunction with SINAMICS, SIMODRIVE 611 digital, SIMODRIVE 611 universal HR/HRS, and 1FE1/2SP1 motors. When the external VPM is used, shielded 6FX8 motor supply cables are required.

Note

Depending on the size of the type used, the conditions associated with the relevant VPM operating instructions must be observed.

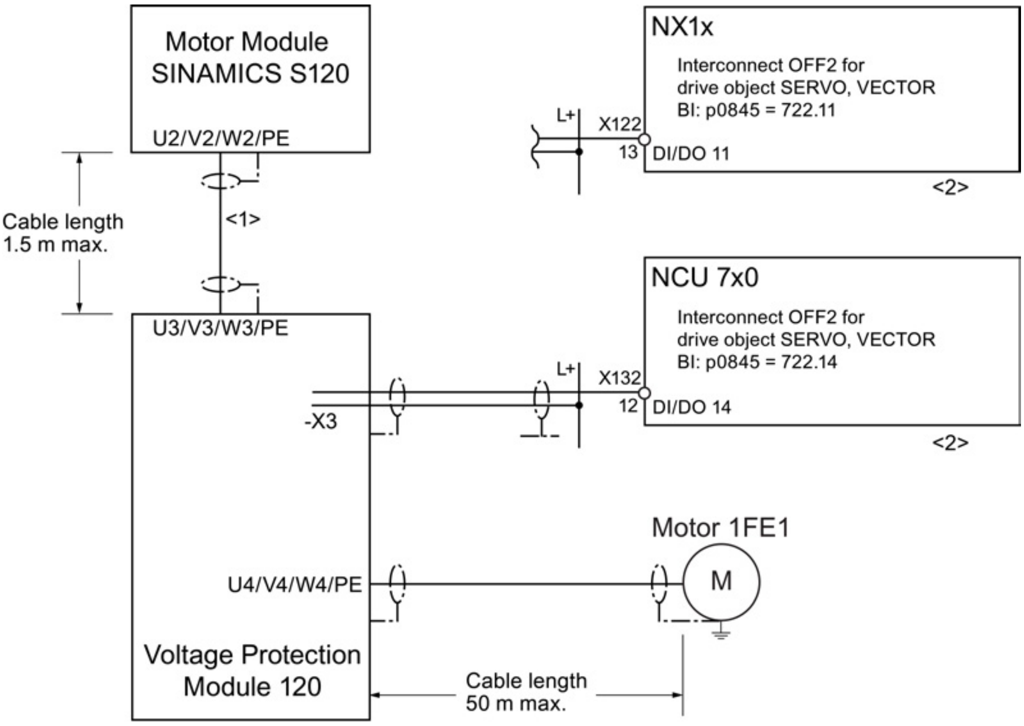
VPM 120, order No.: A5E00302281B
VPM 120 PG, order No.: A5E01017613A
VPM 200, order No.: A5E00302261B
VPM 200 PG, order No.: A5E01018358A
VPM 200 DYN, order No.: A5E00777655A

⚠ WARNING

Under fault conditions, voltages up to 2 kV can occur at cables that are cut or damaged.

Depending on the speed of the motors, the motor terminal voltage of the 1FE1 motors can attain values as high as 2 kV.

Connection example for VPM 120



<1> No additional components may be connected between the Motor Module and Voltage Protection Module.

<2> Signaling contact -X3 of the VPM must be wired to the NCU or NX assigned to the drive, depending on whether the relevant axis is running under an NCU or NX. A separate digital input must be provided for each VPM. The parameters for these digital inputs must be assigned manually.

Figure 8-197 Connection of Voltage Protection Module VPM 120

Signaling contact X3

The X3 signaling contact closes after t > 2 min or after resetting the temperature switch.

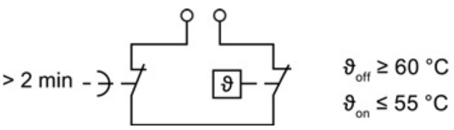


Figure 8-198 Signaling contact X3 of the Voltage Protection Module

⚠ WARNING
Measures must be adopted to prevent the drive from starting automatically.

If the external VPM is being used, the following parameter needs to be set on the NCU or NX:

p0643[0...n]

- **Description:**
  Setting overvoltage protection for synchronous motors in field weakening mode
- **Value:**

  0: No action

  1: Voltage Protection Module (VPM)

Additional references

For more detailed information on the external Voltage Protection Module, please refer to the following:
/GH2/SINAMICS S120/, Booksize Power Units, Motor Side Power Components, VPM/

8.10 Cables

8.10.1 General information

NOTICE
Damage to components due to deficient cable shielding or excessively long cables
If the shielding procedures described and the specified cable lengths are not observed, this may result in damage to the components or the machine failing to operate correctly.
• Observe the shielding and maximum cable length specifications outlined below.

8.10.2 Cable shielding and routing

In order to comply with the EMC requirements, certain cables must be routed apart from other cables and from certain components. To full EMC requirements, the following cables must be used with shields:

- Line supply conductors from line filter via line reactor to Line Module
- All motor cables (if necessary, including cables for motor holding brake)
- Cables for "fast inputs" of the Control Unit
- Cables for analog direct voltage/current signals
- Signal cables for sensors
- Cables for temperature sensors

DANGER
A suitable PE conductor must be connected to all devices in protection class I.
The protective conductor connection of the individual components must be at least 4 mm².

Alternative measures (e.g. routing behind mounting plates, suitable clearances) can also be used provided they have similar results. This excludes measures that relate to the design, installation, and routing of motor power cables and signal cables. If unshielded cables are used between the line supply connection point and line filter, make sure that no interfering cables are routed in parallel.

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

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

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

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

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

DANGER

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

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

8.10.3 Equipotential Bonding

The SINAMICS S120 Booksize drive system is designed for use in control cabinets with protective conductor terminal.

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

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

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

If components are mounted on DIN rails, the data listed in the second item applies for equipotential bonding. If only smaller connection cross-sections are permitted on the components, use the largest possible, e.g. 6 mm² for SMC. These requirements also apply to distributed components located outside the cabinet.

For a PROFIBUS connection between two control cabinets, a fine-wire potential equalizing conductor with a cross-section of 4 mm² should be used. This conductor must be laid together with the PROFIBUS connection cable and connected to the NCU 7x0 using a cable lug.

Equipotential bonding and shielding for PROFIBUS

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

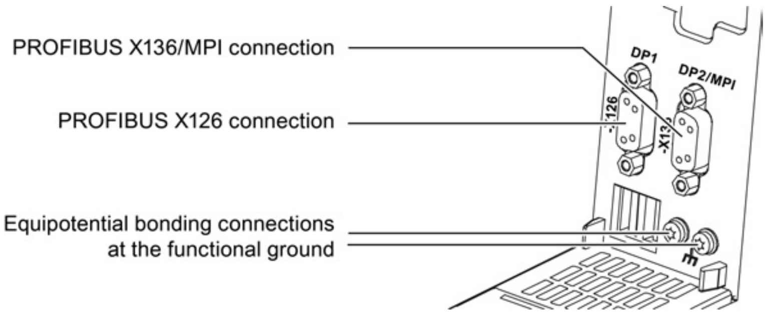


Figure 8-199 PROFIBUS and function ground connections

8.10.4 Protective Ground Connection

The bodies of electrical resources which because of their fastening cannot be included in the protective measure must be connected with the protective conductor circuit of the switching device combination (control cabinet) in order to establish the protection connection.

All protective conductors must be selected to conform with EN 60204-1 or EN 60439-1 and connected in accordance with the specifications of the associated device manuals.

8.10.5 Maximum cable lengths

The table below provides an overview of the maximum permissible cable lengths for signal and supply cables, power cables, and DC link cables.

Table 8- 144 Maximum cable lengths

Type	Maximum length [m]
24 VDC supply cables 1)	10
24 V signal cables 1)	30
DRIVE-CLiQ signal cables MC500 (RJ45)	100
DRIVE-CLiQ signal cables MC500 (M12)	30
DRIVE-CLiQ signal cables MC800PLUS (RJ45)	75
DRIVE-CLiQ signal cables MC800PLUS (M12)	30
DC link, including extensions	10
Total cable length for Active Line Modules 16 kW and 36 kW with Active Interface Module 4)	630 (shielded) 3)
Total cable length for Active Line Modules 55 kW up to 120 kW with Active Interface Module 4)	1000 (shielded) 3)
Total cable length for Active Line Modules with line reactor 4)	350 (shielded) 3)
Total cable length for Basic Line Modules 4)	630 (shielded) 3)
Total cable length for Smart Line Modules 4)	350 (shielded) 3)
Power cable between line filter and line reactor	10 (shielded/unshielded) 2)
Power cable between line reactor and Line Module	10 (shielded/unshielded) 2)
Power cable between Active Interface Module and Active Line Module	10 (shielded/unshielded) 2)
Power cable between Active Interface Module and Basic Line Filter	10 (shielded/unshielded) 2)
Power cable between motor and Motor Module up to I_n = 9 A	50 (shielded) 75 (unshielded)
Power cable between motor and Motor Module I_n = 18 A	70 (shielded) 100 (unshielded)
Power cable between motor and Motor Module I_n ≥ 30 A	100 (shielded) 150 (unshielded)
Power cable between Braking Module and braking resistor	10

1) For longer lengths, suitable wiring must be connected by the user to provide overvoltage protection.

2) To comply with EMC limit values, shielded cables (preferably MOTION CONNECT cables) must be used.

3) Restrictions regarding the total cable length and the secondary conditions required to comply with the corresponding radio interference suppression category are listed in the chapter titled "Possible line reactor and line filter combinations" (Page 158).

4) The total lengths specified for power cables in the drive line-up include motor cables, DC link cable(s), and the line supply conductor from the line filter output on.

8.11 DRIVE-CLiQ cabinet bushings

8.11.1 Description

A DRIVE-CLiQ cabinet bushing is used to connect the DRIVE-CLiQ cables between the inside and outside of the control cabinet. It is used in a control cabinet panel. The data lines and the voltage supply contacts of the DRIVE-CLiQ are also routed through the bushing. The DRIVE-CLiQ cabinet bushing for DRIVE-CLiQ cables is available with RJ45 connector and M12 plug/socket.

DRIVE-CLiQ cabinet bushing for RJ45 connectors

The cabinet bushing has degree of protection IP54 according to EN 60529 from the outside towards the inside. Inside the control cabinet, a connection is established according to degree of protection IP20 or IPXXB acc. to EN 60529. So that the complete outside of the cabinet bushing, including the DRIVE-CLiQ interface, has degree of protection IP54, a DRIVE-CLiQ cable must be used, which as a minimum must also have degree of protection IP54.

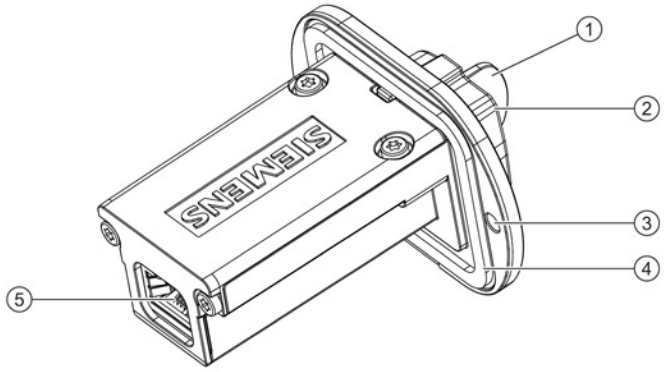
DRIVE-CLiQ cabinet bushing for M12 plug/socket

The cabinet bushing has degree of protection IP67 according to EN 60529 from the outside towards the inside. Inside the cabinet a connection according to degree of protection IP67 in compliance with EN 60529 is realized.

8.11.2 Interface description

8.11.2.1 Overview

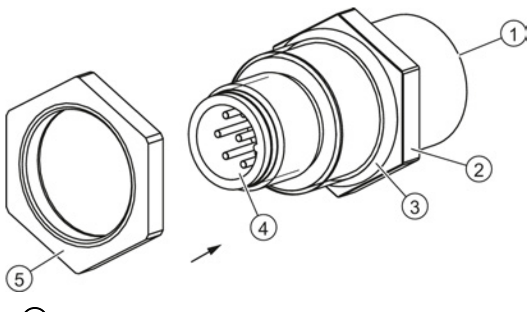
DRIVE-CLiQ cabinet bushing for DRIVE-CLiQ cables with RJ45 plug



① Protective cap, Yamaichi, order number: Y-ConAS-24-S
② DRIVE-CLiQ interface RJ45 on the outside (to connect DRIVE-CLiQ signal cables MOTION-CONNECT with IP67 degree of protection)
③ Mounting holes
④ Flange-type seal to ensure degree of protection IP54 on the outside of the control cabinet
⑤ DRIVE-CLiQ interface RJ45 on the inside (to connect DRIVE-CLiQ signal cables MOTION-CONNECT with IP20 degree of protection)

Figure 8-200 Interface overview, DRIVE-CLiQ cabinet bushing RJ45

DRIVE-CLiQ cabinet bushing for DRIVE-CLiQ cables with M12 plug/socket



① DRIVE-CLiQ interface with M12 socket (8-pin)
② Flange, SW18
③ Seal
④ DRIVE-CLiQ interface with M12 plug (8-pin)
⑤ O ring, SW20, tightening torque: 3 - 4 Nm

Figure 8-201 Interface overview, DRIVE-CLiQ cabinet bushing M12

8.11.3 Dimension drawings

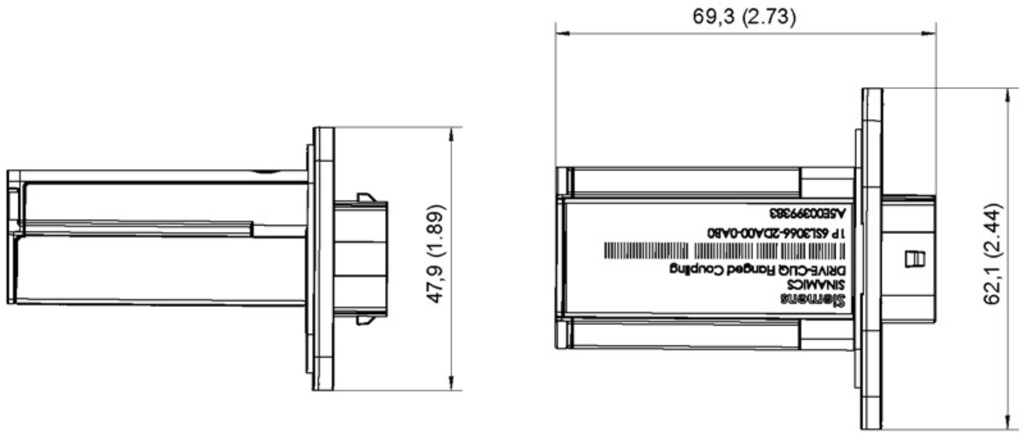
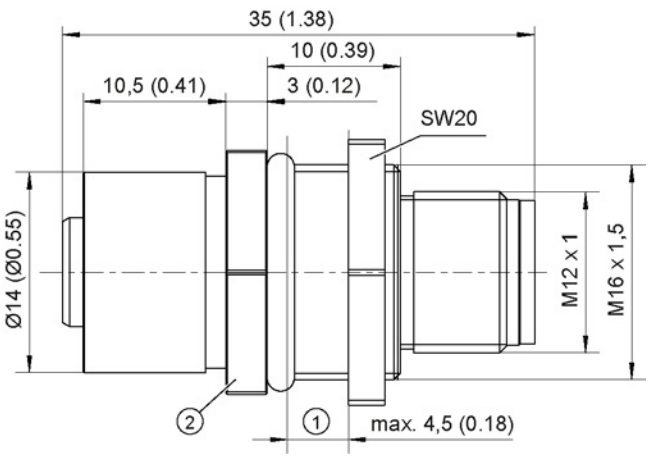


Figure 8-202 Dimension drawing of the DRIVE-CLiQ cabinet bushing RJ45, all dimensions in mm and (inches)



① Cabinet panel

② Flange, SW18

Figure 8-203 Dimension drawing of the DRIVE-CLiQ cabinet bushing M12, all dimensions in mm and (inches)

8.11.4 Installation

8.11.4.1 DRIVE-CLiQ cabinet bushing for cables with RJ45 connectors

In order to install the DRIVE-CLiQ cabinet bushing RJ45, you must make a cutout in the control cabinet panel as shown in the diagram below.

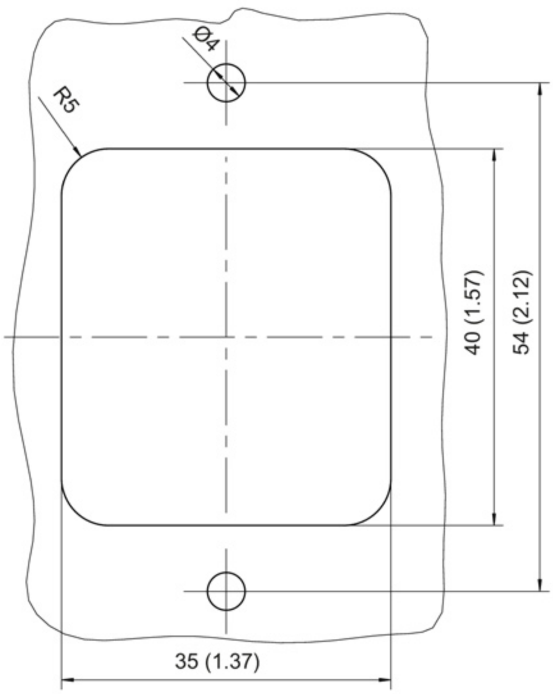
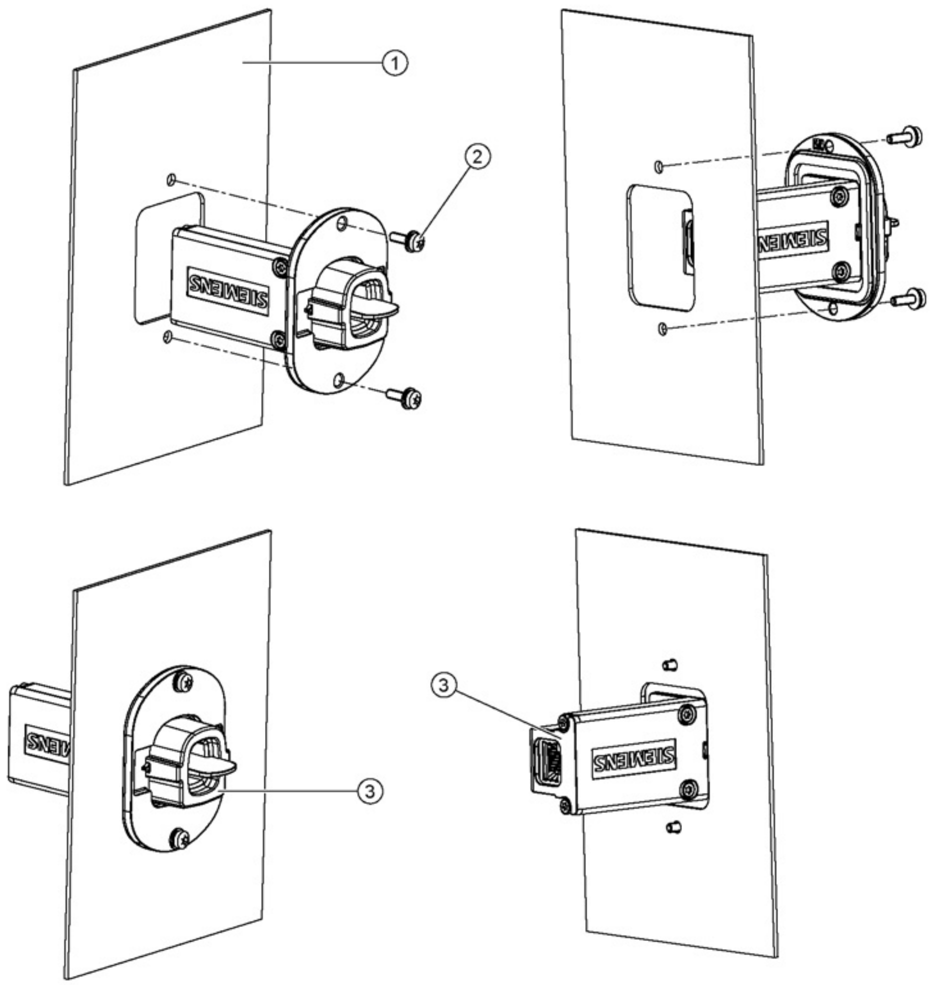


Figure 8-204 Cut-out for the cabinet

Installation

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



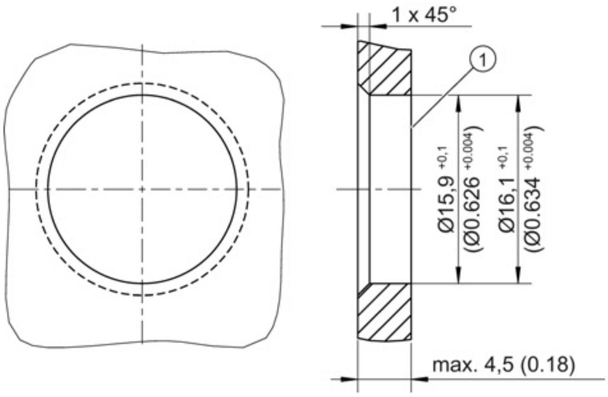
① Control cabinet panel
② M3 screw, tightening torque 0.8 Nm
③ DRIVE-CLiQ cabinet bushing RJ45

Figure 8-205 Mounting DRIVE-CLiQ cabinet bushings for cables with RJ45 connectors

8.11.4.2 DRIVE-CLiQ cabinet bushing for cables with M12 plug/socket

Prepare the cabinet panel for mounting the DRIVE-CLiQ cabinet bushing M12 as shown below. The removable O ring can be screwed from the inside or the outside.

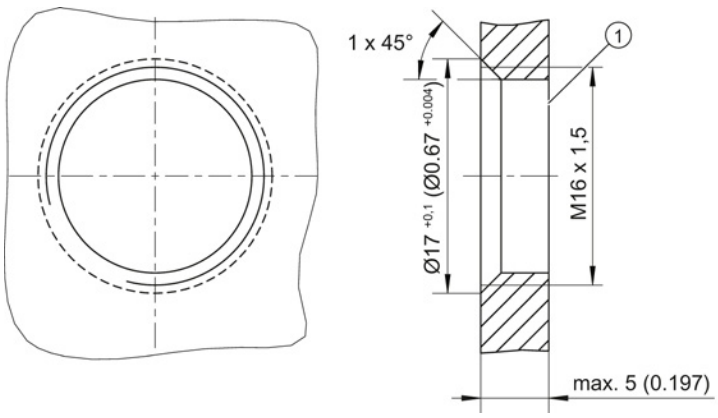
Mounting from the inside using an O ring that can be screwed



① Through-hole with chamfer

Figure 8-206 Through-hole for mounting the DRIVE-CLiQ cabinet bushing M12 with an O-ring that can be screwed from the inside

Mounting from the outside using an O ring that can be screwed

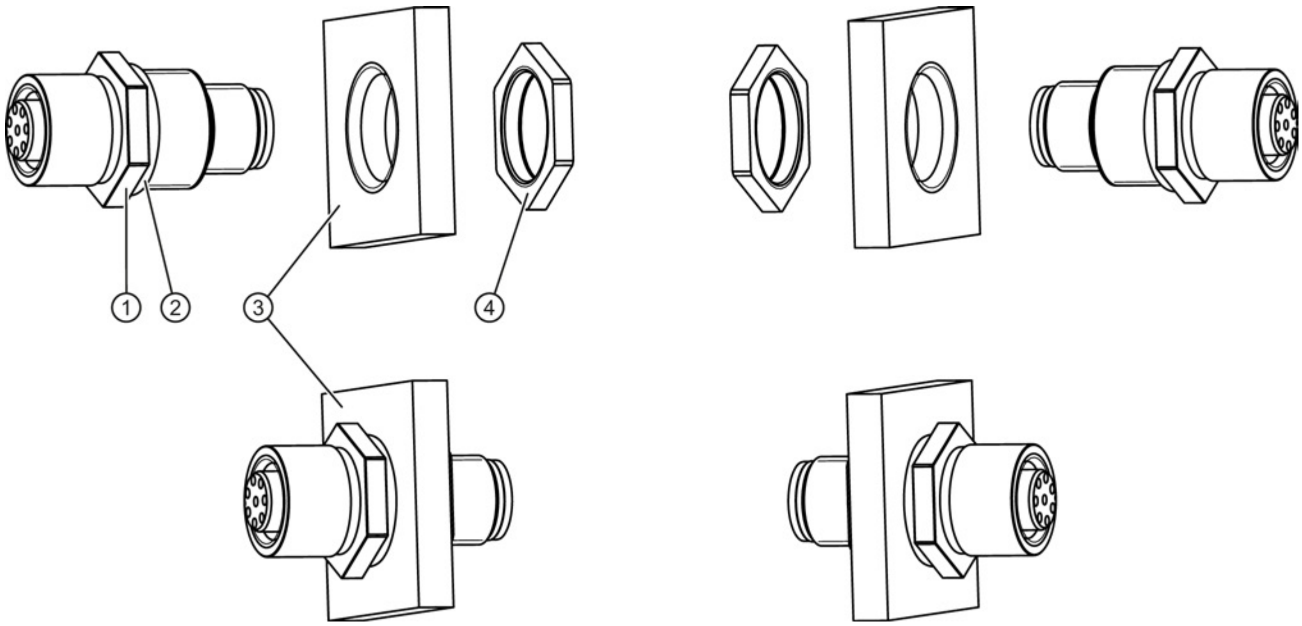


① Threaded hole with chamfer

Figure 8-207 Threaded hole for mounting the DRIVE-CLiQ cabinet bushing M12 with an O-ring that can be screwed from the outside

Installation

1. Insert the DRIVE-CLiQ cabinet bushing through the opening in the cabinet.
2. Fasten the DRIVE-CLiQ cabinet bushing using the associated O ring with a tightening torque of 3 - 4 Nm



① Flange, SW18
② Seal
③ Cabinet panel
④ O ring, SW20, tightening torque: 3 - 4 Nm

Figure 8-208 Mounting DRIVE-CLiQ cabinet bushings for cables with M12 connectors

8.11.5 Technical data

Table 8- 145 Technical data of DRIVE-CLiQ cabinet bushings

	Unit	6SL3066-2DA00-0AA0 RJ45	6FX2003-0DT67 M12
Weight	kg	0.165	0.035
Degree of protection according to EN 60529		IP54 outside the control cabinet IP20 or IPXXB inside the control cabinet	IP67

9 Safety Integrated

Note

The following chapter describes the uses of the "Safety Integrated" functionality. Detailed knowledge of the "Safety Integrated sl" Function Manual (FBSI sl) is assumed as a prerequisite.

Note

No support for TM54F Terminal Module

SINUMERIK 840D sl does not support the TM54F Terminal Module. For this reason, safety solutions that use the TM54F are not described here.

9.1 Safety Integrated terminology

Safety Integrated terminology for SINAMICS S120 and SINUMERIK 840D sl

Only some of the safety functions in the SINAMICS S120 drive system and the SINUMERIK 840D sl control system are the same. Beyond these, the two systems use different terminology to refer to their respective functions. SINUMERIK 840D sl uses EN ISO 13849-1 designations and abbreviations that refer to German terms, whereas SINAMICS S120 is based on EN 61800-5-2 and uses abbreviations that refer to English terms. The table below compares the designations.

Table 9- 1 SINUMERIK 840D sl and SINAMICS S120 safety functions

EN ISO 13849-1 (SINUMERIK 840D sl)			EN 61800-5-2 (SINAMICS S120)		
German	**English**	**Abbr.**	**German**	**English**	**Abbr.**
Sicherer Halt (STOPP A)	Safe standstill (STOP A)	SH	Sicher abgeschaltetes Moment	Safe Torque Off	STO
STOPP B	STOP B	-	Sicherer Stopp 1	Safe Stop 1	SS1
STOPP C	STOP C	-	Sicherer Stopp 2	Safe Stop 2	SS2
STOPP D	STOP D	-	Sicherer Stopp 2	Safe Stop 2	SS2
STOPP E	STOP E	-	Sicherer Stopp 2	Safe Stop 2	SS2
Sicherer Stopp 1	Safe Stop 1	SS1	Sicherer Stopp 1	Safe Stop 1	SS1
Sicherer Betriebshalt	Safe Operating Stop	SBH	Sicherer Betriebshalt	Safe Operating Stop	SOS
Sichere Überwachung auf Beschleunigung	Safe Acceleration Monitor	SBR	-	-	-
Sicher reduzierte Geschwindigkeit	Safely Reduced Speed	SG	Sicher begrenzte Geschwindigkeit	Safely-Limited Speed	SLS

EN ISO 13849-1 (SINUMERIK 840D sl)			EN 61800-5-2 (SINAMICS S120)		
German	**English**	**Abbr.**	**German**	**English**	**Abbr.**
Sichere Software-Endschalter	Safe Software Limit Switch	SE	Sicher begrenzte Lage	Safely-Limited Position	SLP
Sicheres Bremsenmanagement	Safe Brake Management	SBM	-	-	-
Sichere Bremsenansteuerung	Safe Brake Control	SBC	Sichere Bremsenansteuerung	Safe Brake Control	SBC
Sicherer Bremsentest	Safe Brake Test	SBT	-	-	-
Sichere Software-Nocken	Safe Software Cam	SN	Sichere Nocken	Safe Cam	SCA
Sicherheitsgerichteter Ausgang $n < n_x$	$n < n_x$	-	Sichere Geschwindigkeits-überwachung	Safe Speed Monitor	SSM
	-	-	Sichere Bewegungs-/Drehrichtungsüberwachung	Safe Direction	SDI
Sichere programmierbare Logik	Safe Programmable Logic	SPL	-	-	-
Sicherheitsgerichtete Ein-/Ausgabesignale	Safety-related I/O	SGE/SGA	-	Failsafe Digital Input Failsafe Digital Output	F-DI F-DO
Integrierter Abnahmetest	-	-	-	-	-

9.2 SINAMICS Safety Integrated

9.2.1 Safety functions

All of the Safety Integrated functions (SI functions) available with SINAMICS S120 are listed in this chapter.

The safety functions listed here conform to:

- Safety Integrity Level (SIL) 2 according to DIN EN 61508
- Category 3 according to DIN EN ISO 13849-1
- Performance level (PL) d according to DIN EN ISO 13849-1

The safety functions correspond to the functions according to DIN EN 61800-5-2.

SINAMICS makes a distinction between Safety Integrated Basic Functions and Safety Integrated Extended Functions. Extended Functions, however, are not available with SINUMERIK. For this reason, the information below will not address them in any further detail.

Safety Integrated Basic Functions

These functions are part of the standard scope of the drive and can be used without requiring an additional license. They are always available. They do not require an encoder and/or do not place any special requirements on the encoder used.

Function	Abbr.	Meaning
Safe Torque Off	STO	Safe Torque Off is a safety function that prevents the drive from starting unexpectedly, in accordance with EN 60204-1. STO prevents the motor from being supplied with energy that can generate a torque, and corresponds to stop category 0.
Safe Stop 1	SS1	Safe Stop 1 is based on the "Safe Torque Off" function. This means that a category 1 stop (according to EN 60204-1) can be implemented after a delay time (time-controlled).
Safe Brake Control	SBC	Safe Brake Control is used to control a holding brake safely.

Notes

1. The functions must be enabled using parameters.
2. It is possible to group the control terminals for the Safe Torque Off (STO) function.
3. The functions are drive-integrated, i.e. they are present for each drive and must be individually brought into operation for each drive.

9.2.2 Basic Functions

Note

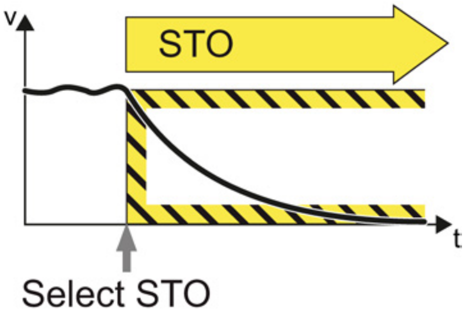
Basic functions do not require an encoder

The Safety Integrated Basic Functions are functions for safely stopping the drive. You do not require an encoder.

9.2.2.1 Safe Torque Off (STO)

Definition according to EN 61800-5-2:

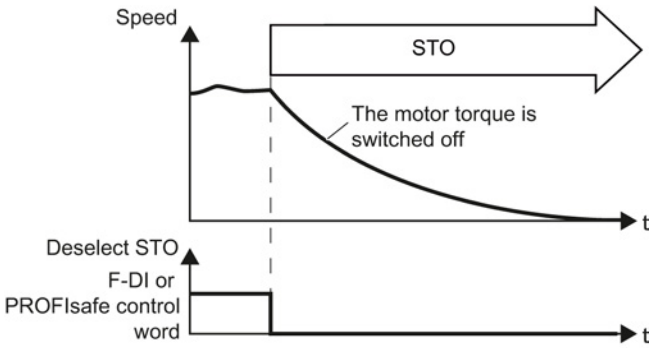
"The STO function prevents energy from being supplied to the motor, which can generate a torque."



Principle of operation

The inverter recognizes the selection of STO via a fail-safe input or via the safe communication PROFIsafe.

The inverter then safely switches off the torque of the connected motor.



Application examples

Example	Possible solution
After an Emergency Stop button has been pressed, the drive must be braked as quickly as possible and brought into the STO state.	• Wire the Emergency Stop button with a fail-safe input. • Select STO via the fail-safe input.
A central Emergency Stop button ensures that several drives are braked as quickly as possible and brought into the STO state.	• Evaluate an Emergency Stop button in a central control. • Select STO via PROFIsafe.

Controlling the Safe Torque Off (STO) safety function using terminals

The Safe Torque Off function is selected/deselected separately for each drive using a specific terminal on the Control Unit and Motor Module.

- Control Unit

  The desired input terminal for STO is selected via BICO interconnection (BI: p9620).

  Digital input DI 0 ... DI 7 on the Control Unit can be used as a signal source (NCU). The NX modules have DI 0 to DI 3 digital input.

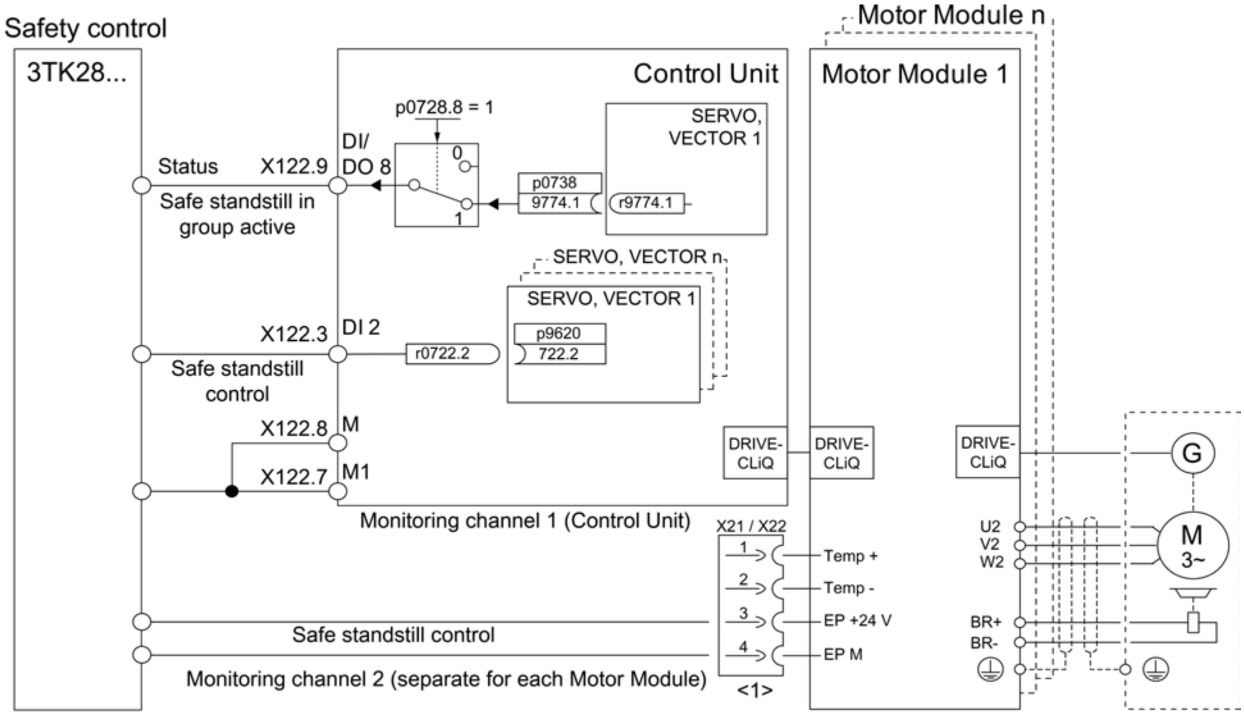
- Motor Module

  The input terminal for STO is the "EP" pulse enable (Enable Pulses) terminal.

Both terminals must be simultaneously energized, otherwise a fault will be issued.

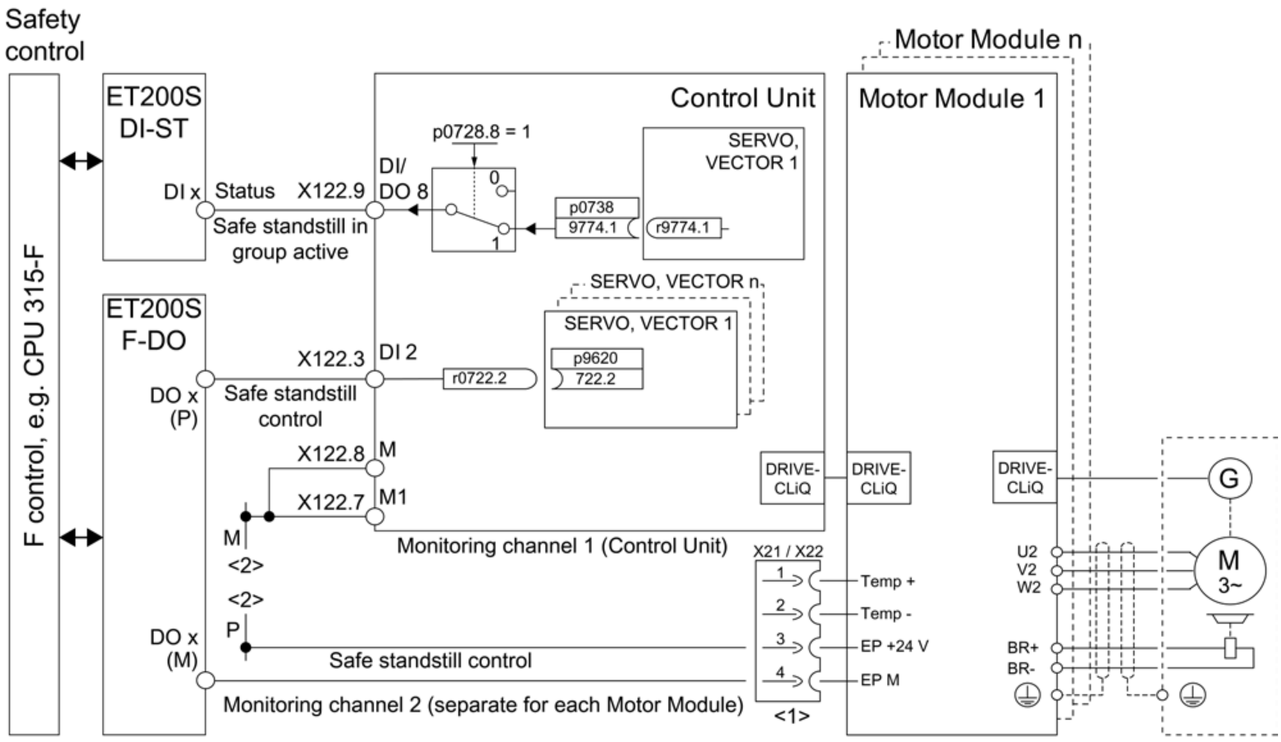
Note

To enable safe control of the safety functions using terminals, an external safety control such as a safety relay (3TK28...) or SIMATIC S7 F control (e.g. ET200S F-DO- P/M-switching) conforming to EN 13849-1 must be provided.



<1> Signal must be routed parallel to the Motor Modules in a group.

Figure 9-1 Terminals for Safe Torque Off



<1> Signal must be routed parallel to the Motor Modules in a group.

<2> Establish potential reference for power supply of ET200S.

Figure 9-2 Safe Torque Off terminals; control using ET200S fail-safe output, for example

Grouping drives

If the function is to be initiated for several drives simultaneously, the terminals for the corresponding drives must be grouped together:

- Control Unit

  By appropriately interconnecting the binector input to a joint input terminal for the drives to be combined to form a group.

- Motor Module

  By appropriately connecting terminal "EP" for the individual Motor Modules belonging to a group.

Note

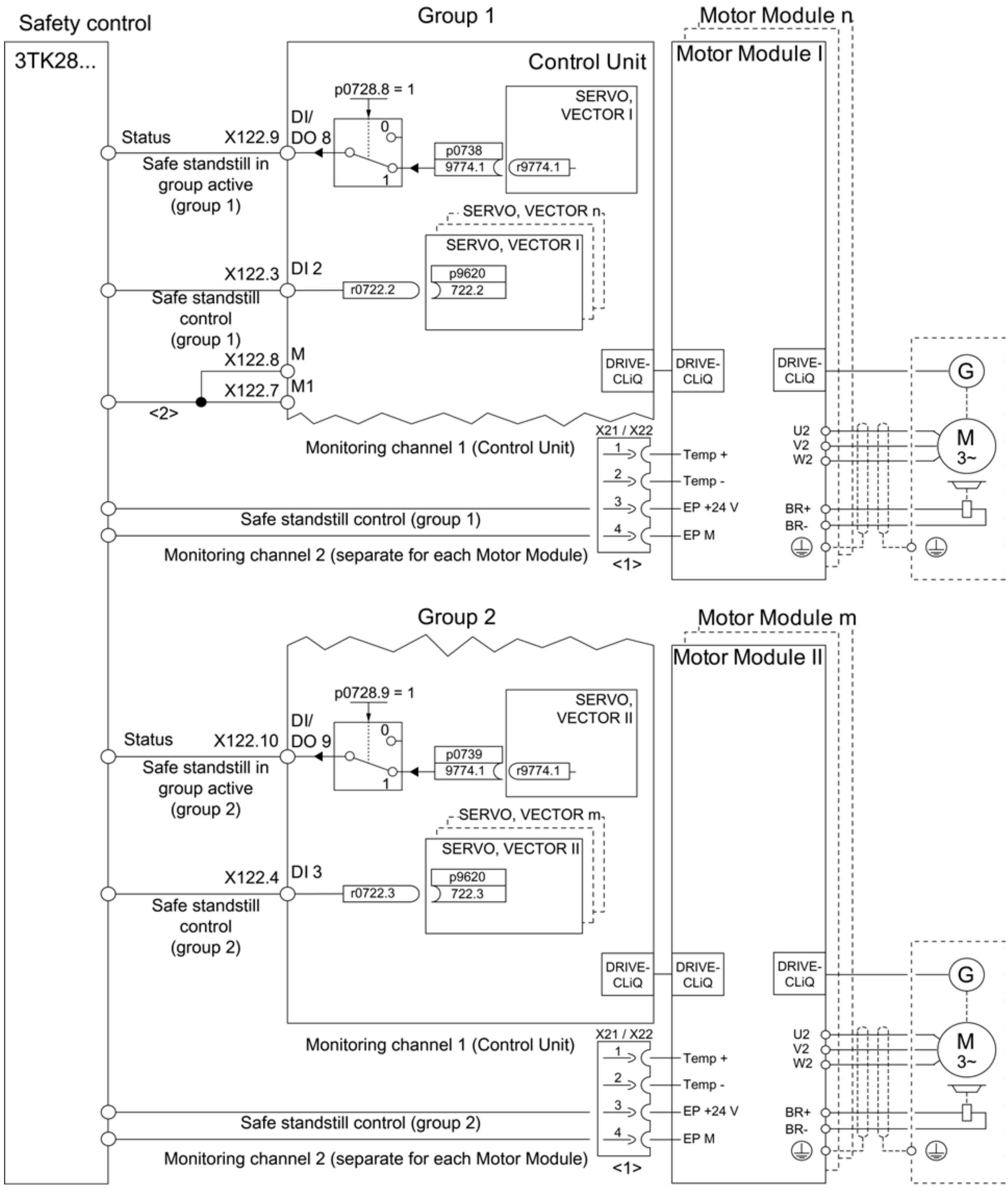
The same grouping must be set in both monitoring channels.

If a fault in a drive leads to an STO, the other drives in the same group will not automatically enter the STO state.

Example: Terminal grouping for Safe Torque Off (STO)

It must be possible to select/deselect the Safe Torque Off function separately for group 1 (drive 1 and 2) and group 2 (drive 3 and 4).

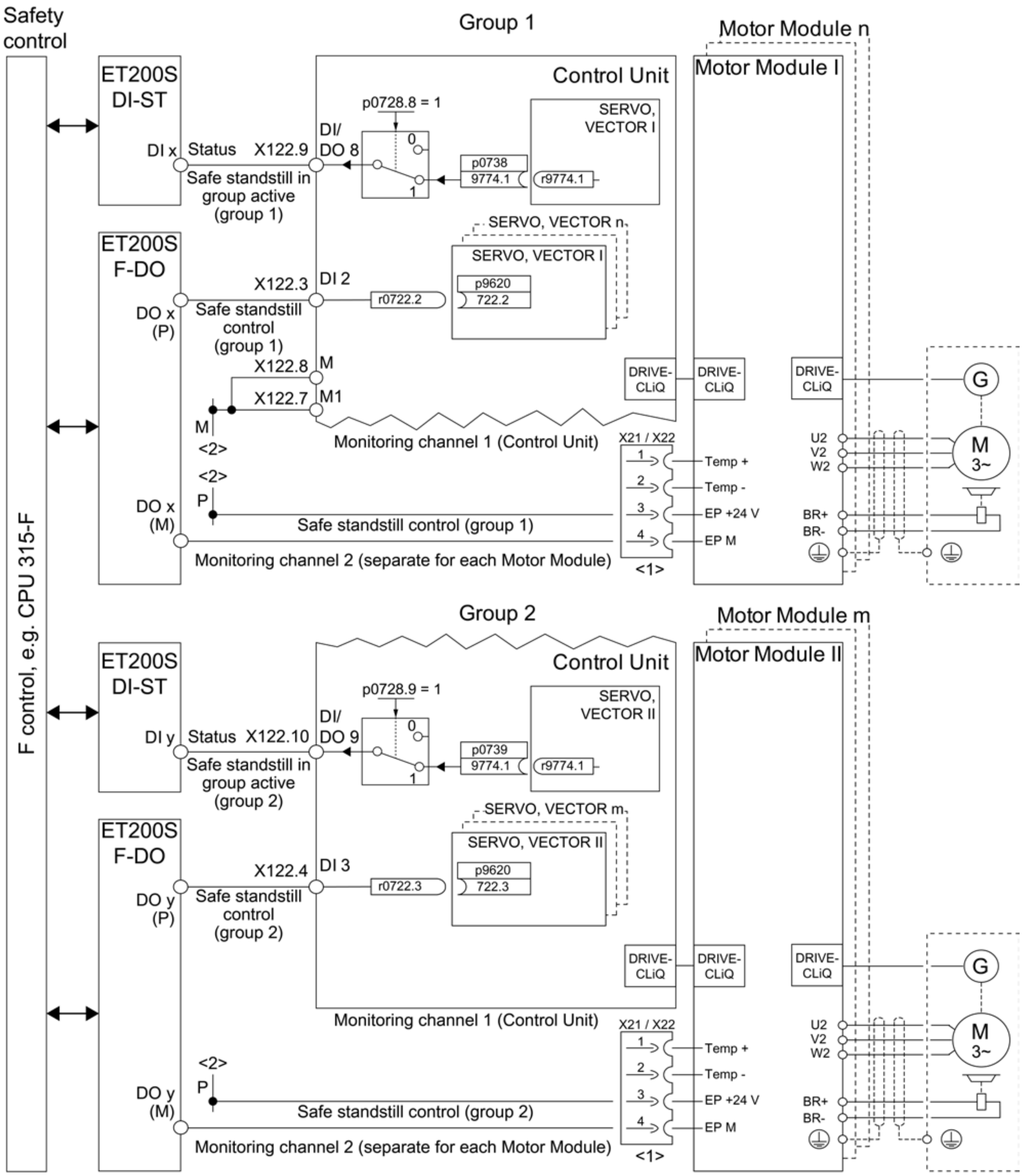
For this purpose, the same grouping for Safe Torque Off must be performed on both the Control Unit and the Motor Modules.



<1> Signal must be routed parallel to the Motor Modules in a group.

<2> Establish potential reference for power supply.

Figure 9-3 Terminal grouping for Safe Torque Off



<1> Signal must be routed parallel to the Motor Modules in a group.

<2> Establish potential reference for power supply of ET200S.

Figure 9-4 Terminal grouping for Safe Torque Off; control using ET200S fail-safe output, for example

Enabling the Safe Torque Off (STO) function

The Safe Torque Off function is enabled via the following parameters:

p9601.0	STO using terminals on the Control Unit
p9801.0	STO using terminals on the Motor Module

The Safe Torque Off function does not need to be enabled for applications that do not require Safety Integrated. All input terminals on the Control Unit can be used.

The STO terminal on the Motor Module does not need to be used.

Selecting/Deselecting Safe Torque Off

The Safe Torque Off function must be selected/deselected simultaneously in both monitoring channels using the input terminals and is only effective for the associated drive.

1 signal: Deselection of the function

0 signal: Selection of the function

Restart after the Safe Torque Off function has been selected

1. Deselect the function in each monitoring channel via the input terminals.
2. Issue drive enable signals.
3. Cancel the power-on inhibit and power-up again.
   – 1/0 edge at input signal "ON/OFF1" (cancel power-on inhibit)
   – 0/1 edge at input signal "ON/OFF1" (power-up drive)
4. Move/traverse the drives again.

Status for Safe Torque Off

The status of the Safe Torque Off function is displayed using the following parameters:

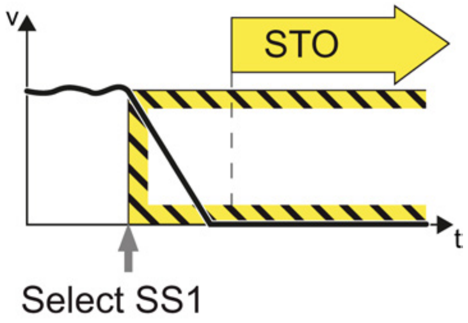
r9772	CO/BO: Safety Integrated Status (Control Unit)
r9872	CO/BO: Safety Integrated Status (Motor Module)
r9773	CO/BO: Safety Integrated Status (Control Unit + Motor Module)
r9774	CO/BO: Safety Integrated Status (Safe Torque Off group)

Further information

For further details and information on how to assign parameters for this function, see the "SINAMICS S120, Safety Integrated" Function Manual.

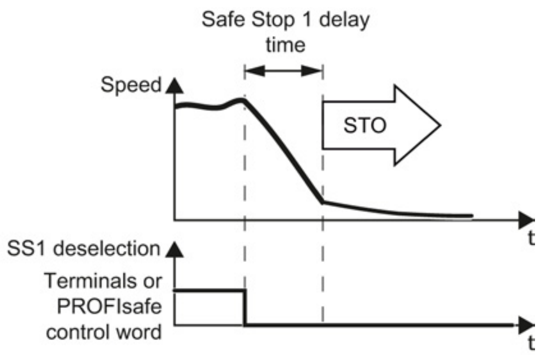
9.2.2.2 Safe Stop 1 (SS1)

Definition according to EN 61800-5-2:
"The function SS1 brakes the motor and trips the function STO after a delay time."



Principle of operation

The drive brakes once "Safe Stop 1" has been selected, and goes into the "Safe Torque Off" (STO) state once the delay time has expired.



Selecting SS1

As soon as the converter identifies that SS1 has been selected via a terminal or via PROFIsafe safe communication, the following happens:

- If the motor has already been switched off when SS1 was selected, then the converter safely switches off the motor torque (STO).
- If the motor is switched on when SS1 is selected, the converter brakes the motor with the AUS3 ramp-down time.

Application examples

Example	Possible solution
After an Emergency Stop button has been pressed, the drive must be braked as quickly as possible and brought into the STO state.	• Wire the Emergency Stop button with a fail-safe input. • Select SS1 via the fail-safe input.
A central Emergency Stop button ensures that several drives are braked as quickly as possible and brought into the STO state.	• Evaluate an Emergency Stop button in a central control. • Select SS1 via PROFIsafe.

Further information

For further details and information on how to assign parameters for this function, see the "SINAMICS S120, Safety Integrated" Function Manual.

9.2.2.3 Safe Brake Control (SBC)

Principle of operation

The "Safe Brake Control" function (SBC) is used to control holding brakes that function according to the closed-circuit principle (e.g. motor holding brake).

SBC is (if configured) initiated together with STO. The Motor Module / Safe Brake Relay / Safe Brake Module then carries out the action and activates the outputs for the brake.

Brake activation via the brake connection on the Motor Module / Safe Brake Relay / Safe Brake Module involves a safe, two-channel method.

Features

- SBC is executed when "Safe Torque Off" (STO) is selected.
- In contrast to conventional brake control, SBC is executed via two channels.
- SBC is executed regardless of the brake control or mode set in p1215. SBC is not recommended, however, when 1215 = 0 or 3.
- When the state changes, electrical faults, such as a short-circuit in the brake winding or wire breakage can be detected.

Two-channel brake control

The brake is essentially controlled from the Control Unit. Two signal paths are available for applying the brake.

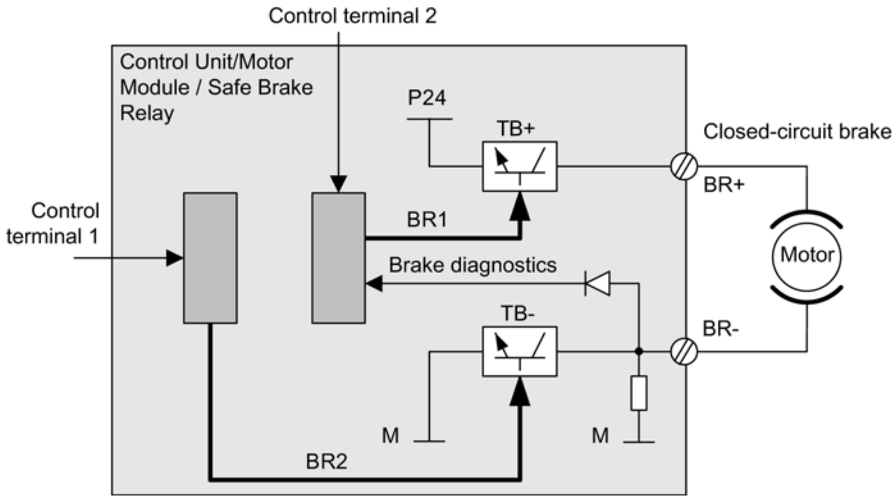


Figure 9-5 Two-channel brake control, blocksize (example)

For the "Safe Brake Control" function, the Motor/Power Module assumes a monitoring function to ensure that when the Control Unit fails or malfunctions the brake current is interrupted therefore closing the brake.

The brake diagnostics can only reliably detect a malfunction in either of the switches (TB+, TB–) when the status changes, i.e. when the brake is released or applied.

If the Motor Module or Control Unit detects a fault, the brake current is switched off and the safe status is reached.

Note

The monitoring and the forced checking procedure of the brake outlet is only possible if the brake is connected directly to the connection terminals, and not using a coupling relay!

Further information

For further details and information on how to assign parameters for this function, see the "SINAMICS S120, Safety Integrated" Function Manual.

9.3 SINUMERIK Safety Integrated

9.3.1 Safety functions

SINUMERIK Safety Integrated provides integrated safety functions for monitoring standstill, speed, and working area.

Table 9- 2 SINUMERIK 840D sl safety functions

Function	Abbr.	Meaning
Safe Stopping Process	SS1	Brakes the drives safely down to standstill if monitoring or a sensor is triggered.
Safe Acceleration Monitor	SBR	Monitors the speed characteristic. The speed must be reduced after a stop request has been issued.
Safe Operating Stop	SBH	Monitors the drives during standstill (to ensure that they remain stationary). The drives remain fully functional for position control.
Safe Standstill	SH	The drive pulses are suppressed, allowing the energy feed to be safely and electronically disconnected.
Safely Reduced Speed	SG	Monitoring of configurable speed limits
Safety-Related Output $n < n_x$	-	Safe speed detection for a drive
Safe Software Limit Switch	SE	Variable traversing range limits
Safe Software Cam	SN	Range detection
Safety-Related Input/Output Signals	SGE/ SGA	Interface with process
Safe Programmable Logic	SPL	Direct connection of all safety-related signals and their internal logical operations
Safe Brake Management	SBM	• 2-channel brake control (SBC) (integrated into Motor Module) • Cyclic brake test (SBT)
Safety-related communication via standard bus	-	• Connection of distributed I/O for process and safety signals via PROFIBUS or PROFINET using the PROFIsafe protocol • Safety-related CPU - CPU communication via PROFIBUS or PROFINET
Integrated acceptance test	-	Partially automated acceptance test for all safety-related functions. Simple operation of the test process, automatic configuration of trace functions, and automatic generation of an acceptance report.

Note

External safety-related process signals are connected via safe input/output modules of the ET200S, ET200M, ET200eco, or ET200pro, and connected to SINUMERIK 840D sl via PROFIBUS or PROFINET.

The safe sensors and actuators are processed within the safe programmable logic, which means that external safety relays are no longer required.

Note

Further information

You can find a detailed description of the individual safety functions in the SINUMERIK Safety Integrated Function Manual (FBSI sl).

9.3.2 Connecting safe sensors and actuators to the SINUMERIK

The following example illustrates the wiring possibilities of the ET200S PROFIsafe component.

No complete plant with all required hardware and software settings is shown. Only the data always required for the application is described for each of the used ET200S components. A detailed description is contained in the associated product/function manuals.

The sensor/actuator connection for SINUMERIK Safety Integrated is established using PROFIBUS or PROFINET with PROFIsafe profile and PROFIsafe-compliant I/O modules (e.g. ET200S, ET200eco, ET200pro, or ET200M).

Overview of the ET200S peripheral connection to the NCU

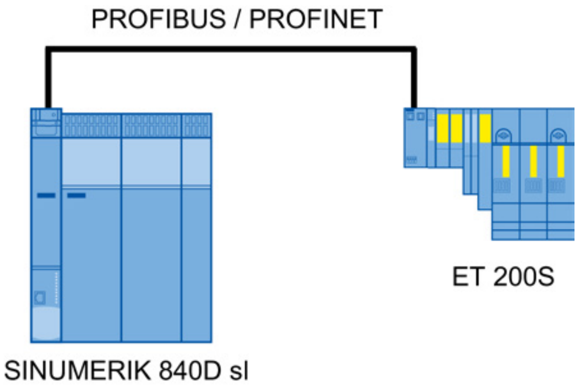


Figure 9-6 Overview of the ET200S peripheral connection to the NCU

Signal assignment and significance

Part of the signal assignment and significance for the PROFIsafe modules is explained in the following section:

4/8 F-DI 24 VDC PROFIsafe electronic module

The safety-related I/O input signals are connected to this module. These sensors in the example are optionally exclusive OR with two break contacts (Emergency Stop actuator and protective door interlocked state), i.e. provided with a break contact and a make contact (agreement button) or with two make contacts (<drive on> button).

All of the sensor signals are connected through two channels.

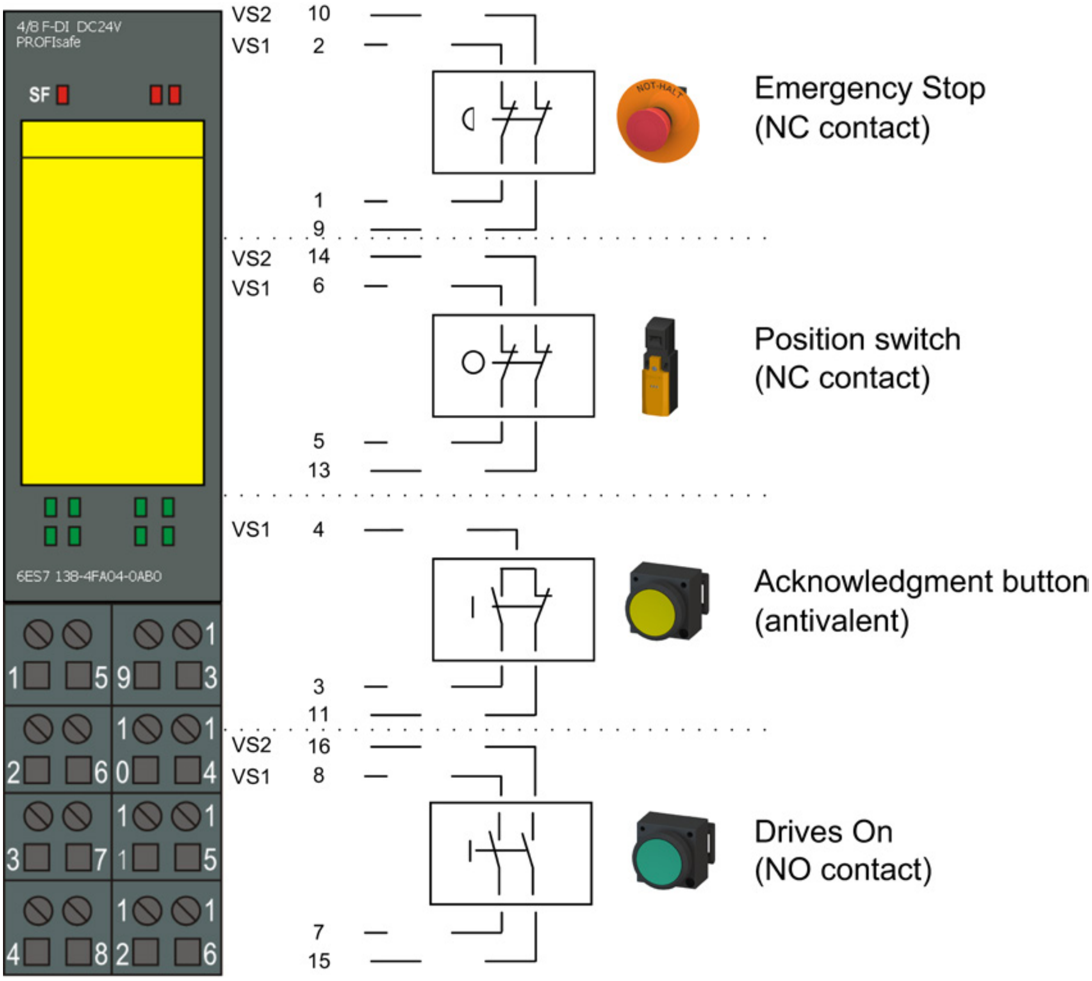


Figure 9-7 Signal assignment, electronics module, 4/8F-DI, 24 VDC, PROFIsafe

Meaning and use of the individual signals

Emergency Stop actuator [F-DI terminal 1 (channel 0), terminal 9 (channel 4)]

Signal state channel 0 = "1" and channel 4 = "1":
Emergency Stop actuator not pressed.

Signal state channel 0 = "0" and channel 4 = "0":
Emergency Stop actuator pressed.

Protective door interlocked state [F-DI terminal 5 (channel 1), terminal 13 (channel 5)]

The door switch only interlocks if the actuator is inserted. The contacts of the monitoring circuit then signal the status "closed and interlocked"

Signal state channel 1 = "1" and channel 5 = "1":
Protective door closed and interlocked.

Signal state channel 1 = "0" and channel 5 = "0":
Protective door not closed or not interlocked.

Agreement button [F-DI terminal 3 (channel 2), terminal 11 (channel 6)]

Signal state channel 2 = "1" and channel 6 = "0":
Acknowledgment button pressed.

Signal state channel 2 = "0" and channel 6 = "1":
Acknowledgment button not pressed.

Drives On button [F-DI terminal 7 (channel 3), terminal 15 (channel 7)]

Signal state channel 3 = "0" and channel 7 = "0":
Drives On button not pressed.

Signal state channel 3 = "1" and channel 7 = "1":
Drives On button pressed.

VS1: internal sensor supply for channel 0 to 3

VS2: internal sensor supply for channel 4 to 7

These two sensor supplies must be used when the short-circuit test is activated. The exclusive OR sensor agreement button is an exception. For this sensor variant, in conjunction with the short-circuit test, the VS1 sensor supply must be used for both contacts.

Electronics module 4 F-DO 24 VDC/2 A PROFIsafe

The actuators that must be shut-down in a safety-related fashion are connected through two channels. Each output channel can be separately shutdown.

Two valve units are connected in the configuration example. These are used to control the motion of the supplementary pneumatic axis.

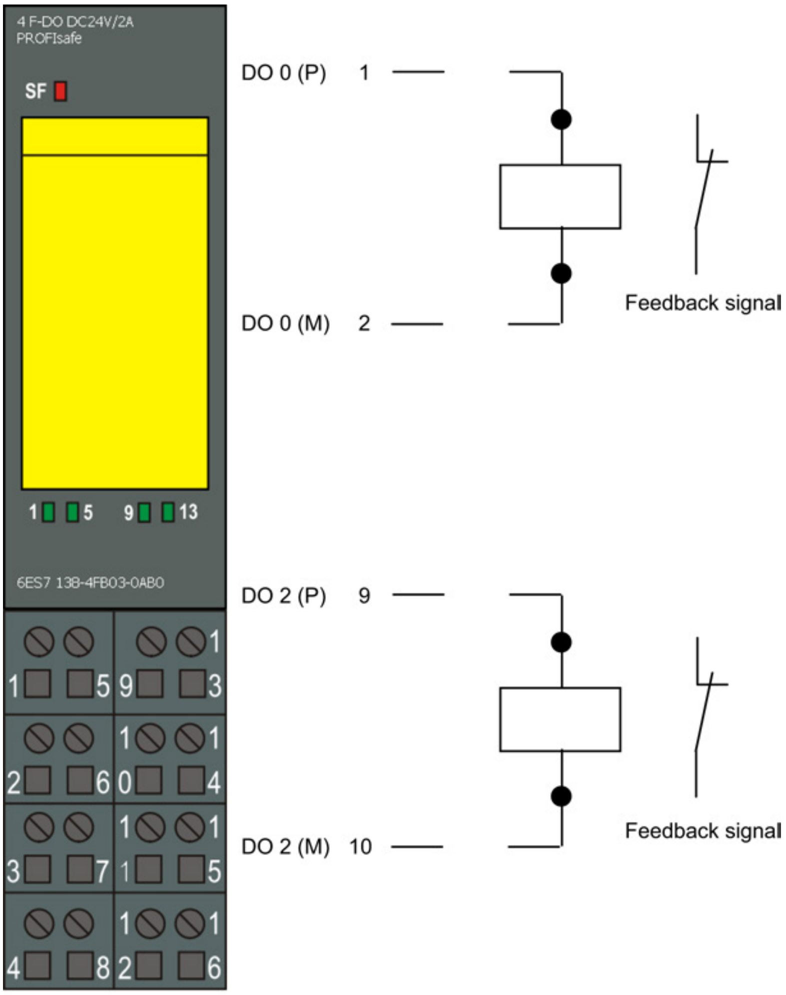


Figure 9-8 Signal assignment electronics module, 4F-DO, 24 VDC_2 A, PROFIsafe

Meaning and use of the individual signals

Valve unit 1 F-DO terminal 1,2 (channel 0 P/M)

Signal state channel 0 = "0"
Valve in the locked neutral position

Signal state channel 0 = "1"
Valve in the flow position

Not assigned [F-DO terminal 5,6 (channel 1 P/M)]

Valve unit 2 [F-DO terminal 9,10 (channel 2 P/M)]

Signal state channel 2 = "0"
Valve in the locked neutral position

Signal state channel 2 = "1"
Valve in the flow position

Not assigned [F-DO terminal 13.14 (channel 3 P/M)]

Power Module PM-E F

This module combines two functions. Not only can individual actuators (comparable with the functionality of an F-DO module) be connected to all three two-channel output channels, but the third DO2 output channel also has a further function.

The DO2 output channel is used to internally (no external wiring required) disconnect safety-oriented (i.e. with two potentials) to supply power for the subsequent standard DO or also standard DI modules. Namely, the outputs on the DO modules can not only be controlled using a single channel in the PLC for the "normal" function, but also a safety-oriented shutdown of the power supply for all DO modules following the PM-E F module is possible.

Power Module PM-D F 24 V DC PROFIsafe

The Power Module can switch off the SG 1 to SG 6 voltage buses in a fail-safe way using six digital outputs. The outputs are implemented using two P switches in each case. There is a main switch for all six shutdown groups and six subsequent (downstream) individual switches for each shutdown group.

The voltage bus U 1 (electronics power supply for the motor starter) is supplied with 24 VDC. In the event of an overvoltage or undervoltage condition, U 1 is shut down by two P switches and the subsequent (downstream) motor starters are deactivated. If the motor starter is safely shutdown, U 1 is not shutdown.

With the six available shutdown groups (SG1...SG6), the Power Module is suitable for tasks including supplying fail-safe motor starters such as F-DS1e-x and F-RS1e-x.

Fail-safe direct starters F-DS1e-x

The fail-safe direct starter with electronic overload protection can either power-up or power-down the connected motor (implemented in the application through the PLC I/O interface). Further, when the SG signal is missing at the upstream PM-D F, the PM module can shutdown the motor in a safety-related fashion.

Depending on the type, three-phase motors up to 7.5 kW can be connected and operated with integrated protection against overload and short-circuit.

On the one hand, the SG 1...SG 6 safe shutdown group will be assigned to the fail-safe motor starter using the STEP 7 hardware configuration. On the other hand, the assignment is realized using the coding connector on the terminal module of the motor starter. Both assignments must match one another.

10 Signal Interconnection

Note

This chapter is still undergoing revision.

11 Typical circuit diagrams

Note

This chapter is still undergoing revision.

Activate/Deactivate Drive System 12

12.1 Overview of the Status Signals

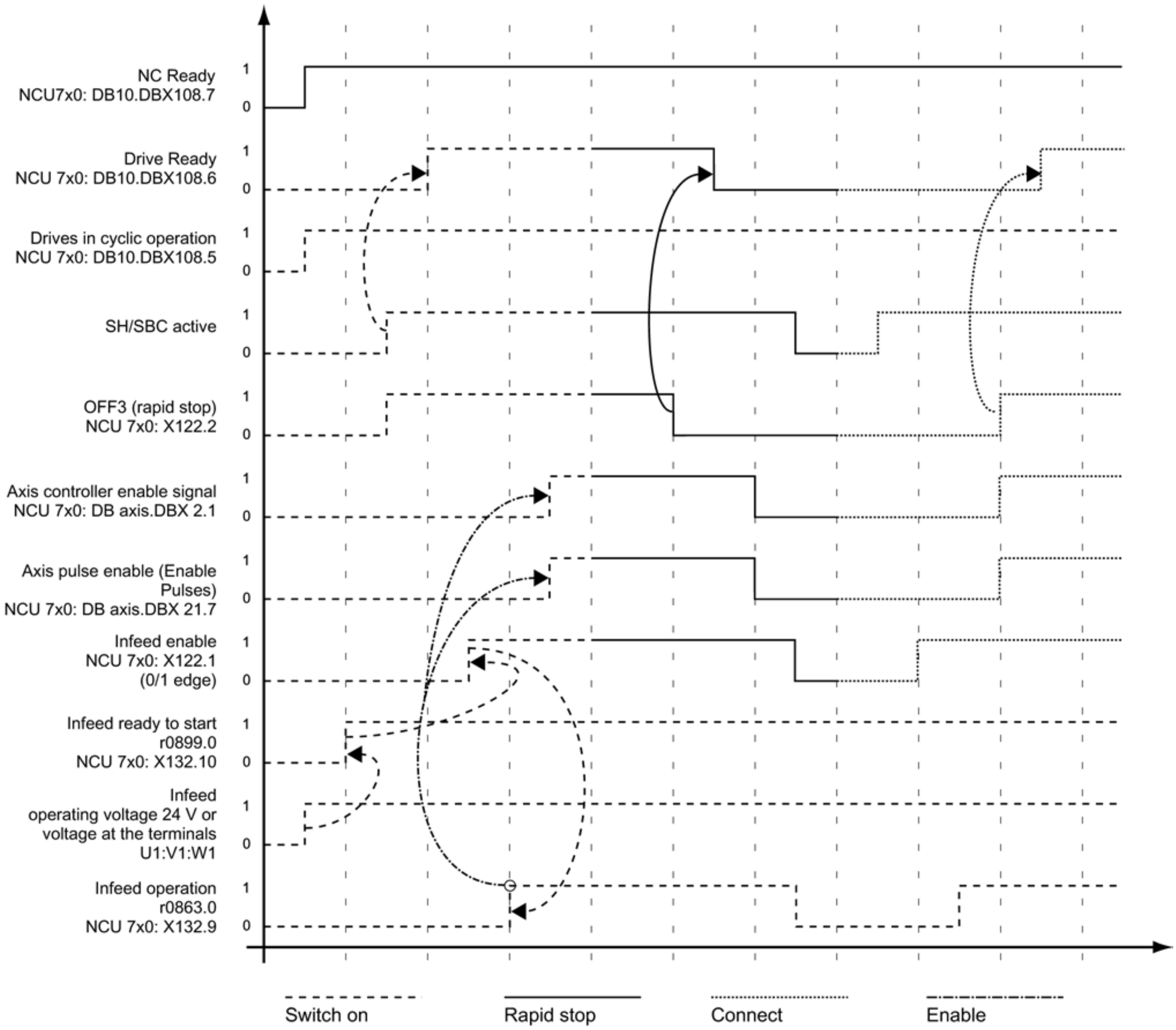


Figure 12-1 Overview of the Status Signals

12.2 Drive Group with Several Axes

The Motor Module is controlled via terminals -X21, -X22 and the DRIVE-CLiQ interfaces -X200/-X201/-X202/-X203 (-X22 and -X203 are only available with Double Motor Modules). You can find a detailed function description for the individual signals and control/status words in the following document:

\LH1\SINAMICS S120/S150 List Manual

To enable the Motor Module, the "infeed ready" signal must be connected from the Line Module.

The following function diagrams show how the individual signals interact.

Activating the infeed

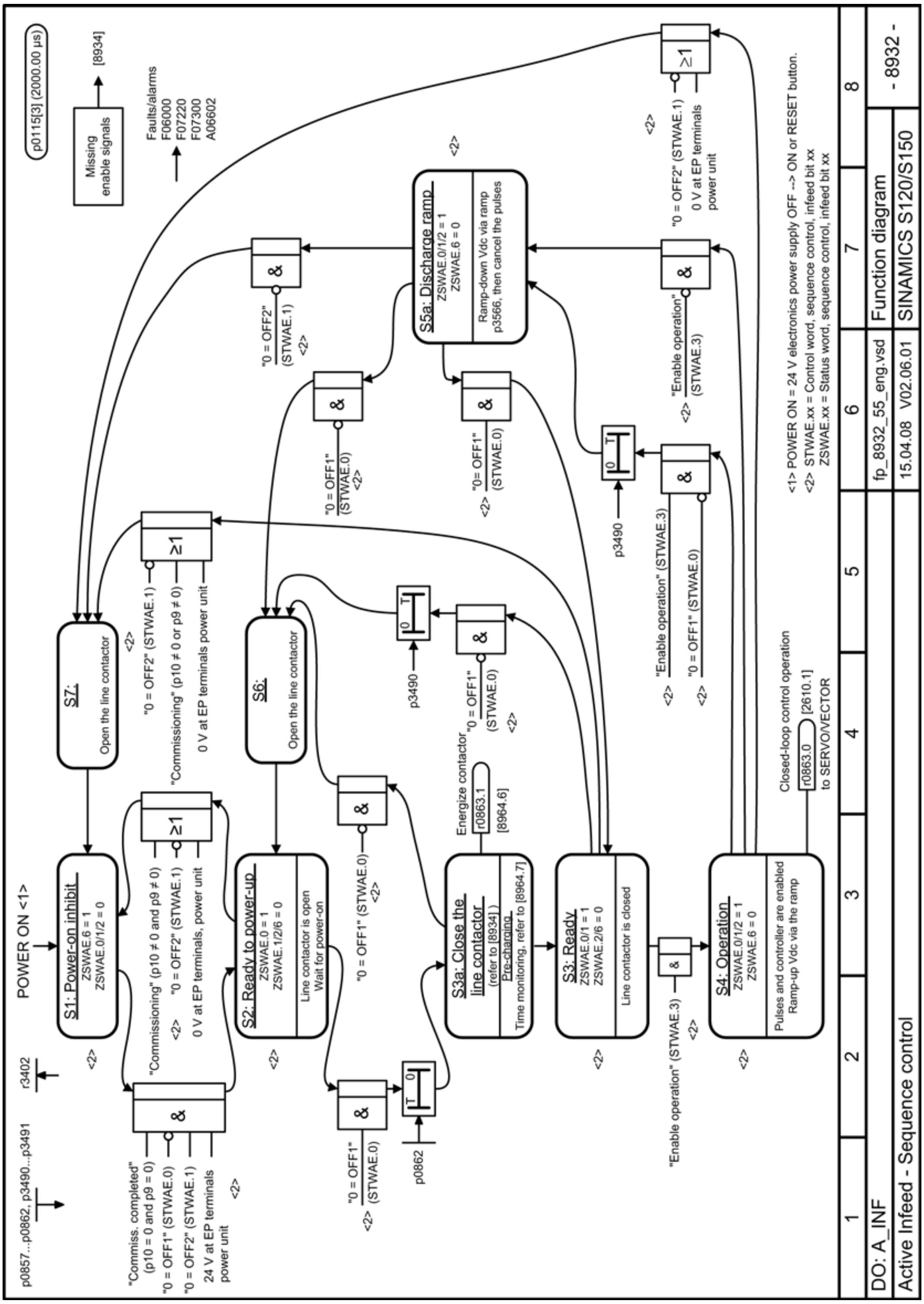


Figure 12-2 "Infeed activation" function diagram

Activating the drive

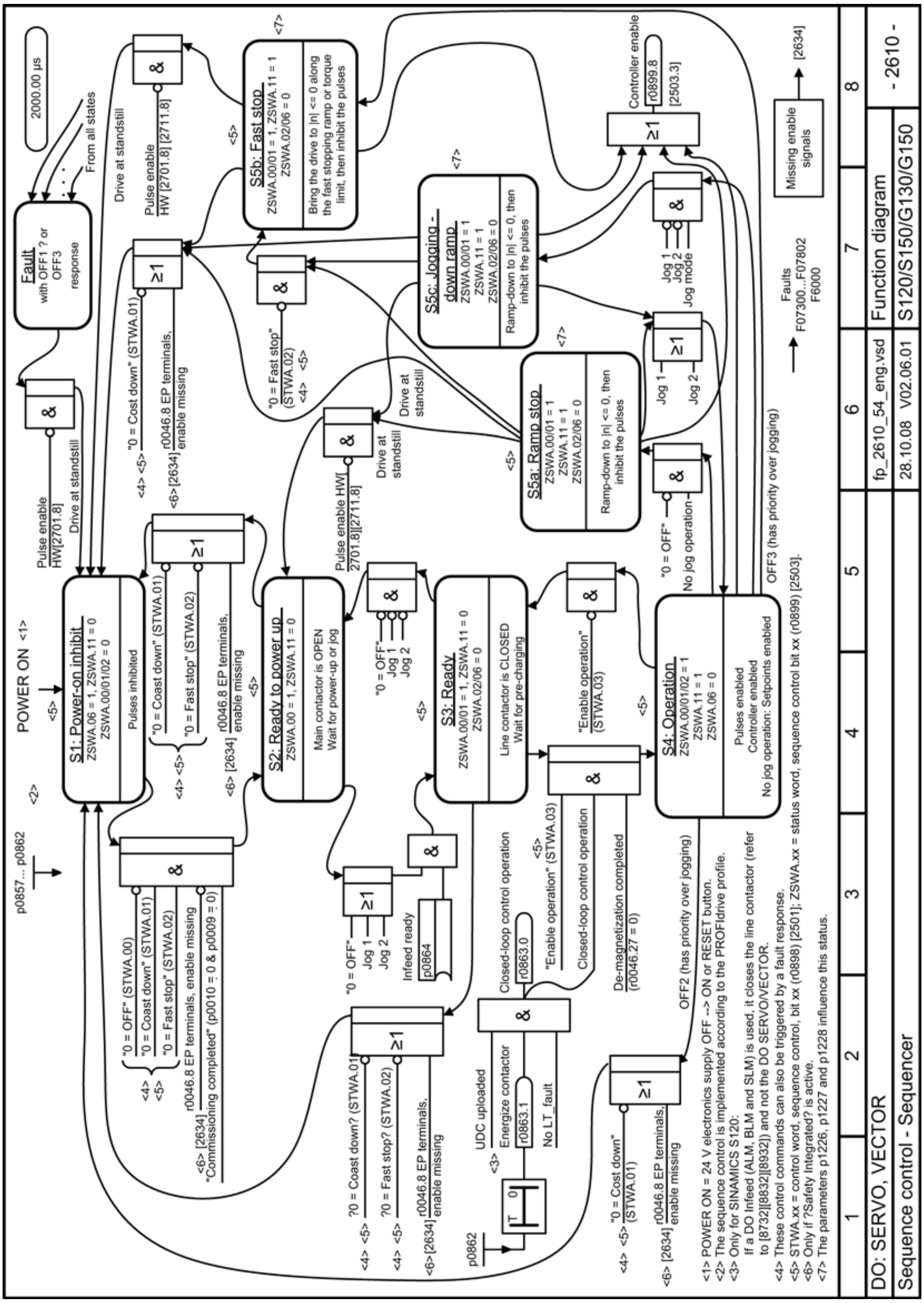


Figure 12-3 "Drive activation" function diagram

Note

Applies to CU320; with integrated drive solutions (e.g. NCU, NX, etc.), some signals are already processed by means of internal communication

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Off responses

- OFF1
  - The immediate specification of n_set = 0 at the ramp generator return ramp (p1121) causes the drive to be braked.
  - When zero speed is detected, the motor holding brake (if parameterized) is closed (p1215). The pulses are suppressed when the closing time (p1217) expires. The zero speed is detected when the speed actual value is lower than the speed threshold (p1226) or when the monitoring time (p1227) started when speed setpoint ≤ speed threshold (p1226) has expired.
- OFF2
  - Immediate pulse suppression, the drive coasts to standstill.
  - The motor holding brake (if parameterized) is closed immediately.
  - Closing lockout is activated.
- OFF3
  - The immediate specification of n_set = 0 at the OFF3 return ramp (p1135) causes the drive to be braked.
  - When zero speed is detected, the motor holding brake (if parameterized) is closed. The pulses are suppressed when the closing time of the holding brake (p1217) expires. The zero speed is detected when the speed actual value is lower than the speed threshold (p1226) or when the monitoring time (p1227) started when speed setpoint ≤ speed threshold (p1226) has expired.
  - Closing lockout is activated.

Control and status signals

Table 12- 1 Switching on/switching off the control system

Signal name	Internal control word	Binector input	PROFIBUS message frame 2 … 106	VDI interface (PLC)
0 = OFF1	STWA.00 STWAE.00	p0840 ON/OFF1	STW1.0	DB(AX).DBX2.1 (controller enable) DB(AX).DBX1.5/6 (measuring system selected and OK) DB(AX).DBX21.7 (pulse enable)
0 = OFF2	STWA.01 STWAE.01	p0844 1. OFF2 p0845 2. OFF2	STW1.1	1
0 = OFF3	STWA.02	p0848 1. OFF3 P0849 2. OFF3	STW1.2	1
Enable operation	STWA.03 STWAE.03	p0852 operation enabled	STW1.3	DBX21.7

Table 12- 2 Activate/deactivate status signals

Signal name	Internal status word	Parameter	PROFIBUS message frame 2 … 106
Ready to start	ZSWA.00 ZSWAE.00	r0899.0	ZSW1.0
Ready	ZSWA.01 ZSWAE.01	r0899.1	ZSW1.1
Operation enabled	ZSWA.02 ZSWAE.02	r0899.2	ZSW1.2
Closing lockout	ZSWA.06 ZSWAE.06	r0899.6	ZSW1.6
Pulses enabled	ZSWA.11	r0899.11	ZSW1.11

Function block diagram overview (see SINAMICS S List Manual)

- 2610 sequence control - sequencer
- 2634 missing enables, line contactor control
- 8732 basic infeed - sequencer
- 8832 smart infeed - sequencer
- 8932 active infeed - sequencer

Appendix A

A.1 Screw terminals

The type of screw terminal can be taken from the interface description of the particular component.

Table A- 1 Connectable conductor cross-sections and tightening torques for screw terminals

Screw terminal type			
1	Connectable conductor cross-sections	Rigid, flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.08 mm² to 1.5 mm² 0.25 mm² to 1.5 mm² 0.25 mm² to 0.5 mm²
	Stripping length	7 mm	
	Tool	Screwdriver 0.4 x 2.0 mm	
	Tightening torque	0.22 to 0.25 Nm	
1_1	Connectable conductor cross-sections	Rigid, flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.14 mm² to 1.5 mm² 0.25 mm² to 1.5 mm² 0.25 mm² to 0.5 mm²
	Stripping length	7 mm	
	Tool	Screwdriver 0.4 x 2.5 mm	
	Tightening torque	0.22 to 0.25 Nm	
2	Connectable conductor cross-sections	Rigid, flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.08 mm² to 2.5 mm² 0.5 mm² to 2.5 mm² 0.5 mm² to 1.5 mm²
	Stripping length	7 mm	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 to 0.6 Nm	
3	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.2 mm² to 2.5 mm² 0.25 mm² to 1 mm² 0.25 mm² to 1 mm²
	Stripping length	9 mm	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 to 0.6 Nm	
4	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.2 mm² to 4 mm² 0.25 mm² to 4 mm² 0.25 mm² to 4 mm²
	Stripping 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 wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.5 mm² to 6 mm² 0.5 mm² to 6 mm² 0.5 mm² to 6 mm²
	Stripping length	12 mm	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.2 to 1.5 Nm	
6	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.5 mm² to 10 mm² 0.5 mm² to 10 mm² 0.5 mm² to 10 mm²
	Stripping length	11 mm	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.5 to 1.8 Nm	
7	Connectable conductor cross-sections	0.5 mm² to 16 mm²	
	Stripping length	14 mm	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.5 to 1.7 Nm	

A.2 Spring-loaded terminals

The type of spring-loaded terminal can be taken from the interface description of the particular component.

Table A- 2 Connectable conductor cross-sections for spring-loaded terminals

Spring-loaded terminal type			
1	Connectable conductor cross-sections	Rigid Flexible Flexible with end sleeve without plastic sleeve AWG/kcmil	0.14 mm² to 0.5 mm² 0.14 mm² to 0.5 mm² 0.25 mm² to 0.5 mm² 26 to 20
	Stripping length	8 mm	
2	Connectable conductor cross-sections	Flexible	0.08 mm² to 2.5 mm²
	Stripping length	8 to 9 mm	
3	Connectable conductor cross-sections	Rigid Flexible Flexible with end sleeve without plastic sleeve Flexible with end sleeve with plastic sleeve AWG/kcmil	0.2 mm² to 1 mm² 0.2 mm² to 1.5 mm² 0.25 mm² to 1.5 mm² 0.25 mm² to 0.75 mm² 24 to 16
	Stripping length	8 mm	
3_1	Connectable conductor cross-sections	Rigid Flexible Flexible with end sleeve without plastic sleeve Flexible with end sleeve with plastic sleeve AWG/kcmil	0.2 mm² to 1.5 mm² 0.2 mm² to 1.5 mm² 0.25 mm² to 1.5 mm² 0.25 mm² to 0.75 mm² 24 to 16
	Stripping length	10 mm	
4	Connectable conductor cross-sections	25 mm² to 95 mm² AWG 4 to 4/0	
	Stripping length	35 mm	
5	Connectable conductor cross-sections	Rigid Flexible Flexible with end sleeve without plastic sleeve Flexible with end sleeve with plastic sleeve AWG/kcmil	0.2 mm² to 10 mm² 0.2 mm² to 6 mm² 0.25 mm² to 6 mm² 0.25 mm² to 4 mm² 24 to 8
	Stripping length	15 mm	

A.3 Power loss of components

A.3.1 Power Loss of the SINUMERIK Components

The following power losses apply to operation with rated power:

Table A- 3 List of power losses

Component	Power loss
NCU 710.2	22 W
NCU 720.2	25 W
NCU 720.2 PN	55 W
NCU 730.2	55 W
NCU 730.2 PN	65 W
NX1x.x	20 W

A.3.2 Power loss of SINAMICS components

The tables below provide an overview of the power loss of all components during rated operation. The characteristic values apply for the following conditions:

- Line voltage for Line Modules 400 V
- Pulse frequency of the Motor Modules 4 kHz
- Rated pulse frequency of the Active Line Modules 8 kHz
- Operating components at their rated power

The total losses of the relevant power unit (Line Module, Motor Module) are calculated from the power loss and the corresponding electronics loss of the power unit.

A.3.2.1 Power loss for Control Units, Sensor Modules, and other system components

Table A- 4 Overview of power loss during rated operation for Control Units, Sensor Modules, and other system components

	Unit	Power loss
Control Units and Option Boards		
CU320-2	W	24
CBC10	W	< 3
CBE20	W	2.8
Sensor Modules		
SMC10	W	< 10
SMC20	W	< 10
SMC30	W	< 10

	Unit	Power loss
SME20/25	W	≤ 4
SME120/125	W	≤ 4.5
Terminal Modules		
TM15	W	< 3
TM41	W	12
TM120	W	2.4
DC link components		
Braking Module Booksize	W	20
Braking Module Booksize Compact	W	< 40
Capacitor Module	W	25
Control Supply Module Line DC link	 W W	 70 65
Voltage Clamping Module	W	50

A.3.2.2 Power loss for line filters and line reactors

Table A- 5 Overview of power loss during rated operation for line filters and line reactors

	Unit	Power loss
Basic Line Filters for Active Line Modules		
16 kW	W	16
36 kW	W	26
55 kW	W	43
80 kW	W	56
120 kW	W	73
Basic Line Filter for Active Line Modules with Active Interface Module		
16 kW	W	16
36 kW	W	26
55 kW	W	43
80 kW	W	56
120 kW	W	73
Wideband Line Filter for Active Line Modules		
16 kW	W	70
36 kW	W	90
55 kW	W	110
80 kW	W	150
120 kW	W	200
Basic Line Filter for Smart Line Modules		
5 kW	W	5
10 kW	W	9
16 kW	W	16

	Unit	Power loss
36 kW	W	26
55 kW	W	43
Basic Line Filter for Basic Line Modules		
20 kW	W	16
40 kW	W	26
100 kW	W	73
Active Interface Modules		
16 kW	W	270 1)
36 kW	W	340 1)
55 kW	W	380 1)
80 kW	W	490 1)
120 kW	W	585 1)
Line reactors for Active Line Modules		
16 kW	W	170
36 kW	W	250
55 kW	W	350
80 kW	W	450
120 kW	W	590
Line reactors for Smart Line Modules		
5 kW	W	62
10 kW	W	116
16 kW	W	110
36 kW	W	170
55 kW	W	200
Line reactors for Basic Line Modules		
20 kW	W	130
40 kW	W	270
100 kW	W	480

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

A.3.2.3 Power loss for power units with internal air cooling

Table A- 6 Overview of power loss at rated operation for power units with internal air cooling (including electronics losses)

	Unit	Power loss
Active Line Modules		
16 kW	W	282.8
36 kW	W	666
55 kW	W	945.6
80 kW	W	1383.6
120 kW	W	2243.2

	Unit	Power loss
Smart Line Modules Booksize		
5 kW	W	79.2
10 kW	W	141.6
16 kW	W	187.8
36 kW	W	406
55 kW	W	665.6
Smart Line Modules Booksize Compact		
16 kW	W	187.8
Basic Line Modules		
20 kW	W	144
40 kW	W	283.6
100 kW	W	628
Single Motor Modules Booksize		
3 A	W	50.4
5 A	W	73.4
9 A	W	100.4
18 A	W	185.4
30 A	W	309.2
45 A	W	455.2
60 A	W	615.2
85 A	W	786
132 A	W	1270.4
200 A	W	2070.4
Single Motor Modules Booksize Compact		
3 A	W	68 [1)]
5 A	W	98 [1)]
9 A	W	100.4
18 A	W	185.4
Double Motor Modules Booksize		
3 A	W	97.6
5 A	W	132.6
9 A	W	187.6
18 A	W	351.2
Double Motor Modules Booksize Compact		
1.7 A	W	114 [1)]
3 A	W	134 [1)]
5 A	W	194 [1)]

1) Power loss at 8 kHz

A.3.2.4 Power loss for power units with external air cooling

Table A- 7 Overview of power loss at rated operation for power units with external air cooling (including electronics losses)

	Unit	Internal Power loss 1)	External power loss	Total power loss
Active Line Modules				
16 kW	W	82.8 (60 + 22,8)	200	282.8
36 kW	W	171 (135 + 36,0)	495	666
55 kW	W	245.6 (200 + 45,6)	700	945.6
80 kW	W	338.6 (305 + 33,6)	1045	1383.6
120 kW	W	533.2 (490 + 43,2)	1710	2243.2
Smart Line Modules				
5 kW	W	41.2 (22 + 19,2)	38	79.2
10 kW	W	66.6 (45 + 21,6)	75	141.6
16 kW	W	64.8 (42 + 22,8)	123	187.8
36 kW	W	116 (80 + 36)	290	406
55 kW	W	185.6 (140 + 45,6)	480	665.6
Single Motor Modules				
3 A	W	35.4 (15 + 20,4)	15	50.4
5 A	W	43.4 (23 + 20,4)	30	73.4
9 A	W	55.4 (35 + 20,4)	45	100.4
18 A	W	95.4 (75 + 20,4)	90	185.4
30 A	W	99.2 (80 + 19,2)	210	309.2
45 A	W	135.2 (110 + 25,2)	320	455.2
60 A	W	160.2 (135 + 25,2)	455	615.2
85 A	W	196 (160 + 36,0)	590	786
132 A	W	270.4 (250 + 20,4)	1000	1270.4
200 A	W	455.4 (435 + 20,4)	1615	2070.4
Double Motor Modules				
3 A	W	62.6 (35 + 27,6)	35	97.6
5 A	W	72.6 (45 + 27,6)	60	132.6
9 A	W	92.6 (65 + 27,6)	95	187.6
18 A	W	111.2 (80 + 31,2)	240	351.2

1) Power loss of the power electronics + power loss of the 24 V electronics

A.3.2.5 Power loss for power units with cold plate

With cold-plate cooling, only part of the power loss remains in the cabinet.
The table below shows the internal and external power loss of the components.

Table A- 8 Overview of power loss at rated operation for power units with cold plate (including electronics losses)

	Unit	Internal power loss 1)	External power loss	Total power loss
Active Line Modules				
16 kW	W	70.4 (50 + 20,4)	210	280.4
36 kW	W	135.2 (110 + 25,2)	520	655.2
55 kW	W	187.6 (160 + 27,6)	740	927.6
80 kW	W	283.6 (250 + 33,6)	1100	1383.6
120 kW	W	443.2 (400 + 43,2)	1800	2243.2
Smart Line Modules Booksize				
5 kW	W	34.4 (20 + 14,4)	40	74.4
10 kW	W	56.8 (40 + 16,8)	80	136.8
Smart Line Modules Booksize Compact				
16 kW	W	56.6 (36,2 + 20,4)	130	186.6
Basic Line Modules				
20 kW	W	46.6 (25 + 21,6)	95	141.6
40 kW	W	71.4 (45 + 26,4)	205	276.4
100 kW	W	168.4 (130 + 38,4)	450	618.4
Single Motor Modules Booksize				
3 A	W	27.6 (12 + 15,6)	18	45.6
5 A	W	35.6 (20 + 15,6)	35	70.6
9 A	W	45.6 (30 + 15,6)	50	95.6
18 A	W	80.6 (65 + 15,6)	100	180.6
30 A	W	85.6 (70 + 15,6)	220	305.6
45 A	W	108 (90 + 18,0)	340	448
60 A	W	128 (110 + 18,0)	480	608
85 A	W	149.2 (130 + 19,2)	620	769.2
132 A	W	220.4 (200 + 20,4)	1050	1270.4
200 A	W	370.4 (350 + 20,4)	1700	2070.4
Single Motor Modules Booksize Compact				
3 A	W	25.6 (10 + 15,6)	40	65.6
5 A	W	30.6 (15 + 15,6)	65	95.6
9 A	W	45.6 (30 + 15,6)	50	95.6
18 A	W	80.6 (65 + 15,6)	100	180.6

	Unit	Internal power loss 1)	External power loss	Total power loss
Double Motor Modules Booksize				
2x3 A	W	55.6 (34 + 21,6)	36	91.6
2x5 A	W	61.6 (40 + 21,6)	65	126.6
2x9 A	W	81.6 (60 + 21,6)	100	181.6
2x18 A	W	95.2 (70 + 25,2)	250	345.2
Double Motor Modules Booksize Compact				
2x1.7 A	W	42 (20,4 + 21,6)	72	114
2x3 A	W	44 (22,4 + 21,6)	90	134
2x5 A	W	59 (37,4 + 21,6)	135	194

1) Power loss of the power electronics + power loss of the 24 V electronics

Note

Lower average power losses are obtained for intermittent duty.

A.3.2.6 Power loss for liquid-cooled power units

Table A- 9 Overview of power loss during rated operation for liquid-cooled power units (including electronics losses)

	Unit	Internal power loss 1)	External power loss	Total power loss
Active Line Modules				
120 kW	W	443.2 (400 + 43,2)	1800	2243.2
Single Motor Modules				
200 A	W	370.4 (350 + 20,4)	1700	2070.4

1) Power loss of the power electronics + power loss of the 24 V electronics

A.3.3 Electronics losses of power units

Table A- 10 Electronics losses for power units with internal/external air cooling

Component		Internal/external air cooling Power loss [W]
Single Motor Modules	3 A	20.4
	5 A	20.4
	9 A	20.4
	18 A	20.4
	30 A	19.2
	45 A	25.2
	60 A	25.2
	85 A	36.0
	132 A	20.4
	200 A	20.4
Single Motor Modules Booksize Compact	3 A	20.4
	5 A	20.4
	9 A	20.4
	18 A	20.4
Double Motor Modules	3 A	27.6
	5 A	27.6
	9 A	27.6
	18 A	31.2
Double Motor Modules Booksize Compact	1.7 A	27.6
	3 A	27.6
	5 A	27.6
Active Line Modules	16 kW	22.8
	36 kW	36.0
	55 kW	45.6
	80 kW	33.6
	120 kW	43.2
Basic Line Modules	20 kW	24
	40 kW	33.6
	100 kW	48
Smart Line Module	5 kW	19.2
	10 kW	21.6
	16 kW	22.8
	36 kW	36.0
	55 kW	45.6
Smart Line Module Booksize Compact	16 kW	22.8

Table A- 11 Electronics losses for power units with cold plate

Component		Cold plate Power loss [W]
Motor Modules Booksize	3 A	15.6
	5 A	15.6
	9 A	15.6
	18 A	15.6
	30 A	15.6
	45 A	18.0
	60 A	18.0
	85 A	19.2
	132 A	20.4
	200 A	20.4
	2x3 A	21.6
	2x5 A	21.6
	2x9 A	21.6
	2x18 A	25.2
Motor Modules Booksize Compact	3 A	15.6
	5 A	15.6
	9 A	15.6
	18 A	15.6
	2x1.7 A	21.6
	2x3 A	21.6
	2x5 A	21.6
Active Line Modules	16 kW	20.4
	36 kW	25.2
	55 kW	27.6
	80 kW	33.6
	120 kW	43.2
Smart Line Module Booksize	5 kW	14.4
	10 kW	16.8
Smart Line Module Booksize Compact	16 kW	20.4
Basic Line Modules	20 kW	21.6
	40 kW	26.4
	100 kW	38.4

Table A- 12 Electronics losses for liquid-cooled power units

Component		Liquid cooled Power loss [W]
Motor Module	200 A	20.4
Active Line Module	120 kW	43.2

A.3.4 Losses for power units in the partial load range

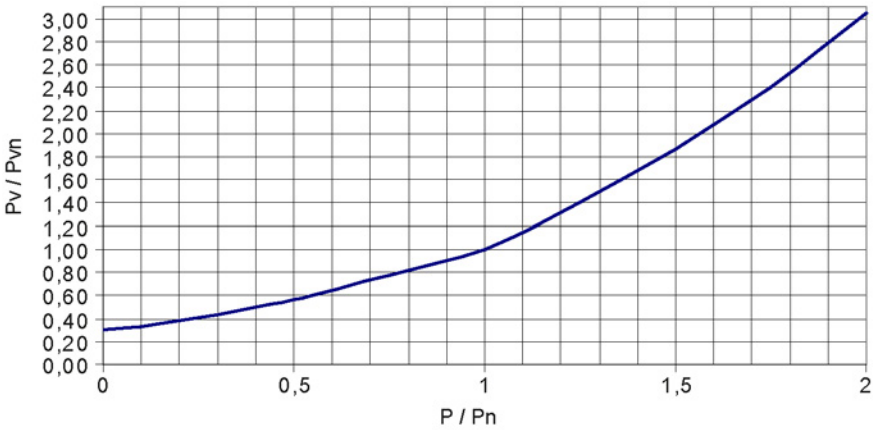

Figure A-1 Losses in the partial load range for Active Line Modules and Smart Line Modules

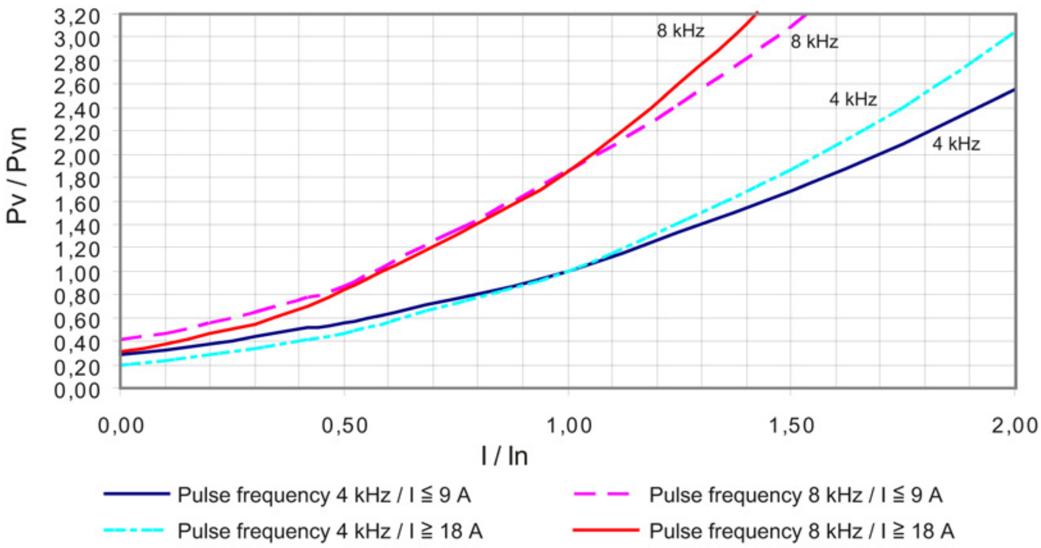

Figure A-2 Losses in the partial load range for Motor Modules

A.3.5 Typical power losses for Motor Modules

The information on the power losses in the previous chapters are maximum values, which occur in the most unfavorable case. For typical applications, the losses are lower.

The following applies as typical application:

- Maximum motor cable length, 30 m
- 4 kHz pulse frequency
- DC link voltage 540 V - 600 V

The power loss for typical applications can be calculated using the following formula:

P_V [W] = a + $S_1 \cdot (I_1 + I_2) + S_2 \cdot (I_1^2 + I_2^2)$

a	Electronics losses of the Motor Module
S_1, S_2	Coefficients to calculate power loss
I_1	Current (arithmetic mean value) of the 1st axis
I_2	Current (arithmetic mean value) of the 2nd axis

Overview of required coefficients

Table A- 13 Coefficients to calculate the power loss in the control cabinet for internally cooled Motor Modules for typical applications

Motor Module	a [W]	S_1 [W/A]	S_2 [W/A^2]
Single Motor Module 3 A	14	3.29	0.205
Single Motor Module 5 A	14	3.29	0.205
Single Motor Module 9 A	14	3.29	0.205
Single Motor Module 18 A	14	3.29	0.205
Single Motor Module 30 A	20	4.71	0.113
Single Motor Module 45 A	25	5.50	0.054
Single Motor Module 60 A	25	5.50	0.054
Single Motor Module 85 A	36	6.11	0.030
Single Motor Module 132 A	150	6.01	0.018
Single Motor Module 200 A	150	6.01	0.017
Double Motor Module 3 A	19	5.20	0.200
Double Motor Module 5 A	19	5.20	0.200
Double Motor Module 9 A	19	5.18	0.247
Double Motor Module 18 A	22	5.57	0.091

Table A- 14 Coefficients to calculate the power loss in the control cabinet for externally cooled Motor Modules for typical applications

Motor Module	a [W]	S_1 [W/A]	S_2 [W/A^2]
Single Motor Module 3 A	10	2.30	0.100
Single Motor Module 5 A	10	2.30	0.100
Single Motor Module 9 A	10	2.30	0.100
Single Motor Module 18 A	10	2.34	0.101
Single Motor Module 30 A	16	1.29	0.057
Single Motor Module 45 A	21	1.31	0.015
Single Motor Module 60 A	27	1.37	0.006
Single Motor Module 85 A	32	1.37	0.006
Single Motor Module 132 A	50	1.06	0.004
Single Motor Module 200 A	50	1.06	0.004
Double Motor Module 3 A	15	1.37	0.240
Double Motor Module 5 A	15	1.37	0.240
Double Motor Module 9 A	15	1.37	0.240
Double Motor Module 18 A	18	1.56	0.056

Overview of typical power losses at the rated operating point

Table A- 15 Typical power losses in the control cabinet for operation at the rated operating point for internally and externally cooled Motor Modules

Motor Module	P_{Vn} [W] internal air cooling	P_{Vn} [W] external air cooling
Single Motor Module 3 A	26	18
Single Motor Module 5 A	36	24
Single Motor Module 9 A	60	39
Single Motor Module 18 A	140	85
Single Motor Module 30 A	263	106
Single Motor Module 45 A	382	110
Single Motor Module 60 A	550	130
Single Motor Module 85 A	772	192
Single Motor Module 132 A	1257	260
Single Motor Module 200 A	2032	422
Double Motor Module 3 A	54	28
Double Motor Module 5 A	81	41
Double Motor Module 9 A	152	79
Double Motor Module 18 A	281	110

A.4 Abbreviations

Table A- 16 Abbreviations and meanings, German/English

Abbreviation	German meaning	English meaning
AC	Wechselstrom	Alternating current
ALM	Active Line Module	Active Line Module
CBC	Communication Board CAN	Communication Board CAN
CBE	Communication Board Ethernet	Communication Board Ethernet
CPU	Zentrale Recheneinheit	Central Processing Unit
CSM	Control Supply Module	Control Supply Module
CU	Control Unit	Control Unit
DC	Gleichstrom	Direct Current
DO	Antriebsobjekt	Drive Object
DP	Dezentrale Peripherie	Decentralized Peripherals
DRIVE-CLiQ	Drive Component Link with IQ	Drive Component Link with IQ
EP	Impulsfreigabe	Enable Pulses
EMC	Elektromagnetische Verträglichkeit	Electromagnetic Compatibility (EMC)
EN	Europäische Norm	European Standard
FI	Fehlerstrom-Schutzschalter	Earth Leakage Circuit Breaker (ELCB)
HMI	Mensch-Maschine-Schnittstelle	Human Machine Interface
IEC	Internationale Norm in der Elektrotechnik	International Electrotechnical Commission
IT	Drehstromversorgungsnetz ungeerdet	Insulated three-phase supply network
LED	Leuchtdiode	Light Emitting Diode
LM :	Line Module	Line Module
NC	Numerische Steuerung	Numerical Control
NCK	Numerik-Kern mit Satzaufbereitung, Verfahrbereich usw.	Numerical Control Kernel
NCU	Numerical Control Unit	Numerical Control Unit
NX	Numerical Extension	Numerical Extension
OP	Bedientafelfront	Operator Panel
PE	Schutzerde	Protective Earth
PLC	Speicherprogrammierbare Steuerung (SPS)	Programmable Logic Controller
SBC	Safe Brake Control	Safe Brake Control
SH	Sicherer Halt	Safe standstill
SIL	Sicherheitsintegritätsgrad	Safety Integrity Level
SLM	Smart Line Module	Smart Line Module
SMC	Sensor Module Cabinet	Sensor Module Cabinet
SME	Sensor Module External	Sensor Module External
SPL	Sichere Programmierbare Logik	Safe Programmable Logic
STW	Steuerwort	Control word
TCU	Thin Client Unit	Thin Client Unit
TM	Terminal Module	Terminal Module

Abbreviation	German meaning	English meaning
TN	Drehstromversorgungsnetz geerdet (Terre Neutre)	Grounded three-phase supply network
TT	Drehstromversorgungsnetz geerdet (Terre Terre)	Grounded three-phase supply network
VPM	Voltage Protection Module	Voltage Protection Module
VS	Power supply	Voltage Supply
ZSW	Zustandswort	Status word

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